

Interactive comment on “Assessment of numerical schemes for transient, finite-element ice flow models using ISSM v4.18” by Thiago Dias dos Santos et al.

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This paper reports on some worthwhile updates made to ISSM, a well known, widely used and world leading ice sheet model. It makes a systematic comparison of two sets of numerical methods. The first set is of standard methods used across the FEM world to deal with advection dominated problems, the second set is of more ice-sheet specific modifications to the numerical treatment of the driving stress. I found the paper straightforward to read and complete in its presentation, and it seems a good match for GMD.

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1 General Comments

1. The paper gives the impression that modifications to the driving stress are not known in the community. In particular, line 75

‘While there exist comparison studies for basal friction and basal melt parameterizations (e.g., Seroussi et al., 2014a; Seroussi and Morlighem, 2018), little attention has been given to the sub-element parameterization of the driving stress.’

Little perhaps, but not none. Modifications made for essentially the same reason as here are reported at least in Cornford et al 2013 (sorry to bring that up, but I do know the paper fairly well) and I think in Feldmann et al 2014

2. The word ‘convergence’ is used in a too-imprecise fashion throughout the paper. For example, ‘better convergence’ appears in a few places, but it is possible to be specific. If the error estimate is ah^n to leading order (h is the mesh spacing), then better convergence could mean that a is smaller, n is larger, or that the error estimate enters the asymptotic region at larger h . Elsewhere, there are phrases that suggest that something has converged, which is common in other papers but I would say, inaccurate. Finite portions of sequences may appear to be converging, but you can’t say more than that without analytic proofs.
3. All of the convergence plots are log-linear. Figure 3 at least should be a log-log plot since it deals with positive definite quantities. With other figures, I would have like to see error estimates rather than raw numbers (e.g Δ VAF), again as log-log plots. Otherwise it is difficult to assess convergence beyond a general sense that ‘it looks like it is converging’. You can always look at $|f(h) - f(2h)|$ (e.g for $f = \Delta$ VAF).
4. ‘Recommending’. The paper ends with some recommendations. Perhaps this is just a personal gripe, but to me, scientists report their findings, managers recommend actions.

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