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## The Greenland ice sheet and the climate of the next 1000 years: an approach with a complex Earth System Model

**M. Vizcaíno** (1), U. Mikolajewicz (1), M. Gröger (1), E. Maier-Reimer (1), G. Schurgers (1), A. Winguth (2)

(1) Max Planck Institute for Meteorology, Hamburg, Germany (vizcaino-trueba@dkrz.de), (2) Center for Climatic Research, Department of Atmospheric and Oceanic Sciences, University of Wisconsin, Madison, Wisconsin, USA

Melting of the Greenland ice sheet due to the increasing concentration of greenhouse gases is thought to be able to cause significant perturbations in the climate of the next centuries by changes in ocean circulation, as well as its contribution to sea level changes and other effects (changes in albedo and atmospheric circulation). Here we offer the results of a modelling approach where all main components of the physical and biogeochemical climate system are included (atmosphere, ocean physics, sea ice, land vegetation, ocean biogeochemistry and ice sheets) with detailed representation of the main processes in each of these components. The core of the coupled Earth System Model is the ECHAM3/LSG AOGCM. Ice sheets are simulated with a threedimensional thermomechanical ice sheet model coupled bidirectionally to the rest of components. The model provides fresh water fluxes, topography and ice mask changes to the system. The experiments performed show the evolution of the climate for different scenarios where the concentration of CO2 is raised until reaching stationary values of 2 times, 3 times and 4 times pre-industrial value. In none of these experiments the water fluxes provided by the ice sheet produce abrupt changes in ocean circulation. Nevertheless, the collapse of the termohaline circulation by other means in the 4xCO<sub>2</sub> experiment produces patterns of accumulation and ablation in the Greenland ice sheet significantly different to those of the 2x and  $3x CO_2$  experiments. The melting rate is lowered due to the cooling of the North Atlantic atmosphere, being significantly lower than in the case of the 3x CO<sub>2</sub>. By the end of the 1000 years simulation, the contribution to sea level rise is 40 cm, whereas it is 1 m for the  $3x \text{ CO}_2$  experiment. All

experiments show an acceleration of the melting rate due to the height feedback. As a conclusion, these experiments with a complex Earth System Model show no dramatic changes in the Greenland Ice Sheet after 1000 years simulations and mild influence of its melting in the ocean circulation. According to our results, the collapse of the thermohaline circulation would significantly slow down the rate of sea level change caused by Greenland.

http://www.mpimet.mpg.de/en/depts/dep3/oph/deklim.html