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GOOS STATUS REPORT 1997

This report provides an annual update on progress in the development of GOOS and of the observing systems that form integral parts of a global observing system. For more information on GOOS consult the GOOS Homepage at: **http://ioc.unesco.org/GOOS/**

1. INTRODUCTION

Oceanography is rapidly becoming operational - like meteorology. For years now meteorologists have been working through the World Weather Watch (WWW) to collect the operational data needed to underpin the increasingly accurate weather forecasts demanded by the user community. Demand is now growing for monitoring and forecasting of the marine environment. In times when even oceanographers did not see the ocean as a whole, it was difficult to imagine anything like the WWW arising for the marine environment. But the advent of powerful new technologies, especially the growth in ocean remote-sensing from satellites, and the steadily increasing power of computers to process huge amounts of information, now enables us to take a global view of data collection and numerical forecasting. These and other changes have led researchers to examine the ocean as a whole for the first time in the World Ocean Circulation Experiment (WOCE).

We are now poised to apply this new way of looking at the ocean, by using operational oceanography, to provide information users need to deal with ocean issues effectively for the first time on a global basis. In effect we are dealing with a new paradigm which deals with the ocean as a whole and forces us to take an integrated systems approach, in which we integrate not only across the science disciplines, but also between them and the social sciences where value is determined by analyses of benefits and costs. It is a prerequisite that social needs are considered in the scientific design of the observing system and the products and services that it applies, which demands interaction between the scientific and user communities in order to identify and prioritise needs.

Operational oceanography consist of routinely making, disseminating and interpreting measurements of the seas, oceans and atmosphere so as to:

- provide the most usefully accurate description of the present state of the sea including living resources;
- provide continuous forecasts of the future condition of the sea for as far ahead as possible;
- assemble long term climatic data sets to provide data for description of past states, and time series showing trends and changes.

Operational observations must be: systematic, routine, sustained for the long term, relevant to users' needs, high quality, cost effective, available in a timely manner. Such observations, of the atmosphere, are being and have been for a long time made by meteorologists. The difference between meteorology and oceanography at this point in time is that meteorologists, together with their major customers (initially the defence and aviation sectors), have managed to convince funding agencies that operational measurements are necessary. For the most part this is not true of oceanography where most measurements, including most of those from satellites, are still funded through research budgets. Governments have to be convinced that this has to change in the future, and we are beginning to see signs of this recognition. For instance, this year the US Government has provided US$5 million to support the operational costs of the TAO array of buoys which monitors El Niño events in the Pacific.

The mechanism through which it is proposed internationally to create an analogue of the World Weather Watch (WWW) to make observations of the oceans is the Global Ocean Observing System (GOOS), through which the new paradigm for ocean measurements will be applied. Its primary tools will be satellites and advanced numerical models run on powerful supercomputers, supported by appropriate in-situ measurements from within the body of the ocean, and at its interfaces with land, air, and ice. GOOS will be the mechanism that enables oceanographers to emulate the WWW and turn observations into useful forecasts. It provides an essential framework for, and stimulus to, international cooperation in data gathering and data sharing. And it will work because through cooperation and sharing the whole will be seen to be greater than the sum of its parts; benefits will be seen to outweigh costs.

GOOS is now up and running. It comprises an initial observing system and a growing set of pilot and demonstrator

projects, as explained below. Growth and refinement of the system in the immediate future require: more pilot projects; an improved interface with users; an improved data and information management system; incorporation of national observing systems; national commitments to exchange data; commitments to adequate (continuous) satellite programmes; improved understanding, models and tools from researchers; an improved infrastructure for managing the system; and increased resources.

2. GOOS DESIGN AND PLANNING

2.1 THE VISION, GOALS, AND OBJECTIVES OF GOOS

The vision guiding the development of GOOS is one of a world where the information needed by governments, industry, science and the public to deal with marine related issues, including the effects of the ocean upon climate, is supported by a unified global network to systematically acquire, integrate and distribute oceanic observations, and to generate analyses, forecasts and other useful products.

GOOS is conceived as:

- a sustained, co-ordinated international system for gathering data about the oceans and seas of the Earth,
- a system for processing such data, with other relevant data from other domains, to enable the generation of beneficial analytical and prognostic environmental information services, and
- the research and development on which such services depend for their improvement.

The primary objectives of GOOS are:

1. to specify the marine observational data needed on a continuing basis to meet the needs of the world community of users of the oceanic environment;
2. to develop and implement an internationally co-ordinated strategy for the gathering, acquisition and exchange of these data;
3. to facilitate the development of uses and products of these data, and encourage and widen their application in use and protection of the marine environment;
4. to facilitate means by which less-developed nations can increase their capacity to acquire and use marine data according to the GOOS framework;
5. to co-ordinate the ongoing operations of GOOS and ensure its integration within wider global observational and environmental management strategies.

GOOS will provide information about the present and future states of seas and oceans and their living resources, and on the role of the oceans in climate change. Its foundations are in place, and the existing states of scientific knowledge, technical capability, and current operational systems point to the need for incremental, progressive implementation now. In fact, implementation has begun, based on the integration of previously separate existing observing systems.

2.2 THE NEED FOR A GLOBAL SYSTEM

Ocean processes know no national boundaries and the ubiquitous nature of many of the problems to be solved means that it is often prudent to implement even local and regional operational or research programmes co-operatively and in a co-ordinated way. Such co-ordination needs to be carried out so as to achieve economy of scale and mutual support, and to enable future global extension. The Tropical Ocean and Global Atmosphere (TOGA) Program is one such co-operative programme. It has established the basis of operational prediction of the onset of El Niño and the associated El Niño-Southern Oscillation (ENSO). This has its origins in the tropical Pacific but creates ramifications well into the mid-latitudes on virtually a global scale.

There are some programmes that must be designed and implemented on an agreed international, global basis - where the problem being addressed is truly global, as in the case of large-scale oceanic circulation for example, or where the investment required is large and the benefits are essentially public goods, i.e. cannot be appropriated. Much of the monitoring and generation of advice relating to environmental change has these properties.

In coastal seas, the achievement of a predictive understanding of coastal ecosystems depends on the development of regional to global networks that link observation and analysis in more effective and timely ways. GOOS is thus

promoting integration of the fragmented coastal environmental research community and its linkage to the community at large, especially user groups like policy makers, environmental and resource managers, NGOs, the business community, and the public in general, to enable them to get the scientific information they need to make informed decisions in a timely fashion. GOOS is also promoting a broad-scale view of coastal ecosystems that takes into account the large scale forcing of the coastal system and which leads to reliable mechanisms for predicting environmental changes and their ecological consequences. The ultimate goal of Coastal GOOS is to encourage and support the development and application of now-casting, forecasting and predictive capabilities as a means of preserving healthy coastal environments, promoting sustainable uses of coastal resources, mitigating coastal hazards, and ensuring safe and efficient marine operations.

2.3 ECONOMICS AND BENEFITS OF GOOS

A significant proportion of world economic activity and a wide range of services, amenities and social benefits depend on wise use of the sea. For many countries, marine resources and services provide 3-5% of their Gross National Products (GNP). For a few countries, the proportion is much higher. In the technically developed 'Group of Seven' countries, marine resources and services contribute, on average, 5% of GNP or about $600 billion per annum (1991). The vast majority of all international trade is carried by sea, with 3.5 billion tonnes of cargo transported in ships. By the year 2020, it is probable that 75% of the world's population will live within 60 km of sea coasts and estuaries. World production of offshore oil and gas was worth $135 billion in 1990, amounting to 20% of world hydrocarbon production. The world fish catch is 80-90 million tonnes/year, amounting to some 20% of the total human consumption of animal protein and worth approximately $70 billion. Wetland and other shoreline areas are extremely important breeding and spawning areas for many species of fish and other organisms and yet, globally, over 50% of such areas have already undergone severe environmental degradation. Expected growth in population with the attendant pressure on natural resources, suggests that the economic significance of the oceans is more likely to increase than to decline, as will the need for its sustainable use. Economic analyses suggest that the costs and benefits of operating GOOS are likely to be similar to those of the World Weather Watch, an analogous system that underpins all weather forecasting.

Direct potential beneficiaries of GOOS will include the managers of coastal defences, ports and harbours, fishing and fish farming, shipping, offshore industry, and recreation. Indirect beneficiaries, through climate forecasting based on ocean observations, will include the suppliers on land of food, energy, water and medical supplies (e.g. for epidemics of malaria like those associated with El Niño events).

Governments will benefit from GOOS because they need ocean information in order to ensure that they are meeting their obligations under various recently devised international Conventions and Action Plans, including: the Convention on the Law of the Sea; the Framework Convention on Climate Change; the Biodiversity Convention; Agenda 21 (agreed at the United Nations Conference on Environment and Development in Rio in 1992); the Global Plan of Action for the Protection of the Marine Environment from Land-Based Activities; the London Dumping Convention; the Agreement on Highly Migratory and Straddling Stocks, and others.

2.4 GOOS AND OTHER INTERNATIONAL INITIATIVES

GOOS was created by the IOC Assembly in 1991 in response to the desire of many nations to improve management of seas and oceans, and to improve climate forecasts, for both of which it is necessary to establish observations dealing with physical, chemical and biological aspects of the ocean in an integrated way. Agenda 21 specifically calls for GOOS to be developed to meet the needs of coastal states for sustainable development of seas and oceans.

GOOS is part of an Integrated Global Observing Strategy (IGOS) in which the UN agencies (UNESCO and its IOC; WMO, UNEP, and FAO) are working together and with ICSU and the satellite agencies (via the Committee on Earth Observation Satellites - CEOS). In that context, the GOOS forms the ocean component of GCOS (the Global Climate Observing System) and the marine coastal component of GTOS (the Global Terrestrial Observing System). GOOS itself is sponsored by the IOC of UNESCO, WMO, UNEP and ICSU. Management of GOOS data is now being considered by a Joint Data and Information Management Panel (J-DIMP) shared by GOOS, GCOS and GTOS.

2.5 GOOS PROGRESS

GOOS planning is coherent, well-founded, and widely accepted at intergovernmental, regional, and local levels. Uncertainties as to method and objectives are being researched in a phased and progressive manner. The operational

systems are being based on sound science and technology. Thought-out strategies, achievable priorities, targets and milestones have been set; methods of accomplishing them have been defined; and all these have been reviewed and endorsed at an appropriate level.

GOOS is being implemented through 5 overlapping phases:

1. planning, including design and technical definition;
2. operational demonstrations and pilot experiments;
3. incorporation of suitable existing observing and related activities and new activities that can be implemented now to constitute the GOOS Initial Observing System;
4. gradual operational implementation of the 'permanent' or ongoing Global Ocean Observing System;
5. continued assessment and improvement in individual aspects and in the entire system.

2.5.1 The Planning Phase

The first phase is well advanced, and a 'Strategic Plan and Principles of GOOS' has been published by IOC. The initial shape of the GOOS is being developed by advisory panels dealing with: (i) climate; (ii) coastal seas; (iii) living marine resources; (iv) the health of the ocean (ie pollution); and (v) marine meteorological and oceanographic services. These panels report to the GOOS Steering Committee (GSC), that is responsible for the design and implementation of GOOS. An Intergovernmental Committee (I-GOOS) assists in gaining intergovernmental support and approval for the design and implementation. Building the capacity of developing nations to contribute to and benefit from GOOS is the responsibility of a Capacity Building Panel.

Discussions are beginning to assist the development process by providing governments with an opportunity to sign up to the Principles of GOOS, and their operational agencies with an opportunity to commit certain of their current operational resources to GOOS to enhance its implementation. Many individual governments have already established, or are creating, their own national GOOS committees to oversee their contribution to GOOS.

2.5.2 Modules

Coastal Module (C-GOOS)

The Coastal Module panel of GOOS held its first meeting in March 1998. It plans to encourage and support the development and application of now-casting, forecasting and predictive capabilities as a means of preserving healthy coastal environments, promoting sustainable uses of coastal resources, mitigating coastal hazards, and ensuring safe and efficient marine operations. Among the coastal elements currently included in the GOOS Initial Observing System are the tide gauge data from the Global Sea Level Observing System (GLOSS), and the information from the Global Coral Reef Monitoring Network (GCRMN). However, other elements of the GOOS Initial Observing System provide valuable information about external forcing on coastal seas, like the TAO array on which El Niño forecasts are based.

A number of pilot projects are currently under consideration by the Panel, which recognises that more effort now has to be put into developing monitoring systems covering chemical and biological information and their integration with physical data, especially in the coastal seas where most living marine resources exist.

Climate Module

The Ocean Observations Panel for Climate (OOPC) lately has focussed on integrating various implementation planning efforts by existing organizations that will be entrained into the GOOS structure. Joint efforts with the CLIVAR Upper Ocean Panel in clarifying requirements, with GLOSS in defining the sea level observing system, and with the Ship Of Opportunity Program (SOOP) in setting priorities, have served to move implementation planning along. Links have been forged with GCOS to develop the space-based observing system and the data and information management system.

All the relevant planning bodies for GOOS and GCOS (I-GOOS, J-GOOS/GSC, JSTC, OOPC) have called for urgent actions to be taken to begin the implementation process for those parts of the systems where requirements are specified and largely agreed. This applies in particular to global physical observations to support the common GOOS/GCOS climate module and is given added weight by the developing concepts of the Integrated Global Observing Strategy

(IGOS) and the Global Ocean Data Assimilation Experiment (GODAE).

The existing bodies themselves have expressed a readiness to participate in this implementation approach, provided explicit requirements and instructions are issued as to what they are expected to do. Accordingly, the OOPC chair organized a joint effort to develop an Action Plan for this purpose and also to establish at least an embryo mechanism for coordinating the in situ operations with those involving satellites. The document that was produced is essentially a strategy defining the role and responsibilities of the existing implementation bodies and mechanisms, initially for global ocean physical observations for the climate module but which later can be progressively extended to other components and/or types of observations.

An International Symposium for Monitoring the Oceans in the 2000s held in Biarritz in October 1997 provided an opportunity to debate the strategy for moving forward with GODAE. The project was accepted by the CEOS Strategic Sub-Committee as one of 6 projects to be used to demonstrate integrated global (satellite) observing systems (consistent with the Integrated Global Observing Strategy). Part of the requested input to CEOS was a specification of the space requirements of GODAE. In complying with this request, the table assembled (see the next page) was intentionally more broadly comprehensive than required for CEOS in that it encompasses the overall requirements for the observing system for the climate module and not just GODAE .

Though GODAE was an initiative of the OOPC, its wide scope and complexity obviously require a special planning structure. It was agreed that GODAE will be developed through "Patron" and "Partner" groups, the latter providing a Steering Committee. GODAE will exercise a level of independence from existing scientific and operational programs in order to provide freedom of development, and to build its own constituency as well as its own resource base.

The next major thrust of the OOPC is the development of a Plan targeted at a coherent, integrated implementation process involving SOOP, XBT sampling, TAO and moorings, potential input from acoustic tomography and floats, the indirect impact of altimetry, etc. It is clear that the existing plans and implementation for subsurface data, particularly T(z) need to be revisited. This exercise will also include the consideration of datas and information management issues in general. Over the coming 12 months OOPC will undertake the preparation of an outline for what that Plan should contain and how it is to be developed. It will also aim toward producing a "proposal" for a workshop in 1999 to draft the Plan.

Health of the Ocean (HOTO) Module

The HOTO Panel (see also section 13.5) is developing plans for pollution-related Pilot Projects in marginal seas that appear to be most at risk, including east Asian seas, the Black Sea, the Red Sea and the Arctic. Together with C-GOOS, the HOTO Panel will also be considering the development of Pilot Projects in the Adriatic and Caribbean. The HOTO-driven Pilot Projects will be developed in the context of a Strategic Plan that has been drafted for pollution monitoring within GOOS.

The HOTO Panel is also beginning to consider (i) how to develop indicators of the sustainability of marine environments, as a guide to coastal seas management, and (ii) the development of numerical models to aid in forecasting, to assist in assessing the sustainable development of ecosystems. Forecasting using sophisticated physical-biogeochemical ecosystem models that incorporate living and non-living components of the system may prove useful, for instance, as the basis for a variety of early warning systems, eg for eutrophication (which may lead to increased algal blooms, anoxia, massive fish deaths and major alterations in biological communities). Simpler models coupled with dynamic models of regional circulation can be used to predict the dispersion of passive tracers such as oil spills, and accidental releases of contaminants, radioactive tracers and sediment load. Water quality modelling can assist in the development and possibly predict the effectiveness of measures to prevent pollution and contamination in the water column. Numerical models may also add value to data by enabling interpolation between data points, and enabling estimation of some of model parameters from a limited number of observations under certain constraints, thereby complementing data obtained by the HOTO observing system.

The list of variables that could be monitored under the HOTO Strategic Plan includes: (i) physical measurements (solid litter and plastic; and suspended particulate matter; (ii) chemical measurements (synthetic organics; polycyclic aromatic hydrocarbons; trace metals; petroleum (oil); herbicides and pesticides; dissolved oxygen; artificial radionuclides; and (iii) pharmaceuticals); and biological measurements (phytoplankton pigments and community structure; human pathogens; nutrients; and algal toxins), which can be used to provide indications of biological

Table of Requirements (threshold and optimal) for global ocean circulation studies, with particular reference to the Global Ocean Data Assimilation Experiment (GODAE) and the space-based observation program. The specifications are based on the OOSDP Report (Compilation by Michel Lefebvre and colleagues.).

Global Observations of Ocean Circulation - Space-based data Requirements

Details			Optimized requirements				Threshold requirements			
Code	Application	Variable	HR(km)	Cycle	Time	Accuracy	HR(km)	Cycle	Time	Accuracy
ALTIMETRY										
A	Mesoscale variability	sea surface topography	25	7 d	2 d	2 cm	100	30 d	15 d	10 cm
B	Large scale variability	sea surface topography	100	10 d	2 d	2 cm	300	10 d	10 d	2 cm
C	Mean SL variations	sea surface topography	200	> 10 yr	10 d	1 mm/yr	1000	> 10 yr	10 d	5 mm/yr
D	Circulation, heat transport	sea surface topography	100	NA	NA	1 cm	500	NA	NA	5-10 cm
REMOTE SALINITY										
E	Circulation water transport	surface salinity	200	10 d	10 d	0.1 PSU	500	10 d	10 d	1 PSU
SCATTEROMETRY										
F	Wind-forced Circulation	surface wind field	25	1 d	1 d	1-2 m/s 20°	100	7 d	7 d	2 m/s 30°
SEA SURFACE TEMPERATURE										
G	NWP; climate, mesoscale models	Sea surface temperature	10	6 h	6 h	0.1°K (relative)	300	30 d	30 d	1°K
SEA ICE										
H	Ocean-ice coupling warnings	sea ice extent, concentration	10	1 d	3 h	2%	100	1 d	10 d	10%
OCEAN COLOR										
I	Biogeochemistry, transparency	ocean color signal	25	1 d	1 d	2%	100	1 d	1 d	10%

Footnotes:

A requires wave height + wind (EM bias correction) measured from altimeter, water vapor content measured from on board radiometer, and ionospheric content / measured from 2 frequency altimeter.

B requires precise positioning system with an accuracy of 1-2 cm for a spatial resolution of 100 km.

C requires precise monitoring of transit time in the radar altimeter.

A, B and C require repeat track at $\overline{+}$ 1 km to filter out unknowns on geoid.

A requires adequate sampling which implies at least 2, and preferably 3, satellites simultaneously.

A, B and C require long lifetime, continuity, cross calibration.

D requires absolute calibration.

F: The requirements on the wind field for sea state determination normally exceed sampling requirements for wind forcing

G: High resolution SST from new geostationnary satellite + combination with low satellite

distress that may be useful in determining the sustainability or otherwise of marine ecosystems. However, what is actually measured in any one region under the HOTO programme will depend on the design of the monitoring programme and will flow from its goals and objectives.

Living Marine Resources (LMR) Module

The Living Marine Resource (LMR) Panel met in March, 1998 and agreed that the goal of LMR-GOOS is to provide useful information on changes in the state of living marine resources and ecosystems. The objectives are to obtain relevant oceanographic and climatic data along with biological fisheries and other information on marine ecosystems, to compile and analyse these data, to describe the varying states of the ecosystem, including exploited species, on useful time scales. The Panel is emphasizing deep ocean and shelf sea conditions dominated by oceanic processes. The types of measurements required for a monitoring system were discussed and a compilation prepared. A report of the meeting is in press. The next meeting of the Panel is in March, 1999.

2.5.3 Pilot Projects

Phase 2 has begun with the formation of pilot projects to test the operation of GOOS in specific regions, and to refine GOOS subsystems. The NEAR-GOOS pilot project covers North East Asian seas. It focuses initially on developing data exchange between its four partners, and on building the user community. In the future it will develop a numerical modelling and forecasting capability. The initial focus is primarily on physical data. In Europe, the EuroGOOS Association of 30 operational agencies from 16 countries is bringing researchers and operators together to create more efficient and effective observing systems for the Arctic, Baltic, Mediterranean, and North West Shelf of the continent, in the process identifying the needs for research and technology to make GOOS more effective in the future. Ocean modelling and forecasting figures high on their agenda, along with improved data exchange. An Atlantic-scale project is proposed to provide improved boundary conditions for the forcing of models for European coastal seas. While the initial focus of EuroGOOS is on physical parameters, chemical (nutrient) and biological (plankton) parameters also feature prominently in the EuroGOOS programme. Active interest in building other regional projects has been expressed by the nations of: (i) the western Indian Ocean (WIOMAP); (ii) S. E. Asia (SEA-GOOS); (iii) Mediterranean (MED-GOOS); and south-west Pacific (Pacific-GOOS).

Technology demonstrator projects include PIRATA (Pilot Research Array (of buoys) in the Tropical Atlantic), and GODAE (Global Ocean Data Assimilation Experiment). PIRATA will demonstrate the value to climate forecasting of measurements from the equatorial Atlantic. GODAE will integrate and assimilate in-situ and satellite data in real time into global ocean models in order to depict ocean circulation on time scales of a few days and space scales of a few tens of kilometres, to demonstrate the viability of GOOS in this domain.

2.5.4 Capitalising on Existing Systems:

Phase 3 has begun with the creation of a GOOS Initial Observing System (GOOS-IOS), from a number of pre-existing observing systems, each of which will continue to serve the group of clients for which it was originally set up. The systems include: the upper ocean measurements of the Ship of Opportunity programme (SOOP); the meteorological observations of the Voluntary Observing Ship (VOS) network; data from the fixed and drifting buoys co-ordinated by the Data Buoy Co-operation Panel (DBCP); data from the buoys of the Tropical Atmosphere Ocean (TAO) array set up to monitor El Niño events in the equatorial Pacific; the tide gauge data from the Global Sea Level Observing System (GLOSS); observations of the sea surface and marine meteorology from NOAA operational satellites; data from the Global Temperature and Salinity Profile Programme (GTSPP); information from the Global Coral Reef Monitoring Network (GCRMN); and communication through the Internet and the Global Telecommunications System (GTS) of the WMO. Calibration and validation of satellite data relies on ocean surface ocean observations from the GOOS Initial Observing System, and the success of ocean forecasts made by numerical models relies on the

integration of remotely-sensed data from satellites with observations of the ocean's surface and subsurface that cannot be made from space. The GOOS Initial Observing System will be overseen by an Implementation Advisory Group. However, it is hoped that in a year or so this task may be taken over by a Joint Commission for Oceanography and Marine Meteorology (J-COMM) formed by a bringing together of the WMO's Commission for Marine Meteorology (CMM) and the WMO-IOC Integrated Global Observing Services System (IGOSS).

At this time, apart from the GCRMN, these measuring systems are concerned primarily with physical observations. However, consideration is now being given to what chemical and biological information is required and how to integrate it with physical data. Living marine resources exist mostly in the coastal zone, but the monitoring requirements for living resources and coastal seas remain under development. The challenge for the Coastal, Health of the Oceans, and Living Marine Resources Panels of GOOS is to develop a high quality, integrated approach to coastal monitoring and forecasting, taking into consideration the needs of resource managers. Examples of existing observing systems currently under consideration include the Harmful Algal Bloom (HAB) programme of the IOC; the international Mussel Watch programme; the Marine Pollution and Monitoring Programme (MARPOLMON); and the Continuous Plankton Recorder (CPR) programme.

2.6 FULL-SCALE DEVELOPMENT

Phase 4 will be developed over the next 10-15 years. It will involve continued integration of other components like those mentioned above, including new systems, with every attempt to enlarge the range of variables to include chemical and biological ones pertaining to the management of sustainable healthy coasts, including living marine resources and ecosystems.

Implementation will proceed following two parallel themes:

1. coastal and shelf monitoring and prediction;
2. open ocean monitoring and prediction.

Within coastal seas actions will focus on preserving healthy coastal environments, promoting sustainable use of coastal resources, mitigating coastal hazards, and ensuring safe and efficient marine operations. Open ocean operations will be more concerned with the short term needs of offshore industries, fisheries and ocean-going trade, with improvements to weather forecasting, and with the medium to longer term detection and forecasting of climate change. Open ocean operations are essential too for managers of coastal seas, in that coastal seas are affected by large scale, open ocean phenomena. Examples include the El Niño and its massive impact on the coastal fisheries of many countries, and the huge regime shifts in sardines and anchovies in many coastal fisheries in recent decades, which reflect some very large scale forcing. Measurements and numerical models of open ocean conditions will be used to provide the boundary conditions at the edges of regional numerical models of coastal seas, to ensure the accuracy of forecasts of coastal conditions.

Within both themes investment will focus on actions that:

1. have a high impact in terms of the delivery of the data and information that are needed;
2. are known to be feasible and thus likely to be successful;
3. continue and enhance activities that are already proving their worth, and encourage replication or expansion at a low level of risk;
4. comprise more substantial demonstration projects having community support;
5. give effect to intergovernmental Conventions and Agreements.

In due course, when the module panels have developed their initial plans, the present modular panel structure of the

GOOS will need to be changed to reflect the thematic structure of this implementation framework.

2.7 INFRASTRUCTURE

Achievement of this implementation framework, and the necessary review of performance of the system required for phase 5, demand the provision by Member States of appropriate structural support and expertise to: (i) conduct appropriate planning and co-ordination; (ii) ensure creation, maintenance and promotion of internationally accepted operational procedures and practices; (iii) facilitate training and awareness and capacity building.

Among the key items in the resulting infrastructure are:

1. establishment of an Information Centre;
2. establishment of a Data and Information Management Service;
3. negotiation of a data policy (the default is application of the data policies of the sponsoring organisations);
4. development of methods to assist capacity building targeted on GOOS;
5. improvement of investment in that capacity building;
6. Development of an appropriate international management structure for overseeing implementation (eg J-COMM).

2.8 RESOURCES

GOOS will be implemented by nations working together. GOOS supporters are now in the process of convincing operational, research and aid agencies that implementation of GOOS can deliver worthwhile benefits for them and those they serve, at a reasonable level of risk which makes investment worthwhile. It is hoped that governmental authorities and international agencies will be persuaded that if the guidance is followed, a coherent effective global system will result, to provide the services they require and wish to encourage and sponsor. A first step will be the contribution of appropriate existing local and regional systems to GOOS by individual nations or groups of states. Equally important at this point in time is the enhancement of support for the GOOS infrastructure which is enabling GOOS to happen.

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 1997, an estimated total of 47,542 unique BATHY messages (temperature versus depth profiles) using expendable bathythermographs (XBT) and 1.382 TESAC (temperature, salinity and conductivity measurements) were taken with Conductivity-Temperature-Depth (CTD) instruments. 3,879 track line data, known as TRACKOB messages were also exchanged. The exchanged drift and stationary buoy data (1005), known as BUOY messages comprise only a small percentage of the total data exchanged.

Since 1976, almost 850,000 BATHY and over 116,000 TESAC messages have been exchanged through the IGOSS (figure 1). 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 modelling, satellite truthing and for use in atmosphere-ocean climate modelling.

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. The first session of the Joint IOC/WMO IGOSS SOOPIP (April 1997, Capetown) reviewed the detailed SOOP resources survey result, which is essential element in overall SOOP management, both internationally and at the national and agency level. The meeting undertook a line-by-line analysis of the network, based in the first instance on the detailed resources survey tabulations. The summary tables were revised on the basis of this analysis, and it was agreed that these revised tables should constitute the next resources survey, which should be circulated by June 1997 at the latest for final review and conformation by SOOPIP members of the SOOPIP meeting in Noumea, November 1998.

Approximately 120 ships (both research and volunteer merchant ships) contributed to the collection of IGOSS data in 1997. The XBT Resources survey yielded many interesting summaries of the distribution of XBT probes by ocean and country (figures 4 - 7). The net result is that approximately 61% of the required number of XBT 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 (figures 8 -10).

3.1.1 Data and Information Access

Data sets derived from IGOSS observations and associated products can be accessed and even down loaded 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 down loaded by file-transfer protocol. From the main page, a list of IGOSS Topics and Keywords contains numerous links to IGOSS-related information. The URL of the page is:

http://ioc.unesco.org/IGOSSweb/igoshome.htm

Finally, another web site was created by the IGOSS Operations Coordinator, under the GOOS Home Page, which gives information on XBT-related topics and gives contacts for national XBT programmes. The URL of the page is:

http://ioc.unesco.org/IGOSSweb/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, and 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), distributed among six member states. A total of 62 countries prepare over 700 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 can be obtained through the 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 consist 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 66 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 1997 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 PTT.

It has proved particularly useful for the transmission of data from automatic stations such as buoys. In February 1997, the ARGOS service was handling reports from 1044 drifting buoys, 284 moored buoys, 4 balloons, 598 fixed stations and 420 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 REFENCES

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

The Task Team on Quality Control of Automated Systems (TT/QCAS) is presently reviewing fall-rate and other data problems encountered with XBT and expendable conductivity-depth-temperature (CDT) 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. The first session of the Joint IOC/WMO IGOSS SOOPIP (April 1997, Cape Town) revised and approved new terms of reference of the TT/QCAS and decided that its name should be changed to SOOP Task Team on Instrumentation and Quality Control (STT/IQC).

IGOSS and GOOS will eventually require a full instrument intercomparison and intercalibration programme, as an integral part of an operational ocean observing system. Such a programme, similar to that now in place for the World Weather Watch, will require additional resources. SOOPIP should therefore make this requirement known to both IGOSS and GOOS, and request that action be taken to identify the resources needed, bearing in mind that the task team is the appropriate body to organize and implement intercomparison tests, provided the necessary resources are available.

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, the SOOP monitoring work, as well as support for the SOOP Implementation Panel, formerly undertaken by the seconded IGOSS Operations Coordinator at IOC, is now being done on a temporary basis by the WMO Secretariat. However, there remains an urgent need to restore this important position, to ensure the full support which is necessary for such a global operational programme.

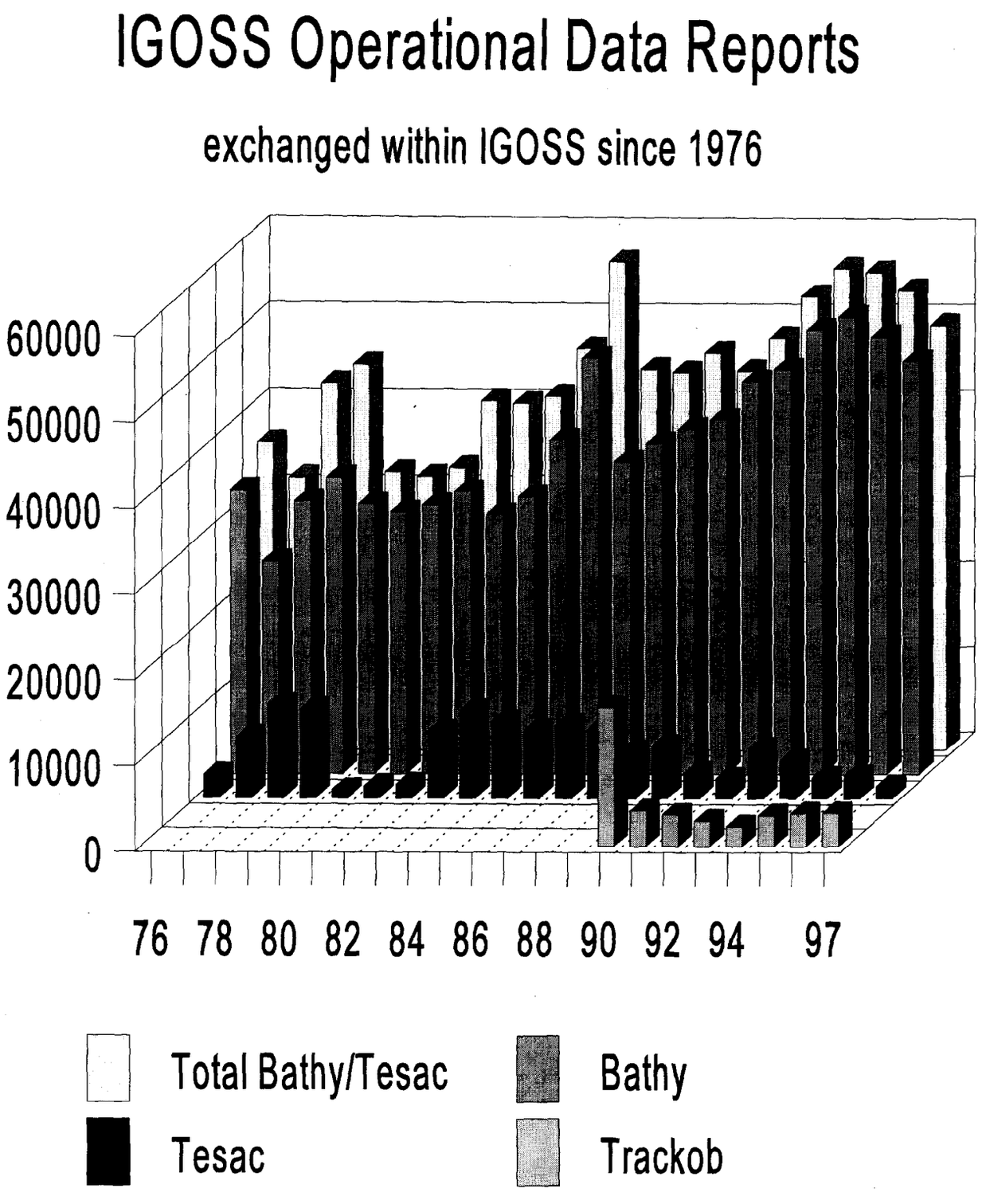

IGOSS Operational Data Reports
exchanged within IGOSS since 1976
60000
50000
40000
30000
20000
10000
0
76 78 80 82 84 86 88 90 92 94 97
Total Bathy/Tesac
Tesac
Bathy
Trackob

Figure 1

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

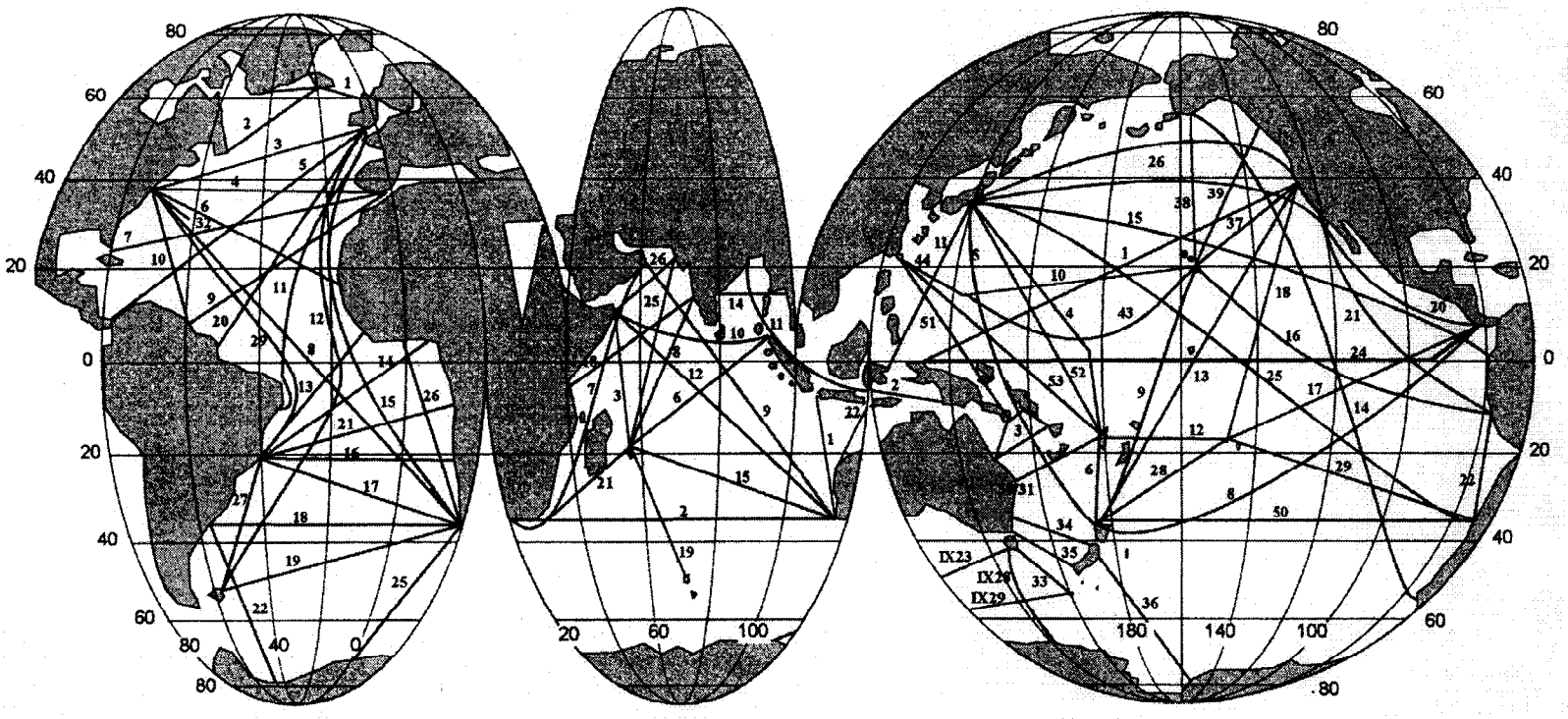


Figure 2

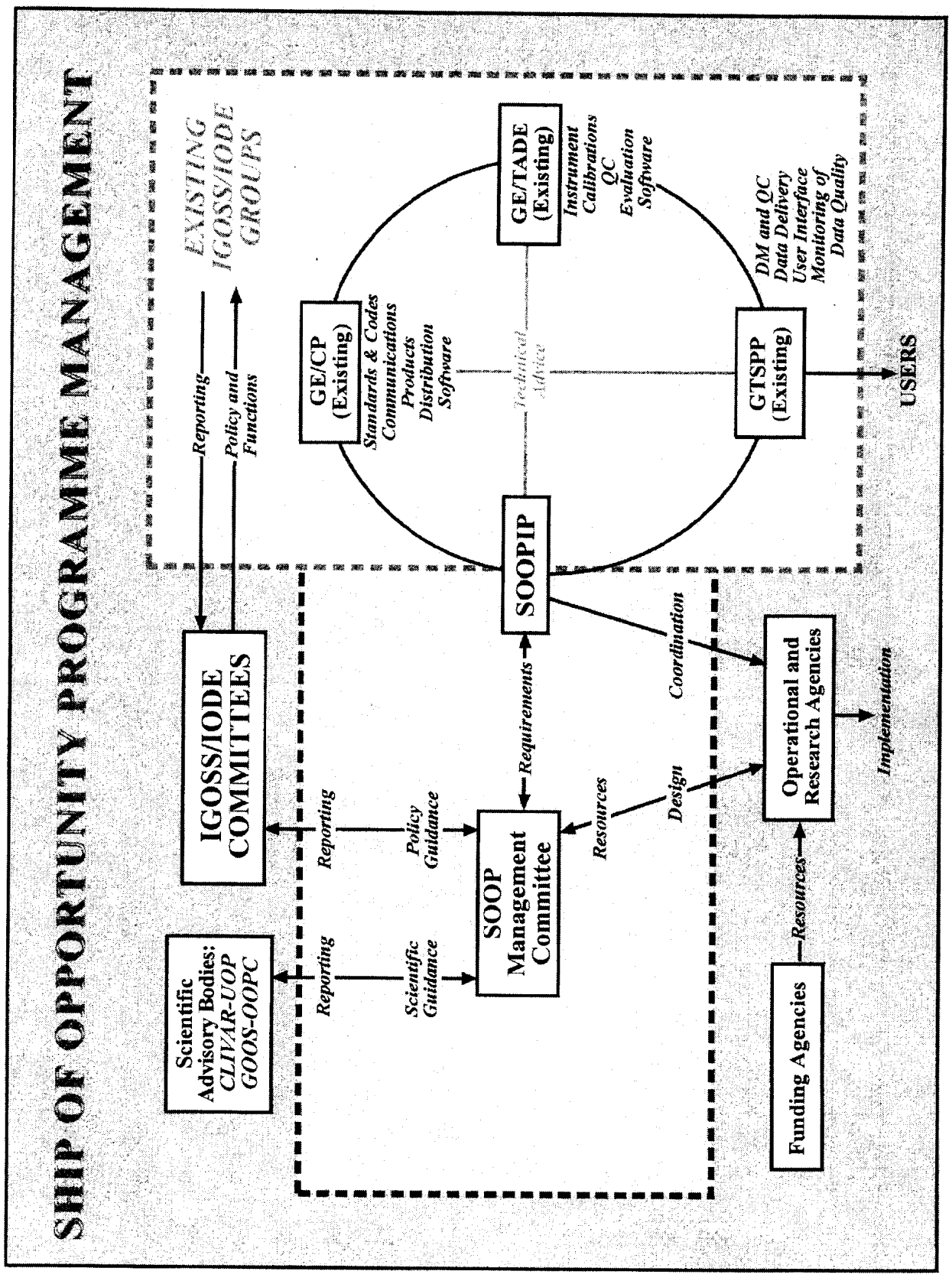

SHIP OF OPPORTUNITY PROGRAMME MANAGEMENT
EXISTING IGOSS/IODE GROUPS
Reporting
Policy and Functions
IGOSS/IODE COMMITTEES
Scientific Advisory Bodies: CLIVAR-UOP GOOS-OOPC
Reporting
Scientific Guidance
SOOP Management Committee
Reporting
Policy Guidance
Resources
Requirements
SOOPIP
Coordination
Design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

Figure 3

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 4

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*

Figure 5

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*

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

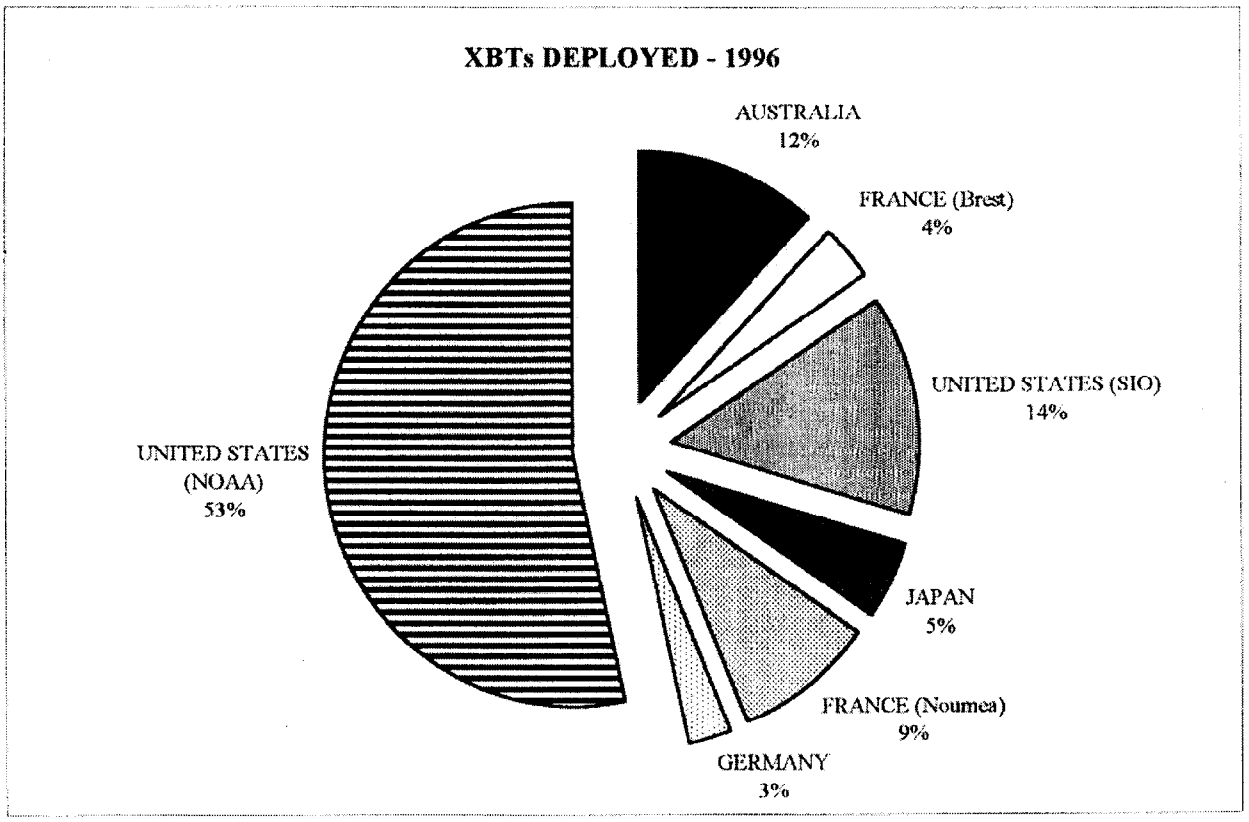
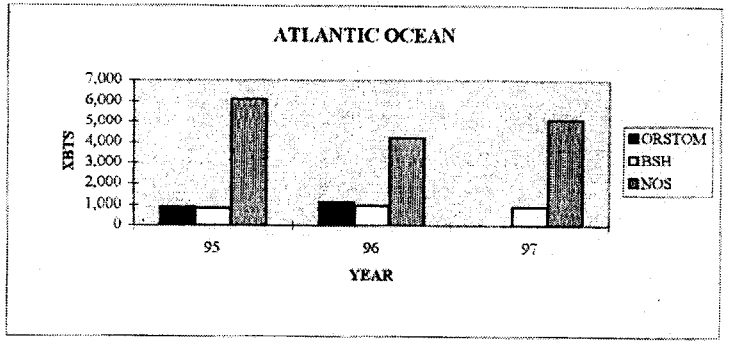


Figure 6

Figure 7

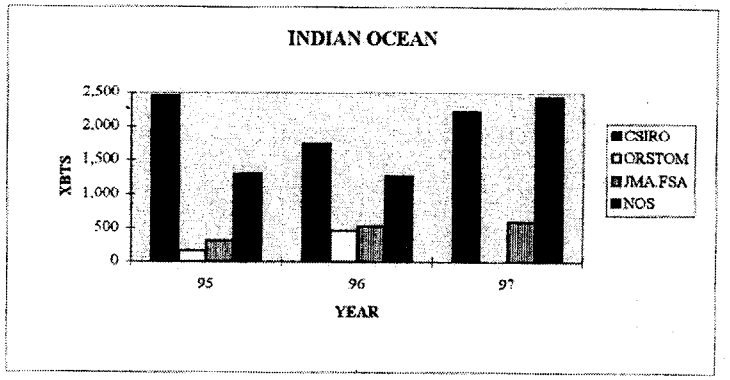
ATLANTIC

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



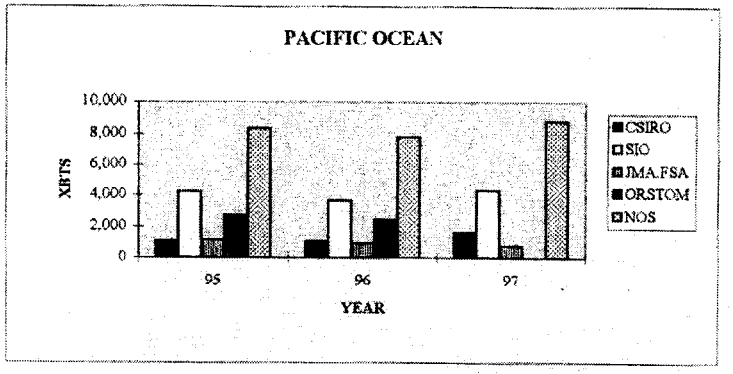
INDIAN

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



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 8

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 - Mulacca 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 9

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 10

4. GLOBAL SEA-LEVEL OBSERVING SYSTEM (GLOSS)

4.1 STATUS

GLOSS is an **operational system** under the auspices of IOC. GLOSS was established by the IOC in 1985 to provide a worldwide mechanism for monitoring global levels, and also to help to develop national capabilities to assess and anticipate changing risks. The basis of the first GLOSS Implementation Plan was the establishment of a network of approximately 300 tide gauge stations distributed along continental coastlines and throughout each of the world's island groups. Since 1990, several major technical developments have taken place, most notably in the ability of satellite radar altimetry to provide reliable and routine measurements of near-global sea level changes. A new Implementation Plan (1997) provides a complete re-assessment of requirements for GLOSS, together with specifications for each component of the system. GLOSS is managed by means of a Technical Secretary at IOC, a set of National and Regional GLOSS Contacts and an international GLOSS Group of Experts. The most recent meeting was GLOSS-V in Pasadena, March 19-21, 1997.

4.2 RESPONSIBILITIES

Responsibilities consist of the provision of an ongoing overview of sea level recording worldwide. This includes: monitoring the status of gauges within the '**GLOSS Core Network**' and scientific and regional sub-networks (including the GLOSS-LTT network for long-term trends; GLOSS-ALT for altimeter calibration; and GLOSS-OC for ocean circulation monitoring); provision of advice and technical support to gauge operators where required; supply of training to sea level scientists and technicians; continuous linkage with related technical areas such as altimetry, GPS and absolute gravity; and definition and implementation of data flow mechanisms.

Responsibilities include ensuring that products are as relevant and as focussed as possible both for scientific research purposes (e.g. study of sea level changes under climate change) and practical coastal studies. For the former, suggestions for formal mechanisms for ongoing scientific advice interchange have been made between GLOSS, OOPC and CLIVAR UOP. For the latter, the development of regional GLOSS activities (IOCARIBE is a good example) is a major means of addressing requirements.

4.3 SERVICES (see GLOSS Implementation Plan for detailed information)

. Data sets provision - Permanent Service for Mean Sea Level; University of Hawaii databank; Southern Ocean Sea Level Centre at Flinders University; 'Fast' and 'Delayed Mode' WOCE Sea Level Centres including ACCLAIM data bank at the BODC delayed mode centre; IAPSO tidal constants at PSMSL; IGOSS sea level anomaly maps in quasi-real time (similar delayed maps from PSMSL).

. Newsletters etc - **GLOSS Bulletin** (web) and **Afro-America GLOSS News** (paper and web). Compilation of GLOSS-related publications and keyword search service at PSMSL.

. Capacity building - Since 1985, over 15 GLOSS training courses have been held in different parts of the world including UK, France, Brazil, China, India, Argentina. Plans are being made for two courses in different continents in 1998.

4.4 PUBLICATIONS

* **Manuals and Guides**: Two manuals on *'How to Operate Tide Gauges'*. A third is planned on *'How to Operate GPS at Gauges'* following the IGS/PSMSL GPS Workshop at JPL in March 1997.
* Three workshop reports on operating gauges in environmentally hostile areas, and in polar areas.
* Two workshop reports on new geodetic techniques (GPS, absolute gravity etc.)

* UNESCO Report for small island states.
* Regional GLOSS/IOC meetings reports.
* PSMSL etc. data holdings reports.
* Tidal analysis software reports from UH, PSMSL and NTF.
* Training course reports following each course.

For a full list of GLOSS-specific publications, see the file '**gloss.pub**' on the PSMSL ftp disk. This excludes the wide range of scientific publications flowing from the GLOSS-related sea level data sets. The scientific assessments of the Intergovernmental Panel on Climate Change represent an important use of GLOSS/PSMSL data sets.

4.5 STRUCTURE

The GLOSS GE has hitherto met approximately every two years, usually alongside a workshop on a relevant technical or oceanographic subject. Future plans are for the complete group to continue to meet at a similar frequency but to take advantage of scientific conferences for at least a regional sub-group to meet every year. For example, the last full GE meeting was March 1997; a West Pacific meeting is planned for July 1998 in Taiwan alongside the WPGM.

Subject to the approval of IOC for the suggested GLOSS/OOPC/CLIVAR scientific study group (which can be considered in a GLOSS context as a sub-group of the GE), meetings will be held of this group typically annually. Technical sub-committees of GLOSS (e.g. a GLOSS Data Coordination Panel, or a Technical Committee recommended by the IGS/PSMSL GPS Workshop) will be based first on email exchange, then meet as opportune. Technical consultants for GLOSS have been proposed but have not been obtained so far due to limited funding.

Day to day development of GLOSS is almost entirely undertaken at present by the Chairman GGE, the present IOC Technical Secretary being a temporary appointment. A permanent position is required at IOC for this important activity. Languages used for GLOSS are primarily English; the AAGN has articles mostly in Spanish and Portuguese. Training courses have been held in the language appropriate for the host country and for attendees.

4.6 OPERATIONAL OBSERVING NETWORK AND DATA EXCHANGE

The PSMSL data set contains data from over 1750 stations of which approximately 1000 are currently operational. The IOC GLOSS system ensures the establishment of a high quality subset of these stations, flagged for global purposes, as far as possible with common operating and reporting standards, with guarantees of longevity.

There are 287 stations in the present '**GLOSS Core Network**' of which 90 percent are operational. Most do not have real-time data reporting. Some are in hostile areas (e.g. Antarctica) with data loggers inspected only once a year. Only a handful have GPS at or near the gauge in order to monitor land movements and provide a calibration system for altimetry.

Mechanisms for data exchange of monthly and annual mean values of sea level, stored at the PSMSL and the basis of most studies of long term sea level change for climate change or geological movements, are long established via FAGS/ICSU. The original requirement for data from GLOSS sites was also only the delivery of monthly and annual data to the PSMSL.

In the new **GLOSS Implemenation Plan**, we now expect contributing organisations to make original (typically hourly) data available. These higher frequency data sets are needed (a) because there is interesting oceanography at higher frequencies, (b) for altimeter calibration and (c) for better quality control. One or more Archiving Centres (e.g. PSMSL) will synthesise the data sets. This requires common standards for formatting and quality control, hence the need for a GLOSS Data Coordination Panel.

Approximately 100 gauges are capable of quasi-real time reporting, e.g. those providing data to the 'Fast' WOCE Centre. 'Real' real-time reporting, for example for storm surge or tsunami warning, is a feature of specialised, usually regional, activities which form important components of regional GLOSS activities. As modems, cellular systems etc. become cheaper and easier, real time reporting will become more common, with benefits to data quality.

5. TAO IMPLEMENTATION PANEL (TIP)

5.1 STATUS

The Tropical Atmosphere Ocean (TAO) Implementation Panel (TIP) has been formed to define strategies that will ensure uninterrupted implementation and long-term maintenance of the TAO array. The TAO Panel was established in 1992 under auspices of the international Tropical Ocean Global Atmosphere (TOGA) program. At the end of TOGA in 1994, sponsorship of the panel shifted jointly to the World Climate Research Program's international Climate Variability and Predictability programme (CLIVAR), the IOC/WMO/UNEP/ICSU Global Ocean Observing System (GOOS) and Global Climate Observing System (GCOS) programmes. The TAO project is managed by NOAA's Pacific Marine Environmental Laboratory in Seattle, Washington, USA. The most recent meeting of the TAO-TIP took place in Reading, UK, 4-6 November 1997.

Most TIP members are representatives of Member States of IOC and WMO which are actively involved in TAO activities. Presently institutes and agencies from the United States, Japan, France and Brazil, and also Taiwan, participate in TAO by contributing critical resources (including ship time, specialized mooring hardware or instrumentation, or funding for operation), to the maintenance and/or expansion of the moored array.

5.2 RESPONSIBILITIES

Services: TIP coordinates technical and logistical support from institutions participating in the maintenance of the array. It also cooperates with organizations such as the WOCE/CLIVAR planning committees to ensure an integrated approach to tropical observational programs. Reports are made regularly to the GCOS/COOS Project Offices and the CLIVAR Scientific Steering Group on the status of the TAO array.

Observations: TIP ensures the rapid dissemination of TAO data to serve both operational and research applications. Near real time surface meteorological and oceanographic data from the tropical Pacific and Atlantic Oceans are provided via Argos on the GTS network in BUOY format to operational weather centers (WWW). TAO works with Argos and DBCP to quality control and monitor GTS transmissions. Data are also provided in near real time to the research community (GOOS/GCOS/CLIVAR) on anonymous ftp and on a Web server. High resolution data are distributed in delayed mode for research purposes.

Technical development and information exchange: TIP promotes new technology and instrumentation for moored buoy applications, impact studies based on buoy data, exchanges of technical information and training between participating countries, and participates in data quality control procedures.

5.3 PUBLICATIONS

- **TAO Implementation Panel Reports** once per year
- Technical reports on instrumentation and calibrations (**NOAA Technical Reports**)
- Scientific publications (see *http://www.pmel.noaa.gov/pubs.html*)
- TAO Web Pages with detailed information on the project:
  http://www.pmel.noaa.gov/toga-tao/

5.4 STRUCTURE

The TAO Implementation Panel meets yearly (September-November) and the working language is English. Membership of the TAO Implementation Panel will be by invitation of the Global Ocean Observing System Project Office, based on recommendations made by the TAO Panel or its sponsors (GOOS/GCOS/CLIVAR). Categories of membership are:

Executive Committee: One representative from each country actively supporting the TAO Array. The TAO Panel chairman and vice-chairman will serve as national representatives on the executive committee. Responsibilities of the executive committee include: coordinating intersessional activities, recommending membership changes, organizing panel meetings, reporting to parent bodies, etc.

Members: Individuals representing institutions (or agencies) that provide resources such as ships, mooring hardware and/or technician time to maintain the TAO array; or individuals having special expertise in analysis and/or interpretation of TAO and other ocean-climate data sets.

5.5 OPERATIONAL OBSERVING NETWORK

The TAO array in the tropical Pacific consists of nearly 70 moored ATLAS and current meter buoys, which transmit via satellite basic marine meteorological, surface, and subsurface data in near-real time. Moorings are typically deployed for a one year period after which the instrumentation is recovered for calibration and refurbishment. The moorings are located between 8N and 8S from 95W to 137E and are maintained primarily through the efforts of the United States, Japan, and Taiwan. Approximately 350 days at sea are required to maintain the array.

The TAO Implementation Panel is also concerned with the PIRATA array in the tropical Atlantic (see section 6), which consists of 5 ATLAS moorings at present with planned deployments of up to 12 buoys in 1999. These moorings are being supported by the United States, France, and Brazil.

Standard sensors consists of surface winds, air temperature, relative humidity, sea surface temperature and ten subsurface temperatures in the upper 500 meters. Ocean currents are also measured at five sites along the equator. Additional sensors including rainfall, radiation, and surface salinity can be added as required by collaborative programs.

Engineering developments continue to incorporate new technology in order to improve data quality and data return from the array.

TAO is now officially supported in the United States by operational funds instead of research funds. This funding is expected to continue for the foreseeable future.

5.6 DATA COLLECTION, EXCHANGE AND MANAGEMENT

5.6.1 Real time

Observations from the TAO moorings are transmitted to shore in real time through Argos. Data are processed and encoded into BUOY code by Service Argos, using calibrations and algorithms supplied by PMEL. Daily averaged subsurface data and several hourly values of surface data are available in real time each day from the moorings. The TAO Project Office works with the Data Buoy Coordination Panel (DBCP) and Service Argos in quality controlling

the real time TAO data. In addition to the GTS data, TAO data are also processed and quality controlled by the TAO Project Office and made available to the community via the World Wide Web (*http://www.pmel.noaa.gov/toga-tao/* and *http://www.pmel.noaa.gov/pirata/*) and anonymous ftp. Quality control checks are performed daily to detect instrumentation failures or calibration problems.

5.6.2 Delayed mode

On-line archives are maintained for all TAO sites. High resolution data (eg, hourly surface data files) are obtained after each buoy is recovered and the data read from onboard storage. These data are processed, quality controlled, and made available via the Web and anonymous ftp within two months after recovery. Current data from subsurface ADCP moorings and traditional current meters are also processed and made available upon completion. Yearly submittals have been made of all TAO data to the USA National Oceanographic Data Center (NODC).

6. PIRATA - A PILOT RESEARCH ARRAY IN THE TROPICAL ATLANTIC

6.1 STATUS

PIRATA is a pilot project carried out in collaboration between Brazil, United States and France, aimed at the establishment of an ocean observing system for the Tropical Atlantic for climate and climate predictability studies. It was conceived in 1995-1996 by a group of scientists as an extension into the Atlantic of the TOGA-TAO Moored Array already completed in the Equatorial Pacific during the TOGA years (1985-1994) for El Nino predictability studies. This decision was one of the results of the Fourth TAO Implementation Panel Meeting held in Fortaleza, in September 1995. A scientific committee was formed with the task of setting up a science-driven proposal for a ocean observing system for the Tropical Atlantic, which was completed in 1996. Implementation of the PIRATA observing system started in 1997, and will be completed during the year 2000. The optimum geographic distribution chosen for the Atlas Buoy Systems (the PIRATA array geometry) was based on scientific criteria, and is not similar to its Pacific Ocean counterpart. Presently there are five Next Generation Atlas Buoys already in place producing data, of a total of twelve planned, and one satellite-transmitting tide gauge, of a total of three. Three island met stations are also planned, one current meter mooring and one equatorial additional met buoy. A total of 20 Atlas systems will be assembled in the US to support continuous operation of the system, with 5 funded by Brazil, 5 by France and 10 by the US. Ship time for deployment is furnished by Brazil and France. A transition of this system from a pilot project phase into a global management framework is expected to be feasible along the lines of the TAO observing system, where other countries will formalise their commitment to maintain and possibly extend the Array.

Members of the PIRATA Executive Committee are from the 3 countries involved: 2 from Brazil, 2 from France and 3 from the United States.

6.2 RESPONSIBILITIES

Observations: Primarily data acquisition from Atlas moorings, tide gauges and meteorological stations, disseminated via Argos on the GTS network in BUOY format; data for the research community is provided on anonymous ftp in both quasi-real time and delayed mode, and through PIRATA homepages. High resolution (10 minute) data is distributed in delayed mode.

Capacity building: Short term training is arranged in a bilateral basis; preparation of research projects, involving the measurement of air-sea fluxes, specialised short-term training courses; seminars and workshops; preparation and exchange of specialised software packages, development of PIRATA homepages from the present-day experimental ones.

Funding: Critical resources are arranged by the 3 countries. The construction and maintenance operations for the Atlas moorings, as well as data delivery, is carried out by the US; Brazil and France are in charge of providing laboratory space for storage and maintenance, and for ship time and general logistics.

6.3 PUBLICATIONS

These include:

- Publication and dissemination through the Web of the **PIRATA Implementation Plan**, to be published in the BAMS.
- PIRATA Executive Committee Meeting Reports.
- PIRATA Cruise Reports.
- Research papers based on PIRATA scientific priorities and data.

6.4 STRUCTURE

The **Executive Committee** comprises seven members from the three countries, co-chaired by two members, who are in charge of representing and promoting PIRATA in the international scientific community.

Members are individuals that took part on the establishment of the Project,and at the same time represent institutions that are collaborating in diverse levels of project execution. These institutions are US-NOAA's Pacific Marine Environmental Laboratory (PMEL), NASA's Goddard Space Flight Center, Columbia University's Lamont-Dorherty Earth Laboratory, Brazil's National Institute for Space Research (INPE), and France's ORSTOM.

Committee meetings were held in February 1996 in Natal, August 1996 in Brest, March 1997 in Seattle, and November 1997 in Rio de Janeiro. Next meeting will be in November 1998, in Abidjan. Questions related to implementation and year-to-year funding are the main themes of discussion.

6.5 OPERATIONAL OBSERVING NETWORK

The PIRATA array already occupies 5 sites between 15°N and 10°S in the Tropical Atlantic, of a total of 12 planned. Moorings have a typical one year lifetime, after which they should be recovered for calibration and refurbishment, and substituted by new ones. Ship time per year is not uniform, varying between 15 and 45 days, the latter to be reached in 1999. Deployment, maintenance and data distribution of meteorological and sea level data from island stations will be an additional task for Brazil and France.

6.6 DATA COLLECTION, EXCHANGE AND MANAGEMENT

Observations are transmitted daily via Service Argos to Toulouse and Seattle (PMEL/NOAA), with a subset of the daily average data (subsurface data) distributed globally via GTS. Some hourly values of surface data are made available each day. All of the daily averaged quality-controlled data are distributed globally through the PIRATA web sites (**http://www.pmel.noaa.gov/pirata and http://www.ifremer.fr/orstom/pirata/pirataus.html**), in the same way as the TAO data.

7. DRIFTING BUOYS

7.1 CURRENT STATUS

In March 1998 data from a total of 1242 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 21 countries (Australia, Brazil, Canada, China, Finland, France, Germany, Iceland, India, Italy, Japan, Korea, Netherlands, New Zealand, Norway, Portugal, South African, Spain, Sweden, Taiwan, United Kingdom, and USA). Of those 1242 drifting buoys, about 52% transmit the data in real time via the Global Telecommunication System (GTS).

For drifting buoys reporting onto the GTS, nearly every buoy measures at least sea surface temperature, and more than 280 measure air pressure. Almost all of those measuring air pressure report on the GTS. About 35 drifting buoys measure wind, and about 105 measure air temperature. Approximately 6% of all drifting buoys have no sensors and are used as Lagrangian tracers only, 25% do not report on GTS because of poor quality (e.g. end of life-time, tests), 7% 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 10% for unknown reasons.

Table 1 shows the total number of different physical buoys per country and the portion of those reporting on GTS for the 14 day period ending 23 March 1998.

Figure 1 shows by country and for the period 9-15 September 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 in February 1998.

Figures 3 through 6 indicate, by Marsden Square, for February 1998, 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 if 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 1998 movement of the reported buoys that passed position and quality control checks.

7.2 QUALITY CONTROL

Twelve Principal Meteorological or Oceanographic Centres for buoy data quality control (PMOC) from nine different countries are participating in the DBCP Quality Control guidelines on a regular basis:

The Australian Bureau Of Meteorology (BOM),
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. In addition, ECMWF, UKMO, CMM, and NCEP produce buoy monitoring statistics on a monthly basis. Those statistics are available from the Internet mailing list and via the DBCP Web. server.

The Guidelines which were formally incorporated in the World Weather Watch in 1992 are very successful in improving the overall quality of drifting buoy data delivered on the GTS. For example, for a total of 1450 buoys that reported onto the GTS during the period 1 August 1996 to 31 July 1997, following 332 status change proposals from PMOCs related to 305 buoys, 171 buoys had their status changed (i.e. 11.8%): 193 buoys or buoy sensors were removed from GTS distribution, no buoy sensors were re-calibrated, and no action has been taken for 30 buoys or buoy sensors (e.g. Principal Investigator denied 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).

7.3 BUOY DATA ARCHIVES

The Responsible National Oceanographic Data Centre for Drifting Buoy data (RNODC/DB) is located in Canada and operated by the Marine Environmental Data Service (MEDS). 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 of Météo France operates the IGOSS Specialised Oceanographic Centre for Drifting Buoy data (SOC/DB).

7.4 DBCP AND JTA

DBCP-13 session was held in La Réunion island, 13-17 October 1997. A scientific and technical workshop was associated with the DBCP session, stressing in applications of buoy data in both meteorology and oceanography. Workshop presentations will be published within the DBCP document series. The Panel decided to organise a similar workshop in association with the next DBCP session, Miami, 12-16 October 1998. The workshop will stress scientific and operational applications of buoy data; moored buoy technology and data applications.

JTA-17 session was held in La Réunion island, 20-22 October 1997. About 1111 PTT.Years had been submitted by the Representatives Of Countries (ROC) for 1998 (as compared to 1158 projected for 1997 based on the first 9 months of the year). The meeting agreed that Representatives of Countries (ROC) had essentially a fixed amount of money to pay to Argos for 1998, the total of which would most likely cover Argos operating costs for that year, based on an unchanged cost per PTT year. It also agreed that for this amount each ROC would be allowed a 35% increase (bonus) in PTT year usage, nominally 35% without further charge or penalty. This increase could be compounded over two years. The basic Argos PTT.Year tariff rate for 1988 was finally unchanged at a level of FF 26000.

7.5 IMPLEMENTATION STRATEGY

The panel is developing a comprehensive implementation strategy plan for itself and its action groups, in support of the requirements of both global programmes and also national/regional projects. Such an implementation strategy would be essential input to the development of a comprehensive GOOS/GCOS implementation strategy. A draft implementation strategy plan was prepared and discussed at the GOOS/GCOS Implementation Workshop on Ocean Observations, Sydney, 3-6 March 1998. It should then be finalised and adopted at the next DBCP session.

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

The European Group on Ocean Stations (EGOS, North Atlantic)

The International Arctic Buoy Programme (IABP)
The International Programme for Antarctic Buoys (IPAB)
The International South Atlantic Buoy Programme (ISABP)
The International Buoy Programme for the Indian Ocean (IBPIO)
The Global Drifter Programme (GDP)
The Tropical Atmosphere Ocean (TAO) array Implementation Panel (TIP)

7.6 TECHNICAL DEVELOPMENTS

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 commercially available. This instrument, which meets both oceanographic research and operational meteorology needs has been deployed in large quantities 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 early March 1998. SVP Barometer drifters are marked as blue dots on the map. Most of SVPBs appear in the South Atlantic, Indian Ocean, and Southern Ocean.

Similarly, prototypes of Lagrangian drifters equipped with wind speed and wind direction sensors (Wind Observation Through Ambient Noise (WOTAN)) have been successfully tested at sea. Such drifters are now commercially available and deployed operationally in small quantities. In addition prototypes equipped with water conductivity (to measure water salinity) and air temperature sensors are now being developed and tested.

Local User Terminals (LUTs) of Cape Town, South Africa, Halifax, Canada, Monterey, USA, and La Réunion Island (Indian Ocean) have been connected to the Argos Global Processing Centres of Toulouse, France, and Landover, USA in order to decrease GTS buoy data availability delays for buoys reporting from ocean areas covered by the LUTs, improve data quality, and enhance data consistency.

7.7 INFORMATION EXCHANGE

DBCP web. Server (http://dbcp.nos.noaa.gov) has been updated to include National reports and DBCP Action Group annual reports. Status information is now available from the server as well as GTS data flow monitoring tools.

The following publications have been published with the DBCP technical document series:

DBCP Document No. 8: Guide to moored buoys and other ocean data acquisition systems (by Eric Meindl);
DBCP Document No. 9: DBCP annual report for 1996;
DBCP Document No. 10: Proceedings of technical presentations made at the 12th session of the DBCP, "Development in buoy and communications technologies".

7.8 GTS CODES

The Panel decided to submit the document reflecting DBCP views on encoding buoy data in BUFR to CBS in 1998 as a formal DBCP request. Small modification was made and implemented with the FM 18-X BUOY code to deal with Argos location quality classes.

Table 1: Number of drifting buoys by country and those reporting via the GTS (based on actual transmissions in the 14 day period preceding 03/23/98)

ORGANIZATION	COUNTRY	TOTAL	GTS
Alfred Wegener Institute	Germany	11	10
Antarctic Division - Department Science And Technology	Australia	2	2
Bedford Institute of Oceanography	Canada	40	21
Bermuda Biological Station for Research, Inc.	USA	1	0
Bureau Of Meteorology	Australia	13	12
Bureau of Mineral Resources	Australia	2	0
CLS, Service Argos	France	6	0
Christian Michelsen Research	Norway	1	0
Coast Guards	Canada	1	0
Cobrecaf	France	2	0
Cubic I	Japan	2	0
Environment Canada	Canada	2	2
Etablissement Principal du Service Hydrologique et Oceano. de la Marine	France	32	20
Global Drifter Center	USA	39	37
Icelandic Meteorological Office	Italy	1	1
Informatique Electronique Securite Maritime	France	6	0
Institut Français de Recherche pour l'Exploitation de la Mer (IFREMER)	France	40	0
Institute Of Ocean Sciences	Canada	4	0
Instituto De Meteorologia	Portugal	1	0
Instituto Nacional de Pesquisas Espaciais	Brazil	7	0
Instituto Universitario Navale	Italy	8	0
Japan Marine Fisheries Research Center	Japan	1	0
Japan Marine Sciences and Technology Centre	Japan	4	2
Korea Ocean Research & Development Institute	Korea	1	0
Laboratoire d'Océanographie Dynamique et de Climatologie (LODYC)	France	1	0
Lamont Doherty Geological Observatory	USA	5	0
Marine Biological Association	UK	5	0
Maritime Safety Agency, Hydrographic Department	Japan	37	0
Meteo France	France	18	15
Meteorological Office	UK	36	22
Meteorological Research Institute	Iceland	7	0
Meteorological Service of New Zealand, Ltd.	New Zealand	8	8
Minerals Management Service	USA	13	0
NATO SACLANT Undersea Research Centre	Italy	14	3
NOAA Atlantic Oceanographic And Meteorological Laboratory	USA	5	2
NOAA Great Lakes Environmental Research Laboratory	USA	7	0
NOAA National Data Buoy Center	USA	8	2
NOAA National Marine Fisheries Service	USA	1	0
NOAA Pacific Marine Environmental Laboratory	USA	18	4
National Ice Center	USA	14	5
National Institute Of Oceanography	India	13	7
Naval Oceanographic Office	USA	101	65
Naval Postgraduate School	USA	45	35

ORGANIZATION	COUNTRY	TOTAL	GTS
Nederlands Instituut Voor Onderzoek Der Zee	Netherlands	2	0
North American CLS, Inc.	Peru	2	0
Norwegian Hydrotechnical Laboratory	Norway	1	0
Norwegian Meteorological Institute	Norway	4	3
Oceanor	Norway	4	0
Royal Netherlands Meteorological Institute	Netherlands	2	2
Scripps Institution of Oceanography	USA	388	288
Sea Fisheries Research Institute	South Africa	1	0
Seikai National Fisheries Research Institute	Japan	1	0
Service Argos, Inc.	USA	3	0
South African Weather Bureau	South Africa	58	54
South China Sea Sub-bureau Of NBO	China	2	0
Southampton Oceanography Centre	UK	3	0
Swedish Meteorological and Hydrological Institute	Sweden	1	0
System Development, Inc.	USA	1	0
Technocean	USA	27	0
Tokai University	Japan	2	0
US Coast Guards, International Ice Patrol	USA	8	3
Universite Du Littoral	France	1	0
University National Of Taiwan	Taiwan	1	0
University Of Alaska	USA	6	0
University Of Hawaii	USA	7	0
University Of Helsinki	Finland	1	0
University Of Kiel	Germany	20	0
University Of Miami	USA	28	18
University Of Oregon	USA	26	5
University Of Tokyo	Japan	6	0
University Of Washington	USA	1	0
Wimpey Environmental	UK	3	0
Woods Hole Oceanographic Institute	USA	49	2
TOTAL		**1242**	**650**

Figure 1: 3D Histogram showing distribution of mean number of obs. by country & sensor, 9-15 Sept. 1997

Figure 2 : Météo France Marsden Square count of BUOY GTS reports, February 1998

Figure 3 : Météo France Data Availability Index Map (pressure) , February 1998

Figure 4 : Météo France Data Availability Index Map (air temperature) , February 1998

Figure 5 : Météo France Data Availability Index Map (sea surface temperature) , February 1998

Figure 6 : Météo France Data Availability Index Map (wind) , February 1998

Figure 7 : MEDS Global map of buoys reporting on GTS, January 98

Figure 8 : Evolution of the number of buoys and messages archived at RNODC/DB from Jan. to Dec. 1997

Figure 9: AOML Status of Global Drifter Array, early March 1998

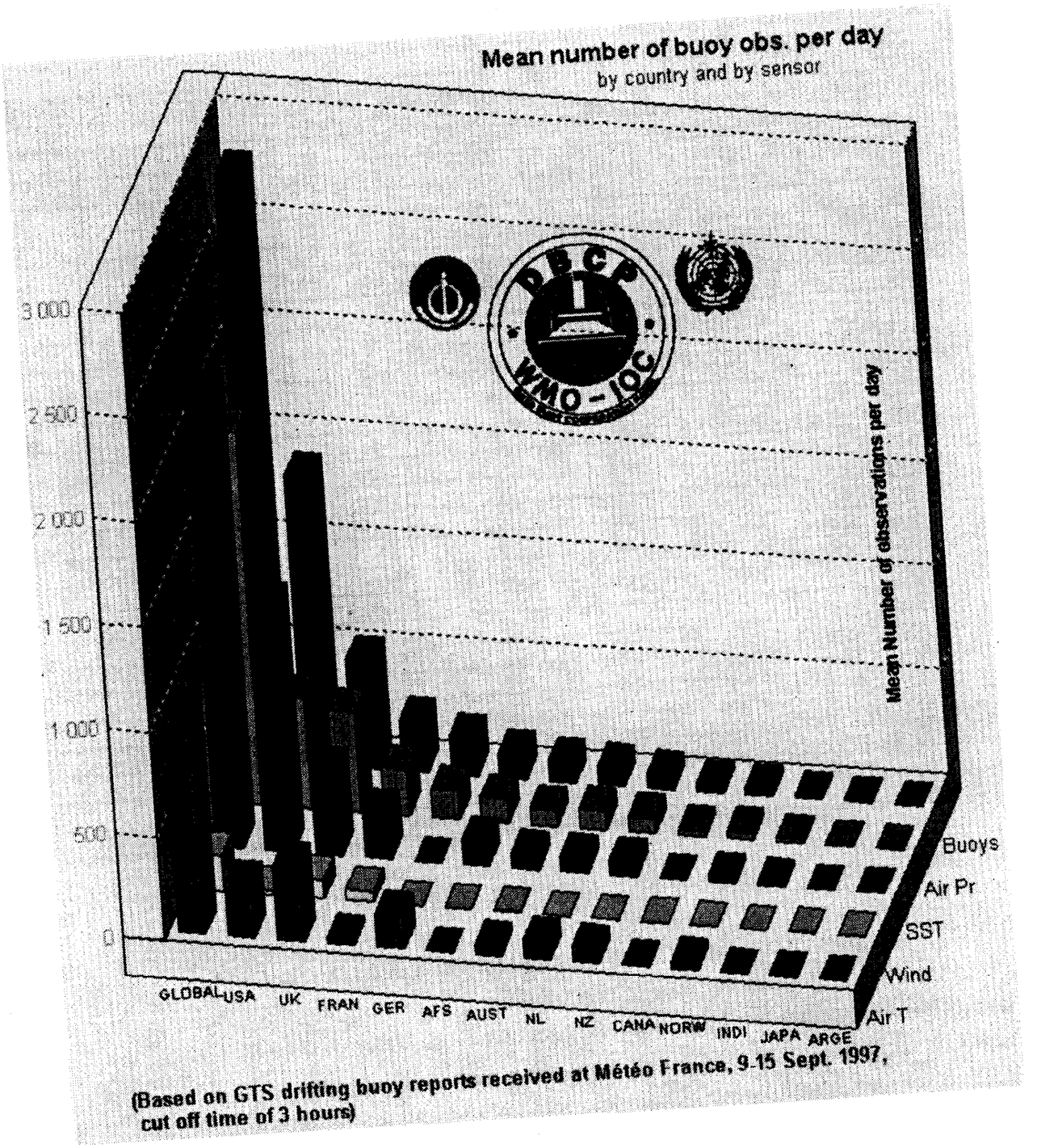

Mean number of buoy obs. per day
by country and by sensor
3 000
2 500
2 000
1 500
1 000
500
0
Mean Number of observations per day
Buoys
Air Pr
SST
Wind
Air T
GLOBAL USA UK FRAN GER AFS AUST NL NZ CANA NORW INDI JAPA ARGE
(Based on GTS drifting buoy reports received at Météo France, 9-15 Sept. 1997,
cut off time of 3 hours)

Figure 1

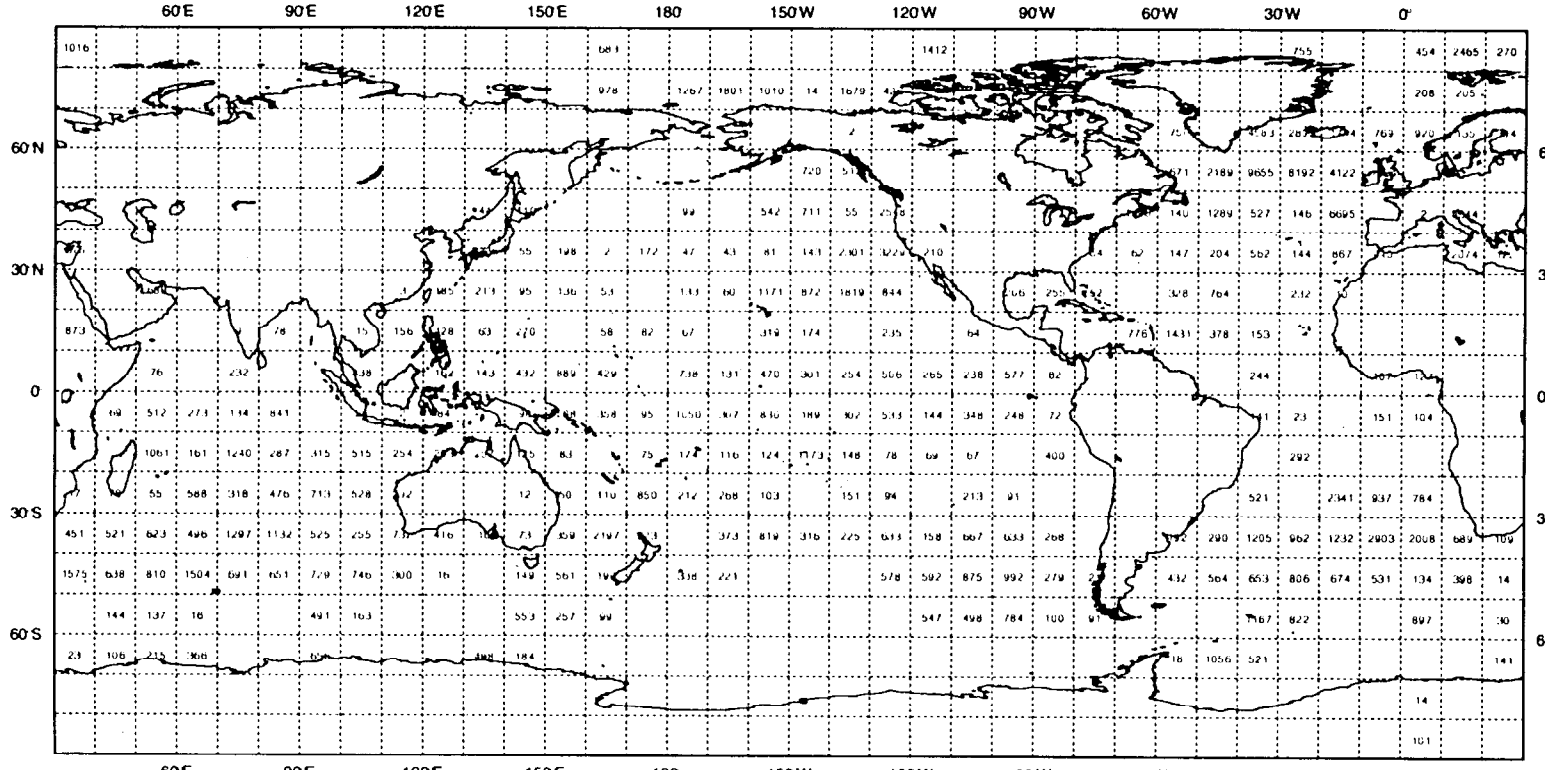
METEO FRANCE

METEO-FRANCE SMISO

Repartition par carre Marsden des observations recues en Fevrier 1998

Marsden square distribution chart of data received during February 1998

Messages : BUOY **Total : 184345**



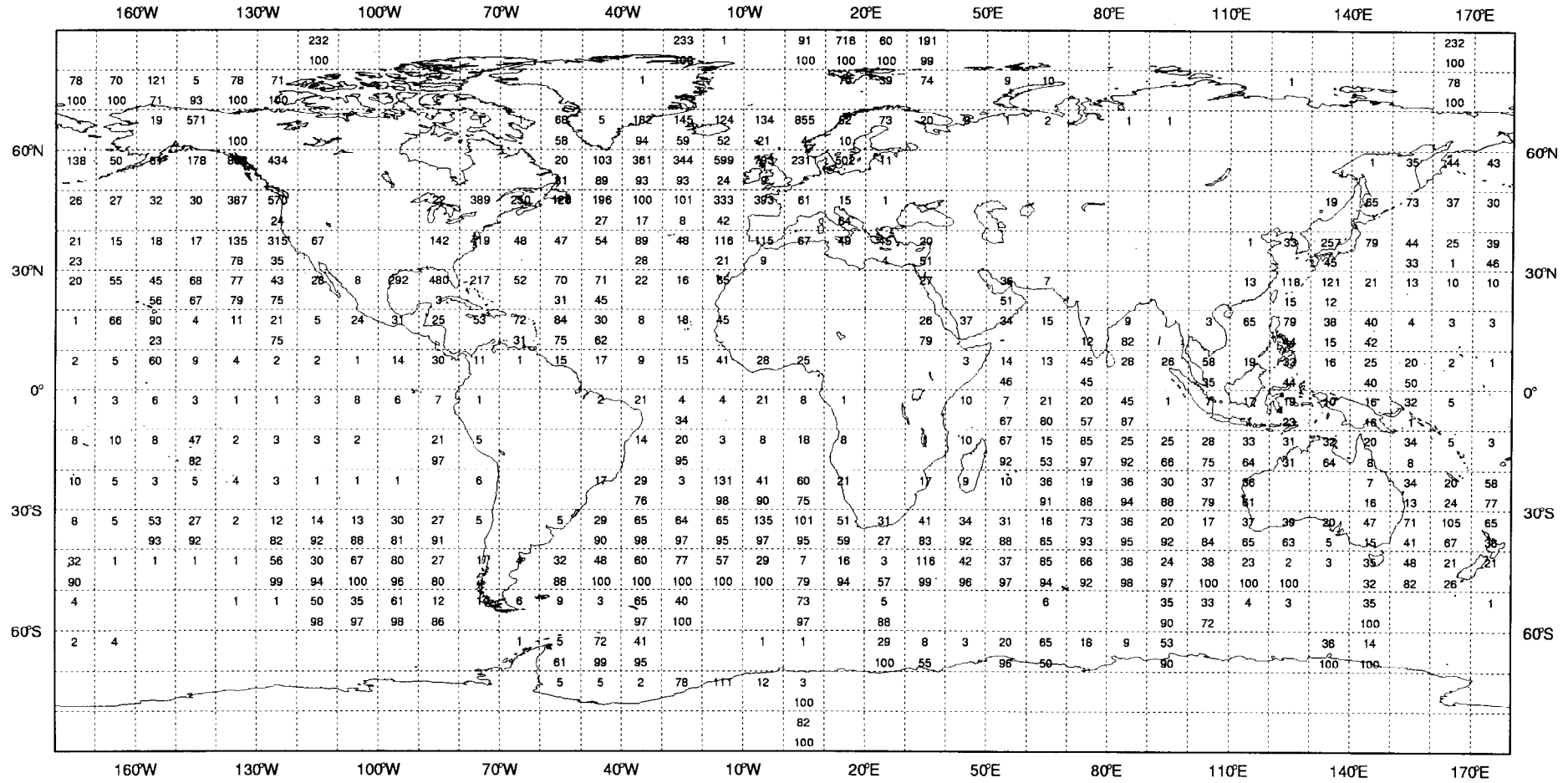
MAGICS 4.2 Solaris - mpma497 - 17 November 1998 10:41:36

Figure 2

METEO
RANCE

METEO - FRANCE **PRESSURE** **FEBRUARY 1998**

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)

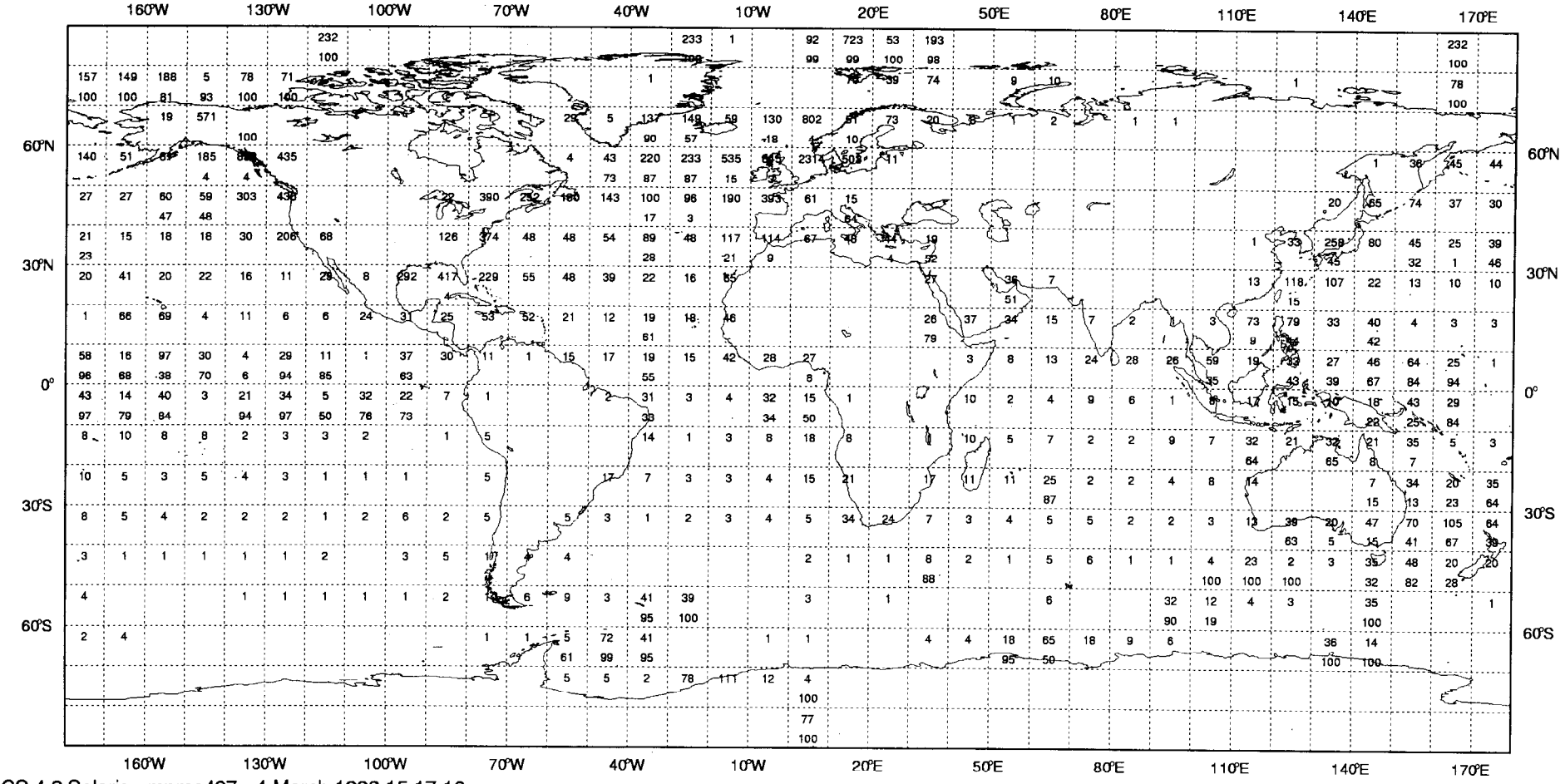


MAGICS 4.2 Solaris - mpma497 - 4 March 1998 15:17:03

Figure 3

METEO - FRANCE **TEMPERATURE** **FEBRUARY 1998**

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)



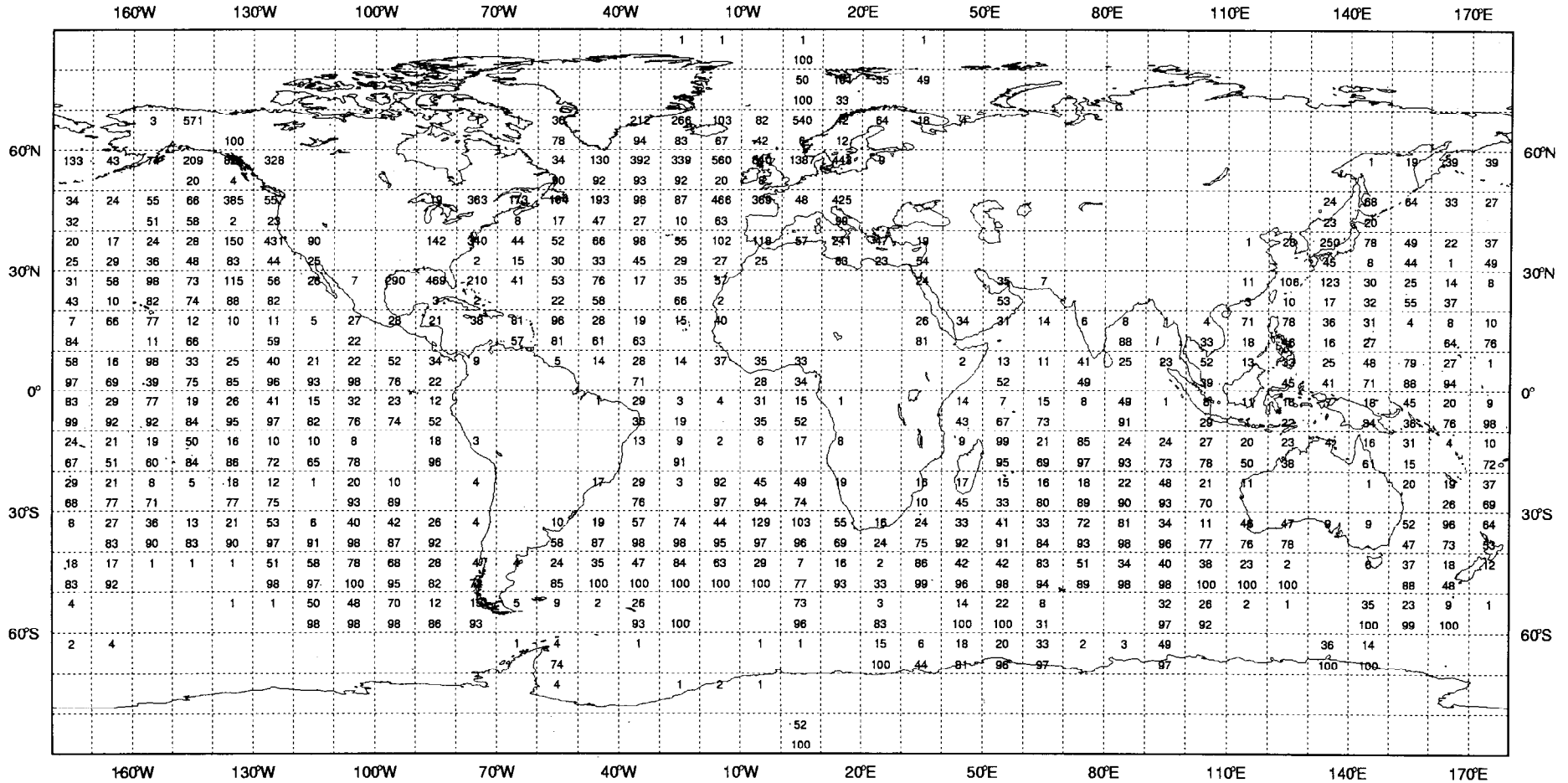
MAGICS 4.2 Solaris - mpma497 - 4 March 1998 15:17:16

Figure 4

METEO
RANCE

METEO - FRANCE **SEA SURFACE TEMPERATURE** **FEBRUARY 1998**

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)



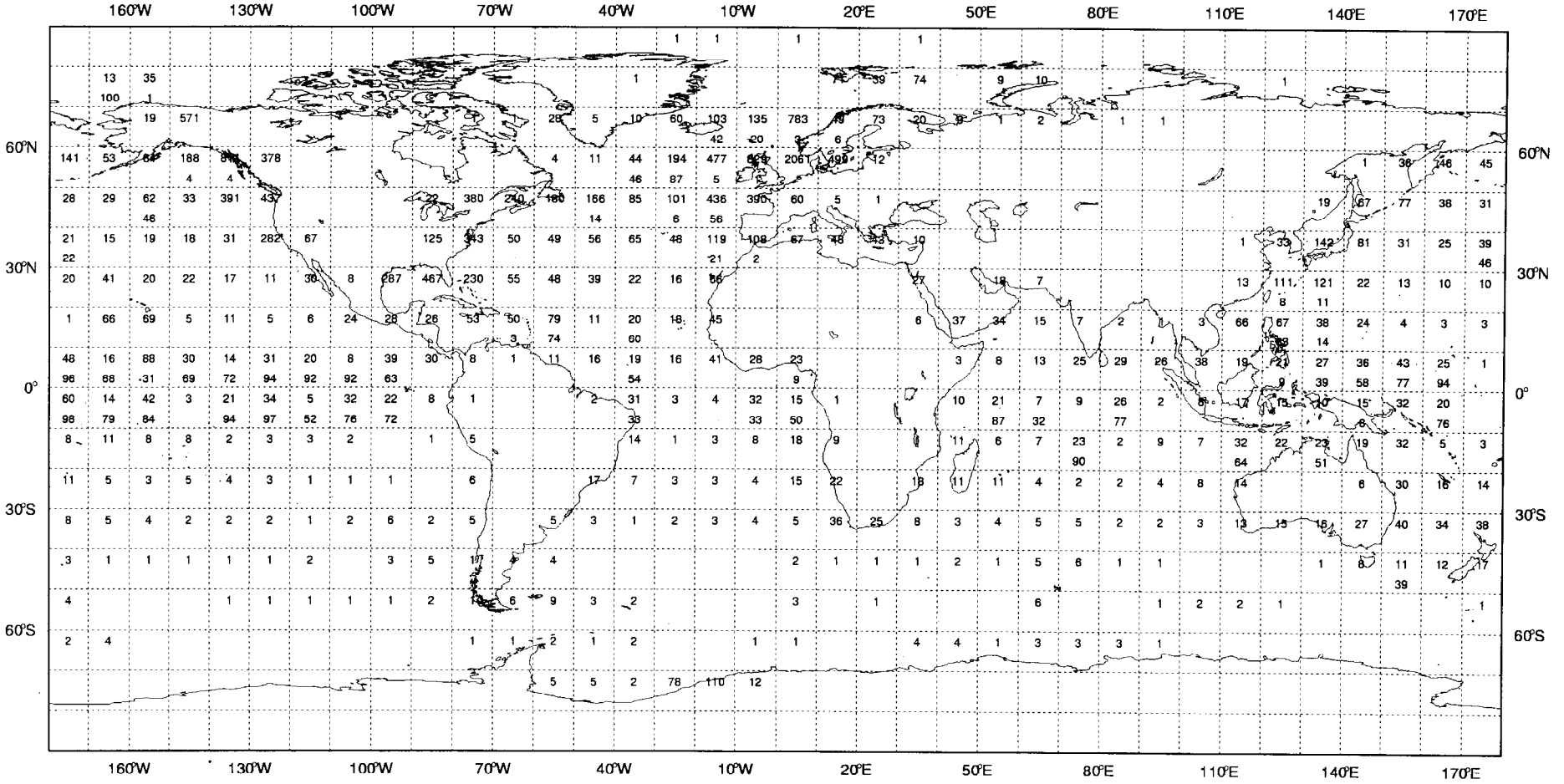
MAGICS 4.2 Solaris - mpma497 - 4 March 1998 15:17:07

Figure 5

METEO
RANCE

METEO - FRANCE **WIND** **FEBRUARY 1998**

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 - 4 March 1998 15:17:11

Figure 6

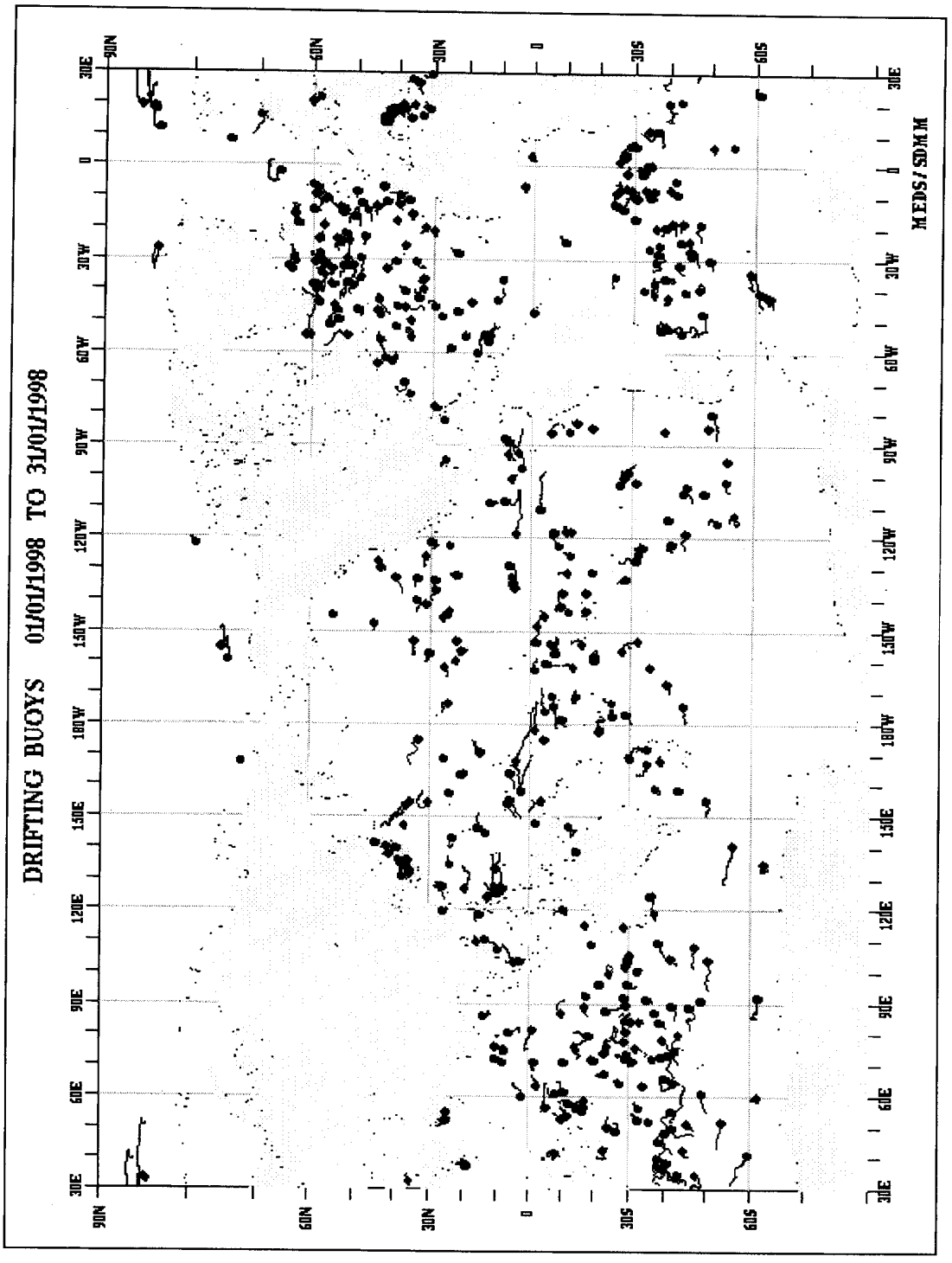


Figure 7

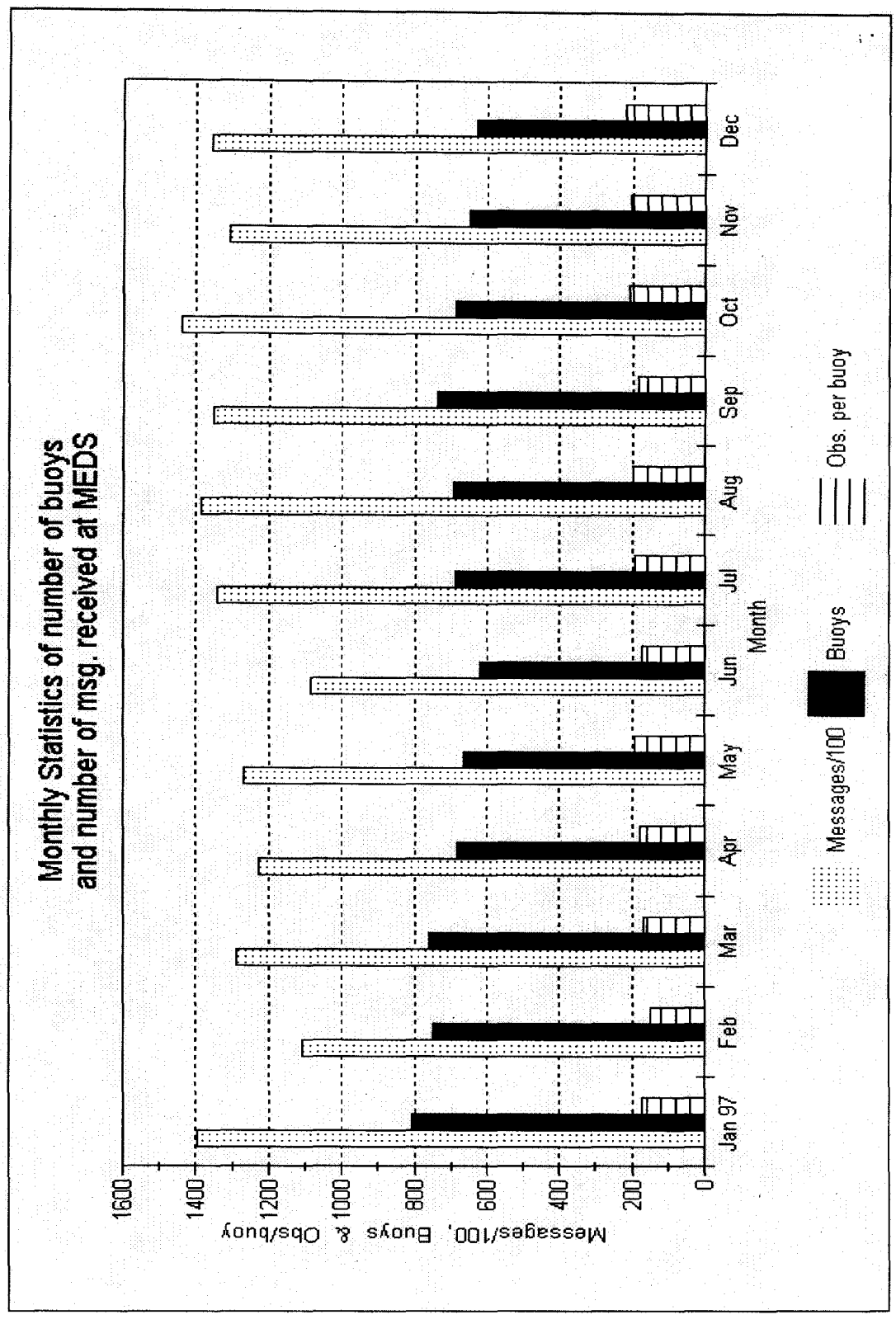
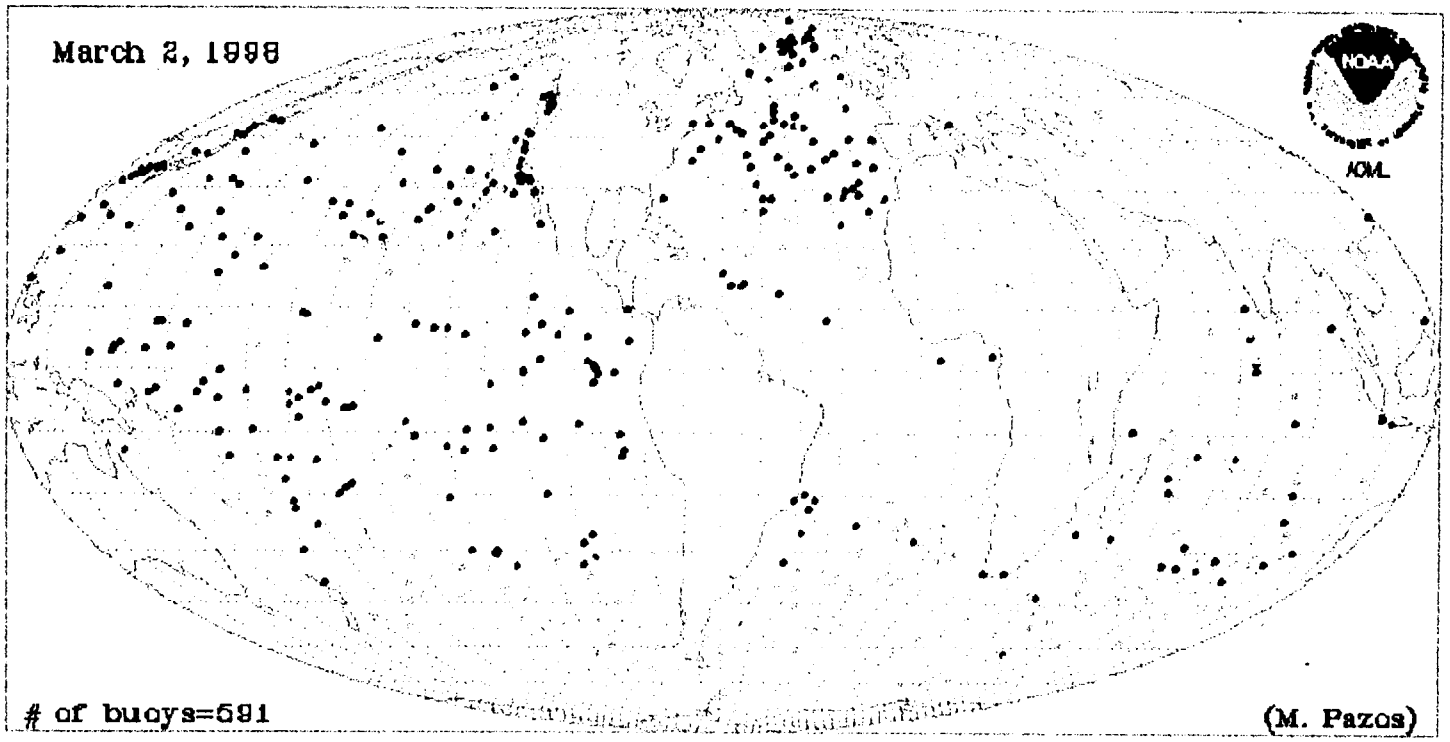

Monthly Statistics of number of buoys
and number of msg. received at MEDS
Messages/100, Buoys & Obs/buoy
1600
1400
1200
1000
800
600
400
200
0
Jan 97
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Month
Messages/100
Buoys
Obs. per buoy

Figure 8

STATUS OF GLOBAL DRIFTER ARRAY



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

GLOBAL DRIFTER PROGRAM
Peter Niiler
Mark Swenson

Figure 9

8. INTERNATIONAL OCEANOGRAPHIC DATA EXCHANGE (IODE)

8.1 STATUS

The IOC's **Committee on International Oceanographic Data and Information Exchange** (IODE) was established in 1961 by the IOC as an intergovernmental mechanism to improve the management and exchange of marine data in delayed mode. Subsequently IGOSS was established for real-time collection, exchange and processing of oceanographic data (see Section 3.3). Today, IODE consists of over 65 member countries and with more than 40 **National Oceanographic Data Centres** and **Designated National Agencies** providing data management services to their countries and assisting the global exchange of data.

8.2 RESPONSIBILITIES

IODE was established to :

> *"enhance marine research, exploration, and development by facilitating the exchange of oceanographic data and information between participating Member States."*

With the advance of oceanography from a science dealing mostly with local processes to one which is also studying ocean basin and global processes, researchers depend critically on the availability of an international exchange system to provide data and information from all available sources. Additionally, scientists studying local processes benefit substantially from access to data collected by other Member States in their area of interest. The success of the IODE programme depends on the support of participating Member States, and the involvement of many individual institutions and marine scientists, who contribute not only data, but also the necessary expertise to maintain and further develop the IODE system.

8.3 PUBLICATIONS

IODE produces a range of publications and other material in support of marine data management and data exchange processes. These range from **Manuals and Guides** on the creation of National Oceanographic Data Centres through to data quality control procedures and data exchange formats. There are other products such as the **OceanPC** suite of software for marine data management, analysis and display of oceanographic data as well as a 'shoe box' of data management software.

8.4 STRUCTURE

The **IODE Committee** provides the direction and coordination for the operation of the IODE program. The physical composition of IODE is a network of agencies, data centres, expert groups and specific projects that provides a framework for the management and exchange of data. This 'infrastructure' also undertakes the development of standards, introduces new technologies and undertakes a range of training and technology transfer activities.

8.4.1 Designated National Agencies

Some Member States that have not established National Oceanographic Data Centres have instead officially assigned the responsibility of international exchange of oceanographic data and information to some other agency within the Member State. These agencies are referred to as **Designated National Agencies** (DNAs). DNA's are generally smaller agencies with few resources but with an interest in the coordination of marine data management.

8.4.2 National Oceanographic Data Centres (NODC)

National Oceanographic Data Centres are funded agencies with an endorsed government responsibility for the management, exchange and archiving of oceanographic data in the national interest. NODCs actively exchange data within their region and with other centres within the IODE program such as the World Data Centres. This facility acquires, processes, quality controls, inventories, archives and disseminates data in accordance with national responsibilities. In addition to disseminating data and data products nationally, NODCs are normally charged with the responsibility for conducting international exchange. Here, the most fundamental responsibility of the NODC within the IODE is to actively seek and acquire from national sources those data which are exchangeable internationally, and to process and quality control the data and submit them in a timely fashion to the appropriate WDC for Oceanography or RNODC. In return, the NODC can request and receive from the WDCs for Oceanography or RNODCs similar data or inventory information which they need for their own requirements.

8.4.3 Responsible National Oceanographic Data Centres (RNODC)

Some countries operate **Responsible National Oceanographic Data Centres** in association with the NODC's. RNODC's assist the World Data Centres in a specific area, such as a specific type of data or data exchange formats or they may cover a specific regions such as the RNODC Southern Ocean. Existing RNODCs include :-

- RNODC-Southern Oceans
- RNODC for Drifting Buoy Data
- RNODC for IGOSS (BATHY and TESAC)
- RNODCs for Marine Pollution Monitoring (MARPOLMON)
- RNODC for IOC Sub-Commission for the Western Pacific (WESTPAC)
- RNODC for Indian Ocean
- RNODC for JASIN
- RNODC-Formats
- RNODC-Acoustic Doppler Current Profiler (ADCP)

8.4.4 World Data Centres (WDC)

The top of the data exchange pyramid are the **World Data Centres (WDC) for Oceanography,** which form part of the network of data centres established by the International Council of Scientific Unions (ICSU). WDCs receive oceanographic data and inventories from NODCs, RNODCs, marine science organisations, and individual scientists. These data are collected and submitted voluntarily from national programmes, or arise from international cooperative ventures. On request, the WDCs provide copies of data, inventories and publications to NODCs/DNAs, to RNODCs and to international co-operative programmes, as appropriate, in exchange, or with a charge not to exceed the cost of providing the service. Another major responsibility of the WDCs for Oceanography is to monitor the performance of the international data exchange system and report their findings to the IOC Secretariat and the IODE Committee. The Committee can use this information to take appropriate action to correct deficiencies in the international exchange system.

There are currently three World Data Centres (Oceanography):

- WDC-A: United States (Silver Spring)
- WDC-B1: Russian Federation (Obninsk)
- WDC-D: China (Tianjin)

8.5 ACTIVITIES

The IODE program undertakes a wide range of activities. Some of the more significant ones include the :-

- **Global Ocean Data Archaeology and Rescue (GODAR)** program which has increased the global data base with in excess of 1.5 million oceanographic observations.

- **Global Temperature and Salinity Profile Program (GTSPP)** which is a joint program with the IOC/WMO Integrated Global Ocean Services System (IGOSS) and provides a highly successful model of 'end-to-end' marine data management, merging both near real-time and delayed mode data streams. The approach used in GTSPP, which integrates IGOSS, IODE and the scientific community in to an effective data management mechanism is considered a model for the GOOS requirements (for more on the GTSPP, see Section 9).

- **Marine Environmental Data Inventory (MEDI) Pilot Project** which is developing a global inventory of marine data sets (metadata) and is compatible with other global data inventory or data directory services such as those being developed by CEOS and NASA with the Global Master Change Data Directory. The MEDI Pilot Project is also compatible with the metadata pilot project being developed by the G3OS Joint Data and Information Management Panel (J-DIMP).

- **OceanPC** which is a suite of PC software for the management, analysis and display of oceanographic data in all parts of the world. The package is in use with over 400 marine scientists and data managers.

9. GLOBAL TEMPERATURE AND SALINITY PROFILE PROGRAMME (GTSPP)

9.1 STATUS

The GTSPP is a joint IOC/WMO project that knits together both real-time (typically IGOSS) and delayed mode (typically IODE) data collections of global ocean temperature and salinity observations into a single programme. Participants are governmental and scientific organizations in various countries who support their contributions to GTSPP through their own budgets. It was initiated jointly by the Intergovernmental Committees for IGOSS and IODE in 1989 as a pilot project, and converted to a long-term programme in 1996.

Tasks in the GTSPP are shared amongst the participants. Real-time data processing services are provided by the **Marine Environmental Data Service (MEDS)** of Canada. The **U.S. NODC** provides data processing services for delayed mode data and maintenance of the **Continuously Managed Database, CMD**. AOML, CSIRO and Scripps provide scientific advice and assessment of the data handled by the project. Through cooperation with WOCE, the WOCE Subsurface Data Centre in Brest has also contributed data and expertise. Other data centres in IODE provide data to the project as they are processed. Cooperation with the GODAR Project also brings data into the GTSPP.

9.2 RESPONSIBILITIES

Observations: The GTSPP concerns itself with temperature and salinity profiles collected from the world's oceans. Other observations made in association with the T and S profiles, such as other profiles or surface marine observations, are also carried with the data.

Services: One of the goals of the GTSPP is to provide data of the highest possible quality as quickly as possible to users. The foundation of this goal is the CMD. This database holds both real-time and delayed mode data. Where both the real-time and delayed mode data exist from a particular location and time, the delayed mode is retained in the CMD because it represents the highest resolution and highest quality data. The contents of the CMD are available upon request from the U.S. NODC.

9.3 PUBLICATIONS

In cooperation with other partners this includes:

- **IOC Manuals and Guides #22**
- **CSIRO Quality Control 'Cookbook'**
- **AOML Quality control manual**
- All meeting reports
- GTSPP CD ROM

9.4 STRUCTURE

The **GTSPP Steering Committee** meets as required to continue the operation of the programme. Meetings have been jointly held with WOCE committee meetings to reduce costs. In the last few years of the programme, meetings have been roughly 18 months apart. The Chair of the GTSPP Steering committee was elected at the start of the Project and this post has been held by the same person since then.

The GTSPP functions by actions undertaken by participants to achieve common goals agreed to at the meetings. Since it is a collection of volunteer organizations, adjustments are always needed to accommodate changes in levels of participation of members. These adjustments are made by current members taking on new roles or by recruiting new members.

9.5 OBSERVING NETWORK

The GTSPP takes advantage of a number of services and infrastructures available at both the international and national levels. Internationally, the WMO provides the use of the GTS for the transmission of oceanographic messages through the IGOSS programme. GTSPP uses this service to acquire the data exchanged this way.

Some nations have developed an extensive infrastructure to provide and service ships of opportunity in the collection of temperature (and some salinity) profiles around the world. These programmes have become a key component of the SOOP, and GTSPP provides the data management component.

Many nations undertake both monitoring and research data collection programmes at sea. These may be through autonomous instruments, such as floats, or from ships. Data collected are provided to their National Oceanographic Data Centres or to RNODCs of the IODE system. From them, T and S data are provided to the GTSPP for inclusion in the programme.

9.6 DATA EXCHANGE AND MANAGEMENT

Real-time data are managed by MEDS. The data are received and processed through quality assessment and duplicates resolution software three times each week. At the same schedule, the data are transferred to the CMD held in the U.S. Users who require fast availability to these data can contact MEDS for this service. MEDS provides response to one time requests or routine downloads of the data received. At present there are both Canadian and international users of the service.

Monitoring of the exchange of real-time data takes place primarily at MEDS. Each month MEDS reviews data from ships that show a more than 10% failure rate on profile data. Systematic problems are noted and ships operators are notified by email. Those ships that have had problems consistently over time are specially noted in the report.

GTSPP also monitors the data received by 4 different centres acquiring GTS data around the world. These include the Germans, Japanese and a U.S. site. Each month a report is prepared comparing the data received from North American sites and then shortly afterwards from all of the sites. Discrepancies noted by these reports are used to track down problems with data getting to the GTS or getting sent around the world.

GTSPP has also participated in special and routine monitoring projects of the GTS run by WMO.

Delayed mode data are managed by the U.S. NODC. They accept the real-time data from MEDS and update the CMD when data are received. Delayed mode data are acquired either from other NODCs, or from cooperation with projects such as WOCE, GODAR and SOOP. Users are supported in a simiar manner as at MEDS. Some of the data are also available through the Internet.

Through comparisons with the holdings of the **WOCE Subsurface Data Centre** in Brest and the U.S. NODC, discrepancies in content have been corrected. Scientific data quality assessment has been provided on yearly files by the scientific institutions noted above. Not only does this provide another level of assessment, but promotes the collaboration and exchange of expertise between scientific and data management personnel.

10. MIM (MARINE INFORMATION MANAGEMENT)

In 1998, the MIM Programme concentrated on (I) the development of a RECOSCIX-WIO network for the IOCEA region; (ii) the migration of RECOSCIX-WIO as a marine information management network towards an integrated information and data management network; and (iii) the continued development of the Global Directory of Marine (and Freshwater) Professionals.

Thanks to financial support from Flanders (Kingdom of Belgium) the IOC was able to launch RECOSCIX-CEA (Regional Co-operation in Scientific Information Exchange in the Central Eastern Atlantic). This project, building on the experiences of the RECOSCIX-WIO network developed for the IOCINCWIO region by IOC with support from Sweden and Belgium, will build a regional information exchange and services network for about 20 countries in West and South Africa..

The RECOSCIX-WIO project, which has now come to maturity (but will continue under IOC and Flemish support), will, through the development of the ODINEA (Oceanographic Data and Information Network for Eastern Africa) programme, evolve into an integrated data and information exchange and management network. In 1997 the programme was launched with a 10-day training course in ocean data management (Mombasa, Kenya) attended by over 20 participants from the region. In 1998 the programme continued with the provision of powerful personal computers to the participating institutions in the region, and with the organization of a 10-day regional data management workshop (Capetown, South Africa). Within the framework of ODINEA special efforts will be made to assist IOCINCWIO Member States with the development of National Oceanographic Data Centres (NODC) or Designated National Agencies (DNA). It is planned that the IOCEA region will gradually follow the same evolution within the ODINAFRICA project (Oceanographic Data and Information Network for Africa).

Responding to the success of the IOC website in 1996, continued through 1997, UNESCO provided a new webserver providing substantial additional storage space and functionality and allowing immediate and continuous updating of the web pages. The IOC website has now been sub-divided into programme sites (each programme having its own sub-site) which are all linked to the IOC 'home'site (http://ioc.unesco.org) The IODE site (http://ioc.unesco.org/iode) was entirely revised. 1998 has also seen the launching and further development of a variety of web-based information services: (i) the GLODIR (Global Directory of Marine (and Freshwater) Professionals) was redesigned allowing for on-line and real-time creation, editing and searching (http://ioc.unesco.org:591/glodir). The new system also allows for automatic emailing of update requests to individuals included in the database (this exercise was carried out in July

1998); (ii) in cooperation with EURASLIC, IOC developed the EURASLIC Directory of European Aquatic Science Libraries and Information Centres (http://ioc.unesco.org:591/euraslic); (iii) the Ocean Pilot (database of ocean related URLs) was remodeled to allow on-line input of new sites (http://ioc.unesco.org:591/oceanpilot).
In the IOC website the news service 'IMS Newsletter on-line' has been completely overhauled and revitalized. Following the success of the 'Activuties and Events' of the '1998 International Year of the Ocean' website, an on-line 'Ocean Activities & Events' database system has also been launched as part of the IOC website.

11. GLOBAL CORAL REEF MONITORING NETWORK (GCRMN)

Coral reefs support some of the highest levels of biological diversity in the marine environment and provide food and livelihood especially in subsistence communities in developing countries. There are estimates that 10% of reefs are degraded beyond recovery and 30% are likely to decline further in the next 20 years.

The International Coral Reef Initiative (ICRI) was established at the UN Global Conference on Sustainable Development of Small Islands and Developing States. The GCRMN program resulted from an ICRI workshop in 1995. IOC, UNEP and IUCN are co-sponsors, IOC coordinates the program. It is part of the Coastal Module of GOOS. Support for the program has come largely from the US, Australia, Japan and the UK.

Included in the objectives of the program is to develop and implement a mechanism to link governments, organizations, institutions and individuals for the long term monitoring of biophysical and social and economic aspects of coral reefs throughout the world within five years.

The program is coordinated by a Global Coordinator, a full time position currently contracted through the Australian Institute of Marine Science. A Management Group consisting of the three aforementioned sponsors as well as the Australian Institute of Marine Science, ICRI Secretariat, International Center for Living Aquatic Resources Management (ICLARM) and the Chair of the Science and Technical Advisory Committee. This group provides advice on policy, strategy and funding opportunities. A Strategic Plan was published in August 1997.

Data resulting from monitoring are deposited in ReefBase, a coral reef data base, maintained by ICLARM. The first major report on the status of reefs will be presented at the International Coral Reef Symposium in 2000.

Regional nodes are being established incrementally in the six ICRI regions: Pacific, East Asian Seas, South Asia, Middle East Gulfs, Western Indian Ocean and Caribbean-Tropical Americas. The nodes (government agencies, universities or marine laboratories) will develop training in biophysical, social, cultural and economic assessments and training in monitoring procedures, data entry, data base operations at the national level and transfer of regional summaries to ReefBase.

Currently there is pilot monitoring on selected reefs which will lead to a report on their status at the International Tropical Marine Environmental Management meeting in Australia in 1998.

This program is one of several devoted to reef monitoring and there is a need for more coordination among them. The program is very ambitious considering the scale of the problem and the limited resources devoted to it. These funds are dependent on country donations and to some extent unpredictable. A major contribution by Department For International Development (UK) has permitted the establishment of a South Asia node for India, Sri Lanka and Maldives and support for a full time Regional Coordinator there.

12. GOOS REGIONAL APPROACH

12.1 NEAR-GOOS

NEAR-GOOS (North-East Asian Regional GOOS) is the first of a set of pilot projects specifically designed to meet GOOS objectives. It has been implemented by China, Japan, the republic of Korea and the Russian Federation. The inset map (Figure 1) shows the area covered by NEAR-GOOS. It is intended to provide a regional framework for gathering, coordinating and distributing data in the North-East Asian region, to enable participating countries to make better use of their investments in ocean observation and research, and to lead to a regional contribution to GOOS.

The initial aim is to share oceanographic data in real time through the Internet, to support daily mapping of sea conditions in the marginal seas bordered by NEAR-GOOS countries, to the benefit of a wide range of users. Oceanographic data and relevant products generated by NEAR-GOOS are available at no cost to registered users on NEAR-GOOS databases through the Internet. Initially the operation has started with basic oceanographic variables such as temperature, salinity, currents, and waves. More information is available at the NEAR-GOOS homepage on the WWW:

http://ioc.unesco.org/goos/neargoos.htm

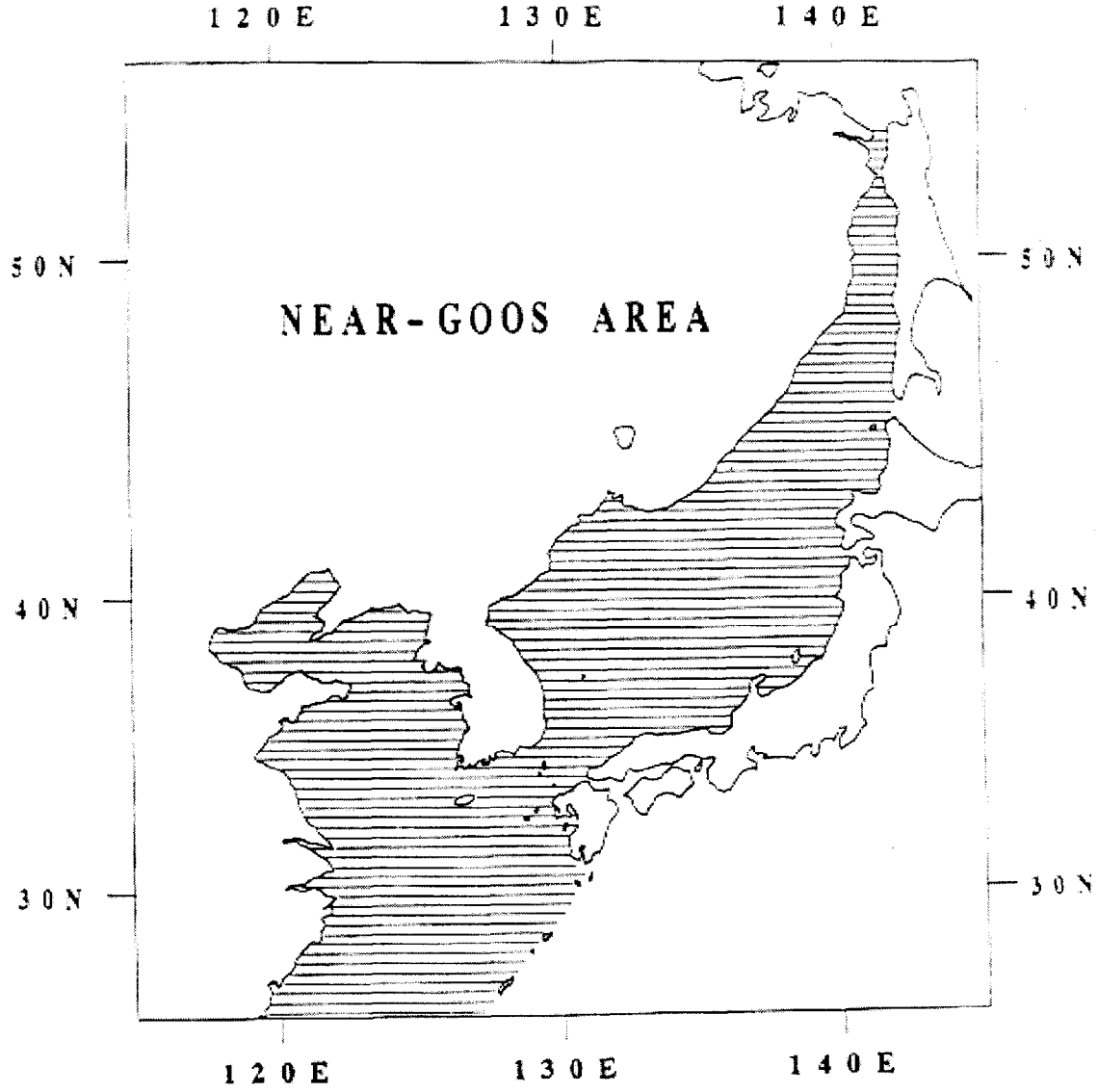


Figure 1

12.1.1 Development of NEAR-GOOS

NEAR-GOOS started its operation in October 1996. It has made significant achievements on following aspects:

i. An intergovernmental agreement on open data exchange policy has been established by NEAR-GOOS in spite of different political and economic conditions in the participating countries. Although there are some problems with certain parameters, and in certain geographic locations, oceanographic data are now flowing in the system, demonstrating first practice of the GOOS policy on open data exchange.

ii. All participating countries are contributing data to the system in one way or another. Although there are still a lot of technical problems to be solved to allow systematic data exchange, participating countries are taking necessary actions to contribute to the operation of the system. For example Russia is contributing real-time data by writing FTP files, and sending its data to the NEAR-GOOS Real Time Data Base.

iii. After more than one year of operation, the system has been recognized by the oceanographic societies and other users in the region, as shown by:
   - increased number of users,
   - increase of oceanographic data in the system. The participation of more institutions more than doubled data contribution to real time data exchange,
   - other programmes are seeking for co-operation and co-ordination with the NEAR-GOOS system.

iv. The operation of the system has enhanced co-operation and co-ordination at regional and national levels. As a result, Japan Fishery Agency now participates in the system, and is contributing oceanographic data from the NEAR-GOOS region, which doubled the quantity of their data in the system.

For the future operation and development of NEAR-GOOS, the following aspects will be considered.

- Inclusion of some chemical and biological parameters, such as nutrients,
- Provision of data products from numerical model and forecasting, to attract more users.

12.1.2 NEAR-GOOS Activities

The 2nd Session of the NEAR-GOOS Co-ordinating Committee was held in the IOC Regional Secretariat, Bangkok, Thailand, from 14-16 May, 1997. A representative from EuroGOOS attended the meeting in order to exchange views and experiences between the regional components of GOOS. The committee reviewed the operation of the system and discussed further development including revising the operational manual and getting a wider contribution of oceanographic data to the system. Also an informal consultation meeting was held during the WESTPAC Scientific Symposium, Okinawa, 2-7 February 1998.

The NEAR-GOOS brochure and the Operational Manual were published during 1997.

The first training course on NEAR-GOOS data management was held at the Japan Oceanographic Data Center (JODC) in Tokyo, 13-24 October. Seven trainees participated in the course from 3 countries: South Korea, Russia and Vietnam. Besides Japan's financial support, South Korea made a financial contribution towards the participation of its trainees.

12.2 EuroGOOS

The first EuroGOOS Projects Forum was held at Meteo-France, Toulouse, France, 11-12 September 1997. There were

95 meeting attendees, including Dr. Pierre Papon, acting for the Chairman of EuroGOOS, Dr. Nick Fleming, Director of EuroGOOS, and Dr. Jean Boissonnas, representing the European Commission. The object of the meeting was to review progress in the several EuroGOOS project areas, and develop a way forward, focussing on the need to spin up proposals for submission to the EC for funding.

EuroGOOS is an Association of 30 operational agencies in 16 countries, which is dedicated to promoting the development of GOOS especially in the European context, in the process providing a mechanism for considering the coherent development of European operational oceanography. It aims to develop regional GOOS operations in 5 areas: the Arctic, the Baltic, the Mediterranean; the Northwest Shelf (including the North Sea); and the Black Sea, and in addition to work on the global approach through an Atlantic-wide project jointly with the USA and Canada. To help it devise its strategic and implementation plans it has Science Advisory and Technical Plan Working Groups. Among other things the Technical Advisory Working Group has surveyed the state of the European infrastructure in technology, and its future requirements, and is evaluating the prospect of instrumenting European ferries as a means of gathering operational data. EuroGOOS has carried out a comprehensive survey of user requirements in several countries, and aims to complete and publish this for all European countries in due course. EuroGOOS has published a Strategic Plan and an abbreviated Implementation Plan, is working on a fully comprehensive Implementation Plan and a Science Plan, and has held a major conference to broadcast its aims and attract new partners (many of them in industry). The conference report was published in January 1998. EuroGOOS also intends to evaluate its potential economic contribution to marine markets and to carry out Capacity Building (technology transfer) in selected areas including the Mediterranean and the South Pacific. EuroGOOS has been particularly successful in Holland in getting the attention of Dutch Ministers. In general terms, the EuroGOOS approach can been seen as a useful way of getting agreement on concerted actions from a diverse range of partners.

The meeting was attended by several representatives of industry, who also made presentations.
Industry sees its role in GOOS as being to: (i) input to strategy; (ii) develop sensors and instruments; (iii) develop systems; (iv) implement operational systems; (v) produce and distribute data products; (vi) export European products and services. There is commercial interest in: (i) equipment design and manufacture; (ii) system engineering and software; (iii) provision of services. To become more effective (profitable) industry needs: (i) partnerships with academia; (ii) a European Metocean Trade Association. Industry's practical operational experience should be valuable in developing GOOS, so we should involve industry at an early stage.

The main body of the meeting was devoted to the activities of working groups.

Mediterranean Task Team Workshop Group Report: The task team is developing an EC proposal for a Mediterranean Forecasting System Pilot Project (MFSPP), whose goal is to explore the potential predictability of ecosystem and physical system fluctuations. It aims to show the feasibility of an operational system for predicting currents and biogeochemical parameters, and involves developing interfaces to users for disseminating results.

Arctic Working Group Report: For the GOOS Climate Module monitoring is needed of sea-ice cover; frequency of severe conditions; and acoustic thermometry (eg Fram Strait). For the LMR Module they are still at research levels in fish stocks and plankton. For the HOTO Module more dialogue is needed to see how to develop it in this area. For the Services Module, sea-ice monitoring services have developed; concerted action is needed on surface currents.

Atlantic Working Group Report: The session dealing with the Atlantic was a precursor of a Workshop held at the Southampton Oceanography Centre in late October 1997, when European requirements for civilian operational forecasts were discussed for the North Atlantic. The workshop goal was to identify and prioritise developments that would increase economic and social benefits for Europe within the Atlantic realm. The aim is to build on existing systems and on existing or planned research. It needs to be a joint venture with the USA and Canada. This work would make a European contribution to GODAE.

Baltic Workshop Group Report: Baltic GOOS is now called BOOS. It comprises a number of existing observing systems, many of them set up to meet the demands of HELCOM (The Helsinki Convention). The immediate goal is to increase the quality of the products. They have made an inventory of stations, and now need to identify a subset where data are exchanged. Some large science (ie research) programmes are incorporated, but coordination is needed. They are developing a matrix of products and users to show the value of the system. Data exchange has started. Now the focus is on: ice services; harmful algae; waves and currents. The ultimate aim is a high resolution operational model. At present there is too little use of the data; they need to explore how much more the data can be used.

NW Shelf Working Group Workshop Report: The goal is to develop integrated ocean services via EU concerted actions. The immediate objectives:

(i) create a network to develop and exchange analyses and forecasts, observations and services between EU agencies.
(ii) develop ESODAE (European Shelf-Seas/Ocean Assimilation and Forecasting Experiment) - inspired by GODAE.
(iii) form catalogue of operational observations
(iv) quantify state and variability of large scale transport.
(v) spell out approach to data and information management.

Science Advisory Working Group (SAWG) Report: The SAWG's role is to provide a vision of long term objectives. Implementation will then be incremental. "The Science Base of EuroGOOS" is now in draft form and will be published early in 1998. A major topic is limits of predictability, as also is data assimilation.

Gridded Bathymetry Working Group: This exists to determine what needs doing to provide the best bathymetry to underpin shelf and ocean models. The grid will cover most of NW Europe, including the Baltic, but not the Mediterranean; the depth will extend to the base of slope. Resolution is 500m now, but may increase in coastal areas (eg fjords). An EC proposal will be prepared for submission in 1998.

Technology Advisory Group Workshop Report: This group exists to identify key technology projects required by EuroGOOS, and to analyse equipment systems already in routine use. A survey of the EU's technologies has just been finalised; results will be available shortly. Main results: need focus on: (i) antifouling; (ii) HF radar; (iii) remote sensing; (iv) buoy sensor packages. There is a need to identify end users and their requirements.

Ferry Box Working Group Report: The plan is to design a sampling strategy and sampling devices for installation on commercial ferries to measure in real-time about 15-20 variables in European waters, and transmit data ashore. The technology for automated systems is developed and available. They plan to apply for a concerted action from the EC.

End Users Workshop Report: EuroGOOS has been using a standard questionnaire to extract information about users requirements in operational oceanography. Surveys have been completed for UK, Italy, Spain, Greece and are about to be completed for Denmark and Holland. The data show a consistent pan-European pattern emerging, which will help to justify calls to the EC for funding operational work. The data: (a) point to what is regarded as most important by the user community; (b) tell politicians that people feel that x, y and z are important; (c) confirm where we should be putting our effort; (d) tell us what kinds of products are needed. The output can be electronically available, eg on CD. Technically skilled volunteers are needed to work up the data properly to get the most out of them. A working group may be needed to collect together the results of all the EuroGOOS country surveys and interpret them in a pan-European manner.

The best information about operational needs comes from "educated" users. These are either: (a) substantial

organisations or companies who do their own environmental work or hire others to do it for them, or (b) proxy end users (the companies or agencies servicing the needs of ultimate end users). Among the ultimate end users, the general public are not "educated" users, except where efforts have been made to show specialist interest groups (like fishermen or ships' captains) what benefits might accrue to them from operational services. Such efforts might include workshops, but these have been found to be labour intensive and extremely time consuming, and do not produce an answer significantly different from approaching "educated" users. Examination of end user requirements can be illuminating, for instance the discovery that cruise ships' captains bounce from eddy to eddy to pick up a quarter knot advantage here and there along track.

Cost-Benefit Workshop Group Report: EuroGOOS is intending to carry out a cost-benefit study as the basis for justifying investment by governments in its projects.

Capacity Building Workshop Report: EuroGOOS plans to invest some of its resources in capacity building for developing states, with emphasis on the Mediterranean and South Pacific. Developments are at an early stage.

13. RESEARCH AND MONITORING PROGRAMMES RELATED TO GOOS

13.1 HARMFUL ALGAL BLOOM PROGRAMME

The Harmful Algal Bloom (HAB) Programme was established in 1992. The programme has its own Intergovernmental Panel that meets every two years to discuss developments of the last two year period and set priorities for the coming intersessional period. The Fourth Session of the Intergovernmental Panel on Harmful Algal Bloom (IPHAB-IV) was held in Vigo, Spain in July 1997 with more than 40 participants from 27 countries attending the session.

For the intersessional period the Panel decided to give priority to the development of an international science agenda on ecology and oceanography in relation to HABs to provide a platform for member states to develop national and international HAB strategies, research and monitoring programmes. Strengthening of a coordinated effort in the regions was recommended. The importance of continued long-term studies of phytoplankton as a routine part of international monitoring programmes was emphasised and it was recommended that the work on improved management and mitigation of the effects of harmful algae be continued at an International Workshop.

In May 1997 the HAB Programme Office at the IOC Secretariat was staffed with one associate expert seconded by Denmark.

Meetings and workshops

The HAB Programme is actively involved in working and study groups on important scientific issues related to HABs. For the moment these are 1) The ICES-IOC Working Group on Harmful Algal Bloom Dynamics which held its fifth annual meeting in France in April 1997 and 2) the ICES-IOC-IMO Study Group on Ballast Water and Sediments that held its first meeting in France in April 1997.

Regional planning workshops are being held to strengthen regional networks and cooperation. The Third IOC/FANSA Workshop on HABs was held in Chile in July 1997 to assess national and regional HAB problems, and common regulations for the region. The Workshop had 56 participants from six Latin American countries

Publications and sponsor-activities

The publication of the IOC newsletter Harmful Algae News continued. The newsletter is available on the internet at:

http://www.unesco.org/ioc/news/newslet.htm.

The "International Directory of Experts in Toxic and Harmful Algae and Their Effects on Fisheries and Public Health", first published in 1995, was updated and is now availably on the IOC home page:

http://www.unesco.org/ioc/isisdb/htlm/habdsearch.htm on the Internet.

The HAB Programme co-sponsored the Eight International Conference on Harmful Algae held in Vigo, Spain 25 - 29 June 1997 and the Second International Conference on Molluscan Shellfish Safety (ICMSS) in the Philippines 17 - 21 November 1997, providing support for experts from developing countries to participate.

A Workshop on Potentially Harmful Microalgae in the South Pacific was held within the Marine Benthic Habitats Conference in Noumea, New Caladonia, 10 - 14 November 1997.

Training and capacity building

The training and capacity building component of the HAB Programme is very strong. Seven training courses on algal taxonomy and biology, algal toxins and monitoring of harmful algae were organized in Denmark, Finland, Japan and Spain during 1997 with almost 100 participants from 40 different countries.

The IOC Science and Communication Centres on Harmful Algae

The IOC Science and Communication Centre on Harmful Algae in Copenhagen, Denmark, opened in May 1995. The Centre has three permanent staff members and is hosted by, and located at the Botanical Institute, University of Copenhagen. Activities are centered around training in taxonomy of harmful species and associated services, including a species identification confirmation service. Co-operation is extensive with the host institute of the University. The Centre is sponsored by DANIDA (through the IOC Trust Fund), the University of Copenhagen, the Danish Ministry of the Environment, the Danish Ministry of Fisheries, and IOC initially for a five-year period.

The Centre organized/co-organized four IOC training courses in 1997. During 1997 the Centre had close cooperation with Vietnam. Staff from the National Fisheries Inspection and Quality Assurance Centre (NAFIQACEN) and the Institute for Aquaculture Research of Vietnam have been specifically trained for monitoring of potentially harmful algae in relation to harvesting of baby-clams in the Mekong delta. In cooperation with DANIDA, laboratory and field equipment have been provided. The cooperation with Vietnam is expected to expand in 1998 through a cooperative research project. Prepartions for publishing a bilingual (Vietnamese-English) identification guide for potentially harmful microalgae in Vietnamese waters have been made. In cooperation with Aarhus University, the Copenhagen Centre is supervising one Msc and one PhD student from Vietnam.

A major task of the Copenhagen Centre is to compile a bibliographic database on harmful algal literature. This comprehensive task is being carried out within the framework of the Aquatic Fisheries and Fisheries Abstracts (ASFA). The work has proceeded well during 1997, and it is expected that the database will be ready for use during first half of 1998.

The Copenhagen Centre offers an extensive literature service to libraries and researchers in developing countries. Key reference books, as well as IOC and UNESCO publications are donated free of charge to research libraries.

Results of the cooperative research at the Copenhagen Centre were presented at the Eight International Conference on Harmful Algae, Spain, June 1997.

THE VIGO CENTRE

The IOC-IEO Science and Communication Centre on Harmful Algae in Vigo, Spain, opened October 1996, and is

hosted by, and located at, the Instituto Espanol de Oceanografia (IEO). There are two permanent staff members and the opportunity to cooperate with other IEO staff. Activities will be centered around training in toxin chemistry and ecological aspects, and in particular in cooperation with research institutions in Latin America. The Centre is sponsored by the Spanish Ministry of Foreign Affairs (through the IOC Trust Fund), Instituto de Cooperacion Iberoamericana, IEO, and IOC initially for a five-year period.

The title of the annual training course in 1997 was 'Toxic Phytoplankton: Analytical Methodologies for the detection of Marine Toxins'. This advanced course dealt with toxin detection techniques implemented in research and monitoring programmes. The course had 12 participants mainly from South America. To complement their training, participants were also invited to attend the VIII International Conference on Harmful Algae, June 1997 that preceded the course.

The Vigo Centre and collaborative institutions also assisted at other courses such as the Doctoral Course on Toxic Microalgae in Mediterranean Countries, Museum National D'Histoire Naturelle in Paris, France, 26-28 March 1997, and the IOC courses in Brazil and Copenhagen.

IOC and IEO publications on harmful algae were distributed free of charge to scientists, managers and other professionals from research and educational institutions in Latin-American countries and Spain. The Vigo Centre edited the abstracts of all contributions to the VIII International Conference on Harmful Algae and made them available at the IOC web-page as a searchable data base.

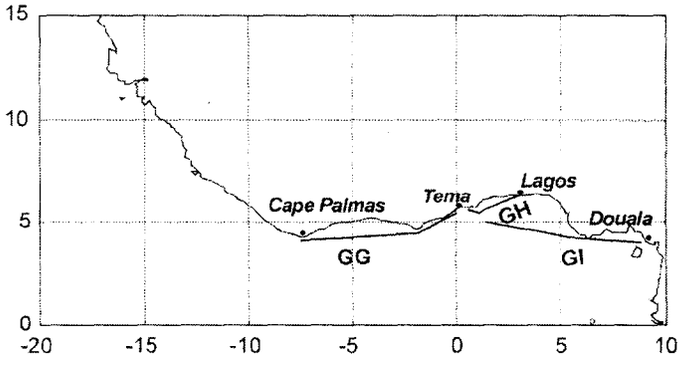
HARMFUL ALGAL BLOOM PROGRAMME in WESTPAC

IOC/WESTPAC-HAB has received significant support from Japan to conduct training courses and capacity building in the WESTPAC region and to provide a species identification confirmation service. The support is for a 10 year period starting 1995. Two training courses were held during 1997 at the University of Tokyo.

The co-operation between the University of Tokyo and the HAB centre in Copenhagen and the WESTPAC secretariat was strengthened during separate visits of representatives of both institutions to Bangkok. Discussions were held on possible follow-up activities in the region.

13.2 THE CONTINUOUS PLANKTON RECORDER (CPR) PROGRAMME

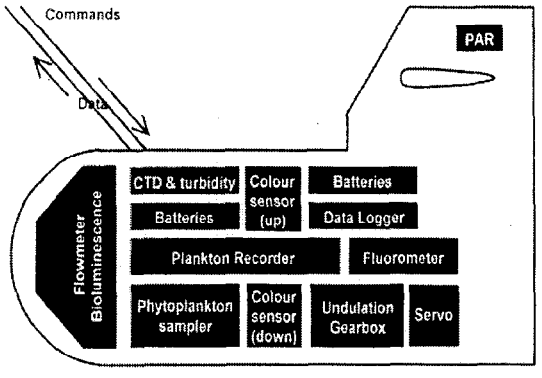
The Sir Alister Hardy Foundation of Ocean Science (SAHFOS), the implementing foundation behind the Continuous Plankton Recorder Survey supported by IOC, has increased further its monitoring activities. The CPR is an integral component of the Gulf of Guinea Large Marine Ecosystem Project (GOG). The new routes in West Africa are shown on the figure below.



CPR Tows along the coast of West Africa in December 1995

Additional environmental sensors have been incorporated into the CPR for possible use on new routes. The recently developed undulating vehicle is not yet routinely used by the ships of opportunity as the vehicle is still undergoing evaluation. Some of the new instrumentation to be included on the towed vehicle is shown on the diagram below. A pilot tow was undertaken in the Pacific Ocean for the first time in August 1997.

During the 19th Session of IOC Assembly in June 1997 SAHFOS provided a exhibition partly on the life of Sir Alister Hardy, partly on the methodology of the CPR survey, including a display of the CPR vehicle with additional environmental sensors and the ability to undulate while sampling.



The undulating CPR showing sensors

The SAHFOS homepage and e-mail is:

Homepage: http://www.npm.ac.uk/sahfos/
E-mail: sahfos@wpo.nerc.ac.uk

13.3 GLOBAL OCEAN ECOSYSTEM DYNAMICS (GLOBEC)

The GLOBEC programme encourages projects that relate to understanding the structure and functioning of the global ocean ecosystem and its major subsystems. The GLOBEC Science Plan has been published (IGBP Report 40) and the Science Implementation Plan will soon be released in draft form. The GLOBEC Open Science Meeting was hosted by IOC at UNESCO on the 17-20 March 1998 with around 200 participants from 40 different countries. Furthermore, the Third Scientific Steering Committee (SSC) of GLOBEC took place on the 16 and 21 March also in UNESCO headquarters. It was proposed that the linkages between GLOBEC-SSC and the GOOS-LMR panel should be strengthen in order to gain from mutual interests. This could be done by representative from the GOOS-LMR panel to attend the GLOBEC SSC meeting and vice versa.

The GLOBEC Core programme includes two projects with major field components - Southern Ocean GLOBEC and Small Pelagic Fishes and Climate Change. There are two regional programmes co-sponsored by GLOBEC: the Cod and Climate Change Programme with the International Council for the Exploration of the Sea, and Climate Change and Carrying Capacity Programmes with the North Pacific Marine Sciences Organization. In addition to these, there are three multinational and ten national programmes including several with substantial field components.

GLOBEC is an IGBP core project and is also sponsored by IOC and SCOR. The homepage is:

http:www1.npm.ac.uk/globec.

13.4 LARGE MARINE ECOSYSTEMS (LME)

A consultative meeting on Large Marine Ecosystems was held at IOC in Paris in January 1997, organized jointly by IUCN, NOAA and IOC. This meeting was a follow up to earlier consultative meetings. The major intention was gathering information on the status of the growing numbers of project proposals for funding by the GEF for the implementation of LME projects. In addition the meeting addressed the future role of the LME concept including recommendations on its development, and proposed to use the International Year of the Ocean in 1998 and EXPO98 in Lisbon to highlight the LME concept. A second LME Consultative meeting was held in IOC, Paris on 15 and 16 March 1998

At present an LME project is established in the Gulf of Guinea and several regions are either in the process of finalizing their project proposals, or have already obtained funds for pilot projects. The following regions are in the process of developing proposals for LME projects, of which several have already been funding in their initial phases: Somali Current, Western Indian Ocean, Gulf of Thailand, Baltic Sea, Yellow Sea, South China Sea, Bay of Bengal, Humboldt Current, Benguela Current, Caribbean Sea, and Canary Current.

13.5 MARINE POLLUTION RESEARCH AND MONITORING

The first meeting of a GIPME Group of Experts on Sediment Quality Guidelines met at IMO Headquarters, London, in May 1997 and discussed approaches to the establishment of sediment quality guidelines for marine environmental protection applications. The workshop report has been issued by IMO. A further workshop is planned for early 1999 to develop specific approaches for applications under the London Convention 1972 and for determining sediment regimes essentially reflecting natural conditions.

As a co-sponsoring agency, IOC continued to contribute, through GIPME, to the GESAMP activities in general and to the activities of the GESAMP Working Group on Marine Environmental Assessments, in particular. This Group is charged with the preparation of: Biennial statements on the condition of the marine environment with the first to be issued in 1998; A global assessment of the state of the marine environment from the perspective of land-based activities for the purposes of the GPA to be completed in 1999; and A new major comprehensive assessment of the state of the marine environment to be completed in 2002. The first biennial review is in draft form and was considered during an editorial meeting 2-14 August, 1998. The Land-Based Sources Review is in various stages of drafting. It comprises 7 Chapters of which Chapters 4,5 and 6 already exist in draft form. Revisions of these chapters and first drafts of other chapters will be prepared in concert with the GEF Global International Waters Assessment (GIWA) which is due to start in fall 1998 under a Core Team established in Kalmar, Sweden.

There is a plethora of other regional assessments underway, either for the Global Programme of Action for the Protection of the Marine Environment from Land-Based Activities, or for other regional purposes. Although these are all relevant to the various global assessments being undertaken by GESAMP and GIWA, there is a need for increased surveillance and knowledge of these activities from IOC perspectives. GIPME has been paying increased attention to the conduct of these assessments and is using them to develop its future regional plans, especially for MARPOLMON.

The co-operation between IOC and SIDA in matters related to marine pollution has allowed GIPME to undertake regional assessments of various pollutants in the Caribbean, East Africa, WESTPAC and to a minor extent West Africa. A major assessment of the State of Pollution of the Caribbean was undertaken during 1997. The basis for this synthesis was the co-operation between IOC and UNEP regional activities in the Caribbean, through the CEPPOL Programme.

GIPME continues its involvement in the ICES-IOC-IMO Working Group on Ballast Water.

It was decided at the 19th Assembly of IOC that GIPME is the appropriate IOC Programme within which to implement pilot projects of the Health of the Oceans (HOTO) Module of the Global Ocean Observing System (GOOS) in full consultation with the GOOS Project Office, The GOOS Steering Committee and the relevant GOOS Panel (Resolution XIX-4). The first specific action taken by GIPME in response to this decision was the implementation of a HOTO Pilot Project in Brazil that is entitled "Rapid Assessment of Marine Pollution: a HOTO Pilot Project in South America". The Project aims to test and provide easy-to-use inexpensive chemical and biological markers that can be used to assess and improve environmental management in developing countries. The techniques being devised will provide cost-effective screening alternatives to more complex procedures currently used in Europe and the USA. As part of the project, newly validated techniques are being introduced into Brazil, together with all the necessary equipment and training. Outputs will include fully validated techniques and manuals. The monitoring approach holds significant promise for the future success for the implementation of the HOTO Strategic Plan and the rapid assessment methods are expected to serve simple and inexpensive approach to global marine pollution monitoring and also enhance the level and range of national/regional participation in GOOS. This HOTO Pilot Project will be carried out in close co-ordination with C-GOOS.

The Health of the Ocean Panel met in Singapore in 1997 to discuss follow-up to the Strategic Plan for HOTO and the development of regional pilot projects. Blueprints for several regional HOTO pilot project were presented and discussed. Also during this meeting two HOTO intersessional activities were commissioned: (i)Capacity Building and Indicators for Sustainable Change, and (ii)Modeling. The proposal for the NOWPAP-3 was reviewed by a sub-panel of HOTO for the purpose of evaluating its scientific content and applicability for assisting in reaching HOTO goals, particularly with regard to the implementation of pilot projects. It was determined that the proposal is a credible document, with few suggestions being made to strengthen it, and it indeed was well focused in providing the necessary framework within which to have a HOTO pilot project implemented in the NOWPAP Region. Finally, both GIPME and the HOTO Panel await developments concerning the IOC Black Sea Regional Committee so as to take further steps in implementing a pilot project in the region.

Pursuant to Resolution 4 of the 19th IOC Assembly, the modus operandi of GIPME will differ somewhat form previous practice. GIPME Programme activities will be steered by a GIPME Expert Scientific Advisory Group (GESAG) instead of through the medium of the Officers and the original Groups of Experts GEMSI, GEEP and GESREM, which have now been disbanded. The new arrangement sanctioned in Resolution XIX-4 has yet to be put into operation. It will start in late 1998 when GESAG meeting will be convened to review the entire programme and its activities. Specific attention will be paid to the needs of the Global Programme of Action and GIPME programmatic contributions particularly the clearing house mechanism.

IOC support for the Marine Environmental Studies Laboratory at the IAEA Marine Environment Laboratory, Monaco is continued for the production of Methods Manuals and Reference Materials. The MESL laboratory is expected to continue to provide assistance primarily by generating information for marine pollution assessments and by building technical capacity of regional laboratories towards this goal. This assistance is therefore crucial to the regional activities carried under GIPME through MARPOLMON.

The co-operation of IOC with UNEP in the context of the MED POL Program continued. In addition to the co-ordination of nine MED POL research projects involving eutrophication, remote sensing and modeling of pollutant dispersion and water quality, IOC participated in the meetings of MED POL National Co-ordinators, MAP National Focal Points and the Mediterranean Commission on Sustainable Development. Through GIPME, the Standard reference material bank for organic contaminants and trace metals at IAEA/MEL in Monaco continued to be developed and eight reference methods were prepared or revised in co-operation with IAEA/MEL. The standards are available cost-free to all institutes participating in MED POL Program. On a case by case basis and depending on

availability, these standard reference materials are also provided cost free to other GIPME related activities. Such was the case in March, 1998, for an International Mussel Watch Training Workshop that was convened in Thailand at the environmental Research and Training Center.

13.6 REMOTE SENSING AND RELATIONSHIP WITH CEOS

13.6.1 Committee on Earth Observation Satellites (CEOS)

To assist in taking forward the remote sensing requirements of the IOC, it has become an Affiliate Member of CEOS. This has meant participation in various CEOS Working Groups, and in the development of the Integrated Global Observation Strategy (IGOS) which has been promoted by CEOS. The business of CEOS and progress with IGOS were reviewed at the CEOS plenary meeting in November 1997.

13.6.1.1 Integrated Global Observation Strategy (IGOS)

The rationale for the IGOS is to provide an overall framework in which users can present their requirements and providers can address their commitments. A more effective use of Earth observation assets requires closer coordination of observing and analysis programmes. Data providers need a strategy to avoid redundancy, to fill data gaps, to integrate data from various sources and to coordinate operational and research systems.

IGOS will be dependent on international coordination among participating agencies, based on a mutually agreed framework for definition, planning and conduct of observations. There is a need for a commitment to full and open data exchange. IGOS has to integrate three different global observing systems as part of its strategy: (1) the operational observing systems, e.g, the World Weather Watch (WWW), (2) systems for coordinated Earth observations (eg the G3OS), and (3) research observing systems. To be successful IGOS requires an integrated framework for space-based and in-situ observations, and voluntary participation from countries and agencies. Within this framework, requirements from multiple user communities have to be integrated and prioritised. One of the major challenges for an IGOS will be the achievement of a balance between research and operations, as well as between space and in-situ measurements.

The IGOS **Strategic Implementation Team (SIT)** was formed by CEOS to define, characterize and develop a vision for IGOS; define responsibilities of the space component of IGOS; address, with relevant partners, the interface between the space component and the in-situ component, in the context of user requirements, with appropriate mechanisms for seamless integration. The SIT agreed at its first meeting in Irvine, California, February 1997, on six key issues, as the basis for developing project statements for prototype activities. The Irvine report includes a table listing the proposed initial IGOS implementation projects. Listed below are the two ocean related projects:

Global Ocean Data Assimilation Experiment

To produce global analyses/forecasts/hindcasts based on limited models and data streams there is a need for an integrated suite of remote (and direct) measurements of the ocean for real-time assimilation, interpretation and application. The project will provide a regular, global depiction of the ocean circulation, from climate down to ocean eddy scales, consistent with the measurements and appropriate physical constraints. It will rely on a real-time satellite data stream; a global in situ observing system; assimilation to exploit the integrated data stream; models and computers for production and output of products; and high band-width communications. Here the OOPC forms the natural partner for the space agencies.

Long-Term Ocean Biology Measurements

To understand and then predict regional influences and variations in the ocean environment there is a need to make effective use of the several satellite-borne ocean colour sensors that are in operation and planned. A coordinated strategy is required to meet the data needs for scientific studies of ocean biogeochemical and ecosystem processes. It will involve a coordinated calibration/validation campaign integrating satellite and in situ observations. Since 1995, the International Ocean Colour Coordination Group has provided the required mechanism to address these needs, and the group has accomplished its specified tasks during 1996 and 1997. Following the establishment of the Living Marine Resources panel of GOOS, the continued activity of IOC in this area may be coordinated through that panel.

13.6.1.2 CEOS Working Group on Information Systems and Services (WGISS)

The CEOS Working Group on Information Systems and Services (WGISS) held its fourth meeting in May 14-16, 1997 at the Canada Centre for Remote Sensing in Ottawa. It was immediately preceded by the first meeting of the WGISS Strategy Task Team on May 12-13. The three WGISS Subgroups - Access, Data, and Networks - met in Toulouse, France (hosted by CNES) in April 1997, along with a number of WGISS Task Teams.

Building on discussions begun at the WGISS Strategy Task Team meeting, WGISS prepared a proposal regarding the Integrated Global Observing Strategy (IGOS) initiative. WGISS offers to support the IGOS pilot projects through tools, techniques, and recommended practices for data identification, locating data needed for the projects; data delivery, using and establishing advanced network capabilities; and data preparation, including formatting and geometric transformation, to support inter-use of data. For each of the six IGOS projects, a WGISS point of contact has been identified and examples offered for how WGISS can contribute to the project.

The Strategy Task Team (STT) agreed to focus on evaluating the consequences of the technical work done by the subgroups/task teams and developing strategic recommendations to direct WGISS toward accomplishing its long-term goals. The STT encouraged Subgroups and Task Teams to engage in pro-active encouragement of adoption of their results by data users and providers. Increased outreach to the user community is urged, by involving users in prototype and demonstration projects. The IGOS projects are seen as a significant opportunity for outreach to the user community.

13.6.2 International Ocean Colour Coordination Group (IOCCG)

The IOCCG was set up to assist in coordinating the interests of the scientific community and space agencies in making ocean colour measurements work effectively for the benefit of (mainly) the ocean biology community. The work of the IOCCG was governed by direction given it by the IOC Assembly, with support from contracts which specified the activities that were to be accomplished, and matching support, in kind and in cash from the IOC.

Overall the IOCCG has accomplished all its major goals having:

(i) provided widespread promotion through publication in the CEOS Newsletter and backscatter Magazine; reports to CEOS, J-GOOS, COSPAR and the IOC Assembly and Executive Council; and development of a Homepage as part of the IOC Homepage and as part of the EU/JRC Homepage.

(ii) convened two sessions of the IOCCG and of its Executive, as well as a Workshop on Calibration and validation. During the year there has been one meeting of the IOCCG,and one meeting of the IOCCG Executive, both in Tokyo.

(iii) visited or contacted a number of countries in S.E.Asia to assess the interest of the ocean community in ocean colour products and the availability of relevant in situ data bases (including a presentation on ocean colour in the Gulf of Thailand Workshop)

(iv) held discussions with countries in the WESTPAC region and South America regarding the development of training workshops on ocean colour.

Because the IOCCG has discharged its requirements, and because GOOS will take over responsibility for ocean colour (through (i) the newly created Living Marine Resources Panel; (ii) GOSSP for coordination of requirements for ocean colour; J-DIMP for management of ocean colour data; and GODAE for assimilating ocean colour data), the IOC's direct sponsorship of IOCCG was terminated at the end of 1997.

13.6.3 Regional Remote Sensing Activities

At the request of and with support from Japan, IOC conducted member state visits to Philippines, Indonesia, Malaysia, Singapore, Bangkok and Tokyo during the period 14-29 January 1997 to formulate an APEC initiative for the development of remotely sensed products, in particular those related to ocean colour, and the expansion of the data and information management systems within the Asian region to distribute these products. The results of this mission were incorporated into documents in Tokyo for presentation at the APEC Seminar on "Earth Observation for Users" (Tokyo, 3-5 March 1997).

13.6.4 Global Observing Systems Space Panel (GOSSP)

Recognizing the need for a comprehensive approach to the various space-based observational activities for the global observing systems, the JSTC of GCOS, the Joint Scientific and Technical Committee for GOOS (J-GOOS), and the Steering Committee (SC) for GTOS have established a Global Observing Systems Space Panel (GOSSP).

The Global Observing Systems Space Panel (GOSSP) and the World Meteorological Organization (WMO) Commission for Basic Systems (CBS) Working Group on Satellites (WGSAT) held a joint meeting in Paris, France, 27 - 30 May 1997 hosted by the IOC. The objectives of the joint session were to realise a mutual approach to problems and to obtain coordinated solutions. One major aim of the GOSSP meeting was to create a coherent set of data requirements for global observing, and in the process to identify overlap or conflicting data requirements from climate related space-based observations. A second aim was to work towards development of a space plan that is valid for GOOS and GTOS, building on the space plan already developed for GCOS by this committee's predecessor.

Noting that space agencies need the evaluation of satellite performance against user requirements to help to define future systems and to fine-tune existing systems, the Chairman presented to the plenary a methodology to evaluate satellite data. GOSSP, WGSAT, the CEOS Task Force and the CEOS Analysis Group (AG) have put efforts into establishing a relational database, listing requirements for science areas, and initiated the development of its analysis. Analysing the relation between requirements and specific applications will make it easier to specify, to validate and to update those requirements.

ANNEX

LIST OF ACRONYMS

ACCLAIM	Antarctic Circumpolar Current Levels from Altimetry and Island Measurements
ADCP	Acoustic Doppler Current Profile
AG	Analysis Group
AOML	Atlantic Oceanographic and Meteorological Laboratory
APEC	Asian Pacific Economic Co-operation
ASFA	Aquatic Sciences and Fisheries Abstracts
AMS	Bulletin of American Meteorological Society
BATHY	Bathythermograph Report
BODC	British Oceanographic Data Centre
BOM	Bureau Of Meteorology (Australia)
BOOS	Baltic GOOS
BUOY	Report of a Buoy Observation
CBS	Commission for Basic Systems
CEOS	Committee for Earth Observation Satellites
CEPPOL	Joint IOC-UNEP Marine Pollution Assessment and Control Programme for the Wider Caribbean Region
C-GOOS	Coastal Panel of GOOS
CLIVAR	Climate Variability Research Programme
CMD	Continuously Managed Data Base
CMM	Commission for Marine Meteorology
COSPAR	Committee on Space Research
CPR	Continuous Plankton Recorder Programme
CSIRO	Commonwealth Scientific and Industrial Research Organization (Australia)
CTD	Conductivity, Temperature, Depth Instrument
DANIDA	Danish Agency for International Development
DBCP	Data Buoy Co-operation Panel
DIU	Data Information Unit
DNA	Designated National Agency
EC	European Commission
ECMWF	European Centre for Medium-Range Weather Forecasts
EGOS	European Group on Ocean Stations
ENSO	El Niño Southern Oscillation
ESODAE	European Shelf-Seas/Ocean Assimilation and Forecasting Experiment
EURASLIC	European Aquatic Sciences and Libraries and Information Centres
EuroGOOS	European GOOS
FANSA	Floraciones de Algas Nocivas en Sudamerica (Working Group on Harmful Algae Blooms in South America)
FAO	Food and Agricultural Organization
FTP	File Transfer Protocol
GCOS	Global Climate Observing System
GCRMN	Global Coral Reef Monitoring Network
GDP	Global Drifter Programme
GE	Group of Experts
GEEP	Group of Experts on Effects of Pollutants
GEF	Global Environment Facility

GEMSI	Group of Experts on Methods, Standards and Intercalibration
GESAG	GIPME Expert Scientific Advisory Group
GESAMP	Group of Experts on the Scientific Aspects of Marine Environment Protection
GESREM	Group of Experts on Standards and Reference Materials
GGE	GLOSS Group of Experts
GIPME	Global Investigation of Pollution in the Marine Environment
GIWA	Global International Waters Assessment
GLOBEC	Global Ocean Ecosystem Experiment
GLODIR	Global Directory of Marine (and Freshwater) Professionals
GLOSS	Global Sea-level Observing System
GLOSS-ALT	GLOSS Network for Altimeter Calibrations
GLOSS-LIT	GLOSS Network for studies of Long-Term Sea-Level Trends
GLOSS-OC	GLOSS Network for Ocean Circulation Monitoring
GODAE	Global Ocean Data Assimilation Experiment
GODAR	Global Oceanographic Data Archaeology and Rescue Project
GOG	Gulf of Guinea Large Marine Ecosystem Project
GOOS	Global Ocean Observing System
GOOS-IOS	GOOS Initial Observing System
GOSSP	Global Observing Systems Space Panel
GPA	Global Plan of Action
GPS	Global Positioning System
GSC	GOOS Steering Committee
GTOS	Global Terrestrial Observing System
GTS	Global Telecommunication System
GTSPP	Global Temperature and Salinity Profile Programme
HAB	Harmful Algal Blooms
HELCOM	Helsinki Commission
HF	High Frequency
HOTO	Health of the Oceans
I-GOOS	Intergovernmental Committee for GOOS
IABP	International Arctic Buoy Programme
IAEA	International Atomic Energy Agency
IAPSO	International Association for the Physical Sciences of the Ocean
IBPIO	International Buoy Programme for the Indian Ocean
ICES	International Council for the Exploration of the Sea
ICLARM	International Center for Living Aquatic Resources Management
ICMSS	International Conference on Molluscan Shellfish Safety
ICRI	international coral Reef Initiative
ICSU	International Council of Scientific Unions
IDPSS	IGOSS Data Processing and Services System
IEO	Instituto Español de Oceanografia
IGBP	International Geosphere-Biosphere Programme
IGOS	Integrated Global Observing Strategy
IGOSS	Integrated Global Ocean Services System
IGS	International Global Positioning Service
IMO	International Maritime Organization
IMS	International Marine Science Newsletter
IOC	Intergovernmental Oceanographic Commission

IOCCARIBE	IOC Sub-commission for the Caribbean and Adjacent Regions
IOCCG	International Ocean Colour Coordination Group
IOCEA	IOC Regional Committee for the Central Eastern Atlantic
IOCINCWIO	IOC Regional Committee for the Co-operative investigation in the North and Central Western Indian Ocean
IODE	International Oceanographic Data and Information Exchange Programme
IPAB	international Programme for Antarctic Buoys
IPB	IGOSS Products Bulletin
IPHAB	Intergovernmental Panel on Harmful Algal Bloom
ISABP	International South Atlantic Buoy Programme
ITA	IGOSS Telecommunication Arrangements
IUCN	World Conservation Union
J-DIMP	Joint GOOS, GCOS, GTOS Data and Information Management Panel
J-GOOS	Joint Scientific and Technical Committee for GOOS
JASIN	Joint Air-Sea Interaction Experiment
JCOMM	Joint Commission for Oceanography and Marine Meteorology
JJXX	Identification group of a former BATHY report
JJYY	Identification group of a present BATHY report
JMA	Japan Meteorological Agency
JODC	Japan Oceanographic Data Centre
JSTC	Joint Scientific and Technical Committee
JTA	Joint Tariff Agreement
LME	Large Marine Ecosystem
LMR	Living Marine Resources
LUT	Local User Terminal
MAP	Mediterranean Action Plan
MARPOLMON	Marine Pollution Monitoring System
MEDGOOS	Mediterranean GOOS
MEDI	Marine Environmental Data Inventory
MEDPOL	Co-ordinated Mediterranean Pollution Monitoring and Research Programme
MEDS	Marine Environmental Data Service (Canada)
MEL	Marine Environment Laboratory
MESL	Marine Environment Studies Labotatory
MFSPP	Mediterranean Forecasting System Pilot Project
MIM	Marine Information Management
NAFIQACEN	National Fisheries Inspection and Quality Assurance Centre (Vietnam)
NCEP	National Centre for Environmental Protection (USA)
NDBC	National Data Buoy Centre (USA)
NEAR-GOOS	North-East Asian Regional GOOS
NTF	National Tidal Facility (Australia)
NOAA	National Oceanic and Atmospheric Administration (USA)
NOC	National Oceanographic Centre
NODC	National Oceanographic Data Centre
NOWPAP	Northwest Pacific Action Plan
NTF	National Tidal Facility (Australia)
NZMS	New Zealand Meteorological Service
OCEANIC	Ocean Information Centre
ODINAFRICA	Oceanographic Data and Information Network for Africa

ODINEA	Oceanographic Data and Information Network for Eastern Africa
OOPC	Ocean Observing Panel for Climate
PI	Principal Investigator
PIRATA	Pilot Research Array in the Tropical Atlantic
PMEL	Pacific Marine Environmental Laboratory (USA)
PMOC	Principal Meteorological or Oceanographic Centre
PSMSL	Permanent Service for Mean Sea-level (UK)
PTT	Platform Transmitter Terminal
RECOSCIX	Regional Co-operation in Scientific Information Exchange
RECOSCIX-CEA	RECOSCIX in the Central Eastern Atlantic
RECOSCIX-WIO	RECOSCIX for the Western Indian Ocean
RNODC	Responsible National Oceanographic Data Centre
RNODC/DB	Responsible National Oceanographic Data Centre for Drifting Buoy data
ROC	Representative Organization for a Country
SAHFOS	Sir Alister Hardy Foundation of Ocean Science
SAWB	South African Weather Bureau
SAWG	Scientific Advisory Working Group
SC	Steering Committee
SCOR	Scientific Committee on Oceanic Research
SEA-GOOS	Southeast Asian GOOS
SIDA	Swedish International Development Authority
SIT	Strategic Implementation Team
SMC	SOOP Management Committee
SOC	Specialised Oceanographic Centre
SOC/DB	Specialised Oceanographic Centre for Drifting Buoy data
SOOP	Ship-of-Opportunity Programme
SOOPIP	Ship-of-Opportunity Programme Implementation Panel
SSC	Scientific Steering Committee
STT	Strategy Task Team
STT/IQC	SOOP Task Team on Instrumentation and Quality Control
SVP	Surface Velocity Programme
SVPB	SVP Barometer Drifter
TAO	Tropical Atmosphere Ocean (buoy array)
TESAC	Temperature, salinity and current report from a sea station
TIP	TAO Implementation Panel
TOGA	Tropical Ocean and Global Atmosphere
TRACKOB	Report of marine surface observation along a ship's track
TT/QCAS	Task Team on Quality Control of Automated Systems
UH	University of Hawaii
UKMO	United Kingdom Meteorological Office
UN	United Nations
UNEP	United Nations Environment Programme
UNESCO	United Nations Educational, Scientific and Cultural Organization
UOP	Upper Ocean Panel
URL	Uniform Resource Locator
VOS	Voluntary Observing Ship
WCRP	World Climate Research Programme
WDC	World Data Centre

WESTPAC	IOC Sub-Commission for the Western Pacific
WGISS	CEOS Working Group on Information Systems and Services
WGSAT	Working Group on Satellites
WIOMAP	Western Indian Ocean Marine Applications Project
WMO	World Meteorological Organization
WOC	World Oceanographic Centre
WOCE	World Ocean Circulation Experiment
WOTAN	Wind Observations Through Ambient Noise
WPGM	Western Pacific Geophysics Meeting
WWW	World Weather Watch
XBT	Expendable Bathythermograph
XCTD	Expendable Conductivity Temperature Depth