

General comments

This paper explores a novel method for mapping the geometry of the Gambertsev Subglacial Mountains using ice surface roughness and slope. Automatic and manual mapping methods are combined to produce detailed maps of ridge and valley morphology for areas between existing radar flight-lines, expanding the pre-glacial fluvial valley network beyond what was previously known. The authors conclude that this map could be of use for selecting drill sites for the oldest ice, or for ice sheet models studying the effect of basal topography on ice flow or hydrology.

The paper is generally very well written and structured. Before publication though, I would like to see an expansion of the methodology for the automated mapping, which I do not think is currently sufficiently detailed to be reproducible by other scientists, but could easily be made to be. The code for the paper is also currently only available on request, and I would like to encourage the authors to make this openly accessible (e.g. through GitHub or Zenodo), which would help with reproducibility. Otherwise, I have only a few minor points.

Specific comments

141 Would you recommend a neighbourhood distance of 1000m if applying this method elsewhere? It would be interesting to see some discussion as to whether you think this value would vary with the ice thickness, or perhaps a trade-off plot between noisiness and crispness of surface features to give a clearer idea of how you came to your decision.

164 Up to this point, I think that your methodology is very clear, and it is well explained which metrics you are focussing on and how those are calculated. However, I would like to see this section expanded further to make this method more reproducible. How was the adaptive binary threshold calculated? Which algorithm did you use for edge-detection? You say that the code for the paper is available on request, but is that the code for this step? I think that the pre and post processing steps should also be explained in the main text, rather than as a footnote.

235 Could you present a figure of the features identified with automated mapping? It would be nice to see a visual representation of the features which are found with the manual mapping but not the automated (and vice versa), especially since you mention that you do the manual mapping in a deliberately interpretive way to try and fill in some gaps. Some kind of visual comparison would be good, and would give a better idea of the overall coverage of features, since the later comparisons in section 3.3 (as far as I can tell) are only to the AGAP radar data?

358 Modelling suggests that for ice sliding over the bed, bed topography is transferred to the ice surface. However, earlier in the paper you mention that the ice is most likely frozen to the bed, allowing it to preserve the pre-glacial topography. Does that mean that the ice is not sliding over the bed, and flowing slowly through internal deformation, and do you think that would have an influence on the way in which bed topography is transferred to the ice surface in this region?

Technical comments

79 I feel like this could be rephrased with fewer commas to read more smoothly. 'The geology of the Gamburtsev Subglacial Mountains is poorly understood, with their...'

100 You could be more explicit about the directionality of the relationship between oxygen isotopes and glaciation here; 'as increased terrestrial ice volume leads to a higher d18O in seawater and hence in benthic organisms.'

115 It is very difficult to see the surface curvature in Figure 2d which is overlain on the RAMP intensity. I would suggest plotting these two separately, or increasing the transparency of the RAMP Intensity layer.

124 Bed elevation models? Or a bed elevation model?

145 Figure 3, could you include a colour scale bar for mean curvature with this figure. If the scale is different for each plot, perhaps a normalised colour scale could be used.

169 REMAv2 has many fewer gaps than REMAv1, so I'm curious to know which version was used (there is no timestamp on the reference for the dataset). Do you think that these gaps made a significant impact to the results of your study?

209 It might be good to mention that the technique used by Bedmachine Antarctica to go from the AGAP RES data to their DEM is streamline diffusion (and not mass conservation as many readers might assume).