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Interactive comment on "A high-resolution bedrock map for the Antarctic Peninsula" *by* M. Huss and D. Farinotti

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1 General comments

Ice thickness and bed topography are critical inputs for ice sheet models. The mapping of bed topography remains challenging, especially in the Antarctic Peninsula, where few measurements of ice thickness are available. In this paper, the authors use an approach based on a high-resolution surface topography dataset and simplified ice dynamics to derive a high-resolution (100 m) ice thickness and bed map for the entire Peninsula. They then compare their results against Bedmap2.

If the approach used here raises some questions (see below), this is the best avail-

able bed topography for the Antarctic Peninsula and many interesting conclusion are reached. The manuscript is well written and clear. The approach is presented clearly and in ample detail, and the figures and tables are adequate. I recommend this manuscript for publication with some revisions outlined below.

2 Specific comments

The first issue that I see in the proposed approach is that mass is not conserved. The method is based on mass conservation principles (equation 1, page 1197), but many operations relax this constraint:

1. page 1199 line 23: unrealistic ice thicknesses become h_{max}
2. page 1199 line 26: the ice thickness map is smoothed to remove local noise
3. page 1202 line 21: a "correction map" is superimposed to the modeled ice thickness map in order to better fit OIB data

These procedures will affect the predictability of ice sheet models because they rely on mass conservation to compute changes in ice geometry (free surfaces and/or mass transport).

The second issue is that the misfits between the calculated flow speed and the measured flow speed (relative error of 50%), as well as the OIB data themselves (RMSE = 255 m) are very large. The solution that the authors propose to reduce the error to OIB data is to create a "correction map" that is based on the difference between the calculated thicknesses and the OIB measurements, and to subtract this map from the calculated ice thickness map. It will indeed reduce the mismatch between the model and the measurements, but it sounds like *sweeping the dust under the carpet*. Why are

these misfits so large? Does it come from the fact that only 2 parameters are optimized (f_{RACMO} and A_f) ? Such large values also call into question some of the conclusions: calculated ice thicknesses reach more than 1500 m (page 1205, line 5), is this something that is supported by direct measurements from OIB data (in which case it should be mentioned), otherwise that might as well be an artifact of the model in a region that is not well constrained... p 1206 line 7, the authors claim that they capture "many features of small scale variability", but are they real given the uncertainty in some regions ?

Here is a list of some other minor suggestions:

- page 1193 line 5: spatially distributed → comprehensive coverage ?
- page 1193 line 25: it has not been shown that the resolution provided by Bedmap2 is sufficient for large-scale ice sheet model (and I personally don't think so). I would add "might" to the sentence
- page 1193 line 28: use "projection" rather than "prediction"
- page 1194 line 20: the velocity map from Rignot et al. is available at a resolution of 450 m, how do you interpolate the data on your 100 m resolution grid?
- page 1195 line 18: is the accumulation rate in water equivalent or ice equivalent?
- page 1197 line 7–14: the SMB data is transformed by using an elevation-dependent relationship. Is the total amount to SMB conserved?
- page 1197 line 16: mention the unit of b (kg/m^2/yr, not m/yr)
- page 1197 eq 1: mention that basal melt is neglected
- page 1198 line 1: is the linear decrease of $\partial H/\partial t$ applied to the entire basin or only to fast-moving ice? Thinning is indeed most commonly present on ice streams (e.g. v>50 m/yr), rather than stagnant ice on the sides.

- page 1198 line 6: how do you constrain the ice thickness at the inflow boundary (or on the divides)?
- page 1200 line 2: derivate → derive, or take the derivative
- page 1200 line 16: I don't agree with the statement that using two independent datasets allows to determine *unambiguously* f_{RACMO} and A_f. It is probably true in this case (because these two parameters are assumed to be constant for the entire domain), but this would probably not be true in a more general case.
- page 1200 line 27: I don't really understand the meaning of " flow speeds determined by grounding line dynamics". Do you mean that the Shallow Ice Approximation (from which you derive your simplified model) is not a valid approximation in the vicinity of the Grounding Line?
- page 1203 line 13: add a comma after "Peninsula"
- page 1203 line 23: have you tried to increase/decrease $\partial H/\partial t$ by $\pm$2 m/yr instead of a factor 2?
- page 1205 line 4: add a comma after "According to our data set"
- page 1205 line 10: why don't you use the firn layer depth provided by RACMO? an average density of 870 kg/m^3 sounds a bit low for the thickest regions of the Peninsula.
- page 1208 line 3: what is the agreement in meters (not in per cent)?
- page 1210 line 18: does TC allow to cite submitted papers?
- page 1217 figure 1: could you change the color of the green line to white? We might visualize it better.

- Throughout the text: many commas are missing before “which”

Interactive comment on The Cryosphere Discuss., 8, 1191, 2014.