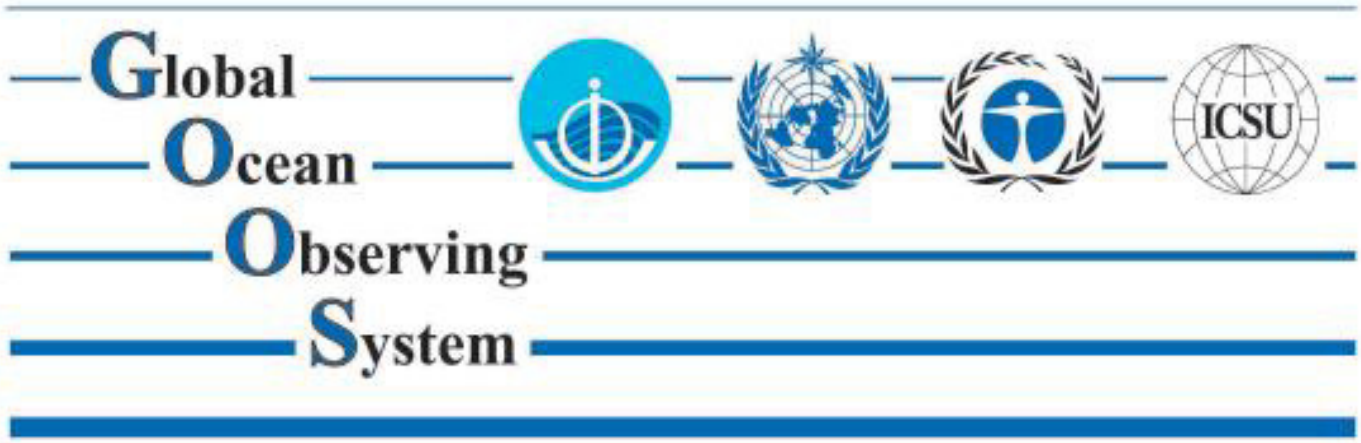

Intergovernmental Oceanographic Commission
Reports of Meeting of Experts and Equivalent Bodies

Electronic copy only

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

Eight Session
Paris, France
13 & 16 – 17 October 2003

GOOS Report No. 141
GCOS Report No. 90
JCOMM Report No. 27

UNESCO

Intergovernmental Oceanographic Commission
Reports of Meetings of Experts and Equivalent Bodies

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

Eight Session
Paris, France
13 & 16 – 17 October 2003

GOOS Report No. 141
GCOS Report No. 90
JCOMM Report No. 27

UNESCO 2004

IOC/GE-GLOSS-VIII/3
Paris, April 2004
English only

ABSTRACT

This report presents a summary of the topics discussed at the Eighth session of the Group of Experts on the Global Sea Level Observing System (GLOSS-GE). The GLOSS-GE reviewed the programme and made recommendations on the programme implementation. In connection with the GLOSS GE meeting a workshop on New Technical Developments in Sea and Land Level Observing Systems

(SC-2004/WS/38)

TABLE OF CONTENTS

page

ANNEXES

1. ORGANIZATION OF THE SESSION

1.1 OPENING OF THE SESSION

The Chairman of the GLOSS Group of Experts, Philip Woodworth opened the Eighth Session of the IOC Group of Experts on the Global Sea level Observing System at 0910 hours on Monday 13 October 2003.

Patricio Bernal, Assistant Director-General of UNESCO and Executive Secretary of IOC welcomed the participants. He recalled that GLOSS had been established in 1983; in the subsequent 20 years IOC had learned the meaning of the terms "feasibility of implementation" and of the "limitations in implementation". This engaged the need to review critically and continuously the range of user needs. So far, the interested IOC member states had participated in GLOSS (and other IOC programmes) on a voluntary basis, and this had proved valuable, but, to obtain significant applicable results, an ocean-observing system needs to be backed by a more formal organization. Even so, there remain ups and downs from place to place and from time to time in the operation of the system. The Executive Secretary noted that the GLOSS goal remains to achieve the best possible resolution and coverage for global sea level measurements and the best derived data products. The Executive Secretary also commended the GLOSS community for trying to attract funds for tide gauge installations through the European Commission's 6th Framework Programme and through collaboration with the IOC ODINAFRICA (Ocean Data and Information Network for Africa) programme. So the IOC is at a make-or-break point: whether or not to convert GLOSS to a fully operational global ocean-observing system in which governments are, as the primary beneficiaries, fully involved. The Executive Secretary finally informed the Group that the next IOC budget does include new programme funding for the development of GLOSS. In closing, he thanked the IOC member states that have offered to support the IOC in this GLOSS adventure, even though there are still many countries in which sea level observation is not given any priority.

1.2 ADOPTION OF THE AGENDA

The Chairman invited comments on the proposed Agenda. There being none, the Group accepted the Agenda for the present session (Annex I). The list of participants is provided in Annex II. The report of the Chairman of the Group of Experts on the Global Sea Level Observing System is in Annex III. The GLOSS Plan of Actions adopted by the Group following its deliberations at the present session is in Annex IV, and the list of Acronyms is in Annex V.

1.3 DESIGNATION OF THE RAPPORTEUR

The Chairman informed the Group that, in a break from customary practice, no Rapporteur would be designated from among the Group's members, and that the rapporteuring of the session and the drafting of the summary report would be entrusted to Thorkild Aarup (Technical Secretary) and Ray C. Griffiths (Editor). Svetlana Jevrejeva (PSMSL) offered to keep a separate set of notes should they be required for checking important items.

2. REVIEW OF GLOSS ACTIVITIES

The Chairman presented his report on GLOSS activities in the last two years (Annex III). The last [Seventh] session of the Group was held at the University of Hawaii, 26–27 April 2001 (GOOS Report 116; http://ioc.unesco.org/goos/docs/GOOS_116_GLOSS_GE7.pdf). He recalled that a GLOSS Workshop had taken place in Hawaii immediately prior to the Seventh Session and had been held in honour of Klaus Wyrtki, a pioneer in ocean-observing systems and one of the founders of GLOSS.

3. REPORTS ON SOME RECENT RELEVANT ACTIVITIES

3.1 GLOSS PARTICIPATION IN OTHER RELEVANT MEETINGS

The Chairman briefly summarized meetings at which GLOSS had been represented:

At the GCOS Regional Workshop for East and Southeast Asia on Improving Observing Systems for Climate (Singapore, 16–18 September 2002; GCOS Report No. 80; http://193.135.216.2/web/gcos/Publications/gcos-80.pdf). John Church represented GLOSS.

At the GCOS Regional Workshop for Western and Central Africa on Improving Observing Systems for Climate (Niamey, Nigeria, 27–29 March 2003; GCOS Report No. 85; http://193.135.216.2/web/gcos/Publications/gcos-85.pdf). Angora Aman represented GLOSS.

At the GCOS Regional Workshop for South America (Santiago, Chile 14–16 October 2003, a regional GLOSS status report was provided and is available at http://www.pol.ac.uk/psmsl/ge8/GCOS_SA3b.doc. Carlos Franca represented GLOSS.

A draft report of the Nineteenth Session of the International Tsunami Warning System (ITSU-XIX, Wellington, New Zealand, 29 September–3 October 2003) is available at http://ioc.unesco.org/itsu/files/GITSU19.pdf. Rodrigo Nunez represented GLOSS.

3.2 WORKSHOP ON NEW TECHNICAL DEVELOPMENTS IN SEA AND LAND LEVEL OBSERVING SYSTEMS

Wolfgang Scherer summarized the Workshop on New Technical Developments in Sea and Land Level Observing Systems (UNESCO, Paris, 14–16 October 2003). The report on the Workshop is in preparation; presentations from the workshop are available at http://www.pol.ac.uk/psmsl/reports.gloss/ge8/presentations/wspresentations.html.

The workshop had provided a good opportunity to compare new techniques now being applied. In that context it was emphasized that when changing to a new measuring technique, the new gauge and the old gauge should be run in parallel for at least a year in order to maintain the stability of the system. If changes are made, careful inter-calibration will be essential. It was considered important to identify the usefulness of a data set for a specific purpose. Ancillary parameters should also be measured. It was stressed that pressure sensors do not measure water level per se. Local dynamics must always be taken into account; a stilling well in a tide gauge also creates specific local conditions.

Following some useful follow-up discussion on the findings of the Workshop, the Chairman raised the question of the publication of the Workshop Report, which could be very

large, considering it better to have both a paper and an electronic version on CD-ROM which could include the PowerPoint presentations. He recommended that the instrument manufacturers who had participated in the Workshop should also be represented in the Workshop Report. Simon Holgate agreed to edit the Workshop Report. The Group of Experts agreed with the Chair's proposals.

4. SEA LEVEL CENTRES AND RELATED ACTIVITIES

4.1 PERMANENT SERVICE FOR MEAN SEA LEVEL (PSMSL)

The Chairman presented a report based on the 4-year PSMSL report to the IUGG (International Union of Geodesy and Geophysics) in July 2003. He apologized for not submitting a completely separate report to the GLOSS meeting, but the IUGG report had been written only a few months before and provided a good summary of PSMSL activities in the past four years, especially with regard to data acquisition achievements and challenges and, relevant to the present meeting, work performed by the PSMSL for GLOSS. The report can be obtained via http://www.pol.ac.uk/psmsl/reports/iugg4y03.pdf.

4.2 UNIVERSITY OF HAWAII SEA LEVEL CENTER (UHSLC)

Mark Merrifield reviewed the work of the UHSLC. The Center collects and distributes two basic sea level data sets: the Joint Archive for Sea Level (JASL, a research-quality data set) and the CLIVAR/GLOSS "fast delivery" data set. It is also the Specialized Oceanographic Centre (SOC) for Mean Sea Level in the Pacific, distributing products from data derived from the Joint IOC–WMO Technical Commission for Oceanography and Marine Meteorology (JCOMM) Sea Level Programme in the Pacific (SLP–Pac). Information on each of these activities can be found at http://www.soest.hawaii.edu/UHSLC/.

Since the inception of JASL, in 1985, the number of UHSLC responses to requests for data has increased from approximately 25 per year to 2125 in 2002. In the past year, the UHSLC increased its JASL holdings to 9344 station–years of hourly quality-assured data. Most of the data are still from the Pacific (5344 station–years), but the Atlantic (3053 station–years) and the Indian Ocean (721 station–years) data sets have now become substantial. The JASL data set now includes 4597 station–years of data in 256 series for 192 GLOSS sites. Of the 101 GLOSS sites now operating on islands, data from 93 of them have been acquired by UHSLC. Although the typical time lag between the collection of data and the public dissemination of the products is a few years, the 2002 submission of the JASL data to World Data Centre–A (Oceanography) included 110 series that contained data up to the year 2001. The next update of the data set at the World Data Centre is now under way.

In its role as the CLIVAR/GLOSS Fast Delivery Data Assembly Centre (DAC), the UHSLC has processed data from a globally distributed set of stations and makes the data set available to users within 1–3 months of data collection. The CLIVAR/GLOSS fast sea level data set now includes data from 141 stations, of which 113 are at GLOSS sites. The fast delivery sea level data set is used extensively in satellite altimetry assessment and calibration, notably for the Jason satellite series and for linking Jason, TOPEX/Poseidon, ERS (ESA Earth Remote-sensing Satellite) and GEOSAT (Geodetic Satellite). The UHSLC is developing a quasi-real-time data set of hourly (with 3-hour delay) and daily filtered values (with a 2-day delay); approximately 50 stations are currently available in real time, via the website and soon via an OPeNDAP server. The Center is also giving particular attention to

extreme values (high or low); for example, extremely low values have been seen to occur recently in the Gulf of Alaska. On the question of what may be understood by the terms "real time" and "fast" in respect of data acquisition/delivery, the UHSLC considers "real time" to be "within about two hours", and "fast" to be "about one month". However, acceptance of the delays depends to a significant extent on the needs of real-time ocean modellers.

The UHSLC is collaborating with the Pacific GPS facility in developing co-located Continuous GPS receivers at selected tide gauge stations (CGPS@TG), as part of the altimeter-calibration network, and as a means of providing local estimates of absolute sea level.

4.3 GLOSS/CLIVAR DELAYED-MODE SEA LEVEL DATA CENTRE

Lesley Rickards presented the work of the British Oceanographic Data Centre (BODC), which acted as the "delayed-mode" sea level data assembly centre for the World Ocean Circulation Experiment (WOCE), complementing the "fast-delivery" centre at the UHSLC. BODC's aim was to assemble, quality control and disseminate the comprehensive sea level data set for WOCE. The set comprises sea level data from over 160 tide gauges worldwide in 20 countries, from many types of instruments (e.g. float and stilling wells, pressure sensors, bubbler gauges, acoustic gauges and bottom pressure recorders), and the UK ACCLAIM data set from island gauges measuring sub-surface pressure and from bottom pressure recorders. They are usually hourly values, but some are at 15 or 6 minutes. A few sites recorded additional parameters (e.g. atmospheric pressure, air temperature, sea temperature, wind speed, gust wind speed and wind direction) and these were also archived. Data documentation (e.g. site histories, benchmark details, datum relationships, etc.) is also made available. Some new gauges were installed during WOCE. Several sites have data extending back over 80 years and approximately 35 extend over 40 years, and the total volume of data is over 3,550 site–years.

Regarding data availability, those at BODC are available via the web (including ACCLAIM) or the DODS (Distributed Oceanographic Data System) servers. Version 3.0 of the WOCE global data set is available on DVD or via DODS servers (Australia and USA). The DVD set includes the WOCE Integrated Search Tool (WIST), which is platform-independent. Data are also available in WOCE-netCDF and in ASCII formats. Other data sets included in the "delayed-mode" sea level folder on the DVDs are: tidal constants from the WOCE Sea Level Data Set, the PSMSL Monthly and Annual Mean-Sea Level Data Set.

The Centre maintains the GLOSS Station Handbook (available at http://www.bodc.ac.uk/services/glosshb/). Staff at the Centre also contributed to the review of sea level research during WOCE (Woodworth PL, Le Provost C, Rickards LJ, Mitchum GT, Merrifield M. 2002. A review of sea level research from tide gauges during the World Ocean Circulation Experiment. Oceanography and Marine Biology: an Annual Review, 40:1–35). BODC will continue to act as the "delayed-mode" sea level centre for CLIVAR, performing a similar role to that played in WOCE. It is currently requesting data from the data suppliers who have provided data for WOCE. This activity is just spinning up and a meeting of the CLIVAR DACS is scheduled to take place in the spring of 2004. Data will continue to be made available on the BODC website, both as ASCII and netCDF files. BODC also operates as a GLOSS Archiving Centre in collaboration with PSMSL. This builds on the work of the WOCE Sea Level Centre.

4.4 SOUTHERN OCEAN SEA LEVEL CENTRE

A decision by the International Hydrographic Organization in the spring of 2000 delimited a fifth world ocean - the Southern Ocean - from the southern portions of the Atlantic Ocean, Indian Ocean, and Pacific Ocean. The Southern Ocean extends from the coast of Antarctica north to 60 degrees south latitude, which coincides with the Antarctic Treaty Limit. The Southern Ocean is now the fourth largest of the world's five oceans (after the Pacific Ocean, Atlantic Ocean, and Indian Ocean, but larger than the Arctic Ocean). See http://www.odci.gov/cia/publications/factbook/geos/oo.html.

The Southern Ocean Sea Level Centre (SOSLC) seeks to improve knowledge of sea levels in the Southern Ocean and to foster increased international cooperation into Southern Ocean sea level research. Recognising the significance of the Southern Ocean in World scale circulation and its links with issues of climate change, the SOSLC aims to secure high quality, geodetically controlled sea level data from the Southern Ocean in order to:

- support oceanographic, geodetic and geographic research requirements for national and international programs (including GLOSS, GCOS and GOOS projects and initiatives sponsored by the SCAR Working Group on Geodesy and Geographical Information);
- enable a focus upon sea level measurements as indicators of ocean dynamics and in the context of climate change;
- assist in datum control for mapping and charting;
- supply tidal predictions for shipping and operational needs including the safety of ships, personnel and equipment.

The Centre will enable sea level observations from other Southern Ocean locations to become more readily accessible. An improved knowledge of sea level and tidal regimes in Antarctic waters will have other advantages for many other users and it is hoped the Centre will serve all those with an interest in the results.

A website has been established at the National Tidal Centre, a unit within the Australian Bureau of Meteorology at http://www.ntf.flinders.edu.au/TEXT/PRJS/SOUTH/south.htm. It contains links and information on not just the data holdings of the Centre but all the collaborators in other countries.

The Australian Antarctic Division maintains four gauges (plus backups) at Macquarie Island, Mawson, Davis and Casey, the three latter being on the Antarctic mainland. Data in delayed mode is processed and quality controlled by the NTC and made available on the website. Hourly data records for Macquarie Island, Mawson and Davis are available from 1993 to the present, whilst records at Casey are from 1996 to the present. All stations are now equipped with CGPS and precisely levelled on a routine basis.

4.5 GLOSS DATA BANKS: VARIOUS ITEMS

4.5.1 System Development

Lesley Rickards presented this topic. Regarding data input, there are currently four data streams to GLOSS: (i) monthly and annual means to PSMSL (i.e. for ALL sites not just GLOSS; i.e. typically 2,000 stations compared to 300); (ii) delayed-mode high-frequency data

to either UHSLC or PSMSL/BODC (NB: Can be satisfied by making data available on own website); (iii) fast-delivery to UHSLC; (iv) GPS data to the TIGA data centre of the International GPS Service.

These data streams are largely historical, building on expertise at the various organizations involved. A Southern Ocean Centre is now being provided by the Australian National Tidal Facility (see 4.4 and 9.13); and other regional centres are also being set up (e.g. ESEAS—European Sea Level Service, Caribbean, ODINAFRICA), holding more data than the GLOSS Core Network. The availability of more than one centre is good insurance in the event of problems either technical or financial with any one of them. In view of possible difficulties for data providers, there is a need to ensure that they are not obliged to provide the same data to more than one site.

Regarding data output, one focal point for data is advisable. In the short term, it would be advisable to utilize the improved GLOSS Handbook (without removing the UHSLC or BODC sites) for data access fast, delayed, mean sea level. The advisability of access to TIGA and links to national and regional sites needs to be considered. In any case, there is a need to ensure good co-operation between UHSLC and PSMSL/BODC (by annual exchange of data), so that "mirror" sites can be operated for delayed-mode data.

In the medium term, the plans outlined by COOP (see below) and US IOOS DMACs (data management and communications systems) for virtual data centres need to be considered, and a link with the JCOMM–IODE Expert Team on Data Management Practices (ETDMP) for the technical side (e.g. the E2EDM—End-to-End Data Management—pilot project) should be maintained.

*The objective is to develop an integrated DMAC that efficiently transmits large volumes of multi-disciplinary data (in real-time, near-real-time, and delayed modes) from many sources (*in situ *measurements, autonomous* in situ *sensors, remote sensors) directly to users for a broad range of applications, including data-assimilating models that process the measurements into maps, plots, forecasts and environmental statistics (e.g. climatologies). The system should provide a user interface that allows non-experts or external customers to access data and obtain answers to practical questions, as well as providing the professional scientist, engineer, or value-added specialist, with a mechanism for manipulating, merging, processing, and modelling data to achieve specialized products. The data-management system is also an essential tool for assessing, designing, managing and up-grading GOOS. To these ends, the development of DMAC must be co-ordinated with the development of the observing and modelling subsystems to ensure that there are no delays in achieving operational status.*

There is a need to agree to a common format. In the past, the UHSLC "card image" was a format widely used, especially as software freely available, but it was designed for hourly values and one parameter only. More recently, for WOCE, netCDF was adopted, and both fast-mode and delayed-mode centres use this; although agreement is not total, it is quite good. Software tools are available for netCDF files, but the format is more complicated. Other ASCII formats ("column" or "spreadsheet") can be used for more than one parameter and times other than hourly, but there is no agreed format of this type at present, although ESEAS may develop one. The use of XML is another possibility.

There has been progress in facilitating use of data in different formats, especially in view of the high demand for national, regional, and global data sets for a variety of purposes. There is some preference also for separating the archival and the application/data product

functions, which may require giving specific data centres specific responsibilities for specific sites. And some countries may prefer to make their data available online, leaving the GLOSS data centres to process them. Such developments, if adopted, would then be incorporated into the “GLOSS Handbook”.

The Group of Experts welcomed the efforts to establish a common data format for the GLOSS data centres and ease the delivery of sea level data to the centres. At the same time the Group emphasized the importance of developing a seamless "one stop shop" for sea level data and it asked UHSLC and BODC to work towards this.

4.5.2 Observations of other parameters than Sea Level

The GLOSS Implementation Plan specified a requirement for meteorological measurements at GLOSS gauges: atmospheric pressure and air and sea temperatures are relatively straightforward, whereas winds are more difficult. In addition, the GOOS Coastal Ocean Observations Panel have suggested using gauges as "data portals" through which data on other parameters could be routed.

However, from a GLOSS sea level centre perspective, there is not much expertise or manpower available at the centres to handle these data types. Therefore, a careful choice will have to be made, as a function of real needs and real capability. In so doing, the importance of the frequency of observation (for sea level as well as other parameters), with respect to the calculation of averages and decisions on data products, will have to be borne in mind. This will also influence the role of data centres in providing metadata information; and in turn, the preservation of a clear link between the creators of data and the corresponding data products.

4.5.3 Data Archaeology Projects

A letter was circulated to the GLOSS contact list and to the IODE (International Oceanographic Data and Information Exchange) address list in August 2001 requesting all countries to assess their holdings of historical tide gauge data which could be rescued, and convey that information to the Permanent Service for Mean Sea Level (PSMSL), which will act as the contact point. The GLOSS Group of Experts undertook to put countries in communication with each other and with sea level centres regarding collaborative data rescue. The GLOSS and other important sites (e.g. those with long records) should be regarded as priority sites.

To date, replies have been received from 26 countries (Australia, Belgium, Brazil, Canada, Congo, Denmark, France, Germany, Greece, Hong Kong, India, Israel, Italy, Japan, Malta, Netherlands, New Zealand, Norway, Peru, Russia, Slovenia, South Africa, Spain, Thailand, Turkey, UK). Not all of these have data to be digitised. Pat Caldwell of the University of Hawaii Sea Level Center has recovered some data from Brazil. A summary of the information received is available at www.bodc.ac.uk/projects/slarch. A follow-up letter, to elicit more responses, will be sent soon.

In Europe, a 3-year EU-funded sea level project titled European Sea Level Service—Research Infrastructure (ESEAS–RI) has recently begun. One of the tasks of this project is to carry out a comprehensive survey of potential data (charts etc.) for data archaeology in Europe. For some selected tide gauges (e.g. in the eastern part of the Baltic Sea, the Adriatic), older analogy records will be digitised and the hourly values, with available digital data, will be made available through a web interface. Participants have been contacted and requested to

complete a similar questionnaire to that circulated for the GLOSS Data Archaeology survey. Catalogues of replies expect to be completed by the end of October 2003. Some ESEAS participants have already started to digitise their data.

It should also be borne in mind that some data are also available in paper form (maps, charts etc.); some of these have been recovered by Patrick Caldwell (UHSLC) and some are available on the BODC website. They have been used to improve the GLOSS questionnaire concerning sea level data archaeology.

4.6 GLOSS DATA SOLICITATION

The Chairman thanked Stan Wilson for his efforts to improve communications on sea level data exchange with several countries. India might be taken as an example. Stan Wilson informed the Group of Experts that oceanographic real-time data available on the Indian Ocean included 3-hour scatterometry, 3-hour altimetry, and other important data sets. Therefore, it was essential to pursue initiatives on coastal-zone sea level tide gauges with data available in near-real time (i.e. days).

The Group recognized that it was necessary to renew the call for sharing all GLOSS data (MSL, high frequency delayed mode, high frequency fast mode and data from GPS-stations close to GLOSS gauges), with the intervention of the IOC Executive Secretary if appropriate.

4.7 GLOSS HANDBOOK UPDATING AND EXTENSION

Lesley Rickards presented this agenda item. The GLOSS Station Handbook has been constructed in order to provide further information on the GLOSS tide gauge network. The Handbook was updated in 2001 and again in 2002. These web pages form Version 5 of the Handbook and were included in the WOCE Global Data, Version 3.0 DVD set.

The Handbook contains information on each gauge in the GLOSS Core Network as defined by the "GLOSS97" description of the network (287 gauges), which differs at the 10% level from the present "GLOSS02" definition of the Network. Links to mean sea level data held by PSMSL and plots of annual mean sea level are available for most sites. In addition, site maps; some better than others, are available from many of these stations.

Links to hourly values of sea level data were added in August 1999 and reviewed and revised in 2002. The links to data held at the WOCE/CLIVAR "Fast-Delivery" Data Assembly Centre and the Joint Archive for Sea Level Data (JASL), both operated by the University of Hawaii Sea Level Centre (UHSLC), and the WOCE/CLIVAR "Delayed-mode" Data Assembly Centre operated by BODC are included. Other sea level data held by these sites can be found by visiting their websites. The Handbook also includes references to individual countries and organizations that have made their sea level data (hourly values) available on the web or have provided information about their tide gauge networks and how to obtain the data. The latest version of the Handbook is on BODC's website (www.bodc.ac.uk).

Over the last two years, improvements have been made to the layout of the Handbook, in particular by simplifying the index table and allowing sorting of the information by GLOSS number, country or station name. A clickable map has been added to access station information.

Regarding future developments, the GLOSS Handbook is currently undergoing another update. GLOSS National Contacts are being asked to check the information relating to their gauges and to provide updates (or point us to the appropriate information on websites if that exists). Most sites have maps indicating the location of the gauge and of the local benchmark, but photographs of the gauges and benchmark can also be included and are encouraged.

At present, selection is either by choosing a station from the map or selecting a site directly from the index table. This could be improved by adding a form, and/or a map, from which an area could be selected (by means of a "rubber-band").

PSMSL set up the GLOSS web pages originally and has maintained them. The GLOSS Archiving Centre/CLIVAR/PSMSL is willing to continue to maintain and develop these web pages if requested. At the same time, member states' national sea level data centres are encouraged to post tide gauge information on their respective websites, preferably with the types of data (e.g. real time, near-real time, archive) clearly identified.

4.8 GPS@TG DATA BANK

Guy Woppelmann presented this agenda item. A significant number of tide gauges are close to a GPS station. Some 62-tide gauge stations are less than 1,000 metres from a GPS station. The information made available is not provided by the tide gauge stations usually, but reported by others and is therefore not detailed. Only 41 stations provide both GPS and tide gauge data. Forty percent of the GPS@TG data is not currently available. Eighty-nine GLOSS stations are associated with GPS observations and there is a need to complete the list of GLOSS stations with GPS. (The inventory of co-located and nearly co-located GPS stations and tide gauges is available at http://sonel.ensg.ign.fr/stations/cgps/surv_update.html)

5. GOOS AND JCOMM MATTERS

5.1 JCOMM OVERVIEW

Savi Narayanan, Co-President of JCOMM, gave a brief overview of JCOMM and highlighted where JCOMM interacts with GLOSS. Mike Johnson-see Section 5.4 further elaborated this. Information about JCOMM is available at http://www.wmo.ch/web/aom/marprog/.

Johannes Guddal, Co-President of JCOMM, presented a new project on natural-disaster reduction relevant to GLOSS titled Marine Impacts on Lowland Agriculture and Coastal Resources (MILAC). This project aims to contribute to natural-disaster reduction (NDR) in coastal lowlands where marine impacts due to tropical cyclones cause severe damage to population, agriculture, freshwater sources, environment and infrastructure. More information on this project is available at http://www.globaloceans.org/globalconference/pdf/JohannesGuddal.pdf.

The GLOSS Group of Experts recognized the relevance of its work to MILAC, and of the importance of analysing/modelling relevant wind fields. Useful wind data should be available from such sources as the US Navy and NASA's Quickscat satellite; and coastal-zone bathymetry would also be useful.

5.2 GOOS–OOPC

Ed Harrison reported on the work of the Ocean Observations Panel for Climate. The importance of sea level information, whether historical, real-time or as forecasts, on all energy-, space- and time-scales, is very widely understood. National sea level programmes span this full range of scales: tsunamis, tides, storm surges, coastal and remotely forced waves, seasonal and longer-scale climate variability and global sea level change.

Governments increasingly understand that climate encompasses the full range of time-scales, that changes in the frequency and other characteristics of extreme events are as important to detect and to forecast as lower-frequency changes. Operational oceanography, which is a key to increased support for sustained ocean-observing activities, will progress most rapidly if all relevant information is shared in real time.

Variability needs to be observed systematically over large regions, if the climate variability context for other modes of variability is to be properly understood. GCOS, through the Second Report on the Adequacy of the Global Climate Observing System, has called on the UNFCCC (UN Framework Convention on Climate Change) to seek international agreement to maintain a sparse global baseline network of reference-quality geo-located gauges (~100 stations). And GOOS has called for global coastal sea level observations in a Global Coastal Network being designed under the auspices of its Coastal Ocean Observations Panel as a key component. GLOSS is invited to participate in the Network's design. GCOS and GOOS recognize the need for greater spatial resolution than that provided by either the GCOS baseline network or the GOOS GCN if particular regional sea level information needs are to be effectively addressed. They also expect that smaller-space-scale information needs will be met by national efforts, perhaps as part of co-ordinated activities within a GOOS Regional Alliance or through focused science or impact projects.

Standards, data exchange and metadata are areas in which GLOSS leadership is important; these issues are simpler for sea level (which is not to say they are simple) in important ways than for many other climate variables.

The Group of Experts expressed its concern that 100 gauges (or 86 has been suggested in some GCOS documents) are not enough to meet the requirements for sea level-related climate monitoring in GCOS, and a considerable amount of discussion took place on what GCOS was actually requesting. Some kind of consensus was reached that GLOSS could view GCOS as one means towards providing a full implementation of the Core Network and regional networks, as long as any lists of 100 (or 86) were properly qualified and not open to misinterpretation in GLOSS, GCOS and other documents. The Chairman offered to take the matter forward in the weeks following the meeting, to see if further consensus on lists of gauges and qualifying words could be reached before the end of the year.

5.3 GOOS-COOP AND GLOSS

Keith Thompson reported on the work of the Coastal Ocean Observations Panel (COOP). COOP is charged with providing design advice for the coastal module of GOOS. It is one of the principal components of GOOS which itself is "… a global network that systematically acquires, integrates and distributes ocean observations, and generates analyses, forecasts and other useful products". The purpose of the coastal module of GOOS is to establish a sustained and integrated ocean-observing system that makes more effective use of existing resources, new knowledge, and advances in technology to provide the data and

information required to: (i) improve the safety and efficiency of marine operations; (ii) more effectively control and mitigate the effects of natural hazards; (iii) improve the capacity to detect and predict the effects of global climate change on coastal ecosystems; (iv) reduce public health risks; (v) more effectively protect and restore healthy ecosystems; and (vi) more effectively restore and sustain living marine resources.

This involves: marine observations; development of models and application of their predictions; generation and distribution of data/information products; data management and communication; enabling research and the implementation of pilot projects; training and transfer of technology.

COOP is based on a global observing system with regional enhancements. The global system is based, initially, on existing observing elements (e.g. satellites, GLOSS) and primarily monitors large-scale changes, provides background for regional changes, sets standards and controls, helps validate satellite observations. Observations will be used to predict and detect change, in response to user needs. COOP considered almost 100 variables initially. The top ten in terms of predictability, and likewise, detectability, although similar, are differently ranked: the highest ranked variables for prediction are all physical, mainly because physical models are fundamental to many sea level-rise forecast systems and all operational systems presently in use are physical. Whereas sea level is only ranked fourth for predictability, it is first for detectability; this latter ranking is mainly due to the wide interest in sea level rise.

COOP therefore recognizes the importance of sea level and hence GLOSS, for both detection and prediction in the coastal ocean. It also strongly supports the expansion of the GLOSS Core Network (more stations and variables) and anticipates the need for regional densification, with a role for GOOS Regional Alliances.

The Group of Experts recognized that the network spatial density requirements for COOP are greater than those of GLOSS as often expressed in terms of its Core Network, and certainly vastly greater than those of GCOS. COOP's specific data requirements of GLOSS were hourly, for observations, and near real time, for data delivery to relevant users.

5.4 JCOMM OBS COMMITTEE

Mike Johnson, Chairman of the JCOMM Observations Programme Area Co-ordination Group (OCG) reported on the work of this Committee. He emphasized the importance of the GLOSS Group of Experts in providing international co-ordination of tide gauge station operations globally. The GLOSS Core Network and its subsets are central components of the Global Ocean Observing System, which is a composite of complementary *in situ,* satellite, data, and modelling subsystems. Each subsystem brings its unique strengths and limitations. Together they build the whole.

The OCG recognized the importance of improving regular reporting of the GLOSS Core Network from the present situation of about 170 stations, reporting regularly, to the design level of approximately 300 stations, and the importance of implementing continuous GPS/DORIS observations at a subset of the stations used routinely for altimeter calibration and as reference for global trends. The GCOS Second Adequacy Report to the UN Framework Convention on Climate Change has called for the Parties to support a minimum subset of geocentrically located climate reference stations. The GLOSS Group of Experts was requested to review existing lists and provide an updated list of stations to serve as this

reference subset considering global distribution, continuous GPS/DORIS measurements, operation in accordance with the GCOS Ten Climate Monitoring Principles, and with the longest records possible. The OCG also suggested that this reference subset should be targeted for priority implementation of real-time reporting upgrades where needed.

A major challenge for the Observations Programme Area is to develop observing system monitoring and performance reporting in order to produce easy-to-understand reports that can help in evaluating the effectiveness of the observing system and help in efforts to convince governments to provide the funding needed to meet implementation targets. The OCG is working to develop standard base maps showing required global coverage against what is presently in place, and it was noted that JCOMM Observing Platform Support has made good progress on standardized mapping over the past year. It was noted that the GLOSS Category 1, 2, 3, 4 maps provide a good representation of the requirement versus present status for the Core Network.

It was noted that it is becoming more important in several countries for observing-system managers to provide routine products that are designed for non-scientists and decision-makers. For example, regular reports are needed for climate to document the present state of the ocean, how it compares with the past, and the confidence/uncertainty in the products. It was suggested that GLOSS might sponsor regular annual reports documenting variations and trends in mean sea level at the GCOS climate reference stations as an initial goal.

5.5 JCOMM-OPS WEBSITE

Etienne Charpentier reported on this agenda item. JCOMM-OPS provides co-ordination at the international level for oceanographic and marine observations from drifting buoys, moored buoys in the high seas, ships of opportunity, and sub-surface profiling floats. JCOMM-OPS operates under the auspices of the Joint WMO–IOC Technical Commission for Oceanography and Marine Meteorology (JCOMM). He highlighted status summaries of the global observing elements under GOOS which are available at the JCOMM-OPS website (http://www.jcommops.org/) and demonstrated the GLOSS status information maps.

5.6 INTERNATIONAL POLAR YEARS 2007 AND GLOSS

The year 2007 will mark the 125th anniversary of the First International Polar Year (1882–1883), the 75th anniversary of the Second Polar Year (1932–1933) and the 50th anniversary of the International Geophysical Year (1957–1958). These Polar Years and IGY all contributed significant new insights into global processes and stimulated intense international collaboration. The International Council of Science (ICSU) has created an IPY Planning Board chaired by the Director of the British Antarctic Survey, Chris Rapley. The IPY is envisioned as an intensive international campaign of co-ordinated polar observations and analysis, with researchers from many nations working together to gain holistic insights into planetary processes, targeted at exploring and increasing our understanding of the poles and their roles in the global system. The IPY is expected to address compelling scientific issues; enable science programmes that otherwise might not occur; attract and develop the next generation of polar scientists; and engage the public. Research activities are envisioned under three overarching themes: (i) exploration of new frontiers; (ii) understanding change at the poles; and (iii) decoding polar processes. ICSU has sent out a planning letter inviting input to the proposed themes and suggestions for research. More information can be obtained from http://ipy.gsfc.nasa.gov/ and http://dels.nas.edu/prb/ipy/index.html.

The GLOSS Chairman considered IPY–2007 to be a good opportunity for GLOSS to develop its polar sea level observations and to deal with the specific problems of making observations under extreme conditions. The Chairman also suggested the preparation of a special issue publication on sea level studies in Polar Regions.

6. GLOSS REQUIREMENTS, PROPOSALS AND RESOURCES

The Chairman introduced this item. He referred to the GLOSS Adequacy Report (available at http://unescodoc.unesco.org/images/0013/001302/130292e.pdf); the GAINS proposals for Africa and South America (available at http://www.pol.ac.uk/psmsl/ge8/GAINS_PARTB.pdf); the ODINAFRICA proposal for Africa; and the GCOS Adequacy Report (available at http://193.135.216.2/web/gcos/gcoshome.html). A memo on GLOSS requirements is also available at http://www.pol.ac.uk/psmsl/ge8/requirements.doc.

The Chairman noted that, if several or all of these proposals are funded, then GLOSS will have a new challenge on its hands in co-ordinating the deployment of considerable resources. In such an event it would be necessary for the various programmes to work together to the common good.

Regarding GLOSS funding, the Technical Secretary informed the Group that the next IOC budget will include extra funds for GOOS; of this, about $100,000 will be earmarked for GLOSS. However, this sum should be used as far as possible to lever external funding; for example, by supporting GAINS proposals. Support from the USA and from the UK is expected to continue at present levels. Space agencies, CNES, ESA and NASA have also provided support for GLOSS calibration and validation and GLOSS training activities.

7. GLOSS SCIENCE SUB-GROUP (SSG) ACTIVITIES

The Chairman of the GLOSS Science Sub-Group, Gary Mitchum, presented this agenda item. Since the Seventh Session of the GLOSS Group of Experts, the Sub-Group's Chairman has represented GLOSS at a meeting of the JCOMM Steering Group, in La Jolla, California.

The Chairman and the Technical Secretary of GLOSS have recently posed several questions to the SSG, as follows (paraphrased):

Regarding GLOSS products: What products should GLOSS be planning to provide in the future, say by 2010 or even 2020? What does the SSG think about: the present monthly mean sea level information provided by the Permanent Service for Mean Sea Level; the high-frequency sea level information provided by the UHSLC (GLOSS "fast delivery" centre); the proposed provision of geodetic (i.e. GPS, DORIS—détermination d'orbite et radio-positionnement intégré par satellite) measurements made at GLOSS sites; and the plan to provide tidal constants for the GLOSS sites? What other things does the SSG think should be GLOSS priorities?

Regarding tsunami and surface-wave observations: Given the suggestion that the GLOSS tide gauges could be equipped to contribute to tsunami warning systems, and to provide ancillary surface-wave-height data, how important would these observations be to the larger community; and what priority should it have in GLOSS?

Regarding gaps in altimetry coverage: Given that satellite altimetry is becoming a routine, operational measurement, but that there is no guarantee of coverage by at least one satellite altimeter in the future, nor that future altimetric data will be of at least TOPEX/Poseidon quality, and supposing that there could be a significant gap in altimetric coverage of, say, 1–5 years (e.g. delay in Jason-2 or other crashes), what could GLOSS do to meet the needs of the larger community during such a break in coverage? Also, in view of the calculations made using empirical orthogonal functions to "expand" the tide gauge sea levels to produce global, altimetric-type maps, can we trust this method? Are there better methods? Are there things that GLOSS should be doing to be able to deal with such a gap in altimetric coverage?

Regarding extremes and extreme levels: Given that sea level data from tide gauges seems to be the best (and maybe only) way to directly measure long-term changes in extreme water levels, that these data are also likely to be very valuable in the study of long-term changes in atmospheric "storminess" (not necessarily the same problem), and that long-term changes in extreme water levels are also probably at the heart of the global-warming/climate-change problem, should GLOSS be making a more concerted effort in this area, or has this problem been worked on sufficiently already? What can GLOSS do to maximize its potential in this area? Are there requirements, other than high-frequency data, that need to be developed?

The SSG has been addressing these issues and will submit a report to the Chairman of the GLOSS Group of Experts in late 2003 or early 2004. The question of swell measurements was also raised; the difficulty is to know where best to measure swell, since local conditions play a big role in such measurements. Also, the optimum areas need to be identified to ensure useful results. The full report from the GLOSS SSG is available at http://www.pol.ac.uk/psmsl/ge8/GLOSS_SSG_report_GE8.doc.

8. REPORTS ON REGIONAL GLOSS ACTIVITIES

8.1 GLOSS IN EUROPE AND THE MEDITTERRANEAN

Hans Plag presented the report. The objectives of the European Sea Level Service (ESEAS) are: to provide sea level data and information for all users and for all European waters; to ensure and co-ordinate long-term measurement and data exchange; to enhance exploitation of the data; and to increase the density of the GLOSS Core Network. The intention is to integrate ESEAS into other systems, to co-ordinate and maintain standards and a list of products, and to undertake quality control. The present products are the pursuit of near-real-time access to data and information, to provide hourly data with relative sea level and air pressure, etc. Two international workshops have been held with the aim of creating and developing the European Sea Level Service. This was funded under the European Commission's 5th Framework Programme. A scientific study has been undertaken on inter-annual to century time-scales. However, in Europe, there are data policy problems, for example. ESEAS contributes to the European Global Monitoring for Environment and Security (GMES) programme, which will start in 2008. A 6th Framework Programme proposal will aim to have all national programmes submitting data to ESEAS. (For additional information please see: www.eseas.org/archive/presentations_and_posters/eseas_pres_GE82003.pdf).

Dov Rosen reported on MedGLOSS. IOC is co-ordinating closely with CIESM, through a Joint Group of Experts on MedGLOSS, in the operation of the system in the

Mediterranean and the Black Sea. The main tasks of MedGLOSS are: to detect relative and absolute sea level change; determine the role of local plate tectonics in the long-term sea level trend; and provide representative hourly data products for use in research and operational oceanography. An IOC–CIESM Training Workshop on Sea Level Observations and Analysis was held at the Proudman Oceanographic Laboratory in 1997. CIESM provided financial support for the upgrading of sea level stations in Croatia, Cyprus, Egypt, Malta, Morocco, Romania and Tunisia.

A CIESM–IOC MedGLOSS Workshop and Co-ordination Meeting for the Pilot Monitoring Network System of Systematic Sea Level Measurements in the Mediterranean and Black Sea (Haifa, 15–17 May 2000) made several important decisions on sea level measurement in conformity with GLOSS standards, including benchmark monitoring and relevant data rescue. IOLR will be the focal point of the network.

Regarding the data, the region's sea level rise may differ significantly from the global average, and in the Mediterranean the local plate tectonics play the main role. IOLR has a highly accurate sensor to detect small but real changes in mean sea level. In some countries some MedGLOSS tide gauge operators submit data directly to MedGLOSS, whereas others submit their data first to their respective national centres (e.g. Romania, Croatia).

An important problem is that MedGLOSS, which has been adopted by MedGOOS as one of its key programmes, and ESEAS are presently overlapping in their interests in establishing Mediterranean gauges. So there is a need for IOC to take a lead in simplifying the various programmes without damaging the achievements already in place. To the questions of how long will it be before the MedGLOSS pilot project becomes fully operational and the overlap with ESEAS, Rosen indicated that these issues could be best discussed in June 2004 at the CIESM Congress in Barcelona, bearing in mind that CIESM is involved and has to be consulted at a high level. For more information on MedGLOSS see http://medgloss.ocean.org.il/.

8.2 CARIBBEAN ACTIVITIES

George Maul (Florida Institute of Technology) was not present at the meeting but had submitted a report on GLOSS in the Caribbean (http://www.pol.ac.uk/psmsl/ge8/ioccaribe_feb02.doc and http://www.pol.ac.uk/psmsl/ge8/ioccaribe_table_feb02.doc) from the IOCARIBE Sub-Commission. The report gives a list of stations and recommends the creation of five more stations, including a capacity to detect tsunamis in the Caribbean. However, before establishing new stations, the capability of a few of the existing stations to deliver acceptable data must be ensured first.

Shelley-Ann Jules-Moore reported on the Caribbean Planning for Adaptation to Climate Change (CPACC) (see http://www.pol.ac.uk/psmsl/ge8/reports/cpacc_report.doc) and emphasized the many problems with regard to maintaining an established network, especially the need for central technical services. This was an important lesson for the proposals associated with Africa and other regions that funds have to be found to maintain networks once established. A report was submitted via e-mail from Alejandro Gutierrez on the Red de Observación del Nivel del Mar para America Central (RONMAC) in Central America which is experiencing very similar maintenance funding problems.

8.3 GLOSS IN AFRICA AND THE WESTERN INDIAN OCEAN

Charles Magori reported on the western Indian Ocean and GLOSS–AFRICA. There are about 15 GLOSS stations overall, but some regional stations are still not operating or, at least, not well. There is a need to train technicians, although quite a few technicians from the region have attended GLOSS training courses. The main need is the upgrading of existing stations, not only to meet basic GLOSS requirements, but also to measure associated additional parameters; this, however, depends also on, for example, whether existing gauges are going to be replaced. If so, the old gauges should be kept operating for 1–3 years, to allow proper intercalibration and to ensure data continuity. He noted the proposal for a tide gauge network in Pakistan (see http://www.pol.ac.uk/psmsl/ge8/reports/pakistan.doc).

Ruth Farre reported on developments in southern Africa (details in section 9.2, here below).

8.4 GLOSS IN SOUTH AMERICA

Juan Fierro reported on the plans of the Chilean Servicio Hidrográfico y Oceanográfico de la Armada (SHOA) and ODINCARSA for the South American co-ordination of a GLOSS Network in the region. They will host the ODINCARSA website (www.odincarsa.org). On it, each country shows the official contacts, the stations (their characteristics, locations etc.), the current activities, workshop contributions and the development of new products. The full report is available at http://www.pol.ac.uk/psmsl/ge8/reports/chile.doc. (Some details of the Chilean national sea level programme are given in section 9.3, here below)

Marcelo Fricks Cavalcante reported on GLOSS activities in Brazil. A GLOSS Implementation Plan is being elaborated, but at present there is no firm basis for Brazil's active participation at the regional level; in effect Brazil's very long coastline covers most of the southwest Atlantic. (Some details of the Brazilian national sea level programme are given in section 9.4, here below)

8.5 GLOSS IN ASIA

The Chairman reported on the upcoming GLOSS training course in Kuala Lumpur, Malaysia, 8–21 February 2004.

The Group of Experts suggested that a GLOSS training course be held in Japan and asked the Technical Secretary to investigate this further with Japanese national focal points for GLOSS. In addition, Manchun Chen offered to consider the possibility of China hosting a GLOSS-Asia website.

9. REPORTS ON NATIONAL SEA LEVEL ACTIVITIES

9.1 PAKISTAN

No one could speak on behalf of Pakistan, but a proposal was submitted via http://www.pol.ac.uk/psmsl/ge8/reports/pakistan.doc. The National Institute of Oceanography (Karachi) wants to acquire six new tide gauges. At present there are two GLOSS stations, one at Karachi with 40 years of data archived. The related human resources are of good quality

and the Navy is competent in this field. The Karachi float gauge station is now broken down; the GLOSS station at Gwadar is working but is 100 m offshore and its data are probably not reliable.

The Chairman stressed the fact that the northwestern Indian Ocean is a data-sparse region. Bill Mitchell offered to work with the NIO and the Pakistan Hydrographic Office to see if an Australian gauge could be donated.

9.2 SOUTH AFRICA

Ruth Farre presented a brief report. There are nine tide gauges in operation in South Africa; they are being converted to radar technology, but two of the present gauges are being maintained for reference purposes. Three new stations are being established to monitor the Benguela Current. Namibia is having two stations installed by Norway, but South Africa may continue to handle the data for them. All South African data are sent regularly to UHSLC. Some data archaeology is also being carried out. (The full report is available at http://www.pol.ac.uk/psmsl/ge8/reports/safrica.doc).

The Chairman observed that the historical South African data appear very "noisy", and requested Ruth's help in trying to get to the bottom of the reasons for the noise and to establish better data-exchange mechanisms than had pertained hitherto.

9.3 CHILE

Juan Fierro of the Chilean Servicio Hidrográfico y Oceanográfico de la Armada reported on the Chilean sea level system. There are currently 19 stations covering over 4,000 km of coastline. A technical upgrading programme was initiated in 1999. In the last two years, a quality-control programme has been carried out using UHSLC as well as Chilean software to validate incoming data. An effort has also been made to make different data sets compatible. Eight stations are currently operated as GLOSS stations; some related parameters (atmospheric pressure, water and air temperature) are also measured at some stations. Monthly mean sea level data are sent to PSMSL; hourly sea level data, as well as "fast" high-frequency data, are sent to UHSLC. GPS data collected at the Valparaiso station are sent to Mike Bevis's group at the University of Hawaii.

9.4 BRAZIL

Marcelo Fricks Cavalcante presented this agenda item. Brazil has 7,400 km of coastline that is therefore hard to manage and understand. The Diretoria de Hidrografia e Navegação is responsible for the implementation of GLOSS. It co-ordinates the relevant institutions. There are nine key institutions, including two from the Navy and two from private harbours; the national geodetic institution is also important in the context of GLOSS. There are about 20 GLOSS stations; the stations are about 500 km apart. The historical data from these stations will be forwarded to the PSMSL. (The full report is available at http://www.pol.ac.uk/psmsl/ge8/reports/brasil.pdf).

The Chairman stressed the importance of the Brazilian sea level system to GLOSS, but there remained a need to choose the best possible reference station. He noted that the station at Cananeia now has a radar gauge.

9.5 CHINA

Manchun Chen, National Oceanographic Data Centre, National Marine Data and Information Service, presented the report. The State Oceanic Administration maintains 40 tide gauge stations. These were updated in 2001 to provide near-real-time data. Twelve stations have data up to 1997. Mean sea level data are submitted to PSMSL for the South China Sea. The National Marine Data and Information Service ensure quality control and the data archiving. The main use of the data is for research. Some data products are being developed and all hourly data up to 1997 are being sent to UHSLC. China and the USA have a co-operation agreement, via SOA and NOAA, respectively, and this could be exploited for GLOSS development. (The full report is available at http://www.pol.ac.uk/psmsl/ge8/reports/china.doc).

The Chairman recalled that Guo Fengyi (at the previous GLOSS Workshop, in Hawaii, 2001) promised to send PSMSL a comprehensive list of the Chinese tide gauge stations, but this had not yet materialized. The Chairman asked Chen whether this list could still be made available. At present, 14 Chinese stations are in the GLOSS Core Network.

9.6 RUSSIA

Oleg Zilberstein presented this agenda item. GLOSS data are held and maintained by the All-Russia Research Institute for Hydrometeorological Information (Roshydromet). Monthly and annual sea level data from eight stations are sent to PSMSL; however, at present, only five of these stations are fully working. The three out of action are at Kaliningrad, Russkaya Gaven, and Yuzhno-Kvrilsk. Five Russian Antarctic stations were proposed in 1991, but they are not up to standard yet. Russia now proposes to add five new tide gauge stations to GLOSS. They will be up to GLOSS standard, with errors of 1–2 cm and 3 min. The maximum distance between stations will not exceed 1,000 km in the Russian tide gauge system. Zilberstein stressed that the Petropavlovsk–Kamchatsky station was also well equipped with tsunami gauges.

Some stations are allowed to provide data directly to PSMSL, whereas others still need permission to do so. (The full report is available at http://www.pol.ac.uk/psmsl/ge8/reports/russia.doc).

The Chairman confirmed that PSMSL gets monthly data from Russia (and has done so for many years). However, he stressed the desirability of incorporating Russian tide gauge stations into the GLOSS Core Network (in spite of the data's current availability only on a monthly basis); he asked about the prospects for receiving hourly data. Zilberstein confirmed that it was now possible for Russia to provide hourly data for the Baltic, but it was much more difficult for the Arctic stations.

The Chairman expressed the GLOSS interest in hourly data from the Pacific Ocean stations.

The Chairman reminded the Group of Experts that the upcoming International Polar Year presented a good opportunity for new proposals, and that Colin Summerhayes (Head, GOOS Project Office Paris) upcoming appointment as Executive Director of SCAR would open up the possibilities for making relevant ocean measurements under ice in the Antarctic.

9.7 FRANCE

Christian Le Provost presented this report. France presently has GLOSS stations in Brest, Marseille and in Nouméa (New Caledonia). Four GLOSS stations are also operated in the Southern Ocean. France intends to install one station in Martinique, one on Ile Royale (Guyane), and to reinstall a gauge in La Réunion. Two French stations are operated in the Central Pacific Ocean under the responsibility of the University of Hawaii Sea Level Center. (The full report is available at http://www.pol.ac.uk/psmsl/ge8/reports/france.rtf).

9.8 UNITED KINGDOM

Elizabeth Bradshaw presented the report. The UK tide gauge system includes 3 GLOSS stations. Two of these have associated GPS facilities. The tide gauge system's stations were recently upgraded. Data have been backtracked to 1990 and it is intended to go further back, to 1980. A report has been produced which discusses the 44 UK tide gauge sites (including the three GLOSS stations) and also the data from the six GLOSS South Atlantic Ocean stations. (The full report is available at http://www.pol.ac.uk/psmsl/ge8/reports/uk.pdf).

9.9 CANADA

Savi Narayanan presented the report. In Canada, Environment Canada is responsible for fresh water and Ocean & Fisheries, for marine water. An Oracle database has been set up covering tide gauge station history. The Oceans & Fisheries Department co-operates with CLIVAR/GODAR/GODAE etc. Relevant data are sent to PSMSL. There are five Arctic stations with digital gauges and GPS. The data are provided on request. Seven-day tidal predictions are issued a week at a time. (The full report is available at http://www.pol.ac.uk/psmsl/ge8/reports/canada.doc).

9.10 JAPAN

Keizo Sakurai presented the report. There are 14 GLOSS stations in the Japanese tide gauge system plus another in the Antarctic; four stations have been added to GLOSS since the Group of Experts' Seventh Session. The principal aims are the prediction of storm surges and tsunamis, and the monitoring of long-term sea level rise. At present in Japan, there are 55 stations based on Fuess gauges, ten acoustic gauges (for tsunami detection), and one pressure sensor. The principal products are: raw data every 15 s; hourly sea level data and deviations; monthly data and monthly extreme values; and tidal harmonic constants. All Japanese stations now have a "fast-delivery" set-up. (The full report is available at http://www.pol.ac.uk/psmsl/ge8/reports/japan.doc).

9.11 PORTUGAL

No one was able to present the report (owing to an unfortunate accident of the Portuguese expert). However, four documents were submitted. (http://www.pol.ac.uk/psmsl/ge8/reports/portugal.doc, including an annex on pressure specifications [http://www.pol.ac.uk/psmsl/ge8/portugal_pressure.doc], an annex on acoustic specifications [http://www.pol.ac.uk/psmsl/ge8/portugal_acoustic.doc] and an annex on radar specifications [http://www.pol.ac.uk/psmsl/ge8/portugal_radarTG.doc]).

9.12 IRAN

Mohamed Moshiri of the National Cartographic Centre of Iran presented the report. Besides the NCC, the key institutions concerned with sea level in Iran are the Shipping and Ports Authority and the Iranian National Centre for Oceanography. Iran has 3,000 km of coastline and a complicated tidal system. The tide gauge system was established 12 years ago, covering the Persian Gulf coast and the Strait of Hormuz (since 1989), notably in the main harbours, but also on the Caspian Sea coast. Other organizations are also interested in sea level data, since there is a strong hydrographic interest. The data are available at www.hydrography.org. There are ten specifically tide gauge stations, but only one (at Shobahar) in the Sea of Oman. About 85% of the tide gauges are mechanical and the remainder are pressure tide gauges.

Mohamed Moshiri asked GLOSS to organize a technical expert visit to review Iran's sea level observation network and provide advice on upgrade options. The Chairman invited Moshiri to determine what Iran needed from GLOSS and to contact the Technical Secretary.

9.13 AUSTRALIA

Bill Mitchell presented the work of the National Tidal Facility Australia (NTFA). The NTFA is being transferred to the Australian Bureau of Meteorology and will become the National Tidal Centre.

The two main activities at present are the Australian Baseline Array and the South Pacific Sea Level and Climate Monitoring Project. Mean sea level trend is being monitored to a precision of 1 mm/year; 3-minute averages are computed every 6 minutes. Tsunamis are monitored at 1-minute intervals; and 2-minute averages are computed every hour for wind speed and direction and for barometric pressure.

Monthly data reports are issued and tide gauge maintenance and calibration services are provided. Data stability is monitored, and data anomalies are notified. Laboratory calibrations of equipment are carried out regularly. Data are quality controlled monthly. The database is available for research purposes. Data are transmitted monthly to the UHSLC. All data are available from NTFA via FTP.

Acoustic tide gauges are adapted to local tidal range; the precision of measurement is 2 mm. There is regular maintenance of tide gauges and pressure gauges; tide gauge benchmarks are established and monitored. Australian SEAFRAME (Sea-level Fine-Resolution Acoustic Measuring Equipment) stations are associated with GPS facilities.

The data time-series show that, over the last 12 years there has been a 5–10 mm/year sea level rise relative to the long-term average, throughout the region, but this rate is slowing. The mean monthly maximum sea level value is rising faster than the mean monthly minimum value; this is considered to be due to ocean noise. At the same time, the rate of change in mean atmospheric pressure is generally negative over the South Pacific region. While the largest atmospheric-pressure change has taken place on the eastern side of the region, the largest rates of change in mean air- and water-temperature have occurred to the south and southwest of Australia.

The GMS/GOES (Geostationary Meteorological Satellite/Geostationary Operational Environmental Satellite) satellite ensures real-time data transmission; telephone/modem is used for transmitting non-real-time data.

Training is provided for tidal practitioners. A Southern Ocean Sea Level Centre has been set up.

10. A GLOSS TECHNICAL ADVISORY GROUP

During the regional (section 8) and national presentations (section 9) some presenters highlighted problems associated with the operation of existing stations up to the standard required by GLOSS, and the establishment of new stations to be incorporated into the GLOSS Core Network. One suggestion was to create a team of travelling technicians (GLOSS Technical Advisory Group) to assist in the installation of new stations and the maintenance of existing stations. Regarding the creation of a GLOSS Technical Advisory Group, Bill Mitchell (NTFA) stressed the need to look first into the basic technical problems and into those of standardization etc.

The Group of Experts considered the proposal to create a GLOSS Technical Advisory Group a valuable idea and asked the incoming Chairman to explore this further during the intersessional period.

11. REPORTS FROM RELEVANT INTERNATIONAL ORGANIZATIONS

11.1 IAPSO

The Chairman noted that Prof. Le Provost was resigning as Chairman of IAPSO’s Committee on Tides and MSL and was not in a position to report to the Group's present session. The important issue is that IAPSO determine its GLOSS requirements, so that these could be addressed and, if possible, met.

11.2 IHO TIDAL COMMITTEE

Steve Shipman reported on this agenda item. IHO currently has 74 member states. Originally created as the International Hydrographic Bureau in 1921, its name and status were changed by a Convention in 1970 and became IHO, comprising the International Hydrographic Conference and the International Hydrographic Bureau, with a staff of nearly 20 persons. Its member states main concerns are: hydrographic surveys, publication of navigational and bathymetric charts, and issuing marine safety information. It is active in capacity building, education and training, technical co-operation, publication etc. It works through Regional Hydrographic Commissions, Committees and Working Groups. The IHO Tidal Committee is open to all the member states and may invite observers to participate in its deliberations. Patrick Caldwell represented GLOSS at the Fifth Session of the Committee (Lima, April 2003). The IHO attaches great importance to co-operation with GLOSS.

11.3 INTERNATIONAL ASSOCIATION OF LIGHTHOUSE AUTHORITIES (IALA)

No one was able to present the IALA report. The Chairman noted that the Association's primary concern is safety at sea, but lighthouse authorities may be a very useful

source of "on the ground" support for GLOSS, notably in harbours; also, lighthouses represented a dense ocean-observing system and GLOSS could help them in making relevant ocean observations. He also noted that, while the Group had not sought a report from WMO, port meteorological offices could also be a source of valuable support to GLOSS, particularly in terms of contacts in the development of the GLOSS Core Network.

12. ALTIMETRY, GRAVITY MISSIONS, GPS ISSUES

12.1 JASON-2

The Chairman reported on his discussions with Gary Mitchum. Jason–2 carries a swath altimeter, the swath being about 300 km across track. GLOSS is ready to meet the calibration/validation requirements of Jason–2. Although it may be necessary in the future to determine whether any enhancements are required, there is nothing that GLOSS needs to do at present.

12.2 RATIONALE, FEASIBILITY AND SCOPE OF AN INTERNATIONAL ALTIMETER SERVICE (IAS)

Wolfgang Bosch reported on developments in the preparation for the establishment of IAS and on its relevance to GLOSS. Currently, five satellites are operating with interdisciplinary applications (in oceanography, sea level determination, hydrology, glaciology, geodesy, global change); the aim is to create a long-term accurate time-series, with cross-calibration. Altimetry is a crosscutting and interdisciplinary activity, and its organization internationally would help to expand the customer base, the application of the results, and the promotion of the relevant research. The potential users are: Aviso (CLS), NASA (Pathfinder), Pacific Ocean DAAC (JPL). The proposed general objectives of IAS are to: compile user requirements, serve users (operational and scientific communities), and integrate value-adding entities. Positive responses to the proposal have been received from: AVISO, ESA, ESEAS, CNES, DEDS, GFZ, IAPSO, KMS, NASA, NOAA, SOC. Altimetric service providers have also welcomed the proposal for IAS. (Further information can be found at http://www.pol.ac.uk/psmsl/ge8/ias.proposal).

Bosch stressed the present lack in the harmonization of ongoing efforts as the reason for creating IAS, but reminded the Group that IAS would be agency-independent and time-limited. It would be disbanded once its objectives had been attained. Although draft Terms of Reference were ready, they still had to be formalized; and likewise for the membership.

The consensus of the Group of Experts was that the altimeter service deserved consideration and that a formal letter of support would be sent by GLOSS to the IAS organizers.

12.3 OTHER RELEVANT GLOSS ACTIVITIES

GLOSS has continued to be represented within working groups of the altimetry community and also the Intergovernmental Panel on Climate Change (IPCC). In 2003, the Chairman helped to construct a proposal for an Integrated Global Geodetic Observation System (IGGOS), led by the International Association for Geodesy.

12.4 IGS AND TIGA NEWS

In the absence of Tilo Schoene, Guy Woppelmann made a brief statement. The GPS at tide gauges initiative (GPS@TG) is not contributing to the IGS/TIGA pilot projects. There are outstanding reference-frame issues still to be addressed globally, especially with respect to data management. Some GPS stations are not contributing to TIGA, for reasons still unclear. There is still some disconnection, hence a need to close the gaps and eliminate the disparities. The problem needs to be submitted to the IGS Governing Board. Its solution may make TIGA processing more complete. There is still a need to develop log-file formats for TIGA; and GLOSS stations with GPS have still not signed up to TIGA.

13. GLOSS CAPACITY-BUILDING ACTIVITIES

13.1 COMPLETED AND PLANNED ACTIVITIES

The Chairman briefly summarized some of the capacity-building activities that had taken place since the GLOSS Group of Experts' Seventh Session and some that were in planning.

Glenn Milne of Durham University had developed a series of palaeo sea level and coastline maps. The maps are available at: http://www.pol.ac.uk/psmsl/palaeoshoreline_webpage/HTML/HOME.htm.

A workshop/training course on vertical crustal motion and sea level change was co-convened with IUGG in Toulouse (17–19 September 2002).

A GLOSS training course on sea level observation and analysis was held at the Servicio Hidrográfico y Oceanográfico de la Armada de Chile, Valaparaiso, Chile, for Spanish-speaking students. The report from the course is available at http://unesdoc.unesco.org/images/0013/001305/130575s.pdf.

A GLOSS training course was planned for Kuala Lumpur, Malaysia, in April 2003 but has been postponed to 8–21 February 2004.

The Indian National Institute of Ocean Technology (NIOT) convened a sea level training course with GLOSS support for Burmese and Indian sea level scientists in February 2003.

13.2 FUTURE TRAINING COURSES

Hans Peter Plag presented a proposal for a university-level graduate course on Sea-level Changes: Observation, Interpretation, Application and asked GLOSS for support. The course will be held at the University of Trinidad (5–17 July 2004) for participants from the Inter-American Seas region. More information is available at http://www.pol.ac.uk/psmsl/ge8/tt_sealcourse.pdf.

The Group of Experts decided to endorse this course and offer GLOSS financial support at an appropriate level, given the nature of the course.

The Chairman and the Technical Secretary informed the Group about various requests/possibilities for courses: (i) The Benguela Current Large Marine Ecosystem Programme will acquire tide gauges for South Africa, Namibia, and Angola and has asked that a GLOSS course be held in Namibia or South Africa in 2004; (ii) Charles Magori has suggested that a sea level training course be convened for East African participants; (iii) Rodney Martinez has offered to host a GLOSS training course in Ecuador; (iv) Philip Woodworth has offered to host a course at the Proudman Oceanographic Laboratory.

The Group of Experts decided to provide support for a GLOSS training course for the Benguela Current LME region. The Group suggested that participation should also be open to East African representatives. The Group encouraged Charles Magori to work with the local organizers of a BCLME region course and with the Technical Secretary in developing course plans.

The Group of Experts requested that other offers for training courses be more fully developed and that the Technical Secretary and the Chairman explore these options in case additional training funds are available for 2005.

14. MISSIONS TO SELECTED COUNTRIES

The Chairman and the Technical Secretary have had discussions with the secretariat of the Programme on the Environment of the Red Sea and the Gulf of Aden (PERSGA) concerning a GLOSS technical expert visit to some countries in the PERSGA region. Such a visit was one of the recommendations from the GLOSS Training Course in Jeddah, Saudi Arabia (15–19 April 2001; IOC Training Course Report 57). The visit has not yet materialized, since co-funding from PERSGA has not yet been identified.

The Group of Experts endorsed a technical expert visit to Iran (see also section 9.12) and asked the Chairman and the Technical Secretary to work out the Terms of Reference for such a visit with Mohamed Moshiri.

15. ELECTION OF CHAIRMAN OF THE GLOSS GROUP OF EXPERTS

Only one nomination was submitted for the Chairmanship of the GLOSS Group of Experts for the next intersessional period and the next session: Christian Le Provost. There being no objection to the nomination, Prof. Le Provost was elected Chairman by acclamation. He expressed his intention to give his full support to the development of GLOSS in the light of the GLOSS Implementation Plan and the GLOSS Adequacy Report. He expressed his appreciation of the work of the outgoing Chairman, Philip Woodworth, and of all the effort that had been put into GLOSS by so many collaborators.

16. INTERSESSIONAL ACTIONS FOR 2003–2005

The Group of Experts adopted a GLOSS Plan of Actions for 2003–2005 which is given in Annex IV.

17. ANY OTHER BUSINESS

There was no other business.

18. DATE AND PLACE OF THE NEXT SESSION

The Group of Experts decided that its next [Ninth] session should precede JCOMM-II, but no specific dates were decided at the present session.

19. CLOSURE

The Chairman thanked the participants for their very active intervention in the discussions and expressed his satisfaction with the progress made in the present session.

In view of his retirement from the Chairmanship, the Technical Secretary presented the Chairman with a token of the IOC's and the Group's appreciations of his hard and conscientious work in the development of GLOSS. The Chairman expressed his appreciation of the support he had received during his tenure and his intention to continue to be involved in the development of GLOSS.

The Chairman declared the Eighth Session of the Group of Experts on the Global Sea Level Observing System closed at 1500 hours on 17 October 2003.

ANNEX I

AGENDA

1. ORGANIZATION OF THE SESSION

1.1 OPENING OF THE SESSION
1.2 ADOPTION OF THE AGENDA
1.3 DESIGNATION OF THE RAPPORTEUR

2. REVIEW OF GLOSS ACTIVITIES

3. REPORTS ON SOME RECENT RELEVANT ACTIVITIES

3.1 GLOSS PARTICIPATION IN OTHER RELEVANT MEETINGS

3.1.1 Workshop on New Technical Developments in Sea and Land Level Observing Systems

4. SEA-LEVEL CENTRES AND RELATED ACTIVITIES

4.1 PERMANENT SERVICE FOR MEAN SEA LEVEL (PSMSL)
4.2 UNIVERSITY OF HAWAII SEA LEVEL CENTER (UHSLC)
4.3 GLOSS/CLIVAR DELAYED-MODE SEA LEVEL DATA CENTRE
4.4 SOUTHERN OCEAN SEA LEVEL CENTRE
4.5 GLOSS DATA BANKS: VARIOUS ITEMS

4.5.1 System development
4.5.2 Observations of other parameters than sea level
4.5.3 Data archaeology projects

4.6 GLOSS DATA SOLICITATION
4.7 GLOSS HANDBOOK UPDATING AND EXTENSION
4.8 GPS@TG DATA BANK

5. GOOS AND JCOMM MATTERS

5.1 JCOMM OVERVIEW
5.2 GOOS–OOPC
5.3 GOOS-COOP AND GLOSS
5.4 JCOMM OBS COMMITTEE
5.5 JCOMM OPS WEBSITE
5.6 INTERNATIONAL POLAR YEAR 2007 AND GLOSS

6. GLOSS REQUIREMENTS, PROPOSALS AND RESOURCES

7. GLOSS SCIENCE SUB-GROUP (SSG) ACTIVITIES

8. REPORTS ON REGIONAL GLOSS ACTIVITIES

8.1 GLOSS IN EUROPE AND THE MEDITTERRANEAN
8.2 CARIBBEAN ACTIVITIES

8.3 GLOSS IN AFRICA AND THE WESTERN INDIAN OCEAN
8.4 GLOSS IN SOUTH AMERICA
8.5 GLOSS IN ASIA

9. REPORTS ON NATIONAL SEA LEVEL ACTIVITIES

9.1 PAKISTAN
9.2 SOUTH AFRICA
9.3 CHILE
9.4 BRAZIL
9.5 CHINA
9.6 RUSSIA
9.7 FRANCE
9.8 UNITED KINGDOM
9.9 CANADA
9.10 JAPAN
9.11 PORTUGAL
9.12 IRAN
9.13 AUSTRALIA

10. A GLOSS TECHNICAL ADVISORY GROUP

11. REPORTS FROM RELEVANT INTERNATIONAL ORGANIZATIONS

11.1 IAPSO
11.2 IHO TIDAL COMMITTEE
11.3 INTERNATIONAL ASSOCIATION OF LIGHTHOUSE AUTHORITIES (IALA)

12. ALTIMETRY, GRAVITY MISSIONS, GPS ISSUES

12.1 JASON-2
12.2 RATIONALE, FEASIBILITY AND SCOPE OF AN INTERNATIONAL ALTIMETER SERVICE (IAS)
12.3 OTHER RELEVANT GLOSS ACTIVITIES
12.4 IGS AND TIGA NEWS

13. GLOSS CAPACITY-BUILDING ACTIVITIES

13.1 COMPLETED AND PLANNED ACTIVITIES
13.1 FUTURE TRAINING COURSES

14. MISSIONS TO SELECTED COUNTRIES; PERSGA VISIT

15. ELECTION OF CHAIRMAN OF THE GLOSS GROUP OF EXPERTS

16. INTERSESSIONAL ACTIONS FOR 2003–2005

17. ANY OTHER BUSINESS

18. DATE AND PLACE OF THE NEXT SESSION

19. CLOSURE

ANNEX II

LIST OF PARTICIPANT

Thorkild AARUP
UNESCO/IOC
1 rue Miollis
75732 Paris Cedex 15
FRANCE
Tel: +33 1 4568 4019
Fax: +33 1 4568 5810
E-mail: t.aarup@unesco.org

Mehmet Emin AYHAN
General Command of Mapping
Geodesy Department
06100 Çebeçi
Ankara
TURKEY
Tel: +90 312 595 2250
Fax: +90 312 320 1495
E-mail: eayhan@hgk.mil.tr

Wolfgang BOSCH
DGFI
Marstallplatz 8
80539 Munchen
GERMANY
Tel/Fax: +49 89 23031 115
E-mail: bosch@dgfi.badw.de

Elizabeth BRADSHAW
British Oceanographic Data Centre
Bidston Observatory
Birkenhead
Merseyside CH43 7RA
UNITED KINGDOM
TEL: +44 151 653 1517
Fax: +44 151 652 3950
E-mail: elizb@bodc.ac.uk

Marcelo Fricks CAVALCANTE
Navy Hydrographic Centre
Rua Barão de Jaceguay
S/N Ponta da Armação
Niteroi
Rj-Cep 24048-900
BRAZIL
Tel: +55 21 2613 8261
Fax: +55 21 2613 8226
E-mail: 112@chn.mar.mil.br

Manchun CHEN
National Oceanographic Data Centre
National Marine Data and Information Service
93 Liuwei Road
Hedong District
Tianjin 300171
CHINA
Tel: +86 22 2401 0845
Fax: +86 22 2401 0926
E-mail: cmc@mail.nmdis.gov.cn

James CREASE
9 West Street
Chipping Norton
Oxon OX7 5LH
UNITED KINGDOM
Tel: +44 1608 642335
E-mail: jimc@udel.edu

Ruth FARRE
S A Navy Hydrographic Office
Private bag x1
Tokai 7966
SOUTH AFRICA
Tel: +27 21 787 2403
Fax: +27 21 787 2233
E-mail: hydrosan@iafrica.com

Luciana FENOGLIO-MARC
Institute of Physical Geodesy
University of Technology Darmstadt
Petersenstrasse 13
64287 Darmstadt
GERMANY
Tel: +49 6151 163 012
Fax: +49 6151 164 512
E-mail: delm@hyzpub.tu-darmstadt.de

Juan FIERRO
Servicio Hidrográfico y Oceanográfico de la Armada de Chile
Errázuriz 232 Playa Ancha
Valparaíso
CHILE
Tel: +56 32 266 676
Fax: +56 32 266 542
E-mail: jfierro@shoa.cl

Ray GRIFFITHS
14 Parc De Béarn
92210 Saint-Cloud
FRANCE
Tel: +33 1 4602 7155
Fax: +33 1 4602 3195
E-mail: r1c2g3@aol.com

Daniel HAREIDE
Norwegian Hydrographic Service
P.O. Box 60
4001 Stavanger
NORWAY
Tel: +47 5185 8700
Fax: +47 5185 8701
E-mail: daniel.hareide@statkart.no

D. Ed HARRISON
PMEL/NOAA/OCRD
7600 Sandy Point Way
Seattle WA 98115
U.S.A.
Tel: +1 206 526 6225
Fax: +1 206 526 6744
E-mail: d.e.harrison@noaa.gov

Simon HOLGATE
Permanent Service for Mean Sea Level
Proudman Oceanographic Laboratory
Bidston Observatory
Birkenhead
Merseyside CH43 7RA
UNITED KINGDOM
Tel: +44 151 653 8633
Fax: +44 151 652 6269
E-mail: simonh@pol.ac.uk

Svetlana JEVREJEVA
Proudman Oceanographic Laboratory,
Bidston Observatory
Birkenhead
Merseyside CH43 7RA

UNITED KINGDOM

Tel: +44 151 653 8633
Fax: +44 151 653 6269
E-mail: sveta@pol.ac.uk

Michael JOHNSON
NOAA/OGP
1100 Wayne Avenue
Suite 1210, Silver Spring
MD 20910
U.S.A.
Tel: +1 301 427 2089
Fax: +1 301 427 2073
E-mail: mike.johnson@noaa.gov

Antony JOSEPH
National Institute of Oceanography
Dona Paula
Goa 403004
INDIA
Tel: +91 832 245 0560
Fax: +91 832 245 0602
E-mail: joseph@csnio.ren.nic.in

Shelley-Ann JULES-MOORE
Department Of Surveying and Land Information
Faculty Of Engineering, Univ. of the West Indies
St. Augustine
TRINIDAD
Tel: +1 868 663 9191
Fax: +1 868 663 9191
E-mail: rac@eng.uwi.tt

Christian LE PROVOST
LEGOS/CNES-CNRS-IRD-UPS
14 Avenue E. Belin
31400 Toulouse
FRANCE
Tel: +33 5 6133 2923
Fax: +33 5 6125 3205
E-mail: christian.le-provost@notos.cst.cnes.fr

Günter LIEBSCH
Bundesamt Fuer Kartographie Und Geodäsie
Aussenstelle Leipzig
Karl-Rothe-Strasse 10-14
04105 Liepzig
GERMANY
Tel: +49 341 563 4429
Fax: +49 341 563 4415
E-mail: gunter.liebsch@bkg.bund.de

Charles MAGORI
Kenya Marine & Fisheries Research Institute (KMFRI)
PO Box 81651
Mombasa
KENYA
Tel: +254 41 475 151
Fax: +254 41 475 157
E-mail: c.magori@yahoo.com

Mark MERRIFIELD
Department of Oceanography
School of Ocean and Earth Science and Technology
University Of Hawaii at Manoa
1000 Pope Road, MSB 317
Honolulu, Hi 96822
U.S.A.
Tel: +1 808 956 6161
Fax: +1 808 956 2352
E-mail: markm@soest.hawaii.edu

Bill MITCHELL
National Tidal Facility
Flinders University of South Australia
GPO Box 2100
Adelaide 5001
AUSTRALIA
Tel: +61 8 8201 7515
Fax: +61 8 8201 7523
E-mail: bill.mitchell@ntf.flinders.edu.au

Gary MITCHUM
College of Marine Science
University of South Florida
140 Seventh Avenue
St. Petersburg, Fl 33701
U.S.A.
Tel: +1 727 553 3941
Fax: +1 729 552 1189
E-mail: mitchum@marine.usf.edu

M. H. MOSHIRI
Hydrographic Department
National Cartographic Center of Iran (NCC)
Azadi Square, Meraj Avenue
Tehran
IRAN
Tel: +98 21 603 4725
Fax: +98 21 600 1973
E-mail: moshiri@ncc.neda.net.ir

Savi NARAYANAN
Marine Environmental Data Service (MEDS)
W083 12th Floor 200 Kent Street
Ottawa
Ontario K1A 0E6
CANADA
Tel: +1 613 990 0265
Fax: +1 613 993 4658
E-mail: narayanans@dfo-mpo.gc.ca

Hans Peter PLAG
Norwegian Mapping Authority
Kartverksveien 21
3511 Honefoss
NORWAY
Tel: +47 3211 8100
Fax: +47 3211 8101
E-mail: plag@statkart.no

David PUGH
Southampton Oceanography Centre
Empress Dock
Southampton SO14 32H
UNITED KINGDOM
Tel: +44 1703-596611
Fax: +44 1703-596395
E-mail: d.pugh@soc.soton.ac.uk

Lesley RICKARDS
British Oceanographic Data Centre
Proudman Oceanographic Laboratory
Bidston Observatory
Birkenhead
Merseyside CH43 7RA
UNITED KINGDOM
Tel: +44 151 653 1514
Fax: +44 151 653 3950
E-mail: ljr@bodc.ac.uk

Dov ROSEN
Israel Oceanographic & Limnological Research Ltd
Tel-Shikmona, POB 8030
Haifa 30180
ISRAEL
Tel: +972 4 851 5202
Fax: +972 4 851 1911
E-mail: rosen@ocean.org.il

Keizo SAKURAI
Office of Marine Prediction
Climate and Marine Department
Japan Meteorological Agency
Otemachi 1-3-4 Chiyodaku
Tokyo 100-8122
JAPAN
Tel: +81 3 3212 8341
Fax: +81 3 3211 3047
E-mail: tide@hq.kishou.go.jp

Wolfgang SCHERER
Columbia
MD 21045
U.S.A.
Tel: +1 301 307 0118
E-mail: wolfscherer@hotmail.com

F. SCHINDELE
Dépt. Analyse et Surveillance de L'environnement
Laboratoire de Géophysique
B.P. 12
91680 Bruyères-Le-Châtel
FRANCE
Tel: +33 1 69 26 50 63
Fax: +33 1 69 26 70 23
E-mail: schindel@ldg.bruyeres.cea.fr

Tilo SCHOENE
GFZ Potsdam
Telegraphenberg
14473 Potsdam
GERMANY
Tel: +49 8153 281 391
Fax: +49 8153 281 207
E-mail: tschoene@gfz-potsdam.de

Steve SHIPMAN
International Hydrographic Bureau
BP 445
MC 98011 Cedex
MONACO
Tel: +377 9310 8106
Fax: +377 9310 8140
E-mail: sshipman@ihb.mc

C K SHUM
Laboratory for Space Geodesy & Remote Sensing Research
The Ohio State University
2070 Neil Avenue
Columbus
OH 43210-1275
U.S.A.
Tel: +1 614 292 7118
Fax: +1 614-292-2957
E-mail: ckshum@osu.edu

Colin SUMMERHAYES
UNESCO/IOC
1 rue Miollis
75732 Paris Cedex 15
FRANCE
Tel: +33 1 4568 4042
Fax: +33 1 4568 5810
E-mail: c.summerhayes@unesco.org

Ana Paula Spinelli da Silva TELES
Southampton Oceanography Centre
Empress Dock
Southampton SO14 3ZH
UNITED KINGDOM
Tel: +44-1703-596611
Fax: +44-1703-596395
E-mail: anateles@soc.soton.ac.uk

Keith THOMPSON
Department of Oceanography
Dalhousie University
Halifax
Nova Scotia B3H 4JI
CANADA
Tel: +1 902 494 3491
Fax: +1 902 494 2885
E-mail: keith.thompson@dal.ca

Michael TSIMPLIS
Southampton Oceanography Centre
University of Southampton
Waterfront Campus, European Way
Southampton SO14 3ZH
UNITED KINGDOM
Tel: +44 23 8059 6412
Fax: +44 23 8059 6204
E-mail: mnt@soc.soton.ac.uk

SIMON WILLIAMS
Proudman Oceanographic Laboratory
Bidston Observatory
Bidston Hill
Merseyside CH43 7RA
UNITED KINGDOM
Tel: +44 151 653 1582
Fax: +44 151 653 6269
E-mail: sdwil@pol.ac.uk

STAN WILSON
NOAA/NESDIS
SSME-I Room 8212
1335 East-West Highway
Silver Spring, MD 20910
U.S.A.
Tel: +1 301 713 3389
Fax: +1 301 713 1249
E-mail: stan.wilson@noaa.gov

Philip WOODWORTH
Permanent Service for Mean Sea Level
Proudman Oceanographic Laboratory
Bidston Observatory
Birkenhead
Merseyside Ch43 7ra
UNITED KINGDOM
Tel: +44 151 653 8622
Fax: +44 151 653 6269
E-mail: plw@pol.ac.uk

Guy WOPPELMANN
Centre Littoral de Géophysique
Université de la Rochelle
Avenue Michel Crepeau
17042 La Rochelle Cedex 1
FRANCE
Tel: +33 5 4645 8613
Fax: +33 5 4645 8249
E-mail: gwoppelm@univ-lr.fr

Oleg ZILBERSTEIN
Hydrometeorological Center Of Russia
11-13 Bol. Predtechnensky Per.
Moscow 123242
RUSSIA
Tel: +7 095 255 9307
Fax: +7 095 255 9307
E-mail: lmra@nm.ru

ANNEX III

REPORT OF THE CHAIRMAN OF THE GLOSS GROUP OF EXPERTS TO THE EIGHTH SESSION (GE8): SUMMARY OF GLOSS ACTIVITIES SINCE THE SEVENTH SESSION

The Global Sea Level Observing System (GLOSS) is a programme of the Joint Commission for Oceanography and Marine Meteorology (JCOMM) of the Intergovernmental Oceanographic Commission (IOC) and World Meteorological Organization (WMO). GLOSS is one of the main components of the Global Ocean Observing System (GOOS).

This short report provides a summary of activities in GLOSS in the two-year period since the Seventh Session of the GLOSS Group of Experts (GE7) held at the University of Hawaii in 2001. Reports of that meeting and of the associated workshops are available on paper, in the IOC web archive and at http://www.pol.ac.uk/psmsl/training/gloss.pub.html. The list of Actions to be undertaken following GE7 can be inspected at http://www.pol.ac.uk/psmsl/reports.gloss/ge7/ge7.actions. It will seem that almost all of those actions have been completed.

GLOSS Status:

The status of the GLOSS Core Network (GCN), measured in terms of data received by the PSMSL, has improved somewhat during the period. Status reports are provided by the PSMSL every year in October and that for 2003 shows 176 of the 290 stations of the GCN being 'Category 1' (i.e. having delivered relatively recent data). See http://www.pol.ac.uk/psmsl/programmes/gloss.info.html for more details.

GLOSS Adequacy Report:

A GLOSS Adequacy (or Assessment) Report (GAR) was prepared for the 22nd IOC Assembly in July 2003 which reviewed the status of the GCN and the LTT, OC and ALT sub-networks. It reviewed the need for each component of the programme and restated the importance of "fast" data which had been made in two circular letters to all GLOSS Contacts in 2002. It made the point that, while improvements in GLOSS do occur from year to year (see above), they have reached a plateau in many respects, and that what is needed now is a set of more co-ordinated approaches. In particular, the GAR made the case for the injection of several M$ of new funding. The Assembly endorsed the GAR unanimously.

The injection of new funding implies several things such as the existence of funding agencies ready to welcome proposals, and the existence of "champions" to construct the proposals. Also implied is the need for regional initiatives, given that the world is probably too large for most proposals (apart from proposals to GEF perhaps) and that the practical, as opposed to scientific, cases for investment can best be made regionally. Unfortunately, funding agencies are scarce, "champions" are even scarcer, and, in the case of certain regions, they are non-existent. A search for the latter must be a GLOSS priority.

GAINS and Other Proposals:

Following on from constructing the GAR, three of us (Aarup, Plag and myself) visited the EU to seek advice on opportunities for proposals. Subsequently, two proposals (both

called GAINS) have been submitted costing about 2M$ each with 23 partners in Europe, Africa, S. America and USA (UHSLC). These are what are called STREP proposals that allows for new hardware (27 and 32 gauges, respectively, the 27 being part of the 32). We intend that a third proposal, with similar content and allowing for countries in the Black Sea, will be submitted in February under what is called the SSA scheme. Of course, at the time of writing, we have no idea of the fate of the proposals. A proposal with a major sea level component for Africa has also been constructed by the ODINAFRICA group for submission to IOC and the Flanders Government that would allow the purchase of perhaps 19 new gauges (overlapping the GAINS set). Possibilities for funding from GCOS etc. will also be followed up.

GLOSS General Funding:

The income that GLOSS relies on for "every-day" activities such as meetings (e.g. GE8), training courses, missions and, in a small number of cases, small contracts for work is at its highest ever level thanks in particular to effective lobbying by the GLOSS Technical Secretary. We now receive earmarked funds from several national sources (UK, USA, France), which go a long way to meeting our requirements. Contributions from space agencies (ESA, NASA, CNES) have also been most appreciated.

GLOSS Training Courses:

One disappointment was the pause in our successful series of training courses after a Saudi Arabian course in 2000, although a sea level course related to GLOSS took place in 2001 in Guatemala for Central American countries; it was attended by Pat Caldwell (University of Hawaii) with some PSMSL input. However, the series was restored in 2003 with a GLOSS-related (but not GLOSS-funded) course in India for countries of the Bay of Bengal region, and with a course in Valparaiso, Chile, for South American countries. The latter was held in April and would have coincided with a further course in Malaysia, but that was postponed to January 2004 because of the SARS situation. Several courses are planned for 2004 in different countries and will be discussed at GE8.

Crustal Motion Meeting 2002:

In September 2002, Mike Bevis (University of Hawaii), Christian Le Provost (Toulouse) and I organized a study week on vertical crustal motion and sea level change and on the use of GPS at tide gauges in Toulouse, France. The meeting was held under the auspices of the IGS/PSMSL/IAPSO/IAG/GLOSS CGPS@TG working group and was in effect an unofficial meeting of the GLOSS Group of Experts. The week included the development of the TIGA project at GFZ, Germany, which aims to better understand the uncertainties in the use of GPS. The meeting was very well attended and we were even given some time on French TV.

On a related topic, I would like to thank Guy Wöppelmann for continuing his data bank of information on GPS and DORIS near to gauges. This data set is very useful for planning and proposal purposes and it is essential that tide gauge operators help Guy keep the data set up to date.

Missions:

Pat Caldwell led a successful mission for GLOSS to DHN, Brazil in 2002 to obtain advice for the programme on hardware and software needs in this important country with an

enormous coastline. Our colleagues in Brazil have since produced a GLOSS–Brazil funding proposal of their own. A mission to countries of the Red Sea and Persian Gulf, to have been co-funded by PESRGA and IOC, was cancelled for PERSGA funding reasons.

Publications:

Leaving aside scientific publications which form the official duty of many of us, GLOSS has continued to provide as many informative reports as it can. Examples include:

- An updated version of the third volume of the IOC Manuals and Guides No.14 on sea level measurement and interpretation, see http://www.pol.ac.uk/psmsl/training/training.html.
- A review of sea level research during the World Ocean Circulation Experiment, by Woodworth, Mitchum, Rickards, Merrifield and Le Provost
- An article on GLOSS status submitted to EOS by the same five people
- An article for *Ports and Harbors* and the *IALA Bulletin*
- Position papers for important conferences; e.g. GOOS-AFRICA Meeting, 19–23 November 2001, Nairobi, Kenya. Intergovernmental Oceanographic Commission, report IOC/INF-1165

Also there have been a number of GLOSS-related reports contained in the proceedings of other programmes; e.g. MedGLOSS workshop and co-ordination meeting for the pilot monitoring network system of systematic sea level measurements in the Mediterranean and Black Seas. Report of meeting, 15–17 May 2000, Haifa, Israel. IOC Workshop Report No. 176.

Data Centres and Data Products:

GLOSS remains extremely grateful to, and dependent upon, the work of data centres that are funded primarily from national resources. A special thanks has to go to those centres which play important international as well as national roles. These include the Permanent Service for Mean Sea Level (PSMSL) in the UK, University of Hawaii Sea Level Center (UHSLC) in the USA which provides GLOSS and CLIVAR "fast" and "delayed-mode" co-ordination, British Oceanographic Data Centre (BODC) in the UK which provides GLOSS and CLIVAR delayed-mode co-ordination, and the National Tidal Facility Australia (NTFA) which provides a S. Ocean sea level centre. Personally, I would like to see these centres appearing more co-ordinated (same web pages, formats etc.) but I realize some of the constraints.

A new version of the WOCE Sea Level Data Set was produced on DVD for the final conference of the WOCE programme in San Antonio in 2002. In addition to the "Fast-delivery" and "Delayed-mode" WOCE sea level data sets, the DVD contains tidal constants from the WOCE sea level data set, PSMSL monthly and annual mean sea level data set, and the GLOSS Station Handbook.

The GLOSS Handbook has always seemed to me to have wonderful potential for providing a focus for GLOSS, both for data, metadata and background information. Discussion at GE8 will explore how that might be developed.

Lesley Rickards initiated a joint project between the IOC International Oceanographic Data and Information Exchange (IODE) Committee and GLOSS to conduct a “data

archaeology" survey of historical sea level records. This project has the aim of extending existing time series and gaining access to observations, which are not in digital form, and has already seen some data "rescued".

Scientific Sub-Group:

Gary Mitchum has steered the GLOSS SSG throughout this period, with some interesting questions for discussion at GE8. (See also agenda item 7 in the main part of the GLOSS GE8 report)

Representation at Meetings and Other Service Provided:

I would like to thank a number of people for representing GLOSS at important meetings. For example:

Gary Mitchum (USA) at the JCOMM Obs meeting San Diego 2002
John Church (Australia) at the GCOS regional meeting Singapore 2002
Carlos Franca (Brazil) at the GCOS regional meeting Santiago 2003

GLOSS has also been represented in a wide range of meetings across the field of sea level technology and science, altimeter and space gravity working groups, coastal programmes (COOP etc.) and of course regional sea level projects (e.g. CPACC, ESEAS). GE8 will see links with IHO and IALA re-established.

A number of other people have provided GLOSS with help in different ways, including (apologies if I forget anyone) Antony Joseph and colleagues at the National Institute of Oceanography, India, for their initiative for gauges in Ghana, Glenn Milne at Durham University for Palaeo sea level training materials, and Dov Rosen and colleagues in Israel for their software developments.

Websites, Newsletters and Brochures:

An excellent development during the period has been the establishment of a website for GLOSS-Africa at http://www.ioc.unesco.org/glossafrica/ and one is planned by ODINCARSA for South America following the Chile 2003 training course.

Meanwhile, there have been some disappointments. In 1995, I started a web newsletter called the GLOSS Bulletin which had to be abandoned in 1999, partly through pressure on my own time and partly from lack of material, and since then I have not been able to find a volunteer to take it on. The Afro-America News, also published on the web at the University of Sao Paulo, continues but again there are pressures on people's time and help is needed. We have tried, and failed so far, to find a group to host a GLOSS website for Asia (or perhaps for parts of Asia).

Brochures on GLOSS have been produced, and are available on the web, in English, French, Spanish, Russian, Chinese, Arabic and Portuguese.

Future Prospects:

I believe that GE8 will demonstrate that the future for GLOSS is brighter than ever because, for example:

The scientific (e.g. "sea level rise") and practical (e.g. flood warning) needs for sea level data are obvious to most people.

The funding situation looks more favourable in a number of countries and regions.

There are exciting, and sensible, groupings taking place between countries regionally with regard to sea level measurements.

The new technical developments of tide gauges and data transmission methods are very exciting and cost-effective, as I believe the GE8 Technical Workshop will demonstrate; I would also like to see GPS demonstrated as a fully working technology as sea level people need; that is what TIGA is for.

Scientific initiatives such as IGGOS (Integrated Global Geodetic Observing System) linked to GOOS and GCOS are demonstrating (for anyone that still needs telling) that sea level is a fundamental parameter across geoscience.

I also believe that the structure of GLOSS is a good one (GCN, LTT etc.) although that must be reviewed regularly by the SSG. What we need, and have always needed, is personal and national commitment, which we shall be looking for at GE8.

Acknowledgements:

I would like to extend to Thorkild Aarup my particular appreciation of his help and advice about GLOSS and other IOC matters during the past two years (and for some years before that). Gary Mitchum (SSG Chair), Mark Merrifield, Christian Le Provost and Lesley Rickards have always been available to help in many ways. Stan Wilson has been a great help in taking the lead in encouraging data flow from certain countries. More generally, I would like to thank the many sea level contacts who make up the GLOSS Group of Experts.

Philip Woodworth
Permanent Service for Mean Sea Level

ANNEX IV

GLOSS PLAN OF ACTIONS FOR 2003–2005

The following list is not in any order of priority. It should also be emphasized that some of these action items came up during the Technical Workshop and were therefore not discussed at any length at the Group of Experts' Eighth Session. The persons or entities responsible for action appear in square brackets at the end of each action item.

It should be borne in mind that the list of actions will be updated regularly on the GLOSS website.

1. Complete GE-GLOSS-VIII meeting report; circulate first draft to meeting attendees for comment. [Chair and IOC]

2. GLOSS Technical Workshop 14–16 October 2003: circular e-mails/letters to all presenters (but not to "silent participants"), including manufacturers, inviting short papers and asking for PowerPoint files also; produce CD–ROM containing workshop report and other relevant files. [Holgate]

3. Higher-Frequency Delayed-Mode Data Banking at UHSLC and BODC/PSMSL:

   (i) Combine UHSLC and BODC/PSMSL delayed-mode data banks into one GLOSS (+CLIVAR) data bank, appearing seamless to outsiders, with same formats and mirror web pages. [Merrifield/Rickards]

   (ii) Agree on which parts of the world to be responsible for. Either convey that information to data providers or arrange for data to be sent to a common point and divide QC and data-banking work. This implies agreement on procedures and standards between centres. [Merrifield/Rickards]

   (iii) Clarify expectations of data centres to data providers—send Circular Letter. [Chair and others]

   (iv) Include other parameters measured at gauges (especially meteorological parameters) in data sets in accordance with the Implementation Plan. Send Circular Letter to remind GLOSS Contacts of requirements. [Chair]. (Note that the GLOSS Handbook contains an information field for meteorological data collected at a nearby meteorological site; this needs to be expanded to include guidance on how to get the data)

4. Update and extend GLOSS Handbook into full GLOSS web resource. [Rickards]

5. Undertake new survey of compliance with the Implementation Plan. [Rickards]

6. Pursue data archaeology project further via ESEAS and African searches. [Rickards]

7. Undertake scientific review of polar sea level science, possibly for publication in a special issue of a journal. (Note recent papers by Proshutinsky et al., Hughes et al., Manning etc.) [Woodworth]

8. Training courses:

   (i) GLOSS training course, Malaysia, 8–21 February 2004, fixed; clarify list of possible participants and detailed arrangements. [IOC and Malaysia]

   (ii) GLOSS training course under the Benguela LME programme; to be held either at UCT or in Namibia; next top priority for 2004. [IOC]

   (iii) Course on sea level changes: observation, interpretation, application, Trinidad, July 2004; to be supported by GLOSS at a level to be decided, and letter of support to be sent to organizers. [IOC]

   (iv) Sea-level training course, Kenya; proposal for a primarily technical course probably to be supported for 2004. An updated proposal requested, to be sent to Aarup. [Magori]

   (v) GLOSS training course, Ecuador, offered by Rodney Martinez; a proper proposal requested [Fierro]

   (vi) One week courses at NTFA; clarify costs and investigate possibilities of attendance by specialists from GLOSS priority sites. [Mitchell; IOC]

   (vii) A further course for Asia; Japan to investigate feasibility. [Sakurai]

   (viii) POL course; agreeable if funding allows in biennium; offer to be pursued. [IOC]

9. Scientific Steering Group issues:

   (i) Update membership list. [Mitchum]

   (ii) Gather in replies to existing questions, and to other questions added as necessary, and report to GLOSS Chair by end of year. [Mitchum]

10. Send Circular Letter to Arctic and Antarctic gauge operators asking for continued support of GLOSS, requesting data to be sent to SOSLC at NTFA, and referring to the IPY 2007 and the need for GLOSS involvement in it. [Chair]

11. JCOMMOPS issues:

   (i) GLOSS at PSMSL—status for 2003 to be sent to Etienne Charpentier. [Woodworth]

   (ii) GLOSS Fast Information status also to be sent. [Merrifield]

   (iii) Mirror of GLOSS Fast Information from UH (real-time displays?). [Merrifield]

12. IHO Tidal Committee: ensure GLOSS participation. [Chair]

13. Send B-gauge technical information to Laurent Testut. [Woodworth]

14. Search for regional "champions" for Asia, possibly within the GOOS Regional Alliances. [Chair]

15. Visit to EU Development Directorate. [Aarup, Le Provost, Woodworth]

16. COOP issues:

   (i) Decide additional parameters, including those specified in the GLOSS Implementation Plan and more exotic ones (salinity, oxygen etc.). Send Circular Letter to remind Contacts of the requirements under the Plan to ask them whether

they have the capability for submitting other parameters and information to GLOSS Handbook. Information needed soon for the COOP Implementation Plan. [IOC; Rickards]

(ii) Consider how the regional networks can be strengthened and what that implies for data management. [Chair; IOC; Thompson]

(iii) How can GLOSS help in designing regional networks? Spacing of stations, standards etc. [Chair; GLOSS SSG]

(iv) How does GLOSS progress "federally" via tiered regional data centres to take on "global oversight" for sea level. [Chair]

17. Stan Wilson to send letter to India requesting DM and Fast Information co-operation (noting earlier GLOSS communications on this subject) [Wilson, Woodworth, Aarup]

18. Complete TASK windowization. [Rosen]

19. CGPS@TG gauges and TIGA:

(i) Send Circular Letter/e-mail inviting people to inspect Guy Woppelmann's website and advise on GPS near gauges not included at present. [Chair]

(ii) In same Circular Letter, ask all operators of GCN gauges with nearby GPS to sign up to TIGA [Chair]

(iii) Send letter (copied to Prof. Reigber) to IGS Central Bureau stating importance of TIGA to GLOSS and requesting a 3-year extension of the TIGA Pilot Project. [Chair]

(iv) Make available new log file for TIGA membership on the TIGA, GLOSS and Woppelmann websites. [Schoene/Woppelmann]

20. Actions following results of EU and ODINAFRICA proposals. [Woodworth, Aarup]

21. Russian issues:

(i) Inclusion in February ESEAS-extension SSP proposal. [Plag and Zilberstein]

(ii) Investigation of possible membership of ESEAS. [Plag and Zilberstein]

(iii) Availability of Pacific (e.g. Petropavlovsk) hourly data via tsunami data stream. [Merrifield]

(iv) Specific Arctic possibilities under EU's 6th Framework Programme. [Woodworth]

(v) Proposals for changes in Russian gauges in GCN

(vi) noted and approved at GE-GLOSS-VIII, needing clarification when Roshydromet studies are completed, and to be included in next redefinition of the GCN. [Chair]

22. Portuguese issues:

Suggested changes to GCN with regard to Azores (SC das Flores to Lajes) and Madeira (Funchal to Canical) stations noted and approved and to be included in GCN when next redefined. [Chair]

23. Brazilian issues:

GLOSS-Brazil Plan needed as soon as possible, in view of its great importance to GLOSS. [Fricks Cavalcante]

24. Iranian issues:

    (i) Historical data to be checked out. [PSMSL]

    (ii) Possibility of a technical mission to be investigated. [IOC]

25. Pakistan issues:

    NTFA to consider providing new gauge to Lt.Cmdr. Hussain for Karachi. [Mitchell, Woodworth]

26. PERSGA countries:

    Feasibility of a technical mission to be re-investigated by IOC and PERSGA. [IOC]

27. Investigate funding related to International Polar Year. [Aarup]

28. Develop high-level sea level products [UHSLC/PSMSL]

29. Send letters to Central American authorities regarding GLOSS links to the tsunami system and asking for co-operation. [Chair]

30. International Altimeter Service: send to IAS proponents a letter confirming GLOSS support. [Chair]

31. Provide GTS information needed for workshop report. [Scherer, Meldrum]

32. Circulate Automatic QC information. [Perez, Rickards]

33. Investigate establishment of GLOSS Technical Committee. [Chair]

34. Consider new version of IOC Manual. [Chair of GLOSS Technical Advisory Group, presumably]. (Note IOC initiative for standards of measurement of a range of parameters to be input to JCOMM-II conference)

35. Websites:

    (i) Establish ODINCARSA-GLOSS website for South America in English and/or Spanish or Portuguese. [Fierro]

    (ii) Update GLOSS-Africa website. [Magori]

    (iii) Investigate GLOSS-Asia website(s). [Chen and Malaysia]

36. GCOS baseline sites and associated words; version submitted to GCOS to be circulated to Experts beforehand. [Woodworth and others]

37. Consider mechanisms of merger of ESEAS and MedGLOSS at MedGLOSS Congress 2004. [Plag, Rosen]

38. Provide Chairman with ideas on how GLOSS may evolve within a global sea level context and in particular on how the Group of Experts might evolve. [All]

39. Investigate training possibilities for GLOSS through Université Pierre et Marie Curie (Paris 6), POGO etc. [All]

40. Investigate all possibilities for publicizing GLOSS in publications and meetings. [All]. GLOSS–COOP–GOOS presentation at Royal Society, February 2004. [Aarup]

41. Place GLOSS tidal constants on web. [Le Provost]

42. Decide GLOSS participation in CIESM Congress, June 2004, which will include a MedGLOSS round table. [Chair]

43. Contact Alejandro Guttierez for RONMAC and see what can be done to recover the deterioration in CPACC/RONMAC operations. [IOC; Chair]

44. Advise Dr. Jimmy Murphy (UC Cork) regarding development of a sea level network in Ireland. [Woodworth]

45. Continue support of PSMSL activities in support of GLOSS (carried forward from GE-GLOSS-VII). [IOC]

ANNEX V

ACRONYMS

ACCLAIM	Antarctic Circumpolar Current Levels by Altimetry and Island Measurements
ALT	Altimeter
ASCII	American Standard Coded Information Interchange
AVISO	Archivage, Validation et Interprétation des données des Satellites Océanographiques
BODC	British Oceanographic Data Centre
CD-ROM	Compact Disk-Read-Only Memory
CGPS	Continuous Global Positioning System
CIESM	International Commission for the Scientific Exploration of the Mediterranean Sea
CLIVAR	Climate Variability and Prediction
CLS	Collecte–Localisation–Satellites
CNES	Centre National d'Etudes Spatiales (France)
COOP	Coastal Ocean Observations Panel
CPACC	Caribbean Planning for Adaptation to Climate Change
DAAC	Data Acquisition and Analysis Center
DAC	Data Assembly Centre
DACS	Data Acquisition and Command System
DHN	Diretoria de Hidrografia e Navegação (Brazil)
DMACS	Data Management and Communications System
DODS	Distributed Ocean Data System
DORIS	Détermination d'orbite et radio positionnement integré par satellite
DVD	Digital Videodisk
E2EDM	End-to-End Data Management
EOS	Earth Observing System
ERS	Earth Remote-sensing Satellite
ESA	European Space Agency
ESEAS	European Sea Level Service
ESEAS-RI	ESEAS Research Infrastructure
ETDMP	Expert Team on Data Management Practices
EU	European Union
EuroGOOS	European Global Ocean Observing System
FTP	File Transfer Protocol
GAINS	GLOSS Development in the Atlantic and Indian Oceans
GAR	GLOSS Adequacy [or Assessment] Report
GCN	GLOSS Core Network
GCOS	Global Climate Observing System
GE	Group of Experts
GEF	Global Environment Facility
GEOSAT	Geodetic Satellite
GFZ	Geoforschungs Zentrum (Germany)
GLOSS	Global Sea Level Observing System
GMES	Global Monitoring for Environment and Security (European Union)
GMS	Geostationary Meteorological Satellite
GODAE	Global Ocean Data Assimilation Experiment

GODAR	Global Oceanographic Data Archæology and Rescue
GOES	Geostationary Operational Environmental Satellite
GOOS	Global Ocean Observing System
GOOS–Africa	GOOS in Africa
GPS	Global Positioning System
IAG	International Association of Geodesy
IALA	International association of marine Aids to navigation and Lighthouse Authorities
IMO	International Maritime Organization
IAPSO	International Association for the Physical Sciences of the Ocean
IAS	International Altimeter Service
ICSU	International Council for Science
IGGOS	Integrated Global Geodetic Observation System
IGS	International GPS Service for Geodynamics
IGY	International Geophysical Year
IHO	International Hydrographic Organization
IOC	Intergovernmental Oceanographic Commission
IOCARIBE	IOC Sub-Commission for the Caribbean and Adjacent Regions
IODE	International Oceanographic Data and Information Exchange
IOLR	Israel Oceanographic and Limnological Research Ltd.
IOOS	Integrated Ocean Observing System
IPCC	Intergovernmental Panel on Climate Change
IPY	International Polar Year
ITSU	International Tsunami Warning System in the Pacific
IUGG	International Union of Geodesy and Geophysics
JASL	Joint Archive for Sea Level
JCOMM	Joint IOC–WMO Technical Commission for Oceanography and Marine Meteorology
JCOMM-OPS	JCOMM Observing Platform Support
JPL	Jet Propulsion Laboratory (USA)
KMS	Kort & Matrikelstyrelsen (Denmark)
LME	Large Marine Ecosystem
LTT	Long Term Trends
MedGLOSS	Mediterranean Programme for the Global Sea-Level Observing System
MedGOOS	Mediterranean Programme for the Global Ocean Observing System
MILAC	Marine Impacts on Lowland Agriculture and Coastal Resources
MSL	Mean Sea Level
NASA	National Aeronautics and Space Administration (USA)
NCC	National Cartographic Centre (Iran)
netCDF	network Common Data Form
NIO	National Institute of Oceanography (Pakistan)
NIOT	National Institute of Ocean Technology (India)
NOAA	National Oceanic and Atmospheric Administration (USA)
NTFA	National Tidal Facility Australia
OBS	Observations [Programme Area]
OC	Ocean Circulation
OCG	Observations [Programme Area] Co-ordination Group
ODINAFRICA	Oceanographic Data and Information Network for Africa
ODINCARSA	Oceanographic Data and Information Network for the IOCARIBE and South America
OOPC	Ocean Observations Panel for Climate

OPeNDAP	Open-source Project for a Network Data Access Protocol
OPS	Observing Platform Support
PERSGA	Programme on the Environment of the Red Sea and the Gulf of Aden
POGO	Partnership for Observing the Global Oceans
POL	Proudman Oceanography Laboratory (UK)
PSMSL	Permanent Service for Mean Sea Level
QC	Quality Control
RONMAC	Red de Observación del Nivel del Mar para América Latina
SARS	Severe Acute Respiratory Syndrome
SCAR	Scientific Committee on Antarctic Research
SEAFRAME	Sea-Level Fine-Sea-Level Fine-Resolution Acoustic Measuring System
SHOA	Servicio Hidrográfico y Oceanográfico de la Armada (Chile)
SLP-Pac	Sea Level Programme in the Pacific
SOA	State Oceanic Administration (China)
SOC	Specialized Oceanographic Centre
SOC	Southampton Oceanography Centre
SOSLC	Southern Ocean Sea Level Centre
SSG	Science Sub-Group
SSP	Scientific Support to Policies (European Union Framework VI program)
STREP	Specific Targeted Research Projects (European Union Framework VI programme)
TASK	POL/PSMSL Tidal Analysis Software Kit
TG	Tide Gauge
TIGA	GPS Tide Gauge Benchmark Monitoring Pilot Project
TOPEX–Poseidon	Ocean Topography Experiment/Poseidon Satellite
UC	University of Cork (Ireland)
UCT	University of Cape Town (South Africa)
UH	University of Hawaii
UHSLC	University of Hawaii Sea Level Center
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNFCCC	United Nations Framework Convention on Climate Change
WIST	WOCE Integrated Search Tool
WMO	World Meteorological Organization
WOCE	World Ocean Circulation Experiment
XML	Extended Mark-Up Language

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 S. Fourth Session of the Joint IOC-WMO-CPPS Working Group on the Investigations of 'El Niño' ***(Also printed in Spanish)***
4. First Session of the IOC-FAO Guiding Group of Experts on the Programme of Ocean Science in Relation to Living Resources
5. First Session of the IOC-UN(OETB) Guiding Group of Experts on the Programme of Ocean Science in Relation to Non-Living Resources
6. First Session of the Editorial Board for the International Bathymetric Chart of the Mediterranean and Overlay Sheets
7. First Session of the Joint CCOP(SOPAC)-IOC Working Group on South Pacific Tectonics and Resources
8. First Session of the IODE Group of Experts on Marine Information Management
9. Tenth Session of the Joint CCOP-IOC Working Group on Post-IDOE Studies in East Asian Tectonics and Resources
10. Sixth Session of the IOC-UNEP Group of Experts on Methods, Standards and Intercalibration
11. First Session of the IOC Consultative Group on Ocean Mapping ***(Also printed in French and Spanish)***
12. Joint 100-WMO Meeting for Implementation of IGOSS XBT Ships-of-Opportunity Programmes
13. Second Session of the Joint CCOP/SOPAC-IOC Working Group on South Pacific Tectonics and Resources
14. Third Session of the Group of Experts on Format 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 lntercalibration
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 lnternacional del Mar Caribe y Parte del Océano Pacífico frente a Centroamérica ***(Spanish only)***
20. Third Session of the Joint CCOP/SOPAC-IOC Working Group on South Pacific Tectonics and Resources
21. Twelfth Session of the Joint CCOP-IOC Working Group on Post-IDOE Studies of South-East Asian Tectonics and Resources
22. Second Session of the IODE Group of Experts on Marine Information Management
23. First Session of the IOC Group of Experts on Marine Geology and Geophysics in the Western Pacific
24. Second Session of the IOC-UN(OETB) Guiding Group of Experts on the Programme of Ocean Science in Relation to Non-Living Resources ***(Also printed in French and Spanish)***
25. Third Session of the IOC Group of Experts on Effects of Pollutants
26. Eighth Session of the IOC-UNEP Group of Experts on Methods, Standards and lntercalibration
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 IGOSS XBT Ship-of-Opportunity Programmes
32. Thirteenth Session of the Joint CCOP-IOC Working Group on Post-IDOE Studies of East Asia Tectonics and Resources
33. Second Session of the IOC Task Team on the Global Sea-Level Observing System
34. Third Session of the IOC Editorial Board for the International Bathymetric Chart of the Mediterranean and Overlay Sheets
35. Fourth Session of the IOC-UNEP-IMO Group of Experts on Effects of Pollutants
36. First Consultative Meeting on RNODCs and Climate Data Services
37. Second Joint IOC-WMO Meeting of Experts on IGOSS-IODE Data Flow
38. Fourth Session of the Joint CCOP/SOPAC-IOC Working Group on South Pacific Tectonics and Resources
39. Fourth Session of the IODE Group of Experts on Technical Aspects of Data Exchange
40. Fourteenth Session of the Joint CCOP-IOC Working Group on Post-IDOE Studies of East Asian Tectonics and Resources
41. Third Session of the IOC Consultative Group on Ocean Mapping
42. Sixth Session of the Joint IOC-WMO-CCPS 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 lntercalibration
46. Second Session of the IOC Editorial Board for the International Bathymetric Chart of the Caribbean Sea and the Gulf of Mexico
47. Cancelled
48. Twelfth Session of the Joint IOC-IHO Guiding Committee for the General Bathymetric Chart of the Oceans
49. Fifteenth Session of the Joint CCOP-IOC Working Group on Post-IDOE Studies of East Asian Tectonics and Resources
50. Third Joint IOC-WMO Meeting for Implementation of IGOSS XBT Ship-of-Opportunity Programmes
51. First Session of the IOC Group of Experts on the Global Sea-Level Observing System
52. Fourth Session of the IOC Editorial Board for the International Bathymetric Chart of the Mediterranean
53. First Session of the IOC Editorial Board for the International Chart of the Central Eastern Atlantic ***(Also printed in French)***
54. Third Session of the IOC Editorial Board for the International Bathymetric Chart of the Caribbean Sea and the Gulf of Mexico ***(Also printed in Spanish)***
55. Fifth Session of the IOC-UNEP-IMO Group of Experts on Effects of Pollutants
56. Second Session of the IOC Editorial Board for the International Bathymetric Chart of the Western Indian Ocean
57. First Meeting of the IOC *ad hoc* Group of Experts on Ocean Mapping in the WESTPAC Area
58. Fourth Session of the IOC Consultative Group on Ocean Mapping

59. Second Session of the IOC-WMO/IGOSS Group of Experts on Operations and Technical Applications
60. Second Session of the IOC Group of Experts on the Global Sea-Level Observing System
61. UNEP-IOC-WMO Meeting of Experts on Long-Term Global Monitoring System of Coastal and Near-Shore Phenomena Related to Climate Change
62. Third Session of the IOC-FAO Group of Experts on the Programme of Ocean Science in Relation to Living Resources
63. Second Session of the IOC-IAEA-UNEP Group of Experts on Standards and Reference Materials
64. Joint Meeting of the Group of Experts on Pollutants and the Group of Experts on Methods, Standards and Intercalibration
65. First Meeting of the Working Group on Oceanographic Co-operation in the ROPME Sea Area
66. Fifth Session of the Editorial Board for the International Bathymetric and its Geological/Geophysical Series
67. Thirteenth Session of the IOC-IHO Joint Guiding Committee for the General Bathymetric Chart of the Oceans ***(Also printed in French)***
68. International Meeting of Scientific and Technical Experts on Climate Change and Oceans
69. UNEP-IOC-WMO-IUCN Meeting of Experts on a Long-Term Global Monitoring System
70. Fourth Joint IOC-WMO Meeting for Implementation of IGOSS XBT Ship-of-Opportunity Programmes
71. ROPME-IOC Meeting of the Steering Committee on Oceanographic Co-operation in the ROPME Sea Area
72. Seventh Session of the Joint IOC-WMO-CPPS Working Group on the Investigations of 'El Niño' ***(Spanish only)***
73. Fourth Session of the IOC Editorial Board for the International Bathymetric Chart of the Caribbean Sea and the Gulf of Mexico ***(Also printed in Spanish)***
74. UNEP-IOC-ASPEI Global Task Team on the Implications of Climate Change on Coral Reefs
75. Third Session of the IODE Group of Experts on Marine Information Management
76. Fifth Session of the IODE Group of Experts on Technical Aspects of Data Exchange
77. ROPME-IOC Meeting of the Steering Committee for the Integrated Project Plan for the Coastal and Marine Environment of the ROPME Sea Area
78. 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
81. Fifth Joint IOG-WMO Meeting for Implementation of IGOSS XBT Ship-of-Opportunity Programmes
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 OSLR for the IOCINCWIO Region
92. Fifth Session of the Joint IOC-JGOFS CO, 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
97. Joint Meeting of GEMSI and GEEP Core Groups
98. First Session of the Joint Scientific and Technical Committee for Global Ocean Observing System
99. Second International Meeting of Scientific and Technical Experts on Climate Change and the Oceans
100. First Meeting of the Officers of the Editorial Board for the International Bathymetric Chart of the Western Pacific
101. Fifth Session of the IOC Editorial Board for the International Bathymetric Chart of the Caribbean Sea and the Gulf of Mexico
102. Second Session of the Joint Scientific and Technical Committee for Global Ocean Observing System
103. Fifteenth Session of the Joint IOC-IHO Committee for the General Bathymetric Chart of the Oceans
104. Fifth Session of the IOC Consultative Group on Ocean Mapping
105. Fifth Session of the IODE Group of Experts on Marine Information Management
106. IOC-NOAA *Ad hoc* Consultation on Marine Biodiversity
107. Sixth Joint IOC-WMO Meeting for Implementation of IGOSS XBT Ship-of-Opportunity Programmes
108. Third Session of the Health of the Oceans (HOTO) Panel of the Joint Scientific and Technical Committee for GLOSS
109. Second Session of the Strategy Subcommittee (SSC) of the IOC-WMO-UNEP Intergovernmental Committee for the Global Ocean Observing System
110. Third Session of the Joint Scientific and Technical Committee for Global Ocean Observing System
111. First Session of the Joint GCOS-GOOS-WCRP Ocean Observations Panel for Climate
112. Sixth Session of the Joint IOC-JGOFS C02 Advisory Panel Meeting
113. First Meeting of the IOC/WESTPAC Co-ordinating Committee for the North-East Asian Regional - Global Ocean Observing System (NEAR-GOOS)
114. Eighth Session of the Joint IOC-WMO-CPPS Working Group on the Investigations of "El Niño" ***(Spanish only)***
115. Second Session of the IOC Editorial Board of the International Bathymetric Chart of the Central Eastern Atlantic ***(Also printed in French)***
116. Tenth Session of the Officers Committee for the Joint IOC-IHO General Bathymetric Chart of the Oceans (GEBCO), USA, 1996
117. IOC Group of Experts on the Global Sea Level Observing System (GLOSS), Fifth Session, USA, 1997
118. Joint Scientific Technical Committee for Global Ocean Observing System (J-GOOS), Fourth Session, USA, 1997
199 First Session of the Joint 100-WMO IGOSS Ship-of-Opportunity Programme Implementation Panel, South Africa, 1997
120. Report of Ocean Climate Time-Series Workshop, Joint GCOS-GOOS-WCRP Ocean Observations Panel for Climate, USA, 1997

121. IOC/WESTPAC Co-ordinating Committee for the North-East Asian Regional Global Ocean Observing System (NEAR-GOOS), Second Session, Thailand, 1997

122. First Session of the IOC-IUCN-NOAA *Ad hoc* Consultative Meeting on Large Marine Ecosystems (LME), France, 1997

123. Second Session of the Joint GCOS-GOOS-WCRP Ocean Observations Panel for Climate (OOPC), South Africa, 1997

124. Sixth Session of the IOC Editorial Board for the International Bathymetric Chart of the Caribbean Sea and the Gulf of Mexico, Colombia, 1996 ***(also printed in Spanish)***

125. Seventh Session of the IODE Group of Experts on Technical Aspects of Data Exchange, Ireland, 1997

126. IOC-WMO-UNEP-ICSU Coastal Panel of the Global Ocean Observing System (GOOS), First Session, France, 1997

127. Second Session of the IOC-IUCN-NOAA Consultative Meeting on Large Marine Ecosystems (LME), France, 1998

128. Sixth Session of the IOC Consultative Group on Ocean Mapping (CGOM), Monaco, 1997

129. Sixth Session of the Tropical Atmosphere - Ocean Array (TAO) Implementation Panel, United Kingdom, 1997

130. First Session of the IOC-WMO-UNEP-ICSU Steering Committee of the Global Ocean Observing System (GOOS), France, 1998

131. Fourth Session of the Health of the Oceans (HOTO) Panel of the Global Ocean Observing System (GOOS), Singapore, 1997

132. Sixteenth Session of the Joint IOC-IHO Guiding Committee for the General Bathymetric Chart of the Oceans (GEBCO), United Kingdom, 1997

133. First Session of the IOC-WMO-UNEP-ICSU-FAO Living Marine Resources Panel of the Global Ocean Observing System (GOOS), France, 1998

134. Fourth Session of the IOC Editorial Board for the International Bathymetric Chart of the Western Indian Ocean (IOC/EB-IBCWIO-IW3), South Africa, 1997

135. Third Session of the Joint GCOS-GOOS-WCRP Ocean Observations Panel for Climate (OOPC), France, 1998

136. Seventh Session of the Joint IOC-JGOFS C02 Advisory Panel Meeting, Germany, 1997

137. Implementation of Global Ocean Observations for GOOS/GCOS, First Session, Australia, 1998

138. Implementation of Global Ocean Observations for GOOS/GCOS, Second Session, France, 1998

139. Second Session of the IOC-WMO-UNEP-ICSU Coastal Panel of the Global Ocean Observing System (GOOS), Brazil, 1998

140. Third Session of IOC/WESTPAC Co-ordinating Committee for the North-East Asian Regional - Global Ocean Observing System (NEAR-GOOS), China, 1998

141. Ninth Session of the Joint IOC-WMO-CPPS Working Group on the Investigations of 'El Niño', Ecuador, 1998 ***(Spanish only)***

142. Seventh Session of the IOC Editorial Board for the International Bathymetric Chart of the Mediterranean and its Geological/Geophysical Series, Croatia, 1998

143. Seventh Session of the Tropical Atmosphere-Ocean Array (TAO) Implementation Panel, Abidjan, Côte d'Ivoire, 1998

144. Sixth Session of the IODE Group of Experts on Marine Information Management (GEMIM), USA, 1999

145. Second Session of the IOC-WMO-UNEP-ICSU Steering Committee of the Global Ocean Observing System (GOOS), China, 1999

146. Third Session of the IOC-WMO-UNEP-ICSU Coastal Panel of the Global Ocean Observing System (GOOS), Ghana, 1999

147. Fourth Session of the GCOS-GOOS-WCRP Ocean Observations Panel for Climate (OOPC); Fourth Session of the WCRP CLIVAR Upper Ocean Panel (UOP); Special Joint Session of OOPC and UOP, USA, 1999

148. Second Session of the IOC-WMO-UNEP-ICSU-FAO Living Marine Resources Panel of the Global Ocean Observing System (GOOS), France, 1999

149. Eighth Session of the Joint IOC-JGOFS CO2 Advisory Panel Meeting, Japan, 1999

150. Fourth Session of the IOC/WESTPAC Co-ordinating Committee for the North-East Asian Regional – Global Ocean Observing System (NEAR-GOOS), Japan, 1999

151. Seventh Session of the IOC Consultative Group on Ocean Mapping (CGOM), Monaco, 1999

152. Sixth Session of the IOC Group of Experts on the Global Sea level Observing System (GLOSS), France, 1999

153. Seventeenth Session of the Joint IOC-IHO Guiding Committee for the General Bathymetric Chart of the Oceans (GEBCO), Canada, 1999

154. Comité Editorial de la COI para la Carta Batimétrica Internacional del Mar Caribe y el Golfo de Mexico (IBCCA), Septima Reunión, Mexico, 1998

IOC Editorial Board for the International Bathymetric Chart of the Caribbean Sea and the Gulf of Mexico (IBCCA), Seventh Session, Mexico, 1998

155. Initial Global Ocean Observing System (GOOS) Commitments Meeting, IOC-WMO-UNEP-ICSU/Impl-III/3, France, 1999

156. First Session of the *ad hoc* Advisory Group for IOCARIBE-GOOS, Venezuela, 1999 ***(also printed in Spanish and French)***

157. Fourth Session of the IOC-WMO-UNEP-ICSU Coastal Panel of the Global Ocean Observing System (GOOS), China, 1999

158. Eighth Session of the IOC Editorial Board for the International Bathymetric Chart of the Mediterranean and its Geological/Geophysical Series, Russian Federation, 1999

159. Third Session of the IOC-WMO-UNEP-ICSU-FAO Living Marine Resources Panel of the Global Ocean Observing System (GOOS), Chile, 1999

160. Fourth Session of the IOC-WMO-UNEP-ICSU-FAO Living Marine Resources Panel of the Global Ocean Observing System (GOOS). Hawaii, 2000

161. Eighth Session of the IODE Group of Experts on Technical Aspects of Data Exchange, USA, 2000

162. Third Session of the IOC-IUCN-NOAA Consultative Meeting on Large Marine Ecosystems (LME), France, 2000

163. Fifth Session of the IOC-WMO-UNEP-ICSU Coastal Panel of the Global Ocean Observing System (GOOS), Poland, 2000

164. Third Session of the IOC-WMO-UNEP-ICSU Steering Committee of the Global Ocean Observing System (GOOS), France, 2000

165. Second Session of the *ad hoc* Advisory Group for IOCARIBE-GOOS, Cuba, 2000 ***(also printed in Spanish and French)***

166. First Session of the Coastal Ocean Observations Panel, Costa Rica, 2000

167. First GOOS Users' Forum, 2000

168. Seventh Session of the Group of Experts on the Global Sea Level Observing System, Honolulu, 2001

169. First Session of the Advisory Body of Experts on the Law of the Sea (ABE-LOS), France, 2001 ***(also printed in French)***

170. Fourth Session of the IOC-WMO-UNEP-ICSU Steering Committee of the Global Ocean Observing System, Chile, 2001

171. First Session of the IOC-SCOR Ocean CO_2 Advisory Panel, France, 2000

172. Fifth Session of the GCOS-GOOS-WCRP Ocean Observations Panel for Climate (OOPC), Norway, 2000 ***(electronic copy only)***

173. Third Session of the *ad hoc* Advisory Group for IOCARIBE-GOOS, USA, 2001 ***(also printed in Spanish and French)***

174. Second Session of the Coastal Ocean Observations Panel and GOOS Users' Forum, Italy, 2001

175. Second Session of the Black Sea GOOS Workshop, Georgia, 2001

176. Fifth Session of the IOC/WESTPAC Co-ordinating Committee for the North-East Asian Regional – Global Ocean Observing System (NEAR-GOOS), Republic of Korea, 2000

177. Second Session of the Advisory Body of Experts on the Law of the Sea (IOC/ABE-LOS), Morocco, 2002 ***(also printed in French)***

178. Sixth Session of the Joint GCOS-GOOS-WCRP Ocean Observations Panel for Climate (OOPC), Australia, 2001 ***(electronic copy only)***

179. *Cancelled*

180. Second Session of the IOC-SCOR Ocean CO_2 Advisory Panel, Honolulu, Hawaii, U.S.A, 2002 ***(electronic copy only)***

181. IOC Workshop on the Establishment of SEAGOOS in the Wider Southeast Asian Region, Seoul, Republic of Korea, 2001 (SEAGOOS preparatory workshop) ***(electronic copy only)***

182. First Session of the IODE Steering Group for the Resource Kit, USA, 19–21 March 2001

183. Fourth Session of the IOC-IUCN-NOAA Consultative Meeting on Large Marine Ecosystems (LMEs), France, 2002

184. Seventh Session of the IODE Group of Experts on Marine Information Management (GEMIM), France, 2002 ***(electronic copy only)***

185. Sixth Session of IOC/WESTPAC Coordinating Committee for the North-East Asian Regional - Global Ocean Observing System (NEAR-GOOS), Republic of Korea, 2001 ***(electronic copy only)***

186. First Session of the Global Ocean Observing System (GOOS) Capacity Building Panel, Switzerland, 2002 ***(electronic copy only)***

187. Fourth Session of the ad hoc Advisory Group for IOCARIBE-GOOS, 2002, Mexico ***(also printed in French and Spanish)***

188. Fifth Session of the IOC Editorial Board for the International Bathymetric Chart of the Western Indian Ocean (IBCWIO), Mauritius, 2000

189. Third session of the Editorial Board for the International Bathymetric Chart of the Western Pacific, Chine, 2000

190. Third Session of the Coastal Ocean Observations Panel and GOOS Users' Forum, Vietnam, 2002

191. Eighth Session of the IOC Consultative Group on Ocean Mapping, Russian Federation, 2001

192. Third Session of the Advisory Body of Experts on the Law of the Sea (IOC/ABE-LOS), Lisbon, 2003 ***(also printed in French)***

193. Extraordinary Session of the Joint IOC-WMO-CPPS Working Group on the Investigations of 'El Niño', Chile, 1999 ***(Spanish only; electronic copy only)***

194. Fifth Session of the IOC-WMO-UNEP-ICSU Steering Committee of the Global Ocean Observing System, France, 2002

195. Sixth Session of the IOC-WMO-UNEP-ICSU Steering Committee of the Global Ocean Observing System, South Africa, 2003

196. Fourth Session of the Coastal Ocean Observations Panel, South Africa, 2002 ***(electronic copy only)***

197. First Session of the JCOMM/IODE Expert Team On Data Management Practices, Belgium, 2003 *(also JCOMM Meeting Report No. 25)*

198. Fifth Session of the IOC-IUCN-NOAA Consultative Meeting on Large Marine Ecosystems (LMEs), Paris, 2003

199. Ninth Session of the IOC Consultative Group on Ocean Mapping, Monaco, 2003 ***(Recommendations in English, French, Russian and Spanish included)***

200. Eighth Session of the IOC Group of Experts on the Global Sea level Observing System (GLOSS), France, 2003 ***(electronic copy only)***