Answers to the comments of Vanessa Round

Thank you for your comments, which will help us to improve our manuscript. In the following, we will give answers to all major questions and comments. The corrections and comments which are not listed here will be fully adopted in the revised manuscript.

L 6-7: *From the results presented it doesn't seem like there is enough evidence to state that there is similar seasonality during the quiescent phases. As you say in L261, there could potentially be seasonality present during the quiescent phases, but it could not be identified due to the limited accuracy of the Landsat velocity fields.*
Response: We will remove the second part of the sentence starting with 'and, to a much lesser extent …'

L 7: *The choice of the word 'peculiar' suggests to me that the seasonal amplitude during surging is something observed only at Harald Moltke Brae, which is not the case – perhaps 'significant', 'noteworthy', 'interesting' or something along those lines would avoid this potential misunderstanding.*
Response: We used the word 'peculiar' to emphasize that such a high seasonal amplitude with velocities decreasing to the level of the quiescent phases every year has not been observed before at Harald Moltke Brae. However, we agree that another word would be more appropriate here. We suggest replacing the word 'peculiar' by 'remarkable'.

L 26-27 and Figure 1: *It is stated that velocity remained low from the end of 2019 to the beginning of 2020 but from Figure 1 it looks like the low velocities extend to mid/late 2020 although it is hard to see for sure when the last data point is. Could the text be updated to state when (which month) in 2020 the data extends until? It would be interesting to know whether the velocity remained low over the summer 2020.*
Response: The velocity data in Figure 1 extends until July 2020. We will include the exact time period in the Figure caption as follows: "Flow velocity for the time period from January 1998 to July 2020 derived (…)"

L 89: *Is it possible that the Sentinel and TerraSAR-X data can be used to get velocity fields with temporal resolution finer than monthly, given that the time basis and temporal resolution is less than a month? If this is the case, the use of a monthly averaged dataset could mean temporal resolution is being lost. I think that the use of a monthly combined velocity dataset is reasonable, but have you analysed the individual datasets to make sure you are not losing potentially valuable information on a finer temporal scale, particularly around the rapid summer decelerations? When looking at the surge of Kyagar Glacier (doi:10.5194/tc-11-723-2017) we used TerraSAR-X data to compare velocities over consecutive 11 day periods to identify similar rapid summer decelerations.*
Response: Besides the monthly velocities we also computed semi-monthly velocities. In Figure 8, the velocities are shown with a semi-monthly resolution. In view of the sparsely available data before 2013, we decided to show the entire time series from 1998 to 2020 with a resolution of one month, so that it is consistent over the entire time period. Figure 1 contains all available velocities. The time series in Figure 1 and the semi-monthly velocities in Figure 8 show that the major temporal variations are already captured with a monthly time series. Instead of changing the resolution we suggest to include an additional sentence in the paper referring to the Figure 1 and stating that a higher resolution will not change our main conclusions.

Table 1: *Could you provide a specific range of days for the Landsat temporal resolution rather than 'few days'?*
Response: The Landsat velocities were estimated from various different combinations of images. This leads to large variations in the resulting time differences between consecutive velocity fields. We believe that the term 'temporal resolution' might be a bit misleading here. Therefore, we decided to replace this term by 'time difference' in the revised version of the manuscript. We will also add the following note in the caption of the table: 'Time difference denotes the interval between two consecutive velocity fields.' In the Table 1, we will show for Landsat the range from the shortest to the longest time difference (1-16 days), without considering the larger data gaps before 2000 and during winter.

L99: *It states that 4 DEMs are used but only three seem to be referred to – the ActicDEM and two interferometric DEMs from January 2011 and Dec/Jan 2013/2014. Is there something missing, or is the fourth DEM referring to the computed ice-height change rates?*
Response: It is true, that only three DEMs were used in this study. This will be corrected.

Figure 3: *The shading representing the most recent surge seems to cover less than the six years of reported surging. Is there a reason for this or is it an oversight? Additionally, I think it might be clearer to remove the black line joining the observed front position points, to better represent the discontinuous nature of the historical dataset.*
Response: The shading was originally done based on reported glacier surges prior to our study. We agree that marking the entire 6-years period of the last surge would be more appropriate here. Thus, we will extend the shading until the year 2019 which marks the end of the latest surge.

Figure 6: *Is there a reason not to include 2019 or even 2020 in this figure considering that the surge continued through 2019? It would give a more complete picture of this very recent surge if the data extended as far as possible, including termination of the surge in late 2019 or in 2020. I also recommend repeating the description of parameters shown on panels rather than refer back to Figure 4 – this allows Figure 6 to be understood in isolation.*
Response: The main data processing for this study was based on data of the front line until 2018 and climate data until 2017. In Figure 6 we confine the time to the period where the different data (climate data, frontal positions) overlap. In the further progress of our work, we only continued with the analysis of the flow velocity. The continuation of the flow velocity until 2020 is shown in Figure 1.

Figure 7: *The colours in the flow velocity profile plots are difficult to distinguish, especially 2013-09 and 2013-12. Please consider using a range with more contrast in these types of figures (e.g. also Figure 14, 15) or perhaps even different line patterns.*
Response: We will change the color map to rainbow

Figure 8: *The year 2018 is almost impossible to detect in the bottom panel. Could you find a way to make it visible or if it is hidden behind one of the other years perhaps make a note of this in the caption.*
Response: There is no data of the meltwater runoff for 2018 as the used climate data set extends only until 2017. We will add a legend in Figure 8b which does not include 2018 so that it becomes clear that there is no plot for that year.

L 209: *I assume this is referring to a lack of significant year-to-year changes in the lake, however it could be useful to provide a brief description of the seasonal patterns observed (lake formation in summer). In section 4.2 it is noted that large meltwater lakes form at the beginning of summer so it would be useful to make note of that here in the results section*
Response: The statement about the stationary lake will be included in the previous section as 'By contrast, the stationary lake at the northern side of the glacier does not exhibit any significant change visible in the Landsat images'. In addition, we will use the term 'stationary lake' already in the introduction to make the distinction between this lake and the supraglacial meltwater lakes clearer.

Figure 11: *I suggest considering switching the axes in this figure i.e. stacking the years vertically, to make it easier to compare the timing of events between the years (as described from L 206 onwards).*
Response: We agree that switching the axes can improve the readability of this plot. Therefore, we suggest plotting the years below each other so that same months will be vertically aligned and can be better compared. We will use four different colors to distinguish between 'Sea ice', 'Lakes', 'Plume' and 'Calving'. Different color saturations will indicate whether a feature is not visible, moderate or strong.

L 275: *It would be nice to briefly summarise the glacier types 2 and 3 identified by Moon et al. here.*
Response: Short explanations of the types 1, 2 and 3 of Moon will be included in the introduction of the revised manuscript as follows: "Pattern 1 exhibits slow velocities in spring with a rapid acceleration of ice flow in summer and velocities remaining high in autumn. Moon et al. (2014) explain this pattern by the seasonally changed glacier front positions. Pattern 2 is characterized by low velocities over most of the year except for a short-lasting velocity peak in mid summer. Pattern 3 shows already high velocities over several months in spring followed by a rapid deceleration in mid summer and velocities remaining low over the rest of the year. In contrast to pattern 1, the patterns 2 and 3 are assumed to be caused by the seasonally changing meltwater availability (Moon et al., 2014)." In Section 4.2 we will refer to these explanations.

L 282: *The observation of seasonal meltwater lakes was not noted in the results and should perhaps be included in section 3.5 too.*
Response: The following sentence will be added in section 3.5: "Supraglacial lakes always formed in summer followed by the formation of meltwater plumes at the glacier front."

L 307: *Regarding the low velocities at the beginning of 2020 – when is the latest available velocity data, i.e. from which month in 2020 and in particular do they extend into the spring/summer?*
Response: The exact time period for the velocities used in this study (January 1998 to July 2020) will be included in the caption of Figure 1 as well as in the introduction.

L 310: *The summary sentence here seems a bit subjective and also contradicts the statement in the abstract that the most recent surge 'lasted significantly longer' than previously observed surges or the passage from L 74-76. If not in terms of maximum velocity then at least in terms of surge duration the most recent surge does seem (in my subjective opinion) significantly different to at least the two well observed surges before it. The various arguments presented in section 4.3 mostly relate to limitations in the data (e.g. lack of data pre 2013, greater smoothing on velocity maxima in the earlier Landsat data). So in summary, it would be more correct* *to say there is insufficient evidence (historical data) to conclude whether the surge behaviour has changed since 2000.*

Response: Instead of the sentence "In summary, …" starting in line 310 we will include the following sentence after describing the surge behavior of 1999/2000 and 2005/2006 in line 307: "However, in terms of its duration, the most recent surge clearly differs from the surges 1999/2000 and 2005/2006". And as a summary of the surge behavior of 1926-1938 and 1954-1956 the revised paper will include in line 311 the sentence: "There is not enough data to state whether there was a significant change in the surge behavior in 2000."

L 319: *The example of September 2013 doesn't show the moderately higher velocities further upstream which is described for pattern A, but rather seems to show velocity decreases up the glacier. Is it just the high velocity at the terminus which is the defining feature of pattern B?*

Response: To clarify this, we will change the description of pattern B as follows: "In pattern B, the glacier exhibits low flow velocities (<0.5 m/s) over most of its area except for a small part at the front where the velocities exceed 1 m/s."

L 326: *I like this concept of categorising the various flow profles but the difference between C and D isn't very clearly defined – both of these patterns show high velocities with the maximum at the glacier front. Is the difference that with C the velocities high up the glacier are lower and hence the overall profile steeper, or that velocities are higher overall for D? Also it might be helpful to add that while pattern D reverses A, the timescales will be quite different because of the difference in the magnitude of velocity between these two patterns.*

Response: We will clarify this by adding the following explanations in the revised version of the paper: "Close to the glacier front the velocities are high in both cases C and D. The difference is that in pattern C the velocities are still low in the upper part of the glacier. Thus, C involves a much steeper velocity profile and a much faster surface thinning in the lower and the middle part than D. Pattern D reversed pattern A, however, with a difference in magnitude. Thus, the effect of the longer lasting quiescent phase can be compensated by a shorter lasting active phase."