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Estimating Horizontal Mixing in the ACC from Argo Trajectories

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Abstract:

There are few direct observations of cross-stream isopycnal mixing in the interior of the Southern Ocean, yet such measurements are needed to determine the role of eddies transporting properties across the ACC, and key to progress toward testing theories of meridional overturning. In light of this we present two new approaches for computing cross-stream isopycnal mixing before testing both in numerical models and the DIMES region and then applying the methods to Argo data to obtain circumpolar diffusivities. Resulting diffusivities ranged from 300 to 3000 m^2s^{-1}, with peaks corresponding to the Scotia Sea; Kerguelen and Campbell Plateaus. Finally, these estimates were compared to mixing length suppression theory presented in Ferrari and Nikurashin (2010). This mixing length suppression theory quantifies horizontal diffusivity similar to Prandtl (1925), but the mixing length is suppressed in the presence of mean flows and eddy phase speeds. Our results suggest that the theory can explain both the structure and magnitude of mixing using mean flow data. An exception is near the Kerguelen and Campbell Plateaus where theory under-estimates mixing relative to our results.