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Interactive comment on "A comparison of two Stokes ice sheet models applied to the Marine Ice Sheet Model Intercomparison Project for plan view models (MISMIP3d)" *by* Tong Zhang et al.

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This manuscript aims at a numerical comparison of a new computational code FELIX-S to the already published computational code Elmer/Ice. Both codes ("models") are based on the same equations: the Stokes equations with grounding-line type boundary conditions. The present code FELIX-S is based on the Hood-Taylor finite elements (second order) while Elmer/Ice is based on the mini-finite element (first order). The dynamic grounding line conditions (friction conditions on the left, floating conditions on the right plus a contact threshold condition) are implemented slightly differently. The two different implementations are presented. The numerical comparisons are made both for prognostic and diagnostic MISMIP3d benchmarks. The two computational codes give reasonably similar results in all cases; the observed discrepancies are very

likely due to the difference in the implementation of the friction boundary condition and the accuracy difference of the two finite elements used. In this sense, this new Stokes code ("model") is interesting for the glaciology community since it proposes an additional computational code solving the Stokes equations with friction and dynamic grounding line.

But the crucial scientific questions and issues are not addressed; in particular the convergence of these codes when refining the mesh in the grounding line vicinity. Such a convergence study is the first step to assess any numerical model before interpreting the results in terms of physics. The close agreement in model outputs between the present two codes demonstrate that they probably do not contain any programming bugs; but it does not demonstrate the validity and reliability of their results in terms of modelling since the two models are the same. (Note that in the manuscript the terminology "model" is inadequately employed since the two codes consider exactly the same physical model solved by very similar numerical methods). These two Stokes models could give reference solutions for the crucial and difficult grounding line problem, in particular when comparing to asymptotic shallow models (SSA), if their assessments would have been complete. To my knowledge that is not fully the case yet, since the crucial issue of convergence seems to remain.

In short, this manuscript is a good description of a new and additional computational code solving the complete Stokes system; it is nicely compared to the Elmer/Ice code. But this manuscript does not address the question of the grounding line modelling nor does it answer the crucial issue of non convergent models.

This is the reason why this manuscript version cannot be considered as a research publication; it may be suitable for the Geoscientific Model Development journal.

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