Geophysical Research Abstracts,
Vol. 10, EGU2008-A-04970, 2008
SRef-ID: 1607-7962/gra/EGU2008-A-04970
EGU General Assembly 2008

Feedbacks between atmosphere and ice sheets: surface mass balance response to Laurentide glacial boundary conditions

J. Liakka, J. Nilsson

Department of Meteorology, Stockholm University, Sweden (liakka@misu.su.se / Phone: +46-8-162534)

In this study, an Atmospheric General Circulation Model (Planet Simulator) is used to examine the interaction between ice sheets and the atmospheric circulation. The ice-sheet topography is based on a reconstruction of the Laurentide Ice Sheet during the Last Glaciation and conceivable set-ups of the sea surface temperatures and the sea-ice cover are prescribed. Sensitivity simulations using different ice-dome heights and shapes are conducted and an off-line surface mass balance (SMB) model is then used to monitor the feedback on glacier growth. The SMB is assumed to be determined solely by snowfall and melt-rate, calculated with the positive degree day approach. The dynamic temperature feedback is obtained by subtracting the positive ice-elevation feedback, using the standard atmospheric lapse rate.

At 90 kyr BP, in the early stage of the Laurentide build-up, the ice sheet approximately covered the Nunavut region, reaching Hudson Bay in the south and the border to Northwest Territories in the west. For this position of the ice sheet, the SMB response to changes in ice-sheet height is mainly determined by the melt rate, which decreases by about 50 percent when the ice-sheet height is increased from zero to 2250 m. The melt-rate signal is dominated by the positive ice-elevation and a slightly-weaker dynamic feedback, which is negative and acts to increase the melting over large parts of the ice sheet. The strength of the combined feedback, which enhances glacier growth, increases linearly with ice-sheet height. Furthermore, there are spatial variations in the dynamic melt-rate signal: it is positive over most of the ice sheet,

whereas a large melt-rate decrease is found downstream (east) the ice sheet. As the ice sheet height is increased from zero to 2250 m, the total snowfall over the ice sheet increases by about 25 percent, which is almost exclusively due to topographic uplifting on the western slope of the ice sheet.