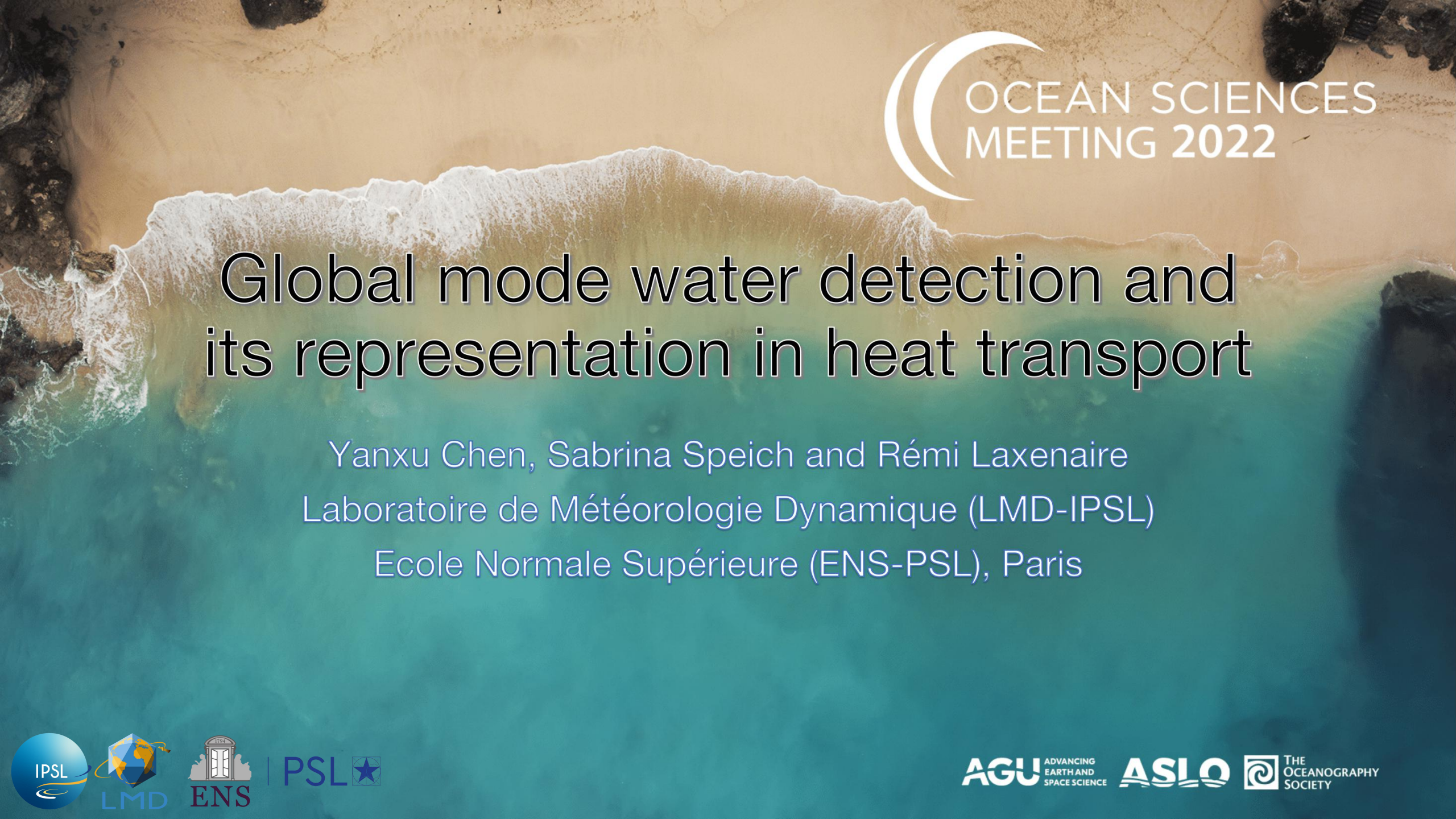

Global mode water detection and its representation in heat transport

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Ocean heat uptake

- Ocean serves as a heat reservoir of the Earth system, accounting for ~93% of the total warming that has occurred since 1955.
- Mode water plays a major role in modulating SST signals and ventilating thermoclines.
- In our study, a new algorithm is developed to determine the mixed layer depth (MLD) and mode water (MW) thickness, which is applied to the Argo global array.
- By co-locating mesoscale eddies derived from satellite altimetric maps (Laxenaire et al., 2019) and Argo profiles, we also assess the role of eddies in mode water transport and subduction.

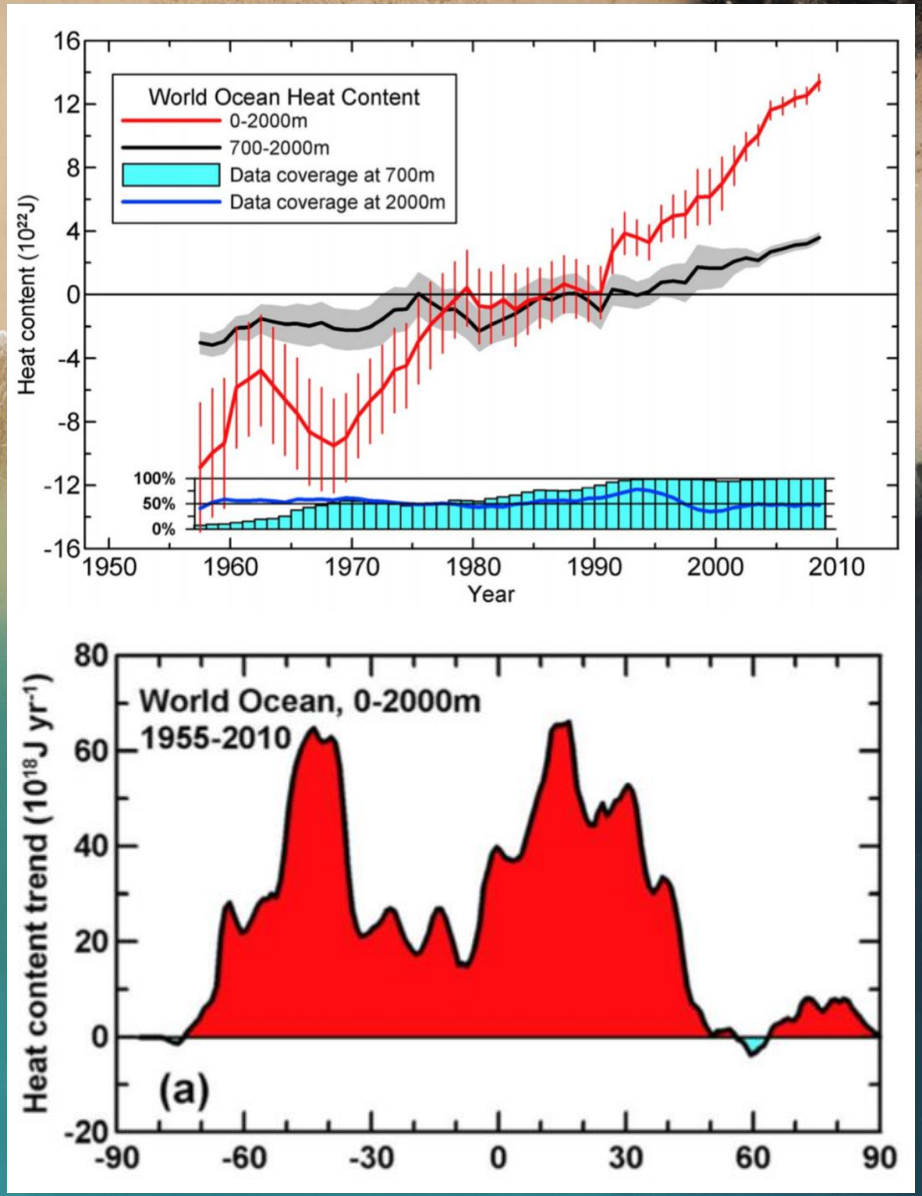
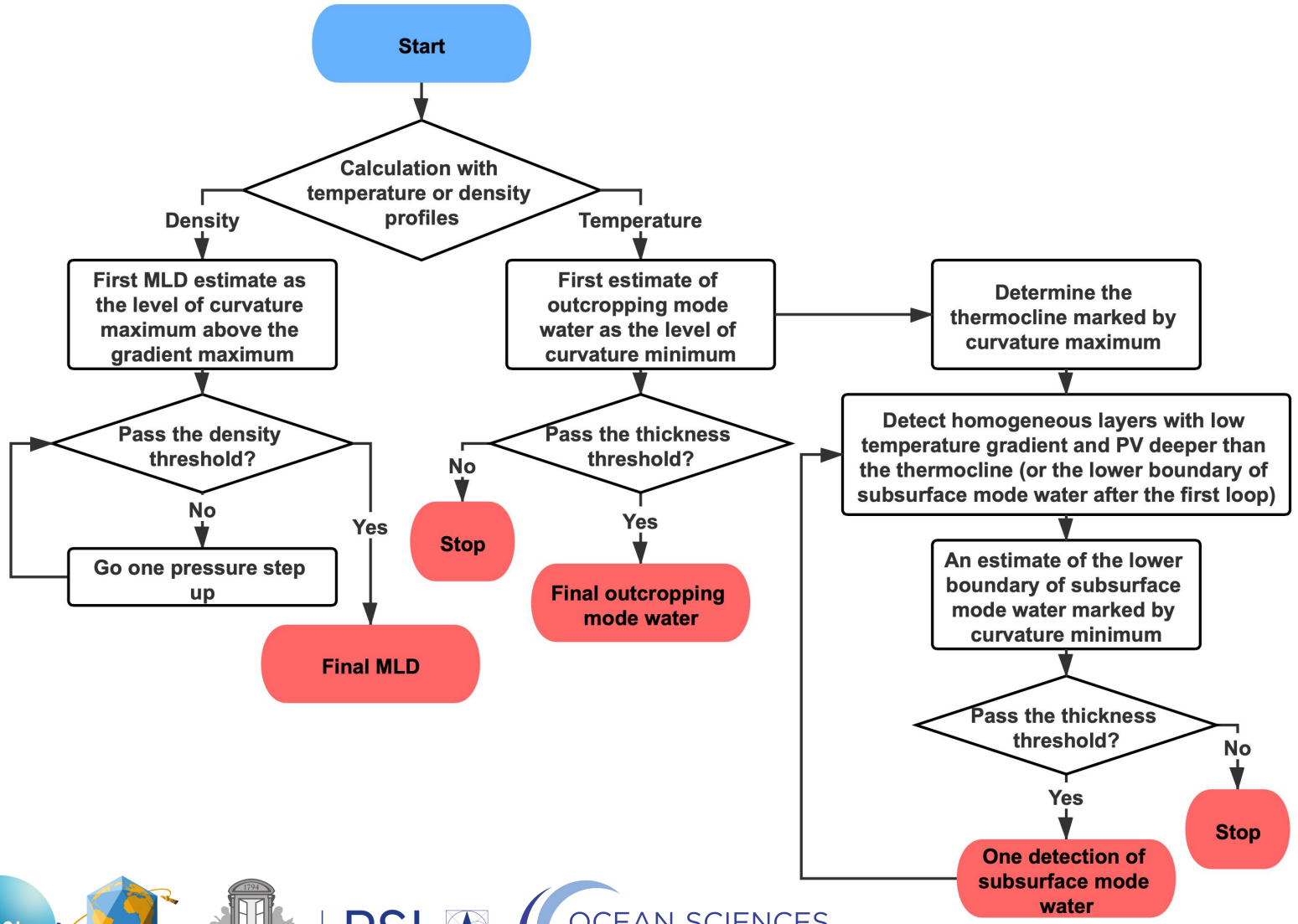


Figure: Ocean heat content. (Levitus et al., 2012)

The MLD and MW algorithm



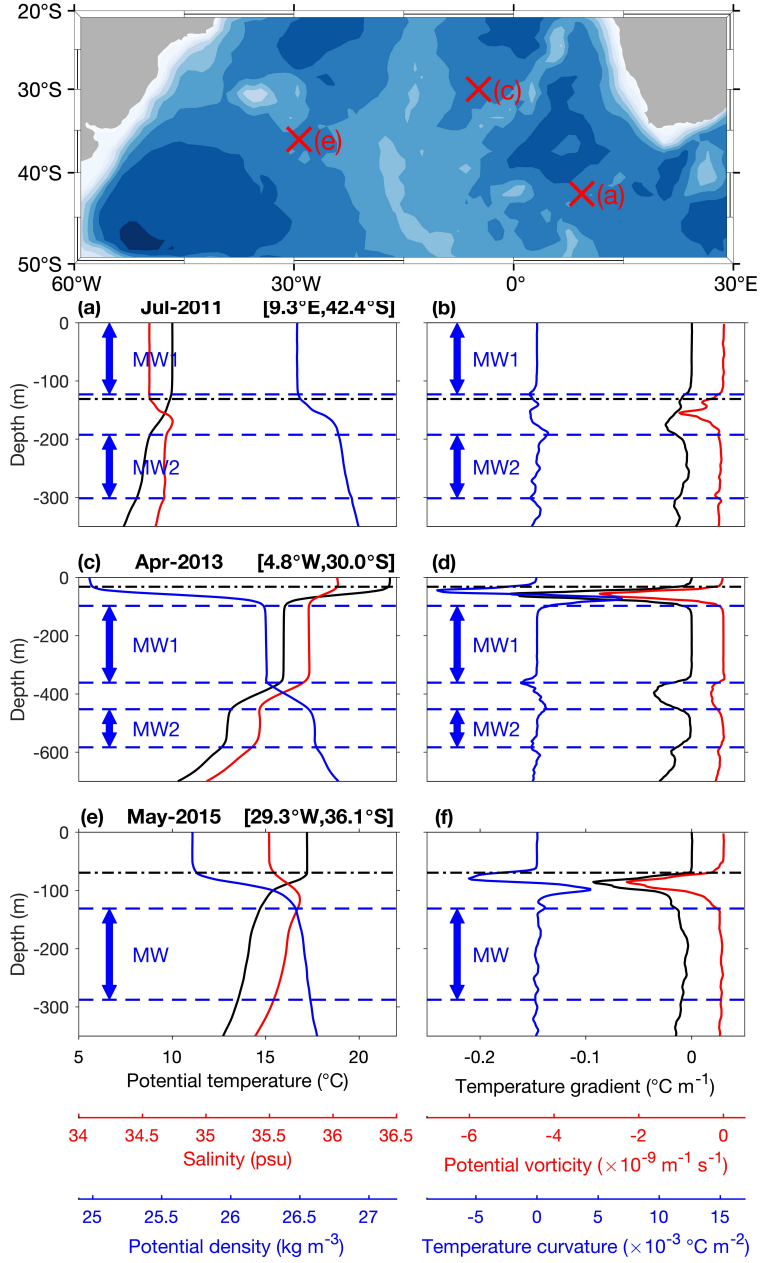


Figure: Three profile examples in the South Atlantic. (Chen et al., 2021)

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Global MLD distribution

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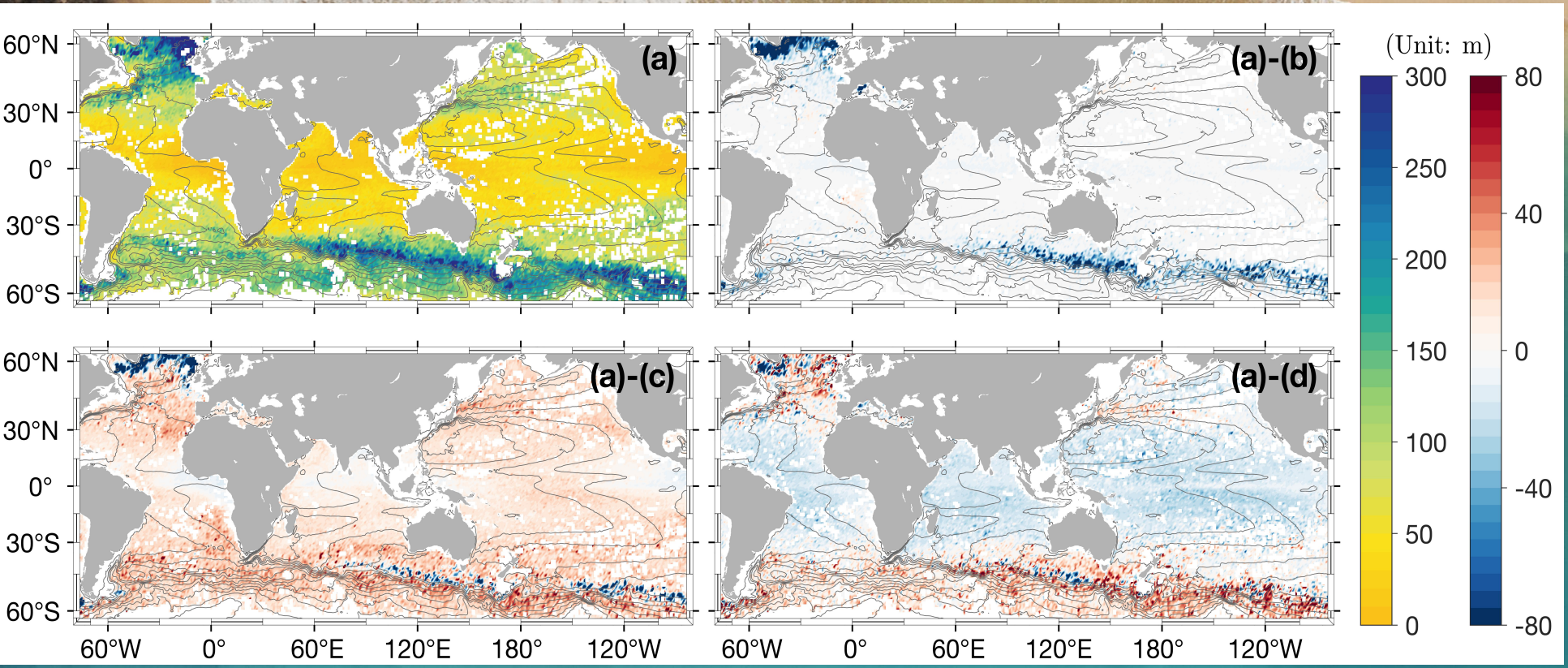

Figure: Winter-mean MLDs.

Four methods of MLD detection are:

(a) The new algorithm

(b) Density threshold

(c) Density gradient

(d) A hybrid method (Holte and Talley, 2009)

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Mode Water T-S relation

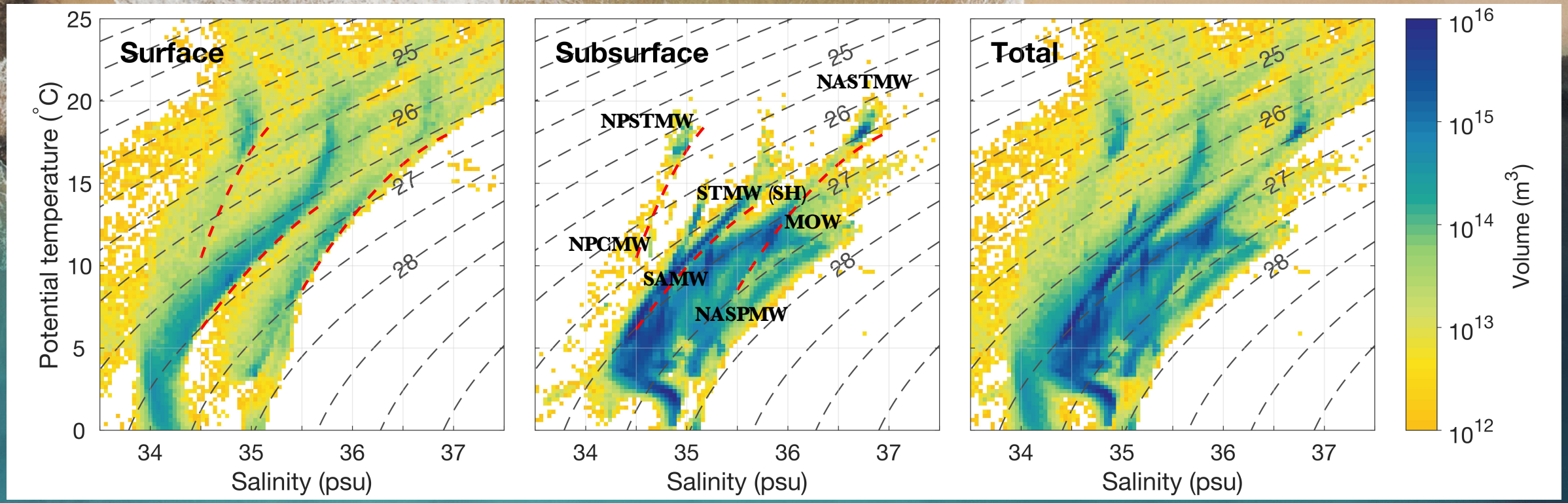
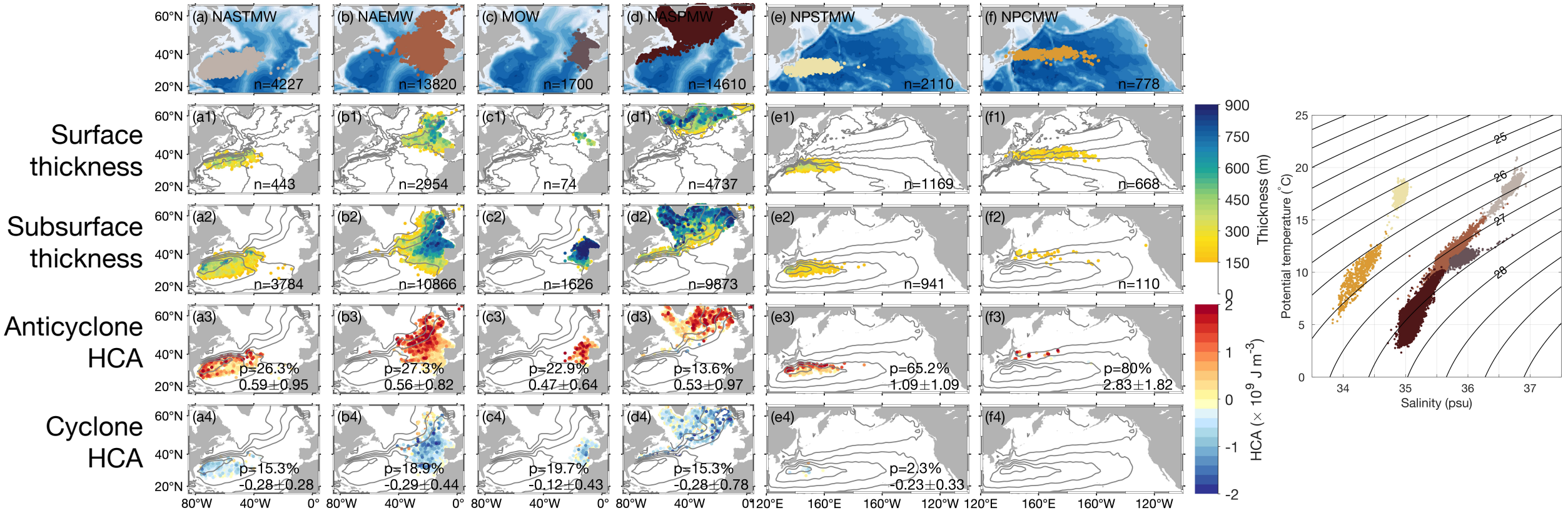


Figure: Temperature-salinity diagram of surface and subsurface mode waters detected by the new algorithm.

Mode Water in the Northern Hemisphere



- 4 MW groups in the North Atlantic, and 2 varieties in the North Pacific.
- Surface MWs for each group are retrieved from the entire pool with the same properties as subsurface MWs.
- The positive HCA inside MWs is related to co-location with anticyclones.

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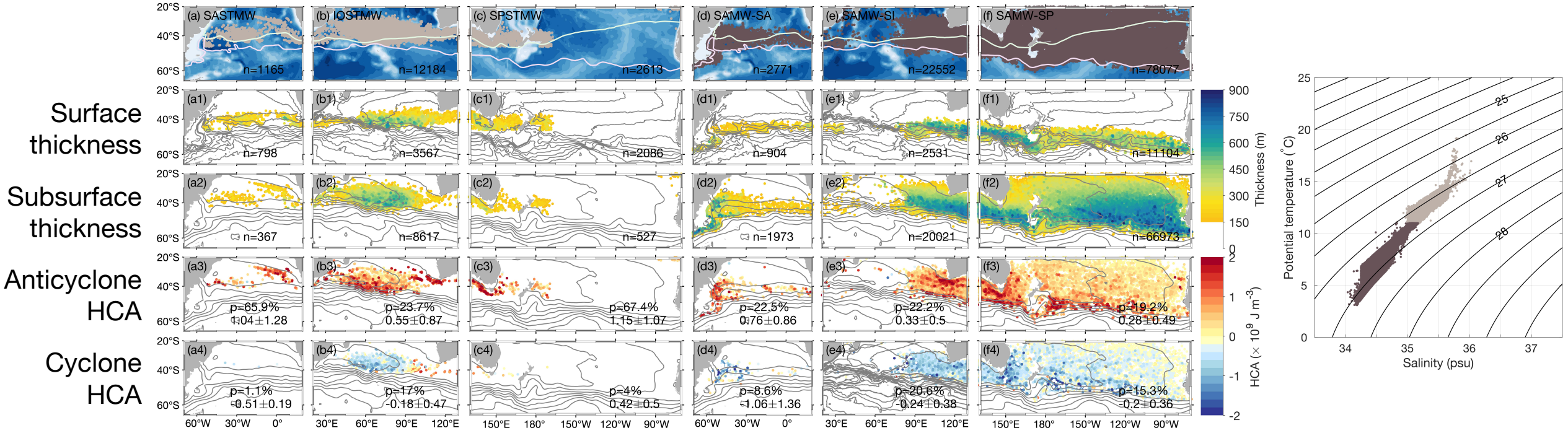
Mode Water in the Southern Hemisphere



- Cluster analysis is applied to divide all subsurface MWs into 2 types.
- STMWs originate at the northern periphery of STF, and SAMWs are formed insize the SAZ.
- Interbasin heat transport is associated with anticyclonic eddies.

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Prospectives

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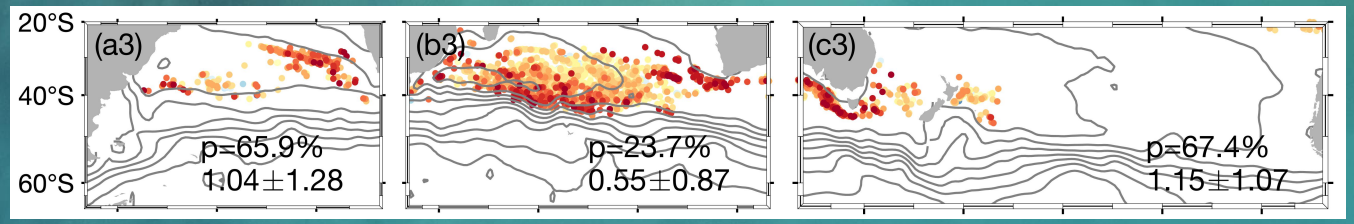
- Evidence shows 60%-90% of excess heat is absorbed by the Southern Ocean, which draws attention to the ability of SAMWs in taking up heat.
- The detection of subsurface eddies (that are not detectable from satellite) needs to improve.
- By comparing the trajectories of anticyclonic eddies and the depths of these mode waters, we can assess the ventilation process associated with eddies.



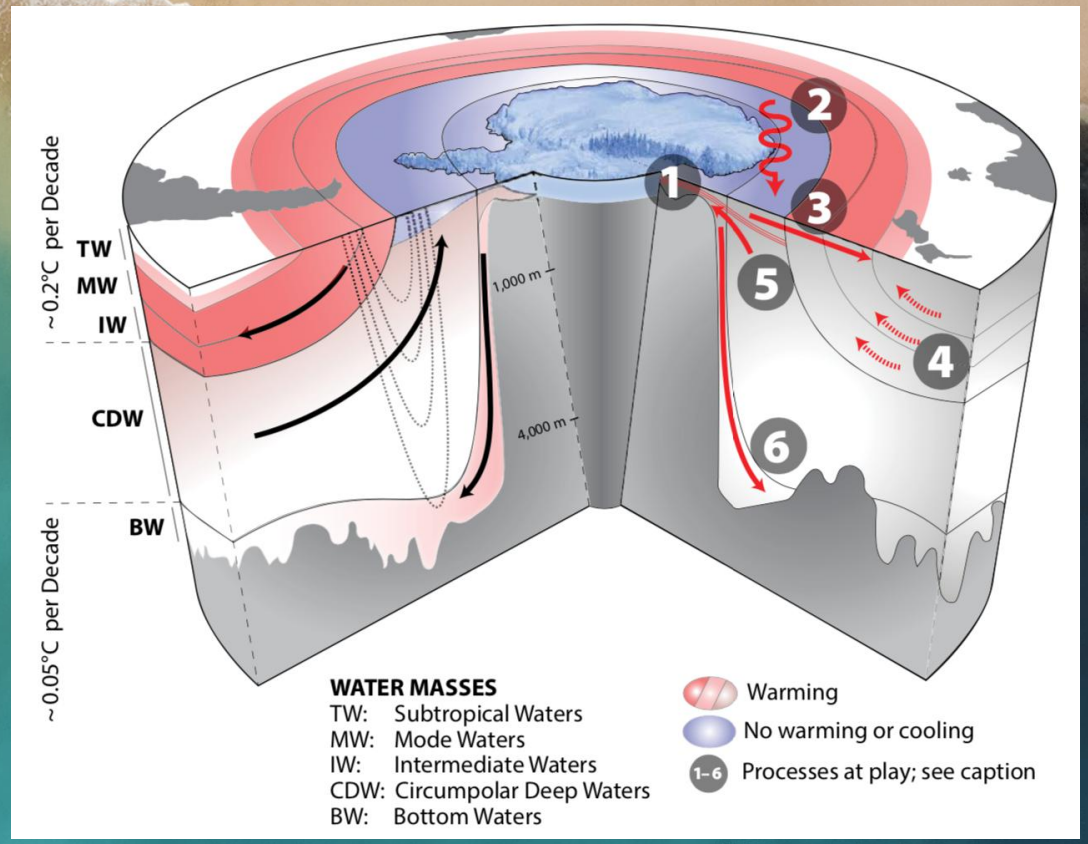


Figure: Temperature trends in different layers of the Southern Ocean. (Sallée, 2018)

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