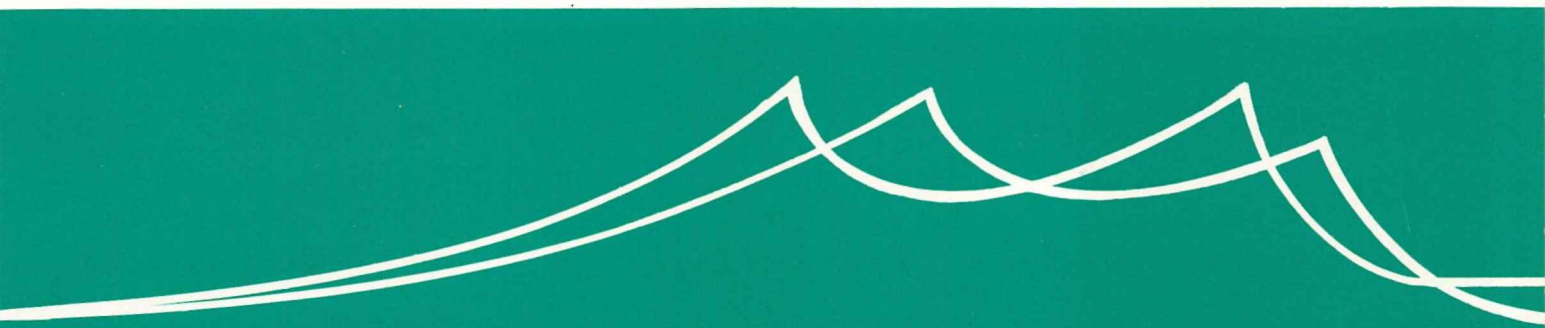
SCIENTIFIC COMMITTEE ON OCEANIC RESEARCH



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INTERNATIONAL COUNCIL OF SCIENTIFIC UNIONS

SCIENTIFIC COMMITTEE ON OCEANIC RESEARCH
THE EXECUTIVE COMMITTEE

President:	Professor J.-O Stromberg Kristineberg Marine Biological Station S-450 34 Fiskebackskil SWEDEN.	Tel: 46-523-22192 Fax: 46-523-22871 Telex: 17073 ROYACAD S OMNET: J.Stromberg
Secretary:	Professor R.O. Fournier Department of Oceanography Dalhousie University Halifax, Nova Scotia B3H 4J1 CANADA	Tel: 902-494-3666 Telex: 7401472 SCOR UC (USA) OMNET: R.Fournier
Past President:	Professor G. Siedler Institut fur Meereskunde Universitat Kiel Dusternbrooker Weg 20 2300 Kiel	Tel: 49-431-597-3890 Telex: 0292619 IFMK D OMNET: G.Siedler Fax: 49-431-565876
Vice-Presidents:	Professor G.R. Heath College of Ocean and Fishery Sciences HN-15 University of Washington Seattle, WA., 98195 U.S.A.	Tel: 1-206-543-6605 OMNET: R.Heath
	Dr. A. Kuznetsov Institute of Oceanology Academy of Sciences of the USSR 23 Krasikova Street Moscow 117218 U.S.S.R.	Tel: 124-59-56 Telex: 411968 OKEAN SU
	Professor T. Asai Ocean Research Institute University of Tokyo 1-15-1 Minamidai Nakano-ku, Tokyo 164 JAPAN.	Tel: 3-376-1251 Telex: 25607 ORIUT J Fax: 3-375-6718 OMNET: ORI.Tokyo
Co-opted Members:	Dr. A. Ayala Castanares Instituto de Ciencias del Mar y Limnologia Universidad Nacional Autonoma de Mexico Apartado Postal 70 - 157 MEXICO, D.F. 04510.	Tel: 52-5-550-5215 X4871 Telex: 1760155 CICME OMNET: A.Ayala Fax: 548-2582
	Dr. Su Jilan Second Institute of Oceanography P.O. Box 507 Hangzhou, Zhejiang 310012 CHINA.	Tel: 886924 Telex: 35035 NBOHZ CN
Ex-Officio: CMG	Professor I.N. McCave Dept. of Earth Sciences University of Cambridge Downing Street Cambridge CB 23 EQ UNITED KINGDOM	Tel: 223-333422 or 3 OMNET: Earth Sci. Cambridge Fax: 223-333450
IABO	Professor P. Lasserre Directeur, Station Biologique 29211 Roscoff FRANCE	Tel: 33-98-69-72-30 Fax: 33-98-61-26-55
IAMAP	Dr. G.B. Tucker CSIRO Division of Atmospheric Research Post Box No. 1, Mordialloc Victoria 3195 AUSTRALIA	Tel: (03) 586 7666 OMNET: CSIRO.DAR.AM
IAPSO	Professor J. O'Brien Mesoscale Air-Sea Interaction Group, B-174 Florida State University Tallahassee Florida 32306-3041 U.S.A.	Tel: 1-904-644-4581 OMNET: J.Obrien Fax: 904-561-1405
Executive Secretary:	E. Tidmarsh Department of Oceanography Dalhousie University Halifax, Nova Scotia B3H 4J1 CANADA	Tel: 902-494-8865 Telex: 7401472 SCOR UC (USA) OMNET: E.Tidmarsh Fax: 902-494-3877

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Additional copies of this publication are available from:
Ms. E. Tidmarsh
Executive Secretary, SCOR
Department of Oceanography
Dalhousie University
Halifax, N.S., B3H 4J1
Canada
Teleph: 1-902-494-8865, Telex: 7401472 SCOR UC (USA)
OMNET: E.Tidmarsh, FAX: 1-902-494-3877

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REPORT OF THE TWENTY-NINTH MEETING OF THE SCOR EXECUTIVE COMMITTEE

Tallahassee, Florida
October 16 - 18, 1989

1.0 OPENING

1.1 Introductory Remarks

The twenty-ninth meeting of the SCOR Executive Committee was held at Florida State University, Tallahassee, Florida at the invitation of Professor J. J. O'Brien of the University's Department of Oceanography. Professor O'Brien is Chairman of IAPSO and an *ex officio* member of the Executive Committee. The President of SCOR, Professor Stromberg, chaired the meeting. A list of participants is given in Annex I. A list of acronyms and abbreviations used in this report appears on the last page. The Abstract of a Special Lecture, presented by Dr. David Halpern, entitled "Pacific Ocean-Atmosphere Interactions", appears in Annex II.

Professor O'Brien introduced the Chairman of the Department of Oceanography, Professor P. Hsueh, who welcomed the participants on behalf of his department. He noted that many of its faculty members are involved in international research activities and in the global programmes which are of interest to SCOR. The text of Professor Hsueh's remarks is given in Annex III.

The President of SCOR thanked Professors Hsueh and O'Brien for their welcome and in particular for the many arrangements which had been made for the meeting. He expressed appreciation on behalf of those members of the Executive Committee who had been able to participate in a very pleasant excursion on the previous day.

Professor Stromberg extended a special welcome to Professor I.N. McCave who was attending his first SCOR Executive Committee meeting in his capacity as newly-elected Chairman of CMG. He also welcomed Professor M. Miah who was attending as an observer on behalf of the recently established Bangladesh Committee for SCOR and to advocate this committee's application for membership in SCOR.

Professor Stromberg recalled the untimely death of Konstantin N. Fedorov, a former President of SCOR, very shortly after the XIX General Meeting of SCOR and the Joint Oceanographic Assembly in Acapulco. Dr. Fedorov died in Moscow on September 21, 1988. He had served SCOR for many years, most recently as President from 1976 to 1980, and as Past-President until 1988. The deaths of Professor J. Zijlstra, Chairman of SCOR WG 65 on Coastal-Offshore Ecosystems Relationships and of Professor I. Ronquillo, Chairman of the Philippines SCOR Committee and Past-Chairman of the IOC, were also noted. The participants observed a moment of silence in honour of these members of the SCOR family.

1.2 Approval of the Agenda

The Agenda as distributed by the Secretariat was approved with the addition of two items relating to proposals for new SCOR Working Groups. This report follows the format of the Agenda as adopted.

1.3 Report of the President

The President gave a brief report highlighting some of his activities on behalf of SCOR since his election at the General Meeting in August 1988. He noted that among the documents for the Executive Committee meeting was an impressive list of new publications arising from SCOR activities, that the reports to be considered would show that the majority of Working Groups had been very active during this period and that the Executive Committee would have one new

membership application to review with the possibility of one or two more being received in the near future.

Professor Stromberg also reported that he had represented SCOR at a number of international meetings, sometimes combining this travel with his responsibilities as a delegate of Sweden. These included meetings of the Arctic Ocean Sciences Board, a consultation between himself and the Chairman of the IOC, the IOC Assembly, the Committee for JGOFS and the General Committee meeting of ICSU.

The President noted that significant progress had been made in the planning for the Joint Global Ocean Flux Study during the past year. The JGOFS Committee held two meetings and is now moving towards the completion of the International Science Plan for JGOFS. The JGOFS North Atlantic Pilot Study, a study of the evolution of the spring phytoplankton bloom, was conducted between March and October 1989. It involved six research vessels and about 250 scientists from seven countries and appears to have been very successful. Readers are referred to item 2.3 for more information on JGOFS.

Close relations have been developed between SCOR and ICSU's Special Committee for the International Geosphere-Biosphere Programme whose oceanic interests overlap with those of SCOR. In May an agreement was concluded between SCOR and the SC-IGBP which designates JGOFS as a Core Project of IGBP and ensures SCOR involvement in all aspects of planning for the oceanic components of IGBP. Professor Stromberg referred to two consultations which have taken place between the officers of SCOR and IOC and which have led to improved cooperation between the two organizations. The first of these took place just before the International WOCE Scientific Conference in Paris in November 1988 and focused on the changing role of the Joint SCOR/IOC Committee on Climatic Changes and the Ocean. The second took place in Washington in May 1989 and concentrated on the topic of the organizational arrangements for WOCE. In accordance with an earlier agreement, the Chairman of IOC and the President of SCOR prepared a joint statement on these arrangements for consideration by the IOC Assembly in July.

Finally the President expressed his concern, recently strengthened during his participation in the ICSU General Committee meeting, about the position of SCOR as a Scientific Committee within the ICSU framework. ICSU's membership (that is, its National Members and the scientific unions), appeared largely ignorant of the work of the interdisciplinary scientific committees like SCOR which have no voting rights or formal membership status in ICSU although they may be responsible for very large and complex international programmes. He did note, however, that the informal working group discussions during the ICSU meeting had provided an excellent opportunity for frank discussions between representatives of various ICSU organizations in the fields of physical and earth sciences.

1.4 Appointment of an *ad hoc* Finance Committee

In accordance with the revised SCOR Constitution, an *ad hoc* Finance Committee was appointed to review the state of SCOR finances, draw up a budget for 1990 and report to the Executive Committee meeting under agenda item 3.3. The members of the Committee were Professor Henry Charnock (Chairman), Dr. Mark Donelan and Dr. Terry Healy.

2.0 SUBSIDIARY BODIES

2.1 Arising from Former Working Groups

WG 54 - Southern Ocean Ecosystems and their Living Resources (with SCAR and IOC)

Although this working group was disbanded by SCOR in 1986, as one of the cosponsors of the BIOMASS programme (Biological Investigations of Marine Antarctic Systems and Stocks) which

was conceived by WG 54, SCOR has maintained relations with SCAR and the BIOMASS Executive during the period of follow-up activities to the field programme and has continued to support these activities financially.

These activities have included a series of BIOMASS Data Evaluation Workshops which were intended to lead up to a final BIOMASS Evaluation Meeting in 1990. Some delays in the planning and execution of these workshops had lead the BIOMASS Executive to propose that the BIOMASS Evaluation Meeting be replaced by a BIOMASS Colloquium to be held in September 1991.

The report received from the Chairman of the BIOMASS Executive, Prof. El-Sayed, requested continuing financial support from SCOR, although it was apparent that none of the Data Workshops for which support had been given in 1989 had taken place. In view of this, the SCOR Executive Committee did not feel that it should provide any further financial support in 1990, but that it should live up to the commitment made in 1988 to support the final meeting of the BIOMASS programme, now known as the BIOMASS Colloquium.

2.2 Current Working Groups

WG 75 Methodology for Oceanic CO_2 Measurement (with UNESCO)

The final meeting of WG 75 was held in Woods Hole in October 1988. The major tasks for this meeting were a review of the reports prepared at previous WG 75 meetings in Lake Arrowhead, California and Les Houches, France, the identification of unfinished tasks and new issues, the review of other activities related to WG 75 and recommendations to SCOR for future action. A report received from the Chairman of WG 75, Dr. C.S. Wong, appears in Annex IV.

Dr. P. Brewer, a member of WG 75, noted that at its first meeting, the group had identified many flaws in the procedures for analyses related to CO_2, and that the ability to measure the carbon system has probably been improved by a factor of five, largely due to the efforts of the members of WG 75. He did note, however, that the standard reference seawater required for the WOCE and JGOFS CO_2 surveys is not yet available. A controversy over a new Japanese technique for measurement of DOC which gives substantially higher results than other methods has yet to be resolved and is central to many questions relating to biogeochemical cycles and oceanic productivity. Finally, he reiterated the point made in the report of the Chairman regarding the variability of pCO_2 measurements between laboratories which is as large as the signal expected for anthropogenic CO_2 .

The Executive Committee agreed that WG 75 should be urged to proceed with the production of its final report as soon as possible and that the recommendations contained in the report to the meeting should be dealt with in correspondence. The representative of IOC, Dr. N. Andersen, expressed the wish of the IOC to cooperate and assist with the dissemination of the results of the group's activities, and through its participation in GESREM (Group of Experts on Standards and Reference Materials), to assist in the provision of standards required for CO_2 analyses.

WG 76 Ecology of the Deep Sea Floor (with IOC)

The Chairman of WG 76 reported that, although progress with the preparation of the final report as outlined at the XIX General Meeting had been slower than anticipated, he expected that it would be forthcoming before the next meeting of SCOR. He noted that one of the more tangible results of the group's deliberations has been increased collaboration between deep-sea biology groups, particularly within Europe, and the incorporation of many of the recommendations of WG 76 into their proposals for research programmes. The Directory of Deep-Sea Biologists prepared by WG 76 includes information on 175 scientists and was to be published in the next edition of the Deep-Sea Newsletter.

WG 77 Laboratory Tests Related to Basic Physical Measurements at Sea (with IOC)

The Executive Committee Reporter for WG 77, Professor Siedler, reviewed the accomplishments of WG 77 since the 1988 General Meeting. These included the CTD Intercomparison Experiment, carried out in the High Pressure Laboratory of the Institute of Applied Physics, Kiel University. Eight CTDs were investigated during three weeks of measurements giving 164 data records at atmospheric pressure and 28 records at various pressures up to 6,000 dbars. A preliminary evaluation of the results of the intercomparison was conducted at a second meeting in Kiel in June 1989. This analysis of the results is continuing in correspondence, the Chairman of the WG, Professor Striggow, having distributed a detailed data report on the intercomparison experiment. The Chairman requested approval for a third meeting of WG 77 in the spring of 1990 at which the publication arising from the intercomparison experiment would be finalized.

The Executive Committee agreed with this request on the condition that a draft of this publication be prepared in advance and be in the hands of the members of WG 77 at least one month before their meeting. It was felt that this would ensure that the meeting has a concrete product to consider. The results of the intercomparison experiment are of great importance to WOCE, and the group will be urged to complete the publication of its results before considering any further activities. It was agreed that the Chairman of WG 77 would present these results to the XX General Meeting in 1990.

WG 78 Determination of Photosynthetic Pigments in Seawater (with UNESCO)

A report from the Chairman of WG 78, Dr. F. Mantoura, appears in Annex V and was presented by the Executive Committee Reporter for the group, Professor Fournier. He reviewed the background to the establishment of WG 78 at the request of UNESCO in recognition of the need to re-evaluate the procedures used in pigment analyses. During the past year the group had organized a series of three practical workshops:

Chlorophyll workshop, Hobart, October 17 - November 7, 1988
Carotenoid workshop, Hobart, January 23 - February 20, 1989
Field application workshop, Plymouth UK, September 11- 22, 1989

The Chairman expected that a separate report would be produced for each of these workshops before March 1990 and that these would be merged into a major report on pigment methods for publication in the UNESCO series *Monographs in Oceanographic Methodology.* However, Professor Fournier shared the concern of the Chairman of WG 78 at the potential delay in publishing the report in this series. The recommendations of WG 78 are eagerly awaited by JGOFS scientists for whom accurate pigment determinations are critical for biomass and productivity estimates and for establishing sea truth data for new satellite ocean colour sensors. It was agreed that this problem should be discussed with representatives of UNESCO and that, if necessary, SCOR should consider publishing the WG 78 report in some interim format.

The Executive Committee approved Dr. Mantoura's request for a small amount of financial support in 1990 in order to permit him and Dr. Jeffrey, organizer of the two workshops held in Hobart, to proceed with editing activities.

WG 80 Role of Phase Transfer Processes in the Cycling of Trace Metals in Estuaries (with UNESCO)

WG 80 met at the Plymouth Marine Laboratories during the week immediately preceding the SCOR Executive Committee meeting and the Chairman, Dr. M. Whitfield, transmitted his report of the meeting for discussion. The group worked in correspondence during the past year and a series of working papers had been prepared for its meeting. Dr. Whitfield reported that this collection of papers meets the basic requirements of the first term of reference of WG 80 (to evaluate the

state of knowledge of particle-water interactions for key metals and metalloids under the range of conditions encountered in estuarine waters and sediments).

In addition to these reviews, the group considered four papers prepared by its members in relation to the major questions raised by the terms of reference. At its meeting, WG 80 reviewed these papers, carried out a discussion of the concepts most directly relevant to its terms of reference, agreed on a structure for its final report and assigned writing tasks. It was agreed that the review papers would form the basis of this report, although it was considered that the terms of reference of WG 80 do not place sufficient emphasis on the problems associated with the incorporation of particle-water interaction data into models of trace metal cycling.

It was agreed that the final report should incorporate this topic, but that in order to do this, a second meeting of WG 80 should be held to focus attention on the experimental and theoretical problems associated with the determination and utilization of partition functions and exchange kinetics to describe particle- water interactions in natural waters. The definition of these parameters was considered to be the main obstacle to the understanding of trace metal interactions in estuaries. The Executive Committee agreed to the Chairman's request for a WG 80 meeting to be held in March 1991 in conjunction with the "Model Estuaries" meeting in Savannah, Georgia.

It was also agreed to invite Dr. W. Gordeev (USSR) to join WG 80 as a Corresponding Member.

WG 82 Polar Deep Sea Palaeoenvironments (with IOC)

The Executive Committee Reporter for WG 82, Dr. Kuznetsov, reviewed the report from the final meeting of WG 82 which was held in conjunction with the 3rd International Conference on Paleoceanography in Cambridge UK in September 1989. The Executive Committee agreed that the report from the Chairman of WG 82 did not contain sufficient information on the format of the final report which was under preparation and that this report should be made available to SCOR well in advance of the 1990 General Meeting.

WG 83 Wave Modelling (with IOC)

The Executive Committee Reporter for WG 83 presented the report from the Chairman on the WG 83 meeting held in Valencia in May 1989. WG 83 serves as a small international steering group for WAM, a large European wave modelling group. Dr. Asai noted the following progress towards the realization of the terms of reference for WG 83:

> Joint development of a third generation wave model is progressing well by the WAM group in collaboration with scientists from several countries. A working global third generation model is in place on the CRAY supercomputer at ECMWF. Several scientists in different countries have copies of the third generation model in their laboratories and are testing various aspects of its performance.
>
> Regional versions of the third generation model have been implemented for various regions of the world. A nested or variable grid version of the WAM model is to be implemented during the Surface Wave Dynamics Experiment (SWADE) and, therefore, is planned to the ready by the next general meeting.
>
> A global version of the model has been implemented at ECMWF and various tests that pertain to medium range forecasting (e.g. significance of wave supported stress) are being done.
>
> WG 83 encourages attention to particular areas of wave dynamics where additional physical studies are required to improve wave modelling. Many members of the WAM group are directly involved in planning and conducting such physical studies. WG 83 forms a useful focus for assessing the value of these studies and suggesting others.

Data assimilation is an important aspect of the work of WG 83 and it provides stimulus to the WAM group to establish data assimilation techniques for global wave modelling. WAM group members are very active in this area. The expected launch of ERS-1 in late 1990 places an imperative on the data assimilation development schedule.

In discussing this report, some participants in the Executive Committee meeting agreed that WG 83 was different from other working groups in that many of its members are from the WAM group and the two have overlapping terms of reference. The SCOR group, however, provides an international connection which promotes the involvement of wave modellers from many countries, and it focusses the WAM activities, directing programmes towards well-defined goals. WG 83 expects to achieve these goals in 1992, two years after the ERS-1 satellite is launched.

The SCOR Executive remained somewhat concerned, however, about the continuing need for a SCOR WG in this field where many activities are being undertaken by individuals and other established groups, driven by the impending launch of ERS-1. It agreed that the group should be asked to focus attention on the preparation of a state-of-the-art report for the next SCOR General Meeting, and to provide SCOR with an interim report on its plans for a final product of its work and the need for SCOR involvement in this field.

In the meantime, the Executive Committee approved the Chairman's request for a fourth meeting of WG 83 to be held, as usual, in conjunction with a WAM meeting in Canada in June 1990.

WG 84 Hydrothermal Emanations at Plate Boundaries (with IOC)

The Executive Committee Reporter for WG 84 expressed regret that the progress envisioned at the XIX General Meeting in 1988 had not materialized, partly due to the relocation of the Chairman. Professor Heath recommended that the Executive Committee should now seek a clear statement from the WG on its objectives and its schedule for achieving them. In the meantime, he also recommended that the Chairman's request for a one year deferral of the meeting previously approved for 1989 be accepted. Finally, the addition of two members, Dr. A.C. Campbell (USA) and Dr. L. P. Zonenshain (USSR) was approved, one member having resigned from the WG.

WG 85 Experimental Ecosystems (with UNESCO)

The Executive Committee had before it a report of the second meeting of WG 85, held in Rhode Island in June 1989. The meeting was held largely to address the second and third terms of reference of the working group, the first having been satisfied by the preparation of a volume for publication by Springer-Verlag of a review of the use of experimental ecosystems in research.

As its next task, WG 85 had agreed to prepare a "Manual of Marine Experimental Ecosystems" consisting of two parts. The first will deal with the choice of experimental ecosystems, including consideration of scientific strategy, design and maintenance. The second part will illustrate various experimental ecosystems and give information on their construction and performance. It was expected that the manual would be completed by the end of 1989 and the Executive Committee agreed that it should be published in the SCOR Report Series.

Finally, the Executive Committee Reporter for WG 85, Professor Fournier, expressed congratulations to WG 85 and to its Chairman and Vice Chairman, Dr. Li Guanguo (China) and Professor T. Parsons (Canada) for the timely manner in which the group had completed its tasks.

WG 86 Ecology of Sea Ice (with SCAR, AOSB and IOC)

The report from the Chairman of WG 86, Dr. Sullivan, noted that he had taken advantage of opportunities to meet with most of the members of the group during the past year and had discussed group activities with them. The other members had been contacted by mail. He reported that

the establishment of WG 86 has fostered an effective communication especially with respect to initiating plans and scientific objectives for investigations of the sea ice ecosystem of the Arctic and Antarctic Oceans. The involvement of Professor Melnikov (USSR) has been particularly fruitful due to his extensive experience on drifting ice stations in both polar regions.

The report from WG 86 presented information on a series of meetings which would take place in 1990 featuring studies of the polar oceans and having substantial involvement of sea ice investigators. These meetings will provide an up-to-date view of sea ice ecology. The group proposed to hold a meeting in late August or September of 1990 in order to assimilate the results of the other meetings and to produce a report summarizing the state of the art of sea ice ecology, recommendations for future research and instrument development. The Executive Committee approved this request.

WG 87 Fine-scale Distribution of Gelatinous Planktonic Animals (with UNESCO)

The President of SCOR, Professor Stromberg, reviewed the report of WG 87 in his capacity as Executive Committee Reporter for the group. The Executive Committee agreed with his concern at the lack of progress made by WG 87, although it has been in existence for three years, and discussed this matter at great length. The group had not satisfied the request of the Executive Committee for an acceptable draft outline of its proposed report, and had, therefore, not held the meeting planned for 1989. The outline submitted in the report to the Executive Committee meeting was not substantially different from an earlier version.

The Committee agreed that the topic of fine-scale distributions of planktonic organisms is an important one due to the potentially large role that these animals may play in the downward fluxes of organic material in the ocean. There is, therefore, a definite need to refine and standardize the methodology of sampling techniques. In view of this, the lack of progress of WG 87 was noted with great regret as was the statement by the representative of UNESCO, Dr. Krause, that his organization would be unable to support WG 87 to any extent as a cosponsor in the future due to the financial constraints on UNESCO at this time.

On these grounds the Executive Committee decided to recommend to the XX General Meeting that WG 87, as presently constituted, be disbanded. At the same time, the Executive Committee agreed that SCOR's interest in this topic should be conveyed to the WG membership and that they should be encouraged to consider formulating a proposal for a new WG with revised terms of reference and a membership which would ensure a commitment to the tasks to be achieved.

WG 88 Intercalibration of Drifting Buoys

Professor O'Brien, the Executive Committee Reporter for WG 88, informed the meeting that he concurred with the view expressed by the Chairman in his report that the terms of reference for the group were, as yet premature. The state of engineering development and testing was not felt to be sufficient for any of the drogue systems being used with drifting buoys to encourage belief that useful progress would be made through organizing some kind of drift-off. Careful measurements of the performance of buoy systems designed to meet various objectives were required before such intercalibrations could be carried out. Professor O'Brien noted that several members of the WG have been working on these tasks (independently of the existence of WG 88) and that a number of publications have appeared. In addition, a number of other groups within WOCE, TOGA and the IOC/WMO Drifting Buoy Cooperation Panel also have an interest in the field and have, in some cases, involved members of WG 88. In summary, it appeared to the meeting that there was no continuing requirement for WG 88 in view of the fairly high level of activity in this area. The Executive Committee agreed to recommend to the XX General Meeting that WG 88 be disbanded with thanks to the group for having provided an early international focus for discussions relating to the differences between drifting buoys.

WG 89 Sea Level and Erosion of the World's Coastlines (with UNESCO)

A progress report from the Chairman of WG 89, Professor Komar, appears as Annex VI. Since the XIX General Meeting when WG 89 was established, the membership has been finalized as follows:

P. Komar	(USA)	Chairman
N. Lanfredi	(Argentina)	Vice-Chairman
R. Dean	(USA)	
B. Thom	(Australia)	
K. Dyer	(UK)	
M. Baba	(India)	
M. Gallegos	(Mexico)	
T. Healy	(New Zealand)	
A. Ibe	(Nigeria)	
G. Terwindt	(The Netherlands)	

The group has begun a compilation of the literature relevant to models of beach responses to sea-level increases. The Chairman also submitted to the Executive Committee a draft outline and introduction for the report of WG 89 which he had circulated to the membership. Professor Healy informed the meeting that he was investigating the possibility of having a special issues of the *Journal of Coastal Research*, of which he is an Associate Editor, dedicated to the report of WG 89.

The Executive Committee Reporter for WG 89, Professor O'Brien, recommended that the request for a meeting in 1990 be approved. It will probably be held in conjunction with the 22nd International Conference on Coastal Engineering in Delft in July. The meeting agreed with this and wished to congratulate Professor Komar on the progress made in initiating WG 89 activities.

WG 90 Chemical and Biological Oceanographic Sensor Technology (with IOC)

This working group was established at the XIX General Meeting in 1988. During the past year the membership was finalized and includes:

D.J. Mackey	(Australia)	Chairman
A. Zirino	(USA)	
M. Atkinson	(USA)	
D. Turner	(UK)	
P. Tett	(UK)	
H.P. Hansen	(FRG)	
A. Herman	(Canada)	
Y.A. Sorokin	(USSR)	

The members were asked to provide the Chairman with comments relevant to the first term of reference of the WG (to review current technologies that may be suitable for measuring chemical and biological properties with high resolution in time and space). The Chairman reported that he was somewhat disappointed in the level of response to this request from his members and that, as a result, he could not plan to hold a meeting of the WG in 1990. He did request approval for one to be held, possibly in Hobart, in early 1991. The Executive Committee urged Dr. Mackey to encourage more communication between the members of WG 90.

WG 91 Chemical Evolution and Origin of Life in Marine Hydrothermal Systems

Dr. Kuznetsov introduced the report from the Chairman of WG 91 (which appears in full in Annex VII), noting that the group was established in 1988 at the XIX General Meeting. The current membership of the group is:

N.G. Holm	(Sweden)	Chairman
A.G. Cairns-Smith	(UK)	
R.M. Daniel	(New Zealand)	
J.P. Ferris	(USA)	
R. Hennet	(Switzerland)	
B. Simoneit	(USA)	
H. Yanagawa	(Japan)	

The Executive Committee agreed with the recommendation of the Chairman that Dr. E. Shock (USA) be invited to join the group. In addition, Dr. Kuznetsov nominated Dr. Y. Bogdanov as a member from the USSR.

During its first year of existence, several of the members of WG 91 had opportunities to meet. Some of them held an informal WG meeting in conjunction with a conference in Prague in July 1989. They identified the kinds of hydrothermal systems that would be the most likely sites for successful monitoring of abiotic production of organic monomers and their polymerization. Contacts for future cooperation have been made with the US RIDGE programme regarding the installation of long term ocean bottom observation devices, and with the White Island Drilling Programme of New Zealand.

The report from the Chairman provided information on the workshop in Prague which involved several of the WG 91 members and served as a basis for planning the programme of work for WG 91. It proposes to organize a symposium summarizing the state of knowledge and future research opportunities in the field in 1992. The Executive Committee, therefore, approved the request of the Chairman for the first formal meeting of WG 91 to be held in Sweden in June 1990.

WG 92 Ocean/Atmosphere Palaeochemistry

The report from the Chairman to the Executive Committee appears in Annex VIII; it was introduced by the Executive Committee Reporter, Professor Heath. He reminded the meeting that WG 92 had been established by the XIX General Meeting as a result of the converging interests of two earlier groups, WG 79 and WG 81. Since the Acapulco meeting, the membership of WG 92 has been established as follows:

E. Sundquist	(USA)	Chairman
E. Boyle	(USA)	
J.C. Duplessy	(France)	
E. Maier-Reimer	(FRG)	
J. McKenzie	(Switzerland)	
D. McCorkle	(USA)	
T. Pedersen	(Canada)	
N. Shackleton	(UK)	
J.R. Toggweiler	(USA)	
Y. Bogdanov	(USSR)	

Some of the members have been active at meetings of opportunity since the XIX General Meeting. In particular, a number of them were involved in a special session on "Paleoceanographic Implications of Ice-Core Records" during the December 1988 AGU meeting and in a poster session on "Carbon Dioxide" at the Third International Conference on Paleoceanography in Cambridge in September 1989.

A formal meeting of WG 92 took place in conjunction with the AGU session and three topics were identified as being of particular concern to the group:

The correlation of marine and ice core records

The development of time-dependent carbon cycle models
The need for a surface sediment calibration collection

Readers are referred to Annex VIII for detailed information on these three topics.

The report from Dr. Sundquist indicated that plans for future activities of WG 92 will focus on the second and third subjects, the group having agreed that there is still insufficient data to support a precise correlation between marine sediment and ice core records. It would continue to monitor developments in this area, however.

The Executive Committee was concerned that WG 92 proposes to continue its work on time-dependent carbon cycle models in correspondence only, in spite of the lively discussion which this topic had engendered between members of the group. It was felt that this issue was the most important when the terms of reference for WG 92 were approved by the XIX General Meeting. The Executive Committee agreed that WG 92 should be urged to deal with this topic more fully and also to reconsider the first in some detail.

At the same time, it could not agree that the third task proposed by the WG (the initiation of a collection of surface sediment samples for calibration purposes) fell within the terms of reference or capabilities of WG 92. While such a collection would be of great value to JGOFS, for example, it was thought to be a task which could more appropriately be undertaken by the Ocean Drilling Program, or perhaps a new SCOR WG with expertise in core collection and archiving. Accordingly, the Executive Committee did not approve the request for a meeting of WG 92 on calibration sediment sampling in 1990. It urged the group to focus on the first two topics it had identified and to develop a proposal to SCOR for a new working group to deal with the third.

2.3 Committees and Panels

Joint SCOR/IOC Committee on Climatic Changes and the Ocean

The Executive Committee Reporter for CCCO, Professor Siedler, introduced the extensive written report from CCCO (see Annex IX). This was supplemented by oral reports from the Vice-Chairman and Secretary of CCCO, Prof. J. O'Brien and Mr. R. Godin.

Professor Siedler began his remarks by reporting on the outcome of discussions at a meeting between the officers of SCOR and IOC relating to the role of CCCO. In the years since the development of TOGA and WOCE within CCCO, the Scientific Steering Groups for these programmes have gradually assumed stronger roles in their direction, leaving CCCO with a reduced responsibility, limited essentially to one of oversight. At the same time, however, there is a growing concern about the appropriate incorporation of oceanography in broader global change research programmes such as the IGBP and in the deliberations of such bodies as the Intergovernmental Panel on Climate Change. The important role of the ocean in understanding global change is not widely appreciated by many of those involved in these discussions. Accordingly, the IOC and SCOR officers agreed that CCCO should assume the role of promoting the importance of oceanographic studies to global change. This should be particularly effective in view of CCCO's unique position in relation to both the intergovernmental and non-governmental bodies involved in the scientific development of the global ocean observing and data management systems which will be needed if the prediction of climate variability is to be a realistic international objective.

Accordingly at the Tenth Session of CCCO, held in Halifax in June 1989, the Chairman of the Committee proposed changes in its mode of operation. The membership agreed that the CCCO should be less concerned with the passive review of ocean climate related activities, more involved in the use and functioning of its subsidiary bodies, and pro-active in its interaction with external agencies involved in climate research initiatives. In order to do this, more must be demanded of the expertise represented in the membership of the Committee through delegation of specific areas

of interest and responsibility to each of the members. For example, more members will be called upon to be involved in intersessional activity and to represent the CCCO at meetings of other programmes or of a specialized nature.

Professor Siedler reviewed the major highlights in the development of CCCO programmes during the past year. A major highlight in TOGA has been the establishment of the first truly operational ocean model for climate prediction. The development of coupled ocean-atmosphere models for TOGA has advanced significantly and TOGA monitoring systems, such as XBT sections in the Indian Ocean and sea level networks in the Pacific and Indian Oceans, have been been considerably expanded. An important milestone in 1990 will be the International TOGA Scientific Conference to be held in Honolulu in July under the cosponsorship of ICSU, WMO, IOC and SCOR. This Conference will be a forum for the presentation of TOGA scientific results and for a mid-life evaluation of the TOGA programme in general. The TOGA programme was expanded in 1989 to include a Coupled Ocean-Atmosphere Response Experiment in the western equatorial Pacific Ocean. COARE has been endorsed by CCCO, IOC and WMO.

WOCE made a major transition from planning to implementation at the IOC-WMO-ICSU-SCOR WOCE International Scientific Conference in Paris in late 1988. The WOCE Implementation Plan was discussed in detail and national commitments to support WOCE were solicited in preparation for the Conference. These commitments proved sufficient to permit WOCE to move forward with regard to Core Project 1 (the Global Description) and Core Project 2 (the Southern Ocean), but serious concerns remained about the availability of resources for Core Project 3 (the Gyre Dynamics Experiment). Finally, consultations between the President of SCOR and the Chairman of IOC following the WOCE Conference and other discussions led to their joint recommendation to the IOC Assembly that an Intergovernmental WOCE Panel be established as a subsidiary of the IOC Technical Committee on Ocean Processes and Climate and with WMO cosponsorship. The Panel will address those WOCE issues which require governmental attention such as the provision of resources to satisfy the demands of the scientific planning process, provide linkages to other IOC and WMO programmes, and monitor the state of WOCE implementation in collaboration with the WOCE SSG, CCCO and JSC.

A new development at the CCCO meeting was the recognition that the goal of climate prediction requires the thoughtful development of a scientifically credible design for a long term global ocean observing system which meets the objectives of a number of programmes such as WOCE, TOGA and JGOFS, all of which have the development of predictive capabilities stated in their long term goals. CCCO-10 agreed that the existing CCCO-JSC Ocean Observing System Development Panel should be reorganized in order to undertake this responsibility.

Readers are referred to Annex IX for more detailed information on these and other CCCO activities. The Executive Committee approved a number of membership changes to CCCO; these were recommended by the Chairman for approval by SCOR and IOC in order to strengthen the Committee to meet the increased demands resulting from international climate change issues as discussed above.

Committee for the Joint Global Ocean Flux Study

The Executive Committee had before it a written report on recent JGOFS activities including the Third Session of the JGOFS Committee which took place in Honolulu in September 1989. This report is given in Annex X. The Vice-Chairman of JGOFS, Dr. P. Brewer, presented this report.

A major focus for JGOFS in its first full year of existence, since the XIX General Meeting, has been the development and execution of the North Atlantic Bloom Experiment (also known as the JGOFS Pilot Study). This study was designed to take advantage of national plans for work in the northeast Atlantic and focused on the evolution of the spring bloom and associated biogeochemical

phenomena during its northward progression. The Pilot Study involved six research vessels from five nations working, primarily along the 20°W transect, between April and October, with coordinated overflights by a NASA remote sensing aircraft during the most intense period of the bloom. In preparation for the Pilot Study, a set of twenty JGOFS Core Measurements was identified, to be conducted, as far as possible, by all participating nations. A set of internationally accepted measurement protocols was developed for each of the core measurements. Dr. Brewer reported that as the preliminary results from the Pilot Study were starting to be analyzed, the success of the international collaboration required seems to have been well demonstrated. For example, intercalibration exercises were arranged when two or more research vessels were visiting the same station simultaneously, data and information were exchanged between vessels on a continual basis and, in some cases, cruise plans were modified during the cruises on the strength of this shared information. Four nations have plans to return to the area in 1990 for a second phase of the North Atlantic Bloom Experiment, and other follow-up activities are planned in 1990. These include a data analysis workshop at Kiel in March. Participants in the cruises will bring their individual data sets with the goal of merging them into integrated data sets for the various parameters, presenting some preliminary scientific results, and initiating a period of more detailed analysis of the results of the Pilot Study. This will lead up to a JGOFS North Atlantic Bloom Experiment Scientific Symposium to be held at the National Academy of Sciences in Washington in November 1990 at which the findings of the Pilot Study will be presented in a more formal setting. This will also be the opportunity to evaluate the overall success of the Pilot Study as a prototype for future JGOFS process studies.

Another focus for JGOFS in 1989 was the development of the JGOFS International Science Plan. This had dominated the discussions at the second and third meetings of the Committee since the XIX General Meeting of SCOR. The two goals of JGOFS have been expanded into a series of more detailed objectives and the basic components of a scientific strategy were agreed. At the JGOFS Committee meeting in Hawaii, a small Science Plan Drafting Group was established, under the Chairmanship of Dr. M. Fasham (UK), and charged with the responsibility of developing the detailed plan based on the extensive committee discussions. The plan will be ready for circulation to the JGOFS Committee members at the end of 1989 in preparation for a detailed review and approval at the Fourth Session of the JGOFS Committee to be held in Kiel in March 1990.

In his report (item 1.3), the President of SCOR had noted the recommendation made to the President of ICSU by himself and the Chairman of ICSU's Special Committee for the International Geosphere-Biosphere Programme that JGOFS be designated a Core Project of IGBP. The responsibility for the planning and direction of JGOFS rests with SCOR although joint activities will be encouraged. The first of these will be a JGOFS/IGBP workshop on "Modelling the Physics, Biology and Chemistry of the Upper Ocean and its Effects upon the Atmosphere" which will take place at the Royal Society in London in March 1990.

Immediately following the JGOFS Committee meeting in Hawaii (September 1989), a JGOFS Pacific Planning Workshop took place. This meeting recommended that the next JGOFS field programme should be a process study in the equatorial Pacific Ocean, an area of outgassing in which primary productivity is driven by equatorial upwelling. Detailed planning for this study will begin at an international workshop to be held in Tokyo in April 1990.

Adequate support for JGOFS is a continuing concern. The Executive Secretary reported that a number of the participating nations had responded positively to the request from the President of SCOR to make special financial contributions in support of JGOFS. The FRG has undertaken to establish a JGOFS Scientific Secretariat at Kiel University and the post of JGOFS Executive Scientist was being advertised at the time of the SCOR Executive Committee meeting. The SCOR

Executive Secretary will continue to provide staff support of an administrative nature to the JGOFS programme.

Dr. Brewer reported that the JGOFS Committee recognized that it must move rapidly from the science planning stage to considerations of issues of implementation and resource allocation for JGOFS in the very near future, probably as soon as the Science Plan is approved. The JGOFS Executive had been urged as early as January 1989 to begin identifying the needs of the programme for resources such as facilities, funding and manpower and to make statements on these issues, scheduling and long-term needs which would be useful to the national supporting agencies. No obvious international mechanism presently exists for the identification, provision and coordination of resources for JGOFS. The JGOFS Committee requested SCOR to consider this matter, possibly by convening a meeting which would develop a proposal for such a mechanism. The Executive Committee agreed with this request and was of the opinion that any such mechanism should be non-bureaucratic, probably of an *ad hoc* nature, established within the SCOR/JGOFS framework, and should ensure links to other programmes, particularly WOCE, with which JGOFS will undoubtedly share resources.

Finally, the Executive Committee was asked to approve the first membership changes to the JGOFS Committee since its establishment, in accordance with the rotational scheme suggested at that time. The revised membership of the Committee is:

B. Zeitzschel	(FRG)	Chairman
M. Fasham	(UK)	Vice-Chairman
P. Brewer	(USA)	
O. Brown	(USA)	
S. Calvert	(Canada)	
H. de Baar	(Netherlands)	
K. Denman	(Canada)	
H. Ducklow	(USA)	
H. Elderfield	(UK)	
D. Hu	(China)	
I. Koike	(Japan)	
J.F. Minster	(France)	
G. Pearman	(Australia)	
T. Platt	(Canada)	
G. Shaffer	(Sweden)	
S. Tambiev	(USSR)	
G. Wefer	(FRG)	

UNESCO/ICES/SCOR/IAPSO Joint Panel on Oceanographic Tables and Standards

The report from the Chairman noted that although JPOTS itself had been relatively dormant during the past year, three of its sub- panels had made progress in specific areas.

The JPOTS subcommittee on standards for CO_2 measurements met in Acapulco in August 1988 and prepared a report on its activities which was ready for publication by UNESCO. The recommendations of the subcommittee regarding the use of standards to ensure the data quality of WOCE and/or JGOFS CO_2 measurements were endorsed by the XIX General Meeting. The group will meet again in 1990 to discuss current work to develop these standards in specific laboratories.

Slow but gradual progress continues on the preparation of the new manual on the processing of oceanographic data by the JPOTS Editorial Panel. It was thought that a camera-ready manuscript was in the final stages of preparation at ICES.

More extensive work has been carried out on the measurements of the equilibrium constants of the CO_2 system in seawater. The recommendations of the JPOTS CO_2 Panel will be finalized when it convenes during the IUGG Assembly in Vienna in 1991.

The Chairman of JPOTS wished to emphasize that while JPOTS has been less active since the completion of its work on the conductivity of seawater and the equation of state of seawater, it continues in existence to finish the tasks on the CO_2 system in seawater and is ready to undertake problems that its sponsoring agencies deem necessary. In noting this point, the Executive Committee recalled that the need for the continued existence of JPOTS had been a matter of some concern at the XIX General Meeting. It was not clear that, should new questions in the field of oceanographic standards require attention, the existing membership of JPOTS would be appropriate. It was agreed that the Chairman of JPOTS would be asked to provide a more detailed statement on the future role of JPOTS in time for the XX General Meeting.

Editorial Panel for the Ocean Modeling Newsletter

The eighty-third issue of the Ocean Modelling Newsletter was published in July 1989. The Executive Committee wished to commend the Editorial Panel for its continuing commitment to this task and for the quality of the newsletter.

2.4 Proposals for New Working Groups

The Executive Committee had before it the following proposals for new working groups:

Pelagic Biogeography

This revised proposal, originally submitted by the Netherlands SCOR Committee and considered by the SCOR General Meeting in 1988, was presented by Dr. A.C. Pierrot-Bults. Readers are referred to *SCOR Proceedings* volume 24 for a report of the original discussion of this proposal. In accordance with the suggestion of the XIX General Meeting, expressions of support from ICES and IOC had been solicited. Additional comments and membership suggestions had been received from SCOR Committees. Dr. Pierrot-Bults noted that the proposed membership is an interdisciplinary one and the Executive Committee concurred with this need. After considerable discussion on this point, the establishment of WG 93 was approved with the following terms of reference:

To review recent developments in biogeographic theory and their application to ocean pelagic biogeography.

To recommend new approaches to the future studies on pelagic biogeography emphasizing the mechanism that result in observed distribution patterns and the interactions of organisms and their physical-chemical- biological environment and their impact on the observed patterns.

To examine the possibilities of more adequate sampling techniques and the interpretation of available data and the use of existing plankton and nekton collections for biogeographical studies.

To prepare a manual in 1992 of existing collections as a guide to all interested scientists.

To hold appropriate workshops, followed by a second international conference on pelagic biogeography in cooperation with other interested organizations.

It was expected that WG 93 would begin its work in correspondence and would hold its first meeting in late 1990. Dr. Pierrot-Bults was asked to refine the membership list based on the large number of suggestions received and on the discussions in the meeting. IOC, Unesco and ICES will be cosponsors of the WG and will have observers in its membership.

Role of Continental Margins on the Distribution and Fluxes of Materials in the Ocean Interior

This proposal arose from the recommendations in the final report of SCOR WG 71 on Particulate Biogeochemical Processes. Professor Heath introduced it, but expressed concern about the proposed terms of reference being too broad and the lack of definition of an end product for the WG. It was also felt that the topic might be advanced by a Dahlem Conference planned for 1990 and that the proposal should be revised to take this into account in time for reconsideration at the XX General Meeting.

Ocean Experiments to Create a Chemical Model to Predict Future Changes in Carbon Dioxide and the Carbon Cycle in Seawater

This proposal was submitted by the Chairman of SCOR WG 75 (Methodologies for Measurement of Oceanic CO_2), Dr. C.S. Wong and was reviewed for the Executive Committee by Dr. Peter Brewer and Professor Heath. The data collected in the JGOFS and WOCE global surveys will be assimilated into models of the carbon cycle and chemical tracers. For such models to be effective, ocean chemists must provide more accurate estimates of biogeochemical relationships and CO_2 thermodynamical equations in selected representative water masses. The proposal suggested that a team of experts should be convened to develop a strategy for such an effort.

The Executive Committee was of the opinion that this is a topic which should be addressed, at least in a preliminary way, by the existing JGOFS/CCCO CO_2 Working Group. This group may wish to assume this task, or may recommend the creation of a separate group for the purpose.

Monitoring Biological Variability in the Ocean

This proposal arose at the XIX General Meeting as a result of the discussions about the possible discontinuation of the Continuous Plankton Recorder Survey (see *SCOR Proceedings* volume 24).

It was suggested in the proposal that in order to determine the effects of human activity on the marine biota, it is necessary to measure changes in the biota. Methods for this monitoring include measurements at coastal (or inshore) stations, surveys (e.e. the CPR or CalCOFI collections) and catch statistics from commercial fisheries. Eventually suitable time series will also result from remote sensing. None of these methods is completely suitable, and some, such as the CPR, are threatened with being curtailed or discontinued. Several major international programmes (e.g. JGOFS, IGBP, IREP) depend on adequate measures of variability in the marine biota for their success. Therefore it was proposed to establish a working group on monitoring biological variability in the ocean with the following terms of reference:

identify and describe existing time series (10 years and longer) of biological variability in the ocean.

evaluate their significance or inadequacies and methods used in interpreting these data sets.

consider cost-effective ways to increase the value of ongoing monitoring programmes (e.g. sampling, analysis, accessibility).

consider alternative ways of observing biological variability in the ocean.

While the Executive Committee wished to support this proposal, it was not accompanied by a strong list of possible members and no potential Chairman was identified. Recognizing that the group, if established, would be more likely to succeed with strong and committed leadership, it was agreed that an effort would be made to identify such a person before the XX General Meeting. The representative of IOC, Dr. Andersen, informed the meeting that IOC would enthusiastically support such a working group as a cosponsor because of its relevance to the OSLR programme.

The Use of Artificial Substrata in the Recultivation of Shelf Ecosystems.

Professor Fournier introduced this proposal which was received from the Polish SCOR Committee. In his view the title could have been better stated as the "use of artificial substrata for the restoration or renewal of damaged shelf ecosystems", and the topic was particularly relevant for those areas in enclosed or semi-enclosed seas. He referred, for example to a programme of this nature in the Baltic, supported by the European Community. The Executive Committee agreed that this topic was not within the mandate of SCOR.

Geological Constraints on Ocean-Atmosphere Modelling.

The UK Committee had been invited to elaborate upon an incomplete proposal which stated that the growth of activity in ocean modelling, with the ultimate objective of developing linked ocean-atmosphere models for climate prediction, makes it important to understand the processes which might limit the accuracy of such models. The proposal suggested that one of these might be the existence of a fluctuating source of heat into the ocean from the volcanic activity of the world's mid-oceanic ridge system. However, no additional information relating to this proposal had been forthcoming. In view of this, and of the lack of well documented evidence in the primary scientific literature to support the theory behind the proposal, the Executive Committee did not feel it could support it.

Working Group for the IGBP

In addition to the above proposals, the UK Committee for SCOR has suggested that consideration be given to the establishment of a "Working Group for the IGBP to define SCOR's contribution to the Global Change Programme and determine priorities." Such groups have been established by a number of ICSU organizations. The Executive Committee felt, however, that the existing agreement which designates JGOFS as a Core Project of the IGBP and also ensures SCOR's active involvement in all phases of planning for oceanic components of the IGBP, already provides a mechanism for this purpose through the Executive Committee itself.

Modelling of Littoral Communities Health Profiles

The Israeli Committee for SCOR submitted an incomplete proposal for a WG which would be charged with the development of a technique for the study of littoral ecosystems using an interdisciplinary approach which results in an Environmental Health Profile for a site or region. A collection of site profiles, stored in a computerized data base would form a reference tool for future assessments of changes in stressed littoral ecosystems. Again, the Executive Committee concluded that this topic was not within SCOR's area of expertise and that other international organizations, such as SCOPE, GESAMP or GIPME, could address it in a more appropriate manner.

The Executive Committee wished to record that, in general, it was disappointed in the quality of the working group proposals submitted for consideration at this meeting. Several of them reflected a lack of understanding of the mandate of SCOR in oceanography. Others, while possibly more appropriate for consideration by SCOR, were so incomplete as to be difficult to assess. It was agreed that SCOR Committees should be asked to consider these points before preparing proposals for the next meeting of SCOR.

3.0 ORGANIZATION AND FINANCE

3.1 Membership

The Executive Committee considered an application from Bangladesh that country and will adhere to SCOR through the Bangladesh Academy of Science as a Category I member. The Executive was satisfied that the new Bangladesh SCOR Committee included members from a broad range of oceanographic institutions and disciplines in the Bangladesh scientific community

and was pleased to accept its application to join SCOR. The meeting welcomed Professor Miah, the Chairman of the Bangladesh SCOR Committee.

The Executive Secretary provided the following information on changes in Nominated Members of SCOR since the XIX General Meeting and on other membership matters:

Executive Committee

Dr. I.N. McCave (UK) has been elected Chairman of the Commission on Marine Geology and replaces Prof. K. Hsu (Switzerland) as an *ex officio* member of the Executive Committee.

Nominated Members

Bangladesh - The first Nominated Members from the newly- established Bangladesh Committee for SCOR are Dr. M.A.H. Pramanik, Dr. A.K.M. Nazrul Islam and Prof. Manirul Hoque.

Denmark - Dr. E. Buch replaces Prof. T. Wolff.

Japan - Prof. Y. Toba replaces Prof. S. Okabe.

Norway - Dr. E. Paasche replaces Prof. G.R. Hasle.

Philippines - The death of Prof. I. Ronquillo leaves a vacancy for a Nominated Member.

South Africa - The South African SCOR Committee has been reconstituted and the three Nominated Members are Prof. J. Field, Prof. D. Lord and Dr. J. Lutjeharms.

Switzerland - The Nominated Members are Prof. K. Hsu, Dr. K. Hanselmann and Dr. F. Nyffler.

Representative Members

Dr. Y. Lancelot (France) became a member of SCOR on his election as Secretary of CMG, replacing Prof. J. Thiede.

3.2 Publications Arising from SCOR Activities

The Executive Secretary presented information on the following publications since the XIX General Meeting (i.e. September 1988 to September 1989):

UNESCO Technical Papers in Marine Science

No. 54 The Acquisition, Calibration, and Analysis of CTD Data. A Report of SCOR Working Group 51.

No. 55 River Inputs to Ocean Systems: Status and Recommendations for Research. Final Report of SCOR Working Group 46.

No. 56 The Ocean as a Source and Sink for Atmospheric Trace Constituents. Final Report of SCOR Working Group 72.

BIOMASS Report Series

No. 57 Meeting of the BIOMASS Executive, Hobart, Tasmania, Australia, 9 September, 1988.

No. 58 SIBEX Acoustic Data Validation and Analysis Workshop, Cambridge, U.K., 11-22 July, 1988.

No. 59 Meeting of the SCAR Group of Specialists on Seals, Hobart, Tasmania, Australia, 23-25 August, 1988.

BIOMASS Scientific Series

No. 9 Biology and Ecology of the Antarctic Krill.

SCOR/IOC CCCO Publications

World Ocean Circulation Experiment Implementation Plan. Vol. I. Detailed Requirements. WCRP-11. WMO/TD No. 242.

World Ocean Circulation Experiment Implementation Plan. Vol. II. Scientific Background. WCRP-12. WMO/TD No. 243

Global Data Assimilation Programme for Air - Sea Fluxes. JSC/CCCO Working Group on Air-Sea Fluxes. WCRP - 16, Oct. 1988 WMO/TD- No. 257.

JSC/CCCO TOGA Scientific Steering Group. Report of the Seventh Session - Cairns, Queensland, Australia, 11-15 July 1988. WCRP-17, Oct. 1988. WMO/TD-No. 259.

WMO/IOC Inter-Governmental TOGA Board. Report of the Second Session. Geneva, 5 - 9 December 1988. WMO-TD - No. 282.

International WOCE Scientific Conference. Unesco, Paris, 28 November - 2 December 1988. WCRP-21. WMO/TD - No. 295.

Time Series of Ocean Measurements. Vol. 4, IOC Technical Series No. 33, Unesco 1988.

Report of the Fourth Session of the SCOR-IOC CCCO Indian Ocean Climate Studies Panel. Islamabad, Pakistan, 27 June - 1 July, 1988.

Carbon Dioxide in the Ocean. Report of the Second Meeting of the CCCO Advisory Panel on Carbon Dioxide. La Jolla, California. October 6-8, 1986.

Summary Report of the Ninth Session of the SCOR-IOC/CCCO Paris, 11-17 May 1988.

Report of the First Meeting of the Joint JGOFS-CCCO Panel on Carbon Dioxide. The Hague, Netherlands, 16- 17 September 1988.

Publications Arising from SCOR Working Groups

WG 56 SCOR-IOC-UNESCO Symposium on Vertical Motion in the Equatorial Upper Ocean and its Effects upon Living Resources and the Atmosphere. Paris, 6-10 May 1985. IOC Workshop Report No. 52.

WG 71 SCOR Report Series No. 1 - Particulate Biogeochemical Processes.

WG 73 Network Analysis in Marine Ecology: Methods and Applications. F. Wulff, J. Field and K. Mann, eds. Lecture Notes on Coastal and Estuarine Studies, No. 32. Springer Verlag.

Publications Arising from Other SCOR Activities

Red Tides Biology, Environmental Science, and Toxicology; Proceedings of the First International Symposium on Red Tides held November 10-14, 1987, in Takamatsu, Kagawa Prefecture, Japan. T. Okaichi, Anderson D.M., Nemoto, T., eds. Elsevier, 1989. This symposium was co- sponsored by SCOR.

SCOR Proceedings, Volume 24. Report of the XIX General Meeting of SCOR, Acapulco, Mexico. August 27 and September 1, 1988.

SCOR Handbook. January 1989.

Ocean Modelling Newsletter. The most recent issue is No. 83.

Oceanography 1988. A. Ayala-Castanares, W. Wooster and A. Yanez-Arancibia (eds.). Proceedings of the Joint Oceanographic Assembly, General Symposia. Acapulco, August 1988

3.3 Finance

The Executive Secretary presented a brief review of the 1988 final financial statement (which appears in Annex X), and an interim report on the 1989 financial situation. The Chairman of the *ad hoc* Finance Committee, Professor Charnock, presented its report which included a draft budget for 1990 and a recommendation on the levels of national membership contributions for 1990 and 1991.

The Finance Committee conducted a thorough review of the state of SCOR finances. The final statements for the year showed that, in general, 1988 income was slightly higher and expenses

slightly lower than expected. The year-end balance was considered to be at an appropriate level, considerably reduced from higher levels at the end of several years preceding 1988. An examination of the current situation and forward projections to the end of 1989 indicated a greatly reduced balance, however. Concern was expressed over the reductions in UNESCO support through its contracts to SCOR, and especially over smaller than expected ICSU grants for CCCO and JGOFS activities.

Professor Charnock introduced a budget proposal for the 1990 fiscal year. It predicted total income of about $560,000.00 and expenses of $600,000.00. Although the requests of Working Groups for support in 1990 had been met and the traditional level of support to CCCO had been maintained, this budget would result in a very significant reduction in the year end balance, to a level which might endanger activities planned early in the 1991 financial year.

Accordingly, the Finance Committee recommended an increase in membership contributions of 8recommendation, Professor Charnock noted that a similar increase had already been approved by ICSU for its National Members, and that these membership contributions represent the only substantial source of flexible income in the SCOR budget. Other major income is dedicated to specific purposes, such as the ICSU grant to support CCCO.

The Executive Committee accepted the report of the *ad hoc* Finance Committee and its recommendations regarding the 1990 budget and 1991 membership contributions. It instructed the President and Executive Secretary to request a number of SCOR Committees to consider increasing their categories of SCOR membership to levels more in keeping with the size and state of development of their oceanographic communities. It was hoped that this would provide some additional income to SCOR.

3.4 Other Organizational Matters

SCOR Constitution

The Executive Secretary reported that ICSU has approved the changes to the SCOR Constitution which were adopted by the XIX General Meeting.

Appointment of a Nominations Committee

The Executive Committee noted that elections of SCOR Officers must be held at the XX General Meeting in October 1990. The terms of the Secretary and three Vice-Presidents will all expire at that meeting, although all of them except Prof. G.R. Heath (who was elected in 1984) are eligible for re-election. A Nominations Committee was appointed to seek and receive nominations for these positions as appropriate in preparation for the XX General Meeting.

The Improvement of the Participation of SCOR Committees in the Activities of SCOR

As a continuation of the discussion on this matter which was initiated at the XIX General Meeting, Dr. Su Jilan presented a preliminary report on the survey he had conducted on the current modes of operation of SCOR Committees. The results of the survey and his initial recommendations are given in Annex XII.

In summarizing his recommendations, Dr. Su noted that one third of the countries belonging to SCOR are not represented in any of its subsidiary bodies. Many of the SCOR Committees in these countries, particularly the smaller ones, expressed a desire for SCOR to undertake more activities requiring international collaboration in the field of coastal oceanography. He suggested that developing countries might be encouraged to join SCOR if there were a short- term initial membership without any obligation to pay a membership fee. Finally, Dr. Su made a number of recommendations relating to ways of increasing the visibility of SCOR through increased dissemination of information.

The lengthy discussion which ensued exposed a large number of views on these points. They focused on three general themes: the role of SCOR in regard to education and training; the traditional emphasis on scientific excellence above all else in the selection of participants in SCOR activities; and the relative importance of open ocean and coastal oceanography in the broad scope of these activities. While all participants agreed that all efforts to increase SCOR's visibility in the oceanographic community, to involve more young scientists and scientists from developing countries in SCOR activities, and to improve communication through SCOR Committees are to be encouraged, it was also recognized that any such efforts would require additional funds and time for the SCOR Secretariat. It was not clear whether these resources could be made available. The discussion on some of the points raised by Dr. Su was inconclusive, in particular with respect to the role of SCOR in the field of coastal science, the demands which large-scale programmes are placing on SCOR resources, and the need to preserve scientific excellence while broadening participation in SCOR activities. Some similar issues were also raised during the following discussion on the Joint Oceanographic Assembly. In order to clarify these points and to prepare for a more focused discussion at the XX General Meeting, the Executive Committee agreed to appoint an *ad hoc* Review Group on the Role and Future Directions of SCOR. This group will be chaired by Prof. Heath and will include the President and Secretary of SCOR, as well as Drs. Su Jilan, I.N. McCave and T. Healy.

4.0 JOINT OCEANOGRAPHIC ASSEMBLY

The Chairman of the Mexican Organizing Committee for the 1988 Joint Oceanographic Assembly reported that the JOA Proceedings were expected to be in press in the very near future and that he would prepare a final report on JOA-88 with recommendations for the future which he hoped would be helpful to SCOR.

Prof. Terry Healy presented the report from the ad hoc Committee to review the JOA and SCOR's role in relation to large international scientific meetings in general. He noted that his committee had collected a large number of divergent ideas on this topic. The main question to be resolved was whether SCOR should continue to organize the traditional JOA, held every six years, with a long schedule (as much as two weeks) and a programme involving broad interdisciplinary topics as well as specialized sessions.

The consensus of the lengthy discussion which followed Professor Healy's report was that the expectations of the JOA were generally unrealistic and that no single international meeting could satisfy the needs of all members of the oceanographic community. The interdisciplinary exchange of ideas fostered by a JOA was generally supported, as was the value of the JOA in promoting exchanges between scientists from the developed and developing countries (a particularly successful aspect of JOA-88). However, it was also recognized that the interest in JOA shown by scientific leaders has decreased and that they are less attracted to large meetings of a general nature, especially as travel funds become restricted. These individuals may also prefer to attend the IUGG Assembly which, while it is a very large meeting, provides a forum for many specialized sessions held concurrently.

The conclusions reached were:

That SCOR should continue to organize an international scientific meeting that meets SCOR's dual commitment to scientific excellence and to fostering interdisciplinary communication.

That future meetings should be smaller, held more frequently and should focus on more narrowly defined themes which would reveal the "depth rather than the breadth" of our knowledge of a topic. An example of an interdisciplinary topic which could be treated in this way might be the carbon cycle in the upper ocean.

It was agreed that these recommendations would be presented by the Executive Committee for approval at the XX General Meeting in 1990. In the meantime, the Secretary of SCOR, Professor Fournier agreed to prepare a paper summarizing this discussion for circulation to SCOR Committees in preparation for the General Meeting.

5.0 RELATIONS WITH INTERGOVERNMENTAL ORGANIZATIONS

5.1 Intergovernmental Oceanographic Commission

The representative of the IOC, Dr. Neil Andersen, noted that many items of concern to the Commission had been addressed under the preceding agenda items. He confirmed the keen desire of the IOC to increase cooperation with SCOR in specific areas of mutual interest.

Dr. Andersen made special mention of several Resolutions of the Fifteenth Session of the IOC Assembly (Paris, July 1989). These are reproduced in Annex XIII and include:

Resolution XV-1 Second Session of the WMO-IOC Intergovernmental TOGA Board
Endorses the TOGA Coupled Ocean-Atmosphere Response Experiment and provides IOC support for the International TOGA Scientific Conference.

Resolution XV-2 Institutional Arrangements for WOCE
This establishes the Intergovernmental WOCE Panel based on recommendations submitted to the Assembly by the President of SCOR and the Chairman of IOC.

Resolution XV-3 Ocean Dynamics and Circulation on the Continental Shelf
Approves the development of a new IOC programme on the Dynamics and Oceanography of Coastal and Shelf Seas and Exchanges and calls upon the Scientific Advisory Bodies of IOC to assist in planning a workshop on this topic.

Resolution XV-4 Global Integrated Ocean Observing System
This Resolution notes the development of WOCE, TOGA and JGOFS and the establishment of a CCCO-JSC Ocean Observing System Development Panel in order to develop a scientific plan for an ocean observing system for monitoring and predictive purposes. It establishes an IOC ad hoc Group of Experts to work with the OOSDP in this effort.

Resolution XV-6 IOC involvement in the International Geosphere-Biosphere Programme (IGBP)
Affirms the Commissions's interest in the IGBP and lists those IOC programmes which may be relevant.

The Executive Committee also received a brief report of a joint IOC/SCOR workshop on the statistical analysis of time series data for recruitment studies, Monterey, July 1989. This activity arose as part of the IOC Programme on Ocean Science and Living Resources. A manual on methods of statistical analysis of this type of data will be published in 1990.

5.2 UNESCO Division of Marine Sciences

The Director of the Division of Marine Science of UNESCO, Dr. Dale Krause, confirmed that his organization will continue to provide some support for SCOR Working Groups in which it has a special interest. In particular, he welcomed the establishment of WG 93 on Pelagic Biogeography and expressed the Division's wish to cosponsor the group and to provide some funds to support its activities.

The Executive Committee accepted Dr. Krause's invitation to cosponsor the Interregional Scientific Conference on Coastal Systems which will take place at UNESCO in early November 1990. SCOR will assist by providing some funds for travel by scientists from developing countries.

The President of SCOR requested UNESCO to involve SCOR in the selection of speakers for this Conference.

5.3 International Council for the Exploration of the Sea

Dr. A.C. Pierrot-Bults reviewed the report from ICES and noted a number of special points.

ICES has currently no direct involvement in the forthcoming global oceanographic experiments, such as WOCE, but some of its working groups are very active in promoting and executing peripheral activities, such as the Greenland Sea Project (GSP) and NANSEN (North Atlantic Norwegian Sea Exchange). In both of these projects, scheduled to run for several years, the resources of the ICES Secretariat are being utilised as a data centre for the cruise information (ROSCOP) and station data.

The foundations for a third multi-ship international project, the Skagerrak Experiment have been laid during the past year. This 15 ship, 8 nation experiment is planned to run during the early 1990s, and has been set up following the success of the Patchiness Experiment which took place in 1986 under the aegis of the ICES/SCOR working group on the pollution of the Baltic. As was the case in PEX, considerable attention is to be paid to shipborne procedures and data quality, a factor which is imperative in such exercises. In doing so ICES has been further promoting the exacting standards set in the report of the SCOR WG 51 on CTD observations. In addition, it has also recognized the necessity to expand the products of the IAPSO Standard Seawater Service, who now produce a low salinity standard of 10 salinity units suitable for use in the Baltic.

In reviewing the slow progress in developing programmes within the framework of IOC's programme in Ocean Science and Living Resources, IREP, ICES decided to set up a small Inter-Committee Recruitment Group who would attempt to coordinate and guide the work of relevant working groups and Committees on this issue. The group has been asked, in particular, to identify interdisciplinary objectives for recruitment research, including possible interactions between ICES working groups and Committees. Of relevance within this context is the SCOR working group proposal on physical processes affecting biological variability but as yet it has not been foreseen how this may link with IREP activities within ICES. ICES also concurred with the SCOR proposal for the establishment of a working group on Pelagic Biogeography, because of the great value of integrating knowledge on the distribution of marine organisms, both from a historical and mechanistic perspective.

ICES has maintained an active involvement in JPOTS, and has continued to support the sub panels on the New Oceanographic Manual and on Carbon Dioxide. Progress with the Manual has now reached an advanced stage. its technical and editorial preparation is underway within the ICES Secretariat, and it is hoped that publication by UNESCO will proceed early in 1990.

At its 1989 meeting ICES agreed to the holding of a major symposium on Hydrobiological Variability in the ICES area, 1980-1989. It is intended that this symposium is the beginning of regular decadal symposia on this topic in order to facilitate, in due course, our recognition and understanding of very long term changes in the marine environment. This first symposium will be held in Mariehamm, Aland Islands, Finland in June 1991.

5.4 World Meteorological Organization

A detailed report from WMO is given in Annex XIV and was summarized briefly by Dr. K. MacLeod.

The joint WMO/IOC Drifting Buoy Cooperation Panel was meeting in Geneva at the time of the SCOR Executive Committee meeting. The Technical Coordinator of the Panel has been able to effect measurable improvements in the quality and quantity of drifting buoy data on the GTS, by at least 10 - 15contacts with the WOCE drifter community with a view to the eventual

development of a new, cheap, multipurpose buoy. Following the publication in 1988 of a Guide to Drifting Data Buoys, the author, Dr. Hamilton, is in the process of producing a companion Guide to Moored Buoys and other Ocean Data Acquisition Systems.

Within the WMO, the proceedings of the Technical Conference on Ocean Waves was about to be published and the WMO Guide to Wave Analysis and Forecasting is now available.

Forty-eight ships from six countries are now participating in the Voluntary Observing Ships Special Observing Project, North Atlantic with over 8000 observations archived in the UK to date.

A WMO/IGOSS group of experts on oceanographic satellites and remote sensing was about to be established. Its terms of reference are given in the detailed report from WMO.

The WMO has agreed that to support global climate monitoring, research and prediction, there is a need to monitor a number of oceanic parameters. Dr. MacLeod referred to the plans for cooperation with IOC (see item 5.1) in order to develop, implement and maintain an integrated operational global ocean observing system.

The draft Science Plan for the TOGA Couple Ocean-Atmosphere Response Experiment will be presented to the Intergovernmental TOGA Board in early 1990 and the drafting of an Implementation Plan for TOGA-COARE is underway. The International TOGA Project Office is located in WMO Headquarters in Geneva and is taking the lead in organizing the International TOGA Scientific Conference (cosponsored by WMO, ICSU, IOC and SCOR) which will take place in Honolulu in July 1990. Finally, Dr. MacLeod reported that the TOGA Compact Disk Pilot Project is well under way. it is hoped that by early 1990 a CD-ROM will be available containing all TOGA observations, monthly SST and wind-stress fields and daily ECMWF surface flux fields for the three years 1985 to 1987.

6.0 RELATIONS WITH NON-GOVERNMENTAL ORGANIZATIONS

6.1 International Council of Scientific Unions

Progress in the Development of the IGBP

The President and the Executive Secretary reported on progress in the development of ICSU's International Geosphere-Biosphere Programme (IGBP). This had been significantly advanced at the first meeting of the Scientific Advisory Council for the IGBP in Stockholm in October 1988. The SAC endorsed the general framework for the IGBP in which a series of Core Projects are being developed, some by other organizations in cooperation with IGBP, and some by the IGBP itself. There has been a great deal of interaction between SCOR and the IGBP, in particular with regard to the development of JGOFS. In May 1989, an agreement was concluded between SCOR and ICSU's Special Committee for the IGBP which designates JGOFS as a Core Project of the IGBP. The responsibility for planning of JGOFS will remain with the SCOR Committee. The text of a letter to the President of ICSU, signed jointly by the Chairman of IGBP and the President of SCOR on this topic is given in Annex XV. This agreement also establishes that SCOR will collaborate with the SC-IGBP in the planning of other oceanographic programmes required for IGBP.

E. Tidmarsh presented a brief review of IGBP planning activities, in particular those of the IGBP Coordinating Panel-2 on Marine Biosphere-Atmosphere Interactions. She remarked that, to a large extent, the activities of this Panel have proceeded more slowly than others while JGOFS was being developed and SCOR's involvement in the IGBP was being discussed.

The main objective of the IGBP is "to describe and understand the interactive physical, chemical and biological processes that regulate the total Earth system, the unique environment it provides for life, the changes that are occurring in this system, and the manner in which they are influenced by human activities." Referring to a report by the Chairman of IGBP, Professor J.

McCarthy, to the recent JGOFS meeting, the Executive Secretary added that the IGBP priorities lie in those areas of each of the fields involved which deal with key interactions and significant changes on the time scales of decades to centuries that most affect the biosphere, that are most susceptible to human perturbation, and that will most likely lead to practical predictive capability.

The themes underlying all of the projects within IGBP involve:

- Documenting and predicting global change
- Observing and improving our understanding of dominant forcing functions
- Improving our understanding of transient phenomena in the total Earth system
- Assessing the effects of global change that would cause large scale and important modifications affecting the availability of renewable and non- renewable resources

These goals, priorities and themes are being addressed through the efforts of five IGBP Coordinating Panels:

- Terrestrial Biosphere-Atmospheric Chemistry Interactions
- Marine Biosphere-Atmosphere Interactions
- Biospheric Aspects of the Hydrological Cycle
- Effects of Climate Change on Terrestrial Ecosystems
- Global Analysis, Interpretation and Modelling

The following initial research priorities have been identified for the IGBP:

1. How is the chemistry of the global atmosphere regulated and what is the role of terrestrial processes producing and consuming trace gases?
2. How do ocean biogeochemical processes influence and respond to climate change?
3. How does vegetation interact with physical processes in the hydrological cycles?
4. How will climate change affect terrestrial ecosystems?

The overall research programme of the IGBP will be conducted through its Core Projects, those programmes deemed to be essential to the success of IGBP. These Core Projects will be planned and implemented in two ways: those which are coordinated by the IGBP, either acting alone or in collaboration with another body; and those which are coordinated by another body without the direct involvement of IGBP. SCOR's JGOFS programme falls into this latter category, as does the International Global Atmospheric Chemistry Programme of IAMAP. On the other hand, a study involving coupled field and remotely-sensed measurements to elucidate the interactions between vegetation characteristics, the hydrological cycle and fluxes between the terrestrial ecosystems and the atmosphere, is being planned by an IGBP group and will be supported jointly by IGBP and the WCRP. Another involving a study of the records of past global changes will be planned and executed by IGBP acting alone.

The activities of the IGBP Coordinating Panel on Marine Biosphere- Atmosphere Interactions (CP-2), are of most interest to SCOR. The Panel had identified three major areas of interest at an early stage: the oceanic carbon cycle, coastal and estuarine systems, and biogeochemical cycles and physical climate linkages. The first of these is being addressed by JGOFS. The third is viewed as a programme which must await the results of JGOFS and WOCE in order to address questions linking the physics of the upper ocean to the processes affecting primary production using, among other things, the much more sophisticated modelling techniques which will become available during the next decade. These complex relationships require parameterization in order to develop useful predictions of the effects of climate change on marine biogeochemical cycles for entire oceans, and to assess quantitatively the potential for feedback to climate. CP-2 is, therefore, focusing its attention on developing studies of coastal and estuarine systems. These may involve the following topics:

- Long term trends and regional patterns in the eutrophication of coastal waters related to urbanization, industrialization, agricultural development and other land use practices in the watersheds of the world's major rivers.
- Effects of anticipated climate change on watershed hydrological cycles that can influence riverine delivery of suspended sediment and dissolved nutrient materials to estuarine and coastal habitats.
- Effects of global sea level rise on estuarine and coastal wetland habitats and its implications.

The membership of CP-2 is now being expanded and will include the Chairman of JGOFS. He will also serve as an *ex officio* member of the Special Committee for the IGBP.

In his report to the JGOFS Committee, Professor McCarthy had noted plans to establish an International Long Range Planning Office for Open Ocean Projects of the IGBP in the UK. The IPO will concentrate its efforts on the planning required for a future programme to examine linkages among biogeochemical cycles and the physical climate system. It will give special attention to projects that require dedicated observing systems, including satellites and a new generation of long-range mobile deep-sea research robotics that have long lead time for development and funding. The Executive Committee noted that SCOR will be consulted in the discussions regarding this office and in all other aspects of planning of the oceanic components of IGBP in accordance with the agreement between SCOR and the SC-IGBP.

Strengthening Scientific Training and Research in the Third World

The Executive Secretary informed the meeting that ICSU and the United Nations Development Programme have recently undertaken to attempt to develop a programme, funded by UNDP, entitled "Strengthening Scientific Training and Research in the Third World". Initial proposals for projects had been sought, at very short notice, from all ICSU organizations. The Secretariat had submitted a proposal for an expansion of the existing NSF-supported programme of travel grants for scientists from developing countries. The Executive Committee considered other activities which might qualify for consideration as part of the possible ICSU- UNDP programme. It agreed that the highest priority should be given to a request for funding to support a series of methodological workshops to train scientists in the Pacific region who would participate in the JGOFS Equatorial Pacific Ocean Process Study in the standard techniques established for the JGOFS Core Measurements. The Executive Secretary was instructed to develop and submit a proposal to ICSU for this project.

ICSU and the UN International Decade for Natural Disaster Reduction

At its General Assembly in 1988, ICSU adopted a resolution in which it agreed to participate in the UN International Decade for Natural Disaster Reduction, in particular with respect to the scientific aspects of natural disasters. An ICSU ad hoc group had sought commitments from all relevant ICSU bodies on their participation in specific projects from a list of eighteen identified by the group. SCOR's name had been linked to three projects by the ICSU group (Intense Atmospheric Vortices: Models of Origin and Prediction; Storm Surge Prediction; and Dynamics of the Oceanic Biosystem in Small Time Scales with Special Attention to Mechanisms and Prediction of Rapid Drops in Fish Production).

In principle, the Executive Committee agreed that there were elements of the proposed projects in which SCOR would be interested in participating, or taking the lead if that were appropriate. It felt, however, that such participation would require the establishment of new SCOR working groups and that the projects listed in the report of the ICSU ad hoc group were not yet well defined enough for this purpose. Considering those projects identified as falling within the area of SCOR's expertise, it was apparent that several aspects were already covered under current programmes, particularly those of the World Climate Research Programme of WMO and ICSU. The Executive

Committee strongly urged ICSU to ensure that a careful survey of existing international activities should be carried out.

The Executive Committee did not feel that this topic should be pursued until more detailed information was forthcoming from ICSU.

6.2 ICSU Unions and Committees

The following organizations responded to a request for reports on activities of mutual interest:

Scientific Committee on Antarctic Research

A brief report from the new Executive Secretary of SCAR, Dr. P.D. Clarkson mentioned the publication of a report entitled "The Role of Antarctica in Global Change", a SCOR effort in support of the IGBP. SCAR wishes to develop close links between the SCAR/SCOR Group of Specialists on Southern Ocean Ecology and the JGOFS Committee in relation to planning a southern ocean component of JGOFS. The Executive Committee was pleased to note that SCAR had agreed to cosponsor a symposium on the "Biogeochemistry and Circulation of Water Masses in the Southern Ocean" to be held in Brest in July 1990. SCOR has also agreed to cosponsor this event and it will provide a forum for initial planning activities for southern ocean JGOFS.

Union Radio Scientifique Internationale

The URSI representative to SCOR, Dr. G. Valenzuela, had submitted a written summary of activities of interest to SCOR which primarily involved the topics of data handling and remote sensing in support of IGBP. URSI has established a working group on Global Change. The General Assembly of URSI will take place in Prague in August 1990 and will feature meetings of all of the URSI Commissions (including Commission F on remote sensing) and a special lecture on URSI and the IGBP.

6.3 Affiliated Organizations

Commission for Marine Geology

The newly-elected Chairman of CMG, Professor I.N. McCave, presented a brief verbal report of the activities of his organization, noting that it had participated actively in the organization of sessions at the meetings of the International Union of Geological Sciences and of the European Geophysical Union during 1989. The Second International Conference on Paleoceanography had been held in Cambridge in September 1989 and had been very successful. Professor McCave made special mention of the increasing interest in Arctic Ocean deep sea drilling and the potential for obtaining cores which would provide new records of climatic change. Five of the symposia to be held at the 1990 International Sedimentological Congress will deal with topics relating to the sedimentary record and global change.

Professor McCave urged the JGOFS Committee to ensure that JGOFS incorporates a benthic component with studies of the sedimentary record. He noted that this need not involve very long cores, but that even the upper two centimeters of sediment may reveal invaluable information about biogeochemical fluxes.

International Association for Biological Oceanography

No written report was available from IABO, although the President, Professor P. Lasserre did provide information on some recent activities, a restructuring of the organization, and its involvement in the COMAR programme of the UNESCO Division of Marine Science.

International Association of Meteorology and Atmospheric Physics

A report from Dr. G.B. Tucker noted that no progress had been made with an IAMAP proposal (noted at the XIX General Meeting) to organize a joint symposium on the methodology used to obtain regional climate change estimates, partly due to the preoccupation of the climate change

community with the activities of Working Group 1 of the Intergovernmental Panel on Climate Change. The topic was to be discussed at the IAMAP meeting in 1989 and further information was expected to be sent to SCOR.

International Association for the Physical Sciences of the Ocean

The President of IAPSO, Professor J.J. O'Brien, introduced a report from the Secretary General of his organization which is given in Annex XVI. This provides detailed information on a number of IAPSO activities, including the IAPSO Commissions on Sea Ice, Sea-Level and Tides, Natural Marine Hazards, Space Oceanography, Cooperation with Developing Countries, and Program and Assembly Planning. The IAPSO report lists a large number of sessions planned for the XX IAPSO General Assembly which will take place in Vienna in August 1991.

Professor O'Brien made special mention of IAPSO's decision to abolish a number of Commissions which had been inactive and to initiate new activities which he hoped will lead to renewed interest by the physical oceanographic community.

6.4 Corresponding Organizations

Arctic Ocean Sciences Board

Mr. L.B. Brown, the Secretary of AOSB, presented his report to the meeting. The Arctic Ocean Sciences Board held its Eighth Meeting in February 1989 in Washington, D.C., under the Chairmanship of Prof. G. Hempel (FRG). The Board considered a broad range of Arctic Ocean science issues. Discussions of the initial results of the first intensive field studies under the Greenland Sea Project (GSP) indicated that there is substantial interannual variability in oceanographic conditions in the Greenland Sea.

Accordingly, it was agreed that: (1) long time-series measurements are necessary to determine the extent of this variability; (2) it is essential to determine the interaction of surface and intermediate layer convection and deep-water formation; and (3) additional studies are needed of small-scale frontal systems, eddies, and sea ice.

The Board strongly endorsed continuation of the Greenland Sea project and requested the GSP Steering Committee to develop plans for a second intensive field study to be conducted when the ERS-1 satellite is operational.

The AOSB accepted the recommendations it had received from two AOSB-sponsored workshops to initiate a comprehensive study of polynyas. The Board adopted the International Arctic Polynya Project (IAPP) and established a Science Coordinating Group under the Chairmanship of Dr. Louis Legendre of Canada to provide coordination and oversight for this Project.

It was agreed that initial IAPP studies should focus on three polynyas: the Northeast Water in the Greenland Sea (NEW), the North Water in Baffin Bay (NOW), and the St. Lawrence Island Polynya in the Bering Sea (SLIP). Small planning groups were set up for each of these studies. The NEW group is scheduled to meet on 27-29 September in Bremerhaven. Planning has advanced most rapidly for North Water, in particular to overwinter a vessel at the Carey Islands during the winter of 1990/1991. The SLIP group met in August in Seattle and are aiming for a SLIP field program in 1991/1992.

Reports on a possible FRAM Commemorative Drift Program and Arctic Ocean drilling were presented to the Board which decided to explore options in both areas further. The Board will thus revisit both of these items at its next meeting. It may be of interest to note that the Norwegian Committee for the Nansen Centennial Arctic Program has prepared a draft interdisciplinary scientific plan for such a program which will soon undergo internal review in Norway. If approved, it is likely to be open to international participation.

The Board will also consider the establishment of a data base on Arctic research operations as a possible initial step in developing improved coordination of such operations in the future.

The Board received a series of presentations from staff of the U.S. National Aeronautics and Space Administration (NASA) on applications of remote sensing to Arctic research and held a round table discussion on this topic.

Prof. Hempel was elected as Chairman and Dr. John Bowman (U.K.) was elected as Vice-Chairman, both for a one-year period.

The AOSB will hold its Ninth Meeting on 15-17 January 1990. This meeting will be hosted by the Scott Polar Research Institute in Cambridge, U.K.

Engineering Committee on Oceanic Research

The representative of ECOR, Mr. Brian Nicholls presented a brief report on the activities of his organization since the XX General Meeting of SCOR. He noted in particular that three working groups of ECOR were approaching conclusion: Ocean Energy Systems, Reliability Methods for the Design and Operations of Offshore Structures, and Ocean Engineering Education and Training. A major effort has been given to the formation of new groups and the following topics were under consideration by ECOR: Marine Robotics, Self-burial of Subsea Pipelines, Large-scale Cleansing of Polluted Seabeds. Marine Pollution, and Small-scale Ocean Energy Systems.

7.0 FUTURE MEETINGS

7.1 Meetings of SCOR

The XX General Meeting of SCOR will take place at the Institut für Meereskunde of the Academy of Sciences of the German Democratic Republic in Rostock-Warnemunde, GDR from October 1-3, 1990. The General Meeting will be followed by a two-day symposium on the topic of small-scale turbulence in the ocean which will be organized by the GDR Committee for SCOR. The Executive Committee agreed to asks the organizers of the symposium to make it slightly more interdisciplinary in approach, including the effect of small- scale turbulence on marine productivity.

The Executive Committee accepted, with gratitude, the invitation of the Chairman of the New Zealand Committee for SCOR, Professor Terry Healy, to hold its thirtieth meeting in that country during the last quarter of 1991.

7.2 Other Meetings

The Executive Secretary presented information on the following international meetings of interest to SCOR which had not been mentioned during the discussion of other agenda items:

International TOGA Scientific Conference. Honolulu, USA, 16-20 July 1990. To be cosponsored by WMO, IOC, ICSU and SCOR. Chairman is K. Wyrtki.

Oceanography from Space 1990. Venice, Italy, May 21-15 1990. Sponsored by the IAPSO Commission on Oceanography from Space. Program Organizer is J. Gower.

Symposium on Global Change. To be held in conjunction with the 28th COSPAR Meeting, The Hague, Netherlands, 25 June - 7 July 1990. The symposium will include a session on satellite observations of Large Scale Biological/Physical Interactions in the Ocean. Program Committee members include J. Gower and D. Halpern.

The Biogeochemistry and the Circulation of Water Masses in the Southern Ocean. Brest, France, July 3-6, 1990. Also being cosponsored by SCAR.

The Executive Committee agreed that all of the above meetings should be cosponsored by SCOR.

8.0 CLOSING

In closing the twenty-ninth meeting of the SCOR Executive Committee, the President extended the best wishes of SCOR to Dr. Dale Krause, who would be retiring in the near future as Director of the Division of Marine Sciences of UNESCO and who had done so much to foster the close working relationship which exists between SCOR and the Division. He also noted that Professor Pierre Lasserre would step down as President of IABO before the XX General Meeting of SCOR and thanked him for his service as an *ex officio* member of the Executive Committee. On behalf of the entire Executive Committee, Professor Stromberg expressed his thanks to Professor O'Brien and the Oceanography Department of Florida State University for the facilities which had been made available for the meeting and for the generous hospitality which had been extended to all participants.

ANNEX I

29TH SCOR EXECUTIVE COMMITTEE MEETING PARTICIPANTS

Members of the Executive Committee

*Professor J-O. Stromberg	Sweden	President
*Professor G. Siedler	F.R.G.	Past-President
*Professor R.O. Fournier	Canada	Secretary
*Professor G.R. Heath	U.S.A.	Vice-President
*Dr. A. Kuznetsov	U.S.S.R.	Vice-President
*Professor T. Asai	Japan	Vice-President
*Dr. Su Jilan	China	Co-opted Member
*Dr. A. Ayala-Castanares	Mexico	Co-opted Member
*Professor J.J. O'Brien	U.S.A.	Ex-Officio / IAPSO
*Professor P. Lasserre	France	Ex-Officio / IABO
Professor K. Hsu	Switzerland	Ex-Officio / CMG
Ms. E. Tidmarsh		Executive Secretary
Mrs. I. Walker		Administrative Assistant

Other Participants

Dr. N. Andersen	IOC
Dr. P. Brewer	JGOFS
Mr. L.B. Brown	NSF
*Prof. H. Charnock	UK
*Dr. M. Donelan	Canada
Mr. R. Godin	CCCO
Dr. D. Halpern	COSPAR
*Prof. T. Healy	New Zealand
Dr. D. Krause	UNESCO
*Dr. M.M. Miah	Bangladesh
Mr. B. Nicholls	Canada
*Dr. F. Nyffler	Switzerland
Dr. A. Pierrot-Bults	Netherlands
*Dr. J. van der Land	Netherlands

* = member of SCOR

ANNEX II

Special Lecture
in
Air-Sea Interactions
by

Dr. David Halpern
Jet Propulsion Laboratory
Pasadena, CA

"Pacific Ocean-Atmosphere Interactions"

ABSTRACT: Ocean-atmosphere interactions within selected regions of the Pacific Ocean strongly influence physical and biological oceanographie conditions and fishery stocks throughout the Pacific. Changes in equatorial sea surface temperature disrupt the normal pattern of the middle latitude atmospheric jet stream, which produces anomalous weather disturbances over North America. Upwelling variations of cold nutrient-rich upper ocean waters in the equatorial Pacific are associated with changes in the annual increase of atmospheric carbon dioxide, which illustrates a substantial role, although currently poorly measured and understood, of the ocean in the air-sea flux of carbon dioxide. Considerable progress has been made in recent years to monitor, understand, and predict several months in advance the natural variable states of Pacific ocean-atmosphere interactions. The arrival of global ocean observations by satellite-borne instrumentation and the development of numerical models of the ocean create opportunities for innovative research and international cooperation for everyone's benefit.

Sponsored by:

The Oceanography Department
The Meteorology Department
The Geophysical Fluid Dynamics Institute
The Mesoscale Air-Sea Interaction Group

October 16, 1989

FSU Conference Center, Room 244, 3:30 PM

ANNEX III

Welcoming Speech
at
the SCOR Executive Committee Meeting
FSU Conference Center
October 16, 1989

When Jim asked me to offer a few words of welcome to this august body of oceanographers from the world-over, I quickly accepted the invitation. After all, one does not get an opportunity like this everyday. Let alone for someone from Tallahassee whose name is not O'Brien.

So, a sincere and cordial welcome from all of us at the Department of Oceanography.

In a broad sense, it is also quite fitting that the SCOR Executive Committee should choose this part of the world for its meeting site. The Oceanography faculty at FSU thrive on international research cooperations and played a key role in the Australian Coast Experiment, the Yellow Sea experiment, the UNESCO- sponsored International Geological Correlation Program, and the Argentine Basin experiment, just to name a few.

Many of our research interests are also global in nature. Our dynamicists have a keen interest in the ventilation of the deep ocean and the ocean thermocline, our biologists in the deep sea community structure and in carbon flux estimates from phytoplankton production, and our chemists in the origin of the build-up of trace gases that are important to the global warming issue.

One of us has just been funded by the NSF for a 2-year program for improving educational opportunities for undergraduates the world over to study about global change.

In the next couple of days, I hope you will be able to find time to visit with some of our 19 faculty members and interact with a student body of 45 which is truly international.

Again my warmest welcome to you and my best wish for an enjoyable stay in Tallahassee and a most productive conference in this beautiful Conference Center.

Professor P. Hsueh, Chairman
Department of Oceanography
Florida State University

ANNEX IV

Report of SCOR WG 75 On Oceanic CO_2 Methodology

The final meeting of SCOR Working Group 75 was held at Woods Hole Oceanographic Institution, Woods Hole, Massachusetts, October 11-14, 1988, hosted by Peter Brewer and chaired by C.S. Wong. Participants included 4 members (P. Brewer, G. Lambert, Y. Sugimura and C.S. Wong) and 7 invited experts from U.S.A. (R.H. Byrne, E. Druffel, R.A. Feely, E.T. Peltzer), France (C.Goyet), P.R. China (J. Zheng) and U.S.S.R. (M. Stashchuk - with written submission).

The major tasks were: (1) to re-examine the documents from the last meetings at Lake Arrowhead and Les Houches to identify accomplishment, unfinished tasks and new issues, (2) review of national and international activities related to WG 75 objectives, e.g. CCCO/JGOFS CO_2 Panel and preliminary results of recent JPOTS/SCOR/ICES international intercalibration on CO_2/alkalinity and (3) recommendations, including the role of a replacement working group following the termination of SCOR WG 75.

Since the first meeting at the 1983 IUGG in Hamburg, SCOR Working Group 75 has done pioneering work in focusing the global strategy and technical problems of oceanic CO_2 measurements. The WG 75 framework has been incorporated into the designs of global CO_2 surveys under international programs of WOCE and JGOFS. The reports of the Lake Arrowhead and Les Houches meetings, edited by Keeling, reviewed the advances and technological gaps in CO_2 methodology, and provided a collective and focused view of the oceanic CO_2-measuring community. The coordinating role of WG 75 has resulted in working with JPOTS and ICES to conduct an international intercalibration exercise on total CO_2 and alkalinity in 1987 coordinated by A. Poisson. The urgent need for a reference seawater for future global CO_2 surveys was recognized, and WG-75 members, such as Poisson, Keeling and Wong have been working within their own national resources towards the availability of reference seawater essential to the CO_2 surveys of WOCE/JGOFS in the coming decade.

A review of the state-of-the art in the methodology for oceanic CO_2 and carbon measurements was made. The group was impressed by recent advances in coulometry for TCO_2, colorimetric measurements of pH, fibre-optic sensors for in-situ pH alkalinity, accelerator mass spectrometry for small sample of C^{14} in seawater, shipboard data handling capability by personal computers and high temperature combustion method for dissolved organic carbon in seawater. The final report will be updated to incorporate these advances. A major issue was dissolved organic carbon in seawater. Sugimura's group developed this new technique which gave 50-400% more DOC than other exlsting methods as confirmed by a recent intercalibration at WHOI. WG 75 discussed the need for further DOC intercalibration, which could be the task of a new or replacement WG. Another idea for a replacement WG was initiated by Brewer for discussion on a scheme to gather world experts on various CO_2 parameters at the same oceanic site, such as Bermuda, to make the best possible measurements on the present- day oceanic chemical system so as to formulate a projection of future CO_2 changes in the ocean. Any deviations from this derived CO_2 chemical relationship in future global CO_2 observations would alert the scientific community on unexpected behaviour of the natural CO_2 system being titrated by fossil- fuel CO_2.

The following recommendations were made:

(1) WG 75 recommended strongly that in the very near future,global oceanic carbon programs should pursue actively accelerated activities on intercalibration and the development of reference seawater and material for quality control in creating a global oceanic carbon data set.

(2) WG 75 recommended to the SCOR Executive Committee to request IOC of UNESCO to continue support of the JPOTS sub-Panel on CO_2 standards to revisit the thermodynamics and the closure problems of the oceanic CO_2 system, till the availability of an acceptable standard reference seawater is assured. At present, the spread in TCO_2 and total alkalinity measurements in the 1987 JPOTS/SCOR/ICES intercalibration between laboratories was as large as the fossil-fuel CO_2 signal and an all-out effort is needed to narrow down the "noise" of the interlaboratory measurement programs.

(3) WG 75 will produce an "interim" CO_2 methodology manual to be published in the UNESCO technical manual series. WG 75 Chairman was asked to pursue the task, by compiling key published papers on (a) pH, (b) alkalinity, (c) TCO_2, (d) pCO_2, (e) isotopic C^{13}, C^{14}, (f) POC, (g) DOC, (h) software in thermodynamics calculations, (i) sources of contacts for reference seawater and material and (j) data. The manual will include a foreword section, to be written by experts in each of these fields, commenting or updating the published methods.

(4) WG 75 recommended that an international oceanic CO_2 symposium be organized in 1990 or 1991 and encouraged Professor Sugimura to host the symposium in Japan. The proceedings will be published to summarize the tasks and achievements of the working group.

(5) WG 75 recommended that SCOR should request IOC during its coming General Assembly, to encourage the world's nations to participate actively in the world CO_2 survey programs with attention to both data quality and data visibility. WG 75 expressed concern that not enough laboratories in third world countries be given sufficient resources to bring their capabilities to world-class levels necessary for a successful CO_2 survey program. SCOR should urge its members to increase the levels of scientific support and international agencies to devote resources to assist such endeavour.

(6) WG 75 recommended to SCOR to consider two major areas for SCOR WGs as replacement of WG 75: (a) To organize international experiments for designing chemical model of future CO_2 changes in the ocean to guide the prediction of CO_2 signals or to detect sudden deviations of CO_2 changes due to natural events. The best measurements, in terms of compatibility and experimental design, will be done by world experts to be gathered at selected sites,and (b) To study the rationalization of DOC for availability of technique to the scientific community. WG 75 Chairman was asked to table a proposal for such a replacement WG for consideration in the next SCOR executive meeting, and this will be established by correspondence.

(7) The final report and the manual should be completed before the next SCOR executive Meeting.

(8) WG 75 recommended SCOR to encourage national standards laboratories with long-term CO_2 program to seek support from their respective governments of SCOR countries to accept the responsibility of ensuring the development, production and distribution of reference seawater for use in the global CO_2 program. These laboratory would also ensure long-term quality control of the global CO_2 data set through a continuing international calibrating network.

ANNEX V

1989 Annual Report on SCOR WG 78
Determination of Photosynthetic Pigments in Seawater

Over the period October 1988 to end September 1989, we have had an extremely busy and productive year in which three "mini workshops" were held on: Algal Chlorophylls and their Breakdown Products, Algal Carotenoids, and Field Application of HPLC Pigment Analyses.

1. CHLOROPHYLL WORKSHOP:

The PML HPLC system was airfreighted to Hobart and used to intercalibrate with CSIRO's HPLCs. Reference algal cultures were grown and their pigments harvested, extracted, purified and where necessary, derivatised to yield reference standards of chlorophyll *a*, *b*, *c*1 + *c*2, *c*3. as well as "Mg 2,4,D", phaeophorbide *a*, chlorophyllide *a*, phaeophytin *a* and *b* and pyrophaeophorbide *a*. We achieved five objectives:

1.1 We critically compared and intercalibrated RP-HPLC systems with standard spectrophometric (S/P) and fluorometric (F) methods for the determination of chloropigment composition and concentration using known mixtures of chlorophyll standards and reference cultures.

1.2 Using HPLC and diode array S/P detection, we determined extinction coefficients at selected HPLC wavelengths and in various solvent systems using chloropigment standards. Relative molar and gravimetric HPLC fluorescence responses were also derived for a range of excitation and emission conditions.

1.3 All the spectral and chromatographic properties of chloropigments in the reference standards and reference cultures were fully documented.

1.4 Pigment extractability from reference cultures and stability in the extracting solvents were assessed using acetone, methanol, grinding and ultrasonication.

1.5 Pigment stability experiments under various storage conditions were assessed over a logarithmic time series of up to 1 month.

1.6 In the course of the Chlorophyll workshop, we modified and refined an HPLC to resolve co-eluting compounds such as zeaxanthin and lutein, chlorophylls-C3 and C1 and C2.

2. CAROTENOID WORKSHOP:

2.1 A total of 25 algal carotenoids which are chemotaxonimcally significant and which occur as major pigment constituents of algal pigments were extracted from the SCOR Algal Collection, previously grown under standard culture, light and nutrient conditions. The crude extracts had to be cleaned up by RP-HPLC, RP-HPTLC and normal phase column chromatography to yield single compound standards.

2.2 We then compared the characteristics of RP-HPLC and NP-HPLC for separation, identification and quantitation of the principal carotenoids from the 8 reference algal cultures.

2.3 We documented the spectral and chromatographic properties of the principal chemosystematic carotenoid markers.

2.4 Carotenoid standards were tested for stability in a variety of solvents and temperatures with a view of recommending procedures for storage and where necessary, repurification of authentic carotenoids.

3. FIELD APPLICATION WORKSHOP:

3.1 The overall emphasis was to apply the knowledge gained from the previous two workshops towards the accurate and routine determination of pigments by HPLC and where appropriate, spectrophotometry and fluorometry. Four HPLC systems were set up, including one for

preparative work for pigment isolation and purification and one for developing simple isocratic system for chloropigments only. The specific achievements of the Workshop were:

3.2 We isolated, purified and characterised a set of external standards for intercalibrating the HPLC's spectrophotometer and fluorometers.

3.3 We investigated the potential of a number of internal standards and, after purification and chromatographic characterisation, we selected canthaxanthin as a stable, well resolved, internal standard for carotenoid analysis. Other pigments proved to be spectrally or chromatographically unsuitable as internal standards. Stable fluorescent derivatives of chlorophyll are currently being synthesised for evaluation as a fluorescent internal chloropigment standard.

3.4 The SCOR Reference Phytoplankton Cultures were regrown in Plymouth and their pigment extracted and quantitated for (1) comparison with Hobart and (2) qualitative intercomparison of resolution between HPLC's.

3.5 The extractability of natural samples were the evaluated using popular extraction protocols.

3.6 Solid phase extraction techniques for the trace enrichment purification and solvent exchange of pigments were refined.

3.7 A simple step - isocratic HPLC system was developed for rapid separation and fluorescence detection of chloropigments only.

3.8 Simple chemical and spectroscopic tests as aids in the identification of carotenoids were tested.

3.9 Natural samples from JGOFS North Atlantic cruises, sediment traps, estuarine and coastal particulate, zooplankton faecal material and sediments were extracted and analyzed and intercalibrated by 2 HPLC techniques, spectrophotometry and fluorometry.

REPORTS

The objectives of all three Mini Workshops originally set out in May 1988 were all attained. We propose to prepare separate reports for each Workshop by March 1990 and merge these into a camera-ready Report for publication in UNESCO Monograph Series on Oceanographic Methodology. This is our preferred publication mode but we are concerned at the possibility of a long delay between submission and publication. The WG 78 reports are desperately awaited by all marine scientists and they will be out of date by the 1993 publication dates suggested by UNESCO. If printing cannot be accelerated then we would have to explore alternative publishers.

We also plan to produce a Pigment Data Handbook for Marine Scientists - a bench top spiral bound compilation of key pigment databases needed by pigment scientists. It is hoped that the Working Group would have completed its tasks by end 1990.

ANNEX VI

Progress Report Working Group 89
Sea Level and Erosion of the World's Coastline

Chairman: Paul D. Komar

Reasonable progress has been achieved by our Working Group in the first year of its operation. Positive responses were received from all but one individual (T. Sunamura of Japan).

We have begun to compile the literature relevant to models of beach responses to sea-level increases, and a copy of that is attached. This list is specific to models, and does not include related subjects such as the volumous literature documenting sea-level changes or dealing with the origin of barrier islands. This list is not final, since we will certainly turn up additional references as the committee's work progresses.

In a letter of August 8 to the membership, I proposed that we meet in conjunction with either the 22nd International Conference on Coastal Engineering (Delft, The Netherlands, July 1990) or the 13th Sedimentological Congress (Nottingham, England, Aug. 1990).

The following is a first-draft outline of the contents of our report, and a draft of the Introduction for that report. I developed this as a starting point, and it has only recently been sent off to the other members. It does not reflect the opinions of the committee as a whole, and therefore can be expected to change in future drafts.

THE REPSONSE OF COASTS TO SEA-LEVEL CHANGES

INTRODUCTION

Importance of sea-level changes to coastal erosion.
Nature of sea-level variations (glacial melting, thermal expansion, short-term fluctuations such as El Nino, and lake levels).
Potential increases due to greenhouse warming.
Objective of this report is to examine beach-response models.

CAUSES AND MAGNITUDES OF SEA-LEVEL FLUCTUATIONS

Long-term changes due to glacial cycles.
Tide-guage records showing locat water-level changes due to eustatic increase plus local tectonic effects.
Short-term variations due to offshore currents, water temperatures, and processes such as El Nino.

THE COASTAL RESPONSE-GENERAL OBSERVATIONS

Long-term migrations of barrier islands.
Short-term versus long-term responses of beaches and barrier islands.
Episodic nature of coastal retreat.
Roles of storm waves, wave set-up, tides, rip currents, as well as sea level.
Need for long-term observatins of beach retreat to provide correlations with sea level changes.
Review past studies that have found empirical correlations.

BEACH RESPONSE MODELS-THEORY

The original Bruun model and direct revisions.
Dune-erosion models.
Barrier-island models.
Other related models (such as erosional platforms, etc.).

BEACH RESPONSE MODELS-DATA TESTS

Review of field and laboratory studies that have been completed testing the various theoretical models.

DISCUSSION

General discussion of status of models.

Discussions of how models might be modified, or what types of field and laboratory tests are needed.

Discussion of whether a global monitoring program is needed to document beach responses.

CONCLUSIONS

Brief summary of principal conclusions reached in the report.

INTRODUCTION

It is well recognized that increased sea levels are an important factor in causing erosion of the world's coastlines. One thinks mainly in terms of the global sea-level rise associated with melting of glaciers, a progressive increase that has been occurring for the past 20,000 years. That long-term sea-level rise has been a primary factor in the evolution of the world's coasts as seen today, and in particular has produced the landward migrations of barrier islands found along low-lying coasts such as those of Brazil, the North Sea and Baltic Sea coasts of Europe, and the east and Gulf coasts of the United States. It is clear that present- day erosion rates of shorelines depend on the continued global rise of sea levels associated with glacial melting and perhaps with thermal expansion of sea water, affected also by any land subsidence or emergence with determines the local effective water- level changes.

There can also be shorter-term fluctuations in ocean-water levels of a more restricted geographical extend that are important to local coastal erosion. For example, the 1982-83 El Nino affected many atmospheric and oceanic processes over the Pacific Ocean, one of them being increased water levels along the shore of South and North America amounting to 10's of centimeters and lasting for several months. The combined processes of that El Nino resulted in major erosion at many coastal sites.

The importance of water levels to beach erosion is not limited to the world's ocean shorelines. Roughly every ten to fifteen years, excessive water levels in the Great Lakes of North America, caused by increased rainfall, have resulted in devistating erosion and property losses.

The awareness and interest in sea level as an agent of coastal erosion has been greatly enhanced in recent years due to predicitons that the rise in ocean levels will accelerate in the next century due to greenhouse warming of the earth that will produce increased glacial melting and thermal expansion of ocean waters. Analyses by the Environmental Protection Agency and the National Academy of Sciences in the United States have attempted to project the impact of greenhouse warming into the future, and have predicted rises of 60 to 300 cm by the year 2100. This is much greater that the 15-20 cm per century rise epxerienced in the recent past according to tide-guage records, the rate that has apparently persisted for the last 2,000 years or longer. The projections of a 60 to 300 cm rise in global sea levels in the next century remain controversial, and have not been accepted by all scientists and engineers. Irrespective of that potential for future catastrophy, it is apparent that even at its present rate, the progressive rise in sea level is a major factor in causeing erosion along the world's coastlines, as are shorter-term increases such as those accompanying the 1982-83 El Nino.

With a *qualitative* awareness that sea level is important to shoreline erosion, what is the status of models and analysis techniques for *quantitative* evaluations of the erosion response of coastlines to a given increase in water levels? The primary objective of Working Group 89 is to consider that

question. Several related questions immediately come to mind. How does a beach change in its morphology when faced with increased water levels? What process models are available to account for the observed morphological changes, and have those models been adequately tested? Does the coastal response depend on the rate of water-level increase, or only on its total magnitude? What impact will seawalls and revetments have on the long-term beach response? Are there new lines of research that would enhance our ability to predict shoreline responses to water-level increases? Should monitoring programs be established on the world's coastlines, especially in those areas which presently lack data bases and would be particularly vulnerable to projected sea-level increases?

This report addresses the above questions and issues. To restrict the scope somewhat, the Working Group decided to consider only models related to the response of beaches to increased water levels, excluding for example the effects on the erosion of sea cliffs and on mangrove-lined coasts. The report begins with a brief review of the types of sea-level fluctuations and the magnitudes of those changes, followed by qualitative observations of the types of beach responses. The bulk of the report examines the status of quantitative process models that predict beach responses to increased sea-levels, and on the committee's findings with respect to future research needs and the necessity to establish field monitoring programs.

ANNEX VII

SCOR Working Group 91

Chemical Evolution and Origin of Life in Marine Hydrothermal Systems
Report of the Working Group Chairman, Nils G. Holm.

Working Group 91 was initiated by SCOR during the 19th General Meeting in Acapulco, Mexico, 1988.

Terms of Reference:

1. To determine likely constituents necessary for neo- abiogenesis according to the state of art of the origin of life sciences and thermodynamic calculations.
2. To review available data concerning primordial organic monomers and polymers already observed in hydrothermal systems (for example, carboxylic acids, amino acids, cyano- and heterocyclic compounds); compile a list of potential substances that have to be searched for; and differentiate compounds formed abiogenically and biogenically.
3. To evaluate the role of different classes of possible inorganic catalysts which may be required for the synthesis of organic compounds in hydrothermal systems.
4. To sponsor a symposium and published set of papers in 1992 summarizing the state of knowledge and identifying research opportunities in this field.

Current members are:

Nils G. Holm (Sweden) Chairman
A. Graham Cairns-Smith (UK)
Roy M. Daniel (New Zealand)
James P. Ferris (USA)
Remy J.-C. Hennet (Switzerland)
Bernd R.T. Simoneit (USA)
Hiroshi Yanagawa (Japan)

During the first year of the existence of Working Group 91 some of its members have met at two occasions. In March 1989 a business meeting was held the 5th Meeting of the European Union of Geosciences in Strasbourg, France. A workshop on "Chemical evolution and neo-abiogensis in marine hydrothermal systems" was also organized during the combined 6th Meeting of the Int. Soc. for the Study of the Origin of Life (ISSOL)/9th Int. Conf. on the Origin of Life in Prague, Czechoslovakia, in July 1989. The Strasbourg business meeting tried to identify the kinds of hydrothermal systems that would be the most likely sites for successful monitoring of abiotic production or organic monomers and their polymerization. As a result contacts for future cooperation have been taken with the US RIDGE program for the installation of long term ocean bottom observation devices and the White Island Drilling Program of New Zealand.

The workshop in Prague was co-chaired by James P. Ferris and Nil G. Holm and was much appreciated because of both its format and the contents. The program consisted of six invited contributions followed by a general discussion. The main goal of the workshop was to answer the question: "What experimental, theoretical and field studies need to be done in order to test the hydrothermal model for the origin of life?" Before closure of the workshop a list of necessary studies had been agreed upon. Such a list includes:

Comparative studies of terrestrial systems (as compared to deep marine systems); for instance, the White Island Volcano of New Zealand.
Comparative studies of shallow marine systems, such as the Kolbeinsey Ridge north of Iceland.
Modelling of systems of O_2 excluded.

Modelling of vent conditions in laboratory experiments.
On Station experiments.
Injection capture experiments.
Survey of areas other than ridge axes - primary ridge flanks.
Pumping of deep-sea water to the sea surface for analysis and experiments.
High pressure/temperature experiments on clays.
Drilling activities on the sea floor within, for instance, the Ocean Drilling Program or the planned European NEREIS Program for light ocean drilling and on station experiments.
Construction and operation of quenching systems.

One of the invited contributions was on thermodynamics of organic compounds in hydrothermal systems and was given by Dr. Everett Shock. His presentation "Geochemical constraints on the abiotic synthesis of organic compounds in hydrothermal systems" represents some important, previously missing expertise of WG 91. I therefore suggest that the SCOR Executive Committee invites Dr. Shock to become an additional member of WG 91.

According to the terms of reference WG 91 will be disbanded in 1992. The work will be terminated by a symposium summarizing the state of knowledge and future research opportunitites of the field. A symposium could probably be co-sponsored by the Int. Soc. for the Study of the Origin of Life (ISSOL) and integrated as a session of the 7th ISSOL Meeting/10th Int. Conf. on the Origin of Life in Barcelona, Spain, in May or June 1992. Such an arrangement would reduce the costs considerably and enable efficient spreading of the results achieved by the WG.

A first official meeting of WG 91 is scheduled for June 18-20, 1990, at the Kristineberg Marine Biological Station on the Swedish west coast.

ANNEX VIII

Working Group 92
Report of current activities and plans

Working Group 92 sponsored two meetings in the past year. A Special Session entitled, "Paleoceanographic Implications of Ice- Core Records," was organized at the December 1988 meeting of the American Geophysical Union. This session was convened by Eric Sundquist and Nick Shackleton. Authors and titles were as follows:

D.J. Erickson III, "Ocean-atmospheric CO_2 exchange: the last glacial."

R.J. Charlson, "Limitations to the quantitative interpretation of substances of aerosol origin in glacial ice."

E.A. Boyle, "Phosphorus distribution in the glacial ocean."

N.J. Shackleton, "Ocean carbon isotope data and the Vostok CO_2 record."

C.D. Charles and R.G. Fairbanks, "Glacial-interglacial differences in the isotopic content of surface and deep water in the Southern Ocean."

W.S. Broecker, "The anatomy of glacial terminations."

H. Oeschger, B. Stauffer, and U. Siegenthaler, "CO_2 and CH_4 variations from ice cores: implications for the carbon system history."

C. Lorius et al., "Vostok ice core data: key series for paleoceanography of the last climatic cycle."

A. Berger et al., "Testing the astronomical theory with a time-dependent climate-ice sheets model."

E.T. Sundquist, "Implications of Pleistocence CO_2 changes for the long-term buffering of anthropogenic CO_2."

Several of these papers have been submitted for publication in scientific journals, although the session as a whole was not deemed to have contained enough new information to justify publication of the collected papers in a special volume.

Working Group 92 also sponsored a Poster Session on "Carbon Dioxide" at the Third International Conference on Paleoceanography (ICP III) in September 1989. The session was organized by Nick Shackleton and Eric Sundquist. Authors and titles were as follows:

E. Birchfield and M. Wyant, "Diverse limiting circulations in a simple ocean box model."

W.S. Broecker, S. Trumbore, and G. Bonani, "The radiocarbon age of deep ocean water during late glacial time as reconstructed from measurements on coexisting benthic and planktonic foraminifera."

H. Erlenkeuser et al., "The Norwegian/Greenland Sea of Stage 5E: a restricted ocean with stratification?"

D. McCorkle et al., "The d13C of Uvigerina and the pore water d13C gradient at the sediment-water interface."

H. Matsuoka, "Differences in carbonate dissolution during glacial and interglacial times between the Pacific and Atlantic Ocean."

T. Oba, "Palaeoceanographic information obtained from isotopic measurement of individual foraminiferal tests."

E. Sundquist, "Rates of response of ocean and sediment buffering mechanisms to global carbon-cycle perturbations."

R. Zahn, N.G. Pisias, and A. Rushie, "Inverse variations of carbonate deposition between the deep North Atlantic and North Pacific oceans: chemical fractionation or productivity phase lags?"

The Working Group's first formal meeting was held in conjunction with the above AGU Special Session at the December 1988 meeting in San Francisco. Follow-up discussions were conducted by correspondence and conversations among WG 92 members throughout the year. Three topics have emerged as areas of particular concern:

1. Correlation of marine and ice core records. Although no formal WG 92 meeting was convened at ICP III. this meeting afforded an opportunity to examine several recent studies of late Quaternary sediments from the N. Atlantic area and to talk to authors about possible means of correlating marine sediments in this area with the long ice core recrds anticipated from Greenland Ice Sheet Project II. It is clear that the correlation of present marine records with the Greenland ice core record will be at least as difficult as the correlation of Southern Ocean sediments with the Vostok and other Antarctic ice records. A possible breakthrough was suggested by W.S. Broecker, who thinks that the minute details revealed by digital color scanning of North Atlantic cores may be correlatable to comparable details in the ice core oxygen isootope (or deuterium) record. This approach has nt yet been proven. The most successful approach in the Southern Ocean has been the correlation of proxy sea-surface temperature records (based on several types of faunal assembleages) with the ice-core deuterium record. This approach will probably be necessary in the effort to correlate the North Atlantic and Greenland records. WG 92 considered the possibility of publishing a marine data compilation that would be available to the Greenland ice core community for correlation purposes, but it was decided that there are simply not enough appropriate data to warrant such a publication. WG 92 will continue to monitor developments in the correlation of marine and ice core records, and will offer support to any new efforts that might benefit from out assistance. However, at this time WG 92 is not planning any further specific activities to address this problem.

2. The development of time-dependent carbon-cycle models. This topic has emerged as a subject of controversy among the members of WG 92. Discussion and correspondence have been spirited and without malice, but it is clear that several issues must be resolved or clarified before a WG-sponsored meeting or other formal activity can be planned to adress carbon-cycle modeling. The differences of opinion center around two issues: 1) the relative value of time-dependent modeling as opoesed to "time- slice" equilibrium modeling; and 2) the extent to which carbon- cycle changes in the recent geologic past can be interpreted as "analogs" of anthropogenic greenhouse warming. It is the chairman's view that, although these isues may be in some sense outside th terms of reference of WG 92 (for example, the terms of reference explicitly specify time-dependent models), the pursuit of these questions is a fundamental prerequisite to our assessment of methods for developing time-dependent carbon-cycle models. However, in the interest of time and budget, this phase of WG 92's consideration of models should be conducted by phone and mail. Disucssions and correspondence will continue this year, with the objective of degining specific activities (such as a workshop and/or special publication) for fulfillment of our modeling-related terms of reference in 1991.

3. The need for a surface-sediment calibration collection. From discussins concerning priority sample and data needs, WG 92 has decided to propose that a primary focus in the coming year be to examine possible strategies for initiating the collection of a worldwide set of surface sediment samples that could be used to calibrate paleochemical and paleoceanographic proxy records. The importance of such a sample set was also emphasized by the April 1989 IUGS Interlaken Workshop on Past Global Changes, attended by several WG 92 members. It is very clear that present data sets (such as the 1970's CLIMAP surface sediment data) and sample collections are not adequate for calibration of many modern methods applied to sediment records. The original CLIMAP surface sediment samples are exhausted, making retrospective

checking impossible. Many new techniques, such as carbon isotope ratio differences, AMS dating of small quantities of calcite, and the ratios of cadmium and other biologically fractionated elements to calcium, have not been adequately calibrated using surface sediments. Improvements in instrumental and statistical techniques are calling previous calibration data sets into question. WG 92 feels that a strong international initiative is needed to begiin the collection, curation, and analysis of a set of surface sediment samples dedicated to calibration of paleochemical and paleoceanographic techniques. This would be a major new global effort and would fill a conspicuous gap among present and planned global studies. Although WG 92's consideration of this topic is still very preliminary, three modes of implementation are under consideration: 1) a dedicated program using box corers and/or benthic landers; 2) a centralized incentive program that would encourage collection of calibration samples by groups taking cores for paleoenvironmental studies; and 3) a "piggy-back" program utilizing innovative small- sample coring techniques in conjunction with hydrographic casts or sediment trap deployments. WG 92 believes that these options span a range of costs and technologies that must be fully considered. We propose to move from our current "brainstorming" phase to consultation with coring experts and relevent program leaders (particularly JGOFS and ODP) during the next year. Toward this end, we are requesting approval for a 2- or 3-day workshop on calibration sediment sampling to be convened in Woods Hole in the last quarter of 1990. This meeting would provide an opportunity for all of the diverse interests that must be involved to meet and work out ideas together. In addition to the combination of modeling and paleceanographic data interests represented by the members of WG 92, other invitees would include specialists in coring technology and representatives of JGOFS and ODP.

ANNEX IX

CCCO Report

The Tenth Session of the Joint Committee on Climatic Changes and the Ocean (CCCO) was hosted by the Dalhousie University and the SCOR Secretariat in Halifax, Canada, 14-20 June 1989. The Committee reviewed its programmes and planned its directions for the future.

The progress in the Tropical Ocean and Global Atmosphere Programme (TOGA) and the World Ocean Circulation Experiment (WOCE)which together constitute the major experimental component of the WCRP was characterized as impressive with a high level of demonstrated co-operation and commitment by the participating scientists, institutions and organizations.

The expansion and proliferation of international climate research initiatives external to the WCRP, and the need to ensure a strong and coordinated oceanographic component, was noted as a significant development since the last meeting. The CCCO recognized its responsibility to provide an essential bridge between the intergovernmental and nongovernmental organizations. Connections with SCOR-sponsored Joint Global Ocean Flux Study (JGOFS) have been established through a joint JGOFS-CCCO Carbon Dioxide Panel. Linkages with the ICSU International Geosphere-Biosphere Programme (IGBP): A Study of Global Change are being strengthened the WMO- ICSU Joint Scientific Committee (JSC) of the WCRP. The strengthening of relationships with the JSC has been reflected in the proposed joint sponsorship of several subsidiary bodies, including the new JSC-CCCO Sea Ice Group and CCCO-JSC Ocean Observing System Development Panel and by the participation of CCCO and JSC officers at each of their respective sessions.

Serious concern was expressed by the CCCO Chairman at the Fifteenth Session of the IOC Assembly regarding the scientific basis for some reports on climate change impact, issued by some scientist and reported upon by the press, particularly with regard to sea level rise. The possible influence on public opinion and resulting governmental policies could have serious economic and social impact. It was stressed that CCCO would take an active role in projecting rational and scientifically based reaction to both the role of the ocean in climate change and the impact on the ocean of climate change.

Tropical Ocean and Global Atmosphere Programme.

TOGA which is designed to determine the predictability of inter annual variations in global climate, including those associated with the El Nino-Southern Oscillation (ENSO) phenomenon has made substantial advances during the past year. Included were:

(i) expansion of the monitoring programme,including new XBT Sections in the Indian Ocean,an expanded sea-level network in the Pacific and Indian Oceans, and the growing efficiency of operational data centres;
(ii) process studies completed or underway to understand the dynamics of the Equatorial Pacific Ocean and its interaction with the atmosphere;
(iii) the development of couple general circulation models of the ocean-atmosphere system in several centres,and studies of sensitivity to surface forcing and surface flux estimation;
(iv) the establishment of the first operational ocean model (at the US NOAA/National Meteorological Center) for seasonal climate prediction; and
(v) the use by some countries of TOGA data in empirical schemes for strategic interseasonal climate forecasting.

A proposal for a major study of oceanatmosphere interaction processes in the West Equatorial Pacific was developed by the TOGA Scientific Steering Group (SSG). The TOGA Coupled Ocean Atmosphere Response Experiment (TOGA-COARE) was reviewed and endorsed by CCCO as an

augmentation to the International TOGA programme. This experiment is seen to be important in leading to the better parameterization of heat and water flux between the ocean and atmosphere for both short and long term climate prediction models. As a focus for Indian Ocean studies, a Monsoon Numerical Experimentation Group (MONEG) has been formed by the TOGA SSG to address the important question of Indian monsoon variability.

At the middle of TOGA's field phase in 1990, an International Scientific Conference will be held in Hawaii to review scientific achievements, assess the prospects for attaining the scientific objectives of TOGA by 1995, and consider the future scientific programme of TOGA.

World Ocean Circulation Experiment.

A major event in the development of WOCE was the endorsement of its Implementation Plan by the ICO-WMO-ICSU-SCOR International WOCE Scientific Conference held at Unesco Headquarters (Paris, 28 November - 2 December 1989). The Implementation Plan for WOCE was used as a framework for statements of intentions to support and participate in WOCE. The Conference found sufficient potentially available resources in the plans presented, to justify commencement of field studies in 1990 on Core Project 1 (the Global Description)and Core Project 2 (the Southern Ocean). Some critical gaps remain in measurements for air-sea flux estimation and repeat hydrography,particularly for Core Project 3 (the Gyre Dynamics Experiment, in the Atlantic Ocean). The field phase of WOCE will provide a comprehensive and near contemporaneous data set over the whole global ocean, together with selected studies of ocean processes.

WOCE was designed and scheduled to exploit the opportunity for ocean observation provided by the experimental satellite radar altimeter and scatterometer missions of TOPEX-POSEIDON, ERS-1, and NSCAT. The delays in satellite launching, the possible hiatus that may occur following the present generation of experimental satellites, and policy issues on access and charging for data also raise serious concerns in relation to the long-term observational strategy for the ocean. The CCCO has addressed its concerns through correspondence with the Administrator of NASA.

Intergovernmental WOCE Panel.

The proposed organizational arrangements for WOCE have been the subject of exhaustive consultations by the Chairman of IOC and the President of SCOR, with the participation of the Chairmen of TC/OPC, CCCO and the WOCE-SSG. The proposal of the Chairman IOC and the President SCOR was endorsed by the IOC Assembly. The Panel will serve to identify WOCE priorities requiring governmental support, to address means of providing resources required by WOCE, and to provide a means by which developing countries could be actively associated with WOCE. The first session has been scheduled for Paris in November 1990.

Ocean Observing System Development Panel (OOSDP).

A significant development arising from the CCCO-X meeting and the IOC XV Assembly is the recognition of the need to develop a strategy for the establishment of a long term oceanographic observation system. Noting that the implementation or initiation of scientific programmes, including TOGA, WOCE, and JGOFS will provide information required for the development of such a system; it was decided that the CCCO-JSC Ocean Observing System Development Panel (which is currently being re-organized) will be responsible for development of a plan for a global integrated ocean observing system. The plan will include requirements, techniques, and an initial implementation strategy. The IOC authorized the establishment of an IOC Ad Hoc Group of Experts as a subsidiary body of the IOC Technical Committee on Ocean Processes and Climate to work with and support the CCCO-JSC OOSDP. Background and a description of the approach is provided by IOC Resolution XV-4.

Tropical Ocean Panels.

The CCCO agreed to change and expand the perspectives of its three CCCO Tropical Panels. The terms of reference have been changed to expand their perspectives beyond just the tropics and beyond TOGA and WOCE. The Committee recognized that while all three panels would have the same generic terms of reference, they would each continue to operate independently as they had in the past. The Committee further recognized that this decision would be seen at first by some as creating overlapping panels (e.g. with WOCE & TOGA) that already have generated controversy. Nevertheless, it believed the panels offered the needed perspective for CCCO of an alterative climate activity review in the various regions. The Committee also recognized the intangible value of coordinating panel meetings with IOC regional activities where possible.

Palaeoclimatology.

The CCCO received a report from the Chairman of its Palaeoclimatology Panel which described the palaeoclimatology research field as having matured, noted the establishment of an IGBP Palaeoclimatology Panel and suggested that the CCCO Palaeoclimatology Panel could therefore be disbanded. The suggestion was accepted and the Panel was disbanded. Before deciding to disband the Panel, the CCCO noted the excellent annual reports provided to the CCCO by Dr. Duplessey and his Panel and recognized that CCCO concerns regarding palaeoclimatology would be adequately covered within the IGBP and other international organizations.

Air Sea Fluxes

At its Tenth Session, the CCCO discussed wind-stress parameterizations under several agenda items. In expressing its concern with the unsatisfactory situation that exists regarding flux calculations, the Committee issued a statement encouraging efforts to improve wind-stress parameterizations as follows:

"The CCCO recognizes that direct measurements of surface wind stress will remain impossible on a global basis, so that forcing fields for ocean models will continue to rely on bulk formulae and data derived from satellite coverage. Recognizing further that surface stress depends largely on sea state, CCCO encourages experimental and observational studies aimed at incorporating wave aspects and models into numerical ocean circulation modelling. In those regions where atmospheric stability can be measured or modelled, its effects should also be included."

CCCO Members.

J. O'Brien was elected Vice-Chairman to replace J. Willebrand. The Committee re-elected A. McEwan as Chairman and recommended two-year extensions to the terms of appointment for A. McEwan and Y. Toba. A one-year extension was recommended for Willebrand. The Committee's recommendations for these extensions along with nominations for filling vacant positions will be forwarded for approval to the President of SCOR and the Secretary of the IOC by separate correspondence.

Work Programme and Resources

The planned CCCO Work Programme for 1990 will require a minimum of $240,900. This estimate is based on the assumption that some of the participants in CCCO activities provide their own support and that direct support to WOCE activities are limited to $68,000. The CCCO Secretariat is supported by the U.S.A. (2), Australia (1) and Unesco/IOC (1); the International WOCE Project Office by U.K (1.5), FRG (1), USA (2), and the WOCE Chief Scientist (1); the International TOGA Project Office by the USA (1), UK (1), France (1) and WMO (1).

ANNEX X

THE JOINT GLOBAL OCEAN FLUX STUDY

Report to the SCOR Executive Committee
October 1989

There have been major developments with regard to the Joint Global Ocean Flux Study (JGOFS) during the past year. The Committee for JGOFS has held two full sessions since its last report to SCOR at the XIX General Meeting. These took place in September 1988 in The Hague, and in September 1989 at the East-West Center of the University of Hawaii. The JGOFS North Atlantic Pilot Study took place between March and September 1989 and has been a great success. The development of an International Science Plan for JGOFS is at an advanced stage, and is expected to be available within six months. Finally, the initial steps have been taken towards a second major field component of JGOFS, an Equatorial Pacific Study. The goal of JGOFS, as stated at the first international planning meeting, convened by SCOR in early 1987, is:

> To determine and understand on a global scale the time-varying fluxes of carbon and associated biogenic elements in the ocean, and to evaluate the related exchanges with the atmosphere, the sea floor and the continental boundaries.

THE JGOFS NORTH ATLANTIC PILOT STUDY

At a very preliminary stage of the scientific planning for JGOFS it became apparent that a fortuitous convergence of national research plans provided an opportunity for a major coordinated international field programme in the North Atlantic and that with a little extra effort this could be used to great advantage by the JGOFS community. Accordingly, it was agreed to conduct the JGOFS North Atlantic Pilot Study in part, as a feasibility study for JGOFS on a larger scale. The collaboration required between the various national activities was organized by a Pilot Study Cruise Coordinating Committee consisting of a chief scientist from each of the five participating nations. This Committee established the overall objective of the Pilot Study which was:

> To study aspects of the carbon cycle and related biogeochemical cycles with reference to the evolution of the spring phytoplankton bloom and its northward passage along 20^{o}.

Although the Pilot Study has only just been completed, the benefits of international cooperation seem to have been well demonstrated already. For example, a set of overall scientific goals for the Pilot Study was defined and a list of twenty core measurements with standard measurement protocols and levels of accuracy to be achieved by all participating research vessels was established several months before the field studies began. Opportunities were exploited for intercalibration exercises when more than one vessel occupied the same station concurrently. NASA provided an aircraft for remote sensing during the most important phase of the Pilot Study and the P-3 flights were conducted in close communication with the scientists at sea on the research vessels of all participating nations in order to establish a solid set of ground truth data. Data and information were exchanged on a real time basis through the extensive use of satellite communication facilities and electronic mail and in accordance with guidelines established by the JGOFS Data Management Working Group. The day-to- day coordination of all field activities was the responsibility of an International Pilot Study Coordinator and the JGOFS Committee is grateful to NOAA for the provision of the services of Dr. S. Piotrowicz for this purpose.

The effectiveness of the North Atlantic Pilot Study will be assessed at a data analysis workshop to be held in Kiel from March 15-20, 1990. This will be a "hands on" session involving participants in the Pilot Study cruises who will bring their data sets for comparison and analysis using computlng

facilities at the Institut fur Meereskunde. This will be followed, in September 1990 by a more formal Pilot Study Science Symposium at the National Academy of Sciences, Washington, DC.

THE JGOFS INTERNATIONAL SCIENCE PLAN

The JGOFS Committee agreed that it should not allow itself to be preoccupied with the North Atlantic Pilot Study when issues of overall scientific planning for JGOFS on a larger scale should receive a high priority. Accordingly, the Pilot Study was planned by a sub-group of national chief scientists, leaving the parent committee to move towards the resolution of broader issues. For example, the JGOFS Committee has devoted a great deal of its attention to the development of a Science Plan for JGOFS. This will be a document to provide the scientific rationale for the overall programme, to enlarge upon its stated goal, to define detailed objectives for meeting that goal, and to discuss various strategies for addressing those objectives. These strategies fall into three categories:

a large-scale global survey activity to improve basic descriptions of biogeochemical variability,

a systematic set of model studies to identify critical processes and variables, to assimilate observed parameters into basin and global scale fields, and to predict the future state of the ocean, and,

a sequenced number of process studies to elucidate the connections between various biogeochemical processes and large scale distributions.

The Committee has devoted most of its attention at its meetings to the development of the International Science Plan for JGOFS. In particular, at the recent Third Session, steps were taken to ensure that the Plan will be completed within the next six months. The status of national science planning in the various countries represented at the meeting was reviewed and it became apparent that many common elements exist, including a consistent focus on strategies involving regional process studies in almost all of the major oceanic basins in combination with significant modelling efforts. The national science plans also identified many common scientific issues such as the air-sea fluxes of biogenic CO_2, upper ocean processes of primary production, new production and transformation, processes of export from the upper ocean, benthic exchanges and the sedimentary record of oceanic fluxes. At the same time, the JGOFS Committee recognized that an ensemble of national plans is not a substitute for an international plan for a truly global cooperative experiment. Each of them reflects a different set of national priorities and expertise. An international plan must define a minimum essential set of process studies for achieving JGOFS goals, for example. It must define a minimal set of biogeographical provinces for the application of these process studies and provide guidance for the integration of remotely sensed data and for the optimal use of modelling to express JGOFS results in a global scale. Another function of the international plan will be to encourage efficient use of resources by identifying redundancies in national plans and opportunities for coordination of activities in various oceanic regions.

In considering these issues, the JGOFS Committee has discussed the relative importance of process studies and a global survey as components of the JGOFS strategy. Some of the needs for a global survey will be met through the agreement that a carbon measurement programme will be conducted on the WOCE cruises. The Science Plan must resolve the need for additional JGOFS transects for deep ocean measurements and upper ocean optics observations, for example.

The JGOFS Committee established a Science Plan drafting group which will consider the many issues raised in Hawaii and at earlier Committee meetings and which will prepare a draft document for distribution to the Committee and external reviewers for comments in January. It is proposed that an advanced draft be presented to the Committee at its Fourth Session in March and that the final version of the JGOFS International Science Plan will be available for wide distribution in May, 1990. The members of the drafting group, which will meet at IOS Wormley in late November,

are presently preparing individual sections in accordance with the format for the plan which was approved in Hawaii.

JGOFS PLANNING FOR THE PACIFIC OCEAN

While the development of the international Science Plan for JGOFS is being given the highest possible priority by the JGOFS Committee, plans for flux studies in various parts of the world ocean are evolving independently in a number of countries. That benefits can be derived from international coordination of such studies has been accepted from the outset by the Committee which includes members from ten countries, and appears to have been demonstrated in the North Atlantic Pilot Study. The JGOFS Committee must provide both the overall scientific plan into which the various national studies can be incorporated and the mechanism for their coordination into a cohesive international programme.

In accordance with this principal, an ad hoc Pacific planning group was established at the 1988 JGOFS Committee meeting. This group decided to organize a Pacific planning meeting which took place immediately after the Third Session of the JGOFS Committee in Hawaii. This meeting attracted about fifty participants including representatives from a number of countries (Australia, Korea, Chile, Peru) with no previous formal involvement in JGOFS. The Pacific Planning Meeting heard many national reports which revealed the depth and diversity of JGOFS-related activities in the Pacific region. It noted, however, that the lack of an International JGOFS Science Plan has resulted in these activities being somewhat disjointed and lacking a clear focus on the stated JGOFS goals. The meeting urged that the highest possible priority be given to the completion of the Science Plan. It noted that special problems will need to be overcome for truly joint work to be successful in the Pacific region because of its enormous distances and cultural differences. Research vessels are costly to operate, communications are more difficult and scientific capabilities vary greatly from nation to nation. The background data sets are poorly developed in comparison to those for the North Atlantic.

The Pacific Planning Meeting recommended to the JGOFS Committee that the next priority for a coordinated field programme be given to an Equatorial Pacific Study. Plans already exist for a number of cruises to this area in 1990 and 1991. A group was established to organize a planning workshop for such a study, similar to the North Atlantic Planning Workshop which laid down the initial plans for the Pilot Study. It was agreed that JGOFS should not establish a regional planning group for the Pacific since the proliferation of such groups might lead to a polarization of the JGOFS community and a loss of focus on the global nature of the programme as a whole.

RELATIONS WITH OTHER PROGRAMMES

JGOFS has developed very close ties to ICSU's International Geosphere-Biosphere Programme (IGBP). The Chairman of the SC-IGBP and the Chairman of its Coordinating Panel on Marine Biosphere- Atmosphere Interactions are both Corresponding Members of the JGOFS Committee. The Chairman of JGOFS has recently been invited to join both the SC-IGBP and the Coordinating Panel.

From the beginning, both SCOR and the SC-IGBP were convinced of the need for an international global scale research endeavour to address biogeochemical processes in the ocean. Three areas of oceanic research have been identified to receive priority consideration in the IGBP. Two of these are closely related to the JGOFS goal: characterization of the oceanic carbon cycle and associated links with the other elements known to be either limiting to biological productivity or of significance to climate, and; examination of linkages among biogeochemical cycles and the physical climate system that require characterization in order to, anticipate not only the effects of global change on these cycles, but also their feedback to climate.

In recognition of the similarities in the goals of these two programmes, and in the interest of making the most effective use of manpower and other resources during the planning and implementation phases of a large global-scale marine research programme, the SC-IGBP has invited SCOR, and SCOR has agreed, to designate JGOFS as a Core Project of the IGBP, in which the full responsibility for both of these phases is retained by SCOR. Liaison between IGBP and JGOFS will be achieved by participation in all relevant planning meetings. A number of joint activities are foreseen; the first of these will be an IGBP/JGOFS international meeting on "Modelling the Physics, Biology and Chemistry of the Upper Ocean and its Interaction with the Atmosphere" which will be held at the Royal Society in London on March 12 and 13, 1990.

Close liaison is being maintained between JGOFS and WOCE, especially in the area of their overlapping interests in the CO_2 question. CCCO and JGOFS have established a joint CO_2 Working Group which is developing the scientific plan for an oceanic CO_2 programme. It has been agreed that the CO_2 programme will be carried out under the auspices of JGOFS, but in close collaboration with the WOCE community and space for JGOFS scientists conducting the CO_2 measurement programme has been set aside on WOCE vessels in accordance with this agreement. Formal links have been established between the WOCE Hydrographic Programme Office in Woods Hole and JGOFS through Dr. H. Livingston of the US GOFS Office.

The JGOFS Committee has also agreed that it must develop a close working relationship with the planners of the International Global Atmospheric Chemistry programme (IGAC). A number of scientific questions common to both programmes have been identified in relation to the marine atmosphere and to modelling efforts. A representative of JGOFS will participate in a meeting to discuss IGBP-JGOFS-IGAC interactions during the AGU meetings in December.

OTHER MATTERS ARISING FROM JGOFS-3

Data Access Policy:

The JGOFS Committee discussed the request of the Data Management Working Group for guidance in the matter of a policy regarding access to JGOFS data. The following statement was approved at the Hawaii meeting:

> Recognizing that science is best served by free and open communication of findings, including data in raw form; and
>
> In view of the enormous value of uncorrupted data sets as input to models useful in the design of field projects and in hypothesis testings; and
>
> Noting that JGOFS will produce, at public expense, high quality data sets of extreme value to ocean biogeochemistry;
>
> The JGOFS Committee believes that READING ACCESS to this JGOFS Data Base(s) should be without restriction for any interested user. The information in the Data Base(s) will be labelled as to its originator and it is EXPECTED that readers would obey the normal scientific obligation to contact the originator for permission to make further use of those elements of interest to them.
>
> The JGOFS Committee hopes that each and every national committee for JGOFS would endorse this policy on data access.
>
> Ensuring that JGOFS investigators submit their data to the master file in a timely manner (as defined in the core measurement protocols) falls within the responsibility of the various national committees.

Membership:

The Committee considered its membership since the first members were due to rotate off the Committee at the end of 1989. A series of recommendations on this matter were passed to SCOR for approval.

Secretariats:

The JGOFS Committee has agreed to function with a decentralized secretariat with two offices linked by telemail and constant liaison. The first will be a JGOFS Executive Secretariat, established within the SCOR Secretariat in Halifax. This arrangement has been in existence for some time, although the rapidly increasing work load for JGOFS makes it impossible for this office to provide adequate staff support to the JGOFS Committee. Funding has now been secured for the establishment of a JGOFS Scientific Secretariat at the Institut fur Meereskunde of Kiel University and the position of JGOFS Executive Scientist is now being advertised. [It was filled in December 1989 by the secondment of a Canadian scientist, Dr. Geoff Evans, to Kiel.]

ANNEX XI

SCIENTIFIC COMMITTEE ON OCEANIC RESEARCH
Final Financial Statement - 1988

Balance Jan.1. 1988			125,285.00
INCOME:			
Membership Contr'ns		128,725.00	
Grant from ICSU		35,000.00	
UNESCO Contracts		10,000.00	
IOC Contract		23,000.00	
NSF Grant/travel		55,868.00	
NSF Grant/geosciences		72,878.00	
TWAS Grant		2,000.00	
UK Subvention		18,000.00	
Interest		209.00	
US award re CCCO Sec't		95,000.00	
Total income			440,680.00
Total CASH + INCOME			565,965.00
EXPENSES - SCIENTIFIC ACTIVITIES			
WG 54 (SCAR/BIOMASS)	5,000.00		
71	9,353.00		
73	6,840.00		
75	6,273.00		
76	3,105.00		
77	8,839.00		
78	14,667.00		
80	0.00		
82	2,221.00		
83	2,003.00		
85	14,305.00		
88	0.00		
92	5,050.00		
CCCO	50,581.00		
* CCCO Sec't	95,000.00		
* JGOFS	68,084.00		
JPOTS	0.00		
Total Expend. Sci. grps.		291,321.00	
Representation	7,499.00		
JOA	28,179.00		
Publications	9,859.00		
General Meeting	18,422.00		
Travel Grant prog.	55,542.00		
TWAS Travel grants	2,179.00		
Total Related Expenses		121,680.00	
ADMINISTRATION			
Salaries	45,875.00		
Communication	14,878.00		
Office equipment	3,191.00		
Audit fees (2 yrs)	2,923.00		
Misc. admin. exp.	1,844.00		
Bank chgs. & loss on exch.	128.00		
Total Admin. expenses		68,839.00	
TOTAL EXPENSES			481,840.00
Balance Dec. 31. 88			84,125.00
TOTAL CASH + EXPENSES			565,965.00

* these 2 items include CCCO and JGOFS Secretariat salaries. In future years these will be shown as separate items under "Administrative Expenses".

ANNEX XII

Report on the Results of the SCOR Participation Survey

Su Jilan

During JOA-Acapulco the SCOR Executive Committee agreed with the suggestion of a group of oceanographers that the level of involvement of oceanographers in general in SCOR affairs needs to be improved. For this purpose a questionnaire was prepared and it was sent out in March 1989 to all SCOR member committees, nominated members, and scientists who took part in the *ad hoc* discussion group in Acapulco on SCOR participation. The results of the survey are reported and suggestions are presented on the actions that SCOR may take to encourage more scientists from the worldwide oceanographic community to participate in SCOR affairs.

I. Statistics of the survey responses

Altogether 16 replies from 10 member committees and 4 non-member countries were received as of 16 August 1989. One reply was co-signed by all three nominated members of the same committee. All three nominated members from another committee responded to the questionnaire individually. The rest of the responding committees each had only one of its nominated members send in a reply, although some represent the consensus of their respective committees. The four non-member respondents are from Bulgaria, Ghana, Nigeria and ROK. All expressed interest in having their country join SCOR. Both Ghana and Nigeria completed the questionnaire. The respondents can be classified in three different ways:

1. In terms of membership categories

Two out of the fourteen member committees in category I have replied. For categories II, III, IV and V the number of respondents are, respectively, 4 out of 13, 0 out of 3, 3 out of 5, and 1 out of 1.

2. In terms of countries participating in current working groups

Of the 24 countries that are taking part in WG 75 to 92 only 10 countries have replied. 9 of these 10 countries are SCOR members. Among the top ten most active countries participating in WG affairs six answered the questionnaire. These top ten most active countries each has five or more scientists serving on the WG's. Incidentally, only one non-member country, namely, Nigeria, is involved in WG activities, and Nigeria is one of the 4 non-member countries that have sent in their replies.

3. In terms of developed vs developing countries

Among the member countries about half of the developed countries and one-eighth of the developing countries have sent in their replies. All the non-member responders are from developing countries.

II. Survey results

The survey results are summarized in eight subject areas listed in the questionnaire.

1. To what extent are scientists from your country involved in SCOR activities? Are you satisified with its present level of involvement?

Member-respondents: Seven respondents expressed satisfaction with their countries' involvement in the SCOR activity. The other three indicated various degrees of dissatisfaction in not having enough involvement.

Non-member-respondents: All expressed dissatisfaction with their countries' lack of SCOR activities.

2. How is your local committee for oceanic research formed? Is it representative of the various types of oceanographic institutions in your country?

Each country has a different way in forming its local committee. All committees have wide representation from the various oceanographic institutions of their respective countries, although a few local committees seem to be dominated by major or large institutions.

3. How does your local committee choose its nominated members to SCOR?

All countries seem to choose their nominated members among the local committee members. The process of selection, however, varies widely from general election to selection by the committee chairman.

4. Does your local committee disseminate information that it receives from SCOR to the oceanographic community in your country?

Materials which SCOR routinely sends to local committees include SCOR handbook, SCOR proceedings, matters concerning SCOR General and Executive Committee Meetings, SCOR WG reports published by SCOR, requests for proposals for new WG's, requests for comments on and membership suggestions for new WG proposals, and requests for feedback on other SCOR matters. Most of the local committees disseminate these information materials selectively to individuals or institutions in their own countries. Some local committees seem to have poor communication even within the committee itself. Japan and New Zealand are the only two countries which gave an affirmative answer to the dissemination question. Japan SCOR uses the publications and meetings of the Oceanographic Society of Japan to achieve this purpose.

5. Does your local committee usually respond when it is asked to nominate scientists to participate in SCOR Working Groups or to comment on proposals for new working groups? If yes, please elaborate on the process by which your country's SCOR committee involves the oceanographic community in the discussion of these matters.

All local committees repsond positively to these requests from SCOR. In general, involvement of the local oceanographic community is on a selective basis.

6. On what scientific problems would your oceanographic community wish SCOR to create new working groups? Please elaborate upon the reasons for the choice of particular topics.

This question was intended to find out whether there are worthwhile scientific problems that may interest scientists from the less active member countries or from the non-member countries. However, except for one specific proposal, "The use of artificial reefs in the recultivation of shelf ecosystems" and one general proposal on coastal oceanographic problems, other respondents expressed no intention of making a proposal on new WG at this time. This is perhaps not surprising since 10 of the 14 responding countries are taking part in WG activities and 6 of them are rather active at present.

7. Are there oceanographic institutions in your country that would be interested in hosting working group meetings or other SCOR activities? If yes, please elaborate.

Except for one country which is limited by an already fully committed facility, all other respondents expressed willingness to host some kind of SCOR activities, including WG meetings.

8. Please give your suggestions on how to encourage more scientists from member countries to participate in SCOR activities and how to encourage non-member countries to join SCOR.

Many valuable suggestions were offered by the respondents. These suggestions are incorporated in the next section.

III. Problems and recommendations

Results of the survey show that there are three areas which should be addressed by SCOR in order to improve the level of involvement of oceanographers in general in SCOR affairs. These three areas are, namely, to encourage more involvement in SCOR activities by wider member countries, to encourage non-member countries to join SCOR, and to make SCOR and its activities more visible to the world-wide oceanographic community. The three areas are discussed separately in the following and finally actions to be taken by SCOR to improve the present situation in these areas are recommended.

1. Involvement of member countries in SCOR activities.

A full one-third (13 out of 36) of the member countries are not involved in WG or committee activities. Among these countries only one has responded to our survey and this country has contributed to WG studies in the past. This state of affairs needs to be changed if SCOR is to strive for international endeavour in furthering scienfitic activity in oceanic research. It is true that most countries, especially the developing ones, just cannot afford the relatively high capital outlay of marine research and thus cannot keep pace with the rapidly advancing science of oceanography. However, these countries do have national interests in coastal oceanography on which their countries usually spend most of their limited research funds. This is reflected in the fact that the 6 developing countries taking part in the WG affairs are found in four WG's which are more or less related to certain aspects of coastal marine sciences. These four WG's are namely, "Determination of Photosynthetic Pigments in Seawater", "Role of Phase Transfer Processes in the Cycling of Trace Metals in Estuaries", "Wave Modelling", and "Sea Level and Erosion of the World's Coastlines". Therefore, one way to increase the level of member countries' involvement is to identify worthwhile scientific problems related to coastal oceanography that requires international collaborative effort.

Benefits to a country joining SCOR can also come in the form of information on recent advances and front-line research which may be utilized in dealing with local oceanographic problems more efficiently and fruitfully. Dissemination of such information is more effective if more scientists from member countries can attend SCOR-related scientific meetings and if findings of the WG's and committees can be synthesized into readily available articles.

2. Broadening of the SCOR membership

All four non-member respondents indicated interest in having their countries become members of SCOR, so there is a potential for increase in the SCOR membership. However, three of them also expressed concern that lack of funds will hinder their participation in SCOR activities.

3. Visibility of SCOR

Even within developed countries there are oceanographers who have scarce knowledge or no idea of what SCOR is. Wide dissemination by local committees of information concerning SCOR is one way to improve this undesirable situation. However, a more active role played by SCOR itself in disseminating information is likely to be more effective. SCOR could send new releases about SCOR activities and summary articles on results of WG's directly to local oceanographic societies which can then publish them in their own bulletins or transactions. For example, EOS is an excellent means to serve this purpose in the United States as well as part of the international community. A brochure explaining the purpose and functions of SCOR and its relationship with other international bodies is also useful.

4. Recommendations

The SCOR is recommended to take the following actions in order to improve the level of involvement of oceanographers in general in SCOR affairs.

- strive to identify potential WG subjects that are related to coastal oceanography.

- require all WG's and committees to write up summary articles.
- establish direct communication link, through recommendation by local SCOR committees, with local societies, that publishes oceanographic news and summary articles.
- make a conscious effort to hold SCOR-related scientific meetings in as many countries as possible.
- allocate funds to support (young) scientists from developing countries to attend SCOR-related scientific meetings.
- introduce a no-fee provisional and temporary (2 year) membership to encourage developing countries to join SCOR.
- prepare a brochure on SCOR.

ANNEX XIII

Resolutions of the Fifteenth Session of the IOC Assembly July 1989

Resolution XV-1

SECOND SESSION OF THE WMO-IOC INTERGOVERNMENTAL TOGA BOARD

The Intergovernmental Oceanographic Commission,.

Having considered the Summary Report of the Second Session of the WMO-IOC Intergovernmental TOGA Board (Geneva, 5-9 December 1988),

Noting Recommendation TC-OPC-III.2 of the Third Session of the Technical Committee on Ocean Processes and Climate,

Accepts the Summary Report of the Second Session of the WMO-IOC Intergovernmental TOGA Board;

Endorses the concept of the TOGA Coupled Ocean-Atmosphere Response Experiment (TOGA COARE) as an integral part of the TOGA programme;

Decides to support planning of TOGA COARE through the SCOR-IOC CCCO and TOGA SSG;

Also decides to provide support for, and interact as needed with, the International TOGA Scientific Conference to be convened jointly by WMO, ICSU, SCOR and IOC in Honolulu, USA, 16-20 July 1990;

Invites Member States to encourage and support participation of oceanographers who are active in TOGA in the above Conference;

Invites the Third Joint IOC-WMO Meeting for the Implementation of IGOSS XBT Ship-of-Opportunity Programme (Hamburg, 16-20 October 1989) to consider and recommend further actions needed to achieve TOGA goals in the Indian and Atlantic oceans;

Invites the Group of Experts on GLOSS to consider and advise on actions to implement the planned TOGA sea-level observing requirements, particularly in the Atlantic Ocean.

Resolution XV-2

INSTITUTIONAL ARRANGEMENTS FOR WOCE

The Intergovernmental Oceanographic Commission,

Recalling Resolution XIV-2 and Resolution EC-XXI.1,

Having considered the proposals made by the Chairman of the Commission and the President of SCOR, based on recommendations of the Chairmen of CCCO, the WOCE SSG and the TC/OPC and the results of the discussions on this matter at the International WOCE Scientific Conference, Paris, 28 November-2 December 1988,

Noting with satisfaction the progress in the planning of the World Ocean Circulation Experiment which is scheduled to start in 1990,

Noting Recommendation TC-OPC-III.1 of the Third Session of the Technical Committee on Ocean Processes and Climate,

Recognising that the WOCE International Project Office (WOCE-IPO) provides staff support for the WOCE SSG, with communication links to the IOC Secretariat and the CCCO Secretariat,

A - Intergovernmental WOCE Panel

Approves the establishment of an Intergovernmental WOCE Panel (IWP) as a subsidiary body of the IOC Technical Committee on Ocean Processes and Climate, with specific responsibilities for intergovernmental WOCE matters;

Invites WMO to co-sponsor, with the IOC, the Intergovernmental WOCE Panel;

Approves, subject to concurrence by WMO, the Terms of Reference and composition of the Panel as shown in the Annex to this Resolution;

Invites Member States that have indicated their on-going involvement or intention to participate in the implementation of WOCE through a letter to the Secretary to nominate their representatives to the Panel, if necessary in consultation with their Permanent Representatives of WMO Member States;

Requests the Scientific Steering Group for WOCE, the SCOR-IOC CCCO and the WMO-ICSU JSC to provide scientific guidance to the Intergovernmental WOCE Panel for the conduct of WOCE, including the requirements for ocean observing and data management systems needed to achieve the scientific objectives of WOCE;

Instructs the Secretary to convene the First Session of the Intergovernmental WOCE Panel in Paris in November 1990.

B - WOCE International Project Office

Authorizes the Secretary IOC to develop formal working arrangements with the WOCE International Project Office for joint activities in support of WOCE.

Annex to Resolution XV-2

TERMS OF REFERENCE AND COMPOSITION OF THE INTERGOVERNMENTAL WOCE PANEL (IWP)

1. FUNCTIONS

The Intergovernmental WOCE (World Ocean Circulation Experiment) Panel (IWP) is established as a subsidiary body of the Technical Committee on Ocean Processes and Climate in order to meet the scientific, managerial, implementational, and resource needs of WOCE as defined by the Scientific Steering Group (SSG). The IWP will carry out the following functions:

1.1 To provide advice and recommendations to the WOCE SSG on intergovernmental matters related to the implementation of WOCE and achievement of its goals, on the basis of briefings and requests by the SSG.

1.2 To review requirements as identified by the SSG for efficient and cost-effective implementation of the WOCE Implementation Plan requiring intergovernmental functions and formulate recommendations accordingly.

1.3 To address means of providing, on the basis of defined requirements, those resources required to meet WOCE needs.

1.4 To ensure, through an appropriate mechanism, interaction and co-ordination with IOC and WMO programmes and committees relevant to the implementation of WOCE, including WCRP, IGOSS, DBCP, IODE, TEMA, GIPME, GLOSS, WWW, VOS, and CMM.

1.5 To monitor the activities of the relevant IOC and WMO operational programmes and to advise the SSG to what extent these are able to meet WOCE needs and on possible specific supplementary requirements for WOCE to be addressed to these bodies and programmes.

1.6 To interact with the WOCE SSG, the SCOR-IOC CCCO and the WMO-ICSU JSC concerning scientific matters related to the implementation of WOCE and the state of progress in the implementation.

1.7 To report to the Assembly and the Executive Council of IOC on these matters through the TC/OPC and to the Executive Council of WMO.

2. SCIENTIFIC AND TECHNICAL ADVICE

2.1 In discharging its tasks, the Panel will be guided by the overall scientific objectives and research strategy formulated by the WOCE SSG and the SCOR-IOC Committee on Climatic Changes and the Ocean.

2.2 The Panel will also be guided by the emerging overall intergovernmental operational strategy being formulated by the IOC Technical Committee on Ocean Processes and Climate and by the relevant WMO bodies.

3. COMPOSITION

3.1 The membership of the IWP is comprised of those Member States of IOC and of WMO that have declared through a letter to the Secretary IOC or the Secretary-General WMO their on-going involvement or intention to participate in the implementation of WOCE, including those committed to participation in WOCE, whether on a global scale or on regional aspects of WOCE implementation.

3.2 The Chairmen or designated representatives of the SCOR-IOC CCCO, the WMO-ICSU JSC, WOCE SSG and TC/OPC will participate, ex officio, in the Panel.

4. ORGANIZATION OF SESSIONS

4.1 The IWP shall hold sessions at the dates and places which will be recommended by the Panel and arranged by the Secretary IOC in consultation with the Secretary-General WMO and the Chairman TC/OPC. Sessions shall normally be held every 18 months. Invitations to attend the sessions shall be sent to:

(i) Member States of the Panel.
(ii) The SCOR-IOC CCCO, the WMO-ICSU JSC, WOCE SSG and TC/OPC.
(iii) Other intergovernmental and non-governmental organizations interested in WOCE.
(iv) Other experts as determined by the Panel.

4.2 Prior to the closure of each session, the Panel will elect from its members a Chairman who will serve in that capacity until the closure of the next session.

4.3 The sessions shall, in principle, be arranged without financial costs to IOC and WMO, except for secretariat support, and travel and per diem support for invited experts which will be shared by WMO and IOC. Sessions will be conducted, documentation will be provided, and the report of each session will be prepared in one language, unless otherwise specifically requested.

4.4 Secretariat support for the Panel will be provided by the Secretary IOC with assistance of the CCCO Secretary.

Resolution XV-3

OCEAN DYNAMICS AND CIRCULATION ON THE CONTINENTAL SHELF

The Intergovernmental Oceanographic Commission,

Having considered the proposal on "An International Programme for the Dynamics and Oceanography of Coastal and Shelf Seas and Exchanges: Rationale and Elements" (Document IOC/INF-769 and Corrigendum) prepared, on the initiative of the Commission, by an ad hoc Group of Experts.

Having received a recommendation from the Technical Committee on Ocean Processes and Climate that the IOC Assembly endorse such a programme,

Noting the importance of establishing such a programme and its great potential value for coastal zone management, exploration and exploitation of living and non-living resources in the coastal zone and shelf seas as well as for the programmes dealing with the global study of ocean and climate, such as GIPME, WOCE, JGOFS,

Decides to establish an ad hoc Group of Experts:

(i) to assist in the organization of a Workshop on Ocean Dynamics and Circulation on the Continental Shelf so as to provide:

  (a) a comprehensive review on a worldwide basis of the state of knowledge of coastal seas in the major regions;
  (b) a comprehensive review of the state of knowledge of the dynamics of basic relevant processes;
  (c) a review and assessment of existing methodologies;
  (d) an evaluation of existing capabilities, needs and opportunities for training; infrastructure development; transfer of technologies and methodologies; and

(ii) 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;

Instructs the Secretary to:

(i) organize the Workshop in 1990 or in the first quarter of 1991.
(ii) involve the widest possible participation of scientists from developing and developed countries;
(iii) assure effective interaction with relevant programmes of Unesco, FAO and WMO, as well as with the Scientific Advisory Bodies of the Commission;
(iv) support the implementation of IOC regional projects in coastal oceanography already initiated or proposed by IOC regional bodies.

Resolution XV-4

GLOBAL INTEGRATED OCEAN OBSERVING SYSTEM DEVELOPMENT

The Intergovernmental Oceanographic Commission,

Noting:

(i) the revised Statutes of the IOC by which the Commission is entrusted to promote, plan and co-ordinate ocean observing and monitoring systems,

(ii) the proposals of the Twenty-first Session of the IOC Executive Council regarding the accelerated progressive development of the next generation global operational ocean observing system and related ocean services,

(iii) Resolution 11 (EC-XLI) from the WMO Executive Council on the development of a global operational ocean observing system,

(iv) the proposals of the Second Session of the WMO-IOC Intergovernmental TOGA Board to initiate planning for the implementation of such a system,

(v) the preparation of long-term plans for some operational elements of such a system, including IGOSS, GLOSS, and IODE,

(vi) the preparation of implementation plans and initiation of scientific programmes, including TOGA, WOCE, JGOFS and possible emerging global geoscience programmes, that will provide information for development of such a system,

(vii) the proposed re-establishment by CCCO and JSC of an Ocean Observing System Development Panel (OOSDP), and

Being concerned about the possible termination of the North Atlantic Ocean Weather Stations at the end of 1989,

Recognizing:

(i) the necessity of systematic global ocean observations for understanding, monitoring, and predicting the state of and changes in the physical and chemical ocean environment and large-scale biological systems and related processes involved in climate change, and large-scale ocean-atmosphere interactions,

(ii) that an adequate ocean observing system must resolve the energy containing structures in the ocean, and that existing observing systems are insufficient for such resolution in space and time,

(iii) that the emerging developments of new technology will make it possible to enhance the scope of a global integrated ocean observing system, and

(iv) that new commitments from governments will be required to implement a global ocean observing system, and that the internationally recognized importance of monitoring and predicting change in the global environment provides the justification for developing such commitments,

Decides that there is an urgent need to substantially modernize and expand the existing global ocean observing systems through: (i) accelerated deployment of existing observation systems and (ii) phased integration of new technology, satellite and in situ. Criteria for this new generation system are provided in the Annex to this Resolution;

Reaffirms that the Intergovernmental Oceanographic Commission is the appropriate intergovernmental organization for the promotion, planning and co-ordination of a global integrated ocean observing system;

Urges Member States to strengthen the IOC Secretariat in order to assist in developing, implementing, and maintaining the global integrated ocean observing system and to develop the necessary training and assistance activities to support the operational measurements, including a remote-sensing training programme, through appropriate mechanisms;

Instructs the Secretary to invite the Secretary-General of WMO and Executive Heads of other appropriate UN Organizations to co-operate, within their respective fields of

competence, in the development of complementary and compatible components of an observing system for ocean and atmosphere, particularly in connection with requirements of global climate studies and assessment;

Instructs the Secretary, in consultation with the Secretary-General of WMO, and with the advice of the TC/OPC and the CCCO, to develop a statement on the importance of the ocean in global environmental change and the consequent need to expand and modernize the global integrated ocean observing system as part of a global system for monitoring and predicting environmental change;

Requests the Chairman IOC to present this statement to the United Nations, the IPCC and interested UN specialized agencies to ensure that development of ocean components of global observing systems be taken into account in planning by these bodies to address the issue of climate change;

Establishes an IOC ad hoc Group of Experts to work with and support the proposed Ocean Observing System Development Panel of the CCCO-JSC to develop a plan for the system. The plan will include requirements, techniques, and an initial implementation strategy. A progress report should be presented to the Twenty-third Session of the IOC Executive Council and transmitted for information to the Forty-second Session of the WMO Executive Council, in 1990, with an elaborated report to be presented to the Fourth Session of the TC/OPC. The report should also be transmitted to the governing bodies of co-operating UN organizations;

Invites Member States to consider ways and means by which they can assist in the continuation of long-term ocean measurements which have been and are being collected from Ocean Weather Ships, since these time series are among the longest and most useful of oceanographic data series; and

Instructs the Secretary to undertake actions to strengthen IOC activities in the application of satellite remotely-sensed data for study of the marine environment. These include facilitating access of scientists and national organizations to remotely-sensed oceanographic data, establishing liaison with satellite operational agencies, and organizing training programmes for graduate oceanographers.

Annex to Resolution XV-4

CRITERIA AND APPROACH FOR THE DEVELOPMENT OF A GLOBAL INTEGRATED OCEAN OBSERVING SYSTEM

1. A statement should emphasize the importance of the ocean in global environmental change and the consequent need to expand and modernize the global integrated ocean observing system for monitoring and predicting environmental change. This statement will be presented to the United Nations, IPCC and UN specialized agencies to ensure that development of a global integrated ocean observing system be taken into account in planning by these bodies to address the issue of climate change.

2. Such a statement will include a short review of the present state and achievements of existing ocean observing systems which, despite their limitations, have already permitted identification of some significant variations and trends in global climate and are already providing information to decision makers responsible for formulating policies designed to respond to the ecological and socio-economic effects of future climate change.

It should clearly state that immediate action can be taken in implementing on-going systematic observations of a number of key elements of the ocean of high priority in monitoring and predicting global change using techniques available today. These immediate elements should include the following specific observations with annual or more frequent sampling resolution when appropriate:

- Global sea level;
- Global distribution of sea-surface temperature;
- Global distribution of upper ocean temperature;
- Sea ice concentration;
- Heat carried by ocean currents, initially in the Atlantic;
- Structure of major elements of the ocean circulation;
- Statistics of the transient motions in the ocean;
- Global distribution of ocean heat content;
- Sea-surface meteorological variables (temperature, pressure, wind).

The statement should also draw attention to the need to continue work on developing methods to monitor elements of the chemical ocean environment, large-scale biological systems and those elements of the ocean system - for example ocean-atmosphere fluxes and upper ocean salinity - which cannot be adequately measured and yet which are crucial for the prediction of global change.

3. A detailed plan for the next generation of a Global Integrated Ocean Observing System must be developed under IOC as a matter of urgency. The plan must take into account:

- completed or on-going studies in this field;
- the existing operational systems of IOC and WMO which include elements such as IGOSS, GLOSS, IODE and WWW;
- the known requirements for climate monitoring research-forecasting, as well as other operational applications.

4. The plan will form the basis for the formulation of IOC strategy for the progressive development of such a system.

5. The plan will be defined by the proposed CCCO-JSC OOSDP with the assistance of an ad hoc Group of Experts designated by the Secretary IOC in consultation with the Secretary-General of WMO and based on recommendations of the Chairman TC/OPC. The experts will be designated on the basis of their expertise and knowledge of elements of the present observing systems, bearing in mind different levels of national and institutional capabilities.

Resolution XV-6

IOC INVOLVEMENT IN THE INTERNATIONAL GEOSPHERE-BIOSPHERE PROGRAMME (IGBP)

The Intergovernmental Oceanographic Commission,

Recognizing the key role of the ocean in geosphere and biosphere processes, as well as in global change,

Having noted that the Special Committee for the IGBP (SC-IGBP) (in its "Plan for Action"; Report N° 4, August 1988) and its Scientific Advisory Council have identified the study of ocean processes as a major focus for the IGBP,

Having also noted the description of a new programme on Global Change of the Past which was provided to the IOC by the CMG and summarized in Document IOC/INF-771,

Noting with satisfaction that the IOC and ICSU have held detailed discussions related to some IGBP elements of mutual interest, specifically between (i) IOC/GIPME and SCOR/JGOFS (a Core Programme in IGBP), and (ii) the ICSU/WMO JSC for WCRP, SCOR and IGBP, (through the CCCO), in relation to the oceanic components of the climate experiments of TOGA and WOCE,

Instructs the Secretary to broaden the IOC's interaction with ICSU and specifically to inform ICSU that the IOC is prepared to contribute to the IGBP and related climate change activities through a broad range of IOC programmes (listed in the Annex to this Resolution);

Further instructs the Secretary to develop this Annex into an IOC information paper and subsequently a publicity brochure, summarizing IOC interests and capabilities related to global change;

Invites Unesco and Member States to allocate the ways and means required to strengthen the IGBP-related scientific programmes and ocean monitoring activities of the Commission; and

Instructs the Secretary to examine ways of co-sponsoring a proposal for an IGBP programme on Past Global Change, using the IGCP as a model for implementation.

Annex to Resolution XV-6

1. Ocean Dynamics and Climate (TOGA; WOCE; etc.)

   - variability and change of the global ocean environment and its interaction with the atmosphere
   - data bases, numerical models and physical ocean process description
   - coastal processes

2. Ocean Science in Relation to Living Resources (OSLR)

   - plankton blooms (in co-operation with GIPME)
   - changes in species dominance
   - recruitment and fish stock variability (IREP)
   - coral bandings

3. Ocean Science in Relation to Non-Living Resources (OSNLR)

   - mapping of past sea-level and environmental changes
   - establishing past global change from the coastal sedimentary record
   - sediment flux and coastal studies

4. Mapping

   - digital data bases

5. Global Investigation of Pollution in the Marine Environment (GIPME)

   - regional monitoring networks and infrastructure
   - standard reference material
   - training in analytical/sampling methodology
   - intercomparison/intercalibration exercises
   - mapping of the distribution of contaminants in the marine environment
   - investigation of anthropogenic changes in the World Ocean and the different regions thereof

6. Ocean Services

- temperature, salinity and currents in the upper layer (e.g. above the main thermocline) and monthly mean sea-level products: Integrated Global Ocean Services System (IGOSS) jointly with WMO
- standard sea-level data: Global Sea-Level Observing System (GLOSS)
- drifting buoy data: Drifting-Buoy Co-operation Panel, jointly with WMO
- global exchange of various kinds of oceanographic data in various time frames: International Oceanographic Data and Information Exchange (IODE)
- exchange of information : Aquatic Science and Fisheries Information System (ASFIS), jointly with FAO

7. Training, Education and Mutual Assistance in the Marine Sciences (TEMA)

- training, workshops, symposia and other such actions for the items above

ANNEX XIV

Report from the World Meteorological Organization

The following paragraphs summarize briefly activities undertaken within or by WMO during the past year which may be of interest to SCOR.

Drifting buoys and other ODAS

The joint WMO/IOC Drifting Buoy Co-operation Panel held its fourth session in New Orleans in October 1988 and its fifth session is scheduled for Geneva, 17-20 October 1989. Largely through the efforts of the panel's technical co-ordinator, substantial improvements have been effected in the quality of drifting buoy data available on the GTS. There has also been some improvement in the average daily numbers of drifting buoy reports on the GTS, although much remains to be done in this area in view of the fact that reports from only a third of all operational drifting buoys at any one time (handled by the Argos system) are distributed on the GTS and eventually appear in the permanent archive for such data operated by MEDS in Canada.

The technical co-ordinator has, during the past two years, has been able to establish contact with most of the managers of major drifting buoy programmes. He thus acts as an effective international focal point for drifting buoy activities on both technical and operational aspects, as well as an advocate for drifting buoy operators within CLS/Service Argos. Unfortunately, the original technical co-ordinator for the Drifting Buoy Co- operation Panel, Mr. David Meldrum, was unable to continue in the post for a third year. He has been replaced by Mr. Etienne Charpentier, who is now located within Service Argos Inc., Landover, MD, USA, so as to be more accessible to North American drifting buoy programme managers.

The Drifting Buoy Co-operation Panel is now in the process of developing contacts with the WOCE drifter community, which hopefully will be mutually beneficial: the operational buoy deployers are examining more closely the feasibility of adding drogues and/or thermistor chains to existing standard meteorological buoys, while the WOCE scientists are likely to add atmospheric pressure sensors to a portion of the WOCE drifters and will also take steps to have their data distributed on the GTS. One possible further outcome of this collaboration may be a concerted effort to develop a new, cheaper multi-purpose buoy for mass deployment.

As noted in last year's report, a Guide to Drifting Data Buoys, by G.D. Hamilton, was published in late 1988 by IOC as Manuals and Guides No. 20. A companion Guide to Moored Buoys and other ODAS is now also being prepared by Dr. Hamilton at the request of the WMO Commission for Marine Meteorology, to be published in due course by WMO. Finally, the Drifting Buoy Co- operation Panel prepares each year its annual report on its activities and on the status of drifting buoy programmes. The report for 1988 was published in February 1989 and given wide distribution to interested individuals, organizations and institutions.

Ocean waves

As noted in last year's report, a Technical Conference on Ocean Waves, sponsored by the WMO Commission for Marine Meteorology and the French Meteorological Society, took place in Paris on 6 and 7 February 1989, in conjunction with the tenth session of CMM. Some 150 people attended and the full tests of all papers presented are to be published shortly, jointly by WMO and the French Meteorological Society. The WMO Guide to Wave Analysis and Forecasting (WMO-No. 702) was published in English in December 1988. A Spanish version is also now available and the French and Russian editions are expected before the end of 1989.

Marine climatological data

The Voluntary Observing Ships' Special Observing Project-North Atlantic (VSOP-NA) is now fully underway. According to the third VSOP-NA Newsletter (July 1989), 48 ships from six countries are participating and around 8,000 observations have so far been received by the archival centre in the United Kingdom. Already these data show a possible systematic difference in air temperatures measured by different techniques. More detailed analyses (including of ships' winds) will become available in early 1990.

Remote sensing of the oceans

The tenth session of CMM (Paris, February 1989) decided to establish, jointly with IGOSS, an *ad hoc* group of experts on oceanographic satellites and remote sensing, primarily to assist meteorological and oceanographic services to prepare for the coming generation of oceanographic satellites. The terms of reference for this group are annexed to this report and its membership is now being established by the president of CMM and the chairman of IGOSS. This group will need to keep in close contact with the satellite operating agencies, as well as the oceanographic research community working on satellite data processing and analysis techniques.

Global ocean observing system

There is now a clear recognition within WMO of the need to monitor operationally a variety of ocean variables in support of global climate monitoring, research and prediction. The recent forty-first session of the WMO Executive Council therefore agreed on the need for WMO to co-operate actively with IOC in the planning, implementation and maintenance of a composite operational global ocean observing system for this and other purposes. From the point-of-view of WMO, first priority in the system should be given to observations relating to the so-called "fast response" climate system, i.e. sea surface meteorological variables (pressure, temperature, wind), heat and salinity content of the upper ocean, sea level. System planning is being undertaken through JSC/CCCO and implementation as much as possible through a strengthening of existing systems such as WWW and IGOSS. A key factor is that all elements of the system must be funded and maintained on an effective long-term operational basis.

Tropical Ocean and Global Atmosphere (TOGA) Programme

As TOGA approaches the half-way point in its planned ten-year life, it continues to be a dynamic programme in all its components. Of many developments in the past twelve months, the following are perhaps of most interest to SCOR:

TOGA Coupled Ocean Atmosphere Response Experiment (COARE)

Following consideration by the Intergovernmental TOGA Board (ITB) at its second session in December 1988, planning for the proposed TOGA Coupled Ocean Atmosphere Response Experiment (COARE) in the warm pool region of the tropical west Pacific has passed several major milestones. At its meeting in March 1989, the JSC endorsed COARE as a component of the international TOGA programme; similar endorsement was given by CCCO at its subsequent meeting in June. The draft COARE Science Plan was reviewed by an International COARE Workshop hosted by ORSTOM, Noumea, in May 1989. This Workshop was attended by approximately 100 scientists from the nine countries which currently are expected to be the major participants. The recommendations arising from this Workshop and from the CCCO will be incorporated into the Plan that will be submitted by the TOGA Scientific Steering Group (SSG) for consideration by the ITB at its next session in January 1990, for subsequent endorsement by the JSC and CCCO and eventual publication as an addendum to The Scientific Plan for TOGA (WMO Technical Document No. 64). Work has started on the drafting of the COARE Implementation Plan. There are encouraging prospects that the necessary resources will be available. Within the

USA, joint NOAA/NSF funding is being sought at the level of $5m for each of FY 1990, 1991 and 1992, with additional contributions by NASA. Other participating nations are also seeking the allocation of national resources to support COARE. Providing that the necessary resources are made available, COARE will be a future major focus of attention of TOGA.

TOGA XBT Ad-Hoc Panel Experts

The newly constituted TOGA XBT Ad-Hoc Panel of experts met for the first time in May 1989 immediately following the COARE Workshop in order to conduct a thorough review of TOGA XBT sampling strategy. The Panel considered the experience gained in operating TOGA XBT lines since 1985, the requirements for XBT data in real- time for operational ocean modelling and in delayed-mode for more traditional techniques of ocean thermal structure analysis and the expected deployment in significant numbers of moored thermistor chains in the tropical Pacific wave-guide. The most recent detailed statistical analyses available to the Panel broadly corroborated the current TOGA requirement to sample the upper mixed layer of the tropical oceans at intervals of 2 degrees of latitude and 10 degrees of longitude every month. Refinements of this requirement to indicate more precise spatial separations, the mix of XBT probe types (e.g. T-4 or T-7), a desirable trade-off between XBT and XCTD and possible variations of strategy to take account of a mooring network or other considerations are the subject of ongoing investigations by the Panel.

International TOGA Scientific Conference 1990

WMO, IOC, ICSU and SCOR have agreed to sponsor an International TOGA Scientific Conference to be held in Honolulu 16-20 July 1990, the primary objectives of which will be to take stock of the scientific achievements of TOGA in the period 1985 to 1990 and to assess the prospects for attaining the scientific objectives of TOGA by 1995. The First Announcement of this Conference, which was addressed by Secretary-General WMO to Permanent Representatives of WMO Members and by Secretary IOC to IOC Member States, has attracted responses from over 300 scientists who have expressed an interest in attending. The Call for Papers is scheduled for publication before October 1989. The Conference programme will be organised by a Committee under the Chairmanship of Professor Klaus Wyrtki, University of Hawaii, the composition of which was the subject of consultations with the President of SCOR. Financial support will be provided by the US TOGA Project Office, the Joint Climate Research Fund (WMO and ICSU), IOC and the TOGA Trust Fund. It is expected that there will be a big demand from scientists in developing countries for financial assistance to meet their travel costs and Secretary SCOR has indicated the possibility that SCOR may be able to direct funds in this direction. The Conference Proceedings will be published by WMO as a WCRP Publication.

TOGA Compact Disk (CD-ROM) Pilot Project

The application of CD-ROM technology to TOGA Data was discussed at a meeting of experts on TOGA Data Management in Washington, DC, in October 1988. Since international standards have now been agreed and since the cost is no longer prohibitive, these experts proposed that a selection of TOGA data sets should be assembled on CD-ROM and the associated interactive access software should be developed as a Pilot Project. Subsequently, the NASA Ocean Data System (NODS) laboratory at JPL, Pasadena, California, has been funded to undertake a Pilot Project to assemble all TOGA observations (sub-surface, marine and sea-level), monthly SST and wind-stress fields and daily ECMWF surface flux fields for 1985, 2986 and 1987 on one CD-ROM. Work has begun and it is hoped that the discs will be available in early 1990. In accordance with NASA policy, the discs and access software will be provided free of charge.

Terms of reference for *ad hoc* group on ocean satellites and remote sensing

(a) To prepare annually a report on the development of the main remote-sensing programmes relevant to marine meteorology and physical oceanography;

(b) To analyse the requirements of marine meteorology and physical oceanography for remote-sensing data;
(c) To prepare recommendations to meteorological and oceanographic analysis centres relating to satellite data analysis and user requirements for such data;
(d) To prepare proposals for satellite-operating agencies relating to procedures for the exchange of satellite data of value to marine meteorological services, in co-ordination with the other working groups of CMM;
(e) To monitor and report on the application of ground- based HF and microwave radars to the provision of the marine meteorological services;

ANNEX XV

The Designation Of The Joint Global Ocean Flux Study As A Core Project Of The IGBP And SCOR's Role In Future Planning For The IGBP

Letter to Professor M.G.K. Menon, President of ICSU, dated May 5, 1989

Dear Professor Menon:

As you perhaps know, over the last few years there has been a convergence of ideas within the planning activities of both SCOR and the SC-IGBP relating to the need for an international global scale research endeavor addressing biogeochemical processes in the ocean.

SCOR has recently taken a bold step towards implementing a major programme in this area, known as the Joint Global Ocean Pilot Study (JGOFS). The North Atlantic was selected for a JGOFS Pilot Study, and this project, which involves the research vessels of five nations, and scientists from an additional eleven, is now under way. A JGOFS meeting to plan the Pacific Ocean component will take place from 14 to 16 September this year.

The Special Committee has reviewed carefully the SCOR planning documents for JGOFS and it finds that the objectives of this project are entirely consistent with the objectives and priorities identified for the IGBP in the areas of marine biosphere-atmosphere interactions.

Thus, in recognition of the role that SCOR plays in defining the international research agenda for ocean science and, in particular, the leadership it has shown in launching JGOFS the Special Committee decided, at its last meeting to invite SCOR to designate JGOFS as one of the Core Global Change Projects. In addition, the Special Committee asked for the assistance of SCOR in defining the research needs for the next generation of studies related to the coupling of biogeochemical cycles and physical processes in the ocean. The Officers of SCOR have consulted with the JGOFS Committee and have agreed to accept this invitation. Correspondence between the two of us and a joint announcement of this agreement are enclosed.

We wish to call your attention to this matter because we believe it is a particularly good example of an effective complementary relationship between the interests and activities of one of ICSU's Scientific Committees and its Special Committee for the IGBP.

Yours sincerely,
James J. McCarthy
Chairman, SC-IGBP
J.-O. Stromberg
President, SCOR

A JOINT ANNOUNCEMENT FROM THE ICSU SPECIAL COMMITTEE FOR THE IBGP PROGRAMME AND THE SCIENTIFIC COMMITTEE ON OCEANIC RESEARCH OF ICSU

The International Geosphere-Biosphere Programme (IGBP) of ICSU has as its overall goal "to describe and understand the interactive physical, chemical and biological processes that regulate the total Earth system, the unique environment that provides for life, the changes that are occurring in this system and the manner in which they are influenced by human activities."

The Scienfitic Committee on Oceanic Research (SCOR) has taken the initiative to establish a major global ocean research programme called the Joint Global Flux Study (JGOFS). The major

goal of JGOFS is "to determine and understand on a global scale the time-varying fluxes of carbon and associated biogenic elements in the ocean and to evaluate the related exchanges with the atmosphere, the sea floor and the continental boundaries." The Science Plan for JGOFS is now being formulated and a Pilot Study in the North Atlantic involving at least seven countries will begin in March 1990.

The Special Committee for the IGBP has a Coordinating Panel on Marine Biosphere - Atmosphere Interactions which has identified three areas of oceanic research to receive priority consideration in the IGBP. Two of these are: characterization of the oceanic carbon cycle and associated links with the other elements known to be either limiting to biological productivity or of significance to climate; and, examination of linkages among biogeochemical cycles and the physical climate system that require characterization in order to anticipate not only the effects of global change on these cycles, but also their feedback to climate.

In recognition of the similarities in the goals of these two programmes, and in the interest of making the most effective use of manpower and other resources during the planning and implementation phases of a large global-scale marine research programme, the SC- IGBP has invited SCOR, and SCOR has agreed, to designate JGOFS as a Core Project of the IGBP, in which the full responsibility for both of these phases is retained by SCOR.

We have also agreed that liaison between IGBP and JGOFS will be achieved by participation in all relevant planning meetings. The Chairmen of the SC-IGBP and of its Coordinating Panel on Marine Biosphere-Atmosphere Interactions are already Corresponding Members of JGOFS and have participated in its early activities. In addition, the Chairman of JGOFS, or an appropriate representative, will attend the future meetings of the Coordinating Panel. A number of joint activities are foreseen; one of these will be an IGBP/JGOFS international meeting on "Modelling Ocean-Atmosphere Interactions including the Effects of Primary Production in the Ocean" which will be held at the Royal Society in London in early 1990.

James J. McCarthy, Chairman SC-IGBP
J-O. Stromberg, President SCOR

ANNEX XVI

Subject: IAPSO Activities, 1988-89

During the year since JOA Acapulco, four of the six IAPSO commissions have held meetings of their respective members, the other two have been active in developing future scientific programs, the Association has co-sponsored two scientific meetings/ symposia, and the members of the Bureau (President and Secretary General) have participated in IUGG Executive Committee sessions, two scientific assemblies in Europe, and published and distributed the Proces Verbaux of the XIXth IAPSO General Assembly, Vancouver.

1. The Sea-Ice Commission, led by President Robin Muench, met at the Scott Polar Institute, Cambridge, England, in October 1988. A report of the meeting was published in EOS and is available from Dr. Muench. The second meeting of this commission will be held in October 1989 during the Workshop on Regional and Mesoscale Modelling of the Ice-Covered Ocean, Nansen Remote Sensing Center, Solheimsvik, Norway; co-sponsored by IAPSO. Some 47 scientists will attend and, once again, the report of the meeting will be published in EOS.
2. The Sea-Level and Tides Commission, David Pugh President, met at Woods Hole Oceanographic Institution, Massachessetts, October 1988, in a session co-sponsored by the National Space and Aeronautics Administration and the National Oceanic and Atmospheric Agency, USA. In addition to planning coordinated activities between national agencies and IAPSO's Sea-Level Service for the 1990's programs of Natural Hazard Reduction, Climate Change, and IGBP, preliminary decisions were made regarding the acquisition, correlation, and dissemination of sea-level data provided from GEOSAT, TOPEX, ERS-1, and other Earth-orbiting systems expected in the next decade.
3. The Natural Marine Hazards Commission, led by President M. El-Sabh, has been active in planning the international meeting "Natural Geophysical Hazards in Developing Countries and their Environmental Impacts," to be held in Visakhaptnam, India, December 1990. The conference is to be co-sponsored by the IAPSO Commission, the newly founded International Society for the Prevention and Mitigation of Natural Hazards, The Tsunami Society, among others. This meeting will, in a sense, act as the "kick- off" for the International Decade of Natural Disaster Reduction, so proclaimed by the United Nations to begin January, 1991.
4. The Commission for Oceanographic Cooperation with Developing Countries, President Eugene C. LaFond, convened workshops in 1987, Vancouver, and 1988, Acapulco. At the latter, 28 formal papers were presented and are in the process of being published by the Commission. Other activities under Dr. LaFond's guidance include (1) a review of national oceanographic programs for Belize and Tanzania, (2) the support of an oceanographer (LaFond) to present the keynote address at a Regional Seminar in Accra, Ghana, Sept. 1988, (3) adjudication of PhD dissertations from two universities in India, and (4) provision of 43 boxes of marine science publications to the National Institute of Oceanography, India, and six boxes to CICESE, Ensenada, Mexico. The CDC plans to hold a workshop/symposium at the XXth IUGG General Assembly, Vienna, Austria, 1991, entitled "Present and Future Oceanographic Programs in Developing Countries."
5. The Space Oceanography Commission, led by Co-President Andre Morel, will co-sponsor with the ICSU Committee on Space Research (COSPAR) an international workshop/symposium on "Oceanography from Space 1990," to be hosted by the Instituto per lo Studio della Dinamica delle Grandi Massi in Venice, Italy, 21- 25 May 1990. Dr. R. Frassetto is chairman of the local organizing committee and Dr. James F. R. Gower, IOS, Sidney, B.C., Canada, leads the COSPAR technical planning committee. The meeting is the decadel follow-on to the Venice

symposium on "Oceanography from Space" in 1980 at which time it was recommended that a review of the field be held in ten years. In May 1990, rather than a strict symposium format, however, the session will be a mixture of formal review presentations (invited), contributed poster papers, and workshop-style discussions. The topics to be covered include:

a. The potential contribution of ocean optics and infrared measurements to global climate programs,
b. The expected application of radar altimetry to ocean circulation studies; such as, WOCE,
c. The use of SAR and scaterometer data in global climate and circulation programs,
d. The possible contributions of satellite data to research on air-sea interaction, polar ice, and the global water/energy balance,
e. Developments in modelling and data assimilation, and,
f. The scientific requirements for new/different spaceborne remote sensors.

6. The Commission on Program and Assembly Planning, Robert Knox and Joris Gieskes Co-Presidents, along with the Secretary General, solicited more than 1,000 oceanographers in the first months of 1989 for suggested symposia topics for the IAPSO General Assembly, Vienna, Austria, August 1991. The response was widespread, both geographically and in suggested subjects. The Commission met with the Secretary General and the Secretary General Emeritus (LaFond) in July, 1989, and selected the following topics for IAPSO's XXth General Assembly:

a. Nonlinearity, Chaos, and Fractals in Oceanic and Atmospheric Flows. Convenors: Kirwan (USA), Fortak (FRG) and Ginsburg (USSR)
b. Present and Future Oceanographic Programs in Developing Countries. Convenors: LaFond (USA), Durvasula (Canada), and Rao (India)
c. Formation and Circulation of Deep and Bottom Waters. Convenors: Gascard (France) and Meincke (FRG)
d. The Mediterranean Sea: A Case Study for General Circulation, Mesoscale Dynamics, and Convection. Convenors: Astraldi (Italy), Rissoli (USA) and Millot (France)
e. Estuarine, Coastal, and Shelf Oceanography. Convenors: Johnson (UK), Longfei (PRC), Sundermann (FRG), and Edwards (Scotland)
f. Global Warming: Effect on Sea Level, Cirulation, and the Ocean Heat Engine. Convenors: Gordon (USA), Yamamoto (Japan),and Pugh (UK)
g. Air-Sea Fluxes and Ocean Waves. Convenors: Toba (Japan), Jones (Australia), and Baba (India)
h. Low-Latitude Coupled Ocean-Atmosphere Interactions. Convenor: Halpern (USA)
i. Results of New Technology in Oceanographic Research. Convenors: Farmer (Canada), Krauss (FRG) and Cornillon (USA)
j. Super-Inertial Processes in the Ocean: Internal Waves, Inertial Motion, and Turbulence. Convenor: Levine (USA)
k. Physical, Chemical, and Geophysical Oceanography (Poster/Precis Sessions). Convenor: Stevenson (USA)

In addition to its own scientific program, IAPSO will convene IUGG Union Symposium 9, on Sea-Air-Ice Interaction (final title to be determined); Convenor, Robin Muench, USA, and will co-convene the following Union symposia:

a. Hann Symposium: Fluxes of Matter Between Global Climate Subsystems. IAPSO co-convenor: Sarmiento (USA)
b. Major Puzzling Problems or Paradoxes in Contemporary Geophysics. IAPSO co-convenor: Holloway (Canada)

c. Application of Gravimetry and Space Techniques to Geodynamics and Ocean Dynamics. IAPSO co- convenor: Cheney (USA)
d. Water as a Geophysical Agent. IAPSO co-convenor: Warren (USA)
e. Sea Level Changes: Determination and Effects. IAPSO co-convenor: Woodworth (UK)
f. Global Climate Variability: Processes and Prediction. IAPSO co-convenor: Bryan (USA)
g. Environmental Effects on Spacecraft Trajectories and Positioning. IAPSO co-convenor: Parke (USA)

The First Circular announcing the XXth General Assembly, IUGG Vienna, 11-24 August 1991, has been distributed by the Local Organizing Committee. Dr. Peter Steinhauser is the Chairman. The General Assembly will be held at the Technical University of Vienna and at the adjacent "Messepalast" in downtown Vienna. Copies of the circular, or other information, may be obtained by writing to:

IUGG '91 Organizing Committee
ZAMG Hohe Warte 38
A-1190 Vienna, Austria

IAPSO's First Circular will be ready for distribution in January 1990 and will include the IAPSO scientific program, names and addresses of convenors, and instructions for those wishing to submit contributed papers.

The Second Circular from the IUGG'91 Organizing Committee is expected to be ready for distribution in the Spring 1990.

7. The IAPSO Bureau (O'Brien and Stevenson) has represented the Association at two IAPSO co-sponsored scientific meetings in the past 12 months and participated in two sessions of the IUGG Executive Committee.

Stevenson attended the annual symposium of the *European Geophysical Society*, held in Barcelona, Spain, in March 1989. In addition to being a regular co-sponsor of EGS symposia and an ad hoc member of the Executive Committee (Stevenson), IAPSO supports the EGS program of travel support for deserving graduate students to the annual meetings. The IAPSO funds are provided to oceanography majors and in 1989, eight such students were able to travel to Barcelona.

Stevenson and O'Brien attended the 5th Scientific Assembly, IAMAP'89, of the *International Association of Meteorology and Atmospheric Physics*, held at the University of Reading, UK, 31 July - 12 August 1989. IAPSO co-sponsored three of the individual symposia and the Bureau members participated in the meetings of the IAMAP Executive Committee. The two associations plan to co-sponsor several symposia planned for the scientific programs of each at the Vienna General Assembly, as well as several of the Union symposia.

O'Brien participated in the IUGG Executive Committee meeting in Trieste, November 1988, and was joined by Stevenson as they both participated in the Union's Executive Committee meeting in Edinburgh, Scotland, August 1989.

The Bureau has agreed to co-sponsor the Symposium on Global Change, and accompanying workshop, scheduled for the *28th COSPAR Meeting and Associated Activities* to be held in The Hague, Netherlands, 25 June -7 July 1990. IAPSO has appointed David Halpern, USA, to be its representative on the program committee led by Dr. Jean-Louis Fellous, France.

ANNEX XVII

ACRONYMS AND ABBREVIATIONS

ACMRR	Advisory Committee on Marine Resources Research (FAO)
AGU	American Geophysical Union
AMS	Absorption Mass Spectrometer
AOSB	Arctic Ocean Sciences Board
ARGOS	Satellite Location Data Collection System (CNES and NOAA)
AVHRR	Advanced Very High Resolution Radiometer
BIOMASS	Biological Investigations of Marine Antarctic Systems and Stocks (SCAR/SCOR/IABO/ACMRR)
CCCO	Joint SCOR/IOC Committee on Climatic Changes and the Ocean
CD-ROM	Compact Disk with Read-Only Memory
CICESE	Centro de Investigacion Cientifica y Educacion Superior de Ensenada
CLIMAP	Climate: Long-Range Investigation, Mapping, and Prediction Study
CLS	Collecte Localisation Satellites (Service ARGOS)
CMG	Commission for Marine Geology (IUGS)
CMM	Commission for Marine Meteorology (WMO)
CNES	Centre National d'Etudes Spatiales (France)
COMAR	Coastal Marine Research (programme of UNESCO)
COARE	Coupled Ocean-Atmosphere Response Experiment (TOGA)
COSPAR	Committee on Space Research (ICSU)
CRAY	Supercomputer
CTD	Conductivity/Temperature/Depth recording instrument
DBCP	Drifting Buoy Cooperation Panel (WMO/IOC)
DOC	Dissolved Organic Carbon
ECMWF	European Centre for Medium Range Weather Forecasting
ENSO	El Niño-Southern Oscillation
ERS-1	ESA's Earth Remote Sensing Satellite - 1
ESA	European Space Agency
FAO	Food and Agriculture Organization
FSU	Florida State University
GEEP	Group of Experts on Effects of Pollutants (IOC-IMO-UNEP)
GEMSI	Group of Experts on Methods, Standards and Intercalibration (IOC/UNEP)
GEOSAT	A U.S. Navy Satellite
GESAMP	Group of Experts on the Scientific Aspects of Marine Pollution
GESREM	Group of Experts on Standards and Reference Materials (IOC-IAEA-UNEP)
GIPME	Global Investigation of Pollution in the Marine Environment (IOC)
GLOSS	Global Sea-Level Observing System (IOC)
GSP	Greenland Sea Project
GTS	Global Telecommunication System
HPLC	High Performance Liquid Chromatography
IABO	International Association for Biological Oceanography (IUBS)
IAEA	International Atomic Energy Agency
IAMAP	International Association for Meteorology and Atmospheric Physics (IUGG)
IAPP	International Arctic Polynya Project
IAPSO	International Association for the Physical Sciences of the Ocean (IUGG)
ICES	International Council for the Exploration of the Sea

ICSU	International Council of Scientific Unions
IGAC	International Global Atmospheric Chemistry Program
IGBP	International Geosphere-Biosphere Programme (ICSU)
IGOSS	Integrated Global Ocean Services System (IOC/WMO)
IOC	Intergovernmental Oceanographic Commission
IODE	International Oceanographic Data Exchange (IOC)
IPO	International Project Office
IREP	International Recruitment Experiment (IOC)
IUGG	International Union of Geodesy and Geophysics (ICSU)
JGOFS	Joint Global Ocean Flux Study
JOA	Joint Oceanographic Assembly
JPL	Jet Propulsion Laboratory
JPOTS	Joint Panel on Oceanographic Tables and Standards
JSC	Joint Scientific Committee (for the WCRP)
MARPOLMON	Marine Pollution Monitoring
NANSEN	North Atlantic Norwegian Sea Exchange
NASA	National Aeronautics and Space Administration (USA)
NEW	Northeast Water in the Greenland Sea
NOAA	National Oceanic and Atmospheric Administration
NOAA-AVHRR	NOAA-Advanced Very High Resolution Radiometer
NODS	NASA Ocean Data System
NSF	National Science Foundation (USA)
ODAS	Ocean Data Acquisition System
OOSDP	Ocean Observing System Development Programme
ORSTOM	Office de la Recherche Scientifique et Technique d'Outre Mer (France)
OSLR	Ocean Science in Relation to Living Resources (IOC)
OSNLR	Ocean Science in Relation to Non-Living Resources (IOC)
PEX	Patchiness Experiment in the Baltic Sea
PML	Plymouth Marine Lab
POC	Particulate Organic Carbon
ROSCOP	Report on Observations/Samples collected by Oceanographic Programmes (IOC)
SCAR	Scientific Committee on Antarctic Research (ICSU)
SC-IGBP	Special Committee for the IGBP (ICSU)
SCOPE	Scientific Committee on Problems of the Environment (ICSU)
SCOR	Scientific Committee on Oceanic Research (ICSU)
SIBEX	Second International BIOMASS Experiment
SLIP	St. Lawrence Island Polynya in the Bering Sea
SSG	Scientific Steering Group
SWADE	Surface Wave Dynamics Experiment
TC/OPC	Technical Committee on Ocean Processes and Climate (IOC)
TEMA	Training, Education and Mutual Assistance (IOC)
TOGA	Tropical Oceans and Global Atmosphere
TOGA-COARE	TOGA-Coupled Ocean Atmosphere Response Experiment
TOPEX	(Ocean) Topography Experiment (USA)
UNEP	United Nations Environment Programme
UNESCO	United Nations Education, Scientific and Cultural Organization
URSI	Union Radio Scientifique Internationale (ICSU)
VOS	Voluntary Observing Ship
VSOP-NA	VOS/Special Observation Programme - North Atlantic

WAM	Wave Modelling Group
WCRP	World Climate Research Programme (WMO/ICSU)
WG	Working Group
WHOI	Woods Hole Oceanographic Institution
WMO	World Meteorological Organization
WOCE	World Ocean Circulation Experiment
WWW	World Weather Watch
XBT	Expendable Bathythermograph
XCTD	Expendable CTD