IOC/INF-992

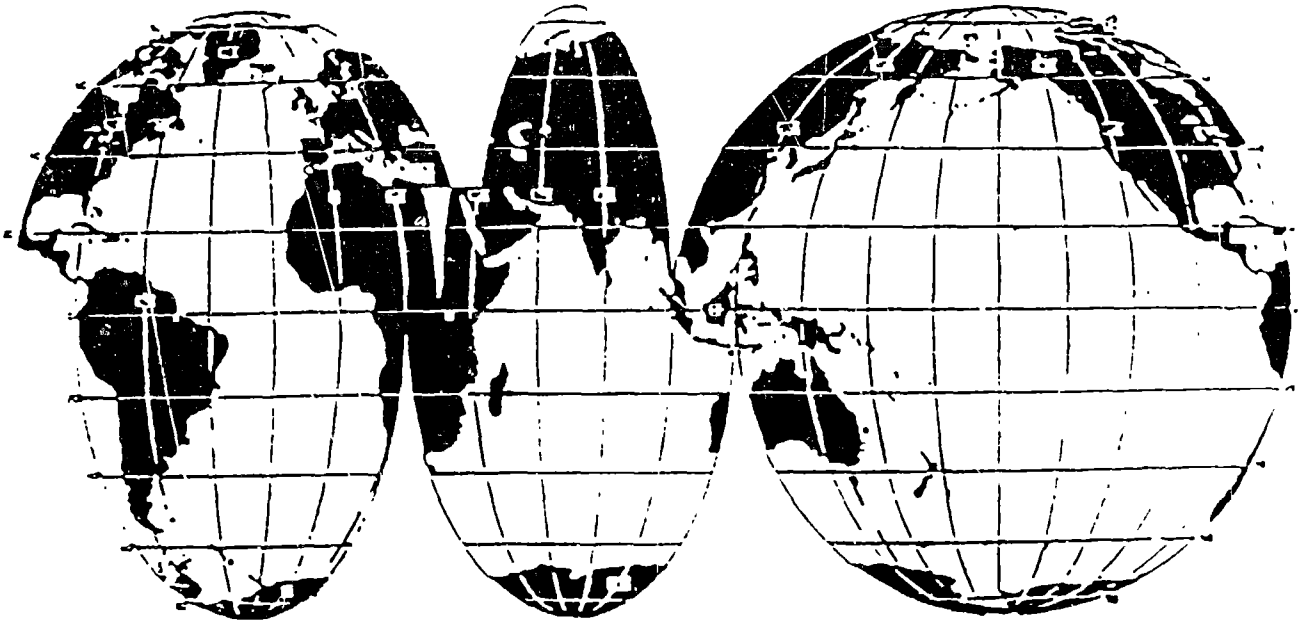
INTERGOVERNMENTAL
OCEANOGRAPHIC
COMMISSION

WORLD
METEOROLOGICAL
ORGANIZATION

UNITED NATIONS
ENVIRONMENT
PROGRAMME

GLOBAL OCEAN OBSERVING SYSTEM

STATUS REPORT ON EXISTING OCEAN ELEMENTS AND RELATED SYSTEMS



DECEMBER 1994

Table of contents

GOOS STATUS REPORT 1994

1. Introduction

Since the initiation of GOOS by IOC in 1989 significant progress has been recorded in the global ocean monitoring especially in the physical aspects domain. To ensure a coherent development of the different GOOS modules the IOC Assembly adopted the document "The Approach to GOOS" which since then served as a strategy document for GOOS planning and development. In 1994 large efforts were devoted to the implementation of the different bodies in charge of GOOS rational design and implementation. In this context the role of the I-GOOS Strategy Sub-Committee (SSC) cannot be over-emphasized to further GOOS planning and implementation programming. Meanwhile the World faced an unprecedented and increasingly fast development of electronic communication of information and data. Most of the observations collected by the ocean systems can now be accessed in nearly real time. We tried to give in this report, in addition to the traditional information on the status of existing systems, an updated list of the different sites where these information can be directly recovered and which prefigure the way GOOS will use in the near future to communicate with the user community.

2. GOOS design and planning: IOC-WMO-UNEP Committee for GOOS and related issues

The First Planning Session of the IOC-WMO-UNEP Committee on GOOS was held in Melbourne, Australia, 18-21 April 1994, and was attended by the representatives of 15 Member States in addition to international organizations/bodies.

The Planning Session reviewed the activities since the First Session of I-GOOS, Paris, February 1993.

The Planning Session noted with interest regional activities related to GOOS - for EUROPE - EUROGOOS and European SEAWATCH, and for the North Pacific, and agreed that such co-ordinated regional efforts were potentially a very effective way of proceeding with GOOS implementation. The Planning Session agreed that existing regional bodies would have an important role in assisting and contributing to GOOS implementation.

Particular consideration was given to the international structure of GOOS, and I-GOOS - J-GOOS interaction: J-GOOS is responsible for scientific design; I-GOOS is responsible for implementation.

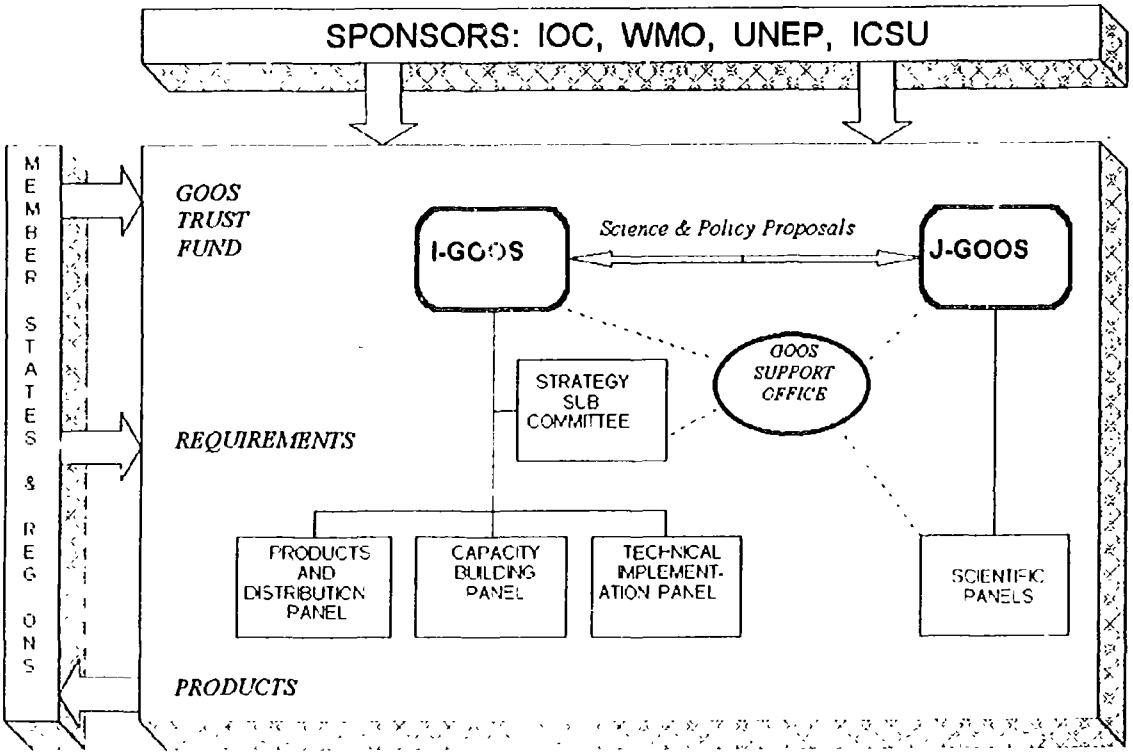
The Planning Session recommended the establishment of:

(i) **A Strategy Sub-Committee** to advise I-GOOS and its chairman on requirements, policy, marketing and resources-related issues.

(ii) **I-GOOS Panel on Technical Implementation** - to advise I-GOOS on the implementation of an integrated ocean observation network capable of meeting GOOS scientific and operational requirements.

(iii) **I-GOOS Panel on Products and Distribution** - to advise I-GOOS on products to meet user needs.

Conceptual GOOS organization structure



The planning Session made proposals on the development of a data management policy for GOOS; revision and more precise definition of the coastal module of GOOS; review and up-dating "The Approach to GOOS" and preparation of a strategic plan.

Recommendation on the establishment of an I-GOOS Panel on Capacity Building was prepared which will be presented for adoption at the Second Session of I-GOOS, Paris, June 1995.

The Planning Session proposed the following Priority Actions for 1994-1995:

(i) Formulation of a GOOS Strategy

(ii) Development of GOOS Coastal Zone Strategy

(iii) Scientific design of GOOS and its modules

(iv) Support of the development of the operational implementation of the post-TOGA Observing System

(v) Support of GOOS-related aspects of existing operational ocean observing and data management systems

(vi) Establishment of the other I-GOOS Panels.

The Twenty-seventh Session of the IOC Executive Council, July 1994, reviewed the Executive Summary of the First Planning Session of I-GOOS and by its Resolution EC-XXVII.6 approved the recommendations of the Planning Session.

The Executive Council agreed that within the IOC, GOOS should be given top priority and serve as one of IOC's major responses to UNCED, and that it be one of IOC's "flagships". Management issues identified centered on the following relationship and their balance: (i) priorities and implementation strategy; (ii) I-GOOS and J-GOOS; (iii) operation and research; (iv) existing and new system; (v) physical-climate community and the biological-health-coastal zone communities; and (vi) GCOS and GOOS. The need to concretely define GOOS objectives was stressed.

Particular consideration was given to the required resources for the implementation of GOOS (as reflected in the Annex VI to the Summary Report of the Twenty-seventh Session of the IOC-EC). The Council urged Member States to contribute to the earmarked GOOS/TEMA part of the IOC Trust Fund, and to consider seconding specialists to the GOOS Support Office. The Council noted the critical importance of establishing a permanent UNESCO post for the Director of the GOOS Support Office.

Issues discussed by the Council will be brought to the attention of the First Session of the GOOS Strategy Sub-Committee in March 1995.

2.1. GOOS Resources in 1994

(i) Major support for GOOS activities was provided through the regular IOC budget as well as contributions by Member States and other organizations to the IOC Trust Fund.

(ii) There were no contributions to the earmarked GOOS/TEMA part of the IOC Trust Fund in 1994.

(iii) WMO and ICSU provided support for the activities of I-GOOS and J-GOOS.

(iv) UNEP provided some support for the sea-level pilot monitoring activity in the Indian Ocean.

(v) The IOC Secretariat, in co-operation with the Oceans and Coastal Areas Programme Activity Centre (OCA/PAC) of UNEP, prepared a proposal on the project to be funded by GEF on "Assisting Developing Countries to participate fully in the next 3-year period". The GEF Council will consider this proposal together with other project proposals in 1995 within the International Waters focal area.

2.2. GOOS Support Office

Dr. W. Scherer, Director of the Office, seconded by USA, completed his term of secondment at the end of 1994. J-P. Rebert has been seconded by France and serves as the Director a.i., of the Office, following agreement of all the GOOS co-sponsors.

Mr. T. Murakami has been seconded by Japan to the GOOS Support Office since June 1994.

Brazil has offered to second a specialist to the Office.

The rest of the GOOS support staff does not only serve GOOS directly, but also serves existing operational programmes/activities (GLOSS, IGOSS, DBCP, OOSDP, etc.).

Two issues of GOOS NEWS were produced and widely circulated in 1994.

During the Oceanology International '94 Exhibition and Conference (Brighton, UK, 8-11 March 1994), special GOOS sessions were held with a number of technical papers presented on GOOS. A GOOS exhibit was organized with the support of SEAWATCH Europe and Oceanor. Close contacts were maintained with GCOS and new linkages were established with GTOS activities.

2.3. Scientific design of GOOS and its modules

The First Session of the IOC-WMO-ICSU Joint Scientific and Technical Committee for the Global Ocean Observing System (J-GOOS) was held at IFREMER in Nantes, France, from 25 to 27 May 1994.

Climate-related issues (GOOS Climate Module) and their priorities as presented in the recommendations of the OOSDP Report were noted. This common GOOS/GCOS module will be closely co-ordinated with JSTC-GCOS.

2.3.1. OOSDP

The OOSDP completed its assigned task on time, in December 1994, i.e., to formulate the conceptual design of an ocean climate observing system, that will serve as the basis for the climate module of GOOS and the ocean component of GCOS. The OOSDP final report (Document IOC/JSC-OOSDP-X/3) was delivered to the JSC, I-GOOS, J-GOOS and GCOS-JSTC, presented at the first session of the Strategy Sub-Committee in spring 1995, and given wide distribution to the ocean climate community. Based on an interpretation of the conclusions and recommendations in the report, I-GOOS is developing a strategy, in consultation with J-GOOS, GCOS-JSTC and JSC for steps leading to a phased implementation.

The complete series of Background Reports is the following:

1. The role of models in an ocean observing system
   prepared by Neville Smith
2. Scientific rationale for recommending Long-Term, Systematic Ocean Observations to monitor the uptake of CO2 by the Ocean - Now and in the Future
   prepared by L.Merlivat and A. Vezina
3. Surface conditions and Air-Sea fluxes
   prepared by R. Weller and P. Taylor
4. The Ocean Freshwater cycle
   prepared by R. Schmitt
5. Monitoring Global Carbon Inventories
   prepared by D. Wallace
6. The role of the Indian Ocean in Global Climate
   prepared by J.S. Godfrey et al
7. Sea Ice in the Global Climate system
   prepared by I. Allison and R. Moritz

Final report of the OOSDP:

Scientific design for the common module of the Global Ocean Observing System:
AN OCEAN OBSERVING SYSTEM FOR CLIMATE

All these reports were published by Texas A&M University and cannot be provided directly by IOC but may be directly requested there. Contact Dr. Worth Nowlin Jr., Department of Oceanography, Texas A&M University (wnowlin@latexsun.tamu.edu)

2.3.2. Other modules

Since the Living Marine Resources *ad hoc* Panel had only one meeting, its terms of reference and membership were discussed at the Second Session of the joint IOC-ICSU-WMO Scientific and Technological Committee for GOOS (J-GOOS), held in April 1995. The design requirements of this module were reviewed.

The Coastal Zone Module was discussed quite extensively, noting the need for common methodology, the wide range of the client/user base, and the need to make use of remotely-sensed data. The overlap with HOTO and LMR was also noted.

GIPME continued in 1994 to take the lead in the development of the strategic plan for the Health of the Ocean (HOTO) module of GOOS. A definitive document "Strategic development of the Health of the Ocean Module of the Global Ocean Observing System" was produced following the second meeting of the *ad hoc* Panel on HOTO in Paris, 10-15 February 1994. As a result, a pilot project to demonstrate the practicability and applicability of the HOTO module of GOOS is being planned to be initiated in the WESTPAC region in 1995.

The brief discussion of the marine services module concluded that no pressing scientific issues had yet been identified and therefore referred the establishment of this module to I-GOOS, since implementation is the critical issue.

3. INTEGRATED GLOBAL OCEAN SERVICES SYSTEM (IGOSS)

3.1. Ships of Opportunity Programme (SOOP)

In 1994 an estimated total of 48,674 BATHY messages (temperature versus depth profiles using expendable and manual bathythermographs) and 2,189 TESAC (temperature, salinity and conductivity measurements taken with Conductivity/Temperature/Depth instruments) were exchanged over the Global Telecommunications System (GTS) through the IGOSS. Although trackline data (designated TRACKOB) and drift and stationary buoy-derived data (once called DRIBU for drift buoy and now BUOY) were also acquired and exchanged in 1994, they comprise only a small percentage of the total data exchanged (figure page 9). This is slightly less than the preceding year but is still the third greatest number of messages in the history of IGOSS. Since 1976, when IGOSS began, nearly a half-million total messages have been exchanged over the GTS. This is shown in figure page 10 , which indicates the number of BATHY and TESAC messages exchanged during the period 1976-1994. There was a significant decrease in the number of TESAC messages exchanged in 1994. The 1994 amount represents less than half the number of TESACs exchanged in 1993 and the lowest number since 1982. IGOSS messages are transmitted in less than 30 days from the time they are acquired and so are considered *near-real time data*. Their application is most useful as boundary criteria, satellite truthing and in air-ocean climatic models. Data transmitted after this time span are designated as *delayed mode data*. Both types of data are eventually archived (figure page 11) which shows the close interaction between IGOSS and the International Oceanographic Data Exchange (IODE).

The OOSDP provides strong scientific arguments for the long term operational maintenance of the XBT low density network put in place by The Tropical Global Analysis (TOGA) and the World Ocean Circulation

Experiment (WOCE) research programmes. With TOGA completed in December 1994 and the WOCE Programme scheduled to be completed in 1997, the scientific justification and international co-ordination mechanisms for the maintenance of SOOP were in jeopardy of disappearing. An end-to-end management proposal has been submitted by IGOSS to perform the necessary international co-ordination of the network though funding for and maintenance of the network will remain as national responsibilities. The proposal is a natural transition of a successful research-driven ocean observation programme to an operational ocean monitoring and data exchange system and would form a cornerstone of the GOOS *Marine Meteorological and Oceanographic Operational Services* module. Figure page 12 shows the organizational structure of the new end-to-end proposal SOOP management proposal.

Approximately 115 different ships (both research and volunteer merchant ships) contributed to the collection of IGOSS data in 1994. A total of eight countries actively participated and reported statistics on data entered onto and extracted from the GTS. Figure page 13 shows the WOCE XBT track lines with their designations and coverage requirements. Following this figure is table 6.1 which shows the actual coverage of these lines for 1990-1993 and the first six months of 1994. A graphic representation of the table follows in the form of a three-dimensional bar graph. Figures page 17, 18 and 19 show map view of real-time and combined real-time/delayed mode data for 1994. Below the last map is another graph of the distribution of real-time and delayed mode data for 1990-1994. The figures and tables cited in this paragraph are taken from *WOCE Report No. 126/95 - Overview of WOCE Activities, January 1995.*

In the North and tropical Pacific and Atlantic Oceans, ships of opportunity supporting WOCE provide monthly and bi-monthly information on the extent and structure of thermal anomalies. When coupled with estimates of winds, air-sea fluxes and sea surface temperature, these data form the basis of the operational models currently being run in the tropical Atlantic and Pacific Oceans. WOCE has designed a high-density XBT sections network in the Pacific which, together with the repeat hydrography, satellite altimetry, surface drifters and mid-depth floats, should describe the seasonal and interannual variability in ocean circulation High density XBT sections are also required for the meridional heat flux sections in the Atlantic and Indian Oceans and of the choke point sections in the Southern Ocean.

3.1.1. data and information access

The data sets collected by these vessels and associated products can be accessed and retrieved electronically using the mechanisms implemented within the framework of the Global Temperature and Salinity Pilot Project (GTSPP). Direct connection through the World Wide Web under the NODC server "NODC Online Data Access" is achieved at the following address **http://www.nodc.noaa.gov/GTSPP/gtspp-home.html**

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

3.2. IGOSS data processing and services system (IDPSS)

The IDPSS consists of national, specialized and world oceanographic centers for the processing of observational data, the provision of products, services and operational data exchange activities to various marine user groups. Seventeen countries have officially established a National Oceanographic Center (NOC) and there are twelve Specialized Oceanographic Centers (SOC) and/or World Oceanographic Centers (WOC) distributed among six member states. A total of 46 countries prepare over 400 surface and sub-surface IGOSS products. **Addresses for the oceanographic centers can be found beginning on page 43 of INC publication *INC/IF-929 rev., Composition of IGOSS.***

IGOSS products are disseminated promptly through the GTS and by radio, radio facsimile, and various electronic and hard-copy mail systems. The IGOSS Bulletin, established in 1991, compiles and publishes IGOSS global and regional products quarterly as a valuable service to the scientific community and international programmes.

Questions about the IPB should be directed to:

Dr. Yves Tourre, Scientific Editor
Lamont-Doherty Earth Observatory of Columbia University
Department of Oceanography
Palisades, New York 10964
E-mail: tourre@ldeo.columbia.edu

Copies of the IGOSS Products Bulletin can be obtained by contacting:

Secretary, IOC
UNESCO, 1 rue Miollis
75732 Paris Cedex 15, France

Recently, a monthly electronic version of the IGOSS Products Bulletin (IPB) was developed and is now available through the World Wide Web of Internet in the form of a Home Page. The IPB provides products in the form of plots, images, and forecasts created with IGOSS data as well as information about the contributors. The address of the new IPB Home page is: **http://rainbow.ldeo.columbia.edu/**

3.3. IGOSS Telecommunication Arrangements (ITA)

The ITA continues to exist mainly of telecommunication facilities of the World Weather Watch GTS and other arrangements necessary for the rapid and reliable collection and distribution of observational data and processed information. At present, there are 57 unique bulletin headers authorized by WMO for the transmission of BATHY, TESAC, TRACKOB, and BUOY oceanographic data reports. A list of these bulletin headers can be found in the *Catalogue of Meteorological Bulletins, Volume C, edition May 1994.*

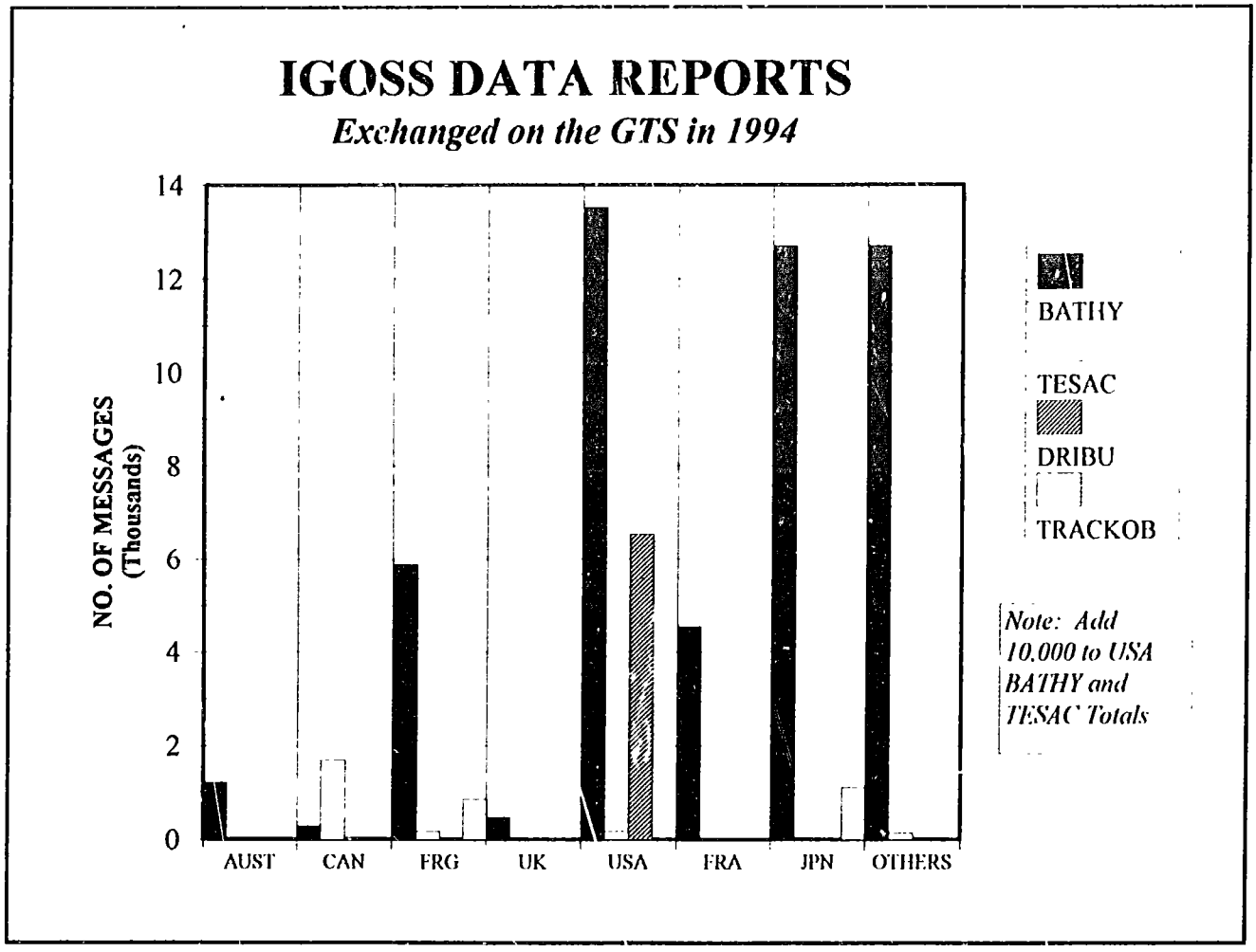
3.4. the ARGOS system

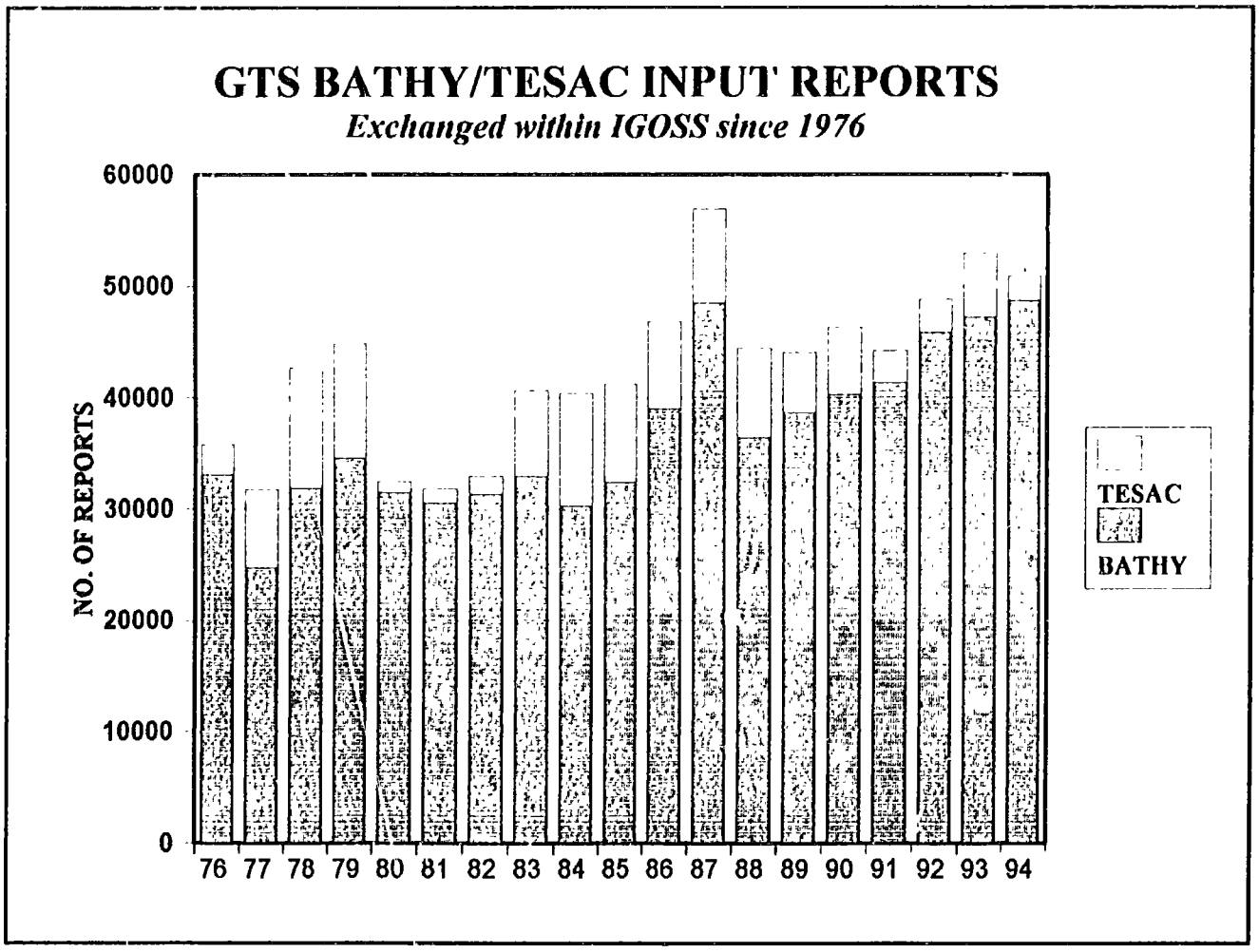
The ARGOS system is used for the collection and transmission of ocean data from fixed or moving platforms equipped with Platform Transmitter Terminals. It has proved particularly useful for the transmission of data from automatic stations such as buoys and from the Indian Ocean where there is no coverage by GOES satellites. In December 1994, the ARGOS service was handling reports from 970 drifting buoys, 310 moored buoys, 15 balloons, 14 ships, 413 fixed stations, and 198 miscellaneous platforms. A discussion of the status of buoy activities is given further.

3.5. references

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

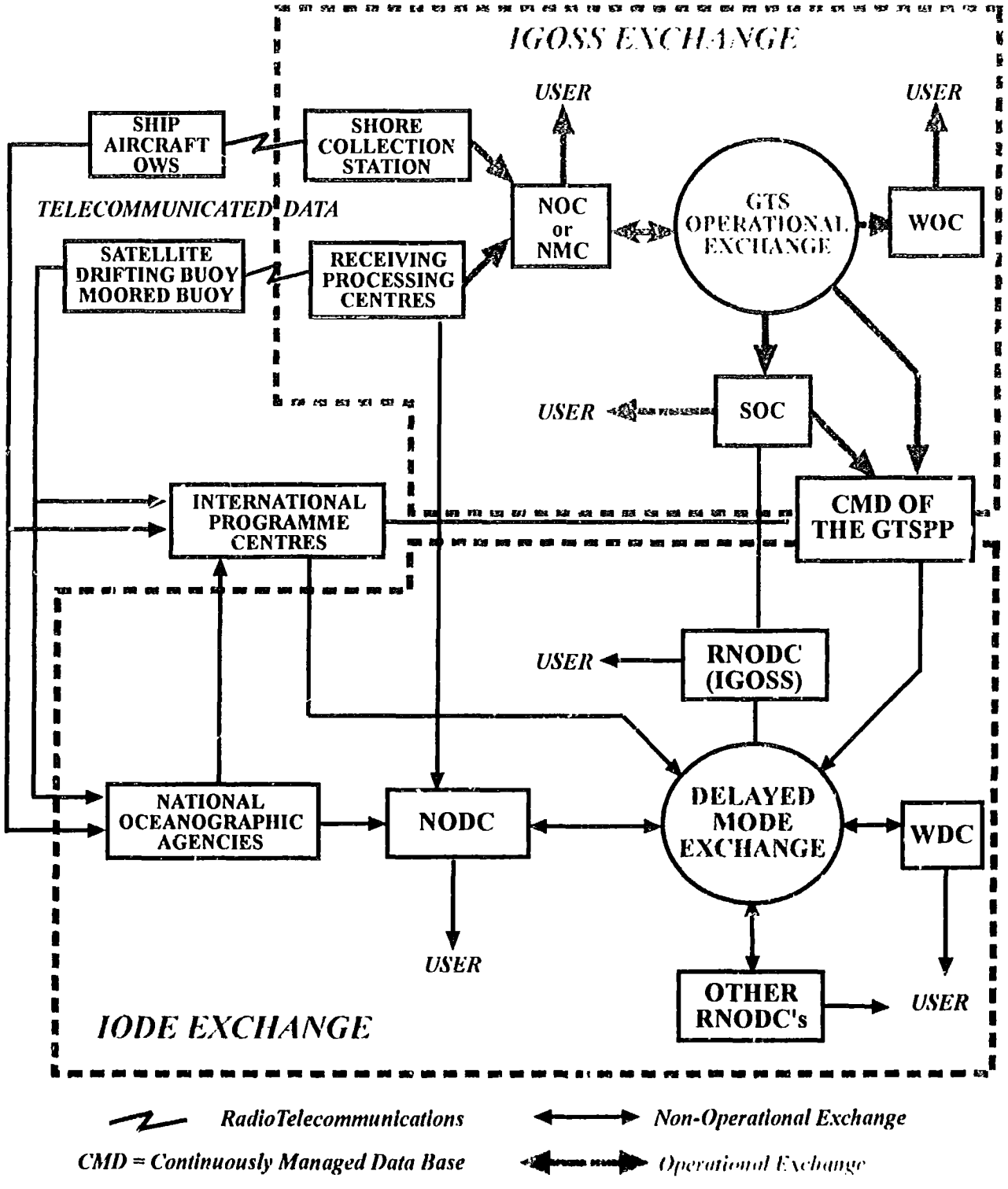
INC/IF-929 rev., Composition of IGOSS.
INC Manuals and Guides No. 1 - Guide to IGOSS Data Archives and exchange (BATHY & TESAC), 1993
INC Manuals and Guides No. 3 - Guide to Operational Procedures for the Collection and Exchange of IGOSS Data, Second revised Edition, 1988
INC Manuals and Guides No. 19 - Guide to Specialized Oceanographic Centers (SOCs), 1988
WMO No. 725 - IGOSS Plan and Implementation Programme, 1989-1995
WOCE Data Handbook, WOCE International Project Office, December 1994


IGOSS DATA REPORTS
Exchanged on the GTS in 1994
NO. OF MESSAGES (Thousands)
14
12
10
8
6
4
2
0
AUST
CAN
FRG
UK
USA
FRA
JPN
OTHERS
BATHY
TESAC
DRIBU
TRACKOB
Note: Add 10,000 to USA BATHY and TESAC Totals

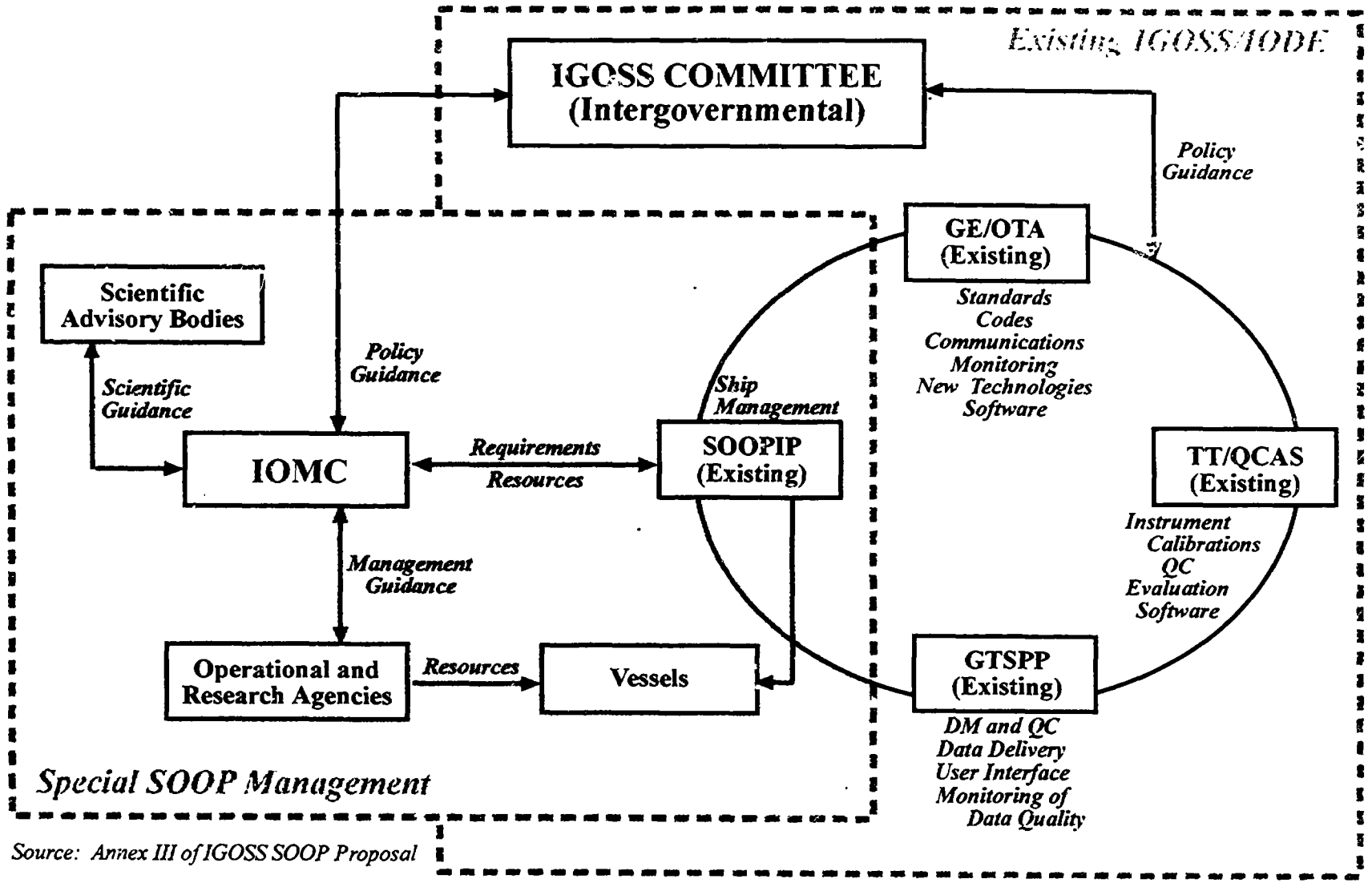

GTS BATHY/TESAC INPUT REPORTS
Exchanged within IGOSS since 1976
NO. OF REPORTS
60000
50000
40000
30000
20000
10000
0
76 77 78 79 80 81 82 83 84 85 86 87 88 89 90 91 92 93 94
TESAC
BATHY

IGOSS-IODE XBT/CTD DATA FLOW

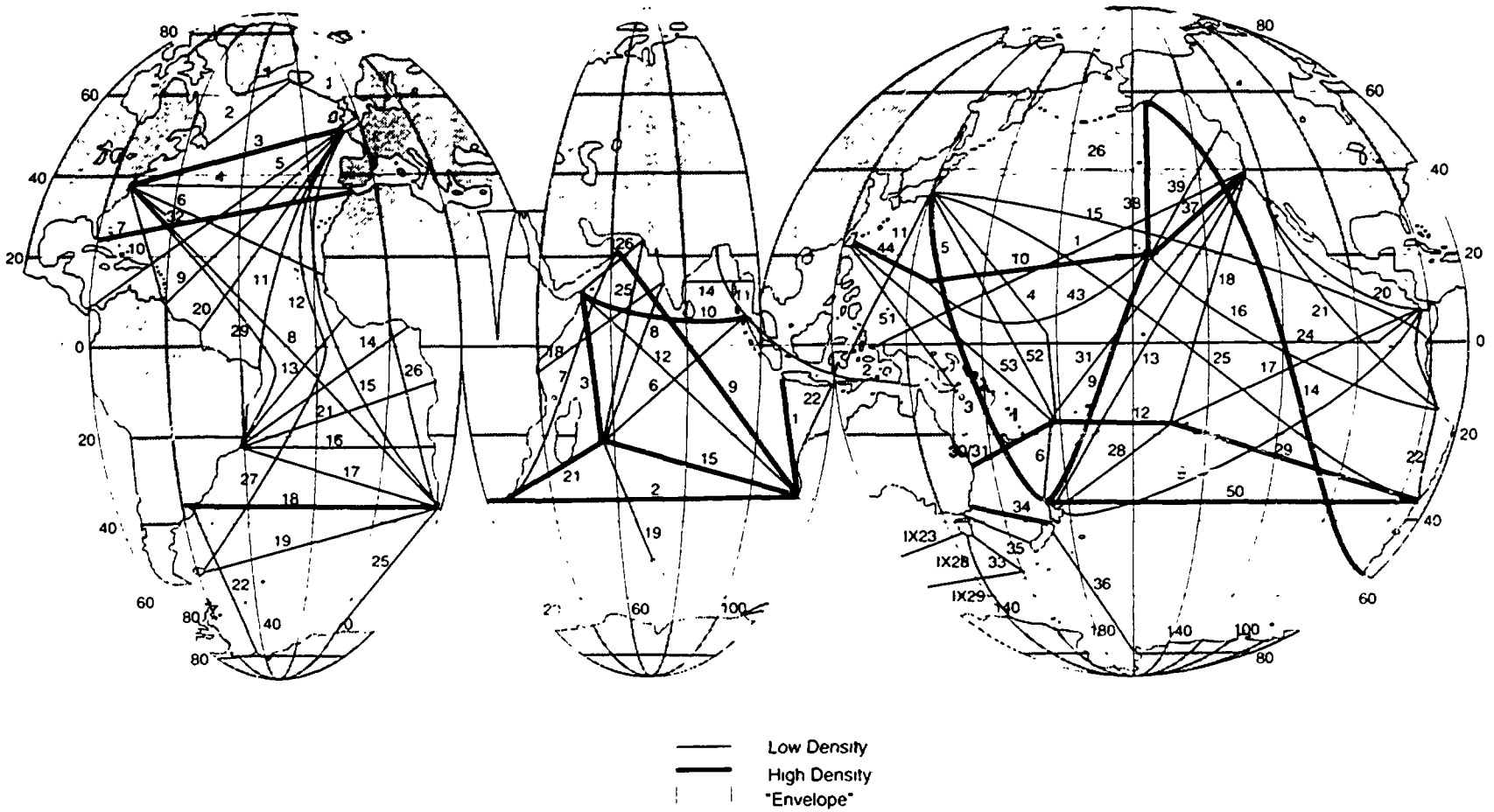
(from IOC Manuals & Guides, Series 1, 1993)



IGOSS SOOP MANAGEMENT



Source: Annex III of IGOSS SOOP Proposal



WOCE XBT Lines

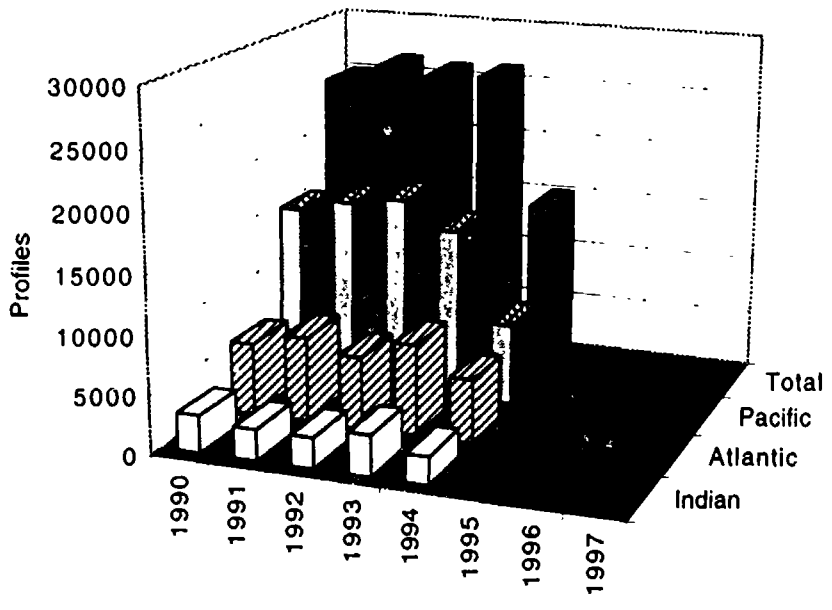
Table 6.1 XBT Commitments and Deployments

20 December 1994

Line	Req'd Obs/ Year	Country	Sects Year (Plan)	Actual Coverage (Sections/Observations) 1990	1991	1992	1993	Jan-Jun 1994
Atlantic Ocean								
Low Density								
AX1	160	Uncommitted		0/54		3/134	4/100	0/535
AX2	200	Canada,UK,USA	12	2/36	0/108	6/138	5/103	15/335
AX3	400	Germany	8	6/146	1/7		1/35	0/274
AX4	440	Netherlands,USA	16	0/536	17/642	22/615	23/551	11/264
AX5	650	France	22	15/196	0/385	17/406	18/578	10/343
AX6	420	Uncommitted	12	2/37			5/270	0/31
AX7	520	USA	12	24/405	20/404	9/114	15/308	11/296
AX8	960	USA	12	9/142	10/808	16/816	5/266	2/215
AX9	500	Uncommitted		25/465	0/286	23/242		0/34
AX10	200	USA	12		8/77	1/28	5/42	0/41
AX11	560	France,Germany	18.8	36/871	0/599	32/871	20/820	11/336
AX12	800	Germany,USA	1-2.12	12/242	13/782	7/598	15/1139	4/333
AX13	200	Uncommitted					1/17	0/3
AX15	650	France	8	25/661	16/402	12/221	4/90	10/144
AX17	430	Germany	12	3/42	3/152	4/76	2/43	8/80
AX18	480	Germany,USA	6.12	0/154	2/50	3/63	1/54	0/2
AX19	480	Uncommitted			0/36		1/56	3/53
AX20	440	France	18	13/167	12/196	12/238	21/590	11/245
AX21	400	Uncommitted		0/77	1/48	1/17		0/2
AX22	120	Uncommitted		1/59				2/36
AX25	216	Germany	?	3/209	2/444		1/29	0/2
AX26	320	France	12		2/25		23/417	13/220
AX27	400	Uncommitted			0/187	6/99	8/132	22/354
AX29	360	USA	12	19/378	13/431	30/670	33/967	29/864
AX32	120	USA	12	49/804	14/671	12/317	11/277	5/210
High Density								
AX3	520	Germany	?	7/569	11/556	13/544	13/928	4/165
AX7	680	Uncommitted						
AX18	680	Uncommitted						
Indian Ocean								
Low Density								
IX1	240	Australia	12-18	20/546	27/633	29/591	27/681	20/487
IX2	520	USA	12					
IX3	240	France	25	26/692	0/159	24/425	24/708	16/399
IX6	340	France/Japan,USA	8.12	11/189	3/43	15/248	9/252	10/198
IX7	480	USA	12	3/45	4/60	4/33	4/133	7/143
IX8	320	India	?					
IX9	650	Australia (part), Japan	6.12	27/383	27/593	23/296	26/346	24/248
IX10	310	France, Japan, USA	10.12.12	36/474	0/334	16/137	25/356	23/343
IX12	700	Australia	16	21/583	13/666	15/668	15/693	0/241
IX14	140	India	?					0/58
IX15	380	USA	12	2/19		0/54	4/67	3/73
IX18	220	Uncommitted					2/34	0/58
IX19	240	Uncommitted		1/16				
IX21	180	USA	12	11/87	1/16		8/64	5/46

Line	Req'd Obs/ Year	Country	Sects Year (Plan)	Actual Coverage (Sections/Observations) 1990	1991	1992	1993	Jan-Jun 1994
IX22	120	Australia	8	7/164	8/115	8/166	9/173	0/89
IX23	320	Uncommitted					1/62	
IX25	360	Uncommitted						
IX26	190	Uncommitted		0/11			1/13	0/93
IX28	180	Uncommitted						
IX29	180	Australia	?					
High Density								
IX1	320	Uncommitted						
IX2	680	Uncommitted						
IX3	320	Uncommitted						
IX6	440	Uncommitted						
IX10	400	Uncommitted						
IX12	920	Uncommitted						
IX15	520	Uncommitted						
IX21	230	Uncommitted						
IX28	180	Australia/USA/France	6					
Pacific Ocean								
Low Density								
PX1	860	Uncommitted		5/93	0/205	14/633	17/650	7/300
PX2	320	Australia	12-18	21/321	20/336	20/398	18/355	16/261
PX3	160	Australia	8	28/522	32/581	12/229	16/379	0/179
PX4	500	France	6	6/71	9/122	6/199	6/187	0/97
PX5	560	France, Japan	24,18	57/1691	52/1076	36/1090	30/1003	10/298
PX6	160	Uncommitted					0/80	0/28
PX8	700	USA	12	28/445	26/1050	23/1070	16/897	8/435
PX9	440	USA	12	28/469	19/415	19/324	20/322	5/57
PX10	440	USA	12	32/435	18/316	38/577	35/504	21/298
PX11	320	Australia	8	6/140	22/600	9/212	9/173	0/124
PX12	370	France	21	23/293	32/334	25/418	29/408	13/249
PX13	770	USA	12	23/421	16/645	20/539	17/397	7/163
PX14	1080	USA	18	0/1080	1/15	7/369	9/251	6/205
PX15	960	USA	12	1/37	2/54		8/221	3/104
PX16	680	USA	12					7/285
PX17	530	France	15	13/438	20/516	13/466	10/380	6/265
PX18	440	USA	18	40/1030	25/1101	19/450	25/533	13/274
PX20	370	Uncommitted		104/2421	21/410	17/425	6/125	0/28
PX21	500	Uncommitted		3/83	22/543	18/407	12/181	1/61
PX22	360	Uncommitted		6/90	7/386	1/46	8/66	8/66
PX24	1200	Uncommitted		4/109		1/124	1/23	0/14
PX25	1320	Uncommitted			5/141	9/244	4/76	0/108
PX26	5500	Japan, USA	18, ?	105/1837	110/2905	155/2941	113/2070	48/1468
PX28	240	Uncommitted		7/107	25/229	1/18		0/3
PX29	560	Uncommitted			0/4	2/33	2/50	4/65
PX30	240	Uncommitted			12/145			2/33
PX31	880	France	12	33/675	38/1319	28/848	16/354	15/321
PX33	130	Uncommitted						
PX34	140	Uncommitted		3/30	20/209	36/269	50/377	14/147
PX35	140	Uncommitted			8/271	4/199		0/3
PX36	400	Uncommitted				2/30	1/23	1/17
PX37	340	Uncommitted		103/1754	25/358	60/679	51/443	26/266
PX38	320	Uncommitted		12/127	6/173	9/93	2/17	0/2

Line	Req'd Obs/ Year	Country	Sects Year (Plan)	Actual Coverage (Sections/Observations) 1990	1991	1992	1993	Jan-Jun 1994
PX43	440	USA	12	6/53	6/106	13/109	20/212	8/98
PX44	160	Uncommitted		10/113	21/173	42/358	46/347	22/242
PX50	720	USA	12				2/64	5/197
PX51	360	France	18			22/699	17/608	4/125
PX52	540	Uncommitted				3/97	1/23	0/13
PX53	540	Uncommitted				9/359	0/43	0/208
PX54	140	Australia	12					
High Density								
PX5	740	Uncommitted						
PX6	210	USA	4		4/227	4/235	5/276	
PX9	600	USA	4	4/847	4/586	4/595	5/716	
PX10	600	USA/ROC	2		1/123	2/260		
PX12	500	Uncommitted						
PX14	1440	Uncommitted						
PX29	720	Uncommitted						
PX30		USA	2		2/167	2/152	2/195	
PX30/31	290	Australia/USA	4		3/291	3/239	2/151	
PX34	200	Australia	4		4/137	4/139	4/256	1/61
PX35	200	Uncommitted				3/194	4/199	
PX36	520	Uncommitted						
PX37	440	USA/ROC	2		1/86	2/166	3/262	
PX38	400	USA/ROC	2				2/248	
PX39		USA/ROC					2/184	
PX44	200	USA/ROC	2		1/75	2/176	3/259	
PX50	920	USA	2				1/245	



Level of actual sampling of XBT Programme (Low and High Density)
(1994 data is for the period of January to June)

METEO FRANCE

METEO-FRANCE/SMISO

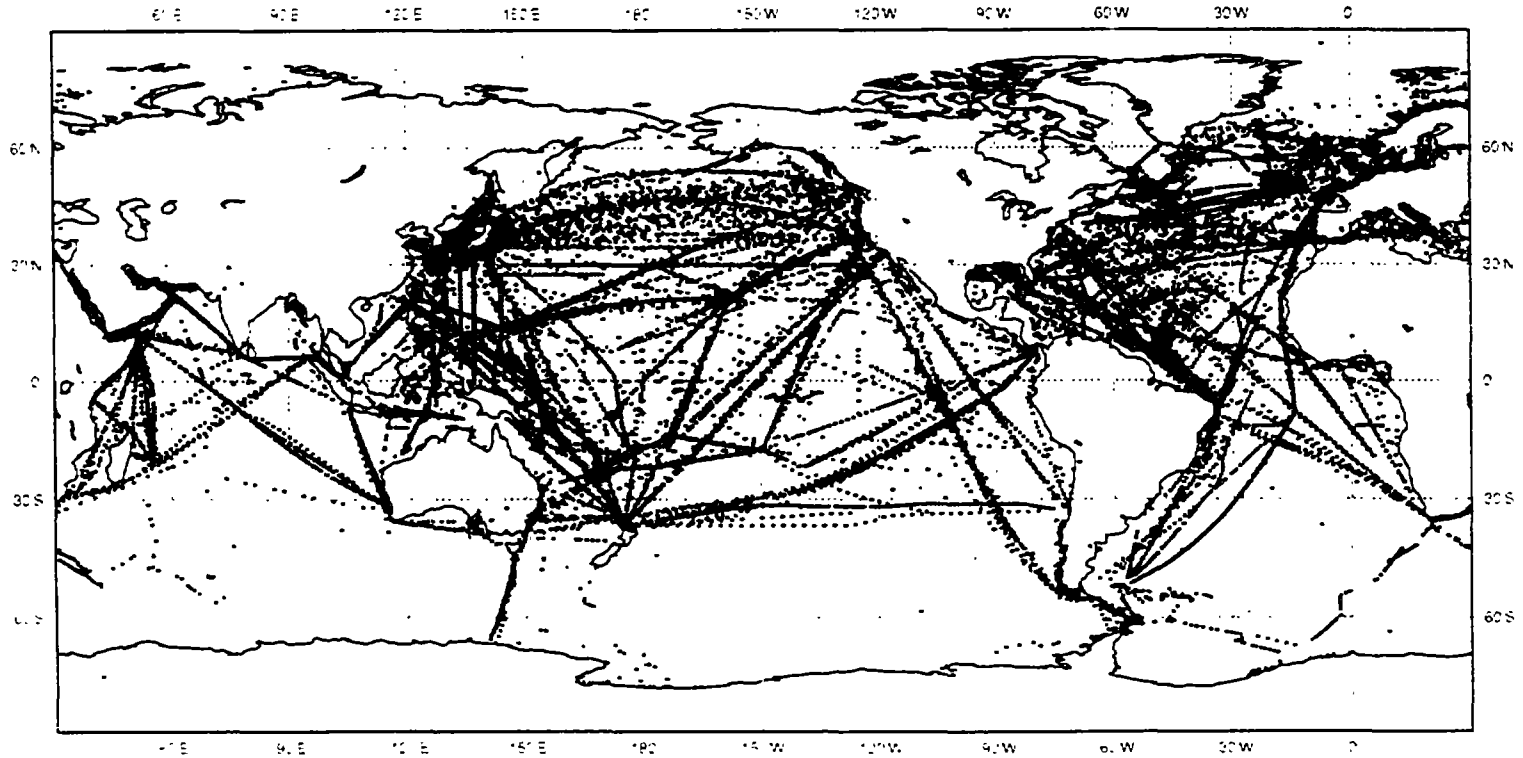
FRENCH MET OFFICE/IGOSS

Carte de pointage des observations recues en 1994

Mapping position plot chart of data received during 1994

Messages : BATHY

Total : 54759



MAGICS 4.2 Solaris - smiso - 4 May 1995 16:47:14

METEO FRANCE

METEO-FRANCE/SMISO

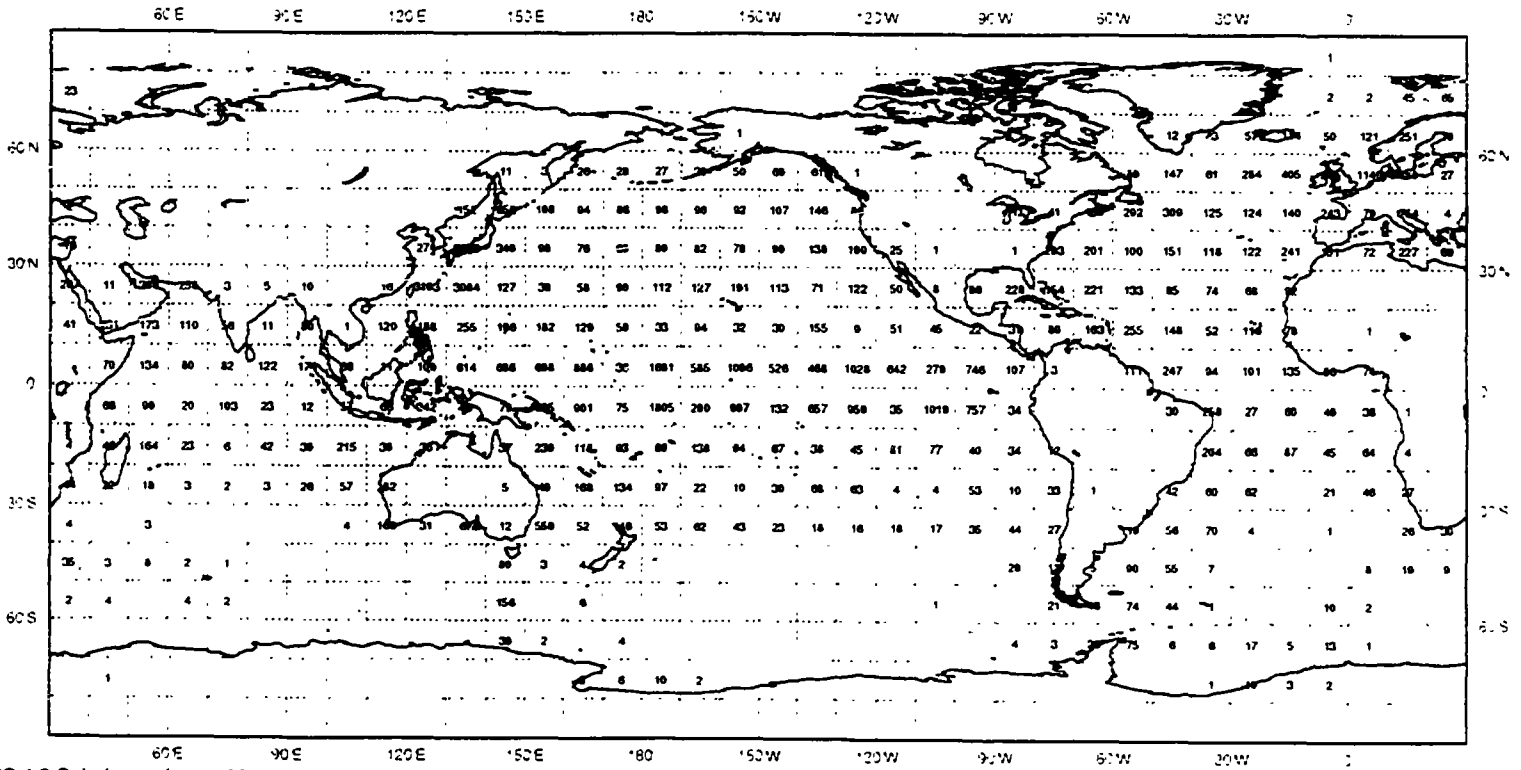
FRENCH MET OFFICE/IGOSS

Repartition par carre Marsden des observations recues en 1994

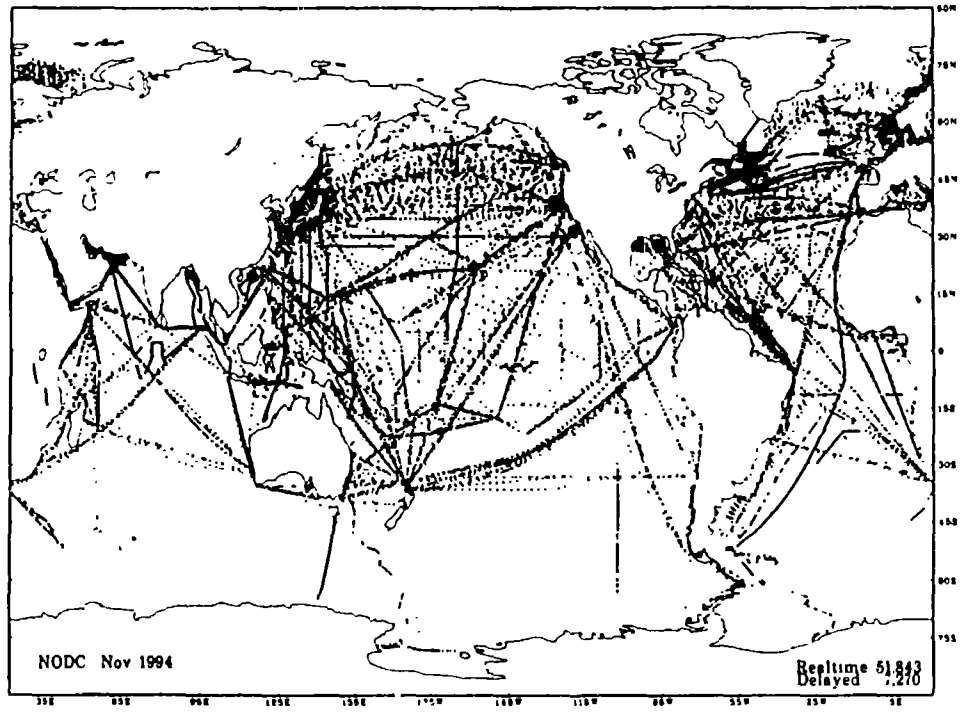
Marsden square distribution chart of data received during 1994

Messages : BATHY

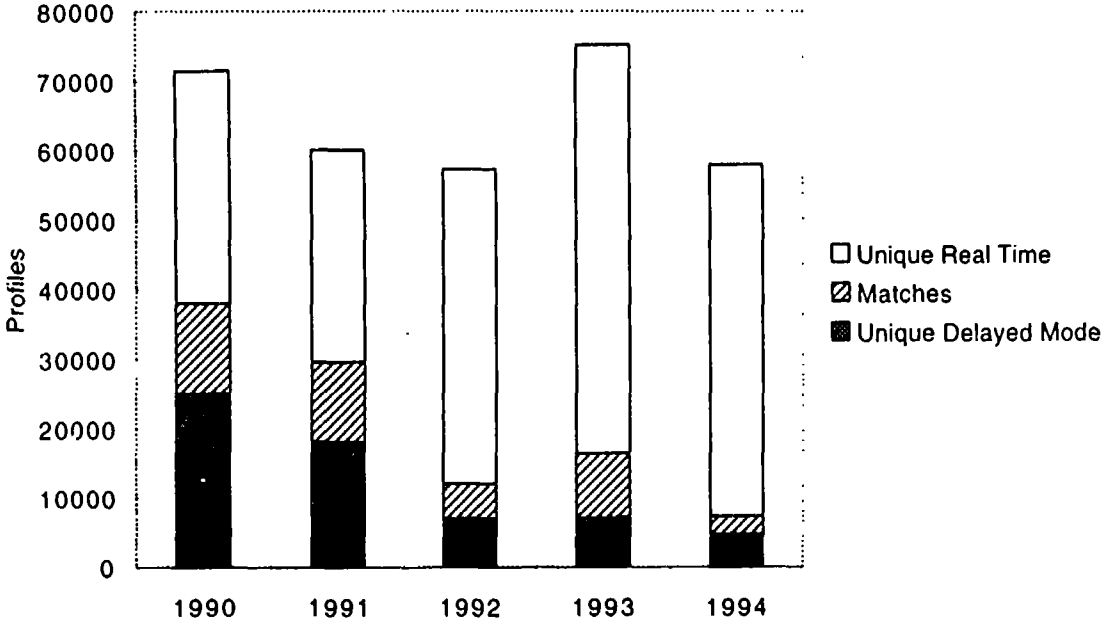
Total : 54759



MAGICS 4.2 Solaris - smiso - 4 May 1995 16:47:38



Real Time and Delayed Mode data at NODC for Year 1994 (Jan-Nov)



XBT data flow (from NODC, November 1994)

3.6. future developments

IGOSS has a Group of Experts on Operations and Technical Operations (GE/OTA) and a Task team for Quality Control of Acquisition Systems (TT/QCAS) that ensure IGOSS data are acquired efficiently and accurately. The GE/OTA is presently investigating the use of the Binary Form for Data Representation or BUFR code to keep pace with improvements in telecommunications, the use of INMARSAT-C for lower-cost data transmission and other demonstration projects designed to keep pace with emerging technologies. The TT/QCAS recently completed a worldwide investigation of XBT fall-rate equations that produced a new, more accurate equation with coefficients specific to each instrument type. A new BATHY Code will soon be implemented so that XBT instrument information and related equation coefficients can be transmitted with the data. TT/QCAS also investigates new technologies and methodologies for improved data acquisition such as Expendable Conductivity-Depth-Temperature (XCTD) probes.

4. GLOBAL SEA LEVEL OBSERVING SYSTEM (GLOSS) 1994

GLOSS has been recognized by the Committee for GOOS (Rec.GOOS-I.3) and by the IOC (Res.XVII-5) as a major existing observational element of the Global Ocean Observing System (GOOS). IOC Group of Experts on GLOSS, as a subsidiary body of the IOC-WMO-UNEP Committee for GOOS, provides scientific and technical advise to IOC on GLOSS development. The GLOSS status and future development was considered by the IOC Group of Experts on GLOSS at its Fourth session, held in Bordeaux, France, 31 January - 3 February 1995.

4.1. Status of the GLOSS Network

GLOSS Handbook -Version 2.1 (on PC disk) was prepared in 1994 by PSMSL to comprise an up-dated comprehensive database of information about 308 GLOSS sea-level stations including tide gauge details, bench mark information, data delivery systems, the National GLOSS contact point. It allows plotting of monthly and annual mean sea level values, where they are available from the PSMSL.

An "operational" station from a PSMSL viewpoint means that recent mean sea level monthly and annual values have been received at Bidston, have been checked as far as possible, and have been included in the databank. For each of the GLOSS stations the PSMSL used the year of the last data entered into the databank, if any, to place the station into one of four categories:

Category 1: "Operational" stations for which the latest data is 1989 or later;
Category 2: "Probably operational" stations for which the latest data is within the period 1980-1989;
Category 3: "Historical" stations for which the latest data is earlier than 1980;
Category 4: For which no PSMSL data exist.

Table 1 lists the number of stations which fall into each category for all stations, then for the subset which have been "committed to GLOSS". Also shown are the numbers in each category reported at previous GLOSS meetings with the category definitions adjusted backwards one, two, three etc. years appropriately. The attached map page 25 shows geographical distribution of different categories of GLOSS stations.

It can be seen that there has been a general modest improvement during 1994 in nominal GLOSS status, following the significant improvement obtained in 1993.

Table 1

Number of Stations in Each Category (All Stations)

Category	Bidston GE Mtg. June 89	Miami GE Mtg. Oct 90	Vienna IUGG Aug 91	Paris GE Mtg. Oct 92	Nowhere Oct 93	Nowhere (pre-Bordeaux GE Mtg.) Oct 94
1	105	133	136	158	177	183
2	51	50	57	46	33	35
3	47	42	36	29	26	26
4	103	81	77	73	72	64
Total	306	306	306	306	308	308

4.2. Sea-level data flow, collection and archival

Sea-level data from the GLOSS network are submitted to the number of international sea-level centers as shown below:

(i) **The Permanent Service for Mean Sea Level (PSMSL)**
Dr. P. Woodworth, Director, PSMSL,
Proudman Oceanographic Laboratory, Bidston Observatory, Birkenhead, MERSEYSIDE L43 7RA, UNITED KINGDOM - Tel: (151) 653 86 33 - Fax: (151) 653 62 69 - E-mail: plw@pol.ac.uk

The PSMSL since 1933 has been responsible for the collection, publication, analysis and interpretation of sea level data from the global network of tide gauges. PSMSL receives monthly and annual mean values of sea level from a worldwide network. The PSMSL acts as a Global GLOSS Centre. Format for submission of monthly and annual sea level data from PSMSL is shown in the GLOSS Implementation Plan, Annex VII (IOC Technical series No. 35, 1990). The detailed current contents of the PSMSL databank are described in the "Data Holdings of PSMSL" issued annually. PSMSL also maintains the GLOSS Handbook and provides data and other information free of charge to the scientific community.

(ii) **Specialized Oceanographic Centre for the IGOSS Sea Level Programme in the Pacific (SOC for ISLP-Pac)**
Dr. G. Mitchum, Director, UH Sea Level Centre,
University of Hawaii, 1000 Pope Road, MSB 307, Honolulu, HAWAII 96822-2336, UNITED STATES OF AMERICA - Tel: (1) 808 956 61 61 - Fax: (1) 808 956 23 52 - E-mail: mitchum@soest.hawaii.edu

The Centre collects monthly mean sea level data in near-real-time from sea level stations of the Pacific Ocean. The Centre prepares and widely distributes monthly maps of the Pacific sea level deviations from the long-term mean as well as maps of the sea level anomalies from the long-term seasonal cycle that are corrected for atmospheric pressure anomalies.

(iii) **TOGA Sea Level Centre (TSLC)**

Dr. G. Mitchum, Director, UH Sea Level Centre,
University of Hawaii, 1000 Pope Road, MSB 307, Honolulu, HAWAII 96822-2336, UNITED STATES OF AMERICA - Tel: (1) 808 956 61 61 - Fax: (1) 808 956 23 52 - E-mail: mitchum@soest.hawaii.edu

The TOGA Sea Level Centre receives hourly data from regional and national sea level networks around the globe operated by various agencies. The emphasis of the collection is in the tropics. The objective is to prepare a scientifically valid, well documented archive of hourly, daily, and monthly sea level values is standardized formats. These data are annually submitted to the WDC-A for Oceanography and the monthly values are provided to PSMSL.

(iv) **WOCE Sea Level Data Assembly Centre - Fast Delivery Centre (WOCE-DAC)**
Dr. G. Mitchum, UH Sea Level Centre,
University of Hawaii, 1000 Pope Road, MSB 307, Honolulu, HAWAII 96822-2336, UNITED STATES OF AMERICA - Tel: (1) 808 956 61 61 - Fax: (1) 808 956 23 52 - E-mail: mitchum@soest.hawaii.edu

The Centre assembles and distributes all sea level data delivery by satellites, or other near-real-time systems, from WOCE gauges. This would be carried out in a time frame of 1-3 months after data collection.

(v) **WOCE Sea Level Data Assembly Centre - Delayed Mode Delivery (WOCE-DAC)**
Dr. L. Rickards, British Oceanographic Data Centre
Proudman Oceanographic Laboratory, Bidston Observatory, Birkenhead, MERSEYSIDE L43 7RA. UNITED KINGDOM - Tel: (151) 653 86 33 - Fax: (151) 653 39 50 - E-mail: ljr@pol.ac.uk

The British Oceanographic Data Centre is responsible for the assembly, quality control and dissemination of the comprehensive sea level data set for WOCE. It began its activities in early (1990) and is at present collating hourly data from approximately 123 tide gauge sites. Distribution should be possible within 18-24 months after data collection. Quality controlled data and documentation are available over Internet via ftp. BODC will also ensure archival of the sea-level data as a WOCE data set in the World Data Centre system by the end of the experiment.

(vi) **Specialized Oceanographic Centre for the IGOSS Sea Level Pilot Project in the North and Tropical Atlantic**
Dr. A. Bolduc, MEDS, Department of Fisheries and Oceans
200 Kent Street, Ottawa, Ontario K1A OE6, CANADA - Tel: (1) 613 990 02 31 - Fax: (1) 613 990 55 10 - Tlx: 534228 - E-mail: bolduc@ottmed.meds.dfo.ca

The Centre established in 1990 continues evaluation of the usefulness and the feasibility of producing mean sea level charts for the prediction of climate trends, long range weather forecasts and ocean processes.

(vii) **IHO Tidal Constituent Bank** - managed by the Canadian Hydrographic Service through the IHB on behalf of Member States. All requests are to be directed to:

International Hydrographic Bureau
7 avenue Président J.F. Kennedy, B.P. 445
MC - 98011 Monaco Cedex
PRINCIPALITY OF MONACO

Tel: (33) 93 50 65 87
Fax: (33) 93 25 20 03
E-mail: ihb@unice.fr

or

Canadian Hydrographic Service
615 Booth Street
Ottawa, Ontario, CANADA K1A OE6
Tel: (1) 613 995 44 13
Fax: (1) 613 996 90 53

4.3. Sea-level products and data/information services

SOME GLOBAL AND REGIONAL SEA-LEVEL PRODUCTS AND SERVICES PRESENTLY AVAILABLE

(i) Operational products:

Specialized Oceanographic Centre (SOC) for Mean Sea Level in the Pacific
Department of Oceanography, University of Hawaii at Manoa, Honolulu, USA

Pacific Ocean

- Monthly maps of the Pacific sea level deviations from the long-term mean (Fig. page 26);
- Maps of the sea level anomalies from the long-term seasonal cycle that are corrected for atmospheric pressure anomalies (Fig. page 26);
- Time series of sea level deviations that are corrected for atmospheric pressure, but retain the seasonal variations;
- Quarterly updates of an index of the tropical Pacific upper layer volume;
- Annual updates of indices of the ridge-trough system and equatorial currents for the Pacific Ocean.

(ii) Demonstration Products:

National Ocean Service
NOAA, Rockville, USA

Global

Monthly Maps of Global Average Sea Level Deviations (relative to Oct. 92 - Sept. 93 year) for December 94 (TOPEX-POSEIDON data) (Fig. page 27); these information can be recovered directly on the World Wide Web at several places, like for this one in the NOAA/PMEL/TAO El Nino Theme Page (http://www.pmel.noaa.gov/toga-tao/el-nino/home.html)

Tropical Pacific

Blended (ERS-1 and TOGA tide gauge data) sea-level anomaly. Interannual changes are relative to 1985-1986 mean (Fig. page 28);

Proudman Oceanographic Laboratory
Bidston Observatory, UK

Global

Altimetric topographic maps of the global ocean for studies of ocean circulation and climate with these maps validated by, and blended with if necessary, *in situ* sea level data from tide-gauges (Fig. page 29);

(iii) Special products on data summaries:

IOC/PSMSL

Publication "Sea Level Monitoring in the Small Island Developing States" (UNESCO 1994), containing summary of monthly mean sea level values for selected island GLOSS stations.

(iv) Sea-Level data/information services:

Permanent Service of Mean Sea Level (Proudman Oceanographic Laboratory, Bidston Observatory, UK)

- Provision of sea level data to scientists via Internet;
- "GLOSS Handbook" PC disk file, containing details of each GLOSS gauge;
- "A Guide to Tide Gauge Networks and Global and Regional Data Sets" a prototype set for provision through the World Wide Web (WWW) information on contacts and access to data;
- Data holdings of PSMSL Centre -annual catalogue of the PSMSL databank;
- Provision of monthly mean sea level data on PC disk to the national institutions participating in the IOC-UNEP-WMO Pilot Activity on Sea Level Changes and Associated Coastal Impacts in the Indian Ocean by PSMSL in 1993.

National Oceanographic Data Centre of USA/PSMSL/TOGA SLC

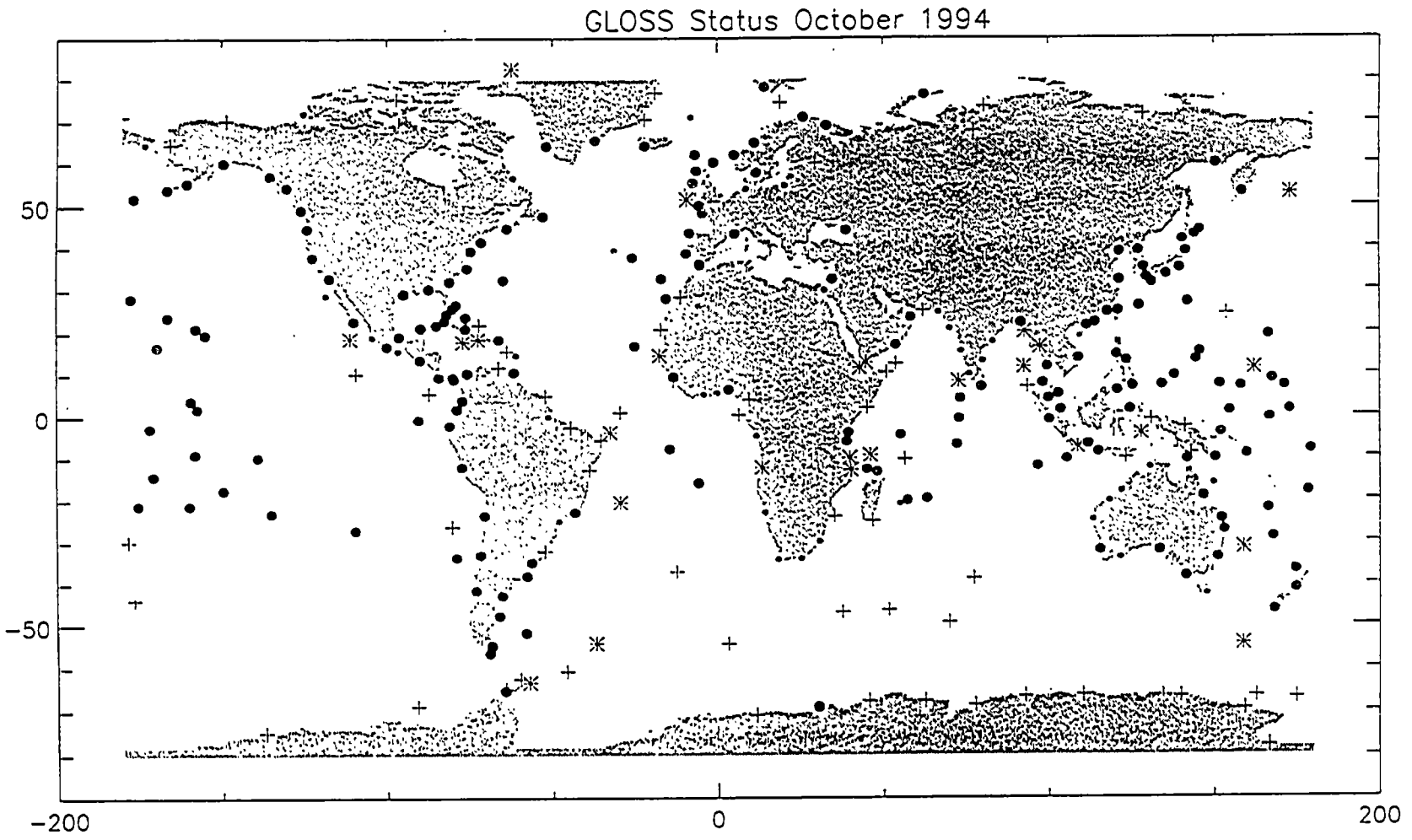
CD-ROM containing the summer 1994 version of the PSMSL dataset and the TOGA sea level dataset.

TOGA Sea Level Centre (TSLC) (University of Hawaii, Honolulu, USA)

Distribution of TSLC dataset (sea level from the global tropics) upon request either directly or through the World Data Centre system and the US NODC

Annual reports of TOGA Sea Level Centre

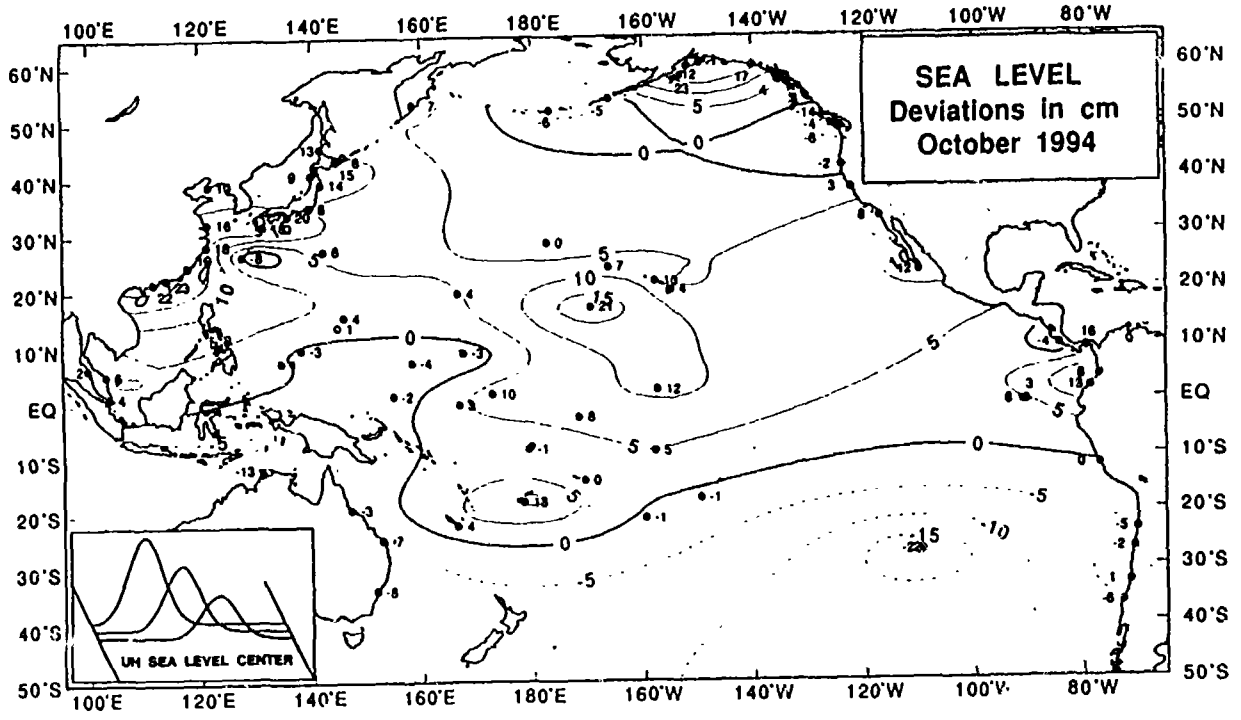
Delayed Mode WOCE Sea Level Data Assembly Centre (British Oceanographic Data Centre)



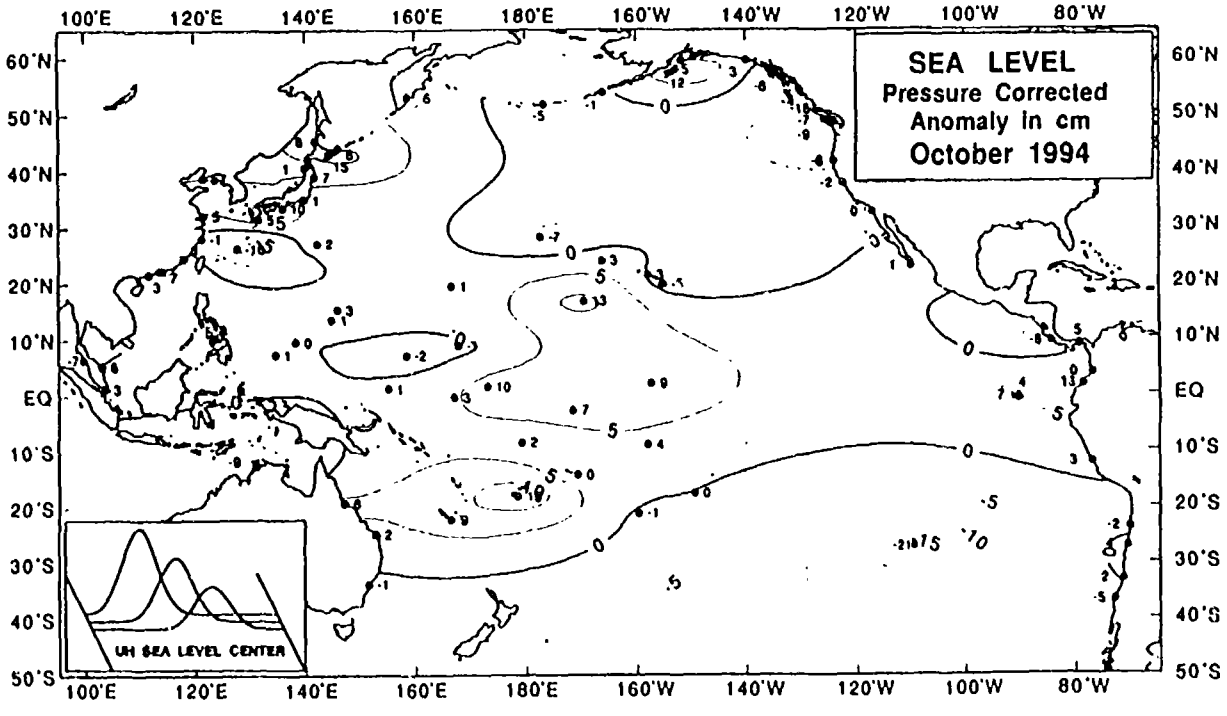
Status Category 1,2,3,4 = Large Dot, Small Dot, Star, Cross

PACIFIC OCEAN SEA LEVEL

(Issued by the Specialized Oceanographic Centre, University of Hawaii)

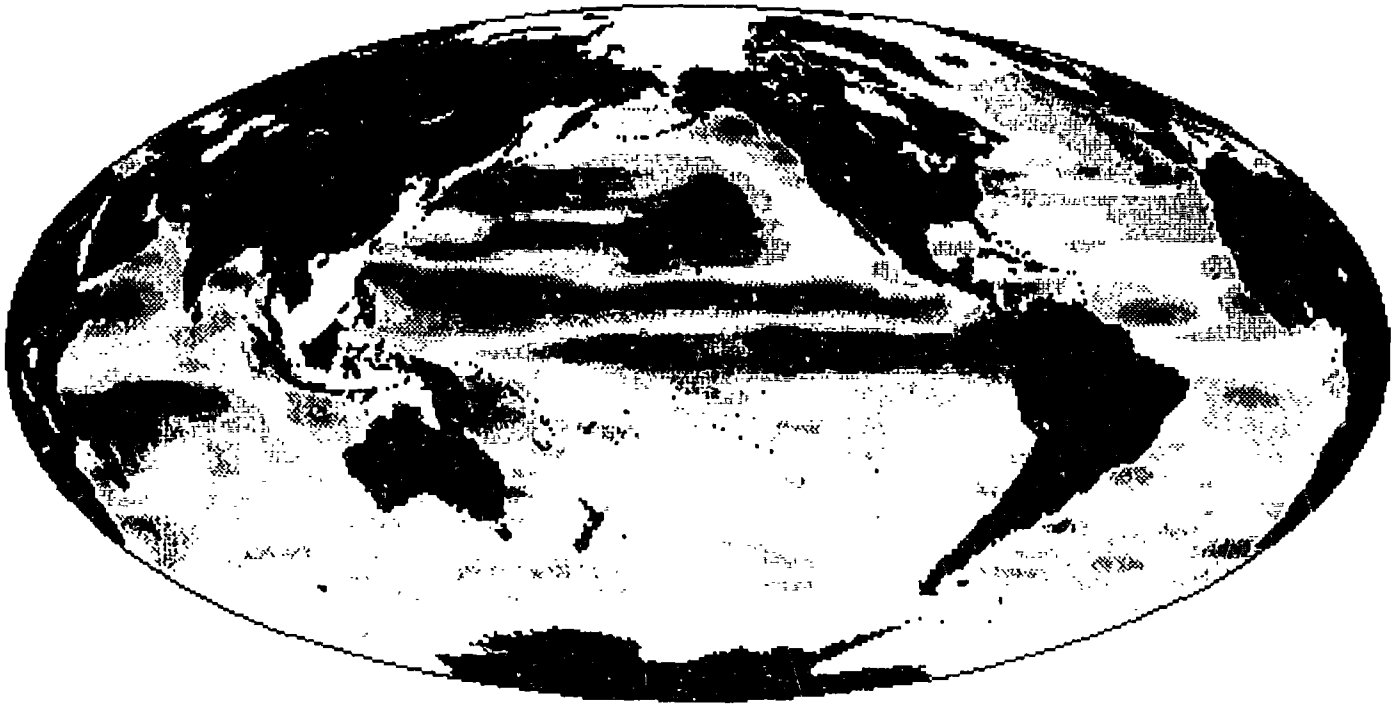


Deviation of sea level from the 1975 to 1986 mean sea level.



Anomaly of sea level from the 1975 to 1986 mean sea level adjusted for atmospheric pressure.

T/P Sea Level Deviation Dec 94



NOAA / National Ocean Service

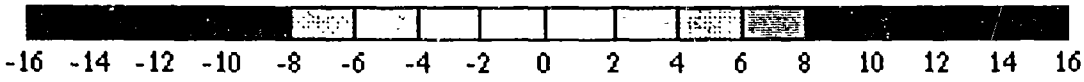
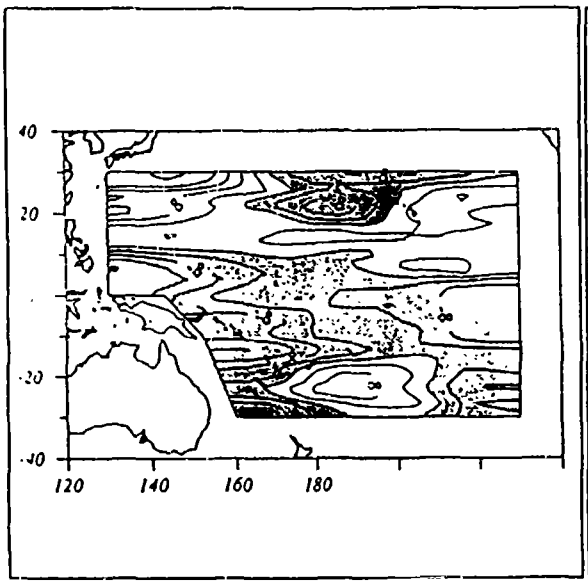
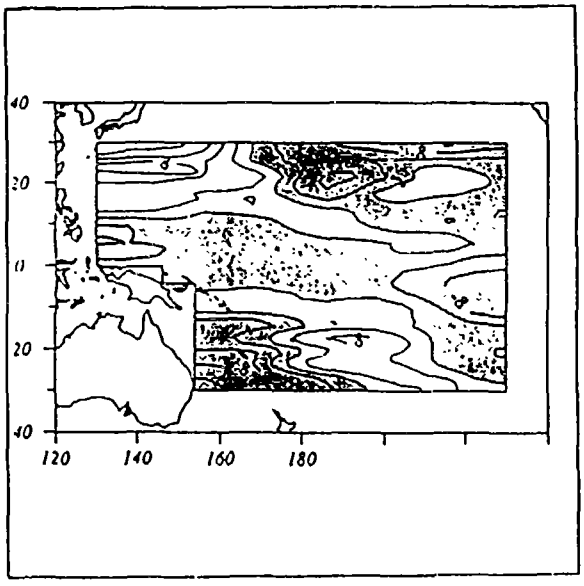


Figure 4. National Ocean Service
NOAA, USA



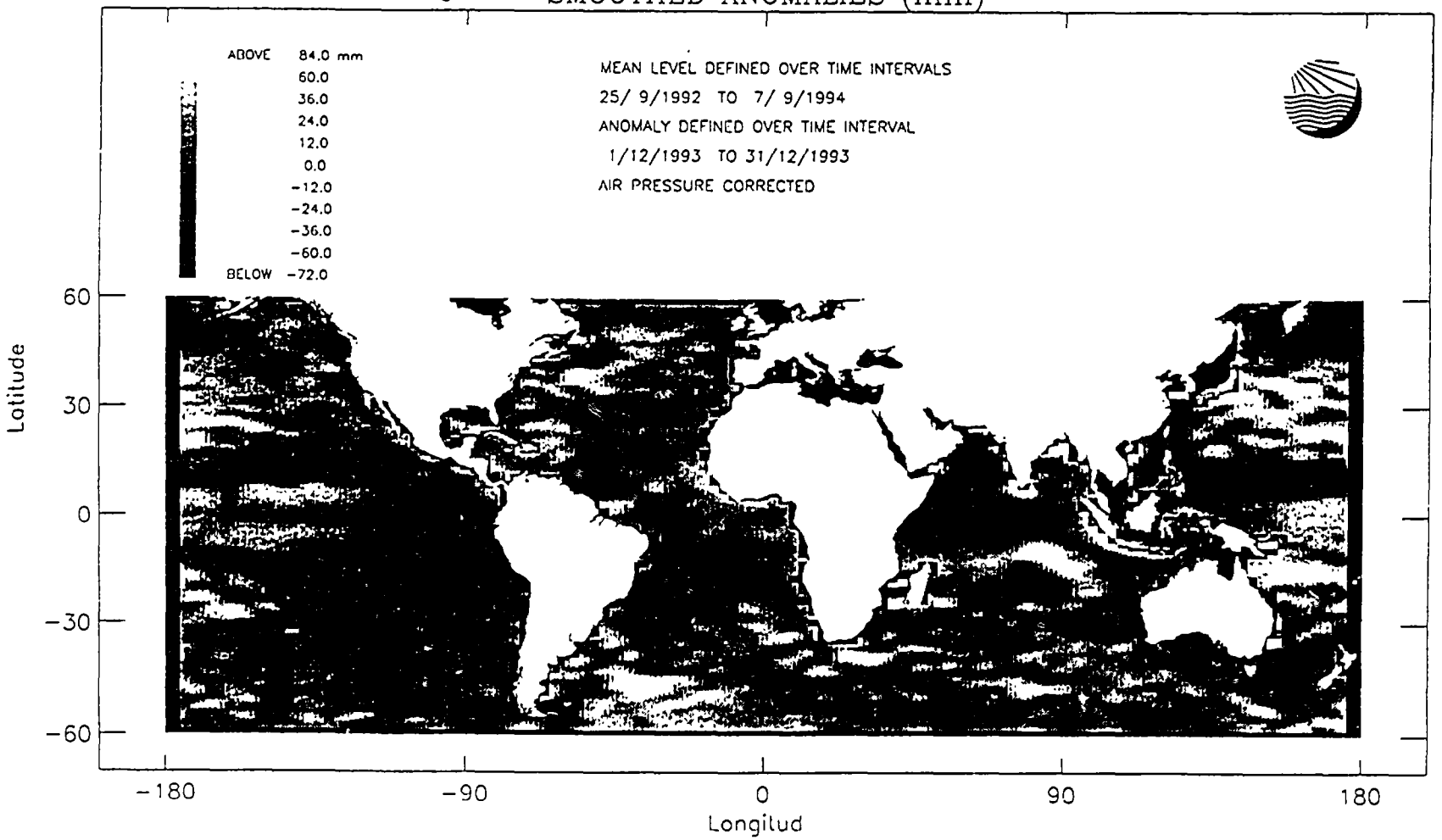
NOT AVAILABLE



ERS-1 Altimetry

Blended (ERS-1 and TOGA tide gauge data) sea-level anomaly. Interannual changes are relative to 1985-1986 mean.
4 cm contour interval. <0 shaded.

Figure 5. SMOOTHED ANOMALIES (mm)



A public access directory containing WOCE sea level data and ACCLAIM (Antarctic Circumpolar Current Levels by Altimetry & Island Measurements) data from coastal tide gauges and bottom pressure stations accessible via Internet

The WOCE "Fast Delivery" Sea Level Data Assembly Centre (University of Hawaii, Honolulu, USA)

Distribution of the WOCE sea level data via the INTERNET computer network

4.4. Capacity building related activities

The Volume II of the IOC Manual on Sea Level Measurement and Interpretation -Emerging technologies was published by IOC in its series Manuals and Guides No.14.

Due to the budgetary limitations no training courses were organized by IOC in 1994. Training however was continued under bi and multilateral agreements by UK, USA, Australia.

4.5. Future developments

The IOC Group of Experts on GLOSS at its Fourth Session (January-February 1995) agreed that the combination of models, satellite altimetry and in situ GLOSS stations measurements would be necessary for the reliable monitoring and prediction of sea level variability and changes and for modeling of ocean circulation.

The Group also agreed to work with the IGS (International Global Positioning System Service) to connect some GLOSS TGBM to global geodetic frame using the GPS techniques as one method enable the monitoring of the absolute sea level.

5. The TAO array

The Tropical Atmosphere Ocean (TAO) array of moored buoys in the Pacific Ocean was completed on 17 December 1994 with the deployment of the 69th and final mooring at 8 °N, 156 °E from the Taiwanese research vessel OCEAN RESEARCHER I. The TAO array measures oceanographic and meteorological variable critical for improved detection, understand and predication of seasonal-to-interannual climate variations originating in the tropics, most notably those related to the El Niño/Southern Oscillation (ENSO). The array spans one third the circumference of the globe, from 95 °W near the Galapagos Islands to 137 °E off the coast of New Guinea (Figure page 32). Moorings are deployed every 2-3 ° of latitude between 8 °N and 8 °S along lines that are separated by 10 °-15 ° of longitude. TAO is presently supported by a consortium of institutions in the United States, Japan, Taiwan, Korea and France.

The TAO array was developed under auspices of the recently completed 10-year (1985-1994) international Tropical Ocean Global Atmosphere (TOGA) program A major objective of TOGA was the development of an ocean observing system to support studies of large scale ocean-atmosphere interactions on seasonal-to-interannual time scales. TAO is now one of the cornerstones of this observing system, which also includes drifting buoy arrays, a volunteer observing ship expendable bathythermograph network, island and coastal tide gauges, an island wind profiler network, and remotely sensed measurements from both operational and research satellites. The growth of the TAO array can be seen in Figure page 32, from only 11 moorings at the beginning of TOGA in 1985 to the present array of 69 moorings.

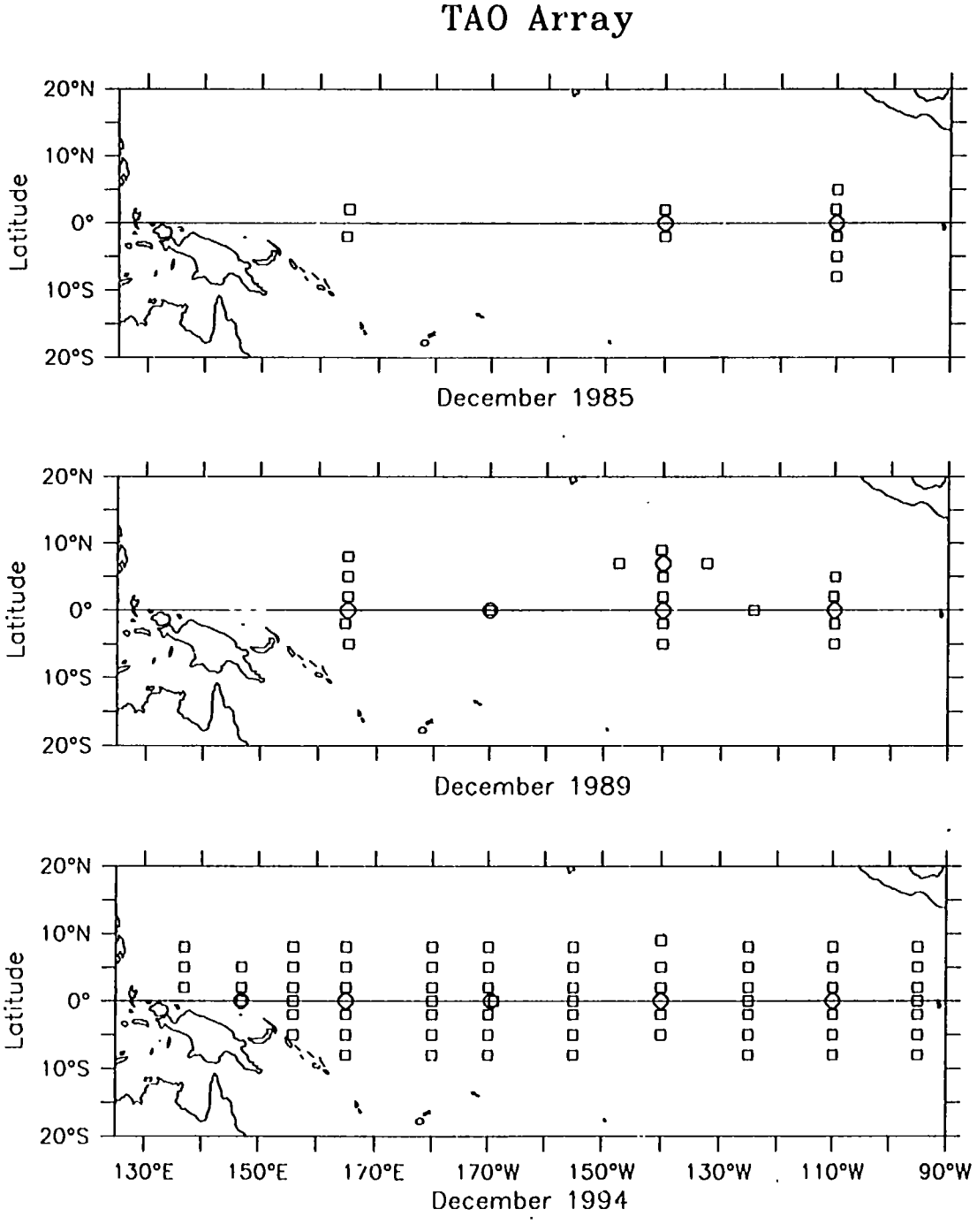
Standard measurements on all TAO ATLAS and PROTEUS moorings include surface winds at 4m, air temperature, relative humidity, and sea surface temperature at 1 meter depth. ATLAS moorings also measure 10 subsurface temperatures down to 500 meters. PROTEUS moorings along the equator are also equipped with acoustic Doppler current profilers, rain gauges, conductivity sensors, and short-wave radiation sensors. Daily averages of all data (except conductivity) are telemetered in real time via Service ARGOS. In addition, spot hourly values of surface variables (winds, air temperature, relative humidity, and sea surface temperature) are received. Daily averaged subsurface temperature and hourly values of the surface variables are sent out over GTS in BUOY format by Service ARGOS. During the past year, major improvements were seen in the number of GTS data transmissions from the TAO buoys. Nearly 100% of all available data is now being distributed; greater than 1400 surface observations and 400 subsurface temperature messages are available on GTS each week from the TAO array. Daily quality control checking of the GTS data, consisting of disabling the distribution of questionable sensors, is performed by the TAO project office to maintain the highest possible data quality.

In addition to the GTS data, the data from the array is available in real time from the TAO Project Office. Scientific utilization of the moored measurements has been encouraged by developing sophisticated data management and dissemination capabilities. These include the TAO Workstation Software, which is a user-friendly, UNIX-Based interactive data display, analysis and distribution system; the creation of an Internet anonymous ftp data base at PMEL (ftp.pmel.noaa.gov); and distribution of TAO data and analyses on the World Wide Web. The WWW address is http://www.pmel.noaa.gov/toga-tao/home.html. Yearly submissions of the TAO data are made to NODC, NCDC, and the TOGA Subsurface Data Center.

Vandalism continues to be a problem throughout the array, particularly on the eastern and western boundaries. At least 19 sites were damaged during the past year, with three along 95 °W in the eastern Pacific, three in the central Pacific, and the remainder west of the date line. Wind sensors are most commonly vandalized but damage is also done to the electronics packages, other sensors, and even the buoy towers. The percent of good data return for the western Pacific winds has been below 70% at most sites, while it is typically 80-90% in the central and eastern Pacific. Attempts to reduce damage to the instrumentation include the installation of a hardened cage which protects the base of the wind sensor and the electronics tube. Efforts will also be made during the next year to work with fishing communities, providing information to them on the scientific value of the moorings in an attempt to alleviate some of these problems.

The maintenance of the array is highly dependent on adequate ship time across the equatorial Pacific. At the present time nearly one year of dedicated ship time per year is required to maintain the fully implemented array of 69 moorings. NOAA provides the shiptime for all of the moorings in the eastern and central Pacific (95 °W to 180 °). This will total 211 days in 1995. NOAA has obtained a ship from the US Navy and it is anticipated that this vessel, which at present is undergoing conversion for buoy operations, will be dedicated to servicing the TAO array starting in early 1996. The availability of shiptime, particularly in the western Pacific, continues to be a critical problem. Only Japan has made a long term commitment of shiptime west of the date line which, at 50 days per year, is half of what is required to maintain the array in the western Pacific. Thus, at present, maintenance of the array west of 180 ° is achieved through ad hoc year-to-year arrangements with most recent contributions coming from Taiwan. Any additional help from interested countries in the form of shiptime would be welcomed by the TAO Project Office.

TAO was developed under auspices of the 10-year international Tropical Ocean Global Atmosphere (TOGA) program which ended in December 1994. However, it is anticipated that the array will be continued under auspices of GOOS/GCOS and CLIVAR/GOALS into the 21st century. The TAO Implementation Panel, under sponsorship of these programs, provides a forum for coordinating international support for the array. The panel meets yearly to discuss shiptime, logistics, technical issues, and scientific applications of the data. The next TAO Panel meeting will be held from 12 to 14 September 1995 in Fortaleza, Brazil. Overall program management is the responsibility of the TAO Project Office located at NOAA's Pacific Marine Environmental Laboratory in Seattle, Washington.


TAO Array
20°N
10°N
0°
10°S
20°S
Latitude
December 1985
December 1989
December 1994
130°E
150°E
170°E
170°W
150°W
130°W
110°W
90°W

6. The Data Buoy Co-operation Panel (DBCP)

The Drifting Buoy Co-operation Panel was jointly established in 1985 by WMO and IOC, and changed name in 1993. The principal objectives of the Panel are: *(i) to achieve the optimum use of any data buoy deployments being undertaken worldwide and an increase in the amount and quality of buoy data available to meet the objectives of major IOC and WMO programmes; and (ii) to encourage and support the establishment of "action groups" in particular programmes or regional applications to effect the desired co-operation in data buoy activities.* Since 1 June 1987, the Panel is served by a full-time Technical Co-ordinator funded through voluntary contributions by some Member States of IOC and Members of WMO.

The Panel has been in existence for more than ten years now and has benefited from the services of a Technical Co-ordinator for more than seven years. Amongst its main achievements, the following are worth noting:

- the improvement and final definition of a code form for transmission of buoy data over the WMO Global Telecommunication System (GTS), as well as various improvements in telecommunication procedures;

- the definition, partial funding and running of a new ARGOS processing sub-system to allow flexibility in transmitting buoy data over the GTS;

- the definition and implementation of a set of procedures for controlling the quality of buoy data forwarded over the GTS, through initially a *Bulletin Board* established on OMNET and, since the end of 1994, through an Internet *distribution list* maintained and run by the Icelandic Meteorological Office;

- the collaboration with the WOCE Surface Velocity Programme (SVP) in designing, on the basis of the SVP drifter, and testing a low-cost lagrangian drifter equipped with a barometer (*SVP-B drifter*);

- the support and/or establishment of various "action groups", such as: the European Group on Ocean Stations (EGOS); the International Arctic Buoy Programme (IABP); the International Programme for Antarctic Buoys (IPAB); and the International South Atlantic Buoy Programme (ISABP). The latter was established by the Panel from scratch within two year time and is being made up of more than 70 drifting buoys in an ocean area previously considered as "data-sparse".

Those achievements have led to some significant quantitative results. As an example, the following shows the evolution of a few figures between 1990 and 1994:

	1990	1994
Number (and percentage) of drifting buoys reporting over the GTS	~ 250 (35-40%)	~ 600 (45-50%)
Mean RMS of "errors" in air pressure measurements	2.32 hPa	1.57 hPa
Number of Action Groups	1	4

Tropical Pacific Drifting Buoys M.S. Swenson / AOML, Miami

At the end of January there were 259 satellite-tracked drifting buoys, of which 64% had subsurface drogues intact, in operation for the WOCE/CLIVAR Surface Velocity Program in the tropical Pacific Ocean. The NEC is seasonally strong and there is evidence of eddy activity in the extreme east. The NECC is poorly sampled except at 160W where it is normal. The SEC is normal except for a notable reversal at about 10S, 155W, which is now two months in duration. SST anomalies at the end of the month are positive and of order 0.5–1.5 degrees C in the equatorial band.

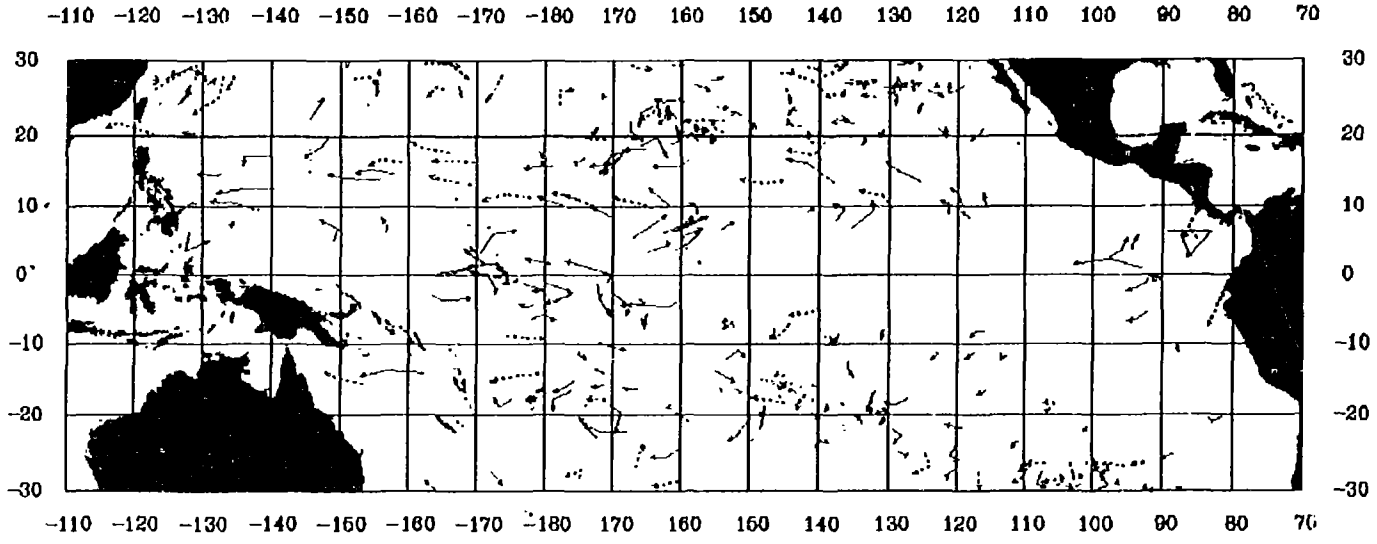


FIGURE T26 – Movements of drifting buoys in the tropical Pacific Ocean during January 1995. The linear segments of the trajectories represent two week displacements. Solid paths (red) show buoys drogued to 15-m depth; dotted paths (blue) show undrogued buoys.

The Panel is now focusing on specific tasks which come out of present international activities regarding the study and monitoring of the marine environment. These tasks include: (i) to establish a closer connection with the scientific community, through *inter alia* the incorporating of scientific and/or technical presentations at future Panel sessions; (ii) to collaborate with existing groups involved in data buoy technical development; (iii) to develop mechanisms for collaboration in planning buoy deployment strategies; (iv) to initiate the establishment of new *action groups* to deal with data-sparse areas of the ocean (e.g. the Indian Ocean); (v) to develop an Internet dedicated server based on World-Wide Web software; etc. Updated information on buoys status and trajectories (Figure T26 page 34) can be presently recovered on the web at the Drifting Buoy Data Assembly Center Home Page (http://larry.aoml.erl.gov:8000/www/drifter.html).

As a matter of general policy, the Panel expresses readiness to try and meet any requirements that GOOS (*inter alia*) might formulate regarding data buoy.

7. GOOS related Pilot Activities

IOC-UNEP-WMO LONG-TERM GLOBAL MONITORING SYSTEM OF COASTAL AND NEAR-SHORE PHENOMENA RELATED TO CLIMATE CHANGE

The long-term coastal monitoring system was initiated in 1990 as international effort to assess climate change and the environmental and socio-economic impacts of this change in the coastal zone. Several pilot activities have been initiated to address variables and phenomena which are both economically important and sensitive to climate change.

7.1. Pilot Activity on Coral Reefs Ecosystems Monitoring

Implementation plan was prepared by the group of experts in 1991.30 countries have expressed their interest in participating in the Pilot Activity and nominated their participating institutions and specialists (40 institutions) as national contacts for the Pilot Activity. The UNEP-IOC-ASPEI-IUCN Global Task Team on the Implications of Climate Change on Coral Reefs provided advise on the project implementation.

The first Training Course on Coral Reef Monitoring and Assessment, jointly sponsored by SPREP, IOC and UNEP was held in Rarotonga, Cook Islands, 22 February-13 March 1994, with the trainees from Cook Islands, Fiji, Papua New Guinea and Solomon Islands and instructors from the Australian Institute of Marine Science and the National University of Singapore. The report of the training course was published in the IOC Training Course Reports Series No. 27.

The report of the UNEP-IOC-ASPEI-IUCN Global Task Team on Coral Reefs entitled "Global Climate Change and Coral Reefs: Implications for People and Reefs" was published in 1994 by IUCN on behalf of the sponsoring agencies.

Recommendations of the Second Meeting of the UNEP-IOC-ASPEI-IUCN Coral Reef Global Task Team (1993) regarding the implementation of Coral Reef Monitoring, were considered at the IOC-IUCN-LOICZ Expert Meeting on Coral Reef Monitoring, Research and Management, held in Bermuda, 23-27 October 1994.

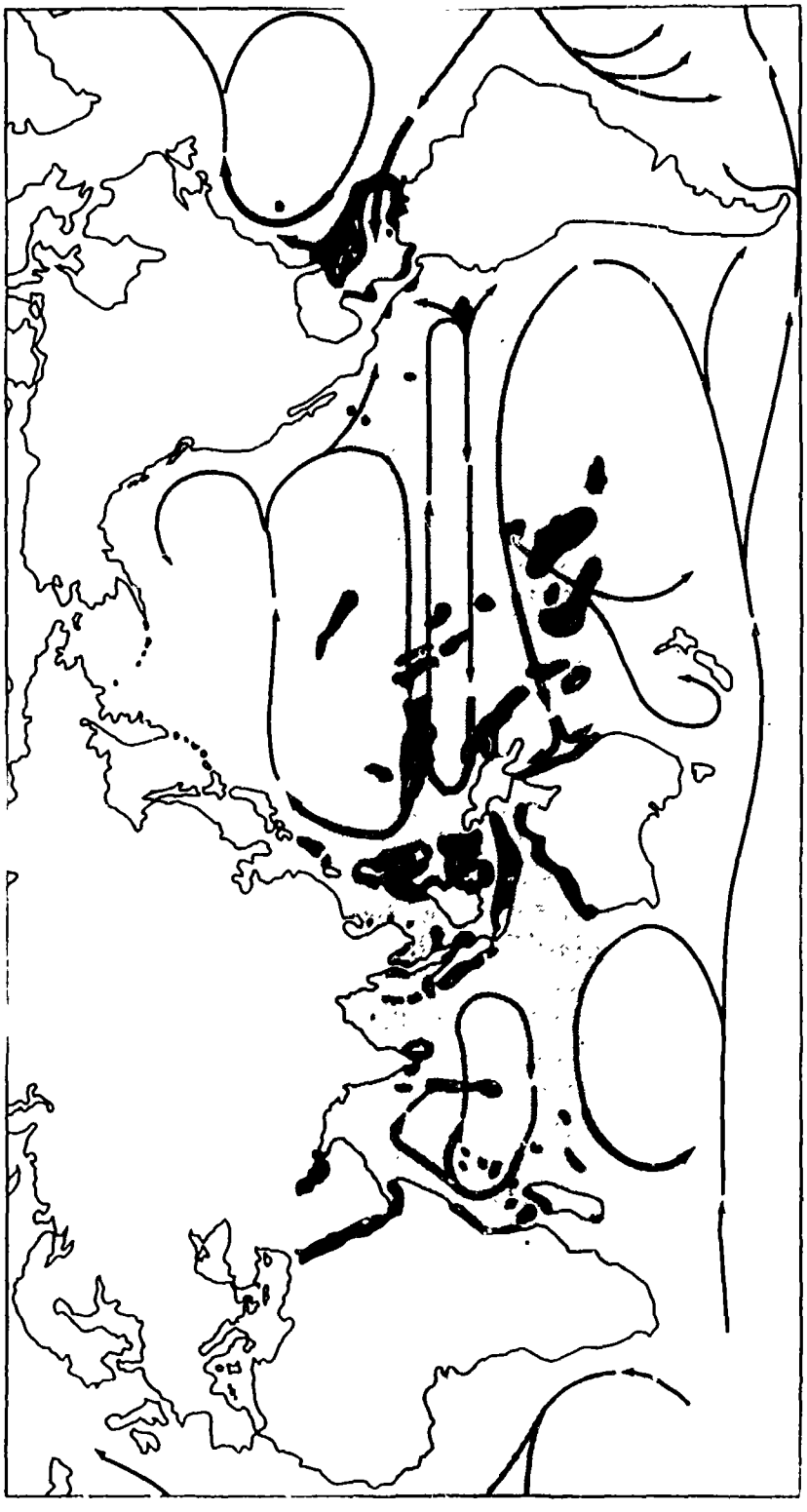


Figure 1.1: Global distribution of coral reefs (dark hatching), along with the major patterns of surface currents. Reefs are predominantly distributed on the eastern margins of continents where favourable currents (emphasised by thicker arrows), of clean low nutrient water, distribute larvae from the tropics into higher latitudes (from UNEP/IUCN 1988 and Veron 1986). Reef growth is generally limited by water temperature down to 13 or 20°C, (the light shaded area is the 20°C isotherm band).

IOC - IUCN - LOICZ
Expert Meeting on
Coral reef monitoring, research and management

Bermuda Biological Station for Research, 23 - 27 October, 1994.

List of countries and institutions having expressed interest in participating in the Coral Reef Monitoring Activity of the Coastal Module of GOOS.

Country	Institute/Laboratory
Australia	Australian Institute of Marine Science (AIMS)
Bahrain (State of)	Biology Department, University of Bahrain: Environmental Protection Committee (EPC): Directorate of Fisheries
Barbados	Coastal Conservation Project Unit: Bellairs Research Institute of McGill University
Brazil	Directoria de Hidrografia en Navegaçao (DHN)
Colombia	Instituto de Investigaciones Marinas (INVEMAR): Instituto Nacional de Pesca y Agricultura - INPA: Fundacion Universidad de Bogota Jorge Tadeo Lozano: Valle University. Marine Biology Station.
Cook Islands	Cook Islands Conservation Service
Ecuador	Instituto Nacional de Meteorologia e Hidrologia
Egypt (Arab Republic of)	Alexandria Institute: Aqaba & Suez Canal Gulf Institute Red Sea Institute
Fiji	The University of the South Pacific (USP): Ministry of Agriculture. Fisheries and Forests (MAFF)
France: - New Caledonia - Tahiti	Institut Français de Recherche Scientifique pour le Développement Laboratoire d'Etude et de Surveillance de l'Environnement
Germany	Centre for Tropical Marine Ecology (ZMT)
India	Institute for Ocean Management
Israel	Interuniversity Institute for Marine Sciences at Elat
Jordan	Marine Science Station
Kenya	Coral Reef Conservation Project
Kuwait	Dept. Mariculture and Fisheries: Kuwait Institute for Scientific Research (KISR)
Maldives (Republic of)	Department of Environmental Affairs
Mauritius	Marine Conservation Division
Monaco (Principality of)	Center of Marine Research (Laboratoire d'Ecologie Expérimentale of Nice University, France)
Oman (Sultanate of)	Sultan Qaboos University
Papua New Guinea	The University of Papua New Guinea: Department of Environment and Conservation: National Weather Service
Philippines (The)	University of the Philippines
Puerto Rico	Dept. of Marine Sciences, University of Puerto Rico at Mayaguez
Senegal (Republic of)	Division d'Hydrométéorologie et Météorologie Maritime
Seychelles (Republic of)	Division of Environment "Commission de l'Océan Indien"
Singapore (Republic of)	Ministry of National Development
Solomon Islands	Ministry of Natural Resources
Tanzania (United Republic of)	Institute of Marine Sciences (IMS)
Thailand	Meteorological Department
Trinidad and Tobago (Republic of)	Centre for Tropical Coastal Management Studies
United Kingdom	Centre for Tropical Management Studies
United States of America	Florida Institute of Oceanography: University of Guam

International Organisations with expressed interests in the Global Coral Reef Monitoring Activity of the Coastal Module of GOOS

Intergovernmental Oceanographic Commission (IOC of UNESCO)
United Nations Environment Programme (UNEP)
World Meteorological Organisation (WMO)
IUCN-The World Conservation Union
Association of South Pacific Environmental Institutions (ASPEI)
Land-Ocean Interaction in the Coastal Zone (LOICZ Core Project of the IGBP))
Pacific Science Association (PSA)
South Pacific Environment Programme (SPREP)

The expert meeting in Bermuda recommended that the following objectives must be met for the monitoring network to become fully operational:

a) the implementation of a Global Coral Reef Monitoring Network within GOOS to assess global change;

b) the organization of a support or co-ordination Office for the Global Coral Reef Monitoring Network where data collected in a standardized manner world-wide are compiled, analyzed and distributed;

c) involve and assist developing countries' participation in the planning and implementation of activities carried out as part of the monitoring system.

The Australian Institute of Marine Science expressed its willingness to provide assistance in database management, data analysis, technology transfer and provision of training courses and seminars.

The US Department of State has offered to provide financial support for Coral Reef International Co-ordination through the US Coral Reef Initiative. The Secretary of IOC had consultations with other sponsoring agencies (UNEP, WMO, IUCN) and the US Department of State on the establishment of international Coral Reef Co-ordination.

To implement the Global Coral Reef Monitoring Network, substantial financial support will be required from the sponsoring agencies and interested Member States. This matter will be brought to the attention of the Second Session of I-GOOS in June 1995, and the Eighteenth Session of the IOC Assembly.

7.2. Pilot Activity on Sea-Level Changes and Associated Coastal Impacts in the Indian Ocean

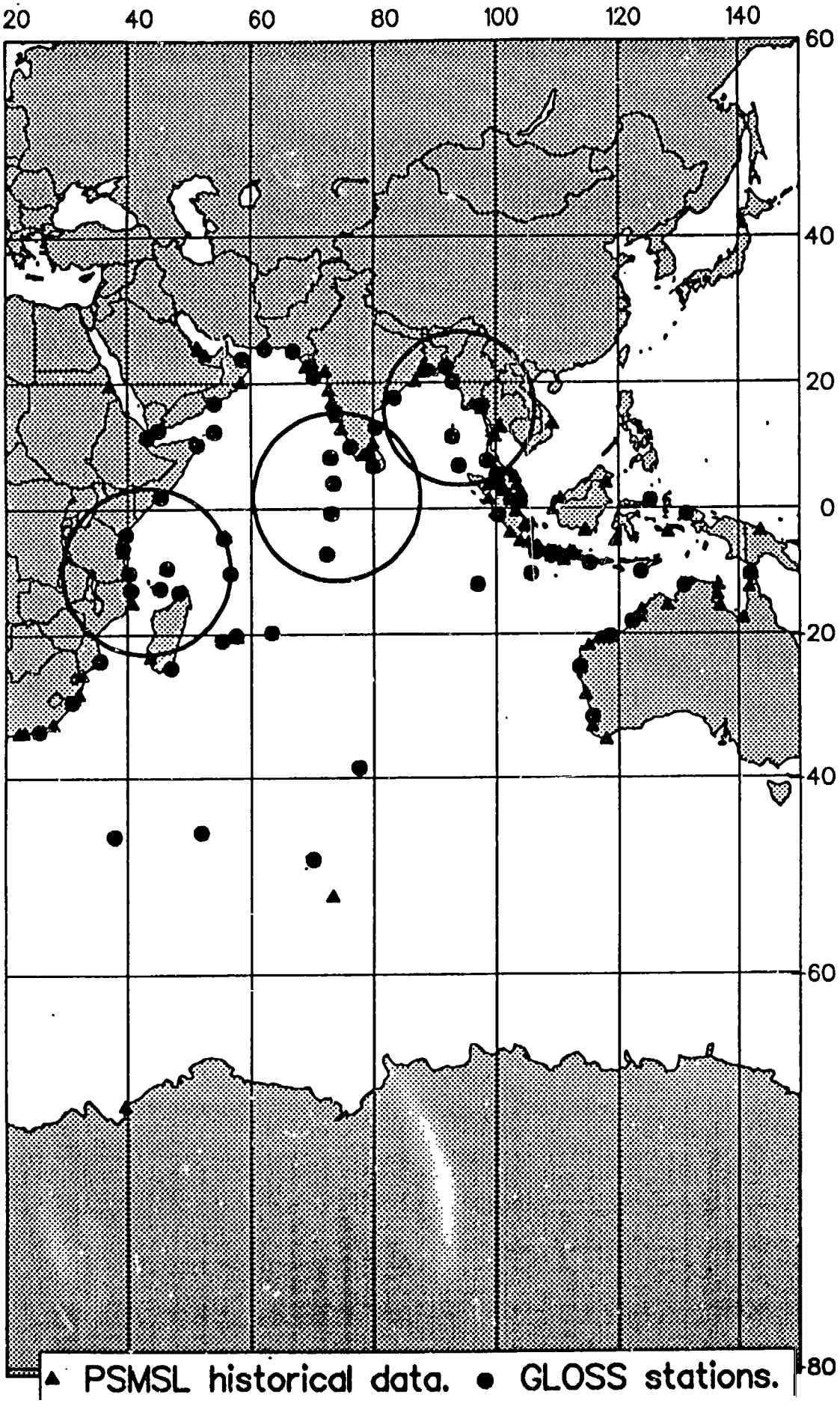
The implementation plan for the pilot activity was prepared in 1992. The long-term objective of the pilot activity is to understand the factors that control the variations of sea level, to identify those factors that are closely related to climate change and to study the likely impact of these factors on coastal areas. The following countries have agreed to participate in the Pilot Activity and designated their institutions/laboratories to act as Cells for Monitoring and Analysis of Sea-Level (CMAS): Bangladesh, India, Kenya, Madagascar, Malaysia, Maldives, Mauritius and Mozambique (see page 41-42).

The first review of the activities of designated CMAS was made in January 1994 at the IOC-UNEP-WMO-SAREC Planning Workshop on an Integrated Approach to Coastal Erosion, Sea-Level Changes and their Impacts (Zanzibar, United Republic of Tanzania, 17-21 January 1994).

The report of the Workshop and two supplements (containing the submitted papers) were published in 1994 as IOC Workshop Report No. 96.

The Workshop encouraged other countries of the region to participate in the Pilot Activity and recommended that Dr. S. Shetye (NIO, India) be the Co-ordinator of the Pilot Activity.

It was stated that most of the CMAS do not have the capacity to analyze sea-level data and prepare products for various categories of users. The Workshop therefore recommended that during the first period 1994/1995, priority should be given to short-term training on analysis of sea-level data (see page 40) and maintenance of tide-gauges. IOC, due to severe budget limitations, could not provide support for such training in 1994.


20
40
60
80
100
120
140
60
40
20
0
20
40
60
80
▲ PSMSL historical data. ● GLOSS stations.

ANNEX IV

LIST OF CELLS FOR MONITORING AND ANALYSIS OF SEA LEVEL (CMAS)

COUNTRY	CMAS Cells for Monitoring and Analysis of Sea-Level	INSTITUTION/SCIENTIST
Bangladesh	DEPARTMENT OF HYDROGRAPHY MINISTRY OF SHIPPING	CMAS: Mr. Abdul Matin MONDAL Senior Deputy Director DEPARTMENT OF HYDROGRAPHY, BIWTA MINISTRY OF SHIPPING 141-143, Motijheel C/A Dhaka - 1000 Tel: 253742/236151-55ext. 2107 - Fax: 880-2-231072
India	SURVEY OF INDIA	CMAS: Mr. Brig B.C. ROY Director, Geodetic & Research Branch SURVEY OF INDIA Hathibarkala, P.O. Box 37, Dehradun-248001 Tel: 0135-24528 - Tlx: 535218 SRVY IN **National Contacts:** Dr. S. SHETYE Scientist, NATIONAL INSTITUTE OF OCEANOGRAPHY Dona Paula, GOA-403004 Tel: 832-46253/56 - Fax: 832-53360/1 Shri J.V.R. PRASADA RAO Joint Secretary, Government of India, Department of Ocean Development "Mahasagar Bhavan", Block-12, C.G.O. Complex, Lodhi Road, New Delhi 110003 Tel: 11-4362101 - Fax: 11-4360336/4360779
Kenya	KENYA MARINE AND FISHERIES RESEARCH INSTITUTE	CMAS: Mr. Mika O. ODIDO and Mr. K.K. KAIRU (Alternate) KENYA MARINE & FISHERIES RESEARCH INSTITUTE (KMFRI) P.O. Box 81651, Mombasa Tel: (254 11) 475574/79 - Fax: (254 11) 472215 - Tlx: 21115 - E-mail: recoscix.mombasa/omnet or recoscix/greennet **National Contact:** Dr. E.N. OKEMWA Director of KMFRI Address as above

COUNTRY	CMAS Cells for Monitoring and Analysis of Sea-Level	INSTITUTION/SCIENTIST
Madagascar	CENTRE NATIONAL DE RECHERCHES OCEANOGRAPHIQUES	**CMAS:** Mr. N.T. RAZAKAFONIAINA Département d'Océanographie Physique et Chimique CENTRE NATIONAL DE RECHERCHES OCEANOGRAPHIQUES (CNRO) B.P. 68, Nosy Be Tel: 61373 - Tlg: OCEAN NOSYBE **National Contact:** Ms. Eulalie V. RANAIVOSON Director of CNRO Address as above
Malaysia	DEPARTMENT OF SURVEY AND MAPPING MALAYSIA	**CMAS:** Mr. Chan PENG YUE Director of Mapping Department of Survey and Mapping Malaysia Jalan Semarak, 50578 Kuala Lumpur Tel: 603-2925311/2926750 - Fax: 603-2934084 - Tlx: 28148 SURMAP MA **National Contact:** Mr. Abdul Majid BIN MOHAMED Director General of Survey & Mapping Malaysia Department of Survey and Mapping Malaysia Jalan Semarak, 50578 Kuala Lumpur Tel: 603-2925311/2955932 - Fax: 603-2917457 - Tlx: 28148 SURMAP MA
Maldives (Republic of)	MARINE RESEARCH SECTION MINISTRY OF FISHERIES AND AGRICULTURE	**CMAS and National Contact:** Mr. Abdulla NASEER Reef Scientist, Marine Research Section Ministry of Fisheries and Agriculture Malé
Mauritius	METEOROLOGICAL SERVICE	**CMAS:** Mr. S. RAGOONADEN and Mr. K. DUNPUTH (Alternate) Scientist, METEOROLOGICAL SERVICE St. Paul Road, Vacoas Tel: (230) 6861031/32 - Fax: (230) 6861033 - Tlx: 4722 METEO IW
Mozambique	NATIONAL HYDROGRAPHIC SERVICE	**CMAS and National Contact:** Mr. David CHEMANE Scientist, NATIONAL HYDROGRAPHIC SERVICE Instituto Nacional de Hidrografia e Navegação Av. Karl Marx n° 153, CP 2089, Maputo Tel: 430186/8 - Fax: 430185/428670 - Tlx: 6-619 SNHB MO

The Workshop recommended specific actions for all designated CMAS regarding the sea-level data analysis and studies. Following a recommendation of the Workshop, information on the Sea-Level Pilot Activity was prepared by Dr. Kamazima Lwiza (State University of New York) and included in the "WINDOW" (Western Indian Ocean Waters) Newsletter.

7.3. Pilot Activity on Monitoring Mangrove Communities

Action plan for the implementation of the project was prepared in 1991. UNEP-UNESCO Task Team on the Impact of Expected Climate Change on Mangroves provides scientific and technical advice on the project implementation. The report on "Assessment and Monitoring of Climatic Change impacts on Mangrove Ecosystems" prepared by the Task Team was published by UNEP in 1994.

7.4. Pilot Activity on Monitoring Plankton Community Structure.

Draft plan for this pilot activity was prepared in 1992. IOC through OSLR programme provides support to Sir Alister Hardy Foundation for Ocean Science for the implementation of the Continues Plankton Recorder Survey -as a long-term monitoring of the planktonic ecosystem.

7.5. Relationship of the Pilot Activities with GOOS

The IOC-WMO-UNEP Committee for GOOS at its First session (1993) recognized that "the proposed pilot activities can be considered as an important contribution to the development of the GOOS Module on Monitoring of the Coastal Zone Environment and Its Changes (Rec.GOOS-I.4). The I-GOOS-I also requested the J-GOOS to review the pilot activities and provide advice on their implementation in the context of the overall strategy of GOOS.

This recommendation was approved by the IOC Assembly at its Seventeenth session (Res.XVII-5)

The First Planning session of I-GOOS in 1994 reviewed the status of the coastal pilot monitoring activities and requested again the J-GOOS at its First session (May 1994) to review and assess the potential contribution of the coastal pilot monitoring activities to the various GOOS modules and to provide advice to I-GOOS, on their findings. The Planning session recommended to establish the I-GOOS Intersessional Ad hoc Group on the Coastal Zone Module and requested the ad hoc Group to identify the potential contribution of existing and planned multi-national coastal zone monitoring and observational systems to the coastal zone module of GOOS, including the pilot monitoring activities which have already been developed and are ready for implementation. The Planning session wished to encourage the sponsoring agencies IOC, WMO, UNEP as well as other collaborating organizations. LOICZ, IUCN, ACPEI, UNESCO to support the prompt implementation of the coastal pilot monitoring activities, in particular the Coral Reef Monitoring. The Planning session also invited Member States to consider their possible support and contribution to the implementation of pilot coastal monitoring activities, particularly pilot activities on coral reefs, mangroves, sea-level and plankton, by establishing global and regional data assembly and analysis centers with the responsibility to organize training activities.

The recommendations of the First Planning Session of I-GOOS were adopted by the 27th session of the IOC Executive Council (1994) by Resolution EC-XXVII.6.

The First session of J-GOOS held in May 1994 did not consider the pilot monitoring activities. The Intersessional Ad-hoc Group on the Coastal Zone Module have not been established.

The Second Session of J-GOOS to be held in April 1995 have been requested to look at this matter and provide advice to I-GOOS.

Upon the initiative of the USA the question on the position of the Global Coral Reef Monitoring Network (GCRMN) coordinator has been considered with the IOC Secretary and interested Member States.

8. GOOS regional approach

8.1. North-East Asian Regional GOOS (NEAR GOOS) - An operational demonstration of certain aspects of GOOS activities

In accordance with Draft Resolution 57 passed by the 27th UNESCO General Conference, IOC organized an expert consultation in Beijing, China, 16-18 August 1994, in order to develop a draft proposal concerning GOOS-related activities in the North-East Asian region. It was attended by experts from China, Japan, Russian Federation, Republic of Korea, Thailand and SEAWATCH. The purpose of the proposal was to establish linkages between global and regional/sub-regional GOOS activities and to show the operational capabilities of the WESTPAC region in the establishment of an operational demonstration project.

The experts felt that the existing observing system (figure page 45) was sufficient to start a NEAR GOOS and expand the present capabilities as the system develops by improving spatial and temporal resolution, by increasing data exchange and products distribution capabilities, and by developing near-real time communication capabilities through technology transfer.

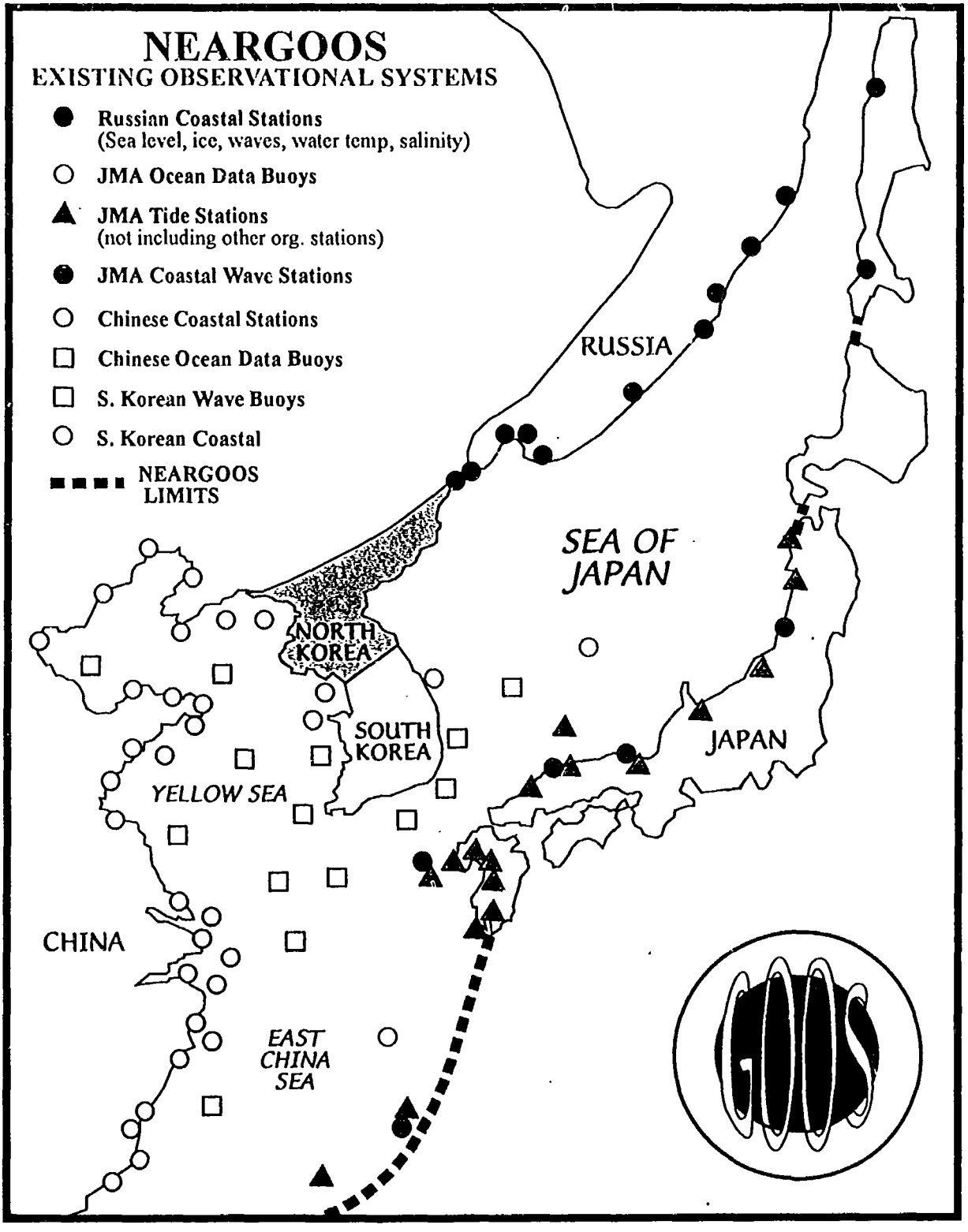
The aims of the North-East Asian regional GOOS (NEAR GOOS) is to satisfy a number of specific applications for ocean services, disaster prevention, fisheries, pollution monitoring, mariculture, recreation, modeling and assimilation workshop. The project proposal was presented to the Third International Scientific Symposium on Sustainability of the Marine Environment (WESTPAC) (Bali, Indonesia, 22-26 November 1994), and particularly to the Pre-WESTPAC Symposium Workshop on NEAR GOOS.

The pre-symposium workshop was attended by representatives from Indonesia, Korea, Japan, Thailand, China, and the Secretariats of IOC as well as WESTPAC. The draft plan, developed out of the Beijing expert meeting, was reviewed and modified to include a section on an action plan. Keen interest was expressed by Indonesia in developing a similar regional approach for the South-East Asian Regional GOOS (SEAR GOOS) plan. It was considered that the next logical step in the implementation of NEAR GOOS, after the review of the revised plan, is the official ratification and commitment by the regional Member States of the plan, including the identification of the appropriate national contact and responsible agency.

The participation in the WESTPAC Symposium included the presentation of a paper entitled "The Importance of the Regions in the Concept of GOOS" and the participation on a discussion panel which discussed integrated coastal zone management. The paper included a formal presentation of the above workshop results regarding NEAR GOOS.

8.2. EuroGOOS A European association fostering European co-operation on GOOS

EuroGOOS is an informal association of national organizations (authorities, agencies, institutes) whose members seek to foster European co-operation on the Global Observing System. The initial list of Members includes 17 organizations from 12 European countries having signed a EuroGOOS Memorandum of understanding. The major activities that EuroGOOS will be designed to collaborate with and maximize the benefits from existing activities in operational oceanography, promoting the integration of these activities within the framework of GOOS. Members of EuroGOOS will collaborate and support the following group of activities:


NEARGOOS
EXISTING OBSERVATIONAL SYSTEMS
Russian Coastal Stations
(Sea level, ice, waves, water temp, salinity)
JMA Ocean Data Buoys
JMA Tide Stations
(not including other org. stations)
JMA Coastal Wave Stations
Chinese Coastal Stations
Chinese Ocean Data Buoys
S. Korean Wave Buoys
S. Korean Coastal
NEARGOOS LIMITS
RUSSIA
SEA OF JAPAN
NORTH KOREA
SOUTH KOREA
JAPAN
YELLOW SEA
CHINA
EAST CHINA SEA
GOOS

Policy in promoting GOOS

i) To develop policies for the furtherance of GOOS and co-ordinating the best European participation in GOOS, identifying where greatest value is added by collaboration.
ii) To promote collaboration between existing European multi-national agencies, programmes, organisations and initiatives having expertise in oceanography, operational systems, and remote sensing of the ocean.
iii) To provide, as appropriate, expertise, WGs, consultants, etc. to J-GOOS and I-GOOS.
iv) To promote studies and evaluation of the economic and social benefits produced by operational oceanography.
v) To co-operate as appropriate with organisations concerned with climate change, global environmental research, and the impact of climate variability and climate change.
vi) To publish findings of meetings, workshops, studies and other documents commissioned by the EuroGOOS members, joint representation at and submission of documents to international meetings related to GOOS, and collective representation of GOOS to European and national agencies, when requested by members.
vii) To co-ordinate GOOS data acquisition with European and national data gathering under agreements and Conventions relating to pollution monitoring, marine meteorology, navigation and safety at sea.

Advancing European operational oceanography in GOOS

viii) Promoting development of European regional and local operational oceanography, taking into account the five Modules of GOOS.
ix) Promoting development of common European operational data procedures and services, including data quality control and data management for operational oceanography.
x) Promoting research and pre-operational research which will solve problems relating to operational oceanography.
xi) Promoting development of common infrastructure and to promote major systems or capital installations required to support European operational oceanography.
xii) Promoting pilot studies in GOOS operations, local, regional or global.
xiii) Promoting development of common European operational oceanographic services and products of maximum value to European Governments and Agencies, furtherance of European industries and services companies, and the protection of the environment and health in the European coastal and shelf seas.

Promotion of Instrumentation and Technology

xiv) To promote the development of low cost efficient operational instrumentation, observing systems, and data acquisition systems.
xv) To support operational oceanography and services in collaboration with public and private sector organisations and programmes in Europe concerned with ocean technology.
xvi) To promote collaboration with space agencies and remote sensing scientists and engineers so as to ensure optimum integration of both in situ and remote sensed data in operational oceanography.

Aid in Capacity building

xvii) To promote aid, technology transfer, and collaboration with developing countries within the framework of GOOS. To promote collaboration between European institutes and agencies in providing aid and assistance to developing countries for operational oceanography, and the necessary capacity building.

The Members of EuroGOOS held their Foundation meeting in Rome on 14 December 1994. EuroGOOS is supported by a EuroGOOS Office. In response to the offer of UK, the first location of this Office will be at the Southampton Oceanography Centre, by June 1995. More information about

EuroGOOS can be currently sought at the EuroGOOS Office, IOSDL, Wormley. The present chairman of EuroGOOS is Dr. Nicolas Flemming (n.flemming@ios.ac.uk)

9. Research and monitoring programmes relevant to GOOS

9.1. Harmful Algal Bloom Programme

The Harmful Algal Bloom Programme Office was established at the IOC Secretariat, UNESCO Headquarters in Paris in 1993, and is presently staffed with two Associate Experts seconded by Denmark.

During 1994, the Harmful Algal Bloom Programme Office has distributed information on the Programme, together with several reference books and proceedings from conferences in relation to HAB, kindly donated by the publishers and the organizers, to more than 100 libraries or scientists, especially from developing countries.

Since the Second Session of the Joint IOC-FAO Intergovernmental Panel on Harmful Algal Blooms, Paris, 14-16 October 1993, three of the intersessional Task Teams on: Aquatic Biotoxins; Taxonomy, and Management and Monitoring have developed their activities. The Task Team on Aquatic Biotoxins includes representatives of GEEP, GEMSI and GESREM.

The IOC newsletter "Harmful Algae News" has a growing number of subscribers. As of 15 November 1994 the total number was over 2,000. Dr. T. Wyatt is the Editor of the newsletter.

A HAB Training and Capacity Building Programme, the TEMA component of the Harmful Algal Bloom Programme, is being developed. The training programme includes taxonomy, toxin chemistry, design and implementation of monitoring systems, management and mitigation techniques, and individual training.

As the second activity within the training component of the Harmful Algal Bloom Programme, an IOC-WHO-FAO Training Course on Qualitative and Quantitative Determination on Algal Toxins was held at the Friedrich-Schiller University of Jena, Germany, 18-28 October 1994, co-sponsored by the Mediterranean Action Plan. More that 65 applications were received for the ten places available.

The ICES-IOC Working Group on Dynamics of Harmful Algal Blooms met 8-12 May 1994, in Vigo, Spain, and held a joint meeting with the ICES Working Group on Shelf Seas Oceanography. In addition to its terms of reference, the Working Group took initiatives regarding an overview of HAB monitoring programmes as a contribution to an IOC document with global coverage; recommended strengthened ICES involvement in the HAB Programme; and establishment of a HAB Database. The Working Group is co-sponsored by IOC.

An ICES-IOC Workshop on Intercomparison on *In Situ* Growth Rate Measurements (Dinoflagellates) was held in Aveiro, Portugal, 25-29 July 1994. 34 scientists participated in the Workshop.

An IOC Regional Science Planning Workshop on Harmful Algal Blooms was organized in Montevideo, Uruguay, 15-17 June 1994, with the aim of reviewing the state of the art concerning research and control of Harmful Algal Blooms in South America and identifying research priorities in the region. Among the training priorities, the total absence of specialists in High Performance Liquid Chromatography (HPLC) for toxin analysis in the region was highlighted and identified as a training

priority. A need to train experts in other disciplines (oceanography, physics, modelling) to undertake future multidisciplinary projects, was also identified.

An IOC-WESTPAC Harmful Algal Bloom, River Input, and Shelf Circulation Seminar was organized in Bali, Indonesia, 20-21 November 1994, when 16 participants were present.

Contact point for the HAB Programme:
HAB Office
IOC Secretariat
UNESCO
1, rue Miollis
75732 Paris Cedex 15 France
Tel. (33 1) 45 68 36 41
Fax (33 1) 40 56 93 16
E-mail hab.ioc@unesco.org

9.2. The Continuous Plankton Recorder Programme

The Assembly, at its Seventeenth Session, Paris, 25 February-11 March 1993, decided to continue support of the Continuous Plankton Recorder (CPR) of the Sir Alister Foundation for Ocean Sciences, UK. The IOC supported the CPR with a contract of US $ 16,000 a year in the biennium 93/94. The Survey concerns the monitoring of living resources (phyto- and zoo-plankton) with the aims of better understand their dynamics and sustainably use them. The Survey, which in the North Sea has been carried out since 1946, also deals with the questions whether there are long-term changes in phyto- and zoo-plankton species composition and abundance and how they would relate with changes in fish stocks.

CPR activities also help address possible connections between the dynamics of plankton populations and changes in the environment; both natural and human-induced, including climate variations and changes, and pollution phenomena.

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

Presently, IOC is assisting the Survey towards extending its activities to new areas, where problems related to the sustainable use of living resources (especially fisheries ones) need to be addressed. The Indian Ocean and the South Atlantic are cases in point.

Contact Point: Dr. P.C. Reid
Continuous Plankton Recorder Survey
Sir Alister Hardy Foundation for Ocean Science
Tel. (44 1752) 22 27 72
Fax (44 1752) 22 68 65
E-mail sahfos@wpo.nerc.ac.uk

9.3. Global Ocean Ecosystem Dynamics

The IOC-SCOR-ICES-PICES Global Ocean Ecosystems Dynamics (GLOBEC) Programme is intended to advance the general understanding of ocean ecological processes and mechanisms and to focus on how these processes and mechanisms change dynamically in time and space under the influence of physical forcing. The Programme focuses on zooplankton population dynamics in relation to the physical forcing of the ocean which will bridge the gap between phytoplankton studies and predator-related research.

The purpose of the PICES-IOC-SCOR-ICES Strategic Planning Conference, Paris, 18-21 July 1994, was to obtain input on a draft science plan; to incorporate the points raised by national and regional programmes, and to set the stage for a GLOBEC implementation meeting. It was felt that GLOBEC has to associate itself with GOOS, for which can serve as a scientific resources programme for specification of elements of GOOS, in particular its Marine Living Resource Module.

Globec includes a series of regional studies (GLOBEC Southern Ocean, ICES-GLOBEC North Atlantic Programme on Cod and Climate Change, Benguela Ecology Programme, etc.); several GLOBEC programmes at the national level are going on, e.g. in Canada, Japan, the United States, China, etc.). A meeting on Small Pelagic Fish and Climate Change (SPACC) Programme of GLOBEC was organized in La Paz, Baja California, Mexico, 20-24 June 1994. The objective of the SPACC Programme is to understand the effect of climate change on pelagic fish population dynamics through comparisons among ecosystems supporting these populations.

Contact Point: Dr. Brian Rothschild
Chair GLOBEC International Scientific Steering Committee
GLOBEC Secretariat
c/o Chesapeake Biological Laboratory
PO Box 38
Solomons, Maryland, 20688 USA
Tel. (1 410) 326 72 89
Fax (1 410) 326 69 87
E-mail brian@cbl.umd.edu

9.4. Large Marine Ecosystems

The Large Marine Ecosystems (LME) concept provides a useful approach to monitor ocean processes at a regional scale. So far forty-nine LMEs have been identified, and symposiums have been/are being organized by IOC in collaboration with other agencies (UNEP, NOAA, IUCN, and others) to develop LME core monitoring programmes.

The issue of how to adapt the Large Marine Ecosystem approach to the East African Region was addressed by the IOCINCWIO Group of Experts on Ocean Science in Relation to Living Resources at its First Session in Mombasa, Kenya, 13-17 September 1994. The Group recommended the formulation of an LME core monitoring programme, including a Continuous Plankton Recorder (CPR)/Undulating Oceanographic Recorder (UOR) sampling strategy to measure variability in LME health; and the preparation of an inshore sampling programme to measure species abundance, biodiversity and stock levels, and to gather data on fish age, growth and size. A Symposium will take place in East Africa by the end of 1995 aimed at the design of a LME core monitoring programme for the Region (East Africa is interested by the the Somali Coastal Current and the Agulhas Current LMEs). A Yellow Sea LME Study is under development. IOC is also being associated with a LME Project on the Guinea Current financed by GEF and to be implemented by UNIDO.

An International Symposium on the Large Marine Ecosystems (LMEs) of the Pacific Ocean was held in Qingdao, R.P. China, 8-11 October 1994. The Symposium was organized by the Yellow Sea Fisheries Research Institute of the Chinese Academy of Fishery Sciences and supported by NOAA, IUCN, IOC, and the National Natural Science Foundation of China, Chinese Fisheries Society.

9.5. Marine pollution research and monitoring (GIPME/MARPOLMON) and related programmes

Actions and activities in fulfillment of the overall objectives and targets of the GIPME programme in 1994 were implemented in accordance with the Decisions of the Seventeenth Session of the IOC Assembly concerning GIPME as well as the provisions of previous Resolutions passed by the Assembly at its Sixteenth Session (Resolutions XVI-6 and XVI-14) and the IOC Executive Council at its Twenty-Fifth and Twenty-Seventh Sessions (EC-XXV.2, EC-XXV.7 and EC-XXVII.4).

The Eighth Session of the IOC-UNEP-IMO Committee for GIPME met in Costa Rica, 18-22 April 1994 to adopt a Third GIPME Action Plan, 1994-97, following expressions of satisfaction with the implementation of the Second GIPME Action Plan, 1991-93.

Contained in the Plan are follow-up activities to UNCED including technical backstopping for the framework Convention on Climate Change and the Convention on Biological Diversity, new activities to assist the IMO-led, GEF funded, regional projects on marine pollution prevention and marine environmental protection, and further activities in continued support for the implementation of the UNEP Regional Seas Programme. The GIPME Plan was approved by the Twenty-seventh Session of the IOC Executive Council, Paris, 5-13 July 1994.

At the global level, the activities of the three Groups of Experts provided the main thrust of GIPME actions, while specific regional activities were accomplished in concert with regional subsidiary bodies.

A successful Symposium was convened by the Joint IOC-UNEP Panel (San Jose, Costa Rica, 14-15 April 1994) which focused on the CEPPOL Programme as a model of a harmonized activity between IOC and UNEP. Results of the CEPPOL programme were presented as well as a number of relevant papers from PAHO, NOAA, USEPA and WMO. The Symposium emphasized the need to structure future joint programmes along the lines of CEPPOL..

9.5.1. The Marine Pollution Monitoring System (MARPOLMON)

In the IOCARIBE Region, the Marine Debris Monitoring Programme continued in Barbados, Cayman Islands, Colombia, Cuba, Mexico, Puerto Rico and St Lucia in 1994. A successful beach clean-up campaign was held on the beaches of Cartagena in September 1994. (See Section 5.1 on IOCARIBE).

In the IOCEA region, on-site training exercises on physical oceanographic factors responsible for the transport, distribution and deposition of pollutants in the coastal and marine environment were carried out in Benin, Senegal, Gambia, Guinea (Conakry) and Sierra Leone with the objective of promoting submission of data. Countries that submitted results during 1994 included Ghana, Côte d'Ivoire, Benin and Nigeria. A joint IOC-FAO-UNEP Training Workshop on Quantitative Evaluation of Pollution in the Marine Environment was held in Accra, Ghana, 21-25 June 1994 for French-speaking countries in the region. Two Training Workshops, one on the Measurements of Nutrients in Tropical Marine Waters, Mombasa, Kenya, 5-15 April 1994, and another on Nutrient and Water Quality Monitoring, Zanzibar, Tanzania, 21-26 November 1994, were organized in the IOCINCWIO region. The Mombasa Workshop took place within the framework of IOC-SAREC capacity Building Initiatives programme for the region while the second was an IOC-UNEP-FAO endeavour within the context of their joint programme on Assessment and Control of Pollution in the Coastal and Marine Environment of Eastern Africa (EAF/6). The emphasis on nutrients derives from the results of an earlier survey in the region of land-based sources of pollution which had pinpointed nutrient loading as the main cause of pollution in the region.

In the Mediterranean region, IOC continued to provide technical backstopping at the national level for the regional monitoring programme MEDPOL. Results from research assisted by IOC grants to Israel, Croatia, Slovenia, Greece and Italy were received during the year and plans are afoot to publish them.

IOC was represented, both at the meeting of experts to review draft programme of MED POL 20-23 June 1994, and the succeeding meeting of the Joint Advisory Committee Meeting on MED POL 24-25 September 1994, all in Izmir, Turkey, as well as the Meeting of Mediterranean Experts, 11-14 October 1994 in Madrid, Spain.

Still in the Mediterranean region, a joint IAEA-IOC-UNEP Workshop on the Determination of Contaminants in Sediments was organized in Mytilini, Lesvos, Greece, 20-24 September 1994.

IOC activities in the ROPME Sea Area were undertaken in the context of the joint IOC-ROPME Integrated Project Plan (IPP), while in the Red Sea region, support was provided to individual laboratories through the agency of the regional organization PERSGA (see section on collaboration with ROPME and PERSGA for full report).

A Training Course on Modelling and Monitoring of Coastal Marine Pollution was organized in India in December 1994. Also in the IOCINDIO region, a Workshop on Integrated Coastal Zone Management was organized in Karachi, Pakistan, in October 1994.

A meeting of GIPME Officers took place at IMO Headquarters, London, UK, 12-14 October 1994, to work out details of GIPME technical assistance, particularly in the area of capacity building, to the IMO-led GEF project in the East Asian Seas. To this end a series of GIPME activities will be implemented in the WESTPAC region starting from January 1995.

In the Black Sea region, IOC financial support continued to be given to the monitoring activities of the co-operative Marine Science Programme for the Black Sea (COMSBLACK) and technical support to monitoring activities under the GEF Project entitled "Environmental Management and Protection of the Black Sea".

9.5.2. International Mussel Watch Project

The IOC-UNEP International Mussel Watch Programme is providing information on potential threats to marine organisms and human health, through monitoring the concentration of selected pollutants and contaminants in the tissues of bivalves (molluscs) on a global scale. The Programme relies on qualified scientists and institutes, merged into regional networks especially established for the programme.

As a follow-up to the 1994 completion of the first Field Implementation Phase of the International Mussel Watch project in 1994 and the decision of the International Mussel Watch Committee, Bermuda, 9-11 September 1993, the Asia Pacific Phase of the project was launched at a planning meeting in Bali in Indonesia, 22-26 November 1994. The Member States of the regions have been invited to participate and principal investigators have been identified at the national level and reference laboratories designated. This phase is expected to take off in 1995.

Within the context of IOC-SAREC Co-operation on Capacity Building in the Eastern African Region, a preliminary meeting was held in Mombasa, Kenya, September 1994, to discuss the possible initiation of the Indian Ocean phase, with emphasis on the IOCINCWO Sector, of the International Mussel Watch. Following a draft proposal from Secretary IOC to SAREC in December 1994, a feasibility study will be implemented in 1995 with the support of IOC-SAREC.

Meanwhile the final report of the First Field Phase was received in the IOC Secretariat in late 1994.

Contact point for LME and the International Mussel Watch Programme:
OSLR Programme
IOC Secretariat
UNESCO
1, rue Miollis
75732 Paris Cedex 15 France
Tel. (33 1) 45 68 40 14
Fax (33 1) 40 56 93 16
E-mail s.arico@unesco.org

9.6. Remote sensing and relationship with CEOS

9.6.1. Recent satellites missions

In 1994, satellite missions improved their success rate over 1993. In April 1994, GOES I (8) was successfully launched eliminating the gap in geostationary coverage and NOAA J (14) was launched in December 1994. The need for backup missions to cover holes left by failed missions remains a consideration for future planning. Gaps would be especially bad for climate studies that require long-term high quality, intercalibrated data sets. The AVHRR data set provided by the NOAA polar orbiters is probably the most important. Meteosat is still experiencing some problem with its imager in the water vapor/IR range.

9.6.2. future satellites

SeaWIFS continues to be delayed. It is presently scheduled for launch in September 1995. ERS-2 is slated for launch in April 1995 and GOES J in May 1995.

The need for a geoidal mission remains. It is currently one of a number of missions under consideration by ESA however a new approach is needed to reduce the cost of the proposed mission. An improvement in the geoid can be developed from a statistical analysis of Topex/Poseidon.

9.6.3. Committee on Earth Observation Satellites

During the intersessional period, IOC continued to work to promote the utilization of remotely-sensed data by all countries. IOC promoted this viewpoint at the CEOS Workshop on Developing Country Activities (San Jose dos Campos, Brazil, 9-12 May 1994). As a result, the workshop concluded that *"CEOS members are committed to assist developing countries"*, that *"a number of CEOS members, observers and affiliates currently have activities underway that support developing countries"*, and that the *"successful plan of action must identify the needs of the developing country to create user demand rather than technology push"*. The goal was to *"contribute to achieve sustainable economic development and environmental management through expanded research, application, and operational use of earth observation data in developing countries"*. As a result, IOC has approached some of the space agencies as well as the EU for assistance in the development of remote sensing capabilities in developing countries.

IOC continues to assist CEOS in the development of satellite requirements (see page 54). This year, the requirements were further refined to include more detailed specifications including temporal and spatial resolution. IOC actively contributed to the on-going activities of the Working

Group Data and the Data Purge procedures, and also participates in the Working Group Calibration/Validation and Working Group Networks.

9.6.4. CMM-IGOSS-IODE sub-group on ocean satellites and remote sensing

In order to more adequately respond to the needs of the ocean community, the IOC, in co-operation with WMO, established the Joint CMM-IGOSS-IODE Sub-Group on Ocean Satellites and Remote Sensing. This group held its first meeting in Paris, 19-22 September 1994, and laid the framework for publication of an annual report covering a wide range of material related to ocean remote sensing. In particular, it reviewed the preliminary list of ocean satellite requirements and set up the framework for maintenance and development of this list. This list of requirements is a direct input to CEOS and incorporated in volume III of the CEOS Dossier.

9.6.5. Data policy

Earth observation by satellite is an essential tool in the management of the earth's ocean resources and for the study and monitoring of climate. Space-derived information is also of increasing value for the implementation of public policy with regard to the ocean, especially in coastal areas. While the potential and importance of earth observation to contribute to the understanding and management of the earth's resources are very high, there are at present potentially incompatible or conflicting policies regarding the management, supply and exchange of that data. A data policy is required that meets the needs for understanding, monitoring and managing the earth's ocean resources.

Many countries and international organizations are formulating their data policies with regard to remotely-sensed data. The users of this data need to keep abreast of the developments and be proactive in the promotion of the free and open exchange of remotely-sensed data for ocean monitoring and management. GOOS is active in the global activities in this regard both through CEOS and through other fora dealing with the development of data policy, such as the World Meteorological Organization (WMO).

Draft
Ocean Satellite Data Requirements[1]

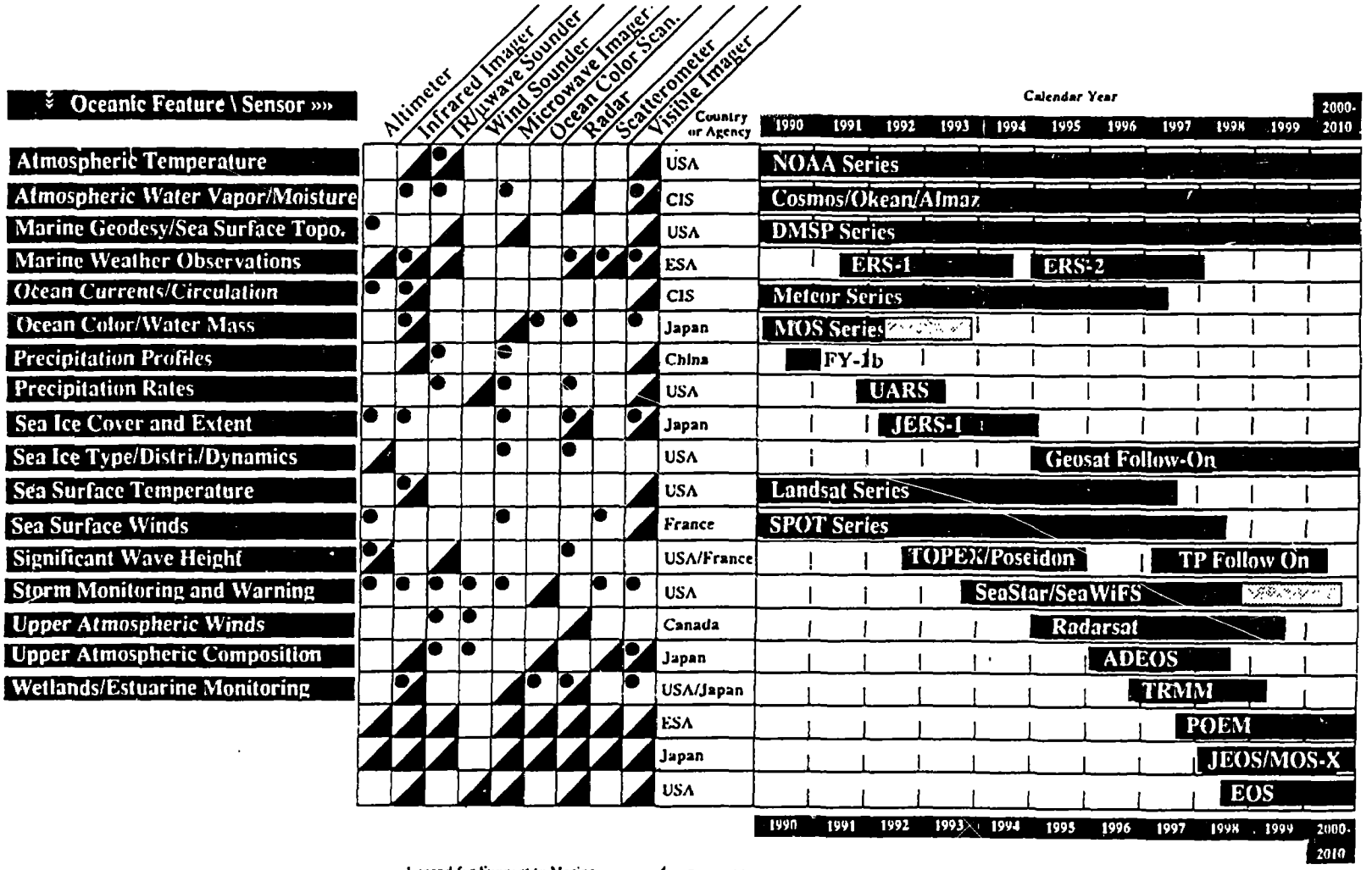
Parameter	Regional/ Global	Horizontal Resolution	Frequency	Accuracy	Source	Application
Wind Vector	Global	200 km	12 hr	1 ms^{-1}/10°	GCOS	C
	Global	25 km	6 hr	2 kts/10°	WMO	S
	Regional	10 km	6 hr	3 kts/10°	WMO	S
SST	Global	100 km	5-10 days	0.2 K	GCOS	C
	Global	1 km	6 hr	0.1 K	WMO	S
	Regional	1 km	6 hr	0.1 K	WMO	S
Ocean Wave Spectra	Global	10 km	1 hr	10%/0.5s	WMO	S
Ocean Topography	Global	100 km	5 days	3 cm	GCOS	C
Ocean Color	Global	100 km	24 hr		GCOS	C
Sea Ice Cover	Regional	10 km	24 hr	2%	WMO	S
	Regional	100 km	24 hr	1-5%	GCOS	C
Sea Ice Thickness	Regional	25 km	12 hr	10%	WMO	S
	Regional	100 km	24 hr	10%	GCOS	C
Sea Ice Edge	Regional	10 km	24 hr	2%	WMO	S

Applications - GOOS Modules
(C) - Climate Module, (L) - Living Marine Resources Module, (Z) - Coastal Zone Module,
(H) - Health of the Ocean Module, (S) - Ocean Services Module

[1] Requirements are given for the Climate and Ocean Services Module: Requirments for other modules will be added as they become available

Current and Planned Satellite Systems in Support of Marine Meteorology and Oceanography (1990-2000)

CURRENT AND PLANNED SATELLITE SYSTEMS IN SUPPORT OF MARINE METEOROLOGY AND OCEANOGRAPHY (1990 THROUGH 2010)



JWS, III. WMO/IOC Summary, October 28, 1992, Version 1.7

BASIC REAL-TIME OBSERVING	EARTH SYSTEM MONITORING	EXPERIMENTAL
Imaging multi-spectral (vis, IR) radiometer	⇒	⇒
Atmospheric sounder (IR, microwave)	⇒	⇒
Wind (microwave) scatterometer	⇒	⇒
	High-resolution multi-spectral mapper	⇒
	Ocean colour radiometer	⇒
	Imaging multi-spectral (microwave) radiometer	⇒
	Earth radiation budget radiometer	⇒
	Limb-scanning radiometer	⇒
	Radar altimeter	⇒
	Precision radar altimetry package	⇒
	Mapping radar (SAR)	⇒
		Doppler lidar
		Atmospheric chemistry spectrometer
		Rain radar
		Multi-directional radiometer
		Polarimeter/radiometer
		Cloud radar profiler
		Gravity gradiometer

Figure A-1
CEOS Affiliates' requirements