National Oceanography Centre
NATURAL ENVIRONMENT RESEARCH COUNCIL

International Programmes, including the GLOSS Programme, and International Sea Level Data Banks

Philip L. Woodworth

National Oceanography Centre, Liverpool

Sea Level Training Course, St Lucia, 17-21 October 2016

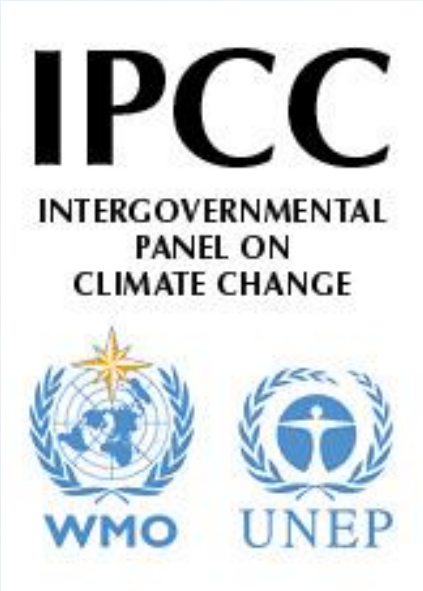
International Programmes relevant to Sea Level

Some of the main acronyms in the alphabet soup of international programmes!

http://www.wcrp-climate.org/

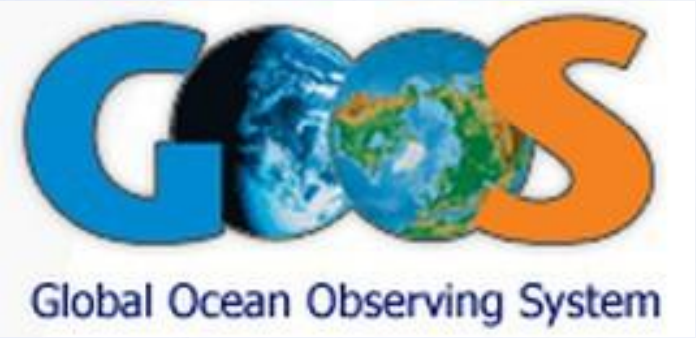
The **World Climate Research Programme** (WCRP) was established in 1980, under the joint sponsorship of the International Council for Science and the World Meteorological Organization, and has also been sponsored by the Intergovernmental Oceanographic Commission of UNESCO since 1993.

The WCRP has initiated programmes such as the Tropical Oceans Global Atmosphere (TOGA) and World Ocean Circulation Experiment (WOCE) which have had large sea level measurement campaigns.



http://www.ipcc.ch/

Data and insight on sea level from WCRP programmes are major inputs to the **Intergovernmental Panel on Climate Change** (IPCC).



http://www.ioc-goos.org/

The **Global Ocean Observing System** (GOOS) is a permanent global system for observations, modelling and analysis of marine and ocean variables to support operational ocean services worldwide.

Responsible to the Intergovernmental Oceanographic Commisson Assembly

Sponsored by IOC, WMO and WCRP

The Global Sea Level Observing System (GLOSS) was the first operational component of GOOS.

www.wmo.int/gcos/

The **Global Climate Observing System** (GCOS), along with the GOOS and the Global Terrestrial Observing System (GTOS) form the G3OS of global observing programmes.

GCOS also has a sea level component which overlaps with GLOSS

The Intergovernmental Oceanographic Commission (IOC) and Sea Level

- GLOSS – primarily focused on providing sea level data for tides, storm surges and climate change
- Various tsunami activities

- There is now a realisation in IOC that these 2 activities have to work more closely together.

United Nations
Educational, Scientific and
Cultural Organization

Intergovernmental
Oceanographic
Commission

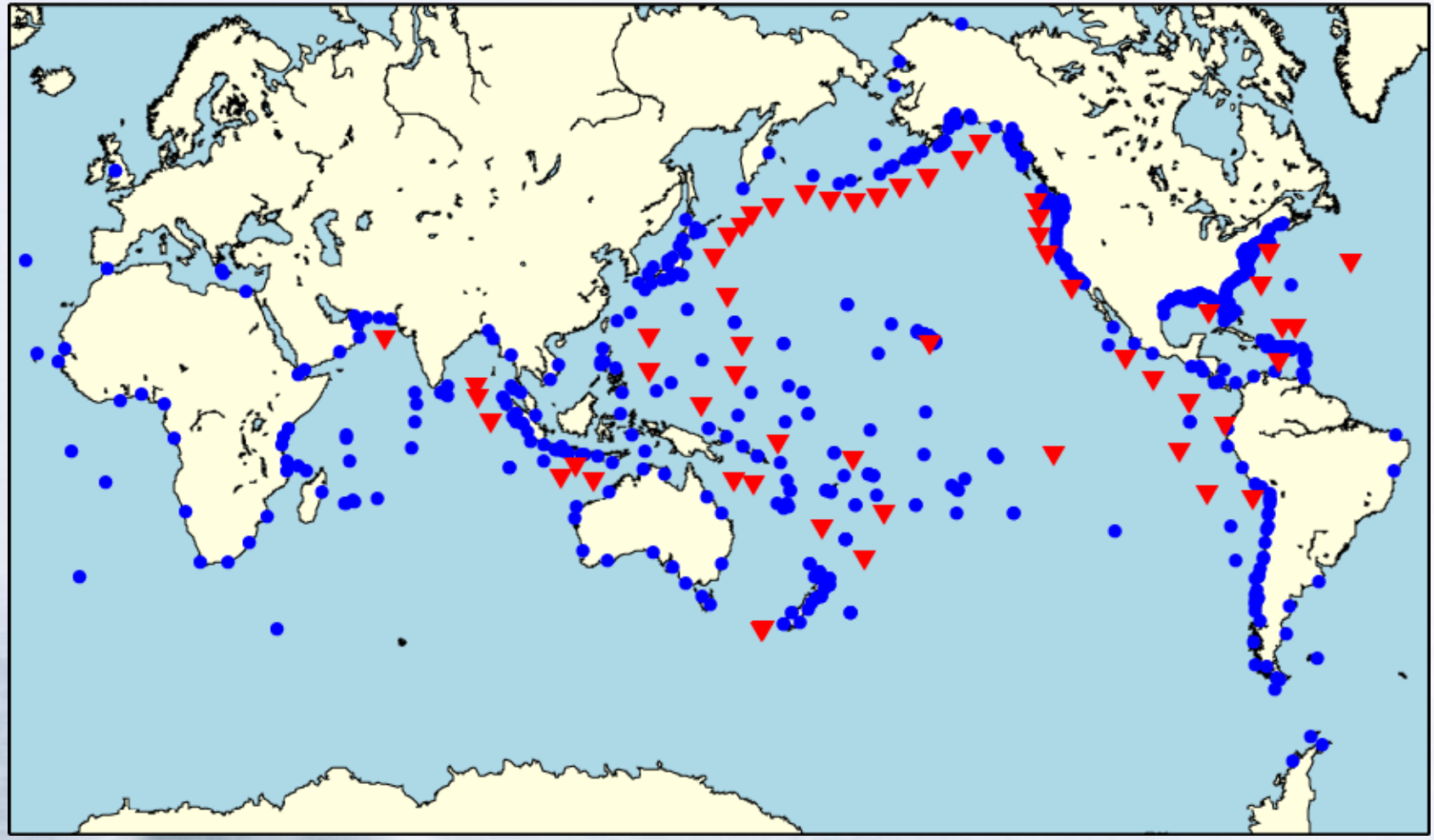
IOC Tsunami Programme

- Pacific Ocean
- Indian Ocean
- Caribbean (IOCARIBE-EWS)
- North-Eastern Atlantic and Mediterranean (NEAMTWS)

Web site: www.ioc-tsunami.org

All of these regional tsunami programmes have important sea level components

Pacific Tsunami Programme



Red triangles = tsunameters. Blue dots = tide gauges reporting in real time to the Pacific Tsunami Warning Center

IOCCARIBE-EWS

- See Carolina Hincapie talk
- ioc-caribe.unesco.org

- Newsletter
- Home
- Quiénes somos
- News
- Regiones

Caribbean
- TWFP
- TNC

- Océano Indico
- Noreste del Océano Atlántico & Mar Mediterráneo
- Océano Pacífico
- Nuestro equipo
- TWFPs & TNCs
- Documentos
- Calendario
- Contacto

Sea Level Monitoring

Portal del Caribe

El Grupo Intergubernamental de Coordinación del Sistema de Alerta contra los Tsunamis y otras Amenazas Costeras en el Caribe y Regiones Adyacentes (ICG/CARIBE-EWS) se creó en 2005 en calidad de órgano subsidiario de la Comisión Oceanográfica Intergubernamental de la UNESCO (COI) a fin de prestar una asistencia eficaz en la reducción de riesgos de tsunami a los Estados Miembros de la región del Caribe tras la experiencia del tsunami del Océano Índico de 2004. Los lineamientos para las actividades del ICG/CARIBE EWS se encuentran en el Plan de Implementación CARIBE EWS

Mesa

Presidente

Sra. Christa von Hillebrandt-Andrade (NOAA Caribbean Tsunami Center, USA)

Vice-chairpersons

Mr Milton Puentes Dirección General Marítima, DIMAR, Colombia)

Mr Paul Martens (Disaster Manager,Sint Maarten Fire Department,Sint Maarten, Kingdom of Netherlands)

Mr Gerard Metayer (Responsable du Dossier Tsunami,Service Maritime et de Navigation d'Haiti, Haiti)

Grupos de Trabajo

El Grupo Intergubernamental de Coordinación se reúne periódicamente para elaborar y poner en práctica planes de trabajo en la región del Caribe. A fin de tratar cuestiones técnicas específicas se constituyeron cuatro grupos de trabajo:

Grupo de Trabajo 1 - Sistemas de vigilancia y detección. Presidente: Sr. Jean-Marie Saurel

Quick Links

ITIC

IOTIC

NEAMTIC

Featured Documents

Tsunami The Grea Waves

http://www.gloss-sealevel.org

GLOSS

The Global Sea Level Observing System

Also known as

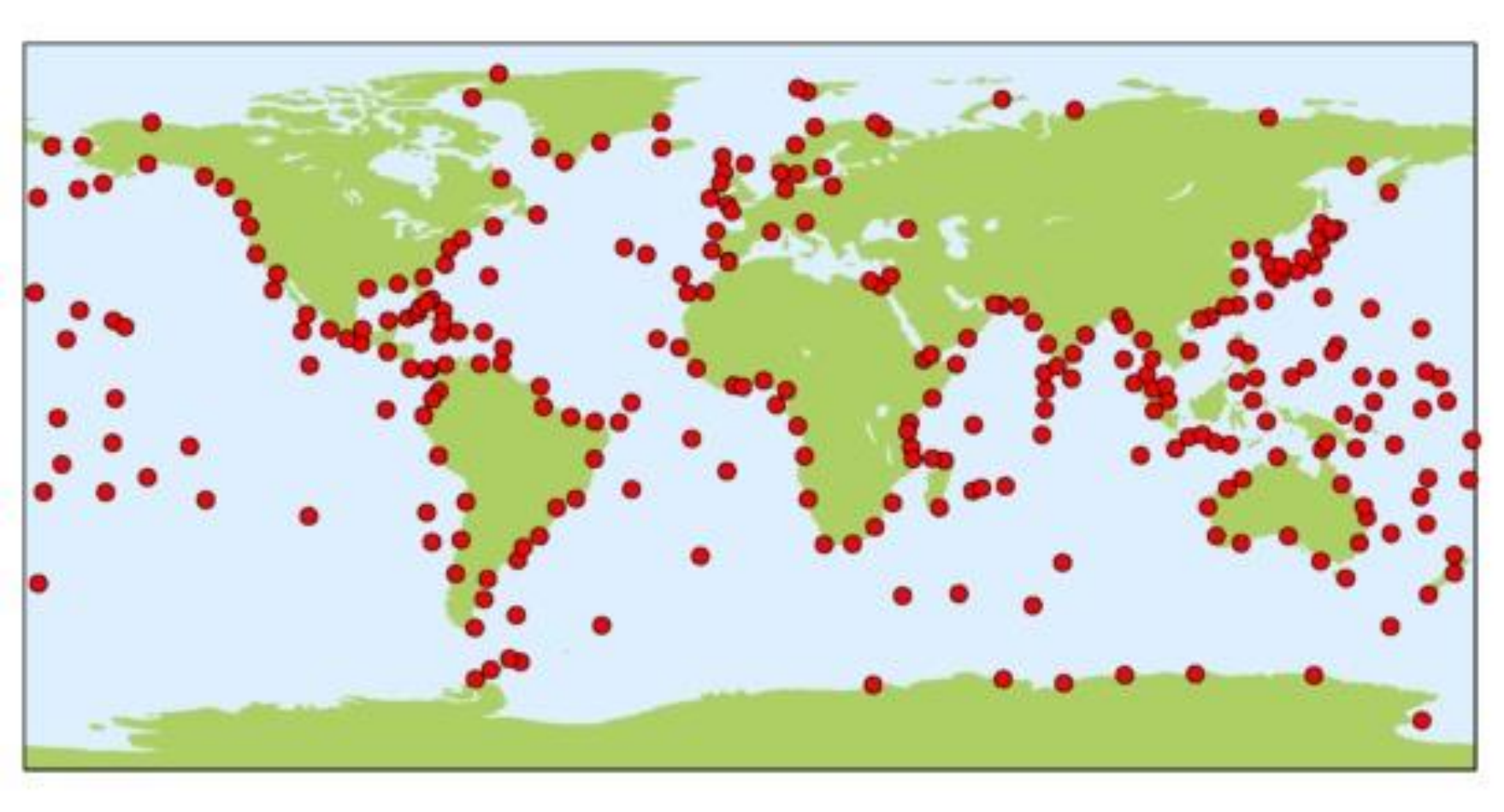
“ Global Level of the Sea Surface”

GLOSS Objectives

- **Establishment of high quality global and regional sea level networks for application to climate, oceanographic and coastal sea level research**
- **Sea level stations around the world for long term climate change and oceanographic sea level monitoring**
- **Coordinated by the Intergovernmental Oceanographic Commission (IOC)**
- **Major contributor to GOOS**

Some History

- GLOSS was initiated in the 1980s with the aim of increasing the quantity and quality of month and annual MSL data to the Permanent Service for Mean Sea Level (PSMSL)
- A network, now called the **GLOSS Core Network**, was defined to which all countries would contribute
- These ideas formed the basis for the first GLOSS Implementation Plan



The GLOSS Core Network

More History

- By the 1990s there had been many technical developments in sea level measurement:
  - Satellite Altimetry
  - GPS for measuring land movements
- The second GLOSS Implementation Plan was written to define:
  - GLOSS Core Network
  - A sub-network for Long Term Trends
  - A sub-network for Altimeter Calibration
  - A sub-network for Ocean Circulation

More History

- By the 2000s there had been more developments to do with:

  The need for real time data from all tide gauge sites and overlap with tsunami networks

  The need for Continuous GPS receivers at all GLOSS tide gauge sites

- The third GLOSS Implementation Plan was published in 2012 to take these into account


Intergovernmental Oceanographic Commission
Technical Series 100
The Global Sea Level Observing System
IMPLEMENTATION PLAN
2012
UNESCO

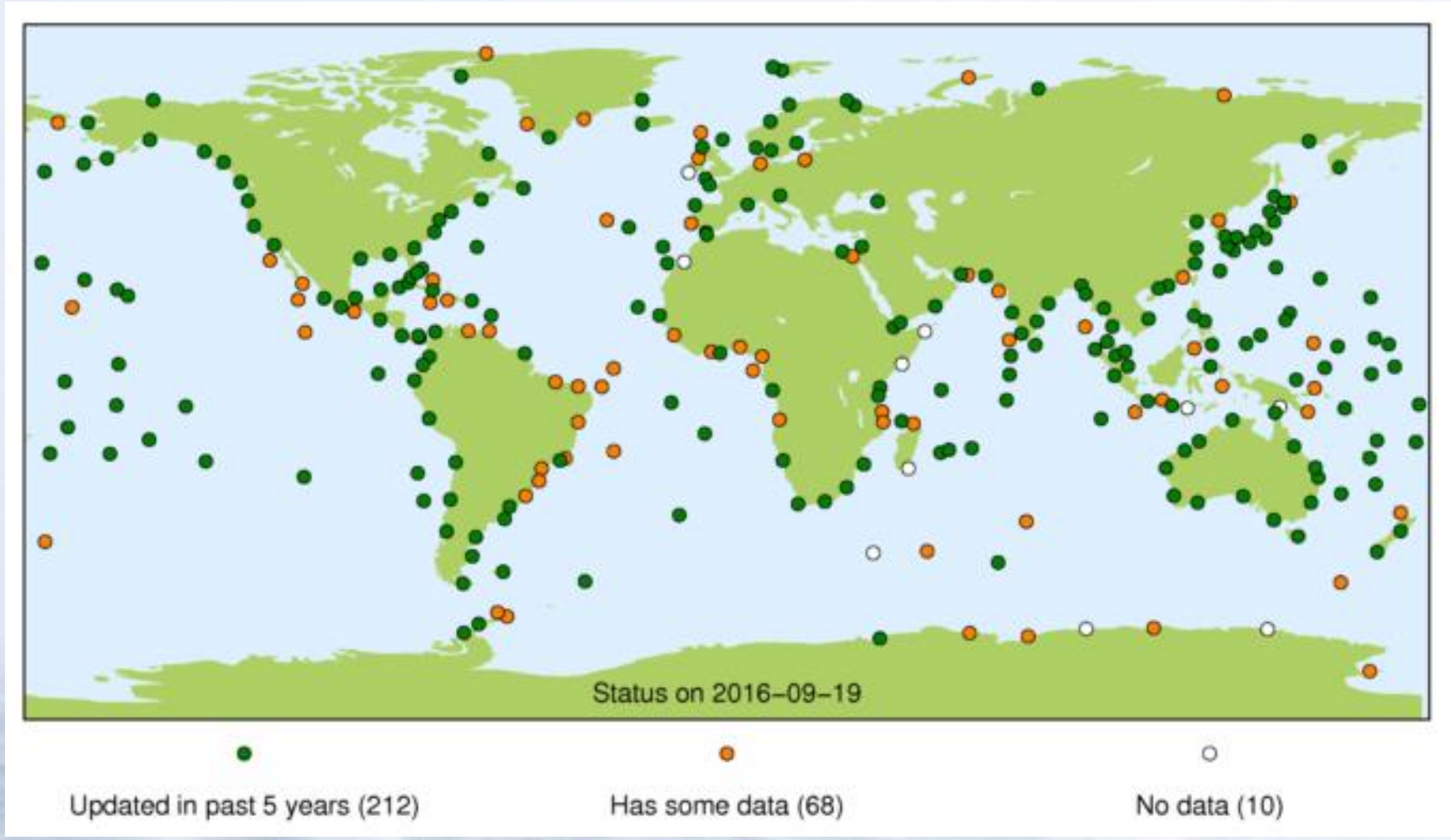
GLOSS Implementation Plan 2012

Chapter 1 - Overview of GLOSS
Chapter 2 - Scientific and Practical Applications of Sea Level Information
Chapter 3 - Status of GLOSS in 2011
Chapter 4 - Sea Level Monitoring Requirements from Ocean, Climate, and Geodetic Study Groups and Research Programmes
Chapter 5 - Sea Level Monitoring Requirements for Research and Practical Applications
Chapter 6 - Implementation Plan
Chapter 7 - Administration of the GLOSS Programme
Chapter 8 - Obligations of GLOSS Member States
Chapter 9 - Capacity Development and Implementation Assistance

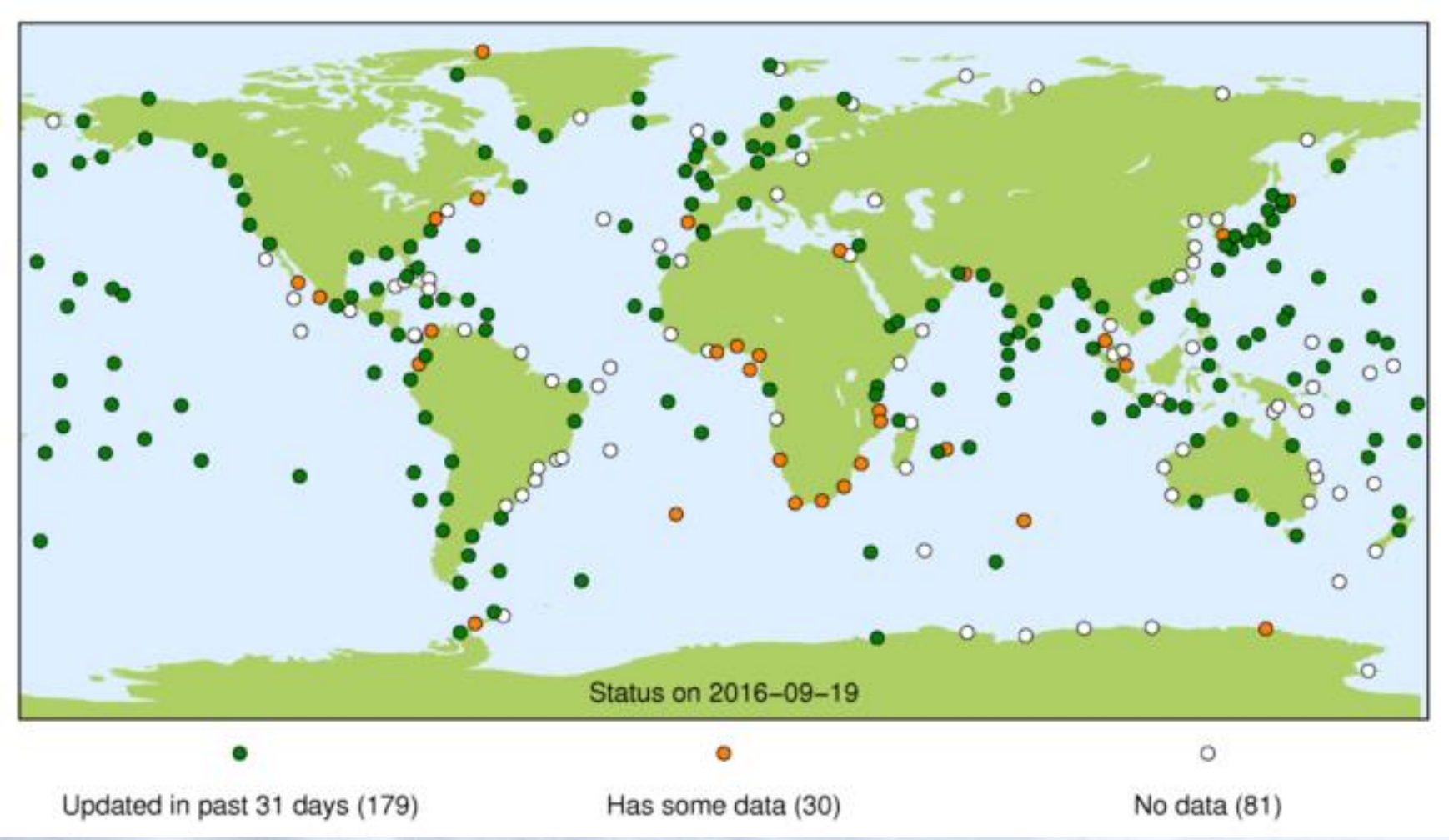
GLOSS Status

GLOSS status can be measured by how well the network is providing data to data centres:

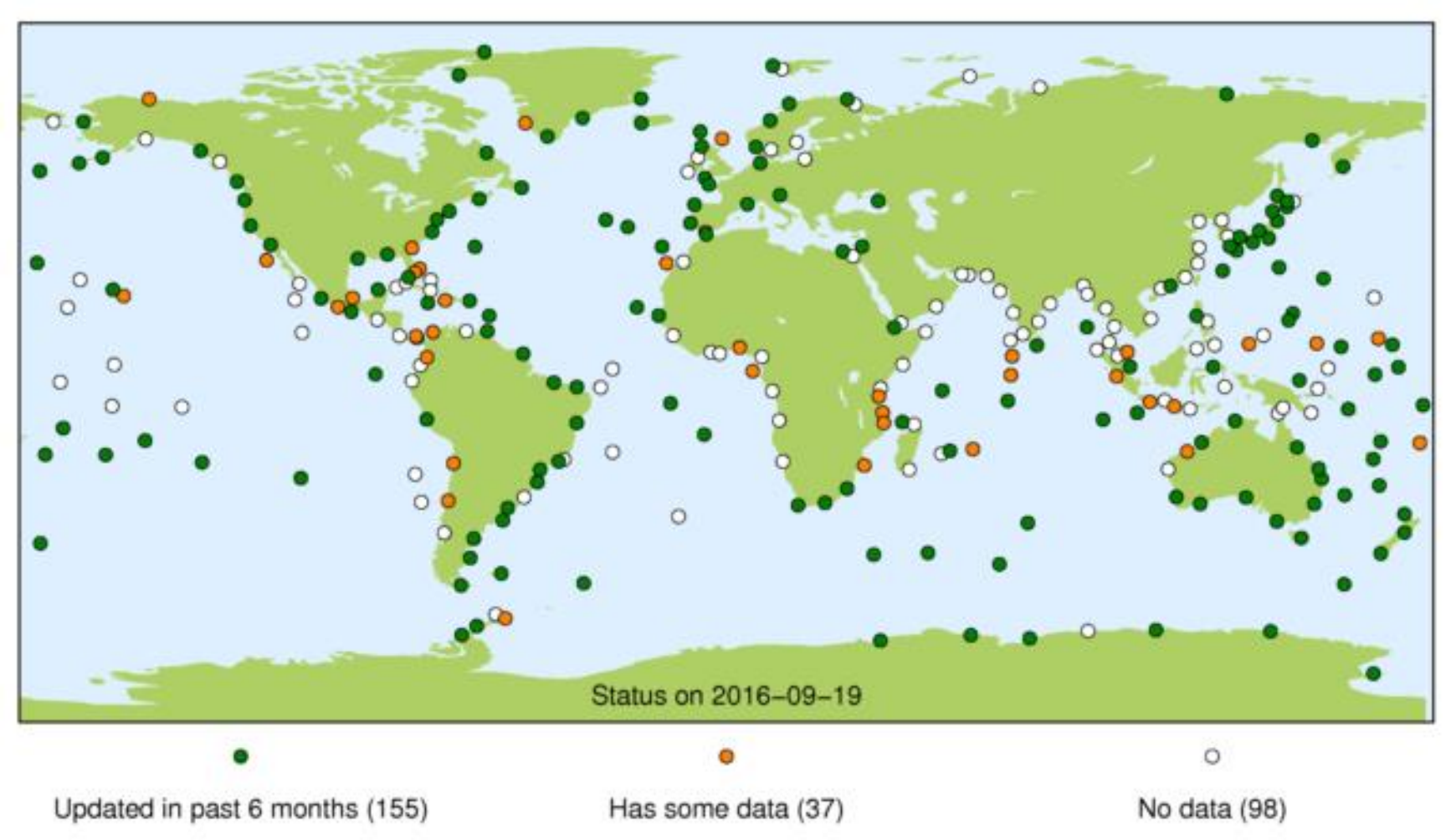
- MSL data available at PSMSL
- Real-time data available at Real-Time Centre
- Delayed-mode data available at Delayed-Mode Centre
- Many status maps at www.psmsl.org/products/gloss/status/



PSMSL – All Data Receipts



Real time data at VLIZ (IOC Monitoring Facility)



Gauges with GPS data at SONEL

GLOSS Activities

Regional Developments

• Regional networks of gauges with greater spatial density, to serve the particular oceanographic interests of those regions

National Activities

• Contribution to the activities of national agencies by improving the standards for sea level recording around the world

Training

• Training courses on the techniques of tide gauge operations, and workshops on special interests e.g. measurements in environmentally hostile areas

International Sea Level Data Banks

There are, of course, many national sea level data centres (a list is available on the PSMSL web site, www.psmsl.org). But here we shall focus on international centres, and particularly those associated with the GLOSS programme

Types of Sea Level Data (and so Data Banks)

- **Real-time**. Data transmitted to a warning centre which can look out for flooding due to storm surges or tsunamis. Delay (latency) has to be as short as possible so there is no time for detailed inspection of the record

- **Fast.** Data needed within a few weeks for operational oceanographic programmes. Needs to have had a light touch of quality control.

- **Delayed Mode.** Delay is not a major issue. Data are archived by a centre for subsequent detailed analysis and removal of errors. Such highest-quality data, fully quality controlled (including datums) are needed for scientific research, for production of a range of products (e.g. tide tables), for computation of MSL etc.

PERMANENT SERVICE FOR MEAN SEA LEVEL (PSMSL)

- Established by IUGG in 1933 and member of World Data System of the International Council for Science

- Responsible for

  - collection,

  - analysis (including research as high level quality control),

  - distribution of monthly and annual MSL data,

  - provision of a wider ‘Service’

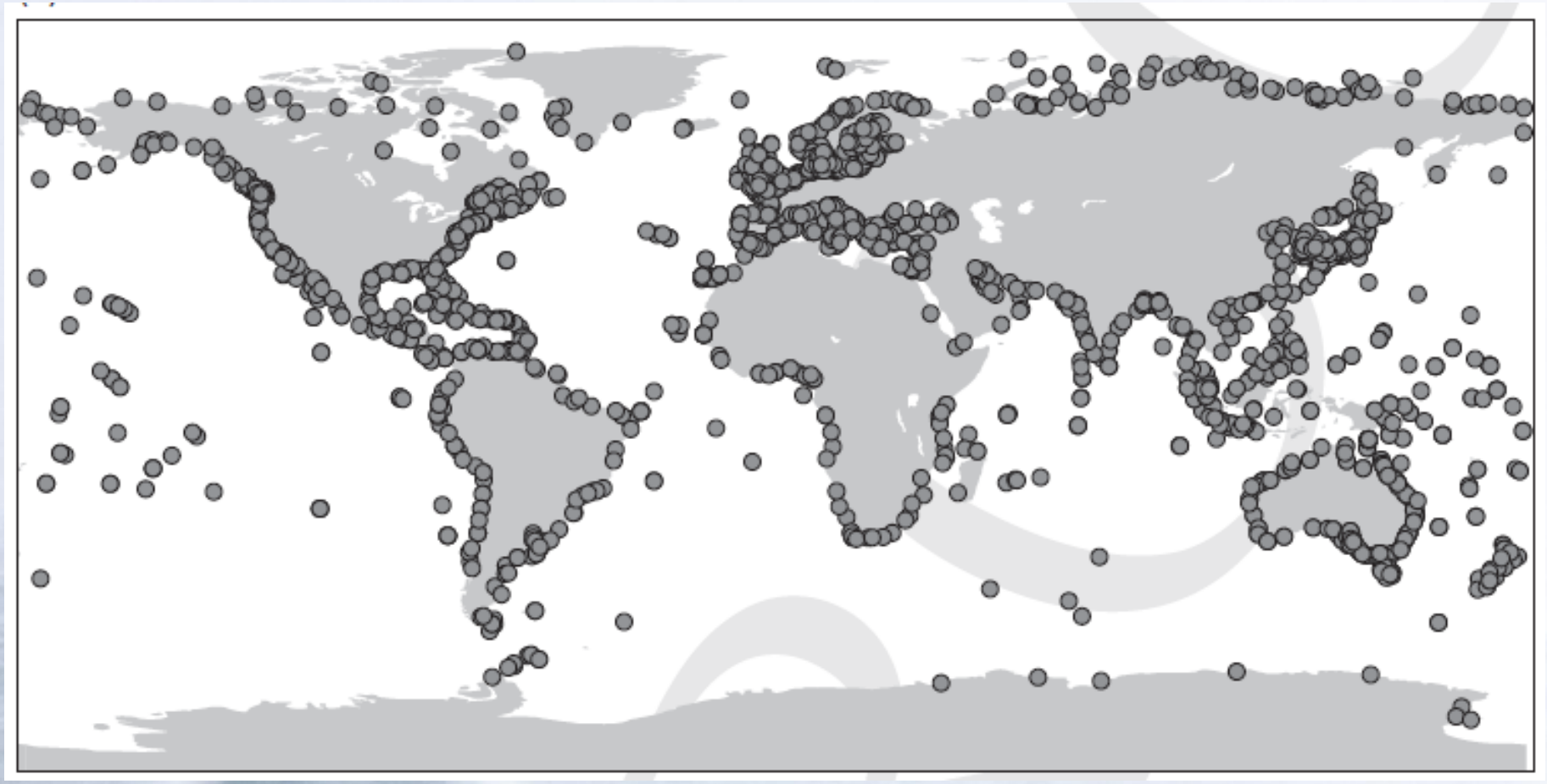
- Web site www.psmsl.org

- Data bank contains
  - over **60,000** station-years of information from almost **2,000** stations in **200** ‘countries’ or coastlines,
  - **1,500** station-years added per year

- If possible, all records converted to a Revised Local Reference (i.e. common station datum)

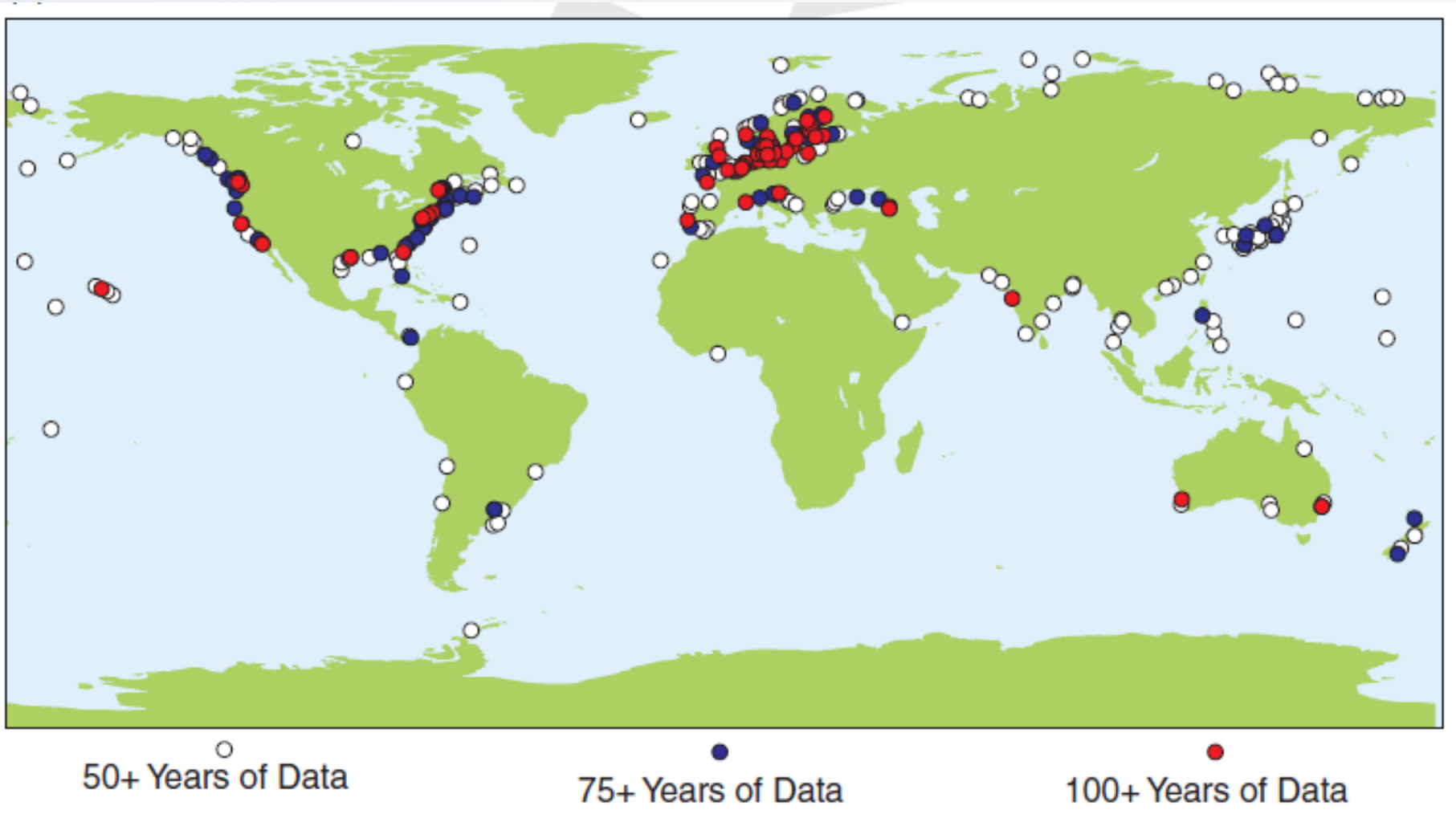
- Data used throughout oceanography, climate change, geology and geodesy (Most obvious application being ‘sea level rise’).

PSMSL Stations (All stations)



From Pugh and Woodworth (2014)

Long Records in the Revised Local Reference (RLR subset of the PSMSL



From Pugh and Woodworth (2014)

Search

PSMSL Permanent Service for Mean Sea Level

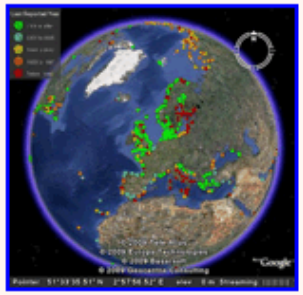
About Us | Data | Products | Training & Information | Links

home >

News

- Changes to the PSMSL Data Files
- PSMSL Launches New Website
- PSMSL Updates Backend Database
- More News ...

Explore the Dataset



Browse dataset in Google Earth

Welcome to the Permanent Service for Mean Sea Level (PSMSL)

Established in 1933, PSMSL is the global data bank for long term sea level change information from tide gauges and bottom pressure recorders.

About Us:

Learn about PSMSL, contact us, read news items and annual reports

Data:

Obtain and submit tide gauge and bottom pressure data

Products:

Browse the data set via GoogleEarth or obtain derived products, view regional commentaries and author archives

Training & Information:

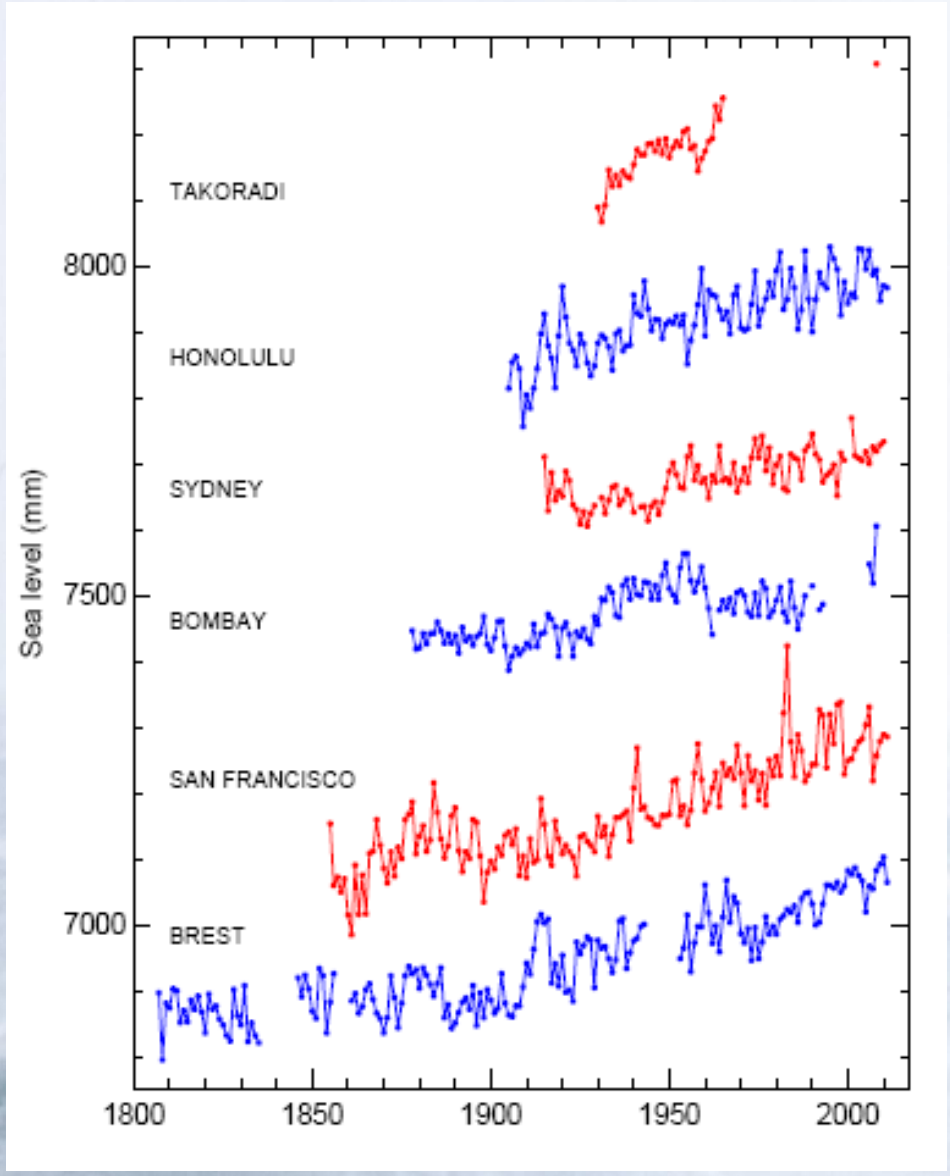
A wide variety of FAQs, training and software documentation, information on non-oceanographic signals in tide gauge records (e.g., glacial isostatic adjustment, atmospheric pressure, etc.)

Links:

Links to other networks and programs, as well as international sea level contacts

www.psmsl.org

Long records from each continent



Most records show evidence for rising sea levels during the past century

IPCC concluded that there has been a global rise of approximately 10-20 cm during the past 100 years

PSMSL and GLOSS

- GLOSS is a programme of the Joint Technical Commission for Oceanography and Marine Meteorology (JCOMM) of the IOC and WMO with primary aim to increase quality and quantity of data to PSMSL

- PSMSL has provided a main management function to GLOSS

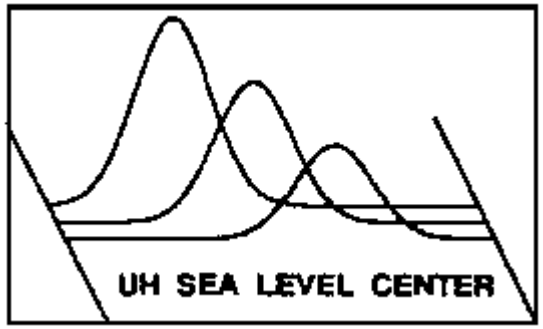
- Organisation of training courses in a number of locations

- Emphasis on training materials, manuals, sea level software etc.

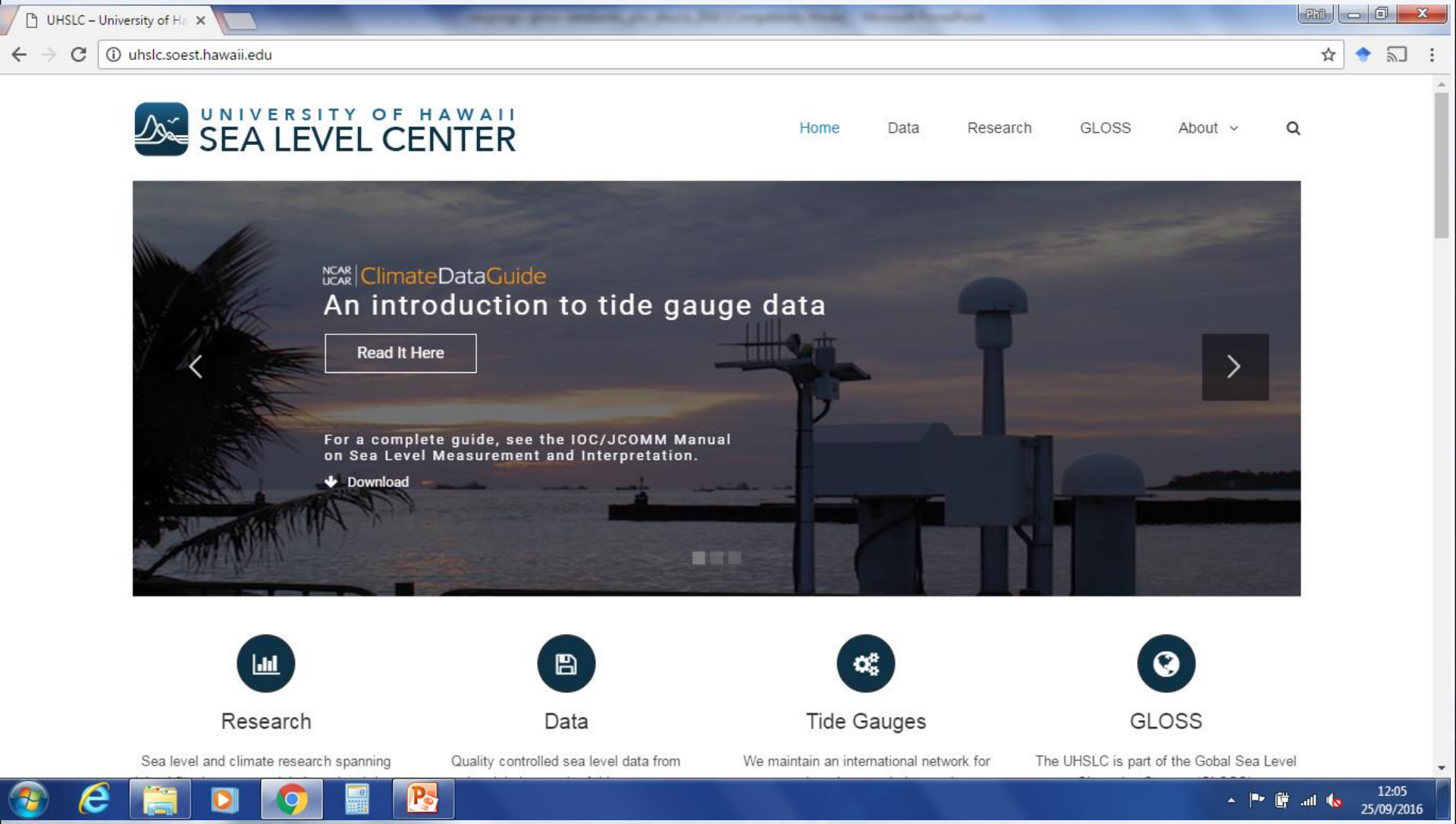
PSMSL Service Aspects

- Technical advice to tide gauge operators
- Data processing advice to network operators and scientists
- Scientific advice to Governments
- General advice to members of the public (many now covered by web Frequently Asked Questions). All letters and emails are replied to
- PSMSL web (data and information pages)

UNIVERSITY OF HAWAII
SEA LEVEL CENTER (UHSLC)



- Originally established as a centre for TOGA programme
- Later became one of the WOCE sea level centres
- Now the major GLOSS Fast and Real-Time Centre
- Research Quality Data Set (RQDS) also produced
- Also responsible to IOC for upgrades to IOTWS
- Web site: http://uhslc.soest.hawaii.edu/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uhslc.soest.hawaii.edu
UNIVERSITY OF HAWAII
SEA LEVEL CENTER
Home
Data
Research
GLOSS
About
NCAR UCAR | ClimateDataGuide
An introduction to tide gauge data
Read It Here
For a complete guide, see the IOC/JCOMM Manual on Sea Level Measurement and Interpretation.
Download
Research
Sea level and climate research spanning
Data
Quality controlled sea level data from
Tide Gauges
We maintain an international network for
GLOSS
The UHSLC is part of the Gobal Sea Level
12:05
25/09/2016

BRITISH OCEANOGRAPHIC DATA CENTRE (BODC) – GLOSS DELAYED MODE CENTRE

- Located at NOC in Liverpool alongside PSMSL (also a delayed mode centre)
- GLOSS delayed mode centre collects ‘higher frequency’ (e.g. hourly or more frequent) data from GLOSS sites
- Responsible for the GLOSS Handbook and GLOSS web pages
- www.bodc.ac.uk

ere to find data
line delivery>
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ormation and
entories>
Biological data
Chemical data
Cruise inventory
EDMED
GLOSS Station Handbook
NERC MetaData Gateway
International current meters
Inventory of Sea Level Obs.
Summary of BODC holdings
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bmitting data to
DC
rtals and links>

GLOSS Station Handbook

What is GLOSS?

The Global Sea Level Observing System (GLOSS) is a programme coordinated by the Intergovernmental Oceanographic Commission (IOC) for the establishment of global and regional sea level networks.

The main component of GLOSS is the 'Global Core Network' of 287 stations around the world for long term climate change and oceanographic sea level monitoring.

Location of the Newlyn tide gauge, UK ©

The GLOSS Station Handbook

The GLOSS Station Handbook was constructed to provide further information on each of the tide gauges in GLOSS core network. It was updated during 2005 and these pages form Version 6 of the Handbook.

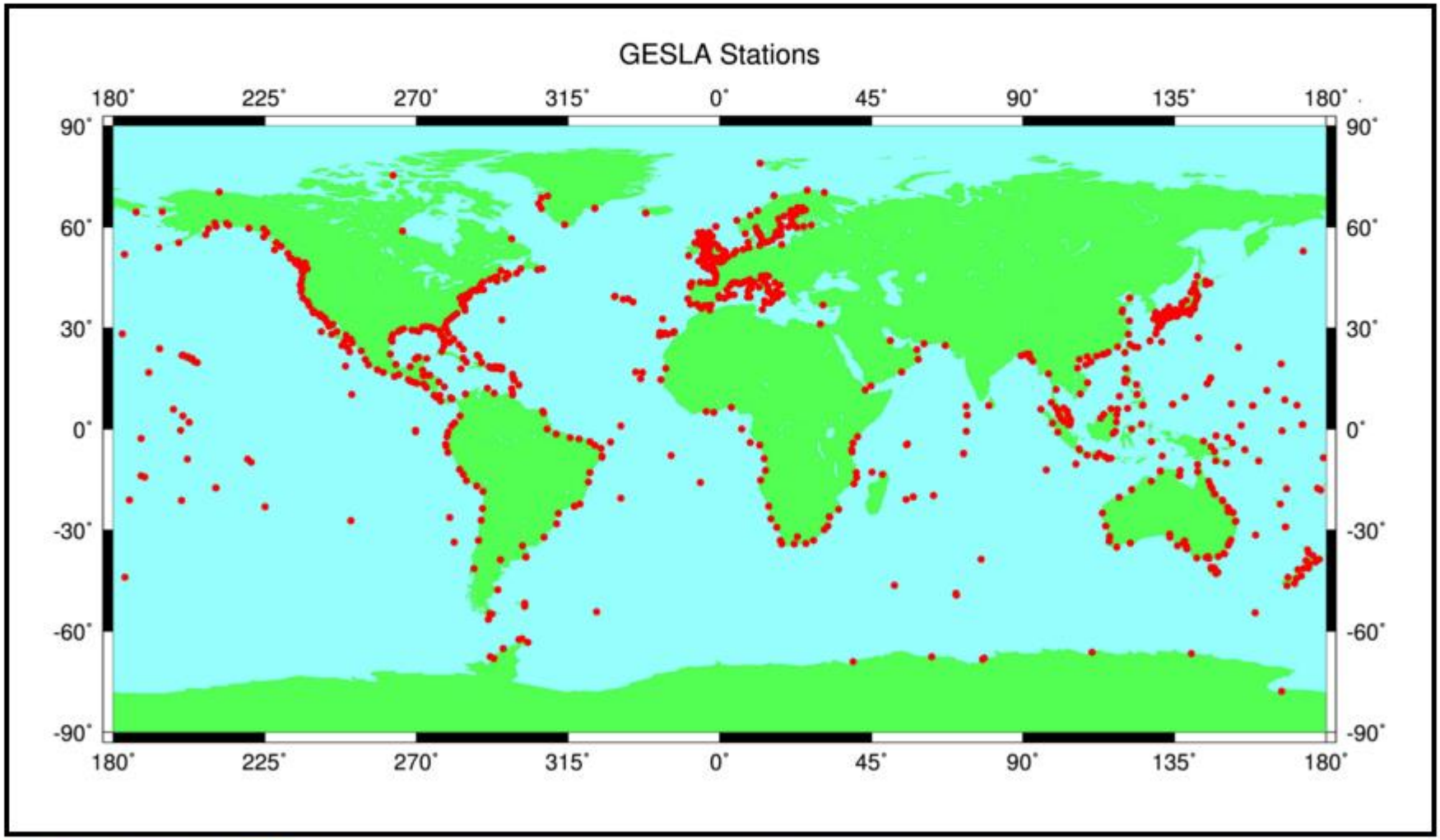
Connect to the GLOSS Station Handbook.

The Handbook includes references to individual countries and organisations who have made their sea level data (hourly values) available. Plots of annual mean sea level are also available for most sites and site maps are provided for many of the stations.

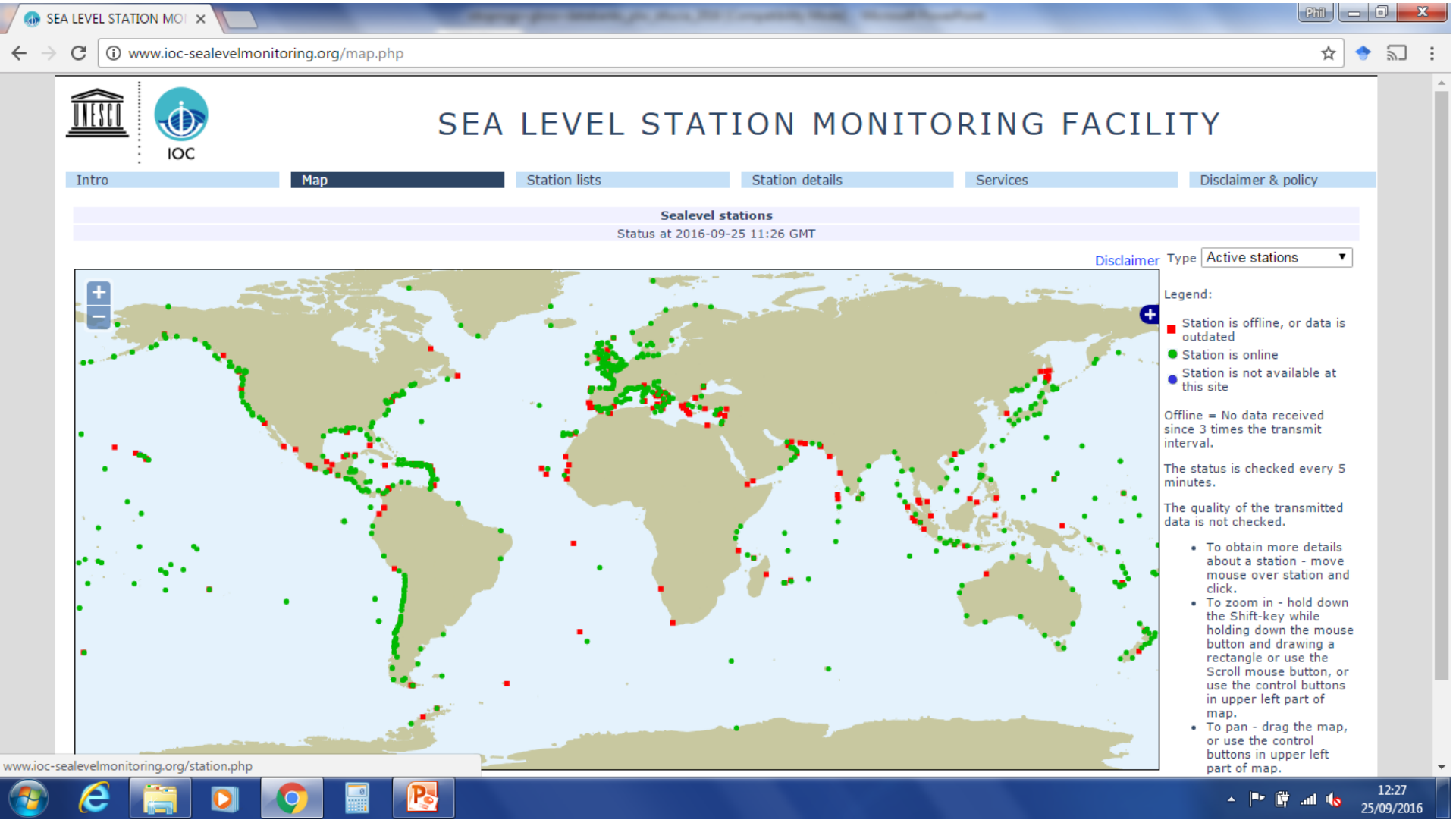
GESLA

Global Extreme Sea Level Analysis

Version 2



www.gesla.org

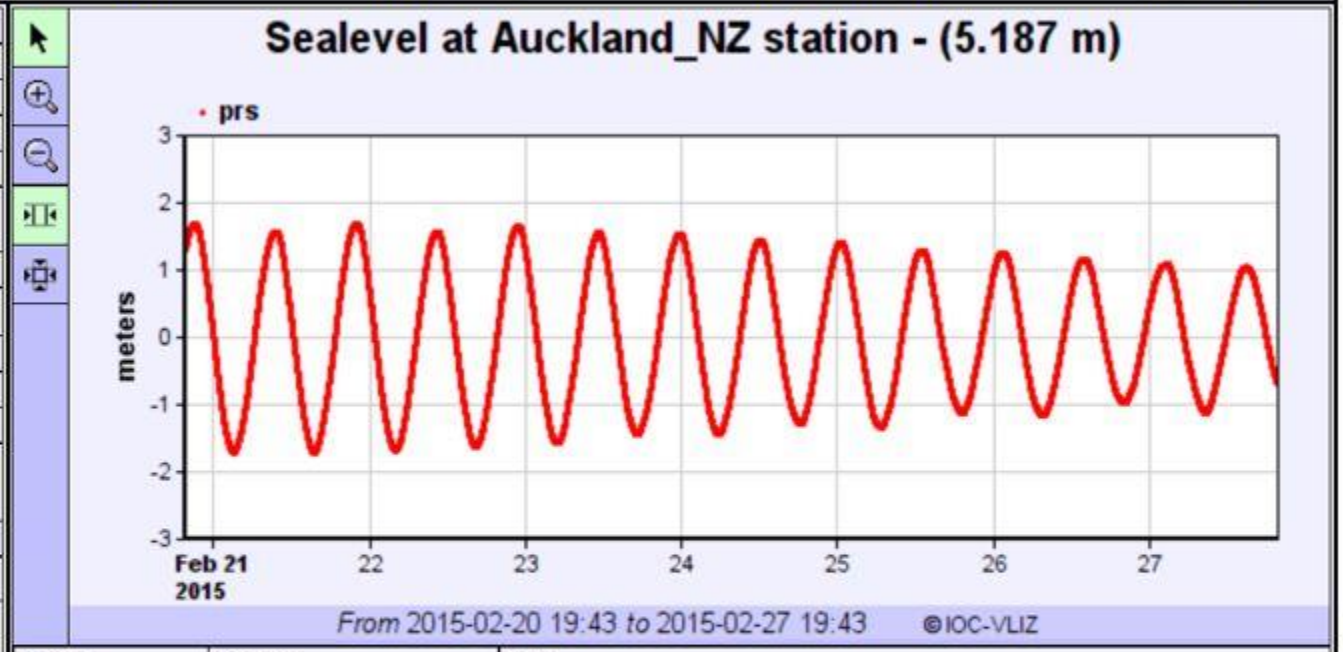


http://www.ioc-sealevelmonitoring.org

[previous station] Station Auckland_NZ at GMT [next station]

[more details] [GTS message] [show data] [show on map] [monitor]

Station metadata	
Code	auct
Country	New Zealand
Location	Auckland_NZ
Status	Operational
Local Contact	Land Information New Zealand (New Zealand)
GLOSS ID	127 [goto handbook]
QC data	UHSLC (1984-05-01|1988-12-31)
Latitude	-36.8314
Longitude	174.7865
Connection	GTS message
GTS message type	SZNZ01
Sensor 1	
Type of sensor	prs
Sampling rate (min)	1



Period	Signals	Data
12h	Remove outliers	Relative levels= signal - average over selected period
day	Remove spikes	Absolute levels= as received
7 days		Offset signals= relative signals + offset
30 days		

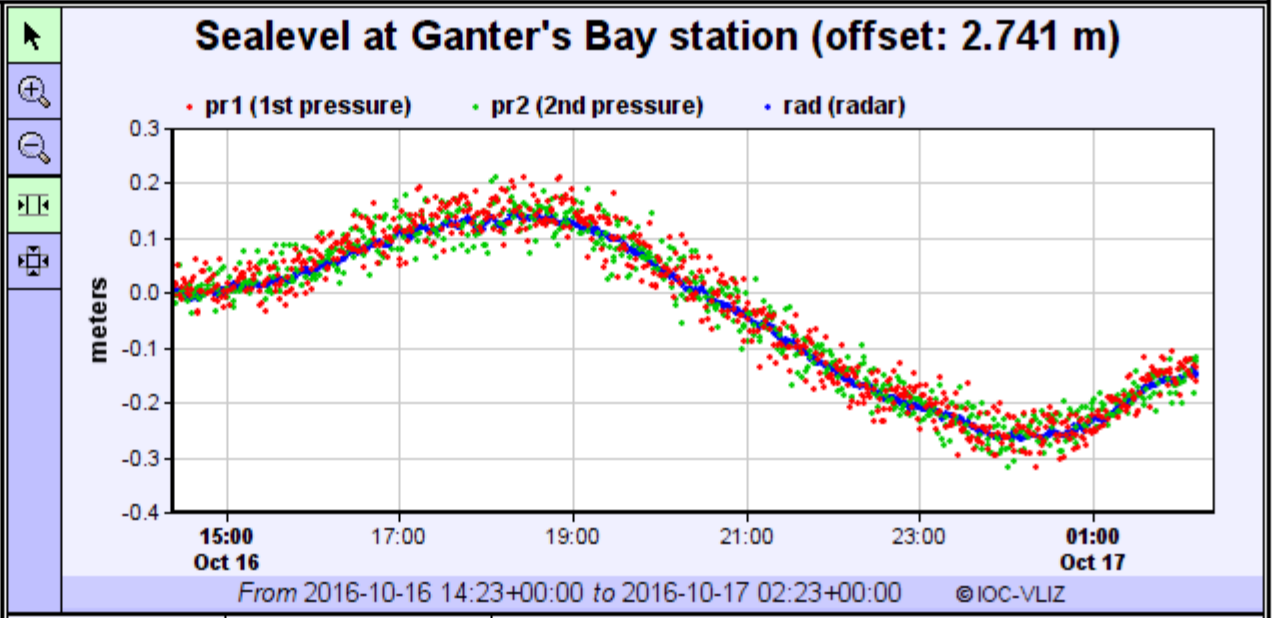
Tip:use left icons to zoom & scroll

SEA LEVEL STATION MONITORING FACILITY

[previous station] Station Ganter's Bay at GMT [next station]

[more details] [GTS message] [show data] [show on map] [monitor]

Station metadata	
Code	stlu
Country	Saint Lucia
Location	Ganter's Bay
Status	Operational
Local Contact	Saint Lucia Met Service (Saint Lucia)
Other Contact	Caribbean Institute for Meteorology & Hydrology (Barbados)
Other Contact	National Oceanography Centre (UK)
QC data	n/a
Latitude	14.016428
Longitude	-60.997351
Connection	GTS message
GTS message type	SOLC10
Sensor 1	
Type of sensor	rad (radar)
Sampling rate (min)	1
Sensor 2	
Type of sensor	pr1 (1st pressure)
Sampling rate (min)	1
Sensor 3	
Type of	pr2 (2nd pressure)



Period	Signals	Data
12h	rad	Relative levels= signal - average over selected period
day	pr1	Absolute levels= as received
7 days	pr2	Offset signals= relative signals + offset
30 days	Remove outliers	Show battery voltage
	Remove spikes	

Tip:use left icons to zoom & scroll

GLOSS Centre for GNSS

(GPS) Information

SONEL (Système d'Observation du Niveau des Eaux Littorales)

at the University of La Rochelle, France

is the GLOSS Centre for GNSS information obtained from tide gauge stations.

05. GPS - Windows Internet Explorer

http://www.sonel.org/-GPS-.html

File Edit View Favorites Tools Help

Search Share Check Translate AutoFill Sign In

05. GPS

Page Tools

SONEL

- Accueil
- Présentation
- Données
- Programmes
- CGPS@TG
- Utilisateurs
- Documentation
- Colloque SONEL
- Contacts

Station manager only

Login

Connection Register

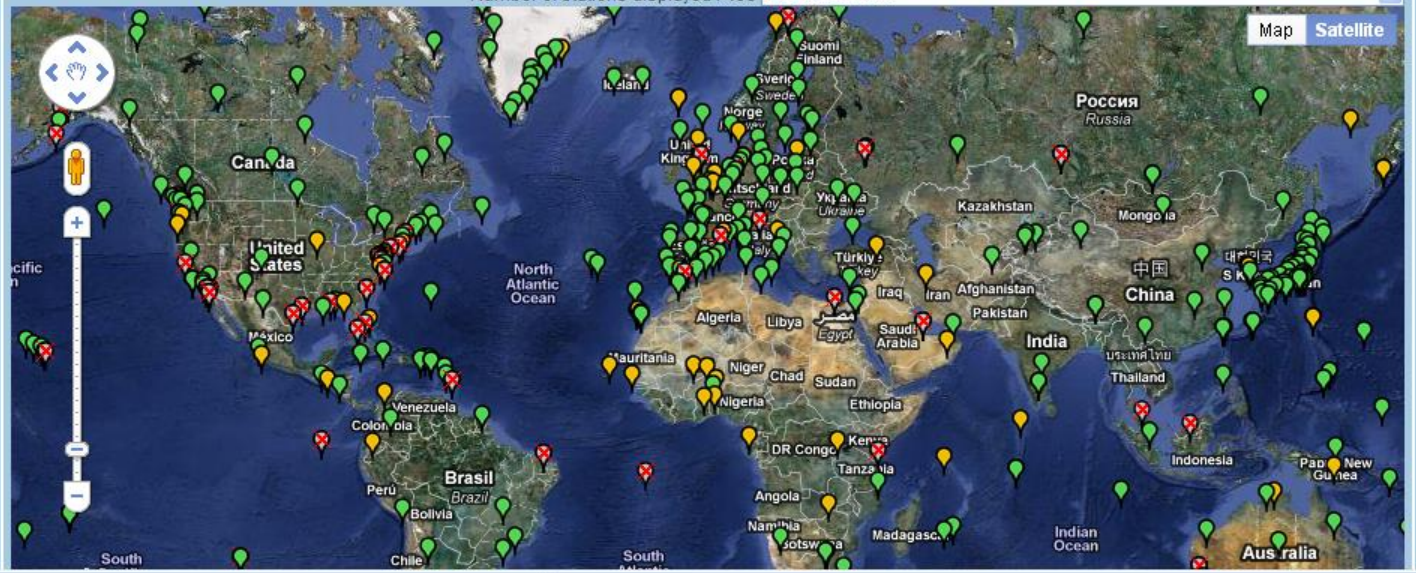
GPS

Accueil du site > Données > GPS

Quelles stations GPS ?

Les stations GPS pour lesquelles vous trouverez des données dans SONEL sont signalées sur une carte dynamique (cliquable). Il s'agit surtout de stations GPS permanentes co-localisées avec des marégraphes, mais aussi des stations GPS importantes pour la réalisation d'un repère terrestre géocentrique stable et précis.

Number of stations displayed : 495 List of stations



start | Global Positioning S... | 05. GPS - Windows... | mtg_estec_apr2011 | reports | Template [Compati... | EN | 13:04

www.sonel.org

Responsibilities (as far as possible) for participants in GLOSS to send data to international centres

1. **Real-time data** to the IOC Monitoring Facility at Ostende
2. **Monthly and annual MSL data** to PSMSL
3. **Delayed-mode higher-frequency data** (typically hourly values, quality controlled) to either UHSLC or PSMSL
4. **Fast H-F data,** not quality controlled to UHSLC (as the designated GLOSS Fast Centre)

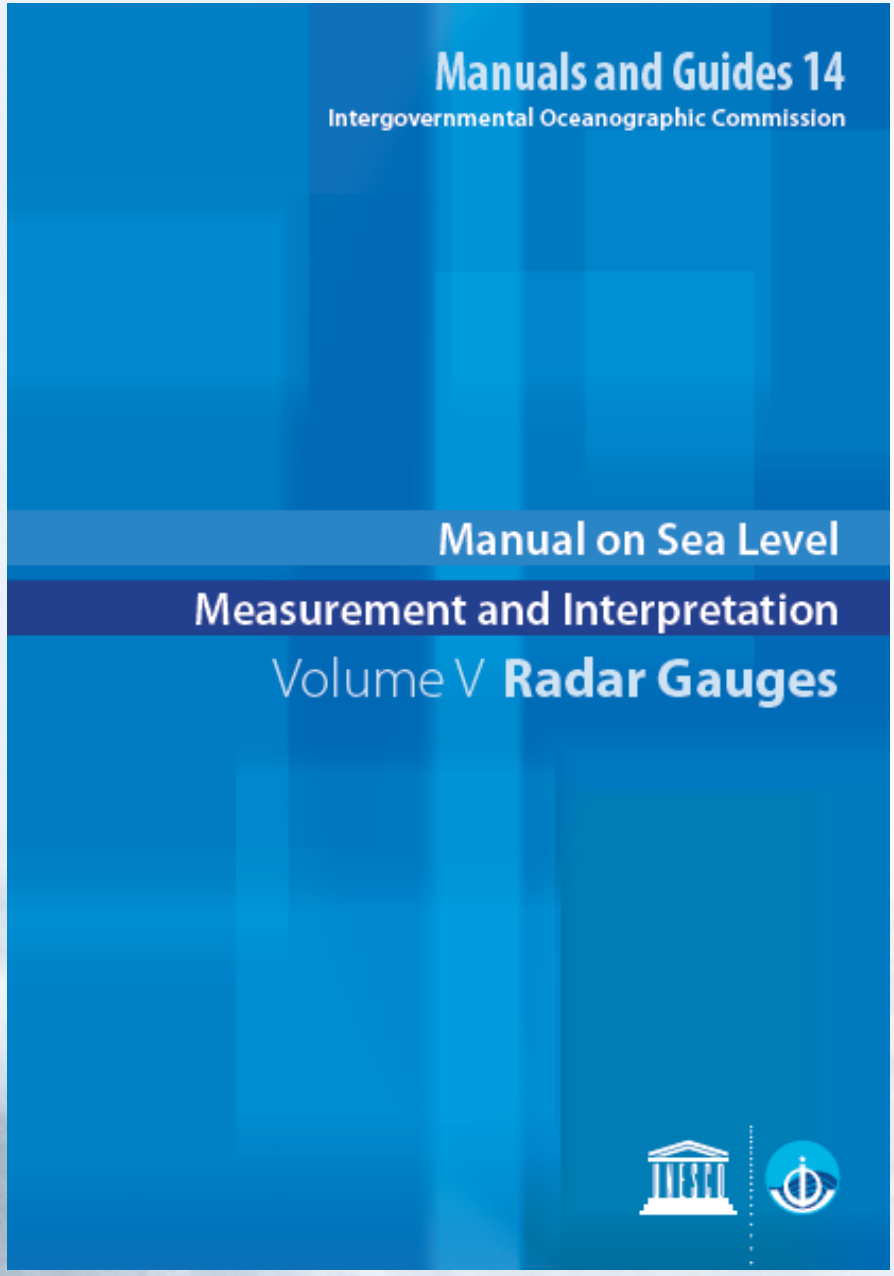
These arrangements can be a bit confusing, but talk to either PSMSL or UHSLC to see how best data can be transferred in your case.

Table 8.1

Sea Level Data Centres

	Location	Role	Data Availability	Web site
Monitoring facility	IOC SLSMF	Plots and downloads of NRT raw data	4-6 weeks	www.ioc-sealevelmonitoring.org
Fast mode	UHSLC	Preliminary QC of data from originators		uhslc.soest.hawaii.edu
Delayed mode	BODC	Final high frequency data from originators	Annually	www.bodc.ac.uk
Hourly data products	JASL/UHSLC	Final hourly data with corrections	Annually	uhslc.soest.hawaii.edu
Monthly averages	PSMSL	Final monthly averages from originators	Annually	www.psmsl.org
GNSS data	SONEL	Archive for GNSS data near tide gauges	Daily	www.sonel.org

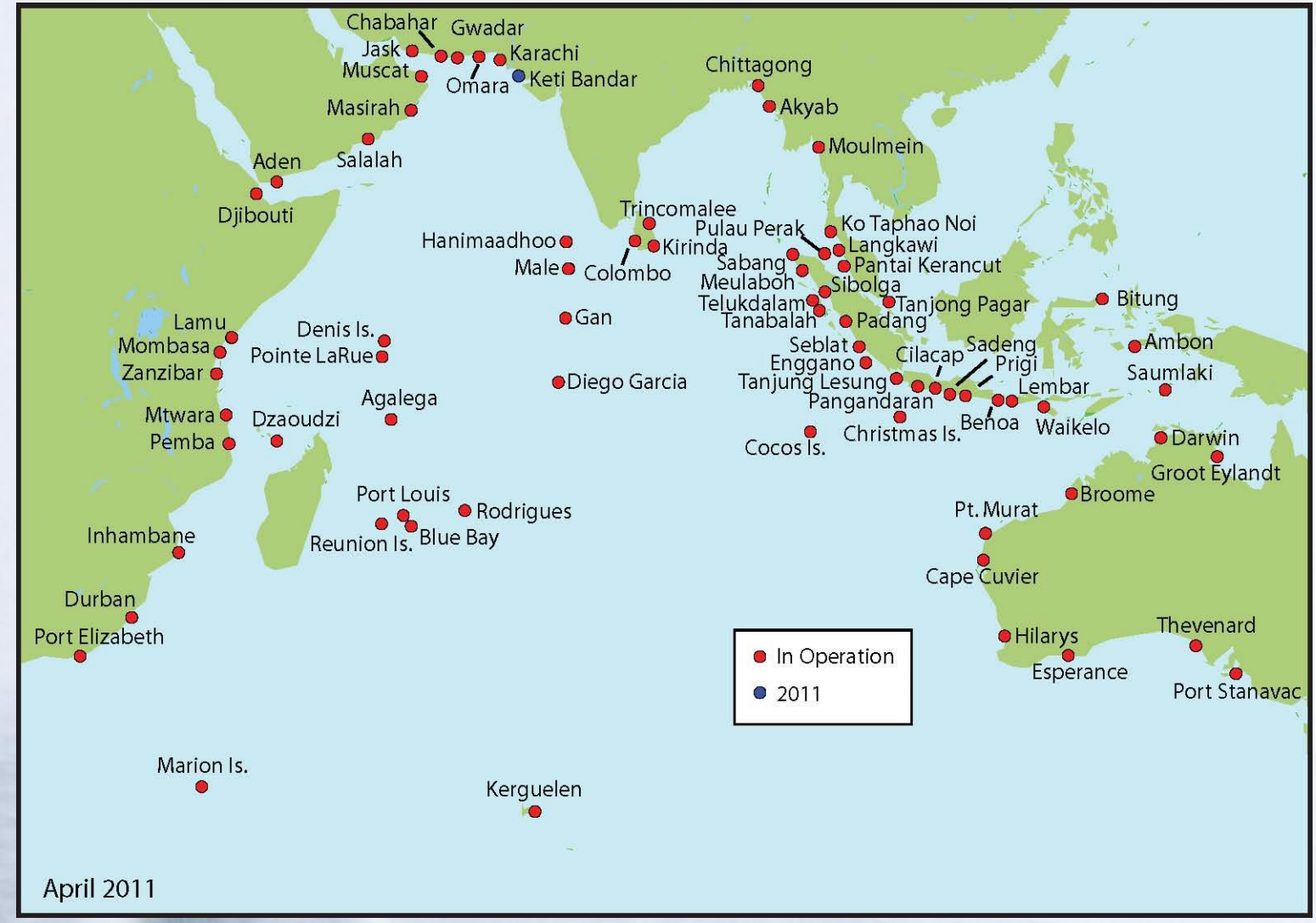
The above web sites contain information from locations around the world. The PSMSL web site also contains a list of many national and regional sources of real-time and delayed-mode sea level data.


Manuals and Guides 14
Intergovernmental Oceanographic Commission
Manual on Sea Level
Measurement and Interpretation
Volume V Radar Gauges

The End

Other GOOS–Related Regional Sea Level Activities

- There are a number of regional sea level measurement programmes which include data exchange for storm surge warning and other oceanography e.g. EuroGOOS, BOOS, NOOS, MOOS, IBIROOS, NEAR-GOOS
- The first of these were developed in Europe and predated GOOS itself



Indian Ocean Tsunami Warning System tide gauges (plus India and Oman stations)

www.jcomm.info

Worldwide marine meteorological and oceanographic communities are working in partnership under the umbrella of the WMO-IOC Joint Technical Commission for Oceanography and Marine Meteorology, in order to respond to interdisciplinary requirements for met/ocean observations, data management and service products.

JCOMM can be thought of as the implementation mechanism for GOOS (and GLOSS)

REGIONAL GLOSS Data Centres

- **MedGLOSS** http://medgloss.ocean.org.il/
- **Southern Ocean (now terminated)**
- **Ostende IOC Facility – monitoring and archiving function for IOC for the various tsunami programmes, GLOSS real-time data, and activities such as ODINAFRICA – see later lecture**

http://www.ioc-sealevelmonitoring.org/