Intergovernmental Oceanographic Commission
Reports of Meetings of Experts and Equivalent Bodies

Second Joint IOC-WMO Meeting for Implementation of IGOSS XBT Ship-of-Opportunity Programmes

Sidney, Canada, 5-8 August 1987

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IOC-WMO/IGOSS-XBT-II/3
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In this Series, entitled

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

1. Third Meeting of the Central Editorial Board for the Geological/Geophysical Atlases of the Atlantic and Pacific Oceans
2. Fourth Meeting of the Central Editorial Board for the Geological/Geophysical Atlases of the Atlantic and Pacific Oceans
3. Fourth Session of the Joint IOC-WMO-CPPS Working Group on the Investigations of «El Niño» *(Also printed in Spanish)*
4. First Session of the IOC-FAO Guiding Group of Experts on the Programme of Ocean Science in relation to Living Resources
5. First Session of the IOC-UN(OETB) Guiding Group of Experts on the Programme of Ocean Science in relation to Non-Living Resources
6. First Session of the Editorial Board for the International Bathymetric Chart of the Mediterranean and Overlay Sheets
7. First Session of the Joint CCOP (SOPAC)-IOC Working Group on South Pacific Tectonics and Resources
8. First Session of the IODE Group of Experts on Marine Information Management
9. Tenth Session of the Joint CCOP-IOC Working Group on Post-IDOE Studies in East Asian Tectonics and Resources
10. Sixth Session of the IOC-UNEP Group of Experts on Methods, Standards and Intercalibration
11. First Session of the IOC Consultative Group on Ocean Mapping *(Also printed in French and Spanish)*
12. Joint IOC-WMO Meeting for Implementation of IGOSS XBT Ships-of-Opportunity Programmes
13. Second Session of the Joint CCOP/SOPAC-IOC Working Group on South Pacific Tectonics and Resources
14. Third Session of the Group of Experts on Format Development
15. Eleventh Session of the Joint CCOP-IOC Working Group on Post-IDOE Studies of South-East Asian Tectonics and Resources
16. Second Session of the IOC Editorial Board for the International Bathymetric Chart of the Mediterranean and Overlay Sheets
17. Seventh Session of the IOC-UNEP Group of Experts on Methods, Standards and Intercalibration
18. Second Session of the IOC Group of Experts on Effects of Pollutants
19. Primera Reunión del Comité Editorial de la COI para la Carta Batimétrica Internacional del Mar Caribe y Parte del Océano Pacífico frente a Centroamérica *(Spanish only)*
20. Third Session of the Joint CCOP/SOPAC-IOC Working Group on South Pacific Tectonics and Resources
21. Twelfth Session of the Joint CCOP-IOC Working Group on Post-IDOE Studies of South-East Asian Tectonics and Resources
22. Second Session of the IODE Group of Experts on Marine Information Management
23. First Session of the IOC Group of Experts on Marine Geology and Geophysics in the Western Pacific
24. Second Session of the IOC-UN(OETB) Guiding Group of Experts on the Programme of Ocean Science in relation to Non-Living Resources *(Also printed in French and Spanish)*
25. Third Session of the IOC Group of Experts on Effects of Pollutants
26. Eighth Session of the IOC-UNEP Group of Experts on Methods, Standards and Intercalibration
27. Eleventh Session of the Joint IOC-IHO Guiding Committee for the General Bathymetric Chart of the Oceans *(Also printed in French)*
28. Second Session of the IOC-FAO Guiding Group of Experts on the Programme of Ocean Science in Relation to Living Resources
29. First Session of the IOC-IAEA-UNEP Group of Experts on Standards and Reference Materials
30. First Session of the IOCARIBE Group of Experts on Recruitment in Tropical Coastal Demersal Communities *(Also printed in Spanish)*

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1. ORGANIZATION OF THE MEETING

1.1 OPENING OF THE MEETING

1.1.1 The Second Session of the Joint IOC-WMO Meeting for Implementation of the Integrated Global Ocean Services System (IGOSS) XBT Ship-of-Opportunity Programmes was opened by Dr. Yves Tourre, Chairman of the Joint IOC-WMO Working Committee for IGOSS, at 10.00 a.m., 5 August 1987, at the Institute of Ocean Sciences in Sidney, British Columbia. Dr. John Garrett, Chief, Ocean Physics Division, Institute of Ocean Sciences, welcomed the participants on behalf of the Institute and wished them a pleasant and productive stay in British Columbia.

1.1.2 Dr. Yves Tourre presented a brief summary of the accomplishments made within IGOSS over the intersessional period:

- .A global map, showing the different programmes with the Ship-of-Opportunity (SOO) lines clearly identified, has been created and disseminated. This map has appeared in various publications such as in reports of the Joint SCOR-IOC Committee on Climatic Changes and the Ocean (CCCO) and the TOGA Implementation Plan.

- .Automatic quality control of the data is implemented and will improve the data quality upstream of the GTS.

- .A sub-surface product was created in the Pacific that has allowed subscribers to follow, "in real time", for the first time, the mild El Nino event of 1986/87.

- .A focal point has been established in Mauritius in the Indian Ocean and will hopefully play an equivalent role to the one in New Caledonia for the Pacific.

- .New SOO lines have been implemented.

- .The Argos system for automatic transmission of XBT reports was tested in the Atlantic and good results were shown. SEAS units are being distributed widely.

- .In response to a request from IGOSS-IV and TOGA in particular, an electronic mailbox for IGOSS XBT management started in January, 1987.

- .Scientists are becoming more aware of the importance of real-time data and consequently more involved in IGOSS activities and product development.

1.1.3 There are still some negative points to be addressed:

.The Indian Ocean and Southern Oceans are critically undersampled.

.Salinity data is much too sparse.

.Participation from research vessels, navies and fisheries is still too small.

.Publicity about IGOSS activities is insufficient.

1.1.4 Despite all of that:

.Data has continuously been increasing from 31,000 reports in 1981 to 46,000 in 1986. During the first semester of 1987, there was an increase of 20% in BATHY/TESAC reports compared to the same period in 1986.

.It also appears at this particular point in time that there is sufficient data available in the tropical Atlantic to warrant the undertaking of a feasibility study for an IGOSS Subsurface Thermal Structure Pilot Project (ISTPP) into that ocean.

1.1.5 A continuous effort has to be made to provide high quality data in sufficient quantity for assimilation in the Global Circulation Model (GCM). In addition, a comparison of GCM output to IGOSS data analysis products is a prerequisite to future forecast of the state of the oceans.

1.1.6 Mr. John Withrow, IGOSS Operations Co-ordinator, welcomed the participants on behalf of IOC and WMO, and thanked the Government of Canada for hosting the Meeting and providing such excellent conference facilities. He remarked that the Meeting constituted a good mixture of scientists and operators of ship-of-opportunity programmes and was confident that the Meeting would achieve the intended objective.

1.1.7 The List of Participants is given in Annex III of this Report.

1.2 ELECTION OF THE CHAIRMAN

1.2.1 Dr. Douglas McLain from NOS/NOAA was nominated as Chairmen by the Representative of Thailand. The nomination was seconded by Representatives from France and Canada, and the Meeting unanimously supported the nomination.

1.3 ADOPTION OF THE AGENDA

1.3.1 The Agenda as adopted by the Meeting is reproduced in Annex I.

1.4 WORKING ARRANGEMENTS

1.4.1 The Meeting adopted the work programme proposed by the local secretariat and agreed to adjust it as necessary, including the establishment of drafting groups to address specific questions.

2. REQUIREMENTS FOR SUB-SURFACE THERMAL DATA

2.1 The discussion on Agenda Item 2 was opened by Dr. McLain. He pointed out that there were four main areas placing requirements on the IGOSS Ship-of-Opportunity Programme: the World Climate Research Programme (WCRP), marine meteorology, fisheries and navigation.

World Climate Research Programme

2.2 The TOGA requirements were presented by Mr. John Marsh, Head of the International TOGA Project Office, and Dr. Bruce Taft, Chairman of the IOC-SCOR CCCO Pacific Ocean Panel. Mr. Marsh reviewed the status of the IGOSS Ship-of-Opportunity Programme in the tropical regions. He noted that much progress had been made in the implementation of lines in all ocean basins but, in nearly all cases, there was a need for further implementation efforts in order to fulfill scientific requirements. The Meeting recognized that conflicting SOO line numbering schemes were confusing for line management and agreed that TOGA and IGOSS officials should meet in the near future to establish common procedures for identifying SOO lines. (See also paragraph 5.1.1 below).

2.3 Dr. Bruce Taft gave a short presentation of the IGOSS Ship-of-Opportunity programme for the tropical Pacific Ocean. He acknowledged the importance of products from ISTPP and pointed out ways they could be improved. He also noted that there was a need for regular lines in the equatorial region around the dateline and in the area east of 140 degrees West. He then gave a brief presentation on sampling density based on continuous measurements taken from fixed moorings on the equator, at 110 degrees West. He concluded that while the Ship-of-Opportunity programme would not be sufficient in the energetic regions of the equatorial waveguide, it would be of great value in other parts of the ocean basin.

2.4 Dr. Allyn Clarke, member of the WOCE Scientific Steering Group and Co-chairman of the WOCE Core 1 Working Group, reviewed WOCE's scientific requirements for IGOSS data and services. While TOGA is chiefly interested in upper ocean temperature fields in the tropics, WOCE needs to expand this coverage at similar spatial and temporal scales to mid and high latitudes, to depths of 750 meters and more, and to include the salinity field as well. The development of an affordable XCTD probe or some alternative technique is essential for WOCE. In addition, some WOCE XBT/XCTD lines will be sampled hourly or even more frequently, increasing considerably the data flow from some vessels. There will also be intensive use of acoustic doppler current profiling systems. While WOCE does not have an immediate need of operational real-time data, exchange of CTD, XBT, XCTD, drifter and float data via IGOSS is essential in order that data coverage and quality can be monitored and some near-real-time data products prepared. WOCE is still in the planning stage and its requirements for data and data products are still expected to evolve.

Marine meteorology

2.5 The requirements from the meteorological point of view were presented by Mr. Vince Zegowitz of the US National Weather Service. He pointed out that meteorologists and oceanographers were pursuing similar

goals in their ship-of-opportunity efforts for real-time forecast and climate studies and close co-operation would be mutually beneficial to both groups. Areas particularly amenable to close cooperation were the areas of vessel recruitment and automated system development. He concluded by stating that while the meteorological community did not have clearly defined time and space scales for sampling, there were areas in the southeast Pacific, southern Atlantic, and Indian Ocean regions that were undersampled.

Fisheries

2.6 The fisheries requirements were presented by Dr. Scott Akenhead, Department of Fisheries and Biological Sciences of Canada, and Ms. Suchada Silpipat, Thailand Department of Fisheries. Fishing activities are becoming increasingly complex and require both better management from the national and international standpoint and more efficient deployment of vessels. Dr. Akenhead reviewed the Canadian efforts to provide ocean services to increase the efficiency of the fishing efforts in Canada. Ms. Silpipat reviewed the initiatives of the Thailand Government in the management of fisheries resources in the Gulf of Thailand. A major effort has been mounted to study the effects of fresh water plumes on the circulation and pollutants in the Gulf of Thailand.

Navigation

2.7 The navigational requirements were presented by Mr. Paul Stevens, US Fleet Numerical Oceanographic Centre. He showed how close co-operation with vessel masters has enabled them to take advantage of subsurface thermal data to increase the efficiency of their power plants to assist in the preservation of cargos, and to follow or avoid major currents.

2.8 Annex IV contains abstracts of each of the individual presentations.

3. SHIP-OF-OPPORTUNITY ACTIVITIES

3.1 EXISTING (OPERATIONAL) LINES

3.1.1 Mr. Withrow introduced this Agenda Item and presented document IOC-WMO/IGOSS-XBT/Doc. 4 which included reports on the existing ship-of-opportunity XBT programmes, their objectives, usefulness, difficulties encountered, etc. It was noted that there were many more observations being made than were inserted onto the GTS for global distribution.

3.1.2 The Meeting agreed that every effort should be made to increase the input onto the GTS, particularly in view of the emerging TOGA and WOCE requirements for rapid data collection and exchange. This is further supported by the fact that the operational XBT data return constitutes a far larger portion of existing data sets than the non-real-time digitized data. Brief descriptions of the existing ship-of-opportunity XBT programmes were given by the participating managers. Summaries of these presentations are given in document IOC/INF-731 "Summary of Ship-of-Opportunity Programmes".

3.1.3 The Meeting recommended that all countries consider the importance of rapid dissemination of meteorological and oceanographic data to assist in solving environmental and economic problems.

3.2 PLANNED AND PROPOSED LINES

3.2.1 The Meeting reviewed the list of planned and proposed lines presented in document IOC-WMO/IGOSS-XBT/Doc. 4. Other planned and proposed lines were addressed by the programme managers in their presentations (see document IOC/INF-731).

3.2.2 When considering the ship-of-opportunity XBT coverage, the Meeting recognized the need to obtain a complete picture of the sub-surface thermal data coverage from all observational platforms. These should include such platforms as WMO Voluntary Observing Ships (VOS) and various research ships. The cruise patterns of some of these ships are regular and well-established. The Meeting proposed that the IGOSS Operations Co-ordinator construct a world-wide map of these observational programmes, including section surveys, etc.

3.3 SUMMARY OF REPORTS OF OCEAN BASIN WORKING GROUPS

3.3.1 The Meeting then broke up into three Drafting Groups for the three main oceans to update the ship-of-opportunity list as established at its First Session (Seattle, USA, 9-13 September 1985). The updated list is given in Annex V. In addition, the Meeting addressed the following questions:

What are the new lines proposed?

3.3.2 Denmark is making available through its government or through government contract ships to provide additional opportunities for transects along line A-2[1] (North Sea to Greenland). In addition to "NIVI ITTUK" the:

"NUKA ITTUK"
"NUNGU ITTUK"
"NAJA ITTUK"
"JOHAN PETERSEN"
"MAGNUS JENSEN"

can provide from 10-13 round trips annually, and are available for instrumentation.

3.3.3 Chile is now proposing 2 ships averaging 6 crossings annually for line A-27. The USA (FNOC) is also proposing to employ 4 Nedlloyd Line ships averaging 6 crossings each along the same line. The two nations need to co-ordinate their efforts to optimize sampling and eliminate duplication. In addition, the USA (FNOC) is proposing two new routes from Eastern North America to Eastern South America (see map in Annex V).

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[1]Note: Line definition is given in Annex V.

3.3.4 The Federal Republic of Germany proposes, pending approval, to deploy "POLARSTERN" to the South Atlantic-Antarctic region for about 18 months beginning in CY - 1988. Transects will be run once a year between Ushuaia, Argentina, the Niemayer Station and Cape Town, South Africa.

3.3.5 France and Mauritius are jointly proposing lines Somalia-Singapore and Mauritius-Singapore which can provide coverage in a presently data sparse area. Arrangements should be made so that equipment could be made available within 6 months and the lines should become operational within a year. The ships will be met by ORSTOM line operators in Marseilles and for Mauritius at Port Louis. The Fisheries Department of Thailand will be responsible for vessels calling at Bangkok.

3.3.6 Ms. Silpipat of the Oceanographic Section, Thailand Department of Fisheries, indicated that her organization had access to four vessels which could deploy XBTs along routes in the Indian and Pacific Oceans if they were provided with XBT recorders and supplies. One of the lines is from Thailand to Japan. "RESEARCH FISHERIES No.4" makes this trip once per year, and "NAKON THON" makes 8 trips per year. Another vessel, "RESEARCH FISHERIES No. 3", sails from the Gulf of Thailand and returns once per year. Both of these ships could also make mini-CTD casts and report the data via satellite if they were provided with the proper equipment. At the meeting, plans for possible loan of XBT and CTD equipment to Thailand by Canada and the United States were reviewed. Implementation of these plans will be made possible by the close personal contacts developed at the meeting.

What are the priorities of line implementation?

3.3.7 It was agreed that the scientific community must review and provide the priority assessments on the basis of sampling requirements meeting the needs to describe oceanic scales of motion or which are deemed relevant to operational analyses and forecasts. The meeting agreed that scientific advice on sampling rates and spatial separation of samples (decorrelation scale) should be part of this review. IGOSS support will clearly be needed to build the long time series of global ocean circulation data needed to support climate research and development, ocean analysis and modeling efforts, as well as routine ocean analyses and prediction operations.

3.3.8 Several problems were noted in the configuration of the existing and proposed lines, such as:

- the equatorial thermocline "hinge point" in the Atlantic between 20 degrees to 30 degrees West is not sampled by any line;

- the Gulf of Guinea, a dynamic region, has no transects crossing it; and

- the North Atlantic routes largely parallel major ocean current systems rather than cross them.

Who will meet the ships? When? Where?

3.3.9.1 The Meeting observed that in the South Atlantic, IGOSS needs to identify Member States able to support long-term ship visitation functions, and to provide them with equipment, training and technical assistance. Workshops held at the technical/working level are the best means to improve co-ordination. The Meeting recommended that ship visitation efforts for meteorological and oceanographic observations be combined where practicable.

3.3.9.2 The Federal Republic of Germany, through DHI, will assist Denmark in setting up its IGOSS programme over the next year.

3.3.9.3 It further considered that some kind of "certificate of appreciation", on the one hand, and a pamphlet describing the IGOSS XBT Ship-of-Opportunity programme, on the other, would be of help to those who had to visit ships. The Meeting adopted Recommendations 1 and 2 (IGOSS-XBT-II) on these topics (Recommendations adopted by the Meeting are given in Annex II).

How to improve co-ordination between programmes?

3.3.10 National Representatives for IGOSS should be able to delegate responsibility, hold national participants accountable, and in general, "know what is going on." They need to obtain and maintain updated lists and names of "national XBT co-ordinators" as well as of persons:

- controlling equipment and expendable resources;

- providing on-site maintenance, instruction;

- operating equipment repair, exchange, and/or storage facilities.

3.3.11 The Meeting also noted the overall need for:

- frequent updates of lists of contributors to the monthly IGOSS XBT Summary Report;

- a set of IGOSS general guidelines and instructions patterned after the WMO Technical Regulation series.

To facilitate the above, the Meeting recommended that the IGOSS Operations Co-ordinator be provided with the necessary computer software and hardware, with access to BATHY message data bases in Paris, Washington and Monterey, and with regular monthly updates of ship activity from all of the major ship-of-opportunity XBT management centres.

3.3.12 The International TOGA Project Office (ITPO) should be contacted to help in co-ordinating the XBT programme. Every opportunity should be taken by CCCO Ocean Panels during their meetings to suggest ways and means for improving co-ordination.

How to obtain observations from the Southern Oceans and the energetic circumpolar current?

3.3.13 The Meeting agreed that IGOSS should actively support all research vessels operating in this region because few merchant vessels transit the area (only 2877 reports for the entire 1986). All data should be acquired and forwarded to National Centres as appropriate. IGOSS needs to be firmly familiar with the science programmes and initiatives underway in this region. For instance, many supply ships ply the route Australia-Antarctica. At the end of this year the Australian vessel " NELLA DAIN" will be equipped by CSIRO to perform observations on that route. The project is expected to continue for the next 5 years. Likewise, as the "MARION DUFRESNE" continues its route from Reunion Island to Kerguelen, it is suggested that XBT observations be also effected on that portion.

What are opportunities for co-operative programmes between:

Research institutions?

Research vessels?

Fishery surveys?

3.3.14 The North Atlantic community is already joined and well aware of the oceanographic measuring programme in the region. However, traditions have to be reevaluated and dependence on ships-of-opportunity may have to grow. The Meeting recommended the use of existing groups where possible, to exploit the use of telemail for routine communication, and to look for alternate means of enhancing working-level communication. It adopted Recommendation 3 (IGOSS-XBT-II) to that end.

3.3.15 In the Indian Ocean, Member States which potentially can contribute to the programme at this time are USA (NOAA), India and Australia (CSIRO). It has been proposed that USA (NOAA) equip the Nedlloyd ships criss-crossing the Indian Ocean with XBT systems. Australia (CSIRO) has agreed to the proposal of providing training to Mauritius operators to encourage the lines converging towards Mauritius. For equipment, ORSTOM will be contacted.

What equipment is required to instrument lines?

XBT strip chart recorders?

XBT probes?

Microcomputers?

Mini-CTDs?

SEAS/Argos transmitters?

3.3.16 There is a basic, overall need for equipment in the following areas:

- expendables;

- probes may be needed to resolve sampling problems now unaddressed;

- mini-CTDs should be assigned to research and other vessels capable of providing full use of the equipment;

- the XCTD, while still expensive, offers promise. However, it requires an advanced microprocessor to process data and encode it automatically.

Most of the lines proposed or planned to be implemented will require XBT recording equipment and XBT probes. Gradually, however, microcomputers should replace the older strip chart recorders. Thailand is also requesting a mini-CTD to be installed on its research ships for production of TESAC messages.

3.3.17 The possibility using the Argos system for transmission of XBT reports along the route Mauritius-Rodrigues through the "Mission de coopération" will be explored through the French Embassy. There is a need identified for XBT strip chart recorders and probes for use on fishing boats in the Arabian Sea.

3.3.18 In view of the fact that at least 15 mini-CTD units are now owned by institutions along the west coast of North America, it seems advantageous to strongly encourage and assist the real time submission of temperature and salinity profiles from these instruments. The Meeting adopted Recommendation 4 (IGOSS-XBT-II) to that end.

What are the communication problems?

3.3.19 The Meeting noted that, in general, the world oceans are adequately served by all common modes of communication. However, improvements are needed in:

- the efficiency of coastal receiving stations handling BATHY/TESAC traffic;

- the use of GOES and INMARSAT data relays (digital encoding techniques to shorten message length);

- the employment of HF ship-to-shore packet switching radiotelemetry in a two-way send/receive mode.

The number of Coastal Radio Stations (CRS) accepting BATHY/TESAC messages is still insufficient in the Indian ocean. Utilizing the Argos System will cost US$10 per day per transmission. The use of the geostationary satellites INSAT (India) and the Russian satellite above the Indian Ocean for transmission purposes could alleviate some of the problems. Dr. Cutchin, from Scripps' Voluntary Observing Ship Programme, indicated that he manages 18 ships which traverse the North Pacific and tropical Pacific. These ships

could probably treble their production of BATHY messages and meteorological messages if provided with SEAS-type automatic systems.

3.3.20 Several members of the Meeting expressed their strong conviction that something should be done to facilitate the submission and improve the quality of BATHY/TESAC and meteorological data transmitted via the various radio communication modes available. At present much of that data is being lost or irretrievably garbled. The Meeting therefore adopted Recommendation 5 (IGOSS-XBT-II) on IGOSS data transmission (see also Agenda Item 7).

What could be done within the framework of the IOC Training, Education and Mutual Assistance in the marine sciences (TEMA) programme?

3.3.21 The Meeting observed that the TEMA needs of the North Atlantic community can best be met by the frequent scheduling of workshops at the working level. The needs for TEMA support are judged to be minimal here.

3.3.22 The Meeting noted that the South Atlantic poses much more difficult questions:

- the needs of African countries should be addressed;

- the ability of South Atlantic members to support high-technology observing and communication equipment is limited;

- there is a need to start using simpler equipment requiring manual operation where practicable;

- there is a need to provide convenient communications mechanisms to enable system maintenance and repair at ports having such capabilities.

The USA will provide strip chart recorders, launches and limited supply of probes to implement some of the lines.

3.3.23 The Meeting observed also that technical training sessions might be better performed by sending designated persons to those nations having the technology and expertise for intensive training in techniques and operation/maintenance procedures rather than by holding expensive "roving seminars" as has been done previously.

3.3.24 The Meeting suggested that a workshop on IGOSS data collection and transmission be organized for the benefit of Member States bordering the Indian Ocean. Potential locations for the workshop are Thailand, Australia, Kenya, and Mauritius.

Miscellaneous

3.3.25 The Meeting noted that the line/section numbering system represented in the charts have inconsistencies and/or incompatibilities. Wherever possible these have been eliminated. The USSR Sections programme, already underway, should also be added to the chart.

3.3.26 The Meeting attempted to up-date and correct the list of ship-of-opportunity XBT lines provided by the IGOSS Operations Co-ordinator. It was recognized that, while the list was a considerable improvement over the documents available at its first session in 1985, there should exist mechanisms to keep such a list accurately updated on a regular basis. It adopted Recommendation 6 (IGOSS-XBT-II) on this topic.

4. REQUIREMENTS VERSUS RESOURCES

4.1 Mr. Withrow opened this Agenda Item by presenting IOC-WMO/IGOSS-XBT/Doc. 7, which contained the summary of replies by WMO Members to an inquiry regarding the possible recruitment of WMO Voluntary Observing Ships (VOS) as ships-of-opportunity for IGOSS purposes. He noted that in general the response had been favourable for utilizing port meteorological officers for servicing XBT Ships-of-Opportunity. Mr. Zegowitz, in charge of the VOS system for the United States, noted the delay in the US response to the WMO inquiry and pledged US port meteorological support.

4.2 When considering requirements versus resources the Meeting agreed that this had been adequately covered under Agenda Item 3.3.

4.3 The Meeting recognized that the limited resources available required that the effectiveness of the programme should be maximized and adopted Recommendation 7 (IGOSS-XBT-II) accordingly.

5. IGOSS XBT SHIP-OF-OPPORTUNITY MANAGEMENT

5.1 SHIP-OF-OPPORTUNITY LINE IDENTIFICATION

5.1.1 This Agenda Item was presented by Mr. Withrow. He pointed out that, in spite of the numbering system adopted at the first session of the Meeting, different numbers had been assigned by the ITPO in its implementation plan. Such discrepancies contributed to confusion in line identification. The Meeting considered that IGOSS was the on-going, operational system to deal with this question and urged the Secretariats to take every opportunity to encourage the TOGA participants to adopt the IGOSS line numbering convention. It adopted Recommendation 8 (IGOSS-XBT-II) on this topic.

5.1.2 Ms. Cole proposed to supplement the line number with the endpoints utilizing the appropriate IATA codes. The Meeting, while recognizing the advantages of utilizing IATA code for the designation of line endpoints, decided that a system utilizing spelled out city names or regions would be more appropriate and directed the IGOSS Operations Co-ordinator to implement such a system.

5.1.3 Mr. Chric Noe of the US NODC requested that for archiving purposes line numbers not be re-used.

5.2 EVALUATION OF THE TOGA XBT MANAGEMENT NETWORK

5.2.1 Mr. J. Withrow presented the IGOSS XBT Report for TOGA. The Meeting endorsed the listing and noted that it was a valuable management tool.

5.2.2 The Meeting agreed that the report should be modified to include both the call sign of the vessel, and the date during the month on which the vessel was met, and directed the IGOSS Operations Co-ordinator to so modify the report. The Meeting also noted that the report covered all regions of the world ocean and directed the Operations Co-ordinator to drop the reference to TOGA in the report title.

6 AUTOMATED SYSTEMS

6.1 The Meeting recognized that manual observations and data reporting are laborsome, error prone, and unreliable. Automation of observations and reporting is vital to the future of IGOSS.

6.2 Dr. McLain reviewed and estimated the presented status of data collection systems and noted that over 300 ships still are equipped with analog strip chart recorders. About 200 ships now have some form of automated observing and reporting system. The automated systems are of three general levels:

(i) microcomputer plus satellite transmitter ("SEAS I");
(ii) microcomputer plus satellite transmitter ("SEAS II and SEAS III" plus XBT and meteorological sensor interfaces systems);
(iii) advanced systems with more powerful computer and/or CTD interface.

6.3 Dr. Cutchin then proposed several possible standards for automated observing systems:

(i) use of industry standard RS232 connections between modules of the system;

(ii) standard algorithms for processing profile data and preparation of BATHY and TESAC messages.

6.4 Mr. R. Bailey of Australia presented a comparison of data collected by a SEAS II system with temperature data collected by a precision CTD on a research vessel. The differences in temperature between the two systems were generally less than 0.2° C with values as large as 1.0° C in regions of strong thermal gradient.

6.5 The meeting recommended that continued efforts be made to identify sources of systematic errors in IGOSS data. Possible sources of error include digitizer errors, errors in depths due to fall rate uncertainties, errors due to the time constant of the XBT thermistor, and others. Australia and Canada agreed to continue their intercomparison study between sampling devices.

6.6 Other problems with SEAS II systems include systematic positive temperature errors in the mixed layer ("bowing" of the profile), spikes in the profiles, transients in the upper few meters of data, awkward user software, electrical interference problems on the CRT caused by the XBT interface with 240 V power supply, and occasional printer problems.

6.7 Mr. Steve Cook of NOAA described efforts to standardize algorithms for calculation of significant data points from XBT data and preparation of BATHY/TESAC format messages. He will compare 4 standard algorithms with a standard set of input data.

6.8 Dr. Mike Miyake then discussed the results of his efforts to determine specifications for an internationally acceptable automated observing system. Dr. Miyake prepared a questionnaire and received 11 replies to date. His report is summarized in Annex VII and indicates general agreement that systems should be small, lightweight, reliable, simple, flexible, and use industry standard MS DOS compatible computers.

6.9 The Meeting adopted Recommendation 9 (IGOSS-XBT-II) on the general topic of automated systems.

7 COMMUNICATIONS

7.1 The Meeting recognized that of the many observations which are now being made, a significant fraction are never reported to data centres and only a small portion of the total are reported in real time. The Meeting thus focused on the problem of reliable, real time, digital communications of environmental data.

7.2 Problems of communication were emphasized by several speakers. Dr. McLain reported that as funding constraints increase, XBT observations cannot be supported that do not result in real time messages. For example, Dr. Cutchin showed that loss of messages costs his VOS programme $200,000 or more per year.

7.3 Dr. Sy reviewed the results of three cruises of DHI in the North Atlantic using a SEAS II with GOES transmitter. On those cruises, Dr. Sy found that up to one third of the messages were lost on average. This was the result of an interference between the Satellite Navigation System and the GOES Transmitter. Dr. Sy also found that excessive RF radiation from the GOES transmitter caused interference with another type of satellite navigation receiver. Representatives of the manufacturer were present at the meeting and agreed to replace the present transmitter and to investigate the interference problem.

7.4 Mr. Rebert then described French efforts to develop an automated observing system using the Argos satellite (see Annex VI). The limitation of Argos messages to 256 bits required that the data be compressed. Mr. Rebert showed that if ocean profiles are represented by 15 or fewer temperature-depth pairs, the data can be stored in 256 bits with only a 1 or 2 percent loss of information. One advantage of the Argos system is that the system can automatically check the reported position of the message.

This is a great advantage when quality controlling the data.

7.5 The Meeting recognized that there are many problems in communications which must be addressed. It recommended that communication experts be invited to future meetings to help solve problems.

8. CLOSURE OF THE MEETING

8.1 Following the review and adoption of the Draft Summary Report of the Meeting, the Chairman thanked all participants for their co-operation and valuable contributions. He paid a special tribute to the staff of the local secretariat whose supporting work contributed greatly to the success of the Meeting.

8.2 Dr. Y. Tourre, on behalf of all participants, congratulated Dr. D. Mclain on the excellent manner in which he conducted the Meeting and thanked him for his leadership.

8.3 The Meeting closed at 1.00 p.m. on Saturday, 8 August 1987.

ANNEX I

AGENDA

1. INTRODUCTION

   1.1 OPENING OF THE MEETING

   1.2 ADOPTION OF THE AGENDA

   1.3 WORKING ARRANGEMENTS

2. REQUIREMENTS FOR SUB-SURFACE THERMAL DATA

   2.1 REVISED WCRP REQUIREMENTS FOR DATA FROM SHIPS-OF-OPPORTUNITY

   2.2 OTHER REQUIREMENTS

3. SHIP-OF-OPPORTUNITY ACTIVITIES

   3.1 EXISTING (OPERATIONAL) LINES

   3.2 PLANNED AND PROPOSED LINES

   3.3 REPORTS OF OCEAN BASIN WORKING GROUPS

4. REQUIREMENTS VERSUS RESOURCES

5. IGOSS XBT SHIP-OF-OPPORTUNITY MANAGEMENT

   5.1 SHIP-OF-OPPORTUNITY LINE IDENTIFICATION

   5.2 EVALUATION OF THE TOGA XBT MANAGEMENT NETWORK

6. AUTOMATED SYSTEMS

   6.1 HARDWARE

   6.2 SOFTWARE

7. COMMUNICATIONS

8. CLOSURE OF THE MEETING

ANNEX II

ADOPTED RECOMMENDATIONS

Recommendation 1 (IGOSS-XBT-II)

The Joint IOC-WMO Meeting for Implementation of IGOSS XBT Ship-of-Opportunity Programmes,

Noting that the urgent need for a suitable document that recognizes the services of observers participating in the IGOSS XBT Ship-of-Opportunity Programme was identified at IGOSS-IV,

Further noting that the IOC and WMO Secretariats still need to obtain official approval for the use of an appropriate logo on such a document,

Recommends that the IOC and WMO Secretariats renew their efforts to finally conclude the discussions to secure approval from the appropriate authorities, and to expend such funds as are necessary to produce such a logo for use by members in preparing certificates of recognition or other appropriate documents,

Further recommends that all members encourage the regular use and distribution of appropriate tokens of recognition to maintain the strong interest and active involvement of voluntary observers in IGOSS at a high level.

Recommendation 2 (IGOSS-XBT-II)

The Joint IOC-WMO Meeting for Implementation of IGOSS XBT Ship-of-Opportunity Programmes,

Noting that a need exists to expand knowledge of, and participation in, the IGOSS XBT Ship-of-Opportunity Programme,

Urges the Secretariats to renew their efforts to produce a pamphlet briefly describing the programme for distribution to prospective ships and ship managers.

Recommendation 3 (IGOSS-XBT-II)

The Joint IOC-WMO Meeting for Implementation of IGOSS XBT Ship-of-Opportunity Programmes,

Noting that a need exists for the regular exchange of newsworthy information of exchange of interest to the scientific community,

Further noting that the success of IGOSS depends upon the strong support of the ocean science community,

Recommends that the Chairman of the Joint IOC-WMO Working Committee for IGOSS explore ways and means to produce an IGOSS scientific newsletter or equivalent, and to determine subject matter and content as appropriate to regional Ocean basin interests,

Further recommends that the Chairman exercise his discretion to initiate a publication during the intersessional period, and report on his actions to the next session of this Meeting.

Recommendation 4 (IGOSS-XBT-II)

The Joint IOC-WMO Meeting for Implementation of IGOSS XBT Ship-of-Opportunity Programmes,

Noting that many small conductivity - temperature - depth profiles ("mini-CTDs") are operated routinely by oceanographic and fisheries institutions in coastal and other areas,

Further noting that these mini-CTDs could provide valuable data in real-time,

Urges the IGOSS community to provide hardware and software so that these mini-CTDs can encode TESAC messages and report them in real time on the GTS.

Recommendation 5 (IGOSS-XBT-II)

The Joint IOC-WMO Meeting for Implementation of IGOSS XBT Ship-of-Opportunity Programmes,

Noting that, at the present time, a large amount of data collected by ships of opportunity is either:

- not transmitted to shore stations,
- not received after transmission,
- received with many errors, or after unacceptable delays,

Further noting that these problems are attributable to deficiencies and limitations in the communication systems now available to the mariner,

Noting in addition that the IOC and WMO communities both depend upon the same vessels for meteorological and oceanographic data,

Recommends that the IOC and WMO communities participating in IGOSS take the following actions:

- Promote the full use of available channels and allotted times aboard the Polar Orbiting Environmental Satellites via Service Argos and via the U.S. Geostationary Orbiting Environmental Satellite (GOES -East and West);

- Encourage the wider use of the Japanese GMS satellite international channels;

- Contact the Permanent Representatives of India and the USSR to encourage the pooling of international channels of these two nations' geostationary satellites now in orbit over the Indian Ocean;

- Promote wider use of INMARSAT services where feasible;

- Study ways and means of automating HF Coastal Radio Stations accepting messages from ships-of-opportunity; and

- Promote the development and adoption of alternative new technology such as HF packet switching radio digital communication techniques, as well as the development of two-way (send/receive) systems,

Further recommends that the general principle of eliminating delays and errors be pursued by the vigorous development and deployment of automated systems wherever possible.

Recommendation 6 (IGOSS-XBT-II)

The Joint IOC-WMO Meeting for Implementation of IGOSS XBT Ship-of-Opportunity Programmes,

Recognizing the need for suitable records of ship's registry, types of observing instruments, and the sighting or placement of critical instruments (e.g., height of observing platform), including maintenance and replacement,

Further recognizing that the US Coast Guard formerly maintained such documentation routinely in the name of maritime safety,

Recommends that the Representative of the USA on the IOC Executive Council be urged to seek ways to continue such functions, so as to support the major international programmes from the World Climate Research Programme such as: the study Tropical Ocean and Global Atmosphere and the World Ocean Circulation Experiment;

Further Recommends that other nations support similar efforts to enhance the exchange of global marine environmental data required for studies of Global Climate Change.

Recommendation 7 (IGOSS-XBT-II)

The Joint IOC-WMO Meeting for Implementation of IGOSS XBT Ship-of-Opportunity Programmes,

Recognizing that there exists a significant rate of loss of data collected by IGOSS XBT ships-of-opportunity,

Further recognizing the need to maximize the effectiveness of the programme at minimum cost,

Urges that members managing IGOSS ship-of-opportunity activities maintain adequate records such as:

- Nature of probe failures and identification of typical failure modes;
- Identification of problem system and communications failures;
- Management information on system and component performance and types of failure modes;
- Information on better ways to allocate and deploy probes; and
- Detailed information on probe performance vs age, storage, handling and other relevant information.

Recommendation 8 (IGOSS-XBT-II)

The Joint IOC-WMO Meeting for Implementation of IGOSS XBT Ship-of-Opportunity Programmes,

Recognizing that a need remains for a standard identification, catalogue and referencing of Ship track and transect information for each of the global ocean basins,

Further recognizing that the International TOGA Project Office and the Scientific Steering Group for WOCE have independently discussed, or recommended implementation of significantly different ship route or track identification schemes, for storing and accessing data in national archives,

Recommends that the present practice within IGOSS be maintained and that IOC and WMO review with all concerned all the available schemes in view of devising one common to all interests and flexible enough to accommodate changes, additions and deletions with the simplest practical identification codes or mechanisms.

Recommendation 9 (IGOSS-XBT-II)

The Joint IOC-WMO Meeting for Implementation of IGOSS XBT Ship-of-Opportunity Programmes,

Noting that existing systems and softwares now in use on various XBT data conversion systems reveal such problems as:

- "Bowing" of mixed layer profile;
- "Spikes" in data;

- Surface start-up transients;
- Inefficient/awkward user software;
- Interference on CPU screens from XBT interfaces;

Further noting that some members are concerned about such problems and are engaging in studies of these issues,

Recommends that the Joint IOC-WMO Working Committee for IGOSS establish a small XBT Data Quality Study Task Team to study both systematic and random error characteristics of each component of the systems in use such as:

- Instrument error characteristics;
- System and software performance limitations; and
- Algorithms used to calculate fall rates, temperatures depth, etc.;

Further recommends that the Task Team membership include Mr. Rick Bailey (Australia) (Chairman), Mr. Steve Cook (USA), Dr. Mike Miyake (Canada) and Dr. Alexander Sy (FRG), and that they report their findings to the next session of this meeting.

ANNEX III

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ANNEX IV

SUMMARY OF SHIP-OF-OPPORTUNITY REQUIREMENTS

PRELIMINARY WOCE REQUIREMENTS

Allyn Clarke

WOCE's requirement for IGOSS services and data are just now being defined. WOCE's first scientific goal is to develop models useful for predicting climate change and to collect the data necessary to test them. To meet this goal, WOCE must determine and understand on a global basis: 1) the large scale heat and fresh water fluxes of the ocean, 2) the dynamic balance of the ocean circulation, 3) the components of ocean variability, and 4) the rates of formation, ventilation and circulation of water masses that influence the climate system on time scales from 10 to 100 years.

The second goal of WOCE is to determine the representativeness of the WOCE data set for the long term behavior of the ocean and to find methods for determining long term changes in the ocean circulation. Hence WOCE will compare its data sets with historical data, identify those oceanographic parameters, indices and fields essential for a climate observing system and to finally develop a cost-effective climate observing system. In fact, in this final task, WOCE is pointing the way toward the IGOSS needs for the next century.

WOCE is divided into 3 CORE experiments. CORE 2 deals with the southern ocean and CORE 3 deals with process studies. Primary user of IGOSS will be CORE 1, the global description. CORE 1 has 5 major parts. The first part is what most scientists who have heard of WOCE believe is the whole of the experiment; that is the large scale global hydrographic/tracer survey coupled with satellite altimitry and deep float tracking to give a 3D picture of the ocean circulation. While most data will be collected over the full ocean depth with CTD's, some lines will be occupied seasonally with XBT's at station spacings of 30 miles or less. This higher density is required for circulation studies.

Secondly, there are a series of heat flux sections circling the globe at 30 - 35 degrees North and South and coupled with mooring arrays to measure the transports in the boundary currents. These sections are to be occupied in each season and while we would like the reoccupations to be full depth CTD sections, research ship resources may require the use of XBT's and XCTD's.

The third part is a program to measure surface fluxes and surface layer processes. It is here that IGOSS will play the largest role. First, in order to get heat estimates of surface fluxes, in situ surface meteorological data is required daily in each 10 degree square. This means an improvement of the WWW-VOS program to a level better that was achieved during FGGE, plus the addition of some surface meteorological drifting buoys in untravelled regions. The most important method of estimating evaporation-precipitation field is the measurement of the heat and salt

content of the upper layers of the ocean. This will require sufficient XBT and especially XCTD profiles to allow monthly estimates over 10 degree squares. At high latitudes, and in the centre of sub-tropical gyres, such traces will have to be to at least 750m and better to 1500m. The present IGOSS North Pacific array, with the addition of salinity information, appears to be close to WOCE requirements. Finally, WOCE will be deploying surface drifters and using acoustic doppler profilers to obtain estimates of the Ekman component of the upper ocean velocity signal.

The final two aspects of CORE 1; abyssal circulation and exchanges with marginal seas primarily involve mooring arrays and hence will not rely significantly on IGOSS.

While WOCE has no operational need for new real time data, it is important when assembling large data sets to get the data together as quickly as possible. Products such as monthly heat and salt content fields will have to be created within a few months delay to avoid falling behind and to maintain a continuous monitor on how well the observational goals are being met. IGOSS will be the primary mechanism for this "fast" data exchange. As WOCE moves closer to implementation and operation, it will have to work closer with IGOSS in the establishment of required analysis centres and delivery of data products.

TROPICAL PACIFIC SHIP-OF-OPPORTUNITY

Bruce Taft

The tropical Pacific ship-of-opportunity XBT program has been expanded significantly on a bimonthly time scale since the inception of TOGA. Spatial coverage is still inadequate in the eastern Pacific and near the international date line. Error maps should be produced with the published maps so that the quality of the product can be assessed.

Filling of these gaps will require the introduction of different modes of data collection; drifting thermister chains will be added to the TOGA thermal array to attempt to alleviate this problem. Serious problems still remain with respect to temporal sampling and the aliasing of high frequency temperature flucuations. Studies of temperature data collected from moored buoys located at 0 degrees, 110 degrees West and 0 degrees, 140 degrees West by S. Hayes and M. McPhaden, presented at the 1986 TOGA Thermal Sampling Workshop, have indicated that in order to reproduce (to within a factor of two) the low frequency portion of the operation of the temperature flucuations at 0 degrees, 110 degrees West, at least five observations per month are required. This intensity of sampling is not yet attained from the ship-of- opportunity program. These requirements are specific only to the equator in the eastern Pacific and it is presumed that sampling requirements away from the equator and to the west are less exacting.

THE VOLUNTARY OBSERVING SHIP PROGRAMME FOR MARINE ENVIRONMENTAL DATA AS A POSSIBLE PLATFORM SOURCE GATHERING XBT DATA FOR THE IGOSS PROGRAMME

Vincent Zegowitz

The National Weather Service of NOAA supports the WMO by administering a Voluntary Observing Ship program consisting of approximately 1560 ships. Participants in the VOS are asked to provide standard shipboard meteorological observations at the 6 HOUR synoptic intervals of 00, 06, 12 and 18 Z whenever they are at sea. Three hour intervals are requested when operating within 200 miles of the N. A. coast. These reports serve as the basis for the NWS marine forecasts.

With this mechanism in place, supporting 1560 VOS ships, the NWS is certainly interested in persuing the possibility of seeking volunteers among these ships to assist in gathering XBT data under the aegis of IGOSS. The feasibility of this effort should be initially demonstrated on a small scale with expansion based on the success of the initial recruitment. Efforts involved in ship/owner liaisons, operation, training, support, etc., are all familiar fields of endeavor under the existing Marine Observations Program and could be utilized as appropriate. The priority of route selection and sampling density could be arrived at through mutual cooperation of the NWS and the IGOSS community.

NODC REQUIREMENTS

Chris Noe

ABSTRACT. As one prototype model for handling ocean data--in particular to ensure their scientific quality and timeliness--the U.S. National Oceanographic Data Center and the Scripps Institution of Oceanography have formed a Joint Environmental Data Center (JEDA). This center's first task is to support subsurface thermal data management for the Pacific Ocean portion of the U.S. Tropical Ocean-Global Atmosphere (TOGA) program. JEDA will track, acquire, quality control, and merge all subsurface thermal data for the tropical Pacific. These data include near-real time data received through the IGOSS system, as well as delayed mode data in analog (strip chart) or digital (cassette) form from national and international sources. The NODC will assemble, reformat, and initiate quality control of the data; Scripps will perform further quality control by using the data set to produce bimonthly oceanographic products. these data and products are available to TOGA investigators monthly, either at Scripps or NODC. Future plans may involve an on-line inventiory, and some data base distribution through NASA's Ocean/SPAN Network.

APPLICATION OF OPERATIONAL OCEANOGRAPHY TO FISHERIES

Scott Akenhead

Data communications have caught up with the old realization that deepsea fishing could be more efficient by providing sea-surface and sea--bottom temperature maps (SST and SBT maps) to fleet managers and fishing captains at sea. The objective is not fisheries management (i.e. quota setting), but involves mapping and predicting temperature patterns for applications in the fish harvesting sector. The communications infrastructure for SST is in place for satellite, buoy and ship data, although data density may require increases before application thresholds are met. SBT maps are more difficult because of observation costs, bottom bathymetry, and data sparseness. The current status of efforts to produce SBT and SST maps is encouraging - many of the required pieces are falling into place. Hardware for data aquisition, processing and for two- way communication is now available technology. Statistical techniques for mapping and error detection are sufficiently developed. The willingness of commercial fishing fleets to invest in these projects speaks for economic viability. What remains is to conduct experimental pilot projects, with controls, to demonstrate the utility of SBT and SST maps to fishing operations. Further developments will utilize dynamic oceanographic models to forecast the advection and distortion of mapped temperature patterns.

FISHERIES OCEANOGRAPHIC RESEARCH IN THE GULF OF THAILAND

Suchada Silpipat

The following research programs are being conducted in Thailand:

1. Ocean circulation to trace migratory of living resource, especially tuna and squid, in order to make clear the relations between the fishing grounds.

2. Relation of river discharge in the Gulf of Thailand to sediment and sea water.

3. Relations between the fishing grounds and the oceanographic conditions.

4. Remote sensing technology relating to fronts and boundaries.

REQUIREMENTS FOR NAVIGATION

Paul Stevens

Analyses centres provide real time depictions of the oceanic environment to a community of "at sea" users. Ideally, these products are based on numerous ocean observations equating distances in time and space. Ultimate goals of these products are increased safety at sea operations and economics of ocean transport. The numbers and quality of oceanic observations available to the analysis/forecasts are increasing by a significant number each year. Figure 1 depicts the first seven months of 1987. Major contributors of these observations are identified on their geographical operating area. However, figure 2, is the same time period for 1986, demonstrates that increased numbers do not necessarily contribute to increased data coverage.

Ocean monitoring systems are becoming more common. Therefore, is now time for a more strategic placing of these systems to accommodate the requirements formats of the analyses centres.

ANNEX V

SHIP-OF-OPPORTUNITY LIST

Ships-of-Opportunity

ATLANTIC OCEAN

Operational

Line No.	Route/Ship Name	Frequency	Country/Sponsoring Organization
A-1	Newfoundland - Iceland		
	Bakkafoss	4	Canada/BIO
A-2	Denmark - Greenland		
	Nivi Ittuk	12	United Kingdom
A-3	Argentina - Antarctica		
	Amirante Irizar	1	Argentina
A-4	Europe - E. Coast S. America		
	La Fayette	8	France/ORSTOM
	Monte Rosa	8	FRG/DHI/FNOC
	Toulon	8	France/ORSTOM
	Zambeze	8	France/ORSTOM
A-6	Europe - S. tip of Africa		
	Ronsard	12	France/ORSTOM
	Ango	12	France/ORSTOM
A-8	Europe - Panama Canal		
	Los Angeles	6	US/FNOC
	Falstria	6	US/FNOC
A-12	New York - Burmuda		
	Oleander	52	US

A-14	Gulf of Mexico		
	Edgar M. Queeny	24	US/NWS/NOS
	Senator	24	US/NWS/NOS
A-17	Gulf of Mexico - Panama Canal		
	Exxon Jamestown	12	US/SIO
A-22	East Coast US - Portugal		
	Damaio de Grois	6	US-NOS/PORTUGAL
A-24	Brazil - S. tip of Africa		
	Nedlloyd Kingston	6	US/FNOC
	Nedlloyd Kimberly	6	US/FNOC
	Nedlloyd Katwick	6	US/FNOC
	Nedlloyd Kyoto	6	US/FNOC
A-29	France - French Guyana		
	Atlas	Irr	France/ORSTOM

Planned

A-9	Europe - E. Coast N. America		
	TBN	12	FRG/DHI
	TBN	12	FNOC/UK

Proposed

A-4	Brazil - S. tip Africa		
	Anakena	6	Chile
	Angol	6	Chile
A-5	Uruguay - Nigeria		
	Angol	6	Chile
	Ankena	6	Chile
A-6	Europe - E. Coast S. America		
	M.V. Kraljevica	3	Yugoslavia

A-7	Nigeria - Europe		
	M.V. River Oshun	4	Nigeria
	M.V. Oli	4	Nigeria
A-18	E. Coast N. America - Venezuela		
	TBN	UNK	NOAA/NOS
A-24	Panama Canal - S. Tip Africa		
	UNK	UNK	FNOC
A-26	S. tip S. America - S. tip Africa		
	Vina Del Mar	4	Chile
A-30	E. Coast N. America - Brazil		
	TBN (2 ships)	UNK	NOAA/NOS
A-31	S. tip of Africa - Antarctica - S. tip of S. America		
	Polarstern	1	FRG/AWI

INDIAN OCEAN

Operational

I-1	Fremantle - Java/Arafura Sea		
	ANRO Australia	8	Australia/CSIRO
	ANRO Asia	8	Australia/CSIRO
I-2	S. tip of Africa - Australia		
	Nedlloyd Kembla	3	US/FNOC
	Nedlloyd Katwyk	3	US/FNOC
	Nedlloyd Kingston	3	US/FNOC
	Nedlloyd Kyoto	3	US/FNOC
I-3	Red Sea - La Reunion		
	Marion Dufresne	4	France/ORSTOM
	Renoir	6	ORSTOM/IMF
	Ile Maurice	12	ORSTOM/IMF
I-9	Fremantle - Red Sea		
	Flinders Bay	10	Australia/CSIRO
	Botany Bay	10	Australia/CSIRO
	Encounter Bay	10	Australia/CSIRO

I-12	Fremantle - Dubai		
	Australia Star	6	Australia/CSIRO
I-22	Fremantle - Sunda Str		
	Swan Reefer	24	Australia/CSIRO
I-21	Mauritius - Durban		
	Renoir	6	ORSTOM/TAFF

Planned

I-10	Somalia - Singapore		
	TBN	8	ORSTOM
I-11	Gulf of Thailand - andaman Sea		
	RV Fishery No. 3	*2*	*Thailand*
	RV Fishery No. 4	2	Thailand
	Nakoin Thon	2	Thailand
I-14	Bangkok - Columbo		
	R.V. Fishery No. 4	2	Thailand
I-23	Australia - Antarctica		
	Nella Dain	1	Australia/CSIRO

Proposed

I-7	Mombasa - Pakistan		
	Various	UNK	Kenya
I-8	Mauritius - India		
	TBN	4	Mauritius

I-12	Red Sea - Australia		
	M.V. Admiral Purisic	4	Yugoslavia
	M.V. Heroj Paic	4	Yugoslavia
I-15	Mombasa - Bombay		
	Various	UNK	Kenya
I-16	Mombasa - Singapore		
	Various	UNK	Kenya
I-18	Mombasa - La Reunion		
	Various	UNK	Kenya
I-19	La Reunion - Kerguelan		
	Marion Dufresne	4	MNHN/TAAF
I-20	Mauritius - Rodriguez		
	M.V. Mauritius	12	Mauritius

PACIFIC OCEAN

Operational

P-1	Noumea - Taiwan		
	Jebsen Timaru	6	ORSTOM/SIO
P-2	Noumea - Japan		
	Pacific Islander	5	ORSTOM/SIO
P-3	Noumea - Hawaii - W. Coast US		
	Lillooet	6	ORSTOM/SIO
	Elgaren	6	ORSTOM/SIO
P-4	Tahiti - W. Coast US		
	Polynesia	12	ORSTOM/SIO
	Moana Pacific	12	ORSTOM/SIO

P-5	Noumea - Tahiti		
	Rodin	6	ORSTOM/SIO
	Rostrand	6	ORSTOM/SIO
	Rousseau	6	ORSTOM/SIO
	Pacific Islander	6	ORSTOM/SIO
	Gauguin	6	ORSTOM/SIO
	Coriolis	6	ORSTOM/SIO
P-6	W. Coast US - Japan (TRANSPAC)		
	Hakone Maru	12	US/SIO
	Tokyo Maru	12	US/SIO
	Pacbaroness	6	US/FNOC
	Pacmerchant	6	US/FNOC
	Hira Maru	12	US/SIO
	Shinkashu Maru	12	US/SIO
	Hikawa Maru	12	US/SIO
	Yamahsin Maru	12	US/SIO
	America Maru	12	US/SIO
	Pacprincess	8	US/FNOC
	Pacmonarch	8	US/FNOC
	Lars Maersk	8	US/SIO
	Lexa Maersk	8	US/SIO
	Hiyoshi Maru	8	US/SIO
	Pacprince	8	US/FNOC
	Ambassador Bridge	12	US/SIO
	McKinney Maersk	8	US/SIO
P-7	W. Coast US - Indonesia		
	Nedlloyd Kembla	6	US/FNOC
	Nedlloyd Katwyk	6	US/FNOC
	Nedlloyd Kingston	6	US/FNOC
P-8	Equador - Japan		
	Isla Floreana (?)	12	INOCAR/AOML
P-9	Japan - Hong Kong		
	Pacbaroness	6	US/FNOC
	Pacmerchant	6	US/FNOC
	Pacprincess	6	US/FNOC
	Pacmonarch	8	US/FNOC
P-10	Hawaii - New Guinia - Guam - Hawaii		
	Micronesian Independence	4	US/SIO
	Micronesian Commerce	4	US/SIO
	Cap Anamur	4	US/SIO

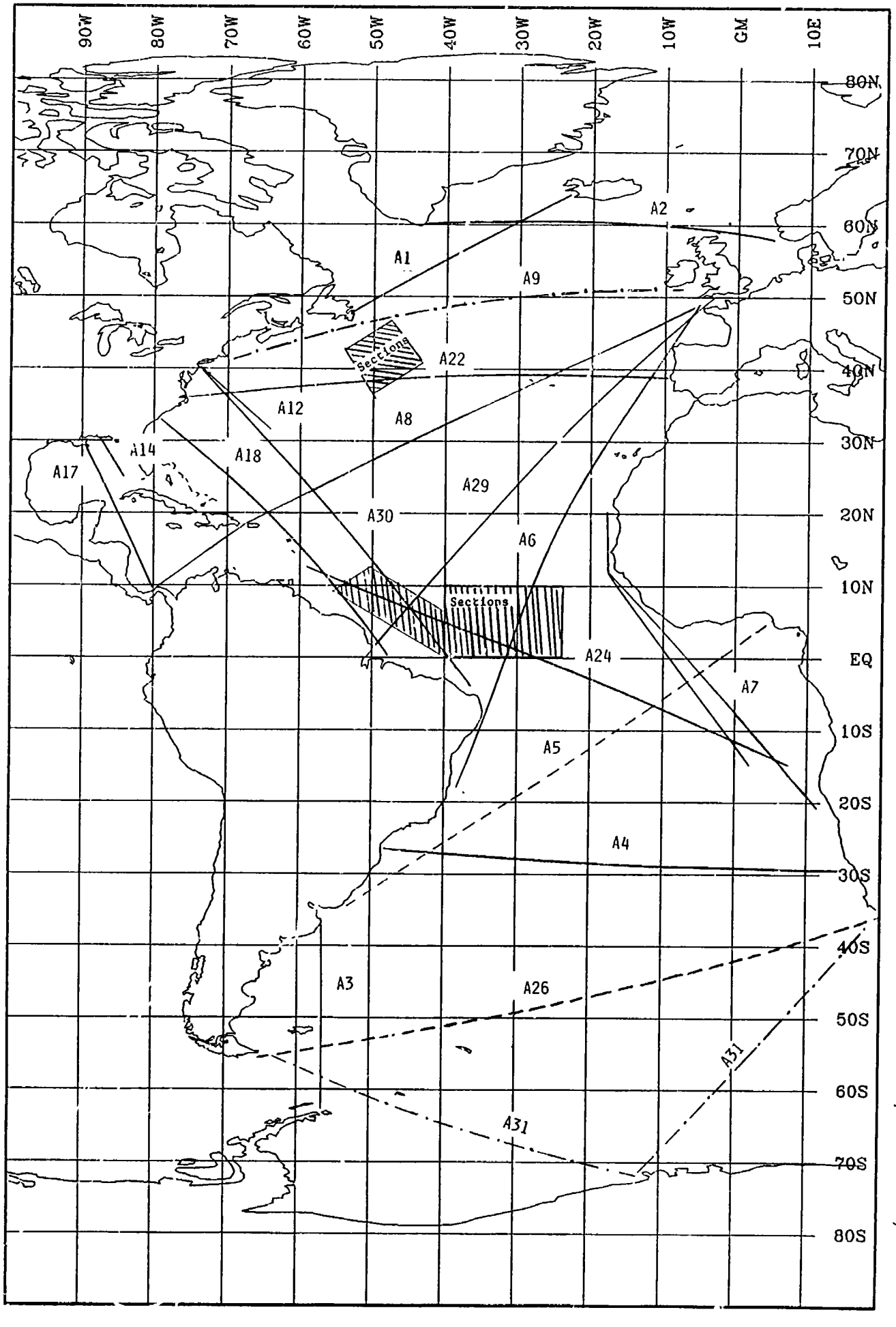
P-14	Equador - Galapagos		
	Bucanero (?)	24	INOCAR/AOML
P-15	ALASKA - Hawaii		
	Chevron California	3	US/SIO
	Chevron Mississippi	3	US/SIO
P-18	Alaska - S. tip S. America		
	Seal Island	6	US/SIO/IOS
	Mt. Cabrite	6	US/SIO/IOS
	Santa Lucia	6	US/SIO/IOS
	Sealift Arctic	6	US/FNOC
P-20	W. Coast US - Panama Canal		
	Exxon Jamestown	12	US/SIO
	Falstria	12	US/FNOC
	Packing	6	US/FNOC
P-22	W. Coast US - Australia		
	Columbus Canada	12	US/FNOC
	Columbus Victoria	12	US/FNOC
	Columbus Virginia	12	US/FNOC
	Columbus Wellington	12	US/FNOC
	Columbus California	12	US/FNOC
	Lillooet	12	ORSTOM/SIO
P-23	Port Hedland - Japan		
	Australian Progress	24	Australia/CSIRO
P-29	Peru - Japan		
	Scrim	6	Peru/AOML
P-32	Sidney - Panama		
	Act III	4	CSIRO/ORSTOM
	Act IV	4	CSIRO/ORSTOM
	Act VI	4	CSIRO/ORSTOM
P-34	Coral Sea		
	Nimos	12	Australia/CSIRO

Planned

P-6	W. Coast US - Japan		
	Pac Emporer	8	US/FNOC
P-9	Japan - Hong Kong		
	Pac Emporer	8	US/FNOC

Proposed

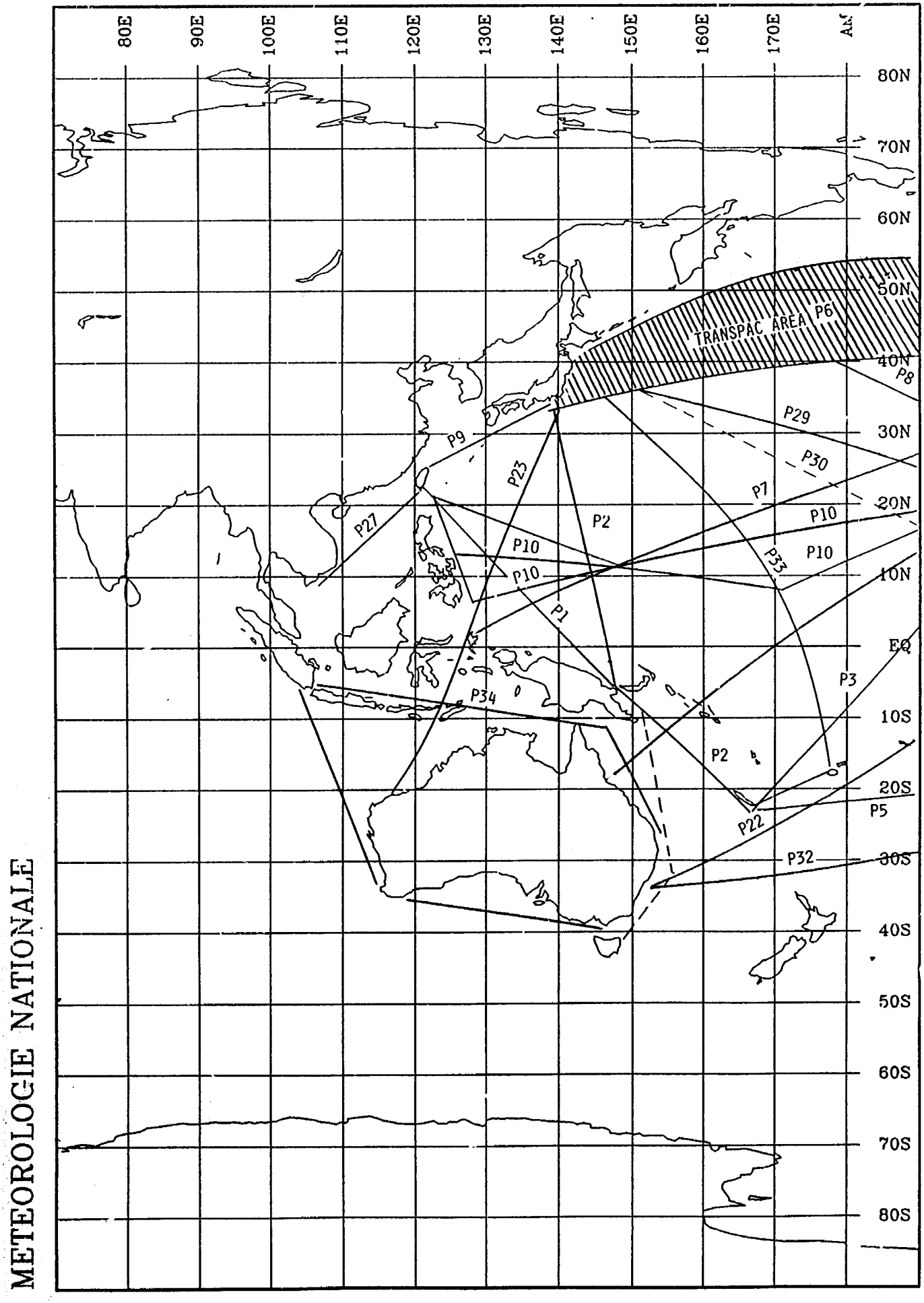
P-9/27	Bangkok - Japan		
	Nakon Thon (HSGG)	8	Thailand
P-19	Chile - Peru		
	Malleco	4	Chile
	South Diamond	4	Chile
P-19/21	Chile - W. Coast US		
	Anakena	3	Chile
	Angol	3	Chile
	Maipo	4	Chile
	Rubens	4	Chile
	Malleco	4	Chile
	South Diamond	4	Chile
	Valparaiso	4	Chile
	Presidente Banex	4	Chile
	Presidenta Gonzoles Videla	4	Chile



METEOROLOGIE NATIONALE

SCEM/PREVI/MAR

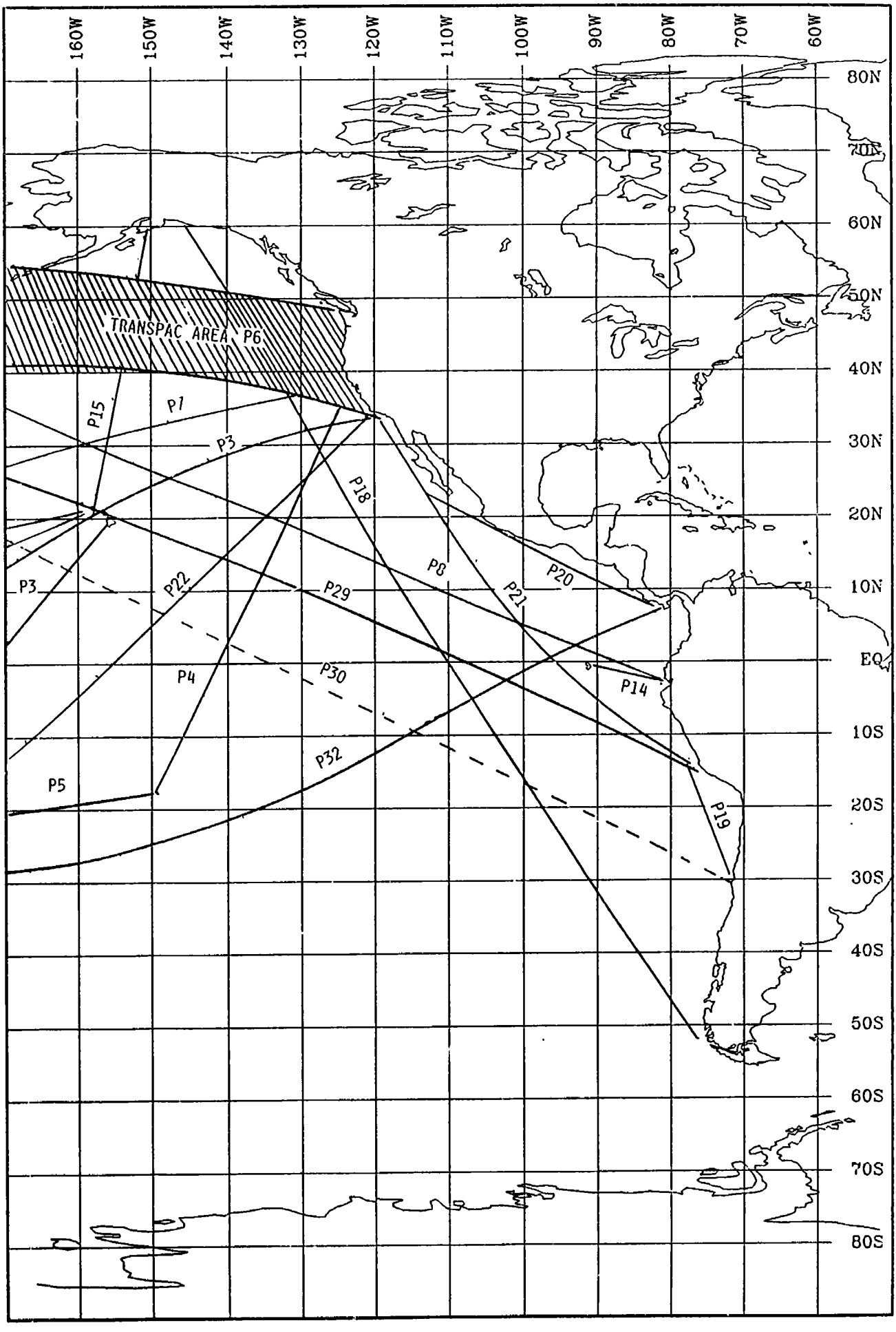
Atlantic Ocean



METEOROLOGIE NATIONALE

.SCEM/PREVI/MAR

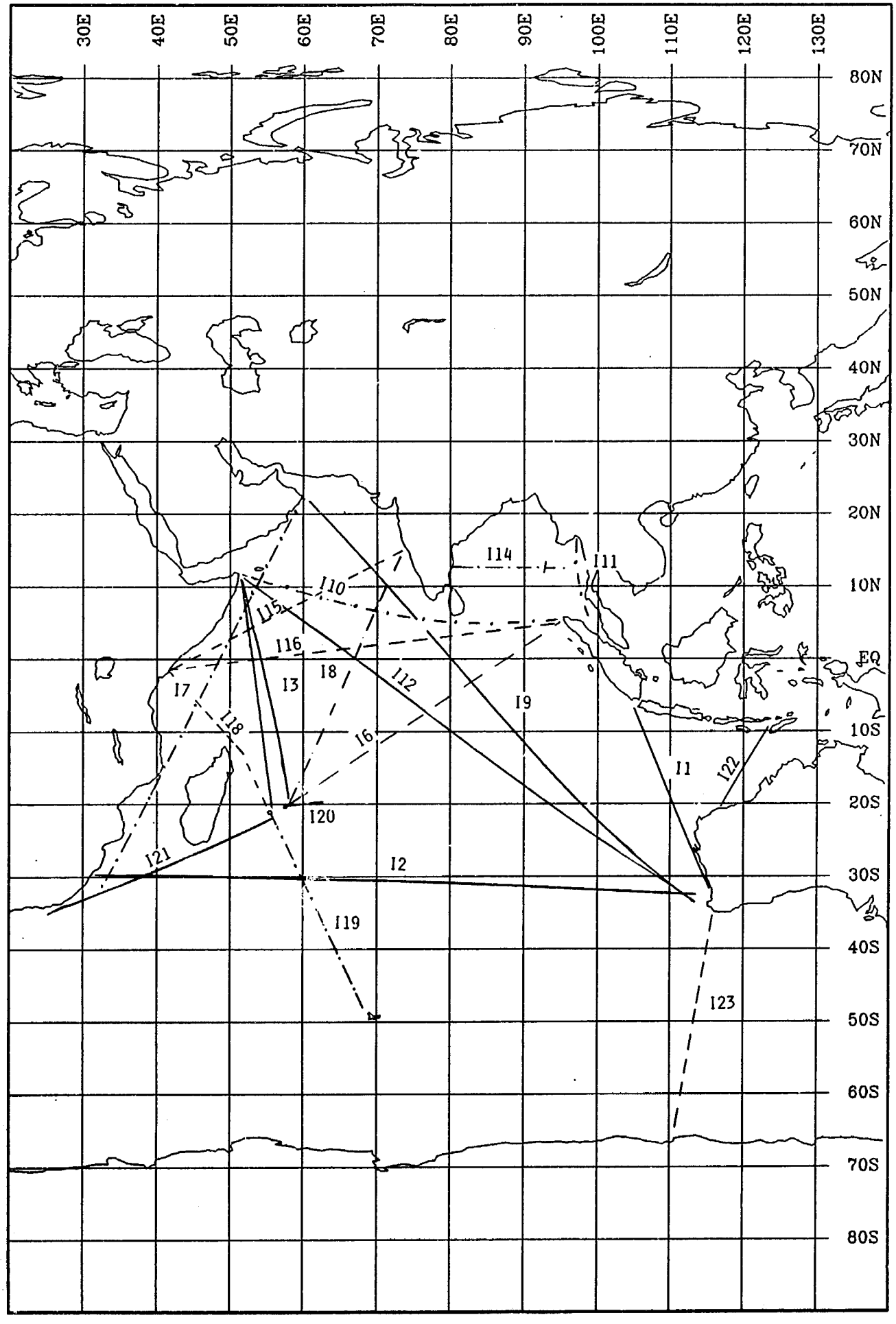
Western Pacific Ocean



Eastern Pacific Ocean

METEOROLOGIE NATIONALE

SCEM/PREVI/MAR



METEOROLOGIE NATIONALE

SCEM/PREVI/MAR

Indian Ocean

ANNEX VI

DATA ACQUISITION UTILIZING SERVICE ARGOS

XBT data acquisition and transmission to the GTS via ARGOS

A prototype has been developed and tested at sea transmitting XBT data via ARGOS. The development was funded by IFREMER (France), manufacturers are PROTECNO and Argos and scientific control was ensured by ORSTOM.

This system is based on one case unit containing the analog to digital converter, an ARGOS emitter and a transmission management unit. The role of this last unit is to store 256 bit messages, send them to the emitter on a cyclical basis and switch off automatically the transmitter if there is no new message for 14 hours. This will reduce the cost of utilization.

The computer used is a standard portable PC with two 3.5" disk drives. Standard sampling rate is 6 copies.

The coded ARGOS message contains only 15 temperature/depth couples, and according to a preliminary study lead by ORSTOM, the loss of accuracy compared to a 21 point bathy-message in less than 1 percent.

ARGOS implemented at Toulouse a dedicated XBT service whose functions are to decode the message, convert it into WMO code and send it over the GTS. Preliminary quality control will be achieved at the same time. An interesting feature of this service will be its capability to check the positions by comparison with the position deduced by computation of the emitter location. Obvious errors will be corrected and suspicious data flagged.

IFREMER will purchase 15 units in 1987 and ORSTOM will manage them on its Pacific ships-of-opportunity network.

France recommends that the 256 bit map presented be used in other systems so that information exchange will be standardized.

ANNEX VII

RESULTS OF AUTOMATED SYSTEMS QUESTIONNNAIRES

New Generation XBT Reporting System

Recommended Further Modifications to SEAS III

Size	It is preferable that the entire system be the size of an IBM computer within 20 cmx 30 cm x 40 cm
Computer	Should be reasonably IBM compatible to be able to run Lotus on MS DOS 2.x and upward. Hardware should be upward compatible to new DOS.
I/O port	1. RS-232 port for XBT :2. RS232 for satellite 3. parallel centronics for Printer
XBT interface	RS232 port :communication protocol should be standardized (ASCII code should be specified for READY STATUS etc).
POWER	Should be prepared to be used under different power supply and grounding. 110V or 240V, either 60Hz to 50 Hz, either one side or center grounded
SOFTWARE	A. Must be simple (do not have too much choice for routine operator but should have option for equipment managers and researcher) B.Data editing capability should be strengthened beyond cutting the bottom . However data disk should record original data automatically. C.Automatic spike removable capability needed. Criteria may be change of temperature of 5°C between data points D. Sea surface recognition and transient must be made better E. Source program should be available to change (by the XBT ship managers.) F. There should be an easy short circuit for Met report in XBT report. Code change possibility should be examined.
DATA FILE	Should be made international standard written in ASCII
Transmitter	I/O communication protocol should be made international standard. Argos based system should be developed, and adapt the French coding scheme.