

Interactive comment on “Countervailing regional snowfall patterns dampen Antarctic surface mass variability” by Jeremy Fyke et al.

Anonymous Referee #1

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General comments:

This paper assesses natural variability in Antarctic snowfall patterns using output from a long CESM pre-industrial control simulation. It is determined that different Antarctic regions – delineated using ice drainage basins – exhibit out-of-phase snowfall anomalies that lead to a dampening of the overall ice sheet-integrated snowfall variability. This has implications for the variability of global mean sea level, and the detection of anthropogenically-forced changes in Antarctic mass balance.

This is a nice study that represents a valuable addition to the literature on Antarctic mass balance variability and change. While the main result – out-of-phase snowfall anomalies in different parts of Antarctica – is not terribly surprising or novel, it is worth documenting in a systematic way as the authors have done, using a basin-scale anal-

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ysis and a long (1800-year) model control simulation (these latter aspects of the study are, I believe, novel). The paper is clear and well written, and the conclusions drawn are supported by the analyses presented. While I believe that the manuscript can basically be published in its present form, I include below several specific comments and technical corrections that the authors may wish to consider.

Specific comments:

1) p. 5, lines 25-33: It would be helpful to give the spatial correlation between the CESM and RACMO2 snowfall variability patterns (i.e., the correlation between the matrices in Figs. 3a and 3b).

2) p. 7, lines 28-33: This might be a good place to remind the reader that on annual timescales P-E is essentially equivalent to moisture flux convergence, since changes in atmospheric moisture storage can be neglected.

3) p. 8, lines 20-26: The last two sentences of this paragraph are confusing to me. First, it is stated that the basin 22 composite depicts an eastward shift of the ABSL. This looks like a westward shift to me. Second, for this same composite, it is stated that “strong southerly flow over the Weddell Sea...precludes the large increases to continental outflow over the AIS”. In contrast, I would think of southerly flow over the Weddell Sea as being associated with continental outflow, not precluding it. Finally, it is stated that the basin 20/26 composites depict a westward shift of the ABSL. I don't see this; to me, these composites suggest a weakening/strengthening of the ABSL (rather than a shift in position), and, in fact, this is how they are described in the same paragraph above.

4) p. 10, lines 18-25: It seems to me that it would be easy enough to check whether these biases are actually present in the CESM LE preindustrial simulation, rather than just speculating.

Technical corrections:

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- 1) p. 1, line 12: "AIS" not yet defined.
- 2) p. 3, line 17: The word "also" appears twice.
- 3) p. 3, lines 30-31: I suggest removing "climatological" from the phrase "standard deviation of the climatological annual-averaged accumulation".
- 4) p. 4, line 11: "WAIS" not yet defined.
- 5) p. 19, Fig. 3 caption: "Significance shaded at the 95% level." – Would be clearer (and consistent with subsequent figures) to say that stippling indicates significance at the 95% level.
- 6) p. 5, line 15: Should be "for a set".
- 7) p. 5, line 16: "Analogous" is misspelled.
- 8) p. 6, lines 24-25: Should be "Figure 4".
- 9) p. 7, line 6: "EAIS" not yet defined.
- 10) p. 22, Fig. 6 caption: "arrows as in Figure 4" – I don't see arrows in Figure 6.
- 11) p. 7, line 28: "P-E" not yet defined.
- 12) p. 9, line 4: Should be "ZW3 index".
- 13) p. 9, line 7: Should be "basins tend to receive".
- 14) p. 10, line 5: Should remove the word "just" from this sentence.
- 15) p. 10, line 14: The word "corroboration" is misspelled.
- 16) p. 10, line 19: The word "the" appears twice.
- 17) p. 10, line 31: Would be better to say "This greater variability".
- 18) p. 11, lines 14-15: I suggest "supported by the presence of very similar behaviour in the regional RACMO model".

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- 19) p. 11, line 22: I'd remove the word "drives".
- 20) p. 11, line 22: I'd suggest instead "Important sources of variability".

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