Geophysical Research Abstracts
Vol. 18, EGU2016-16439, 2016
EGU General Assembly 2016

Multi-millennia simulation of Greenland deglaciation from the Max-Plank-Institute Model (MPI-ISM) 2xCO_2 simulation

Vincent Cabot (1), Miren Vizcaino (1), and Uwe Mikolajewicz (2)

(1) Delft University of Technology, Delft, Netherlands (v.j.b.cabot@tudelft.nl), (2) Max Plank Institute for Meteorology, Hamburg, Germany

Long-term ice sheet and climate coupled simulations are of great interest since they assess how the Greenland Ice Sheet (GrIS) will respond to global warming and how GrIS changes will impact on the climate system. We have run the Max-Plank-Institute Earth System Model coupled with an Ice Sheet Model (SICOPOLIS) over a time period of 10500 years under two times CO_2 forcing. This is a coupled atmosphere (ECHAM5T31), ocean (MPI-OM), dynamic vegetation (LPJ), and ice sheet (SICOPOLIS, 10 km horizontal resolution) model. Given the multi-millennia simulation, the horizontal spatial resolution of the atmospheric component is relatively coarse (3.75°). A time-saving technique (asynchronous coupling) is used once the global climate reaches quasi-equilibrium.

In our doubling-CO_2 simulation, the GrIS is expected to break up into two pieces (one ice cap in the far north on one ice sheet in the south and east) after 3000 years. During the first 500 simulation years, the GrIS climate and surface mass balance (SMB) are mainly affected by the greenhouse effect-forced climate change. After the simulated year 500, the global climate reaches quasi-equilibrium. Henceforth Greenland climate change is mainly due to ice sheet decay. GrIS albedo reduction enhances melt and acts as a powerful feedback for deglaciation. Due to increased cloudiness in the Arctic region as a result of global climate change, summer incoming shortwave radiation is substantially reduced over Greenland, reducing deglaciation rates. At the end of the simulation, Greenland becomes green with forest growing over the newly deglaciated regions.

References:

Helsen, M. M., van de Berg, W. J., van de Wal, R. S. W., van den Broeke, M. R., and Oerlemans, J. (2013), Coupled regional climate-ice-sheet simulation shows limited Greenland ice loss during the Eemian, Climate of the Past, 9, 1773-1788, doi: 10.5194/cp-9-1773-2013

Helsen, M. M., van de Wal, R. S. W., van den Broeke, M. R., van de Berg, W. J., and Oerlemans, J. (2015), Coupling of climate models and ice sheet models by the surface mass balance gradients: application to the Greenland Ice Sheet, The Cryosphere, 6, 255-272, doi: 10.5194/tc-6-255-2012

Robinson, A., Calov, R., and Ganopolski, A. (2011), Greenland ice sheet model parameters constrained using simulations of the Eemian Interglacial, Climate of the Past, 7, 381-396, doi: 10.5194/cp-7-381-2011

Vizcaino, M., Mikolajewicz, U., Ziemen, F., Rodehacke, C. B., Greve, R., and van den Broeke, M. R. (2015), Coupled simulations of Greenland Ice Sheet and climate change up to A.D. 2300, Geophysical Research Letters, 42, doi: 10.1002/2014GL061142