

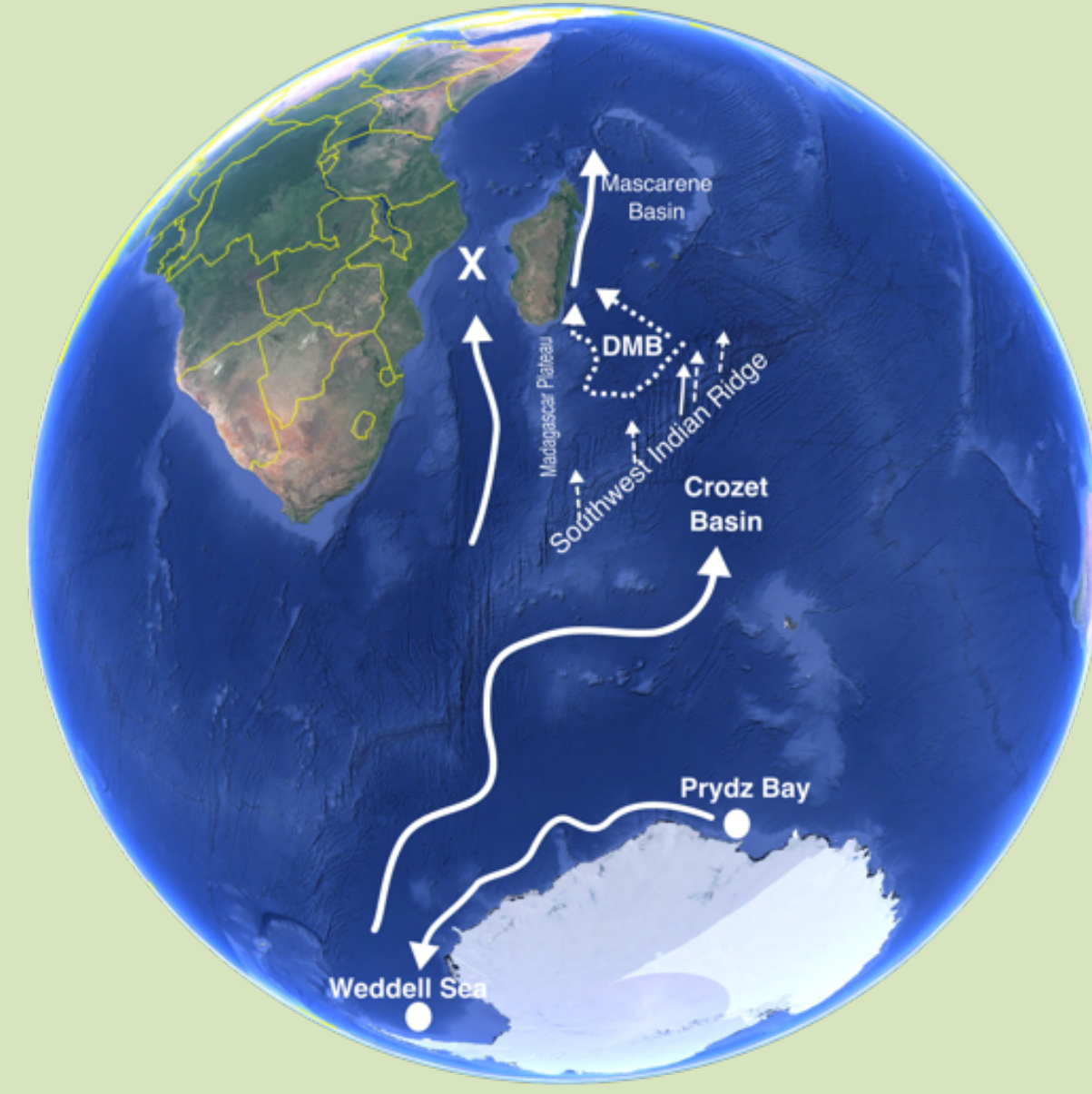
# Deep Argo Observations in the Deep Fracture Zones of the Southwest Indian Ridge

A primary pathway for the southern-originated waters (Antarctic Bottom Water and Circumpolar Deep Water) is through the **Fracture Zones (Fz) of the Southwest Indian Ridge (SWIR)** that connects the Crozet Basin in the Southern Ocean to the Madagascar Basin in the South Indian Ocean. **Atlantis II Fz** is considered the main AABW conduit into the Indian Ocean (IO), accounting for 20-30% of the total IO meridional overturning circulation. The other Fz contributions are unknown. In May 2023, the **Deep Madagascar Basin (DMB) Experiment** was implemented to understand the abyssal pathways to and in the Madagascar Basin, how abyssal temperature varies in the basin interior, and the effects of the tortuous seafloor topography in steering the abyssal flows



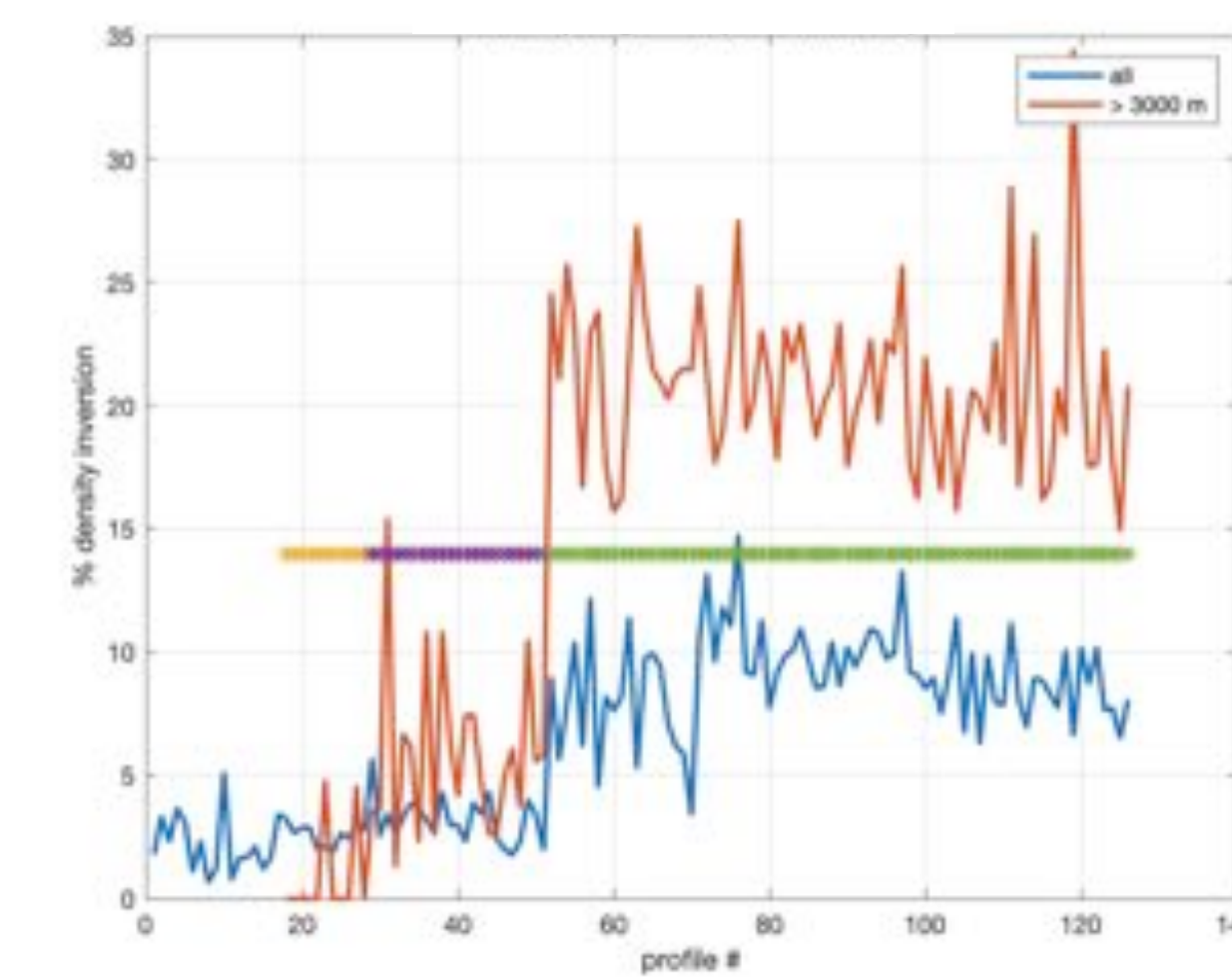
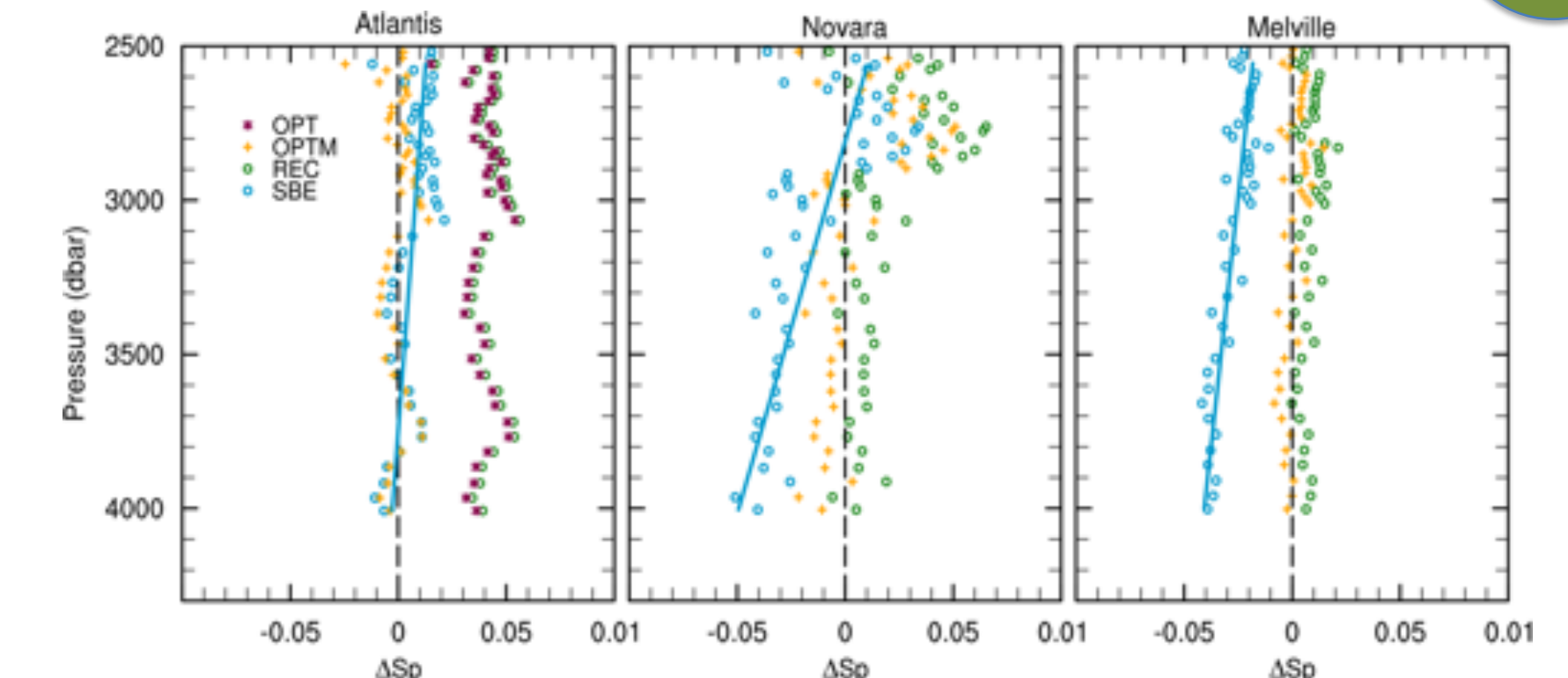
Here, we discuss the lessons learned from our three Deep SOLO floats (rated to 6000 dbar) deployed in the exit of three SWIR Fz as part of the DMB Experiment

Distinct from the pilot arrays and future global program, the DMB floats are obtaining profiles at a much **higher frequency (3-5 days)**, with an **enhanced vertical resolution of 5 dbar** below 3000 dbar, and parked at a depth where regional currents are overall weak to avoid the floats dispersing. It is important to highlight that to conserve float batteries, the Deep SOLOs operate in dual vertical sampling mode: continuous in the upper layer when the float is descending most rapidly and discrete at slower descent speeds in the deep layers. Also distinct from the regional arrays, the DMB floats operate over a **very rough topography**, where the global relief databases are not as accurate



## Salinity Issues & Calibration

Pressure-dependent cell compressibility coefficient (CPcor) adjustment



Data compression

$$Sp = \text{counts} * \text{gain} - \text{offset}$$

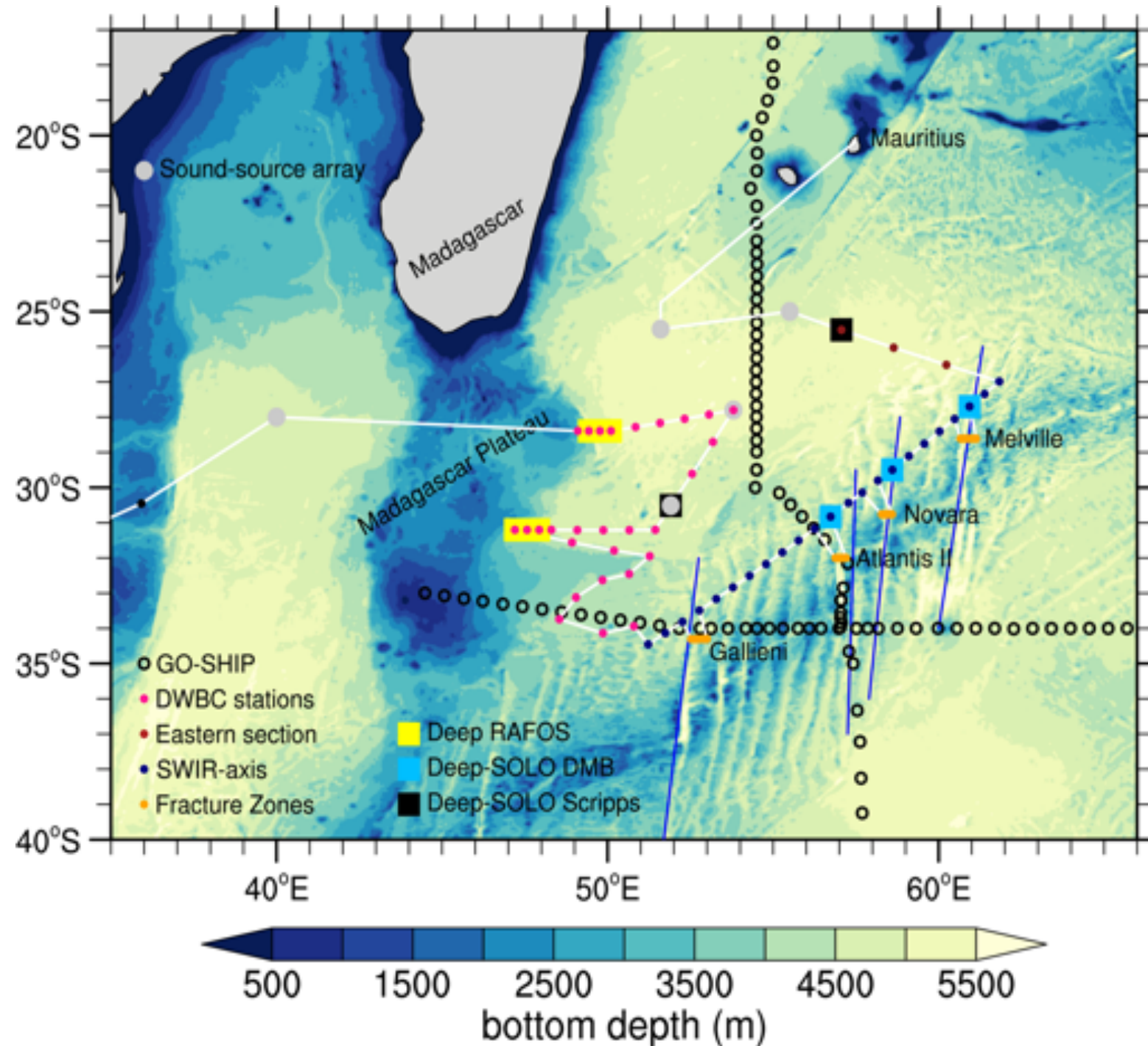
$$\text{Gain} = 1/1000 \text{ and } \text{offset} = 1$$

Thus, salinity scale resolution is 0.001  
At 5dbar vertical resolution, truncation to 3<sup>rd</sup> decimal place results in a noisy salinity profile (but not in temperature), increasing density inversion

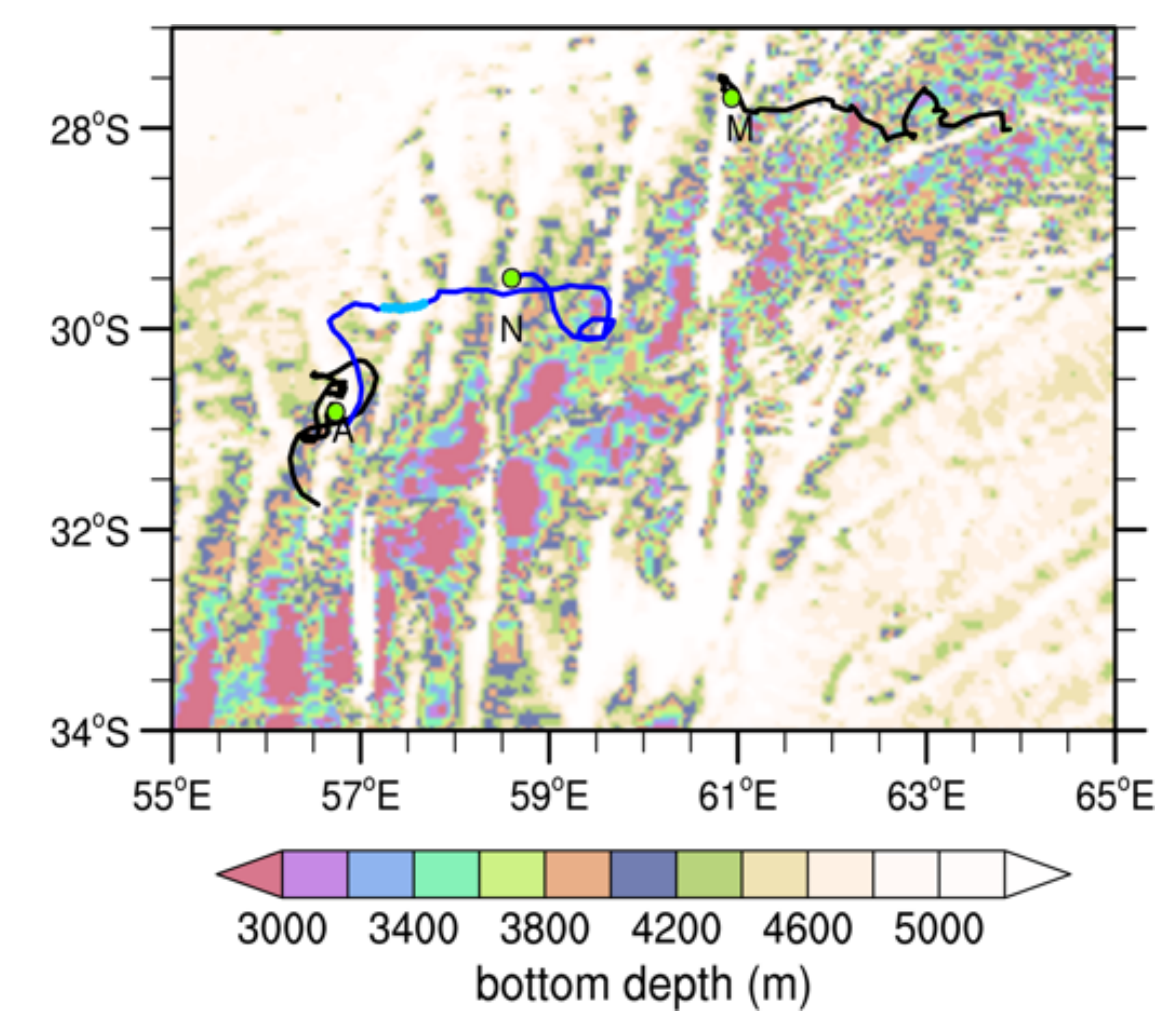
To mitigate the salinity noise, we applied Barker and McDougall (2017)

## Navigating over rough terrain

DMB Cruise April 9 to May 13, 2023

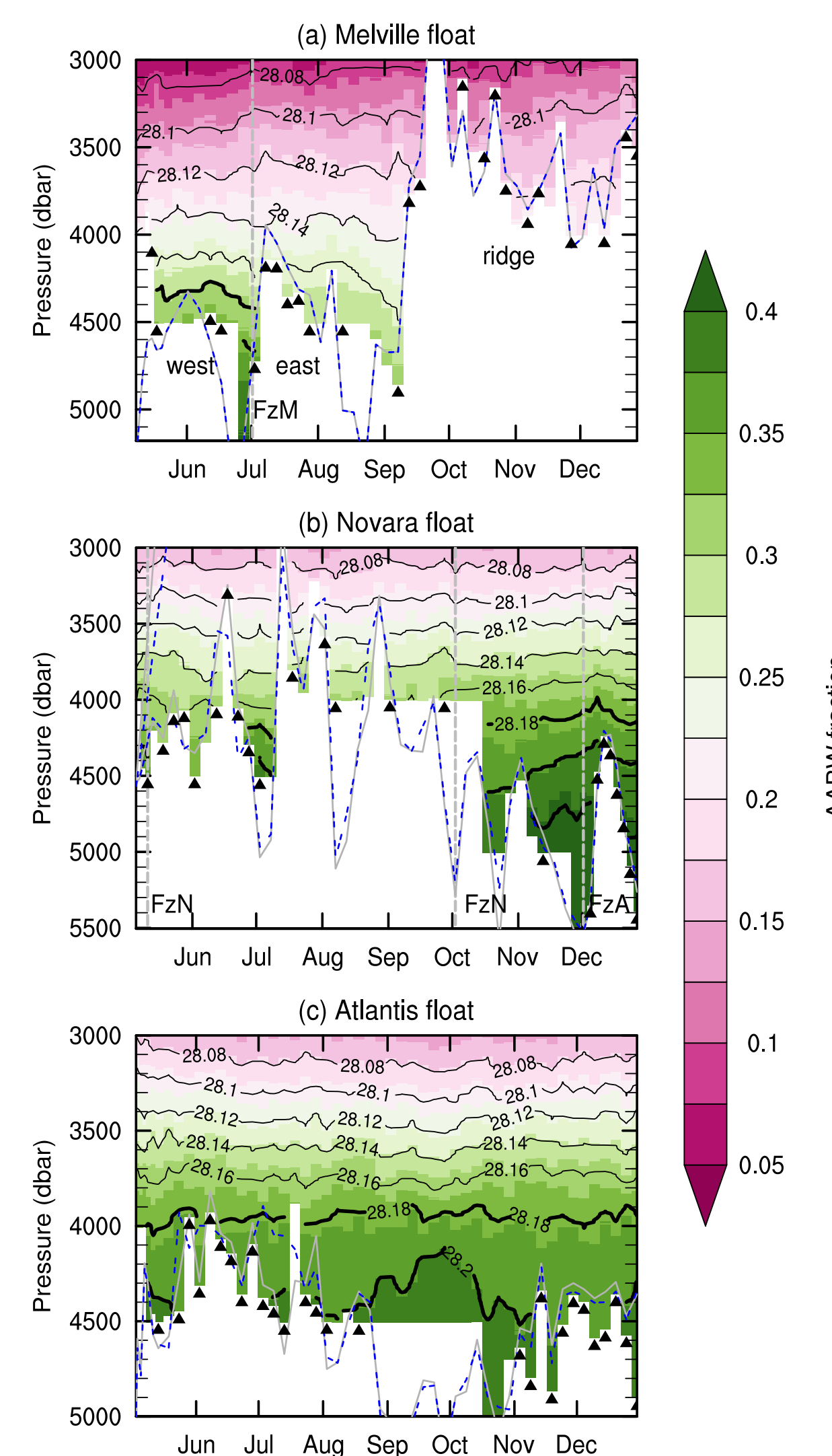


- DMB Assets**
- 3 Deep SOLO Argo floats
  - 77 CTD/LADCP/tracer stations
  - 22 deep RAFOS floats in the DWBC
  - Augmented by 113 GO-SHIP stations (2018-2023)



In 50-60 % of the casts, the float touched the seafloor (black triangles), but no damage

float	mean difference [minimum maximum]	
	ETOPO2022	GEBCO_2023
Atlantis	57.47 [ -261.58 473.46]	29.61 [ -323.64 452.96]
Novara	-106.73 [ -1105.04 430.46]	-91.16 [ -1171.43 294.77]
Melville	-78.44 [ -602.37 167.50]	-90.75 [ -821.56 305.03]



## Key Points

Calibrated salinity meets the Deep Argo target accuracy

Product	CPcor	Atlantis	Novara	Melville
Level 1 optimized	0.0001	0.0004	9.3 × 10 <sup>-6</sup>	
Level 0 recommended	0.0042	0.0009	0.0006	
Level 0 SBE	0.0003	-0.0031	-0.0034	
Level 1 optimized	0.0007	0.0009	0.0004	
Level 0 recommended	0.0043	0.0011	0.0007	
Level 0 SBE	0.0009	0.0033	0.0034	
range(Δ)	Level 1 optimized	[-0.0008 0.0015]	[-0.0009 0.0025]	[-0.0007 0.0010]
Level 0 recommended	[0.0033 0.0056]	[-0.0006 0.0028]	[-0.0001 0.0015]	
Level 0 SBE	[-0.0011 0.0021]	[-0.0051 -0.0007]	[-0.0042 -0.0019]	

New abyssal ventilation source (Novara Fz) to the Madagascar Basin and solved the 50-year-old Melville puzzle

