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 #2

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Fyke et al. describe a technique to generate ice-sheet model initial conditions that are consistent with the climate forcing as given by a climate model. The method is applied to construct a pre-industrial Greenland ice-sheet. The ice-sheet model is forced during a glacial/interglacial cycle. The method is very similar to what is usually done by other ice-sheet models. The novelty is that temperature and surface mass balance fields have been previously computed with the climate model for LGM, MHO and pre-industrial typical conditions. During the ice-sheet spin-up temperature and SMB are interpolated from these "end-member" climates using the NGRIP dO18 record.

The ice-sheet thermal state can be important for future projections as the temperature field govern the ice viscosity and can affect basal sliding, and there is no consensus on

the best method to initialise an ice sheet model to present day conditions, each method having its own advantages and disadvantages. There is no fundamental improvement presented in the paper compared to previous studies, but the technical description of the method enters the GMD scope.

But before publication the paper would benefit from some clarifications:

- P.2496, l 4-5: *"equilibrium 30-yr SMB climatology"* does that mean a time period of 30 years chosen when the climate model as reach an equilibrium for the given climate states? Justify the 30 years.

- P.2496, section 2.1 : maybe a sketch featuring the different models with their inputs and outputs used to generate the climatology would help the readers not familiar with the Community suite of models.

- P.2496, l18-19: *".... for a 122kyr standalone 5km resolution, ..."*. just say here that the end-member climatologies are used to force the ice sheet model initialisation as described in sec. 2.2 and move the description of the ice sheet model and spin-up duration to sec. 2.2

- P.2497, l1-3: One motivation for generating SMB lapse rates is that the climatology is affected by the ice-sheet topography and especially the elevation. So that having SMB and T values that do not depend on the ice-sheet elevation could be a limitation of the technique? Please comment.

- P.2497, l17: why 600 years?

- P.2497, l22-24: *"thresholded slighlty"*. How the threshold values have been chosen?

- P.2498, Equation 1,2,3: The end-members climates are denoted EM_{+1} and EM_{-1} in (1) but with an arrow in (3). I find the notation with the arrows hardly understandable.

- section 2.2: it is not clear if the surface Temperature is also interpolated as done for the SMB in eq.3.

- P2499, l16-17: maybe show the location of the summit and location in the western ablation zone in one of the Greenland map.

- P2500, end of section 3.1: It would be easier to follow the discussion with maps of the mean SMB fields as given by the 3 end-members.

- P2500, l19-23: Move this explanation to the methodology section 2.2

- P2501, end of section 3.2 : It would be easier to follow the discussion with a map of the basal temperature (relative to pressure melting point) in 1850

- P2501, section 3.3: Please show the volume evolution.

- P2504, l6: there is a typo change "is" to "in large part..."

- P2504, from l15, discussion on inverse methods: Acknowledge that the main motivation for the inverse methods is to start short term forecast simulation with an ice sheet in a state as close as possible as the observations (topography and surface velocities). I agree that for the moment there is no inverse method that include the memory of the SMB and T forcing, but the problem of the initial state of the ice-sheet that can be far from the observations for present day remains with the proposed technique. Which can be an issue for short term simulations (1 to 2 centuries).

- P2505, l2, reference to Price et al.: In Price et al. the model is initialized with respect to balance velocities (which respect modeled surface conditions) but not with observed velocities.