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WORLD METEOROLOGICAL ORGANIZATION

INTEGRATED GLOBAL OCEAN SERVICES SYSTEM (IGOSS)

SUMMARY OF SHIP-OF-OPPORTUNITY PROGRAMMES

This document contains the consolidated national reports of countries participating in ship-of-opportunity programmes as presented at the First Session of the Joint IOC-WMO IGOSS Ship-of-Opportunity Programme Implementation Panel (Cape Town, South Africa, 16-18 April 1997). It is intended to complement the Summary Report of the Meeting.

SC-97/WS/60

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1. Introduction

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 1982-83 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 (SST) in the eastern Indian Ocean (see Nicholls, 1989 and Figure 1)

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 inter-annual time scales, and is very much related to the varying phases of the El Nino Southern Oscillation (ENSO) phenomena. 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. Even less is known of the dynamics controlling the dipole of SST in the Indian Ocean which is also suspected to have an influence on climatic variability in Australia.

Because of thermal inertia, ocean heat storage 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 inter-annual 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.

In order to measure the transport of mass, heat, and salt in the surface layer of the ocean and the storage capacity of the surface layer for heat and salt, it is necessary to carry-out repeated measurements of global upper ocean variability. These must be taken at both intra- and inter-annual time scales, and the only feasible way at present to carry out this program is to use volunteer merchant ships (ships-of-opportunity) that are frequent carriers on particular routes that transect regions known to have an influence on both Australian and global climate. At present this is the most cost-effective and practical way to obtain such measurements. Satellites do not have the ability as yet to accurately and directly determine sub-surface ocean structure, and the use of research vessels dedicated to maintaining measurements on a regular basis on multiple routes which span ocean basins would be both expensive and impractical.

2. CSIRO SOOP Objectives

The practical objective of the CSIRO Ship-of-Opportunity Programme (SOOP) is to collect the full suite of in situ measurements of ocean temperature, salinity, and absolute velocity from volunteer ships on a routine basis. This can be done in two ways, either as broadscale, low-density sampling through volunteer observers launching eXpendable BathyThermographs (XBTs) and eXpendable Conductivity, Temperature, and Depth instruments (XCTDs) to determine general circulation and upper ocean heat and salt content, or by high-density (high-resolution) sampling along exactly-repeated sections with scientists or oceanographic technicians on board to make the extra measurements required to determine large-scale velocity and geostrophic current and eddy transport variations in the ocean.

The specific research goals the CSIRO Ship-of-Opportunity Program (SOOP) supports are:

a) Document ocean temperature in the heat pool north of Australia and across the Indian Ocean, and to evaluate the relative importance of surface fluxes, advection, and mixing processes to the thermodynamics of the region. As part of this goal it is necessary to document the variability of the major geostrophic currents in the tropical Indian Ocean on seasonal and inter-annual time scales, and to evaluate their role in changing sea surface temperature (see Figure 2).

b) Understand sea level's response to El Nino Southern Oscillation (ENSO) events by examining combined sea level and subsurface ocean temperature data in the eastern Indian Ocean and south west Pacific Ocean.

c) Measure the transport of mass, heat and salt in the surface layers by the major geostrophic currents in the eastern tropical Indian Ocean, south west Pacific Ocean and Southern Ocean, and to determine the role of these currents in climate change and climate variability (see Figure 3).

d) Help initialise and validate data assimilation models for the Indian Ocean and EEZ Region which are being developed.

e) Form a basis for the design and development of an Regional Ocean Observing Network (ROONet) as a contribution to the proposed Global Ocean Observing System (GOOS).

Nationally, the CSIRO SOOP provides valuable large-scale, long-term coverage of the waters of economic and environmental importance to Australia. These waters include the EEZ region, the Indian and Southern Oceans, and the south west Pacific Ocean. The data is used in real-time by the National Climate Centre (NMC) of the Bureau of Meteorology (BoM), as well as other climate centres around the world, for input into climate prediction schemes. It has been shown that the data enhances climate prediction skills. The CSIRO program also actively supports the Royal Australian Navy's (RAN) data collection and regional analysis activities. In general, the data is made available through the national and international archives for general use by government organisations, the civilian community, and industry.

The CSIRO activity is closely coordinated with major international research programs. In particular, the CSIRO program has contributed significantly to the Tropical Ocean Global Atmosphere project (TOGA; 1985-95) and the World Ocean Circulation Experiment (WOCE; 1990-96) of the World Climate Research Program (WCRP). A corner-stone for both of these international projects has been the implementation of an international ocean 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 achieve this goal. The CSIRO activity is a reasonably large and integral part of the global coverage required.

The WCRP officially launched the 10-year TOGA project in 1985, as damage estimates from the 1982-83 El Nino topped several billion dollars. The project aimed to describe how oceans and atmosphere interact, creating short-term climate changes, and to determine whether those changes were predictable. Much has since been learned. Advances in theory, observations, and computer modeling now enable climatologists to predict the onset of El Nino up to 1-1/2 years in advance with reasonable accuracy. With the TOGA project officially finishing at the end of 1994, scientists are now advancing a 15-year follow-up program to build on the enormous success of TOGA. The new WCRP-coordinated effort beginning in January 1995, is called CLIVAR (short for Climate Variability).

As more and more results are derived from ongoing research, the need for permanent observational systems is being recognised. Indeed, the concept of a Global Ocean Observing System (GOOS), an internationally coordinated, scientifically based program for systematic data collection and exchange, is taking shape and gaining momentum at the national and international level. Already the CSIRO activity contributes significantly to the Integrated Global Ocean Services System (IGOSS), jointly established by the International Oceanographic Commission (IOC) and the World Meteorological Organisation (WMO).

3. The Observing Network

The CSIRO broadscale, low-density XBT program, using voluntary observers, began operation in 1983. The high-density sampling program began in the Tasman Sea and Coral Sea region at the beginning of 1991, across the Throughflow region between Fremantle and Singapore in 1995, and in the Southern Ocean in the austral summer of 1992-93. Since 1983, a total of more than 30,000 XBTs have been successfully deployed.

The network is presently operated from a centre in Hobart under the management of research oceanographers. It is deemed vitally important to the success of the program to keep the activities closely linked to the research efforts and operational applications. Once the data is received in Hobart, it undergoes extensive scientific quality control and analysis using purposefully developed in-house software and procedures which have been adopted internationally. The recording equipment is installed and serviced by technicians from CSIRO, with general supply and ship-greeting support being provided in the major ports around the nation by other Divisions of the CSIRO, the Bureau of Meteorology (BoM) and the Australian Oceanographic Data Centre (AODC). The BoM also manage the national hub for the Global Telecommunications System (GTS).

3.1 Data Coverage

Tables 1 and 2 give the total number of XBTs (including failures), good XBTs, sections, and number of bathy reports sent over the GTS for each line occupied by the CSIRO SOOP during 1995 and 1996 (See Figure 4). Wherever possible, lines are sampled at the sampling frequencies and spacing as determined by extensive optimal sampling studies (Meyers et al. 1989, 1991; Phillips et al. 1990) and as adapted and recommended by the TOGA Implementation Plan (Feb, 1990).

Due to a change in general merchant ship routing on line IX-9 , this line was only sampled north of the latitude of Sri Lanka during 1995, as no regular shipping presently exists between Fremantle and Sri Lanka. Only occasionally have the ships returned to the previous route due to cargo requirements temporarily changing. Given the Japanese and French also collect data on this northern section using vessels en route to Singapore, sampling ceased on the northern section of IX-9 during early 1996. Insufficient regular shipping on lines PX-3 and IX-22/PX-11 (same ships cover both these lines) has unfortunately meant that these lines have not been sampled at the recommended sampling intervals. Efforts are continuing to identify the appropriate shipping to correct this deficiency.

Lines PX-30/31, PX-34, IX-1, and IX-28 are high-density XBT lines. Oceanographic observers are placed onboard the participating merchant vessels to sample the temperature of the upper 800m of the ocean every 25-50 km. The line in the Southern Ocean (IX-28) is operated by a French Antarctic supply vessel, and operates only during the austral summer months. The operation of this line provides a very significant and invaluable contribution to the otherwise sparsely sampled Southern Ocean. Lines PX-34 and PX-30/31 are run in collaboration with the Scripps Institution of Oceanography (SIO), whilst line IX-28 is run in collaboration with SIO, ORSTOM, and the French Polar Institute (FPI).

Figure 5 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 1996. The total does not include XBTs that have failed (approx.7%). Figures 6 and 7 show those XBTs accepted for 1995 and 1996.

Surface salinities have been collected with surface sample buckets along the high-density line PX-34, IX-1 and IX-28. A Sea-Bird SBE-21 thermosalinograph is operated in collaboration with ORSTOM and the FPI on the polar supply vessel, L'Astrolabe, operating between Hobart and Dumont d'Urville in Antarctica (IX-28). Surface samples collected by sample buckets along the route are used to calibrate the thermosalinograph system.

3.2 Support and Collaboration

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 under the control of research oceanographers. The strategy has proven to be extremely successful, to the point that nearly 4000 ocean soundings are made each year. CSIRO provided 500 XBTs during 1995, whilst the RAN provided 2000 XBTs in 1995 and 2500 XBTs in 1996. Scripps Institution of Oceanography provided 500 XBTs and 24 XCTDs per year in 1995 and 1996, and the National Ocean Services Branch (NOS) of the National Oceanographic and Atmospheric Administration (NOAA) provided 600 XBTs per year. The BoM, as a major user of the real-time data, also assists by paying for the cost of transmitting the bathy reports via satellite for insertion onto the GTS as a contribution to the Integrated Global Ocean Services System (IGOSS). Significant funding is also received through the CSIRO Climate Change Research Program in support of the high-density XBT project.

Numerous shipping companies kindly support our research by allowing us to install our recording equipment on board their vessels. BHP Transport, Pacific Forum Line, P&OCL, South Pacific Shipping, and the French Polar Institute kindly allowed oceanographic observers on board their vessels to undertake the high-density XBT sampling which cannot easily be undertaken by the officer-of-the-watch, unlike the low-density XBT sampling.

3.3 Data Acquisition Systems

CSIRO operates Sippican MK-9/Lap-Top configured XBT systems on its merchant ships. A user-friendly software interface has been developed by CSIRO for the voluntary observer environment. The XBT systems are also interfaced to CLS ARGOS "add-on" satellite transmitters (co-developed with CSIRO) to enable the relay of XBT data in near real-time. The data undergoes filtering and general quality control checks (tests for spikes, erroneous temperature gradients, out-of-range temperatures, single temperature profiles, etc), as designed by ARGOS in conjunction with ORSTOM, and as recommended by the IGOSS Task Team for Quality Control of Automated Systems (TT/QCAS) (IOC, 1996a), before it is sent via satellite for insertion onto the GTS for distribution to scientists and climate prediction centres around the world. The JJYY bathy report format was gradually introduced onto participating vessels after 8th November, 1995 to replace the old JJXX format in accordance with WMO requirements. All vessels now use the JJYY format.

A number of problems continue to plague the GTS and ARGOS relay stations. Monitoring projects under IGOSS and WOCE, in conjunction with tests performed by ARGOS, are used to keep track of these transmission deficiencies and to seek appropriate solutions. Common problems include insufficient satellite coverage, bathy reports not reaching the GTS due to ARGOS processing problems, or once reaching the GTS not reaching all destinations. On several occasions the bathy reports inserted on the GTS by ARGOS were not appropriately up-dated to indicate the message should be in the JJYY format as opposed to the JJXX format (i.e. depth errors were therefore introduced to the data). This has been corrected in the global data bases with the help of the Marine Environmental Data Service (MEDS) in Canada. CSIRO also provides feedback to the MEDS on their quality control of the real-time data.

The prototype SIO XBT automatic-launcher has been installed on merchant ships involved in the high-density program. This is a device which can automatically deploy up to six XBTs at predetermined times or positions (via interfaced GPS units), making it possible for the deployment of only one oceanographic observer on board a merchant vessel to maintain the required around the clock high-density XBT sampling. The system uses the Sippican MK12 recorder to collect the data. Profile comparison tests alert the observer onboard to any equipment malfunctions. CSIRO has extensively modified the auto-launcher hardware. The trapdoor mechanisms have been redesigned to provide increased mechanical advantage for the solenoid firing pins, and the deck-electronics and launching units have now been mounted in the one unit to facilitate installation. As there is no real-time data transmission capability for the auto-launcher system as yet, the profiles are sub-sampled to meet low density sampling requirements and inserted onto the GTS by SIO as soon as possible after the observer returns to the laboratories (under WOCE guidelines, the full vertical and horizontal resolution data is not released until two years after collection to provide first use of the data to the principal investigators involved).

XCTDs have been deployed from merchant vessels involved in the high-density program along IX-1 and IX-28. The Sippican MK12 recorder and manufacturer's software were used to collect the data. Due to the extreme cost of XCTDs, sampling is very much limited to areas where variations in the salinity field require greater resolution than provided by standard climatologies (for instance in the South Java Current and the Sub-Antarctic front). Considerable problems have been experienced with the XCTDs deployed so far. These problems are discussed in the next section.

Plans for the deployment of further thermosalinographs on merchant vessels are progressing. A thermosalinograph is planned to be installed on the vessel occupying line IX-1 during the later half of 1997. This will provide weekly sampling of the surface salinity field associated with the Indonesian Throughflow and the Leeuwin Current System. The procedure adopted of placing the pump for the thermosalinograph downstream from the temperature and conductivity sensors on the L'Astrolabe has proven successful in minimising air bubbles in the vacinity of the sensors. Bubbles can effect conductivity readings, and it is therefore essential that these be eliminated if at all possible. Figure 8 shows sea surface temperature (SST) and sea surface salinity (SSS) results along one section from the P.V *L'Atstrolabe* on line IX-28.

3.4 Equipment Evaluations

CSIRO tests and evaluates equipment developed and deployed for the research program to ensure data accuracy and integrity. All such tests and evaluations are coordinated with and submitted to the IGOSS Task Team for Quality Control of Automated Systems (TT/QCAS).

Work continues on evaluating the accuracy of XBTs and XBT data acquisition systems, including an evaluation of the fall rate equation of the XBT. This work has contributed to the work of the XBT Fall Rate Study Subgroup of the TT/QCAS, and a joint paper on the findings has been published in the Journal of Deep Sea Research (Hanawa et al. 1995). The manufacturer's depth-time equation for the XBT was found to be in error; maximum depth error at 760m was found to be approximately 26m (manufacturer's accuracy specifications give 15m at 760m). A new depth-time equation has been proposed by Hanawa et al. 1995 for T-7, T-6, and T-4 types of Sippican and TSK XBTs, which is now implemented on all ships in the CSIRO network.

The XBT-7 model of XBT produced by Sparton of Canada has been evaluated at sea against a precision CTD. Unfortunately due to adverse weather conditions, only 12 of the proposed 36 probe-to-CTD profile comparisons could be obtained. This data has been forwarded to the IGOSS TT/QCAS for consideration. Preliminary results indicated a fall rate error of the approximately the same magnitude as that observed by Hanawa et al. 1995 for the comparable Sippican and TSK T-7 types of XBT (i.e. XBTs rated to 760m). The Sparton XBT-7 has also been deployed at sea simultaneously with Sippican Deep Blue probes as part of a further comparison study for evaluating depth accuracies and general probe reliability. These test showed the same depth errors.

Significant problems with the Sippican XCTD have been encountered with early deployments of the probe on some of the high-density XBT lines. Failures initially occurred due to snagging of the wire on the probe assembly (leading to early termination) and from apparent interference/spiking (results to be reported and discussed at the TT/QCAS meeting). The XCTDs were also compared to precision CTDs on the R.V.Franklin, and with XBTs launched within 5-10 minutes of the XCTD during the high-density XBT voyages. These comparisons indicate a depth error outside manufacturer's specifications of the order of the depth error determined for the Sippican and TSK T-7, Deep Blue, T-6, and T-4 types of XBT by Hanawa et al. 1995 (approx. 25m at 760m). They also indicate a continuing problem of errors associated with air bubbles being trapped around the conductivity cells of the XCTD during the upper 0-100m (IOC, 1996a and personal communication with Sippican Inc.). The manufacturers have recommended spraying a surfactant on the conductivity cells just prior to deployment of the probe to reduce the possibility of air bubbles forming. This has not been trialed as yet.

3.5 Volunteer Observers

The success of the program relies heavily on the support given by the voluntary observers on board the merchant vessels. Indeed, several of the vessels have participated in the CSIRO SOOP for 10 or more years (M.V. Anro Australia, M.V. Swan Reefer, M.V. Anro Asia, S.S. Flinders Bay, M.V. Botany Bay, M.V. Encounter Bay, M.V. Australia Star) - a truly remarkable accomplishment, and a measure of their generous support of our research. It is considered essential that considerable effort is put into maintaining good public relations with the voluntary observers and their shipping companies. Each ship is visited on every return to an home Australian 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. Each ship is also visited by a scientist involved in the research program at least once per year.

We are truly indebted to the generous and high level of quality support from the voluntary observers, shipping companies and their agents.

4. Data Processing and Data Management

All data collected by the CSIRO SOOP undergoes scientific quality control before submission to the international archives, as per the recommendations of IOC, 1996b and WOCE, 1995. Scientific quality control (QC) is the process of combining statistical analyses of data (in this case, generally subsurface temperature profiles) with knowledge of historical means (Climatology) and of the relevant environment (regional oceanography) to make a scientifically based decision about the validity of each data point. It is a vital step to be taken with any data set before scientific analysis can proceed. A knowledge of the recording instrument's performance and characteristics is also used when evaluating the data (see Figure 9). This is particularly important when undertaking the quality control of XBT. Due to the nature of the instrument (XBTs provide wide coverage at a relatively low cost), there are a number of possible, subtle malfunctions whose characteristics are very hard to distinguish from real oceanic features. It therefore takes a skilled knowledge of the instrumentation and its limitations, in conjunction with a thorough knowledge of the regional oceanography to adequately and accurately QC the XBT data that is collected. Such regional expertise may not be necessary for other forms of data collected by more accurate and reliable instrumentation.

CSIRO DMR and the Bureau of Meteorology Research Centre (BMRC) have developed a comprehensive software system for the scientific quality control of sub-surface ocean temperature and salinity data (see Bailey and Gronell 1995). This system, called QUEST (which stands for Quality Evaluation of Subsurface Temperatures) combines the subsurface ocean temperature statistical analysis scheme developed by BMRC and CSIRO (Smith et al., 1991; Meyers et al., 1991) with the quality control procedures of CSIRO as outlined in Bailey et al. (1994) (henceforth referred to as the CSIRO Cookbook). QUEST enables individual temperature profiles to be compared to Climatology (Levitus), to an objective (statistical) analysis of all the available data, and to other profiles in the immediate area, in order to identify real features of a given region and to help distinguish between such features and erroneous data. QUEST enables profiles affected by malfunctioning of the instrumentation to be identified, and areas where vertical and horizontal temperature structures with small to medium scales occur frequently to be flagged. Examples of vertical and horizontal structures include inversions, intrusions, steps, thermostads, eddies, low salinity layers at the surface due to rainfall and runoff, and unusual vertical structure associated with interactions between strong coastal currents and the continental slope.

Quality control begins with the volunteer observers, who are taught to recognise unusual vertical structure and asked to make extra drops when they see it. The extra drops are invaluable when a data quality expert later decides if the unusual structure is real or a malfunctioning of the instruments. QC back at the lab is assisted by a catalogue of profiles (the Cookbook) that illustrates the XBT malfunctions and small scale vertical structures. The data quality expert has to be thoroughly familiar with the catalogue, and needs to know where to expect to find particular types of vertical structure.

The quality controlled data is stored in the standard MEDS-ASCII format and submitted to the national and international archives 3-5 months after the end of the year in which it was collected (as per international requirements). QC decisions on common malfunctions and real oceanographic features are coded on the data set. The data is further flagged (0-5) by depth according to the type of code associated with the data and according to IGOSS/IODE protocol. Class 0 data has had no QC. Class 1 data is good data. Class 2 data has unusual features, but which are considered to be probably real. Class 3 data has features considered to be most likely the result of instrument malfunctions and not real features, and therefore not acceptable. Class 4 data is obviously erroneous data. Class 5 data is data which has been modified (with original values stored in the history file). All data except Class 4 data is submitted to the national and international archives. This enables the possible later reflagging of Class 3 data should this data be verified as valid by other data sources. This cannot be accomplished if the operators only submit what they qualify as "good" data.

The cost of our QC method is an increment of about 4% on the cost of the XBTs. What we gain from this is a research-quality data set that to a high degree of confidence has all of the good and bad data identified. We try to assure the quality of each and every profile because our research is often based on time series in fairly small areas (1 or 2 deg squares) that have a limited number of drops. For WOCE and CLIVAR the 0.2-0.5 deg C accuracies detected by the extensive profile-by-profile examination will be crucial for the study of interdecadel variability and change, and for the development of climatologies to be utilised by operational forecasting schemes. We therefore maintain that such data integrity and accuracies must be obtained in any future operational implementation of the SOOP. By quality controlling the data as soon as possible after the vessels returns to port, equipment malfunctions can be determined at an early stage and rectified before the vessel departs for its next voyage, thus ensuring data accuracy and integrity.

CSIRO is also the lead organistion for the WOCE Indian Ocean Upper Ocean Thermal Data Assembly Centre (UOT/DAC). Other participants include BoM/BMRC and the AODC. 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 quality control of XBT and other UOT data to produce a "scientifically" quality controlled data set for WOCE. QUEST has been used for the scientific quality control of the data set supplied by the World Data Centre A (WDCA) which contains all available upper ocean temperature data collected in the Indian Ocean from 1990 onwards. Efforts have begun to also QC data for before this period. AODC staff have assisted CSIRO staff in the quality control of the data in Hobart under a training program. The principle quality control procedures developed by CSIRO are being implemented by the WOCE UOT/DAC's for the Atlantic and Pacific Oceans.

5. Future of the CSIRO SOOP

TOGA is now completed, and the field component of WOCE is nearing completion. The value of the upper ocean data collected by SOOP for climate prediction has clearly been identified by the Knox report and the findings of the Ocean Observing System Development Panel (The OOSDP 1995). Given this, and given that the CSIRO low-density XBT SOOP has been developed to a level at which it is ready for operational implementation, a strategy has been developed nationally to transfer the CSIRO low-density XBT SOOP from a research activity, predominantly supported by research funds, to an operational program supported by the Australian Bureau of Meteorology, with continuing support from the RAN. The transition began in mid 1996, with the BoM providing capital and part of the operational funding for the low-density XBT SOOP. From mid 1997 to late 1997, the BoM will also allocate staff to the project. During this time, CSIRO will complete the transfer of expertise to the BoM through an extensive training program. All efforts will be made wherever possible to continue to maintain the sampling at the present levels and in-line with agreed national and international priorities.

Nationally it will be important to maintain a strong link between the research and operational activities, as this has proven to be one of the main reasons for the acknowledged high success of the present CSIRO SOOP. The research resources freed up by the transfer of the low-density CSIRO SOOP to the BoM will be reallocated to ongoing research of the collected data and to the development of enhanced technologies for the observing system. CSIRO will continue its high-density XBT programme, and will continue to develop new and existing instrumentation and techniques for use by the national SOOP (such as the implementation of a salinity observing network, studies into the optimal deployment of XBTs and PALACE floats, development of synthetic XBTs from satellite altimeters, etc). A joint proposed project and Memorandum of Understanding (MOU) between CSIRO, BoM, and the RAN will provide ongoing management and coordination of national SOOP activities. The SOOP developed by CSIRO will form one of the components of a Regional Ocean Observing Network (ROONet) as an Australian contribution to GOOS.

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Table 1.

1995 CSIRO Ship-of-Opportunity Progress Summary (January - December Line Coverage)

Line	CallSigns	#Sections	#Drops	#Good*	#Xmitted**
PX-2	9VUU	5	126	121	84
	VJBQ	6	136	130	92
	9VWM	3	46	45	44
		----	----	----	----
		14	308	296	220
PX-3	VJDP	6	194	188	167
	VJDI	3	116	107	64
		----	----	----	----
		9	310	295	231
PX-30/31 ***	A3CA	2	199	190	77
PX-32	GYSE	2	29	29	26
	GYSA	3	33	31	28
	GYRW	2	15	14	15
		----	----	----	----
		7	77	74	69
PX-34	VNGZ	4	274	268	0
	GYSA	1	8	8	7
		----	----	----	----
		5	282	276	7
IX-1	S6FK	26	710	677	664
	GYRW	2	185	181	73
	9VUU	1	58	53	48
	GYSA	1	78	78	0
		----	----	----	----
		30	1031	989	785
IX-9 (P)	9VWM	6	83	80	80
IX-12	GYSA	4	222	211	169
	GYSE	4	184	176	155
	GYRW	4	204	197	173
		----	----	----	----
		12	610	584	497
IX-22/ PX-11	VJDI	3	107	104	101
	VJDP	5	218	211	203
		----	----	----	----
		8	325	315	304
IX-28	FHZI	5	434	381	162
TOTALS:			3659	3480	2432

NOTES:
*A good profile is a succesful profile of > 100 m depth
** In some cases numbers transmitted are approximates only. Some high density XBT runs have not been able to transmit due to a lack of a transmitter and appropriate software. When high density lines have transmitted it is not guaranteed that all messages will reach the satellite, and hence GTS, as a result of the number of samples compared to the number of satellite overpasses.
*** This line is run in conjunction with Scripps - only CSIRO cruises are reported.
(P) = partial coverage of line

CALL SIGNS:

9VUU = ANRO ASIA
VNGL = IRON FLINDERS
VJDI = IRON NEWCASTLE
A3CA = FUA KAVENGA
GYSE = BOTANY BAY (EX NEDLLOYD TASMAN)
VJBQ = ANRO AUSTRALIA
FHZI = L'ASTROLABE
VNGZ = IRON DAMPIER
S6FK = SWAN REEFER
VJDP = IRON PACIFIC
GYRW = ENCOUNTER BAY
GYSA = FLINDERS BAY
9VWM = NEW ZEALAND STAR (EX MANDAMA)
9VBZ = AUSTRALIA STAR (EX MAHSURI)

Table 2.

1996 CSIRO Ship-of-Opportunity Summary

Line	Callsigns	#Sections	#Drops	#Good*	#Xmitted**
PX2	9VUU	6	117	111	98
	9VWM	5	78	78	73
	VJBQ	3	69	62	56
		14	264	251	227
PX3	VJDP	5	155	140	140
	VJDI	4	131	125	115
		9	286	265	255
PX30/31***	A3CA	2	200	190	0
PX32	GYXG	1	14	11	11
	GYSA	2	19	18	17
	GYSE	2	16	15	14
	GYRW	4	21	20	19
		9	70	64	61
PX34	VNGZ	3	196	183	14
	V2LM	1	67	63	64
		4	263	246	78
IX1	S6FK	21	486	460	403
	VJBQ	1	29	28	27
		22	515	488	430
IX9(P)	9VWM	1	17	14	15
IX12	GYXG	1	57	51	44
	GYSA	3	129	117	110
	GYSE	4	195	192	173
	GYRW	4	205	197	166
		12	586	557	493
IX22/PX11	VJDP	3	121	119	117
	VJDI	2	98	92	82
		5	219	211	199
IX28	FHZI	6	471	378	150
TOTALS:			**2891**	**2664**	**1908**

*A good profile is a successful profile of > 100m depth

** In some cases numbers transmitted are approximates only. Some high density XBT runs have not been able to transmit. Data has been sent via SCRIPPS to the GTS where possible..

*** This line is run in conjunction with Scripps - only CSIRO cruises are reported.

(P) = Partial coverage of the line.

CALLSIGNS:

9VUU = ANRO ASIA
VJDP = IRON PACIFIC
VNGZ = IRON DAMPIER
A3CA = FUA KAVENGA
GYSA = FLINDERS BAY
GYRW = ENCOUNTER BAY
GYXG = DISCOVERY BAY
9VWM = NEW ZEALAND STAR (EX MANDAMA)
VJBQ = ANRO AUSTRALIA
VJDI = IRON NEWCASTLE
FHZI = L'ASTROLABE
S6FK = SWAN REEFER
GYSE = BOTANY BAY (EX NEDLLOYD TASMAN)
9VBZ = AUSTRALIA STAR (EX MAHSURI)
V2LM = RANGITANE

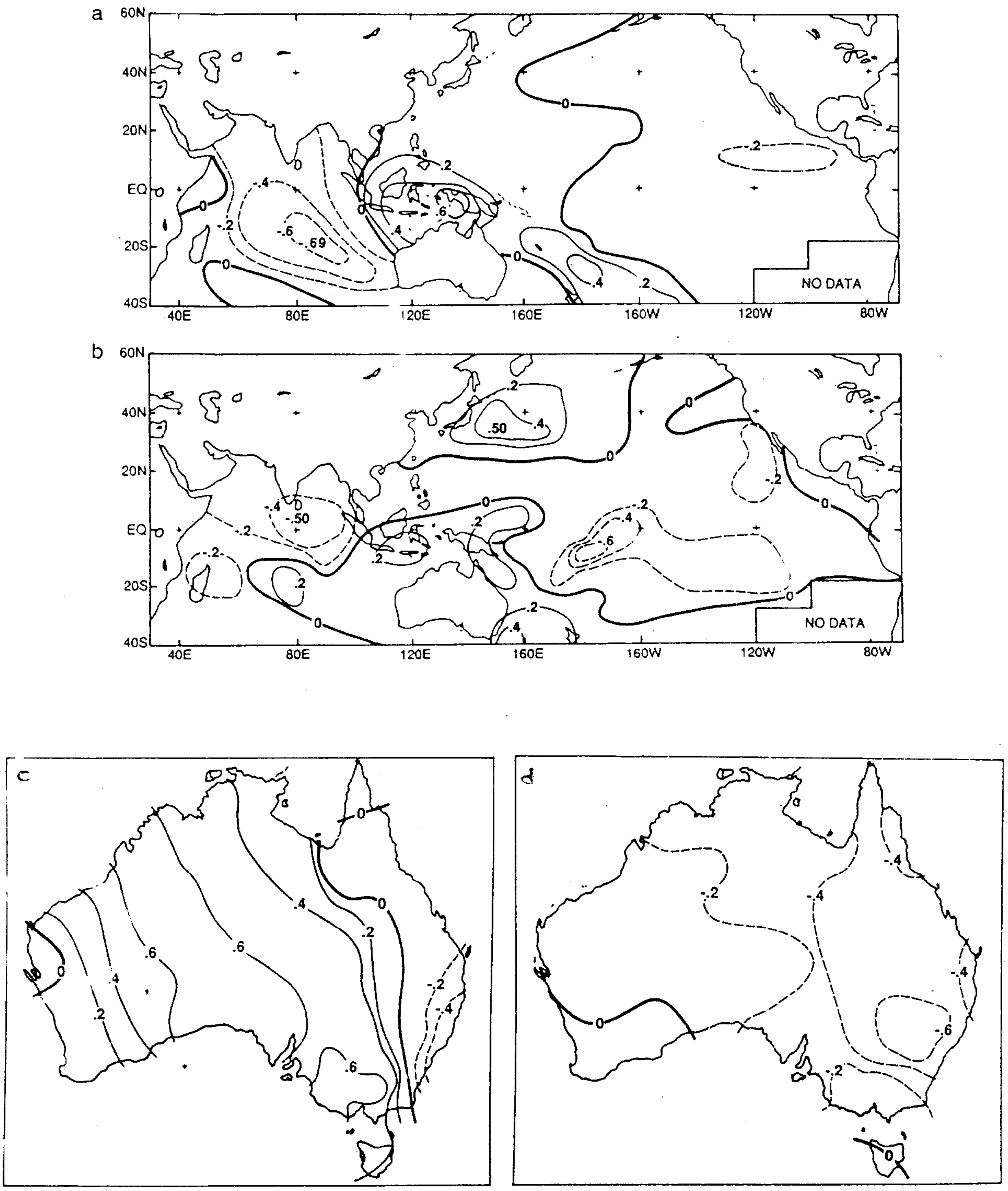


Figure 1: Correlations between SSTs and (a) the first rotated principal component of Australian rainfall and (b) the second rotated principal component. Correlations between winter rainfall and (c) the difference in SST between Indonesia and the central Indian Ocean and (d) the SST in the central equatorial Pacific Ocean (after Nicholls, 1989).

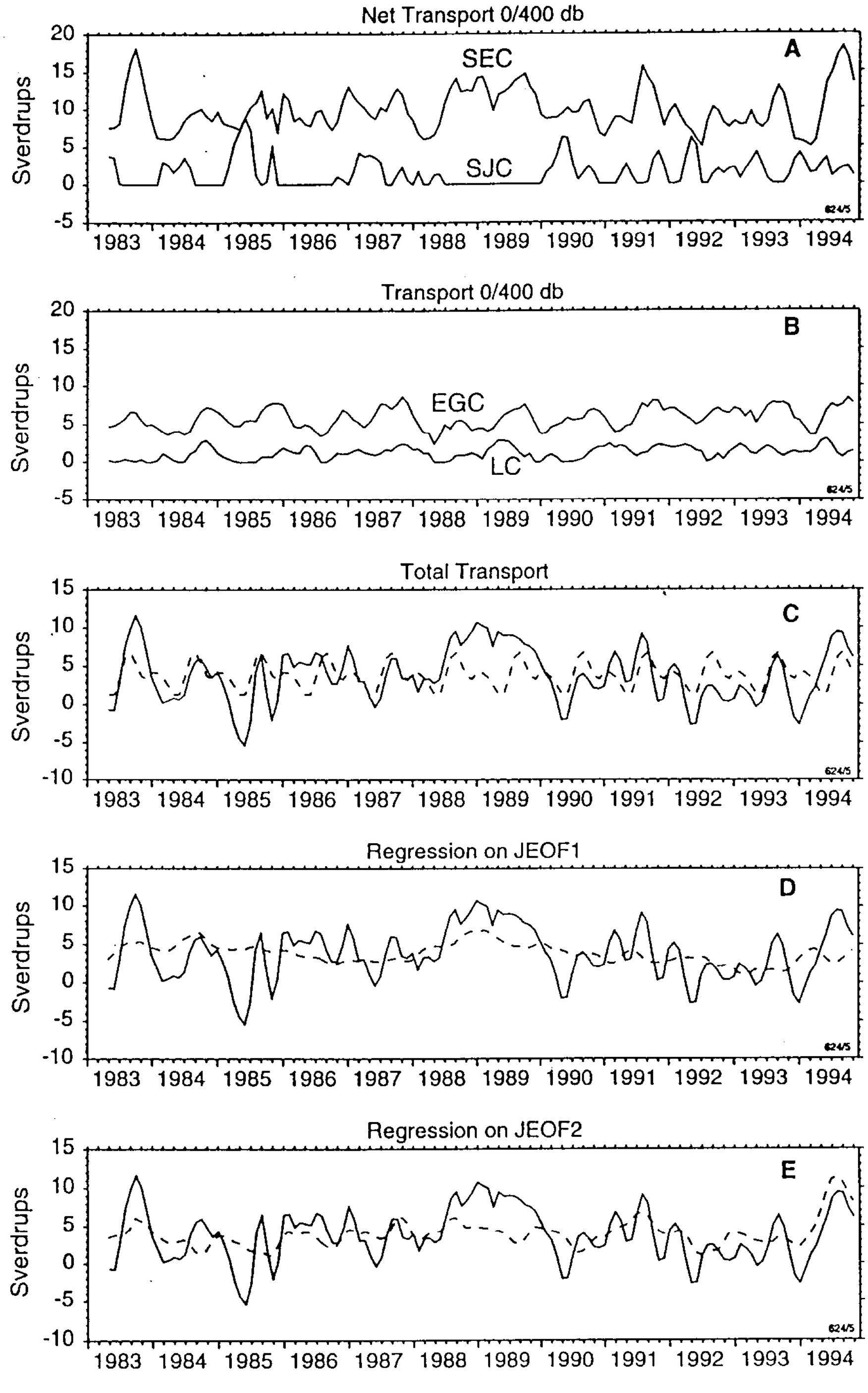


Figure 2: Geostrophic transport (0/400 dbar) along XBT line IX-1 in sverdrups ($10^6 m^3 s^{-1}$) of the (a) South Equatorial Current (SJC) and (b) Leeuwin Current (LC) and Eastern Gyral Current (EGC). (Note that the transport of all the currents is plotted as a positive number, indicating westward flow for the SEC, eastward flow for the SJC and EGC, and southward flow for the LC). (c) Net geostrophic transport (0/400 dbar) through line IX-1 from Shark Bay to Sunda Strait (solid line) and mean annual cycle for the period 1983 and 1994 (dashed line). (d) The ENSO signal (dashed line) in Throughflow estimated by regression analysis (dashed line). (e) The flow through line IX-1 estimated by regression analysis with joint EOF2 (dashed line). (After Meyers, 1996).

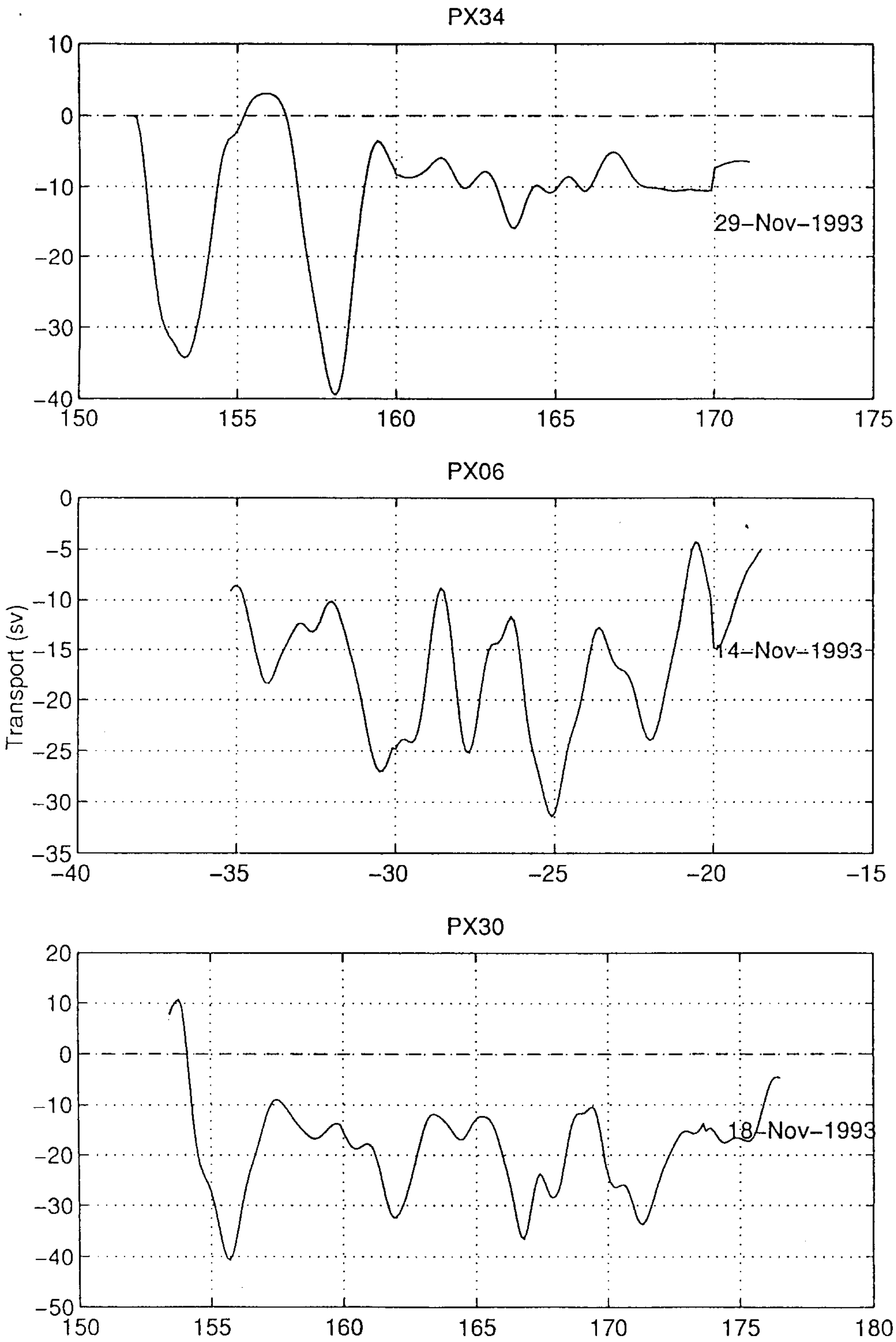


Figure 3: Nett mass transport in sverdrups ($10^6 m^3 s^{-1}$) along high-density XBT lines in the Tasman and Coral Seas.

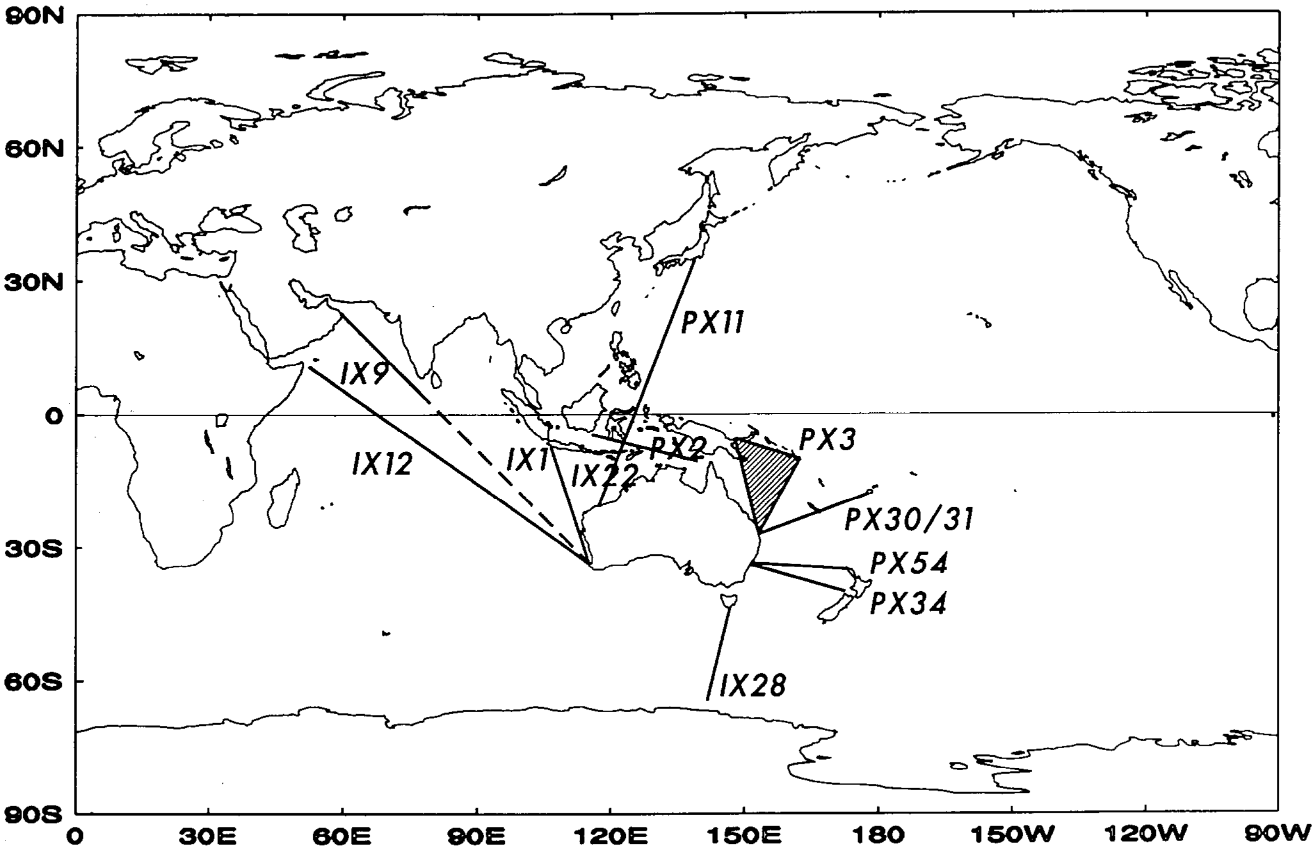


Figure 4: CSIRO Ship-of-Opportunity lines.

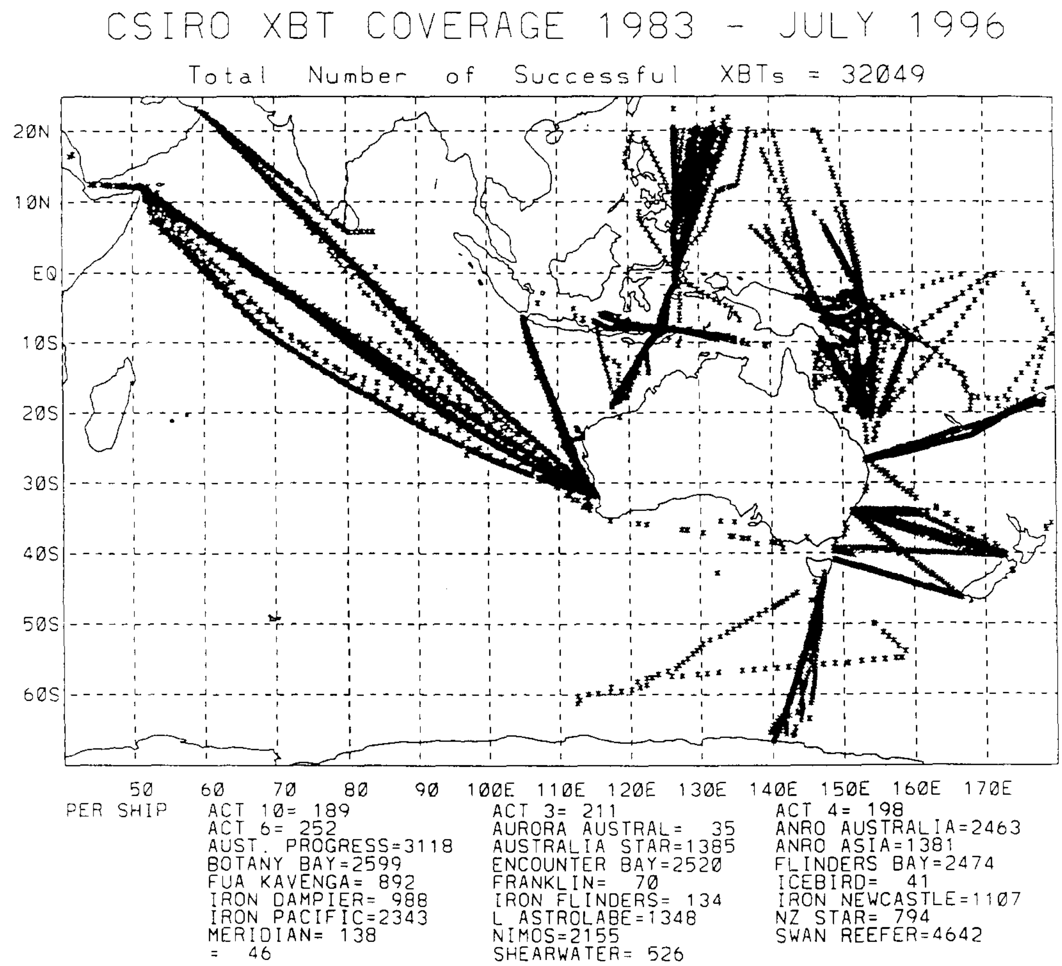

CSIRO XBT COVERAGE 1983 - JULY 1996
Total Number of Successful XBTs = 32049
20N
10N
EQ
10S
20S
30S
40S
50S
60S
50 60 70 80 90 100E 110E 120E 130E 140E 150E 160E 170E
PER SHIP
ACT 10= 189
ACT 6= 252
AUST. PROGRESS=3118
BOTANY BAY=2599
FUA KAVENGA= 892
IRON DAMPIER= 988
IRON PACIFIC=2343
MERIDIAN= 138
= 46
ACT 3= 211
AURORA AUSTRAL= 35
AUSTRALIA STAR=1385
ENCOUNTER BAY=2520
FRANKLIN= 70
IRON FLINDERS= 134
L ASTROLABE=1348
NIMOS=2155
SHEARWATER= 526
ACT 4= 198
ANRO AUSTRALIA=2463
ANRO ASIA=1381
FLINDERS BAY=2474
ICEBIRD= 41
IRON NEWCASTLE=1107
NZ STAR= 794
SWAN REEFER=4642

Figure 5:

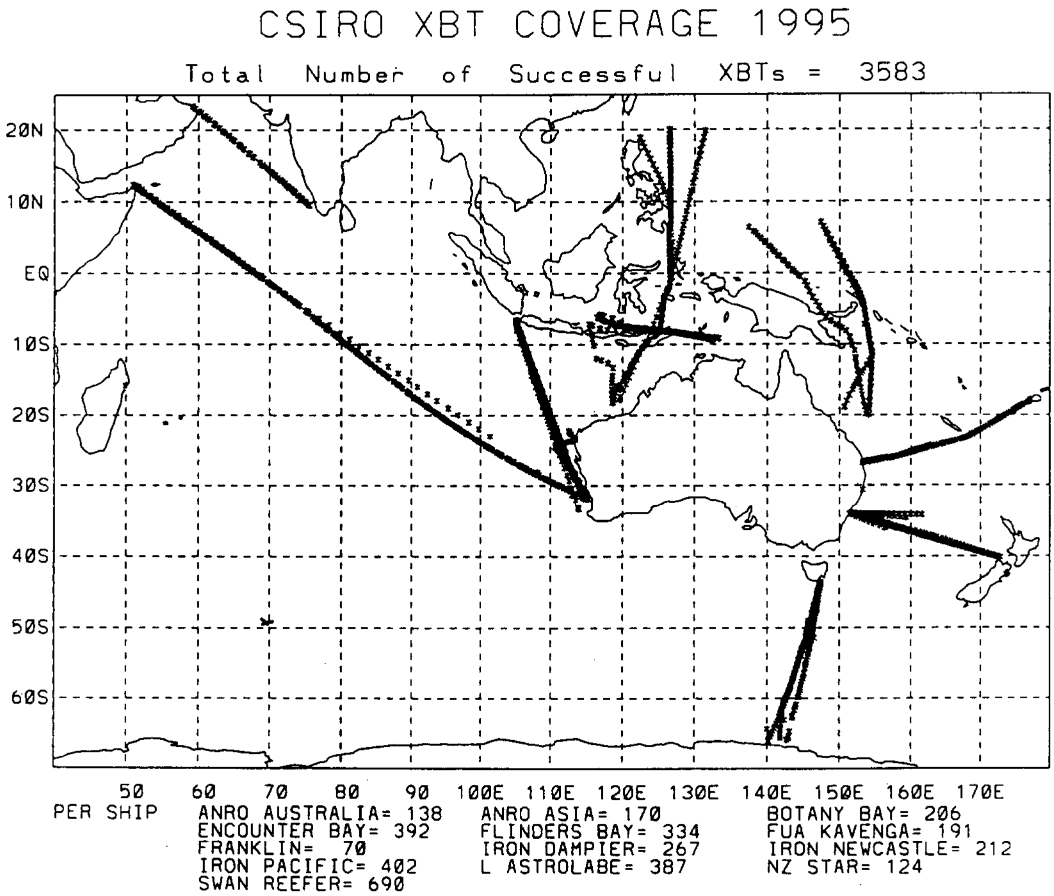

CSIRO XBT COVERAGE 1995
Total Number of Successful XBTs = 3583
20N
10N
EQ
10S
20S
30S
40S
50S
60S
50 60 70 80 90 100E 110E 120E 130E 140E 150E 160E 170E
PER SHIP
ANRO AUSTRALIA= 138
ENCOUNTER BAY= 392
FRANKLIN= 70
IRON PACIFIC= 402
SWAN REEFER= 690
ANRO ASIA= 170
FLINDERS BAY= 334
IRON DAMPIER= 267
L ASTROLABE= 387
BOTANY BAY= 206
FUA KAVENGA= 191
IRON NEWCASTLE= 212
NZ STAR= 124

Figure 6:

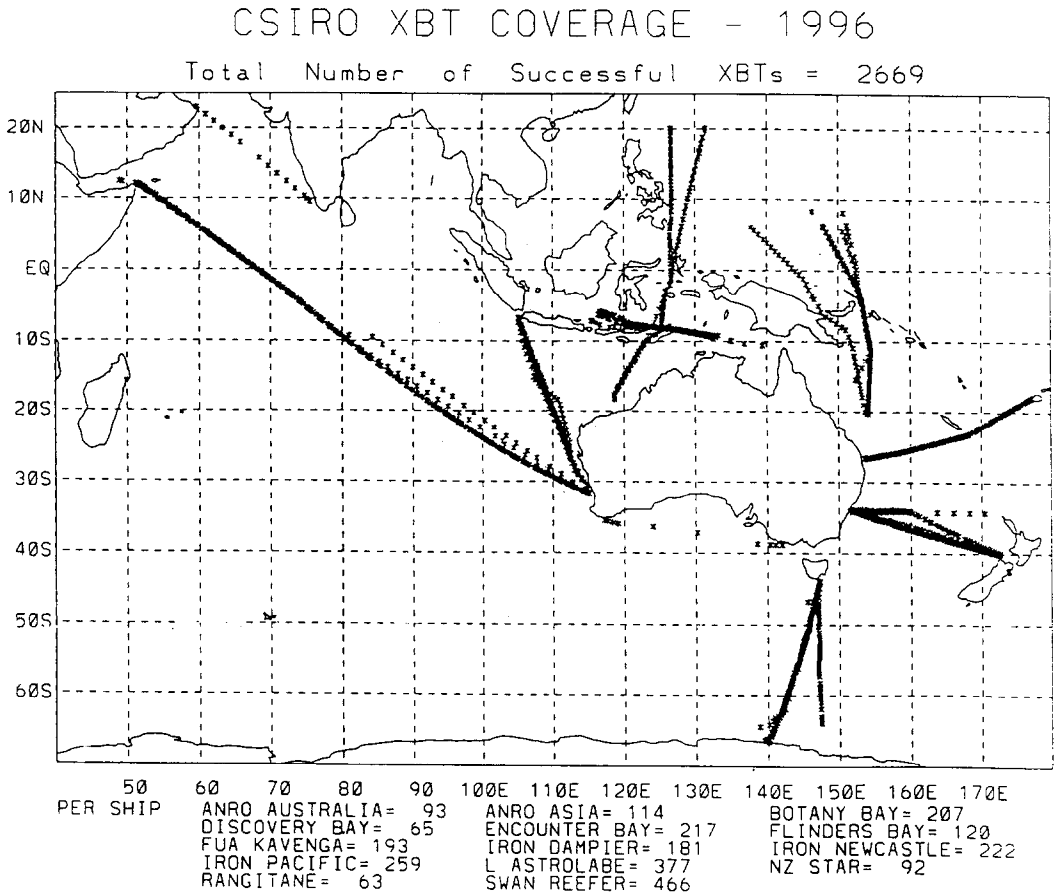

CSIRO XBT COVERAGE - 1996
Total Number of Successful XBTs = 2669
20N
10N
EQ
10S
20S
30S
40S
50S
60S
50 60 70 80 90 100E 110E 120E 130E 140E 150E 160E 170E
PER SHIP
ANRO AUSTRALIA= 93
DISCOVERY BAY= 65
FUA KAVENGA= 193
IRON PACIFIC= 259
RANGITANE= 63
ANRO ASIA= 114
ENCOUNTER BAY= 217
IRON DAMPIER= 181
L ASTROLABE= 377
SWAN REEFER= 466
BOTANY BAY= 207
FLINDERS BAY= 120
IRON NEWCASTLE= 222
NZ STAR= 92

Figure 7:

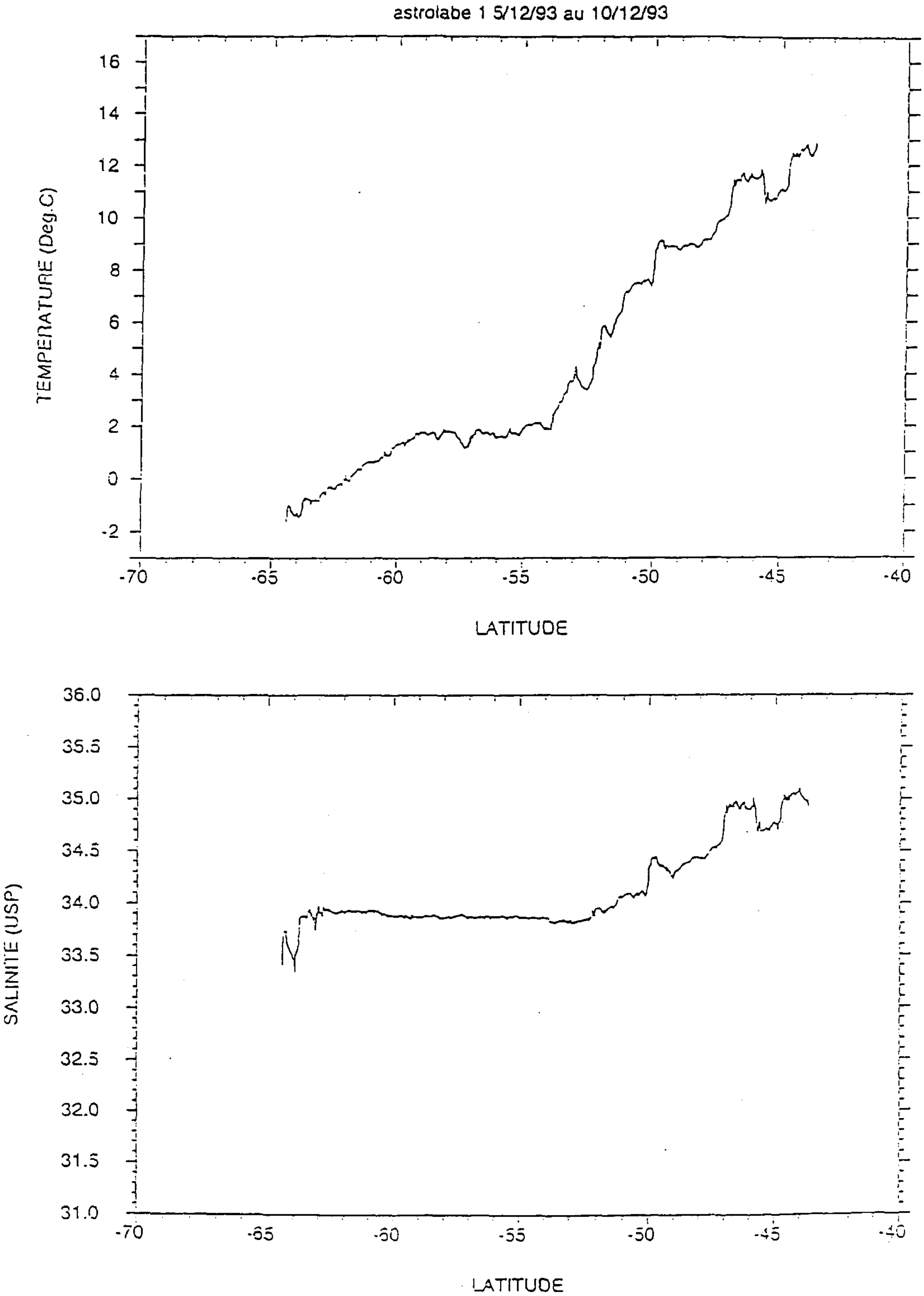


Figure 8: SST and SSS between Hobart and Dumont d'Urville (IX-28).

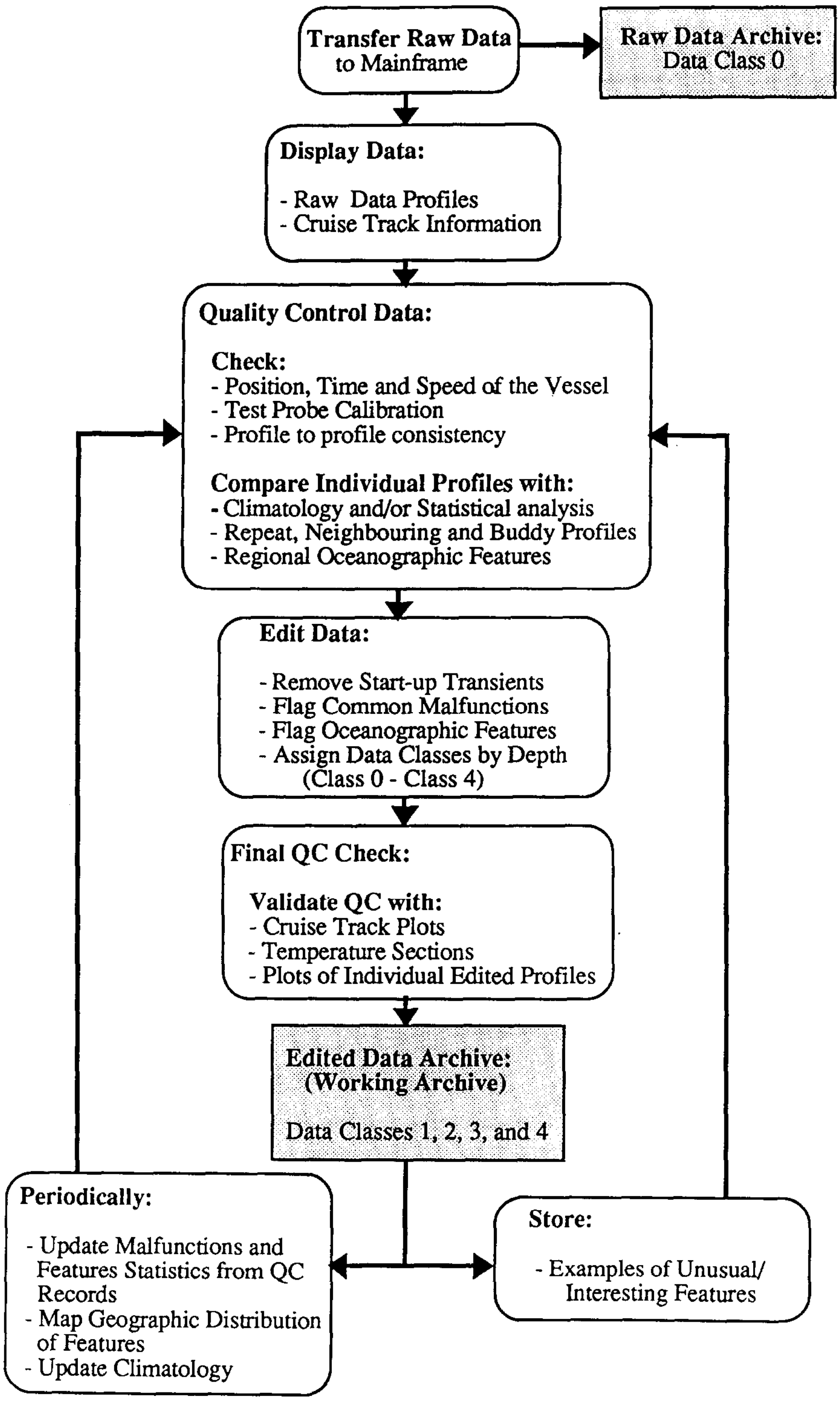


Figure 9: CSIRO XBT data processing flow chart.

B. ROYAL AUSTRALIAN NAVY (RAN) AND ROYAL NEW ZEALAND NAVY (RNZN) XBT PROGRAMME ACTIVITIES

1. BACKGROUND

1.1 XBT DATA - Delayed Mode

The AODC is a national archival centre and processing centre for RAN and RNZN gathered XBT data.

During 1996 AODC received over 2000 XBT's from 48 seperate crusies and 17 RAN and RNZN ships. Table A lists statistics of the crusies received.

Data comes predominantly from the Sippican Inc. model mk12 digital XBT recorder, however 1 RAN ship and 3 RNZN ships are still using the older analogue mk2a recorder.

The installation and maintainence of the mk12 systems on RAN ships is done by the RAN - Applied METOC Centre (AMC) with technical input from the AODC.

The mk12 digital data is processed and quality controlled at AODC using the CSIRO developed QUEST software. The analogue mk2a traces are checked for faults at AODC and forwarded to NODC in the USA for digitising. The digitsed mk2a data is then added to the global database at NODC/WDC-A. All analogue and digital data is submitted on an annual basis to NODC/WDC-A.

1.2 BATHY DATA - Real-Time

The AODC is a national archival and monitoring centre for real-time BATHY signals received from the Australian node of the WMO operated Global Telecommunications System (GTS). The Austalian node of the GTS is located at the Australian Bureau of Meteorology (BOM) in Melbourne.

A global data set of BATHY signals from the GTS are received on a weekly basis via ftp from the BOM. A copy of these signals is also passed to the CSIRO Division of Marine Research for SOOP monitoring on a weekly basis.

The AODC produces monthly monitoring report of the number of BATHY signals received from each ship call-sign. This report is forwarded to the US National Ocean Service who combine reports from other GTS nodes in France, Japan and USA into a global report.

The aim of producing these reports is to monitor the data flow over ofGTS and to detect and correct any data routeing problems so that eachdata center gets a complete real-time dataset.

2. DEVELOPMENTS DURING 1995 - 1997

2.1 REVISED XBT FALL RATES AND THE NEW 'JJYY' BATHY CODE

In April 1995 the IOC-WMO advised of the implementation of a revised XBT fall-rate equation for certain types of XBT probes in conjunction with a revision of the BATHY code to be effective from 8 November 1995.

In November 1995 the AODC revised its monthly BATHY report software to recognise and count the new BATHY signal format which begins with 'JJYY' instead of the old 'JJXX'. The software was modified to include seperate counts for JJYY and JJXX and also a combined count.

In January 1996 AODC and AMC decided to implement the JJYY code in conjunction with a planned upgrade to the old 386 type PC and mk12 v1.6 software/hardware on RAN warships. Ships were planned to receive new Pentium model PC's and a RAN customised v4.0 of the mk12 software.

During 1996 the AMC in conjunction with AODC and a contractor for Sippican (Digital Marine Inc.) worked on the modifying the Sippican v4.0 software to include automatic JJYY message generation and XBT data storage with the revised XBT fall rates. The operator data entry interface was improved to include format and range checking of latitude and longitude.

In January 1997 the first ship (HMAS Melbourne) received the new system and transmitted its first JJYY signal to the GTS. During 1997 new PC's and mk12/JJYY software will be installed on all RAN ships.

2.2 IMPLEMENTATION OF THE REVISED FALL RATES IN DELAYED MODE DATA

In August 1995 AODC submitted 1986 to 1994 digital mk9 and mk12 data to WDC-A in MEDS ASCII GTSPP format. This data format includes data fields to indicate:

a. the type of XBT recorder used [IOC-WMO code table 4770]
b. the probe type and fall rate used [IOC-WMO code table 1770]

Code tables 4770 and 1770 above were those as advised by IOC-WMO for the new JJYY BATHY codes. All the 1986-1994 data had depths using the old fall rates.

The 1995 data in MEDS ASCII GTSPP format also has depths with old fall rates. All data from 1996 onwards will use the depths calculated from the revised fall rates.

2.3 ROYAL NEW ZEALAND NAVY ACTIVITIES

The RNZN is prograssively replacing the analogue mk2a recorder with the mk12 recorder. The Hydrographic survey ship HMNZS Monowai already has the mk12 system. The warship HMNZS Canterbury converted over the mk12 v3.0 software in September 1996.

Very few BATHY signals appear from RNZN ships in the GTS data between 1996 and January 1997. These signals are in the old JJXX format.

TABLE A

Royal Australian Navy (RAN) XBT data collected in 1996

Cruise No.	No. Deployed	No.Accepted	Recorder Type
96001.AD	10	9	MK12
96002.ME	33	33	MK12
96003.NE	98	87	MK12
96004.SY	62	60	MK12
96005.SW	78	73	MK12
96006.ME	31	30	MK12
96007.BR	74	67	MK12
96008.AD	80	79	MK12
96012.ME	48	45	MK12
96013.PE	91	79	MK12
96014.NE	82	79	MK12
96015.PE	84	78	MK12
96016.NE	65	57	MK12
96017.ME	8	8	MK12
96018.CA	12	11	Mk12
96019.BR	78	77	Mk12
96020.SY	99	93	MK12
96021.SW	70	68	MK12
96022.NE	68	60	MK12
96023.AD	70	60	MK12
96024.FL	20	20	MK2a
96025.DA	93	81	MK12
96026.ME	90	87	MK12
96027.BR	86	74	MK12
96031.AN	85	61	MK12
96032.NE	50	49	MK12
96035.AD	70	51	MK12
96036.SY	99	97	MK12
96037.CA	9	8	MK12
96038.AN	84	73	MK12
96042.HO	21	14	MK12
96043.TO	84	82	MK12
96044.ME	56	53	MK12
96045.PE	57	51	MK12
96046.BR	55	52	MK12
96047.DA	73	70	MK12
96048.MO	4	4	MK12
Total	2277	2060	

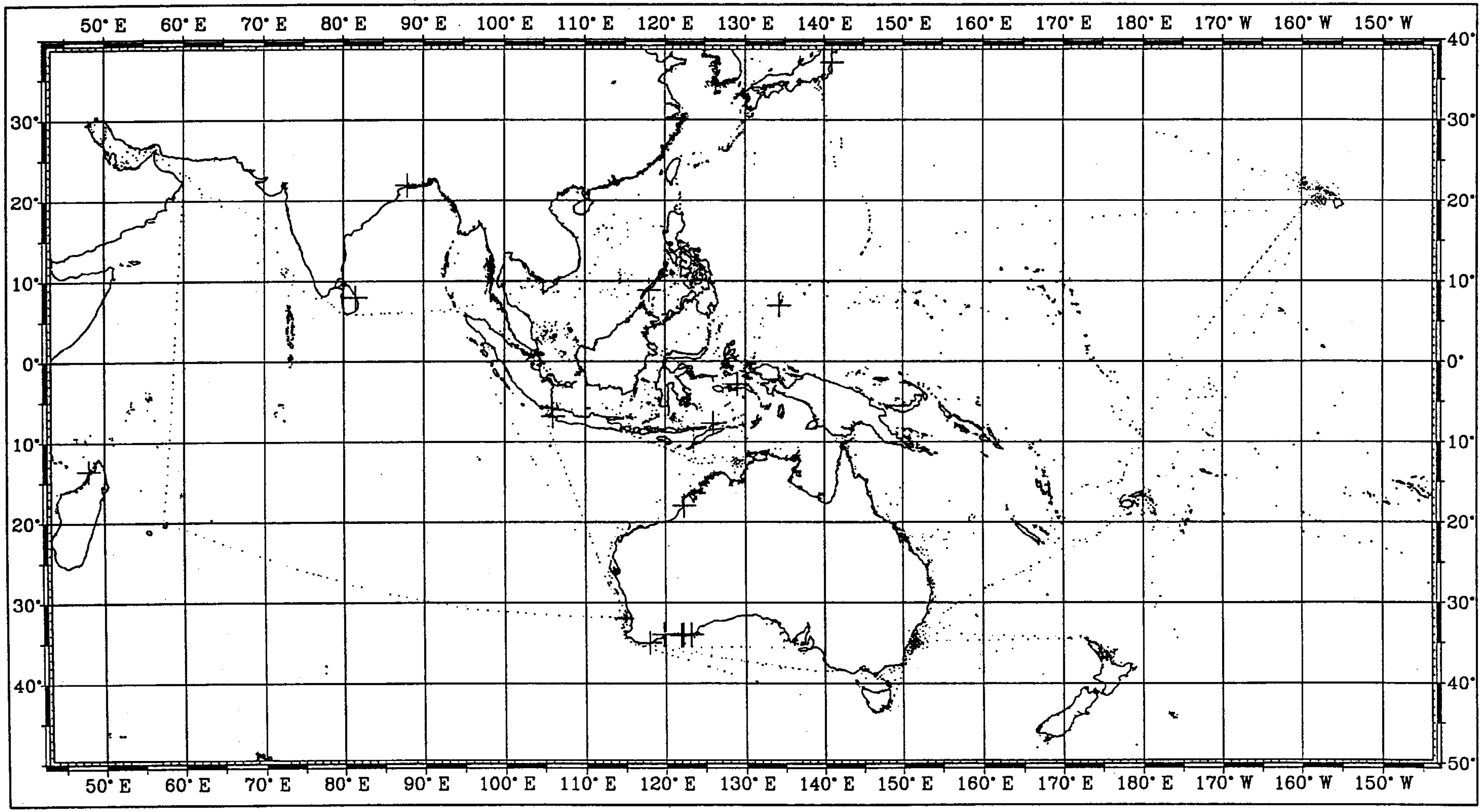
TABLE A (cont)

Royal New Zealand Navy (RNZN) XBT data collected in 1996

Cruise No.	No. Deployed	No.Accepted	Recorder Type
96009.MW	5	4	MK12
96010.MW	14	12	Mk12
96011.MW	2	1	MK12
96028.WE	45	36	MK2a
96029.WE	38	31	MK2a
96030.CN	6	5	MK2a
96033.CN	5	4	MK2a
96034.CN	39	28	MK2a
96039.CN	6	6	MK2a
96040.CN	17	13	MK12
96041.CN	8	5	MK12
Total	185	145	

RAN/RNZN MK12 XBT DATA COLLECTED IN 1996

Total – 2060



CANADA

XBT ACTIVITIES IN CANADA 1996

1. Military

XBT TRANSMISSIONS 1996 CANADIAN NAVY

NAVY XBT CR_NUMBER	SHIP	STN	SV	START DATE	END DATE	ACCESSION
18AH96001	ATHABASKAN	87	1	20/8/96	24/9/96	A9705901
18AO96001	ANNAPOLIS	2		4/18/96	4/25/96	A9618601
18AO96002	ANNAPOLIS	12		5/7/96	7/7/96	A9705801
18AO96003	ANNAPOLIS	7		10/7/96	17/7/96	A9705801
18AQ96001	ALGONQUIN	36		1/30/96	2/19/96	A9618601
18AQ96002	ALGONQUIN	4		3/6/96	3/8/96	A9618601
18AQ96003	ALGONQUIN	222		19/3/96	27/6/96	A9705801
18AQ96004	ALGONQUIN	11		24/9/96	1/10/96	A9705801
18AQ96005	ALGONQUIN	11		10/9/96	17/10/96	A9705801
18AQ96006	ALGONQUIN	12		23/10/96	30/10/96	A9705801
18AQ96007	ALGONQUIN	9		18/11/96	21/11/96	A9705801
18C696001	CALGARY	90		15/8/96	24/10/96	A9705801
18C696002	CALGARY	2		4/12/96	4/12/96	A9705801
18C896001	CHARLOTTETOWN	60	54	2/23/96	4/5/96	A9615501
18HL96001	HALIFAX	5	5	28/11/96	29/11/96	A9704201
18HL96002	HALIFAX	3	3	3/12/96	5/12/96	A9704201
18HN96001	HURON	8		16/9/96	20/9/96	A9705801
18HN96002	HURON	7		5/9/96	27/9/96	A9705801
18HN96003	HURON	16		1/10/96	10/10/96	A9705801
18HN96004	HURON	28		13/11/96	20/11/96	A9707701
18MP96001	MONTREAL	2		2/8/96	2/8/96	A9615501
18NN96001	NIPIGON	17	1	2/6/96	3/6/96	A9615501
18NN96002	NIPIGON	4	4	3/26/96	3/27/96	A9615501
18NN96003	NIPIGON	3		19/9/96	25/9/96	A9704201
18NN96004	NIPIGON	45	43	8/10/96	17/10/96	A9704201
18NN96005	NIPIGON					A9704201
18NN96006	NIPIGON					A9704201
18OD96001	ONONDAGA	6		1/10/96	1/21/96	A9615501
18OW96001	OTTAWA	36		29/11/96	18/12/96	A9605801
18RN96001	REGINA	191		19/3/96	21/6/96	A9705801
18RN96002	REGINA	15		17/9/96	27/9/96	A9705801
18RN96003	REGINA	11		3/10/96	10/10/96	A9705801
18S696001	ST JOHN'S	24		13/11/96	26/11/96	A9705901
18TN96001	TERRA NOVA	27		2/5/96	2/29/96	A9615501
18TN96002	TERRA NOVA	12		3/25/96	3/29/96	A9615501
18TR96001	TORONTO	112	1	2/22/96	4/1/96	A9615501
18TR96002	TORONTO	51		13/6/96	27/6/96	A9705901
18TR96003	TORONTO	16	6	19/8/96	10/9/96	A9705901
18TR96004	TORONTO	44		17/9/96	8/10/96	A9705901
18VQ96001	VILLE DE QUEBEC	80	79	2/23/96	4/2/96	A9615501
18VQ96002	VILLE DE QUEBEC	27	19	20/8/96	30/8/96	A9704201
18VQ96003	VILLE DE QUEBEC	21	12	4/11/96	8/11/96	A9704201
18VC96001	VANCOUVER	10		1/29/96	2/1/96	A9618601
18VC96002	VANCOUVER	15		6/8/96	18/8/96	A9705801
18WN96001	WINNIPEG	46		1/29/96	2/18/96	A9618601
18WN96002	WINNIPEG	254		19/3/96	26/6/96	A9705801
18WN96003	WINNIPEG	6		10/9/96	11/9/96	A9705801
18WN96004	WINNIPEG	10		24/9/96	27/9/96	A9705801

18WN96005	WINNIPEG	29	30/9/96	11/10/96	A9705801
18WN96006	WINNIPEG	30	13/11/96	21/11/96	A9705801

2. Line AX2 (Joint with NOAA)

AX2 XBT Line for 1996

Crossing	Dates	Number of Drops
1	January 6 to 10	20
2	February 3 to 8	19
3	March 2 to 8	48
4	March 30 to April 2	18
5	May 11 to 15	13
6	June 8 to 12	17
7	July 8 to 12	38
8	August 31 to September 4	17
9	October 26 to 28	11

3. OTHER

XBT probes are also used on oceanographic cruises at three scientific laboratories of Fisheries and Oceans Canada:

A) Bedford Institute of Oceanography, Dartmouth, NS
B) North Atlantic Fisheries Centre, St. John's, NF
C) Institute of Ocean Sciences, Victoria, BC

These laboratories collect their XBT data from individual scientific missions, do their own initial QC, and archive the profiles at MEDS. There is normally no attempt to make the delayed-mode deadline and so the profiles are normally not included in the IGOSS database.

FRANCE

France participated to the SOOP Programme regularly to monitor the tropical area of Pacific, Atlantic and Indian oceans from several ORSTOM Centers.

GOOS-France being not yet organized, ORSTOM, IFREMER and METEO-France provided funds to run the programme.

Pacific Ocean .

1995 :

XBT
- -1995 map
- -Drops / lines
- -Drops / ships

TSG
- -1995 map
- -Voyages / lines

Buckets
- -1995 map (2168 observations)

1996 ;

XBT
- -1996 map
- -Drops / lines
- -Drops / ships

TSG
- -1996 map
- -voyages/ lines

Buckets
- -1996 map (2276 observations)

Atlantic and Indian Oceans

XBT
- -1995 map
- -1996 map
- -1996 Drop / ships

Bathy and Tesac Messages
- -1995 map (53 281 messages)
- -1996 map (50 755 messages)

France participated actively to Ship of Opportunity Programme in 1995 and 1996 in the four oceans by operating major XBT lines, the reception of Bathy and Tesac messages on the GTS and the processing and archiving of data in Brest Subsurface data Center. P.Rual (ORSTOM-Noumea) contributed to the determination of new Depth Equation for XBT.

In the Atlantic and Indian ocean 13 ships selected by ORSTOM-Le Havre observed thermal structures on XBT lines AX20, AX11, AX05,AX11,AX15, IX03and IX10 (1587 profiles in 1996).

ORSTOM-Noumea selected 11 ships which launched XBTs in the western Pacific (PX03, PX04,PX05,PX06, PX53) and in the central (PX12) and eastern Pacific (PX17)

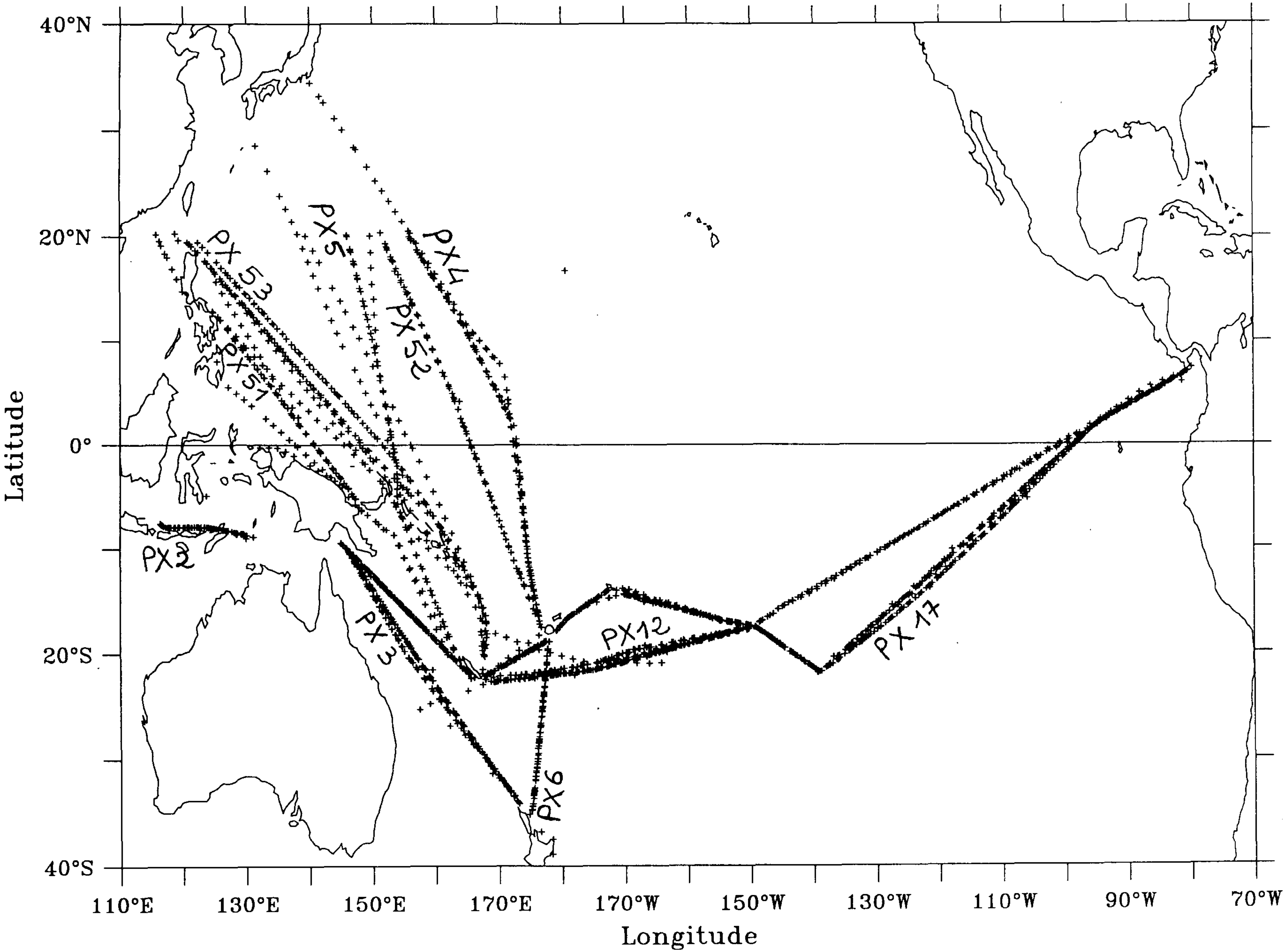
In the Southern ocean the Supply Vessel L'Astrolabe (IFRP) made every austral summer, 10 surveys between Hobart(Tasmania) and Terre Adelie (Antarctica) according a joint French-Australia-US programme.

Besides sea surface salinity measurements from bucket sampling (4500 observations/year) France developped the sea surface salinity monitoring with automated Thermosalinographs on ships of opportunity. Actually two ships operate in the Atlantic, two in the western Pacific, two on a shipping line around the world and one in the Southern ocean.

The development of the thermosalinograph network in cooperation is beyond the objectives of ORSTOM.

References : Henin C. and J. Grelet, 1996 : A merchantship thermosalinograph network in the Pacific Ocean. *Deep Sea Research* Vol 43, 11-12, pp 1833-1855.

Rual P., A.Dessier, JP Rebert, A.Sy, K.Hanawa, 1996 : New depth equation for Sparton XBT-7. Preliminary results. *International WOCE Newsletter*, 24, pp 39-40



XBT 95 2815 tirs

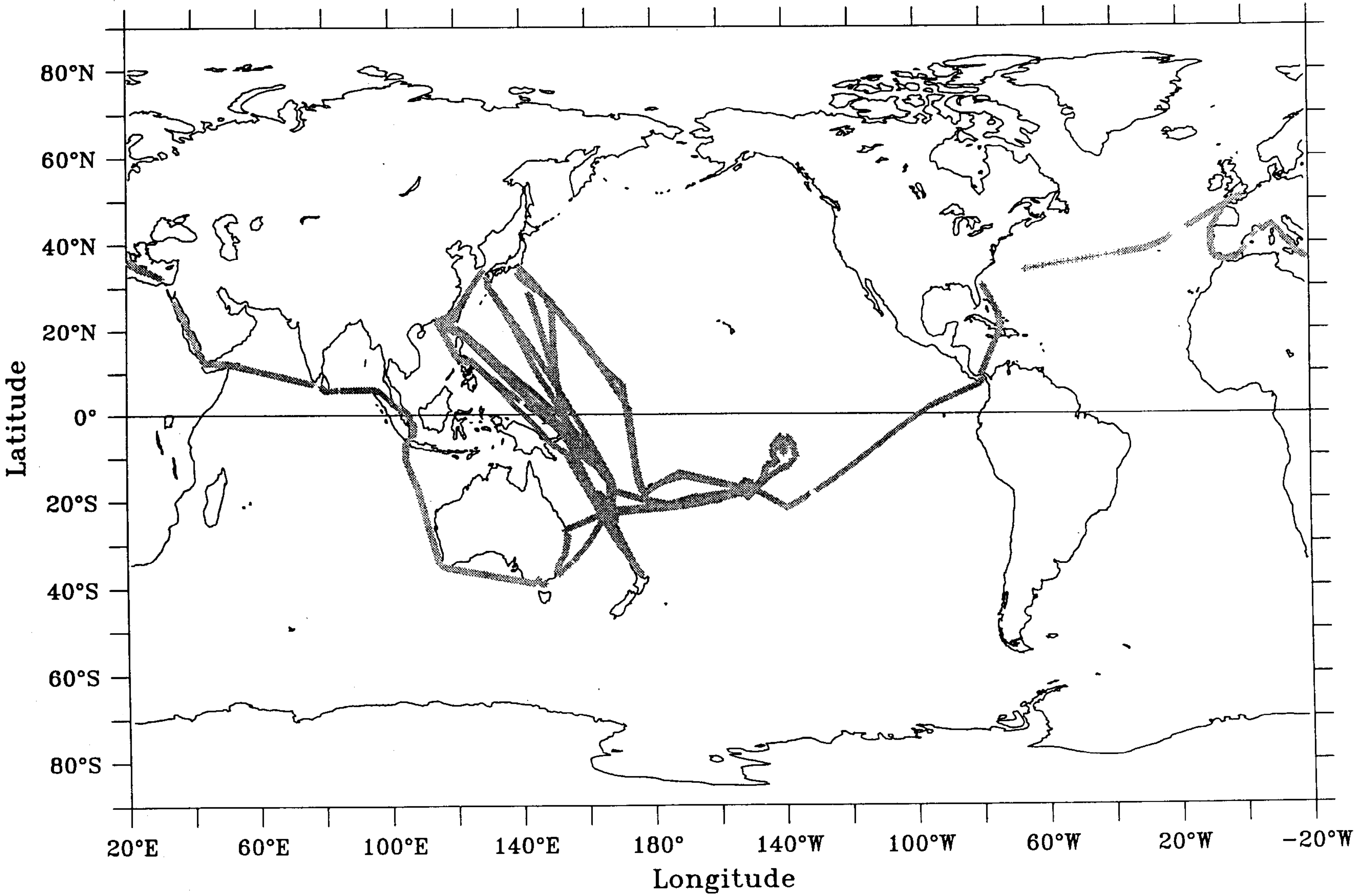
BILAN95.XLS

BILAN DES TIRS XBT POUR L'ANNEE 1995.

NAVIRE	SIGLE	Nb de voyages	Voyages	tirs enreg.	bons tirs	% bons tirs	dernier passage	premier voyage
Coral Islander	CORA	6	CORA03 à O8	566	513	90,6	02/02/1996	16/08/1994
CGM Rimbaud	RIMB	3	RIMB26 à 28	172	155	90,1	19/02/1996	09/08/1988
CGM Ronsard	RONS	4	RONS10 à 13	233	200	85,8	08/01/1996	08/10/1988
CGM Racine	RACI	4	RACI25 à 28	228	210	92,1	06/12/1995	06/09/1988
CGM Renoir	RENO	2	RENO04 à 05	112	103	92,0	05/02/1996	fev .94
FORTHBANK	FORT	2	FORT13 à 14	155	145	93,5	24/12/1995	18/08/1989
EXPLORER	EXPL	3	EXPL21 à 23	168	158	94,0	12/07/1995	04/07/1991
CRUSADER	CRUS	6	CRUS07 à 11	366	348	95,1	10/02/1996	19/01/1994
CHALLENGER	CHAL	5	CHAL06 à 10	357	334	93,6	27/01/1996	22/12/1993
CLYDEBANK	CLYD	2	CLYD03 à 04	154	137	89,0	14/02/1996	17/03/1994
Pacific Islander	PAIS	6	PAIS85 à 90	542	506	93,4	30/12/1995	avant 86
TOTAUX	**11 Navires**	**43**		**3053**	**2809**	92,0		

BILIGN95.XLS

BILAN DES TIRS XBT PAR LIGNE POUR 1995.					
LIGNES	BATEAUX	VOYAGES	BONS TIRS	BATHYS	SECTIONS
PX 2	1	7	79	79	4,5
PX 3	2	23	352	352	14
PX 4	2	10	222	222	9
PX 5	4	11	190	190	7,5
PX 6	2	10	111	111	9
PX 12	11	38	630	630	29
PX 17	7	23	654	654	17,5
PX 30	2	2	12	10	1
PX 31	2	5	37	37	2,5
PX 51	3	5	135	135	3,5
PX 52	1	4	107	107	4
PX 53	2	9	265	265	6
TOTAUX	39	147	2794	2792	107,5



distribution thermosalino 95

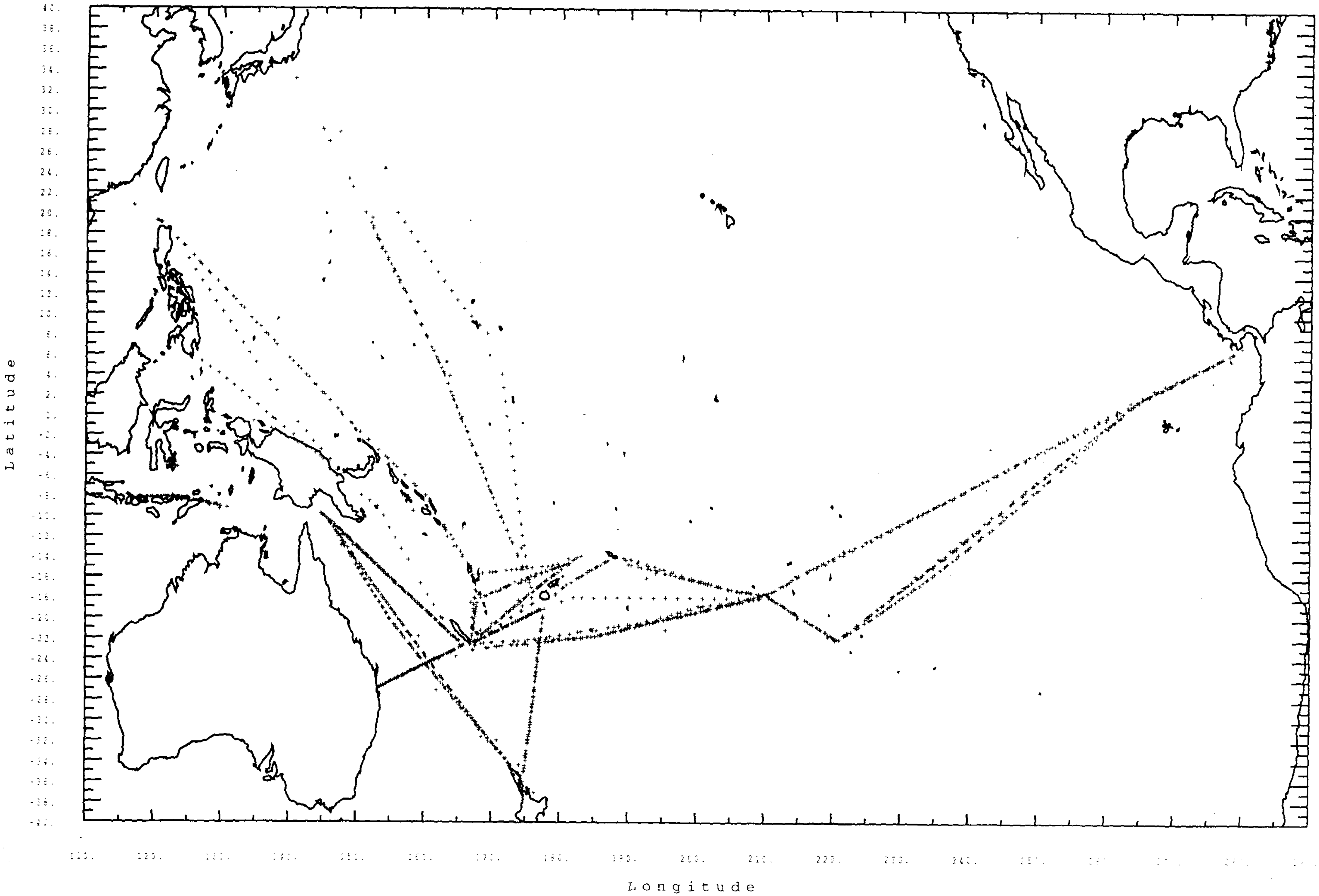
THERMO95.XLS

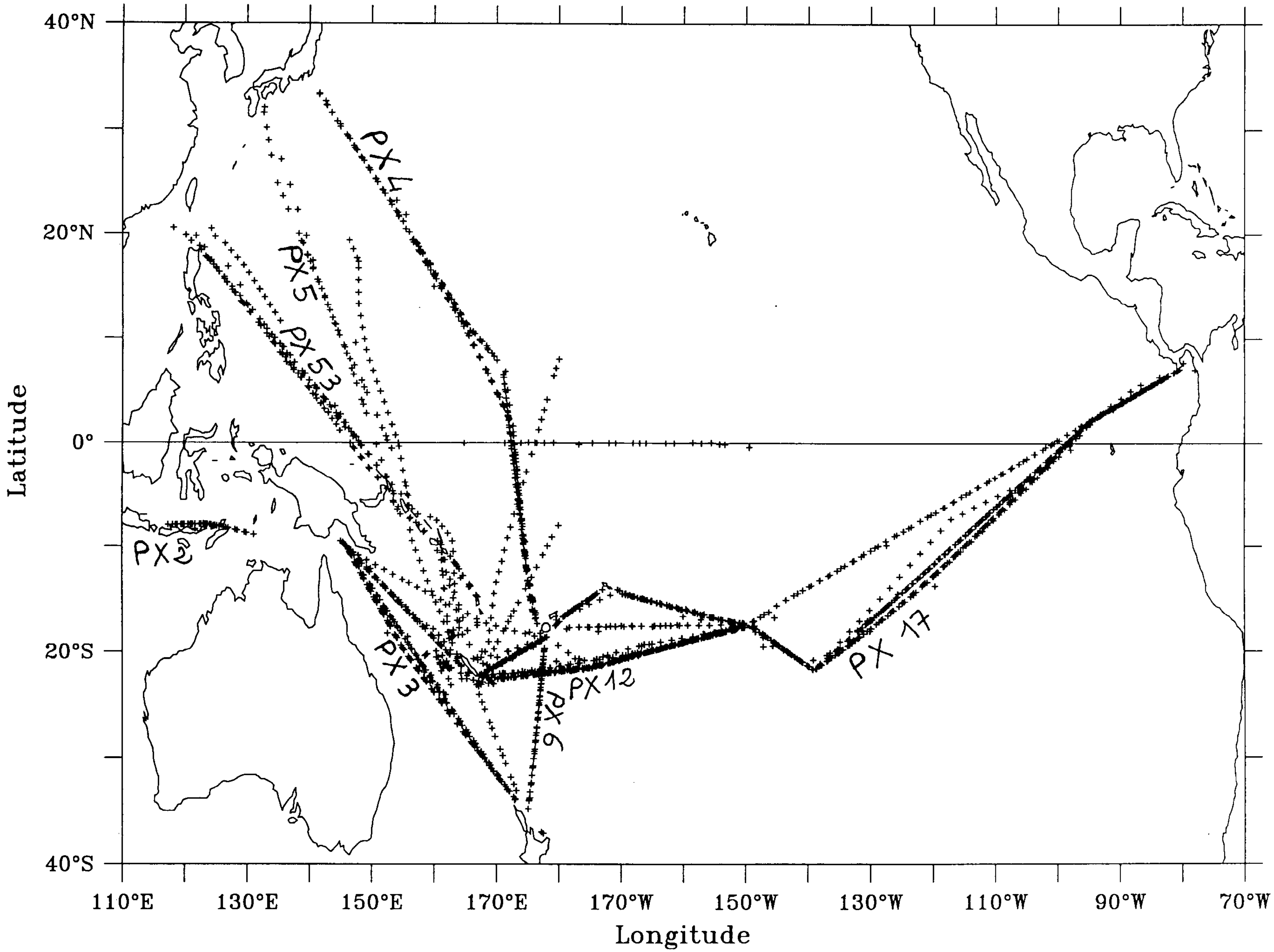
	BILAN THERMO PAR LIGNE POUR 1995.			
LIGNE	**NAVIRE**	**FICHIERS EN BASE**	**DONNEES PAR FICHIER**	**TRANSECTS**
PX 4	pacific islander	pais9501		1
		pais9502		1
		pais9503		1
		pais9504		1
		pais9505		1
		pais9506		1
	coral islander	cora9501		1
		cora9502		1
		cora9503		1
	s.total	**9 fichiers**		**9**
PX 5	explorer	expl9501		1
		expl9502		1
		expl9503		1
	s.total	**3 fichiers**		**3**
PX 9	explorer	3 idem		3
	s.total	**3 fichiers**		**3**
PX 12	pacific islander	6 idem		6
	coral islander	3 idem		3
	ronsard	rons9502		1
		rons9503		1
		rons9504		1
	s.total	**9 fichiers**		**9**
PX 17	ronsard	3 idem		1
	s.total	**3 fichiers**		**1**
PX 30	ronsard	3 idem		3
	s.total	**3 fichiers**		**3**
PX 51	explorer	3 idem		3
	s.total	**3 fichiers**		**3**
PX 53	pacific islander	6 idem		6
	coral islander	3 idem		3
	s.total	**9 fichiers**		**9**

THERMO95.XLS

ZONECO NC	N/O alis	alis9501		
		alis9502		
		alis9503		
		alis9504		
		alis9506		
		alis9507		
		alis9508		
		alis9509		
		alis9510		
		alis9511		
	s.total	**10 fichiers**		
	Pdt yewhene	yeye9501 (manque les voyages 24,27,28,30,43)		
		........à..........		
		yeye9544		39
	s.total	**39 fichiers**		
	Lady géraldine	lady9501		
		lady9503		
		lady9504		
		lady9505		
		lady9506		
		lady9507		
	s.total	**6 fichiers**		
IX 1	ronsard	3 idem		3
	s.total	**3 fichiers**		**3**
IX 10	ronsard	3 idem		3
	s.total	**3 fichiers**		**3**
AX 3	ronsard	3 idem		1
	s.total	**3 fichiers**		**1**
TOTAUX		**70 fichiers**		**47**
		differents.		**transects.**

ST/SSS NM : 1/95 a12/95 LONG 110./ 290. LAT -40./ 40. 2168





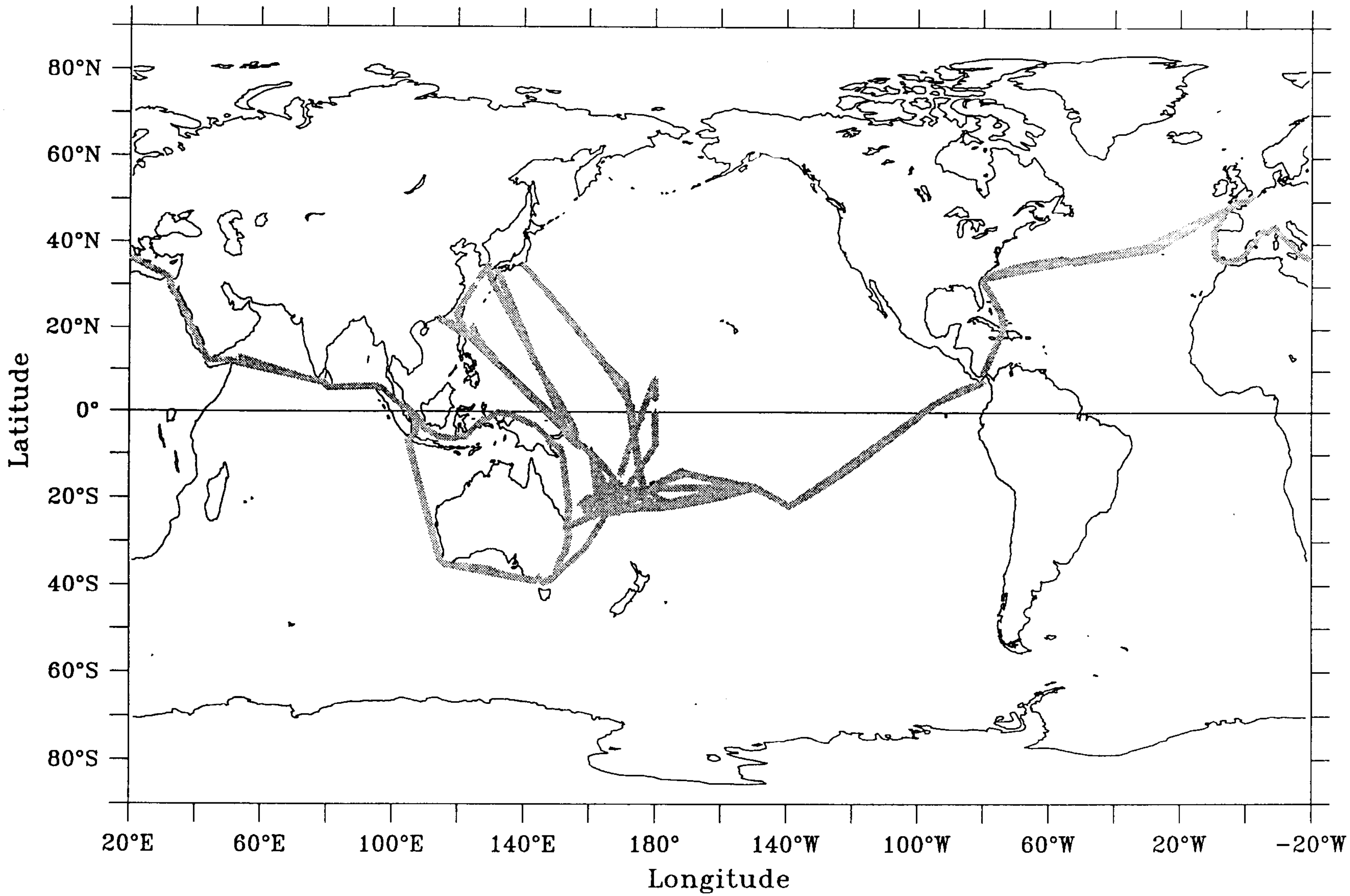
XBT 96 2589 tirs

BILIGN96.XLS

BILAN DES TIRS XBT PAR LIGNE POUR 1996.					
LIGNES	**BATEAUX**	**VOYAGES**	**BONS TIRS**	**BATHYS**	**SECTIONS**
PX 2	1	5	34	34	3
PX 3	2	19	330	330	14.8
PX 4	2	14	314	314	11.5
PX 5	3	10	150	150	2.3
PX 6	2	9	82	82	7.7
PX 9	2	3	32	32	3
PX 12	9	40	607	607	32.5
PX 17	5	25	616	616	16.6
PX 31	1	1	7	7	0.3
PX 53	3	9	178	178	6
IX 10	4	9	127	126	7.8
ZONECO	1	4	106	106	
EBENE	1	1	29	29	
TOTAUX	**36**	**149**	**2612**	**2611**	**105.5**

BILAN96.XLS

BILAN DES TIRS XBT POUR L'ANNEE 199				**1996.**				
NAVIRE	**SIGLE**	**Nb de voyages**	**Voyages**	**tirs enreg.**	**bons tirs**	**% bons tirs**	**dernier passage**	**premier voyage**
Coral Islander	CORA	6	CORA09 à 14	440	403	91,6	10/03/1997	16/08/1994
CGM Rimbaud	RIMB	4	RIMB29 à 32	256	245	95,7	25/02/1997	09/08/1988
CGM Ronsard	RONS	4	RONS14 à 17	296	273	92,2	16/01/1997	08/10/1988
CGM Racine	RACI	4	RACI29 à 32	296	283	95,6	19/12/1996	06/09/1988
CGM Renoir	RENO	3	RENO06 à 08	188	177	94,1	13/08/1996	fev .94
CRUSADER	CRUS	5	CRUS12 à 16	264	251	95,1	04/03/1997	19/01/1994
CHALLENGER	CHAL	6	CHAL11 à 16	300	291	97,0	27/01/1997	22/12/1993
Pacific Islander	PAIS	6	PAIS91 à 96	499	480	96,2	30/12/1995	avant 86
L'ATALANTE	ATAL	4	ATAL05 à 08	188	184	96,8	19/11/1996	27/06/1993
THOMSON	THOM	1	THOM01	25	25	100,0	01/05/1996	Avr-96
TOTAUX	**10 Navires**	**43**		**2752**	**2612**	**94,7**		



distribution thermosalino 96

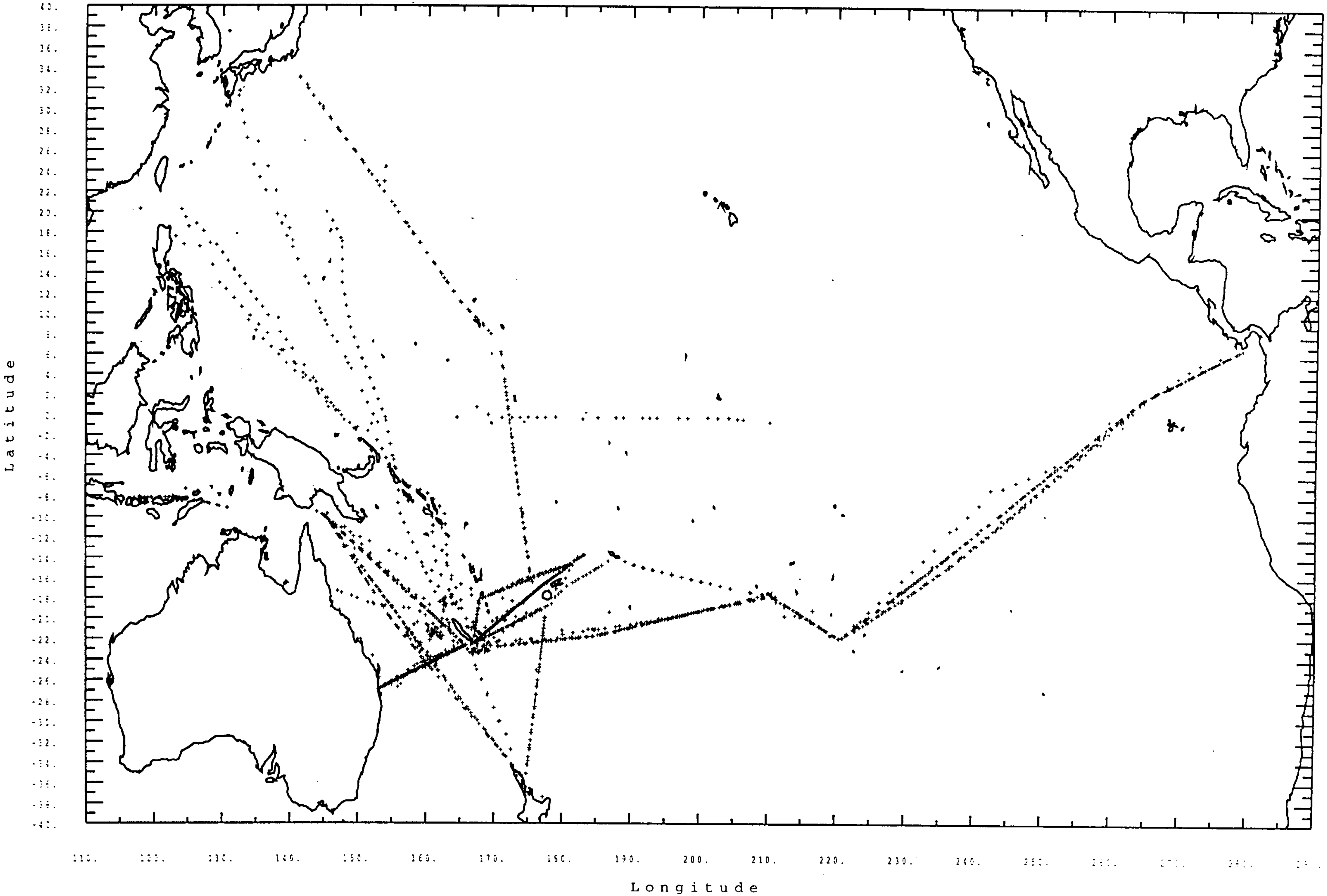
THERMO96.XLS

BILAN THERMOSALINOGRAPHES PAR LIGNE POUR 1996.				
LIGNE	NAVIRE	FICHIERS EN BASE	DONNEES PAR FICHIER	TRANSECTS
PX 4	pacific islander	pais9601		1
		pais9602		1
		pais9603		1
		pais9604		1
		pais9605		1
	coral islander	cora9601		1
		cora9603		
		cora9605		1
	s.total	**8 fichiers**		**8**
PX 12	pacific islander	5 idem		5
	coral islander	3 idem		3
	ronsard	rons9601		1
		rons9602		1
		rons9603		1
	rimbaud	rimb9602		1
		rimb9603		1
	s.total	**13 fichiers**		**13**
PX 17	ronsard	3 idem		3
	rimbaud	2 idem		2
	s.total	**5 fichiers**		**5**
PX 30	ronsard	3 idem		3
	rimbaud	1 idem		1
	s.total	**4 fichiers**		**4**
PX 53	pacific islander	5 idem		5
	coral islander	2 idem		2
	s.total	**7 fichiers**		**7**
ZONECO NC	l'atalante	atal9603		
		atal9604		
		atal9605		
	s.total	**3 fichiers**		
	lady geraldine	lady9601		
		........à.........		
		lady9662		
	s.total	**60 fichiers**		
	total	**63 fichiers**		
ZONALFLUX	R/V thomson	thom9601		
	s.total	**1 fichier**		
IX 1	ronsard	3 idem		3
	rimbaud	2 idem		2
	s.total	**5 fichiers**		**5**

THERMO96.XLS

IX 10	ronsard	3 idem		3
	rimbaud	2 idem		2
	s.total	**5 fichiers**		**5**
AX 3	ronsard	3 idem		3
	rimbaud	2 idem		2
	s.total	**5 fichiers**		**5**
TOTAUX		**77 fichiers**		**52**
		differents.	**données.**	**transects.**

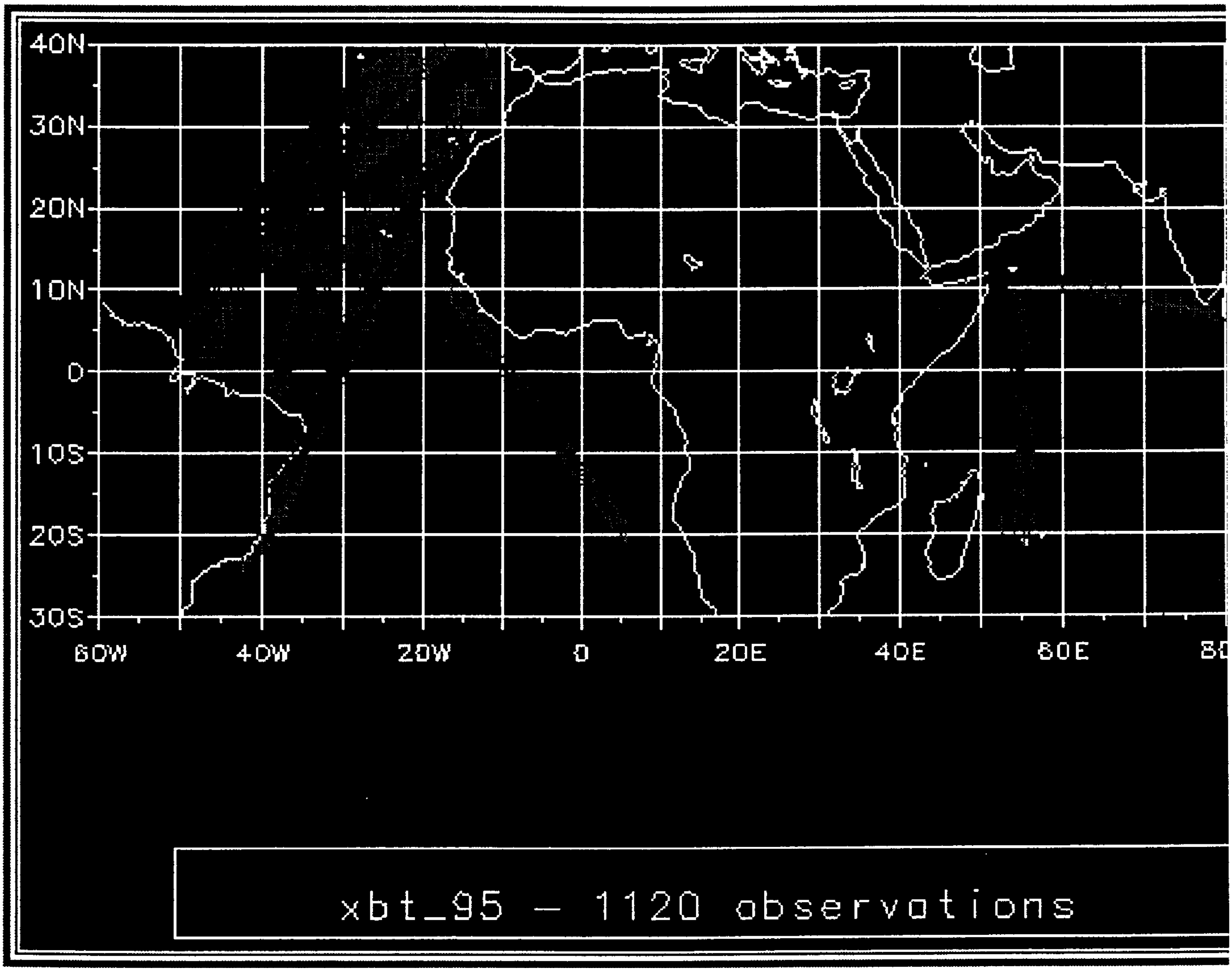
ST/SSS NM : 1/96 a12/96 LONG 110./ 290. LAT -40./ 40. 2276



Centre de Brest

Année 1995

1120 observations

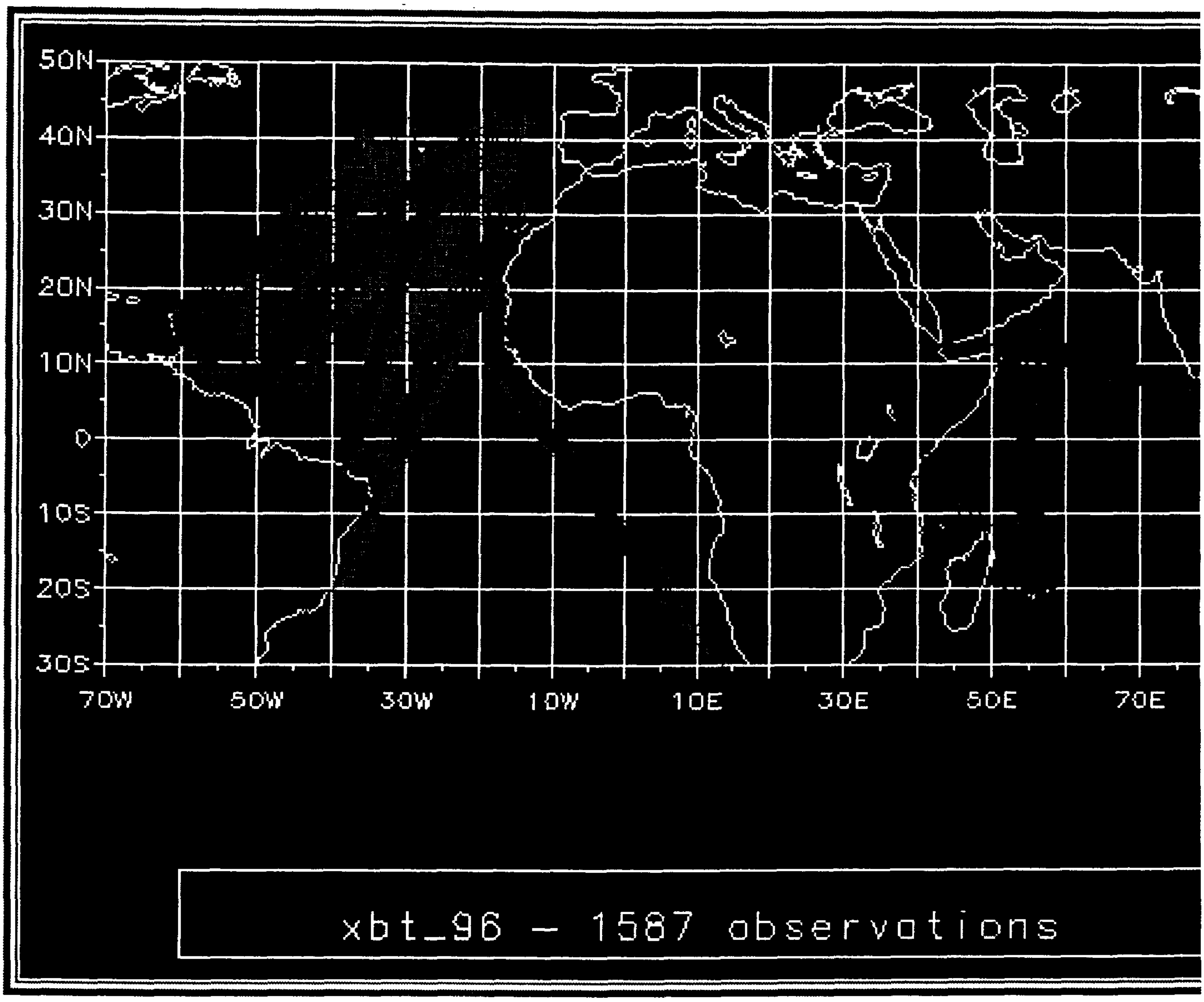


Les navires ayant participé à la collecte des observations en 1995

Centre de Brest

Année 1996

1587 observations



Les navires ayant participé à la collecte des observations en 1996

ORSTOM Centre de Brest

Statistiques par navire pour 1996

NAVIRE	Code radio	Nu balise	Code OMM	Nu ligne	Total lancers
ARIANA	DIDA	8749	04222	AX20/AX05	91
CARRYMAR	J8JA4	4726	04222	AX20/AX11	489
GUYANE	J8IU7	4724	04222	AX20/AX11	77
LA PÉROUSE	FNDH	4721	04222	AX11	236
NATHALIE DELMAS	FNWC	4722	04222	IX03	140
PATRICIA DELMAS	FNDK	8748	04222	IX03	97
RACINE	FNZP	4712	04221	IX10	42
RAIMBAUD	FNZQ	4712	04221	IX10	35
RENÉE DELMAS	FNQC	4704	04221	IX03	84
RENOIR	FNOM	4723	04222	IX10	40
RONSARD	FNPA	4725	04222	IX10	35
SEAL MADAGASCAR	C6ML4	8745	04222	AX15	81
SEAL RÉUNION	C6MJ2	8742	04222	AX15	159

Total - 1306

Le numéro de la balise Argos permet l'identification de la plate-forme et la récupération des données transmises par celle-ci.

Le code OMM, transmis avec les données, est composé de deux parties :

- un code de trois chiffres indiquant le type de sonde utilisée (042 = sonde Sippican T7, équation de calcul de la profondeur utilisant les coefficients en vigueur depuis le 08/11/95)
- un code de deux chiffres indiquant le type d'instrument :
  - 21 = interface CLS-ARGOS/Protecno modèle 1
  - 22 = interface CLS-ARGOS/Protecno modèle 2.

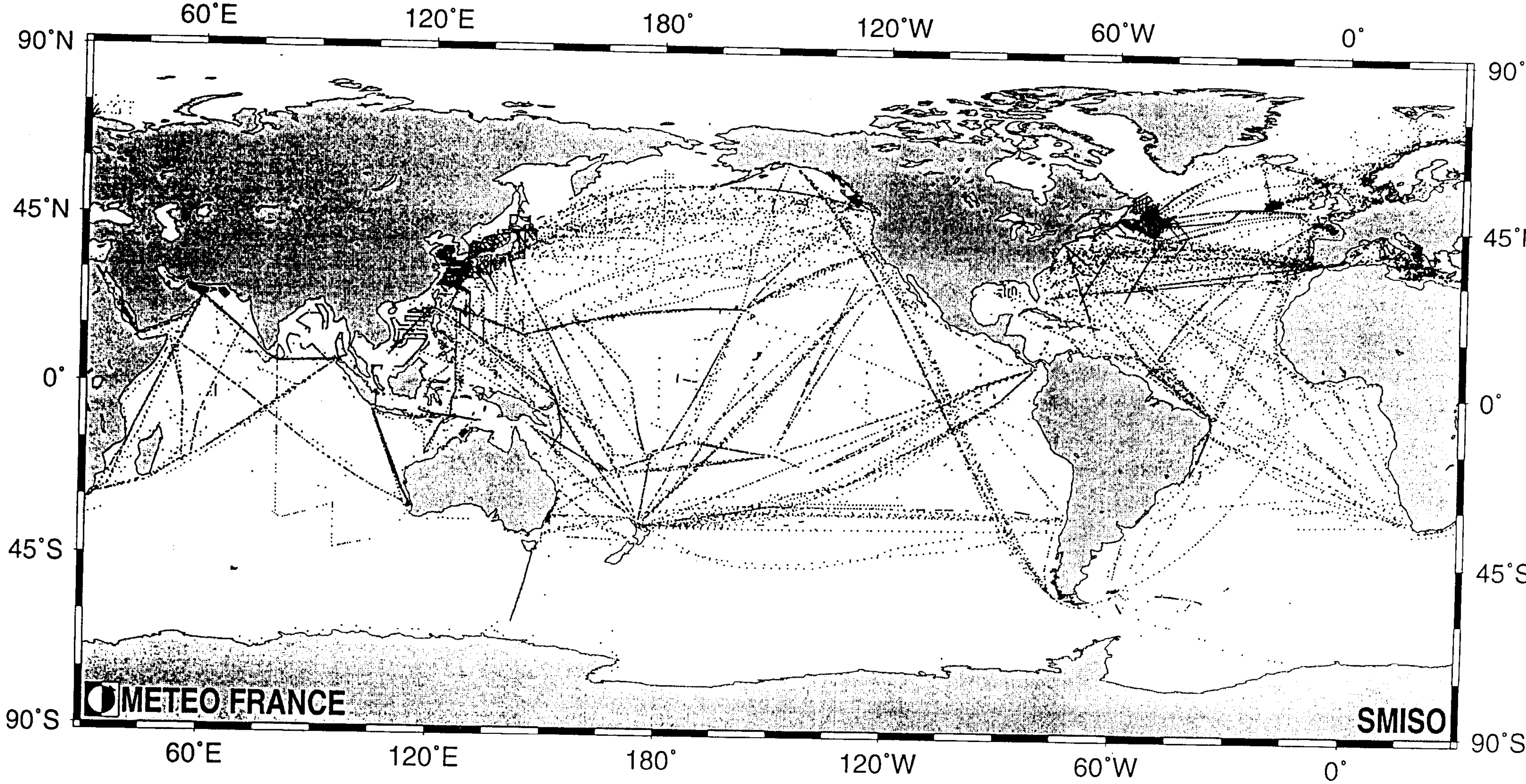
Page d'accueil

Carte de pointage des observations reçues en 1995

Mapping position plot chart of data received during 1995

Messages : BATHY (blue) + TESAC (red)

Total : 53281

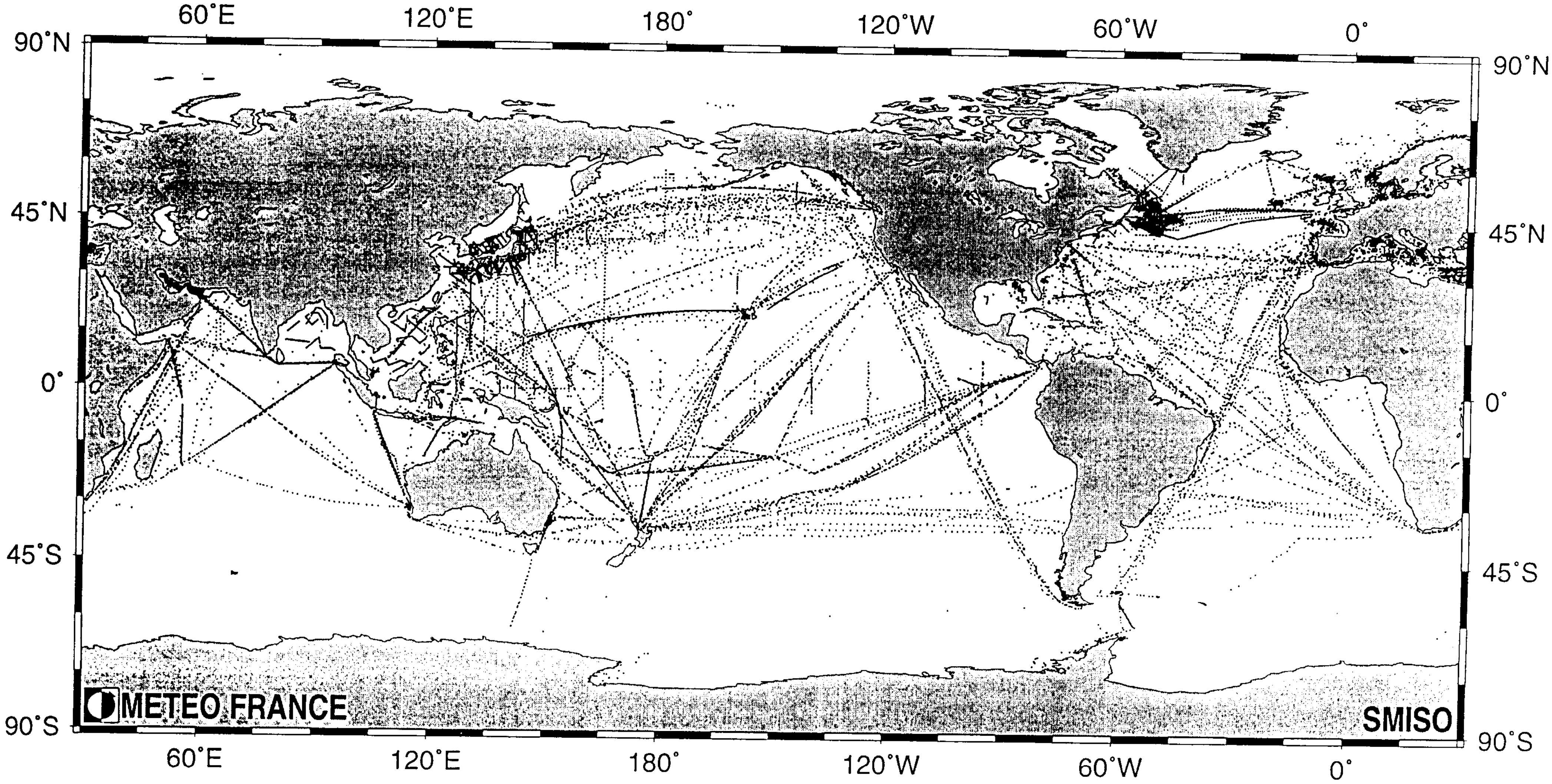


Carte de pointage des observations reçues en 1996

Mapping position plot chart of data received during 1996

Messages : BATHY (blue) + TESAC (red)

Total : 50755



GERMANY

1. Overview

As in previous years German ship-of-opportunity (SOO) activities are focussed on the Atlantic Ocean and are virtually unchanged from those reported at the last two IGOSS ship-of-opportunity programme meetings (IOC, 1993; 1995). Two German institutions operate ship-of-opportunity lines since several years: "Institut für Meereskunde", Kiel (IfM Kiel), and "Bundesamt für Seeschiffahrt und Hydrographie", Hamburg (BSH). Technical and organizational status of existing lines is summarized in the attached Table. These commercial vessel-based programmes are part of the German contribution to WOCE (TWI lines AX-3, 11, 17/18). In addition, in 1996 also several research vessels, e.g. "Gauss", "Polarstern", "Sonne" and "Walther Herwig III", carried out XBT measurements while en route. As in the past most of these SOOP activities are PI-driven, and thus are research-based rather than being an application-based official German contribution to IGOSS. Consequently, the termination of the WOCE field phase is marked by a significant reduction of XBT funding which finally will completely ceased until the end of 1997. In other programmes XBT funding suffers from budget cuts due to the tightened financial situation in Germany. Almost all real-time SOOP data are inserted onto GTS by BSH with a delay of about 3 days to 1 week. Real-time data from various oceans have been contributed to IGOSS by the German Navy which accounts for about 50 % of the German data circulating on the GTS.

2. XBT network

A regional overview of XBT measurements carried out in 1996 by BSH initiated SOOP is given in Fig. 1.

2.1 Line AX-1/2

XBT measurements in the subpolar North Atlantic are carried out about twice a year by R.V. "Walter Herwig III" operated by "Bundesforschungsanstalt für Fischerei", Hamburg (BFAFI). These contributions which occur on BSH's initiative are based on cruises in the framework of her fishstock surveys for the North Atlantic Fisheries Organisation (NAFO). Real-time and delayed mode data are processed by BSH. These measurements probably will be continued for the next years (M. Stein, pers. comm.).

2.2 Line AX-3

This line from the English Channel to Halifax/New York has been operated by BSH as a high density line without serious problems since 1988. The WOCE related programme is funded by the German Ministry of Education, Science, Research and Technology (BMBF) until the end of 1997. The scientific rationale is described in IOC (1993). From the start of the programme in 1988, measurements have been carried out regularly by the German container vessel "Köln Express" and have been supplemented irregularly by several research vessels. A Sippican MK-12 unit and NOAA's SEAS IV software is used for data acquisition and transmission. So far, the line has been kept operational almost without interruptions last but not least because some problems could be solved immediately thanks to the help of NOAA's SEAS field staff. Most transsects have a resolution of better than 40 nautical miles (Fig. 2). "Fast Deep" probes are used as a standard because these modified T-5 probes are capable of covering the upper 1200 m at a ship's speed of 20 knots.

2.3 Line AX-11

The Europe-Brazil line was established in 1981 by former DHI (now BSH) as the first German contribution to the IGOSS SOOP line system, and has been kept operational until today without major interruptions. Until summer 1996 the measurements were carried out by the German container vessel "Monte Rosa" on her way due north (Fig. 3). She has been replaced by "Cap Finisterre" as our new ship-of-opportunity on this line. At present no insuperable problems are recognizable which could jeopardize continuation of this programme. Both data acquisition system and data management are the same as for line AX-3 except that "Deep Blue" (T-7) XBTs are used as the standard probe type.

2.4 Line AX-17/18

The lines from South Africa to Brazil and Argentina were set up by IfM Kiel, as part of WOCE in 1989. The scientific objective is to investigate the heat storage variability in the upper ocean and the eddy activity of the Subtropical Gyre. The operation of these lines proved difficult due to long service distances between Germany and South Africa. The last two years, however, these lines could be improved by logistical support of the South African National Research Institute for Oceanology, Stellenbosch. Measurements with "Fast Deep" probes have been carried out by two Taiwanese vessels, "Excellence Container" and "Prosperity Container" (Fig. 4). Funding by the German Ministry of Education, Science, Research and Technology (BMBF) has already been terminated in 1995 but measurements continued for another year and will now fade out in spring/summer 1997 after the remaining probes in stock have been used up (T. Müller, pers. comm.).

2.5 Southern Ocean

Although efforts have been continued to collect data from the Southern Ocean R.V. "Polarstern" from "Alfred-Wegener-Institut", Bremerhaven (AWI), failed to transmit her BATHY messages during the 1995/96 Antarctic season due to technical problems. During the season 1996/97 no XBT measurements are carried out by AWI scientists, however, plans do exist to use XBTs in the next Antarctic research season (E. Fahrbach, pers. comm.).

3. XCTD Measurements

XBTs alone do not satisfactorily meet the requirements for the investigation of heat flux or other important processes. XCTD probes were therefore used as soon as they became available, and the first ocean crossing section was carried out by "Köln Express" in February 1992. Up to now 5 sections with XCTD measurements have been carried out along line AX-3. Whereas first XCTD versus CTD comparisons showed that XCTD probes needed further design developments by the manufacturer (Sy, 1993), the last field tests in the North Atlantic in December 1994 and October 1995 showed more satisfacory results (Sy, 1996). Finally, measurements carried out in June 1996 (Fig. 5) showed further significant data quality improvements after following a simple procedure of applying wetting agent just prior to launch. Nevertheless, XCTD data were not transmitted in real time via GTS following a recommendation from SOOP V (IOC, 1993) because the present TESAC code form do not allow to distinguish measurements made by different instruments.

4. Further activities

In 1996 we have continued to convert the CTD bottle readings into TESAC coded messages for transmittion from ship to BSH by e-mail in order to comply with the IGOSS request for more TESAC data. However, this procedure is used only for WOCE cruises because of the higher data quality standards of WOCE CTDs (e.g. along section AX-1 and AX-3).

The SST programme of BSH, which was established in 1987, has been started in 1996 to be supplemented by SSS measurements. Data are collected by both governmental and commercial vessels using Pt100 hull contact thermometers or thermosalinographs. All SST and SSS data received at BSH are inserted onto GTS as TRACKOB coded reports (Fig. 6).

Finally, temperature data from the following selected stations of the BSH's stationary "Marine Environmental Monitoring Network in the North and Baltic Seas" (MARNET) are inserted onto GTS as BATHY coded messages:
"Nordseeboje II" (55° 00.0' N, 6° 20.0' E)
"Deutsche Bucht" (54° 10.0' N, 7° 26.0' E)
"Fehmarnbelt" (54° 36.0' N, 11° 09.0' E)

5. 25 years of devoted BSH contribution to IGOSS

Since 1972 BSH has participated actively in IGOSS and acts as the German input and output GTS hub for real-time oceanographic bulletins. All German BATHY, TESAC and TRACKOB bulletins circulating on the GTS have been submitted by BSH. We hope to contribute in the same way in the future. Trackplots of the output for BATHY and TESAC messages in 1996 are given in Fig. 7 and Fig. 8 respectively. Fig. 9 shows that the contribution to the IGOSS real-time data flow has been relatively continuous during this period of time. Quality control of real-time data prior to insertion onto GTS is carried out by BSH personnel for most SOO data but not for Navy data. After transition deadline of November 8, 1995 and where information about probe types, recorders and fall rates (Hanawa et al., 1995) were available JJXX coded BATHY messages have been converted into new JJYY coded data prior to insertion onto GTS (IOC/WMO, 1995).

6. References

IOC (1993): Fifth Joint IOC-WMO Meeting for Implementation of IGOSS XBT Ship-of-Opportunity Programmes, Hobart, Tasmania, Australia, 23-26 March 1993. IOC Meeting Report No. 81.

IOC (1995): Sixth Joint IOC-WMO Meeting for Implementation of IGOSS XBT Ship-of-Opportunity Programmes, Ottawa, Canada, 26-20 October 1995. IOC Meeting Report No. 107; Summary of SOOP and Technical Reports (IOC/INF-1021)

IOC/WMO (1995): Joint IOC/WMO circular letter IGOSS Sp. No. 95-95.

Hanawa, K., P. Rual, R. Bailey, A. Sy and M. Szabados (1995): A new depth-time equation for Sippican or TSK T-7, T-6 and T-4 expendable bathythermographs (XBT). Deep-Sea Res. 42, 1423-1451.

Sy, A. (1993): Field Evaluation of XCTD Performance. WOCE Newsletter, **14**, pp 33 - 37.

Sy, A. (1996): Summary of field tests of the improved XCTD/MK-12 System. International WOCE Newsletter, **22**, 11-13.

Table 1: Status of existing SOO lines operated by German institutions (spring 1997)

	Europe-Greenland	Europe-Halifax	Europe-Brazil	S.America-Cape Town	Cape Town-Antarctica
TWI #	AX-1/2	AX-3	AX-11	AX-17/AX-18	AX-22/25
Ship	"Walther Herwig III"	"Köln Express"	"Monte Rosa" "C.Finisterre"	"Prosperity Cont." "Excellence Cont."	"Polarstern"
Callsign	DBFR	9VBL	DGLM DACF	BMAD BMAE	DBLK
Start	11/1989	5/1988	1981	1989	
Finish	open	1998	open	summer 1997	
Frequency	2/yr	8/yr	7/yr	6/yr	irregular
Density	6/d	12/d	6/d	6/d	6/d
Probes	Sippican T-7	Sippican FastDeep occ. XCTD	Sippican T-7	Sippican FastDeep	Sparton XBT-7
Equipment	Bathy S. SA-810	SEAS IV MK-12	SEAS IV MK-12	Nautilus PC, DCP	Nautilus PC, DCP
Real-time	METEOSAT	METEOSAT	METEOSAT	METEOSAT	METEOSAT
Agency	BFAFI Hamburg	BSH Hamburg	BSH Hamburg	IfM Kiel	AWI Bremerhaven
Programme	Fisheries	WOCE	IGOSS/WOCE	WOCE	AWI
PI	M.Stein	A.Sy	A.Sy	G.Siedler	E.Fahrbach
1-12/1995:					
Sections	2	8	7	7	1
Profiles	60	442	362	287	?
GTS	36	394	361	146	76
1-12/1996:					
Sections	3	9	6	11	2
Profiles	70	598	309	468	305
GTS	-	521	299	183	-
Problems:	-	-	-	Shipping Lines, Funding, Logistics	Data Quality, Costs vs.Benefit
Remarks:		proposed for GOOS	proposed for GOOS	End of operation late spring 1997	

In addition, several research vessels carry out XBT measurements irregularly while en route, e.g.

R.V. "Meteor"	DBBH
R.V. "Walther Herwig III	DBFR
R.V. "Gauss"	DBBX
R.V. "Valdivia"	DESI
R.V. "Poseidon"	DBKV
R.V. "Polarstern"	DBKL
R.V. "Sonne"	DFGG

Figure Captions

Fig. 1: XBT data distribution of BSH initiated measurements carried out in 1996

Fig. 2: Example of a "Fast Deep" XBT section across the North Atlantic (AX-3) carried out by CMS "Köln Express" in July 1996

Fig. 3: The last AX-11 XBT section carried out by CMS "Monte Rosa" (August 1996)

Fig. 4: XBT data distribution of line AX-17/18 in 1995 and 1996 and XBT section from Cape Town to Buenos Aires along 34 °S (AX-18) carried out by CMS "Prosperity Container" in December 1996.

Fig. 5: XCTD Sections of temperature and salinity obtained from R.V. "Gauss" in June 1996 along AX-3

Fig. 6: Trackplot of TRACKOB messages of the BSH SST/SSS programme in 1996

Fig. 7: Trackplot of BATHY messages received at BSH in 1996 (output + input)

Fig. 8: Trackplot of TESAC messages received at BSH in 1996 (output + input)

Fig. 9: Time series of yearly BATHY, TESAC and TRACKOB input by BSH

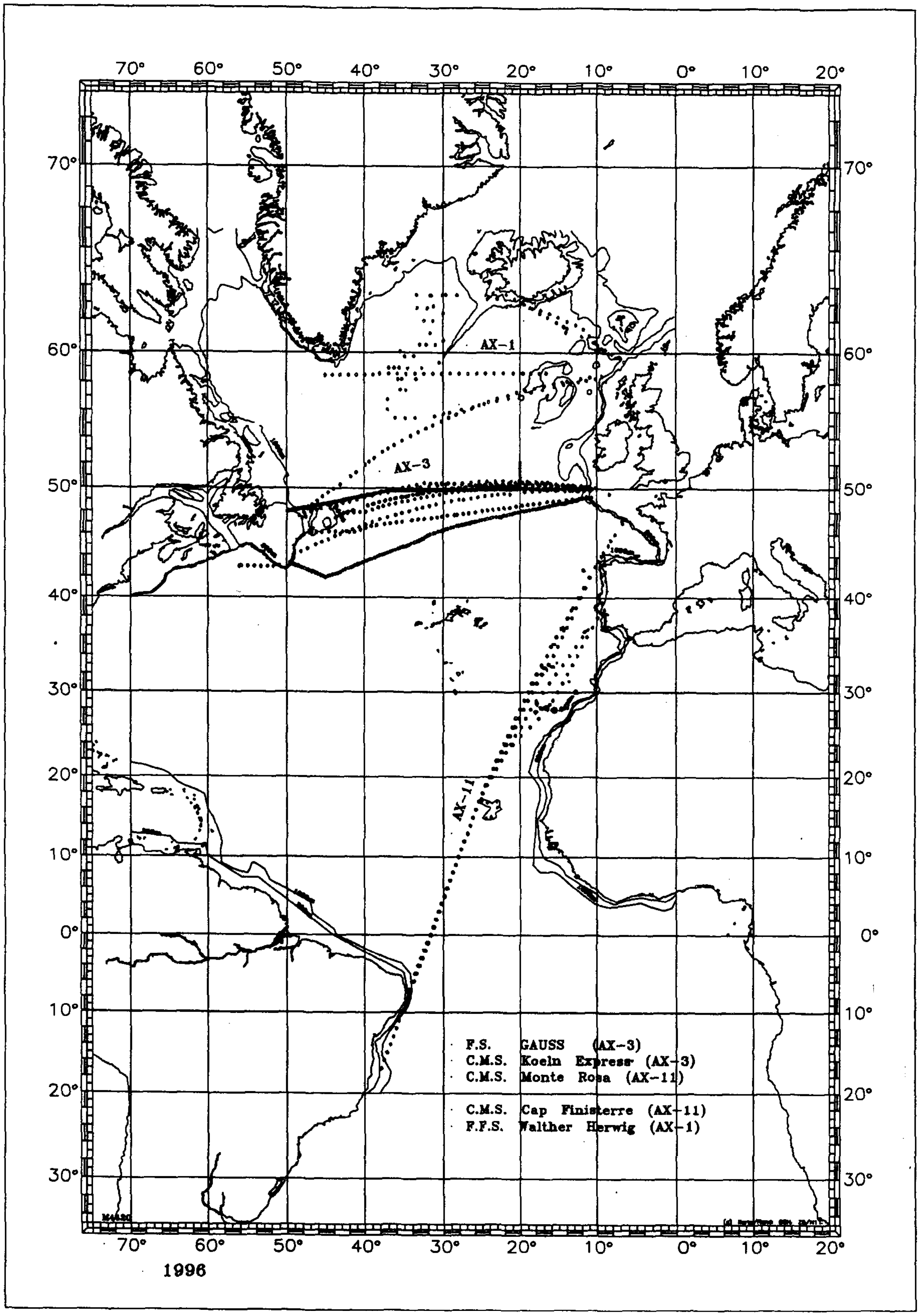
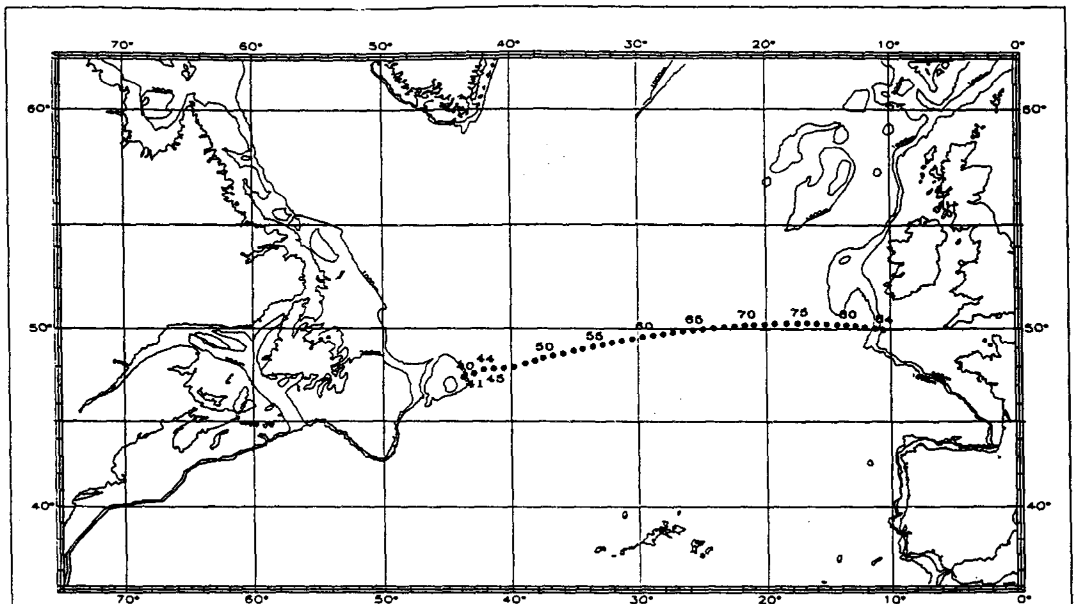

AX-1
AX-3
AX-11
F.S. GAUSS (AX-3)
C.M.S. Koeln Express (AX-3)
C.M.S. Monte Rosa (AX-11)
C.M.S. Cap Finisterre (AX-11)
F.F.S. Walther Herwig (AX-1)
1996

Fig. 1



"KOELN EXPRESS" (9VBL 197 eastbound 09.06.1996 – 12.06.1996)

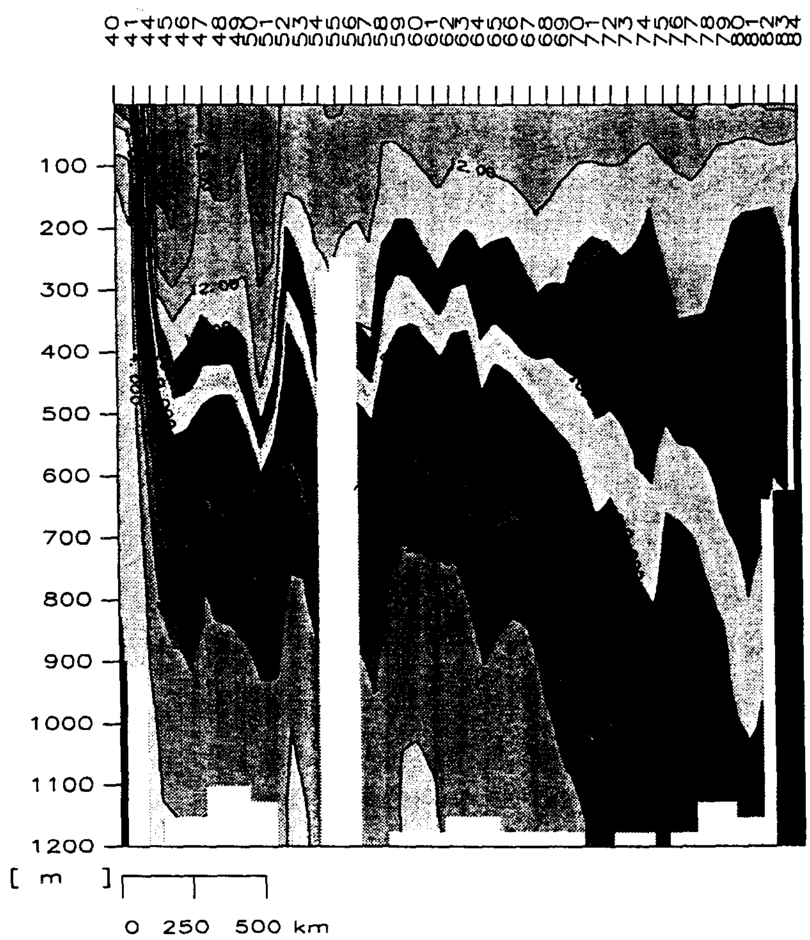
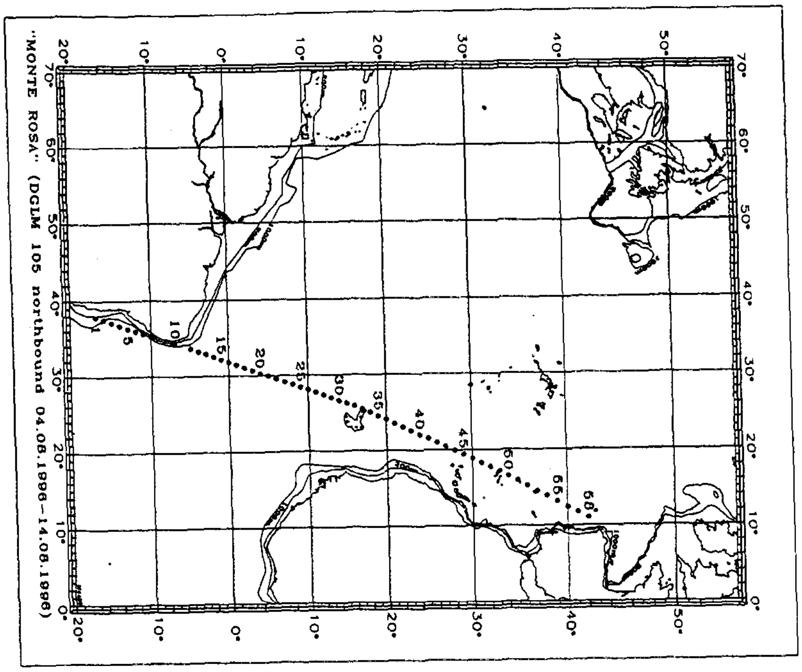


Fig. 2



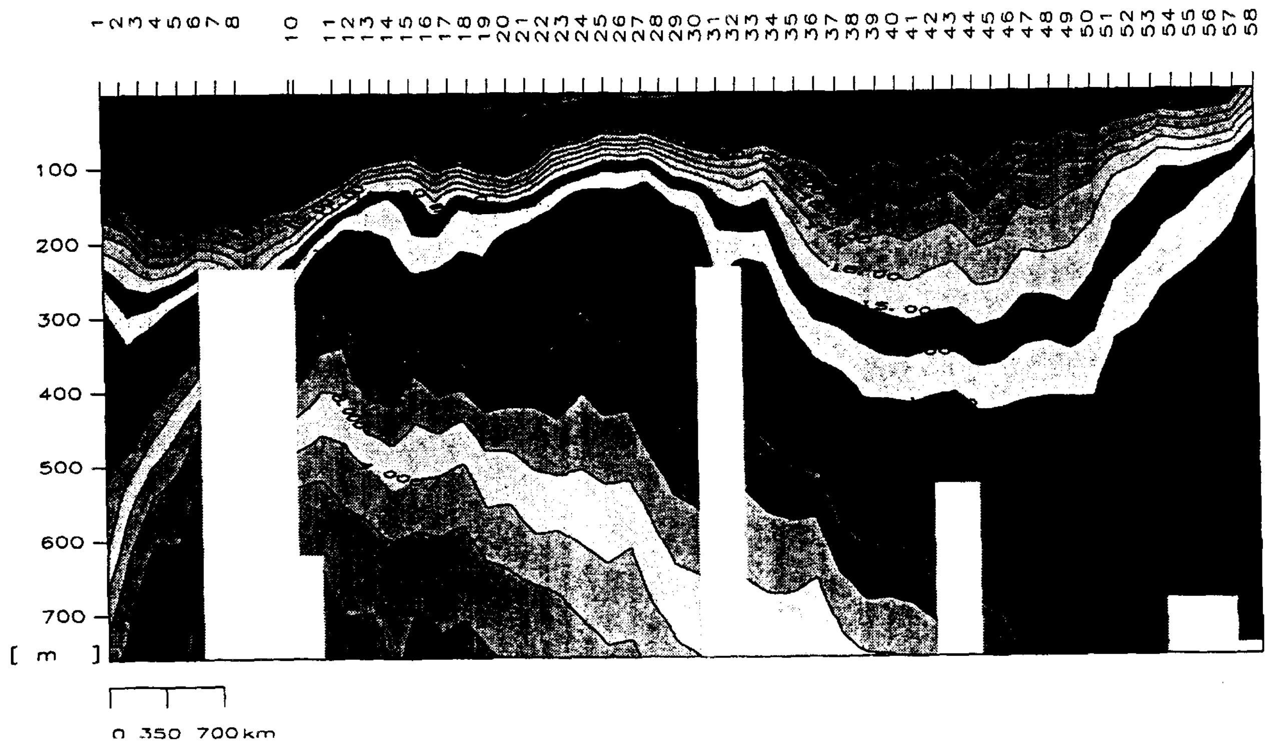
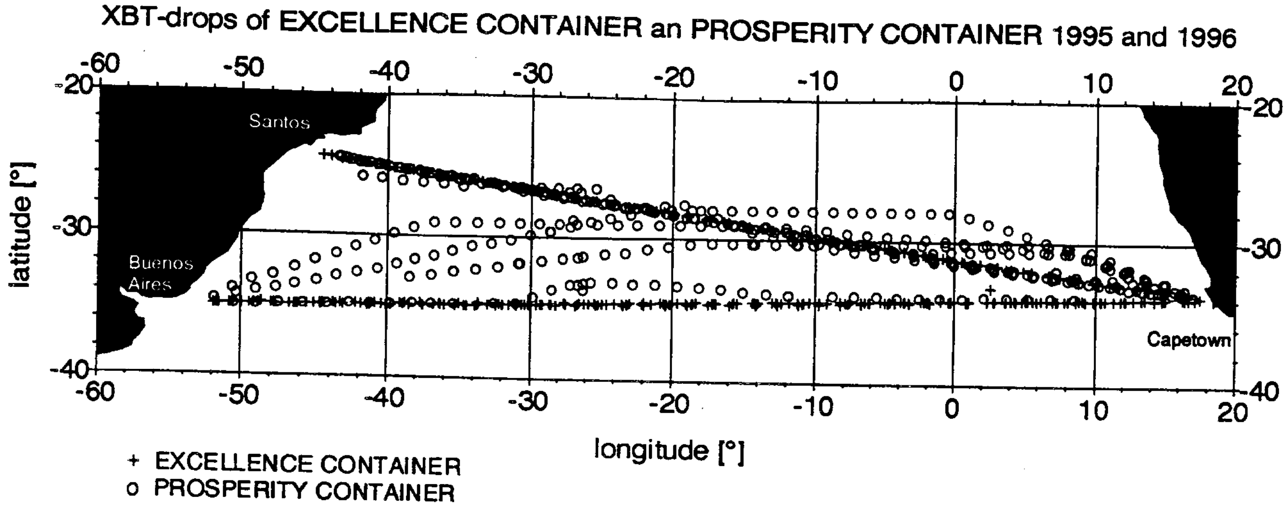


Fig. 3


XBT-drops of EXCELLENCE CONTAINER an PROSPERITY CONTAINER 1995 and 1996
Santos
Buenos Aires
Capetown
latitude [°]
longitude [°]
-60
-50
-40
-30
-20
-10
0
10
20
-30
-40
+ EXCELLENCE CONTAINER
o PROSPERITY CONTAINER

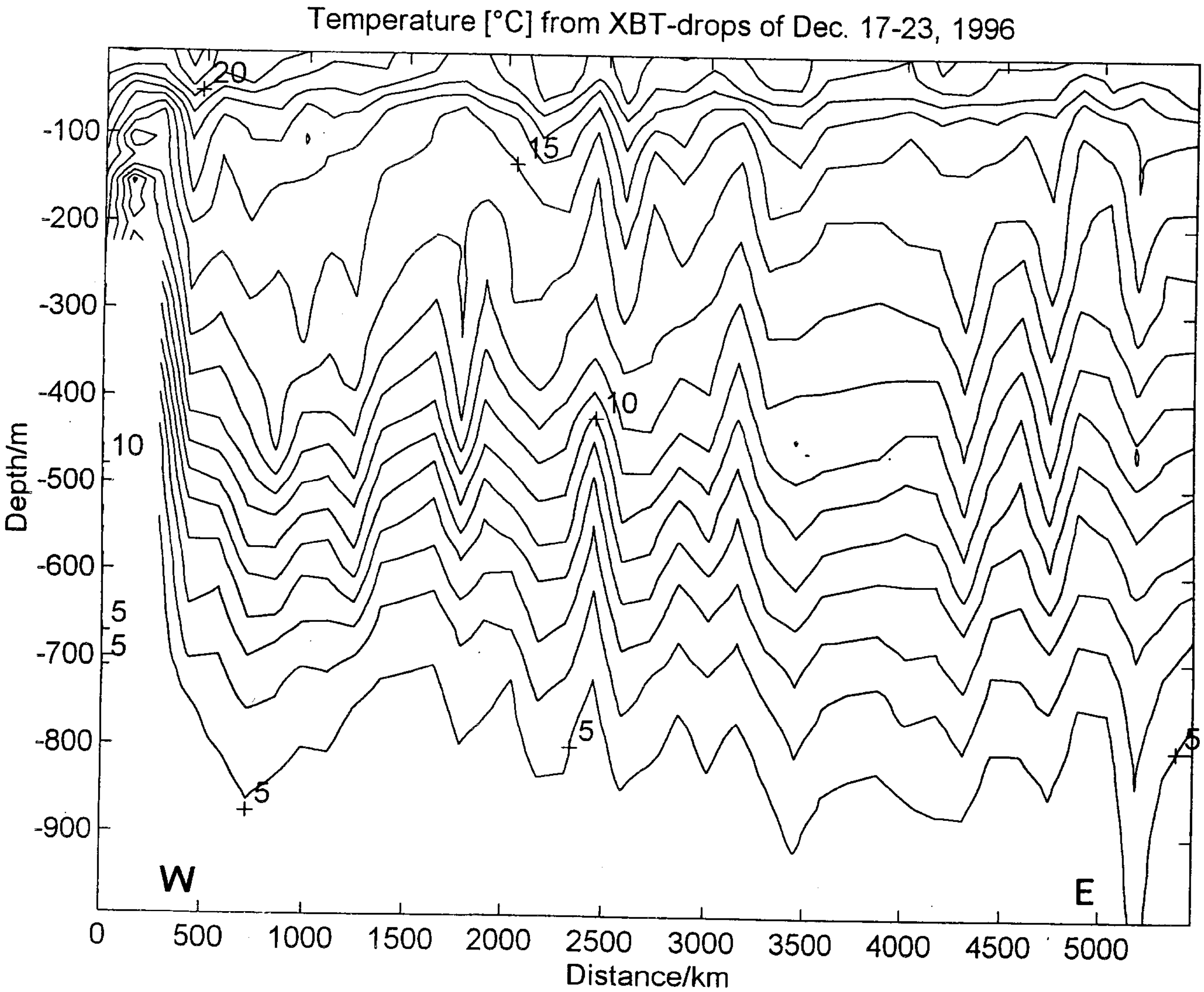
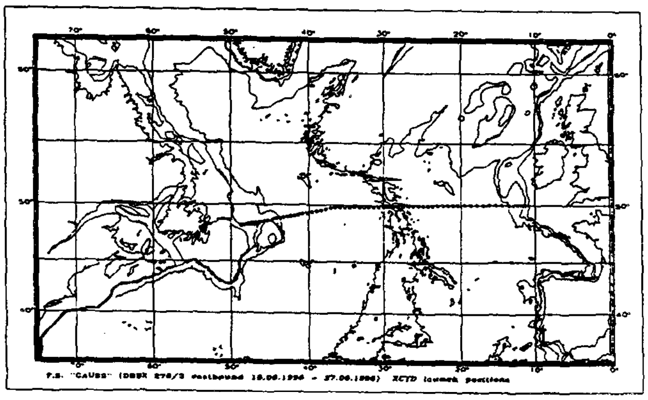
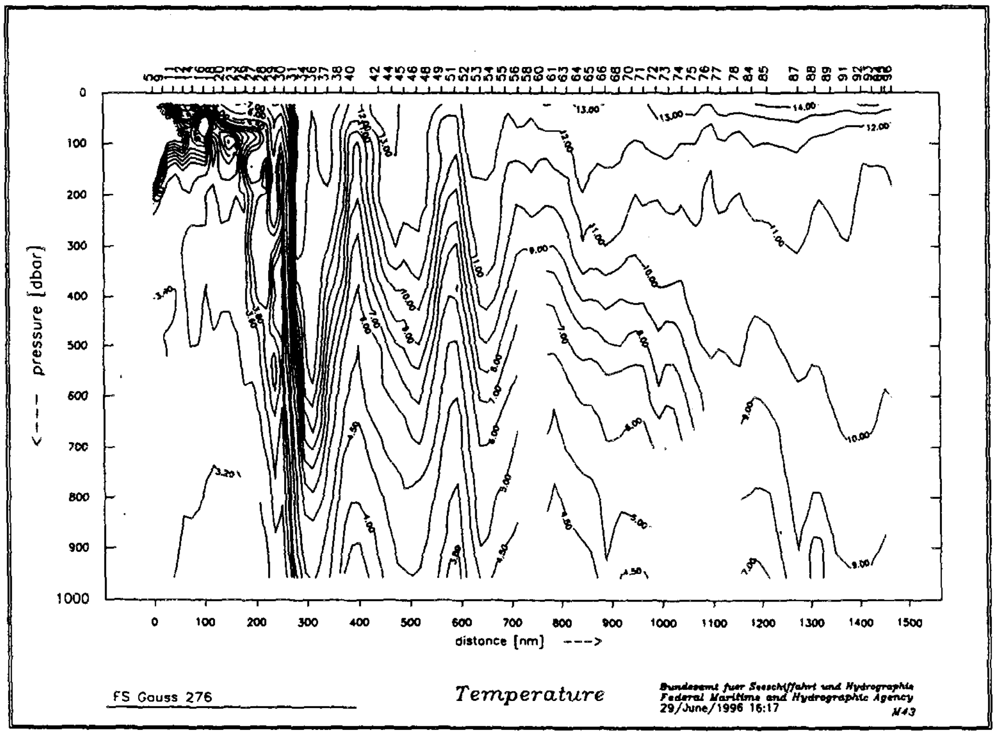

Temperature [°C] from XBT-drops of Dec. 17-23, 1996
Depth/m
Distance/km
W
E
20
15
10
5
-100
-200
-300
-400
-500
-600
-700
-800
-900
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000

Fig. 4


XCTD launch positions


<--- pressure [dbar]
distance [nm] --->
FS Gauss 276
Temperature
Bundesamt fuer Seeschiffahrt und Hydrographie
Federal Maritime and Hydrographic Agency
29/June/1996 16:17

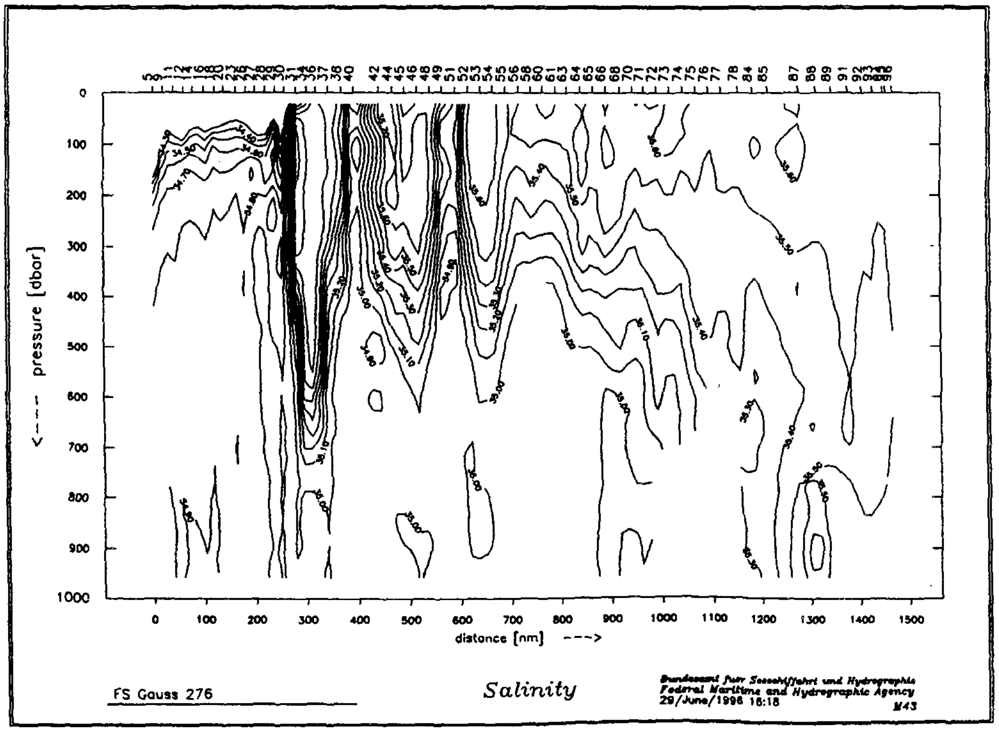

<--- pressure [dbar]
distance [nm] --->
FS Gauss 276
Salinity
Bundesamt fuer Seeschiffahrt und Hydrographie
Federal Maritime and Hydrographic Agency
29/June/1996 16:18

Fig. 5

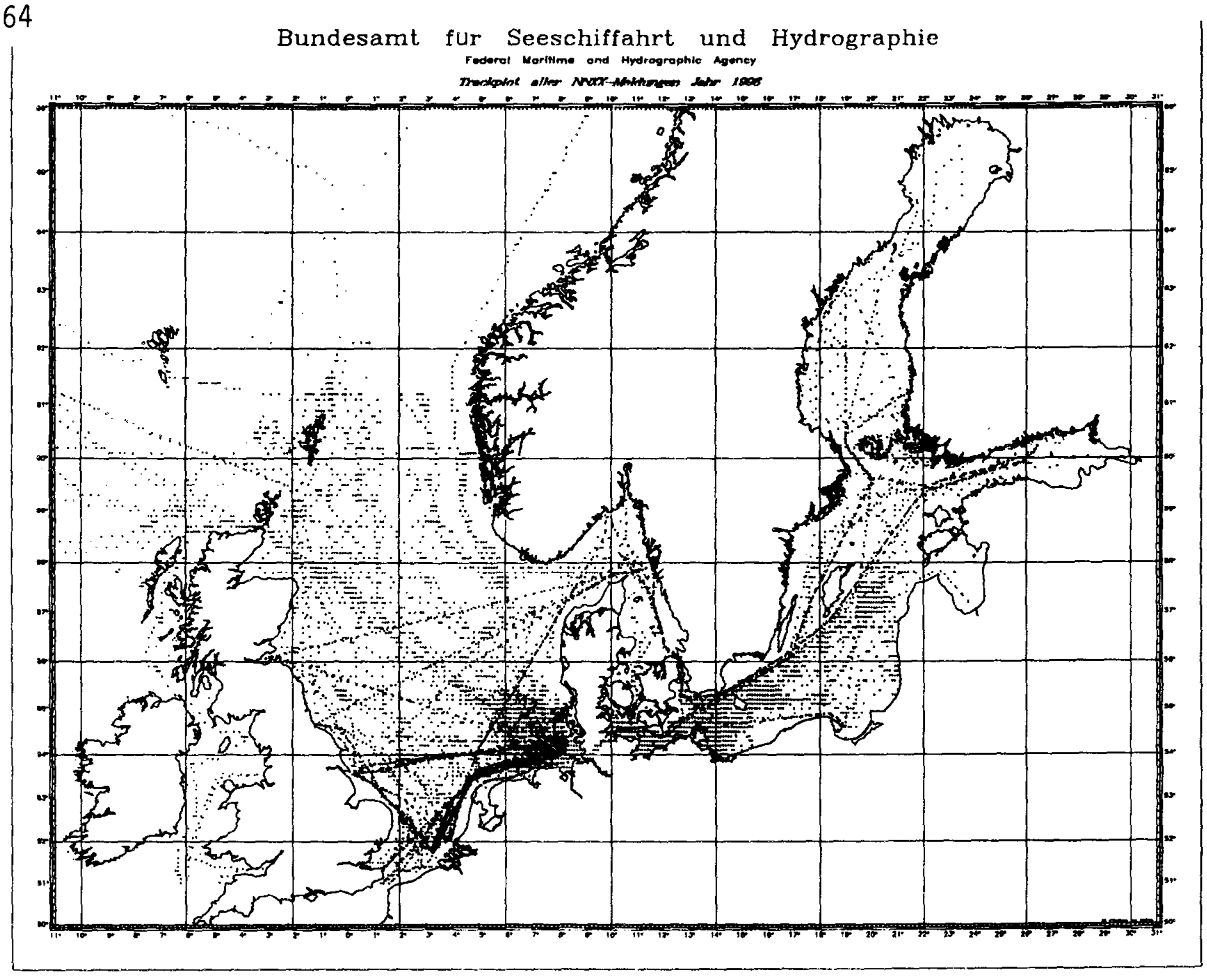

Bundesamt fUr Seeschiffahrt und Hydrographie
Federal Maritime and Hydrographic Agency
Trackplot aller NNXX-Meldungen Jahr 1996

Fig. 6

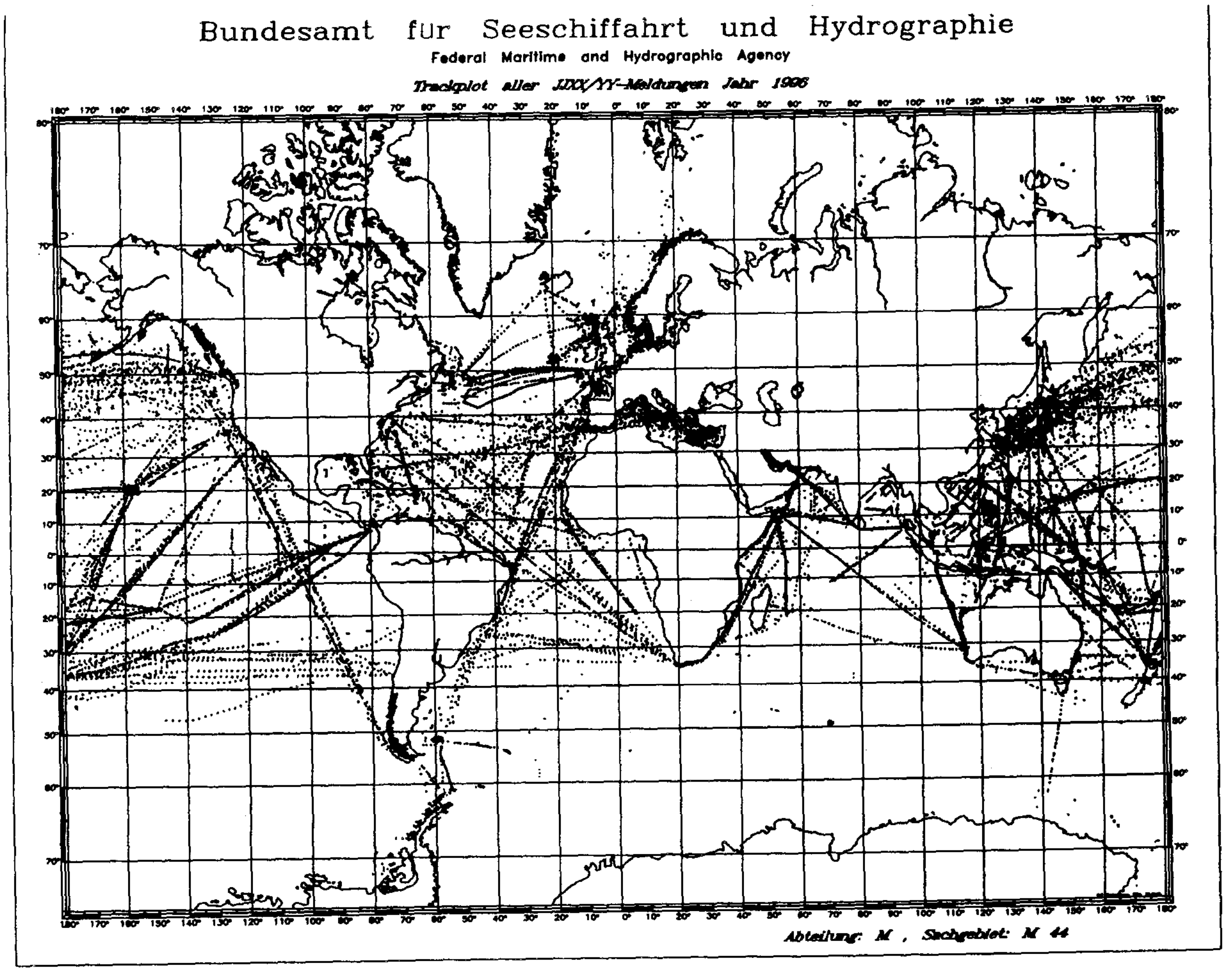

Bundesamt fUr Seeschiffahrt und Hydrographie
Federal Maritime and Hydrographic Agency
Trackplot aller JJXX/YY-Meldungen Jahr 1996
Abteilung: M , Sachgebiet: M 44

Fig. 7

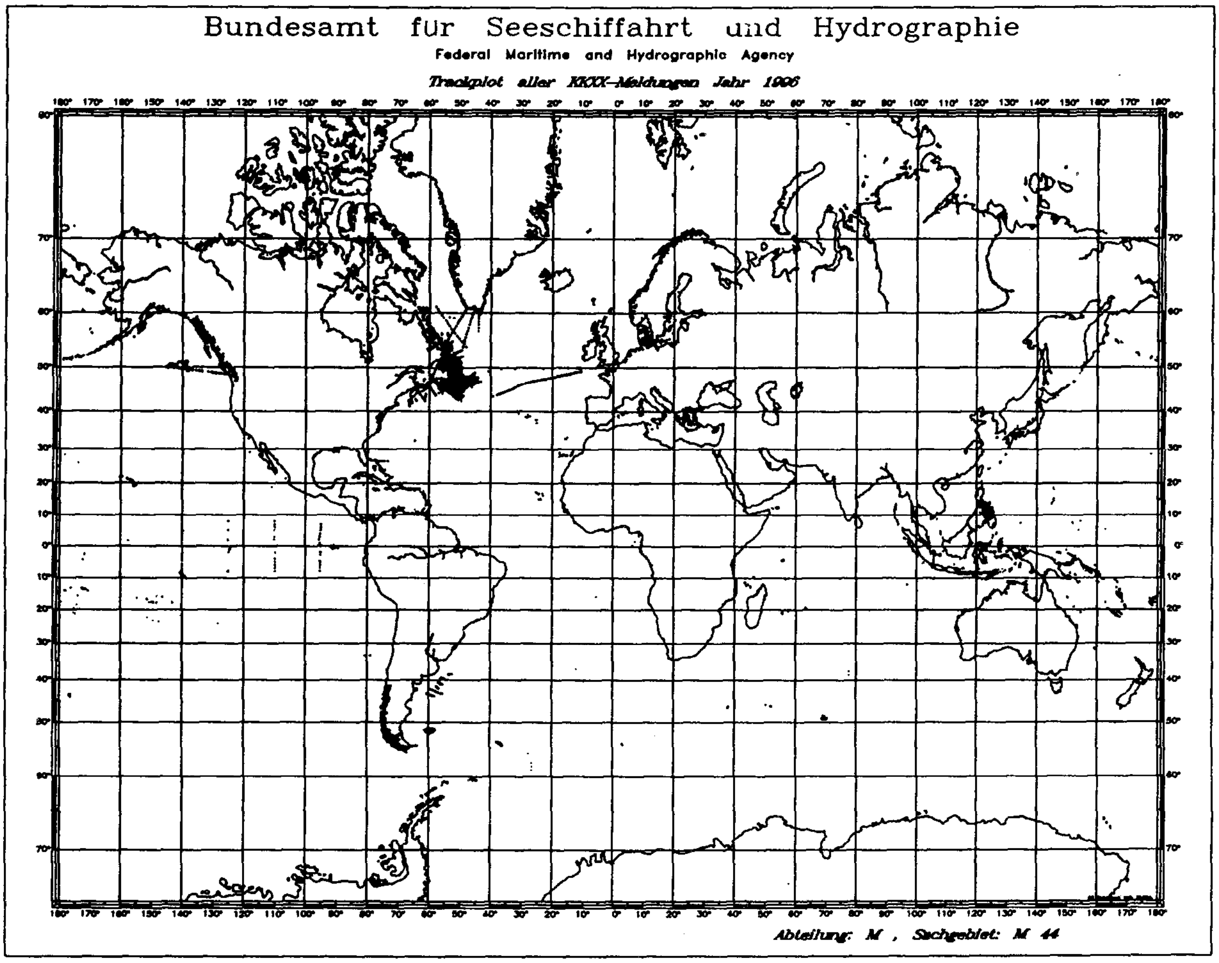

Bundesamt für Seeschiffahrt und Hydrographie
Federal Maritime and Hydrographic Agency
Abteilung: M , Sachgebiet: M 44

Fig. 8

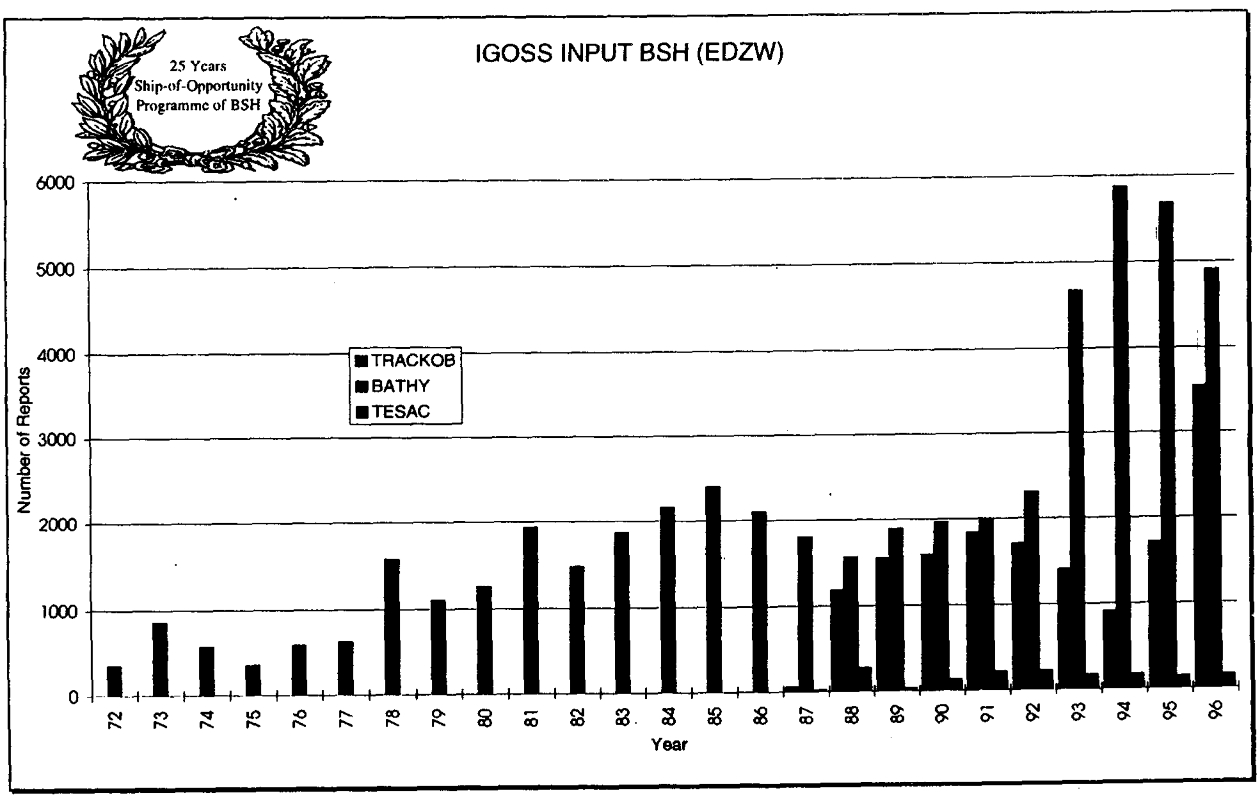

25 Years
Ship-of-Opportunity
Programme of BSH
IGOSS INPUT BSH (EDZW)
TRACKOB
BATHY
TESAC
Number of Reports
0
1000
2000
3000
4000
5000
6000
72
73
74
75
76
77
78
79
80
81
82
83
84
85
86
87
88
89
90
91
92
93
94
95
96
Year

Fig. 9

INDIA

A long-term programme of XBT observations onboard ships of opportunity, for routine monitoring of the upper ocean thermal structure along a few selected shipping lanes in the tropical Indian Ocean was launched by National Institute of Oceanography in 1990, as a component of Indian TOGA Programme (supported by Department of Science & Technology, Government of India). To start with XBT observations were carried out along Madras-Port Blair (Andamans)-Calcutta route in the Bay of Bengal and subsequently extended to Bombay-Mauritius route (1992) and to Visakhapatnam-Singapore route in 1995. Temperature data in the upper 800 m (using the standard Deep Blue XBT probes with PC-based MK-12 System) together with surface meteorological data are being collected at one degree (100 km) intervals along these routes, once in two months, depending on the availability of merchant ships. During the period April 1996 to March 1997 about 200 XBT profiles were obtained along these routes.

The data are screened for quality, processed for archiving in standard formats and disseminated to user community including the TOGA Subsurface Data Centre at Brest (France). The data have been analysed to study the evolution of upper ocean thermal structure on annual time scales and its year-to-year variability. The relationship between upper ocean heat content and cyclogenesis (in the Bay of Bengal) and monsoon activity are also being investigated.

The XBT observations are being continued along the above routes as a part of Ocean Observing Systems, under the Indian Climate Research Programme (Indian component of CLIVAR). It is planned to use XCTD probes also, once in each season, and extend the observations to additional routes (Cochin-Muscat and Bombay-Mombasa) during the next 5 years, subject to availability of merchant ships (with the support of Department of Ocean Development and Department of Science & Technology, Govt. of India).

JAPAN

1. Status of Existing SOOP Lines

In 1996, Japan Meteorological Agency (JMA) operated two ships of opportunity (SOO), namely WELLINGTON MARU (JITV) and KASHIMASAN MARU (JFPQ). A total of 1,220 BATHY messages were transmitted from these ships. The Japan Fisheries Agency (JFA) made high density XBT sampling on IX6 with 12 drops a day by Tropical Challenger (3FIK5) in August 1996. Details are shown in Table 1. These XBT observations were made under the Science and Technology Agency (STA)'s project "Japanese Experiment on the Asian Monsoon (JEXAM)".

Besides the above three ships, a number of research vessels of national organizations also reported XBT/CTD sampling in the form of BATHY messages in 1996 as shown in Table 2.

2. Planned and Proposed SOOP Lines

The Japan's planned SOOP lines in 1997-1999 are provided in Table 3.

The JMA will continue the sampling by the above two ships in 1997 under the STA project. The project is expected to continue until 2001.

The JFA plans to make high density XBT sampling in the Indian Ocean in 1997. However, the JFA is seeking another SOO because Tropical Challenger has shifted its route.

A new STA project, called "Subarctic Gyre Experiment in the North Pacific (SAGE)" is planned to start in FY1997, under which JMA plans to make cooperative XBT sampling with U.S. in the TRANSPAC region (PX26), and JFA plans to make XCTD sampling by fishery research vessels in the subarctic gyre region in the North Pacific. The detailed plan of SAGE, such as funding of individual studies, will be determined in a few months.

TABLE 1. JAPAN's SOOP LINES SUMMARY IN 1996

LINE	FROM	TO
PX5	NEW ZEALAND	JAPAN

SHIP (CALL SIGN)	SECTIONS	DENSITY	BATHY
WELLINGTON MARU (JITV)	**8/YR**	**4/DAY**	**297**

LINE	FROM	TO
PX49	TAIWAN	MALACCA STR.

SHIP (CALL SIGN)	SECTIONS	DENSITY	BATHY
KASHIMASAN MARU (JFPQ)	**14/YR**	**4/DAY**	**178**

LINE	FROM	TO
IX6	MALACCA STR.	MAURITIOUS

SHIP (CALL SIGN)	SECTIONS	DENSITY	BATHY
TROPICAL CHALLENGER (3FIK5)	**1/YR**	**12/DAY**	**77**

LINE	FROM	TO
IX9	OFF SRI LANKA	PERSIAN GULF (north)

SHIP (CALL SIGN)	SECTIONS	DENSITY	BATHY
KASHIMASAN MARU (JFPQ)	**14/YR**	**4/DAY**	**272**

LINE	FROM	TO
IX10	MALACCA STR.	OFF SRI LANKA (east)

SHIP (CALL SIGN)	SECTIONS	DENSITY	BATHY
KASHIMASAN MARU (JFPQ)	**11/YR**	**4/DAY**	**132**
	2/YR	**8/DAY**	**50**

LINE	FROM	TO
	HONG KONG	NEW ZEALAND

SHIP (CALL SIGN)	SECTIONS	DENSITY	BATHY
WELLINGTON MARU (JITV)	**8/YR**	**4/DAY**	**291**
		TOTAL	**1,297**

TABLE 2. NUMBER OF INSERTED DATA ONTO GTS IN THE FORM OF BATHY MESSAGES DURING 1996 IN JAPAN

LEGEND JMA = JAPAN METEOROLOGICAL AGENCY
JFA = JAPAN FISHERIES AGENCY
MSA = MARITIME SAFETY AGENCY
DA = DEFENSE AGENCY
JAMSTEC = JAPAN MARINE SCIENCE AND TECHNOLOGY CENTER
U. TOKYO = UNIVERSITY OF TOKYO
TOKYO U. FISH.= TOKYO UNIVERSITY OF FISHERIES
KAGOSHIMA U.= KAGOSHIMA UNIVERSITY
TOHOKU U. = TOHOKU UNIVERSITY

SHIP	CALL SIGN	AGENCY	BATHY	LINES
RYOFU MARU	JGQH	JMA	346	
KEIFU MARU	JBOA	JMA	292	
KOFU MARU	JDWX	JMA	468	
SHUMPU MARU	JFDG	JMA	373	
CHOFU MARU	JCCX	JMA	409	
SEIFU MARU	JIVB	JMA	473	

WELLINGTON MARU	JITV	JMA	588	PX5
KASHIMASAN MARU	JFPQ	JMA	632	PX49,IX9,IX10
KAIYO MARU	JNZL	JFA	180	
SHOYO MARU	JDRD	JFA	35	
HOKKO MARU	8LRY	JFA	53	
YOKO MARU	7KDD	JFA	13	
WAKATAKE MARU	JDVE	JFA	96	
WAKATORI MARU	7JJX	JFA	13	
TOSHI MARU NO.11	JNOL	JFA	36	
KYOSHIN MARY NO.2	JFHR	JFA	54	
TROPICAL CHALLENGER	3FIK5	JFA	77	IX6
SHOYO	JCOD	MSA	87	
TAKUYO	7JWN	MSA	6	
SHIRASE	JSVY	DA	5	
KAIYO	JRPG	JAMSTEC	141	
HAKUHO MARU	JDSS	U. TOKYO	74	
UMITAKA MARU	JGBB	TOKYO U. FISH.	15	
KEITEN MARU	JGDW	KAGOSHIMA U.	49	
KAGOSHIMA MARU	JLVC	KAGOSHIMA U.	13	
OGASAWARA MARU*	JRBM	TOHOKU U.	110	
		TOTAL	4,638	

*: A domestic ferry (SOO) which regularly shuttles between Tokyo and Chichijima (Bonin Islands: 27-20N, 142E)

TABLE 3. JAPAN's SOOP PLANS FOR 1997-1999

LINE	CALL SIGN	SECTIONS 1997	1998	1999	PROBE TYPE	DENSITY
PX5	JITV	8(1*)	8	8?	T7	4/DAY
PX26	?	?	?	?	?	?
PX49	JFPQ	14(2*)	14	14?	T6	4/DAY
IX6	?	2	2	2?	T7	12/DAY
IX9 north	JFPQ	14(2*)	14	14?	T6	4/DAY
IX10 east	JFPQ	14(2*)	14	14?	T6	4/DAY
HONG KONG - NEW ZEALAND	JITV	8(2*)	8	8?	T7	4/DAY

*: completed as of February 28 in 1997.

UNITED STATES OF AMERICA

I. National Report of XBT Activities for the USA, including new developments in organizational and/or funding issues.

The United States VOS XBT Program continued to collect XBT data along internationally agreed upon routes (see Table 1.) in support of scientific activities of the World Climate Research Program including WOCE, CLIVAR, GCOS the GOOS and emerging short-term climate forecasting. We still continue to expect level or reduced funding over the next couple of years, but will continue to monitor our XBT routes as best we can. We continue to fine tune our sampling instructions and frequency to each of our participating vessels as described in Table 2. We continue to equip as many vessels as necessary, to provide back up "samplers" on all our XBT lines, in the ongoing effort to guarantee the required monthly coverage for the Low Density Network, the Frequently Sampled Network, as well as our High Density Lines. We continue to convert from GOES to Inmarsat Standard C technology when practical to take advantage of reduced transmission costs and more efficient data transfer methods between National Data Centers.

Specifically during this past year (1996) we:

- Increased to 57 the number of vessels utilizing Std. C transceivers for their SEAS observations.
- Implemented standardized procedures and format for the submission of delayed mode SEAS data. (Table 3)
- Lost most of the vessel traffic along PX-14.
- Added a new transect (PX-80) to help make up for the loss of data along PX-14.
- Added a new transect (AX-34) to continue to take advantage of the vessels transferred from PX-14.
- Lost all of the vessel traffic along IX-15.
- Added a new transect (IX-2) to help make up for the loss of traffic along IX-15.
- Lost most of the vessel traffic on the upper 1/3 of PX-9 (Hawaii to Seattle).
- See Table 4 for all U.S. sampling by route.
- Reduced ad hoc (off route) sampling by about 26%. (see Table 5)
- Collected approximately 14,000 XBT observations. (see 1996 dot plot and route coverage)
- Provide our colleagues in France and Australia with approximately 19 pallets or over 6,000 XBT probes.
- Add two new foreign SEAS logistic depots in Capetown, South Africa and Le Havre, France. (see Global Network of SEAS Depots)

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Table 1. Existing United States/ NOAA/NOS XBT Lines as of March 1997 .

ATLANTIC OCEAN:

Routes/Requirements	**Ships - Call Sign**
AX-2 (Newfoundland-Iceland): Req.: 400 obs/yr., 33/mo. 12 trans./yr.	Godafoss - V2EZ Strong Icelander - WBD9290
AX-4 (N.Y. - Gibraltar): Req.: 390 obs/yr., 33/mo. 12 trans./yr.	Addiriyah - HZLL ????????? ?????????
AX-7 (Gulf of Mex.- Gibraltar): Req.: 490 obs/yr., 41/mo. 12 trans./yr. High Density Req.: 800 obs/yr., 4 trans./yr.	Monterey - PGAF Morelos - PGBB Cont. Houston - ELUA5
AX-8 (N.Y. - Cape of Good Hope): Req.: 910 obs/yr., 76/mo. 12 trans./yr.	Nomzi - MTQU3 Charles Lykes - 3EJT9 Olivebank - 3ETQ5 (B) Columbine - 3ELQ9
AX-10 (N.Y. - Caracas/Trinidad): Req.: 245 obs/yr., 20/mo. 12 trans./yr. High Density Req.: ??	Sea Wolf - KNFG Sea Lion - KJLV S/L Crusader - WZJF (B) Sea Merchant - ELQN2 (B) Sea Fox - KBGK
AX-12 (Europe to Antarc./Falklands): Req.: 800 obs/yr, 67/mo. 12/trans./yr., 4/day. Supported by the U.K.	Arktis Vision - OXWJ2 (pend) Anne Boye - OYLZ2
AX-14 (Rio to Nigeria): Req.: 455 obs/yr., 38/mo. 12/trans./yr.	Clipper Sao Louis - 9HV03 ???????????
AX-29 (New York - Brazil): Req.: 580 obs/yr., 48/mo. 12 trans./yr. (B) Sea Merchant - ELQN2	Sea Wolf - KNFG Sea Lion - KJLV (B) Sea Fox - KBGK
AX-34 (Car. to G. of Guinea) Req.: 432 obs/yr., 36/mo. 12 trans./yr.	Western Lion - A8BN Northern Lion - A8IE Southern Lion - V7AW8
AX-35 (Rec. to C. of G. Hope)	Barbican Star - DYZJ

Req.: 384 obs/yr., 32/mo. 12 trans./yr.	Barbican Spirit - DVFS Barbican Success - DUWH

INDIAN OCEAN:

Routes/Requirements	**Ships - Call Sign**
IX-2 (Cape Town - Fremantle) Req.: 575 obs./yr., 48/mo. 12/trans./yr., 4/day	Barbican Star - DYZJ Barbican Spirit - DVFS Barbican Success - DUWH
IX-6 (Mauritius - Malacca Strait): Req.: 360 obs/yr., 30/mo. 12 trans./yr.	S.A. Oranje - J8FG9 Vaal - ZSDS Pacific Link - 3FYD4 (B) Alberni Dawn - ELAC5
IX-7 (C. of Good Hope - Arabian Gulf): Req.: 575 obs/yr., 48/mo. 12 trans./yr.	Afris Pioneer - P3FY5 Umfolozi - P3NX4 Al Samidoon - 9KKF Al Shuhadaa - 9KKH Al Awdah - 9KWA (pend) Bunga Mas Satu - 9MVB8
IX-8 (Bombay - Mauritius): Req.: 315 obs/yr., 26/mo. 12 trans./yr.	Afris Pioneer - P3FY5 (pend) Bunga Mas Satu - 9MVB8
IX-15 (Mauritius-Fremantle):	????????????
Req.: 380 obs/yr, 32/mo.	????????????
12 trans./yr. Note- Replaced by IX-2, probes go to support IX-2.	
IX-21 (C. of Good Hope - Mauritius): Req.: 345 obs/yr., 29/mo. 12 trans./yr.	Vaal - ZSDS S.A. Oranje - J8FG9 Pacific Link - 3FYD4 Afris Pioneer - P3FY5 (B) Alberni Dawn - ELAC5 (pend) Bunga Mas Satu - 9MVB8

PACIFIC OCEAN:

Routes/Requirements	**Ships - Call Sign**
PX-1 (Calif.- Indonesia): Req.: 865 obs/yr., 72/mo. 12 trans./yr.	Bogasari Lima - YDLR Goldensari Indah - 9VVB ??????????????
PX-8 (Panama-New Zealand): Req.: 930 obs/yr., 78/mo. 12 trans./yr.	America Star - C6JZ2 Queensland Star - C6JZ3 Columbus America - ELSX2 (pend)Columbus Australia - DAFC

PX-9 (New Zealand-Hawaii-Seattle): Req.: 535 obs/yr., 45/mo. 12 trans./yr.	Columbus Canada - ELQN3 Melbourne Star - C6JY6
PX-10 (Hawaii - Guam/Saipan): Req.: 440 obs/yr., 37/mo. 12 trans./yr.	Sealand Enterprise - KRGB Sealand Navigator - WPGK (B) Sealand Trader - KIRH
PX-13 (Calif.-New Zealand): Req.: 815 obs/yr, 68/mo. 12 trans./yr.	Columbus Canada - ELQN3 Columbus California - DHCM Melbourne Star - C6JY6 (B) Columbus Victoria - DNKL
PX-14 (Alaska - Cape Horn): Req.: 1530 obs/yr., 128/mo. 18 trans./yr.	Northern Lion - A8IE Western Lion - A8BN Southern Lion - V7AW8 Equatorial Lion - V7AS7 (pend) Meridian Lion - V7AS8
P -18 (California - Tahiti): Req.: 700 obs/yr., 58/mo. 18 trans./yr.	Polynesia - D5NZ Moana Pacific - OWUO6 (pend) Vaimama - ELTC7
PX-26 (TRANSPAC REGION): Req.: 2000 obs/yr., 167/mo. 36 trans./yr.	Sealand Defender - KGJB Sealand Enterprise - KRGB Sealand Navigator - WPGK Sealand Pacific - WSRL Sealand Trader - KIRH Tai He - BOAB Skaubryn - LAJV4 Skaugran - LADB2 Saga Spray - LATI4
PX-39 (Hawaii - C. Flattery): Req.: 330 obs/yr., 28/mo. 12 trans./yr.	??????????? ???????????
PX-50 (Valparaiso-New Zealand): Req.: 680 obs/yr, 57/mo. 12 trans./yr.	Gulf Current - ELMF9 California Current - ELMG2 Merchant Premier - VROP (pend) Rossel Current - J8FI6
PX-80 (Tahiti - Cape Horn) Req.: 528 obs/yr., 44/mo. 12 trans./yr.	Barbican Star - DYZJ Barbican Spirit - DVFS Barbican Success - DUWH

(B) = Back up ships.

?????????? = Back up or required ships not yet identified.

****

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TABLE 2. Sampling procedures used for generating "Vessel Sampling Instructions".

- XBT sampling, when possible, should begin and end at the 100 fathom or 200 meter depth contour to better discern nearshore boundary current conditions.

- XBT sampling requirements are based on the general working formula of:

  1 XBT/1.5 degree of Latitude and 7.5 degrees of Longitude plus 2 extra to cover the beginning and ending observations at the 100 fathom or 200 meter depth contour.

- XBT Line or Transect distances are determined by "Great Circle" calculations.

- XBT sampling frequency is based on vessels speed.

  < 10 knots = 2 XBT's per 24 hours
  10 - 13 knots = 3 XBT's per 24 hours
  14 - 17 knots = 4 XBT's per 24 hours
  18 - 20 knots = 5 XBT's per 24 hours
  > 20 knots = 6 XBT's per 24 hours

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TABLE 3. Procedure and format for the submission of delayed mode data.

1- Each SEAS field representative will use PKZIP in the following manner to compress the data files prior to sending to HQ.

pkzip -a -r -P xxxxxxxx.jjj

where -a -r -P represent the zip commands that control path, directories and sub-directories that insure the recreation of a SEAS data disk after unzipping.

where xxxxxxxx represents the ships call sign (up to 8 alphanumeric characters).

and where the extension .jjj represents the Julian Day of the last meteorological observation or in the event of no meteorological observations, the last XBT observation.

2- Each SEAS field representative will save these zip files in a way convenient for each of us to recall, if necessary, for at least one year after collection. Meteorological only data that does not require zipping will be saved in the same format.

Additionally, the zipped files will be saved on the vessels PC in a file labeled "savedata".

3- Each SEAS field representative will send the zipped files by any of two methods. (a) FTP to the server and stored under "pub\seasdata" or (b) to the Data Base via AWSEND and stored under "o:\zip\delay\user name".

4- Each SEAS field representative will then send a mail message to HQ informing them that the subject files have been transferred including the file name, vessel name and start and finish dates of the data set.

5- Each SEAS field representative will also save and/or print and/or file the above mail message with the purpose of using it to verify the proceeding months Delayed Mode Data files collated by HQ.

****

Table 4. U.S. SAMPLING BY ROUTE

ROUTE A02 NEWFOUNDLAND ICELAND
NO./YEAR 400

SHIP	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
GODAFOSS	0	0	14	2	21	18	38	3	17	19	0	20	152
SKOGAFOSS	19	19	55	11	0	0	0	0	0	0	0	0	104
ROUTE TOTAL	19	19	69	13	21	18	38	3	17	19	0	20	256

ROUTE A04 NEW YORK GIBRALTAR
NO./YEAR 390

SHIP	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
ADDIRIYAH	0	0	0	0	1	0	0	26	16	45	0	71	159
AL-WATTYAH	0	0	0	0	0	27	0	15	3	0	0	0	45
NEDLLOYD RALEIGH BAY	22	20	13	15	26	5	0	0	0	0	0	0	101
SEA PREMIER	29	0	0	0	0	0	0	0	0	0	0	0	29
ROUTE TOTAL	51	20	13	15	27	32	0	41	19	45	0	71	334

ROUTE A06 NEW YORK DAKAR
NO./YEAR 420

SHIP	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
CHARLES LYKES	0	0	30	0	0	22	0	0	32	0	0	0	84
OLIVEBANK	0	19	0	0	0	0	0	39	0	26	7	0	91
ROUTE TOTAL	0	19	30	0	0	22	0	39	32	26	7	0	175

ROUTE A07 GULF OF MEXICO GIBRALTAR
NO./YEAR 490

SHIP	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
CALIFORNIA CURRENT	0	0	0	0	0	35	0	0	0	0	0	0	35
COLIMA	43	37	0	0	0	0	0	0	0	0	0	0	80
MITLA	1	0	62	127	24	29	109	0	0	0	0	0	352
MORELOS	0	0	0	33	0	35	32	36	0	34	38	12	220
TOLUCA	0	0	0	0	0	0	0	0	57	0	162	0	219
ROUTE TOTAL	44	37	62	160	24	99	141	36	57	34	200	12	906

ROUTE A08 NEW YORK — CAPE OF GOOD HOPE
NO./YEAR 910

SHIP	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
CHARLES LYKES	0	0	0	0	0	0	0	0	0	0	36	2	38
NOMZI	23	51	67	71	0	43	0	1	71	40	44	61	472
ROUTE TOTAL	23	51	67	71	0	43	0	1	71	40	80	63	510

ROUTE A10 NEW YORK — TRINIDAD/CARACAS
NO./YEAR 245

SHIP	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
AMERICA STAR	0	0	0	0	0	0	0	0	0	5	0	4	9
NOMZI	19	0	0	0	0	0	0	0	0	0	0	0	19
SEA LION	0	0	0	0	0	0	4	1	0	0	0	0	5
SEA-LAND CRUSADER	0	3	18	24	23	3	11	73	54	42	23	71	345
SHINING STAR	26	0	0	0	0	0	0	0	0	0	0	0	26
ROUTE TOTAL	45	3	18	24	23	3	15	74	54	47	23	75	404

ROUTE A11 BRAZIL — EUROPE
NO./YEAR 720

SHIP	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
ARKTIS VISION	0	21	0	0	24	2	12	6	0	0	0	0	65
ROUTE TOTAL	0	21	0	0	24	2	12	6	0	0	0	0	65

ROUTE A12 ANTARCTICA — EUROPE
NO./YEAR 800

SHIP	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
ARKTIS VISION	34	16	11	61	4	30	0	0	0	0	0	0	156
ROUTE TOTAL	34	16	11	61	4	30	0	0	0	0	0	0	156

ROUTE A13 RIO DE JANEIRO — MONROVIA (LIBERIA)
NO./YEAR 200

SHIP	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
CLIPPER SAO LUIZ	0	0	0	0	0	0	0	0	14	0	0	0	14
ROUTE TOTAL	0	0	0	0	0	0	0	0	14	0	0	0	14

ROUTE A14 RIO DE JANEIRO LAGOS (NIGERIA)
NO./YEAR 455

SHIP	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
CLIPPER SAO LUIZ	0	0	0	0	0	0	0	15	12	16	1	7	51
ROUTE TOTAL	0	0	0	0	0	0	0	15	12	16	1	7	51

ROUTE A15 CAPE OF GOOD HOPE EUROPE
NO./YEAR 720

SHIP	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
AL AWDAH	0	0	0	0	0	5	0	0	0	0	0	0	5
ROUTE TOTAL	0	0	0	0	0	5	0	0	0	0	0	0	5

ROUTE A21 RIO DE JANEIRO POINTE NOIRE/LUANDA
NO./YEAR 400

SHIP	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
CLIPPER SAO LUIZ	0	0	0	0	0	0	4	3	0	0	10	0	17
ROUTE TOTAL	0	0	0	0	0	0	4	3	0	0	10	0	17

ROUTE A23 GULF OF MEXICO GULF OF MEXICO
NO./YEAR 192

SHIP	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
AMERICA STAR	0	0	4	0	4	0	0	0	0	5	0	0	13
CHARLES LYKES	0	11	0	0	8	0	0	1	0	9	3	0	32
MORELOS	0	0	1	0	0	0	0	0	0	0	0	0	1
OLIVEBANK	0	0	0	0	0	0	0	0	0	0	0	4	4
QUEENSLAND STAR	0	0	0	0	2	0	1	0	0	0	0	0	3
TEXAS CLIPPER II	0	0	0	0	1	9	0	0	0	0	0	0	10
TOLUCA	0	0	0	0	0	0	0	3	0	0	0	0	3
ROUTE TOTAL	0	11	5	0	15	9	1	4	0	14	3	4	66

ROUTE A26 CAPE OF GOOD HOPE LAGOS NIGERIA
NO./YEAR 320

SHIP	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
CHARLES LYKES	0	0	6	4	0	0	3	0	11	0	0	0	24
OLIVEBANK	0	0	0	0	0	0	0	17	2	0	11	0	30
ROUTE TOTAL	0	0	6	4	0	0	3	17	13	0	11	0	54

ROUTE A27 GULF OF MEXICO CAPE HORN
NO./YEAR 400

SHIP	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
EASTERN LION	0	0	2	0	0	0	0	0	0	0	0	0	2
SOUTHERN LION	0	0	0	5	0	2	0	0	0	0	0	0	7
WESTERN LION	1	0	0	40	0	27	0	0	0	0	0	0	68
ROUTE TOTAL	1	0	2	45	0	29	0	0	0	0	0	0	77

ROUTE A29 NEW YORK BRAZIL
NO./YEAR 580

SHIP	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
CHARLES LYKES	0	8	0	0	6	0	0	10	0	9	0	0	33
SEA LION	14	22	29	0	30	5	41	8	17	14	1	6	187
SEA WOLF	37	0	31	54	0	18	24	14	16	17	23	4	238
ROUTE TOTAL	51	30	60	54	36	23	65	32	33	40	24	10	458

ROUTE A32 NEW YORK BERMUDA
NO./YEAR 120

SHIP	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
OLEANDER	0	34	29	12	21	33	29	32	0	69	33	22	314
ROUTE TOTAL	0	34	29	12	21	33	29	32	0	69	33	22	314

ROUTE A33 BOSTON HALIFAX
NO./YEAR 144

SHIP	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
GODAFOSS	0	0	0	0	8	9	10	0	9	1	16	9	62
SKOGAFOSS	12	12	10	10	0	0	0	0	0	0	0	0	44
ROUTE TOTAL	12	12	10	10	8	9	10	0	9	1	16	9	106

ROUTE A34 GULF OF GUINEA CARIBBEAN
NO./YEAR

SHIP	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
EASTERN LION	0	0	0	0	0	0	0	44	28	8	0	0	80
ROUTE TOTAL	0	0	0	0	0	0	0	44	28	8	0	0	80

ROUTE A35 CAPE OF GOOD HOPE RECIFE
NO./YEAR

SHIP	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
CHARLES LYKES	28	1	0	16	1	0	15	10	0	16	0	0	87
OLIVEBANK	0	0	16	0	0	0	0	0	30	0	0	0	46
ROUTE TOTAL	28	1	16	16	1	0	15	10	30	16	0	0	133

ROUTE I02 CAPE OF GOOD HOPE FREMANTLE
NO./YEAR 575

SHIP	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
BARBICAN SPIRIT	0	0	0	0	0	0	8	2	0	0	0	0	10
BARBICAN STAR	0	0	0	0	3	3	0	0	0	0	0	0	6
BARBICAN SUCCESS	0	0	0	0	0	0	0	0	0	1	0	0	1
ROUTE TOTAL	0	0	0	0	3	3	8	2	0	1	0	0	17

ROUTE I06 MAURITIUS/LA REUNION MALACCA STRAIT
NO./YEAR 360

SHIP	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
PACIFIC LINK	13	1	4	8	1	0	0	0	0	0	0	0	27
S A ORANJE	19	24	15	0	0	3	0	29	23	13	2	0	128
VAAL	8	18	7	31	5	20	0	12	2	3	0	0	106
ROUTE TOTAL	40	43	26	39	6	23	0	41	25	16	2	0	261

ROUTE I07 CAPE OF GOOD HOPE PERSIAN GULF
NO./YEAR 575

SHIP	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
AFRIS PIONEER	26	0	0	34	48	4	55	0	23	18	7	3	218
AL AWDAH	0	0	0	0	0	5	0	37	0	0	0	0	42
AL SAMIDOON	29	50	22	8	1	32	0	30	0	24	0	1	197
AL SHUHADAA	0	0	0	0	40	0	0	0	25	16	0	0	81
UMFOLOZI	0	31	38	0	14	23	19	0	0	0	0	0	125
ROUTE TOTAL	55	81	60	42	103	64	74	67	48	58	7	4	663

ROUTE I08 BOMBAY INDIA MAURITIUS
NO./YEAR 315

SHIP	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
AFRIS PIONEER	3	0	14	0	6	0	0	0	25	0	1	5	54

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
ROUTE TOTAL	3	0	14	0	6	0	0	0	25	0	1	5	54

ROUTE I21 CAPE OF GOOD HOPE MAURITIUS
NO./YEAR 345

SHIP	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
AFRIS PIONEER	14	0	15	0	0	0	0	0	7	0	0	4	40
AL AWDAH	0	0	0	0	0	0	0	7	0	0	0	0	7
AL SAMIDOON	14	0	11	0	0	2	0	9	0	9	1	0	46
AL SHUHADAA	0	0	0	0	10	0	0	0	0	7	0	0	17
BARBICAN STAR	0	0	0	0	0	0	0	0	0	0	0	2	2
PACIFIC LINK	3	6	1	2	0	1	0	0	0	0	0	0	13
S A ORANJE	15	8	9	0	0	0	0	19	16	0	0	0	67
VAAL	0	4	0	25	0	7	0	16	0	2	0	0	54
ROUTE TOTAL	46	18	36	27	10	10	0	51	23	18	1	6	246

ROUTE P01 CALIFORNIA INDONESIA
NO./YEAR 865

SHIP	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
BOGASARI LIMA	26	15	0	0	0	0	0	0	0	0	0	0	41
GOLDENSARI INDAH	62	1	0	44	30	0	47	41	22	28	44	55	374
ROUTE TOTAL	88	16	0	44	30	0	47	41	22	28	44	55	415

ROUTE P06 SUVA (FIJI) AUCKLAND
NO./YEAR 160

SHIP	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
COLUMBUS CALIFORNIA	0	4	0	9	0	0	0	0	0	4	0	0	17
ROUTE TOTAL	0	4	0	9	0	0	0	0	0	4	0	0	17

ROUTE P08 AUCKLAND PANAMA
NO./YEAR 930

SHIP	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
AMERICA STAR	59	59	35	32	38	55	59	57	43	31	33	64	565
GULF CURRENT	0	0	0	0	0	0	0	0	0	26	1	0	27
QUEENSLAND STAR	26	21	44	20	42	18	25	32	37	43	0	0	308
ROUTE TOTAL	85	80	79	52	80	73	84	89	80	100	34	64	900

ROUTE P09 HAWAII NOUMEA/AUCKLAND
NO./YEAR 535

SHIP	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
COLUMBUS CALIFORNIA	0	26	0	0	0	0	8	0	23	0	0	0	57
COLUMBUS CANADA	0	0	21	0	26	0	29	29	6	32	0	18	161
MELBOURNE STAR	12	5	1	24	0	27	1	22	22	12	42	0	168
MOANA PACIFIC	0	0	0	0	0	0	0	0	0	5	0	0	5
ROUTE TOTAL	12	31	22	24	26	27	38	51	51	49	42	18	391

ROUTE P10 HAWAII GUAM/SAIPAN
NO./YEAR 440

SHIP	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
SEA-LAND ENTERPRISE	0	19	9	36	23	33	23	74	37	33	7	34	328
SEA-LAND NAVIGATOR	9	13	0	0	17	33	25	43	37	37	20	21	255
SEA-LAND PACIFIC	4	15	18	28	25	0	9	0	0	0	0	0	99
SEA-LAND TRADER	19	6	12	17	12	14	16	0	0	0	0	0	96
ROUTE TOTAL	32	53	39	81	77	80	73	117	74	70	27	55	778

ROUTE P12 TAHITI CORAL SEA
NO./YEAR 370

SHIP	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
MOANA PACIFIC	1	0	2	0	0	0	0	0	5	0	0	0	8
POLYNESIA	2	6	2	0	0	0	0	0	0	1	9	0	20
ROUTE TOTAL	3	6	4	0	0	0	0	0	5	1	9	0	28

ROUTE P13 NEW ZEALAND CALIFORNIA
NO./YEAR 815

SHIP	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
COLUMBUS CALIFORNIA	44	0	34	0	0	13	0	0	0	22	14	0	127
COLUMBUS CANADA	12	23	9	51	1	46	16	31	50	0	54	13	306
MELBOURNE STAR	2	9	65	7	43	0	39	17	32	45	0	44	303
ROUTE TOTAL	58	32	108	58	44	59	55	48	82	67	68	57	736

ROUTE P14 ALASKA CAPE HORN
NO./YEAR 1,530

SHIP	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
EASTERN LION	65	0	0	65	0	0	0	0	0	0	0	0	130

MT CABRITE	37	37	13	0	0	0	0	0	0	0	0	0	87
NORTHERN LION	0	55	85	2	75	68	2	0	34	27	0	44	392
SOUTHERN LION	0	1	0	68	39	0	0	0	0	0	0	0	108
WESTERN LION	3	22	8	6	41	0	0	0	0	0	0	0	80
ROUTE TOTAL	105	115	106	141	155	68	2	0	34	27	0	44	797

ROUTE P17 TAHITI/MURURAO PANAMA
NO./YEAR 540

SHIP	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
CALIFORNIA CURRENT	0	0	0	0	0	0	0	4	49	0	0	0	53
ROUTE TOTAL	0	0	0	0	0	0	0	4	49	0	0	0	53

ROUTE P18 TAHITI CALIFORNIA
NO./YEAR 700

SHIP	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
MOANA PACIFIC	29	0	13	24	0	28	9	18	7	0	20	0	148
POLYNESIA	17	23	14	21	0	18	14	16	14	17	25	24	203
ROUTE TOTAL	46	23	27	45	0	46	23	34	21	17	45	24	351

ROUTE P26 TRANSPAC TRANSPAC
NO./YEAR 2,000

SHIP	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
ALBERNI DAWN	0	0	0	0	0	0	0	0	0	0	0	2	2
GOLDENSARI INDAH	0	0	0	4	44	0	0	0	0	10	0	0	58
SAGA SPRAY	0	0	0	0	0	0	0	13	16	22	21	21	93
SEA-LAND DEFENDER	2	2	32	0	0	3	0	27	1	12	4	5	88
SEA-LAND ENTERPRISE	11	9	4	5	15	14	17	16	11	12	1	0	115
SEA-LAND NAVIGATOR	9	8	0	15	31	55	17	19	32	41	41	29	297
SEA-LAND PACIFIC	19	40	13	15	17	16	32	17	16	16	17	20	238
SEA-LAND TRADER	8	5	22	14	7	6	3	13	33	25	18	23	177
SKAUBRYN	0	0	0	7	58	21	29	51	53	36	19	20	294
SKAUGRAN	31	28	3	20	37	31	0	47	34	45	5	30	311
TAI HE	3	17	14	28	18	28	11	29	23	32	31	10	244
ROUTE TOTAL	83	109	88	108	227	174	109	232	219	251	157	160	1917

ROUTE P28 TAHITI SYDNEY/AUCKLAND
NO./YEAR 240

SHIP	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
CALIFORNIA CURRENT	0	0	0	0	0	0	0	22	0	0	0	0	22

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
ROUTE TOTAL	0	0	0	0	0	0	0	22	0	0	0	0	22

ROUTE P31 CALIFORNIA SYDNEY/NOUMEA
NO./YEAR 880

SHIP	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
COLUMBUS CALIFORNIA	0	0	0	32	0	0	0	0	0	0	16	3	51
ROUTE TOTAL	0	0	0	32	0	0	0	0	0	0	16	3	51

ROUTE P34 SYDNEY WELLINGTON
NO./YEAR 140

SHIP	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
AMERICA STAR	5	3	0	6	0	6	6	0	11	0	10	0	47
CALIFORNIA CURRENT	0	0	0	0	0	0	0	7	0	0	0	0	7
COLUMBUS CANADA	0	0	1	0	0	0	0	16	0	18	0	0	35
GULF CURRENT	0	0	0	0	0	0	0	0	0	2	0	0	2
MELBOURNE STAR	0	4	0	0	0	0	1	0	0	0	0	1	6
QUEENSLAND STAR	0	0	6	1	0	1	0	1	0	0	0	0	9
ROUTE TOTAL	5	7	7	7	0	7	7	24	11	20	10	1	106

ROUTE P37 HAWAII CALIFORNIA
NO./YEAR 340

SHIP	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
COLUMBUS CANADA	0	0	0	0	0	0	0	0	0	21	0	9	30
KA'IMIMOANA	0	0	0	0	0	57	0	0	0	0	0	0	57
MELBOURNE STAR	0	0	0	0	0	0	0	0	0	18	22	0	40
SEA-LAND DEFENDER	0	0	3	0	0	0	1	0	0	0	0	1	5
SEA-LAND ENTERPRISE	0	11	0	0	0	14	29	0	0	3	0	0	57
SEA-LAND NAVIGATOR	6	8	0	10	2	0	1	0	1	0	0	0	28
SEA-LAND PACIFIC	14	0	7	22	14	0	0	0	0	0	0	0	57
SEA-LAND TRADER	5	2	9	0	8	5	4	0	0	0	0	0	33
ROUTE TOTAL	25	21	19	32	24	76	35	0	1	42	22	10	307

ROUTE P39 HAWAII SEATTLE/VANCOUVER
NO./YEAR

SHIP	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
COLUMBUS CALIFORNIA	0	0	0	0	0	0	5	0	6	0	0	0	11
COLUMBUS CANADA	0	0	0	0	9	0	15	0	17	0	0	0	41
MELBOURNE STAR	3	0	5	0	0	13	0	17	0	0	0	0	38
MOANA PACIFIC	0	0	0	0	0	0	0	0	0	2	0	0	2

ROUTE TOTAL	3	0	5	0	9	13	20	17	23	2	0	0	92

ROUTE P44 TAIWAN GUAM
NO./YEAR 160

SHIP	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
SEA-LAND ENTERPRISE	0	0	0	1	0	0	1	20	1	0	0	1	24
SEA-LAND NAVIGATOR	0	1	5	0	0	0	1	1	1	2	0	0	11
SEA-LAND PACIFIC	0	1	2	11	7	0	0	4	0	0	0	0	25
SEA-LAND TRADER	0	1	2	5	0	0	0	0	0	0	0	0	8
ROUTE TOTAL	0	3	9	17	7	0	2	25	2	2	0	1	68

ROUTE P50 VALPARAISO AUCKLAND
NO./YEAR 680

SHIP	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
CALIFORNIA CURRENT	8	4	67	59	0	0	78	0	0	28	17	0	261
GULF CURRENT	47	59	18	0	0	0	0	0	60	5	0	56	245
ROUTE TOTAL	55	63	85	59	0	0	78	0	60	33	17	56	506

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U.S. XBT DATA COMPARISON
1995 vs 1996

TABLE 5

ATLANTIC OCEAN ROUTES						
ROUTE	1995			1996		
	COUNTS	REQ.	OVER SAMPLED	COUNTS	REQ.	OVER SAMPLED
AX-2	328	200	128	256	400	
AX-4	958	440	518	332	390	
AX-5	33		33			
AX-6	281		281	175		175
AX-7	917	520	397	440	490	
AX-8	505	960		506	910	
AX-10	320	200	120	356	245	111
AX-11	44		44	65		65
AX-12	182	800		156	800	
AX-13				14		14
AX-14	95	480	95	51	455	
AX-15				5		5
AX-17	61		61			
AX-21	24		24	17		17
AX-23	146		146	180		180
AX-26	100		100	54		54
AX-27	179		179	77		77
AX-29	926	360	566	402	580	
AX-32	443		443	314		314
AX-33	135		135	105		105
AX-34	135		135	80		80
AX-35	351		351	133		133
TOTAL	6163	3960	3756	3718	4270	1330

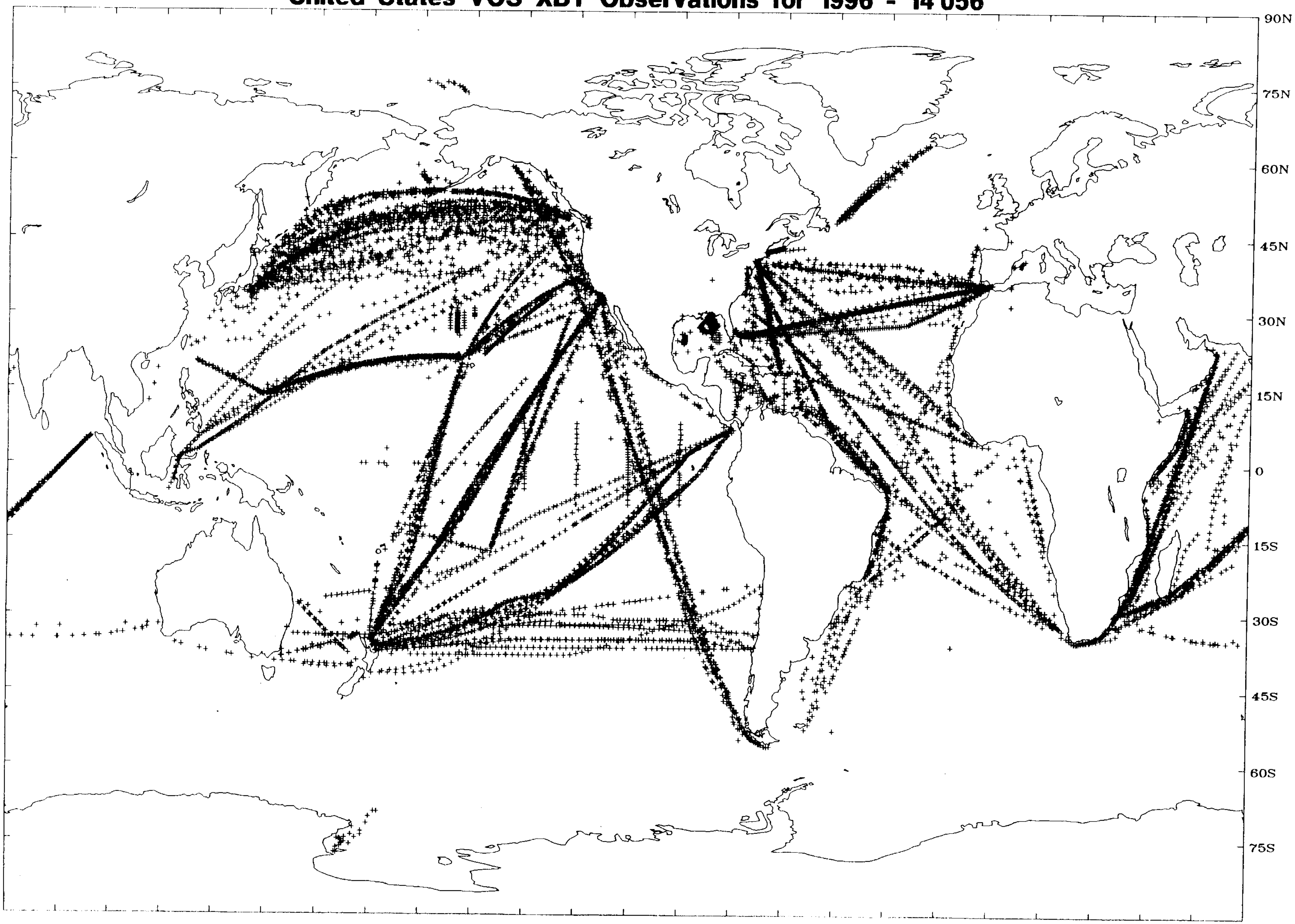
PACIFIC OCEAN ROUTES								
ROUTE		1995				1996		
		COUNTS	REQ.	OVER SAMPLED		COUNTS	REQ.	OVER SAMPLED
PX-1		607	860			415	865	
PX-6						17		17
PX-7/9		230	1080			391	535	
PX-8		1035	700	335		900	930	
PX-10		620	316	304		778	440	338
PX-12		32		32		28		28
PX-13		513	770			736	815	
PX-14		1259	1080	179		797	1530	
PX-15		54		54				
PX-17						53		53
PX-18		402	900			351	700	
PX-20		58		58				
PX-21		204		204				
PX-26		1678	2000			1917	2000	
PX-28						22		22
PX-31		118		118		51		51
PX-34		175		175		106		106
PX-37		292		292		307		307
PX-39		50		50		92	330	
PX-43		9		9				
PX-44		202		202		68		68
PX-80		70		70				
PX-49		1		1				
PX-50		829	700			506	680	
TOTAL		8438	8406	2083		7535	8825	990

INDIAN OCEAN ROUTES								
ROUTE		1995				1996		
		COUNTS	REQ.	OVER SAMPLED		COUNTS	REQ.	OVER-SAMPLED
IX-2						17	575	
IX-6		338	340			261	360	
IX-7		458	520			663	575	88
IX-8		165		165		54	315	
IX-15		92	380					
IX-21		241	400			246	345	
IX-25			360			7		7
IX-26		30		30				
TOTAL		1324	2000	195		1248	2170	95

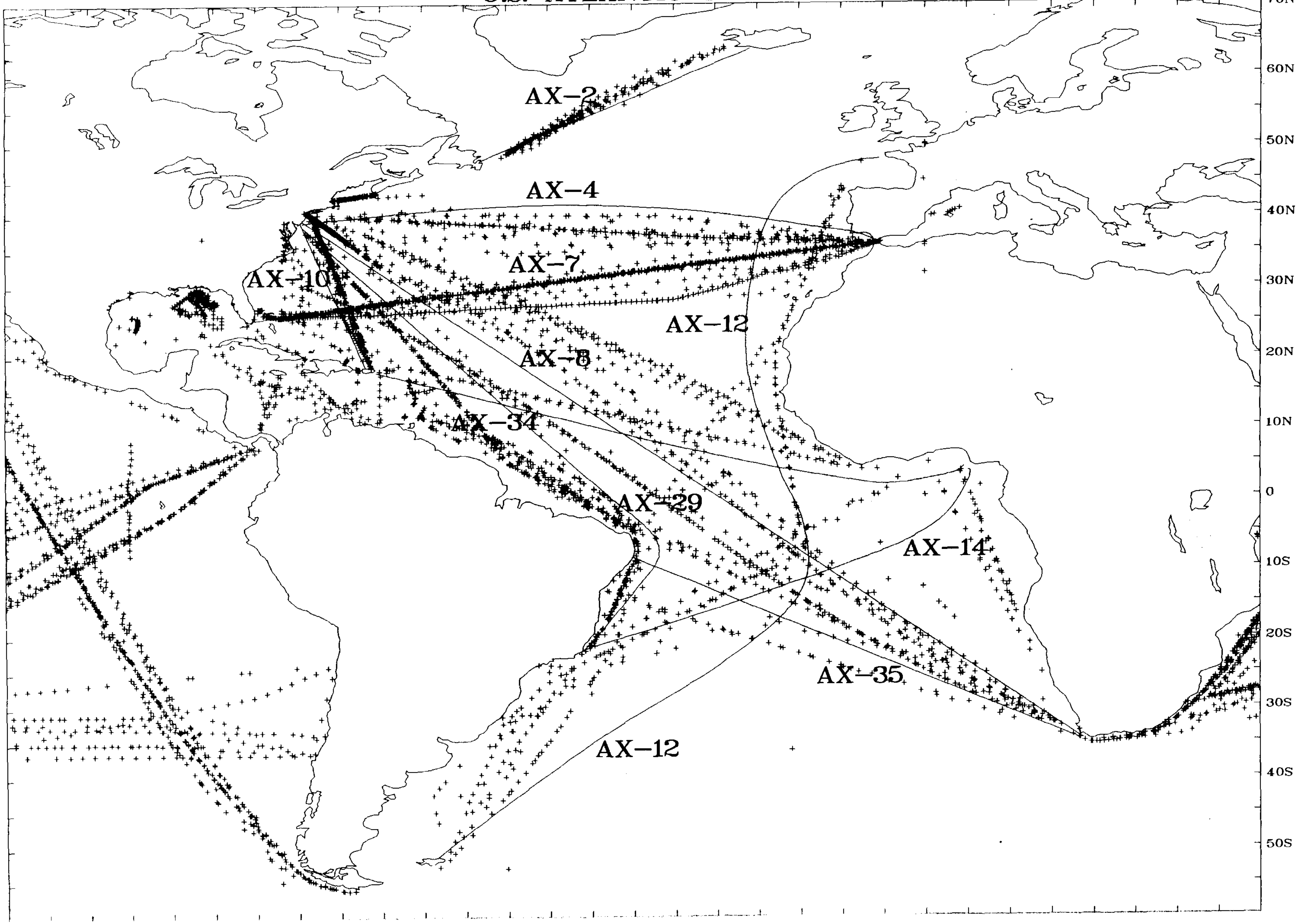
GLOBAL TOTALS								
OCEAN		1995				1996		
		COUNTS	REQ.	OVER SAMPLED		COUNTS	REQ.	OVER SAMPLED
ATLANTIC		6163	3960	3756		3718	4270	1330
PACIFIC		8438	8406	2083		7535	8825	990
INDIAN		1324	2000	195		1248	2170	95
TOTAL		15925	14366	6034		12501	15265	2415

ROUTE COVERAGE STATISTICS									
OCEAN		REQUIREMENTS MET			OVER SAMPLING			EFFICIENCY	
		1995	1996		1995	1996		1995	1996
ATLANTIC		60.8 %	56 %		94.8 %	31.1 %		42.2 %	60.3 %
PACIFIC		75.6 %	72 %		24.8 %	11.2 %		75.5 %	77.6 %
INDIAN		56.5 %	53.1 %		9.8 %	4.4 %		67.8 %	67.3 %
GLOBAL		68.9 %	66.1 %		42 %	15.8 %		65.2 %	68.2 %

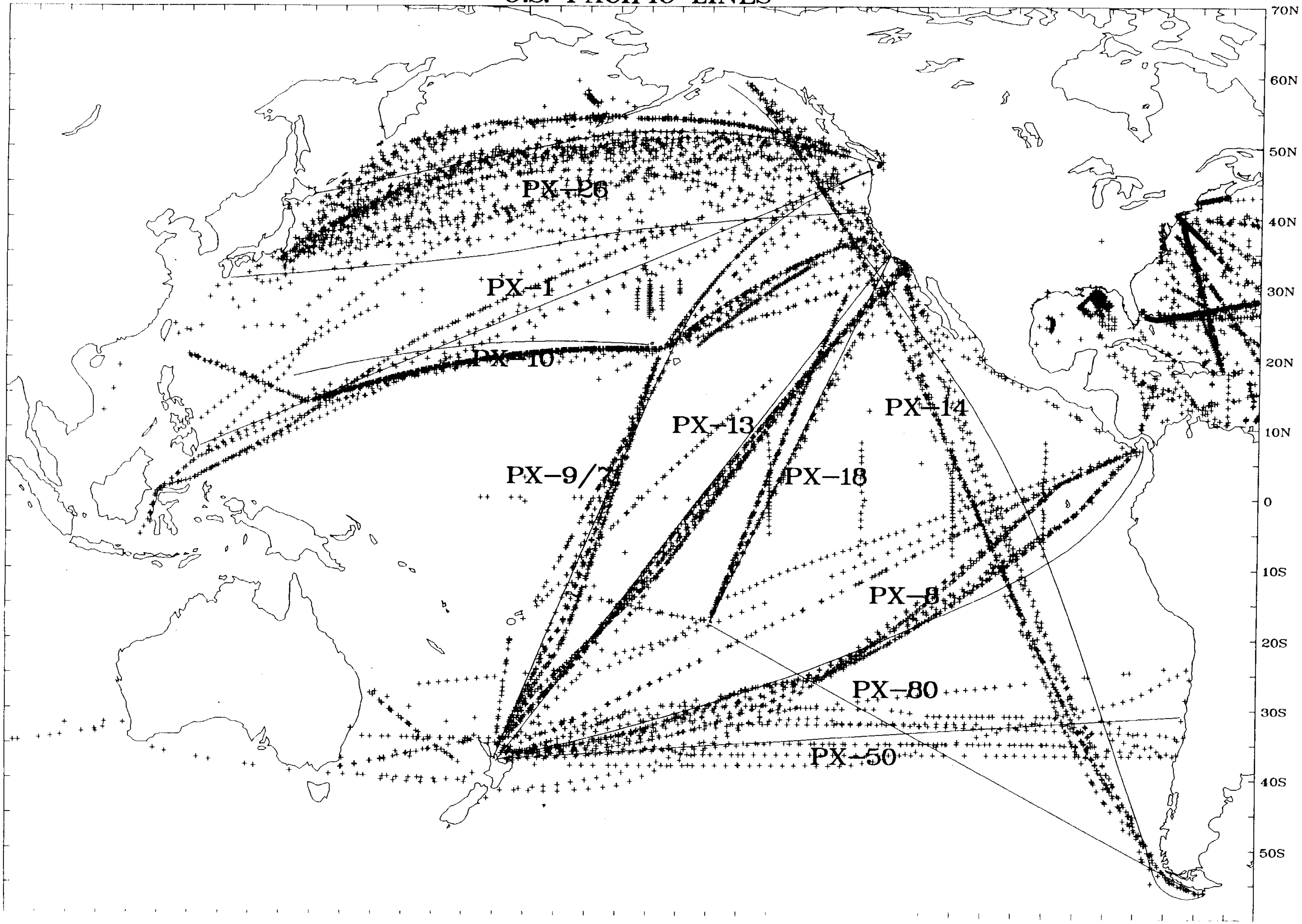
United States VOS XBT Observations for 1996 - 14'056



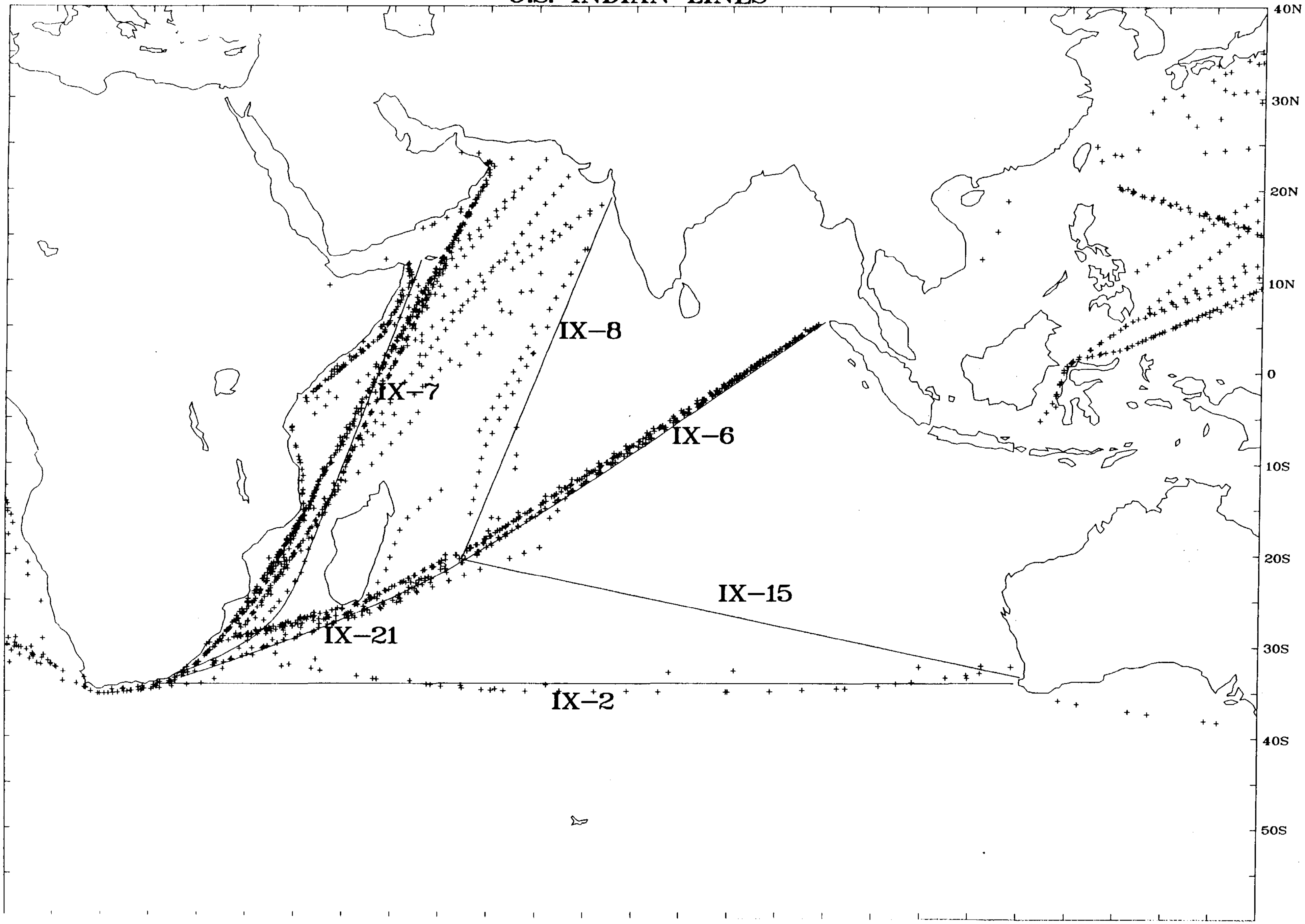
U.S. ATLANTIC LINES



U.S. PACIFIC LINES



U.S. INDIAN LINES



Global Network of SEAS Depots

II. Status of Communication & Data Collection Systems (this is something Chris Noe typically prepared and discussed INMARSAT and other improvements, cost savings, improved transmission capabilities, etc.)

Status of Communication and Data Collection Systems for the U.S.

The United States National Oceanic and Atmospheric Administration (NOAA) has developed a software package, called SEAS IV to facilitate the compilation, encoding, and transmission of meteorological (BBXX)and bathy (JJYY) observations via INMARSAT Standard C. In 1996, ships using SEAS collected and transmitted 17,514 met and 927 bathy observations through Standard C (see *attached plots for 1996). SEAS IV is an upgrade to previous SEAS programs and incorporates the ability to generate Automated Mutual assistance VEssel Rescue System (AMVER) messages and transmit data in compressed binary format through Standard C, resulting in significant savings.

The software is available at no cost from NOAA. The software requires an IBM PC or laptop (MET/AMVER only) computer with DOS 3.3 or higher. Ships are not required to participate in the U.S. VOS program in order to receive this software. However, to take advantage of the compressed message capability and thus reduced cost, the ship will need to register with the U.S. program.

The software:

(a) Compiles ships' meteorological, bathy and AMVER reports in standard code and prepares them for transmission. Extensive help-fields are available. An AMVER position report is automatically generated each time a meteorological and/or bathy report is prepared and transmitted. An AMVER sail plan function is also included.

(b) Performs quality control on the met and AMVER reports prior to transmission and storage.

(c) Stores the reports on diskette (or hard disk) for later retrieval, further quality control, and permanent archival for climatological and research purposes and data exchange.

(d) Is compatible with a Synergetics GOES and many Standard C transmitters.

The reports are stored in files or can be printed, for:

- Transmission by telefax, Telex over Radio (TOR), Inmarsat-A TELEX, Inmarsat-C TELEX, morse code, or voice manually;

- Transmission via NOAA-GOES satellites automatically;

- Transmission as a compressed binary message through the ship's Inmarsat-C system semi-automatically via COMSAT. The reports are converted back to standard format upon receipt.

Advantages for the system are:

(a) Help-fields for every element, a VOS code card is no longer necessary;

(b) A number of quality control checks achieve increased accuracy and reliability of the observed data.

(c) Transmission of an observation through Inmarsat-C in the binary mode is very cheap, compared to other transmission methods such as INMARSAT-C TELEX.(56 cents vs. $5-$8 dollars for met reports. Bathy and AMVER reports will vary in cost depending on the size of the report.)

(d) Standard C also provides error checking in the transmission process which greatly reduces the number of transmission errors using GOES.

(e) AMVER messages transmitted in the binary mode via INMARSAT-C are paid by the AMVER program rather than the participating vessel. The increased frequency of AMVER messages (each met/xbt observation vs. several days) assure an enhanced level of safety. The AMVER functionality of SEAS IV provides additional incentive for ships to participate in the VOS program.

Additional SEAS Features

(a) SEAS IV also provides the capability to transmit TESAC (KKXX) messages.

(b) An ancillary benefit in the development of SEAS IV has been the availability to NOAA of the U.S. Coast Guard Data Network (GGDN). Through a cooperative program with the Coast Guard and COMSAT, NOAA is allowed to use the CGDN for its land traffic from the satellite ground station and eliminate the landline costs for the messages.

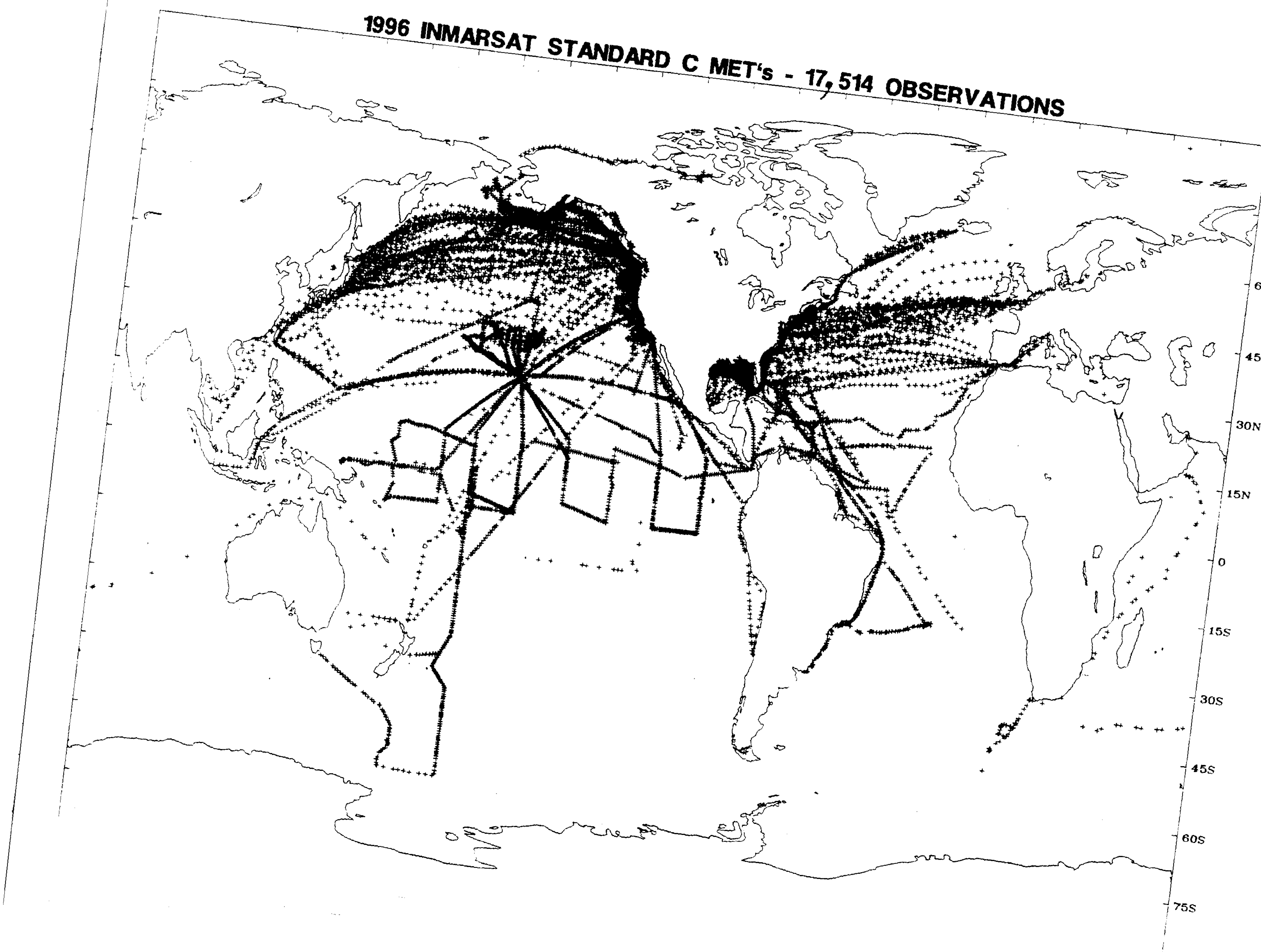
Future Developments

(a) The ability to transmit messages via the INMARSAT-C signaling channel at even greater savings is under study.

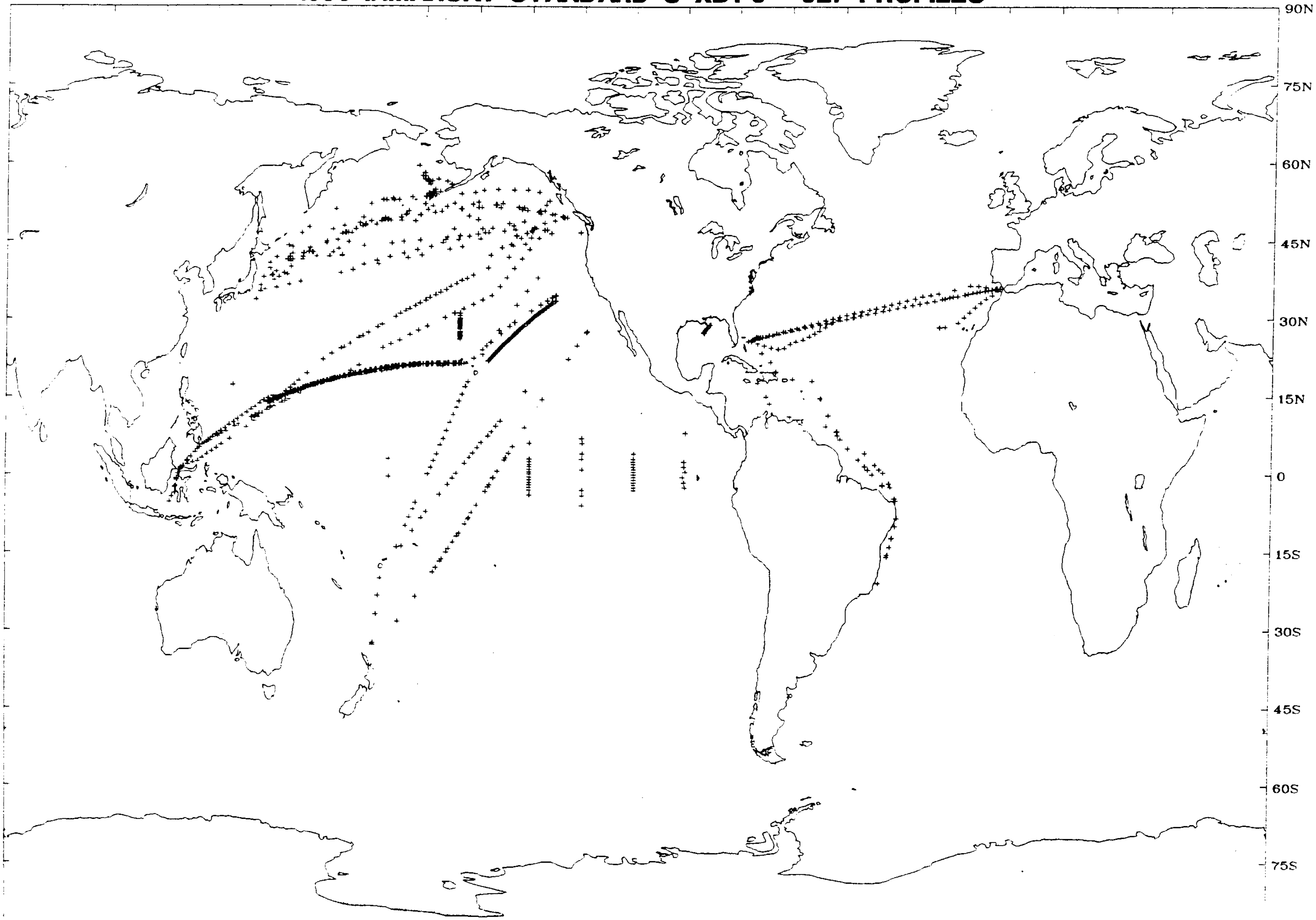
(b) The integration of data from:
   1) XBT auto-launcher developed by AOML.
   2) thermosalinograph to generate trackob(NNXX) messages.

(c) To integrate SEAS with automated meteorological and navigation sensor data as might be provided by an integrated bridge or electronic chart system. Current SEAS software allows connection to a GPS receiver for automatic entry of vessel position.

1996 INMARSAT STANDARD C MET's - 17,514 OBSERVATIONS



1996 INMARSAT STANDARD C XBT's - 927 PROFILES



III. ADDITIONAL ISSUES TO BE CONSIDERED AT THE SOOPIP MEETING:

1. Defining a practical and timely mechanism for acquiring scientific advice on XBT sampling strategies.

It appears that the OOPC and the CLIVAR UOP are willing to provide such advice and that this issue was raised at the first SOOP Management Committee last May in Toulouse. We hope that this issue can be discussed at the SOOPIP meeting and perhaps a proposal drafted for how such a mechanism should be implemented. On the practical side, I think that any proposed mechanism must include ways to insure timely answers to specific sampling questions as they arise. For example, an intersessional "executive body" of the OOPC could be suggested to respond quickly via e-mail to sampling strategy questions.

2. Developing International Cooperative Agreements for mutual support of the global XBT program under the auspices of SOOP.

During the TOGA period the U.S. entered into bilateral agreements with France and Australia for joint support of the TOGA XBT Program. Although those agreements have expired with the completion of TOGA, the cooperative efforts have fortunately continued. As everyone's budget shrinks it will become more and more difficult for the national programs to maintain their present global cooperative commitments. The U.S. would like to consider the possibility of forming international bilateral agreements under the auspices of SOOP to establish XBT cooperation more formally. It is envisioned that the establishment of these agreements would provide a stronger global program and provide more stability to the national programs participating in the agreements.