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The Cryosphere Discussions

Interactive comment on "Refined broad-scale sub-glacial morphology of Aurora Subglacial Basin, East Antarctica derived by an ice-dynamics-based interpolation scheme" *by* J. L. Roberts et al.

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This article presents a new method to reconstruct basal topography of an ice sheet from sparse thickness data. The main improvement over already used methods is that the interpolation scheme is based on glaciological hypothesis and moreover accounts for local characteristics (belonging to the same flowline or having similar thickness factor). The method is applied to a large sector of East Antarctica where measurements were really very sparse. The interesting aspect of this article is that thickness predicted with the new scheme is compared with the new ICECAP measurements and this comparison indicates that this new approach allows a better reconstruction of the basal topography than the previous methods. An important feature revealed by the reconstructed ice thickness map is that the Aurora Subglacial basin is more extended and deeper than previously estimated and that this area could be subject to a marine instability.

Although this article is interesting there are some points that should be better explained or more deeply discussed:

1. The method to calculate ice fluxes from the stream lines seems interesting but must be better explained.

- How exactly is the flux computed, is it on the Eulerian cells or in the Lagrangian frame ?

- How convergence and divergence of the flow lines are taken into account ?

- What is the difference with for instance Testut et al. (2003) method ?

- How are subsampled streamlines in order to have 16 upstream seeds ?

This is the major point to correct. May be an additional figure could help the reader to understand (would be also useful to better understand the stream line interpolation p. 662)

2. The method is rather well described (with the exception of balance fluxes calculation) but there should be deeper discussion about the selection of regions where the dynamical method can be applied, the role of basal sliding, and the difficulty to detect deep gradients, also in relation to the SIA hypothesis.

- In figure 3a, the breakaway from constant slope at high local thickness factor appears around t = 400-500 m 2/5 yr -1/5 but to exclude regions from dynamical interpolation the authors use a limit at t = 600 m 2/5 yr -1/5 . Could this high threshold be an explanation of the relatively bad performance (see comment on figure 5) at high thickness.

- Additionally, based on this figure, could it be possible to add a third case of exclusion by looking a posteriori at the calculated thickness (if the calculatted thickness is higher than 4500 m, use inverse distance cube interpolation) ?

3. The authors obviously made an effort to quantify bias and robustness of the method and this is a point I appreciate in this paper. I still have a few questions:

- Is it possible to use the fact that SIA is not valid at horizontal small scale to quantify the limits of the methods in term of detection of deep gradients ?

- Is it possible to assess the relative role of data points sparsity and SIA hypothesis ? This would require an estimation of sparcity (consistent with equations 2-4).

Detailled comments.

Page 659, equation (1), please give the horizontal scale upon which is calculated the slope. Is it the same as the one used for Lagrangian flow lines ?

Page 659, line 12. It would be better to join figure 1 and 2 to make the comparison easier.

Page 662, line 5 (In streamline interpolation). As mentioned in general comments, a figure could help to understand how are obtained all the streamlines involving p.

p. 666. last paragraph in comparison of regions below sea level both in bedmap and TELVIS. Please give extent in surface rather than in %.

Table 2, it would be easier to understand if the definition of "mega-scale ice thickness range" was also given in the caption.

Figure 4. where are lines R19 and R21 ? Why were these flight lines selected ?

Figure 5, could the authors explain the important number of "outliers points' with calculated ice thickness substancially higher than observation (in the range 3500-4500 of observed thickness). It would be interesting to know where they are located for in-

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stance (I guess they are in red in figure 8a), and if the sparcity of data is higher for those points. Because it occurs in thick regions, could it be related to a different type of base (cold-basal melting) allowing or not sliding (for instance).

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