The role of turbulent mixing in the modified Shelf Water overflows that produce Cape Darnley Bottom Water

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The mixing process associated with modified Shelf Water (mSW) overflows that eventually mix to form Cape Darnley Bottom Water (CDBW) was investigated by hydrographic and microstructure observations off the Cape Darnley Polynya (CDP), East Antarctica, in January 2009. Closely spaced microstructure observations revealed that mSW properties varied considerably within a distance of ~4 km across the shelf edge. Near the bottom, the rate of turbulent kinetic energy dissipation was enhanced to values greater than 10^{-7} W kg^{-1}, and the vertical scale of the bottom boundary layer (BBL) was on the order of 10 m. The observed BBL around the shelf edge was characterized by strong vertical mixing with turbulent eddy diffusivities of ~$O(10^{-3}$–$10^{-2})$ m^2 s^{-1}. A geostrophically balanced density current, which resulted from the presence of mSW over the continental shelf, is considered the primary energy source for the turbulent mixing in the BBL. This turbulent mixing transforms the overflowing mSW through mixing with ambient water masses, specifically with the overlying modified Circumpolar Deep Water. The BBL is also thought to partly contribute to the gradual descent of mSW down the continental slope through bottom Ekman transport. We conclude that turbulent mixing, primarily caused by a density current, plays an important role in CDBW formation, by modifying the mSW overflowing from the CDP.

Keywords: turbulent mixing, modified Shelf Water, Cape Darnley Bottom Water

