

## ***Interactive comment on “Persistent Tracers of Historic Ice Flow in Glacial Stratigraphy near Kamb Ice Stream, West Antarctica” by Nicholas Holschuh et al.***

### **Anonymous Referee #1**

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#### General comments

Here I review “Persistent Tracers of Historic Ice Flow in Glacial Stratigraphy near Kamb Ice Stream, West Antarctica” by Holschuh et al. submitted to The Cryosphere Discussions. In this paper the authors use early 2000s ground-based radar profiles from the Siple Coast to image the radio-stratigraphy of an area near Kamb and Bindschadler Ice Stream onset areas.

The authors find a discontinuity in the radio-stratigraphy on the lee side of Mt. Resnik, which the paper discusses possible causes of. As I understand the paper, the authors favor a mechanism in which the thinning of ice over Mt Resnik after 3.4 ka leads to

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changes in surface slope. In turn, this drives a southern expansion of the blue ice area in the lee of the subglacial obstacle. This erosive region then explains both the presence of an unconformity and its kinked morphology.

I enjoyed the paper and think it makes a worthwhile contribution to the glaciological understanding of the locality and the wider region. Broadly the scientific content of this paper is good, and the conclusions are valid given the presented data. However, the progression of the paper is often difficult to follow and requires major reorganisation before I can recommend it for publication. I encourage a resubmission and I would be happy to review a revised manuscript.

#### Specific Comments

I found the introduction section confusing, with an “Introduction (1.1)” section and then two subsidiary sections (1.2 and 1.3). Section 1.1 states what a persistent tracer is and the direction of the paper, before repeating and expanding this in the subsequent Introduction sections. The content is there but needs reorganising to a clearer progression from: Scientific background, what englacial tracers can contribute, and how these will be applied to the study area to work towards the paper’s scientific and methodological conclusions.

The need for Section 2.3 is not immediately clear to me and appears somewhat surprisingly after no mention of this line of evidence in the Introduction. I would argue that much of this section is not “Data” at all but analysis performed to explain the observations in the data presented in Sections 2.1 and 2.2, and it must therefore be integrated into Section 3 or a Methods section.

In 2.3 the authors are seeking to explore reasons why the radar unconformity is present using RACMO model output at much lower resolution than the target features. This line of evidence and enquiry is then abandoned, and used to motivate Section 2.4 which looks for the occurrence of surface scour in satellite imagery. It would be more logical to first see if a blue ice area exists, and then try to explain its occurrence using climate

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model output.

The beginning of Section “3 Results” is not Results. P5 L13-25 are Introduction (that Mt Resnik is a good tracer, what layers record in general, current ideas about what unconformities represent), and most of P5 L24-P6 L2 should be integrated into Section 3.1. In Section 3.1 the idea that Mt Resnik is a persistent tracer is unnecessarily repeated again (P6 L8-9).

Another structural point arises in Section 3.2 which I found a little confusing. At P6 L27-30 the authors reject the first formation mechanism based on some travel time calculations. The paper then goes onto “select a favored formation mechanism” in Section 3.3. having already rejected one of the mechanisms. This dis-order also happens for the second mechanism (P7 L5-7).

Technical comments

P1 L27. Ross et al., 2011 not in reference list?

P2 L9. Suggest a rewrite of “limited to reconstructions of behaviour \*outboard\* of current margins” as meaning not immediately obvious.

P2 L24. Stylistic point - I think “centennial timescales” is more standard than “century timescales”

P3 L15-21. Check whether the in text referencing to Figures is correct. Text states Fig 2.B shows unconformity but caption and image itself show conformable layers. 2.A is similarly contradictory.

P6 P24. It would be clearer if the specific figure panel was referred to in text – e.g. Fig 4a, etc.

P7 L1-7. Is Mechanism 2 mutually exclusive from the other mechanisms?

P7 L12-14. The meaning of the sentence “This way, snow....in the radar data” is unclear. Does the blue ice area explain the unconformity? Or does the change from

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“quiescent” or “turbulent” snow deposition?

P8 L12-13. I wouldn’t say basal friction, accumulation or melt are “spatially locked” as all three are emergent and dynamic boundary conditions in ice sheet flow and, therefore, stratigraphy.

Fig 3. It would be informative to see an indication of the radar unconformity zone and modern ice flow mapped onto the current Landsat-8 identified modern day blue ice areas.

Fig S1. Caption L4. “un” typo.

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