Reply to RC1

We thank the referee for the time and effort spent on reviewing our manuscript. A point-by-point reply (in blue) to each comment is given below.

1 General comments

This study highlights the evolution of the Bowdoin glacier calving style towards buoyant calving. The shift in calving style is exposed through a multi method monitoring using both field based and remotely sensed data.

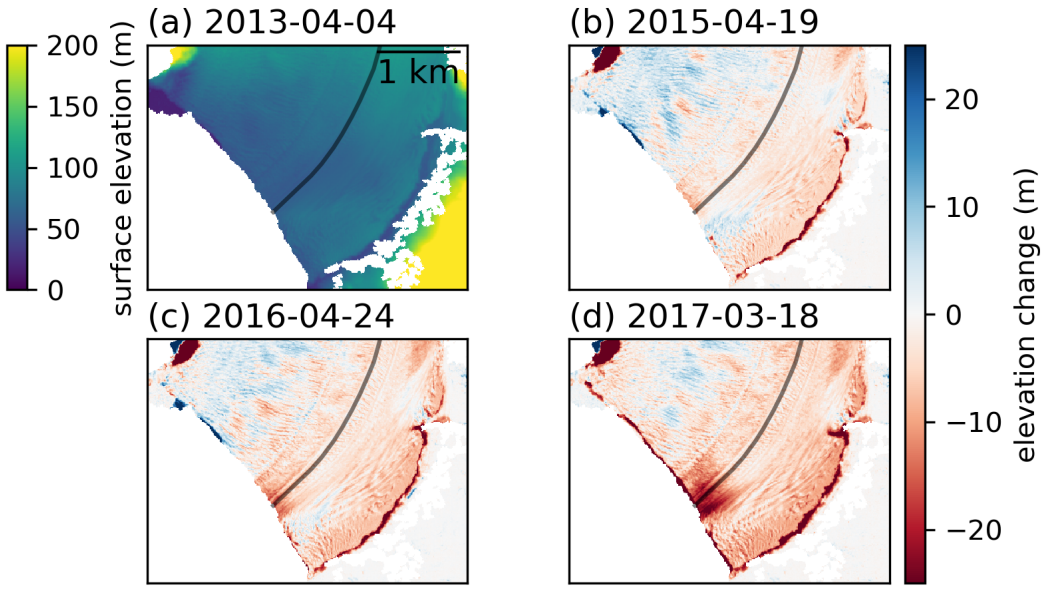
The paper first goes through the different dataset that have been acquired in great details before analysing those results to assess the timing of the ungrounding of the glacier. The analysis is then discussed in term of calving style before concluding on the effect on mass loss that can be measured from space.

This study is clear and well written, I have just a few general comments and some minor points that are listed in Section 2.

Thank you.

In Section 4.1 I don't completely agree with the analyse of the thickness data evolution. From the presented figure it seems to me that the front thickened from 2014 to 2015 before starting to thin, isn't that the case? Did you use a global variable here that shows lowering during 2014?

Thank you for pointing out this ambiguity. Indeed, Fig. 4b suggests that the front thickened from 2014 to 2015, but this is a result of our choice to use the ArcticDEM strip of 2014-09-06 as reference, which is then compared to the ArcticDEMs acquired in March and April 2015 – 2017, such that the winter accumulation results in a thickening between September 2014 and April 2015. Unfortunately, no ArcticDEM is available for March-April in 2014, but we propose to change the reference to the ArcticDEM of 2013-04-04, such that all elevation models are from approximately the same time of the year. This shows that the front is indeed thinning during the entire period.



Regarding the calving quantification, the calving area is reported to the annual discharge which is given in $km^2\ yr^{-1}$ and not $km^3\ yr^{-1}$ as one would expect. I suppose that this is due to the fact that the annual displacement has not been integrating over the ice thickness but that should be stated.
Yes, this is correct, the displacement is only integrated horizontally, not over the ice thickness, which we will state in the revised manuscript.

In Section 5.1 the effect of the tides are analysed to assess the flotation of the ice front. Have you considered to look at the strain measurements in correlation to tides to strengthen this case. It seems that at least on station 1 there is a signal in the strain that looks to be in phase with the tides with a compression regime at high tide. I also wonder if it would not be better to plot the instantaneous values rather than cumulative ones on Figure 8 to help with readability.
Yes, we have tried plotting instantaneous values of strain rather than cumulative, which indeed highlights the tidal modulation of strain with compression at high tide, but it makes it more difficult to see the longer term changes in strain related to the calving events. Therefore we chose to show the cumulative strain instead. We find it difficult to draw conclusions concerning the flotation condition from the compression regime at high tide, because this could also be related to tidal modulation resulting from the water pressure forcing at the ice cliff, not necessarily from buoyant forces below the ice. In that sense, we do not think the observed tidal modulation of strain can be conclusive to support either flotation or grounded conditions for this specific case.

2 Specific comments

Bellow is a list of more specific comments throughout the manuscript given with line and page number:

• Line 19: Projections is missing a capital.
Thanks, we will fix this in the revised manuscript.
• Line 29: I am not sure that I get the meaning of “large-scale” here.
Here, ‘large-scale’ is also meant relative to the glacier size, hence velocity gradients which are present on a large portion of the calving front. In the revised manuscript, we remove ‘large-scale’ from L29 as your comment made us realise that it can be confusing after introducing ‘large-scale calving events’ in the preceding paragraph.
• Line 61: It is the glaciers fronts that advance and retreat depending on the season, not the glaciers themselves.
We will rephrase to ‘most tidewater glacier termini on Greenland advance in winter’
• Line 71: Replacing “the submarine melt rate increases in summer in shallow fjords” by “in the shallower fjords submarine melt rate increases in summer” would make that sentence clearer in my opinion.
Thanks, we will rephrase this.
• Line 75: Shouldn’t King (2020) be added to the IMBIE team (2018) reference here.
Yes, we will add this.
• Line 212: The end of this sentence is a repetition from the one above and could be omitted.
We will omit the last part of line 212.
• Line 230: “9b” should be “9d” twice on this line.
We will fix this.
• Line 231: “9d” should be “9b”.
We will fix this.
• Line 249: Is it annual “ice discharge” that is meant here?
Yes, we will specifically mention this.
• Line 305: “9e” should be “9a”.

We will fix this.
• Line 307: A reference to Fig. 8a should be added.
We will add a reference to 9a (8a concerns the strain, not the elevation mentioned in this sentence).
• Line 309: “8e” should be “8a”.
We will fix this.
• Line 313: A reference to Fig. 8d should be added.
We will add a reference to 9d (8d concerns the strain, not the elevation mentioned in this sentence).
King, M. D., Howat, I. M., Candela, S. G., Noh, M. J., Jeong, S., Noël, B. P. Y.and Negrete, A. 2020. Dynamic ice loss from the greenland ice sheet driven by sustained glacier retreat. Communications Earth & Environment. 10.1038/s43247-020-0001-2
IMBIE team. 2018. Mass balance of the Antarctic Ice Sheet from 1992 to 2017. Nature. 10.1038/s41586-018-0179-y10.1038/s41586-018-0179-y