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Interactive comment on "Brief communication: Time step dependence (and fixes) in Stokes simulations of calving ice shelves" *by* Brandon Berg and Jeremy Bassis

Anonymous Referee #1

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This paper presents a simple method to overcome time step dependence of the solution arising when solving for an ice-shelf which departs significantly for hydrostatic equilibrium. This could be the case for instantaneous non-vertical icebergs calving or supraglacial lake drainage.

This is quite a technical paper but as the problem might be encountered by other groups using different Stokes solver, this brief communication certainly deserve to be published. The overall writing of the paper is quite good even if I think that there is some room for improvement.

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Discussion paper

My main concern is the fact that the time step dependence of the solution is sometime seen as negative (e.g. title) or positive (e.g. caption Fig. 2). And indeed it is not completely clear from Figs. 2 or 3 to see which of the two solutions is the one that works better. The viscosity has no timestep dependence for the sea-spring solution and it is the sea-spring+NS solution that has no time step dependence for effective strain-rate. This is even less clear for stress where both solutions are diverging but presents both a timestep dependence. I would expect more comments on the text on this and how from the figure one can decide which is the working solution.

I have also listed a number of smaller points below.

- page 2, line 41: ", where u_1 is a constant"
- Figures 2 and 3: the quality of Figs. 2 and 3 are very low. It is not clear from the text and the captions if what is plotted on these figures is the solution after the timestep following the calving event. What are the differences of setup between Fig. 2 c and d and Fig. 3? I would suggest to modify Pa to MPa or kPa. For the x axis, the caption should tell that time step are varying from xx seconds to xx years?
- page 5, line 95: not sure the second sentence of part 3.2 should start with "Furthermore"?
- Eq. (9): specify that u_{i-1} is the velocity at previous timestep?
- page 6, line 113: "where the damping coefficient is"
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