Response to Anonymous Referee #2

We sincerely thank the reviewer for the insightful and constructive comments and important suggestions. These comments were very helpful for revising and improving our paper. We have endeavored to address all of the comments and to improve the manuscript to the best of our ability. Our point-by-point responses are detailed below.

Comment 1: P2, L55, the authors grouped the state of arts by different spatial resolution, not by the detection method?

Response 1:

Thanks for the comment. In P2, L55, we make a short literature review of the existed calving monitor results. The detection methods of those studies can be classified into three categories, automatic extraction, semi-automatic extraction, and manual extraction. More detailed information on different calving detection methods can be seen in (Qi et al., 2020), in which we introduced the extraction method we used during producing this dataset and also summarized other calving extracting methods. In this manuscript, we grouped the state of arts by different spatial resolution in order to make a comparison between the existed calving monitor results through the dimension of spatial and temporal resolution. Then, we found the gap that there is a lack in the long time series, high spatial resolution, and wide coverage calving dataset. That's why we made such a dataset.

Comment 2: P6, Section 3.2, it's not clear here why August 2005, 2010 and 2015 were used as the input benchmark. According to the descriptions in this section, every year's actual coastline modified from last year's extraction was used as the input of next year.

Response 2:

Thanks for the comment and it's a really good question. Theoretically, every year's actual coastline modified from last year's extraction was used as the input of next year, so we can use only one benchmark coastline to generate the next-yr coastline and iterate this step to get the coastlines of the following years. However, while modifying the simulated coastline derived from the last-yr coastline and ice velocity, we mainly modify the coastline near the calved area to make sure it fit in the actual coastline from the satellite imagery and manually correct the system errors at the regional scale. That means the rest of the simulated coastline where calving did not occur may have systematic errors (introduced by ice velocity product). Here, in order to reduce the error caused by the ice velocity during the iterative calculation of the coastline, we divided 14 consecutive years into three intervals. We used coastlines of 2005, 2010, and 2015 (checked and manually corrected) as the benchmark to control the error of coastline simulation within five years.

Comment 3: P8, L 178, to my knowledge, Bedmap 2 may not provide thickness data in some of the coast areas, how do you deal with such situation.

Response 3:

Thanks for your comment. During the production of the dataset, we also considered this situation. We tried to solve the problem in the following three steps. First, we masked out the ice-shelf zone thickness in Bedmap 2. Second, we extracted the average thickness of each calving event from the masked ice thickness through step 1. Then, we checked the average thickness of all calving events. For missed and abnormal values (results show that they only account for a small proportion of the total), we moved the polygon backward along the ice flow to the calving front where there is thickness data coverage. After that, we re-extracted the average thickness of those calving events to make sure they are given appropriate thickness. Besides, we also used Bedmachine as a supplement and validation.

To reduce misunderstandings among readers, we have added the following description to the manuscript.

3.4.1 Calved area and calved mass

After acquiring vectors of the calved area polygons, we calculated their areas under polar projection. Then, these values were divided into four different scales: small-scale (1-10 km2), medium-scale (10-100 km2), large-scale (100-1,000 km2), and extra-large-scale values (>1,000 km2). We further obtained the average thickness of each calved area from the Antarctic ice thickness products (Bedmap 2 and Bedmachine). First, we masked out the ice-shelf zone thickness in Bedmap 2 and Bedmachine. Second, we extracted the average thickness of each calving event from the masked ice thickness through step 1. Then, we checked the average thickness of all calving events. For missed and abnormal values (results show that they only account for a small proportion of the total), we moved the polygon backward along the ice flow to the calving front where there is thickness data coverage. After that, we re-extracted the average thickness of those calving events to make sure they are given appropriate thickness.

Comment 4: P10, Section 3.3.3, this section is not clear, how to define the center point, the perimeter of a calving area? Line 224-L228, this paragraph is confusing.

Response 4:

Thanks for your question. Each calving event was recorded as a polygon depicting its boundaries. We used the function “Feature to Point” in ArcMap to get the center points of each individual calving polygon. For an input polygon feature, the location of the output point will be determined as the center of gravity (centroid) of the polygon. As for the perimeter of a calving area, we calculated it through the function “Calculate Geometry” in ArcMap. To reduce the confusion about this paragraph, we rewrote section 3.3.3 (now section 3.4.3 in the manuscript) and made the following modifications.

3.4.3 Recurrence interval

Calving recurrence means that a calving event with the same spatial scale reoccurs at the same calving front (Liu et al., 2015), which are usually thought to be part of the natural cycle of advance and retreat of ice shelves. The recurrence interval of a calving event, a measurement of the natural calving cycle, is defined as the year interval between the two recurrence calving events. To acquire this attribute, we performed the following work. First, we get the perimeter of each calving polygon through the function “Calculate Geometry” in ArcMap. Based on that, we calculated the average perimeter of all calving events at the same scale for 15 years. We defined the Buffer radii as half of the average perimeters at different scales rounded upwards to the nearest integer. The specific values used for this dataset are shown in Table 3.

…

After that, we used the function “Feature to Point” in ArcMap to get the center points of each individual calving polygon. For an input polygon, the location of the output point will be determined as its center of gravity. Then, we build buffers for each calving center point based on the radii calculated in the previous steps. For each calving event, we count the number of calving center points with the same scale that falls into its buffer. For buffers that fall into more than two points, the calving recurrence interval is defined as the total number of years (15) divided by the exact number of calving center points falling within. For buffers with only one point, the calving recurrence interval is defined as the greater value of time intervals between these calving events and boundary years (2005 or 2020).

Comment 5: P10, L230, the iceberg calving events were divided into two types, high frequency and low frequency; it seems contradictory with calving frequency (Table 4). Is calving frequency means the number of calving events in every year?

Response 5:

Calving frequency in Table 4 represents "the number of calving events". While the definition of high-frequency calving and low-frequency calving is classified based on its calving recurrence interval.

In the beginning, we divided calving events according to the level of intensity of their occurrence and tried to categorically explore their response to climatic and environmental factors. According to the calving recurrence interval, we classified the annual iceberg calving events into two different types: high-frequency (calving recurrence interval of ≤7 years) and low-frequency calving events (calving recurrence interval of >7years). The longer the recurrence interval is, the less calving that occurs in a given period and the lower the frequency.

After careful consideration, we decided that this classification criterion might be confused and it is not the main nature of this dataset, so we removed it. Also, we have replaced the expression "calving frequency" with "number of calving events" for better understanding

Comment 6: P11, Table 4, please also include the standard deviation for the calving areas.

Response 6: Thank you for your suggestion. We have added the standard deviation for the calving areas in Table 4.

Comment 7: P12, add standard deviation in section 4.2.

Response 7: Thank you for your suggestion. We added the standard deviations of area uncertainty, thickness uncertainty, and mass uncertainty.

Comment 8: The calving events with high uncertainty should be excluded or discussed separately in Section 5.

Response 8: Thank you for your suggestion.

The uncertainty is calculated based on the equations in section 3. The calving events with high uncertainty don't mean their existence is not justified. The uncertainty does not represent the reliability of the calving extraction results, but the reliability of attribute calculation results. For example, the calved area uncertainty is mainly determined by the perimeter of each single calving event. In the case of the same area, a long and narrow calving area has higher uncertainty than a square calving area. Thickness uncertainty is mainly attributed to firn depth correction. The calved mass uncertainty is mainly determined by thickness uncertainty.

In order to ensure the accuracy of calving extraction, we performed manual checking, semi-automatic extraction, and removal of calving events with an area less than 1 km^2. Therefore, we think that the calved area polygons retained in the current dataset are true and reliable.

We also discussed it in Section 6 Discussion. "The calved-area uncertainty of our direct observation (Qi et al., 2020) is dependent on the spatial resolution of the imagery, uncertainty of velocity data, and the perimeter-to-area ratio of the calved area. In the case of the same area, a long and narrow calving area has higher uncertainty than a square calving area. The relatively low-spatial-resolution satellite imagery used in this work and the characteristic of a long and narrow calving area is the main reasons this method is not suitable for high-accuracy calving observation of marine-terminating glaciers."