

Interactive comment on “A synthesis of the antarctic surface mass balance during the last eight centuries” by M. Frezzotti et al.

Anonymous Referee #1

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A synthesis of the Antarctic surface mass balance during the last eight centuries by M. Frezzotti, C. Scarchilli, S. Becagli, M. Proposito, and S. Urbini

General

In this paper, the authors use accumulation data of 66 medium deep firn cores from Antarctica (of which seven previously unpublished ones from Wilkes/Victoria Land) to assess continent-wide accumulation variability over the last 800 years. The most important result is that overall, accumulation trends have been minor, with the exception of a 10% increase in the wet coastal regions as well as in some parts of interior East Antarctica since about 1960. However, no distinct patterns of SMB increase/decrease can be identified.

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The effort of compiling these accumulation records must be commended, as it provides unprecedented insight in the temporal variability of snow accumulation over most of the Antarctic ice sheet. I therefore suggest publication, but that at the same time major revisions are necessary, especially in the discussion part of the paper in which hypothetical links are described between accumulation, the large scale atmospheric circulation and solar irradiance.

Major comments

My first major comment is of technical nature. Although most of the time it is clear what the authors intend to convey, the English must be checked and formulations streamlined by a native English speaker to enhance the readability of the paper.

My second major concern is the discussion section 4, which remains rather speculative and qualitative.

The first major point of discussion should be the fact that ice core-derived temperatures from H and D isotopes do not correlate with accumulation rates, as stated in the second paragraph in section 4. Why is this so? This result is significant as it challenges the often-made assumption that high-accumulation episodes are associated with above-normal temperatures in Antarctica, linked to well-developed meridional air mass transport. Moreover, it challenges the hypothesis that accumulation Antarctica will increase when atmospheric temperatures increase in a future warmer climate. If for instance the authors have the impression that isotope-derived temperatures from ice cores do not robustly represent atmospheric temperatures, this is also a significant finding, as it would challenge the way temperature records from ice cores are currently used. Anyway, this topic deserves more discussion than it gets now.

On page 832, line 14, it is stated that cyclic variations in accumulation in the full stacked record are mirrored by total solar irradiance from the GRIP core. Judging from Fig. 4, there is temporal correlation for some parts of the record, while it is absent or even changes into anticorrelation in other parts (e.g. 1700-1900). My question is: what

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would explain these periods of high and low correlation? Is the correlation for the full record significant?

Another aspect of the discussion is the role of blocking anticyclones. The authors assert that these systems lead to higher coastal precipitation; in my opinion they would at the upstream side, but a dry anomaly would be expected at the downstream side. Are these dry anomalies somehow underrepresented in the data set?

A third aspect of the discussion is the role of drifting snow sublimation. In my view, the potential impact of temporal variations in drifting snow sublimation on ice sheet integrated SMB is overstated in the discussion. In a recently published paper in GRL, Lenaerts and others show that, integrated over the ice sheet, the interannual variability of drifting snow sublimation is small, 12 Gt yr⁻¹, being only approximately 0.5% of the total accumulation over the ice sheet. Comments?

Minor/technical comments

Improve the level of English throughout MS

Abstract: suggest to remove first two sentences, which belong in Introduction

p. 823, l.19: The uncertainty in SMB does not dominate the uncertainty in the mass budget of Antarctica; based on recent literature, I would say SMB and discharge estimates have similar (large) uncertainties in Antarctica.

p. 825, l. 17: Why 'volume'? I assume you are more interested in mass?

p. 825, l. 22: 'described' -> 'describe', and same for following lines.

p. 825, l. 27: 'paragraph' -> 'section'

p. 826, l. 23: near surface wind

p. 828, l. 19: 'stacked'

p. 829, l. 21: '...a high SMB...?'

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p. 829, l. 25: use '20th century' instead of 'XX century' throughout the paper.

p. 831, l. 18: 'stacked'

p. 832, l. 13: 'reconstruction'

p. 833, l. 21: 'father' -> 'further'

In my pdf, Figs. 1 and 2 were of poor quality.

Reference

Lenaerts, J. T. M., M. R. van den Broeke, W. J. van de Berg, E. van Meijgaard, and P. Kuipers Munneke (2012), A new, high-resolution surface mass balance map of Antarctica (1979–2010) based on regional atmospheric climate modeling, *Geophys. Res. Lett.*, 39, L04501, doi:10.1029/2011GL050713.

Interactive comment on The Cryosphere Discuss., 6, 821, 2012.

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