Intergovernmental Oceanographic Commission

Workshop Report No. 148

IOC/WESTPAC International Scientific Symposium – Role of Ocean Sciences for Sustainable Development

Okinawa, Japan
2-7 February 1998

UNESCO

IOC Workshop Report No. 148
Paris, 15 January 1999
English only

SC-99/WS/9

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1. INTRODUCTION

At its Third Session (Tokyo, 26 February - 1 March 1996), the IOC Sub-Commission for the Western Pacific (WESTPAC) proposed, through Recommendation SC-WESTPAC-III.1, that the Fourth International IOC/WESTPAC Scientific Symposium be organized in 1997 or 1998 in view of the success of the previous Symposia in 1986 (Townsville), 1991 (Penang), and 1994 (Bali). The IOC Assembly at its Nineteenth Session (Paris, 2-18 July 1997) decided to organize the Symposium and encouraged the Member States to participate in and provide for this important activity.

With the kind offer of the Government of Japan to host the Symposium and financial support from Japan and Sweden (SIDA/SAREC), the Symposium was held in Okinawa, Japan, 2 - 7 February 1998 as the first big event of the International Year of the Ocean. About 160 scientists from 14 countries/regions from inside and outside the WESTPAC region participated in the Symposium. Six keynote speeches and 80 scientific papers were presented to the plenary session, with six poster presentations. Seven workshops were held in parallel with the plenary session.

The list of the participants is shown in Annex IV, and the comprehensive programme of the Symposium is attached as Annex I.

2. OPENING

The opening ceremony began at 0930 hour 2 February 1998 at the Okinawa Convention Center, Ginowan-City, Okinawa, Japan.

Mr. Yasuo Nozaka, Deputy Director-General, Science and International Affairs Bureau, Ministry of Education, Science, Sports and Culture of Japan made an opening speech, in which he emphasized the significance of the Symposium to further development of ocean sciences and various scientific fields related to the global environment and wished that it would contribute to the public awareness on the importance of the science of ocean.

Prof. Kosho Katsura, President of the University of Ryukyus made a welcome speech. He expressed his pleasure in that Okinawa is hosting the first IOC/WESTPAC Symposium to be held in Japan, and encouraged the participants to benefit not only from the scientific point of view, but also from what they learn of the Okinawan people and their culture.

The speeches by Mr. Nozaka and Prof. Katsura are attached in Annex III.

Prof. Keisuke Taira, Director-General of the Ocean Research Institute, University of Tokyo, reported to the Symposium, as Chairman of IOC/WESTPAC, the activities of WESTPAC which were identified at the Third Session of WESTPAC on 26 February - 1 March, 1996 held in Tokyo. He mentioned that the Symposium is one of the actions of the International Year of the Ocean -1998 and wished the GOOS project will be accelerated through this year. He, mentioned that the past WESTPAC Scientific Symposia have contributed greatly to the promotion of ocean science in the region, expressed his belief that this Symposium would be the most valuable one.

Finally, Dr. Colin Summerhayes, Director of the GOOS Project Office of IOC, on behalf of Dr. Gunnar Kullenberg, Executive Secretary IOC, thanked the Government of Japan for hosting the Symposium at a very beautiful location. First, he briefly described the function and mechanism of IOC/WESTPAC. Then, stressing upon the importance of 'operational oceanography', with an example of the greatest public interest - forecasting of El Nino, he stressed the importance of the success of GOOS, the Global Ocean Observing System.

Dr. Summerhayes further commented on taking advantage of the opportunity of the International Year of the Ocean, to encourage the government of each member state to develop coherent and integrated policies for ocean development, ocean science, and ocean services, as well as raising awareness of the importance of the ocean in the society by contacting the mass media. He finally pointed out the significance of the WESTPAC office in Bangkok, encouraging it to play a substantial role in helping nations to develop GOOS throughout the region, as well as bringing marine issues to the attention of governments, industry and the general public.

3. SCIENTIFIC PRESENTATION

In the plenary session, the scientific presentations were held in two rooms, sessions of physics and biology in Room A (the largest room), and sessions of geology and chemistry in Room B.

The following six keynote speeches were presented in Room A.

(1) The Global Ocean Observing System: Making World Ocean Data an Operational Resource, by A. McEwan (Australia)

(2) Implementing GOOS, the Global Ocean Observing System, by C. Summerhayes (IOC)

(3) The NEAR-GOOS Data Exchange System for Better Ocean Services, by N. Hasegawa (Japan)

(4) The Indonesian Throughflow as it Enters the Eastern Indian Ocean, by S. Wijffels (Australia)

(5) Western Pacific Marginal Seas: Response to Glacial Cycles and its Impact on Global Climate, by P.-X. Wang (China)

(6) Living Coastal Resources of the WESTPAC Region: Environmental and Management Perspectives, by M.D. Fortes (Philippines)

Besides these keynote speeches, a total of 80 papers (Physics: 37, Biology: 15, Geology: 11, Chemistry:17) were presented in general sessions. In addition, there were six poster presentations.

Papers in physics session were mainly concerned with observational study on the volume and heat transports by the Kuroshio Current with several theoretical works using corresponding numerical models. The researches on the ocean circulations in the South China Sea, Indonesian Sea, the Gulf of Thailand were also presented.

In the geology session, many studies were focused on the Okinawa Archipelago and the Ryukyu Trench such as sea-level changes and recent crustal movement in the Ryukyu Arc, paleo-oceanography and tectonic features in the Ryukyu Trench, and sedimentation behavior of red soils in the coral reef zone of the Okinawa Island. Sediment transport in the East China Sea, heavy mineral placers in the Gulf of Thailand were also reported.

The presentations in biology session extended over bio-diversity, community structure, bio-monitoring and ecosystem dynamics. For example, zooplankton community and food chain structures in the western North Pacific, seagrass dynamics and bio-monitoring of micro-pollutants in the tropical waters were among the topics of the Session. As the WESTPAC region encompasses the

largest area of coral reef zone in the world, papers highlighted the ecology of coral reef organisms, management and conservation of its ecosystems. Studies on the marine mammals and harmful algal bloom were also presented.

Papers in chemistry mainly dealt with carbon cycles and isotopes in the marine waters, mussel watch, water quality management, contamination and bio-accumulation of heavy metals, butyltin and organochlorine in the animals and ecosystem.

The abstracts of the keynote and general presentations are attached in Annex II.

4. WORKSHOPS AND SIDE MEETINGS

In parallel with the plenary sessions, two workshops and five side meetings were held from 3 February through 7 February. The summaries of the meetings based on the report from each coordinator are shown below.

4.1 WORKSHOP ON THE NUMERICAL MODELING OF OCEANOGRAPHIC PROCESSES IN THE GULF OF THAILAND

The workshop was convened by Dr. Anond Snidvongs, Project Leader, IOC-WESTPAC project on International Cooperative Study on the Gulf of Thailand. Dr. Snidvongs introduced the participants to the background and development of the project, followed by some information about the data system and the project data center which is located at SEA START RC in Bangkok. He further gave some examples about the past and present modeling activities in Thailand. Yet most models had not been fully implemented because of the inaccuracies of the outcome, the insufficient technological transfer from the developer to users, the temporal and spatial scale of the model that were irrelevant to the interests of the agencies, and the lack of quality controlled observation data to verify the model result.

Dr. Eric Wolanski, reviewing some of the work done by his group based on SEAWATCH data in the Thailand EEZ, concluded that local wind in the gulf and the tidal residual were insignificant forcing functions for the net surface circulation. Rather, the net current in the Gulf was forced by the circulation in the South China Sea which was controlled by the large regional scale monsoon system.

Professor Tetsuo Yanagi presented three models based on different concepts. In the first model, a large scale hydrodynamic model for the South China Sea where Gulf of Thailand was a small part of the model, the circulation in the Gulf was cyclonic during the Northeast Monsoon and anti-cyclone during the Southwest Monsoon. The result generally agree with those of Wolanski. However in this model small and local features could not be reproduced. His second model with a coupling between tide and current reproduced some local features such as eddies and meanders, on top of the generally clockwise and anti-clockwise circulation in the Southwest and Northeast Monsoon seasons, respectively. In the third model based on density driven and the observed temperature and salinity distribution during the NAGA Expedition in 1959-1960, local features were clearly seen. The circulation in the Gulf was actually a suite of eddies and meanders. One major anti-cyclonic eddy was formed on the eastern part, off the coast of Cambodia and Vietnam. This eddy existed throughout the year except between December 1959 and January 1960. Another eddy was a cyclonic one off the lower part of Thailand. This clockwise eddy existed throughout the period from October 1959 to August 1960. The third eddy was the smallest and least strong. It was a cyclonic eddy that was located more northward than the first two. The position of this third eddy shifts between east and west according to seasons.

Mr. Anukul Buranapratheprat presented the result of his 2D diagnostic model where strong anti-cyclonic circulation was simulated for January to August 1997. In September-November 1997, weak anti-cyclonic circulation was observed until December when it was switched to anti-cyclonic again. No small and local features were reproduced except some meanders which seem to be due to the coastal morphological effects rather than the local effects.

Dr. Anond Snidvongs showed a result of an application of a density driven model similar to professor Yanagi's third model but using different datasets. Despite some different assumptions on the surface heat flux, the model also reproduced eddies and meanders in the Gulf in all simulations carried out by Dr. Pramot Sojisuporn (Circulation eddies in the Upper Gulf of Thailand), by Dr. Supichai Tangjaitrong (Application of a wave prediction model (WAM) in the Gulf of Thailand), and by Dr. Dinh Van Uu (A 3D diagnostic and prognostic model for the South China Sea region).

The results of the discussion are summarized as follows:

1. There is still a debate on which are the forcing functions for the net circulation in the Gulf of Thailand; local wind, tidal residual and/or the South China Sea General circulation.

2. Lack of synoptic data for model development as well as for model verification

3. Many of the datasets are lacking in data quality control

4. Observation, especially for current measurement, must consider small scale features.

5. Task team should be set-up to handle each aspect of the Gulf of Thailand, such as numerical modeling, data-information system, etc.

6. Develop a proposal to restore and perform quality control of old data in the region, maybe through GODAR.

7. One way to get around the reluctance to share data with other people is the use of grid data instead of raw data.

4.2 WORKSHOP ON REMOTE SENSING FOR INTEGRATED COASTAL AREA MANAGEMENT

Dr. Weigen Huang, the coordinator of the IOC/ WESTPAC project of Remote Sensing for Integrated Coastal Area Management (ICAM) welcomed all the participants and briefed them on the background and objective of the workshop.

Mr. Yihang Jiang, the IOC Regional Secretariat for WESTPAC, addressed administrative matters. He welcomed the participants on behalf of the IOC/WESTPAC. The IOC/WESTPAC Secretary thanked SIDA/SAREC for financial support for the Workshop and the local organizing committee for all necessary preparation for the Workshop. Mr. Jiang emphasized the importance of the Workshop in integrating remote sensing techniques into the coastal area management in the WESTPAC region. He wished the Workshop all success.

Nine speakers from nine WESTPAC member states presented their remote sensing applications for integrated coastal area management. These applications include coastal environment change and coastal hazard monitoring, oceanographic parameter measurement, and coastal process studies. There was an active exchange of ideas in science and techniques of remote sensing for ICAM

among participants. Each lecture was of 25 minutes duration with 5 minutes for discussion and comments.

The workshop provided the participants with opportunities to discuss the implementation of the IOC/WESTPAC project on remote sensing for ICAM. The following questions were addressed;

(1) what are the coastal problems which are faced by each Member State in the WESTPAC region?

(2) what can remote sensing do on a regional basis for ICAM?

(3) how can the project be implemented?

The workshop recognized the importance of the project and recommended that all participating countries provide support to national marina remote sensing institutions to implement the project.

The workshop recognized the coastal problems which are faced by member states of the WESTPAC region and stressed that remote sensing should play a fuller role in integrated coastal area management and sustainable use of the coastal area.

The workshop noted the importance of implementing the project and recommended that two sub-projects, Coastal Change Monitoring Using Remote Sensing and Remote Sensing. In coastal Habitats, be developed, and the research proposals be submitted to IOC/WESTPAC for approval in 1999.

The workshop deemed that training courses and exchange visits are essential project activities. Existing IOC/ WESTPAC infrastructure should be used as much as possible for this purpose.

4.3 INFORMAL MEETING ON NEAR-GOOS

Convened by Mr. Naoyuki Hasegawa, Chairman of NEAR-GOOS Coordinating Committee (CC), two informal meetings on NEAR-GOOS were held on 4 February 1998, taking advantage of the presence of several NEAR-GOOS CC members. In the morning, CC members had a closed meeting to discuss various internal matters. In the afternoon, people involved in other projects such as the Gulf of Thailand Project were invited to an informal meeting on the use of NEAR-GOOS.

(1) CC Meeting

The meeting was attended by Mr. Hasegawa (Chair, Japan), Prof. Yu (China) and his adviser Ms. Wen, Dr. Hahn (Korea), Dr. Tkalin (Russia), Mr. Jiang (WESTPAC), Dr. Mitsumoto (WESTPAC) and Prof. Taira (Chair, WESTPAC).

Each CC member presented the recent development of the NEAR-GOOS related activities in the respective country.

Korea

In January, the Korea Meteorological Administration (KMA) agreed to participate in the NEAR-GOOS activities. KMA would be in charge of the real time data exchange soon. KODC would soon start the operation of the database for delayed mode data exchange. The Korean

Oceanographic Date Center (KODC) already provided, through its Homepage, the satellite SST data. Though changes in the governmental structure were expected, the part related to the oceanographic activities could remain unchanged. The national committee for NEAR-GOOS was yet to be organized in future.

China

The database for delayed mode was almost complete and was waiting for the government decision as to which data should be provided through NEAR-GOOS. The database for real time was still under preparation, but was progressing.

Russia

The FERHRI started to send the ship observation data to RTDB. The government was still considering the general policy on GOOS including NEAR-GOOS. In particular, the data from coastal stations could not be exchanged until the government decision could be made. If some useful products could be shown as the examples of the benefit of NEAR-GOOS, it could be helpful to persuade the government of the importance of NEAR-GOOS. The meeting felt that the next CC meeting should consider the feasibility of producing another brochure on NEAR-GOOS which contains product aspect of the project. It was, however, noted that some required products may be outside of the NEAR-GOOS activities taking into account the fact that NEAR-GOOS is a free and open project while some products are of national or commercial interest.

Japan

A Japanese version of the NEAR-GOOS brochure was printed and distributed widely to attract users. This contributed to the increase of the Japanese users to 12. At the end of January, 21 users were registered altogether.
The Fisheries Agency of Japan started the contribution through GTS and the number of the reports from the ships of the Agency increased substantially.

The CC appreciated the effort of Dr. Lee to prepare the interim report on the revision of the Operation Manual, as well as some other relevant information. The meeting did not discuss the substance of the revision, but agreed to study it carefully to enable fruitful discussion on it at the 4th meeting.

Talking about the future directions of NEAR-GOOS, consideration on the inclusion of some chemical and biological parameters, such as nutrients and DO. It was also suggested that data products from numerical models should be provided to attract more users when feasible.

Prof. Taira informed the meeting that a 5 year research program was going to be implemented by Japanese universities on monitoring technology for ocean currents, temperature, salinity and nutrients, numerical modeling, monitoring of chemical substance for environmental changes, monitoring of primary production, and remote sensing for ocean monitoring.

The meeting was informed that the 4th Pacific Ocean Remote Sensing Conference (PORSEC'98) would be held in Qingdao, China, 28-31 July 1998, and a session co-chaired by Prof. Taira and Dr. Lee would be on NEAR-GOOS among other things. The meeting agreed that the CC meeting should be held immediately after PORSEC'98. According to the suggestion by Prof. Yu, the meeting felt that it would be appropriate to have the next CC meeting in Beijing, with a trip to Tianjin to have opportunity to visit both real time and delayed mode databases in China.

(2) Informal Meeting on the Use of NEAR-GOOS Data

The meeting was attended by the CC members above and Prof. Alekseev (Russian Academy of Science), Dr. Ali (US Office of Naval Research Asian Office), Dr. Dang (Vietnam National Centre for Natural Science and Technology), Dr. Huh (KORDI), Dr. Liu (National Taiwan University), Dr. Snidvongs (Gulf of Thailand) and Dr. Summerhayes (IOC).

One point discussed in the meeting was the problem of data policies. Different countries and programmes have different data policies and data delivery procedures. It was felt that it was very important to respect those different data policies, and at the same time, to encourage the free and open data exchange. Some specific data sets were identified during the Symposium as the data not free at the moment but very useful if they could be open.

The data requirement was also discussed. Though the participants in this meeting did not of course represent all the user community, some specific data requirements were expressed. Ocean current data would be useful for various applications such as fisheries, aquaculture, and material transport. Real time availability of winds, waves, sea surface temperature, and sea ice and other maritime meteorological data were required for the prediction of the sea surface conditions. Fresh water discharge from the rivers would be very useful for fishing and aquaculture. Data on the nutrients and chlorophyll were also required. Requirements for historical data were also discussed . It was suggested that not all the required data may be appropriately delivered by NEAR-GOOS. The meeting noted that some requirements were already met to some extent by existing programmes.

The point of the data quality was raised as a fundamental function of a data system. The Japan Meteorological Agency had been requested to propose a quality control mechanism for NEAR-GOOS. The Agency was developing a proposal taking into account the existing activities for oceanographic data quality control.

The importance of the products for the end users was pointed out. However, some of the products for the end users were found to be sometimes of national interest or of commercial interest. Therefore, consideration should be given on the extent to which NEAR-GOOS should cover in the flow from the observation to the end users. In some fields of application, NEAR-GOOS may have to offer the final products for end users. In other fields, NEAR-GOOS may be required to deliver basic data or products to other projects or to private sectors for them to generate the final products outside the NEAR-GOOS framework, still benefiting from NEAR-GOOS.

The data assimilation and numerical prediction was identified as a promising data processing tool for product generation. Modeling technology for waves and tides was considered to be at the level of operational application, and some of these elements were already covered by the existing operational maritime meteorology programmes. Multi-layer ocean general circulation models were at the level of successful simulation of the climatological circulation, and future advancement in the research in this field was anticipated. The data from models, when available, could be useful for fisheries, transportation, material transport, recreation, offshore operations, and many other fields.

4.4 AD HOC CONSULTATION FOR SEA-GOOS

An ad hoc Consultation on development of the South East Asian (SEA) - GOOS was held with the participation of 28 experts and scientists including several GOOS resource persons.

First Admiral Mohd Rasip Bin Hassan chaired the meeting and welcomed all participants to express their views on the subject. The Chairman began with some background information on several relevant aspects of GOOS, NEAR-GOOS, the possible relationship with Gulf of Thailand

project and/or SEACAMP project, and some views from Dr. Aprilani Soegiarto's (Indonesia) paper submitted to the Symposium. He highlighted the objectives of the consultation:

1) To establish the need for development of the SEA-GOOS; and

2) To seek the views on the best possible means and actions which need to be taken in establishing the system.

Mr. Yihang Jiang, IOC Regional Secretariat for WESTPAC, was invited to provide further information on the status of development, including the willingness of the Member States as expressed in the 3rd Session of the IOC Sub-Commission of WESTPAC, Tokyo, Japan (March 1996), consultations among experts from countries in the region; and actions taken during the last IOC Assembly (July 1997), with emphasis on the draft resolution to be submitted to the UNESCO General Conference. Two other initiatives were also mentioned, namely the South East Asian Center for Atmospheric and Marine Prediction (SEACAMP), and the IOC/WESTPAC Project on the Co-operative Study in the Gulf of Thailand.

The following notable points were expressed by participants and resource persons during the consultation:

a. Whilst considering the requirements of the countries in the region, SEA-GOOS could take advantage of the experiences from the successful development and operation of NEAR-GOOS.

b. The requirement for open oceanographic data exchange is urgent, which requires a full co-operation and co-ordination at national, regional and international levels.

c. Capacity building in developing SEA-GOOS is required for full national participation, including setting - up of the database, and a data management system;

d. To develop the SEA-GOOS system, support from governments of the participating countries is essential in this region. In order to convince the governments, justification and benefits of the system should be clearly identified. It was suggested that an IOC-GOOS mission to the area could be beneficial to bring policy makers and scientists together.

e. It was also suggested that on initiation the focus should be on limited but commonly agreed parameters and possibly in certain geographic areas.

For developing a programme proposal, the meeting suggested that an expert consultation/workshop needs to be organized in the near future, to access existing information in the region, and identify common exchange parameters and areas which could be included in the system in order that oceanographic and environment data could be shared by the participating countries. It would be desirable if participants could be well prepared before the workshop and have obtained the necessary mandate from respective governments, especially regarding the data exchange policy.

The proposal developed by the workshop will be submitted to the next session of the IOC Sub-commission for WESTPAC, Seoul, Republic of Korea, (March 1999) for approval. In the meantime, experts from countries in the region are encouraged to discuss with their national focal points to explore the possibility of submitting a Draft Resolution to UNESCO to secure special

funding for the development of SEA-GOOS and using the successful development of NEAR-GOOS as an example.

4.5 OPEN MEETING ON HIGH EDUCATION FOR MARINE SCIENCES

The Meeting was convened by Prof. Ian Jones, University of Sydney, now staying at Ocean Research Institute, University of Tokyo, and was chaired by Prof. Manuwadi Hungspreugs. A number of lecturers from southeast Asian countries attended the meeting.

The Rockefeller foundation has an interest in developing highly qualified institutes of graduate and PhD training in Oceanography in both Africa and South-East Asia, following an example of the University of Concepcion in Chile which is already functioning as a graduate school in Latin America. Prof. Ian Jones, also associated with the University of Chile, proposed the ad hoc consultation in order to obtain something of a regional perspective on developing such an institution.

A number of issues were raised but not resolved during the discussion. Questions were: one regional university versus a network of regional universities, aim of rivaling a school like Scripps, need for sustained financial support, importance of expensive equipment, need for overseas training / internship, need for local students to sustain the faculty, visiting faculty not necessarily consisting of developed country experts, visiting faculty should continue commitment, development of library resources, focus research on regional / local issues, role of tuition fees, how to get support of countries that the local school is not located in, scholarship money for students, other models for graduate research education.

The meeting agreed to identify the most recent survey of graduate programmes in the region and update this. An article in the next WESTPAC newsletter can be used to draw attention to this subject, and to receive comment from the region. Prof. Manuwadi will be invited to present a synthesis during an especially organized workshop in Italy in the second half of this year.

4.6 WESTPAC CONSULTATION ON THE ICAM

A consultation on the development of ICAM programme in the WESTPAC region was held in the Pacific Hotel Okinawa, in the evening of 4 February 1998. Some 20 people from the countries of WESTPAC participated in the consultation. Dr. Huh, the Second Vice - Chair of WESTPAC chaired the meeting. This consultation was organized in the light of the IOC decision at the 19th session of the IOC Assembly, July 1997, to establish a focused and interdisciplinary programme on marine science and observation inputs to the integrated coastal management, with separate funding, with a view to linking more closely marine science to coastal management needs.

The subjects proposed for the consultation included:

a. An introduction to follow-up activities to IOC Resolution XIX-5: Marine Science and Observation Inputs to ICAM;

b. General Policy and Strategy for WESTPAC ICAM;

c. Possible Activities for 1998-1999

d. Cooperation with Other Organizations of the Region; and

e. Potential funding sources.

Comments were made on some general policy issues related to the integrated coastal management. It was recognized that though there is not a lack of marine scientific knowledge in the region, there is an apparent lack of understanding, communication and interaction between scientists and coastal managers and policy makers. There is therefore an urgent need to strengthen these aspects through focusing more on interaction between marine scientists and coastal managers/policy makers and between marine science and management needs. It was also pointed out that the IOC/WESTPAC strategy on ICAM should be problem and issue oriented, and try to solve practical problems facing coastal managers.

Through consultation during and after the meeting, several important issues have been identified as potential new areas of action for the IOC/WESTPAC in the field of integrated coastal area management. These include:

a. remote sensing for ICAM, particularly mapping of coastline changes and study of coastal habitat changes;

b. development of guidelines on habitat preservation and protection in the form of CD-ROM;

c. training workshops on marine science/policy interaction and effectiveness of marine science contribution to coastal management;

d. enhanced study of coastal erosion due to natural disasters, sea level rise, as well as anthropogenic activities; and

e. development of data product based on the result of the Gulf of Thailand Study.

Due to the unpreparedness of some participants resulting form late distribution of relevant documents and the limit of time, discussion of the proposed agenda items were not completed. However, it was agreed that written inputs on the development of IOC/WESTPAC strategy in ICAM should be forwarded to the IOC Coordinator on the Integrated Coastal Management. It was also recommended that further consultation on the WESTPAC ICAM be pursued based on the inputs from the participants, taking advantage of other future occasions.

4.7 WORKSHOP ON OSNLR - DISCUSSION ON TECTONICS AND ITS IMPACT ON THE COASTAL ZONE (TICZ)

In the workshop on OSNLR (Ocean Sciences on Non-living Resources), convened by Prof. Hideo Kagami, the TICZ Project was mainly discussed together with the Paleo-geographic Map Project following the Geology Session on 4 February.

The objectives of the TICZ are:

a) Research on coastal hazards which have a great effect on large cities

b) Utilization of the coastal zone in engineering ways, including assessment or resources

c) Studies on environmental protection, conservation and mitigation

The project was officially approved in the Third Session of WESTPAC in Tokyo, March 1996. International Geological Congress was held in Beijing, August 1996, when a symposium on evolution of marginal sea basins was convened by Prof. Xiang-Long Jin and H. Kagami. Also, the

eastern Asia natural hazards mapping project was discussed among 20 Asian countries during the Congress. It is fully supported by CCOP.

International symposium on Challenge against Great Earthquake Disasters '97 was held in Tokyo and Kobe, January 1997. UN-IDNDR (International Decade of Natural Disaster Reduction) officer were invited to give a talk.

The International Symposium on International Geomorphologist Association was held in Bologna, Italy, August 1997, when Prof. Kagami gave a talk on coastal zone management.

Temporary IOC-OSNLR Meeting was held in the occasion of the IHO-IOC Editorial Board on the continental shelf limit at Monaco, January 1998, when discussions were made in support of assessment of marine resources, management of the sea and coastal hazards.

After the discussion, the following recommendations were presented:

(a) To make a continued effort to build a feasible scheme on the coastal hazard project.

(b) To support collaboration with CCOP activity on the eastern Asia natural hazards mapping project, although the WESTPAC project is more focused on the coastal zone.

(c) To prepare a workshop jointly with Paleo-geographic Map project on the occasion of the meeting of Fourth Asian Marine Geology to be held at Qingdao in 1999.

5. CLOSING

First, Dr. Hyung Tack Huh, the Vice-Chairman of WESTPAC summarized the Symposium. He mentioned that a total of 92 presentations contributed quite well to the theme of the Symposium "on the Role of the Ocean Science for Sustainable Development" and particularly evaluated the six keynote lectures by commenting on each of them. Referring to the presentations in each of the four categories, physical oceanography, geology, biology, and chemistry, he summarized that the symposium as a whole was very successful in exchanging the views and ideas among the scientists, as well as providing participants a good opportunity to share problems and issues of common interest and the spirit of cooperation in the field of ocean science in the WESTPAC Region.

Next, Prof. Manuwadi, also a Vice-chairperson of WESTPAC made a brief review of the WESTPAC activities since the Third Symposium in 1994.

Then, Mr. Li Haiqing, on behalf of Dr. Summerhayes of IOC, made a comment on the Symposium.

He first appraised the high quality of the presentations reflecting the high quality research work done by marine scientists of the region since the last Symposium in Bali, 1994. By also evaluating the usefulness of the various workshops held in conjunction with the Symposium, he then emphasized the importance of contributing the basic science to the sustainable development through operational oceanography and integrated coastal area management.

Prof. Terazaki, the Co-Chairman of the Local Organizing Committee, made an announcement with respect to the Proceedings of the Symposium.

Finally, Prof. Taira, the Chairman of WESTPAC, made a closing remark and introduced all the secretariat staff of IOC and IOC/WESTPAC at the end of his speech.

The Symposium was closed at 16:00 hours on 7 February 1998.

ANNEX I

PROGRAMME OF THE SYMPOSIUM

Room A
2 FEBRUARY 1998

0930-0950 Opening Ceremony

- Opening Address by Deputy Director-General, Science and International Affairs Bureau, Ministry of Education, Science, Sports and Culture
(Mr. Yasuo Nozaka)

- Welcome Address by President of the University of Ryukyus
(Prof. Kosho Katsura)

- Report by Chairman of WESTPAC
(Prof. Keisuke Taira)

- Address by Director, GOOS Project Office, IOC
(Dr. Colin Summerhayes)

1000-1200 Keynote Addresses
Chaired by Prof. Keisuke Taira

1. The Global Ocean Observing System: Making World Ocean Data an Operational Resource;
(Dr. Angus McEwan)

2. Implementing GOOS, the Global Ocean Observing System;
(Dr. Collin Summerhayes)

3. The NEAR-GOOS Data Exchange System for Better Ocean Services;
(Dr. Naoyuki Hasegawa)

1200-1400 Lunch

1400-1540 General Session
Chaired by Dr. Susan Wijffels

4. Mean Values of Volume and Temperature Transports of the Kuroshio South of Japan in 1993-1995;
(H. Ichikawa, S. Imawaki, H. Uchida, S. Umatani and M. Fukasawa)

5. Monitoring of Volume and Heat Transports of the Kuroshio Over the Izu Ridge by an Acoustic Transceiver Array;
(T. Takeuchi, K. Taira and S. Kitagawa)

6. Seasonal and Interannual Variability of the Alaskan Stream in the Central North Pacific;
(H. Onishi and K. Ohtani)

Chaired by M. Ibrahim Seeni M.

7. A Satellite-Based System for Monitoring the Oceans Around Japan;
(H. Kawamura, N. Ebuchi, K. Kutsuwada, K. Kozai and F. Sakaida)

8. Study on Sea Surface Temperature Distribution Characteristics Using AVHRR Image Database;
(E. Sakata, F. Sakaida and K. Kozai)

1540-1600 Coffee Break

1600-1700 **Chaired by Dr. Angus McEwan**

9. The Upper Ocean Variability in the Midlatitude North Pacific: An Approach to Effective Monitoring;
(T. Suga and K. Hanawa)

10. Development of a Compact, Self-Contained Surface Meteorological Observation System;
(H. Otobe, N. Iwasaka and S. Kizu)

11. Oceanographic Observations in the Seasonal Sea Ice Zone of Polar Seas;
(M. Wakatsuchi, K. I. Ohshima, Y. Fukamachi and G. Mizuta)

1700-1800 **Chaired by R. C. Wajsowicz**

12. Modeling the Kuroshio;
(T. Yamagata and T. Kagimoto)

13. Short-Range Forecasting of the Kuroshio Variability With a 1 1/2-Layer Primitive Equation Model;
(N. Komori, Y. Ishikawa, T. Awaji, K. Akitomo and T. Kuragano)

14. Research Activities of Numerical Modeling for Marginal-Sea and High-Latitude Processes Associated With the Japanese GOOS;
(T. Awaji, K. Akitomo, J. -H. Yoon and Y. Sekine)

3 FEBRUARY 1998

0910-1050 **Chaired by Dr. S. D. Hahn**

- Development of Marine Carbonate Observation System and its Application in the Western North Pacific Region;
(S. Tsunogai and S. Watanabe)

- Monitoring of the Ocean Currents by Using Submarine Cables;
(K. Rikiishi, M. Michigami, T. Araki and K. Shiowaki)

- Submarine Cable Voltage Measurement in the Beginning of the Kuroshio for Monitoring the Kuroshio Volume Transport;
(M. Koga, C. -T. Liu, J. C. Larsen, C. Villanoy and K. Taira)

Chaired by I. F. Jones

- North-South Sections of ADCP-SV Values Between Japan and Australia in Winter and Summer;
(T. Sugimoto, S. Kimura, N. Gohda and A. Kaneko)

- Assimilation of Ocean Color Data Into a Coupled Ecosystem Model for Estimating Fluxes of Particulate Organic Matter in the Northern Pacific Ocean;
(M. J. Kishi, M. Kawamiya, T. Saino and S. Saitoh)

1050-1110 Coffee Break

1110-1210 **Chaired by Dr. Collin Summerhayes**

- Activity of the RNODC/WESTPAC & JODC Data Online Service System (J-DOSS);
(G. Matsuura)

- Coastal Dynamics and Climate Change in the NEAR-GOOS Area;
(S. D. Hahn)

- Satellite Remote Sensing of Sulu Sea;
(I. S. F. Jones and Y. Toda)

1210-1400 Lunch

1400-1600 Keynote Speech

Chaired by T. Yamagata

- The Indonesian Throughflow as it Enters the Eastern Indian Ocean;
  (Dr. Susan Wijffels)

General Session

- A Simple Model of the Circulation Within the South China and Indonesian Seas;
  (R. C. Wajsowicz)

Chaired by T. Yanagi

- South China Sea Warm Pool;
  (Y. He)

- The Seasonal Variability of the Circulation and Thermohaline Structure of the South China Sea in the Condition of Reversing Monsoon Winds: Preliminary Result of a Three-Dimensional Model for its Analysis and Simulation;
  (D. V. Uu)

- Seasonal Variation in Residual Flow in the South China Sea;
  (D. -V. Manh and T. Yanagi)

1600-1620 Coffee Break

1620-1800 **Chaired by K. Rikiishi**

- Monsoon Circulation in the Southern Bay of Bengal in an OGCM;
  (P. N. Vinayachandran and T. Yamagata)

- Clockwise Phase Propagation of Semi-Diurnal Tides in the Gulf of Thailand;
  (T. Yanagi and T. Takao)

- Tide and Natural Oscillation in the Gulf of Thailand;
  (T. T. N. Duyet, N. T. V. Lien, P. V. Ninh and D. N. Quynh)

- On the Mechanism of Interaction of South China Sea Tides and Mekong River Flood;
  (L. P. Trinh)

- The AIMS-IBM Marine Research Project in Thailand, Vietnam, China, and Malaysia;
(Eric Wolanski)

4 FEBRUARY 1998

0930-1010 Keynote Speech
Chaired by S. Tsunogai

- Western Pacific Marginal Seas: Response to Glacial Cycles and its Impact on Global Climate;
(Prof. Pinxian Wang)

1010-1050 **Chaired by N. Maximenko**

- Use of Satellite Remote Sensing Techniques for Some Marine Applications in Malaysian Waters;
(M. Ibrahim Seeni M., S. Ahmad and A. Abdullah)

- Water Exchange Between the Subtropical and Equatorial Oceans Near the Philippine Coast;
(T. Qu, H. Mitsudera and T. Yamagata)

1050-1110 Coffee Break

1110-1210 **Chaired by P. N. Vinayachandran**

- Water Mass Structure and its Variation in the Western North Pacific;
(H. Yoritaka and H. Kinoshita)

- Near-Surface Circulation in the North-Western Pacific as Derived by Variational Method From Lagrangian Drifters;
(N. Maximenko, G. Panteleev, P.P. Niiler and T. Yamagata)

Recent Variations of Subsurface Temperature in the North Pacific;
(T. Yoshida and T. Ando)

1210-1400 Lunch

1400-1520 **Chaired by M. Wakatsuchi**

- Numerical Simulation of the Kuroshio-Oyashio Current System;
(H. Mitsudera, Y. Yoshikawa, B. Taguchi and H. Nakamura)

- Features of Waters Dynamics in the Northeast Part of Okhotsk Sea in Winter-Spring of 1995-1996;
(I. A. Zhigalov)

- The Features of Waters Termic and the Classification of the Waters Thermal Structure in the Okhotsk Sea;
(I. A. Zhigalov)

- A Climatology of Binary Typhoon Systems in the North-Western Pacific;
(S. Isijima, N. Servando)

6 FEBRUARY 1998

0930-1050 Keynote Speech
Chaired by Suharsono

- Living Coastal Resources of the WESTPAC Region: Environmental and Management Perspectives;
(M.D. Fortes)

General Session

Interannual Variation of Zooplankton Community Along 41^0 30' N Latitude off South of Hokkaido With Special Reference to Copepods;
(T. Shiotani, N. Shiga and N. Kubo)

- Plankton Food Chain Structure Across a Trophic Gradient in Marine Coastal Waters;
(S. Uye)

1050-1110 Coffee Break

1110-1210 **Chaired by H. R. Othman**

- Biomass and Faunal Characteristics of Deep-Sea Benthoeplagic Organisms in the Western North Pacific;
(T. Kikuchi, T. Toda, J. Hashimoto and M. Terazaki)

- Seagrass Demographic Dynamics as Indices of Marine Environmental Change;
(M.D. Fortes)

- Fate of Seagrass Production as Assessed by Cage Experiments in Enhalus Acoroides Bed in Gerupuk Bay, Lombok, Indonesia;
(M. H. Azkab, H. Ogawa)

1210-1400 Lunch

1400-1500 **Chaired by S. Uye**

- Biomonitoring of Micropollutants in Tropical Coastal Organisms for Sustainable Use of Living Resources;
(S. K. Sarkar, B. Bhattacharya and G. Bandopadhaya)

- Biodiversity of Copepods Associated With Macroinvertebrates From Coral Reefs in Malaysia;
(H. R. Othman, T. Toda, H. S. Nanni, T. Kikuchi and M. Terazaki)

- A Review of the Artificial Reef in Malaysia - A Leaning Paradigm;
(M. R. M. Kushairi)

1500-1540 Coffee Break

1540-1620 **Chaired by M.D. Fortes**

- Experience From Setting up and Operating Real Time Ocean Monitoring Systems in Thailand, Indonesia and Vietnam;
(P. E. Soras, A. Setiawan)

- Use of Environmental Data From the SEAWATCH System in Marine Aquaculture- Help to Obtain Sustainability and Productivity;
(F. V. Willumsen and T. Adibroto)

7 FEBRUARY 1998

0930-1010 **Chaired by N. Miyazaki**

- Preliminary Study on Age Determination of Dugong (Dugong Dugon) in Thailand;
(K. Adulyanukosol, M. Amano and N. Miyazaki)

- Temporal and Spatial Distribution of Sand-Dwelling Dinoflagellates in a Tidal Flat of Yashima Bay, the Seto Inland Sea, Japan;

(S. Montani and L. Huang)

1010-1030 Coffee Break

1030-1130 **Chaired by Yasuwo Fukuyo**

- An Establishment of Red Tide Monitoring Center in Samar, Philippines;
(J. T. Racuyal, R. C. Diocton and R. T. Severo Jr.)

- Harmful Algal Bloom Management Programs in Southeast Asia;
(R. V. Azanza)

- Role of Waves in Initiating and Triggering Algal Blooms;
(R. P. Babaran and R. A. Espinosa)

1130-1400 Lunch

1400-1500 **Chaired by Manuwadi Hungspreugs**

- Workshop Reports

1500-1600 Closing Ceremony

PROGRAMME OF THE SYMPOSIUM
ROOM B

4 FEBRUARY 1998

1010-1050 **Chaired by S. Tsunogai**

- Three Sequential Steps of Disaster Reduction Processes in the Coastal Zone;
(H. Kagami)

- Coastal Morphodynamics of Haiphong-Halong Area and Some Related Problems of Coastal Management;
(D. V. Huy)

1050-1110 Coffee Break

1110-1210 **Chaired by Prof. Wang Pinxian**

- Evaluation of the Anthropogenic Impact on Trace Element Composition of Sediments (South China Sea, Mekong River Delta);

(A. Alekseev, E. Shumilin, R. Smith and H. Windom)

- Non-Marine Heavy-Mineral Placers in the Gulf of Thailand;
(P. Kohpina and R. Vongpromek)

- Monitoring on Sedimentation Behavior of Terrigenous Red Soils Through Mooring and Weather Stations in Coral-Reef Coastal Area, the Okinawa Island, Japan;
(S. Yamamoto and Y. Yokoyama)

1210-1400 Lunch

1400-1520 **Chaired by Prof. Hideo Kagami**

- Subaerial Exposure and Alteration (Weathering) of Pre-Holocene Marine Deposit in the Haenam Bay and Hampyung Bay, West Coast of Korea;
(Y. -A. Park)

- Late Quaternary Paleoceanography Around the Ryukyu Arc: Its Significance for the Paleoclimate in the Northwest Pacific Region;
(H. Ujiie)

- Sea-Level Change and Recent Crustal Movement in the Ryukyu Arc;
(M. Kimura)

- Active Tectonic Features as Observed by Precise Seafloor Surveys in the Southwestern Nanseishoto (Ryukyu) Trench;
(T. Matsumoto, M. Kimura, T. Ono and C. Uechi)

1520-1540 Coffee Break

1540-1620 **Chaired by Y. A. Park**

- Sedimentary Record of Paleoproductivity in the Bering Sea;
(K. B. Yunus and S. Tsunogai)

- Terrigenous Sediment Transport Processes in the East China Sea Based on Mineralogical Study;
(H. Katayama and Y. Watanabe)

6 FEBRUARY 1998

1010-1050 **Chaired by S. Tanabe**

- Organic Carbon Cycle Studied With Particulate Fatty Acids in the Western North Pacific
(K. H. Shin, T. Hama, N. Yoshie, S. Noriki and S. Tsunogai)

- Estimation of Total Dissolved Inorganic Carbon Dioxide Below the Mixed Layer of the World Ocean;
(R. Chen, M. Akiyama and Y. Sugimori)

1050-1110 Coffee Break

1110-1210

- Th Isotopes, U Isotopes and 210Pb in Settling Particles From the Continental Slope of the East China Sea;
(M. Yamada and T. Aono)

- Profiles of Polonium-210 and Lead-210 in the East China Sea;
(T. Aono and M. Yamada)

- Measurement of the Purification Rate of Polluted Brackish and River Waters, Kumoji Naha, Okinawa Japan;
(M. K. Maalim amd A. Tokuyama)

1210-1400 Lunch

1400-1520 **Chaired by M. Yamada**

- Asia-Pacific Mussel Watch in Russian Far-East: the First Results;
(A. V. Tkalin)

- Mussel Watch Project in Tokyo Bay;
(H. Takada, K. Akiyama, Y. Yamaguchi and P. Z. Mohamad)

- Mussel Watch: Marine Pollution Monitoring of Butyltins and Organochlorines in Coastal Waters of Thailand, Philippines and India;
(S. Tanabe, S. Kan-atireklap, M. S. Prudente and A. Subramanian)

- Concentration of Heavy Metal Residues in Green Mussels (Perna Viridis) From Coastal Area, Thailand;
(S. Boonchalermkit, S. Srilachai and P. Wongpan)

1520-1540 Coffee Break

1540-1640 **Chaired by S. K. Sarkar**

- Current Status of Micro Organic Contaminants in Common Cormorants From Japan;
(K. S. Guruge and S. Tanabe)

- Accumulation of Organochlorine Pesticides, PCBs, Butyltin Compounds in Resident and Migratory Birds Collected From South India;
(K. Senthilkumar, S. Tanabe, K. Kannan and A.N. Subramanian)

- Marine Sediments: Evaluation on Recent Status for Possible Management Schemes;
(C. Chareonpanich, S. Meksumpun and A. Hoshika)

7 FEBRUARY 1998

0930-1030 **Chaired by Dr. Alexander V. Tkalin**

- Water Quality Management in Seto Inland Sea, Japan by Using the Water and Sediment Quality Model;
(I. -C. Lee, K. Fujita, M. Ukita)

- Contamination and Bioaccumulation of Butyltin Compounds in the Otsuchi Bay Ecosystem, Japan;
(S. Takahashi, S. Tanabe, I. Takeuchi and N. Miyazaki)

- Relation Between Butyltins and Total Tin in the Liver of Cetaceans From Japanese Coastal Waters;
(L. T. H. Le, K. Saeki, N. Nakatani, S. Takahashi, S. Tanabe and N. Miyazaki)

1030-1110 Coffee Break

1110-1150 **Chaired by Sukanya Boonchalermkit**

- Butyltin and Organochlorine Contamination in Marine Mammals From the North Pacific and Asian Coastal Waters;
(M. S. Prudente, S. Tanabe, M. Watanabe, H. Iwata, N. Miyazaki and A. Subramanian)

- Cadmium Accumulation and Metallothionein in Liver of Northern Fur Seals (Callorhinus Ursinus) Collected From Pacific Coast of Japan;
(H. Sakai, M. Niida, S.Tanabe, R. Tatsukawa and N. Baba

Poster Session: Physics

Fine- and Micro-Structure Measurement Systems Developed in the JGOOS, by S. Kanari, T. Matsuno, T. Hibiya, H. Nagashima, J. Yoshida

Mesoscale Variabilities in the Western Pacific and the Indonesian Throughflow Fluctuations Appeared in a Global High-Resolution GCM, by A. Ishida, Y. Kashino, H. Mitsudera, N. Yoshioka, T. Kadokura

Numerical Experiments of Nonliner Energy Transfer Within the Oceanic Internal Wave Spectrum, by Y. Niwa, K. Fujiwara, M. Nagasawa, T. Hibiya

Forced Rossby in the Southern Tropical Indian Ocean by Y. Matsumoto, G. Meyers

Poster Session: Biology, Chemistry, and Geology

Pollution by Polychlorinated Biphenyls and Organochlorine Pesticides in Resident and Migratory Birds From North Vietnam, by N.T.H. Yen, S. Tanabe, V. Qui

High Accumulation of Copper and its Subcellular Distribution in the Liver of Green Turtle (Chelonia Mydas), by M. Niida, H. Sakai, S.Tanabe, R. Tatsukawa

ANNEX II

ABSTRACT OF SCIENTIFIC PAPERS

IMPLEMENTING GOOS, THE GLOBAL OCEAN OBSERVING SYSTEM

C. Summerhayes
Director GOOS Project Office, IOC, 1, Rue Miollis, 75732 Paris, Cedex 15, France

Keynote speech

GOOS is now moving rapidly from planning into implementation. Implementation will take place in several different ways, but mainly through (i) pilot project, (ii) technology demonstrator projects, (iii) incorporation or adaptation of existing national or international operation oceanographic systems, and (iv) development of purpose built systems. Pilot Projects: (l) The first official GOOS Pilot Project is the NEAR-GOOS Pilot Project shared by Japan, China, the Republic of Korea and the Russian Federation, which began in October 1996 and involves developing a data exchange system. (2-6) In Europe, the EuroGOOS Association is in the process of developing and funding regional pilot projects in the Arctic, Baltic, Mediterranean, and Atlantic, and on the NW Shelf. While data exchange will be an important element of these projects, the main focus is on the combination of data and models to produce forecasts, as in the Mediterranean Forecasting System Pilot Project, for instance. (7) The nations of the Western Indian Ocean have formed the Western Indian Ocean Marine Applications Project (WIOMAP). Technology Demonstrator Projects: To make it work, GOOS requires the integration of satellite and in-situ data and their incorporation and assimilation into advanced numerical models to produce forecasts. To develop and test the technology for accomplishing this on the global scale the OOPC has created the Global Ocean Data Assimilation Experiment (GODAE), (8), which is now evolving through various workshops and meetings to attract funding; it is designed for a full scale test in 2003-2005.

Existing Systems: Several pre-existing operational oceanographic systems clearly do make contributions to GOOS, and it has been agreed that along with the GOOS Pilot Projects (1 through 7) and GODAE (8) they form parts of a GOOS Initial Observing System (GOOS IOS), which provisionally includes (9) the Tropical Atmosphere Ocean (TAO) array of buoys in the equatorial Pacific; (10) the PIRATA array of buoys in the equatorial Atlantic; (11) the global Ship of Opportunity (SOOP) network (formally under IGOSS); (12) the Global Sea-Level Observing System (GLOSS); (13) the Global Coral Reef Monitoring Network (GCRMN); (14) the drifting buoys coordinated by the DBCP (see DBCP Implementation Plan); (16) the WMO's Global Telecommunications System (GTS), which is acknowledged to serve operational oceanographic requirements; (16) the WMO's Voluntary Observing Ship (VOS) network (whose Implementation Plan will seek to address GOOS/GCOS requirements); (17) the Global Temperature and Salinity Profile Programme (GTSPP). In addition national groups are now adapting themselves to make specific GOOS contributions; in the USA, NOAA has formed the NOAA GOOS Centre at AOML in Miami (18), which will take care of US Ship of Opportunity (SOOP) data and drifting buoy data. The various pre-existing systems (9 through 17) evolved for other purposes than serving GOOS needs, but also address, are compatible with and satisfy GOOS requirements, and so can provide contributions to GOOS as well as to the original groups of clients for whom they were set up.

Other pre-existing systems could provide contributions to GOOS, but while general contributions can be assumed; specific contributions remain to be negotiated. These Level 2 contributions to the GOOS-IOS include: (19) the ocean observing satellites; (20) appropriate

parts of IGOSS (to be negotiated); (21) appropriate parts of IODE (to be negotiated); (22) appropriate national observing systems; (23) appropriate commercial observing systems (including oil platforms); (24) international Mussel Watch; (25) marine pollution monitoring (MARPOLMON/GIPME); (26) harmful algal bloom programme; (27) various operational oceanographic observations managed by WMO's Commission on Marine Meteorology (outside of the VOS). At a meeting in Sydney in March 1998 the managers of existing systems will meet with GOOS and GOOS managers to agree on an action plan for greater integration of existing systems into GOOS and GCOS. At the First GOOS Agreements Meeting in September 1998, operational agency heads will be asked to agree to label parts of their national observing systems contributions to GOOS, further implementing the system. Thus the GOOS-IOS now exists, is growing, and will grow further by the addition of such projects as SEA GOOS. Serious thought must now be given to managing GOOS data and information.

THE GLOBAL OCEAN OBSERVING SYSTEM: MAKING WORLD OCEAN DATA AN OPERATIONAL RESOURCE

A. McEwan
Australian Bureau of Meteorology, Chairman, Intergovernmental Committee for the Global Ocean Observing System (I-GOOS), Australia

Keynote speech

One of the outstanding emerging examples of growing cooperative interaction between nations has been the creation of the Global Ocean Observing System (GOOS).

Long a vision, the realisation of GOOS moved closer with the success of recent international scientific experiments of unprecedented global scale, notably the Tropical Ocean Global Atmosphere Experiment (TOGA) and the World Ocean Circulation Experiment (WOCE), which showed

1) The feasibility of ocean observations conducted to a coordinated strategy
2) The capacity for distributed archiving and access to large datasets
3) The international acceptability of common standards and procedures
4) The capacity of coordinated marine data to deliver valuable information, and to support numerical modeling for operational purposes.

On this basis GOOS has been conceived from the outset as a system that is designed to function 'operationally', with the intention that observations will be continued or repeated on an ongoing basis and widely accessible in near real-time according to the use made of them.

The foundation of this design is that marine data is a costly resource whose value increases with completeness, accessibility and comprehensiveness. To deliver value in some applications of enormous importance to society through the next century, some data types need to be regional or even global in coverage. GOOS has therefore been structured into five Modules' to reflect the 'sectors' of marine activity it benefits and the data they need. The paper will speculate on these benefits, recognising the cross-interaction between data, scientific understanding, application and added value.

GOOS must be built from the voluntary participation of nations and their marine agencies, and its integrated systems must grow mostly from existing observational facilities and networks. The GOOS organisation will encourage these to be steered and enhanced according to carefully developed designs, in order to deliver maximum value from the combined international effort.

To encourage participation a set of GOOS Principles has been written, together with a Strategic Plan and an initial prospectus or program for implementation. These will be outlined. At the same time it is recognised that all participants must be free to choose the form of involvement most suitable to their national circumstances and purposes, hence the emergence of regional implementations of GOOS such as NEARGOOS.

THE NEAR-GOOS DATA EXCHANGE SYSTEM FOR BETTER OCEAN SERVICES

N. Hasegawa
El Nino Monitoring and Prediction Center, Japan Meteorological Agency, Tokyo 100, Japan

Keynote

Monitoring of the ever changing oceans and appropriate and timely guidance are essential for safe, efficient and sustainable use of the oceans. The monitoring of the oceans would not be possible without the oceanographic data exchange. This paper gives the overview of North East Asian Regional GOOS (NEAR-GOOS), a new framework for the exchange of the oceanographic data and products.

NEAR-GOOS is WESTPAC's regional pilot project of GOOS and is implemented by China, Japan, the Republic of Korea and the Russian Federation. Initially, NEAR-GOOS will concentrate its efforts on the establishment of a system to exchange existing oceanographic data and products for the seas in the North East Asia. The system now consists of the Real Time Data Base, Delayed Mode Data Base, and Associated Data Bases, which are linked with each other and with users via the Internet.

The next step of NEAR-GOOS should be the usage of these data for helpful products. The author believes that data assimilation will lead to useful applications. Some data assimilation experiments have recently been carried out for this region with success. With such scientific achievements and the real time data exchange, NEAR-GOOS is expected to contribute to better ocean services. When NEAR-GOOS succeeds, its experience should be used for the success of the 'global' GOOS.

MEAN VALUES OF VOLUME AND TEMPERATURE TRANSPORTS OF THE KUROSHIO SOUTH OF JAPAN IN 1993-1995

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S. Imawaki, H. Uchida, S. Umatani
Research Institute for Applied Mechanics, Kyusyu University, Kasuga 816, Japan
M. Fukasawa
Faculty of Oceanography, Tokai University, Shimizu 424, Japan

Direct current measurements were conducted along a line crossing the Kuroshio south of Japan during an intensive survey period from October 1993 to November 1995 in which a group called ASUKA came out repeated hydrographic surveys (CTD and/or XBT measurements) along the line 40 times. The line was chosen to coincide with a subsatellite track of TOPEX/POSEIDON. Absolute geostrophic volume transports of the Kuroshio, KVT, are calculated by areal integration of northward flowing absolute geostrophic velocities in the top 1000 m layer north of 30 N from the repeated hydrographic data with reference to observed ten-day mean current velocities at a nominal depth of 700 m. Using tight relationship between KVT and sea surface dynamic high differences across the Kuroshio, KVT are estimated every ten days during 1992-1995 from TOPEX/POSEIDON altimetry data. The three-year mean KVT is obtained to be 63 Sv (1 Sv = 10^6 m^3/sec) with a standard deviation of 13 Sv. Total temperature transport, TTT, in the whole water column north of 30 N is estimated for each of 20 transects from volume-transport-averaged mean potential temperature and absolute geostrophic volume transport in the top 800 m layer using their relations with those in the lower layer than 800 m determined for five transects reaching to the sea bed. The temporal means of TTT and total-volume transport-averaged temperature during the intensive survey period are estimated to be 3.69 pW and 14.02 °C, respectively. Dominant periods of KVT and TTT fluctuations are shorter than one year.

MONITORING OF VOLUME AND HEAT TRANSPORTS OF THE KUROSHIO OVER THE IZU RIDGE BY AN ACOUSTIC TRANSCEIVER ARRAY

T. Takeuchi
University of Electro-Communications, Tokyo182, Japan
K. Taira, S. Kitagawa
Ocean Research Institute, University of Tokyo, Tokyo164, Japan

Current velocity can be determined by measuring the difference of sound wave traveling time between two points, which is well known as time difference method. We developed the "multipaths inverted echo sounder (MIES)"[1] in order to apply this method to the monitoring of volume and heat transport of the Kuroshio. Measurement of mean current velocity can be made with difference of reciprocal travel times of sound wave along two sides of a triangle in a vertical plane, which is constructed by a base side of two inverted echo sounders moored about 10km apart on the sea bottom and the other two sides as a traveling path of a sound wave reflected by the sea surface. Heat content is evaluated from round trip time between the bottom and the surface.

In 1995, four sets of inverted echo sounders were moored over the Izu Ridge at the depth of about 1100 m, where the Kuroshio flows eastward. Observations were conducted during 100 days from 29 May to 8 September. In 1996, seven sets of inverted echo sounders were deployed at the same site so as to construct a network in a line of regular triangles of which one side is 10 km distant. Unfortunately, two sets of them were not recovered and one set of them did not work correctly. In this paper, we present how we estimated volume and heat transports of the Kuroshio from above acoustical observation data.

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[1] 1) T. Takeuchi and K. Taira, "Development of multipath inverted echo sounder," in Deep Ocean Circulation, Physical and Chemical Aspects, T. Teramoto, eds. (Elsevier, Amsterdam, 1993), pp. 375-382.

SEASONAL AND INTERANNUAL VARIABILITY OF THE ALASKAN STREAM IN THE CENTRAL NORTH PACIFIC

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The Alaskan Stream is the westward boundary current of the north Pacific subarctic gyre. In the central region of the north Pacific, the Alaskan Stream makes the role of connection among the Alaskan gyre, Western subarctic gyre and Bering Sea gyre. Then its volume transport is very important for the estimation of the scale in the north Pacific subarctic gyre. In order to clarify its variability of seasonal and interannual, we made the observation section along with a longitude 180-degree once a year June from 1990 to 1997 and made direct measurements by mooring systems from 1995 to 1997. CTD observations were operated by T.S. Oshoro-Maru of Hokkaido University. Station interval is about 20 n.m. and maximum depth is 3000m. Mooring systems were set between CTD stations, Moor1 (50-38.4N, 179-47.3W), Moor2 (50-17.4N, 179-51.0W) at the center and southern area of the Alaskan Stream respectively.

Results from the calculation of geostrophic volume transport referred from 3000m, the Alaskan Stream has a large interannual variability in it. Average volume transport of 8 years is 27.45sv and standard deviation is 6.53sv. Maximum volume transport is 41.0sv in 1997 and minimum is 21.7sv in 1995 At Moor1 station stable westward flow was observed at both layers 1500m (260 degree, 11.7cm/sec), 3000m (240 degree, 3.6cm/sec, 1996-1997 year average). The ratio of eddy to mean kinetic energy (KE'/KE) is very small (<0.6) through the year. At Moor2 station 3000m depth, relatively weak and unstable flow was observed and at 5000m depth average flow direction was eastward.

A SATELLITE-BASED SYSTEM FOR MONITORING THE OCEANS AROUND JAPAN

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K. Kozai, F. Sakaida
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Kobe, 658 Japan

In order to develop a ocean monitoring system using operational visible and infrared radiometers, the scatterometers and oceanographic sensors onboard satellites, researches have been conducted for the oceans around Japan. The satellite-derived parameters have been validated using the in situ data, and the validation results provide evaluations of each parameters in terms of applicability to the ocean monitor.

A satellite database system linked to the computer networks(i.e., internet) have been developed using AVHRR sensors onboard the NOAA series satellites. The daily images of visible and IR showing the oceans around Japan (called Japan Image Database: JAIDAS) are generated operationally, archived, and distributed to the research community. An AVHRR database to investigate the coastal oceans in detail are also developed (called N-LAND

database system), which contains all the AVHRR information together with ancillary data necessary for various types of corrections and analyses. The two databases are designed to be utilized supplementary to monitor the oceans harmonizing with the conventional in situ monitoring systems.

STUDY ON SEA SURFACE TEMPERATURE DISTRIBUTION CHARACTERISTICS USING AVHRR IMAGE DATABASE

E. Sakata
Remote Sensing Technology Center, Saitama 355, Japan
F. Sakaida, K. Kozai
Ocean Mechanical Engineering Chair, Kobe University of Mercantile Marine, Kobe 658, Japan

Osaka Bay is known as typical enclosed coastal sea with complex structure of water masses. Oceanic front represents boundary between different type of water masses. NOAA/AVHRR is a useful tool for analysing temporal and spatial sea surface temperature phenomena such as oceanic fronts. This study is an attempt to investigate seasonal and temporal variations of water mass structure and fronts in Osaka Bay using NOAA/AVHRR image database.

THE UPPER OCEAN VARIABILITY IN THE MIDLATITUDE NORTH PACIFIC: AN APPROACH TO EFFECTIVE MONITORING

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Seeking for an effective way to monitor the upper ocean variability with minimum efforts and limited resources, especially for most effective sites where permanent observing stations should be occupied, we have analyzed the historical hydrographic and XBT data to document the variability of the upper ocean thermal condition of the midlatitude North Pacific. Our analysis shows that the upper ocean variability is fairly dominated by the two mode waters: the North Pacific Subtropical Mode Water in the western region or the Kuroshio recirculation region and the North Pacific Central Mode Water in the central to eastern region. The mode waters, characterized as thermostads/pycnostads, are formed in the wintertime thick mixed layer as a result of vigorous air-sea interaction, and then spread beyond their spatially confined formation areas. The mode water properties at a given site vary with reflecting variations of the air-sea interaction and/or the upper ocean circulation. Based on the proper knowledge about characteristics of the mode water formation and circulation, the upper ocean variability will be effectively monitored by observing the mode waters at a limited number of permanent stations because the mode waters memorize the results of the air-sea interaction and carry them widely. Effective sites for the monitoring are suggested and possible variability to be monitored on the seasonal, interannual and decadal-to-interdecadal scales are described.

DEVELOPMENT OF A COMPACT, SELF-CONTAINED SURFACE METEOROLOGICAL OBSERVATION SYSTEM

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We have been developing a compact, self-contained surface meteorological observation system since 1995. The system has been developed to make it possible to perform automated comprehensive marine meteorological observation on a voluntary ship or a surface moored buoy.

The system consists of a pyranometer, a pyrgeometer, air temperature and humidity sensors, a rain gauge, an anemometer, a vane and a recorder. A polytetrafluoroethylene (Teflon) dome is employed to cover the thermopile of the pyrgeometer because the material is strong enough to keep the dome's shape under severe weather. A magnetic sensor is used to determine the wind direction. All of the data obtained by the sensors are recorded in the digital recorder. It can store about 60-day observation with the sampling interval of 10 minutes. The system has a solar battery, which supplies the electric power to the recorder and charges the inner battery in daytime. It does not need the power supply outside of the system in nighttime.

The first trial observation aboard a ship was made from October 17th through November 27th, 1996, during the R/V Hakuhomaru research cruise KH96-4. The system encountered severe weather during the first half of the cruise, revealing some shortcoming of the sensors.

In 1997, we have been improving the system to survive hard weather condition. After a trail observation in open ocean, we will install the system on a ferry around the Japan Island

OCEANOGRAPHIC OBSERVATIONS IN THE SEASONAL SEA ICE ZONE OF POLAR SEAS

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There are extremely few in-situ oceanographic observations in the seasonal sea ice zone of winter polar seas. This is a preliminary report on the results of oceanographic observations in which we have performed in the seasonal sea ice zones of two high latitude seas, off the Adelie Land, Antarctica, and the southern Okhotsk Sea.

The region off the Adelie Land is thought to be one of sources of Antarctic Bottom Water though the major sources are among the Weddell and Ross Seas. Our observations made by two cruises in the austral summers of 1995 and 1996 show the existence of bottom water with the lower temperature, lower salinity, lower silicate, higher freon and higher

methan concentrations. All of these water properties for the bottom water is characteristic of relatively young water. We also carried out current-meter moorings at three stations on the continental slope in this region. At one of these moorings, data were successfully obtained from January 1995 to March 1996. These currents were deployed at 1075, 1778 and 2632 m deep (sea depth of 2665 m) in this mooring. These data show that current speeds and variability of speeds and temperatures were largest at the lower current meter near the bottom. In addition, seasonal variability of speeds and temperatures were evident only at this current meter. From August to December, speeds and their variability were larger, temperatures were lower and their variability was larger. Unfortunately, we had no record of current directions because this region was located just near the geomagnetic south pole. According to our observational results, the maximum current speed was 19.8 cm/s during the period from August toDecember. At that period, the lowest temperature -0.34° C was recorded and this was 0.24 ° C lower that that during the other period. This suggests that the formation of bottom water occurs seasonally in this region.

We have performed in-situ oceanographic observations within the sea-ice cover in the southern Sea of Okhoitsk, using an icebreaker Soya in the winters of 1996 and 1997. Fortunately, we were able to do the observations both in the lighter (1996) and heavier (1997) sea-ice years. Our observations show that the convection layer in the heavier sea-ice year of 1997 was much thicker than that in the lighter sea-ice year of 1996; the maximum thickness of the convection layer in 1997 was about 400 m deep. This suggests that the deep, convection layer may be transported to this region through the wind stress and ocean current after it was produced in northern regions accompanied with sea ice formation.

MODELING THE KUROSHIO

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Numerical simulation is performed using a high-resolution ocean general circulation model to investigate seasonal variations of the Kuroshio transport. The simulated velocity profiles of the Kuroshio agree surprisingly well with ADCP observations and dynamic calculations. The annual mean of the model Kuroshio transport relative to 700 m across the PN-line near the Nansei (Ryukyu) Islands is about 25 Sv, which is almost the same with the estimate based on the long-term hydrographic observations. The model transport variations across the PN-line are also almost the same as the observation; the transport shows a weak maximum in summer and a weak minimum in winter. Although the Sverdrup balance is valid in the broad interior of the basin as shown by Hautala et al.(1994), it fails to predict the variations as well as the transport of the Kuroshio south of Japan due to existence of the Kuroshio recirculation.

The above discrepancy between the Sverdrup theory and the model (observations, as well) is studied in detail by analyzing the torque balance. In winter the Kuroshio transport across the PN-line is much smaller than expected from the Sverdrup theory because the topographic control prevents the western boundary current from intruding west of the continental slope near the Nansei (Ryukyu) Islands. The current over the slope region

Seasonal variability in the transports is also discussed and shown to be strongly influenced by local forcing and frictional effects within straits.

SOUTH CHINA SEA WARM POOL

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South China Sea Institute of Oceanology, Academia Sinica, Guangzhou 510301, China

Data used in this study are mainly time sequence of temperature-depth and climatological data of salinity - depth in SCS for the period from 1959 to 1988 with a grid 20m in the vertical, 2 (latitude) by 2 (longitude) on horizon, and bimonthly in time. It is found that there exists a warm pool in the South China Sea (SCS). The water temperature in a depth of 20m in the ocean is a better indicator of the SCS warm pool and is adopted to describe temporal and spatial distribution of SCS warm pool and its variation. The formation of the warm pool is also discussed by combining water temperatures with geostrophic currents and simulated oceanic circulation. Main results are as following.

1. There is a remarkable seasonal change in the SCS warm pool. In winter the warm pool has a minimum size with lower water temperature; in late spring and early summer it northeastwards expands quickly with water temperature rising rapidly, in summer the size of the warm pool is in its maximum with water temperature reaching its highest; in autumn it retracts southwards with water temperature descending.
2. There is also a remarkable interannual change in the SCS warm pool. In the El Nino year the warm pool is bigger than normal with higher water temperature; which is out of phase with those in the equatorial western Pacific, and is in phase with water temperature changes in the equatorial eastern Pacific with a lag by about half year. This is consistent with interannual changes in the heat content in the upper ocean (0-100m) of SCS.
3. Development of SCS warm pool is closely related to distribution and evolution of gyres in the sea, as well as imported warm water from Indian ocean (Java Sea) to SCS induced by southwest monsoon, besides solar radiation.

THE SEASONAL VARIABILITY OF THE CIRCULATION AND THERMOHALINE STRUCTURE OF THE SOUTH CHINA SEA IN THE CONDITION OF REVERSING MONSOON WINDS: PRELIMINARY RESULT OF A THREE-DIMENSIONAL MODEL FOR ITS ANALYSIS AND SIMULATION

D. V. Uu
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The South China Sea, one of the largest continental semi-closed Mediterranean seas, is connected by the deep Bashi strait to the Pacific Ocean and by the narrow straits and passages: Taiwan to East China Sea, Karimata and Mandoro to Ocean Indian via the Java and the Sulu seas.

result, we have succeeded in reproducing the key features of the Japan Sea circulation and the Okhotsk Sea circulation. In addition, the basic properties of open-ocean deep convection, which plays an important role in the formation of the intermediate and deep waters in these regions, was investigated with a nonhydrostatic model in a rotating frame, and the importance of the thermobaricity of sea water on subduction processes at high latitudes was revealed.

Finally, we proposed a simultaneous assimilation model of drifting buoy and altimetric data to determine the mean SSH (Sea Surface Height) as well as the temporal evolution of the surface circulation on synoptic scales. The result showed that realistic buoy deployment (32 in a 40° square) can effectively constrain the model variables; that is, both the absolute (mean plus time varying) velocity and SSH fields are significantly improved. Further, successive correction of the mean SSH was attempted with the simultaneous assimilation of drifting buoy and altimetric data. Consequently, a better correction of the mean SSH was obtained: the initial error of the mean SSH is reduced by approximately 40% after the 1-year experiment. These clearly show that simultaneous assimilation of the drifting buoy and altimetric data into the dynamical model is a very useful tool for improving the model's realism and hence has the ability to predict the surface circulation.

DEVELOPMENT OF MARINE CARBONATE OBSERVATION SYSTEM AND ITS APPLICATION IN THE WESTERN NORTH PACIFIC REGION

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We have developed precise determination methods of water column inventories of total carbon dioxide, alkalinity and pH as well as nutrient elements, and of surface water f(CO2) values using permeable membrane. The methods have been applied to water of the North Pacific including its adjacent seas, although a continuous measurement on the moored buoy system has not yet been devised.

We have also established the estimation method of excess CO_2 in the North Pacific water due to the recent human activities and found the large excess CO_2 for the North Pacific water. The large excess CO_2 can be explained by the large potential sink capacity of the North Pacific water and the existence of processes recovering the capacity. The large sink capability is due to the loss of CO_2 in the Southern Ocean in winter forming the Pacific Deep Water not consuming nutrients and the dissolution of $CaCO_3$ in the deep Pacific besides the recent increase in the atmospheric CO_2. We have pointed out four processes for the recovery of the potential capacity. They are the formation of North Pacific Intermediate Water, heavy storms in winter, high organic C to carbonate C ratios induced by dissolved and the continental shelf pump.

MONITORING THE OCEAN CURRENTS BY USING SUBMARINE CABLES

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In the geomagnetic field the motion of the sea water induces the cross-stream voltage which is proportional to the volume transport of the ocean current. This implies that the measurement of the motion-induced voltage across a channel or strait may provide us with

MONSOON CIRCULATION IN THE SOUTHERN BAY OF BENGAL IN AN OGCM

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T. Yamagata
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We use results from an ocean general circulation model to study the response of the southern Bay of Bengal to climatological monsoon winds. Comparison of the model results with climatological hydrographic data and TOPEX/POSEIDON altimetry shows that the model simulates the seasonal cycle of the upper ocean reasonably well. The Southwest Monsoon Current (SMC) in the North Indian ocean flows westward during the winter and eastward during the summer. The SMC splits into two parts east of Sri Lanka. The major part turns northeastward and flows into the Bay of Bengal and the rest continues eastward. The part that flows eastward terminates at progressively western longitudes as the season progresses. Rossby waves generation associated with the reflection of spring equatorial (Wyrtki) jet in the Indian Ocean from the eastern boundary plays a dominant role on the dynamics of the SMC in this region. The study suggests that the summer circulation in this region consists of several vortices. A large anticyclonic vortex is embedded in the SMC, where the eastward flow and the Rossby wave converges. North of the SMC, a thermal dome associated with cyclonic circulation forms along the east coast of Sri Lanka in response to the local wind stress curl. The model results also shows the presence of an anticyclonic eddy east of the dome

CLOCKWISE PHASE PROPAGATION OF SEMI-DIURNAL TIDES IN THE GULF OF THAILAND

T. Yanagi
Research Institute for Applied Mechanics, Kyusyu University, Kasuga 816, Japan
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The phase of semi-diurnal tides (M_2 and S_2) propagates clockwise in the central part of the Gulf of Thailand though that of diurnal tides (K_1, O_1, and P_1) counter-clockwise. The mechanism of clockwise phase propagation of semi-diurnal tides at the Gulf of Thailand in the northern hemisphere is examined using a simple numerical model. The natural oscillation period of the whole Gulf of Thailand is near the semi-diurnal period and the direction of its phase propagation is decided to be clockwise mainly by the propagation direction of large amplitude part of the incoming semi-diurnal tidal wave from the South China Sea. The simplified basin model with bottom slope and Coriolis force well reproduces the co-tidal and co-range charts of M_2 tide in the Gulf of Thailand.

started May 1997 after the OLU cable retirement of its commercial use. Observations show the overlapped voltage variations induced by geomagnetic field changes, tidal currents, longer-period ocean currents like the Kuroshio, unsteadiness of the cable power supply system, etc. This paper shows our preliminary results of the measurements and discusses the possibility of monitoring the Kuroshio volume transport using the OKITAI and OLU cables at the entrance into the East China Sea.

NORTH-SOUTH SECTIONS OF ADCP-SV VALUES BETWEEN JAPAN AND AUSTRALIA IN WINTER AND SUMMER

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In the Living Marine Resources module of International GOOS Project, it is expected to establish monitoring systems of seasonal, interannual and interdecadal scale variations in plankton biomass and dominant species and size, as well as their physical environment, focusing on decadal scale regime shift. The ADCP manufactured by RD Instruments with a frequency of 150 kHz (broad band type) is equipped on a cargo named "First Jupiter" (84,000 ton in weight and 16 kt in ship speed) shuttling between Japan (Kashima and/or Wakayama) and Australia (Brisbane and/or Port Headland) across the Western North Pacific once about a month. By using this ADCP, we have been monitoring the water temperature at the bottom of the ship (8 m depth), vertical profiles of the current velocity and the back scattering intensity (SV. values) down to about 350 m depth from the sea surface since January in 1997.

In this paper we will present preliminary results of the ADCP data obtained by First Jupiter in January and July in 1997, describe biological characteristics represented by back scattering data and compare with the previously observed hydrographic and plankton data in a cruise of R/V Ryofu-Maru of JMA. The current field in winter exhibits the strong northeastward Kuroshio Current and the broad westward North Equatorial Current including eddy feature, as well as the Mindanao Current to the south of 12-13^0 N. The back scattering intensity (volume) in the upper 150 m shows clear daily variation associated with diel vertical migration of zooplankton. The scattering intensity al night had a subsurface maximum at 70-120 m with horizontal variations of 80 km in wave length. Values of the scattering volume in the area of 12-17-N (North Equatorial Current region) was almost one order lower than those in the area of 25-30^{0}N (Kuroshio Counter Current region).

ASSIMILATION OF OCEAN COLOR DATA INTO A COUPLED ECOSYSTEM MODEL FOR ESTIMATING FLUXES OF PARTICULATE ORGANIC MATTER IN THE NORTHERN PACIFIC OCEAN

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Center for Climate System Research, University of Tokyo, Tokyo 153, Japan
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Institute for Hydrospheric-Atmospheric Sciences, Nagoya University, Nagoya 464, Japan

Satellite remote sensing techniques have been found to be useful in many areas of application. The frequent and wide area coverage provided by remote sensing satellites has made it possible to obtain up-to-date information of features and phenomena over large areas of the earth's surface.

This paper reports *on* studies related to bathymetry, turbidity and sea bottom features mapping using the optical wavelengths of the Landsat-5 Thematic Mapper data over specific study sites in Malaysia. The papers also reports on some studies that were carried out by using the ERS-1 Synthetic Aperture Radar data to detect oil slicks/spills, to determine ocean wavelengths and directions, bathymetry and some marine phenomena in Malaysian waters.

The results of the studies are encouraging and indicate the usefulness of using satellite remote sensing data for various marine applications.

WATER EXCHANGE BETWEEN THE SUBTROPICAL AND EQUATORIAL OCEANS NEAR THE PHILIPPINE COAST

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This study provides a comprehensive description of the mean flow and water mass structure near the Philippine coast, using available historical and recent hydrographic data. In general, the present results agree with many earlier observations in the upper thermocline, but show considerable discrepancies in the deeper layers. On σ_θ=27.2 surface, the bifurcation of the North Equatorial Current (NEC) occurs at about 20^{0}N, indicative of a southward flow along the Luzon coast (called the Luzon Undercurrent). Also at this density a clockwise recirculation is found east of Mindanao. There are indications that this clockwise recirculation is related to the Halmahera Eddy that moves northwestward from about 4^{0}N, 130^{0}E in the thermocline to about 7^{0}N, 127^{0}E at the intermediate depth, suggesting that the Mindanao Undercurrent (MUC) is mainly a component of local recirculation associated with the Halmahera Eddy. North Pacific Tropical (NPTW) and Intermediate Waters (NPIW) enter the western ocean at about 15^{0}and 20^{0}N, respectively. Some of them continue southward as part of the LUC/MC either into the Indonesian throughflow or into the Pacific equatorial circulation. The influence of the south Pacific sources is limited in the upper thermocline and becomes increasingly important with depth. In the intermediate layer, water of south Pacific origin (Antarctic Intermediate Water) is traced to about 12^{0}N at the coast of Mindanao. Water properties are also examined at the NPTW and NPIW salinity extremes to explore the effect of mixing on the water masses. The primary result is that mixing of temperature and salinity are not jointly compensated, and so both NPTW and NPIW change their densities along the Philippine coast.

WATER MASS STRUCTURE AND ITS VARIATION IN THE WESTERN NORTH PACIFIC

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Hydrographic Department, Maritime Safety Agency, Tokyo 104, Japan

As a result of systematic and long term operational observations nearly a century, coastal water circulations and potential climate change in the NEAR-GOOS area are described. Combination of satellite observation and in situ observation give us more detailed information on impact of El Nino in this region.

Coastal dynamics is governed by Tsushima Current variability and seasonal air-sea interaction in the NEAR-GOOS area. Climate change is governed by global warming particularly winter season warming up. Impacts of El Nino is not clear in this region, as high SST anomaly leads high rainfall anomaly a month later.

THE INDONESIAN THROUGHFLOW AS IT ENTERS THE EASTERN INDIAN OCEAN

S. Wijffels
Australian Commonwealth Scientific and Industrial Research Organisation, Australia

Keynote

The leakage of warm waters from the Western Pacific into the eastern Indian Ocean has been subject to intense observation over recent years by the CSIRO's volunteer ship XBT program, the Indonesian/French JADE and Indonesian/US ARLINDO programs and, in 1995, as part of the WOCE Indian Ocean survey. Work is underway to synthesize these data to produce an overall picture of the Throughflow as it leaves the Indonesian archipelago and enters the Indian Ocean. Best estimates will be given of the Throughflow's mean volume transport and depth penetration. Strong variability of the Throughflow and the currents in the Indonesian-Australian Basin occurs at intraseasonal (~60days) as well as seasonal and interannual timescales.

A SIMPLE MODEL OF THE CIRCULATION WITHIN THE SOUTH CHINA AND INDONESIAN SEAS

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As a thought experiment, it is assumed that all of the passages between the Asian and Australian continents, e.g. Torres Strait, Sunda Shelf, Makassar Strait, are dynamically wide and deep. The resulting archipelago circulation, calculated using a Sverdrup model, is found to be vastly at odds with observations: the throughflow between the Pacific and Indian Oceans is provided by a large westward transport through Torres Strait; a large westward transport through Luzon Strait passes southward through the South China Sea into the Sulu Sea and exits into the Pacific Ocean through the Celebes Sea; there is a northwestwards transport through the remainder of the archipelago, including the Makassar Strait.

The experiment shows the pattern of pressure gradients within the seas that the wind stress wants to set up, and which frictional effects must overcome to yield the observed mean circulation. By successively closing straits under the assumption that frictional effects are sufficient to arrest the flow in the strait, it is demonstrated how the observed mean circulation within the Indonesian seas arises.

Seasonal variability in the transports is also discussed and shown to be strongly influenced by local forcing and frictional effects within straits.

SOUTH CHINA SEA WARM POOL

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Data used in this study are mainly time sequence of temperature-depth and climatological data of salinity - depth in SCS for the period from 1959 to 1988 with a grid 20m in the vertical, 2 (latitude) by 2 (longitude) on horizon, and bimonthly in time. It is found that there exists a warm pool in the South China Sea (SCS). The water temperature in a depth of 20m in the ocean is a better indicator of the SCS warm pool and is adopted to describe temporal and spatial distribution of SCS warm pool and its variation. The formation of the warm pool is also discussed by combining water temperatures with geostrophic currents and simulated oceanic circulation. Main results are as following.

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3. Development of SCS warm pool is closely related to distribution and evolution of gyres in the sea, as well as imported warm water from Indian ocean (Java Sea) to SCS induced by southwest monsoon, besides solar radiation.

THE SEASONAL VARIABILITY OF THE CIRCULATION AND THERMOHALINE STRUCTURE OF THE SOUTH CHINA SEA IN THE CONDITION OF REVERSING MONSOON WINDS: PRELIMINARY RESULT OF A THREE-DIMENSIONAL MODEL FOR ITS ANALYSIS AND SIMULATION

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The South China Sea, one of the largest continental semi-closed Mediterranean seas, is connected by the deep Bashi strait to the Pacific Ocean and by the narrow straits and passages: Taiwan to East China Sea, Karimata and Mandoro to Ocean Indian via the Java and the Sulu seas.

Located in the southeastern part of the Asia, the seasonally reversing monsoon winds play an important role in formation of the circulation and hydrological structure of the sea. This variation is very important in meteorological and marine prediction.

One of the objects of this study is to investigate seasonal variation of the meteorological conditions, the air-sea exchange fluxes, the three-dimensional temperature and salinity fields and the water masses in the sea.

Another object is to simulate the general circulation during two monsoon seasons.

The result of a model for three-dimensional thermohaline analysis and geostrophic flow calculation improve our perception of the dominant processes and forcing mechanisms

The preliminary result of a three-dimensional model for simulation of the circulation, temperature and salinity variation show the necessity to employ a complete thermohydrodynamic model with realistic conditions of the oceanatmosphere couplings during monsoon and the exchange fluxes between the South China Sea and adjacent seas and oceans.

SEASONAL VARIATION IN RESIDUAL FLOW IN THE SOUTH CHINA SEA

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The South China Sea is the largest marginal sea in the Southeast Asian Waters. It is situated between the Asian continent, Bomeo, the Philippines and Taiwan. The northern part is a deep sea basin where depths exceed 4000m. The southern part is a shelf sea, where the depths range between 50m and 100m.

The South China Sea is situated within the monsoon regime and is thereby strongly influenced by the circulation of the atmosphere. In winter, northeasterly wind prevails over the whole region, in summer the wind distribution totally reverses.

This study concerns to investigate by numerical model the seasonal variation in the residual flow, including wind-driven current, density-driven current and tide induced residual current, in the South China Sea. On the basis of the observed data on sea water temperature and salinity as well as the monthly averaged wind a diagnostic three-dimensional model is established. In this numerical model the finite difference method and the vertical σ-stretching technique are applied. The calculations of the residual flows in spring, summer, autumn and winter are carried out and compared to the previous studies as well as the observed data. The major characteristics of the seasonal variation in residual flow in the South China Sea are revealed.

MONSOON CIRCULATION IN THE SOUTHERN BAY OF BENGAL IN AN OGCM

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TIDE AND NATURAL OSCILLATION IN THE GULF OF THAILAND

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Results of hydrodynamical modeling of tide and natural oscillation in the Gulf of Thailand (GoTh) are presented in this paper. The report consists of two parts:

The fist part is related to the tide. Distribution of the main constituents O_1, K_1, M_2, S_2, and of the amplitude and the phase harmonics constants has been obtained. Furthermore, some features of the tide picture such as amphidrome areas and the tide regime will be also described.

The second part is given for natural oscillation. Simulation of the sea water elevation for the GoTh is based on consideration of the propagation of forced oscillation given at the liquid boundaries of the South China Sea. It can be concluded the natural periods of the GoTh are nearly daily (18-21 hours), nearly semidaily (11-12 hours) and more than two days ones (50-60 hours), for which the amplitude can be amplified 5÷6, 2÷2.5, 1.5÷2.5 times respectively.

The obtained results can make some new contribution to better understanding of the sea water level oscillation in the GoTh.

ON THE MECHANISM OF INTERACTION OF SOUTH CHINA SEA TIDES AND MEKONG RIVER FLOOD

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Induced tidal energy in the estuary especially its most important elements such as energy flow and harmonic impulse are used for formulation and investigation of the problem of interaction of South China Sea Tides and Mekong River Flood. Based on careful search of the data of new current registrations in the mouths of Co-Chien (Mekong River) during dry and flooding periods of 1996-1997 the quantitative and qualitative features of such constituent elements as current and energy ellipses, energy transport, videoimpulses and their forces, etc., are introduced and analysed. For example, maximum and average values of energy flows on vertical oriented themselves toward to higher sections of downstreams can reach to 70.10^8erg/cm.s and to 29.10^8erg/cm.s respectively, the corresponding impulse force is in the side 67.10^6 kG. It means that the downstreams of Co-Chien have to get a quantity of tidal energy induced from South continental shelf of Vietnam and blocked a flooding unchoke. Some characteristics of the interaction are evaluated by numerical comparison of relative hydrodynamic situations occurring in both dry and flooding seasons.

USE OF SATELLITE REMOTE SENSING TECHNIQUES FOR SOME MARINE APPLICATIONS IN MALAYSIAN WATERS

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Satellite remote sensing techniques have been found to be useful in many areas of application. The frequent and wide area coverage provided by remote sensing satellites has made it possible to obtain up-to-date information of features and phenomena over large areas of the earth's surface.

This paper reports *on* studies related to bathymetry, turbidity and sea bottom features mapping using the optical wavelengths of the Landsat-5 Thematic Mapper data over specific study sites in Malaysia. The papers also reports on some studies that were carried out by using the ERS-1 Synthetic Aperture Radar data to detect oil slicks/spills, to determine ocean wavelengths and directions, bathymetry and some marine phenomena in Malaysian waters.

The results of the studies are encouraging and indicate the usefulness of using satellite remote sensing data for various marine applications.

WATER EXCHANGE BETWEEN THE SUBTROPICAL AND EQUATORIAL OCEANS NEAR THE PHILIPPINE COAST

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This study provides a comprehensive description of the mean flow and water mass structure near the Philippine coast, using available historical and recent hydrographic data. In general, the present results agree with many earlier observations in the upper thermocline, but show considerable discrepancies in the deeper layers. On σ_θ=27.2 surface, the bifurcation of the North Equatorial Current (NEC) occurs at about 20^{0}N, indicative of a southward flow along the Luzon coast (called the Luzon Undercurrent). Also at this density a clockwise recirculation is found east of Mindanao. There are indications that this clockwise recirculation is related to the Halmahera Eddy that moves northwestward from about 4^{0}N, 130^{0}E in the thermocline to about 7^{0}N, 127^{0}E at the intermediate depth, suggesting that the Mindanao Undercurrent (MUC) is mainly a component of local recirculation associated with the Halmahera Eddy. North Pacific Tropical (NPTW) and Intermediate Waters (NPIW) enter the western ocean at about 15^{0}and 20^{0}N, respectively. Some of them continue southward as part of the LUC/MC either into the Indonesian throughflow or into the Pacific equatorial circulation. The influence of the south Pacific sources is limited in the upper thermocline and becomes increasingly important with depth. In the intermediate layer, water of south Pacific origin (Antarctic Intermediate Water) is traced to about 12^{0}N at the coast of Mindanao. Water properties are also examined at the NPTW and NPIW salinity extremes to explore the effect of mixing on the water masses. The primary result is that mixing of temperature and salinity are not jointly compensated, and so both NPTW and NPIW change their densities along the Philippine coast.

WATER MASS STRUCTURE AND ITS VARIATION IN THE WESTERN NORTH PACIFIC

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The Hydrographic Department of the Maritime Safety Agency of Japan has carried out hydrographic observations along the 133-40E line twice a year from 1993. The main part of this line is located to the west of Kyusyu-Palau Ridge and covered from the Kuroshio to the North Equatorial Counter Current. Typical water masses in the subtropical gyre of the North Pacific are found in the vertical sections along the 133-40E line for temperature and salinity, such as NPSTMW (North Pacific Subtropical Mode Water) and NPIW (North Pacific Intermediate Water). NPSTMW is found in the Kuroshio recirculation area as the minimum layer for potential vorticity. NPIW is found from the Kuroshio recirculation area to the North Equatorial Current area as the minimum layer for salinity. Temperature, salinity and potential density at the core of these water masses varied between seasons (summer and winter) and in each year as a reflection of the variation in the water mass formation.

The positions of the steep temperature gradients at 23-24N and 16-17N are consistent with ones of the eastward flow observed by shipboard ADCP. We consider that the eastward flow at 23-24N is the Subtropical Counter Current which divides the NPSTMW and the TW (Tropical Water).

NEAR-SURFACE CIRCULATION IN THE NORTH-WESTERN PACIFIC AS DERIVED BY VARIATIONAL METHOD FROM LAGRANGIAN DRIFTERS

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We analyzed data of 296 WOCE/TOGA Lagrangian drifters (106.8 drifter years in total), drogued at 15 m depth, in the North Western Pacific (20-60^{0}N, 120-180^{0}E). Large-scale velocity field and its variability are calculated with statistical and variational methods. The later uses ajoint technic of minimization of horizontal divergence and non-linear advective terms, along with fitting drifter data and some horizontal smoothing. Minimization of advective terms results in a quasigeostrophic regime of currents and provides anisotropic effective smoothing, remaining narrow strong jets, typical for the region. The Kuroshio Extension and Subarctic Front are represented by two intensive eastward jets. At the same time, weak, but rather stable, westward countercurrent has been found between them. Interaction of the jets with the Shatsky Rise and Emperor Seamounts is shown to broaden and weaken them, as well as it increases eddy activity. Individual trajectories demonstrate the lack of horizontal north-south water exchange across the frontal zone in the upper ocean.

RECENT VARIATIONS OF SUBSURFACE TEMPERATURE IN THE NORTH PACIFIC

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The authors investigated subsurface temperature variation in the North Pacific based on a monthly subsurface temperature grid point value data set made from the IGOSS BATHY

reports exchanged through the GTS on a real time basis. The data set consists of monthly subsurface temperature fields at the depth of 100, 200, 300, and 400 m for the period from March 1986 to September 1997.

In the western and central part of the North Pacific mid-latitude area, seasonal 100 m temperature variation is clearly found, though it is not clear in the eastern part. Time series of area mean 100 m temperature anomaly in the central part shows a remarkable warming during the period from the end of 1988 to the middle of 1991. After a peak in the middle of 1991, positive anomaly of 100 m temperature reduced and no significant changes have been observed since the middle of 1992. In the eastern part, on the other hand, a gradual warming occurred from the end of 1989 to 1992, and warm condition of 100 m temperature continued during the period from 1993 to 1994. In the western part, the time series shows similar temperature variation as seen in the central part. Similar variations of temperature anomaly are observed at the deeper layers though they are weaker than that observed at 100 m.

Unfortunately number of XBT sampling and real time data exchange in the North Pacific mid-latitude area, i.e. the TRANSPAC region, has reduced since 1995, and therefore data coverage has been worse. To provide more sub-surface temperature data and improve data coverage, the Japan Meteorological Agency started Japan-US cooperative XBT sampling in the TRANSPAC region in 1997.

NUMERICAL SIMULATION OF THE KUROSHIO-OYASHIO CURRENT SYSTEM

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A numerical model including Kuroshio and Oyashio current system have been constructed using a primitive equation ocean model with σ-coordinate for vertical grids. We drive the model with the Kuroshio in-flow near the PN-line close to Okinawa, and with the Oyashio in-flow off Kamuchatska Peninsula, while the outflow is given as currents associated with the Kuroshio-extension and the subarctic-front. The model is also forced by Hellerman & Rosenstein wind stress and COADS heat flux.

The control experiment is run with a seasonal forcing with in-flowing Kuroshio volume transport being fixed at 25Sv. The Kuroshio exhibits a straight path in this case. The modeled flow field of the Kuroshio and the Kuroshio extension is remarkably similar to that observed by e.g. drifters, current mooring arrays and ADCP equipped with a regular ferry. Further, separation of the Kuroshio off the Boso Peninsula is well represented. Oyashio is then extended southward along the Sanriku coast, and is fed into the Kuroshio.

To examine bimodality of the Kuroshio paths south of Japan, the model is driven by steady forcings with variable Kuroshio inflow. It tends to have the "meander path" when the inflow transport becomes large. The multiple states are found for the in-flowing transport $\geq$ 30Sv .

FEATURES OF WATERS DYNAMICS IN THE NORTHEAST PART OF OKHOTSK SEA IN WINTER-SPRING OF 1995-1996

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The results of geostrophical currents calculates on data of oceanological observation have been carried out in the TINRO expeditions (11-25.04.95, 9-26.12.95, 03.03-11.05.96) in the West Kamchatka region and North-Okhotsk shelf are analyzed.

Such basic elements of horizontal circulation of waters as West-Kamchatka current (WKC), Penzhinsk current, cyclon circulations in the region of Kashevarov Bank and on entrance to Shelikhov gulf are distinctly traced on the maps of dynamic topography.

In April 1995 the main transportation of waters in Western Kamchatka region was directed to the north. The main flow of WKC was placed between 154- 155 E from 52 to 56 N, then the flow of WKC was divided into two branches: a northwest and northeast direction.

In December 1995 WKC followed as wide flow between 150 E and the Kamchatca peninsula .The main flow of WKC was oriented along 154 E, approaching TINRO Basin, WKC was divided into two branches. One of the branches followed to the north, deviating then to the northeast and directed to the east coast of Shelikhov bay; the second branch deviated to the northwest and spread to the North-Okhotsk shelf, then it interflowed with the North-Okhotsk current westwards of Tauiskiy bay After division of WKC on two branches, 0.9 Sv- was transferred to the North-Okhotsk shelf and 0.8 Sv- to the north and northeast.

In the northeast part of region the Penzhinsk current was marked, which running out from Shelikhov bay turned to the east, forming the quasistationaly cyclonic circulation.

The availability of compensatory countercurrents near the Kamchatka coast, the absence of a northeast branch of WKC and the gyrestructure of the horizontal currents field on the Kamchatka shelf were the main difference of water dynamics in March-May 1996.Thus, the countercurrent was expressed mostly in March.

THE FEATURES OF WATERS TERMIC AND THE CLASSIFICATION OF THE WATERS THERMAL STRUCTURE IN THE OKHOTSK SEA

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The results of oceanological observations have been carried out on the RV "Levanidov" from the 9th to 26th of December 1995 in me northeastern part of the Okhotsk sea are analyzed.

The water structure of the North-Okhotsk shelf, the Shelikhov bay and of the West-Kamchatka region was formed in December 1995, mainly under me influence of Autumn-Winter convection, wind and tidal mixing and currents. The water temperature on surface was

changed from -0.2°C in the northwest part of region up to 2.7°C in the West Kamchatka region.

The advection of the warm waters by the West-Kamchatka current (WKC) was carried out down to the coastal regions of the North Okhotsk shelf. In the eastern part the warm waters of WKC promoted to increase of water temperature near the eastern coast of Shelikhov bay in the layer from the surface to the bottom. In distribution of bottom temperatures there is the nucleus of a cold (-1.4°C)in the region of 146-147 E and 58 N. The similar nucleus, but of higher temperature (0.1°C)is found out in the northern part of Shelikhov bay as well. By the increasing of depth observations over large depths there was the increasing of temperature, in deep-water basin the temperature was on the average 1.6°C.

The vertical structure typification of waters was conducted on temperature profiles. There were marked four types: the West-Kamchatka type (I), Coastal North-Okhotsk (II), the North-Okhotsk type of open waters (III), Kashevarov type (IV).

The West-Kamchatka type is characterized by the highest temperature of water in the surface layer. In the open part of the sea over the large depths the surface waters with temperature close to 2.0°Care presented by the quazi-homogeneous layer with capacity on the average 50 m. For the waters of the 1-st type the availability of a layer of minimum temperatures (LMT) is characteristic also. An intermediate maximum of temperature, the layer of me intermediate cold Okhotsk waters and deep water with temperature 1.6-1.8°C were deeper of LMT..

The coastal North-Okhotsk waters were generated basically under the influence of Autumn-Winter convection. The characteristics of these waters are the low temperature in layer of convective cooling and uniformity of temperature and salinity from surface to the bottom above shoals and from surface up to horizont of 70-90m. Over the depths of 150-200m. Thus, in the region of Tauyskiy bay on profiles it can be marked the subsurface maximum of temperature, generated under the influence of transformed warm waters of West-Kamchatka current. The waters of the Shelikhov bay are the typical representative of the coastal North Okhotsk waters.

The North-Okhotsk type of the open waters was generated under the great influence of WKC waters, actually this type represents considerably transformed waters of WKC. The cold subsurface layer with the temperature -1° - 0°C and the layer with comparatively warm bottom waters with temperature (0.1°C) - (-1 .5°C) are the characteristic features of these waters.

The Kashevarov type of the waters vertical structure was charactered by the increase of temperature and salinity values from the surface to the bottom. The temperature values on the surface were within the limits of 0.2-0.7°C, near the bottom -within the limits of 1.0-1.5°C. The availability of numerous inversions and the stepness in the vertical distribution of me temperature and salinity, connected with intensive vertical waters movements is also the characteristic for the waters of this type.

Besides of the basic types there were distinguished the waters subtypes, showing the structure features within the limits of the waters types.

Evaluating as a whole the thermal conditions of the North-Okhotsk and West-Kamchatka regions we must note, that December of 1995 was warmer of norm. Thus, the temperature of the surface waters was higher, than "normal" temperature on 0.5-1.0^{0}C.

A CLIMATOLOGY OF BINARY TYPHOON SYSTEMS IN THE NORTH-WESTERN PACIFIC

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In the north western Pacific near 1200 typhoons were recorded for the period of 43 years (1952-1994) . Among them some typhoons had other typhoon in their neighborhood and demonstrated a binary typhoon system(ETS) in which two typhoons are interacting each other. The interacting behavior was first discussed by Fujiwara, Japanese meteorologist in 1924 and some basic character concerning this has been made familiar to us. Recently some further interesting features have been reported by some scientists who depended more upon the computer simulation technique to further study this matter. For example, the feature is found in which two typhoons approached toward each other's center to a certain distance but they suddenly changed their path toward an unexpected direction. This kind of unexpectedness is considered to create quite a lot of difficulty in predicting the short range of typhoon prediction.

In our paper we will report about the climatology obtained from the analysis of the JMA data for 93 years as a first step to investigate what are the involving factors to maintain the system and what controls happenings of unexpectable sudden changes in the path of typhoons forming up this system in the actual atmosphere over the north western Pacific basin.

WESTERN PACIFIC MARGINAL SEAS: RESPONSE TO GLACIAL CYCLES AND ITS IMPACT ON GLOBAL CLIMATE

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Keynote speech

A series of marginal seas separate Asia from the Pacific, the largest continent from the largest ocean in the modern world, significantly modifying the material and energy flux linkage between land and sea. Since many of the Western Pacific marginal seas are connected with each other or with the open ocean through narrow and/or shallow seaways, the flux linkage is highly sensitive to sea-level variations. In the glacial cycles, the sea-level induced environmental signal has been amplified in the marginal seas, giving rise to drastic changes in sea area and configurations, and to reorganization of seawater circulation.

East and South Asia and its islands provide over 70% of suspended sediment load contribution to the global ocean, but the major part of terrigenous clasts supplied by East Asia is being trapped by the marginal basins. This explains the absence of deep-sea sediment fans in the Western Pacific and the high deep-water sedimentation rates in its marginal seas which can be one or two orders of magnitude higher than in the open ocean, offering ideal locations for high-resolution records of climate changes. Both sedimentation rate and sediment

composition are closely related to the climate changes. At least four types of carbonate cycles have been recognized in the Western Pacific marginal seas, and each of those embodies environmental signals from the surface and deep water, as well as from the drainage basins.

Since most of the Western Pacific marginal seas are influenced by monsoon circulation and some of those are located within the Western Pacific Warm Pool, the glacial geographic changes have produced a profound impact on heat balance and vapor transport of the entire region. The glacial intensification of the winter monsoon and reorganization of circulation has resulted in increased seasonality of SST and enhanced glacial/interglacial contrast of winter SST in the marginal seas, as compared with the open ocean at similar latitudes. A climatic impact of this increased seasonality and emergence of shelves in the marginal seas was reduced evaporation which intensified glacial aridity in the East Asian hinterland. On the other hand, the low winter SST together with the strong northern monsoon wind in the glacial time might explain, at least partly, the apparent discrepancy between the tropical paleotemperature estimations based on terrestrial and open-ocean records in the region. The geographic and oceanographic changes in the low latitude marginal seas have led to a reduction in size of the Warm Pool which in turn should influence the global atmospheric circulation.

Of great significance are water exchanges between individual marginal seas. For example, variations in connection between the Sea of Japan and the East China Sea, or between the South China Sea and the Sulu Sea, have caused remarkable hydrographic and sedimentological changes there. In sum, the Western Pacific marginal seas are critical areas for exchanges not only between land and sea, but also between higher and lower latitudes, between the Indian and Pacific Oceans. The role of the marginal seas becomes even more prominent when the climate patterns of the Western Pacific region before the formation of marginal seas are compared with the modern ones.

THREE SEQUENTIAL STEPS OF DISASTER REDUCTION PROCESSES IN THE COASTAL ZONE

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The coastal areas in the WESTPAC region have been suffered from several kinds of natural disasters. An advancement in Disaster Sciences allow us to handle natural hazards in two ways; the risk management before disaster occurrence, and the crisis management at the moment of the disaster. In this paper, I would like to discuss disaster reduction / mitigation processes of the risk management from the coastal scientific studies.

Natural disasters occurring in the coastal zones are coastal structure failure, coastal erosion and deposition, flood, ground failure with lifeline damage, land subsidence, coastal slope failure, and weather disturbance. These disasters are caused by natural hazards, which are tide and wave, tsunamis, drift ice, sea level rise, earthquake, soil compaction, landslides, volcanic eruption, typhoon (hurricane), strong winds, and heavy rain.

The three sequential steps of disaster reduction processes are 1) to search causes of disaster and to identify specific works among natural sciences, 2) to find out real threat of the hazard and evaluate the extent and duration of damage to be caused by the hazard. This

process will be called damage parameter extraction, 3)to prepare damage reduction plan and establish structural mitigation for the natural hazard.

For example, the ground failure with lifeline damage is caused by a strong motion of earthquake. The major damage parameter of the earthquake depends on intensity scale of the earthquake. In 1971, Regulation of Road and Bridge was issued, in which the intensity of earthquake(Fh) was shown for the earthquake-proof design. Fh = Kh x W Here, Kh is a horizontal intensity and is ruled out by the Regulation to be 0.24. W is a weight of structure, and can be expressed in 980 gals or 1 G. A breaking test of material permits 3 times allowance than Kh. Therefore, actual horizontal intensity of the construction reaches 0.72 value. The resultant Fh becomes 706 gals corresponding to intensity scale of 7. The Hansin Earthquake in 1995 • 1 • 17 recorded the horizontal intensity of 818 gals at the Kobe Marine Meteorological Observatory, and this is the reason why most of the high-way bridges were collapsed.

After knowing such a damage parameters, physical reduction of damage will be easily evaluated, and mitigation tactics for disaster can be proposed within a limit of great cost.

COASTAL MORPHODYNAMICS OF HAIPHONG-HALONG AREA AND SOME RELATED PROBLEMS OF COASTAL MANAGEMENT

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Haiphong-Halong Area is in first position for the economic-social development of coastal zone in North Vietnam. Belonging to it, Halong Bay has been recognized as a World's natural heritage and Haiphong sea port is the biggest one in the North Vietnam.

With a shoreline of 125 km long, the coastal area in divided into 3 parts. The Halong Part in the northeast is noted by the wonderful landscape with the bay, hundreds limestone Islands, beaches and coral reef. In this part, the tidal current is violent, the wave energy is low and the shoreline is rather stable. The Bach Dang Estuary part in the middle characterized by abundant mangroves, dense tidal creeks and deep channels. In this part, the tide is the dominant dynamics, the coastal erosion tends to be increased on the base of ingression sea. The Van Uc deltaic part in the southwest has been being expanded seaward 10m/year that brings to the precious wetland resources.

The difference in morphodynamics of each coastal part leads to that in coastal changes and their sensibility under the human activities. Halong Area needs to be interested in the protection of landscape, coral reef and water quality concerning coastal tourist development. The protection of mangroves, the prevention of coastal erosion and the decrease of sedimentation for the port channel are the focus tasks in Bach Dang Estuary. The plantation of mangroves, the conservation and suitable use of coastal wetland for aquaculture and agriculture are the priorities in the coastal deltatic part.

MARINE SEDIMENTS: EVALUATION ON RECENT STATUS FOR POSSIBLE MANAGEMENT SCHEMES

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According to the needs of up-to-date oceanographic information for establishment of suitable schemes for marine fishery resource development in the Gulf of Thailand, the characteristics of marine sediments together with related oceanographic conditions had been thoroughly investigated under SEAFDEC Collaborative Research Project. Obtained sedimental cores were examined for the levels of water contents, acid volatile sulfides contents, total organic matter contents total organic carbon and total nitrogen contents, and sedimentation rates. These sedimentary data are used as a key to illustrate the historical and recent situations of marine environments in the Gulf.

The overall results indicated comparatively low amounts of organic matters and sulfides accumulated in the sediments The vertical profile characteristics of sediments have revealed coupled efforts of a low rate of sedimentation and a comparatively high rate of organic decomposition. Particulate matters which had settled onto the sea bed and formed the sediments can be remarkably observed to accumulate in two major zones; one in the central part and another one in the western part of the Gulf. Such an accumulation pattern was considered to be directly affected by bottom topography and current effort. The accumulation of organic materials there also implied the mode of biological fishery resources in the water column and benthic communities.

Information obtained from the sediment characteristics have been consequently discussed in the view points of fishery resources and related environmental perspectives. Consequently, possible management schemes for sustainable development of the fishery resources were discussed.

NON-MARINE HEAVY-MINERAL PLACERS IN THE GULF OF THAILAND

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Exploration for mineral deposits in the Gulf of Thailand has been conducted for more than ten years in the joint project between the government of Thailand and the United Nations. Geophysical surveys were conducted along a total distance of several thousands kilometers. Minerals were extracted from hundreds of drillholes samples recovered from the coastal plains and shallow marine areas.

Minerals found in the Gulf of Thailand are titanium minerals (ilmenite, rutile, leucoxene), abrasive minerals (zircon, garnet, staurolite) and tin mineral (cassiterite). A total ore reserve of the assorted heavy minerals is more than one million metric tonnes.

Occurrence of the mineral deposits were interpreted from characteristics of the sediments by comparison with the sediments in the nearby coastal plains. Period of deposition of the mineral deposits were estimated by comparison with global sea level curves.

The unconsolidated sediments in the Gulf of Thailand are deposited in several environments of deposition, including marine, non-marine, and coastal environments. The minerals are concentrated in the coarse-grained alluvium and the alluvial gravel bed.

The mineral deposits in the Gulf of Thailand are formed by materials transported from granitic mountains in the adjacent coastal areas, to form non-marine heavy-mineral placers in the shallow marine areas during periods of sea-level low-stands when the Gulf of Thailand was a dry land in the Pleistocene Epoch between 10,000-1,600,000 years before present .

MONITORING ON SEDIMENTATION BEHAVIOR OF TERRIGENOUS RED SOILS THROUGH MOORING AND WEATHER STATIONS IN CORAL-REEF COASTAL AREA, THE OKINAWA ISLAND, JAPAN

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Monitoring of sedimentation of fine-grained reddish soil derived from denuded lands is an important study to prevent the coastal area of the Okinawa Island from pollution. The reddish soil pollution to coral reefs is a severe environmental problem in the Okinawa Island. Sedimentation behaviors of reddish soil dispersed in coral-reef coastal area were studied by mooring systems in the sea as well as by weather station on land at the coastal area of the Kin Bay, the Okinawa Island. The observation site is located in outer coral reefs which are developed off the estuary of the Okkubi River. The observation period was between October 3 and October 26 in 1996.

Turbidity in the surface layer was mainly increased after the rain precipitation. Suspended sediment in the surface layer derived from the inflowing river sinks downward as shown by shifting of turbidity peaks from the surface to bottom layers. Resuspension behaviors were represented by the appearance of turbidity peak in the bottom layer and shifting of this peak to the surface layer. Roughly, resuspension occurred when the bottom current was intensified at the phase of ebbing tide. In addition, resuspension occurred when waves were intensified due to the increase of wind velocity. Turbidity and flux of suspended sediment are important criteria for living conditions of corals. Because meteorologic conditions including rain precipitation and oceanographic conditions are important factors to control the sedimentation of reddish soil, detail meteorologic and oceanographic observations are required to monitor sedimentation.

SUBAERIAL EXPOSURE AND ALTERATION (WEATHERING) OF PRE-HOLOCENE MARINE DEPOSIT IN THE HAENAM BAY AND HAMPYUNG BAY, WEST COAST OF KOREA

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Late Quaternary stratigraphy of Holocene tidal deposit and pre-Holocene marine deposits (intertidal deposit) has been established in the Haenam and Hampyung Bay tidal basins, Korea. In particular, the upper part (more than 3 km in thickness) of pre-Holocene marine deposit was subjected to subaerial exposure and alteration (weathering) during late Quaternary low sea-level stands. The following characteristics and features obtained from the upper part of pre-Holocene marine (intertidal) deposit, such as peculiar cryogenic structure, brownish yellow color of the sediments, ichnologic burrow structure, geochemical nature, magnetic susceptibility, geotechnical properties and clay mineral composition of the sediments (the upper part of pre-Holocene marine deposit) are interpreted as valuable evidences and clues indicating subaerial exposure and following alteration (weathering) during late Quaternary (late Pleistocene) low sea-level stands. Finally, the upper part of the pre-Holocene marine deposit containing such subaerially exposed features is the very important stratigraphical marker for climate environmental change and also for stratigraphic correlation.

LATE QUATERNARY PALEOCEANOGRAPHY AROUND THE RYUKYU ARC: ITS SIGNIFICANCE FOR THE PALEOCLIMATE IN THE NORTHWEST PACIFIC REGION

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Synthetic study on more than 36 piston cores collected from the Ryukyu Arc region indicates that the drastic course changes of the Kuroshio Current occurred during the last glacial period by the formation of a land bridge connected the central Ryukyu Arc through the southern Arc and Taiwan and also ca. 1,000 years from ~4,400 to ~3,300 years ago by the tentative appearance of a barrier along the central to southern Arcs. Owing to the land bridge and the barrier, the Kuroshio Current could not flow into the Okinawa Trough like in today but quickly turned to the east. These main path changes of the Kuroshio necessarily caused distinct climatic deterioration in the Japanese Islands and its surrounding seas, respectively. Different from the last glacial period, the 4.5 to 3.5 ka event was not tied up with global cooling but caused local cooling in the northwestern corner of the Pacific such an episodic cooling during the late Early Jomon Era (a prehistoric period in Japan) .

Post glacial signals recognized in the cores show collapsing mode of the land bridge, beside of gradual retreatment of continental shore lines.

SEA-LEVEL CHANGE AND RECENT CRUSTAL MOVEMENT IN THE RYUKYU ARC

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Recent submarine, geological and geophysical investigations including diving surveys reveal that land bridges connecting from the Chinese continent through Taiwan and Okinawa to Honshu, Japan had appeared sometime during two major stages such as 2-1 Ma and 0.4-0.02 Ma. The last land bridge has been submerged since 0.002 Ma, according to sea level rising of the post Ice Age accompanied with a crustal movement. Probable artificial monuments was found beneath the sea along the Ryukyu Islands. The Iseki point (Fig. 1)

that is the largest of them and stands from about the 30 m deep might have been formed on the land by excavating a huge mass of natural sandstone strata belong to the Yaeyama Group of early Miocene. The whole shape is very similar to a castle or shrine, showing its sizes of about 200 m (length) x 140 m (width) x 25m (height). The feature resembles to a giant "gusuku" in Okinawa such as Shuri Castle and Nakagusuku Castle. Flat terraces, straight walls and its surface structure of walls strongly show that the point should be artificial. The formation age is expected to be around 10,000 years ago if it was submerged by only uprising of sea-level change by the eustatic movement of the post Ice Age. On the contrary, another age of about 4,000 years ago is available, too. Because the ^{14}C ages of submarine, artificial ruins at the almost same depth in the middle Ryukyu Arc region showed those ages . The existence of submarine ruins should be very good marker showing subsiding processes of the Ryukyu Arc.

ACTIVE TECTONIC FEATURES AS OBSERVED BY PRECISE SEAFLOOR SURVEYS IN THE SOUTHWESTERN NANSEISHOTO (RYUKYU) TRENCH

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The southwestern part of the Nanseishoto (Ryukyu) Trench has unique topographic features such as wide (30-40km) axial flat plane, large-scale topographic depression on the landward slope, etc. Considering that a hazardous tsunami named "the 1771 Yaeyama Earthquake Tsunami" occurred 40krn south of Yaeyama Islands due to a large-scale underwater landslide, it should be assumed that a lot of landslides and/or collapse of the sea floor should exist in wide areas around the trench axis. Since 1992, precise seafloor survey cruises on the landward slope and axial area of the trench were carried out by JAMSTEC fleets: by YOKOSUKA/SHINKAI 6500 (June, 1992), by KAIYO/JAMSTEC-Deeptow (October-November, 1996), by KAIREI/KAIKO (September, 1997) and NT97-14 Cruise by NATSUSHIMA/SHINKAI2000/DOLPHIN3K.

Seamounts on the trench axial plane: A collapse of the bottom covered with sediment was observed on the slope of the two seamounts, suggesting that the seamount suffered from deformation recently, maybe when it reached the trench area by the motion of the Philippine Sea Plate.

Landward slope, 5900m in water depth: Both SHINKAI6500 and KAIKO diving revealed that the area is characterised dominantly by rough topography consisting of steep slopes and escarpments. The site was covered with suspended particles during the both diving, which might be due to the present and continuous sliding of the surface materials and erosion on the surface layer.

The southern slope of the Kuroshima Knoll: A large collapse along the southern slope of the knoll, especially the water depth shallower than 1700m was observed. Thick sediment with the dead Calyptogena community was found at the southern foot of the knoll where water depth exceeds 2400m, suggesting an existence of a hidden fault.

On the Kuroshima Knoll: Calyptogena colony corresponding to the cold seepage on the landward slope of the trench was discovered on the flat plane of the Kuroshima Knoll, south of the Yaeyama Islands. Most of the clams were dead although several on the eastern edge of the knoll were alive.

SEDIMENTARY RECORD OF PALEOPRODUCTIVITY IN THE BERING SEA

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Ocean sediments has recorded information on the paleoproductivity. Unfortunately, we do not have many adequate proxies describing the temporal variation in biogenic materials transported to the seafloor. In many previous studies, 1 or 2 sedimentary proxies were used to estimate paleoproductivity and often giving only ambiguous results. Therefore, more sedimentary proxies are desirable to be introduced for the reconstruction of paleoproductivity.

For this purpose, sediment cores from the highly productive Bering Sea have been studied by measuring several chemical components. They are, besides Ba which has recently gained an important position as a paleoproductivity indicator, U, Cd, and opal as well as Mn and Al. The terrigenous fractions and the age of sediments were calculated, respectively, from the concentration of Al and the sedimentation rate of 50cmkyr^{-1} obtained in the previous work.

We have divided the sedimentation stage of a core (10m long) into 2 phases based on the obtained vertical record profiles. During the phase I (0-13 kyrs ago), the concentrations of these biophile were comparably high and varied widely while the phase II (13-20 kyrs ago) showed little variation except for Mn components. For the entire date set, Ba was fairly well correlated with opal and Mn while the correlation between U and Cd was weak. For the phase I only, Ba was correlated fairly well not only with opal but also with Mn and the terrigenous fraction. On the other hand, in the phase II, all components shows a week significant correlation with Ba. We discuss the implications of these correlations.

TERRIGENOUS SEDIMENT TRANSPORT PROCESSES IN THE EAST CHINA SEA BASED ON MINERALOGICAL STUDY

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The East China Sea receives more than 10 % of the fluvial sediment discharge of the world from two large rivers, the Huanghe and the Changjiang Rivers. Transport processes of these terrigenous materials in the East China Sea have been examined by mineralogical analysis of surface sediments and sediment trap samples. Huanghe derived sediments are characterized by high content of calcium carbonate minerals. Surface sediments of the northern part of the East China Sea shelf and the Okinawa Trough contain detrital calcium carbonate minerals in some degree indicating the extensive influence of Huanghe derived sediments. In the settling particles obtained by time series sediment traps moored at SST-1 and SST-2, the central part of the Okinawa Trough, contents of calcium carbonate minerals

show seasonal changes, namely the contents are higher in spring and autumn than in summer and winter. As most of the sediment discharge of the Huanghe comes in summer, and erosion of old Huanghe mouth region is considered to occur throughout the year, these seasonal changes do not reflect the supply of Huanghe derived materials to shelf, but reflect the seasonal change of sediment transport processes from shelf to the Trough.

TWO DIMENSIONAL MODEL AND BATHYMETRIC CHANGE SIMULATION CAUSED BY BOTTOM SEDIMENT TRANSPORT PERPENDICULAR TO THE SHORE

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Modeling in oceanography is divided into two types, they are analitic model and numerical model. In this paper, I will try to represent the application of wave and sedimentation using the analitic model with the help of running out of computer programming of Turbo Pascal.

I will review the motion of Airy waves in deep sea and 2 nd order Stokes waves in shallow waters m playing the role of bottom sediment transport in the area before breaker line, toward the deep sea, but not reach the deep sea. It can be understood, because the velocity of the motion of water particle under the motion of waves, on the bottom of the deep sea, is zero.

Because of the limited condition as explained above, that's why I assume the incident waves as waves which run perpendicular to the shore and the waves are neglected from the storm.

The result of the modeling shows that the random waves with constant frequency/period and the changes of amplitude, will result m the initial topographic slope that is straight and smooth, become fluctuate. It is described, as follows:

The waves which have the height change in every 750 wave cycle, will result in the erosion at the start of waves motion, and then sedimentation, a few of erosion, and sedimentation before the wave breaks. While the waves at the height changes in every 1 wave cycle (more random), will result in the erosion for the area where moving of the wave start, and it will result in the sedimentation which fluctuates continuously.

For the regular waves with the constant period and amplitude, they will also result in the change of topography regularly or on the other hand, just happen the sedimentation in the area near breaker line and the erosion in the area of the beginning of the wave motion.

In relating to the breaker zone, in fact random waves cause the wave breaks slower or on the other hand the wave breaks near to the shore line, while the regular waves cause the wave breaks farther from the shore line, that is 30 up to 40 metres from the shore line.

To arise random waves, is used Rayleigh subrutine in computer programming.

As a verification with field data, in fact the changing of bottom topography of the sea, results of the analitic modeling, the results are not far different from the changing of topography results of the field data. So, according to the accuracy of the results of analitical model, it is few different from the results of numerical modeling. For further development, analitical mathematics formulas can be changed to the numerical formulas.

ORGANIC CARBON CYCLE STUDIED WITH PARTICULATE FATTY ACIDS IN THE WESTERN NORTH PACIFIC

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This study has been done in order to understand the biogeochemical cycle of organic carbon in the western North Pacific showing a large seasonal variation of primary production. We have two focuses on the present study. One is to understand the factors controlling the composition of particulate organic matter with special attention on the formulation process of settling organic matter. The other is to clarify the fate of organic matter over continental margins having high primary production.

The compositions of photosynthetically produced fatty acids and suspended particulate fatty acids were determined seasonally (February, March, April, July, September) outside Ishikari Bay, Hokkaido. In April, there was a large diatom bloom judging from diatom biomass indexes. During this diatom blooming, remarkably high production of storage lipids (16:0, 16:1) was measured in the upper 10m euphotic layer. This less polyunsaturated degree in C16 fatty acids accounts for higher turnover rate on account of nitrogen limitation caused by pycnocline in the surface layer. In addition, the higher polyunsaturated degree in C16 fatty acids at 100m water depth in April suggest that phytoplankton aggregates sank rapidly from the upper layer, but stayed there possibly due to the pycnocline. This is also supported by high Chl.*a* concentration and low Chl.*a* normalized fatty acids concentration at 100m water depth. As these results, physical factors including pycnocline can influence the time lag and/or loss between primary production and export production. Furthermore, these can have an effect on the formation process of settling particles and the quality of settling organic matter.

In order to understand the fate of organic matter produced over the continental shelf, time series sediment traps were deployed at three depths (1000m, 4200m and 6800m water depths) for one and a half years in the northern Japan Trench. In the present study, a significant proportion of particulate organic matter produced over the shelf and slope zones is found to be transported laterally to the deeper open ocean. Furthermore, the transported particles showed a strong seasonal variation in the freshness and the origin of laterally settling organic matter in the northern Japan Trench in the western North Pacific.

ESTIMATION OF TOTAL DISSOLVED INORGANIC CARBON DIOXIDE BELOW THE MIXED LAYER OF THE WORLD OCEAN

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Compared with currently available hydrographic and nutrients measurements taken at sea, total inorganic carbon dioxide (TCO_2) data are far from enough to produce a gridded mapping of high resolution, which is crucial to estimate the carbon budget in the oceans and provide initial values to constrain the geochemical models. In order to contribute this large historical data set to TCO_2 estimation, TCO_2 properties and its relation with nutrients in the world oceans are presented and discussed using ship data from several international programs. Based on these, a new parameterization method is proposed and tested to estimate. TCO_2 below the upper ocean(>400m) where its seasonal variations is comparatively small. The accuracy may reach 5.8±8.0μM for Pacific Ocean and 0.5±5.4μM for Atlantic Ocean. Calculated TCO_2 on a global scale can be obtained at Levitus grid point (1^0x1^0) down to a depth of 5500m, including vast ocean regions where field investigation of TCO_2 have never been performed.

TH ISOTOPES, U ISOTOPES AND ^{210}Pb IN SETTLING PARTICLES FROM THE CONTINENTAL SLOPE OF THE EAST CHINA SEA

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Th, U, and ^{210}Pb were used as tracers to investigate the particle transport process on the continental slope in the East China Sea. Samples were collected at two observation lines (D and F lines) by using sediment traps and Th, U, and ^{210}Pb were analyzed for the alpha activities of Th isotopes and U isotopes and beta activity of ^{210}Bi using alpha spectrometers and a low-background beta counter after chemical separations. Sediment traps were deployed on the continental shelf and slope in the Fall of 1995 (F line) and sequential sediment trap was deployed on the continental slope from November l0, 1995 to May 9, 1996 (D line). Total mass fluxes from the shelf edge and slope (F line) in the Fall of 1995 range from 0.5 to 23 g/m^2 /day and show a general tendency to increase with depth, especially showing a very large increase at near bottom. ^{210}Pb concentrations in settling particles increase with depth almost linearly from 50 dpm/g at 100 m depth to 200 dpm/g at l000 m depth. However, total mass fluxes collected from the sequential sediment trap (D line) show large seasonal variation and ^{210}Pb concentrations range from l5 to 80 dpm/g. An inverse correlation is observed between total mass flux and ^{210}Pb concentration. These results suggest that a lateral transport process occurs on the continental slope on the F line and large fluxes come from resuspension of surface sediments on the D line.

PROFILES OF POLONIUM-210 AND LEAD-210 IN THE EAST CHINA SEA

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The uranium-238 series radionuclides ^{210}Pb and its daughter ^{210}Po, are important tracers in the marine environment. They are especially useful for studies on material transport scavenging processes within relatively short times and on the mechanism of material transport from coastal zones to the open sea. Profiles of ^{210}Pb and ^{210}Po were determined at several stations during the MASFLEX (Marginal Sea Flux Experiment in the West Pacific) project cruises in the East China Sea. The concentrations of ^{210}Pb in the Kuroshio Current region were higher than those in the coastal and shelf waters and the concentrations of ^{210}Po and ^{210}Pb decreased rapidly in the area from the Okinawa Trough to the East China Sea. The concentrations of ^{210}Pb was almost constant within the shelf of the East China Sea. The residence times of ^{210}Po and ^{210}Pb within the shelf area in winter were 5-10 months and ~1.5 months, respectively. But the residence time of ^{210}Po in the shelf edge area were ranged from 4 months to 3 years in summer and winter. These reactive nuclides were scavenged from the water column within a short time in the shelf of East China Sea in winter.

MEASUREMENT OF THE PURIFICATION RATE OF POLLUTED BRACKISH AND RIVER WATERS, KUMOJI NAHA, OKINAWA JAPAN

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Self-purification rate in brackish and in river waters were observed by setting model experiments and direct field sampling. Analysis of dissolved inorganic nutrients, oxygen demand, MBAS, DO and physico-chemical parameters like pH, Temp, EC, SS, Alkalinity etc. were periodically done.

In the model experiment temperature was kept constant and sampling from six flasks (3000 ml) was periodically made. At least two experiments were conducted under 30 ^{0}C and 20 ^{0}C temperatures. Modeling supposed three physical conditions; bubbling, stagnant and stirring water state.

The purification rate in brackish water was found to be slower than in river water especially in summer temperatures. Oxidation of Ammonium-Nitrogen to Nitrite-Nitrogen seemed to be rapidly achieved compared to the Nitrite -Nitrate oxidation. This is probably because of predomination of *Nitrosomonas* bacterial. Replenishment of Dissolved Oxygen (DO) in the brackish water even at the limited oxygen supply flasks imply diminishment of biomass oxygen consumers due to decrease of nutrients and oxygen dissolving from atmosphere etc. MBAS seemed to be exponentially decreases with time as the final concentrations were approaching to zero in all runs.

Direct sampling at field area was also made owing to tidal circle and seasons. Samples were collected at the river mouth (New Asahi Bashi), river body (Kumi Bashi) and further inland (Gitsukanji Bashi).

The effect of sea water dilution was clearly observed at the river mouth where high chlorinity corresponding to low level of inorganic dissolved nutrients were noted. From the chlorinity distribution pattern, it is evident that sea water comes further inland in its tidal cycling and influence purification of the river.

ASIA-PACIFIC MUSSEL WATCH IN RUSSIAN FAR-EAST: THE FIRST RESULTS

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Hexachlorocyclohexane (HCH) isomers, DDT, and its metabolites were analyzed in mussels and bottom sediments collected from 13 sites in the Japan Sea coastal zone near Vladivostok, Russia in August 1996. Total HCH was determined in sediments in the range 0.3-5.7 ng/g and in mussels from 0.8 to 15.9 ng/g. Concentrations of total DDT at some sites, both in sediments and mussels were above the "high" level defined by the US NOAA National Status and Trends Program (NS&T). Contribution from river runoff was of minor importance in comparison with pesticide discharges from sewage outfalls and other land-based sources.

Some gamma-emitting isotopes and trace metals were also analyzed in mussels and bottom sediments of Peter the Great Bay around Vladivostok. While activities of radionuclides were found at background level, elevated contents of trace metals were observed both in sediments and mussels near the city landfill and combined sewage outfalls (industrial and domestic). Concentrations of lead and copper at some stations were above those reported to cause biological effects. Results of this survey might be used within the Asia-Pacific stage of International Mussel Watch.

MUSSEL WATCH PROJECT IN TOKYO BAY

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"Mussel Watch" is an observation protocol to monitor environmental contamination of micro pollutants in coastal environments using bivalves as bioindicator. It was proposed in 1970s and has been implemented in many national monitoring programs. International Mussel Watch is supported by some inter-governmental organizations and now in the second phase, that is Asian Mussel Watch. In the present paper some results obtained in mussel watch in Tokyo Bay, Japan.

Mussel samples were collected from navigational markers located throughout the bay. The samples were taken from 38 locations under cooperation with Maritime Agency of Japan in 1994. n-Alkanes, linear alkylbenzenes (LABs), polychlorinated biphenyls (PCBs) and

polycyclic aromatic hydrocarbons (PAHs) were analyzed. The contaminants concentrations were higher in western north part of the bay. This is consistent with pollutant sources (e.g., industrial and sewage effluents) are located in the area. The results also show sharp gradient of decreasing contaminants concentration downbay with a half distance value of ~ 5 km. This implies selection of monitoring stations is critical for the mussel watch programs. Compositions of contaminants in mussels were different from those observed in sediments. For example, PAHs in mussels were abundant in alkylated homologues indicating their petroleum origin. On the-other hand, sedimentary PAHs were depleted in the alkyl homologues, which is characteristic to pyrogenic origin. The difference suggests mussel can represent pollution situation in a part of systems (i.e. surficial water column). For comprehensive understanding of organic pollution in coastal environments, analysis of mussel and, at least, surface sediments are necessary.

MUSSEL WATCH: MARINE POLLUTION MONITORING OF BUTYLTINS AND ORGANOCHLORINES IN COASTAL WATERS OF THAILAND, PHILIPPINES AND INDIA

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Contamination by butyltin (BTs) and organochlorine compounds (OCs) in green mussels collected along the coastal areas of Thailand, Philippines and India during a period of 1994 to 1997 were examined. The BT residues in green mussel were widely detected, suggesting a widespread contamination along the coastal waters of Asian developing countries. Relatively high concentrations of BTs in green mussel were found in high boating activity and coastal aquaculture areas, implying the usage of TBT as a biocide in antifouling paints used on boat hulls and marine aquaculture facilities. The composition of BT derivatives in mussel was in the order of TBT > DBT > MBT, suggesting also the presence of significant butyltin source in Asian coast. BT residues pattern in green mussels from Thailand revealed higher levels in aquaculture than in boating activity sites. This result may indicate that the developing countries showing high economic growth rate (like Thailand) tend to increase the usage of TBT for aquaculture activities. BT contamination levels in Asian developing countries were lower than those in developed nations. However, considering the fact that the unregulated usage of organotins in Asian developing countries and increasing demand of antifouling paints in Asia-Pacific regions, BTs contamination in aquatic environment may be serious in future. Concentrations of OCs detected in green mussels were lower than BTs. Considerable residues of *p,p'*- DDT found in mussel indicated the current usage of DDTs in Asian regions. HCHs and DDTs contamination in India are apparently higher than other Asian developing countries. The present study clearly indicates that the aquatic environment in Asia-Pacific regions is still being contaminated by some OCs. To our knowledge, this is a first report on the detection of butyltin compounds in green mussels *(Perna viridis)* from Thailand, Philippines and India.

CONCENTRATION OF HEAVY METAL RESIDUES IN GREEN MUSSELS *(Perna Viridis)* FROM COASTAL AREA, THAILAND

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The accumulations of six heavy metals, i.e. cadmium, chromium, nickel, manganese, copper and lead in the whole soft parts of green mussels (Perna viridis) have been studied. Green mussels were collected along, the coastal area of Thailand during 1994-1997. Concentrations of heavy metals accumulating, in green mussels were different depend upon sampling locations and types of heavy metals. The trends of accumulations of chromium and copper were increasing, on the other hand, the accumulations of the others were not so different during the period of the study. It also was found that most of the high concentration of heavy metals were found at Krabi and Pang Nga Province which located along the Andaman Sea. However, the concentration of residues were within the acceptable limits with respect to the public health standards.

CURRENT STATUS OF MICRO ORGANIC CONTAMINANTS IN COMMON CORMORANTS FROM JAPAN

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Concentrations of organic contaminants (OC) such as butyltins, PCBs, DDTs, chlordanes (CHLs), HCHs and HCB were determined in common cormorants to understand the current status of contamination and geographical differences. The birds from Shinobazu pond, central Tokyo, exhibited significantly higher OC levels than those in the Lake Biwa. Residue level of PCBs was the highest followed by the DDTs regardless of the locations and growth stages. CHLs and HCB were also higher in the Shinobazu pond adults and juveniles, whereas HCHs were comparable with the Lake Biwa.

The calculated mean 2,3,7,8-TCDD toxic equivalent (TEQ) concentration in cormorants was 1.8 1.7 ng/g wet wt and was dominated by IUPAC 118, followed by IUPAC 126. A significant increase of ethoxyresorufin-*O*-deethylase (EROD) and pentoxyresorufin-*O*-deethylase (PROD) activities were observed with estimated TEQ of PCBs in the cormorants, suggesting that current contamination level is sufficient for altering their biochemical responses.

Concentrations of butyltin compounds were determined and compared with various seabirds collected from Japan, Korea, North Pacific Ocean and Southern Atlantic/Indian Ocean. Butyltins were also detected in most of the samples, which indicated widespread contamination in higher trophic aquatic animals even in remote areas. The highest mean residue concentrations of butyltins were in common cormorants from Lake Biwa, Japan. Laysan albatross from North Pacific Ocean accumulated higher butyltin residues in the liver among open-ocean birds.

This data suggested that birds inhabiting inland to coastal areas had higher exposure to micro organic contaminants than those in the ocean.

ACCUMULATION OF ORGANOCHLORINE PESTICIDES, PCBS, BUTYLTIN COMPOUNDS IN RESIDENT AND MIGRATORY BIRDS COLLECTED FROM SOUTH INDIA

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Persistent organochlorines such as DDTs, HCHs, Chlordanes, HCB, polychlorinated biphenyls (PCBs) and butyltin compounds (BTs) were determined in whole body homogenates and feather of resident and migratory birds collected from South India. Organochlorine residue pattern in birds varied depending on their migratory behaviour. Resident birds contained relatively greater concentrations of HCHs (14-8800 ng/g wet wt) while migrants had elevated concentrations of PCBs (20-4400 ng/g wet wt). Concentrations of BTs (sum of TBT+DBT+MBT) in soft tissue homogenates of residents (<8.0 - <27 ng/g) and migrants (<8.0 - 28 ng/g). Concentrations in feathers were greater than in soft tissue homogenates and were also comparable between residents (14-190 ng/g) than in migrants (<9.9 - 300 ng/g). The gender differences in concentrations and burdens of organochlorines in birds were pronounced, with females containing less levels than males however, those differences of BTs were less pronounced in birds. Organochlorine contamination levels varied according to the feeding habit. Hazards associated with elevated exposure to DDT were assessed to identify the species at risk.

WATER QUALITY MANAGEMENT IN SETO INLAND SEA, JAPAN BY USING THE WATER AND SEDIMENT QUALITY MODEL

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For the water quality management in Seto Inland Sea, the relationship between inflow loads from land and water quality in water basin was studied by using the Water-Sediment Quality Model (WSQM). WSQM is an ecosystem model formed boxes type that describes the interaction between the water column and bottom sediment, such as the behavior of oxygen consumption and regeneration phosphate in sediment. Computed results of tidal residual current showed an eastward flow pattern flowing from Bungo-Channel and out through Kii-Channel, and it was in good agreement with the phenomenon of model domain in Seto Inland Sea. The numerical model experiment of water quality can reproduce seasonal variation of water quality, especially chemical oxygen demand (COD) and dissolved oxygen (DO). Moreover, according to the simulation of loads reduction from land, it was shown that relatively large effort of loads reduction would be required in the eastern Seto Inland Sea, from Bisan Seto through Osaka Bay, and that not only TP but TN load reduction was also required. On the other hand, it was indicated that increase of loads lead to increase of primary production, while not straightly to increase of fish catch

DIFFERENTIAL UPTAKE OF HEAVY METALS BY SOME GASTROPODS (MOLLUSCA) FROM EASTERN COASTAL PART OF INDIA

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Bioindicators are being widely employed to assess environmental pollution in aquatic systems: biomonitoring provides a direct, rapid and time-integrated measure of pollutant bioavailability. Molluscs, by virtue of their existing characteristics, have proved to be useful monitoring organisms in marine and estuarine system. The present paper reports seasonal and temporal variations of variations of Fe, Zn, Cu, Mn, Hg, Pb and Cd in five gastropod molluscs collected from the tidal flat of the Hooghly estuary, eastern coastal part of India. Among these the three gastropods (Cerithidea (Cerithideopsilla) cingulata, Cerithidea(Cerithidea) obtusa, and Telescopium telescopium) belong to order Mesogastropoda and the rest two, Nerita articulata and Thais lacera, belong to orders Archaeogastropoda and Neogastropoda respectively.

Specimens were sampled manually from three specific biota in the Gangetic delta. A uniform specimen size was maintained throughout the work. All the gastropods, excepting T. lacera. metal concentrations in the body tissues decreased in the following order: Fe>Zn>Mn>Cu>Cd>Hg>Pb. They were differentially selective for the accumulation of the studied metals. This must reflect the availability of the elements in the environment and the diet and digestive physiology of these animals. The carnivorous gastropod T.lacera showed distinct efficiency for accumulation of Zn, Cd, Cu and Hg while the cerithiid herbivorous gastropods (C.cingulata and C. obtusa) for Fe.

It would be prudent, however, to maintain regular and continuous monitoring to ensure that the situation does not deteriorate as the environs strive for further urbanization.

CONTAMINATION AND BIOACCUMULATION OF BUTYLTIN COMPOUNDS IN THE OTSUCHI BAY ECOSYSTEM, JAPAN

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Aquatic pollution by organotin compounds has been a matter of great concern due to their deleterious effect in organisms. Despite this, fate and bioaccumulation of organotins in an entire aquatic ecosystem is not well studied. The present study was attempted to determine butyltin compounds including tributyltin (TBT) and its breakdown products, di- (DBT) and monobutyltin (MBT), in seawater, sediment, and biota at various trophic levels in the food chain, collected from Otsuchi Bay, Japan, for understanding the distribution and bioaccumulation in natural marine ecosystem.

Comparison of the residue levels of butyltins among various compartments of the marine ecosystem revealed that these compounds were accumulated in organisms up to

50,000 times higher than in seawater. However, no considerable biomagnification was observed for these compounds thorough the food chain. Although residue levels of butyltins in Otsuchi Bay appeared to be lower than those in other polluted area in Japan, relatively high concentrations were found in caprellids and their predators. In addition, such organisms accumulated TBT as the predominant compound among butyltin derivatives and showed higher values of bioconcentration factors for TBT than in other species reported so far. Our results suggest that certain organisms in food chain may have a low capacity to degrade TBT, and therefore may accumulate butyltin compounds at elevated levels.

RELATION BETWEEN BUTYLTINS AND TOTAL TIN IN THE LIVER OF CETACEANS FROM JAPANESE COASTAL WATERS

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During the last two decades, the toxic effect of the antifouling agent, tributyltin (TBT), on the marine organisms has received considerable attention in many countries worldwide, particularly in developed nations. While the adverse effect of butyltins have been well documented in certain marine invertebrates, studies on the contamination and possible toxic effects in marine mammals have been initiated only recently. Moreover, investigations on total tin comprising both of organic and inorganic forms are still lacking, except few representative work on organotin in marine biota. The present study aimed at determining concentrations of total tin ($\sum$Sn: organic+inorganic) and butyltin compounds ($\sum$BT: MBT+DBT+TBT) in the liver of cetaceans collected from 11 locations along Japanese coastal waters, in order to elucidate the contamination status and specific accumulation of organotin compounds.

Hepatic concentrations of $\sum$Sn and $\sum$BT varied largely according to species and sampling locations. Higher concentrations were measured in coastal species than in offshore species, indicating greater input of tin compounds near coastal regions. Furthermore, $\sum$Sn concentrations increased with an increase in BT residues in all the species ($r = 0.95$, $p<0.001$). The proportions of total butyltins in total tin ($\sum$BT/$\sum$Sn) in the liver were considerably high in coastal species, with up to 74% in finless porpoise *(Neophocaena phocaenoides)* and 90% in bottlenose dolphin *(Tursiops truncatus)*. Our results suggest that the hepatic tin in cetaceans exists predominantly in the organic form, as butyltins. Considering this, it can be suggested that, Sn residues in marine mammals reflect input from anthropogenic sources such as butyltins. This feature is different from those of Hg and Cd in marine mammals, which mostly originate from natural background exposure.

BUTYLTIN AND ORGANOCHLORINE CONTAMINATION IN MARINE MAMMALS FROM THE NORTH PACIFIC AND ASIAN COASTAL WATERS

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Concentrations of butyltin compounds (BTs) in liver, and organochlorines (OCs) in blubber of cetaceans collected from North Pacific and Asian coastal waters were determined. BTs including tributyltin (TBT), dibutyltin (DBT), and monobutyltin (MBT) were detected in almost all the liver samples suggestive of its worldwide distribution. Among the BTs, DBT was predominant, followed by TBT and MBT. While for the OCs, DDTs were the predominant compounds followed by PCBs, chlordane compounds (CHLs), hexachlorocyclohexane (HCHs) and hexachlorobenzene (HCB). Elevated BTs residues detected in coastal species and low concentrations found in off-shore species indicate high degree of BTs contamination in coastal waters than in the open sea. Mammals inhabiting waters of developed nations were found to contain higher BTs concentrations than those collected from the waters proximal to developing countries. These observations strongly suggest serious BTs contamination in the waters of developed countries at present. Whereas cetaceans inhabiting temperate waters revealed maximum residual OCs concentrations, and the elevated DDT and PCB residues detected seemingly suggest that some of the species might potentially be at high risk. HCHs levels in animals inhabiting cold and temperate waters were higher than those inhabiting tropical waters, perhaps reflective of atmospheric transport from the tropical source to the northern sinks. Similar pattern was observed in PCBs, CHLs and HCB, indicative of ongoing OCs discharge from mid-latitude and those originating in tropical regions. While high DDTs found in tropical water species could be attributed to the current usage of DDT in the tropics and its less movable nature.

CADMIUM ACCUMULATION AND METALLOTHIONEIN IN LIVER OF NORTHERN FUR SEALS *(CALLORHINUS URSINUS)* COLLECTED FROM PACIFIC COAST OF JAPAN

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This study was aimed at elucidating Zn, Cu, and Cd accumulation in the liver of northern fur seal (NFS), in relation to metallothionein (MT) concentration and subcellular

distribution of metals. The relationship between variations in metal concentrations and their subcellular distributions was also investigated. Metallothionein like protein was separated by gel filtration from the liver tissues. More than 90% of Cd in hepatic supernatant was bound to MT. Eighty percent of Cu in the supernatant was associated with MT, and the rest were found in the fraction containing high molecular weight proteins (HM). In contrast, more than 60 % of Zn existed in HM fraction, while there in NFS were similar to those in other marine mammals, while Cu distribution in MT was relatively higher in NFS. Percentages of Zn, Cu, and Cd contents to total metals in MT fraction were 56%, 33% and 6%, respectively. Concentrations of Cd and Zn in the supernatant were significantly correlated with MT content. Furthermore, Zn concentration in MT fraction increased with Cd accumulation in the supernatant, while Zn in HM remained constant. Therefore, increase in Cd concentration raised the proportion of Zn in MT fraction, while the percentages of Zn in HM was decreased. These results suggest that hepatic MT plays an important role of Zn, Cu, and Cd metabolism and detoxification in NFS. Especially, present study indicates that the subcellular distribution of Zn is influenced by Cd accumulation.

USE OF ENVIRONMENTAL DATA FROM THE SEAWATCH SYSTEM IN MARINE AQUACULTURE- HELP TO OBTAIN SUSTAINABILITY AND PRODUCTIVITY

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Food demands worldwide are increasing yearly caused by increasing populations and standard of living. Catch from wildstocks of fish has stopped on 100 thousand tons per year and harvest from agriculture is limited. The increase in food supply in the future therefore must be obtained from cultivation of the sea.

Cultivation of the sea needs to consider a sustainable environment since their output both regarding quality and quantity very much depend on this in the long run. The need for environmental information in planning and operating such cultivation is therefore crucial.

The SEAWATCH concept monitors environmental conditions continuously on a real-time basis. This gives the opportunity to produce important information to different kind of users among which are fishfarmers, authorities and insurance companies The SEAWATCH buoy equipped with sensors and moored in the sea is the main source for information. Using satellite the data is transmitted to a land base for further analyses. Together with other data sources like water samples, meteorological information, satellite remote sensing and by use of numerical models and software programs the SEAWATCH system provides information specialized for each usergroup.

Typical information areas available are wind waves, currents, temperature, salinity, oxygen, nutrients, radioactivity and light transmission. Such information. showing extremes and variations are useful tools when planning localization of farms and evaluate economical potential from different sites. Current models might as an example be used to predict spreading of bacteria and viruses. During operation at site the farmer, insurance companies or institution might need SEAWATCH data for monitoring and forecasting the surroundings to be alarmed of algae blooms, extreme weather conditions or others changes in the environment.

The SEAWATCH system has been successfully used in Norway during the last ten years by governmental institutions, insurance companies and salmon farmers. During algae blooms in Norway the information from the system has been an important instrument for saving the salmon production as also through other types of contingency operations.

The SEAWATCH system are installed in Indonesia, Thailand, India, Vietnam, Spain and Norway.

LIVING COASTAL RESOURCES OF THE WESTPAC REGION: ENVIRONMENTAL AND MANAGEMENT PERSPECTIVES

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The Indo-West Pacific region is the center of generic richness and diversity in the world. Here, coral reefs, seagrass beds, and mangroves perform a wide spectrum of biological and physical functions which are the bases of their environmental and economic roles, making them an essential link in the energy dynamics of coastal and marine environments. But because development of the coastal zone in the region is inevitable, these habitats will be the object of man-influenced perturbation. While the governments have not been remiss in offering solutions, these give short-term benefits to select groups and degrade the environment at society's cost. Unfortunately, knowledge on these habitats, especially seagrass beds, are scanty, and we are losing our reefs, grass beds, and mangroves at an alarming rate even before we could better understand their ecology. This fact raises a serious doubt as to their normal recovery within this generation. Our experiences in the past show that an explosive population growth coupled with rapidly dwindling resources has brought about short-term economic development mostly at the expense of the environment. This fact has aggravated the social and economic conditions of the greater portion of the region's population making ecological concerns serious socio-economic issues. Today these issues bring about problems with far-reaching effects that go beyond socio-political boundaries.

The priority issues in the WESTPAC region include: destruction of coastal habitats; declining water quality; declines in coastal fisheries; erosion/siltation; coastal hazards; losses in cultural/scenic resources; rising sea level; and the decision-making process for development. Unless there is a substantial change in the national and regional legislative agenda, the lack of commitment to support and encourage the development of coastal and marine science in the region will remain a major deterrent to economic and environmental sustainability.

The EIA or its equivalent should be considered as an environmental planning and management tool. Incorporating carrying capacity as an integral part of the process. It provides opportunity for clearly determining the public interest; clarifies the role and objectives of science; and the process explicitly deals with uncertainty that regulates development and long-term conduct of an activity. Some other recommendations include: fostering conservation in the spirit of international cooperation; encouraging an assessment of existing knowledge on the component ecosystems; fostering conservation partnerships with 'unlikely' allies (e.g. tourism); eliciting people's involvement in World Heritage conservation;

sharing regional experience, knowledge, and resources; and seeking the interest and involve young people in marine conservation effort.

If not yet done, all these considerations should be institutionalized i.e., incorporated in management decisions, translated into legislation, and infused within social norms. Decisions should be placed in the context of emerging trends in environmental and management activities, concepts, and approaches.

INTERANNUAL VARIATION OF ZOOPLANKTON COMMUNITY ALONG 41°30'N LATITUDE OFF SOUTH OF HOKKAIDO WITH SPECIAL REFERENCE TO COPEPOD

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The abundance of zooplankton was investigated along 41°30' N latitude from 144° to 146°E in the Western North Pacific. The samples were collected by vertical hauls from 150m to the surface with Norpac nets (334-μm mesh) in the summers from 1979 through 1994. The study area was influenced by the Kuroshio Warm-Core Ring (KWCR), the Oyashio Water (OW) and the Tsugaru Warm Current (TWC). The present study aimed to reveal the relationship between the abundance of zooplankton and the oceanographic conditions. Zooplankton was found to be abundant in the cold water (OW). Copepoda dominated in the zooplankton community (mean: 81%), and it was followed by Euphausiacea (5%), Appendicularia (4%) and Hydrozoa (3%). It was suggested that Copepoda was distributed in OW, and Hydrozoa in the warm water (KWCR and TWC). However no clean relationship was found between other communities (such as Euphausiacea and Appendicularia) and the water systems. Among copepods, the following five species were found to be the most important species in terms of the body size; *Neocalanus cristatus, N. plumchrus, Metridia pacifica, Eucalanus bungii bingii* and *Calanus pacificus.* The former four species are well known as indicator species of the cold water, and the last as that of the transitional water. It was also found that 55% of the total copepods abundance was comprised of the former four species. In conclusion, we suggested that the abundance of zooplankton in this area can be regulated by the large copepods which originated from OW.

PLANKTON FOOD CHAIN STRUCTURE ACROSS A TROPHIC GRADIENT IN MARINE COASTAL WATERS

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The geographical variations in food chain structure of the plankton community, as defined by total and relative carbon biomass of phytoplankton (PP), bacteria (BA), heterotrophic nanoflagellates (HNF), microzooplankton (MZ), and herbivorous (HNZ) and carnivorous net-zooplankton (CNZ), were investigated along an inshore-offshore transect from the head of Osaka Bay to the Pacific Ocean off Kii Channel, Japan. Based on physico-

chemical properties of the water and topographical features, the transect was divided into 3 trophic areas, i.e. eutrophic, mesotrophic and oligotrophic ones. The average carbon biomass of the total plankton community was highest (438 mg m^{-3}) in thc eutrophic area, and steeply declined offshore (141 and 26.6 mg m^{-3} in the mesotrophic and oligotrophic areas, respectively). In the oligotrophic area, where the biomass of each component decreased steadily with the increase of trophic level, the biomass ratio of BA to PP and relative biomass of HNF and MZ were higher than those in the other areas, indicating that the microbial food chain predominated. In the mesotrophic area, the biomass of HNZ (primarily copepods) was conspicuously high, even higher than that of PP, suggesting that the traditional grazing food chain prevailed. In the eutrophic area, the biomass of HNZ was much smaller compared to enormous biomass of PP, indicating that a considerable amount of primary production was not utilized directly by the metazoan zooplankton. However, the relative contribution of BA, HNF and MZ to the total heterotrophs' biomass was higher in this area, like in the oligotrophic area. The traditional food chain prevailed in the mesotrophic area contributes to the formation of a productive fishing ground.

BIOMASS AND FAUNAL CHARACTERISTICS OF DEEP-SEA BENTHOPELAGIC ORGANISMS IN THE WESTERN NORTH PACIFIC

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The environment just above the sea floor is the boundary layer which divide marine ecological divisions into pelagic and benthic realms. Marine ecological zones have been investigated with various equipments, however, the deep-sea benthopelagic zone have not well been studied because of the difficulties of samplings.

A survey of deep-sea benthopelagic organisms by means of a multiple plankton sampler attached to the Deep-Tow System (DT-MPS) of the Japan Marine Science and Technology Center (JAMSTEC) have been carried out at several locations in the western North Pacific.

Benthopelagic biomass ranged from 4.0 - 22.6 g/1000m^3. The biomass of Copepods and other animals ranged from 1.5 - 14.3 g/ 1000m^3 and 2 - 11.0 g/1000m^3, respectively. The percentage of benthopelagic biomass to the biomass of epipelagic zooplankton varied from 5 - 30%.

Faunal composition and horizontal distribution of deep-sea benthopelagic zooplankton was studied. Copepods, Ilyarachnid isopods, Lophogastrid mysids and Gammarid amphipods are the dominant components in the western North Pacific and these animals have no relationship with pelagic species. Distributional characteristics of these deep-sea benthopelagic organisms shows relatively small scale distribution patterns in

compared with pelagic species. This pattern was thought to have close relationship with benthic topography and/or benthic organisms in the survey areas.

SEAGRASS DEMOGRAPHIC DYNAMICS AS INDICES OF MARINE ENVIRONMENTAL HEALTH

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This paper highlights the most significant results of three projects (1986-1997) that wholly or partially studied the responses of seagrasses to experimental burial, siltation, and nutrient loading at some sites in Southeast Asia. Seagrass response to burial was species - specific, but in general, it caused an increase in vertical growth and frequency of branching of vertical shoots. Buried under >4 cm of sediment, however, caused the mortality of H. ovalis, the most resistant among the species studied.

There was species loss with increasing siltation, the loss being consistent with the earlier prediction based on the plants' architecture and resistance to experimental disturbance. In addition, leaf biomass was reduced as the silt content of the sediments exceeded 10-15%.

Nutrient addition significantly increased density of both shoots and rhizome apices. Rhizomes of E. acoroides confirm the existence of seasonal oscillations in organic production, with peaks about once after every 2 years. This response was directly correlated with the El Nino phenomenon, rainfall, and the passage of typhoons.

Overall, data suggest that interspecific competition among the species might be important in shaping the mixed seagrass community. The response of the seagrass to burial, siltation and nutrient loading points to the existence of a predictable pattern of species loss and may have a diagnostic power as an early warning of stress. Conversely, they also predict how species richness is expected to improve following reduction of siltation. Hence, they demonstrate not only seagrass response to disturbance but also the dynamics of its early recovery. The seasonal oscillation in organic production in E. acoroides allows for a simple and pragmatic technique to backdate and predict seagrass production in relation to major stressors and to detect changes in the health of the plants' environment.

FATE OF SEAGRASS PRODUCTION AS ASSESSED BY CAGE EXPERIMENTS IN *Enhalus Acoroides* BED IN GERUPUK BAY, LOMBOK, INDONESIA

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This report is the results and crude data obtained in the LIPI-JSPS Joint Research Programme (Lombok Project).

The fate of seagrass production was measured by in situ cage experiments in *Enhalus acoroides* bed in Gerupuk Bay, Lombok Island and carried out in 1995. Results showed that

the average rate of the floating and depositing leaves were 4.62± 0.32 and 8.71±0.37 gDW m^2day^{-1}, respectively. Then, among the 65.34% of seagrass production deposited on the seagrass bed and 34.66% floated away from the seagrass bed.

BIOMONITORING OF MICROPOLLUTANTS IN TROPICAL COASTAL ORGANISMS FOR SUSTAINABLE USE OF LIVING RESOURCES

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West Bengal is endowed with the most diversified coastal ecosystem among all the maritime states of India. This is a biologically productive and physically diverse marine system currently facing environmental threats particularly from organic pollution. This is originated from untreated sewage, agricultural run off and industrial effluents. The present paper examines the level of mercury, lead and cadmium in seagrass (Porterasia coarctata), bivalve molluscs (Pelecyora trigona and Meretrix meretrix) and potentially edible fishes (Liza parsia, Harpodon nehereus, Mystus sp., and Stromateus sp.,) at three locations of deltaic Sundarban, eastern part of India. The primary objective of this work is to provide baseline data for future environmental quality monitoring programme and suitability of these organisms to be used as indicators of pollution.

The metals were analysed by atomic absorption spectroscopy method. Both species-dependent variability and regional variations of these micropollutants were observed. In case of bivalve molluscs, a high degree of organ-specificity was also pronounced where gill and mantle revealed distinct efficiency in accumulation. Mercury content per individual in bivalves and fishes could be related to body weight (W) as the power formula $Y= aW^b$, where Y is the metal body burden and a and b are constants

A continuous monitoring programme is recommended covering both polluted and control areas in order to (i) clarify the present trend to protect its ecological and economical viability and (ii) to establish the studied organisms as sentinel and bioindicator species.

ENVIRONMENT MONITORING SYSTEM OF THE INDONESIAN ARCHIPELAGIC WATER

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Indonesia is recognized by The United nations Convention on the Law of The Sea (UNCLOS) 1982 as an archipelagic state. Accordingly, Indonesian state covers a large water area consisting of around $2.9x10^6$ km^2 archipelagic water, $0.3x10^6$ km^2 territorial water, $2.7x10^6$ km^2 Economic Exclusive Zone. Of course, such large water area considerably contains abundant living and non-living resources which preserve for efficient utilization to support nation building at the present and the future time.

In order to support the oceanographic data for planning of coastal zone management and offshore engineering projects, for monitoring the sea behavior and comprehensive study of the ocean hydro-dynamic especially Indonesian Throughflow, Indonesian Monsoonal Current and the effects of external forces such as el nino which may affect national development and social live, the Indonesian government has assigned the Hydro-Oceanographic Office (DISHIDROS) to take responsibility in establishing an array of 38 tidal observation stations enclosing the Indonesian archipelagic water. The tidal observation stations are provided by automatic tide gauge with high-accuracy, long-term and continuous reading by applying a telemetric technology. The data will sent on the basis of near-real time period to National Tidal Data Center positioned at DISHIDROS, Jakarta. The project has been started in 1997 for five year planning. Currently, 2 stations were established on sites of Aru Islands and Lombok Strait

This paper will cover technical background, technology, present results and problems happening during the exercise.

INTEGRATED COASTAL MANAGEMENT IS ESSENTIAL TO SUSTAINABLE DEVELOPMENT OF COASTAL ECOSYSTEMS

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Coastal ecosystems are very fragile. Usually each of these ecosystems, mangrove, seagrass beds, coral reef, sandy coast, mud flat etc. have been treated separately since each type does have differents charactrsistics. Actually, they are all interconnected and should be considered holistically. Deterioration of any of these coastal ecosystems would result from various activities which impact both directly and indirectly. Hence land use of that area should also be taken into consideration. The case study from Thailand along the west coast of the Gulf from Petchaburi to Nakorn Srithamarat demonstrated a clear example that integrated coastal management is essential to sustainable development. Settlements, pollution discharge, industries, roads and railway, coastal construction, shrimp farming, erosion, fisheries activities, tourism etc. all these have to be integrated for coastal sustainable development.

BIODIVERSITY OF COPEPODS ASSOCIATED WITH MACROINVERTEBRATES FROM CORAL REEFS IN MALAYSIA

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The waters surrounding Malaysia are ideal places to launch many marine research programs on biodiversity. Geographically, it lies at the heart of the Indo-Pacific Region at the junction of two major oceans, the Pacific on the east, and the Indian Ocean on the west. However, unfortunately studies on biodiversity in this region are much lacking. The coral reef ecosystems have received some attention in the past and studies on biodiversity of soft coral, hard corals, sea anemonies, molluscs, echinoderms and reef fishes have been initiated and some studies are still ongoing. However, very little work have been done on the copepods associated with macroinvertebrates in the coral reef ecosystem.

We introduce our research on biodiversity in the coral reefs of Malaysia. We examined orders poecilostomatoid and siphonostomatoid copepods associated with six species of echinoderms at five locations, namely Langkawi Archipelago, Port Dickson in the Malacca Straits; Perhentian and Tioman Islands on the west South China Sea and Ambong Bay in the east South China Sea. A total of 47 species from 13 genera of copepods were identified. We have also examined the poecilostomatoids and siphonostomatoids associated with six species of scleretinid corals from Payar, Perhentian and Tioman Islands, where 50 species of copepods from 22 genera were collected.

A REVIEW OF THE ARTIFICIAL REEF IN MALAYSIA - A LEANING PARADIGM

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Malaysia started its artificial reef project in 1975. The objective of the project was to increase the fish stock for the benefit of the fishermen. The artificial reefs comprised of materials such as rubber tyre, concrete, polyvinyl chloride (PVC), and unoperational wooden fishing vessel (UFV). To date there are 66 locations of tyre reef (which make up an estimated three and a quarter million car and truck tyres), 5 concrete, 3 PVC and 13 UFV (comprised of 581 vessels) in Malaysian water, some of which were situated within the area of marine parks, the natural reef. Questions grew in the minds of the scientists and policy makers in the country whether the objective was achieved, what actual benefit do these reefs provide and what possible negative implications could there be to the marine environment caused by the material used in building the reefs. These questions evolved from some literature and observations, which suggest that artificial reefs merely gather fish, but do not increase the number. This paper discusses in detail the implementation of the project, the present condition of the artificial reefs, some of which after many years of establishment, the observations made on the encrustation of corals and other marine organisms on the different materials of artificial reef, the research on the fish and other organisms in and around the artificial reefs as well as the problems faced at present in assessing the actual function of artificial reef and the major role it plays.

DISTRIBUTION OF CORAL SPECIES WITH DEPTH IN THE GULF OF THAILAND AND THE ANDAMAN SEA

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Differences in physical parameters between the Gulf of Thailand and the Andaman Sea resulted in differences in the distribution of coral species with depth. The areas of studysites in the Gulf of Thailand included; Ngam Yai and Ngam Noi Islands in Chumporn province, Nang Yuan and Tao Island in Surathani province, Manvichai and Phai Islands in Chonburi province. The Andaman Sea sites included; Mieng, Payu and Similan in the Similan Islands National Park, Surin Nua and Tachai in the Surin Islands National Park. Line intercept transect technique recorded by VDO camera was used for this study.

IMPACT OF ADDITIONAL FEEDING IN CORAL REEF FISH

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Koh larn island, Pattaya, Chonburi province was selected as a study site because it is a major preference for tourism in this area. Two spots were selected. The first spot is Larm-Sang-Warn where many activities contribute to additional feeding to the reef fish. One of the good examples of this spot is Sea Walker activity. Forty pounds of breads would be fed to the fish in that area everyday for a year before this survey was conducted. The second spot is Hard-Non where no feeding activity was found. Lotinone solution was applied followed by the catch with gill net. Visual census was also included in this study. From the results of the survey, it can be concluded that there were more fish species at Hard-Non than in Laem-Sang-Warn. On the other hand, there was more fish of each species collected in the Larm-Sang-warn. The major family is Pomacentridae which being the local family of that area.

PRELIMINARY STUDY ON AGE DETERMINATION OF DUGONG *(DUGONG DUGON)* IN THAILAND

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Dentinal growth layer groups (GLGS) of dugong tusks have been examined from 12 stranded animals (6 in each sex) from the Andaman coast of Thailand with the purpose of age determination. Body length of the dugongs ranges from 160-273 cm while the tusk length measured at left inside varies from 16-210 mm. The nine large tusks (55-210 mm) were bisected longitudinally in the mesiodistal plane using the Buehler Isomet low-speed saw and were etched in formic acid. Decalcified and haematoxylin-stained thin sections were prepared for the remaining three small tusks (16-35 mm). The GLGS counts ranged 1-43 for females and 2-16 for males. Among 6 older animals (3 in each sex) over 13 GLGS, the tusks of two males (14 and 15 GLGS) were worn while those of the remaing one male (16) and three females (14, 34 and 43) were not, suggesting sexual difference in growth of tusk. Based on the 11 samples including a new born calf and excluding the above two males with worn tusks, the relationship between body length (L) in cm and age (A) was calculated using the von Bertalanffy growth model as the following equation; $L_A = 2.61*(1-\exp(-0.337A))$.

STATUS OF DOLPHINS IN THE INNER GULF OF THAILAND

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In the Inner Gulf of Thailand there are one species of porpoise, *Neophocaena phocaenoides;* finless porpoise and three species of dolphins *Orcaella brevirostris;* Irrawaddy dolphin, *Sousa chinensis;* Indo-Pacific humpback dolphin and *Tursiops truncatus;* bottlenose dolphin. *O. brevirostris* inhabited only shallow and brackish water, while *N. phocaenoides* preferred away from estuaries. Both can be found along the coast of the Inner Gulf of Thailand except Pattaya and the lower part of the east coast. *S. chinensis* was commonly found in almost all estuaries although it could sometimes be seen offshore. *T. truncatus* is usually found offshore, around every island but sometimes found along the coastline. Intrusion of *O. brevirostris* in Chao Phraya and Bang Pakong River were recorded. At present, *S. chinensis* is seen almost in every river up to only few km from the mouth and it is the only one species found in the Mae Klong and Ta Chin River. *S. longirostris* has a very small population if not gone from the study area. The largest male *N. phocaenoides* was 141 cm in length and 133 cm for largest female which was in lactation period were caught in August. Cephalopods, crustaceans and fishes were found to be food of finless porpoise. Spinner dolphin in the Gulf of Thailand should not be considered as *S. longirostris* because it possesses differences in morphological proportion and obvious less number of teeth. The other four species could not be separated as new species as suggested by some authors because their differences were not distinctively different enough.

WHALE SHARKS IN THE THAI WATERS

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Records of whale shark's distribution were collected from both in the Gulf of Thailand and the Andaman Sea. Divers, dive shops and tourists at the target areas were interviewed about the vicinities and dates when the whale sharks were encountered. Divers frequently visit the areas where the whale sharks could usually be seen. In the Gulf of Thailand, they had been encountered in the middle of the Gulf and more frequently found near the reefs around Hin Pae, Chumporn Pinnacles and Southwest Pinnacles. They were also often seen at the far end of the Gulf at Losin Pinnacles. There are reports that they were regularly found in several places in the Andaman Sea, around offshore islands such as Richelieu Rock, Koh Bon, Koh Tachai, Surin Island, Christmas Point, Similan Island, Koh Rok Nok, Hin Daeng and Hin Muang. Whale sharks were usually found as single individuals but aggregations were sometimes reported. Their appearance isprobably dependent on the availability of their planktonic food source and they might have some connection to the change of water temperature. For all these datas will be formulated for management and of the whale sharks since they are becoming one of the major tourists attraction.

TEMPORAL AND SPATIAL DISTRIBUTION OF SAND-DWELLING DINOFLAGELLATES IN A TIDAL FLAT OF YASHIMA BAY, THE SETO INLAND SEA, JAPAN

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During a one-year quantitative study on the sand-dwelling dinoflagellates in a tidal flat of Yashima Bay, the Seto Inland Sea, Japan, sixty eight species of dinoflagellates had been found in the sediment samples, of which 58 species in 4 orders, 8 families, 19 genera were thought to be associated with a sand-dwelling life. Besides their dorsal-ventrally flattened or elongate characteristics, mucus producing, thus coccoid cells, was common in these species. The stresses caused by the variations of solar irradiance, salinity, temperature and sediment water content must be experienced by these dinoflagellates. The species within the genera of *Amphidinium, Gymnodinium, Gyrodinium, Peridinium* and *Prorocentrum* were more dominant than other ones. The seasonal succession and vertical (from surface to 10 cm depth) distributional patterns of these dinoflagellates had been found. Temperature seems to play the most important role in the succession of these sand-dwelling dinoflagellates, while nutrition status may be the deciding factor in their vertical distribution natures. The size composition of sediment particle was required for these special group of dinoflagellates to survive a benthic life. Compared with their cell densities and Chlorophyll-a contents in the sediment, dinoflagellates seem to be a minute participant of beach flora in such a productive temperate tidal flat, although they could aggregate dense enough to form patches (always called colored sand) in the beach surface on some occasions. Combined with the environmental factors, their living strategies were discussed.

AN ESTABLISHMENT OF RED TIDE MONITORING CENTER IN SAMAR, PHILIPPINES

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The recurrence of red tide and paralytic shellfish poisoning (PST is major concern among the government institutions in the country. In recent years, however, Maqueda Bay and Villareal Bay face the problem of periodic occurrence of the harmful algal bloom where the mariculture of green mussels (*Perna viridis*) are located. Cognizant of the need of information by the government to draw-up contigencies and minimize the effects of the harmful algal bloom on fisheries and public health, a red tide monitoring center was established in Samar, Philippines. The center has mainly focused its activities on upgrading of existing laboratory facilities, environmental monitoring of hydrographic parameters and cell density of *Pyrodinium behamense var. compressum* and other marine microalgae.

Results from monitoring cruises indicated that there was an isolated presence of toxic dinoflagellates in April (5,000 cells/liter) and November (24 cells/liter). But the presence of the species was considered insignificant Among the dinoflagellates identified, it was observed that *Noctihula sp.* was the most abundant However, 32 diatoms species were also identified and comprised 85% the largest concentrations of the total samples of the plankton population.

It was observed that *Thalasstostra sp,* (2,032,400 cells/l) was recorded was the most dominant. *Rhizosolenia sp. (1,792,000* cells/l) was recorded next in rank, followed by T*halassionema sp.* and *Cheatocer sp.* with total concentration of 633,634 cells/l. The distribution and abundant in station in station 2 in December and while the *Chaetoceros sp.* was found abundant in April Hydrographic result showed within the ranged of the observed values for *Pyrodinium* bloom, i.e. 24.4 - 31.9°C and 24.7 - 36.8 ppt in Papua New Guinea

HARMFUL ALGAL BLOOM MANAGEMENT PROGRAMS IN SOUTHEAST ASIA

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Records of Harmful Algal Blooms (HABs) in Southeast Asia (i.e., the Philippines, Indonesia, Malaysia, Thailand, Brunei Darussalam, Singapore and Vietnam) have been increasing during the last five years. In order to prevent or mitigate health and fisheries problems and negative impacts associated with HABs, these countries have taken up measures to enhance existing management programs or implement new ones.

This paper presents a review of harmful algal bloom programs in Southeast Asia specially those in line with the regional red tide/HAB alert and information networks. Needs and concerns for improved monitoring, research and management of harmful algal blooms are highlighted.

ROLE OF WAVES IN INITIATING AND TRIGGERING ALGAL BLOOMS

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The actual mechanisms that may be responsible for initiating and/or triggering harmful algal blooms, commonly called *red tide* events, are not yet completely understood. Thus, it has been difficult to predict the onset of such events. So far, algal bloom have been variably associated with environment factors such as increasing temperature and excessive eutrophication. Using field observations of algal bloom events in Philippine waters since 1983, the role of waves in initiating and triggering past red tide events is presented and discussed in this paper. Results strongly suggest that waves may actually play a key role in the onset of algal blooms. These findings are highly significant because they will allow a better understanding of the life cycle of cyst-forming dinoflagellates whose blooms can hinder the sustainable development of global shellfish fishery. Moreover, the new insights will highlight the role of ocean science towards formulating more effective red tide management programs to ensure the safety of shellfish for human consumption throughout the world.

ANNEX III

Speeches at the opening ceremony
by Mr. Nozaka
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Science and International Affairs Bureau,
Ministry of Education, Science, Sports, and Culture of Japan

Prof. Taira, Chairperson of WESTPAC
Dr. Summerhayes of the IOC Secretariat
Prof. Katsura of the University of the Ryukyus,
Distinguished Participants,
Ladies and Gentlemen,

On behalf of the Ministry of Education, Science, Sports and Culture of Japan, MONBUSHO, it is my great pleasure to extend my warmest welcome to all participants from the WESTPAC region and other regions of the world, at the opening of the Fourth UNESCO, IOC/WESTPAC International Scientific Symposium entitled "Role of Ocean Sciences for Sustainable Development".

As you know, this year, 1998 has been declared to be the International Year of the Ocean by the United Nations General Assembly upon UNESCO's proposal. It is also my pleasure to note that at the beginning of such a special year, this Symposium is convened here in the archipelago of Okinawa surrounded by the beautiful ocean.

The Special Session of the United Nations General assembly was held last June to review the progress achieved over the five years after the United Nations conference on Environment and Development held in Rio de Janeiro in 1992 and adopted the Programmed for the Further Implementation o AGENDA 21. Within the Programme, oceans and seas were named as one of the high priority areas for us to take precautionary actions. Also at the COP3, the Third Session of the Conference of the Parties to the United Nations Framework Convention on Climate Change held last December in Kyoto, Japan, grave concerns were expressed about the direct effects on oceans and seas by global warming. We have to solve these problems for the future of humankind. Basic research on the movement of oceans are becoming more and more important.

This Symposium is held at such a critical moment when increasing attention is given to the oceans. I am convinced that this Symposium will make great contributions to the further development of ocean sciences and various scientific fields related to the global environment. At the same time, I hope that this Symposium will contribute to raising public awareness on the importance of oceans, which is necessary to conserve and maintain marine environment effectively.

Finally, I would like to express our sincere gratitude to the staff of the IOC Secretariat, the WESTPAC Secretariat, the University of the Ryukyus, and the Ocean Research Institute of the University of Tokyo all of whom have made great efforts to bring about this symposium.

I wish the Symposium great success.

Thank you very much.

Welcome Address
by Prof. Kosho Katsura
President of the University of the Ryukyus

Mr. Chairman, Distinguished Guests, Participants, Ladies and Gentlemen:

On behalf of the University of the Ryukyus, it is indeed my great privilege and pleasure to seize this opportunity to welcome all of you who have gathered for this important meeting, the Fourth WESTPAC International Scientific Symposium on the "Role of Ocean for Sustainable Development".

I am especially pleased that this, the Fourth Symposium, Australia 1989, subsequent to the ones in Malaysia 1991 and Indonesia 1994. It is very significant for us that this is the first to be held in Japan and that Okinawa in particular has been given the honor of hosting it. During this Symposium, leading researchers in various fields related to western pacific studies will present the results of their work. It is an excellent opportunity for promising young researchers to enter into active and fruitful discussions with their peers as well as with established figures in this field of scientific research. I believe that this Symposium will be a stimulating experience for researchers not only in the field of marine science, but also other scientific fields, both in Okinawa and Japan as a whole.

The study of the role of ocean sciences is a multi-disciplinary area of research which is related to the oceanic branches of Physics, Geology, Biology and Chemistry. Ocean sciences are valuable tools for elucidating the mechanism of ocean dynamics and clarifying the sustainable development of the ocean. Research in the field of the role of ocean sciences for sustainable development is especially important today because environmental pollution has become a series of serious problems in our society.

People here in Okinawa are known for their longevity arising from the benevolence of nature including that of the ocean, especially the Kuroshio Warm Current. I hope that this Symposium will contribute to the improvement not only of the science, but also of the quality of our lives.

I am sure that his gathering will be a great success, and that every participant will benefit from having attended it and leave enriched by the experience, not only from a scientific point of view, but also, we trust, from what they learn of the Okinawan people and their culture.

Thank you very much.

ANNNEX IV

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ANNEX V

LIST OF ACRONYMS

CC	Coordinating Committee
CCOP	Coordinating Committee for Coastal and Offshore Geoscience Programmes in East and South East Asia
EEZ	Exclusive Economic Zone
FERHRI	Far Eastern Regional Hydrometeorological Research Institute
GODAR	Global Oceanographic Data Archaeology and Rescue Project
GOOS	Global Ocean Observing System.
GTS	Guinean Trawling Survey
ICAM	Integrated Coastal Area Management.
IHO	International Hydrographic Organization
IOC	Intergovernmental Oceanographic Commission
KMA	Korea Meteorological Administration.
KODC	Korea Oceanographic Data Center
KORDI	Korea Ocean Research and Development Institute
NEAR-GOOS	North-East Asian Regional GOOS
OSNLR	Ocean Sciences on Non-Living Resources
PORSEC	Pacific Ocean Remote Sensing Conference.
RTDB	Real Time Data Base
SEA-GOOS	South East Asian Regional GOOS
SEACAMP	South East Asian Center for Atmospheric and Marine Prediction
SST	Sea Surface Temperature
TICZ	Tectonics and Its Impact on the Coastal Zone
UN-IDNDR	UN-International Decade for Natural Disaster Reduction
WAM	Wave Prediction Model
WESTPAC	IOC Sub-Commission for the Western Pacific.

IOC Workshop Reports

The Scientific Workshops of the Intergovernmental Oceanographic Commission are sometimes jointly sponsored with other intergovermental or non-governmental bodies. In most cases, IOC assumes responsibility for printing, and copies may be requested from:

Intergovernmental Oceanographic Commission - UNESCO
1, rue Miollis, 75732 Paris Cedex 15, France

No.	Title	Languages
1	CCOP-IOC, 1974, Metallogenesis, Hydrocarbons and Tectonic Patterns in Eastern Asia (Report of the IDOE Workshop on); Bangkok, Thailand, 24-29 September 1973 UNDP (CCOP), 138 pp.	E (out of stock)
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)
3	Report of the IOC/GFCM/ICSEM International Workshop on Marine Pollution in the Mediterranean; Monte Carlo, 9-14 September 1974.	E, F E (out of stock)
4	Report of the Workshop on the Phenomenon known as 'El Niño'; Guayaquil, Ecuador, 4-12 December 1974.	E (out of stock) S (out of stock)
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 E (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, Côte d'Ivoire, 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, U.S.A., 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), E, 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; Liège, 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, Japan, 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; Nouméa, 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, France, 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, France, 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 1963.	E
34	IOC Workshop on Regional Co-operation in Marine Science in the Central Eastern Atlantic (Western Africa); Tenerife, 12-17 December 1963.	E, F, S
35	CCOP/SOPAC-IOC-UNU Workshop on Basic Geo-scientific Marine Research Required for Assessment of Minerals and Hydrocarbons in the South Pacific; Suva, Fiji, 3-7 October 1983.	E
36	IOC/FAO Workshop on the Improved Uses of Research Vessels; Lisbon, Portugal, 28 May-2 June 1984.	E
36 Suppl.	Papers submitted to the IOC/FAO Workshop on the Improved Uses of Research Vessels; Lisbon, Portugal, 28 May-2 June 1984.	E
37	IOC/UNESCO Workshop on Regional Co-operation in Marine Science in the Central Indian Ocean and Adjacent Seas and Gulfs; Colombo, 8-13 July 1985.	E
38	IOC/ROPME/UNEP Symposium on Fate and Fluxes of Oil Pollutants in the Kuwait Action Plan Region; Basrah, Iraq, 8-12 January 1984.	E
39	CCOP (SOPAC)-IOC-IFREMER-ORSTOM Workshop on the Uses of Submersibles and Remotely Operated Vehicles in the South Pacific; Suva, Fiji, 24-29 September 1985.	E
40	IOC Workshop on the Technical Aspects of Tsunami Analysis, Prediction and Communications; Sidney, B.C., Canada, 29-31 July 1985.	E
40 Suppl.	First International Tsunami Workshop on Tsunami Analysis, Prediction and Communications, *Submitted Papers;* Sidney, B.C., Canada, 29 July - 1 August 1985.	E
41	First Workshop of Participants in the Joint FAO/IOC/WHO/IAEA/UNEP Project on Monitoring of Pollution in the Marine Environment of the West and Central African Region (WACAF/2); Dakar, Senegal, 28 October-1 November 1985.	E
43	IOC Workshop on the Results of MEDALPEX and Future Oceanographic Programmes in the Western Mediterranean; Venice, Italy, 23-25 October 1985.	E
44	IOC-FAO Workshop on Recruitment in Tropical Coastal Demersal Communities; Ciudad del Carmen, Campeche, Mexico, 21-25 April 1986.	E (out of stock) S
44 Suppl.	IOC-FAO Workshop on Recruitment in Tropical Coastal Demersal Communities, *Submitted Papers;* Ciudad del Carmen, Campeche, Mexico, 21-25 April 1986.	E
45	IOCARIBE Workshop on Physical Oceanography and Climate; Cartagena, Colombia, 19-22 August 1986.	E
46	Reunión de Trabajo para Desarrollo del Programa "Ciencia Oceánica en Relación a los Recursos No Vivos en la Región del Atlántico Sud-occidental"; Porto Alegre, Brazil, 7-11 de abril de 1986.	S
47	IOC Symposium on Marine Science in the Western Pacific: The Indo-Pacific Convergence; Townsville, 1-6 December 1966.	E
48	IOCARIBE Mini-Symposium for the Regional Development of the IOC-UN (OETB) Programme on 'Ocean Science in Relation to Non-Living Resources (OSNLR)'; Havana, Cuba, 4-7 December 1986.	E, S
49	AGU-IOC-WMO-CPPS Chapman Conference: An International Symposium on 'El Niño'; Guayaquil, Ecuador, 27-31 October 1986.	E
50	CCALR-IOC Scientific Seminar on Antarctic Ocean Variability and its Influence on Marine Living Resources, particularly Krill (organized in collaboration with SCAR and SCOR); Paris, France, 2-6 June 1987.	E
51	CCOP/SOPAC-IOC Workshop on Coastal Processes in the South Pacific Island Nations; Lae, Papua-New Guinea, 1-8 October 1987.	E

No.	Title	Languages
52	SCOR-IOC-UNESCO Symposium on Vertical Motion in the Equatorial Upper Ocean and its Effects upon Living Resources and the Atmosphere; Paris, France, 6-10 May 1985.	E
53	IOC Workshop on the Biological Effects of Pollutants; Oslo, 11-29 August 1986.	E
54	Workshop on Sea-Level Measurements in Hostile Conditions; Bidston, UK, 28-31 March 1988	E
55	IBCCA Workshop on Data Sources and Compilation, Boulder, Colorado, 18-19 July 1988.	E
56	IOC-FAO Workshop on Recruitment of Penaeid Prawns in the Indo-West Pacific Region (PREP); Cleveland, Australia, 24-30 July 1988.	E
57	IOC Workshop on International Co-operation in the Study of Red Tides and Ocean Blooms; Takamatsu, Japan, 16-17 November 1987.	E
58	International Workshop on the Technical Aspects of the Tsunami Warning System; Novosibirsk, USSR, 4-5 August 1989.	E
58 Suppl.	Second International Workshop on the Technical Aspects of Tsunami Warning Systems, Tsunami Analysis, Preparedness, Observation and Instrumentation. *Submitted Papers*; Novosibirsk, USSR, 4-5 August 1989.	E
59	IOC-UNEP Regional Workshop to Review Priorities for Marine Pollution Monitoring Research, Control and Abatement in the Wider Caribbean; San José, Costa Rica, 24-30 August 1989.	E, F, S
60	IOC Workshop to Define IOCARIBE-TRODERP proposals; Caracas, Venezuela, 12-16 September 1989.	E
61	Second IOC Workshop on the Biological Effects of Pollutants; Bermuda, 10 September-2 October 1988.	E
62	Second Workshop of Participants in the Joint FAO-IOC-WHO-IAEA-UNEP Project on Monitoring of Pollution in the Marine Environment of the West and Central African Region; Accra, Ghana, 13-17 June 1988.	E
63	IOC/WESTPAC Workshop on Co-operative Study of the Continental Shelf Circulation in the Western Pacific; Bangkok, Thailand, 31 October-3 November 1989.	E
64	Second IOC-FAO Workshop on Recruitment of Penaeid Prawns in the Indo-West Pacific Region (PREP); Phuket, Thailand, 25-31 September 1989.	E
65	Second IOC Workshop on Sardine/Anchovy Recruitment Project (SARP) int he Southwest Atlantic; Montevideo, Uruguay, 21-23 August 1989.	E
66	IOC *ad hoc* Expert Consultation on Sardine/Anchovy Recruitment Programme; La Jolla, California, U.S.A., 1989.	E
67	Interdisciplinary Seminar on Research Problems in the IOCARIBE Region; Caracas, Venezuela, 28 November-1 December 1989.	E (out of stock)
68	International Workshop on Marine Acoustics; Beijing, China, 26-30 March 1990.	E
69	IOC-SCAR Workshop on Sea-Level Measurements in the Antarctica; Leningrad, USSR, 28-31 May 1990.	E
69 Suppl.	IOC-SCAR Workshop on Sea-Level Measurements in the Antarctica; *Submitted Papers*; Leningrad, USSR, 28-31 May 1990.	E
70	IOC-SAREC-UNEP-FAO-IAEA-WHO Workshop on Regional Aspects of Marine Pollution; Mauritius, 29 October - 9 November 1990.	E
71	IOC-FAO Workshop on the Identification of Penaeid Prawn Larvae and Postlarvae; Cleveland, Australia, 23-28 September 1990.	E
72	IOC/WESTPAC Scientific Steering Group Meeting on Co-Operative Study of the Continental Shelf Circulation in the Western Pacific; Kuala Lumpur; Malaysia, 9-11 October 1990.	E
73	Expert Consultation for the IOC Programme on Coastal Ocean Advanced Science and Technology Study; Liège, Belgium, 11-13 May 1991.	E
74	IOC-UNEP Review Meeting on Oceanographic Processes of Transport and Distribution of Pollutants in the Sea; Zagreb, Yugoslavia, 15-18 May 1989.	E
75	IOC-SCOR Workshop on Global Ocean Ecosystem Dynamics; Solomons, Maryland, U.S.A., 29 April-2 May 1991.	E
76	IOC/WESTPAC Scientific Symposium on Marine Science and Management of Marine Areas of the Western Pacific; Penang, Malaysia, 2-6 December 1991.	E
77	IOC-SAREC-KMFRI Regional Workshop on Causes and Consequences of Sea-Level Changes on the Western Indian Ocean Coasts and Islands; Mombasa, Kenya, 24-28 June 1991.	E
78	IOC-CEC-ICES-WMO-ICSU Ocean Climate Data Workshop Goddard Space Flight Center; Greenbelt, Maryland, U.S.A., 18-21 February 1992.	E
79	IOC/WESTPAC Workshop on River Inputs of Nutrients to the Marine Environment in the WESTPAC Region; Penang, Malaysia, 26-29 November 1991.	E
80	IOC-SCOR Workshop on Programme Development for Harmful Algae Blooms; Newport, U.S.A., 2-3 November 1991.	E
81	Joint IAPSO-IOC Workshop on Sea Level Measurements and Quality Control; Paris, France, 12-13 October 1992.	E
82	BORDOMER 92: International Convention on Rational Use of Coastal Zones. A Preparatory Meeting for the Organization of an International Conference on Coastal Change; Bordeaux, France, 30 September-2 October 1992.	E
83	IOC Workshop on Donor Collaboration in the Development of Marine Scientific Research Capabilities in the Western Indian Ocean Region; Brussels, Belgium, 12-13 October 1992.	E
84	Workshop on Atlantic Ocean Climate Variability; Moscow, Russian Federation, 13-17 July 1992.	E
85	IOC Workshop on Coastal Oceanography in Relation to Integrated Coastal Zone Management; Kona, Hawaii, 1-5 June 1992.	E
86	International Workshop on the Black Sea; Varna, Bulgaria 30 September - 4 October 1991.	E
87	Taller de trabajo sobre efectos biológicos del fenómeno «El Niño» en ecosistemas costeros del Pacífico Sudeste; Santa Cruz, Galápagos, Ecuador, 5-14 de octubre de 1989.	S only (Summary in E, F, S)
88	IOC-CEC-ICSU-ICES Regional Workshop for Member States of Eastern and Northern Europe (GODAR Project); Obninsk, Russia, 17-20 May 1993.	E
89	IOC-ICSEM Workshop on Ocean Sciences in Non-Living Resources; Perpignan, France, 15-20 October 1990.	E
90	IOC Seminar on Integrated Coastal Management; New Orleans, U.S.A., 17-18 July 1993.	E
91	Hydroblack'91 CTD Intercalibration Workshop; Woods Hole, U.S.A., 1-10 December 1991.	E
92	Réunion de travail IOCEA-OSNLR sur le Projet « Budgets sédimentaires le long de la côte occidentale d'Afrique » Abidjan, Côte d'Ivoire, 26-28 juin 1991.	F
93	IOC-UNEP Workshop on Impacts of Sea-Level Rise due to Global Warming. Dhaka, Bangladesh, 16-19 November 1992.	E
94	BMTC-IOC-POLARMAR International Workshop on Training Requirements in the Field of Eutrophication in Semi-Enclosed Seas and Harmful Algal Blooms, Bremerhaven, Germany, 29 September - 3 October 1992.	E
95	SAREC-IOC Workshop on Donor Collaboration in the Development of Marine Scientific Research Capabilities in the Western Indian Ocean Region; Brussels, Belgium, 23-25 November 1993.	E
96	IOC-UNEP-WMO-SAREC Planning Workshop on an Integrated Approach to Coastal Erosion, Sea Level Changes and their Impacts; Zanzibar, United Republic of Tanzania, 17-21 January 1994.	E
96 Suppl. 1	IOC-UNEP-WMO-SAREC Planning Workshop on an Integrated Approach to Coastal Erosion, Sea Level Changes and their Impacts; *Submitted Papers* 1. Coastal Erosion; Zanzibar, United Republic of Tanzania 17-21 January 1994.	E
96 Suppl. 2	IOC-UNEP-WMO-SAREC Planning Workshop on an Integrated Approach to Coastal Erosion, Sea Level Changes and their Impacts; *Submitted Papers* 2. Sea Level; Zanzibar, United Republic of Tanzania 17-21 January 1994.	E
97	IOC Workshop on Small Island Oceanography in Relation to Sustainable Economic Development and Coastal Area Management of Small Island Development States; Fort-de-France, Martinique, 8-10 November, 1993.	E
98	CoMSBlack '92A Physical and Chemical Intercalibration Workshop; Erdemli, Turkey, 15-29 January 1993.	E
99	IOC-SAREC Field Study Exercise on Nutrients in Tropical Marine Waters; Mombasa, Kenya, 5-15 April 1994.	E
100	IOC-SOA-NOAA Regional Workshop for Member States of the Western Pacific - GQDAR-II (Global Oceanographic Data Archeology and Rescue Project); Tianjin, China, 8-11 March 1994.	E
101	IOC Regional Science Planning Workshop on Harmful Algal Blooms; Montevideo, Uruguay, 15-17 June 1994.	E
102	First IOC Workshop on Coastal Ocean Advanced Science and Technology Study (COASTS); Liège, Belgium, 5-9 May 1994.	E
103	IOC Workshop on GIS Applications in the Coastal Zone Management of Small Island Developing States; Barbados, 20-22 April 1994.	E
104	Workshop on Integrated Coastal Management; Dartmouth, Canada, 19-20 September 1994.	E
105	BORDOMER 95: Conference on Coastal Change; Bordeaux, France, 6-10 February 1995.	E
105 Suppl.	Conference on Coastal Change: Proceedings; Bordeaux, France, 6-10 February 1995	E
106	IOC/WESTPAC Workshop on the Paleographic Map; Bali, Indonesia, 20-21 October 1994.	E
107	IOC-ICSU-NIO-NOAA Regional Workshop for Member States of the Indian Ocean - GODAR-III; Dona Paula, Goa, India, 6-9 December 1994.	E
108	UNESCO-IHP-IOC-IAEA Workshop on Sea-Level Rise and the Multidisciplinary Studies of Environmental Processes in the Caspian Sea Region; Paris, France, 9-12 May 1995.	E
108 Suppl.	UNESCO-IHP-IOC-IAEA Workshop on Sea-Level Rise and the Multidisciplinary Studies of Environmental Processes in the Caspian Sea Region; *Submitted Papers*; Paris, France, 9-12 May 1995.	E
109	First IOC-UNEP CEPPOL Symposium; San José, Costa Rica, 14-15 April 1993.	E
110	IOC-ICSU-CEC Regional Workshop for Member States of the Mediterranean - GODAR-IV (Global Oceanographic Data Archeology and Rescue Project) Foundation for International Studies, University of Malta, Valletta, Malta, 25-28 April 1995.	E

No.	Title	Languages
111	Chapman Conference on the Circulation of the Intra-Americas Sea; La Parguera, Puerto Rico, 22-26 January 1995.	E
112	IOC-IAEA-UNEP Group of Experts on Standards and Reference Materials (GESREM) Workshop; Miami, U.S.A., 7-8 December 1993.	E
113	IOC Regional Workshop on Marine Debris and Waste Management in the Gulf of Guinea; Lagos, Nigeria, 14-16 December 1994.	E
114	International Workshop on Integrated Coastal Zone Management (ICZM) Karachi, Pakistan; 10-14 October 1994.	E
115	IOC/GLOSS-IAPSO Workshop on Sea Level Variability and Southern Ocean Dynamics; Bordeaux, France, 31 January 1995.	E
116	IOC/WESTPAC International Scientific Symposium on Sustainability of Marine Environment: Review of the WESTPAC Programme, with Particular Reference to ICAM Bali, Indonesia, 22-26 November 1994.	E
117	Joint IOC-CIDA-Sida (SAREC) Workshop on the Benefits of Improved Relationships between International Development Agencies, the IOC and other Multilateral Intergovernmental Organizations in the Delivery of Ocean, Marine Affairs and Fisheries Programmes; Sidney B.C., Canada, 26-28 September 1995.	E
118	IOC-UNEP-NOAA-Sea Grant Fourth Caribbean Marine Debris Workshop; La Romana, Santo Domingo, 21-24 August 1995.	E
119	IOC Workshop on Ocean Colour Data Requirements and Utilization; Sydney B.C., Canada, 21-22 September 1995.	E
120	International Training Workshop on Integrated Coastal Management; Tampa, Florida, U.S.A., 15-17 July 1995.	E
121	Atelier régional sur la gestion intégrée des zones littorales (ICAM); Conakry, Guinée, 12-22 décembre 1995.	F
122	IOC-EU-BSH-NOAA-(WDC-A) International Workshop on Oceanographic Biological and Chemical Data Management Hamburg, Germany, 20-23 May 1996.	E
123	Second IOC Regional Science Planning Workshop on Harmful Algal Blooms in South America; Mar del Plata, Argentina, 30 October - 1 November 1995.	E, S
124	GLOBEC-IOC-SAHFOS-MBA Workshop on the Analysis of Time Series with Particular Reference to the Continuous Plankton Recorder Survey; Plymouth, U.K., 4-7 May 1993.	E
125	Atelier sous-régional de la COI sur les ressources marines vivantes du Golfe de Guinée ; Cotonou, Bénin, 1-4 juillet 1996.	F
126	IOC-UNEP-PERSGA-ACOPS-IUCN Workshop on Oceanographic Input to Integrated Coastal Zone Management in the Red Sea and Gulf of Aden Jeddah, Saudi Arabia, 8 October 1995.	E
127	IOC Regional Workshop for Member States of the Caribbean and South America GODAR-V (Global Oceanographic Data Archeology and Rescue Project); Cartagena de Indias, Colombia, 8-11 October 1996.	E only
128	Atelier IOC-Banque Mondiale-Sida/SAREC-ONE sur la Gestion Intégrée des Zones Côtières ; Nosy Bé, Madagascar, 14-18 octobre 1996.	E, F
129	Gas and Fluids in Marine Sediments, Amsterdam, the Netherlands; 27-29 January 1997.	E
130	Atelier régional de la COI sur l'océanographie côtière et la gestion de la zone côtière ; Moroni, RFI des Comores, 16-19 décembre 1996.	F
131	GOOS Coastal Module Planning Workshop; Miami, USA, 24-28 February 1997.	E
132	Third IOC-FANSA Workshop; Punta-Arenas, Chile, 28-30 July 1997	S/E
133	Joint IOC-CIESM Training Workshop on Sea-level Observations and Analysis for the Countries of the Mediterranean and Black Seas; Birkenhead, U.K., 16-27 June 1997.	E
134	IOC/WESTPAC-CCOP Workshop on Paleogeographic Mapping (Holocene Optimum); Shanghai, China, 27-29 May 1997.	E
135	Regional Workshop on Integrated Coastal Zone Management; Chabahar, Iran; February 1996.	E
136	IOC Regional Workshop for Member States of Western Africa (GODAR-VI); Accra, Ghana, 22-25 April 1997.	E
137	GOOS Planning Workshop for Living Marine Resources, Dartmouth, USA; 1-5 March 1996.	E
138	Gestión de Sistemas Oceanográficos del Pacífico Oriental; Concepción, Chile, 9-16 de abril de 1996.	S
139	Sistemas Oceanográficos del Atlántico Sudoccidental, Taller, TEMA; Furg, Rio Grande, Brasil, 3-11 de noviembre de 1997.	S
140	IOC Workshop on GOOS Capacity Building for the Mediterranean Region; Valletta, Malta, 26-29 November 1997.	E
141	IOC/WESTPAC Workshop on Co-operative Study in the Gulf of Thailand: A Science Plan; Bangkok, Thailand, 25-28 February 1997.	E
142	Pelagic Biogeography ICoPB II. Proceedings of the 2nd International Conference. Final Report of SCOR/IOC Working Group 93; Noordwijkerhout, The Netherlands, 9-14 July 1995.	E
143	Geosphere-biosphere coupling: Carbonate Mud Mounds and Cold Water Reefs; Gent, Belgium, 7–11 February 1998.	E
144	IOC-SOPAC Workshop Report on Pacific Regional Global Ocean Observing Systems; Suva, Fiji, 13-17 February 1998.	E
145	IOC-Black Sea Regional Committee Workshop: 'Black Sea Fluxes' Istanbul, Turkey, 10-12 June 1997	E
146	Living Marine Resources Panel Meeting, Paris, France, 23-25 March 1998	E
147	IOC-SOA International Training Workshop on the Intregration of Marine Sciences into the Process of Integrated Coastal Management, Dalian, China, 19-24 May 1997	E
148	IOC/WESTPAC International Scientific Symposium – Role of Ocean Sciences for Sustainable Development Okinawa, Japan, 2-7 February 1998	E