Geophysical Research Abstracts
Vol. 13, EGU2011-2203, 2011
EGU General Assembly 2011

Simulated Greenland evolution during the Eemian and MIS 11 interglacials

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Gaining insight into the long-term change of Greenland ice volume is important for understanding the future rise of sea level due to global warming. Here, we compare the reduction in simulated ice volume of the Greenland ice sheet (GIS) during the Eemian with that during MIS 11. The MIS 11 period is very interesting, because it is potentially the most recent time when Greenland was mostly ice free. This hypothesis is supported by DNA found at Dye-3 indicating the existence of boreal forest there around the time period of MIS 11. Therefore, simulations of MIS 11 combined with paleo data could help to validate model parameters. For the simulations, we utilize the regional energy-moisture balance model REMBO bi-directionally coupled to the polythermal ice sheet model SICOPOLIS, and forced with anomaly fields computed by the Earth system model of intermediate complexity CLIMBER-2. CLIMBER-2 is forced by isolation and atmospheric CO_2 over past eight glacial cycles and realistically simulates the evolution of the northern Hemisphere ice sheets and global climate. We use the temperature anomaly from CLIMBER-2 as external forcing for REMBO, along with insolation, CO_2 and sea level changes. In order to span the potential uncertainty in temperature changes and surface mass balance during MIS 11, we perform an ensemble of simulation by scaling the positive temperature anomaly during interglacial by factors ranging from 0.5 to 2 and by varying a free parameter in the surface melt scheme (within a constrained range found in a previous study). We present a detailed comparison of the simulated Greenland ice volume during the Eemian and MIS 11. While Greenland's melt during the Eemian is equally driven by temperature and insolation, the temperature plays a more important role for the melt of the GIS during MIS 11. In general, we found a stronger reduction in Greenland ice volume during MIS 11 than during the Eemian, in spite of much higher boreal summer insolation during Eemian. The simple explanation for this result is that warm climate conditions during MIS 11 lasted much longer than during Eemian interglacial.