

Interactive comment on “Multi-Channel and Multi-Polarization Radar Measurements around the NEEM Site” by Jilu Li et al.

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Others have shown that depth-profiles of radar-detected fabric show good agreement with direct measurements of fabric from ice cores (e.g. Drews et al. 2012, Eisen et al., 2007 at EDML; Fujita et al, 2006 at Dome Fuji and Mizuho). Here, the authors report multi-channel and multi-polarization radar measurements in the vicinity of the NEEM ice-core site. The radar measurements are used to infer depth-profiles of birefringence and fabric and compared with published measurements along the core (Montagnat et al. 2014 and Weikusat et al. 2017).

The new measurements, together with those from previous work, gives confidence that profiles of ice fabric in ice sheets can be determined using remote sensing methods.

C1

Given the importance of ice-fabric on ice dynamics, and the logistical difficulties of extracting and processing ice cores, this is an important contribution.

A few comments/questions: Sections 2, 3.1 & 3.2 provide in-depth descriptions and details of a very impressive radar system, data collection and processing methods. You also note a power mismatch between the two transmitters when used in HH and VV orientations, and provide a simulation to estimate the influence of the truss on the antenna radiation pattern. Conclusion is that the power mismatch was likely caused by interference between the radiation patterns. The focus for the remaining part of the paper is on polarization measurements from just one of the transmitters, which includes HH and HV transmit-receive polarizations. In order to make the manuscript more accessible to readers who are not so interested in details of the radar system, I suggest you consider moving these detailed descriptions (together with Figs. 1, 2, 3, 4, 6, 7 & 8) into supplementary information.

In order to keep the manuscript accessible to readers, you might also consider moving the discussion of filtering data (together with Figs 11&12) to the supplementary section.

Detailed questions

Page 1 - line 29. I think this point should be the main emphasis of the abstract. It should be expanded to state details of the “very good agreement”. The importance of the work is that it enables confidence in radar-detected polarimetry and it can be applied in places where there are not measurements from ice cores.

Page 10 - line 5ff. Does this mean that you profiled along circle 3 twice, or something else? - line 9. In fig.9 it looks like the upper ~125m is blank (rather than 250m expected from a 3 μ s delay). - line 16. Do you mean signal “extinction” (rather than “distinction”)?

Page 13 - line 21ff. Reference to Fig.10b -it would be helpful to also explain Fig. 10b in the figure caption (Page 34). Are dotted “measured” lines raw data or have they been filtered? Are they from Circle 3 or from some other circle?

C2

Page 15 - line 5ff. I have trouble interpreting Fig. 11. What do the different colors of power profiles represent? It is not clear to me what criteria has been used to assign the annotations in Fig. 11a. I see now that this is described on Page 17 line 18ff. It would help if you pointed the reader to this explanation. Also, it would be helpful to include a note about the annotations in the caption rather than having to refer to Fig. 14.

Page 18 - Concerning Figs 14b & 14d; how is normalized power determined in the upper 250m? Also, the depth scale in Fig. 14e needs to be clear; I am not sure – does it range from 1.34 to 1.5km?

Page 19 - lines 11&14. What is meant by “at the internal ice layer interface”? It might also be instructive to plot a full-depth-profile of the power difference, which might help the reader to delineate regions of ISO/ANISO-1/ANISO-2. - line 21. Fig 15 – not 14. It might be a more instructive comparison to compare the measured profile of eigen values with a full-depth-profile of the power difference, calculated either from Fig. 14b or from the cross-over measurements (Fig. 14d&e)

Page 20 - line 9. Presumably you observe “weak radar reflectors” (rather than “weak ice layers”) - line 18. Fig. 16 seems redundant; full-depth information is given in Fig 15a

Page 24 - line 3. Is this correct? I suspect that the borehole measurements of fabric have already provided insight into the ice flow history. More important here is that the radar polarimetry measurements are closely similar to measurements from the borehole and can be used with confidence to extrapolate ice-flow histories spatially. - line 5. Do you mean stresses rather than forces?

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