

## ***Interactive comment on “Glacial cycles simulation of the Antarctic Ice Sheet with PISM – Part 1: Boundary conditions and climatic forcing” by Torsten Albrecht et al.***

**Johannes Sutter (Referee)**

johannes.sutter@awi.de

Received and published: 4 July 2019

The study by Albrecht et al. is an impressive compendium of Antarctic Ice Sheet ensemble simulations covering the response of the ice sheet to different forcing settings and ice sheet model parameterizations. This manuscript is poised to become standard literature for people starting to use the Parallel Ice Sheet Model (PISM) as well as for scientist which already use PISM. The scope of the manuscript fits well into the topics covered by The Cryosphere and I think it is a nice entry into the ice sheet modelling literature.

That being said, the manuscript needs some additional work to improve the readability

C1

and to clarify the main “take-aways” for the reader. Due to its holistic scope and length it is sometimes difficult to follow the line of thought. Also typos and the german-style syntax sometimes hampers the reader to fully grasp the content of the manuscript. In isolation these points are very minor but clustered throughout the manuscript they make it difficult to enjoy the overall high quality of this work.

I will provide some general remarks which I deem necessary to be addressed followed by minor comments. Please also find comments and corrections to the manuscript in the annotated attached pdf.

1. The manuscript truly has an epic length and discusses the impact of different model parameterisations, forcing approaches as well as specific research questions regarding e.g. Termination I. In theory the manuscript could be actually split into two publications, one covering the uncertainties intrinsic to the choice of model parameterisations and climate forcings, and one investigating specifically the response of the AIS to the latter in glacial and Terminations, specifically Termination I. I assume the authors would like to abstain from splitting the manuscript in two, so I suggest reordering the discussion of the results into a part covering the effect of different parameterisations and forcings (e.g. individual forcings versus combined forcings) and a part specifically addressing the intricacies of glacial termination and the impact of model parameterisations and forcings during that period.

2. Model results are almost exclusively illustrated as integrated variables (ice volume or SLE ice volume). It would be nice to see some illustrations of ice sheet geometry as modelled for the LIG, LGM and present day, either within the manuscript or as e.g. supplementary videos.

3. Currently, there is a study in TCD by Tigchelaar et al. (<https://doi.org/10.5194/tc-2019-83>) addressing the effect of isolated forcings versus combined forcings on late Quaternary (ca. last 400 kyr) ice sheet evolution. A similar discussion can be found in condensed form in Section 4.5 of this manuscript. It would be nice to include a

C2

comparison to the findings in Tigchelaar et al. as to put the results presented here in perspective.

Minor comments:

In general, throughout the manuscript you often omit articles ("e.g. the") which makes some sentences hard to read. I marked the spots which were most obvious to me (attached annotated pdf) but maybe I missed a couple.

It would be helpful to know which "baseline" parameter set was used in the parameter sensitivity experiment shown in the various volume line-plots. Is it the one highlighted (in brackets) in Table 1? I guess you put this Table almost to the end of the manuscript as to provide the reason for your parameter selection in the preceding sections. I would prefer to see such a Table at the very beginning of the paper as to get a quick overview of which parameters have been investigated and which are the optimal combination for paleo-studies with PISM. Some readers might not get to page 38 and miss the table altogether.

Check your use of past tense, you almost never use it, I tried to mark all instances in the annotated pdf.

You mostly discuss glaciation timescales, glacial maximum ice volume and glacial termination while only shortly touching on the effects of different parameterisations and forcings on interglacial ice volume and extent. Is there a specific reason for this? Also, in your simulations MIS5e ice volume seems to be very similar to your simulated present day ice volume. I think it would be worth discussing this briefly in the manuscript.

p8, l214-216 Doesn't your study from last year (Kingslake et al. 2018) show sensitivity specifically of the Ross Sea grounding line to the Eigencalving parameterization (Extended Data Figure 7)? I guess it is a question of the ice sheet state and memory effects whether the calving parameterization can play a role or not.

C3

Naturally for such an extensive manuscript, the discussion sections is covering a lot of ground which makes it difficult to structure. Maybe one or two sentences at the beginning of the discussion preparing the reader with respect to the structure would be helpful (e.g. in the following we summarize the main findings of our study with regard to the impact of different parameterisation and climate forcing choices on the evolution of the Antarctic Ice Sheet during the last glacial cycles analysed above.).

Please also note the supplement to this comment:

<https://www.the-cryosphere-discuss.net/tc-2019-71/tc-2019-71-RC1-supplement.pdf>

---

Interactive comment on The Cryosphere Discuss., <https://doi.org/10.5194/tc-2019-71>, 2019.

C4