The Cryosphere Discuss., 5, C167–C173, 2011
www.the-cryosphere-discuss.net/5/C167/2011/

The Cryosphere Discussions

Interactive comment on "Velocity structure, front position changes and calving of the tidewater glacier Kronebreen, Svalbard" *by* M. Sund et al.

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Received and published: 22 March 2011

The intention of this paper is to increase the understanding of the processes important to glacier front positions and calving in Svalbard, which is an area holding a large percentage of surge-type glaciers in combination with tidewater glaciers. This leads to short periods of rapid advance followed by longer periods of stagnation, where the glacier flux is too low to maintain the front position. This is why we found it important to discuss longer-term changes and glacier history in relation to current calving processes in the same setting. It is therefore here that our study adds new insights. We agree that some of the findings of our study are not new in a general context, like the water depth-calving connection and the covariance of day-to-day velocities with certain meteorological parameters. Nevertheless, few of such data have been presented from

Svalbard, especially at the high temporal resolution of our paper. This study therefore complements previous work in other regions whilst also improving the state of the science in an increasingly important research location. Further, Svalbard is subject to significant episodes of intense rain and mild weather, even during mid-winter. These affect the velocities of the glaciers and may also have an influence on the calving. We wish to point out that neither has been discussed beyond a limited degree in previous Svalbard literature.

Since both reviews were rather general with just a few specific comments, we have chosen to give a rather generalized response here. Both referees have commented on the structure and suggested a division into two papers and a need for reorganisation. The structure of the submitted paper (and its relation to the crevasse-depth model), along with the use of a period with detailed data for investigating the crevasse-depth model all resulted from changes recommended prior to submission. However, based on the referees' comments, we now acknowledge that these did not work out and we recognize the need to reorganize and better specify the objectives in a more focused way.

We truly apologize for errors in figure order which differs from the submitted version; this should of course have been corrected by the authors' scrutiny of the page proofs. The order of Fig. 3a and 3 b is inverted so they do not correspond to the text (which should also refer to cumulative "displacements" instead of "velocities"). This is particularly problematic in the current figure 3b. The velocities in Table 1 are also wrong due to changes that we should also have seen when reading the proofs, (see new attachments).

Response to Amundson

First, considering the somewhat vague demarcation of the glacier (mirrored by the large variation in area assumed to belong to this particular outlet (Rolstad and Norland, 2009; Melvold, 1992), where we have followed the border outlined by Liestøl, 1988 we do not

find it adequate to do a length/area comparison in the setting presented here.

Response to Nick

There are three objectives of this paper. Referee F.M. Nick to a large degree only comment on one of them. We acknowledge that the objectives could have been defined better.

1. We take the responsibility and apologize for the errors in figure text. The cumulative displacement (as referred to in body text) shows changes in displacement accumulated over time.

2. We have no data on the water pressure and as the crevasses are mostly water-free this was not considered, but we acknowledge that this situation could have been addressed.

3. The length of the dataset was an interesting point, which we will take into account in our future work. Camera malfunction is the main reason for our inability to present more of these unique observations from the study site. We therefore found it a bit confusing that the referee would like the work to be based on a longer period of data (as well as better data). The presented data are, to our knowledge, all the existing data available for this part of the glacier at this high resolution during this particular year. The first author was responsible for setting out and collecting the cameras used and all usable images have been included in the study by her.

We find it a bit peculiar that so much of the review considers datasets other than those actually presented here. It is also difficult to respond to views about datasets shown in a non-referred presentation. The dataset referred to by the reviewer may be the same as that presented in Mari Svanem's MSc-thesis 2010 from Norwegian University of Life Sciences, which uses image data from Chapuis (and also includes data provided by the lead author of the present paper) to derive velocities for different periods. If so, this dataset holds different temporal (and spatial) resolution and is thus not of a comparable

accuracy or relevance to this paper.

4. We have not claimed to undertake a comparison between water-depth and crevasse depth models precisely due to the differences in the data sets used.

Interactive comment on The Cryosphere Discuss., 5, 41, 2011.

Period	Velocity m d^{-1}	Standard deviation
30 May – 29 August 2008	1.82	< 1 cmd^{-1} (accuracy < 1^%)
29 August – 28 September 2008	2.09	< 1 cmd^{-1} (accuracy < 1^%)
30 May 2008 – 17 May 2009	1.63	< 1 cmd^{-1} (accuracy < 1^%)
28 September 2008 – 17 May 2009	1.48	< 1 cmd^{-1} (accuracy < 1^%)

1

Fig. 1. Table 1

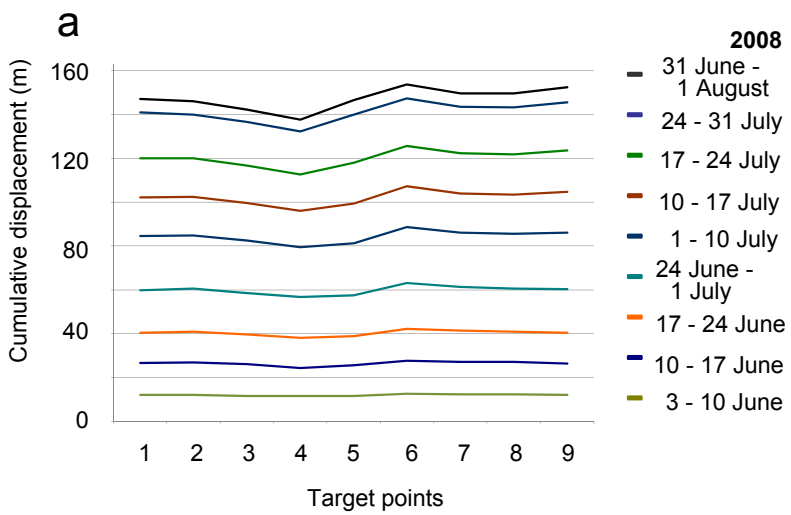

Fig. 2. Fig. 3a

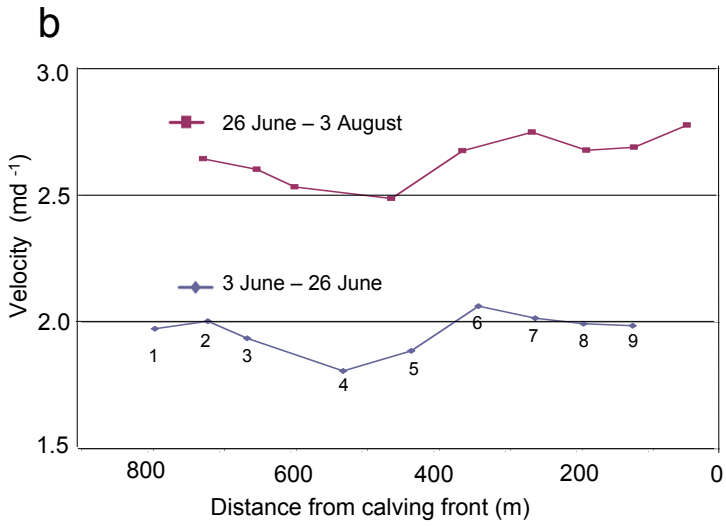
b
3.0
2.5
2.0
1.5
Velocity (md -1)
26 June – 3 August
3 June – 26 June
1
2
3
4
5
6
7
8
9
800
600
400
200
0
Distance from calving front (m)

Fig. 3. Fig. 3b