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Interactive comment on "Two independent methods for mapping the grounding line of an outlet glacier – example from the Astrolabe Glacier, Terre Adélie, Antarctica" *by* E. Le Meur et al.

Anonymous Referee #2

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The manuscript reviews methods for determining the grounding line, and provides field data from the Astrolabe glacier and ice tongue that aim to re-map the grounding line in an adjusted location relative to past determinations.

The paper seems to work very hard to shrink the extent of floating ice on Astrolabe, and it is unclear to me why that is. High densities of the ice column are used. Large areas of very nearly floating ice are excluded; airborne radar is not shown in profile; damped tidal signals are considered grounded ice (Figures 11-13).

Fundamentally, this is a rather thick glacier (500 - 800 m) in a rather narrow fjord (3

to 5 km). Strong effects from the ice flexure, dampening the tidal signal, are to be expected. Moreover, a complex thin water layer beneath much of the lower Astrolabe, with isolated and perhaps partial pinning points, would be expected to strongly modify the tidal signal timing and flexural amplitude.

A firn correction to density is not considered or discussed (perhaps I missed it?). The airborne WISE profiles are not shown.

The MOA-based grounding line for Astrolabe Glacier has been significantly revised since the publication of 2007, using a second MOA mosaic assembled in 2010. This is available from NSIDC. See attached. The new line is similar to the Bindschadler et al 2011 ASAID line.

While it looks like perhaps the western margin of the Astrolabe embayment should be adjusted slightly inward relative to past determinations, there is a lot of complication and subjective selection of interpretation paths in the publication as it stands. While it is a good exercise in several different means of using field data and modeling ice flexure and response, the final result lacks confidence.

It seems clear to me that the kinematic GPS points 1,2,3,and 4 show evidence of floatation.

Please have a look at the attached oblique aerial image. Perhaps this places what we are discussing in plainer view.

P3971 L11 – ', rigid elastic deviations are computed' – rigid versus elastic? the deviations expected between a rigid plate and an elastic one, given the model parameters?

P3971 L12 – change to (?) 'With this solution for the extent of the grounding zone calculated, the estimate derived from the kinematic approach is consistent with the hydrostatic map.'

P3971 L16 – eliminate the first sentence, and add something general to the second sentence to start there.

P3972 L18 – remove 'all the' this migration is more pronounced, or this migration is still more pronounced.

P3972 L26 change to '..,no rigid stress transmission need be considered, allowing for'

P3973 L5 – 5x10-5 Hz —> 'daily' or 'hourly to daily'

P3980 L15-27. The statement regarding the low sensitivity to a change in the ice density assumed pertains only to the fjord wall areas; in the center of the fjord, small changes clearly imply a very large shift in the grounding line location. Why do you assume such high densities for the glacier ice column? I see that several stripe areas on Astrolabe are blue, and therefore dense – but the radar profiles in Figure 5 (QR) show snow layering there. Even a small thickness of firn, and even relatively high-density firn, can change the mean density of the ice layer significantly. For example, a 50m firn layer at 700 kg m-3 mean density would shift the mean density of a 500 m ice layer from 900 to 880, the low end of the values you consider.

P3996 Fig1 - the upper left inset is AVHRR, not MODIS or MOA; lower left should be a 'regional view' not a 'global picture' – and this could be more of a close-up, such as the attached image; can the SPOT (which one? what acquisition date?) image be processed better? somewhat burned out in this view.

P3998 Fig3 - caption needs to be re-written, it is hard to follow. 'Ocean push' – tides. 'elastic rigid flexure', a trio of words that don't really belong together.

P4000 Fig4 - I would make the letter labels bold, and slightly larger in font. Caption - '..in order to constitute the profiles of difference in elevation..' re-state, unclear. 'Drop-off spots' for the GPS - you mean long-term monitoring locations?

P4001 Fig5 - label the profiles with the end points used in Figure 4, to avoid a lot of looking back and forth. Profile C (I and J) is not convincing, see comments above.

P4003 Fig7 - this appears to be the crux of the paper. However, you explore only a very narrow range of densities to determine floatation versus grounding. Even with this

narrow range, a broad area upstream of your preferred grounding line shows characteristics of floatation or near-floatation. Why not a new grounding line that encloses all 880 kg m-3 areas?

P4006 Fig10 - add 'on sea ice near the Astrolabe ice front' in the caption.

P4007 Fig11 - hard to see how you chose to consider kinematic points 1 and 2 as grounded rather than floating here.

The selected densities are quite high, and do not allow for much of a firn layer. Instead of the narrow range in Fig7, you should consider creating a figure that explores the range 700 - 900, in steps of (perhaps) 20 kgm-3.

Interactive comment on The Cryosphere Discuss., 7, 3969, 2013.

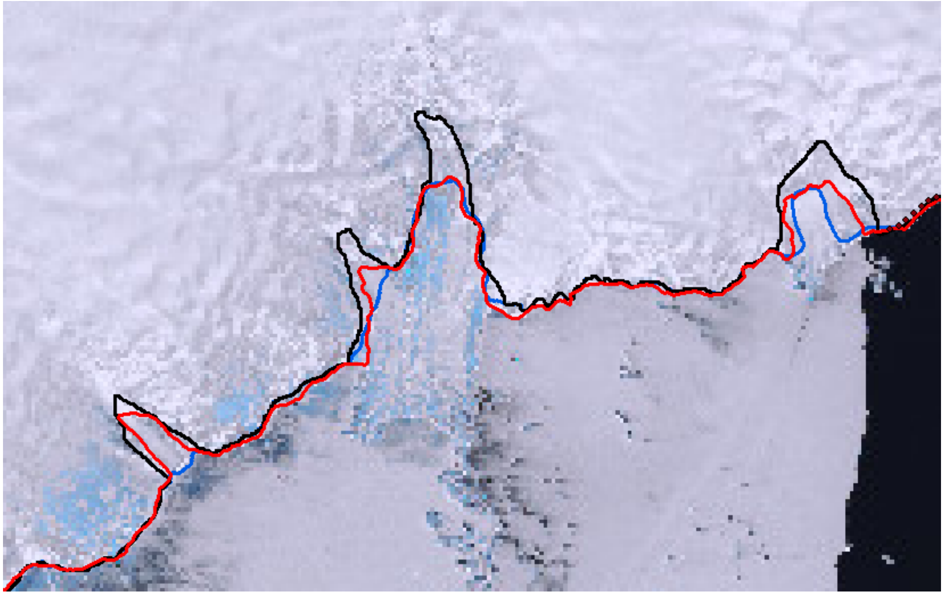

Fig. 1.

Fig. 2.