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Different ice sheets – different AMOC? Revisiting the ice-sheet effect on the LGM AMOC

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Coupled climate models have produced very different states of the Atlantic Meridional Overturning Circulation (AMOC) in simulations of the Last Glacial Maximum (LGM). In particular, many of them failed to capture the shoaling of the upper AMOC cell, which was indicated by reconstructions. In sensitivity simulations with the Max-Planck-Institute Earth System Model (MPI-ESM) we found that the glacial AMOC response is the sum of two large opposing effects: a strengthening and deepening of the upper cell in response to the glacial ice sheets and a weakening and shoaling of the upper cell in response to the low glacial greenhouse gas concentrations. The magnitude of the respective effects likely depends on the background climate, the ice sheet reconstruction used, and model specifics such as the representation of brine release in the Southern Ocean.

Transient simulations of the deglaciation with two differently tuned versions of MPI-ESM and two different ice-sheet reconstructions differ strongly in their respective AMOC states during the LGM. These simulations, together with selected PMIP3 and PMIP4 LGM simulations, provide a good opportunity to compare the effect of different ice sheet reconstructions on the glacial AMOC. We compare key variables such as water mass properties, salt transport and Southern Ocean sea-ice formation across this ensemble of opportunity with the aim of increasing our understanding of the role of ice sheets in the glacial AMOC response.