

Author replies to editor

Replies in blue

The authors have done a nice job responding to the comments from both referees, and the manuscript is close to being ready to go. There are a few small changes that need to be made, however.

In reading through the most recent version of the manuscript I found some discrepancies between the submitted manuscript and the authors' tracked changes, so my edits below refer to line numbers in the manuscript itself. As I point out below, there are also places in the manuscript where special formatting has not been applied (i.e. greek letters are missing, subscripts are not formatted).

I would strongly recommend that for all two-panel figures where the difference between the two panels cannot be determined from the axes labels, the authors add a title to each panel that will allow the reader to begin interpreting the figure before they read the caption (e.g. figs. 3-6)

Many (most) of the references do not include a DOI. This will get flagged when the manuscript goes in for final editing, and it is much easier to fix this now rather than at the proof stage.

I hope that none of this will be too difficult, and we can get this paper published soon!

We thank the editor for a thorough look through our manuscript. We will check the special formatting in equations and wherever we use symbols in the text (according to the comments below). We will add titles on the panels of Figure 3,4,5,6,7. We will add the DOI of the references. We will reformat the whole reference list because of a change in laptop (and EndNote bibliography/version, and add the DOI's). We furthermore corrected small grammatical errors and typos.

Line numbers refer to the revised version of the manuscript

Line 35 : add "in" after "uncertainty"

We will do so.

68-71: please specify what Van Den Akker's technique adjusts

We will add a (sub)sentence: '.. in which the gridded observed mass change rates are subtracted from the mass transport equation. In this way, the resulting modelled ice sheet can start future simulations immediately from the observed imbalance'

86: add add space between "imbalance" and "influence"

we will do so

104: Please also cite the original Schoof paper that developed the RC law

We will add Schoof (2005) as the first one to postulate this relation

113: There needs to be an explanation of the exponent 'p'

We will add, move and rewrite Ln 113 to: 'In eq 1.4a, p [0,1] controls the strength of the effective pressure decrease of ice resting on bedrock below sea level. Setting this value to 1 implies that, at the modelled grounding lines, the effective pressure at the ice base is completely balanced by the ocean pressure and approaches zero. In this study we use $p=1$, assuming full ocean connectivity of the subglacial hydrological network an the ocean. This implies that the scheme proposed by Leguy et al. (2014) accounts for basal water pressure (which reduces N) only near grounding lines and not in other parts of the ice sheet; thus the effective pressure equals ice overburden for most of the ice sheet.'

116: Add a sentence describing how the time-stepping associated with the nudging works (this should stand a little bit more on its own, rather than requiring readers to be familiar with the cited papers)

We will add 'i.e. a 10 kyr simulation with present-day forcing in which the modelled ice sheet is allowed to evolve freely while slowly changing unknown parameters based on observational targets like the ice thickness'

119-123: the subscripts and special characters have not rendered correctly in the PDF version of the manuscript. The changes described in the response to referee 1 seem adequate but are not legible in the PDF.

We will make sure that they are rendered correctly.

173: check citation style

We will change this too (PMP, see Leguy et al. (2021)).

186: "...which scales the basal sliding and melt rate proportionally to its grounded and floating area fraction respectively." Please specify over what spatial domain the grounded and floating areas are treated. Is this within each element?

We will add to this sentence: 'in elements that contain the modelled grounding line.'

269: suggest "following Jourdain" rather than "by Jourdain"

We will write 'following'

317: suggest replacing "similarly to as discussed by" with "following"

We will also add 'following' here

319-21: the math symbols did not render correctly.

We will make sure that subscripts and superscripts are rendered correctly now.

323-24 suggest "the magnitude of the sum of all ice fluxes (including the pseudo flux in Eq. 1.10) can become similar to or larger than the negative of the SMB."

We will follow this suggestion

324-25: suggest "For these locations, achieving an equilibrated transient ice sheet requires a reduced ice flux divergence compared to that in the equilibrated equilibrium ice sheet, or even ice flux convergence"

We will rewrite this sentence accordingly

350: Check subscript on C_c , add 'because' before C_c

We will add the subscript

516: My understanding is that the ice shelves in the current model cannot disintegrate.
Would “effectively disintegrate” be more correct here?

Yes, good suggestion. We will write ‘effectively disintegrate’.

624 lead -> leads

We will do so

631 delete both commas

We will do so