Past water flow beneath Pine Island and Thwaites glaciers, West Antarctica

Kirkham et al. 2019

Review: Calvin Shackleton

General comments:

This manuscript presents new mapping and morphometric analysis of subglacial channels and basins on the seafloor exposed by the retreating Pine Island and Thwaites glaciers, West Antarctica. The work also utilises a modelled LGM ice surface and isostatically corrected bed topography to model past water flow, with particular focus on water production and storage. The methodology for morphometric analysis of channels is thorough and well-explained, and the modelling approach is justified appropriately. It should perhaps be noted in the methods that the model approach does not allow for the prediction of anastomosing channels, and should be/is used only to predict water flow direction rather than simulate the behaviour of individual channels.

The results section is concise, and provides select relevant metrics from what was undoubtedly a large dataset. The figures are useful and informative, although a detailed map of the interpreted subglacial basins is currently lacking and could be incorporated into Figure 3, along with some long- and cross-profiles of the basins. This manuscript is very well written and addresses an important topic in subglacial hydrology, with an interesting discussion of the origin and cyclic behaviour of high-magnitude subglacial lake drainage events and their impacts on subglacial hydrology and landscape development. I think this work should be published and I propose a small number of minor suggestions and corrections to improve the manuscript.

Specific comments:

L247: I like this interpretation, but it would be nice to see some evidence of the "lines of geological weakness" for comparison to the channels.

L255-259: Refer to the appropriate figure that you based your descriptions and interpretations on. At the moment I can't find a figure where the basins are clearly mapped, and suggest that a detailed description of the basins should be included, supported by select long- and cross-profiles that could be incorporated into figure 3.

L344-347: This could be true, or they could have been formed over a longer period, potentially over multiple glacial cycles. Is there any other evidence that can be presented here that leads you to favour formation by large volumes of subglacial water? Or to rule out formation over longer periods?

L347-354: What if the channels were widened (and/or deepened) by sliding ice following infilling/ channel closure during their inactive phase (i.e. seasonally) rather than during subsequent ice advance/retreat?

L375: This interpretation needs to be justified a little better. Why would surface water **not** reach the bed? Are there no crevasses in these regions? Can you rule out hydrofracture? To me the documentation of surface meltwater rivers by Bell and Kingslake conversely indicates a high potential for surface meltwater entering the englacial and basal system.

L494: Insert comma after "Thwaites Glacier"

L519: Given that this paragraph is discussing floods from subglacial lakes, the comparison to proglacial lake Missoula seems a little out-of-place. It should be made clear that this is a proglacial lake and the comparison you are making is between their high-discharge rather than drainage environment.

L879: "Bindschadler" missing an r

L1227: Indicate that the long profiles are from **several/select** channels in the Labyrinth and Pine Island Bay region.

Figures:

Figure 3:

I cannot see an inset map as described in the caption. Are you referring to the labelling in figure 1?

It is a little confusing to have the labels on the downstream end in 3c and upstream end in 3d, I suggest to have labels only at downstream end to match the profiles in 3e and 3f below.

Figure 5:

Perhaps include a grid on 5a to help orient readers who are not used to looking at projections of Antarctica.

Here it would be nice to show the overlap between modelled basins and geomorphologically mapped basins (which I think should also be presented in figure 3).