Geophysical Research Abstracts
Vol. 13, EGU2011-10425-1, 2011
EGU General Assembly 2011

The impact of a shrinking Greenland Ice Sheet on the climate in the North Atlantic region during the Last Interglacial.

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The early phase of the Last Interglacial (around 130 ka) was characterized by relatively warm climatic conditions, causing the Greenland Ice Sheet (GIS) to shrink to approximately 30% of the present size. This shrinking was accompanied by enhanced freshwater runoff from the GIS, lowered topography and changes in albedo.

We investigated the influence of this shrinking GIS on the 130ka ago climate in experiments performed with the LOVECLIM global climate model of intermediate complexity. A set of simulations with 130 ka forcings was performed, only differing in the applied freshwater forcing around Greenland. Reconstructions of the GIS during the Last Interglacial suggest that a minimum ice sheet volume was reached in around 3ka, yielding an average freshwater flux of 0.013Sv. However, because of the uncertainty involved, we forced our simulations with freshwater fluxes ranging from 0.065Sv up to around 0.15Sv.

We find that for melt rates below $\sim$0.04Sv, deep convection is mainly affected southeast of Greenland. This reduces the AMOC to $\sim$70% of its present strength while the European climate remains warm, which is in agreement with proxy-based reconstructions. If the freshwater flux is further enhanced in the model, deep water formation in the Labrador Sea is suddenly shut off, slightly cooling Western Europe. Only for fluxes over $\sim$0.13Sv large scale cooling in Europe is simulated, as a consequence of decreasing overturning in the Nordic Seas.

In additional simulations we investigated how changes in GIS topography and albedo associated with a shrinking GIS influence the climate. By comparing the model simulations with proxy data from key North Atlantic regions, melt rates during the Last Interglacial can be constrained and insight gained into the sensitivity of both past and future climates to a shrinking GIS.