Intergovernmental Oceanographic Commission
Workshop Report No. 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

SC/91/WS/30

UNESCO

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SUMMARY REPORT

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1. OPENING

The representative of the Organizing Committee called the meeting to order on 9 October 1990 at 10.00 and welcomed the participants attending this meeting in Kuala Lumpur, Malaysia, 9-11 October 1990.

On behalf of IOC Sub-Commission for WESTPAC, Professor Su Jilan, Vice-Chairman of the Sub-Commission, addressed the meeting. He expressed his thanks to the local Organizing Committee and welcomed the participants. Prof. Su stressed the importance of the continental shelf on the national economy and the need to have physical oceanography plans to monitor the marine conditions for various purposes. Since the shelf areas are, in some regions, shared by several countries, this project initiated by IOC provides an opportunity for cooperative studies in the WESTPAC region. He indicated that this meeting will discuss and finalize the implementation plan for the project to meet the scientific goals identified by the previous workshop in Bangkok.

The Honorable Dato' Mohd. Noordin bin Hassan, Secretary-General, Ministry of Science, Technology and Environment, Malaysia, welcomed the participants from various countries on behalf of the Government of Malaysia. He emphasized the importance of the project and indicated that the countries participating in the project will benefit from the study, especially in the wise of utilization and management of marine resources. He also indicated that the Malaysian government has paid special attention to the shelf-sea studies and has actively participated in various IOC activities since July 1965. He wished all experts a good time in Kuala Lumpur. The Secretary-General then opened the Meeting.

On behalf of the Secretary IOC, Dr. Gunnar Kullenberg, Mr. Yihang Jiang expressed his gratitude to the Ministry of Science, Technology and the Environment, Malaysia, and the University of Technology Malaysia, for hosting this meeting. He also extended his sincere thanks to participants for their contributions to the draft implementation plan and for their attendance in the meeting. Mr. Jiang informed the meeting of the progress on the Programme of Coastal Ocean Circulation Dynamics and Fluxes (COCDYF), especially the recent-developed draft plan for the program me.

The programme of the Meeting is shown in Annex I.

Prof. Ir. Ishak Abdul Rahman, Dean of Faculty of Civil Engineering and all participants attended the opening. The list of participants is attached in Annex II. Prof. Su was invited to act as Chairman of the meeting and Mr. Jiang was designated as Rapporteur.

2. GENERAL DISCUSSION ON THE IMPLEMENTATION PLAN

Mr. Jiang briefed the meeting on the progress of the project and presented the draft project document based on the previous meetings, workshops and the contribution from the members of the Scientific Steering Group (SSG). He mentioned the IOC's responsibility in the implementation phase. The Meeting noticed that financial support for project activities, such as workshops, seminars, symposia and training may be obtained from IOC. However, funding for implementation of the project should come from countries interested in the project, as well as the United Nations funding agencies such as UNEP and UNDP etc. The Meeting agreed to the structure of the document. The Meeting invited the Secretary IOC explore with the other UN agencies on possible sources of funds for implementing the project.

3. DISCUSSION ON SUB-REGIONAL PROJECTS

3.1 GULF OF THAILAND

Dr. M. Bunpapong introduced the background and development of project. He briefly explained the approach of draft project document of shelf circulation in the Gulf of Thailand with the aim of understanding implication of water circulation to marine pollution and fishery.

Drs. Wolanski and Yanagi presented some numerical results of the circulation in the Gulf of Thailand, showing the importance of the winds, tides and offshore forcing from the South China Sea.

The general circulation in the Gulf of Thailand as inferred from hydrographic sections obtained from previous experiments between 1956-1958 was a clockwise gyre during the SW monsoon and a counter clockwise gyre in the NE monsoon period. A diagnostic model of circulation with constant depth but vertically stratified and both steady and uniform wind field (for each monsoon period was developed and employed for the Gulf of Thailand. The result indicated the inflow of South China Sea water in to the Gulf and flow northward along the east coast during winter. On the contrary South China Sea water flow toward the lower part of the west coast before turning north with the clockwise gyre.

The Gulf of Thailand has four major rivers that drain fresh water into the top boundary of the Gulf. The amount of discharge ranges from a few hundred cubic meter per second during dry period to an order of thousands of cubic water per second during wet period.

Tide in the Gulf of Thailand are mainly mixed tide with semi-diurnal species predominate. Some small area on the east coast near Kumpudea border the tide is of diurnal type.

The meeting agreed that the study should focus on mass transfer across the Gulf of Thailand including the coastal boundary layer. The river discharges should also be taken into account.

The present participating countries are: Thailand, Australia, Japan, and Malaysia.

The implementation plan for Gulf of Thailand is attached in Annex III.

3.2 NORTH WEST COAST OF BORNEO

Mr. Tuen Kwong Lum introduced the draft project plan based on the existing knowledge and financial condition. The areas to be studied include coastal area of north-west of Borneo and Balabac Straits. Based on previous studies, it is understood that :

This area experiences strong monsoonal forcing and the currents are thus expected to be mainly wind-driven. During the North-East Monsoon, there is the warm North Equatorial Current flowing along the coastal areas of Borneo. This feature is well marked by the strong SST gradient from Borneo to Vietnam as a result as the interaction of this warm current and the cold current from the northern South China Sea. During the SW Monsoon, the current in the region is north-easterly and it flows into the Sulu Sea.

The Meeting felt agreed that the project will focus on monsoon forcing on the coastal circulation pattern. The upwelling will be carefully studied if observations verify existence of such phenomena. The results of coastal ocean circulation will be applied to red tide and pollution disposal.

The implementation plan for north west coast of Borneo is attached in Annex III.

3.3 EAST CHINA SEA

Prof. Su Jilan introduced some results on the shelf circulation from previous studies.

The Kuroshio enters the East China Sea along the east coast of Taiwan. It flows north eastward alorg the shelf edge and then veers away eastward to the Pacific Ocean through the Tokara Strait. The Kuroshio induces a pressure field
on the shelf, resulting in a persistent northward Taiwan Warm Current

(TWC) on the shelf all year round. It is believed that most of the TWC water originates from intrusion of Kuroshio water northeast of Taiwan. Some of the TWC water is thought to have its origin from the South China Sea Warm Current.

The East China Sea receives a large amount of fresh water influx both from rivers along its western boundary and from the semi-enclosed Bohai and Yellow Seas to the north. The Changjiang River alone discharges about 925 cubic kilometer into the East China Sea annually.

In Winter, the strong northerly winds induce a northward current, the Yellow Sea Warm Current, flowing from the East China Sea to the Yellow Sea through the trough in the Yellow Sea Basin. The strong winds also drive the Changjiang River plume southward along the coast to the west of TWC. The water on the shelf is vertically homogeneous except in the area north of Taiwan where the surface water of the Kuroshio intrudes significantly on-shelf.

In Summer, the prevailing wind is from the southwest and it is mild. The combined effects of southerly winds, stronger TWC and larger river runoff result in the turning of the Changjiang River plume northeastward upon entering the East China Sea. Significant shelf intrusion of the Kuroshio northeast of Taiwan is limited to the lower layer water only. The Yellow Sea Warm Current is much reduced in strength. It extends only slightly north of Chejudo Island before it turns eastward.

Frontal eddy features are frequently present along the Kuroshio front. Southwest of the Kyushu large pools of separated Kuroshio water is often found. The East China Sea shelf water exits both through shelf-edge processes and through the Korea Strait as a year-round current, i.e. the Tsushima Current. In Winter, some of the shelf water may also enter the South China Sea through the Taiwan Strait.

Based on the existing knowledge, he identified the scientific problems to be addressed.

Dr. Yanagi suggested, after discussion with Profs. Su and Yu, that the project shall focus on the shelf edge area because of availability of resources. They also urged that the Changjing River plume should be studied if resources
can be obtained.

Prof. Yu introduced the draft implementation plan and invited the Secretary IOC to consider the possibilities of supporting a group meeting among participating countries.

The experts expresses that the study area should be extended to the inner shelf area, in order to obtain a complete knowledge on the circulation in the region.

The Meeting agreed that project should be developed in two phases.

The implementation plan for the East China Sea project is attached in Annex III.

3.4 SULU SEA

Dr. Ordonez presented existing knowledge and the draft implementation plan in Sulu Sea.

Although a number of studies have been made on the physical oceanography of Sulu Sea, there is still no definite understanding of the water circulation occurring in the area caused by various barotropic and baroclinic processes. The highly varied topographic features of the Sulu Sea basin especially on the shelf area where there are numerous reef areas and small islands make a clean understanding of water circulation more difficult.

General wind-induced water circulation in apparently known based inferentially on the effect of wind forcing caused by prevailing seasonal winds occurring during the North-East and the South-West Monsoon periods.
Later studies have shown evidence of the existence of internal swash produced by the large tide-generated internal solitary waves which in turn could excite coastal seiche.

The agreed that the study shall focus on (i) internal-wave generation and its role on upward transfer of nutrients, (ii) to exchange of coastal waters with other seas through straits and (iii) basin-wide wind- driven circulation.

Dr. Ordonez welcomed scientists from other countries participate in the Sulu Sea project.

The implementation plan for the Sulu Sea project is attached in Annex III.

3.5 MALACCA STRAITS

Mr. Tuen was introduced the existing scientific knowledge and draft plan for the Straits. The Malacca Straits is one of the channels in South East Asia through which the exchange of water masses from the Pacific and Indian Oceans occur. During the Northeast Monsoon, the water from the Pacific Ocean is pushed towards the southern end of the South China Sea, raising the water level in the southern end of the Malacca Straits and causing the water to flow into the Indian Ocean through the Straits. During the Southwest Monsoon, the reverse process occurs and there is a flow of water from the Indian Ocean towards the South China Sea through the Straits. The semi-diurnal tidal wave of the Indian Ocean affects the tidal characteristics of the water in the northern end of the Malacca Straits while the diurnal tidal wave from the Pacific Ocean propagates into the water in the southern end of the Straits. Hence there is an interaction of tidal wave of different characteristics in the Straits. In the central region of the Straits, the spring tidal range is about 5 meters while the spring tidal ranges at either end are about 2 meters. Hence there exists strong tidal currents in this region. Therefore tides are also important to main process of the Straits circulation.

Dr. Yanagi presented interesting tidal model results in the Malacca Straits showing that the tides play an important role in formatting of sand waves in the Straits.

The Meeting agreed that the physical process study in Malacca Straits shall focus on the interaction amount tidal current, wind-driven currents and currents induced by along-straits sea level slop.

The present participating countries are Malaysia, Indonesia, Japan and Australia.

3.6 PACIFIC/INDIAN OCEAN THROUGH FLOW

Dr. Birowo introduced the scientific knowledge of circulation in Indonesia Seas.

The general feature of circulation in the Indonesia's seas shows a clearly reversing seasonal flows of surface current pattern and deeper water mass distribution apparently originating from different areas of the south western Pacific Ocean. The Indonesian Seas represent the only tropical interocean link between the western Pacific with the eastern Indian Ocean. A number of investigators have estimated the magnitude of the Pacific to Indian Ocean transport based on different methods. They all agree about the direction of through flow from the Pacific to Indian Ocean, but there is a wide range of estimates of its magnitude. It is therefore long term measurement of current in selected straits connecting the Pacific and Indian Oceans are essential for providing better insight the total of transport from one ocean to the other.

He informed the Meeting about the on-going programme/project such as ASEAN-Australia Regional Ocean Dynamics, Java-Australia Dynamic Experiment (JADE), etc.

The experts indicated that Pacific/Indian Ocean Through Flow is a very important aspect of the world-wide ocean circulation. However they also felt that more emphasis should be placed on the theme of coastal circulation problem.

The implementation plan for Pacific/Indian Ocean Through Flow is attached in Annex III.

In general the Meeting noticed that financial constraints are problems for the implementation of the all projects. It also recognized that environment related project are more likely to be funded.

4. COMPLETION OF THE IMPLEMENTATION PLAN AND IDENTIFICATION OF TEMA NEEDS WITH ASSOCIATED POSSIBLE RESOURCES

Based on the discussion, the Meeting prepared a revised version of the Implementation Plan for the project with relatively minor changes in the working document presented by the Secretariat in the sections of Objectives and Expected Outputs. The meeting agreed that the final editing will be done in the IOC Secretariat. It is suggested that the Plan should be circulated to the Member States through IOC after it finally print out.

The Meeting carefully studied the needs of training activities within the implementation of the project and identified specific requirements. The Meeting composed these activities into two training courses :

(i) Training Course on Field Observation and Data Analysis

(ii) Training Course on Numerical Modelling

The Meeting endeavoured to identify the possible resources for the training courses. For the first training course, China, Australia, Malaysia, Japan and Thailand may find possible facilities and ship-time for hosting the training course. For the second training course, the Meeting noticed that Chinese Delegation announced the willingness to host the training in the First Institute of Oceanography. Some other countries informed the meeting that the computer available in their countries. It was concluded that China, Australia, Japan, Malaysia will be the possible place for this training activities.

5. CLOSURE

Prof. Madya Dr. Mohd Noor Salleh, Deputy Vice Chancellor addressed the meeting. He congratulated the meeting for its success and thanked all participants for their excellent work during the meeting. He informed the meeting the establishment of the Institute of Coastal and Offshore Engineering and hope that more co-operation with participating institutions and with the Ministry of Science, Technology & Environment, Malaysia will be strengthened.

Prof. Su thanked all participants for their contribution to the implementation plan and the University of Technology Malaysia for their assistance during the meeting.

Mr. Jiang expressed, on behalf of the Secretary IOC, sincere gratitude to all participants for their attendance and their hard work and to the University of Technology Malaysia and the Ministry of Science, Technology & Environment, Malaysia for the excellent arrangement for the meeting.

Prof. Madya Dr. Mohd Noor Salleh closed the meeting at 1700 furs, 11 October 1990.

ANNEX I

PROGRAMME

DAY 1: 9 OCTOBER 1990

8.15 am Arrival and registration of delegates

8.45 am Arrival of Guests of Honour
- Y.Bhg. Dato' Nordin bin Hassan,
Secretary-General, Ministry of Science, Technology and Environment, Malaysia
- Prof. Madya Ishak Abdul Rahman Dean,
Faculty of Civil Engineering, representing the Vice Chancellor, Universiti Teknologi Malaysia

9.00 am Welcoming Address by the SSG COSWES Chairman.
9.15 am Opening Speech by the Secretary-General, Ministry of Science, Technology and Environment, Malaysia, Y. Bhg. Dato' Noordin bin Hassan ;
Speach by Mr. Yihang Jiang, Representative of IOC.

9.45 am Tea/Coffee Break

10.30 am **SESSION 1 : BRIEF INTRODUCTION ON THE DEVELOPMENT OF THE PROJECT**

11:30 am General Discussion on the Implementation Plan

12.30 am Lunch Break

SESSION 2 : DISCUSSION ON THE SUB-REGIONAL IMPLEMENTATION PLAN (I)

2.00 pm Gulf of Thailand

presented by: Dr. Eric Wolanski
Dr. Teteno Yanagi
Dr. M. Bonpapong

3.00 pm Northwest Coast of Borneo

presented by: Mr. Tuen Kwong Lum
Dr. José Ordon~ez

4:00 pm Tea/Coffee Break

DAY 2 : 10 OCTOBER 1990

SESSION 3 : DISCUSSION ON THE SUB-REGIONAL IMPLEMENTATION PLAN (II)

9.00 am East China Sea

presented by: Prof. Zhouwen Yu
Prof. Su Jilan
Dr. Tetsuo Yanagi

10.30 am Tea/Coffee Break

11.00 am Sulu Sea presented by: Dr. José Ordon~ez

12.30 pm Lunch Break

SESSION 4: DISCUSSION ON THE SUB-REGIONAL IMPLEMENTATION PLAN (III)

1:30 pm Malacca Straits and the Andaman Sea

presented by : Mr. Tuen Kwong Lum

3:30 pm Tea/Coffee Break

4:00 pm Pacific/Indian Ocean Through Flow

presented by : Mr. Sujatno Birowo

DAY 3 : 11 OCTOBER 1990

9:00 am **SESSION 5: To complete the Implementation Plan and the Report.**

10.30 am Tea/Coffee Break

11:00 am **SESSION 5:** (continue)

12:30 pm Lunch Break

2:00 pm **SESSION 6: Discussion on the Relationship of the Project with the Global Programme**.

3:30 pm Closing Ceremony

4:00 pm Farewell Tea

ANNEX II

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ANNEX III

IMPLEMENTATION PLAN FOR THE PROJECT ON CO-OPERATIVE STUDY OF THE CONTINENTAL SHELF CIRCULATION IN WESTERN PACIFIC

1. PROJECT IDENTIFICATION

1.1 TITLE OF PROJECT

Co-operative Study of the Continental Shelf Circulation in the Western Pacific (CoSCWEP)

1.2 PROJECT NUMBER

1.3 GEOGRAPHIC SCOPE

The project covers, in principle, all of the continental shelf area in western pacific. The areas to be considered for the initial sub-projects include:

- Gulf of Thailand
- North west coast of Borneo and the island of Pahlawan
- Malacca Strait and the Andaman Sea
- Pacific/Indian Ocean through flow region
- East China Sea
- Sulu Sea

1.4 IMPLEMENTATION

Intergovernmental Oceanographic Commission, through its Sub-Commission for Western Pacific, in co-operation with national institutions.

1.5 PROJECT DURATION

36 months - commencing
- completing

2. BACKGROUND

The Project on the Co-operative Study of the Continental Shelf Circulation in Western Pacific was adopted by the IOC Regional Committee for Western Pacific at its Fourth Session (Bangkok, 1987). The Scientific Plan for the project have discussed and finalized in an IOC Workshop on the project (Bangkok, Thailand, 31 October-3 November 1989), and published in the IOC Workshop Report No. 63.

This document intend to provide guidance for implementation of the project in the WESTPAC region with a view of enhancing the co-ordination of the relevant national and regional Programmes and projects.

World wide the sea is used as a valuable source of protein, oil and gas and as a sink for wastes. This in particular applies to shelf and coastal seas. In view of the demands of a rapidly growing world population, these areas deserve special attention and a better understanding of the marine environment is required. The circulation provides the transport means for living and non-living material within the sea and therefore plays a key role.

On the other hand, the dynamical phenomena in these shallow sea areas are specially complicated compared with that in the deep ocean owing to the existence of lateral boundary, shallow depth, and river discharge. A co-operative study of the circulation on these areas will lead to a better

understanding of the dynamical phenomena, and advancement of physical oceanography.

With potential increase of contamination in the coastal waters of many parts of the region, great attention is being paid to the concentration of pollutants in different marine matrices and to the movement of contaminants. Pollutants discharged in the sea water undergone physical, chemical and biological alterations. The physical factors have a very significant initial effect upon pollutants discharged into the marine environment through the spreading and movement with wind and current.

Red tide and other abnormal plankton blooms phenomena might be linked with the continental shelf sea fronts. Research of the formation and decay of these fronts may yield useful information on the occurrence and formation of red tide phenomena.

The high population density in the WESTPAC region demands the placement of a special weight on a joint co-cooperative study devoted to the understanding of the circulation in Western Pacific shelf and coastal seas, with emphasis on Southeast Asian seas. In particular the main driving forces of the circulation and its variability and energetics shall be studied on different levels of complexity.

In view of obvious importance, the project was further discussed by the IOC Sub-Commission for Western Pacific at its First Session and the Scientific Seminar. The Scientific Plan, which was prepared by a Workshop on the project, Bangkok, Thailand, 31 October-3 November 1989, was adopted by the Sub-Commission and being included in the Medium-Term Plan for the period of 1990-1995.

The research activities have been carried out, on the national bases or bilateral co-operation, in the region, and some results have been introduced in the Workshop on the project.

3. OBJECTIVES

The objectives of this project is to build up adequate scientific knowledge about the physical oceanography of selected shallow seas of the WESTPAC region, so as to eventually develop predictive models of the circulation
pattern and water level variation.

3.1 LONG-TERM OBJECTIVES

(i) to assess the major features of the circulation, its associated energetics and variability, and to provide better understanding of their influence on productivity of living resources and their distribution, as well as on the fate of pollutants in coastal and offshore area.

(ii) to understand the role of various driving mechanisms and their application, by using the circulation models, to biological and chemical processes and climatic changes.

(iii) to provide to national authorities, on the bases of the knowledge indicated in (i), the adequate scientific recommendations on the management of the coastal and shelf areas;

3.2 SHORT-TERM OBJECTIVES

(i) to understand the main characteristics of river discharges, density flows, tidal currents and other factors which contribute to the continental shelf circulation;

(ii) to identify and understand the fundamental mechanisms of the circulation and their variabilities;

(iii) to develop the numerical models for shelf sea areas;

(iv) to identify implications of the circulation for the distribution of biological, chemical and sedimentological properties to provide better understanding of processes important for the transport of pollutants; and

(v) to establish a network of observation systems for physical oceanographic parameters in coastal and continental shelf seas.

4. PROJECT ACTIVITIES

During the IOC Workshop on the project, it was decided that the project should be implemented in sub-regional bases since large coverage of WESTPAC region and the existence of complex shelf area. The sub-regions where the project will be initiated were identified.

The action-oriented implementation plan for these designated and appended as Annex III. They are dealt with:

CoSCWEP-1: Gulf of Thailand
CoSCWEP-2: North west coast of Borneo
CoSCWEP-3: Malacca Strait and the Andaman Sea
CoSCWEP-4: Pacific/Indian Ocean through flow region
CoSCWEP-5: East China Sea
CoSCWEP-6: Sulu Sea

The activities might be carried out in the different ways as the different sub-regions concerned and which will be specified in the relevant sub-regional implementation plan. However, the standard methods are required to be identified in order to ensure the results will be comparable.

5. EXPECTED OUTPUTS

(i) Description of major circulation features and its implication on the biological, chemical and sedimentological properties as well as environment changes in the study areas;

(ii) Intercomparable database on the parameters measured in the observations and analyzed in the standard format;

(iii) Developed and verified numerical models of the shelf circulation; clarify the role of various driving mechanisms and the applications to environment problems, including management of fishery and west disposals, and the implication on climate changes;

(iv) Increased capabilities of environmental scientists and marine research laboratories in the region, achieved through individual training and implementation of workshops; and

(v) Strengthened network for the regional co-operation in respect of coastal zone studies and managements.

6. GENERAL STRATEGY

The general strategy will be:

(i) to analyze the actual available data to:

a) incorporate them in numerical or/and analytical models in order to understand for instance, how and where, under specific meteorological forcing, the coastal-ocean can store potential energy which can be converted later on into

kinetic energy during the formation process;

b) make a survey experiment which would allow us both to check for the quality of the models and to identify more clearly the fundamental parts of the problem mainly: the preconditioning phase (coastal ocean general circulation, meteorological forcing and circulation, meteorological forcing and water masses characteristics defined synoptic time scale means an order of magnitude lower than seasonal time scale so around 15 days) on a large scale (seasonal and basin wide) with a resolution down to the internal radius of deformation.

(ii) make an intensive experiment specifically studying the formation processes; to check the nature of the process, the different scales involved, the relative role of one dimensional mixed layer process and a quasi two dimensional thermo-dynamic model from which we can objectively analyze our data; and

(iii) apply existing models and develop new models in the individual area based on the absorbing new date in a consistent fashion.

7. INSTITUTIONAL FRAMEWORK AND EVALUATION

The overall technical responsibility will lie with the IOC Secretariat and the Regional Secretariat for WESTPAC, when it is finally established, who will execute the project through the appropriate ways. The scientific supervision will be ensured by the Scientific Steering Group (SSG).

The evaluation of on-going project and review new project will be done at annual meetings of the SSG, with further evaluation by the participating countries and the IOC Secretariat.

CoSCWEP-1 GULF OF THAILAND

1. INTRODUCTION

At the IOC/WESTPAC Workshop on Co-operative Study of the Continental Shelf Circulation, held in Bangkok 31 October- 3 November 1989, a Scientific Steering Group (SSG) was established to put forward a plan for an oceanographic study in the Western Pacific region. The Gulf of Thailand was given priority. In particular, emphasis was put on the coastal circulation in the Gulf in view of socio-economic reasons. At a meeting of the SSG at Kuala-Lumpur 9-ll October 1990, a proposal was put together by scientists from Australia, Thailand, Malaysia and Japan for such study. UNDP was seen as a possible funding agencym with IOC acting as a catalyst. This report is a summary of the proposal.

2. AIMS OF THE STUDY

The study team aims to:

(i) collect oceanographic data in order to calibrate and verify numerical models of the circulation in the Gulf of Thailand. The location of the measurement sites has been chosen to focus on the 'coastal boundary layer'. The existence of a coastal boundary layer trapping water and matter inshore in the Gulf of Thailand has not been demonstrated in detail, since no detailed oceanographic data exist, but is derived from:
   a) numerical models of the joint wind and tide-driven circulation in the Gulf of Thailand;
   b) a comparison with the findings in the topographically and hydrodynamically similar Gulf of Carpentaria.

(ii) obtain satellite pictures of the Gulf of Thailand to map the location of fronts, various water masses etc.;

(iii) run a large-scale numerical model of the water circulation in the ASEAN region in order to obtain data of tide, current and low-frequency sea level at the mouth of the Gulf of Thailand, as the boundary conditions;

(iv) run a small-scale mathematical model of the water circulation in the Gulf of Thailand, using the results from the large-scale model as a forcing function for the open boundary conditions, and using measured local wind stresses: calibrate and verify the model using the oceanographic observations;

(v) study the resulting non-explained variance in the oceanographic observations (e.g any frontal features not explained by the models) in order to plan more detailed studies in the future;

(vi) link these oceanographic studies with chemical and biological studies (e.g. coastal trapping of nutrients, river plumes and pollutants; zones of high and low coastal retention times and oil pollution etc.), to serve environment study and management.

3. PRINCIPAL INVESTIGATORS (PARTICIPANTS)

Following principal investigators involving in the study are listed by alphabetic order:

Dr. Mahanop Bunpapong, Chulalongkorn University, Thailand:
General co-ordination (Thailand);
Field work in Thailand;

Processing oceanographic data;
Modelling coastal circulation;

Dr. Abdul Aziz Ibrahim, Univ. Technology Malaysia:
General coordination (Malaysia)
Field work in Malaysia;
Processing oceanographic data;
Modelling coastal circulation;
Satellite imagery.

Mr. Tuen Kwong Lum, Malaysian Meteorological Services:
Provide Gulf wind data both from meteorological models and from anemometers on oil platforms in the Gulf of Thailand.

Dr. Gullaya Wattayakorn (Chulalongkorn Univ.-Thailand):
Satelitte imagery
Chemical oceanography
Oil pollution
Field work.

Dr. Eric Wolanski (AIMS-Australia):
General co-ordination (Japan, Malaysia, Thailand, Australia);
Field work (Malaysia and Thailand);
Processing oceanographic data;
Modelling coastal circulation.

Dr. Tetsuo Yanagi (Ehime University, Japan):
large-scale circulation and providing boundary condition for small scale model of the Guld of Thailand.

4. FIELD WORK

Two intensive field studies are planned, each one month long in order to obtain a time series long enough to resolve dominant local constituents, and some low frequencies. These field study will be centered in two distinct seasons, one during the monsoon season and one during the dry season. The seasons are as follow in the Gulf of Thailand:

N.E. monsoon: Nov-Jan
March-April: transition period (also dry season)
S.W. monsoon season: June-August (also wet season)
Sept-Oct: transition period

It is proposed to select mid-March to mid-April 1992 (best likelihood of light winds and very small runoff), and August 1992 (best likel hood of monsoonal winds and large river runoff). These will provide a contrast between widely different atmospheric forcings.

During these intensive field studies period, vector-averaging current meters will be deployed on two cross-shore transects on the west coast of the Gulf of Thailand. The first transect will be in Thailand off Cumpron (11!N). The second transect will be in Malaysia off Kuala Trengganu (5!N). The Thai transect will have four moorings at the 10,20, 30 and 40 meter depthes, At the Thai transect (see Fig. 1) the two inshore sites will have only one current meter per mooring as the waters are very shallow indeed and expected to be vertically well-mixed. The two offshore sites will each have two current meters, one in the bottom l/3 and one in the top 1/3 of the water column as stratification effects may be significant there. Note that none of the moorings are located in the middle of the Gulf or in very deep waters because the emphasis of this study is coastal water circulation because this aspect of the circulation is more important for socio-economic reasons. The meters will all be vector-averaging types. These meters will be provided by Chulalongkorn University (2), AIMS (3) and one to be purchased by this project.

The Malaysian transect (see Fig. 1) will have three moorings. These will be on the 10 and 30 meters depth contours, using SD2000 current meters available at UTM, and one mooring at the offshore oil platforms at 60 meter depth. Two meters will be deployed at the 60m depth mooring under a subsurface buoy and acoustic releaser, and one meters each at the 10 and 30m depth moorings suspended from a ship.

Because of extensive fishing in the Gulf, it is not possible, except for the mooring near the oil platform, to leave the meters unattended. As a result, the final determination of the study site will depend on

(i) determination on site (e.g. to find out if drifting nets are used)
(ii) providing ships (e.g. fishing boats) to be chartered at typically $300 per day to guard the moorings 24 hours a day.

The meters will then be deployed either simply suspended from these ships or on the bottom using acoustic releasers and subsurface buoys. In inshore waters, suspension from a ship is the only option because of heavy fishing pressure. In deeper waters, subsurface moorings (but still with a moored boat close by to guard it from fishermen except for the oil well mooring) may be necessary as it may not be possible to anchor a boat there for a month. AIMS may be in a position to loan these instruments and deck unit if need be.

Another two vessels will need to be chartered at weekly interval for 2 days each week to service these ships, one vessel each in the Thai and Malaysian transects. Thess vessels will also be used to obtain cross-shore distribution of temperature and salinity, using CTD'S. A CTD-cum nephelometer will be loaned by AIMS for the Thai transect, and UTM has a suitable STD for shallow water profiles in Malaysian waters.

This vessel will also be used to obtain water samples data and these samples will be analyzed at Chulalongkorn University for this chemical biological oceanography study, disposables, chemicals and an autoanalyser will be purchased by the project.

A weather station will be installed out of existing stocks, one off Sonokhla in Thailand and one off Kuala Trengganu in Malaysia on oil drilling platform in the Gulf. One weather station will be purchased by the project. Offshore wind data are also available at Sichang Island off Pattaya in Thailand but this island is very close to the coast. Twice daily numerically predicted wind field over the Gulf will be proviede by Malaysian Meteorological Office.

The Thai Hydrographic Office for Thailand and port authorities in other countries along the Gulf of Thailand will be requested to provide access to the raw sea level data collected during the study period, or photocopies thereof. It is important to obtain the raw data in order to process the data scientifically ourselves to incorporate any effect that Hydrographic offices may discard (e.g. seiching etc). Costs for an investigator to visit these stations and obtain the data need to be budgeted in the project.

All data will be shared by the principal investigators and remain in their possession until after publication of the results. The data will then be made freely available in the form of a technical report and floppy discs for interested scientists.

About four AVHRR satellite data tapes will be purchased by project money, but processed at no charge at Chulalongkorn University and University of Technology Malaysia.

None of the institutions of the principal investigators is able to support the logistics and field trips and these costs will be charged to the project. All instruments need to be insured by the project.

5. MODELLING THE LARGE SCALE CIRCULATION

This model of the water circulation will encompass the whole area of the Gulf of Thailand as well as offshore waters and has a relatively coarse grid (e.g. mesh size of 20 x 20 km) but is necessary to provide tidal and low-frequency sea level and current forcing (wind and buoyancy) at the mouth of the Gulf of Thailand. This model is three-dimensional model with a semiimplicit scheme. It can provide information on the tidal current, tide-induced residual current, wind-driven current and density-driven current in the whole area of the Gulf of Thailand. This model is operating at Ehime University, Japan.

The results of this model will also be used to provide the basis for open boundary forcing of the small scale circulation model (typical mesh size < 2km) that will encompass the whole of the Gulf of Thailand but focussing on the coastal region. This model is operating at AIMS, Australia.

6. DATA ANALYSIS

The data will be analyzed at AIMS and Chulalongkorn University using classical oceanographic techniques. All the AIMS programs will be shared with Chulalongkorn University. Techniques used are many and include

(i) detrending
(ii) de-spiking
(iii) low-pass, window-pass, and high-pass filters
(iv) spectra
(v) co-spectra
(vi) coherence and phase relationships
(vii) tidal harmonic analysis etc.

Airfares and travel allowances for Wolanski to travel to Bangkok and for Mahonop and Wattayakorn to travel to AIMS are to be supported by the project. AIMS will provide freely access to computer, office space, Wolanski's time, telephone and fax etc. as well as the equipment listed above.

The processing of the four AVHRR satellite views will provide information on the location of water masses, frontal features and biological features of the Gulf of Thailand.

7. MODELLING THE COASTAL CIRCULATION

In the initial phase of the study, the AIMS alternate-direction implicit finite-difference small-scale numerical model of water circulation will be used to simulate the two-dimensional (depth-averaged) water circulation in the Gulf, with small resolution in the coastal waters. This model will be shared with Chulalongkorn University. The model will be calibrated and verified against available field observations.

It is anticipated that Dr. Wolanski and Mr. B. King of AIMS will work at Chulalongkorn University for a month on final implementation of the coastal circulation model, while Drs. Yanagi, Mahonop and Wattayakorn will work for a month at AIMS in preparation of the final report. Air fare and travel allowances will come from this project budget.

8. JOINT REPORT

The final report will detail all phases of field work, present and discuss the data, detail the numerical models used, detail the model results and the calibration and predictions of the model. This publication will take the form of a number of collated manuscripts. These manuscripts will be in

a stage ready for publication in international refereed scientific journals.

9. BUDGET

The detailed budget needs finalizing but estimated to be of the order US$ 300,000. It is to be noted that the study is relatively cheap by international standards because it involves the cooperation of active scientists whose salary is not costed to the project. Most instruments will be loaned at no cost for the study, all data will be processed at no cost and, all computer modelling will be carried also at no cast. Only a few instruments need to be purcased by AIMS from budget money. These include one self-recording weather station, one VACM current meter, one SD 2000 current meter and one auto-analyser with its disposables. All consumables (batteries, tapes, etc.) for all oceanographic instruments will be charged to the project. The costs to the project are then mostly in the actively producing area of the hiring of 8 local fishing vessels for 2 periods of one month, insurance of all loaned equipment, air fare and travel allowances for the Chulalongkorn-AIMS-Ehime-UTA scientists and support staff actively working on the project, and for hiring one research assistant at AIMS fully involved in the project.

Administration costs are to be costed as 20% of the budget relevant to both Chulalongkorn University and AIMS, and are then small by comparison with typical consulting firms overhead (100%).

Money will need to be sent to AIMS to support its costs (e.g. airfares, travel allowances, purchase of one VACM current meter and one weather station, all disposables for oceanographic equipment, freight and insurance of equipment etc.) and to Chulalongkorn University to support its costs (e.g. airfares, insurance of equipment, chartering ships, disposables and chemicals, autoanalyzer, purchase of a SD 2000 current meter, AVHRR tapes, etc.).

Hence the study is extremely cost-efficient as nearly all money is directly scientifically productive. This is the great advantage of this proposal.

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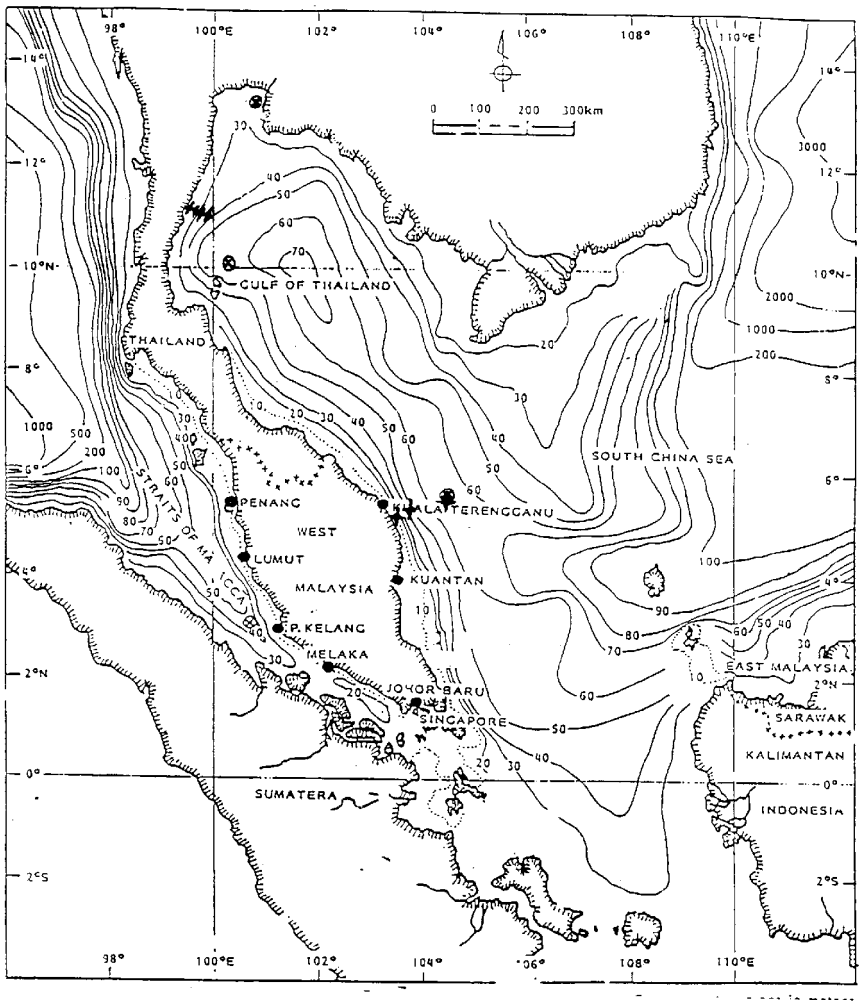

Fig. 1
Observations in the Gulf of Thailand

⊗ Wind Stations

✦ Current Meters Mooring

● Tide Stations

CoSCWEP-2: NORTHWEST OF BORNEO

1. BACKGROUND

The continental shelf in the north-west of Borneo (Fig. 2) has been identified by the Government of Malaysia as a rich fishing ground for tuna. Efforts have been made by the authority concerned to develop this area for commercial fishing venture.

The shallow areas of the study area near to the shore of Sabah has been identified with outbreaks of red tides and shellfish toxicity. These outbreaks tend to occur during a dry period following a wet spell and the period of occurrences are June/July and December/January.

Warm equatorial water flows through the various channels in Philippines into this area from the Pacific Ocean. In the early northern hemisphere winter, this warm water maintains a distinct sharp SST temperature gradient across the southern South China Sea and this affects the development of weather over Borneo island.

There is a need to understand the water circulation on this part of the continental shelf to provide proper guidance for the formulation of policy with regards to the management and development of the marine resources, formulation of numerical models to predict oil spill as well as to improve the long-term weather forecast over the East Malaysia.

2. OBJECTIVES

(i) To understand the characteristics of the water circulation of the area with special interests on a introduced upwelling phenomena, if observation verify the existence of such phenomena;

(ii) To identify the temporal and spatial distribution of SST in South China Sea and its inferences on the weather and climate in the coastal countries;

(iii) To utilize the understanding of the circulation for possible improvement in the prediction of movement of oil spill as this area is an intensely exploited zone for petroleum and gas;

(iv) To study the relation of the water circulation as well as the airsea interaction with the red tides outbreaks which afflicts the coastlines at an increasing rate and at a great cost to human lives and national economies; and

(v) To provide basic scientific information for the management on the continental shelf and coastal zone.

3. PRESENT STATUS OF AVAILABLE DATA

There have been few oceanographic surveys of the general features in the study area. Among which are the two cruises organized jointly by the Agriculture University of Malaysia and the Kagoshima University in 1987 and 1989, the duration of each cruise was about 10-15 days. Data such as temperature and salinity profiles with depth, and other oceanographic parameters were acquired at various sampling stations during the cruise.

Fig. 2 also indicates the locations of the oil platforms and meteorological stations in the area. The Sarawak Shell Limited (SSB) has been recording the tide data at few of its platforms for the past few years. Limited current data at these platforms are also existed. Tidal data also available at the Terumbu Layang Layang (Swallow Reef, 7.4!N, 113.9!E) and the island of Labuan just off the coast of Borneo. These two tidal stations are

under the maintenance of the Royal Malaysian Navy and are part of the network of the tide gauges under the ASEAN-Australia Cooperative Programme on tidal phenomena.

The SSB has also been recording the various meteorological data at these platforms and such data are available in the Malaysian Meteorological Service (MMS).

A meteorological station is established by the MMS in the deep water of the shelf at the Terumby Layang-Layang. Along the coastal area, there are a number of meteorological stations maintained by the SSB and MMS.

4. FIELD OBSERVATION PROGRAMME

(i) The main thrust of the field observation on the acquisition of the current flow in the study area. The possible mooring locations of the current meters are at the few platforms straddled in the deep water as well as along the coast of the Borneo. Current meters can also be deployed at the Terumbu Layang-Layang and the Labuan Island. In this configuration of deployment of current meters, current flow at the three corners of the areas (with the exception of the north-east corner) will be acquired. Ideally the observation can be continued at these locations for one year.

(ii) Co-operation will have to be seeded from the SSB on the deployment of current meters at their platforms. In view of the politically sensitivity of the area and intense fishing activity, it will not be advisable to deploy current meters at places which are unguarded.

5. PARTICIPATING AGENCIES

	Names	Agencies
(1)	Mr. Tuen Kwong Lum	Malaysian Meteorological Service
(2)	Dr. Abdul Aziz Ibrahim	University of Technology Malaysia
(3)	Dr. Nasir Saadon	University Pertanian Malaysia
(4)	Mr. Ridzuan Yusof	Department of Environment
(5)	Lt. Mashrap Mokhtar	Royal Malaysian Navy
(6)	Mr. Yusuf Badwi	Sarawak Shell Limited (Mal)
(7)	Mr Zulkunain Ayub	Marine Department
(8)	Mr. Azmi Rahman	Department of Mapping & Survey

6. ANALYSIS AND QUALITY ASSURANCE

The analysis and quality control of the tide data will be done in house by the SSB as well as the Royal Malaysian Navy. The current data collected will be handled by the University of Technology Malaysia and Malaysian Meteorological Service.

7. INTERACTION OF THE SUB-REGION PROJECT WITH EXISTING NATIONAL PROJECT AND INTERNATIONAL PROJECTS

The Malaysian Meteorological Service has already started a real time monitoring on the variation of SST in the South China Sea. This is an effort in understanding of the sea surface condition on the weather in Malaysian. As mentioned earlier, this area of interest is a data-sparse area and also located away from the main shipping line. Hence not much is known of the SST variation in this area. This project will help to improve the understanding of variation of the SST with the knowlodge of shelf circulation. The local scientists has already started a modest project on the

monitoring and study of the outbreaks of red tides in the coastal water off the west coast of Sabah. They have identified the outbreaks to be happened in the dry periods. This project will be able to provide more oceanographic information on the coastal water circulation for such study.

The local authority is well aware of the potential of oil spill from any of the production platforms as well as present exploration drilling activities. There is always an interest in the understanding of the circulation pattern to assist in the development of realistic oil spill control models.

8. COST

It is apparent that the cost of the project is minima as it involves with the deployment of currents at existing structures. There is trained personnel in Malaysia in this deployment. However, there may be a need for the purchase of current meters. Vessels will be hired at about US$100/- per day for the deployment and retrieval of the current meters. It is estimated the cost of the project is a modest sum of about US, 40,000/-.

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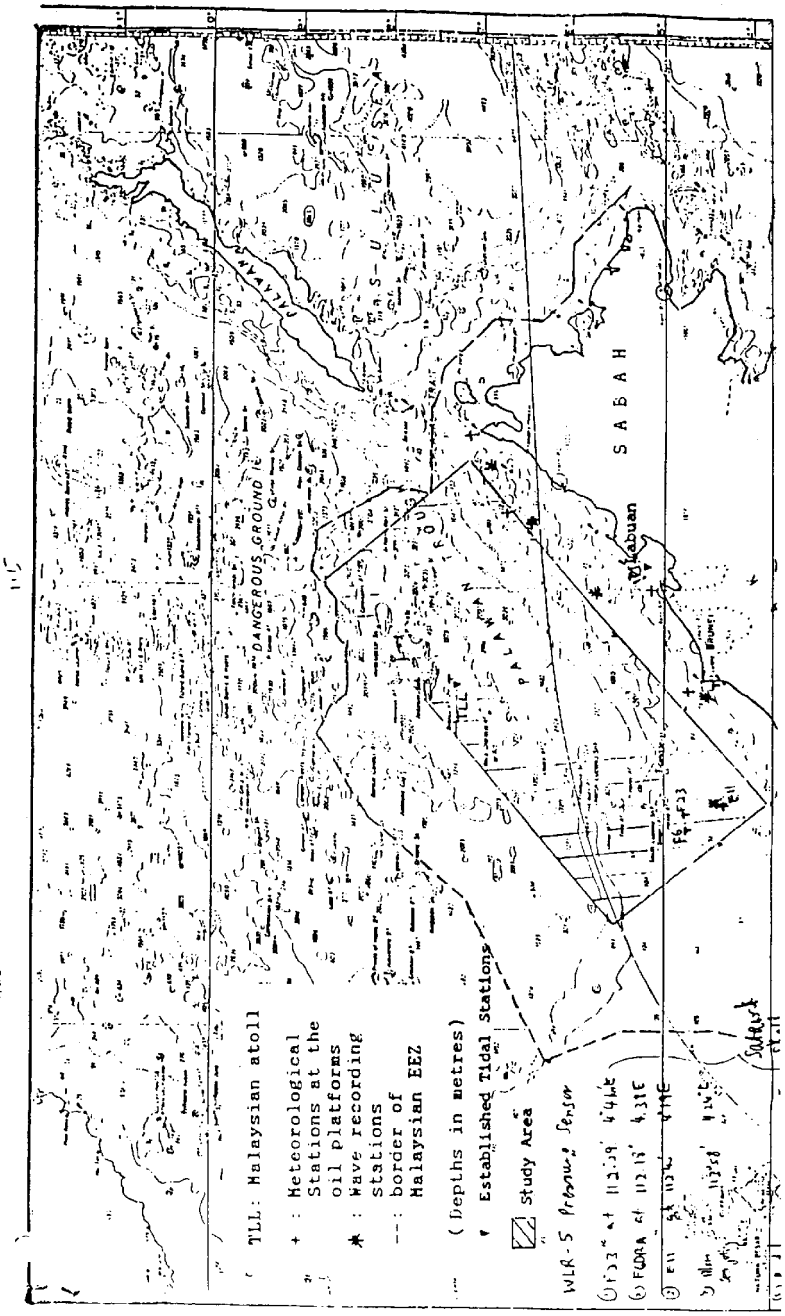

Fig. 2
Observations in Palawan Trough

CoSCWEP-3: MALACCA STRAITS

1. BACKGROUND

The Straits of Malacca is a narrow strait through which plied about 200 merchant vessels and oil tankers every month. This heavy shipping activity has resulted in accidental discharge and deliberate discharge of oil from the vessels. Among the prominent and tragic oil spill accidents were those involving with the vessels Showa Maru and Diego Silang in the midseventies .

The west coast of Peninsular Malaysia bordering the Straits is endowed with rich and diverse ecosystems. Mangroves being the dominant coastal forest, serve as an important breeding and nursery grounds of various species of fish. 70% of the total fish landings in Peninsular Malaysia are from these places. Contamination of these ecosystems by oil spill will lead to disastrous economic hardship for many people.

The west coast of Peninsular Malaysia is also the center of major industrial, economic and social developments. The intense development activities threaten the Straits with land-based discharges such as the effluent discharges from industries and silts from land clearings. The pollutants being transported to the Straits will need to be flushed away from the ecosystems while the silts deposition has to be properly controlled to eliminate hindrance to coastal traffic.

2. OBJECTIVES

To study the water circulation in the Straits of Malacca.

3. PRESENT STATUS OF AVAILABLE KNOWLEDGE

The tides in the Straits of Malacca are semi-diurnal. The Malaysian Department of Survey and Mapping has established 6 tidal stations along the west coast of Peninsular Malaysia (see Fig. 3) and it has already acquired a few years of good quality tidal data. Long record of current flow is not available but the Joint Malaysian-Indonesia-Singapore survey did acquire some current data but only for a very short period. Detailed bathymetry of the Straits is also available (Fig. 1)

4. FIELD OBSERVATION PROGRAMME

(i) The currents in the Strait composed of the tidal currents, winddriven current as well as the monsoonal current associated with the NE and SW monsoons. Since the Straits is a busy shipping lane, there are only limited places where mooring of the current meters can be carried out. At present only the lighthouse at One Fathom Bank in the middle of the Straits (Fig. 4) can be identified as the possible permanent place for the mooring of current meters. The Malaysian Meteorological Service has already recruited the assistance of the staff of the lighthouse to measure and observe few meteorological and oceanographic parameters such as SST and wave height.

(ii) Other possible sites for the mooring of current meters are away from the main channel towards either coast of Indonesia and Malaysia. In view of the lack of suitably established infrastructure to place the meters and their potential losses due to high fishing activities in the near-coast area, the moorings can only be done with vessels. Measurement of the current will be restricted for short period for each of the two monsoons. Safety consideration will rule out the deployment of floating

buoys due to heavy ship traffic. It is hence proposed to have two vessels anchored in the near shore area, one near to the northern island of Penang while another in the southern part of the Straits near to Singapore. Two vessels will have to be rented for such purposes while two other smaller vessels will be needed to send relief personnel and supplies to the moored vessels.

5. CORE PERSONNEL

The following scientists/personnel will be participating in the project.

Names	Agencies
1. Mr. Tuen Kwong Lum	Malaysian Meteorological Service
2. Dr. Abdul Aziz	University of Technology Malaysia
3. Dr. Nadir Saadon	University Pertanian Malaysia
4. Mr. Radzuan Yusof	Department of Environment
5. Mr. Azmi Rahman	Department of Survey $ Mapping
6. Dr. Tetsuo Yanagi	Ehime University, Japan

6. ANALYSIS

As Dr. Tetsuo Yanagi and Mr. Azmi Rahman have already done substantial numerical work on the currents and tides in the Straits, they will be the principal investigators of the water circulation in the Straits.

7. COST OF THE PROJECT

The principal sum of the cost will be the hiring of the 2 vessels for a month in each monsoon as well as the hiring of the two supply vessels. Purchase of current meters with other expenses will make a total cost of about US$ 40,000/-

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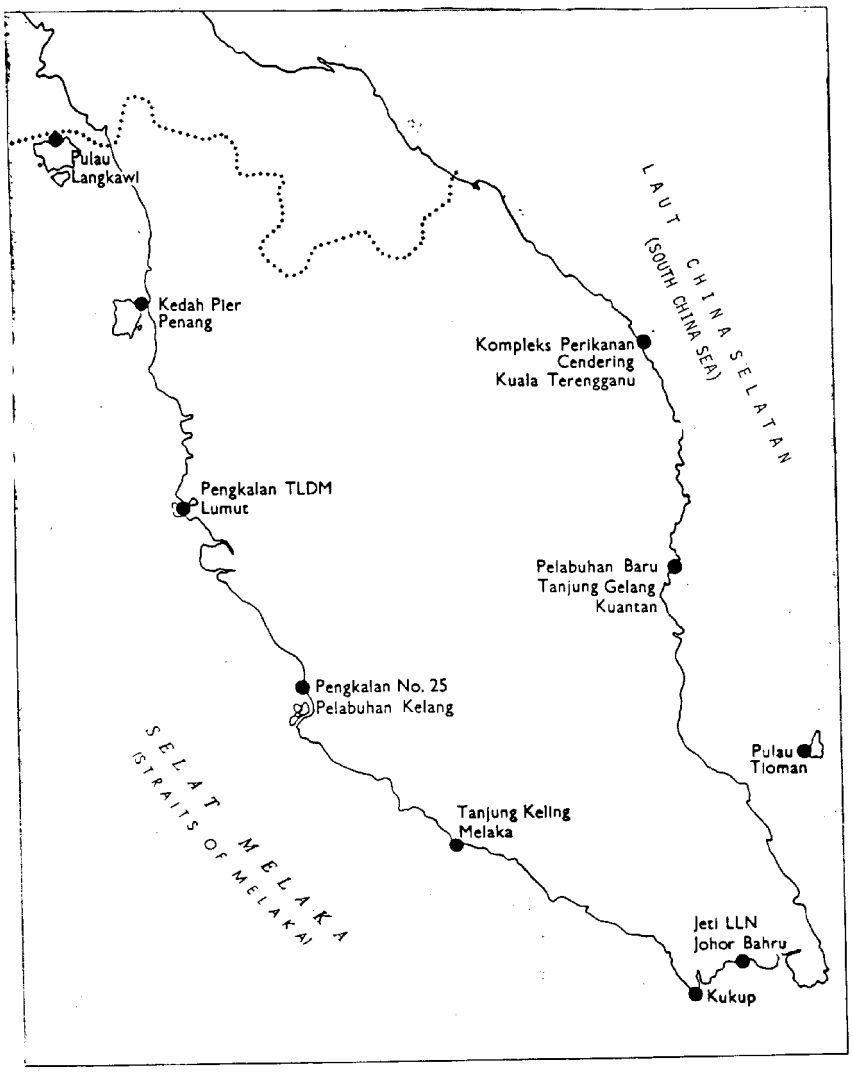

Fig. 3

Location of Tide Stations

CoSCWEP-4 PACIFIC/INDIAN OCEAN THROUGH FLOW

1. INTRODUCTION

Pacific Equatorial Current transports warm water mass from the coast of Central and South America to the Indonesian Archipelago. On the other hand Indian Equatorial current carries these waters away from the Indonesian Archipelago towards the east coast of Africa. The such system causes the sea surface along the coast of the Indonesian Archipelago bordering the Pacific Ocean be slightly higher than the sea surface along the coast of island bordering the Indian Ocean. The difference of sea level height across the Indonesia's seas between the western Pacific and the eastern Indian Ocean then generates current flowing from the Pacific Ocean through the seas and deep straits in the Indonesian Archipelago to the Indian Ocean. This flow is identified as " Indonesia's Seas Through Flow" or in Indonesia it is called as "Ailran Lints Indonesia=ARLINDO".

Though estimates of the through flow transport have been made by several scientists using different methods, but there is still wide range of estimates as to its magnitude. Highest estimate is 18 Sv/s (Sv=). It is nearly half of the amount of waters transported by Kuroshio Current in the Pacific or Gulf Stream in the Atlantic. The heat and fresh water flux between the Pacific and Indian Ocean through the Indonesia's seas is also estimated to be considerable. In large scale, perhaps global scale, Indonesia's Sea Through Flow may have considerable contribution to the world ocean circulation and may also have impact on the ocean climate. In small scale, particularly in the Indonesian Archipelago, this flow has strong influence on oceanographic process, such as the occurrence of upwellings at several locations. There is evidence that high productivity in the eastern part of the archipelago is closely related to these upwellings. In order to have better knowledge about Indonesia's Seas Through Flow, systematic and detail observations is still needed.

This research plan is being proposed to the Indonesian Institute of Sciences by the Center for Oceanological Research and Development/ ^The execution of the plan is much depended on the budget allocation approved by the National Development Planning Board.

The proposed research is intended to measure directly the velocity of the flow at several important passages, namely in the Makassar Strait, Molucca and Halmahera Sea. The research Kupang, and the determination of water and salts budget. The result of these observations is expected to facilitate good data for the estimate of the magnitude of through flow transport.

2. OBJECTIVES

The main objective of the proposed research is to carry out direct measurement of the velocity of the flow and to evaluate the magnitude of the water transport and its seasonal variability.

RESEARCH METHOD

(i) Current measurement will be conducted by mean of moored current meter arrays deployed at three strategic passages/positions, namely at Makassar Strait, Molucca Sea (Lifomatola Strait and Halmahera Sea. At each station five current meters will be arrayed in the depth between 50 and 1000 meters, and it is expected to operate in one year period. The type of Andera Current meter will preferably be used in this research.

(ii) To measure sea level height, tide gauges will be installed at

several locations, primarily at Menado (facing the Pacific Ocean) and Kupang (facing the Indian Ocean). The type of Endeco or Leopold Steven A-7 tide gauge will be used.

(iii) CTD cast, measurements of nutrients, oxygen content and tracers, such as freon and tritium at selected cross sections in Makassar Strait, Celebes, Molucca, Halmahera, Banda, Flores and Timor Sea.

3. AREA OF INVESTIGATION

The area of investigation covers Strait of Makassar, Celebes, Molucca, Halmahera, Banda, Banda, Flores and Timor Sea. (See map)

4 RESEARCH VESSEL

R/V Barima Jaya I is planned to be used in supporting the research Programmes.

5, TIME SCHEDULE AND FIELD PROGRAMME

It is proposed that the field Programme take place in 1991-1993 period (1991/92 and 1992/93 fiscal year). It will comprise of three cruises and each cruise will last for about 25 days. There are two main field activities: mooring current stations (deployment, maintenance and retrieval); and CTD cast and chemistry/tracer observation.

6. EXECUTING AGENCIES AND PERSONNEL

Executing agency of the proposea researcn is the Oceanological Research and Development (CORD) of LIPI Jakarta.

Scientists and technicians involved are mainly from CORD and universities, namely, Institute of Technology Bandung (ITS) and Institute of Agriculture Bogor (IPB). Principal scientists and their specialization are the following:

Dr. Xasijan Romimohtarto, biologist, Director of CORD
Dr. A.G. Ilahude, descriptive oceanography, CORD
Dr. Dharma Arief, physical oceanography, CORD
Mr. Muswerry Mochtar, chemical oceanography, CORD
Dr. John Pariwono, physical oceanography, IPB
Dr. Safyan Hadi, physical oceanography, ITS

7. BUDGET

The budget estimate is amount to Rp. 850,000,000 (1 US$ equivalent to Rp. 1,860). It covers four main expenditures, namely:

for instrumentations: Rp. 500,000,000;
for daily allowance and travel:Rp. 20,000,000;
for spare parts and report: Rp. 30,000,000; and
for vessel operation: Rp.300,000,000 (Rp. 4,000,000/day)

8 CO-OPERATION EXPECTED

Co-operation or assistance from WESTPAC member countries is welcome, especially expertise and scientific instrumentations. A number of current meters and current profilers (preferably Acoustic Doppler Current Profiler) are still needed in the research.

CoSCWEP-5: EAST CHINA SEA

1 INTRODUCTION

The East China Sea have large area where the water depth less than 200 meters. Therefore coastal-ocean circulation plays very important role in the East China Sea and influences other processes in the area. One of strongest western boundary currents, the Kuroshio, and its branches dominate dynamic processes in most part of continental shelf area in the Sea. The river discharge, mainly Changjiang River, with large amount of freshwater, dissolved matter and suspended materials, are also considerable forcing for water circulation in the Sea, and it extend to a large areas covering parts of continental shelf and coastal zone. It is believe that the freshwater either flow to the Sea of Japan as part of the Tsushima current through the Korea Strait or go to the Pacific Ocean with the Kuroshio through shelf-edge processes. Another main factor contributed to the coastal water circulation in the area is tidal effects.

A lot of efforts have been achieved to the Kuroshio studies, such as CSK, KER, JRK, etc. and some very interesting results have been obtained from those studies. It has been found that the Kuroshio induces a pressure field on the shelf, resulting in a persistent northward Taiwan Warm Current (TWC) on the shelf-edge all year round. It is believed that most of the TWC water originates from intrusion of Kuroshio water northeast of Taiwan. Some of the TWC water is thought to have its origin from the South China Sea Warm Current.

It is also noticed that in Winter strong winds drive the Changjiang River plume southward along the coast to the west of TWC. The water on the shelf is vertically homogeneous except in the area north of Taiwan where the surface water of the Kuroshio intrudes significantly on-shelf. In Summer, the prevailing wind is from the southwest and it is mild. The combined effects of southerly winds, stronger TWC and larger river runoff result in the turning of the Changjiang River plume northeastward upon entering the East China Sea. Significant shelf intrusion of the Kuroshio northeast of Taiwan is limited to the lower layer water only. The Yellow Sea Warm Current is much reduced in strength. It extends only slightly north of Chejudo Island before it turns eastward.

According to the previous studies and on-going Programmes, the studies in this project will focus on two areas:

(i) Shelf-edge area, to understand the interaction between Kuroshio current and shelf water;

(ii) Changjiang River plume area, to study physical and dynamic processes and the influences to the environmental aspects.

2. AIMS OF THE STUDY

The study aims on:

(i) collect oceanographic data both by collection of existing data and by the field observation in this project. The existing data can be obtained from previous studies on the Kuroshio and the on-going co-operative study co-sponsored by Japan and China. The measurements will be initiated in shelf-edge area, e.g. northeast Taiwan with possible extension to inner shelf area if necessary funds can be obtained;

(ii) develop numerical model for the water circulation in the shelf edge area to identify the mechanism of the water exchange between Kuroshio current and shelf waters;

(iii) calibrate and verify models of Changjian River plume to describe both the structure and seasonal patterns of the plume and to understand the roles of wind effects, freshwater discharge as well as coastal current in plume dynamics;

(iv) study the influences of the physical and dynamic processes to coast environment, such as nutrients fluxes through river discharge and upwelling, the pollutants and sediments transport through relevant coast current, etc.

3. ACTION AND METHODOLOGY

(i) By using the available data of Hydrographic and other oceanographic observation in the East China Sea, the fundamental oceanographic properties in the study areas should be mapped. Special attention will be paid to the clarification of seasonal variations and for estimating reliability of the obtained distributions.

(ii) Analyzing the data of direct current measurements and mapping the current fields. Through this analysis, the new technology and new instruments, such as satellite imagery and Acoustic Doppler Current Profiler (ADCP), in shallow coastal water will be applied. Data processing techniques such as a method to obtain steady component from observed data which are contaminated with periodic tidal components will be developed. For this purpose, detailed mapping of tidal current characteristics based on observed data and/or numerical modelling of tidal components with sufficient accuracy should be attempted.

(iii) By selecting some key areas such as (1) the inflow region of the Kuroshio near Taiwan, (2) the Kuroshio front and mixed water zone, and (3) the Taiwan Strait, direct current measurement and detailed oceanographic observations should be carried out.

a) On-board observation

General survey of coastal-ocean hydrography T. S. and general meteorological observation should be carried out in the key areas identified in the former section by using CTD and other direct-measured and self-recorded instruments;

b) Floats and drifters

The field Programme will involve the first attempt to map directly the circulation on the shelf areas and it cab be accomplished with current-following drifters and floats. The results can be expected to:

- measure the velocity at one subsurface level to be used in conjunction with Hydrographic in establishing the full-column absolute geostrophic velocity field and its associated transports of heat and tracers;
- characterize large-scale transport in the upper layer to determine the magnitude and effect of both geostrophic and a geostrophic wind-driver flow; and
- provide observational resolution above the basic global standard in regions where it is needed.

c) Moorings

Moored current measurements will be used both for direct estimates of current structure and transport, using coherent

arrays in relatively confined areas, and for exploration of the vertical structure of the eddy field, using single moorings or incoherent, large-scale arrays.

(iv) In co-operating with the above-mentioned investigations, the numerical experiments will be undertaken to clarify mechanisms of key processes and for constructing diagnostic and prognostic models of the current field in the study areas.

4. STRATEGY

(i) To convene a small group meeting of participating scientists from interesting countries to discuss in detail the necessary works for implementation of the project. It could be done in conjunction with the Fifth Session of Japan and East China Seas Study (JECSS) in Fukuoka, Japan, April 1991;

(ii) To analyze of the existing data and identify the gaps of the data which expected to be obtained from the field observation;

(iii) To start the field observation in the areas identified in late 1991 or in early 1992 To exchange the study results through scientific seminars and exchange the scientists between participating institutions. The scope depend upon the funds obtained for the project;

(iv) to summarize the project by a comprehensive workshop in late 1993 or the first half of 1994.

5. PRESENT PARTICIPATING INSTITUTIONS

The project is open to all scientists and institutions who are interesting in it. However the present participating institutions are:

China: The first Institute of Oceanography, SOA
The Second Institute of Oceanography, SOA
The Third Institute of Oceanography, SOA

Japan: Ehime University
Kagoshima University
Nagasaki University

6. BUDGET ESTIMATION

The main financial support will be contribute from the participating institutions, which including the ship-time, most of instruments, computers,etc. The following activities should be supported in this project:

1.	Two-days meeting as mentioned in previous section in April 1991	US$ 8,000
2.	Scientific seminar	US$ 12,000
3.	Exchange of scientific personnel	US$ 5,000
4.	Final Workshop for summarizing project results	US$ 15,000
	TOTAL ESTIMATION OF THE BUDGET FOR THE PROJECT IS ABOUT	US$ 40.000

CoSCWEP-6 SULU SEA

1. INTRODUCTION

In consideration of the agreement reached during the IOC/WESTPAC Workshop on the Co-operative Study of the Continental Shelf Circulation in the Western Pacific held 31 October to 3 November 1989 in Bangkok, the scientists from Thailand and the Philippines signified its intention to participate in the co-operative study in the Sulu Sea.

The Philippines, being an archipelagic country, having more water area than land, views this co-operative study significant, in the light of its contribution to addressing practical problems associated with continental shelf circulation, not only in the Philippines but in whole of the western Pacific region.

The Sulu Sea, as the largest of the archipelagic waters, contributes substantially to the total fish production of the country. The coastal waters around the Sulu Sea continue to be the source of harvestable fishery resources ranging from demersal fish resources in the southwest to small pelagic fish resources in the north. Large pelagic, from skipjack to yellowfin tuna, are caught in substantial quantities in the northeast and eastern sides of the Sulu Sea.

Scattered reef areas continue to provide fishery reef resources as well as attraction to tourists who want to enjoy the beauty of coral reefs. The seasonality of fishing activity, tourism, and other maritime activities are governed by the two prevailing monsoon winds. The northeast monsoon (November-March is characterized by dry cold winds coming from Siberia entering the Philippines from the northeast side, and the southwest monsoon (May-September) characterized by heavy precipation when it intensifies, and during the occurrences of typhoons or low pressure areas.

A number of studies have been done in Sulu Sea but they are far from providing a good understanding of the physical oceanography of the area. The lack of physical oceanographers in the Philippines has hampered the progress of physical studies not only in Sulu Sea but the other areas in the Philippines.

The distribution of fish eggs and larvae, the occurrence of red tide and the dispersal of marine pollutants are just a few of the concerns of the Philippines with regard to the study of coastal circulation.

With the limited manpower, laboratory facilities, equipment and survey platform, the Philippines will focus on limited areas in the conduct of physical oceanographic studies, such as that being planned for implementation in Sulu Sea.

2. FOCUS OF THE STUDY

(i) Internal wave generation and its role in the upward transport of nutrients;

(ii) Exchange of waters with other seas through straits; and

(iii) Basin-wide wind-driven circulation.

4. POTENTIAL CORE GROUP OF SCIENTISTS/PARTICIPANTS

Dr. Jorge de lar Alar
Department of Meteorology and Oceanography
College of Science
University of the Philippines

Involvement:wind induced current circulation study
numerical and mathematical modelling
field work

Dr. Gil Jacinto
Institute of Marine Sciences
University of the Philippines
Involvement: ocean fluxes studies
current transport
field work

Mr. Roln Encarnacion
Philippine Atmospheric Geophysical and Astronomical Services Administration
Involvement: air-sea interaction
internal wave and seiches

Mr. Romeo Tejada
Coast and Geo.. Survey Department
National Mapping and Resource Information Authority
Involvement: Tides and tidal current studies
field work

Mr. Cislits Gongales
Bureau of Fisheries and Aquatic Resources
Department of Agriculture
Involvement: Fisheries oceanography studies
field work

4. IMPLEMENTATION STRATEGIES

4.1 PRE-FIELD WORK

All available data on Sulu Sea including historical data shall be compiled and analyzed to determine what specific works have been made on the physical oceanography of Sulu Sea.

Based on the requirements, the gaps of necessary data shall be identified. On the basis of available date, a preliminary modelling shall be attempted. The field strategy will be developed on the basis of what has come out of the synthesis of all data

4.2 FIELD WORK

All field observations and measurements will be carried out on research vessels of member institutions/agencies of the Philippine National Committee on Marine Sciences (NCMS), but principally the vessels of the Coast and Geodetic Survey Department (CGSD) of the National Mapping and Resources Information Authority (NAMRIA).

On agreed arrangements the research vessels of the University of the Philippines College of Fisheries and those of the Bureau of Fisheries and Aquatic Resources may be needed for the field research activities.

Over-all guidance and advisory services and other administrative concerns shall be provided by the NCMS,-being the focal point and the clearing home on all matters pertaining to marine science activities in the Philippines.

5 DATA MANAGEMENT AND EXCHANGE

The Philippines will comply with the system to be adopted or agreed upon by the participating countries as regards data management and exchange.

On the national level, the Philippines has its oceanographic data center in CGSD-NAMRIA which shall serve as the notional center to link up with WESTPAC's data center.

6. TRAINING REQUIREMENTS

(i) On-board training on the proper use of oceanographic equipment and other paraphernalia. This would include their calibration, maintenance and other related exercises;

(ii) Training on data processing, analysis and interpretation. This would include data management.

(iii) training on modelling which would include exercises on existing models and on the possibilities of developing new ones.

7. POTENTIAL SUPPORT AND /OR MUTUAL ASSISTANCE

To implement the Sulu Sea study, the national government shall be the main source of support in terms of providing funds for:

(i) the salaries of scientists involved in the study;

(ii) the maintenance and operating expenses of research vessels and laboratory facilities, and

(iii) procurement of supplies and materials.

Acquisition of needed equipment, instruments, and apparatuses shall be obtained through other sources most particularly from international organizations and /or foundations which will support such a study.

Bilateral or even multi-lateral arrangements could be a possibility as a sources of support based on the spirit of co-operation and mutual assistance.

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