Interactive comment on "Snowfall versus sub-shelf melt: response of an idealized 3D ice-sheet-shelf system to mass redistribution" by Feldmann et al.

In this article, the authors conducted a series of experiments to test ice-sheet response to the distribution of surface mass balance and sub-shelf melting based on the ice-sheet model PISM. Different parameters of ice properties and geometries are implemented as a sensitivity study. From the ensemble of experiments, the authors concluded that (1) the combination of increasing sub-shelf melting and surface accumulation under climate warming could result in a thicker ice sheet with smaller extent; (2) the de-buttressing effect due to lateral ice-shelf melting induces more loss on grounded ice than centeral ice-shelf melting; (3) ice-shelf thinning has more influence on upstream grounded ice than 'far-field' ice shelf removal.

1 General comments

The redistribution of mass perturbation result in grounding line retreat while having negative sea level contribution. I don't find this situation 'counter-intuitive' (P1L6) in the relatively stable geometry implemented, as it's a combination effect of moving ice from floating ice shelf to grounded ice and debuttressing.

For the experimental design, the perturbation in snowfall is added inland near the ice divide, which result in higher accumulation inland than near the coast. However, in reality accumulation decreases toward inland in general. The distribution of ice mass impacts the surface slope, and thereby the driving force. The authors mentioned an initial examination of changing perturbation zones has been conducted (P4L1). I suggest showing the difference in the supplementary.

The rather narrow range of parameters make the results limited and so less compelling. For example, instead of using the retrograde slope as Asay-Davis et al. (2016), the bed slopes range is 1.0, 1.1 and 1.2. However, the bed slopes of Antarctica basins can be flatter and negative. Will the retreat-mass-gain conclusion fail in that case? Similarly, the width difference between experiments is 8 km at most, while in reality the width/length ratio range is much larger and can be >1. The ice sheet response to different perturbations and the coefficients of the backstress formula could be different. The choice of parameters exclude the West Antarctic geometry and wider ice shelves, therefore more experiments are needed to confirm the conclusions.

2 Minor comments

P2L10: or → and

P4L25: 9*2*3 → 12*2*3? There are four parameters A,s,a,w_c with 3 values for each.

P6L3: extra quotation mark

P6L19: maybe add a figure of velocity to show the 'low advection of ice from the lateral ridges'

P7L5: maybe add a figure of the ice shelf cross section to compare the ice-shelf thinning after years of different perturbations

P7L31: Formulas or references needed to explain how you calculate the back-stress

P21L20: a bit confusing. The grounding-line retreat is stronger at the sides than in the center, but the grounding-line is retreating overall. Why does ΔL decrease?