

Review for the “Future Sea Level Contribution from Antarctica inferred from CMIP5 Model Forcing and its Dependence on Precipitation Ansatz” by Rodehacke et al.

In this manuscript, the authors describe an ice-sheet modeling study of the evolution of the Antarctic Ice Sheet under a number of different forcing scenarios from various climate models. In particular, the authors are interested in determining how ice sheet mass balance changes in response to the treatment of accumulation within the simulation. The results of the ensemble illustrate that simulations forced with anomalies respond differently than simulations forced with precipitation that is scaled according to changes in temperature (a method that is often utilized for long ice sheet model simulations). The authors conclude that the latter method is unsuitable for capturing the dynamic response of accumulation rates due to atmosphere and ocean to warming. Therefore, a precipitation scaling scheme is not as realistic as forcing an ice-sheet model with the spatial and temporal anomalies derived from climate model projections. While specific areas of the ice sheet contribute to sea level with the use of either precipitation-forcing scheme, other areas have responses that disagree on the sign of their sea-level contribution. The authors caution that the choice of how future precipitation is simulated may strongly influence future projections of the Antarctica Ice Sheet and contribute to significant model uncertainty.

This study uses PISM, a state-of-the-art ice-sheet model to run a number of simulations to investigate the sensitivity of future projections of the Antarctic Ice Sheet to the model treatment of accumulation. The authors conduct a variety of simulations and thoroughly present results from experiment variations in order to illustrate that their results, most importantly, are robust with respect to the comparison between forcing schemes. The text and figures are comprehensive and the conclusions will be of interest to the ice-sheet modeling community. In addition, the authors have made significant improvements on the manuscript language and structure, as well as the title and abstract. The figures are very readable and support the main discussion points. As a result, I support the publishing of this manuscript in ESD.

Note, however, that I still find that in a few locations in the manuscript, the language could be improved, for readability. The meaning of some statements tends to get lost from time-to-time. For these such statements, and some other minor points, I make suggestions and comments, listed below.

Comments/suggestions:

Line 37: “An” ice sheet’s contribution

Line 45: “the temporal evolution is spatially homogeneous” => Please be clearer here. Maybe “often, in these experiments, the anomalies forced through time are spatially homogeneous” ? Or something similar.

Line 53: “globally” => “when considered globally, this rate”

Line 53: “termed” => “hereafter, referred to as mean precipitation scaling ... “

Line 59: “limits the scaling” => “exposes a limitation of this scaling”?

Line 77: “this approach” is unprecedented

Line 83: "Following, is the description" is what I think you mean here

Lines 85-94: I suggest that this section go after or is appended to the end of section 1.2 (or it could even be moved to the methods before the scaling description). It seems out of place here, and may be more impactful if it is present after the reader is introduced to the idea of precipitation scaling.

Line 94: "further on" => "from this point on"

Line 136: "they differ in" => "they differ on"

Line 137: "Past studies suggest that the overall mass loss..." or something similar

Line 162: However, "in reality", atmospheric dynamics ... (or an equivalent statement for clarity)

Line 173: I think you mean here that piControl is of different lengths for the different models. Could the length of these piControl runs be added to a table somewhere for reference?

Line 183: "ends in" => "ends up in"

Line 185: "For instance", a disintegrating Greenland Ice Sheet (or a similar phrase)

Line 189: "On the other hand, locally ..." (?)

Line 191: "probably" -> "likely"

Line 251: utilize these constants "respectively" (?)

Line 235: The last part of this sentence is awkward. Maybe something like: "any signal, though the SMB computed via PDD does allow for melting ..."

Line 253: I think here you refer to the mean ensemble, spatial mean over Antarctica? Please make this clear if so.

Line 280: "Least" -> "The least"

Line 307: It is unclear what "(probably)" means in this context. Please remove it, or clarify what it means for the reader.

Line 319: "risen" -> "elevated" or similar

Line 321: "we could" => "could we"

Line 327: I am not sure what "it excludes floating ice shelves with low elevation along the coasts" means. Please rephrase.

Line 391: Can you add a statement here (or when you discuss this later in the text) about what year in the simulation the response to this shock probably becomes negligible?

Line 423: "rated" => "rates"

Line 484: "However", ice in deep troughs... (or the equivalent)

Line 513: This first sentence is very awkward to read. Please rephrase for clarity.

Line 536: Perhaps a word is missing here. I am not sure what you say is consolidated.

Section 4.2: This is just a suggestion, but perhaps consider moving this section to the end of the discussion. Placing it here breaks up the flow of your nice discussion, and seems disjointed, especially since you have not even explained how you correct basal melt and the implications.

Lines 570-573: These sentences are awkwardly phrased, and their meaning is not clear. Please rephrase them.

Line 580: allow "to represent the" regional conditions => allow "the representation of" regional conditions

Line 617: is compensated by "accumulation on" grounded ice ?

Line 649: "ea" => "sea"

Lines 654-657: These conclusions should be rephrased to be very clear for the reader. They are a bit confusing to read as written. I suggest that you use these sentences to directly answer, for the reader, the question that you pose on line 637.

Line 656: Please specify which "discrepancy" in particular you refer to here

Lines 659-660: Awkward, please rephrase. Maybe "How precipitation is specified in ice-sheet simulations is crucial to the outcome of numerical simulations of Antarctica's sea-level contribution." Or something similar.

Line 668: where "marginal ice wanes due to ocean warming"

Line 669: "as average" => "on average"

Figures 2, A1, A2 captions: Please start each of these captions with the sentence that you place towards the end. i.e. "Anomalies of the CMIP5 ... (mean, max, min) " Or a similar sentence that summarizes where the anomalies are from. That is, if all three figures were next to each other, the reader would be able to know how they are different by just reading the first sentence in the caption. Right now, the reader has to read very far into the caption to differentiate the figures.

Lines 1069-1070: The sentence is written twice.

Line 1071: "importance" => "consequence"

Figure A5 caption: “depicts the” => “is depicted in the”

Figure A10 caption: “lists the” table A1 => “is listed in” Table A1