2025 Forum for Operational Oceanography | Fremantle

Southern Ocean Sea Level Monitoring Network

Project AAS4626 Investigators

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Building a Resilient Sea Level Monitoring Network

in the Australian Antarctic Territories of the Southern Ocean

Australian Government

AUSTRALIAN ANTARCTIC PROGRAM

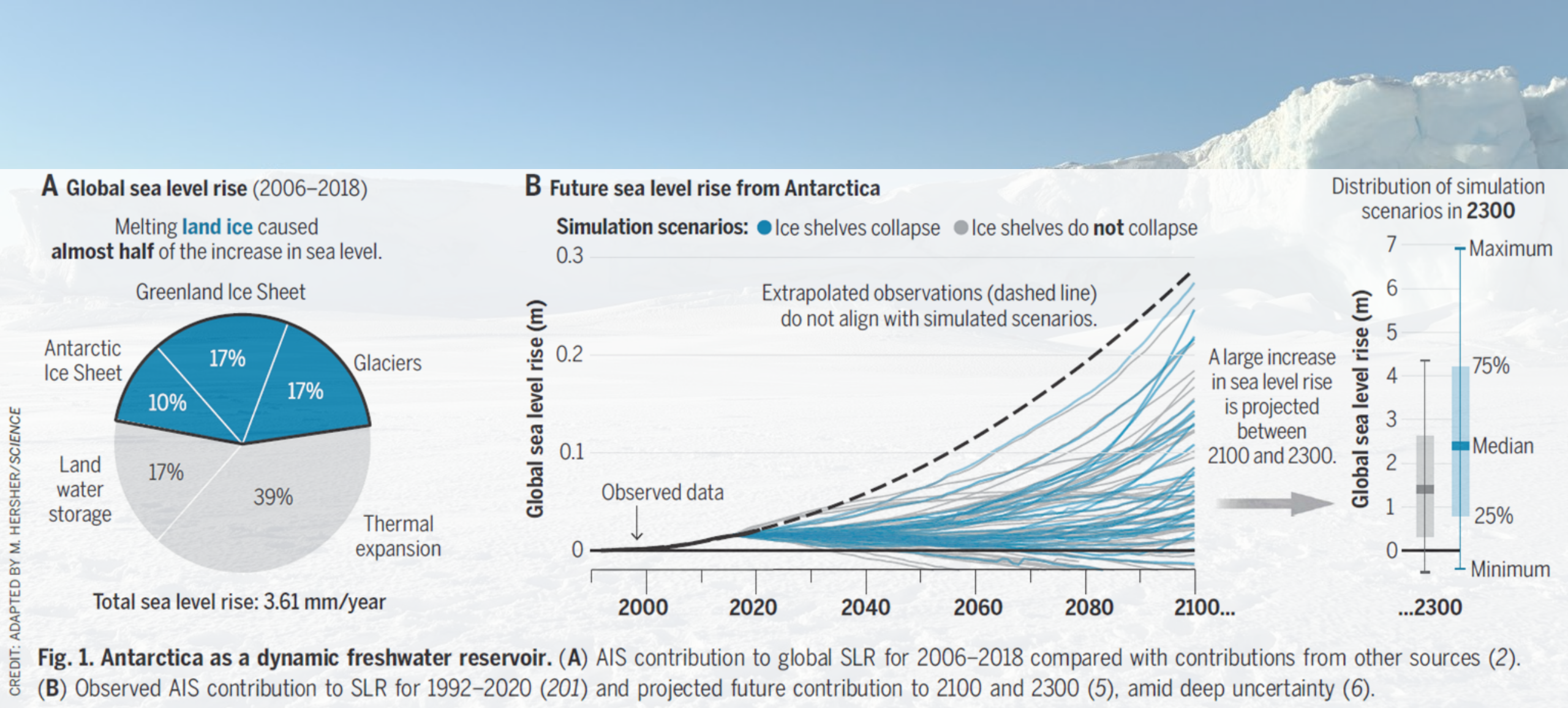

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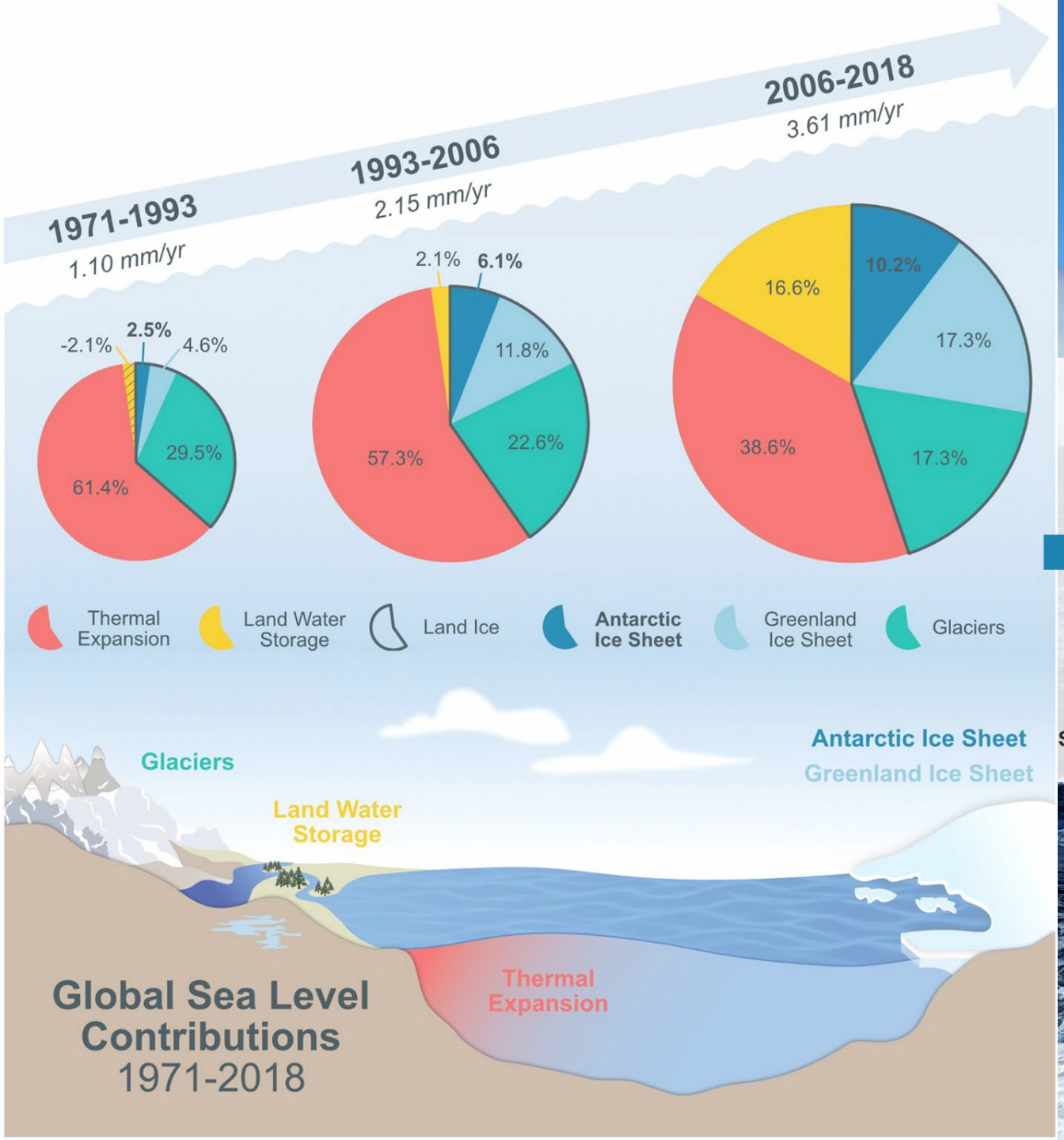
Fig. 1. Antarctica as a dynamic freshwater reservoir. (**A**) AIS contribution to global SLR for 2006–2018 compared with contributions from other sources (*2*). (**B**) Observed AIS contribution to SLR for 1992–2020 (*201*) and projected future contribution to 2100 and 2300 (*5*), amid deep uncertainty (*6*).

Source: Fricker et al., 2025. Antarctica in 2025: Drivers of deep uncertainty in projected ice loss. *Science 387*



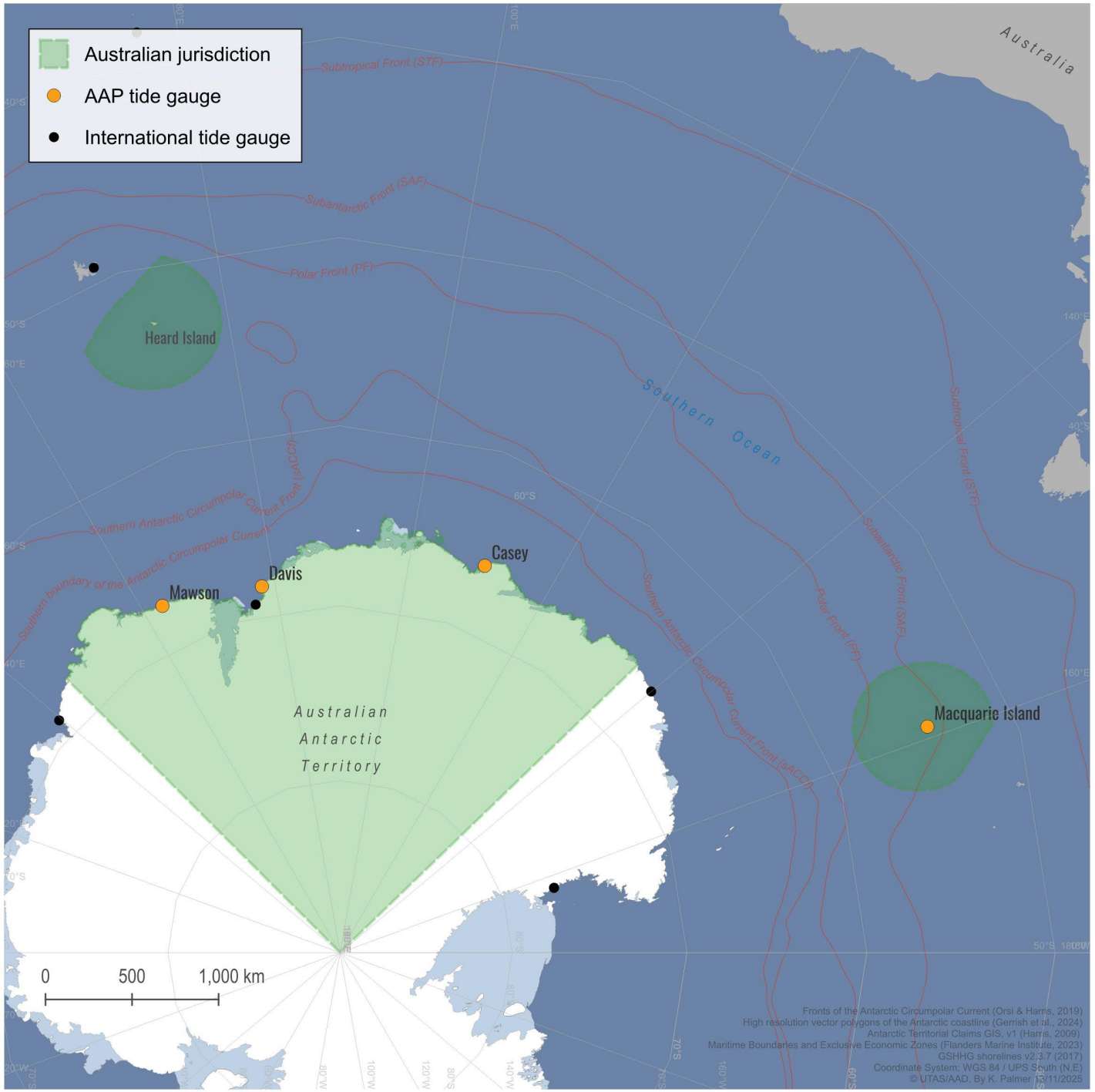
Sea level data are vital for

- **Research into sea level change and ocean circulation**
- **Coastal protection during events such as storm surges**
- **Providing flood warning and monitoring tsunamis**
- **Tide tables for port operations, fishermen, and recreation**
- **Defining datums for national or state boundaries**

Sea level is one of the most useful oceanographic variables, used for a wide variety of scientific, economic and social purposes.

https://gloss-sealevel.org/

Source: Fricker et al., 2025. Earth at 1.5 degrees warming: How vulnerable is Antarctica? *Dialogues on Climate Change* **2025**



Building a Resilient Sea Level Monitoring Network

in the Australian Antarctic Territories of the Southern Ocean

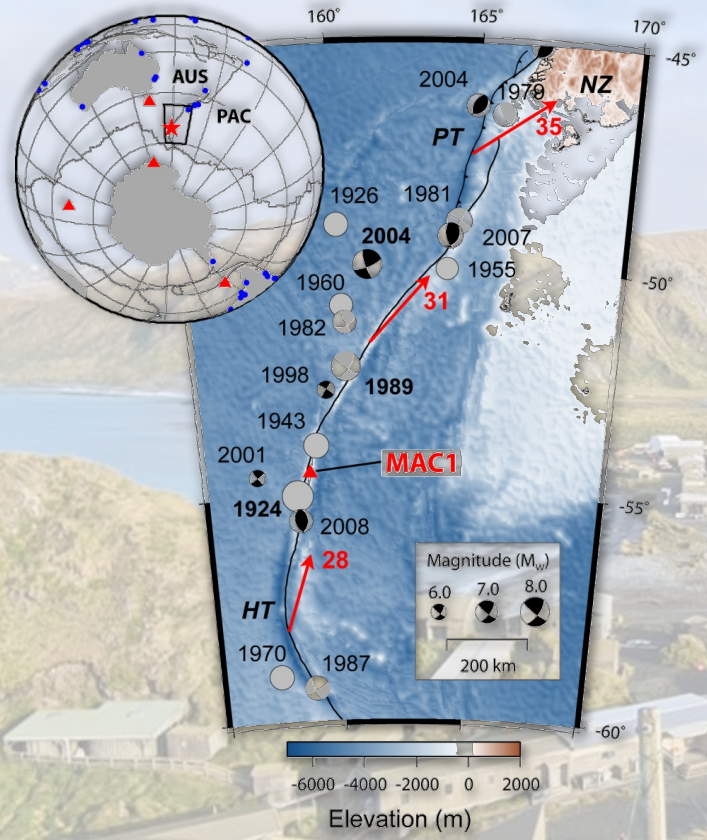
- Challenges & gaps
- Achievements
- Implementation strategy

Macquarie Island

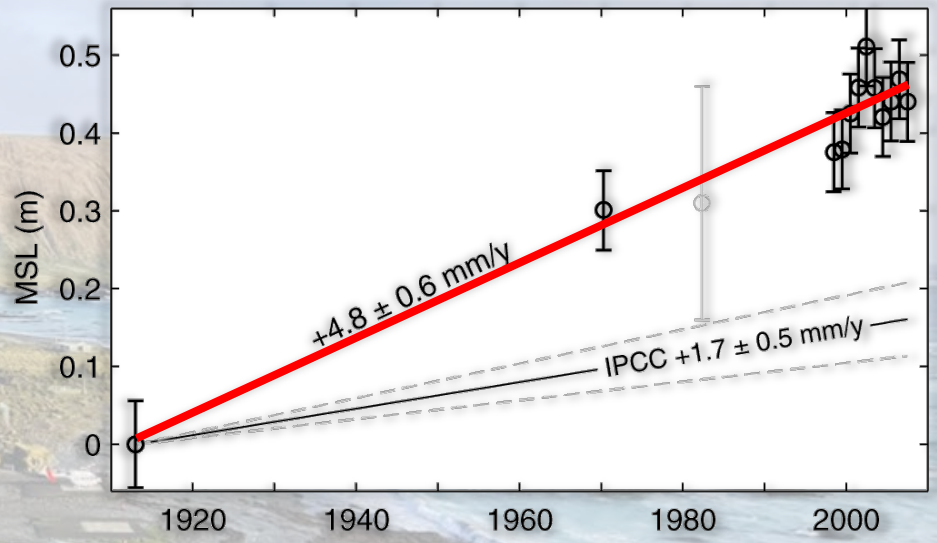
Garden Cove: Site of 1993-present tide gauge

Macquarie Island

Records since 1912



Relative Sea Level Rise, Macquarie Island (Indicative of land subsidence)



Source: Watson et al., 2010. Twentieth century constraints on sea level change and earthquake deformation at Macquarie Island. *Geophysical Journal International*

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Davis Station, Antarctica

Site of 1993-present tide gauge

Bottom mounted pressure sensor

Photo by James Newlands

Drilling through the sea ice

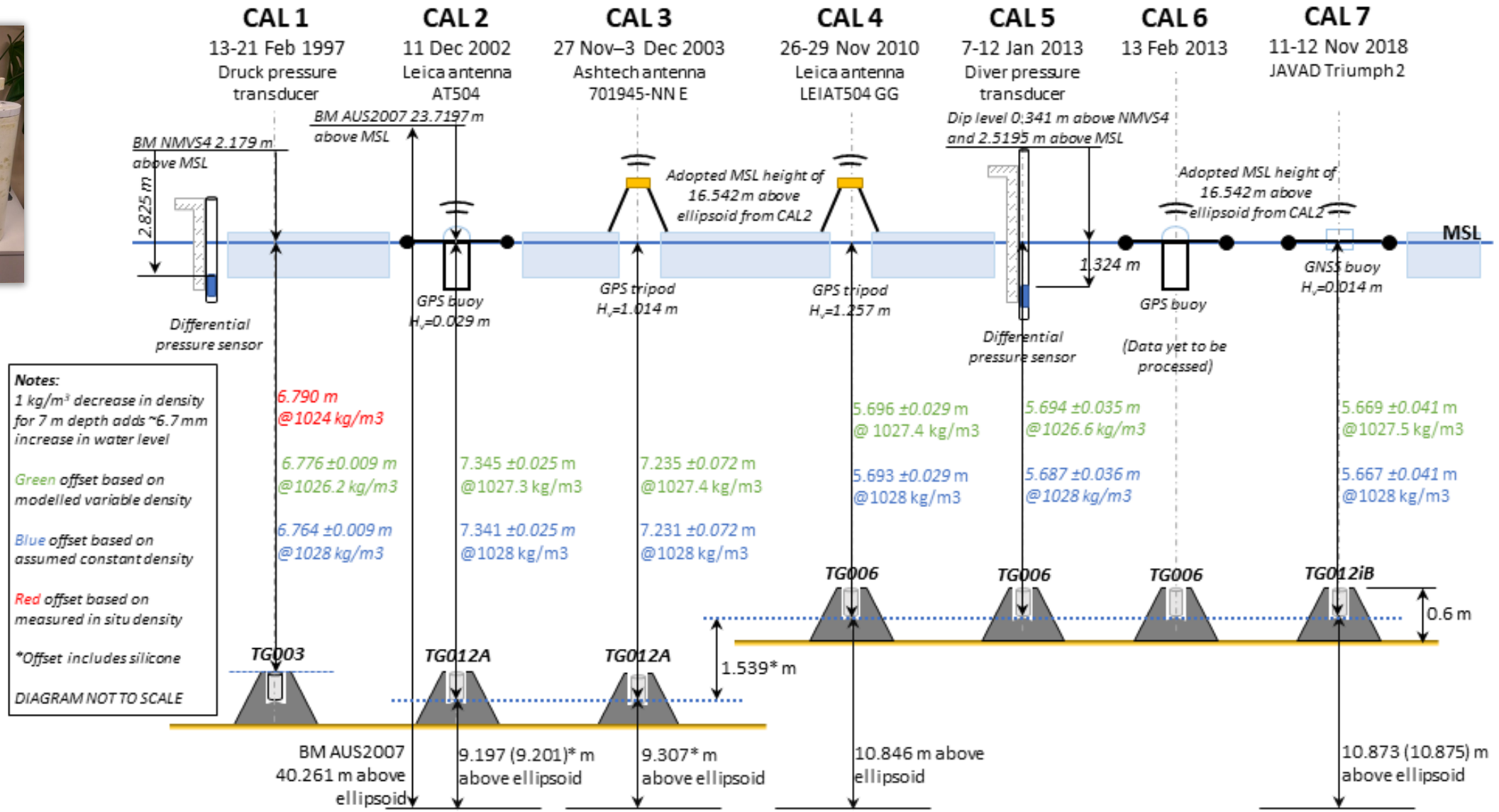
Photo by John French

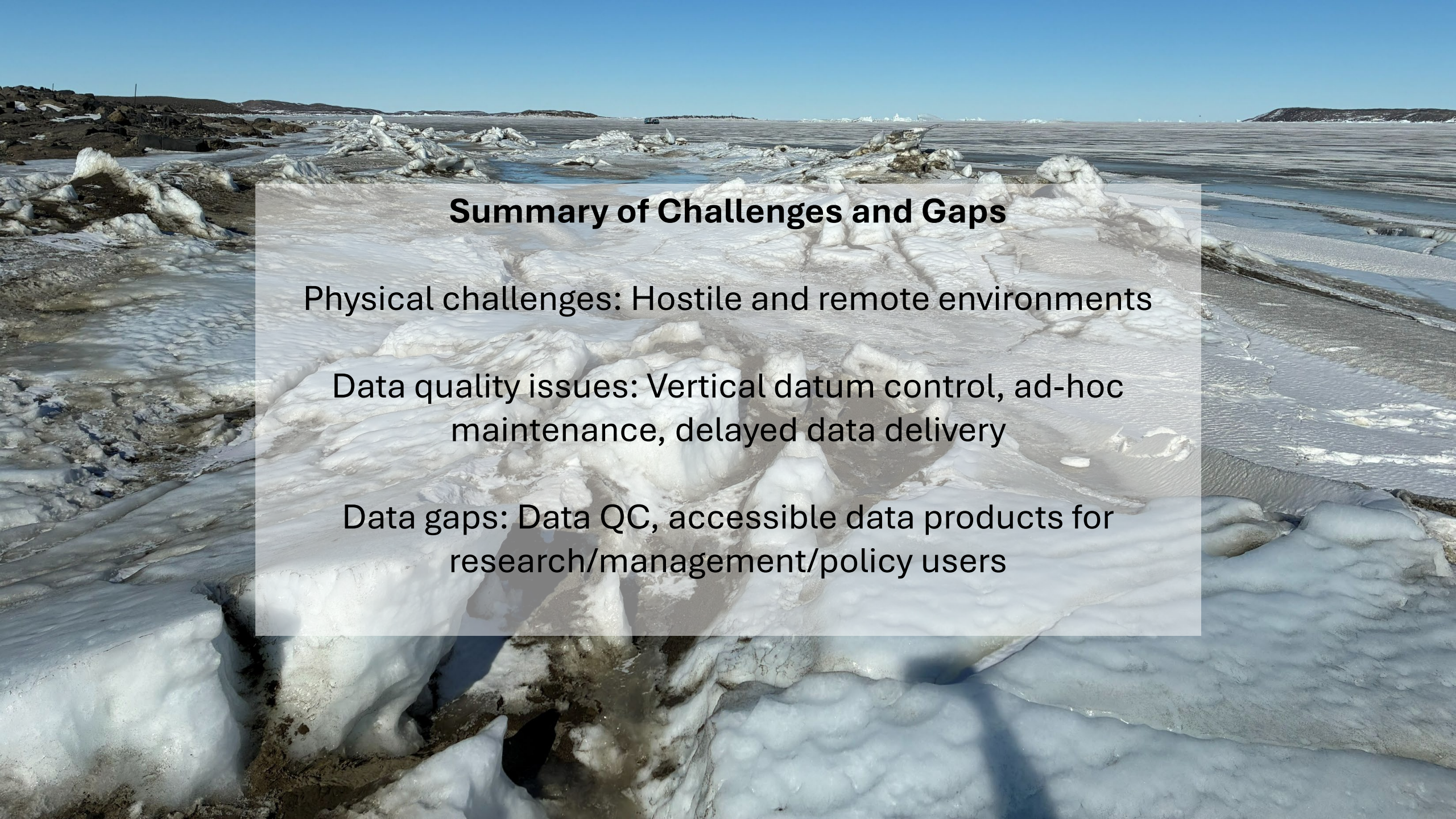
GNSS buoy calibration

Photo by Sarah Thompson

Davis Station, Antarctica

Discontinuity in vertical datum control





Summary of Challenges and Gaps

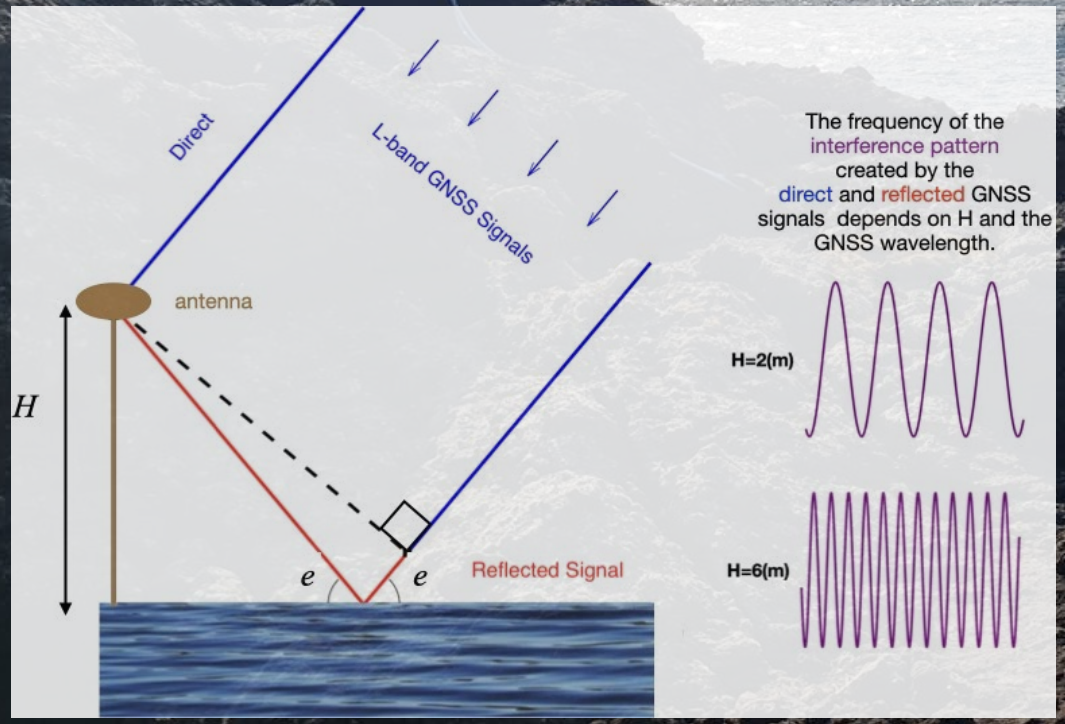
Physical challenges: Hostile and remote environments

Data quality issues: Vertical datum control, ad-hoc maintenance, delayed data delivery

Data gaps: Data QC, accessible data products for research/management/policy users

Heard Island Station

Sea level observation via GNSS-IR
(GNSS Interferometric Reflectometry)
Installed 19 October 2025



Geometry of a reflected multipath GNSS signal

https://ihr.iho.int/articles/water-level-measurements-using-reflected-gnss-signals/
Kristine Larson & Simon Williams (2023)

Station:
Latitude: -52.975327
Longitude: 73.320597
Ellipsoidal Height(m): 57.403
Reflection Ht. (m) : 17.413
Elevation Angles (deg) : 5,10,15
Azimuth Angles (deg) : -75 to 135
Constellation : GPS
Frequency: L2

Heard Island Station

Sea surface elevation
Vertical land motion
Weather observations
Photo / video

5°
10°
15°

GNSS-IR Reflection Zone Mapping
https://gnss-reflections.org/rzones, version 2.0, 25/10/2025

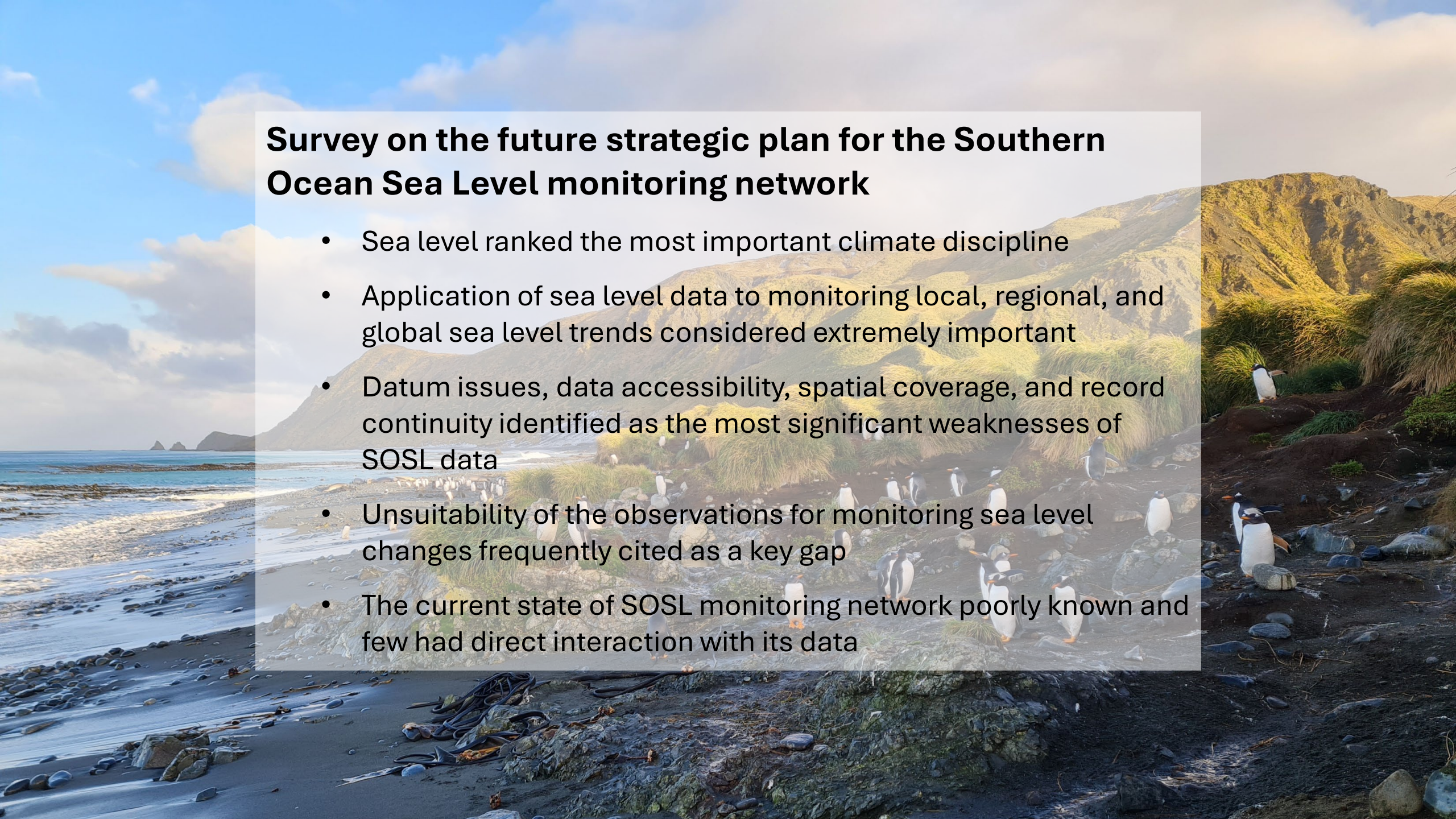

07:07 07-11-2025 (UTC+5) Magnet Point, Heard Island

Summary of Achievements

Tide gauges at all four AAP stations since 1993: Platypus pressure gauge, wharf pressure gauge, borehole gauge

Collaboration with Federal and International agencies: BOM, GA, AHO, France, UK, NZ, Canada

Technological advances: GNSS-IR at Heard Island (Macquarie Island, Davis)



Survey on the future strategic plan for the Southern Ocean Sea Level monitoring network

- Sea level ranked the most important climate discipline
- Application of sea level data to monitoring local, regional, and global sea level trends considered extremely important
- Datum issues, data accessibility, spatial coverage, and record continuity identified as the most significant weaknesses of SOSL data
- Unsuitability of the observations for monitoring sea level changes frequently cited as a key gap
- The current state of SOSL monitoring network poorly known and few had direct interaction with its data

Southern Ocean Sea Level 2025 Stakeholder Workshop

Two themes:

1) Current state of the network and technical requirements
2) Intra and inter organisational roles in making SOSL data accessible and useable for diverse user needs

- 5 invited speakers
- 2 panel discussions
- 2 workshop discussions

Follow-up Actions

- Distribute workshop report
- 2-page summary of SOSL in the context of the Australian Antarctic Science Decadal Strategy 2025-35
- Summarise Australia’s existing international obligations to sea level monitoring in the Southern Ocean region
- Revise the MOU between AAD and BOM
- Explore the creation of an MOU between AAD and GA
- Co-author a white paper (or similar)

Southern Ocean Sea Level Monitoring Network

Australian Antarctic Science Project AAS4626

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Australian Government

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Magnet Point, Heard Island
Photo by Christopher Mooney