

The Cryosphere Discuss., referee comment RC2
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Comment on tc-2021-329

Babak Ravaji (Referee)

Referee comment on "Long-term analysis of cryoseismic events and associated ground thermal stress in Adventdalen, Svalbard" by Rowan Romeyn et al., The Cryosphere Discuss., <https://doi.org/10.5194/tc-2021-329-RC2>, 2021

The authors of the manuscript "Long term analysis of cryoseismic events and associated ground thermal stress in Adventdalen, Svalbard" performed a study on a large temperature and seismic database of Adventdalen valley on the island of Spitsbergen, gathered in the past two decades. The seismic data are then evaluated using STA/LTA and MFP approaches to a) filter out cryoseismic events and distinguish them from the mine activities and b) figure out the activity source location. The spatiotemporal temperature data are used to compute the stress history at different depths of the ice layer. Elastic, thermal and viscous strains drive the stress calculations. A simple fracture model is used to predict the possible cracks and cryoseismic events and compare them to the recorded seismic data. The authors concluded that there is good agreement between the model predictions and the recorded data.

In my opinion, the current manuscript lacks enough novelty and depth to get published in The Cryosphere journal. I do not have enough expertise to judge the MFP calculations section, but I hope the comments I made for the thermal stress and fracture sections help the authors to elevate the existing manuscript to The Cryosphere journal-level quality.

I added my comments to the pdf version of the manuscript and copy them here for your convenience as well.

- The Introduction is not coherent. I could not find a clear bridge between paragraphs, and also the relation between written paragraphs and the paper's goal is not clear to me.
- Figure 2 needs more description. I assume each sub-plot corresponds to a certain year; you need to show that in the figure or caption.
- Figure 3: It would be nice if you zoom in into one of the detected events for better clarity of your method.
- Figure 6: It is hard to distinguish differences between seasons only by checking these contours. Adding numbers to either image or in the caption would help readers to notice the fluctuations across seasons.
- Page 16, 325: Your justification here to exclude summer-autumn events from your study does not seem sufficient to me. I am looking for better justification in the rest of your paper...
- Page 16, 330: Again, the justifications in this paragraph are not enough and lack scientific statements. At least, I as a reader, expect to know what type of data you need to draw a more accurate conclusion.
- Figure 8: I suggest reducing the legend of the plot to -0.5-1.5 for better contrast. I do not see values below -0.25 in the contour plots.
- Section 4.2: What are the initial and boundary conditions for solving equation 12?
- Page 17, 345: I do not understand how you associated the 20-30cm regolith to the peak stress in the ice above it. How the peak stress in the ice could lead to high stress in the rocks beneath it?
- Figure 9: I am interested to see the contribution of each strain portion (elastic, thermal, viscoelastic) into the total stress where ever you report the stress value (Figs 8-11).
- Page 20, 395: This paragraph suits better in the conclusion section.
- Section Conclusion: This section is better to be named Summary rather than Conclusion. To enrich your paper's conclusion section (which should be the most important section) I suggest discussing pros/cons of your thermal and MFP model, potential improvements of your work, and maybe possibilities to apply your model to other geographical locations..
- I am curious if you noticed any pattern in the recorded quakes for daytime versus night times (heating vs. cooling periods)?

Best regards,

Please also note the supplement to this comment:

<https://tc.copernicus.org/preprints/tc-2021-329/tc-2021-329-RC2-supplement.pdf>