

**EVIDENCE FOR A CROSS FRONTAL HEAT PUMP IN THE SOUTHERN OCEAN**

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The Southern Ocean plays a critical role in the global thermohaline circulation. With no continental barriers, the ACC is the primary means by which, water, heat and salt is transferred between the Pacific, Atlantic, and Indian Oceans. Furthermore, the creation of specific water masses that move meridionally across the frontal regions of the Southern Ocean are an inherent component of global climate. Indeed, topographically induced meridional transport suggest that advection by transient eddies plays a central role in the Southern Ocean overturning circulation. This meridional exchange of heat and salt is not geographically uniformly distributed, but is concentrated in a number of specific regions where high levels of mesoscale turbulence are generated. We have identified a powerful and heuristic example of such a region at the South-West Indian Ridge in which cross-ACC heat transport is dependent on diapycnal processes. We show from first direct measurements of eddy shedding and meridional fluxes, that compact eddies of pure Antarctic water are shed across the APF into the Subantarctic at an average of 3 a year, that they have a longevity of approx. 10 months and that they sustain annual meridional heat and salt fluxes of  $-17 \times 10^{19}$  J and  $-24 \times 10^{11}$  kg. These results may be applicable to similar eddy pumping locations elsewhere in the Southern Ocean and could in principle be relatively easily monitored with appropriate remote sensing. Despite the importance of these processes, eddy heat transport remains one of the most poorly observed quantities in the Southern Ocean and coarse resolution climate models do not accurately resolve the transport associated with these features. Current meter data does provide point estimates of heat fluxes, however coverage is poor and there has been no means to determine whether these isolated measurements provide reliable indicators of zonally integrated meridional heat fluxes. It is thus crucial that the meridional heat and salt fluxes forced by these eddies be adequately quantified from hydrographic data and incorporated into regional and global climate models.