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Simulating the impact of an AMOC weakening on the Antarctic Ice Sheet using a coupled climate and ice sheet model

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Many model studies show that a shutdown of the Atlantic meridional overturning circulation (AMOC) causes reduced northward heat transport into the North Atlantic and a warming Southern Ocean in addition to shifts in large-scale atmospheric circulations. How these changing climate conditions could influence the present-day state of the Antarctic Ice Sheet is little studied even though observational data of AMOC strength show a slowdown trend over the last decades. The ocean current as well as the Antarctic Ice Sheet might reach climate tipping points triggering irreversible processes with consequences already on human time-scales. It's unclear whether increasing Southern Ocean temperatures due to a AMOC shutdown could accelerate basal melting rates, the critical parameter which in turn may induce tipping of the West Antarctic Ice Sheet.

Here, a freshwater hosing that forces the shutdown of the AMOC is applied to the North Atlantic in a global climate model with an interactive ice sheet model for Antarctica. This model framework consists of the Parallel Ice Sheet Model (PISM) that is coupled to the CM2Mc global Earth system model via the ice shelf cavity model PICO (Potsdam Ice-shelf Cavity mOdel). PISM is interactively coupled to the ocean module in order to investigate feedbacks at the ice-ocean boundary, while the atmospheric forcing is prescribed. Preliminary results show that an AMOC shutdown results in warming sea surface temperatures in the southern hemisphere along with a small shift in the mid-latitude westerlies due to reduced northward heat transport, which is in line with previous studies. Antarctic marginal temperatures decrease, however, resulting in a reduction of Antarctic mass through increased calving and decreased basal melting.