Review of "Dynamically coupling Full Stokes and Shallow Shelf Approximation for marine ice sheet flow using Elmer/Ice (v8.3)"

1 Summary statement

This manuscript is much improved compared to the previous version. I especially like that the authors clarified several points concerning the resolution of the mass balance equation or the treatment of Stokes and Shallow Shelf Approximation elements in the mesh. There are a few points (listed below) that I think should be nuanced or better explained. The last point on the derivation of the force in the Appendix is especially important I think for people being able to understand and reproduce this work.

2 Specific comments

The page and line numbers refer to the manuscript with including the differences for this new version.

p.2 l.11-20: I think this paragraph should be nuanced: we don't know how much of the difference is caused by the difference in the stress balance approximation used, and how much is due to the different treatment of the grounding line problem (contact versus hydrostatic equilibrium).

p.6 l.19: I don't really understand why the reduction of memory is independent of the coupling implementation. For example, here "ghost" nodes are created for Stokes even when the Shallow Shelf Approximation is used. Different choices would lead to different memory requirements, so it seems that the choices made for the coupling impact the memory requirements.

p.8 l.18: remove (Gagliardini et al., 2013) as this is generic to the finite element method and not specific to Elmer/Ice.

p.9 l.22-29: So what are the criteria used to stop the iterations for the Stokes iterations, the Shallow Shelf iterations, and the coupled iterations?

Response to reviewer: the numbers provided for the difference between the Stokes and Shallow Shelf Approximation solutions for the prognostic case should be added to the text. I agree that the figure does not add much, but these numbers are important. Also, a 1.8% maximum difference between the two solutions is really small. The difference between Stokes and the coupled solution is much reduced, but there must be a simple

test that provides larger differences between Stokes and Shallow Shelf Approximation. The introduction emphasizes the importance of using Stokes, so an example showing that would be appropriate.

p.19 Eq.A14: Thanks for clarifying the Appendix, it is now easier to follow. However, I am not sure to understand the last step leading to Eq.A14. From Eq.A13 and using the information in lines 19-23, I still don't understand how you go from the integrated form to Eq.A14. You are left with the term in A11 equal to the first term of Eq.12 integrated over Γ_{SSAint}. How do you go back to a regular equation given that one term has v and the other one $\nabla_h v$? I probably missed something, so it would be great to add an intermediate step before Eq.A14.