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The Cryosphere Discussions

Interactive comment on "Parameterization for subgrid-scale motion of ice-shelf calving-fronts" *by* T. Albrecht et al.

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Reviewer: Xylar Asay-Davis

I am not a fan or anonymous review, and I therefore have chosen not to review this paper anonymously.

General comments:

The paper describes and validates a method for parameterizing the sub-grid scale motion of ice-shelf calving fronts. The method is novel and of broad interest to ice sheet modelers. Furthermore, this paper is a nice companion to the two other papers from the same group on the PISM-PIK model that are also currently under review. The validating experiments are appropriate and provide a convincing case that the sub-grid

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scale parametrization is both useful and necessary in order to capture the correct ice shelf dynamics. The length of the paper and the number of figures are entirely appropriate for the material being presented. It is my feeling that the manuscript is ready for publication with some minor revisions. My suggested revisions are described in the specific comments below, and are focused largely on clarifying the description of the method and the experiments used to validate it. I do not think that any additional experiments or figures are required in order for the manuscript to be ready for publication.

Specific comments:

p. 1501 although the definitions will be obvious to most (perhaps all) readers, it doesn't hurt to define all variables and parameters in your equations. In particular, please define v_c, H_c, \Delta x (this can be especially ambiguous when dealing with fractions of a cell – is \Delta x the size of a cell or the size of the fraction of the cell containing ice?âĂŤMy understanding is the latter), \bar{v}, \rho, \rho_w, i and j.

p. 1503 lines 10-12: Presumably advance doesn't happen in such a way that R = 1 exactly at the end of a time step, so that in reality i+2 will begin to fill up in the same time step as when i+1 is full.

p. 1503 line 15: "This effect is not desirable. . ." It's a minor point, but I'm not quite clear on why this is a problem. It just seems like you're extending most of the properties of cell i (ice thickness, etc.) into cell i+1 by a fraction R but thinning in cell i+1 is the same as i. This seems physically reasonable.

p. 1504 line 5: Could you explain a bit more about the residual volume that is lost? This is because the cell is full and you can't change the thickness, since this is determined by the neighboring cell?

p. 1505 line 4: Maybe mention that Q_0 will be defined in Sec. 4.

p. 1505 line 8-9: I don't completely understand what is meant by the assertion that guessing at the reference thickness neither jeopardizes mass conservation nor the

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parameterization. Could you explain a bit more why this is true?

p. 1505 line 24: What at precisely is meant by "The bottom of the ocean does not influence ice-shelf propagation"? Does this refer to the bathymetry? Or to the ocean dynamics at the bottom of the ocean under the ice shelf?

p. 1506 Eqs. (9)-(12): Again, a minor point. Can these be generalized to n not equal 3? If so, this might be useful as Richard Hindmarsh has stated in one of his talks (and I think in his publications) that there is good evidence for n=4.5 or 5 in certain circumstances.

Also, it might be helpful for someone trying to reproduce your results if you included a table of variables and the values you used of each. You do this with some variables in the text (e.g. B_0, H_c, n, etc.). Maybe these could be added to Table 1, where appropriate.

p. 1506 line 18: It would be helpful (at least to me) to describe briefly here what the numerical experiments are that produces the transient profiles.

p. 1507 line 22: I don't follow what is meant by the phrase "even without applied calving rule."

p. 1508 line 8-9: I don't understand the sentence "Respective velocities for the different tested resolution increase up to 730 m/year at the terminus." Maybe you can reword this to make it clearer?

p. 1508 line 14: I don't understand the phrase "(higher order terms in approximation)". Can you clarify?

p. 1508 lines 18-19: I am confused about why ice from whole grid cells is calved off. Isn't the point of the sub-grid scale scheme that it doesn't calve off whole grid cells?

p. 1511 line 8: "with less than 0.025% of error variance": How is this number defined? It seems extremely low to me (though that depends on how it is defined).

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p. 1511 lines 15-16: You may want to say, “We show in transient simulations that variant 1. . .”

Technical corrections:

Please consider these to be suggestions. It is not my intent to be pedantic, just to be helpful.

Title: Calving fronts should not be hyphenated.

Eq. (1): I suggest changing the d’s to \partial’s

p. 1505 line 8: “does neither jeopardize. . .” -> “jeopardizes neither”

p. 1507 lines 12 and 16 (perhaps elsewhere): “below” should be changed to “less than”.

p. 1507 line 26: the word “whole” is not needed

p. 1508 line 10-11: I would delete the sentence “Also the calving front position. . .” because this is stated already three sentences earlier.

p. 1508 line 14: “gets” -> “becomes”

p. 1508 line 21: “velocities equal accurately the analytical value.” -> “velocities are very close to the analytic value.” (You would probably do better to replace “very close” or “accurately” with something more numerical and concrete.)

p. 1509 line 8: “externsion”-> “extension”

p. 1509 line 27: “too low velocity profiles” -> “velocity profiles that are slightly less than the analytic solution” or similar. (Again, you would do well to give numerical values rather than expressions lie “too low”.)

p. 1511 line 6: “can be set to zero”->”can be ignored”

p. 1511 line 20 “Note, that”->”Note that”

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Interactive comment on The Cryosphere Discuss., 4, 1497, 2010.