



Simulating the effect anthropogenic climate change on the Greenland ice sheet

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In the standard simulations of CMIP5 the coupling with the ice sheets is not included. Only few groups have been able to perform CMIP5 simulations with interactively coupled ice sheets. Beside its importance for the future development of global mean sea level, the Greenland ice sheet has also the potential to strongly affect deep water formation especially in the Labrador Sea but also in the Nordic Seas. Here simulations are presented with interactively coupled ice sheet models, which allows to assess the uncertainty arising from ice sheet model and coupling technique.

The climate model ECHAM5/MPIOM is coupled interactively to two different ice sheet models using two different coupling strategies. The ice sheet models are a Greenland set-up of SICOPOLIS with 10 km horizontal resolution and a northern hemisphere set-up of PISM with a horizontal resolution of 20 km. The coupling is done either with a simple positive degree days approach or a mass-balance scheme calculating the surface melting with an energy-balance scheme. The models are run without flux correction of anomaly coupling.

The resulting net mass loss rates for the Greenland ice sheet in a 1 percent scenario capped at 4x preindustrial atmospheric CO₂ concentrations showed a considerable dependence on both ice sheet model and coupling technique. The resulting differences in atmospheric climate, however, are small within the first centuries and restricted to the immediate vicinity of Greenland.

The feedbacks between atmosphere, ocean and the Greenland ice sheet are studied in a series of sensitivity experiments, where is partially suppressed. It turns out that the future development of the Atlantic overturning and its associated heat transport are quite important for the future development of the mass of the Greenland ice sheet: The stronger the Atlantic overturning remains, the stronger the mass loss of the Greenland ice sheet.