Linking the Permanent Service for Mean Sea Level's (PSMSL) global mean sea level dataset to the ellipsoid

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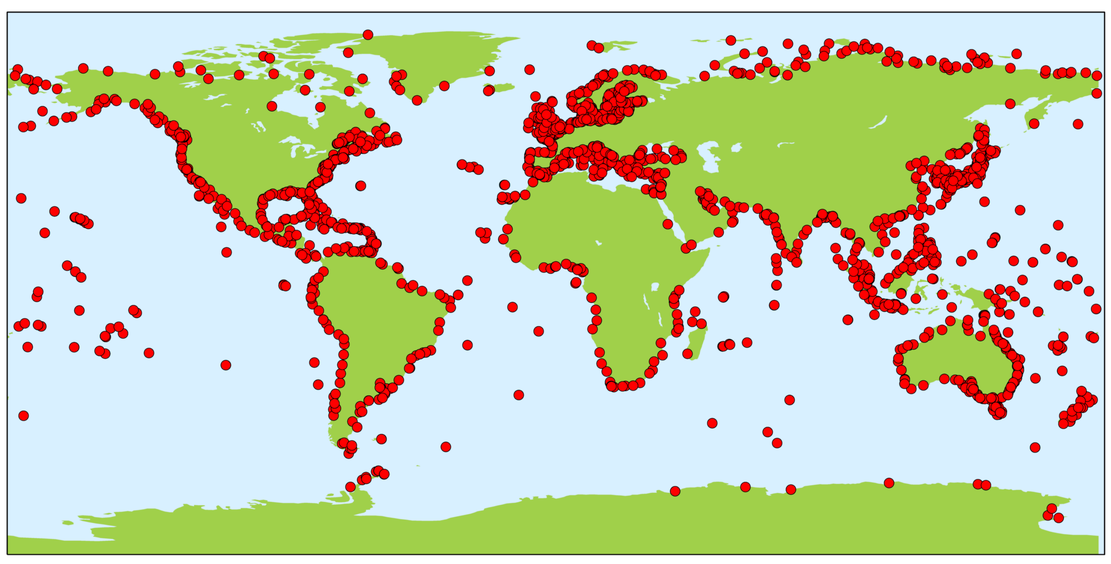
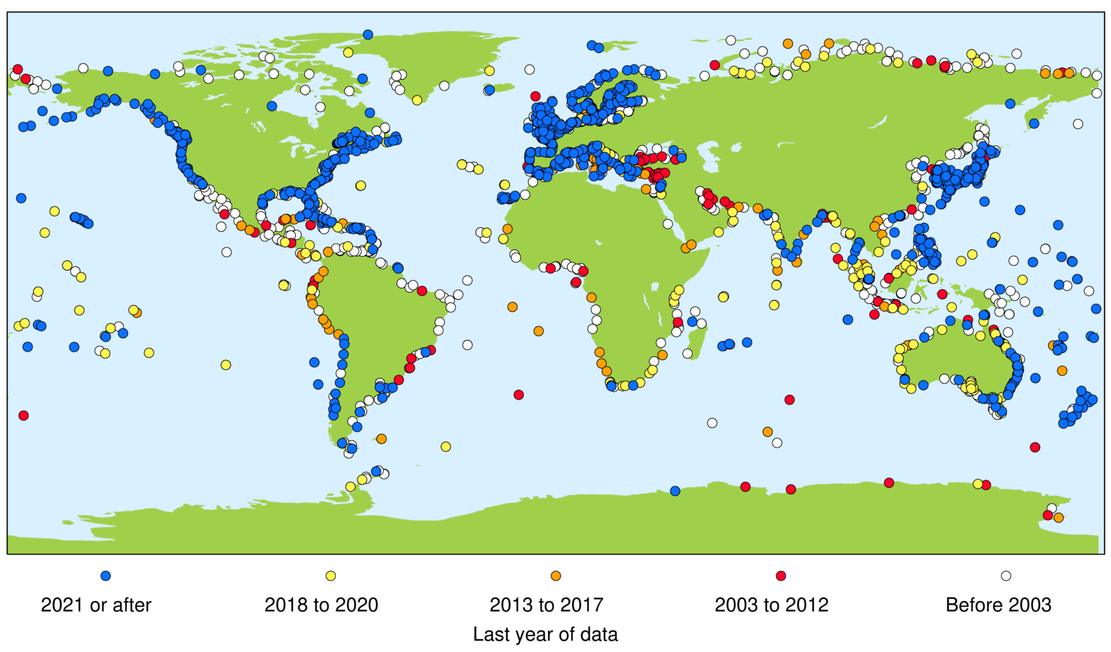
Introduction

The Permanent Service for Mean Sea Level (PSMSL) is the internationally recognised global data centre for long term sea level data from tide gauges over all around the world. Established in 1933, the PSMSL is responsible for the collection, publication, analysis and interpretation of sea level data from the global network of tide gauges.

The Mean Sea Level Dataset



All stations in the PSMSL databank



Latest updated year of data for all stations

- A dataset of monthly and annual means from **over 2000 locations**
- **Over 200 suppliers** operating tide gauges across the globe provide monthly mean sea level data and approximately 80 suppliers provide the data throughout the year
- **Free access to the dataset** and ancillary information through the PSMSL website (www.psmsl.org)

Revised Local Reference (RLR) dataset

- To ensure the data can all be referred to a fixed point on land and a **consistent vertical reference** frame is used throughout the record
- Defined to be **approximately 7000mm below mean sea level** in order to avoid negative numbers in the resulting RLR monthly and annual mean values
- Approximately **two thirds of the stations** in the PSMSL dataset have had their data adjusted in this way

Linking tide gauges to geocentric reference

- Our RLR dataset can be affected by **vertical movement of the land**
- If we are attempting to **reconstruct historical global mean sea level** from PSMSL records, we need to remove the local land movement from each site
- If we wish to compare sea level measured by tide gauges with sea level measured by **satellite altimetry**, we need to know the height difference between the local tide gauge datum and the reference ellipsoid used
- The **GNSS receiver** measures heights relative to an ellipsoid, and can be used to estimate the rate of vertical movement of the local land mass

➡ **Using continuous GNSS measurements from a receiver located near the tide gauge** can solve both of the cases mentioned above

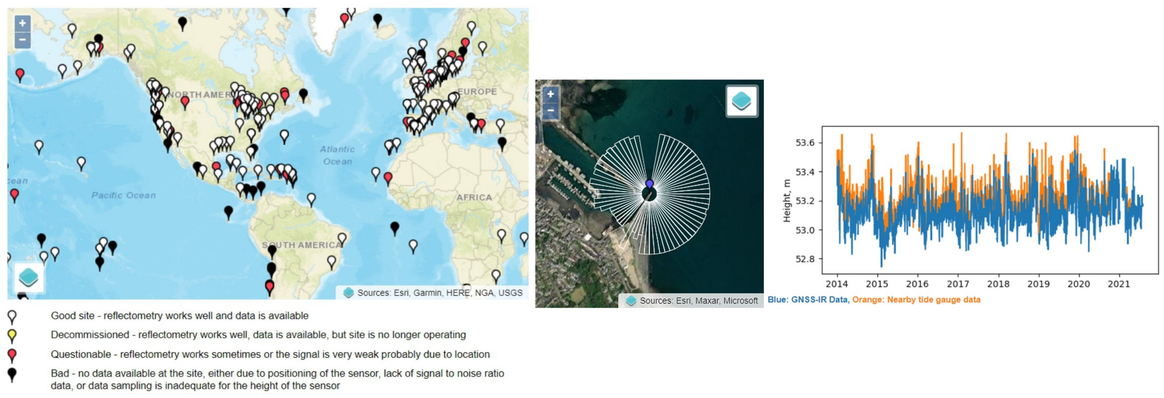
GNSS	Solution	Height	Velocity	Epoch	GNSS Start	GNSS End	Distance
BRST	ULR7a	44.094 ± 0.007	-0.22 ± 0.17	2020.0000	1998-10-31	2023-03-23	293
BRST	JPL14	44.078 ± 0.004	-1.12 ± 0.23	2020.0000	1998-10-31	2023-03-23	293
BRST	NGL14	44.073 ± 0.004	-1.09 ± 0.41	2020.0000	1998-10-31	2023-03-23	293
BRST	GT3	44.094 ± 0.006	-1.50 ± 0.30	2020.0000	1998-10-31	2023-03-23	293

Ellipsoidal link table from RLR diagram page for BREST

Solution: GNSS solution used
Height: Height of PSMSL RLR datum above ellipsoid (GRS80), in metre
Velocity: Vertical movement of PSMSL RLR datum relative to ellipsoid, in mm/yr.
Positive value: land rising
Epoch: The date when the height is fitted

GNSS-IR

GNSS-IR Site Map



Good site - reflectometry works well and data is available
Decommissioned - reflectometry works well, data is available, but site is no longer operating
Questionable - reflectometry works sometimes or the signal is very weak probably due to location
Bad - no data available at the site, either due to positioning of the sensor, lack of signal to noise ratio data, or data sampling is inadequate for the height of the sensor

- GNSS receivers suffer from **multipath errors** caused when the main signal from the satellite is interfered with by the signal reflected off the water surface
- These variations in the signal strength are measured by the receiver's **Signal to Noise ratio (SNR)**

➡ By extracting the frequency of variations in the SNR, **we can estimate the sea surface height**

Our Future Plan

- Improvement of the mean sea level dataset with sources of higher frequency data and improving the quality of accompanying metadata
- Continued development of interoperable metadata formats for tide gauge data and use standardized names for variables
- Allocate DOI for the dataset to make finding citations easier
- Use proper data servers for our data such as ERDDAP
- Continue developing the portal delivering sea level records measured using GNSS reflectometry (www.psmsl.org/data/gnssir)
- Improve software for automatic first level quality control of high frequency data