

The paper under review investigates the sensitivity of projections of the Greenland ice sheet evolution to parameter uncertainties. Using the well-established ice sheet model SICOPOLIS, a 100-member ensemble with perturbed physics is obtained by spinning up the model for 125 ka using information about past climate. Present-day ice sheet volume serves as validation metric, taking into account uncertainties in the observed ice sheet volume. Even after culling the ensemble, the authors observe a large spread in simulated future mass loss between the different model realizations.

The manuscript addresses the important question of quantifying uncertainties in future sea-level projections. The manuscript is well written, reads fluently, and is clearly within the scope of The Cryosphere. Use of a Latin hypercube method is appropriate to sub-sample the parameter space. The methods used in the paper are explained in enough detail, and references to published literature is made whenever appropriate (SICOPOLIS has already been described in detail in the literature).

I have a few minor comments.

General Comments

As reported here (and previously elsewhere, e.g. Stone et al. (2010)) model results are very sensitive to the choice of the PDD factors. I agree with the author's conclusion "We attribute the bulk of the remaining errors in geographically distributed ice thickness values to problems with the modeled mass balance" (lines 347–349). I suggest to expand on this statement, and point out potential consequences. Even members of the culled ensemble, i.e., model realizations with reasonable ice sheet volumes, contain large errors in local ice thickness. Due to the temperature-altitude feedback (lapse rate), this will have an impact on the model sensitivity. Figure 7 is very illustrative as it reveals the spatial pattern of differences between modeled and observed ice thickness. From this manuscript it becomes evident that ice sheet volume is a way too weak metric to assess the skill of an ice sheet model to reproduce the present state of the ice sheet. This could be stated explicitly, e.g. at the end of the manuscript, as a recommendation for future work.

Model simulations are run until the year 3000 AD, however, the discussion almost exclusively focuses on the short term response (2100 AD). Everything past 2100 AD doesn't seem to add much to the manuscript. I am thus wondering if it would make more sense to remove those parts of the manuscript (incl. figures) that deal with the time past 2100 AD.

Detailed Comments

Title I agree with the other reviewer, "Preliminary" should be dropped from the title.

80 "...is agreed upon by the ice sheet modeling community." From reading this sentence it is not clear to me what is agreed upon. You could either explain or slightly rephrase: "Our approach builds on existing work by Stone et al. (2010) by using a spinup procedure that takes past climate variability into account (see, e.g., SeaRISE partners, 2008)". Or something along these lines.

132 change "0–20 m yr⁻¹/Pa" to "0–20 m yr⁻¹ Pa⁻¹"

205–06 Awkward sentence: "..., the science of sea level rise is evolving rapidly,..."

259–60 "...simulated ice volumes... are consisten among runs". The range is actually quite large, around 3 m SLE, during that period. I assume you're trying to say that ice volume changes are consisten among runs.

315 "High values of the ice flow". I assume you mean "large values of the enhancement factor". Throughout the manuscript (incl. Fig. 1), you may want to use "Flow-enhancement factor", or simply "enhancement factor" instead of "Flow factor".

375 change "surfacetemperature" to "surface temperature"

415–17 While some longitudinal stress coupling may be needed to propagate thinning inwards, this will only occur if appropriate forcing at the ocean boundaries is applied. That is, using a higher-order model does not guarantee to accurately reproduce observed rapid thinning.

Fig. 7 . "Simulated ice volumes are..." Don't you mean "simulated ice thicknesses"?

References

Stone, E. J., D. J. Lunt, I. C. Rutt, and E. Hanna (2010). Investigating the sensitivity of numerical model simulations of the modern state of the Greenland ice-sheet and its future response to climate change. *The Cryosphere*, **4**(3), 397–417. doi:10.5194/tc-4-397-2010. URL <http://www.the-cryosphere.net/4/397/2010/>.