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Interactive comment on "Coastal complexity of the Antarctic continent" *by* Richard Porter-Smith et al.

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General comments

Anonymous Reviewer #1 (Received and published: 22 September 2020)

Comments: 'This is a novel first attempt to characterize the coast of Antarctica, using techniques normally used for non-icy coasts. The significance of this technique is that it will allow the changes in coastal margins as the glacier/ice shelves retreat/change to be monitored. Problems may be that it is not clear how the "complexity" of an icy coastal margin relates to glacial processes. In the 'normal' coast, the recognition of bays etc is important for coastal erosion and deposition but within this icy sphere the link is not so obvious. So, leading on from this, how frequently should the resurvey take place (daily, seasonal, annual decadal?), and how would you test the significance of the

changes? Overall, I think this is a significant increase in knowledge about Antarctica and so should be published. I suggest the authors add more detail on – how the complexity adds to glacial processes and plans for future resurvey.'

Response: To the reviewer#1, we thank you for taking the time to read and review our manuscript. Your insightful comments and suggestions – in particular, your reference to how frequently should re-evaluation take place given the temporally variability of the landscape – have gone a long way in helping us improve it to a way better standard. We have revised our original submission with your input and will submit the revised manuscript, along with a version containing all the changes made. Many thanks again.

We acknowledge that that we have generally talked about the influence of the complexity on other processes. As to the underlying reasons behind the changes in complexity, knowledge of the underlying rock type is severely limited due to inability to access much of the geology through the ice (Stål et al., 2019).

We clarified this point with modified text, "Characterisation of the complexity of terrestrial coastlines is a fundamental measure of the lithological mix. Coastlines of a homogeneous lithology tend to be straighter than coastlines of mixed lithology. Wave action promotes a straight coastline if the lithology is homogeneous and a complex one if the lithology is heterogeneous (Porter-Smith and McKinlay, 2012). The Antarctic coastline is a different challenge in that it is almost totally covered by glacier ice and surrounded by ice barriers that influence ocean processes acting on the continent and is likely to be more temporally-variable in nature than terrestrial coastlines. Additionally, knowledge of the underlying rock type is severely limited due to inability to access much of the geology through the ice (Stål et al., 2019). However, even in this homogeneous environment, one might expect a relatively higher complexity due to the presence of glacial valleys an example would include the western Peninsula's fjord-like coast, where there are glacial erosion processes in motion. Glacial erosive processes have a distinct signature (Anderson et al., 2006) that would result in a higher coastal complexity. Although the formative processes may differ between Antarctic and terres-

trial scenarios, the methodology does not assume prescriptive or formative processes but classifies purely on differences in complexity over a range of length scales. The analysis of Cx using this multi-scale approach also allows the identification and analysis of morphologically similar coastal environments and forms the basis for further research into their relationship to, and synergy with natural processes."

To clarify the point of 'how frequently should the resurvey take place?', we have added a paragraph in the 'Conclusion' e.g. "Given the temporally variable nature of ice and as to the question of how frequently the complexity of the Antarctic coastline should be recalculated, most major change in margins happens with ice shelf advance/retreat (i.e., calving and ice front advance). Of these processes, retreat has by far a shorter timescale. So, one could argue that a re-assessment should happen in conjunction with major calving - but such events tend to be regionally limited (e.g., the calving of the Amery Ice Shelf in 2020). Ice shelf collapse (e.g., Wilkins in 2008/09) is a little more dramatic but still geographically limited. Thereby, such re-evaluations aren't needed frequently unless there's major change. Runaway grounding line retreat leading to major coastal margins changes might be sufficient grounds for re-evaluation, but this hasn't yet happened. Significance of changes could be assess using standard change detection metrics (e.g., estimate the distribution of the current coastline features, see if the new coastline complexity falls outside of this distribution) thus justifying another evaluation."

References

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