EC: Editor comment, AR: Author response

Dear Editor and reviewers,

We deeply thank you for the time and effort put into the review process of this paper. Here are the final responses to the last comments.

EC: L76 remove "very"
AR: Done

EC: L90 " nonlinear " surface. Do you mean "curved" surface or something similar? Nonlinear has a mathematical connotation for me which I don't think is what is meant here.
AR: « non-linear » free surface is a term widely used in the ocean modelling community: a non-linear free-surface implementation allows one to deal with large amplitude free-surface variations relative to the vertical resolution (see NEMO Team, 2019).

EC: L122 are u_oc and v_oc the horizontal velocity components?
AR: Yes, we have clarified:
“and the ocean horizontal and vertical velocity components u_oc and v_oc”

EC: L166 listed, e.g., in (commas)
AR: Done

EC: Consider making this paper more accessible by introducing all variables in a table or even up front (sort o an extension of table 2.) Clearly all variables are defined in the text, but some readers may only read details for a specific parameterization.
AR: Thank you for this interesting suggestions. We have now added such a table in the Appendix. We argue that everything is explained in the text and the table is so large that it would break the flow of the paper, so putting it in the Appendix is more appropriate. We mention it in the beginning of Sec. 2.2:
“As a range of slightly different definitions of the variables are introduced, we provide two tables in Appendix C summarizing the main variables and different subscripts used in the following description.”

EC: I wonder if the melt m should rather be marked with $\dot{m}$ and consistently be referred to as "(basal) melt rate" (units m ice per s)
AR : In previous literature, \dot{m} and {m} have been used nearly interchangeably. We prefer sticking with m for the melt rate. We added “rate” to all occurrences where we mentioned melt in units m ice per s.

EC: Eqs (20) and (26) appear to have some randomly placed $\mathbf{}$ notation. This bold fonts should be used for vectors. Double check.
AR: The bold terms highlight the differences between the formulations, as explained in the text just before. We would like to keep it this way. We argue that it is clear that this is not describing vectors in this particular case.

EC : *I wonder if it would be better to have Fig. 3 as Fig. 1 as it attempts to explain the main approach of the paper.*
AR: We have now moved this figure to the beginning of Sec. 2.

EC : Eq (34) are the $\cdot$ needed?
AR: Ok, we removed it.

EC : Fig. 5 have you tried showing the difference relative to the reference? This could possibly be more informative.
AR: We have chosen not to show the difference for 2 reasons: (1) it is difficult to represent difference between two quantities that are best represented on a logarithmic scale and (2) we lose the information whether a negative difference stands for underestimated melt or for the difference between freezing and melting.

EC : L633 here you refer to it as "melt rates". I suggest to do this everywhere.
AR: We went through the manuscript to change this where appropriate.

EC : Eq (36) remove \cdot
AR: Done

EC : L855 "A higher number of boxes leads to a slightly lower RMSE." Is this surprising, given that more free parameters are available to reduce the RMSE? I wonder if overfitting can play a role here.
AR: Independently of the number of boxes, there are only two free parameters to tune, so we do not think that there is a risk of overfitting. Actually, we find it more surprising that it does not lower the RMSE even more, because having more boxes leads to a more heterogeneous pattern that might capture better spatial heterogeneities in the melt rates.

EC : L866 "On the one ..." not (One)
AR : Done