Permanent Service for Mean Sea Level and British Oceanographic Data Centre Report to GLOSS Group of Experts XVIII Panama, March 2025

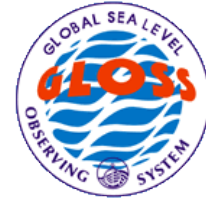**Elizabeth Bradshaw, Andrew Matthews, Chanmi Kim**

Current status of the PSMSL data centre
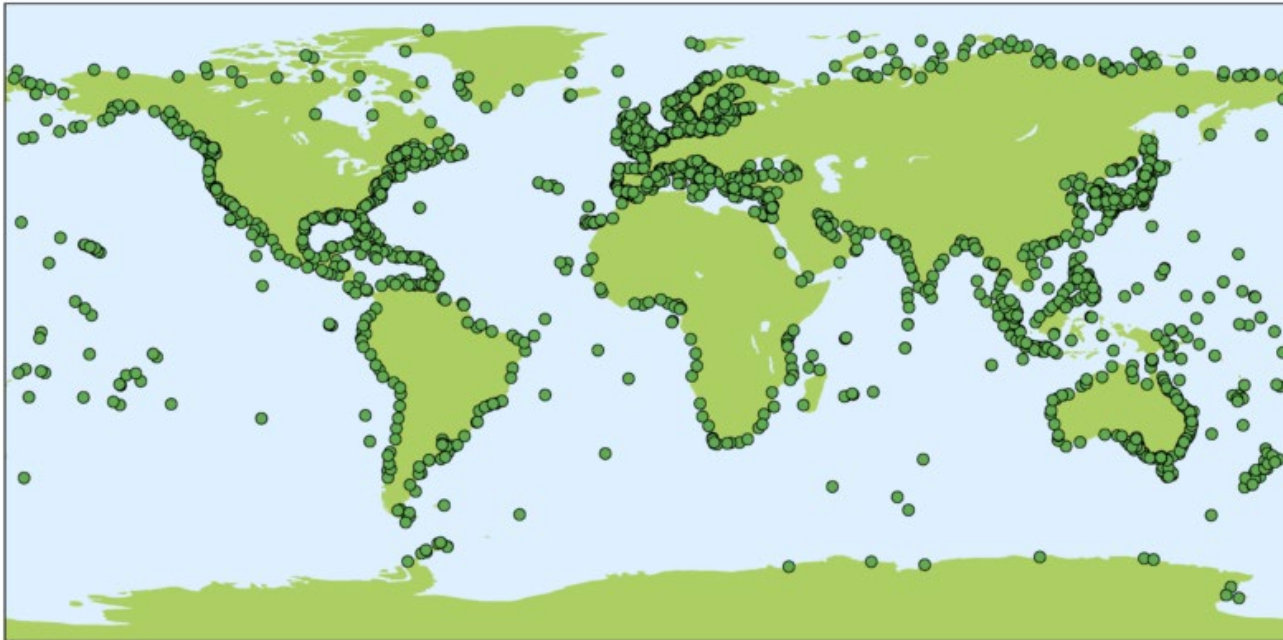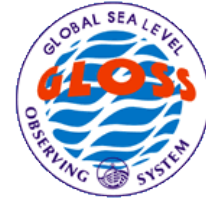
All stations in the PSMSL databank

- Global data centre for long term mean sea level data, with history dating back to 1933

- Hosted and funded by the UK's National Oceanography Centre (NOC) and is one of the key data centres for the Global Sea Level Observing System (GLOSS)

- Service for both IAG and IAPSO

- Member of GGOS Bureaus of Networks & Observations, and Products & Standards

- Data are used to develop and validate ocean circulation, tidal and storm surge models; monitor tsunamis, storm surges, and long-term sea-level changes; and help validate satellite ocean surface altimeters

Staff members

PSMSL Staff

- Elizabeth Bradshaw*, Head of the PSMSL

- Andrew Matthews, Technical lead, PSMSL

- Chanmi Kim, PSMSL data manager

* British Oceanographic Data Centre's (BODC) lead for sea level data management, including GLOSS and UK's tide gauge network
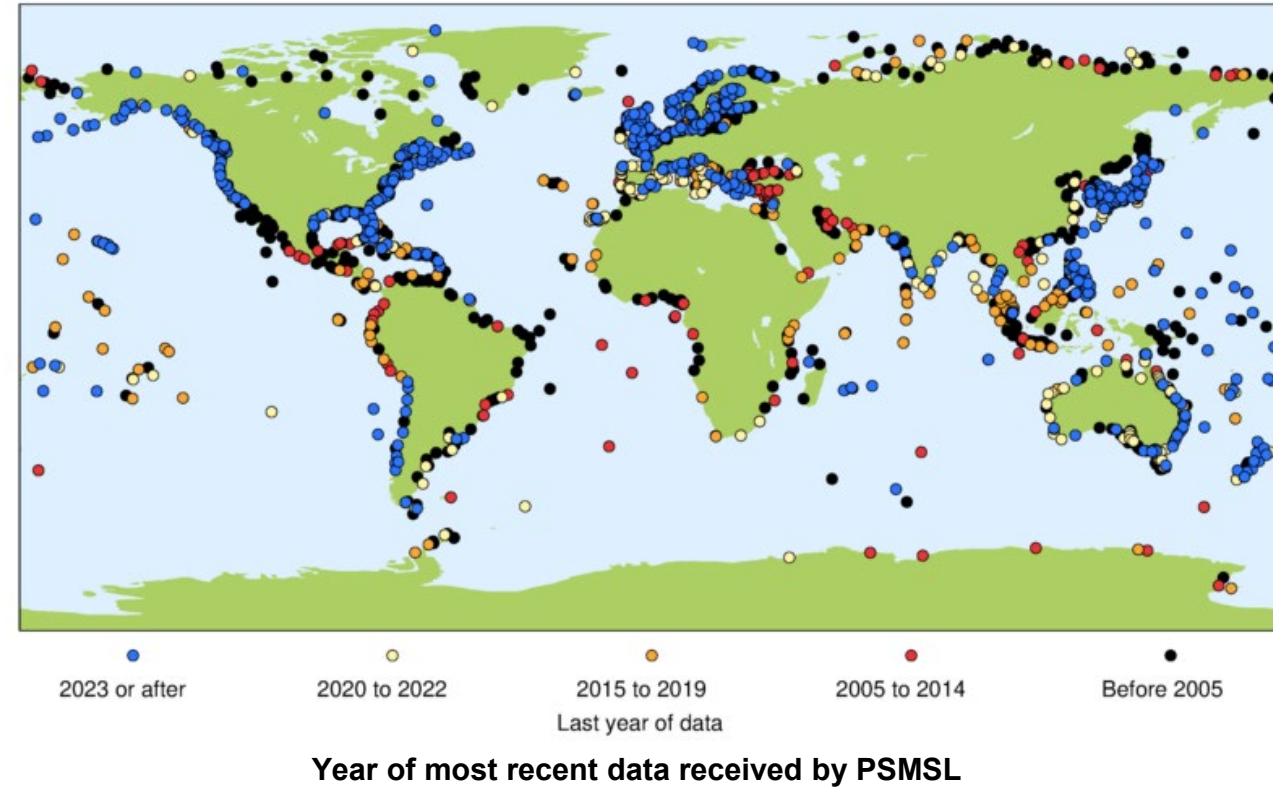
NOC staff

- Angela Hibbert, capacity building

- Chris Hughes, scientific advisor

- Svetlana Jevrejeva, projections, impact and adaptation

- Joanne Williams, surges, extremes and tides

- Simon Williams, GNSS and VLM

- Chris Wilson, ocean circulation and modelling

- Philip Woodworth, scientific advisor

- Lesley Richards, former director

Mean sea level dataset
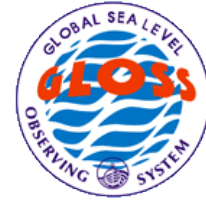
- Acquire, quality control and make available mean sea level data

- The PSMSL MSL dataset has continued to grow from 2020 to 2024

- Some sites have not contributed data for over 20 years, and it may be that these stations have ceased to function

- Many of older stations are in the Arctic and Antarctic and are key gaps in the dataset

- Produce and distribute sea level related products (e.g. estimates of trends, land movement)

| 2023 or after | 2020 to 2022 | 2015 to 2019 | 2005 to 2014 | Before 2005 |

Last year of data

Year of most recent data received by PSMSL

Year	2020	2021	2022	2023	2024
No. of stations	790	636	688	693	730
Station years	1361	1099	1325	1350	1796

Data added to the PSMSL databank

Mean sea level dataset
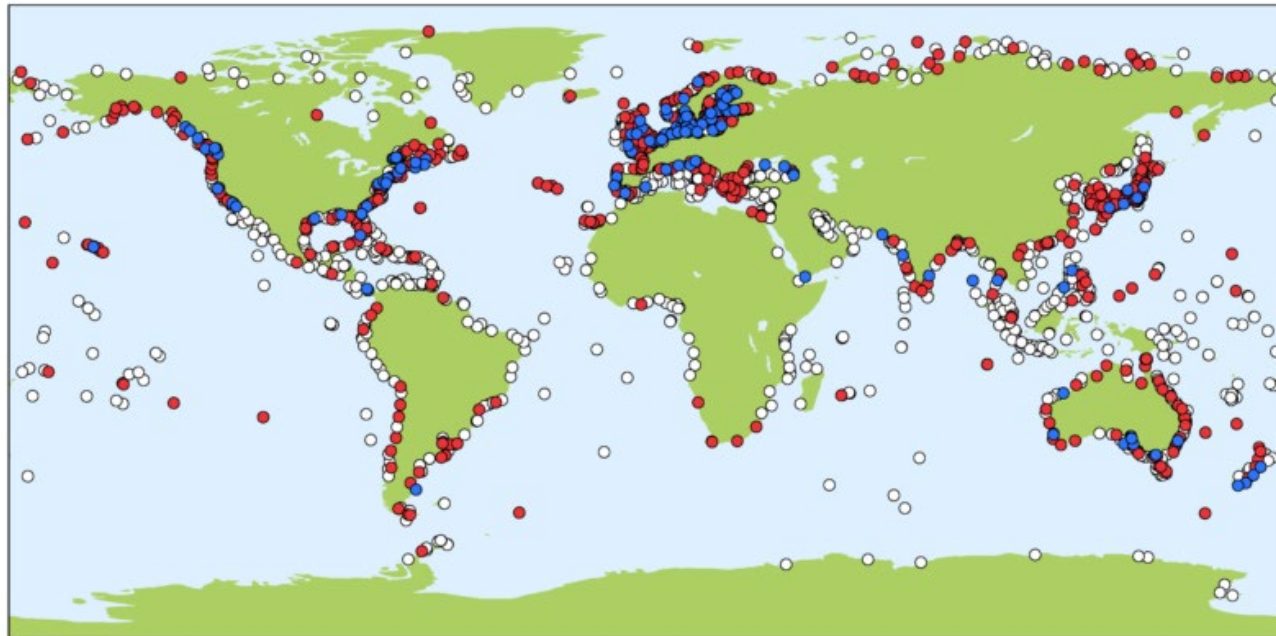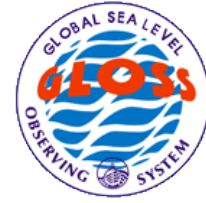

Distribution of long tide gauge records
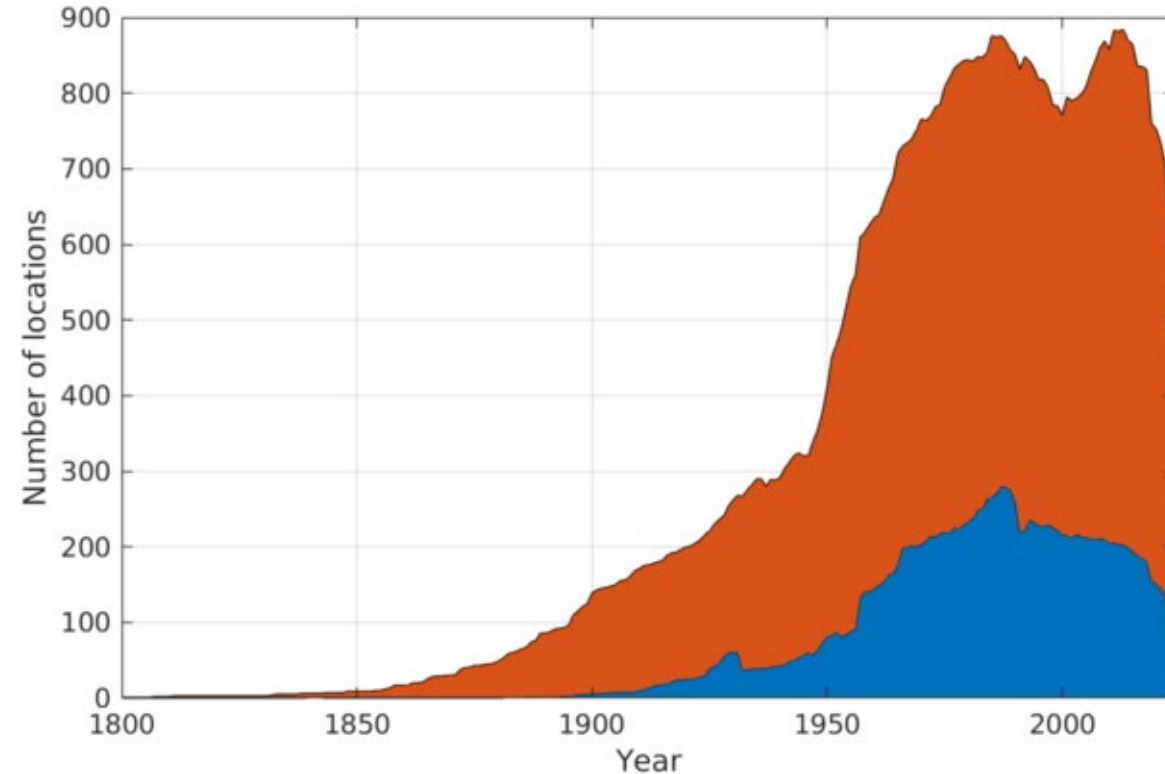
North-South hemisphere distribution of data received by PSMSL

- No datum-controlled records at PSMSL longer than 100 years for the Arctic, Africa, South America or Antarctica

- In 2022, the head of the PSMSL wrote a letter of support for the Southern Ocean Sea Level Monitoring Network as part of Australian Antarctic Division Decadal planning activities to highlight the need for data in the Southern Ocean

Citations of PSMSL data
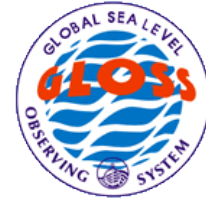
- 451 papers published in 182 journals (2018–2022)

- 14 journals had an Impact Factor > 10, with 38 papers published in these

- Top 3 journals by Impact Factor:
  - Nature
  - Reviews of Geophysics
  - Nature Climate Change

- Top 3 journals by number of publications:
  - Advances in Space Research (21)
  - Remote Sensing (18)
  - Geophysical Research Letters (16)

- Wide-ranging subject areas: climate studies, satellite altimetry, marine engineering, environmental assessment, geology


Number of dataset citations from 2018-2022
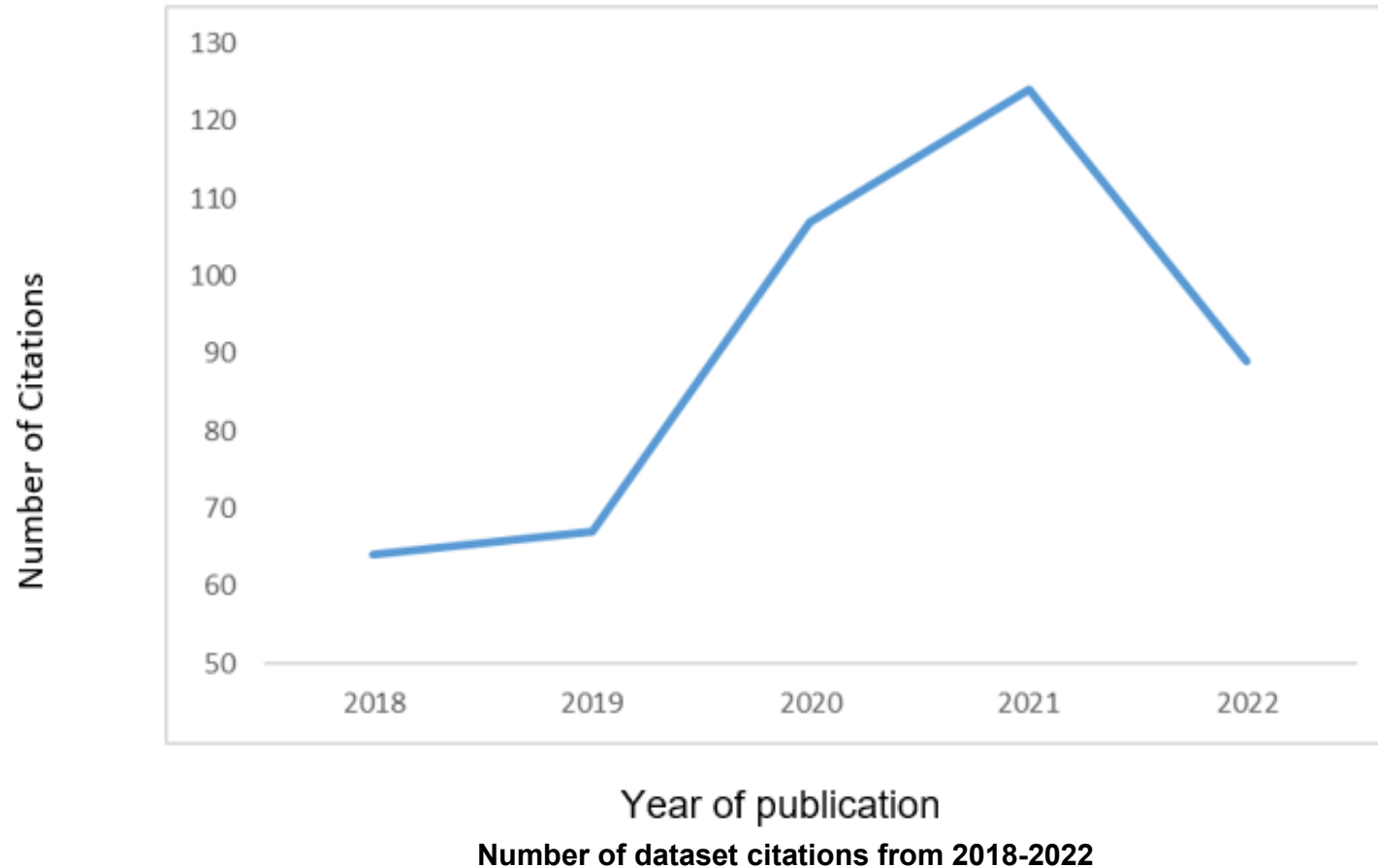
GNSS Interferometric Reflectometry (GNSS-IR)

GNSS-IR sea level records available from PSMSL

- As well as a receiving a direct signal from a GNSS satellite, the GNSS receiver detects a reflected signal off the surface of the water. Noise changes as sea rises and falls and sea level data can be extracted from signal-to-noise ratio

- The PSMSL continues to host a repository of sea level data extracted from GNSS receivers using interferometric reflectometry (GNSS-IR)

Data portal at https://psmsl.org/data/gnssir
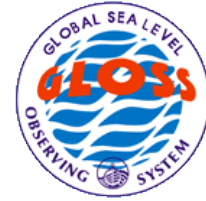
Barcelona

Information

ID:	10106
IGS type code:	bcl1
Latitude:	41.341779°
Longitude:	2.165683°
Ellipsoidal Height:	56.117 m
Ellipsoidal Height Epoch:	2020.0000
Reflector Height:	7.048 m
Provider:	IGN ES
Alternative Providers:	SONEL
SONEL Link:	bcl1
NGL Link:	

📍 GNSS Receiver
⬤ Mask used

Sources: Esri, Maxar, Microsoft

Data

Zipped data file

Plot of daily data
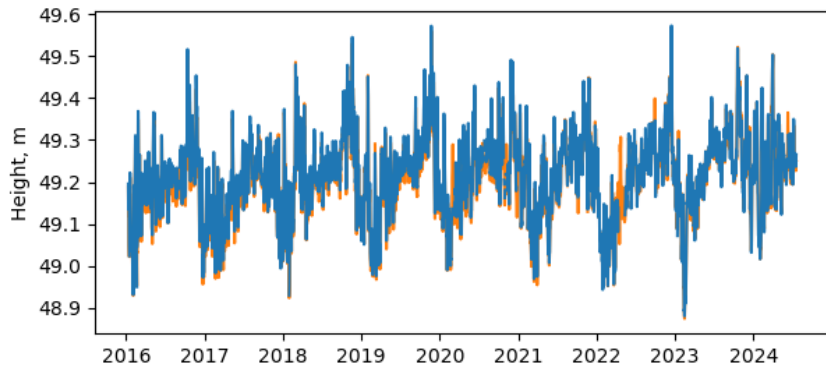
Blue: GNSS-IR Data, Orange: Nearby tide gauge data

- The PSMSL initially created the portal with funding from the European Union Horizon 2020 EuroSea project, and are now maintaining it using core NOC funding.

- Over the past two years, we have expanded the portal from about 250 sites to nearly 350

- Improved the documentation on the website, including adding Python notebooks illustrating the available parameters in the data files, and details of metadata files that will help those wishing to access data programmatically

BODC developments
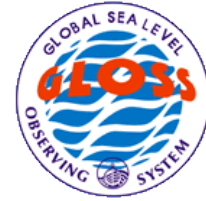


BODC's new quality control software
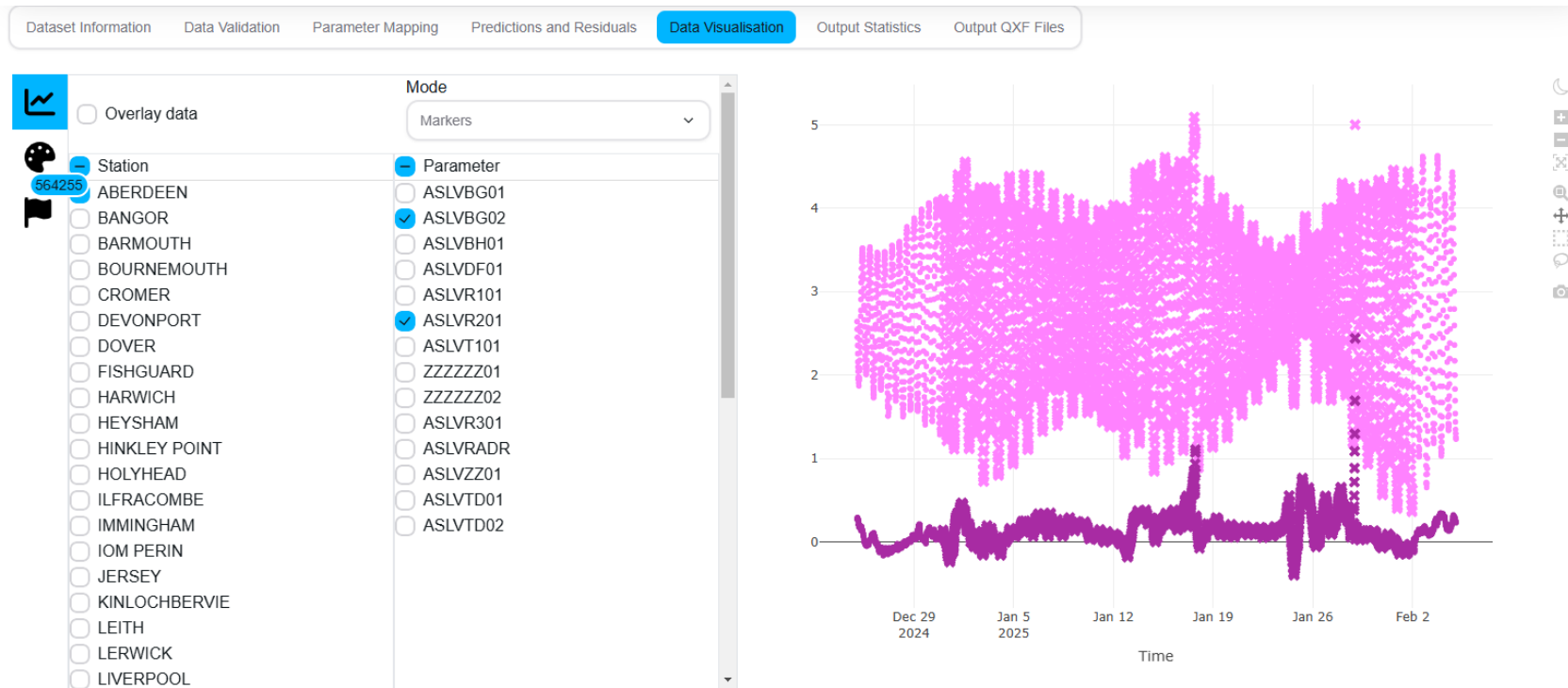
- The previous package for quality controlling sea level data become difficult to maintain due do its complexity and the current IT team's relative unfamiliarity

- With help from PSMSL scientists, BODC developers modernized the package using common libraries and best practices

- Now being used to quality control sea level data from the UK's national tide gauge network
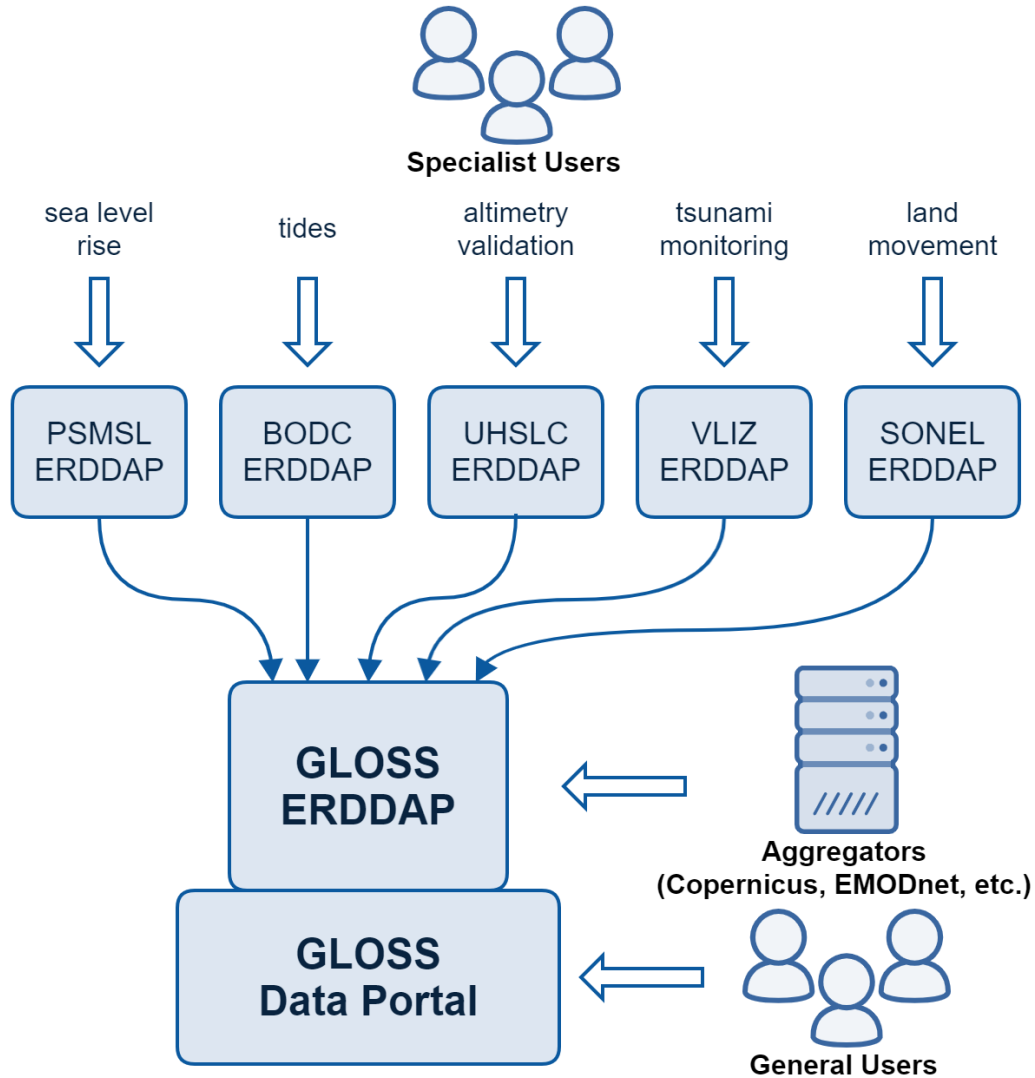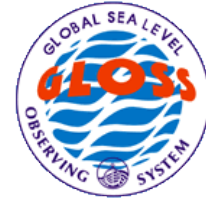
BODC developments
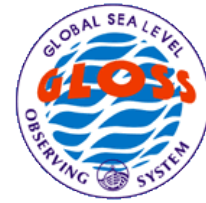
The prototype BODC dashboard

- Tide gauge data from two UK sites were added to BODC's ERDDAP server under the CreamT project, which developed a dashboard for coastal flood monitoring

- Expanded to include the entire UK tide gauge network, with another prototype dashboard
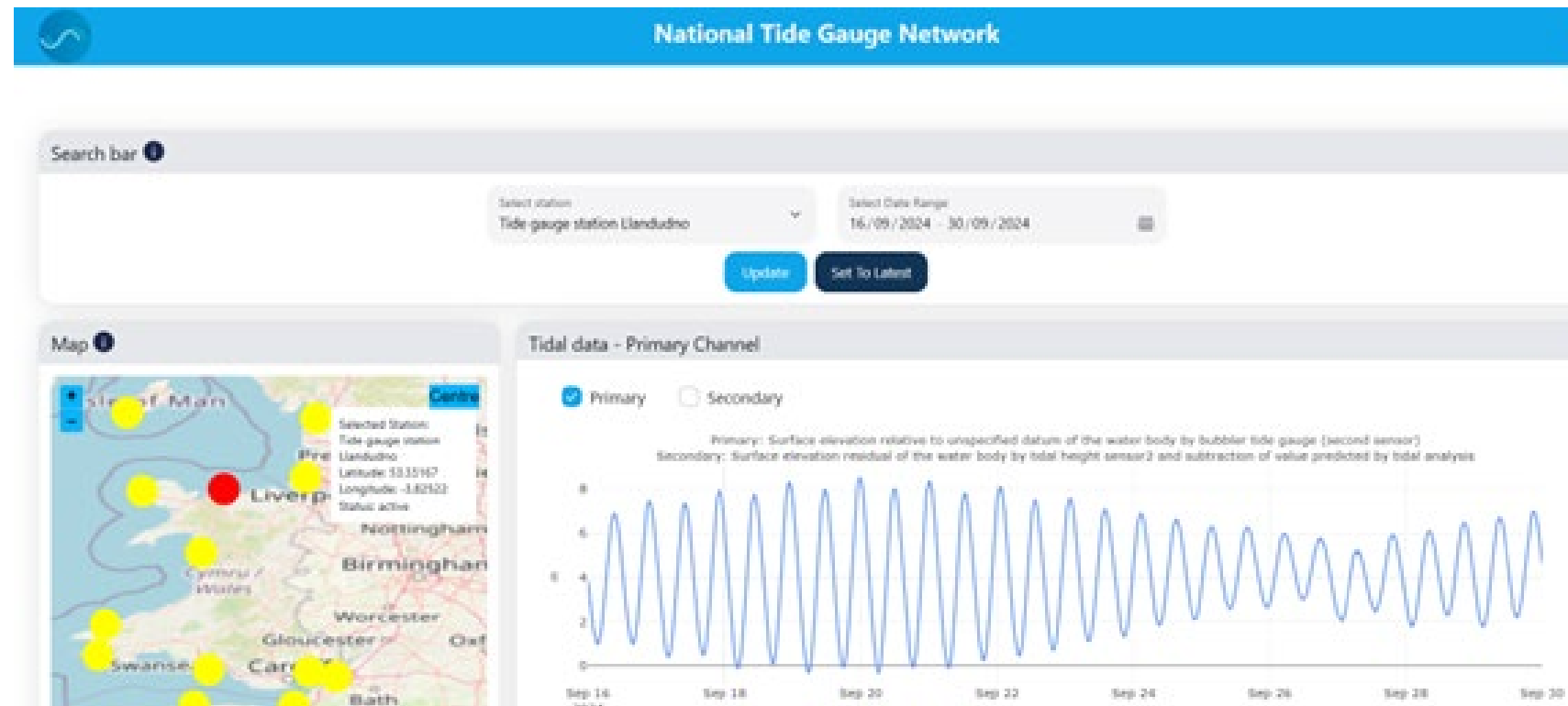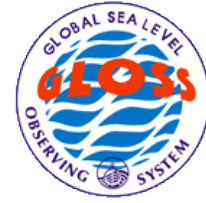
BODC developments

Schematic of the proposed unified GLOSS data portal, and how different users might interact with our data

- PSMSL is exploring ways to deliver data through ERDDAP for the upcoming GLOSS ERDDAP server

- Initial test netCDF files are ready, but metadata may need updates to align with the final GLOSS data model

Other activities

Data rescue

- Finished quality control of data from two sites in Liverpool Bay (1853–1903) recovered using volunteers on citizen science platform Zooniverse.org

- Final data submitted to BODC for ingestion and used to validate a reanalysis of a storm surge in 1902 (Hawkins et al., 2023)
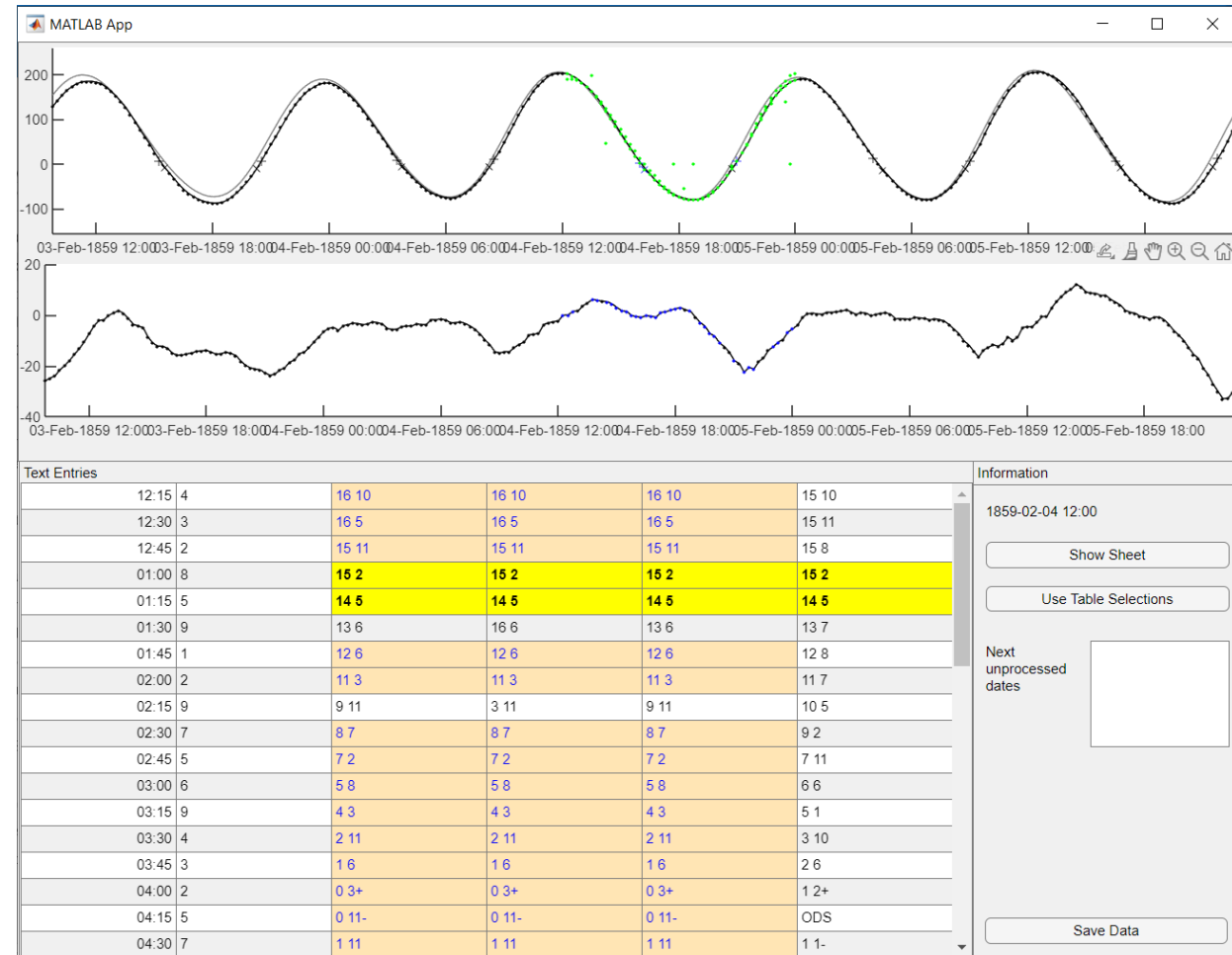
An example of quality controlling data recovered from ledgers in the UK Tides Zooniverse project

Other activities
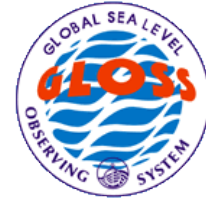
Meetings and Trainings

Trainings:

- Providing training in sea level monitoring and science to remote sensing PhD students in the UK (January 2023)

- Delivering training in tidal analysis and sea level variability to Madagascan stakeholders (January 2024)

- Visiting Anguilla to support their project to obtain tsunami ready accreditation from the IOC, including sessions on tide gauge maintenance and sea level science (March 2024)

Meetings:

- Members of the PSMSL helped organise a tide gauge workshop alongside the EuroGOOS Tide Gauge Task Team as part of the EuroSea programme (May 2023)

- Held a workshop on best practices in tidal analysis as part of an ongoing IAPSO study group

Reorganisation of PSMSL archives

A selection of mareograms from Australia contained in the PSMSL archives

- In 2024, NOC refurbished its Liverpool office, prompting the relocation of PSMSL's paper archives. We used this opportunity to review, reorganise, catalogue, and dispose of outdated content.
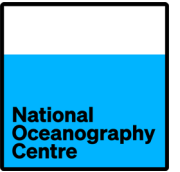
Other activities

Refurbishment of the Doodson-Légé tidal prediction machine

The Doodson-Légé Machine, and a close up of the mechanisms used to adjust the parameters for an individual constituent.

- The NOC Liverpool site still hosts two analogue tidal prediction machines, on loan from National Museums Liverpool

- In July 2024, a metals conservator performed routine maintenance on the newer Doodson-Légé machine

- In the 1950s, a team of assistants known as "computers" operated these machines. As they retired, the knowledge was passed down, but only a few staff members knew how to operate them. We took the opportunity to train four more "computers" and document the process to preserve this important history

Future plans

- Finalising the delivery of PSMSL and BODC data through ERDDAP servers

- Improving PSMSL metadata, particularly lineage metadata, so our data suppliers are properly credited

- Continuing investigation of the use of permanent identifiers to improve tide gauge metadata

- Further developing the use of GNSS-IR, in particular near real time delivery and significant wave height data.

- Continuing to explore methods of recovering historical sea level data

National Oceanography Centre

Permanent Service for Mean Sea Level

Thank you for your attention!