

Interactive comment on “Review of regional Antarctic snow accumulation over the past 1000 years” by Elizabeth R. Thomas et al.

Elizabeth R. Thomas et al.

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Thank you for the positive and helpful comments and suggestions. We have addressed all the concerns raised and made all the minor corrections to the revised text.

Below we address each comment individually.

Anonymous Referee #1 Received and published: 3 May 2017

Overall comments The authors compile some 80 Antarctic ice core records that meet their requirements for temporal coverage, time resolution, and corrections for layer thinning. The records are grouped into regions, composited, and then the regional trends and variability over the past 200-1000 years are discussed. Finally, estimate an overall increase in SMB of ~ 44 GT since 1800 AD, with much of it occurring within the

past couple decades. In general, the paper is very well written and logically organized. It is hard to find a major fault with this paper. It is an accomplishment just to compile the records, requiring the cooperation of scientists from many nations and reflecting many years of field work. If anything, the paper is a bit too guarded and tentative at times: “However, this is just a qualitative explanation, more research using model and field data would be needed to prove this.” or “The reduced period of overlap...makes this interpretation less C1 reliable.” and many other examples. Caveats are of course a natural part of science, but the inclusion of so many in this paper prevents it from being the final word on snow accumulation or even a paper that would get cited a lot (perhaps they are planning a Nature paper that will pack more punch.).

- In response to the general comments (and following discussions with others) we have decided to shorten the title. Removing the word “review” from the title will hopefully increase the papers impact as this is an independent study into Antarctica mass balance, not just a review.

Specific comments

Affiliations, page 1: I think some of the affiliations are incorrect, please check. For instance, I believe B. Medley is at #9 (NASA), not #10 (U Victoria).

- Updated

Abstract, line 14: increase in SMB across grounded AIS of 44 GT since 1800: Some context for this number would be helpful. Is that a lot in terms of mitigating SLR? What is the SLR equivalent? Does this number make sense in terms of published global sea level budgets over the past 100-200 years (is it in the noise or a significant number?)?

- During the revision process we updated the RACMO data (version 2.3p2) and noticed a minor error in the mask we had selected for certain regions (which included ocean as well as land). The data has all be updated and the new values of total SMB change included.

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- The total AIS SMB has been presented in a new figure, with a histogram of the running 50-year and 100-year trends.

- The increased SMB has been related to SLR equivalents. To add context we relate the net reduction in sea level as a result of the increase in snowfall in Antarctica since 1800 AD to the estimated sea level contribution from the mass loss in the southern Patagonian ice fields.

Page 4, first paragraph: Given the projected increase in SMB, is it expected to offset overall ice sheet mass loss; is Antarctica expected to be a net contributor to SLR given the overall mass budget?

- The snowfall is expected to mitigate some of the sea level, but not completely offset the ice loss. In the introduction I am reviewing the current literature but make no claims that snowfall will offset mass loss.

Page 4, line 30: PAGES Antarctica 2K community: Only a select few readers may know what PAGES is, let alone the 2K community. Define?

- Defined PAGES and future earth

Page 6, lines 11-14: Was there any requirement for proven dating precision and accuracy? Are we assuming that all of the records are perfectly dated?

- A full assessment of all the published age-scales for each ice core was beyond the scope of this study. All data submitted to the Antarctica 2k database was required to submit evidence of independent reference horizons (eg volcanic tie-points) or have evidence in the published literature. For data extracted from other databases, or direct from authors, we checked that independent reference horizons had been used when calculating the age-scale. We cannot be 100% confident that dating errors do not exist, but we have confidence that the published snow accumulation records were dated as accurately as possible.

- The published dating errors range from 1-3 years for the period 1800-2010, increasing

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to ~5 years for some sites prior to ~1500 AD. This has been added to section 2.3.

Page 8, lines 19-20: “predominantly positive phase of the IPO/PDO.” There was a major shift in the PDO/IPO in 1998-1990, from positive to negative, affecting more than a third of the 1979-2010 period. This has been shown to impact a number of Antarctic climate trends and it may even be reflected in the recent increase in accumulation in the AP and the decrease in VL. So, I don’t think it is accurate to say the the IPO/PDO was predominantly in its positive phase.

- I acknowledge that the IPO has changed sign during the instrumental period (1979-2010), so I have made reference to the changing sign of the IPO during this period.

Pages 13-14: “The principal teleconnection associated with the Rossby wave propagation from the western tropical Pacific...which originates from the central, tropical C2 Pacific.” This sentence is repetitive, as well as contradictory (western Pacific vs central Pacific). A rewrite is needed.

- Sentence re-written (pages 13-14).

Also, in the discussion of the VL and AP composites (sections 3.24 and 3.26), I can’t help but notice that the teleconnection patterns of these two regions are roughly opposite in sign. See Figure 4d and 4f. I’m surprised this isn’t mentioned somewhere in the paper. 4d resembles the trend pattern associated with the negative PDO, which could have played a role in the recent increase in AP accumulation and decrease in VL precipitation. I also wonder why tropical teleconnections aren’t mentioned with respect to AP accumulation.

- The discussion on SAM, ENSO and PDO has been expanded in the section relating to AP.

- Reference to the similarities in VL and AP has been expanded in the VL section.

Page 15, line 14: change “unit less” to “unitless.”

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- Word changed

Page 15, bottom two paragraphs: As mentioned above, it would be interesting to discuss the opposing accumulation trends in terms of the PDO phase and/or the ASL deepening trend.

- expanded in the text

Page 17, line 27: Change “were, quality” to “were quality”

- Corrected

Figures 4 and 5: In contrast to figures 2 and 3, no significance levels are indicated on Figures 4 and 5. Could stippling for significance be added to Figures 4 and 5?

- Figures 4 & 5 stippling added for 95% significance

Figure 5 caption, page 23: should be “correlations...cover” or “correlation...covers.”

- Changed

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