2nd Review of: *The role of basal hydrology in the surging of the Laurentide Ice Sheet*

by William H. G. Roberts, Antony J. Payne, and Paul J. Valdes

General Impression

Since the last version, the authors have taken a few changes to the manuscript that put their method to produce the binge-purge mechanism into a more critical light. I of course would have loved to see – even just for one parameter setup, to overcome the argument of lacking computational resources – a comparison to a model that would account for longitudinal stress transfer. That would have pointed towards a trigger of the surges by physics and leave less room for speculation about numerical artefacts in in their oversimplified ice flow as well as basal hydrological model, linked by the sliding law. Nevertheless, I think by adding these additional explanations readers even outside the relatively small community of ice sheet modelers now get the idea of the weak points within the model setup, hereby avoiding the impression that the case of the ice sheet (thermo-)dynamics leading to Heinrich events would be solved, but this paper rather delivers a new perspective to this problem. As you do not claim to investigate the surge mechanics itself, or derive quantitative values (although you actually provide numbers on calving fluxes) of fresh water fluxes, which would need a physically correct description of the outlet, I am able overcome my uneasiness to publish the paper without adding higher order model runs.

Major points of critics

Despite my request during the last review, you fail to give the details on the **time-step size** of your model. You updated the information only by the output-interval of 10 years. But knowing the actual time-step size is not irrelevant in order to judge about potential numerical instabilities, since – I presume you are running an explicit FD scheme – it determines your CFL condition. In particular, the statement that you test your model on different horizontal mesh sizes, but – at least that is what I extract from the test – not with different time-stepping sizes, leaves room for speculation that actually all your runs could fall into an instable regime defined by the applied time-step size and spatial resolution. Admittedly, your coarse mesh size plays into your favour for being able to apply longer time steps, but with SIA (and this is also in particular mentioned in the Bueler et al. paper from 2007) you have to clearly have an eye on the vertical direction (which I guess remains fixed in resolution). If you could give that information and additionally **drop a few lines on the CFL condition of the heat transfer equation** that applies in your model, it would improve your chain of arguments.

Concerning your newly added statement: *We argued, however, that at the grid resolution that we use this effect is likely negligible*. I do not like the word *neglibile*, as by this it easy to be misinterpreted, as it exactly is the large grid spacing in your model that contradicts the proper resolution of the physics at fast outlets and grounding lines. It should become clear that this is a consequence of your chosen resolution and not a justification for applying it. You cold rephrase: *We argued, however, that at the grid resolution that we use this effect is* ***not accounted for***.

You should give more details about the newly applied smoothing. As I understand from the Bueler et al. (2007) reference, they applied such a kernel to friction heat production (which is proportional to the shear rate, hence kind of introducing something similar to horizontal stress transfer) rather than the temperature field. Did you apply the same strategy? Else, if you really smoothed the temperatures, explain how you

applied the kernel and elaborate how you see that such a smoothing mimics the effect of longitudinal stresses (I would say it just enhances heat conductivity).

Minor issues

Page 5, line 24: parameteristions -> parametrization

Page 5, line 29: period is missing at the end of the line

page 11, line 34: period is missing at the end of the line