

Dear Editor,

We have uploaded a revised version of the manuscript based on the comments from referees. We would like to first thank all of the referees for their valuable comments, which have helped with improving the manuscripts.

In the revised version and the supplementary sections, all changes are marked in red font. Below we list our responses (in black) item by item to each of the referee's comments and questions (in blue):

Referee 1 (Howard Conway):

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

Thanks for the very positive comments.

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.

As suggested, we moved the detailed description of the radar system into supplementary section S1 and Fig. 1 into Fig. S1. We moved the description of the antenna geometry, radiation patterns and field installation into supplementary section S2, together with Figs. 2, 4 and 8 into Figs. S2, S3 and S4. We would like to keep Fig. 3 as now Fig. 1 in the paper because we think it is essential to understanding the rest of the paper. We moved the detailed discussions about the receive channel equalization into supplementary section S3, together with Fig. 6 into Fig. S6. We moved the detailed discussions on the transmit power mismatch between H and V orientations into supplementary section S4, together with Fig. 7 into Fig. S7.

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.

As suggested, we moved the discussion of data filtering into supplementary section S5, together with Fig. 12 into Fig. S8. We would like to keep Fig. 11 as now Fig. 5 in the paper because it is the basis for the later analyses in the rest of the paper.

Detailed questions

Please see <https://www.the-cryosphere-discuss.net/tc-2018-94/tc-2018-94-AC1-supplement.pdf> uploaded on June 19, 2018. Also see the revised manuscript and the supplementary sections.

Referee 2 (Zoe Courville):

General Comments: This is a general well-written manuscript that presents very interesting results comparing multi-channel/multi-polarization radar results to measured crystal orientation fabric from the NEEM ice core. The results show good comparison between the two methods. The methods are well-presented and clear.

Thanks for the very positive comments.

Specific Comments

Please see <https://www.the-cryosphere-discuss.net/tc-2018-94/tc-2018-94-AC2-supplement.pdf> uploaded on June 28, 2018. Also see the revised manuscript and the supplementary sections.

In addition to the changes based on the referees' comments, we further improved the manuscript by including an anisotropic simulation to support the analysis and discussion on the observed anisotropic patterns in HH measurements. Please see this improvement by the added Fig. 4b and modified Fig. 4c, and the added discussion at the end of the first paragraph on page 9 in the revised manuscript.

Sincerely

Jilu Li, corresponding author