

Africa

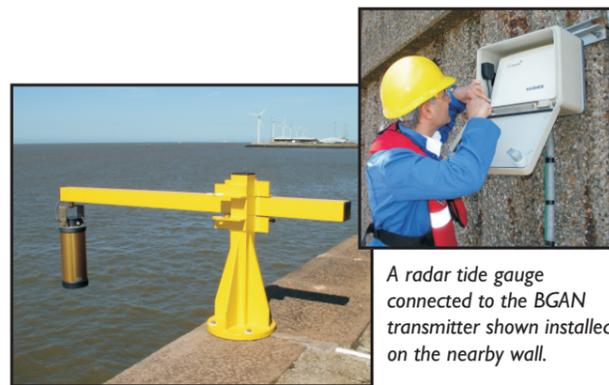
Many African countries have no working sea level stations, or have antiquated sea level infrastructure incapable of delivering information to modern standards. In the last few years, considerable new investment has taken place through IOC, especially within a programme called ODINAfrica (Ocean Data and Information Network for Africa). In the latest phase of the programme, plans are in place for installation of a dozen new sites which will dramatically improve the situation.

POL contributed considerably to the development of the original proposal for this activity to IOC and the Government of Flanders and subsequently has accepted responsibility for:

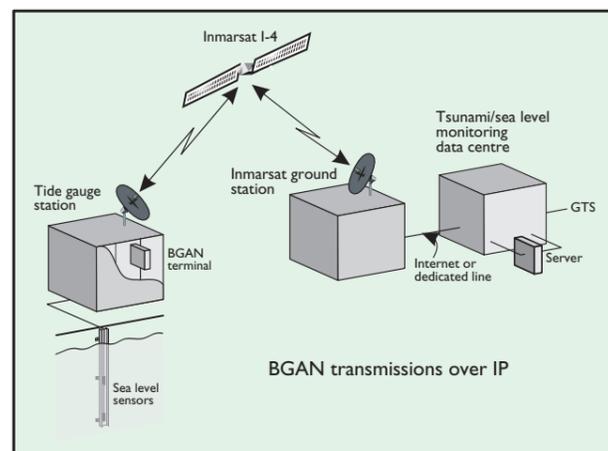
- specification and purchase of installation hardware;
- training of local specialists;
- provision of technical briefs for site visits by consultants.

POL has also led the design of a 'baseline tide gauge' for new African installations consisting of:

- a 'sea level' gauge usually in the form of a radar or acoustic sensor;
- a 'tsunami' sensor in the form of a pressure transducer;
- a 'mid tide' pressure sensor for datum control;
- dual satellite data telemetry using Meteosat and a backup system (e.g. ORBCOMM or BGAN).



A radar tide gauge connected to the BGAN transmitter shown installed on the nearby wall.



A schematic illustration showing how data are transmitted to tsunami and sea-level centres using BGAN.



Locations in Africa and the NW Indian Ocean in which POL has an interest in the installation of new tide gauges (blue). UK South Atlantic network and three sites in South Africa with real time data (red).

As part of the GLOSS programme, POL has also delivered equipment to Pakistan (Karachi) and Yemen (Aden) in the northern Indian Ocean, the coastlines of which contain major cities vulnerable to tsunamis originating from the Makran Subduction Zone.

Training Courses and Materials

POL has hosted or co-organised training courses for the GLOSS programme every year since 1983. These courses are attended by typically 12–20 people and have significantly enhanced the sea level knowledge base in developing countries. More ad hoc training activities consisting in 2–3 days instruction are also held from time to time at POL.

POL has also led the preparation of different types of documentation (Implementation Plans, Technical Manuals, Software Packages etc.) for the GLOSS programme (www.pol.ac.uk/psmsl/training).

POL and GLOSS in Future

POL and BODC's work for GLOSS complements their scientific and data management responsibilities under the UK Natural Environment Research Council Oceans 2025 programme. This work has recently been approved for funding by the Council for the period 2007–12. Consequently, both organizations look forward to continued close collaboration with GLOSS and to further progress in the development of the programme.

POL believes that GLOSS and other monitoring programmes with global scope will never be successful by using a model of 'national contributions to an international programme' while there are major requirements for assistance in developing countries. POL has attempted to extend its involvement in GLOSS beyond its formal obligations of providing data from UK and South Atlantic sites. POL would be interested in working with other organizations which are similarly interested in extending their activities to developing countries and in making GLOSS a truly global network.

Contacts

Any questions about this brochure may be sent to psmsl@pol.ac.uk

POL and BODC contributions



to the development of the



GLOBAL SEA LEVEL OBSERVING SYSTEM of the



JOINT TECHNICAL COMMISSION for OCEANOGRAPHY and MARINE METEOROLOGY of the INTERGOVERNMENTAL OCEANOGRAPHIC COMMISSION and WORLD METEOROLOGICAL ORGANIZATION

Introduction

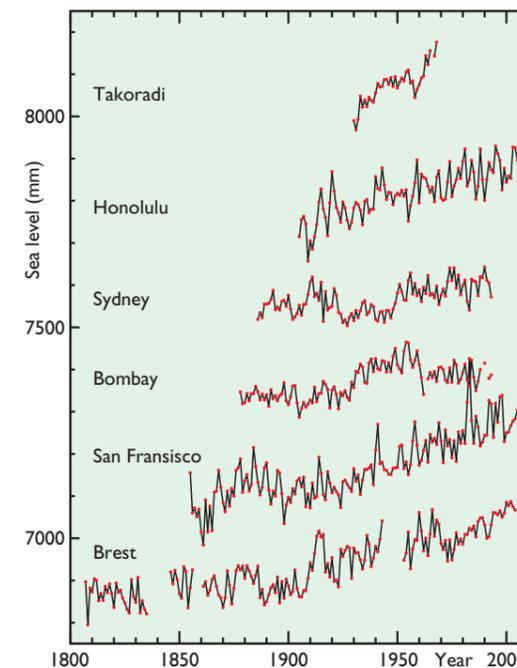
In the mid-1980s David Pugh from the Proudman Oceanographic Laboratory (POL) and Klaus Wyrтки from the University of Hawai'i proposed the Global Sea Level Observing System (GLOSS) programme with the objective of establishing global and regional sea level monitoring networks with the highest measuring standards.

The main initial aim of GLOSS was to improve the quality, quantity and timeliness of the worldwide set of Mean Sea Level (MSL) information provided to the Permanent Service for Mean Sea Level (PSMSL) at POL which is the global data bank for MSL data from tide gauges. GLOSS was eventually accepted as a programme of the Intergovernmental Oceanographic Commission (IOC), through which requests to Member States to provide data are issued. The programme has since been adopted as a joint activity of the Joint Technical Commission for Oceanography and Marine Meteorology (JCOMM) of IOC and the World Meteorological Organization (WMO), and became one of the first components of the Global Ocean Observing System (GOOS).

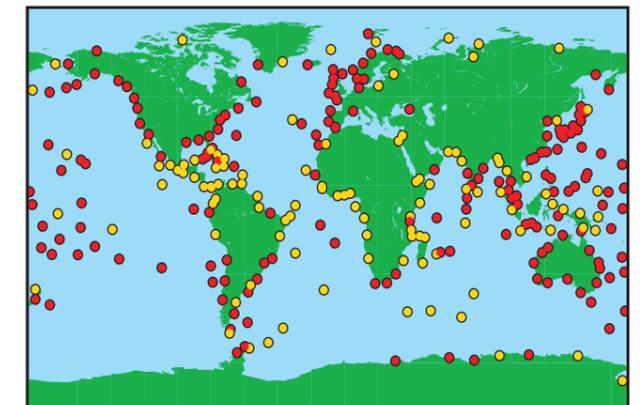
Data Banking

The PSMSL has been based at POL since 1933 and its data are used in many branches of geophysics including global sea level rise related to climate change. Data have always been freely donated by many countries, routinely by some countries and on a more ad hoc basis by others.

thirds of which now deliver monthly and annual MSL data regularly and efficiently to the PSMSL. This is only a fraction of 2000-odd total sites from which the PSMSL receives information. However, the GLOSS Core Network is valued as providing a high-quality subset.



Examples of long sea level records from around the world in the PSMSL data bank.

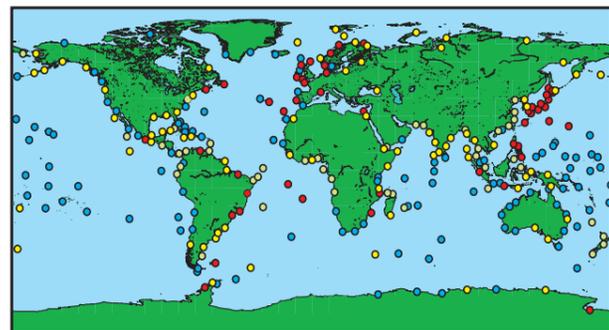


Map of the GLOSS Core Network. Red stations deliver MSL data to the PSMSL in a timely manner, those in yellow either deliver data slowly, or never, or the station is not operating.

Thanks in large part to GLOSS, the PSMSL has been able to considerably enhance its data set in recent years.

Provision of MSL data takes place in what is called 'delayed-mode' (DM), as opposed to 'near real-time' (NRT). In the mid-1990s, GLOSS extended its requests to national authorities to provide the programme with higher-frequency (HF, typically hourly) data as a strategic backup of raw data to the MSL information. In 2007 the PSMSL combined its MSL DM activities with the HF DM data collection from GLOSS sites conducted by the British Oceanographic Data Centre for the last

decade. This will enable a more efficient collection of data and metadata (related information such as technical details, photographs and maps) from the two DM activities and will extend the range of possible global sea level studies at POL.



GLOSS high frequency delayed mode data holdings – 2006.

- Category 1: 'Operational' stations – data is 2002 or later.
- Category 2: 'Probably operational' stations – data is 1992–2001.
- Category 3: 'Historical' stations – data is earlier than 1992.
- Category 4: no data exist in the BODC archive.

In particular, while MSL research is most closely related to climate change (global warming, melting of glaciers etc.), it is the changes in extremes which are of most interest to people at the coast due to the possibility of changing frequency and magnitude of flooding.



An extreme sea level at Sea Palling in Norfolk on the east coast of the UK due to the storm surge of 31 January–1 February 1953.

GLOSS website and GLOSS Handbook

POL and BODC host the web site for the GLOSS programme (www.gloss-sealevel.org) from which overviews of the status of the GLOSS network can be obtained. The site links into the GLOSS Handbook, now a set of web pages and formerly a CD product, which provides metadata information on each of the tide gauges in the GLOSS Core Network and access to available DM data.



UK-owned sites in the GLOSS Core Network

The UK is an enthusiastic member of GLOSS and is responsible for providing data to the programme from three nominated sites in the UK itself (Newlyn, Lerwick and Stornoway), Gibraltar and several sites in the South Atlantic and Antarctica. All of these sites provide delayed-mode higher frequency and MSL information to GLOSS and PSMSL data banks for free access by any interested scientist worldwide.



Maps of the UK National Tide Gauge Network and South Atlantic Network. Both networks provide data freely to GLOSS and other international sea level programmes.



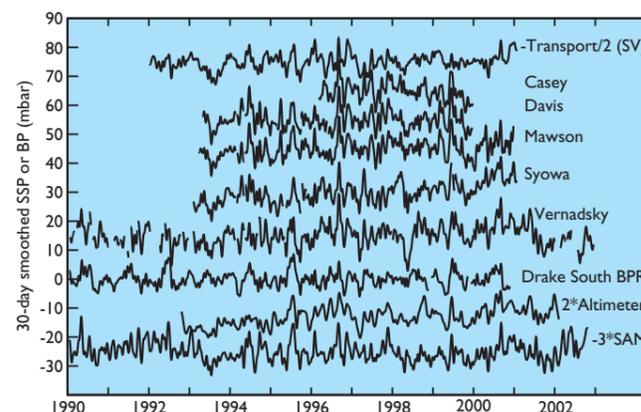
The new Gibraltar tide gauge which is operated as part of the UK network.

Some of these sites, such as Ascension or Port Stanley, are easy to access for maintenance as they have airports, but others, such as St. Helena or Tristan da Cunha, need to make use of irregular visits by either commercial or research ships. As a result, some sites have good long sea level records derived from some of the most technically advanced tide gauges in the world and with data delivered back to POL in NRT, while others have fragmented information and do not provide NRT information. The intention is to perform complete or partial upgrades at all sites over the next 3 years.

Near Real-Time Applications

As the PSMSL, and POL's scientific research programme, is concerned primarily with DM sea level information, one might ask why we are also interested in NRT data. Reasons for such interest include:

- in the UK, the need for data in real time through the Storm Tide Forecasting Service of the Environment Agency for the provision of flood warning information to local authorities. POL is responsible for the entire UK National Network of 44 sites, of which the three named left are in the GLOSS Core Network;
- at Gibraltar, the NRT data are used to monitor flows through the Straits and are also employed by Spanish colleagues in their regional flood warning system;
- at Port Stanley and other locations in the South Atlantic the NRT data are inspected routinely for flood danger by public works departments;
- at Vernadsky and Rothera on the Antarctic Peninsula, data are used to determine in NRT the strength of the Antarctic Circumpolar Current, the largest ocean current in the world.



Time series of sea level in the form of 'sub-surface' or 'bottom pressure' at stations around Antarctica: the coherent part of these records provides a measure of the flow of the Antarctic Circumpolar Current (Hughes et al Geophysical Research letters 2004).

An important scientific requirement for NRT (or 'fast') tide gauge data comes from the need to calibrate satellite radar altimeter data. In ocean circulation studies, sea level data from tide gauges are often combined with those from satellite altimeters. Without copious 'fast' data from many GLOSS sites worldwide, reliable altimeter calibrations would not be possible.

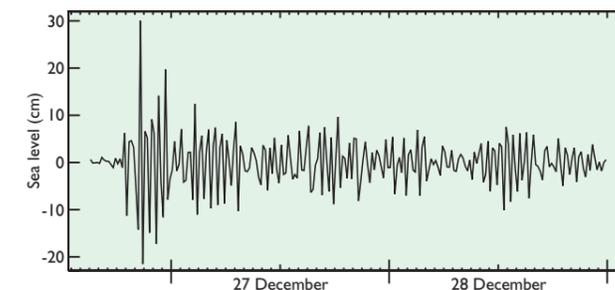


The hut which contains the tide gauge at the Vernadsky polar base (formerly called Faraday) which has provided the longest tide gauge record in Antarctica.

There are also many good practical reasons for tide gauge data to be delivered in NRT. For example, faults can be identified and fixed faster, resulting also in much improved DM information in the long run.

Tsunamis

The Sumatra tsunami on 26 December 2004 changed many lives including those of participants in GLOSS. Until then, and for reasons now consigned to history, tsunamis had not been considered alongside other sea level variations, with the result that observation networks for tides, surges and MSL change including GLOSS were developed separately from those for tsunamis.



The Sumatra tsunami of 26 December 2004 arrived at Signy in the SW Atlantic approximately 18 hours after the earthquake. The tsunami signal of about +/- one foot was clearly identified by a POL pressure transducer gauge.

After 2004, it became obvious to everyone that all new tide gauges had to be multi-purpose and therefore capable of NRT data transmission. Out of this disaster came investment for new hardware, most obviously as part of the development of the Indian Ocean Tsunami Warning System but also in other areas. For example, renewed interest in tsunamis impacting European (and especially Mediterranean) coastlines are being taken up by the European Union.

NRT Technology

The importance of NRT information has led POL to take a special interest in different forms of telemetry. Methods investigated have included OrbcComm, Iridium, GPRS (mobile phone), Meteosat Data Collection Platform (DCP), and Inmarsat's Broadband Global Area Network (BGAN). The Meteosat system is an international NRT standard at present. However, there are limitations of bandwidth and latency which makes the search for an alternative urgent. POL has been most impressed with BGAN which enabled high-bandwidth, always-on connectivity via an embedded Linux processor either through a web-based system or via text messaging.



Portux – the tiny Linux computer which connects a tide gauge to BGAN.