Intergovernmental Oceanographic Commission
Reports of Meetings of Experts and Equivalent Bodies

Sixth Joint IOC-WMO Meeting for Implementation of IGOSS XBT Ship-of-Opportunity programmes

Ottawa, Canada
16-20 October 1995

UNESCO

In this Series, entitled

Reports of Meetings of Experts end Equivalent Bodies, which was initiated in 1964 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
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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 International 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
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23. First Session of the IOC Group of Experts on Marine Geology and Geophysics in the Western Pacific
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25. Third Session of the IOC Group of Experts on Effects of Pollutants
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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
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64. Joint Meeting of the Group of Experts on Pollutants and the Group of Experts on Methods, Standards and Intercalibration
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66. Fifth Session of the Editorial Board for the International Bathymetric and its Geological/Geophysical Series
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1. ORGANIZATION OF THE MEETING

1.1 OPENING OF THE MEETING

1 The Sixth Joint IOC-WMO Meeting for the Implementation of IGOSS XBT Ship-of-Opportunity programmes was opened by Mr Geoff Holland, Chairman of the IOC and past Chairman of the IGOSS Joint Working Committee, at 10.00 am on Monday 16 October 1995, at the facilities of the Marine Environmental Data Service (MEDS) in Ottawa, Canada.

2 Mr Holland first welcomed the participants on behalf of the Department of Fisheries and Oceans (DFO) and the Government of Canada. He noted that this was the second time Canada has hosted a SOOP meeting, the first having been held in 1987 at the Institute of Ocean Sciences in British Columbia.

3 In speaking for Dr Scott Parsons, Assistant Deputy Minister of the DFO, he noted that, with budget squeezes everywhere, Canada notwithstanding, utilization of ships of opportunity is more and more becoming a cost-effective way to collect environmental data, particularly if the data are exchanged in operational time frames to benefit more than just the originator.

4 Operational oceanography is becoming increasingly important to Canada. As scientists better understand and are able to. predict events such as El Niño, the country will be in a better position to understand potential effects and manage our fisheries in a prudent manner. Ship-of-opportunity data, when combined with other data, such as remote sensing data, provide valuable insights into the environmental conditions that are known to influence the abundance, distribution and migration of fish stocks. Any changes that can improve this system, both in its coverage and timeliness, would be most welcome.

5 Mr Holland was pleased to see that science is the building block upon which the ship-of-opportunity programme is based. SOOP data are the important operational link for the exchange of data for many of the international science experiments, so that when combined with other data sets, such as drifting buoys, acoustic measurements, etc. sensible products can be derived. And with advances in communications such as the through Internet and the World Wide Web, clients can access both raw data and analyzed products in time frames that have an economic payoff.

6 Mr Holland encouraged participants not to forget about opportunistic measurements from ships of opportunity. Obviously, systematic measurements from ships of opportunity are most desirable but should take into account where and when the data are actually needed. Filling in time and space holes in data coverage can be just as important to clients such as fisheries, and these holes can often be filled through ships of opportunity if managed properly.

7 Speaking on behalf of the IOC, Mr Holland recalled his involvement in the planning and implementation of the IGOSS programme during the early 1970’s. Considering the time that IGOSS has been trying to improve the operational collection of ocean data and broaden its application, he noted that a relatively small amount of effort and resources expended to date have produced significant achievements. Although IGOSS was conceived as a network of moored ocean buoys, initially the greatest contribution was from research vessels and the greatest need was to convince researchers of the advantages of sharing their data in an operational mode. Over the years, automated data collection from ships of opportunity has become increasingly important and this meeting reflects the trend.

8 Mr Holland discussed the evolution and success of the TOGA and WOCE SOO network in predicting El Niño events and the need to transfer the network into an operational programme. With the initiative of the Global Ocean Observing System (GOOS), it is the intention of governments to use existing systems and programmes whenever possible in its establishment. IGOSS is one of the obvious existing systems which have to produce and contribute to the new initiative.

9 Finally, Mr Holland proposed a vision that the maritime industry will someday adopt an automated communication system for cargo vessels, a capability. that already exists in some cases and would mirror systems already in place in the aviation industry. If such a “black box” concept is promoted globally, it will be a responsibility of IOC to help plan it’s design to incorporate environmental data as well. The environmental information would be stripped from the management data to prepare reports and predictions of ocean conditions to the ships. Mr Holland closed by wishing the meeting success in its deliberations.

1.2 ELECTION OF THE CHAIRMAN

10 Mr Dick Stoddart, National IGOSS Representative for Canada, was proposed as Chairman by the Representative of Australia. The nomination was seconded by the Representative from the United States. The Meeting unanimously supported the nomination.

1.3 ADOPTION OF THE AGENDA

11 The Meeting reviewed the Agenda and approved it with the exception of delaying Agenda Item 2.3 until the next-day arrival of the Representative from the CLIVAR Programme. The Agenda, as adopted by the Meeting, is reproduced in Annex I.

12 The List of Participants is given in Annex VI of this report.

1.4 WORKING ARRANGEMENTS

13 The Meeting adopted the work programme proposed by the local secretariat and agreed to adjust it as necessary.

1.5 ECONOMIC BENEFITS OF IGOSS

14 The Chairman presented a draft paper on the Economic Benefits of IGOSS Data that will be presented at IGOSS-VII in November 1995. The paper described the user community and the need to identify useful products from an operational oceanographic programme. A discussion followed and the meeting pointed out problems that arise when soliciting funding for operational oceanography. For example, many policy makers and users do not fully grasp the variability of the ocean and are often content with one-time sampling of an area, thinking that as long as spatial coverage is sufficient then further sampling is unnecessary.

15 Mr Holland stated that more work needed to be done on modeling techniques as is being done in WOCE to develop consistent, predictive models. He also felt that more use must be made of sporadic data in the models, which presently sometimes exclude data based on “undesired” locations.

16 Models require data to be included quickly after data collection and therefore rely heavily on real-time data. It was pointed out that both the Canadian and United States Navies use real-time data in their models.

17 The paper provides a framework to discuss the value of real time exchange of ocean data. For the most part the documented benefits refer to larger integrate-d data of which Ship of Opportunity data are a part. The benefits of prediction of such phenomena as El Niño are amply demonstrated in the paper, with costs related to damage and to dollars saved for improvements in predictive capability to specific sectors, such as agriculture. There are other examples, such as has been recently documented in a Canadian study on the potential benefits that could be realized from Canadian contributions to GCOS. But, while such predictions clearly rely on ship-of-opportunity data, benefits from improved climate prediction cannot be solely attributed to these data because they rely on larger data sets derived from additional observations from other sources, such as moored and drifting buoys and remote sensing data. That is, phenomena such as El Niño prediction need more than just ship-of-opportunity data, so the economic benefits resulting from such predictions have to be attributed to the various data collection systems, and this is exceedingly difficult to do. The problem is compounded when dealing with other real time ocean data users, such as fisheries, where competitive advantage plays a key role, or military applications where cost benefit considerations are hidden by other factors.

18 So how can we convince funding agencies that monies are well spent on probes, data exchange, real time ocean products, etc. from Ship-of-Opportunity programmes? Firstly we must rely on the research community and operational programmes to identify needs and cost effective monitoring strategies, and provide visible products that clearly demonstrate the utility of the programme. Secondly, we must encourage more cost benefit analysis, when individual circumstances present themselves, such as particular fishery requirements or climate prediction efforts such as El Niño. In this latter case, we should join forces with sister programmes in weather prediction, marine transportation, search and rescue, fate and effect of spills, etc., through larger integrated data sets, to demonstrate the necessity of the collection and exchange of systematic ship-of-opportunity data as a vital component of an overall strategy.

2. REQUIREMENTS FOR SUB-SURFACE THERMAL DATA

2.1 OOSDP REPORT - REQUIREMENTS FOR GOOS AND GCOS

19 The Meeting reviewed the requirements of the common climate modules of GOOS and GCOS (Global Climate Observing System) for upper ocean thermal data, as specified in the Executive Summary of the OOSDP (Ocean Observing System Development Panel) report. The Meeting discussed the role of the new End-to-End SOOP Management proposal in fulfilling the specific requirements for Upper Ocean Thermal sampling. The Meeting felt that the initial TOGA-WOCE low density network, as included with the IGOSS End-to-End SOOP Proposal needed to be re-evaluated for priorities by the scientific bodies providing guidance.

2.2 CWXXPPC MEETING RESULTS AND REQUIREMENTS

20 The results of the CWXXPPC (CLIVAR WOCE XBT XCTD Programme Planning Committee) Meeting held the week before were not available in final report form. The Meeting expressed concern about the future funding of the SOOP. This issue was originally raised at the last IGOSS SOOP Meeting in Hobart, Australia in 1993. Funding for the low density expendable bathythermograph (XBT) lines is in general only secured up to the end of 1996; indeed funding will be considerably reduced by mid 1996. This is mainly the result of the network being predominantly operated Up until now by the research communities (TOGA and WOCE).

21 With TOGA completed, and the field phase of WOCE almost completed, research funds are being re-directed to ongoing research activities. These communities cannot be expected to fund the continuation of the low density XBT lines as an operational programme. It is extremely difficult to maintain research funding in support of long time series measurements. The value and need of the low density XBT network for climate prediction has been well documented (see Ocean Observing Systems Development Panel Final Report). It is now time for this part of the SOOP to be supported by operational funds.

22 A draft list of recommendations from the CPWXXPP meeting was presented. The recommendations that had specific relevance to SOOP-VI are:

(i) The CWXXPP Committee expressed their support of the IGOSS End-to-End SOOP Proposal and suggested several changes to the proposal be made (see Agenda Item 3).

(ii) The Committee suggested that a global archive be created for upper ocean salinity data. It is essential to measure salinity data in boundary current regions, the Pacific warm pool, and high latitudes. In addition, other methods or instruments used to measure salinity should be placed on the GTS for users worldwide. This would include data from thermosalinographs and XCTDs.

(iii) The present TESAC and TRACKOB code forms cannot distinguish between temperature and salinity data from different instruments. The formats must be changed in the same way that the BATHY message has been modified.

23 The Meeting discussed these recommendations and agreed that these actions were necessary.

2.3 JGOFS, CLIVAR AND OTHER PROGRAMME REQUIREMENTS

24 There were no specific programme requirements issued by JGOFS (Joint Global Ocean Flux Study) to be addressed by the Meeting. However, the Meeting agreed that opportunistic data besides XBTs must be considered in the Ship-of-Opportunity Programme.

25 Dr Allyn Clarke gave a presentation on CLIVAR including its goals, scientific objectives, and emerging organizational structure. Relevant to SOOP was the new Upper-Ocean Panel (UOP) that, along with the GOOS Ocean Observation Panel for Climate (OOPC), will be asked to provide scientific guidance to the SOOP Steering Committee. Dr Clarke advised the meeting to take a proactive role in alerting these groups to the impending cessation of research funds to maintain an operational SOOP network. The Meeting agreed with this recommendation and acted on it (see Agenda Item 4.3).

3. IGOSS SOOP PLAN

3.1 INITIAL OPERATIONAL SOOP NETWORK

26 The initial operational SOOP network, as defined in the IGOSS SOOP Plan, is the low density TOGA-WOCE Network, which the OOSDP recommended be continued as a requirement of the GOOS/GCOS common module. The Meeting decided that a thorough review of the network is necessary, especially in the event that probes cannot be acquired in the optimal numbers presently specified. The total optimal number of required probes is presently computed to be 42,100 to operate the network. However, at present, only about half this number of probes is available to complete the existing WOCE XBT lines.

27 RECOMMENDATION: The appropriate scientific bodies of CLIVAR and GOOS review the lines and sampling in light of experience gained during TOGA and WOCE.

3.2 SOOPIP - TERMS OF REFERENCE AND ACTIVITIES
3.3 TRANSITION TO OPERATIONAL LINE MANAGEMENT

28 The Meeting considered these agenda items to be closely related and agreed to discuss them together.

29 Several problems, both organizationally and in regard to terms of reference were identified by the Meeting. The most important problem arose because the proposal itself seemed to be addressing both the specific needs of maintaining the low density XBT network and the concerns of other programmes and data types to be acquired on ships of opportunity in general.

30 The Meeting discussed the IGOSS SOOP proposal in detail and identified deficiencies and decided that revisions to the proposal and accompanying organizational diagram were needed. The proposal will be submitted to Dr Peter Dexter at WMO and to the Chairman of IGOSS for consideration prior to IGOSS-VII. Annex III contains the most recent proposal, as agreed upon at IGOSS-VII.

4. SHIP-OF-OPPORTUNITY LINE MANAGEMENT

4.1. STATUS OF EXISTING OPERATIONAL LINES
4.2 PLANNED AND PROPOSED LINES

31 The Meeting considered that these agenda items to be closely related and agreed once more to discuss them together.

32 Representatives of countries presented reports describing SOOP activities supported by them. The discussions reviewed activities since the last SOOP meeting and also activities from the beginning of the programme. The individual reports from the countries, because of their number, are included in a separate document referenced IOC/INF-1021 - Summary of Ship-of-Opportunity programmes and Technical Reports.

33 In general, it was noted that there were difficulties in maintaining the existing network. There were a number of factors responsible but largely these

were due to trying to maintain a long term monitoring programme on research funding (see Agenda Item 4.3)

34 The Representative of Australia stated that line 1X9 continues generally to be sampled only north of Sri Lanka. The lines in the Southern Ocean (1x23, 1X28, 1x29, and IX30) are operated by Antarctic supply and research vessels and operate only during the Austral summer months. The operation of these lines provides a very significant and invaluable contribution to the otherwise sparsely sampled Southern Ocean. Lines PX34 and PX30/31 in the Pacific are run in collaboration with the Scripps Institution of Oceanography (SI0), while line 1X28 is run in collaboration with SI0, ORSTOM, and the French Polar Institute. To date, the CSIRO SOOP has received most of its funding support from CSIRO appropriation and CSIRO Climate Research Programme funds, with significant contributions from the Royal Australian Navy, Australian Bureau of Meteorology, National Ocean Service of the US and SI0.

35 The report from Canada noted that while conducting only modest SOOP activities, the use of other platforms such as fishing vessels, and other programmes such as fisheries, biological and other cruises to collect data from waters of interest are regularly undertaken. Quite often these platforms are equipped with sensors such as ADCPs, which provide valuable information. This sort of opportunistic sampling can substantially augment data collected by the SOOP.

36 The French report noted that in the Pacific Ocean, the same lines will be operated as before; in the Atlantic Ocean, the lines AXO, AX26 will not be operated, and AX15 may have only 1 ship; and in the Indian Ocean, 1X6 will not be operated due to lack of a ship, and IX1O east of Sri-Lanka will be stopped due to over-sampling. They also described their development of a reliable thermosalinograph system. They also discussed plans to use INMARSAT-C for real-time transmission of the data.

37 The German report noted that most activities are research driven rather than being a formal German contribution to IGOSS. The funding will be reduced in 1996 and definitely end in 1997 for all WOCE related S00 lines. He noted additional sources of data (accounting for about 50% of the German data circulating on the GTS) were collected by their navy. Navy data are declassified some 14 days after collection. Roughly once per month, BSH receives a diskette with navy XBT data. Some of these data are older than 30 days when they arrive at BSH. The time-consuming procedure of declassification, data collection and data shipping by mail causes a considerable amount of the German Navy data to fail the IGOSS real-time definition. At BSH, there is only a provisional archive of real-time data. However, this is very provisional due to a lack of personnel and customers. Although the BSH high resolution data are archived very carefully, there is no present archive for the Navy data; one needs to be found. Details of the tests can be found in the report of the TT/QCAS meeting of October 23-25, 1995.

38 The Japanese report noted that the Japan Meteorological Agency (JMA) will continue XBT sampling on PX5 and PX51 through 1997, and PX49, 1X9 (north) and IX1O (east) through 1998. XBT sampling is funded by the Science and Technology Agency of Japan. He also described an automated XBT launcher which made operations much simpler to perform on certain ships.

39 The Representative from the United States described level or reduced funding over the next couple of years, but that the US will continue to monitor their assigned routes. The US Navy ceased providing XBTs to the SOOP effort in 1993, which had supported PX26 and several other Pacific lines. In light of this, NOS will continue to support PX26 as long as probes are available. It is estimated that support will continue until mid-1996. He also described the development and implementation of a new version of SEAS software and the use of INMARSAT STANDARD-C transmissions will proceed. It is becoming increasingly common for companies to move the routes of their ships from one part of the world to another and that this made it increasingly difficult to maintain sampling along TOGA-WOCE lines. In order to respond, NOS is developing a relationship with managers in various shipping companies so that they have early knowledge of changes in shipping and to seek alternative vessels to keep SEAS equipment deployed along sampling lines.

4.3 ANALYSES OF DEFICIENCIES AND PROPOSED SOLUTIONS

40 Included in the reports prepared by each country was a report of the deficiencies developing in the SOOP programme and these are the same problems noted by the CWXXPPC. Specifically it was noted that the end of the WOCE field programme occurs at the end of 1997 and that the TOGA-WOCE Low Density network has no secure funding beyond the end of 1996. In some countries, this translates into no funds to purchase probes while in others it is due to a shifting of research efforts and support personnel into other projects. Coverage has already been stopped or substantially reduced on a number of lines covering important regions for climate prediction. The lines affected are listed here (see the diagram of TOGA-WOCE lines in Annex III):

(i) Pacific: TRANSPAC (PX26), PX20-22, PX37-39, and PX43.

(ii) South Atlantic and Antarctic Circumpolar Current regions: AX12, AX15, AX17, AX18, AX22/25, and AX26.

(iii) Indian Ocean: IX6, the major part of IX9, part of IX1O, IX15, IX21, and IX8.

41 The Meeting prepared a short description of these line-sampling problems and faxed the information to the GCOS Committee that was meeting concurrently in Tokyo, Japan. A copy of the fax was also delivered to the Director, GOOS Support Office. This was to alert GOOS personnel of the urgent need to secure funding from national agencies to ensure further uninterrupted sampling of the network. The text of this fax message is contained in Annex IV.

42 RECOMMENDATION: The Joint Committee for IGOSS to encourage IGOSS National Representatives to pursue declassification of data collected by their navies and encourage these data to be inserted onto the GTS.

4.4 DATA FLOW MONITORING

4.4.1 Review of IGOSS/XBT-Related Monitoring Reports

43 The IGOSS Operations Co-ordinator reviewed six data monitoring reports and requested input on the format and utility of each report.

44 The Meeting suggested that further analysis of the monthly GTS statistics report is needed. The IGOSS Operations Co-ordinator will add additional rows in the report to compute the percentage of reports received by each country from the total number of reports input to the GTS by each country. It was requested that the six month line report be mailed in hard copy.

45 *ACTION: The IGOSS Co-ordinator to revise the GTS Monthly Statistics Report to include more analysis.*

46 It was also requested that a separate 6-month report be prepared by ship call sign in contrast to the present summary by track line. The report will include two additional columns. The first will list the total XBTs deployed and the second the total number of BATHY messages received at the GTSPP centre in MEDS. The total number of XBTs will be provided by the ship operators and the number of BATHYs received by MEDS.

47 *ACTION: The IGOSS coordinator to create* a *supplementary six-month report to include total XBTs deployed and the total number of BATHY messages received at GTSPP by ship* call *sign.*

48 These changes aside, the meeting concurred that all six reports provided useful information to the SOOP community and commended the work of the IGOSS Operations Co-ordinator. It was suggested that, due to high e-mail costs, reports eventually be located in an FTP area on the IGOSS Home Page. It was also agreed that there was no present need for an end-to-end data monitoring exercise that was to be considered at IGOSS-VII.

49 The Meeting was presented with the WMO/IGOSS data flow monitoring proposal to be presented to the Joint Committee for IGOSS to conduct a special monitoring of bulletins containing BATHY, TESAC and TRACKOB messages. The

Meeting was encouraged by the interest shown by the WMO in helping the oceanographic community identify problems in message routing. Because the volume of oceanographic data is small, data losses are strongly noticed. In order for this to be successful it is necessary for a number of countries to participate.

50 RECOMMENDATION: IGOSS National Representatives contact the appropriate agencies in their countries to inform them of the proposal and to secure their participation.

51 RECOMMENDATION: WMO accompany its data flow monitoring proposal at IGOSS-VII with documentation describing what will be required of participants so that they may judge the work required and estimate how soon they can be ready for the monitoring exercise.

52 RECOMMENDATION: The WMO data flow monitoring exercise be conducted over a two week period *separate* from the usual GTS monitoring period in October.

4.4.2 Global Temperature-Salinity Pilot Project

53 *Mr* Bob Keeley presented the work carried out by the GTSPP and this report is included in Document IOC/INF-1021 - Summary of Ship-of-Opportunity programmes and Technical Reports. The report noted that this project undertakes to improve the timeliness and quality of data made available to users. To do this, a variety of activities are required including acquisition of real-time data, pursuing delayed mode data in order that they "reach archives more quickly, standardizing quality control procedures at data centres, enlisting the support of the scientific community to undertake more quality control of the data, generation of products and data sets, and active monitoring of data flows. The presentation was slanted towards a discussion of efforts taken to manage the real-time data.

54 Since the start of the GTSPP, the number of BATHY messages has increased but this increase is due almost solely to the deployment of buoys in the TOGA/TAO array with thermistor chains. It also noted that the total number of TESAC reports is unchanged. A variety of statistics were presented regarding the quality of data reported, the timeliness of the data reaching archives, and the distributions of data collections in the various oceans. The report described data flow monitoring activities which are used to notify ship operators when the quality of real-time data needs attention. The report described a variety of users with requirements for daily, or weekly access to the data. The report also included a brief description of products that are issued regularly from the participating science centres.

55 RECOMMENDATION: GTSPP archive delayed-low resolution data to ensure that these data (such as are available from the German Navy) are not lost.

56 *ACTION: Operators send delayed-low resolution data to the GTSPP.*

4.4.3 WOCE IPO Monitoring

57 It was the intention of the Meeting to discuss the present data and line monitoring efforts by the WOCE IPO in preparation for the future transition to operational status of the low density XBT network. However, as the appropriate Representative of the WOCE IPO was unable to attend the meeting, information will be exchanged with the IGOSS Operations Co-ordinator. The Meeting supported the need for continuity in monitoring the network during the transition from research to operational mode.

5. EQUIPMENT

5.1 STATUS OF EXISTING COMMUNICATION AND DATA COLLECTION SYSTEMS

58 Mr Chris Noe of the USA gave a presentation on the status of INMARSAT STANDARD-C for transmitting oceanographic data. He reviewed the Automated Mutual-assistance VEssel Rescue (AMVER) system and compared GOES coverage with the new global (75 N to 75 S latitude) satellite coverage obtainable with INMARSAT STANDARD-C. He noted the problem that some ship captains prohibit

any connections to the bridge-located STANDARD-C unit which restricts access to the unit for the transmission of BATHY and other messages.

59 The Meeting discussed the limitations of ARGOS and GOES in transmitting oceanographic messages. It was suggested that national agencies consider changing over to INMARSAT STANDARD-C in place of ARGOS and GOES due to the reduced costs and greater flexibility of the system.

60 Mr Noe gave a thorough demonstration of the new SEAS software which showed the ease of operation. The system set-up and installation is menu driven and accommodates default values to reduce time spent recentering parameters. The data plot and message generation capabilities were also demonstrated. He reviewed the relative costs, benefits and data transmission capabilities of the present GOES system and STANDARD-C.

61 A brief discussion was held on the upcoming deadline for the transition to the new BATHY code on November 8, 1995. Many Representatives inferred that the transition would not be as smooth and immediate as hoped for due to organizational changes in their respective national agencies and/or problems with software of ship-board systems.

62 *ACTION: Operators convert to the new BATHY code form* as *soon* as *possible and ensure that information about probe types, recorders and fall rate coefficients is included.*

63 ACTION: *GTSPP and the IGOSS Operations Co-ordinator monitor the progress in converting to the new BATHY code form.*

5.2 INFORMATION ABOUT NEW DEVELOPMENTS (TSG's, XCTD's, ETC.)

64 Dr Allyn Clarke gave a presentation on the state of technologies for profiling the ocean. A table of these technologies and their respective capabilities and associated deployment costs was shown (included as Annex V). Dr Clarke focused on the moving CTD (MVCTD) probe that is being developed at Bedford Institute of Oceanography. The MVCTD is designed to obtain CTD-quality data while the ship is underway at full speed and is reusable for many deployments before changing batteries and servicing the wire. Future design improvements will include the automated deployment by computer on the bridge and auto-downloading, encoding and transmission of the data.

65 Mr Pierre Rual made a presentation on France's efforts and experiences with thermosalinographs (TSG) for obtaining sea surface temperature (SST) and sea surface salinity (SSS). It is known that SSS is important in understanding climate variability but SSS is not well sampled at present. Also, there are many meteorological parameters (such as cloud cover, sunlight intensity, wind speed, and rainfall intensity and duration) that are not satisfactorily measured that are necessary to resolve high frequency variations in SST and SSS.

66 Mr Pierre Rual also described the sampling system for TSGs and noted that installations are difficult and must be tailored to the design of individual ships. The system records the observations once every 5 minutes which is more frequent and accurate than bucket SST samples that are taken about every 6 hours. The price to purchase and configure a TSG is approximately US$ 15,000, including extra sensors, a GPS unit for navigation, and computer.

67 Mr Pierre Rual made a presentation on the TT/QCAS's results of comparisons between CTDs and Sparton T-7 probes in different areas of the world. While good agreement was obtained by samples taken by ORSTOM in the tropical Atlantic and Pacific Oceans and by Germany's BSH in the North Atlantic Ocean, there were unresolved disparities in samples obtained by NOAA and Sparton near Bermuda. It is probable that the probes meet specifications but more work needs to be done on the NOAA data set to explain the difference.

68 Mr Jim Hannon of Sippican, Inc. gave an update of his company's activities. Sippican is producing XBT's in Mexico. This move was made to reduce production costs of XBTs. The production plant will obtain ISO 9001 certification (for quality control) in November 1995. Mr Hannon then gave an overview of the XBT quality control procedures which Sippican employs in its production facilities. The Expendable Conductivity Temperature Depth (XCTD)

probes will continue to be made in the USA. A deep XCTD, good to 2,000 meters, has been developed for the French Navy but is limited to a vessel speed of ***3*** knots. To date, 1,200 such probes have been built and deployed. The Meeting requested that Sippican provide more detailed results on the XCTD tests at the TT/QCAS meeting for evaluation.

69 Dr Alexander Sy presented the results of his comparisons in the North Atlantic of XCTD probes and CTD measurements. His results reveal that the manufacturer of the MK-12/XCTD has made significant progress in design improvements. The system is at the point of meeting the claimed specifications. Unsolved deficiencies remain and include a slow conductivity start problem, the reduced conductivity accuracy at low pressure, and the inaccurate depth formula. He suggested that the XCTD depth fall rate should be one of the next actions taken by the IGOSS Task Team on Quality Control of Automated Systems.

70 Dr Alexander Sy also reported on XCTD measurements performed without serious problems on a commercial vessel along line AX3 just prior to the meeting. Due to the vessel speed of 15-19 knots and severe weather conditions, the mean depth range of the profiles was 600 m. The drop failure rate caused by software and hardware problems was 13% and about 50% of the total of 60 profiles showed startup problems of conductivity in the upper 10-50 m.

71 Mr Rick Bailey presented the Australian results of comparisons of XCTDs and CTD. He noted that there is still a problem with bubble-forming around the conductivity cell in the upper 50-100 meters depths. The bubble, which disappears at depth due to pressure, causes inaccuracies in the measurement of salinity in the upper layer. Conductivity calibration at depth appeared to be good. J. Hannon stated that Sippican is aware of the problem but it is a difficult “materials” issue to be solved and that wetting agents have been tried without success to date. The same depth-error problems that were detected earlier in XBTs also exist for the XCTDs.

72 Mr Tadashi Ando informed the meeting that TSK, Tsurumi Seiki Company has invented an XCTD that is based on an inductive conductivity cell. He showed the group a comparison of five probes but their agreement of the small scale structures in the profiles appeared to be very good. The probe has not obtained the necessary tolerance in salinity accuracy and there was an offset between the CTD profile and those from the XCTD. In addition there appeared to be no depth offsets or spikes.

73 These and other developments in instrumentation in recent years demonstrate very clearly the increasing role of commercial vessels in ocean research and monitoring. Because of the cost effectiveness of SOOs, several research institutions and commercial manufacturers have increased their development efforts significantly. The meeting noted this with satisfaction.

74 Detailed discussions on these matters will be held at the upcoming TT/QCAS meeting and results will be included in the final report of the meeting.

5.3 METEOROLOGY, SST AND SURFACE SALINITY MEASUREMENTS AS PART OF SOOP

75 The Meeting discussed the need for transmitting SST and SSS measurements in real-time but SST sensors are infrequently calibrated and SSS measurements are not yet entered as TRACKOB messages. These data would be extremely useful if the quality of the data were known. It was suggested again that delayed mode SSS data be archived and the use of TSGs, when available aboard ship, be promoted whenever possible.

76 RECOMMENDATION: GTSPP archive both real-time and delayed mode SSS data.

77 RECOMMENDATION: GTSPP archive TRACKOB messages and include these in their data exchanges.

78 *ACTION: IGOSS National Representatives encourage submission of SSS data in both TRACKOB messages and in delayed mode.*

79 *ACTION: Operators collect SSS data whenever possible and to submit them to the GTSPP.*

80 Germany has sent hull-mounted temperature data that was originally formatted as SHIP messages by VOS by re-formatting them into TRACKOB messages.

81 RECOMMENDATION: WMO consider whether SST sensors could be calibrated and the TRACKOB format be modified to indicate the type of sensor used.

5.4 IGOSS HOME PAGE AND SOOP APPLICATIONS

82 A demonstration of the IGOSS Home Page was given by the IGOSS Operations Co-ordinator. The URL (Uniform Resource Locator) of the IGOSS Home Page is:

http://www.unesco.org:8O//ioc/igoss/HOME/HTML

(this URL is case sensitive)

83 The Home Page is maintained in conjunction with the UNESCO and IOC Pages in Paris. The Meeting was asked to comment on the general idea of the Home Page and to suggest improvements and other information to be included. The Home Page was well received and the meeting concurred that there is a definite need for its existence, to pass information to the IGOSS community, general public and scientific community. Suggestions to improve both the format and content of the home page were offered and included assigning highest priority to providing FTP capability for the exchange of reports; including the Terms of Reference of IGOSS committees and other groups in the "Composition of IGOSS" section; and the use of a counter to monitor the number of home page users on a monthly basis.

84 The Meeting felt that the scope of the page should include IGOSS at large while offering more specific reports and features for the technical side of programmes such as SOOP. In addition, the Meeting insisted that the title of the page be "IGOSS Home Page" in the link from the GGOS Home Page until such time as a formal relationship is established between the two bodies.

85 *ACTION: The IGOSS National Representative for Canada to contact the IOC-WMO Secretariat to request* a *demonstration of the IGOSS Home Page at IGOSS-VII in November.*

6. DATA QUALITY

6.1 QUALITY CONTROL (QC) : AUTOMATED SHIPBOARD SYSTEMS

86 Mr Pierre Rual made a presentation about onboard QC procedures long used by Australian and French ships and shortly to be adopted on NOS operated ships. Only BATHY messages for temperature profiles that pass the onboard QC tests are sent to the satellite transmitter and the messages are computed only to the depth of the deepest "good" data point. The XBT profiles are despiked and low pass filtered prior to application of the data reduction method (broken stick) to determine significant data points. This *is* followed by a linear regression of the profile between the significant data points to reduce discrepancies between the BATHY message and the full profile. The QC software must be flexible enough to allow modification of the test parameters on a per-cruise basis should the ship transit to waters markedly different in temperature, such as the Arctic.

87 RECOMMENDATION: TT/QCAS address the question of using the above QC procedures in non-tropical waters.

88 Mr Pierre Rual also presented a paper about the French and Australian onboard QC procedures that gave more details of the filters and tests cited above. He stated that the 512 meter depth limitation for transmission via ARGOS continues to be a problem. Although the delayed mode, high resolution data are recorded as measured, the real time profile is insufficiently deep to delineate coastal boundary currents for transport modeling needs. The meeting noted that users of BATHY messages constructed using linear interpolation methods should reconstruct the full profile using the same linear interpolation between significant points.

89 RECOMMENDATION: Argos remove the limitation that constrains the transmission of information from a single XBT profile to 256 bits

and restricts the deepest depth to 512m. Removing this limitation will allow profiles to be reported to deeper depths and greater detail to improve general accuracy and to allow the transmission of information on probe type, recorder and fall rate equation coefficients.

6.2 QUALITY CONTROL PRIOR TO GTS INSERTION

90 Mr Herve Roquet of the marine forecast subdivision of METEOFRANCE made a brief presentation on QC procedures employed on oceanographic messages prior to insertion on the GTS at CLS-Argos and at the IGOSS Specialized Oceanographic Centre (SOC) in Toulouse. A processing chain has been developed and was implemented in 1987 at the SOC and in 1993 at Argos which performs a set of tests on the messages inserted onto the GTS. These tests check the syntax and content of the messages and are performed every working day, either automatically or by personnel with interactive software.

6.3 QUALITY CONTROL: QUIPS SYSTEM AND OTHER SHORE-BASED EQUIPMENT

91 Mr Rick Bailey presented a list of extracted recommendations form the Report of the WOCE Upper-Ocean Thermal (UOT) Data Assembly Centres (DAC) Workshop for Quality Control, held at Scripps Institution of Oceanography in May 1995. He gave an overview of data routing through the UOT/DAC and summarized the QC procedures that are employed at each science centre. From the list of recommendations that resulted from the meeting, there were four that had direct relevance to SOOP and were adopted by the meeting.

92 RECOMMENDATION: Operators include appropriate documentation of QC procedures and flags with the data.

93 RECOMMENDATION: Data originators submit all data (good and bad) and flag rather than delete bad data.

94 RECOMMENDATION: Data originators perform extensive QC on the collected data before submission to the data centres to ensure those with the best knowledge of the data collection programmes are part of the QC process.

95 RECOMMENDATION: Operators configure their data acquisition software to generate BATHYs with a high number of significant points because profiles with a high number of significant points are more suitable for QC.

RECOMMENDATION: XBT manufacturers provide information about storing and deploying XBTs which could be placed with the equipment on board ships. IGOSS to help spread the information as widely as possible.

96 Mr Chris Noe gave a short status report on the QUIPS QC software that has recently arrived at the NOS Observing Networks Branch (ONB). Because of organizational changes within NOS, the responsibility for maintaining the software is now ONB’s. Due to a lack of programmers, the branch will need some time to implement the software that was once done by the Ocean Product Branch in Camp Springs, Maryland. Likewise, the job of forwarding GTS statistics each month to the IGOSS Operations Co-ordinator will also fall under the purview of ONB. QUIPS is not ready to accommodate the new BATHY code yet but ONB will continue to work on the transition. Daily data transfer from the Fleet Numerical Meteorological and Oceanographic Center (FNMOC) in Monterey has also ceased due to the abolishment of NOAA personnel, computer equipment, and the removal of a data transmission line.

97 RECOMMENDATION: NOS restore the daily data transfers from FNMOC to NOS.

7. **TEMA-RELATED COMPONENTS**

98 While the Joint IOC-WMO Meeting for Implementation of IGOSS XBT Ships-of-Opportunity programmes has always supported the TEMA concept, there have never been resources in TEMA to take advantage of the plan. However, when the

need arises, member nations utilizing their own resources have participated in TEMA activities.

99 In the past two years, the United States-NOS SEAS programme has provided equipment and trained two people from Nigeria, two from South Africa, and one person each from Chile, Costa Rica, Kuwait and Singapore, in support of the SEAS Volunteer Observing Ships XBT network. The United States will continue this activity as the need arises and resources remain available.

100 There are many members of IGOSS that expressed a desire to attend the SOOP meeting but did not have funds available for travel. Among these ember States is South Africa, which is not a formal participant but which helps service SOOP ships. It has suggested that funding for the next SOOP meeting be increased to reflect this need. To increase participation by IGOSS Member States, the SOOP end-to-end management proposal considers this need under the section that details funding requirements.

101 RECOMMENDATION: Joint Committee on IGOSS recognize that increased funding for SOOPIP meetings is intended to encourage wider participation by representatives from interested Member States.

8. FUTURE WORK

102 The future work of the Committee is given both as a list of recommendations in Annex II, and as a list of action items in Annex VII.

9. DATE AND PLACE OF NEXT MEETING

103 The Meeting deferred decisions on the time and location of the next meeting until after the SOOP proposal was considered by IGOSS-VII.

10. CLOSURE OF THE MEETING

104 The IGOSS Operations Co-ordinator, on behalf of the IOC and WMO Secretariats, thanked Mr Stoddart for his effective chairmanship; Mr Keeley for the excellent meeting facilities and support provided by MEDS and for his contribution in preparing the summary report; and to all the participants for making the meeting productive and successful. The Meeting closed on the afternoon of Friday 20 October 1995.

ANNEX I

AGENDA

1. ORGANIZATION OF THE MEETING

1.1 OPENING OF THE MEETING

1.2 ELECTION OF THE CHAIRMAN

1.3 ADOPTION OF THE AGENDA

1.4 WORKING ARRANGEMENTS

1.5 ECONOMIC BENEFITS OF IGOSS

2. REQUIREMENTS FOR SUB-SURFACE THERMAL DATA

2.1 OOSDP REPORT - REQUIREMENTS FOR GOOS AND GCOS

2.2 CWXXPPC MEETING RESULTS AND REQUIREMENTS

2.3 JGOFS, CLIVAR AND OTHER PROGRAMME REQUIREMENTS

3. IGOSS SOOP PLAN

3.1 INITIAL OPERATIONAL SOOP NETWORK

3.2 SOOPIP - TERMS OF REFERENCE AND ACTIVITIES

3.3 TRANSITION TO OPERATIONAL LINE MANAGEMENT

4. SHIP-OF OPPORTUNITY LINE MANAGEMENT

4.1. STATUS OF EXISTING OPERATIONAL LINES

4.2 PLANNED AND PROPOSED LINES

4.3 ANALYSES OF DEFICIENCIES AND PROPOSED SOLUTIONS

4.4 DATA FLOW MONITORING

4.4.1 Review of IGOSS/XBT-Related Monitoring Reports
4.4.2 Global Temperature-Salinity Pilot Project
4.4.3 WOCE IPO Monitoring

5. EQUIPMENT

5.1 STATUS OF EXISTING COMMUNICATION AND DATA COLLECTION SYSTEMS

5.2 INFORMATION ABOUT NEW DEVELOPMENTS (TSG’s, XCTD’s, ETC.)

5.3 METEOROLOGY, SST AND SURFACE SALINITY MEASUREMENTS AS PART OF SOOP

5.4 IGOSS HOME PAGE AND SOOP APPLICATIONS

6. DATA QUALITY

6.1 QUALITY CONTROL (QC): AUTOMATED SHIPBOARD SYSTEMS

6.2 QUALITY CONTROL PRIOR TO GTS INSERTION

6.3 QUALITY CONTROL: QUIPS SYSTEM AND OTHER SHORE-BASED EQUIPMENT

7. TEMA-RELATED COMPONENTS

8. FUTURE WORK

9. DATE AND PLACE OF NEXT MEETING

10. CLOSURE OF THE MEETING

ANNEX II

LIST OF RECOMMENDATIONS

1. The appropriate scientific bodies of CLIVAR and GOOS review the track lines and sampling requirements of the original TOGA-WOCE Low Density XBT network in light of experience gained during TOGA and WOCE.

2. The Joint Committee for IGOSS to encourage IGOSS National Representatives to pursue declassification of data collected by their navies and encourage these data to be inserted onto the GTS.

3. IGOSS National Representatives contact the appropriate agencies in their countries to inform them of the IGOSS End-to-End SOOP Management Proposal and to secure their participation.

4. WMO accompany its data flow monitoring proposal at IGOSS-VII with documentation describing what will be required of participants so that they may judge the work required and estimate how soon they can be ready for the monitoring exercise.

5. The WMO data flow monitoring exercise be conducted over a two week period *separate* from the usual GTS monitoring period in October.

6. GTSPP archive delayed-low resolution data to ensure that these data (such as are available from the German Navy) are not lost.

7. GTSPP archive both real-time and delayed mode Sea Surface Salinity data.

8. GTSPP archive TRACKOB messages and include these in their data exchanges.

9. WMO consider whether Sea Surface Temperature sensors could be calibrated and the TRACKOB format be modified to indicate the type of sensor used.

10. TT/QCAS address the question of using the above QC procedures in non-tropical waters.

11. Argos remove the limitation that constrains the transmission of information from a single XBT profile to 256 bits and restricts the deepest depth to 512m. Removing this limitation will allow profiles to be reported to deeper depths and greater detail to improve general accuracy and to allow the transmission of information on probe type, recorder and fall rate equation coefficients.

12. (Ship) Operators include appropriate documentation of QC procedures and flags with the data.

13. Data originators submit all data (good and bad) and flag rather than delete bad data.

14. Data originators perform extensive QC on the collected data before submission to the data centres to ensure those with the best knowledge of the data collection programmes are part of the QC process.

15. Operators configure their data acquisition software to generate BATHYs with a high number of significant points because profiles with a high number of significant points are more suitable for QC.

16. XBT manufacturers provide information about storing and deploying XBTs which could be placed with the equipment on board ships. IGOSS to help spread the information as widely as possible.

17. NOS restore the daily data transfers from FNMOC to NOS.

18. Joint Committee on IGOSS recognize that increased funding for SOOPIP meetings is intended to encourage wider participation by representatives from interested Member States.

ANNEX III

SHIP -OF- OPPORTUNITY PROGRAMME CO-ORDINATION PLAN

I. INTRODUCTION

The goal of this co-ordination plan is to fulfill upper ocean data requirements which have been established by GOOS and GCOS, based on the results of programmes of the World Climate Research Programme (WCRP), and which can be met at present by measurements from ships of opportunity (SOO). With the cessation of these research programmes (e.g. TOGA and WOCE) the operation and funding of the data collection networks developed for them will cease unless some mechanism is established (under IGOSS, GOOS, or CLIVAR) to continue the management, funding and coordination of the activities. The plan proposes to make maximum use of existing operational mechanisms of IOC and WMO, most notably those of the Integrated Global Ocean Services System (IGOSS) and the International Oceanographic Data and Information Exchange (IODE) in the transition of the programme from research to operations. Specifically, these mechanisms are the co-ordination of operations of the IGOSS Ship-of-Opportunity Programme (SOOP) managers; the IGOSS Group of Experts on Communications and Products (GE/CP); the IODE Group of Experts on Technical Aspects of Data Exchange (GE/TADE); and the Global Temperature Salinity Programme (GTSP) Steering Group. Terms of reference and/or objectives for these bodies are given in Appendix 1.

II. JUSTIFICATION

The initial upper ocean thermal data requirements to be met by this proposal ate those which were developed by the TOGA and WOCE programmes for the low density XBT network (see Appendix 2), and endorsed by the WCRP Ocean Observing System Development Panel (OOSDP), The final report of the OOSDP has emphasized the value of long-term monitoring of upper ocean heat content using XBTs from ships of opportunity (SOO) for climate prediction. It recommended the operational maintenance of the existing TOGA and WOCE network. This represents an agreed base network, to be maintained operationally and on which research programmes can build as required. The XBT network is recognized at present as being one of the major means of obtaining upper ocean thermal data at the required spatial and temporal scales. The newly-formed GOOS/GCOS/WCRP Ocean Observation Panel for Climate (OOPC) will be charged to continuously assess these requirements for operations and research, taking into account new technological developments and scientific advances, in particular the work of the CLIVAR Upper Ocean Panel (UOP). The proposed terms of reference for both the OOPC and the UOP are also given in Appendix 1. The Intergovernmental Committee for GOOS has agreed that IGOSS should be responsible for the continued operational maintenance of the SOO programme, based initially on the continuation of the former TOGA/WOCE XBT network.

This implementation plan is therefore directed initially towards the continued operational maintenance and co-ordination of the low-density ship of opportunity network. This network in itself supports many other operational needs (such as for fisheries, shipping, defense, etc.) through the provision of upper ocean data for data assimilation in models and for various other ocean analysis schemes. The continuing challenge is to optimally combine upper ocean thermal data collected by XBTs from the SOO with data collected from other sources such as the TAO array and satellites (eg. AVHRR, altimeter, etc.).

It is recognized that there are observations other than upper ocean temperatures (such as salinities) which can be collected under the SOO programme. The report of the OOSDP identifies these as of importance to monitor climate related ocean changes. Likewise there are other programmes, such as those conducted by fisheries agencies or navies, which can augment the data collected through the SOO. The proposal has been designed to be flexible enough to accommodate these other measurements and programmes as the opportunities, technological capability and operational needs arise. However, initially it is considered most important to have the proposal focused on supporting climate prediction in order to ensure the continued operation of the present network. The use of the network to support climate prediction has already been clearly identified as a priority. The network maybe later extended to incorporate other observations and requirements as appropriate.

III. SOO PROGRAMME ORGANIZATION AND RESPONSIBILITIES

The plan calls for the establishment of an ad hoc Management Committee, co-sponsored by IGOSS, GOOS. GCOS and the WCRP, charged with the responsibility of managing the resources made available by contributing nations to meet the scientific requirements provided to it from GOOS, GCOS and the WCRP. The plan also calls for the formalization of a SOOP Implementation Panel within IGOOSS. This panel will have as one of its terms of reference, the requirement to support the SOOP Management Committee in implementing the scientific programme with the resources allocated from the Management Committee.

The two primary co-ordination bodies foreseen under the plan are detailed below.

A. IGOSS/GOOS/GCOS/WCRP SOOP Management Committee (SMC)

This Committee has as primary terms of reference:

(i) To co-ordinate and consolidate contributions of resources (expendable, ships, etc.) to the programme by national agencies;

(ii) To make decisions about which measurement requirements can/will be met within the constraints of available resources.

Specific responsibilities for the SMC include:

(a) Consider scientific and operational requirements (set by GOOS, GCOS and the WCRP) and develop an implementation plan based on these requirements and on resources available;

(b) Identify, recommend and co-ordinate individual agency support needed to execute the plan;

(c) Monitor the programme and ensure programme flexibility;

(d) Provide instructions and advice as necessary to the SOOPIP, as well as to other relevant technical bodies.

(e) Report regularly to the sponsoring bodies.

It is envisaged that the SMC will need to meet occasionally, but will largely work by correspondence (e-mail and fax). The initial membership of the SMC will include:

The Chairman of IGOSS (will chair the SMC),
Representatives of scientific advisory bodies (e.g. UOP, OOPC),
Representatives of each agency contributing resources,
A representative of the IOC/WMO Secretariats,
The Chairman of the SOOPIP.

B. SHIP OF OPPORTUNITY PROGRAMME IMPLEMENTATION PANEL (SOOPIP)

A SOOP Implementation Panel will be established within IGOSS, consisting of operators from the various contributing national agencies, and the IGOSS Operations Co-ordinator, to oversee the implementation and co-ordination of the operational aspects of the SOO network. Specifically, the Panel will be an extension and formalization of the present informal, biennial meetings of IGOSS SOOP managers, which have been in existence for ten years. The SOOPIP will have the following responsibilities:

(i) Monitor and co-ordinate the observations to maintain the specified scientific sampling strategy, under the overall guidance of the SMC;

(ii) Ensure the distribution of available programme resources to ships to meet the sampling strategy in the most efficient way;

(iii) Co-ordinate the installation of shipboard recording equipment and ship greeting operations;

(iv) Ensure transmission of low resolution data (profiles represented by inflection points) in real-time (within 30 days of collection) from participating vessels;

(v) Ensure that delayed mode high resolution (profiles sampled at 1 or 2 m resolution) data are checked and distributed in a timely manner to the data processing centres;

(vi) Maintain, in conjunction with the IGOSS Operations Co-ordinator, an inventory of participating vessels, operators, on-board instrumentation, data accuracy, etc.;

(vii) Provide general guidance to the IGOSS Operations Co-ordinator in his support for the SOO;

(viii) Promote the exchange of technical information on equipment and expendable development, functionality, reliability, and accuracy;

(ix) Liaise with other IGOSS groups and the WMO VOS programne as required;

(x) Establish *ad hoc* task teams to address such issues as:

(a) accuracy of hardware and software used in the SOO programme;

(b) data quality control procedures for shipboard instrumentation, and other data quality control issues raised by the SOOPIP;

(c) specifications for modifications to data transmission codes and general data formats, on the basis of other findings of the task teams;

(xi) Investigate, develop and implement new technology and techniques in data collection, processing and transmission, co-operatively with the IGOSS GE/CP and IODE GE/TADE;

(xii) Provide information to the SMC and relevant scientific groups on sampling success. availability of ships for requested routes, etc.

IV. DATA COLLECTION AND EXCHANGE

The existing IGOSS GE/CP and the new SOOPIP collectively have terms of reference which cover most aspects of SOOP data collection and exchange (see Appendix 1). If necessary, these terms of reference can be further expanded to ensure that all SOOP requirements are satisfied.

Standards, Codes and Software

Standards and procedures exist for on-board, real-time and high resolution (often delivered in delayed-mode) report compilation and transmission, as do codes for real-time data transmission and exchange (BATHY. TESAC, TRACKOB, BUFR). These will all be maintained and further developed as necessary. Procedures will be put in place to ensure compliance with these standards and codes. Software and equipment for automated report compilation, quality control and transmission already exist and are in widespread use (e.g. SEAS). These will be progressively extended, and new software developed as the need arises.

Communications

Existing communication facilities for data collection and exchange include INMARSAT, Argos, coastal radio (real-time, low resolution data collection), and the GTS, Internet, etc. (both low and high resolution data exchange). Procedures are already well established within WMO for ensuring the most effective use of these facilities, as well as for enhancing cost-efficiency and accuracy of data transmission for both meteorological and oceanographic data, These procedures will continue to be applied to the SOOP data, and further refined as the need arises,

Monitoring

Extensive monitoring of both low and high resolution oceanographic data transmission and exchange is now undertaken by the IGOSS Operations Co-ordinator, the research community (e.g. WOCE Data Information Unit), the GTSP and WMO (main GTS centres and the Secretariat), in conjunction with ship operators. This monitoring will continue to be applied to SOOP data, with new monitoring procedures and analyses being developed and applied as necessary. Results of all monitoring will be provided on a routine basis to programme operators, communication agencies and the SMC. Monitoring efforts will be co-ordinated by the IGOSS Operations Co-ordinator, with guidance from the SOOPIP.

V. DATA MANAGEMENT

The data management of the project will be handled with procedures and resources most of which are currently in place and used to support the Global Temperature and Salinity Programme (GTSP), including regional upper ocean science centres, and the existing IGOSS Specialized Oceanographic Centre (SOC) network. The Marine Environmental Data Service (MEDS) in Canada is the GTSP centre responsible for collecting temperature and salinity data from the GTS on a daily basis. The data are passed through well documented quality control procedures as well as procedures to detect and remove duplicates. The GTSP regularly monitors the volumes, timeliness and quality of data received in real-time.

The assembly and incorporation of delayed mode data into the GTSP data stream in a timely manner is an essential activity. Experience has shown that significant amounts of real time data are not being replaced with high resolution versions and that large quantities of additional data are only available in delayed mode. While these data are not available for operational use, they are critical for climate products and research. The responsibility for tracking and submission of delayed mode data is entrusted to SOOPIP, which will work closely with IODE and the research community, e.g. WOCE IPO, to ensure that these data are submitted within one year of observation, as required by IODE.

Because the data management aspect of this SOOP proposal makes use of existing linkages between data archives and oceanographic and meteorological research centres, the products currently available through the GTSP would continue in support of the project. Details of GTSP data management are given in Appendix 4.

The IGOSS SOC network both contributes to and receives data and products from the GTSP. Both the GTSP and the SOCs prepare and deliver products directly to end users, and these functions and procedures will continue as essential components of the plan,

VI. RESOURCES

Estimates of the resources required, both at the national and international levels, to implement the plan and achieve the initial objectives, are given in Appendix 5. These resources include, at the national level, items such as on-board equipment and expendable, logistics and personnel, and data management costs. Secretariat resources will be required to support the operations of the international bodies charged with programme management and maintenance.

VII. SUMMARY

A diagrammatic representation of the proposed SOOP management is given in Appendix 3.

Appendix 1

Existing Bodies and programmes to Support the SOOP Plan

IGOSS Group of Experts on Communications and Products

(i) To evaluate any technological development with potential applications to the operational exchange of ocean data and products;

(ii) To consider requirements, system characteristics and computer techniques for the operational exchange of ocean data and products;

(iii) To investigate methods of product formulation and provision of services to users;

(iv) To review the status of IGOSS publications;

(v) To undertake any other tasks assigned by the chairman of the committee,

Global Temperature Salinity Programme Objectives

(i) To create a timely and complete data and information base of ocean temperature and salinity data of known quality in support of the World Climate Research Programme (WCRP) and of national requirements;

(ii) To improve the performance of the IOC IODE and IOC/WMO IGOSS data exchange systems by actively pursuing data sources, exercising the data inventory, data management and data exchange mechanisms as they are intended to work, and recommending changes where necessary to meet national and international requirements;

(iii) To disseminate, through a widely distributed monitoring report produced on a regular basis, information on the performance of the IODE and IGOSS systems;

(iv) To improve the state of historical data bases of oceanographic temperature and salinity data by developing and applying improved quality control systems to these data bases;

(v) To improve the completeness of these historical data bases by the digitization of historical data presently in analogue or manuscript form and by including digital data not presently at a World Data Centre (WDC);

(vi) To distribute copies of portions of the database and selected analyses to interested users and researchers.

IODE Group of Experts on Technical Aspects of Data Exchange

(i) To evaluate and support the demands on IODE for new technical solutions for oceanographic data exchange, particularly with reference to the needs expressed by the Ocean Climate Data Workshop;

(ii) To collaborate with IGOSS GE/OTA and the data management groups of other international bodies and scientific programmes in the development of technical solutions to support the management and exchange of oceanographic data;

(iii) To keep under review the formatting systems being used in the exchange of oceanographic data and ensure the proper development of such systems in support of the needs of IODE, of scientific programmes and for the development of GOOS;

(iv) To provide advice and guidance on the use of the GF3 formatting system, maintain and develop the system including its code tables, documentation and supporting software;

(v) To continually review the impacts of new technologies which increase capabilities in data collection and the integration and co-management of both data and information on these collections, to identify opportunities and propose solutions for the evolution of the IODE system in light of these developments;

(vi) To compile and maintain an inventory of software and expertise available from members of the IODE system which maybe freely exchanged and which maybe used by other members of the system to enhance their products and services capabilities.

CLIVAR Upper Ocean Panel

Preamble

CLIVAR has as one of its objectives, to describe and understand the physical processes responsible for climate variability and predictability on seasonal, interannual, decadal and centennial time-scales, through the collection and analysis of observations and the development and application of models, CLIVAR should build on the knowledge gained from TOGA and WOCE to develop observing systems that will meet its needs.

For the seasonal-to-interannual time scales CLIVAR needs to build on the TOGA Observing System which is already in place and, where appropriate, extend the observing network to other parts of the global domain and identify the optimal mix of measurements from the various available platforms. In particular CLIVAR needs to assess the requirements for ENSO prediction systems and develop strategies for ameliorating any deficiencies.

The ongoing WOCE programme has a significant upper ocean requirement involving many different measurements and platforms contributing to the determination of the global ocean circulation and providing estimates of the variability in the upper ocean circulation and transports. CLIVAR also needs to identify the appropriate mix of upper ocean measurement platforms and data types to fully describe variability at decadal and longer time scales.

An extensive and comprehensive scientifically-based design of an ocean observing system for climate has been reported on by OOSDP (1995), and should be recognized by the panel. [The Ocean Observing System Panel (OOSDP), 1995: “Scientific design for the common module of the Global Ocean Observing System and the Global Climate Observing System: An Ocean Observing system for Climate. ” Texas A&M Univ, College Station, TX. 265 pp]

This Panel must be aware of the various platforms and measuring techniques available but should aim to refine and implement an observational system which responds to user requirements for specific fields or quantities, rather than instrumental capabilities, The Panel should seek synergism and, where possible, tradeoffs amongst the available observing techniques to produce an effective, but efficient, upper ocean observing system compatible with the scientific objectives of CLIVAR. The Panel should be prepared to advise on optimal observing strategies compatible with the resources available.

For the purposes of this task, the upper ocean is defined to include that part of the ocean involved in the seasonal cycle and interannual variability as well as associated effects at the decadal scales.

Terms of Reference

(i) To assess and evaluate the effectiveness of the observing system by examining actual data flow and related products of the CLIVAR research programmes, in particular data assimilation products and, as appropriate, operational products and to provide advice on optimal observing strategies compatible with the resources available;

(ii) To determine observational requirements for experimental and operational ENSO prediction systems, develop strategies for ameliorating any deficiencies, and determine appropriate levels of redundancy within the upper ocean measurement system by taking into account other information sources such as wind stress and sea surface temperature estimates;

(iii) To evolve an implementation strategy for an upper ocean observation system based on a mix of physical variables (temperature, salinity, sea level and velocity) and measurement platforms to meet the scientific requirements of CLIVAR in light of existing and new technologies and the emerging operational observing systems of GOOS/GCOS;

(iv) To advise the CLIVAR SSG and WOCE SSG on the status of the upper ocean observing system and related products, and to liaise with the CLIVAR NEGs, CLIVAR/GCOS TAO IP, WOCE SMWG and WOCE DPC as appropriate;

(v) To liaise with GOOS/GCOS and. in particular the OOPC in regard to operational and quasi-operational systems and products.

Ocean Observations Panel for Climate

(i) To evaluate, modify and update, as necessary, the design of the observing system for the common module of GCOS and GOOS whose goals are:

to monitor, describe and understand the physical and biogeochemical processes that determine ocean circulation and the effects of the ocean on seasonal to multi-decadal climate change, and

to provide the information needed for climate prediction

(ii) To provide a procedural plan and prioritization for an integrated set of requirements consistent with the observing system design criteria, thereby also drawing from findings of the World Ocean Circulation Experiment (WOCE) and the Tropical Ocean-Global Atmosphere Programme (TOGA), and in a form that enables timely and effective implementation.

(iii) To liaise and to provide advice, assessment and feedback to other panels and task groups of GCOS, GOOS and WCRP as requested concerning ocean observing for climate in order to ensure that the designs and implementation schedules are consistent and mutually supportive.

(iv) To establish the necessary links with scientific and technical groups to ensure that they are cognizant of, and can take advantage of the recommended system and that, in turn, the Panel can benefit from research and technical advances.

(v) To carry out agreed assignments from and report regularly to the JSTC, J-GOOS and the JSC for the WCRP.

Appendix 2

WOCE and TOGA Low density XBT Lines

Following are the WOCE and TOGA low density lines with their respective required number of observations per year (monthly sections with 4 observations per day; approximately 1 XBT per 150km each month). The list contains all lines that are part of the WOCE and TOGA networks, though not all are both (for example, Pacific coastal sections are not WOCE, and high latitude lines are not TOGA). The complete list of TOGA/WOCE/IGOSS (TWI) lines includes further lines which are not considered required WOCE or TOGA lines,

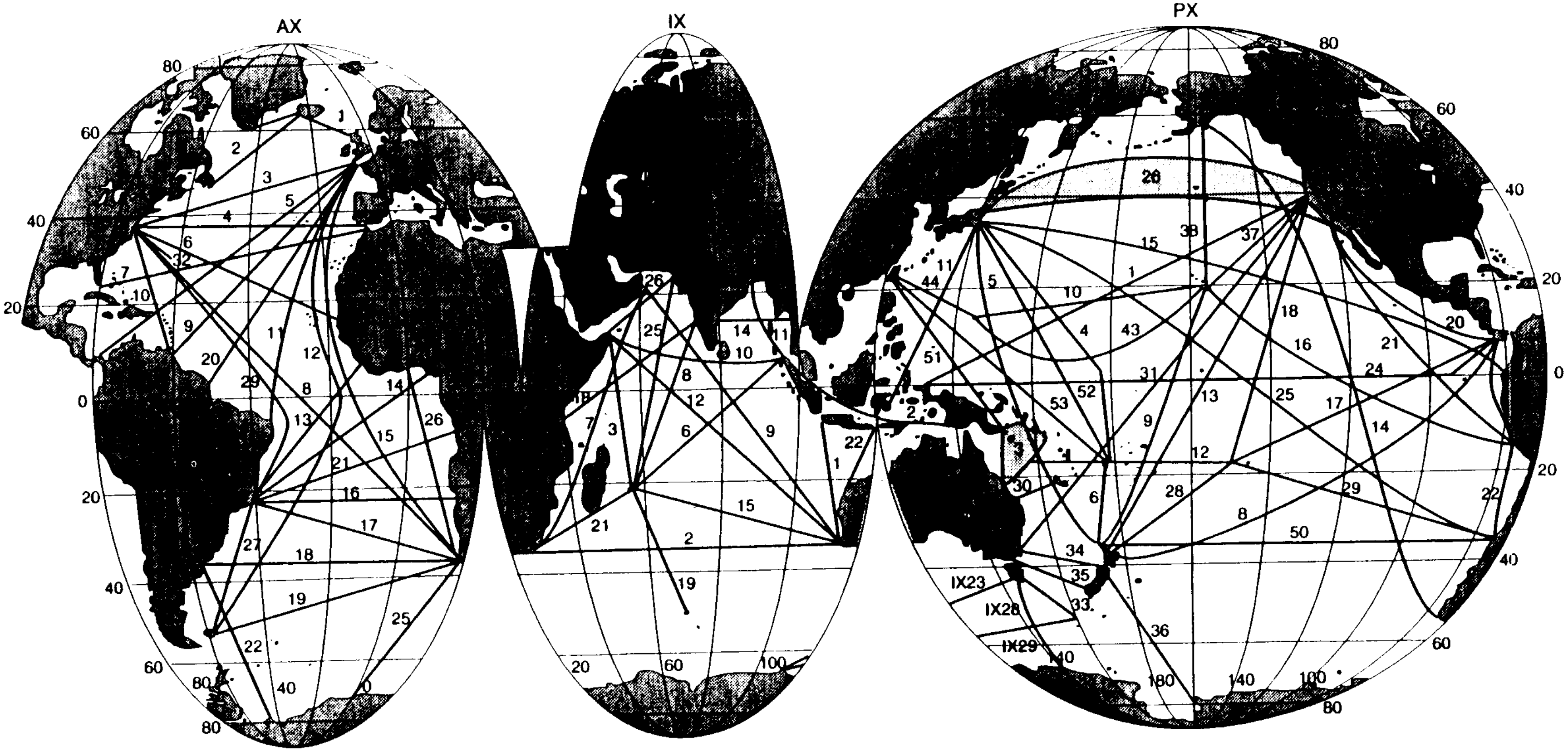
The entire WOCE and TOGA low density network requires 43060 XBTs per year for complete coverage.

Line	Route	SOOP LD/Yr
AX0	Iceland - Mediterranean	
AX0l	Greenland - Scotland/Denmark	160
AX02	Newfoundland - Iceland	200
AX03	Europe - New York	400
AX04	New York - Gibraltar/Lisbon	440
AX05	Europe - Panama Canal	650
AX06	New York - Dakar	420
AX07	Gulf of Mexico - Gibraltar	520
AX08	New York - Cape of Good Hope	960
AX09	Trinidad - Gibraltar	500
AX10	New York - Trinidad Caracas	200
AX11	Europe - Brazil	560
AX12	Europe - Antartica	800
AX13	Rio - Monrovia (Liberia)	200
AX14	Rio - Lagos (Nigeria)	310
AX15	Europe - Cape of Good Hope	650
AX16	Rio - Walvis Bay	420
AX17	Rio - Cape of Good Hope	430
AX18	Buenos Aires - Cape of Good Hope	480
AX19	Cape Horn - Cape of Good Hope	480
AX20	Europe - French Guyana	440
AX21	Rio - Pointe Noire/Luanda	400
AX22	Argentina - Antarctica	220
AX25	Cape of Good Hope - Antarctica	220
AX26	Lagos, Nigeria - Cape of Good Hope	320
AX27	Brazil - Cape Horn	400
AX29	New York - Brazil	360
AX32	New York - Bermuda	120
IX01	Fremantle - Sunda Straits	240
IX02	Cape of Good Hope - Fremantle	520
IX03	Red Sea - Mauritius/La Reunion	240
IX06	Mauritius/La Reunion - Malacca Strait	340
IX07	Cape of Good Hope - Persian Gulf	480
IX08	Mauritius - Bombay	320
IX09	Fremantle - Persian Gulf	650
IX10	Red Sea - Malacca Strait/Singapore	310
IX11	Calcutta - Java Sea	320
IX12	Fremantle - Red Sea	700
IX14	Bay of Bengal	140
IX15	Mauritius - Fremantle	380
IX18	Mombasa - Bombay	220

IX19	La Reunion - Amsterdam/Kerguelen	240
IX21	Cape of Good Hope - Mauritius	180
IX22	Fremantle - Timor Strait/Banda Sea	120
IX23	Hobart - Casey Station (Antarctica)	180
IX25	Mauritius - Karachi	360
IX26	Red Sea - Karachi	190
IX28	Hobart - Dumont D'Urville (Antarctica)	180
IX29	Macquarie Island - Casey Station (Antarctica)	180
PX01	California - Indonesia	860
PX02	Flores Sea - Torres Strait	320
PX03	Coral Sea	160
PX04	Japan - Kiribati - Fiji/Samoa	500
PX05	Japan - New Zealand	560
PX06	Suva, Fiji - Auckland	160
PX08	Auckland - Panama	700
PX09	Hawaii - Noumea/Auckland	440
PX10	Hawaii - Guam/Saipan	440
PX11	Flores Sea - Japan	320
PX12	Tahiti - Coral Sea	370
PX13	New Zealand - California	770
PX14	Alaska - Cape Horn	1080
PX15	Ecuador - Japan	960
PX16	Peru - Hawaii	680
PX17	Tahiti/Mururoa - Panama	530
PX18	Tahiti - California	440
PX20	California - Panama	370
PX21	California - Peru	500
PX22	Panama - Valparaiso	360
PX23	Mexico - 115W	60
PX24	Panama - Indonesia	1200
PX25	Valparaiso - Japan/Korea	1320
PX26	TRANSPAC	5500
PX27	Guayaquil - Galapagos	120
PX28	Tahiti - Sydney/Auckland	240
PX29	Tahiti - Valparaiso	560
PX30	Brisbane - Noumea	120
PX31	Sydney - Noumea - California	880
PX33	Hobart - Macquarie Island	130
PX34	Sydney - Wellington	140
PX35	Melbourne - Dunedin	140
PX36	Christchurch - McMurdo	400
PX37	Hawaii - California	340
PX38	Hawaii - Alaska	320
PX39	Hawaii - Seattle/Vancouver	320
PX43	Hawaii - Marshall Is. - Guam	440
PX44	Taiwan - Guam	160
PX50	Valparaiso - Auckland	720
PX51	Taiwan/Mindanao - Coral Sea/New Caledonia	360
PX52	Japan - Fiji	540
PX53	Taiwan/Mindanao - Fiji	540
PX76	Costa Rica Coast	60
PX77	Peru Coastal	60
PX78	Peru Coastal	60
PX79	Valparaiso - 80W	60
Total		43060

Low Density Network

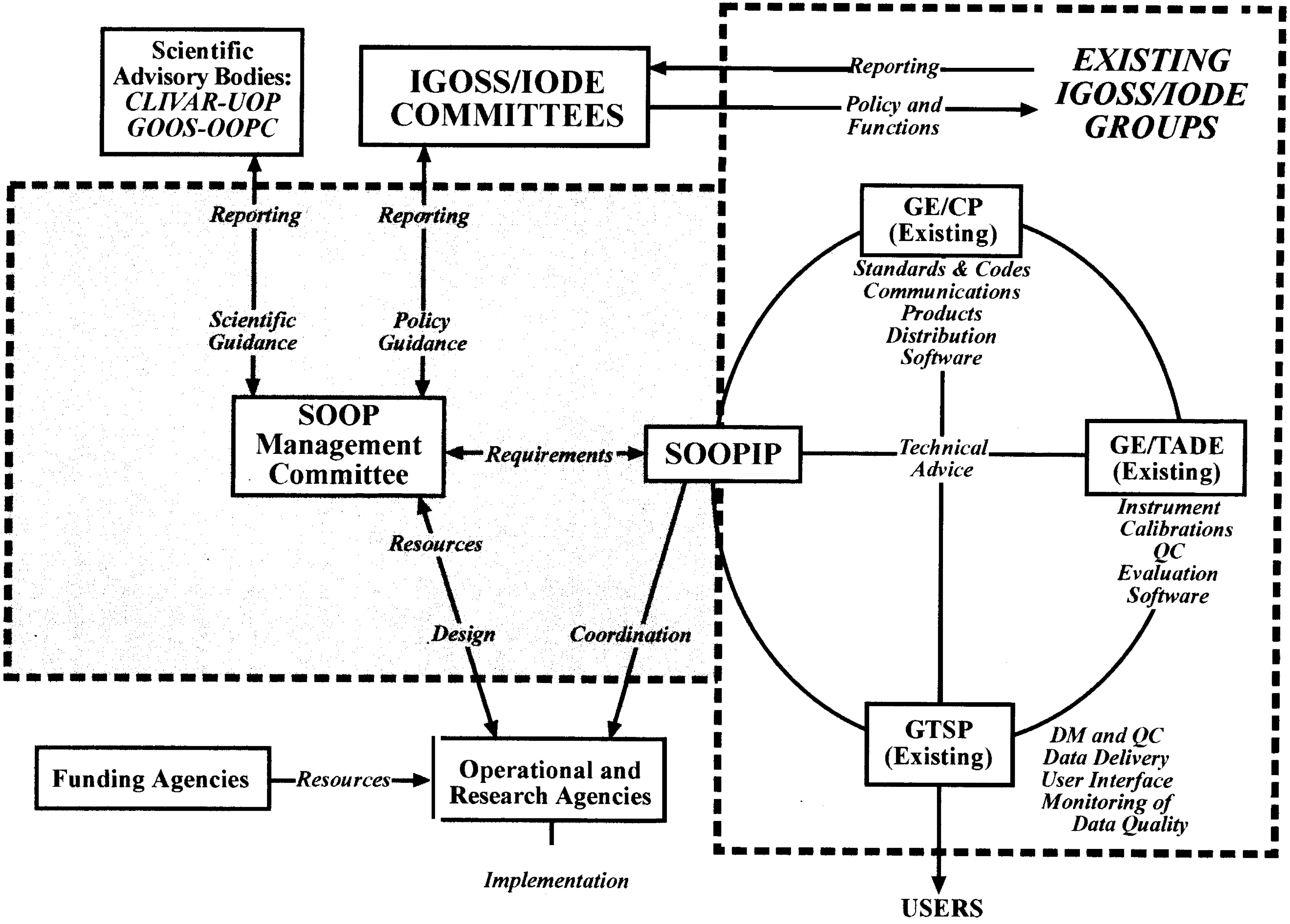
WOCE/TOGA Low Density Lines



Appendix 3

Ship-of-Opportunity Programme Management

SHIP OF OPPORTUNITY PROGRAMME MANAGEMENT



Appendix 4

GTSP Data Management

The red-time data acquired from the Global Telecommunications System are processed by MEDS each working day. These data are then passed to the US NODC three times per week to be added to the Continuously Managed Database (CMD). The CMD ensures that all data are made available at the highest level of quality possible at the time of request. This is carried out by US NODC through the acquisition and processing of high resolution data received in delayed mode. The data are passed through GTSP quality control and duplicates checking to identify the real-time data based on the high resolution data. The real-time data are then replaced by the higher quality, higher resolution data received in delayed mode.

At the end of each month, the GTSP reviews the statistics of failures of quality control tests for all real-time data received and notifies the IGOSS Operations Co-ordinator and the WOCE International Project Office. The IGOSS Operations Co-ordinator then contacts the operators of the ships noted as having problems to inform them and seek their help in remedying the problems. On the same schedule, information about the performance of the GTS will be relayed to WMO for their information and action.

Once per year high resolution data are sent to science centres (AOML, CSIRO and Scripps), where the data are passed through scientific quality control in order to generate such products as sea surface temperature and mixed layer depths and to be used in coupled ocean-atmosphere models. It is envisaged that at the end of WOCE, the expertise developed at these centres will be passed on to a single data processing centre, yet to be identified, but which should be established as part of the IODE system.

As data quality is checked, any problems noted in the data are referred back to the originators for resolution whenever this is possible. Sometimes there is a significant delay between the data collection and receipt of the data at the CMD which impedes this referral process. In general, however, with TOGA/WOCE data the delay is on the order of a few months to two years.

With voluntary observing ships, the high resolution XBT profiles collected with SEAS and similar automated or semi-automated equipment are available as soon as the ship is met in port. The diskettes are forwarded to the US NODC and processed immediately. The delayed-mode data entering the CMD become available for international data exchange through the participation of GTSP data centres in IODE. They are available to anyone with an interest.

The management of data exchange issues, such as finding ways to improve data exchange, are the responsibility of established groups of experts in IGOSS (the Communications and Products Group) and in IODE (the Group of Experts on Technical Aspects of Data Exchange), as well as possible groups to be established under GOOS and GCOS in the future. Both the CP and TADE groups have as a responsibility the task to improve the volume, timeliness and quality of data reaching the world data archives. As such, discussions are constantly undertaken to try to improve these aspects of data exchange.

In the long-term, quality control of real-time data will effectively be achieved as an integral part of the 4-D data assimilation schemes run by operational climate modelling and prediction centres.

There are plans by the GTSP to issue CD-ROMs of the data sets and all documentation for the project. The issue date of the first is early 1996. These CD-ROMs will be available at a price sufficient to cover costs of reproduction. Other plans are to post electronic copies of both data and products and these will be available to all users with Internet capabilities.

The TADE group of IODE has initiated plans for World Wide Web sites devoted to data and information of the IOC system. While plans are still being formulated it is expected that these will contain data and both scientific and data monitoring products. It is expected that the IGOSS Products Bulletin will be made available through this system.

The following statistics are presented for the real-time data received and archived by the GTSP since the start of the project. The first table shows the volumes of real-time data handled by the GTSP. The column labelled

BATHYs is the total number of BATHY messages (ships + buoys) received. The column labeled Buoys totals the number of temperature profiles received as BATHYs from moored buoys,

The second table shows the numbers of real-time and delayed mode data in the CMD (as of mid-1995). Delayed mode data' in the CMD have replaced approximately 50% of the data in the early 1990s, with less replacement in more recent years

Quarter-Year	BATHYs	Buoys	TESACs
Jan-Mar '91	8207	352	612
Apr-Jun '91	8449	793	1089
Jul-Sep '91	8298	757	476
Oct-Dec '91	11174	1419	701
Jan-Mar '92	11800	2784	345
Apr-Jun '92	11114	2761	754
Jul-Sep '92	11697	2554	595
Oct-Dec '92	12043	4032	1147
Jan-Mar '93	13973	4775	862
Apr-Jun '93	16046	6414	1707
Jul-Sep '93	16808	6262	1554
Oct-Dec '93	15386	5254	2000
Jan-Mar '94	14588	4612	1119
Apr-Jun '94	15149	6317	1517
Jul-Sep '94	14516	6848	1344
Oct-Dec '94	16081	7013	1193
Jan-Mar '95	16157	6509	853
Apr-Jun '95	18814	3623	1042

Year	Delayed	Real-time
1990	38411	33290
1991	30020	30489
1992	14158	44050
1993	18582	57168
1994	7196	60450

Appendix 5

Resources

This appendix summarizes what resources are required to implement the plan, to achieve the initial objectives and to maintain the network as an operational activity. It divides these requirements into those that are expected to be funded by national contributions to the proposal and those which must be funded internationally by the IGOSS Secretariats with the acceptance of this plan.

A. NATIONAL CONTRIBUTIONS

Operational

On-board equipment and probes - The full implementation of the low density network requires equipping a minimum of 150 ships ($2000/ship/year) and 42,000 probes ($2 million/year).

Logistical and Personnel support - This includes such items as salaries, shore facilities, equipment, processing software development, etc.

Data Management

Data transmission - existing costs borne by meteorological and oceanographic agencies (coastal radio, INMARSAT, GTS, Argos) as part of their normal operational activities.

Data processing/archival - MEDS supports the GTSP by maintaining the necessary infrastructure to acquire data from the GTS, then process, archive and exchange these data, This is MEDS contribution in support of this plan.

Products and services - GTSP will support the plan through current activities of the programme. Data will be supplied upon request to agencies which require fast delivery of real-time data. Products and services are expected to be disseminated by national agencies. IGOSS SOCs will continue and augment existing services in support of the plan.

B. SECRETARIAT RESOURCES TO SUPPORT SOOP PLAN MEETINGS IN THE FIRST BIENNIUM

All costs are based on a biennium. Figures for required finding take into consideration that the present international programme management is under-funded. Costs also assume that it may be necessary to have two meetings of the SMC initially, but that thereafter, a meeting every two years would be sufficient.

Requirements

SMC - two meetings US$ 20,000
SOOPIP - one meeting US$ 30,000 (for increased participation)

Funding required for SMC and SOOPIP in 1996-97 will be found partly through re-allocation of existing IGOSS programme funds, coupled with limited support from GCOS, GOOS and the WCRP, as co-sponsors of the SMC. In the longer term, all SOOP management requirements will be met under the IGOSS programme of IOC-WMO.

ANNEX IV

FACSIMILE **FROM THE SOOP MEETING TO THE I-GOOS COMMITTEE**

To: **The I-COOS Committee Meeting, Tokyo, Japan**
From: **IGOSS Ship-of-Opportunity Meeting, Ottawa, Canada**
CC: **Prof. D.Kohnke, Chairman, IGOSS**
A. Frische, WOCE International Project Office

During the IGOSS Ship-of-Opportunity Program (SOOP) Meeting, which is presently being held at the Marine Environmental Data Service (MEDS) in Ottawa, Canada, a number of important issues concerning the immediate future of the SOOP have arisen which we feel need to be brought to the attention of the I-GOOS Committee. These issues were also raised at last week's meeting of the CLIVAR/WOCE XBT XCTD Program Planning Committee (CWXXPPC) . We forward the following information to you now in this form, as it felt many of the issues require your urgent consideration. Full reports from both meetings will be available in the near future.

In both meetings considerable concern was once again raised about the future funding of the SOOP. This issue. was originally raised at the last IGOSS SOOP Meeting in Hobart, Australia in 1993. Funding for the low density expendable bathythermograph (XBT) lines is in general only secured up to the end of 1996; indeed funding will be considerably reduced by mid 1996. This is mainly the result of the network being predominantly operated up until now by the research communities (TOGA and WOCE) .

Coverage has already been substantially reduced or even stopped on the following lines:

i) TRANSPAC (PX26), PX20-22, PX37-39, PX43, PX50 (PX7,9,13 have been consolidated due to reduced resources)
ii) Antarctic Circumpolar Current AX12, AX22, AX25-26
iii) South Atlantic AX12, AXIS, AX17-18
iv) Indian Ocean 1X15, 1X21, 1X8 (ends in 1996), western half of IX1O.

With TOGA completed, and the field phase of WOCE almost completed, research funds are being re-directed to ongoing research activities. These communities cannot be expected to fund the continuation of the low density XBT lines as an operational program. It is extremely difficult to maintain research funding in support of long time series measurements. The value and need of the low density XBT network for climate prediction has been well documented (see Ocean Observing Systems Development" Panel Final Report) . It is now time for this part of the SOOP to be supported by operational funds.

It would be very unfortunate if this successful, existing observing program, which has been identified by GOOS as essential for the monitoring of the global upper ocean, begins to fall into disrepair at this vital stage. A proposal is being prepared under IGOSS for the ongoing coordination of the SOOP, but funds will need to be secured to ensure SOOPs continuation.

RECOMMENDATION: I-GOOS to take note that the situation is severe, and that actions need to be taken immediately by the member countries to ensure that funding is provided for the ongoing operation of the XBT network.

ANNEX V

PRESENT TECHNOLOGIES FOR PROFILING THE OCEAN

Instrument	Ship Speed (kts)	Max Depth (m)	Cost/Station	Cost/Vessel
XBT	> 20	1500	$100	> $10K
XCTD	< 12	750	$400	> $10K
CTD	4	8000	$5000	$100K
BATFISH/Seasoar	8	400	$2000	$150K
Profiling ALACE	N/A	2000	$ 500[1]	nil
MVCTD	20 10 8	400 1500 2000	$ 300[2]	$100K

Notes

1 This is mostly the initial cost of purchasing, calibrating and launching the float averaged over 75 profiles. Argos tracking and data transmission costs are the only ongoing cost.

2 This cost is based on assuming that the fish and cable will need to be replaced every 100 stations. We have not yet done sufficient testing to determine the lifetime of the cable in this type of operation.

ANNEX VI

LIST OF PARTICIPANTS

I. EXPERTS FROM MEMBERS STATES

Mr. Tadashi Ando
Marine Department
Japan Meteorological Agency
1-3-4 Ote-machi, Chiyoda-ku
Tokyo 100
Japan
Tel: 81 3 3211 4966
Tlx: 222 2163 METTOK J
Tfax: 81 3 3211 3047
Tmail: ocean@hq.kishou.go.jp

Mr. Rick Bailey
Ocean Observing Networks
CSIRO Division of Oceanography
GPO Box 1538
Hobart, Tasmania 7001
Australia
Tel: 61 02 325 222
Tlx: AA.57182
Tfax: 61 02 325 123
Tmail: bailey@ml.csiro.au

Mr. Steve Cook
NOAA-National Ocean Service
8604 La Jolla Shores Drive
La Jolla, CA 92037
USA
Tel: 619 546 7103
Tfax: 619 546 7185
Tmail: scook@its.ucsd.edu

Mr. Bob Keeley *(Rapporteur)*
Chief, ocean Information and Systems Division
Marine Environmental Data Service
Fisheries and Oceans
1202 - 200 Kent Street'
Ottawa, Ontario KIA OE6
Canada
Tel: 613 990 0246
Tfax: 613 993 4658
Tmail: keeley@ottmed.meds.dfo.ca

Vice-Admiral Lazaro Mendoza
Mexican Navy
Naval Attache, Mexican Embassy
1500-45 O'Connor Street
Ottawa, Ontario K1P 1A4
Canada
Tel: 613 232 4792
Tfax: 613 232 0175

Dr. Savi Narayanan
Section Head, Physical Oceanography
Department of Fisheries and Oceans
P.O. BOX 5667
St. John' s, Newfoundland
Canada A1C 5X1
Tel: 709 772 2844
Tmail: savi@bartlett.nwafc.nf.ca

Mr. Chris Noe
Observing Networks Branch
National Ocean Service
NOAA
N/0ES42 Room 6308, SSMC4
1305 East West Highway
Silver Spring, MD 20910-2381
USA
Tel: 301 713 2790
Tfax: 301 713 4490
Tmail: cnoe@nos.noaa.gov

Mr. Jim Powell
Ocean Climate Advisor
Fisheries and Oceans Science Directorate
1256-200 Kent St
Ottawa, Ontario K1A OE6
Canada
Tel: 613 998 2886
Tfax: 613 954 0807
Tmail: ay297@freenet.carleton.ca

Mr. Herve Roquet
SCEM/PREVI/MAR
M&60-France
42, avenue Gustave Coriolis
31057 Toulouse Cédex
France
Tel: (33) 61 07 82 92
Tlx: 530530 F
Tfax: (33) 61 07 82 32
Tmail: herve.roquet@meteo.fr

Mr. Pierre Rual
ORSTOM
BP AS Noumea
New Caledonia
Tel: 687 26 10 00
Tlx: 3193 NM
Tfax: 687 2643 26
Tmail: rual@noumea.orstom.nc

Mr. Robert Stoddart *(Chairman)*
Department of Fisheries and Oceans
Centennial Towers, 12th Floor
12th Floor
Ottawa, Ontario K1A OE6
Canada
Tel: 613 990 0302
Tfax: 613 954 0807
Tmail:
bu772@freenet.carleton.ca

Dr. Alexander Sy
Bundesamt für Seeschiffahrt und Hydrographie
Bernhard-Nocht-Str. 78
D-20359 Hamburg
Germany
Tel: 40 3190 3441
Tlx: 215448 hydro d
Tfax: 40 3190 5000
Tmail:
sy@m4.hamburg.bsh.d400.de

II. REPRESENTATIVES OF ORGANIZATIONS AND INTERNATIONAL PROGRAMMES/GROUPS

Intergovernmental Oceanographic Commission (IOC)

Mr. Geoff Holland
Chairman, IOC
Former Chairman, IGOSS
Special Advisor, Oceans Science
Department of Fisheries and Oceans
200 Kent Street, Room 1208
Ottawa, Ontario K1A 0E6
Canada
Tel: 613 990 0298
Tlx: 053-4228
Tfax: 613 990 5510
Tmail: gholland@resudox.net

IGOSS'Task Team on Quality Control for Automated Systems (TT/QCAS)

Mr. Rick Bailey
Chairman, IGOSS Task Team on QCAS
Ocean Observing Networks
CSIRO Division of Oceanography
GPO BOX 1538
Hobart, Tasmania 7001
Australia
Tel: 61 02 325 222
Tlx: AA.57182
Tfax: 61 02 325 123
Tmail: bailey@ml.csiro.au
(also representing Australia)

WMO Climate Variability and Predictability Programme (CLIVAR)

Dr. Allyn Clarke
Co-Chairman, CLIVAR SSG
Head, Ocean Circulation Section
Bedford Institute of Oceanography
P.O. Box 1006
Dartmouth, Nova Scotia B2Y 4Az
Canada
Tel: 902 426 2502
Tfax: 902 426 7827
Tmail:
a_ clarke@bionet.bio.dfo.ca

World Ocean Circulation Experiment (WOCE)

Ms. Andrea Frische
WOCE International Project Office
Room 256/17
Southampton Oceanography Centre
Empress Dock
Southampton S014 3ZH
United Kingdom
Tel: 44 1703 596205
Tfax: 44 1703 596204
Tmail:
andrea.frische@soc.soton.ac.uk
Woceipo@soc.soton.ac.uk

III. SECRETARIAT

Intergovernmental Oceanographic Commission (IOC)

Mr. Bruce Hillard
IGOSS Operations Co-ordinator
Intergovernmental Oceanographic Commission
UNESCO
1, rue Miollis
F-75732 Paris Cédex 15
France
Tel: (33) 1 45 68 39 75
Tlx: 204461
Tfax: (33) 1 40 56 93 16
Tmail: b.hillard@unesco.org

World Meteorological Organization (WMO)

Mr. Mikhail Krasnoperov
Scientific Officer
Ocean Affairs Division
WWW Department
World Meteorological Organization
41, Av. Giuseppe-Motta
Case postale 2300
CH-1211 Geneva 2
Switzerland
Tel: (41) 22 730 8223
Tfax: (41) 22 733 0242
Tmail: krasnop@www.wmo.ch

IV. VENDOR

Sippican Inc.

Mr. Jim Hannon
Director of Marketing
Sippican, Inc.
7 Barnabas Road
Marion, MA 02738
USA
Tel: 508 748 1160
Tfax: 508 748 3626
Tmail: hannon@sippican.com

ANNEX VII

LIST OF ACTION ITEMS

(Note: The term "Operators" refers to ship managers who provide equipment and training to ships of opportunity and are responsible for the data collection.}

1. The IGOSS Operations Co-ordinator to revise the GTS Monthly Statistics Report to include more analysis,

2. The IGOSS Operations Co-ordinator to create a supplementery six-month report to include total XBTs deployed and the total number of BATHY messages received at GTSPP by ship call sign.

3. Operators send delayed-low resolution data to the GTSPP.

4. Operators convert to the new BATHY code form as soon as possible and ensure that information about probe types, recorders and fall rate coefficients is included.

5. GTSPP and the IGOSS Operations Co-ordinator monitor the progress in converting to the new BATHY code form.

6. IGOSS National Representatives encourage submission of SSS data in both TRACKOB messages and in delayed mode,

7. Operators collect SSS data whenever possible and to submit them to the GTSPP.

8. The IGOSS National Representative for Canada to contact the IOC-WMO Secretariat to request a demonstration of the IGOSS Home Page at IGOSS-VII in November.

ANNEX VIII

LIST OF ACRONYMS AND ABBREVIATIONS

BATHY	Bathythermograph Report
BSH	Bundesamt für Seeschiffahrt und Hydrographies (Germany)
CLIVAR	Climate Variability and Predictability
CSIRO	Commonwealth Scientific and Industrial Research Organization
CTD	Conductivity-Temperature-Depth
CWXXPPC	CLIVAR WOCE XBT XCTD Programme Planning Committee
DFO	Department of Fisheries and Oceans (Canada)
GCOS	Global Climate Observing System
GOES	Geostationary Operational Environmental Satellite
GOOS	Global Ocean Observing System
GPS	Global Positioning System
GTSPP	Global Temperature-Salinity Pilot Project
I-GOOS	Intergovernmental Committee for GOOS
IGOSS	Integrated Global Ocean Services System
INMARSAT	International Maritime Satellite Organization
IOC	Intergovernmental Oceanographic Commission (of UNESCO)
JGOFS	Joint Global Ocean Flux Study
MEDS	Marine Environmental Data Service (Canada)
MVCTD	Moving CTD
NOAA	National Oceanic and Atmospheric Administration (USA)
NOS	National Ocean Service (USA)
ONB	Observing Networks Branch (of NOS)
OOPC	Ocean Observations Panel for Climate
OOSDP	Ocean Observing System Development Panel
ORSTOM	Institut français de recherche scientifique pour le développement en coopération
QC	Quality Control
QCAS	Quality Control of Automated Systems
QUIPS	Quality Improvement Performance System
SIO	Scripps Institution of Oceanography (University of California, USA)
SOC	Specialized Oceanographic Centre (IGOSS)
SOOP	Ship-of-Opportunity Programme
SOOPIP	SOOP Implementation Panel
SSS	Sea-surface Salinity
SST	Sea-surface Temperature
TAO	Tropical Atmosphere Ocean Array
TESAC	Temperature, salinity and current report from a sea station
TOGA	Tropical Ocean and Global Atmosphere (WCRP)
TRACKOB	Report of marine surface observation along a ship's track
TSG	Thermosalinograph
TT	Task Team
UNESCO	United Nations Educational, Scientific and Cultural Organization
UOP	Upper-Ocean Panel
UOT DAC	Upper-Ocean Thermal Data Assembly Centre
URL	Uniform Resource Locator
WCRP	World Climate Research Programme
WMO	World Meteorological Organization
WOCE	World Ocean Circulation Experiment
XBT	Expendable bathythermograph
XCTD	Expendable CTD

82. Second Meeting of the UNEP-IOC-ASPEI Global Task Team on the Implications of climate Change on Coral Reefs
83. Seventh Session of the JSC Ocean Observing System Development Panel
84. Fourth session of the IODE Group of Experts on Marine Information Management
85. Sixth Session of the IOC Editorial Board for the International Bathymetric chart of the Mediterranean and its Geological/Geophysical Series
86. Fourth Session of the Joint IOC-JGOFS Panel on Carbon Dioxide
87. First Session of the IOC Editorial Board for the International Bathymetric Chart of the Western Pacific
88. Eighth Session of the JSC Ocean Observing System Development Panel
89. Ninth Session of the JSC Ocean Observing System Development Panel
90. Sixth Session of the IODE Group of Experts on Technical Aspects of Data Exchange
91. First Session of the IOC-FAO Group of Experts on OSLR for the IOCINCWIO Region
92. Fifth Session of the Joint IOC-JGOFS CO_2 Advisory Panel Meeting
93. Tenth Session of the JSC Ocean Observing System Development Panel
94. First Session of the Joint CMM-IGOSS-IODE Sub-group on Ocean Satellites and Remote Sensing
95. Third Session of the IOC Editorial Board for the International Chart of the Western Indian Ocean
98. Fourth Session of the IOC Group of Experts on the Global sea Level Observing System
97. Joint Meeting of GEMSI and GEEP Core Groups
98. First Session of the Joint Scientific and Technical Committee for Global Ocean Observing System
99. Second International Meeting of Scientific and Technical Experts on Climate Change and the Oceans
100. First Meeting of the Officers of the Editorial Board for the International Bathymetric Chart of the Western Pacific
101. Fifth Session of the IOC Editorial Board for the International Bathymetric Chart of the Caribbean Sea and the Gulf of Mexico
102. Second Session of the Joint Scientific and Technical Committee for Global Ocean Observing System
103. Fifteenth Session of the Joint IOC-IHO Committee for the General Bathymetric Chart of the Oceans
104. Fifth Session of the IOC Consultative Group on Ocean Mapping
105. Fifth Session of the IODE Group of Experts on Marine Information Management
106. IOC-NOAA *Ad hoc* Consultation on Marine Biodiversity
107. Sixth Joint IOC-WMO Meeting for Implementation of IGOSS XBT Ship-of-Opportunity programmes