Intergovernmental Oceanographic Commission
Reports of Meetings of Experts and Equivalent Bodies

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

Washington, DC, USA, 1-4 October 1991

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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
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26. Eighth Session of the IOC-UNEP Group of Experts on Methods, Standards and intercalibration
27. Eleventh Session of the Joint IOC-IHO Guiding Committee for the General Bathymetric Chart of the Oceans *(Also printed in French)*
28. Second Session of the IOC-FAO Guiding Group of Experts on the Programme of Ocean Science in Relation to Living Resources
29. First Session of the IOC-IAEA-UNEP Group of Experts on Standards and Reference Materials
30. First Session of the IOCARIBE Group of Experts on Recruitment in Tropical Coastal Demersal Communities *(Also printed in Spanish)*
31. Second IOC-WMO Meeting for Implementation of IGOSS XBT Ship-of-Opportunity Programmes
32. Thirteenth Session of the Joint CCOP-IOC Working Group on Post-IDOE Studies of East Asia Tectonics and Resources
33. Second Session of the IOC Task Team on the Global Sea-Level Observing System
34. Third Session of the IOC Editorial Board for the International Bathymetric Chart of the Mediterranean and Overlay Sheets
35. Fourth Session of the IOC-UNEP-IMO Group of Experts on Effects of Pollutants
36. First Consultative Meeting on RNODCs and Climate Data Services
37. Second Joint IOC-WMO Meeting of Experts on IGOSS-IODE Data Flow
38. Fourth Session of the Joint CCOP/SOPAC-IOC Working Group on South Pacific Tectonics and Resources
39. Fourth Session of the IODE Group of Experts on Technical Aspects of Data Exchange
40. Fourteenth Session of the Joint CCOP-IOC Working Group on Post IDOE Studies of East Asian Tectonics and Resources
41. Third Session of the IOC Consultative Group on Ocean Mapping
42. Sixth Session of the Joint IOC-WMO-CPPS Working Group on the Investigations of « El Niño » *(Also printed in Spanish)*
43. First Session of the IOC Editorial Board for the International Bathymetric Chart of the Western Indian Ocean
44. Third Session of the IOC-UN (OALOS) Guiding Group of Experts on the Programme of Ocean Science in Relation to Non-Living Resources
45. Ninth Session of the IOC-UNEP Group of Experts on Methods, Standards and Intercalibration
46. Second Session of the IOC Editorial Board for the International Bathymetric Chart of the Caribbean Sea and the Gulf of Mexico
47. First Session of the IOC Editorial Board for the International Bathymetric Chart of the Western Indian Ocean
48. Twelfth Session of the Joint IOC-IHO Guiding Committee for the General Bathymetric Chart of the Oceans
49. Fifteenth Session of the Joint CCOP-IOC Working Group on Post-IDOE Studies of East Asian Tectonics and Resources
50. Third Joint IOC-WMO Meeting for Implementation of IGOSS XBT Ship-of-Opportunity Programmes
51. First Session of the IOC Group of Experts on the Global Sea-Level Observing System
52. Fourth Session of the IOC Editorial Board for the International Bathymetric Chart of the Mediterranean
53. First Session of the IOC Editorial Board for the International Chart of the Central Eastern Atlantic *(Also printed in French)*
54. Third session of the IOC Editorial Board for the International Bathymetric Chart of the Caribbean Sea and the Gulf of Mexico *(Also printed in Spanish)*
55. Fifth Session of the IOC-UNEP-IMO Group of Experts on Effects of Pollutants
56. Second Session of the IOC Editorial Board for the International Bathymetric Chart of the Western Indian Ocean
57. First Meeting of the IOC *ad hoc* Group of Experts on Ocean Mapping in the WESTPAC Area
58. Fourth Session of the IOC Consultative Group on Ocean Mapping
59. Second Session of the IOC-WMO/IGOSS Group of Experts on Operations and Technical Applications
60. Second Session of the IOC Group of Experts on the Global Sea-level Observing System
61. UNEP-IOC-WMO Meeting of Experts on Long-Term Global Monitoring System of Coastal and Near-Shore Phenomena Related to Climate Change
62. Third Session of the IOC-FAO Group of Experts on the Programme of Ocean Science in Relation to Living Resources
63. Second Session of the IOC-IAEA-UNEP Group of Experts on Standards and Reference Materials
64. Joint Meeting of the Group of Experts on Pollutants and the Group of Experts on Methods, Standards and Intercalibration
65. First Meeting of the Working Group on Oceanographic Co-operation in the ROPME Sea Area
66. Fifth Session of the Editorial Board for the International Bathymetric and its Geological/Geophysical Series
67. Thirteenth Session of the IOC-IHO Joint Guiding Committee for the General Bathymetric Chart of the Oceans *(Also printed in French)*
68. International Meeting of Scientific and Technical Experts on Climate Change and Oceans
69. UNEP-IOC-WMO-IUCN Meeting of Experts on a Long-Term Global Monitoring System
70. Fourth Joint IOC-WMO Meeting for Implementation of IGOSS XBT Ship-of-Opportunity Programmes

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1. ORGANIZATION OF THE MEETING

1.1 OPENING OF THE MEETING

1 The Fourth Joint IOC-WMO Meeting for Implementation of the Integrated Global Ocean Services System (IGOSS) XBT Ship-of-Opportunity Programmes was opened by Mr. John Withrow, of the IOC Secretariat, on behalf of Dr. Yves Tourre, Chairman of the Joint IOC-WMO Committee for IGOSS, at 10:00 a.m., 1 October 1991, at the National Academy of Sciences, Washington D.C. Dr. Tourre expressed his regrets that he could not attend due to a scheduling conflict.

2 Dr. Dana Kester, NOAA, welcomed the participants to the United States and thanked the National Academy of Sciences for the use of their facility.

3 He reviewed some of the recent developments in the Global Ocean Observing System and the Global Climate Observing System noting that the oceans are becoming widely recognized by the governments of the world for their importance to climate and the environment. The importance of worldwide data sets were discussed, specifically in regard to ocean thermal data. The ocean related aspects of global change are a matter of concern in a variety of aspects. Some of these aspects are climate change and variability, ocean variability and the monitoring of marine living resources.

4 The Global Ocean Observing System (GOOS) is being developed as a series of modules. The principal goals are observing climate change, providing ocean services and monitoring coastlines and living marine resources. Some of the elements of this system will include satellite data together with *in situ* data to monitor the oceans, numerical models to assimilate this data and make predictions and the exchange and management of data on a global scale.

5 The goal is that, as of 2001, the Global Ocean Observing System should be a functional observational system, utilizing systems such as moored and drifting buoys worldwide and ship-of-opportunity XBT transects.

6 Mr. Timothy Wright, IGOSS Operations Co-ordinator, on behalf of the IOC, and Dr. Mikhail Krasnoperov, Scientific Officer, on behalf of the WMO, welcomed the participants and thanked the Government of the United States and the National Academy of Sciences for hosting the meeting.

7 Mr. John Withrow thanked NOAA and the National Academy of Sciences for hosting the meeting. He noted that at the first ship-of-opportunity meeting in Seattle in 1985, much time was spent in describing what ocean monitoring was being done. Now we are to the point where we are doing well at describing the system. We should begin moving on to the next phase - the monitoring of the activity that is taking place. He noted that this would be an excellent opportunity as the current and past two IGOSS Operations Co-ordinators were present. In the current environment of reduced resources it was necessary to insure that each measurement was captured and passed through the system.

8 The List of Participants is given in Annex II of this Report.

1.2 ELECTION OF THE CHAIRMAN

9 Mr. William Woodward of the National Oceanic and Atmospheric Administration was proposed as Chairman by the Representative of Germany. The proposal was seconded by representatives from France and Australia and the Meeting unanimously supported the nomination.

1.3 ADOPTION OF THE AGENDA

10 The Meeting decided to discuss Agenda Items 3.1 and 3.2 together as Agenda Item 3.1 and renumbered Agenda Item 3.3 accordingly. It also decided to consider Agenda Item 4.1 in conjunction with Item 5.1 as Item 5.1 deleting Item 4.1 and renumbering Item 4.2 accordingly. The Agenda, as adopted by the Meeting, is reproduced in Annex I.

1.4 WORKING ARRANGEMENTS

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

2. **REQUIREMENTS FOR SUB-SURFACE THERMAL DATA**

12 The discussion on Agenda Item 2 was opened by Mr. Woodward.

Tropical Ocean Global Atmosphere (TOGA) Programme

13 Dr. Gary Meyers, CSIRO, presented the WOCE/TOGA XBT requirements. He proposed that in the future the IGOSS ship-of-opportunity meetings should be held after the TOGA/WOCE XBT meetings rather than before like this year, to better integrate the scientific research requirements with the operational aspects of data gathering. The Meeting supported this proposal.

14 The TOGA Scientific Steering Group (SSG), at its meeting in July 1988, requested the International TOGA Project Office (ITPO) to co-ordinate a review of the implementation of TOGA XBT sampling strategy in light of the resources likely to be available in the second half of TOGA. The SSG further requested the ITPO to institute a mechanism to assign priorities when resource constraints and conflicts in requirements arise.

15 After consultation with the agencies concerned, the mechanism envisaged by the Memoranda of Agreement signed between the original three agencies contributing to the TOGA "pool" of XBTs was activated. A TOGA XBT Operations and Management Committee (OMC) was established, with representation from NOAA (USA), CSIRO (Australia), IFREMER (France) and BSH (Germany), chaired by the Director of the ITPO. This Committee, advised by an *Ad hoc* Panel of Experts, was tasked to:

(i) develop plans;

(ii) identify and recommend agency support to execute plans;

(iii) ensure programme flexibility; and

(iv) monitor the programme.

16 The expert advisors to the OMC, viz the TOGA XBT *Ad hoc* Panel of Experts, met twice, once in Noumea, New Caledonia, in May 1989, and again in Honolulu, USA, in July 1990.

17 At the Noumea meeting, the Panel reviewed the requirements contained in the second edition of the TOGA Implementation Plan for XBT sampling along VOS lines, in light of recent studies of decorrelation scales in the tropical Pacific and Indian Oceans. A subset of the lines was identified for sampling at a rate of three observations per decorrelation scale and the balance at two observations per decorrelation scale. A summary of the recommendations is included in the TOGA Implementation Plan, third edition (ITPO-1, February 1990). Full sampling of the TOGA network at these rates would require approximately 29,000 probes annually.

18 The OMC met in January 1990 when it forecast that the TOGA "pool" of probes for 1991 would be virtually the same size as 1990 (approximately 12,500 probes). The OMC submitted to the *Ad hoc* Panel a proposal for distribution of probes to the various operators. This proposal was reviewed and ratified by the Panel at its second meeting in July 1990 and was implemented in 1991.

19 At its first meeting, the Panel noted with concern evidence which suggested that at least 40% of the XBT observations made in the tropical oceans are not reported in near-real-time and are, thus, lost to the operational ocean models. The Panel recommended that this be drawn to the attention of the Committee for IGOSS and that the ITPO should give high priority to actions designed to increase real-time reporting.

20 The Panel also noted with concern the low percentage of profiles which, having been reported in real time, are later submitted in delayed-mode to the TOGA Sub-surface Data Centre (TSDC) at Brest. The Panel recommended that IGOSS and the ship operators take action to ensure that a greater percentage of data reported in real-time are also submitted in delayed mode to the TDSC.

21 The Panel recommended that the ITPO, in co-operation with the TSDC, the IGOSS Operations Co-ordinator, and the WOCE International Project Office, build on existing reporting mechanisms to develop a means to effectively monitor the programme as a whole.

22 At its second session, the *Ad hoc* Panel recognized that there were many overlapping goals and concerns between the WOCE and TOGA XBT programmes and requested the ITPO to explore with the WOCE IPO the possibility of merging the WOCE VOS Programme Planning Committee with the TOGA Panel. Both the WOCE and TOGA SSGs concurred and the newly formed TOGA/WOCE XBT/XCTD Programme Planning Committee was scheduled to meet for the first time 8-10 October 1991 in Washington D.C., directly following the IGOSS Ship-of-Opportunity Programmes Meeting (SOOP-IV). The TOGA/WOCE Committee looks forward to receiving reports from SOOP-IV concerning several important issues, including the XBT fall rate investigation and the "bowing" problems.

23 A Representative from TOGA will report on the results of the first session of the TOGA/WOCE XBT/XCTD Programme Planning Committee to the IGOSS Operations Co-ordinator.

24 A second meeting of the TOGA XBT Operations and Management Committee is planned for 25 November 1991 to discuss programme implementation in 1992.

Global Ocean Observing System and Global Climate Observing System

25 Mr. John Withrow opened his presentation on the Global Ocean Observing System and Global Climate Observing System, noting the excellent presentation already made by Dr. Dana Kester on the subject. He went on to note that as a component of the Integrated Global Ocean Services System, the Ship-of-Opportunity Programme was already contributing to the effort to observe the ocean. The requirements for the GOOS and the GCOS were for the moment those of the existing ocean research and services programmes while the long-term requirements were in the process of being formulated through the activities of such groups as the Joint JSC-CCCO Ocean Observing System Development Panel which was meeting this week in Boston. He emphasized the fact that the GOOS was at this time a framework in which all of the existing programmes were being viewed and that the impact of the GOOS on existing programmes would be to enhance and support their activities. Thus the best way to contribute to the Global Ocean Observing System is to fully support existing activities such as the IGOSS Ship-of-Opportunity Programme.

3. SHIP-OF-OPPORTUNITY ACTIVITIES PRESENT AND FUTURE

3.1 STATUS OF EXISTING, PLANNED AND PROPOSED LINES

26 Mr. William Woodward introduced this Agenda Item.

27 Reports were submitted by Representatives of the following Member States: Argentina, Australia, Germany, France, Japan, United Kingdom and the United States. These reports are included in Annex III.

28 Mr. Richard Hayes of the U.S. Navy gave a presentation on the US Navy XBT programme. The Navy is presently reexamining its requirements for all ocean thermal data. It will also conduct a careful review of the VOS system to select the most productive lines for Navy requirements. A review will also be conducted of the XBT Co-operative Programme. He discussed the Navy review of XBT data sets and the declassification of a large segment of the data collected from 1985 to 1988, some 75% of which are being placed in the NODC database. A report was submitted by Mr. Paul Stevens of FNOC on the Navy COOP Programme and is attached in Annex III.

29 Mr. Vince Zegowitz gave a presentation on the status on the US National Weather Service VOS programme. He stressed the importance of close co-operation between the meteorological and oceanographic communities in light of the present budget constraints.

3.2 MANAGEMENT OF THE SHIP-OF-OPPORTUNITY PROGRAMME INCLUDING DATA FLOW MONITORING AND COMMUNICATIONS

30 Mr. Timothy Wright, IGOSS Operations Co-Ordinator, introduced this agenda item and gave the status of present monitoring activities being conducted. The role of the Operations Co-ordinator in assisting communications and monitoring of data flow problems through an international organization was addressed.

31 Dr. Mikhail Krasnoperov, WMO Scientific Officer, reminded the Meeting of the proposal of the Second Session of IOC-WMO IGOSS Group of Experts on Operations and Technical Applications (OTA) (Paris, November 1990) to draft monitoring guidelines and compile a list of bulletin headers. This list was completed in co-operation with MEDS (Canada), BSH (Germany) and the IGOSS Operations Co-ordinator, and will be published in the IGOSS XBT Bulletin, the World Weather Watch Monthly Letter and the GTSPP monthly report.

32 Dr. Alexander Sy gave a presentation on IGOSS data monitoring. Real-time data flow monitoring requires that every message that enters a particular centre be accounted for. That is all JJXX, KKXX and NNXX messages entering a centre must be counted in the same way. He proposed that the counting period be from 0001 UTC GTS time on the first day of the month through 0001 UTC of the third day of the following month. He also recommended putting all the abbreviated headings in the report with the ship call signs and a note on the status of the quality control for input data and the number of counted messages.

33 The Meeting recommended that the practical application of GTS for the exchange and monitoring of XBT data should be included in the next SOOP meeting agenda item. It further recommended to invite a WMO telecommunications representative to give a presentation on this subject.

34 Mrs. Penny Holliday gave a presentation on the WOCE XBT Data Tracking System. A description of this tracking system is attached in Annex IV to this report.

35 The Meeting recommended that the Monthly Ship Visit Report be revised and made to reflect a more meaningful monitoring tool for IGOSS and the WOCE/TOGA programmes. A working group was formed to revise this report. A revised form has been prepared and is attached to this report as Annex V. This revised report will be distributed for recommendations and approval on the next Monthly Ship Visit Report. A target date for implementation is 1 January 1992.

36 Mr. Jean-Paul Rebert gave a presentation of the Global Temperature Salinity Pilot Project study conducted in September 1989 to monitor data flow. The test was conducted at MEDS in Canada, and collected real-time temperature and salinity data. 3,742 unique messages were obtained by assembling the data collected at six IGOSS centres. The number of messages captured by individual countries varied from less than 50% to nearly 80% of the total data set. This confirmed the value of combining data from the three sources used since then by MEDS. At the last GTSPP steering Group Meeting held in July 1991 in Obninsk, several new countries (France, Japan, Germany and the USSR) volunteered to provide MEDS with their national inputs on an experimental basis. This will contribute to a more complete global real time data set. It was decided to continue the monitoring reports which are issued each month by MEDS in the GTSPP monthly reports.

37 Presentations were made by Mr. Mike Szabados of the data flow in the NOAA XBT Programme and by Mr. Sonny Richardson of the NOAA Ocean Products Center on Quality Control and data flow from NOAA ocean platforms.

4. **EQUIPMENT: INFORMATION ABOUT NEW DEVELOPMENTS (XCTD,ETC.)**

38 This Agenda Item was opened by Mr. William Woodward noting that, in addition to new equipment, there are also new versions of existing equipment that need to be examined. Presentations were given on a new XBT, the XCTD, thermosalinographs, the doppler current profiler, hull mounted temperature sensors, multiple XBT launchers and new software for tracking ships of opportunity.

39 The Meeting noted the announcement by Sippican that the XCTD (10 knot version) had gone into production. The Meeting felt that a 18-20 knot version was needed to be useful to the ship-of-opportunity community. Several participants were working with thermosalinograph installations with encouraging results. Concern was expressed over the problems of fitting existing thermosalinographs and it was agreed that manufacturers should be encouraged to produce a more easily deployable sensor. The need for a vendor to develop and manufacture a multiple XBT launcher was expressed.

40 The Meeting recognized that there was a possibility to receive additional resources from satellite agencies for the collection of XBT data in data sparse areas to verify and calibrate their instruments on sea-level data. The Meeting recommended that the Sixth Session of the Joint Committee for IGOSS (Geneva, 18-27 November 1991) consider ways and means in which the satellite community could be approached to fund XBT activities for this and other purposes.

5. **DATA QUALITY**

5.1 QUALITY CONTROL; AUTOMATED SYSTEMS ABOARD SHIP

41 Mr. Rick Bailey, Co-Chairman of the IGOSS Task Team on Quality Control for Automated Systems, opened this agenda item with a brief overview of the history of the Task Team. He then made presentations on the following activities of the Task Team, which are contained in its report:

(i) The Bowing Problem;

(ii) Sippican MS-DOS IEEE Timing Problem;

(iii) Resistance to Temperature Conversion;

(iv) XBT Fall Rate; and

(v) New XBTs, equipment, etc.

42 The Meeting noted with interest the resolution of the first three problems. The Meeting reviewed the results of the XBT fall rate study and endorsed the following recommendations made by the Task Team for presentation at IGOSS-VI:

(i) Continue using the existing equation until:

(a) An international mechanism is in place to make a decision on the appropriate solution to the problem;

(b) International co-ordinated effort to implement the solution is in place and an implementation date is set;

(c) A scientific paper to be produced by the Task Team is reviewed by the community and published in the literature.

(ii) New Data Codes are required for the JJXX and Data Centre Data Sets to track Probe Type and XBT equipment and fall rate equations used.

(iii) Evaluate the fall rates for probes produced by other manufacturers.

(iv) Conduct on-going random testing of all manufactured XBTs to be co-ordinated by the Task Team.

(v) Conduct similar independent testing of the XCTD when VOS version (i.e. 18-20 knot ship speed capabilities) is available.

(vi) Due to on-going, expanding, critical nature of the instrumentation evaluation effort, the terms of reference of the Task Team need to be modified and adequate funding made available for the team to meet at least once a year.

5.2 QUALITY CONTROL PRIOR TO GTS INSERTION MINIMUM REQUIREMENTS; QUIPS SYSTEM AND OTHER SHORE-BASED EQUIPMENT

43 Reports were submitted by Representatives of Australia, Germany, France, the United States, Japan and Argentina on the status of the "Minimum Quality Control Procedures for IGOSS Data to be Transmitted on the GTS". It was found that multiple quality control steps are followed by some Member States before data is submitted to the GTS. The Meeting noted that the closer the quality control effort is to the source of the data, the better and more effective it is. Emphasis should be placed on collecting the highest quality data before any quality control steps are applied. The data that is taken from the GTS and supplied to GTSPP is submitted to even further quality control procedures through National Ocean Data Centres and scientific research organizations. The Meeting recommended that a report on quality control activities that are conducted prior to insertion of data onto the GTS be compiled for the next ship-of-opportunity meeting. It was also recommended that the TT/QCAS provide recommendations on standards for shipboard data acquisition software, including procedures for shipboard quality control of data before transmission.

6. TEMA-RELATED COMPONENTS

44 This agenda item was introduced by Mr. John Withrow. He noted that while this item came near the end of the agenda, it was not an indication of the priority. On the contrary, the assistance to countries without the resources to develop their own programmes is necessary to fill many of the data gaps in the Southern Ocean, South Atlantic and Southeast Pacific, and in order to make the programme really global. These countries have ships and personnel who are highly motivated and who could contribute to the global data collection effort. They could also benefit from the data they collect and that which they receive from participation in global exchange.

45 Mr. A. Lusquinos of Argentina noted that the situation in his country could be defined as typical for a country that has to cope with a large external debt. Although there is a full understanding of the necessity to increase the XBT database of the South Atlantic, Argentine co-operation has to be considered in light of the severe scale of priorities enforced in order to solve the above mentioned problem. Existing facilities, such as oceanographic and fishing vessels, as well as knowledgeable investigators and technicians who are not fully employed due to funding restrictions, could be reactivated through a policy of bilateral country to country or institution to institution arrangements. The IOC Secretariat was asked to consider ways and means to increase the VCP and TEMA support.

7. CLOSURE OF THE MEETING

46 The Representative from Australia offered to host the next Ship-of-Opportunity Meeting in Hobart, Tasmania, in the last week of March 1993.

47 The Chairman, Mr. Woodward, expressed his thanks to the Academy of Sciences and the Ocean Studies Board, the Secretariats of the IOC and WMO, and Miss Melanie Jenard of the NOS International Affairs staff for the excellent support and facilities for the meeting.

48 Mr. John Withrow, on behalf of the Secretariats, expressed the thanks of the IOC and WMO for Mr. Woodward's excellent chairmanship and to all the Representatives of Member States for making this meeting productive and successful in its tasks.

ANNEX I

AGENDA

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6. **TEMA-RELATED COMPONENTS**

7. **CLOSURE OF THE MEETING**

ANNEX II

LIST OF PARTICIPANTS

I. EXPERTS FROM MEMBER STATES

Mr. M. Amino
Senior Specialist
Japan Meteorological Agency
1-3-4 Otemachi, Chiyoda-ku
Tokyo 100
Japan
Tel: 81-3-3212-8341
Tlx: 222-2163.METTOK. J.
Tfax: 81-3-3211-3047

Dr. L. Baer
NOAA/NOS
Office of Ocean and Earth Observations
6001 Executive Blvd.
Room 912
Rockville, MD 20852
USA
Tel: 301-443-8938

Mr. R. Bailey
Oceanographer
CSIRO Division of Oceanography
GPO Box 1538
Hobart TAS 7001
Australia
Tel: (002) 206222
Tlx: AA.57182
Tmail: R.BAILEY.CSIRO
(also Co-Chairman of the IGOSS TT/QCAS)

Dr. C. R. Berman, Jr.
Deputy Director
NOAA/NOS/COAP
Center for Ocean Analysis & Prediction
2560 Garden Rd., Ste. 101
Monterey, CA 93940
USA
Tel: 408-647-4207
Tmail: C.BERMAN

Mr. M. Connolly
Physical Scientist
NOAA/NOS
Office of Ocean & Earth Sciences
6010 Executive Blvd.
Rockville, MD 20852
USA
Tel: 301-443-8110

Mr. S. Cook
Oceanographer
NOAA/NOS
Office of Ocean & Earth Sciences
8604 La Jolla Shore Dr.
La Jolla, CA 92038
USA
Tel: 619-546-7103
Tlx: 7408528
Tmail: S.COOK

Dr. D. Enfield
Research Oceanographer
NOAA/OAR/AOML
4301 Rickenbacker CSWY
Miami, FL 33149
USA
Tel: 305-361-4351
Tmail: D.ENFIELD

Mr. R. Fauquet
Deputy Director
NOAA/NESDIS
National Oceanographic Data Center
1825 Connecticut Ave., N.W., Ste. 406
Washington, DC 20334
USA
Tel: 202-606-4596

Lt CDR T. Hallpike
Hydrographic Department
Ministry of Defence
Room 742
Lacon House
Theobalds Rd.
London WCIX 8RY
United Kingdom
Tel: 071-430-5765
Tfax: 071-430-6919

Mr. D. Hamilton
Oceanographer
NOAA/NESDIS
National Oceanographic Data Center
1825 Connecticut Ave., N.W.
Washington, DC 20235
USA
Tel: 202-606-4636
Tmail: NODC.WDCA

Ms. M. Hamilton
Oceanographer
NOAA/NESDIS
National Oceanographic Data Center
1825 Connecticut Ave., N.W.
Washington, DC 20235
USA
Tel: 202-606-4642
Tmail: NODC.WDCA

Mr. R. Hayes
Head, Interagency Programs
U.S. Navy
Office of the Oceanographer of the Navy
34th and Massachusetts Ave., N.W.
Washington, DC 20392-5101
USA
Tel: 202-653-1604

Miss M. Jenard
NOAA/NOS
International Affairs
1825 Connecticut Ave., N.W.
Room 615
Washington, DC 20235
USA
Tel: 202-606-4178

Dr. D. Kester
Senior Scientist
NOAA
Office of the Chief Scientist
1825 Connecticut Ave., N.W.
Room 625
Washington, DC 20235
USA
Tel: 202-606-4243

Mr. J. Kundrat
NOAA/NOS
Office of Ocean & Earth Observations
5200 Auth Rd.
Camp Springs, MD
USA
Tel: 301-763-8030
Tmail: K.MCCARTHY

Mr. S. Levitus
Oceanographer
NOAA/NESDIS
National Oceanographic Data Center
1825 Conneticut Ave., N.W.
Washington, DC 20235
USA
Tel: 202-606-4642

Lic. A. J. Lusquinos
Oceanographer
Servicio de Hidrografia Naval
Montes de Oca 2124
Buenos Aires
Republic of Argentina
Tel: 212918

Dr. G. Meyers
Oceanographer
CSIRO
Division of Oceanography
GPO Box 1538
Hobart, Tasmania
Australia
Tel: 61-02-206222
Tlx: 57182
Tmail: G.MEYERS

Mr. I. Perlroth
Oceanographer
NOAA/NESDIS
National Oceanographic Data Center
1825 Connecticut Ave., N.W.
Washington, DC 20235
USA
Tel: 202-606-4598
Tmail: I.PERLROTH

Mr. J. Poitevin
Chief of the Marine Forecasting Division, SCEM
Météo France
42, avenue G. Coriolis
F-31057 Toulouse Cédex
France
Tel: 33-61 07 82 90
Tfax: 33-61 07 82 32

Mr. J. Sherman, III
Chief, Research Planning Group
NOAA/NESDIS
Room 701 WWB
Washington, DC 20233
USA
Tel: 301-763-4626

Dr. A. Sy
Physical Oceanographer
Bundesamt fuer Seeschiffahrt und Hydrographie (BSH)
Bernhard-Nocht-Str. 78
D-2000 Hamburg 36
Germany
Tel: 40-3190-440
Tlx: 215-448
Tmail: BSH.HAMBURG

Mr. M. Szabados
Oceanographer
NOAA/NOS
Office of Ocean & Earth Sciences
6010 Executive Blvd. Room 925
Rockville, MD 20854
USA
Tel: 301-443-8110
Tfax: 301-443-8208
Tmail: M.SZABADOS

Mr. B. Woodward
NOAA/NOS
Office of Ocean & Earth Sciences
6010 Executive Blvd.
Rockville, MD 20852
USA
Tel: 301-443-8105
Tfax: 301-443-8208
Tmail: W.WOODWARD (Chairman)

Mr. D. Wright
Physical Scientist
NOAA/NOS
Office of Ocean & Earth Sciences
6010 Executive Blvd.
Rockville, MD 20852
USA
Tel: 301-443-8110
Tfax: 301-443-8208
Tmail: D Wright.NOS

Mr. V. Zegowitz
Marine Observations Program Leader
NOAA
National Weather Service
1325 East-West Highway
Room 17312
Silver Spring, MD 20910
USA
Tel: 301-427-7724
Tmail: V.ZEGOWITZ

II. REPRESENTATIVES OF INTERNATIONAL PROGRAMMES/GROUPS

IGOSS Task Team on Quality Control Procedures for Automated Systems	Mr. R. Bailey Co-Chairman, IGOSS Task Team on QCAS CSIRO Division of Oceanography GPO Box 1538 Hobart TAS 7001 Australia Tel: (002) 206222 Tlx: AA.57182 Tmail: R. BAILEY.CSIRO (also representing Australia)
	Mr. J. Withrow Co-Chairman, IGOSS Task Team on QCAS Senior Assistant Secretary IOC UNESCO 7, place de Fontenoy F-75700 Paris France Tel: 45 68 40 08 Tlx: 204461 Paris Tfax: 40 56 93 16 Tmail: J.WITHROW (also representing IOC)
Tropical Oceans and Global Atmosphere (TOGA)	Mr. J. P. Rebert Director, TOGA Centre Centre ORSTOM BP 70 F-29280 Plouzane France Tel: 33-98-22-45-13 Tfax: 33-98-22-45-14 Tmail: ORSTOM.BREST
World Ocean Circulation Experiment (WOCE)	Mrs. P. Holliday WOCE International Project Office IOSDL Brook Rd. Wormley, Godalming, Surrey GU6 8UB United Kingdom Tel: 0428-68-4141 Tmail: WOCE.IPO

III. SECRETARIATS

WORLD METEOROLOGICAL ORGANIZATION	Mr. M. Krasnoperov Scientific Officer, Ocean Affairs Division World Weather Watch Department WMO Case Postale n° 2300 CH-1211 Geneva 2 Switzerland Tel: 41-22 730 8223 Tlx: 23 260 OMM CH Tfax: 41-22 734 09 54
INTERGOVERNMENTAL OCEANOGRAPHIC COMMISSION	Mr. J. Withrow Senior Assistant Secretary IOC UNESCO 7, place de Fontenoy F-75700 Paris France Tel: 33-1-45 68 40 08 Tlx: 204461 Paris Tfax: 33-1-40 56 93 16 Tmail: J.WITHROW (also Co-Chairman of the IGOSS TT/QCAS)

Mr. T. Wright
IGOSS Operations Co-ordinator
Intergovernmental Oceanographic Commission
UNESCO
7, place de Fontenoy
F-75700 Paris
France
Tel: 33-1-45 68 39 75
Tlx: 204461 Paris
Tfax: 33-1-40 56 93 16
Tmail: T.WRIGHT

IV. VENDORS

Mr. T. Bracken
Vice-President of Marketing
Sippican, Inc.
7 Barnabas Rd.
Marion, MA 02738
USA
Tel: 508-748-1160
Tfax: 508-748-3626

Mr. J. Hannon
Manager, Ocean Products Marketing
Sippican, Inc.
7 Barnabas Rd.
Marion, MA 02738
USA
Tel: 508-748-1160
Tfax: 508-748-3621

Mr. R. Kaiser
Vice-President of Engineering
Sippican, Inc.
7 Barnabas Rd.
Marion, MA 02738
Tel: 508-748-1160
Tfax: 508-748-3621

Mrs. E. Holmes
A&T, Inc.
2341 Jefferson Davis Hwy., Ste. 1250
Arlington, VA 22202
USA
Tel: 703-418-8690

Mr. F. Quick
Engineer
Analysis & Technology, Inc.
4 John Clarke Rd.
Middletown, RI 02840
USA
Tel: 401-849-5952

Mr. E. Swift
Manager
Sparton of Canada
Business Development
99 Ash St.
London, Ontario N52 4v3
Canada
Tel: 519-455-6320
Tfax: 519-452-3967

ANNEX III

NATIONAL REPORTS ON SHIP-OF-OPPORTUNITY ACTIVITIES

The following pages contain national reports on ship-of-opportunity activities submitted by the following countries:

ARGENTINA

Actual Status

1. Argentina is producing a limited input to the South Atlantic XBT Data Base mainly in the route of ALTE IRIZAR ICEBREAKER, BUENOS AIRES, ANTARCTICA.

2. The Argentine Navy is considering partially declassifying XBT information.

3. As a consequence of a request made some years ago by IOC-WMO, Argentina became SOC-VOS XBT information for the South Atlantic Ocean.

4. No answer has been received up to now to the Argentine offer of two merchant ships as VOS on the route to Buenos Aires - Santos - Tip of South Africa - Yo Ku Hama. The XBT system as well as probes should be provided by interested parties.

AUSTRALIA

CSIRO Division of Oceanography

Research Goals

Australia's economic well-being is intimately linked to climate fluctuations, with periods of severe drought or extensive flooding having a negative effect on economic activity. The occurrence of such fluctuations is largely controlled by the temperature of ocean waters north of Australia. For example, the severe drought of 1982-1983 was linked to sea surface temperature changes in the western equatorial Pacific Ocean (the 1982-83 El Nino). Australia's rainfall is also strongly affected by the sea surface temperature in the eastern Indian Ocean.

The geography of the "heat pool" to the north of Australia is characterised by changes in location of its temperature maximum over thousands of kilometres on seasonal and interannual time scales. Details of the geography are known to have statistical relationships to the occurrence of the abovementioned climate anomalies, but the physics underlying these relationships is not well understood.

Because of thermal inertia, temperature in the heat pool varies relatively slowly, and acts as a memory in the coupled ocean-atmosphere system. Consequently, ocean temperature can be used as a predictor of rainfall anomalies, either as direct input into statistical models or in the initialisation of numerical/dynamical, coupled, general circulation models. In either prediction scenario, model development must be preceded by process studies to identify the physics of ocean temperature change. An increase in the accuracy of climate predictions on seasonal to interannual time scales will have a significant impact on the ability of society and the economy to adjust to climate variation. Of particular importance will be the ability of primary industry to plan for anomalous conditions in coming seasons. In the longer term, improved information on regional climate change over decades is required by both government and industry. Accurate ocean models can also be applied usefully in shipping, fishing, air-sea rescue, and defence related activities.

One goal of the Commonwealth Scientific and Industrial Research Organisation's (CSIRO) research program on ocean/climate interactions is to document temperature in the heat pool north of Australia to evaluate the relative importance of surface heat fluxes, advection, and mixing processes of the thermodynamics in the region. A second goal is to document the variability of the major geostrophic currents in the tropical Indian Ocean on seasonal and interannual time scales, and to evaluate thier role in changing sea surface temperature. The third goal is to measure the transport of mass, heat and salt in the surfaçe layers by the major geostrophic currents in the eastern tropical Indian Ocean and in the south west Pacific Ocean.

Observing Network

A temperature observing network, using expendable bathythermographs (XBTs) launched from volunteer observing vessels, provides the primary data base for the CSIRO program. The network is operated from a centre in Hobart, with ship-greeting activities in the major ports around the nation. At the beginning of 1991, an high density XBT sampling program was also begun in the Tasman Sea and Coral Sea region. This has involved placing oceanographic observers onboard participating merchant ships to undertake the additional measurements.

The CSIRO activity is closely coordinated with major international research programs. In particular, the CSIRO program contributes significantly to the Tropical Ocean Global Atmosphere (TOGA) project and the World Ocean Circulation Experiment (WOCE) of the World Climate Research Program (WCRP). The CSIRO Division of Oceanography has taken a leading role in both TOGA and WOCE since their beginnings.

A corner-stone for both projects has been the implementation of an oceanographic observing network which can provide the observational data needed for process studies, and for model development and initialisation. Global coverage of the oceans is a key requirement for both projects, and a coordinated international effort has helped to achieve this goal. As a TOGA and WOCE contribution, the CSIRO Voluntary Observing Ship program is expected to continue to operate until at least the end of TOGA and WOCE (1995-97).

a)Coverage

Figure 1 shows the lines recently and presently in operation. Due to a change in general merchant ship routing on line IX-9, this line is now only sampled north of the latitude of Sri Lanka. Similarly, the ship previously operating on line PX-3 has been sold by its owners and no longer operates in the Coral Sea. As yet a replacement has not been organised, however, sampling by the ships on line PX-5 has been extended into the Coral Sea region. Lines PX-31, PX-34, PX-35 are high density XBT lines.

Figure 2 shows the location of all XBT stations which have been processed, edited, and accepted at CSIRO from the start of the program, in 1983, to the middle of 1991. The total does not include XBTs that have failed. Figure 3 shows those XBTs accepted for 1990 only, whilst Table 3 gives the total number of XBTs (including failures), good XBTs, sections, and number of bathy reports sent to the GTS for the same period. Figure 4 and Table 2 show the same details for the first half of 1991, which also includes the beginning of the high density sampling program.

Table 3 gives the projected XBT usage for 1992. A third ship is to begin operation at the beginning of 1992 on lines IX-22/PX-11 and PX-5 in an effort to achieve the recommended sampling for these lines. Wherever possible, lines are sampled at the sampling frequencies and spacings as determined by extensive optimal sampling studies[1,2,3], as adapted and recommended by the TOGA Implementation Plan (Feb, 1990).

Surface salinities are being collected by surface sample buckets along the high density lines PX-31, PX-34, PX-35.

b) Support and Cooperation

The field program has been a very large undertaking. Although viewed by the Division as necessary in the national interest, it has been too large for the Division to accomplish with its own resources. The strategy for funding from the outset has been to gain resources from several national and international agencies, while maintaining scientific direction and management of the program the under control of research oceanographers. This strategy has proven to be extremely successful, to the point that now nearly 4000 ocean soundings will be made each year.

Table 4 shows the contributors of XBTs and the amount of XBTs contributed to the CSIRO Ship-of-Opportunity Program during 1991. During 1991, the Australian Navy has increased its regular support by 500 XBTs to 2000 XBTs per year in aid of the high density sampling program in the Tasman and Coral seas. The Japan Meteorological Agency has also replaced the University of Hokkaido as a contributor of XBTs.

The Australian Bureau of Meteorology, the Australian Oceanographic Data Centre, and the CSIRO Division of Fisheries help the Division of Oceanography by forwarding supplies to participating merchant ships through their personnel located in the major ports. The Australian Bureau of Meteorology also assists by paying for the cost of transmitting the bathy reports via satellite for insertion onto the GTS. This data is used in their objective mapping routines for the Pacific and Indian Oceans.

Line IX-22/PX-11 up until recently has been run with the assistance of the University of Hokkaido. This has included the provision of an XBT system. Assistance is now being provided by the Japan Meteorological Agency (JMA). The high density line PX-31 is being operated in conjunction with the Scripps Institution of Oceanography(SIO) and ORSTOM. CSIRO operates the line twice per year, whilst SIO and ORSTOM each operate the line once per year.

c)Equipment Design and Development

During 1991, CSIRO extensively upgraded all its merchant ships to Sippican MK-9/Lap-Top configured XBT systems. The software was extensively re-written for the volunatary observer environment. Figures 5 and 6 show examples of the operator menu and temperature profile display respectively. The XBT systems have also been interfaced to CLS ARGOS satellite transmitters to enable the relay of bathy data in near real-time. The data undergoes filtering and general quality control checks, as designed for the ARGOS XBT system, before it is ent via satellite for insertion onto the GTS. Unfortunately, a problem has apparently been identified at the Bureau of Meteorology in Paris which has prevented a large percentage of the data from being inserted onto the GTS. Bulletins for the GTS did not have sufficient space for all data to be included, and accordingly, data was lost from the system. This is currently being corrected and the situation is being closely monitored closely.

The SIO XBT automatic-launcher has been installed on merchant ships being used in the high density program. This is a device which can automatically deploy up to six XBTs at predetermined times. CSIRO plans to modify the unit for eventual operation in the volunteer observer environment, and to also incorporate the Sippican MK-12 card to allow deployment of XCTDs in the future.

A thermosalinograph will be developed during 1992 for initial deployment on the high density lines PX-34 and PX-35. CSIRO intends to work closely with ORSTOM in Noumea on this project, learning from their previous experiences of deploying a thermosalinograph on merchant ships.

d)Equipment Evaluations

CSIRO will continue to test and evaluate equipment deployed for the research program to ensure its accuracy and integrity. All such tests and evaluations will be coordinated with and submitted to the IGOSS Task Team for Quality control of Automated Systems (TT/QCAS).

A study[4] has recently been completed on the accuracy of XBTs and XBT data acquisition systems, including an evaluation of the fall rate equation of the XBT. This work has contibuted to the work of the XBT Fall Rate Study Subgroup of the TT/QCAS. A study is also underway on evaluating the accuracy and reliability of Sparton XBTs. CSIRO will be participating in a field evaluation of the XCTD when a 20 knot production version is available.

e)Volunteer Observer Relations

Considerable effort is put into maintaining a high level of public relations with the voluntary observers and shipping companies. Each ship is visited on every return to home port so that new supplies can be forwarded, data collected, instrumentation checked, and most importantly, so that good public relations through feedback and attention to observer requirements are maintained. Also, each ship is visited by a scientist involved in the research program at least once per year, although generally more often than this.

Data Management and Quality Control

Quality Control (QC) of XBT data at the delayed mode stage is closely supervised by research oceanographers participating in the program. A flow chart of the QC procedures is shown in figure 7. The vertical profiles are checked on a voyage basis for common malfunctions, regional oceanographic features, drop to drop consistency along the ship track, and duplicate drops of unusual features (which we encourage our observers to take). The data are also checked against a climatology based on the data collected by ships participating in the CSIRO Ship-of-Opportunity Program. An archive of profiles with unusual features observed along the different lines is used in the QC process. The features are checked with CTD data as opportunities arise.

An interactive editing routine has been set up on the in-house mainframe (VAX/VMS) computer to edit the data. QC decisions on common malfunctions and real oceanographic features are flagged on the data set (see Table 5 for list and description of QC flags). The data is further classed (1-4) by depth according to the type of flag associated with the data. Class 1 data is good data. Class 2 data has unusual features, but they are considered to be probably real. Class 3 data has features considered to to be most likely the result of instrument malfunctions and not real features. Class 4 data is obviously erroneous data.

The data is stored in three archives. The first archive contains the unedited, full resolution, raw data as collected from the merchant ships. The second archive consists of the edited, full resolution data (Class 4 removed). The third data archive has the data condensed to a 2 metre format (Class 3 removed). This third data archive is the archive used in scientific analysis, and for the transfer of data to other organisations.

Quality control of the data is considered to start by providing the voluntary observers with continual feedback on why they are collecting the data as well as the results obtained. The two-way communication between observers and researchers inevitably leads to a more carefully collected and generally higher quality data set.

Discussions are presently underway between CSIRO, Australian Bureau of Meteorology (BOM), and the Australian Oceanographic Data Centre (AODC) concerning the formation of a WOCE Upper Ocean Thermal Data Assembly Centre (UOT/DAC) for the Indian Ocean. Although the BOM and the AODC already jointly operate the Specialised Oceanographic Centre for the Indian Ocean and South Pacific region, the idea of the WOCE UOT/DAC is to involve research scientists in the QC of XBT data to produce a "scientifically" quality controlled data set for WOCE.

References

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2 Meyers, G., J.Sprintal, H.Phillips, J.Peterson and T.Fonesca (1989): Design of an ocean temperature observing network in the seas north of Australia. Part I, Tropical Pacific Ocean: Statistics. *CSIRO Marine Laboratories Report* No.204.

3 Phillips, H., R.Bailey, and G.Meyers (1990): Design of an ocean temperature obsserving network in the seas north of Australia. Part II, Tropical Indian Ocean: Statistics. *CSIRO Marine Laboratories Report* No.211.

4 Bailey, R., S.Newbery, H.Phillips and G.Meyers (1991): Examination of the accuracy of XBTs and XBT data acquisition systems (in preparation).

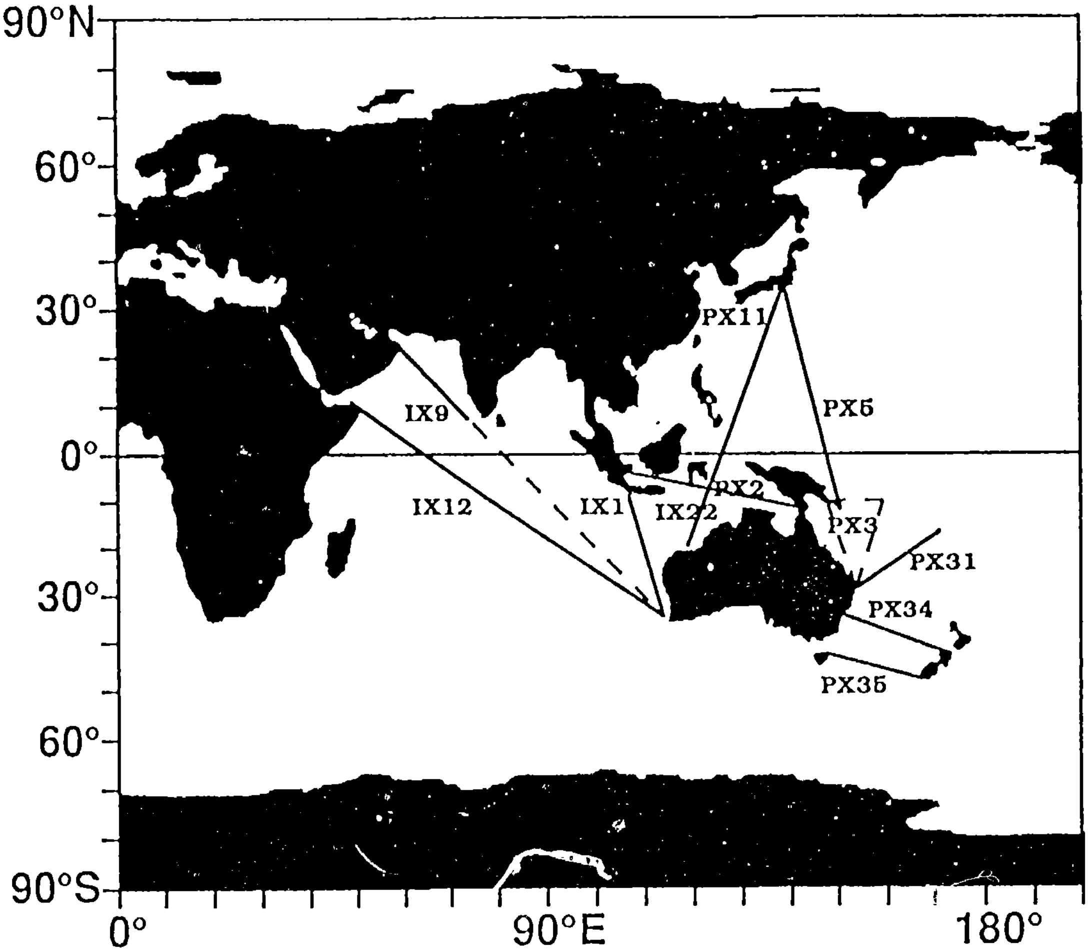

Figure 1. CSIRO SHIP-OF-OPPORTUNITY LINES - 1991
(_____ operational; -------- non-operational)

CSIRO XBT COVERAGE JAN 1983 - JUN 1991

Total Number of Successful XBTs = 15582

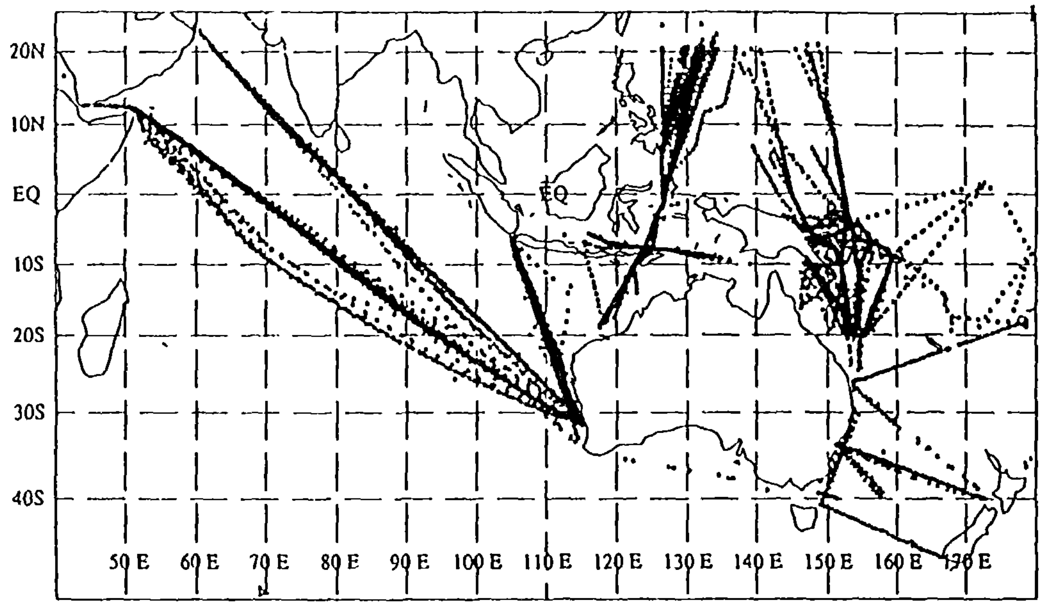

Figure 2.

CSIRO XBT COVERAGE 1990

Total Number of Successful XBTs = 2629

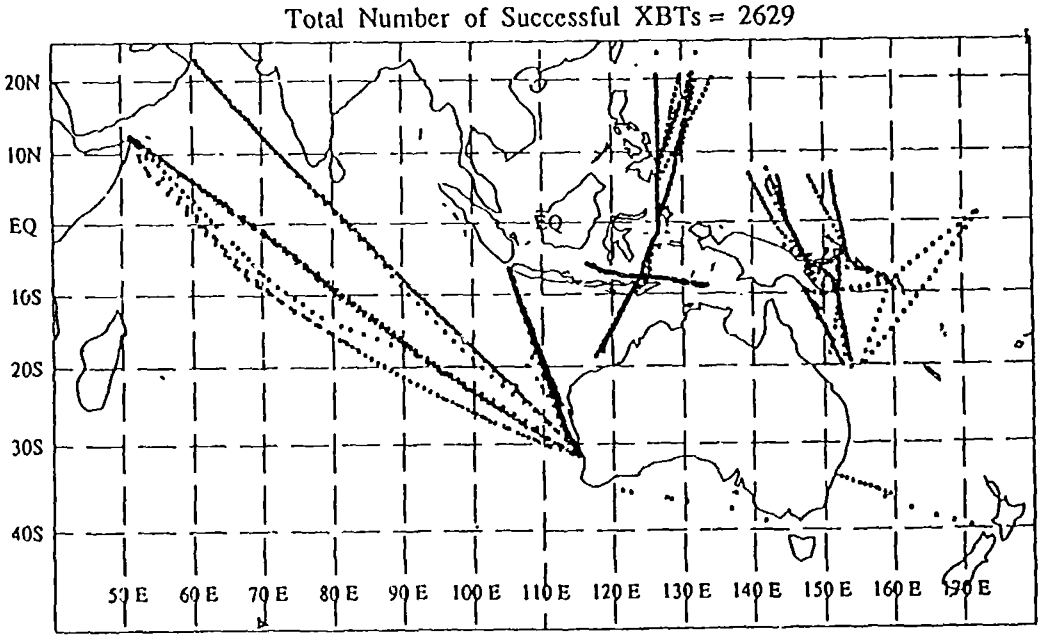

Figure 3.

CSIRO XBT COVERAGE JAN 1991 - JUN 1991

Total Number of Successful XBTs = 1542

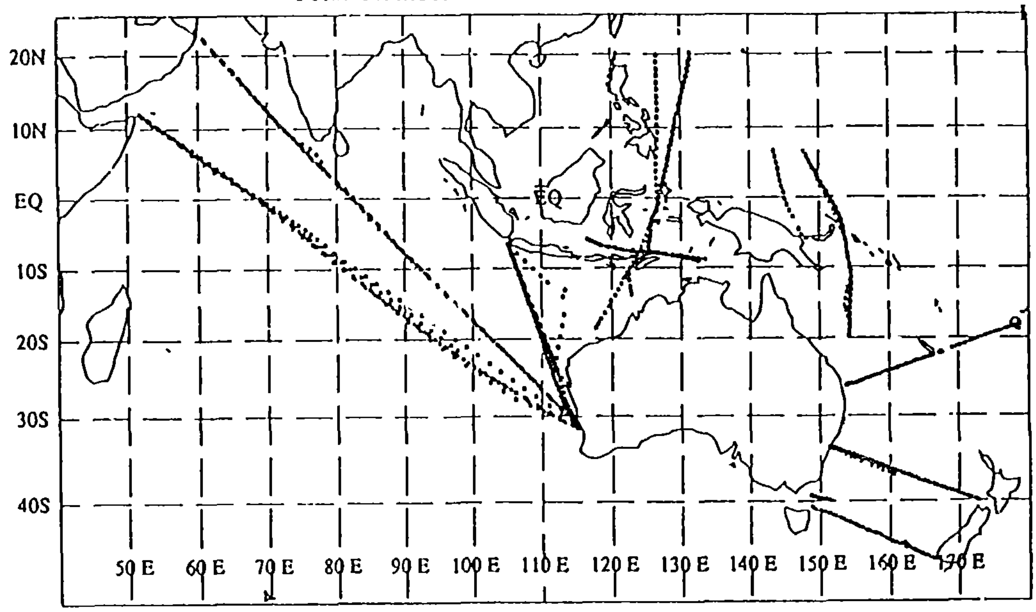

Figure 4.

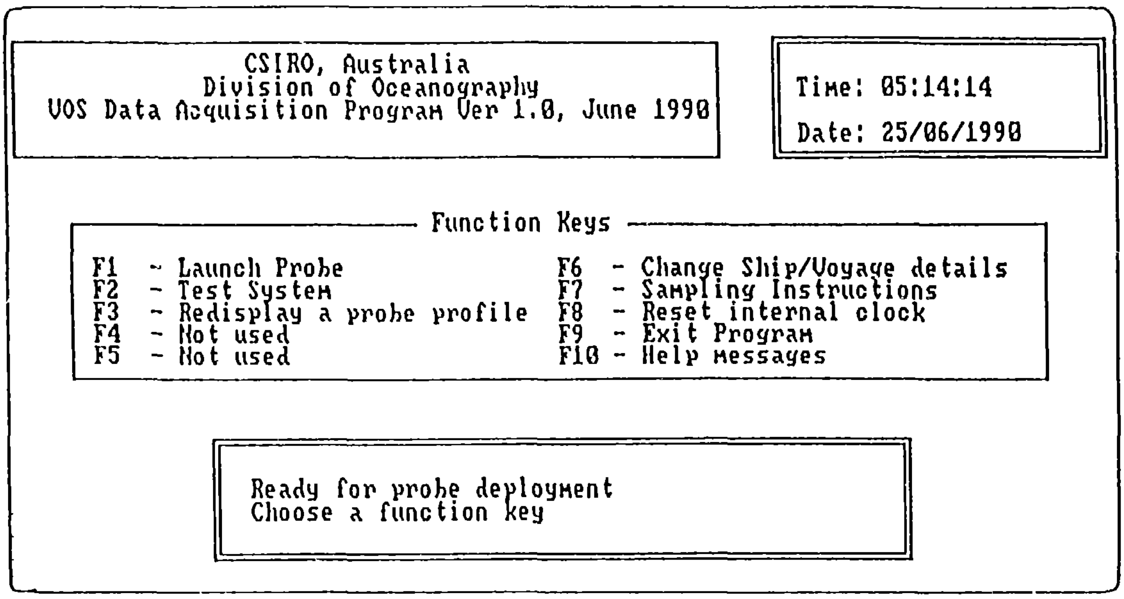

Figure 5. CSIRO XBT Data Acquisition System - Function Menu

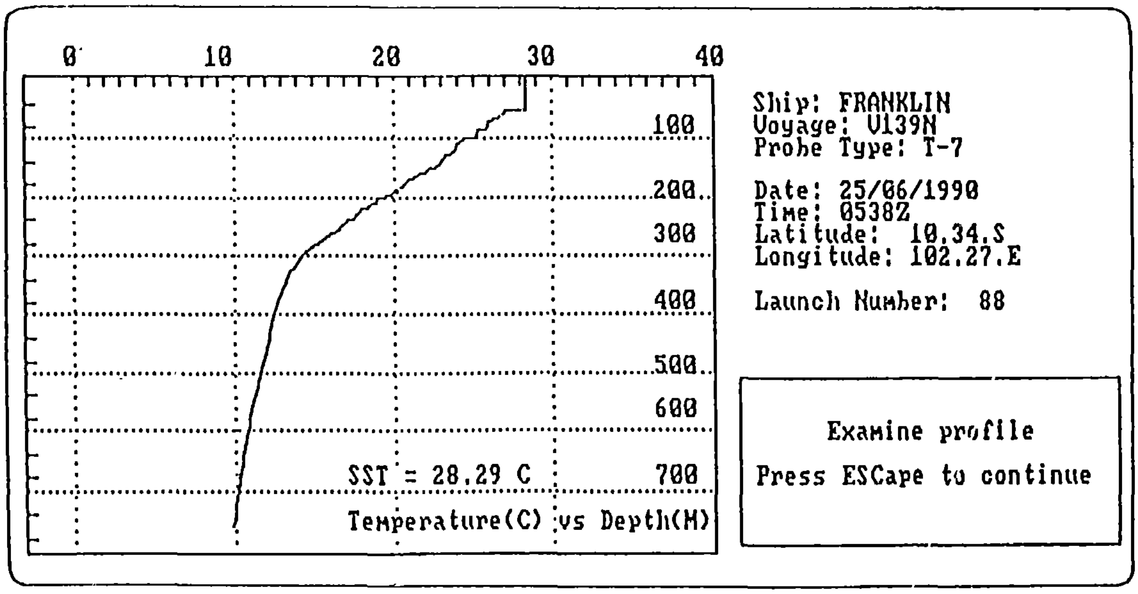

Figure 6. CSIRO XBT Data Acquisition System - Profile Display

XBT Data Processing

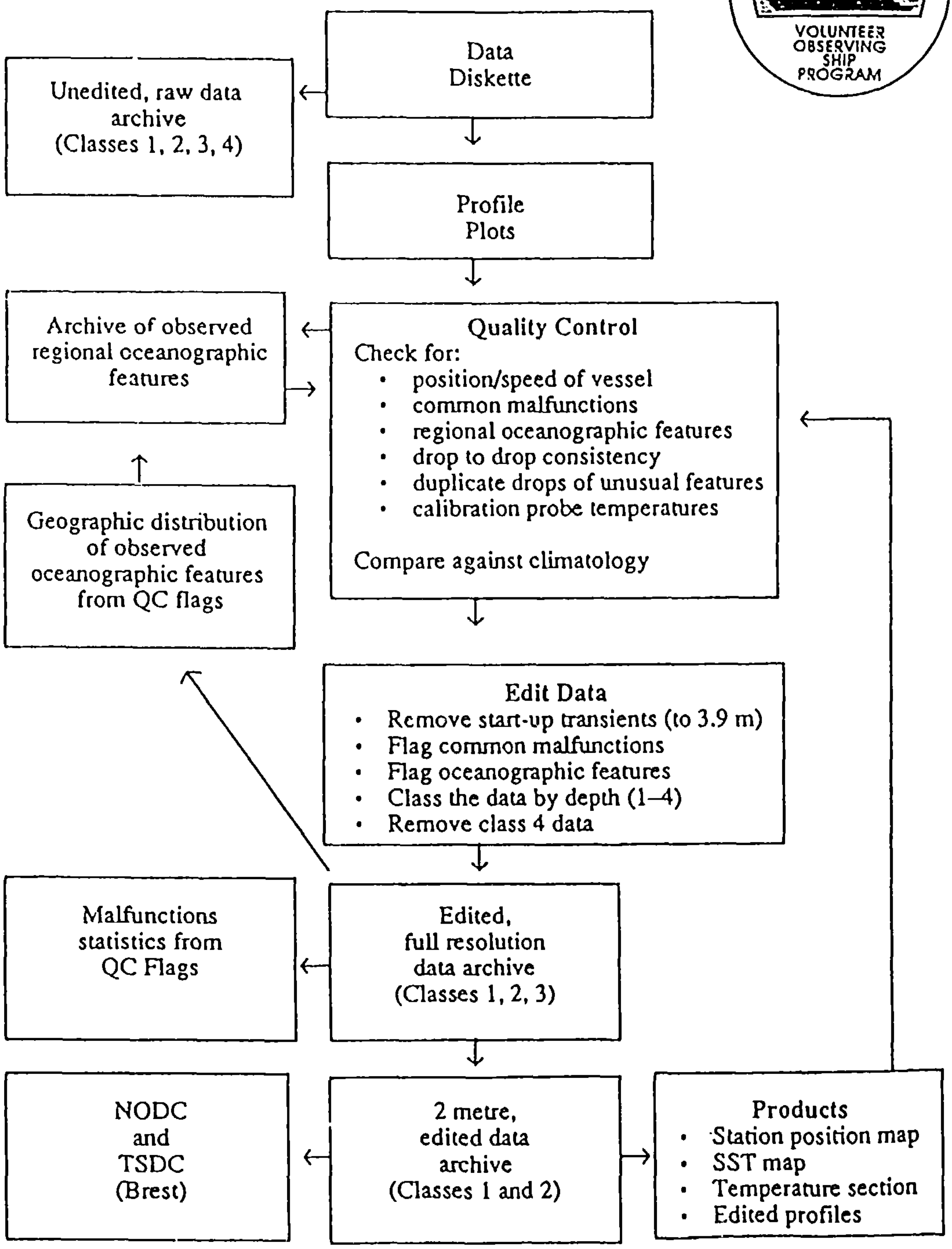

Figure 7. CSIRO XBT Data Processing Flow Chart

TABLE 1

CSIRO XBT Line Summary [January 1990 - December 1990]

Line	Ship	Callsign	#Drops	#Good	#Sections	#Sent
IX1	Swan Reefer	S6FK	497	461	26	412
			(497)	(461)	(26)	(412)
IX9	Mahsuri	9VBZ	201	183	4	0
	Mandama	9VWM	98	93	2	19
			(299)	(276)	(6)	(19)
IX12	Nedlloyd Tasman	GYSE	258	163	5	206
	Encounter Bay	GYRW	168	158	4	70
	Flinders Bay	GYSA	200	186	4	147
			(626)	(507)	(13)	(423)
IX22/	Aust. Progress	VMAP	362	341	7	48
PX11	Iron Pacific	VJDP	196	189	4	191
	Iron Newcastle	VJDI	0	0	0	0
			(558)	(530)	(11)	(239)
PX2	Anro Asia	9VUU	88	73	7	37
	Anro Australia	VJBQ	251	232	14	228
			(339)	(305)	(21)	(265)
PX3	Nimos	ZCSL	290	272	9	267
			(290)	(272)	(9)	(267)
PX5	Aust. Progress	VMAP	239	225	11	209
	Iron Pacific	VJDP	37	36	1	30
	Iron Newcastle	VJDI	0	0	0	0
			(276)	(261)	(12)	(239)
PX31	ACT 10	C6HL8	0	0	0	0
			(0)	(0)	(0)	(0)
PX34	Flinders Bay	GYSA	6	5	1	0
	Nedlloyd Tasman	GYSE	12	12	1	11
			(18)	(17)	(2)	(11)
Totals:			**2903**	**2629**	**100**	**1875**

TABLE 2

CSIRO XBT Line Summary [January 1991 - June 1991]

Line	Ship	Callsign	#Drops	#Good	#Sections	#Sent
IX1	Swan Reefer	S6FK	260	254	14	243
			(260)	(254)	(14)	(243)
IX9	Mahsuri	9VBZ	134	125	4	124
	Mandama	9VWM	145	130	3	127
			(279)	(255)	(7)	(251)
IX12	Nedlloyd Tasman	GYSE	104	100	2	0
	Encounter Bay	GYRW	99	96	2	90
	Flinders Bay	GYSA	95	93	2	86
			(298)	(289)	(6)	(176)
IX22/	Aust. Progress	VMAP	51	46	1	42
PX11	Iron Pacific	VJDP	53	52	2	51
	Iron Newcastle	VJDI	45	44	1	26
			(149)	(142)	(4)	(120)
PX2	Anro Asia	9VUU	63	61	4	50
	Anro Australia	VJBQ	77	73	4	57
			(140)	(134)	(8)	(107)
PX3	Nimos	ZCSL	0	0	0	0
			(0)	(0)	(0)	(0)
PX5	Aust. Progress	VMAP	17	16	1	14
	Iron Pacific	VJDP	70	63	2	30
	Iron Newcastle	VJDI	36	36	1	30
			(123)	(115)	(4)	(74)
PX31	ACT 10	C6HL8	105	98	1	99
			(105)	(98)	(1)	(99)
PX34	Flinders Bay	GYSA	30	26	2	18
	Nedlloyd Tasman	GYSE	148	138	2	83
			(178)	(164)	(4)	(101)
PX35	Nedlloyd Tasman	GYSE	113	100	2	64
			(113)	(100)	(2)	(64)
Totals:			**1645**	**1551**	**50**	**1235**

TABLE 3

CSIRO XBT Usage Projection - 1992

TWI Line Number	Sampling Density	Call Sign	Sections per Year	XBT's per Section	XBT's per Year	Probe Type
IX-1	Low	S6FK	24	20	480	T-7
IX-9*	Low	9VBZ 9VWM	12	20	240	T-4/T-7
IX-12	Low	GYSE GYRW GYSA	14	50	700	T-4/T-7
IX-22/+ PX-11	Low	VJDP VJDI "SHIP"	15	55	825	T-7
PX-2	Low	VJBQ 9VUU	20	16	320	T-7
PX-5+	Low	VJDP VJDI "SHIP"	15	30	450	T-7
PX-31	High	C6HL8	2	100	200	Deep Blue
PX-34	High	GYSE	4	80	320	Deep Blue
	Low	GYSA GYRW	10	12	120	T-4/T-7
PX-35	High	GYSE	4	80	320	Deep Blue
				Total	3975	

*As of August 1991: Sri Lanka - Persian Gulf segment only
+New ship to start January 1991

TABLE 4

1991 XBT SUPPLY*

Contributor	Type	#XBT's
CSIRO	Deep Blue	1075
RAN	T-7	2000
JMA	T-7	300
NOS/NOAA	T-7	600
Total		3975

(* All XBT's are manufactured by Sippican)

TABLE 5

CSIRO Quality Control Flags

Category	Accept Feature			Reject Feature		
	Character Code	Integer Code	Action	Character Code	Integer Code	Action
Surface Spikes (start up transients)	CSA	1	No change to class of data. Surface data removed to 3.7m and replaced with 99.99.	—	—	Not applicable.
Modulo 10 Spikes	MOA	2	No change to class of data. Spikes replaced with linearly interpolated values.	—	—	Not applicable.
Wire Break	—	—	Not applicable.	WBR	-3	Class 4. Data deleted below depth of wire break.
Hit Bottom	HBA	4	Class 3 below depth of possible hit bottom.	HBR	-4	Class 4. Data deleted below depth of bottom hit.
PET Fault (A type of leakage malfunction which occurs at the bottom of PROTECNO profiles — thought to be a problem with the recorder-processor)	PFA	5	Small amplitude. Class 2 below depth of PET fault.	PFR	-5	Large amplitude. Class 4. Data deleted below starting depth of anomaly.
Inversion	IVA	6	No change to class of data.	—	—	Not applicable.
Nub (Inversion at the base of the mixed layer)	NUA	7	No change to class of data.	—	—	Not applicable.
Step-like Trace / Fine Structure	STA	8	No change to class of data.	—	—	Not applicable.
Wire Sretch / Inversion	WSA	9	Class 2 below depth of possible wire stretch.	WSR	-9	Class 3 below depth of wire stretch.
Leakage/Fine Structure	LEA	10	Class 2 below depth of possible fine structure.	LER	-10	Class 3 below depth of leakage.
Cusping	CUA	11	Small amplitude. Class 2 below start of cusping.	CUR	-11	Large amplitude. Class 3 below start of cusping.
High Frequency Instrument Noise	HFA	12	Small amplitude. Class 2 below start of noise — noisy data filtered.	HFR	-12	Large amplitude. Class 3 below start of noise.

TABLE 5 (cont)

Category	Accept Feature			Reject Feature		
	Character Code	Integer Code	Action	Character Code	Integer Code	Action
Insulation Penetration (isolated noise event with very small depth range)	IPA	13	Trace recovers after penetration. Class 2 below spike. Spike replaced with linear interpolation.	IPR	-13	Trace does not recover. Class 3 below spike.
Spike(s) / External Interference	SPA	14	Small amplitude. Class 2 below anomaly. Erroneous data removed and linearly interpolated.	SPR	-14	Large amplitude. Class 3 below anomaly.
Bowed Mixed Layer	BOA	15	Class 2 from surface.	BOR	-15	Class 3 from surface.
Other Surface Anomaly	SAA	16	Class 2 from surface.	SAR	-16	Class 3 from surface.
Temperature Difference / Offset	TOA	17	Class 2 from surface.	TOR	-17	Class 3 from surface.
Constant Temperature Trace	CTA	18	Class 1 to 10 metres, class 3 below.	CTR	-18	Class 3 from surface.
No Trace	—	—	Not applicable.	NTR	-19	Class 4 from surface.
NBG	—	—	Not applicable.	NGR	-20	Class 4 from surface.
Test Probe	—	—	Not applicable	TPR	-21	Class 3 from surface.
Digitised Data	DDA	22	No change to class of data.	—	—	Not applicable.
Bathymessage Data	BDA	23	No change to class of data.	—	—	Not applicable.
Duplicate Drop	DUA	24	No change to class of data. Duplicate to be kept.	DUR	-24	Class 3 from surface. Duplicate to be rejected
Converted to RAW from 2 metre	2MA	25	No change to class of data.	—	—	Not applicable.
Converted to RAW from 5 metre	5MA	26	No change to class of data.	—	—	Not applicable.
Sticking Bit Problem	SBA	27	Class 2 from surface (19 point filter with coeffs of 0.0526).	—	—	Not applicable.
Operator Error	—	—	Not applicable.	OPR	-28	Class 3 from surface.
Fine Structure	FSA	29	Class 2 from surface.	—	—	Not applicable
Driver Problem	DRA	30	Class 2 from surface.	DRR	-30	Class 3 from surface.
Probable Inversion	PIA	31	Class 2 below depth of probable inversion.	—	—	Not applicable.

FRANCE

ORSTOM

**Status of the TOGA Sub-surface Data Centre
Data Collection and Inventory**

I. Introduction

Since the implementation of the TOGA subsurface data Centre several reports have been presented at the different meetings related to TOGA data management or ships of opportunity activity. We will not repeat here the functions of the Centre and the procedures adopted, which had been described in previous reports. No major modification has been brought since then in the principles and rules of the data management which are still to collect, process, qualify, distribute, archive and inform. The only improvements that we brought to the system were done in order to gain efficiency and timeliness.

We will give here an overview of the present status of the data collection, the developments achieved in the different domains of the TOGA data management and will put a special emphasis on the informations concerning the progress of the TOGA ships of opportunity network implementation.

II. The management system. Status and problems.

We remind the reader that all the data are assembled in a unique data base which can be constantly accessed on line. The data base is located on a hard disk on the mainframe (presently a BULL DPS 7000 computer). The DBMS is always IDS2 using the query language IQS. The data base size is therefore increasing with time, and is now not far from 200 Mb. This data base must therefore be resized and reorganized from times to times, two operations which are not quite simple with this system. It is well known that the performances of these DBMS tend to become awfully slow with the increase in size of the data base. We had to face and solve this problem too.

We succeeded in maintaining on line the complete TOGA data set together with an acceptable level of performances by:

-improving the programmes and simplifying the entrance controls

-renouncing to manage some types of data in the data base (such as buoys data which are managed as simple separate files)

-recommending to the operators to reduce the amount of information in reducing the profiles to the so-called inflexion points

-creating a simple annex data base containing the headers information. This data base is used for all the operations where the profiles themself are not needed (statistics, plots, reports) and is updated each time the main data base is modified.

III. The global data set.

The composition of the global data set, as processed at the end of September, is described below in Table 1. The total number of data is now over 160 000 profiles, which means that an average number of 25 000 profiles per year are recovered in the TOGA area. As the principle of continuous updated data base has been adopted, columns 1 and 2 in the table represent the amount of real time data remaining in the data base after elimination of the duplicates with the corresponding delayed mode data. Comparing the number of real time data remaining in the data base to that transmitted by the French IGOSS Centre (see further), one can conclude that more than 50 000 real time profiles have been replaced since the beginning of the operations.

Table 1: The TOGA Centre data collection per year and per Ocean

09/24/91

TOGA SUBSURFACE DATA CENTRE

Total number of data

Year	BATHY	TESAC	XBT	CTD and Nansen	Total real-time data	Total delayed data	Total
** Ocean: Atlantic							
85	1732	63	5167	938	1795	6105	7900
86	1707	435	4147	187	2142	4334	6476
87	1004	215	4660	33	1219	4693	5912
88	818	31	4050	51	849	4101	4950
89	1766	210	2886	0	1976	2886	4862
90	1983	62	2678	0	2045	2678	4723
91	2285	91	120	0	2376	120	2496
** Sous-total **							
	11295	1107	23708	1209	12402	24917	37319
** Ocean: Indian							
85	1636	454	3261	99	2090	3360	5450
86	804	386	2390	83	1190	2473	3663
87	939	690	2820	43	1629	2863	4492
88	536	505	2670	33	1041	2703	3744
89	1100	523	2648	69	1623	2717	4340
90	822	253	2366	0	1075	2366	3441
91	1600	25	170	0	1625	170	1795
** Sous-total **							
	7437	2836	16325	327	10273	16652	26925
** Ocean: Pacific							
85	2921	792	11060	226	3713	11286	14999
86	2994	778	10993	219	3772	11212	14984
87	4977	1190	12130	163	6167	12293	18460
88	3533	915	9371	89	4448	9460	13908
89	7129	711	6216	74	7840	6290	14130
90	10248	1153	4907	0	11401	4907	16308
91	6546	159	137	0	6705	137	6842
** Sous-total **							
	38348	5698	54814	771	44046	55585	99631
*** Total ***							
	57080	9641	94847	2307	66721	97154	163875

Figure 1 below confirms that after three years the number of data tends to stabilize between 25 000 and 30 000 profiles per year in the intertropical belt (30°N-30°S). However very old data continue to be recovered. For instance since the TOGA CD ROM has been recorded, more than 3 500 new profiles have been loaded for years 1985-1986 in the TOGA data base.

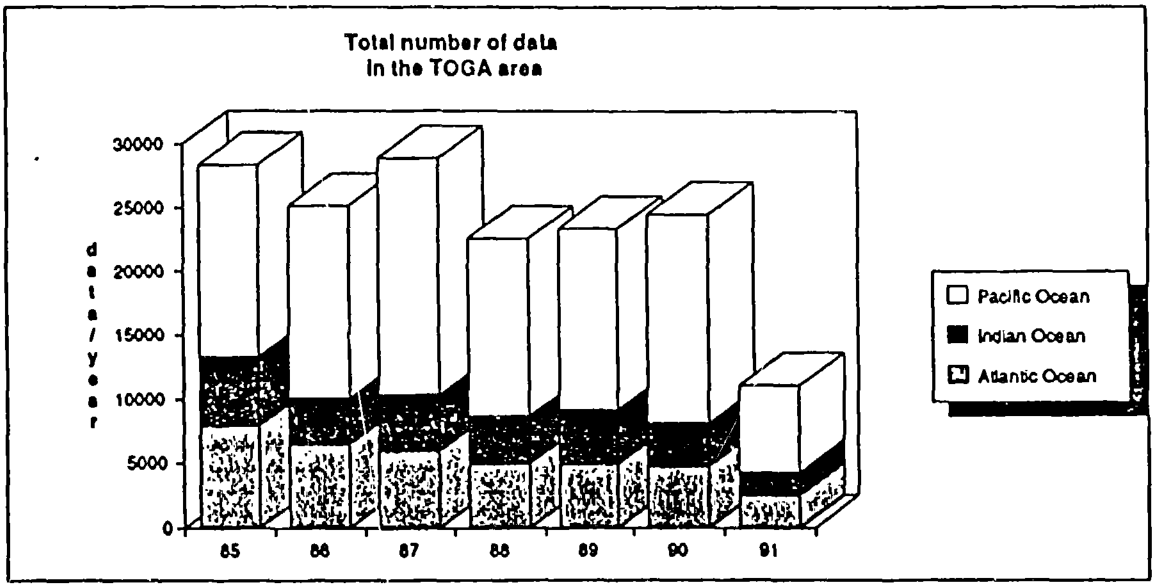

Figure 1: The data distribution per year and per Ocean

Figure 2 located below summarizes the overall data distribution per Ocean. Though the ratio of data may vary with time due to the large weight of the periodic transmission of the Pacific data set by the NODC, one can conclude that the gross sampling of the Pacific Ocean (60%) is a little better or more effective than that of the other Oceans. The ratio of the respective surface in the tropical area is actually 1/2 for the Pacific and 1/4 for the two other Oceans. Notice that the sampling for the Indian Ocean, though the smallest, is larger than commonly believed.

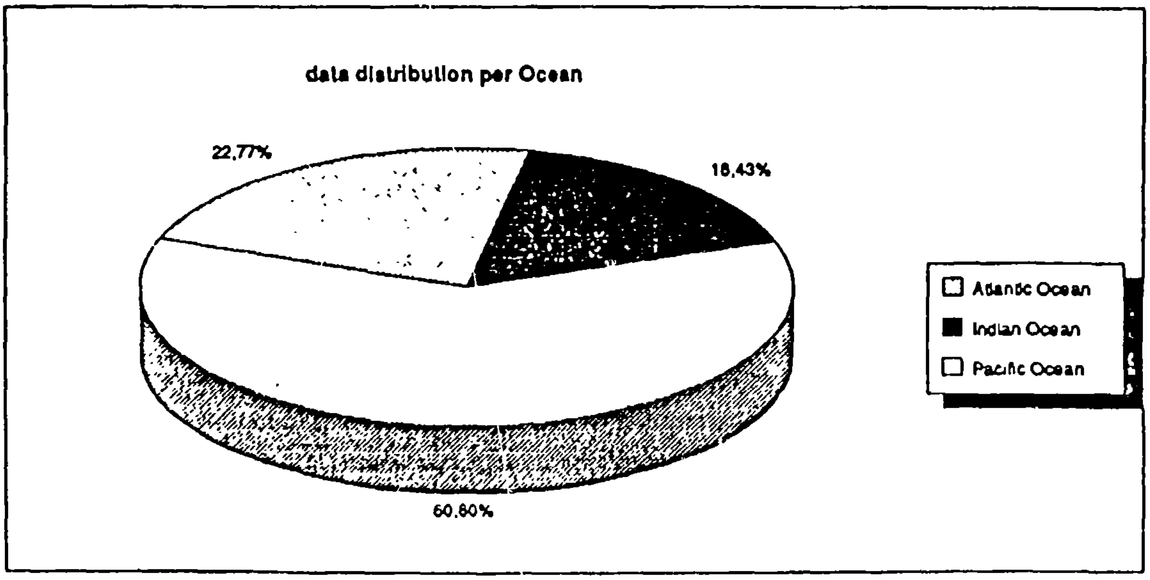

Figure 2 : Overall data distribution per Ocean

On figure 3 below are described the proportions of the different types of data which constitute the data base. This illustrates that the amount of delayed mode data (59%)has definitely outnumbered the amount of real time data, though the difference was a little larger one year ago (we are expecting a large NODC Pacific data set).

The other striking feature is the very small amount of hydrographic data transmitted (CTD and Nansen bottle data have been merged here). This is one of the major concern for TOGA and we hope that the implementation of the GTSPP will help to solve this problem. Notice that all the TESAC transmitted in the TOGA area have been collected by soviet vessels and only a very small amount has been replaced by delayed mode data in the Atlantic.

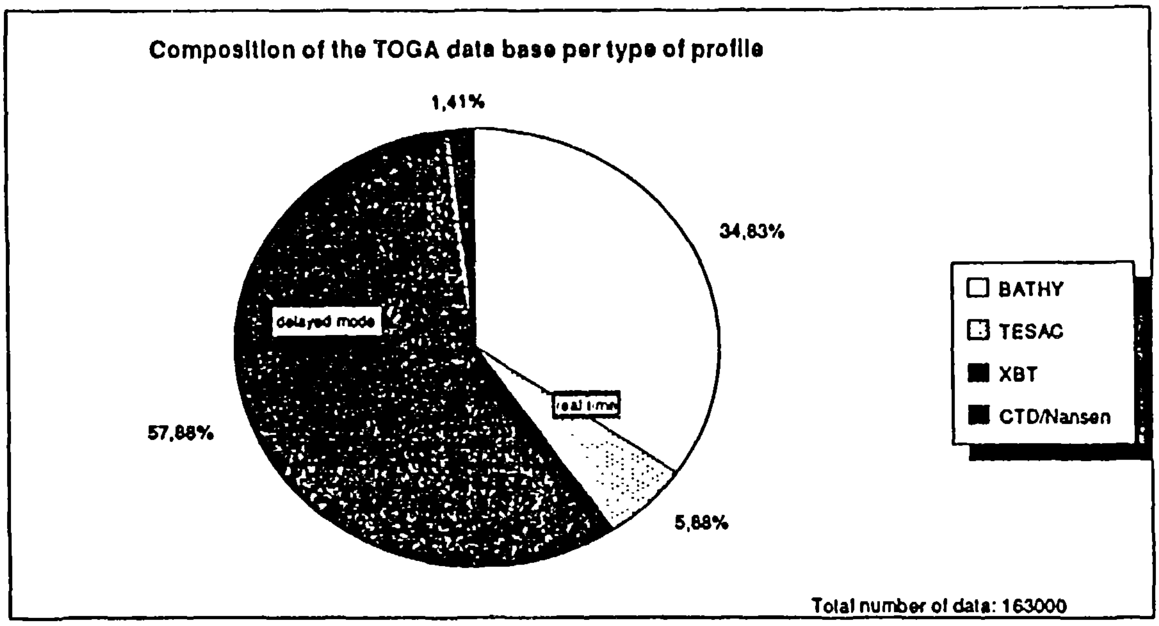

Figure 3: Composition of the global TOGA data set.for the 5 types of data available

Of course the ratio of these different types of data is varying in time and in figure 4 below, one can see that the amount of real time data is progressively decreasing while the amount of XBT increases with time.

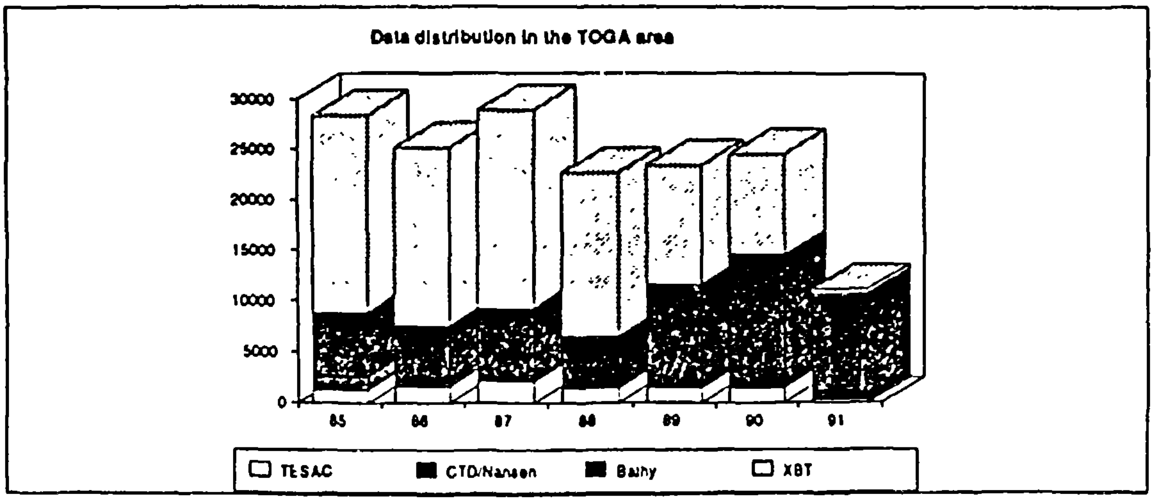

Figure 4 : The data distribution per year and per type of data

An other way to represent that is to plot directly the ratio of real time and delayed mode data as in figure 5 As previously noticed the proportion of delayed mode data increases very quickly during two years and then much more slowly for years, tending to stabilize around 80% of the data set. It takes three years for the delayed mode data set to overcome the real time one.

As we already mentionned in the report to the first Ad Hoc Panel (Noumea 1989), there are several reasons for an irreducible, though surprisingly large, amount of real time data never replaced. Lookinng into this data set part, it appears that most of them had been collected by research vessels, navy ships and for the countries by USSR. This is to be compared to the ships of opportunity network data implemented for TOGA for which the replacement rate (see further)is nearly perfect.

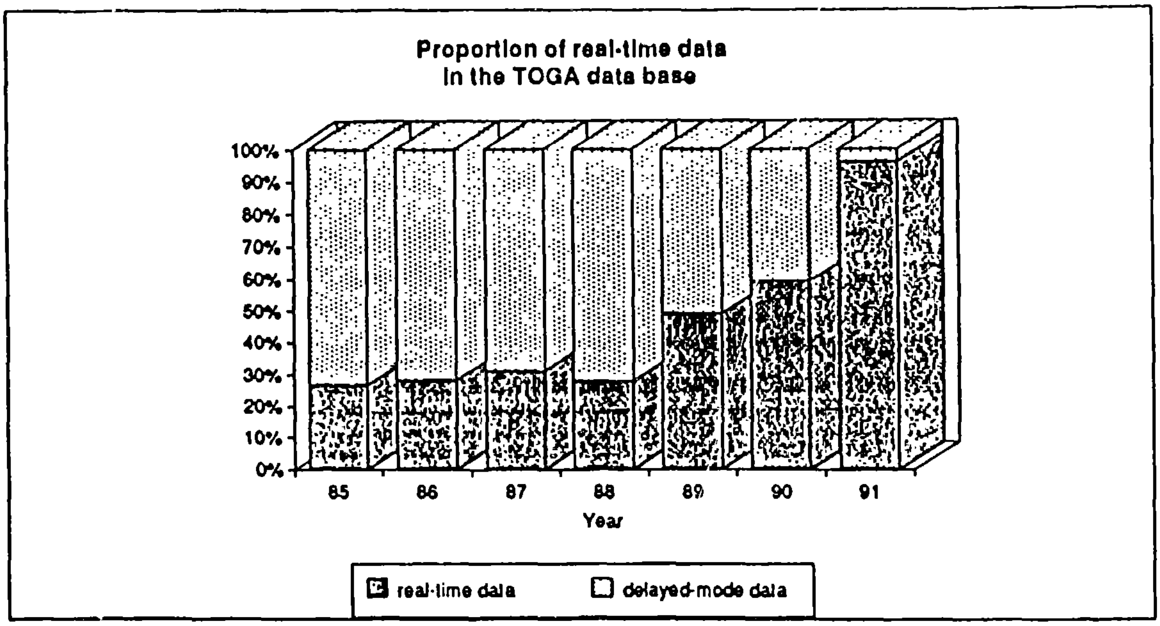

Figure 5 : delayed mode and real time data ratio, giving an estimate of the rate of replacement

Interesting at this stage is probably to know how many real time data have been actually replaced by their delayed mode correspondant and how many delayed mode data had never been transmitted before. Having saved the statistics of real time transmission since the beginning of the implementatio of the Centre, we can now compare what is remaining from the original data set, what has been replaced and what has been added; These informations are summarized in figure 6 below which we can interpreted as follows:

-the upper part is the ratio of XBT never sent in real time
-the lower part of the bar represents the residual of the real time data set
-the lower and middle part represents the original data set
-the middle part is the ratio of real time data replaced by delayed mode data
-middle and upper parts are the present delayed mode data set

The most surprising feature is probably that for none of the years since 1985 the amount of dtaa transmitted by both ways represents more than half of the data set. A global gross estimate can be done : as we will see further we received 112 000 real time BATHY. 57 000 are still in the data base i.e. half that part. Meanwhile we received 95000 XBT, i.e. 40 000 more than the real time data replaced. This illustrates once more the advantage of the principle of continuously updated data base.

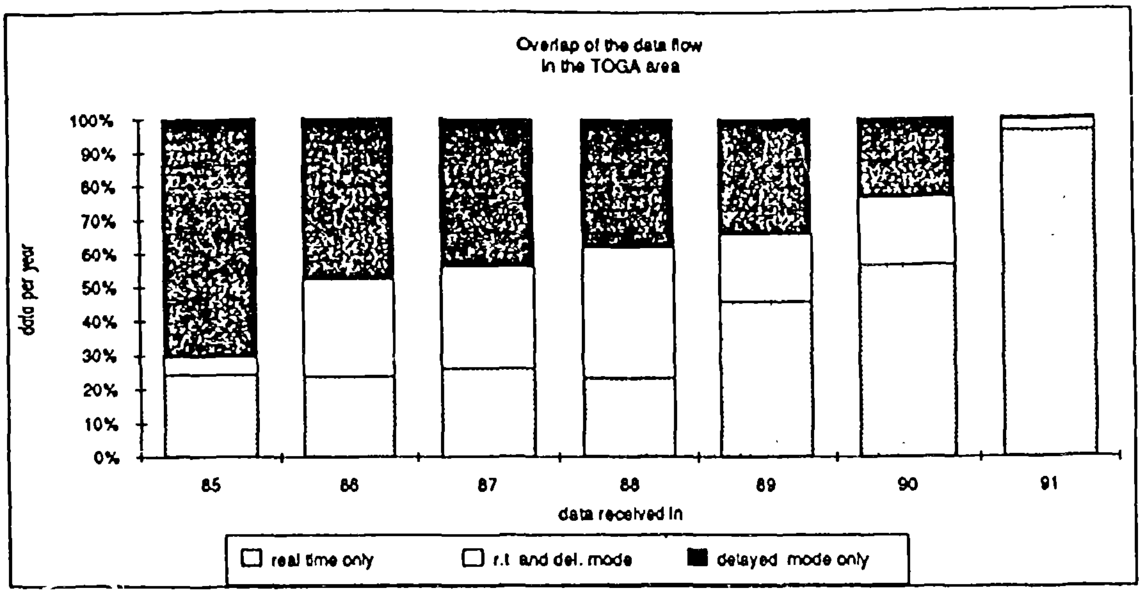

figure 6 : Overlap of the two data flows in the TOGA area

IV. Real time data transmission

As one of the major goals of TOGA is to implement operational systems of data acquisition, transmission and processing to monitor the Oceans, it is part of the duty of the TOGA data Centres to check if this task is being successfully accomplished. In terms of subsurface data, this means that the amount and quality of real time data should increase with time. Figure 1 could therefore be misleading, as the number of data seems to decrease these last years. To overcome the artefact of slow delayed mode data transmission, one must therefore examine figure 7, which represent the amount of data really loaded in near real time, i. e. with less than one month delay.

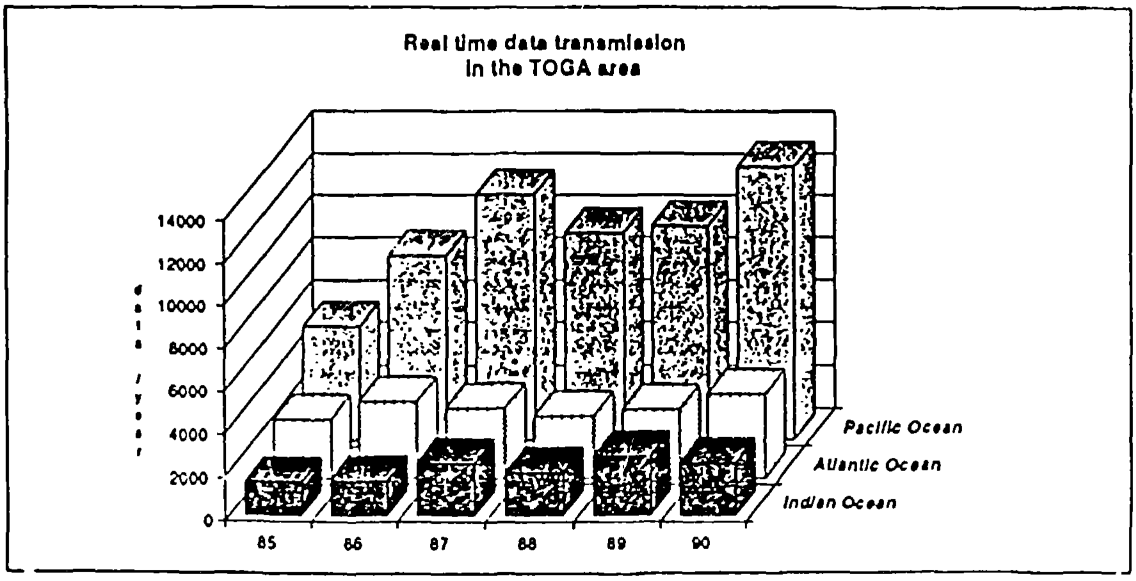

Figure 7 : real time data transmission from 30'N to 30'S per Ocean since 1985

Some concerns have been expressed recently about a possible real time data transmission decrease. Obviously this has not been the case in the TOGA area. A small decrease can be noticed in 1988/1989 after the peak of 1987, especially in the Pacific, but over the TOGA period a significant positive trend is obvious for all the three Oceans. The global yearly data transmission has progressed from less than 10 000 data per year in 1985 to mc , than 18 000 data in 1990. Year 1991 being not finished is not represented here, but will be further for ships of opportunity for which we will present statistics on a monthly scale. As can be seen this progression is particularly clear in the Pacific, though prtly due for year 1990 to the inclusion of moored thermistor chains data from the TAO array under the BATHY code over the GTS.

Wether this progression is due to an increase in sampling or an increase in transmission effectiveness is a little beyond the scope of this report. But this issue is constantly examined by the TOGA Centre and reported at the ad hoc meetings. The appropriate data bases have been implemented at Brest to check, process, update and archive the informations concerning the ships of opportunity activity which is presented further.

An attempt has been done to try to discriminate for year 1990 the origin of these real time data. Of course this is based only on the knowledge of the type of vessel as represented by her call sign on the GTS. Thanks to the efforts of the IGOSS and TOGA/WOCE tracking system the list of ships of opportunity is now well known. However for the other call signs the type of vessel had sometimes been subjectively attributed and a irreducible 4% of the data (from the 236 call signs having transmitted in 1990 over the GTS ans whose list is not presented here but available to the author) are of unknown origin.

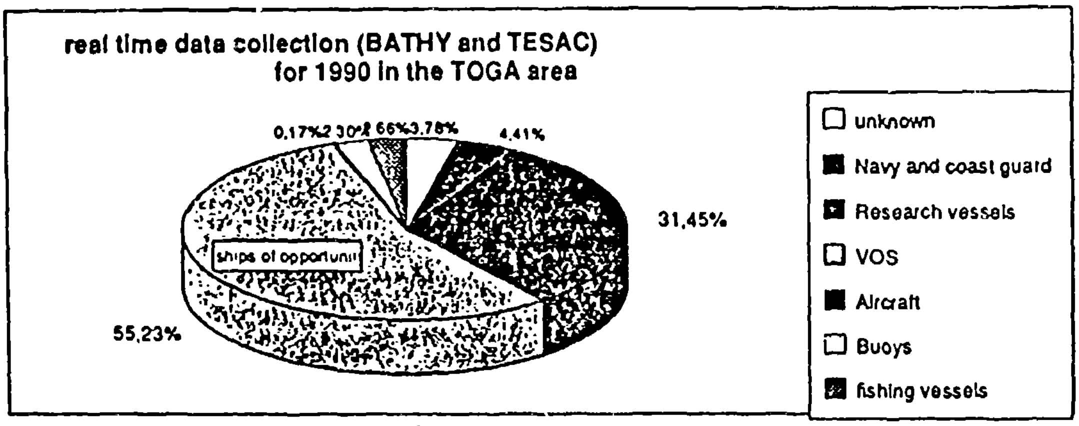

Figure 8 : tentative description of the origin of the real time data in 1990

Though these uncertainties, once more the importance of the ships of opportunity transmission is obvious, as they have transmitted more than half of the data. Notice the 2.7% ATLAS buoys data mentionned previously.

V. Ships of opportunity

Since the beginning of the TOGA programme, the TOGA subsurface data Centre has paid a special attention to the ships of opportunity activity, considered here strictly as merchant vessels operating along regular shipping lines. We continue to distribute on OMNET (see further) a monthly list of these vessels which can be considered now as a part of the complex data tracking system implemented by the IGOSS, TOGA and WOCE communities.

As usual ,we will present hereafter an update of the major results concerning their sampling since 1985.
-172 vessels have transmitted data since 1985 in real time or delayed mode.
-the total number of XBT transmitted is now 53 000
-they have reported 45 800 data in real time

More detailed informations on the number of vessels having participated to the real time transmission and its improvement, together with the number of data transmitted each month are given in the two tables below and illustrated by the consecutive figures. We give in annex 1 of this report a complete table of the VOS reports during the last year, sorted by operators and completed with their delayed mode data set when received.

Table 2 : Number of ships of opportunity having reported in real time

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
85	22	20	19	19	21	24	17	18	21	22	20	23
86	19	19	23	28	27	28	29	32	26	25	34	25
87	32	35	31	30	34	33	39	44	39	37	40	40
88	39	46	41	39	39	39	42	46	43	46	42	38
89	44	44	50	50	47	21	47	50	47	41	36	40
90	41	44	37	40	49	48	50	48	52	53	52	56
91	55	45	50	45	44	44	49	47	0	0	0	0

Table 3 : Total number of data transmitted in real time by ships of opportunity

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
85	285	212	173	192	172	248	145	215	258	223	204	275
86	271	290	377	451	419	431	426	506	490	401	698	436
87	582	621	529	490	533	481	545	554	452	527	383	694
88	503	527	616	476	579	570	631	611	567	634	532	470
89	683	466	691	748	619	147	645	744	697	642	598	715
90	741	635	675	633	830	686	837	995	1052	1061	1178	1072
91	977	1032	1132	777	710	739	842	886	0	0	0	0

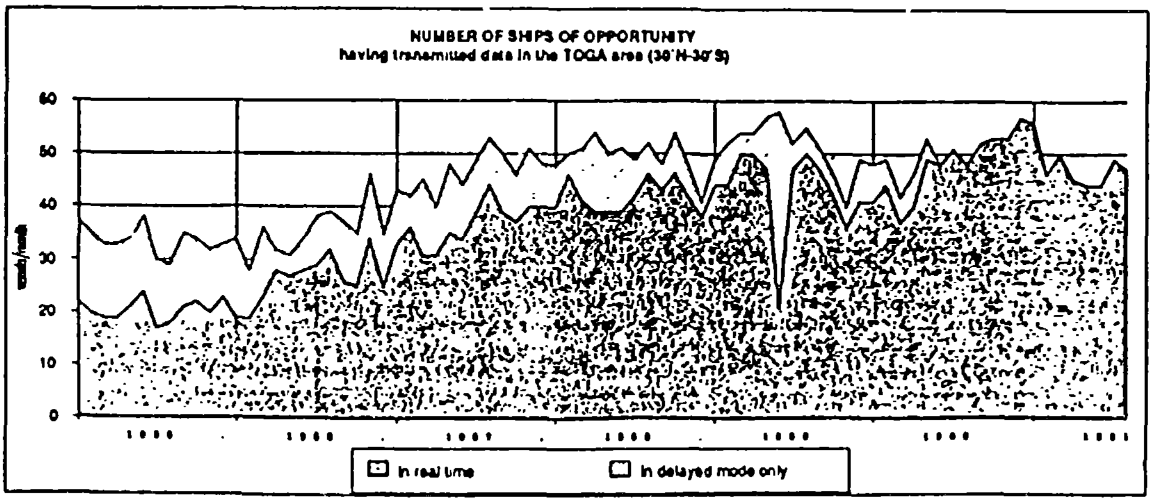

Figure 9 : monthly number of ships of opportunity having reported data

As can be seen the number of ships in activity peaked at the end of 1990 with more than 50 vessels reporting per month. At the same period the number of data transmitted reached nearly 1200 profiles per month. Since then, for reasons that cannot yet been elucidated, the number of vessels stabilizes between 40 and 50 per month, with a mean 1000 data transmitted. -The large drop in June 89 is an artefact due to strikes at the french IGOSS Centre-.

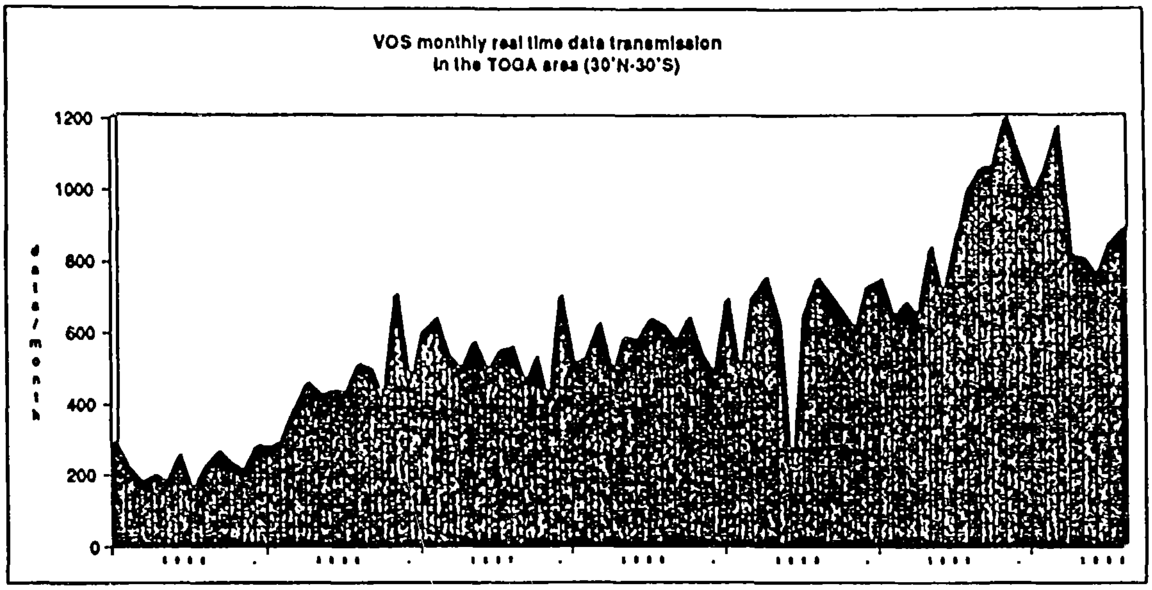

Figure 10 : monthly number of data transmitted by these vessels

A question often raised is that of the increase of the efficiency of the real time data transmission, i.e. how many are actually recovered in real time compared to what has been collected. A first very simple index is to look at the progression of the number of data transmitted bty vessel each month which is given hereafter.

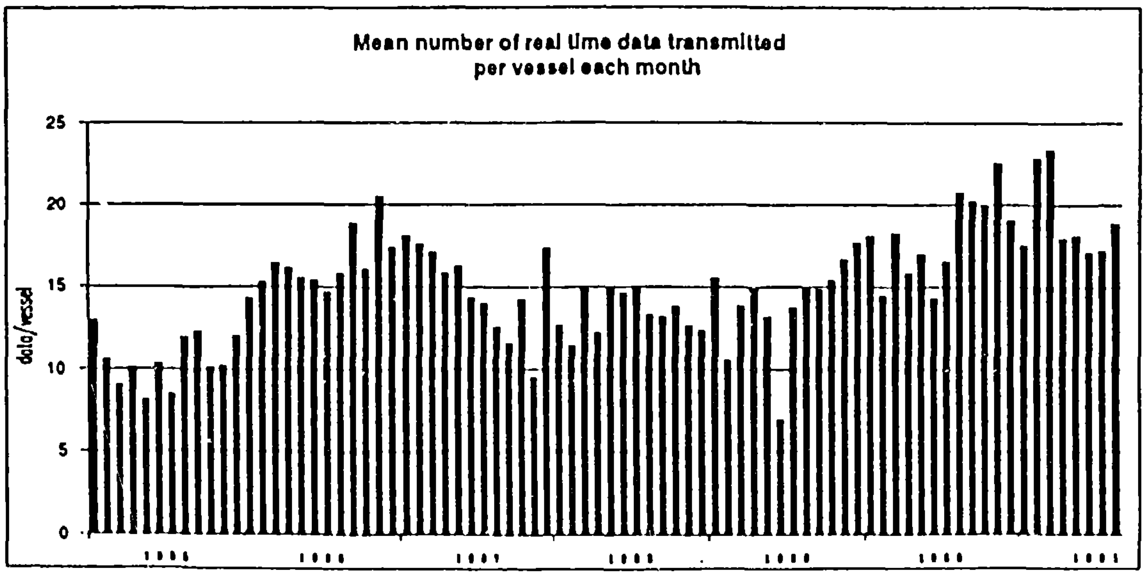

figure 11 : mean number of data transmitted in real time by the ships of opportunity

There is a clear positive trend in this index, which however varies very irregularly. It is of course higly dependant on the implementation of short or long lines. We give further a second index of the improvement of the real time transmission which is probably more relevant and in accordance with the numbers provided by the national reports. This index has been computed using the data reported both in real time and delayed mode by the different vessels.

The figure below illustrates the complete data collection for the ships of opportunity. It shows as previously stated that more than 95% of the data for the years prior to 1990 have now been replaced by XBT.

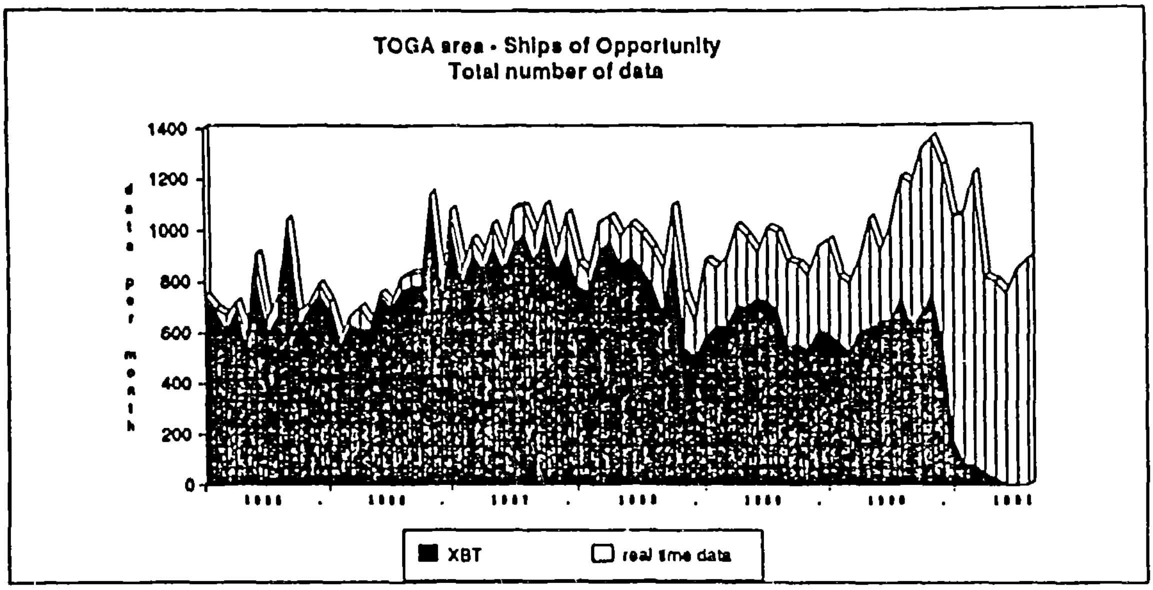

figure 12 : The ships of opportunity data collection in September 1991

Selecting only the vessels for which we have received XBT and which had transmitted data in real time, which is an exercice of relation between data bases, we computed the ratio of the monthly sum of these two numbers and drawn figure 13 below, whiwh illustrates much better the progress made and transmission mainly due to the implemenation of automatic satellite transmission systems.

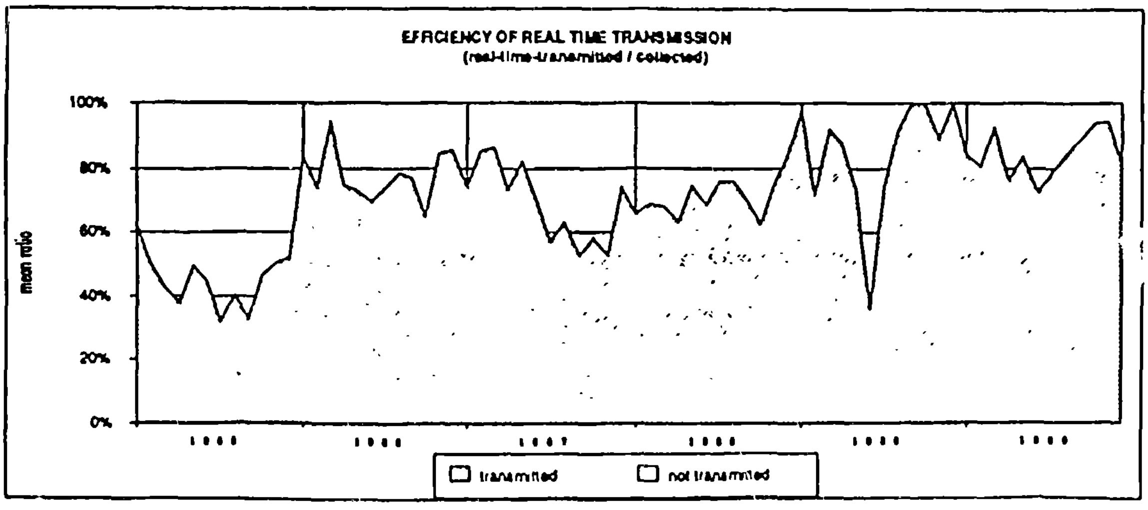

figure 13 : ratio of real time data transmission for vessels having transmitted in real time

VI. Data qualification

The procedures adopted to control and qualify data have not been basically modified since the beginning of the data collection. These procedures have been described in an internal report entitled "Data Quality Control at the TOGA Subsurface data Centre", which was distributed within the GTSPP community and updated each time the procedures are modified or improved.

The most difficult type of controls we had to solve, in terms of programming, was that of data duplication, due the several data sources used by the Centre. We have implemented a three steps procedure to eliminate near duplicates which eliminates now more than 98% of the duplicates and is very powerful to detect large or unexpected errors (like one year difference) in the data sets:

-An entrance control based on small space-time discrepancies between data
-An off line procedure on a PC based on sorted data sets and speed control
-An interactive procedure based on choice of fields which can be identical

The quality control of the data is based on data editing and visual comparison with the LEVITUS climatology. All the data have passed this control which is now fully operational. Though subjective, this procedure appeared to give in many cases more satisfactory results with a trained operator than an automatic procedure based on simple statistics. The results of these controls are presented hereafter in Table 4.

TABLE 4: Status of the data qualification per type of data and per flag
(1=good, 3=doubtful, 4=erroneous)

DISTRIBUTION OF QUALIFIED DATA PERIOD : FROM : 85/01 TO 91/09

THE TOGA data base contains 157419 PROFILS

OCEAN ATLANTIQUE : 37009 PROFILS

QUALITY PROFILE	XBT	BATHY	TESAC	SONDE	NANSEN	DRIBU	BOUEE DERIV.	BOUEE MOUIL.
1	22501	9204	1051	585	617	0	0	0
3	858	1316	37	1	3	0	0	0
4	196	629	8	3	0	0	0	0
TOTAL	23555	11149	1096	589	620	0	0	0

OCEAN PACIFIQUE : 93818 PROFILS

QUALITY PROFILE	XBT	BATHY	TESAC	SONDE	NANSEN	DRIBU	BOUEE DERIV.	BOUEE MOUIL.
1	52245	30449	5485	751	0	0	0	0
3	1237	1923	160	17	0	0	0	0
4	330	1177	41	3	0	0	0	0
TOTAL	53812	33549	5686	771	0	0	0	0

OCEAN INDIEN : 26592 PROFILS

QUALITY PROFILE	XBT	BATHY	TESAC	SONDE	NANSEN	DRIBU	BOUEE DERIV.	BOUEE MOUIL.
1	15854	6319	2741	259	57	0	0	0
3	380	637	67	4	5	0	0	0
4	89	150	28	0	2	0	0	0
TOTAL	16323	7106	2836	263	64	0	0	0

This table requires only a few comments. For delayed mode data there are approximately 3% of doubtful data and less than 1% erroneous data. The exaggerate amount of suspect and erroneous data for real time data must be correctly interprcted: these data are remaining in the data base due to the fact that the corresponding XBT have never been sent by the scientists themselves as erroneous. This explains by the way why a rough 5% of the real time data will never be replaced.

VII. Data flow

1. Input

The data flow within TOGA has been described in the previous reports and the basic rules have not been modified until now. The real time data are still coming from the french IGOSS Centre, Meteo France now in Toulouse. The monthly data sets are transfered to the TOGA Centre on line by TRANSPAC within the first week of each month. This real time data set is completed afterwards with the NODC real time data collection coming from two US Centres (new procedures within the framework of the GTSPP are being implemented).

The delayed mode TOGA data sets are coming either directly from some TOGA operators or through the NODC. Constant informations exchanges with the NODC prevents us from duplication of processing of large data sets for those which are sent simultaneously to the two data Centres. The origin and amount of all the data sets processed are given hereafter.

TABLE 5: Total amount of data received and their origin

Institute	Country	number of data
NODC	USA	241182
CSIRO	Australia	9277
ORSTOM Noumea	New Caledonia	20 795
ORSTOM Brest	France	8641
ORSTOM Mahe	Seychelles	305
METEO France	France	112124
TAAF/LODYC	France	1 703
IFREMER/BNDO	France	239
SMSR	Tahiti	193
IFM Kiel	Germany	776
BSH Hamburg	Germany	739
Sections	USSR	944
Mauritius Met	Mauritius	21
JODC	Japan	3 298
JMA	Japan	1301
NIO Goa	India	197
Total		401735

The comparison between the total number of data received and processed (400 000) and the number of data really loaded (160 000) in the data base gives an estimate of the work achieved to replace or eliminate duplicates data. An estimate of the amount of real time data data replaced can be deduced too from this table. One can roughly estimate to 40% the number of real time data replaced by delayed mode data and a 50% more delayed mode data which had not been transmitted before.

Following a letter sent by the IOC General Secretariat and inviting the member States to submit their data to the TOGA Centre, we received some new data sets (India, Kuweit, Nigeria) which are being reformatted, digitized with the help of the French Hydrographic Office and processed.

2. Output

Data subsets can be selected according to a large variety of criteria including quality levels. A special order form has been prepared for users and is available on line on our OMNET catalogs (see further). The data are mainly distributed using our own ASCII TSDC format. The data are exchanged with the world data Centres using the GF3 format. Development of binary formats (BUFR) reading and writing capability has not yet been undertaken.

Data shipment is achieved
(i) either on line, mostly for periodic shipment to french laboratories (particularly LODYC for the Atlantic model),
(ii) or on MS DOS diskettes for small data sets requested by individual scientists and developping countries,
(iii) or on magnetic tapes for large shipments requested by well equiped Institutes.

A brief summary of the amount of data and shipments performed since 1987 is given below.

Year	number of data	number of shipments
1987	4 464	3
1988	145 302	20
1989	171 500	17
1990	236 774	26
1991	156 644	21

VIII. Information

A complete unit of information has been built using PC data bases. The PC is linked to the mainframe and the data bases are updated after each monthly data submission. The elementary information is the vessel, month, ocean, type and number of data collected. This data base is updated on the other hand with information concerning lines collected mainly from the operator reports on IGOSS.XBT or directly upon request. Secondary data bases were created oriented towards the satellite transmission and connected to the ARGOS annex service in Toulouse.

These data bases, primarily developed to check the completeness of the data submission and the quality of the processing, allow now the TOGA Centre to maintain a good data tracking capacity with regard to the ships of opportunity activity within TOGA. We have described the evolution of the TOGA ships of opportunity fleet and the improvement of its data transmission from 1985 until now. An exemple of the data transmission and collection for these vessels is given in annex of the present report.

Since autumn 1989 some of these informations can be consulted and captured by electronic mail on OMNET. We have created a data board which is updated monthly after each real time data set processing. It contains the complete list of operational ships of opportunity, the data statistical table presented here page 2, news on the data processing (informal), the last 12 months of real time data statistics and a data order form

The TOGA subsurface data Centre catalog on OMNET can be simply accessed by a COMPOSE command and the front end access Menu is reproduced hereafter:

```
COM

User name?  X.SMITH
Password?


  No new mail.

Command?  COMPOSE TOGA.SUBSURFACE

  Connecting to the TOGA Subsurface Databoard  --->  ---->  ----->

  Board catalog.


        ---------- TOGA Subsurface Data Centre Catalog -----------
          Questions or comments can be addressed to Orstom.Brest

              News and recent data received.................1
              Current year's real-time data, by month.......2
              Ship of Opportunity catalog...................3
              Data statistics by year.......................4
              Data order form...............................5
              Quit..........................................Q


          Your choice -
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IX. Products

1.Level III data

The global data set and the monthly real time data set are systematically processed to obtain standard derived quantities which consist of

(i) Temperatures at standard depths down to 500 meters
(ii) Isotherm depths from 31 to 10 degrees
(iii) heat content down to 3 standard depths
(iiii) thermocline and mixed layer characteristics

These data are presently managed in a PC data base which offers the same flexibility in terms of data selection on space time criteria. However these data are not yet officially distributed, except for an experimental monthly on line transmission towards Noumea to test the feasibility of the system. They are being used at the Centre to create graphic experimental products published in the BOAT and will be used to create a TOGA climatology. The fixed length format of these data facilitates their processing with standard commercial tools like spreadsheets (see exemple in annex of a time serie processing). These data will eventually be distributed when managed on a workstation besides the master data base.

2. Standard products

The products described in the previous reports (stations locations, mean temperature and heat content by 5° square and their anomalies) are still produced, but the distribution of these products on a regular basis has not been estimated as a priority by our funding agencies. These products are however available on request at every moment. We take the opportunity of these reports to include some of them in the annexes.

On request of ITPO we implemented the creation of statistical reports of the number of data collected per geographical square of variable size. We give in annex an exemple for real time data collected in December 1990. This kind of report being useful mainly to compare the number of data held by different Centres, the TOGA Centre implemented a facility to transfer these statistical data files in spreadsheets for possible automatic comparisons.

A complete serie of maps of real time data collected by quarter, by Ocean, and by 5° square has been edited and will be periodically updated. One copy has been brought to this meeting, another sent to ITPO.

Monthly data plots and list of vessels having collected these data in the area covered by the french Tropical Atlantic model are published each month in the BOAT published at Brest by Jacques Servain.

X. Conclusion

The TOGA subsurface data Centre has now the capacity of processing the data in an operational mode until the end of the TOGA programme. However new developments on the present system are not planned. The major concern is the extension of our activities to the management of the WOCE upper layer global subsurface data set. The size of this data set will constrain the Centre to modify its equipment and procedures. A complete reanalysis of the problem has been achieved, given the experience gained with the TOGA data management, and the present plans are to use an ORACLE DBMS implemented on SUN workstations or server.

New international procedures are being implemented too, within the framework of the GTSPP and the WOCE UOT DAC. We hope that the apparent simplicity of the schemes proposed will improve the efficiency of the global data management and will help to solve some of the critical points that have been mentionned here.

List of annexes

1. Table of ships of opportunity data collected in 1990

2. Distribution of the data collected from 85 to 90 per Ocean

    1. alltogether
    2. by the TOGA ships of opportunity
    2. by the other vessels

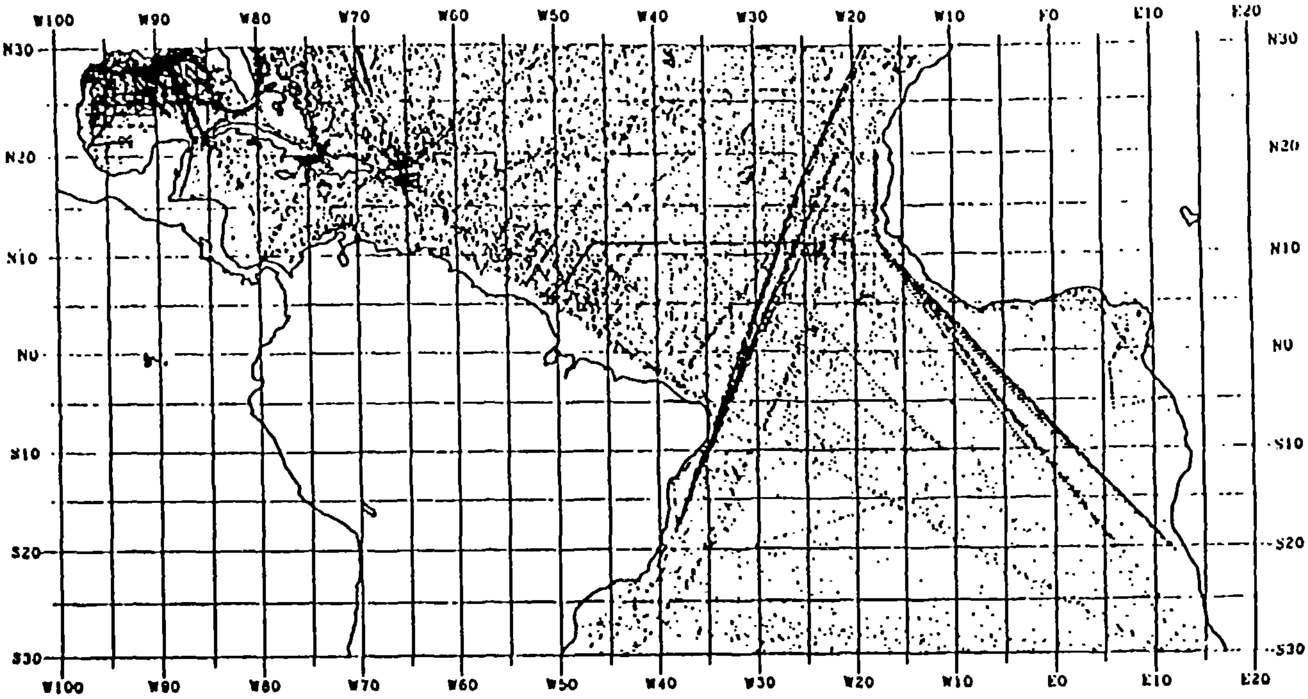
3. Real time data statistics report for the three Oceans

4. Exemple of monthly data use in the Atlantic model and report in the BOAT

at the TOGA subsurface data Centre

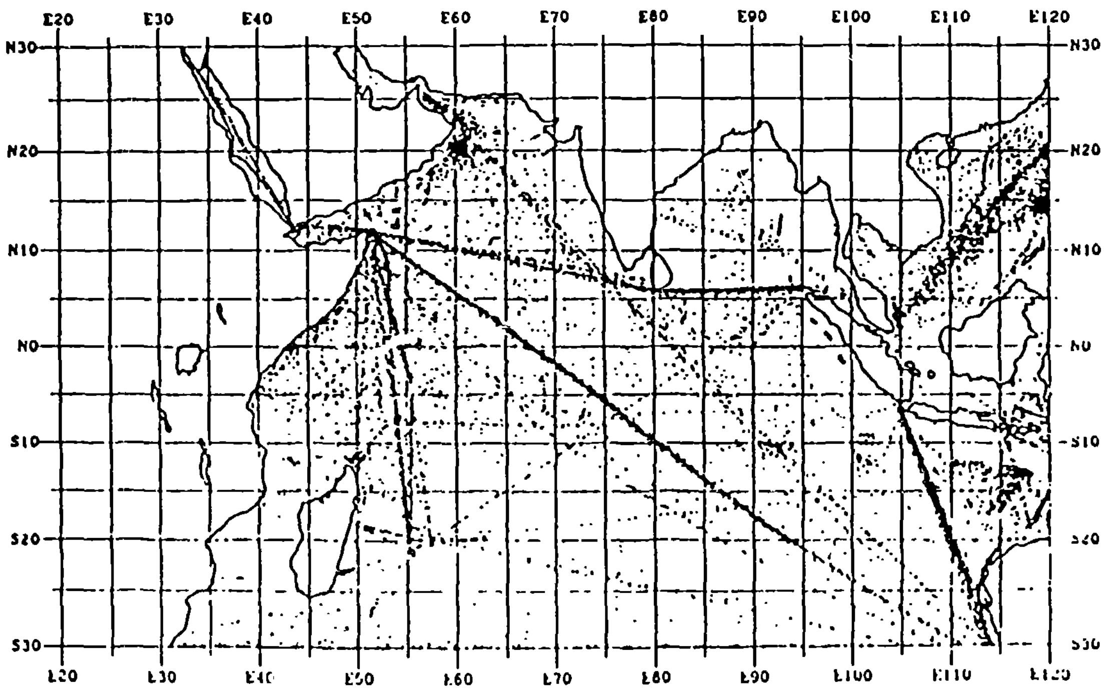
RADIO	VESSEL	TWI LINE	Operator	IGOSS data(*)	months with data	XBT received at TSDC
** Operator: BSH Hamburg						
DGLM	MONTE ROSA	AX11	BSH	125	8	0
PGDS	NEDLLOYD KYOTO	PX22 AX5	BSH	38	6	58
** Sous-total **						
				163	14	58
** Operator: CSIRO						
9VUU	ANRO ASIA	PX2 IX1	CSIRO	39	5	58
9VWM	MANDAMA	IX9	CSIRO	42	2	88
GYRW	ENCOUNTER BAY	IX12	CSIRO	91	6	118
GYSA	FLINDERS BAY	IX12 PX34	CSIRO	122	5	169
GYSE	NEDLLOYD TASMAN	IX12 PX34	CSIRO	150	7	150
S6FK	SWAN REEFER	IX1	CSIRO	310	12	433
VJBQ	ANRO AUSTRALIA	PX2 IX1	CSIRO	69	11	228
VJDP	IRON PACIFIC	IX22 PX11/5	CSIRO	113	3	133
VMAP	AUSTRALIAN PROGRESS	PX11 IX22	CSIRO	222	7	278
ZCSL	NIMOS	PX3	CSIRO	185	10	266
** Sous-total **						
				1343	68	1921
** Operator: FNOC						
NQST	SEALIFT ARCTIC	PX9	FNOC	19	4	0
PGDG	NEDLLOYD KINGSTON	AX5	FNOC/DHI	82	11	0
** Sous-total **						
				101	15	0
** Operator: IFM Kiel						
H8CB	TILLY	AX21 AX17	IFM KIEL	21	1	0
HOQT	PAUL	AX21 AX18	IFM KIEL	30	1	0
** Sous-total **						
				51	2	0
** Operator: JMA						
JFPQ	KASHIMASAN MARU		JMA	0	3	107
JITV	WELLINGTON MARU	PX5	JMA	661	10	674
** Sous-total **						
				661	13	781
** Operator: MAURITIUS						
3BBA	MAURITIUS	Local	MAURITIUS	2	1	0
** Sous-total **						
				2	1	0
** Operator: NOAA/NOS						
9VVB	GOLDENSARI INDAH	PX21 PX22 PX25	NOAA/NOS	37	3	0
A3BE	COLUMBUS CANADA	PX7 PX13 PX28	NOAA/NOS	285	12	143
A8VI	PACDUCHESS	PX7	NOAA/NOS	29	2	0
CBVM	VINA DEL MAR	PX25	NOAA/NOS	20	7	0
D5NZ	POLYNESIA	PX18 PX12 PX31	NOAA/NOS	338	12	348
DGVK	COLUMBUS VICTORIA	PX13 PX28 PX31	NOAA/NOS	94	7	75
DGZV	COLUMBUS VIRGINIA	PX31	NOAA/NOS	109	11	0
DHCW	COLUMBUS WELLINGTON	PX7 PX13 PX28	NOAA/NOS	90	10	0
DHOU	PURITAN	AX5	NOAA/NOS	123	12	0
ELED7	PACPRINCE	AX7	NOAA/NOS	49	11	0
ELED8	PACPRINCESS	AX7	NOAA/NOS	65	8	0
ELHL6	COLUMBUS OHIO	AX29 AX10	NOAA/NOS	236	9	75
GOVL	ACT 4	PX8 PX31	NOAA/NOS	50	6	0
GOVN	ACT 6	PX8 PX31	NOAA/NOS	101	8	0
GYSJ	DIRECT KOOKABOORA	PX18 PX28 PX31	NOAA/NOS	12	2	0
GZKA	ACT 3	PX8 PX31	NOAA/NOS	177	11	0
H9BO	MICRO. INDEPENDANCE	PX37 PX44	NOAA/NOS	42	9	51

[illegible]	SEA [illegible]	[illegible]	NOAA/NOS	[illegible]	[illegible]	
KRGB	SEA-LAND ENTERPRISE	PX37 PX10 PX26	NOAA/NOS	169	12	172
NIKA	SEALIFT ATLANTIC	AX23	NOAA/NOS	37	4	0
OWEQ2	LOEDAU MAERSK	PX26 PX49 PX20	NOAA/NOS	18	4	15
OWUO6	MOANA PACIFIC	PX18	NOAA/NOS	390	12	354
OXMD2	LARS MAERSK	PX37 PX49 AX3	NOAA/NOS	28	7	14
PGDI	NEDLLOYD MANILA	PX18 PX12 PX31	NOAA/NOS	175	10	206
PGDT	NEDLLOYD BALTIMORE	PX18 IX2 AX17	NOAA/NOS	144	8	111
PGDV	NEDLLOYD BANGKOK	PX18 PX28	NOAA/NOS	69	4	24
PGDY	NEDLLOYD MADRAS	PX18 PX12 PX31	NOAA/NOS	0	6	89
PGEH	NEDLLOYD BAHREIN	PX18 IX2 AX17	NOAA/NOS	86	8	70
PGEM	NEDLLOYD BARCELONA	PX18 IX2 AX17	NOAA/NOS	153	11	69
WCGN	CHEVRON CALIFORNIA	PX38 PX47 PX37	NOAA/NOS	19	4	3
WSD3628	ROYAL DAWN		NOAA/NOS	1	1	0
WSG6552	IPOKAI		NOAA/NOS	4	1	0
WSRL	SEA-LAND PACIFIC	PX10 PX26 PX37	NOAA/NOS	18	3	22
WUS9293	MOANA WAVE		NOAA/NOS	34	5	62
WUW9647	BARBARA H.		NOAA/NOS	21	7	28
WXBR	CHEVRON MISSISSIPPI	PX38 PX47 PX37	NOAA/NOS	25	5	32
ZCSK	SKEENA	PX26 PX37 PX40	NOAA/NOS	3	1	0
** Sous-total **						
				3534	280	2171
**** Operator: ORSTOM**						
3EAJ8	PACIFIC FERNANDA	PX5 PX3	ORSTOM N.	165	5	0
3EBD8	PACIFIC GRACIA	PX5 PX3	ORSTOM N.	130	4	0
3EET4	SEAS EIFFEL	AX11	ORSTOM B.	216	12	307
DIDA	ARIANA	AX20	ORSTOM B.	38	4	50
ELEH4	DELMAS TOURVILLE	IX6	ORSTOM/JMA	123	7	211
FNCZ	DELMAS SURCOUF	AX5	ORSTOM B.	311	12	320
FNED	UTRILLO	AX15 IX3	ORSTOM	5	1	17
FNGS	LA FAYETTE	AX11	ORSTOM B.	203	12	279
FNJT	KORRIGAN	IX10	ORSTOM B.	75	11	167
FNOM	ANGO	AX15	ORSTOM B.	170	12	175
FNPA	RONSARD	AX15 IX3	ORSTOM B.	134	6	158
FNQB	ILE MAURICE	IX3	ORSTOM B.	234	10	241
FNQC	VILLE DE ROUEN	AX15 IX3	ORSTOM B.	44	2	45
FNQD	ILE DE LA REUNION	AX15 IX3	ORSTOM B.	87	5	119
FNQM	SUZANNE DELMAS	AX15 IX3	ORSTOM B.	142	11	212
FNZB	SAINT ROLAND	G.G.	ORSTOM B.	38	7	99
FNZO	RABELAIS	PX17 PX12 IX10	ORSTOM N.	282	12	0
FNZP	RACINE	PX17 PX12 IX10	ORSTOM N.	255	10	0
FNZQ	RIMBAUD	PX17 PX12 IX10	ORSTOM N.	146	10	0
GQEK	FORTH BANK	PX17 PX12	ORSTOM N.	161	5	0
GTIA	IVY BANK	PX17 PX12	ORSTOM N.	193	7	0
HPEW	PACIFIC ISLANDER	PX5 PX4 PX3	ORSTOM N.	344	12	0
JQNY	ZUIRYU MARU	PX5	ORSTOM N.	171	7	0
ZDBE9	VOYAGER	PX5 PX3	ORSTOM N.	24	1	0
** Sous-total **						
				3691	185	2400
**** Operator: SIO**						
A3BZ	ACT 12	PX31	SIO/ORSTOM	363	12	0
C6HL8	ACT 10	PX31	SIO/ORSTOM	289	10	0
D5NE	MT CABRITE	PX14	SIO/IOS	21	4	0
DHJW	ACT 9	PX31	SIO/ORSTOM	4	1	0
DHLS	SVENJA	PX39 PX42	SIO	5	2	27
DPIB	ICEBIRD	PX37 PX10	SIO	49	6	35
ELDM8	SEAL ISLAND	PX14	SIO/IOS	21	3	0
HPYZ	ASIAN PROGRESS	PX41	SIO/ORSTOM	14	4	18
JJZC	HAKONE MARU	PX26 PX49	SIO	2	1	0
** Sous-total **						
				768	43	80
**** Operator: TAAF/LODYC**						
FNCB	MARION DUFRESNE	IX3	TAAF/LODYC	115	4	127
** Sous-total **						
				115	4	127
*** Total ***						
				10429	625	7538



34027 OBS.

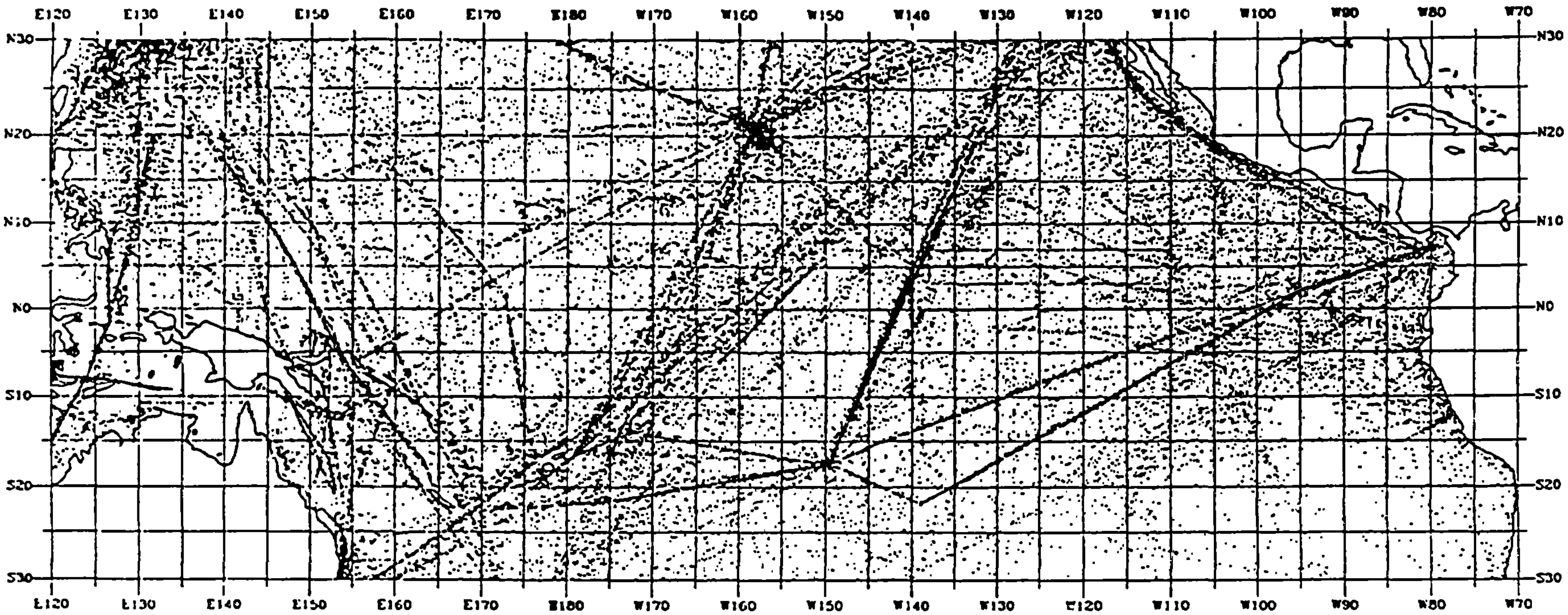
DATA DISTRIBUTION FROM 85/01/01 TO 90/12/31 INDIAN OCEAN



23599 OBS

DATA DISTRIBUTION FROM 85/01/01 TO 90/12/31

PACIFIC OCEAN

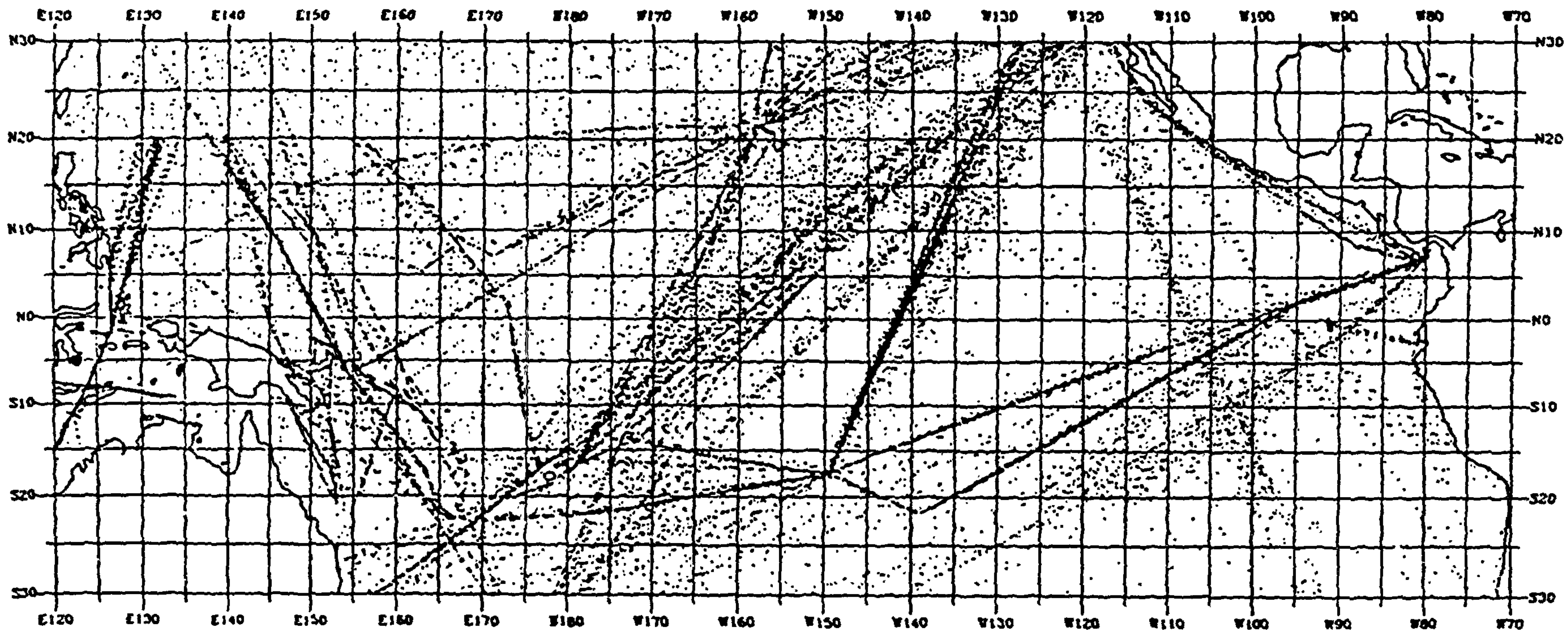


85027 OBS.

TOGA Subsurface data Centre

DATA DISTRIBUTION FROM 85/01/01 TO 90/12/31

PACIFIC OCEAN



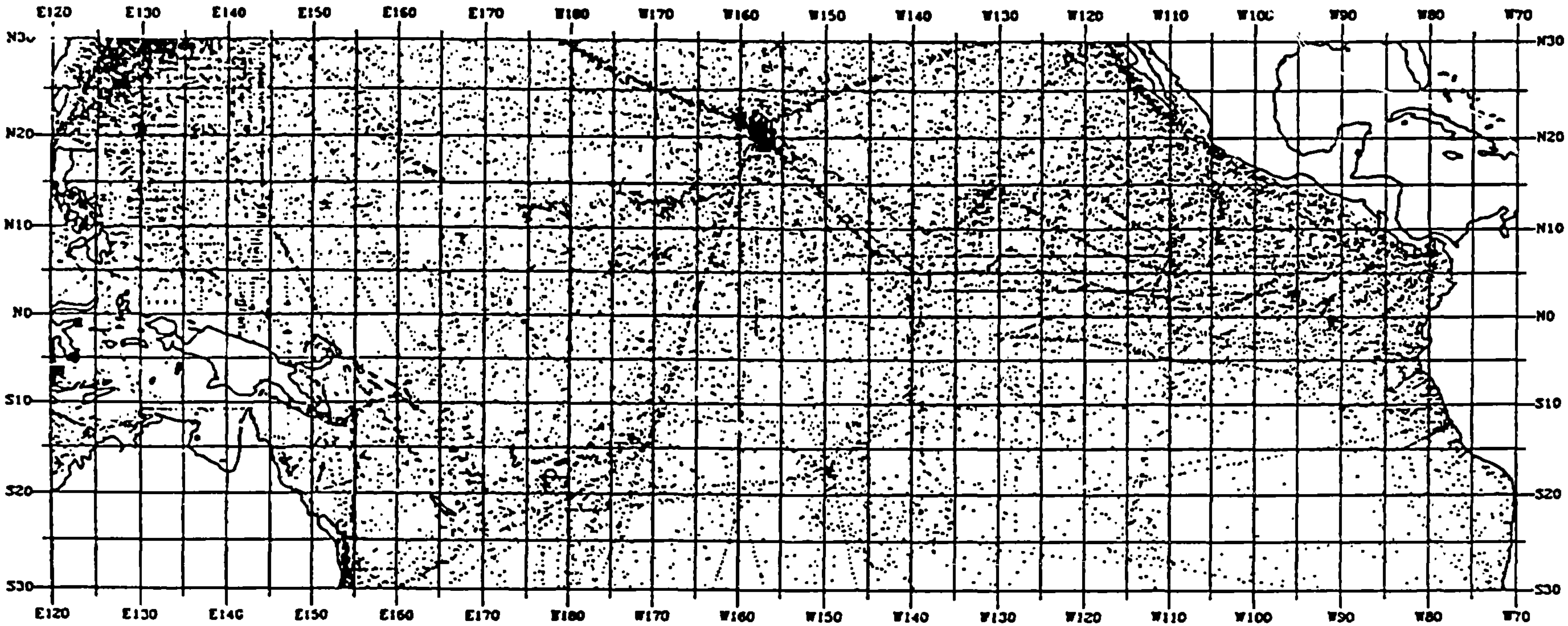
35913 OBS.

ships of opportunity data transmission

TOGA Subsurface data Centre

DATA DISTRIBUTION FROM 85/01/01 TO 90/12/31

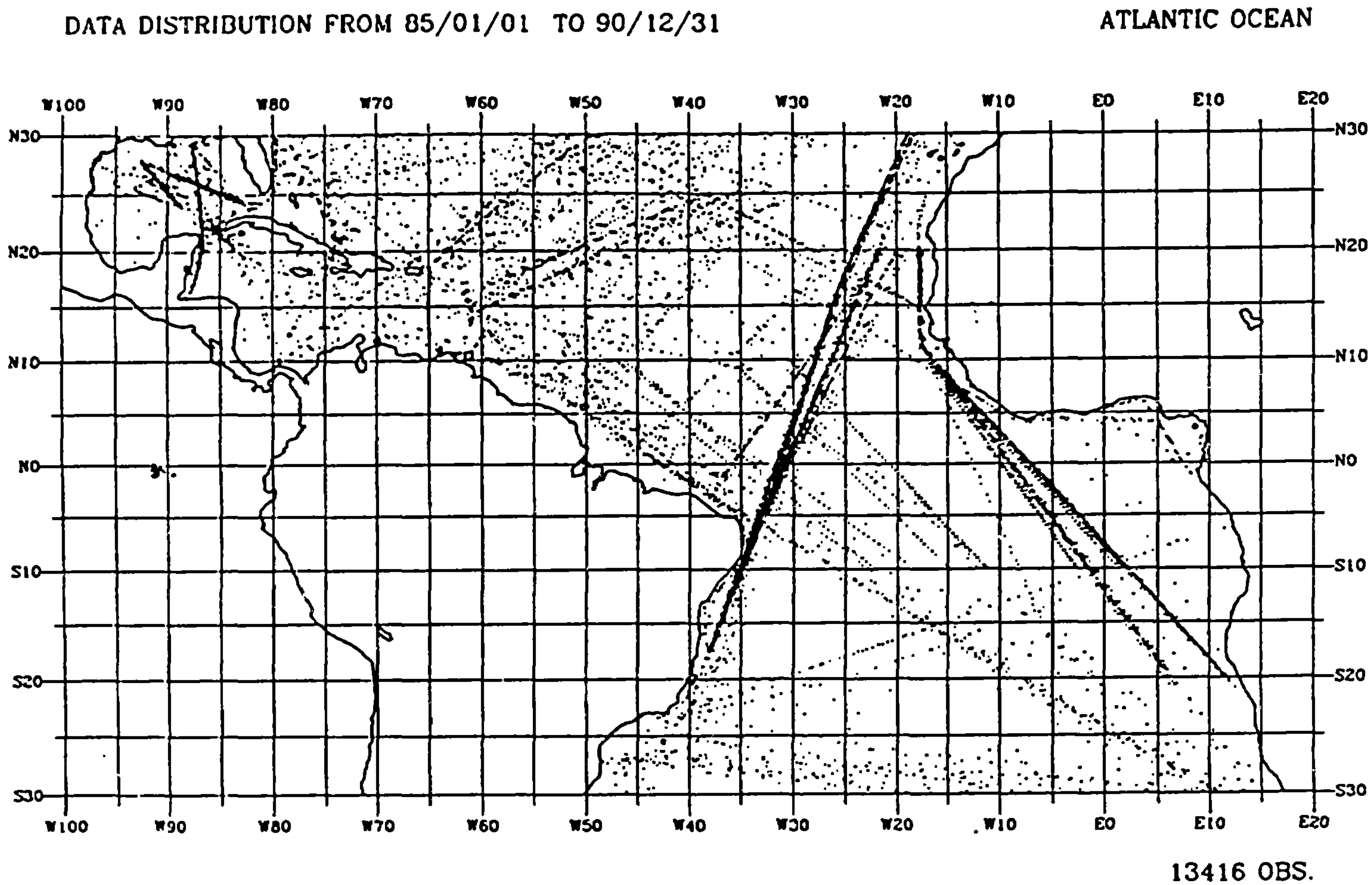
PACIFIC OCEAN



49111 OBS.

Other vessels data transmission

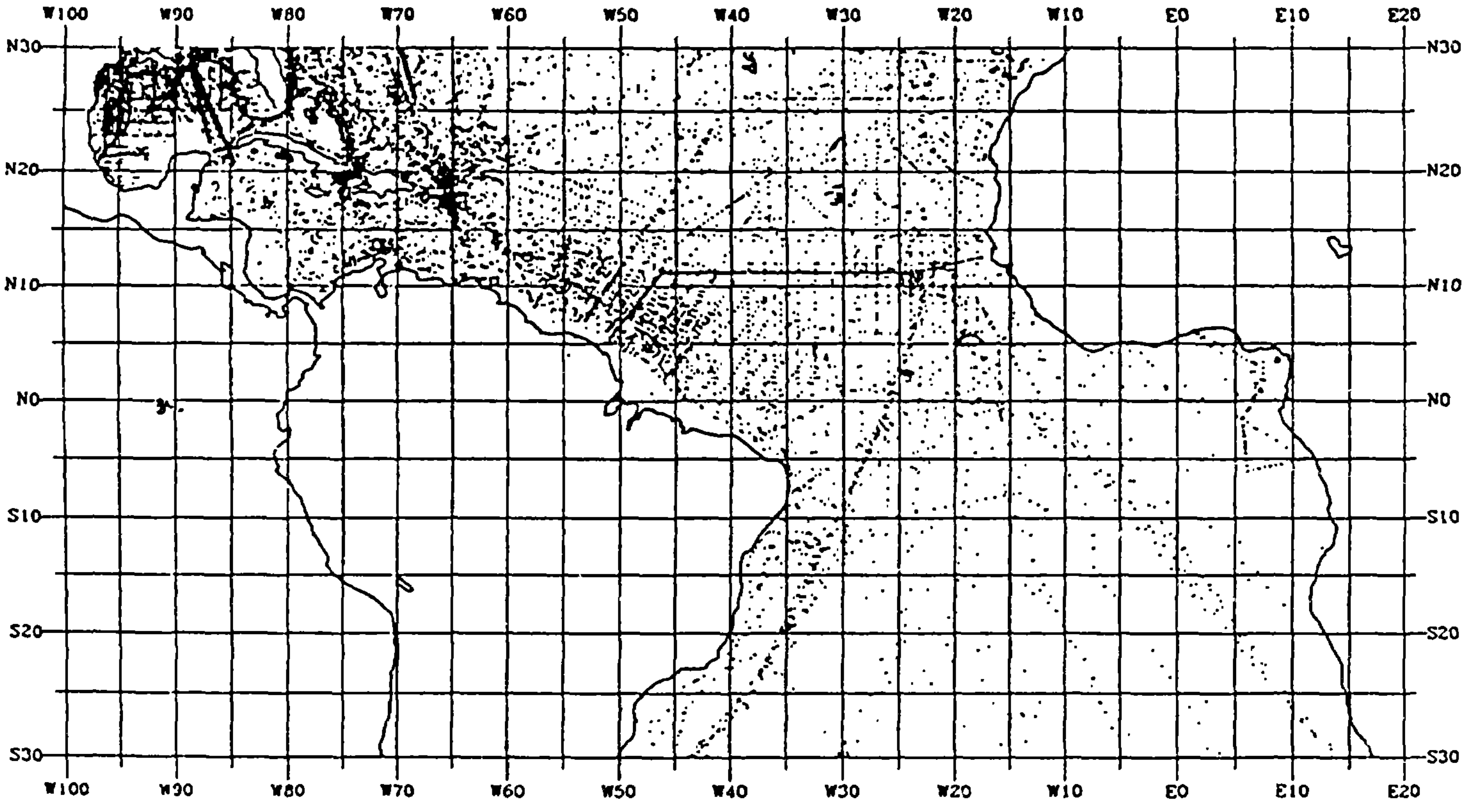
TOGA Subsurface data Centre



Ships of opportunity data

TOGA Subsurface data Centre

DATA DISTRIBUTION FROM 85/01/01 TO 90/12/31 ATLANTIC OCEAN



20603 OBS.

Other vessels data

TOGA Subsurface data Centre

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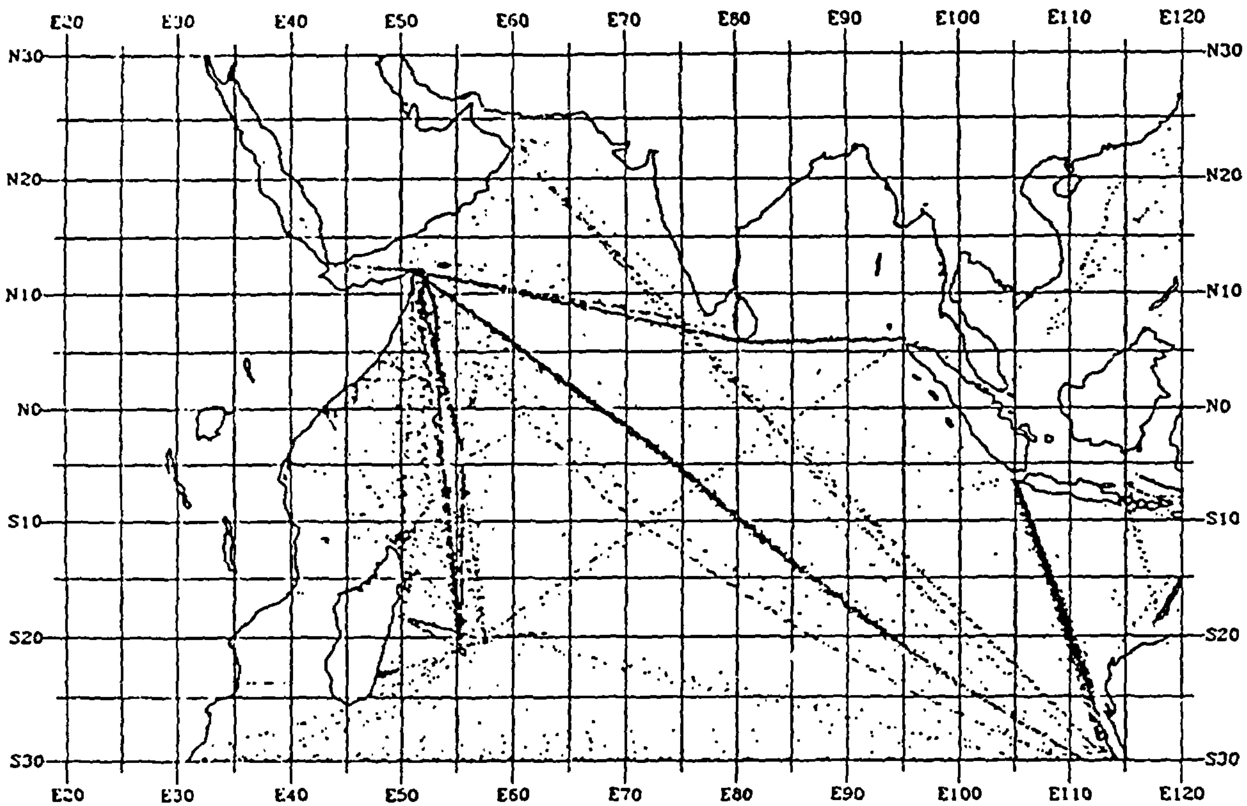
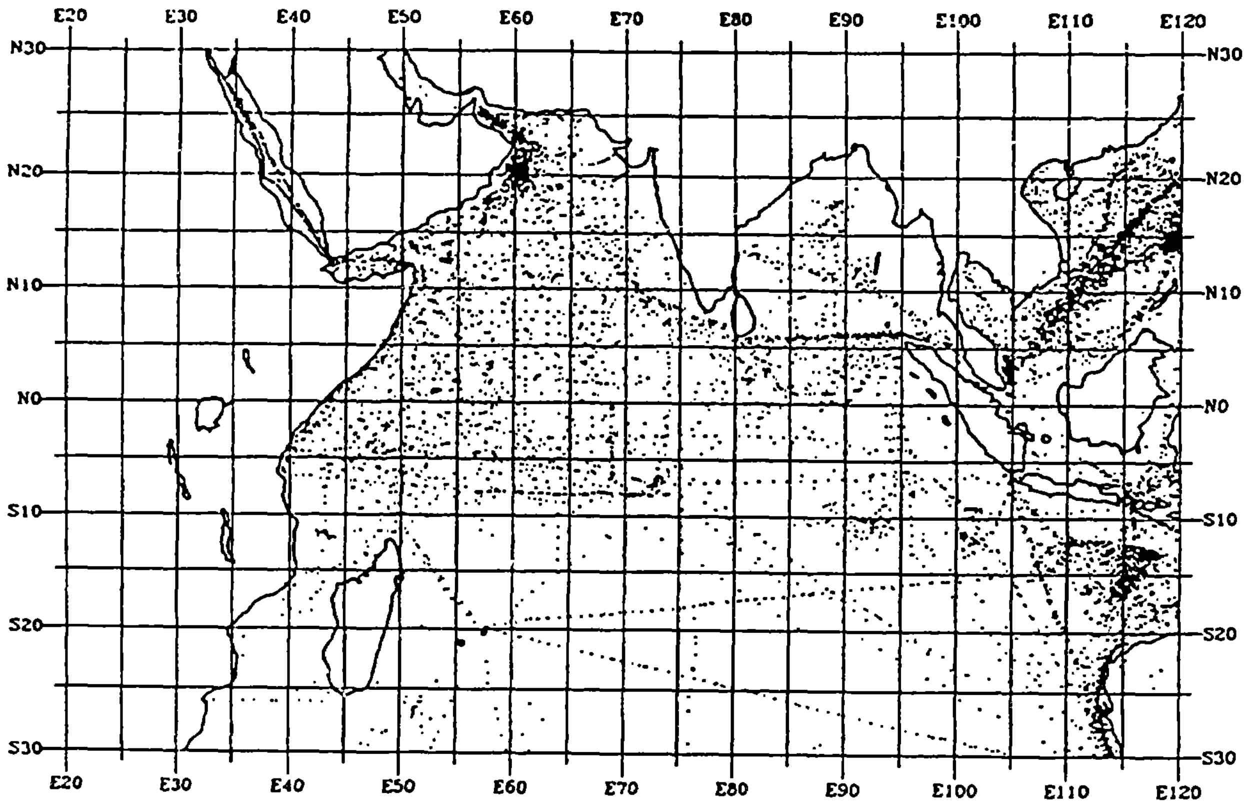


9642 OBS.

TOGA ships of opportunity data

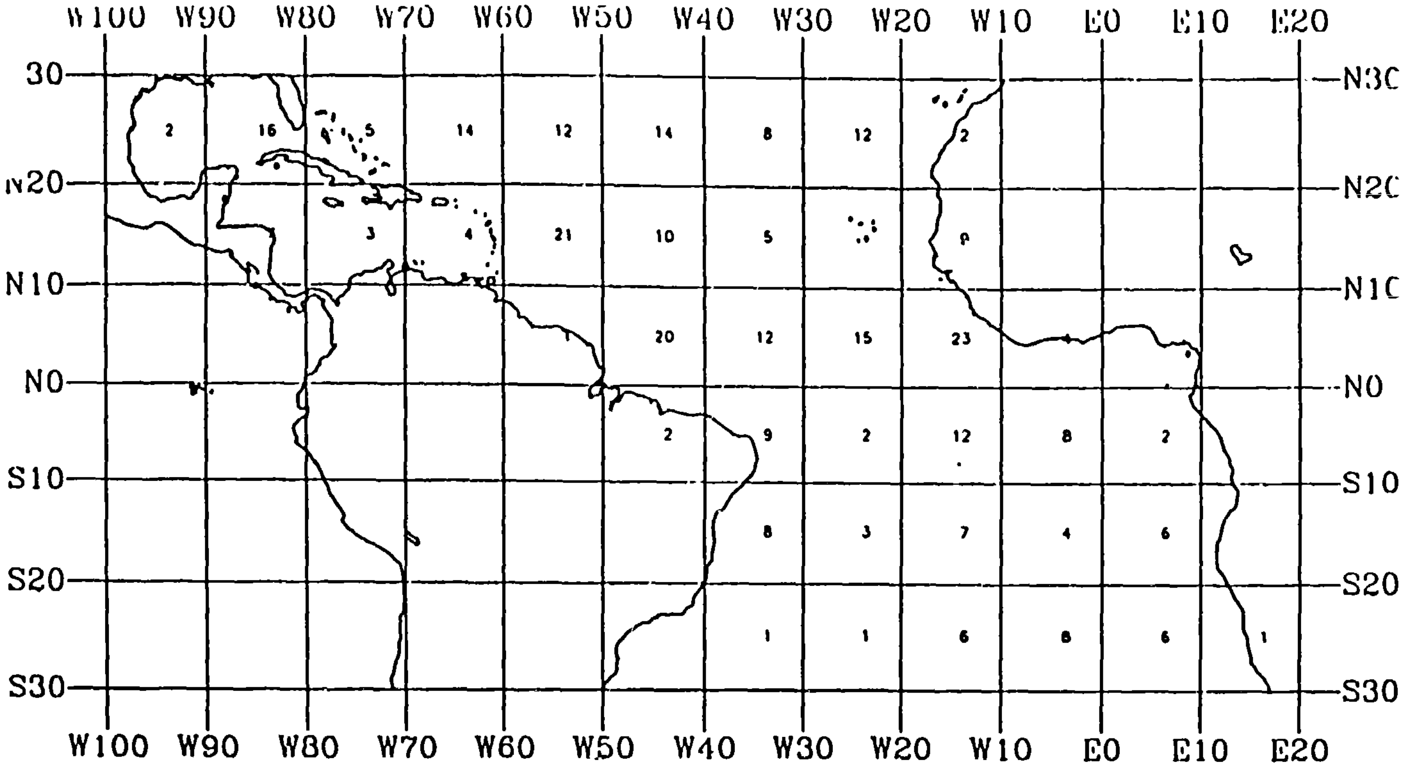
TOGA Subsurface data Centre

DATA DISTRIBUTION FROM 85/01/01 TO 90/12/31 INDIAN OCEAN



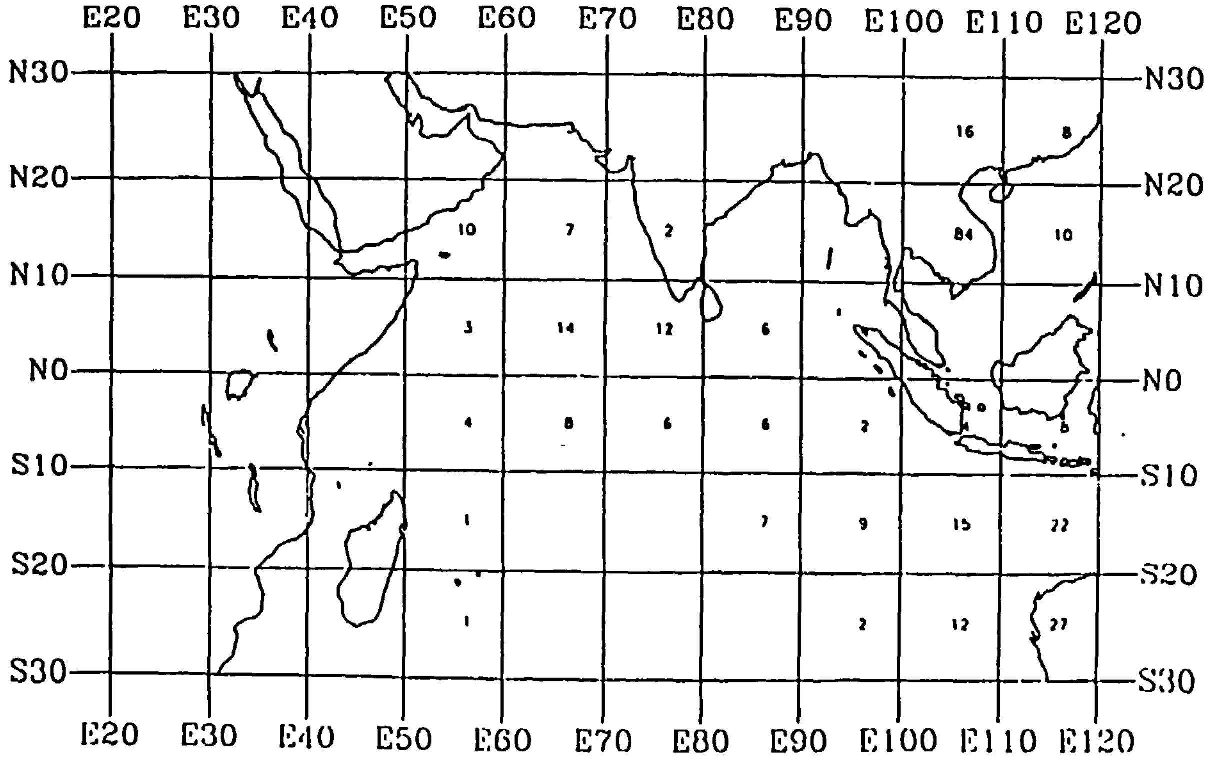
14094 OBS.

Other vessels data



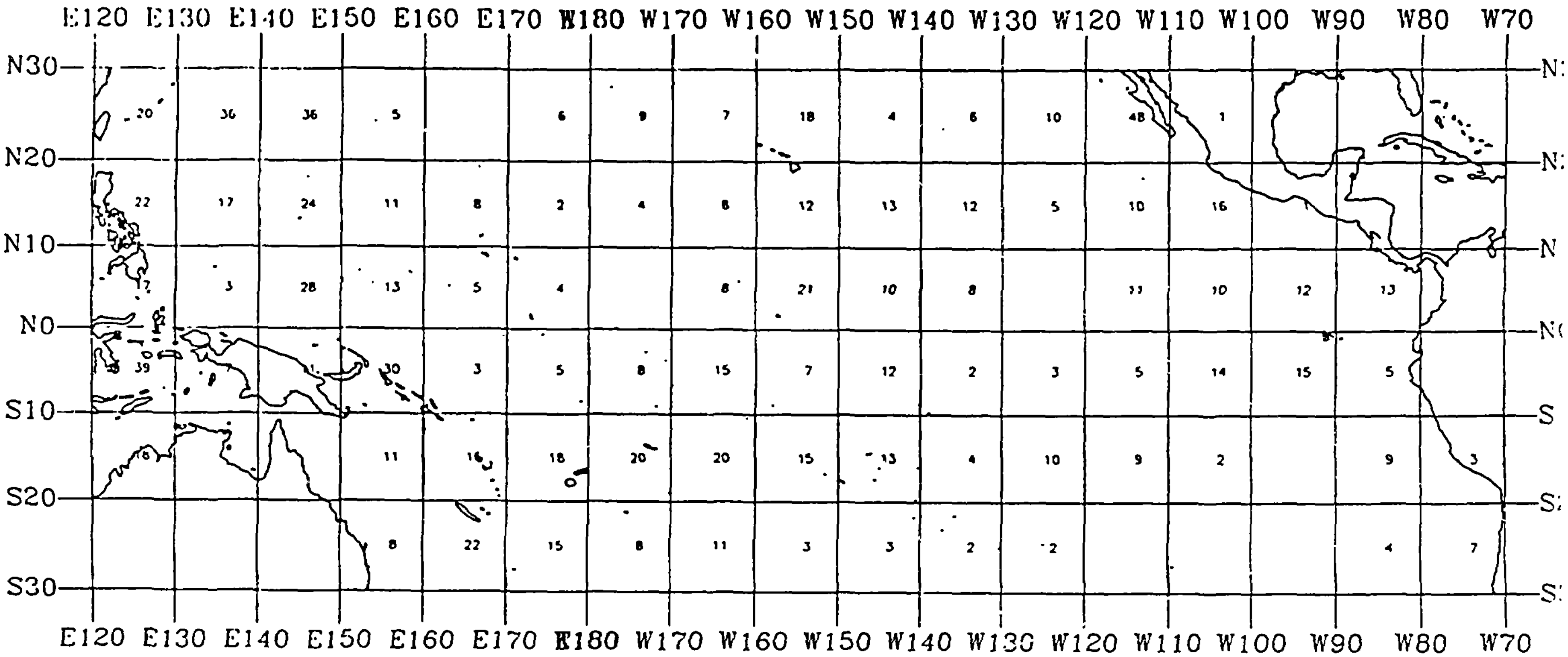
TOGA SUBSURFACE DATA CENTRE JAN 14, 1991

DONNEES TEMPS REEL DECEMBRE 1990 INDIAN OCEAN



TOGA SUBSURFACE DATA CENTRE JAN 14, 1991

DONNEES TEMPS REEL DECEMBRE 1990 PACIFIC OCEAN



TOGA SUBSURFACE DATA CENTRE JAN 14, 1991

REMERCIEMENTS

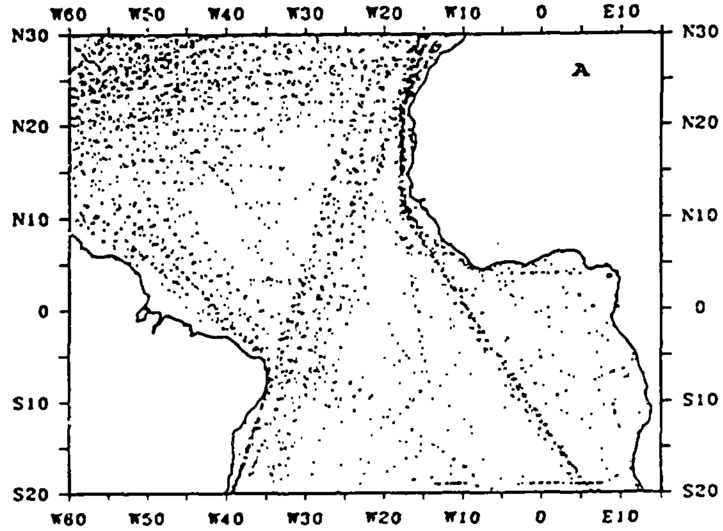
Ce travail est réalisé mensuellement avec l'aide de James Stricherz (FSU) pour la sélection des données de surface, de Michel Privé (ORSTOM) pour son travail de liaison avec les équipages de navires marchands effectuants les mesures XBT d'origine françaises, de Thierry Ludjet (Météo-France) pour la sélection des données XBT sur le SMT, de Noël Cloatre et Yvette Raguenes (IFREMER) pour la validation de ces données, de François Jamet (ORSTOM) pour l'expédition du bulletin.

Jean-Jacques Lechauve et Daniel Corre ont participé à la création des logiciels d'exploitation des données, Michèle Joubert et Christine Kermarrec à la mise en oeuvre initiale de la maquette d'édition.

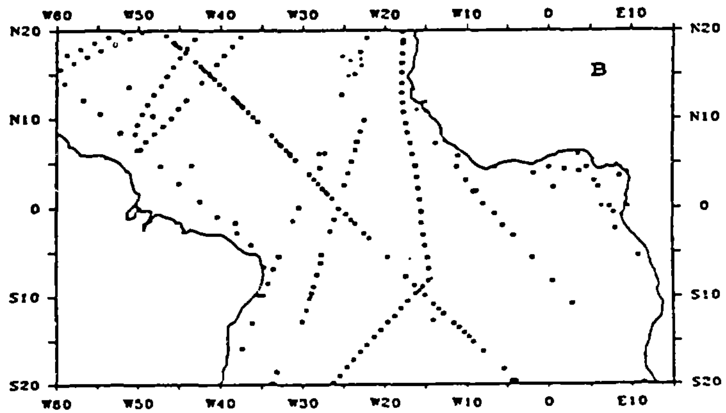
Les simulations numériques ont étés réalisées sur le calculateur CRAY 2 (Palaiseau) avec le soutien du Centre de Calcul Vectoriel pour la Recherche (CCVR). L'ensemble du projet a reçu le soutien financier de l'ORSTOM, de l'IFREMER, du CNRS et du PNEDC.

Nous tenons en outre à remercier les commandants, officiers et équipages des navires qui ont réalisé et transmis en **mars 1991** les observations de subsurface, en collaboration avec les Instituts Scientifiques listés ci-dessous.

Code radio	Navire	Institut	Pays	nombre de profils thermiques fournis
3EET4	SEAS EIFFEL	ORSTOM	France	7
DBBH	METEOR		Allemagne	2
DIDA	ARIANA	ORSTOM	France	24
ELHL6	COLUMBUS OHIO	NOAA/NOS	USA	13
FNCZ	LIBREVILLE	ORSTOM	France	12
FNGS	LA FAYETTE	ORSTOM	France	8
FNOM	ANGO	ORSTOM	France	8
FNPA	RONSARD	ORSTOM	France	5
FNQM	SUZANNE DELMAS	ORSTOM	France	6
FNZB	SAINT ROLAND	ORSTOM	France	10
J8FN	ROWANBANK	NOAA/NOS	USA	12
J8FO	ROSEBANK	NOAA/NOS	USA	50
KNFG	SEA WOLF	NOAA/NOS	USA	4
SHIP	inconnu			1
UPUI	PROFESSOR VIZE		URSS	22
V2PM	WEST MOOR	NOAA/NOS	USA	38



6924 observations



222 observations

- **Répartitions en mars 1991, (a) des observations de surface et (b) des observations de subsurface.**
- *Distributions for March 1991 of (a) the surface data and (b) the subsurface data*

BOAT Vol. 2. *N° 3*, 1991

GERMANY

Bundesamt für Seeschiffahrt und Hydrographie

As in previous years, German Ship-of-Opportunity (SOO) activities are focussed on the Atlantic Ocean. Two German institutions are involved, the Institut für Meereskunde, Kiel (IfM Kiel) and the Bundesamt für Seeschiffahrt und Hydrographie, Hamburg (BSH; formerly DHI); each operates two lines on a regular basis. These lines are part of the German contribution to WOCE and should be operational at least until 1993/94. Technical and organizational information about these lines is summarized in the Table below.

	Europe-N.America	Europe-Brazil	Br/Arg.-Capetown	Matadi-Brazil
TWI #	AX-3	AX-11	AX-17	AX-21
Vessel	"Köln Atlantic"	"Monte Rosa"	"Tilly" "Paul"	"Tilly" "Paul"
Callsign	DAKE	DGLM	H8CB HOQT	H8CB HOQT
Programme	WOCE	IGOSS/WOCE	WOCE	WOCE
Start	5/1988	1981	5/1989	9/1989
Finish	1994 ?	open	1994 ?	1994 ?
Frequency	12/yr	8/yr	6/yr	6/yr
Density	12/d	6/d	6/d	6/d
Probes	T7/T5	T4/T7	T7/T5	T7/T5
Equipment	SEAS II Bathy S.	SEAS II Bathy S.	Nautilus PC, DCP	Nautilus PC, DCP
Agency	BSH	BSH/FNOC	IfM Kiel	IfM Kiel
Real-time	METEOSAT	METEOSAT	METEOSAT	METEOSAT
GTS Hub	BSH/EDZW	BSH/EDZW	BSH/EDZW	BSH/EDZW
Abbr.Head.	SOVF01	SOVF01	SOVF01	SOVF01

In addition, several research vessels carried out XBT measurements irregularly while en route (braodcast mode). Some of the results were transmitted in real-time.

The sampling strategy for line AX-3 is designed to meet both WOCE requirements and our own scientific objectives in an area just south of the where our WOCE hydrographic activities are currently carried out. Besides investigating heat content variability and, possibly, heat flux, another focus of attention is the statistical analysis of specific regional features concerning

1. the temporal and spatial variability of the North Atlantic current system,
2. the thermal front between the Labrador Current and the North Atlantic current,
3. and winter convection in the eastern part of the North Atlantic.

The programme is funded by the German Ministry of Science and Technology.

From the start of the programme, measurements have been taken by the German container vessel "Köln Atlantic" on her way due east. So far, the line has been kept operational almost without interruption. Minor problems, e.g. controller circuit damage caused by a lightning strike on the XBT wire during launch, were fixed immediately thanks to the help of Jim Farrington of NOAA. As of September 1991, 40 sections had been collected; most had a resolution better than 40 nautical miles (Fig. 1).

The vessel is equipped with a SEAS II unit (upgraded Bathy Systems SA-810) linked to a Synergetics transmitter for real-time data transfer. An upgrade to a lap-top configured XBT system (SEAS III) is under development. The standard probe type used is T-7 (Deep Blue), replaced occasionally by T-5(20 kn). An example of a T-5(20 kn) section is given in Fig. 2.

Real-time data are inserted into GTS with an average delay of about 3 days, but delayed mode data are processed more carefully for our scientific aims and are documented in annual data reports. Investigations into the heat content variability (Fig. 3) are underway and are focussed on the mapping of the seasonal heat content of the 300 nautical miles-wide band across the North Atlantic. Temperature data alone, however, are not sufficient for heat flux studies in dynamically active regions like the western North Atlantic. It is therefore planned to use XCTD probes, too, as soon as they are available. Plans for additional SSS measurements are also being made. Initial results on a WHP research cruise using a Seabird thermosalinograph attached to the deck's fire pipe system proved encouraging.

In co-operation with FNOC, line AX-11 was significantly improved in 1990 by triplicating the drop rate and by replacing T-4 by T-7 probes. Both the data acquisition system and data management are the same as on line AX-3. The measurements are carried out by the German container vessel "Monte Rosa" on her way due north (Fig. 1). Unfortunately the ship was taken off the Europe-Brazil route in July 1991 but she is expected to return to it in November 1991. This means that we should be able to continue our longest IGOSS time series so far.

As part of WOCE, a SOOP was set up by IfM Kiel in the South Atlantic (lines AX-17 and AX-21). The scientific objective is to investigate

1. the annual and interannual variability of heat storage in the upper ocean and
2. in particular, the eddy activity of the Subtropical Gyre.

This programme is funded by the German Ministry of Science and Technology.

Two vessels, M.V. "Paul" and M.V. "Tilly", on their irregular service between Santos, Buenos Aires - Cape Town - Matadi - Santos are carrying out measurements (Fig. 4) using T-5(20 kn) probes at a drop rate of 6 drops per day (Fig. 5). Both vessels are equipped with a Nautilus Marine Service data acquisition system designed for real-time data transmission via METEOSAT. Unfortunately, because of technical and logistical problems, the real-time data flow ended in summer 1990 and has not yet been reestablished.

As requested by IGOSS, efforts have been made to collect data from data-sparse areas. During operations in the Southern Ocean, R.V. "Polarstern" and R.V. "Meteor" carried out XBT measurements some which were transmitted in real-time via telex or telefax to BSH to be inserted into GTS. For the next Antarctic research season, R.V. "Polarstern" will be equipped for routine XBT measurements and real-time data transmission.

An even more data-sparse area is the Arctic Ocean. In co-operating with IfM Hamburg, we had the opportunity to carry out XBT measurements on board the Soviet atomic icebreaker "Rossiya" during a passenger cruise to the North Pole in 1990 (Quadfasel et al., 1991). As expected, XBT drops in iced areas proved difficult, especially at a speed of 14 knots. The failure rate was thus about 50 % or greater. Nonetheless, the exercise was successful and temperature sections were collected in the Barents Sea, Kara Sea, Laptev Sea and across the Eurasian Basin (Fig. 6). The subsurface boundary current along the continental slope in the Eurasian Basin consisting of warm Atlantic Water (Fig. 7) was found to be unusually warm when compared with climatological and recent synoptic data (Quadfasel et al., subm. pap.). A second series of measurements this summer on board "Sovjetski Sojus" was not possible because the Soviet military authorities withdrew our working permit.

Over the last 20 years, the BSH has participated actively in IGOSS and acts as the German input and output GTS hub for real-time oceanographic bulletins. For problems with JJXX, KKXX and NNXX messages issued by EDZW (Offenbach, Germany), the BSH should be contacted. New hard and software for real-time data acquisition and distribution became operational at the BSH in 1990. Since then the volume of our IGOSS output data has increased significantly. A trackplot of the output for BATHY messages in 1990 is given in Fig. 8. An overview of the monthly numbers of input and output data is given in Fig. 9; input data sorted by vessels is given in Fig. 10.

To comply with the IGOSS request for more TESAC messages, we linked a module to our CTD acquisition software which encodes the CTD bottle readings into TESAC form to be transmitted to shore by telex or telefax. So far, however, this procedure has only been used for WHP cruises because of the higher data quality standards of WOCE CTDs. To support production of the BSH's weekly North Sea SST map (IGOSS, 1991), several vessels have been equipped with Pt100 contact thermometers (Sy and Ulrich, 1989). All SST data received at the BSH are inserted into GTS in the form of TRACKOB messages (Fig. 11). Finally, plans are being made for real-time linkage to GTS of selected stations in the BSH's automatic measuring network in German coastal waters in the North Sea and Baltic Sea.

References

IGOSS (1991): Integrated Global Ocean Services System Products Bulletin, June 1991. IOC/WMO, 18 pp.

Quadfasel, D., A. Sy, D. Wells and A. Tunik (1991): Warming in the Arctic. Nature, 350, p. 385.

Quadfasel, D., A. Sy and B. Rudels (subm. pap.): A Ship of Opportunity Section to the North Pole: Upper Ocean Temperature Observation. Subm. to Deep-Sea Res..

Sy, A. und J. Ulrich (1990): North Atlantic Ship of Opportunity XBT Programme, 1989 - Data Report. Wiss.-Techn. Berichte aus dem Deutschen Hydrographischen Institut, 1990-2, 89 pp.

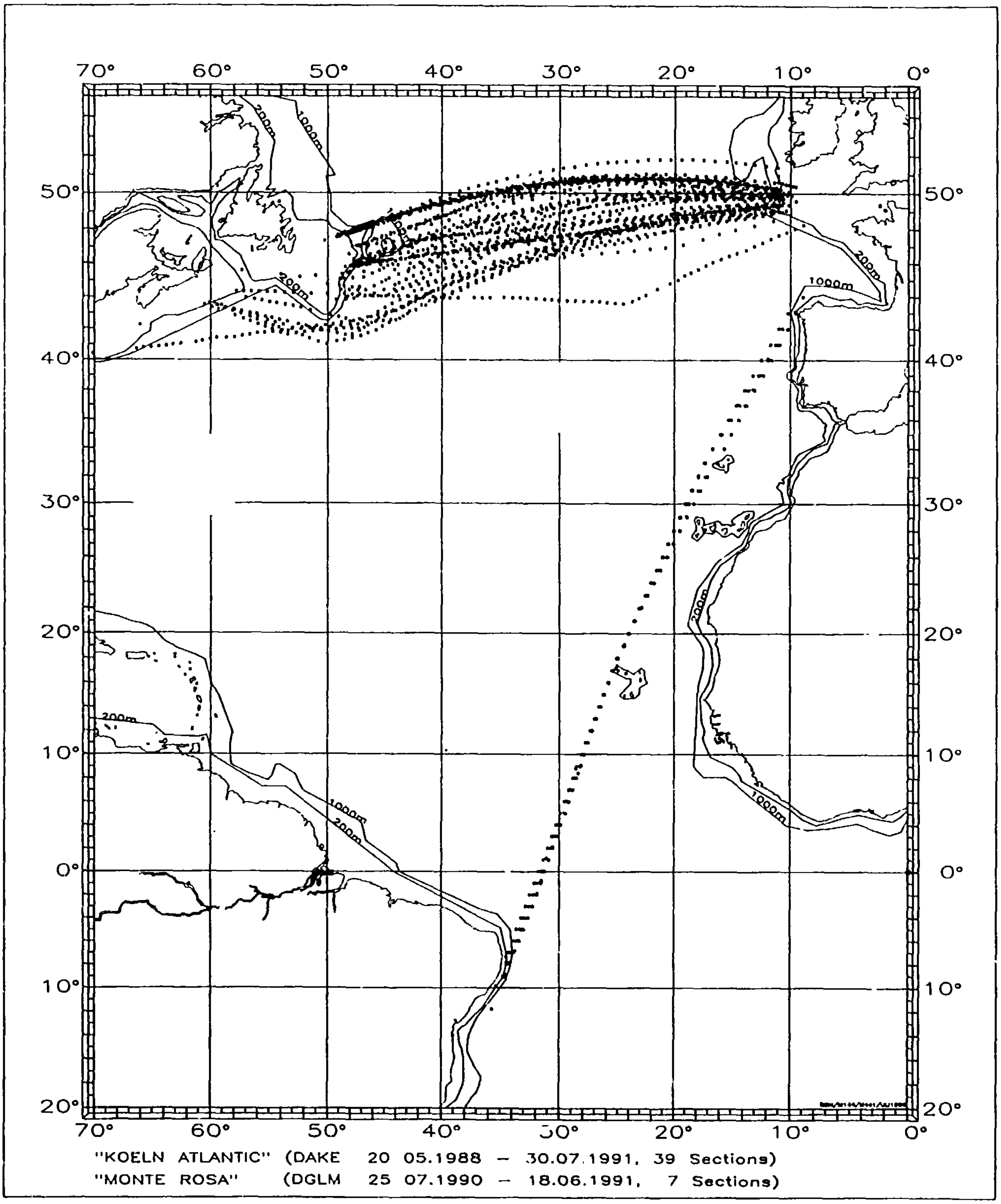


Fig. 1: Trackplot of BSH XBT programme as of July 1991

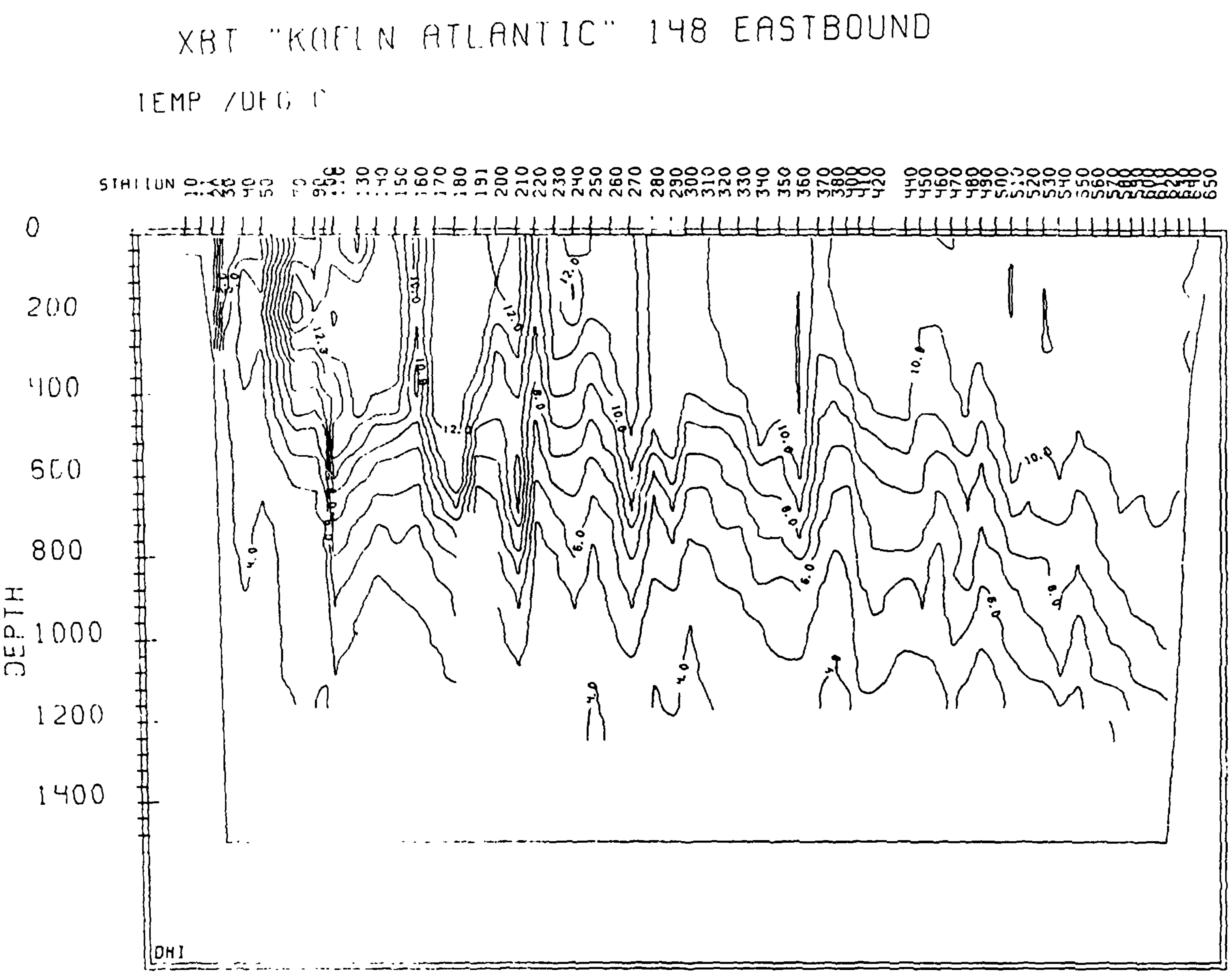
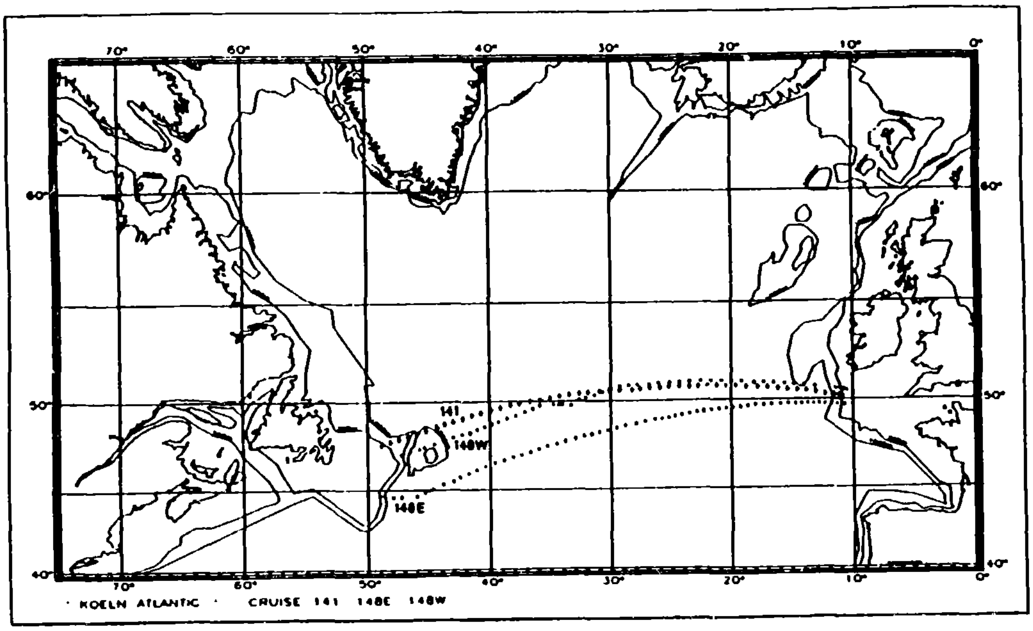


Fig. 2: T-5(20 km) section across the North Atlantic carried out by CMS "Köln Aatlantic" in February 1990

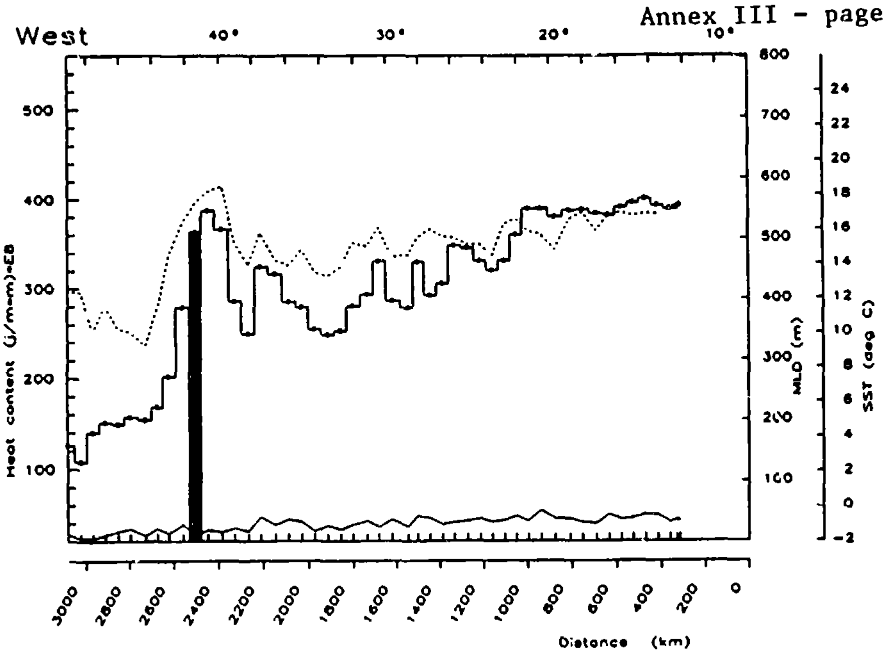


a)

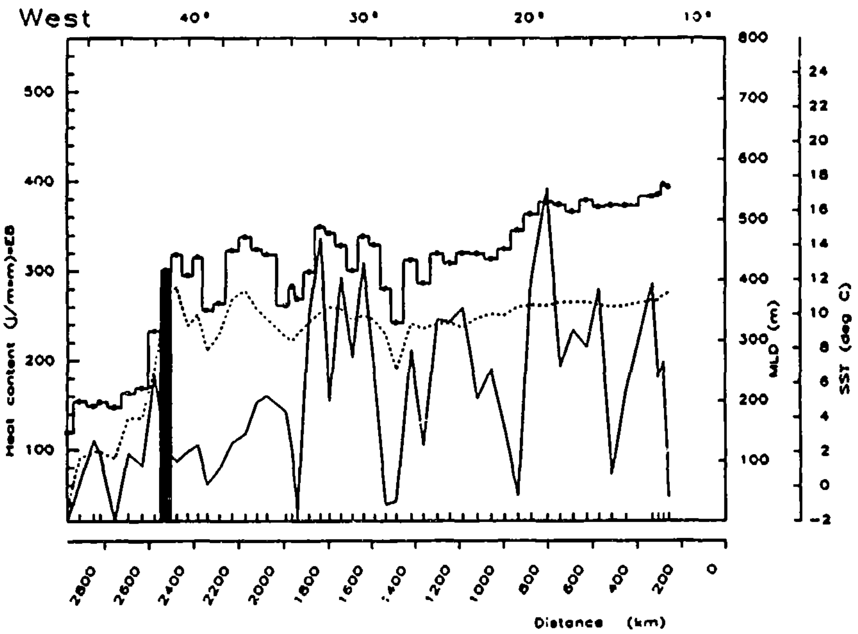
Fig. 3: Three examples of the North Atlantic heat content variability.

a) Trackplot of selected sections
b) 141: August 1989
c) 148W: February 1990 (westbound)
d) 148E: February 1990 (eastbound)

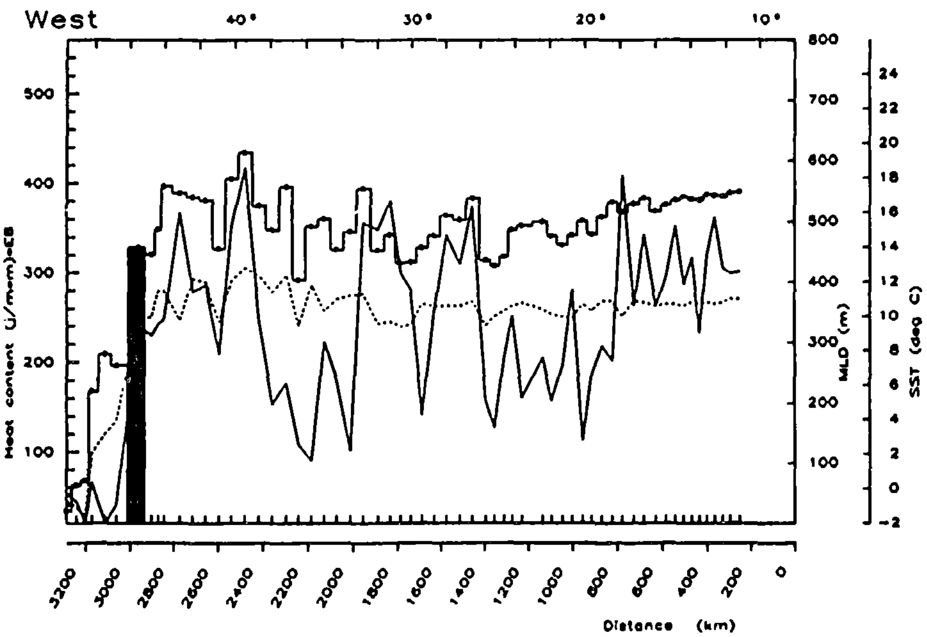
Heat content Q: solid line marked with dots
LC/NAC frontal zone: black column
SST: broken line
Depth of mixed layer MLD: solid lines without marking


West
40°
30°
20°
10°
Heat content (J/m*m)-E8
MLD (m)
SST (deg C)
Distance (km)

b)

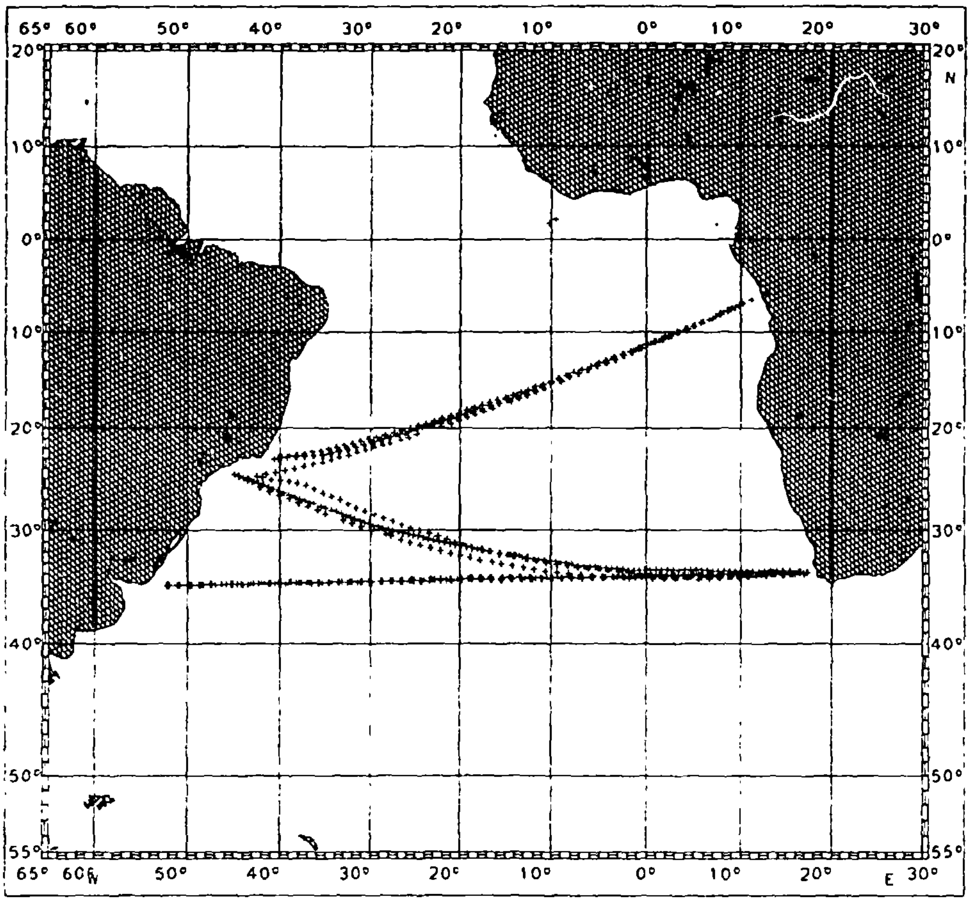

West
40°
30°
20°
10°
Heat content (J/m*m)-E8
MLD (m)
SST (deg C)
Distance (km)

c)


West
40°
30°
20°
10°
Heat content (J/m*m)-E8
MLD (m)
SST (deg C)
Distance (km)

d)

M/V PAUL STAND: 8.8.1991



M/V TILLY STAND 8.8.1991

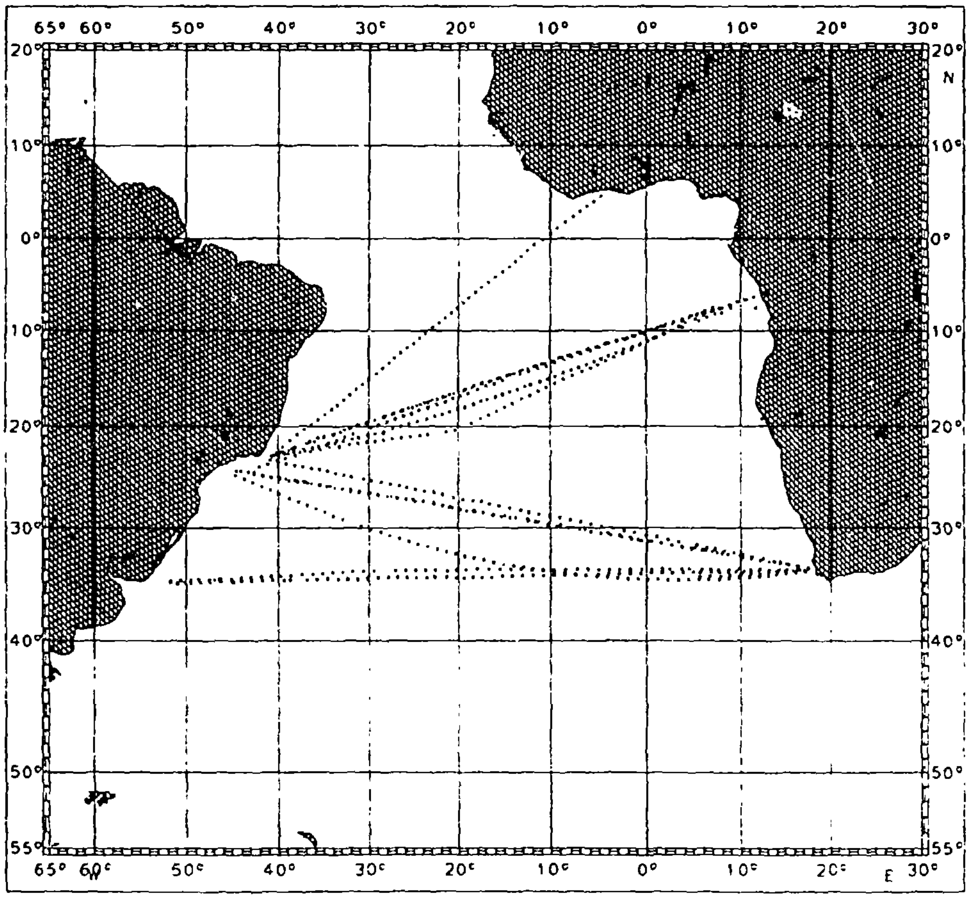


Fig. 4: Trackplot of IfM Kiel XBT programme as of August 1991

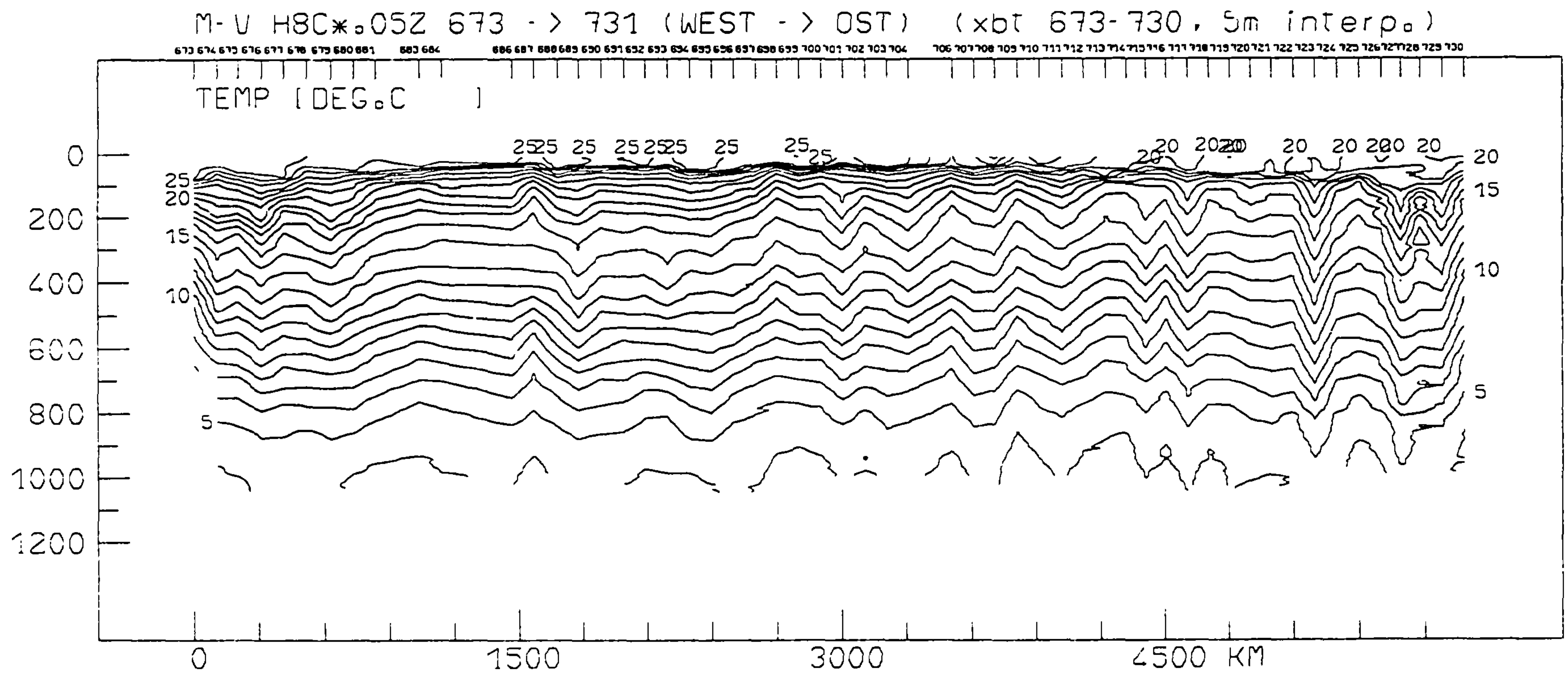


Fig. 5: Example of a temperature section of line AX-17 from Santos to Cape Town

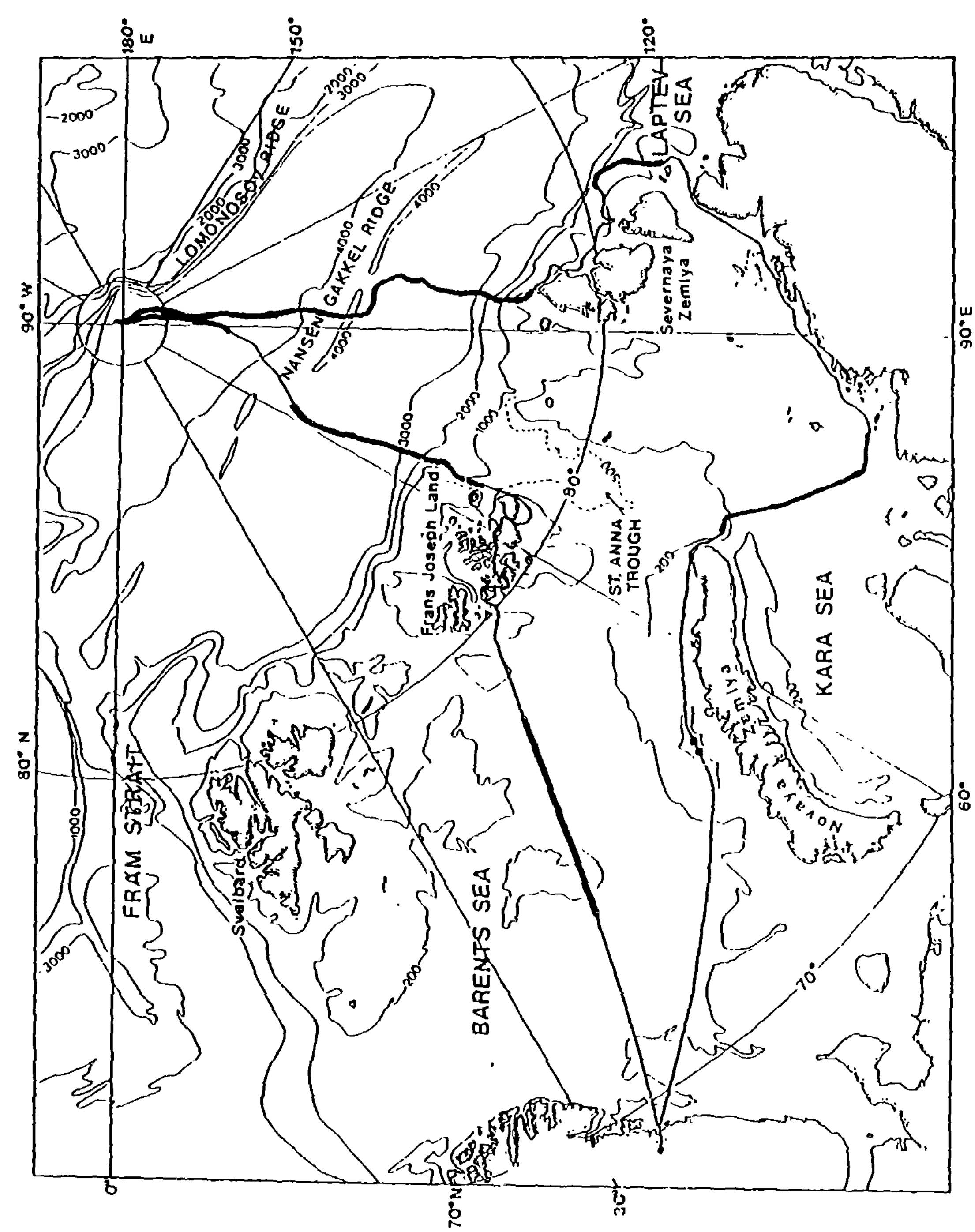


Fig. 6: Cruise track of A.I. "Rossiya" during August 1990. Bold lines indicate location of XBT sections.

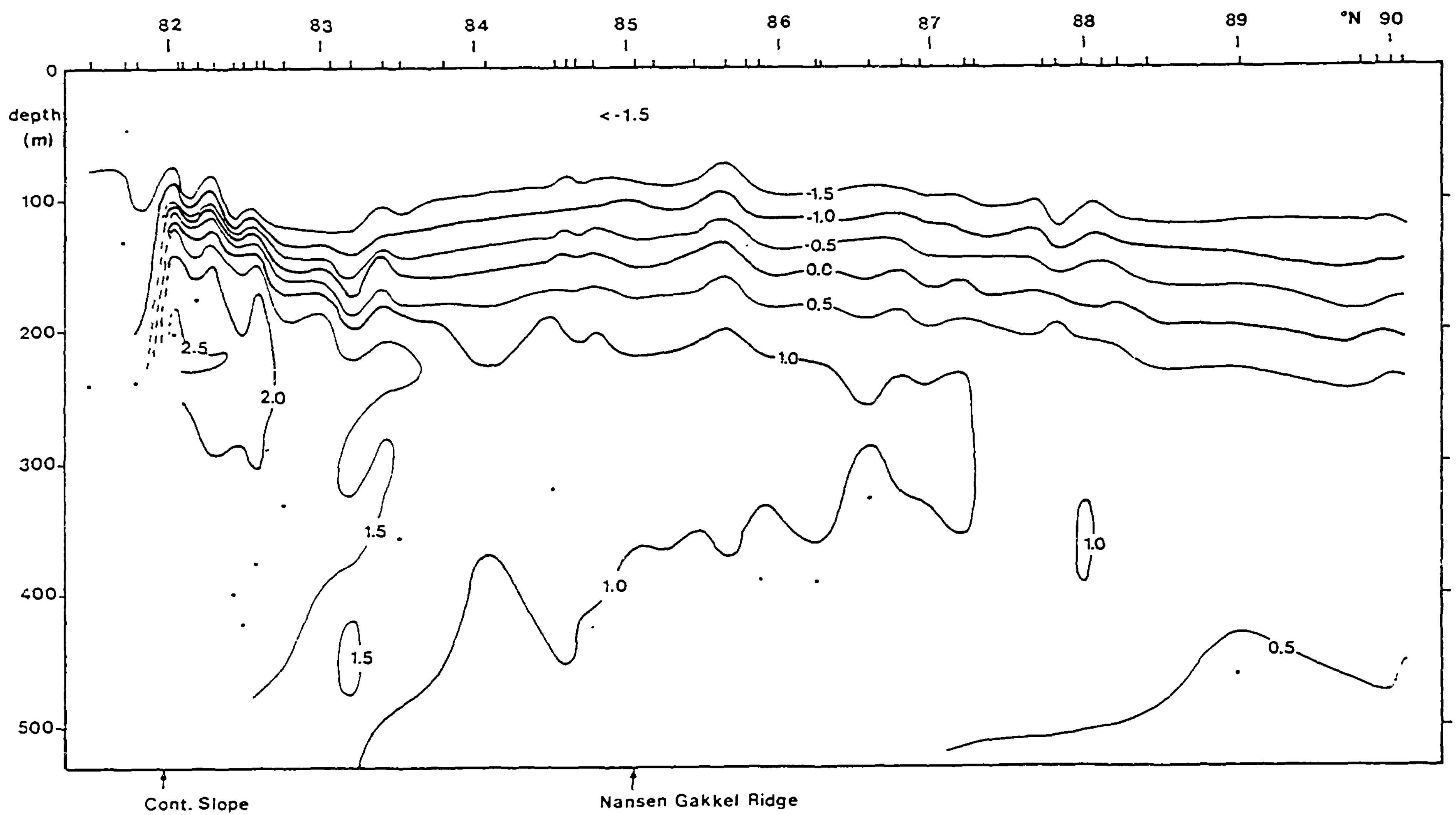


Fig. 7: Temperature section across the Eurasian Basin

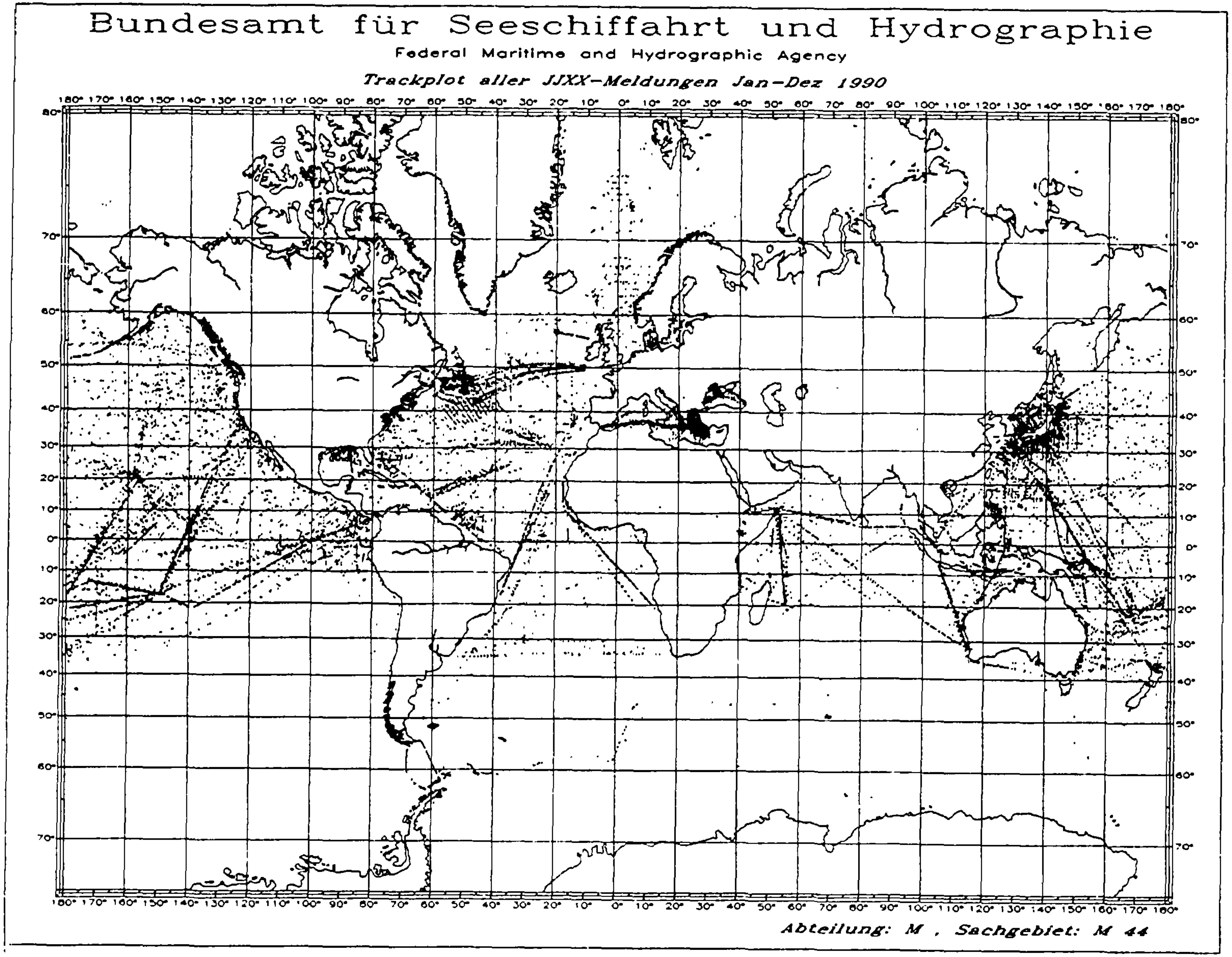


Fig. 8: Trackplot of BATHY messages as received at BSH

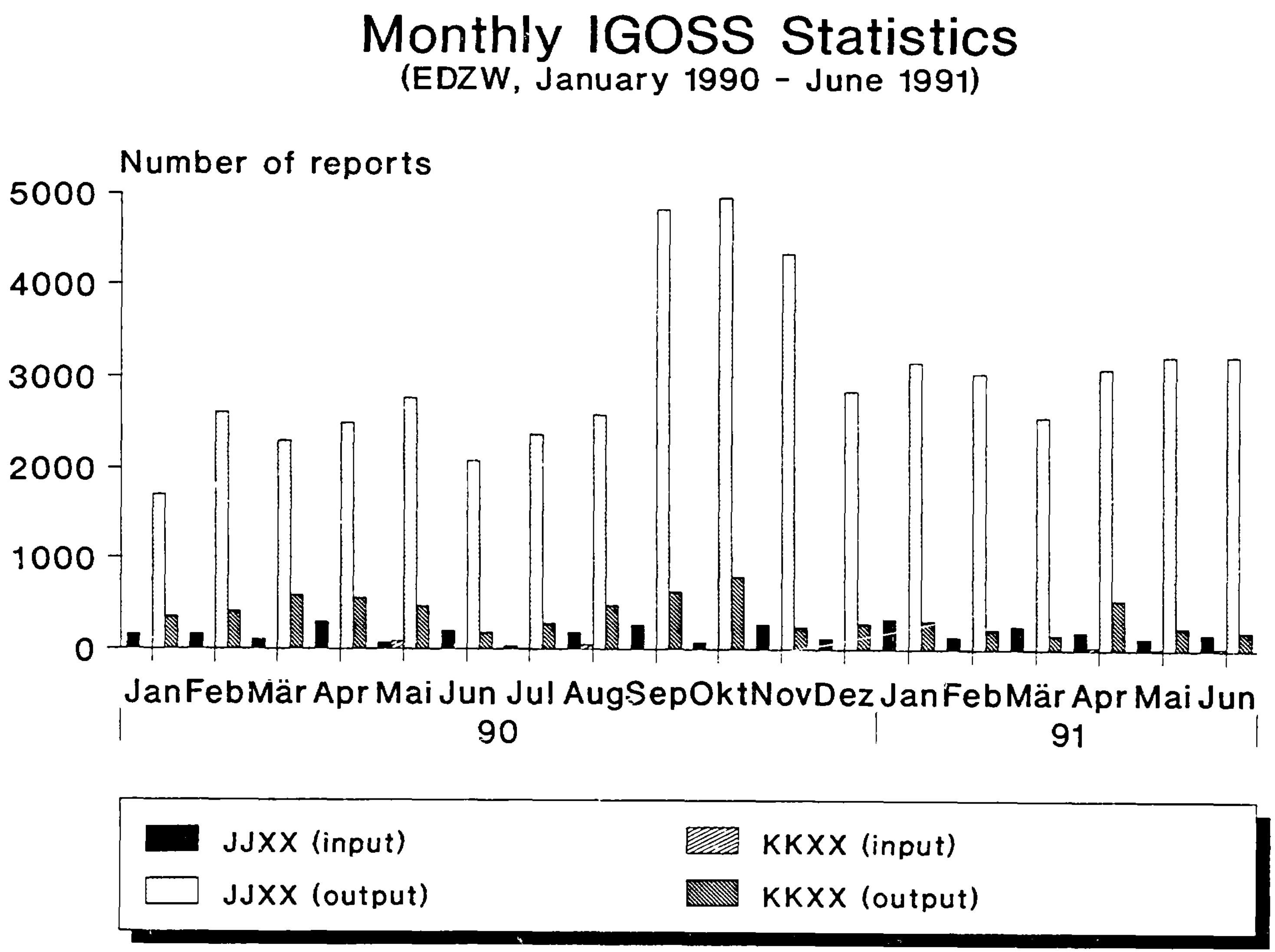


Fig. 9: IGOSS input and output statistics (BSH)

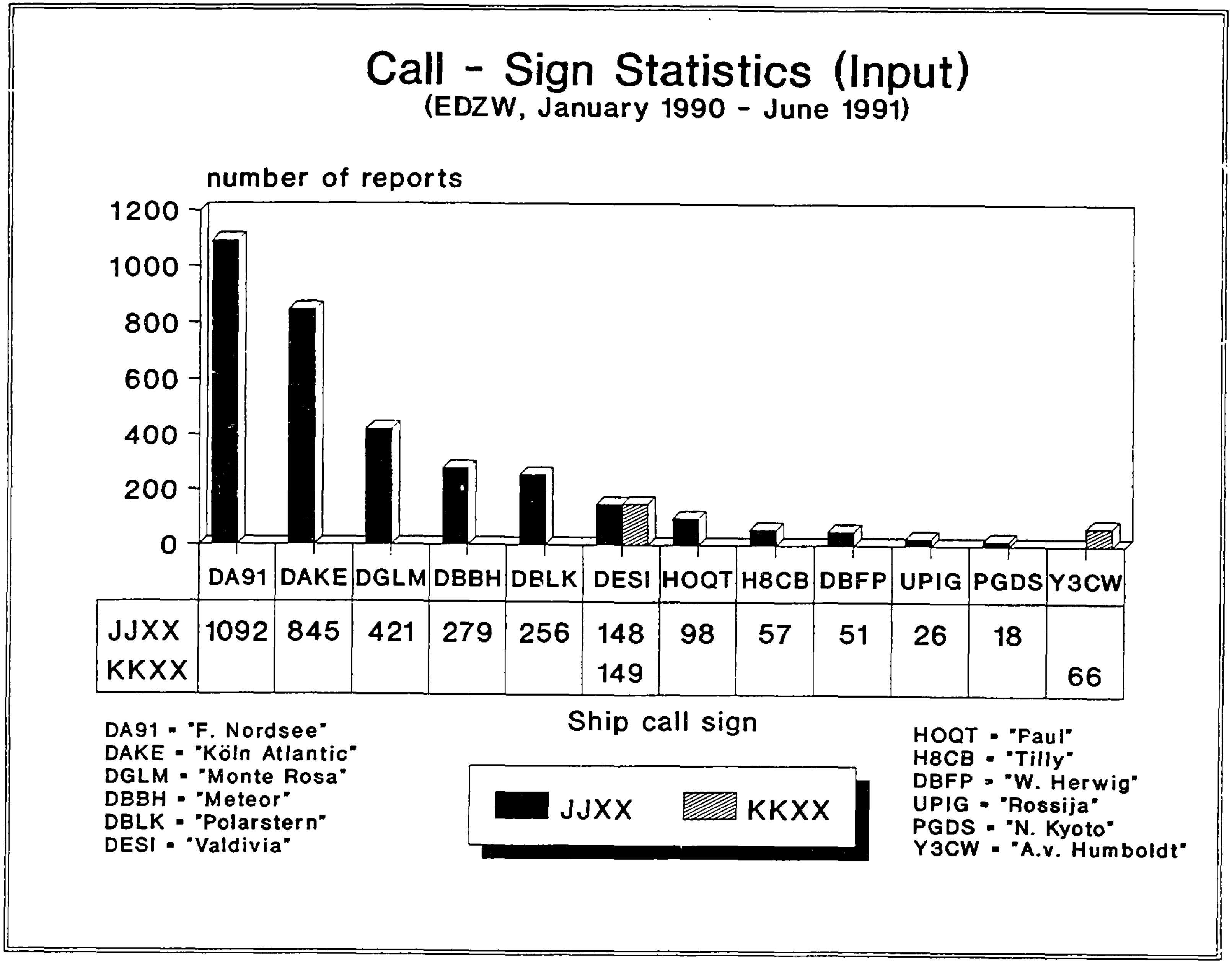


Fig. 10: Input statistics sorted by call signs (BSH)

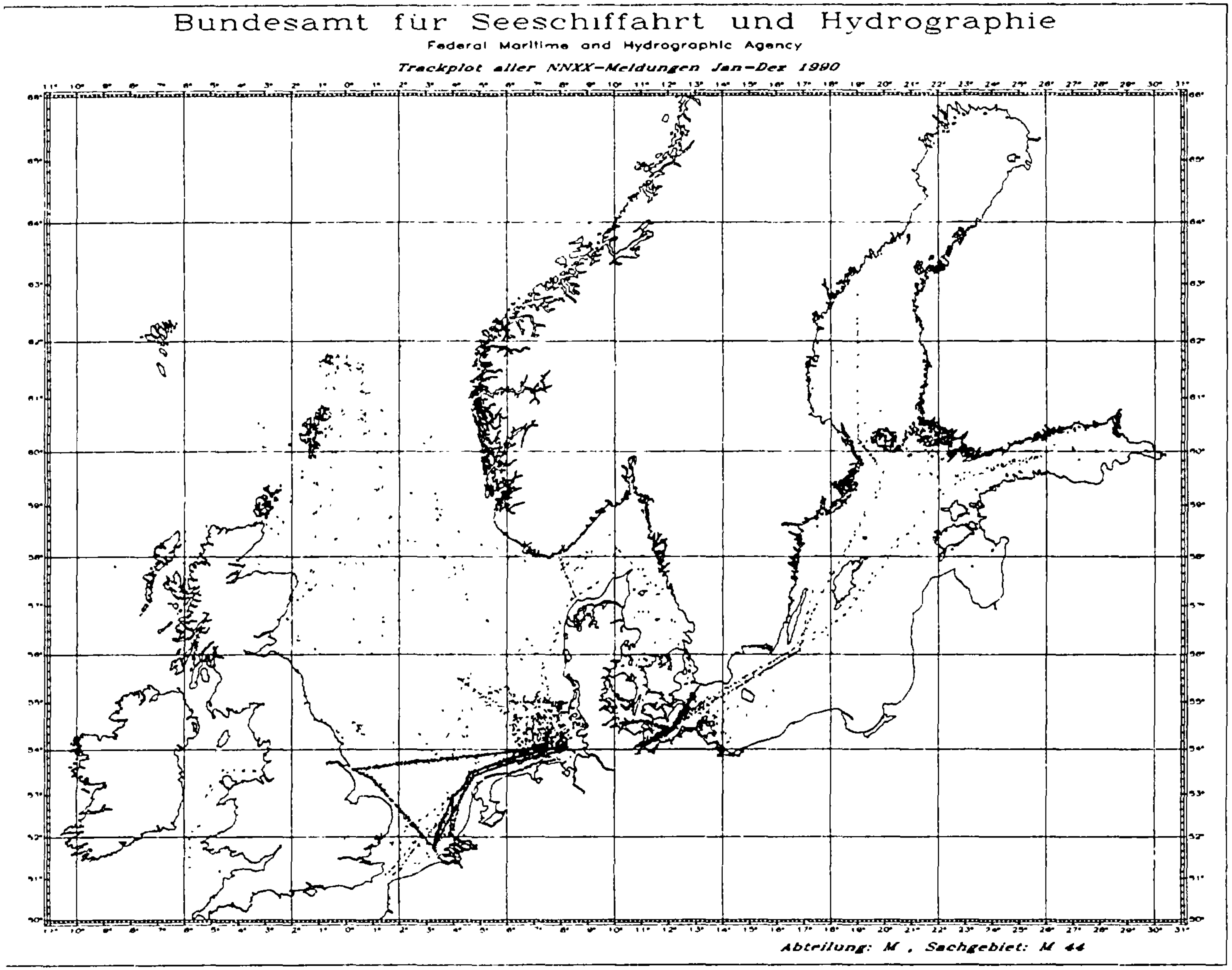


Fig. 11: Trackplot of TRACKOB messages of the BSH SST programme

JAPAN

Japan Meteorological Agency

* The Japanese XBT program consist of three elements. The first is the VOS XBT measurements made by the Japan Meteorological Agency (JMA) and the University group. The second is the XBT, DBT or MBT and compact-BT observations made by volunteer fishing vessels. These data are collected and compiled by the Japan Fisheries Agency (JFA). Note that the observation stations of this program are distributed in wide tropical area. The third is the XBT observations along the routine hydrographic observation lines carried out by the Hydrographic Department of the Maritime Safety Agency (HD/MSA) and the Japan Marine Science and Technology Center (JAMSTEC).

* JMA is preparing to start the Japan - California VOS line (PX-26) in early 1992 as a part of the Japanese Ocean Circulation Experiments (JOCES), the government WOCE program coordinated by the Science and Technology Agency (STA). The Japan - Persian Gulf line (PX-49 east, IX-10 east, IX-9 north) observation started in Oct. 1990 and the Japan - New Zealand line (PX-5) is ongoing since 1989, although the latter ship lane has changed to Hong Kong - New Zealand - Japan in July 1991. Also, JMA is cooperating with ORSTOM Brest to maintain IX-6 and IX-21 and will cooperate with CSIRO for PX-11 and IX-22. These projects are funded by programs coordinated by STA. A summary is on table 1.
(contact person: M.Amino)

* As one of the activities of the Japanese-COARE, Tohoku University began to measure the partial pressure of CO_2 in the surface layer along the line from Japan to the east coast of Australia in August through September 1991. On this line, XBT measurements were conducted using T-7 probe every 2 degrees in latitude from 35^oN to 30^oS. This attempt will be made on four transects per year and approximately 300 probes will be thrown down in a year. The XBT data will be sent to the Japan Oceanographic Data Center (JODC) in the delayed mode.
(contact person: K.Hanawa)

* Tohoku University will continue the Tokyo-Ogasawara Line Experiment (TOLEX) XBT monitoring by using a ferry ship, Ogasawara-Maru. This monitoring will be made basically every two months using T-7 probes with spacing of 50km. Approximately 100 probes will be thrown down and the data will be also sent to JODC in the delayed mode. Tohoku University installed an ADCP on this ship and the data obtained are now processed and are expected to be available for all users.
(contact person: K.Hanawa)

* JFA has carried out the collection of surface and subsurface temperature data under two programs. One is the collection of DBT and MBT data observed by research vessels of prefectural fisheries experimental stations and fisheries high school vessels. These observations are made as one of the activities of the Resource Research for Tuna, under the supervision of JFA. The other is the collection of XBT and compact-BT observations made by JFA research vessels and volunteer commercial fishing vessels. This program is performed as a part of the Japan Pacific Climate Study (JAPACS) program since 1987 in the Pacific (Figs.1a,b) and the Japan Experiment on Asian Monsoon (JEXAM) for the tropical Indian Ocean since 1989 (Figs.2a,b), financially supported by STA.

(contact person: K.Mizuno)

* HD/MSA carries out XBT/CTD casts on the Fremantle - Antarctica line (IX-23) and the Antarctica - Sydney line (150E) on board an ice breaker annually (Figs.3,4). Since 1984, HD has routinely made the WESTPAC cruise once a year along 144^{o}E from Japan to the equator (Fig.5). In addition to CTD observations, about 10 dozens of XBTs are launched in every cruise.

(contact person: H.Ishii)

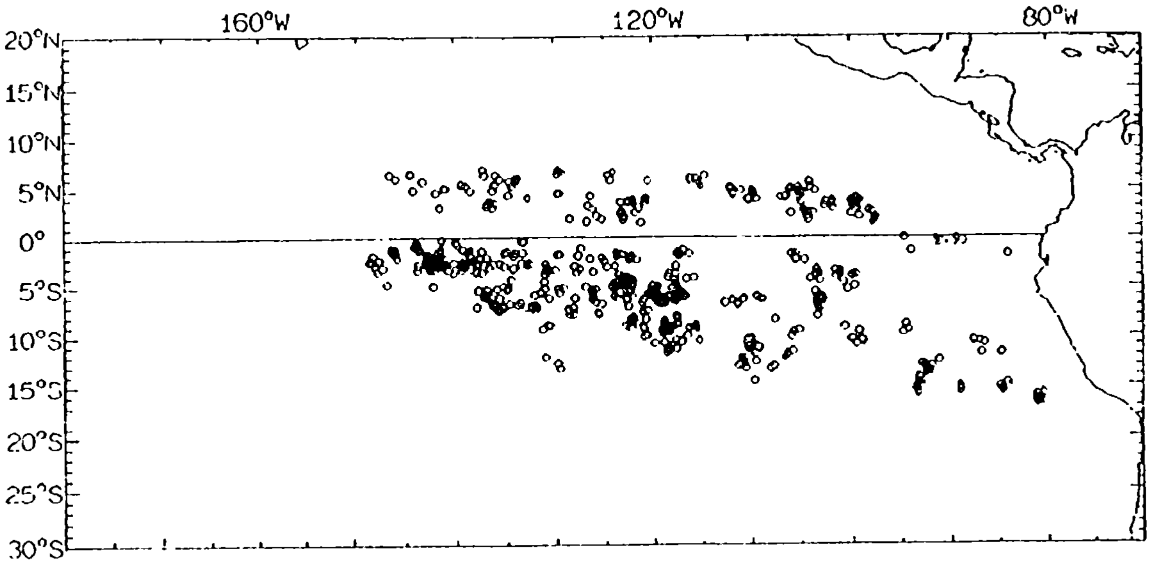
* Under the JAPACS program, JAMSTEC with other agency people has conducted hydrographic observations around the equator by using their R/V Natsushima every Jan.-Feb. (Fig.6). In this cruise, about 10 dozens of XBTs are launched. They will participate the TOGA COARE IOP with her in 1992-1993.

(contact person: K.Muneyama)

Table 1. TOGA/WOCE XBT program status of Japan
(on TWI lines only)

Line	Secs/Year	Probes	XBTs/day	notes
IX6	4-8	T6	4	cooperate with ORSTOM with IX21, T320/year
IX9 (N of 5N)	12	T6	4	with IX10,PX49, T360/year
IX10 (E of 80E)	12	T6	4	with IX9,PX49
IX21	4-8	T6	4	with IX6
IX22	-	T7	-	cooperate with CSIRO, start 1991 with PX11, T360/year
	1	T5,T4	-	by an ice breaker
IX23	1	T5,CTD	4	by an ice breaker

Line	Secs/Year	Probes	XBTs/day	notes
PX5	12	T6	4	1 High Den. considered, 700/year
	1	T5,T4	-	by an ice breaker
	8	T7	35/section	300/year
PX11	-	T7	-	with IX22
	1	T5,T4	-	by an ice breaker
PX26	-	T7	4	to start 1992
PX49 (E of 110E)	12	T6	4	with IX9,IX10
[PX46 (PR2)	3	CTD	30/section	by observation ships]



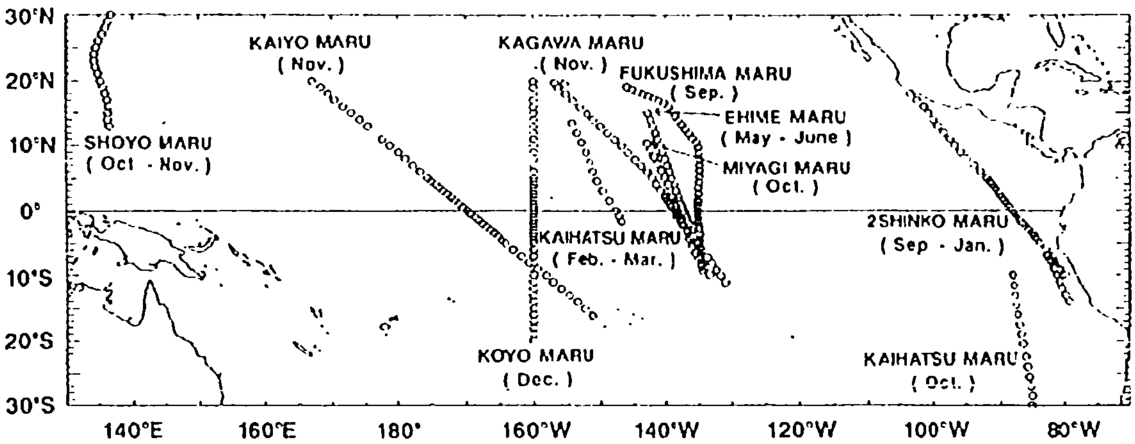


Fig.1 (a) Distribution of compact-BT stations by volunteer commercial fishing vessels in the Pacific, 1990. Additional data from other vessels will be reported.
(b) Distribution of XBT stations by JFA research vessels in the Pacific, 1990.

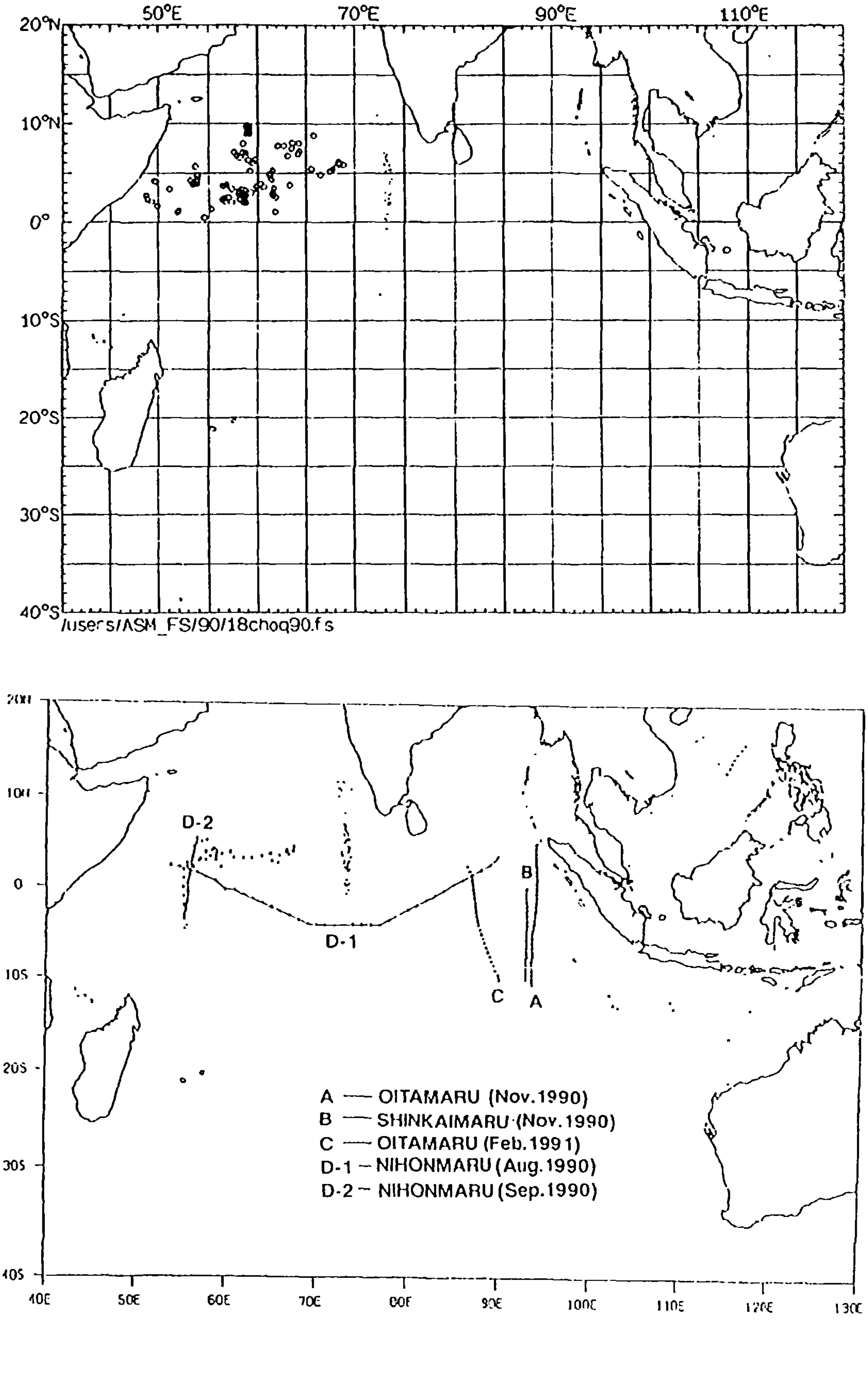


Fig.2 (a) Distribution of compact-BT stations by volunteer commercial fishing vessels in the Indian Ocean, 1990. Additional data from other vessels will be reported.
(b) Distribution of XBT stations by JFA research vessels in the Indian Ocean, 1990.

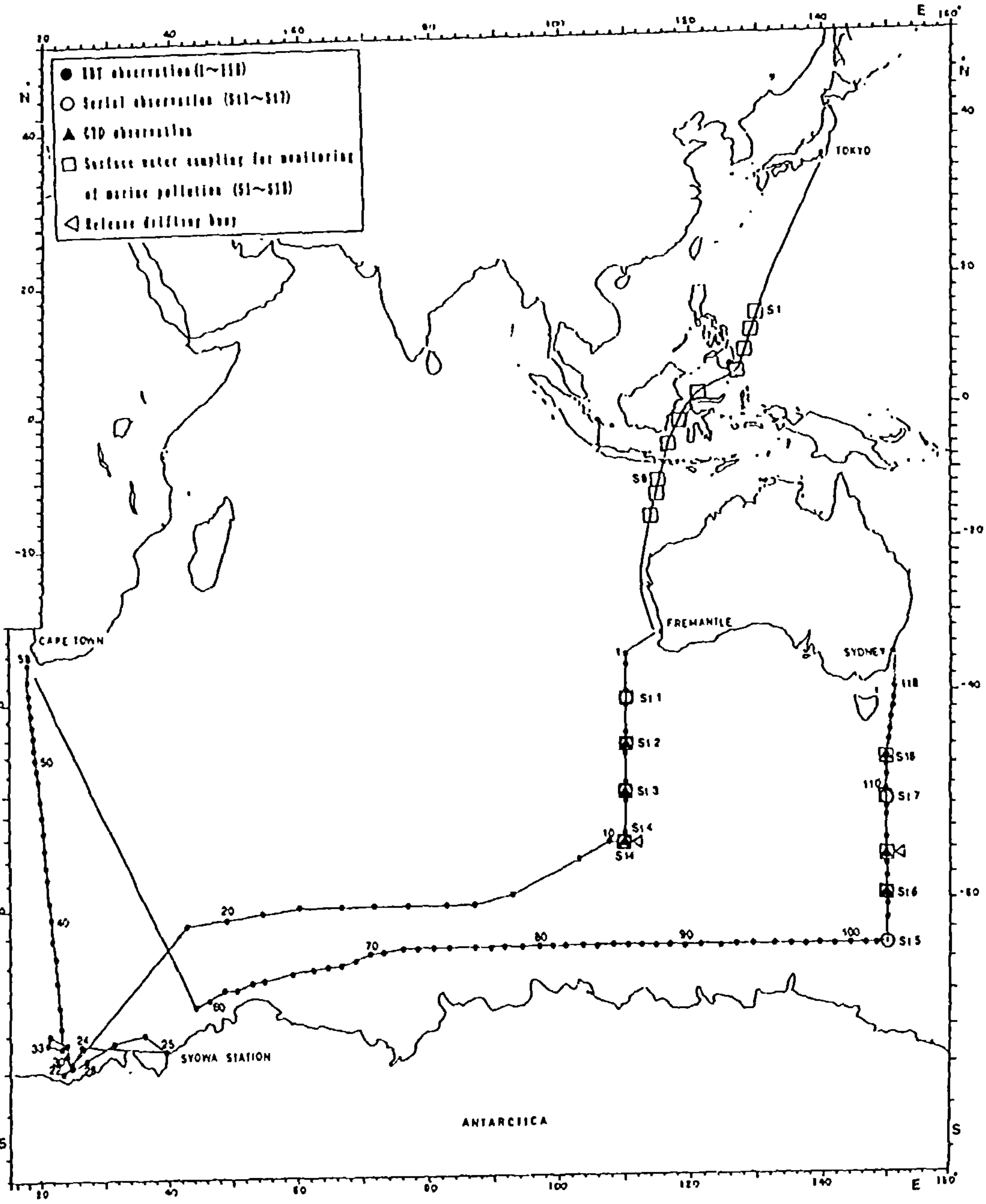


Fig.3 Ship track of the 30th JARE, Nov. 1988 to Mar. 1989.
JARE data reports No.161 (1991)

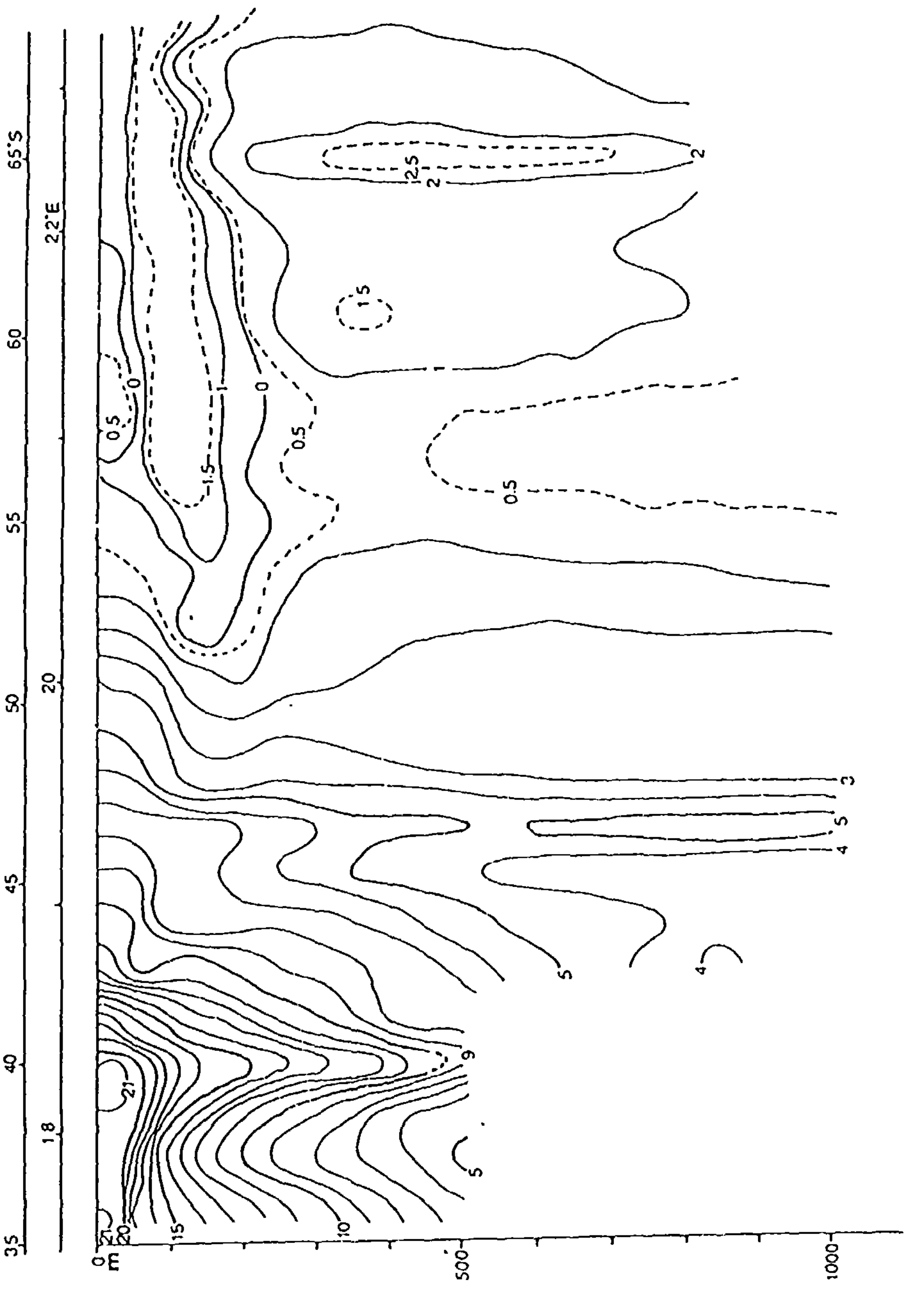


Fig.4 Vertical profile of water temperature observed on the northward leg between the ice edge and Cape Town. JARE data reports No.161 (1991)

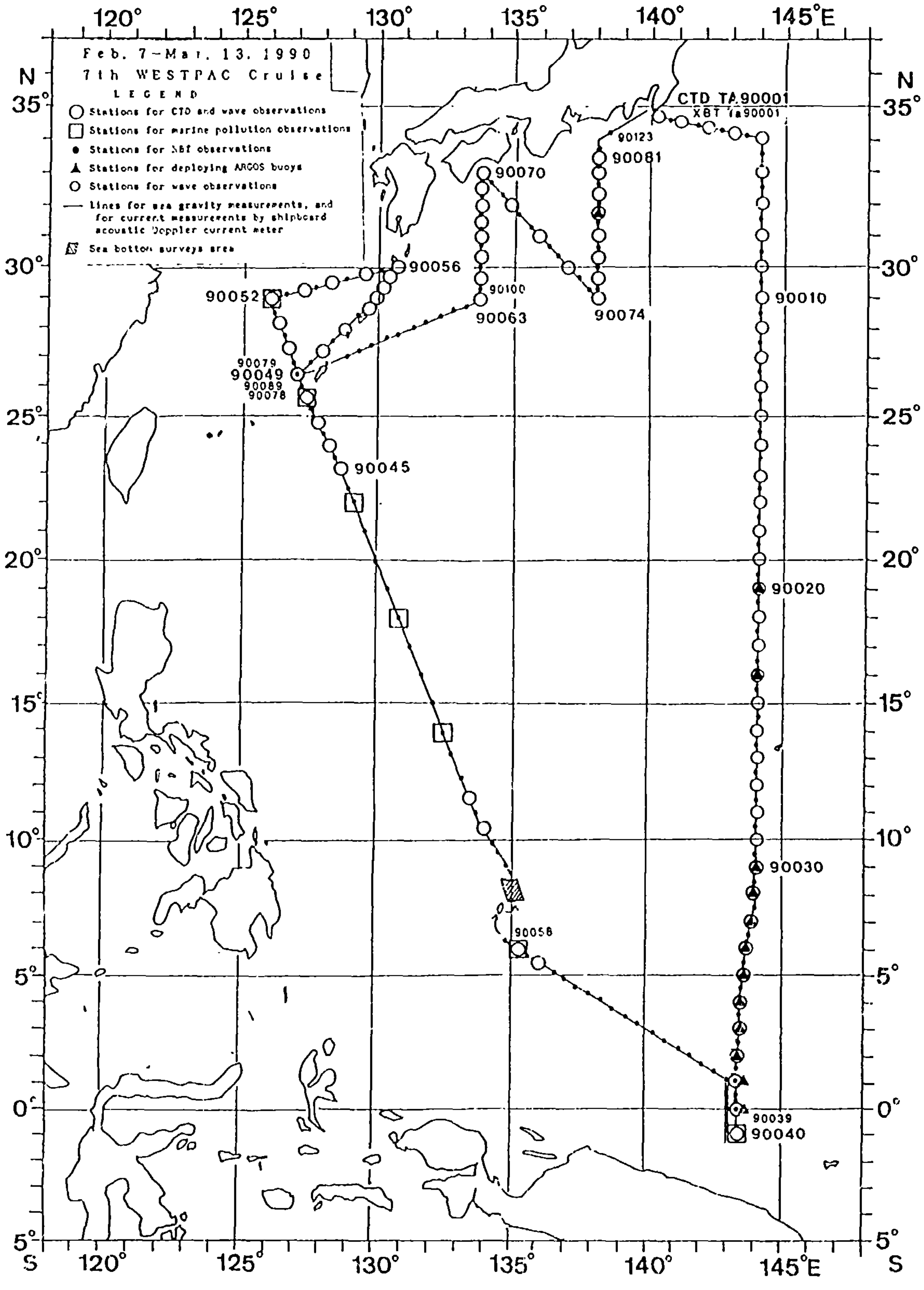


Fig.5 Ship track of the 7th WESTPAC cruise by the R/V Takuyo, HD/MSA, 1990. Small dots represent XBT stations.

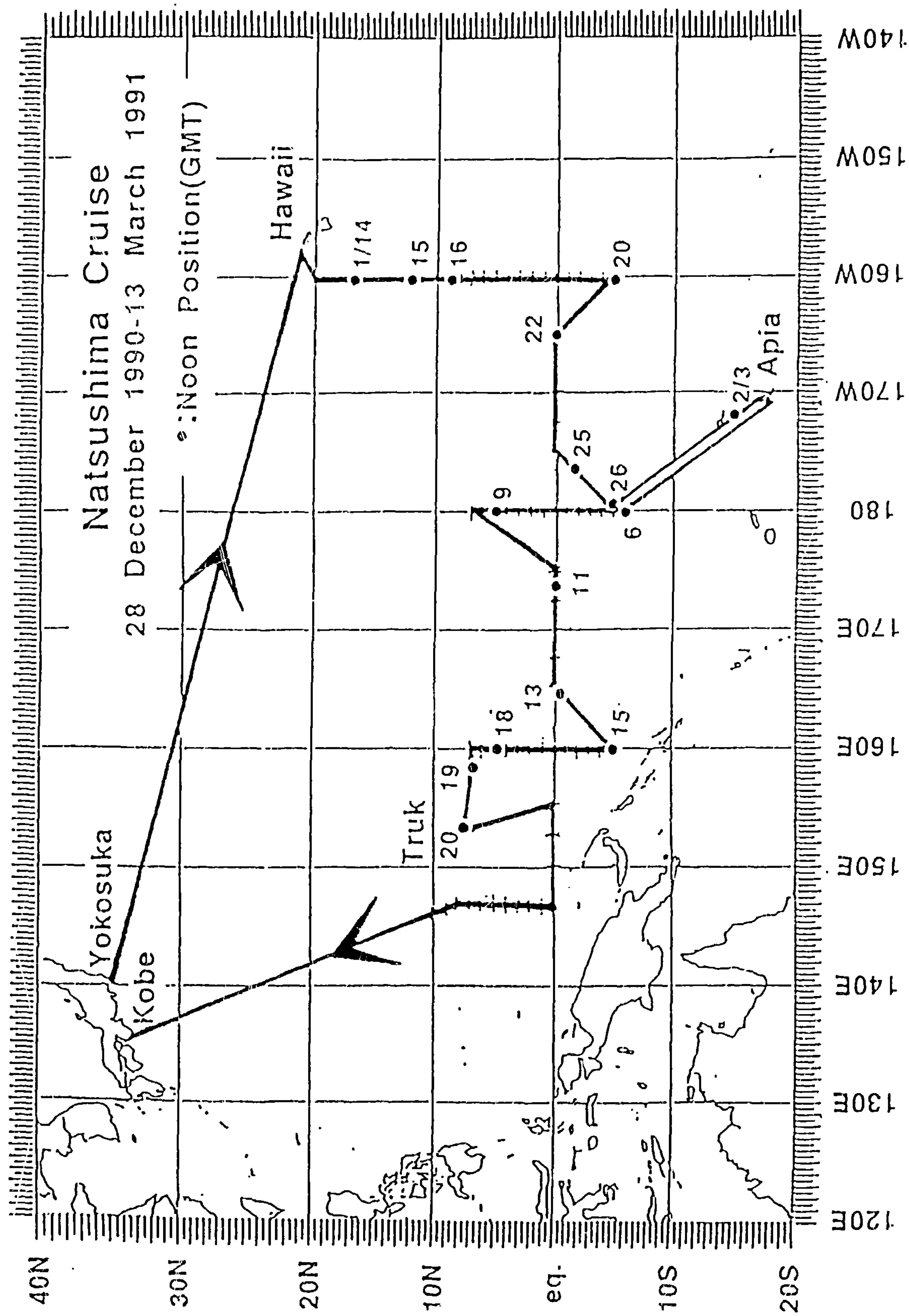


Fig.6 Ship track of JAPACS by the R/V Natsushima, 1991.

UNITED KINGDOM

1. **Status of Voluntary Observing Ships (VOS)**

(sponsored by UK Hydrographic Department)

(a) **OWS CUMULUS** (c/s GACA) - occupies Weather Station Lima and presentaly fitted with Bathy Systems SA 810 XBT Recorder and Synergetics 3400 Platform Transmitting Terminal (PTT). GB BATHY 1 commenced DCP transmissions August 89.

(b) **MV SKAFTAFELL** (c/s LALW4) - previously **MV POLAR NANOQ** (c/s OWVG2) - runs the eastern half of WOCE line AX-1 (between Iceland and UK Continental Shelf). Although fitted with same equipment as OWS CUMULUS, no XBT data has been gathered since April 91 when new crew (associated with change of owner) embarked. GB BATHY 2 commenced DCP transmissions December 89.

(c) **RRS CHARLES DARWIN** (c/s GDLS) and **RRS CHALLENGER** (c/s GPIU). At present 1 x XBT/DCP system (identical to that in OWS CUMULUS) is shared between the 2 ships with the equipment being fitted to which ever ship is conducting physical oceanography within the CINCEASTLANT area (N.E. Atlantic). GB BATHY 3 commenced DCP transmissions July 90.

(d) **MV SELFOSS** (c/s TFAB) - fitted with the same XBT/DCP equipment as OWS CUMULUS and presently operating between Iceland and the Mediterranean (WOCE line AX-0). GB BATHY 4 commenced DCP transmissions July 91.

(e) **RV BJARNI SAEMUNDSSON** (c/s TFEA) - fitted with the same XBT/DCP equipment as OWS CUMULS and operating, primarily, within a 200 mile radius of Iceland. GB BATHY 5 commenced DCP transmissions August 91.

The Hydrographic Department also:

(i) Looks after the NOAA-sponsored VOS MV WESTMOOR (c/s V2PM) i.e. meets ship on arrival at the Port of London, supplies XBT probes and trouble-shoots any technical problems.

(ii) Supplies sufficient XBT probes to MV SKOGAFOSS (sponsored by the Bedford Institute, Nova Scotia) to cover the section of her route (WOCE line AX-1) that falls within the CINCEASTLANT area i.e. Cape Farewell to Reykjavik.

(iii) Supplies XBT probes to National Environmental Research Council (NERC) scientists and Sail Training Ship TS ASTRID (c/s MKUE3) for use within the CINCEASTLANT area.

2. **UK Ship-of-Opportunity IGOSS Return for Period 1/1 90 - 31/12/90**

SHIPS NAME	OBS RECEIVED AT HO TAUNTON VIA MAILED DATA-DISC	OBS ACCEPTED AFTER ANALYSIS AT HO TAUNTON	OBS RECEIVED AT BRACKNELL VIA METEOSAT
OWS CUMULUS	782	673	547
MV POLAR NANOQ	128	119	124
RRS CHALLENGER	61	56	3
RRS CHARLES DARWIN	0	0	29
TS ASTRID	48	48	0

3. **Planned Expansion of/Changes to the Existing VOS Network**

(a) Procure an additional XBT/DCP system for use by the Royal Research Ships.

(b) Transfer existing XBT/DCP system from the MV SKAFTAFELL to either the MV BRUAFOSS or the MV LAXFOSS (both EIMSKIP ships running between Iceland and North Sea ports).

4. **Planned Improvements to Monitoring of VOS Activities**

(a) Monitor METEOSAT transmissions from UK-sponsored VOS directly by installing a METEOSAT receiver at the Hydrographic Office, Taunton.

(b) Monitor JJXX messages being transmitted over the GTS from Bracknell through liaison with the IGOSS Co-ordinator in Paris.

UNITED STATES OF AMERICA

Fleet Numerical Oceanographic Center (FNOC)

Narrative:

These views, of archived Bathythermograph Observations, are intended to give some historical sense to the quantity of our data sets that are made up of "real time data". Where we have been and in which direction we are headed.

Three data sets graph two slides. Mainly, the data are XBT or "Bathy" observations, (with a smattering of TESAC observations -- whose origins are either USSR or NOAA and will have been included in each categories total).

The data files were screened to separate reports so that we could definitely identify and attribute specific observations to the appropriate contributor,i.e. these are NOAA probes furnished to an International program or these are observations from probes provided by the Australian Navy. Lastly, the data set was "washed" of any duplicate and/or unidentified observations.

There are no military files counted in these totals, except those of the Australian Navy and those of the U.S. Navy, which are reports, that will eventually reach the U.S. NODC as "delayed mode observations".

Data Sets:

DATA SET 1. Current years "Bathy" base is "January thru August 1991", (and the first 19 days of September 1991) from the MOODS file at FNOC and depicts the current trend of probes expended to past expenditures. Comparing the current total with the annual total of 1990; even though the projected total of 42,372 observations is about 5,000 obs less....the percentages of contributions remain nearly the same.....as does the Coop/Noaa file. Mainly, this graph illustrates the total subsurface temperature efforts of the past two years.

DATA SET 2. Is a five year summary of comparative totals. The "Bar" chart graphs a disturbingly downward trend in data acquisition that is more dramatically illustrated by the companion "Area" chart for the same period. In five years the observational data base has dwindled by 50%. The ups and downs of yearly funding for Coop and Noaa XBT probes cause a "yo-yo" affect in data acquisition. Stability in funding for expendables must be achieved to reverse the present course......or retrievable sampling devices must be developed.

DATA SET 3. Comparison of FNOC "monitor" totals with NMC "monitor" totals yields a fairly acceptable difference. Pointing to the reliability of automated observing and satellite transmitting systems. Projected totals for 1991 using (January thru July) of John Kundradt's monthly total and subtracting the buoy/ unidentified data as:

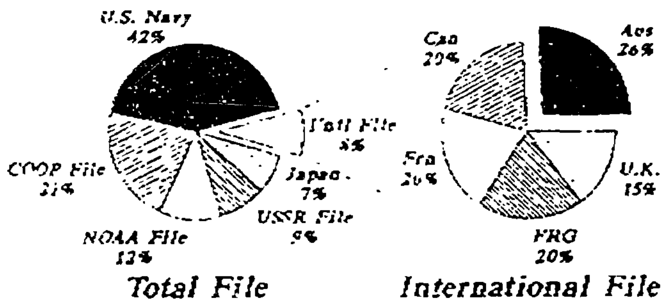
41844 without buoys/unidentified
42427 legitimate XBTs/TESACs
----
583 data set difference

The first nineteen days of September, totals and percentages, agree pretty much with the previous percentage and totals...While the cumulative bar graph shows very dramatically how each file augments the other and results in a meaningful historical archive.

Also, the "Bar" graph by contributors, really shows the stability of Coop and Noaa contributions, although the total numbers of each is neither excessively large, but, it does show that each program has remained relatively constant in the numbers passed to the international community during the past five years (even though each program's annual total tend to "bounce up and down").

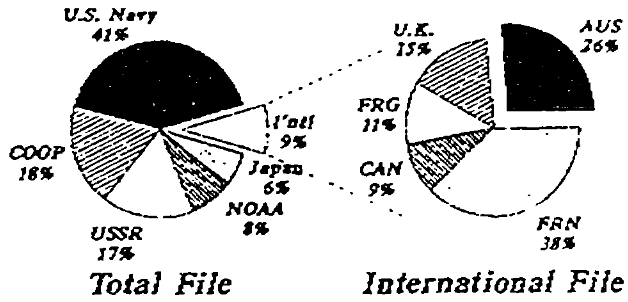
The bar graphs of Usable vs Error'd Radio Messages (all Januarys and all Julys) are included to show the quality improvement introduced by automated sampling systems. Error rates contained in radio messages diminished remarkedly as stripchart recorders evolved to MK 9's then to the SEAS II and III.

Bathythermograph Observations
January thru August 1991



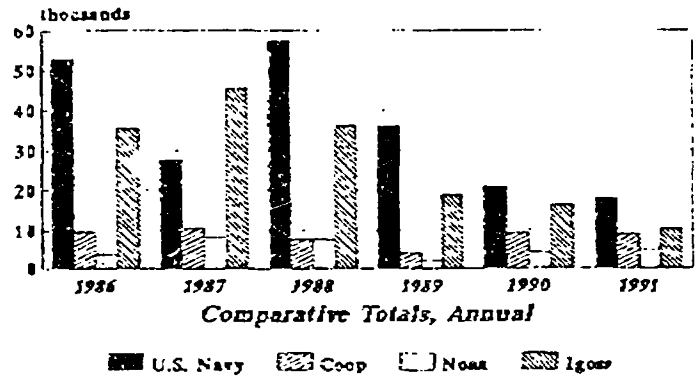
Based on 21,249 record file at FNOC

Bathythermograph Observations
January thru December 1990



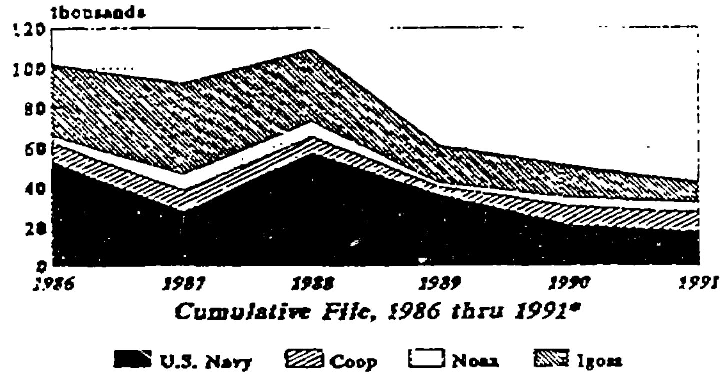
Based on 47,417 record file at FNOC

Bathythermograph Observations
Radio Message Receipts, FNOC



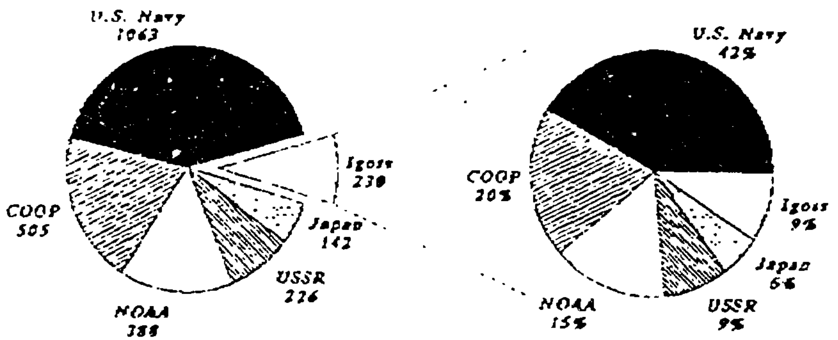
*1991 data are projected totals.
IGOSS is made up of the International file.

Bathythermograph Observation
Radio Message Receipts, FNOC



*1991 data are projected totals.
Igoss category is made up of the International file.

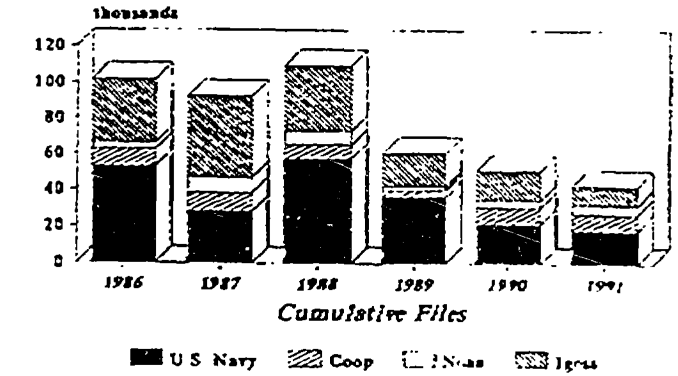
Bathythermograph Observations
September 1991 (first 19 days)



Numerical Total *Percentage Total*

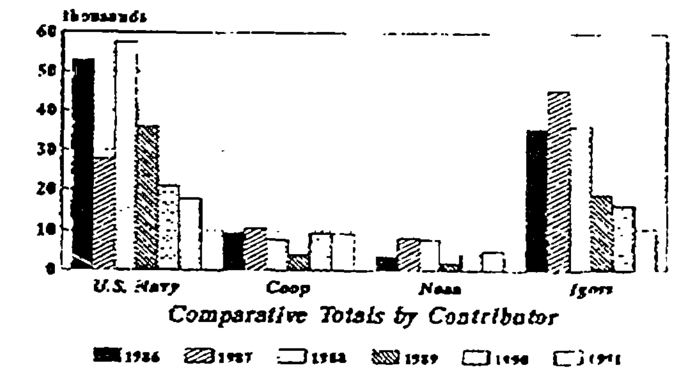
Igoss is made up of the International file.

Bathythermograph Observation
Radio Message Receipts, FNOC



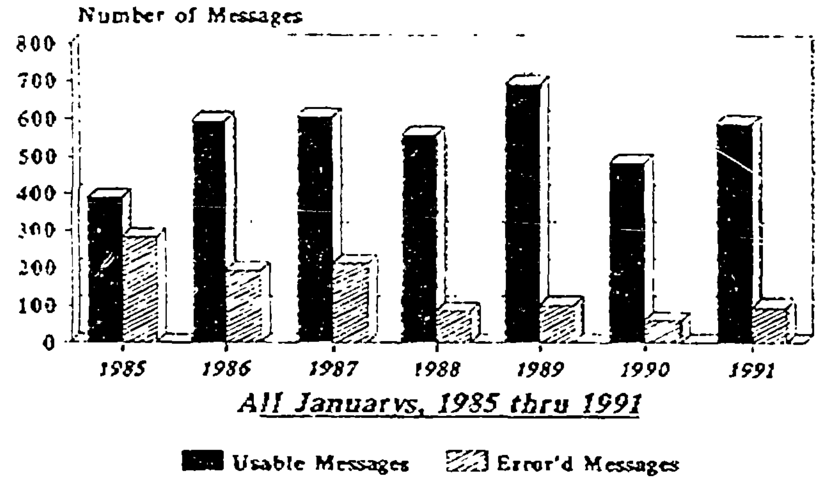
*1991 data are projected totals. Igoss is made up of the International file.

Bathythermograph Observations
Radio Message Receipts, FNOC



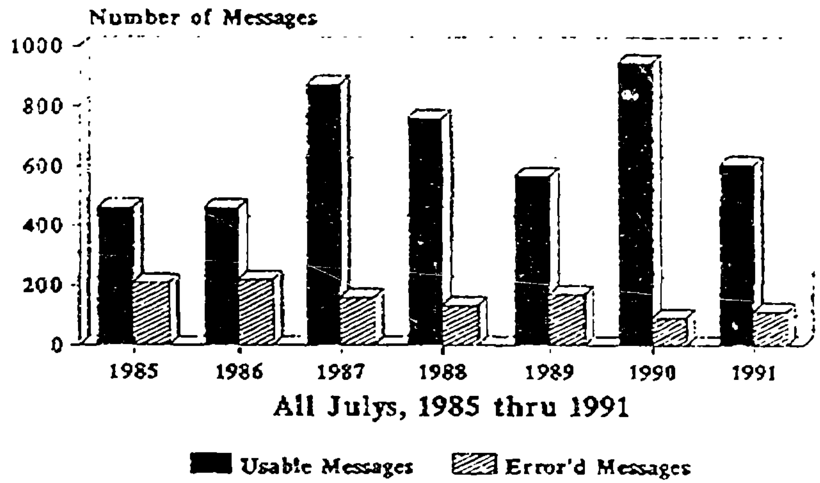
*1991 data are projected totals. Igoss is made up of the International file.

Bathythermograph Observation
Usable vs Error'd Radio Messages



Compiled from MOODS file at FNOC

Bathythermograph Observation
Usable vs Error'd Radio Messages



Compiled from MOODS file at FNOC

ANNEX IV

WOCE XBT DATA TRACKING SYSTEM

The tracking system has been developed to summarize the activity on the designated WOCE XBT lines in order to reveal on which lines observations are being made and to what extent, and to give an indication of the dataset which will become available.

Data are collected from three main sources at quarterly intervals; Ocean Applications Group of NOAA/NOS, TOGA monthly subsurface data board, and the IGOSS ship visit reports. These provide the real and near-real time data shown in the first section of the information on each line in the Tracking Tables.

The data from OAG are from the GTS and are presented in the form of plots of cruise tracks and waterfall charts for each call sign. These provide the most accurate indication of where the observations were made (ie which line the ship covered) and to some extent, the depth of the probe used.

The TOGA Subsurface Data Board (on OMNET) summarizes monthly the tropical real-time data sent to TOGA having been collected at the French IGOSS Center and undergone processing and qualification. The tables sow the number of BATHYS and TESACS received for each callsign and of the TWI number of the line(s) covered.

The IGOSS monthly ship visit reports list for each ship the number of probes loaded and used, and the number of good profiles obtained. They also list the TWI number of the line(s) covered. The reports are compiled by the IGOSS Coordinator from reports sent by individual centers. The figures do not always relate precisely to the month under which they are listed.

Information from the operators about their activities has been received as a result of individual requests from IPO, Sy and Meyers. These details give a clear and accurate picture of coverage and are shown in the second section of the information on each line in the tracking tables. Often the operators list the number of profiles inserted onto the GTS which can be compared with the number received at the various centers. This often raises questions about the dataflow.

Delayed mode data will be added to the system when this becomes available. A global plot of the distribution of real-time and delayed mode data was drawn up at NODC in March 1991, and a more recent map (data received as of August 1991) will be given at the meeting.

The Tracking Tables are condensed into 2-3 page tables for each basin. This gives an overall impression of the coverage without all the ship details, and compares the planned coverage with the reported coverage for each country on each line.

The information collected is stored on a database at the IPO from which the Tracking Tables and summary tables are produced. These tables are also stored on OCEANIC (WOCE DIU) where they are updated quarterly.

ANNEX V

FORMAT ADOPTED FOR MONTHLY SHIP VISIT REPORT

FOR TRANSMISSION VIA ELECTRONIC MAIL

OLD REPORT FORM

SHIP NAME CALL SIGN	YR/MO	LINE #	OP	VST/DAY	USED	GOOD	LOADED	ABOARD
ACT 3 C6JZ2	91/10	PX-8	NO	?T/08	16	16	--	73

NEW REPORT FORM

SHIP NAME	CALL SIGN	LINE # (TWI)	NUMBER OF TRANSITS	TRANSMISSIONS RECEIVED	GTS INSERTED
IRON	VJDI	IX22	1	22	20
NEWCASTLE		PX11	2	15	15
		PX5	1	5	3

These reports would be submitted for transmissions received during the period of the reporting month only (i.e. the 1st day of the month through the last day of the month unless otherwise noted).

The Fourth Joint IOC-WMO Meeting for Implementation of IGOSS XBT Ship-of-Opportunity Programmes recommended that the Monthly Ship Visit Report be revised and made to reflect a more meaningful monitoring tool for IGOSS and the WOCE-TOGA programmes. A working group was formed to revise this report. The target date for implementation is 1 January 1992.