Intergovernmental Oceanographic Commission
Reports of Meetings of Experts and Equivalent Bodies

JOINT SCIENTIFIC COMMITTEE

JSC Ocean Observing System Development Panel (OOSDP)

Seventh Session

Lisbon, Portugal, 19-23 April 1993

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In this Series, entitled

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

1. Third Meeting of the Central Editorial Board for the Geological/Geophysical Atlases of the Atlantic and Pacific Oceans
2. Fourth Meeting of the Central Editorial Board for the Geological/Geophysical Atlases of the Atlantic and Pacific Oceans
3. Fourth Session of the Joint IOC-WMO-CPPS Working Group on the Investigations of 'El Niño' *(Also printed in Spanish)*
4. First Session of the IOC-FAO Guiding Group of Experts on the Programme of Ocean Science in Relation to Living Resources
5. First Session of the IOC-UN(OETB) Guiding Group of Experts on the Programme of Ocean Science in Relation to Non-Living Resources
6. First Session of the Editorial Board for the International Bathymetric Chart of the Mediterranean and Overlay Sheets
7. First Session of the Joint CCOP(SOPAC)-IOC Working Group on South Pacific Tectonics and Resources
8. First Session of the IODE Group of Experts on Marine Information Management
9. Tenth Session of the Joint CCOP-IOC Working Group on Post-IDOE Studies in East Asian Tectonics and Resources
10. Sixth Session of the IOC-UNEP Group of Experts on Methods, Standards and Intercalibration
11. First Session of the IOC Consultative Group on Ocean Mapping *(Also printed in French and Spanish)*
12. Joint IOC-WMO Meeting for Implementation of IGOSS XBT Ships-of-Opportunity Programmes
13. Second Session of the Joint CCOP/SOPAC-IOC Working Group on South Pacific Tectonics and Resources
14. Third Session of the Group of Experts on Format Development
15. Eleventh Session of the Joint CCOP-IOC Working Group on Post-IDOE Studies of South-East Asian Tectonics and Resources
16. Second Session of the IOC Editorial Board for the International Bathymetric Chart of the Mediterranean and Overlay Sheets
17. Seventh Session of the IOC-UNEP Group of Experts on Methods, Standards and Intercalibration
18. Second Session of the IOC Group of Experts on Effects of Pollutants
19. Primera Reunión del Comité Editorial de la COI para la Carta Batimétrica Internacional del Mar Caribe y Parte del Océano Pacífico frente a Centroamérica *(Spanish only)*
20. Third Session of the Joint CCOP/SOPAC-IOC Working Group on South Pacific Tectonics and Resources
21. Twelfth Session of the Joint CCOP-IOC Working Group on Post-IDOE Studies of South-East Asian Tectonics and Resources
22. Second Session of the IODE Group of Experts on Marine Information Management
23. First Session of the IOC Group of Experts on Marine Geology and Geophysics in the Western Pacific
24. Second Session of the IOC-UN(OETB) Guiding Group of Experts on the Programme of Ocean Science in Relation to Non-Living Resources *(Also printed in French and Spanish)*
25. Third Session of the IOC Group of Experts on Effects of Pollutants
26. Eighth Session of the IOC-UNEP Group of Experts on Methods, Standards and Intercalibration
27. Eleventh Session of the Joint IOC-IHO Guiding Committee for the General Bathymetric Chart of the Oceans *(Also printed in French)*
28. Second Session of the IOC-FAO Guiding Group of Experts on the Programme of Ocean Science in Relation to Living Resources
29. First Session of the IOC-IAEA-UNEP Group of Experts on Standards and Reference Materials
30. First Session of the IOCARIBE Group of Experts on Recruitment in Tropical Coastal Demersal Communities *(Also printed in Spanish)*
31. Second IOC-WMO Meeting for Implementation of IGOSS XBT Ship-of-Opportunity Programmes
32. Thirteenth Session of the Joint CCOP-IOC Working Group on Post-IDOE Studies of East Asia Tectonics and Resources
33. Second Session of the IOC Task Team on the Global Sea-Level Observing System
34. Third Session of the IOC Editorial Board for the International Bathymetric Chart of the Mediterranean and Overlay Sheets
35. Fourth Session of the IOC-UNEP-IMO Group of Experts on Effects of Pollutants
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40. Fourteenth Session of the Joint CCOP-IOC Working Group on Post IDOE Studies of East Asian Tectonics and Resources
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45. Ninth Session of the IOC-UNEP Group of Experts on Methods, Standards and Intercalibration
46. Second Session of the IOC Editorial Board for the International Bathymetric Chart of the Caribbean Sea and the Gulf of Mexico
47. First Session of the IOC Editorial Board for the International Bathymetric Chart of the Western Indian Ocean
48. Twelfth Session of the Joint IOC-IHO Guiding Committee for the General Bathymetric Chart of the Oceans
49. Fifteenth Session of the Joint CCOP-IOC Working Group on Post-IDOE Studies of East Asian Tectonics and Resources
50. Third Joint IOC-WMO Meeting for Implementation of IGOSS XBT Ship-of-Opportunity Programmes
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52. Fourth Session of the IOC Editorial Board for the International Bathymetric Chart of the Mediterranean
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54. Third Session of the IOC Editorial Board for the International Bathymetric Chart of the Caribbean Sea and the Gulf of Mexico *(Also printed in Spanish)*
55. Fifth Session of the IOC-UNEP-IMO Group of Experts on Effects of Pollutants
56. Second Session of the IOC Editorial Board for the International Bathymetric Chart of the Western Indian Ocean
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59. Second Session of the IOC-WMO/IGOSS Group of Experts on Operations and Technical Applications
60. Second Session of the IOC Group of Experts on the Global Sea-Level Observing System
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62. Third Session of the IOC-FAO Group of Experts on the Programme of Ocean Science in Relation to Living Resources
63. Second Session of the IOC-IAEA-UNEP Group of Experts on Standards and Reference Materials
64. Joint Meeting of the Group of Experts on Pollutants and the Group of Experts on Methods, Standards and Intercalibration
65. First Meeting of the Working Group on Oceanographic Co-operation in the ROPME Sea Area
66. Fifth Session of the Editorial Board for the International Bathymetric and its Geological/Geophysical Series
67. Thirteenth Session of the IOC-IHO Joint Guiding Committee for the General Bathymetric Chart of the Oceans *(Also printed in French)*
68. International Meeting of Scientific and Technical Experts on Climate Change and Oceans
69. UNEP-IOC-WMO-IUCN Meeting of Experts on a Long-Term Global Monitoring System
70. Fourth Joint IOC-WMO Meeting for Implementation of IGOSS XBT Ship-of-Opportunity Programmes
71. ROPME-IOC Meeting of the Steering Committee on Oceanographic Co-operation in the ROPME Sea Area
72. Seventh Session of the Joint IOC-WMO-CPPS Working Group on the Investigations of 'El Niño' *(Spanish only)*
73. Fourth Session of the IOC Editorial Board for the International Bathymetric Chart of the Caribbean Sea and the Gulf of Mexico *(Also printed in Spanish)*
74. UNEP-IOC-ASPEI Global Task Team on the Implications of Climate Change on Coral Reefs
75. Third Session of the IODE Group of Experts on Marine Information Management
76. Fifth Session of the IODE Group of Experts on Technical Aspects of Data Exchange
77. ROPME-IOC Meeting of the Steering Committee for the Integrated Project Plan for the Coastal and Marine Environment of the ROPME Sea Area
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This report is a continuation of the series of OOSDP Meeting Reports I through VI that were previously published under a Committee on Climatic Changes and the Ocean (CCCO) cover. Until 31 December 1992 the OOSDP was a joint body of the ICSU-WMO Joint Scientific Committee (JSC) and the SCOR-IOC CCCO. With the agreement of IOC to become a co-sponsor of the WCRP, the activities of the CCCO were subsumed by the JSC including sole oversight of the OOSDP.

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SUMMARY REPORT

ANNEXES

1. WELCOMING REMARKS

1 The seventh session of the IOC-JSC Ocean Observing System Development Panel (OOSDP) was held 20-23 April 1993, in the Sala de Conselho, Biblioteca Geral of the Faculty of Science of the University of Lisbon, Portugal. The meeting was hosted by Professor Armando Fiuza of the Oceanography Group, Physics Department, who welcomed the participants. Chairman Worth Nowlin thanked Professor Fiuza on behalf of the Panel and expressed admiration for the richly furnished ancient meeting room with its impressive collection of very old as well as the most up-to-date books and journals. The scholarly ambiance was conducive to a productive meeting.

2 Participants were Panel members Liliane Merlivat, Worth Nowlin, Neville Smith, Peter Taylor, Masaaki Wakatsuchi, and Robert Weller; liaison members Michael McPhaden (TOGA), George Needler (WOCE), and Alain Vezina (JGOFS); invited guests Jacques Merle (GCOS), Pierre Morel (WCRP), and Armando Fiuza (University of Lisbon); and IOC Secretariat representative Arthur Alexiou. The list of attendees with their addresses is given as Annex II.

2. REVIEW AND ADOPTION OF THE AGENDA; WORKING DOCUMENTS

3 Nowlin remarked that the main objective of this session would be to arrive at decisions on what must be done in the next few meetings to complete the work of the Panel and to finish the Final Report. A secondary objective was to prepare a response to the request from Thomas Spence, Director of the GCOS Joint Planning Office for a critique of the GCOS Draft Plan. Nowlin distributed several working documents and copies of correspondence from S. Tsunogai underscoring the need for more ocean time-series stations. Panel members were then invited to comment on the provisional agenda. After brief discussion, the Panel adopted the agenda as given in Annex I.

3. REVIEW OF RELATED ACTIVITIES AND PLANS SINCE OOSDP VI

3.1 STATUS OF GCOS PLANNING

4 Nowlin reported briefly on the second GCOS Joint Scientific and Technical Committee (JSTC) meeting held in Washington 11-14 January 1993. That meeting focused on the development of the plan for GCOS. Nowlin stated that the JSTC is looking for implementation and prioritization advice and is open to any views OOSDP might have in this respect. JSTC would also like to arrive at a cost figure for GCOS. In this regard Nowlin believed OOSDP might reconsider whether recommendations made in the Interim Report could be prioritized and costs developed for all or part of the priority items. Discussion pointed out that the Interim Report's categorization of short term recommendations and longer term issues could not be interpreted as being equivalent to priorities. Some observations which may be developed in the longer term may merit higher priority than some observations now recommended for short term implementation. We must begin the observing system with those observations which we feel sure will be needed and for which we can recommend and defend a sampling plan on the basis of what is known now. It was agreed the matter of prioritization and estimates of commensurate resources required would be addressed in the OOSDP Final Report.

5 J. Merle briefed the Panel further on progress in GCOS Planning. He referred to the GCOS Draft Plan, and emphasized the word "Draft". The document was prepared under a very tight time constraint in order to have it ready for the Intergovernmental Meeting of the World Climate Programme, 14-16 April 1993 in Geneva. He reiterated T. Spence's invitation to carefully review the document to address omissions, correct inaccurate statements, and generally strengthen the next version. (Copies of the draft Plan had been made available in April to OOSDP members just prior to the meeting.) Merle underscored Nowlin's earlier remarks regarding JSTC's desire

to seek broad counsel, including the OOSDP, in setting priorities and estimating costs. If such assistance is not received it will have to be done by the few oceanographers available on the GCOS Joint Scientific and Technical Planning Committee. Merle concluded with a word of appreciation for the assistance and cooperation provided by the OOSDP to the GCOS Joint Planning Office (JPO) and JSTC and an offer to provide financial support if needed for future assistance.

3.2 RECENT IOC ACTIONS REGARDING DEVELOPMENT OF GOOS

6 A. Alexiou reviewed several events beginning with the first meeting in February 1993, of the IOC Committee on GOOS (I-GOOS) held just prior to the Seventeenth Session of the Assembly of the IOC. Alexiou had an opportunity to brief the Committee on OOSDP progress; it was well received. The Committee concluded that the OOSDP approach to designing the climate module of GOOS was an excellent example for development of the other modules. Michel Glass (France) was elected Chairman and Grant Gross (USA) and B.N. Krishnamurthy (India) were elected as Vice-Chairmen. Nations were invited to submit National Reports covering steps being taken with regard to GOOS. The observation was made that there was yet no organized body for GCOS equivalent to I-GOOS for co-ordinating intergovernmental implementation efforts.

7 I-GOOS adopted several recommendations which were subsequently accepted by the Assembly in the form of a broad resolution on GOOS (Annex III). Among other things, the resolution instructs the Secretary IOC to hasten the finalization of the Memorandum of Understanding (MOU) on co-sponsorship of a GOOS technical and scientific advisory mechanism by the concerned organizations (expected initially to include IOC, WMO, and ICSU), and to establish Panels for the other GOOS modules with assistance from ICSU and SCOR. The resolution also accepts as an interim report the document on the Health of the Ocean Module prepared by an IOC *ad hoc* Panel, it officially invites WMO and UNEP to become co-sponsors of I-GOOS, and it registers IOC adoption of the "The Approach to GOOS" as the strategy document for planning and developing GOOS. With respect to OOSDP in particular, the 17th Assembly of the IOC agreed that OOSDP should complete its given task for and within the WCRP, and that a new panel would have to be considered to follow on the present OOSDP after its final report is submitted in December 1994.

8 During March 15-20, Alexiou attended JSC-14. The JSC was meeting for the first time since CCCO had been terminated and JSC membership expanded to include par representation of ocean scientists with atmospheric scientists. He reported that OOSDP was not on the agenda, but the subject was brought up as something that JSC would have to deal with in the future now that CCCO was gone. Chairman G. McBean, in reviewing the results of the GCOS JSTC, opined that while there was general agreement that GOOS and GCOS would share a common ocean climate module, the troubling issue of which organization had the lead in implementation was further complicated by the UNEP announcement that it would establish a Global Terrestrial Observing System. P. Morel, on the basis of his initial reading of the OOSDP Interim Report, voiced his concern that OOSDP might be overextending its mandate and addressing subject matter beyond its expertise in several areas. The JSC, with a full agenda, decided to hold off detailed discussion of OOSDP's work until JSC-15; to which meeting the Chairman of OOSDP would be invited. At Alexiou's urging, Morel agreed to attend at least part of the upcoming OOSDP-VII, perhaps to allay his concerns.

9 Smith and Alexiou reported on an *ad hoc* GOOS meeting organized by the IOC and hosted by the government of Japan at the Tokyo United Nations University 24-25 March 1993. That meeting was originally intended to be the first meeting of the GOOS Joint Scientific and Technical Committee (J-GOOS) but agreement on the MOU establishing such a group had not been concluded at that time. To avoid losing time till this was accomplished, the *ad hoc* group, representing both science and government/operations (see Annex IV), was assembled on short notice to set directions and actions for progress during the year. The group was chaired by Michel Glass on the first day and by Nic Flemming on the second.

10 That meeting took note of the two documents: "The Case for GOOS" and "The Approach to GOOS". A discussion of the status of the various GOOS modules and how overall co-ordination would take place led to the preparation of generic terms of reference (given in Annex V) that outlined tasks to be completed by Panels (yet to be organized, except for OOSDP) before the next I-GOOS meeting (approximately one year hence). These Panels might be expected to report to J-GOOS when it is formed. It was assumed that the current OOSDP would be replaced by a GOOS climate module Panel upon completion of its work and that a new orientation to its terms of reference would be required at that time.

3.3 THE WCRP DIRECTOR'S ASSESSMENT OF OOSDP-RELATED MATTERS

11 Prof Pierre Morel, WCRP Director, opened with an apology for any disruption in communications between the Joint Scientific Committee (JSC) for WCRP and the OOSDP during the period following the termination of CCCO activities in 1992. He recalled the explicit recommendation of the IOC Assembly in March 1993 concerning the completion of the task of OOSDP. He was pleased that OOSDP will continue its work within the WCRP and prepare a final report synthesizing the views of the scientific community on the concept of a long-term Ocean Observing System (OOS) which would provide the wide range of oceanic observations that are being sought for applications to economic development, as well as scientific research.

12 He emphasized that not all data requirements of climate research could or should be satisfied by operational environmental observation systems such as GCOS or GOOS. Global change research will therefore continue to include observational research projects, designed and implemented in the framework of WCRP or IGBP core programmes to address the specific observational needs for scientific investigations, in addition to the operational or quasi-operational data services provided by GCOS or GOOS.

13 Morel understood that a primary objective of both GOOS (or GCOS) and WCRP is to find means for maintaining essential observing programmes initially implemented by research institutions and funded by research agencies, that serve identified applications as well as a wide range of scientific requirements. He encouraged the Panel to consider not only the concept of an ideal Observing System (the "end-product") but also the priorities for building up the OOS from the existing basis (i.e., how to "get there from where we are"). In this process, he expressed his belief that there is the need to clearly distinguish between:

(i) Existing operational observing systems or networks that are maintained for traditional applications other than global change (e.g., GLOSS);

(ii) Proposed new operational or quasi-operational observing systems that would serve well-established climate applications, in addition to adding to the pool of scientific information, and are based on proven techniques (e.g., TAO array);

(iii) Observational research programmes that still require the direct involvement of scientific institutions and are supported by research and development funds [Such global and regional observational research programmes may be needed to develop and test new techniques, e.g., the next generation of subsurface floats, or for a limited period of time to acquire the data needed to address scientifically new problems in the field of global change]; and

(iv) Interim funding and/or implementation arrangements to ensure a smooth transition from (iii) to (ii) above.

14 The Director of WCRP cautioned the group that formal GCOS and GOOS planning meetings cannot escape involvement in a variety of institutional and administrative issues, both international and inter-agency. The OOSDP, not being so hindered, should be in a better

position to exercise objective judgement in sorting out scientifically justified needs and realistic priorities for implementation, or for conveying opinions or information obtained from national agencies through informal individual contacts.

15 Regarding the request to OOSDP from GCOS to advise on cost versus benefits, Morel advised the group to refrain from attempting to assess the economic benefits from potential applications of the proposed observing systems (which he felt is a questionable exercise at best), but rather to concentrate on spelling out the deliverable services or new information that could be expected from each system at various levels of implementation. As a specific example, what new service and or scientific information can one expect from arrays of 100, 200 or 400 ocean drifters? How would these different sampling densities affect the errors in resulting sea surface temperature fields?

16 Finally, Morel questioned some specific technical points of the OOSDP Interim Report, such as the requirement for accurate estimations of precipitation P and evaporation E, for the purpose of estimating the corresponding buoyancy flux or P-E. Although P (and E) could be needed independently for some purposes (e.g., to understand transient changes in the upper-ocean stratification and energy budget), there is no chance of deriving long-term P-E with the required accuracy from separate estimates of P and E. On the other hand, except for relatively minor fresh water inflow from rivers, the oceanic P-E is precisely the complement of the fresh water budget of the atmospheric circulation. Hence, the most promising method for obtaining P-E from atmospheric data is to derive its value from the atmospheric water vapor flux divergence. This point, stemming from the consideration of atmospheric data analysis methods, was missed in the current Interim Report. Then, he expressed his opinion that the Report touched upon a variety of meteorological observations and data management issues that would be best left to other specialized subgroups of the Joint Scientific and Technical Committee for GCOS. He also made a distinction between the use of models and model development in an OOS; the latter, he believed, was not within the purview of an observing system. Morel hoped for changes in the Panel's Final Report. To make his points clearly and concisely, Morel provided the OOSDP with an annotated copy of the Interim Report.

17 . There was insufficient time for a complete discussion of views regarding Morel's remarks. However, there was general agreement with his position regarding the monitoring of E-P and it was decided to split Panel recommendations regarding wind stress and fluxes in the Final Report of the OOSDP. The Panel also broadly agreed with his remarks regarding prioritization. But on some issues there was disagreement. For example, the OOSDP agreed that it must express opinions outside its immediate domain when their specification directly affects the ocean component of GOOS or GCOS; and the OOSDP affirmed that their approach to models and model development as part of the OOS is appropriate. All in all, this interchange was quite useful to the OOSDP. Morel stayed for the remainder of the meeting and contributed actively and helpfully to the discussions.

3.4 SELECTED NATIONAL ACTIVITIES RELATED TO GOOS DEVELOPMENT

18 Individuals present were invited to comment briefly on recent national activities related to GOOS.

3.4.1 Australia

19 Smith reported that incipient planning activities were just beginning to get organized in Australia with the establishment of a GCOS/GOOS Joint Working Group. Smith will chair an Expert Subgroup to assess priorities within the Australian context for the GOOS modules.

3.4.2 **Canada**

20 Needler reported that in Canada an *ad hoc* committee of the Research Committee of the Canadian Climate Board has been constituted to provide advice on the requirements for GOOS and its implementation.

3.4.3 **France**

21 Merlivat reported that Michel Glass has been selected to head French efforts contributing toward GOOS with emphasis on the climate module. There is no parallel effort for GCOS. Glass has taken the lead in organizing discussions aimed at identifying GOOS funds from ministries distinct from those funding scientific research. The meteorological service has expressed some willingness to support some GCOS activities. Planning in response to the recent CLIVAR proposal is still in the exploratory stage but will most likely incorporate continuance of French TOGA activities.

3.4.4 **Japan**

22 Japan's GOOS plans were reported by Wakatsuchi as being jointly developed by the Ministry of Education, which has most of the skilled people, and the Science and Technology Agency, which has most of the funds. The Japanese plan includes 5 thrusts, focused on the western North Pacific: estimation of volume and heat transports in the north Pacific system; establishment of methods for estimating fundamental ocean processes; employing high resolution models for designing ocean observing systems; developing methods for obtaining time series data; and monitoring biological processes.

3.4.5 **United Kingdom**

23 While keen interest is being demonstrated at high levels (as witnessed by the time and effort devoted by J. Houghton and assisted by D. Croom), Taylor reported that no formal mechanisms were yet established in response to international GOOS developments.

3.4.6 **United States of America**

24 Nowlin reported the NOAA within the US is taking action regarding GOOS planning, although there is no formal interagency or national committee structure. There is no planning structure for GCOS.

25 He briefed the Panel on recent US WOCE concerns and actions. At present the focus in WOCE is on determining how well the observational programme will meet WOCE subgoals and in planning for a post-observational phase of WOCE for synthesis of the data sets. Consideration also is being given to what should and can be done to extend after WOCE selected data sets to establish the representativeness of the WOCE measurements.

4. RECONSIDERATION OF THE OOSDP TERMS OF REFERENCE

26 The OOSDP re-examined its existing terms of reference (given in Annex VI) in light of the draft generic terms of reference and short term tasks developed by the *ad hoc* group in Tokyo for the Panels of the other GOOS modules (see Annex V). No compelling reasons surfaced to adopt changes.

5. REVIEW OF THE GCOS DRAFT PLAN

27 The Panel conducted first a general overall discussion of the Draft GCOS Plan and then a page-by-page review. Considering the short deadline for its preparation, the consensus was that the Plan was rather well done. It was assumed that this was an initial document and subsequent improved versions would be developed based on feedback from those reviewing it and as developments dictated. It is not clear in the Plan just how far GCOS's role regarding implementation would extend beyond preparing a Plan, setting standards and developing protocols, i.e., what sequential steps are required, and by whom, to actually begin putting a system in place. It was concluded that the plan would be stronger if it included specific actions that should be carried out within a specified time frame in order to proceed with the initial implementation. It was also believed the next draft should identify the back-up documents used in preparing the GCOS plan.

28 The Panel's detailed findings were to be assembled in a letter to T. Spence. One specific to note is that some recommendations regarding the ocean observations included in the OOSDP Interim Report and endorsed at JSTC II (e.g., regarding sea ice and salinity) were deleted or changed in last-minute changes in the GCOS Draft Plan without concurrence by the JSTC or the OOSDP. It was felt that this constitutes more than editing.

6. STATUS OF BACKGROUND REPORTS

29 In addition to the three already published papers (by Smith, Weller and Taylor, and Merlivat and Vezina), there are three other Background Papers in various stages of preparation. J. Stuart Godfrey, Chairman of the WCRP Indian Ocean Panel, is preparing a paper addressing the unique features of the Indian Ocean that should be considered in the design of an ocean observing system for that Ocean. R. Schmitt is considering the preparation of a paper on the hydrologic cycle in climate and consequent ocean measurements that are needed. He also has been cooperating with D.J. Baker in assembling data received in response to their questionnaire (Annex VI of the report of OOSDP-V) for a paper on Enabling Technologies for OOS With Baker's move to head NOAA, this latter paper needs a new primary author; Schmitt is too committed with his own paper to.take the lead. The Enabling Technologies paper became the subject of a separate discussion later in the meeting (see section 6.1).

30 During discussion, several names surfaced as qualified potential authors for this and other background papers on sea ice and climate, alternative sampling strategies, decadal changes in the Atlantic related to climate, high-latitude processes and deep water formation. Nowlin indicated he will widen the search for candidates through further personal contacts. He requested that the Panel members supply him with possibilities after giving the matter further thought.

6.1 ENABLING TECHNOLOGIES BACKGROUND REPORT

31 Given its importance and the rather large personal commitment needed, consideration was given to forming a group to undertake this paper, perhaps headed by an investigator in a position to assign staff to assist in running down specifications, costs, etc., and in general gathering detailed information needed. Some financial support would otherwise almost certainly be required for this purpose. The GCOS Joint Planning Office might be a source of support.

32 Nowlin provided the Panel with an updated list of respondents to the questionnaire; that list is included as Annex VII. For working purposes the Panel prepared a list of contacts, that matched observation variables with names of known specialists in the technology for measuring them, that was based on personal knowledge and names from the questionnaire response list. The Panel then turned its attention toward developing an outline for the Background paper. The result is given in Annex VIII.

7. TOWARD THE FINAL REPORT

7.1 REVISED TABLE OF CONTENTS

33 In the light of new information since an annotated outline for the OOSDP Final Report initially was framed and the experience gained with the Interim Report, it was decided to modify the outline of the Final Report and to strengthen parts that have already been drafted. Among the changes considered, it was agreed that a section should be added in the introduction defining the scope of the report. It seemed clear that a section should be included in which the sub-goals of the observing system are stated and an assessment is given as to how well we believe the recommended observing system will meet these goals; considerable discussion ensued as to the best approach to take in relating sub-goals to observations. It was further agreed that additional effort should be devoted to identifying benefits related to detection of long-time-scale ocean changes. Finally, an attempt should be made to include in the Final Report estimates of resources needed and priorities for what is proposed in the Interim Report. The new Table of Contents is given in Annex IX.

7.2 ASSIGNMENTS FOR TEXT REVISIONS AND ADDITIONS

34 Chapters I, II, III, IV, and V are to be reorganized as per the new outline. Specifically, the new Chapter I: Introduction, will include new text on examples and benefits of detection and a new section on the scope of the report. A new Chapter II: 'The Ocean's Role in Climate' is to be written around subgoals; it will merge IIB and parts of III and IV from the Interim Report. The new Chapter III: System Design Considerations, is to contain what in the Interim Report was IIA, System Design Strategy, and IIC: System Applications. The latter will address priorities for the applications. New Chapter IV will include most of Interim Report Chapter III, and New Chapter V will cover Interim Report Chapter IV. The old chapter V will be deleted in favor of merging modelling considerations with the text of Chapter II through VII. Assignments for specific tasks relating to these first five chapters were agreed as follows:

Needler/Nowlin : Revise existing material in these chapters to conform to new outline and include new text; the Panel is expected to provide material to be included in Chapter I (see below) and guidance on a new Chapter II (due in June).

Vezina : Contribute text on biological aspects to section IB and material on roles of biology and gases in Chapter II (due in June).

McPhaden : Revise material for section IC, including examples of both successful and unsuccessful predictions of ENSO (due in June).

Smith : Prepare a candidate division of components of the ocean climate system for use in structuring Chapters II and VII (provided in April).

35 Chapter IV on Scales of Ocean Variability must be strengthened and expanded beyond what was included in the Interim Report. Some assigned tasks for this:

Weller : Beef up the treatment of sea-level variability in the Interim Report.
Vezina : Address variability of phytoplankton, including long-term variability in the euphotic zone.

Wakatsuchi : Expand the treatment on scales of variability of sea ice.

36 Chapter V on Observations of Ocean Properties will be based on the Interim Report Chapter IV with the following in mind:

Taylor : In Chapter V, separate the treatment of surface heat fluxes and surface wind stress into two sub-sections: VB and VC (due in June).

Schmitt : In Chapter V, revisit material on water and salt cycles to see if it makes sense in the new approach; discussion of salt now weak.

37 Chapter VI on Information Management, covers a number of elements that involve reporting and communications. In the section F on Archiving: the OOSDP position is that this should be done at an international center(s). Observational data, with metadata, should be flagged as climate data. Who will produce the data products, under what kind of formal arrangement, and who will distribute the data products, are subjects that must be addressed in this chapter. The importance of real-time data transmission should be discussed. The availability of real-time data for system management and control purposes is a distinct plus. (For example, knowing in real time, rather than six months after the fact, that an important mooring or a VOS ship has dropped from the regular reporting pattern allows management to do something about it)

Smith : Draft new Chapter VI, including section VIG on required uniformity of long-term data sets.

Weller : Contribute text covering communications aspects of Chapter VI on Information Management.

38 The discussion of Chapter VII on System Organization and Evolution covered some areas only superficially considered previously. A new section A, Enabling Research, will address the research that allows development of the observing system. One possibility considered for Section B, Enabling Technology Development, is to offer workable techniques and specify requirements but let the reader decide. This section can be taken later from the planned Background Report dealing with the same subject. Section C should articulate the principles of the strategic planning function. The approach to section D, Tradeoffs, is not intended as the tradeoff of one instrument vs. another to obtain a particular variable, but one sampling strategy vs. an alternative for deriving a needed quantity. This will be done by example in the text. The basic position of the OOSDP on Section E, Management, is that there will have to be one entity managing things on a day-to-day basis.

McPhaden : Prepare a draft for the new section IIIA on Enabling Research (due beginning of July).

Nowlin : Prepare drafts for sections IIIC on Strategic Planning and IIID on Tradeoffs (due beginning of July).

Alexiou : For section IIIE on Management prepare a draft, describing a candidate management structure embedded in the existing web of agencies involved (due beginning of July).

39 Chapter VIII, the wrap-up chapter, is tentatively titled System Integration and Synthesis. In this chapter that the OOSDP critiques its design by restating the system subgoals of OOS and examining whether the recommended observational system meets these goals. If to meet some objective(s) it does not now seem possible to recommend observation(s) as part of the OOS (say, because of lack of understanding or adequate technology), then the question of what the suggested future actions are which must be taken to remedy the shortcomings so that observations can be added to meet the objective, should be addressed.

40 Annex I of the Final Report is to contain the OOSDP's Terms of Reference. Annexes (rather than a part of the main text) were also decided as the appropriate means for addressing Linkages and Existing Systems, (Annex II - the paper by Tim Wright and John Withrow), and the Implementation Schedule (Annex III - this remains to be drafted).

7.3 CONSIDERATION FOR FUTURE GROUPS

41 Looking ahead to what kind of transition mechanisms would be helpful to the OOSDP while it is winding down, and to any successor GOOS/GCOS Climate Panel to be formed, Nowlin opened a discussion focused on special groups that might be brought usefully into play. Although no conclusions or recommendations were reached, the discussion explored the possible usefulness of groups focused on the areas of information management, sea surface temperature, and developing technologies.

42 Examples of questions posed that a group concerned with information management might tackle included: How best to take advantage of existing permanent mechanisms, e.g., IODE, IGOSS, in the future? How to assure that needed TOGA/WOCE data centers continue after WOCE and TOGA end? Who are the people that should be considered for such a group? From where would financial support come?

7.4 SCHEDULE OF MEETINGS AND ACTIONS FOR TIMELY COMPLETION OF THE FINAL REPORT

43 The panel ended its meeting by identifying the sequence of tasks that must be addressed to complete the final report and developing a rough schedule to assure completion on time. Three future OOSDP meetings were scheduled, having the major agenda items listed below.

OOSDP-VIII
16-19 November 1993 (3 1/2 days)
Bedford Institute in Halifax

* Review first drafts of pending Background Reports
* Review drafts of new or revised sections for Final Report
* First attempt to group recommended observations by objectives and assessment of success in meeting sub-goals of OOS
* Review/ and discuss the recommended observations, with emphasis an subsurface ocean
* Identify actions/procedures which should be undertaken as alternatives in cases where it is not yet possible to recommend a system of measurements (this should be more specific than just "more research")
* Consider resources and prioritization

OOSDP-IX
12-15 April 1994 (3 1/2 days)
Australian Bureau of Meteorology Research Centre

* Review/discuss all recommended modifications or additions
* Complete first draft of entire Report
* Review Background Reports and incorporate appropriate materials from them, e.g., regarding enabling technologies, into the Final Report
* Decisions regarding review/production schedule
* Consider a schedule for implementation

Draft Executive Summary before Fall 1994 meeting

OOSDP-X
3-7 October 1994
Garrett Creek Ranch near Dallas-Fort Worth

- Final decision on recommended observations by property
- Final decision on recommended observations and needed future developments to meet sub-goals
- Editing of Final Report
- Approval of outstanding Background Reports

ANNEX I

AGENDA

1. WELCOMING REMARKS

2. REVIEW AND ADOPTION OF THE AGENDA: WORKING DOCUMENTS

3. REVIEW OF RELATED ACTIVITIES AND PLANS SINCE OOSDP-VI

   3.1 STATUS OF GCOS PLANNING
   3.2 RECENT IOC ACTIONS REGARDING DEVELOPMENT OF GOOS
   3.3 THE WCRP DIRECTOR'S ASSESSMENT OF OOSDP-RELATED MATTERS
   3.4 SELECTED NATIONAL ACTIVITIES RELATED TO GOOS DEVELOPMENT

      3.4.1 Australia
      3.4.2 Canada
      3.4.3 France
      3.4.4 Japan
      3.4.5 United Kingdom
      3.4.6 United States of America

4. RECONSIDERATION OF THE OOSDP TERMS OF REFERENCE

5. REVIEW OF THE GCOS DRAFT

6. STATUS OF BACKGROUND REPORTS

   6.1 ENABLING TECHNOLOGIES BACKGROUND REPORT

7. TOWARD THE FINAL REPORT

   7.1 REVISED TABLE OF CONTENTS
   7.2 ASSIGNMENTS FOR TEXT REVISIONS AND ADDITIONS
   7.3 CONSIDERATION FOR FUTURE GROUPS
   7.4 SCHEDULE OF MEETINGS AND ACTIONS FOR TIMELY COMPLETION OF THE FINAL REPORT

ANNEX II

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ANNEX III

IOC RESOLUTION ON GOOS

Resolution XVII-5

GLOBAL OCEAN OBSERVING SYSTEM (GOOS)

The Intergovernmental Oceanographic Commission,

Noting:

(i) IOC Resolutions XV-4, XVI-8 ,XVI-10, EC-XXIII.5 and EC-XXV.3 on GOOS, which call for the IOC to develop GOOS and establish the necessary international co-ordination mechanisms, and to initiate jointly with UNEP and WMO coastal pilot monitoring activities,

(ii) WMO Resolutions 11 (EC-XLI), 9 (Cg-XI) and 21 (Cg-XI) which express WMO support for GOOS development and relevant co-operation with the IOC,

(iii) UNEP Governing Council Decisions 16/26, 16/27 and 16/41 which express UNEP support for actions which will meet the needs to be addressed by GOOS,

(iv) the decisions made by UNCED, including the two Conventions and Chapter 17, Section E, of Agenda 21 (Section E, para 17.102), which call for:

  (a) Member States to support IOC in co-operation with WMO, UNEP, *inter alia*, in the systematic collection and exchange of ocean data needed to apply integrated management approaches and to predict impacts of environmental change;

  (b) the IOC to develop fully the strategy for providing training, education and technical assistance for developing countries through its Training, Education and Mutual Assistance (TEMA) programme,

(v) the report of the meeting of the ad hoc panel for the Health of the Ocean Module of GOOS and the need for input from other panels and GOOS modules in order to resolve effectively the issues identified,

Recognizing the limited human and financial resources available for the GOOS planning and development,

Having reviewed the Executive Summary and Recommendations of the First Session of the IOC Committee for GOOS,

Takes note of the Executive Summary;

Decides to take the following action on the recommendations:

Recommendation GOOS-I.1 Further Development of the Global Ocean Observing System (GOOS) and Co-ordination Mechanisms for Scientific Advice and Inter-Agency Co-operation

(i) Approves the Recommendation;

(ii) **Instructs** the Secretary, in close consultation with the Chairmen of IOC and the IOC Committee for GOOS, to pursue and finalize the negotiations leading to the signature of a Memorandum of Understanding on the co-sponsorship of a GOOS technical and scientific advisory mechanism by concerned organization(s) and to facilitate the establishment of this body as quickly as possible;

(iii) **Calls upon** ICSU/SCOR to assist the IOC and the co-sponsors in the establishment of scientific design panels for the GOOS modules, as a matter of urgency, ensuring that the best possible use is made of existing mechanisms;

(iv) **Instructs further** the Secretary to make as wide a use as possible of ICSPRO to facilitate the formation of GOOS;

Recommendation GOOS-I.2 The Approach to GOOS and National Commitments

(i) Approves the Recommendation;

(ii) Agrees that the document "The Approach to GOOS" (Doc.IOC-XVII/8 Annex 2) as amended by the First session of the IOC Committee for GOOS should be used as a strategy document for GOOS planning and development;

(iii) Invites WMO and UNEP to co-sponsor, jointly with IOC, the IOC Committee for GOOS;

(iv) Urges Member States, especially developed countries, to contribute to GOOS through an earmarked part of the IOC Trust Fund to support the costs of the planning and development phase of GOOS;

(v) Urges Member States and co-sponsoring Organizations, together with the GOOS Support Office, to conduct public and information activities to promote GOOS;

Recommendation GOOS-I.3 Global Sea Level Observing System (GLOSS)

(i) Approves the Recommendation;

(ii) Instructs the Secretary to arrange, through appropriate means and in consultation with Member States, for the position of a Technical Secretary for GLOSS as part of the GOOS Support Office in order to promote and fully support GLOSS development;

Recommendation GOOS-I.4 UNEP-IOC-WMO Long-Term Global Monitoring System of Coastal and Near-Shore Phenomena Related to Climate Change

(i) Approves the Recommendation;

(ii) Invites UNEP and WMO, as co-sponsoring agencies, to continue their support for the implementation of the pilot activities;

(iii) Urges Member States to consider, and inform the Secretary on their participation in the pilot activities as well as on their possible support of and contribution to the implementation of the pilot activities;

Recommendation GOOS-I.5 GOOS Linkage With Existing Programmes/Activities

(i) Approves the Recommendation;

(ii) Agrees that the strengthening and accelerated development of existing ocean observational and data management activities, particularly IGOSS, GLOSS, DBCP, IODE, MARPOLMON, International Musselwatch, CPR and TEMA components of these programmes should be considered as a priority for GOOS development and that adequate staff and financial support should be provided for their implementation;

(iii) Urges the Chairmen of the concerned scientific/technical subsidiary bodies of the Commission, as well as of its regional subsidiary bodies and of the Committee for TEMA, to work with the IOC Committee for GOOS and GOOS scientific advisory bodies with regard to the design, planning and development of GOOS;

Recommendation GOOS-I.6 TEMA In Relation to GOOS

(i) Approves the Recommendation;

(ii) Agrees that "Capacity Building" can only result from (a) long-term commitments and partnerships between developing and developed countries, and (b) identification and use of new and external sources of support;

(iii) Stresses that provision of equipment should keep pace with education and training in developing countries;

(iv) Decides to establish an earmarked GOOS/TEMA part of the IOC Trust Fund to support the TEMA-related activities within GOOS;

(v) Urges developing Member States to:

(a) identify their needs in terms of human resource development and infrastructure in relation to GOOS;
(b) identify their existing training facilities and institutions for participation in the GOOS/TEMA efforts;

(vi) Requests the IOC Committee for GOOS to provide guidance to the GOOS support office on actions required by IOC Member States and co-sponsoring agencies;

Accepts the interim report on developing the Health of the Ocean Module, and instructs the Secretary to ensure the timely completion of this report.

Approves the attached Statement (Annex to Resolution XVII-5) to be proposed for adoption by the Intergovernmental Meeting on the World Climate Programme and requests the Secretary to bring this Statement to the attention of the Meeting.

Financial implications (1994-1995):

Required	Anticipated 27C5 (Doc.IOC-XVII/8, 6.1.1 GOOS)
Recommendation 1	
Meetings of 5 Panels (2) $330K	
Ad hoc Meetings (4) $110K	
Total: $440K	$150K
Expected net shortfall: $290K	

Recommendation 2
Translation/Publication of the Document and GOOS Brochure
$30K

Recommendation 3 (Doc. IOC-XVII/8, 6.1.2 GLOSS)
Preparation and publication of the GLOSS up-dated Handbook $20K
Meeting of GE/GLOSS $30K
Sea-level training courses (2) $40K
Position of GLOSS Technical Secretary $100K
Staff travel $5K
Total: $195K $100K
Expected net shortfall: $95K

Recommendation 4 (Doc.IOC-XVII/8, 6.1.3 GOOS Coastal)
Meetings of the Task Team on Coral Reefs (2) - $50K
Meetings of the Global Task Team on Mangroves (2) - $50K
Meetings of experts on Sea Level Project in the Indian Ocean (2) - $50K

Meetings of experts on Coastal Circulation project (2) - $50K
Workshop on plankton community structure monitoring (1994) - $40K

Preparation and publication of Methodology manuals - $30K
Consultancy services to advise countries on projects implementation and related training - $100K
Staff travel- $20K
Total: $390K $100K
Expected net shortfall: $290K

Recommendation 5
None

Recommendation 6
None

Grand Total: $1055K $ 350K
Expected net shortfall: $705K

Annex to Resolution XVII-5

Statement for the Intergovernmental Meeting on the World Climate Programme by the Seventeenth Assembly of the Intergovernmental Oceanographic Commission
Paris, France, 25 February - 11 March 1993

The Assembly of the Intergovernmental Oceanographic Commission of UNESCO at its seventeenth session, deeply concerned with the need to improve understanding and prediction of the climate change and its impact on economic development, transmits to the Intergovernmental Meeting on the World Climate Programme for its consideration the statement in the conclusion to the present text.

Introduction

1. The ocean plays a key role in determining Earth's climate. The Global Atmosphere and the World Ocean are an interactive system. The oceans are both a source and a sink for carbon dioxide and other "greenhouse gases". The ocean also drives the global cycle of evaporation and rainfall. Any possibility of predicting climate changes beyond a few weeks demands that the ocean behaviour be taken into account. Long-term, systematic observations in the World Ocean are needed to reduce the uncertainty which now exists with regard to the ocean's role in climate variability.

2. The Intergovernmental Oceanographic Commission, consisting of 122 Member States, was established in 1960 to promote marine scientific investigations, related ocean services and capacity building with a view to learning more about the nature and resources of the oceans through concerted action of its Members.

3. The recognition by States and Organizations of the UN System of the importance of IOC for international oceanographic co-operation and capacity building has been demonstrated in the reference to IOC as a joint specialized mechanism in the ICSPRO Agreement and as a competent international organization in the UN Convention on the Law of the Sea; and by the acceptance of the IOC in its own right as a co-sponsor of the Second World Climate Conference and at the United Nations Conference on Environment and Development.

4. IOC in its 30 years of activity, has accumulated a capital of experience, both at global and regional levels, as the only UN organization fully devoted to marine research, ocean services and related training, education and mutual assistance. The Commission established formal contacts with many governmental and non-governmental international organizations including UN, FAO, WMO, UNEP, IMO, IAEA, IHO, ICES, CPPS, ICSEM, ICSU and SCOR.

5. Since the establishment of the World Climate Programme in 1979 the IOC actively supported and participated in the planning and implementing the World Climate Research Programme, presently sponsored jointly by IOC, WMO and ICSU in co-operation with SCOR, particularly TOGA and WOCE.

6. The Commission has promoted the development of the Integrated Global Ocean Services System in co-operation with WMO; the Global Sea Level Observing System; and the International Oceanographic Data and Information Exchange (IODE) system that laid down a basic international infrastructure for the development of the Global Ocean Observing System.

Intergovernmental Decisions

7. The Second World Climate Conference (29 October - 7 November 1990) adopted conclusions and recommendations to create a Global Climate Observing System (GCOS). The Conference statement noted the importance of developing a Global Ocean Observing System of physical, chemical and biological measurements.

8. The United Nations Conference on the Environment and Development (June 1992) in Agenda 21, Chapter 17, Section E called for States to support the role of IOC, in co-operation with WMO, UNEP and other international organizations, in the collection, analysis and distribution of data and information from the oceans and all seas, including as appropriate through the proposed Global Ocean Observing System (GOOS), giving special attention to the need for IOC to develop fully the strategy for providing training and technical assistance for developing countries through its Training, Education and Mutual Assistance (TEMA) programme. The UNCED also emphasized that the developed countries should provide the financing for the development and the implementation of the GOOS system. Two Conventions signed by 154 countries, namely the UN Framework Convention on Climate Change and the UN Convention on Biological Diversity, also calls for systematic observation of the components of the climate and bio-diversity systems.

9. The agreement on the joint sponsorship of the World Climate Research Programme by WMO, IOC and ICSU was signed in 1992.

10. The agreement on the co-operation among WMO, IOC of UNESCO, ICSU and UNEP in organizing a Global Climate Observing System was signed in 1991 and 1992. By this agreement the co-operating organizations agreed that GCOS will be based on the co-ordinating of existing or planned operational and research programmes for observing the global climate system and that it will be based inter alia on the establishment of a Global Ocean Observing System. It is further agreed that GOOS and GCOS share a common module: the climate module for GOOS is the same as the ocean component of GCOS.

Action Taken

11. The Intergovernmental Oceanographic Commission, by decisions of its Fifteenth and Sixteenth Assemblies and Twenty Fifth session of its Executive Council, decided to develop a Global Ocean Observing System (GOOS) and established the IOC Committee for GOOS as an intergovernmental forum for promoting GOOS, and the GOOS Support Office within the IOC Secretariat to co-ordinate GOOS development.

12. WMO, by decisions of the Eleventh World Meteorological Congress and the 43rd and 44th sessions of the Executive Council, expressed WMO support for GOOS development and relevant co-operation with IOC.

13. UNEP, by decisions of its Sixteenth Governing Council, expressed UNEP support for actions which will meet the needs to be addressed by GOOS.

14. IOC, UNEP, and WMO agreed to cooperate in developing a Long-Term Global Monitoring System of Coastal and Near-Shore Phenomena Related to Climate Change as a contribution to GOOS, particularly its Coastal module

15. The IOC Assembly, at its seventeenth session, adopted a strategy paper for GOOS planning and implementation, and invited WMO, UNEP and ICSU to co-operate in these efforts. The Assembly also emphasized that the existing ocean observational and data management activities, particularly IGOSS, GLOSS, DBCP, IODE, MARPOLMON, Musselwatch and CPR, and TEMA components of these programmes, should be considered as a priority for GOOS development and that TEMA components of these programmes be given particular consideration. The Assembly decided to earmark a part of the IOC Trust Fund for this development.

Conclusion

16. Therefore,the Member States of the Intergovernmental Oceanographic Commission requests the Intergovernmental Meeting on WCP to adopt the following recommendation:

> **"Recognizing the key role of the oceans in the Earth's Climate System and the urgent need to develop GOOS for long-term, systematic collection, analysis and distribution of ocean data, the Meeting assigns a high priority to the planning, development and implementation of the Global Ocean Observing System as an important contribution to the World Climate Programme. The Meeting encourages the IOC to continue the development of this system in co-operation with WMO, UNEP, ICSU and other concerned international organizations on the basis of existing and planned international and national ocean observing systems. The Meeting urges countries to support this system through their national facilities and services. The Meeting also urges countries to increase their support for the training, education, mutual assistance and capacity building programme of IOC as well as the related Voluntary Co-operation Programme, in order to enable all countries to participate in GOOS and to interpret and apply the resulting data and information and encourages the concept of partnerships between developing and developed countries."**

ANNEX IV

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ANNEX V

DRAFT GENERIC TERMS OF REFERENCE FOR GOOS MODULE PANELS

[For each module: an introductory paragraph giving the present scope of the module, time-limited to permit completion of the tasks before the next IOC Committee for GOOS meeting, in approximately April 1994. Each GOOS Module Panel will report to the J-GOOS when it is formed and should present an interim report to the first meeting of J-GOOS.]

TASKS

1. Specify the "deliverables" anticipated from the module (including from applicable existing bodies) both on the short-term (1-3 years) and long-term (10 years and longer). [Note: "Deliverables" are the data and/or interpretive products that are needed by end-users and that will be provided by the module or existing body.]

2. Specify how these deliverables could be provided to the users, in the sense of who would do it and what the distribution system or mechanism will be.

3. Specify the conceptual design for an observing system that will provide those deliverables, and elaborate on the scientific basis for the specification, indicating where the design is strong and where it is weak, and what additional scientific basis is needed.

4. Develop a plan for the technological needs (including existing technologies and future needed technology) in relation to this basis.

5. Develop TEMA and capacity-building plans to meet the conceptual design specification and technological development plan and to provide the deliverables.

6. Suggest methods of proceeding further with this module and any membership changes needed.

In addressing the tasks above, in so far as possible in the time allowed:

(a) take into account, and/or make use of, existing systems and on-going programmes as far as possible, and provide cross-references to those systems or programmes;

(b) relate the specifications and development plans to perceived or specified user needs; and

(c) define the sampling requirements of the variables in the specifications and the related development plans, and those needed for the existing scientific and technical bodies.

Priorities: In the limited time available, address all the tasks to some extent, with primary emphasis on Tasks 1 and 3.

ANNEX VI

OOSDP TERMS OF REFERENCE

(i) To formulate the conceptual design of a long-term, systematic observing system in order to monitor, describe, and understand the physical and biogeochemical processes that determine ocean circulation and the effects of the ocean on seasonal to decadal climate changes, and to provide the observations needed for climate predictions.

(ii) To co-operate as appropriate with the planners of other scientific or operational programmes related to climate and climate change and to collate relevant data requirements and observing system specifications.

(iii) To liaise with responsible scientific institutions and agencies, including environmental administrations and space agencies, to attempt to ensure the compatibility of the proposed global ocean observing system development programme with the long-term plans of these organizations.

ANNEX VII

UPDATED LIST OF ENABLING TECHNOLOGIES QUESTIONNAIRE RESPONDENTS

AES Bedford, N.S. CANADA	Nomad Buoy System
AMETEK USA	Acoustic Doppler Current Profiler
Stuart J. Anderson HF Radar Division Surveillance Research Laboratory Defence Science and Technology Organisation Adelaide, S.A. 5001 AUSTRALIA	HF Skywave Radar
Sebastian Archer MIROS Limited Ablgownie Technology Centre Campus 3, Balgownie Drive Bride of Don Aberdeen AB22 8GW UNITED KINGDOM	Wave Radar
Richard Burt Chelsea Instruments Ltd. 2/3 Central Ave. East Molesey, Surrey KT80QX UNITED KINGDOM	1. pCO_2 2. Chlorophyll Fluorimeter 3. Nutrient Sensor
Lennart Bengtsson Max Planck Institute for Meteorology Bundesstr. 55 D-2000 Hamburg 13 GERMANY	*
Mike Bewers B.I.O. P.O. Box 1006 Dartmouth, NS CANADA B2Y 4A2	*
Albert M. Bradley Advanced Engineering Laboratory Woods Hole Oceanographic Institution Woods Hole, MA 02543 USA	Fast Hydrographic Profiler

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* Provided only general comments on what might be measure, philosophy or measurements, etc.

Neil Brown Woods Hole Oceanographic Institution Woods Hole, MA 02543 USA	Acoustic Current Meter
Etienne Charpentier Technical Co-ordinator of the WMO-IOC Drifting Buoy Co-operation Panel	Drifting Bouys
Alan Chave Woods Hole Oceanographic Institution Woods Hole, MA 02543 USA	Horizontal Electrometer
Ong Tiong Cheong Malaysian Meteorological Service Jalan Sultan 46667 Petaling Jaya MALAYSIA	Gas Production Platforms
Earl F. Childress Pacer Systems, Inc. 900 Technology Park Dr. Billerica, MA 01821 USA	Data Logger
P. G. Collar Natural Environment Research Council Institute of Oceanographic Sciences Deacon Laboratory Brook Road, Wormley, Godalming Surrey GU8 5UB UNITED KINGDOM	Autosub
LeRoy W. Collins, Jr. COMSAT/Maritime Services 950 L'Enfant Planza, SW Washington, DC 20024 USA	Satellite Communications
C. Contralmirante S.I.O. Mexico	Current Meter Moorings
Michael D. DeGrandpre Woods Hole Oceanographic Institution Woods Hole, MA 02543 USA	pCO_2 Sensor
Jean-Guy Dessureault Dept. of Fisheries & Oceans Bedford Institute of Oceanography P.O. Box 1006 Darmouth, NS, CANADA B2Y 4A2	Moving Vessel CTD

Tom Dickey
Dept. of Geological Sciences
University of Southern California
3651 Truesdale Parkway
Science Bldg. Rm. 117
Los Angeles, CA 90089-0740
USA

1. Beam Transmissometer
2. Stimulated Fluorometer
3. Current Meter
4. Natural Fluorometer
5. Scalar Irradiance
6. Spectral Irradiance

F.A. Dongen
Director
The Oceanographic Company of the Netherlands
Rotterdamseweg 185
PO Box 177
2600 MH Delft
THE NETHERLANDS

Users of sensors for:
1. Air Pressure
2. Nutrients
3. Radioactivity
4. Temperature Chain
5. Wind Speed/Direction
6. Air Temperature
7. Surface Waves
8. Oxygen
9. Currents

Daniel Frye
Woods Hole Oceanographic Institution
Woods Hole, MA 02543
USA

Moored Vertical Profiler

Arnold Furlong
Brooke Ocean Technology Limited
Bedford Institute of Oceanography
PO Box 2220
East Dartmouth, Nova Scotia
CANADA B2W 3Y2

1. Moving Vessel CTD
2. Moored Ocean Profiler
3. Programmable Diving Buoy

John Gamble
The Sir Alister Hardy Foundation
for Ocean Science
c/o Plymouth Marine Laboratory
Prospect Place, The Hoe
Plymouth Pll 3DH
UNITED KINGDOM

1. Continuous Plankton Recorder
2. Undulating Oceanographic Recorder

Philippe Gaspar
ARGOS/CLS
18, Avenue Edouard-Belin
31055 Toulouse Cedex
FRANCE

Altimeter

Michael Gregg
Applied Physics Laboratory
University of Washington
1013 NE 40th Street
Seattle, WA 98105
USA

Mixing Measurements

Trygve Gytre Institute of Marine Research P.O. Box 1870/72 N-5024 Bergen NORWAY	1. Mini Current Meter 2. Mini STD
Dave Hosom Woods Hole Oceanographic Institution Woods Hole, MA 02543 USA	Improved Meteorology (IMET) System
Peter Jones B.I.O. P.O. Box 1006 Dartmouth, NS CANADA B2Y 4A2	Marine Chemistry (Comments Only)
Arata Kaneko Hiroshima University Department of Environmental Sciences 1-4 Kagamiyama, Higashi-Hiroshima Hiroshima 724 JAPAN	ADCP on VOS
Junzo Kasahara Earthquake Research Institute University of Tokyo 1-1-1 Yayoi, Bunkyo Tokyo 113 JAPAN	Cabled Seismometers with ancilliary measurements
V. Kogan 27A Komsomolskaya St. 14 Apartment 690002 Vladivostok RUSSIA	Doppler Profiler Mooring
C. Langdon Lamont-Doherty Earth Observatory Palisades, NY 10964 USA	Pulsed Oxygen Sensor
Jim Larsen Pacific Marine Environmental Laboratory 7600 Sand Point Way N.E. Seattle, WA 98115 USA	Cross-stream Voltages
M. Maccio, J. Marra Lamont-Doherty Earth Observatory Palisades, NY 10964 USA	Spectro-Radiometer

B.S. McCartney
Proudman Oceanographic Laboratory
Birkenhead
Merseyside L43 7PA
UNITED KINGDOM

1. Deep Sea Pressure Recorder
2. Deep Sea Inverted Echo Sounder
3. Coastal Sea Level Network
4. Island Sea Level Gauge

Hugh Milburn
Pacific Marine Environmental Laboratory
NOAA Building Number 3
7600 Sand Point Way N.E.
Seattle, WA 98115
USA

1. Sea-cables for transport
2. Bottom Pressure
3. Rumbleometer
4. Acoustic Ambient Noise
5. Chemical Scanner
6. Proteus Mooring
7. Atlas Mooring
8. Acoustic Extensometer
9. Miniature T/P Recorder

Vincent Mourier
Tekelec Systems
29 Avenue de la Baltique
91953 Les Ulis Cedex
FRANCE

Subsurface Floats

Richard Phelps
Conrad Blucher Institute
for Surveying and Science
Corpus Christi State University
6300 Ocean Drive
Corpus Christi, TX 78412
USA

Water Properties/Water Level

Michael Reynolds
Dept. of Applied Sciences
Brookhaven National Laboratory
Bldg. 318
Upton, NY 11973
USA

Atmospheric Radiation Measurements

P. Richardson
Woods Hole Oceanographic Institution
Woods Hole, MA 02543
USA

Autonomous Profilers
(Slocum profiler and glider)

Tom Sanford
Applied Physics Laboratory
University of Washington
1013 NE 40th Street
Seattle, WA 98105
USA

1. Absolute Velocity Profiler
2. Expendable Velocity Profiler
3. EM Cables
4. Moored Electric Field Sensor
5. Electric Field Float
6. Towed Transport Meter
7. EM Surface Drifter

Gary Sharp Cooperative Institute for Research in the Integrated Ocean Sciences 2560 Garden Road Monterey, CA 93940 USA	High Seas Fisheries Fleets
Edward Sholkovitz Woods Hole Oceanographic Institution Woods Hole, MA 02543 USA	Precipitation Chemistry
Robert Stewart College of Geosciences and Maritime Studies Texas A&M University College Station, TX 77843-3146 USA	(Comments Only)
Albert Tolkachev Intergovernmental Oceanographic Commission of UNESCO 1, rue Miollis 75732 Paris Cedex 15 FRANCE	IOC Sea Surface Topography
John Toole Woods Hole Oceanographic Institution Woods Hole, MA 02543 USA	Moored Vertical Profiler
TSKA 828 Mills Pl. North Bend, WA 98045 USA	Remote Wave Height Meter
Richard Worsfold Institute for Space & Terrestrial Science 4850 Keele St. North York, Ontario M3J 3K1 CANADA	Sea Ice/Remote Sensing
Vince Zegowitz National Weather Service NOAA Silver Spring, MD 20910 USA	Marine Observations Program

ANNEX VIII

ENABLING TECHNOLOGIES BACKGROUND REPORT CHAPTER OUTLINE

I. PHILOSOPHY

System depends on technologies/cost
Continuity/Accuracy are keys
Long term aspects does entail development

II. REVIEW OF TECHNOLOGIES NEEDED TO ESTIMATE PARAMETERS (BY GROUPS):

- Surface fluxes and fields
- Upper ocean
- Full ocean
- Communication ?

For each parameter:

Measurements parameters (Annex 1)
What is now available (Annex 2) - (A present reality)
What will be available in 10-15 years - (Discuss)
likely improvement and costs
What will be available in the far future - (Speculate)
likely sources of development and interactions

Annex 1: Parameters to be estimated
Accuracy, frequency, etc.

Annex 2: Technologies available now
A catalog of characteristics and costs

ANNEX IX

TABLE OF CONTENTS FOR OOSDP FINAL REPORT

ANNEX X

GLOSSARY OF ACRONYMS AND SPECIAL TERMS

CCCO	Committee on Climatic Changes and the Ocean (SCOR-IOC)
CLIVAR	Climate Variability and Prediction Programme
CPPS	Comision Permanente del Pacifico Sur
CPR	Continuous Plankton Recorder
CSIRO	Council for Scientific and Industrial Research Organization (Australia)
DBCP	Data Buoy Co-operation Panel
E	Evaporation
EC	Executive Council (IOC)
ENSO	El Niño Southern Oscillation
FAO	Food and Agriculture Organization (UN)
GCOS	Global Climate Observing System
GEWEX	Global Energy and Water Cycle Experiment
GLOSS	Global Sea-Level Observing System
GOOS	Global Ocean Observing System
IAEA	International Atomic Energy Agency
ICES	International Council for the Exploration of the Sea
ICSEM	International Council for the Scientific Exploration of the Mediterranean
ICSPRO	Intersecretariat Committee on Scientific Programmes Relating to Oceanography
ICSU	International Council of Scientific Unions
IFREMER	Institut Français de Recherche pour l'Exploitation de la Mer
I-GOOS	IOC Committee for the Global Ocean Observing System
IGOSS	Integrated Global Ocean Services System
IGM-WCP	Intergovernmental Meeting of the World Climate Programme
IHO	International Hydrographic Organization
IMO	International Maritime Organization
IOC	Intergovernmental Oceanographic Commission (of UNESCO)
IODE	International Oceanographic Data & Information Exchange
JGOFS	Joint Global Ocean Flux Study
J-GOOS	Joint Scientific and Technical Committee for GOOS
JPO	Joint Planning Office (GCOS)
JSC	Joint Scientific Committee for the WCRP
JSTC	Joint Scientific and Technical Committee (for GCOS)
LODYC	Laboratoire d'Océanographie Dynamique et de Climatologie (France)
MARPOLMON	Marine Pollution Monitoring
MOU	Memorandum of Understanding
NMFS	National Marine Fisheries Service (NOAA)
NOAA	National Oceanic and Atmospheric Administration (USA)
NOS	National Ocean Service (NOAA)
OOS	Ocean Observing System
OOSDP	Ocean Observing System Development Panel (JSC)
P	Precipitation
PMEL	Pacific Marine Environmental Laboratory (NOAA)
SCOR	Scientific Committee on Oceanic Research (ICSU)
TAO	Tropical Atmosphere Ocean (Moored Buoy Array)
TEMA	Training, Education and Mutual Assistance in Marine Sciences
TOGA	Tropical Ocean and Global Atmosphere Programme (WCRP)
UN	United Nations
UNCED	1992 United Nations Conference on Environment and Development
UNEP	United Nations Environment Programme

UNESCO	United Nations Educational, Scientific and Cultural Organization
VOS	Volunteer Observing Ship
WCP	World Climate Programme
WCRP	World Climate Research Programme
WMO	World Meteorological Organization
WOCE	World Ocean Circulation Experiment
XBT	Expendable Bathythermograph Instrument