**The Cryosphere
Discussions**

Interactive comment on "The ISMIP-HOM benchmark experiments performed using the Finite-Element code Elmer" *by* O. Gagliardini and T. Zwinger

Anonymous Referee #2

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The paper describes how the finite element model Elmer was used to perform the ISMIP-HOM benchmark experiments. Its strength lies in the comparison of model output resulting from technical choices in the model formulation, such as the effect of different stabilization methods for the Stokes equation, or meshes. The question of finding the right balance between CPU time and accuracy is raised, and this should be considered in model development. The provision of simulation output files in the complementary material will facilitate future model comparison and testing.

However, the paper is weakened by the quality of the figures and captions. Captions do not generally include sufficient information for the reader to understand the figures

without having to read the manuscript. It is also a shame that the conclusion does not include a summary of their finding, such as the general rules that optimize the computing time versus the accuracy of the results (as mentioned in the abstract), or which stabilization method is optimum.

The paper also makes the assumption that the reader will have access to the description of the ISMIP-HOM experiment given in Pattyn and Payne (2006). As this reference is a web posting, this might no longer be available in the future. For example "experiment A040" on P89, L4, does not have any meaning without having read Pattyn and Payne (2006). On the other hand one could reproduce the experiments by having access to Pattyn et al (2008), but in the style of that paper "experiment A040" would have been written as "experiment A with length L=40km". I suggest the authors use the longer description or to state somewhere in the paper that the last 3 numbers refer to the length of the domain. In the same train of thought, the output data in the complementary material have no meaning should Pattyn and Payne (2006) be lost. One could include a readme file describing the column entries of the output files.

Technical corrections:

P77, L20: replace "(28)" by "(28 in total)".

P78, L20: is the sign in front of the pressure gradient correct?

P78, L21: state that u is the velocity vector.

P79, L20: replacing "Note if" by "Note that when" could be preferable.

P83, section 2.4.4 is quite confusing and would benefit from a rewrite. Why is it necessary to apply vertical connections between points on the free surface and the bedrock? Consider grouping the last 2 paragraphs, and rewording the 1st paragraph.

P84, L19: change "The in total six variations" to "In total, six variations".

P85, L7: change "excepted" to "except".

P85, L10: change "increasing" to "increases".

P86, L4: change "experiment A040" to "experiment A with domain length L=40 km".

P86, L8: do you mean "Most of the gain in CPU is due to the decrease 8230;"

P86, L22: change "we showed" to "we established" (since you have not showed it in the paper, but must be a result inferred from your model runs).

P86, L23: change "two first" to "first two".

Section 4: It seems that there is a mix up in the referencing of the tables, or in the caption of tables 2 and 3. For example P87 L24, should it be "Table 2" instead of "Table 3"? Also check P88 L4, L25, L28.

P88, L2: web link to supplement not needed since it was given a few sentences before on P87.

P88, L5: I assume that the figure discussed is "oga1a005" of figure 2 in the supplementary material. It would be useful to have a caption for figure 2 similar to: "Horizontal velocity at the upper surface, $u_x(z_s)$ in ma^{-1}, for experiment A and lengths: L=160km (a), L=80km (b), L = 40km (c), L = 20km (d), L = 10km (e), L = 5km (f)."

P88, L13-16: Are you talking about Fig 7 of supplement? If so, say so.

P89, L14: change "very very small" to "extremely small" or "very small".

P90, L10: change "in between" to "between".

P90, L11-14: consider rewriting to something like: "These findings lead to the conclusion that the solution is influenced by the numerical method used to solve the equations, and the method used to generate a computational grid from a digital elevation model (DEM)."

P91, L10: move sentence to the 1st paragraph of section 4.3.

P91, L26: change "it does correspond" to "this corresponds".

P92, L12: change "A shown" to "As shown".

Figure 1: The mesh is difficult to see, can you change it so that it has the same quality as the meshes shown in Figure 2?

Figure 2: Change either the caption or the layout of the figure, since they do not agree. Use "(a)" instead of "(up, left)", or vice versa, to be consistent with figures 4, 7, 9, 11.

Figure 4: Insert (a) and (b) in your figures. In the caption change "experiment A040" to "experiment A with length L = 40 km".

Figure 5: Can you remove the green lines and label the axis. In the caption can you give a name to S_{xx} and change "experiment D005" to "experiment D with length L = 5 km".

Figure 6, 8, 10: Since you are calling your meshes "E-1-10" etc in figure 2 and in the text in section 4.3, it would make sense to use the same nomenclature everywhere. Use "E-1-10" instead of "arolla100-1-10".

Figure 7: These figures are small and therefore the lines are difficult to distinguish. The clarity of the figures could be improved by removing the dashed grid. Can you label the axis, insert (a), (b), (c), (d) or use (top, left) in your caption. Also can you define in your caption UX, UZ, TXZ, DP.

Figure 9: The comments for figure 7 and its caption apply here too. Also change in the caption "E000" to "E001".

Most captions of the supplementary material can be expended as suggested in the comments for P88, L5.

Interactive comment on The Cryosphere Discuss., 2, 75, 2008.