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(of Unesco)

SCIENTIFIC ADVISORY BOARD

PROGRESS REPORT

on the

Review of ongoing and possible future programmes

of the Commission contributing to

Ocean Climate Studies

This document was adopted at the fourth session of the Scientific Advisory Board (SAB-IV), Unesco, Paris, 26-30 March 1979. It highlights the considerations and conclusions of the Board on suggested investigations on the problem of climatic changes and variability, undertaken by a Task Team of Board Members with Professor E. Seibold (discussion leader), Dr. E. O. Tan, Dr. A. Ramirez-Flores, Dr. A. R. Bayoumi and Dr. V. Kort.

Review of ongoing and possible future programmes of the Commission contributing to Ocean Climate Studies

Introduction

The first meeting of the IOC Working Group on the Future Role and Functions of the Commission (FUROF-I, FAO, 12-15 June 1978) requested the Scientific Committee on Oceanic Research (SCOR) to continue investigating the various aspects of research into "climatic changes in the ocean and their global impact", and to advise the Working Group on the possible role for the Commission to play, and that the Scientific Advisory Baord (SAB) be requested to review the ongoing and possible future programmes of the Commission in order to determine how these programmes of the Commission can contribute to ocean climate studies. The Working Group felt that SCOR and SAB could work closely on this item and report as fully as possible to the second session. In any event their findings should be considered at the eleventh session of the Assembly (Paris, 24 October - 2 November 1979).

Up to now an integrated IOC programme of "Ocean research and related services for investigations on the problem of climatic changes and variability" does not exist. Nevertheless SAB feels it should make a scientific stock-taking of results to hand, and provide recommendations for the Commission to undertake in this highly complex, global and multi-disciplinary scientific field.

A number of conferences, working group meetings and other activities mentioned in the Appendix dealt with several aspects of these problems. In the following paragraphs an attempt has been made to summarize these activities.

The Problem

Primarily climate research is concerned with the atmosphere but the ocean as the biggest solar heat and water reservoir on earth, interacts strongly with the air above it. Air mass movements, heat transport by currents, evaporation, precipation, distribution and amount of gases such as CO_2, and other processes and factors are influenced by this interaction. Furthermore, changes and variations in the atmosphere are buffered by the ocean's longer reaction times.

"Oceanic" climate changes have occurred and will occur over decades or longer periods. Climatic variability refers to monthly, seasonal and annual anomalies of surface temperatures, ice cover, sea level, currents, depth of thermoclines and other parameters. So climatic research is important and may elucidate:

- a better understanding of fundamental processes like the atmosphere and oceanic circulation or the solar heat budget of our earth;

- a better understanding not only of presently occurring changes and variabilities - within months, years and decades - but also of variations from past centuries to millions of years ago and, hopefully, of future events. One of the intriguing unsolved problems is quasi-periodicities of several years to several 10,000 years. Naturally, variability within weeks and decades has first priority for planning, development and management;

- Natural variations against impacts of human activities may be identified. The increase of CO_2 in the atmosphere is an outstanding example;

- Finally, climatic research may give us tools to limit the extremes of climatic changes and their consequences such as, for example, the extent of polar ice, sea level changes, physical oceanographic variations and their effects e.g. on living resources in the oceans.

Applications of climatic research results on land are obvious and especially important in areas bordering arid zones. Possible predictions of oceanic climate variability will influence fisheries, such as in the "El Niño" area off South America or ship's traffic, particularly in high latitudes with sea-ice occurrences. Understanding of trends in mean sea level changes will be necessary for coastal management.

In order to improve understanding of oceanic climate variability climate models with different scales in time and space, and extensive time series of observations both in the atmosphere and within the ocean system and at its boundaries are needed.

Measurements are the bases for the verification of numerical models, but models can guide and improve the planning of further observations. These observations can then be used to test and improve the models.

Both of these areas of feedback are tremendous challenges for scientists:

i) Long time-series observation seem not to be very attractive to the working scientists and to most funding agencies. Therefore, it will be a challenge to develop instruments working independently for a year or longer. The storage, handling, distribution and evaluation of large amounts of data from all over the earth is a similar methodological problem.

ii) Modelling has to be improved substantially. The amplitudes of variations, for example, seem to increase with time. Therefore the effects of these variations may become more and more important for mankind, too.

iii) We cannot wait for decades or centuries to evaluate observation series beginning today. We have partly to use historical data sets including annual information from tree rings or corals and we urgently have to improve the quantitative evaluation of geological records as stored in annual layers of some marine and lake sediments. We further have to study in more detail the dramatic situations of the past, particularly in respect to the marine environment, such as the general warming some 5,000 years ago together with a nearly complete shrinking of deserts or the general cooling about 18,000 years ago with hugh ice accumulations in higher latitudes and mountains and their consequences for global sea level changes. The last interglacial with its transitional phases to the last glacial may be the key for the understanding of the world's future climate, hopefully *far* in the future.

iv) We should not forget, however, that the solution of many of these problems depends on a better understanding of some fundamental relationships, processes and causes. Only then will we be successful with prediction.

Many basic processes are open for discussion such as variations of solar activity and their relations with climates, the oceanic heat transport between the hemispheres, the vertical mixing on different scales, the effects of different aerosols on radiation, or the fact that many of the ocean's most significant effects occur in relatively small areas, or in thin bands: ice margins, coastal upwelling, boundary currents, ocean fronts or eddies of different scales.

Recommendations

SCOR should be encouraged and get increased support from IOC and other bodies to give high priority to the work of the Committee on Climate Changes and the Ocean (CCCO) for the definition of a scientific programme of "ocean research and climatic changes and variability". We are pleased that CCCO consists of oceanographers including marine biologists and geologists together with meteorologists and climatologists. The group should, taking into account that this is a long-term programme exceeding the activities of normal working groups, discuss the existing related working groups, regional and global programmes. In our opinion IOC needs advice on:

i) Definition of a minimum of few standard parameters in different water depths for repeated and long-term measurements including data from marine biology and fisheries for in the beginning pragmatism may be more helpful than perfectionism.

ii) The location and frequency of time series of oceanographic sections so that IOC can design possibly within existing programmes various ocean monitoring schemes using ships including commercial ones (*"Phantom Weather Ship Networks"*), ocean buoys and satellites.

iii) Development of automated measurement systems.

iv) Definition of "crucial areas" with important gaps as in the southern hemisphere or for the understanding of some of the fundamental processes, or for most obvious consequences of climatic changes for man, etc. This will be a prerequisite for the development of a measurement network strategy.

v) Improvement and use of ocean and ocean-atmosphere interaction models.

vi) Quantitative evaluation of historical, biological and geological data sets.

IOC should continue to:

a) develop the Global Ocean Data Inventory (as an input to the Marine Environment Data Information Referral System (MEDI)), including long-term series with conventional oceanographic and climatological data together with relevant geological and biological data. The data must be quality controlled and physically and internationally compatible. It is noted that this inventory plus the Global Ocean Climate Base referred to below are activities of the Responsible National Oceanographic Data Centre-First GARP Global Experiment (FGGE) Operational Year (RNODC-FOY). The possible continuation of RNODC-FOY activities should be explored;

b) develop the Integrated Global Ocean Station System (IGOSS) with substantially more input from Member States in climate sensitive regions, e.g. "El Niño" and the IOC Working Group for the Western Pacific (WESTPAC);

c) develop a Global Ocean Climate Data Base in which mean sea level data is included;

d) encourage through Training, Education and Mutual Assistance in the marine sciences (TEMA) long-term systematic measurements with permanent stations off developing countries as a part of new responsibilities foreseen from the United Nations Law of the Sea Conferences; and,

e) discuss whether some of these activities need international Conventions between the States. For example, because of the long-term and global aspects, an International Data Board could be formed within the Working Committee on International Oceanographic Data Exchange (IODE) with real responsibilities for different countries using the experiences from the World Meteorological Organization (WMO) climatological summary reports and other similar activities.

APPENDIX

Background Material for the Board's
Discussion on Contributions to Ocean Climate Studies

1. Second objective of GARP in the Global Atmospheric Research Programme (GARP), in IOC Technical series N° 17 (Unesco 1977)

2. SCOR WG 48 Report of the Panel on Monitoring Ocean Climate Fluctuation (ICSU/WMO GARP, Geneva 1977)

3. General Circulation Models of the Ocean and their relation to Climate Extract from the Report of the Study Conference organized by the GARP Joint Organizing Committee and the Scientific Committee on Oceanic Research (Helsinki, 23-27 May 1977)

4. Report of the WMO Scientific Workshop on Atmospheric Carbon Dioxide (Washington DC, 28 November - 3 December 1976), prepared in co-operation with UNEP (WMO Publication N° 474, Geneva, 1977).

5. Letter from the Secretary SCOR dated 14 December 1977 summarizing SCOR Working Group activities related to climate problems

6. Summary Report on the first session of the IOC Working Group on the Future Role and Functions of the Commission (FUROF-I, FAO, Rome, 12-15 June 1978) (doc. IOC/WG-FUROF-I/3).

7. Proposals on the Organization of International Investigations of the Interaction between the Ocean and the Atmosphere (Submitted by the USSR Delegation) (doc. IOC/EC-X/21 dated June 1977).

8. Oceanographic Aspects of the First GARP Global Experiment (FGGE) (doc. IOC/INF-351, Unesco, November 1978).

9. Report of the JOC/SCOR Specialists Meeting on the Role of the Ocean in the Global Heat Budget (Kiel, 6-8 November 1978).

10. Summary Report of the first session of the Joint IOC-WMO-CPPS Working Group on the Investigations of "El Nino" (Callao, Lima, Peru, 16-20 October 1978) (doc. IOC-WMO-CPPS/EL NINO-I/3 dated January 1979).

11. Summary Report of the IOC Workshop on the Western Pacific (Tokyo, Japan, 19-20 February 1979) (doc. IOC Workshop Report N° 16 dated February 1979).

12. Report on IOC activities related to the Study of Climate submitted to the fifteenth session of the ICSU/WMO Joint Organizing Committee for GARP (Dubrovnik, Yugoslavia, 28 February - 6 March 1969).

13. SCOR Report to the Commission at the eleventh session of the IOC Executive Council (Mexico City, 26 February - 3 March 1979) (doc. IOC/EC-XI/7).