**Author reply to both reviewer comments of tc-2021-130, revised version**
**by Christian Wild (20 Dec'21)**

**Reviewer #1 : Clemens Schannwell**

Thank you for the second round of comments (all agreed) and for your very constructive review of our paper. We have thoroughly enjoyed this learning process and are excited about its outcome.

line 16: delete 'unprecedented' before ice-shelf thinning, agreed and implemented

Fig 1 caption: typo, agreed and implemented

Fig 2 caption: black arrows disappeared pointing towards areas with surface elevation above flotation height, agreed and implemented

Eq (4) and beyond: bold characters for vector/matrices/tensor only according to TC's policy: We changed throughout the manuscript following the author's guidelines.

From the copernicus Latex template for TC:

%%% Physical quantities/variables are typeset in italic font (*t* for time, *T* for Temperature)
%%% Indices which are not defined are typeset in italic font (*x, y, z, a, b, c*)
%%% Items/objects which are defined are typeset in roman font (Car A, Car B)
%%% Descriptions/specifications which are defined by itself are typeset in roman font (abs, rel, ref, tot, net, ice)
%%% Abbreviations from 2 letters are typeset in roman font (RH, LAI)
%%% Vectors are identified in bold italic font using \vec{x}
%%% Matrices are identified in bold roman font
%%% Multiplication signs are typeset using the LaTeX commands \times (for vector products, grids, and exponential notations) or \cdot
%%% The character * should not be applied as mutliplication sign

For example, ice thickness H is a 2d matrix and therefore non-italic and bold font, while basal velocity v_b is a 2d vector and therefore italic and bold font.

Fig 3 caption: delete 'light' before blue, agreed and implemented

line 225-226: change start of sentence to 'Here we use the SSA to infer both', agreed and implemented, deleted 'Full-Stokes'

line 291: delete space between '3 d', agreed and implemented

line 355: reword 'swamp-like' to 'large patches of slippery subglacial conditions', agreed and implemented

Fig. 7: missing note about view rotation of the Figure, agreed and implemented

line 512: reword 'stress-balance experiments' to 'diagnostic experiments', agreed and implemented

**Reviewer #2 : Anonymous**

We thank the reviewer for providing insightful comments throughout the review process, especially regarding the thought provoking discussion about friction laws and assumptions surrounding the effective pressure.

HO vs SSA

We agree that using HO for both the inversions and the forward runs would be a further step in the analysis, but prefer to keep the SSA throughout the present study to be in line with the analysis of Barnes et al., 2021 for glaciers draining into the Amundsen Sea. The authors demonstrate that inversion products, particularly basal friction fields, are directly transferable between different ice flow models and their underlying stress-balance equations. When modeling an ice shelf and other areas of relatively low friction, then the SSA is the appropriate approximation to use. Higher order models would clearly do a better job in the area of transitional flow, especially the grounding line. But that is not the focus of the paper. It is possible that our grounding line flux estimates would change slightly. But given other uncertainties, such as temperature distribution this is not likely to be a major problem. We therefore believe that replacing the SSA with HO in our analysis would not be a major cause of differences nor impact the conclusions. Furthermore, the SSA has been used successfully in related perturbation experiments using ISSM by Still and Hulbe, 2021 for pinning points on the Ross Ice Shelf.

Minor/technical comments

line 210: replace ‘recent’ with ‘past’, agreed and implemented

line 223-24: replace ‘Weertman’ with ‘Budd’-type friction law but keep the equation, agreed and implemented. We added a few sentences about alternative friction laws to the discussion. Budd includes the effective pressure, N, in the equation and Weertman depends on the friction coefficient only. Because N is a constant, an inversion without it would simply raise the value of the determined basal friction coefficient. A Schoof-type sliding law is treating flow over an undulated bedrock and becomes essentially plastic at high water pressure, just like Coulomb laws for till. The important feature of the basal sliding law is that friction becomes low for low N. That effect is captured in Budd, Schoof, Coulomb.

line 226: add a sentence about the assumptions regarding effective pressure and what processes this formulation neglects, agreed and implemented.

line 250-52: state in parentheses what a Dirichlet and Neumann boundary condition means in practice here, agreed and implemented

line 553-55: What processes/feedbacks make it ‘very likely’ that current thinning will accelerate. We discuss the nonlinear processes and our reasoning to state ungrounding occurs sooner than later within the reported range in the last three paragraphs of the Discussion section. We therefore only enumerate these again in the Conclusion. Text added.

Figures

Fig. 3B: Colorbar label ‘m’ what ? We changed to ‘m a.f.’ to indicate meters above flotation here and in the text

Fig 7: (a) label should be ice surface, disagreed, the displayed variable is ice thickness, which is in ‘m’
(b) label should be bed elevation in ‘m a.s.l.’, agreed and implemented