

Referee's Report

A generalized stress correction scheme for the MEB rheology: impact on the fracture angles and deformations

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This manuscript describes a modification of the return algorithm for supercritical stresses in the Maxwell-Elasto-Brittle (MEB) model for sea ice. The stated purpose of this modification is to better match simulated and observed fracture angles, and to reduce numerical growth of errors over the course of the simulation. The modification is tested on uniaxial deformation of a rectangular patch of sea ice. The modifications provide improvement over the previous approach but do not yet quite match observation. Overall, the goal and methods are clearly stated, although some notation is sloppy.

Trying to adjust the return algorithm to influence the failure angle is rather an indirect course of action. There does not appear to be a direct prediction of failure angle, just a demonstration through a full numerical simulation. It would be good to emphasize/clarify this point in the text (if it is in fact true), or explain how to predict the failure angle (if it is not true).

One aspect that is lacking in the presentation is the behavior of the numerical algorithm when the mesh size is changed. Fracture models are notorious for ill-posedness and it would be good to illustrate that this model's predictions do not depend on the mesh size. It is also common for the failure angle to depend on the mesh aspect ratio. Both mesh refinement and aspect ratio need to be explored.

I have some additional questions, comments, and suggested improvements.

1. Abstract: The VP model does not include fracture.
2. Page 3: You are using an Eulerian grid but I don't see equations that show advection of parameters (eg damage parameters). Are you assuming small deformations only? (See equation 12, for example.)
3. Page 4: Equation 5. Is a superposed dot the same as a partial time derivative or a material time derivative? Is this rate equation objective? Is ice deformation really rate dependent? Are there experiments about that?
4. Page 4: Equations 6 and 7: You are using multiple notations for the same thing: x and y components, 1 and 2 components. In Eq. 5, \mathbf{C} is a fourth order tensor, Eq. 6 is a 2×2 matrix (components of a second order tensor?).
5. Page 5: Probably helpful to define σ_I and σ_{II} in terms of stress components.

6. Page 6: Line 150: What is the 'standard' path?
7. Page 6: Line 151: Change 'to for' to 'for'.
8. Page 6: Line 162: Schreyer et al do not use 'granular theory', assuming that means models of granular flow. It is also confusing to refer to σ_c as a decohesive stress tensor since it has no apparent connection to Schreyer et al.
9. Page 7: Line 177: Change 'correspond' to 'corresponding'.
10. Page 7: last line: What is included in the 'solution vector'?
11. Page 8: Line 204: τ_a is a vector. I assume the scalar value you assign to it is for one component and the other is zero. (Also Page 9, Line 245.)
12. Page 9: First line: Please give a reference showing the connection between failure in granular material and sea ice under uniaxial compression.
13. Page 9: Line 226: I don't see a definition of δ .
14. Page 9: Line 228: 'In general, the fracture angle ...' is this the fracture angle for sea ice?
15. Page 9: Line 244: Change 'waves' to 'wave'.
16. Page 9: Line 248: '4 cfi)' means Figure 4?
17. Page 10: Line 254: Change 'are' to 'is'. I do not see in Fig. 5 that large values of R is associated with growth in ε_{sym} . Can you illustrate this better?
18. Page 10: Line 255: Change 'growths R ' to 'growth in R '.
19. Page 10: Line 258: Change 'indicate' to 'indicates'.
20. Page 10: Line 269: Change 'depends on corrected' to 'depend on the corrected'.
21. Page 10: Lines 274-278: MEB and VP (and granular material models) make different predictions. Is there any evidence for your model behavior in experiments? The VP model is based on plasticity there is no fracture, so no 'post-fracture behavior.'
22. Page 11: Line 284: Change 'approaches' to 'approach'.
23. Page 11: Line 286: Change 'sensitive other' to 'sensitive to other'.

24. Page 11: Line 290: Change 'increase' to 'increases'.
25. Page 12: Line 332: Change 'divergence' to 'divergent'.
26. Page 12: Line 335: Change 'reach' to 'reaches'. Change 'wave' to 'waves'.
27. Page 13: Line 357: Change 'generalizes' to 'generalized'.