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Variability in surface-layer currents and acoustic backscatter observed from Drake Passage repeat ADCP observations

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In 1999 we began a program of high-resolution current profiling from the U.S. Antarctic supply vessel ARSV Laurence M. Gould (LMG), and in 2004 we increased the vertical profiling range from about 300 m to 800 m by adding a 38 kHz phased array. The ship crosses Drake Passage 2-4 times per month in all seasons. Though irregular in space and time, the LMG dataset provides a unique time series of highly resolved (5-km horizontal resolution) velocity and backscattering strength sampled continuously along 172 crossings as of December 2006.

Variability in surface-layer velocity is dominated by mesoscale eddies and near-inertial currents. Inertial currents increase the eddy kinetic energy (EKE) more in the mixed layer than below. EKE at all depths decreases poleward, ranging from $\sim$800 cm^2 s^{-2} to $\sim$200 cm^2 s^{-2}. ADCP EKE estimates are everywhere significantly higher than altimetric EKE estimates, although the pattern of poleward decrease is the same. Mesoscale eddies dominate the variance in northern Drake Passage where EKE is concentrated between the Subantarctic Front and the Polar Front. Inertial variability is constant with latitude and together with baroclinic tides accounts for some but not all of the discrepancy between the ADCP surface-layer EKE and altimetry-inferred EKE. The cross-passage wavenumber spectrum of the down-passage velocity component peaks at 250 km wavelength. Backscattering strength shows significant differences north and south of the Polar Front on seasonal time scales, with the average summer maximum north of the Polar Front more than twice the maximum to the south. On interannual time scales, a fourfold decrease in backscattering strength over 5 years is observed south of the Southern Antarctic Circumpolar Current Front.