Reviewer 1:

First of all, sorry for being late for my review

The manuscript presents a suite of experiment with a flowline ice-flow model coupled with a subglacial hydrology model. The transient experiments are very similar to the work of Brondex et al. (2017), where the authors studied the sensitivity of the grounding dynamics to the choice of the friction law, including the Budd and Coulomb friction law, however using a very simplified model, i.e. assuming perfect connectivity to the ocean, for the basal hydrology.

Here, the subglacial hydrology model is for a one-dimensional subglacial channel and follows Fowler (1999) and Drews et al. (2017).

The ice flow and hydrology models at two way coupled and the manuscript present a suite of steady and transient experiments to explore how this coupling could apply dynamics. This is synthetic experiments and the authors acknowledge in the discussion that their hydrology model is fairly simple and that more work would be required to make quantitative comparisons in realistic settings.

They show that the hydrology model leads to a maximum in the effective pressure upstream of the grounding line and that it is essential to have an active model to predict the evolution of the grounding line dynamics.

This manuscript is an original extension of the work of Brondex et al. (2017).

Thank you very much for your constructive review. Our responses to the comments in grey are in black below. Line numbers refer to the submitted version of the manuscript.

I only have relatively minor comments, the main point is that the description of the experimental design is relatively complex, and often the differences between some experiments are only on the numerical aspects, i.e. grid resolution or time-steps. For example experiment S1 is part of the sensitivity experiment, the only difference being the grid resolution. It's mainly a matter of presentation, but I have the impression that it would be easier to read by presenting the steady-state experiments a two experiments, a first set to study the sensitivity to the physical parameters and a second experiments using one particular set of physical parameters to study the effect of the coupling.

We agree that we should present the steady-state experiments as two sets, one examining sensitivity, and another using a particular set of parameters to study the effect of the coupling. We will introduce our sensitivity experiments first (around line 188), and explicitly label them as such. We will then specify a selected set of parameters used for the sake of studying the effect of the coupling in further detail, and highlight that as a second set of experiments, after describing the sensitivity experiments (around line 200).

Also while the work of Brondex et al. is referenced in the manuscript, I think it would be also easier to present the transient experiments as an extension of Brondex et al.. The main difference being the forcing used to push the grounding line in the retreat phase. To make

reading easier, I think it could be possible to first summarize the main aim of the experiments before entering the details.

We agree that Brondex et al. (2017) is an important foundation upon which this paper is partially built, but the driving goals behind our transient experiments are different. While Brondex et al. investigates the impact of different sliding laws on retreat, our experiments are focused on the impact of an active hydrology system. We chose to test two sliding laws to demonstrate the ubiquity of the impact that hydrology may have, rather than to test the effect of the two different sliding laws. We will mention Brondex et al. (2017) as a basis for our experimental setup in regards to sliding law choices at line 225.

Detailed comments:

L25: "Usually, this parameter remains static"; Maybe "usually" is not appropriate as there is more and more applications that try to account for the feedback with the basal hydrology in a more or less parameterized way, as discussed in the next paragraph. So "usually" could maybe be replaced by "often"? or "often, in large scale experiements"?
We will replace "usually" with "often".

Eqs (1) and (2):
these equations are often referred to the "Shallow Shelf" or "Sheflfy Stream" Approximation. Maybe use this notation to avoid confusion?
"b" is not defined
We will refer to those notations and include a definition for b.

L104: *"One drawback associated with this sliding law is that the inclusion of N can result in large, nonphysical stresses »* . I don't understand what you mean by this.
We are reiterating statements from Schoof (2005) which states that equations of this form allow for arbitrarily high shear stresses, regardless of N, which disagrees with Iken's bound, which says that there is an upper limit to stress set by bed geometry. We can see how the "inclusion of N" and "nonphysical stresses" may be unclear. We will instead say how this equation allows for arbitrarily high shear stresses, which is unphysical.

L172 *"one with coarse resolution and another with fine resolution near the terminus":* Maybe use grounding line instead of terminus? The ice shelf being unbuttressed there is no difference if the grounding line is also the terminus or if there is a shelf.
We will refer to the terminus as the grounding line instead.

L176: "through enforcing continuity of thickness at the junction between the two segments of each grid and imposing the flotation condition.". I'm not sure I fully understand this.
We can see how this sentence may be confusing. We will delete "the two segments", and emphasize that the flotation condition is enforced at the grounding line, and not the junction.

L206: *"coupled model. S1.B uses";* notation is a bit confusion and at first read one wonders what was S1.A before realizing that B and C refer to Budd and Coulomb

We can see how labeling experiments as S1.B and C suggests the possible existence of S1.A. On first usage, we will introduce the experiments as S1.Budd and S1.Coulomb, referred to as S1.B and S1.C thereafter.

*L209: "*the same points of coupling are preserved ». Unclear

We will expand the sentence to "Note that although different sliding laws are used, the subglacial drainage system and the ice-flow components of the model are coupled in the same way in S1.B and S1.C"

References

Brondex, J., Gagliardini, O., Gillet-Chaulet, F., and Durand, G.: Sensitivity of grounding line dynamics to the choice of the friction law, Journal of Glaciology, 63, 854–866, https://doi.org/10.1017/jog.2017.51, 2017.

Schoof, C.: The effect of cavitation on glacier sliding, Proceedings of the Royal Society A: Mathematical, Physical and Engineering Sciences, 461, 609–627, https://doi.org/10.1098/rspa.2004.1350, 2005