



How does Greenland respond and interact in near-future projects: Fully coupled ice sheet-earth system simulations

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As ice sheets belong to the slowest climate components, they are usually not interactively coupled in current climate models. Therefore, long-term climate projections are incomplete and only the consideration of ice sheet interactions allows tackling fundamental questions, such as how do ice sheets modify the reaction of the climate systems under a strong CO₂ forcing?

The earth system model MPI-ESM, with the atmosphere model ECHAM6 and ocean model MPIOM, is coupled to the modified ice sheet model PISM. The ice sheet model represents the Greenlandic ice sheet at a horizontal resolution of 10 km. The coupling is performed by calculating the surface mass balance based on 6-hourly atmospheric data to determine the boundary condition for the ice sheet model. The response of the ice sheet to this forcing, which includes orographic changes and fresh water fluxes, are passed back to the ESM. In contrast to commonly used strategies, we use a mass conserving scheme and do therefore neither apply flux corrections nor utilize anomaly coupling.

Under a strong CO₂ forcing a disintegrating Greenlandic ice sheet contributes to a rising sea level and has the potential to alter the formation of deep water masses in the adjacent formation sites Labrador Sea and Nordic Seas. We will present results for selected scenarios and for idealized forcings, such as a growing atmospheric CO₂ concentration that rises by 1% per year until four-times the pre-industrial level has been reached. We will discuss the reaction of the ice sheet and immediate responses of the ocean to ice loss.