

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 #2

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The discussion paper presents a modelling study of Thwaites glacier, Antarctica in which the effects oceanic melt and crevasse propagation are investigated. The manuscript presents a 2D Full Stokes model and two simplifications – a higher order model (HO) and shallow shelf approximation (SSA) and investigates the sensitivity of grounding line position to a range of basal melt conditions and to different scenarios for crevasse propagation (the latter by combining the ice model with a Linear Elastic Fracture Mechanics – LEFM – theory) for all three models.

This is an interesting and potentially useful study since both processes are very important and should be included in models predicting future changes in Antarctic glaciers. However, lateral drag is neglected in the 2D model and the paper states that this is

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not a major limitation (see section 2.2, page 3). But without lateral drag it appears that the effects of buttressing are not parameterised and so any changes in ice shelf due to melting or crevassing would not be propagated upstream and hence not affect the grounding line position. This is at odds with many previously published studies such as Schoof 2007 and Gagliardini et al. 2010, who also used a Full Stokes model (e.g. "studying the effect of melting in a plane strain problem with no lateral resistance may lead to unrealistic results"), as also described by RC1. The results in section 4 clearly show this is not the case, at least for the FS model: significant grounding line retreat is seen as basal melt conditions are varied (see figure 8b), so the ice shelf *does* have an effect on the grounded ice. Since it is not clear either to me or the other reviewer how this is possible for the model described, could the authors please provide clarification on this point before we proceed, since it is of fundamental importance to assessing the manuscript?

Schoof, C.: Ice sheet grounding line dynamics: steady states, stability, and hysteresis, *J. Geophys. Res.*, 112, F03S28, doi:10.1029/2006JF000664, 2007.

Gagliardini, O., Durand, G., Zwinger, T., Hindmarsh, R. C. A., and Meur, E. L.: Coupling of ice-shelf melting and buttressing is a key process in ice-sheets dynamics, *Geophys. Res. Lett.*, 37, L14501, doi:10.1029/2010GL043334, 2010.

[Interactive comment on The Cryosphere Discuss.](#), doi:10.5194/tc-2016-101, 2016.

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