Summary and comments on the manuscript entitled

Impact of frontal ablation on the ice thickness estimation of marine-terminating glaciers in Alaska

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by

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General comments

First, I want to express my appreciation for the serious efforts to address the concerns is raised on the convergence. The authors now clearly show that the iterative procedure does converge to the same calving front thickness starting from various initial thickness values.The authors make clear that this iterative procedure is actually nothing else than solving a polynomial of degree 4 in two variants: with and without sliding. This also means that there is an analytical solution to the calving front ice thickness H_f and thus the calving flux $F_{calving}$. This resolves my initial concern on the 'missing' target quantity of the iterative optimisation. It is inherent in their formulation. My sincere apologies that it took me a moment to get my head around this. However, in the presented iterative scheme the μ^* calibration is entangled with the iterative determination of the calving flux $F_{calving}$. This makes the iterative procedure unnecessarily complex and blurs which variables actually determine $F_{calving}$. In my opinion, it is possible to neatly separate the calving flux problem from the μ^*-calibration. If I am wrong here, please justify well and ignore my comments below. Otherwise, please disentangle these two steps to avoid needless complexity. The presentation of the procedure will strongly profit in terms of clarity.

In essence, your iterative procedure boils down to setting the flux values in Eqs. (1) and (8) to be equal at the calving front. In this way, the calving flux is eliminated and it no longer needs to be determined by integrating the apparent mass balance along the glacier centreline. The solution for H_f is thus independent of μ^*. The resultant polynomial of degree 4 has an analytical solution and you could avoid any iterative procedure. Moreover, an analytical solution would add to the computational efficiency of OGGM. Though I prefer an analytical formulation, I refrain from urging the authors to implement the equations for the root determination. However, I urge the authors to make clear that these iterations are simply a numeric strategy to solve for the real roots of a 4th order polynomial. Clarify that this polynomial is independent of the apparent mass balance integration. You should also consider to simplify and streamline the iterative procedure.

Here, my suggestion:

Step 1 Determine initial thickness H_f^0 guess (1/3 E_f or whatever) at calving front and compute a first guess for the calving flux $F^0_{calving}$ using Eq. 8. Set i=0.

Step 2 Use $F^i_{calving}$ to update the ice thickness H_f^{i+1}using Eq. (1) either with or without sliding.

Step 3 Use Eq. 8 to update the calving flux $F^{i+1}_{calving}$.

Step 4 Set i=i+1. Iterate **Step 2** and **Step 3** until convergence is reached.

I think the above scheme becomes much easier to implement, if you swap Eqs. (8) and (1). Then, you would only need to solve for the roots of a polynomial of degree 2 (Eq.8) to update the thickness guess in **Step 2**. The polynomial of degree 5 (Eq. 1) would then only be evaluated in **Step 1, Step 3** by inserting a the iteratively updated thickness value.

Once the calving flux $F_{calving}$ is determined, you simply add it to the subsequent μ^*-calibration. You could even keep the condition that μ^* should not become negative. The structure of the manuscript would need to be slightly adjusted to clarify the one-way dependence of μ^* on $F_{calving}$ and NOT vice versa.

Specific comments

- Explain the improvement of using Eq. (8) to prescribe the calving flux for Eq. (1). Why not simply use a fixed value per region as in Huss and Farinotti (2012). What is the physically added value of the parameterisation from Oerlemanns (2005). A motivation of this choice is missing (P7L30ff). Why is this a good or even better choice?
- Rethink the necessity of section 3.5.
- You could check internal consistency: Remember $F_{calving}$ used for the μ^*-calibration. Run the thickness reconstruction and insert H_f into Eq. (8). Do you get the same value?

Technical corrections

P7L13ff Comparing Eq. (6) and (7), it seems that q is equal to $F_{calving}$ at the calving front. You could use one variable name for the flux, either F or q.

P11L2 What is the default value for k. If you used $k = 2.4yr^{-1}$ here, this would mean that after the regional calibration to $k = 0.66yr^{-1}$, the Columbia calving flux would decrease by a factor 4. This is important. In this case, the

McNabb values would no longer compare well and you should reconsider your regional calibration. Please specify the default value for k and discuss.

P11L4 Fig.7 ⟶ Fig.6 (please re-check all figure references.)

P13L24 '..., we increase ...' ⟶ 'estimate is increased from ... to ...'