

Dear Editor and Authors,

Please find attached my second-round review of Mutter and Holschuh (manuscript number: egusphere-2024-2450) with manuscript title “Advancing interpretation of incoherent scattering in ice penetrating radar data used for ice core site selection”. In general, I would recommend this paper to be published in The Cryosphere with minor revision, and I very much look forward to seeing the updated version soon. Please find below a series of additional comments. With best wishes, Julien Bodart

Julien – Thank you for your careful consideration of our manuscript throughout the review process. Your comments have helped us think deeply about the data and their implications, and have resulted in a much stronger manuscript as a result. For your specific recommendations, see our comments below. Thank you again.

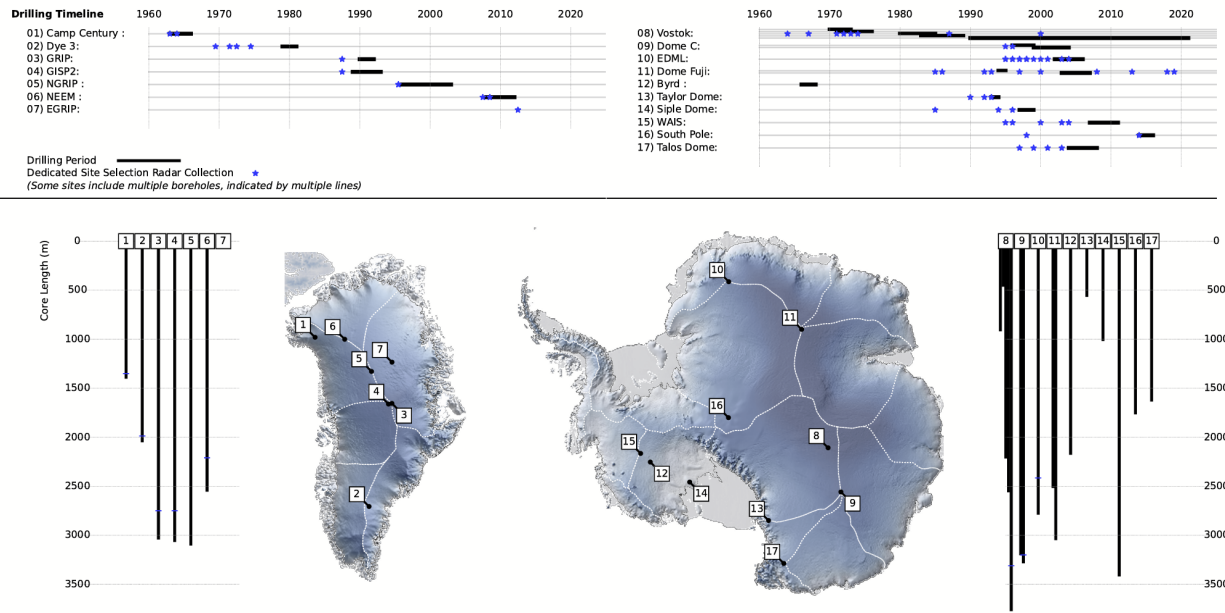
Ellen and Nick

Additional comments:

- Figure 1: Could I suggest an alternative to the “core length” diagram on the right-hand side of Figure 1? I was suggesting in my first review to add the age of the ice cores in a figure in the main text as I think it would help the reader who might not be familiar with the age depth at each core. The authors mentioned that this information was now in the supplementary materials, which is great. However, I believe that perhaps a good compromise (or opportunity) would be to order the cores in the diagram of Figure 1 by oldest to youngest (or reverse), so 1 in this scenario would be Dome C (currently 9), etc. This is motivated by the fact that there is no current logic behind the ordering of the cores in Figure 1, so ordering them by age would be an easy change that could address my comment (and the editor’s).

We understand your desire to add age information to this figure, as it is an interesting dimension one can use to compare cores. We believe the current alphabetical listing makes ice cores more easily findable for the reader, and that additional information in the figure, while interesting, makes it less effective for its primary function – access to the ice thickness and location of each core site (relevant for deep deformation). But, we have constructed the figure as requested and include it in the supplementary figures (Fig. S5) for the manuscript.

Our earliest draft of the figure included more information about each core. Most notably, it included the timeline for site selection and exploration (as that is what motivated this work originally). In that version (provided below) we found that cross-referencing the figure and the text became more and more complicated, and as the figure got more information dense, the information we cared most about got lost in the noise. In redrafting the figures during the most recent round of review, we considered several options to include the age based on your recommendation, including re-ordering the cores, color-coding their labels based on maximum age, and more. We ultimately concluded that these modifications made it harder for the reader to quickly determine where cores were, the piece of information we care most about here.



- Also, and maybe this is unfair at this stage of the manuscript, but do the authors think that the new WACSWAIN (Wolf et al., 2025; <https://doi.org/10.1038/s41586-024-08394-w>) ice core at the Skytrain ice rise site (WAIS) could be added to the manuscript? There is evidence of disruption in the depth-age scale in the deepest part of the core which remains unresolved. I know this is very early results and comes in late in this paper's process, but perhaps this could be interesting to add if there is time. This is not a strict requirement though and I understand that such addition at this stage is slightly unfair. I leave it up to the authors.

We spent time reading the literature on the WACSWAIN project, considering what data we would need to meaningfully include it in our analysis. The volume of discontinuous ice in the record there spans a different scale (10s of meters) than we are primarily focused on at the other core sites (100s of meters), and without physical properties measurements published, there is little we can say about the radar data at Skytrain Ice Rise. But your recommendation got us thinking about how we should reference the coastal domes generally: at present, we include Taylor Dome, but not Law Dome, Skytrain Ice Rise, Berkner Island, or the ice cores from James Ross Island and the Fletcher Promontory. These all have thicknesses of less than 1000 m, typically don't have published optical logging data or fabric measurements, and are (on average) much younger than the deep ice cores. In reflecting on what should be included based on your question, we actually concluded that we should probably *remove* Taylor Dome. It did not currently contribute to our narrative, and by removing it we maintain consistency in our practice excluding Skytrain and other coastal domes in our analysis here.

- Line 223: "of to" – rephrase

Fixed. Thanks for catching this!

- Conclusion: I appreciate the observations made in this paper and believe that the conclusions from the analysis of the radar data made here is valid; however, I would like to see another sentence in the conclusion which highlights the potential subjectivity of the analysis and acknowledges that conclusions are not entirely independent from the acquisition or processing of the underlying radar presented here. I leave it up to the Editor and other reviewer(s) whether this step is a pre-requisite for acceptance of the manuscript, but in my opinion, it is an important caveat to add.

Indeed, if I am an ice-core person with little knowledge of radar, I might assume that this type of analysis/conclusions (especially Figure 5) are independent from things that can affect the quality of the radar data in its current form (i.e. acquisition or processing, whether pre or post-processing to enhance layering for example) and that such strict classification can be made without potential subjectivity, when in fact, and as acknowledge by the authors in their response to the reviews, there is some subjectivity when it comes to this analysis. This is not just subjectivity from the human eye, but also from the pre processing or acquisition frequencies which affect the strength of the reflectors which are used to make the conclusions in this analysis. I take, for example, Figure 5a “Dye-3” sub panel, where one could argue that there is some layering below the boundary that the authors put as “no signal”, or Figure 5b “Dome F” where different conclusions could be made as to what each section represents. The addition of a simple gain function to these data could likely alter slightly the exact location of these boundaries and the type of scattering they represent, but I believe that the conclusions of the paper do not really acknowledge this caveat clearly.

I think the addition of Lines 125-127 earlier in the manuscript was really useful, thank you for that. But potential ice-core experts might skim through this and focus on the conclusions, and I think it would be worth adding a sentence here to acknowledge this caveat. I do note your addition of paragraph 443-449 in the Conclusion which might be read as an acknowledgement of such caveat, but in my opinion, it lacks a clear acknowledgment of the dependency of acquisition and pre-processing steps which could affect the “strict” classification made in e.g. Figure 5. A simple sentence, as in Lines 125-127 would be enough for me. As already mentioned, I leave it up to the Editor to decide whether this point is a bit too harsh. In any case, I really enjoyed reading the paper, I learned a lot, and I am sure it will be read by many others in the community for the right reasons, so I thank the authors for their work on this and sharing their findings and insights with the community.

We agree that this caveat is important for all readers to consider, and should exist in a prominent place in text. We’ve updated the paragraph starting on line 443 to make this point explicit, and added a sentence pointing folks to a more objective approach that (while not possible with all of the historical data) *should* be used for future studies of this type.

Thank you again for all of your work in reviewing this, we really appreciate it.