Review of "Simulated dynamic regrounding during marine ice sheet retreat" by Jong et al.

General Comments:

This study uses 2D flowline simulations in Elmer/Ice to investigate the impact of the choice of sliding law on ice sheet and grounding line dynamics during retreat over retrograde bedslopes, and discusses the process of 'dynamic regrounding', whereby a retreating ice sheet may reground on a pinning point due to advection of thicker ice, potentially stabilising the retreat. The authors find that regrounding for this particular model domain is possible with the cavitation sliding law, but not with the Weertman law. The authors also propose that the shape of real ice sheet transition zones may provide clues as to the true nature of sliding under ice sheets.

This is an interesting piece of work which makes a valuable contribution to the field, and so merits publication. However, I have some concerns about the experimental setup which should be addressed.

The main results presented for cavitation and weertman sliding are at 500m and 250m, respectively, but the authors have also run the cavitation model at 1 and 2km resolution, and the weertman at 500m, 1km. Why not present and compare the 500m resolution results for both models?

The simulations also use different timestep sizes. For cavitation sliding, dt = 0.1 years, but for Weertman, dt = 0.5 years. Why? Can you be sure that these simulations, which have different mesh resolution and timestep size, are comparable?

Retreat of the grounding line is forced by reducing the effective channel width. This doesn't seem to reflect any hypothesised real-world drivers of ice sheet collapse, except perhaps progressive weakening of shear margins? Are your results sensitive to the nature of the retreat forcing? Would it not be more realistic to alter the SMB or apply basal melting to the floating tongue?

Specific Comments:

The comparison of the Weertman-style sliding vs cavitation sliding seems to centre on the fact that Weertman sliding is tricky to implement in models, but this isn't the only shortcoming of sliding laws which neglect effective pressure, surely? Can the authors not also make the case that Weertman sliding is fundamentally unsuitable for systems with significant water pressure at the base?

I guess water pressure at the base is simply defined by sea level? This should be explicitly stated in the methods, I think. Is this what you mean by P3L15: "based on the assumption of full connectivity between the subglacial hydrologic system and the ocean"?

I think you could be clearer on how lateral drag is implemented. You describe the lateral resistance parameter K but don't explain how that modifies the Stokes solution. Also, when you say "… which we use to modify the lateral drag from high to low", do you mean that the channel width varies through space or time? This becomes clear later on, but it would be good to avoid confusion here.

Also, on the issue of lateral drag and channel width, the parameter W, as used by Gagliardini et al. (2010) refers to the half-width, rather than the width. Comparing your Eq. 6 with their supporting material, I see that you've adapted the equation somewhat, so I am unsure whether this should *still* be half-width or if your adaptation accounts for this.

I like how you've presented the results in Figs. 2 and 4, but I found myself flicking back and forth between them for comparison. Perhaps you could reformat to show 2a alongside 4a, 2b alongside 4b, etc?

The velocity plots in Figure 3b are strange, and, I guess, indicative of mesh dependency? At any rate, the high frequency variability should be explained.

Technical Issues:

P2L1: "and when focusing on retreating glaciers such as Pine Island" Slightly odd wording?

P2L11: Elmer has a few sliding relations implemented, including Weertman and Budd.

Fig 1,2,3,4: Missing a,b,c labels

P3L14: C is the max value of Tb/N, I believe.

P3L18: "is *the* non-linear Weertman-type"?

P3L20: Why not redefine *m* to something else to avoid confusion with *m* in Eq. 3

P3L22 and elsewhere: Perhaps "lateral buttressing" or "lateral drag" would be clearer? When I think of 'buttressing' I think of melange or sea-ice buttressing.

P4L28: Here you state that you increase W from 100km to 350km, but I think you also run 400 and 500km (Fig. 3), right?

P9L1: "iceshelf" => "ice shelf"