Geophysical Research Abstracts
Vol. 14, EGU2012-6978-2, 2012
EGU General Assembly 2012

Anthropogenic climate change and the Greenland ice sheet

U. Mikolajewicz (1), M. Vizcaíno (2), C. Rodehacke (1), and F. Ziemen (1)

(1) Max-Planck-Institut f. Meteorologie, Hamburg, Germany (uwe.mikolajewicz@zmaw.de), (2) Institute for Marine and Atmospheric Research Utrecht (IMAU), Utrecht University, Utrecht, The Netherlands

In the standard CMIP5 simulations the ice sheets are kept fixed. Only few groups have been able to perform CMIP5 simulations with interactively coupled ice sheet models. Beside its importance for the future evolution of global mean sea level, the Greenland ice sheet also has the potential to strongly affect deep water formation, especially in the Labrador Sea, but also in the Nordic Seas. Here we present a set of simulations with two interactively coupled ice sheet models, which allows to assess the uncertainty arising from both the ice sheet model as well as the 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 atmospheric forcing is applied directly to the ice sheet model without flux correction or anomaly coupling, which avoids inconsistencies between the models.

The resulting net mass loss rates for the Greenland ice sheet in a 1-percent-scenario capped at 4x preindustrial atmospheric CO_2 concentrations show 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 individual feedbacks were suppressed. It turns out that the future development of the Atlantic overturning and its associated heat transport are quite important for the future evolution of the Greenland ice sheet: The stronger the Atlantic overturning remains, the stronger the mass loss of the Greenland ice sheet.

Results from the simulations using the actual scenarios applied for the CMIP5 simulations are presented as well.