Intergovernmental Oceanographic Commission
Workshop Report No. 73

Expert Consultation for the IOC Programme on Coastal Ocean Advanced Science and Technology Study (COASTS)*

Liège, Belgium 11-13 May 1991

Previously named Coastal Ocean Circulation Dynamics and Fluxes (COCDYF)

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1. OPENING

The Chairman of the Expert Consultation for the IOC Programme on Coastal Ocean Advanced Science and Technology Study, Prof. A. Robinson opened the meeting at 10:00 on 11 May 1991 in the University of Liege, Liege, Belgium. He thanked all participants attending the meeting and working during the week-end after attendance of the five-day Liege Colloquium. The list of participants is attached as Annex II.

The agenda of the meeting (Annex I) was proposed by Prof. Robinson, taking into account the previous meeting and the relevant document concerning this Programme. The agenda was agreed as follows:

(i) Review and modification of the first draft of the Programme document in accordance with the comments and suggestions received by the IOC Secretariat;

(ii) Discussion and accomplishment the Workshop Plan; and

(iii) Considering and developing a framework for co-ordination and co-operation with other Programmes.

2. DISCUSSION AND MODIFICATION OF THE PROGRAMME DOCUMENT

The first draft of the Programme plan for Coastal Ocean Circulation Dynamics and Fluxes (COCDYF) was prepared in conjection with a visit of IOC staff to Professor Robinson's institute of Harvard University in September 1990. The document was despatched by the IOC Secretariat to a number of scientists. Some of them have provided their comments and suggestions on the draft plan. In general the response were supportive of the concept and the proposal. No responses disputed the need for an improved understanding and knowledge of coastal physical oceanography and potential inferences to other processes. However, in considering the necessity of having comprehensive studies in coastal and shelf seas, some responses encouraged IOC to take into account from the start also the interdisciplinary processes in the coastal ocean. The meeting carefully discussed the comments and agreed upon following points:

(i) Scientific Coverage of the Programne

In considering the complex of processes in coastal and shelf seas, and also considering to save efforts and time during implementation, the Programme should pay attention to the multidiscilinary aspects, e.g. biological, chemical and geological processes and contribution to the global problems such as global sea-level changes and global carbon cycle. However, it has been recognized that the physical and dynamical processes are fundamental mechanisms also for other processes. The Programme should investigate the fundamental mechanisms and its contribution to and interaction with interdisciplinary aspects. It is apparent that this consideration also meets the needs of some regional and national Programme on coastal zone managements.

(ii) **Geographic Scope of the Programme**

It was proposed that estuary areas, especially related esturine processes of water exchange and interaction with the shore-line, should be included in the programme.

(iii) **Name of the Programme**

Since the nature of programme has been modified, the title of the programme was suggested to be modified accordingly as: **Coastal Ocean advanced Science and Technology Study (COASTS).**

The Programme Plan has been reviewed paragraph by paragraph and the revised version is attached as Annex III.

3. PREPARATION OF THE FIRST WORKSHOP

The meeting reviewed the progress of preparing the Workshop and took into consideration of the financial constraints for the planned activity. It has been agreed that a comprehensive review of the coastal oceanography on a global bases is very important for the development of the programme. The widest possible involvement of scientists from various parts of world dealing with various coastal processes are apparently necessary for assessment of knowledge in global coastal and shelf seas to assist in design of the programme plan and to judge the implementation. It has been agreed to postpone the workshop until fall of 1992 in order to approach donor agencies who are interested in the programme and willing to provide financial support.

4. CO-ORDINATION AND CO-OPERATION WITH OTHER PROGRAMMES

Taking into account the fact that there are some international, regional and national Programmes dealing with coastal oceanography and resources studies, the overlapping interests between those and COASTS programme are existing. Co-ordination and cooperation with these Programmes are required for effective implementation of the Programmes and for avoiding duplication of efforts.

The meeting considered some Programmes, which could be co-ordinated or cooperated, in detail, e.g. Land-Ocean Interaction in Coastal Zone (LOICZ) Joint Global Ocean Fluxes (JGOFS), Coastal Ocean Processes (CoOP), IOC regional projects on shelf seas dynamics and UNEP Regional Seas programme, etc. and advised the Secretary IOC to consult with relevant organization on appropriate co-ordination with COASTS.

Dr. P. Holligan, the Chairman of the LOICZ programme, introduced the recent development of LOICZ and informed the meeting on the activities planned for the near future. He expressed willingness and necessity to co-ordinate LOICZ with COASTS, especially in the field of biological and chemical processes. He suggested that a mechanism for co-ordinating these two Programmes should be established.

5. CLOSURE

Prof. Robinson closed the meeting at 14:30 hours, 13 May 1991. He expressed his sincere gratitude to Prof. Nihoul and Dr. Djenidi for hosting the meeting in University of Liege and thanked all participants for their hard and constructive work during the week-end.

ANNEX I

AGENDA

1. OPENING

2. DISCUSSION AND MODIFICATION OF THE PROGRAMME DOCUMENT

3. PREPARATION OF THE FIRST WORKSHOP

4. CO-ORDINATION AND CO-OPERATION WITH OTHER PROGRAMMES

5. CLOSURE

ANNEX II

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ANNEX III

PROGRAMME PLAN ON COASTAL OCEAN ADVANCED SCIENCE AND TECHNOLOGY STUDY (COASTS)[1]*

PREFACE

The objectives and content of a Programme for Coastal Ocean Circulation Dynamics and Fluxes were initially discussed by an Experts Consultation of IOC, Unesco, Paris, 4-7 January 1989. A proposal on an "International Programme for the Dynamics and Oceanography of Coastal and Shelf Seas and Exchanges: Rational and Elements" was prepared and submitted to the Third Session of the IOC Committee on Ocean Processes and Climate (Paris, 27-29 June 1989) and to the Fifteenth Session of the IOC Assembly (Paris 4-19 July 1989). The Assembly in principle adopted the proposal by the Resolution XV-3 and instructed the Secretary IOC to organize a Workshop in 1990 or in the first quarter of 1991, dealing with scientific, methodological and infrastructure issues to develop a Programme Plan to present to the next IOC Assembly. Following this decision, a planning meeting for organization of the Workshop was held in Paris on 9-11 May 1990 to which SCOR was invited, to discuss in detail the schedule, objectives and contents of the suggested first workshop.

The Workshop was then planned to be organized in Turkey in the late fall of 1990. However, subsequent events in the adjacent areas and the related conditions did not provide the necessary basis for convening the Workshop as planned.

The Sixteenth Session of the IOC Assembly reviewed the progresses in development of draft Programme document and instructed the Secretary to organize, pursuant to Resolution XV-3, the first Workshop later in 1991, using extrabudgetary resources when available.

A Group of Experts met in Liege, Belgium (11-13 May 1991) to discuss the Programme document and to plan the first workshop. The Workshop is now planned for fall 1992 due to financial and preparation constraints.

This document presents a second draft of the Programme document, including the elements of Programme and schedule. It will be presented to the Workshop so as to be completed by the workshop taking into account the comments, advises and directives provided by the IOC Committee on Ocean Processes and Climate and the Assembly.

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[1]*Previously named Coastal Ocean Circulation Dynamics and Fluxes (COCDYF)

1. INTRODUCTION

The COASTS Programme Plan provides an international framework within which national and regional Programmes and projects may be co-ordinated and synthesized to contribute to an understanding of fundamental properties and variability of the transition zone from the land to the open sea on a global basis.

The geographic scope of the Programme will cover the areas extending from the shorelines, beach and estuaries across continental shelves and slopes, to the external regions where exchanges and interactions occur with the deep open ocean. The physical and dynamical oceanography of coastal and shelf seas involves many and complex processes. Winds, tides, density differences, deep ocean or river influences can produce dominant effects and responses. Much remains to be researched and understood. Especially timely are studies of exchange mechanisms and transport rates across the shelf break. Motions occur on many scales which transport dissolved and particulate material. Fluxes to and from rivers and estuaries, the atmosphere, and the sea bed occur. Thus the physical processes and transports of these seas profoundly effect biological, chemical, geological (sedimentary), and marine meteorological processes and thereby impact the effective use of these seas, including related esturine processes exchanges and interaction with shoreline, and their management.

Coastal and shelf seas provide the natural environment for adjacent nations to develop national Programmes in ocean science and technology. Such Programmes are essential for marine environmental management and operations including pollution control, weather and micro-climatic forecasting, hazard prevention (e.g. the avoidance of erosion and the protection against storm surges), rational use and management of renewable and nonrenewable resources (e.g. fisheries, oil, minerals). Indeed, ongoing Programmes in research and development concerned with resource and environmental management presently are impaired by insufficient or inadequate information on physical oceanographic conditions. A Programme of international cooperation in coastal ocean circulation dynamics and fluxes will allow concerted actions on common processes and methodological problems. Studies of analogous processes, occurring in somewhat differing circumstances from similar processes already partially understood, can substantially enhance fundamental and generally applicable scientific understanding. The shelf break exchange component provides a natural connection to deep sea oceanography.

Some problems and hazards are global in threat and extent, such as the general rise in sea level which will occur if the greenhouse effect continues to warm the earth. Shelf sea transports and shelf break exchanges of important material may require multinational/regional efforts. Contamination studies in the Mediterranean, the Baltic, the North Seas and Wider Caribbean provide clear regional examples. Organic carbon, of central and critical importance to the problem of climate change, requires a global balance including coastal contributions. The coastal and shelf sea, which link the continents to the world ocean, require a fully international and globally conceptual approach as we move into the decades of whole-earth science.

Issues of coastal zone managements are now receiving more and more attention in IOC

many areas and regions both by scientists and policymakers. It is basic knowledge that human existence depends on a stable and healthy environment. It is also known that many of the world's most productive resources are located in riverine and coastal zones. Coastal ecosystems and upwelling areas are capable of producing about 10 times as much organic matter per square meter per year as offshore waters. It is thus important to maintain this marine environment in a state capable of supporting marine resources in a sustainable manner. Scientific knowledge is the fundamental basis for management of the coastal zone.

The shelf sea regions play a role in relation to human activities which is disproportionate to the fraction of the global ocean which they represent. The physical mechanisms which operate in these regions profoundly influence the conditions there and their understanding is essential for interdisciplinary studies and managements. It is now known, as early observations indicated, that shelf currents are not steady, and that their fluctuations are important on many scales revealing a new richness of coastal ocean phenomena.

Understanding the physics of the shelf seas is also of critical importance in relation to understanding of the ocean as a whole. In broad terms we distinguish fundamentally different dynamical regimes occurring in the deep ocean, where flow in the interior is geostrophically balanced, and on the shelf, where surface and bottom stresses associated with wind and tidal forcing together with buoyancy inputs at the boundaries are much more dominant.

2. OVERALL GOAL AND OBJECTIVES

2.1 OVERALL GOAL

The overall goal of this Programme is to:

Encourage and facilitate coastal and shelf ocean sciences and technology on a global basis in order to promote the enhancement of capabilities to carry out such studies, to increase scientific understanding, and to provide scientific inputs to an effective coastal zone management. To achieve these, the Programme aims to promote understanding of physical and dynamical processes as the fundamental of multiciplinary processes and to enhance and interact with comprehensive studies.

2.2 SPECIFIC OBJECTIVES

The main specific objectives are:

(i) To generate cooperative studies and personnel exchanges between participating scientific institutions and regions, especially between advanced and developing institutions, in order to facilitate:

a) co-operative field Programmes;

b) research on analogous processes in similar settings but with different conditions;

c) the possibility of identifying the "isolated amplified process";

d) a rapid development of new knowledge in previously not very well explored regions using state of the art of science and technology; and

e) development and co-operation in modelling of processes in coastal area.

(ii) To facilitate continuing communication between interested institutions able to support the necessary training activities, as well as with institutions and individuals in need of such support; training and scientific advancement of young scientists through working with advanced scientists;

(iii) To provide support with a minimum of new bureaucratic costs under the IOC umbrella to regional studies which are scientifically natural and necessary; and

(iv) To provide a scientific and technical framework for co-operation and global quantification and estimates of the role of the global coastal ocean in climate and global change.

2.3 LONG-TERM OBJECTIVES

(i) To assess the major features of various physical mechanisms and their application to biological and chemical processes; and assess major interactive processes.

(ii) To provide on the basis of knowledge enhanced and synthesized by this Programme, an improved and possibly adequate scientific foundation for the management of the coastal and shelf areas.

3. ELEMENTS OF THE PROGRAMME

The purposes of this Programme are: to strengthen communication among the global ocean science communities, to foster co-operation, collaboration and technology transfer, and to evaluate, assess and synthesize knowledge in this field. The elements of the Programme which reflect these purposes include communication via workshops and seminars, training via courses and visits, and the publication of a newsletter, manuals and treatises, the maintenance of a coordinating office and guidance via a Group of Experts.

This Programme activities will initially focus on the physical, dynamical studies including elucidation of implications of these study results for other interdisciplinary processes and regional enclosed and semi-enclosed shelf seas condition. The main elements for the Programme are identified as follows:

3.1 COMMUNICATION

The activities for achieving and improving communication mainly include Workshops, IOC

Scientific Seminars, Publication of Newsletters and two scheduled major books.

3.1. 1 **Workshops**

For the exchange of existing knowledge on national, regional and global bases, Workshops will play an essential role. They will be organized every three years.

The First Workshop will focus on a comprehensive review of the coastal ocean circulation dynamics of the various scales and the implication to and interaction with interdisciplinary processes. The topics for the workshop have been considered in a Planning Meeting and divided into several groups. It is planned to be held in fall 1992.

The Second workshop is planned for 1993-1994, aimed at training and exchange of knowledge in numerical modelling. This workshop will be divided into two phases:

Phase 1: A training course providing basic insight of numerical modelling will be given to the participants from developing countries. Some simple models will be introduced in the training course.

Phase 2: Presentations and discussions on development of models for different regions will be provided at the workshop. The future developments of modelling are also to be discussed and recommended.

This workshop will facilitate the assessment and exchange of knowledge in using numerical models to study coastal processes. The results of the workshop will feedback to the Programme, providing approprete information for observation design.

The Third Workshop: This workshop will deal with the following topics: (i) The assessment of physical oceanographic processes; and (ii) interdisciplinary processes and implication of the results acquired from circulation, dynamics and physical process studies.

3.1.2 **Scientific and Technical Symposia on Selected Topics**

In order to facilitate effective co-operation in the Programme and to exchange information and results, scientific symposia on selected topics will be organized at appropriate times. Examples of potential topics are:

(i) Methodological Topics
- Remote sensing
- data management
- computation methodology

(ii) Processes Topics
- Tide-forced shelves
- Wind-forced shelves
- Externally forced shelves
- Ice covered shelves

(iii) Regional Topics

These symposia will be held at the regional level, especially in regions that would benefit from co-ordinated research. They can be arranged prior to the workshops and feed with the global workshops.

(iv) Importance of Shelf Seas to Global Ocean conditions and Global Changes.
- biogeochemical cysle, e.g. carbon cycle
- ecosystem dynamics sea-leavel changes

(v) Application and Management topics
- operational fishery
- shelf seas pollution research and monitoring
- engineering

The results of the studies will finally communicate by appropriate ways to the national and international oceanographic communities and the coastal zone management communities.

3. 1.3 **Publications**

Publications to be included in the Programme for supporting and accelerating the communication and summarizing the scientific results are as follows:

(i) Manuals on the methods

The manuals will include the main aspects and procedures of the field observations, data processing and other methods to be used in the Programme. The introduction of methods will be coordinated with seminars on methodology topics and the training courses. The Group of Experts will be responsible for preparing, reviewing and testing the manuals.

(ii) Workshops and Symposia Reports

The reports of workshops and seminars will present the main outputs of the relevant workshops/seminars and the recommendation for future studies, and will be the under the scientific guidance and responsibility of the Group of Experts The reports will be published in the IOC Workshop Report Series.

(iii) Newsletters

The newsletter for COASTS will inter alla provide information on progress of the Programme, the research results on national regional and global bases and on events in the Programme implementation. It also provide a way to establish co-operation, collaboration and exchange of personals. It will be prepared by the IOC Secretariat and the Chairman of the Group of Experts.

(iv) Major treatises on the coastal Oceans - Planned Books

Refer to 3.6 "Evaluation of the Programme".

3.2 RESEARCH ACTIVITIES

The main research activities in this programme include field programme, modelling, training activities in a global scale programme of interdisciplinary processes and the role of physical processes therein. A scenario provides some guidance for developing coastal ocean programme. The main processes to be investigated were identified at a Planning Meeting in Paris, May 1990. The scientific assessment of these processes will be a result of the workshop scheduled for fall 1992. They are:

(i) Physical and Dynamical Processes, including: wind effects, air-sea interaction, wave, mixing and boundary layers, tide effects, buoyancy effects and deep sea forcing;

(ii) Biological, chemical and geological processes
- primary productivity and ecosystem dynamics;
- biogeochemical processes;
- sediment transport and terrigenous fluxes;
- recruitment.

(iii) Global processes and integrated budgets
- shelf ice dynamics, variability and climatic effects;
- bottom, deep and intermediate water formation on shelves and exchange with open ocean;
- contribution of the coastal ocean to global energe cycle, e.g. carbon cycle;
- global sea-level changes, coastal effects and feedbacks.
- global balances

(iv) regional processes.

3.2.1 **Field Programme**

The main field programme contributions will depend upon national and regional institutional contributions and will include the regional or sub-regional studies formulated and implemented through the IOC regional subsidiary bodies. The planning of these studies will be coordinated with this global framework porgramme. The COASTS contribution to the research programme will be achieved through providing necessary manuals and guidance on methods, carrying out training activities and data processing and managements, and the fostering of co-operation and collaboration by workshops, seminars and publication of newsletters. To achieve this, the following activities are planned: (i) provide necessary manuals and guidance on the methods and standards to be used in the programme;

(ii) encourage the Member States and participating institutions to carry out co-operative field observations; and

(iii) co-ordinate the efforts made by various institutions towards a reasonable network. .

2.2 **Modelling**

The developing and testing of coastal ocean models capable of providing a complete dynamical description of the coastal ocean circultation is one of the main objectives of the Programme, which include prognostic models on the one hand and inverse or data assimilative models on other.

The efforts in modelling aspects will include workshops, training courses, seminar on the methodology topics and exchange of and between individual scientists.

3.2.3 **Training**

The training and exchange elements of the Programme will be encouraged to be carried out gradually in all shelf and coastal seas. The widest possible participation will be supported and especially the participation of developing countries. This approach will ensure the understanding of the coastal circulation and dynamics on a global bases.

Training activities are an essential part of the Programme and include:

(i) the training activities co-ordinated with relevant workshops and seminars, such as modelling techniques;

(ii) selected technical training courses, e.g.
- modelling
- field observation
- data managements

(iii) individually arranged visits for 1-6 months and on-board training supported by the TEMA Programme.

3.2.4 **Global Scale Problems**

The shelf seas are geographically and scientifically related to the global conditions and processes. The quantification of contributions from the coastal area to global changes will help in understanding the mechanisms and processes involved in global changes. The efforts in this Programme will focus on:

(i) co-operation and co-ordination with the IGBP LOICZ (Land-Ocean Interaction in the Coastal Zone) and other global and regional Programmes related to the coastal ocean studies;

(ii) identification of the parameters to attempt to measure and monitor changes on a global basis:

(iii) identification of simple measurements for all institutions to contribute to a global data base;

(iv) communication to the governmental authorities the importance of coastal ocean scientific studies for proper management and sustainable uses of coastal resources with a view of encouraging their involvement in the programme;

(v) promotion of the capability of coastal physical oceanography study in developing countries through the infrastructure of the programme; and

(vi) provision of necessary technology transfer in relation to these measurements.

In order to achieve these goals, umbrella funds for the global study will be required and the funding should be considered seriously by the IOC. It is clearly necessary to obtain much more financial support than that is at presently available.

3.2.5 **A Scenario for Developing a Coastal Ocean Programme**

The COASTS programme will provide, on a continuous bases, information of general and particular methodology as starting points for developing filed and modelling programme in new areas. In principle, the development of a programme might be divided into four phases:

First Phase of the programme consists in the collection and analysis of available data, the identification of the problems, the specification of the objectives through a dialogue with the potential users, the clarification of issues and the determination of priorities.

Topography, remote sensing images, coastal sea level observations and available information from archived hydrographical surveys, meteorological maps etc. will help, at this stage, to identify and forecast essential physical processes, dominant time scales and length scales, to appraise the main characteristics of the shelf area under study, to specify the extent and geometry of the region implicated, and to suggest the appropriate resolution of observational networks and numerical grids.

Second Phase of the programme includes the setting up, and preliminary testing in simple cases, of a mathematical model, the organization of exploratory process experiments and field surveys (associating eventually, within the framework of the physically designed project, scientists from other disciplines).

The observational programme will include, as necessary, Hydrographic cruises, moored instruments, remote sensing, tracer dispersion experiments, development of sea level gauges on appropriate space and time scales (as determined by the geometry of the coast, the forcing mechanisms, and the particular objective of the study), wind measurement systems,

river flow monitoring. They are designed to complete and update the information provided by the analysis of available data, allowing a better specification of the shelf system and providing orders of magnitude and numerical data for the calibration and preliminary tests of the model.

The experimental work at this stage should ensure the definition of kinematical space and time scales of the phenomena and the identification of the specific dynamical processes. Third Phase includes mature research. It consists of the:

(i) design and conduct of process experiments;
(ii) design and implementation of observational/monitoring system for long-time series;
(iii) development, calibration and validation of a scientifically useful, realistic and applicable model, following an iterative procedure, where imperatives of the model and results of data simulation and hindcasting/forecasting exercises are taken into account in revising the design of process experiments and observational networks, while at the same time the model is constantly improved by inputs of experimental data.

Fourth Phase of the Programme is devoted to the exploitation of the results in subsequent interdisciplinary studies and the application of the model to coastal/shelf management. During this phase, continued interpretation of scientific results and interfacing of the application and management activities with ongoing scientific activities, including in other disciplines, will be of critical importance.

3.3 DATA MANAGEMENT

COASTS is global in spatial scale and long-term in temporal scale. The data acquisition, processing, quality control and exchange are very important for the implementation of the Programme. The specific elements will be considered at the first Workshop.

3.4 CO-ORDINATION OF THE PROGRAMME

For co-ordination of the Programme, the establishment of a Group of Experts and a Co-ordinating Staff in the IOC Secretariat are considered.

It was decided by the IOC Assembly at its Fifteenth Session (Paris, 4-19 July 1989) to establish an ad hoc Group of Experts to assist in organization of a Workshop on Ocean Dynamics and Circulation on the Continental Shelf and to follow-up the recommendations of the Workshop by preparing strategies and a draft Programme Plan for presentation to the Sixteenth Session of the IOC Assembly.

For co-ordination of the Programme a Group of Experts is needed with the following terms of reference:

(i) identify the scientific requirements for the coastal ocean studies;
(ii) develop Programme details;
(iii) provide relevant guidance and overview for the Programme implementation;
(iv) identify the TEMA (Training, Education and Mutual Assistance in the Marine Sciences) needs and provide guidance and possible resources;
(v) report, through its Chairman, to the IOC Assembly and the Executive Council.

The Group will be guided by the scientific objectives of the Programme and will provide scientific oversight to the Member States when necessary.

The composition of the Group will based on the personal capacity and expertise taking into account geographical distribution and the distribution of advanced and developing oceanographic communities, in accordance with established procedures of the IOC.

3.5 EVALUATION OF THE PROGRAMME

As a substantial comprehensive summary of the results of the Programme at the highest scientific level, an advanced book on coastal oceans on the earth is suggested to be published in two volumes:

Volume 1: Descriptive Coastal Oceanography
Volume 2: Coastal Ocean Processes

Volume 1 will include presentation of regional coastal seas in different chapters which provide opportunity for the scientists working on the regional problems to present these results. This volume will be scheduled to enter the final editorial process in the 5th year.

Volume 2 will deal with the different identified processes based on the knowledge obtained from the coastal ocean studies. The final editorial process will start in the 9th year.

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