Journal: TC

Title: Changes in the Area, Thickness, and Volume of the Thwaites "B30" Iceberg Observed by Satellite Altimetry and Imagery

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MS No.: tc-2021-13

MS type: Research article

General comments

The article *"Changes in the Area, Thickness, and Volume of the Thwaites "B30" Iceberg Observed by Satellite Altimetry and Imagery"* presents area, thickness, and volume variations of the iceberg B30 along its lifespan. To get such estimates, the authors rely on different remote sensing products – altimetry from CryoSat-2 and optical and radar imagery from MODIS and Sentinel 1, respectively. The article is, in general, very well written and thorough, and brings new data to iceberg science, a growing field of research. Such data are necessary to better parameterize numerical models that intend to study the role of icebergs in freshwater distribution in the ocean. My most significant comments relate to the author's definition of geolocation, and if this geolocation is indeed worth the extra amount of work given its questionable uncertainties. I conclude that, with a clearer explanation of the methodology and a few corrections, this work will be ready to be published – and will be a welcomed contribution for The Cryosphere.

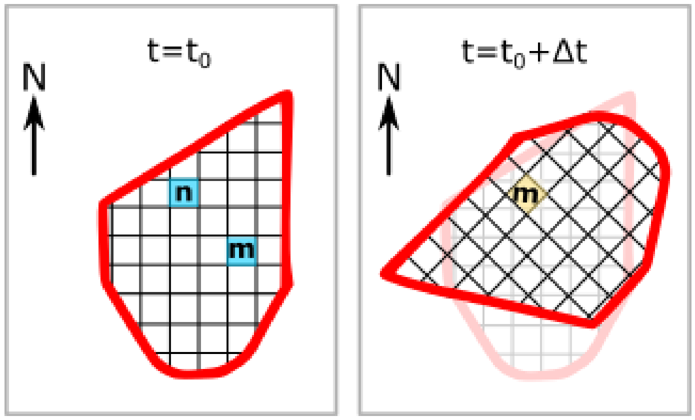
Specific comments

Line 13: What do you mean by "*different modes*"?

Line 15: "*compare this time series to precisely located tracks using the satellite imagery*"

This sentence and the further use of "***geolocation***" in the paper confuses me. I'm not a person that works with remote sensing, but as far as my understanding goes (please correct me if I'm wrong), altimetry data (at least in its final product) should have latitude-longitude information associated with each data point. And, to my mind, geolocation means using some land feature with known coordinates in a non-referenced image to infer the lat-lon points in that image. That wouldn't seem to be a problem with altimetry data. From what I have understood from the paper, by "geolocation" you actually mean being able to tell the orientation of the iceberg, so the points over the iceberg are compared with themselves even when the iceberg has rotated.

E.g.: Say you have points **n** and **m** assigned before calving (t_0); after Δt amount of time drifting, CryoSat-2 measures the height indicated by the yellow "pixel". If you don't know the iceberg's orientation, you could assume the height taken refers to point n (as if the iceberg has not rotated, transparent image in the background. But if you to know the new orientation (by "geolocating" the iceberg using imagery), you see that the height measure actually refers to point m.



Did I understand this correctly? Either way, I think this needs to be clarified on the text. I would say something like "determine the iceberg's orientation" instead of "geolocate" or, in case you really mean geolocate, to explain that altimetry data is not referenced to lat-lon positions.

Line 26: Very nice overview paragraph!

Line 128: *"(ii) using measurements of the semi-major and semi-minor axes provided by the NIC* ***and assuming an elliptical shape*** *and (iii) using measurements of their arc lengths recorded in satellite altimetry* ***and assuming a circular shape****."* Just to be bluntly clear.

Line 176: "*to align all images to a common orientation (Fig. 3)*". From my point of view, the common orientation can be seen in Figure 7a-l, not in Fig.3. Unless you are talking about the altimeter track orientation – if so, please specify.

Figure 3: There is a **Okt** in figure (a) and a **Dez** in figure (c). I'd also indicate which sensor each image is from, which might not be obvious to a person that does not work with satellite data.

Line 237: How exactly are you accounting for the iceberg drift? Have you calculated the distance the iceberg has travelled between the CryoSat and MODIS/Sentinel measurements*? And what does this imply? I assume you look at different locations between altimetry and imagery to find the iceberg (which has drifted between measurements). Or do you take the height measurements from the same points the iceberg is occupying in the imagery, assuming they didn't move but assigning an uncertainty to the drift?

*In model simulations, the icebergs' average speed is 0.14 m/s, which means it would have moved around 500 m in 1h.

Then, you assume that the iceberg has kept the same orientation but account for an error of 15°/day. How do you combine all those uncertainties to get to a final error in the freeboard estimate? Could you include an equation or give more detailed information on the supplementary material?

Although the methodology is, in general, very well described, I'm not sure about this part. And that makes me wonder if using the imagery to infer spatial height variability (assigning the altimetry data to specific points on the iceberg) is worth the trouble. I see that the final variability is reduced when this procedure is done (compared to the averaged freeboard estimate) on line 340, but as you mention, this is probably the case because the iceberg has a "homogeneous thickness", i.e., if you mistake one grid cell for another it is not a big deal. And, if the thickness is homogeneous, then the averaged height along the track (without "geolocation") should be good enough – which indeed is the case, since you mention that the different methodologies' results are in good agreement. So, maybe this "geolocation" is more useful when one is dealing with a non-tabular iceberg, where the thickness from point to point varies a lot and doing simply a freeboard average along the iceberg would lead to the significant loss of spatial information. However, in this case, the uncertainties brought by the time difference between the altimetry and imagery would be much more damaging to final results, since mistaking one point of the iceberg for another would imply much larger errors.

Line 253: I assume by thickness you mean draft + freeboard?

Line 267: Define SWE.

Figure 7: The caption needs to be updated with the subplots' correct letters.
"***m**) mean difference of each new overpass along time.*"
"***a-l**) freeboard difference in each grid cell*"

Also, in a-l, the Δt is indeed always positive? i.e., is the satellite image taken always after the CryoSat overpass? If not, you could differentiate them with a minus sign for images taken before the CryoSat overpass.

Figure 8: (a), (b), (c), and (d) labels missing from plots

Line 376: I'd actually move the reference to Figure 8d to the next sentence:
"*This amounts to 117 ± 38 m of thinning **(Fig 8d)***"

Line 391: Fig 8d actually shows the thickness **differences**

Line 400: "*volume changes due to fragmentation become the dominant source of ice loss towards the end of our survey*". Isn't that funny, though? I'd imagine it is much easier to break a large piece of ice than a small one. And it even somewhat contradicts what was said in line 57: "breakage dominates over melting for large icebergs". Could you offer an explanation, then, why fragmentation becomes more important at the end of this iceberg's life?

Line 406: A relevant reference here is Martin and Adcroft (2010) when talking about bergy bits.

A note about the colormaps used in the figures: although I do enjoy rainbow colormaps, it is good to think about inclusion – namely, colorblind readers. Even for me, the colormap in Figure 1 and 2 could get confusing: it starts with red and finishes with… red. Of course, we infer which color corresponds to which year just by following the progression of the iceberg, but that should be clear from the color scheme as well. The colormap in Figure 4c and 4d is a good one: starts with bright colors, finishes with dark ones. When in doubt, there are resources such as:

https://www.color-blindness.com/coblis-color-blindness-simulator/

where you can upload you figure and see how it looks like for someone with color vision deficiency. Also, I prefer discrete color bars rather than continuous ones, so you can really see what values are attributed to each color. I don't expect you to change all your figures now, but I wanted to throw the idea out there to keep in mind for next publications.

Technical corrections

Line 27: Be mindful of commas. I found them missing from some places, but there could be more around. Here: "*At any time*, *(…)*".

Line 34: Check if there is a space between "*production*" and the following parenthesis.

Line 56: "*iceberg melting*, *to first order*, *(…)*" or rearrange the sentence such as "*found that iceberg melting is proportional to water temperature to first order (…)*".

Line 71: "*also include**d***" – just to be consistent with "*studied*" in line 70.

Line 73: "*employ**ed** altimetry measurements*" – same as above.

Line 125: "*The initial **area***" (also, could you provide the length of the iceberg?)

Line 74: "*Bouhier et al. (2018) analyse**d***" – same as above; plus, that's a long sentence. I'd just split it into 3 shorter ones, one for each citation.

Line 75: "*(…) geolocation. Li et al. (2018) calculate**d***"

Line 76: "*(…) overpasses. Han et al. (2019)*"

Line 78: "*When thickness and area changes are combined, it is possible (…)*"

Line 174: "*CryoSat-2 overflights.*" – the end of this sentence doesn't read well, so you can just remove it.

Line 287: Maybe "less accurate" would sound better than "*more approximate*"

Figure 6: On the caption: "*over time (a) and as scatter plot **(b)**.*"

Line 315: "*larger sections ~~and~~ more rapidly.*"

Line 320: "*In 2018, (…)*"

Line 341: Do you mean Figure 7m instead of 5a?

Line 393: "*To compute changes in mass, we (…)*"

Line 412: "*thickness, and volume (…)*"