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The response of the glacial AMOC to changing greenhouse gas forcing

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Although most climate models reproduce the Last Glacial Maximum (LGM) climate reasonably well, there are still large differences between the models regarding the state of the glacial Atlantic Meridional Overturning Circulation (AMOC). The cause for these differences is not yet well understood.
The present study has the scope of studying the response of the glacial AMOC to different sets of forcings (greenhouse gas concentrations, orbit configurations and ice sheets) in the coupled climate model MPI-ESM.
With these experiments we want to investigate possible non-linearities of the glacial AMOC and whether a threshold, similar to the one found by Oka et al (2012) in an uncoupled ocean model, can be found in a coupled climate model.
In a first set of experiments we apply different sets of greenhouse gas concentrations (GHGCs) to a setup with glacial topography, ice sheets and orbit. The concentrations range from values below the glacial level up to values above the preindustrial level. The intervals are chosen such that the radiative forcing increases approximately linearly. The model is integrated to a quasi-equilibrium for each set of GHGCs and we analyze the steady state response.
First results indicate that the strength of the AMOC decreases with decreasing GHGCs. For GHGCs with pCO_2 below 230 ppm the North Atlantic Deep Water (NADW) overturning cell shallows and no deep convection occurs in the Nordic Seas. The density contrast between NADW and Antarctic Bottom Water (AABW) increases due to a non-linear salt increase in the Weddell Sea. Deep convection patterns in the North Atlantic suggest a deep water formation mode which is triggered by the presence of the glacial land ice sheets.
Additional experiments will further investigate the effect of the ice sheets.