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The Cryosphere Discussions

Interactive comment on "Speedup and fracturing of George VI Ice Shelf, Antarctic Peninsula" *by* T. O. Holt et al.

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The authors thank Anonymous Referee #2 for the positive and constructive comments on the manuscript; responses to each of these are below.

RC#2: 1) I really like Table 2. I also found that the language throughout the paper, based on this table, was consistent and therefore very easy to follow.

AC: Thank you.

RC#2: 2) I really like Figure 2, but the detail of the entire northern half of the ice shelf is lost at the currently published scale. Perhaps a second inset, similar to the one associated with the South ice front is needed.

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AC: We agree that at the published scale a lot of the detail is lost in Figure 2. We have therefore added a second inset that details the structures at the North ice front.

RC#2: 3) Pg 384, line 9 and Fig 8: The authors use a 200 m mask when examining ICESat data on the ice shelf. The zone of flexure is usually twice that, so the authors may be including non-hydrostatic ice in their surface-elevation-change analysis. This is especially apparent around the Eklund Islands and the western side of DeAtley Island, where it looks like much less than 200 m was masked. At a minimum, a justification of the 200 m length scale is needed.

AC: During the processing stage, the ICESat data were used to subset the ice shelf area believed to be in hydrostatic equilibrium using the dataset of Brunt et al. (2010) (see pg 383 ln 26 to pg 384 ln 2 of the discussion paper). This included the areas around the Eklund Islands and De Atley Island, but the authors agree that some of these measurements remain close to the inferred grounding zone. We have re-evaluated these areas in particular, and recalculated the mean elevation change of tracks 0040 and 0093 accordingly.

Just to clarify the use of the 200 m buffer: This only applies to the surface structures identified (fractures, rifts, longitudinal structures etc), excluding the grounding zone, as this was dealt with separately prior to the buffer being applied. We apply this buffer to the 2003 and 2010 digitised structures to dampen the effect of the horizontal motion of the shelf, and therefore obtain our elevation changes from the 'flattest' parts of the ice shelf. The authors do recognise, however, that there is likely to be some immeasurable residual error in the calculation of surface elevation change between the two acquisitions. We come back to this point below in response to RC#2: 7).

RC#2: 4) Pg 387, lines 10-11 and Fig 6: Is there a typo somewhere? The text refers to '2009' while figure times out at 2007.

AC: Yes, this is meant to read 'ca. 2007' in the main text; the Figure is correct in this case. Typo has been amended.

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RC#2: 5) Pg 387, line 21 and Fig 7: Similar comment as above. The text refers to 2009 and the figure shows 2010. 6) Pg 388, line 1 and Fig 7: Same comment as above. The text refers to 2009 and the figure shows 2010.

AC: Again, these are typos and the text should read 'ca. 2010' in both instances; Figure 7 is correct and the typos have been amended.

RC#2: 7) Section 4.4: Generally, deriving surface-elevation change on ice shelves is difficult (Fricker & Padman, 2012). I am most concerned about the advection of surface features (surface highs and lows that migrate with ice-shelf flow between ICESat campaigns, e.g., crevasses). Can you make any comments about this with respect to your analysis of the Central section of the ice shelf (in Figure 8)?

AC: This has partly been explained above (see authors' response to RC#2: 3) and we acknowledge that obtaining accurate and precise surface elevation changes on ice shelves is difficult. In response to your query regarding Figure 8 and the central section: This area is largely absent of distinct surface features, with the most prominent being the longitudinal structures aligned parallel to flow direction. As a result we have mostly-uninterrupted coverage of this region that shows significant (greater than the uncertainty) thinning across this area, with some locations exhibiting significant thickening, also.

Because of the geometry of GVIIS with respect to ICESat ground tracks, a "true" Lagrangian processing of the data (i.e., propagating footprints down flow based on velocity maps, then calculating elevation changes) would result in very sparse data and therefore the mask around visible surface features is used in an effort to eliminate the issue

We suggest that the greater changes in the central section are a result of greater ice-shelf draft in this region compared to the northern and southern sections, rather than the results being 'more accurate' due to less surface undulation. We feel this is already covered in the manuscript and have therefore not altered anything in the main text, but

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the ice thickness dataset of Griggs and Bamber (2011) has been added to Figure 8 in light of this comment and the Short Comment of T. Scambos.

RC#2: 8) Section 4.5: Perhaps a before and after satellite image, that really demonstrates the grounding zone retreat, might be really nice.

AC: This was considered during the preparation of the discussion paper, but omitted in favour of the change map shown as this documented the grounding line retreat more clearly along the English Coast. It was difficult to produce a clear and coherent image illustrating the grounding line change at an appropriate scale using the 'before and after' images.

RC#2: 9) Pg 391, lines 9-13: I am slightly confused by where exactly the authors are defining as the lee side of the Eklund Islands. Based on Fig 5, my expectation is that the ice-flow lee-side of the islands would be generally to the west. Thus, I expect lower ice-surface elevations on the west side of the islands. However, in Line 12 the authors state that the ice on the (north and) west side is thicker. I think that clarification is needed.

AC: Having reread this section it is apparent that it needs clarifying. The area 'west' of the Eklund Islands refers to the ice shelf between them and De Atley Island (meaning the Eklund Islands as a whole, rather than west of each individual ice rise). Here we are meant to point to the area referred to as SIF2 in Figure 5I. This has been made clearer in the revised paper, and now reads:

"To the north of the Eklund Islands the ice shelf is thicker, but heavily fractured, as it is between the Eklund Islands and De Atley Island."

Interactive comment on The Cryosphere Discuss., 7, 373, 2013.