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Discussions

# Interactive comment on "A glacial systems model configured for large ensemble analysis of Antarctic deglaciation" *by* R. Briggs et al.

**Anonymous Referee #2**

Received and published: 24 June 2013

### General comments
In this article, Briggs and coauthors describe the MUN/PSU glacial systems model developed for analyzing past Antarctic Ice Sheet evolution and evaluate the model parameter sensitivity in a large set of ensemble runs. This is an interesting manuscript that underlines the importance of exploring the uncertainties in ice physics, climate forcing as well as ice-ocean interaction.

Clearly, a lot of work went into generating the ensemble - however, it is not apparent why the authors chose certain parameters over others and how the appropriate parameter ranges were constrained. While I appreciate the authors' main conclusion that the 31 parameters described in the manuscript have significant influence on at

least one of the chosen model metrics, the manuscript lacks a systematic discussion of the observed parameter sensitivity and the implications for future modelling studies. Since most ice sheet models do not allow for generating such large ensembles due to computational constraints, it would be extremely valuable to learn from a wide-ranging sensitivity study such as this one.

### Specific comments
- The model description should be as complete as possible. Right now, several papers are required in order to gather the necessary information for the parameterizations. For the scope of this article, it would really help if all parameters were (re-)introduced in the manuscript, even if that means repeating some equations from prior publications (e.g., for the enhancement values.)

- While I understand that it might be computationally too costly to generate large ensembles of 2000-3000 runs on a finer grid, I am concerned about the very coarse resolution of 40km. It is very probable that a change in resolution will have a much larger impact on the results than the choice of some of the 31 parameters discussed in the manuscript. The implications and limitations of using this low resolution need to be thoroughly discussed.

- It seems as if some of the chosen metrics are more sensitive to the choice of parameters than others - could the authors comment on this observation and its implications?

- page 1564, line 15: How do the authors define a 'significant effect'?

- I agree that the appropriate choice of the metrics depends on the scientific question (cf. page 1564, line 21). However, it remains unclear to me why the authors have

chosen these 6 diagnostics? Why not include, e.g., present-day ice velocity as a metric?

- How does the introduction of the grounding line flux condition affect the sensitivity of, e.g., the Ross and Filchner-Ronne shelf area? Does this affect the interpretation of the results with respect to metrics 4, 5 and 6?

- page 1566, lines 21-23: It would be interesting to learn more about the quantitative score for the other parameters as well. What does this imply for the relative importance of a specific parameter?

- page 1566, lines 8-11: Could the authors speculate as to why the WAIS volume is less sensitive to the shelf flow parameter than the EAIS volume? (It seems that the parameters concerning shelf dynamics and shelf-ocean interaction generally have more impact on WAIS than on EAIS.)

- Fig.2: A zoom of the Ross region would be helpful since the melt patterns cannot be seen at this scale.

- In addition to figures 7, 8 and 9, could the authors include maps illustrating for instance the lateral boundaries for the baseline run and for ensemble members particularly close to/far from present-day observations of the Antarctic Ice Sheet?

**Technical corrections**
- Since there are so many parameter and variable names, they should be as short and self-explanatory as possible. As an example, vol0gw could be renamed something like

V_WAIS etc.

- It would be helpful if the authors could repeat the variable names instead of just using their symbol/abbreviation in the main text.

- Abbreviations which are only introduced in the main text should be repeated in the figure captions (e.g., GLZ, ACZ,...).

- page 1535, line 12: 'As such, there is an urgent requirement [...]'

- page 1566, line 14: '[...] less impact than the calving parameters [...]'

- page 1585, lines 2-3: '[...] two observations for the cumulative RON-FIL are also shown.'

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