Rebuttal 2

Dear Hilmar,
Thanks for the very positive news. Below you find the answers to the questions. The corrections are made in the revised manuscript.
Kind regards,
-Frank

Stephen:

I am happy with the revised manuscript, it clearly deals with all the major issues from the first round of reviews.

One bit of pedantry: it is now clear that you have SSA+SIA in the grounded ice and SSA in the shelf, and so the transition is not strictly smooth (in the sense that du/dx, d^2u/dx^2 etc are defined). It is not a big issue in typical ice stream cases (as Winkelmann 2011 notes), but might be in others.

I have added that this addition is valid for ice stream flow.

Hilmar:

Top of page 11. : Eq (16) is just the normal viscous sliding law, is it not? Why call it a plastic sliding law? Eq. (16) is clearly not a Coulomb friction law! Are you maybe referring to Eq. (12)?

Yes, you are right. Thanks for spotting this. Eq. (16) is a sliding law and not a Coulomb friction law. I corrected this. Eq. (12) is the Coulomb friction law.

Page 12: What controls b_f?

The user controls b_f. All the experiments in the paper are with either b_f=1 (which is the case presented in Schoof, 2007) or b_f=0, for the experiments where the ice shelves are removed. In the latter case \Theta=1 throughout. Since may be a bit confusing, I corrected the sentence and added another one: b_f is an additional buttressing factor to control the buttressing strength of ice shelves and may be varied between 0 (no buttressing) and 1 (full buttressing). All experiments in this paper use $b_f=1$, except the sensitivity experiments on ice-shelf de-buttressing where $b_f=0$.

Your \Theta appears different from the one used by Christian. I think you get Christian's definition for b_f=1

Indeed. See previous remark.

Do you calculate \tau_{xx} from the model then use (18) to fix u_b? But how do you fix the value of b_f? I saw a statement on page 21 suggesting that b_f is determined from measured surface velocities. Is that correct?

See previous remark: b_f is a parameter controlled by the user (no real physical meaning). It is not as such determined in the model.

In (27) I'm missing the shear heating due to deformation in the horizontal plane. What is the justification for not including that part?

Shear heating due to deformation is given by Φ in Eq. (27). The thermodynamic model is only based on SIA, so only vertical shear strain heating is included (dv/dz).

Bit surprise by (29). Thought the Peclet number for ice shelves was >> 1

The thermodynamic part of the ice shelf is not really crucial for the model, it is merely considered as being a boundary condition. It is a simple analytical solution. Many models just apply a linear profile in the ice shelves (bounded by two Dirichlet conditions given by surface and ocean temperature).