

Interactive comment on “Repeat UAV photogrammetry to assess calving front dynamics at a large outlet glacier draining the Greenland Ice Sheet” by J. C. Ryan et al.

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This is an interesting and timely paper that presents a large amount of practical information on the setup, and implementation of UAV surveys, and their potential for investigating tidewater glaciers. Sections 1-3 of the paper are very strong, and need only minimal correction. However, due to the limited temporal frequency of the 2013 data, Section 4 (on glaciological processes) is not very conclusive. Consequently, this part of the paper is much weaker than the rest, and could be substantially reduced. The paper demonstrates very convincingly the kind of data that can be derived from UAV surveys and its greatest value lies in this alone. The overall impact is actually

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weakened by the attempt to reach wider conclusions about the glaciology.

For example, in section 4.1, the comparison between the UAV-derived velocities and TSX velocity data from other years is inconclusive. Two hypotheses are presented to account for observed differences, but it is not possible to tell which is correct. It would be far better to omit this section, and wait until higher frequency UAV data are available, and present these in a separate paper. Secondly, the conclusion that crevasse patterns reflect drag against the valley walls is not a major insight, and could be omitted without loss to the paper as a whole. Third, the discussion of dynamic thinning invokes measurements of ice acceleration through time, whereas dynamic thinning requires variations in velocity in space. Proper analysis of this important issue will need much more comprehensive data, the current text is inconclusive and of little real value.

However, the data provide do interesting insights into some glaciological processes, especially crevassing, and it is worth retaining the discussion of crevasses in the paper. The observation that the calving events were bounded by pre-existing surface crevasses is interesting, and could be highlighted in the abstract. The data also shed light on the role of water in crevasses, although key issues remain unresolved. The fact that the area of water filled crevasses became lower during the summer suggests that drainage may have occurred, although the crevasses may simply have been advected out of the frame and lost through calving. Surface meltwater in areas without water-filled crevasses must be draining to the bed somehow, and this may weaken the ice by fracturing or cryo-hydrological warming. Thus, even though water filled crevasses are not widespread, water draining into crevasses may play some role in the chain of events that culminate in calving. Although the current data do not allow these issues to be solved, it may be possible to do so in future using the kind of data obtainable by UAV surveys.

I recommend that most of Section 4 is deleted from the paper, and the strongest glaciological conclusions used to boost Section 3. The paper would then have greater focus and impact, without the weaker baggage.

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Some minor points:

2244.12, 2254.6, 2260.2, and 2261.25: 3.5 m m⁻¹? Does the second 'm' stand for month? This is potentially very confusing (especially in the abstract) where it seems the units are 'metres per metre'. Better to present the values as metres per day, and if possible, standardized to ice thickness (e.g. metres per day per metre of ice thickness).
2245.5: TSX - needs to be spelled out.

2246.15: 14 and 30% - what does this mean? What do the two figures refer to?

2246.17, 2247.12-13 and 2247.15-16: the use of hyphens here is incorrect. Hyphens need to be used for compound adjectives, but not verb-adverb combinations. So, breaks-out in 2246.17 should be 'breaks out'; 'lower-level' and 'higher-level' in 2247.12-13 should be 'lower level' and 'higher level'; and 'lower level' and 'higher level' in 2247.15-16 should be 'lower-level' and 'higher-level'.

2254.5 and elsewhere: no need for 'the' in front of dates.

2254.14: '200m wide sector'

2255.1: add 'depth' after 'between 200 and 300m'

2255.5: the glacier was resting on the bottom when the side-scan data were acquired (2010 and/or 2012), but this does not mean it was the case in 2013.

2257.10: are these values averages across the entire front?

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