The Cryosphere Discussions

The Cryosphere Discuss., referee comment RC2
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Comment on tc-2021-13

Jessica Scheick (Referee)

Referee comment on "Tracking changes in the area, thickness, and volume of the Thwaites tabular iceberg “B30” using satellite altimetry and imagery" by Anne Braakmann-Folgmann et al., The Cryosphere Discuss., https://doi.org/10.5194/tc-2021-13-RC2, 2021

General Comments:

The manuscript tracks Antarctic iceberg B30 using satellite imagery and altimetry observations. The authors utilize these observations to determine changes in iceberg area, freeboard, and volume through the iceberg’s drift from its calving location from the Thwaites Ice Shelf. Their analysis investigates the viability of using semi-automated methods for estimating iceberg area, the importance of geolocation in estimating iceberg freeboard, and the impact of including snow accumulation and snow and ice density variations in computations of ice thickness.

This work contributes to our ability to scale up analyses of iceberg drift and disintegration by quantifying the limitations of some common assumptions and uncertainties of various methods, especially as they relate to semi-automating the analysis. However, it would benefit from a more thorough exploration of these assumptions and discussion of where future work should focus on improvements. A few key areas of focus for improvement prior to publication are:

- Overall clarify and improve the motivations and contextualization within the literature. What is unique about this investigation? The novel contributions of this work (investigating the influence of geolocation on iceberg freeboard estimates; including snow accumulation and density variations in thickness calculations) only become clear towards the end of the manuscript. Many areas of the methodology and discussion are lacking citations and explicit connections between previous results and this investigation (a few specific cases are pointed out in the line comments, below, but this list is not exhaustive). Why did you choose to focus on iceberg B30? What should we take away from this investigation, and how should it inform our future work? What are the critical next steps needed to further this work?
- Clean up precision of language, passive voice, and extraneous phrases (“more recently, for example”). This includes separating run-on sentences and connecting ideas

throughout and between paragraphs (there are a few abrupt transitions and locations where critical information is presented a page or two later than the reader needs the information).

- Closely examine the text for statements that need further quantification, explanation, citation, etc. This is similar to 1 and 2, but refers to particular statements like "While manual delineation provides the most consistent and accurate area estimate" or "boundary detection techniques" or "large" icebergs or iceberg "area" and "thickness". Additional details on your approach, methods, and definitions will convince the reader they agree with your interpretations and make your method reproducible.
- Data and code access. The manuscript does a reasonable job of outlining what computational tools are used but does not provide enough details to make the study reproducible nor indicate where readers can get more information. What software and data versions are you using? What corrections did you apply? Is your code publicly available? Why or why not? Are the iceberg polygons available?

Specific ("line") comments:

Abstract:

p1 Line 15: You're comparing a time series to a geospatial track?

p1 Line 18: geolocation of imagery reduces the uncertainty of what by 1.6 m? Iceberg location? Freeboard?

Introduction:

p2 Line 52: "ice shelf barriers" = "ice shelf fronts"? I think this may be a British/American English difference, since I'd previously only heard this term in reference to Ross Ice Shelf

p2-3 Lines 55-56: be careful not to mix terms: melting and breakage are both forms of mass loss

p3 Line 65: Explicitly state your focus on tabular Antarctic icebergs, versus icebergs generally

p3 Line 83: the studies cited here occurred before the ones cited in the previous sentence…

p3 Line 85: this is an abrupt transition. Also, is your method less labor intensive?

Iceberg location:

p4 Line 103: longer than 6 km in what dimension (their longest? How is this estimated?)

Initial iceberg shape, size and calving position:

p6 Line 126: The initial area may be more appropriately reported in the next subsection.

Iceberg area:

p6 Line 128: please clearly define "iceberg area". I am assuming for the purposes of this review that "area" refers to the two-dimensional, plan-view, non-submerged portion of the iceberg

p6 Line 130: I would like to see some justification for the statement that manual delineation provides the most consistent and accurate area estimates. From my experience, selecting consistent iceberg boundaries manually is non-trivial and can result in multiple "correct" delineations with vastly different areas. The introduction of multiple operators can further increase the spread of possible surface area estimates.

p6 Line 137: Please include which orbital and radiometric corrections you're using.

p6 Line 144: What boundary detection techniques do you use? How do you select any parameters used in these techniques, and how do these affect your area estimates?

p6 Line 146: What "rules" (explicit or implicit) are you using during manual delineation? Shadows cast on the sea ice? Texture differences? How do you handle areas that are "blurry"?

p6 Line 147: What shape kernel do you use for the shrinking and expansion?

p6 Line 148: What is the standard deviation on this mean relative difference?

p7 Line 157: How are the NIC axes determined? If this is done manually (as stated in line 160), then you cannot argue this approach is less time consuming or subject to individual judgement (line 156).

p7 Line 163: Can you compare one of your area estimates to one of the elliptical ones from NIC and combine the area datasets?

p7 Line 166: How are iceberg arc lengths determined from CRYOSat-2 data? Is this an existing product or are you deriving the iceberg arc lengths?

p7 Line 168: Please provide additional information on the "significant variations" in area estimates from your third method.

p8 Line 169: what dimension is the moving mean computed across?

Iceberg orientation:

p8 Line175: is the rotation performed manually or automatically?

Initial iceberg freeboard:

p9 Line 198-201: Were the outliers removed sequentially using the filters described (i.e., were the median and mean filters applied to the range of freeboard heights subsequent to the removal of values outside the 20-60 m range?). Also, with median it is customary to use standard absolute deviation, rather than standard deviation. What criteria were used to select the 20-60 m initial filter, and could similar removal of outliers be accomplished with only one or two median or mean filters?

p9 Line 202: What criteria are used to detect and exclude crevasses?

p9 Line 209: Be aware of using "significantly" without quantification.

Iceberg freeboard change:

p10 Line 220+: It's unclear exactly what filtering is done here to extract icebergs. Is land excluded geospatially, or is it excluded using one of the height filters? It might help the reader to be explicit that you are automatically extracting iceberg freeboards from tracks, motivating the need for multiple filtering steps.

p10 Line 226: The editing steps to remove rugged features and crevasses are not previously described (as such).

p11 Line 248: If you were to compute an iceberg freeboard for the pre-calved iceberg using just one of the tracks used in your compilation, how would that value compare to the mean freeboard calculated using the composite? Making this comparison would be a compelling way to show that your mean along-track freeboard computations can be directly compared to the mean surface height prior to calving as a measure of changes in freeboard.

Iceberg thickness:

The equations presented in this section are described in the text but are not incorporated into it. Instead, they hang between paragraphs. Constants used within the equations should be explained and/or cited.

Results and Discussion:

p16 Line 343-345: The reader could benefit from this information on the variability of freeboards being presented earlier in the manuscript.

Iceberg thickness change:

p17-18: this section presents a lot of critical information but is rather confusing because it switches between negligible and non-negligible influences on iceberg thickness and density. Please revise to flow logically and indicate which processes were considered and which were included in the final calculations.

p18 Line 366: Is the snow density averaged vertically, assuming a uniform horizontal

thickness?

p18 Line 369: where were above-freezing degree hours calculated?

p19 Line 377: Is a linear, annual average the most representative of iceberg processes?

p20 circa Line 385: The authors clearly articulate and demonstrate the importance of including snow accumulation in thickness computations. It would be great to see some further discussion of this. Some potential avenues for exploration include noting over what temporal and/or spatial scales (e.g. when the iceberg is close to the coast) these effects are important, recommendations for when this is a critical component that should be included in estimating iceberg thickness, and or discussing the limits of including snow accumulation but excluding wind scour and other snow removal processes.

Iceberg volume and mass change:

p20 Line 389-390: This line is a great example of a clear, simple statement that provides information about your logic/assumptions and objectives. Awesome!

p20: What are the implications of your assumptions about shape on volume? This is a critical assumption in estimating iceberg volume that has been quantified (to the best of our ability) and discussed in the literature (e.g. Enderlin and Hamilton 2014, Sulak et al 2017, Schild et al 2021, and many others). Your discussion needs to address the assumptions you've made and justify the interpretation on the results accordingly.

p20 Line 407: Do you calculate freshwater flux? If not, why?

Figures (overall):

What uncertainties are shown (two sigma?)

Figure 1: Why is there such a large data gap circa 2018-2019?

Figure 2: It would be helpful to have the icebergs in panel (b) oriented as they are in

panel (a). Is the orientation of all of the depictions in panel (b) with north to the left? What is the influence of outline complexity on area? there is a very clear difference between the level of detail in the iceberg outlines that were manually derived versus the edge detection derived outlines.

Figure 3: Can you really see the iceberg orientation in panel (l)? Also, why doesn't the initial iceberg fully encompass the iceberg depicted in later panels? This suggests to me either the initial iceberg outline needs to be modified or the rotational alignment should be improved.

Figure 4: It's interesting that one of the areas with the largest number of observations is also one of the areas with a comparatively higher standard deviation. Is this a particularly complex or crevassed region?

Figure 5: This figure is immensely helpful for visualizing your workflow. It might be helpful to the reader to isolate some of the filtering steps to illustrate why each one is needed (perhaps as a supplementary figure?).

Figure 7: Why does the difference in freeboard have such a potentially large positive range (it appears there are no values larger than about 7 m)? Plots are mislabeled relative to the caption. What is the shaded region showing? Label the axes in plot n. How do you explain the large variability (specifically the increases in freeboard)?

Grammar:

- Heading titles have inconsistent capitalization
- inconsistent use of Oxford comma
- watch for possessive apostrophes (both missing and extraneous)
- p16 Line 341: there is no (a) in figure 5