IMOS Integrated Marine Observing System

The Ship of Opportunity Program: eXpendable BathyThermographs (SOOP-XBT)

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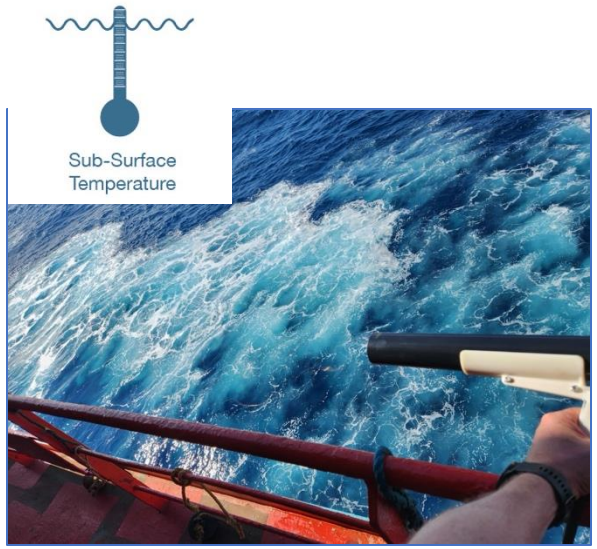
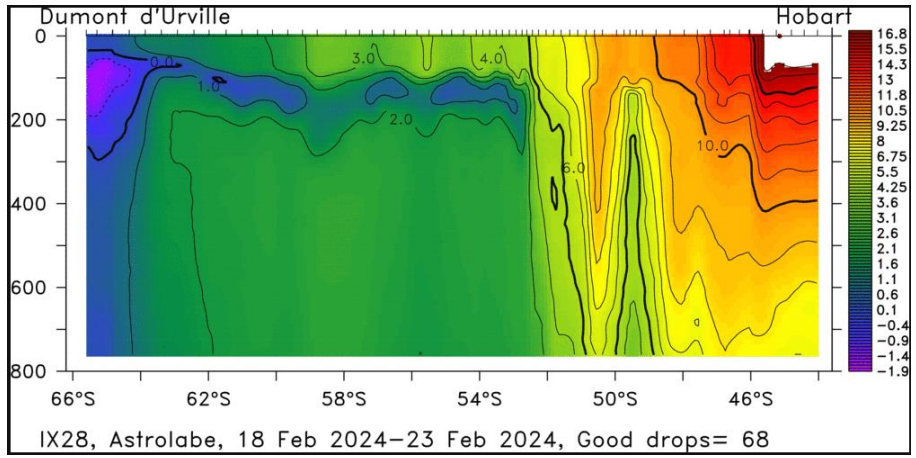
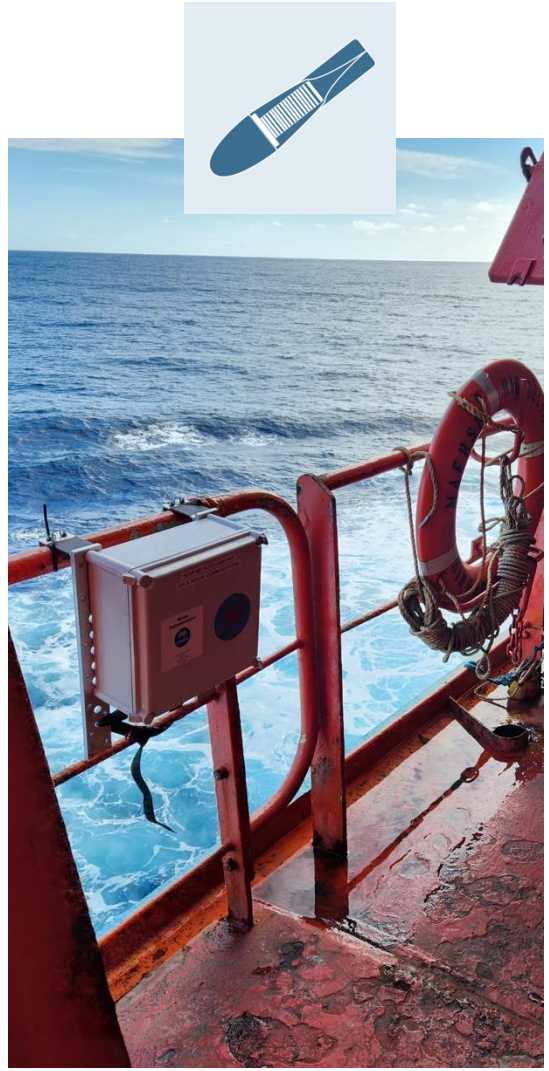
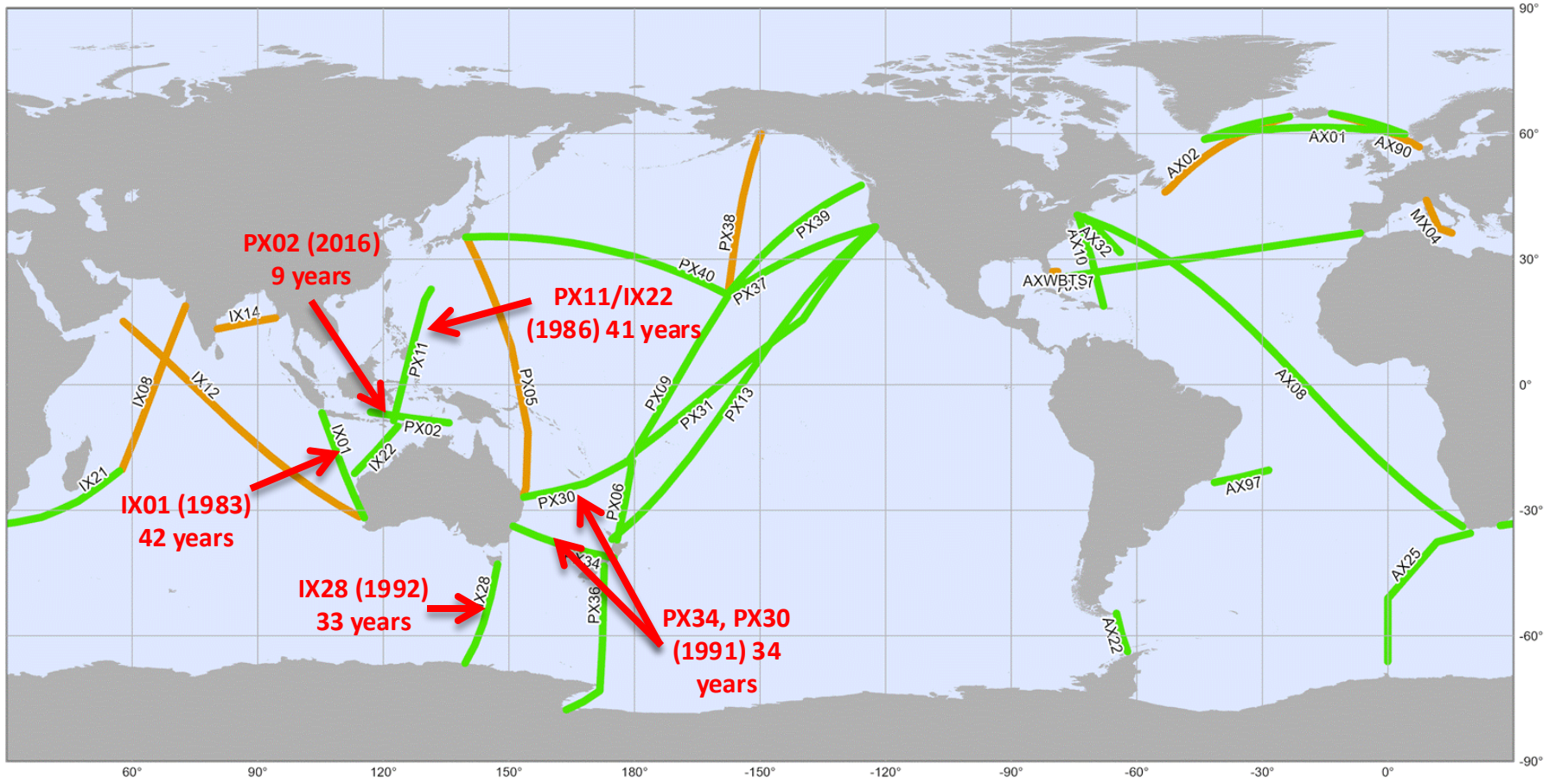






IMOS acknowledges the Traditional Custodians and Elders of the land and sea on which we work and observe, and recognise them as Australia's first marine scientists and carers of Sea Country. We pay our respects to Aboriginal and Torres Strait Islander peoples past and present.

The Global XBT network



Ship Observations Team

SOOP-XBT Network Status

February 2025

Active SOOP-XBT line

SOOP line not funded or no ships

Generated by www.ocean-ops.org, 2025-02-10
Projection: Plate Carree (-150,0000)

IMOS Integrated **Marine Observing** System

International contributors

Australia:

- CSIRO
- Bureau of Meteorology
- Defence Australia

USA:

- Atlantic Oceanographic and Meteorological Laboratory - NOAA
- Scripps Institution of Oceanography
- Woods Hole Oceanographic Institution
- National Marine Fisheries Service – NOAA
- University of Rhode Island
- Stony Brook University

South Africa:

- University of Cape Town
- Department of Environmental Affairs

New Zealand:

- National Institute of Water and Atmospheric Research

Italy:

- National Agency for new Technologies, Energy and Sustainable Economic Development

France:

- Institute of Research for Development
- IFREMER
- IPEV - LEGOS

Brazil:

- Federal University of Rio Grande

Japan:

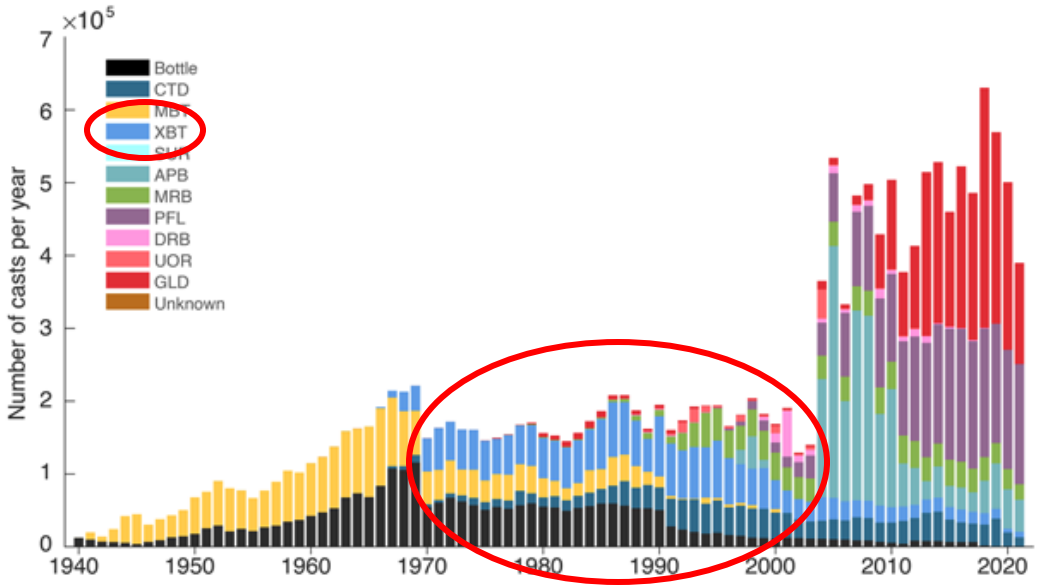
- Japan Meteorological Agency

India:

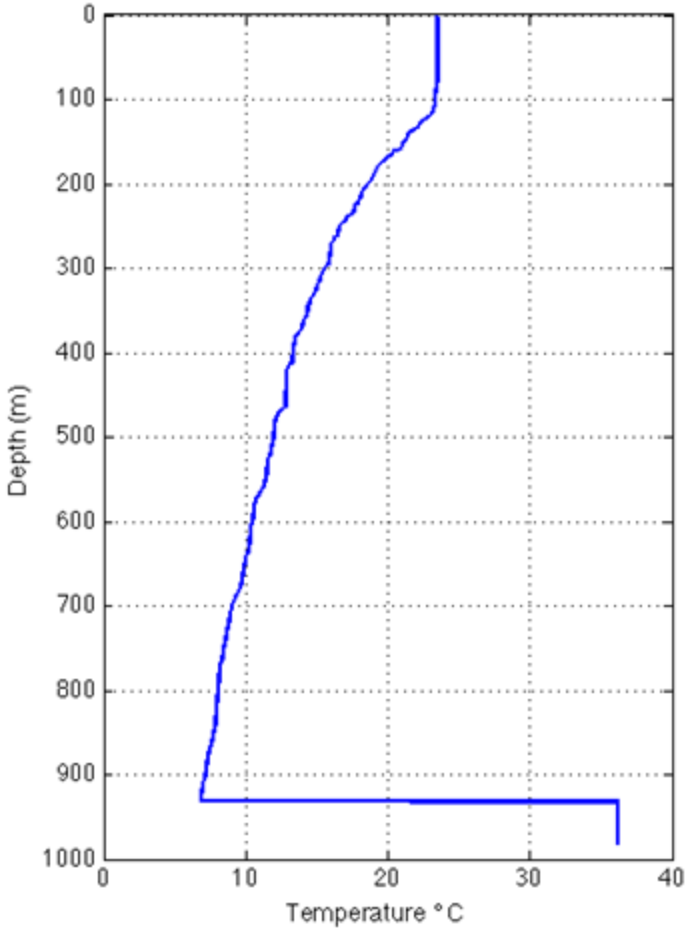
- National Institute of Oceanography

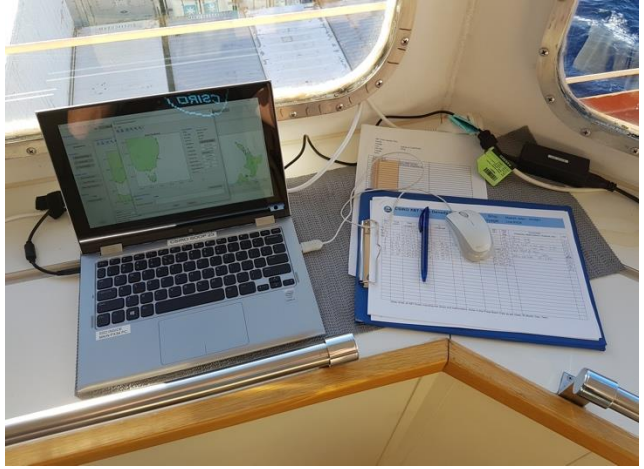
What are XBTs?

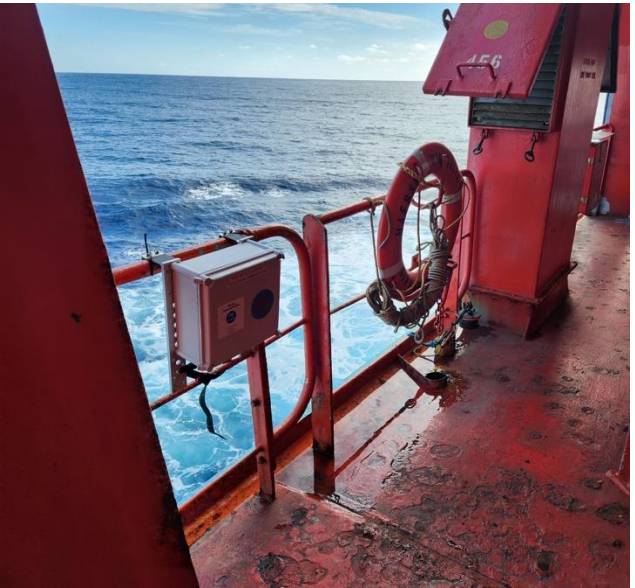
- XBTs (expendable bathythermographs) record temperature to ~200-1800m
- Various probe types for depth/ship speed
- Two major manufacturers – Sippican (USA), TSK (Japan)
- XBT data largest source of upper ocean temperature data, 1970-2000

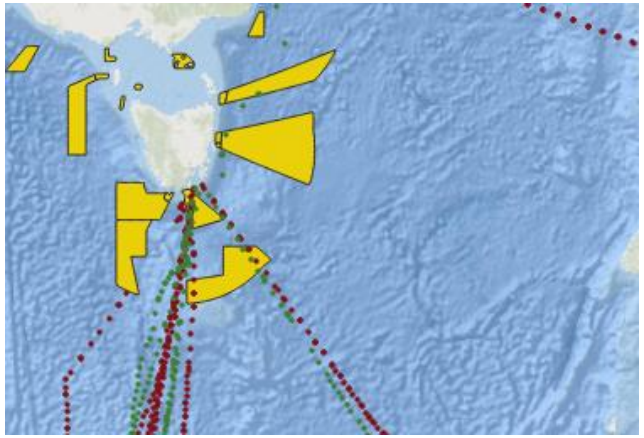


Tan et al, https://doi.org/10.1016/j.dsr.2022.103961.









The XBT system on a SOOP ship

- PC
- Communications (Iridium)
- Location (GPS)
- Recorder (Turo Quoll)
- Hand Launcher
- Probes (16kg per box of 12)

Data Distribution

All data collected is:

- Findable
- openly Accessible
- Interoperable
- Reusable

Quickly and widely distributed.

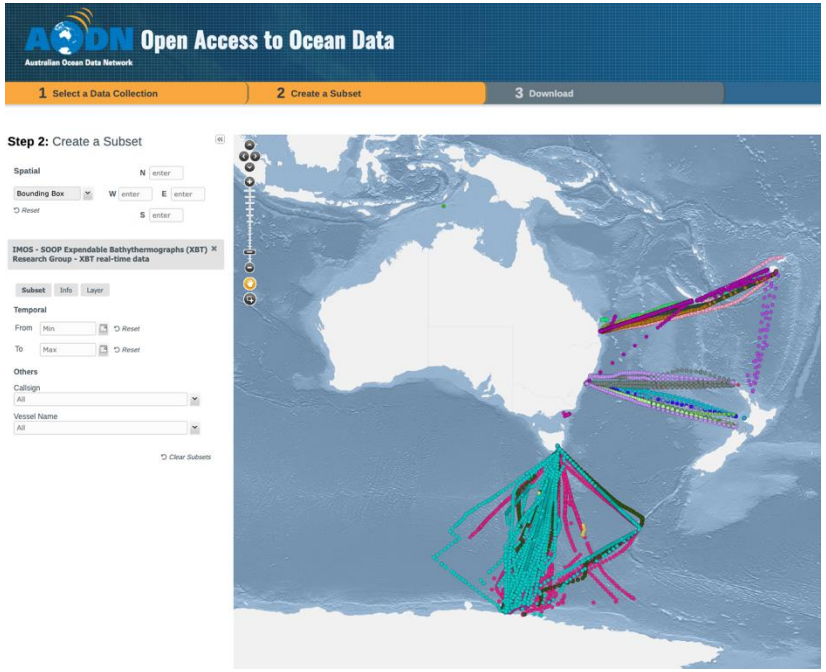
Real Time data relayed through GTS for weather prediction models

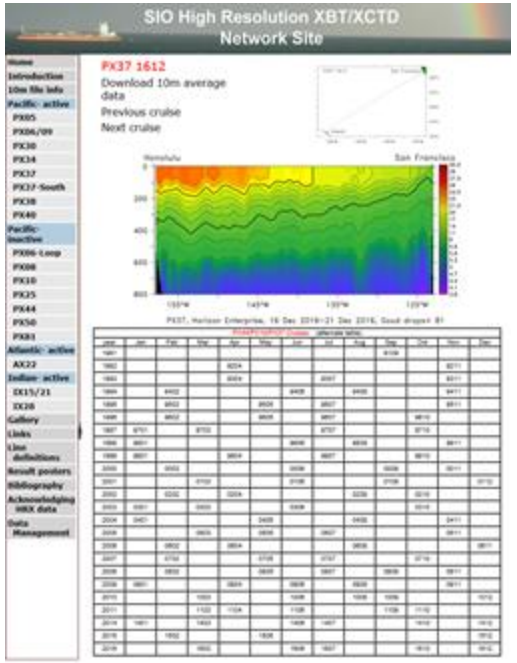
Delayed Mode data:
Transect Mode:
http://www.aoml.noaa.gov/phod/hdenxbt
http://www-hrx.ucsd.edu/

Individual Profiles:
http://www.iquod.org/
https://www.ncei.noaa.gov/
http://www.coriolis.eu.org/
https://portal.aodn.org.au/

Science Products:
http://www.aoml.noaa.gov/phod/goos/xbtscience/

NOAA NATIONAL CENTERS FOR ENVIRONMENTAL INFORMATION
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION





AODN Open Access to Ocean Data
Australian Ocean Data Network

IQOD International Quality controlled Ocean Database
Home | About us | News | Products | Documents and Progress reports | Contact Us | Links | Member

IMOS Integrated Marine Observing System

Strengths of the XBT Network

Operations are driven by scientific questions for education (PhD students) and research goals:

1. Maintain **repeat surface and subsurface temperature profile observations along fixed transects** across strong boundary currents, providing data not reproduced by other observational platform

2. **Measurements of geostrophic ocean currents in** Western Boundary Currents, equatorial zonal current systems, ACC; **Meridional Heat Transport, and global ocean heat content** estimates that contribute to improve climatological records

3. The XBT SOOP network is a key **contributor to the historical temperature profile record**, with many transects providing data for longer than 20, 30 or even 40 years

4. Can be implemented and maintained in a cost-effective fashion together with partners and collaborators

5. XBT ships can collect additional ocean (e.g. ADCP, pCO2) and atmospheric (e.g. meteorological) data to create key interdisciplinary records. Ships also provide a platform for deployment of other observational instrumentations (e.g. drifters, floats)

SURVOSTRAL Project IX28 :
34 years of Southern Ocean upper ocean monitoring

SURVOSTRAL – Observations from the French Antarctic resupply ship - l'Astrolabe

P. Bretel

Logistics :

6-10 seasonal transects per year :

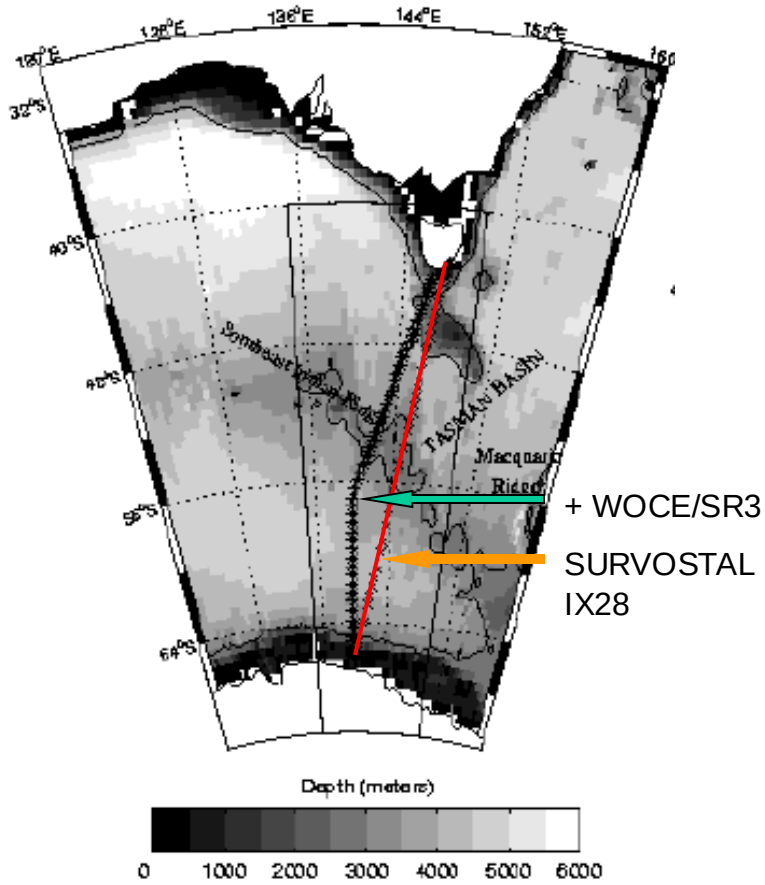
Oct to Mar since 1992. **New ship > 2017**

Observations :

Temperature Profiles (XBTs) (0-800 m) 6 sections /yr with onboard volunteers

Underway surface salinity (TSG): 10 sections /yr

pCO2 science van



Partners SURVOSTRAL : **FRANCE :** LEGOS – IPEV; **AUSTRALIA :** CSIRO; **US :** SCRIPPS/NOAA.

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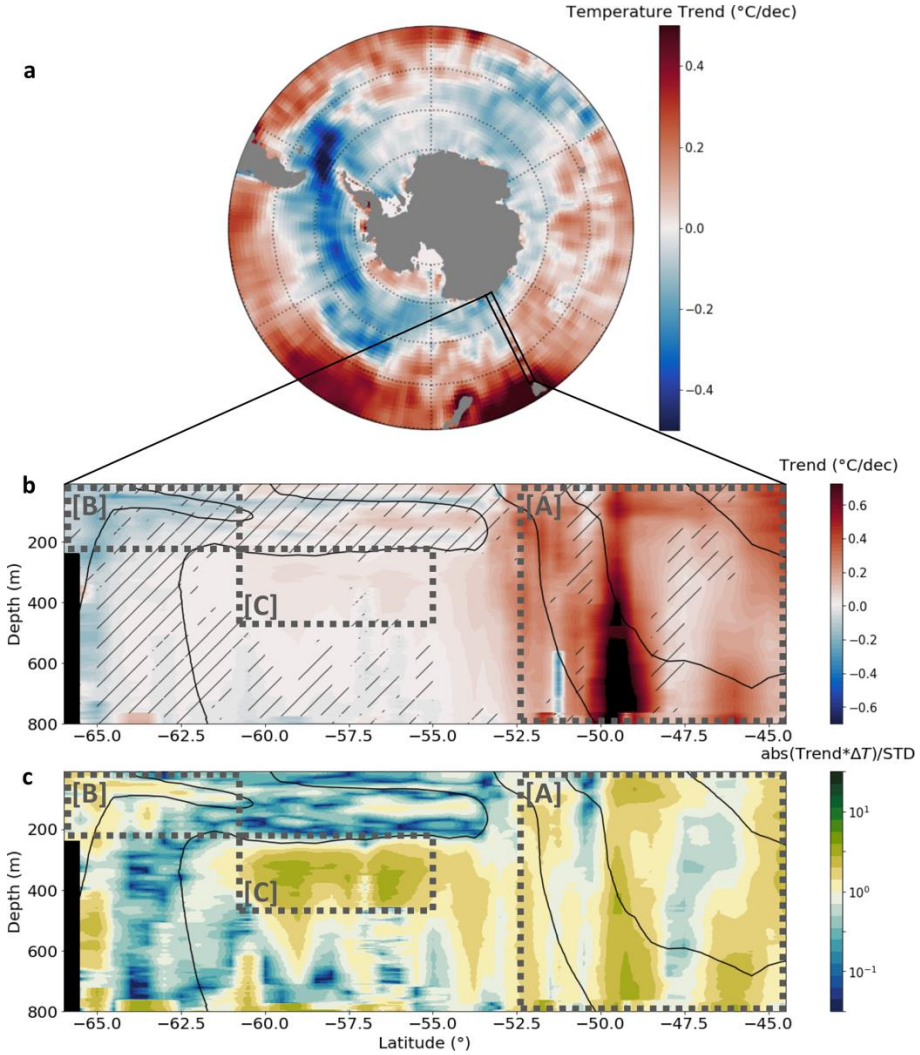
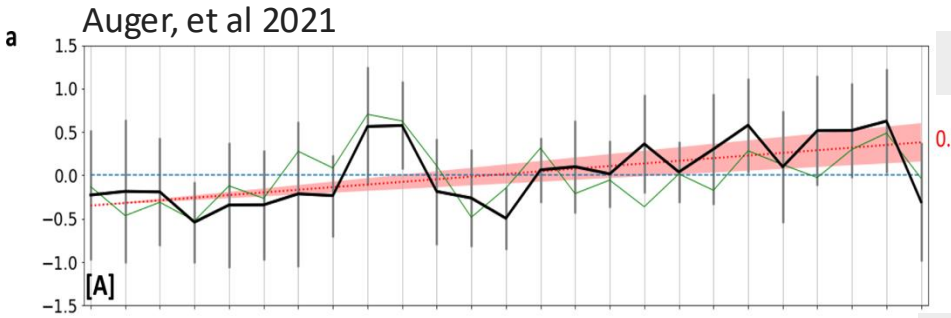
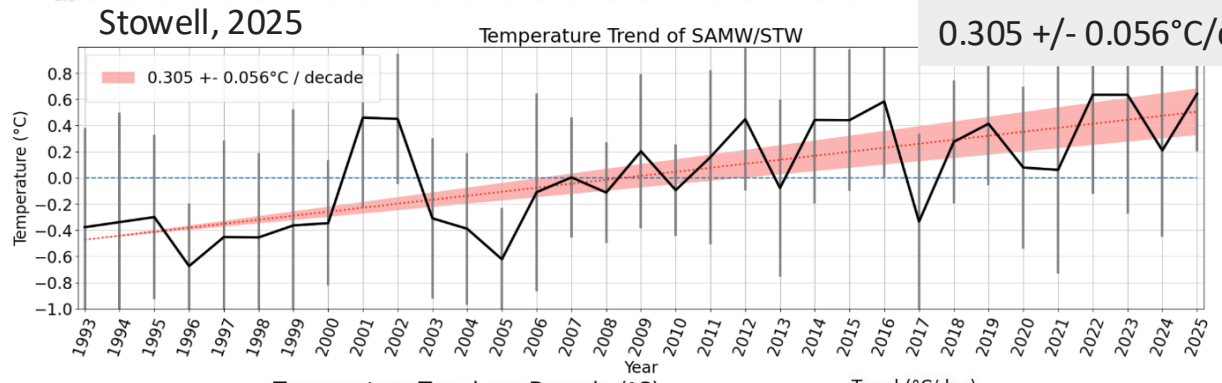
Warming in the Southern Ocean



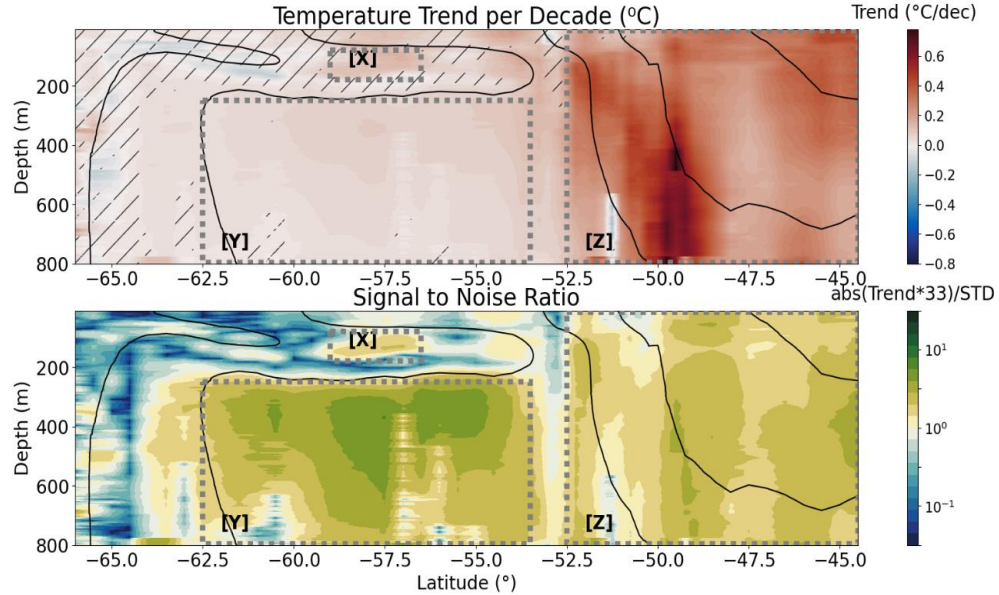
Auger, M., Morrow, R., Kestenare, E. *et al.* Southern Ocean in-situ temperature trends over 25 years emerge from interannual variability. *Nat Commun* **12**, 514 (2021). https://doi.org/10.1038/s41467-020-20781-1



0.29 +/- 0.09°C/decade



0.305 +/- 0.056°C/decade



New Observations of Southern Ocean Temperature Trends

Scientific Research Project, Olivia Stowell

Supervisors: Edward Doddridge and Matthis Auger

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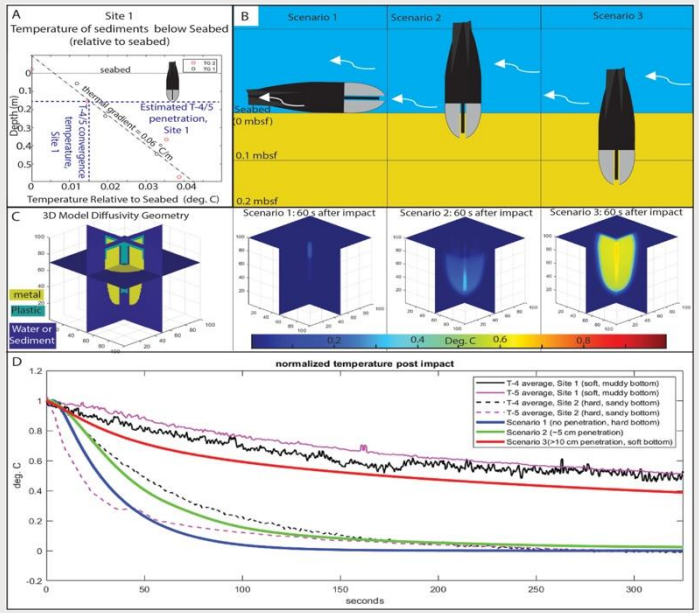
Recent XBT Science and decadal dataset publications

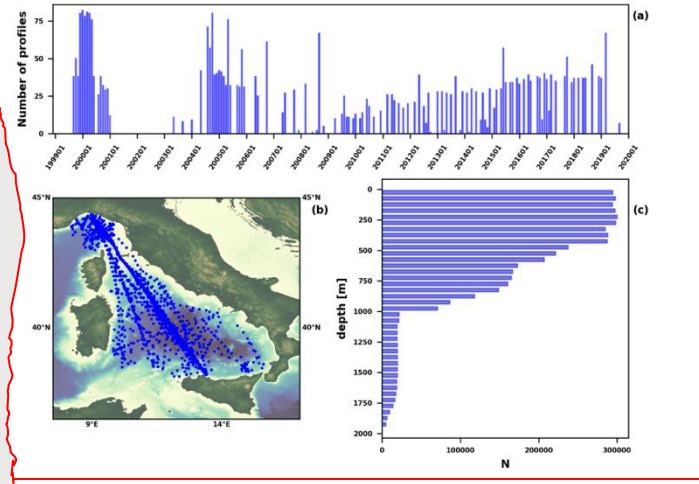


Hornbach, M. J., Wood, W. T., Lee, T. R., Phrampus, B. J., Abelev, A., Herdic, P. C., et al. (2024). XBTs provide first-order characterization of seabed physical properties. Earth and Space Science, 11,e2023EA003441. https://doi.org/10.1029/2023EA003441

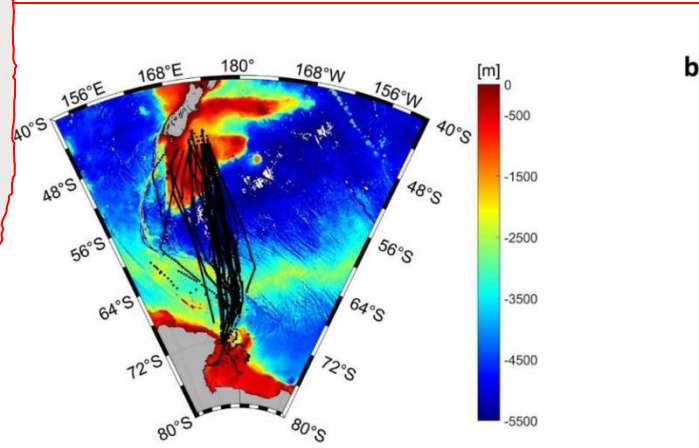
SWOT SSH analysis:

Carli, E., Siegelman, L., Morrow, R., Legresy, B., and Vergara, O.: Reconstructing vertical velocities and heat fluxes in the Southern Ocean from SWOT SSH fields, EGU General Assembly 2024, Vienna, Austria, 14–19 Apr 2024, EGU24-6805, https://doi.org/10.5194/egusphere-egu24-6805, 2024.

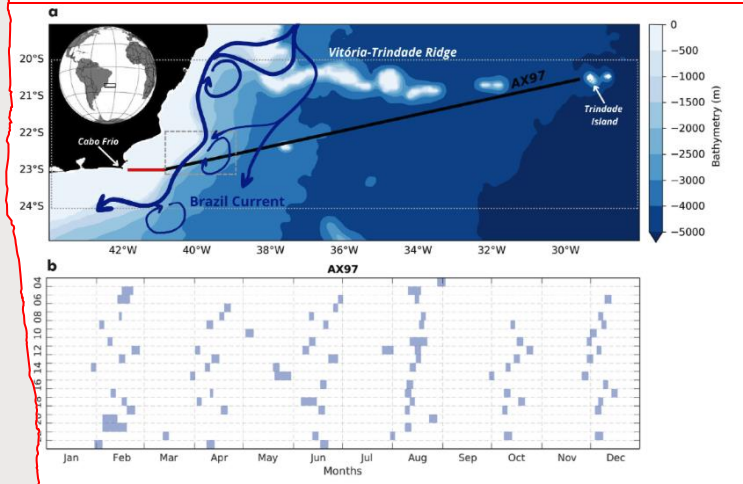
Simoncelli, S., Reseghetti, F., Fratianni, C., Cheng, L., and Raiteri, G.: Reprocessing of eXpendable BathyThermograph (XBT) profiles from the Ligurian and Tyrrhenian seas over the time period 1999–2019 with a full metadata upgrade, Earth Syst. Sci. Data, 16, 5531–5561, https://doi.org/10.5194/essd-16-5531-2024, 2024



Aulicino, G., Ferola, A. I., Fortunato, L., Budillon, G., Castagno, P., Falco, P., Fusco, G., Krauzig, N., Spezie, G., Zambianchi, E., and Cotroneo, Y.: XBT data collected along the Southern Ocean "chokepoint" between New Zealand and Antarctica, 1994–2024, Earth Syst. Sci. Data Discuss. [preprint], https://doi.org/10.519



Ferreira, T.P., P. Marangoni G.M.P., M. Cirano, A.M. Paiva, S.B.O. Cruz, P.P. Freitas, M. Goes, and M.M. Mata. 2025. Twenty years monitoring the Brazil Current along the NOAA AX97 high-density XBT transect. In *Frontiers in Ocean Observing*. *Oceanography* 38 (Supplement 1), https://doi.org/10.5670/oceanog.2025e113.



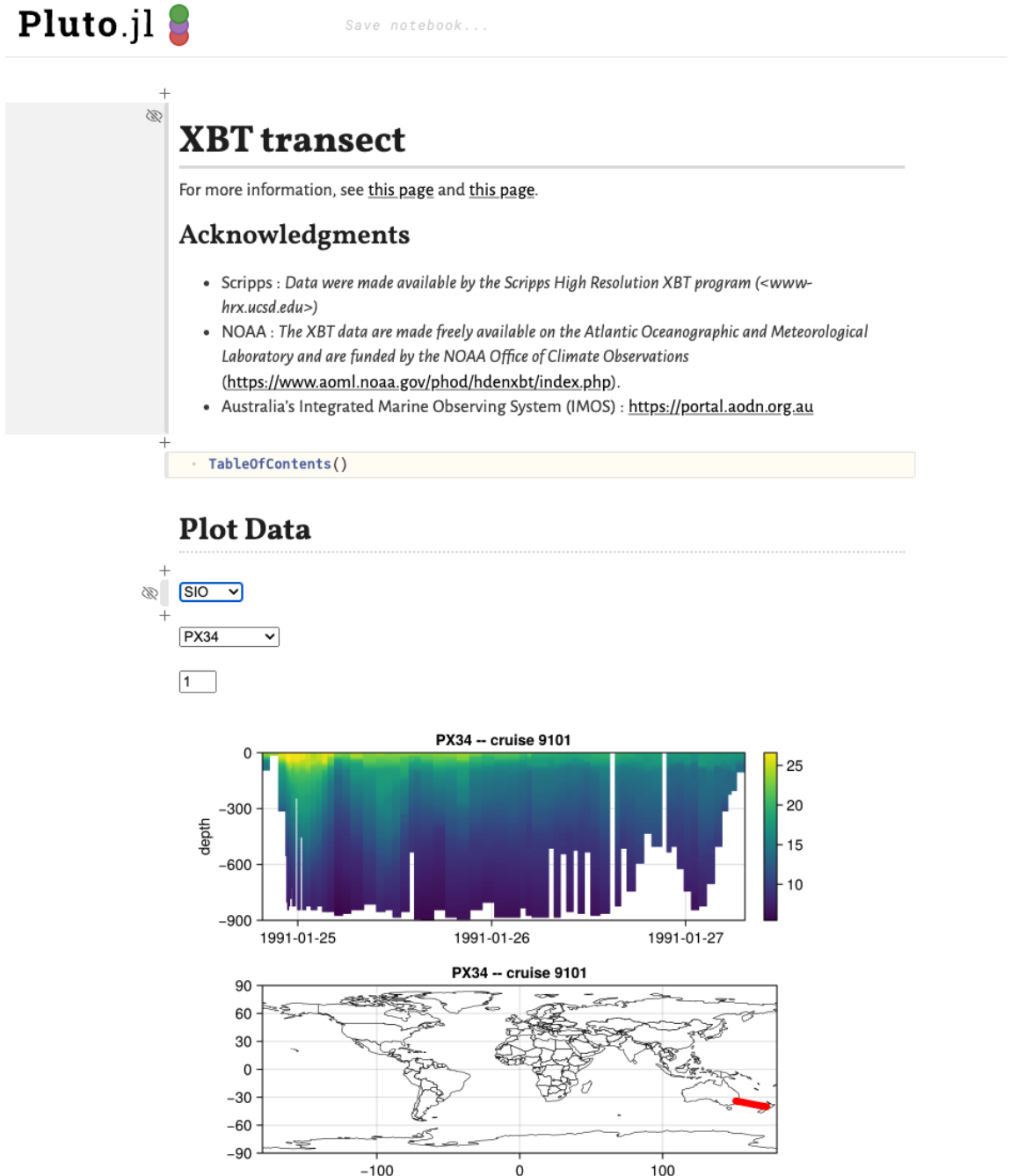
IMOS Integrated Marine Observing System

A new international XBT data repository

International effort in with IQuOD (International Quality-controlled Ocean Database) and the SOOP communities

- Goals:
  - Single consistent format for all XBT data
  - Data rescue effort
  - Combined location for all XBT data from SOOP programs
  - Easy access to the data via independent platform (eg Dataverse or Zenodo)
  - Open source software tools to grid the data along transect lines and to view/plot the data
  - Publications

- Achievements:
  - Test Pluto notebook for plotting via https://juliaocean.github.io/OceanRobots.jl
  - Netcdf format under review
  - Test dataset nearly ready for review by team

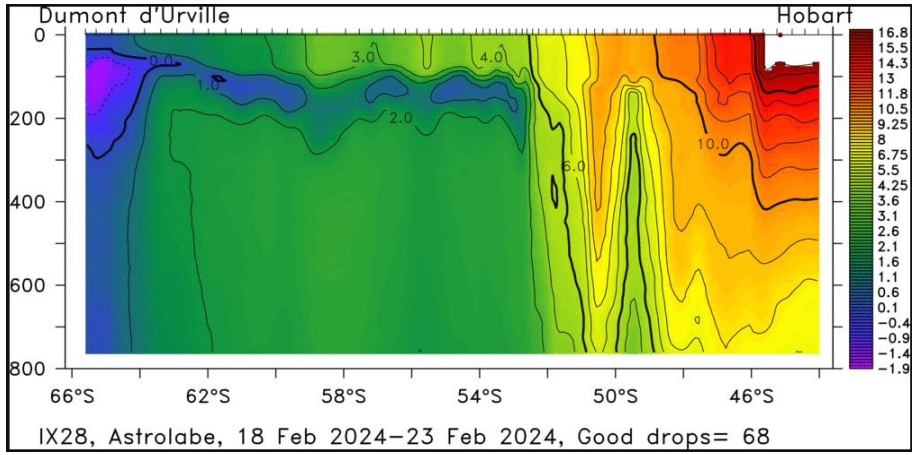


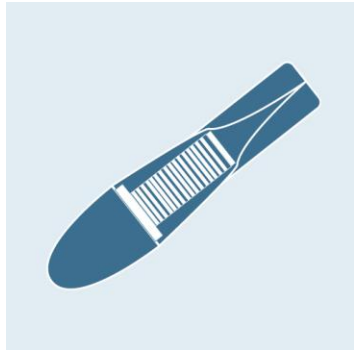
Autolauncher

Our Autolauncher was designed and built by SOOP technical team (thanks to Pat McMahon and Craig Hanstein) and the CSIRO Engineering group.

- Solves a HSE issue
- At sea and calibration lab testing completed
- Currently finalising software issues

Questions?





NCRIS
National Research Infrastructure for Australia
An Australian Government Initiative

Australia's Integrated Marine Observing System is enabled by the National Collaborative Research Infrastructure Strategy (NCRIS). It is operated by a consortium of institutions as an unincorporated joint venture, with the University of Tasmania as Lead Agent.

PRINCIPAL PARTICIPANTS

University of Tasmania (Lead Agent)
Australian Government
Australian Institute of Marine Science
Australian Government Bureau of Meteorology
CSIRO
Government of South Australia
SARDI
The University of Western Australia
sims sydney institute of marine science
UTS
The University of Sydney
Macquarie University
UNSW Sydney

SIMS is a partnership invoving four universities

ASSOCIATE PARTICIPANTS

Curtin University
Australian Government Department of Climate Change, Energy, the Environment and Water Australian Antarctic Division
Australian Antarctic Program
Deakin University
The University of Melbourne

IMOS thanks the many other organisations who partner with IMOS, providing co-investment, funding and operational support, including investment from the Tasmanian, Western Australian and Queensland State Governments.