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Antarctic Forcing of Abrupt Global Climate Change During Isotope Stage 3

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Contrasting Greenland and Antarctic temperature trends during the late Pleistocene (60,000 to 11,650 years ago) are thought to be driven by imbalances in the rate of formation of North Atlantic and Antarctic Deep Water (the 'bipolar seesaw'), with millennial-scale cooling Dansgaard-Oeschger (D-O) events in the north leading warming in the south. An alternative origin for these abrupt climate shifts, however, is the Southern Hemisphere whereby changes are transmitted globally via atmospheric and/or oceanic teleconnections. Testing these competing hypotheses is challenging given the relatively large uncertainties associated with dating terrestrial, marine and ice core chronologies. Here we use a fully coupled climate system model to investigate whether freshening of the Southern Ocean has extra-regional climate impacts. Focusing on an Isotope Stage 3 cooling event preserved in Antarctic ice cores immediately prior to Antarctic Isotope Maximum 4 (AIM 4; around 29,000 years ago) we undertook an ensemble of transient meltwater simulations. We observe no impact on the Atlantic Meridional Overturning Circulation (AMOC) from freshwater hosing in the Southern Ocean but a dramatic warming over the North Atlantic and contrasting precipitation patterns across the low latitudes. Exploiting a new bidecadally-resolved 14C calibration dataset obtained from New Zealand kauri (Agathis australis) we undertook intensive radiocarbon dating and high-resolution multiproxy analysis of the tropical Australia Lynch's Crater terrestrial peat sequence spanning this same period and find a synchronous change in hydroclimate to the purported meltwater event in the Southern Ocean. Our results imply Southern Ocean dynamics played a significant role in driving global climate change across this period via atmospheric teleconnections, with implications for other abrupt events through the late Pleistocene.