Summary

This manuscript offers a novel approach to understanding the role of proglacial lake level changes on ice dynamics under a range of different scenarios. It is generally well written and well referenced although some paragraphs require some rewording. The manuscript reveals how both long and shorter term increases in lake level result in increased ice velocities and higher rates of thinning compared to a land terminating scenario. The glacier response to changing water levels is shown to be non-linear with grounding line mass flux dramatically increasing once flotation occurs. The authors also show that shorter term reductions in lake level can lead to high tensile and compressive stresses at the terminus that could drive significant crevassing, however they suggest that slow drainage could act as a viable geoengineering strategy to mitigate GLOF risk and lower glacier retreat rates. At present there remain a number of limitations that require significant revision that I have immediately addressed below.

Major comments

The most significant limitation, which the authors have acknowledged, is the exclusion of calving and subaqueous melting. In real lake-terminating systems, thermal undercutting and calving are primary drivers of mass loss. By omitting these to isolate hydrostatic buoyancy, the model represents a highly conservative estimate of glacier sensitivity. If there is a way to incorporate subaqueous melt, relative to changes in lake temperature (which is likely to vary significantly seasonally, with lake volume, and be influenced by the presence of icebergs and inflow from non-glacial water sources), this studies results would be greatly strengthened. The lack of removal of ice through calving is most likely resulting in unrealistically thin ice tongue formation that may presumably be acting to stabilise ice/reduce velocities behind the grounding line thus resulting in underestimations of glacier change.

The paper frames Experiment 3 as testing a GLOF like scenario, however the time period of drainage is on a magnitude of years rather than hours or at the most days which real life GLOF events typically occur. I think this is therefore misleading and the authors either need to cite examples of GLOFs which have undergone drainage in this style or reframe what this experiment is trying to demonstrate. It would also be great to see an experiment showing very rapid lake level changes that compare to an observed real world GLOF.

During Experiment 3, the model shows stress peaking and then relaxing back to equilibrium within 5 to 10 years due to the viscoelastic nature of ice. However, because the model lacks a fracture mechanics or calving law component, it assumes the ice simply "absorbs" this stress and relaxes. In reality, stresses that high (exceeding typical ice tensile strength of ~300 kPa) would result in physical breakage and therefore calving rather than just mathematical stress relaxation, this needs to be properly addressed in the manuscript.

Minor comments

L38: The language in this sentence could be a bit more precise; Lakes can form without having a major impact on ice dynamics, particularly when they are small. Maybe frame as →

increasing lake growth can result in glaciers becoming increasingly detached from climatic drivers on ice dynamics.

L61: Replace semicolon with full stop.

L75-78: The last part of this paragraph feels like a different message to the first part, maybe remove discussion of significance of glacial lake outburst floods to the following paragraph or a new paragraph as it doesn't quite fit with the discussion on ice dynamics above.

L96-107: This reads well.

L142: "Poorly unknown" double negative, amend to something like 'poorly quantified' or just 'unknown'.

L160-162: The way this is worded makes it a little tricky to follow.

L174: Consistency with the formatting compared to the below experiments, other experiments have "and" after the semi col whereas this line doesn't.

L206: Define extent of "lake region" how was this region determined?

L207: A 20% difference between lake and land terminating velocities does not seem to be "modest".

L215/Fig 4: This plot could be improved, the figures are quite small, and it is hard to make out the bits of the glacier we are interested in i.e. the terminus regions, maybe full glacier plots could be put in the supplementary so this plot can focus on the terminus region?

L230: Again, what is meant by "lake area" here, I am not sure how much glacier this refers to, could we say within x m of the terminus or a point that is fixed? A map showing this lake area could also solve this problem.

L236-240: These sentences currently don't read so well, change "lake terminus" to something like "while the glacier was still lake terminating".

L251/Fig 7: Same as comment for fig 4.

L256-259: We could do with a plot like fig 6 to show this velocity stabilisation as this transition point is not clear from fig 7.

L274-313: This feels like a totally different experiment and is very interesting in its own right, it should therefore be described as such earlier on.

L277: What are these lake levels?

L308-311: This feels better placed in the discussion.

L314: Although the focus of this section is on the stress response, it would also be interesting to see the velocity/thinning response included to allow for comparison with the other experiments.

L351: Please define these or make clear what these "unstable feedbacks" are here.

L387-389: This opening sentence could do with improvement in readability and how it sets up the coming paragraph.

L406-408: Given that ice discharge (calving?) is not quantified in this study, this sentence needs a citation.

L410-414: I am not sure how quickly ice advancing over the grounding line would result in a change in lake level? I imagine it wouldn't be too hard to quantify and also work out how much this would change the discharge of the lakes outlet stream. I feel that any displacement of water by ice flowing into the lake would be quickly offset by increasing drainage from the lakes outlet.

L412-414: Do we have any examples of such rapid lake rise?

L422-424: Describe these examples of where this has happened.

L438-439: This sentence doesn't read well at the moment from "however" onwards, not clear what it's trying to say.

L456-457: This sentence is confusing, not sure where lake-contact margins come into this.

L470: "propagate also" → also propagate.

L485: I would be cautious about linking these results to these poorly constrained historical events especially given that this study doesn't quantify the glacier response to sub annual changes in lake levels.

L505-508: Could be a good point to discuss how icebergs would affect water temperature and the energy balance at the terminus and what would mean for thinning rates.

L544: Would this be considered rapid, most would assume rapid refers to a GLOF style event i.e. hours? South Lohnak could be a good case study here for examining how the stress changes at the terminus resulted in crevassing/acceleration etc if we are to discuss mountain systems.