



20 years of surface ocean carbon observing



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.

IMOS ship and moored carbon observing

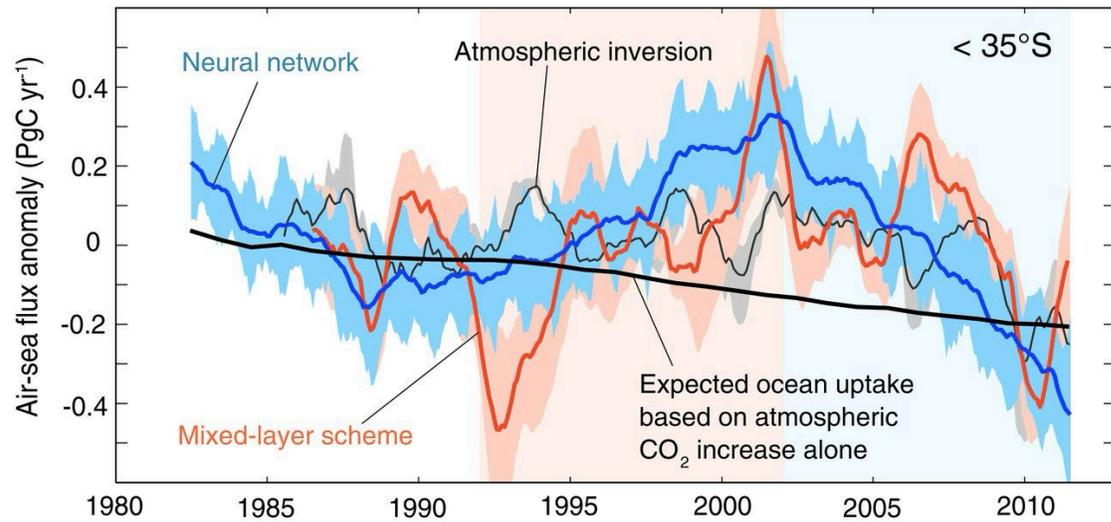
- Uptake, storage and trends of CO₂ in the Southern Ocean and Australian regional seas.
- Detect ocean acidification change in Australian shelf and offshore waters



Global Ocean, 3.2 ± 0.4 GtC/yr
Southern Oc. $<30^{\circ}\text{S}$, 1.6 ± 0.2 GtC/yr [1.2 - 1.9]

- Observation and model-based estimates of the ocean CO₂ uptake are diverging
- Observing capacity declining since 2018
- Data sparsity in Southern Hemisphere needs to be overcome to improve models and reduce uncertainty in uptake from CO₂ products
- Ocean acidification issues are on the way 
- SOCONET established in GOOS to streamline and grow the observing network, improve data products, and deliver to WMO Global Greenhouse Gas Watch

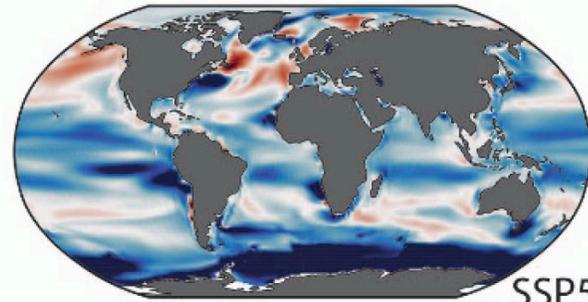
The observing system is critical to resolving the current and future ocean CO₂ sink



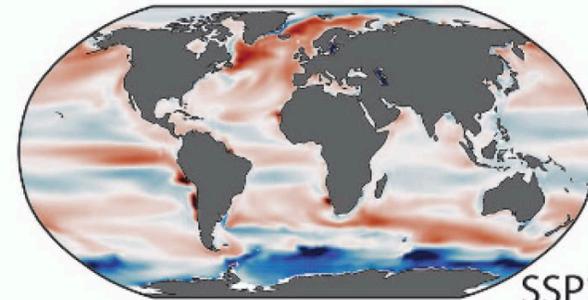
Landschutzer et al., 2017

Non-steady state uptake emerging in Sth. Ocean (Landschutzer et al., 2017; Gruber et al., 2023)

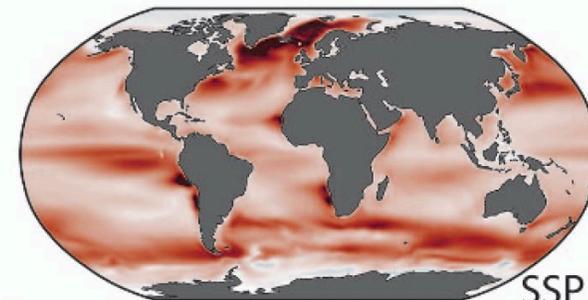
(d) 2090s IPSL flux difference



SSP5-8.5



SSP2-4.5

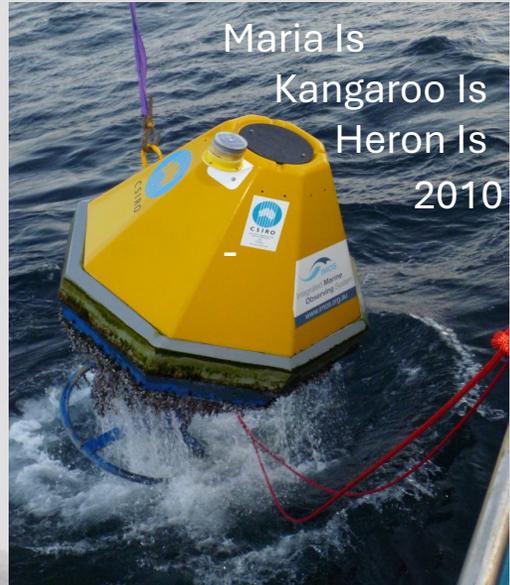
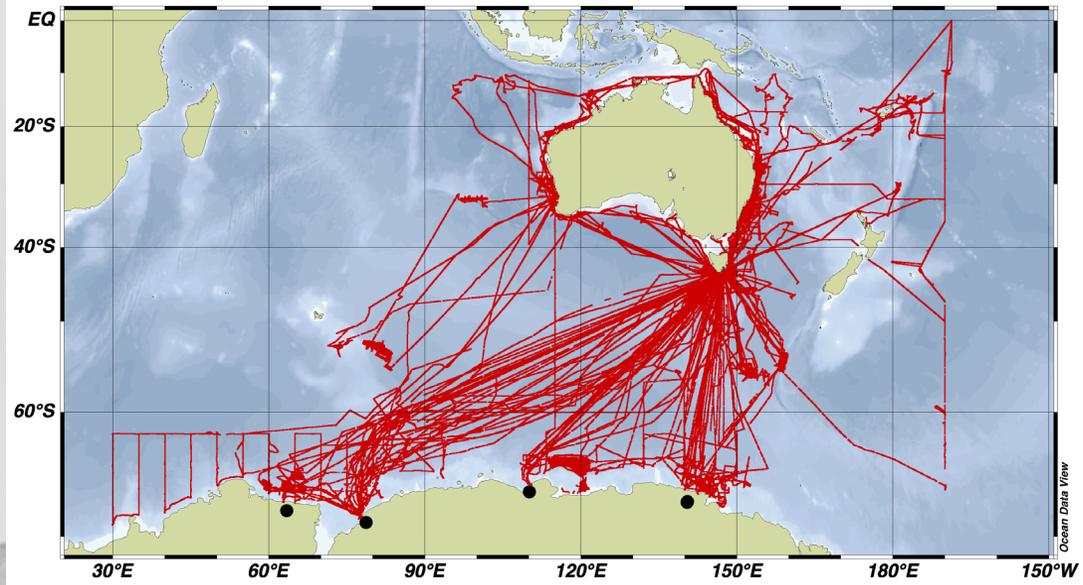
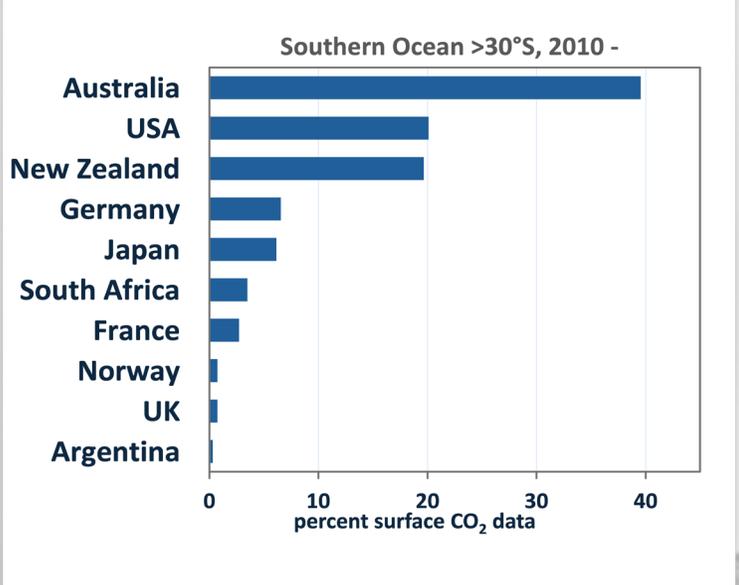


SSP1-1.9

CO₂ flux change relative to present day

- Emission pathways influence ocean uptake efficiency
- Large emission reductions will increase the ocean influence and shift where the ocean uptake is occurring

McKinley et al., 2023



Data: Australian Ocean Data Network (NRT & delayed mode)
SOCAT (delayed mode)



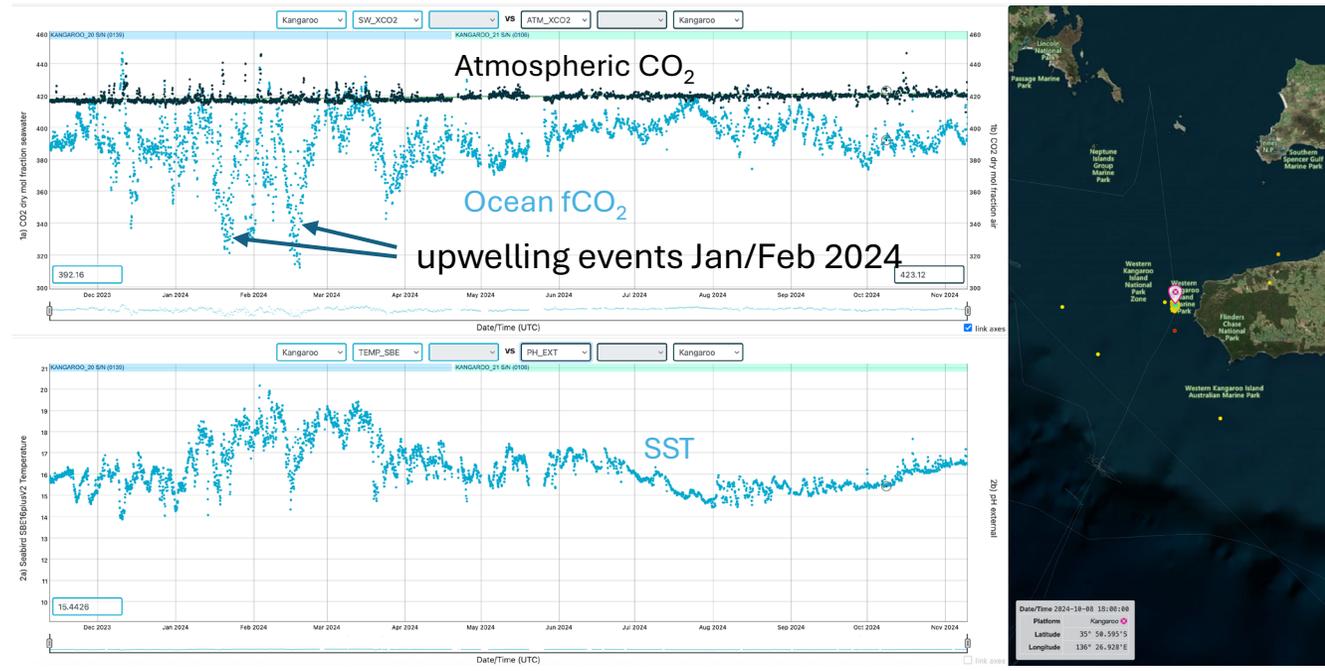
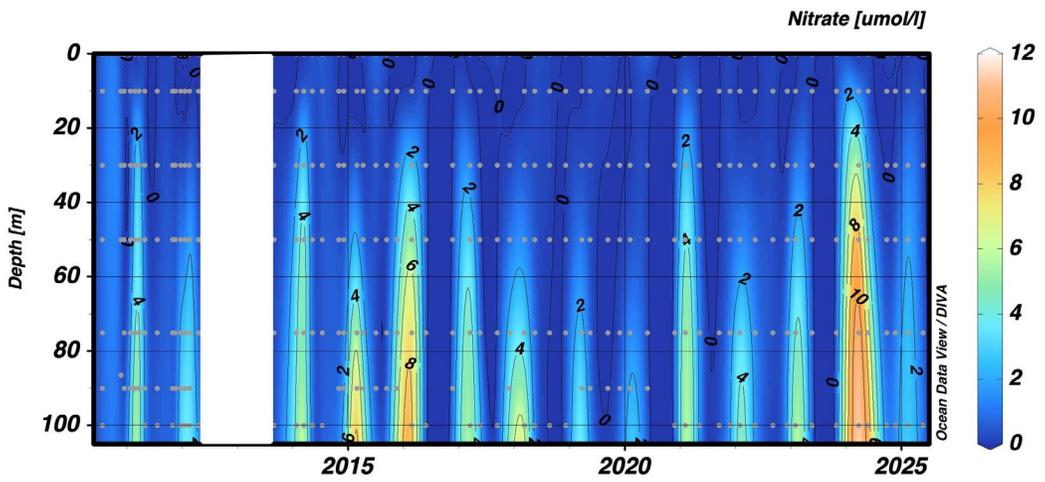
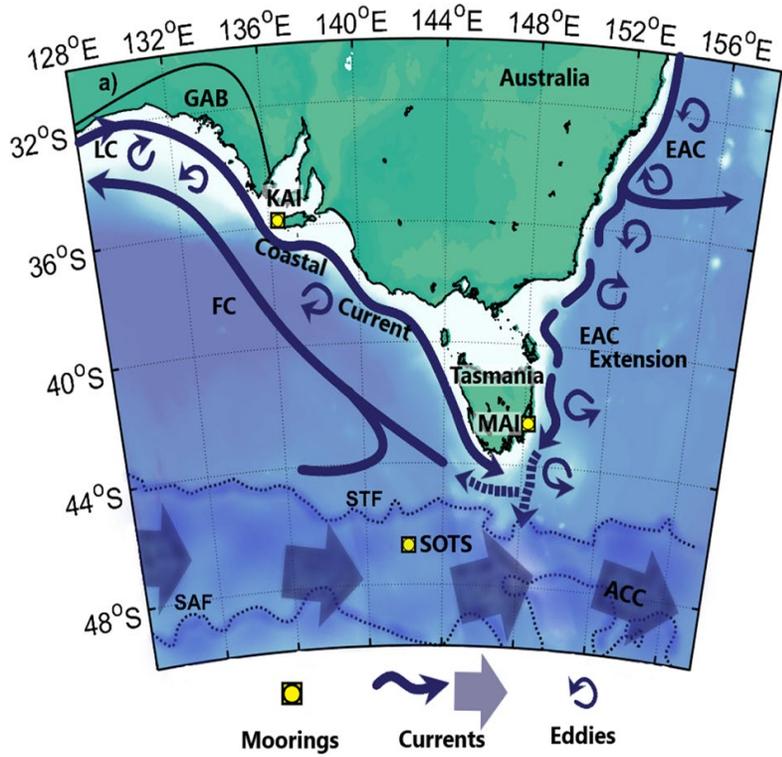
l'Astrolabe – France-Australia collaboration on integrated Southern Ocean monitoring

- Hobart – Dumont D'Urville base, Antarctica
- CNRS, Sallée, Metz
- First voyage Dec. 2024, 3+ return trips/yr
- Collaboration with XBT and underway S and T
- Lab van measurements
 - continuous pCO₂, T, S, O₂
 - discrete δ¹⁸O of H₂O, δ¹⁸C & DIC

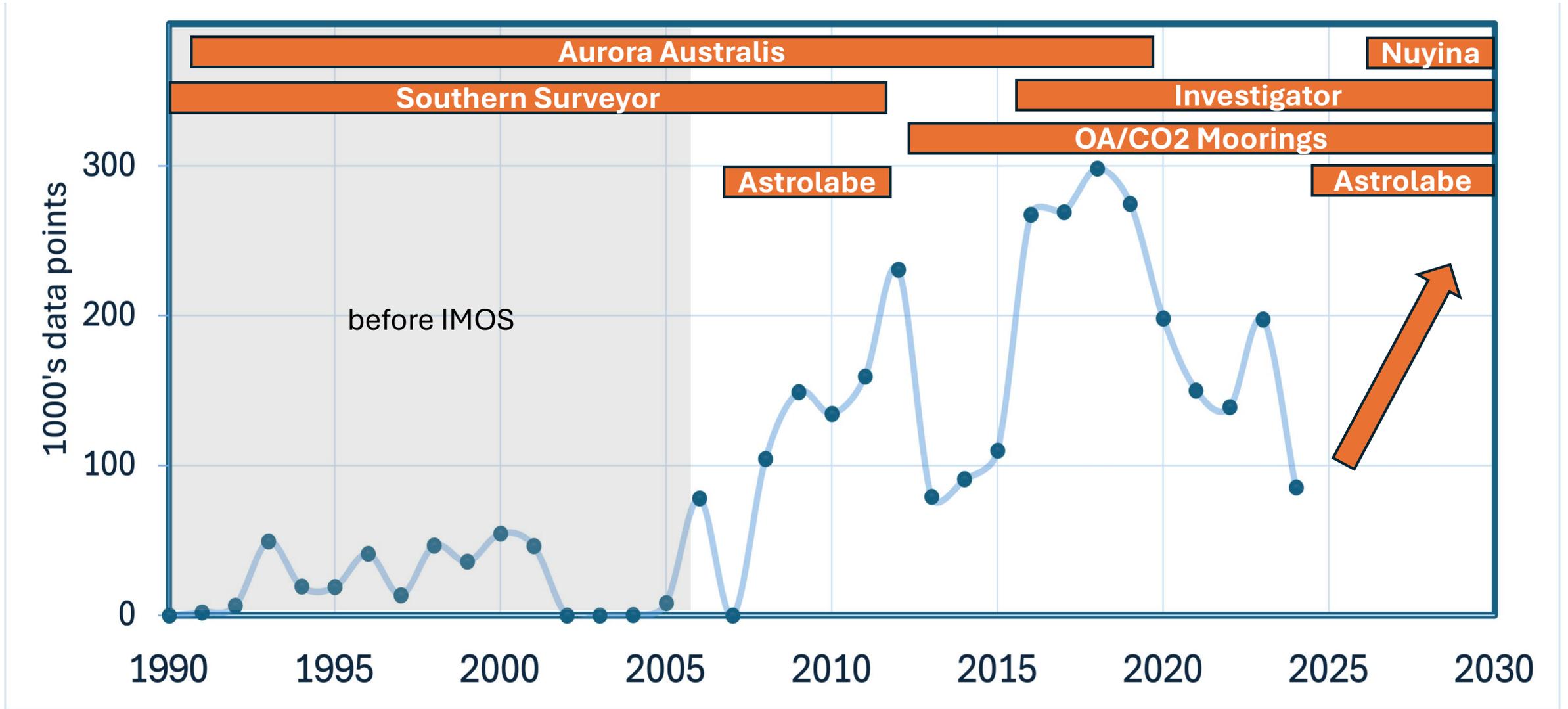


CO₂/Acidification moorings

- pCO₂, MAPCO2 system, ±3 microatm
- pH, durafet solid state electrode, ± 0.01
- Dissolved oxygen, Aanderaa optode, ± 1 mmol/kg
- Temperature, SBE37, ±0.005°C
- Salinity, SBE37, ±0.01
- Calibrated before and after deployments
- NRT and delayed mode data

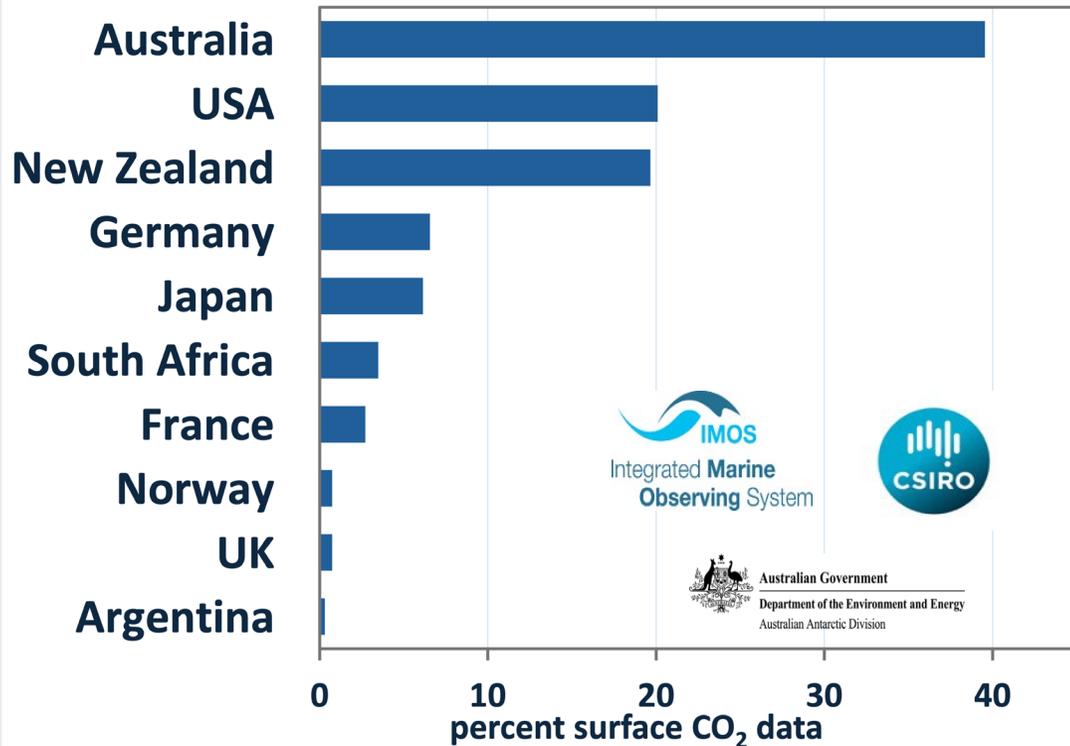


IMOS data in SOCAT 2025



IMOS role for Southern Hemisphere Ocean carbon is big

Southern Ocean >30°S, 2010 -



Global Carbon Budget 2025
release mid 2026

SOCAT V2026
release Jun 2026

- Impacts:**
- State of Environment & State of Climate
 - Ocean carbon sink (GCB, UNFCCC)
 - WMO Global Greenhouse Gas Watch (G3W)
 - Ocean acidification (SDG14.3)
 - Sensor evaluation (ASV)
 - BGC model evaluation, synthesis, process studies

Publications

77

Total

Citing Articles

13,469 Analyze

Total



Times Cited

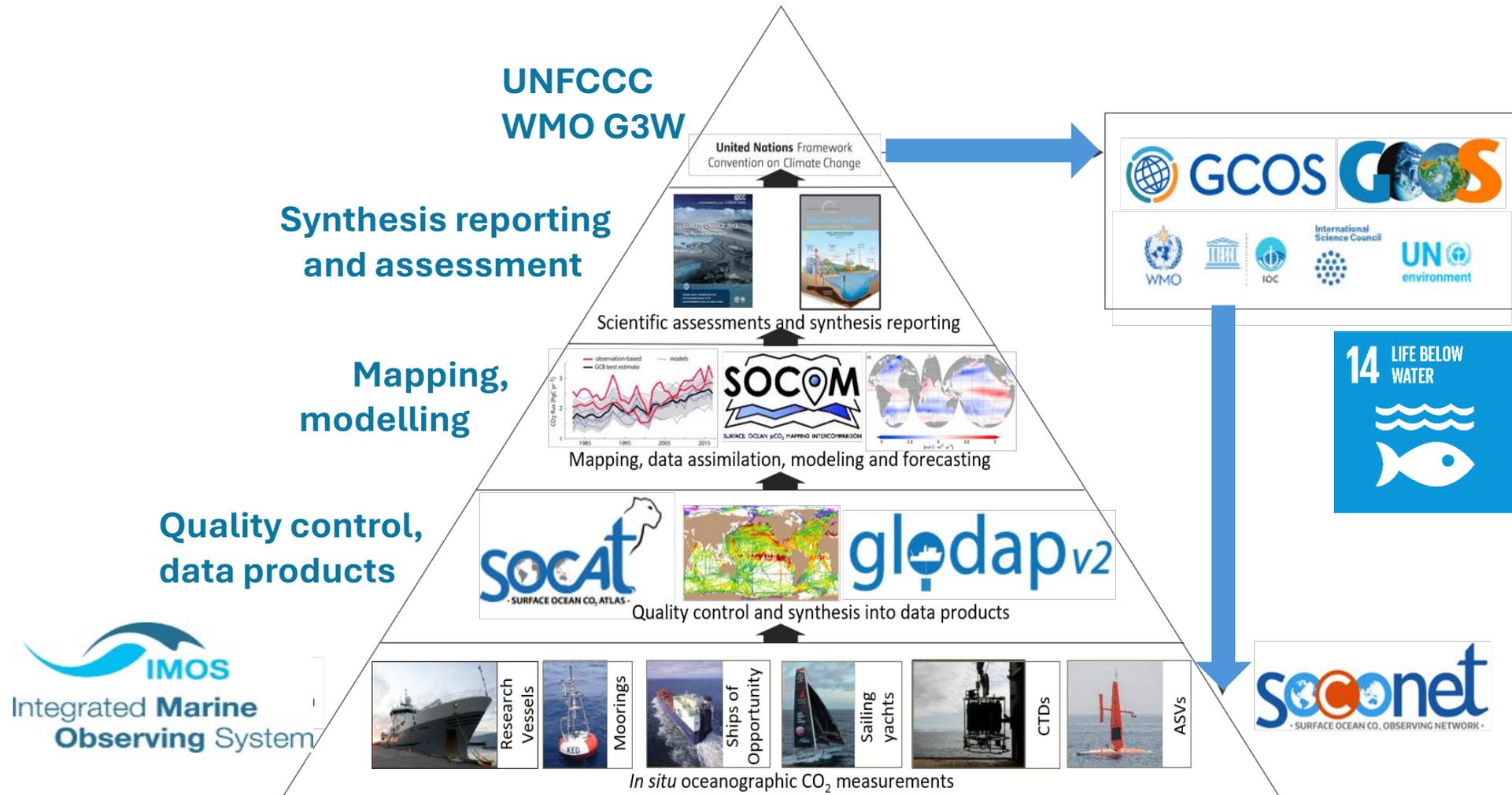
17,091

Total

221.96

Average per item

SOCONET: New GOOS Surface CO₂ Reference Network to streamline data collection and deliver policy relevant products



New observing platforms and sensor technology to fill data gaps

Constraining Ocean Carbon with Optimized Observing (COCO₂)

