The Cryosphere

Discussions

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Interactive comment on "The material properties of ice bridges in the Maxwell Elasto-Brittle rheology" *by* Mathieu Plante et al.

Anonymous Referee #1

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The manuscript named "The material properties of ice bridges in the Maxwell Elasto-Brittle rheology" test the MEB sea-ice rheology in a traditional finite difference framework. The aim is to investigate the damage parameterisation. This is achieved with an idealized model setup of a channel that is narrow in the middle an wider In the two ends. I think that this is a very relevant to study the damage parameterisation as this (at least in my opinion) is important for new developments within sea-ice dynamics. The manuscript is in general well written and therefore fairly easy to read.

I could wish for a better organization of the figures. In addition, the result section would be much easier to read if the figures were numbered in the order they are referenced. At last I think that the simplifications made in terms of zero ocean currents/sea surface tilt may have bigger impact, especially in some of the examples mentioned within the

Canadian archipelago, where tides are significant. This is not necessary to include within this study but a better discussion of the limitation would be nice.

The results in general seems less impressive than other studies using the MEB rheology. A discussion of the performance of these would also be nice. Many of these points are mentioned but I think that it would be beneficial to collect these in a discussion and maybe spend a few more words.

Mayor revisions:

I think that the focus of the abstract is a bit off and I would like this to be revised. It is not that important that the framework of the sea-ice model originally was build for VP dynamics as this is not mentioned in the manuscript. The eulerian/lagrangian implementation is more relevant. I would like the abstract to include line 77-82 as these fit well into a summary/abstract and less into the introduction Discussions are scattered around in the manuscript. I would like a collected discussion.

- What improvements/limitations are there when the framework moves from a Lagrangian to an Eulerian approch

The study limits the effects of the ocean(eg tides) by neglecting it. For an idealized study like this it is fine just to look at the wind. But in terms of comparisons with real data then this restricts the value og the study. Tides are very high from Kanes Basin and southwards. This is an important factor when the stability of the last fast ice is to be considered and compared with real life. This is briefly mentioned on line 500, however I would like a bigger discussion of this.

Figures are very inconsistent when labeling. These should be changed. I have suggested updates to almost all of the figures. These comments are in the minor correction/technical correction part.

Minor details

Line 2- Please revise sentence. An example is provided: The effect of the material

parameters on ice arches in a numerical framework that includes both the Maxwell Elasto-Brittle (MEB) including a damage parameterization and the Viscous-Plastic (VP) dynamics.

Following lines after line 2: I assume that this is MEB but it is a little unclear

Line 20 I think that this should be reformulated. For instance, ice keel don't protect sea-ice from forcing. It creates a friction that resist the forcing. I would reformulate this

Line 35 Ice thickness anomaly is this in time or space? I guess that the influencing factor is the current ice thickness, spatial variation (anomaly).

Line 47: replace new rheology with new rheologies

Line 67. References to figures in other articles makes it hard to read. Please either add the location on figure 1 or add a map where this can be shown.

Line 77 to 82: This part would be well suited for conclusions and/or abstract. The introduction should be more overview of previous studies and an overview of what will be presented. Not results.

Line 95 Nares Strait has strong tides in the part near Baffin Bay, thus the ocean currents would most likely be an important factor especially before and probably after the fast ice region has formed. Therefore, this should be mentioned in the discussion. Coriolis is only zero when the ice is not moving. The discussion of the influence of the ocean is too small. Equation 6 ":" in the equation?. This is described in equation 8. This should be moved here (first place that it is used)

Line 119 lhs and rhs should be written without using a abbreviation.

Line 120- 124. These sentences are a bit hard to follow. Please revise.

Line 265 Figure 3 No need to show a ARAKAWA grid. This is a standard. I would remove the figure.

Line 317 Remove "-" 2 times

Line 404 In short the physical solution did not converge until the tolerance is lower than 10^{-10}. How many iterations are required? Is this important for the computational time (how important?)

Line 447 Nature is a bit more complex than just wind. Orography ocean currents etc also play a role, thus values like the cohesion of sea ice should be smaller than 21 KN/m seems to be a very rough estimate based on parts of the momentum equation. Admitted wind is normally the dominant factor along with the resistance (internal strength)

Line 473 How does this compare with results from other MEB implementations.

Line 520: is the ":" suppose to be there?

Line 528: It would be very interesting to include this in a VP/EVP model.

Figure 5 text. Top panel? I can only see one panel in figure 5.

Figure 6. This figure should be labeled a through d instead of a1 2 3 b

Figure 7 Same as 7, Which points?

Figure 8: I would say colored dashed lines

Figure 10 Dots are very hard to see. It would be nice to increase the size of these.

Figure 11: Which colored lines? They are defined in figure 8. Are they the same?

Figure 12: I would still label these a, b,c and d. Then add to the text.

Figure 13 which colored lines? Are they the same?

Figure 14. Please use a,b,c. . . References to the residual tolerance are not very easy. Left 10^{-6} and right 10^{-10} does not make sense.

Figure 17 Arrows are very hard to see.

C4

Figures in general should be in order of them being mentioned in the text. For instance the result section seem to jump back and forth. I assume that when done with the review process they need to be inserted at appropriated places.

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