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Interactive comment on "DeepBedMap: Using a deep neural network to better resolve the bed topography of Antarctica" *by* Wei Ji Leong et al.

Anonymous Referee #2

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This paper introduces a new method, based on Machine Learning, namely a Generative Adversarial Network (GAN), to add short-scale roughness to the bed of Bedmap2. The paper is well written, easy to follow and well illustrated, I really enjoyed reading it. I recommend publication after minor revisions. My main problem while reading the manuscript was that I felt like the authors were overselling their approach and the performance of the GAN. What the GAN is doing is to essentially try to reintroduce basal roughness in the smooth bed of Bedmap2 based on surface features. While the method is different, the goal of this study is very similar to the paper of Graham et al. 2017 (www.earth-syst-sci-data.net/9/267/2017/) or Goff et al. 2017 (https://doi.org/10.3189/2014JoG13J200), papers that are barely mentioned in the text.

It is clearly an excellent idea to try to use these methods, established in other fields, to

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the mapping of the Antarctic bed. It also seems natural to use surface data (velocity, SMB, etc) as a "predictor" for the shape of the bed. That being said, it seems like the surface observations provided to the GAN do not make it possible to recover big features such as ridges or valleys in the bed that could have a large impact on ice flow models, but only to add some high-resolution roughness to the overly smooth bed of Bedmap2. This is a valuable exercise and using machine learning to do this is definitely a good idea and worth publishing, but I don't think we are there yet. The training dataset is extremely small and probably not representative of all the different types of terrains under the Antarctic ice sheet (as mentioned by the authors). We see a lot of artifacts in the solution and many of these artifacts are discussed in the text: dunes and missing mountains around Byrd (4h), Terraces (4i), Speckle (4a), etc. In the maps of figure 4, I could not find a bed that seemed realistic. Even along the flight line of OIB (figure 6) the roughness of DeepBedMap seems exacerbated and not necessarily representative of the actual roughness measured by the radar. And again, the authors make it clear, I just find the title/abstract and parts of the paper a bit misleading in the sense that I don't think this approach achieves the objectives of this work, and that's ok! I would not say that the GAN "better resolves" the bed topography for example.

Another problem is that it is not straightforward to constrain the model with radar data, and this is not mentioned in the text. The roughness of the bed that is captured (and known) by the radar data along flightlines cannot be preserved. This is an important limitation.

I also did not understand the paragraph line 204-205: why would we use the inferred bed under ice shelves when clearly surface features do not reflect the shape of the bathymetry? It is not because the authors "can" do it that they should do it.

Other than that, the paper is easy to follow and really well written, I only found one typo:

- line 297: care has been taking → taken

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