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Intergovernmental Oceanographic Commission
Reports of Meetings of Experts and Equivalent Bodies



**UNEP-IOC-WMO Meeting
of Experts on Long-Term Global
Monitoring System of Coastal
and Near-Shore Phenomena
Related to Climate Change**

Paris, 10-14 December 1990

UNESCO

In this Series, entitled

Reports of Meetings of Experts and Equivalent Bodies, which was initiated in 1984 and which is published in English only, unless otherwise specified, the reports of the following meetings have already been issued:

1. Third Meeting of the Central Editorial Board for the Geological/Geophysical Atlases of the Atlantic and Pacific Oceans
2. Fourth Meeting of the Central Editorial Board for the Geological/Geophysical Atlases of the Atlantic and Pacific Oceans
3. Fourth Session of the Joint IOC-WMO-CPPS Working Group on the Investigations of «El Niño» (*Also printed in Spanish*)
4. First Session of the IOC-FAO Guiding Group of Experts on the Programme of Ocean Science in relation to Living Resources
5. First Session of the IOC-UN(OETB) Guiding Group of Experts on the Programme of Ocean Science in relation to Non-Living Resources
6. First Session of the Editorial Board for the International Bathymetric Chart of the Mediterranean and Overlay Sheets
7. First Session of the Joint CCOP(SOPAC)-IOC Working Group on South Pacific Tectonics and Resources
8. First Session of the IODE Group of Experts on Marine Information Management
9. Tenth Session of the Joint CCOP-IOC Working Group on Post-IDOE Studies in East Asian Tectonics and Resources
10. Sixth Session of the IOC-UNEP Group of Experts on Methods, Standards and Intercalibration
11. First Session of the IOC Consultative Group on Ocean Mapping (*Also printed in French and Spanish*)
12. Joint IOC-WMO Meeting for Implementation of IGOSS XBT Ships-of-Opportunity Programmes
13. Second Session of the Joint CCOP/SOPAC-IOC Working Group on South Pacific Tectonics and Resources
14. Third Session of the Group of Experts on Format Development
15. Eleventh Session of the Joint CCOP-IOC Working Group on Post-IDOE Studies of South-East Asian Tectonics and Resources
16. Second Session of the IOC Editorial Board for the International Bathymetric Chart of the Mediterranean and Overlay Sheets
17. Seventh Session of the IOC-UNEP Group of Experts on Methods, Standards and Intercalibration
18. Second Session of the IOC Group of Experts on Effects of Pollutants
19. Primera Reunión del Comité Editorial de la COI para la Carta Batimétrica Internacional del Mar Caribe y Parte del Océano Pacífico frente a Centroamérica (*Spanish only*)
20. Third Session of the Joint CCOP/SOPAC-IOC Working Group on South Pacific Tectonics and Resources
21. Twelfth Session of the Joint CCOP-IOC Working Group on Post-IDOE Studies of South-East Asian Tectonics and Resources
22. Second Session of the IODE Group of Experts on Marine Information Management
23. First Session of the IOC Group of Experts on Marine Geology and Geophysics in the Western Pacific
24. Second Session of the IOC-UN(OETB) Guiding Group of Experts on the Programme of Ocean Science in relation to Non-Living Resources (*Also printed in French and Spanish*)
25. Third Session of the IOC Group of Experts on Effects of Pollutants
26. Eighth Session of the IOC-UNEP Group of Experts on Methods, Standards and intercalibration
27. Eleventh Session of the Joint IOC-IHO Guiding Committee for the General Bathymetric Chart of the Oceans (*Also printed in French*)
28. Second Session of the IOC-FAO Guiding Group of Experts on the Programme of Ocean Science in Relation to Living Resources
29. First Session of the IOC-IAEA-UNEP Group of Experts on Standards and Reference Materials
30. First Session of the IOC-ARIBE Group of Experts on Recruitment in Tropical Coastal Demersal Communities (*Also printed in Spanish*)
31. Second IOC-WMO Meeting for Implementation of IGOSS XBT Ship-of-Opportunity Programmes
32. Thirteenth Session of the Joint CCOP-IOC Working Group on Post-IDOE Studies of East Asia Tectonics and Resources
33. Second Session of the IOC Task Team on the Global Sea-Level Observing System
34. Third Session of the IOC Editorial Board for the International Bathymetric Chart of the Mediterranean and Overlay Sheets
35. Fourth Session of the IOC-UNEP-IMO Group of Experts on Effects of Pollutants
36. First Consultative Meeting on RNODCs and Climate Data Services
37. Second Joint IOC-WMO Meeting of Experts on IGOSS-IOE Data Flow
38. Fourth Session of the Joint CCOP/SOPAC-IOC Working Group on South Pacific Tectonics and Resources
39. Fourth Session of the IODE Group of Experts on Technical Aspects of Data Exchange
40. Fourteenth Session of the Joint CCOP-IOC Working Group on Post IDOE Studies of East Asian Tectonics and Resources
41. Third Session of the IOC Consultative Group on Ocean Mapping
42. Sixth Session of the Joint IOC-WMO-CPPS Working Group on the Investigations of « El Niño » (*Also printed in Spanish*)
43. First Session of the IOC Editorial Board for the International Bathymetric Chart of the Western Indian Ocean
44. Third Session of the IOC-UN (OALOS) Guiding Group of Experts on the Programme of Ocean Science in Relation to Non-Living Resources
45. Ninth Session of the IOC-UNEP Group of Experts on Methods, Standards and Intercalibration
46. Second Session of the IOC Editorial Board for the International Bathymetric Chart of the Caribbean Sea and the Gulf of Mexico
47. First Session of the IOC Editorial Board for the International Bathymetric Chart of the Western Indian Ocean
48. Twelfth Session of the Joint IOC-IHO Guiding Committee for the General Bathymetric Chart of the Oceans
49. Fifteenth Session of the Joint CCOP-IOC Working Group on Post-IDOE Studies of East Asian Tectonics and Resources
50. Third Joint IOC-WMO Meeting for Implementation of IGOSS XBT Ship-of-Opportunity Programmes
51. First Session of the IOC Group of Experts on the Global Sea-Level Observing System
52. Fourth Session of the IOC Editorial Board for the International Bathymetric Chart of the Mediterranean
53. First Session of the IOC Editorial Board for the International Chart of the Central Eastern Atlantic (*Also printed in French*)
54. Third session of the IOC Editorial Board for the International Bathymetric Chart of the Caribbean Sea and the Gulf of Mexico (*Also printed in Spanish*)
55. Fifth Session of the IOC-UNEP-IMO Group of Experts on Effects of Pollutants
56. Second Session of the IOC Editorial Board for the International Bathymetric Chart of the Western Indian Ocean
57. First Meeting of the IOC *ad hoc* Group of Experts on Ocean Mapping in the WESTPAC Area
58. Fourth Session of the IOC Consultative Group on Ocean Mapping
59. Second Session of the IOC-WMO/IGOSS Group of Experts on Operations and Technical Applications
60. Second Session of the IOC Group of Experts on the Global Sea-level Observing System
61. UNFP-IOC-WMO Meeting of Experts on Long-Term Global Monitoring System of Coastal and Near-Shore Phenomena Related to Climate Change

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Paris, 10-14 December 1990

UNEP-IOC-WMO/GCNSMS-I/3
Paris, 28 January 1991
English only

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1. OPENING OF THE MEETING

1 Mr. G. Kullenberg, Secretary of IOC, opened the meeting and welcomed the participants (Annex V) on behalf of IOC, UNEP and WMO acting as the Joint Secretariat of the meeting. He emphasized the wide range of expertise present and the importance of the experts' involvement and expressed on behalf of the co-sponsors his appreciation for their participation.

2 He pointed out that the joint initiative taken by UNEP, IOC and WMO was based on an initial proposal made by UNEP (OCA/PAC) in October 1989, and with the agreement of UNEP and WMO, IOC had acted as lead agency. The proposal to prepare an outline and draft plan for a Long-term Global Monitoring System of Coastal and Near-Shore Phenomena Related to Global Climate Change was based on the recognition through several regional assessments of the extent of possible impacts of sea level rise and global climate change on coastal zones and near-shore areas combined with the fact that the coastal zone is an area of intense use by society, where many coupled processes govern the natural conditions through land-sea-atmosphere interactions.

3 The co-operating Organizations had invited and supported the work of two consultants in the preparation of the draft proposal for a monitoring system (Draft proposal for a Long-term Global Monitoring System of Coastal and Near-Shore Phenomena Related to Global Climate Changes). Discussions with several Member States were undertaken by the consultants in order to identify their interests, ongoing activities and plans and to ensure harmonization of this interagency proposal with national plans. Harmonization with regional and relevant international programmes was ensured through review of these programmes, discussion and contact with the relevant secretariats, and preparation of document UNEP-IOC-WMO/GCNSMS-I/Inf. 3, as part of the overall background for the meeting.

4 The first draft of the proposal prepared by the consultants was reviewed at an intersecretariat meeting in Geneva, July 1990, when it was agreed to circulate the revised draft to a number of experts, and to other agencies and programmes, particularly those previously contacted and to invite comments on the draft proposal. Comments were received and integrated in a separate document (UNEP-IOC-WMO/GCNSMS-I/7).

5 Mr. Kullenberg indicated the relevance and timeliness of this proposal in the light of the recent conclusions of the WMO-UNEP Intergovernmental Panel on Climate Change (IPCC) and of the Second World Climate Conference which had called for the extension of the Global Climate Observing System to include both open ocean and coastal monitoring systems.

6 The Secretary IOC referred to the development of a plan and implementation strategy by IOC, in co-operation with WMO and SCOR/ICSU, for the establishment of a Global Ocean Observing System as recommended by the IPCC and SWCC in 1990. Clearly there needs to be appropriate co-ordination between these two initiatives.

7 Mr. Kullenberg emphasized that a primary task for the meeting of experts was to review the contents of the draft proposal prepared by the joint secretariat with the assistance of expert consultants; to revise and expand the current proposal; and to prepare concrete recommendations for consideration by the governing bodies of the three sponsoring agencies in 1991.

8 The meeting was invited to finalize the proposal; to consider the feasibility of initiating a pilot phase of the monitoring system; to provide advice on the manner in which such a pilot phase might be launched; to identify the linkages and interactions with other relevant programmes, systems

and activities; to consider how the experiences gained through other regional and international monitoring systems might be applied to the present initiatives, and, to advise the joint secretariat on how such a system might contribute to the global efforts concerned with improving our understanding of the potential impacts of climate change.

9 Mr. M. Gerges welcomed the participants on behalf of UNEP and indicated the great importance which UNEP placed on the outcome of this meeting. UNEP was concerned about the need to identify the impacts of climate change as an initial step in developing policy alternatives for mitigating such impacts. He indicated that the long-term monitoring of phenomena attributable to climate change in coastal and near-shore areas was considered essential to assessing the scale of the adverse impacts on natural environments and the socio-economic structures and activities of coastal societies.

10 In this connection Mr. Gerges referred to the work of the regional Task Teams on the implications of climate change and to the fruitful co-operation between IOC and UNEP in this endeavour. Copies of the report of the recent meeting of co-ordinators of the regional Task Teams held in Singapore, 12-16 November were provided for the information of participants.

11 Mr. P. Dexter also welcomed participants on behalf of WMO, and apologized for missing the first part of the meeting due to other conflicting commitments in Geneva. He indicated that WMO saw a need for improved, co-ordinated long-term monitoring of climate - related changes in the coastal zone, which would ultimately assist countries in mitigating the impacts of such changes. In this context, there was potential value to be gained from the development and implementation of a project of the type being proposed. In addition, Mr. Dexter foresaw a role for WMO's maritime Members in the implementation of a coastal monitoring project, since many of them already maintain coastal observing stations on an operational basis monitoring a range of meteorological and sometimes oceanographic variables.

12 Mr. Dexter cautioned, however, that to have any chance of success, the project must clearly identify both likely end products and particularly users of the monitoring. It must also be realistically structured in terms of available resources and must take account of, and be heavily based on existing monitoring and data management systems. Finally, he stressed the importance of undertaking pilot, feasibility projects related to the proposal, before any plans were made to develop a full global system. From the point of view of WMO, it was essential to do this before the Member States could be asked to commit resources to such a system.

2. ADMINISTRATIVE ARRANGEMENTS

2.1 ELECTION OF OFFICERS

13 Mr. S. Keckes was elected Chairman and Mr. J. Pernetta was elected as the Rapporteur for the meeting.

2.2 ADOPTION OF THE AGENDA

14 The proposed agenda was adopted (Annex I).

2.3 CONDUCT OF THE MEETING

15 The Senior Assistant Secretary of IOC, Mr. A. Tolkachev, introduced the documentation available for the meeting (Annex IV) and the proposed timetable and working hours which were adopted without change.

3. LONG-TERM GLOBAL MONITORING SYSTEM OF COASTAL AND NEAR-SHORE
PHENOMENA RELATED TO CLIMATE CHANGE

- 16 A brief presentation of the draft proposal was made by Mr. L. Jeftic on behalf of the joint Secretariat. The nature of potential impacts in coastal and near-shore areas which might result from climate change; the objectives of the proposed system; the principles, variables, sites, methods and issues of data handling and management were all reviewed.
- 17 The contents of responses to the draft proposal received from some 25 individuals and three meetings (Document UNEP-IOC-WMO/GCNSMS-I/7) were outlined and it was indicated that no response had disagreed with the need for such a monitoring system. Responses from developing countries' scientists had emphasized the need for a broad approach which would include consideration of other, anthropogenic sources of change in coastal zones.
- 18 Many responses emphasized the need for more detail to be presented in the proposal including the need for a clearer definition of the types of variables, methods and frequency of data collection and sampling programmes proposed. Several respondents had indicated the need to provide greater detail concerning the biological and chemical variables that should be included in the system and suggested that as presently drafted the proposal laid too great an emphasis on monitoring physical variables.
- 19 Following these presentations the Chairman invited participants to consider the principles and objectives as outlined in the draft proposal. A frank and extended discussion ensued, covering detailed consideration of the goals, objectives and principles. These discussions covered inter alia consideration of the nature of monitoring to be included in the system (whether it should concentrate on ascertaining trends; on research monitoring; or, on monitoring of spatial pattern); issues of data quality; and the need to use the system for referral and accessing existing data and data sources.
- 20 Following initial discussion, a listing of over thirty phenomena were identified by the meeting as being important in any consideration of climate change in coastal and near-shore areas. It was recognized that coastal and near-shore areas represent a complex of interacting sources of change (global climate, anthropogenic) which results in a need to identify systems and phenomena which might be expected to provide clear indications of change.
- 21 Phenomena were initially divided into three major groups: physical, biological and biogeochemical and the meeting considered priority rankings within each group. Phenomena considered to be of high priority within the group of physical phenomena were sea level changes, coastal circulation, cyclones/storminess (including storm surges); among the biological phenomena plankton community structure, primary production and algal blooms; and in the biogeochemical grouping sedimentation, salinity intrusion and organic carbon accumulation in sediments.
- 22 It was recognized that this listing was far from exhaustive but that an all encompassing programme would be impossible to launch given the limited resources available and that there was a need to demonstrate the feasibility of managing various physical, chemical and biological data through a single system. Three working groups were therefore established to consider priorities for action among the phenomena and variables considered and to advise on the mechanisms whereby a pilot phase could be initiated to provide a starting point for the system as a whole.
- 23 The working group on the physical oceanographic aspects of climate change and its impacts on coastal environments met to consider suggestions made in plenary regarding physical components of the system. It was evident that these were of two types: firstly, physical components are required in support of the biological and biogeochemical elements of the system and would need to be defined following consideration of the particular needs of these

elements. Secondly, the physical phenomena which are expected to show variations as the result of global climate change and which can be used as indicators of that change and/or must be measured to evaluate the impact of climate change on the coastal environment. In the latter category the working group identified the change in sea-level and various aspects of the coastal circulation as being important. Pilot projects were proposed in outline to cover both of these identified priority areas.

24 The working group formed to consider several biogeochemical factors related to a global coastal ocean observing system, considered assessment of changes in the cryosphere - sea ice and glaciers, and recommended that this aspect of the earth climate system be addressed by other sections of the ocean observing system. The importance of methane production in coastal systems and the coastal sulphur cycle were briefly discussed as being significant in the earth's radiation balance. It was concluded that these will be important areas for research during the 1990s, but that it is premature to design a global coastal methane or gaseous sulphur compounds monitoring programme. Four areas were ultimately identified for physical and geochemical monitoring in a global coastal ocean observing system: (i) coastal sediments as a sink for fossil fuel carbon; (ii) riverine inputs of water, dissolved substances, and particulate material; (iii) the inventory of fresh waters and monitoring of salt water intrusion (surface and ground waters) that affects the potable water supply for increasing coastal populations; and (iv) shifts in shoreline resulting from sea level rise, changes in sediment budget, and changes in patterns of erosion and accretion. Each of these areas has direct links to global climate change, and each has significant consequences for human habitation and utilization of coastal regions.

25 The working group concerned with biological phenomena discussed the monitoring of among other things; primary productivity, algal bloom frequency, intensity and extent; coral bleaching; plankton species composition; growth rates of marine organisms; zonation, species composition and dominance among benthic communities; marginal ecosystems; coastal terrestrial vegetation and wetlands. It was considered that initial activities for implementation in the pilot phase of the system should cover representative systems which could be expected to respond to climate change. Mangroves were selected as representative of coastal vegetation, coral reefs as representative of benthic coastal communities and plankton community structure in temperate and sub-polar latitudes as representative of pelagic ecosystems.

26 The importance of the socio-economic implications of climatic changes was stressed. It is expected that the long-term monitoring system, particularly in its post pilot-phase, will contribute significantly to the better understanding and development of predictive capabilities for such implications.

4. FURTHER DEVELOPMENT AND FUTURE IMPLEMENTATION OF THE GLOBAL COASTAL AND NEAR-SHORE MONITORING SYSTEM

27 The working group reports were presented to the meeting which agreed to replace section 6 of the original proposal with newly drafted paragraphs reflecting the justification for the variables selected for inclusion in the monitoring system and a new section 11 detailing the selected pilot phase activities. It was agreed that the separate reports would be integrated by the rapporteur and the revised proposal reflects the agreement of the meeting concerning the pilot phase, selection of variables, sites and justification for these activities.

28 The integrated working group reports and proposals were considered and adopted by the meeting and the entire proposal was approved in its revised form (Annex III).

29 During the course of the discussions, it was indicated that a considerable number of agencies and programmes had been invited to participate in the present meeting and to indicate their interests in, and possible modes of contribution to, the proposed system. It was suggested that various other agencies and programmes, specifically Unesco through its COMAR programme, could contribute to the proposed initiative.

5. **RECOMMENDATIONS TO THE GOVERNING BODIES OF UNEP, WMO AND IOC CONCERNING THE DEVELOPMENT OF THE SYSTEM AND PROPOSED PLAN OF ACTION**

30 A draft recommendation was considered and amended by the meeting which agreed to recommend the adoption of the general concept of the system and the implementation of pilot activities to initiate it. The recommendation as approved is attached in Annex II of this report.

6. **ADOPTION OF THE REPORT OF THE MEETING**

31 The meeting considered and approved the draft summary report presented by the rapporteur and requested the Secretariat:

- (i) to prepare an edited version of the report reflecting the changes agreed by the meeting;
- (ii) to circulate the edited version of the report for comments by the meeting participants; and
- (iii) to issue the final version of the report, taking into account the comments received by 15 January 1991.

7. **CLOSURE OF THE MEETING**

32 In closing the meeting the Chairman thanked participants for their constructive comments and hard work during the week which had resulted in substantial improvement and advance of the proposal. The meeting was formally concluded at 18h45 on Friday 14 December 1990.

ANNEX I

AGENDA

1. **OPENING OF THE MEETING**
2. **ADMINISTRATIVE ARRANGEMENTS**
 - 2.1 **ELECTION OF OFFICERS**
 - 2.2. **ADOPTION OF THE AGENDA**
 - 2.3 **CONDUCT OF THE MEETING**
3. **LONG-TERM GLOBAL MONITORING SYSTEM OF COASTAL AND NEAR-SHORE PHENOMENA RELATED TO GLOBAL CLIMATE CHANGE**
4. **FURTHER DEVELOPMENT AND FUTURE IMPLEMENTATION OF THE GLOBAL COASTAL AND NEAR-SHORE MONITORING SYSTEM**
5. **RECOMMENDATIONS TO THE GOVERNING BODIES OF UNEP, WMO AND IOC CONCERNING THE DEVELOPMENT OF THE SYSTEM AND PROPOSED PLAN OF ACTION**
6. **ADOPTION OF THE REPORT OF THE MEETING**
7. **CLOSURE OF THE MEETING**

ANNEX II

ADOPTED RECOMMENDATION

The meeting recommends that the Secretariats of UNEP, IOC and WMO bring the proposal on the establishment of a Long-term Global Monitoring System of Coastal and Near-Shore Phenomena Related to Climate Change to the attention of their respective Governing bodies, with the request to:

- (i) endorse the concept and objectives of the proposed Long-term Global Monitoring System of Coastal and Near-Shore Phenomena Related to Climate Change and specifically the proposal to initiate it through the pilot phase;
- (ii) provide guidance and directives on actions needed to initiate planning and implementation of the pilot phase, and help to identify resources that can be made available for its implementation;
- (iii) consider the establishment of an interagency mechanism required for planning, co-ordination and implementation of the pilot phase; including financial implications, taking into account existing co-ordination mechanisms and relevant programmes and activities of UNEP, IOC and WMO; and
- (iv) provide advice on the appropriate manner in which information on the system including its pilot activities may be brought to the attention of the 1992 United Nations Conference on Environment and Development (UNCED).

ANNEX III

PROPOSAL ON LONG-TERM GLOBAL MONITORING SYSTEM OF COASTAL AND NEAR-SHORE PHENOMENA RELATED TO CLIMATE CHANGE

1. INTRODUCTION

1.1 Recognizing the lack of a comprehensive programme for monitoring climate related changes relevant to coastal and near-shore areas,¹ the secretariats of the United Nations Environment Programme (UNEP), the Intergovernmental Oceanographic Commission of Unesco (IOC), and the World Meteorological Organization (WMO) undertook the development of a proposal for a long-term monitoring system for coastal and near-shore observations, to provide data on global changes, with special reference to those associated with or attributable to the various impacts of expected climate change.

1.2 The proposal was intended as a direct contribution and input into the monitoring and assessment discussed under the auspices of the Intergovernmental Panel on Climate Change (IPCC) and the Second World Climate Conference (SWCC), and as a contribution to the process leading to the 1992 United Nations Conference on Environment and Development (UNCED).

1.3 The draft of the proposal was reviewed by the UNEP-IOC-WMO Meeting of experts on Long-Term Global Monitoring System of Coastal and Near-Shore Phenomena related to Climate Change (Paris, 10-14 December 1990). The proposal, as revised by the meeting, is presented in this document.

2. GOAL AND OBJECTIVES

2.1 The goal of the proposed coastal and near-shore monitoring system is to contribute to: (i) the global, regional and national efforts to assess climate change and the environmental and socio-economic impacts of this change and, (ii) the development and implementation of policies and measures designed to mitigate the undesirable effects of the expected impacts. Specific objectives are:

- (a) to provide a framework for a long-term monitoring system for coastal and near-shore observations of physical, geological, chemical and biological variables or phenomena, with particular reference to changes which may be associated with, or attributable to, the impact of expected climate changes;
- (b) to identify short and long-term changes in the variables and phenomena monitored and to forecast where possible the magnitude of future changes;
- (c) to obtain the data required to test models relevant to climate change in coastal and near-shore areas;
- (d) to serve as a timely warning mechanism for threats which may be associated with anthropogenic and climate change impacts in coastal and near-shore areas;

In the context of this document "coastal and near-shore areas" are arbitrarily defined as the landward part of the oceans from the outer limits of the exclusive economic zones together with the adjacent terrestrial environment which influences or is influenced by that part of the oceans.

- (e) to facilitate international and intergovernmental co-operation in monitoring, assessing and anticipating environmental threats related to the impacts of climate changes;
- (f) to involve and assist developing countries' participation in the planning and implementation of activities carried out under the monitoring system; and,
- (g) to facilitate access to and exchange of data generated through other relevant programmes and activities.

3. PRINCIPLES

3.1 The monitoring system should be:

- (a) considered as an integral part of the United Nations system-wide EARTHWATCH and the Global Climate Observing System; and specifically as a response to several resolutions of the United Nations General Assembly² dealing with issues related to climate change;
- (b) based on observations and data included within the framework of the system, which are collected using appropriate standardized methods and procedures;
- (c) implemented by networks of institutions and experts, taking into account and building upon the on-going and planned, national and international (regional and global) programmes and activities relevant to the monitoring and assessment of the impacts of climate changes. The system should incorporate, to the fullest extent possible, data generated by these programmes and activities and should not duplicate any of their efforts;
- (d) designed to make available to governments and interested individuals data generated by, or through, the monitoring system;
- (e) co-ordinated under a joint UNEP-IOC-WMO arrangement, in close collaboration with relevant UN bodies and international scientific organizations and programmes, with IOC providing the day-to-day co-ordination of agreed activities;
- (f) guided on policy matters by a group of government representatives who will consider the system from the perspective of its relevance to the socio-economic impacts of climate change; and,
- (g) guided on scientific technical and socio-economic matters by meetings of experts selected in their personal capacity by UNEP-IOC-WMO.

4. JUSTIFICATION

4.1 The use of the coastal and near-shore zones by human populations is multi-faceted, involving: the use of living and non-living resources (80 percent of the world's fish supply comes from within 9 km of the coast); settlement, tourism and recreation; waste discharge and disposal; mariculture; and use of the coast as the focus for transport systems supporting trade and exchange between countries.

² Resolution 44/206 on Possible adverse effects of sea-level rise on islands and coastal areas, particularly low-lying coastal areas.

Resolution 44/224 on International co-operation in the monitoring, assessment and anticipation of environmental threats and in assistance in cases of environmental emergencies.

4.2 The consequences of existing human activities on the quality of the coastal and near-shore environment is already a cause of concern to Governments in many regions. Causes of the present problems are diverse, but are fundamentally a reflection of increased population pressures resulting in high levels of demand on space and on natural resources.

4.3 Added to these currently pressing issues is the concern of many Governments surrounding the potential consequences of climate and other global and regional changes (including sea level rise) in coastal areas, consequences which will exacerbate an already critical situation in many regions of the world.

4.4 The impacts of climate change are expected to be both diverse and extensive, and will include alterations of physical, chemical, biological and socio-economic elements. Consequently, the environmental and social problems associated with the potential impacts of predicted climate change in coastal and near-shore areas may prove to be among the major problems facing mankind in the not too distant future.

4.5 The interaction between the oceans, the atmosphere and the terrestrial environment is nowhere so important as in the coastal and near-shore zone. Therefore, the phenomena and the processes occurring at the interfaces of these three systems cannot be fully understood and interpreted if examined separately.

4.6 Mankind's timely and effective response to the impacts of climate change in coastal areas will largely depend on the quality of information concerning the rate and magnitude of the expected changes, and the impact of these changes on natural and man-made systems, including present socio-economic structures and activities.

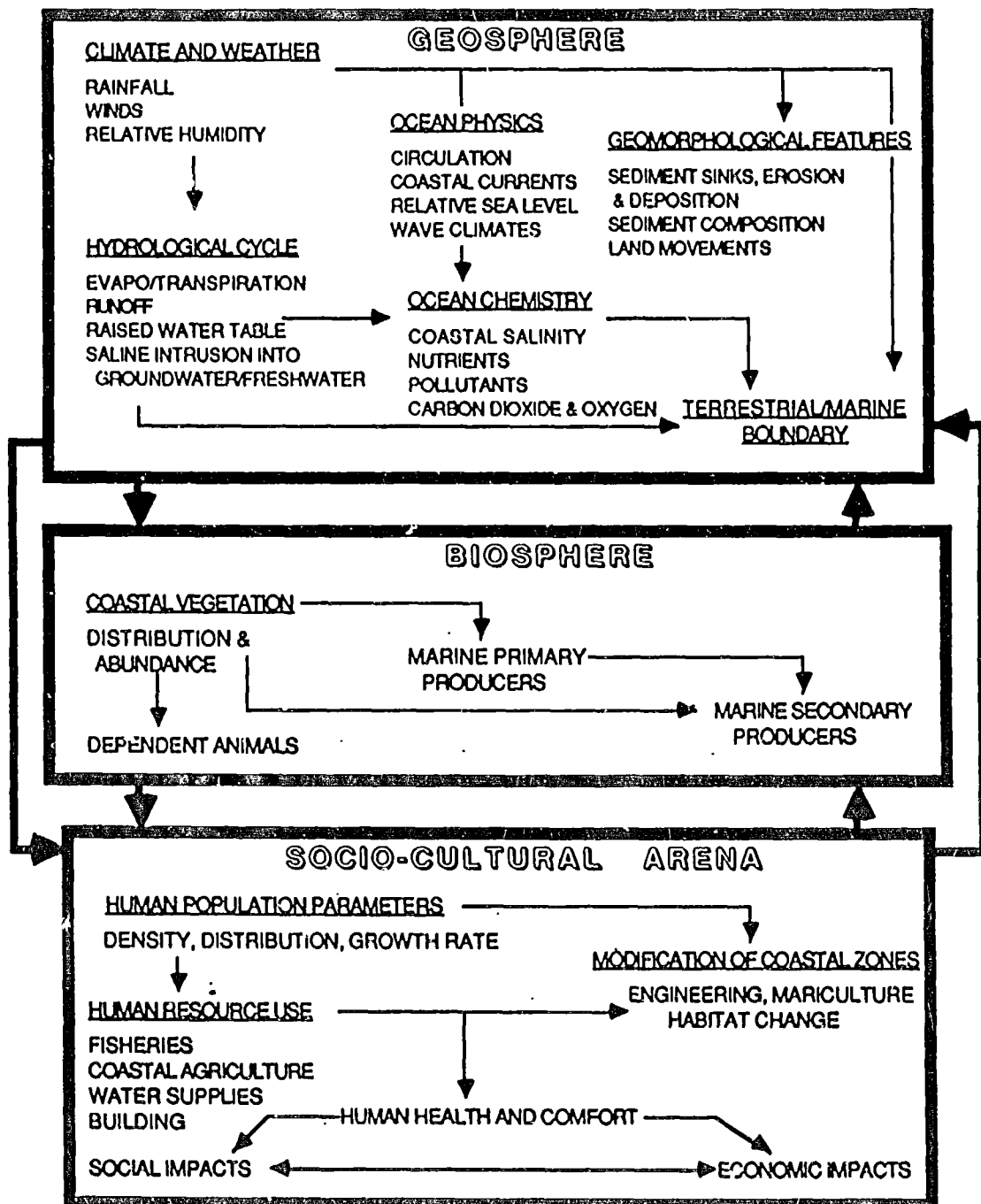
4.7 A number of existing regional and global programmes contribute to a better understanding of the processes causing climate change and to an improved assessment of the rate and magnitude of expected changes. None of these programmes is designed, however, to monitor and document the full complexity of changes in coastal and near-shore zones on a long-term basis.

4.8 Monitoring and documenting changes in coastal and near-shore zones require a global and inter-disciplinary approach that integrates physical, chemical, biological and geological observations and measurements with socio-economic uses of the coastal zone (Figure 1). Sectoral approaches will fail to achieve the consistent, global perspective required for effective responses to climate change.

4.9 The expected outputs of an integrated monitoring system would contribute to the rational scientific basis needed for development of global, regional and national policies and measures which may be formulated and implemented in order to avoid or reduce the negative impact of expected climate change.

Figure 1

MAJOR FIELDS IN WHICH PARAMETERS NEED
TO BE MEASURED TO ASSESS CHANGES IN
COASTAL ZONES



5. LINKAGES WITH OTHER PROGRAMMES

5.1 All data will be collected by institutions, frequently for more than one purpose including national, regional, and international operational and/or research programmes. Consequently, the proposed System will have many linkages, and will support and be supported by relevant data from a number of programmes and systems. Of specific importance will be:

- (a) data on certain physical and chemical variables collected and disseminated through existing systems such as the Global Sea Level Observing System (GLOSS), the Integrated Global Ocean Services System (IGOSS), the World Weather Watch (WWW) and the Global Atmosphere Watch (GAW);
- (b) information on global oceanic processes common to both open ocean and near-shore areas generated by programmes and activities such as the Tropical Ocean Global Atmosphere (TOGA), the World Ocean Circulation Experiment (WOCE), the Global Energy and Water Cycle Experiment (GEWEX), Climate System Monitoring (CSM), Joint Global Ocean Flux Study (JGOFS) and the proposed core projects of the International Geosphere Biosphere Programme (IGBP);
- (c) data to be collected through the IOC-WMO Global Ocean Observing System (GOOS) and other elements of the Global Climate Observing System;
- (d) data on atmospheric, oceanic and terrestrial physical, chemical and biological variables collected in the coastal and near-shore zones through numerous regional and national programmes, selected on the basis of their relevance to the global assessment of changes planned to be provided through the system proposed in this document.

5.2 Thus, the flow of data generated by these systems, programmes and activities and by the proposed system will be in both directions, contributing ultimately to a more effective integration of all activities into a general global framework.

6. PHENOMENA TO BE CONSIDERED

6.1 The proposed coastal ocean observing system should focus on major climate-related phenomena which are identified in the following paragraphs. There is a further need to define a vision of what type of coastal ocean observing system should ultimately exist.

6.2 In the physical domain it is recognized that certain variables should be monitored, not only to provide a baseline for detecting changes in the physical environment but also as an integral component of the monitoring of biological environments. The framework for physical measurements in coastal waters may take the form of transects or sections and/or off-shore reference stations for continued measurements of some parameters depending on the location and nature of expected changes. When extended off-shore, the physical measurements could provide a link with the domain of the Global Ocean Observing System (GOOS).

6.3 Sea-level change should be determined from land-based locations, on the basis of hourly records. The gauges would need to be fixed in geocentric co-ordinates through geodetic location of bench marks, thus allowing for separation of vertical land movement from changes in mean sea-level. Storm surges could be determined from the same data by removing predictable tidal water level variation from the hourly data.

6.4 Heat and freshwater content determinations could be based on regular/seasonal, shore normal sections measuring profiles of temperature, salinity, total suspended solids, nutrients and chlorophyll-a, from stations near-shore towards the outer edge of the coastal and near-shore zone. In many coastal environments, these sections will need to be supplemented by more

frequent/continuous measurements of some of the parameters. These data could be used to identify the horizontal position of a turbid coastal boundary layer and stratification as a determinant of algal blooms. Changes in heat content, freshwater content, location of the horizontal position of the coastal boundary layer and chlorophyll-a content could then be determined by analysis of time series for each parameter. River discharge and satellite imagery (AVHRR, Ocean Color, Altimetry and observations by Landsat, Spot, etc.) should be used simultaneously to aid in these analyses.

6.5 Global climate change is expected to result in variations in the large-scale wind patterns and perhaps the intensity and location of storms. This will result in changes in the wave climate on both global and local scales and thus varying impacts on the coastal zone. Global changes could be ascertained from large-scale wave models driven by output from atmospheric GCM's and measurements from satellite sensors. Determination of local changes in the wave climate would be aided by local measurements of meteorological variables and the waves themselves.

6.6 Changes in benthic organic carbon content could be determined from benthic cores collected every five years in the marginal vegetation area, benthic zone and pelagic shelf region. The total sedimentation rate, organic carbon content, and that fraction of the latter permanently buried, would be determined as one component of the anthropogenic carbon budget to assess how much CO₂ will remain in the atmosphere. Changes in organic content could be determined from successive sediment cores.

6.7 Saltwater intrusion, changing riverine inputs to coastal waters, and shoreline change, while of concern, are characterized by large natural variation and anthropogenic influence. Resolving climate-change driven signals in them would require extensive monitoring at the national level, covering not only the variables of direct interest (e.g. shoreline position, river exports), but also the other controlling variables (e.g. land use, water use, coastal use). The monitoring system should endeavour to compliment the relevant national monitoring programmes and case-studies.

6.8 The strategy of measurement of biological phenomena should allow for different levels of involvement depending upon available technical capabilities and resources, but should include observations in the three coastal and near-shore zones:

- (a) Marginal vegetation
- (b) Benthic near-shore communities
- (c) Pelagic coastal ecosystems

6.9 Recognizing the complexity of inter-acting factors causing change in coastal and near-shore areas, and recognizing further the need for selection of pilot activities which are feasible and practical for immediate implementation and which would provide a high probability of detecting climate change signals, a limited sub-set of phenomena (Table 1) have been selected which could be monitored, as part of a pilot phase for the system, on the basis of a series of integrated physical, geological, biological and chemical variables (Table 2).

6.10 The relationship between the phenomena and variables to be included in the pilot phase is indicated in Figure 2. It should be recognized that not all these variables will be monitored simultaneously at all sites, but initial selection of variables will reflect financial, logistic and local expectations with respect to each site. Where possible, sites selected for implementation of pilot phase activities should be coincident. Pilot phase activities are outlined in section 11.

Table 1 SUB-SET OF PHENOMENA CONSIDERED FOR INCLUSION IN THE
PILOT PHASE OF A LONG-TERM GLOBAL COASTAL AND NEAR-SHORE MONITORING SYSTEM

PHYSICAL

Sea Level Change	$\Delta t = 1 \text{ hr}$
Heat Content Change	$\Delta t = \text{seasonal}$
Freshwater Content Change	$\Delta t = \text{seasonal}$
Horizontal Position of the Turbid Coastal Boundary Zone	$\Delta t = \text{seasonal}$

BIOLOGICAL

Marginal Vegetation: Mangroves	$\Delta t = 5 \text{ yrs}$
Changes in Latitudinal Extent	
Changes in Zonation	
Changes in Species Composition	
Benthic Coastal: Coral Reefs	$\Delta t = 1 \text{ yr}$
Bleaching (frequency and extent)	
Changes in Species Composition	
Changes in Areal Extent	
Pelagic:	$\Delta t = \text{monthly}$
Changes in Plankton Community Structure	

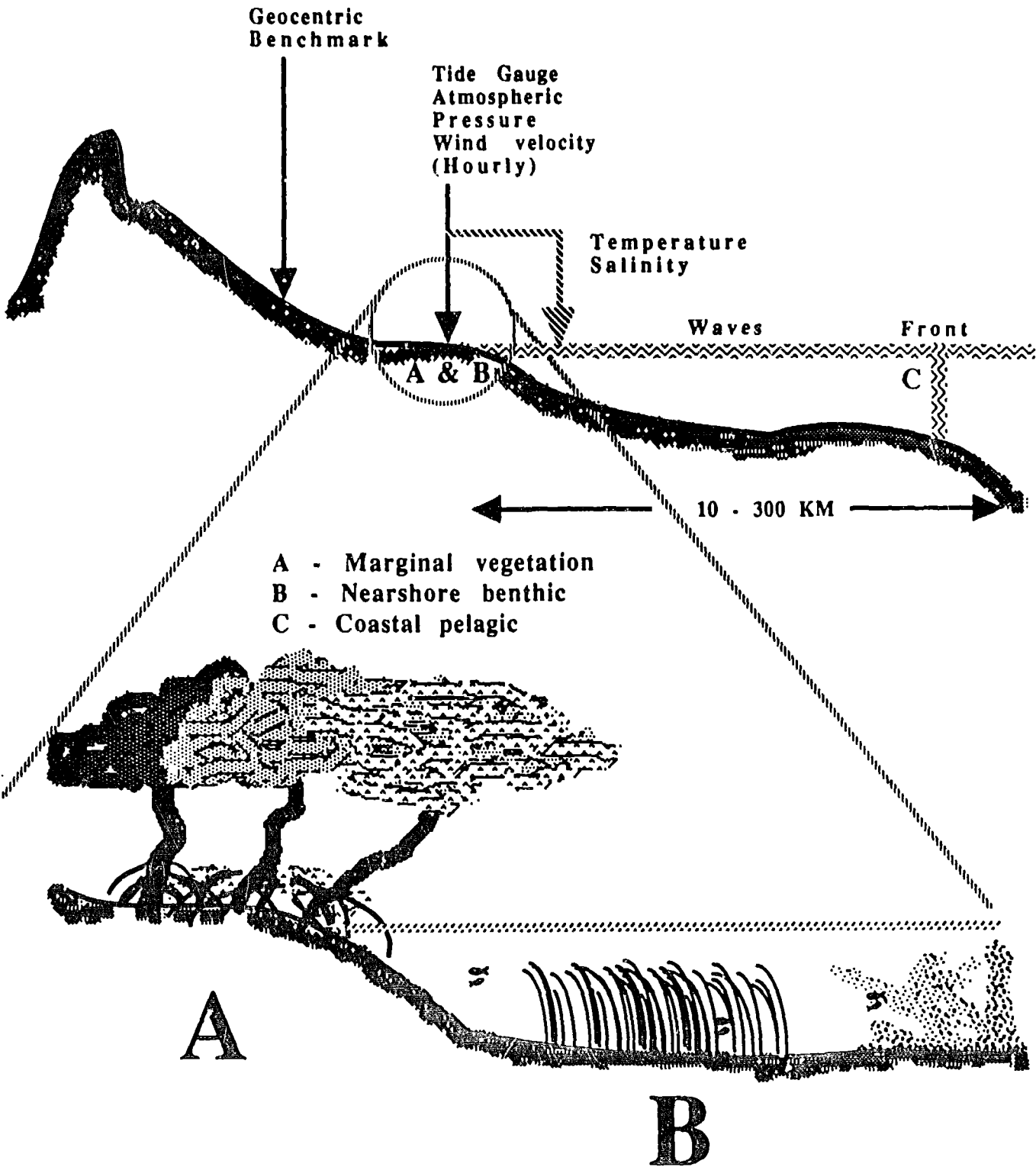
CHEMICAL

Coastal Nutrient, Flux Changes	$\Delta t = \text{seasonal}$
Riverine Input Changes	$\Delta t = \text{monthly}$
Coastal Organic Carbon Accumulation	$\Delta t = 5 \text{ yrs}$

Table 2 **MINIMUM SET OF VARIABLES TO BE MEASURED AS COMPONENTS
OF THE LONG-TERM MONITORING SYSTEM (* A, B AND C REFER TO
THE FIELDS ILLUSTRATED IN FIGURE 2)**

	A*	B	C
PHYSICAL			
Temperature	+	+	+
Salinity	+	+	+
Sea Level (pressure corrected)	+		
Waves		+	
Winds	+		+
River Discharge	+		
Insolation (normalized cloud cover)		+	+
Currents	+	+	+
BIOGEOCHEMICAL			
Organic Carbon	+	+	+
Total Suspended Solids	+	+	
Chlorophyll-a		+	+
Nutrients		+	+
Oxygen		+	+
BIOLOGICAL			
Zonation	+	+	
Species Composition	+	+	+
Cover	+	+	
Abundance	+	+	+
Biomass	+	+	+

Figure 2 **DIAGRAMATIC REPRESENTATION OF THE FIELDS WITHIN WHICH
VARIABLES AND PHENOMENA ARE TO BE MEASURED**



7. SITES

7.1 While all sites which will be considered part of the proposed system will be located in the coastal and near-shore areas, distinction is made between:

- (a) Global sites which could serve as long-term stations for the collection of information indicating global changes; they should be located in "far-field" environments, where direct anthropogenic influences and the influences of factors other than climate changes are reduced to a minimum. These sites should be representative of the major biogeographic regions of the world;
- (b) Regional sites which could serve as long-term stations for the collection of information indicating changes relevant to specific regions; the requirements for location of these stations will be the same as those for the sites under (a) above; and
- (c) national sites which could serve as short- and medium-term stations and will provide site-specific information on the changes; their location will span the full range of near- and far-field conditions, and will be determined in co-operation with the appropriate national authorities.

7.2 Advantage should be taken of the vast number of sites monitored at present in the framework of various national and regional programmes for purposes related to the goals of this system.

7.3 In the selection of new sites consideration should be given to the existence of data sets which have already been or may be analyzed in the future to elucidate past climate changes. Likewise, the availability of national infrastructures which may contribute to the operation of the sites, should be taken into account.

8. METHODS

8.1 In systems, programmes and activities operated or supported by IOC, WMO and UNEP standardized methods and procedures have been developed, adopted and applied for sampling, analysis, observation, and data processing (analysis, reporting, quality control, reduction, dissemination, etc.) of relevant variables and observations. Whenever applicable these methods should be used.

8.2 In the selection of new or additional methods and procedures the following considerations should be kept in mind:

- (a) full use of currently available technologies;
- (b) desirable mix of in situ and remote sensing techniques;
- (c) accuracy, precision and reproducibility of results;
- (d) the requirement for appropriate statistical analysis;
- (e) ease of application; and,
- (f) capital investment and recurrent costs.

8.3 A permanent data quality control programme should be established which should include, inter alia, sampling techniques, intercalibration of methods, standardization of methods, data format and processing, and agreed levels of precision and accuracy.

8.4 In view of the long-term nature of the proposed programme, the development of new technologies will result in better methods which may replace those used in the initial phase of the programme. Careful intercalibration between the method in use and the proposed new method should be carried out before the adoption of the new method. A suitable period of simultaneous use of both methods should also occur, to ensure long-term continuity and comparability of data.

8.5 By the end of this century, measurements derived from satellite-based sensors will be invaluable for obtaining a global perspective of changes in the coastal ocean. The feasibility of determining from satellites, variations in cloud cover, sea surface temperature, surface chlorophyll-a concentration, sea surface elevation, sea ice, and sea surface wind patterns have all been demonstrated to date. International commitments should be made to ensure operationally based satellite remote sensing to support the needs of both the long-term global monitoring system of coastal and near-shore phenomena related to climate change. On local and regional scales aircraft remote sensing can provide cost effective data on a broad scale and from inaccessible areas.

8.6 Encouragement should be provided for the development and application of new technologies during this decade, including Doppler radar wind field and surface current monitoring and moored arrays or bottom mounted instrument packages for physical, chemical, and biological variables. Numerical models are being developed to provide a basis for assimilation of diverse data sets and for new predictive capabilities in the coastal ocean.

9. DATA MANAGEMENT

9.1 The database of the system proposed in this document will consist of:

- (a) selected data generated by the systems, programmes and activities reviewed in Section 5 of this document; and
- (b) data generated by monitoring carried out directly under the system proposed in this document.

9.2 The procedures already adopted and used for management of data generated by systems, programmes and activities listed in Section 5 will obviously remain unchanged.

9.3 Participants in the proposed system may wish to consider in due time the establishment of new specialized data centres for individual variables or observations, preferably in conjunction with existing international and national centres, such as IGOSS, IODE and GLOSS data centres. The establishment of such regional and global centre(s) consolidating the information concerning individual variables and observations, or sets thereof, may be envisaged at a later stage of the programme's development.

9.4 Processed datasets and analyses will be published in a timely manner and will be made available to Governments, international and non-governmental organizations, as well as to interested individuals. Datasets will be periodically transmitted to existing relevant data centres.

10. IMPLEMENTATION

10.1 The long-term global monitoring system of coastal and near-shore phenomena related to global climate change, as proposed in this document, is intended to be based on:

- (a) work of institutions organized in networks dealing with monitoring of individual variables or phenomena, or of sets thereof; and
- (b) data expected to be received through systems, programmes and activities referred to in Section 5 of this document.

10.2 Participation in the system will be open to all interested institutions. In order to ensure the broadest possible involvement of institutions and experts in the proposed system, assistance (expert advice, training, equipment) should be provided to national institutions from developing countries.

10.3 The system is planned to be implemented in phases, starting with a pilot phase which would include only a few variables and observations on a limited number of sites. The pilot phase will last for a period of three

years, at the end of which time a review of the implementation will be undertaken in order to decide upon the continuation of the system.

10.4 During the pilot phase the system will be jointly sponsored by UNEP, IOC and WMO, and will be under the general guidance and joint supervision of the UNEP-IOC-WMO secretariats with IOC providing the day-to-day co-ordination of agreed activities on behalf of the system's co-sponsors.

10.5 As part of the review of the pilot phase, recommendations will be made to the governing bodies of sponsoring agencies concerning the possible methods for policy guidance and scientific and technical direction which might be established for longer term management of the system.

11. PILOT PHASE

11.1 The Pilot Phase will be needed in order to define and develop the major elements and mode of operation of the future global monitoring system which will eventually include systematic measurements of various physical, biological and biogeochemical variables in different geographic conditions. Initial activities have therefore been identified to provide coverage of selected variables and phenomena which are both economically important and deemed to be sensitive to climate change. The following six inter-related activities are recommended for inclusion in the pilot phase of the system:

Activity 1. Sea level changes and coastal flooding

Justification

The analysis of tides and sea level has practical importance, not only from an understanding of meteorologically induced storm surges but also for the calculation of the return period for extreme events. On an operational basis sea level data are needed as input to flood warning procedures and a basic requirement for developing such a capability is several years of good quality sea level data.

Probabilities of coastal flooding may change both in response to mean sea level rise, and in response to changes in weather patterns. For assessing total flooding risks, wave climates and their changes must also be monitored. Hourly measurements of sea level over long periods provide the basic data needed to identify changes in the statistics of extreme levels and hence changing probabilities of coastal flooding.

Sites

A global network of gauges is being developed under the IOC, Global Sea Level Observing System (GLOSS) with a primary goal to identify changes in the total volume of water in the oceans. For local coastal impact studies and design requirements every coastal area liable to flooding should have at least one sea level recorder operating to GLOSS standards. They should also have in place procedures for identifying wave climates and changes. Sites selected for inclusion in this pilot phase will be determined in consultation with the UNEP-IOC Regional Task Teams on the implications of climate change.

Measurement requirements

Details of the basic requirements for sea level measurement are provided in IOC-XV/8 Annex 4, essentially each sea level station should aim to satisfy the basic requirements, outlined therein. Sea level measurements should be accompanied by observations of atmospheric pressure, and winds which are of direct relevance to sea level data analysis.

As data products are made available and analyzed the correlation between mean sea level and climatic phenomena will become clearer, as will their application to forecasting. In combination with technological advances it is anticipated that this will lead eventually to near-real-time reporting

of such data.

Data management

There are already agreed procedures and formats for sea level data exchange: these will also be used for the planned system and will include reporting of monthly mean sea level to the Permanent Service for Mean Sea Level while hourly and more frequent data will be held by national authorities and made available as required for regional studies and flood warning systems.

Implementation

The technology and local resources required for a long-term sea level monitoring programme are modest, and such measurements represent a minimum yet very valuable oceanographic commitment from countries which do not yet have the resources available for more elaborate coastal monitoring programmes.

As part of the pilot phase selected regional components of the GLOSS network will be developed with priority being assigned to those areas already identified through the UNEP-IOC Regional Task Teams on the implications of climate change; and major cities which have problems of subsidence increasing the potential impacts of sea level rise. Local authorities will be encouraged to contribute to the cost of these co-operative studies and in return will receive assistance in evaluating their local risks as an input to developing adaptive strategies.

Activity 2. Coastal circulation

Justification

The circulation on the continental shelves, including the temperature and salinity of the water, is expected to change in many regions as a result of changes in local heating, evaporation and precipitation, freshwater run-off, forcing by the wind, and the open ocean circulation. The details of existing and future circulation patterns will depend on a number of additional factors such as topography and residual tidal currents. Depending on the region, measurements of changes in the circulation will provide direct observations of the local effects of global climate change and input to the assessment of its impacts.

Sites

The location of monitoring sites to ascertain changes in the coastal circulation should be determined by:

- (a) the likelihood that climate changes are observable in a particular location;
- (b) the existence of long-term records, extensive data sets, and ongoing programmes from which to evaluate the effects of climate change;
- (c) available instrumentation, expertise, and locally available resources.

Measurement requirements

Determination of changes in residual currents and circulation is a complex matter, which requires a combination of data on temperature, salinity, currents, sea-level (atmospheric pressure corrected), winds, and certain long-shore aspects of the off-shore circulation as well as the analysis of satellite imagery. The most appropriate sampling strategy must be determined locally, based on available facilities and resources.

Changes in the coastal circulation can be detected through shore-normal sections of temperature and salinity which can be used to resolve seasonal and long-term changes in the heat and freshwater content of the coastal ocean, and may be related to components of the circulation. Deep water temperature/salinity stations permit analysis and computation of changes in steric effects and their contribution to coastal sea-level change.

To the fullest possible extent numerical models should be developed and applied to coastal ocean systems to ascertain changes in the circulation in response to changes in forcing. Such models can be effectively used to assimilate data from a number of observation systems and to ascertain changes in the circulation arising from climate changes.

Data management

The data generated through this pilot activity should be stored under existing national agreements and exchanged as a part of existing international arrangements.

Implementation

The implementation of this pilot activity will depend on locally available expertise, facilities and resources, and will rely initially on existing national efforts, co-ordinated with the on-going IOC initiative in coastal ocean circulation dynamics and fluxes.

Activity 3. Assessment of organic carbon accumulation in surface coastal sediments

Justification

Approximately 25% of the anthropogenic carbon flux is unaccounted for by known atmospheric and oceanic sinks, some of this fraction may be deposited in coastal sediments. Knowledge of this potential sink is necessary if we are to reliably balance the carbon budget.

Sites

May be selected either to provide a global picture of organic carbon deposition in coastal sediments or initially to provide an indication of the relative importance of different coastal formations as carbon sinks.

Measurement requirements

Requirements include, total carbon, total sediment measured at five yearly intervals.

Data management

The volume of data generated through this activity would be relatively small and could be handled by regionally appointed lead institutions or agencies, participating in the activity, with global co-ordination to ensure regional consistency.

Implementation

Initially this effort should be directed towards compilation of a database of existing values for organic carbon and its relationships to other sediment properties such as grain size. There should also be a review of the analytical procedures, and the development of inter-calibration exercises to establish the methodologies and analytical procedures.

Activity 4. Changes in plankton community structure

Justification

The partitioning of observed variation between that which is due to

climate and that which reflects other sources of change dictates a careful choice of the biological systems selected for initial inclusion in the monitoring programme. Temperate plankton communities are considered sensitive indicators of climate change and may therefore provide a more obvious and less ambiguous response to global warming than the physical environment itself. In addition, through biogeochemical cycling in the highly productive coastal zones of the world plankton may have significant feedbacks on climate regulation; and the general problem of assessing the future sustainable yield of living resources in coastal seas requires a separation of climate impacts from those related to man's direct exploitation. A switch towards dinoflagellates and certain other species might be expected if reinforcement of stratification were to occur as a consequence of global warming, it may also occur as a consequence of anthropogenically caused eutrophication hence it is important to establish a sound basis for determining the causes of such change.

Sites

The focus will be on the Atlantic temperate and sub-arctic in the first phase due to the existence of a forty year record of established Continuous Plankton Recorder (CPR) data forming a substantial base for future comparison and the existence of long-term, standard hydrographic sections in the North West Atlantic and NW European shelf. Phase 1 will include the re-establishment of CPR routes at numerous crossings of the temperate shelf around the North Atlantic, plus additional data from a few open ocean CPR routes for comparison.

Measurement requirements

In addition to the CPR routes, ancillary measurements will include wind-over-sea, insolation, nutrients, temperature and salinity on sections. Each of the primary and support variables require different scales and frequencies of observation and will be subject to different quality assurance procedures. During Phase 2 the field programme would be extended to selected transects across equivalent latitudes of the Pacific, while in phase 3 a truly global assessment would be initiated incorporating appropriate data from satellite ocean color sensors (SEAWIFS; ADEOS).

Data management

Via existing laboratories and facilities.

Implementation

Via existing laboratories and facilities and later through distance learning aids and visiting research associates.

Activities 5. Benthic communities: coral reef ecosystems

Justification

Coral reefs have a pantropical distribution and are ideal indicators of climate change since their major components, the benthic corals are highly sensitive to environmental forcing. Through careful monitoring of key environmental variables alongside relevant biological variables it should be possible to distinguish climate signals due to temperature, rainfall or other factors from other causative agents such as anthropogenic impacts or biotic interactions.

Sites

A number of sites covering the Caribbean, Indian and Pacific oceans should be selected spanning the range of reef types and degrees of anthropogenic impact. Criteria for site selection should include the

existence of infrastructure which could immediately implement a long-term monitoring programme; the sensitivity of particular reef locations to climatic forcing; and minimal additional anthropogenic sources of change which might obscure the climate signal.

Measurement requirements

Biological variables proposed for inclusion include zonation, species composition and relative cover with changes in cover due to mortality, accelerated growth of certain species, replacement or succession of species or bleaching events being recorded. Standardized methods for monitoring the above components are already in place in certain locations and a logical step would be to link these programmes into a more integrated system. The ASEAN-Australia project "Living Resources in Coastal Areas" has developed a standardized reef survey technique based on the line intercept method which, since it is already in widespread use is a possible candidate for adoption on a global basis.

Key environmental variables which should be monitored would include temperature (daily maxima and minima), salinity, siltation, plus episodic changes due to predation, disease, storms or destructive fishing damage.

Data management

In the initial phase (2-3 years) data will be produced which provides a base-line status report for the reef systems in selected sites. Such base-line data will be of value to coastal zone managers in localities where reefs form a major coastal habitat and consequently a source or renewable resources. During the initial phase, development of standardized formats for data exchange will receive priority attention.

Implementation

It is envisaged that the implementation of the initial phase of the pilot project would be organized by the Task Team established by UNEP and IOC in co-operation with ASPET to examine the impacts of climate change on coral reefs. This group should initially meet to consider selection of suitable sites, adoption of standardized methodologies, and identification of responsible institutions.

Activity 6. Terrestrial vegetation: Mangrove communities

Justification

Mangroves are economically significant in tropical and subtropical regions since they serve as breeding/nursery grounds for commercial and subsistence fish and penaeid prawn stocks, and as a valuable source of timber. It is expected that these communities will respond to climate change forcing and they are already subject to other sources of anthropogenic change.

Sites

A number of sites covering the Caribbean, Indian and Pacific oceans should be selected spanning the range of mangrove community types and varying degrees of anthropogenic impact. Criteria for site selection should include the existence of infrastructure which could immediately implement ground truth surveys to accompany mapping of zonation and extent based on remotely sensed data. In addition, the existence of historic time sequences of satellite images or aerial photographs should be used as a criterion for site selection.

Measurement requirements

It is proposed to initiate a programme to map and monitor mangrove communities at representative sites in terms of their species composition,

zonation, geographic and latitudinal extent since such characteristics are sensitive to changes in sea temperature, salinity, sedimentation inputs, beach composition, and coastal dynamics in terms of sea bottom profile, long-shore drift, erosion and accretion. The most appropriate and cost effective mapping and monitoring technique is digital image technology from satellites and aircraft combined with ground measurement of secondary variables, and it is suggested that a 5 year time interval between mapping periods may be sufficient.

Data management

An informal data exchange mechanism is already operating between professionals involved in mangrove ecosystem studies. The co-operative exchange mechanism could be re-focussed to meet the requirements of this pilot study. The COMAR Mangroves Project could act as a central referral centre for network assistance. The experience of the ASEAN-Australia project in data management could also be drawn upon, among other existing mechanisms.

Implementation

Existing programmes which are already in operation include the ASEAN-Australia marine science project; Australia QNPWS Coastal wetlands mapping project and the COMAR projects. UNEP has indicated its intention to form in co-operation with Unesco a Task Team for the investigation of the impacts of climate change on mangrove communities and it is suggested that this task team should take the lead in defining the nature of the sampling programme and sites for implementation of this element of the pilot phase.

LIST OF ACRONYMS

ASPEI	Association of South Pacific Environmental Institutions
COMAR	Unesco Major Interregional Project on Research and Training leading to the Integrated Management of Coastal Systems
CPR	Continuous Plankton Recorder
CSM	Climate System Monitoring
GAW	Global Atmosphere Watch
GCOS	Global Climate Observing System
GEWEX	Global Energy Water Cycle Experiment
GLOSS	Global Sea Level Observing System
GOOS	Global Ocean Observing System
IGBP	International Geosphere Biosphere Programme
IGOSS	Integrated Global Ocean Services System
IOC	Intergovernmental Oceanographic Commission
IODE	International Oceanographic Data and Information Exchange System
IPCC	Intergovernmental Panel on Climate Change
SWCC	Second World Climate Conference
TOGA	Tropical Ocean Global Atmosphere
UNCED	United Nations Conference on Environment and Development
UNEP	United Nations Environment Programme
WMO	World Meteorological Organization
WOCE	World Ocean Circulation Experiment
WWW	World Weather Watch

ANNEX IV

LIST OF DOCUMENTS¹

Document Code	Title
WORKING DOCUMENTS	
UNEP-IOC-WMO/GCNSMS-I/1	Agenda
UNEP-IOC-WMO/GCNSMS-I/1 Add.	Timetable
UNEP-IOC-WMO/GCNSMS-I/2	Annotated Provisional Agenda
UNEP-IOC-WMO/GCNSMS-I/3	Summary Report
UNEP-IOC-WMO/GCNSMS-I/4	List of Documents
UNEP-IOC-WMO/GCNSMS-I/5	List of Participants
UNEP-IOC-WMO/GCNSMS-I/6	Draft proposal for a long-term monitoring system of coastal and near-shore phenomena related to global climate changes
UNEP-IOC-WMO/GCNSMS-I/7	Summary of Responses to the draft proposal for a long-term monitoring system of coastal and near-shore phenomena related to global change
INFORMATION AND OTHER REFERENCE DOCUMENTS	
UNEP-IOC-WMO/GCNSMS-I/Inf.1	Climate changes and the coastal zone: justification for a long-term monitoring system
UNEP-IOC-WMO/GCNSMS-I/Inf.2	A description and physical oceanographic rationale for IOC-WMO-UNEP long-term monitoring system for coastal and near-shore areas
UNEP-IOC-WMO/GCNSMS-I/Inf.3	International systems, programmes and activities, relevant to the development of a coastal and near-shore monitoring system
IOC-XVI/8 Annex 3	Toward a Global Ocean Observing System (GOOS): A Strategy (IOC Ad hoc Group of experts on Global Ocean Observing System, September 1990)

¹ This list is for reference only. No stocks of these documents are maintained.

IOC/INF-829	Summary Report of the First Session of the IOC <u>Ad hoc</u> Group of experts on a Global Ocean Observing System (Washington, DC, USA, 6-7 September 1990)
IOC/INF-811	The Ocean and Climate
-	GLOSS Brochure
-	Second World Climate Conference - Final Conference Statement Scientific/Technical Sessions
-	Coastal Marine Project (COMAR) Brochure (Unesco)
-	Africa's Coastal Marine Systems (COMAR AF) Brochure (Unesco)
Unesco Reports in Marine Science No. 54	Relative sea-level change: a critical evaluation. Unesco (COMAR) Working Group on Mean Sea-Level Rise and its Influence on the Coastal Zone
CCCO-JSC/OOSDP-I/3	Report of the First Session of the Joint CCCO-JSC Ocean Observing System Development Panel (Alexandria, Virginia, USA, 10-12 September 1990)
-	Draft Programme Plan on Coastal Ocean Circulation Dynamics and Fluxes (COCDYF) (IOC, September 1990)
UNEP(OCA)/WG.8/2	Report of the Joint Meeting of the Co-ordinators of the regional Task Team on Implications of Climate Changes (Singapore, 12-16 November 1990)
-	The Coastal Ocean Prediction Systems - Programme: Understanding and Managing our Coastal Ocean (USA programme, June 1990)

ANNEX V

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