

Intergovernmental Oceanographic Commission
Reports of Meetings of Experts and Equivalent Bodies



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

Fourth Session

Bordeaux, France, 31 January–3 February 1995

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 IOUE 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 IGOSST 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 IOUE 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 IOCARIBE Group of Experts on Recruitment in Tropical Coastal Demersal Communities (*Also printed in Spanish*)
31. Second IOC-WMO Meeting for Implementation of IGOSST 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 RNODCs and Climate Data Services
37. Second Joint IOC-WMO Meeting of Experts on IGOSST-IOUE Data Flow
38. Fourth Session of the Joint CCOP/SOPAC-IOC Working Group on South Pacific Tectonics and Resources
39. Fourth Session of the IOUE 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 IGOSST 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/IGOSST 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 IGOSST 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 IOUE Group of Experts on Marine Information Management
76. Fifth Session of the IOUE 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. Third Session of the IOC Group of Experts on the Global Sea-level Observing System
79. Third Session of the IOC-IAEA-UNEP Group of Experts on Standards and Reference Materials
80. Fourteenth Session of the Joint IOC-IHO Guiding Committee for the General Bathymetric Chart of the Oceans
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Observing System (GLOSS)**

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Bordeaux, France, 31 January–3 February 1995

UNESCO

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1. ORGANIZATION OF THE SESSION

1.1 OPENING THE SESSION

- 1 The Session was opened by the Chairman of the Group of Experts, Dr. David Pugh. He noted that this session was preceeded by the IOC/GLOSS-IAPSO Workshop on Sea Level Variability and Southern Ocean Dynamics (Bordeaux, France, 31 January 1995) organized and chaired by Dr. C. Le Provost.

1.2 ADOPTION OF THE AGENDA

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

1.3 DESIGNATION OF RAPPORTEUR

- 3 Mrs. Elaine Spencer was elected as the Rapporteur of the Session.

2. REVIEW OF GLOSS ACTIVITIES

2.1 PROGRESS REPORT

- 4 Dr. A. Tolkatchev presented the Progress Report which focussed on the implementation of plan of actions recommended by the Third Session of the Group held in October 1992.

- 5 He pointed out particularly the Sea Level Training Seminar/Workshop for Spanish and Portuguese countries held in Brazil, February 1993, the preparation and publication of the second volume of the Manual on Sea-Level Measurement and Interpretation - Emerging Technologies, the preparation of the revised GLOSS Handbook - Version 2, the active support by GLOSS Regional Co-ordinators the development of GLOSS in the IOCARIBE, IOCINCWIO and IOCEA regions, and the development of the IOC-UNEP-WMO Pilot Activity on Sea Level Changes and Associated Coastal Impacts in the Indian Ocean, the financial support provided by UK through earmarked IOC Trust Fund for GLOSS, the preparation of the report on Sea Level Monitoring in the Small Island States and the first issue of Afro-America GLOSS News produced by Brazil as well as close interaction with IAPSO Commission on Mean Sea Level and Tides, PSMSL and other sea level centres.

2.2 STATUS OF GLOSS NETWORK

- 6 Dr. Lesley Rickards presented the report on the status of GLOSS network. The summary reflects good progress and shows 250 operational sites (80% compared with 76% at the Paris meeting, October 1992). She presented an updated version of GLOSS Handbook which was made available to the participants on PC disk. She also reported on the preparation of CD-ROM which will include station maps together with the latest version of the Handbook and the PSMSL dataset. Dr. Rickards noted that there are problems of format presentation of maps and copyright.

- 7 **The Group emphasized** the importance of station maps with the inclusion of the tide gauge bench marks locations.

- 8 **The Group thanked** Dr. Rickards for the preparation of the revised GLOSS Handbook and indicated the need for updating of the list of non-operational stations. The latter was further discussed under item 9.

- 9 **The Group then discussed** the nature of the Handbook, GLOSS CD-ROM and their formats and **agreed** that the Handbook and future CD-ROM would be useful products. Dr. B. Douglas offered the help of US NODC in producing and reproduction of the required numbers of GLOSS CD-ROM. **The Group requested** PSMSL and NODC/USA to proceed with the preparation of GLOSS CD-ROM.

- 10 **The Group also discussed** the use of World Wide Web (WWW) for circulation of GLOSS-related information and **agreed** that the WWW would serve as a very useful additional mean for GLOSS data/information dissemination.

3. **ACTIVITIES OF INTERNATIONAL SEA LEVEL CENTRES**

3.1. **PERMANENT SERVICE FOR MEAN SEA LEVEL (PSMSL)**

- 11 Dr. P. Woodworth, Director of PSMSL, presented the report on Intersessional activities of PSMSL. The report indicates that data receipts (GLOSS and non-GLOSS) during 1994 were higher than in a typical year and that data are supplied to scientists now almost entirely via FTP. A CD-ROM of PSMSL and TOGA sea-level data, provided by NOAA/NODC, can be supplied to scientists without FTP links. GF3 magnetic tapes have been abandoned. A set of World Wide Web pages has been prepared giving information on GLOSS and PSMSL, WOCE, TOGA, ACCLAIM (Antarctic Circumpolar Current Levels by Altimetry and Island Measurements) and National Tidal Facility (Australia) databanks. The PSMSL continues its linkage to altimetry (especially TOPEX/POSEIDON) and European Sea Level Projects. The Director of PSMSL has been involved in the activity of IPCC Sea Level Group. A suggested format for a formal PSMSL Advisory Board has been constructed.

- 12 Dr. Woodworth provided a report on GLOSS Status, October 1994, based on the data received from GLOSS stations. The report is included as Annex IV. The GLOSS Status has continued to improve with 183 of the 300 stations now in Category 1 - Operational Stations for which the latest data is 1990 or later.

3.2. **WOCE SEA LEVEL DATA ASSEMBLY CENTRES**

- 13 A global network of sea level gauges provides WOCE with *in situ* data for ground truth calibration of satellite missions, as well as an estimate of surface geostrophic currents. Many of the WOCE stations are part of GLOSS.

- 14 The Group received a report of two WOCE Data Assembly Centres: Fast Delivery Data Assembly Sea Level Centre operated by the University of Hawaii and the Delayed Mode Sea Level Data Assembly Centre operated by BODC.

- 15 Dr. Gary Mitchum presented a report on the activity of the WOCE Fast Delivery Sea Level Centre. By mid-October 1993 hourly, daily, and monthly sea level time series covering at least part of the TOPEX/POSEIDON data period were available from 70 stations. There are now 92 stations in the network (68 Pacific, 15 Indian, 9 Atlantic) that deliver data in near-real time. The data are distributed via the Internet computer network. The WOCE Sea Level Centre is now functioning routinely, which means that the dataset is updated every month on a strict schedule. The network is still sparse in the Southern Ocean and in parts of the Atlantic and Pacific Oceans. Dr. Mitchum pointed out that this centre maintains close collaboration with the WOCE Delayed Mode Centre.

- 16 The report on the activity of the WOCE Delayed Mode Sea Level Data Assembly Centre was presented by Dr. L. Rickards. The British Oceanographic Data Centre has responsibility for assembling, quality controlling and disseminating the comprehensive sea level dataset for WOCE. At present the Centre collating data from approximately 123 tide gauge sites of which 112 are operational and data have been received from 103 stations. A public access directory containing WOCE sea level data and ACCLAIM data from coastal tide gauges and bottom pressure stations has been set up to allow access via Internet. Access via World Wide Web is being developed.

- 17 Both Centres provide data and information to scientists and national organizations upon request.

- 18 **The Group noted** with satisfaction the progress in the activities of these two Centres and their close interaction with PSMSL.

3.3 TOGA SEA LEVEL DATA CENTRE

19 Dr. G. Mitchum presented the report on the activities of the TOGA Sea Level Centre (TSLC) which was created in 1985. The Centre collects sea level data from many data originators, of which the Indo/Pacific Sea Level Network is a primary one. The Centre is charged with collecting sea level from the global tropics, processing and quality controlling these data, and distributing them within 18 months where possible. At the present time the data holdings of the TSLC are 3677 stations/years of data from 309 stations. This represents the doubling of the dataset in the past two years. Most of the data is still in the Pacific, but the Atlantic and Indian datasets have become substantial. In the past year all of the TSLC data have been added to the FTP facility. With the assistance of the NODC of USA the Centre produced a CD-ROM of sea level data that is available through the US/NODC. Dr. Mitchum reported that close contact with contributors has proved beneficial in ensuring continuity of data input. The demand for data has continued to rise.

20 The Group noted with satisfaction the progress in the activities of TOGA Sea Level Data Centre and its good services in providing data to individual scientists and countries.

3.4 SPECIALIZED OCEANOGRAPHIC CENTRE FOR MEAN SEA LEVEL IN THE PACIFIC

21 The progress report on the IGOSS Sea Level Programme in the Pacific was presented by Dr. G. Mitchum, Director of the Centre. This activity was an early, and very successful example of operational oceanography, and the Specialized Oceanographic Centre for the Programme provides monthly maps of the Pacific sea level deviations from the long-term mean and also maps of the sea level anomalies from the long-term seasonal cycle that are corrected for atmospheric pressure anomalies. Since 1994 the Centre also distributes time series of sea level deviations that are corrected for atmospheric pressure, but retain the seasonal variations. The Centre also produces quarterly updates of an index of the tropical Pacific upper-layer volume and annual updates of indices of the ridge-trough system and equatorial currents for the Pacific Ocean. The most up to date versions of all the Centre's IGOSS products are now available through the Internet Computer Network. From the outset of the project to present, the number of stations has risen from 20 to 93 and the number of countries participating has risen from 11 to 33. A high priority is placed on the routine functioning of this activity. Dr. Mitchum noted however with concern the reduction in funding in support of the activity of the Centre.

22 The Group noted with great satisfaction of the activities of the Centre as an example of future GOOS operational oceanographic centers.

23 The Group requested the IOC to encourage the USA to continue supporting the operation of the Centre.

24 Annex IX gives a brief summary of each of the International Sea Level Centres.

4. RELATED SEA LEVEL REGIONAL ACTIVITIES

4.1 IOCARIBE SEA LEVEL PROGRAMME

25 The progress report on the GLOSS Development within the IOCARIBE was prepared and submitted to the Session by Dr. G. Maul, GLOSS Regional Co-ordinator for IOCARIBE. Dr. Maul was unable to attend the meeting and his report was presented by Dr. A. Tolkachev. Since 1992 one new tide gauge has been established in Cayos Pichones, Honduras and two more are funded and will be installed in early 1995 in Georgetown, Guyana and Kingston, Jamaica. All other existing gauges listed in the 1992 report are operational, except Charlotteville, Tobago. Priorities for the next four gauges, for which IOC funding has been established, are as follows: Cap du Mole, Haiti; Havana, Cuba; Fort George, Belize; Isla de Providencia, Colombia. The regional GLOSS development was discussed at the Chapman Conference on the Circulation of the Intra-Americas Sea in January 1995. It is expected that the direction of the regional GLOSS will be towards more modernization and real-time telemetering of

data, both oceanographic and meteorological. Dr. Maul will propose adopting the Next Generation Water Level Measurement System as the standard system for all future installations. The report provided by Dr. Maul includes details of the proposal to establish a sea level and climate monitoring network within CARICOM.

26 The attention of the meeting was brought to the request of Cuba for assistance in training their specialists in the application of advanced methods and techniques for sea level measurement, analysis and forecasting within the framework of the UNDP sponsored project on the "Development of Prediction Techniques of Coastal Floods Prevention and Reduction of Damages".

27 It was also noted that the requirements for training in the region had been expressed by other countries.

28 The Group agreed to discuss further this request as well as other requirements for training under agenda item 8.

29 The Group expressed its thanks to Dr. G. Maul for the continued active involvement in the development of the IOC/ARIBE Sea Level Programme as well as global GLOSS activity.

4.2 IOC/UNEP-WMO PILOT MONITORING ACTIVITY ON SEA LEVEL CHANGES AND ASSOCIATED COASTAL IMPACTS IN THE INDIAN OCEAN

30 The progress report on the IOC/UNEP-WMO Pilot Activity on Sea Level Changes and Associated Coastal Impacts in the Indian Ocean was presented by Dr. Satish Shetye, Project Co-ordinator. The primary objectives of this project are:

- (i) To improve understanding of the processes that control sea level variability at sites where sea level is monitored in the Indian Ocean.
- (ii) To enhance capabilities of countries of the Indian Ocean to monitor and analyze sea-level data.

31 The project envisages setting up of a network of Cells for Monitoring and Analysis of Sea Level (CMAS). The tasks of scientists associated with each CMAS are: to secure high quality sea-level data, to analyze these data to identify important features of variability, and to undertake research to understand the causes behind the variability. A CMAS has now been set up in each of the following eight countries: Bangladesh, India, Kenya, Madagascar, Malaysia, Republic of Maldives, Mauritius and Mozambique.

32 Scientists associated with these Cells and from other interested countries of the Indian Ocean met at the Planning Workshop on an Integrated Approach to Coastal Erosion, Sea Level Changes and their Impacts held in Zanzibar in January 1994. The Workshop concluded that the most important challenge for the Project at the present is to enhance the expertise available with many of the Cells through training programmes, both short-term (training in routine data analysis and maintenance of tidal installations) and long-term (graduate studies in physical oceanography).

33 Dr. Shetye presented a proposal for a "hands-on" Training Workshop which was proposed to be organized by the Survey of India in collaboration with the National Institute of Oceanography and will be held in October/November 1995 in Dehra Dun. During the Workshop, participants will be able to analyze data collected by them using PCs with the help of experts from different sea-level centres.

34 Some participants of the GLOSS meeting felt that during the Workshop more emphasis should be given to the training of specialists in the operation of tide gauges with a view to ensuring the continuity of GLOSS stations in the Indian Ocean. However strong views were expressed by many participants on the need to train scientists in sea level analysis and interpretation to enable them to use fully and efficiently data resulting from GLOSS for national scientific and practical applications. This approach will be more efficient in better understanding the value of long-term sea level measurements and eventually will help to convince Governments to maintain the GLOSS stations.

35 The proposed programme of the Workshop was then reviewed by a group consisting of S. Shetye, G. Mitchum, D. Pugh, P. Woodworth, T. Murty and A. Tolkathev. **The Group expressed** thanks to Dr. Shetye for his efforts in developing the project and **wished** to encourage continued development of the project as an important link between GLOSS and GOOS objectives. Dr. Shetye was encouraged to establish close contacts with all scientists participating in the project and work closely with the Survey of India and the GLOSS Technical Secretary in the preparation of the Workshop. Dr. Shetye was also requested to report on the progress to the Fifth Session of GLOSS Group of Experts.

36 **The Group requested** IOC to provide financial support for the Training Workshop in India as a basis for successful implementation of the project.

37 **The Group requested** Dr. Shetye and Dr. Mitchum to consider ways and means to maintain the GLOSS network in the Indian Ocean and make proposals on this matter to the next session of the Group.

4.3 SEA LEVEL PILOT PROJECT FOR THE SOUTHERN OCEAN

38 Following recommendations of the Third Session of the Group, Dr. Tad Murty presented the proposal on the development of the Sea Level Pilot Project for the Southern Ocean. The objectives of the project are to improve knowledge of sea levels in the Southern Ocean, and to foster increased international co-operation into Southern Ocean sea level research. In addition the investigators plan to use sea level results for research into the role of the Southern Ocean and the Circumpolar Current in global climate studies. It is intended to set up a centre for Southern Ocean sea levels at the National Tidal Facility. The project will start soon with funding made available by the Australian Government. It is planned to investigate the possibility of producing monthly mean sea level anomaly maps. The Centre will serve as a forum for discussion of various aspects of sea level research and monitoring and producing useful sea-level products for the Southern Ocean region.

39 **The Group wished** to encourage the National Tidal Facility of Australia to continue the development of the project in close collaboration with other relevant international centers in the region on an exploratory basis. **The Group also invited** Dr. Murty to investigate the use of satellite altimetry data for preparation of sea level products. **The Group requested** IOC to invite other countries to collaborate with the Project Centre in providing monthly mean sea level data to the Centre.

40 **The Group welcomed** the offer of Australia to assist Russia in arranging sea-level observations at the Russian Antarctic stations.

41 **The Group requested** Dr. Murty to report on the progress in the project development to its next session.

42 **The Group noted** that two workshops had been held with the focus on sea-level measurements and studies in the Southern Ocean. These are Workshop on Sea Level Measurements in Hostile Conditions (1988); IOC Workshop on Sea Level Measurements in Antarctica (1990) and IOC/GLOSS-IAPSO Workshop on Sea Level Variability and Southern Ocean Dynamics, held in Bordeaux, on 31 January 1995 just prior to this session. The report of the two first workshops had been published by IOC and the report of the last workshop will also be published by IOC.

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

43 Mr. A. Bolduc presented the progress report on the development of the IGOSS Sea-Level Pilot Project for the North and Tropical Atlantic Ocean initiated in 1990. One of the initial objectives of ISLPP/NTA was to evaluate the usefulness and the feasibility of producing synoptic mean sea level charts for the prediction of climatic trends, long range weather forecasts and ocean processes. The studies made indicated the difficulty in drawing contour lines of the data to represent a meaningful picture of anomalies across the Atlantic basin because of high variability of sea levels without knowledge of the variations of both in space and in time. Various countries located around the basin were asked to

forward the mean sea level data to MEDS in Canada in supporting this international venture. Only a few countries (Norway, Sweden, Germany, UK, Ireland, Spain, USA and Canada) provided data for the period 1990 to 1992 with drastic reductions in 1993 and 1994 in particular. In 1994 only Canada and Sweden provided sea level data to MEDS. MEDS established good contact with the PSMSL and has received their full support.

44 **The Group recognized** that the mean sea level data from coastal stations are too scarce to produce, with any significance, maps of the ocean basin for this particular area. **The Group discussed** the possible use of TOPEX/POSEIDON satellite altimetry data - already existing and available in electronic form - in combination with mean sea level data from GLOSS stations around the Atlantic basin to produce valuable products for scientific applications as well as in combination with XBT observations in the North Atlantic for monitoring of the fluctuation of the thermocline. **The Group, however, felt** that additional studies should be made of the historical database and available satellite altimetry information in order to propose types of products of scientific and practical value for this region. **The Group decided** to establish an Intersessional Task Team consisting of Mr. A. Bolduc and Dr. P. Woodworth to investigate this matter in close collaboration with Dr. Robert Cheney, NOS/NOAA and **requested** the Task Team to prepare proposals for the next session of the Group of Experts on GLOSS.

45 **The Group requested** the IOC to invite the countries of the region to make available sea-level data required for the proposed study.

46 **The Group requested** the Technical Secretary for GLOSS to inform the forthcoming session of the IOC-WMO Committee for IGOS on its opinion regarding further development of the project.

4.3 EUROGLOSS

47 Dr. P. Woodworth presented a proposal for the definition of a strategic European network for sea level and coastal land level monitoring for "EuroGLOSS" as a complementary regional project in Europe. There are both GLOSS-type i.e. oceanographic and geodetic aspects, for which the latter appears to parallel a similar proposal for a European Primary Tide Gauge Network (EPTN) from the Institut Geographique National, France, by Mr. Claude Boucher. Copies of the proposal were made available to the participants of the meeting. Sea level monitoring in Europe varies considerably between states and with the moves towards more co-ordinated European activities, such a programme might be timely. A prototype network, which includes not only GLOSS stations, was defined in the proposal. EuroGLOSS will also serve in support of regional oceanography.

48 Replies received from European scientists and national agencies showed support for the project.

49 Mr. Boucher informed the Group on the proposal for a European Primary Tide Gauge Network (EPTN). The proposal is aimed at designing as a part of the European Reference Frame (EUREF) a specific network of stations located at tide gauge locations in order to ensure enough common stations with other networks. The proposal includes all the GLOSS stations on the European plate continent. These scientific quality tide gauge sites are expected to be monitored by regional GPS surveys which also observe additional tide gauges organized into regional densification networks. Mr. Boucher confirmed strong requirements from the mapping community to establish permanent GPS stations at some GLOSS sites in Europe and expressed full support for the proposal to establish "EuroGLOSS" which will combine interests of oceanographic and geodetic communities.

50 **The Group expressed** its support for the establishment of "EuroGLOSS" as a regional complementary GLOSS activity and **encouraged** Dr. P. Woodworth to proceed in collaboration with other scientists of the region with the submission of this proposal to the European Commission for support. **The Group also asked** Dr. Woodworth to serve as a EuroGLOSS liaison with the Group of Experts and to keep the Group informed on project development. **The Chairman of the Group was requested** to inform the I-GOOS on this proposal and its possible interaction with the EuroGOOS.

4.6 ASEAN SEA LEVEL PROGRAMME

- 51 Dr. T. Murty reported on the ASEAN Sea-Level Programme within the ASEAN-Australia Marine Science Project. The Regional Ocean Dynamics Project, as a component of the Marine Science Project has developed a comprehensive network of tide gauges systematically gathering sea level data over the length and breadth of ASEAN region. Data is analyzed to produce mathematical models relevant to: (i) tidal prediction; (ii) shipping movement; (iii) oil spill management; (iv) pollution and siltation disposal; (v) storm surge prediction; (vi) search and rescue; (vii) meteorological forecasting; (viii) offshore engineering; and (ix) fisheries management and larval transport.
- 52 Dr. Murty noted with concern that financial support for data collection and analysis will be terminated by June 1995. However, financial support will be continued for sea level training. In February 1995 a training course on sea level will be organized for participants of the Project.
- 53 The Group noted the progress in the development of the regional sea-level network which is of great importance for the assessment of water flow between the Pacific and Indian Ocean and also for TOGA. The Group however expressed its concern that the data from many sea-level stations of Indonesia have never been released to the TOGA Sea Level Centre or PSMSL. The Group requested Dr. Murty to investigate the submission of sea-level data to TOGA Centre and PSMSL from the regional sea-level network.

4.7 OTHER REGIONAL SEA-LEVEL PROGRAMMES/ACTIVITIES

- 54 Dr. Larry F. Awosika, IOCEA GLOSS Regional Co-ordinator, presented a report on the IOCEA GLOSS Status. GLOSS in the IOCEA region can best be described as being in its development stage. With about 19 coastal countries in the region only about two tide gauges in two countries (Nigeria-Lagos and Senegal-Dakar) are known to be fully functional and supplying data to PSMSL. This is because many of the tide gauge station lack spare parts, maintenance, consumables and trained personnel. Ghana is yet to report on the status of a tide gauge (OTT type) installed in Tema with the assistance of a German expert, Dr. B.S. Scharringhausen. The two stations in Dakar and Lagos are equipped with the Acoustic Next Generation Water Level Measuring System while the Lagos station is also equipped with the float type tide gauge supplied by the Government of Sweden and installed with the assistance of Dr. Scharringhausen.
- 55 In 1994 IOC asked the IOCEA GLOSS Regional Co-ordinator to assist in identifying those countries that would like to receive and install any of the 4 OTT tide gauges donated by the Government of Sweden. The Co-ordinator sent out a questionnaire to all the GLOSS contacts in 15 countries in the region. Only four countries (1) Sierra Leone, (2) Togo, (3) The Gambia, and (4) Côte d'Ivoire completed and returned the questionnaire. They all indicated their willingness to receive the tide gauges. The Nigerian Institute for Oceanography and Marine Research, Lagos, intends to install a tide gauge in Escravos estuary in the Niger delta and would be happy to receive one of the tide gauges. However, there was a general consensus that a national contribution in the form of funds to construct shelters and stilling wells was lacking. There is a need to pursue this aspect of tide gauge installation in these countries in the 1995 - 96 biennial.
- 56 In order to improve the GLOSS status in the IOCEA region, Dr. Awosika proposed to take the following actions:
- (i) An IOC mission to the following countries should be initiated - Côte d'Ivoire (Abidjan), Togo (Lomé), Ghana (Accra and Tema), Benin (Cotonou), Cameroon (Douala), Guinea (Conakry), Sao Tome, and Congo (Pointe Noire) to collect first hand information on the status of the GLOSS stations and the possibilities of either establishing the new stations or revitalizing the old ones.
 - (ii) There is a need to increase the number of tide gauge stations in the region. Efforts should be made to install the available four tide gauges in the countries that have indicated their readiness to accept and install them. IOC should also look into the possibility of providing token funds to

the recipients of the tide gauges. This will assist them to build shelters and ensure installation.

- (iii) Efforts should be made for the provision of regular maintenance of existing and proposed stations. Regular supply of tide gauge charts and any other consumables should form part of the GLOSS programme in the region.
- (iv) Transfer of data and information on tidal data between scientists in the region should be part of the programme. This could be incorporated in the data exchange network centre in Abidjan.
- (v) Efforts should be made to increase the participation of regional scientists in the Global sea level activities.

57 **The Group expressed** thanks to Dr. L. Awosika for his efforts in developing GLOSS network in the IOCEA region. **The Group requested** Dr. L. Awosika to bring these proposals to the attention of the next IOCEA session in May 1995. **The Group also requested** the Chairman, Dr. Pugh, to draw the attention of the forthcoming IOC Assembly to the need to assist the countries of the IOCEA region in establishing and maintaining GLOSS regional network through IOC regional activities and TEMA. **The Group recommended** that priority in provision of the 4 available tide gauges be given to the GLOSS sites in Côte d'Ivoire and Sierra Leone. **The Group requested** Dr. Awosika to assist the IOC Secretariat in arranging the provision and installation of the tide gauges in the proposed sites.

58 Dr. O. Zilberstein, National GLOSS Contact of the Russian Federation, presented the report on the status of GLOSS stations operated by the Federal Service for Hydrometeorology and Environmental Monitoring. The All-Russian Research Institute for Hydrometeorological Information - WDC-B collects the data and forward them to PSMSL. The only stations considered to be operational at present are: Murmansk (274), Barentsburg (231), Nagaev Bay (92), Petropavlovsk-Kamchatsky (93), Russkaya-Gavan (99) and Tuapse (98). In November 1994 the Yuzhno-Kurilsk (90) station was destroyed by an earthquake. There are no operational stations and no plan to install them at the Russian Antarctic stations, included in the GLOSS network (Leningradskaya [31], Mirny [25], Molodezhnaya [294], Novolazarevskaya [270] and Russkaya [135]). The inclusion of five more stations, proposed by the GE/GLOSS-III into the GLOSS network: Provideniya Bay (309), Kronstadt (310), Nakhodka (311), Dikson (312) and Tiksi (313) is yet being considered by the Federal Service for Hydrometeorology. Most data from these stations have not yet been transferred onto magnetic tape. Dr. Zilberstein noted that during the last few years the state of sea level monitoring stations in Russia has deteriorated significantly. Now actions are under way to restore the sea-level monitoring network in the Russian seas with particular attention to the Caspian Sea due to the fast increase of the Caspian sea level since 1977.

59 Dr. Zilberstein pointed out that Russia presently needs help in receiving high precision tide gauges, in transferring sea level data records of 5 new Russian GLOSS stations to a computer facility and in connecting TGBM at GLOSS stations to the Global Geodetic Reference System.

60 **The Group expressed** its thanks to Dr. Zilberstein for the report on the status of Russian GLOSS stations. **The Group also emphasized** the importance of sea-level data submission to the SOC-ISLP-Pac from the Yuzhno-Kurilsk station and **requested** Dr. Zilberstein to inform the GLOSS Technical Secretary on the assistance required to restore observations at this station.

61 **The Group welcomed** the offer of US NODC to assist Russia to convert sea level data records from the five new stations to computer facility within the framework of the bilateral project on the oceanography data rescue and the offer of Australia to assist in the organization of sea-level observations at the Russian Antarctic Stations.

62 **The Group requested** Dr. Zilberstein to investigate, as the first priority, the possibility to provide monthly and annual mean sea level from the 5 new Russian stations, especially Kronstadt to PSMSL and provide PSMSL with the details of all GLOSS stations of Russia to be included in the GLOSS Handbook.

63 Mr. E.A. Rodriguez informed the Group on the GLOSS development in the South American group of countries: Argentina, Uruguay, Chile and Brazil. 54 sites have been proposed for the GLOSS

network, of which 24 are operational and committed to GLOSS and 7 are in Category 4. Most stations are operated by the hydrographic services. He noted the successful results of the Sea-Level Training Seminar for Spanish/Portuguese speaking countries organized by Brazil in February 1993. Another similar seminar is scheduled to be held in Argentina at the end of 1995 subject to the availability of support from IOC. The Afro-America GLOSS Newsletter has been initiated by the Instituto Oceanografico da Universidade de Sao Paulo (Prof. A.R. de Mesquita) in 1994.

64 Several efforts have been made to upgrade existing GLOSS stations in the region including installation of 3 Next Generation Water Level Measurement Systems in Argentina with the support of NOAA/USA.

65 The Group wished to encourage the countries of the region to continue their collaborative efforts to promote the GLOSS development and requested the IOC to consider the possibility to support the proposed sea-level training seminar and the preparation and distribution of the "Afro-America GLOSS Newsletter".

66 Mr. Hans-Peter Rohde, the Representative of IHO, reported on the IHO Tidal Constituent Bank, managed by the Canadian Hydrographic Service through the IHB on behalf of Member States. Mr. Hans-Peter Rohde presented the Third Edition of the IHO Tidal Constituent Bank published by IHO in June 1994. All requests for information from the IHO Tidal Constituent Bank should be forwarded to the IHB or the Canadian Hydrographic Service.

67 In response to the question on the availability of the IHB dataset for scientists involved in tide modelling, Mr. Rohde informed the Group that according to IHO rules in addressing requests to IHB or CHS the intended use of the data in some detail required, particularly if there is any commercial aspect. Procedures for obtaining the data are described in the IHO Tidal Constituent Bank Station Catalogue. Mr. Rohde confirmed the willingness of IHO to assist the GLOSS contacts in providing the datasets to scientists and to continue its co-operation with IOC in promoting GLOSS development through better co-ordination of regional activities (such as Maputo Conference to be held in Maputo, Mozambique in April 1995), training and individual visits to the countries.

68 The Group expressed its thanks to Mr. Rohde for the offer of IHO to co-operate with IOC in promoting GLOSS development and requested the GLOSS Technical Secretary to maintain close contact with IHB on all matters related to GLOSS development. The Group recognized the value of tidal constants for research and invited IAPSO and PSMSL to continue discussion with IHB regarding the availability of IHO Tidal Constituent datasets for scientists.

69 Dr. T. Murty presented the report on the South Pacific Sea Level and Climate Monitoring Project as a joint initiative of South Pacific Forum Member States. The Project aims to help Pacific Island Countries and their Governments understand the scale, and implications of changing sea level and climate. There are eleven stations for monitoring sea level and climate equipped with SEAFRAME (Sea Level Fine Resolution Acoustic Measuring Equipment); in Manus, Majuro, Nauru, Tarawa, Honiara, Funafuti, Port Vila, Lautoka, Apia, Nuku'alofa and Rarotonga. Drawing on Australian and regional scientific and financial resources the project is an intensive study that will benefit to Pacific Islanders by the data collected on changes to sea levels and climate and which will also have useful short-term information.

70 The Group noted the long-term scientific value of the project as well as its usefulness for maintaining and upgrading the GLOSS network in the South Pacific, and providing training to the GLOSS operators in the countries of the region.

5. SATELLITE ALTIMETRY SEA-LEVEL MEASUREMENTS

5.1 EXPERIENCE OF INTEGRATION OF SATELLITE ALTIMETRY AND TIDE-GAUGE DATA

- 71 Dr. D. Pugh opened the discussion noting, in particular, the success of the TOPEX/POSEIDON satellite mission in providing global synoptic picture of sea-level topography with high level of precision (2 cm). This satellite mission as well as ERS satellite mission have proved that they could serve as another very powerful method for monitoring of sea-level variability and changes. Those measurements in combination with the *in situ* tide gauge measurements could provide complementary data for producing the products which will allow the monitoring of global and regional sea-level variability and changes.
- 72 Dr. P. Woodworth informed the Group on the Sea Surface Topography Mapping Project initiated by the Proudman Oceanographic Laboratory (POL) in 1993. The POL has been producing since 1993 altimetric topographic maps of the global ocean for studies of ocean circulation and climate. These maps are validated by, and blended with if necessary, *in situ* sea level data from tide gauges. The resulting maps show evidence for the mesoscale, the seasonal cycle and interannual variability. The interest in obtaining such a product has been expressed by several individuals.
- 73 Dr. B. Douglas reported on the activities of NOS/NOAA. He referred in particular to the demonstration products, produced by NOS/NOAA, on the average sea-level deviation (relative to October 1992 - September 1993 year) based on TOPEX-POSEIDON Data and Blended (ERS-1 and TOGA tide gauge data) sea-level anomaly maps for Tropical Pacific region.
- 74 Dr. C. Le Provost reported on the experimental activities of France to assimilate the satellite altimetry data in a high resolution general circulation model for the North and South Atlantic.
- 75 Dr. G. Mitchum reported on the experience of the TOGA Sea Level Centre in the application of satellite altimetry data for understanding and predicting of seasonal/interannual climate variability and changes.

5.2 FUTURE DEVELOPMENTS

- 76 **The Group agreed** that the combination of models, satellite altimetry and *in situ* GLOSS stations measurements would be necessary for the reliable monitoring and prediction of sea level variability and changes and for modelling of ocean circulation.
- 77 Mr. J. Withrow requested the Group to advise on the requirements for sea-level measurements by satellites including the numbers of sensors, class of sensors, accuracy and resolutions that can be addressed to CEOS, as the IOC/GOOS requirements for surface topography observations.
- 78 **The Group agreed** that although it was not its task uniquely to formulate such requirements it could provide some advice on this matter, from the point of view of its usefulness for ocean-atmosphere prognostic modelling. **The Group noted** the importance of satellite measurements of wind field (using the scatterometer), and air-sea fluxes for future satellite mission.
- 79 The importance of gravity satellite missions was emphasized for the development of precise geoid for oceanographic and geophysical research.
- 80 **The Group then discussed** the usefulness of satellite altimetry data for regional and practical application. It noted that many countries, especially developing countries, are not fully aware of the value of satellite altimetry information for their regional and local practical applications. The participants noted the potential usefulness of satellite altimetry data for climate studies, tidal models and coastal currents and diagnostic purposes. The present time/space resolution of satellite altimetry is at present quite inadequate for their use in predicting of storm surge and tsunami warning.
- 81 **The Group noted** the need to demonstrate the importance and value of satellite altimetry data for global, regional and local practical application and **recommended** that this aspect of sea level monitoring be included in future GLOSS related training activities.
- 82 **The Group wished** to encourage various GLOSS International centres to initiate producing global

and regional sea-level products merging the satellite altimetry data and *in situ* tide gauge measurements.

83 **The Group recommended** that the actions should be taken to publicize the usefulness of satellite altimetry data and to encourage their availability to all countries and individual scientists for research and practical applications.

6. **CONNECTION TO A GLOBAL GEODETIC REFERENCE SYSTEM-ABSOLUTE SEA LEVEL MEASUREMENTS**

6.1 IAPSO MEETING ON TIDE GAUGE BENCH MARKS

84 Dr. D. Pugh introduced this item. He brought to the attention of the participants the conclusions and recommendations of the Workshop of the IAPSO Tide Gauge Bench Mark Fixing Committee held at IOS, Wormley, December 1993.

85 The Workshop concluded that the advances in the Global Positioning System (GPS) now make it the best method for measuring vertical crustal motions at tide gauge stations to be used to monitor changes in absolute global sea level. The central role now foreseen for GPS should not be interpreted as reason to discontinue or reduce ongoing efforts in complementary techniques, most particularly VLBI and absolute gravimetry.

86 The Workshop had recommended that: (i) the President of MSLT Commission should formally request that the IGS take on additional duties of organizing and managing the operation of the GPS global sea level monitoring network as a fully integrated composed of the IGG-IERS International Terrestrial Reference Frame (ITRF); (ii) the PSMSL archiving system should be designed to provide the vertical crustal velocities derived from selected IGS solutions, along with explanation information including experts that can be contacted by users of the data.

87 The representative of the International GPS Service for Geodynamics and experts involved in global and regional GPS have been invited and attended this session.

6.2 INTERNATIONAL GPS (GLOBAL POSITIONING SYSTEM) SERVICE (IGS)

88 Mrs. R. E. Neilan, Director, IGS Central Bureau, presented the report on the IGS and co-operative partnership with GLOSS.

89 The IGS mission is to provide a service to support geodetic and geophysical research activities, through GPS data and data products. Presently a network of about 50 permanent precision P-code receivers produce GPS data on a daily basis. The IGS objective is to ensure accuracies of the IGS data and products to be sufficient to support scientific requirements including monitoring the deformation of the liquid Earth (sea-level, ice sheets, etc.), monitoring the deformation of the solid Earth and scientific satellite orbit determination. A map showing GPS stations is shown in Annex VII.

90 The IGS data and products that are readily available to users include GPS tracking station data, high accuracy GPS ephemerides, earth rotation parameters, the co-ordinates and velocities of the ground tracking station, and GPS satellite and clock information.

91 Mrs. Neilan then referred the recommendation of the IAPSO Workshop (Dec. 1993) and proposed to work together with GLOSS to:

- (i) gain better working knowledge of each other's system, organization, objectives and goals;
- (ii) review the station list and plan to demonstrate a joint implementation;
- (iii) define the areas where the IGS can assist GLOSS to establish GPS analysis for absolute sea-

level monitoring;

- (iv) address joint technical issues, such as monument stability, the motion of the tide gauge bench mark stations, local site ties errors, and improvement of the vertical.

92 Under this item Mr. Bjørn Engen, Director of Geodetic Institute of Norway informed the Group on Collocation of Permanent Geodetic Facility and Tide Gauges in Norway. The Norwegian tide gauges have over the last 10 years been modernized and rebuilt at stable locations. Data from all the tide gauge sites are downloaded every day to a control computer and analyzed on a regular basis. The permanent geodetic stations are all located with antenna monuments and plers on solid bedrock and a geodetic connection will be made between the tide gauge bench marks and the permanent geodetic station.

6.3 SELF (SEA LEVEL FLUCTUATIONS: GEOPHYSICAL INTERPRETATION AND ENVIRONMENTAL IMPACT) PROJECT

93 Prof. S. Zerbini, Project Co-ordinator, informed the Group on the Mediterranean project on Sea Level Fluctuation: geophysical Interpretation and environmental Impact - "SELF" being implemented by joint efforts of Italy, Switzerland, Greece, Germany, United Kingdom and recently joined Poland.

94 The participating institutions are working together to connect, on a global reference frame, an ensemble of selected tide gauges in the Mediterranean area in order to be able to contribute to estimate sea level changes. Fiducial reference stations and tide-gauges have been selected in the Mediterranean region and the GPS links have been provided between the (SLR/VLBI) fiducial stations and the tide gauges. Water Vapor Radiometers are used to improve GPS measurement procedures. Absolute gravity measurements are made at some sites to monitor vertical surface elevation changes. At the conclusion of the work, the results are expected to provide the necessary base to successfully approach the measurements of sea level fluctuations and to reliably assess the factors causing sea level rise.

6.4 GLOSS RESPONSE

95 **The Group expressed** its willingness and readiness to work closely with IGS, as proposed by Mrs. Nellan, to connect some GLOSS TGBM to global geodetic frame using the GPS techniques as one method enable the monitoring of the absolute sea level.

96 As the first pilot phase **the Group recommended** that IGS and GLOSS co-operatively plan and evaluate the process for accurate connection of Tide Gauge Bench Marks of GLOSS stations to the GPS geodetic stations. The following list of GLOSS TGBM stations was proposed based on the length of available tide gauge records and geographical distribution:

1. Stavanger (Norway) (proposed to be included in the GLOSS Network)
2. Vishakhapatnam (India) (GLOSS station 35)
3. Bermuda (UK), (GLOSS station 221 operated by NOAA/US)
4. Lagos (Nigeria) (GLOSS station 259)
5. Sydney (Australia) (GLOSS station 57)
6. Montevideo (Uruguay) (GLOSS station 300)/Mar Del Plata (Argentina) (GLOSS station 192)
7. Honolulu (USA) (GLOSS station 108)
8. La Jolla (SIO/USA) (GLOSS station 159)
9. Mawson (Australia) (GLOSS station 22)

97 This list will be considered further and revised after discussions and further examination of the access and resources available. Other TGBM GLOSS stations in close proximity to the GPS tracking stations, with a longer time series, and those GPS stations supporting precise satellite orbit determination (e.g., TOPEX/POSEIDON) will also be evaluated.

98 **The Group encouraged** the PSMSL, GLOSS Chairman and Technical Secretary and National GLOSS contacts to establish close contacts with IGS organization to work together in connecting the GLOSS TGBM to the GPS stations.

7. GLOSS PRODUCTS AND SERVICES

99 Dr. A. Tolkatchev presented this item. He pointed out that data analysis and product preparation required for scientific and/or practical application is an important element of GLOSS as defined by the GLOSS Implementation Plan.

100 The Group reviewed the existing products and services, produced by various international sea-level centres in the form of operational, global and regional sea level anomaly maps, specific publications containing the analysis of data for certain regions or selected locations, sea level data/information services on line or through PC disk files and/or CD-ROM and services. Several existing sea level products and services are shown in Annex V.

101 The Group recalled that Dr. M. Glass, Chairman of I-GOOS, had invited the Group to give particular attention to the GLOSS elements dealing with provision of products and services to various users considered as a main task of GOOS.

102 The Group then discussed and proposed other possible products and services of scientific and practical value which can be initiated by national and international centers. Those proposed products and services include:

- (i) regional and local sea-level products required for the coastal zone protection and management, particularly related to storm surges, tsunamis, coastal erosion;
- (ii) analysis of seasonal and interannual sea level variability and changes and sea level monitoring activities for certain oceanic regions; Indian Ocean; North and Tropical Atlantic; South Pacific, Southern Ocean, Arctic Ocean etc.;
- (iii) sea level anomaly maps based on the satellite altimetry and *in situ* measurements;
- (iv) preparation and wide dissemination of CD-ROM containing the available sea level data sets, detailed description of all GLOSS stations and relevant GLOSS information and documentation;
- (v) production of GLOSS bulletin and its dissemination through the electronic mailing system, such as World Wide Web.

103 Under this item Dr. A. Patwardhan, Carnegie Mellon University, USA, informed the Group on the Project on the Value of Information on Future Sea Level Rise and Climatology for Land Use Decisions in Coastal Areas. This project is an interdisciplinary study of climate and geophysical processes leading to sea level change and the importance of knowledge regarding these processes and associated forecasts of sea level change for decisions in coastal areas. A key element of the project is the valuation of information from research. In the context of coastal decision-making the appropriate variable is relative sea level which can be expressed as a combination of global mean sea level, regional variations, and local sea level, which depends in turn on land position.

104 The Group expressed its thanks to Dr. Patwardhan for his presentation and noted the value of such studies for bringing together observers, scientists and decision-makers in the application of sea level data, their analysis and predictions for decision models related to the coastal zone development and management.

8. TEMA RELATED ACTIVITIES

105 This item was introduced by Dr. A. Tolkatchev who pointed out that many developing countries participating in GLOSS require long-term regular assistance in the provision of instruments, spare parts, their installation and upgrading and training of the specialists in sea level observation and analysis.

- 106 Up-to 1995, training courses have been held with the support of IOC in Brazil (1993), France (1990), the People's Republic of China (1984), and the United Kingdom, 9 courses (1983-1991). Those courses were intended mainly for technicians and focused on tide-gauge installation, maintenance, operation, connection to local benchmarks and basic procedures for data reduction and interpretation. The training course in Brazil included some elements of sea-level analysis. Report on this training course was published as IOC Training Course Report No. 20. In 1993 India, with the support of IOC, organized training for two Vietnamese specialists in sea level observations, interpretation and analysis. Some training was organized through bilateral arrangements.
- 107 Due to the budgetary limitations no training courses were organized in 1994.
- 108 Two volumes of the IOC Manual on Sea-Level Measurement and Interpretation, prepared with the help of PSMSL, have been published in the IOC Manuals and Guides series No. 14. Volume I - Basic Procedures (1985) and Volume II - Emerging technologies (1994).
- 109 Provision of instruments and assistance in their installation are mainly done through bi-lateral and multi-lateral co-operation.
- 110 **The Group expressed** its concern that the 4 tide-gauges donated by Sweden and located in Germany have not yet been provided to the countries of the IOCEA region. This was mainly due to unpreparedness of the countries of the IOCEA region to install the gauges as most countries are unable to provide financial support for the construction of shelters and stilling wells. Many countries of the region require advice on the location and installation of tide gauges. **The Group requested** the IOC Secretary to consider possible support for the provision of the tide gauges and their installation in GLOSS sites of IOCEA with the priority to Côte d'Ivoire, Sierra Leone.
- 111 **The Group noted** that many countries of the IOCEA and IOCINCWIO regions will require sustainable support in the installation, maintenance and operation of tide gauges as well as training in sea level measurements, interpretation and analysis. Those requirements, particularly for training, were expressed at the Planning Workshop on Integrated Approach to Coastal Erosion, Sea-Level Changes and Their Impacts (Zanzibar, January 1994), IOCEA-III session (January 1993).
- 112 **The Group therefore wished to draw the attention** of IOC, IOCEA and IOCINCWIO bodies and IOC/TEMA Committee to the need to develop and support the training/assistance programme related to GLOSS.
- 113 **The Group reviewed** the list of requests for assistance provided by the GLOSS Technical Secretary in Document IOC/GE-GLOSS-IV/18.
- 114 **The Group expressed its support** for the Training Workshop on Sea Level Interpretation and Analysis proposed to be held in India in October/November 1995 to enable many GLOSS contacts and scientists of the Indian Ocean to be trained in sea-level analysis. The request for such assistance had been expressed at the Zanzibar Workshop by Bangladesh, India, Kenya, Madagascar, Malaysia, Maldives, Mauritius, Mozambique, Seychelles and Tanzania.
- 115 **The Group also requested the IOC** to consider possible support for the training seminar in Argentina for the South American countries.
- 116 Dr. T. Murty noted that Malaysia participates in the ASEAN/Australia project and NTF can consider the training of Malaysian specialists at the training course organized within the framework of the Project. Australia will also provide training for other countries of the ASEAN region as well as South Pacific who participate also in GLOSS. **The Group requested** the Technical Secretary to keep aware of GLOSS requirements for training in these regions.
- 117 **The Group expressed** the strong wish to resume the Sea Level training courses, held by POL/PSMSL annually from 1983-1991. The Technical Secretary was requested to investigate the possibility of providing some financial support for continuation of this course.

118 **The Group considered** the request of Cuba for training and **advised** on the specialists to be contacted to provide such training. The Chairman of the Group was requested to inform Cuba on the proposals of the Group.

119 **The Group wished again** to draw the attention of IOC, IOC regional bodies and TEMA to the need to develop a special TEMA programme related to GLOSS.

120 Due to the limited funds available in IOC, **the Group emphasized** the need to investigate the possibility of receiving support for GLOSS TEMA elements from other international (for example GEF) or national funds, such as JICA and SAREC. **The Group requested** the Chairman to liaise with GEF on possible funding of such activities.

121 **The Group also proposed** that GLOSS related training be included in other training courses on physical oceanography planned by IOC. In this connection the Group welcomed the offer of IHB to co-operate with GLOSS in organizing its training activities.

9. CHANGES IN THE GLOSS NETWORK

122 **The Group reviewed** the present status of the GLOSS network and discussed the necessary adjustments on the basis of the criteria developed at the Third session of the Group. Particular attention was given to the GLOSS sites proposed in the GLOSS Implementation Plan which have not yet become operational (as shown in Annex VIII).

123 Since active programmes have been reported in the IOCARIBE and the IOCEA regions, non-operational gauges from these areas were not considered by the Group in detail. Plans for some new gauges are already underway. The remaining non-operational stations were considered in two groups, those in the Antarctic and those elsewhere. **The Group made** the following recommendations:

GLOSS No.	Name (Country)	Comments
132	Balleny Is. (New Zealand)	No plans to install a gauge. Remove from network.
133	Scott Is. (New Zealand)	No plans to install a gauge. Remove from network.
269	Bouvet Is. (Norway)	Some discussions, but no plans to install gauge. Remove from network.
136	Peter Is. (Norway)	No plans to install a gauge.
91	Leningradskaya (Russia)	The National GLOSS Contact and the GLOSS Technical Secretary to check with the national authorities about plans for these stations.
25	Mirny (Russia)	
294	Molodezhnaya (Russia)	
270	Novolazarevskaya (Russia)	
135	Russkaya (Russia)	
20	Marion Is. (South Africa)	Difficult site, intermittent data only.
183	Palmer Is. (U.S.A.)	No plans to install a gauge. Remove from network, as there are other gauges not too far away.
187	South Georgia (U.K.)	No plans to install a gauge.

GLOSS No.	Name (Country)	Comments
279	Willis Is. (Australia)	Difficult site, bottom pressure recorder in the past. Remove from network.
2	Djibouti (Djibouti)	No information, but important location, so leave as in.
165	Clipperton Is. (France)	Dr. C. Le Provost was requested to investigate the plans to install a tide gauge.
104	Minami-tori-shima (Japan)	May happen with GPS.
110	Enewetok (Marshall Islands)	No plans to re-install a gauge.
232	Bjornoya (Norway)	No plans for a permanent station, but an anchored gauge was operated for a year at the southern end of the island. A gauge was also due to be deployed for a year at the northern end of the island.
298	Aves Is. (Venezuela)	The GLOSS Technical Secretary was requested to contact Venezuela to find out gauge status and plans.
299	La Orchila (Venezuela)	
304	Socotra Is. (Yemen)	No information, although contact has recently been re-established with the Yemen.
29	Minicoy (India)	No information.
41	Nicobar (India)	No information.
16	Agalega Is. (Mauritius)	Awaiting spare parts. The GLOSS Technical Secretary was requested to check the status of this gauge.
14	Aldabra (Seychelles)	The GLOSS Technical Secretary was requested to check the status. This site could be replaced by nearby Farquhar Is.
5	Muscat (Oman)	It has been moved to another location close by. Need to find out the name of that gauge and designate it as the GLOSS site.
147	Fanning Is. (Kiribati)	No longer exists. It is highly coherent with Christmas. Remove from network.
126	Kermadec Is. (New Zealand)	Gauge installation unlikely. Possibly to be removed from the network. Further investigation is required.
226	Alert (Canada)	A. Bolduc was requested to check the status of these. There are no plans for these, but there are other operational gauges in the western Arctic.
152	Sachs Harbour (Canada)	

New stations were proposed for Norway (Ny Alesund, Stavanger and Andenes) and for Oman (Masirah). The Director PSMSL was requested to investigate these.

- 124 **The Group requested** the GLOSS Technical Secretary to bring those proposals to the attention of national GLOSS contacts of relevant countries in order to receive their confirmation. The replies should be passed to PSMSL for preparation of the updated list of GLOSS stations. **The Group requested** the Technical Secretary to report on these actions as well those proposed at the Third session to the Fifth session of the Group together with the updated list of GLOSS stations.

10. GLOSS STRATEGY FOR NEXT DECADE: GLOSS AND GOOS

- 125 Dr. M. Glass, Chairman of the IOC-WMO-UNEP Committee on GOOS, presented a report on GOOS concept, development, structure and recent activities. He noted that GLOSS has been recognized by IOC as an existing operational element of GOOS and its contribution to the climate and coastal zone modules of GOOS will be of particular value. The GLOSS Group of Experts has become a subsidiary body of I-GOOS. GOOS will rely on existing systems such as GLOSS and also influence the GLOSS development by encouraging GLOSS to strengthen its activities related to products and services required for scientific and practical applications, using both GLOSS stations data as well as the satellite altimetry information. Dr. Glass noted that GOOS as a permanent operational oceanographic system would require long-term national support and will involve new relationships with customers, scientists, international scientific programmes and developing countries. It will require close partnership among countries in developing their capacities to enable all countries to participate actively in GOOS and to use GOOS data and information for practical and research applications. Regional approach for GOOS implementation was encouraged at the First Planning session of I-GOOS.

- 126 Some participants emphasized the need for GOOS to focus on an operational practical application related to the coastal zone, such as storm surge and tsunami prediction. Some participants expressed concern that the reallocation of national funds to operational oceanography under GOOS may undermine the research programmes which are crucial for the assessment and prediction of the state of the ocean and its interaction with the atmosphere. GOOS as stated by some participants is not yet well known in many countries.

- 127 **The Group then discussed** the approach to the development of GLOSS strategy for the next decade. The GLOSS Implementation Plan (IOC Technical series No. 35, UNESCO, 1990) prepared by the GLOSS Group of Experts and adopted by the Fifteenth Session of the IOC Assembly in 1989 has served as a strategy document for GLOSS planning and development.

- 128 Since the approval of GLOSS as a programme of IOC in 1985 many important developments have taken place. These include the progress in GLOSS itself and the establishment of GOOS, progress in the technology development, particularly in satellite altimetry and geodesy, and the need for strengthening GLOSS elements related to the products and services and capacity building.

- 129 **The Group recommended** that the Chairman, in collaboration with the GLOSS Technical Secretary and other GLOSS experts, prepare proposals on the preparation of the revised GLOSS Implementation plan for the Fifth session of the Group.

- 130 **The Group also invited** the Chairman to continue his close interaction with I-GOOS in order to ensure complementarity in the development of these systems and mutual benefit.

11. WORK PLAN FOR 1995-1997

- 131 In the light of the discussions under previous agenda items **the Group prepared** a plan of actions for 1995-1997 period, as shown in Annex VI, to be submitted to the Second session of I-GOOS and the Eighteenth IOC Assembly for approval and to identify required financial support.

- 132 The Group realized that the implementation of some of the proposed actions will depend on the availability of the required financial support from IOC and its Member States. **The Group requested** the

Chairman to inform the Second Session of I-GOOS and the Eighteenth Session of the IOC Assembly on the need to strengthen financial support for GLOSS, recognized by IOC as an existing successful element of GOOS with the participation of more than 80 countries and include relevant GLOSS aspects in the programme and budget of GOOS, IOC regional activities and TEMA. **The Group recommended** that IOC at its Assembly urge Member States to strengthen their support for GLOSS, and urge IOC regional bodies to include GLOSS development in their programmes for 1996-1997 period.

12. ADOPTION OF THE SUMMARY REPORT AND RECOMMENDATIONS

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

13. DATE AND PLACE OF THE NEXT SESSION

134 **The Group recommended** to hold its Fifth Session in early 1997. Several offers were made to host the Fifth Session: in Honolulu by TOGA SLC, in Goa by India and Monaco by IHB.

135 **The Group recommended** that the exact dates and place of the next meeting be considered and proposed by the Chairman in consultation with the IOC Secretary at a later stage.

14. CLOSURE

136 The Chairman closed the Session at 16h00 on 3 February 1995.

ANNEX I

AGENDA

- 1. ORGANIZATION OF THE SESSION**
 - 1.1 OPENING THE SESSION
 - 1.2 ADOPTION OF THE AGENDA
 - 1.3 DESIGNATION OF RAPPORTEUR
- 2. REVIEW OF GLOSS ACTIVITIES**
 - 2.1 PROGRESS REPORT
 - 2.2 STATUS OF GLOSS NETWORK
- 3. ACTIVITIES OF INTERNATIONAL SEA LEVEL CENTRES**
 - 3.1. PERMANENT SERVICE FOR MEAN SEA LEVEL (PSMSL)
 - 3.2. WOCE SEA LEVEL DATA ASSEMBLY CENTRES
 - 3.3 TOGA SEA LEVEL DATA CENTRE
 - 3.4 SPECIALIZED OCEANOGRAPHIC CENTRE FOR MEAN SEA LEVEL IN THE PACIFIC
- 4. RELATED SEA LEVEL REGIONAL ACTIVITIES**
 - 4.1 IOCARIBE SEA LEVEL PROGRAMME
 - 4.2 IOC-UNEP-WMO PILOT MONITORING ACTIVITY ON SEA LEVEL CHANGES AND ASSOCIATED COASTAL IMPACTS IN THE INDIAN OCEAN
 - 4.3 SEA LEVEL PILOT PROJECT FOR THE SOUTHERN OCEAN
 - 4.4 IGOSS SEA-LEVEL PILOT PROJECT IN THE NORTH AND TROPICAL ATLANTIC
 - 4.5 EUROGLOSS
 - 4.6 ASEAN SEA LEVEL PROGRAMME
 - 4.7 OTHER REGIONAL SEA-LEVEL PROGRAMMES/ACTIVITIES
- 5. SATELLITE ALTIMETRY SEA-LEVEL MEASUREMENTS**
 - 5.1 EXPERIENCE OF INTEGRATION OF SATELLITE ALTIMETRY AND TIDE-GAUGE DATA
 - 5.2 FUTURE DEVELOPMENTS

- 6. CONNECTION TO A GLOBAL GEODETIC REFERENCE SYSTEM-ABSOLUTE SEA LEVEL MEASUREMENTS**
 - 6.1 IAPSO MEETING ON TIDE GAUGE BENCH MARKS**
 - 6.2 INTERNATIONAL GPS (GLOBAL POSITIONING SYSTEM) SERVICE**
 - 6.3 SELF (SEA LEVEL FLUCTUATIONS: GEOPHYSICAL INTERPRETATION AND ENVIRONMENTAL IMPACT) PROJECT**
 - 6.4 GLOSS RESPONSE**
- 7. GLOSS PRODUCTS AND SERVICES**
- 8. TEMA RELATED ACTIVITIES**
- 9. CHANGES IN THE GLOSS NETWORK**
- 10. GLOSS STRATEGY FOR NEXT DECADE: GLOSS AND GOOS**
- 11. WORK PLAN FOR 1995-1996**
- 12. ADOPTION OF THE SUMMARY REPORT AND RECOMMENDATIONS**
- 13. DATE AND PLACE OF THE NEXT SESSION**
- 14. CLOSURE**

ANNEX II

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ANNEX III

LIST OF DOCUMENTS¹

Document Code	Title
IOC/GE-GLOSS-IV/1	Agenda
IOC/GE-GLOSS-IV/1 Add.	Timetable
IOC/GE-GLOSS-IV/2	Annotated Provisional Agenda
IOC/GE-GLOSS-IV/3	Summary Report
IOC/GE-GLOSS-IV/4	List of Documents
IOC/GE-GLOSS-IV/5	List of Participants
IOC/GE-GLOSS-IV/6	Progress Report
IOC/GE-GLOSS-IV/7	Sea Level Pilot Project in the Southern Ocean
IOC/GE-GLOSS-IV/8	GLOSS Network-Status
IOC/GE-GLOSS-IV/9	PSMSL
IOC/GE-GLOSS-IV/10	TOGA Sea Level Data Centre
IOC/GE-GLOSS-IV/11	WOCE Sea Level Data Assembly Centres
IOC/GE-GLOSS-IV/12	SOC for ISLP-Pac
IOC/GE-GLOSS-IV/13	IGOSS SLPP/NTA Project
IOC/GE-GLOSS-IV/14	GLOSS Development within the IOCARIBE
IOC/GE-GLOSS-IV/15	Pilot Activity on Sea Level Changes and Associated Coastal Impacts in the Indian Ocean
IOC/GE-GLOSS-IV/16	Satellite Altimetry Sea Level Measurements
IOC/GE-GLOSS-IV/17	Cancelled
IOC/GE-GLOSS-IV/18	TEMA Related Activities
IOC/GE-GLOSS-IV/19	GLOSS Strategy for 1996-2001

¹ For reference only. No stocks of these documents are maintained, except for the Report.

Document Code	Title
IOC/GE-GLOSS-IV/20	Draft GLOSS Plan of Actions: 1995-1997
IOC/GE-GLOSS-IV/21	GLOSS Products and Services
IOC/GE-GLOSS-IV/22	Conclusions and Recommendations of the IAPSO Tide Gauge Bench Mark Fixing Committee
IOC/GE-GLOSS-IV/23	Cancelled
IOC/GE-GLOSS-IV/24	EuroGLOSS
IOC/GE-GLOSS-IV/25	ASEAN Sea Level Programme
IOC/GE-GLOSS-IV/26	GLOSS IOCEA Status Report
IOC/GE-GLOSS-IV/27	International GPS Service for Geodynamics (IGS) and A Cooperative Partnership with the Global Sea Level Observing System (GLOSS)
IOC/GE-GLOSS-IV/28	SELF Project
IOC/GE-GLOSS-IV/29	Proposal to IAPSO/GLOSS/IOCEA for an Official Set of Tidal Constants for Global Modelling
IOC/GE-GLOSS-IV/30	Characterizing Information from Research: A Case Study of Sea Level Measurement Techniques
IOC/GE-GLOSS-IV/31	South Pacific Sea Level and Climate Monitoring Project
IOC/GE-GLOSS-IV/32	Current Status and Perspectives of Development of GLOSS in Russia
IOC/GE-GLOSS-IV/33	Contribution of EUREF to Geodetic Fixing of Tide Gauges in Europe

ANNEX IV

GLOSS STATUS - OCTOBER 1994

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

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

Table 1 lists the number of stations which fall into each category for all stations, then for the subset which have been "committed to GLOSS". ("Committed to GLOSS" means that formal commitments have been made by national authorities to IOC to keep gauges operational). Also shown are the numbers in each category reported at previous GLOSS meetings with the category definitions adjusted backwards one, two, three etc. years appropriately. The attached map shows geographical distribution of different categories of GLOSS stations.

Note that earlier we used the "GLOSS90" definition of GLOSS, whereas last year and this we have used "GLOSS93". However, I don't believe that modifies the statistics to a great extent.

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

Table 1

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

Number of Stations In Each Category (Committed to GLOSS)						
Category	Bidston GE Mtg. Jun 89	Miami GE Mtg. Oct 90	Vienna IUGG Aug 91	Paris GE Mtg. Oct 92	Nowhere Oct 93	Nowhere (pre-Bordeaux GE Mtg.) Oct 94
1	98	122	118	135	151	156
2	45	40	47	38	25	26
3	28	25	21	15	13	12
4	44	28	29	27	28	23
Total	215	215	215	215	217	217

using 'GLOSS Definition'	90	90	90	90	93	93
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A full breakdown of the status of each of the 308 GLOSS gauges is given in the following Tables.

COLUMN 1 = GLOSS NUMBER
COLUMN 2 = GLOSS SITE NAME
COLUMN 3 = RESPONSIBLE COUNTRY/TERRITORY
COLUMN 4 = COMMITTED TO GLOSS FLAG
COLUMN 5/6 = PSMSL COUNTRY/STATION CODE LATEST DATA
COLUMN 7 = YEAR OF LATEST PSMSL DATA

VERSION OF GLOSS USED = GLOSS93

262	LOBITO	ANGOLA	426/021	1975
185	BAHIA ESPERANZA	ARGENTINA	C A /001	1978
192	MAR DEL PLATA	ARGENTINA	C 860/101	1993
190	PUERTO DESEADO	ARGENTINA	C 860/011	1993
191	PUERTO MADRYN	ARGENTINA	C 860/031	1993
181	USHUAIA	ARGENTINA	C 860/002	1993
61	BOOBY IS.	AUSTRALIA	C 680/025	1991
58	BRISBANE	AUSTRALIA	C 680/079	1990
40	BROOME	AUSTRALIA	C 680/498	1989
59	BUNDABERG	AUSTRALIA	C 680/074	1990
52	CARNARVON	AUSTRALIA	C 680/480	1989
278	CASEY	AUSTRALIA	C	
47	CHRISTMAS IS.	AUSTRALIA	C 563/001	1990
46	COCOS IS. (KEELING)	AUSTRALIA	C 680/521	1990
62	DARWIN	AUSTRALIA	C 680/010	1988
277	DAVIS	AUSTRALIA	C	
54	ESPERANCE	AUSTRALIA	C 680/447	1989
53	FREMANTLE	AUSTRALIA	C 680/470	1990
148	LORD HOWE IS.	AUSTRALIA	C 680/122	1977
130	MACQUARIE IS.	AUSTRALIA	C 680/208	1974
22	MAWSON	AUSTRALIA	C	
124	NORFOLK IS.	AUSTRALIA	C 680/091	1990
51	PORT HEDLAND	AUSTRALIA	C 680/495	1989
55	PORTLAND	AUSTRALIA	C 680/232	1990
56	SPRING BAY	AUSTRALIA	C 680/200	1989
57	SYDNEY, FORT DENISON	AUSTRALIA	C 680/141	1993
308	THEVENARD	AUSTRALIA	C 680/440	1990
60	TOWNSVILLE	AUSTRALIA	C 680/053	1990
279	WILLIS IS.	AUSTRALIA	C 680/039	1981
12	EXUMA	BAHAMAS	C 941/021	1993
211	SETTLEMENT POINT	BAHAMAS	C 941/001	1992
36	CHITTAGONG	BANGLADESH	510/011	1991
120	MALAKAL	BELAU	C 710/021	1992
194	CANANEIA	BRAZIL	C 874/051	1986
198	FERNANDA DE NORONHA	BRAZIL	C 874/141	1972
196	ITAPARICA	BRAZIL	C	
200	PONTA DA MADEIRA	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	1991
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	1992
153	LITTLE CORNWALLIS IS.	CANADA	C	

224	NAIN	CANADA	C 970/134	1988
155	PRINCE RUPERT	CANADA	C 822/001	1991
152	SACHS HARBOUR	CANADA	C 970/203	1982
223	ST. JOHNS, NEWFLND.	CANADA	C 970/121	1992
156	TOFINO	CANADA	C 822/116	1991
254	PORTO GRANDE (ST. VICENTE)	CAPE VERDE	C 380/002	1990
174	ANTOFAGASTA	CHILE	C 850/012	1992
189	CAPTAIN PRAT (ANTARCTICA)	CHILE	C	
180	DIEGO RAMIREZ	CHILE	C 850/091	1991
176	JUAN FERNANDEZ IS.	CHILE	C 850/039	1992
137	PASCUA IS.	CHILE	C 810/003	1992
178	PUERTO MONTT	CHILE	C 850/051	1991
177	SAN FELIX IS.	CHILE	C	
175	VALPARISO	CHILE	C 850/032	1992
94	KANMEN	CHINA, PEOPLE'S REP.	C 610/016	1992
79	LAOHUTAN (DALIAN)	CHINA, PEOPLE'S REP.	C 610/044	1992
283	LUSI	CHINA, PEOPLE'S REP.	C 610/032	1992
247	XIAMEN	CHINA, PEOPLE'S REP.	C 610/005	1992
78	ZHAPO	CHINA, PEOPLE'S REP.	C 610/002	1992
170	BUENAVENTURA	COLOMBIA	C 842/011	1993
207	CARTAGENA	COLOMBIA	C 902/021	1993
171	TUMACO	COLOMBIA	C 842/021	1993
261	POINTE NOIRE	CONGO	424/021	1988
143	PENRHYN	COOK ISLANDS	C 775/001	1992
139	RAROTONGA	COOK ISLANDS	C 785/001	1992
166	I. DEL COCO	COSTA RICA		
167	QUEPOS	COSTA RICA	836/011	1992
257	ABIDJAN	COTE D'IVOIRE	C 405/002	1988
214	CABO SAN ANTONIO	CUBA	C 930/071	1992
276	GIBARA	CUBA	C 930/031	1992
215	SIBONEY	CUBA	C 930/016	1992
228	ANGMAGSSALIK, GREENLAND	DENMARK	C 980/071	1992
227	DANMARKSHAVN, GREENLAND	DENMARK	C	
225	GODTHAB/NUUK, GREENLAND	DENMARK	C 980/031	1993
315	ITTOQQORTOORMIT, GREENLAND	DENMARK	C	
237	TORSHAVN, FAEROES	DENMARK	C 015/011	1993
2	DJIBOUTI	DJIBOUTI	475/001	1972
169	BALTRA, GALAPAGOS IS.	ECUADOR	C 845/034	1992
172	LA LIBERTAD	ECUADOR	C 845/012	1991
1	SUEZ	EGYPT	330/041	1986
182	ACAJUTLA	EL SALVADOR	833/011	1991
122	SUVA	FIJI	C 742/012	1991
242	BREST	FRANCE	C 190/091	1994
165	CLIPPERTON IS.	FRANCE		
21	CROZET IS.	FRANCE		
131	DUMONT D'URVILLE	FRANCE		
96	DZAOUZI (MAYOTTE)	FRANCE	C 438/001	1992
23	KERGUELEN IS.	FRANCE		
204	LE ROBERT, MARTINIQUE	FRANCE	C 912/001	1984
205	MARSEILLE	FRANCE	C 230/051	1992
123	NOUMEA, NEW CALEDONIA	FRANCE	C 740/011	1992
142	NUKU HIVA, MARQUESAS IS.	FRANCE	C 805/011	1992
17	PTE DES GALETS, REUNION IS.	FRANCE	C 451/001	1986
24	ST. PAUL IS.	FRANCE		
202	CAYENNE, FRENCH GUIANA	FRENCH GUIANA		
140	PAPEETE, TAHITI	FRENCH POLYNESIA	C 780/011	1992
138	RIKITEA, GAMBIER IS.	FRENCH POLYNESIA	C 808/001	1992

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	1992
32	COCHIN	INDIA	C 500/081	1989
34	MADRAS	INDIA	C 500/091	1989
281	MARMAGAO	INDIA	500/065	1989
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	1989
68	AMBON	INDONESIA	C 590/001	1931
49	BENOA	INDONESIA	560/135	1990
291	CILACAP	INDONESIA	C 560/121	1931
50	KUPANG, TIMOR	INDONESIA		
69	MANADO (BITUNG)	INDONESIA	580/012	1990
45	PADANG (TELU BAYUK)	INDONESIA	560/032	1990
67	SORONG	INDONESIA		
292	SURABAYA	INDONESIA	C 560/162	1990
240	CASTLETOWNSEND	IRELAND	175/051	1978
239	MALIN HEAD	IRELAND	C 175/011	1992
80	HADERA	ISRAEL	C 320/016	1993
210	PORT ROYAL, KINGSTON	JAMAICA	C 932/011	1969
82	ABURATSU	JAPAN	C 645/021	1992
103	CHICHIJIMA	JAPAN	C 648/001	1992
88	HAKODATE	JAPAN	C 641/031	1992
85	KUSHIMOTO	JAPAN	C 642/141	1992
89	KUSHIRO	JAPAN	C 641/022	1992
86	NERA	JAPAN	C 642/061	1992
104	MINAMI-TORI-SHIMA	JAPAN	C	
83	NAGASAKI	JAPAN	C 645/064	1992
81	NAHA	JAPAN	C 646/024	1992
87	OFUNATO	JAPAN	C 642/022	1992
95	SYOWA	JAPAN	A /041	1991
8	MOMBASA	KENYA	470/001	1992
145	CANTON IS. PHOENIX IS.	KIRIBATI	C 750/012	1992
146	CHRISTMAS IS. LINE IS.	KIRIBATI	C 770/022	1992
147	FANNING IS. LINE IS.	KIRIBATI	C 770/013	1990
113	TARAWA, GILBERT	KIRIBATI	C 730/008	1992
307	WONSAN	KOREA, P.D.R.	C 625/011	1992
84	PUSAN	KOREA, REPUBLIC OF	620/046	1992
271	FORT DAUPHIN (TAOLANARO)	MADAGASCAR		
15	NOSY-BE	MADAGASCAR	440/002	1991
293	CENDERING/KUALA TERENGGANU	MALAYSIA	C 550/017	1992
43	PENGKALAN/TLDM/LUMUT	MALAYSIA	C 550/005	1992
27	GAN	MALDIVES	454/002	1992
28	MALE	MALDIVES	454/011	1992
110	ENEWETOK	MARSHALL ISLANDS	720/002	1979
111	KWAJALEIN	MARSHALL ISLANDS	C 720/011	1990
112	MAJURO	MARSHALL ISLANDS	C 720/016	1992
252	NOUADHIBOU (CAP BLANC)	MAURITANIA	C	
16	AGALEGA	MAURITIUS	C	
18	PORT LOUIS	MAURITIUS	C 450/012	1992
19	RODRIGUES	MAURITIUS	C 450/021	1992

267	ACAPULCO, GRO.	MEXICO	C 830/081	1990
161	CABO SAN LUCAS	MEXICO	C 830/020	1992
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
117	KAPINGAMARANGI, CAROLINE IS.	MICRONESIA FED. STATES	C 710/026	1992
115	POHNPEI, CAROLINE IS.	MICRONESIA FED. STATES	C 710/031	1992
116	TRUK, CAROLINE IS.	MICRONESIA FED. STATES	C 710/001	1990
119	YAP, CAROLINE IS.	MICRONESIA FED. STATES	C 710/011	1991
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
314	WALVIS BAY	NAMIBIA	427/001	1988
114	NAURU	NAURU	C 715/001	1991
127	AUCKLAND-WAITEMATA HBR.	NEW ZEALAND	C 690/001	1993
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		
134	SCOTT BASE	NEW ZEALAND	C	
133	SCOTT IS.	NEW ZEALAND		
101	WELLINGTON	NEW ZEALAND	C 690/011	1993
259	LAGOS	NIGERIA	C 420/004	1992
118	SAIPAN	NORTHERN MARIANA ISLANDS	C 700/011	1992
232	BJORNOYA (BEAR ISLAND)	NORWAY		
269	BOUVETEYA (BOUVET IS.)	NORWAY		
275	HONNINGSVAG	NORWAY	C 040/015	1993
230	JAN MAYEN IS.	NORWAY	012/001	1983
235	MALØY	NORWAY	C 040/211	1993
136	PETER IS.	NORWAY		
234	RORVIK	NORWAY	C 040/136	1993
5	MUSCAT (QABOOS PORT)	OMAN	487/021	1991
4	SALALAH	OMAN	487/001	1992
295	GWADAR	PAKISTAN	C	
30	KARACHI, MANORO IS.	PAKISTAN	C 490/021	1987
168	BALBOA	PANAMA	840/011	1993
208	COCO SOLO	PANAMA	904/006	1993
63	ALOTAU	PAPUA NEW GUINEA	670/006	1990
272	DARU	PAPUA NEW GUINEA		
65	RABAUL	PAPUA NEW GUINEA	C 670/021	1992
64	VANIMO	PAPUA NEW GUINEA		
173	CALLAO	PERU	C 848/032	1992
71	DAVAO	PHILIPPINES	C 660/121	1993
70	JOLO	PHILIPPINES	C 660/141	1993
72	LEGASPI	PHILIPPINES	C 660/021	1993
73	MANILA	PHILIPPINES	C 660/011	1993
246	CASCAIS	PORTUGAL	C 210/022	1991
244	FLORES, AZORES	PORTUGAL	C 360/041	1989
250	FUNCHAL, MADEIRA	PORTUGAL	C 365/001	1991
245	PONTA DELGADO, AZORES	PORTUGAL	C 360/001	1991
206	SAN JUAN	PUERTO RICO/USA	938/021	1992

231	BARENTSBURG (SPITSBERGEN)	RUSSIA	C 025/001	1993
312	DIKSON	RUSSIA		
97	KALININGRAD	RUSSIA	C 080/181	1986
310	KRONSTADT-SHEPELEVO	RUSSIA		
91	LENINGRADSKAY (ANTARCTICA)	RUSSIA		
25	MIRNY (ANTARCTICA)	RUSSIA		
294	MOLODEZHNYAYA (ANTARCTICA)	RUSSIA		
274	MURMANSK	RUSSIA	C 030/018	1993
92	NAGAEVO BAY	RUSSIA	C 630/011	1993
311	NAKHODKA	RUSSIA		
270	NOVOLAZAREVSKAYA (ANTARCTIC)	RUSSIA		
93	PETROPAVLOVSK-KAMCHATSKY	RUSSIA	C 630/021	1993
98	PORT TUAPSE, BLACK SEA	RUSSIA	C 300/001	1993
309	PROVIDENYA	RUSSIA	630/041	1989
135	RUSSKAYA	RUSSIA		
99	RUSSKAYA GAVAN	RUSSIA	C 030/001	1991
313	TIKSI	RUSSIA		
90	YUZHNO KURILSK	RUSSIA	C 630/001	1993
260	SAO TOME	SAO TOME & PRINCIPE		
253	DAKAR	SENEGAL	390/001	1966
14	ALDABRA	SEYCHELLES	441/001	1977
273	PORT VICTORIA, HODOUL IS.	SEYCHELLES	442/002	1991
256	ABERDEEN POINT	SIERRA LEONE	C	
44	SINGAPORE	SINGAPORE	555/002	1993
66	HONIARA	SOLOMON ISLANDS	C 734/002	1992
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 340/008	1991
243	LA CORUNA	SPAIN	C 200/030	1991
251	LAS PALMAS, CANARY IS.	SPAIN	C 370/045	1991
33	COLOMBO	SRI LANKA	520/003	1992
233	GOTEBORG	SWEDEN	C 050/032	1993
9	MTWARA	TANZANIA	C 460/001	1962
297	ZANZIBAR	TANZANIA	C 460/016	1992
39	KO LAK	THAILAND	C 600/021	1993
42	KO TAPHAO NOI	THAILAND	C 545/001	1993
125	TONGATAPU	TONGA	744/001	1992
203	PORT OF SPAIN	TRINIDAD AND TOBAGO	C 890/001	1990
121	FUNAFUTI, ELLICE IS.	TUVALU	C 732/011	1992
263	ASCENSION	U.K.	C 402/001	1993
221	BERMUDA, ST.GEORGES IS.	U.K.	C 950/011	1992
26	DIEGO-GARCIA IS.	U.K.	453/003	1992
266	EDINBURGH (TRISTAN DA CUNHA)	U.K.	C	
188	FARADAY (ANTARCTICA)	U.K.	A /003	1991
248	GIBRALTAR	U.K.	215/001	1990
236	LERWICK	U.K.	C 170/001	1993
241	NEWLYN	U.K.	C 170/161	1993
306	SIGNY, SOUTH ORKNEY IS.	U.K.		
296	SOUTH CAICOS	U.K.		
187	SOUTH GEORGIA (S.ATLANTIC)	U.K.	866/001	1959
264	ST. HELENA	U.K.	C 425/001	1993
305	STANLEY, FALKLAND IS.	U.K.	863/002	1993
238	STORNOWAY	U.K.	C 170/251	1993

302	ADAK, ALEUTIAN IS.	U.S.A.	C 820/011	1992
149	APRA HARBOUR, GUAM, MARIANAS	U.S.A.	C 700/001	1992
219	DUCK, N.C.	U.S.A.	C 960/063	1992
289	FORT PULASKI, GA.	U.S.A.	C 960/031	1992
107	FRENCH FRIGATE SHOALS, H.IS.	U.S.A.	C 760/016	1992
217	GALVESTON	U.S.A.	C 940/007	1992
287	HILO, HAWAII, HAW. IS.	U.S.A.	C 760/061	1992
108	HONOLULU, HAWAIIAN IS.	U.S.A.	C 760/031	1992
109	JOHNSTON IS. HAWAIIAN IS.	U.S.A.	C 760/011	1992
216	KEY WEST	U.S.A.	C 940/071	1992
159	LA JOLLA, SAN DIEGO	U.S.A.	C 823/071	1992
303	MASSACRE BAY, ATTU IS., ALASKA	U.S.A.	820/001	1966
218	MIAMI (HAULOVER PIER)	U.S.A.	C 960/002	1990
106	MIDWAY IS. HAWAIIAN IS.	U.S.A.	C 760/001	1992
290	NEWPORT, RI.	U.S.A.	C 960/161	1992
74	NOME	U.S.A.		
144	PAGO PAGO, AMERICAN SAMOA	U.S.A.	C 745/001	1992
183	PALMER (ANTARCTICA)	U.S.A.		
288	PENSACOLA, FLORIDA	U.S.A.	C 940/041	1992
151	PRUDHOE BAY, ALASKA	U.S.A.	C	
158	SAN FRANCISCO	U.S.A.	C 823/031	1992
100	SAND POINT, ALASKA	U.S.A.	C 821/006	1992
150	SEWARD, ALASKA	U.S.A.	C 821/017	1992
154	SITKA, ALASKA	U.S.A.	C 821/031	1992
157	SOUTH BEACH, OREGON	U.S.A.	C 823/016	1992
102	UNALASKA, ALEUTIAN IS.	U.S.A.	C 820/021	1992
220	VENTNOR (ATLANTIC CITY), N.J.	U.S.A.	C 960/091	1992
105	WAKE IS. MARSHALL IS.	U.S.A.	C 720/021	1992
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	485/001	1969
304	SOCOTRA IS.	YEMEN		

NUMBER OF STATIONS FOR EACH "RESPONSIBLE" COUNTRY/TERRITORY FOR EACH CATEGORY

CATEGORY 1:	LATEST DATA 1990 OR LATER. THIS DEFINES "OPERATIONAL" STATIONS.
CATEGORY 2:	LATEST DATA 1980 - 1989. THIS DEFINES "POSSIBLY OPERATIONAL" STATIONS!
CATEGORY 3:	LATEST DATA PRE-1980. THIS DEFINES "HISTORICAL DATA" STATIONS.
CATEGORY 4:	NO PREVIOUS PSMSL DATA EXIST.

IN BRACKETS IS SHOWN THE NUMBER OF GAUGES FOR THAT COUNTRY/TERRITORY IN EACH CATEGORY WHICH ARE "COMMITTED TO GLOSS"

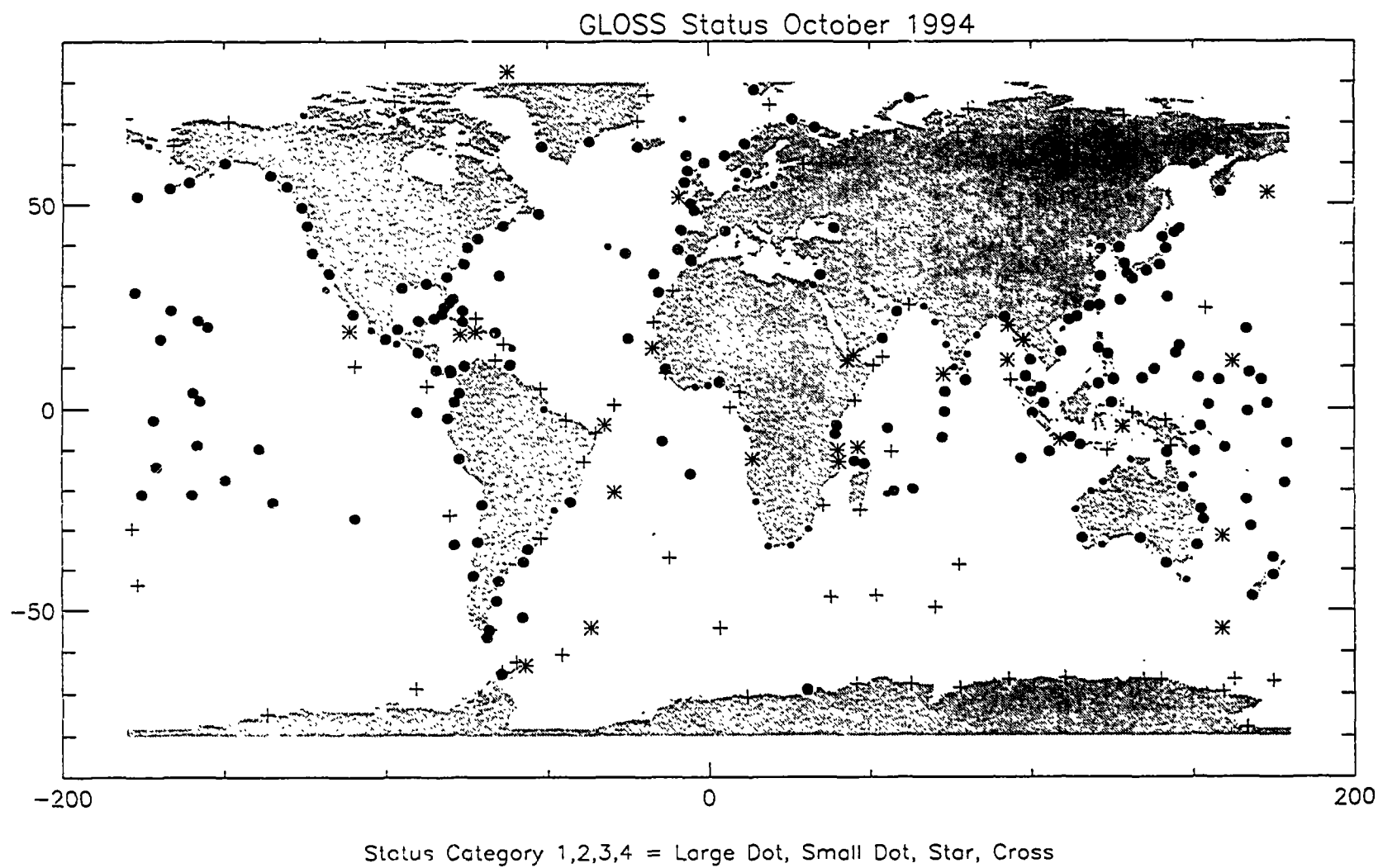
ANGOLA	0 (0)	0 (0)	1 (0)	1 (0)
ARGENTINA	4 (4)	0 (0)	1 (1)	0 (0)
AUSTRALIA	11 (11)	7 (7)	2 (2)	3 (3)
BAHAMAS	2 (2)	0 (0)	0 (0)	0 (0)
BANGLADESH	1 (0)	0 (0)	0 (0)	0 (0)
BELAU	1 (1)	0 (0)	0 (0)	0 (0)
BRAZIL	1 (1)	2 (2)	2 (2)	5 (4)
CAMEROON	0 (0)	0 (0)	0 (0)	1 (0)

CANADA	4 (4)	2 (2)	1 (1)	1 (1)
CAPE VERDE	1 (1)	0 (0)	0 (0)	0 (0)
CHILE	6 (6)	0 (0)	0 (0)	2 (2)
CHINA, PEOPLE'S REP.	5 (5)	0 (0)	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)	1 (1)	0 (0)	0 (0)
CUBA	3 (3)	0 (0)	0 (0)	0 (0)
DENMARK	3 (3)	0 (0)	0 (0)	2 (2)
DJIBOUTI	0 (0)	0 (0)	1 (0)	0 (0)
ECUADOR	2 (2)	0 (0)	0 (0)	0 (0)
EGYPT	0 (0)	1 (0)	0 (0)	0 (0)
EL SALVADOR	1 (0)	0 (0)	0 (0)	0 (0)
FIJI	1 (1)	0 (0)	0 (0)	0 (0)
FRANCE	5 (5)	2 (2)	0 (0)	5 (0)
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	0 (0)	5 (4)	2 (1)	1 (0)
INDONESIA	4 (1)	0 (0)	2 (2)	2 (0)
IRELAND	1 (1)	0 (0)	1 (0)	0 (0)
ISRAEL	1 (1)	0 (0)	0 (0)	0 (0)
JAMAICA	0 (0)	0 (0)	1 (1)	0 (0)
JAPAN	10 (9)	0 (0)	0 (0)	1 (1)
KENYA	1 (0)	0 (0)	0 (0)	0 (0)
KIRIBATI	4 (4)	0 (0)	0 (0)	0 (0)
KOREA, P.D.R.	1 (1)	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	2 (0)	0 (0)	0 (0)	0 (0)
MARSHALL ISLANDS	2 (2)	0 (0)	1 (0)	0 (0)
MAURITANIA	0 (0)	0 (0)	0 (0)	1 (1)
MAURITIUS	2 (2)	0 (0)	0 (0)	1 (1)
MEXICO	4 (4)	3 (3)	1 (1)	0 (0)
MICRONESIA FED. STATES	4 (4)	0 (0)	0 (0)	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)
NAMIBIA	0 (0)	1 (0)	0 (0)	0 (0)
NAURU	1 (1)	0 (0)	0 (0)	0 (0)
NEW ZEALAND	3 (3)	0 (0)	0 (0)	5 (1)
NIGERIA	1 (1)	0 (0)	0 (0)	0 (0)
NORTHERB MARIANA ISLANDS	1 (1)	0 (0)	0 (0)	0 (0)
NORWAY	3 (3)	1 (0)	0 (0)	3 (0)
OMAN	2 (0)	0 (0)	0 (0)	0 (0)
PAKISTAN	0 (0)	1 (1)	0 (0)	1 (1)
PANAMA	2 (0)	0 (0)	0 (0)	0 (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)
RUSSIA	7 (7)	2 (1)	0 (0)	9 (0)
SAO TOME E 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 ISLANDS	1 (1)	0 (0)	0 (0)	0 (0)
SOMALIA	0 (0)	0 (0)	0 (0)	2 (0)
SOUTH AFRICA	0 (0)	3 (0)	0 (0)	1 (0)
SPAIN	3 (3)	0 (0)	0 (0)	0 (0)
SRI LANKA	1 (0)	0 (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	1 (0)	0 (0)	0 (0)	0 (0)
TRINIDAD AND TOBAGO	1 (1)	0 (0)	0 (0)	0 (0)
TUVALU	1 (1)	0 (0)	0 (0)	0 (0)
U.K.	10 (6)	0 (0)	1 (0)	3 (1)
U.S.A.	24 (24)	0 (0)	1 (0)	3 (1)
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	0 (0)	0 (0)	1 (0)	1 (0)

NUMBERS IN EACH CATEGORY

183	35	26	64	GRAND SUM	308
156	26	12	23	GRAND SUM	217



ANNEX V

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

Operational products:

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

Pacific Ocean

Monthly maps of the Pacific sea level deviations from the long-term mean (Fig. 1);

Maps of the sea level anomalies from the long-term seasonal cycle that are corrected for atmospheric pressure anomalies (Fig. 2);

Time series of sea level deviations that are corrected for atmospheric pressure, but retain the seasonal variations;

Quarterly updates of an index of the tropical Pacific upper layer volume;

Annual updates of indices of the ridge-trough system and equatorial currents for the Pacific Ocean.

Demonstration Products:

National Ocean Service
NOAA, Rockville, USA

Global

Monthly Maps of Global Average Sea Level Deviations (relative to Oct. 92 - Sept. 93 year) for (TOPEX-POSEIDON data) (Fig. 3);

Tropical Pacific

Blended (ERS-1 and TOGA tide gauge data) sea-level anomaly. Interannual changes are relative to 1985-1986 mean (Fig. 4);

Proudman Oceanographic Laboratory
Bidston Observatory, UK

Global

Altimetric topographic maps of the global ocean for studies of ocean circulation and climate with these maps validated by, and blended with if necessary, *in situ* sea level data from tide-gauges (Fig. 5);

Special products on data summaries:

IOC/PSMSL

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

Sea-Level data/information services:

Permanent Service of Mean Sea Level

Proudman Oceanographic Laboratory, Bidston Observatory, UK

Provision of sealevel data to scientists via Internet;

"GLOSS Handbook" PC disk file, containing details of each GLOSS gauge;

"A Guide to Tide Gauge Networks and Global and Regional Data Sets" a prototype set for provision through the World Wide Web (WWW) information on contacts and access to data;

Data holdings of PSMSL Centre -annual catalogue of the PSMSL databank;

Provision of monthly mean sea level data on PC disk to the national Institutions participating in the IOC-UNEP-WMO Pilot Activity on Sea Level Changes and Associated Coastal Impacts in the Indian Ocean by PSMSL in 1993.

National Oceanographic Data Centre of USA/PSMSL/TOGA SLC

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

TOGA Sea Level Centre (TSLC)

University of Hawaii, Honolulu, USA

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

Annual reports of TOGA Sea Level Centre

Delayed Mode WOCE Sea Level Data Assembly Centre

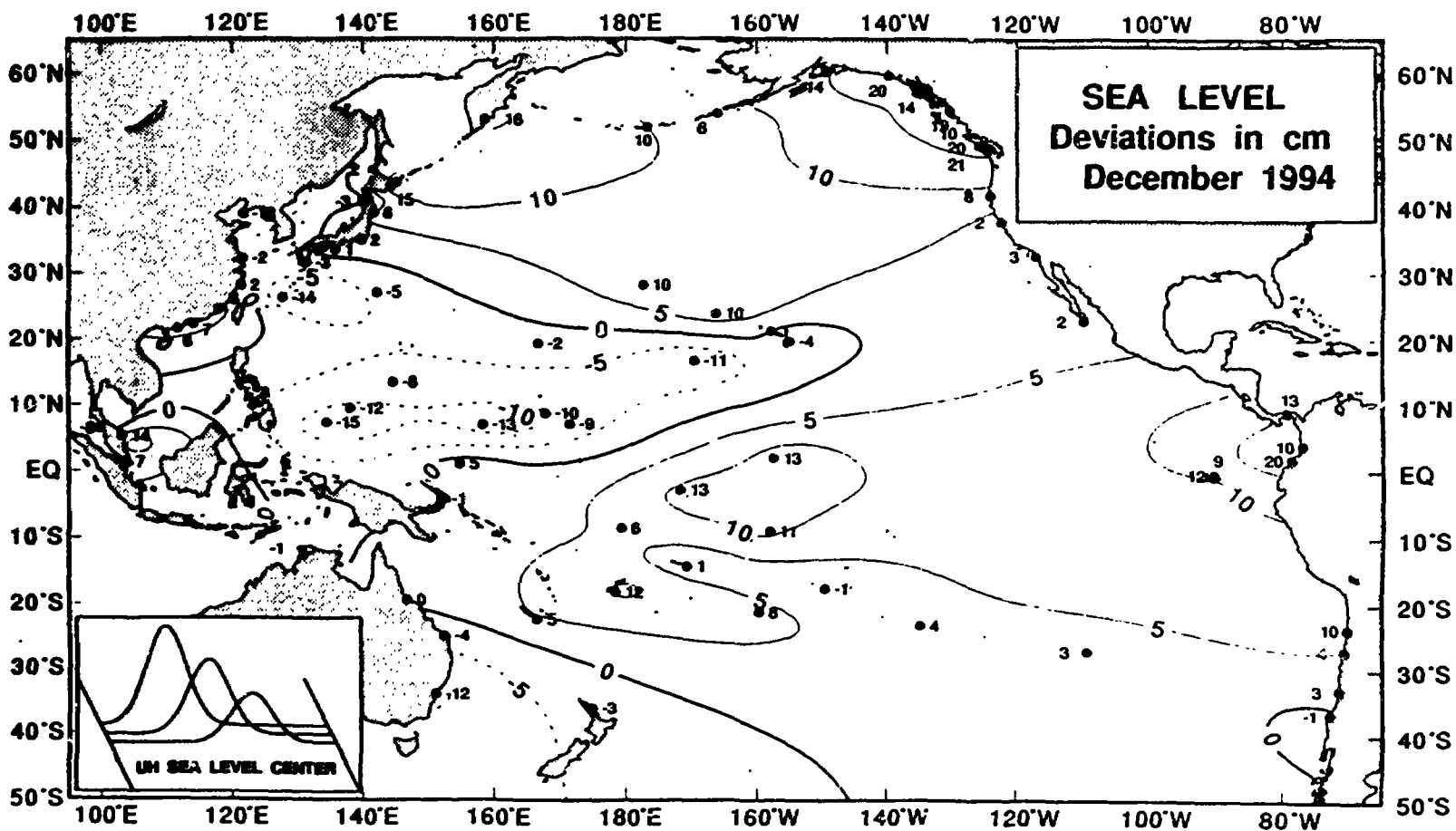
British Oceanographic Data Centre

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

The WOCE "Fast Delivery" Sea Level Data Assembly Centre

University of Hawaii, Honolulu, USA

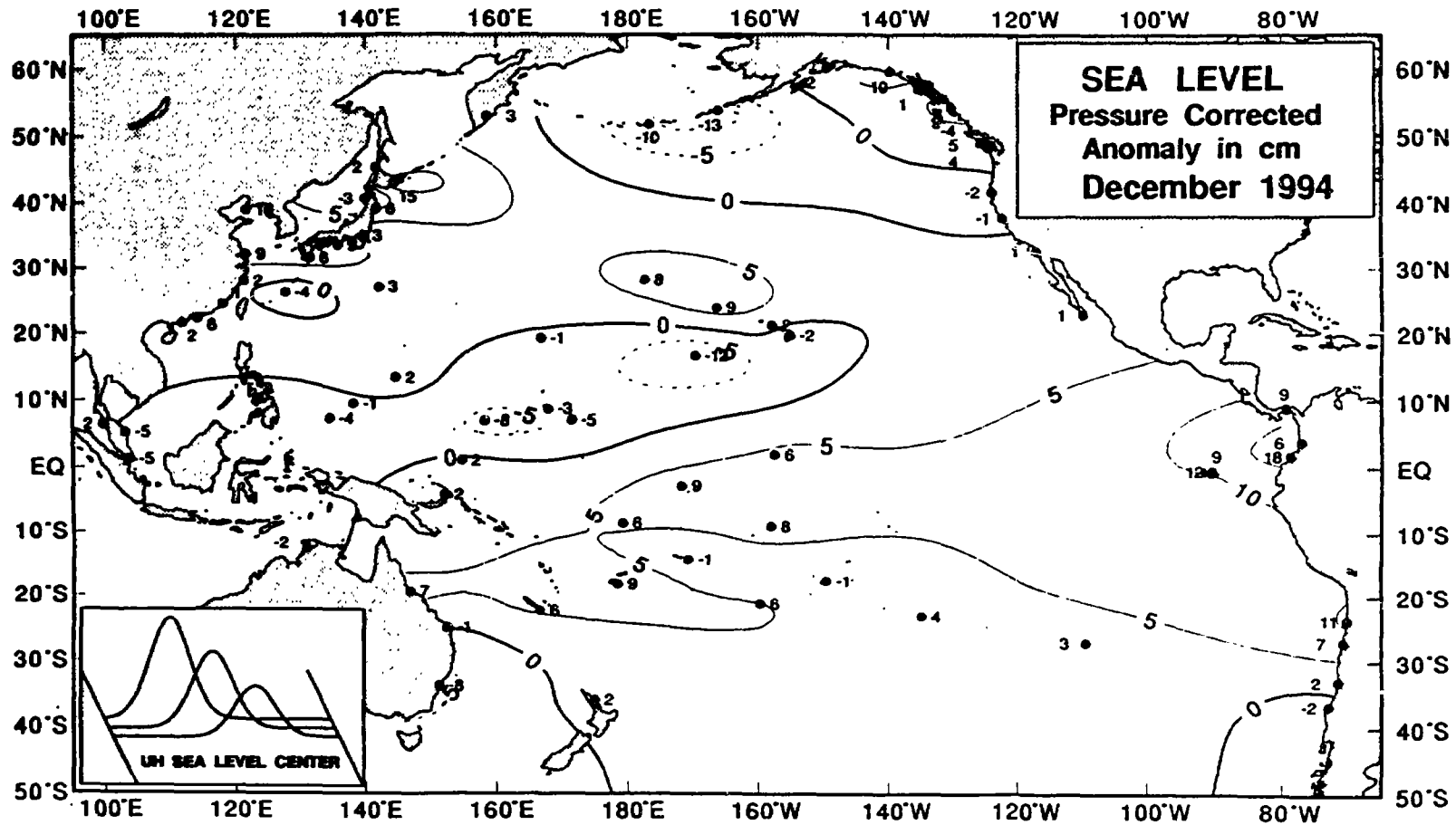
Distribution of the WOCE sea level data via the INTERNET computer network



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

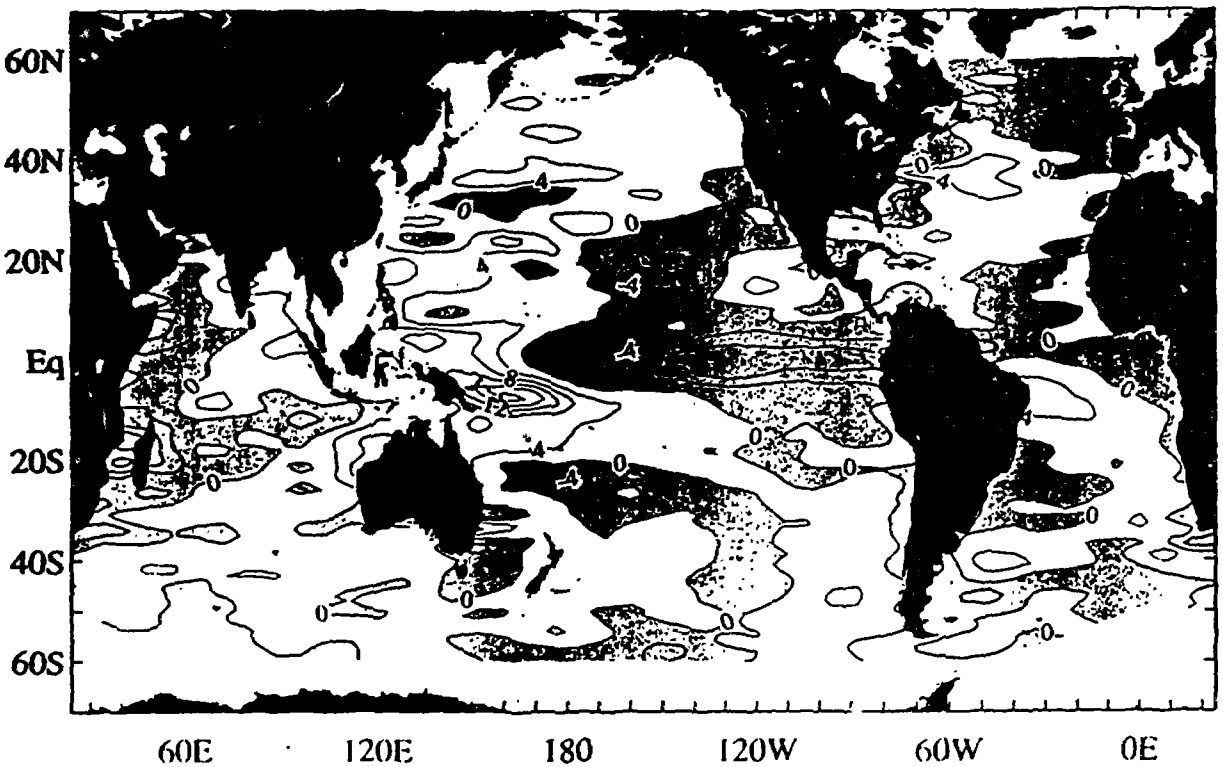
Figure 1. Specialized Oceanographic Center (SOC)
for the IGOS Sea Level Programme in the Pacific (ISLP-Pac)

Figure 2. Specialized Oceanographic Center (SOC)
for the IGOS Sea Level Programme in the Pacific (ISLP-Pac)



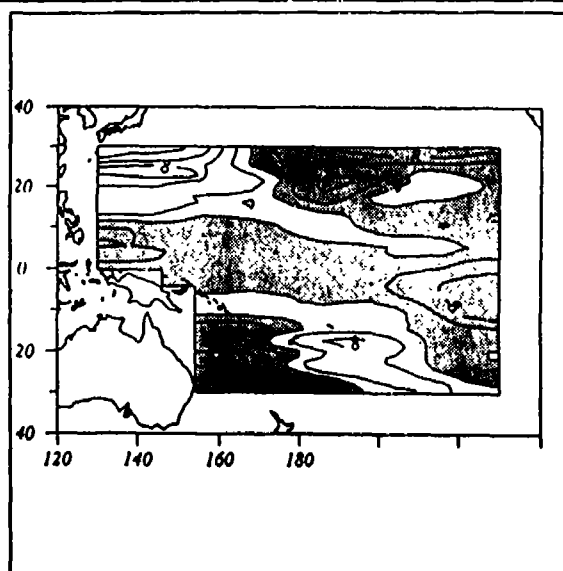
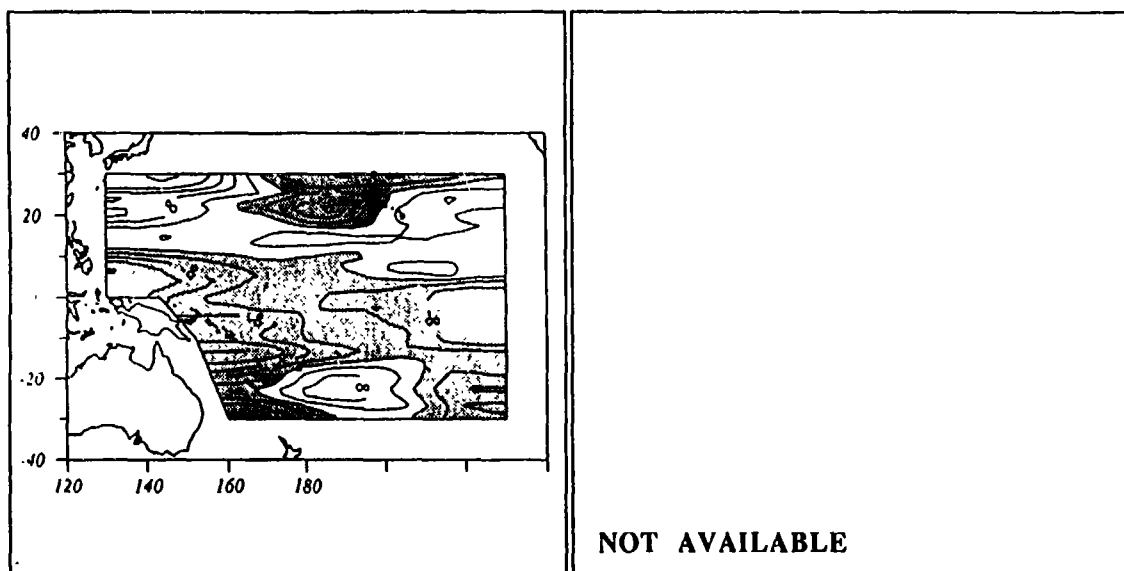
Anomaly of sea level from the 1975 to 1986 mean sea level
adjusted for atmospheric pressure.

Figure 3. National Ocean Service
NOAA, USA



Average sea level deviation (relative to Oct. 92-Sept. 93 year) for the last month of the period. TOPEX-POSEIDON data. 4 cm contour interval. <0 shaded.

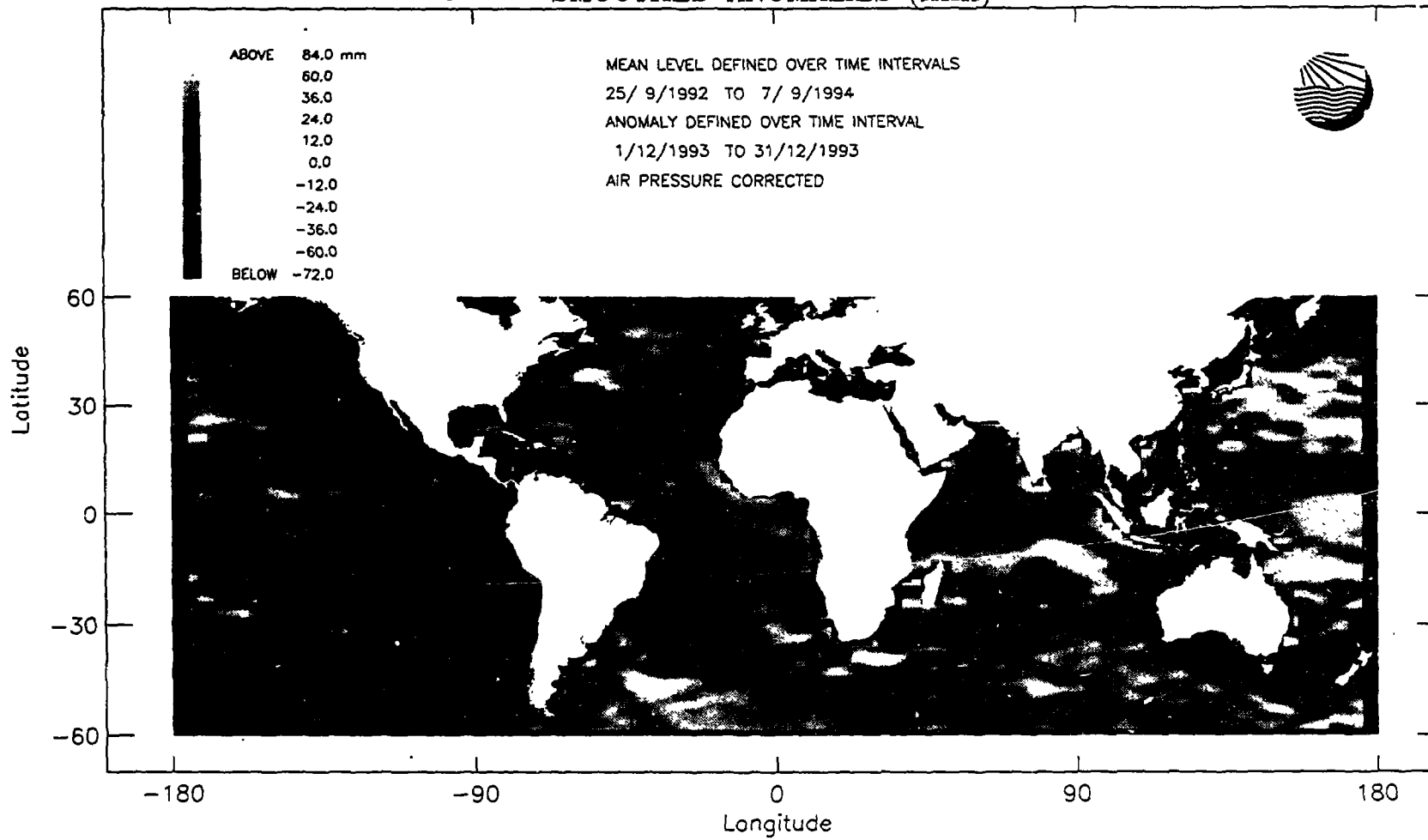
Figure 4. National Ocean Service
NOAA, USA



ERS-1 Altimetry

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

Figure 5. SMOOTHED ANOMALIES (mm)



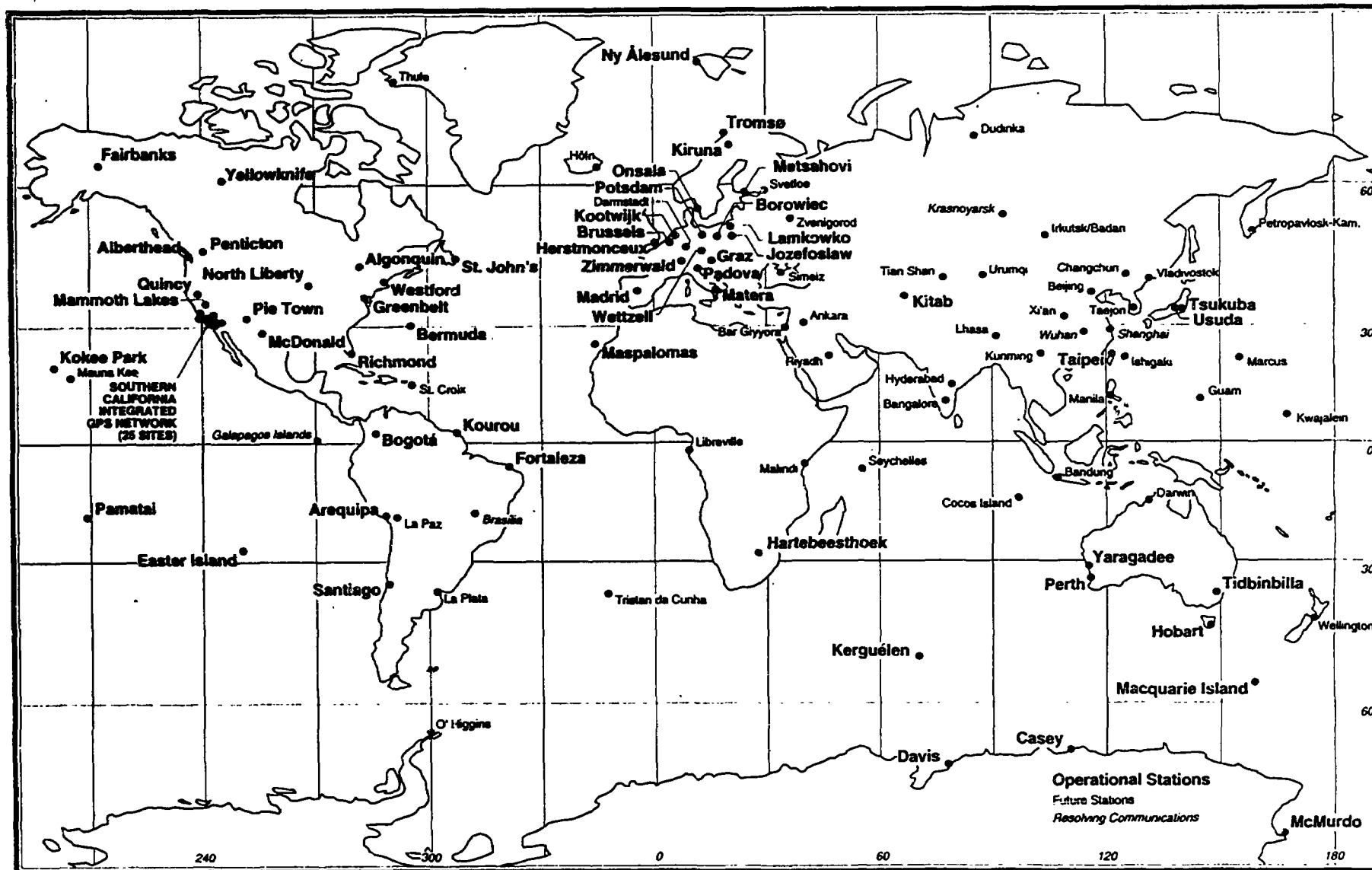
ANNEX VI

GLOSS PLAN OF ACTIONS 1995-1997

ACTIONS	1995-1997	RESPONSIBILITY
1. Presentation of GLOSS-IV report to I-GOOS-II and IOC-XVIII Assembly	June, 1995	D. Pugh, Chairman Technical Secretary
2. GLOSS/GOOS Training Workshop on Sea Level Analysis for the Indian Ocean countries (Sea Level Pilot Activity - CMAS)	October/November 1995	S. Shetye, B.C. Roy Technical Secretary PSMSL, TOGA SLC, NTF
3. Production and Distribution of GLOSS CD-ROM	1995-1996	PSMSL/NODC US, B. Douglas
4. Proposals on Sea-Level Products for North/Tropical Atlantic	1996-1997	A. Bolduc, P. Woodworth, R. Cheney
5. Other Training Seminars/Courses on Observations and Analysis including satellite altimetry		
* PSMSL/POL, UK	1996, 1997	PSMSL/POL
* South America	1996	E. Rodrigues,
* IOCARIBE	1997	G. Maul, IOCARIBE Sec.
* IOCEA	1996 or 1997	L. Awosika, IOCEA
* Collaboration with IHB in training activities	1995-1997	IOC/IHB
6. Preparation and distribution of demonstration (global/regional) blended sea-level products (maps) on satellite altimetry and coastal stations data and proposals for such products	1995-1997	PSMSL, NOS/NOAA, USA NTF/Australia, MEDS/Canada
7. Selection of GLOSS TGBM for connection to GPS geodetic stations and implementation of a pilot phase for such connections	1995-1997	IGS, PSMSL, National Contacts
8. Continued support of PSMSL activities	1995-1997	IOC/PSMSL
9. Promotions of GLOSS through GOOS, IOC Regional Bodies and TEMA and other relevant activities and visits to individual countries	1995-1997	Chairman, Technical Secretary Regional GLOSS Co-ordinators
10. Preparation of the updated GLOSS demonstration set	1996	Chairman, Technical Secretary
11. GLOSS-V Session	early 1997	Chairman, Technical Secretary
12. Proposals on the revision of the GLOSS Implementation Plan by GLOSS-V	1997	Chairman, Technical Secretary
13. Communication with individual countries on the proposed GLOSS Network adjustments	1995	Technical Secretary

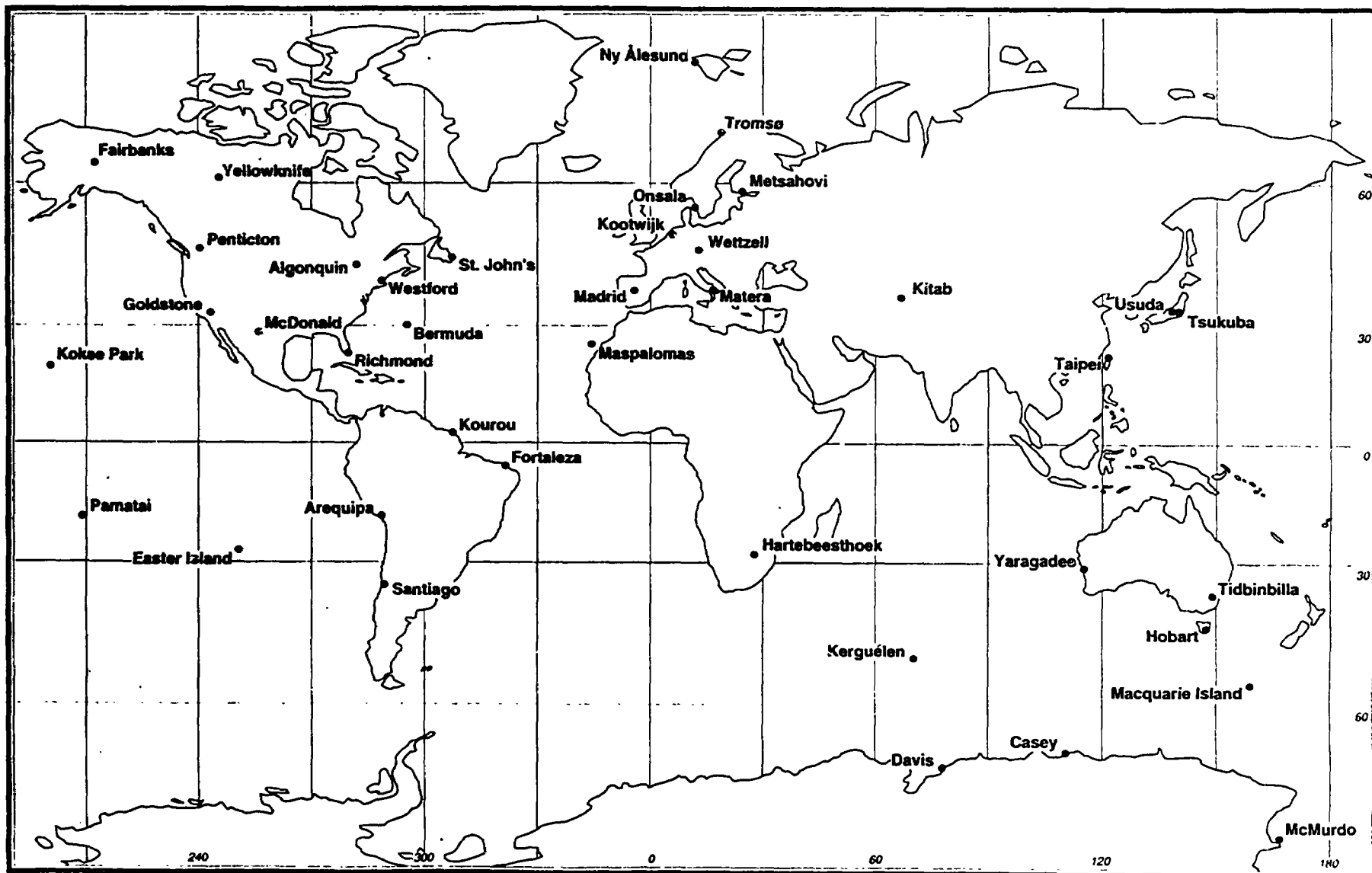
ACTIONS	1995-1997	RESPONSIBILITY
14. Summarized description of various sea-level centres (to be included in the GLOSS-IV report)	1995	Technical Secretary PSMSL/SOC-ISLP-Pac/ TOGA/WOCE SLCs/SOC
15. GLOSS Newsletter preparation and dissemination via WWW (World Wide Web)	1995-1997	PSMSL, Technical Secretary GLOSS contacts (input)
16. Preparation of an information paper on Sea-Level Measurements in the Arctic Sea for publication by IOC	1996	A. Bolduc, GLOSS contacts Technical Secretary
17. Preparation and publication of the papers submitted to the Workshop on Sea Level Variability and Southern Ocean Dynamics	1995	C. Le Provost, Authors Technical Secretary
18. Provision of tide gauges to the IOCEA countries (Côte d'Ivoire, Sierra Leone, Nigeria) and assistance in their installation	1995	Technical Secretary L. Awosika, Germany
19. Development of EuroGLOSS proposal	1996	P. Woodworth
20. Proposal on the maintenance of GLOSS stations in the Indian Ocean	1996-1997	S. Shetye, G. Mitchum
21. Implementation of the Pilot Activity on Sea Level Changes and Associated Coastal Impacts in the Indian Ocean	1995-1997	S. Shetye, CMAS Technical Secretary
22. Preparation of the paper on Sea Level Variability and Changes in the Indian Ocean for publication by IOC	1995-1996	S. Shetye, Technical Secretary
23. Provision of detailed information on GLOSS stations of Russia and sea-level data to PSMSL	1995-1996	O. Zilberstein Technical Secretary PSMSL/NODC US
24. Distribution of the revised GLOSS Handbook	1995	L. Rickards
25. Co-operation with IHB on Tidal Constituents Datasets for Scientific Purposes	1995-1996	IHB IAPSO
26. Publication and distribution of the report of GLOSS-IV	1995	Technical Secretary
27. Preparation and distribution of the "Afro-America GLOSS Newsletter"	1995-1997	A.R. de Mesquita (Brazil)

GPS TRACKING NETWORK OF THE INTERNATIONAL GPS SERVICE FOR GEODYNAMICS OPERATIONAL AND PLANNED STATIONS



January 1995

GPS TRACKING NETWORK OF THE INTERNATIONAL GPS SERVICE FOR GEODYNAMICS GLOBAL STATIONS †



† Processed by three or more IGS Analysis Centers, one of which is on another continent

January 1995

ANNEX VIII

LIST OF NON-OPERATIONAL GLOSS STATIONS
(February 1995)

No.	Station Name	Country/Territory	Lat.	Long.	Ocean/Sea
262	Lobito	Angola	12 20'S	013 34'E	Atlantic
279	Willis Is.	Australia	16x19'S	149x59'E	Pacific
197	Porto de Natal	Brazil	05x46'S	035x12'W	Atlantic
226	Alert	Canada	82x30'N	062x20'W	Arctic
152	Sachs Harbour	Canada	71x58'N	125x15'W	Arctic
261	Pointe-Noire	Congo	04x47'S	011x50'E	Atlantic
166	Isla del Coco	Costa Rica	05x33'N	087x04'W	Pacific
2	Djibouti	Djibouti	11x36'N	043x09'E	Indian
165	Clipperton Is.	France	10x17'N	109x13'W	Pacific
131	Dumont d'Urville	France	66x40'S	140x01'E	Southern
209	Port-au-Prince/Les Cayes	Haiti	18x34'N	072x21'W	Atlantic
29	Minicoy, Laccadive Is.	India	08x17'N	073x03'E	Indian
41	Nicobar	India	07x00'N	093x50'E	Indian
38	Port Blair, Andaman Is.	India	11x41'N	092x46'E	Indian
67	Sorong	Indonesia	00x53'S	131x15'E	Indian
240	Castletownsend	Ireland	51x32'N	009x11'W	Atlantic
104	Minami-tori-shima	Japan	24x18'N	153x58'E	Pacific
147	Fanning Is., Line Is.	Kiribati	03x51'N	159x22'W	Pacific
110	Enewetok	Marshall Islands	11x22'N	162x21'E	Pacific
252	Nouadhibou (Cap Blanc)	Mauritania	18x06'N	016x02'W	Atlantic
16	Agalega Is.	Mauritius	10x23'S	056x36'E	Indian
282	Tan Tan	Morocco	28x30'N	011x03'W	Atlantic
141	Moulmein (Mawlamyine)	Myanmar	16x29'N	097x37'E	Indian
132	Balleny Is.	New Zealand	66x35'S	162x50'E	Southern
126	Kermadec Is. (Raoul)	New Zealand	29x50'S	178x15'W	Pacific
134	Scott Base	New Zealand	77x51'S	166x40'E	Southern
133	Scott Is.	New Zealand	67x00'S	175x00'E	Southern
232	Bjornoya (Bear Island)	Norway	74x26'N	019x10'E	Atlantic
269	Bouvetoya (Bouvet Island)	Norway	54x22'S	003x22'E	Southern
136	Peter I. Oy	Norway	68x47'S	090x35'W	Southern
272	Daru	Papua New Guinea	09x03'S	143x12'E	Pacific
64	Vanimo	Papua New Guinea	02x41'S	141x18'E	Pacific
97	Kaliningrad	Russia	54x57'N	020x13'E	Baltic
91	Leningradskaya (Antarctica)	Russia	69x30'S	159x23'E	Southern
25	Mirny (Antarctica)	Russia	66x33'S	093x01'E	Southern
294	Molodezhnaya (Antarctica)	Russia	67x40'S	045x50'E	Southern
270	Novolazarevskaya	Russia	70x46'S	011x50'E	Southern
135	Russkaya	Russia	74x46'S	136x51'W	Southern
90	Yuzhno Kurilsk	Russia	44x01'N	145x52'E	Pacific
260	Sao Tome	Sao Tome & Principe	00x25'N	006x35'E	Atlantic
14	Aldabra	Seychelles	09x30'S	046x20'E	Indian
256	Aberdeen Point	Sierra Leone	08x30'N	013x14'W	Atlantic
6	Hafun (Dante)	Somalia	10x27'N	051x15'E	Indian
7	Mogadishu	Somalia	02x01'N	045x20'E	Indian
20	Marion Is.	South Africa	46x52'S	037x52'E	Indian
9	Mtwara	Tanzania	10x17'S	040x11'E	Indian
187	South Georgia, S. Atlantic	U.K.	54x15'S	036x45'W	Atlantic
303	Massacre Bay, Attu Is., AK	U.S.A.	52x50'N	173x12'E	Pacific
218	Miami, Haulover Pier	U.S.A.	25x54'N	080x07'W	Atlantic
183	Palmer (Antarctica)	U.S.A.	64x46'S	064x03'W	Southern
298	Aves Is.	Venezuela	15x39'N	063x35'W	Atlantic
299	La Orchila	Venezuela	11x48'N	066x08'W	Atlantic
3	Aden	Yemen	12x47'N	044x59'E	Indian
304	Socotra Island	Yemen	12 30'N	054 00'E	Indian

ANNEX IX

INTERNATIONAL SEA LEVEL CENTRES

1. The Permanent Service for Mean Sea Level (PSMSL)

Dr. P. Woodworth, Director, PSMSL,
Proudman Oceanographic Laboratory, Bldston Observatory, Birkenhead, MERSEYSIDE
L43 7RA, UNITED KINGDOM - Tel: (151) 653 86 33 - Fax: (151) 653 62 69 - E-mail:
plw@pol.ac.uk

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

2. Specialized Oceanographic Centre for the IGOSS Sea Level Programme in the Pacific (SOC for ISLP-Pac)

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

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

3. TOGA Sea Level Centre (TSLC)

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

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

4. WOCE Sea Level Data Assembly Centre - Fast Delivery Centre (WOCE-DAC)

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

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

5. WOCE Sea Level Data Assembly Centre - Delayed Mode Delivery (WOCE-DAC)

Dr. L. Rickards, British Oceanographic Data Centre

Proudman Oceanographic Laboratory, Bidston Observatory, Birkenhead, MERSEYSIDE L43 7RA, UNITED KINGDOM - Tel: (151) 653 86 33 - Fax: (151) 653 39 50 - E-mail: ljr@pol.ac.uk

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

6. Specialized Oceanographic Centre for the IGOSS Sea Level Pilot Project in the North and Tropical Atlantic

Dr. A. Bolduc, MEDS, Department of Fisheries and Oceans

200 Kent Street, Ottawa, Ontario K1A 0E6, CANADA - Tel: (1) 613 990 02 31 - Fax: (1) 613 990 55 10 - Tlx: 534228 - E-mail: bolduc@ottmed.meds.dfo.ca

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

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

International Hydrographic Bureau
7 avenue Président J.F. Kennedy, B.P. 445
MC - 98011 Monaco Cedex
PRINCIPALITY OF MONACO
Tel: (33) 93 50 65 87
Fax: (33) 93 25 20 03
E-mail: ihb@unice.fr

or

Canadian Hydrographic Service
615 Booth Street
Ottawa, Ontario, CANADA K1A 0E6
Tel: (1) 613 995 44 13
Fax: (1) 613 996 90 53

82. Second Meeting of the UNEP-IOC-ASPEI Global Task Team on the Implications of Climate Change on Coral Reefs
83. Seventh Session of the JSC Ocean Observing System Development Panel
84. Fourth Session of the IODE Group of Experts on Marine Information Management
85. Sixth Session of the IOC Editorial Board for the International Bathymetric Chart of the Mediterranean and its Geological/Geophysical Series
86. Fourth Session of the Joint IOC-JGOFS Panel on Carbon Dioxide
87. First Session of the IOC Editorial Board for the International Bathymetric Chart of the Western Pacific
88. Eighth Session of the JSC Ocean Observing System Development Panel
89. Ninth Session of the JSC Ocean Observing System Development Panel
90. Sixth Session of the IODE Group of Experts on Technical Aspects of Data Exchange
91. First Session of the IOC-FAO Group of Experts on OCLR for the IOC/INCWIO Region
92. Fifth Session of the Joint IOC-JGOFS CO₂ Advisory Panel Meeting
93. Tenth Session of the JSC Ocean Observing System Development Panel
94. First Session of the Joint CMM-IGOSS-IODE Sub-group on Ocean Satellites and Remote Sensing
95. Third Session of the IOC Editorial Board for the International Chart of the Western Indian Ocean
96. Fourth Session of the IOC Group of Experts on the Global Sea Level Observing System