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The Antarctic Circumpolar Current's Southern Boundary at the Greenwich Meridian

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The southern boundary of the Antarctic Circumpolar Current (ACC) is often associated with the southern limit of Upper Circumpolar Deep Water, and so forms the boundary between warm ACC waters and colder waters within the marginal seas of Antarctica. Strong density gradients across the southern boundary constitute the frontal jet and are thought to modulate the heat transport across the southern boundary. It is well known that eddies cross the fronts of the ACC and are advected downstream, but how does an eddy interact with the southern boundary of the ACC? Does it change its frontal structure? Does it impact the intensity of the frontal jet? Can changes of the southern boundary's frontal structure impact mixing? These are questions that we aim to discuss.

As part of the Robotic Observations And Modelling in the Marginal Ice Zone (ROAM-MIZ) project, profiling ocean glider observations at the Greenwich Meridian between 54-57 °S from the 20th of October 2019 to the 18th of February 2020 provide a unique data set of 5 highly resolved hydrographic transects that cross the southern boundary repeatedly. Θ/S diagrams from the hydrographic transects, maps of absolute dynamic topography and dive average currents are used to identify the location, properties and rotational direction of eddies crossing the meridional transects in close proximity to the southern boundary and the frontal jet. We demonstrate that a cyclonic eddy crossing the meridional transect significantly impacts the southern boundary's frontal structure. While the eddy is crossing the meridional transect, density gradients are strengthened and geostrophic velocities show a narrow and strong frontal jet (~50 km wide with velocities of ~80 cm/s). Shortly after the eddy has crossed the meridional transect, density gradients are weakened and geostrophic velocities show a broadened and weakened frontal jet (~75 km wide with velocities of ~60 cm/s). Mixing length scales (the length at which a water parcel can move before mixing laterally) are calculated for all transects with L_mix=Θ_rms/(□_n Θ_m) (Θ_rms a measure of temperature fluctuations , □_n the gradient along density surfaces and Θ_m mean temperature field). Values of L_mix are near zero across the frontal jet while the eddy is crossing and near 40 km after the eddy has crossed the meridional transect. The increased mixing length scales indicate that the exchange of water parcels between ACC waters and waters further south is increased after the eddy has crossed the meridional transect.