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Antarctic warming driven by internal Southern Ocean deep convection oscillations

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Simulations with the free-running, complex coupled Kiel Climate Model (KCM) show that heat release associated with recurring Southern Ocean deep convection can drive centennial-scale Antarctic temperature variations of 0.5–2.0 °C.

We propose a mechanism connecting the intrinsic ocean variability with Antarctic warming that involves the following three steps:

1. *Preconditioning*: heat supplied by the lower branch of the Atlantic Meridional Overturning Circulation (AMOC) accumulates at depth in the Southern Ocean, trapped by the Weddell Gyre circulation;
2. *Convection onset*: wind and/or sea-ice changes tip the preconditioned, thermally unstable system into the convective state;
3. *Antarctic warming*: fast sea-ice–albedo feedbacks (on annual to decadal timescales) and slower Southern Ocean frontal and sea-surface temperature adjustments to the convective heat release (on multi-decadal to centennial timescales), drive an increase in atmospheric heat and moisture transport towards Antarctica resulting in warming over the continent.

Further, we discuss the potential role of this mechanism to explain climate variability observed in Antarctic ice-core records.