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# Deep-water temperature change across ‘Heinrich-events’ and its implications for inter-hemispheric coupling via the thermal bipolar seesaw

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The canonical theory for explaining past abrupt climate change recorded in the polar ice-cores is that it represents a ‘thermal bipolar seesaw’, where high latitude Northern Hemisphere temperature changes drive Antarctic temperature changes ‘with a fading memory’, specifically due to changes in ocean heat transport associated with the Atlantic Meridional Overturning Circulation (AMOC). A key element of this theory is the relatively long time-scale for temperature adjustment in Antarctica; a timescale that incidentally (perhaps accidentally) is broadly consistent with deep-water turnover times for example. Notably, a similar timescale applies to a major component of atmospheric $CO_2$ changes that occurred in parallel. A further key element of the thermal bipolar seesaw theory is that significant changes in the distribution of temperature, in particular within the ocean interior, are expected to have occurred in parallel with seesaw events. Here we present deep-water temperature reconstructions from the last glacial period that tentatively confirm this latter expectation, broadly (though crucially not always exactly) as many numerical model simulations suggest. The thermal fingerprint implied by the available data may help to constrain the mechanisms responsible for warming Antarctica during North Atlantic stadials, and may also provide insights into the millennial timescale required for this warming process. As the number of viable mechanisms responsible for the thermal bipolar seesaw increases, it will become increasingly important to precisely pin down the deep ocean’s thermal fingerprint across millennial seesaw events. We propose that numerical model simulations will prove invaluable in identifying which thermal fingerprints in which parts of the ocean are best able to distinguish between the various candidate bipolar seesaw mechanisms.