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THE NORTHERN HEMISPHERE ICE COVER SIMULATED WITH A COUPLED CLIMATE-SYSTEM MODEL

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We study the temporal evolution of the northern Hemisphere's ice sheets through the last glacial cycle with special emphasis on the inception of glaciation and deglaciation using the climate-system model CLIMBER-2 (CLIMate and BiosphERe model) coupled to the polythermal ice-sheet model SICOPOLIS (SImulation COde for POLythermal Ice Sheets). CLIMBER-2 is a coarse resolution climate-system of intermediate complexity. It describes the atmosphere, sea ice, ocean, and the biosphere. The polythermal ice sheet model SICOPOLIS simulates the time-dependent extent of thickness, velocity, temperature, water-content and age for grounded ice sheets. The bedrock responds to the load of the ice through the buoyancy forces of the asthenosphere. SICOPOLIS provides CLIMBER-2 with the temporal change of orography and areas of land and ice sheets. Inversely, the climate characteristics (air temperature and humidity, long-wave and short-wave radiation, precipitation) on the coarse grid of CLIMBER-2 are used to calculate the energy and mass balance on the fine grid of SICOPOLIS accounting for the orography on the fine grid. The only external forcing for CLIMBER-2 are the Milankovitch insolation and the atmospheric CO_2-concentration.

The validation of the new coupled model CLIMBER-2/SICOPOLIS shows, in particular, that the modeled present-day surface mass balance and precipitation of Greenland are in good agreement with observations, and that the modeled northern Hemisphere's ice cover at LGM corresponds to the geological findings. Here, we study the role of different factors for the inception of glaciation (at 115 kyr BP) and deglaciation (after 21 kyr BP) of the northern Hemisphere. These factors are in particular the oceanic transport, the sea ice, the vegetation, the atmospheric dust and the flow properties of ice. Furthermore, we compare the importance of these factors for glaciation and deglaciation.