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Interactive comment on "Brief Communication: Newly developing rift in Larsen C Ice Shelf presents significant risk to stability" *by* D. Jansen et al.

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The authors have identified a newly-propagating rift in the southern Larsen C using satellite images. The rift, formerly stable with the rift tip lying just inside a suture zone of marine ice, has grown significantly in 2013-2014 as revealed by Landsat images. The authors describe some scenarios for future growth and eventual calving of a major iceberg from the Larsen C, which they show would adjust the strain field significantly.

The paper requires a table of the Landsat images used. There is a significant change in the imagery between Landsat 7 and Landsat 8, but this is not mentioned or discussed. Improved radiometry could lead to a more sensitive detection of the rift tip, and falsely

appear as a rapid growth of the rift. How did they insure that the interpretations were consistent across sensors?

Overall, the authors were understandably eager to get this out in front of the community; to do so, they cut short a lot of descriptive details, a lot of analysis of the actual observations, a lot of details of image processing, tables of images, data points, etc. and a lot of other analyses that are straightforward but time-consuming to do.

Data that might have been brought to bear: MODIS thermal images (identify date ranges of rapid progression of the fracture, and investigate what might have triggered them); TerraSAR images (same goal). IceBridge data (radar for ice thickness and detailed surface topo). Repeat ice velocity mapping. More analysis of past calvings and rift progressions. Oceanographic data (speed of sub-shelf water flow, from moorings within the ice shelf?)

It is likely that the author team is working on some of these things during the review process.

I should probably note a potential deal-breaker for the paper's hypothesis up front: Figure 1 and Figure 2 show a fracture in the same new zone, downstream of the current one, which has been there for some time (see http://nsidc.org/data/ iceshelves_images/ and http://nsidc.org/MMS/moa/ moamap.html). If a rift has occurred in the same area in the past and not continued to propagate further and cause a calving, then the point of this study is a bit moot. Note the many structural similarities between the downstream 'stalled' rift and the new rift. Looking at current maps of flow speed, the downstream rift was in the new rift's position approximately 60 years ago. A check of earlier Landsat images (LIMA, Landsat TM, Landsat MSS) would at least indicate if the downstream rift has been there for decades.

P863 L15 – I think 'medium' is subjective, perhaps just say 'at 250 m pixel scale' (note also that pixels are not equal to resolution, picky point but often forgotten).

P863-864 L26-L1 – ‘minimized by careful control of brightness and contrast’ - - a less subjective approach would be to high-pass filter the data and then match histograms of the image area of the shelf with a reference image. I admit, it’s not likely to change the measurements much, but it sounds better than ‘we turned the knobs’.

P864 – it reads as though the selection of the two calving scenarios was also somewhat subjective. More of a discussion here of past calvings of the Larsen C could strengthen the choice. Icebridge data or surface radar would help justify the image-based picks. For Scenario 2, using the ice front as a guide seems very ad hoc. Since you have a numerical model, is there not some indication of where a fracture might propagate?

P865 L10-11, please give a quantitative speed to go with ‘modestly’. What is the basis for saying ‘previously appeared to resist transverse fractures’? If you mean that the rift tips terminated in the suture zone, this might not be how you want to say it, because ‘previously’ implies that something changed to permit rift propagation. L12, I think a look at more available data might constrain the timing of a rapid jump more accurately. Again, what are the quantitative speeds, or lower limits, for all of the time intervals that rift propagation was mapped?

P865 Numerical model. Did you also look at the present-day stresses with the rift in place (but not broken away)? If this is truly a fracture through the ice sheet, it will significantly alter the stress field on either side – this experiment should be run. This brings up a more general question about rift propagation – as a rift moves across a shelf, the ‘lever arm’ of ice that has been set apart by the fracture grows. Wind and ocean stress should concentrate at the propagating tip, accumulating from a wide area (the area of the future berg). I note also that you don’t cite or discuss Joughin and MacAyeal in regards to rift propagation (2005 GRL). This would be a good one to look at, and would point directly to the importance of repeat velocity mapping near the rift zone.

P866 I think it is clear that there is much more that could be said about the results of

the numerical model. Was there a flow speed change with the new geometries? Does the shear stress present at Bawden Ice Rise change? Is there support for the guess at the calving front for Scenario I or II? What front shape (of several plausible ones) tends to maximize the amount of low, or high, stress-flow ice at the front?

P866 L23 – ‘development of the rift width – a bit awkward, just say ‘spreading rate’? The following sentence is interesting, and related to a thought I had looking at rifts in Figure 1 – the presence of marine ice in a suture can reduce fracture penetration in that zone, but stress leading to fracture might be propagated on the far side of the suture, causing a ‘leap-frog’ fracture. This seems to be the case downstream of the new rift.

Figure 1 – How was the background image produced? It appears to be a shaded relief of the Peninsula (from Alison’s excellent DEM) above the grounding line, and a high-pass filtered MODIS image below that. That is not described.

Figure 2 – I believe the point labeled Dec 2012 should be Dec 2013? I think it would be important to map this progression better and show the January 2014 point and the August 2014 point on the image.

An additional figure showing the rift expansion at the 2011 rift tip point would be interesting as well.

Interactive comment on The Cryosphere Discuss., 9, 861, 2015.