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Geoscientific Model Development Discussions

Interactive comment on "On the calculation of normalized viscous-plastic sea ice stresses" *by* Jean-François Lemieux and Frédéric Dupont

Anonymous Referee #2

Received and published: 19 December 2019

Topic of the manuscript is the correct evaluation of the normalized viscous-plastic sea ice stresses. The model under consideration is the viscous-plastic sea ice model which was formulated by Hibler in 1979 with a replacement pressure introduced by Kreyscher et al. in 2000. The manuscript focuses on the evaluation of the normal stress that are archived with a Picard solver. Two error sources that may occur using the diagnostic are described.

Main issues:

I miss a more detailed discussion of the term numerical convergence of the VP solution and a more careful use of the term numerical convergence. Sometimes you describe by numerical convergence that all stress states are on/in the ellipse (physical consistency) sometimes you use the term the numerical convergence for the convergence of the sea

ice velocity. Please distinguish better between this two cases. Applications might think that the diagnostic implies numerical convergence of the solution VP solution (sea ice velocity). Explanation/motivation why plotting the normalized stresses is a suitable diagnostic to evaluate numerical convergence of the VP solution in a first step. Clarify that being physical consistent does not imply that one has a convergent approximation of the sea ice velocity. Maybe add a paragraph to the introduction how this diagnostic needs to be used.

2) Can you please explain how the diagnostic should be evaluated for Newton-like solvers? I don't think that it is straight forward. Using your 1D example a fully implicit discretized rheology reads as sigma=Pp/(2|epsilon_{k}| epsilon_k) -Pp/2= -Pp. Does this mean that the diagnostic is unnecessary? I do not think so as Newton-type methods also introduce some from of linearization. . .

3) Please provide the explicit formulation of the yield curve that you use to plot the figures.

4) Is the diagnostic effected if other limitations are used in (4)? How to deal with different linearization

I recommend that the paper be published only after addressing this issues.

Minor issues:

L. 5 -8 The first example is true for approximations calculated with Picard solver. What about Newton and EVP? The 2 sentences can be misleading

L106 Here numerical solution describes the numerical convergence of v. In line 90 the term numerical convergence is used to describe that the stress states are in/on the ellipse (which is the physical consistency). Be more specific when using the term numerical convergence.

L106 The residual of the momentum equation? Which residual ?

L107-110 I think this point must be emphasized and moved to the introduction (see main issue 1))

L 121 The solution of the momentum equation ?

L154 Please be more specific how numerical convergence can be assessed

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