

The Cryosphere Discuss., referee comment RC2
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Comments on tc-2020-370 by Reza Ershadi et al

Anonymous Referee #2

Referee comment on "Polarimetric radar reveals the spatial distribution of ice fabric at domes and divides in East Antarctica" by M. Reza Ershadi et al., The Cryosphere Discuss., <https://doi.org/10.5194/tc-2020-370-RC2>, 2021

The paper by Reza Ershadi et al documents the utility of polarimetric radar and derived parameters such as power and phase to map ice-fabric, critical for ice flow observations and modeling. With my expertise in satellite radar polarimetry (and with a limited experience in ice fabric), my brief notes (for this round of review) below will focus more towards the pros and cons of this manuscript related to the polarimetric aspect of this study.

Overall, the authors have presented a novel observational approach, supported by strong modeling framework towards baseline retrievals of ice fabric parameters (orientation, anisotropy and their vertical variability) from the two sites in the Antarctic; which makes the paper **compelling** and **impactful** to be published in TC. There are some general comments though, which requires revision, focused towards paper structuring (conciseness) and interpretation, before which the paper can be accepted.

I keep this round of review brief owing to the reasons I mention below with the Paper Structuring and Conciseness. I am willing to review the revised manuscript where I will include specific comments related to presentation quality etc.

Paper Structuring: In general, I find the paper (excluding the appendix) to be way too long, with a substantial focus given to the methods (which is OK for me), but diverts the attention away from the interesting results and discussions. By the time, I finished methods, I found 31 equations in the methods to be exhaustive, although the authors took time to have Table 1 with the list of symbols. Here is my suggestion. Section 3.3 can be refined by referencing the methods, and shortening the section by explaining how radar polarimetry is used for this particular study. This will really help the readers to follow through the objectives and methods with a strong connect, and make the paper more concise.

Results and Discussion: At the EDC site, the authors clearly illustrate the co-polarization node (CPN) at 1100 m and at around 2000 m. Especially the HH and VV phase coherence shows strong phase shifts at these depths. Just curious, but why don't (or what is the reason), the derived anisotropy shows almost negligible change in measured or estimated eigen values, vectors and anisotropy at these depths. From my knowledge, when there is a 90 degree phase shift (most prominent at 1100 m), that change is clearly

demonstrable of anisotropic scattering (as a function of change in ice grain size or orientation).

I find this vertical homogeneity even more interesting, when we compare them to the displayed vertical heterogeneity in fabric parameters from the EDML site. This is in slight contradiction to your statement in the discussion '**Multi-layer cases, however, are difficult to interpret, particularly if the ice-fabric orientation changes strongly (by several 10s of degrees) with depth.** Fortunately, **this does not appear to be the case for the data presented here,** so that the initial guess already results in a forward model that **adequately captures characteristic features in the data**'.

I think, since both sites indicate demonstrable differences in derived ice-fabric parameters (across depth) (based on Figure 5 and 6), that shows the applicability of the method used in this study. But at the same time, the paper lacks explanation about why there are site-specific differences, which will be a neat discussion to include.