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The Cryosphere Discussions
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Interactive comment on "Elevated melt causes varied response of Crosson and Dotson Ice Shelves in West Antarctica" *by* David A. Lilien et al.

Anonymous Referee #1

Received and published: 7 February 2018

This paper describes observations of mass budget for the Crosson and Dotson ice shelves in the Amundsen Sea sector of the Antarctic ice Sheet and attempt to provide a narrative for the timing of imbalance and for the succession of events and interaction that led to the current state of imbalance and mass loss of both floating and grounded ice in the region. The paper integrates new and existing observations with modelling in a balanced way in the context of existing literature. The manuscript is well structured, detailed and illustrated. I support the publishing of the manuscript with only minor changes.

General comments:

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I find the title vague and confusing; how varied, what response, and how varied are the elevated melt in the first place. Do you imply here that the same, elevated, melt under both ice shelf induce the various response? From the findings of this paper it does not look to me that this is the case.

Thinning rates used to calculated ice shelf elevation back in time are resolved over spatial resolution of 10's of kilometres; recent work have shown that, at least for Dotson, thinning is highly localised to the grounding lines and on the western margin of the shelf. You should at least address the impact that this might have, or not, on your analysis. You allude to it in section 4.3 but can you be more specific as to where this might be the case?

Specific comments

Page1

L12: Ambiguous, suggests rephrasing. Is what is meant here that the melt under Dotson is dominating the mass loss? Or that the melt under Dotson is driving the mass loss elsewhere? From fig.3 it looks as though the mass loss of Dotson and Crosson are pretty much equal, that the increase in melt rate through he study period is similar, and that one is dominated by loss through basal melt (Dotson) and the other through calving (Crosson).

L17: The preceding line gives an explanation for the observation, but this one does not - what is causing the lack of response of Dotson's velocity?

Page 2

L36: The terminology is indeed varied - Smith West is sharing a drainage basin and an ice shelf with Kholer, shouldn't this then be Kholer East instead as in Mouginot et al., 2014?

Page 3

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L15: Ambiguous, suggest: "No similar changes in extent were observed over Dotson"

L23: "over" -> "under"

L24: "much higher than the surrounding ice" with the exception of the grounding line regions of Smith and Kholer

Page 5

L15: Medley has no sup. Material.

L27: What air thickness is found here and how does this compares with modelled values? There are evidence that firn-air content found using this approach differs from model output, so well worth addressing this here. A map in Supp. Mat. For example.

Page 10

Line 6: The longer dataset also agrees with recent, high-resolution, estimates. Line 10: Reference Shepherd 2010 is missing

Page 11

L2: You might want to compare and contrast the weakening described here with the shelf weakening and impact on speedup of Smith described in goldberg et al (2016, fig 3) - I think it is relevant here as there are similitudes but also new patterns, especially along the Eastern margins.

Page 13

L14: There is also no indication of freeze-on from EO-based basal melt extraction

L35: There seems to be melting occurring at the southern end of this portion of the channel. In fact it looks to me that the effect of the advection is visible along most of the length of the channel (ice flow is transverse to the channel up to about half-way down the shelf) as the locus of melt occupies only a fraction of the entire topographic depression. Then, can other sections of the channel be used to derive timing? How

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would ice divergence influence the time-evolution of this channel's width and depth (e.g. Drews et al., 2016)? How does this timing relate to timings deduced from grounded ice thinning and ice shelf channel formation (e.g. Konrad et al., 2017; Gourmelen et al., 2017)?

Page 16

Line 21: Ok, how does these melt estimates fit in your comparison earlier in this paragraph between melt obtain here and melt rates obtained by Khazendar et al?

Fig. 3: b and c should have the same y-axis range (e.g. [0 50]) caption: steady state (SS) The cross-hatched light grey bar is labelled floating ice in the figure and grounded ice in the caption - should it be floating ice everywhere?

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