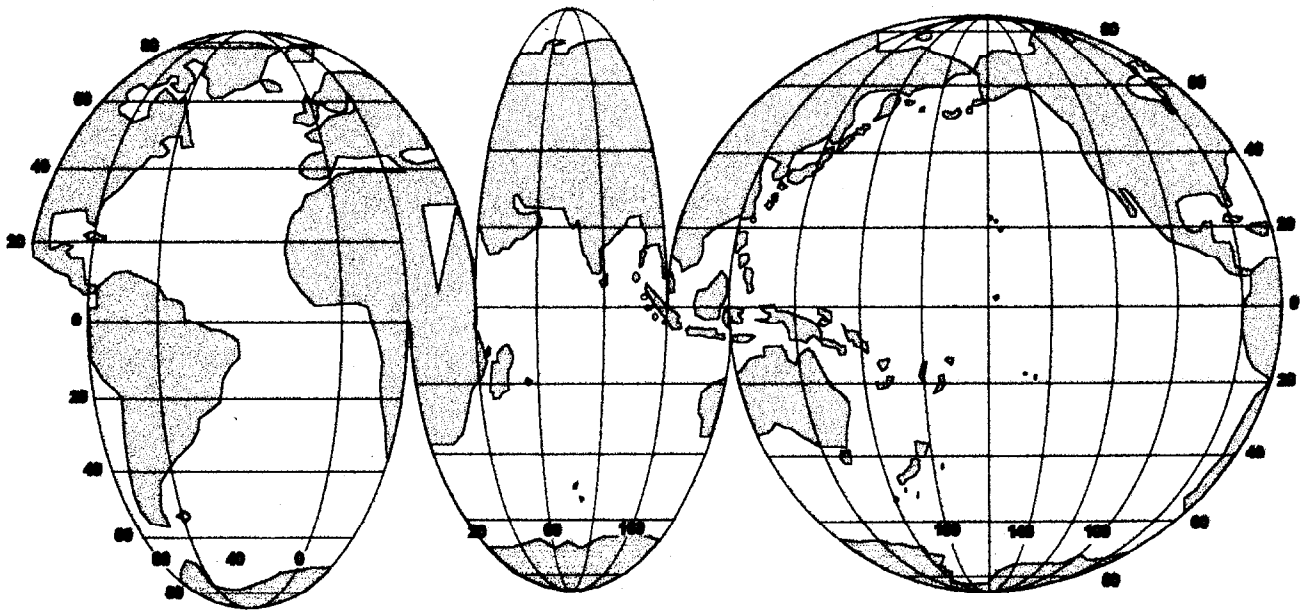
Global Ocean Observing System

Intergovernmental Oceanographic Commission

Status Report on Existing Ocean Elements and Related Systems



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GOOS STATUS REPORT 1996

EXECUTIVE SUMMARY

GOOS is making steady progress. It is now reaching the peak of the initial planning phase which will culminate in a Commitments Meeting with Heads of operational Agencies in mid 1998. In parallel with planning, phase 2, the development of pilot or demonstrator projects, has begun. The first of these, the NEAR-GOOS Pilot Project, started in October 1996. It comprises a data exchange system involving four nations in the North-East Asian Region. Other Pilot Projects are being developed, including several in Europe under the aegis of EuroGOOS and with the assistance of funding from the European Commission. In addition 6 Pilot Projects for the Coastal Module are being developed in the USA. A global data assimilation experiment (GODAE) is being designed to advance the data assimilation technology needed for GOOS. It has been adopted as a Pilot Project by CEOS, along with another on Ocean Colour. Capacity building has begun with workshops in Mombasa and Goa. Preliminary analyses of costs and benefits have been made, but more work is needed on this topic. Steps are now being made towards development of a Data and Information Management strategy and plan, jointly with GCOS, GTOS, IGOSS and IODE.

Space-based requirements are being identified jointly with GCOS and GTOS. A change to the structure of GOOS to improve its efficiency has been proposed, to take effect at the beginning of 1998. It involves the amalgamation of J-GOOS with the GOOS Strategy Sub-committee into a GOOS Steering Committee which will enable the more rapid development and implementation of GOOS. A key advance in 1996 was the creation of a permanent UNESCO post for the GPO Director, and the appointment of someone to that post in early 1997. Nevertheless, the great expectations held of the GOOS Project Office by Member States will not be met without resources which can only come from the Member States themselves, including (i) staff secondments to assist in planning and implementation; (ii) earmarked donations to the GOOS Trust Fund, to support meetings especially of the Coastal and LMR modules, of the TAO panel, of the data and information management and space panels, of workshops on costs and benefits in developing countries, and of regional capacity building workshops; and (iii) earmarked donations to the GOOS Trust Fund to develop a new brochure and an up-to-date travelling exhibit for use at key meetings, and to purchase state of the art office equipment.

1. INTRODUCTION

The Global Ocean Observing System (GOOS) is a new, internationally organised system for the gathering, coordination, quality control, and distribution of all kinds of marine and oceanographic data and derived products of common worldwide importance and usefulness as defined by the requirements of the broadest possible spectrum of user groups. GOOS is a concept similar to the global meteorological observing network, supported by national governments and implemented through contributions of national agencies, organisations and industries, with the assistance of national and international data management and distribution bodies. It is an ambitious undertaking which will include diverse marine observations which have not been systematically or routinely assembled before. At its core, maximum use will be made of existing systems and organisations, which will be encouraged to modify and enhance their activity to accommodate observations contributing to a coordinated GOOS Plan.

This report is about new GOOS endeavours and about the pre-existing systems which in one way or another are likely eventually to contribute wholly or in part to GOOS. In reading what follows it will be useful to recall that GOOS will develop through 5 overlapping but discrete phases:

1. planning, including design and technical definition
2. operational demonstrations (Pilot Projects)
3. incorporation of suitable existing and new observing activities

4. gradual operational implementation of the permanent or ongoing GOOS
5. continued assessment and improvement.

Currently we are in phase I, which is approaching its peak with the production of a set of key planning documents (the GOOS Principles; the GOOS Strategic Plan; and the GOOS Design entitled GOOS 1998). The emphasis is now moving towards implementation. Phase 2 has begun with the implementation of the NEAR-GOOS Pilot Project initiated by IOC's WESTPAC in the North-East-Asian Region. Phase 2 will ramp up during late 1997 and 1998 with the addition of several European Pilot Projects being developed by the EuroGOOS consortium of 22 operational agencies from 14 countries. Phase 3 has begun with the planned conversion of the TAO (Tropical Atmosphere-Ocean) array into an operational system, which is considered by the USA to be a key component of GOOS. The precise relationship of other existing systems (eg IODE, IGOSS, DBCP, SOOP, GLOSS etc) to GOOS awaits definition , in that in some cases not all parts of these pre-existing systems fit comfortably (at least, at present) in the GOOS framework.

Nevertheless these systems are seen as vital to GOOS development in some way or other. Completion of the GOOS Strategic Plan and the GOOS Design by early 1998 will make the relationship of existing systems to GOOS clearer, facilitating dialogue with the management bodies of those systems about their relationship to GOOS. In the meantime the world community has a proto-GOOS observing system in operation which includes the elements listed in this report, as well as many national operational elements not listed here. Taken as a whole they represent the birth of international operational oceanography at the global level; there is a long way to go before this child becomes a respected adult capable of making a solid contribution to global environmental management.

How far have we come already? Comparison of this report with preceding issues, which began in December 1990, shows that GOOS has been ramping up slowly but steadily over that past few years since the IOC committed itself to the development of the system and made the Technical Committee for Ocean Processes and Climate responsible for its development. Subsequently the Intergovernmental IOC-WMO-UNEP Committee for GOOS (I-GOOS) was formed to take over this responsibility and to widen the scope beyond the area of climate. I-GOOS held its first meeting in early 1993. The scientific and technical design of GOOS began formally in March the following year with the first meeting of the Joint Scientific and Technical Committee for GOOS (J-GOOS), which is sponsored in addition by ICSU. These two complementary committees are now working in tandem to finalise the first phase of GOOS plans. GOOS had an earlier history dating back at least to 1989 when the IOC accepted that a global observing system of some kind would be needed, but until 1992-93 the arrangements for achieving it were ad hoc.

More information about GOOS can be obtained from:

- the IOC publication: Towards Operational Oceanography: The Global Ocean Observing System (GOOS); IOC/INF-1028; April 1996.
- the GOOS Homepage on the Internet: http://www.unesco.org/ioc/goos/IOCGOOS.html
- the GOOS Newsletter (available from the GOOS Project Office)

2. GOOS DESIGN AND PLANNING

2.1 General Progress

In its initial planning stage the scientific and technical issues of GOOS are being considered for convenience through 5 so-called Modules: (i) Coastal, including coastal seas, the shoreline, runoff from land and exchanges with the open ocean and the atmosphere; (ii) Health of the Ocean (HOTO), dealing primarily with pollution; (iii) Living Marine Resources (LMR), dealing with fish and the food chain and their relation to marine ecosystems; (iv) Climate (this being the ocean component of the Global Climate Observing System

- GCOS); and (v) Services, encompassing the identification of the user community and its requirements, and the design of end-to-end (data-to-product-or-service) outputs to satisfy user requirements. The focus of the panels will shift through time from scientific design to implementation. Thus far the Climate Module and the HOTO module have made this transition. Planning for the Coastal and LMR Modules is less far advanced, but beginning to ramp up. Nobody expects GOOS to be implemented through its modules, since in one way or another they cut across each other. The present emphasis is on implementation at the national or regional level of the elements for which planning is most advanced. These currently lie in the Climate Module and HOTO Module, for which detailed plans have been published. However, several of the elements of these modules which are ready for implementation are equally important for the Coastal and LMR modules.

GOOS is expected to grow from national and regional efforts combined with some global initiatives that already exist, and will eventually become completely global as gaps are identified and commitments are made to fill them in. Implementation, then, is expected to be incremental and gradual and to move from the local and regional to the global.

2.1.1 Coastal Module

A GOOS Coastal Workshop was held in Miami in February 1997. Discussions were particularly well informed thanks to the availability of a report on a US GOOS Coastal Module Workshop which had taken place in December 1996. In keeping with the spirit of GOOS, the US GOOS Coastal Workshop had recommended the formation of 6 Pilot Projects dealing with different aspects of coastal seas, including questions of run-off from land. The Miami workshop concluded:

- that there are ubiquitous coastal problems and processes which can be observed or managed in consistent ways globally.

- that the Coastal Module of GOOS requires a global approach and structure to ensure (i) economies of scale, (ii) application of proven technology and procedures, and (iii) widespread use of best practice.

Among other things it recommended that: (i) a Panel be formed to take things forward, (ii) cost benefit studies should be encouraged to identify the services of greatest use; and that (iii)regional GOOS groups should develop GOOS coastal activities involving developing countries as partners and encouraging capacity building.

2.1.2 Climate Module

The Ocean Observation Panel for Climate (OOPC) has identified data assimilation as a major area demanding technological advance to enable GOOS to make the best use of satellite data. In response to this need, OOPC has developed the concept of a Global Ocean Data Assimilation Experiment (GODAE), which J-GOOS-IV approved for further development to the state where it could be taken to funding agencies.

Space missions designed to provide data suitable for studies of climate change (and to meet the needs of other GOOS modules) are already largely fixed through to 2005. Influencing what happens after that will depend on development of forceful arguments now and delivering them to groups like the Committee for Earth Observing Satellites (CEOS). One particular development on the horizon and now appearing reasonably feasible is a space-based measurement of sea-surface salinity.

Good arguments are also needed in support of the continuation of time series measurements to monitor climate change. Recognizing this, a Time Series workshop was held in Baltimore in March 1997.

To support coupled ocean-atmosphere climate modelling, and other GOOS activities, J-GOOS approved

development of a cross-cutting global core system which will be an integration of observing systems, both remote sensing and in situ/direct, with global numerical models, to deliver a detailed field description of the global ocean on a real-time operational basis. The products will be used to specify boundary conditions for coastal and regional forecasts and to extend the limits of predictability for the benefit of all GOOS customers, not only those interested in climate. This initiative is seen as complementary to the efforts being put into data assimilation through GODAE, but whereas GODAE is a technical experiment with a finite life, the core system will be an essential feature of the operation of GOOS.

2.1.3 Health of the Oceans (HOTO) Module

A HOTO Strategic Plan was published in 1996 and distributed widely. The HOTO Panel is now focusing on regional implementation through the development of pilot projects emphasising human health issues and prognostic modelling. The IOC's Global Investigation of Pollution in the Marine Environment (GIPME) programme has played a major role in developing this module.

2.1.4 Living Marine Resources (LMR) Module

Defining a course of action for the LMR module is not straightforward, partly because the LMR community is itself divided on what the scope of this module should be. An LMR Workshop in Dartmouth, USA, in 1996, identified an attractive approach in which observations and models are combined to provide both now-casts and forecasts to customers. J-GOOS plans soon to establish a panel for LMR along the lines suggested by the Dartmouth workshop. We hope for assistance from the IOC's Ocean Science in Relation to Living Resources (OSLR) programme to take this forward.

2.2 Combining Forces with Other Global Observing Systems

One important recent development is the recognition that there are certain advantages to be gained by combining forces and promoting the three global observing systems (GOOS, GCOS, and GTOS - the Global Terrestrial Observing System) as parts of a single overarching system (loosely referred to as the G3OS). To this end the three systems now have a joint space panel (the Global Observing Systems Space Panel - GOSSP), which meets next in late May 1997, and a Joint Data and Information Panel (J-DIMP), which meets in July 1997. In taking this path GOOS will benefit from the thinking that has already gone into the production of the GCOS Space Plan and the GCOS Data and Information Plan. Adapting these plans to GOOS needs will enable us to avoid re-inventing the wheel. In the case of GOOS, we will need to integrate the thinking done by this route with that already done by IGOSS and IODE and by regional groups such as NEAR-GOOS.

Data and Information Management will be at the heart of GOOS, so the development by J-DIMP of a Data and Information Management Plan for GOOS, modelled on the GCOS Data and Information Management Plan and incorporating features of the present IGOSS and IODE operations is seen as a very high priority for the immediate future. This will require assessment of existing observational networks as the basis for developing a GOOS observational network.

Recognizing that a great deal of attention was being given to space-based ocean observations, a meeting was co-organised by GOOS, GCOS and GTOS on In Situ Observations for the Global Observing Systems. Held in Geneva in September 1996, it addressed the requirements for in situ as well as space-based marine observations, not least for the calibration and validation of space-based observations.

2.3. Pilot Projects

Now that the peak of the planning phase is almost past it is essential that a range of Pilot Projects be established quickly to demonstrate that GOOS will work, and to assist us in gaining commitment from operational agencies to implement GOOS. Pilot projects do not have to be regional. They may also develop

as bilateral between partner nations. Individual nations may also develop their own GOOS Pilot Projects, as in the case of the USA with its Coastal Pilot Projects mentioned earlier.

We need Pilot Projects (a) to demonstrate the feasibility of data exchange between neighbouring nations, and (b) to make progress in key technology areas. The first official Pilot Project of GOOS is WESTPAC's NEAR-GOOS (North-East Asian Region) Project sponsored by Japan, China, the Republic of Korea and the Russian Federation. The first stage will involve data exchange. An Implementation Plan and an Operations Manual were finalised at the NEAR-GOOS Coordination Committee meeting in Bangkok (4-6, September, 1996). The system became operational on October 1st 1996. A Training Course for the WESTPAC region has been organised with the help of Japan to widen the NEAR-GOOS experience, and will be held in October 1997.

The EuroGOOS consortium intends shortly to create a suite of six pilot projects, in the Baltic; the Arctic; the Mediterranean; the Black Sea; the Northwest Shelf (which includes the North Sea); and the Atlantic. In addition it has reviewed the technology requirements for EuroGOOS members, and assessed the possibility of instrumenting European ferries as a means of capturing routine observations from coastal seas as is done around Japan. The findings of the technology surveying group and the ferry box group will be of generic as well as local value, and therefore useable by other nations developing operational oceanography under the GOOS banner. Several bids have been made to the EC to fund these EuroGOOS activities and there is a strong likelihood that much of this work will be funded.

In an independent development the Committee on Earth Observation Satellites (CEOS) has identified the need for operational satellite agencies to make their operations more coherent through an Integrated Global Observing Strategy (IGOS). To take this concept forward it has identified 6 Pilot Projects, two of which are in the GOOS area: (i) Ocean Colour; and (ii) Data Assimilation. The GODAE proposal of the OOPC has been accepted as a Pilot Project on Data Assimilation by the CEOS Strategy Implementation Team and by J-GOOS. Representatives of the HOTO Panel recently visited the WESTPAC area to explore the possibilities of developing regional pilot projects there.

A prototype Pilot Project (prototype because it started before GOOS did) is the international TAO observational array in the equatorial Pacific, which provides the basis for forecasts of the El Niño events which affect the nations of the Pacific Basin and other areas. Many Pilot Projects will lead eventually to operational programmes, as did the Global Temperature Salinity Project of IGOSS, which is now an operational programme (GTSP).

In due course, when the GOOS Data and Information Strategy and Plan have been developed and the GOOS Design has been published, we will have to revisit the early Pilot Projects to ensure that they conform to GOOS standards and policies. From then on new Pilot Projects will be designed from the beginning with those standards and policies in mind.

2.4. Gaining Commitment

As GOOS will be implemented ultimately by national operational meteorological and/or oceanographic agencies it is important that they are involved in the planning process. To that end planning documents are being prepared for a high level Commitments Meeting with the Heads of such agencies in mid 1998, the Year of the Ocean. The process will open at the First GOOS Forum in Paris on June 25th, with exposure of GOOS progress to date to representatives of operational agencies. However, much has already been done to entrain appropriate operational agencies in GOOS planning through the efforts of national and regional GOOS programmes, including NEAR-GOOS and EuroGOOS. And much is presently being done by the GCOS, GOOS and GTOS working with CEOS in designing an Integrated Global Observing Strategy.

It is also essential for the success of GOOS as a global programme that it involves developing countries through partnerships or Capacity Building programmes. To begin this involvement a series of GOOS

regional workshops began with one in Goa (18-19 November, 1996) and continued with one in Mombasa (11-15 March 1997). A third workshop, planned for Mediterranean countries, will be held in Malta later in 1997. Other workshops are planned for the SOPAC and South American regions.

In order to encourage investment in GOOS, it is widely believed that we must first demonstrate that its benefits outweigh its costs. To address this issue a NOAA-IOC Workshop on Socio-Economic Aspects of the Global Ocean Observing System was held in Washington on May 15th 1996. At the workshop it was concluded that activities to determine the costs and benefits of GOOS were needed in selected regions. South-East Africa, the Mediterranean, including North Africa, and Latin America were selected, but studies have yet to begin.

2.5 Structural Changes

GOOS is about to become restructured to improve its efficiency. A Strategy Sub-Committee (SSC) had already been developed to achieve this and to link the two main committees I-GOOS and J-GOOS more firmly. It has now been recommended that the structure of GOOS should be harmonised with that of the other observing systems (GCOS and GTOS), with the formation of a GOOS Steering Committee which would sit alongside I-GOOS and take executive responsibility for the planning and implementation of GOOS in accordance with the requirements of I-GOOS. The new committee would merge the roles of J-GOOS and the SSC. Recognizing the change of emphasis of GOOS from planning (phase 1) to implementation of Pilot Projects (phase II), the membership of the new Committee would evolve to include a substantial number of people from operational agencies. This proposal, which would take effect from 1/1/98, has been endorsed by the GOOS sponsors and J-GOOS and awaits the comment of I-GOOS in June 1997 before being finalised.

A change in GOOS structure requires a commensurate change in the GOOS Office. Consistent with the more proactive role expected of the GOOS Office, the sponsors and J-GOOS have accepted the new Director's proposal that it should be designated the GOOS Project Office, rather than, as formerly, the GOOS Support Office. The GOOS Project Office (GPO) exists to assist in the promotion, coordination, implementation and management of GOOS, to provide staff support to GOOS committees and officers, consistent with resources, and to facilitate coordination not only between I-GOOS and J-GOOS but also with the Secretariats of the other global observing systems, GCOS and GTOS. Its tasks include identifying the resources needed for GOOS and the means for obtaining them, developing and updating plans for initiating implementation stages and monitoring their progress, liaising with related research projects and GCOS and GTOS, and conducting public and information activities to promote GOOS.

Currently there are two systems, IGOSS and the WMO's Commission for Marine Meteorology (CMM), providing global operational oceanographic services of the kind that GOOS is ultimately likely to provide. Recognising that it may not be cost-effective to have two such systems operating in parallel, it has been suggested that ways need to be explored to see if might be possible to combine them and thereby (i) strengthen operational oceanography to the benefit of the wider community, and (ii) provide a stronger underpinning for GOOS. To carry out that task consultants were engaged by IOC and WMO to consider how such a combination might take place. One route being considered is the possible joint sponsorship of the CMM by IOC and the WMO. This question was discussed at the CMM meeting in Havana in March 1997, but still needs widespread consideration within IOC. The Joint Scientific and Technical Committee (JSTC) for GCOS has endorsed the idea that the CMM might provide ocean observations for climate as a joint IOC-WMO body.

2.6. Resources, and Proposals for the Future

A key advance in 1996 was the creation of a permanent UNESCO post for the GPO Director, and the appointment of someone to that post in early 1997. Nevertheless, the great expectations held of the GOOS Project Office by Member States will not be met without resources which can only come from the Member

States themselves. To take matters forward at an appropriate pace we need:

staff seconded by Member States, especially:

i. to assist in implementing pilot projects in the Health of the Oceans Module;
ii. to facilitate planning and eventually the implementation of pilot projects in the Coastal, and Living Marine Resources Modules;

earmarked donations to the GOOS Trust Fund:

i. to support meetings of the Coastal and LMR modules;
ii. to enable the IOC to fund meetings of the TAO panel;
iii. to contribute to the costs of meetings of the joint G3OS data and information management and space panels;
iv. to facilitate meetings and workshops on costs and benefits in developing countries;
v. to support regional capacity building workshops;
vi. to enable GOOS to play its proper part with CEOS in developing the IGOS;
vii. to enable the Director to carry out appropriate travel to build the GOOS constituency;
viii. to develop a new brochure and an up-to-date travelling exhibit for use at key meetings;
ix. to purchase state of the art computer equipment to facilitate production of newsletters and brochures, and maintenance of the GOOS Homepage on the Web;.
x. to purchase a GOOS Office Fax to facilitate communication with the GOOS community.

3. INTEGRATED GLOBAL OCEAN SERVICES SYSTEM (IGOSS)

3.1 Ships of Opportunity Programme

The Ships of Opportunity Programme (SOOP) is an existing operational component of GOOS and directed primarily towards the implementation of the common GOOS/GCOS ocean climate module. In addition, many of the SOOP lines also serve or contribute to other aspects of GOOS, including in particular the coastal and services modules.

In 1996, an estimated total of 48,560 unique BATHY messages (temperature versus depth profiles) using expendable bathythermographs (XBT) and 2,585 TESAC (temperature, salinity and conductivity measurements) were taken with Conductivity-Temperature-Depth (CTD) instruments. Although track line data, known as TRACKOB messages and drift and stationary buoy data (known as BUOY) were also exchanged, they comprise only a small percentage of the total data exchanged.

Since 1976, almost 800,000 BATHYs and over 115,000 TESAC messages have been exchanged through the IGOSS (figure 1). Since the TAO buoy array was created in the South Pacific in 1992 to monitor El Niño Southern Oscillation (ENSO) events, the number of BATHYs originating from these buoys has steadily increased to where roughly half of the BATHY messages exchanged in 1996 were from fixed buoys such as the TAO array. IGOSS messages are transmitted in less than 30 days from the time of observation and so are considered *near-real time data.* Their applications are varied with particular emphasis on determining boundary conditions for ocean modeling, satellite truthing and for use in atmosphere-ocean climate modeling.

Data transmitted or submitted after the 30-day period are considered to be *delayed mode data* and typically contain many more data points per profile than a typically BATHY message. BATHY messages are constructed by selecting significant data points in a temperature-depth profile to characterize an entire profile. This is necessary at present because of limitations in satellite data transmission capabilities. The present accepted terminology for BATHY messages and delayed mode data are *low- and high-resolution*,

respectively. Both types of data are archived as they are received by data centres with BATHYs or low-resolution data ultimately being replaced whenever possible by the higher resolution delayed mode data. The archiving responsibilities internationally fall under the purview of IOC's International data and Information Exchange (IODE).

The field acquisition phase of the ten-year World Ocean Circulation Experiment (WOCE) was completed at the end of 1996. This major oceanographic research programme was the driving force along with the Tropical Ocean Global Atmosphere (TOGA) experiment for the XBT Ship of Opportunity Programme or SOOP. The Joint Committee for IGOSS assumed the responsibility for maintaining the TOGA-WOCE low density XBT network (figure 2) for operational purposes. At IGOSS-VII in November of 1995, the joint committee approved a SOOP Plan that created a management structure for the SOOP (figure 3) that relied on the continuing expertise of countries that had formed the TOGA-WOCE SOOP and is steered by scientific input from the operationally-oriented Ocean Observing Panel for Climate (OOPC) of the Global Ocean Observing System (GOOS) and the research-oriented Upper Ocean Panel (UOP) of the Climate and Variability (CLIVAR) programme of the World Climate Research Programme (WCRP).

The SOOP Management Committee (SMC) has terms of reference that direct it to coordinate resources from participating countries so that XBT probes and equipment and available ships are deployed optimally in a concerted global effort. A principal result of the first SMC meeting held in May 1996 was an XBT Resources Survey which was distributed to the eight participating countries who were represented at the meeting. Input from the countries to the survey (figure 4, example of page 1 of the survey), along with actual deployments from the two 1996 WOCE Six-Month XBT Line Reports were compiled by the IGOSS Operations Co-ordinator and will be presented at the next SMC meeting and at the first meeting of the SOOP Implementation Panel (SOOPIP) to be held in April 1997 in Capetown, South Africa.

Approximately 117 ships (both research and volunteer merchant ships) contributed to the collection of IGOSS data in 1996. The XBT Resources survey yielded many interesting summaries of the distribution of XBT probes by ocean and country (4 figures 5 - 8). The net result is that approximately 61% of the required number of XBTs needed to fully cover the low density XBT network were deployed. A summary of coverages for each track line defined in the network is provided for each ocean (3 figures 9 -11). While both the research and operational communities benefit from the exchange of IGOSS data, the emphasis at IGOSS during its next Implementation plan is toward the generation and marketing of derived products. Accordingly, a new *group of experts* was formed at IGOSS-VII for promoting advances in *Communications and Products*. This group will have its first meeting in 1998.

3.1.1 Data and Information Access

Data sets derived from IGOSS observations and associated products can be accessed and even downloaded on-line from the World Wide Web (WWW) within the framework of the Global Temperature and Salinity Profile Programme (GTSPP). Direct connection through the WWW under the U.S.'s National Oceanographic Data Centre's (NODC) server *NODC Online Data Access* is achieved at the following Uniform Resource Locator (URL or Internet address):

http://www.nodc.noaa.gov/GTSPP/gtspp-home.html

For detailed information on WOCE activities, data and information, contact the WOCE Data Information Unit (DIU) through the OCEANIC system. Access can be obtained through the WWW at:
http://www.cms.udel.edu/
or via internet e-mail at :
woce.diu@delocn.udel.edu

There is an IGOSS Home Page on the WWW that contains information about SOOP and IGOSS in general and contains many tables and reports, many of which can be downloaded by file-transfer protocol. From the

main page, a list of *IGOSS Topics and Keywords* contains numerous links to IGOSS-related information (figure 12). The URL of the page is:

http://www.unesco.org/ioc/igoss/igoshome.htm

Finally, another web site was created by the IGOSS Operations Co-ordinator, under the GOOS Home Page, which gives information on XBT-related topics and gives contacts for national XBT programmes (3 figures 13 -15). The URL of the page is:

http://gateway.unesco.org:80/ioc/igoss/xbt.htm

3.2 IGOSS Data Processing and Services System (IDPSS)

The IDPSS consists of national, specialized and world oceanographic centres for the processing of observational data, the provision of products, services and operational data exchange activities to various marine user groups. Seventeen countries have established a National Oceanographic Data Centre (NOC) and there are twelve Specialized Oceanographic Centres (SOC) and/or World Oceanographic Centres (WOC), distribute among six member states. A total of 51 countries prepare over 500 surface and sub-surface IGOSS products. Addresses for the oceanographic centres can be found beginning on page 45 of *publication IOC/INF-998, Composition of IGOSS, dated 19 May 1995*

IGOSS products are disseminated through various media including the Global Telecommunication System (GTS), the Internet, by radio and even radio facsimile. The IGOSS Bulletin (IPB), established in 1991, is a showcase for many of the IGOSS global and regional products as a service to the scientific community. Hard copies of the IGOSS Bulletin will be discontinued after 1997 due to escalating publishing costs and the ready access to an electronic version of the IPB on the following WWW URL:

http://rainbow.ldeo.columbia.edu/igoss/productsbulletin/

Questions about the IPB can be sent via e-mail to the bulletin editor, Dr. Yves Tourre at:

tourre@ldeo.columbia.edu

3.3 IGOSS Telecommunication Arrangements (ITA)

The ITA continues to exist mainly of the telecommunication facilities of the World Weather Watch GTS and other arrangements necessary for the rapid collection and distribution of observational data and processed information. At present there are 65 unique bulletin headers authorized by the World Meteorological Organization (WMO) for the transmission of BATHY,TESAC, BUOY and TRACKOB messages. A list of these bulletin headers can be found in the *Catalogue of Meteorological Bulletins, Volume C, edition May 1996* as well as on the IGOSS Home Page.

3.4 The ARGOS System

The ARGOS system is used for the acquisition and transmission of oceanographic data from fixed or floating platforms equipped with Platform Transmitter Terminals (PTT), as well as for the geographic position of the PTTs. It has proved particularly useful for the transmission of data from automatic stations such as buoys. In October 1996, the ARGOS service was handling reports from 1272 drifting buoys, 299 moored buoys, 4 balloons, 422 fixed stations and 332 miscellaneous platforms. Further discussion of buoy activities is given in this report under sections on the TAO Array and the Data Buoy Co-operation Panel (DBCP).

3.5 IGOSS References

More detailed information on IGOSS activities and procedures can be found in the following references:

IOC/INF-998, Composition of IGOSS
IOC Manuals and Guides No. 1 - Guide to IGOSS Data Archives and Exchange (BATHY and TESAC), 1993
IOC Manuals and Guides No. 3 - Guide to operational Procedures for the Collection and Exchange of IGOSS Data, Second Revised Edition, 1988
IOC Manuals and Guides No. 19 - Guide to Specialized Oceanographic Centres (SOC), 1988
IOC Technical Series No. 43 - IGOSS Plan and Implementation programme, 1996-2003
WOCE Data Handbook, 6th Edition, 1995

3.6 Future Developments

IGOSS has formed a Group of Experts on Communications and Products (GE/CP) which will meet for the first time in 1998. The GE/CP will investigate new data transmission technologies and capabilities and look into how IGOSS can produce and market products exchanged through the IGOSS. There is also an ad hoc Task Team on Quality Control of Automated Systems (TT/QCAS) that meets whenever the SOOPIP itself convenes. The TT/QCAS is presently reviewing fall-rate and other data problems encountered with XBTs and expendable conductivity-depth-temperature (XCTD) probes. The team also investigates the feasibilities and accuracies of new sampling technologies to supplement the XBT network such as thermosalinographs, ALACE and PALACE drifting buoys and CTDs that can be deployed underway.

IGOSS successfully implemented a change to the old JJXX BATHY code (now called JJYY) that includes important information on equipment used and fall-rate equations applied to the data. A similar change to the existing TESAC code is also planned for the near future.

Finally, after twenty years of seconding the position of IGOSS Operations Co-ordinator, the U.S. has decided to cease supporting the position. The possibility exists that the Co-ordinator position will be filled by a secondment from Japan, effective in late 1997 with the Co-ordinator position being moved to the WMO in Geneva.

BATHY & TESAC REPORTS INPUT TO THE GTS: 1976-1996

YEAR	BATHY	TESAC	TOTAL
1976	33,119	2,675	35,794
77	24,752	7,025	31,777
78	31,846	10,839	42,685
79	34,568	10,303	44,871
80	31,506	919	32,425
81	30,544	1,274	31,818
82	31,358	1,582	32,940
83	32,960	7,724	40,684
84	30,276	10,120	40,396
85	32,378	8,870	41,248
86	38,998	7,829	46,827
87	48,510	8,383	56,893
88	36,439	7,977	44,416
89	38,615	5,444	44,059
90	40,300	6,039	46,339
91	41,359	2,873	44,232
92	45,845	2,962	48,807
93	47,217	5,705	52,922
94	48,674	2,189	50,863
95	50,856	2,132	52,988
1996	48,560	2,585	51,145
TOTALS	**798,680**	**115,449**	**914,129**
AVERAGES	**38,032**	**5,498**	**43,530**

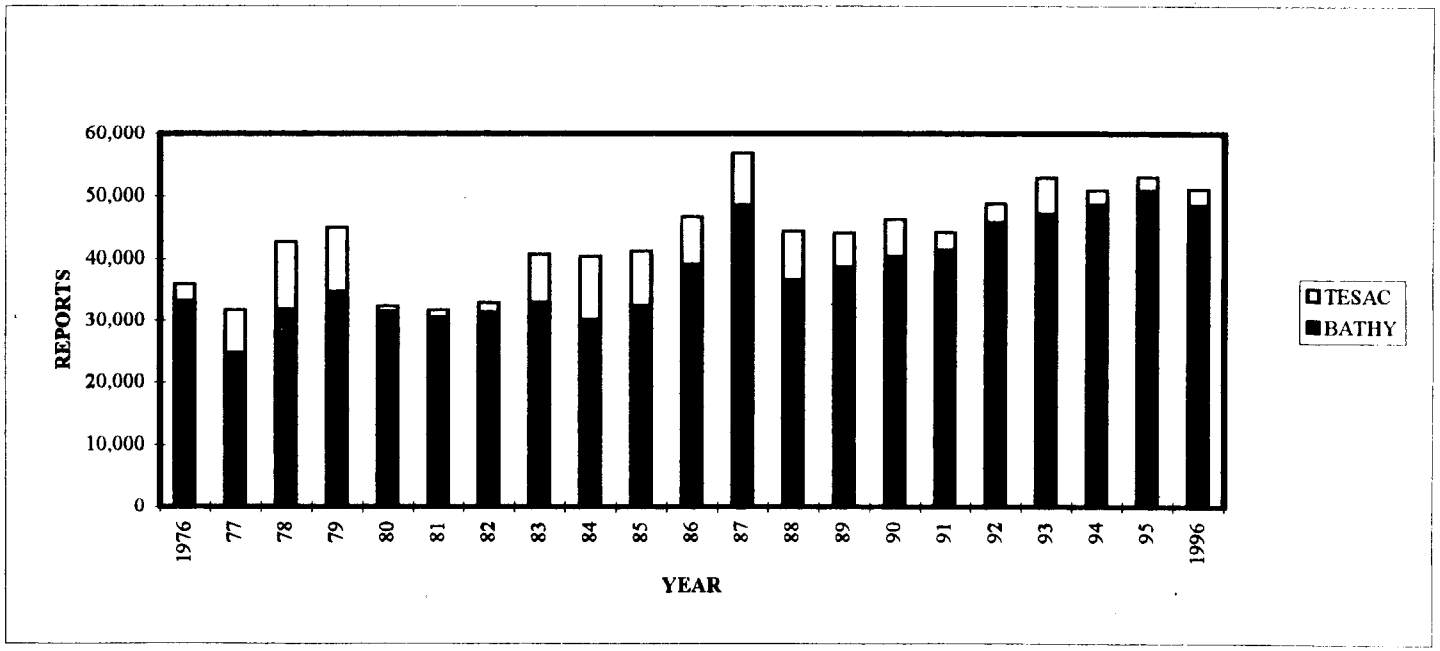


Figure 1

OPERATIONAL SHIP-OF-OPPORTUNITY-PROGRAMME
LOW DENSITY XBT NETWORK

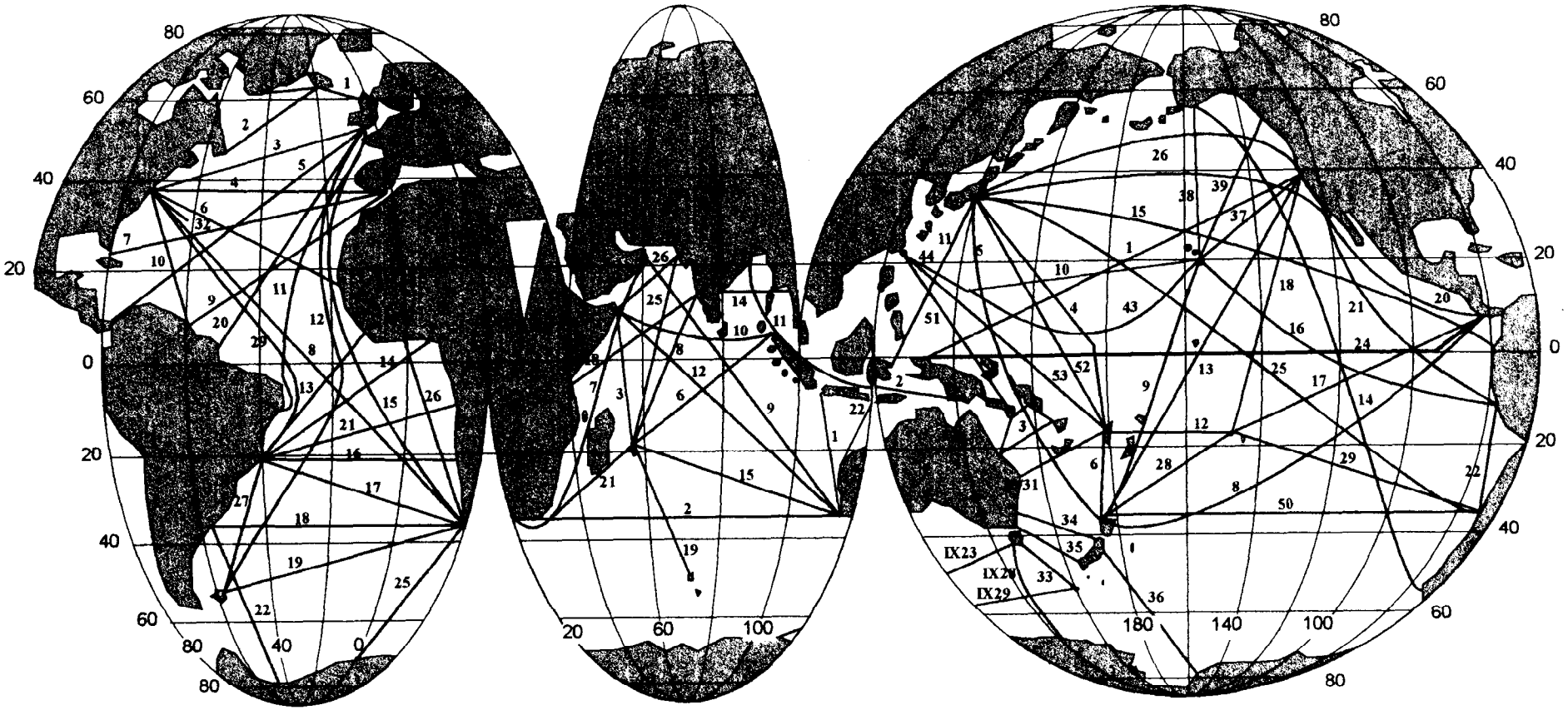


Figure 2

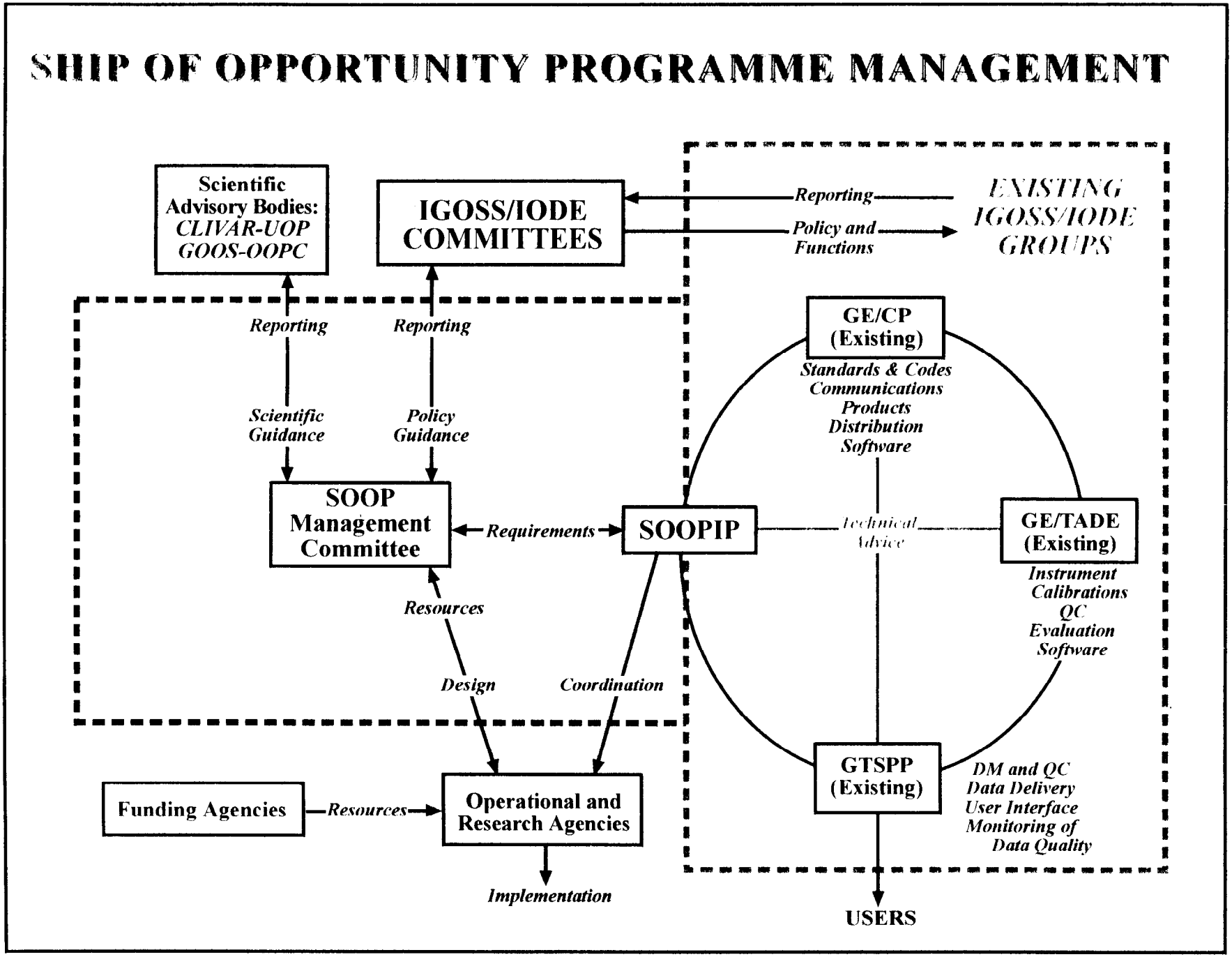

SHIP OF OPPORTUNITY PROGRAMME MANAGEMENT
Scientific Advisory Bodies: CLIVAR-UOP GOOS-OOPC
IGOSS/IODE COMMITTEES
Reporting
Policy and Functions
EXISTING IGOSS/IODE GROUPS
Reporting
Reporting
Scientific Guidance
Policy Guidance
GE/CP (Existing)
Standards & Codes
Communications
Products
Distribution
Software
SOOP Management Committee
Requirements
SOOPIP
Technical Advice
GE/TADE (Existing)
Instrument Calibrations
QC
Evaluation
Software
Resources
Design
Coordination
GTSPP (Existing)
DM and QC
Data Delivery
User Interface
Monitoring of Data Quality
Funding Agencies
Resources
Operational and Research Agencies
Implementation
USERS

Figure 3

ATLANTIC

XBT RESOURCES FOR OPERATIONAL SOOP - ATLANTIC OCEAN

	Denotes High Density Lines									1996	1997		1998	
LINE		REQUIREMENTS			CALL	COUNTRY /	(R)	NATIONAL	GLOBAL	NO. OF	NO. OF	SHIP?	NO. OF	SHIP?
NO.	LINE ENDPOINTS	XBTs	TRANS	SHIP NAME	SIGN	OPERATOR	(O)	PROGRAMME	PROGRAMME	XBTs	XBTs	(Y/N)	XBTs	(Y/N)
AX01	Greenland - Scotland/Denmark													
				WALTHER HERWIG	DBFR	GER/BFA	R	FISHERIES	CL-WOCE-GOOS		60	Y		
				METEOR	DBBH	GER/BSH	R	WOCE	CL-WOCE-GOOS		100	Y		
				WALTHER HERWIG	DBFR	GER/BSH				70				
	TOTAL FOR AX01 =	160	12							70	160			
AX02	Newfoundland - Iceland													
				GODAFOSS	V2EZ	USA/NOAA				152				
				SKOGAFOSS	V2QT	USA/NOAA				104				
				USA TOTAL			O	SICP	CL-WOCE-GOOS		400	Y		
	TOTAL FOR AX02 =	200	12							256	400			
AX03	Europe - New York													
				GAUSS	DBBX	GER/BSH	R	WOCE	CL-WOCE-GOOS					
				METEOR	DBBH	GER/BSH	R	WOCE	CL-WOCE-GOOS		120	Y		
				KOELN EXPRESS	9VBL	GER/BSH	R	WOCE	CL-WOCE-GOOS		350	Y		
				GAUSS	DBBX	GER/BSH				311				
				KOELN EXPRESS	DAKE	GER/BSH				287				
	TOTAL FOR AX03 =	400	12							598	470			
AX04	New York - Gibraltar/Lisbon													
				NEDLLOYD RALEIGH BAY	PHKG	USA/NOAA				101				
				SEA PREMIER	FNXB	USA/NOAA				29				
				AL-WATTYAH	9KJP	USA/NOAA				44				
				ADDIRIYAH	HZLL	USA/NOAA				158				
				GALVESTON BAY	WPKD	USA/NOAA				1				
				USA TOTAL			O	SICP	CL-WOCE-GOOS		390	Y		
	TOTAL FOR AX04 =	440	12							333	390			
AX05	Panama - Europe													
				CARRYMAR	J8JA4	FRA/BREST				25				
				GUYANE	J8IU7	FRA/BREST				24				
	TOTAL FOR AX05 =	650	12							49	0			
AX06	New York - Dakar													
				CHARLES LYKES	3EJT9	USA/NOAA				72				
				OLIVEBANK	3ETQ5	USA/NOAA				91				
				ARIANA	DIDA	FRA/BREST				22				
	TOTAL FOR AX06 =	420	12							185	0			
AX07	Gulf of Mexico - Gibraltar													
				COLIMA	DZST	USA/NOAA				73				
				MITLA	XCNX	USA/NOAA				352				
				MORELOS	PGBB	USA/NOAA				203				
				TOLUCA	3EFY7	USA/NOAA				219				
				USA TOTAL			O	SICP	CL-WOCE-GOOS		490	Y		
				USA (HD) TOTAL			O	SICP	CL-WOCE-GOOS		800	Y		
	TOTAL FOR AX07 =	520	12							847	1290			
AX08	New York - Cape of Good Hope													
				NOMZI	MTQU3	USA/NOAA				472				

Figure 4

SUMMARY OF XBT RESOURCES & REQUIREMENTS

ATLANTIC

	1996 - DONE		1997 - Projected	
REQ'D XBTs	NO. OF XBTs	% OF REQ'D NO.	NO. OF XBTs	% OF REQ'D NO.
11,260	6,327	56.2	6,000	53.3

INDIAN

	1996 - DONE		1997 - Projected	
REQ'D XBTs	NO. OF XBTs	% OF REQ'D NO.	NO. OF XBTs	% OF REQ'D NO.
6,490	4,093	63.1	3,280	50.5

PACIFIC

	1996 - DONE		1997 - Projected	
REQ'D XBTs	NO. OF XBTs	% OF REQ'D NO.	NO. OF XBTs	% OF REQ'D NO.
25,310	15,910	62.9	13,985	55.3

TOTAL

	1996 - DONE		1997 - Projected	
REQ'D XBTs	NO. OF XBTs	% OF REQ'D NO.	NO. OF XBTs	% OF REQ'D NO.
43,060	26,330	61.1	23,265	54.0

Figure 5

XBT INVENTORY BY YEARS

		1995 XBTs			1996 XBTs			1997 XBTs		
COUNTRY	AGENCY	ATL	IND	PAC	ATL	IND	PAC	ATL	IND	PAC
AUSTRALIA	CSIRO		2,452	1,086		1,738	1,047		*2,220*	*1,640*
FRANCE (Brest)	ORSTOM	917	158		1,132	470				
UNITED STATES (SIO)	SIO			4,220			3,687		*260*	*4,300*
JAPAN	JMA.FSA		306	1,127		532	898		*600*	*740*
FRANCE (Noumea)	ORSTOM			2,743		74	2,469			
GERMANY	BSH	864			977			*930*		
UNITED STATES (NOAA)	NOS	6,114	1,306	8,363	4,218	1,279	7,809	*5,070*	*2,430*	*8,825*
	TOTALS:	7,895	4,222	17,539	6,327	4,093	15,910	*6,000*	*5,510*	*15,505*

XBT INVENTORY BY OCEANS

		ATLANTIC			INDIAN			PACIFIC		
COUNTRY	AGENCY	95	96	97	95	96	97	95	96	97
AUSTRALIA	CSIRO				2,452	1,721	*2,220*	1,086	1,047	*1,640*
FRANCE (Brest)	ORSTOM	917	1,132		158	470				
UNITED STATES (SIO)	SIO						*260*	4,220	3,687	*4,300*
JAPAN	JMA.FSA				306	532	*600*	1,127	898	*740*
FRANCE (Noumea)	ORSTOM					74		2,743	2,469	
GERMANY	BSH	864	977	*930*						
UNITED STATES (NOAA)	NOS	6,114	4,218	*5,070*	1,306	1,279	*2,430*	8,363	7,809	*8,825*
	TOTALS:	7,895	6,327	*6,000*	4,222	4,076	*5,510*	17,539	15,910	*15,505*

Figure 6

AGENCY	COUNTRY	1996 XBTs DEPLOYED
CSIRO	AUSTRALIA	3538
ORSTOM	FRANCE (Brest)	1075
SIO	UNITED STATES (SIO)	4220
JMA.FSA	JAPAN	1433
ORSTOM	FRANCE (Noumea)	2743
BSH	GERMANY	864
NOS	UNITED STATES (NOAA)	15,783
	TOTAL:	29,656

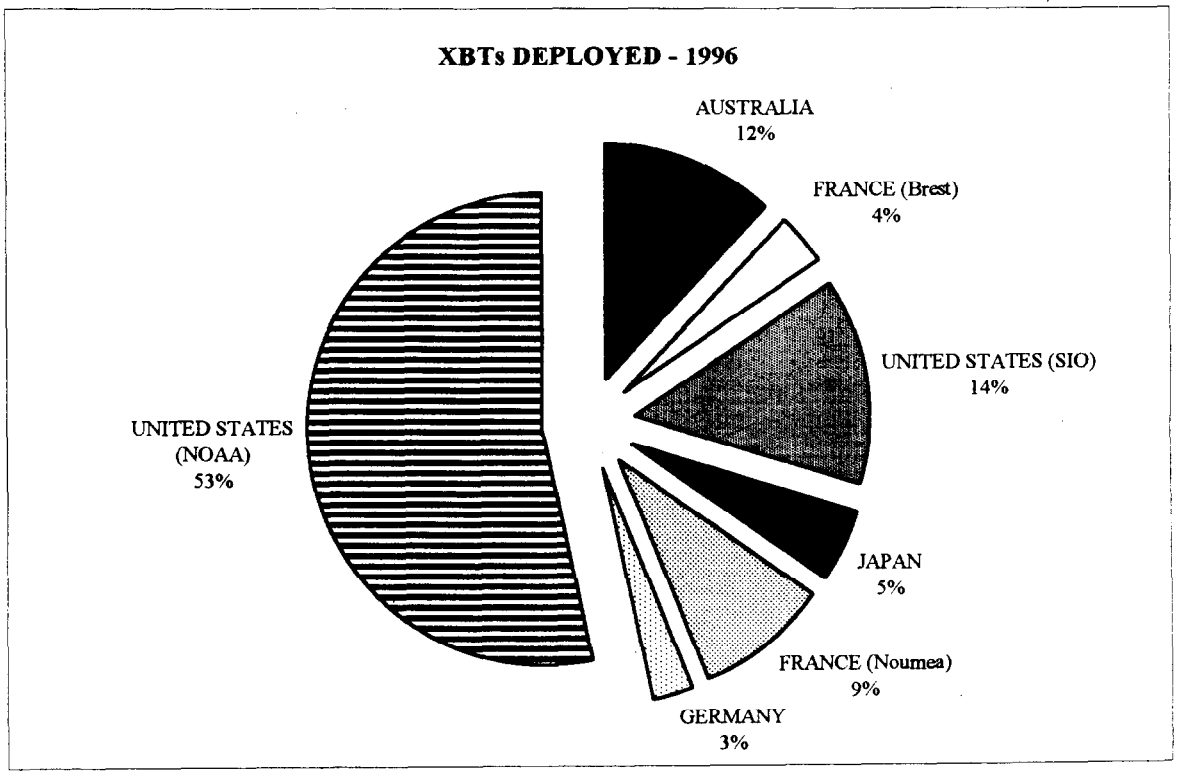
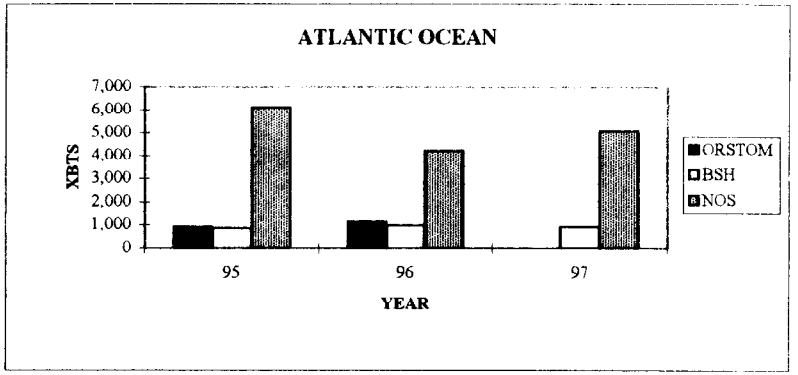
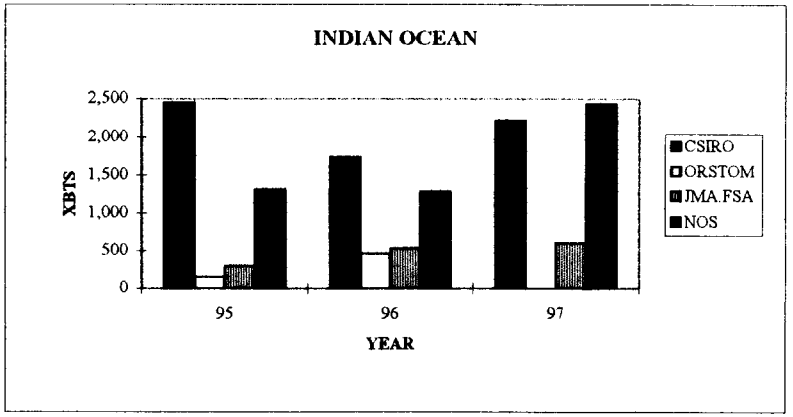


Figure 7

ATLANTIC				
COUNTRY	YEAR	95	96	97
FRANCE (Brest)	ORSTOM	917	1,132	
GERMANY	BSH	864	977	930
UNITED STATES (NOAA)	NOS	6,114	4,218	5,070
	TOTALS:	7,895	6,327	6,000



INDIAN				
COUNTRY	AGENCY	95	96	97
AUSTRALIA	CSIRO	2,452	1,738	2,220
FRANCE (Brest)	ORSTOM	158	470	
JAPAN	JMA.FSA	306	532	600
FRANCE (Noumea)	ORSTOM		74	
UNITED STATES (SIO)	SIO			260
UNITED STATES (NOAA)	NOS	1,306	1,279	2,430
	TOTALS:	4,222	4,093	5,510



PACIFIC				
COUNTRY	AGENCY	95	96	97
AUSTRALIA	CSIRO	1,086	1,047	1,640
UNITED STATES (SIO)	SIO	4,220	3,687	4,300
JAPAN	JMA.FSA	1,127	898	740
FRANCE (Noumea)	ORSTOM	2,743	2,469	
UNITED STATES (NOAA)	NOS	8,363	7,809	8,825
	TOTALS:	17,539	15,910	15,505

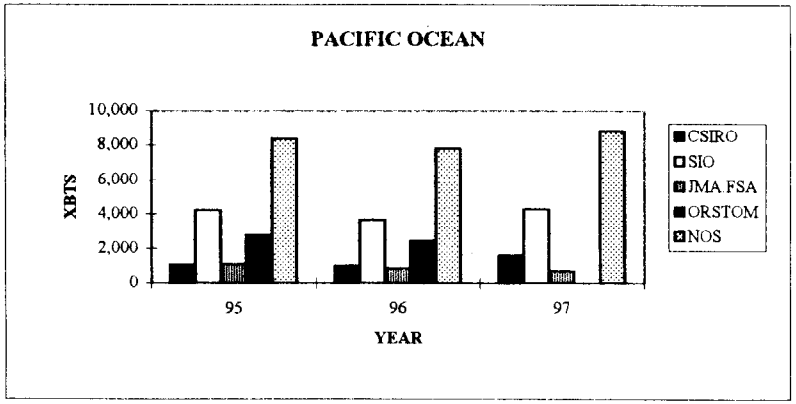


Figure 8

ATLANTIC OCEAN (includes actual 1996 XBTs)							
		(a) XBTs	*(b) XBTs*	*DIFF*	*% of*	*(c) XBTs*	*DIFF*
LINE	*ROUTE*	*Needed*	*in 1996*	*(b-a)*	*Coverage*	*in 1997*	*(c-a)*
AX01	Greenland - Scotland/Denmark	160	70	(90)	44	160	0
AX02	Newfoundland - Iceland	200	256	56	128	400	200
AX03	Europe - New York	400	598	198	150	470	70
AX04	New York - Gibraltar/Lisbon	333	333	0	100	390	57
AX05	Europe - Panama Canal	650	49	(601)	8	0	(650)
AX06	New York - Dakar	420	185	(235)	44	0	(420)
AX07	Gulf of Mexico - Gibraltar	520	847	327	163	1290	770
AX08	New York - Cape of Good Hope	960	510	(450)	53	910	(50)
AX09	Trinidad - Gibraltar	500	0	(500)	0	0	(500)
AX10	New York - Trinidad/Caracas	200	384	184	192	245	45
AX11	Europe - Brazil	560	800	240	143	300	(260)
AX12	Europe - Antartica	800	159	(641)	20	800	0
AX13	Rio - Monrovia (Liberia)	200	14	(186)	7	0	(200)
AX14	Rio - Lagos (Nigeria)	310	51	(259)	16	455	145
AX15	Europe - Cape of Good Hope	650	245	(405)	38	0	(650)
AX16	Rio - Walvis Bay	420	0	(420)	0	0	(420)
AX17	Rio - Cape of Good Hope	430	0	(430)	0	0	(430)
AX18	Buenos Aires - Cape of Good Hope	480	0	(480)	0	0	(480)
AX19	Cape Horn - Cape of Good Hope	480	0	(480)	0	0	(480)
AX20	Europe - French Guyana	440	395	(45)	90	0	(440)
AX21	Rio - Pointe Noire/Luanda	400	17	(383)	4	0	(400)
AX22	Argentina - Antarctica	220	0	(220)	0	0	(220)
AX23	Gulf of Mexico	?????	172	?????	?????	0	
AX25	Cape of Good Hope - Antarctica	220	0	(220)	0	0	(220)
AX26	Lagos, Nigeria - Cape of Good Hope	320	56	(264)	18	0	(320)
AX27	Brazil - Cape Horn	400	75	(325)	19	0	(400)
AX29	New York - Brazil	360	478	118	133	580	220
AX32	New York - Bermuda	120	314	194	262	0	(120)
AX33	Boston - Halifax, Nova Scotia	?????	106	?????	?????	0	?????
AX34	Gulf of Guinea - Caribbean	?????	80	?????	?????	0	?????
AX35	Cape of Good Hope - Recife	?????	133	?????	?????	0	?????
	UNNUMBERED LINES:						0
	TOTAL ATLANTIC OCEAN:	11,153	6,327	(5,317)		6,000	(5,153)

Figure 9

INDIAN OCEAN (includes actual 1996 XBTs)							
		(a) XBTs	(b) XBTs	DIFF	% of	(c) XBTs	DIFF
LINE	ROUTE	Needed	in 1996	(b-a)	Coverage	in 1997	(c-a)
IX01	Fremantle - Sunda Straits	240	496	256	207	0	(240)
IX02	Cape of Good Hope - Fremantle	520	11	(509)	2	575	55
IX03	Red Sea - Mauritius/La Reunion	240	318	78	133	0	(240)
IX06	Mauritius/La Reunion - Malacca Strait	340	327	(13)	96	770	430
IX07	Cape of Good Hope - Persian Gulf	480	677	197	141	575	95
IX08	Mauritius - Bombay	320	61	(259)	19	315	(5)
IX09	Fremantle - Persian Gulf	650	290	(360)	45	280	(370)
IX10	Red Sea - Malacca Strait/Singapore	310	408	98	132	160	(150)
IX11	Calcutta - Java Sea	320	0	(320)	0	0	(320)
IX12	Fremantle - Red Sea	700	575	(125)	82	0	(700)
IX14	Bay of Bengal	140	0	(140)	0	0	(140)
IX15	Mauritius - Fremantle	380	0	(380)	0	0	(380)
IX16	Mombasa - Singapore	?????	0		?????	0	
IX17	Mombasa - Karachi	?????	0		?????	0	
IX18	Mombasa - Bombay	220	0	(220)	0	0	(220)
IX19	La Reunion - Amsterdam/Kerguelen	240	0	(240)	0	0	(240)
IX20	Mauritius - Rodriguez	?????	0	?????	?????	0	?????
IX21	Cape of Good Hope - Mauritius	180	256	76	142	345	165
IX22	Fremantle - Timor Strait/Banda Sea	120	215	95	179	0	(120)
IX23	Hobart - Casey Station (Antarctica)	180	0	(180)	0	0	(180)
IX25	Mauritius - Karachi	360	7	(353)	2	0	(360)
IX26	Red Sea - Karachi	190	0	(190)	0	0	(190)
IX27	Mombasa - La Reunion	?????	0		?????	0	
IX28	Hobart - Dumont D'Urville (Antarctica)	180	452	272	251	260	80
IX29	Macquarie Island - Casey Station (Antarctica)	180	0	(180)	0	0	(180)
IX30	Hobart - Macquarie Island	?????	0	?????	?????	0	?????
IX31	Melbourne - Freemantle	?????	0	?????	?????	0	?????
	UNNUMBERED LINES:						
	TOTAL INDIAN OCEAN:	6,490	4,093	(2,397)		3,280	(3,210)

Figure 10

PACIFIC OCEAN (includes actual 1996 XBTs)							
		(a) XBTs	*(b) XBTs*	*DIFF*	*% of*	*(c) XBTs*	*DIFF*
LINE	*ROUTE*	*NEEDED*	*in 1996*	*(b-a)*	*Coverage*	*in 1997*	*(c-a)*
PX01	California - Indonesia	860	416	(444)	48	865	5
PX02	Flores Sea - Torres Strait	320	295	(25)	92	0	(320)
PX03	Coral Sea	160	605	445	378	0	(160)
PX04	Japan - Kiribati - Fiji/Samoa	500	314	(186)	63	0	(500)
PX05	Japan - New Zealand	560	438	(122)	78	290	(270)
PX06	Suva, Fiji - Auckland	160	355	195	222	260	100
PX07	Auckland, NZ - Seattle	?????	0		?????	0	
PX08	Auckland - Panama	700	899	199	128	930	230
PX09	Hawaii - Noumea/Auckland	440	1017	577	231	1075	635
PX10	Hawaii - Guam/Saipan	440	1375	935	313	980	540
PX11	Flores Sea - Japan	320	0	(320)	0	0	(320)
PX12	Tahiti - Coral Sea	370	655	285	177	0	(370)
PX13	New Zealand - California	770	740	(30)	96	815	45
PX14	Alaska - Cape Horn	1080	793	(287)	73	1530	450
PX15	Ecuador - Japan	960	0	(960)	0	0	(960)
PX16	Peru - Hawaii	680	0	(680)	0	0	(680)
PX17	Tahiti/Mururoa - Panama	530	669	139	126	0	(530)
PX18	Tahiti - California	440	359	(81)	82	700	260
PX20	California - Panama	370	0	(370)	0	0	(370)
PX21	California - Peru	500	46	(454)	9	0	(500)
PX22	Panama - Valparaiso	360	0	(360)	0	0	(360)
PX23	Mexico - 115W	60	0	(60)	0	0	(60)
PX24	Panama - Indonesia	1200	0	(1,200)	0	0	(1,200)
PX25	Valparaiso - Japan/Korea	1320	0	(1,320)	0	0	(1,320)
PX26	TRANSPAC	5500	1957	(3,543)	36	2000	(3,500)
PX27	Guayaquil - Galapagos	120	0	(120)	0	120	0
PX28	Tahiti - Sydney/Auckland	240	22	(218)	9	0	(240)
PX29	Tahiti - Valparaiso	560	0	(560)	0	0	(560)
PX30	Brisbane - Noumea	120	200	80	167	0	(120)
PX31	Sydney - Noumea - California	880	67	(813)	8	340	(540)
PX32	Sydney - Auckland	?????	65	?????	?????	?????	?????
PX33	Hobart - Macquarie Island	130	0	(130)	0	0	(130)
PX34	Sydney - Wellington	140	359	219	256	0	(140)
PX35	Melbourne - Dunedin	140	0	(140)	0	0	(140)
PX36	Christchurch - McMurdo	400	0	(400)	0	0	(400)
PX37	Hawaii - California	340	655	315	193	360	20
PX38	Hawaii - Alaska	320	470	150	147	540	220
PX39	Hawaii - Seattle/Vancouver	320	403	83	126	710	390
PX43	Hawaii - Marshall Is. - Guam	440	0	(440)	0	0	(440)
PX44	Taiwan - Guam	160	445	285	278	300	140
PX45	Surtropac (Noumea, N. Caldonia)	?????	0	?????	?????	?????	?????
PX46	137E Section	?????	132	?????	?????	?????	?????
PX47	Alaska - California	?????	0	?????	?????	?????	?????
PX49	Japan/Taiwan - Singapore	?????	178	?????	?????	150	?????
PX50	Valparaiso - Auckland	720	1441	721	200	1720	1,000
PX51	Taiwan/Mindanao - Coral Sea/New Caledonia	360	0	(360)	0	0	(360)
PX52	Japan - Fiji	540	0	(540)	0	0	(540)
PX53	Taiwan/Mindanao - Fiji	540	178	(362)	33	0	(540)
PX55	Melbourne - Wellington	?????	0	?????	?????	0	?????
PX56	Brisbane - Dunedin	?????	0	?????	?????	0	?????
PX57	Brisbane - Wellington	?????	0	?????	?????	0	?????
PX76	Costa Rica Coast	60	0	(60)	0	0	(60)
PX77	Peru Coastal	60	0	(60)	0	0	(60)
PX78	Peru Coastal	60	0	(60)	0	0	(60)
PX79	Valparaiso - 80W	60	0	(60)	0	0	(60)
	UNNUMBERED LINES:						
	Bashi Strait - New Zealand	?????	291	?????	?????		?????
ZONECO3	New Caledonia EEZ	?????	32	?????	?????	300	?????
ZONECO4	New Caledonia EEZ	?????	39	?????	?????		?????
	TOTAL PACIFIC OCEAN:	25,310	15,910	(10,137)		13,985	(11,775)

Figure 11

IGOSS TOPICS & KEYWORDS

If you are uncertain where to find certain information about IGOSS, the following list contains IGOSS-related topics and keywords.

- Intergovernmental Oceanographic Commission (IOC)
  - IGOSS Contacts
    - IGOSS Composition
      - Introduction
      - IGOSS Bureau
      - Participating Countries
      - IGOSS Subsidiary Bodies
      - National Contacts for Specific Programmes
      - IGOSS IDPSS Centres
      - IGOSS Secretariat
    - IGOSS E-Mail Addresses
  - Global Ocean Observing System (GOOS)
  - Data Monitoring & WMO's Global Telecommunications System (GTS)
    - BATHY/TESAC/TRACKOB Bulletin headers
    - Bulletin Shore Stations
    - Data Flow Diagrams by Country
    - GTS Routing of IGOSS Data
    - BATHY/TESAC/TRACKOB Statistics: 1976-1994
    - Monthly GTS Statistics
    - Year-To-Date GTS Statistics
  - Global Temperature Salinity Profile Programme (GTSPP)
  - IGOSS Data and Products
    - IGOSS Products Bulletin
  - IGOSS Meetings
  - IGOSS News
  - IGOSS Publications
  - IGOSS Reports
    - Monthly GTS Statistics
    - Year-To-Date GTS Statistics
    - Monthly Ship Performance Report
    - WOCE Six Month XBT Report
  - TOGA Programme
  - Ship of Opportunity Programme (SOOP)
    - SOOP Organization
    - SOO Call Sign Data Base
    - SOOP Ship Operators
    - WOCE Six Month XBT Report
  - World Ocean Circulation Experiment (WOCE)
    - Low Density XBT Network Tracklines
    - WOCE DIU Oceanic System

Figure 12

IOC at UNESCO, Paris

GOOS XBT Observing System

- WHAT EXACTLY IS AN XBT?
- WHO MANUFACTURES XBTs?
- WHO LAUNCHES XBTs?
- THE LOW DENSITY XBT NETWORK
- ARE XBT DATA RELIABLE?
- HOW ARE XBT DATA EXCHANGED GLOBALLY?
- NATIONAL XBT ACTIVITIES
- NATIONAL AND WORLD DATA CENTRES HOLDING XBT DATA

Oceanographers have used eXpendable BathyThermographs (XBT) to obtain subsurface temperature profiles from a ship either at station or underway for over thirty years. Data from XBTs is extremely useful in oceanic circulation and climate modelling and forecasting, particularly for catastrophic weather events such as the El Nino Southern Oscillation (ENSO) that causes droughts, floods and can destroy fisheries stocks. Because the data obtained by XBTs is below the surface, satellite scanners cannot accurately infer or determine temperature profiles. Eventually, it is expected that GOOS operational products will result from a combination of data provided by satellite, drifting and fixed buoys and XBTs taken from volunteer ships.

WHAT EXACTLY IS AN XBT?

As shown above, an XBT probe consists of a small projectile with a leaded nose and a plastic casing that contains a spool of fine copper wire. As the probe descends through the water column, the wire self-spools and transmits the temperature from a thermistor in the nose to a recorder on deck. Corresponding depths are computed from an empirically-derived, second order fall rate equation given by the manufacturer of the probe. More detailed information on XBTs can be found at several other web sites.

WHO MANUFACTURES XBTs?

There are presently several manufacturers of XBT probes, including Sippican (USA), Sparton of Canada, Ltd., and TSK of Japan. These companies can be contacted by sending an e-mail request for address/phone to the IGOSS Operations Coordinator (**b.hillard@unesco.org**). The probes are normally launched manually, but work continues on the development of automatic launchers that can be pre-programmed to deploy probes by position or time.

WHO LAUNCHES XBTs?

The probes are generally launched by research ships, naval vessels, and by the crew aboard volunteer merchant ships that transit regular shipping routes. The existing Ship of Opportunity Programme (SOOP) is in a transition from a successful research-managed network of XBT track lines (created by the TOGA and WOCE programs) to an operational network.

Figure 13

THE LOW DENSITY XBT NETWORK

The Low Density XBT Network is aimed at determining the monthly to interannual variability in the large-scale upper ocean heat content. Implementation of the network is constrained by the availability of volunteer merchant ships. This limitation aside, the network was carefully designed during the TOGA and WOCE projects employing statistical properties of the upper ocean thermal variability to determine optimum sampling strategies, both spatially and temporally. The Ocean Observing System Development Panel (OOSDP) has determined that the low density XBT network should be an integral part of any an ocean observing system because of the importance of subsurface temperature. The OOSDP Final Report provides details concerning the design and importance of the network. Now that the XBT network is moving towards an operational mode, joint scientific guidance is provided to ship operators by the operationally-oriented Ocean Observing Panel for Climate (OOPC) and by the Climate Variability and Predictability (CLIVAR) Programme's research-oriented Upper Ocean Panel (UOP).

ARE XBT DATA RELIABLE?

Although XBTs have been used for some time, it is only in the last few years that errors have been detected and corrected in the fall-rate equation coefficients and with the thermistors. Problems have also been detected in shipboard XBT recorders. Quality control of XBT data is now achieved through improved error-checking acquisition systems followed by several similar types of software that analyse (along with the operator's visual inspection) temperature profiles and flag known types of errors or problems. A source of quality control information for data acquired in the Pacific Ocean is the JEDA CENTRE at the Scripps Institute of Oceanography in San Diego, California.

The Global Temperature Salinity Profile Programme (GTSPP) is a successful international effort to quality control XBT profiles exchanged over the Global Telecommunications System (GTS). It has successfully increased the quality and the number of profiles available by analyzing real-time profiles and informing ship operators when problem data are suspected.

HOW ARE XBT DATA EXCHANGED GLOBALLY?

XBT data is transmitted in two modes: **real-time (<30 days from the observation)** and delayed-mode. The real-time data is usually transmitted via data collection platforms such as the US's Shipboard Environmental Acquisition System (SEAS) via GOES or INMARSAT satellites or using the French Service ARGOS. This data is received ashore and placed on the GTS for global exchange. The international data exchange system that makes this possible is the Integrated Global Ocean Services System (IGOSS). Delayed mode data consists of the entire profile of data points, not just selected or significant points. Therefore, **delayed mode data** are more useful to scientists and modelers but it generally is a matter of months to years before the high resolution data are submitted to data centres. Delayed mode data can be obtained from several world and national data centres that are participating to the International Oceanographic Data and Information Exchange (IODE) IOC Programme.

NATIONAL XBT ACTIVITIES

These countries and agencies are contributing to the long-term, systematic XBT monitoring programme. This table is directly linked to those providing on-line information about their past and current activity.

Figure 14

COUNTRY	NATIONAL AGENCY
ARGENTINA	INSTITUTO ARGENTINO DE OCEANOGRAFIA
AUSTRALIA	COMMONWEALTH SCIENTIFIC AND INDUSTRIAL RESEARCH ORGANIZATION (CSIRO)
BRAZIL	DEPARTMENT DE GEOFISICA
CANADA	BEDFORD INSTITUTE OF OCEANOGRAPHY (BIO)
FRANCE	INSTITUT FRANCAIS DE RECHERCHE SCIENTIFIQUE POUR LE DEVELOPPEMENT EN COOPERATION (ORSTOM)
GERMANY	BUNDESAMT FUR SEESCHIFFAHRT UND HYDROGRAPHIE (BSH)
JAPAN	JAPAN METEOROLOGICAL AGENCY (JMA)
UNITED KINGDOM	U.K. HYDROGRAPHIC OFFICE, MINISTRY OF DEFENSE
UNITED STATES	JEDA CENTRE, SCRIPPS INSTITUTE OF OCEANOGRAPHY
UNITED STATES	NOAA ATLANTIC OCEANOGRAPHIC AND METEOROLOGICAL LAB (AOML)
UNITED STATES	NOAA SHIPBOARD ENVIRONMENTAL ACQUISITION SYSTEM (SEAS)

NATIONAL AND WORLD DATA CENTRES HOLDING XBT DATA

Information on XBT data acquired during the WOCE Programme is also available through the WOCE DATA INFORMATION UNIT (DIU)

COUNTRY	NATIONAL AGENCY
AUSTRALIA	AUSTRALIAN OCEANOGRAPHIC DATA CENTRE
CANADA	MARINE ENVIRONMENTAL DATA SERVICE (MEDS)
FRANCE	GLOBAL SUBSURFACE DATA CENTRE (GSDC) - BREST
JAPAN	JAPAN OCEANOGRAPHIC DATA CENTRE (JODC)
RUSSIAN FEDERATION	National Oceanographic Data Centre/World Data Centre B - MOSCOW
UNITED KINGDOM	U.K. METEOROLOGICAL OFFICE, MINISTRY OF DEFENSE
UNITED STATES	NOAA NATIONAL OCEANOGRAPHIC DATA CENTRE/World Data Centre A

Figure 15

4. GLOBAL SEA-LEVEL OBSERVING SYSTEM (GLOSS)

A new revised GLOSS Implementation Plan has been prepared by the Chairman of the IOC Group of Experts on GLOSS with contributions from many experts. It was reviewed by the IOC Group of Experts on GLOSS at its Fifth Session (March 1997) and will be submitted to the 19th session of the IOC Assembly in July 1997. The draft Plan includes suggestions for the evolution and prioritisation of the tide gauge network and for data flow etc., particularly as new techniques (GPS, altimetry, electronic communications) become more important. It defines a new strategy for GLOSS development for the next decade.

The IOC Group of Experts on GLOSS provides scientific and technical advice to IOC on GLOSS implementation. Dr. David Pugh has served as the Chairman of the Group from 1985 to 1996. From 1 January 1996 the Group has been chaired by Dr. Philip Woodworth. GLOSS is co-ordinated by IOC through the national and regional GLOSS contacts established by participating countries and programmes. A GLOSS-CD-ROM (1996) as well as the GLOSS Home page on the Web provide names and addresses of the national and regional contacts.

4.1 Status of the GLOSS Network

Summary of the status of GLOSS from the viewpoint of data submission to PSMSL (Table):

Cat.	Jun. 89	Oct. 90	Aug. 91	Oct. 92	Oct. 93	Oct. 94	Oct. 95	Oct.96
1	105	133	136	158	177	183	168	186
2	51	50	57	46	33	35	59	46
3	47	42	36	29	26	26	22	21
4	103	81	77	73	72	64	59	55
Total	306	306	306	306	308	308	308	308

Category 1: "Operational" stations for which the latest data is 1992 or later;

Category 2: "Probably operational" stations for which the latest data is within the period 1982- 1991;

Category 3: "Historical" stations for which the latest data is earlier than 1982;

Category 4: For which no PSMSL data exist.

There has been significant progress in 1996 within the number of Category 1 stations being larger than previously. Figure 1 shows the geographical distribution of different categories of GLOSS stations.

4.2 Sea-Level Products and Data/Information Services

The GLOSS Homepage was setup by the IOC in 1997 (http://www.unesco.org/ioc/goos/gloss.htm). It provides information on GLOSS objectives, network, data, products, organization and training.

The Permanent Service for Mean Sea Level (PSMSL) acts as a GLOSS Global Data Centre and is responsible for collection, publication, analysis and interpretation of sea level data from the global network of tide gauges. All PSMSL data are available via Anonymous FTP as well as on CD-ROM, and can be provided on an ad hoc basis on floppy disk or on computer printout.

The GLOSS CD-ROM was produced in 1996 by the British Oceanographic Data Centre in co-operation with the Permanent Service for Mean Sea Level and with the support of the National Oceanographic Data Centre of the USA. It contains: an overview of the GLOSS system; the GLOSS Stations handbook; PSMSL Data Sets; PSMSL Public Access Files and two volumes of the IOC Manual on Sea-Level Measurement and Interpretation. The GLOSS CD-ROM was presented by the Executive Secretary IOC at a special event and made available to the participants of the Second Conference of Parties of the UN Framework Convention on Climate Change (July 1996, Geneva) and also was widely distributed to GLOSS and IODE national contacts, participants of training courses and international meetings.

There have been 3 issues (and a short 4th to advertise the GLOSS Implementation plan) of the GLOSS Bulletin produced by PSMSL on the Web [http://www.nbi.ac.uk/psmsl/gb.html]. Three issues of the Afro-American GLOSS News have been produced, with articles mostly in Spanish and Portuguese, by the University of São Paulo, Brazil. All sea level centres (PSMSL, BODC, UHSCL, NTF) now have good Web pages which serve to spread information to the public as well as the scientific community. The University of Hawaii Sea Level Centre, acting as a Specialized Oceanographic Centre (SOC) for Mean Sea Level in the Pacific, continued (since 1984) production and wide circulation of monthly maps of Sea Level anomalies and other sea-level products in the Pacific Ocean (Figures 2, 3, 4).

The National Ocean Service, NOAA, USA, continued producing monthly Topex/Poseidon sea level deviation and anomaly maps which can be displayed in colour at URL [http://www.grdl.noaa.gov /SAT/products /topex.html]. The complete Topex NOAA analysis for 1992-96 is available via Internet on anonymous ftp at [harpo.grdl.noaa.gov]. Figure 5, 6, produced by PSMSL, shows long-term sea level changes in some selected locations with long-term records.

4.3 GLOSS Training activities

The IOC/GLOSS-GOOS Training Workshop on Sea-Level Data Analysis was held at the Survey of India, Geodetic and Research Branch, Dehra Dun, India, from 21 November to 1 December 1995. The Workshop was co-organised and co-funded by the Indian Department of Ocean Development and the National Institute of Oceanography, and contained hands on training sessions as well as science lectures. It was attended by trainees from Bangladesh, India, Kenya, Madagascar, Malaysia, Maldives, Mauritius, and Tanzania, and by invited lecturers from the UK, USA and Australia.

The IOC/GLOSS Seminar/Workshop on Sea-Level Observations and Analysis for Spanish and Portuguese-speaking countries of South America was held in Argentina, 19-27 November 1996. It was hosted by the Hydrographic Service of Argentina and attended by trainees from Argentina, Brazil, Chile, Colombia, Costa Rica, Cuba, Ecuador, El Salvador, Guatemala, Mexico, Panama, Peru, Venezuela, and Mexico, and by invited lecturers from the UK, USA and Brazil. This course included more science than training reflecting perceived priorities.

The second part of the IOC Manuals and Guides No.14 "Manual on Sea-Level Measurement and Interpretation, Volume II-Emerging Technologies" was published in 1994 and widely circulated. Two volumes were included in the GLOSS CD-ROM produced in 1996.

Four tide-gauges, donated by Sweden and adjusted for tropical conditions by Germany, were sent by Germany to Cote d'Ivoire, Gambia, Nigeria and Guinea, in 1996. All these Member States had expressed their readiness to receive and install the tide-gauges.

4.4 Global and Regional Sea Level Activities Related to GLOSS

There are several regional sea-level monitoring activities related to GLOSS. They presently include:

- IGOSS Sea Level Program in the Pacific (ISLP-Pac) -Dr. M. Merrifield, the University of Hawaii,

USA

- Sea Level Pilot Project for the Southern Ocean (SLPP-SO)- Dr. W. Mitchell, National Tidal facility, Australia
- South Pacific Sea Level and Climate Monitoring Project- Dr. W. Mitchell, National Tidal Facility, Australia
- Monitoring Network System for Systematic Sea Level Measurements in the Mediterranean and Black Seas (MedGLOSS), joint activity of IOC and CIESM, initiated in 1997- Dr. D. Rosen, National Institute of Oceanography, Israel
- IGOSS Sea-Level Pilot Project in the North and Tropical Atlantic (ISLPP-NTA)-Mr. A. Bolduc, Marine Environmental Data Service (MEDS), Canada
- Sea Level Fluctuations: physical interpretation and environmental impact (SELF) project -Prof. S. Zerbini, University of Bologna, Italy
- Sea-Level Programme within the IOC Sub-Commission for the Caribbean and Adjacent Regions (IOCARIBE)-Dr. G. Maul, GLOSS Regional Co-ordinator, Florida Institute of Technology, USA
- Pilot Monitoring Activity on Sea-Level Changes and associated Coastal Impacts in the Indian Ocean (SLP-IO) -Dr. S. Shetye, National Institute of Oceanography, India
- The European Sea Level Observing System (EOSS)
- IOC Regional Committee for the Central Eastern Atlantic -Dr. L. Awosika, GLOSS Regional Co-ordinator, Nigerian Institute for Oceanography, Nigeria
- IOC Regional Committee for the Co-operative Investigation in the North and Central Western Indian Ocean (IOCINCWIO)-Mr. M. Odido, GLOSS Regional Co-ordinator Kenya Marine & Fisheries Research Institute, Kenya
- the IOC Tsunami Warning System in the Pacific-Dr. C. S. McCreeny, International Tsunami Warning Centre, Hawaii, USA
- Storm-Surge Warning System in the North Sea - UK Storm Tide Warning Service

World Ocean Circulation Experiment (WOCE):

- The WOCE Sea Level Data Assembly Centre-Fast Delivery Centre (WOCE-DAC) -Dr. M. Merrifield, University of Hawaii Sea Level Centre, USA
- The WOCE Sea Level Assembly Centre - Delayed Mode Delivery (WOCE-DAC) Dr. L. Rickards, British Oceanographic Data Centre, UK
- International GPS Service for Geodynamics - Mrs. R. Neilan, Jet Propulsion Laboratory, USA

4.5 GLOSS Interaction with GOOS

It has been recognized by the GOOS and GLOSS communities that GLOSS, as an existing ocean observational system, will contribute to GOOS, particularly its Climate and Coastal Modules. Close interaction has been established between the IOC Group of Expert on GLOSS and the Joint GCOS-GOOS-WCRP Ocean Observations Panel for Climate (OOPC) in designing and planning sea-level observing system for the GOOS Climate module. As the Coastal Module of GOOS develops and matures it is anticipated that links to GLOSS will become apparent at the global, regional and local level.

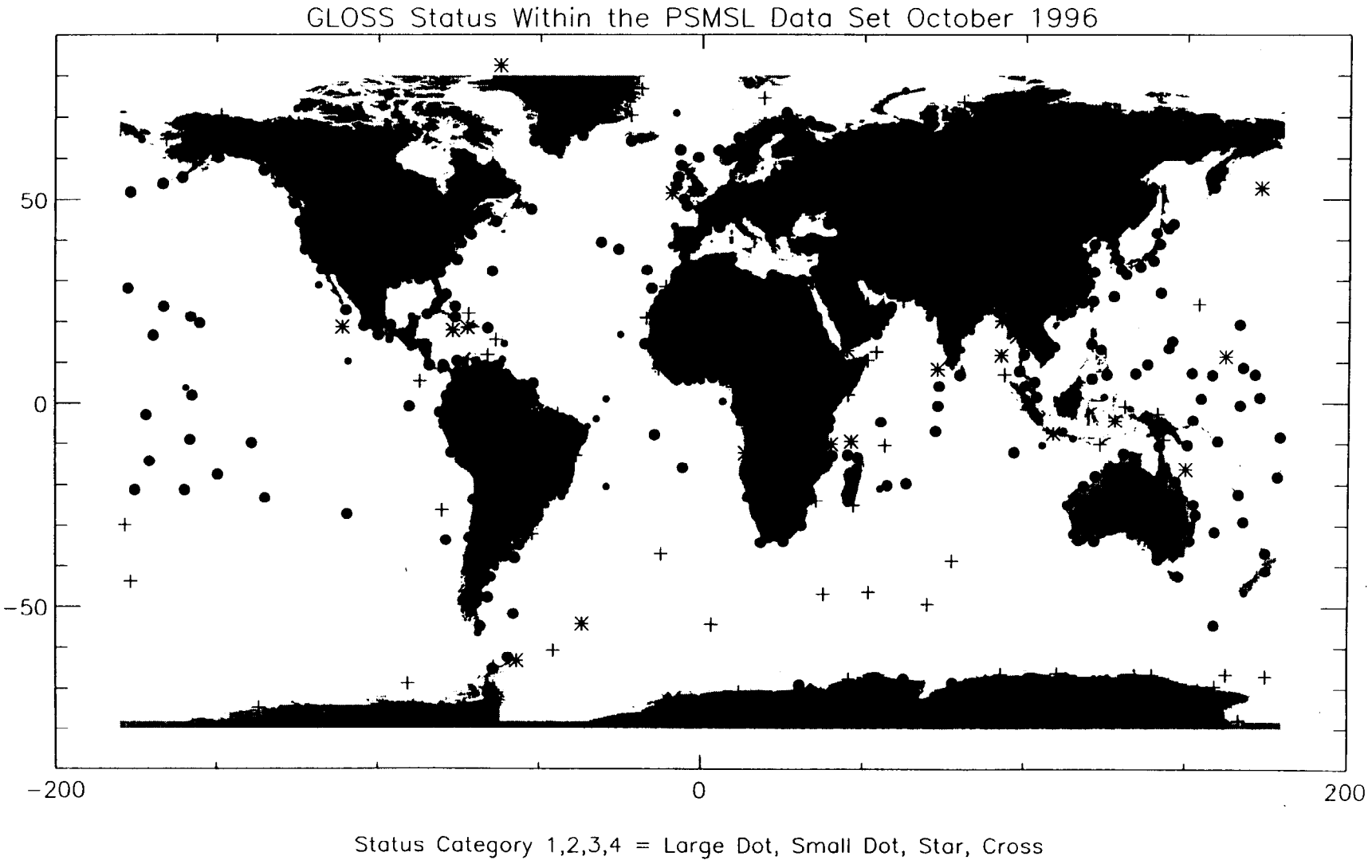
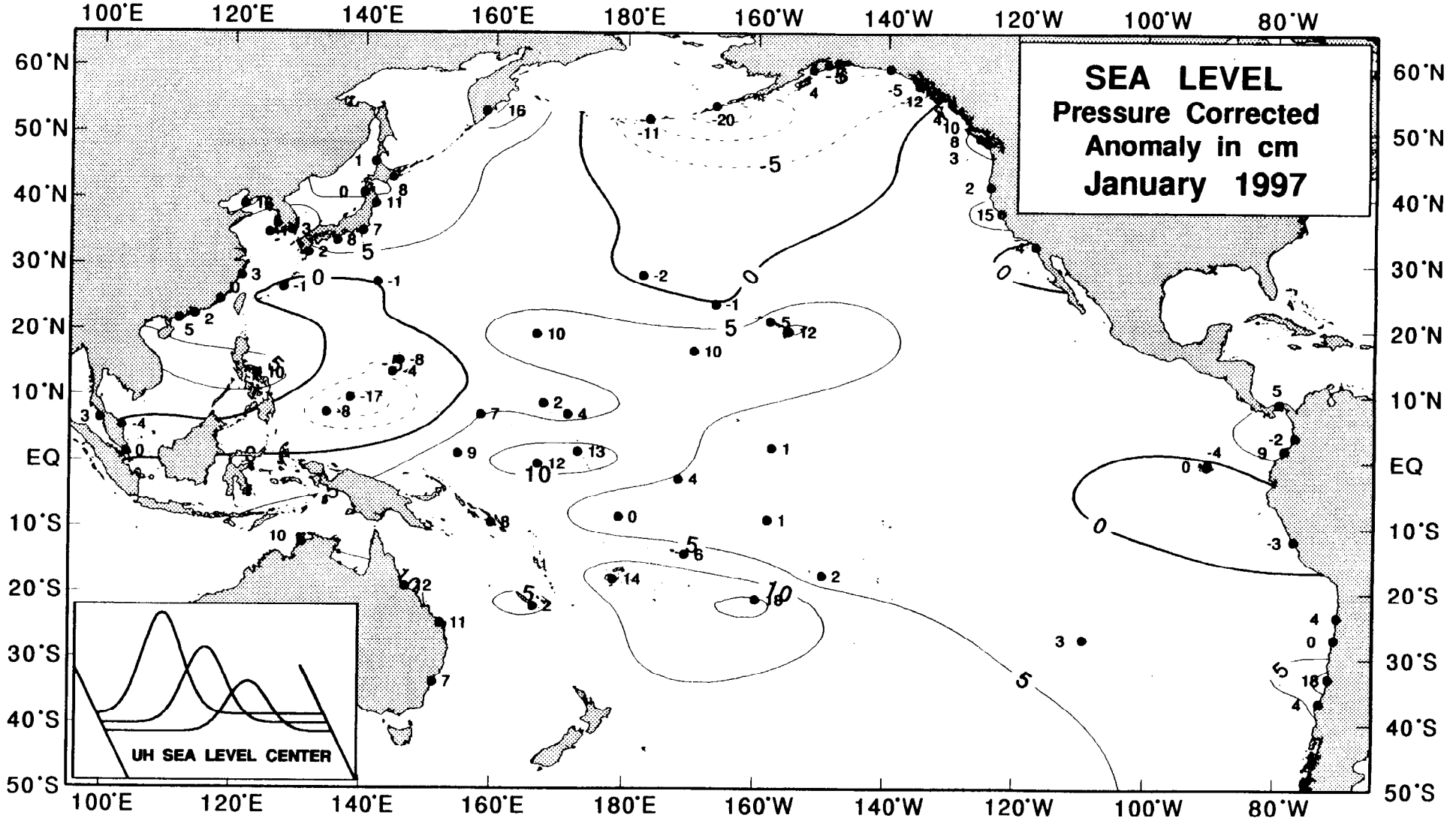

GLOSS Status Within the PSMSL Data Set October 1996
50
0
-50
-200
0
200
Status Category 1,2,3,4 = Large Dot, Small Dot, Star, Cross

Figure 1



Anomaly of sea level from the 1975 to 1995 mean sea level adjusted for atmospheric pressure.

Figure 2

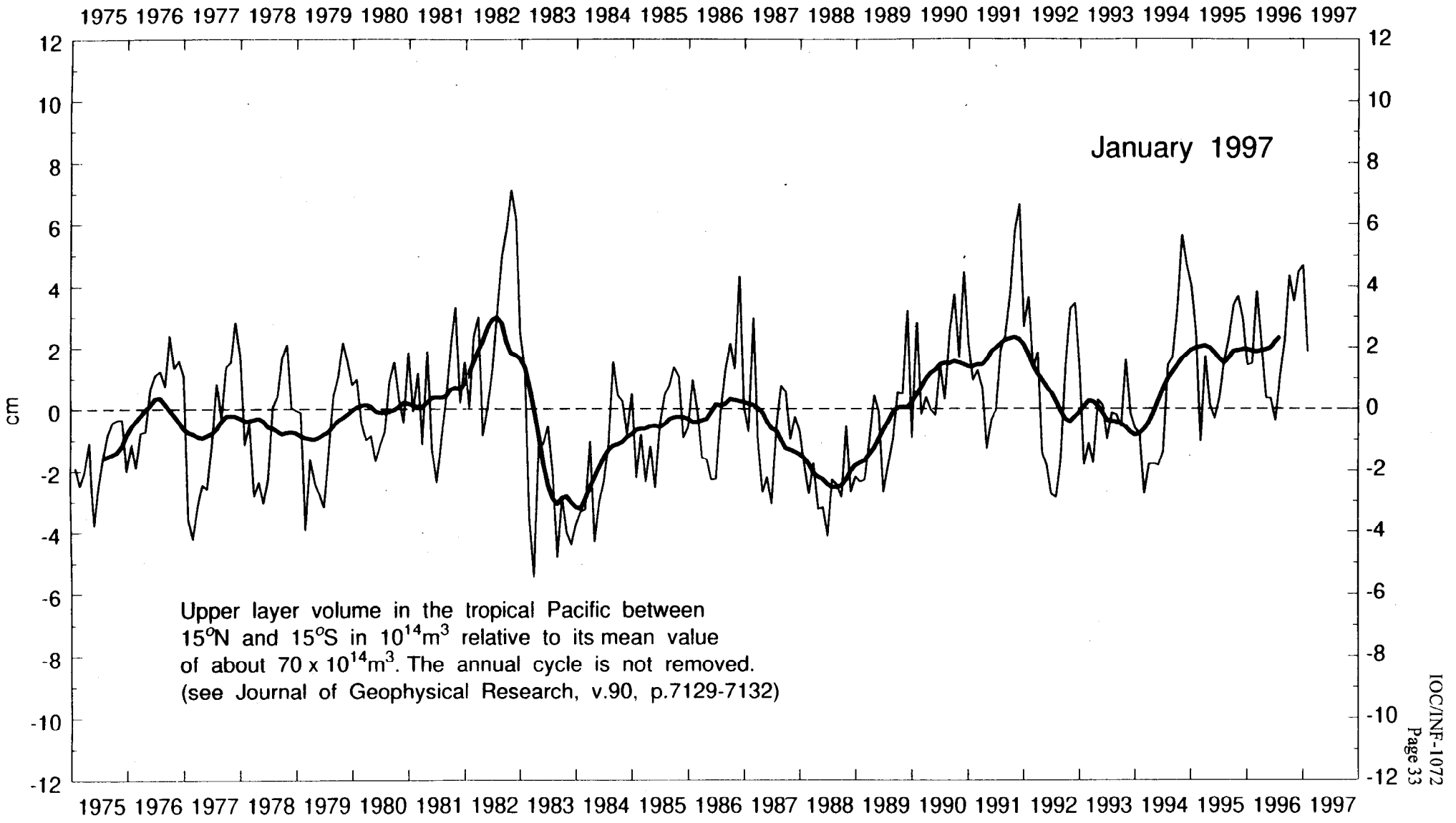
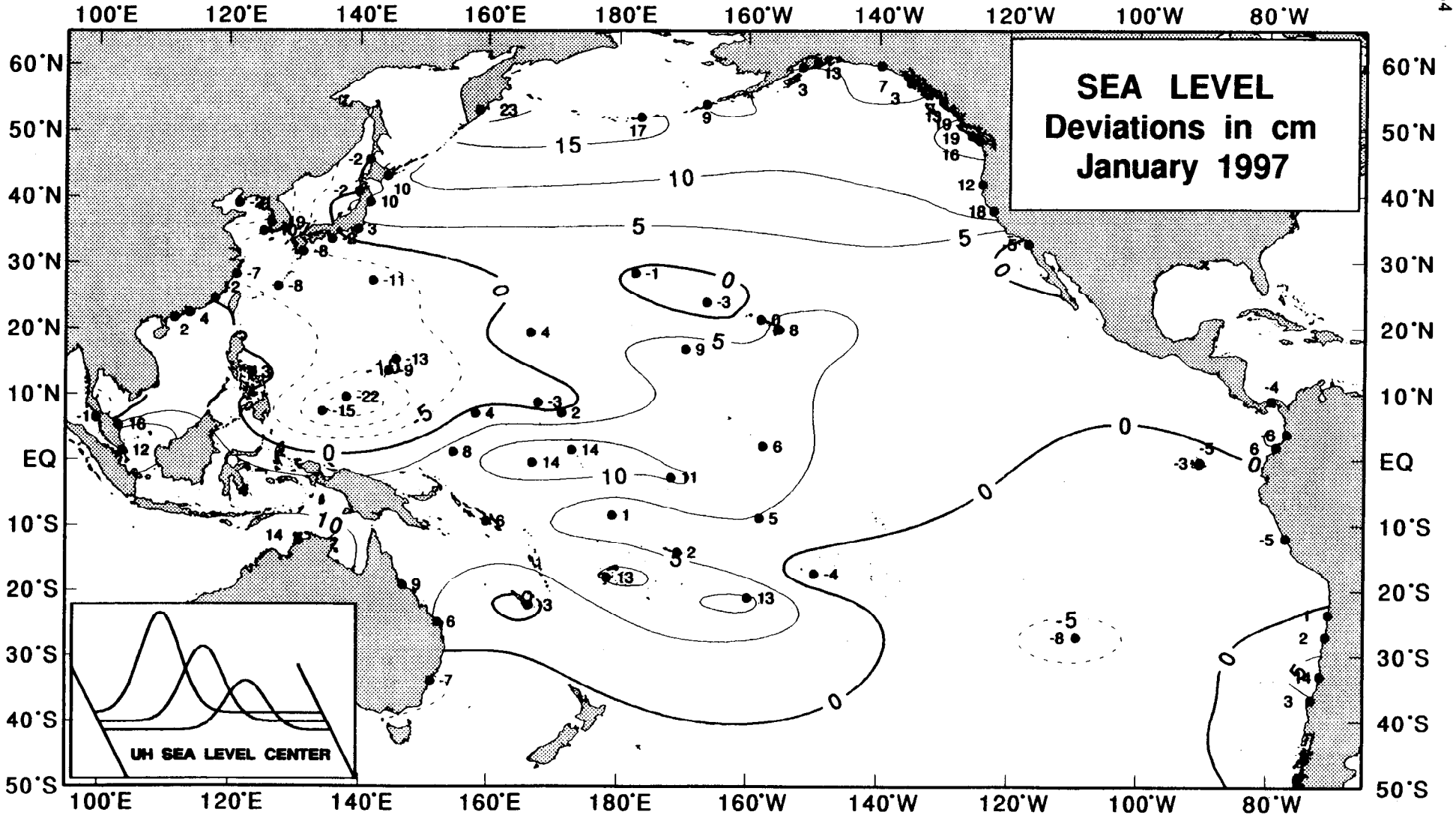

1975 1976 1977 1978 1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997
12
10
8
6
4
2
0
-2
-4
-6
-8
-10
-12
cm
January 1997
Upper layer volume in the tropical Pacific between
15°N and 15°S in $10^{14}m^3$ relative to its mean value
of about $70 \times 10^{14}m^3$. The annual cycle is not removed.
(see Journal of Geophysical Research, v.90, p.7129-7132)

Figure 3



Deviation of sea level from the 1975 to 1995 mean sea level.

Figure 4

Figure 5

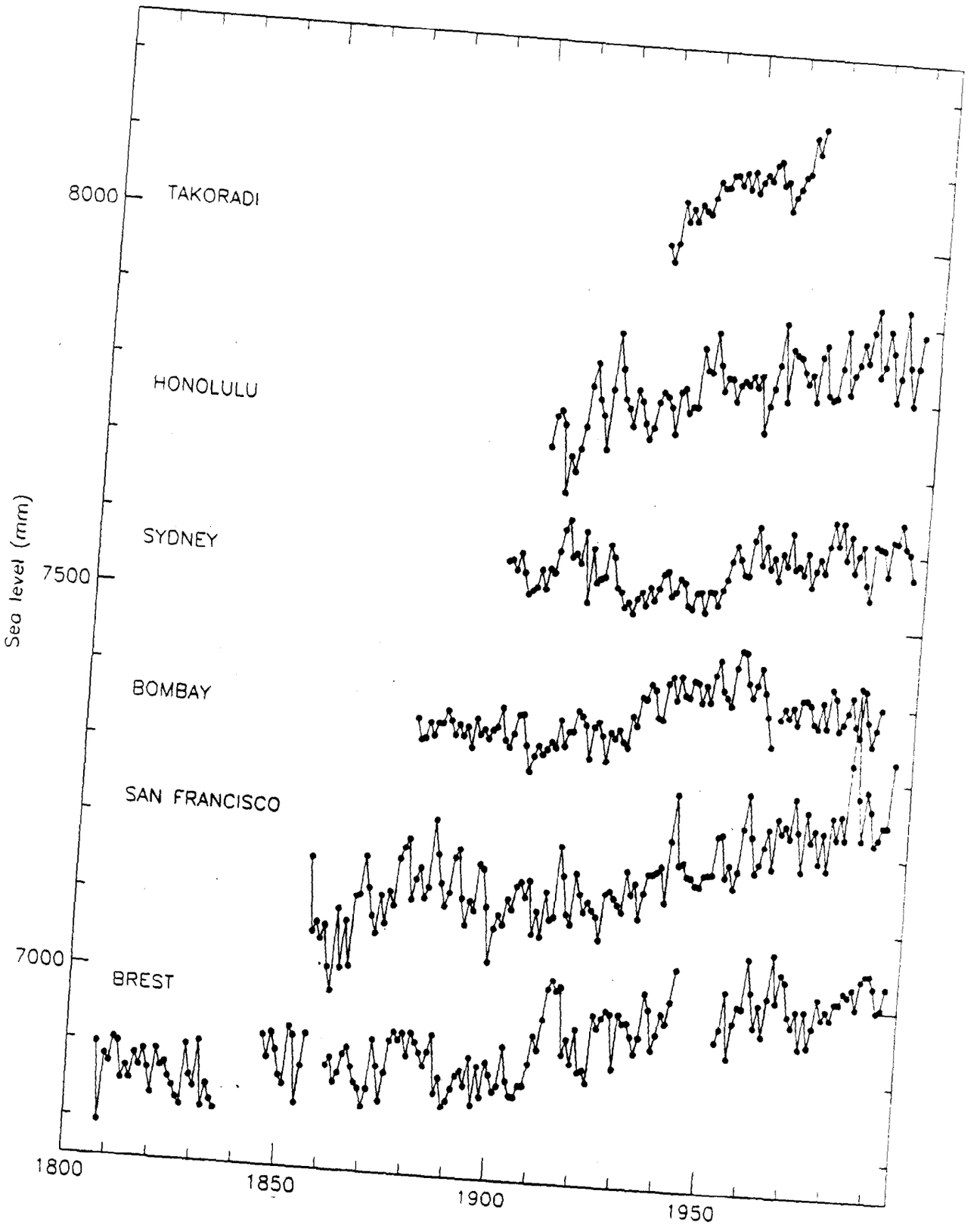
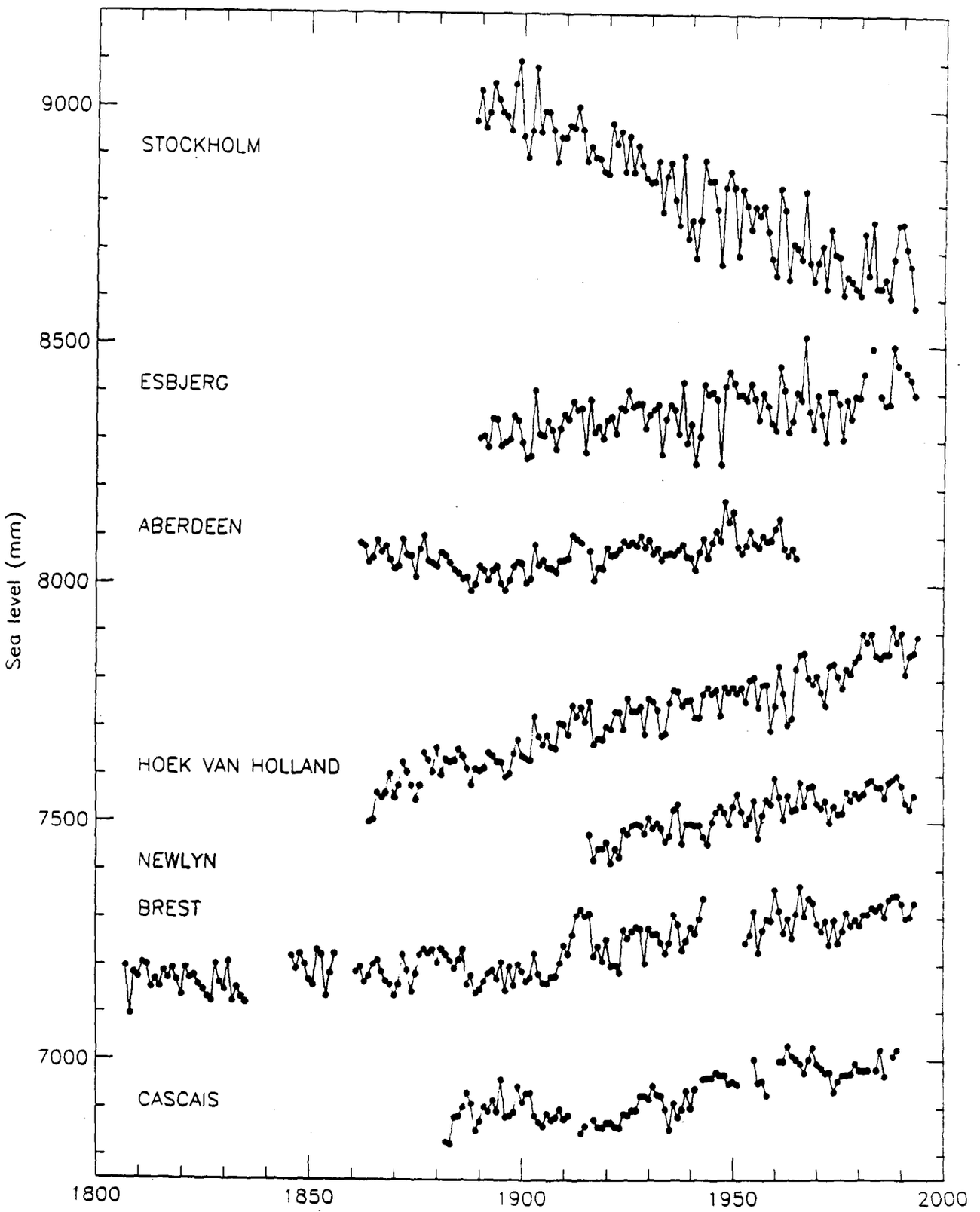

TAKORADI
HONOLULU
SYDNEY
BOMBAY
SAN FRANCISCO
BREST
Sea level (mm)
8000
7500
7000
1800
1850
1900
1950

Figure 6


9000
8500
8000
7500
7000
Sea level (mm)
STOCKHOLM
ESBJERG
ABERDEEN
HOEK VAN HOLLAND
NEWLYN
BREST
CASCAIS
1800
1850
1900
1950
2000

5. TAO ARRAY

The Tropical Atmosphere-Ocean (TAO) Array consists of approximately 70 deep-ocean moorings spanning the equatorial Pacific Ocean between 8N and 8S from 95W to 137E. It is a major component of the global climate monitoring system, and is supported by an international consortium, involving cooperation between the United States, France, Japan, Korea and Taiwan. The purpose of the array is to provide high quality, in-situ, real-time data in the equatorial Pacific Ocean for short-term climate studies, most notably those relating to the El Niño/Southern Oscillation (ENSO) phenomenon. TAO measurements consist primarily of surface winds, sea surface temperature, upper ocean temperature and currents, air temperature, and relative humidity. Data are telemetered in real time via Service Argos, and a subset of these data is placed on the Global Telecommunications System (GTS) for distribution to operational centers for assimilation into weather and climate forecast models. A major step forward in long -term support for the array was the commissioning in FY96 of the NOAA Ship Ka'imimoana, a research vessel dedicated to servicing TAO moorings between 95W and 165E. Also in FY 96, new Next Generation ATLAS moorings were introduced into the array.

TAO data support research efforts at institutions around the world on the causes and consequences of climate variability originating in the tropical Pacific. Work at PMEL (Pacific Marine Environmental Laboratory) during the past year has focused on describing the evolution of recent ENSO warm events, on analyzing upper ocean heat, salt and momentum balances in the western equatorial Pacific, on investigations of the mean seasonal cycle in the eastern equatorial Pacific cold tongue, on large scale ocean dynamical processes involving equatorial waves and currents, on defining tropical Pacific surface layer hydrography and ocean mixed layer structure on seasonal to interannual time scales, on the combined use of TOPEX/POSEIDON altimeter and TAO moored measurements to understand large scale sea level and circulation patterns in the tropical Pacific, on assessments of TAO array design and sampling strategies for climate analyses and predictions, and on validation of recent ocean and atmospheric model reanalyses using TAO data. A historical overview of the development of the Tropical Ocean Global Atmosphere (TOGA) observing system was initiated. Specific plans for new measurement programs were advanced: for a Pilot Research Moored Array in the Tropical Atlantic (PIRATA) in collaboration with Brazil and France, for a moored ATLAS array as part of the South China Sea Monsoon Experiment (SCSMEX) in collaboration with Taiwan, and for the Triangle Trans Ocean Buoy Network (TRITON) in collaboration with Japan. The TAO project also established collaborations with the US Department of Energy/Atmospheric Radiation Measurements (DOE/ARM) program to provide long term solar radiation measurements in the western Pacific, with the NASA Scatterometer (NSCAT) program to provide in situ validation data and sensitivity testing of wind forced ocean models, with the NASA Tropical Rainfall Measuring Mission (TRMM) to provide basin scale in situ rainfall and salinity measurements, and with the NOAA Ocean Atmosphere Carbon Exchange Studies (OACES) program. These efforts all contribute to studies of ocean-atmosphere interaction and climate variability of central interest to PMEL.

The TAO project provides interactive access to TAO data, display software and graphics via the World Wide Web and workstation-based TAO Display Software. The TAO software features a point-and-click interface and a data subscription service providing remote users with automated daily updates to real time and historical TAO data, and is actively used at nearly 50 research institutions throughout the world. This year, time series of data from individual instruments on the TAO moorings have been made available on the World Wide Web. The TAO Project Office has also established a TOGA COARE moored data centre, with Web access to nearly all moored time series collected during the COARE experiment. More information on TAO can be obtained via a World Wide Web site [http://www.pmel.noaa.gov/toga-tao/home.html].

6. DRIFTING BUOYS

In early April 1997 data from a total of 1222 drifting buoys were collected and processed at the Argos global Processing Centres of Toulouse, France and Landover, Maryland, USA for distribution in real-time or deferred-time to respective Principal Investigators (PI). These buoys are operated by 19 countries (Australia,

Brazil, Canada, China, Finland, France, Germany, Iceland, India, Italy, Japan, Korea, Netherlands, New Zealand, Norway, South African, Spain, United Kingdom, USA).

Of those 1222 drifting buoys, about 52.8% transmit the data in real time via the Global Telecommunication System (GTS).

Most of the buoys measure at least sea surface temperature data, and approximately 250 measure air pressure. Almost all of those measuring air pressure report on the GTS. Approximately 7% of all drifting buoys have no sensors and are used as Lagrangian tracers only; 20% do not report on GTS because of poor quality; 8% are not inserted on GTS because permission was not granted (buoys principally from research programmes, for which data are being released only after formal publication of related studies); and 12% for unknown reasons.

Table 1 shows the total number of different physical buoys per country an the portion of those reporting on GTS for the 12 month period from April 1996 to March 1997.

Figure 1 shows by country and for the period 1-4 April 1997, the mean number of observations transmitted on GTS per day for air pressure, sea surface temperature, wind and air temperature data as received at Météo France using a cut off time of 3 hours (i.e. reports received after 3 hours after the observation time are not counted).

Figure 2 indicates, by Marsden Square, the number of reports received at the Toulouse Hub of Météo France during March 1997.

Figures 3 through 6 indicate, by Marsden Square, the availability of in situ air pressure, air temperature, sea surface temperature, and wind data respectively from ship and buoy GTS reports as compared to basic World Weather Watch (WWW) requirements (top figure is a percentage of how we meet requirements of 8 observations per day for an area of 500 by 500 kilometres, and bottom figure is the percentage of buoy reports compared to the total of ship plus buoy reports).

Figure 7 is a global track chart produced by the RNODC/DB that plots the month of January 1997 movement of the reported buoys that passed position and quality control checks.

At the tenth session of CBS (Geneva, November 1992), the Quality Control Guidelines for buoy data as proposed by the DBCP have been formally incorporated as part of the World Weather Watch (WWW). Twelve Principal Meteorological or Oceanographic Centres for buoy data quality control (PMOC) from nine different countries are participating in the guidelines on a regular basis:

- The Australian Bureau Of Meteorology (ABOM),
- Environment Canada,
- The European Centre for Medium-Range Weather Forecasts (ECMWF),
- The Icelandic Meteorological Office (IMO),
- The Japan Meteorological Agency (JMA),
- Météo France (CMM, Centre de Météorologie Marine),
- The Meteorological Service of New Zealand, Ldt. (NZMS),
- The National Data Buoy Center (NDBC of NOAA, USA),
- The National Center for Environmental Protection (NCEP of NOAA, USA),
- The Pacific Marine Environmental Laboratory (PMEL of NOAA, USA),
- The South African Weather Bureau (SAWB),
- The United Kingdom Meteorological Office (UKMO).

PMOCs can make status change proposals via an Internet mailing list for these buoys which report bad quality data onto the GTS.

The Guidelines have been successful so far in improving the overall quality of drifting buoy data delivered on the GTS. For example, for a total of 1498 buoys that reported onto the GTS during the period 1 June 1995 to 31 May 1996, following 496 status change proposals from PMOCs related to 318 buoys, 210 buoys had their status changed (i.e. 15.6%): 239 buoys or buoy sensors were removed from GTS distribution, 8 buoy sensors were re-calibrated, and no action has been taken for 96 buoys or buoy sensors (e.g. PI declined to change the buoy status because he believed the buoy data were good although one or more PMOC commented on the quality of the data).

The Responsible National Oceanographic Data Centre for Drifting Buoy data (RNODC/DB) is located in Canada. The data is maintained in a data base structure. The number of buoys and BUOY messages archived per month by the RNODC/DB is shown in Figure 8. In addition, the French National Oceanographic Centre operates the IGOSS Specialised Oceanographic Centre for Drifting Buoy data (SOC/DB).

The so called SVP Barometer drifter (SVPB) which has been designed by Scripps Institution of Oceanography (La Jolla, California, USA) and tested in co-operation with DBCP members is now reliable and commercially available. This instrument, which meets both oceanographic research and operational meteorology needs has been deployed in large quantity in co-operation between the two communities. As a result the number of air pressure reports available in real-time dramatically increased in the last few years. Figure 9 shows the positions of all Lagrangian drifters reporting from the world oceans in February 1997. SVP Barometer drifters are marked as blue dots on the map. Most of SVPBs appear in the South Atlantic, Indian Ocean, and Southern Ocean.

Since the creation of the DBCP, a number of regional action groups have been established leading to a much better coverage of ocean basins than a few years ago.

- The European Group on Ocean Stations (EGOS, North Atlantic) in 1989
- The International Arctic Buoy Programme (IABP) in 1991
- The International Programme for Antarctic Buoys (IPAB) in 1994
- The International south Atlantic Buoy Programme (ISABP) in 1994
- The International Buoy Programme for the Indian Ocean (IBPIO) in 1996
- The Global Drifter Programme (GDP) in 1996

More information on buoy data can be obtained via a World Wide Web site which has been established by the DBCP in February 1995 [http://dbcp.nos.noaa.gov/].

Table 1: Number of drifting buoys by country and those reporting via the GTS (based on actual transmissions between April 1996 to March 1997).

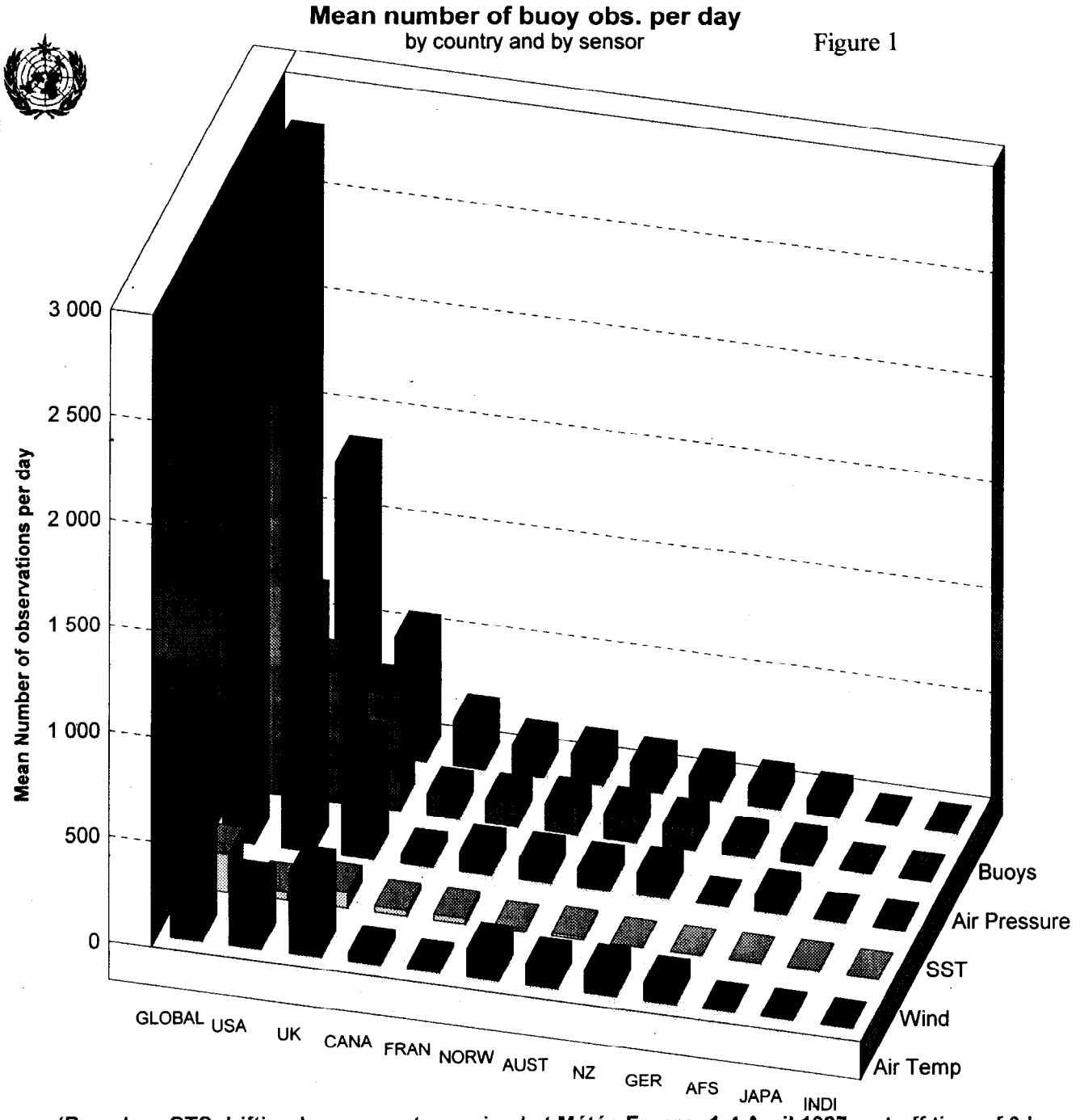
Organism	Country	Buoys	GTS
Alfred Wegener Institute	Germany	21	18
Ampolex	Australia	4	0
Antarctic CRC	Australia	1	1
Antarctic Division, Dept. Of Sciences and Technology	Australia	28	2
Atlantic Oceanographic and Meteorological Laboratory	USA	60	29
Bedford Institute of Oceanography	Canada	73	41
Bermuda Biological Station For Research, Inc.	USA	1	0
Bureau Of Meteorology	Australia	38	28
Christian Michelsen Research	Norway	7	3
Coast Guards	Canada	6	0
COMAPEGA	France	2	0
Commissariat a l'Energie Atomique	France	2	0
CSIRO	Australia	2	0
Department of Energy	USA	9	2
Department of Fisheries and Oceans	Canada	1	0
Environment Canada	Canada	22	16
EPSHOM	France	18	0
Global Drifter Center	USA	100	76
IFREMER	France	86	8
Institut de Ciencies del Mar	Spain	18	0
Institut fur Meereskunde	Germany	2	0
Institute of Marine Research	Norway	10	0
Institute of Ocean Sciences	Canada	16	1
Instituto di Meteorologia e Oceanografica	Italy	1	0
Instituto Nacional de Pesquisas Espaciais	Brazil	6	0
Instituto Universitario Navale	Italy	11	0
Japan Marine Fisheries Research Center	Japan	8	0
Japan Marine Science and Technology Center	Japan	2	1
Japan Meteorological Agency	Japan	27	0
Korean Ocean Research and Develomment Institute	Korea	54	0
LODYC	France	14	0
Louisiana State University	USA	4	0
Marine Biological Association	United Kingdom	20	0
Marine Research Institute	Iceland	29	0
Marine Sciences Research Center	USA	10	0
Maritime Safety Agency	Australia	2	0
Maritime Safety Agency, Hydrographic Department	Japan	29	0
Meteo France	France	52	36
Meteorological Office	United Kingdom	37	23
Meteorological Service	New Zealand	13	12
Metocean Data Systems, Ltd.	Canada	2	0
Minerals Management Service	USA	346	0
MP Rogers and Associates Pty, Ltd	Australia	2	0

National Data Buoy Center	USA	69	50
National Ice Center	USA	12	8
National Institute of Oceanography	India	18	15
National Marine Fisheries Service	USA	4	0
National Research Institute of Far Seas Fisheries	Japan	1	0
National Sciences Foundation	USA	4	0
National Sun Yat-Sen University	Taiwan	4	0
National Taiwan Ocean University	Taiwan	8	0
NATO SACLANT ASW Research Center	Italy	25	9
Natural Environment Research Council	United Kingdom	37	3
Naval Postgraduate School	USA	12	0
Nederlands Instituut Voor Onderzoek Der Zee	Netherlands	15	0
North American CLS	USA	22	0
Norwegian Hydrotechnical Laboratory	Norway	17	0
Norwegian Meteorological Institute	Norway	5	3
Norwegian Polar Institute	Norway	4	0
NOVA University Oceanographic Center	USA	1	0
OCEANOR	Norway	13	0
OceanRoutes Seimac	Canada	2	0
Pacific Marine Environmental Laboratory	USA	31	6
Proudman Oceanographic Laboratory	United Kingdom	1	0
Remote Sensing Technology Center of Japan	Japan	1	0
Royal Netherland Meteorological Institute	Netherlands	31	19
Rutgers University	USA	21	0
Scripps Institution of Oceanography	USA	961	632
Seikai National Fisheries Reserrch Institute	Japan	1	0
SERPE IESM	France	1	0
South African Weather Bureau	South Africa	63	46
South China Sea sub-Bureau of NBO	China	5	0
Southampton Oceanography Centre	United Kingdom	7	0
Tokai University	Japan	18	0
Universitat de Las Palmas de Gran Canaria Depto.Biologia	Spain	4	0
Universitat Politecnica De Catalunya	Spain	1	0
University Of Bremen	Germany	1	0
University Of Cambridge	United Kingdom	5	0
University Of Delaware	USA	10	0
University Of Hamburg	Germany	9	0
University Of Hawaii	USA	47	47
University Of Helsinki	Finland	8	4
University Of Kiel	Germany	26	0
University Of Main	USA	6	0
University Of Miami	USA	128	90
University Of New Hampshire	USA	3	0
University Of North Wales	United Kingdom	7	0
University Of Oregon	USA	25	13
University Of Pisa	Italy	1	0
University Of Southern Mississippi	USA	2	0

University Of Tokyo	Japan	10	1
University Of Wales	United Kingdom	5	0
University Of Washington	USA	16	1
University Of Wisconsin-Madison	USA	4	0
US Coast Guards, International Ice Patrol	USA	62	11
US Naval Oceanographic Office	USA	296	162
US Navy Postgraduate School	USA	25	0
William Sound Science Center	USA	1	0
Woods Hole Oceanographic Institution	USA	174	8
TOTAL		**3486**	**1425**

Figure 1: 3D Histogram showing distribution of mean number of obs by country & sensor
Figure 2 : Météo France Marsden Square count of BUOY reports
Figure 3 : Météo France Data Availability Index Map (pressure)
Figure 4 : Météo France Data Availability Index Map (air temperature)
Figure 5 : Météo France Data Availability Index Map (sea surface temperature)
Figure 6 : Météo France Data Availability Index Map (wind)
Figure 7 : MEDS Global map for January 97
Figure 8 : Evolution of the number of buoys and messages archived at MEDS
Figure 9: AOML Status of Global Drifter Array

Figure 1



(Based on GTS drifting buoy reports received at Météo France, 1-4 April 1997, cut off time of 3 hours)

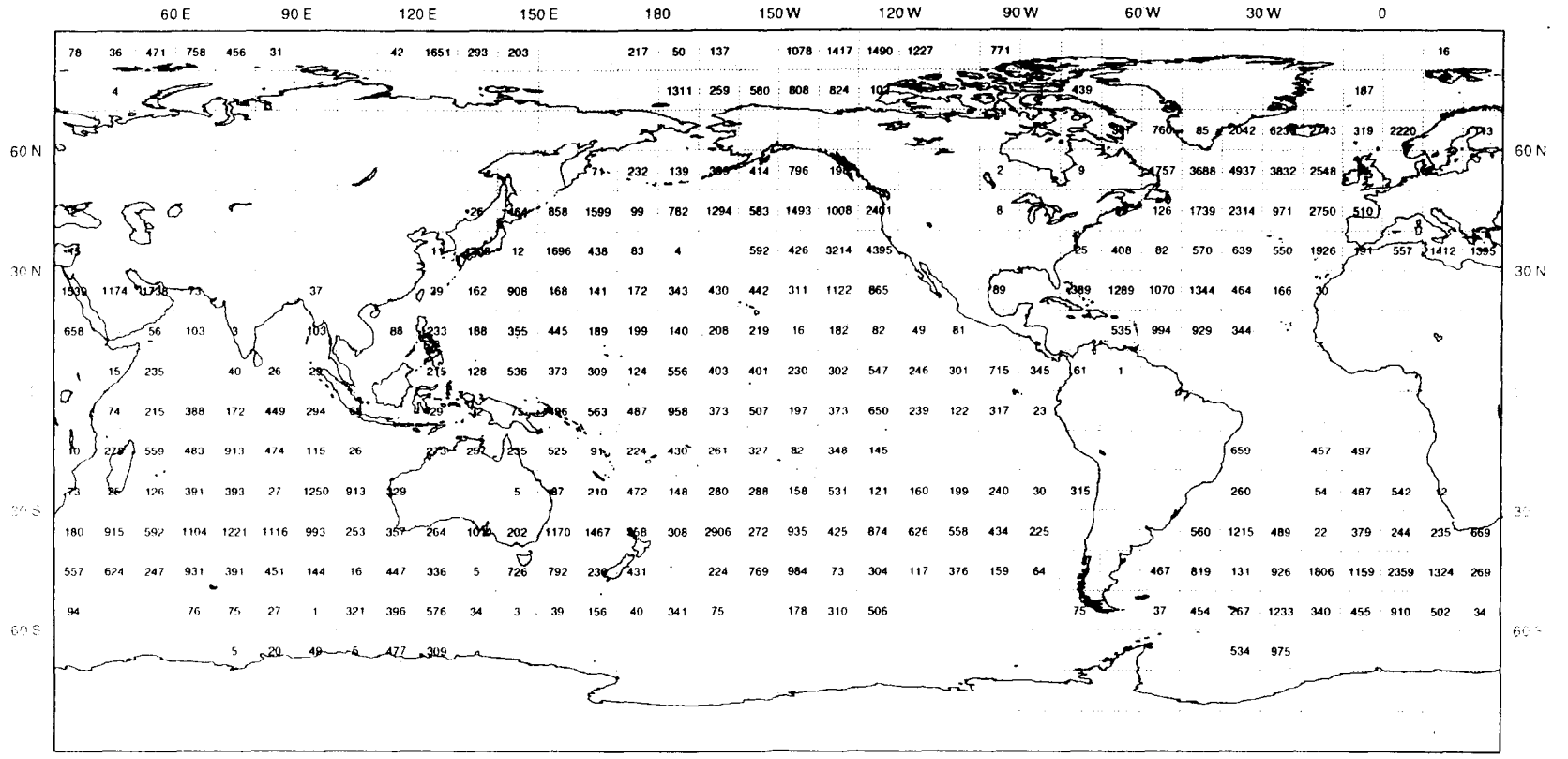
METEO FRANCE

METEO-FRANCE SMISO

Repartition par carre Marsden des observations recues en Janvier 1997

Marsden square distribution chart of data received during January 1997

Messages : BUOY **Total : 188067**



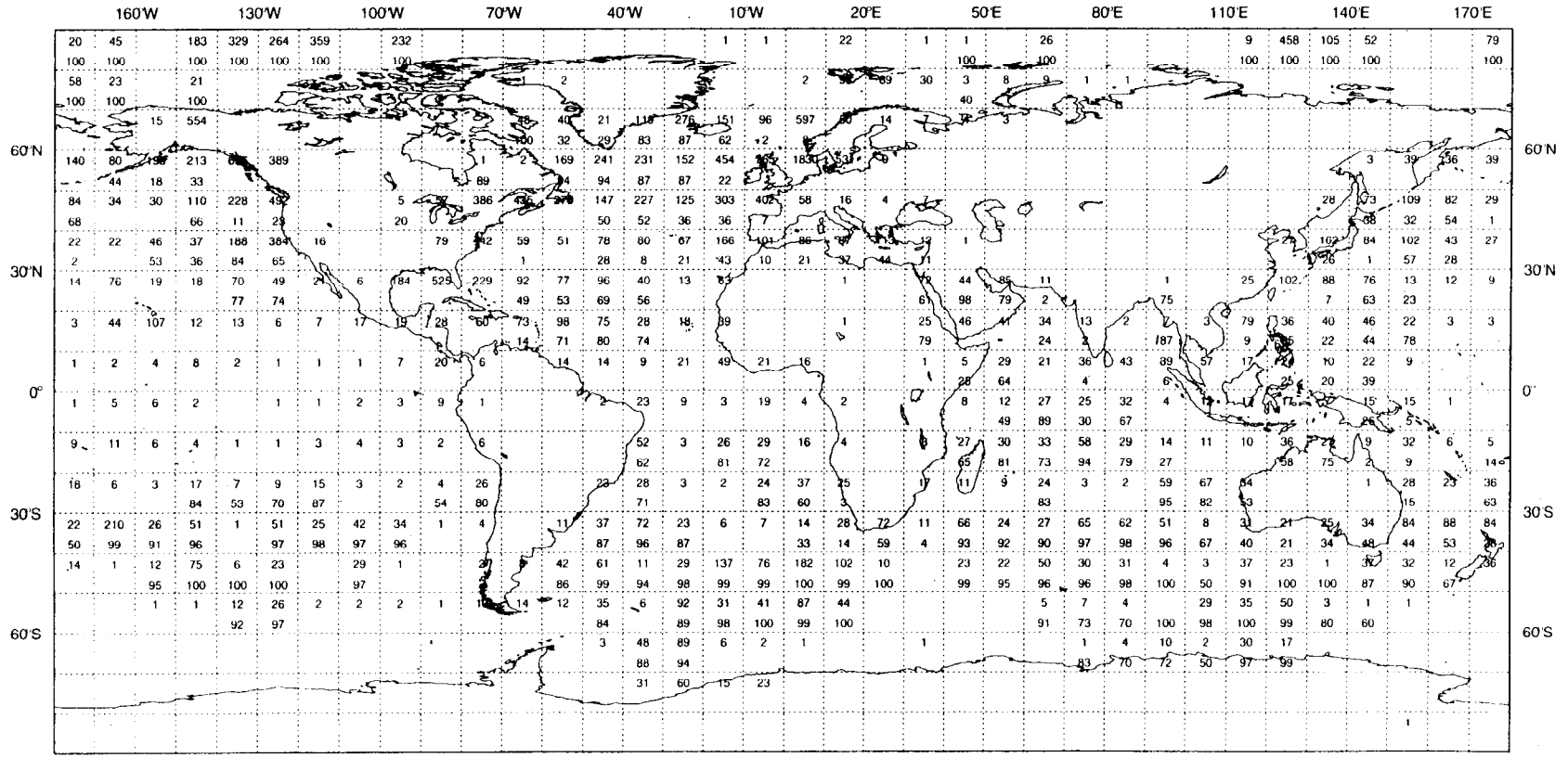
MAGICS 4.2 Solaris - smiso - 5 February 1997 10:01:16

Figure 2

METEO
FRANCE

METEO - FRANCE **PRESSURE** **JANUARY 1997**

Marsden square distribution chart of mean monthly data availability index (top)
(Index 100 = 8 obs. per day per 500kM * 500kM area of SHIP and BUOY reports)
and
Percentage of BUOY reports compared to SHIP+BUOY reports (bottom)



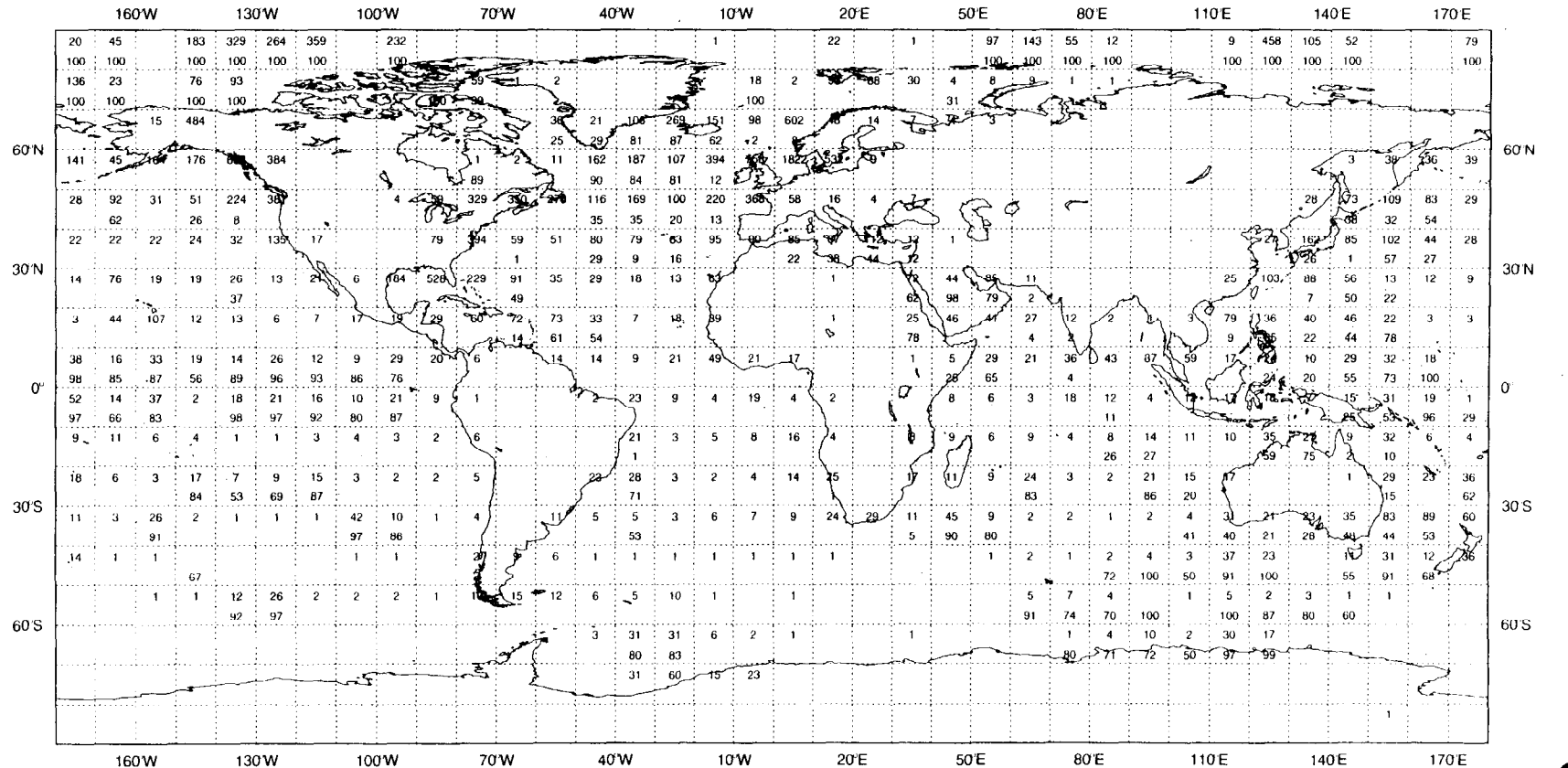
MAGICS 4.2 Solaris - mpma497 - 3 February 1997 17:30:25

Figure 3

METEO
FRANCE

METEO - FRANCE **TEMPERATURE** **JANUARY 1997**

Marsden square distribution chart of mean monthly data availability index (top)
(Index 100 = 8 obs. per day per 500kM * 500kM area of SHIP and BUOY reports)
and
Percentage of BUOY reports compared to SHIP+BUOY reports (bottom)



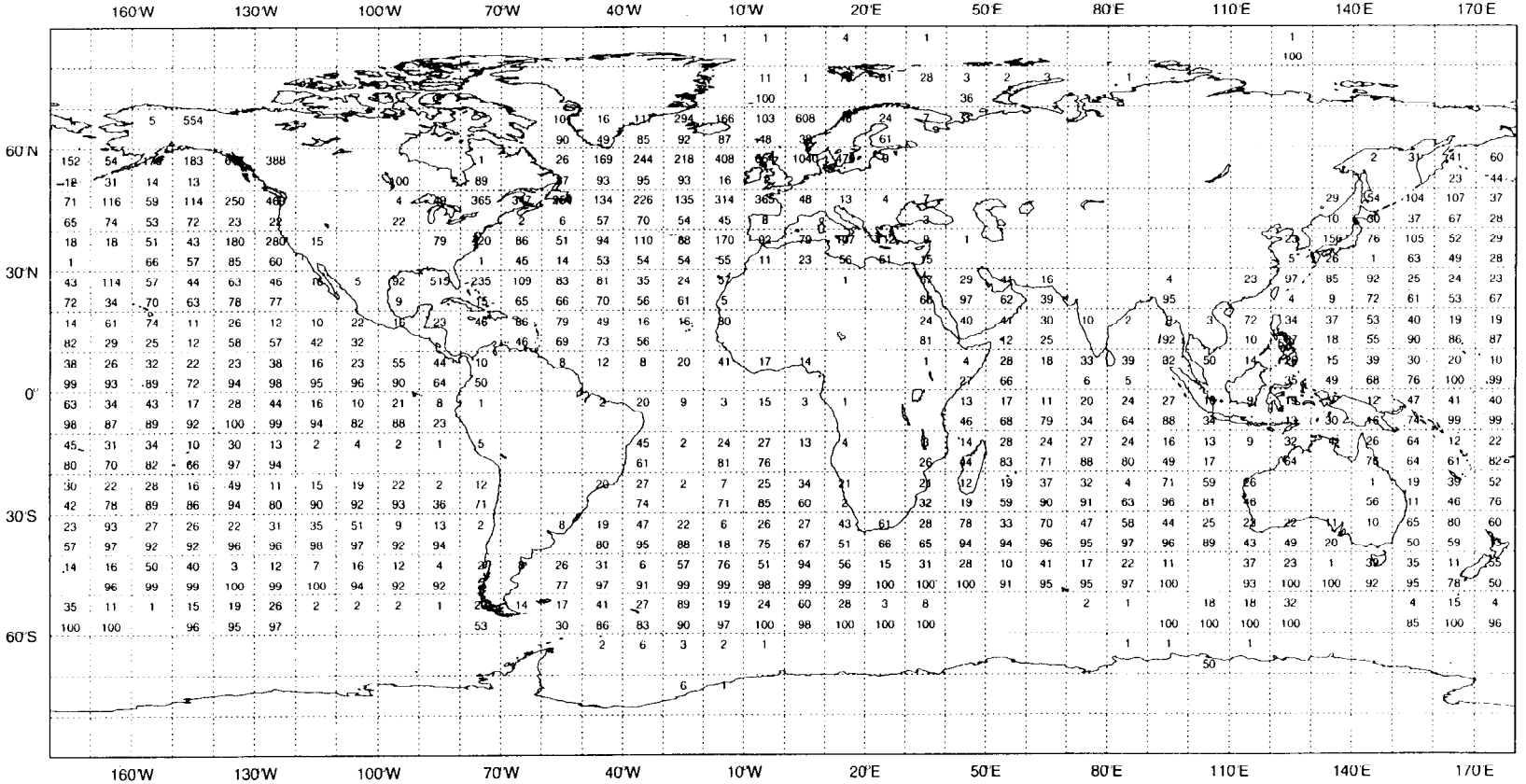
MAGICS 4.2 Solaris - mpma497 - 3 February 1997 17:30:38

Figure 4

METEO FRANCE

METEO - FRANCE **SEA SURFACE TEMPERATURE** **JANUARY 1997**

Marsden square distribution chart of mean monthly data availability index (top)
(Index 100 = 8 obs. per day per 500kM * 500kM area of SHIP and BUOY reports)
and
Percentage of BUOY reports compared to SHIP+BUOY reports (bottom)



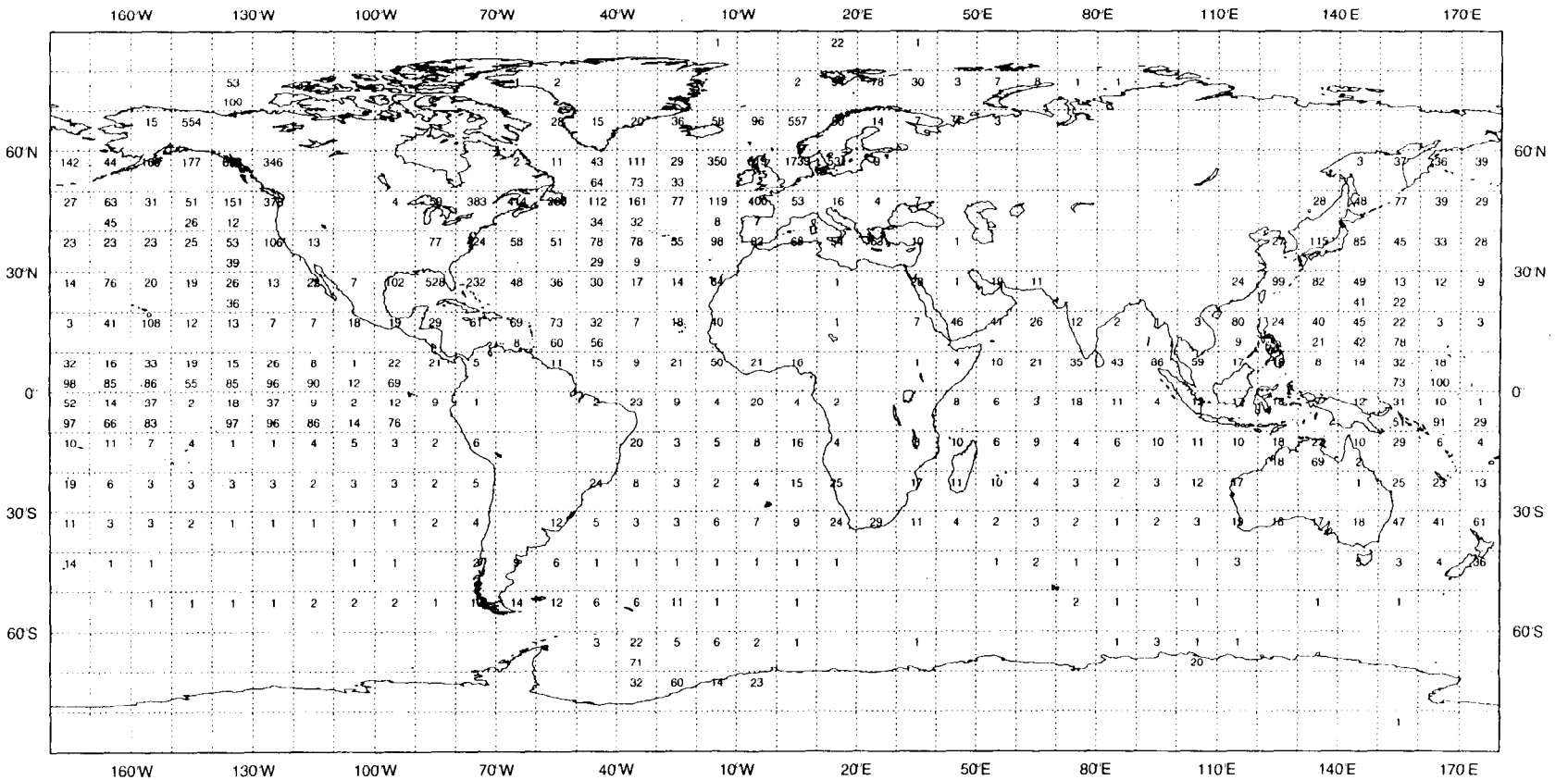
MAGICS 4.2 Solaris - mpma497 - 3 February 1997 17:30:30

Figure 5

METEO
FRANCE

METEO - FRANCE **WIND** **JANUARY 1997**

Marsden square distribution chart of mean monthly data availability index (top)
(Index 100 = 8 obs. per day per 500kM * 500kM area of SHIP and BUOY reports)
and
Percentage of BUOY reports compared to SHIP+BUOY reports (bottom)



MAGICS 4.2 Solaris - mpma497 - 3 February 1997 17:30:34

Figure 6

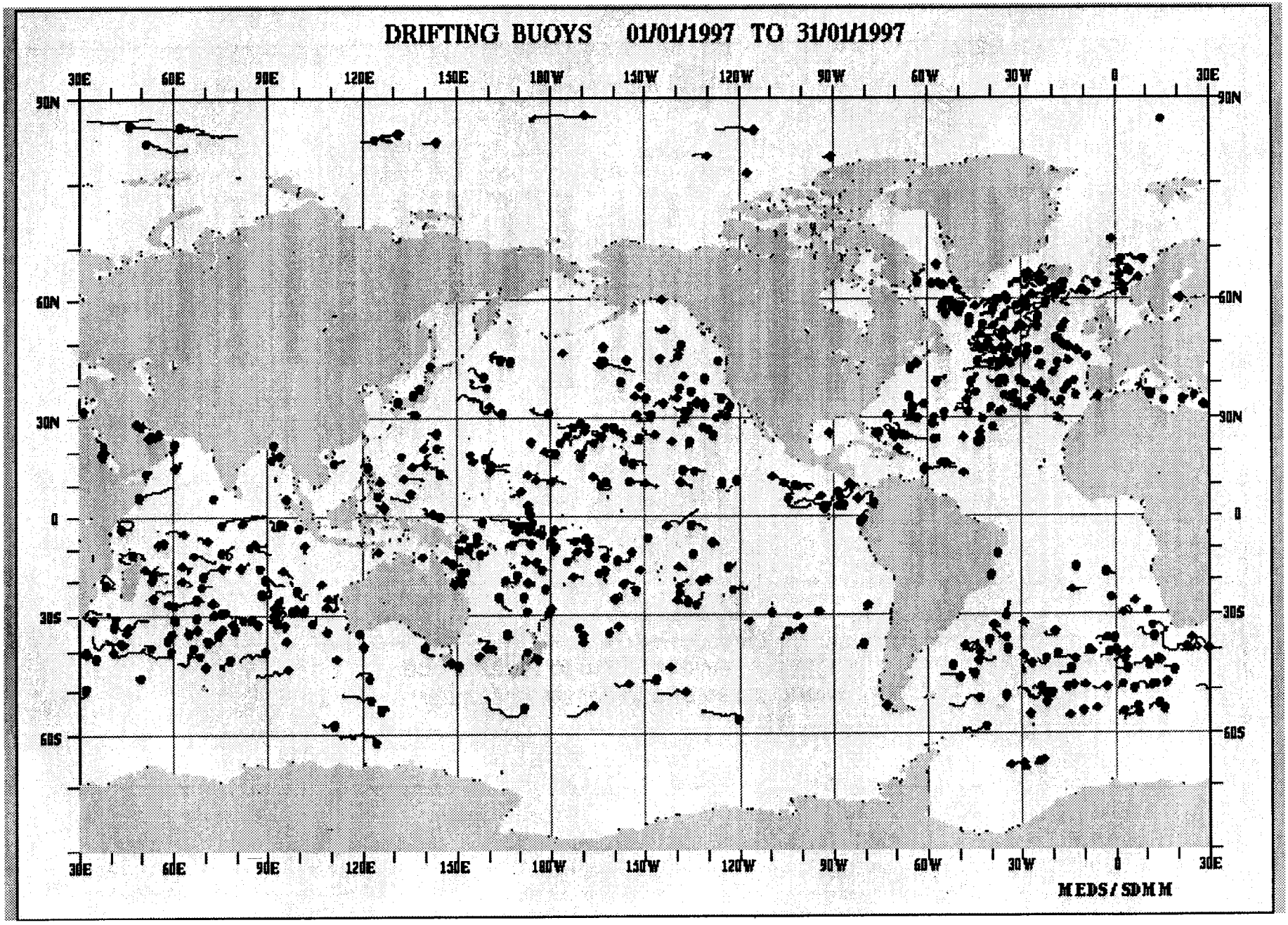

DRIFTING BUOYS 01/01/1997 TO 31/01/1997
30E
60E
90E
120E
150E
180W
150W
120W
90W
60W
30W
0
30E
90N
60N
30N
0
30S
60S
MEDS / SDMM

Figure 7

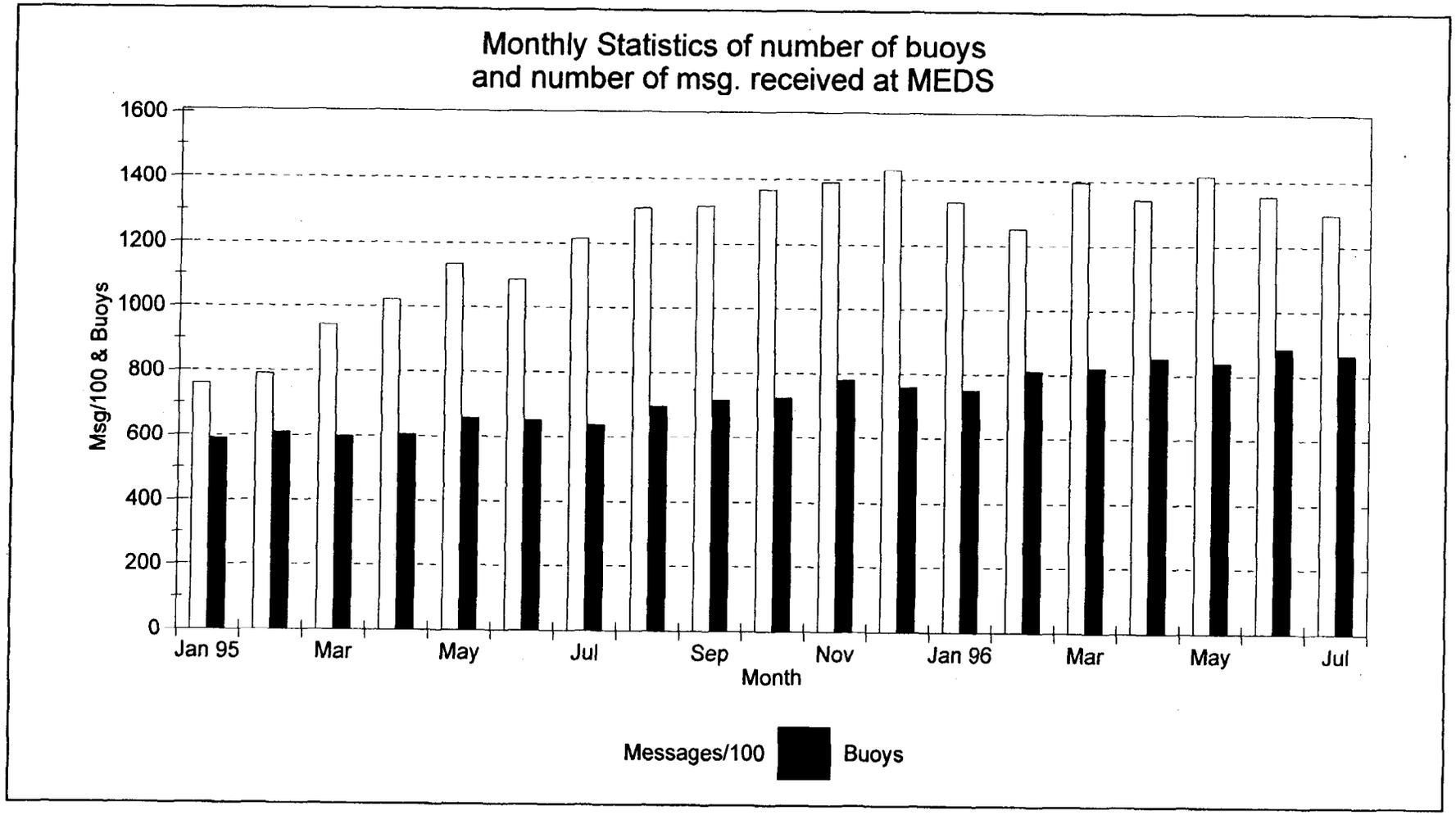
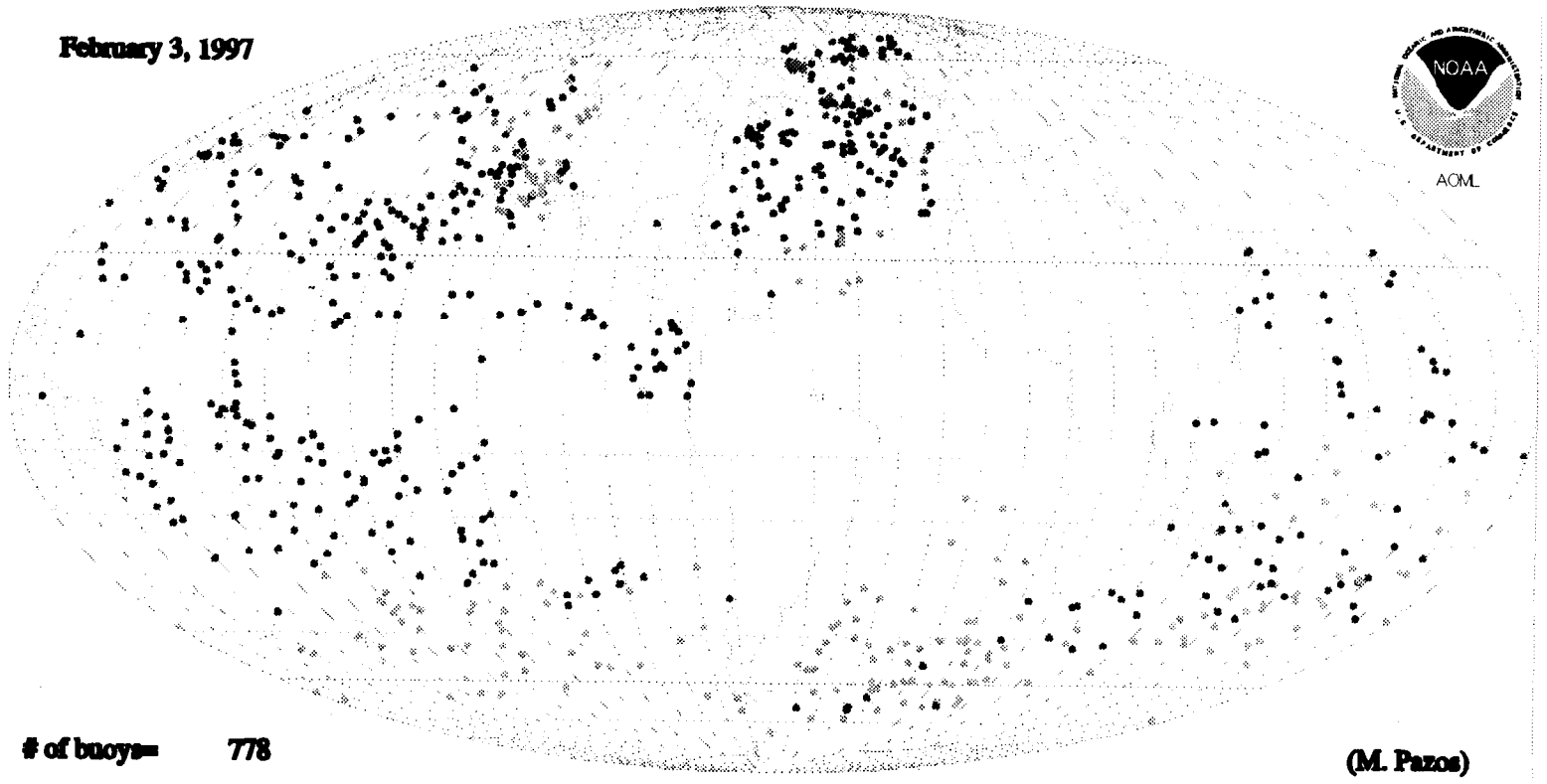

Monthly Statistics of number of buoys
and number of msg. received at MEDS
Msg/100 & Buoys
1600
1400
1200
1000
800
600
400
200
0
Jan 95
Mar
May
Jul
Sep
Nov
Jan 96
Mar
May
Jul
Month
Messages/100
Buoys

Figure 8

STATUS OF GLOBAL DRIFTER ARRAY



- SST ONLY
- SST AND BAROMETRIC PRESSURE
- SST AND SALINITY
- SST/SLP/WIND

GLOBAL DRIFTER PROGRAM
Peter Niiler
Mark Swenson

Figure 9

7. INTERNATIONAL OCEANOGRAPHIC DATA EXCHANGE (IODE) [1]

The year 1996 started with the landmark event - the Fifteenth Session of the Committee on IODE which took place in Athens, Greece, from 23-31 January. The Meeting was attended by about 100 participants from 38 countries and 17 partner organizations with almost half the participants coming from Africa, Asia and South America.

Increased interest in IODE caused by political changes, scientific needs and technological development resulted in the expansion of the IODE System. Today, almost 70 Member States expressed interest in joining the IODE programme by nominating IODE Co-ordinators, establishing NODCs or designating DNAs, and by supporting IODE activities. Fifty-four NODC/DNAs are in operation within the IODE system (Figure 1: *Distribution of IODE Data Centres as of January 1997*).

1996 also marked an increase in new products development and a widening range of services provided by NODCs and RNODCs. Some examples are presented here (Figures 2: *Japan/MARPOLMON RNODC Activity Report No. 8, 1997*, Figure 3: *RNODC/SOC 1995 Report* & Figure 4: *Annual Summary SEAS Programme Data 1996*).

7.1 GTSPP (Global Temperature-Salinity Profile Programme)

Started in 1990 as a pilot project, GTSPP gained a world wide reputation by bringing closer operational (near real-time) and delayed mode data streams. GTSPP uses a "*continuously managed database*" to provide for the integration of the real-time data stream, generally of low resolution, with the delayed mode data of generally high resolution. GTSPP has a variety of users. The data are passed on a daily or 3-times per week schedule to agencies running operational coupled ocean-atmosphere models, to weather forecasting centres, and from time-to-time to fishing companies. All research and operational users benefit from the GTSPP because of the more complete and timely database that is available. In 1996, the GTSPP CD-ROM was completed containing data and documents relevant to GTSPP. Applications are provided to view the documents and data, to browse through bibliographies of data sources and directories of GTSPP participants, to retrieve and filter the data, to analyze and display the data. A few hundred copies of the CD-ROM were provided to IOC and WMO Member States. The design and implementation of a distributed WWW site for GTSPP has been started. [2]

7.2 GODAR (Global Oceanographic Data Archeology and Rescue Project)

The GODAR Project started in 1993 and after the first 3 years of GODAR activities the size of the global temperature profile database has been increased by approximately 1.5 million temperature and 300,000 salinity profiles. This data has been made available on 10 CD-ROMs and has been widely distributed without restriction. The CD-ROM set and products based on this data are known as the World Ocean Atlas 1994. In 1996, due to the implementation of the regional approach in data search and rescue operations, the global dataset of temperature and salinity profiles has increased to over 2.0 million. (Figure 5: *WDC-A, Oceanography Catalogue of Data & Report of Data Exchange, 1994-1995*). It is expected that in 1997 an updated version of the World Ocean Atlas will be published on CD-ROMs which will include new data types,

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1 Description of the IODE System, its structure and procedures are presented in the IODE Manual and numerous IOC publications related to the ocean data and information management. A list of relevant publications is given in the IODE Handbook, 1994 and an updated version is on the IOC Homepage.

2 More information about the progress in GTSPP developments and the plan for the future can be found in IOC/INF-1033 '*Summary Report of the Joint IOC-WMO Steering Group on GTSPP, Fourth Session, Washington, DC, USA, 16-19 April 1996*'.

such as biological and chemical data. GODAR succeeded in making increased quantities of naval data which have been classified before, accessible to a wide international user community. The project assisted in raising the profile of marine data management and increased technology and capability transfer to developing countries. A list of the GODAR products is presented in GODAR-V Regional Workshop Report. Other GODAR publications can be acquired from the IOC Secretariat or WDC-A, Oceanography.

7.3 OceanPC

OceanPC is an IODE project to develop personal computer software to support entry, processing and international exchange of oceanographic data, particularly in developing countries. It is the key to attaining a global data and information distribution network. The OceanPC software package was developed in 1995 which includes modules for general purpose mapping, ROSCOP oceanographic cruise inventories and entry and processing of vertical profile data. The first version of OceanPC software has been distributed to over 500 users. A new Window compatible version is envisioned in the near future. Access to a wide range of material on CD-ROMs, as well as on-line services will be a key component of the new version. The objective is to provide the scientist/ocean resource manager with access to data, as well as the tools to derive the information and products required.

7.4 MIM (Marine Information Management)

In 1996, the focus of the MIM programme was on the development of regional information networks, the development of the IOC WWW Server; on the implementation of an action plan which includes the development of a full-text CD-ROM of IOC publications, the Global Directory of Marine Science Institutions and Scientists, the MIM publication series, on the further development of the ASFISIS software and integration of information and data.

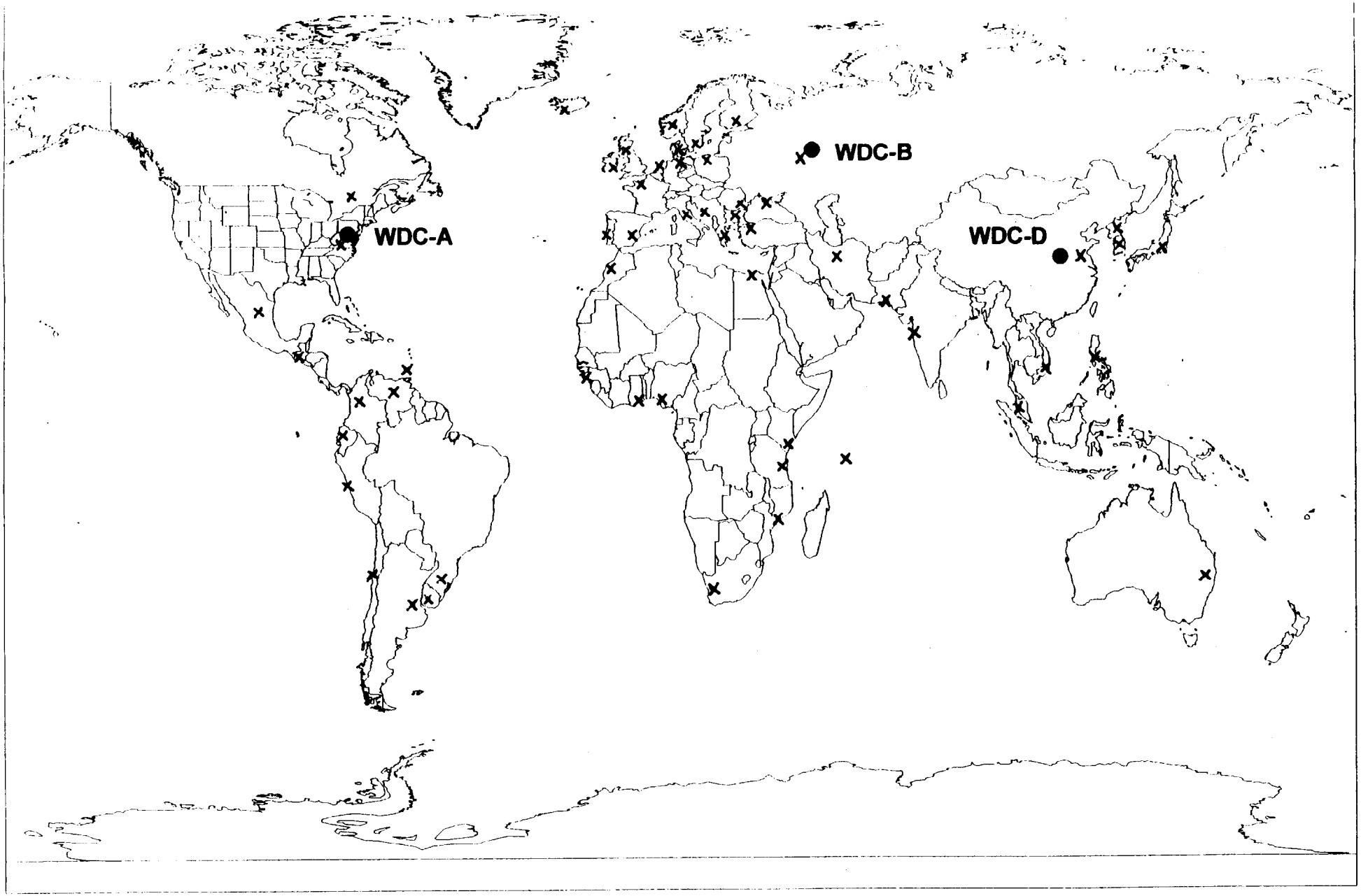
In May and August 1996, missions have been arranged to the IOCINCWIO region countries with a view to develop a regional maritime data management network. The project similar to the RECOSCIX-WIO is under development for Western African countries. Started in September 1995, the development of the WWW has been accelerated in 1996. The server was completely revised and became operational from February 1996. In 1996, the development concentrated on user-oriented products. Between 1 January and 30 November 1996, the IOC WWW server received 64,245 visits (Figure 6: *IOC Webserver Statistics 1996-1996*). In November 1996, the WWW by e-mail was established to provide the following services to users: ocean pilot - a quick reference to find WWW servers; ocean experts directory; on-line IOC publications service; IOC list of acronyms, etc.

The IODE has continued its active involvement in ASFA by participating in the 1996 ASFA Board and by providing support to the countries which were accepted as new ASFA input centres. Within the ASFA Reference Series, the ASFA-2 Guide on "*Subject Categories and Scope Descriptors*" was published in 1996.

7.5 New Data Types

While IODE is well placed to address many of the requirements resulting from different IOC programmes activities, it recognizes the need to improve its capabilities to manage and exchange a much wider range of marine parameters. IODE and IGOSS developed a joint data and information management strategy in support of GOOS which was approved by the Second Planning Meeting of I-GOOS in Washington, May 1996. In this document, the necessary attention was given to the need for data from coastal areas, for biological and remote-sensing data. To meet the requirements of GIPME, OSLR and the IOC Marine Biodiversity Strategy, the Workshop on Marine Chemical and Biological Data Management took place in Hamburg, Germany from 20-24 May. The deliberations of the Workshop have been included in the Workshop Report N°. 122 published in the IOC Workshop Report Series. The volume of the proceedings was widely distributed.

The fundamental question of the IODE implementation is facilitating regional co-operation and capacity building. A number of regional workshops, missions and training activities have been implemented in 1996, including those in Africa, South America and South-east Asia.



X = NODC/DNA

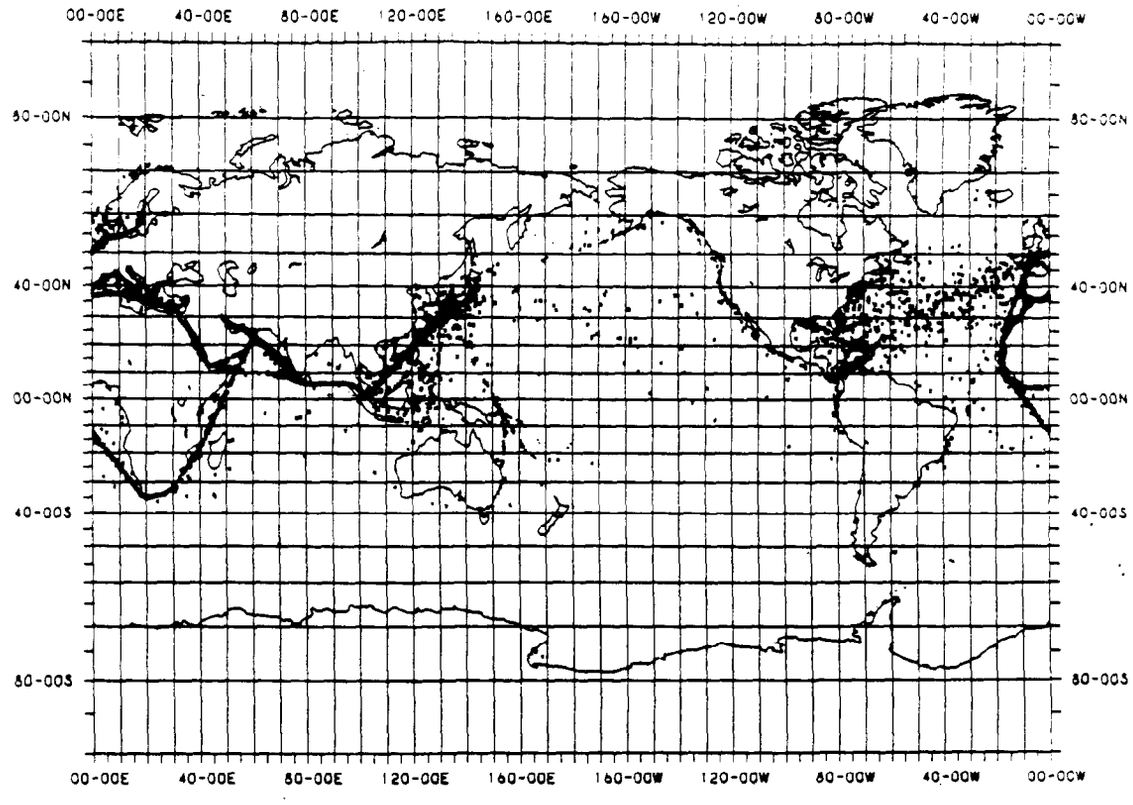
Figure 1

DISTRIBUTION OF IODE DATA CENTRES AS OF JANUARY 1997

Figure 2

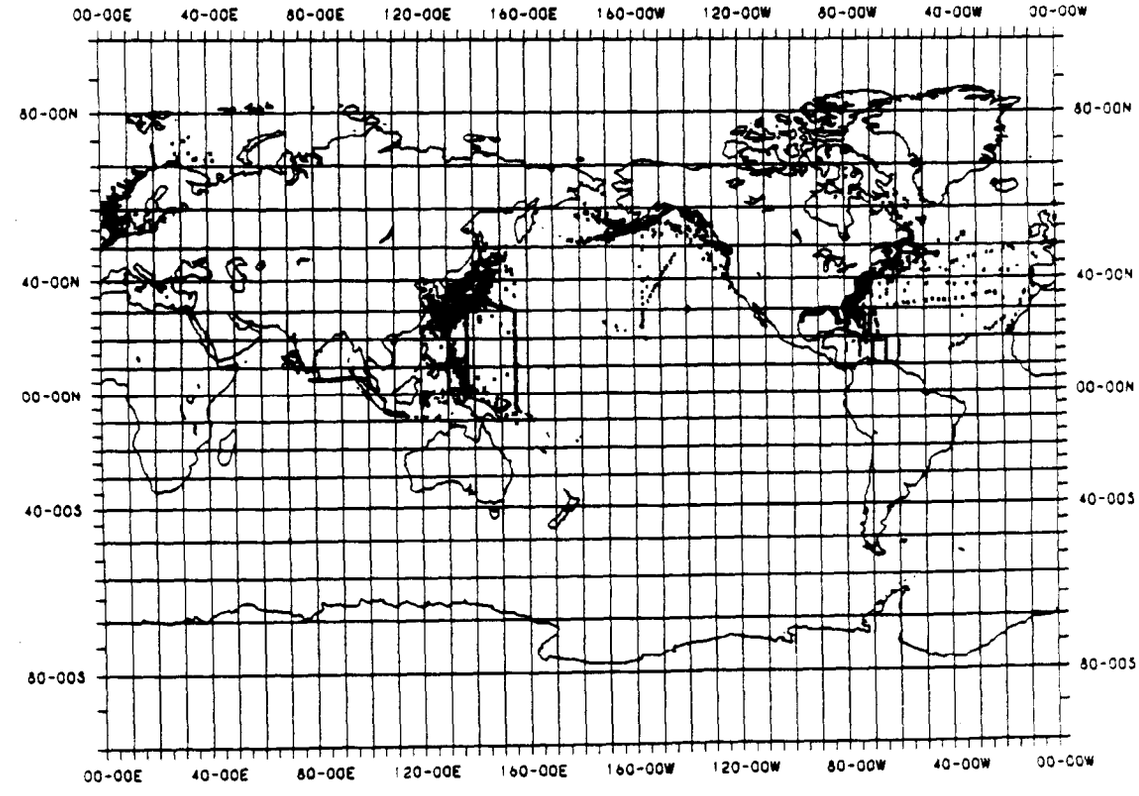
Existence Spots for MARPOLMON Oil Slick for 1975-1996

Number of all observations : 6,805

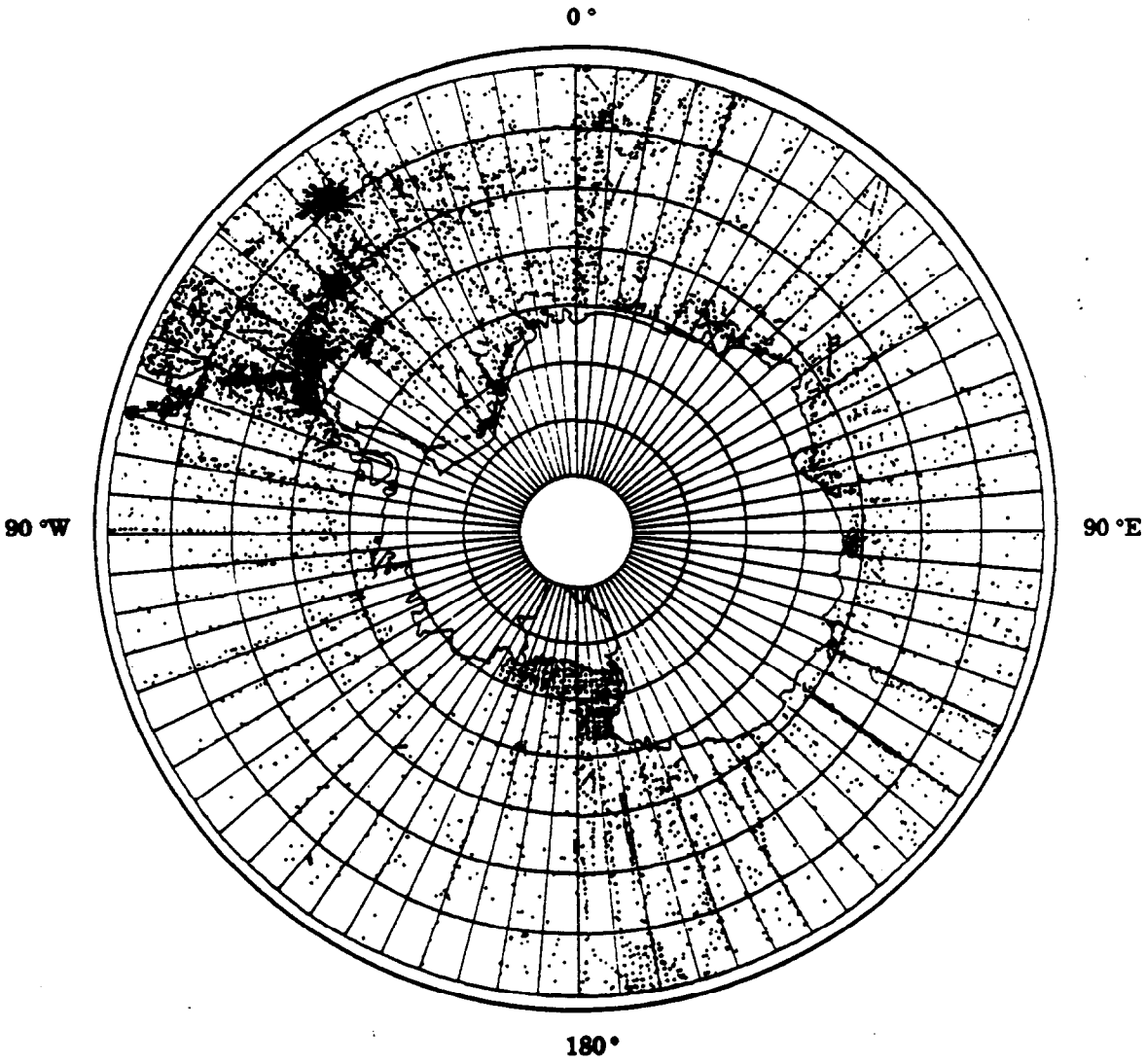


All Observation Points for MARPOLMON Tar Ball for 1973-1996

Number of all observations : 11,754

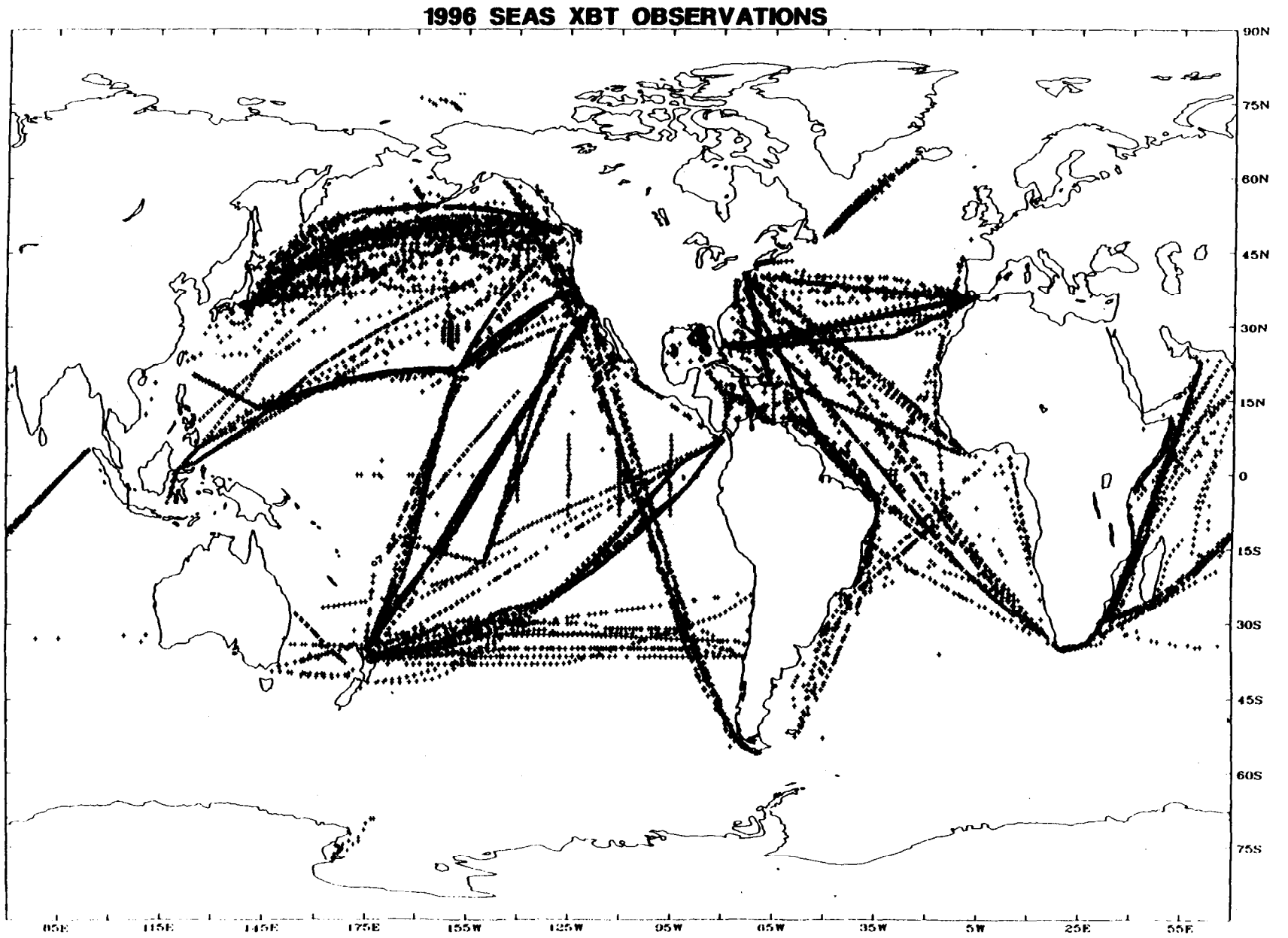


SOUTHERN OCEANS
OCEANOGRAPHIC STATION PLOT

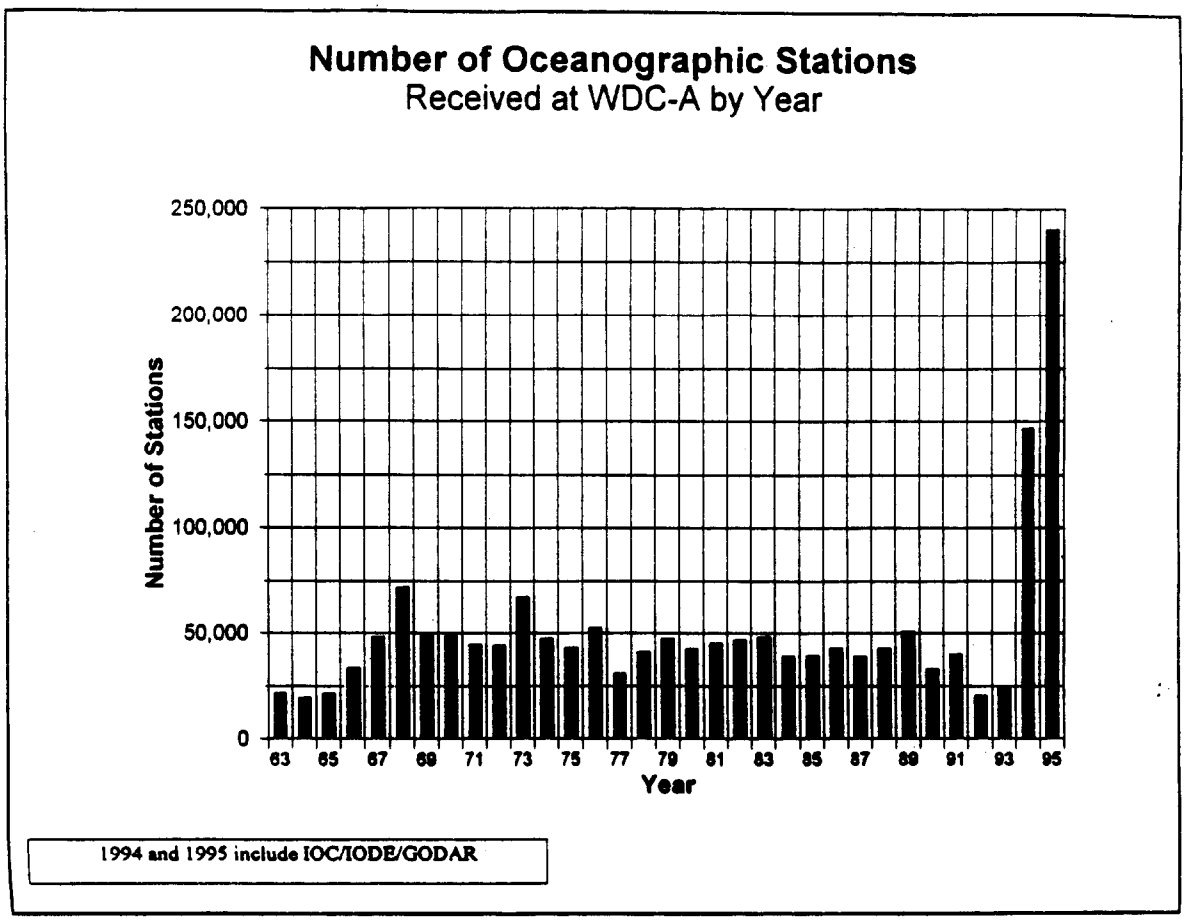


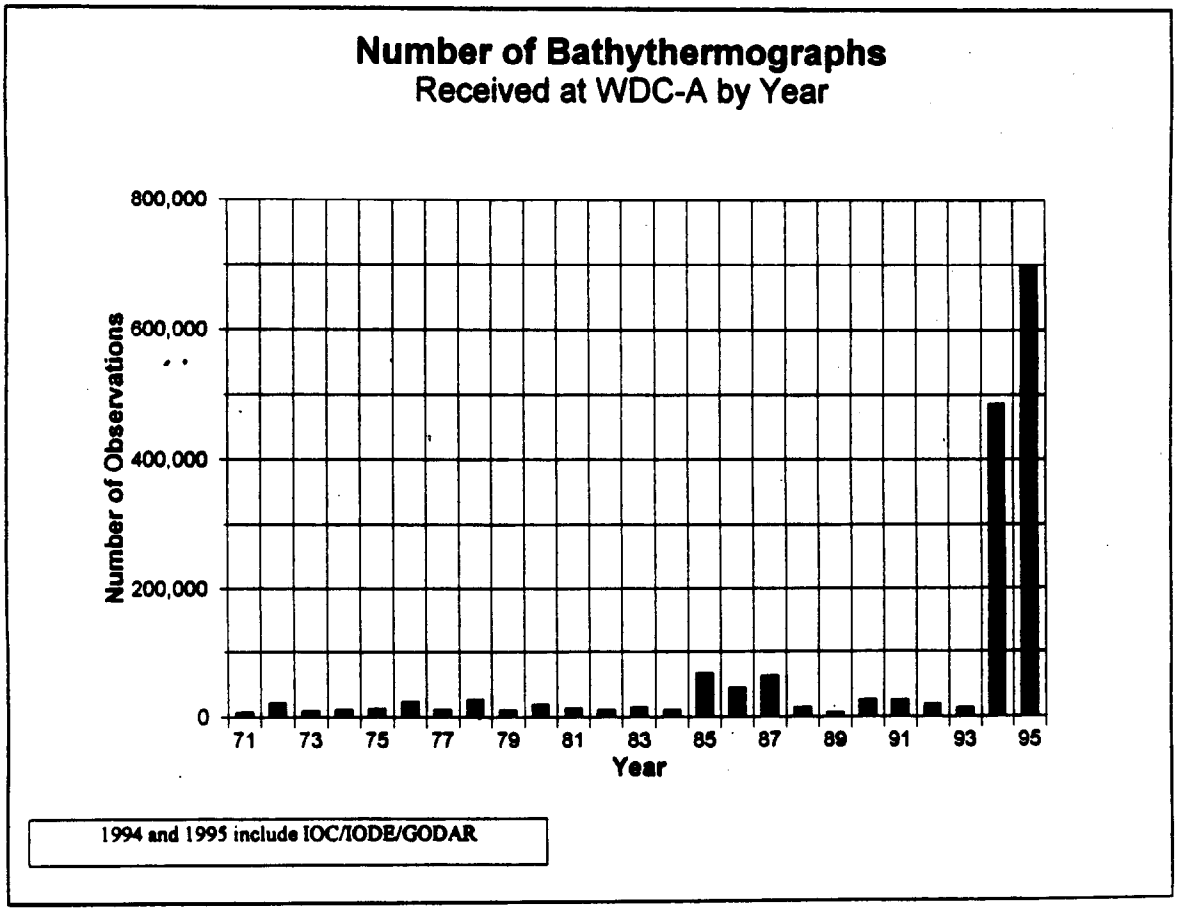
This plot shows the locations of 13,919 oceanographic data observations made in the Southern Oceans and registered in the RNODC/SOC master data file.

Figure 4



Annual Summary SEAS Programme Data 1996

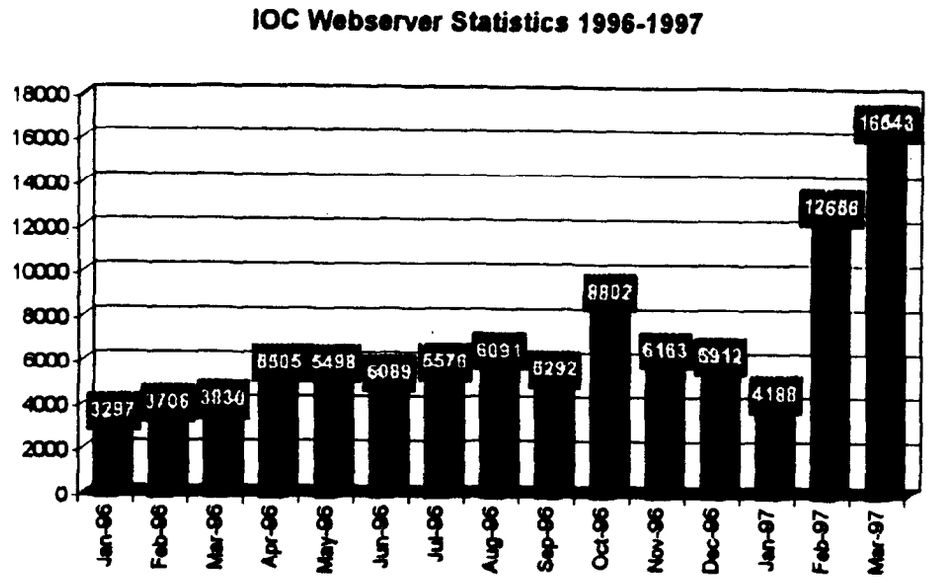




WDC-A, Oceanography Catalogue of Data and Report of Data Exchange, 1994 - 1995

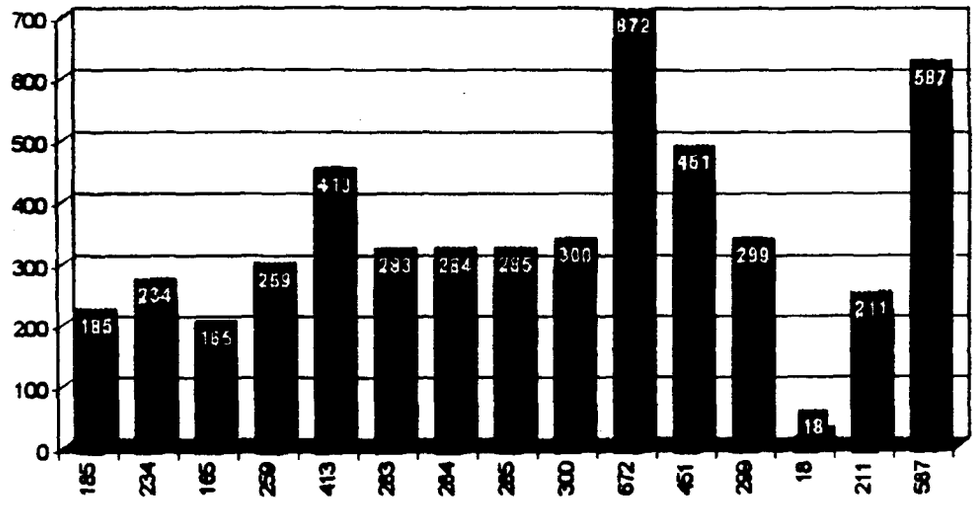
Figure 6

IOC WEBSERVER STATISTICS 1996 - 1996 (Total)



OCESERV INCLUDING IODE (Only)

IOC Webserver Statistics 1996 - 1997



8. GLOBAL CORAL REEF MONITORING NETWORK (GCRMN)

8.1 Background

The health of coral reefs, one of the most dramatic, diverse and productive living systems on earth, is in serious decline. Globally, best estimates suggest that about 10% of coral reefs are already seriously degraded, many beyond recovery, and another 30% are likely to decline further within the next 20 years. At least two-thirds of the world's coral reefs may collapse ecologically within the lifetime of our grandchildren, unless we implement effective management of these resources as an urgent priority.

Coral reefs are distributed throughout the tropical and sub-tropical waters of the world, mostly in developing countries. They support some of the highest levels of biological diversity in the marine environment and form an important basis for sustainable development. Millions of people around the world depend on coral reefs for their food and livelihood, particularly subsistence communities.

Coral reef degradation results principally from human activities. These include destructive fishing practices and overfishing, inappropriate coastal development, poor land use practices, and the discharge of human and industrial wastes into near shore waters. Global climate change may impose new stresses on reefs, such as changes in the frequency and severity of storms and floods, and increased seawater temperatures. Most worrying is that global climate change may interact synergistically with direct human impacts to accelerate degradation.

Information on the health of coral reefs and their social, cultural and economic values is critical to their conservation and sustainable use. Unfortunately, this knowledge is absent in most cases. Therefore, there is an urgent need to increase our efforts to assess and monitor coral reefs at national, regional and global levels on a sound scientific basis. This need has also been identified as a priority in the International Coral Reef Initiative (ICRI) Framework for Action and through ICRI regional workshops. Responding to this need will require a framework and mechanism to link resource managers, stakeholders and scientists into networks for the collection, dissemination and use of assessment and monitoring information.

In 1996 IOC, UNEP and IUCN agreed to form a partnership to develop a Global Coral Reef Monitoring Network (GCRMN) in response to the evident need for data and information to support coral reef conservation and sustainable use.

8.2 GCRMN Development and Objectives

8.2.1 Setting Up of the GCRMN

The first attempt to develop a global coral reef monitoring system was made through a partnership between the United Nations Environment Programme, the Intergovernmental Oceanographic Commission, the World Meteorological Organisation and the World Conservation Union in 1990 in developing the UNEP, IOC, WMO and IUCN Long-Term Global Monitoring System of Coastal and Near-Shore Phenomena Related to Climate Change. During the 7th International Coral Reef Symposium in 1992, many national institutions expressed their wish to participate in a pilot coral reef monitoring activity.

In December 1994, several countries launched the International Coral Reef Initiative (ICRI) introduced by the United States of America at the SIDS Conference (Barbados, May 1994). In 1995, the 18th Session of the IOC Assembly endorsed the ICRI all to Action and Framework for Action and decided to support the establishment of a Global Coral Reef Monitoring Network (Resolution XVIII-12).The IOC Assembly considered that the GCRMN has the potential to be a significant component of the coastal module of GOOS and emphasised the need to improve interactions between the GCRMN Coordinator and I-GOOS and J-GOOS in order to define the potential contribution of this network to the GOOS Coastal Module. UNEP and IUCN have agreed to co-sponsor the GCRMN development. The strategies for developing the GCRMN were

reviewed at the 8th International Coral Reef Symposium in 1996. This has resulted in this GCRMN Strategic Plan.

8.2.2 Objectives of the GCRMN

i. improve the conservation, management and sustainable uses of coral reefs and related coastal ecosystems for peoples of the tropics and the world through assessing the trends in biophysical status and social, cultural and economic values of these ecosystems;

ii. provide individuals, organisations and governments with the capacity to assess their coral reef resources within a global network to document and disseminate data on reef status and trends.

The GCRMN will contribute to the implementation of Chapter 17, Agenda 21 and other international conventions and programmes, particularly the Convention on Biological Diversity, the Global Programme of Action for the Protection of the Marine Environment from Land-Based Activities, and the IOC-WMO-UNEP-ICSU Global Ocean Observing System (GOOS).

8.2.3 International Coordination Mechanism

In 1996, the GCRMN Co-ordinator position was established and Dr Clive Wilkinson appointed as the coordinator, thanks to the financial contribution by the Government of the USA to the IOC Trust Fund, as well as the support provided by the Australian Institute of Marine Science (AIMS) and IOC. The GCRMN International Co-ordinator office is shared between two institutes: the Australian Institute of Marine Science (AIMS) and the International Center for Living Aquatic Resources Management (ICLARM) of Philippines.

The GCRMN Management Group and the IOC-UNEP-IUCN Scientific and Technical Advisory Committee (STAC) were established in 1996. GCRMN Management Group provides high level policy, political and strategy advice. The Group consists of representatives of IOC, UNEP, IUCN, AIMS, ICLARM, ICRI and ex officio the Chair of STAC. The GCRMN Co-ordinator acts ex officio as the Group Secretary. The STAC chaired by Dr. Bernard Salvat, consisting of 20 members, provides scientific and technical advice to the sponsoring agencies, regional organisations and governments on GCRMN development and implementation.

8.2.4 GCRMN Strategic Plan

The GCRMN Strategic Plan was prepared by the Co-ordinator with considerable advice from the Management Group and STAC. The Methods Manual for the GCRMN is currently being reprinted by AIMS and GCRMN Monitoring Protocols are now being reviewed to implement these methods in different countries with markedly different reef structures and cultures. A set of methods for gathering socio, cultural and economic data are being developed through collaboration between IUCN, UNEP, ICLARM and IOC.

8.2.5 Coral Reefs Database- Reefbase

ICLARM (International Center for Living Aquatic Resources Management) in Manila maintains a large database for coral reefs, Reefbase, which will be used as the receiving database for summary data from the GCRMN Nodes throughout the world. Data in this database will be used to prepare annual summaries of reef status and major reports every two years to coincide with international meetings. The first major global report is scheduled for September, 1998 in time for the International Tropical Marine Environment Management Symposium, in Townsville late 1998. ICLARM also provides assistance to the GCRMN, particularly on the assessment of socioeconomic parameters of coral reef use and understanding.

8.3 Status of GCRMN Regional Nodes (April 1997)

Middle East Region: The first ICRI Technical Workshop, was held in Aqaba, Jordan, 15-17 December 96 with representatives of Egypt, Israel, and Jordan. The GCRMN was represented by Dr Emre Turak. An ICRI Regional Workshop for the Red Sea and Gulf of Aden is scheduled for September, 1997. The Workshop is being coordinated by the Government of Jordan and NOAA, USA.

Western Indian Ocean - Eastern African States Region: The ICRI Regional Workshop, Seychelles (March-April 1996) was attended by 8 Indian Ocean countries. The Workshop decided that there would be 2 GCRMN Nodes: Mauritius, hosted by the Indian Ocean Commission, for Western Indian Ocean island states; and Kenya, hosted by Kenya Marine Fisheries and Research Institute, for Eastern African States. A GCRMN temporary Coordinator, Dr. Alain Jeudy de Grissac, was appointed under the European Union Regional Environmental Programme to Mauritius. He visited Comoros, Madagascar, Mauritius, Seychelles and provided training on coral reef monitoring for 20 people; the contract has since ended. Methodology and approaches for the GCRMN were discussed at a Western Indian Ocean Coral Reef Workshop organised by UNEP in Mombasa, Kenya, 25-29 February 1997. Sweden has appointed an assistant to UNEP, to assist activities in this region.

South Asia Region: SACEP (South Asia Co-operative Environment Programme) in Colombo was designated as the ICRI Node for South Asia at the ICRI Regional Workshop, held in Maldives in November 1995. The Workshop was attended by all 5 countries of the region and observers from another 5 countries. Negotiations are under way between IOC and the Overseas Development Administration (ODA) of UK to appoint an Associate Professional Officer (Mr Jason Rubens) to develop the GCRMN in this region with initial emphasis on Sri Lanka, India and Maldives. The ODA has agreed to provide adequate operational funds for initial training and monitoring. IUCN will host the stationing of the regional coordinator in Colombo, Sri Lanka along with the IOC.

East Asian Seas Region: The ICRI Regional Workshop in Bali, Indonesia, March 1996, attended by 11 Asian countries and 3 observing nations, endorsed the establishment of the GCRMN in this region. A Second ICRI Regional Workshop, held in Okinawa, Japan, 16-20 February 1997, resolved that many countries had excellent capacity for monitoring and database activities and would, therefore, become GCRMN Nodes and maintain their own databases. An urgent need was identified to provide training to Myanmar, Cambodia and Vietnam to bring them up to the monitoring capacity of countries in South East Asia. Neighbouring ASEAN countries offered to co-ordinate this training, which will require an input of funding. There was a similar need to provide training to North Asia with the establishment of a coral reef centre in Okinawa by Japan as probable location for this training and coordination. The East Asian Seas/Regional Coordination Unit of the UNEP offices in Bangkok was reaffirmed as the coordination node for ICRI activities, including the GCRMN. The ENRIN data base, managed by UNEP, was regarded as the suitable repository for regional summary data to prepare GCRMN annual summaries through cooperation with partner countries. It was suggested that the activities in the region should be coordinated through COBSEA (Coordinating Body on the Seas of East Asia) and non-member countries were urged to consider COBSEA membership.

Pacific Region: The ICRI Regional Workshop, Fiji (November 1995), attended by 21 Pacific countries, agreed on the need for the GCRMN. The ICRI Regional Node, designated as SPREP in Apia, Western Samoa, is inviting country participation and suggestions for GCRMN functional Nodes. An offer has been made by the President of French Polynesia for a Polynesian Node. The Governments of Japan and the USA are cooperating with the Government of Pilau to construct the Pilau Coral Reef Conservation and Research Center. This center is considered as a possible Node location for the North West Pacific. The University of the South Pacific in Fiji is investigating the hosting of a node for the South West Pacific. The Pacific Science Inter-Congress and IYOR meeting in Fiji (July 1997), will be used to confirm major GCRMN decisions on Node sites and investigate funding possibilities.

Tropical Americas - Caribbean Region: The ICRI Regional Meeting in Jamaica (July 1995), attended by 32 countries, endorsed the ICRI coordination role for the UNEP RCU, headquarters in Jamaica. An important

role for CARICOMP was indicated in this region. The GCRMN was discussed at a CARICOMP meeting in Cancun, Mexico in November 1996. France and UK expressed an interest in establishing a GCRMN Node in the Leeward and Windward Islands based around St Lucia, and possibly Montserrat. Strong interest has been shown for the Pilot Monitoring Project by people monitoring reefs in some smaller states and islands. GCRMN will be further discussed at a Meeting of Association of Marine Laboratories of the Caribbean (CIMAR) in Costa Rica in July 1997.

8.4 GCRMN Pilot Monitoring Project

The Pilot Project to assess a series of reefs between March and September was launched via the Internet in October 1996, and now has approximately 50 institutes or individuals participating: Middle East - 5; Western Indian Ocean/Eastern Africa - 2; South Asia - 3; East Asian Seas - 13; Pacific - 10; Tropical Americas/Caribbean -15. Database structures are available over the Internet. This Pilot Project has generated considerable interest in the GCRMN with many more inquiries. Communication is active with volunteer projects (Reef Check, Hong Kong; AQUANAUT, Philippines; Reef Watch and Eye on the Reef, Australia) to coordinate activities and avoid potential overlaps during 1997, the International Year of the Reef.

8.5 Appraisal

GCRMN Node arrangements have been finalised for 3 regions (South Asia, Western Indian Ocean-Eastern African States and East Asian Seas). Funding is currently adequate to initiate the GCRMN in South Asia and monitoring training and field work is under way for the other two. Arrangements and funding to initiate nodes or coordinate existing monitoring for the other three regions should be decided within the next 5 months of 1997. Currently, GCRMN coordination on global and regional levels is financially supported by USA, Australia, UK and sponsoring agencies (IOC, UNEP and IUCN). Other donor countries and organisations are requested to assist by providing seed money to support coordination and initiate the GCRMN through training and database operations. To facilitate this, closer interactions should be established between the GCRMN and the GOOS mechanisms (I-GOOS and J-GOOS) to provide data for the management and conservation of reefs at a global scale.

9. GOOS REGIONAL APPROACH

9.1 NEAR-GOOS

NEAR-GOOS (North East Asian Regional GOOS), is the first official pilot project specifically designed to meet GOOS objectives. The participating countries are China, Japan, the Republic of Korea and the Russian Federation. The concept is to create a small pilot version of the global system for oceanographic observation to test the feasibility of GOOS.

The planning of NEAR-GOOS started in 1993 with Resolution 57 at the 27th Session of the General Conference of UNESCO, which called on the IOC to establish a GOOS regional pilot activity in North East Asian region. Following encouraging discussions at the Expert Meetings in Beijing in 1994, in Bali in 1995 and in Bangkok in 1996, an NEAR-GOOS Implementation Plan was adopted at WESTPAC III in Tokyo in 1996. The NEAR-GOOS Coordinating Committee, which is composed of representatives of the participating countries, was established for periodic review of the implementation of the over all system.

The NEAR-GOOS region (Figure 1) is one of the most densely and frequently surveyed areas in the world. Therefore, it has been recognized that the first step of NEAR-GOOS should be the establishment of an efficient data exchange scheme for existing observations to be able to produce maps and forecasts of oceanographic conditions similar to those produced by meteorological communities. In the initial phase, NEAR-GOOS efforts are focused on the exchange of observational data which have already been collected but have not been exchanged. In response to the endorsement of the 29th Executive Council of the IOC, data within the region began to be exchanged within the NEAR-GOOS system in October 1996.

The initial goals of NEAR-GOOS are:

i. improve ocean services in the region,
ii. to provide data and information useful in the mitigation of the effects of natural disasters caused by waves, storm surges, and sea-ice,
iii. to increase the efficiency of fishing vessels,
iv. to provide information useful in pollution monitoring,
v. to monitor parameters useful to mariculture, particularly with regard to harmful algal blooms,
vi. to provide information on the health of the coastal zone for recreation purposes,
vii. to provide data sets required for data assimilation, modeling and forecasting.

Operation of NEAR-GOOS

An NEAR-GOOS Operation Manual was prepared by the NEAR-GOOS Coordinating Committee in September 1996. The Operation Manual defines, in detail, the operation of NEAR-GOOS system. It is available on the World Wide Web http://www.goos.kishou.go.jp/subpages/manual.html.

Oceanographic data and relevant products generated by NEAR-GOOS are available at no cost to registered users through the Internet. NEAR-GOOS works as shown in the diagram (Figure 2). It has two databases; one is a real-time database (RTDB) for daily mapping of sea conditions. It is run by the Japanese Meteorological Agency (JMA). Users transmit data to the RTDB through the WMO's Global Telecommunications Service (GTS) or through the Internet. The other is a delayed mode database (DMDB) for archiving data; it is run by the Japanese Oceanographic Data Centre (JODC), which is the Responsible National Oceanographic Data Centre (RNODC) for IGOSS for WESTPAC. Data are transferred from the RTDB to the DMDB after 30 days. Associated Databases may be installed to facilitate the data exchange by participating countries. The oceanographic data for NEAR-GOOS will be temperature, salinity, currents, waves, sea-level, dissolved oxygen, nutrients and other hydrographic elements. Initially the operation has started with basic oceanographic variables such as temperature, salinity, currents, and waves. To ensure the security and to maintain effective utilization of the data bases, user registration is required.

A first result of the operation is likely to be a rapid increase in data reports, and a considerable improvement in ocean services for the benefit of users. Once an efficient data collection and exchange system has been demonstrated, the capabilities of NEAR-GOOS will be expanded by improving spatial and temporal resolution and quality assurance. A long term objective is to expand the operational system to the entire WESTPAC area.

As a contribution to capacity building, a NEAR-GOOS Data Management training course will be held for WESTPAC countries in Japan, October 1997. The training course will be focused on dissemination of technical knowledge and skill of acquisition, processing, compilation and exchange of oceanographic data.

More information about NEAR-GOOS may be obtained from the NEAR-GOOS homepage on the World Wide Web http://www.unesco.org/ioc/goos/neargoos.htm.

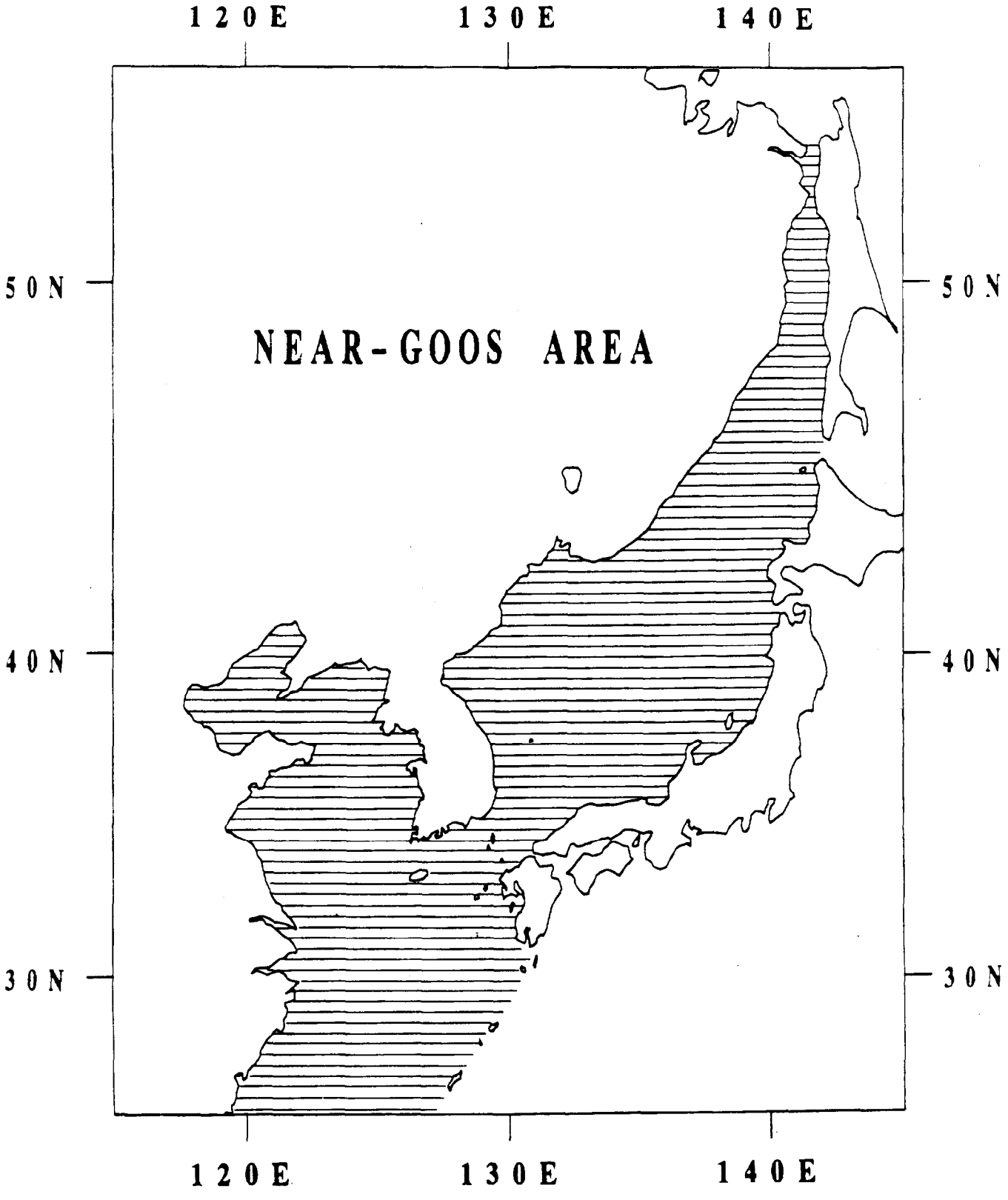
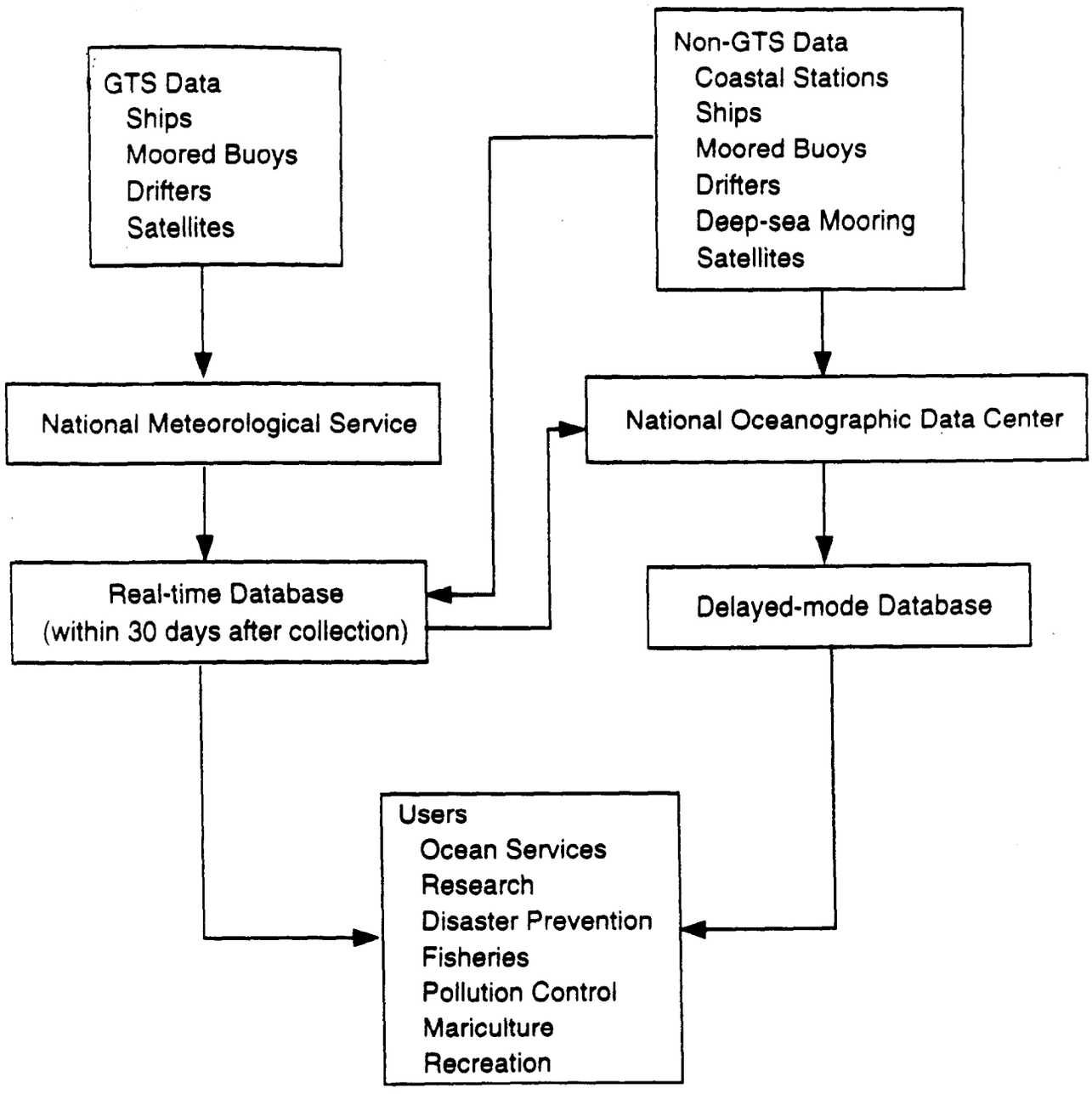


Figure 1



NEAR-GOOS Data Flow

Figure 2

9.2 EuroGOOS

EuroGOOS was founded in December 1994 in Rome, and held its second Annual Meeting in Dublin in November 1995. The aims of EuroGOOS are:

- Identify European priorities for operational oceanography.
- Promote the development of scientific technological and computer systems for operational oceanography.
- Assess the economic and social benefits of operational oceanography.
- Establish a concerted European approach to the planning and implementation of the Global Ocean Observing System.
- Establish methods of routine collaboration between European national and multi-national agencies for the conduct of operational oceanography.

During the year 1995-96 EuroGOOS established its structure and subsidiary bodies, held technical meetings, organized a large conference, and started a series of practical projects.

The EuroGOOS Science Advisory Working Group (SAWG) and the Technology Plan Working Group (TPWG) have identified priorities for collective initiatives by Members, bringing EuroGOOS to the point where field trials and pilot projects can be designed by Members and funded. The Regional Task teams have developed projects to create operational forecasting systems at the sub-European scale. Work has started on plans for projects at the Atlantic and global scale. The Strategy for EuroGOOS and the EuroGOOS Plan have been published. The EuroGOOS Conference, organized and hosted by RIKZ, Netherlands, was a major achievement for 1996. Other publications and workshops are in the planning stage.

During the year 1996 EuroGOOS has completed the following actions:

- Complete the Oceanography Technology Survey and publish the statistics
- Write and publish the Strategy Report
- Visit the EU-EC Brussels and establish the ground rules for contacts with EC-DGs
- Set up the Regional Seas Test Case Task Teams
- Start collaboration on Atlantic and global marine forecasting
- Organise a Conference at European level, and publish proceedings
- Improve assessment of customer base
- Start the Ferry Box group, with assessment of funding options
- Contact other Euro-organizations, OECD, Euromar, Eumetsat, ICES, etc.
- Expand membership
- Put EuroGOOS Handbook on Internet
- Publish EuroGOOS Plan

The Strategy for EuroGOOS

The Strategy for EuroGOOS was requested by decision of the Annual Meeting in November 1995. The outline was prepared by a meeting of the Officers in January 1996, and Members then contributed to three draft editions of the Strategy. The final version was prepared for the Conference of EuroGOOS at the Hague in October 1996. At the Conference it was distributed to the 230 participants, and was discussed in EuroGOOS committees and in open Panel sessions. There was a general and strong support for the Strategy both in the working sessions and committees of EuroGOOS Members, and in the open Panel Sessions. Eight hundred copies have been provided to Member Agencies. The Strategy will be used as the basis for the EuroGOOS Plan.

The following ten points are identified by EuroGOOS Strategy as major sectors of activity:

1. Identification of EuroGOOS customers

2. Estimation of benefits from operational oceanography
3. Scientific basis of EuroGOOS
4. Technology for EuroGOOS
5. Trials, test, pilot projects, and case studies
6. Operational design, and optimum structure of an observing system
7. Numerical modeling
8. Products and deliverables
9. Global dimension and capacity building
10. Links to other European agencies.

The achievements in each Sector are summarized below:

1. Identification of EuroGOOS Customers

Data requirements surveys have been carried out in UK, Greece and Italy, using a standard survey procedure. Modified surveys have been carried out in Ireland and the Netherlands. France and Spain have translated the questionnaire, but not yet circulated it. The Technology Survey has also produced evidence of those parameters which customers need in operational mode. There is now a strong basis for listing the priorities of data requirements, and the accuracy and resolution needed.

2. Estimation of benefits from operational oceanography

Several papers at the EuroGOOS Conference dealt with this subject. A study group has been set up to analyze standard methods for measuring and comparing statistics on maritime industries and the benefits from them across Europe. The provisional estimate of the GNP benefit to Europe is in the range 2-5bn ECU per year. These figures need refining.

3. Scientific basis of EuroGOOS

The scientific basis of EuroGOOS is defined by the Science Advisory Working Group (SAWG). The meetings in Brighton and the Hague listed the sections needed for a Science Plan document, which could be blended into the EuroGOOS Plan in 1997. A workshop on data assimilation was held on 10 October at the end of the EuroGOOS Conference. A paper on the limits of predictability has been prepared. The requirement for standardized high resolution bathymetry for the whole European area was discussed at the Mediterranean Task Team Meeting in Madrid, September 1996, and by the NW Shelf Task Team. This will be implemented in 1997.

WOCE has entered its modeling and analysis phase, which will continue to 2001. CLIVAR is now starting as a global science project. The design and gradual implementation of EuroGOOS and GOOS must be linked to these activities. Meetings of the SAWG to draft sections of the EuroGOOS Science Plan were held on 10 December 1996 and 29 April 1997.

4. Technology for EuroGOOS

The Technology Plan Working Group (TPWG) met at Brighton on 6 March 1996. The Operational Oceanography Technology Survey has been almost completed, with a draft final report circulated for comment at the TPWG Meeting on 7 October 1996. The survey forms were distributed in late 1995, and a sub-set of the replies were partially analyzed for the OI96 Conference in March 1996. The decisions made at the TPWG Meeting on 6 March 1996 resulted in a data base design being completed, and the data entry being carried out by staff of the Environmental Agency (UK). Data base queries and detection of errors and anomalies were carried out. The draft report will be revised in the light of comments, and published as a EuroGOOS publication. The text and tables of the Report will be put on line on the EuroGOOS Web page. The full data base can also be made available electronically, or on disc, subject to decisions on confidentiality.

The TPWG met in October 1996, and is now working on its contribution to the EuroGOOS Plan.

5. Trials, pilot projects, and case studies

Actions during 1996-1997 have led to preparation of a number of draft proposals covering various interests and objectives of EuroGOOS. Many of these are in early stages of drafting, and it would not be appropriate to summarize them here. Those projects which have either been developed by EuroGOOS corporately, or by a small number of EuroGOOS Members wishing to be identified as linked to EuroGOOS, are listed in the EuroGOOS Plan.

6. Operational design, optimum structure of an observing system

This is an aspect of EuroGOOS work which is starting now. The Mediterranean Forecasting System is planned on a 10-year time scale, and optimization of design is implicit. The practice of operational modeling and forecasting in the Baltic already includes assessment of the best way to develop and improve the system.

Priorities for EuroGOOS are likely to include sensitivity trials, and studies of the needs for special shelf-edge modeling criteria.

7. Numerical modeling

Numerical modeling is considered within the SAWG as a scientific, mathematical, and physical subject. In the TPWG it is regarded as an engineering and operational activity. Actions during the last 12 months include:

- Preparation of a paper on limits of predictability in shelf seas modeling
- Inclusion of papers on modeling in the EuroGOOS Conference
- Holding a meeting on data assimilation, 10 October 1996
- Collecting information on all models used in the North West Shelf Seas
- Including operational models in the EuroGOOS Technology Survey
- Discussions with ESF-EMaPS on limits of predictability

8. Products and deliverables

The Technology Plan Working Group Technology Survey lists a wide range of information products presently delivered by EuroGOOS Members. The ongoing survey of customers and requirements will provide further information in a more structured way.

9. Global dimension and capacity building

The Director of EuroGOOS presented reports to the 2nd I-GOOS Planning Session in Washington in May 1996, and to the IOC Executive Council on 26 September 1996. He also chaired the J-GOOS Workshop on Coastal GOOS in February 1997, and attended J-GOOS IV in April 1997. There are three topics of particular importance:

- Aid, technology transfer, and capacity building
- Global modeling and participation in global GOOS.
- Regional GOOS projects.

9.1 Technology transfer and capacity building

This subject was included as a theme in the EuroGOOS Conference. Participants were funded from developing countries to attend the Conference. EuroGOOS set up a Study Group for Capacity Building at

its Plenary Meeting on 7 October 1996.

9.2 Global modeling and participation in Global GOOS

There is a need for EuroGOOS to develop its policies and actions on global modeling. All states with Members in EuroGOOS are Members of IOC, and many of the people active in EuroGOOS also act as delegates to IOC meetings. Four Members of EuroGOOS are also Members of J-GOOS. The Director of EuroGOOS acted as Rapporteur for the meeting of the Living Marine Resources Workshop, reporting to J-GOOS. The Workshop was sponsored by SCOR. The Director of EuroGOOS was Chairman for the first meeting of the Coastal Module Workshop of GOOS in Miami in February 1997. At the EuroGOOS Annual Meeting on 9 December 1996 the meeting decided to convene a workshop on Atlantic scale modeling for GOOS and EuroGOOS applications.

9.3 Regional GOOS projects

Two years ago the countries in North-East Asia (Japan, Russia, Korea, China) started discussion at an agency level with a view to establishing a GOOS Region. Meetings have been held within the framework of IOC-WESTPAC, and the North East Asian Region of GOOS has been established (NEAR-GOOS). EuroGOOS is working closely with representatives of NEAR-GOOS and the Director of EuroGOOS will attend a NEAR-GOOS meeting in May 1997.

10. Other European Agencies

At the time of the last Plenary, November 1995, ESA and EUROMAR were Observers of EuroGOOS. IOC and ICES have reciprocal Observer status. During 1996 the Secretariat has corresponded with EEA, OSPARCOM, Eumetsat, SACLANT Laboratory, JRC-Ispra, ECMWF, and OECD. In July 1996 Officers of EuroGOOS visited DG-VII, DG-XII, and DG-XIV, and COST in Brussels. Meetings have been held with representatives of ESF-EMaPS. Contacts will be strengthened with HELCOM. SACLANT Laboratory, La Spezia was recognized as an Observer at the Annual Meeting on 9 December 1996.

10. RESEARCH AND MONITORING PROGRAMMES RELATED TO GOOS

10.1 Harmful Algal Bloom Programme

The HAB Programme Office at the IOC Secretariat was staffed with one Associate Expert seconded by Denmark, whose assignment ended in May 1996. From May onwards the Harmful Algal Bloom programme was mainly implemented through the IOC Science and Communication Centre on Harmful Algae, which was established at the University of Copenhagen in 1995. As from the second quarter 1997 the HAB Programme Office will receive an Associate Expert seconded by Denmark.

The major achievements of the Programme were:

i association with and support of the SCOR-IOC NATO Advanced Study Institute on the Physiological Ecology of Harmful Algal Blooms, Bermuda Biological Station, 27 May - 6 June 1996. The workshop assessed our understanding of the fundamental physiological and ecological issues underlying harmful algal events, identified inadequacies, impediments, and advanced and disseminated new approaches and technologies. The workshop had 80 participants. Proceedings will be published by NATO. The workshop resulted from activities of SCOR-IOC Working Group 97;

ii agreement with the Spanish Institute of Oceanography (IEO) on the establishment of a Science and Communication Centre on Harmful Algae at the IEO Oceanographic Centre in Vigo, Spain. The activities of the HAB Centre in Vigo are directed towards assisting countries in Latin America and the Caribbean in their research and training endeavors on harmful algal blooms. The Centre in Vigo started its operations in October 1996;

iii consolidation of services and activities at the IOC Science and Communication Centre on Harmful Algae, University of Copenhagen:

- development of cooperative research projects/proposals with institutions in Member States (Institute of Oceanography, NhaTrang, Vietnam; University of the Philippines; College of Fisheries, University of Agricultural Sciences, Man galore, India; Institute Agronomique et Veterinaire Hassan II, Morocco). The projects include supervision of Ph.D and M.Sc. students;
- advanced training of 35 scientists in the identification and biology of harmful algae (see below);
- progress in the establishment of a HAB bibliographic database within ASFA;
- provision of HAB Literature Grants' to libraries of marine science institutions in developing countries through which more than 1200 books were donated. Grants consist of copies of one or more key reference books.

The Annual Report of the Centre is published in the IOC Training Course Report series.

iv preparation and publication of the IOC newsletter *Harmful Algae News*;

v publishing, jointly with Tohoku University, Japan, of the Proceedings of the 7th International Conference on Toxic Phytoplankton;

vi continuation of the ICES-IOC Working Group on the Dynamics of Harmful Algal Blooms including attendance at its meeting in Brest, France, 17-20 April 1996;

vii publication of an IOC-ICES technical report presenting examples of design and implementation of harmful algal monitoring systems (IOC Technical Report No. 44);

viii establishment of an ICES-IOC-WMO Working Group on Transfer of Organisms by Ballast Water, in response to one of the recommendations of the IOC Intergovernmental Panel on Harmful Algal Blooms (IPHAB) at its meeting in 1995;

ix cooperation with the Asia-Pacific Economic Cooperation (APEC). APEC has adopted a marine science programme and has invited the IOC and the Centre to help implement elements of training efforts on harmful algae aimed at APEC's developing nations. A joint IOC-APEC course is planned for May 1997, as part of the IOC-WESTPAC programme.

x obtaining extra-budgetary funding for the HAB Training and Capacity Building Programme from the Nordic Research Academy;

xi preparation of a series of slides for identification and demonstration of harmful algae. The slides are prepared by WESTPAC/HAB/ University of Tokyo, essentially for teaching purposes;

xii obtaining support from Swedish SIDA for a joint activity between the Kenya Marine Fisheries Research Institute, the Marine Science Institute, Dar-es-Salaam, Tanzania, and the IOC Science and Communication Centre in Copenhagen;

xiii preparation of a database on scientists and managers engaged in matters of toxic and harmful algae. The database is accessible at the IOC WWW and will also be made available in print version.

Two advanced training activities, attended by 35 scientists, have been organized within the IOC HAB Training and Capacity Building Programme, the TEMA component of the Harmful Algal Bloom Programme:

i The IOC/SAREC-DANIDA Regional Training Course on the Biology and Taxonomy of Harmful Marine Microplankton, University of Mauritius, 4-14 February 1996.

ii The Third IOC-DANIDA Training Course on the Biology and Taxonomy of Harmful Marine Microplankton, IOC Science and Communication Centre, University of Copenhagen, 15-26 July 1996.

Marine Biodiversity and Interaction with the Convention on Biological Diversity

Implementation of IOC Resolution XVIII-9 on Marine Biodiversity and the related work plan for the period 1995-97 is progressing. A number of decisions have been carried out and activities launched, as follows:

- Regular interaction with the Subsidiary Body on Scientific, Technical and Technological Advice (SBSTTA) to the Convention on Biological Diversity on specific needs and requirements of SBSTTA for scientific input which can be provided through IOC. IOC participated in the Second Meeting of SBSTTA (Montreal, Canada, September 1996) and used that occasion to reiterate the offer of providing input through its expertise to SBSTTA and the Conference of the Parties (COP) to the Convention. The identification of specific inputs which IOC might provide to SBSTTA and COP in the future is also being addressed within the framework of cooperation between the IOC Secretariat and the Secretariat to the Convention on Biological Diversity.

- Interaction with the International Sea Bed Authority on matters of the effects of possible future exploitation of sea bed resources and dumping on marine biodiversity, as well as discussions on the possibility for IOC to provide scientific input to the International Sea Bed Authority in this respect. The IOC Secretariat is thus developing a biodiversity component to be included into an agreement on cooperation between IOC and the International Sea Bed Authority.

- Strengthening of the links with the UNESCO Man and Biosphere Programme in order to develop joint

activities in the field of sustainable use and conservation of marine biodiversity. Cooperation between IOC and MAB is ongoing, and is also supported by the related decisions of the last session of the MAB Council. Joint IOC-MAB activities in the field of marine biodiversity, as identified in the IOC marine biodiversity work plan for 1995-97, will be implemented.

- Assistance to Member States to undertake efforts at the national and regional levels to compile inventories of their marine flora and fauna, building on existing databases, containing *inter alia* species description and figures, ecological information and distribution and economical importance. Assistance is thus provided to IOC Member States as well as to non-member states to compile inventories, in particular through the UNESCO-IOC Register of Marine Organisms project, - now available on Internet, which is progressing very successfully.

Priority has been given to the planning, organization and implementation of those activities within the IOC marine biodiversity work plan which are directly linked to the recommendations developed by the SBSTTA to the Convention. Among these, an activity on indicators appears to be of very urgent need. Discussions are going on between the IOC Secretariat and the Secretariat of the Convention on Biological Diversity on the organization of a workshop on this important subject. In the meantime, the IOC Secretariat has contacted several experts in the field for their input to the preparation of relevant background documents.

10.2 The Continuous Plankton Recorder Programme (Sir Alister Hardy Foundation for Ocean Sciences)

At the Eighteenth Session of the IOC Assembly, in Paris 13-26 June 1995, it was decided to continue support of the Continuous Plankton Recorder (CPR) Survey of the Sir Alister Hardy Foundation for Ocean Science (SAHFOS) in Plymouth, United Kingdom. The IOC supported the CPR activities with a contract of US$15,000 a year in the biennium 95/96. The survey concerns the monitoring of living resources with the aim of a better understanding of their dynamics and sustainable use. The Survey, which in the North Atlantic has been carried out since 1946, also addresses questions on the influence of climate on long term changes in the abundance and composition of phytoplankton and zooplankton and the related changes in fish stocks.

The CPR activities are now, through the work of SAHFOS, being applied to more and more areas by the use of commercial ships of opportunity. The development of Large Marine Ecosystems (LME) in the Gulf of Guinea has been closely associated with the activities of the SAHFOS and the Continuous Plankton Recorder (CPR) has been used in the Region in the development of new routes.

The "GLOBEC-IOC-SAHFOS-MBA workshop on the analysis of time series with particular reference to the Continuous Plankton Recorder Survey" has been published (IOC Workshop Report No. 124). The papers submitted at the Workshop are inclosed in the Report.

The Survey, since it has been operational for very long, provides a considerable experience in operational aspects, data handling, analyses and presentation of results.

Contact point:

Dr. P.C. Ried
Continous Plankton Recorder Survey
Sir Alister Hardy Foundation for Ocean Science
The Laboratory, Citadel Hill
Plymouth PL1 2PB, United Kingdom
Tel. + 44 1752 22 11 12

Fax. + 44 1752 22 11 35
Email. sahfos@wpo.nerc.ac.uk

10.3 Global Ocean Ecosystem Dynamic (GLOBEC)

The Global Ocean Ecosystem Dynamic (GLOBEC) Programme was in 1995 adapted as one of the Core Projects of the International-Geosphere-Biosphere Programmes (IGBP), and is co-sponsored by SCOR and IOC. The aim of the programme is to increase the general understanding of ocean ecological processes and mechanisms and to focus on how these change in time and space under the influence of physical forcing. The program focuses on zooplankton population dynamics in relation to the physical forcing of the oceans, which will bridge the gap between phytoplankton studies and predator related research and link the research to climate change perspectives.

GLOBEC includes a range of different regional and international activities such as GLOBEC Southern Ocean Program, Cod and Climate Change Program (CCC), Climate Change and Carrying Capacity (CCCC), Small Pelagic Fish and Climate Change (SPACC). Furthermore, several countries have established, or are in the process of establishing national or regional GLOBEC programmes; United States, Canada, UK, Japan, China and Mara Cognitum (Norway, Island and Faroe Islands).

Besides the main sponsors of GLOBEC, several other organizations are involved in and contributing to the development of the Program. Organizations like ICES and PICES are active in the process of developing GLOBEC regionally, participating in consultations and scientific working groups, and can be considered as regional co-sponsors of GLOBEC.

The new Scientific Steering Committee (SSC) of GLOBEC had its first meeting in Baltimore 11-13 November 1996, and an advanced version of the GLOBEC Science Plan is in press for publishing. During 1997 the SSC is expected to develop a Implementation Plan in collaboration with GLOBEC key researchers. This Implementation Plan is meant to be presented for further discussion by the international scientific community at the first GLOBEC Open Science Meeting at IOC/UNESCO in Paris 17-20 March 1998.

Contact Point:

Chairman Dr. Roger Harris
GLOBEC International
Plymouth Marine Laboratory
Prospect Place, Plymouth PL1 3DH
United Kingdom
Tel. + 44 1752 633 400
Fax + 44 1752 633 101
Email. r.harris@pml.ac.uk

10.4 Large Marine Ecosystems

The Large Marine Ecosystem (LME) concept provides a useful approach to monitoring ocean processes at a regional scale, empowering nations towards long-term sustainability of marine resources. So far forty-nine LMEs have been identified and symposiums are currently been organized by IOC in collaboration with NOAA, IUCN and UNEP to develop LME core monitoring programmes. The LME concept has now been included as one of the principal activities designated for support under the World Bank-Global Environmental Facility for the International Waters projects.

The LME concept has recognized the importance of the use of the Continuous Plankton Recorder (CPR) and sampling strategies addressing studies in large scale variability are relying on the CPR as a convenient instrument. This has lead to the use of the CPR in the Gulf of Guinea LME project and future LME core monitoring programs are considering the CPR as an appropriate tool as well. LME monitoring and assessment projects are being planned for the following areas; The Benguela Current System, Baltic Sea, South China Sea, Yellow Sea, Bay of Bengal, Canary Current and the Caribbean LME.

An international consultative meeting on Large Marine Ecosystems was held at IOC in Paris 23-24 January 1997 to discus the developments of LME and how to proceed with the future activities. Representatives from several international organization discussed together with marine scientists the use of the LME concept to link science to marine environmental and natural resource management and the further application of the concept to other activities in the marine sciences. The meeting was a follow up to the first consultative meeting on LMEs "Large Marine Ecosystems Concept and its application to Regional Marine resources Management" held in Monaco 1990.

Contact Point:

Dr. Kenneth SHERMAN
United States Department of Commerce
NOAA, National Marine Fisheries Science Center
Narragansett Laboratory
28 Tarzwell Drive
Narragansett RI 02882-1199
USA
Tel: + 1 401 782 3200
Fax: + 1 401 782 3201
E-mail: Kenneth.Sherman@noaa.gov

10.5 Marine Pollution Research and Monitoring

10.5.1 Global Investigation of Pollution in the Marine Environment (GIPME)

The GIPME Programme provided, on request, advice and assistance to the Regional Organization for the Protection of the Marine Environment (ROPME) on the evaluation of progress, new monitoring programme directions and the assessment of priorities for the Regional Sea Area in the context of the Global Programme of Action for the Protection of the Marine Environment from Land-Based Activities adopted in Washington, D.C., in November, 1995. GEMSI and GEEP experts undertook an evaluation of regional activities during March, 1996.

A wide range of advice and assistance was also provided to the Black Sea Region through the medium of involvement in the review of the GEF Black Sea Environmental Programme. Assistance on monitoring project design was provided by GIPME experts and the Marine Environmental Studies Laboratory, Monaco, to the Institute for Sea Research, Odessa. A workshop was conducted at the Plymouth Marine Laboratory, U.K. for scientists from this region to provide training in biological effects techniques.

A major issue stemming inter alia from the adoption of the Global Programme of Action for the Protection of the Marine Environment from Land-Based Activities under UNEP auspices, and the major amendment of the London Convention completed in October-November 1996, for which IMO is the Secretariat, is the establishment of sediment quality guidelines for marine areas. GIPME has adopted a proactive role in attempting to devise a scientific basis for the development such guidelines that can be used for environmental management purposes. A workshop to evaluate different approaches to formulating guidelines, originally planned for June, 1996, had to be postponed due to fiscal restraints but is now planned to be held in

conjunction with the meeting of the Scientific Group of the London Convention at IMO Headquarters in London in May, 1997.

GIPME Expert Groups continued to assist the Marine Environmental Studies Laboratory, Monaco, in the preparation of UNEP Reference Manuals on sampling and analytical methodology. During 1996, a Reference Manual on the analysis of sediments for inorganic analyses was published and a similar manual dealing with the determination of metals in marine biological tissues was finalized for publication in early 1997. All such manuals are reviewed prior to publication through a peer review mechanism established by GIPME in response to the needs of the co-sponsoring agencies, IOC, UNEP and IMO.

Some responses were received to the questionnaire prepared during the VIIIth Session of the Scientific Committee for GIPME held in Costa Rica, 18-22 April, 1994, and distributed as IOC Circular Letter 1843. These responses are being analysed to determine future directions of the GIPME Programme especially in respect to activities in developing regions.

GIPME formed the nucleus for the further development of the strategic plan for the Health of the Oceans (HOTO) Module of the Global Ocean Observing System published as <IOC/INF-1044, May 1996>. Evaluations of the need for HOTO implementation in a number of regional marine areas are being evaluated by GIPME Experts, and the interests of countries in the WESTPAC and Southeast Asian area are being investigated by GIPME Officers.

Problems being experienced with organophosphate pesticides in some South and Central American countries stimulated GIPME through its GEEP and GEMSI Expert Groups to design a Training Workshop on the analyses of sediment and fauna for organophosphates, organochlorines, heavy metals, hydrocarbons and biological effects measurements in Costa Rica. A visit to Costa Rica to select an appropriate workshop location and investigation sites was undertaken in October-November, 1996 by the Chairman of GEMS and GEEP. A preliminary workshop design has been formulated in consultation with scientists in the region with the intention of holding the Workshop for 20 scientists in January 1998, during the dry season.

Monitoring

The Open Ocean Baseline Study of the Atlantic Ocean was further advanced with the completion of the third and final cruise in the South Atlantic aboard the United States Oceanographic Research Vessel Knorr. This cruise, coordinated by Dr. Gregory Cutter of Old Dominion University, USA, commenced on May 15th, 1996, in Montevideo, Uruguay, and ended in Bridgetowm, Barbados. Scientists from Canada, Germany, the United Kingdom and the United States participated in the sampling of major oceanic water masses for subsequent analyses of heavy metals and organic contaminants at the four designated Baseline Study Stations in the Southwest Atlantic. Two additional stations were occupied off the Amazon to evaluate this river's contribution to organic and inorganic substances in the western Atlantic. Surface water was continuously sampled while the ship was underway between stations to investigate the composition of water in the various surface currents and the Intertropical Convergence Zone and to evaluate the effects of equatorial upwelling and variable atmospheric deposition of aeolian material derived primarily from North Africa. The data from this and the previous two baseline cruises will not only serve the purpose of establishing the contemporary baseline distributions of a range of contaminants in the Atlantic deep waters, including source water regions, but will also provide valuable information on biogeochemical processes that determine the transport and fate of contaminants in the open ocean environment. A web site [http://www.soest.hawaii.edu/oceanography /ioc96/ioc. html] has been established for the exchange of data and information from the latest baseline cruise. Results from the two previous baseline cruises have been published as a volume of the journal Marine Chemistry and, as reported in the 1995 IOC Annual Report, by G.A. Cutter, W.M. Landing, C.I. Measures and P.A. Yeats in EOS 77, 12-13, 1996, under the title "Trace contaminants measured in the Atlantic Ocean." Additional scientific papers describing the results of the first two baseline cruises are in the acceptance or final revision stages for publication in a second special issue of Marine Chemistry under the editorship of Alan Shiller.

10.5.2 Marine Pollution Monitoring System (MARPOLMON)

The Fifth Caribbean Marine Debris/Waste management workshop was conducted in Curacao, July 21-25, 1996 under MARPOLMON Programme auspices. Most of the action items stipulated in the IOC-UNEP-NOAA-USCG-IMO Marine debris/Waste Management Action Plan, which was finalized in Nassau, Bahamas, January 1994, have been completed. The Caribbean Marine Debris Monitoring Project will initiate its follow-up phase in which 10 countries in the region will initiate monitoring in December, 1996, consistent with the US-NOAA Manual. In addition, environmental awareness and outreach campaigns on the subject of marine debris have been carried out in cooperation with the Center for Marine Conservation. GIPME is also cooperating with the UNIDO Large Marine Ecosystem Project on Pilot Monitoring of Marine Debris in the Gulf of Guinea. The results were evaluated during the Third IOC-LME Marine Debris/Waste Management Workshop in Abidjan, December 9-11, 1996. This workshop also decided upon actions to be taken based on the Marine Debris Action Plan elaborated during the First Marine Debris/Waste Management Workshop, convened in Lagos, Nigeria, December 15-17, 1994.

The joint IOC-UNEP CEPPOL (Caribbean) Programme has devoted major effort to the synthesis of the results of the eight research components of the Programme. This synthesis will serve as a basis for determining the state of marine pollution in the wider Caribbean as well as providing guidance on further actions to be taken regarding research and management. The report of this analysis will be published in early 1997.

During 1996-1997, the IOC has carried out a mission to assess national capabilities within IOCINCWIO for conducting baseline monitoring studies of pesticides, metals, nutrients, persistent organics, sediment load, dissolved oxygen and turbidity. This action followed the outline based on the recommendations arisen from the IOC-Sida (SAREC) Field Study Exercise on Nutrients in Tropical Marine Waters (IOC Workshop Report No. 99) in which the expert group recommended following the IOCINCWIO action plan regarding the establishment of baseline stations under the MARPOLMON Programme.

Based on the results and institutional capabilities, contracts are being issued with five countries in the region to initiate the monitoring programme. The purpose is to continue to upgrade facilities and human resource capabilities to acquire data and information needed for planning and management purposes. A clear linkage to the ICAM programme will be incorporated in these activities. The objective of these activities is to have the baseline station monitoring running coherently and gathering data on contaminants in the region by 1998.

10.6 Remote Sensing and Relationship with CEOS

10.6.1 Satellite Missions and Activities

The last year has been a salient one for marine remote sensing. It started on 21 March 1996 with the launch of MOS on the Indian Satellite IRS-P3. It was followed on 26 April with the launch of MOS on the Pirorda space station and the launch of OCTS and POLDER on ADEOS on 17 August.

MOS follows a concept of a specialized instrument for remote sensing of the atmosphere-ocean system that has been tested with non-imaging spectrometers built by the Institute for Space Research in Berlin for several missions (MKS, MKS-M on Intercosmos-21, space stations Salyut-7 and MIR). It consists of two separate spectrometer blocks: the atmospheric spectrometer MOS-A provides 4 narrow channels in the O2A-absorption band at ~760 nm to allow measurements that can be used to estimate the aerosol-optical thickness and stratospheric aerosols. It measures simultaneously with the bio-spectrometer MOS-B that has 13 channels of 10 nm width in the range from 408 to 1010 nm. MOS-IRS provides a 14th channel from the MOS-C camera in the SWIR for improved surface term and roughness estimation. Using the MOS-A measurements and the NIR-channels of MOS-B it is possible to remove the atmospheric influence from the VIS - MOS-B data and one can compute the water leaving radiance (reflectance) on the surface level. The

advantage of the O2A-method is to provide additional measurements on aerosol content and profile.

The center wavelengths of the MOS-B channels are chosen in accordance with the spectral characteristics of ocean and coastal zones, and are appropriate to construct quantitative retrieval algorithms of different water constituents. They also give the opportunity of vegetation signature determination (red edge) and estimation of H_2O vapour content in the atmosphere from the NIR-measurements.

Ocean Color and Temperature Scanner (OCTS) is an optical radiometer to achieve highly sensitive spectral measurement with 12 bands covering the visible and thermal infrared region. In the visible and near-infrared bands, the ocean conditions are observed by taking advantage of the spectral reflectance of the dissolved substances in the water and phytoplankton. On the other hand, the sea surface temperature is accurately measured in 4 thermal infrared bands. As the swath width of OCTS is about 1,400km, with scanning mirror (west-east) and OCTS also scans south and north, it can observe the entire earth surface in 3 days. The spatial resolution is about 700m.

POLDER is a wide field of view imaging radiometer that will provide the first global, systematic measurements of spectral, directional and polarized characteristics of the solar radiation reflected by the Earth/atmosphere system. Its original observation capabilities open up new perspectives for discriminating the radiation scattered in the atmosphere from the radiation actually reflected by the surface. POLDER-acquired data will be processed in order to :

- determine the physical and optical properties of aerosols so as to classify them and study their variability and cycle,
- improve the climatological description of certain physical, optical and radiative properties of clouds,
- precisely determine the influence of aerosols and clouds on the Earth's radiation budget,
- quantify the role of photosynthesis from the continental biosphere and oceans in the global carbon cycle.

On March 22-23 the first session of the IOC International Ocean Color coordination Group (IOCCG) was held followed by the a Workshop on Ocean Color Calibration and Validation. Both events were hosted by CNES. The IOCCG laid out its terms of reference and laid out its work plan in pursuit of the following goals:

- Foster Expertise in Using Data (Training)

Broaden the user community for ocean color, particularly in developing and emerging countries, through training courses and workshops. Facilitate development of data systems in these areas to support and sustain the user communities. Promote international cooperation in research and application development through international symposia, provision of data and software for scientific research and scientific exchange programs. Develop training materials that provide the user with the tools and the capability to utilize real data, both in the course of instruction and after the completion of the course material.

- Provide the Voice of User Community

Develop consensus among users on key issues related to satellite-ocean-color science and technology and communicate the collective view to those who design and operate satellite ocean color sensors and who develop, distribute and archive ocean-color-data products. Evaluate, on request, proposals from CEOS members for new sensors, new data products and new applications related to satellite-ocean-color measurement.

- Advocate the Importance of Ocean Color Data to Global Community

Develop appropriate information systems such as a newsletter, home page, and data access networks to show the importance of ocean color data to the global community. Organize workshops and conferences targeted at potential users of the data (e.g. fisheries, coastal resource agencies). Promote demonstration projects that

involve both providers and users of ocean-color data.

- *Optimize the Quality of Data for Calibration and Validation*

Encourage the formation of an international calibration and validation network for ocean color. Recommend that sea truth measurements conform to accepted international protocols such as the SeaWiFS optics protocols and the JGOFS biogeochemical protocols, and that sensor calibrations be traceable to national calibration standards. Encourage the development of an international protocol for satellite sensor characterization, quality assurance of data, exchange of validation data. Facilitate the formation of a distributed calibration and validation archive and database network.

- *Advocate the collection of essential ocean & atmosphere data*

Identify processes and phenomenon relevant to the application of ocean-color data and publicize these through CEOS as well as other international fora, such as COSPAR, examining requirements for satellite data. Recommend data-collection strategies to fill existing gaps in time and space, of key variables.

- *Facilitate merging of Data*

Encourage agencies to agree on common formats for data exchange, common data products and algorithms. Facilitate provision of common tools to access data in different formats. Provide assessments of data quality and work to identify and eliminate errors and uncertainties of measurements. Recommend workshops to address issues relevant to data merging and integrated use.

- *Facilitate Access to Data*

Facilitate access to ocean-color data and ancillary data (wind, ozone, etc). Encourage the provision by relevant agencies of *in situ* data where such data are required for the derivation of secondary products. Recommend that both satellite and *in situ* data transit the data system together and are accessible in common data-exchange formats from the same source.

10.6.2 Future Satellite Missions

The Pegasus XL system should be ready to return to flight in mid April 1997 with a commercial Minisat launch. SeaSTAR will be the second launch. These launches have 30 day windows, with 45 days between the launch windows. The SeaSTAR launch is now scheduled for June 1, 1997. SeaSTAR has a final vibration test and final comprehensive performance test for the flight software load left to complete before it is ready to ship (*SeaWiFS update 21 March 1997*).

10.6.3 Committee On Earth Observation Satellites

GOOS continued to participate in the other activities of CEOS regarding user requirements for ocean remotely sensed data. Of particular interest was the development by CEOS of the concept of an Integrated Global Observing Strategy (IGOS). This strategy will initially address how the space agencies will work together to address the many diverse interests of the Affiliate organizations. A meeting to address the remote sensing issues of this concept was held in Seattle in March followed by a meeting to address the *in-situ* interests which was held in Geneva in September. Subsequent to these meetings the CEOS plenary (Canberra, 13-15 November 1996) decided to form two groups to address the ongoing development of this strategy. The first is the Analysis Group which is designed to follow-on with work conducted by the CEOS Requirements Task Force and the Affiliates Requirements Group. The second is the Strategic Implementation Team that is composed of high level agency and affiliate people and designed to continue the development of the IGOS. GOOS as an affiliate agency along with IOC will participate representing the ocean community in both the Analysis Group and the Strategic Implementation Team.

IOC Satellite Requirements

Requirement	Hor Res	Obs Cycle	Accuracy	Timeliness	Wv Amp	Wv Per	Wv Dir	Use	Ident
OCEAN SURFACE WIND VECTOR	100 km	12 hr	2 m/s-10 deg.	720 hr				GOOS Climate	IOC 2
OCEAN SURFACE WIND VECTOR	25 km	6 hr	4 m/s-10 deg.	2 hr				GOOS Surface	IOC 3
SEA SURFACE TEMPERATURE	1 km	6 hr	0.1 K	2 hr				GOOS Surface	IOC 4
SEA SURFACE TEMPERATURE	200 km	720 hr	0.1 K	720 hr				GOOS Climate	IOC 5
SEA SURFACE TEMPERATURE	200 km	360 hr	0.3 K	720 hr				GOOS Climate	IOC 6
OCEAN WAVE SPECTRA	10 km	1 hr		2 hr		0.5 sec	10 deg.	GOOS Surface	IOC 7
OCEAN SURFACE TOPOGRAPHY	100 km	240 hr	5 cm	720 hr				GOOS Climate	IOC 8
SEA-ICE COVER	100 km	24 hr	1%	720 hr				GOOS Climate	IOC 10
SEA-ICE COVER	10 km	24 hr	2%	24 hr				GOOS Surface	IOC 11
SEA-ICE EDGE	10 km	24 hr	2%	24 hr				GOOS Climate	IOC 12
ICE THICKNESS	25 km	24 hr	10%	24 hr				GOOS Surface	IOC 14
OCEAN COLOUR (Biomass)	100 km	24 hr		720 hr				GOOS Climate	IOC 9A
OCEAN SURFACE TOPOGRAPHY	100 km	120 hr	3 cm	720 hr				GOOS Coastal	IOC 15
SEA-ICE CONCENTRATION	1 km	12 hr	1%	24 hr				GOOS Surface	IOC 16
GEOID	250 km	20 yrs	2 cm	12 mo				GOOS Coastal/Climat	IOC 17

Figure 1

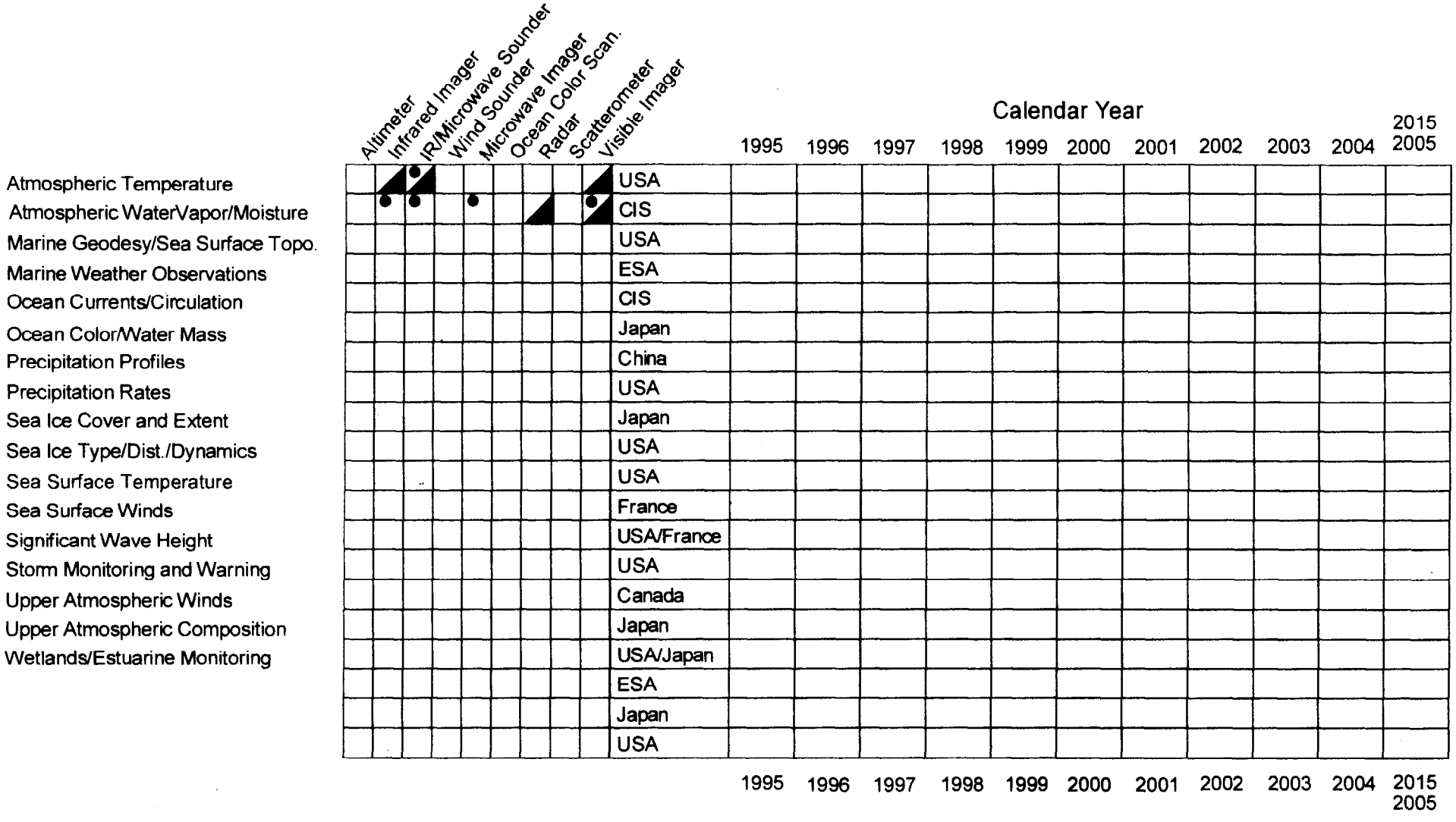

Altimeter
Infrared Imager
IR/Microwave Sounder
Wind Sounder
Microwave Imager
Ocean Color Scan.
Radar
Scatterometer
Visible Imager
Calendar Year
1995 1996 1997 1998 1999 2000 2001 2002 2003 2004 2015 2005
Atmospheric Temperature
Atmospheric WaterVapor/Moisture
Marine Geodesy/Sea Surface Topo.
Marine Weather Observations
Ocean Currents/Circulation
Ocean Color/Water Mass
Precipitation Profiles
Precipitation Rates
Sea Ice Cover and Extent
Sea Ice Type/Dist./Dynamics
Sea Surface Temperature
Sea Surface Winds
Significant Wave Height
Storm Monitoring and Warning
Upper Atmospheric Winds
Upper Atmospheric Composition
Wetlands/Estuarine Monitoring
USA
CIS
USA
ESA
CIS
Japan
China
USA
Japan
USA
USA
France
USA/France
USA
Canada
Japan
USA/Japan
ESA
Japan
USA
1995 1996 1997 1998 1999 2000 2001 2002 2003 2004 2015 2005

Figure 2