

## Review of the paper “Coupling the regional climate MAR model with the ice sheet model PISM mitigates the melt-elevation positive feedback, by Delhasse et al.

I would like to congratulate the authors for their efforts to make clearer the manuscript and for their detailed responses to my comments. However, I feel that the paper would be improved if further explanations were provided.

**PISM description:** I acknowledge that the PISM description has been extended. I wonder if the explanations are sufficient for someone not familiar with ice sheet modelling but I understand that the authors ask the readers to refer to the original publications. However, there is a mix between some very specific terms and very general explanations. I give a few examples below:

- Mentioning the value of the exponent ( $q=0.6$ ) in the sliding law does not make sense if the Mohr-Coulomb criterion is not explained.
- The basis of the von Mises calving law could be explained
- The hypotheses underlying the shallow-ice and shallow-shelf approximations are missing
- Specify that  $E = 3$  is a value often used in most ice-sheet models.

**PISM initialisation:** The explanations do not still sound very clear to me. I suggest to reorganize this section:

- 1/ Keep the first sentence and continue with “For a realistic thermodynamics representation
- 2/ Explain why you use anomalies. Note that I do not fully understand the sentence “This is why it is common practice...” Find a clearer explanation or remove this sentence. Also, you should replace “For a glacial spinup, it is assumed that” by “For a glacial spinup, **we** assume that...”.
- 3/ Mention at the end of the section that your reference climate is given by the MAR mean fields (ST and SMB) over the 1961-1990 when Greenland was close to balance.

**Offline-correction method:** The explanations of the method are now much clearer. However, I have to admit that I found it hard to understand what the 16 pairs of grid points corresponded to and how they were obtained. I finally came to the conclusions that the following associations are considered: (1,2,4,5), (2,3,5,6), (4,5,7,8) and (5,7,8,9). Is my understanding correct? If so, this should be explained or mentioned in Fig. 1 (or at least in Fig. 1 caption).

Also, Page 6 (L23-24), the fields obtained with the offline-correction method are computed using the eight surrounding grid points, but in Fig. 1 you mention the nine nearest grid points. I think it is a typo error. Otherwise, clarifications should be made.

**MAR initialisation:** It would be interesting to have an idea of how MAR is initialised, particularly with regard to the snowpack model to which the authors refer extensively in the Discussion section.

**Abstract: Line 4:** Positive-degree day models cannot be classified as atmospheric models. They just parameterise the amount of runoff.

**Section 2.3.1:** The velocity fields are compared to those provided by Joughin et al. (2018) over the 1995-2015 period. Differences between modelled and observed velocities are on average  $\pm 80$  m s<sup>-1</sup> and are much larger on the margins. The authors refer to problems of resolution to explain these differences. However, these differences may also be explained by the fact that Greenland was not in balance in 2015 (and even before). This could be mentioned as an additional possible explanation.

**Supplement:** I guess that the authors did not upload the revised version of the Supplement as there is a mismatch between figure numbering in the main text and in the Supplement.

### **Other comments**

I mention below some English mistakes (but the list is not exhaustive). I insist on the need to have the manuscript proof read and corrected by a native speaker. My feeling is that some sections are quite difficult to read with often long sentences which are not always grammatically correct.

P1-L17: Replace “highlighted” by “highlight”

P3-L6: Remove “First”

P3-L21: “input by” → “inputs to”

P3-L25: mention → mentioned

P3-L31: for a doubling of CO<sub>2</sub> → for a doubling of atmospheric CO<sub>2</sub> concentration.

P6-L3: Add a reference to Section 2.3.1 when you refer to the coupled spinup runs.

P9-L15: of melt-elevation feedback → of **the** melt-elevation feedback (and in other places in the manuscript).

P9-L22: “are only responsible for 10% of the MB” → How is it evaluated ??

P9-L31: “since 1991 of > “ → Remove “of” (same remark for P10-L3)

P14-L1: What do you mean with “intermediate results”? Please reformulate

P14-L14: add in MAPI-1w after “from the ME excess”

P14-L15-16: SHF is not plotted in Fig. 9

P15-L7: changes to → changes in

P17-L17: What do you mean with “at depth”?

P19-L4 “They used MAR and GRISLI” → “They used MAR and the GRISLI ice sheet model. Add a reference for GRISLI. For example Quiquet et al. (2012).

### **Reference:**

Quiquet, A., Punge, H. J., Ritz, C., Fettweis, X., Gallée, H., Kageyama, M., Krinner, G., Salas y Méria, D., and Sjolte, J.: Sensitivity of a Greenland ice sheet model to atmospheric forcing fields, *The Cryosphere*, 6, 999–1018, <https://doi.org/10.5194/tc-6-999-2012>, 2012.