Climate impact on interannual variability of Weddell Sea Bottom Water

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Bottom water formed in the Weddell Sea plays a significant role in ventilating the global abyssal ocean, forming a central component of the global overturning circulation. To place Weddell Sea Bottom Water in the context of larger scale climate fluctuations, we analyze the temporal variability of an 8-year (April 1999 through January 2007) time series of bottom water temperature relative to the El Niño/Southern Oscillation (ENSO), Southern Annular Mode (SAM), and Antarctic Dipole (ADP). In addition to a pronounced seasonal cycle, the temperature record reveals clear interannual variability with anomalously cold pulses in 1999 and 2002 and no cold event in 2000. Correlations of the time series with ENSO, SAM, and ADP indices peak with the indices leading by 14–20 months. Secondary weaker correlations with the SAM index exist at 1–6 month lead time. A multivariate EOF analysis of surface variables shows that the leading mode represents characteristic traits of out-of-phase SAM and ENSO impact patterns and is well separated from other modes in terms of variance explained. The leading principal component correlates with the bottom water temperature at similar time scales as did the climate indices, implying impact from large-scale climate. Two physical mechanisms could link the climate forcing to the bottom water variability. First, anomalous winds may alter production of dense shelf water by modulating open-water area over the shelf. Second, surface winds may alter the volume of dense water exported from the shelf by governing the Weddell Gyre's cyclonic vigor.