

Interactive comment on “Full-Stokes modeling of grounding line dynamics, ice melt and iceberg calving for Thwaites Glacier, West Antarctica” by H. Yu et al.

Anonymous Referee #1

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Yu and co-authors investigate the sensitivity of Thwaites Glacier to melting and calving using a flow-line model. They compare various flow approximations and conclude that complete resolution of Stokes equations substantially improves the description of ice flow dynamics at the grounding line.

This is an appealing manuscript. However, I see a very serious flaw in their hypotheses preventing to my opinion acceptance of the proposed manuscript and an in depth review. In section 2.2, authors compare lateral drag, longitudinal drag and driving stress to conclude that lateral drag is negligible -not a surprise for this part of Thwaites ice shelf- and is therefore neglected in their model (“we conclude that neglecting the lateral drag in our 2D model is not a major limitation”). To my understanding of the manuscript,

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this means that there is no parameterization of buttressing in their 2D flow-line modeling attempt. This is indeed a drastic limitation to any investigation of ice shelf perturbations and related impact on grounded ice flow! This is clearly stressed in Schoof (2007) section 4.2: “We now turn to the main limitation of our model, namely that it describes only a two-dimensional ice sheet. This restriction allows us to decouple the evolution of the shelf from the problem of grounded ice flow. . . Moreover, changes to a two-dimensional ice shelf, for instance through basal melting, DO NOT AFFECT THE GROUNDED ICE SHEET”. This was also verified numerically using a full-Stokes model in Gagliardini et al. 2010. Therefore, the design of their entire set of experiments is inconsistent with well-grounded knowledge. So, this would require first demonstrating that previous works have been incorrectly established before embarking in any further discussion on the impact of ice shelf perturbations on grounded ice.

References

Gagliardini, O.; Durand, G.; Zwinger, T.; Hindmarsh, R. C. A. & Le Meur, E. Coupling of ice-shelf melting and buttressing is a key process in ice-sheets dynamics Geophysical Research Letters, 2010, 37, n/a-n/a

Schoof, C. Ice sheet grounding line dynamics: Steady states, stability, and hysteresis Journal of Geophysical Research: Earth Surface, 2007, 112, n/a-n/a

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