Geophysical Research Abstracts
Vol. 16, EGU2014-2266, 2014
EGU General Assembly 2014

Uncertainly in the contribution of the Greenland ice sheet to Eemian sea level rise

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We present new simulations of the Greenland ice sheet over the last two glacial cycles in order to estimate Greenland's contribution to Eemian sea level rise. For this purpose, we use the polythermal ice sheet-model SICOPOLIS, which is bi-directional coupled with the regional climate model of intermediate complexity REMBO. The ice sheet model includes a novel sub-grid scale ice discharge parameterization, which mimics both fast processes and ice discharge into the ocean via outlet glacier in a heuristic statistical approach. In our simulations, the total as well as the sectoral parameterized present-day ice discharge agrees well with the mass fluxes into the ocean from observations and findings by others.

We constrain our model using the partition between ice discharge and surface melt as found by regional climate models. For the shape of the ice-sheet, we introduce a measure of the ice thickness error at any grid point of the ice sheet and restrict it with an error limit. As further constraint, serves the range of the recently found Eemian drop in surface elevation at the NEEM ice borehole location (NEEM community members, 2013). We investigate the uncertainty due to the representation of precipitation in different model approaches in our intermediate complexity model. Further on, we inspect the uncertainty in the surface air temperature during Eemian. Finally, we compare our results with simulation by other workers.

Our simulated best-guess for Greenland contribution to the Eemian highstand lies well in between the estimates by other authors. Disregarding the uncertainly in precipitation and Eemian surface air temperature, we find a range of Eemian Greenland contribution between 0.6 and 2.5 m. When introducing the additional uncertainty the range is widening somewhat, but not drastically.

Reference

NEEM community members Eemian interglacial reconstructed from a Greenland folded ice core, Nature 493(7733), 489-494, doi: 10.1038/nature11789, 2013.