Review of "Phase-field Models of Floe Fracture in Sea Ice"

December 2, 2022

1 Overview

Dinh et al. present a phase-field model of sea ice intra-floe fracture. The method is interesting but the analysis of model simulations is cursory. With some additional simulations and analysis this work would be suitable for publication in the Cyrosphere.

2 Main comments

- The analysis presented uses a single type of imperfection in the ice pack, namely a fixed number of linear imperfections. Please provide a discussion on why this particular imperfection type was used (i.e.why is it the most appropriate for sea ice) and what other types could be used instead. Also, a brief analysis of the effect on varying the number of imperfections would add to the analysis.
- Figure 3 shows two large peaks significantly higher than the rest of the histogram. Are these statistically significant and if they are what is their cause?
- The analysis in section 3.3 is a quite cursory. I would like to see the analysis presented in figure 4 repeated for other quantities other than just average thickness. It would be interesting to see it repeated with the minimum thickness and with the summed thickness deficit from all the cracks. Also, the average angle of linear ice features used in the analysis (equation 12) should be repeated with weighted averages such as weighted by feature minimum thickness, visible length, or thickness deficit.
- The analysis only considers tension fracture, potentially to avoid complications with ridging in convergence. Some analysis on simulations with shear forcing are warranted though.

3 Other comments

- Line 12: "ice area concentrations" → "ice concentrations"
- Line 13: "have impact" → "have had an impact"
- Line 89: "Degeneration near the crack" - describe what this means
- Line 143: Expand briefly the discussion on one dimensional solutions.
- Equation after line 162: It would be useful to see a small diagram of what this crack cross section looks like
- Figure 4: The brightness-based colorbar used for this figure makes the described important features hard to see. I think the figure would be clearer with a color based colormap
- Line 227: This single line paragraph should be merged with another paragraph
- Figure 5: Same comment about colormaps as figure 4.
- Line 283: "theoretical results of Neitzel et al. (2017)" - describe briefly what these are