



Irreversible melting of the Greenland Ice Sheet

A. Robinson (1,2,3), M. Perrette (1), R. Calov (1), and A. Ganopolski (1)

(1) Potsdam Institute for Climate Impact Research, Potsdam, Germany, (2) Universidad Complutense de Madrid, Madrid, Spain (robinson@fis.ucm.es), (3) Instituto de Geociencias, CSIC-UCM, Spain

Increasing temperatures have recently increased both the melt area and mass loss of the Greenland Ice Sheet. With more anthropogenic CO₂ emissions, this trend will continue. Even if emissions are reduced in the future, global temperatures will likely remain high for millennia, which can lead to irreversible melting of the Greenland Ice Sheet. To assess this problem, we have performed long time-scale simulations of the Greenland Ice Sheet using the Earth system model of intermediate complexity CLIMBER-2 fully coupled to the regional climate-ice sheet model REMBO-SICOPOLIS. The model is forced by various future CO₂ emissions scenarios that peak in the next centuries. The temperature anomalies driving the high-resolution regional climate and ice sheet model thus include both the temperature increase over the next centuries and the subsequent decline over the next millennia. Freshwater forcing to the North Atlantic and any reduction in area of the Greenland Ice Sheet can feedback into the global climate. Using an ensemble of model versions with perturbed physical parameters that control both the climate sensitivity and sensitivity of the ice sheet to climate change, we investigate the reaction of the Greenland Ice Sheet to the long-term global warming. We consider the potential thresholds in cumulative carbon emissions that lead to disappearance or significant melting of the Greenland ice sheet. Through these simulations we are able to calculate a probability of decline for each scenario as well as estimate the time scale of mass loss.