Reply #2 to Dr. Ringeisen:

Thank you for your additional comments. Please find below point-by-point replies (in blue) to your comments and questions (which are reprinted in black). We only reproduced the unresolved comments and did not keep the entire history of comments but only reprinted what's needed for context.

Page 3, L58 to L63

Referee: There is some confusion here. I think the paragraph you removed is necessary, I was referring to the paragraph between the title of the section 2 Methods) and the title of the subsection 2.1 Phase-field model of brittle fracture. I think these section introductions are not necessary, but you decided to keep them in the rest of the manuscript, and I accept your choice. However, I think the summary paragraph is necessary, especially the first sentence defining your paper's study. Please add the summary paragraph back.

We apologize for the confusion. We reinstated the last paragraph from the intro. Additionally, we slightly shortened the leading paragraph of Section 2.

Authors: We ran simulations of both compressive and shearing displacements and shear forcing. We found the shear displacement produced crack geometry different from compressive experiments. We added a new figure Fig. 3 with images of the shearing cracks along with discussion in lines 198-204.

Referee:

I am happy that you (the authors) took the time to perform the additional shear and compression experiments. I find the results of the shear experiments of Fig 3 to be very interesting! However, I do not see a mention of the compression experiments in the manuscript. Is it because you observed the same fracture pattern as in tension experiments? Or do you run into other difficulties in the compression regime?

Yes, the compression experiments produced crack profiles similar to those in the tension experiments. We did not encounter any numerical difficulties in these simulations, and added brief remarks in Sec 3.2 about these compression experiments. Below, in Figure 1 we have provided some pairs of crack and ice thickness profiles.

Timings for VP vs. phase field models

Referee: Thanks for the precisions, I did not realize that it was so fast, I thought it would still take some time to find the fracture fields as you have iterations in Alg. 1 and describe a solver in Sect. 2.4. What it the usual number of iteration that it takes? You could also give the values used for and of Alg. 1, for reproducibillity.

We have added the values for ϵ and N to the paper. The number of iterations depends on the experiment. In our case, those with boundary forces should take longer to converge than the displacement experiments. We did not record the number of iterations for the experiments, but based on the results we have, the forcing experiments ran for about 1500 seconds on average. Solves took about one second each, so the average number of iterations is 1500. We added the range of typical iterations to the paper as well.

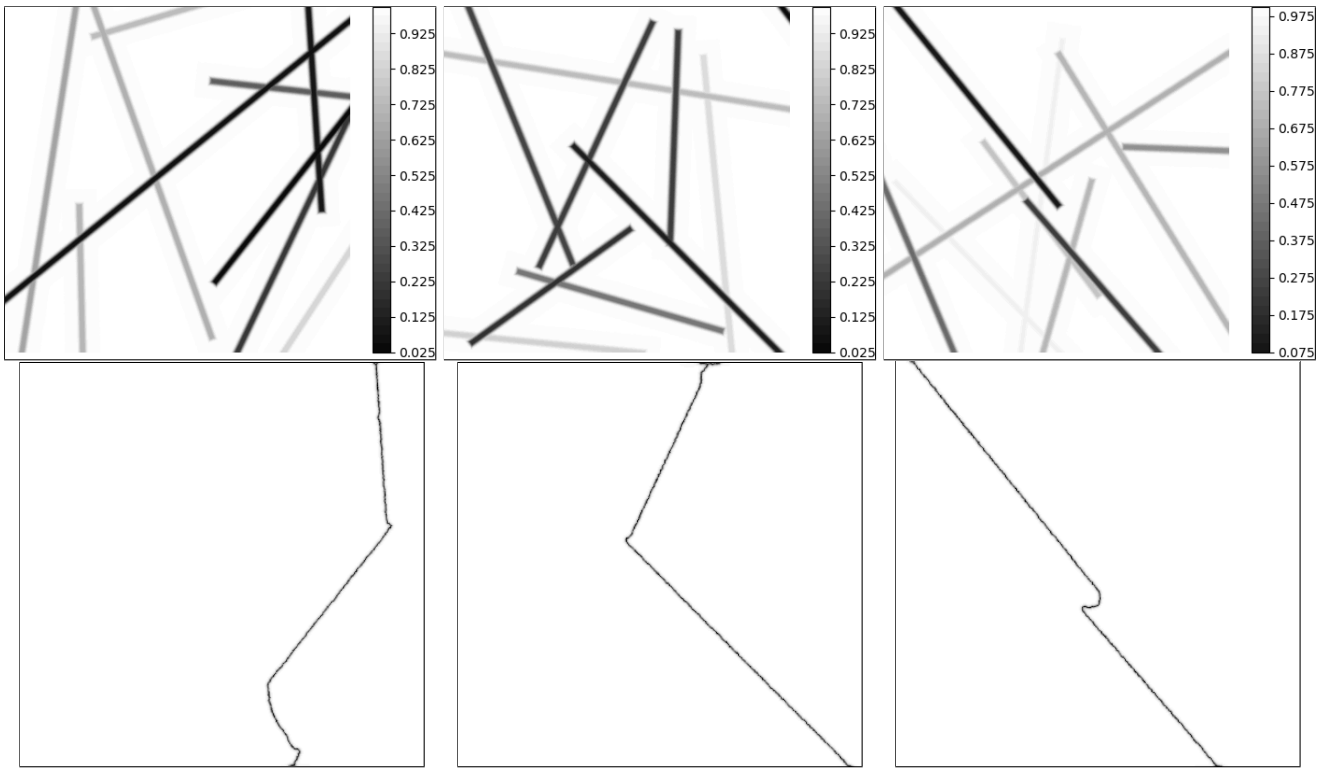

Figure 1: Random thickness distributions (top row) and corresponding fractures (bottom row). Note that a different color map compared to the paper is used.