Subsurface cross-slope exchange in the Australian-Antarctic Basin

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Autonomous profiling float (Argo) data during the last decade, including under-ice data, were analyzed to describe the mean structure of the subpolar gyre in the Australian-Antarctic Basin. According to their trajectories, the gyre is meridionally regulated by the westward Antarctic Slope Current and the eastward flow maximum along the 4000 m isobath, which corresponds to the southernmost jet of the Antarctic Circumpolar Current (ACC). The Southern Boundary of ACC, commonly defined by the southern limit of the 1.5 °C isotherm, travels inside the gyre in contrast to the Weddell and Ross Gyres, so that Circumpolar Deep Water (CDW) offshore can deliver relatively much heat to the shelf. The Antarctic Slope Current flows generally along the continental slope and is deflected by the topographic features, leading to meridional flows near the slope. The meridional flows were accordingly observed with the potential temperature; northward and southward flows are correlated with cold and warm waters, respectively, indicating the heat transport by mean flows.

Potential temperature for a subsurface density range 27.7-27.8 kg/m^3 (in σ_θ) is presented in Fig.1. Since the southward intruding warm waters are accompanied by the shallow temperature maximum, they shall correspond to CDW intrusions onto the shelf. The distinctive intrusions are recognized at 113 and 120 °E. Meanwhile, the seaward excursions of cold water can be the signal of either Shelf Water export or deepened Winter Water. To discern the nature of watermass, the depth of permanent pycnocline was examined. Subsequently, as winter mixing is not likely to reach the isopycnal of 27.7 kg/m^3 as reported in Wong and Riser (2011), the cold signals can be attributed to water originated from the shelf. Furthermore, the density of 27.7 kg/m^3 well agrees with the upper limb of CDW signals, whereas 27.8 kg/m^3 is the typical density for bottom on the shelf (Nistche et al. 2017). We conclude that this subsurface layer is responsible for the cross-slope exchange in the region.

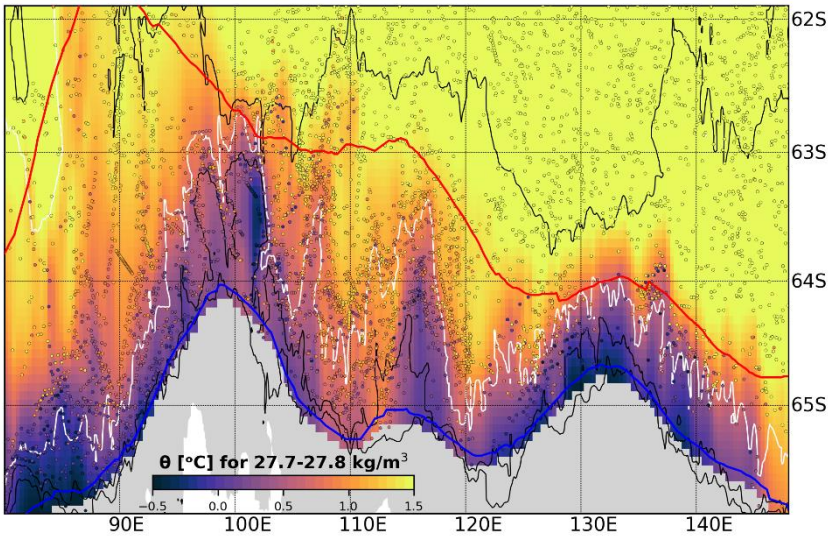

Figure 1. Potential temperature averaged for the isopycnal range 27.7-27.8 kg/m^3 in study region. Bathymetry is drawn for every 1000 m, while the isobath of 3000 m is highlighted by white contour. Red and Blue lines denote the Southern Boundary and the Antarctic Slope Front, respectively, calculated from the gridded climatological dataset of Shimada et al. (2017).

References

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