

Response to second round of reviewer comments for the manuscript *Results of the second Ice Shelf – Ocean Model Intercomparison Project (ISOMIP+)*

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We thank the three reviewers (in two reviewer teams) for their time and effort reviewing our manuscript again, and for their supportive feedback and technical corrections.

Below we respond to each comment in turn, with our responses indicated in blue, with changes that we have made to the manuscript in response to the reviewers' suggestions. Line numbers refer to the revised manuscript.

Reviewer 1

The authors have done a commendably thorough job in responding to the earlier review comments. The manuscript is publishable more-or-less as is. It will make an extremely valuable contribution to the literature and a benchmark for future inter-comparison projects.

I spotted only a few minor typographic errors, which I think it would be worthwhile correcting in the final draft.

Thank you for your time and support, and for your thorough reading that found these typographic errors!

Minor comments:

Lines 34-35: FRISP stands for “Forum for Research into Ice Shelf Processes”.

Fixed as suggested.

Lines 56-57: Maybe rephrase to “. . . retreat and are potentially major contributors to sea level rise because of the large volumes of grounded ice contained in the regions they buttress.”.

Fixed as suggested.

Lines 92-94: For consistency with the MISOMIP2 citation, consider putting the RISE citation in the first set of parentheses on line 92 and removing the second set of parentheses.

Fixed as suggested.

Line 109: “. . . model variability on which future work can focus as we progress . . .”.

Fixed as suggested.

Line 149: “. . . in cold Antarctic ice shelf cavities . . .”.

Fixed as suggested.

Table 2 caption, line 4: “. . . over which meltwater was . . .”.

Fixed as suggested.

Line 461: "... features across models ...".

Fixed as suggested.

Line 510: "... in Antarctic ice shelf cavities ...".

Fixed as suggested.

Lines 511-512: "... been observed at cold cavity ice fronts ...".

Fixed as suggested.

Reviewer 2

Second round of review of: Results of the second Ice Shelf–Ocean Model Intercomparison Project (ISOMIP+) Authors: Claire K. Yung et al. We greatly appreciate the effort the authors put into addressing our comments from the first round of review. We are now happy to recommend publication of this manuscript. This paper will be an extremely useful resource for the community; the leading author(s) have done a remarkable job bringing this information together. We provide a few minor suggestions below that the authors might want to consider in preparing their final version of the manuscript. This is a joint review from a senior and an early-career researcher.

Thank you for your time and support, and for your further suggestions!

General comment: The ISOMIP+ protocol covers a broader range of physical processes than ISOMIP. However, one important process not yet considered in the protocol is tidal forcing and its potential impact on melt rates and ocean circulation within ice-shelf cavities. While we do not expect the authors to re-run any simulations, it would be valuable to acknowledge tidal forcing as a relevant process for future studies. We suggest mentioning this in the discussion section, where future research directions are outlined.

Thank you for the suggestion, we agree that tidal forcing is an important process to include in future studies. We have added the following text to the Discussion:

L868-869: Tidal forcing is also an important process that is missing from ISOMIP+ (with the exception of the ROMS TYP submission) and will affect ice shelf melt.

and listed tides in L881 where we describe missing features that next-generation model inter-comparison projects might include.

L881: We agree that the model representation of ice-shelf boundary layers is an important area for future research. In addition, the treatment of physical processes within the boundary layer—such as temperature sampling and the distribution of freshwater fluxes, as already discussed by the authors—is also critical. We suggest modifying the sentence to read, for example: “model representation of ice-shelf boundary layers and the physical processes within ...”

Thanks for the suggestion, we think you are referring to L891 and have edited the text as you suggested.

L836: The term “meltwater forcing sampling” is unclear. We believe the authors are referring to oceanic forcing sampling; if so, please revise accordingly.

Revised to “oceanic forcing sampling” as suggested.

Table 1: The authors describe z/s ALE as “arbitrary Eulerian–Lagrangian coordinates with a quasi...”. We are unclear why the term ‘quasi’ is used here and request clarification.

The coordinates used in the two ALE coordinates are z coordinates in the open ocean and a hybrid in the ice shelf cavity, where the uppermost layers follow the ice draft in a terrain-following-like fashion, but lower layers outcrop in the topography. We have added references to Stern et al. (2019) and Comeau et al. (2022), which describe these vertical coordinates in MOM6 and MPAS-Ocean in more detail. We have edited the Table 1 caption and removed “quasi” with a better description of the coordinate.

Table 1 caption: We list the vertical coordinate (z -level, sigma/terrain-following (s -level), isopycnal, and z/s ALE for Arbitrary Eulerian-Lagrangian coordinates. In the latter, z coordinates in the open ocean transition into an ice shelf draft-following target coordinate in the ice shelf cavity; see Stern et al. (2019) and Comeau et al. (2022) for further details), heat transfer

For MPAS-Ocean, the superscripts c and d appear to refer to Section 3.5 rather than Section 3.6; please correct this.

Section 3.5 is the methods section which describes MPAS-Ocean. We believe this is the correct reference, since Section 3.6 discusses the NEMO models. We apologise that the response to reviewer document’s copy of the table referred incorrectly to Section 3.6 whilst the manuscript correctly had Section 3.5.

L345–347: The authors attempt to justify using freshwater fluxes averaged over the previous three months to adjust the surface forcing so that sea level does not rise abruptly. However, it remains unclear why a three-month running mean was specifically chosen. An additional explanation would be helpful.

We have added:

L344-346: The 3-month averaging window was chosen so that the lagged sea-level adjustment would not over-react to monthly fluctuations in the melt rates, though in retrospect this was likely not needed for the ISOMIP+ experiments.

L454: We suggest adding “representations of” before “bed topography and ice shelf draft between models.”

Modified as suggested.

Figure 13: The statement “In some panels, COCO results fall outside the main range of the other models,” mentioned in the authors’ response to reviewers, was not added to the figure caption. We recommend including this clarification in the caption.

Apologies for the omission, this is now in the manuscript caption as well.

References

- Comeau, D., Asay-Davis, X. S., Begeman, C. B., Hoffman, M. J., Lin, W., Petersen, M. R., Price, S. F., Roberts, A. F., Van Roekel, L. P., Veneziani, M., et al.: The DOE E3SM v1. 2 cryosphere configuration: Description and simulated Antarctic ice-shelf basal melting, *Journal of Advances in Modeling Earth Systems*, 14, e2021MS002468, <https://doi.org/10.1029/2021MS002468>, 2022.
- Stern, A., Adcroft, A., and Sergienko, O.: Modeling ice shelf cavities and tabular icebergs using Lagrangian elements, *Journal of Geophysical Research: Oceans*, 124, 3378–3392, <https://doi.org/10.1029/2018JC014876>, 2019.