

PSMSL Annual Report for 2004

1. Introduction

The Permanent Service for Mean Sea Level (PSMSL) has been based at Bidston Observatory, near Liverpool UK, since its foundation in 1933 by Joseph Proudman who became its first Secretary. In December 2004, the PSMSL relocated to new offices in the Joseph Proudman Building on the campus of Liverpool University, where the Proudman Oceanographic Laboratory (POL) itself can also be found. We had expected the PSMSL to move to the new premises over a year ago. However, the relocation was held up for a number of reasons, and the various uncertainties have caused some disruption which we have had to work around.

In spite of these distractions, the PSMSL maintains its aims of providing the global data bank for long term sea level information from tide gauges, and of providing a wider Service to the sea level community. The PSMSL contributed during the year to major conferences, including the organization of a major conference at the Royal Society, and has continued to provide strong support to the further development of the Global Sea Level Observing System (GLOSS).

2. Reporting

During November 2004, the PSMSL reported to an expert panel established by the UK Natural Environment Research Council, which was charged with reviewing the work of POL during the past six years, including that of the PSMSL. We understand that the panel made very favourable reports on all our work. The PSMSL has continued to report to the International Association for the Physical Sciences of the Ocean Commission on Mean Sea Level and Tides (IAPSO/CMSLT) and has an Advisory Board consisting of scientists expert in each area of sea level research. Annual reports on the work of the PSMSL are circulated each year to the International Association of Geodesy (IAG), the Intergovernmental Oceanographic Commission (IOC), IAPSO/CMSLT, the Federation of Astronomical and Geophysical Data Analysis Services (FAGS), and other relevant bodies and are available publicly via the PSMSL web site <http://www.pol.ac.uk/psmsl/>.

It continues as a member of FAGS, working under the auspices of the International Council for Science (ICSU), and will make a further formal progress report to FAGS Council in May 2005.

3. PSMSL Data Receipts for 2004

In the period since the last Annual Report (i.e. since mid-December 2003), almost 900 station-years of data were entered into the PSMSL database, bringing the total PSMSL data holdings to approximately 53000 station-years.. This was considerably less than the remarkable 3500 station-years entered in 2003, which were largely due to receipt of an extensive data set from the Arctic coast of Russia. Nevertheless, it is consistent with the number of station-years in previous years, in spite of not including the large regular updates from North America and Europe which we deferred until after our office relocation.

Appendix 1 lists countries from which sea level data were obtained, while Figure 1 shows their locations. Most data originated from Asia, Australia, Japan and the Pacific. Major gaps in data receipts persist in South America and Africa and parts of Asia which are receiving special attention through recent initiatives (see section 5 below).

4. GLOSS Activities

The Global Sea Level Observing System (GLOSS) is a project of the Joint Technical Commission for Oceanography and Marine Meteorology (JCOMM) of the Intergovernmental Oceanographic Commission (IOC) and the World Meteorological Organisation (WMO). One of the main aims of GLOSS is to improve the quality and quantity of data supplied to the PSMSL. GLOSS has been one of the first components of the Global Ocean Observing System (GOOS).

4.1 GLOSS Status from a PSMSL Viewpoint (October 2004)

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 2004 can be found at:

<http://www.pol.ac.uk/psmsl/programmes/gloss.info.html>

In brief, the status of the programme at the present time is similar to that in previous years with the GCN considered to be approximately two-thirds operational.

4.2 GLOSS Training Courses

GLOSS training courses have been held in many countries since the mid-1980s. In February 2004, a most successful course was held in Malaysia organized by the Department of Survey and Mapping, in which the PSMSL was represented by Dr. Simon Williams. He presented a set of lectures on tides and sea and land level changes, and gave instructions in tidal analysis software packages. Further courses are planned for 2005 and 2006 in Indonesia and Japan.

4.3 GLOSS Experts Meetings

A large number of actions have been completed following the 8th Meeting of the GLOSS Group of Experts in October 2003. That meeting included a Technical Workshop from which a report ("New technical developments in sea and land level observing systems. IOC Workshop Report No 193.") has been edited by Dr. Holgate (PSMSL) and Dr. Aarup (IOC). Planning is now underway for 9th Meeting of the Group in February 2005.

4.4 Tidal Analysis Software Kit (TASK) Online

A web-based version of the TASK tidal analysis and prediction software has been made available to academic users within the GLOSS community by the UK National Tidal & Sea Level Facility. The package may be accessed via <http://www.pol.ac.uk/ntslf/task.html>.

4.5 Time Series Analysis Software Online

A software package for analysing the components of sea level (and other) time series has been produced by Dr. Jevrejeva and can be accessed via <http://www.pol.ac.uk/home/research/waveletcoherence/>.

4.6 New Tide Gauges for GLOSS

The PSMSL has acted as advisor to IOC and the University of São Paulo with regard to the installation of a new radar tide gauge at Cananeia. Installation is now underway. In addition, POL/PSMSL has provided with IOC funds two new gauges for Mozambique, which will use Orbcomm data transmission systems. These will be located at Pemba and Inhambane, at the two ends of the Mozambique Channel. A third gauge is being considered for provision (again by POL/PSMSL with IOC funds) at a suitable location, possibly in the Middle East. Each of these tide gauge stations will serve as 'regional demonstration sites' for GLOSS.

5. Enhanced Sea Level Networks in Africa

During 2003, the PSMSL took the lead in two major proposals to the European Union for funds to enhance the sea level networks in Africa, South America and certain Island States. Both proposals were unsuccessful, in spite of being highly graded for scientific quality. In addition, the PSMSL provided similar input to a proposal for enhancement to environmental monitoring systems (not only sea level) in Africa submitted to the Government of Flanders by the ODINAFRICA group. This proposal was successful and should see the establishment of over 12-15 new tide gauge stations in Africa during 2005-2008.

During October, the PSMSL undertook a set of correspondence concerning data archaeology as a prelude to the new ODINAFRICA initiative. Letters were sent to all tide gauge authorities in Africa and to selected other authorities. Replies will be coordinated with those from a previous 'global' set of correspondence undertaken for IOC by Dr. Lesley Rickards of the British Oceanographic Data Centre (BODC).

6. PSMSL-Related Scientific Meetings, Study Groups and Events

In February, the PSMSL helped to organize a two day 'Celebration of UK Sea Level Science' at the Royal Society in London, which was attended by approximately 100 UK scientists. This meeting marked the establishment of the UK National Tidal & Sea Level Facility. A Theme Volume of Philosophical Transactions of the Royal Society, containing papers based on presentations at the meeting, will be published in 2005.

The meeting was attended by Dr. Christian Le Provost, a long-standing friend of PSMSL and other colleagues at POL, and Chairman of the GLOSS Group of Experts. Christian died shortly after the Royal Society meeting and the Theme Volume will be published in his memory.

The following other important meetings were also attended during the year:

- In April Drs. Jevrejeva and Holgate attended the European Geophysical Union conference in Nice.

- In April Dr. Woodworth attended the final meeting of the UK Foresight (Flood and Coastal Defence) project at the Institute of Civil Engineers in London.
- In September Drs. Jevrejeva and Holgate attended the UK Marine Science conference in Liverpool.
- In November, Drs. Jevrejeva and Rickards and Miss Elizabeth Bradshaw (BODC) represented the PSMSL at the European Sea Level Service (ESEAS) conference in Malta.
- In November, Dr. Rickards represented the PSMSL at the 2nd International Workshop for GODAR-WESPAC in Tokyo and presented a talk on 'GODAR-Sea Level'.

The following study groups relevant to the PSMSL may also be mentioned:

- Dr. Woodworth has been asked to lead the IAPSO Commission on Mean Sea Level and Tides until the IAPSO conference in 2005.
- PSMSL and POL colleagues have been appointed Principal Investigators for the NASA/CNES OSTM (Jason-2) mission.
- Dr. Woodworth has been asked to be a contributing author to the Intergovernmental Panel on Climate Change (IPCC) 4th Assessment.

7. Publications and Outreach

Appendix 2 provides a list of relevant papers published at POL/PSMSL in 2004 which have made use of PSMSL and related data.

The PSMSL provided posters to the large, international conferences of CLIVAR (Climate Variability and Predictability) and JCOMM during the year. PSMSL and GLOSS were publicised via posters at the 'Celebration of UK Sea Level Science' in February. A PSMSL entry, with reference to GLOSS, was contributed to the upcoming Wiley 'Encyclopaedia of Water' by Dr. Jevrejeva. A letter concerning techniques for measuring sea level by Dr. Holgate was published in New Scientist. Radio interviews were given on BBC Radio Merseyside and CBC (Canada) Radio. The PSMSL has continued to answer questions about sea level matters from members of the public, by responding to emails and letters and by providing 'Frequently Asked Questions' web pages.

8. Awards

Dr. Woodworth was presented with an IOC Certificate of Appreciation by the IOC Executive Council in June. Dr. David Pugh (former PSMSL Director) has been appointed as Visiting Professor at POL and Liverpool University.

9. Visitors to the PSMSL in 2004

Visitors welcomed to the PSMSL during the year included Dr. John Church (CSIRO, Australia), Mr. Goncalo Crisostomo (IGEO, Portugal), Mr. Noel O'Murchu (Dept. of Communications, Marine and Natural Resources, Ireland), Mr. Marko Pavic (University of Zagreb) and Dr. Alexander Frolov (Deputy Head Roshydromet, Russia and Vice-President IOC). The Chairman and Chief Executive of the UK Natural Environment Research Council (Mr. Robert. Margetts and Prof. John Lawton) visited the PSMSL during the opening of the Joseph Proudman building in June.

Summary

It can be seen that 2004 has been a further active year with regard to important workshops, international conferences and working groups. Scientific outputs, represented by the number of POL publications in sea level and related fields, are as high as ever.

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.

P.L. Woodworth, S. Jevrejeva and S. Holgate
December 2004

Appendix 1: Number of station-years entered into the databank for each country or coastline in the period mid-December 2003 to mid-December 2004 (897 total).

SWEDEN	20	AUSTRALIA	340
GERMANY (FORMER DDR) BALTIC	4	NEW ZEALAND	
GERMANY (FORMER FRG) BALTIC	2	3	
UNITED KINGDOM	43	NORTHERN MARIANA ISLANDS	1
IRELAND	5	CAROLINE IS (FED. STATES OF	
CHANNEL ISLANDS	1	MICRONESIA)	5
TURKEY	7	PALAU ISLANDS	12
TURKISH REP. NORTHERN CYPRUS	4	MARSHALL ISLANDS	3
PORTUGAL (AZORES)	4	KIRIBATI	2
CAPE VERDE ISLANDS	2	TUVALU	3
SEYCHELLES	3	VANUATU	2
MAURITIUS	5	FIJI	5
MALDIVES	2	TONGA	2
TANZANIA	1	WESTERN SAMOA	2
KENYA	2	PHOENIX ISLANDS (KIRIBATI)	3
MUSCAT & OMAN	3	HAWAIIAN ISLANDS	1
INDIA	31	LINE ISLANDS	1
ANDAMAN ISLANDS	1	PENRHYN ISLAND	1
MALAYSIA	24	COOK ISLANDS	2
JAPAN (HOKKAIDO)	5	GAMBIER ISLAND	1
JAPAN (HONSHU-PACIFIC)	18	EASTER ISLAND	31
JAPAN (HONSHU-INLAND SEA)	7	MEXICO (PACIFIC)	8
JAPAN (SHIKOKU)	6	EL SALVADOR	3
JAPAN (KYUSHU)	8	COLOMBIA (PACIFIC)	4
JAPAN (AMAMI GUNTO)	2	ECUADOR	2
JAPAN (HONSHU-JAPAN SEA)	7	CHILE	177
JAPAN (OGASAWARA GUNTO)	1	ARGENTINA	4
JAPAN (MINAMI-TORI-SHIMA)	1	FALKLAND ISLANDS (MALVINAS)	3
SARAWAK	4	COLOMBIA (CARIBBEAN)	1
SABAH	12	ANTARCTICA	32
PAPUA NEW GUINEA	8		

Appendix 2: Some Relevant Reports dated 2004

Woodworth, P.L. and Blackman, D.L. 2004. Evidence for systematic changes in extreme high waters since the mid-1970s. *Journal of Climate*, 17, 1190-1197.

Mathers, E.L. and Woodworth, P.L. 2004. A study of departures from the inverse barometer response of sea level to air pressure forcing at a period of 5 days. *Quarterly Journal of the Royal Meteorological Society*, 130, 725-738.

Vassie, J.M., Woodworth, P.L. and Holt, M.W. 2004. An example of North Atlantic deep ocean swell impacting Ascension and St. Helena islands in the central South Atlantic. *Journal of Atmospheric and Oceanic Technology*, 21(7), 1095-1103.

Woodworth, P.L., Moore, P., Dong, X. and Bingley, R. 2004. Absolute calibration of the Jason-1 altimeter using UK tide gauges. *Marine Geodesy*, 27(1-2), 95-106.

Tsimplis M.N., Woolf, D.K., Osborn, T.J., Wakelin, S., Wolf, J., Flather, R., Shaw, A.G.P., Woodworth, P., Challenor, P., Blackman, D., Pert, F., Yan, Z. and Jevrejeva, S. 2004. Towards a vulnerability assessment of the UK and northern European coasts: the role of regional climate variability. *Proc. Roy. Soc. London* (in press)

Woodworth, P.L., Gregory, J.M. and Nicholls, R.J. 2004. Long term sea level changes and their impacts. pp.717-752 (chapter 18) in *The Sea*, Volume 13, edited by A.R. Robinson, J. McCarthy and B.J. Rothschild. Harvard University Press.

Holgate, S.J. and Woodworth, P.L. 2004. Evidence for enhanced coastal sea level rise during the 1990s. *Geophysical Research Letters*, 31, L07305, doi:10.1029/2004GL019626.

Meredith, M.P., Woodworth, P.L., Hughes, C.W. and Stepanov, V. 2004. Changes in the ocean transport through Drake Passage during the 1980s and 1990s, forced by changes in the Southern Annular Mode. *Geophysical Research Letters*, 31, L21305, doi:10.1029/2004GL021169.

Woodworth, P.L., Aarup, T. and Rummel, R. 2004. IGGOS as a potential partner in IGOS. *Journal of Geodynamics* (in press).

Jevrejeva S., Moore, J., Woodworth, P. and Grinsted, A. 2004. Influence of large scale

atmospheric circulation on the European sea level: results from wavelet transform. *Tellus* (in press).

Woodworth, P.L., Pugh, D.T., Meredith, M.P. and Blackman, D.L. 2004. Sea level changes at Port Stanley, Falkland Islands. *Journal of Geophysical Research* (in press).

Woodworth, P.L. 2004. Benefits to studies of global sea level changes from future space gravity missions. *Earth, Moon and Planets* (in press). (Issue title: "Future satellite gravimetry and Earth dynamics").

Woodworth, P.L., Smith, D.E., Flather, R.A., Baker, T.F. and Rickards, L.J. 2004. Proposals for the development of the UK national tide gauge network. Proudman Oceanographic Laboratory Internal Document No. 161.

Woodworth, P.L. and Smith, D.E. 2004. A one year comparison of radar and bubbler tide gauges at Liverpool. *Proceedings of GLOSS/IHO/IALA Technical Workshop*, October 2003 (in press).

Woodworth, P.L. 2004. The Permanent Service for Mean Sea Level. *Journal of Geodesy*, 77(10-11),604.

New PSMSL Data 2004

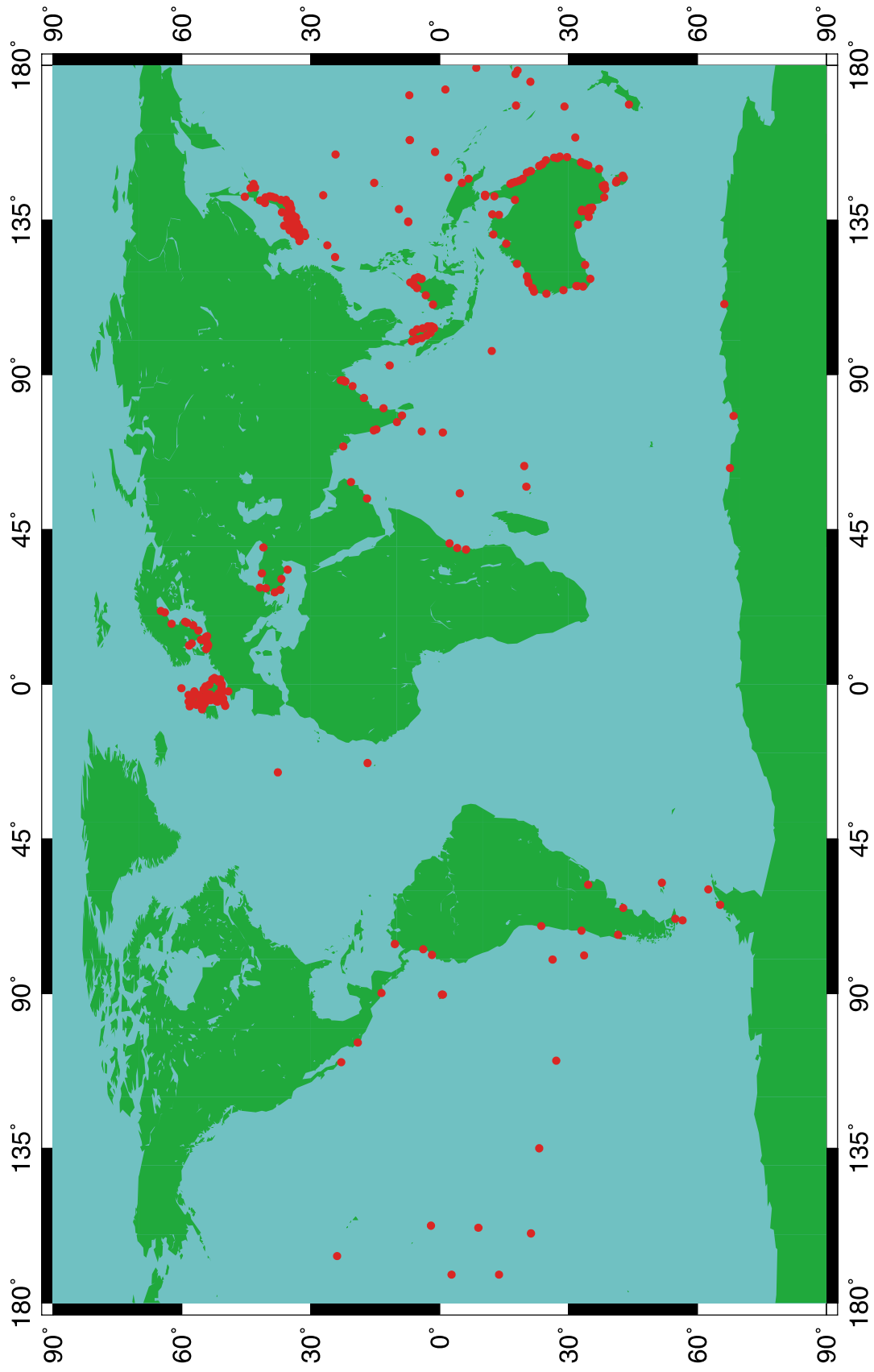


Figure 1