

# ***PSMSL Report for GE/GLOSS-XI***

**Lesley Rickards  
Permanent Service for Mean Sea Level  
Proudman Oceanographic Laboratory and British Oceanographic Data Centre  
6 Brownlow Street, Liverpool L3 5DA, United Kingdom**

## **1. Introduction**

The Permanent Service for Mean Sea Level (PSMSL) is based at the Proudman Oceanographic Laboratory (POL) on the campus of Liverpool University. For many years it has been a member of the Federation of Astronomical and Geophysical Data Analysis Services (FAGS) and operates under the auspices of the International Council for Science (ICSU).

As a result of the Priority Area Assessment on Data and Information in 2004, ICSU is reorganizing FAGS and the World Data Centres. This takes into account the recommendations of the *ad hoc* Strategic Committee on Scientific Information and Data which were approved by the ICSU General Assembly in October 2008. An ICSU World Data System will be established and to smooth the way a FAGS-WDC Transition Team has been formed, with Philip Woodworth, the previous PSMSL Director and FAGS Secretary, as a member. Lesley Rickards will be a member of the newly formed World Data System Scientific Committee. However, as far as PSMSL is concerned, there should be little change in function.

The PSMSL has been based at POL for many years, having been established in 1933 by Joseph Proudman who became its first Secretary. PSMSL organised two major symposia in 2008 to mark the 75th anniversary of the PSMSL. The first was at the EGU 2008 conference in Vienna in April and a second was at the British Association Science Festival in September. This latter meeting was held in Liverpool, designated the European Capital of Culture for 2008. In addition, PSMSL partially sponsored The Geological Society of London's William Smith meeting "Observations and Causes of Sea-Level Changes on Millennial to Decadal Timescales".

PSMSL has continued to provide strong support to the Global Sea Level Observing System (GLOSS) and to related projects such as the Ocean Data and Information Network for Africa (ODINAFRICA). It has provided advice and assistance to a large number of people with interests in sea level science, thereby fulfilling its overall obligations as a FAGS Service. Finally, and most importantly, it has redoubled its efforts in its primary aim of providing the global data bank for long term sea level information from tide gauges.

In September 2008, the PSMSL Advisory Board met in Liverpool. Members of PSMSL staff provided an overview of current and planned activities including restructuring of the database to bring it up to modern standards, a new web-site, and development of a wider range of scientific and practical products.

## 2. Staffing and funding

The main PSMSL scientific staff concerned with the collection and analysis of monthly MSL data are Philip Woodworth, Simon Holgate and Svetlana Jevrejeva. In April 2007, Mark Tamisiea joined the PSMSL. He contributes primarily to links between PSMSL and geodetic and geophysical programmes (e.g. GGOS), to the provision of geophysical information in PSMSL web pages, and to analysis of sea level data which requires geophysical insight. Kathy Gordon continues to be responsible for management of the mean sea level data set. In February 2008, Dr Andrew Matthews joined the PSMSL staff. He is contributing to clearing the backlog of GLOSS delayed-mode high frequency data, re-structuring the database and improving data delivery and provision of new tools to aid data input, quality control and reporting.

Alongside the monthly MSL collection, the PSMSL together with BODC, is responsible for an archive of delayed-mode higher-frequency sea level data from the GLOSS network. This activity has so far included Elizabeth Bradshaw and other colleagues in the British Oceanographic Data Centre (BODC).

## 2. PSMSL Data Receipts for 2007 and 2008

During 2007 and 2008 over 4000 station-years of data were entered into the PSMSL database, increasing the total PSMSL data holdings to over 57000 station-years. Although data receipts were a little below average in 2007, 2008 saw a large increase compared to the norm of recent years. Most data originated from Europe and North America. However, large data sets were also obtained from Asia, Australasia and southern Africa. Major gaps in data receipts persist in other parts of Africa which are receiving special attention through ODINAFRICA (see section 4.4 below).

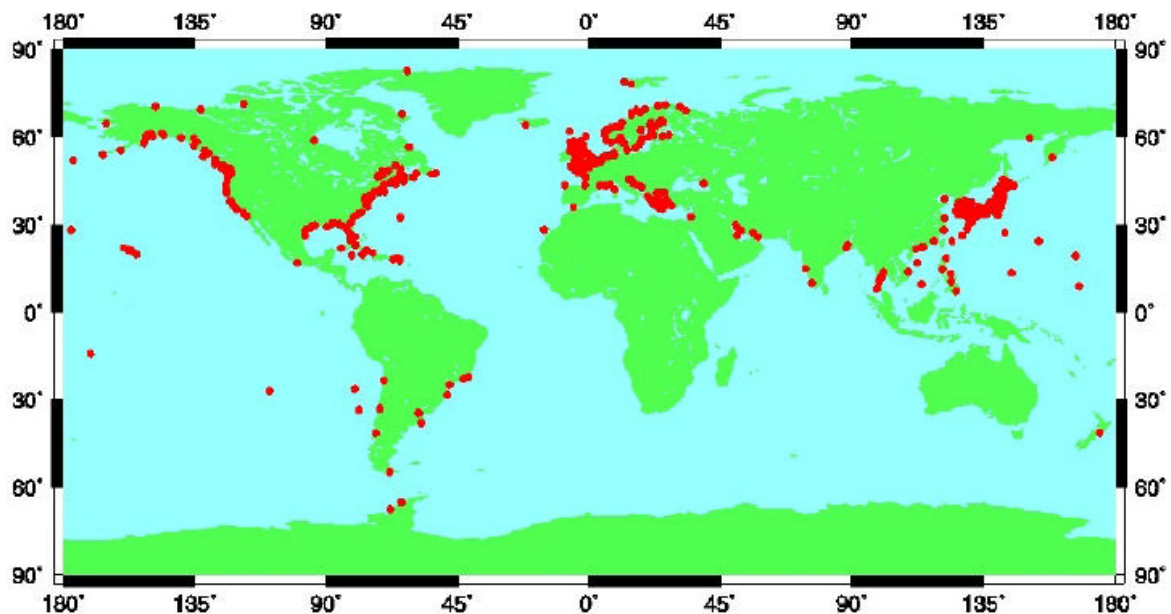
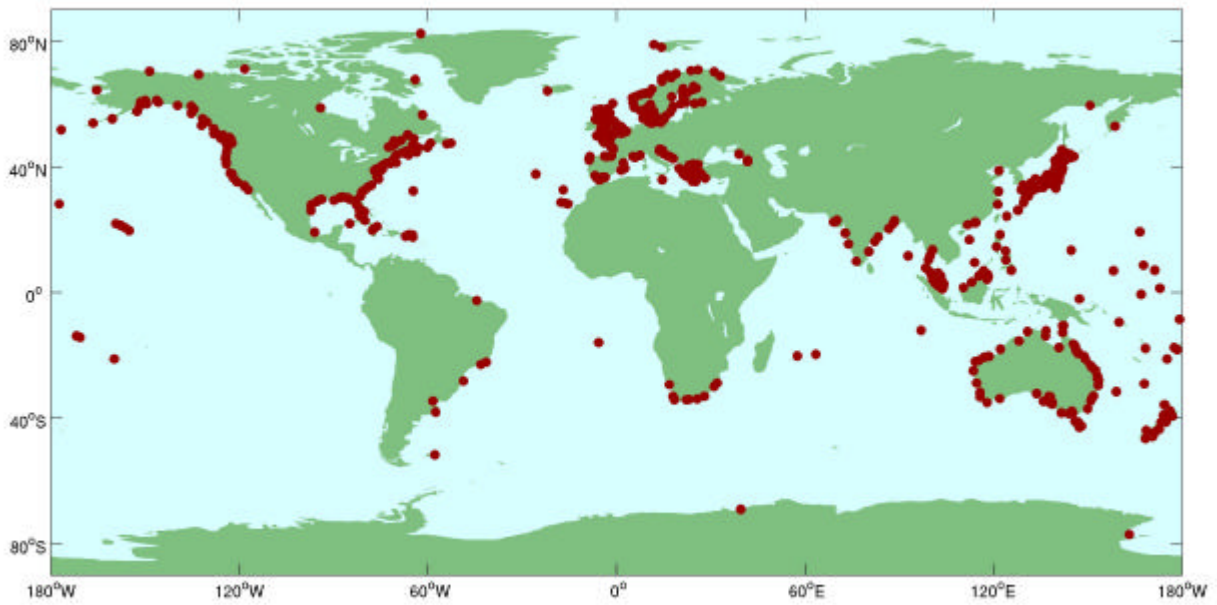
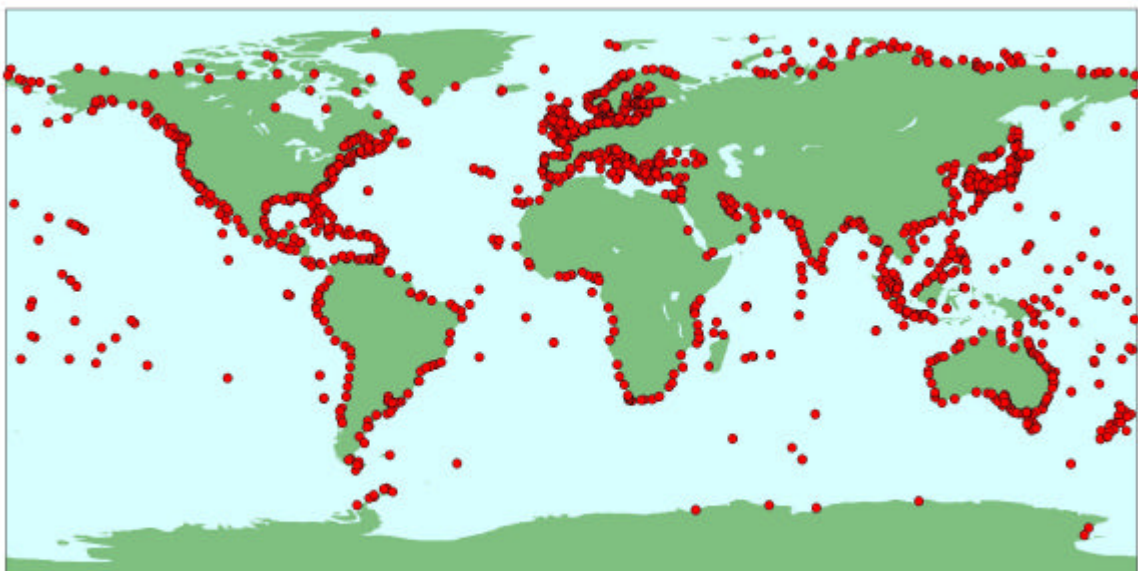


Figure 1a: New PSMSL data for 2007

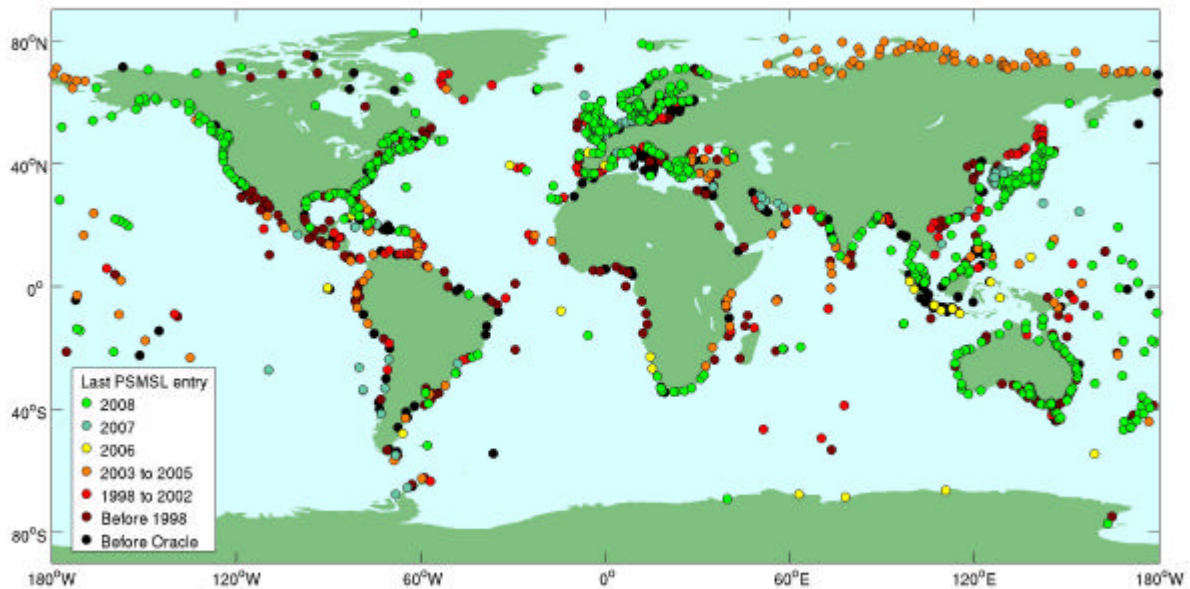


**Figure 1a: New PSMSL data for 2008**

The figures below show (i) the all of the stations that have contributed to the PSMSL and (ii) the year of the most recent data received from each site.



**Figure 2a: Stations providing data to PSMSL**



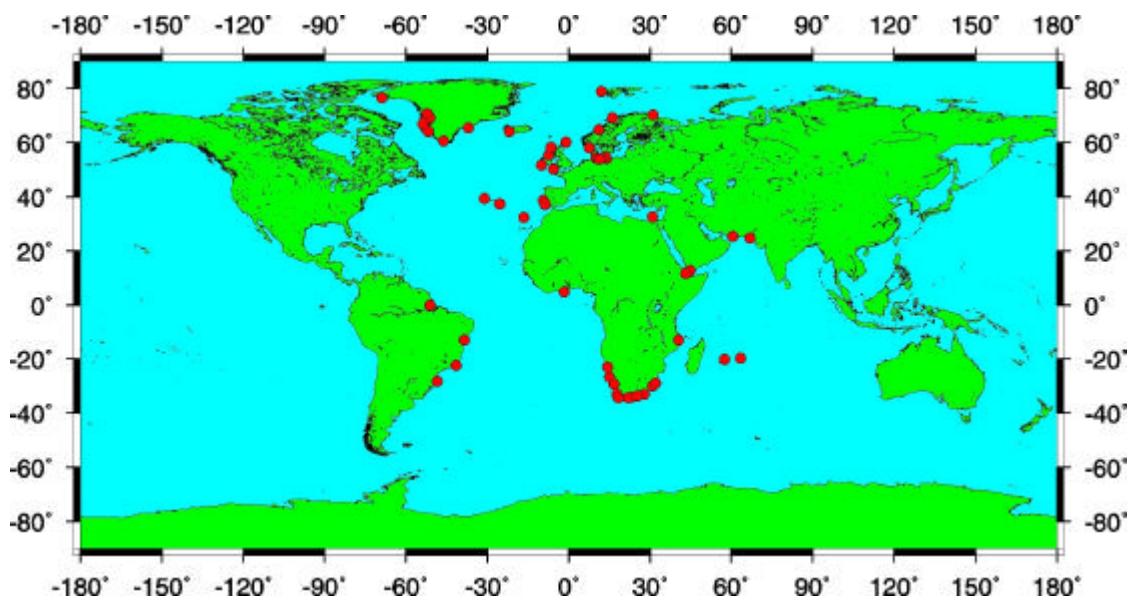
**Figure 2b: Year of most recent data received by PSMSL**

### **3. Delayed Mode High Frequency (DM HF) Data Receipts for 2007-2009**

The PSMSL and BODC are responsible for the archive of delayed-mode higher-frequency sea level data (e.g. hourly values and higher frequency) from the GLOSS network. Approximately 750 site years of high-frequency delayed-mode were received during the period June 2007- April 2009.

Once again data have been received from important data sparse regions. Six gauges that form part of the ODINAFRICA network have supplied over a year's worth of quality controlled data. The Polar Regions are also an area of interest where there are few tide gauges. There has been data submitted from the new gauge at Thule, in Greenland, as well as more recent data from other more established Greenland gauges.

There has been a complete revision of the historic South African tide gauge dataset, with some sites having over 45 years worth of data. There was also a submission of more recent data from the region. Portugal also submitted long time series, with the GLOSS station of Funchal (Madeira) having nearly 50 years worth of data, and 2008 been the latest year supplied.



**Figure 3: New DM HF Data received during 2007 and 2008**

#### **4. GLOSS Activities**

##### **4.1 New GLOSS and PSMSL Web Sites**

The GLOSS web pages ([www.gloss-sealevel.org](http://www.gloss-sealevel.org)) have been completely modernised and updated. The GLOSS Station Handbook has also been revised and updated and is being merged with the GLOSS web-site. New material has been added to the GLOSS web pages including training material and national reports from the GE-GLOSS-X meeting. Much of the information text has been reviewed and revised. A new page providing quality controlled data from ODINAFRICA and the Indian Ocean has been added. The web-site continues to be maintained by the PSMSL and BODC on behalf of GLOSS.

The current PSMSL web site ([www.pol.ac.uk/psmsl](http://www.pol.ac.uk/psmsl)) was launched in 2007 with a revised home page and the addition of a section with commentaries on the interpretation of long sea level records. Plans are now underway for a completely redesigned PSMSL web-site a new structure and simpler navigation with improved data delivery.

##### **4.2 GLOSS Status from a PSMSL Viewpoint (October 2008)**

For several years, the PSMSL has provided a summary of the status of the GLOSS Core Network (GCN) from its viewpoint. A review of its status as of October 2008 can be found at the above GLOSS web-site. 2007 showed a modestly improvement compared to that a year ago, but 2008 showed a decrease in the Category 1 stations which needs to be addressed. Although improvements to the network, some following on from the considerable investments being put into sea level recording in Africa and in the Indian Ocean following the Sumatra tsunami, will feed through to status improvement in the coming years, further work is still required to develop the network further in order that all stations can be Category 1.



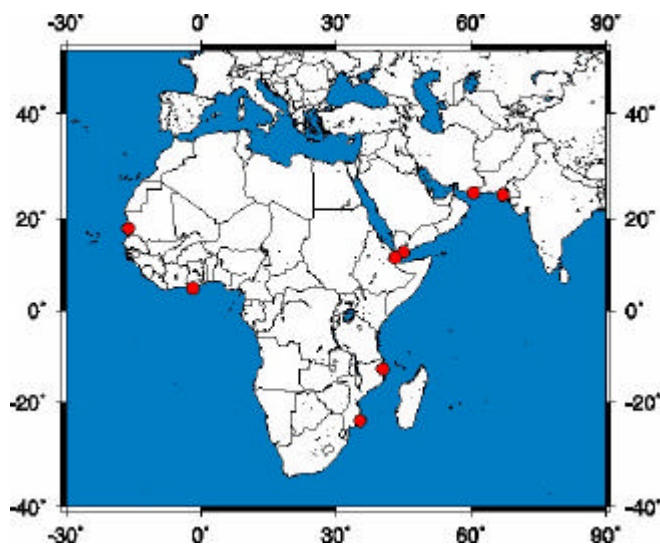
#### **4.3 GLOSS Training Courses and IOC Indian Ocean Tsunami Warning System (IOTWS) fellowships**

GLOSS training courses have been held in many countries since the mid-1980s. IN May 2007 PSMSL organised a short training course at POL for technicians from Egypt, Germany and Iran which was most useful preparation for the recent tide gauge installations.

In 2007 PSMSL hosted two visitors under the IOC Indian Ocean Tsunami Warning System (IOTWS) fellowship scheme. These were Dr. E.M.S. Wijeratne from the National Aquatic Resources Research and Development Agency (NARA) in Sri Lanka and Mr. D. Sundar from the National Institute of Oceanography in India. This was followed in 2008 by a further three visitors under the same Fellowship scheme: Mr Naimatullah Sohoo from the National Institute of Oceanography, Pakistan, Dr Parluhutan Manurung from National Coordinating Agency for Surveys and Mapping (BAKOSURTANAL), Indonesia and Mr Rene Ibara from Pointe Noire, Republic of Congo.

#### **4.4 New GLOSS and ODINAFRICA Tide Gauges**

The PSMSL has been closely involved in the delivery of sea level hardware for a number of stations in Africa and the western Indian Ocean. Currently eleven tide gauges have been installed in Africa and the Indian Ocean. These are: Aden (Yemen), Chabahar (Iran), Djibouti (Djibouti), Karachi (Pakistan), Inhambane (Mozambique), Lagos (Nigeria), Nouakchott (Mauritania), Pemba (Mozambique), Pointe Noire (Republic of Congo), Port Sonara (Cameroon) and Takoradi (Ghana). Eight of these gauges are currently providing data to the real-time Sea Level Station Monitoring Facility operated by the Flanders Marine Institute (VLIZ), Belgium. PSMSL is moving towards devising effective methods for maintenance and assurance of data flow from the newly installed sites. A new data logger and replacement batteries have been dispatched and should resolve the problems at the two sites. Delayed-mode quality controlled 15 minute data with documentation are available for download from the GLOSS web-site from Aden, Chabahar, Djibouti, Karachi, Pemba and Takoradi. Inhambane and Nouakchott will be added soon



**Figure 4: African and Indian Ocean tide gauges on the GLOSS website**

## **5. BGAN Satellite Transmission**

The PSMSL and POL took a major interest in 2006 in the use of the Inmarsat BGAN (Broadband Global Area Network) system for real-time transmission of tide gauge data from remote stations, and especially for data of interest for tsunami warning. This telemetry enables always-on broadband internet connections to tide gauges, providing higher bandwidth and reduced latency in data transfer than available at present by systems such as Meteosat. Inmarsat have been very helpful in providing test equipment.

In December, Dr. Philip Woodworth attended a ceremony at Inmarsat headquarters in London which included the signing of an agreement between IOC and Inmarsat for the use of the Inmarsat BGAN system in the IOTWS. The use of BGAN in this way had been suggested by PSMSL and other POL staff (notably Dr. Simon Holgate, Mr. Peter Foden and Mr. Jeff Pugh) and subsequently demonstrated in a series of tests. BGAN has the potential to improve the speed of tsunami warnings, and therefore to save lives.

## **6. European and other international projects**

### **6.1 Tsunami Projects**

PSMSL staff are contributing to UK-organised tsunami warning activities (e.g. for the UK Defra ministry), European Union ones (TRANSFER) and those coordinated under the auspices of the IOC (e.g. IOTWS, NEAMTWS). These activities have included leading a survey of European sea level infrastructure, studies of optimum networks and hardware and modelling of tsunami propagation. PSMSL also contributed to an IOC Global Meeting of the Intergovernmental Coordination Groups for Tsunami Warning Systems.

### **6.2 European Projects**

The PSMSL continues to provide input to the European Sea Level Service (ESEAS) through its Governing Board and has also contributed proposals to the Chair of the ESEAS Governing Board through which the delivery of delayed mode sea level data from the region can be placed on a more reliable basis. Subsequently funding has been secured and an ESEAS Data Portal developed which is currently undergoing testing.

## **7. Publications**

The PSMSL has a responsibility to not only collect and redistribute sea level information, but also to analyse data and publish scientific results. The main papers published each year are listed in PSMSL Annual Reports.

## **8. Visitors to the PSMSL 2007 - 2008**

Visitors welcomed to the PSMSL since GE-GLOSS-X included David Dixon (Plymouth, UK), Dr. Hans von Storch (GKSS, Germany), Dr. Rolf Weisse (GKSS, Germany), Dr. Thorkild Aarup (IOC), Dr. Rui Manuel da Silva Fernandez (Portugal), Drs. Norman Teferle and Richard Bingley (University of Nottingham, UK), Sir David Wallace (Isaac Newton Institute, Cambridge, UK), Prof. Afranio Rubens de Mesquita (University of Sao Paulo, Brazil), Prof. Roland Gehrels (Plymouth University, UK), Drs. Marta Marcos and Mikis Tsimplis (National Oceanography Centre, Southampton, UK), Drs. Carl Wainman and Sanette Gildenhuys (Institute for Maritime

Technology, South Africa), Dr. Siobhan O'Farrell (Bureau of Meteorology, Australia), representatives of the Miros tide gauge company, Mikhail Karpytchev, Mélanie Becker, Thomas Gouriou and Nicholas Poivreau (University of La Rochelle, France), Graham Alcock (New Zealand), Dr. David Pugh (UK), Dr. Matt King (Newcastle University, UK), Alexander Rabinovich (NOAA, USA), Anton Felder (OTT Germany), Prof. Gary Mitchum (University of South Florida), Dr. Per Knudson (DTU Space, Denmark) and Prof. Richard Peltier (University of Toronto, Canada).

## **9. Summary**

It can be seen that the period since GE/GLOSS-X has been a further active period with regard to important workshops and conferences, and a busy one with regard to data acquisition and analysis. The functions provided by the PSMSL are in as much demand as ever, and several successful events were organised to celebrate the 75th anniversary of the Service in 2008. Particular thanks as usual go to PSMSL staff and to colleagues at the Proudman Oceanographic Laboratory and British Oceanographic Data Centre who contribute part of their time to PSMSL activities.