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The Cryosphere
Discussions

Interactive comment on "Greenland annual accumulation along the EGIG line, 1959–2004, from ASIRAS airborne radar and detailed neutron-probe density measurements" *by* T. B. Overly et al.

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1 Author Response to Anonymous Referee #3

1. Comment: "It is not straightforward what is the objective of the paper other than present accumulation rates already reported. Also, there are sections where the methodology explanation is not completely clear, and the author needs to address certain issues. For instance, the radar analysis using the ASIRAS data set is basically a repeat of de la Peña et al. (2010) method to estimate accumula-

tion rates; the paper follows the same methodology and use the same data. The use of a different (and more numerous) set of density profiles (already published in Morris and Wingham, 2011) cannot be the only reason to present these data since the results and conclusions are basically the same, and the author has to better explain why. "

2. Author's Response: We agree that the manuscript would benefit from a better explanation of our study compared to de la Peña et al. (2010) and Hawley et al. (2006). As we state on pg 6793, Line 14, Peña present mean accumulations from 1998–2003 (6 internal reflection horizons) at 25km intervals (9 point measurements) along 200 kilometers of EGIG. We present accumulations from 1959–2004 (46 internal reflection horizons) at 3m intervals (74038 points). Our study expands the temporal and spatial extend of accumulation estimates across central Greenland, allowing our results to be compared to Regional Climate Models. Additionally, we use eight NP density profiles compared to previous studies use of two profiles. The detailed in-situ density profiles allow us to assess radar-derived accumulation estimates sensitivity to density compared to modeled density estimates.

3. Author's Changes in Manuscript: The revised manuscript clarifies methodology and emphasizes the spatial and temporal differences between Peña et al. (2010) and our study. Where the editor deems appropriate, we can emphasize the dual-objectives (increased spatial and temporal accumulation estimates, comparison to regional climate models) and potential implications of this work (the use of modeled density to correct radar travel-time in place of in-situ density measurements).

2 Author Response to Anonymous Referee #3

1. Comment: “As has been addressed, there has to be an explanation of the dating of the radar isochrones and the dating of the neutron probe profiles. The radar isochrones do not form in the summer; in the dry-snow zone, the reflections are caused autumn hoar, which is formed after the summer and do not occur at the same time each year.”

2. Author’s Response: We agree that further explanation of the timing of annual accumulations will improve the paper (see previous reviews). We make no argument that the radar isochrones are summer density peaks. We defined the ASIRAS accumulation year as Autumn to Autumn to account for what you state above (“the reflections are caused autumn hoar, which is formed after the summer and do not occur at the same time each year.”). We reference Hawley et al. (2006) (pg 6795, Line 20), which correlates high density winter peaks with local peaks in radar power return. The ASIRAS and NP profiles were collected simultaneously (April 2006) and therefore can be aligned with certainty.

3. Author’s Changes in Manuscript: We revise our document to clarify the timing of annual accumulations for ASIRAS, NP, and ground-based shallow cores.

3 Author Response to Anonymous Referee #3

1. Comment: “In general, the paper lacks important references, and while some of the results are worthy of publishing (especially the comparisons), the document needs a revision. I would suggest focusing on the differences between observed and modeled accumulation rates, and expand the discussion on the differences in accumulation rates derived from ASIRAS using Herron and Langway and neutron probe densities.”

2. Author’s Response: We revise our paper to include references to Simonsen et al. (2013), Medley et al. (2013), Helm et al. (2007), Mosley-Thompson et al. (2001), and clarify additional references within the text. We expand the discussion on the ASIRAS-NP and ASIRAS-HL comparisons.

3. Author’s Changes in Manuscript: We add references and comparison to RACMO and MAR regional climate models.

4 Author Response to Anonymous Referee #3

1. Comment: “In addition to the commentary from other reviewers, I have the following specific comments: p. 6792 ln 21: Remove ‘conservatively’; maybe include the estimated sea level rise range based on all scenarios. p. 6792 ln 22: Use ‘Assumptions’ instead of ‘Simplifications’. p. 6793 ln 5-10: This needs to be rephrased. The first sentence implies that ‘Depth and age’ of a given radar isochrone yield accumulation by itself ? density needs to be accounted for (which is done, but this is not clear). p. 6794 ln. 18-19. Is not clear what you mean by ‘katabatic winds compact the upper snow layer’. Katabatic winds will create a ‘crust’ at the surface, and redistribute the snow, but it does not create compaction. Without a reference, I would discard this. p. 6794 ln. 22-24. Include reference Mosley-Thompson et al., (2001). p. 6795 Include reference Helm et al., (2007). p. 6799 ln. 11-12. While I tend to agree, the author mentioned before that east of T21 is considered the ‘dry-snow zone’ where temperatures never dropped below freezing. This statement contradicts that, and if ice was indeed found in some sections, the accuracy of the estimated accumulation rates would suffer, since there is no way to calculate ice content from the radar by itself.”

2. Author’s Response: We accept these specific comments.

3. Author's Changes in Manuscript: Above changes incorporated into revised manuscript.

Interactive comment on The Cryosphere Discuss., 9, 6791, 2015.

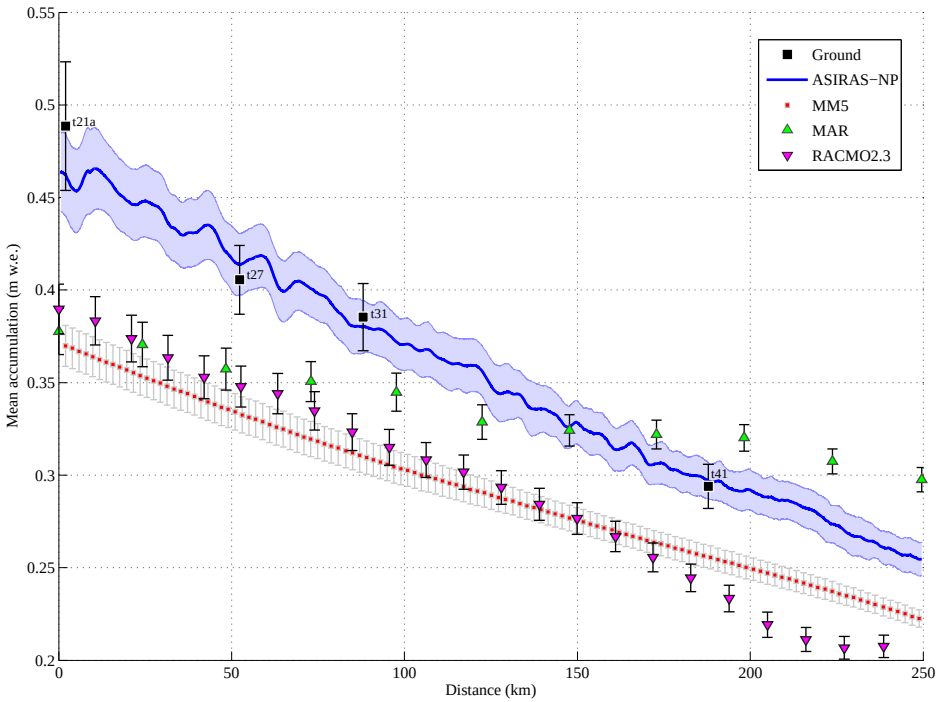

Fig. 1.