

This paper uses fluxgate approach and a multi-year series of remotely sensed surface velocities and ice-front positions to estimate the frontal ablation rates, including calving and subaerial and subaqueous melt, for Kronebreen and Kongsbreen in Svalbard. The use of medium and fine resolution SAR data enables year-round velocity and ice-front observations from 2007 to 2013. The study benefits from contemporary airborne radar measurements of ice thickness for Kronebreen. Advantage was taken of an excellent opportunity to compare offset tracked velocities with in-situ GPS measurements on Kronebreen. Mean ablation rates between April 2012 and December 2013 were found to be 0.21-0.25  $\text{Gta}^{-1}$  and 0.14-0.16  $\text{Gta}^{-1}$  for Kronebreen and Kongsbreen, respectively. The authors link variability in flux to the timing and amount of surface melt water production and rainfall. A link is also made between retreat at Kongsbreen and acceleration owing to reduction in backstress.

### General comments

The paper is a well written and important contribution to the evolution of mass balance history for two significant glaciers in Svalbard. There is sufficient background information to place the study in context and the methods appear to have been applied rigorously.

However, there is an over emphasis on the conclusion that the seasonal variation in the ice-flux component of frontal ablation is driven by surface melt and liquid precipitation penetrating to the bed and enhancing lubrication. This is a perfectly reasonable discussion, but more consideration should be paid to other processes which may contribute to the seasonality of frontal ablation. For example, Figures 8 and 12 indicate that the change in ice front position is a significant component of ablation. Why does the front advance and retreat? What causes changes in calving rates? Is it due changes in back pressure of fjord ice, increased subaqueous melt, surface ablation? Possible warming of fjord water is invoked to account for the retreat of Kronebreen in 2011, could this not also be a regular seasonal driver?

A case is also made that retreat causes increases in ice flow (Abstract and Conclusions); it is not possible to verify this from any of the plots. The authors should be more specific about the timescale over which they are suggesting that this process operates, and include long term plots, 2007 to 2014, of frontal positions compared with flow speeds where available. This would also make it easier to visualise changes in 'background' speed, which should be defined at some point.

### Specific comments

Regarding the period between May and September in 2013 with poor coverage of velocity measurement a better estimate of flux across the gate for Kronebreen could be obtained by scaling the preceding or succeeding fluxes by the respective centreline velocities. For Kongsbreen I suggest either leaving the plot blank in this gap or interpolating for the purposes of ablation calculations. For both glaciers the plotting of a flux of zero is clearly not realistic and misleading.

You report a thinning rate for Kongsbreen of 3 m/a. This is significant in terms of the error estimates for glacier thickness therefore you should include it in these estimates.

In section 5.1.1 reference is made to summer speedups in 2009 but no speeds are shown for summer 2009 in Figure 6. This point arises again in the Discussions section.

Also in the Discussions, the idea of warm water entering the fjord in 2011 is proposed to explain the retreat of Kronebreen. What is the evidence for this warming? Why would 2011 be warmer than in other years? Does the glacier retreat at the same time every year? Again, this could be elucidated using a time series plot of frontal positions. Do the earthquakes peak at this time every year or just in 2011?

#### Section 5.1.2

A time series of frontal positions would help this description, similarly for Kongsbreen.

#### Section 5.1.3

A number of different figures are given and it is necessary to refer to Table 5 try to make sense of these figures. Please try and make it clearer in the text, for example, that  $q = 0.21 - 0.25 \text{ Gta}^{-1}$  refers to the two different values of velocity correction factor, and the figures in brackets are the min and max bounds on each of these values, if I understand correctly. When reporting the split between terminus retreat and ice flux you then quote only a single figure? Also include a reference to Table 5.

#### Technical corrections

##### P 6194

Line 18. 'Retreat is an ...' ie delete 'The'.

Line 26. SLE? Have used SLR earlier.

##### P 6195

Line 6. 'at a rate of a few meters'

Line 7. Delete 'it'

Line 11. 'climate basal balance (B)' but SMB was used earlier?

##### P 6197

Line 10 'estimated to be 0.25'

Line 21. 'northern branch ends in a deep fjord'

##### P 6198

Line 6. 'and there is widespread cloud cover during summer'

##### P 6199

Line 16. 'We assume' do you mean this is your estimate based on the SPIRIT DEM?

##### P 6200

Line 14. 'well established' hyphen not necessary.

Line 22. 'erroneous speed estimates' how were these identified?

P 6201

Line 15. It would be helpful to express these displacement accuracies in terms of their impact on velocities.

P 6202

Line 10. 'in the vicinity'

Line 15. Replace 'depth averaged speed' with 'correction factor'.

P 6203

Line 17 replace 'extend' with 'extent' (and P 6204, Line 12).

Line 18. Observation period being 2007-2014?

Line 25. 'December 2007 to December 2013'?

Line 16. Do you mean 'mean frontal ablation rates' not 'total frontal ablation'?

Line 20. 'This period spans an entire year and is therefore unbiased...'

P 6207

Line 21. A summer peak did develop on Kronebreen at this distance from the front, are the elevations the same at this point?

P 6209

Line 5. 'but as the likely...'

Line 26. Specify which glacier.

P 6210

Line 5. No early velocities are shown for Kongsbreen so what does 'typical' refer to?

Line 15. '1990s'

Line 22. 'in contrast to previous years'.

P 6211

Line 8. 'depends on high SAR image resolution and persistent surface conditions.'

P 6212

Line 6. 'have been studied over multiple years'

Line 19. Use 'largest' or 'major' instead of 'vastest'.

Figures

The figures are generally well produced and clear. It would be useful to see a bedrock map including where measurements were obtained and therefore the extent of the interpolation.

As mentioned above, time series plots of frontal positions would be helpful.

In captions and keys be consistent using 'centreline' or 'center line' or 'centre line'.

Figs. 3 and 4. Text on graph axes and in th key is too small. Need a) and b) labels on figure panels.

Fig. 5. Vertical lines marking year boundaries would make seasonal effects clearer.

Fig. 6. As mentioned earlier, the text refers to both PDDs and velocities for 2009 but these are not shown on this plot.

Fig. 7. Use Dec instead of Dez in the key. Mark the location of the inferred pinning point.

Fig. 10 As for Fig. 6.