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Geoscientific Model Development Discussions

Interactive comment on "A technique for generating consistent ice sheet initial conditions for coupled ice-sheet/climate models" *by* J. G. Fyke et al.

Anonymous Referee #1

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The manuscript presents the procedure developed for coupling an ice sheet model to a climate model that includes detailed surface mass balance calculations based on an energy-balance model. This is a worthy goal and the technique applied provides the ability to take advantage of a sophisticated model to calculate the surface mass balance of the ice sheet and run a transient glacial cycle simulation for initialization. The problem of coupled ice sheet – climate initialization is nicely framed in the introduction of the paper with regard to the various time scales. I find the method description straightforward and easy to follow and overall, I believe that the manuscript is near ready for publication.

However, I do feel that some presentation of the results could be improved. I noticed

that most of the plots compare the transient spin-up model fields to an equilibrium simulation, but as far as I understand it, the point of the paper is to show the new coupling approach. Furthermore, it is not really necessary to show that it is a better idea to perform a transient spin-up, as this has been demonstrated in the past (eg, Rogozhina et al., 2011). As a reader trying to understand the coupling approach, I would be much more interested in seeing more information about the SMB fields used to drive the ice sheet model. For example, a spatial plot of average SMB anomalies (and perhaps precip and temperature) for the three end member simulations (LGM, Holocene optimum, 1850), a comparison showing how important including the Holocene optimum in the temporal interpolation is, etc.

Additionally, I have some minor comments:

I was glad to see discussion on Page 2505 concerning optimizing parameters through the transient spin-up procedure. But I was surprised that on Page 2498, the authors chose to optimize the model parameters from an equilibrium simulation. It seems contradictory. As this paper is meant to show that the procedure works, I think it's not too important whether the right parameters are used, but perhaps it's worth addressing this inconsistency somewhere in the text.

The year 1850 appears throughout the text, which makes the method seem very specific. I realize this year appears because the authors chose to spin up to that preindustrial year. However, perhaps during the Introduction, it would be better to remain more general using "preindustrial state". There is no reason why this preindustrial state must correspond to 1850, but could be 1880, or any other year.

The phrase "end-member" appears numerously and in different contexts ("Paleoclimate end-member simulations" - abstract, "end member NGRIP values" – Page 2497 line 20, etc). It was not immediately clear is meant, although later on I understood that interpolations are made between "end-member" simulations. A brief definition of what is meant specifically by this term somewhere could be helpful.

Page 2500, Lines 19-22. The initialization procedure seems reasonable. However it is quite specific and it would be beneficial to add a sentence or two to justify this approach.

Page 2501, Line 27: “climate-derived bias” is too specific. It is well known that SIA ice sheet models produce too large ice sheets, even with such transient spin-up procedures and with good climatic fields. While the climatic biases can be partly to blame, a large part of this is simply due to the lack of proper representation of fast processes in the ice dynamics that would otherwise contribute to increased ice discharge into the ocean and reduced ice volume and area.

Figure 4b: Consider plotting temp difference with GRIP to better highlight the reduction in mismatch.

Interactive comment on Geosci. Model Dev. Discuss., 6, 2491, 2013.