

## ***Interactive comment on* “Physical properties of shallow ice cores from Antarctic and sub-Antarctic islands” by Elizabeth Ruth Thomas et al.**

### **Anonymous Referee #2**

Received and published: 15 July 2020

The manuscript by Thomas et al. presents a preliminary analysis of the potential of a number of ice cores from sub-Antarctic islands for short-term climate reconstructions. The data are novel and exciting, though this is somewhat undersold until the Conclusions. The structure of the manuscript could be much improved; in particular, the Methods need to be complete (including uncertainties) and a separate Discussion section would allow for more detailed and clearer interpretations. I also wonder if the title best summarises the manuscript, as the ultimate goal is currently to calculate the bottom age of a longer core at each site (though no climate reconstruction is actually carried out) – certainly to keep the title, more description (and analysis) would be required. There are a large number of minor technical inconsistencies that need correcting.

Major comments

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1. The manuscript would benefit from having a Discussion section. At present, the small amount of discussion is mixed in with the Results, and as such, is lacking in detail. I at least expected a discussion of the suitability of each of the sites (ice conditions and location as that was a primary focus in the Methods) – some of this is hidden in the Results and would be much clearer in the Discussion, perhaps organised with a sub-section structure for this section that answers each of the aims.

2. The structure of the Methods and Figures 2-5 could be improved. I would expect the field site/ice core descriptions to come first, followed by ice core analysis, GPR, then met data. This makes more sense with the order the aims are presented in the preceding paragraph (and would make more sense for the structure of the following sections as well). The Methods are incomplete in places and some important details are floating around in the Results/Discussion section rather than the Methods. In addition, I don't see the value in separating Figures 2-5 into sea sectors when this isn't referred to elsewhere and when the Methods describe each site in turn. I suggest either dividing the Method sub-sections by sea sector (if that makes sense with discussion later in the manuscript), or combining these figures into one – perhaps as subpanels on Figure 1, colour/shape-coded by site. It would also be useful to show the GPR lines on these figures as well as the ice core locations.

3. A large part of the Results focuses on the GPR results but is isn't clear what these data ultimately contribute to other than general characterisation and providing ice depth for one site – they are set up as if they will provide much more than this. It almost feels like the data analysis is not complete(ly presented). Layers are identified in the radargrams, but this seems a little haphazard and is not compared with the ice cores – why? 4. Uncertainties for the measured densities and fitted density curve are not presented, and the calculations for the calculated depths are not explained?

Minor comments

L21 and throughout: Please be consistent with hyphenation; e.g. ground-penetrating

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radar, pore close-off

L28: Units should be kg m<sup>-3</sup>?

L33-53: These first four paragraphs are a little repetitive and double back on themselves. I think it could be condensed into two paragraphs, with, for example, the first explaining why climate records are important and missing in this region, and the second detailing the potential of SAIs. This would lead nicely into the few paleoclimate records that do exist.

L57 and throughout: Be consistent in use of comma to denote thousands in numbers

L58: Remove comma after limitation

L71: Terminus should be termini

L74: How much retreat has occurred – how much of the record is lost?

L83: Why the upper 40 m? The longest ice core was 24 m, and the GPR up to 51 m so this seems quite a strange depth to choose. Perhaps instead state the “upper ice column”?

L88: ECMWF acronym needed after this first use

L90 and throughout: Either use “degree” or the symbol, unless there is a reason for swapping between these?

L91: Comma needed before “however”

L95-100: Links and DOIs might be better provided in the reference list rather than in-text. This would allow a clearer description of the Bouvet station, for example (what does WMO stand for?). You state in this paragraph what data is available, but what is actually used for this study?

L97: Unnecessary comma and missing space after “Island”

L107: Use defined SAI acronym

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L108-109: This sentence belongs in the Results

L150: Missing space between 3,110 and m

L152 and throughout: “average annual temperatures” should be singular

L153: You haven’t defined or used a.s.l. as an abbreviation prior to now – either use throughout or don’t

L173-174: The phrasing of this sentence is confusing – if the cores aren’t used, then how are the bottom ages obtained? If they aren’t used, I simply wouldn’t mention them at all (save for your future study), but if they are, perhaps present this site at the end of this sub-section and describe what you do do with the core (differently to the others)

L174: Elevation, not altitude

L178 and throughout: “islands” should be “island’s”

L188: I think “extent” should be “extend”

L198: GPR has been used prior to this (without the acronym. . .)

L226: How much correction was applied for ice thinning – is it possible to give an idea with a mean and range?

L226: “that” should be “which”

L228: Where are the methods for estimating the bottom depth of each site? Found – Sections 3.3 and 3.4; I think these would make more sense here at the end of the Methods, with more detail than currently provided (how are uncertainties calculated?)

L236-238: The number of clauses in this sentence makes it hard to follow. Perhaps rewrite to something like: “Layers could not be distinguished in the upper ~7 m of snow and only reflected weakly beneath this depth; 11 distinct, but discontinuous, layers were identified down to a depth of 62 m. We estimate this to be the...”

L245: Typical of what?

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LL268-269: I don't see the multiple layers you interpret in the radargram. Perhaps they would be clearer if you made the radargrams larger or only showed a section of the image currently presented?

L275: Have you only shown some of the layers in Figure 9 – there appear to be many more?

L281: I see the horizontal layers discussed here, but not the nearer-vertical layers that are shown in Figure 10? Is this again a size-resolution issue with the figure?

L303: “effected” should be “affected”

L309: Thus far, the project has been subICE not SUBICE

L317: AWS has already been used so doesn't need defining here

L320: What could have caused the large number of melt layers at Young Island if not surface temperature? Is it possible to plot the number of positive degree days from the AWS (admittedly over a short period)? A discussion of the depth distribution of these layers might be interesting and help to suggest other causes

L356: This sentence is incomplete

L365: If the annual layer counting was done in this study please describe in Methods, or if another please provide a reference

L371: Table 5 should be Table 3?

L412: Estimate should be plural. Is this sentence stating that only Bouvet provided an ice thickness estimate?

L414: I think core should be plural

Figures 5-10: It would make more sense to me to have the reference map first, then the uninterpreted radargram, then the interpreted radargram on the far right. All these figures need panel labels for consistency with other figures, and the captions can be

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shortened (e.g. axes do not need to be described). Font size could be larger and some of the radargrams, as previously mentioned. The figures would also be neater if the reference map panel was the same height as the other panels and all the of the tracks filled each box. The mid-panel y-axis on Figure 7 is obscured.

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Interactive comment on The Cryosphere Discuss., <https://doi.org/10.5194/tc-2020-110>, 2020.

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