

The Cryosphere Discuss., referee comment RC3
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Comment on tc-2020-354

Anonymous Referee #3

Referee comment on "A generalized stress correction scheme for the Maxwell elasto-brittle rheology: impact on the fracture angles and deformations" by Mathieu Plante and L. Bruno Tremblay, The Cryosphere Discuss., <https://doi.org/10.5194/tc-2020-354-RC3>, 2021

In this paper the authors introduce a modification of the MEB rheology in the form of a generalized damage parameterisation. They then proceed to test this new parameterisation using an idealised uniaxial loading setup. They find that the new parameterisation influences the resulting fracture angle, bringing it in the range of observations. The paper is well written and clear, using good English and sentence structure, and a logical flow from section to section and paragraph to paragraph.

The introduction of a modification of the MEB rheology is a niche topic, but potentially an important one and certainly one relevant for publication in the Cryosphere. As it stands, the paper has some faults I would like the authors to address. I expect they can do this adequately and that the resulting work will be fit for publication in the Cryosphere.

Major comments:

It is not clear why the authors are proposing this addition to the MEB. Is it numerics or physics, or something else? You say something general at the start, but it's vague and really only says what your modification does, not why you want to do it in the first place. This point should be crystal clear and guide the entire paper. Ideally the authors

should say something like: "we want to introduce this scheme because we know it represents better the physics (and is incidentally better for the numerics). We see this by looking at the fracture angles (or some other measure)". Such a statement at the top would make this paper very strong. An admittedly overly harsh evaluation of the current state is that the authors change something for dubious reasons and get a different response – so why should we care? Is this the right result, but for the wrong reasons? I don't think that's a fair assessment, but unless the motivation is clearer it will be the impression a critical reader gets.

Related to this lack of clear focus, I find it difficult to understand why you do the experiments that you do, so reading sections 4 and 5 is more demanding of the reader than it need be.

I also question the fact that the authors don't introduce heterogeneity into their model. They even point out themselves that it "is responsible for much of the brittle material behaviour in progressive damage models" and indicate that the residual errors are not important in a heterogeneous field – which is what MEB is supposed to give. This choice needs to be much better justified than is currently done.

Finally, there's almost a hostile tone towards the MEB rheology in the discussion and conclusion section. The authors are practically gleeful in pointing out various faults of the model that are not relevant to the modifications they propose. It is of course fine to point out the faults of MEB - which apparently are plentiful – but the way it is done here borders on un-professional, in my opinion.

Minor comments:

L16: The formulation makes it sound as if leads and LKFs are interchangeable, but they are not.

L120: Shouldn't the cohesion be a function of resolution (see Weiss, 2007)? If that's the case, how do you get the same value from large scale and the lab?

L135: What's the physical justification for proposing this generalised stress correction?

L222: Mohr-Coulomb and Roscoe theories both concern granular materials, but here we're dealing with the fracturing of a solid. Are they still valid? Please elaborate.

L248: There's a lot of information in figure 4 and the reader needs more help in deducing why you created it and what it's supposed to tell us.

L276: A reference to the contrasting results is needed.

L291: A reference for what is typical for granular material is needed (a textbook will suffice).

L316: This entire paragraph is a bit up-side-down to me. You start by saying the MEB is not good enough, for various reasons (begging the question of why you use it in the first place, actually) - and then you say how your new addition will not save it. A more natural way to write this is to first say that although the decohesive stress tensor can do some things it cannot fix everything, including etc.

L329: This paragraph is off topic, discussing experiments not introduced before and not relevant to the introduction of the decohesive stress tensor. Please remove.

L353: Now I'm confused, did you want to solve the ridging problem by introducing the decohesive stress? Again, a more natural way to present your results would be to first

state what works and then what remains.