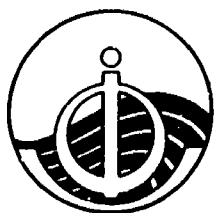


25 JAN 1993

Intergovernmental Oceanographic Commission
Reports of Meetings of Experts and Equivalent Bodies



IOC Group of Experts on the Global Sea-Level Observing System (GLOSS)

Third Session

Paris, 13-15 October 1992

UNESCO

In this Series, entitled

Reports of Meetings of Experts and Equivalent Bodies, which was initiated in 1984 and which is published in English only, unless otherwise specified, the reports of the following meetings have already been issued:

1. Third Meeting of the Central Editorial Board for the Geological/Geophysical Atlases of the Atlantic and Pacific Oceans
2. Fourth Meeting of the Central Editorial Board for the Geological/Geophysical Atlases of the Atlantic and Pacific Oceans
3. Fourth Session of the Joint IOC-WMO-CPPS Working Group on the Investigations of 'El Niño' (*Also printed in Spanish*)
4. First Session of the IOC-FAO Guiding Group of Experts on the Programme of Ocean Science in Relation to Living Resources
5. First Session of the IOC-UN(OETB) Guiding Group of Experts on the Programme of Ocean Science in Relation to Non-Living Resources
6. First Session of the Editorial Board for the International Bathymetric Chart of the Mediterranean and Overlay Sheets
7. First Session of the Joint CCOP(SOPAC)-IOC Working Group on South Pacific Tectonics and Resources
8. First Session of the IODE Group of Experts on Marine Information Management
9. Tenth Session of the Joint CCOP-IOC Working Group on Post-IDOE Studies in East Asian Tectonics and Resources
10. Sixth Session of the IOC-UNEP Group of Experts on Methods, Standards and Intercalibration
11. First Session of the IOC Consultative Group on Ocean Mapping (*Also printed in French and Spanish*)
12. Joint IOC-WMO Meeting for Implementation of IGOSS XBT Ships-of-Opportunity Programmes
13. Second Session of the Joint CCOP/SOPAC-IOC Working Group on South Pacific Tectonics and Resources
14. Third Session of the Group of Experts on Formal Development
15. Eleventh Session of the Joint CCOP-IOC Working Group on Post-IDOE Studies of South-East Asian Tectonics and Resources
16. Second Session of the IOC Editorial Board for the International Bathymetric Chart of the Mediterranean and Overlay Sheets
17. Seventh Session of the IOC-UNEP Group of Experts on Methods, Standards and Intercalibration
18. Second Session of the IOC Group of Experts on Effects of Pollutants
19. Primera Reunión del Comité Editorial de la COI para la Carta Batimétrica Internacional del Mar Caribe y Parte del Océano Pacífico frente a Centroamérica (*Spanish only*)
20. Third Session of the Joint CCOP/SOPAC-IOC Working Group on South Pacific Tectonics and Resources
21. Twelfth Session of the Joint CCOP-IOC Working Group on Post-IDOE Studies of South-East Asian Tectonics and Resources
22. Second Session of the IODE Group of Experts on Marine Information Management
23. First Session of the IOC Group of Experts on Marine Geology and Geophysics in the Western Pacific
24. Second Session of the IOC-UN(OETB) Guiding Group of Experts on the Programme of Ocean Science in Relation to Non-Living Resources (*Also printed in French and Spanish*)
25. Third Session of the IOC Group of Experts on Effects of Pollutants
26. Eighth Session of the IOC-UNEP Group of Experts on Methods, Standards and Intercalibration
27. Eleventh Session of the Joint IOC-IHO Guiding Committee for the General Bathymetric Chart of the Oceans (*Also printed in French*)
28. Second Session of the IOC-FAO Guiding Group of Experts on the Programme of Ocean Science in Relation to Living Resources
29. First Session of the IOC-IAEA-UNEP Group of Experts on Standards and Reference Materials
30. First Session of the IOC-ARIBE Group of Experts on Recruitment in Tropical Coastal Demersal Communities (*Also printed in Spanish*)
31. Second IOC-WMO Meeting for Implementation of IGOSS XBT Ship-of-Opportunity Programmes
32. Thirteenth Session of the Joint CCOP-IOC Working Group on Post-IDOE Studies of East Asia Tectonics and Resources
33. Second Session of the IOC Task Team on the Global Sea-Level Observing System
34. Third Session of the IOC Editorial Board for the International Bathymetric Chart of the Mediterranean and Overlay Sheets
35. Fourth Session of the IOC-UNEP-IMO Group of Experts on Effects of Pollutants
36. First Consultative Meeting on RNOCDs and Climate Data Services
37. Second Joint IOC-WMO Meeting of Experts on IGOSS-IODE Data Flow
38. Fourth Session of the Joint CCOP/SOPAC-IOC Working Group on South Pacific Tectonics and Resources
39. Fourth Session of the IODE Group of Experts on Technical Aspects of Data Exchange
40. Fourteenth Session of the Joint CCOP-IOC Working Group on Post-IDOE Studies of East Asian Tectonics and Resources
41. Third Session of the IOC Consultative Group on Ocean Mapping
42. Sixth Session of the Joint IOC-WMO-CPPS Working Group on the Investigations of 'El Niño' (*Also printed in Spanish*)
43. First Session of the IOC Editorial Board for the International Bathymetric Chart of the Western Indian Ocean
44. Third Session of the IOC-UN(OALOS) Guiding Group of Experts on the Programme of Ocean Science in Relation to Non-Living Resources
45. Ninth Session of the IOC-UNEP Group of Experts on Methods, Standards and Intercalibration
46. Second Session of the IOC Editorial Board for the International Bathymetric Chart of the Caribbean Sea and the Gulf of Mexico
47. First Session of the IOC Editorial Board for the International Bathymetric Chart of the Western Indian Ocean
48. Twelfth Session of the Joint IOC-IHO Guiding Committee for the General Bathymetric Chart of the Oceans
49. Fifteenth Session of the Joint CCOP-IOC Working Group on Post-IDOE Studies of East Asian Tectonics and Resources
50. Third Joint IOC-WMO Meeting for Implementation of IGOSS XBT Ship-of-Opportunity Programmes
51. First Session of the IOC Group of Experts on the Global Sea-Level Observing System
52. Fourth Session of the IOC Editorial Board for the International Bathymetric Chart of the Mediterranean
53. First Session of the IOC Editorial Board for the International Chart of the Central Eastern Atlantic (*Also printed in French*)
54. Third Session of the IOC Editorial Board for the International Bathymetric Chart of the Caribbean Sea and the Gulf of Mexico (*Also printed in Spanish*)
55. Fifth Session of the IOC-UNEP-IMO Group of Experts on Effects of Pollutants
56. Second Session of the IOC Editorial Board for the International Bathymetric Chart of the Western Indian Ocean
57. First Meeting of the IOC *ad hoc* Group of Experts on Ocean Mapping in the WESTPAC Area
58. Fourth Session of the IOC Consultative Group on Ocean Mapping
59. Second Session of the IOC-WMO/IGOSS Group of Experts on Operations and Technical Applications
60. Second Session of the IOC Group of Experts on the Global Sea-Level Observing System
61. UNEP-IOC-WMO Meeting of Experts on Long-Term Global Monitoring System of Coastal and Near-Shore Phenomena Related to Climate Change
62. Third Session of the IOC-FAO Group of Experts on the Programme of Ocean Science in Relation to Living Resources
63. Second Session of the IOC-IAEA-UNEP Group of Experts on Standards and Reference Materials
64. Joint Meeting of the Group of Experts on Pollutants and the Group of Experts on Methods, Standards and Intercalibration
65. First Meeting of the Working Group on Oceanographic Co-operation in the ROPME Sea Area
66. Fifth Session of the Editorial Board for the International Bathymetric and its Geological/Geophysical Series
67. Thirteenth Session of the IOC-IHO Joint Guiding Committee for the General Bathymetric Chart of the Oceans (*Also printed in French*)
68. International Meeting of Scientific and Technical Experts on Climate Change and Oceans
69. UNEP-IOC-WMO-IUCN Meeting of Experts on a Long-Term Global Monitoring System
70. Fourth Joint IOC-WMO Meeting for Implementation of IGOSS XBT Ship-of-Opportunity Programmes
71. ROPME-IOC Meeting of the Steering Committee on Oceanographic Co-operation in the ROPME Sea Area
72. Seventh Session of the Joint IOC-WMO-CPPS Working Group on the Investigations of 'El Niño' (*Spanish only*)
73. Fourth Session of the IOC Editorial Board for the International Bathymetric Chart of the Caribbean Sea and the Gulf of Mexico (*Also printed in Spanish*)
74. UNEP-IOC-ASPEI Global Task Team on the Implications of Climate Change on Coral Reefs
75. Third Session of the IODE Group of Experts on Marine Information Management
76. Fifth Session of the IODE Group of Experts on Technical Aspects of Data Exchange
77. ROPME-IOC Meeting of the Steering Committee for the Integrated Project Plan for the Coastal and Marine Environment of the ROPME Sea Area
78. IOC Group of Experts on the Global Sea-level Observing System

Intergovernmental Oceanographic Commission
Reports of Meetings of Experts and Equivalent Bodies

**IOC Group of Experts
on the Global Sea-Level
Observing System (GLOSS)**

Third Session

Paris, 13-15 October 1992

UNESCO

IOC/GE-GLOSS-III/3
Paris, 4 December 1992
English only

TABLE OF CONTENTS

SUMMARY REPORT		Page
1.	ORGANIZATION OF THE SESSION	1
1.1	OPENING OF THE SESSION	1
1.2	ADOPTION OF THE AGENDA	1
1.3	DESIGNATION OF RAPPORTEUR	
2.	REVIEW OF ONGOING ACTIVITIES	1
2.1	REVIEW OF ACTIONS RECOMMENDED BY GE/GLOSS-II	1
2.2	IGOSS SEA LEVEL PROGRAMME IN THE PACIFIC	2
2.3	IGOSS SEA-LEVEL PILOT PROJECT IN THE NORTH AND TROPICAL ATLANTIC	2
2.4	PERMANENT SERVICE FOR MEAN SEA LEVEL (PSMSL)	3
2.5	TOGA SEA LEVEL PROGRAMME	3
2.6	WOCE SEA LEVEL PROGRAMME	3
2.7	IGOSS PILOT PROJECT ON ALTIMETRIC SEA SURFACE TOPOGRAPHY DATA	5
2.8	STATUS OF GLOSS NETWORK AND DATA FLOW	5
3.	REGIONAL AND GLOBAL COMPONENTS OF GLOSS	6
3.1	IOCINCWIO - GLOSS REGIONAL COMPONENT	6
3.2	IOCARIBE SEA LEVEL PROGRAMME	7
3.3	WESTPAC - WORKSHOP ON SEA LEVEL MONITORING IN THE WEST PACIFIC	7
3.4	ASEAN SEA LEVEL PROGRAMME	8
3.5	SOUTHERN OCEAN	9
4.	GLOSS RELATIONSHIP WITH OTHER PROGRAMMES AND ACTIVITIES OF IOC AND OTHER ORGANIZATIONS	10
4.1	GLOBAL OCEAN OBSERVING SYSTEM (GOOS) AND GLOBAL CLIMATE OBSERVING SYSTEM (GCOS)	10
4.2	INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE (IPCC), INTERNATIONAL HYDROGRAPHIC ORGANIZATION (IHO), AND INTERNATIONAL GEOSPHERE-BIOSPHERE PROGRAMME (IGBP)	12
5.	REVIEW OF THE OUTCOME OF THE GLOSS/IAPSO WORKSHOP ON SEA LEVEL MEASUREMENTS AND QUALITY CONTROL	12
6.	GEODETIC CONTROL OF SEA LEVEL MEASUREMENTS	13
7.	TEMA RELATED ACTIVITIES	13
7.1	TRAINING ACTIVITIES AND PROVISION OF EQUIPMENT, SPARE PARTS, AND SOFTWARE	13
7.2	MANUAL ON METHODOLOGY	14
8.	GLOSS PRODUCTS	14
8.1	GLOBAL AND REGIONAL SEA LEVEL ANALYSES	14
8.2	GLOSS HANDBOOK	14
9.	GLOSS DEVELOPMENT	15
9.1	CHANGES IN THE GLOSS NETWORK AND PROGRESS WITH PRIORITY GLOSS STATIONS	15
9.2	PLAN OF ACTIONS FOR 1992-1994	17
10.	ADOPTION OF THE SUMMARY REPORT	17
11.	DATE AND PLACE OF THE NEXT SESSION	18
12.	CLOSURE	18

ANNEXES

- I **Agenda**
- II **List of Participants**
- III **List of Documents**
- IV **Status of Sea Level Data Submission to PSMSL (1992)**
- V **GLOSS Station Index (1992)**
- VI **IOCARIBE Sea Level Station Network (1992)**
- VII **ASEAN Sea Level Station Network (1992)**
- VIII **Summary Report of the IOC-UNEP-WMO Ad hoc Meeting of Experts on the IOC-UNEP-WMO Pilot Activity on Sea-Level Change and Associated Coastal Impacts (Paris, 16 October 1992)**

1. ORGANIZATION OF THE SESSION

1.1 OPENING OF THE SESSION

1 The meeting was opened by the Chairman of the Group of Experts on GLOSS, Dr. D. Pugh. He pointed out that the Group of Experts on GLOSS, following the decision of the Twenty-fifth session of the IOC Executive Council, has become a subsidiary body of the IOC Committee for GOOS. GLOSS is the first official component of GOOS. Dr. Pugh welcomed the participants noting that participants of each meeting are determined according to key subjects to be considered at each session. He particularly welcomed representatives of UNEP, WMO, IHO and the GCOS Planning Office.

1.2 ADOPTION OF THE AGENDA

2 The Agenda was adopted by the Group as shown in Annex I. The List of Participants is shown in Annex II.

1.3 DESIGNATION OF RAPPORTEUR

3 Dr. B. Parker was elected as Rapporteur of the Session.

2. REVIEW OF ONGOING ACTIVITIES

2.1 REVIEW OF ACTIONS RECOMMENDED BY GE/GLOSS-II

4 Dr. A. Tolkachev presented the progress report on GLOSS development since the Second session of the Group of Experts on GLOSS, held in Miami, USA, in October 1990. In his report he particularly referred to Resolution XVI-9 by which the Assembly approved the report of the Second Session and urged Member States to identify and provide the funds, staff and equipment required for implementation of the Work Plan for 1991-1993 period proposed by the Group. The IOC Assembly also invited IOC Regional Subsidiary Bodies to consider the development of GLOSS regional components.

5 The IOC Committee on Ocean Processes and Climate at its Fifth session (March 1992) by Recommendation OPC-V.2 invited the Chairman of the Group of Experts on GLOSS to initiate preparation of the Action Plan for the Sea Level Changes and Coastal Flooding Pilot Project particularly in the Indian Ocean and submit a draft plan to the 1993 meeting of the IOC Committee for GOOS. The IOC Executive Council at its Twenty-fifth Session adopted this recommendation.

6 Actions have been taken in consultation with the Chairman of the Group of experts on GLOSS to initiate preparation of draft plan for the above mentioned project with the assistance of Dr. S. Shetye (NIO, India). The draft plan for the project will be discussed on 16 October during the IOC-UNEP-WMO Ad hoc Meeting of Experts on the IOC-UNEP-WMO Pilot Project on Sea-Level Change and Associated Coastal Impacts (Annex VIII).

7 The IOC Executive Council also invited the Group of Experts on GLOSS to consider examination of global sea-level trends.

8 The Group was also informed of the decisions of the IOC Governing bodies related to GOOS development and relevant recommendations of the UNCED which called for GOOS in Agenda 21. Within the framework of GOOS the Secretariat started preparations of the GOOS Status reports on existing ocean elements and related systems, including GLOSS. Two reports for the period 1990 and 1991 have been prepared and published and the Group was requested to assist in the preparation of the GLOSS section of the report for 1992 period. In reply to IOC Circular Letter No 1318 of 31 October 1991, a number of countries provided information on the status of national GLOSS stations, particularly with regard to the priority GLOSS stations as proposed by the Group of Experts at its Second Session. This information was made available to the meeting.

9 Due to the lack of funds, no sea level training courses were organized in 1991-1992. Preparations are under way to organize a sea level training course in Brazil in February 1993 for Portuguese and Spanish speaking countries. The report provides information on various meetings and publications related to GLOSS.

10 The Group noted with concern that due to budget limitations some activities proposed by the Group at its Second Session in the Work plan could not be implemented, particularly proposed training courses, preparation of the up-dated GLOSS handbook, GLOSS newsletter and scientific workshop. The Group therefore requested the Chairman to draw the attention of the First Session of the IOC Committee for GOOS and the Seventeenth Session of the IOC Assembly to the need to increase financial and staff support for GLOSS.

11 The Group however noted with satisfaction that the progress in the implementation of GLOSS has been achieved thanks to active participation of countries and support provided by a number of countries in establishing and upgrading the GLOSS network, particularly within TOGA and WOCE programmes.

2.2 IGOSS SEA LEVEL PROGRAMME IN THE PACIFIC

12 Dr. G. Mitchum presented the report on the IGOSS Sea Level Programme in the Pacific (Doc. IOC/GE-GLOSS-III/7D). The report states that since June 1984 monthly maps of the Pacific sea level topography have been produced without fail. Presently monthly sea level values are collected from 89 participating stations in 32 countries throughout the Pacific basin. The maps are presently distributed by mail to users, including several national agencies that reproduce the maps and further distribute them. In addition, a text description and time series from selected stations are posted to the ENSO.INFO bulletin board on OMNET, and the maps are also submitted to the NOAA Climate Diagnostics Bulletin and to the IGOSS Products Bulletin. The net result is that approximately 5 weeks after the end of a month, hundreds of users throughout the world have received an analysis of the state of the Pacific Ocean sea surface topography for that month.

13 The number of stations has risen from 20 to 89 and the number of countries participating has risen from 11 to 32. In addition to the maps of the sea level deviation from the long-term mean that defined the original product, maps of the anomalies from the mean annual cycle that have been corrected for the inverted barometer response of the sea surface to atmospheric pressure changes have been added. Also, quarterly updates of the time series of the tropical Pacific upper layer volume are routinely produced. Indices of the variability of the tropical Pacific ridge-trough topography and the current indices derived from this topography are produced once per year. The result after 6 years of effort is a rich set of products for users that are produced regularly and in a timely fashion.

14 The INTERNET network is widely available for provision of IGOSS products throughout the United States with connections to Europe, Asia, and Africa developing rapidly. Recently a new version of the "ftp" programme has been installed that allows monitoring of the number of people who access this system. In the first two months 15 users logged into this system to copy the IGOSS datasets.

2.3 IGOSS SEA-LEVEL PILOT PROJECT IN THE NORTH AND TROPICAL ATLANTIC

15 The written report was received on the development of the project from Dr. A. Bolduc - ISLPP/NTA Project Manager (Doc. IOC/GE-GLOSS-III/7A). The pilot project was proposed and accepted at the IGOSS V meeting held in Paris in 1988. It was officially initiated in June of 1990 with the Joint IOC-WMO Circular Letter No. 90-67 requesting Member States to support this new Pilot Project. Shortly after, a letter was sent by the Canadian Marine Environmental Data Service (MEDS) to particular countries directly involved in the ISLPP/NTA project requesting their full support for the project and providing specific information on how to submit each month their mean sea level data to MEDS in Canada.

16 During those planning years, the Project was conceived as a test of the feasibility and usefulness of an operational mean sea level network for producing synoptic anomaly charts for the North and Tropical Atlantic Ocean.

17 A by-product in completing the first phase of the data management is the capability to produce anomaly maps for the entire baseline period (1975-86) for gauges used in the computation of the long-term mean. A sample set of these maps was presented last summer at the IUGG meeting in Vienna as a poster paper. A full paper, describing in detail the ISLPP/NTA project has been accepted for publication in the IUGG Symposium and should be available within a few weeks. A full set of maps (144 maps) will be published and distributed this coming fall with various statistics derived while processing this data set received from PSMSL.

18 The Group discussed the difficulties in providing dynamically

meaningful contours in the North Atlantic due to the scarcity of islands. The Group encouraged Dr. Bolduc to investigate alternative products for providing useful monthly sea level deviations and anomalies. There will be a full review of this project at the next meeting of the Group of Experts.

2.4 PERMANENT SERVICE FOR MEAN SEA LEVEL (PSMSL)

19 Dr. P. Woodworth presented a report on the activities of PSMSL over the past two years (Doc. IOC/GE-GLOSS-III/7C). This report summarizes the overall operational status of GLOSS. "Operational" from a PSMSL viewpoint means that recent MSL monthly and annual values have been received by PSMSL at Bidston Observatory, have been checked as far as possible and have been included in the databank. The table 1 (Annex IV) shows the progress in sea level data submission to PSMSL from 1989 through 1992 according to PSMSL categories. Table 2 (Annex IV) lists the number of stations which fall into each category for each "responsible" country according to the GLOSS Implementation Plan and Table 3 (Annex IV) lists the latest data entered into PSMSL databank for each GLOSS gauge ordered by country name. These tables do not include large updates recently received from the TOGA Sea Level Centre, already received for about a year from Canada (but for which there are a number of problems), and to be sent the following week by NOAA. The geographical distribution of the various categories is shown in Figure 1 (Annex IV) for GLOSS overall and Figure 2 (Annex IV) for "committed" stations according to the GLOSS Implementation Plan.

20 PSMSL has started collecting information from GLOSS contacts and known GPS groups on the geocentric coordinates of tide gauge benchmarks, in particular in relation to IERS fundamental points required for (i) development of a dataset of vertical land movements at tide gauge sites; and (ii) location of tide gauge measurements in the same geocentric coordinate system as satellite altimetry

21 A new version of the GLOSS Handbook is nearly completed and may be installed eventually on the PSMSL public access disk allowing datasets to be available on-line. GLOSS contacts have been asked for copies of all historic tide gauge data in computer form from GLOSS Sites.

2.5 TOGA SEA LEVEL PROGRAMME

22 Dr. G. Mitchum presented the report on the activities of the TOGA Sea Level Centre (TSLC) (Doc. IOC/GE-GLOSS-III/7E). The TOGA Sea Level Centre is charged with collecting sea level from the global tropics, processing and quality controlling these data, and distributing data 1.5 years after the end of the year in which the data were collected. For stations operated by the Indo-Pacific Sea Level Network (IPSLN) the data are generally available for distribution one year earlier than this. These data are also archived and distributed by the World Data Center-A for Oceanography, co-located at the US NODC in Washington, DC.

23 In the first years of operation of the TSLC it was decided to concentrate effort on assembling a dataset for the Pacific Ocean. The Pacific variability was of central importance to the TOGA scientific programme, and the sea level network in the Pacific was fully mature. After the Pacific dataset was completed attention turned to the Indian Ocean where the network was progressing. The first Indian Ocean dataset was submitted in 1990. Finally, data from the Atlantic were acquired and the first submission of an Atlantic dataset was made in July 1992.

24 The data holdings of the TSLC presently consist of 1827 station-years of data from 207 stations. Data have been obtained from 35 different data originators. Of the 101 GLOSS stations that are presently operating on islands data from 58 of them has been obtained by the TSLC. Most of the remaining stations lie outside the tropical band that the TSLC deals with.

25 In 1985 the Centre answered approximately 25 data requests per year. By 1991 the number of requests answered had risen to nearly 100, and at the present rate there will be on the order of 150 requests satisfied in 1992.

2.6 WOCE SEA LEVEL PROGRAMME

26 The reports of two WOCE Sea level Centers were presented to the meeting. The report on the activities of the WOCE Sea Level Data Assembly Centre (DAC) at the British Oceanographic Data Centre was presented by Ms. S. Dowell as document IOC/GE-GLOSS-III/7H.

- 27 The British Oceanographic Data Centre (BODC) has responsibility for assembling, quality controlling and disseminating the comprehensive sea level data set for WOCE. It began its activities in early 1991 and is at present collating data from approximately 110 tide gauge sites. The first task addressed by the DAC was to review the status of the WOCE sea level network, identifying gaps and operational problems. An information sheet describing the role of the DAC was produced and distributed to potential data suppliers and to WOCE scientists. A WOCE sea level data tracking system was established to ensure that up to date information pertaining to the WOCE tide gauges was readily available. Presently approximately 95 of the stations are operational and data have been received from 60 of these. When data arrive at the DAC they are converted to BODC's internal format, passed through a range of automatic checks, and adjusted to GMT if necessary.
- 28 Data quality control is carried out with the aid of a high speed graphics work station and sophisticated screening package, which allows rapid visual inspection of the data. Once this is completed the data are loaded to the BODC Data Bank.
- 29 The main priorities over the coming year are as follows:
- (i) to set up a system for transferring data collected by the ACCLAIM project to BODC at regular, probably monthly intervals. This will be carried out in conjunction with upgrading the quality control software. The data will then be regularly passed on to the "fast" sea level centre in Hawaii;
 - (ii) to complete quality control of the 1990 and 1991 data and chase up outstanding data; and
 - (iii) to investigate setting up and maintaining a public access directory containing the WOCE sea level catalogue and data to allow access over Internet.
- 30 Dr. G. Mitchum presented the report on the proposed new WOCE Sea Level Centre, that will be operated by the University of Hawaii (USA). A proposal for funding has been submitted to the NOAA Climate and Global Change Programme beginning in February 1993.
- 31 This centre will operate as the "fast" sea level DAC for WOCE and will focus on processing sea level from a globally-distributed set of stations and making it available to users within 1 to 3 months of data collection.
- 32 A major use of the WOCE sea level dataset will be for joint use with satellite altimeters. The altimeter data need to be constantly checked against the more traditional, and well understood, sea level data from tide gauges. The usefulness of tide gauge data for altimetry researchers has been recognized by the TOPEX/POSEIDON Science Working Team (SWT).
- 33 The proposed project explicitly concentrates on satellite-transmitting sea level stations. In the first year of the proposed activity the Centre will concentrate on stations that already transmit data to the University of Hawaii, primarily stations operated by University of Hawaii and NOAA. In the second year the Centre will expand coverage to include data from other countries, including the British ACCLAIM gauges in the Southern Ocean and the French ARGOS-reporting gauges in the Tropical Atlantic.
- 34 The WOCE Centre will process the data, perform quality control checks, and make the data available to researchers within 1 additional month. It is anticipated that an on-line database will be used. This database will be updated on a monthly basis and will include the full time series for each station rather than only the newest data.
- 35 The Group noted with appreciation the reports presented by Dr. L. Rickards and Dr. G. Mitchum on activities already undertaken by BODC and plans of the University of Hawaii to support the WOCE Sea Level programme by implementing the functions of WOCE Sea Level Data Assembly Centers.
- 36 The Group also emphasized the need for close cooperation between these two WOCE sea level centers as well as other sea level centers and the International Planning Office for WOCE and expressed its readiness to continue its close collaboration with WOCE sea level centers and WOCE scientific groups in

implementing required sea level observations from GLOSS to achieve the objectives of WOCE and GLOSS.

2.7 IGOSS PILOT PROJECT ON ALTIMETRIC SEA SURFACE TOPOGRAPHY DATA

37 This pilot project was proposed by the Joint IOC-WMO Committee on IGOSS at its Fifth session in 1988, initially to be based on GEOSAT data. The project was abandoned after the failure of GEOSAT. The IGOSS Committee at its 6th session in 1991 welcomed the proposal by the USA to re-activate the project subject to the availability of relevant data from ERS-1.

38 Dr. B. Parker presented the report of the Project Manager, Mr. R. Cheney (NOS, NOAA, USA).

39 Since March 1992, altimeter data from the European Space Agency remote sensing satellite, ERS-1, have been available in near-real time (approximately 6-hour delay). Based on these fast delivery data, interim geophysical data records are produced at NOAA (with about a 1-week delay) by incorporating precise orbits, a tide model, and corrections for the troposphere and ionosphere. Sea level anomalies in the tropical Pacific Ocean are then derived from crossover difference solutions involving both the new ERS-1 measurements and existing altimeter data from Geosat. By this process, anomalies can be expressed relative to the mean over April 1985-86, a time period considered to be normal in the Pacific. In addition, the annual and semiannual signal is explicitly removed, isolating the interannual component of sea level variation.

40 Tropical Pacific anomaly maps, averaged over a 1-month period, are produced approximately one week after the end of that month. They have been published in the NOAA Climate Diagnostics Bulletin since July 1992 and they will be published in the IGOSS Products Bulletin beginning with the Bulletin for September 1992. Although the analyses are presently based only on ERS-1 altimeter data, it is hoped that Topex/Poseidon altimeter data will also be available in near-real time beginning in late 1992.

41 A sea level anomaly map for the Pacific from ERS-1 altimeter data for September 1992 was presented to the meeting.

42 The Group noted that the objective of the pilot project is to evaluate the value of the experimental sea level products derived from satellite altimetry and assess relationship with ground truth. The Group recognized the enormous potential value of satellite altimetry for global sea level monitoring and the important service that Mr. Cheney's group at NOAA is providing the community. The Group recognized the need to undertake careful study of combination satellite altimetry measurements with ground truth and noted that such studies have been already started by Mr. Cheney's group, SSG for WOCE and other groups. The Group wished to encourage these careful studies with the objective to produce in final analysis blended sea level global products, using satellite measurements and *in situ* measurements. Parallels with integration of satellite and *in situ* sea surface temperature were encouraging.

2.8 STATUS OF GLOSS NETWORK AND DATA FLOW

43 The Group set up a sessional working group under the chairmanship of Dr. L. Rickards to analyze the present status of the GLOSS network on the basis of information presented by the participants, as well as information received by the IOC Secretariat and available at PSMSL, TOGA and WOCE Sea Level Centers. It was noted that some countries proposed addition to or omission from GLOSS network sea level stations in responses to the proposals made by the Group at its Second session. The up-dated status of GLOSS network accepted by the Group is attached as Annex V to this report. The Group recommended that this status report should be included in the GOOS Status report for 1992 to be submitted to the First Session of the IOC Committee for GOOS and the Seventeenth session of the IOC Assembly. The Group also recommended that the IOC Assembly again urge Member States to provide in a timely fashion sea level data from the GLOSS stations to PSMSL, SOC for ISLP-PAC, SOC for ISLPP-NTA, TOGA and WOCE Sea Level centres. Member States should be requested to inform the Secretariat on all changes regarding their GLOSS stations.

44 The Group discussed the requirements for real-time sea level data transmission through the GTS in view of consideration of new codes at the forthcoming meeting of the WMO Commission for Basic Systems (CBS). This applies in particular to the proposed SRALRV code, which has been adopted from the IGOSS Flexible Code as a title-based character code, compatible with GF-3, for the

international exchange of sea level and related ancillary data on the GTS. The Group noted that presently sea level data are exchanged via various satellite systems and other means of communication. The Group however recognized the potential value of GTS for exchange of sea level products between various centers and for provision of data and data products to developing countries. The requirements for international exchange of sea level data via GTS will need to be further studied particularly in view of the need for global exchange of data from the Global Ocean Observing System. The Group also noted that BUPR will eventually be the most appropriate format for the international exchange on the GTS of all oceanographic data, but recognized that it was not yet widely available, and that character codes remained necessary for many purposes and in many parts of the world. The Group therefore requested the representative of WMO to bring these views to the attention of the CBS.

45 The Group discussed the problem of availability of some meteorological observations required for analysis and interpretation of sea level measurements at GLOSS stations. The Group noted with concern that there are difficulties in obtaining required hourly air pressure and surface wind observations for each GLOSS station from National Meteorological Services and coastal meteorological stations. Dr. P. Dexter informed the Group that the current measurement practices and accuracy requirements are detailed in WMO Publications No. 8 and 717. Atmospheric pressure measurements are made at all stations in the basic synoptic network. Complete list is given in the WMO publication WMO - No. 9 Volume A - Observing stations and WMO - No. 2 Meteorological services of the World. All meteorological data collected nationally from terrestrial stations are also archived nationally. The best initial approach is to contact the respective national meteorological services for advice and elaboration. Data from at least the basic synoptic network stations are also stored in general archives through the ICSU-WDC network. The best first contact with this network would be WDC-A for Meteorology which is the National Climatic Data Center in Asheville, North Carolina, USA. Dr. Dexter also pointed out that the CLICOM project that provides a software package for storing and processing meteorological data with the use of PC, is presently available at some 50 countries and could be of potential help in obtaining required meteorological data at individual stations.

3. REGIONAL AND GLOBAL COMPONENTS OF GLOSS

3.1 IOCINCWIO GLOSS REGIONAL COMPONENT

46 The Group considered a written report on GLOSS implementation in the IOCINCWIO region submitted by Dr. Mika O. Odido, GLOSS Regional Co-ordinator for IOCINCWIO (Doc. IOC/GE-GLOSS-III/7B). The report provided information on the present status of 17 GLOSS stations proposed in the IOCINCWIO region. The report also refers to the recommendations on the improvement and maintenance of the IOCINCWIO regional component of GLOSS made by the IOC-SAREC-KMFRI Regional Workshop on Causes and Consequences of Sea Level Changes on the West Indian Ocean Coasts and Islands (Mombasa, Kenya, 24-28 June 1991) (IOC Workshop Report No. 77). The report of the Workshop was made available to the participants. Dr. G. Alcock represented IOC at the Workshop. The Workshop requested assistance for installation of 8 tide gauges, repair of 3 gauges, and installation of satellite transmitting systems at Fort Dauphin and Mtwara. The Workshop also recommended the establishment of a regional sea level data centre and the provision of training for interested scientists of the region in sea level data analysis and prediction. It was also proposed to organize a mission of experts, particularly to Djibouti, Somalia, Seychelles, Mozambique and Madagascar.

47 The Group noted with appreciation the report of Dr. Odido and his efforts to promote the GLOSS implementation in the IOCINCWIO region. It was noted however that there are serious difficulties in communicating with national GLOSS contacts and relevant national authorities. The Group also noted that Mozambique has been invited to nominate a specialist to participate in the sea level training course to be held in Brazil next year.

48 The Group requested the Chairman to bring recommendations of the Workshop and the need to assist countries of the IOCINCWIO region to the attention of the IOC Assembly. The Group also asked the IOC Secretariat to bring the matter to the attention of the Third Session of the IOC Regional Committee for IOCINCWIO and also to approach UNEP with the request to assist in improving communication links with the countries of the region particularly in connexion with the proposed joint IOC-UNEP-WMO pilot project on sea level changes and associated coastal impacts in the Indian Ocean.

3.2 IOCARIBE SEA LEVEL PROGRAMME

49 Dr. G. Maul presented a report on GLOSS development within the IOCARIBE
(Doc. IOC/GE-GLOSS-III/8).

50 In recognition of the central importance of sea level to all Member
States of the IOCARIBE, a regional component of GLOSS has been actively supported
by the IOC Sub-Commission. The regional component of GLOSS has been integrated
into the concerns of the IOCARIBE Group of Experts on Ocean Processes and Climate
(GE/OPC), of the Working Group on OSLNR (Ocean Science in relation to Non Living
Resources), and to several joint programmes between the IOC and UNEP - notably the
UNEP-IOC Task Team on Climatic Changes in the Wider Caribbean. The single most
important conclusion of this Task Team *vis à vis* sea level is that the five
tectonic plates of the region so complicate the sea level signal with land motion,
that scenarios of global sea level rise through the year 2050 *per se* are not
adequate at any given site. Thus strong geodetic surveying and geophysics
components to the regional GLOSS programme are required.

51 Sea level is recognized by the IOCARIBE GE/OPC and other groups as
essential to monitoring currents, and as a surface (pressure) boundary condition
in numerical forecasting models, such as proposed at the August 1992 GE/OPC meeting
in Cartagena. This places the extra burden on sea level observations within
IOCARIBE in that real-time data transmission will soon be required at numerous
sites, not only of sea level but of other variables such as temperature, wind
velocity, and atmospheric pressure.

52 It is within the context of the above requirements that this IOCARIBE
GLOSS report is formulated. Annex VI provides summary of tide gauge stations
operating within the region. The GE/OPC strongly favors upgrading all the IOCARIBE
tide gauges to digital instruments, and is inclined to favor the newly developed
non-contact acoustic tide gauges because of their inherent precision and stability
for the long-term process of determining climate/diastrophism signals, and for
application to the requirements of sustained economic development for a vertical
datum.

53 Since the last GE/GLOSS meeting (October 1990, Miami) a number of tide
gauge stations have been established: Sint Nicolaas, ARUBA; Exuma, BAHAMAS;
Gunatanamo Bay, CUBA; Charlotteville, TRINIDAD & TOBAGO; and South Caicos, TURKS
& CAICOS. In addition, gauges at Bridgetown, BARBADOS, Cartagena, COLUMBIA and
Puerto-Limon, COSTA RICA have been improved or re-established and a 20-year analog
record is reported from Curacao. Unfortunately, the gauge at Kingston, JAMAICA
and Miami, Florida, USA are destroyed, and the gauge at Port-au-Prince, HAITI is not
operational; both these are gauges listed in the GLOSS Implementation Plan. UNEP
has provided US\$ 20,000 to IOCARIBE to establish gauges at Punta Maisi, CUBA,
Georgetown, GUYANA, Kingston, JAMAICA, and Cap du Mole, HAITI; additional funds
are required for full implementation at these sites.

54 In view of the importance of GLOSS to GOOS and in light of the
recommendations from UNCED, further attention to tide gauges and sea level training
courses should be given. In this regard, a proposal for CARICOM (Caribbean
Community and Common Market) was prepared for submission to UNDP to establish at
least one tide gauge on the territory of each CARICOM nation; gauges for ANTIGUA
& BARBUDA, BELIZE, DOMINICA, GRENADA, MONTSERRAT, ST KITTS-NEVIS, ST. LUCIA, and
ST. VINCENT & THE GRENADINES were proposed; funding has not been established at
this writing. A training course in Spanish has been scheduled for January 1993 in
Cartagena, but funding has not been committed by the IOC; action is requested.

55 The Group noted with satisfaction the progress in the development of
sea level network in the IOCARIBE region thanks to support provided by USA, UNEP
the IOC Sub-Commission on IOCARIBE and personal efforts of the GLOSS Regional Co-
ordinator, Dr. G. Maul. The Group requested Dr. Maul to report the results of this
meeting to the IOCARIBE-IV meeting in December 1992.

3.3 WESTPAC - WORKSHOP ON SEA LEVEL MONITORING IN THE WESTERN PACIFIC

56 Dr. M. Odamaki presented report (Doc. IOC/GE-GLOSS-III/9) on the
International Seminar on Mean Sea Level Monitoring in Asian and Oceanian Region.

57 The International Seminar on Mean Sea Level Monitoring in Asia and
Oceanian Region was held in Tokyo, 26-27 November 1991, in order to promote MSL
monitoring in Asian and Oceanian regions. The above-mentioned seminar was
organized by Hydrographic Department of Japan Maritime Safety Agency, and sponsored

by Sasakawa Peace Foundation and Japan Hydrographic Association. The seminar was attended by 13 experts and representatives from 10 countries, 4 from international organizations and about 80 from various governmental agencies, institutes and universities in Japan. Dr. D. Pugh attended the seminar as IOC representative.

58 The report of the seminar was made available at the session. It contains information on the activities relevant to MSL monitoring in various countries and organizations.

59 Dr. Odamaki also reported on sea level observations in Japan. Sea level observations are carried out by various organizations such as Geographical Survey Institute, Japan Meteorological Agency, Hydrographic Department of Japan Maritime Safety Agency, etc. In order to compile tidal observation results promptly and to detect crustal movements for the forecasting earthquakes, the Coastal Movements Data Centre has been organized within Geographical Survey Institute (GSI). The centre collects data and publishes a Monthly Report, an Annual Report, and various information concerned with mean sea level. Recently, GSI started the geocentric fixing of the tide gauge benchmarks using VLBI and GPS.

60 The works of the centre and the various organizations are briefly introduced in the report of the seminar mentioned above.

61 Dr. D. Pugh reported on his participation in the Second WESTPAC Scientific Symposium in Penang, 2-6 December 1991. Prof. K. Wyrski also attended the Symposium. Both emphasized that it was a good opportunity to establish direct contacts with the specialists of the region and to promote GLOSS development in the region.

62 The Group noted with appreciation the activities of Japan in supporting and promoting GLOSS development in the country and the Asian region. It particularly noted the support provided by Japan in establishing a network of sea level stations in Malaysia that provides high quality data to the TOGA Sea Level Center. The Group requested Japanese experts to investigate the possibility of installing a GLOSS station at Minamitorishima island. The Group requested the participants of the meeting to contact their national delegates who will participate at the Second Session of the WESTPAC Sub-Commission in January 1993 with the view to bring to their attention the results of this meeting and to promote further GLOSS development and co-ordination in the WESTPAC region. The Group realized that it was difficult for such a vast area to be covered up by a single Regional Co-ordinator and therefore wished to invite the WESTPAC Sub-Commission to consider other possible mechanism for regional co-ordination of GLOSS.

3.4 ASEAN SEA LEVEL PROGRAMME

63 The Group received and reviewed the written report of Captain Wilson Chua (Doc. IOC/GE-GLOSS-III/10) on Asean-Australia Economic Cooperation Programme on Marine Sciences Regional Ocean Dynamics.

64 The Tides and Tidal Phenomena Project was implemented from December 1985 to June 1989 under the auspices of the Asean-Australia Economic Co-operation Programme on Marine Sciences. The Project entailed the installation of tide gauges at 24 locations in the seas of the ASEAN region. The main objective of the Project is to develop human resource skills in physical and dynamic oceanography, especially hydrography to enable the ASEAN countries to carry out analysis and predictions of tides. The data collected and analyzed provide a better understanding of sea level signals for the benefit of maritime environmental interests in ASEAN and Australia.

65 Phase II of the Project commenced in July 1989 and is expected to be completed in June 1994. The Phase II known as Regional Ocean Dynamics (ROD) includes a current metering element in addition to the continuous collection of the sea-level data from the 24 tide stations. An off-shore exercise will be conducted using vessels from Indonesia, Malaysia and Singapore. In addition to water property measurements an attempt will be made to monitor the Indo-Pacific Throughflow over a whole year by deploying instrumented moorings, using current meter profilers, in the Makassar, Malacca and Halmahera Strait, five moorings in all. Two further shallow-water moorings will be placed in the Malacca Straits and also in Singapore waters. The moorings will be deployed in May/June 1993 and will be recovered a year later.

66 The objectives of the extended and expanded ROD Project to include the

development of a range of data products of value to ports and harbor managers, shipping, agriculture and fisheries, public works departments, environmental management agencies, offshore oil and gas developers, engineering companies etc.; a regional tidal data bank; an understanding of the relationship between observed currents in the equatorial straits with the topography of the region sea surface as determined by the tide gauge array.

67 Request for data should be directed to the respective countries in whose waters the tide gauges are installed.

68 The list of Project tide stations is shown in Annex VII.

69 Dr. G. Lennon provided further information on the establishment of a network of sea level stations within this Programme. He informed the Group that Australia provides training to the specialists of the region on collection, archiving, processing and interpretation of sea level data.

70 The Group noted the progress in the development of sea level observing system in the ASEAN region. The Group also noted the value of sea level stations for TOGA, WOCE and GLOSS. The Group advised the Directors of TOGA and WOCE sea level centers and the Secretariat to contact directly the respective countries with regard to obtaining required sea level data.

3.5 SOUTHERN OCEAN

71 Dr. G. Lennon presented a report on the development of sea-level observation in the Southern Ocean.

72 From the IOC-SCAR Workshop on Sea-Level Measurements in Antarctica, May 1990, there was a request that Dr. Lennon on behalf of National Tidal Facility (NTF) should conduct a feasibility study of a Sea Level Pilot Project for the Southern Ocean. At the Second GLOSS Group of Experts Meeting held in Miami in October 1990 it was reported that attempts within Australia to gain support, had produced much of a moral nature but no practical support. The plan then took the following form:

If the Australian National Tidal Facility (NTF) is to proceed with the proposal then two criteria must be met: first, there should be a recognizable infrastructure within Australia involving more than NTF enthusiasm; second, there should be an active experimental programme.

73 The progress to date is as follows. A working infrastructure has been established. Within the SCAR Community and following a meeting of the Working Group on Geodesy and Geographic Information (WG-GGI) in June 1992 at Bariloche in Argentina it was reported that Australia had co-ordinated a GPS Observation Campaign involving 16 Antarctic and 18 mid-latitude sites. Mr. Drew Clarke of AUSLIG, Australia was elected Chairman of WG-GGI for the 2 year period 1992-94.

74 In a work plan of 9 sub-programmes Australia is to convene Geodetic Infrastructure for Antarctica (GIANT) which plans to develop a co-ordinated permanent network of geodetic stations using survey, GPS, SLR, VLBI, gravity and tide gauge techniques. This being so there had been established in Australia a co-operative consortium comprising AUSLIG (Dr. John Manning, Head of the Geodetic Branch), Australian Antarctic Division (Mr. Rupert Summerson, Mapping and Ethics Officer), and NTF (Prof. G. Lennon, Director, NTF).

75 With the active assistance and enthusiasm of Mr. Rupert Summerson an enhanced experimental Programme is underway. A specially designed bottom pressure tide gauge has been developed and is manufactured by PLATYPUS ENGINEERING of Tasmania. This gauge uses a Paroscientific Digiquartz sensor, has a 5-year battery life and 2 year duration data storage, and logs a 10-minute average of 1 second samples. Programming and down-loading is by induction-loop technology. Field procedures involve deployment in concrete block in ~ 8 m of water. A communication bell is lowered through a hole in the ice cover on a monthly basis to the instrument. This technique has been successful at one station but has proven difficult at another due to turbidity but his problem now seems to have been overcome.

76 For remote islands, notably Macquarie, the plan is to shelter the gauge from large surf by drilling a 50 mm hole through coastal rock to access ocean at depth and to use a small diameter pressure sensor. Discussions are continuing so as to decide whether an acoustic system might be used in such an inclined barhole

notwithstanding the increased sensitivity of the acoustic sensor to irregularities in the flight path in low temperature conditions, and whether it is possible to have a permanent induction link to the Platypus tide gauge through such a borehole. In such a case real-time telemetry would be possible.

77 The present plans include deployment and maintaining the Platypus System at Mawson and Casey stations and late at Davis. A borehole system is planned for Macquarie Island in the 1993/1994 Summer period and meanwhile to conduct tests in a high energy zone in Western Tasmania.

78 Having met the two criteria, Australia is now prepared to put into operation the proposed Sea Level Pilot Project for the Southern Ocean should this step be the wish of the GLOSS Group of Experts.

79 The Group noted with satisfaction the progress in establishing the GLOSS stations in the Southern ocean region by Japan, France, USA, Argentina, Australia and UK. The Group reaffirmed its request to Dr. Lennon to proceed with the feasibility study for the Sea Level Pilot Project in the Southern Ocean and asked Dr. Lennon to prepare draft plan for the project to be considered at the Fourth Session of the Group in 1994. The Group also recommended that the Fourth session of the Group of Experts should be preceded by a Workshop on sea level measurements in Antarctica.

4. GLOSS RELATIONSHIP WITH OTHER PROGRAMMES AND ACTIVITIES OF IOC AND OTHER ORGANIZATIONS

4.1 GLOBAL OCEAN OBSERVING SYSTEM (GOOS) AND GLOBAL CLIMATE OBSERVING SYSTEM (GCOS)

80 Dr. A. Toikachev presented the report on Global Ocean Observing System (GOOS) (Doc. IOC/GE-GLOSS-III/12). The Assembly, at its Fifteenth Session, decided to initiate development of GOOS and at its Sixteenth Session re-confirmed its decision to undertake development of GOOS.

81 The United Nations Conference on Environment and Development (Rio de Janeiro, June 1992) in Chapter 17 of its Agenda 21 specified the need for addressing critical uncertainties for management of the Marine Environment and Climate change and called for the establishment of GOOS. GOOS will allow for co-ordinated systematic observations and subsequent prediction of environmental and climate changes globally, regionally and nationally. As envisaged, this comprehensive and integrated system will provide a mechanism for the coordinated management of data generated from regular satellite and *in situ* observations of major physical, chemical and biological properties of the ocean, including the coastal zone and enclosed and semi-enclosed seas.

82 GOOS will take full advantage of the findings of global research programmes. An initial priority is the climate module. To satisfy the ocean monitoring needs of the Global Climate Observing System, this module of GOOS is envisioned to become operational over the next two decades.

83 Close interaction is taking place with scientific groups in order to insure a sound scientific design. A joint CCCO-JSC Ocean Observing System Development Panel is formulating the design of the aspects of the system which will contribute to the common element of two systems GOOS and Global Climate Observing System, i.e. ocean observations required for climate prediction. The IOC Committee for GOOS will hold its First Session 16-19 February 1993 and will *inter alia* review a draft development plan for GOOS which has been commented on by Member States.

84 Actions have been taken by UNEP, IOC, WMO and IUCN to initiate pilot activities for a long-term global monitoring system of coastal and near-shore phenomena related to climate change. Among the proposed pilot activities, the proposed pilot project on sea level changes and coastal flooding was addressed by IOC Executive Council to the GE/GLOSS for consideration and preparation of the draft Plan.

85 GOOS is to be built as far as possible on existing activities and bodies such as IGOSS, GLOSS, IODE, DECP and MARPOLMON as well as on the progressive development and implementation of new elements and capabilities.

86 The Group was invited to:

- (i) advise the IOC Committee for GOOS and the IOC Assembly as to how the implementation of the GLOSS network can be accelerated and the amount and quality of data increased for international exchange;
- (ii) provide guidance to the Ocean Observing Systems Development Panel (OOSDP) concerning present technologies and plans for tide gauges, in particular by responding to the OOSDP questionnaire on enabling technologies for GOOS.

87 The Group noted that it will have close contact on all aspects of sea surface topography with the IOC Committee for GOOS as its subsidiary body and expressed its readiness to participate in the GOOS design and planning. The GLOSS as an existing observing element of the GOOS will be an important contribution to the climate and coastal modules of GOOS. The report of this session will be brought to the attention of the First Session of the IOC Committee for GOOS.

88 In response to the request of the OOSDP the Group reviewed the questionnaire submitted to the meeting and set up a sessional working group chaired by Dr. G. Maul to prepare reply to OOSDP in relation to the sea level observations to be included in the climate module of GOOS. The Group requested the Secretariat to send the views of the Group to the Chairman of OOSDP, Dr. W. Nowlin.

89 Dr. J. Merle, IOC Seconded expert to the Joint Planning Office for GCOS, presented a report on the development of the Global Climate Observing System (GCOS).

90 The second World Climate Conference in Geneva in 1990 prompted participants to urge the creation of GCOS to meet the needs for:

- (i) climate system monitoring, climate change detection and response monitoring, especially in terrestrial ecosystems;
- (ii) data for application to national economic development;
- (iii) research toward understanding, modeling and prediction of the climate system.

91 The Joint WMO-IOC-UNEP-ICSU Scientific and Technical Committee (JSTC) for GCOS and a Joint Planning Office have been established.

92 At its first meeting in Geneva, the JSTC provided the impetus to plan and implement GCOS and take a systematic approach to observations needed to understand global change uncertainty. The second JSTC meeting in Washington D.C., in January 1993 should see the adoption of a draft plan for the early phases of GCOS.

93 Both IOC and WMO agreed that the climate module of GOOS should provide the ocean component of GCOS.

94 The Group was invited to express their views on how existing systems of measurements of the global sea level could be maintained and enhanced to meet the new requirements which are emerging from GCOS and the climate module of GOOS. Of particular interest for GCOS and the climate module of GOOS are the questions of the utility of *in situ* tide gauges measurements of sea level for the detection of climate signals such as ENSO, and how altimetric measurements from experimental satellites could be coupled with these *in situ* tide gauge measurements. Altimetric measurements have been shown to provide good estimates of the global variations of sea level on the time and the space scales of interest the ENSO climate signal and to provide coverage in areas not available from tide gauges on ocean islands. If satellite altimetry becomes routine, it should form the basis for an integrated system of sea level measurements, but, tide gauges network should be maintained. *In situ* observations will also be necessary to calibrate and to provide regular corrections for satellite altimetry.

95 The Group discussed the questions addressed to it by GCOS and wished to express the following opinions:

- (i) GLOSS is a permanent system to observe sea level variations on all time scales and for many purposes on a global scale. The data have a large variety of scientific applications. They have been used for the analysis, monitoring and prediction of El Nino. The GLOSS network of sea level stations in the Pacific and around Australia is virtually complete and the data will be available for the prediction of El Nino.

- (ii) In its spatial and temporal scales, and in its links with inter-ocean circulation features, the monitoring of sea level, with a focus upon the low frequency spectrum, is a strong indicator and forecasting basis for inter-annual climate variation.

96 The Group wished to express its willingness to cooperate with JSTC-GCOS in design and planning of the ocean-climate component of Global Climate Observing System.

4.2 INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE (IPCC), INTERNATIONAL HYDROGRAPHIC ORGANIZATION (IHO), AND INTERNATIONAL GEOSPHERE-BIOSPHERE PROGRAMME (IGBP)

97 The Group was informed by Dr. G. Maul on his participation in the WMO-UNEP International Workshop "The Rising Challenge of the Sea" (Margarita Island, Venezuela, 8-14 March 1992). Dr. Maul, on behalf of the IOC, presented a report on "Activities and Plans of IOC Related to Coastal Zone Management and Sea Level Rise".

98 The Group was also informed that Mr. D. Scott presented the report on GLOSS at the XIVth International Hydrographic Conference (May 1992, Monaco).

99 The Group wished to express its thanks to Dr. Maul and Mr. Scott for the promotion of cooperation with IPCC and IHO in relation to GLOSS activities. Mr. Kerr (IHO) confirmed the willingness of IHO to cooperate with IOC in promoting GLOSS development through national hydrographic agencies.

100 The Group was also informed on the proposed IGBP core project on Land-Ocean Interaction in the Coastal Zone (LOICZ) which includes as a research foci responses to changes in relative sea level.

101 The Group wished to encourage continued participation of GLOSS experts in the activities of various organizations interested in dealing with the problem of sea level changes and associated impacts with the view of promoting GLOSS as a source of sea level observations and data sets required for analysis and prediction of global sea level trends.

5. REVIEW OF THE OUTCOME OF THE GLOSS/IAPSO WORKSHOP ON SEA LEVEL MEASUREMENTS AND QUALITY CONTROL

102 The Group reviewed the outcome of the Joint IAPSO-IOC Workshop on Sea Level Measurement and Quality Control (Doc. IOC/GE-GLOSS-III/15) which took place 12-13 October 1992, immediately prior to the Third Meeting of the GLOSS Group of Experts. The Workshop was convened following the recommendations of the Second Session of the GLOSS Group of Experts, and consisted of two sessions. The first session dealt with the latest techniques in measuring sea level, and was chaired by Dr. G. Mitchum. The second session dealt with data processing and quality control and was chaired by Dr. G. Maul.

103 Operational experience with acoustic gauges was described in presentations by Mr. P.Y. Dupuy, Dr. B. Parker, Prof. G. Lennon, and Dr. J. Vassie. A review on the effects of stilling wells on sea level data was presented by Prof. G. Lennon. Dr. P. Woodworth described an automated calibration device for relating pressure gauge data to a local datum. Presentations on subsurface pressure gauges were given by Dr. J.-M. Verstraete and Dr. J. Vansie. Dr. G. Maul described the use of inverted echo sounders. Dr. G. Hein presented a method of using differential GPS between a moored buoy and a land-based station for measuring sea level. The determination of sea surface topography using satellite altimetry was discussed in presentations by Dr. C. Le Provost, Dr. P. Woodworth, and Dr. J. Powell.

104 Data processing and quality control procedures and activities at a number of institutions were described in the second session. This included activities at: PSMSL (Dr. P. Woodworth), the TOGA Sea Level Centre (Mr. P. Caldwell), BODC (Dr. L. Rickards), the Japanese Maritime Safety Agency (Dr. M. Odamaki), the Australian National Tidal Facility (Prof. G. Lennon), and the National Ocean Service, NOAA (Dr. B. Parker).

105 The Group recommended speedy publication of the papers from the Workshop as they would provide valuable guidance for others working with sea level data.

6. **GEODETIC CONTROL OF SEA LEVEL MEASUREMENTS**

106 The Group discussed the need to update the progress in geodetic control of sea level measurements since the 1989 IAPSO Workshop on Geodetic Fixing of Tide Gauge Benchmarks held in Woods Hole (Technical Report WHOI-89-31). Dr. Pugh informed the Group that the International Association of Geodesy had established a Working Group and had asked the IAPSO Commission on Mean Sea Level and Tides to participate. Prof. G. Lennon, Dr. P. Woodworth, Dr. G. Maul and Dr. C. Le Provost are IAPSO members and will attend.

107 Dr. P. Woodworth described PSMSL's efforts (Doc. IOC/GE-GLOSS-III/7C) to obtain geocentric co-ordinates for GLOSS station benchmarks, as discussed at the Second Meeting of the GLOSS Group of Experts. In February 1992 a joint circular letter from the PSMSL and the WOCE Sea Level Centre at BODC was sent to national sea level authorities, GLOSS contacts, and known GPS groups asking for information on geocentric co-ordinates of tide gauge benchmarks, in particular in relation to IERS fundamental points. These are required for two reasons: (i) to start some kind of dataset of vertical land movements at tide gauge sites even though accuracies at present are probably not at the centimetre level, and (ii) to locate tide gauge measurements in the same geocentric co-ordinate system as satellite altimetry. About 20 replies were received. No replies were received from some of the larger countries which are known to have extensive GPS experience. This may be because they do not yet feel this can be done to sufficient accuracy.

108 The Group wished to support these activities and to encourage further actions in geodetic control of sea-level measurements by GLOSS stations.

7. **TEMA RELATED ACTIVITIES**

109 The Secretary IOC recalled the need to ensure active participation of Member States in GLOSS and the requirements that human resources be made available to participate at the sites. Automatic transmission of data and feed-back was not sufficient - it is necessary to ensure that the local/national people feel that they are involved and see the data. He recalled that UNCED had put capacity building in focus, and he emphasized the necessity to provide training, education, and involvement, in the use of data and feed-backs.

7.1 **TRAINING ACTIVITIES AND PROVISION OF EQUIPMENT, SPARE PARTS, AND SOFTWARE**

110 Dr. Tolkachev informed the Group that due to severe budget limitations no sea level training courses were held during 1991-1992 period. At present a sea-level training course for Portuguese and Spanish speaking countries is being organized in Brazil to be held in February 1993 at the University of Sao Paulo. Angola, Argentina, Cape Verde, Chile, Mozambique, Peru and Uruguay have been invited to nominate the candidates for this course. Negotiations are underway with India to assist Vietnam in installation of a GLOSS station and training their specialists.

111 The Group then considered possible participation of the specialists from IOCARIBE region at this training course. It recognized that this will require additional financial support to be provided by IOC which is impossible at present. The Group felt that a special training course would be more desirable for the countries of the region preferably in Colombia as soon as funds are available in view of the common interests of the countries of the IOCARIBE region.

112 The Group also wished to emphasize the need for continuation of sea level training courses in UK and France subject to the availability of funds. More emphasis should be given now to sea level data analysis and interpretation. Such training courses have proved to be efficient in promoting the GLOSS development in developing countries.

113 The participants then exchanged information on the training and assistance activities organized by individual countries. The Group noted with great satisfaction that USA, Japan, Australia provide assistance on bilateral or multilateral basis to other countries in training specialists and providing equipment and spare parts.

114 The Group requested the Chairman to bring to the attention of the IOC Assembly the need to strengthen technical assistance and training to developing countries on a more systematic manner in view of the permanent nature of GLOSS as an element of GOOS, and to provide necessary resources for this.

7.2 MANUAL ON METHODOLOGY

115 Dr. P. Woodworth presented the draft Manual on Sea Level Measurement and Interpretation, Volume II, prepared under the editorship of Mr. D. Blackman. Detailed proposals for improvements were made for transmission to Mr. Blackman, who was congratulated on the work already accomplished. The Group recommended that Volume II be published in the IOC Series "Manuals and Guides".

8. GLOSS PRODUCTS

8.1 GLOBAL AND REGIONAL SEA LEVEL ANALYSES

116 The GLOSS Implementation Plan emphasizes the importance of various international sea level centres producing sea level products derived from the data submitted from GLOSS stations so that participating countries can use them for the national and regional scientific and practical applications.

117 The Group reviewed the activities of various Sea Level Centres and noted that the products produced by the SOC for ISLP-PAC served an important role in the development and operation of the GLOSS network in the Pacific. It was recognized however that types of sea level products may be different depending on the tasks of the centers, data collected and interests of participating countries. PSMSL is considering in particular, producing global sea level indices and a list of scientific publications on sea level observations and analysis. In the IOCARIBE region sea level data will be used for producing with the help of existing prognostic numerical models analyses and forecasts of surface currents which are of particular value for practical application by oil companies, transportation and fishery industries and for search and rescue operations.

118 The Group therefore encouraged the Sea Level Centers to produce sea level products that may be of value for participating countries and recommended, in particular, that the Sea Level Centers assist the participating countries in preparation of more local products to be used by individual countries, for example in the form of graphs of sea level changes for particular stations.

119 The Group considered examination of sea level trends, as requested by the IOC Executive Council at its Twenty-fifth Session. It recognized that the IPCC had published widely used figures for projected sea level rise in the next century, and considered that it would be rather inappropriate or necessary for GLOSS to repeat this exercise. Concerning analysis of trends in recent observations of sea level, there have been two detailed analyses (references to Douglas, B.C. (1992). Global Sea Level Acceleration. Journal of Geophysical Research, 97 (C8) pp 12699-12706 and Woodworth, P.L. (1990). A Search for Accelerations in Records of European Sea Level. International Journal of Climatology, 10, 129-143). These analyses show no significant accelerations in records to date. Accelerations such as those predicted by the IPCC Report would be detectable early in the next century. The time required to detect accelerations may possibly be reduced if the interdecadal fluctuations of sea level can be understood in terms of their forcing mechanisms, and removed even in part from the tide gauge records.

8.2 GLOSS HANDBOOK

120 Dr. L. Rickards presented a report on the preparation of the up-dated GLOSS Handbook (Doc. IOC/GE-GLOSS-III/16).

121 At the last meeting of the GE/GLOSS a draft version of the GLOSS Handbook and software package was demonstrated. Between then (October 1990) and about February 1991 more GLOSS Station Information Sheets were received, so that by the time Version 1.0 was produced, replies covering 217 of the 306 sites (71%) had been collated. Site location maps were received from just over half of the stations. So far about 80 requests for the Handbook have been received. An article advertising the Handbook was included in the IMS Newsletter. No problems have been reported by users and some complimentary comments have been received. Copies of the Handbook have also been supplied to GLOSS Contacts (approx. 100).

122 The GLOSS Handbook will be included in OCEAN-PC, a project by IODE to provide ocean-data-related software to developing countries. The Group agreed that the University of Hawaii sea level data processing software may also be appropriate for inclusion in OCEAN-PC.

123 Work began on updating the Handbook early in 1992, Station Information Sheets were mailed out to GLOSS Contacts in March. Replies have been received

covering 172 stations (56%). The Handbook has been updated to include the new information and a draft of Version 2.0 has been produced. It is intended that the Handbook will be available using the 'anonymous ftp' facility in the near future.

124 Considering the two mailings for information together, replies have been received for about 250 sites (81%). A list has been produced detailing those contacts who have not replied to either of the two mailings. There are 41 of these: Angola, Bangladesh, Cameroon, Canada, Cape Verde, Congo, Costa Rica, Côte d'Ivoire, Cuba, Egypt, France, Guinea, Haiti, Indonesia, Jamaica, Japan, Madagascar, Morocco, Norway, Pakistan, Panama, Papua New Guinea, El Salvador, Sao Tome and Principe, Senegal, Seychelles, Sierra Leone, Somalia, Tanzania, Trinidad and Tobago, Uruguay, Venezuela and the P.D.R. Yemen.

125 A large number of maps showing the tide gauge locations have been collated. At present these are only available on paper. It would seem useful to incorporate these into the Handbook, either by scanning or digitizing them.

126 The Group carefully reviewed the list of GLOSS stations for which the status was uncertain.

127 Dr. K. Wyrcki recommended that the presentation of GLOSS station names be revised where necessary in order to make them more easily recognizable. The format of a GLOSS station name should be: more recognizable name (specific site) [Bermuda] [St. Georges].

128 The Group agreed and requested that Dr. L. Rickards make recommendations on name changes.

129 The Group noted with satisfaction the progress in developing an updated GLOSS Handbook. The Group agreed that incorporation of maps showing the tide gauge location into the Handbook would improve the usefulness of the Handbook and encouraged Dr. Rickards to investigate this possibility. The Group requested the IOC Secretariat and the participants of the meeting to assist in receiving required information from the countries who have not yet provided information.

9. GLOSS DEVELOPMENT

9.1 CHANGES IN THE GLOSS NETWORK AND PROGRESS WITH PRIORITY GLOSS STATIONS

130 Dr. K. Wyrcki reviewed the principles for adjusting the GLOSS network. If a site is requested to be deleted for reasons previously agreed other than redundancy it must be replaced with another site. A site should not normally be added based on a new installation until reliable data is obtained from the site. For the primary network, the sites must be globally representative. There can be regional networks within the GLOSS system, but those stations are not part of the primary GLOSS global network.

131 Based on acceptance of the recommendations of the Second Meeting of the GLOSS Group of Experts by the Sixteenth Session of the IOC Assembly, five stations have now been removed from the GLOSS Network: Bahia Scotia (196), Pelabuhan (48), Palmyra Island (301), Nawiliwili (285), and Kahului (287).

132 The Group considered formal proposals from IOC Member States for GLOSS primary network adjustment, Israel requested adding Hadera as a GLOSS station. The GLOSS primary network is limited to two stations in the Mediterranean Sea. The nearby station of Port Said has not provided data to PSMSL since 1946 and could be replaced by Hadera if it is not made operational by Egypt. The Group asked that the GLOSS Technical Secretary contact Egypt on this matter.

133 The Group agreed with the request by Argentina to delete Jubany from the GLOSS network; this site is very near Esperanza, which should become operational in January 1993 with NOAA NGWLMs gauges. The Group recommended against the addition of requested station additions by Greece and Saudi Arabia within the primary global network because these sites are located in semi-enclosed seas.

134 The Group agreed with recommendation for GLOSS network changes proposed by Australia, i.e. to replace Hobart (56) by Spring Bay; P. Adelaide (55) by Portland and to add a new GLOSS station: Thevenard.

135 In addition the Group requested the Secretariat to seek further information from Member States to allow possible further adjustment following the

proposals made during the meeting by:

- (i) Dr. K. Wyrтки and Dr. G. Mitchum suggested to delete Fanning Is. since it is redundant with Christmas Is and contact Kiribas;
- (ii) Dr. G. Mitchum suggested to replace Aldabra in the Seychelles by Farquar.

136 The Group also requested the participants to provide the IOC Secretariat with available updated information regarding the status of other GLOSS stations and their views regarding their future operation within the GLOSS network for follow-up contact with the countries and consideration at the Fourth Session of the Group of Experts on GLOSS in 1994.

137 The Group recommended that the GLOSS Technical Secretary contact the following Member States in order to clarify the status of GLOSS stations. This list includes outstanding actions from the GE/GLOSS-II in 1990:

- Australia, to request that the existing gauge at Twin Islands be committed to GLOSS as an additional Australian gauge.
- Bahamas, to request that the existing gauges at Settlement Point and Exuma replace the gauges at Bimini and San Salvador as GLOSS gauges.
- Chile, to request that Diego Ramirez be committed to GLOSS to replace the existing committed gauges at Punta Arenas and Puerto Williams.
- Egypt (Suez Canal Authority and Alexandria University), requesting the installation of a gauge at Port Said, taking into account the proposal made by Israel.
- France (GLOSS contact - Dr. C. Le Provost), to note and encourage the installation of gauges at Martinique.
- Ghana, to seek advice on the status and desirability of gauges at Tema and Takoradi.
- Haiti, to install sea level station at Cap du Mole.
- Iceland, to note the importance of the committed Reykjavik gauge and request quicker data transmission.
- Indonesia, to encourage the installation of a gauge at the important site of Kupang; to propose that the existing tide gauge at Pelabuhan Ratu be deleted, the location is covered by the existing gauge at Cilacap.
- Japan, to encourage installation of a gauge at the important site at Minamitorishima.
- Mexico, to request the existing gauge at Puerto Morelos replace the existing committed gauge at Progreso, explaining that scientifically the former is a more important site.
- Morocco, to seek advice on the desirability of a GLOSS gauge at Tan Tan or another site.
- Mozambique, to encourage installation of gauges at Pemba and Inhambane.
- Myanmar, to welcome their positive approach to installing gauges.
- Namibia, to request that the existing gauge at Walvis Bay be committed to GLOSS.
- New Zealand, to recommend that Scott Base replace McMurdo Sound at the GLOSS gauge.
- Russian Federation, to encourage the installation of the committed gauge at Mirny; to request that the existing gauges at Providenya, Kronstadt-Shepelevo, Nahodka, Dikson and Tiksi all be committed to GLOSS.
- Sao Tome and Principe (copied to relevant offices in Lisbon), to request a committed GLOSS gauge at Sao Tome.
- Somalia, to request information on the status of the gauge at Mogadishu.
- Tanzania, to encourage installation of the committed gauge at Mtwara.
- United Kingdom, to encourage the modernization of existing gauges at Ascension and Faraday; and to encourage installation of a committed gauge at South Georgia.
- U.S.A., to encourage advice on replacing existing stations at Corpus Christi, Lake Worth and Fernandina Beach with more suitable locations.
- Venezuela, to recommend that the existing committed gauge at La Guaria replace the other 2 Venezuelan gauges.

9.2 PLAN OF ACTIONS FOR 1992-1994

138 In the light of the discussion under previous agenda items and bearing in mind IOC budget limitations the Group recommended the following actions for 1992-1994 period to promote further development of GLOSS in the context of GOOS:

No.	Actions	1992	1993	1994
1.	Letters to IOC Member States on GLOSS Status	x		
2.	Sea Level Training Course in Brazil		February	
3.	Report to ICG-I		February	
4.	Presentation of GLOSS to IOC-XVII		Feb.-March	
5.	Participation of GLOSS Regional Co-ordinators/Experts in the regional activities of IOC IOCARIBE Dr. G. Maul WESTPAC IOCEA Dr. Konate IOCINCWIO Drs. Odido/Ragoonaden	2-7 December (Mexico) 14-18 Dec. (Mauritius)	25-29 Jan. (Thailand) 18-22 Jan. (Senegal)	
6.	Preparation and publication of the GLOSS Manual (Vol. II)		x	
7.	Training Seminar/Workshop on Sea Level Analysis			x
8.	Provision of PC software		x	x
9.	Sea Level Training Course in Spanish/Portuguese		x (Brazil)	x IOCARIBE
10.	Updated GLOSS Handbook		x	
11.	Visits of individual countries		x	x
12.	Programme for GLOSS upgrading			x
13.	Experts mission IOCINCWIO/Central America		x	x
14.	Fourth Session of GE/GLOSS			x

10. ADOPTION OF THE SUMMARY REPORT

139 The draft report of the meeting was adopted as it appears in this document.

140 This document also includes as Annex VIII the Summary Report of the
IOC-UNEP-WMO Ad hoc Meeting of Experts on the IOC-UNEP-WMO Pilot Project on Sea-
Level Change and Associated Coastal Impacts held in Paris on 16 October 1992. The
revised Draft Action Plan for the Implementation of the IOC-UNEP-WMO Pilot Project
on Sea-Level Change and Associated Coastal Impacts in the Indian Ocean prepared
during the above-mentioned meeting will be published as IOC/INF-908.

11. DATE AND PLACE OF THE NEXT SESSION

141 The Group recommended to hold its Fourth Session in 1994. The exact
place and dates for the meeting should be discussed with the IOC Secretariat.

142 Dr. D. Pugh recalled that the Group had recommended that a workshop
precede the Fourth GLOSS meeting which should deal with sea level measurements in
Antarctica and the Southern Ocean.

143 Dr. K. Wyrcki suggested that special attention be given at the Fourth
GLOSS meeting to reviewing the gaps in the GLOSS network and recommending ways to
fill these gaps.

144 Dr. B. Parker suggested that special attention be given to inviting to
the Fourth Meeting sea level experts from countries who have not participated in
GLOSS. Such lack of previous participation may have only been based on the fact
that no GLOSS station may exist in a particular country because either it is
located on an inland sea, or such a location would be too close to another GLOSS
station. Dr. P. Woodworth suggested the Netherlands as a good example of this and
cited excellent sea level research from that country.

12. CLOSURE

145 The Chairman closed the Session at 18:00 on 15 October 1992.

ANNEX I

AGENDA

1. ORGANIZATION OF THE SESSION
 - 1.1 OPENING OF THE SESSION
 - 1.2 ADOPTION OF THE AGENDA
 - 1.3 DESIGNATION OF RAPPORTEUR
2. REVIEW OF ONGOING ACTIVITIES
 - 2.1 REVIEW OF ACTIONS RECOMMENDED BY GE/GLOSS-II
 - 2.2 IGOSS SEA LEVEL PROGRAMME IN THE PACIFIC
 - 2.3 IGOSS SEA-LEVEL PILOT PROJECT IN THE NORTH AND TROPICAL ATLANTIC
 - 2.4 PERMANENT SERVICE FOR MEAN SEA LEVEL (PSMSL)
 - 2.5 TOGA SEA LEVEL PROGRAMME
 - 2.6 WOCE SEA LEVEL PROGRAMME
 - 2.7 IGOSS PILOT PROJECT ON ALTIMETRIC SEA SURFACE TOPOGRAPHY DATA
 - 2.8 STATUS OF GLOSS NETWORK AND DATA FLOW
3. REGIONAL AND GLOBAL COMPONENTS OF GLOSS
 - 3.1 IOCINCWIO - PROPOSED SEA LEVEL PROGRAMME (MOMBASA WORKSHOP)
 - 3.2 IOCARIBE SEA LEVEL PROGRAMME
 - 3.3 WESTPAC - WORKSHOP ON SEA LEVEL MONITORING IN THE WEST PACIFIC
 - 3.4 ASEAN SEA LEVEL PROGRAMME
 - 3.5 SOUTHERN OCEAN
4. GLOSS RELATIONSHIP WITH OTHER PROGRAMMES AND ACTIVITIES OF IOC AND OTHER ORGANIZATIONS
 - 4.1 GLOBAL OCEAN OBSERVING SYSTEM (GOOS) AND GLOBAL CLIMATE OBSERVING SYSTEM (GCOS)
 - 4.2 INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE (IPCC), INTERNATIONAL HYDROGRAPHIC ORGANIZATION (IHO), AND INTERNATIONAL GEOSPHERE-BIOSPHERE PROGRAMME (IGBP)
5. REVIEW OF THE OUTCOME OF THE GLOSS/IAPSO WORKSHOP ON TECHNIQUES AND ACCURACY OF SEA LEVEL MEASUREMENTS
6. GEODETIC CONTROL OF SEA LEVEL MEASUREMENTS
7. TEMA RELATED ACTIVITIES
 - 7.1 TRAINING ACTIVITIES
 - 7.2 PROVISION OF EQUIPMENT, SPARE PARTS, AND SOFTWARE
 - 7.3 MANUALS ON METHODOLOGY
8. GLOSS PRODUCTS
 - 8.1 GLOBAL AND REGIONAL SEA LEVEL ANALYSES
 - 8.2 GLOSS HANDBOOK
9. GLOSS DEVELOPMENT
 - 9.1 CHANGES IN THE GLOSS NETWORK
 - 9.2 PROGRESS WITH PRIORITY GLOSS STATIONS
 - 9.3 PLAN OF ACTIONS FOR 1993-1994
10. ADOPTION OF THE SUMMARY REPORT
11. DATE AND PLACE OF THE NEXT SESSION
12. CLOSURE

ANNEX II

LIST OF PARTICIPANTS

I. INVITED EXPERTS

Mr. P.C. CALDWELL
TOGA Sea-Level Centre
University of Hawaii at Manoa
1000 Pope Road
Honolulu, Hawaii 96822
USA

Tel: (808) 948 76 33
Tlx: 650-247-8678

Mrs. S. DOWELL
British Oceanographic Data Centre
Bidston Observatory
Birkenhead, Merseyside L43 7RA
UNITED KINGDOM

Tel: 51 653 86 33
Fax: 51 652 39 50
Tlm: BODC.UK

Dr. P.Y. DUPUY
Centre Hydrographie Section
Geodesie-Geophysique Epsom
B.P. 426

29275 Brest Cedex, FRANCE
Tel: 98 22 15 89
Fax: 98 22 12 08

Prof. G.W. LENNON
Director, National Tidal Facility
The Flinders University of
South Australia
GPO Box 2100
Adelaide

SOUTH AUSTRALIA 5001
Tel: (618) 201 75 32
Fax: (618) 201 75 23

Dr. C. LE PROVOST
Research Director
Institut de Mécanique de Grenoble
B.P. 53X
38402 St. Martin D'Hères Cedex
FRANCE

Tel: 76 82 50 65
Fax: 76 82 50 01
Tlm: C.LEPROVOST

Dr. G. MAUL
Vice-President IOCARIBE
NOAA/AOML
Physical Oceanography Division
4301 Rickenbacker Causeway
Miami, FL 33149-1097
USA

Tel: (305) 361 43 43
Fax: (305) 361 45 82
Tlx: 510-600-3049
Tlm: AOML.MIAMI

Dr. J. MERLE
Joint Planning Office
Global Climate Observing System
c/o World Meteorological Organization
Case Postale No. 2300
CH-1211 Geneva 2
SWITZERLAND

Tel: (41 22) 730 82 75
Fax: (41 22) 740 14 39

Dr. G. MITCHUM
Department of Oceanography
University of Hawaii at Manoa
1000 Pope Road
Honolulu, Hawaii 96822
USA

Tel: (1) 808 956 6161
Tlx: 650-247-8678
Tlm: G.MITCHUM

Dr. M. ODAMAKI
Assistant Professor of
Oceanography
Maritime Safety Academy
5-1 Wakaba-Cho, Kure-shi
Hiroshima-Ken
737 JAPAN

Tel: (823) 21 49 61
Fax: (823) 21 81 05

Dr. B. PARKER (Rapporteur)
National Ocean Service, NOAA
N/OES2, Room 110
6001 Executive Boulevard
Rockville, MD 20852
USA

Tel: 301 443 86 91
Fax: 301 443 19 20
Tlm: B.PARKER

Dr. D.T. PUGH (Chairman)
Natural Environment Research Council
Deacon Laboratory
Brook Road, Wormley, Godalming
Surrey GU8 5UB
UNITED KINGDOM

Tel: 428 68 41 41
Fax: 428 68 30 66
Tlm: D.PUGH

Dr. L. RICKARDS
British Oceanographic Data Centre
Bidston Observatory
Birkenhead, Merseyside L43 7RA
UNITED KINGDOM

Tel: 51 653 86 33
Fax: 51 652 39 50
Tlm: BODC.UK

Dr. S.R. SHETYE
National Institute of
Oceanography (NIO)
Dona Paula
Goa 403-004
INDIA

Tel: 6253-6256
Tlx: 194-216 NIO IN
194-316 MGG IN

Mr. B. SIMON
Ingénieur Sur Contrat
Section Géodésie-Géophysique
Centre "Hydrographie"
EPSHOM
B.P. 426
29275 BREST CEDEX
FRANCE

Tel: 98 22 15 89
Tlx: HYDRO 940568
Fax: 98 22 12 08

Mrs. E. SPENCER
Proudman Oceanographic
Laboratory
Bidston Observatory
Birkenhead
Merseyside L43 7RA
UNITED KINGDOM

Tel: 51 653 86 33
Fax: 51 653 62 69
Tlm: PSMSL.POL

Dr. J.M. VASSIE
Proudman Oceanographic Laboratory
Bidston Observatory
Birkenhead, Merseyside L43 7RA
UNITED KINGDOM

Tel: 51 653 86 33
Fax: 51 653 62 69
Tlm: POLD.BIDSTON

Dr. J.-M. VERSTRAETE
Laboratoire d'Océanographie
Physique
Muséum d'Histoire Naturelle
43 rue Cuvier
75231 Paris Cedex 05
FRANCE

Tel: (1) 47.07.85.44
Tlx: 270686 F LOPMNH

Dr. P. WOODWORTH
Director, Permanent Service for
Mean Sea Level (PSMSL)
Bidston Observatory
Birkenhead, Merseyside L43 7RA
UNITED KINGDOM

Tel: 51 653 86 33
Fax: 51 653 62 69
Tlm: PSMSL.POL

Prof. K. WYRTKI
Department of Oceanography
University of Hawaii at Manoa
1000 Pope Road
Honolulu, Hawaii 96822
USA

Tel: (1) 808 956 6161
Fax: (1) 808 956 7729
Tlx: 650-247-8678
Tlm: K.WYRTKI

II. REPRESENTATIVE OF ORGANIZATION

United Nations Environment Programme
(UNEP)

Dr. Makram GERGES
Deputy Director
Oceans & Coastal Areas Programme
Activity Centre (OCA/PAC)
U N E P
P.O. Box 30552
Nairobi
KENYA

Tel: (2542) 23 08 00
Fax: (2542) 23 01 27

World Meteorological Organization
(WMO)

Dr. Peter DEXTER
Chief Ocean Affairs Division
World Weather Watch Department
W M O
Case Postale No. 2300
CH-1211 Geneva 20
SWITZERLAND

Tel: (41 22) 730 81 11
Fax: (41 22) 734 09 54
Tlm: P.DEXTER

International Hydrographic Bureau
(IHB)

Mr. Adam J. KERR
Director
I H B
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
Tlx: 479164 MC INHORG

III. IOC SECRETARIAT

Dr. A. TOLKACHEV
Senior Assistant Secretary
Ocean Services Unit
Intergovernmental Oceanographic
Commission (IOC)
UNESCO
1 rue Miollis
75732 Paris Cedex 15
FRANCE

Tel: (1) 45 68 39 78
Fax: (1) 40 56 93 16
Tlm: IOC.SECRETARIAT

Ms. F.L. SCHILLER
Secretary for Ocean Services Unit
(Same address, tlm, fax as above)
Tel: (1) 45 68 39 77

ANNEX III

LIST OF DOCUMENTS¹

Document Code	Title
WORKING DOCUMENTS	
IOC/GE-GLOSS-III/1	Agenda
IOC/GE-GLOSS-III/1 Add.	Revised Timetable
IOC/GE-GLOSS-III/2	Not allocated
IOC/GE-GLOSS-III/3	Summary Report of the Session
IOC/GE-GLOSS-III/4	List of Documents
IOC/GE-GLOSS-III/5	List of Participants
IOC/GE-GLOSS-III/6	Progress Report on GLOSS Development
IOC/GE-GLOSS-III/7	Report on GLOSS Related Activities
7A	IGOSS Sea Level Pilot Project for the North and Atlantic Ocean (ISLPP-NTA)
7B	Summary on the Development of GLOSS in the IOCINCWIO Region
7C	PSMSL report
7D	IGOSS Sea Level Project in the Pacific (ISLP-Pac)
7E	The TOGA Sea Level Centre (TSLC)
7F	The WOCE Sea Level Centre (Hawaii)
7G	The Indo-Pacific Sea Level Network (IPSLN)
7H	WOCE Sea Level - BODC: Report of Activities up to October 1992
IOC/GE-GLOSS-III/8	GLOSS Development within the IOCARIBE Programme
IOC/GE-GLOSS-III/9	Activities concerned to GLOSS in Japan and WESTPAC
IOC/GE-GLOSS-III/10	Report on ASEAN-Australia Economic Co-operation Programme on Marine Sciences Regional Ocean Dynamics
IOC/GE-GLOSS-III/11	(Cancelled)
IOC/GE-GLOSS-III/12	Report on Global Ocean Observing System (GOOS)
IOC/GE-GLOSS-III/13	Report on Global Climate Observing System (GCOS)
IOC/GE-GLOSS-III/14	Draft Action Plan for Implementation IOC-UNEP-WMO Pilot Project on Sea-Level Changes and Associated Coastal Impacts in the Indian Ocean
IOC/GE-GLOSS-III/15	Summary Report of the Joint IAPSO-IOC Workshop on Sea Level Measurements and Quality Control
IOC/GE-GLOSS-III/16	GLOSS Handbook
-	Draft Manual on Sea Level Measurement and Interpretation Volume II

¹ This list is for reference only. No stocks of these documents are maintained, except for the Summary Report.

Document Code

Title

OTHER INFORMATION/REFERENCE DOCUMENTS

-	Report on the International Seminar and Follow-up Study on Mean Sea Level Monitoring in Asian and Oceanian Regions - February 1992 - Japan Hydrographic Association (Tokyo, 26-27 November 1991)
IOC Workshop Report No. 77	IOC-SAREC-KMFRI Regional Workshop on Causes and Consequences of Sea-Level Changes on the Western Indian Ocean Coasts and Islands (Mombasa, Kenya, 24-28 June 1991)
IOC/GE-GLOSS-II/3	IOC Group of Experts on the Global Sea-Level Observing System (GLOSS), Second Session (Miami, USA, 22-26 October 1990)
IOC/INF-879	Global Ocean Observing System (GOOS), Status Report on Existing Ocean Elements and Related Systems - December 1991
IOC Workshop Report No. 69 and Supplement	IOC-SCAR Workshop Sea-Level Measurements in Antarctica in Antarctica (Leningrad, USSR, 28-31 May 1990)
IOC/EC-XXV/8 Annex 1	Global Ocean Observing System - Draft Development Plan
-	GOOS Brochure
-	GCOS Brochure
IOC Technical Series No. 35	Global Sea-Level Observing System (GLOSS) Implementation Plan
IOC Manuals and Guides No. 14	Manual on Sea-Level Measurements and Interpretation (UNESCO 1985)
UNEP	The Status and Development of Climate Impact Studies supported by UNEP's Oceans and Coastal Areas Programme Activity Centre

ANNEX IV
STATUS OF SEA LEVEL DATA SUBMISSION TO PSMSL
(1992)

Table 1

Number of Stations in Each Category (All Stations)

Category	Bidston Jun 89	Miami Oct 90	Vienna Aug 91	Paris Oct 92
1	105	133	136	158
2	51	50	57	46
3	47	42	36	29
4	103	81	77	73
Total	306	306	306	306

Number of Stations in Each Category (Committed to GLOSS)

Category	Bidston Jun 89	Miami Oct 90	Vienna Aug 91	Paris Oct 92
1	98	122	118	135
2	45	40	47	38
3	28	25	21	15
4	44	28	29	27
Total	215	215	215	215

Table 2

Category 1: 'Operational' stations for which the latest data is 1988 or later;
 Category 2: 'Probably Operational' stations for which the latest data is within the period 1978-1987;
 Category 3: 'Historical' stations for which the latest data is earlier than 1978;
 Category 4: For which no PSMSL data exist.

	<u>Cat.1</u>	<u>Cat.2</u>	<u>Cat.3</u>	<u>Cat.4</u>
Angola	0 (0)	0 (0)	0 (0)	1 (0)
Argentina	4 (4)	1 (1)	0 (0)	2 (2)
Australia	4 (4)	13 (13)	2 (2)	3 (3)
Bahamas	0 (0)	0 (0)	0 (0)	2 (0)
Bangladesh	0 (0)	0 (0)	1 (0)	0 (0)
Belau	1 (1)	0 (0)	0 (0)	0 (0)
Brazil	1 (1)	2 (2)	2 (2)	5 (4)
Cameroon	0 (0)	0 (0)	0 (0)	1 (0)
Canada	0 (0)	6 (6)	1 (1)	1 (1)
Cape Verde	0 (0)	0 (0)	1 (1)	0 (0)
Chile	5 (5)	2 (2)	0 (0)	2 (2)
China, People's Rep.	4 (4)	1 (1)	0 (0)	0 (0)
Colombia	3 (3)	0 (0)	0 (0)	0 (0)
Congo	0 (0)	1 (0)	0 (0)	0 (0)
Cook Islands	2 (2)	0 (0)	0 (0)	0 (0)
Costa Rica	1 (0)	0 (0)	0 (0)	1 (0)
Cote D'Ivoire	0 (0)	0 (0)	1 (1)	0 (0)
Cuba	3 (3)	0 (0)	0 (0)	0 (0)
Denmark	2 (2)	0 (0)	0 (0)	2 (2)
Djibouti	0 (0)	0 (0)	1 (0)	0 (0)
Ecuador	1 (1)	1 (1)	0 (0)	0 (0)
Egypt	0 (0)	1 (0)	1 (0)	0 (0)
El Salvador	1 (0)	0 (0)	0 (0)	0 (0)
Fed. Micronesia	4 (4)	0 (0)	0 (0)	0 (0)
Fiji	1 (1)	0 (0)	0 (0)	0 (0)
France	4 (4)	2 (2)	0 (0)	6 (1)
French Guiana	0 (0)	0 (0)	0 (0)	1 (0)
French Polynesia	2 (2)	0 (0)	0 (0)	0 (0)
Germany	0 (0)	1 (1)	0 (0)	0 (0)
Ghana	0 (0)	1 (1)	0 (0)	0 (0)
Guinea	1 (0)	0 (0)	0 (0)	0 (0)
Haiti	0 (0)	0 (0)	1 (0)	0 (0)
Hong Kong	1 (1)	0 (0)	0 (0)	0 (0)
Iceland	1 (1)	0 (0)	0 (0)	0 (0)
India	4 (3)	1 (1)	2 (1)	1 (0)
Indonesia	4 (1)	0 (0)	3 (2)	2 (0)
Ireland	1 (1)	1 (0)	0 (0)	0 (0)

Jamaica	0 (0)	0 (0)	1 (1)	0 (0)
Japan	10 (9)	0 (0)	0 (0)	1 (1)
Kenya	0 (0)	1 (0)	0 (0)	0 (0)
Kiribati	4 (4)	0 (0)	0 (0)	0 (0)
Korea, Republic of	1 (0)	0 (0)	0 (0)	0 (0)
Madagascar	1 (0)	0 (0)	0 (0)	1 (0)
Malaysia	2 (2)	0 (0)	0 (0)	0 (0)
Maldives	1 (0)	0 (0)	0 (0)	1 (0)
Marshall Is.	1 (1)	1 (0)	0 (0)	0 (0)
Mauritania	0 (0)	0 (0)	0 (0)	1 (1)
Mauritius	2 (2)	0 (0)	0 (0)	1 (1)
Mexico	5 (5)	2 (2)	1 (1)	0 (0)
Morocco	0 (0)	0 (0)	0 (0)	1 (1)
Mozambique	0 (0)	0 (0)	1 (0)	1 (0)
Myanmar	0 (0)	0 (0)	2 (0)	0 (0)
Nauru	1 (1)	0 (0)	0 (0)	0 (0)
New Zealand	3 (3)	0 (0)	0 (0)	4 (0)
Nigeria	1 (1)	0 (0)	0 (0)	0 (0)
North Mariana Is.	1 (1)	0 (0)	0 (0)	0 (0)
Norway	3 (3)	1 (0)	0 (0)	3 (0)
Oman	1 (0)	0 (0)	0 (0)	1 (0)
Pakistan	0 (0)	1 (1)	0 (0)	1 (1)
Panama	1 (0)	0 (0)	0 (0)	1 (0)
Papua New Guinea	2 (1)	0 (0)	0 (0)	2 (0)
Peru	1 (1)	0 (0)	0 (0)	0 (0)
Philippines	4 (4)	0 (0)	0 (0)	0 (0)
Portugal	3 (3)	1 (1)	0 (0)	0 (0)
Puerto Rico/USA	1 (0)	0 (0)	0 (0)	0 (0)
Sao Tome/Principe	0 (0)	0 (0)	0 (0)	1 (0)
Senegal	0 (0)	0 (0)	1 (0)	0 (0)
Seychelles	1 (0)	0 (0)	1 (0)	0 (0)
Sierra Leone	0 (0)	0 (0)	0 (0)	1 (1)
Singapore	1 (0)	0 (0)	0 (0)	0 (0)
Solomon Is.	1 (1)	0 (0)	0 (0)	0 (0)
Somalia	0 (0)	0 (0)	0 (0)	2 (0)
South Africa	3 (0)	0 (0)	0 (0)	1 (0)
Spain	0 (0)	1 (1)	2 (2)	0 (0)
Sri Lanka	0 (0)	1 (0)	0 (0)	0 (0)
Sweden	1 (1)	0 (0)	0 (0)	0 (0)
Tanzania	1 (1)	0 (0)	1 (1)	0 (0)
Thailand	2 (2)	0 (0)	0 (0)	0 (0)
Tonga	0 (0)	0 (0)	0 (0)	1 (0)
Trinidad and Tobago	1 (1)	0 (0)	0 (0)	0 (0)
Tuvalu	1 (1)	0 (0)	0 (0)	0 (0)
U.K.	7 (4)	0 (0)	0 (0)	7 (3)
U.S.A.	26 (26)	2 (1)	2 (0)	3 (1)
U.S.S.R.	7 (7)	1 (1)	0 (0)	5 (0)
Uruguay	1 (1)	0 (0)	0 (0)	0 (0)

Venezuela	0 (0)	0 (0)	0 (0)	2 (2)
Viet Nam	1 (1)	0 (0)	0 (0)	0 (0)
Yemen, P.D.R.	0 (0)	0 (0)	1 (0)	1 (0)
Totals	158 (135)	46 (38)	29 (15)	73 (27)

Table 3

Column 1 = GLOSS Number
 Column 2 = GLOSS Site Name
 Column 3 = Responsible Country
 Column 4 = Committed to GLOSS flag
 Column 5/6 = PSMSL Country/Station code
 Column 7 = Year of latest PSMSL data

262 LOBITO	ANGOLA			
185 BAHIA ESPERANZA	ARGENTINA	C A	/001	1978
186 BAHIA SCOTIA	ARGENTINA	C		
184 JUBANY	ARGENTINA	C		
192 MAR DEL PLATA	ARGENTINA	C	860/101	1991
190 PUERTO DESEADO	ARGENTINA	C	860/011	1991
191 PUERTO MADRYN	ARGENTINA	C	860/031	1991
181 USHUAIA	ARGENTINA	C	860/002	1991
61 BOOBY IS.	AUSTRALIA	C	680/025	1980
58 BRISBANE	AUSTRALIA	C	680/078	1984
40 BROOME	AUSTRALIA	C	680/486	1983
59 BUNDABERG	AUSTRALIA	C	680/073	1985
52 CARNARVON	AUSTRALIA	C	680/476	1984
278 CASEY	AUSTRALIA	C		
47 CHRISTMAS IS.	AUSTRALIA	C	563/001	1990
46 COCOS IS. (KEELING)	AUSTRALIA	C	680/501	1990
62 DARWIN	AUSTRALIA	C	680/011	1984
277 DAVIS	AUSTRALIA	C		
54 ESPERANCE	AUSTRALIA	C	680/446	1985
53 FREMANTLE	AUSTRALIA	C	680/471	1985
56 HOBART	AUSTRALIA	C	680/201	1985
148 LORD HOWE IS.	AUSTRALIA	C	680/121	1970
130 MACQUARIE IS.	AUSTRALIA	C	680/208	1974
22 MAWSON	AUSTRALIA	C		
124 NORFOLK IS.	AUSTRALIA	C	680/091	1990
55 PORT ADELAIDE	AUSTRALIA	C	680/311	1985
51 PORT HEDLAND	AUSTRALIA	C	680/481	1985
57 SYDNEY, FORT DENISON	AUSTRALIA	C	680/141	1991
60 TOWNSVILLE	AUSTRALIA	C	680/051	1985
279 WILLIS IS.	AUSTRALIA	C	680/039	1981
211 BIMINI	BAHAMAS			
12 SAN SALVADOR	BAHAMAS			
36 CHITTAGONG	BANGLADESH		510/023	1968
120 MALAKAL	BELAU	C	710/021	1989
194 CANANEIA	BRAZIL	C	874/051	1986
198 FERNANDA DE NORONHA	BRAZIL	C	874/141	1972
196 ITAPARICA	BRAZIL	C		
200 PORTO DE ITAQUI	BRAZIL	C		
197 PORTO DE NATAL	BRAZIL	C		
193 PORTO DE RIO GRANDE	BRAZIL	C		
201 PORTO DE SANTANA	BRAZIL	C	874/171	1984
195 RIO DE JANEIRO	BRAZIL	C	874/092	1990
199 ST. PETER & ST. PAUL ROCKS	BRAZIL			
265 TRINIDADE IS.	BRAZIL	C	874/101	1975
280 DOUALA	CAMEROON			
226 ALERT	CANADA	C	970/162	1977
222 HALIFAX	CANADA	C	970/011	1984

153	LITTLE CORNWALLIS IS.	CANADA	C		
224	NAIN	CANADA	C	970/134	1983
155	PRINCE RUPERT	CANADA	C	822/001	1984
152	SACHS HARBOUR	CANADA	C	970/203	1982
223	ST. JOHNS, NEWFLND.	CANADA	C	970/121	1984
156	TOFINO	CANADA	C	822/116	1984
254	PORTO GRANDE (ST. VICENTE)	CAPE VERDE	C	380/001	1950
174	ANTOFAGASTA	CHILE	C	850/011	1990
189	BASE ANTARCTICA (CAPT. PRAT)	CHILE	C		
176	JUAN FERNANDEZ IS.	CHILE	C	850/037	1984
137	PASCUA IS.	CHILE	C	810/002	1984
178	PUERTO MONTT	CHILE	C	850/051	1991
180	PUERTO WILLIAMS	CHILE	C	850/081	1991
179	PUNTA ARENAS	CHILE	C	850/061	1991
177	SAN FELIX IS.	CHILE	C		
175	VALPARISO	CHILE	C	850/031	1990
79	DALIAN	CHINA, PEOPLE'S REP.	C	610/044	1979
94	KANMEN	CHINA, PEOPLE'S REP.	C	610/016	1991
283	LUSI	CHINA, PEOPLE'S REP.	C	610/032	1991
247	XIAMEN	CHINA, PEOPLE'S REP.	C	610/005	1991
78	ZHAPO	CHINA, PEOPLE'S REP.	C	610/002	1991
170	BUENAVENTURA	COLOMBIA	C	842/011	1990
207	CARTAGENA	COLOMBIA	C	902/021	1990
171	TUMACO	COLOMBIA	C	842/021	1989
261	POINTE NOIRE	CONGO		424/021	1987
143	PEHRHYN	COOK ISLANDS	C	775/001	1989
139	RAROTONGA	COOK ISLANDS	C	785/001	1989
166	I. DEL COCO	COSTA RICA			
167	QUEPOS	COSTA RICA		836/011	1989
257	ABIDJAN	COTE D'IVOIRE	C	405/001	1976
214	CABO SAN ANTONIO	CUBA	C	930/071	1989
276	GIBARA	CUBA	C	930/031	1990
215	SIBONEY	CUBA	C	930/016	1990
228	ANGMAGSSALIK, GREENLAND	DENMARK	C		
225	GODTHAB/NUUK, GREENLAND	DENMARK	C	980/031	1991
227	NORD, GREENLAND	DENMARK	C		
237	THORSHAVN, FAEROES	DENMARK	C	015/011	1991
2	DJIBOUTI	DJIBOUTI		475/001	1972
169	BALTRA, GALAPAGOS IS.	ECUADOR	C	845/034	1987
172	LA LIBERTAD	ECUADOR	C	845/012	1991
80	PORT SAID	EGYPT		330/001	1946
1	SUEZ	EGYPT		330/041	1986
182	ACAJUTLA	EL SALVADOR		833/011	1991
117	KAPINGAMARANGI, CAROLINE IS.	FED. MICRONESIA	C	710/026	1989
115	PONAPE, CAROLINE IS.	FED. MICRONESIA	C	710/031	1989
116	TRUK, CAROLINE IS.	FED. MICRONESIA	C	710/001	1988
119	YAP, CAROLINE IS.	FED. MICRONESIA	C	710/011	1989
122	SUVA	FIJI	C	742/012	1989
242	BREST	FRANCE	C	190/091	1991
165	CLIPPERTON IS.	FRANCE			
21	CROZET IS.	FRANCE			
131	DUMONT D'URVILLE	FRANCE			
96	DZAOUDZI (MAYOTTE)	FRANCE	C		
23	KERGUELEN IS.	FRANCE			
204	LE ROBERT, MARTINIQUE	FRANCE	C	912/001	1984
205	MARSEILLE	FRANCE	C	230/051	1991
123	NOUMEA, NEW CALEDONIA	FRANCE	C	740/011	1989
142	NUKU HIVA, MARQUESAS IS.	FRANCE	C	805/011	1989
17	PTE DES GALETS, REUNION IS.	FRANCE	C	451/001	1986
24	ST. PAUL IS.	FRANCE			
202	CAYENNE, FRENCH GUIANA	FRENCH GUIANA			
140	MATAVAI, TAHITI	FRENCH POLYNESIA	C	780/011	1989
138	RIKITEA, GAMBIER IS.	FRENCH POLYNESIA	C	808/001	1989
284	CUXHAVEN	GERMANY	C	140/011	1986
258	TEMA	GHANA	C	410/016	1982
255	CONAKRY	GUINEA		396/001	1992
209	PORT-AU-PRINCE/LES GAYES	HAITI		934/011	1961

77	QUARRY BAY	HONG KONG	C 611/010	1991
229	REYKJAVIK	ICELAND	C 010/001	1989
32	COCHIN	INDIA	C 500/081	1988
34	MADRAS	INDIA	C 500/091	1988
281	MARMAGAO	INDIA	500/065	1988
29	MINICOY, LACCADIVE IS.	INDIA	C 455/011	1977
41	NICOBAR	INDIA		
38	PORT BLAIR, ANDAMAN IS.	INDIA	540/001	1964
31	VERAVAL	INDIA	C 500/021	1983
35	VISHAKHAPATNAM	INDIA	C 500/101	1988
68	AMBON	INDONESIA	C 590/001	1931
49	BENOA	INDONESIA	560/135	1989
291	CILACAP	INDONESIA	C 560/121	1931
50	KUPANG, TIMOR	INDONESIA		
69	MANADO (BITUNG)	INDONESIA	580/012	1989
45	PADANG (TELU BAYUK)	INDONESIA	560/032	1989
48	PELABUHAN RATU	INDONESIA	560/111	1931
67	SORONG	INDONESIA		
292	SURABAYA	INDONESIA	C 560/162	1989
240	CASTLETOWNSEND	IRELAND	175/051	1978
239	MALIN HEAD	IRELAND	C 175/011	1991
210	PORT ROYAL, KINGSTON	JAMAICA	C 932/011	1969
82	ABURATSU	JAPAN	C 645/021	1990
103	CHICHIJIMA	JAPAN	C 648/001	1990
88	HAKODATE	JAPAN	C 641/031	1990
85	KUSHIMOTO	JAPAN	C 642/141	1990
89	KUSHIRO	JAPAN	C 641/022	1990
86	MERA	JAPAN	C 642/061	1990
104	MINAMI-TORI-SHIMA	JAPAN	C	
83	NAGASAKI	JAPAN	C 645/064	1990
81	NAHA	JAPAN	C 646/024	1990
87	OFUNATO	JAPAN	C 642/022	1990
95	SYOWA	JAPAN	A /041	1988
8	HOMBASA	KENYA	470/001	1987
145	CANTON IS. PHOENIX IS.	KIRIBATI	C 750/012	1989
146	CHRISTMAS IS. LINE IS.	KIRIBATI	C 770/022	1989
147	FANNING IS. LINE IS.	KIRIBATI	C 770/013	1989
113	TAKAWA, GILBERT IS.	KIRIBATI	C 730/008	1989
84	PUSAN	KOREA, REPUBLIC OF	620/046	1991
271	FORT DAUPHIN (TAOLANARO)	MADAGASCAR		
15	NOSY-BE	MADAGASCAR	440/002	1991
293	CENDERING/KUALA TERENGGANU	MALAYSIA	C 550/017	1990
43	PENKALAN/TLDM/LUMUT	MALAYSIA	C 550/005	1990
27	GAN	MALDIVES	454/002	1989
28	MALE	MALDIVES		
110	ENIWETOK	MARSHALL IS.	720/002	1979
112	MAJURO	MARSHALL IS.	C 720/016	1989
252	NOUADHIBOU (CAP BLANC)	MAURITANIA	C	
16	AGALEGA	MAURITIUS	C	
18	PORT LOUIS	MAURITIUS	C 450/011	1990
19	RODRIGUES, PORT MATHURIN	MAURITIUS	C 450/021	1989
267	ACAPULCO, GRO.	MEXICO	C 830/081	1990
161	CABO SAN LUCAS	MEXICO	C 830/020	1989
160	ISLA GUADALUPE	MEXICO	C 830/012	1985
163	MANZANILLO, COL.	MEXICO	C 830/071	1988
213	PROGRESO, YUC.	MEXICO	C 920/001	1990
164	PUERTO ANGEL	MEXICO	C 830/086	1986
162	SOCORRO IS.	MEXICO	C 830/061	1959
212	VERACRUZ, VER.	MEXICO	C 920/041	1990
282	TAN TAN	MOROCCO	C	
10	INHAMBANE	MOZAMBIQUE		
11	PEMBA	MOZAMBIQUE	432/031	1973
37	AKYAB	MYANMAR	530/001	1942
141	MOULMEIN	MYANMAR	530/021	1964
114	NAURU, GILBERT IS.	NAURU	C 715/001	1989
127	AUCKLAND-WAITEMATA HBR.	NEW ZEALAND	C 690/001	1991
132	BALLENY IS.	NEW ZEALAND		

129	BLUFF HBR.	NEW ZEALAND	C 690/041	1991
128	CHATHAM IS.	NEW ZEALAND		
126	KERMADEC IS. (RAOUL)	NEW ZEALAND		
133	SCOTT IS.	NEW ZEALAND		
101	WELLINGTON	NEW ZEALAND	C 690/011	1991
259	LAGOS	NIGERIA	C 420/004	1992
118	SAIPAN	NORTH MARIANA IS.	C 700/011	1989
232	BJORKNOYA (BEAR ISLAND)	NORWAY		
269	BOUVETEYA (BOUVET IS.)	NORWAY		
275	HONNINGSVAG	NORWAY	C 040/015	1990
230	JAN MAYEN IS.	NORWAY	012/001	-1983
235	MALOY	NORWAY	C 040/211	1990
136	PETER IS.	NORWAY		
234	RORVIK	NORWAY	C 040/136	1990
5	MUSCAT (QABOOS PORT)	OMAN	487/001	1989
4	SALALAH	OMAN		
295	GWADAR	PAKISTAN	C	
30	KARACHI, MANORO IS.	PAKISTAN	C 490/021	1985
168	BALBOA	PANAMA	840/011	1991
208	COCO SOLO	PANAMA		
63	ALOTAU	PAPUA NEW GUINEA	670/006	1990
272	DARU	PAPUA NEW GUINEA		
65	RABAU	PAPUA NEW GUINEA	C 670/021	1989
64	VANIMO	PAPUA NEW GUINEA		
173	CALLAO	PERU	C 848/032	1988
71	DAVAO	PHILIPPINES	C 660/121	1991
70	JOLO	PHILIPPINES	C 660/141	1991
72	LEGASPI	PHILIPPINES	C 660/021	1991
73	MANILA	PHILIPPINES	C 660/011	1991
246	CASCAIS	PORTUGAL	C 210/021	1987
244	FLORES, AZORES	PORTUGAL	C 360/041	1989
250	FUNCHAL, MADEIRA	PORTUGAL	C 365/001	1989
245	PONTA DELGADO, AZORES	PORTUGAL	C 360/001	1989
206	SAN JUAN	PUERTO RICO/USA	938/022	1988
260	SAO TOME	SAO TOME/PRINCIPES		
253	DAKAR	SENEGAL	390/001	1966
14	ALDABRA	SEYCHELLES	441/001	1977
273	PORT VICTORIA, HODOUL IS.	SEYCHELLES	442/002	1989
256	ABERDEEN POINT	SIERRA LEONE	C	
44	SINGAPORE	SINGAPORE	555/003	1989
66	HONIARA	SOLOMON IS.	C 734/002	1989
6	HAFUN (DANTE)	SOMALIA		
7	MOGADISHU	SOMALIA		
13	DURBAN	SOUTH AFRICA	430/091	1989
20	MARION IS.	SOUTH AFRICA		
76	PORT ELIZABETH	SOUTH AFRICA	430/088	1989
268	SIMONSTOWN	SOUTH AFRICA	430/061	1989
249	CEUTA (SPANISH N. AFRICA)	SPAIN	C 340/001	1964
243	LA CORUNA	SPAIN	C 200/030	1987
251	LAS PALMAS, CANARY IS.	SPAIN	C 370/041	1951
33	COLOMBO	SRI LANKA	520/001	1979
233	GOTEBORG	SWEDEN	C 050/032	1990
9	MTWARA	TANZANIA	C 460/001	1962
297	ZANZIBAR	TANZANIA	C 460/016	1991
39	KO LAK	THAILAND	C 600/021	1991
42	KO TAPHAO NOI	THAILAND	C 545/001	1991
125	TONGATAPU	TONGA		
203	PORT OF SPAIN	TRINIDAD AND TOBAGO	C 890/001	1990
121	FUNAFUTI, ELLICE IS.	TUVALU	C 732/011	1989
263	ASCENSION	U.K.	C	
221	BERMUDA, ST.GEORGES IS.	U.K.	C 950/011	1988
26	DIEGO-GARCIA IS.	U.K.	453/003	1989
266	EDINBURGH (TRISTAN DA CUNHA)	U.K.	C	
188	FARADAY (ANTARCTICA)	U.K.	A /003	1991
248	GIBRALTAR	U.K.	215/001	1989
236	LERWICK	U.K.	C 170/001	1991
241	NEWLYN	U.K.	C 170/161	1991

296	NORTH CAICOS	U.K.		
306	SIGNY, SOUTH ORKNEY ILS.	U.K.		
187	SOUTH GEORGIA (S.ATLANTIC)	U.K.		
264	ST. HELENA	U.K.	C	
305	STANLEY, FALKLAND IS.	U.K.		
238	STORNOWAY	U.K.	C 170/251	1991
302	ADAK, ALEUTIAN IS.	U.S.A.	C 820/011	1988
149	APRA HARBOUR, GUAM, MARIANAS	U.S.A.	C 700/001	1988
219	CAPE HATTERAS, N.C.	U.S.A.	C 960/063	1988
289	FORT PULASKI, GA.	U.S.A.	C 960/031	1988
107	FRENCH FRIGATE SHOALS, H.IS.	U.S.A.	C 760/016	1989
217	GALVESTON	U.S.A.	C 940/007	1988
287	HILO, HAWAII, HAW.IS.	U.S.A.	C 760/061	1988
108	HONOLULU, HAWAIIAN IS.	U.S.A.	C 760/031	1988
109	JOHNSTON IS. HAWAIIAN IS.	U.S.A.	C 760/011	1988
286	KAHULUI HARBOR, MAUI, HAW.IS.	U.S.A.	C 760/051	1988
216	KEY WEST	U.S.A.	C 940/071	1988
111	KWAJALEIN, MARSHALL IS.	U.S.A.	C 720/011	1988
303	MASSACRE BAY, ATTU IS., ALASKA	U.S.A.	820/001	1966
134	MCMURDO (ANTARCTICA)	U.S.A.	A /061	1985
218	MIAMI (HAUOVER PIER)	U.S.A.	C 960/002	1988
106	MIDWAY IS. HAWAIIAN IS.	U.S.A.	C 760/001	1988
285	NAWILIWILI, KAUAI, HAW.IS.	U.S.A.	C 760/021	1988
290	NEWPORT, RI.	U.S.A.	C 960/161	1988
74	NOME	U.S.A.		
144	PAGO PAGO, AMERICAN SAMOA	U.S.A.	C 745/001	1988
183	PALMER (ANTARCTICA)	U.S.A.		
301	PALMYRA IS., LINE IS.	U.S.A.	770/001	1957
288	PENSACOLA, FLORIDA	U.S.A.	C 940/041	1988
151	PRUDHOE BAY, ALASKA	U.S.A.	C	
159	SAN DIEGO	U.S.A.	C 823/071	1988
158	SAN FRANCISCO	U.S.A.	C 823/031	1988
100	SAND POINT, ALASKA	U.S.A.	C 821/006	1988
150	SEWARD, ALASKA	U.S.A.	C 821/017	1988
154	SITKA, ALASKA	U.S.A.	C 821/031	1988
157	SOUTH BEACH, OREGON	U.S.A.	C 823/016	1984
102	UNALASKA, ALEUTIAN IS.	U.S.A.	C 820/021	1988
220	VENTNOR (ATLANTIC CITY), N.J.	U.S.A.	C 960/092	1988
105	WAKE IS. MARSHALL IS.	U.S.A.	C 720/021	1988
231	BARENTSBURG (SPITSBERGEN)	U.S.S.R.	C 025/001	1991
97	KALININGRAD	U.S.S.R.	C 080/181	1986
91	LENINGRADSKAY (ANTARCTICA)	U.S.S.R.		
25	MIRNY (ANTARCTICA)	U.S.S.R.		
294	MOLODEZHNYAYA (ANTARCTICA)	U.S.S.R.		
274	MURMANSK	U.S.S.R.	C 030/018	1991
92	NAGAEVO BAY	U.S.S.R.	C 630/011	1991
270	NOVOLAZAREVSKAYA (ANTARCTIC)	U.S.S.R.		
93	PETROPAVLOVSK-KAMCHATSKY	U.S.S.R.	C 630/021	1991
98	PORT TUAPSE, BLACK SEA	U.S.S.R.	C 300/001	1991
135	RUSSKAYA	U.S.S.R.		
99	RUSSKAYA GAVAN	U.S.S.R.	C 030/001	1990
90	YUZHNO KURILSK	U.S.S.R.	C 630/001	1991
300	MONTEVIDEO	URUGUAY	C 870/011	1990
298	AVES IS.	VENEZUELA	C	
299	LA ORCHILA	VENEZUELA	C	
75	QUI NHON	VIET NAM	C 605/041	1990
3	ADEN	YEMEN, P.D.R.	485/001	1969
304	SOCOTRA IS.	YEMEN, P.D.R.		

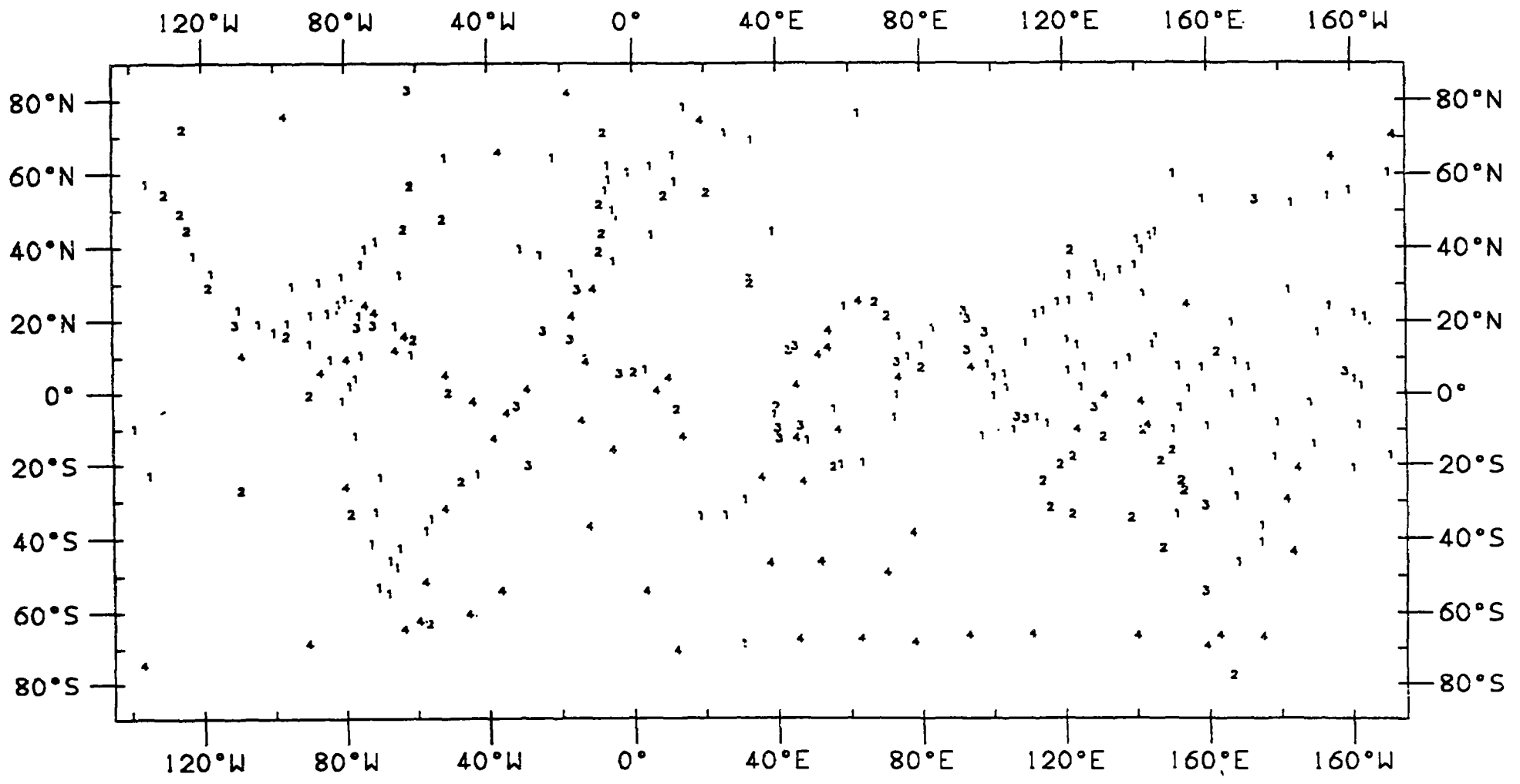


Figure 1 - ALL GLOSS STATIONS

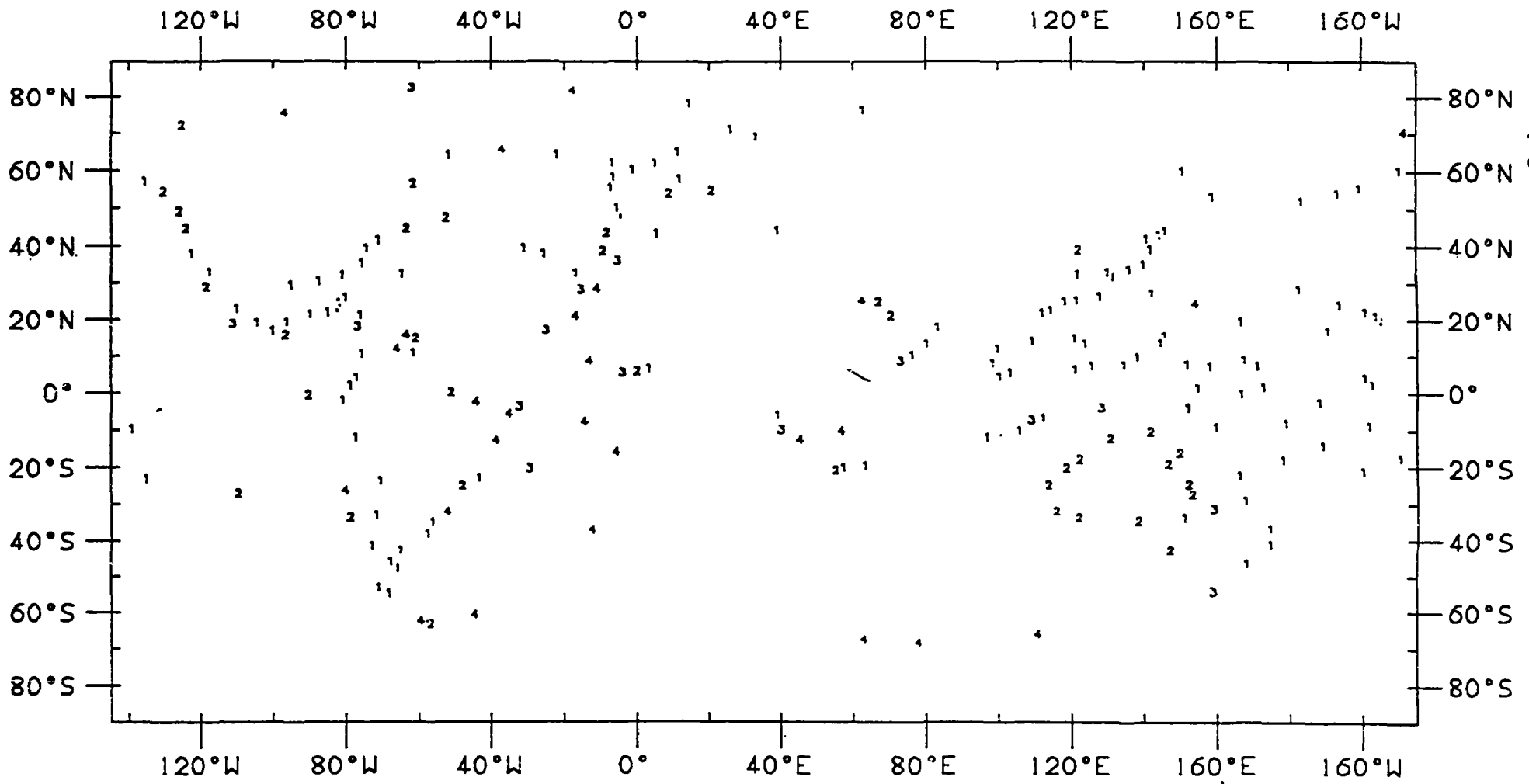


Figure 2 - COMMITTED TC GLOSS

ANNEX V
GLOSS Station Index (1992)

No.	Station Name	Country	Latitude	Longitude	Ocean/Sea	R	Op.	Gauge	A/D	Interv.	Exch.	Lev.	Year	Sat.	Inst.	Gauge	No.	Comments
262	Lobito	Angola	12°20'S	013°34'E	Atlantic	N	??										262	????
186	Bahiz Scotia	Argentina	60°44'S	044°39'W	Southern	Y	N								None		186	
185	Esperanza	Argentina	63°18'S	056°55'W	Southern	Y	N										185	NOAA will install Jan 1993
184	Jubany	Argentina	62°14'S	058°40'W	Southern	Y	N								None		184	
192	Mar del Plata	Argentina	38°03'S	057°33'W	Atlantic	Y	Y	A	D	6	D	A	1992	Y			192	NOAA installed Feb 1992
190	Puerto Deseado	Argentina	47°45'S	065°55'W	Atlantic	Y	Y	F	A			L	1987	N			190	
191	Puerto Madryn	Argentina	42°46'S	065°02'W	Atlantic	Y	Y	F	A			L	1980	N			191	
181	Ushuaia	Argentina	54°49'S	068°13'W	Atlantic	Y	Y	A	D	6	D	A	1992	Y			181	NOAA installed May 1991
61	Booby Is.	Australia	10°36'S	141°55'E	Indian	Y	Y	FP	D	10				Y			61	Not a good gauge
58	Brisbane (West Inner Bar)	Australia	27°22'S	153°10'E	Pacific	Y	Y	P						N			58	New gauge installed
40	Broome	Australia	18°00'S	122°13'E	Indian	Y	Y	AF						Y			40	New gauge installed
59	Bundaberg	Australia	24°46'S	152°23'E	Pacific	Y	Y	F						N			59	Poor gauge
52	Camarvon	Australia	21°54'S	113°39'E	Indian	Y	Y	F						N			52	Better gauge at Hillarys
278	Casey	Australia	66°17'S	110°32'E	Southern	Y	N									P	278	Test pressure gauge installed
47	Christmas Is.	Australia	10°25'S	105°40'E	Indian	Y	Y	F		15				N			47	
46	Cocos Is. (Keeling)	Australia	12°07'S	096°53'E	Indian	Y	Y	AF		15				N			46	NOAA installed Aug 1992
62	Darwin	Australia	12°28'S	130°51'E	Indian	Y	Y	AF						Y			62	NOAA installed May 1990
277	Davis	Australia	68°35'S	077°58'E	Southern	Y	N								93/4	P	277	Proposal exists to install
54	Esperance	Australia	33°52'S	121°54'E	Southern	Y	Y	AF						N			54	New gauge good
57	Fort Denison, Sydney	Australia	33°51'S	151°14'E	Pacific	Y	Y	F						N			57	
53	Fremantle	Australia	32°03'S	115°43'E	Indian	Y	Y	F						N			53	
56	Hobart	Australia	42°53'S	147°20'E	Southern	Y	Y	F		5				N			56	NOAA installed May 1991
148	Lord Howe Is.	Australia	31°31'S	159°04'E	Pacific	Y	Y	F		15				N			148	
130	Macquarie Is.	Australia	54°30'S	158°56'E	Southern	Y	N	P?	D	10				93/4	P/A		130	Plans to install in 1993/4
22	Mawson	Australia	67°36'S	062°52'E	Southern	Y	N								92/3	P	22	Proposal to install 1992/3
124	Norfolk Is.	Australia	29°04'S	167°57'E	Pacific	Y	Y	F		15				N			124	
55	Port Adelaide (Outer HB)	Australia	34°47'S	138°28'E	Southern	Y	Y	F	A					N			55	
51	Port Hedland	Australia	20°19'S	118°34'E	Indian	Y	Y	F	AD					N			51	Gauge not very good
60	Townsville	Australia	19°16'S	146°50'E	Pacific	Y	Y	F						N			60	
279	Willis Is.	Australia	16°19'S	149°59'E	Pacific	Y	N	P?									279	Difficult site

No.	Station Name	Country	Latitude	Longitude	Ocean/Sea	R	Op.	Gauge	A/D	Interv.	Exch.	Lev.	Year	Sat.	Inst.	Gauge	No.	Comments
12	Exuma	Bahamas	23°46'N	076°06'W	Atlantic	Y	Y*	F	AD	60	LD	M	1992	N			12	Started 25 March 1992
211	Settlement Point	Bahamas	26°41'N	079°00'W	Atlantic	Y	Y	FPA	AD	6	LMD	A	1992	Y			211	NOAA installed Jan 1992
36	Chittagong	Bangladesh	22°15'N	091°50'E	Indian	N	??										36	????
120	Malakal	Belau	07°20'N	134°28'E	Pacific	Y	Y	F	D	15	MD	L	1990	Y			120	
194	Cananea	Brazil	25°01'S	047°55'W	Atlantic	Y	Y	F	A	60	LMD	A		N			194	
198	Fernando de Noronha	Brazil	03°52'S	032°25'W	Atlantic	Y	Y	P	D	60				Y*			198	*from end 1992
265	Ilha da Trindade	Brazil	20°30'S	029°18'W	Atlantic	Y	Y	P	D	20	LMD	A	1991	N			265	
196	Itaparica	Brazil	12°52'S	038°41'W	Atlantic	Y	Y	FP	D	60	LMD	A	1991	N			196	
199	Penedo Sao Pedro e Paulo	Brazil	01°00'N	029°23'W	Atlantic	Y	Y	P	D	60				Y*			199	*starting 1992
200	Porto de Itaqui	Brazil	02°34'S	044°22'W	Atlantic	Y	N										200	replace by Ponta de Madeira
197	Porto de Natal	Brazil	05°46'S	035°12'W	Atlantic	N											197	
193	Porto de Rio Grande	Brazil	32°06'S	052°11'W	Atlantic	Y	Y	F	A	60	LMD	A	1991	N			193	
201	Porto de Santana	Brazil	00°03'S	051°10'W	Atlantic	N											201	
195	Rio de Janeiro	Brazil	22°52'S	043°08'W	Atlantic	Y	Y	F	A	60	LMD	M	1992	N			195	
280	Douala	Cameroon	04°03'N	009°41'E	Atlantic	N	??										280	????
226	Alert	Canada	82°30'N	062°20'W	Arctic	N	N										226	
222	Halifax	Canada	44°40'N	063°35'W	Atlantic	N	Y	F	AD	15				Y			222	
153	Little Cornwallis Island	Canada	75°23'N	096°57'W	Arctic	N	N										153	????
224	Nain	Canada	56°32'N	061°41'W	Atlantic	N	Y	P		60				N			224	
155	Prince Rupert	Canada	54°19'N	130°19'W	Pacific	N	Y	F						N			155	????
152	Sachs Harbour	Canada	71°58'N	125°15'W	Arctic	N	N										152	????
223	St John's, Newfoundland	Canada	47°34'N	052°42'W	Atlantic	N	Y	P	AD	15,60				Y			223	
156	Tofino	Canada	49°09'N	125°55'W	Pacific	N	Y	F						N			156	????
254	Porto Grande	Cape Verde	16°52'N	024°59'W	Atlantic	N	??										254	NOAA installed Sep 1991
174	Antofagasta	Chile	23°39'S	070°24'W	Pacific	N	Y	P	A					N			174	
189	Capitan Prat (Antarctica)	Chile	62°29'S	059°38'W	Southern	N	Y	P	A					N			189	
137	Isla da Pascua	Chile	27°09'S	109°27'W	Pacific	N	Y	AP	AD					Y			137	NOAA installed Feb 1992
176	Juan Fernandez	Chile	33°37'S	078°50'W	Pacific	N	Y	P	A					N			176	
178	Puerto Montt	Chile	41°29'S	072°58'W	Pacific	N	Y	P	A					N			178	
180	Puerto Williams	Chile	54°56'S	067°37'W	Pacific	N	Y	P	A					N			180	
179	Punta Arenas	Chile	53°10'S	070°54'W	Pacific	N	Y	P	A					N			179	

No.	Station Name	Country	Latitude	Longitude	Ocean/Sea	R	Op.	Gauge	A/D	Interv.	Exch.	Lev.	Year	Sat.	Inst.	Gauge	No.	Comments
177	San Felix	Chile	26°17'S	080°07'W	Pacific	N	Y	P	A					Y			177	
175	Valparaiso	Chile	33°02'S	071°38'W	Pacific	N	Y	FP	AD					Y			175	NOAA installed Jul 1991
94	Kanmen	China, People's Rep.	28°05'N	121°17'E	Pacific	Y	Y	F	A		L	A	1991	N			94	
79	Laohutan (Dalian)	China, People's Rep.	38°52'N	121°41'E	Pacific	Y	Y	F	A		L	A	1991	N			79	
283	Lusi	China, People's Rep.	32°08'N	121°37'E	Pacific	Y	Y	F	A		L	A	1991	N			283	
247	Xiamen	China, People's Rep.	24°27'N	118°04'E	Pacific	Y	Y	F	A		L	A	1991	N			247	
78	Zhapo	China, People's Rep.	21°35'N	111°50'E	Pacific	Y	Y	F	A		L	A	1991	N			78	
170	Buenaventura	Colombia	03°54'N	077°05'W	Pacific	Y	Y	F	D	6	L	L	1992	N			170	
207	Cartagena	Colombia	10°24'N	075°33'W	Atlantic	Y	Y	F	D	6	L	L	1992	N			207	
171	Tumaco	Colombia	01°50'N	078°44'W	Pacific	Y	Y	F	D	6	L	L	1992	N			171	
261	Pointe-Noire	Congo	04°47'S	011°50'E	Atlantic	N	??										261	????
143	Penrhyn	Cook Islands	09°01'S	158°04'W	Pacific	Y	Y	F	D	15,4	MD	L	1992	Y			143	
139	Rarotonga	Cook Islands	21°12'S	159°46'W	Pacific	Y	Y	F	D	15,4	MD	A	1992	Y			139	
166	Isla del Coco	Costa Rica	05°33'N	087°04'W	Pacific	N	Y?	P									166	Operational from Oct 1990?
167	Quepos	Costa Rica	09°24'N	084°10'W	Pacific	N	Y	F						N			167	
257	Abidjan	Cote d'Ivoire	05°15'N	004°00'W	Atlantic	N	??										257	????
214	Cabo San Antonio	Cuba	21°54'N	084°54'W	Atlantic	N	Y	F	A				1991				214	
276	Gibara	Cuba	21°07'N	076°07'W	Atlantic	N	Y	F	A				1991				276	
215	Siboney	Cuba	23°05'N	082°28'W	Atlantic	N	Y	F	A				1991				215	
228	Angmagssalik, Greenland	Denmark	65°30'N	037°00'W	Atlantic	Y	Y	P	D		D	L	1991	N			228	
225	Godthaab/Nuuk, Greenland	Denmark	64°10'N	051°44'W	Atlantic	Y	Y	F	P	15	D	L	1973	N			225	
227	Nord, Greenland	Denmark	81°40'N	018°00'W	Atlantic	Y	N								??	P	227	
237	Torshavn, Faroe Islands	Denmark	62°00'N	006°46'W	Atlantic	Y	Y	F	D	15	P	L					237	New gauge due 1993
2	Djibouti	Djibouti	11°36'N	043°09'E	Indian	N	??										2	????
169	Balra, Galapagos	Ecuador	00°26'S	090°17'W	Pacific	N	Y	FP	D					Y			169	
172	La Libertad	Ecuador	02°12'S	080°54'W	Pacific	N	Y	F	AD	15				Y			172	
80	Port Said	Egypt	31°15'N	032°18'E	Med. Sea	N	??										80	????
1	Port Taufiq (Suez)	Egypt	29°55'N	032°33'E	Red Sea	N	??										1	????
182	Acajutla	El Salvador	13°35'N	089°50'W	Pacific	N	??										182	????
117	Kapingamarangi, Carolines	Fed. Micronesia	01°06'N	154°47'E	Pacific	Y	Y	F	D	15,4	MD	L	1990	Y			117	
115	Ponape, Carolines	Fed. Micronesia	06°59'N	158°14'E	Pacific	Y	Y	F	D	15,4	MD	A	1991	Y			115	

No.	Station Name	Country	Latitude	Longitude	Ocean/Sea	R	Op.	Gauge	A/D	Interv.	Exch.	Lev.	Year	Sat.	Inst.	Gauge	No.	Comments
116	Truk Atoll, Carolines	Fed. Micronesia	07°27'N	151°51'E	Pacific	Y	Y	AP	D	6	LMD	A	1992	Y			116	
119	Yap, Carolines	Fed. Micronesia	09°31'N	138°08'E	Pacific	Y	Y	F	D	15,4	MD	L	1990	Y			119	
122	Seva	Fiji	18°08'S	178°26'E	Pacific	Y	Y	AF	D	6	LMD	A	1991	Y			122	NOAA installed Feb 1989
242	Brest	France	48°23'N	004°30'W	Atlantic	N	Y										242	Acoustic gauge in future
165	Clipperton	France	10°17'N	109°13'W	Pacific	N	N										165	No gauge exists
21	Crozet Island	France	46°25'S	051°52'E	Indian	N	N								1993	P	21	
131	Dumont d'Urville	France	66°40'S	140°01'E	Southern	N	N								1993	P	131	
96	Dzaoudzi (Mayotte)	France	12°47'S	045°15'E	Indian	N	Y	F									96	
23	Kerguelen Island	France	49°21'S	070°12'E	Indian	N	Y	P									23	2 months data (Oct 92)
204	Le Robert (Martinique)	France	14°41'N	060°56'W	Atlantic	N	N	F									204	not working
205	Marseille	France	43°18'N	005°21'E	Med. Sea	N	Y	F									205	
123	Noumea, Nouvelle Calédonie	France	22°18'S	166°26'E	Pacific	Y	Y	F	D	15,4	MD	L	1990	Y			123	
142	Nuku Hiva, Marquesas Is.	France	08°56'S	140°05'W	Pacific	Y	Y	F	D	15,4	MD	L	1992	Y			142	
17	Pointe des Galets, Reunion	France	20°55'S	055°18'E	Indian	N	??	F									17	New gauge installed
24	Saint Paul Island	France	38°43'S	077°35'E	Indian	N	N								1993	P	24	Amsterdam Is. instead
202	Cayenne	French Guiana	05°00'N	052°00'W	Atlantic	N	Y	F	A				1980				202	
140	Papeete (Thaiti)	French Polynesia	17°32'S	149°34'W	Pacific	Y	Y	AF	D	15,6	MD	L	1989	N			140	NOAA installed Aug 1990
138	Rikitea, Gambier	French Polynesia	23°08'S	134°57'W	Pacific	Y	Y	F	D	15	MD	L	??*	N			138	*Levelled by French
284	Cuxhaven, Steubenhof	Germany	53°52'N	008°43'E	Atlantic	N	Y	F	A	30				N			284	
258	Tema	Ghana	05°37'N	000°00'E	Atlantic	N	Y	F	D	15				N			258	
255	Conakry	Guinea	09°30'N	013°15'W	Atlantic	N	Y	F									255	
209	Port-au-Prince/Les Cayes	Haiti	18°34'N	072°21'W	Atlantic	N	N										209	destroyed
77	Quarry Bay	Hong Kong	22°18'N	114°13'E	Pacific	Y	Y	F	D	1	LM	A	1991	N			77	
229	Reykjavik	Iceland	64°09'N	021°56'W	Atlantic	N	Y	F	A					N			229	
32	Cochin	India	09°58'N	076°16'E	Indian	N	Y	F	A	60				N			32	
34	Madras	India	13°06'N	080°18'E	Indian	N	Y	F	A	60				N			34	
281	Marmagao	India	15°25'N	073°48'E	Indian	N	Y	F	A	60				N			281	Regularly maintained
29	Minicoy	India	08°17'N	073°03'E	Indian	N	N	F									29	
41	Nicobar	India	07°00'N	093°50'E	Indian	N	N										41	
38	Port Blair	India	11°41'N	092°46'E	Indian	N	N	F									38	
31	Veraval	India	20°54'N	070°22'E	Indian	N	Y	F	A	60				N			31	

No.	Station Name	Country	Latitude	Longitude	Ocean/Sea	R	Op.	Gauge	A/D	Interv.	Exch.	Lev.	Year	Sat.	Inst.	Gauge	No.	Comments
35	Vishakhapatnam	India	17°41'N	083°17'E	Indian	N	Y	F	A	60				N			35	
68	Ambon	Indonesia	03°42'S	128°12'E	Pacific	N	N										68	????
49	Benoa	Indonesia	08°46'S	115°13'E	Indian	N	Y	F						N			49	Info. from Univ. Hawaii
69	Bitung	Indonesia	01°26'N	125°12'E	Indian	N	Y	F						N			69	Info. from Univ. Hawaii
291	Cilacap	Indonesia	07°34'S	108°59'E	Indian	N	Y	F						N			291	Info. from Univ. Hawaii
50	Kupang	Indonesia	10°10'S	123°35'E	Indian	N	N										50	????
45	Padang (Telu Bayuk)	Indonesia	01°00'S	100°22'E	Indian	N	Y							N			45	Info. from Univ. Hawaii
48	Pelabuhan Ratu	Indonesia	07°00'S	106°30'E	Indian	N	N										48	????
67	Sorong	Indonesia	00°53'S	131°15'E	Indian	N	N										67	????
292	Surabaya	Indonesia	07°13'S	112°44'E	Pacific	N	Y	F						N			292	Info. from Univ. Hawaii
240	Castletownsend	Ireland	51°32'N	009°11'W	Atlantic	Y	N										240	NOAA may consider
239	Malin Head	Ireland	55°22'N	007°20'W	Atlantic	Y	Y	P	A		L	A		N			239	
210	Port Royal, Kingston	Jamaica	17°56'N	076°51'W	Atlantic	N	Y	A									210	
82	Aburatsu	Japan	31°34'N	131°25'E	Pacific	Y	Y	F	AD	0.5	LM	L	1989	N			82	
103	Chichijima	Japan	27°05'N	142°11'E	Pacific	Y	Y	F	AD	0.5	LM	L		N			103	
88	Hakodate	Japan	41°47'N	140°44'E	Pacific	Y	Y	F	AD	0.5	LM	L	1984	N			88	
85	Kushimoto	Japan	33°28'N	135°47'E	Pacific	Y	Y	F	AD	0.5	LM	L	1988	N			85	
89	Kushiro	Japan	42°58'N	144°23'E	Pacific	Y	Y	F	AD	0.5	LM	L	1982	N			89	
86	Mera	Japan	34°55'N	139°50'E	Pacific	Y	Y	F	AD	0.5	LM	L	1991	N			86	
104	Minamitorishima	Japan	24°18'N	153°58'E	Pacific	Y	N										104	
83	Nagasaki	Japan	32°44'N	129°52'E	Pacific	Y	Y	F	AD	0.5	LM	L	1991	N			83	
81	Naha	Japan	26°13'N	127°40'E	Pacific	Y	Y	F	AD	0.5	LM	L	1989	N			81	
87	Ofunato	Japan	39°01'N	141°45'E	Pacific	Y	Y	F	AD	0.5	LM	L	1991	N			87	
95	Syowa	Japan	69°00'S	039°35'E	Southern	N	Y	P									95	????
8	Mombasa	Kenya	04°03'S	039°40'E	Indian	Y	Y	F	A	60	MD	L	1989	N			8	
146	Christmas, Line Is.	Kiribati	01°59'N	157°29'W	Pacific	Y	Y	F	D	15.4	MD	L	1990	Y			146	
147	Fanning, Line Is.	Kiribati	03°51'N	159°22'W	Pacific	Y	N	F	D	15	MD	L	1987	N			147	Not operating at present
145	Kanton, Phoenix Is.	Kiribati	02°49'S	171°43'W	Pacific	Y	Y	F	D	15	MD	L	1990	Y			145	
113	Tarawa, Gilbert Is.	Kiribati	01°22'N	172°56'E	Pacific	Y	Y	F	D	15.4	MD	L	1991	Y			113	
84	Pusan	Korea, Republic of	35°06'N	129°02'E	Pacific	N	Y	F	A					N			84	
271	Fort Dauphin	Madagascar	25°01'S	047°00'E	Indian	N	N										271	Installed not operating

No.	Station Name	Country	Latitude	Longitude	Ocean/Sea	R	Op.	Gauge	A/D	Interv.	Exch.	Lev.	Year	Sat.	Inst.	Gauge	No.	Comments
15	Nosy-Be	Madagascar	13°24'S	048°17'E	Indian	N	Y	F									15	???
293	Chendering	Malaysia	05°16'N	103°11'E	Pacific	N	Y	F	D	5				N			293	
43	Lumut	Malaysia	04°14'N	100°11'E	Indian	N	Y	F	D	5				N			43	
27	Gan	Maldives	00°42'S	073°10'E	Indian	Y	Y	F	D	15,4	MD	L	1991	Y			27	
28	Male	Maldives	04°10'N	073°30'E	Indian	Y	Y	P	A	60	MD	L	1991	N			28	
110	Eniwetok	Marshall Is.	11°22'N	162°21'E	Pacific	Y	N								None		110	
111	Kwajalein	Marshall Is.	08°44'N	167°44'E	Pacific	Y	Y	AF	D	6	LMD	A	1992	Y			111	
112	Majuro	Marshall Is.	07°06'N	171°22'E	Pacific	Y	Y	F	D	15,4	MD	L	1990	Y			112	
252	Nouakchott	Mauritania	18°06'N	016°02'W	Atlantic	N	N										252	
16	Agalega Is.	Mauritius	10°23'S	056°36'E	Indian	Y	N								??*		16	*unknown
18	Port Louis Harbour	Mauritius	20°09'S	057°30'E	Indian	Y	Y	F	AD	60,4	MD	L	1992	Y			18	
19	Rodriguez, Port Mathurin	Mauritius	19°41'S	063°25'E	Indian	Y	Y	F	A	60	MD	L	??*	N			19	*unknown
267	Acapulco, Gro.	Mexico	16°50'N	099°55'W	Pacific	Y	Y	F	A		L	L	1990	N			267	
161	Cabo San Lucas	Mexico	22°53'N	109°54'W	Pacific	Y	Y	P	A		L		1990	Y			161	
160	Isla Guadalupe	Mexico	28°53'N	118°18'W	Pacific	Y	Y	P	A		L	A	1991	Y			160	Temporarily out
163	Manzanillo, Col.	Mexico	19°03'N	104°20'W	Pacific	Y	N								1992	P	163	NOAA installed May 1992
213	Progreso, Yuc.	Mexico	21°18'N	089°39'W	Atlantic	Y	Y	F	A		L	A	1987	N			213	
164	Puerto Angel	Mexico	15°39'N	096°30'W	Pacific	Y	N	F	A		L	M		N	??	??	164	
162	Socorro Is.	Mexico	18°44'N	111°01'W	Pacific	Y	N								1992	P	162	NOAA installed May 1992
212	Veracruz, Ver.	Mexico	19°12'N	096°08'W	Atlantic	Y	Y	F	A		L	A	1990	N			212	
282	Tan Tan	Morocco	28°30'N	011°03'W	Atlantic	N	??										282	???
10	Inhambane	Mozambique	23°55'S	035°30'E	Indian	Y	NT								1992	F	10	to be installed soon
11	Pemba	Mozambique	12°58'S	040°29'E	Indian	Y	NT								1992	F	11	to be installed soon
37	Akyab (Sitwe)	Myanmar	20°09'N	092°54'E	Indian	N	N										37	
141	Moulmein (Mawlamyine)	Myanmar	16°29'N	097°37'E	Indian	N	N										141	
114	Nauru	Nauru	00°32'S	166°54'E	Pacific	Y	Y	F	D	15,4	MD	L	1991	Y			114	
127	Auckland-Waitemata Harbour	New Zealand	36°51'S	174°46'E	Pacific	Y	Y	FP	AD	10	LD	A	1991	N			127	
132	Balleny Is.	New Zealand	66°35'S	162°50'E	Southern	Y	N								??*		132	*unknown
129	Bluff Harbour	New Zealand	46°36'S	168°21'E	Pacific	Y	Y	A	A		L	L	1990	N			129	
128	Chatham Is.	New Zealand	43°50'S	176°30'W	Pacific	Y	Y	P	AD	?	M	L	1991	Y			128	
126	Kermadec Is.	New Zealand	29°50'S	178°15'W	Pacific	Y	N								??*	??*	126	*unknown

No.	Station Name	Country	Latitude	Longitude	Ocean/Sea	R	Op.	Gauge	A/D	Interv.	Exch.	Lev.	Year	Sat.	Inst.	Gauge	No.	Comments
133	Scott Is.	New Zealand	67°00'S	175°00'E	Southern	Y	N								??*		133	*unknown
101	Wellington Harbour	New Zealand	41°17'S	174°47'E	Pacific	Y	Y	F	D	10	LD	A	1991	N			101	
259	Lagos	Nigeria	06°25'N	003°27'E	Atlantic	Y	Y	AF	AD	60	L	L	1992	N			259	NOAA installed May 1992
118	Saipan	North Mariana Is.	15°14'N	145°44'E	Pacific	Y	Y	F	D	15	MD	L	1990	N			118	
232	Bjornoya (Bear Island)	Norway	74°30'N	019°00'E	Atlantic	N	N										232	????
269	Bouvetoya (Bouvet Island)	Norway	54°22'S	003°22'E	Atlantic	N	N										269	????
275	Honningsvaag	Norway	70°59'N	025°59'E	Atlantic	N	Y	F	D	10				Y			275	
230	Jan Mayen Island	Norway	70°55'N	008°43'W	Atlantic	N	N										230	????
235	Maloy	Norway	61°56'N	005°07'E	Atlantic	N	Y	F	D	10				Y			235	
136	Peter Is.	Norway	68°47'S	090°35'W	Southern	N	N										136	????
234	Rorvik	Norway	64°52'N	011°15'E	Atlantic	N	Y	F	D	10				Y			234	
5	Muscat (Qaboos Port)	Oman	23°37'N	058°35'E	Indian	Y	Y	F	A	15,60	LMD	L	1989	N			5	upgrade to satellite
4	Salalah	Oman	17°00'N	054°00'E	Indian	Y	Y	F	D	15,4	LMD	L	1991	Y			4	
295	Gwadar	Pakistan	25°07'N	062°20'E	Indian	N	??										295	????
30	Karachi, Manoro Island	Pakistan	24°48'N	066°58'E	Indian	N	??										30	????
168	Balboa	Panama	08°58'N	079°36'W	Pacific	N	??										168	????
208	Coco Solo	Panama	09°22'N	079°53'W	Atlantic	N	Y	A					1991				208	
63	Alotau	Papua New Guinea	10°19'S	150°27'E	Pacific	N	Y	F	D	15				N			63	Info. from Australia
272	Daru	Papua New Guinea	09°03'S	143°12'E	Pacific	N	N										272	Info. from Australia
65	Rabaul	Papua New Guinea	04°12'S	152°11'E	Pacific	N	Y	F	AD	15				Y			65	Info. from Australia
64	Vanimo	Papua New Guinea	02°41'S	141°18'E	Pacific	N	N										64	Info. from Australia
173	Callao	Peru	12°03'S	077°09'W	Pacific	Y	Y	F	AD	15	D	A	1992	Y			173	
71	Davao, Davao Gulf	Philippines	07°05'N	125°38'E	Pacific	N	Y	F						N			71	
70	Jolo, Sulu	Philippines	06°04'N	121°00'E	Pacific	N	Y	FP						N			70	
72	Legaspi, Albay	Philippines	13°09'N	123°45'E	Pacific	N	Y	F						N			72	
73	Manila, South Harbor	Philippines	14°35'N	120°50'E	Pacific	N	Y	F						N			73	
246	Cascais	Portugal	38°41'N	009°25'W	Atlantic	Y	Y	F	A	60	D			N			246	Acoustic gauge installation?
244	Flores (Azores)	Portugal	39°27'N	031°07'W	Atlantic	Y	Y	P	A	60	D	L	1991	N			244	
250	Funchal (Madeira)	Portugal	32°38'N	016°54'W	Atlantic	Y	Y	F	A	60	D	L	1991	N			250	NOAA reconned
245	Ponta Delgada, Azores	Portugal	37°44'N	025°40'W	Atlantic	Y	Y	F	A	60?					1992	A	245	NOAA installed Jun 1992
13	Durban	South Africa	29°53'S	031°02'E	Indian	N	Y	AF	AD	60				N			13	

No.	Station Name	Country	Latitude	Longitude	Ocean/Sea	R	Op.	Gauge	A/D	Interv.	Exch.	Lev.	Year	Sat.	Inst.	Gauge	No.	Comments
20	Marion Is.	South Africa	46°52'S	037°52'E	Indian	N	Y	A	D	10							20	Intermittant data only
76	Port Elizabeth	South Africa	33°58'S	025°38'E	Indian	N	Y	AF	D	60				N			76	
268	Simonstown	South Africa	34°11'S	018°26'E	Atlantic	N	Y	AF	D	60				N			268	
260	Sao Tome	Sao Tome & Principe	00°25'N	006°35'E	Atlantic	N	Y	P									260	ORSTOM pressure gauge
253	Dakar	Senegal	14°38'N	017°27'W	Atlantic	N	Y	P						Y			253	NOAA installed Sep 1991
14	Aldabra	Seychelles	09°30'S	046°20'E	Indian	N	N										14	Replace by Farquar?
273	Port Victoria	Seychelles	04°40'S	055°28'E	Indian	N	N	F									273	Pier reconstruction
256	Aberdeen Point	Sierra Leone	08°30'N	013°14'W	Atlantic	N	??										256	????
44	Keppel Harbour	Singapore	01°28'N	103°50'E	Indian	N	Y	F	A	60				N			44	
66	Honiara	Solomons	09°26'S	159°57'E	Pacific	Y	Y	F	D	15,4	MD	L	1988	Y			66	
6	Hafun	Somalia	10°27'N	051°15'E	Indian	N	N										6	No gauge
7	Mogadishu	Somalia	02°01'N	045°20'E	Indian	Y	N	F	A	60	MD	L	1989	N			7	No recent data
249	Ceuta	Spain	35°54'N	005°19'W	Atlantic	N	Y	F	A	60				N			249	
243	La Coruna	Spain	43°32'N	008°24'W	Atlantic	N	Y	F	A	60				N			243	
251	Las Palmas, Canary Is.	Spain	28°08'N	015°25'W	Atlantic	N	Y	F	A	60				N			251	
33	Colombo	Sri Lanka	06°56'N	079°51'E	Indian	Y	Y	F	A	60	MD	L	1989	N			33	
233	Goteborg-Torshamnen	Sweden	57°41'N	011°48'E	Atlantic	Y	Y	F	A	60	LD	L	1984	N			233	
9	Mtwara	Tanzania	10°17'S	040°11'E	Indian	N	N										9	No gauge
297	Zanzibar	Tanzania	06°09'S	039°11'E	Indian	Y	Y	F	D	10	MD	L	??*	N			297	*unknown
39	Ko Lak	Thailand	11°47'N	099°49'E	Pacific	Y	Y	F	A	10	L	M	1991	N			39	
42	Ko Taphao Noi	Thailand	07°50'N	098°26'E	Indian	Y	Y	F	A	10	L	M	1992	N			42	
125	Tongatapu	Tonga	21°10'S	175°15'W	Pacific	N	??										125	????
203	Port of Spain	Trinidad and Tobago	10°39'N	061°31'W	Atlantic	N	??										203	????
121	Funafuti, Ellice Is.	Tuvalu	08°23'S	179°13'E	Pacific	Y	Y	F	D	15,4	MD	L	1990	Y			121	
300	Montevideo	Uruguay	34°54'S	056°15'W	Atlantic	N	??										300	????
263	Ascension	U.K.	07°55'S	014°25'W	Atlantic	Y	Y	P	D	60	LMD			N	1992	P	263	Not levelled
221	Bermuda, St. Georges Is	U.K.	32°22'N	054°42'W	Atlantic	Y	Y	P	D	6	LMD	A	1991	Y			221	NOAA installed May 1989
26	Diego Garcia	U.K.	07°17'S	072°24'E	Indian	N	Y	F	D	15				Y			26	NOAA installed Aug 1990
305	Falkland Is., Malvinas	U.K.	51°45'S	057°56'W	Southern	Y	Y	P	D	15	LMD			Y			305	Not levelled
188	Fansday	U.K.	65°15'S	064°16'W	Southern	Y	Y	FP	AD	60,15	LMD	L	1992	N			188	Real time data link soon?
248	Gibraltar	U.K.	36°07'N	005°21'W	Atlantic	Y	NT								1992	F	248	

No.	Station Name	Country	Latitude	Longitude	Ocean/Sea	R	Op.	Gauge	A/D	Interv.	Exch.	Lev.	Year	Sat.	Inst.	Gauge	No.	Comments
236	Lerwick	U.K.	60°09'N	001°08'W	Atlantic	Y	Y	FP	AD	15	LMD	L	1985	N			236	
241	Newlyn	U.K.	50°06'N	005°33'W	Atlantic	Y	Y	FP	AD	15	LMD	L	1989	N			241	
306	Signy, South Orkney Is.	U.K.	60°42'S	045°36'W	Southern	Y	Y	P	D	15	LMD			Y			306	Not levelled
296	South Caicos	U.K.	22°00'N	072°00'W	Atlantic	Y	Y	A	D	6	LMD	A	1991	Y			296	
187	South Georgia	U.K.	54°15'S	036°45'W	Atlantic	Y	N								*	P	187	Depends on new BAS base
238	Stomoway	U.K.	58°12'N	006°23'W	Atlantic	Y	Y	FP	AD	15	LMD	L	1989	N			238	
264	St. Helena	U.K.	15°58'S	005°42'W	Atlantic	Y	Y	P	D	15	LMD			Y			264	Not levelled
266	Tristan da Cunha	U.K.	37°03'S	012°18'W	Atlantic	Y	Y	P	D	15	LMD			Y			266	Not levelled
302	Adak	U.S.A.	51°52'N	176°38'W	Pacific	Y	Y	FPA	AD	6	LMD	A	1991	Y			302	
219	Duck, N.C.	U.S.A.	35°11'N	075°45'W	Atlantic	Y	Y	FPA	D	6	LMD	A	1991	Y			219	
289	Fort Pulaski, GA	U.S.A.	32°02'N	080°54'W	Atlantic	Y	Y	FPA	AD	6	LMD	A	1991	Y			289	
107	French Frigate, Shoal H	U.S.A.	23°52'N	166°17'W	Pacific	Y	Y	F	A	15							107	
217	Galveston (Pier 21), TX	U.S.A.	29°19'N	094°48'W	Atlantic	Y	Y	FPA	AD	6	LMD	A	1991	Y			217	
149	Guam, Marianas	U.S.A.	13°26'N	144°39'E	Pacific	Y	Y	FPA	D	6	LMD	A	1991	N			149	
287	Hilo, HI	U.S.A.	19°44'N	155°04'W	Pacific	Y	Y	FPA	AD	6	LMD	A	1991	Y			287	Remove from GLOSS list
108	Honolulu, HI	U.S.A.	21°18'N	157°52'W	Pacific	Y	Y	FPA	D	6	LMD	A	1991	Y			108	
109	Johnston Island	U.S.A.	16°44'N	169°32'W	Pacific	Y	Y	FPA	AD	6	LMD	A	1991	Y			109	
286	Kahului, HI	U.S.A.	20°45'N	156°28'W	Pacific	Y	Y	FPA	AD	6	LMD	A	1991	Y			286	
216	Key West, FL	U.S.A.	24°33'N	081°48'W	Atlantic	Y	Y	FPA	AD	6	LMD	A	1991	Y			216	
159	La Jolla (Scripps Pier)CA	U.S.A.	32°52'N	117°16'W	Pacific	Y	Y	FPA	AD	6	LMD	A	1991	Y			159	
303	Massacre Bay, Attu Is.	U.S.A.	52°50'N	173°12'E	Pacific	Y	N								??*		303	*none planned, no pier
134	McMurdo	U.S.A.	77°51'S	166°40'E	Southern	Y	N								??*		134	*none planned
218	Miami, Haulover Pier	U.S.A.	25°54'N	080°07'W	Atlantic	Y	Y	FPA	AD	6	LMD	A	1991	Y			218	Hurricane damage 1992
106	Midway Island	U.S.A.	28°13'N	177°22'W	Pacific	Y	Y	FPA	AD	6	LMD	A	1991	Y			106	
285	Nawiliwili, HI	U.S.A.	21°57'N	159°22'W	Pacific	Y	Y	FPA	AD	6	LMD	A	1991	Y			285	Remove from GLOSS list
290	Newport, RI	U.S.A.	41°30'N	071°20'W	Atlantic	Y	Y	FPA	AD	6	LMD	A	1992	N			290	
74	Nome	U.S.A.	64°30'N	165°30'W	Pacific	Y	N							1992	P		74	Gauge installed Jul 1992
144	Pago Pago, Samoa	U.S.A.	14°17'S	170°41'W	Pacific	Y	Y	FPA	AD	6	LMD	A	1991	Y			144	
183	Palmer (Antarctica)	U.S.A.	64°46'S	064°03'W	Southern	Y	N								??*		183	*none planned
301	Palmyra	U.S.A.	05°52'N	162°06'W	Pacific	Y	N										301	Remove from GLOSS list
288	Pensacola, FL	U.S.A.	30°24'N	087°13'W	Atlantic	Y	Y	FPA	AD	6	LMD	A	1991	N			288	

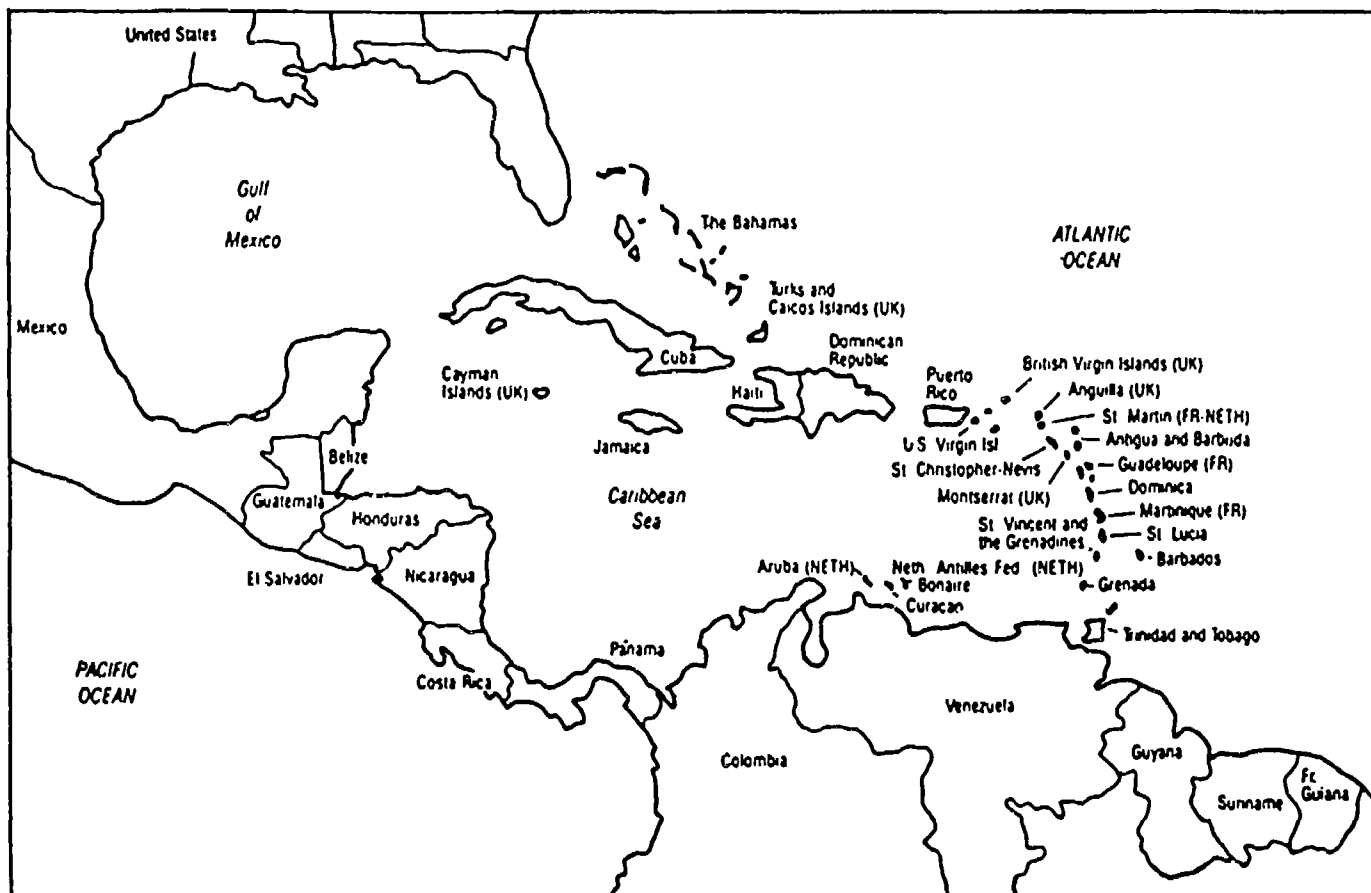
No.	Station Name	Country	Latitude	Longitude	Ocean/Sea	R	Op.	Gauge	A/D	Interv.	Exch.	Lev.	Year	Sat.	Inst.	Gauge	No.	Comments
151	Prudhoe Bay, AK	U.S.A.	70°23'N	148°30'W	Arctic	Y	Y	PA	D	6	LMD	A	1991	Y			151	
158	San Francisco, CA	U.S.A.	37°48'N	122°28'W	Pacific	Y	Y	FPA	AD	6	LMD	A	1991	Y			158	
206	San Juan, Puerto Rico	U.S.A.	18°28'N	066°07'W	Atlantic	Y	Y	PA	D	6	LMD	A	1991	Y			206	
100	Sand Point, AK	U.S.A.	55°20'N	160°30'W	Pacific	Y	Y	FPA	AD	6	LMD	A	1991	Y			100	
150	Seward, AK	U.S.A.	60°07'N	149°26'W	Pacific	Y	Y	FPA	AD	6	LMD	A	1991	Y			150	
154	Sitka, AK	U.S.A.	57°03'N	135°20'W	Pacific	Y	Y	FPA	AD	6	LMD	A	1991	Y			154	
157	South Beach, OR	U.S.A.	44°38'N	124°03'W	Pacific	Y	Y	AF	AD	6	LMD	A	1991	Y			157	
102	Unalaska, AK	U.S.A.	53°53'N	166°32'W	Pacific	Y	Y	FPA	AD	6	LMD	A	1991	Y			102	
220	Ventnor, NJ	U.S.A.	39°20'N	074°29'W	Atlantic	N	??										220	Atlantic City reinstalled 1991
105	Wake Island	U.S.A.	19°17'N	166°37'E	Pacific	Y	Y	FPA	AD	6	LMD	A	1991	Y			105	
231	Barentsburg (Spitsbergen)	Russia	78°04'N	014°15'E	Arctic	N	Y	F									231	
97	Kaliningrad	Russia	54°57'N	020°13'E	Baltic	N	Y										97	
91	Leningradskaya	Russia	69°30'S	159°23'E	Southern	N	N										91	
25	Mimiy	Russia	66°33'S	093°01'E	Southern	N	N										25	
294	Molodezhnaya	Russia	67°40'S	045°50'E	Southern	N	N										294	
274	Murmansk	Russia	68°58'N	033°03'E	Atlantic	N	Y	F									274	
92	Nagarvo Bay	Russia	59°44'N	150°42'E	Pacific	N	Y	F									92	
270	Novolazarevskaya	Russia	70°46'S	011°50'E	Southern	N	N										270	
93	Petropavlovsk-Kamchatsky	Russia	52°59'N	158°39'E	Pacific	N	Y	F									93	
135	Russkaya	Russia	74°46'S	136°51'W	Southern	N	N										135	
99	Russkaya Gavan	Russia	76°14'N	062°35'E	Atlantic	N	Y										99	
98	Tuapse	Russia	44°06'N	039°04'E	Black Sea	N	Y	F									98	
90	Yuzhno Kurilsk	Russia	44°01'N	145°52'E	Pacific	N	Y	F									90	
298	Aves Is.	Venezuela	15°39'N	063°35'W	Atlantic	N	??										298	to be installed 1992?
299	La Orchila	Venezuela	11°48'N	066°08'W	Atlantic	N	??										299	to be installed 1992?
75	Qui Nhon	Viet Nam	13°46'N	109°13'E	Pacific	Y	Y	F	A	60	L	A	1991	N			75	India helping to improve
3	Aden	Yemen, P.D.R.	12°47'N	044°59'E	Indian	N	??										3	????
304	Socotra Island	Yemen, P.D.R.	12°30'N	054°00'E	Indian	N	??										304	????

KEY TO COLUMN HEADINGS AND CODES

Heading	Explanation	Code & Meaning
R	Reply to March 1992 questionnaire	Y Yes N No
Op.	Site operational during the first half of 1992	Y Yes N No
Gauge	Gauges operating at site	F Float P Pressure A Acoustic
A/D	Analogue or digital recording	A Analogue D Digital
Interv.	Digitising interval (minutes)	
Exch.	Hourly data stored	L Listings M Magnetic Tape D Magnetic disk/diskette
Lev.	Levelling frequency	A Annually L Less than annually M More than annually
Year	Year levelling last carried out	
Sat.	Data transmitted by satellite	Y Yes N No
Inst.	Installation date of new gauge	
Gauge	Type of gauge to be installed	F Float P Pressure A Acoustic
No.	GLOSS No.	
Comments	Suggested improvements to site	

ANNEX VI

IOCARIBE SEA LEVEL STATION NETWORK
(1992)



Map showing the nations in the area of the IOC Sub-Commission for the Caribbean and Adjacent Regions (adapted from UNEP, 1987). IOCARIBE Member States include: Bahamas, Barbados, Brazil, Colombia, Costa Rica, Cuba, Dominican Republic, France, Guatemala, Guyana, Haiti, Jamaica, Mexico, Netherlands Antilles, Nicaragua, Panama, former Soviet Union, Surinam, Trinidad and Tobago, United Kingdom, United States, and Venezuela. St. Lucia joined the IOC in 1991, and may affiliate with IOCARIBE in 1992.

Table 1
Tide Gauges in the IOCARIBE
(as of October 1992)

Station	Gauge Type	Recording	Levl Date	IOC Plan	Status
ARUBA					
Sint Nicolaas	Press	Digital	1991	IOCAR	Operational
BAHAMAS					
Exuma	Float	Digital		GLOSS	Operational
Settlement Point	Float	Digital	1992	GLOSS	Operational
BARBADOS					
Bridgetown	Press	Digital	1991	IOCAR	Operational
BERMUDA					
St. Georges	Pneum	Digital		GLOSS	Operational
BRITISH WEST INDIES					
Grand Cayman	Float	Analog	1989	IOCAR	Operational
COLOMBIA					
Cartagena	Float	Digital	1992	GLOSS	Operational
La Providencia				IOCAR	Requested
COSTA RICA					
Puerto Limon	Press	Analog	1980	IOCAR	Reinstalled
CUBA					
Cabo San Antonio	Float	Analog	1991	GLOSS	Operational
Gibara	Float	Analog	1991	GLOSS	Operational
Guantanamo Bay	Acous	Digital	1991	IOCAR	Operational
Punta Maisi	Acous			IOCAR	Requested
Siboney (Havana)	Float	Analog	1991	GLOSS	Operational
FRANCE					
Basse Terre, Guadeloupe				IOCAR	Unknown
Cayenne, Fr. Guiana	Float	Paper	1980	GLOSS	Operational
Kourou, Fr. Guiana	Press	Analog	1990	Nat'l	Operational

Le Robert, Martinique				GLOSS	Unknown
GUYANA					
Georgetown				Nat'l	Requested
HAITI					
Cap du Mole	Acous			IOCAR	Requested
Port-au-Prince				GLOSS	Destroyed
HONDURAS					
Puerto Cortes				IOCAR	Unknown
JAMAICA					
Discovery Bay				IOCAR	Requested
Kingston	Acous			GLOSS	Requested
MEXICO					
Progreso	Float	Analog	1987	GLOSS	Operational
Puerto Morelos	Float	Digital	1991	IOCAR	Operational
Veracruz	Float	Analog	1989	GLOSS	Operational
NETHERLANDS ANTILLES					
Curacao	Float	Analog	1992	Nat'l	Operational
PANAMA					
Coco Solo	Float	Analog	1991	GLOSS	Operational
TRINIDAD & TOBAGO					
Charlotteville	Press	Digital	1991	IOCAR	Operational
Port of Spain				GLOSS	Unknown
TURKS & CAICOS					
South Caicos	Acous	Digital	1991	GLOSS	Operational
UNITED STATES					
Charlotte Amalie USVI	Acous	Analog	1992	Nat'l	Operational
Clearwater, Florida	Float	Digital	1991	GLOSS	Operational
Corpus Christi, Texas	Acous	Digital	1992	GLOSS	Operational
Fernandina Beach, FL	Float	Digital	1992	GLOSS	Operational
Key West, Florida	Float	Digital	1992	GLOSS	Operational
Lake Worth, Florida	Acous	Digital	1991	IOCAR	Destroyed
Limetree Bay, USVI	Acous	Digital	1991	Nat'l	Operational

Magueyes, Puerto Rico	Acous	Digital	1992	Nat'l	Operational
Haulover (Miami), FL	Acous	Digital	1992	GLOSS	Destroyed
Pensacola, Florida	Float	Digital	1992	GLOSS	Operational
San Juan, Puerto Rico	Acous	Digital		GLOSS	Operational
VENEZUELA					
Carupano	Float	Analog	1991	Nat'l	Operational
Cumana	Float	Analog	1991	IOCAR	Operational
Isla de Aves				GLOSS	mid-1992
Isla de Margarita	Float	Analog	1991	Nat'l	Operational
La Guaira	Float	Analog	1990	IOCAR	Operational
La Orchila				GLOSS	mid-1992

Table 2
Contributors to Table 1

Name & Address	Station
Ing. Luis Alvarado Hydromet Division Panama Canal Commission APO Miami, Florida 34011 USA	Coco Solo
Prof. Rubin Aparicio Instituto Oceanografico de Venezuela Universidad de Oriente Cumana, VENEZUELA	Carupano Cumana Isla Margarita La Guaira
Mr. J. Lee Chapin Mote Marine Laboratory 1600 Thompson Parkway Sarasota, Florida 34236 USA	Charlottetown Guantanamo Bay Sint Nicolaas
Dr. Christian Colin ORSTOM B.P. 165 97323 Cayenne, FRENCH GUIANA	Cayenne Kourou
Dr. A.J. Dania Meteorological Service of the Netherlands Antilles & Aruba Seru Mahuma z/n Curacao, NETHERLANDS ANTILLES	Curacao
Dr. John E. Davies Mosquito Research & Control Unit Cayman Islands Government P.O. Box 486 Grand Cayman, BWI	Grand Cayman
Dr. Artemio Gallegos UNAM, ICMYL A.P. 70-305 Mexico 04510 D.F., MEXICO	Progreso Puerto Morelos Veracruz
Mr. Guillermo Garcia Comite Oceanografico Nacional Calle 1ra. y 60 Miramar, Ciudad de Habana, CUBA	C. San Antonio Gibara Siboney

Name & Address	Station
Mr. Alejandro Gutierrez Instituto Meteorological Nacional Apartado 7-3350 San Jose 1000, COSTA RICA	Puerto Limon
Dr. J.M. Guillerm ORSTOM 213, rue la Fayette 75480 Paris, FRANCE	France
Dr. S.M. Kahn Hydrometeorological Service Homestretch Ave., Durbin Park Georgetown, GUYANA	Georgetown
Mr. Douglas M. Martin NOAA, National Ocean Service 6001 Executive Blvd. Rockville, Maryland 20852 USA	USA Bermuda Settlement Pt.
Mr. Chris Ninnes Ministry of Fisheries, Works, and Immigration Grand Turk, TURKS & CAICOS	South Caicos
Dr. Leonard A. Nurse Coastal Conservation Project unit Oistins Government Complex Christ Church, BARBADOS	Bridgetown
Ing. Jean-Francois Remy Service Maritime et de Navigation d'Haiti P.O. Box 724 1563 Port-au-Prince, HAITI	Port-au-Prince
Dr. Ned P. Smith Harbor Branch Oceanographic Institution 5600 Old Dixie Highway Fort Pierce, Florida 34946 USA	Exuma
Ing. Jorge Ivan Valencia Instituto Colombiano de Hidrologia, Meteorologia y Adecuacion de Tierras A.A. 20032 Santafe de Bogata, COLOMBIA	Cartagena

ANNEX VII

ASEAN SEA LEVEL STATION NETWORK
(1992)

List of Project Tide Stations

Brunei Darussalam

1. Muara

Indonesia

2. Lhok Seumawe
3. Pasir Panjang
4. Tarakan
5. Tarempa
6. Batu Payung
7. Meneng
8. Pulau Pari

Malaysia

9. Tapis Alpha
10. Pulau Lakei
11. Labuan
12. Layang-Layang
13. Sandakan

Philippines

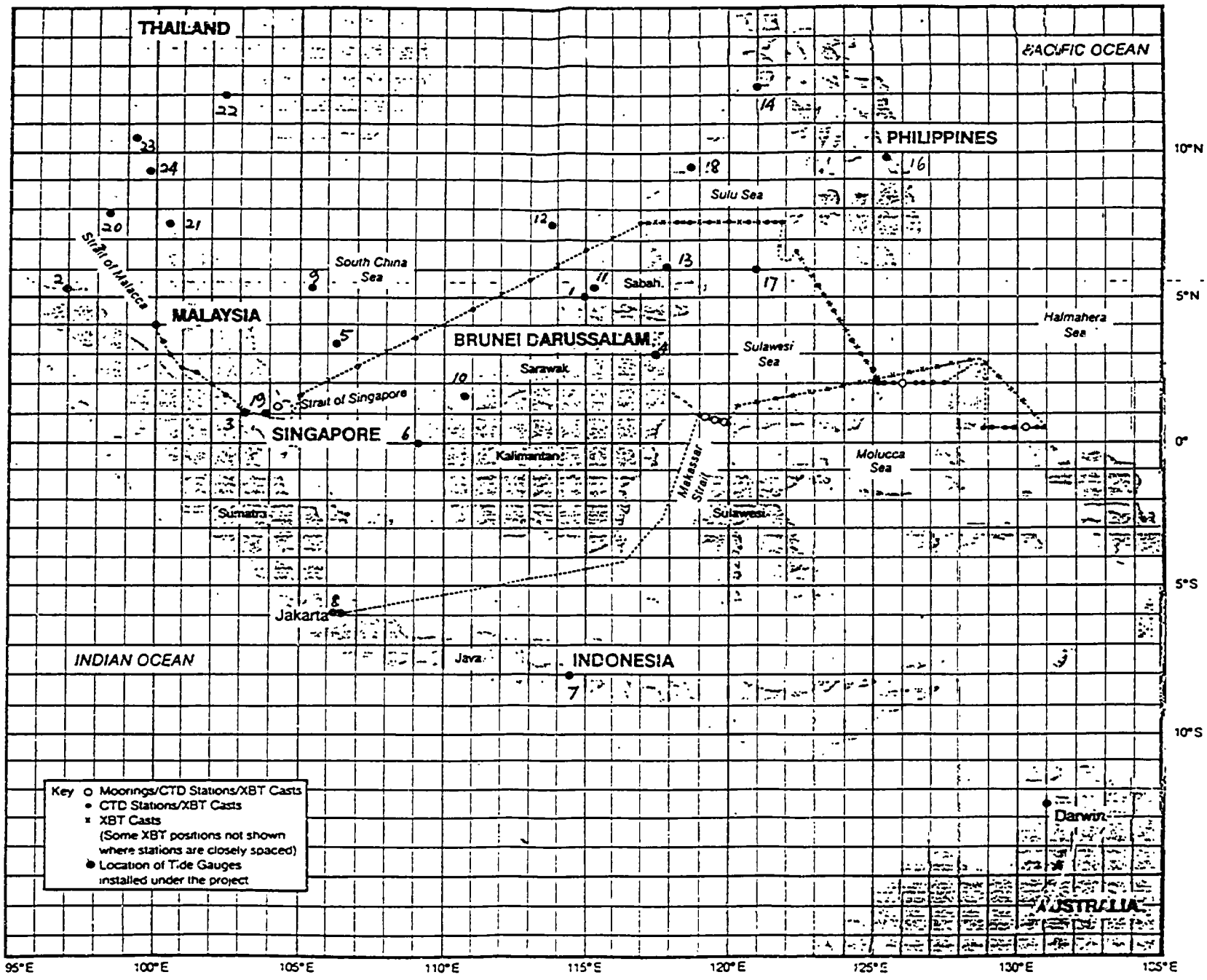
14. San Jose
15. Port Irene
16. Surigao
17. Jolo
18. Puerto Princesa

Singapore

19. Raffles

Thailand

20. Laem Panwa
21. Ko Nu
22. Laem Thammachat
23. Ko Mattaphon
24. Ko Samui



Key

- Moorings/CTD Stations/XBT Casts
- CTD Stations/XBT Casts
- x XBT Casts
(Some XBT positions not shown where stations are closely spaced)
- Location of Tide Gauges installed under the project

ANNEX VIII

**SUMMARY REPORT OF THE
IOC-UNEP-WMO AD HOC MEETING OF EXPERTS ON THE
IOC-UNEP-WMO PILOT ACTIVITY ON SEA-LEVEL CHANGE
AND ASSOCIATED COASTAL IMPACTS
(Paris, 16 October 1992)**

1. **INTRODUCTION**

1 Dr. M. Gerges opened the meeting and welcomed the participants on behalf of the Joint Secretariat IOC-UNEP-WMO of this project. He referred to the proposal of the joint UNEP-IOC-WMO meeting of experts in December 1990 which recommended the establishment of a Long-Term Global Monitoring System of Coastal and Near-Shore Phenomena Related to Climate Change to contribute to efforts to assess climate change and the socio-economic and environmental impacts of that change. Six pilot activities were recommended to initiate the development of the proposed system, including the pilot activity on sea-level changes and coastal flooding. The Governing Council of UNEP endorsed the development of proposed pilot activities. Dr. Gerges pointed out that the Ocean Chapter of Agenda 21 (UNCED) repeatedly calls for coastal observations for integrated management and sustainable development.

2 Dr. A. Tolkachev noted that the plans for the development of the pilot activities were endorsed by the IOC Executive Council at its Twenty-fifth Session and the IOC agreed to take responsibility on behalf of three organizations for planning and developing these pilot activities. The recommended pilot activities are considered as contribution to the development of Global Ocean Observing System. The Executive Council adopted recommendation of the Fifth session of the IOC Committee on Ocean Processes and Climate by which the Group of Experts on GLOSS was requested to initiate the preparation of the Action Plan for the Sea Level Changes and Coastal Flooding Pilot Activity particularly in the Indian Ocean region.

3 Dr. P. Dexter reported that the WMO Executive Council agreed to co-operate with IOC and UNEP in developing proposed pilot activities.

4 Dr. D. Pugh was invited and agreed to chair the meeting.

2. **ADOPTION OF THE AGENDA**

5 The Agenda as amended was adopted (see Appendix).

3. **PRESENTATION OF THE DRAFT ACTION PLAN FOR THE IOC-UNEP-WMO PILOT ACTIVITY ON SEA-LEVEL CHANGES AND ASSOCIATED COASTAL IMPACTS AND ITS IMPLEMENTATION IN THE INDIAN OCEAN**

6 The draft action plan for the pilot activity was presented by Dr. S. Shetye, who had been invited by IOC in consultation with UNEP and WMO, to assist in the preparation of the draft plan. The draft action plan was submitted as document IOC/GE-GLOSS/UNEP/WMO/SLPIO/14. The draft plan included the scientific concept of project and its objectives; proposed methodology, sites for observations, parameters to be observed and data management as well as proposed outputs envisioned during the pilot activity and financial requirements for its implementation.

4. **EXPERIENCE IN THE IOCARIBE REGION**

7 Dr. G. Maul, Co-ordinator of the Joint UNEP-IOC Task Team on Implications on Climate Change for Wider Caribbean region, informed the meeting on the activities of the Task Team. The Task Team's tasks include the study the effects of climate-change induced sea level rise on coastal ecosystems including: deltas, estuaries, wetlands, coastal plains, coral reefs, lagoons, mangroves, seagrass beds, fisheries, rivers, coastal lakes, and beaches; also included are studies of climate impacts on socio-economic infrastructure and anthropogenic activities.

8 The Task Team on Implications of Climate Change Studies are co-ordinated with other related activities of IOC, particularly GLOSS and the IOCARIBE Sub-commission. It includes the establishment of the network of long-term, systematic measurements of sea level and other oceanographic and meteorological parameters as

a key element in understanding and predicting of the potential impact of sea level rise. Thanks to support provided by UNEP and IOC and intense local interest to this problem some progress has been achieved in establishing sea level observational network in the region. This was reported during the Third session of the Group of Experts on GLOSS. The experience has also showed the need to have close interaction with the activities of WMO in the region to obtain required meteorological data and observations.

5. DISCUSSION

9 The participants then discussed the proposed draft plan with particular emphasis on the objectives of the pilot activity and its relationship with the GLOSS. The participants have recognized that sea level measurements should be closely associated with the practical interests of coastal states. Probabilities of coastal flooding, coastal erosion and other associated coastal impacts may change both in response to mean sea level rise, and in response to changes in weather patterns. It is therefore important to connect the regional projects with the global monitoring of the oceans and climate system. The GLOSS as a global system will provide in the future data for assessment and eventually for prediction of global sea level change without which it would be impossible to talk about regional or local impacts. The meeting therefore considered that the development of such a project will be of mutual benefit for local and regional practical interests and development of Global sea level observing system required.

10 It was agreed that the project should be closely associated with the problems of the vulnerable areas of the coastal zones of the Indian Ocean due to anticipated sea level rise: coastal erosion in the East Africa; coastal flooding in the Bay of Bengal and sea level variability in the Maldives. The meeting also agreed that such a project will require various oceanographic and meteorological measurements, including satellite altimetry observations to interpret correctly coastal sea level observations. Dr. P. Dexter expressed willingness of WMO to assist in identifying available meteorological data and observations required for the project.

The meeting noted that there are a number of projects and activities in the Indian Ocean related to this project. This includes two regional Climate Impact Task Teams of UNEP (EAF and SAS), IOC regional activities - IOCINCWIO and IOCINDIO, M. Steyaert reported on regional studies within the COMAR (UNESCO Coastal Marine programme). The implementation of the project will greatly benefitted if properly co-ordinated with above activities.

11 Assistance and support from organizations and experts outside the region will be also required.

6. CONCLUSIONS AND RECOMMENDATIONS

12 The *ad hoc* meeting expressed its thank to Dr. S. Shetye for his assistance in preparing the draft action plan and requested him to revise the draft plan in the light of its discussion during the meeting.

13 The meeting agreed that the selection of the Indian Ocean region for the pilot activity is well justified and its implementation should be carried out by existing IOC and UNEP regional groups in co-operation with GLOSS.

14 The *ad hoc* meeting recommended that:

- (i) the Chairman of the Group of Experts on GLOSS present the draft action plan for the project to the First Session of the IOC Committee for GOOS and Seventeenth Session of the IOC Assembly;
- (ii) IOC, UNEP and WMO consider provision of required support for implementation of the pilot activity and invite their Member States to assist in the implementation of the project;
- (iii) the Secretariats of IOC, UNEP and WMO submit the draft plan to the relevant regional groups in order to define specific actions and responsibilities of participating countries to initiate the implementation of the project.

7. CLOSURE

15 The meeting was closed at 15:00 on 16 October 1992.

APPENDIX

AGENDA

1. INTRODUCTION
2. ADOPTION OF THE AGENDA
3. PRESENTATION OF THE DRAFT ACTION PLAN FOR THE IOC-UNEP-WMO PILOT ACTIVITY ON SEA-LEVEL CHANGES AND ASSOCIATED COASTAL IMPACTS AND ITS IMPLEMENTATION IN THE INDIAN OCEAN
4. EXPERIENCE IN THE IOCARIBE REGION
5. DISCUSSION
6. CONCLUSION AND RECOMMENDATIONS