

High-Resolution Modelling of the Greenland Ice Sheet in Past and Future Climate-Change Scenarios

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The Greenland ice sheet is the second-largest ice body on Earth, with a present-day ice volume of approximately 2.9 million km³ or 7.5 m sea-level equivalent. Like the Antarctic ice sheet, it is an active component of the terrestrial climate system. In this study, a new attempt is made to reconstruct the evolution and dynamics of the Greenland ice sheet over past glacial-interglacial cycles and predict its behaviour under future climate-warming scenarios. To this end, the thermo-mechanical, three-dimensional ice-sheet model SICOPOLIS is applied to the Greenland ice sheet at the very high spatial resolution of 10 km. For the past, climatic forcing (surface temperature, precipitation) is derived based on present-day conditions from data, Last-Glacial-Maximum anomalies from GCM output and a time-dependent glacial index derived from the GRIP and Vostok ice cores. For the future, scenarios for surface-temperature and precipitation increases are derived from the WRE profiles which assume a stabilisation of the future atmospheric CO₂ concentration at 450, 550, 650, 750 and 1000 ppm, respectively. The new simulations confirm that the Greenland ice sheet underwent major changes over the past glacial-interglacial cycles and will most likely react significantly to future climate change on time-scales of decades to centuries.

Keywords: Greenland; ice; ice sheet; climate; climate cycles; global warming.