

Estimating the Mean Antarctic Circumpolar Current in Drake Passage using Satellite Altimetry and Direct Velocity Observations

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The Antarctic Circumpolar Current (ACC) is a key component of the global overturning circulation where mesoscale eddies are thought to transport heat and momentum vertically and meridionally. However estimates of eddy heat and momentum fluxes are sensitive to the mean field used and defining a high resolution mean ACC has been inhibited by the paucity of Southern Ocean observations. Here we present an estimate of improved mean surface velocities of the ACC that integrates AVISO sea-surface height anomaly maps ([1], [2]), produced by merging altimetry from several satellites, with a new dataset of repeat in situ velocity observations in Drake Passage. The coverage and time resolution of the merged altimeter product resolves the 2-D structure and evolution of the geostrophic eddies well. This complements the velocity observations that are limited to ship tracks and irregularly sampled in time but have high horizontal resolution. Surface geostrophic current anomalies, inferred from the sea surface height anomaly maps, compare well with direct surface-layer velocity observations of mesoscale eddies in Drake Passage. By subtracting the inferred geostrophic current anomalies from instantaneous direct current observations, removing the predicted barotropic tide and depth- and time-averaging to reduce the inertial current signal, an improved gridded mean of surface layer velocities in Drake Passage is produced. The improved mean surface velocities are smoother and less divergent than gridded mean velocities computed from the direct velocity measurements alone. Variance ellipses for the improved mean are appreciably smaller than variance ellipses for the gridded mean direct velocities, indicating that the variability seen in the altimetry accounts for a significant portion of the in situ variability. The improved mean surmounts the limitation of imperfectly knowing the geoid, and hence absolute sea surface height from altimetry, and also includes the mean ageostrophic component of the ACC in Drake Passage.

Keywords: Altimetry; Antarctic Circumpolar Current; Mesoscale Eddies; Mean Velocities.

References

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