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SUMMARY REPORT OF THE IOC/SCOR/ECOR CONSULTATIVE MEETING ON DRIFTING BUOYS PROGRAMMES

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The Joint IOC/SCOR/ECOR consultative meeting on Drifting Buoy Programmes was held in London from 6-7 April 1981 under the chairmanship of Dr. J. Garrett, Chairman of SCOR Working Group 66. The list of participants is attached as Annex I.

The Session took place in the building of the British Committee for ECOR and was opened on 6 April 1981 at 10.00 a.m. In his opening remarks, the Chairman thanked ECOR for hosting this meeting and for the facilities provided. The Chairman of the meeting described also the events which led to the organization of the meeting and referred to the recommendations and resolutions of IOC, WMO, SCOR governing and consultative bodies relevant to this affair. The summary of the aforementioned recommendations is attached (Annex II).

The meeting adopted the provisional agenda without changes (Annex 3).

Introduction

The development and application of drifting buoys, as well as other related systems, will require an unprecedented teamwork among scientists, engineers, and programme officials in the years to come. Co-ordination of funding, new and re-vitalized international mechanisms, and the use of the best available technical expertise must be combined to make the endeavour a successful one.

The meeting agreed that selected technical aspects of planning and design of drifting buoy systems could well be enhanced by a modest, but broadly based, ocean engineering input. Recommendation 1 in this respect was adopted.

1. Probable applications for drifting buoys in the near future: review foreseen activities in which drifting buoys are planned for a major role

The participants of the meeting agreed that recent years have seen drifting buoy technology developed and demonstrated to a remarkable extent: small expendable units with simple sensors have survived severe ocean environments for periods of a year and more, successful satellite positioning and data retrieval have become routine, and functional arrays of buoys have had a measurable impact as a unique source of marine weather data. In the oceanographic arena, drifting buoys have established a widely accepted potential for significant contributions. However, the currently demonstrated oceanographic capability falls far short of this promise. In order to focus attention on the spectrum of scientific and operational problems for which drifters may be an effective tool, the meeting formulated an overview of probable applications. These applications fall into four general categories:

i) Process-oriented oceanographic research. Examples of on-going and planned studies include PEQUOD, circulation experiments in the Southern Ocean and the North Atlantic, ice experiments in regions of active formation, and a broadening ocean-atmosphere research programme in the Pacific;

ii) Localized, site-specific uses for a variety of operational purposes. These include monitoring of surface and sub-surface motion of contaminants (such as oil spills), wave and weather observations at emergency sites (oil spills, search and rescue, etc.), and tracking of ice motions in areas of potential threat.

iii) Large-scale arrays for ocean climate research and monitoring. These applications will occur in two ways, at first somewhat distinct, but increasingly convergent as knowledge of the climate system increases.

a) Throughout the 1980s, major ocean process experiments will be increasingly co-ordinated into large studies with significant atmospheric components (CAGE or GINSCAGE, for example) linked, in part, by broad coverage of parameters such as wind stress and sea surface topography from satellites. Drifters are seen as having significant potential in these studies, provided a new generation of buoys, specialized for this purpose, can be developed.

b) In some oceanographic problems critical to climate, a long-term monitoring activity is beginning to develop in parallel with process studies. Long-term observations of the tropical and sub-tropical Pacific Ocean heat content (upper) is one example. Drifters are believed to be a realistic option for augmenting data obtained from satellites and ships-of-opportunity in such programmes.

iv) The modification (add-on) of simple meteorological arrays. As an international programme to exploit FGGE buoy technology for weather prediction develops, the resulting arrays could be of significant value for ocean monitoring if their observational capability can be significantly improved. Clearly, significant new developments in sensor systems, air deployment, etc. will be needed before this can be done.

Several types of new systems will be required for these applications to be realized. They will require more than one configuration of surface float/satellite tracked drifter to provide observations of:

- parameters related to air-sea mass and heat fluxes
- upper layer ocean dynamics (currents) with varying temporal and spatial resolution, depending upon the applications
- the thermal structure of the ocean mixed layer
- parameters contributing to satellite determinations of wind stress fields (direct wind observations, ambient acoustic noise, etc.).

At least one configuration of subsurface float will be needed, possibly combining acoustic range and satellite tracking techniques. These floats will provide information on deep processes such as meso-scale eddies and will contribute knowledge on the general ocean circulation.

The Group considered two additional aspects of drifting buoy applications to be worth particular emphasis. Cost of systems will be a major factor in their uses described above. This cost includes both the direct cost of the buoy and sensor system, which varies according to the number of parameters measured and the complexity of on-board data processing, and the costs associated with the operation of the tracking and data recovery system. At the present time, these latter costs exceed the initial purchase price of simple current-following drifting buoys when calculated over the typical life of such buoys and present a considerable obstacle to the expanded use of drifting buoys. Secondly, the meeting emphasized that drifters will realize their true potential when used in concert with other systems, particularly satellite based sensing. Wind stress determination, global precipitation estimates, and atmospheric temperature sounding (surface pressure) are examples of observational problems that must ultimately be resolved via satellite, but where drifters may play a helpful role.

2. Capabilities of SCOR WG-66: Review terms of reference and possibilities of this Group

The Chairman of the meeting, Dr. J. Garrett, and the Assistant Secretary of IOC, Dr. I. Oliounine, summarized the information on the background of organizing SCOR WG-66. At the joint IOC/WMO Informal Planning Meeting on Drifting Buoy Programmes held at WMO, Geneva, in December 1979, it was recognized that the development and understanding of oceanographic capabilities of drifting buoys was not as advanced as was the case for their meteorological capabilities. One of the recommendations of this meeting was that an oceanographic group of experts be established to exchange information and to uncover and highlight needs for research and development. Partly as a result of this recommendation, the SCOR Executive Council decided at its meeting in early 1980 to investigate the establishment of such a group. Other contributing factors were the resolution of the governing bodies of IOC (Resolution IOC EC-XIII.10) and discussions held at the 32nd Session of the WMO EC encouraging increased efforts on drifting buoys, as shown in Annex II. On the basis of an informal survey of some of the oceanographers active in the use of drifting buoys, SCOR WG-66 on the Oceanographic Applications of Drifting Buoys was approved at the SCOR General Meeting in September 1980.

The terms of reference and membership of this committee were reviewed and are found in Annex IV.

It was noted by the meeting that SCOR working groups often suggest changes in their own terms of reference, and that significant contributions are frequently made by persons who are not formally members of the working group. Therefore, the terms of reference and membership should not be reviewed as restricting the activities of the group.

The preliminary plan of work proposed for the SCOR WG-66 was outlined by the Chairman of the meeting. It involves three main objectives:

1) Compilation of annotated bibliographies and historical reviews listing published and unpublished reports and containing brief summaries of unreported work on two major aspects of drifting buoys and lists of institutions and individuals working on drifting buoys:

   a) Technical developments, including performance and reliability of buoys, drogues, and sensors

   b) Scientific applications of drifting buoys during the last 10 years, including techniques of interpretation of Lagrangian data

2) Preparation of topical reviews consisting of collections of short articles presenting the ideas of different workers on important problems. Topics proposed so far include:

   a) What can be deduced about ocean currents from buoy drifts in the presence of waves and wind?

   b) What methods of displaying, analyzing, and interpreting Langrangian drifter data can be utilized?

3) Review of potential oceanographic and meterological applications of drifting buoys, for the purpose of assessing technological and organizational needs. These will include projects already planned, for which the technical basis is presumably already assured but which may have needs for organizational or administrative help, as well as more forward-looking ideas which may require development of new or improved techniques. The question of desirable characteristics for future systems for collecting buoy data and tracking buoys will also be addressed.

Although the plan of work is not organized in the same way as the terms of reference, the results produced are expected to satisfy the needs expressed in these terms. The meeting agreed that this plan can be expected to evolve as work progresses. The present idea is to make each of the bibliographies and topical reviews produced under a and b available as soon as it is completed without writing for a final complete report.

Because of the potential value of the reports and the reviews and bibliographies planned in particular, it might be helpful if an agency such as IOC were to arrange for this publication and distribution to a wider group than would otherwise receive them.

The background and interests of the WG members are such that the group's reports can be expected to be highly technical and detailed. Although there is a need for a more general introduction to the capabilities of drifting buoys and the experience which has been gained with their use, it is probably unrealistic to expect it to be provided by this group. One way of preparing such information would be for some agency to engage a consultant who could draw on materials available as a result of FGGE and from WG 66.

The role of the SCOR WG 66 was clarified during subsequent discussion. This WG should not be expected to plan or coordinate any major international programs, although its reports will be intended for use in planning such programs and some of its members may be participants. The members of the WG might however wish to organize or recommend experiments related to drifting buoy techniques if they felt such experiments to be necessary and appropriate.

The meeting determined also to underscore the supportive role which ECOR should play in the evaluation and advisory aspects of an internationally coordinated drifting buoy program and recommends that ECOR be encouraged to seek the proper technical talent and forge an effective liaison with SCOR working group 66 and IOC in order to add a valuable new dimension to the development process. In particular, ECOR may wish to:

1) Provide technical assistance as requested, in the performance of tasks i, ii, iii, of the SCOR WG 66 terms of reference, leaving the scientific research/applications (iv, v, vi) aspects to the WG above

2) encourage and assist the transfer of technology developed for research programs to operational programs --- on an international basis

3) broaden the consideration of drifting buoy applications to include their potential in site surveys (broad area) for offshore structures design, fisheries engineering development, and commercial ship routing

4) cooperate in providing information on the maritime safety and identification aspects of operational drifter arrays, and

5) assist in the formation of operational field procedures needed in both the development and utilization of the new techniques.

In view of the fact that planning of several large-scale programs is already in its preliminary stages the meeting decided that the work of the working groups of SCOR, ECOR, with the assistance of IOC will have maximum value if it is available fairly soon. In any case, some sort of report is required for the IOC General Assembly, currently scheduled for April 1982. Since the activities of the group are only just starting or plan to be started, the meeting agreed that it was not possible to be very precise about its timetable. However, significant progress should be possible within 12 months, and efforts will be made to finish the present work plan before August 1982.

3. Other items: identify needs not met by SCOR WG 66 and possible mechanisms for meeting them.

The meeting came to an agreement that there is a need for timely exchange of information on programs now underway or planned which are being carried out by individual agencies. As an example of the type of problem

which might be avoided by better exchanges of information, FGGE type buoys using system Argos have been released on one side of an ocean in an area of local interest/with subsequent termination of tracking when the buoys drifted out of the local area of interest. The tracking of these buoys might have been continued by interested agencies or the other side of the ocean had they known of them. This situation could be improved if there were a central point of which information on deployments and plans could be collected, published, and distributed at intervals frequent enough and with sufficient lead time for such situations to be exploited.

Suggestions were made that ICES could perhaps take on this task in the North Atlantic or that IOC could add such information as an annex to present IOC/WMO bulletins. In view of the fast turn around time required and the importance of such information to the drifting buoy users. The meeting felt that special quasi-operational mechanisms should be developed for this purpose (recommendation 2).

This aspect was viewed by the participants as particularly necessary during the developmental phases of drifting buoys since failures must be expected and the recovery of buoys to determine causes of failures becomes extremely important.

The meeting addressed the recovery of buoys and whether in fact it was still appropriate to consider as expendable buoys, such as the FGGE type, with considerable built in technology. There is now evidence that recovery of such buoys in limited but large oceanic areas is economically feasible. Success depends upon recovery vessels receiving real-time buoy position, so that it is then possible to home-in on the buoy-satellite transmissions or special radiobeacons which may have been attached to the buoy. If drifting buoys are no longer considered expendable, but recoverable, then the recovery operation should be considered when planning the logistics of proposed programs. The great advantages of recovery buoys to check on their performance and physical conditions is obvious. Recovery is likely to become increasingly desirable as buoys become more sophisticated and costly, as will be the case if they are equipped with thermistor chains or wave-measuring devices. Recovery rates can be increased through bilateral and international cooperation (recommendation 3).

Another need identified was that of a "satellite users' club", the purpose of which would be to permit those drifting buoy agencies or groups who use satellite telemetry systems to take advantage of the reduced rates offered by satellite agencies to users with large numbers of platforms, by grouping together (recommendation 4).

The question was raised as to whether the SCOR WG 66 would investigate new satellite capabilities in view of limited life of present systems, replacement schedules, and developing technology. The conclusion of the meeting was that existing connections between SCOR, COSPAR, and WMO could be exploited to exchange information between buoy users and the satellite developers (recommendation 5).

The meeting showed concern on the preparation and dissemination of technical information on drifting buoys and examined the possibilities of improving it. Such information should be made available to engineering companies in order to advise them of the standards required for drifting buoys and to allow them to develop improved performance. Further, such

information is of value to potential users. In parallel with these basically engineering data, documentation should be provided on overall buoy performance. Relevant to that discussion recommedation 6 was adopted.

The participants of the meeting paid much attention to possible implications of the widespread use of drifting buoys on the possibility of increasing numbers of encounters between buoys and ships or other marine traffic, potentially resulting in damage to both. The meeting discussed the question of whether and how this problem should be brought to the attention of the appropriate international bodies. In particular, it would be helpful to obtain information as to what size or mass a buoy must have to be considered a navigational hazard. Several aspects of the problem of collision avoidance were discussed. During the Global Weather Experiment, the WMO distributed a pamphlet on FGGE buoys to port meteorological officers describing how to identify FGGE buoys and their purpose. The pamphlet included a request to report their position if sighted, thus adding a positive aspect to a buoy sighting. The questions of salvage rights, awards, marking, and safety are beyond the capabilities of SCOR, ECOR groups and should be examined by bodies such as IOC. Recommendation 7 was adopted.

Closure of the Meeting

The chairman thanked all participants for their constructive and cooperative work during the meeting as a result of which it had been possible to deal with some difficult questions and to adopt the whole of the summary report. The meeting was closed at 1730 on Tuesday, 7 April 1981.

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Conclusions and Recommendations

1. One conclusion of the meeting was that each of the agencies involved could contribute in a definite and specific way. SCOR clearly has the best possibilities for dealing with questions relating to scientific applications of drifting buoys and the scientific basis for measurements made using this technique. ECOR has the potential to involve the industrial sector, both from the point of view of determining the needs of the engineering community and the point of view of bringing scientific needs for improved buoys and sensors to the attention of engineers. The intergovernmental agencies, such as IOC and WMO, offer the capabilities for organizing and coordinating the international aspects of the applications of drifting buoys to oceanographical and meteorological problems.

2. In view of the needs for exchange of timely information on buoy deployments, possible drift of buoys into regions of interest to agencies other than the deployer, and possible assistance with buoy recovery, the meeting recommended that the establishment of a small, quasi-operational buoy information center at an oceanographic laboratory or within the secretariats of IOC, WMO should be investigated.

3. Now that practical ways of recovering satellite-tracked drifting buoys are becoming available, which will lead to an increasing interest in buoy recoveries, particularly in the case of experimental systems, the meeting recommended that IOC, SCOR, and WMO remind all groups involved in planning programs using drifting buoys that recovery plans should be included from the beginning and that such groups can not always expect to rely on the generosity of other agencies downstream of their experimental area without having consulted such agencies during the planning of the experiment.

4. Taking into account the evolution of drifting buoy techniques and the increasing number of buoys being used for scientific purposes, together with the multinational nature of many projects now being planned, the meeting suggested that the idea of an "Argos users' club" for the purpose of combining needs to obtain the lower rates associated with large numbers of platforms, should be reexamined. The meeting felt that IGOSS might provide an appropriate framework for this, although other agencies might serve equally well.

5. One of the problems identified by the meeting was that of conveying the requirements and wishes of oceanographers to the groups concerned with designing and planning future satellite systems, as well as helping the oceanographic community to become aware of the technological possibilities under consideration by the satellite developers. It was felt that the existing links between SCOR, COSPAR, and WMO might be useful for this, provided efforts were made to ensure that this area was covered.

6. The transfer of buoy technology among users and between the research and operational communities needs to be improved. It was felt that ECOR might be able to play a significant role in this. One recommendation of the meeting was that general documentation for the information of potential buoy users should be prepared, perhaps using a consultant employed by IOC or WMO.

7. The meeting took note of the potential problems associated with encounters between drifting buoys and other marine vehicles. It was felt that it would be helpful if IOC could consult with appropriate international bodies to obtain information on the relationship between size of floating bodies and the degree of navigational hazards they might pose.

8. Taking into account the different objectives and capabilities of the various agencies currently involved with drifting buoys, such as SCOR, IOC, IGOSS, WMO, and ECOR, it was felt that occasional informal consultative meetings, such as organized in London, would be of great value in discovering areas of common interest where cooperation or coordination might be beneficial.

AGENDA

1. Probable applications for drifting buoys in near future: review foreseen activities in which drifting buoys are planned for a major role.

2. Capabilities of SCOR WG 66: review terms of reference and possibilities of this Group.

3. Other items: identify needs not met by SCOR WG 66 and possible mechanisms for meeting them.

WG-66 - OCEANOGRAPHIC APPLICATIONS OF DRIFTING BUOYS

Terms of reference:

i) To review and summarize the existing technological knowledge on drifting buoys

ii) To identify the technological problems needing further investigations, in the laboratory as well as at sea, and the oceanographic institutions willing to work on them

iii) To advise on the standardization of buoy and sensor characteristics in order to obtain comparable measurements under the conditions experienced at sea

iv) To review and summarize the oceanographic results obtained with the drifting buoys method since circa 1972

v) To advise on the best ways of using this method for the study of oceanic surface circulation on meso and planetary scales (i.e. density of horizontal distribution of the buoys etc...)

vi) To advise on regions of the world ocean where drifting data are most needed to supplement observations of other types.

Membership:

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