

Interactive comment on “Water Content of Greenland Ice Estimated from Ground Radar and Borehole Measurements” by Joel Brown et al.

Anonymous Referee #4

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Summary

In this study, the water content of the Greenland ice sheet near the margin is estimated. This is achieved by combining ice sheet borehole and radar surveys from a 1km long transect in southwest Greenland. The reflected travel times from the radar data are inverted to calculate the electromagnetic propagation velocity of the ice body. The borehole data are used to constrain the inversion by providing data for ice sheet depth and the boundary between temperate and cold ice. Their results points toward, higher than previously thought, water content in the ice sheet, specifically in a thick temperate ice layer right above the glacier bed. These findings are an important contribution to the study of Greenland ice sheet as it will results in improved ice viscosity estimates and modeling of ice sheet velocity fields and ice thickness.

C1

I can't speak to the details in the radar surveys and inversion methodology, but the overall methods are well designed. The paper is for the most part easy to read and follow. I don't have any major comments. I only provide some suggestion below for the authors to consider that may clarify the manuscript to readers. In particular those readers who are interested in the topic, but does not have a foundation working with radar data would benefit from some clarification of terms.

Minor comments:

Abstract: Mention the study period (2011 to 2012?)

Page 2:L28-29: Add standard deviation to the mean values

Page 2:L26-27: Clarify how the data were retrieved (e.g. datalogger) and the timespan of the study

Page 3: L1: Add the depth of the reported temperatures and also over what time period the estimates are representative (e.g. a year?). Provide the temperature of the temperate ice. Also rephrase sentence, change “boundary with temperature ice” to something like “boundary that separates cold and temperature ice”.

Page 3:L5. The meaning of “common offset” and “common source point” GPR needs to be explained for the reader. You kind of do this later, but consider briefly explaining it the first time you mention these two methods. Also, explain why it is important to use both methods.

Page 3:L9: MATLAB

Page 3:L10: Check manuscript for tense, here present tense is used “ the wave is adjusted”, the previous sentence used past tense “oscilloscope was triggered”. Make sure that the tense in the paper is consistent in each section.

Page 3:L24: Add reference for Ormsby bandpass filter

Page 3:L28: Explain “spatial aliasing”, and “stacking” and why it matters

C2

Page 4: L18-19: Explain “survey geometry”.

Page 4: L20: Confusing. It is not clear what survey method are you using in this study, or why it matters.

Page 4: L24: Explain “dip magnitude”

Page 4: L29 Explain “Dix inversion”

Page 7: L 24: Explain “RMS misfit”. Is it the same as “RMSE”?

Comments on tables and figures :

Table 1: The units are sometime provided in the header and always in the table (except for gain). Provide units in header or in the body of the table, but not both.

Table 2: Provide a header for the column between S3 and S4 (upper layer, lower layer etc). Rephrase “clear that the radar data” to “clear that the radar transect”. Add text to explain that the inset Greenland map shows the study area. Add text to explain that the rectangle in panel a is the outlines of the WV-2 image in b.

Figure 2 caption: Is “reflection picks” a scientific term? Can you use another word than “picks”. Also mention the geographic direction of the glacial flow in the last sentences.

Figure 3 caption: Explain “moveout”, “interfacial”. Clarify what “Dashed lines are the velocity model boundaries” refer to by adding the color of the dashed line in question. Explain that the temperature profiles are collected at site S3 and S4 respectively.

Figure 3 other: Revise the black dashed line with another color, they are very difficult to find in panel a.

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