

Review of manuscript "Comparison of hybrid schemes for the combination of Shallow Approximations in numerical simulations of the Antarctic Ice Sheet" by Jorge Bernales, Irina Rogozhina, Ralf Greve and Maik Thomas [The Cryosphere Discuss. Doi:10.5194/tc-2016-117]

General comments

This paper describes a study of 4 hybrid schemes, combining the Shallow Ice and Shelfy Ice approximations for Antarctic Ice Sheet simulations comparison with Shallow Ice approximation only is also done. The 4 schemes are implemented into the open source ice sheet model Sicopolis (Greve, 1997), and a number of simulations are made for the Antarctic Ice Sheet. The paper is clearly written and the conclusions are clear

Specific comments:

The description of the study of model sensitivity to resolution is not clearly written and the higher resolution is not given in the result section, it would give the study more weight if it was clearly stated what resolutions were tested (in the result section) and what conclusions were drawn from the sensitivity study.

Technical corrections:

Page 1, Abstract

Line 1, suggest to add "equations" after "force balance" or rephrase the sentence

Line 2, suggest to rewrite to avoid personalizing SIA (SUA alone is not able to....) something like SIA cannot ...

Line 8 and line 9 instead of "parameter distribution" something like "calibrated basal sliding coefficient" would clarify the sentences

Line 11, it is not clear to what limitations is being referred to, rewriting suggested.

Line 11-12, it is not clear what "easily adaptable calibration techniques" refers to here, the text in the abstract should stand alone and some clarification is needed here.

Page 2, line 1 replace "has" with "have" after approximations

Line 5, suggest to replace "usually described" with something like "can be" or "often"

Line 16, suggest to replace "valid" with "applicable"

Line 20 suggest to replace "heuristically" with "heuristic"

Page 3, line 4, suggest to replace "approaches" with "schemes"

Lines 5-6 something is missing in sentences, something like "as validation" in the end would make sense?

Line 24, here Sicopolis is personalized, suggest to rewrite to something like "is applicable for"

Page 4 line 9 suggest to replace "bedrock stress conditions" with "stress conditions at bed"

Page 8, line 7, suggest to replace "we believe" with something like "assume" or "think"

Line 22, suggest to delete “that” after “crust”

Line 28, suggest to rewrite, replace “is not able to” with “cannot”

Line 30-line 2 on page 9, something is missing in description, it appears that PDD method is used to computed the surface melt and accumulation and T is coming from RACMO, why is then a comparison made with surface mass balance in the RACMO paragraph? Is SMB from RACMO used at all in the study? How does the SMB computed with the accumulation and the PDD method applied in this study with the observations?

Line 30, suggest to replace “data” with “model output”

Page 9, line12, how high resolution is tested? See comment above

Page 11, line 13, it is not clear what initialised state refers to here, after 100 ka, or after the full thermal and dynamic equilibria are attained?

Line 31, suggest to add “average” before “error”

Line 32, delete “an” before 83%

Page 12, line 3, suggest to add “absolute” before “error”

Line 5, not clear what “generalized” means here, so you mean “volume change”?

Line 21, it is not clear what is meant by the sentence “areas where it is applied directly”, suggest rewriting

Line 27, suggest to replace “recovered” with “estimated”

Line 29 suggest to replace “retrieved” with “estimated”

Page 13, not clear what “relatively higher coverage “ means here, suggest to rewrite

Line 20 suggest to replace “regimes” with “velocities”

Page 15, line 22,suggest to replace “distribution” with “values”

Page 16, line 33 suggest to replace “imply” with “results in”

Page 18, line 33, suggest to add “model” after SIA flow

Page 19, line 21, see comment above, how high resolutions were tested, can this sensitivity study be better described?

Line 26, suggest to replace “influence” with “improve”?

Line 33, suggest to add “sliding parameter” after “calibrated”

Page 29, add s at the end of need, “one needs” also, it is not clear what results “these results” are refereeing to, suggest to clarify

Table 3, suggest to explain in table caption what SoS stands for, so that the table can be read independently

Table 4, also for independence of table suggest to explain what “prescribed median” means here

Figure 2, suggest to add information what happens at each 100 ka time interval, it makes the figure easier to read. Suggest to add in inset figure “absolute” before “error” and also in figure caption line 2

Figure 7, it is strange that the thick blue line is not in between the thin and dotted blue lines, like the green and the red, is the reference value not between the upper and lower limit? This is strange.

Figure 8, suggest to add “absolute” before “difference in line 1 of figure caption.