Author's point-by-point response

Benn: "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."

Ryan: This section has been omitted

Benn: "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."

Ryan: We have removed discussion invoking dynamic thinning as the sole cause of the surface lowering but have raised some questions that could be addressed by further studies.

Benn: "2246.17, 2247.12-13 and 2247.15-16: the use of hyphens here is incorrect."

Ryan: Hyphens now corrected

Pelto: "Not referencing Ahlstrom et al (2013)"

Ryan: We have now referred to Ahlstrom in the discussion regarding the possible causes of surface lowering. Their GPS record is impressive but was located > 8 km upstream of the calving front at Store so the actual applicability of their results to ours is quite limited.

Pelto: "The ablation rate cited here is not compatible with temperatures indicated from any degree day model. You would have ablation of 0.001 m/day. If we use data from Hock (2005) the degree day factors for Greenland range from 6 to 10 mm per degree per day. A few warm days were noted. For example at an average daily temperature of 8 C, this would yield ablation rates of 0.048-0.10 m/day and for 3 C 0.018-0.03 m/day. How does this affect your conclusion about the potential role of ablation."

Ryan: We have now treated ablation much better and used a simple degree-day model to estimate melt in metres per day. Paragraph now reads, "Towards the end of the melt season (23 August), widespread surface lowering of 0.12 m d^{-1} is observed (Fig. 4A). A simple degree-day model shows that part of this lowering can be attributed to ablation. Average daily air temperatures were recorded 4 m a.s.l. at a weather station located near the UAV launch site (Fig. 1) and, using a factor of 6 – 10 mm per degree per day (Hock et al. 2005), surface lowering due to ablation is estimated at 0.038 - 0.064 m d^{-1}. Therefore surface ablation alone cannot account for all the observed thinning."

Nolan: "Section 2.4. Here you have not discussed what is probably your largest error source, which is caused by not knowing when the picture was actually taken."

Ryan: We have addressed this point stating, "Positional errors were due to: 1) the specified limits of the onboard L1 GPS of ± 5.0 metres horizontally and, when combined with the barometric sensor, to a similar accuracy vertically, and 2) the time lag between the camera triggering and actually taking a picture. The time lag was not corrected for in this study and is likely to introduce a few metres of systematic horizontal error for every image. Hence, a secondary stage of processing was carried out which involved 3D co-registration of the DEMs."

Nolan: "Section 2.6. In sorting out accuracy vs precision, can you say whether manually shifting two of the DEMs to match the bedrock improved the comparison? It is unclear here whether you mean your 'conventional' gcp was used here, but was this for manual alignment after DEM creation or to improve DEM creation itself?"

Ryan: We have now explicitly stated that manually shifting the DEMs improved the relative positional errors, "The two-stage procedure outlined in Section 2.4 therefore enabled us to improve the relative positional uncertainties from nearly 15 m to about 1 m."

We have also clarified the statement regarding the conventional GCPs, "For future studies, it is thought that several CPs on the bedrock either side of the glacier front would further reduce these uncertainties." In this study only one was used which explains the confusion of the reviewer.