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The Cryosphere Discussions

Interactive comment on "Centuries of intense surface melt on Larsen C Ice Shelf" *by* Suzanne Bevan et al.

Anonymous Referee #1

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Review of Bevan et al. A nice study of apparent thick ice layers in a set of ice cores, and the history of the climate and melt frequency on the Larsen C ice shelf that may be inferred from their depth and flow history.

I think the study needs minor revisions. It should not be published as it is (in my view) but a good and serious round of general improvement and attention will make it a good addition.

It seems like a lot of the content comes from earlier papers, so without a thorough look through all of the papers mentioned, it's a potential question as to what is new here. I presume the timing of warm periods and the connecting of the ice-layer indications along the flowline in time and vertical space are the main new contributions.

One fairly apparent question: in Greenland, in areas of moderate to high snow fall and abundant melting, water may percolate several meters, even tens of meters, before accumulating in massive soaked-firn layers called 'aquifers'. If this were happening on the Larsen C, what would this extensive vertical percolation do to your estimates of age and climate trends? Note that this implies that the melting could have occurred significantly downstream of the notional location, as well as later in time. — seems like maybe you are referring to this idea in P7L28-30. I think this can be addressed with a discussion in the Discussion. Refer to recent papers on the Greenland system by Koenig, and Forster.

P1L03 'known to be experience. . .' remove 'be' P1L09 remove currently – this area would always have been impacted by foehn events. . . well, for as long as there have been mountains and westerlies. . .. P1L10 'preconditioning of the ice' that would be 'snow'? P1L11 change to '. . .. that the modern period of melt ponding began.' P1L12 how deep? Can you give a range? And it would also be good to indicate if there was still a density anomaly relative to expected compaction – or was it an ice textural identification? P1L15 'Further south. . .' this sentence has more words than it needs. P1L18 '. . ..we demonstrate that, even by the time. . .' Remove 'even by the time' you demonstrate that at the ice front, the ice shelf is comprised of 40 to 50% meteoric ice. P1L19 This last sentence comes rather 'out of the blue'. I suggest removing it, discussing what you want to say in the main text. You might also remove the preceding sentence as well – its just not clear where you are going here at the end. P2L04 Rott et al., 2002 primarily discusses the speed-up of Drygalski Glacier on the Larsen A, very little on the Larsen B breakup. Rack and Rott, 2004, Annals might be better here. P2L06 please add that cooler temperatures prevail over the ice shelf. Note that its unclear what the -9C limit really means. A summer limit of -2C or similar might make for a better link to the causes of retreat. Note that a -9C annual isotherm limit is unlikely to apply to any other region in Antarctica because of the different continentality of other regions (e.g. Ross, Fimbul) P2L08 Paolo et al., 2015 note a thickening in the most recent decade, when CryoSat-2 data is included. P3L06 – '. . .over the last 600

to 800 years..' explain this number. P7L18 '. . .are limited to the continental or basal accreted. . .' change to 'are only found within' or something similar. When I first read this here, and earlier in the paper, it seemed that you might be saying that the meteoric ice somehow prevented the basal crevasses from penetrating upward.

Table 1 – You should establish a reference year, such as (perhaps) 2015, and adjust your age ranges as needed with respect to that date. You may also wish to add a column of absolute ages on the C.E. scale. (In the future, others may want to relate your ages to layers deep within ice cores drilled in the 2020s or 2030s)

Figures 2 and 3 – please provide more explanation in the captions – what do the colors and numbers mean (binary classification), where exactly in the ice core is the evidence for increased surface ponding/melting episodes?

Figure 4 – what are the gray outlines in the two panels? Is that the ice shelf thickness? What are the units, which axis is active for the gray area? Ok, you have this in Figure 5 but perhaps the grey shaded areas should be removed from Figure 4, they are not used here.

Figure 5 – what is the lime-green section in the upper panel near the grounding line?

Another approach would be to merge Figure 4 and Figure 5 panels into one four-panel figure, and then refer the grey shaded area (which helps one track what is happening where in the vertical dimension of the shelf to the m.a.s.l. axis in the Figure 5 panels. This and your map would be the key figures.

It would be good to have a clearer Figure 2 and 3 as well, perhaps by lightening the gray-scale in the image, perhaps making it a clear-to-dark blue scale instead? With a yellow line and expanded scale (amplified 800 – 910 kg/m3 section) for the density. As it stands, Figure 2 and 3 are your main data, but are not helping the understanding much.

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