The Cryosphere Discuss., 9, C524–C527, 2015
www.the-cryosphere-discuss.net/9/C524/2015/

The Cryosphere
Discussions
Open Access

Interactive comment on "Assimilation of Antarctic velocity observations provides evidence for uncharted pinning points" *by* J. J. Fürst et al.

M. Depoorter (Referee)

mathieu.depoorter@gmail.com

Received and published: 22 April 2015

This study is about finding pinning points on Antarctic ice shelves from a modelling inversion of ice geometry and speed. The authors use a shallow shelf approximation version of Elmer/Ice to simultaneously invert for basal friction and ice viscosity. The concept is novel and interesting. The manuscript is well written and provides informations in great details. This study is an interesting modelling exercice highlighting the need for a better sub-ice shelf bathymetry in order to accurately model ice shelf flow. I am not sure however that this methodology is the most effective way of mapping pinning points in Antarctica as measurements from satellite altimetry (ICESat, CryoSat), interferometry (InSAR) or imagery (Landsat, RADARSAT) would be more straightforward and comprehensive. My comments are directed towards the datasets part of the

study. I believe this study would make a nice contribution to the ice shelves modelling community after addressing a few minor issues.

1. General comments

P1468, l 22. This point is about Section 2.4.1 Ice sheet geometry: - It should be stated more clearly why the authors take a multiple approach for assuring floatation. I believe it is because Bedmap2 (Fretwell et al., 2013) ice thickness can be in contradiction with its own mask around the grounding line. - For ice shelves, inverting the thickness from the surface or the basal topography of Bedmap2 does not make sense. Indeed, Bedmap2 ice shelf thickness and basal elevation both stem form an elevation inversion taking into account firn air content and geoid corrections (Griggs and Bamber 2011). - There will however be a positive bias in elevation around the grounding line as Bedmap2 elevation 5 km around the grounding line is an interpolation of two different products, the ice sheet DEM, and the ice shelf DEM (Fretwell et al., 2012). See Griggs and Bamber (2011) to understand the positive bias. The grounding line position of the Bedmap2 mask is a potential source of error here.

P1470, L2-4. The meaning of this sentence is unclear to me: " Therefore, details in this generic density field should not be interpreted in terms of snow/ice transformation."

P1470, L4-8. The value of 15 meters is typical for firn-air content on ice shelves. As the authors make no mention of it, I wander if a firn correction has been applied for thickness inversions U or L. This is substantial correction to make for the thickness inversion from elevation as 15 meters of firn air content translates into roughly 150 meters of ice thickness.

P1473, L1. This point is about Section 3.2 Geometry at flotation: Again this discussion seems to indicate that firn air content hasn't been taken into account. Thickness U or L should not be considered, see earlier comment.

P1473, L7-9. How can case T have thicker ice thicknesses than Bedmap2 thicknesses

when there are the same?

P1474, L25-28. It is unclear to me how you use the observed velocity in the optimisation in terms of grid and how this affects the shear margins of channelized flow.

P1479, L25-27. I don't understand this statement Âń Almost half of the newly identified grounded shelf positions are located within 2 km of grounded parts of the ice sheet Âż. What is the "newly identified grounded shelf"?

P1480, L4. How can a large radius include less points? Also, I am not sure I exactly understand the intended purpose of PIN1, PIN5 and PIN10. It is presumably to deal with multiple grounding lines as provided in Rignot et al. (2011) dataset.

P1480, L2-9. The fact that including pinning points does not improve the mismatch might be a sign of over-fitting. Indeed, if the modelled velocities are too much forced to resemble the observed velocities, then there is no reason to have differences between the runs with and without pinning points. Could you elaborate on this?

P1481, L22. Figure 7 is really too zoomed out. I would zoom in onto individual ice shelves. From this figure, it is very difficult to retrieve anything else that the approximate position of the "un-charted" pinning points.

Figure 8. Location of PPP1-7 should be marked in here so that it is clear where you place the pinning points.

P1482, L11-12. Jugging from the RAMP images in Figure 8, satellite imagery alone seems to be quite effective at spotting pinning points. I believe altimetry data would as well, see also Table 2.

2. Specific comments

P1465, L8. give rise to biases.

P1473, L25. I am not aware of a "Griggs" ice rise in LC.

P1482, L9. Venable ice shelf

P1484, L21. ice shelf front

P1485, L9. Operation IceBridge

3. References

Fretwell, P., et al. (2013), Bedmap2: improved ice bed, surface and thickness datasets for Antarctica, The Cryosphere, 7(1), 375-393.

Griggs, J. A., and J. L. Bamber (2011), Antarctic ice-shelf thickness from satellite radar altimetry, Journal of Glaciology, 57(203), 485-498.

Rignot, E., J. Mouginot, and B. Scheuchl (2011), Antarctic grounding line mapping from differential satellite radar interferometry, Geophys. Res. Lett., 38(10), L10504.

Interactive comment on The Cryosphere Discuss., 9, 1461, 2015.