



# OneArgo for the Deep-Ocean

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and Virginie Thierry on behalf of the Deep Argo  
Mission Team

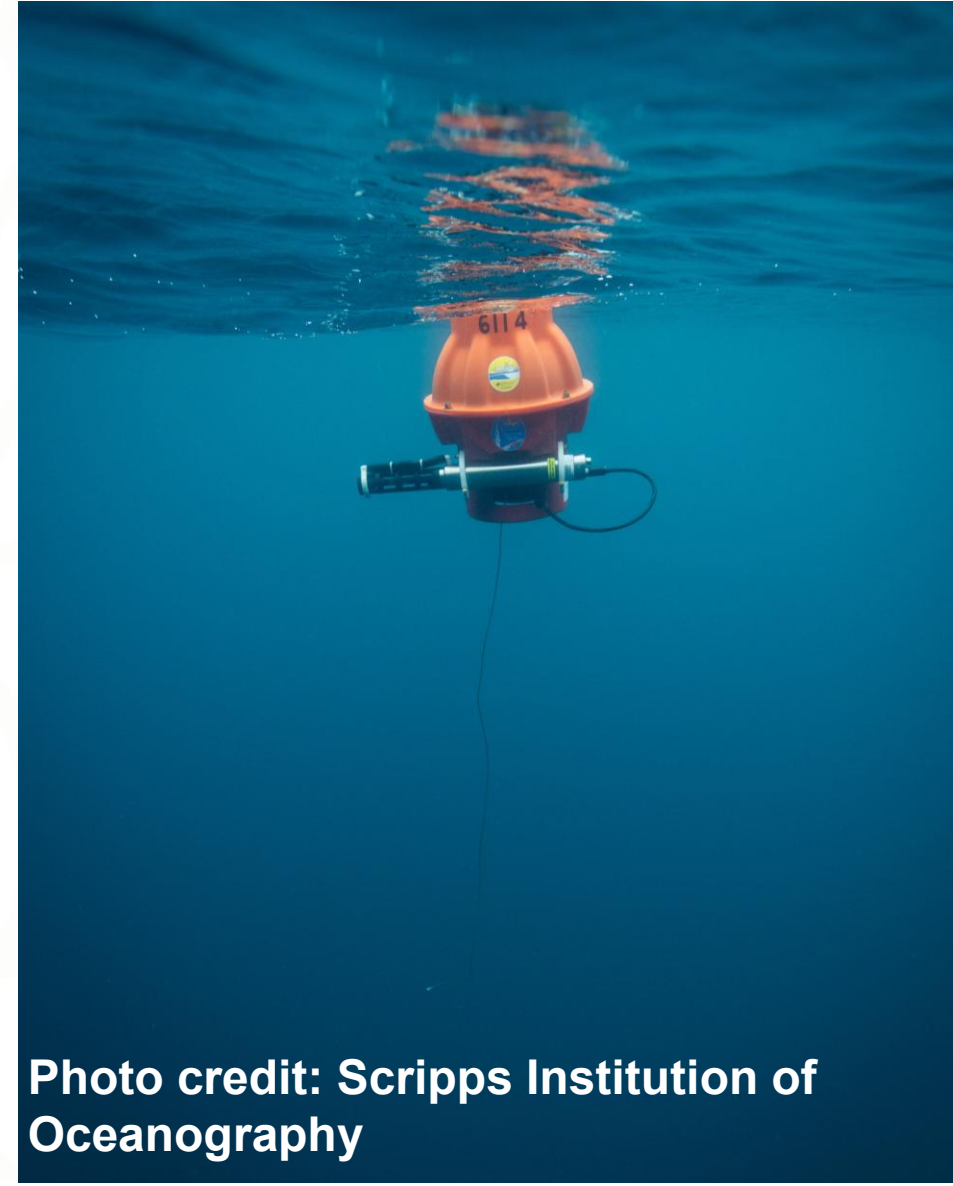
**Scripps Institution of Oceanography, UCSD**

# The deep ocean is a dynamic environment impacting ocean heat, climate projections, and marine habitats ...

- The deep ocean carries heat between the northern and southern hemispheres and among ocean basins, impacting the upper ocean and influencing ocean interactions with the atmosphere
- Seasonal to interannual fluctuations of wind forcing at the surface can control deep ocean temperature to near the seafloor
- The deep ocean influences sea level variability
- The absorption of atmospheric heat extends to the abyss
- The morphology of the seafloor plays a leading role in ocean circulation, storm surge propagation, ocean mixing, marine habitats, and tectonic evolution

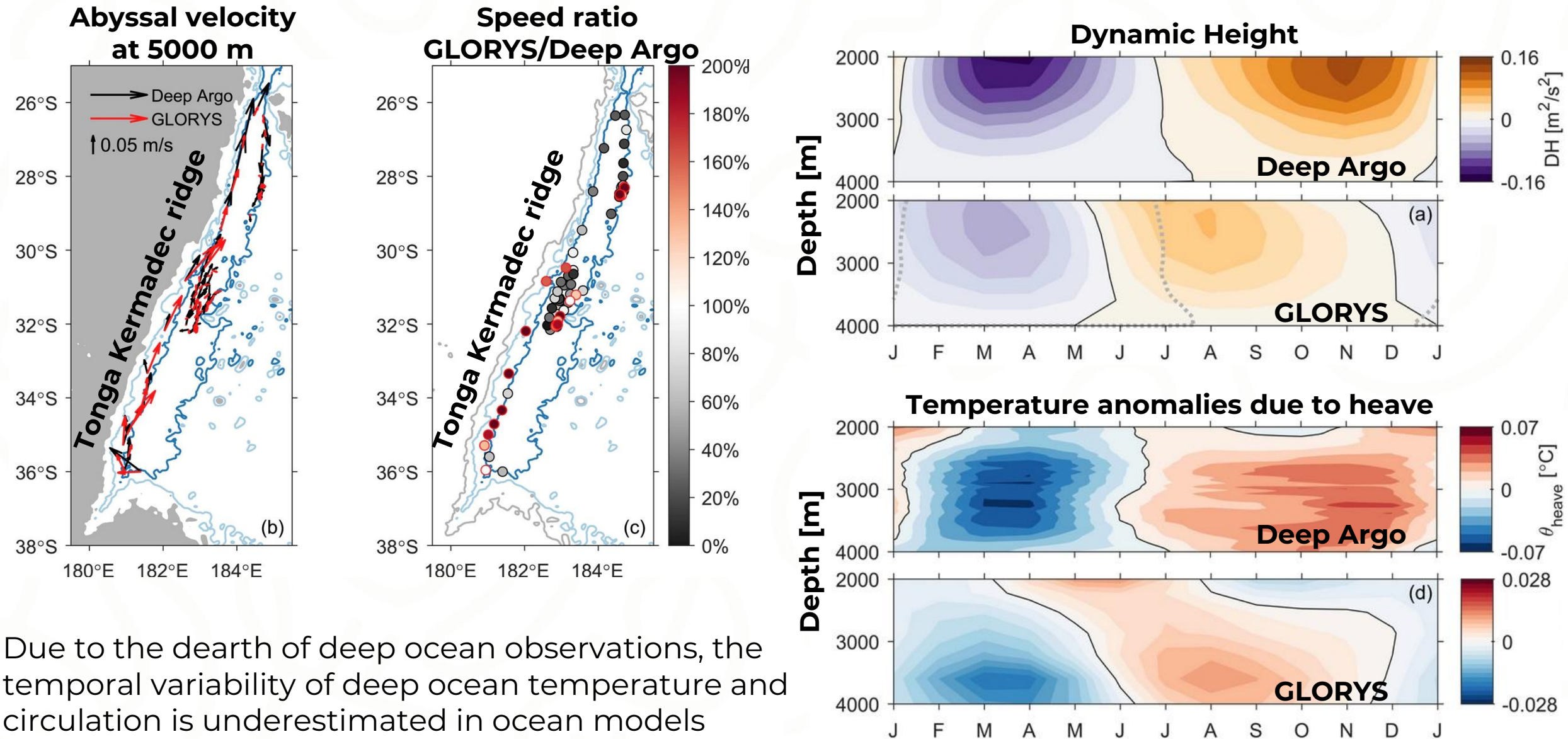
**... but despite its instrumental role for ocean's health and society, only 27% of the deep ocean volume is measured**

**Deep Argo has the ability to fill this observational gap**



**Photo credit: Scripps Institution of Oceanography**

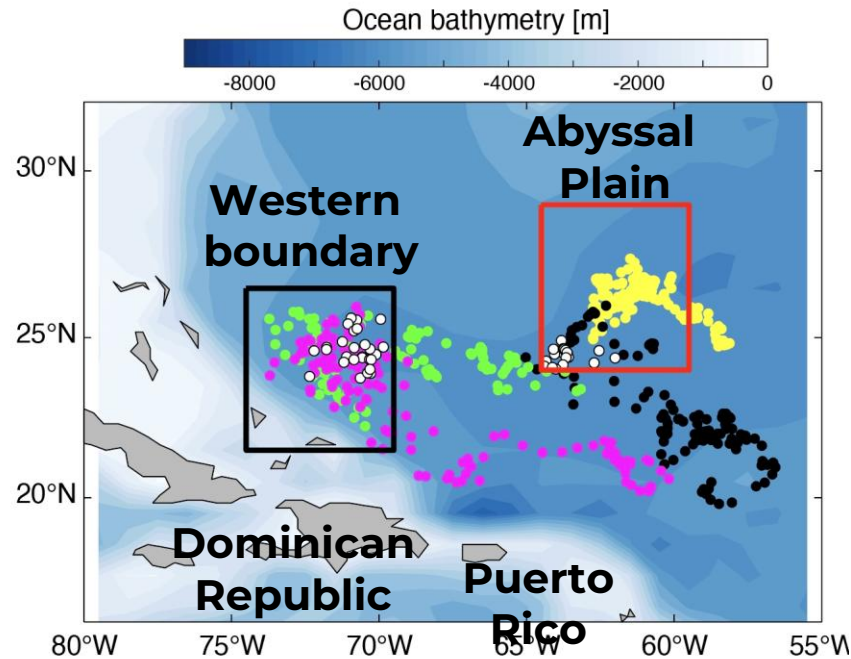
# Seasonal changes of temperature due to wind forcing at the surface can penetrate to near the seafloor



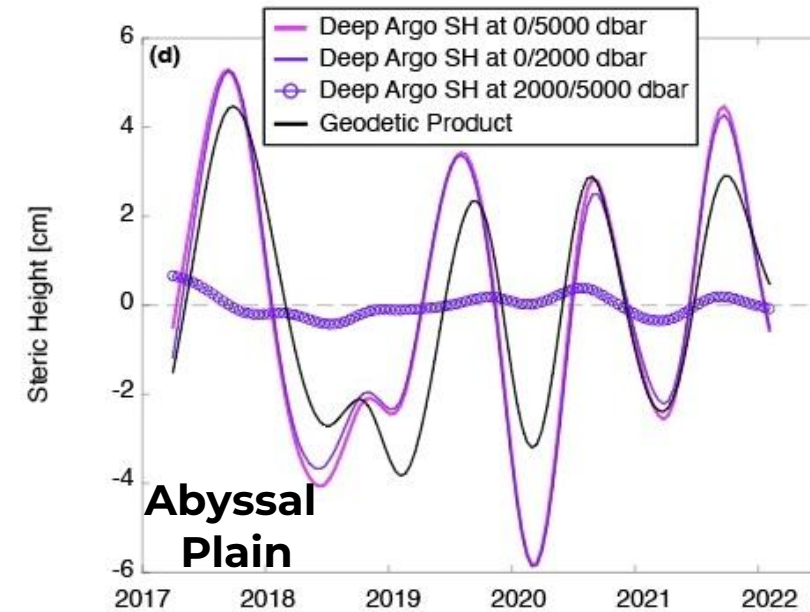
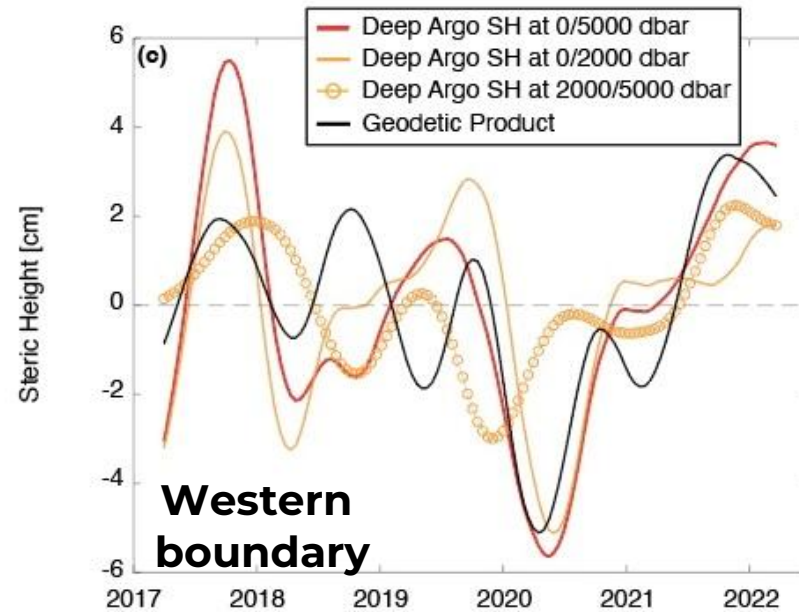
Due to the dearth of deep ocean observations, the temporal variability of deep ocean temperature and circulation is underestimated in ocean models



# The contribution of the deep ocean to interannual sea level varies between abyssal plains and ocean boundaries



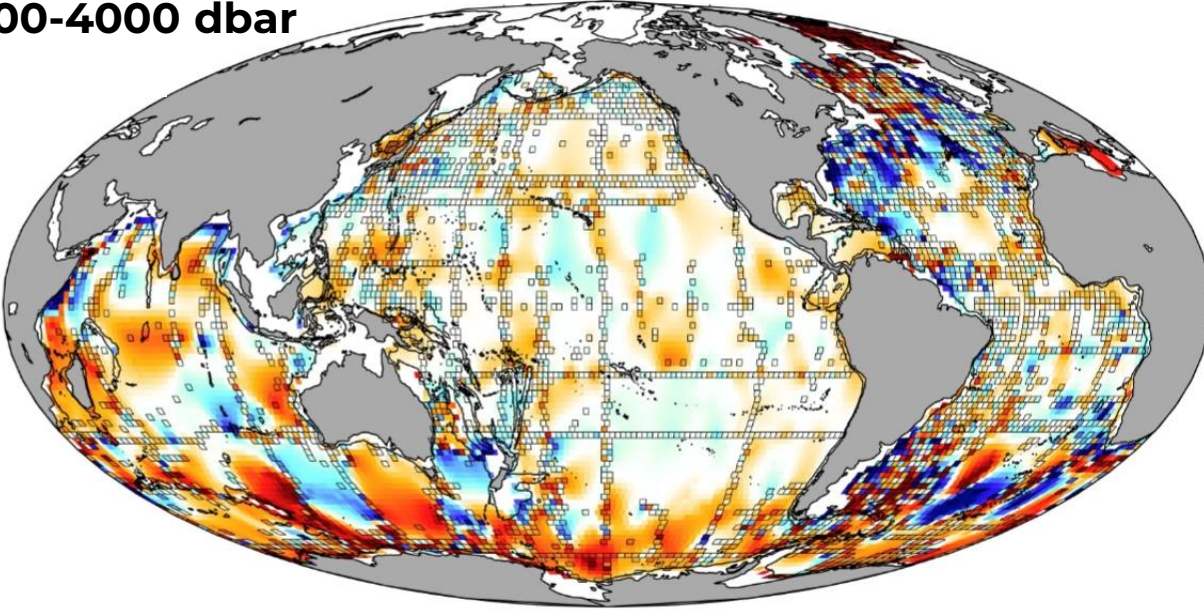
## Deep ocean contribution to sea level change due to temperature



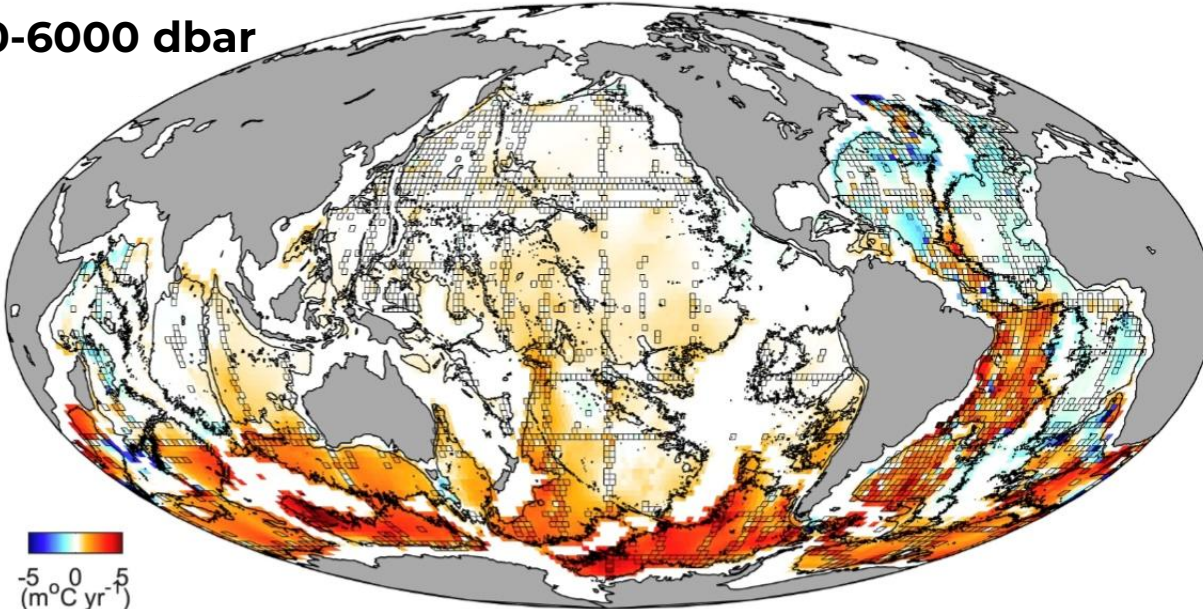
- Deep ocean contribution to interannual sea level variability is 7 times larger at the western boundary than over the abyssal plain
- Full depth Deep Argo profiles are complementary to satellite measurements and improve our understanding of regional sea level budgets


# Ocean warming extends to the seafloor

2000-4000 dbar



4000-6000 dbar



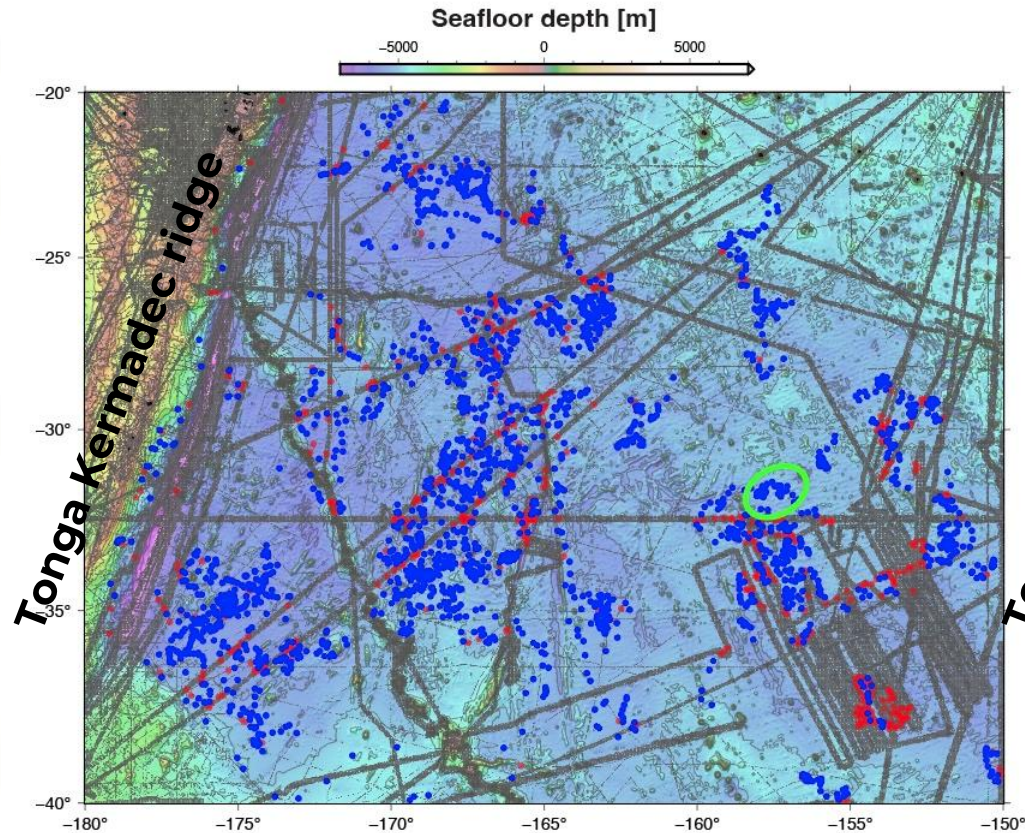
  
-5 0 5  
( $^{\circ}\text{C yr}^{-1}$ )

- The deepest waters of the ocean have warmed from the mid-1980s to the mid-2010s
- Deep warming follows deep western boundary currents and decreases with distance from deep water formation regions located at high latitudes
- Deep Argo has reduced uncertainties in deep ocean warming trends by 50%
- Deep ocean warming is predicted to accelerate in the future

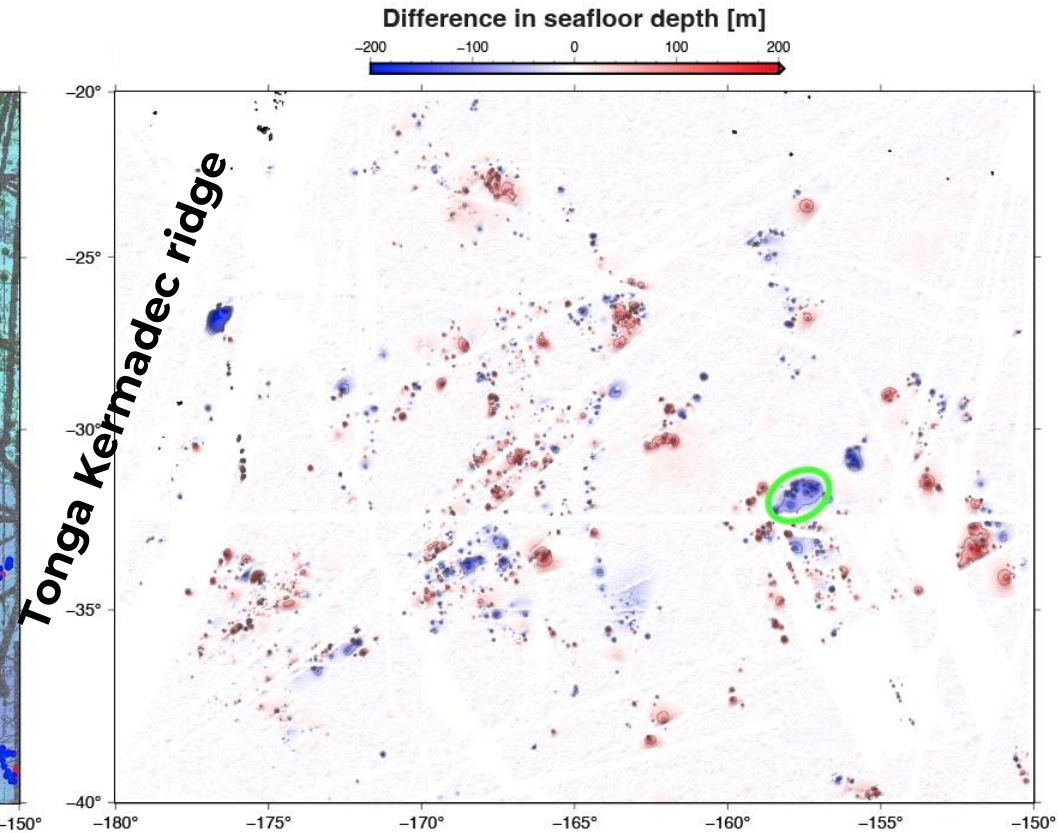


# Deep Argo is a new ocean bathymetry data source in GEBCO grid

Locations of soundings and Deep Argo measurements in GEBCO\_2024 bathymetry



Differences in ocean bathymetry before and after integrating Deep Argo



- Nominal horizontal uncertainty of ocean bathymetry from Deep Argo,  $< 1.5$  km, is 3 times larger than echo sounders but 10 times lower than satellite altimetry
- Vertical accuracy (4 m at 6000 m) is higher than echo sounders (12 m at 6000 m)
- Deep Argo generates 50-200-m range improvement in the GEBCO grid



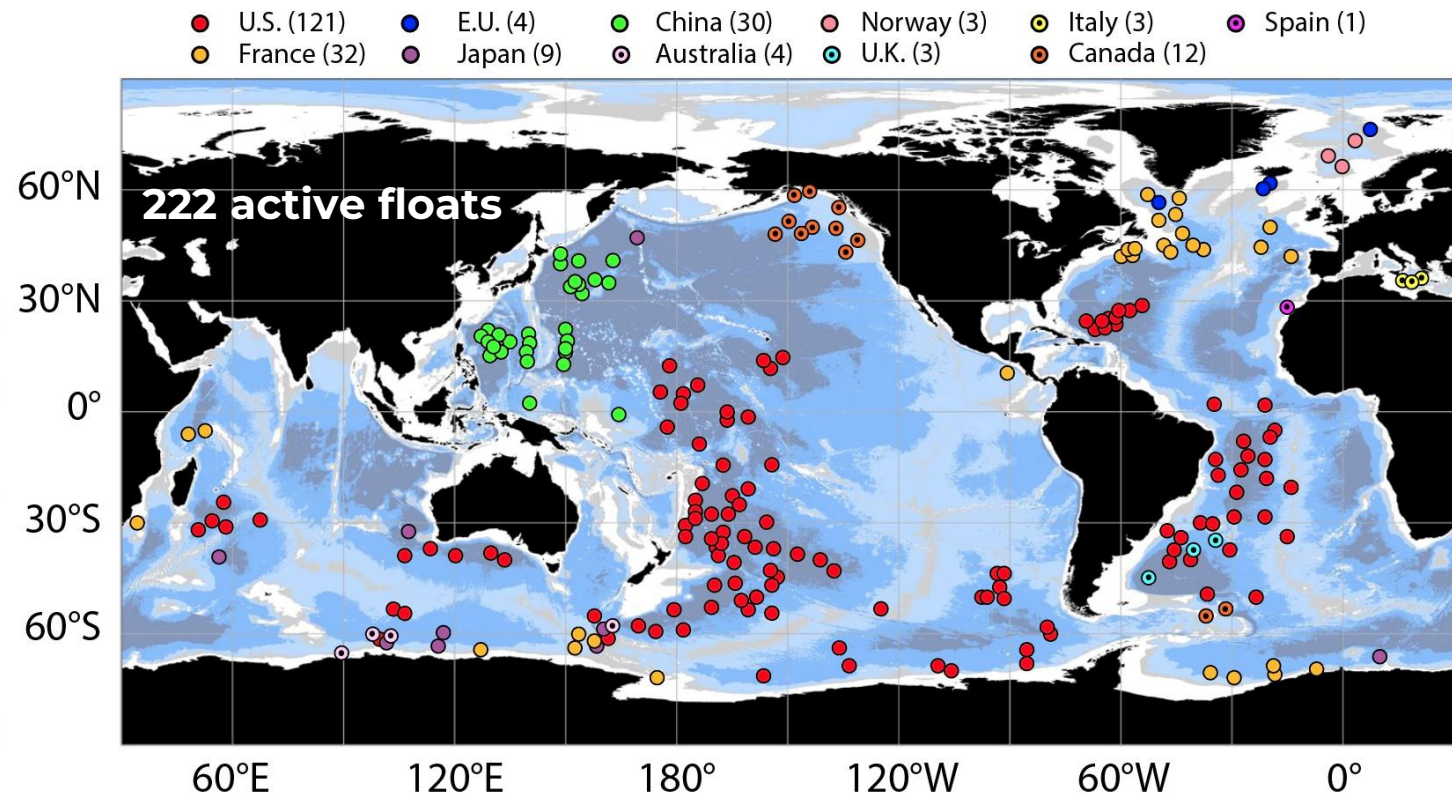
# New applications will increase the interdisciplinary value of Deep Argo

26% of Deep Argo floats are measuring oxygen to 4000 m depth. Oxygen sensor integration on 6000-m float models is under development to resolve deep ocean deoxygenation

Future plans include testing of optical scattering sensors on Deep Argo floats to study sediment transport

Although the need to implement Deep Argo is recognized at the international level, only 18% of the global Deep Argo array is implemented with no long-term sustained funding

➡ Significant additional support is urgently needed



OceanOPS