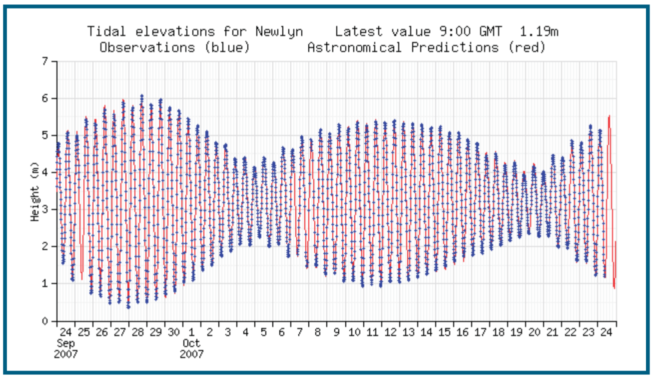
# GLOSS

## The Global Sea Level Observing System

GLOSS is the international programme for improving the quality, quantity and timeliness of delivery of global sea level data to operational agencies and the scientific community.

GLOSS is an activity of the Joint Technical Commission for Oceanography and Marine Meteorology (JCOMM) of the Intergovernmental Oceanographic Commission and the World Meteorological Organization (WMO). GLOSS was one of the first components of the Global Ocean Observing System (GOOS).

# Why Measure Sea Level?




Spring-Neap tidal variations at Newlyn, UK.

People living on the coast are familiar with the regular rise and fall of sea level caused by the tides.

Flooding on the east coast of England during a storm surge in 1953.

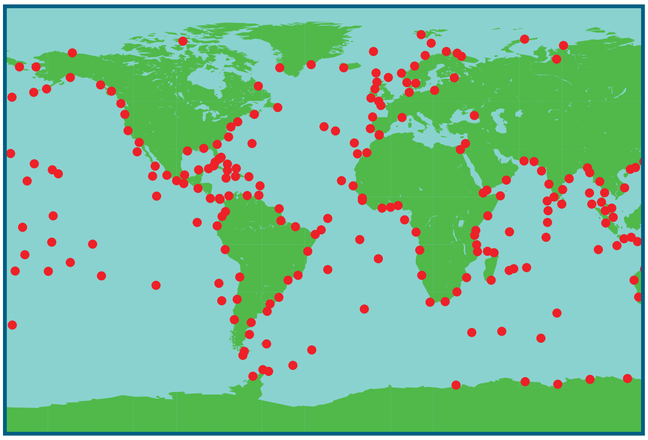
Many areas also experience rises due to air pressure and winds. If these storm surges combine with high tides there may be extensive flooding and damage. This damage can be made even worse by sea level rise.

Mâle, the capital of the Maldives Islands, is a coral island only a few metres above sea level.

If we are to understand the present-day changes in sea level, and if we are to be able ultimately to predict future changes, then we need the best possible sea level data sets.

## The GLOSS Programme

The Global Sea Level Observing System (GLOSS) is a programme coordinated by IOC. It aims to establish global and regional networks of sea level stations for scientific research and which can also be used in many practical local applications. The GLOSS Core Network (GCN) of aproximately 300 stations forms the major component of the programme.



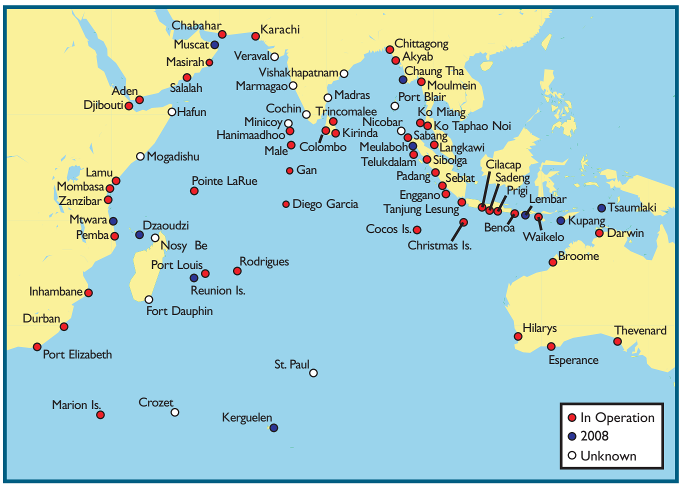
GLOSS Core Network of sea level stations.

GLOSS has stimulated the development of several regional networks of gauges with greater spatial density than that provided by the GCN.

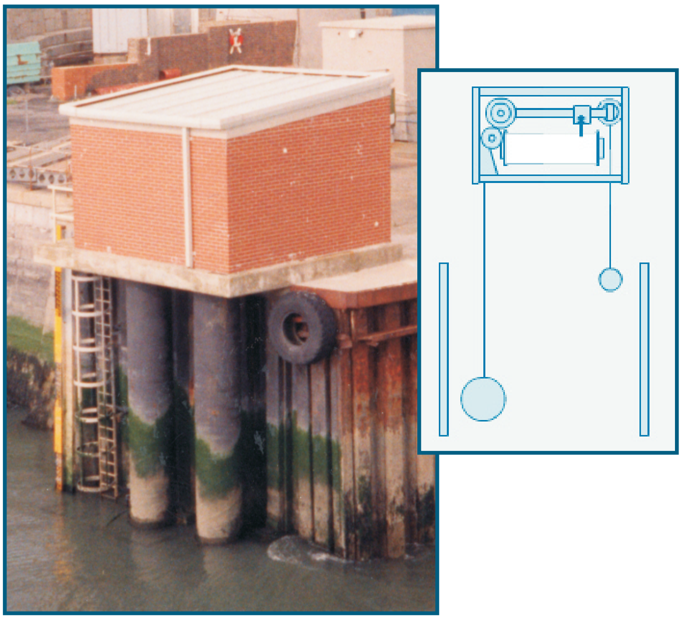
GLOSS needs most development in Africa and in other regions of economic transition. In the last few years considerable improvements have been made in concert with the Ocean Data and Information Network for Africa (ODINAfrica) programme of IOC.


Timelines for installation of GLOSS stations along the African coastline

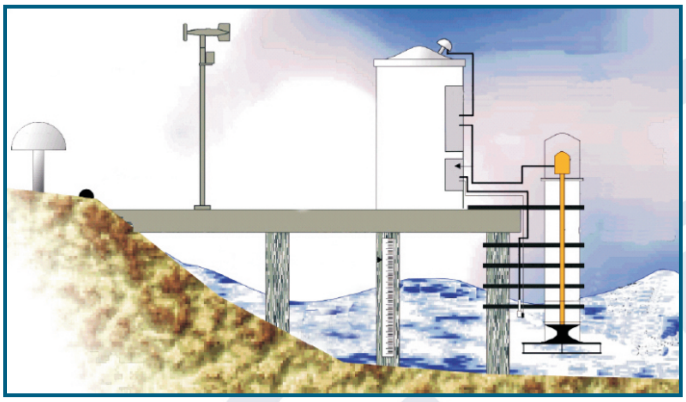
GLOSS has also benefited recently from the investments in sea level infrastructure following the Sumatra tsunami in December 2004. Now many new stations throughout the Indian Ocean function as both GLOSS sites and monitoring stations for the Indian Ocean Tsunami Warning System (IOTWS).




Timelines for installation of Indian Ocean stations



Stilling well float gauge.



Acoustic gauge.

Pressure gauge.

Radar gauge.

## Tide Gauge Technologies

GLOSS organises regular workshops on new technologies for measuring sea level in order to spread the most up-to-date technical information to the sea level community and to encourage best practice.

Different technologies enable sea level to be monitored at almost all locations. However, it is important that technologies are capable of meeting the GLOSS Standards.

These are defined by the GLOSS Implementation Plan and in the IOC Manuals on Sea Level Measurement and Interpretation.

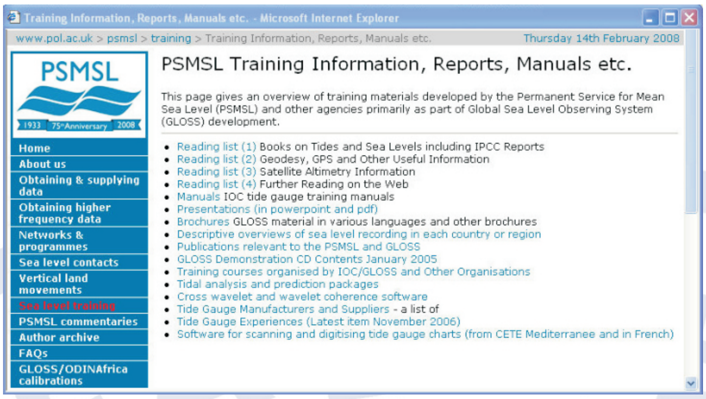
Technology for sea level data gathering now includes satellites and various kinds of telephony. Systems include Orbcomm, Iridium, GPRS (mobile phone), GOES/Meteosat/MTSAT Data Collection Platform (DCP), and Inmarsat's Broadband Global Area Network (BGAN). The DCP system is an international standard at present. However, there are limitations of bandwidth and latency which makes the search for an alternative urgent.

# Training courses and materials

GLOSS aims to maintain and even enhance the extent and quality of sea level monitoring by providing various forms of training to the community. These include:

- On site technical training during tide gauge installations
- Provision of a range of training materials on the hardware and data analysis freely available on the web
- Organisation of training courses in different countries
- Provision of products useful at a local level, and training in the use of those products, thereby increasing the number of stakeholders.

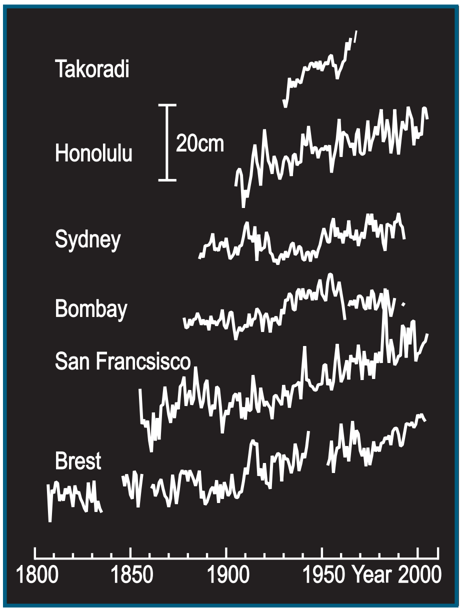
Takoradi, Ghana – the installation team received on-site training while installing the tide gauge.




The Permanent Seavice for Mean Sea Level provides an extensive set of training materials (www.pol.ac.uk/psmsl/training).

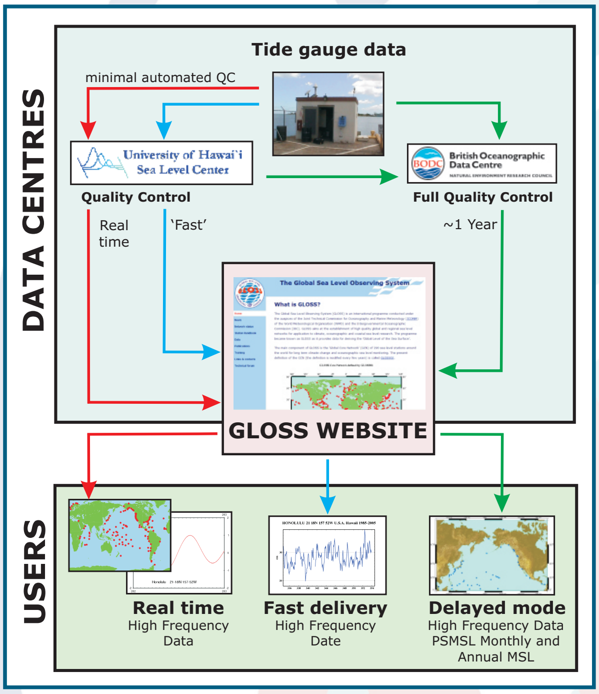
GLOSS publishes a range of manuals, training materials, workshop reports, leaflets, posters and CDs.

African and UK sea level specialists during a two-week GLOSS training course in Ostende, Belgium.




Some long tide gauge records indicating sea level rise.


Website of the WCRP Workshop on Sea Level Rise and Variability (http://copes.ipsl.jussieu.fr/Workshops/SeaLevel/index.html).




GLOSS sea level data flow.

## GLOSS Sea Level Data Flow

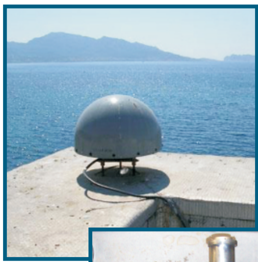
Data from GLOSS stations contribute to many national and international sea level data centres and programmes. GLOSS was originally proposed in order to improve the quantity and quality of Mean Sea Level data supplied to the Permanent Service for Mean Sea Level (PSMSL)[FN], and GLOSS continues to perform that function. The PSMSL data are used within a wide range of climate studies, oceanography, geology and geodesy. Their most well-known application is in the estimation of rates of change of global sea level for input to studies such as the Intergovernmental Panel on Climate Change (IPCC) and the World Climate Research Programme (WCRP).

However, that is not now the ONLY requirement of a country participating in GLOSS. The Implementation Plan 1997 specifies requirements for the free exchange of the original (typically hourly) sea level data in delayed-mode to the GLOSS Delayed Mode Centre. Other data streams are 'Fast' Mode (i.e. within a few days) and Real-Time Mode (i.e. within a few minutes). These data go to the GLOSS Fast Centre at the University of Hawaii. Another centre for real time data is being developed at the IOC facility at Ostende, Belgium.

[FN] The PSMSL was established in 1933 and is hosted at the Proudman Oceanographic Laboratory under the auspices of the International Council for Science

## Measuring Land Levels and Vertical Movements

Advanced satellite techniques, especially the Global Positioning System (GPS), are employed at GLOSS sites to locate tide gauge movements in the same coordinate system as data from satellites and to measure the rates of vertical land movements. Absolute gravity(AG) and DORIS provide complementary techniques. It is intended that GCN sites and a large number of other stations will eventually be equipped with GPS.



GPS

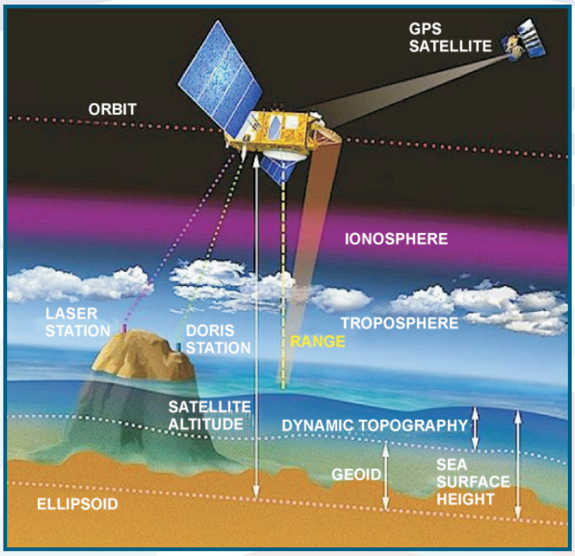
AG

DORIS

## Near Real-Time Applications

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.

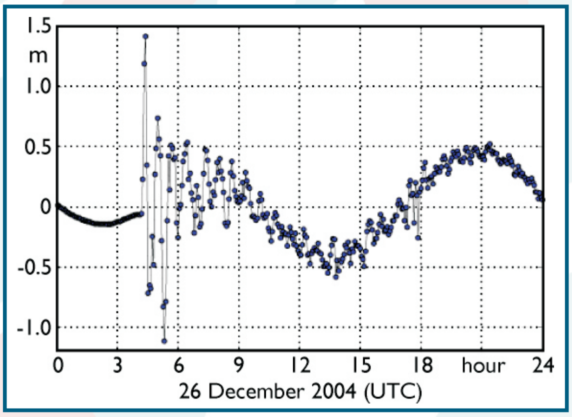
Without copious 'fast' data from many GLOSS sites worldwide, reliable altimeter calibrations would not be possible.
Also NRT data enables faults to be identified and fixed faster, resulting also in much improved DM information in the long run.




Calibration system for radar altimetry.

## Tsunamis

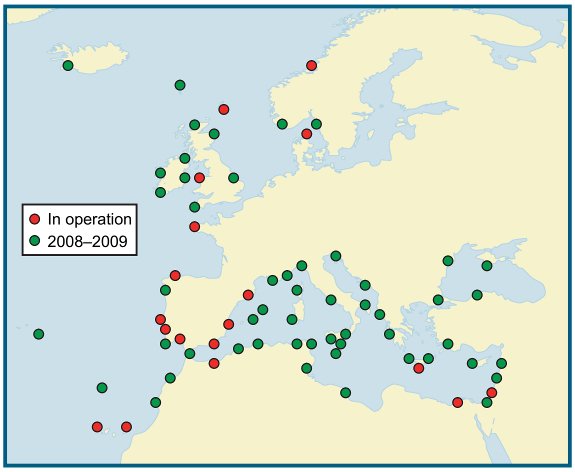
The Sumatra tsunami on 26 December 2004 changed many lives including those of participants in GLOSS. Until then, tsunamis had not been considered alongside other sea level variations, with the result that observation networks for tides, surges and MSL change including GLOSS were developed separately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




The 2004 Sumatra tsunami recorded at Mâle in the western Indian Ocean with an amplitude of 1.5m.

After 2004, it became obvious 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 interests in tsunamis impacting European (and especially Mediterranean) coastlines are been taken up by the European Union.



Implementation plan of the sea level stations to be upgraded/installed in the near future.

For more information see the GLOSS website:
www.gloss-sealevel.org
or contact either of the addresses below.

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