

REPORT OF THE
SCIENTIFIC COMMITTEE ON OCEANIC RESEARCH

By: E. Tidmarsh
Executive Secretary, SCOR

This report covers the period from June 1989 to June 1990.

ORGANIZATION

The twenty-ninth Executive Committee meeting of SCOR took place at Florida State University, Tallahassee in October 1989. As usual, much of the meeting was taken up with a review of the scientific activities which are the *raison d'être* of SCOR. This review was based on the information contained in the progress reports from the Chairmen of all SCOR Subsidiary Bodies.

Applications for membership in SCOR from Bangladesh and Korea have been accepted, bringing the number of countries involved in SCOR to thirty-eight.

SCOR continues to serve as an official scientific advisory body to both the Division of Marine Science and the Intergovernmental Oceanographic Commission of Unesco. These organizations cosponsor and provide some financial support for a number of SCOR working groups and other activities of mutual interest.

A grant from the US National Science Foundation continues to make possible a programme of travel grants for oceanographers from developing countries wishing to participate in international scientific meetings which are organized or cosponsored by SCOR. Between twenty-five and thirty such awards are made annually.

The Executive Committee discussed the results of a survey which was conducted during the year in which SCOR Committees were asked for their suggestions on how to broaden the involvement of the oceanographic community in SCOR affairs. This survey revealed a number of points of general concern. For example, a third of SCOR's member countries are not represented in any SCOR Subsidiary Bodies, perhaps because it is not well understood that nominations of qualified scientists may be made by any SCOR Committee and that their participation in such activities will be supported by SCOR. For a number of years the main focus of SCOR's scientific endeavour has been in "open ocean" science and many smaller countries indicated a desire to see more activities in coastal oceanography undertaken. The survey also revealed a need for better communication between SCOR and its member committees, but even more importantly, between some of those committees and the scientific communities they represent. Efforts must be made to increase the visibility of SCOR in these countries, and to involve younger scientists and more scientists from developing countries in its activities. It was also recognized, however, that any such efforts would require additional funds and time for the SCOR Secretariat and it was not clear whether these resources could be made available. Another issue is the very large demands placed upon the Secretariat for the administration of large-scale programmes, such as JGOFS. In order to clarify these points and to prepare for a more focused discussion at the XX General Meeting, the Executive

Committee has appointed an ad hoc Review Group on the Role and Future Directions of SCOR.

The Executive Committee also received a report of an ad hoc group established to review the rationale and need for the Joint Oceanographic Assembly, a large interdisciplinary meeting which has traditionally been organized by SCOR every six years in collaboration with other international organizations. The review also considered the role of SCOR in relation to other large international meetings, such as the IUGG Assembly. It was the consensus of the Executive Committee to recommend to the next SCOR General Meeting that the traditional JOA be discontinued in favour of more frequent, more focused interdisciplinary meetings on oceanographic topics.

Information on the many publications arising from SCOR activities during the past year can be found in the latest issue of SCOR Proceedings.

SCIENTIFIC ACTIVITIES

A full list of the current SCOR Working Groups, Committees and Panels is given at the end of this report. A few highlights of their recent achievements will be given here, but more detailed information on any of them may be obtained from the SCOR Secretariat.

WG 77 Laboratory Tests Related to Basic Physical Measurements at Sea

A CTD is an automated instrument of critical importance to oceanographers since it is used to take continuous measurements of conductivity (and by derivation, salinity) and temperature with depth producing data for a vertical profile through the water column. An unprecedented laboratory intercomparison of commercially available CTD's was organized by WG 77 and took place late in 1988. It involved the use of the high pressure laboratory of the Institute of Applied Physics at the University of Kiel. Planners of both the TOGA and WOCE experiments have expressed great interest in the results of this intercomparison, and are anxious that the results be made available as quickly as possible. The WG is now carrying out detailed analysis and discussion of the results of the intercomparison experiment and its report to the SCOR Executive included recommendations to CTD users and manufacturers. These will be given with more detail in the publication of the group which is now in the final stages of preparation.

WG 78 Determination of Photosynthetic Pigments in Seawater

This SCOR working group is charged with the development of new protocols for the analysis of photosynthetic pigments in seawater. New technical standards are urgently needed in order to improve our ability to estimate the productivity of the ocean and to understand the role of marine photosynthesis in the global carbon cycle. In September 1989 the last of a series of three laboratory workshops organized by WG 78 took place. These included one on chlorophyll determinations, one on carotenoids and a field applications workshop. The objectives of all three Mini Workshops originally set out in May 1988 were attained. The group is now editing a report for publication by UNESCO which will contain methodological recommendations for pigment analyses and will replace the standard handbook now in wide use which was published by UNESCO in 1966 as a result of the efforts of a much earlier SCOR WG. WG 78 is also going to prepare

a Pigment Data Handbook for Marine Scientists - a bench top spiral bound compilation of the key databases needed by pigment scientists.

WG 83 Wave Modelling

The main task assigned to WG 83 is the development of a third generation spectral wave model to permit global-scale wave prediction. The group has served to broaden the international participation in WAM, a large, European wave modelling research group, for which WG 83 now acts as an executive body. WG 83 has recently reported on the following achievements: Joint development of a third generation wave model is progressing well with the collaboration of scientists from several countries. A working model is in place on the CRAY supercomputer at the ECMWF and copies are being used by a number of scientists to test various aspects of its performance. Regional versions of the third generation model have been implemented for various regions of the world. A global version of the model has been implemented at ECMWF and various tests that pertain to medium range forecasting are being done. WG 83 encourages attention to particular areas of wave dynamics where additional studies are required to improve wave modelling. Many of the group's members are directly involved in planning and conducting such physical studies. Data assimilation is an important aspect of the work of WG 83 and it is encouraging the establishment of data assimilation techniques for global wave modelling. The anticipated launch of the ERS-1 satellite in 1991 makes this an urgent task.

WG 85 Experimental Ecosystems

WG 85 has completed its assignment during the period covered by this report. A volume now in press with Springer-Verlag will provide a review of the use of experimental ecosystems in marine research. As its second major task, WG 85 agreed to prepare a "Manual of Marine Experimental Ecosystems" consisting of two parts. The first deals with the choice of experimental ecosystems, including consideration of scientific strategy, design and maintenance. The second part illustrates various experimental ecosystems and gives information on their construction and performance. It is expected that this manual will be published in the SCOR Report Series in the near future.

Two major activities of SCOR warrant special attention in a report such as this. These are the Joint SCOR/IOC Committee on Climatic Changes and the Ocean (CCCCO) and the SCOR Committee for the Joint Global Ocean Flux Study.

Joint SCOR/IOC Committee on Climatic Changes and the Ocean (CCCCO)

The Eleventh Session of the CCCCCO took place in Paris in May 1990. The Committee addressed scientific planning, intergovernmental climate initiatives, and the implementation of its WOCE, TOGA, and ocean observing system development activities.

The Committee sought to identify current gaps not covered by existing international programmes (e.g., WOCE, TOGA, JGOFS, and GEWEX) related to climate change. The following themes emerged as being scientifically important and international in scope upon which the Committee should focus its intersessional efforts:

1. Ocean Observing System Development. The development of a scientifically based plan for long-term climate related ocean observations was identified as a matter requiring urgent attention. The highest priority should be given to elements necessary for operational modelling and the prediction of events such as El-Nino. The Committee requested its CCCO-JSC Ocean Observing System Development Panel to draft a plan for an observing system based on conventional upper ocean measurements before September 1990. It was agreed that a means of monitoring near-surface salinity was urgently required to meet the needs of GEWEX (the WCRP Global Energy and Water Cycle Experiment).

2. Carbon Dioxide Gas Exchange on Gyre-Global Scale. The design of a plan to acquire a global oceanic data set, including pCO_2 , total CO_2 , and alkalinity was addressed as an important international priority. The Committee has proposed to JGOFS that the joint JGOFS-CCCO Carbon Dioxide Panel address this matter through reconstituted terms of reference and membership.

3. Review of IPCC Working Group-I Report. The Committee established a working group to undertake a review of the relevant ocean related sections of the IPCC WG-I report, including source references, and new material as appropriate. The group will assess the degree to which the report is an accurate and comprehensive summary of current knowledge of ocean dynamics, ocean-atmosphere interaction and ocean chemistry in relation to global climate prediction and change, and propose appropriate action to be undertaken by the CCCO.

4. Fresh Water Budget. More information on the energy and mass exchanges with the ocean surface and the upper ocean transports of heat and salt is required in order to improve our understanding of global energy and water cycles. Ocean general circulation models will need to be developed to assimilate satellite data with in situ surface and subsurface measurements. There is a gap in the availability of observations of heat and freshwater content in the upper ocean which are required to narrow the uncertainty on the surface fluxes and in methods to determine the surface fluxes as constraints on the energy and water cycles. The CCCO officers will address these questions and make recommendations for action by the Committee at its next session.

5. Improving Predictions of Regional Impact of Climate Change on the Coastal Environment. There is a need to encourage further investigation on how a global rise in mean sea level would be manifested in steric heights, and how changes in ocean currents would affect regional sea level. The CCCO Atlantic, Indian and Pacific Ocean Climate Studies Panels have been asked to examine these questions and to report to the CCCO on the feasibility of improving predictions on a regional basis and identifying potential studies toward this end.

6. Control of Thermohaline Circulation. Consideration of the influence of the Arctic Ocean on climate represents a gap in the programmes being conducted within the WCRP. The feasibility of an Arctic experiment regarding the relation between circulation, salinity structure, freezing and melting, and freshwater budget in the Arctic Ocean and the deep water production on the North Atlantic needs to be investigated. The recently formed JSC-CCCO Working Group on Sea-Ice and Climate was requested to

address and present a report at the next meetings of the CCCO and JSC.

There has been considerable collaboration with the JSC on the development of the WCRP. In addition to the formation of CCCO-JSC Ocean Observing System Development Panel noted above, collaborative efforts have resulted in the formation of a joint JSC-CCCO Working Group on Sea-Ice and Climate, organization of the International TOGA Scientific Conference (Hawaii, July 90), the formulation of the JSC-CCCO TOGA Coupled Ocean and Atmosphere Response Experiment (COARE), and in the mutual attendance of Committee meetings.

Committee for the Joint Global Ocean Flux Study

During the past year, the JGOFS Committee focused on three main activities: preparation of the JGOFS Science Plan, the JGOFS North Atlantic Pilot Study, and planning for JGOFS activities in the Pacific Ocean. These goals were successfully achieved as JGOFS planning has proceeded very quickly as evidenced by the fact that the Committee found it necessary to hold two sessions during the period covered by this report.

The International JGOFS Science Plan, which has been approved by the Committee and is about to be published by the SCOR Secretariat, sets out the core scientific problems and detailed objectives for JGOFS and puts forward plans for the research strategies required to advance our understanding of these problems. The plan is also intended to provide a framework within which to develop the international cooperation and collaboration which will be essential is this large set of research problems is to be addressed successfully. Each of the two goals of JGOFS are developed into a series of more detailed scientific objectives which emphasize the scientific questions which need to be resolved to meet these goals.

Goal 1: To determine and understand on a global scale the processes controlling the time-varying fluxes of carbon and associated biogenic elements in the ocean, and to evaluate the related exchanges with the atmosphere, sea floor, and continental boundaries.

Goal 2: To develop a capability to predict on a global scale the response of oceanic biogeochemical processes to anthropogenic perturbations, in particular, those related to climate change.

In order to achieve these goals, the JGOFS plan proposes a five part scientific strategy:

- A sequenced number of process studies to elucidate the processes controlling the carbon cycle in different parts of the world ocean.
- A large scale, global, survey activity using remote sensing plus ship observations on a global set of transects, and a long time series observation programme at key sites, 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,

- A comprehensive study of the historical climatic record by means of biogeochemical sampling of deep-sea and continental shelf sediments, and,
- An international data archiving effort to assimilate and use effectively the vast amount of high quality data that will be obtained during the JGOFS observational period.

The JGOFS Committee has also devoted a great deal of its attention to its first major field programme, the JGOFS North Atlantic Pilot Study, also known as the North Atlantic Bloom Experiment, the first phase of which took place in 1989. The Pilot Study grew out of the fortuitous convergence of plans in five nations for work in the northeast Atlantic during the 1989 field season, and it came to be regarded as a prototype for future JGOFS Process Studies. Its focus was a detailed examination of the development, evolution and decay of the annual phytoplankton bloom and associated phenomena during its northward progression. This study eventually involved six research vessels and more than 250 scientists, as well as a NASA remote sensing aircraft. The benefits of the international cooperation promoted by the JGOFS Committee became obvious as agreements were crafted on a set of core measurements and the related protocols and levels of accuracy to be achieved. This collaboration also made possible extensive intercalibration exercises on several occasions when more than one research vessel was present at the same station. This spirit of cooperation was most evident recently at a JGOFS Pilot Study Data Workshop (Kiel, March 1990) at which about 150 participants shared their data from the 1989 field season and merged them to create truly international data sets for the Study. A mechanism for the submission, archiving and sharing of these data was established.

Finally, the planning for the second JGOFS Process Study, in the equatorial Pacific Ocean in 1991-1992, is now well advanced as a result of a workshop held in Tokyo in April 1990. The equatorial Pacific is the largest single oceanographic province and it has been suggested that this region may supply as much as half of the global new production. The province differs from most oceanic systems in that its interannual variability, which results from its response to the El Niño-Southern Oscillation phenomenon, is greater than its seasonal variability, and appears to dominate the controls on biological fluxes. Similarly, plans are beginning to be made for process studies in the Southern Ocean and the Indian Ocean.

The SCOR Committee for JGOFS at its Fourth Session (Kiel, March 1990) began to translate its International Science Plan into a detailed Implementation Plan. A preliminary schedule of JGOFS Process Studies for the decade was discussed. The first four (the North Atlantic Bloom Experiment, the equatorial Pacific study, the Southern Ocean and the Indian Ocean) have a firm basis in current national plans. The JGOFS Committee has also undertaken to ensure that the JGOFS/WOCE CO₂ global survey is achieved by assuming the responsibility, through the JGOFS/CCCCO CO₂ Panel, for placing JGOFS scientists on the WOCE Hydrographic Programme cruises in accordance with an agreement between the two programmes. The

development of a detailed JGOFS Implementation Plan, however, requires a concerted effort. This will be achieved through a set of strategy-oriented Task Teams on Process Studies, Global Survey, Time Series Stations, Historical Record, Benthic Processes, Modelling and Data Management. It is hoped that this document will be available during the first half of 1991. The Task Teams will subsequently review each component of JGOFS during its implementation to ensure that it continues to meet JGOFS scientific objectives.

The next meeting of SCOR is the XX General Meeting which will take place at the Institut fuer Meereskunde of the GDR Academy of Sciences in Rostock, GDR from October 1 - 3, 1990. Readers are encouraged to refer to SCOR Proceedings, the SCOR Handbook, or to contact the Executive Secretary of SCOR, E. Tidmarsh, for information on SCOR activities. The SCOR Secretariat is located in the Oceanography Department, Dalhousie University, Halifax, N.S., Canada B3H 4J1.

SCOR Subsidiary Bodies as at June 1990

WG 75 Methodologies for Oceanic CO₂ Measurements
 WG 76 Deep Sea Ecology
 WG 77 Laboratory Tests Related to Basic Physical Measurements at Sea
 WG 78 Determination of Photosynthetic Pigments in Seawater
 WG 80 Role of Phase Transfer Processes in the Cycling of Trace Metals in Estuaries
 WG 82 Polar Deep Sea Palaeoenvironments
 WG 83 Wave Modelling
 WG 84 Hydrothermal Emanations at Plate Boundaries
 WG 85 Experimental Ecosystems
 WG 86 Sea Ice Ecology
 WG 89 Sea Level and Erosion of the World's Coastlines
 WG 90 Chemical and Biological Oceanographic Sensor Technology
 WG 91 Chemical Evolution and Origin of Life in Marine Hydrothermal Systems
 WG 92 Ocean/Atmosphere Palaeochemistry
 WG 93 Pelagic Biogeography
 CCCO Joint SCOR/IOC Committee on Climatic Changes and the Ocean
 JGOFS Committee for the Joint Global Ocean Flux Study
 JPOTS SCOR/UNESCO/ICES/IAPSO Joint Panel on Oceanographic Tables and Standards
 Editorial Panel for the Ocean Modelling Newsletter