Geophysical Research Abstracts
Vol. 13, EGU2011-442, 2011
EGU General Assembly 2011

Pliocene Ice Sheet Modelling Intercomparison Project: PLISMIP - Simulating the Antarctic and Greenland ice sheets in the mid-Pliocene warm period

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In the context of future climate change, there is increasing interest in understanding the nature and behaviour of the major ice sheets during warm intervals in Earth history. One epoch of geological time receiving considerable attention is the Pliocene, due to atmospheric CO2 concentrations and temperatures similar to those predicted for the 21st century. The mid-Pliocene warm period (ca. 2.97 to 3.29 Ma BP) has been the focus of major data synthesis and palaeoclimate modelling efforts, most recently with the internationally coordinated Pliocene Model Intercomparison Project (PlioMIP), a component of the new PMIP3 initiative. A major player of the climate system, the cryosphere, is still poorly constrained, i.e. the likely locations, extents and volumes of continental ice in northern and southern hemispheres during the Pliocene remain largely unknown.

Here, we present initial results from the efforts to simulate Antarctic and Greenland ice sheets for the mid-Pliocene warm period through an international Pliocene Ice Sheet Modelling Intercomparison Project (PLISMIP). The aim of this project is to test and compare the performance of existing numerical ice sheet models (ISMs) under prescribed climatic forcing in simulating Greenland and Antarctic Ice sheets in the mid-Pliocene.

In the control simulations, the ISMs are initialized with model specific present-day ice sheets and imposed present-day GCM output and observational data. These tests point to ice sheet model dependent biases when simulating present-day ice sheets on Greenland and Antarctica. In addition to sensitivity tests applying modern control climates and ice sheets, climatologies obtained from the Global Circulation Model (GCM) HadAM3 experiments using PRISM3 Pliocene boundary conditions are used to force a broad range of ISMs over Greenland and Antarctica. We compare and discuss the results from the ISMs run over Greenland, the grounded East Antarctic Ice Sheet and both East and West Antarctica. Finally, these simulations are complemented by a suite of sensitivity experiments in order to quantify the uncertainties in ice sheet sizes in the Pliocene by prescribing reconstructed/modelled ice sheet sizes.

We assess uncertainties introduced in existing Pliocene ice sheet reconstructions, due to both the use of a single GCM and a single ISM. We provide new benchmarks in the simulation of ice sheets in a past warm period, which could directly inform the uncertainty predictions of future ice sheet behaviour and sea level response.