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Recent recovery of Antarctic Bottom Water formation in the Ross Sea driven by climate anomalies

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Antarctic Bottom Water (AABW) supplies the lower limb of the global overturning circulation, ventilates the abyssal ocean and sequesters heat and carbon on multidecadal to millennial timescales. AABW originates on the Antarctic continental shelf, where strong winter cooling and brine released during sea ice formation produce Dense Shelf Water, which sinks to the deep ocean. The salinity, density and volume of AABW have decreased over the last 50 years, with the most marked changes observed in the Ross Sea. These changes have been attributed to increased melting of the Antarctic Ice Sheet. Here we use in situ observations to document a recovery in the salinity, density and thickness (that is, depth range) of AABW formed in the Ross Sea, with properties in 2018–2019 similar to those observed in the 1990s. The recovery was caused by increased sea ice formation on the continental shelf. Increased sea ice formation was triggered by anomalous wind forcing associated with the unusual combination of positive Southern Annular Mode and extreme El Niño conditions between 2015 and 2018. Our study highlights the sensitivity of AABW formation to remote forcing and shows that climate anomalies can drive episodic increases in local sea ice formation that counter the tendency for increased ice-sheet melt to reduce AABW formation.

