RC2: 'Comment on egusphere-2024-2349', Marie G. P. Cavitte, 13 Oct 2024

Review of "Age-depth distribution in western Dronning Maud Land, East Antarctica, from three decades of radar surveys" by Steven Franke et al.

In this study, the authors trace nine IRHs over western Dronning Maud Land, with radar transects gathered over three different radar systems. They date them at the EDML ice core, using a combination of forward DEP modeling, as well as twtt-to-depth conversion using wave propagation and firn corrections. They then describe the IRH depths and geometries for the whole survey region and highlight the overlap between the IRHs traced here and other tracing studies in East and West Antarctica, showing very good promise for the AntArchitecture endeavour.

This paper is a very important contribution to making sure the interpreted internal stratigraphy of the Antarctic Ice Sheet is published and accessible to the community. Such efforts to document data sets should be praised and encouraged. However, I would suggest to consider submitting this article to ESSD, not for lack of quality of this manuscript, but because it seems like a better fit for a dataset paper. See minor comments below. I suggest this paper be published, here or in ESSD with technical revisions.

> We would like to thank Marie Cavitte for taking the time to review our paper and appreciate the constructive suggestions and the overall positive assessment. Below, we share our thoughts on the suggestion regarding whether the paper might be better suited for a data journal (e.g., ESSD).
>
> First of all, we fully understand the concerns and recognize valid reasons for submitting to either type of journal. A key aspect is whether the traced IRHs and their depth distribution in the ice sheet are viewed primarily as data or as a form of results. In our opinion, both perspectives can apply. Looking at similar manuscripts in the literature, we see that they have been published in both scientific journals and data journals. However, we acknowledge that our paper, in its current form, is mainly data-driven.
>
> Taking this review, along with the other reviews and discussions with the editor into account, we have decided to expand the scientific focus to ensure the paper is suitable for *The Cryosphere* (TC). This expansion will primarily involve deepening the discussion of IRH depths (or normalized depths) in relation to glaciological aspects such as ice flow velocity, bed topography, and accumulation. Additionally, we will expand the discussion to include comparisons with similar IRHs from other studies, and we will introduce a new figure illustrating these connections.

Specific comments:

The first sentence of the introduction is very vague, and therefore not so useful, particularly "observing and modelling" which can encompass everything.

> We agree and the first sentence now reads as follows:
> *"Studying the dynamics of the Antarctic ice sheet (AIS) through geophysical observations and ice-sheet modeling is crucial for understanding its response to climate change and predicting future sea-level rise."*

The impact of the firn correction of 13m taken as constant for the whole survey region should be discussed, as the snowfall regimes are quite different across it.

> Fully agreed and we added the following sentence in Section 2.5 (IRH depth and normalized depth):
> *"However, even though a 13 m firn correction was applied uniformly, snowfall and accumulation rates vary across western Dronning Maud Land (e.g., Rotschky et al., 2007) potentially affecting depth calculations of IRHs."*
>
> Furthermore, we have expanded our discussion on the topic of firn correction uncertainty in our paper.

Line comments:

Abstract – The last sentence uses "fundamental data", I would suggest "boundary conditions" instead.

> Done.

L16 – Comprehend → Understand

> Done.

L17 – Maybe specific where the melting is occurring (basal, surface)

> Done.

L21 – hundreds thousands → Hundreds of thousands

> Done.

L27 – linked to conductivity contrasts and density

> Done.

L28 – what does "detected across the ice sheet" mean? Reword

> Added "*thousands of kilometres*".

L30 – what is mean by boundary layers? And why use the word layer here? Not defined

Good point. We rephrased the sentence to:
"Thus, IRHs represent interfaces of changes in the dielectric properties in the ice that indicate synchronous snow deposits."

L30 – suggest to change"time horizons of the same of snow deposits" to "synchronous snow deposits"

Done.

Table 1 – Developper → Developer

Done.

L39 – why use the word "layer" and not "IRH" ?

Done.

L44 – Suggest to modify to "where reflections have a different radar signatures due to their different vertical wavelengths"

Thank you for the suggestion. Done.

L75 – the ice internal structure

Done.

L84 – which serves as a transmit and receive

Done.

L88 – Define fk

Done.

L109 – what is meant by the final sentence? Clarify

We want to highlight with this sentence that we show partially existing data (from Winter et al., 2019), e.g., their 38 and 74 ka IRHs and want to clarify with this sentence that we did not pick them ourselves but integrate this data into this study. We modified the sentence slightly and hope it is clearer now.

L175 – mention Ey after "electric field envelope"

Done.

L235 – abscent → absent

Done.

L239 – number of data points does not represent much for the readers…I think it could be left out.

> We deleted “points”, however, on the other hand it is now unclear what the increase in data refers to.

L362- The review paper of AntArchitecture can now be cited here (https://egusphere.copernicus.org/preprints/2024/egusphere-2024-2593/)

> Done.

Figure 1 – The Dome Fuji survey is missing. Also why aren’t the EMR long-pulse lines drawn on this map, as drawn later on Fig.7. It’s confusing to have different datasets on these two sets of figures. I would suggest to also mention in the figure caption what the background map is and also that ice core sites are highlighted with circles. Finally, the three shades of dark blue are really difficult to tell from each other on printed paper.

> The purpose of Figure 1 is to show and focus on those radar lines that have been used in this study and their coverage. We explicitly want to avoid the expectation that tracing these nine IRHs is possible in all AWI lines. Hence, it covers only EMR short-pulse and UWB data and not the Dome Fuji EMR long-pulse.
>
> We agree with the reviewer and follow the suggestion about mentioning the background map and also the ice core site markers in the figure caption. We also changed the color map on panel (b).

Figure 2 – the ice base reflection marker on panel c is not visible

> We are not sure if the reviewer is referring to the marking symbol (the white arrow) or the bed reflection the arrow is pointing to. From our perspective both are visible in the radargrams. If the reviewer is referring to the modeled radar data, there is no bed reflection visible because it is not included in the model at all.

Figure 5 – Could Jutulstraumen be added to this figure too as it is discussed? It is helpful to have all the info on that one figure. Also, the figure caption could mention the different Features highlighted. Same for Figure 6.

> Done.