Geosci. Model Dev. Discuss., 4, C1795–C1798, 2012
www.geosci-model-dev-discuss.net/4/C1795/2012/

Geoscientific
Model Development
Discussions

Interactive comment on "Pliocene Ice Sheet Modelling Intercomparison Project (PLISMIP) – experimental design" *by* A. M. Dolan et al.

Anonymous Referee #2

Received and published: 9 May 2012

This paper presents the PLISMIP intercomparison project (which is a sub part of the PlioMIP project) dedicated to the evaluation of uncertainties associated to the reconstruction of Greenland and Antarctic ice sheets during the mid-Pliocene Warm Period (mPWP) and the design of experiments carried out within the framework of this project. The mPWP period is characterized by a warmer climate than the modern one (with slightly higher atmospheric CO2 content, 405 ppmv). Therefore, as outlined in the present paper, the evaluation of ice sheet model uncertainties during the mPWP could be used to evaluate the uncertainties of simulated ice sheets and sea level changes in a "warmer than today climate". Such a project requires a rigorous comparison of ice sheet model results as well as a rigorous definition of the experimental design. From a general point of view, I do think that intercomparison projects are essential in any modeling-based approach to evaluate to which extent results are model-dependent.

Therefore, any initiative like PLISMIP must be encouraged. However, in the present paper, I found that a number of points must be further clarified and additional simulations should be proposed to optimize the analysis of uncertainties and to better highlight the interest of the work.

Specific comments

1) Ice-sheet models:

The chosen approach needs to better clarified. Ice sheet models do not only differ from the fact that they are based on SIA, SSA or a combination of both approximations, but also from their intrinsic parameterizations or poorly constrained variables (e.g. ice flow law, enhancement factor, basal sliding, geothermal heat flux, ablation computation, isostasy model ...) that may lead to largely different results under the same climatic forcing. I guess that the uncertainties associated to each parameterization will not be assessed because the authors mention that "the different ISMs are set up in standard mode" (see section 4.2). Here, I understand that "standard mode" refers as to the standard version of a given ISM. However, it would be also interesting to quantify the uncertainties associated to each parameterization by using the same parameterization (when it is possible) in each ice sheet model. It appears that PLISMIP does not intend to perform such evaluations. This choice should be better justified.

The way of computing surface mass balance should be mentioned. Since temperature is used as a forcing field, I suppose that ablation will be computed with the positive-degree-day method. It will be therefore crucial that each ISM uses the same PDD parameters (same degree day factors for snow and ice, same refreezing scheme and eventually same standard deviation of temperature distribution).

I agree with the fact that current ice sheet models fail to capture rapid changes observed in present-day ice sheets. However, why models based on SSA are not used to simulate Greenland ice sheet? Due to the spatial resolution, these models may still fail to capture rapid ice flow over Greenland (and over EAIS), but will likely better compare

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with current observations.

The approach adopted to compute basal melting under the ice shelves in West Antarctic ice sheet should be explained. How will be considered the grounding line? Will it be dynamically computed or not?

Finally, I think that a table describing the main characteristics of ice sheet models participating to the PLISMIP project should be given.

2) Control runs :

I disagree with the authors when they claim that “the differences in the modern/pre-industrial climatologies are relatively small”: 6°C and 10°C cooler over Greenland and Antarctica respectively are not small differences. Therefore, any differences in simulated ice sheets may reflect the temperature difference between NCEP and HadAM3 and do not necessarily "reveal any threshold or instability" as mentioned in the paper. A better approach would be based on the use of a present–day control HadAM3 run (instead of a pre-industrial one). Why such a run cannot be used? Moreover, summer temperature differences may be larger than the difference between mean annual temperatures. Boreal and austral temperature difference should be also displayed in Figures 1 and 2 respectively.

3) HadAM3 boundary conditions and ISM initial conditions :

I did not manage to clearly see the objective of runs 3, 8 and 13 where climate forcing (HadAM3 runs with PRISM3 ice sheet boundary conditions) is not consistent with initial ice sheet configurations. If the objective was to test the ISM sensitivity to climate forcing, a more appropriate approach would have been based on the use of other GGMs run with boundary conditions consistent with initial ice sheet geometry taken for the ISM experiments. The deviations in model results linked to climate forcing probably represents the largest source of uncertainty. Therefore, using several GCMs in PLISMIP seems to be crucial to fit in with the aim of the project.

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It is undoubtedly interesting to test the ISM response to various initial conditions but it would be also useful to investigate the time needed for the ISM to “forget” the initial conditions. Accordingly, it may be necessary to carry out some preliminary tests with a length higher than 30 and 100 kyr for Greenland and Antarctica respectively.

4) Forcing procedure :

Temperatures are corrected using a uniform lapse rate but nothing is specified concerning the precipitation and the depletion of humidity with the altitude. Moreover, it would be great to precise whether the climatic outputs used as driving fields will be used in a perturbation mode of the present-day climate or in an “absolute mode”.

Minor remarks: Color captions are not visible in figures 1, 2, 4 and 5. In figures 4 and 5, the captions should mention that HadAM3 simulations are run with PRISM3 ice sheet boundary conditions.

Interactive comment on Geosci. Model Dev. Discuss., 4, 2661, 2011.