European Pavilion

Digital Ocean

Nice | France

2 - 13 JUNE 2025

In-situ monitoring of sea level rise - The Global Sea Level Observing System (GLOSS)

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Bradshaw, Elizabeth

National Oceanography Centre, UK

National Oceanography Centre

Permanent Service for Mean Sea Level

GLOSS

United Nations Educational, Scientific and Cultural Organization

Intergovernmental Oceanographic Commission

Puertos del Estado

National Oceanography Centre

British Oceanographic Data Centre

SONEL

UNIVERSITY OF HAWAI'I SEA LEVEL CENTER

Observing sea level

https://oceanexplorer.noaa.gov/explorations/22sunfish/features/fish-weir/fish-weir.html

Image from an ROV of semi-circular stacked stones on the seafloor, part of a larger weir complex. The actual age of the weir is determined based on sea level reconstruction to be approximately 11,100 years.

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Why do we need to monitor sea level?

Changing sea levels will have a major impact on human life over the next 100 years.

Photo: Kaitha Poo Manam, (CC BY-SA 4.0)

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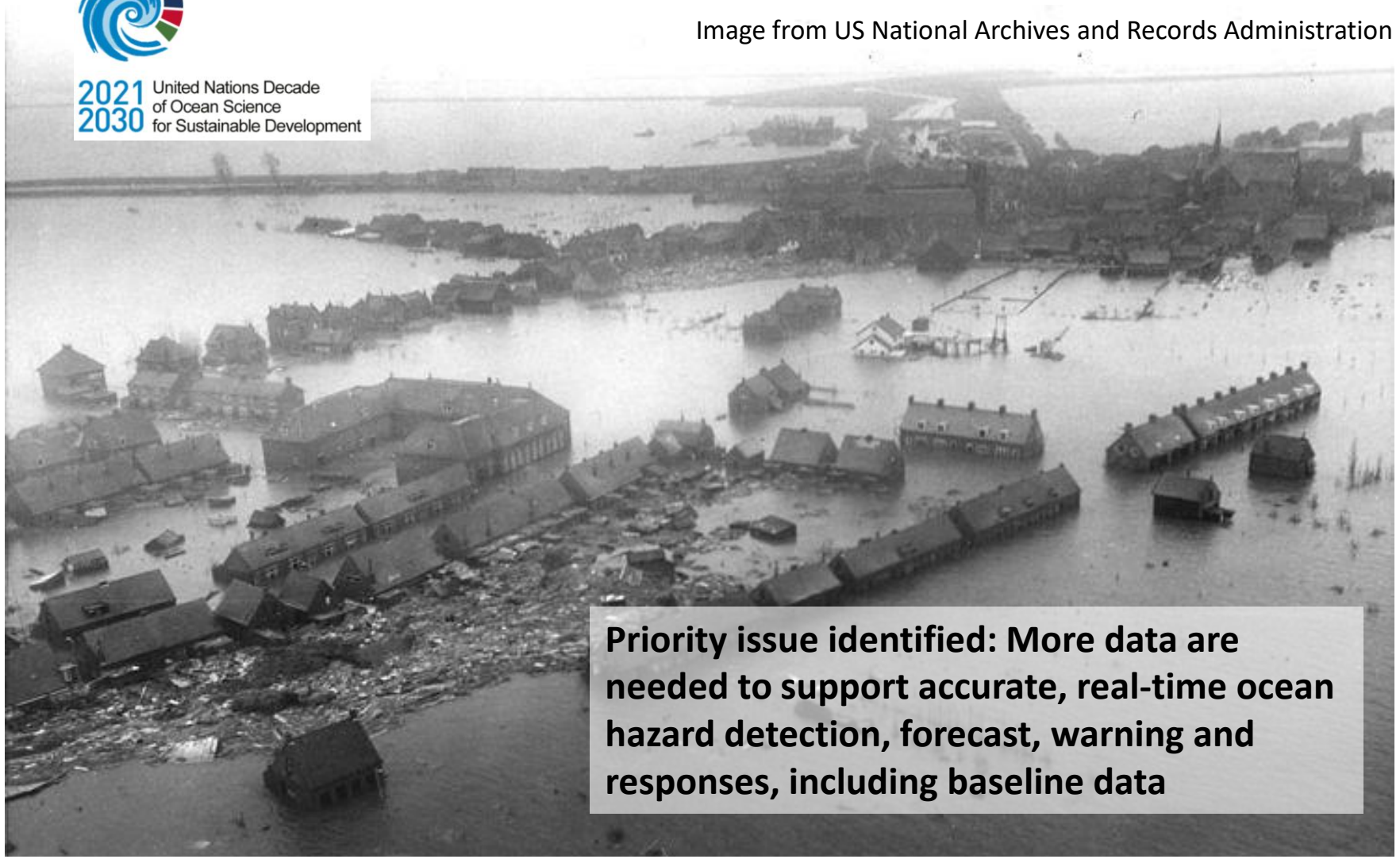
Priority issues

2021 2030 United Nations Decade of Ocean Science for Sustainable Development

Image from US National Archives and Records Administration



Priority issue identified: More data are needed to support accurate, real-time ocean hazard detection, forecast, warning and responses, including baseline data

Summary Report of the First Global Planning Meeting: UN Decade of Ocean Science for Sustainable Development. June 2019, Decade Reports and Documents No.4

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Priority issues

Priority issue identified: Gaining access to a large amount of existing data not currently shared

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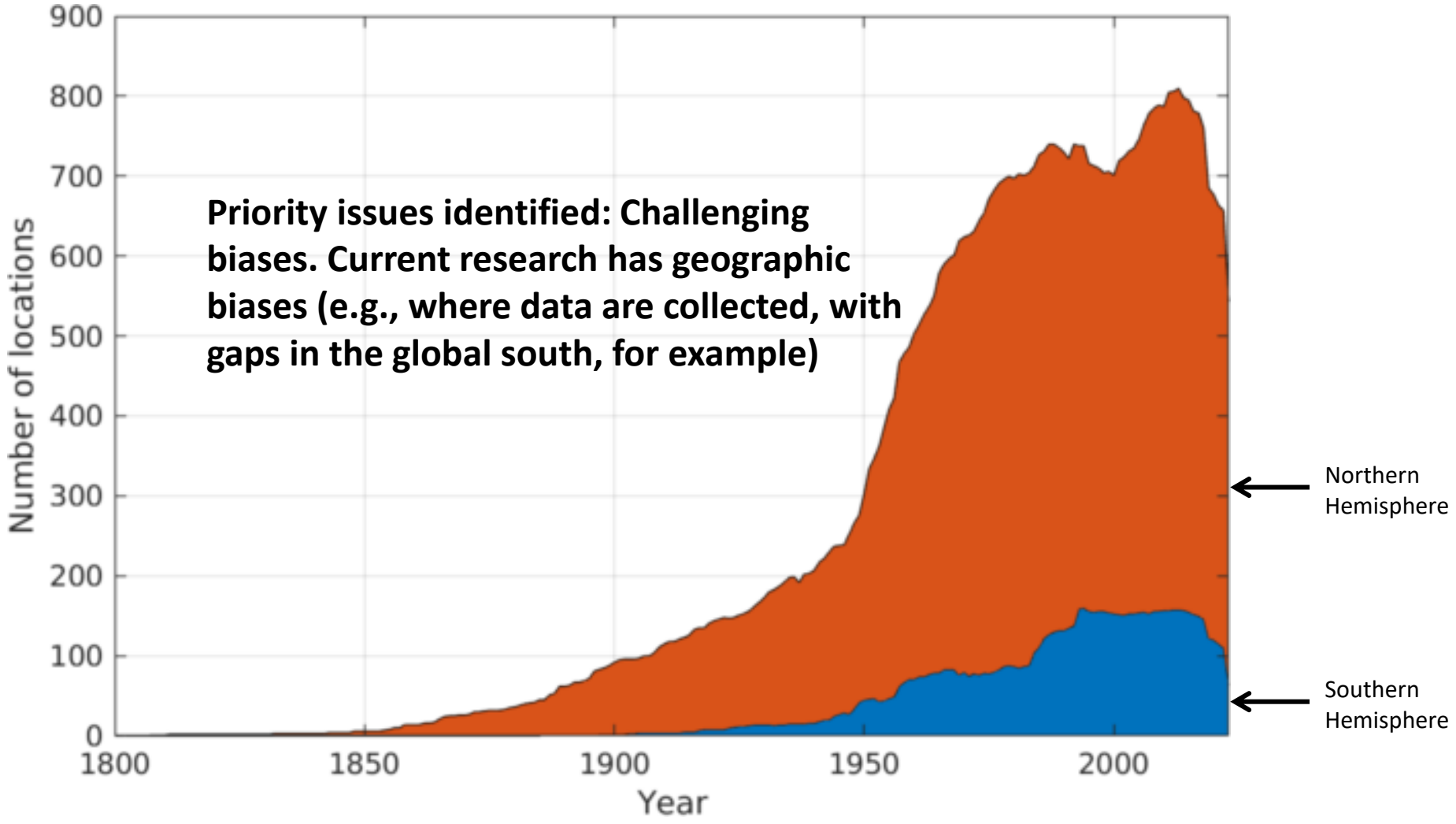
Priority issues

Number of the tide gauge measurements in the global mean sea level database available since 1807



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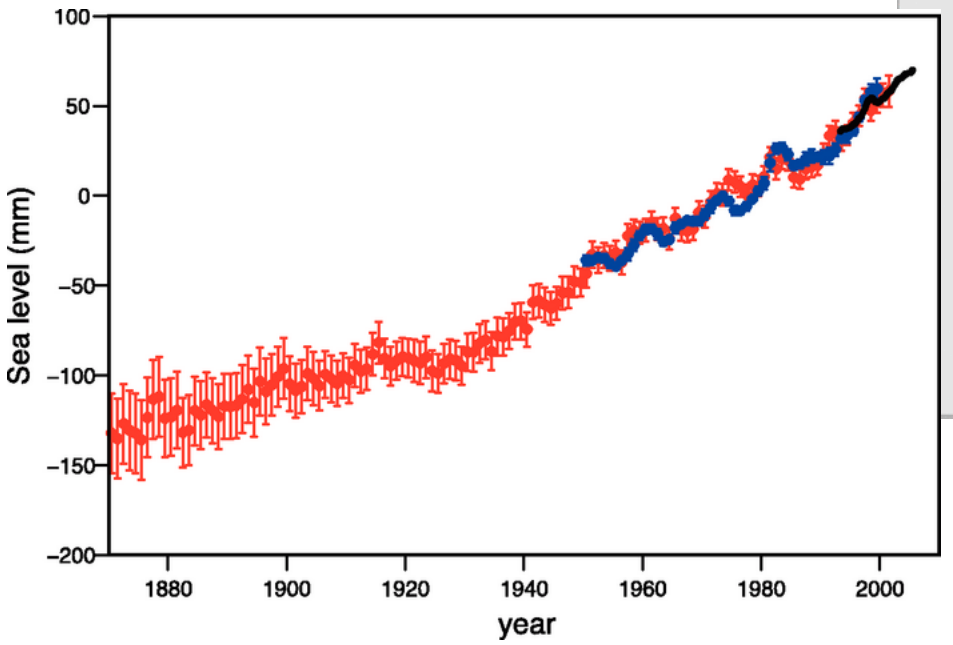
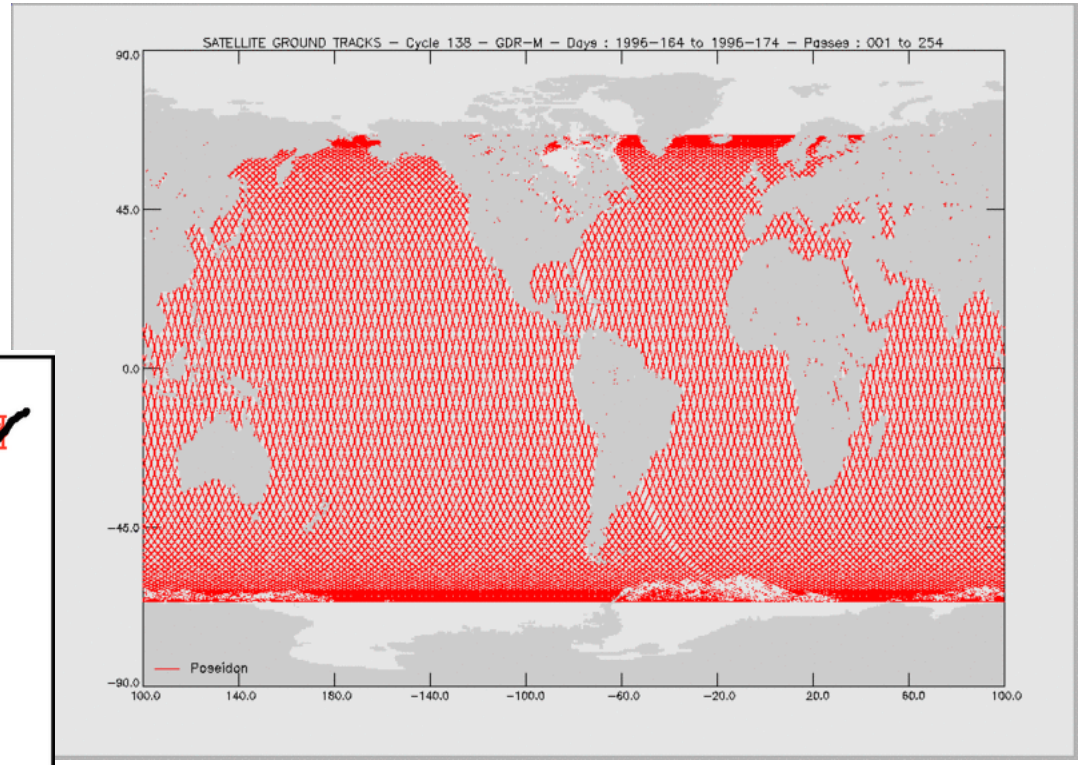
Why In-situ monitoring





https://www.aviso.altimetry.fr/en/missions/past-missions/topex-poseidon/orbits.html ©CNES

Figure 5.13. Annual averages of the global mean sea level (mm). The red curve shows reconstructed sea level fields since 1870 (updated from Church and White, 2006); the blue curve shows coastal tide gauge measurements since 1950 (from Holgate and Woodworth, 2004) and the black curve is based on satellite altimetry (Leuliette et al., 2004). The red and blue curves are deviations from their averages for 1961 to 1990, and the black curve is the deviation from the average of the red curve for the period 1993 to 2001. Error bars show 90% confidence intervals.
In IPCC, 2007: Climate Change 2007: The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change [Solomon, S., D. Qin, M. Manning, Z. Chen, M. Marquis, K.B. Averyt, M. Tignor and H.L. Miller (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, 996 pp.

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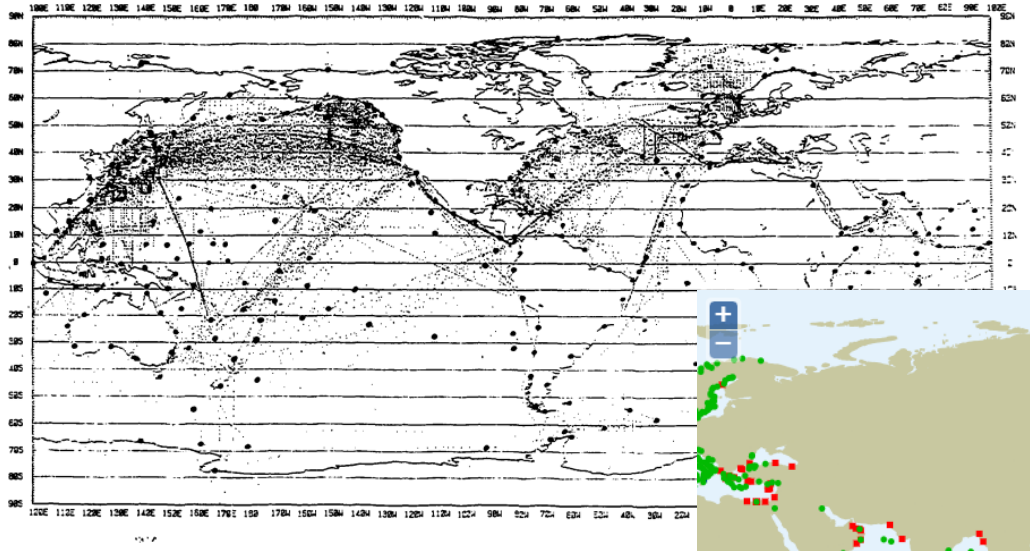
The Global Sea Level Observing System (GLOSS)

United Nations Educational, Scientific and Cultural Organization

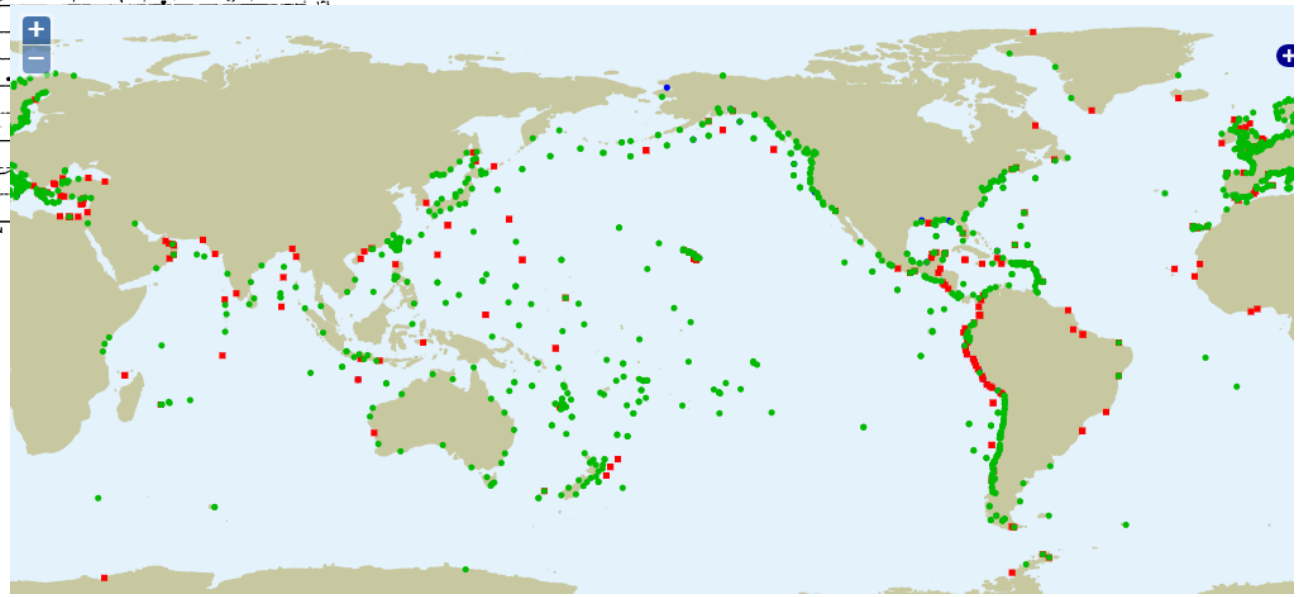
Intergovernmental Oceanographic Commission

"propose a network of some 250 sea level gauges"



Wyrtki, K., & Pugh, D. (1984). Plan for a global sea-level network. Prepared for the 17th Session of the Executive Council of the Intergovernmental Oceanographic Commission, Paris, 31.

1254 stations reporting in near real time



Flanders Marine Institute (VLIZ); Intergovernmental Oceanographic Commission (IOC) (2025): Sea level station monitoring facility. Accessed at https://www.ioc-sealevelmonitoring.org on 2025-05-30 at VLIZ. DOI: 10.14284/482

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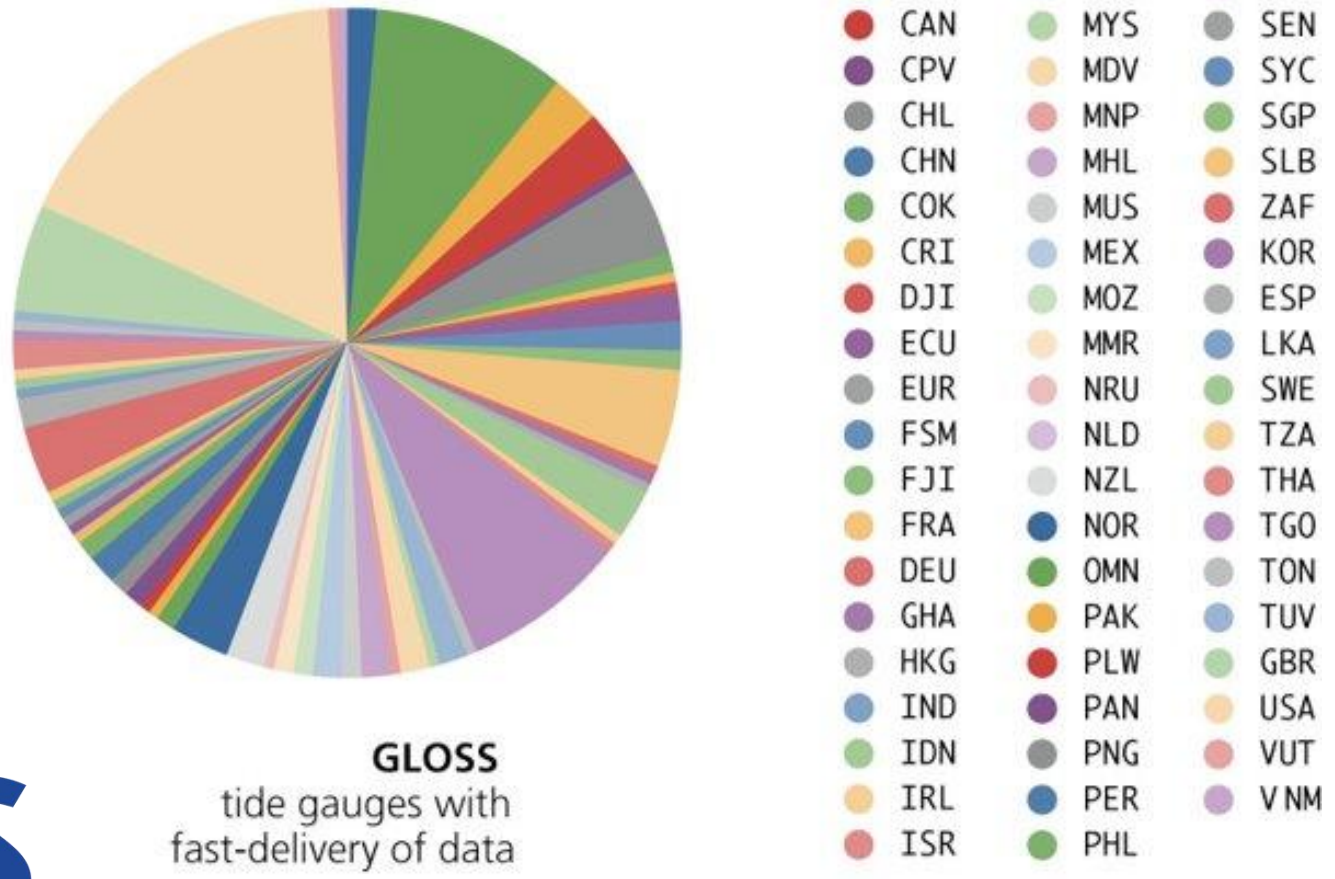
The Global Sea Level Observing System (GLOSS)

Image adapted from one by Albert Fischer,
Head of Ocean Observation and Services, IOC



Global Ocean Observing System

Countries operating gauges transmitting fast delivery of data

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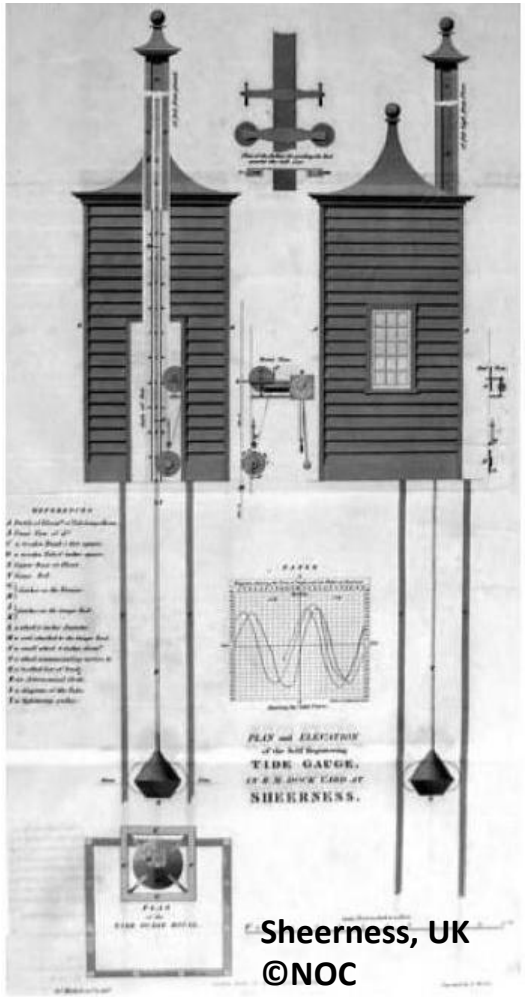
Mechanical tide gauges



Sheerness, UK
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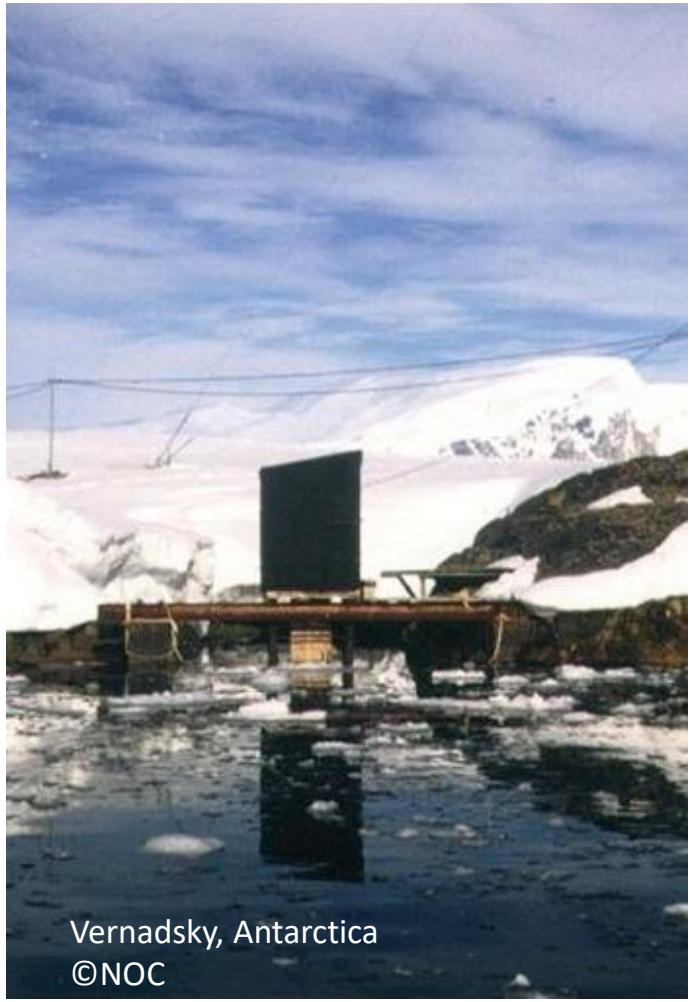
Cape Town, South Africa
Harvey Barrison, CC BY-SA 2.0



Vernadsky, Antarctica
©NOC

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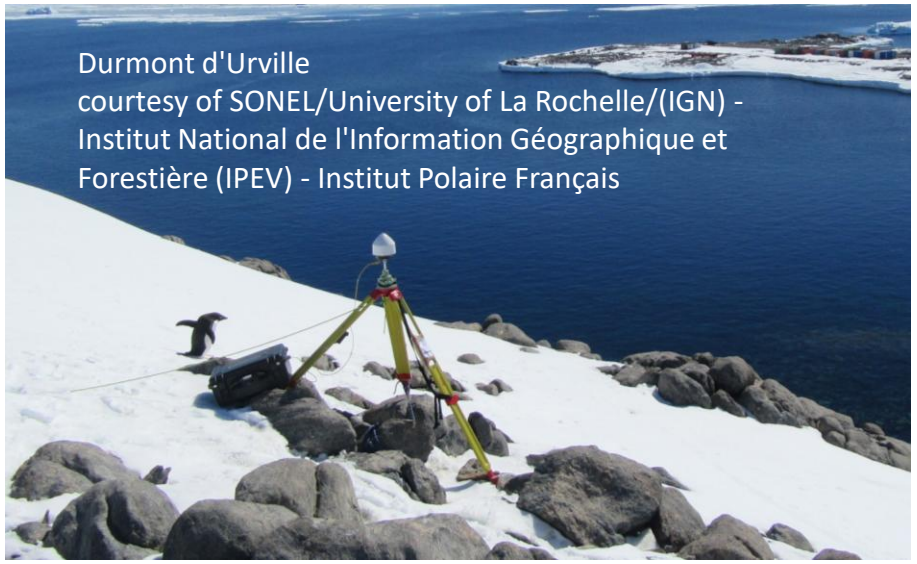
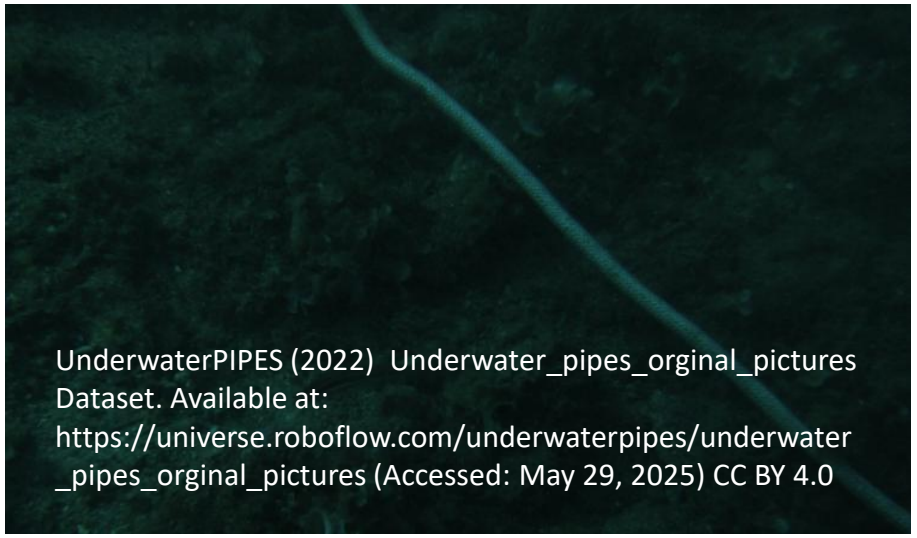
Latest sensor technology


Radar gauge, Dominica ©NOC


Durmont d'Urville
courtesy of SONEL/University of La Rochelle/(IGN) - Institut National de l'Information Géographique et Forestière (IPEV) - Institut Polaire Français


UnderwaterPIPES (2022) Underwater_pipes_orginal_pictures Dataset. Available at: https://universe.roboflow.com/underwaterpipes/underwater_pipes_orginal_pictures (Accessed: May 29, 2025) CC BY 4.0

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Upcoming challenges

- We're going to get more data and we need help to quality control it
- We need to ensure value for money when installing and operating in-situ instruments and we need to make sure we're putting the most suitable sensors in critical locations
- We need complimentary observations, such as monitoring the movement of the land, the weather, and other ocean parameters to help us understand the in-situ sea level measurements we make
- Just because we've been observing sea level for a long time, doesn't mean we've "solved" it. We need to carry on monitoring it and improve how we do so.

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Thank you

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