Review of “Numerical modeling of the tipping processes of ice detachment: a case study of Sedongpu Glacier in the Southeastern Tibetan Plateau”
By Zhang et al.
Submitted to *The Cryosphere*

Overview

Zhang and co-authors present a numerical model to represent glacier detachment, a rapid process that is not typically represented in physical glacier models – and a process that I believe many in the glaciology community are not likely familiar with. The novelty of this study is that it provides a framework for coupling the rapid evolution of internal stresses with basal friction, with great potential for applicability to improve hazard prediction in High Mountain Asia and other glacierized regions.

General comments

In general, the manuscript is well written and organized, with clear descriptions of the mathematical equations. The authors openly acknowledge the missing processes from this model that are also involved in glacier detachments, and justify their focus on internal stresses and basal sliding.

The paper includes links to a GitHub repository of model code and a Zenodo repository of data. The links are valid, but the repositories themselves need a bit of work to make them more usable. The Zenodo archive lacks a description of the files included, with no description of the variables saved in the MATLAB file or even a description of which simulation those results correspond to (out of several sensitivity simulations presented in the paper). In the GitHub repository, the README file does not provide any practical instructions for using the model scripts or descriptions of the different files included in the repository. I am also not sure if GitHub qualifies as a suitable repository for this journal or not.

Please see below for specific comments and questions that should be addressed to further strengthen this manuscript. Given the novelty of this topic and modeling approach, I recommend this paper for publication with some minor revisions. I enjoyed reading this paper, and I feel that it will make a great contribution to the glaciological literature, serving as a foundation for improved understanding and representation of dramatic detachment events in more complex glacier models.

Specific comments

Figure 1b,c – It would be helpful to draw on the broader map (Fig. 1a) the boundary of the DEMs to get properly oriented. You might consider including only one of the DEMs here, since they look so similar, but I can also understand the reasoning for including both. It’s great that the caption points toward the difference DEM in a later figure.

Line 70 and Table 1: It would be helpful to provide a citation to justify the value chosen for A (10^-16), as it is several orders of magnitude higher than the values according to Cuffey/Paterson (10^-24).

Line 73: Is the basal friction coefficient held constant through time using the value from the inversion? (Section 3.1.1) Please clarify.

Figure 3b: The velocity looks very spotty, with alternating patterns of high and low velocity along the glacier center-line. This should be at least discussed, with some validation or justification for the pattern.

Figure 4: Are the values of basal friction prescribed to be 1000 at both ends of the glacier? What is the sensitivity to this value? Especially at the terminus, it seems like physically the friction should continue to be very low to allow for free movement.

Figure 5: It looks like there are numerical oscillations in the initial ice viscosity (5a) and also in the new steady state of mean speed and mean effective stress following the detachment event (5b). While they appear to be stable oscillations, it would be good to discuss these numerical artefacts. Did you experiment with using a smaller time step to resolve this oscillation?

Line 209: If ice thickness is being evolved, why does the cross-sectional profile look the same across all time steps in Figure 7?

Editorial comments

I am not going to identify individual typos and grammatical errors, but there are several throughout the paper.

Figure 6a: Where is the black line in this plot? Make it visible by using dashes or symbols if it is perfectly aligned with one of the other lines.

Figure 7: I suggest using the same colormap for all three cases for better comparison.