Geophysical Research Abstracts
Vol. 16, EGU2014-2111, 2014
EGU General Assembly 2014

Dependence of Eemian Greenland temperature reconstructions on the ice sheet topography

Niklaus Merz (1,2), Andreas Born (1,2), Christoph Raible (1,2), Hubertus Fischer (1,2), Thomas Stocker (1,2)

(1) University of Bern, Physics Institute, Switzerland (merz@climate.unibe.ch), (2) Oeschger Centre for Climate Change Research, University of Bern, Bern, Switzerland

The impact of a reduced Greenland ice sheet (GrIS) on Greenland's surface climate during the Eemian interglacial is investigated employing the CCSM4 climate model. We find a distinct impact of changes in the GrIS topography on Greenland's surface air temperatures (SAT) even when correcting for changes in surface elevation which influences SAT through the lapse rate effect. The resulting lapse rate corrected SAT anomalies are driven by changes in the surface energy balance. In winter, the variable reacting strongest to changes in the topography is the sensible heat flux (SHFLX). The reason is its dependence on surface winds, which themselves are controlled to a large extent by the shape of the GrIS. Hence, regions where a receding GrIS causes higher surface wind velocities also experience anomalous warming through increased SHFLX. Vice-versa, regions that become flat and ice-free are characterized by low wind speeds, low SHFLX and anomalous cold winter temperatures. In summer, we find surface warming induced by a decrease in surface albedo in deglaciated areas and regions which experience surface melting.

The results have implications for the interpretation of Eemian temperature reconstructions based on Greenland proxy archives such as the NEEM ice core. Changing the GrIS topography acts as a local forcing for Greenland's climate, whereas the effect on the climate outside of Greenland is small and mostly negligible. For the NEEM ice core site, our model suggests that up to 3.2 °C of the annual mean Eemian warming can be attributed to these topography-related processes and hence is not linked to large-scale climate variations.