Brief Communication: Rapid acceleration of the Brunt Ice Shelf after calving of iceberg A-81

Reviewed by Chad A. Greene of NASA/JPL, Oct 10, 2023

In this Brief Communication, Marsh et al. report on an acceleration in ice shelf velocity that occurred after the January 2023 calving of iceberg A-81. The calving event was significant enough to make news headlines when it occurred, and in this paper, the authors present a straightforward and sound analysis of the resulting ice shelf acceleration. I believe this paper is suitable for publication as a Brief Communication in *The Cryosphere*, but I think the presentation of the conclusions could be strengthened before final publication.

Main Concerns

My main question after reading this paper is, "Why does the calving of iceberg A-81 matter?" The most significant finding mentioned in the abstract is "*potential consequences for the stability of the remaining ice shelf*", but it's not clear what the consequences could be, when we might see them, or how likely they are to happen.

The abstract *tells* us that something may be threatening the stability of Brunt Ice Shelf, but after reading the paper, I feel like I'm missing an intuition for what exactly the threat is and how it might unfold. The closest we get is this passage:

"…we observe new areas of concentrated high strain rates in this area making the remaining ice shelf more vulnerable to external forcing. The future stability of the ice shelf now depends on when, and if, the iceberg keels incorporated within the ice shelf are able to re-establish contact with the bed at the McDonald Bank".

The passage above is at the heart of the main finding of this paper, but the keels are not shown in any figure, there's no diagram of any process that could stabilize or disintegrate the ice shelf, and there's no visual depiction of how close or how far we may be from catastrophic events. The authors *tell* us that the ice shelf may be under threat, but they stop short of *showing* us what that threat looks like and how serious it is. We are missing any sort of quantitative metrics for how bad the new state of vulnerability is and what exactly that will mean for the ice shelf in the future.

The language in the passage above loosely relates high strain rates to ice-shelf weakening, but it feels like the analysis stops just a little bit short of where it needs to be to come to meaningful conclusions about the fate of Brunt Ice Shelf. As a result, the conclusion of *"potential consequences for the stability of the remaining ice shelf"* seems like it's trying to raise alarms for Brunt, yet the wording is too vague to carry any real meaning.

The calving of Iceberg A-81 is a recent event, so a Brief Communication in *The Cryosphere* is a perfect place to report on it. Assuming the authors do not wish to incorporate modeling that would expand the scope of the work to a full Research Article, **I recommend publishing this paper as a Brief Communication after drawing the main conclusions into clearer focus.**

The most straightforward path to clarifying the conclusions of the paper may be found in focusing on why Brunt Ice Shelf matters, then it may be possible to perform some back-of-the-envelope calculations to support a clear conclusion related to that topic. For example, Halley Research Station is mentioned in the manuscript, but that narrative thread is never really followed. Is Halley in danger? Do the authors have any recommendations related to Halley? A Brief Communication would be a perfect place to issue guidance on this matter.

Whether it's the fate of Halley or something else that's chosen to motivate the "plot" of this manuscript, I think it will really help to shape the analysis and conclusions around something that will allow for a clear take-home message.

Minor Comments

L8: "the rate of acceleration increased by a factor of ten" It's not immediately clear what is meant by this statement. On first read, it would be easy to assume the ice was flowing at a constant velocity until the calving of A-81 caused the velocity to increase by a factor of ten. However, this is about *acceleration*, not *velocity*.

If the ice shelf was previously near steady state (constant velocity) then the acceleration would previously be near zero. This puts a near-zero value in the denominator, which makes it easy to get big numbers like a tenfold increase in acceleration. From a glaciological standpoint, I do not know that a change in acceleration has any particular meaning, so if it is in fact meaningful for some reason, that should be stated more clearly.

If I'm reading the time series of Fig 1b correctly, it looks like the velocity in Jan 2023 increased from around 900 m/yr to maybe 930 m/yr, so a ~3% increase in velocity in response to the calving of A-81? If the velocity only increased by a few percent, then the statement that "acceleration increased by a factor of ten" feels inflated for effect, unless there's some greater meaning to this statement that isn't mentioned in the abstract. Please consider rewording to clarify the main findings.

L11: "with potential consequences". Can we bring this statement into clearer focus? Right now, the sentence implies there's a looming threat that something major might be about to happen, but the threat is somewhat vague without a clear description of exactly what might happen, when, or why it's important. One solution may be to split the sentence in two and explicitly stating the main conclusion in the new, second sentence. Something along the lines of "...loss of

contact with the sea floor and has led to high strain rates to the south. We posit that if X happens, Y will happen." Or however the authors wish to tackle this one.

L23-24: The text states, "*Modelling and observations show that ice shelf thinning around Antarctica drives acceleration (Reese et al., 2018), but there are fewer observations of how tabular calving impacts ice shelves because large calving events are rare."*

This sentence may cause a reaction among readers who will naturally think of recent calving events and all the papers that have been written about them. I recommend rewording to make it more of an "and" sentence than a "but" sentence. Something like "previous work has been done (citations), *and* we will build on it…" I don't think it's necessary to mention thinning at all, although there's no particular harm in keeping it.

L103: The final concluding sentence of the paper reads, *"This has implications for other ice shelves where fractures interact with grounded margins or pinning points."*

I'm wanting a stronger concluding statement, both from a stylistic and scientific point of view. Readers are left wondering what's implied in the phrase "has implications for", I recommend rewording to state major conclusions directly and unambiguously.

Figure order: Figure 2 is referenced on line 20, which is before Figure 1 is referenced in the manuscript. It makes sense to reference (the current) Fig 2 first, because it's nice to establish the geographic setting before digging into the details of the time series. I recommend placing the map in Figure 1 and adjusting references to the figure numbers accordingly.

Context map: Right now, the spatial context map does not appear until Fig 3d, but the purpose of the context map is to help orient readers to the location of the study, so it will be most effective in the first figure that shows a map.

Figure 1: The caption mentions Halley Research Station, says it's shown in Fig 2c, but Halley is not labeled in Fig 2c. I recommend either labelling Halley in the map, or not mentioning it in the caption of Fig 1.

Figure 2: The panels of Fig 2 require some active effort on the part of the viewer to piece together what story is being told by all the different parts of the figure. The task is difficult because the eight panels mix and match three different zoom levels of overlapping regions, and it's not immediately clear how the GPS data relates to the other panels in the figure.

Aside from the panel depicting the GPS positions, the figure presents a time series of images, but panels a-b are presented out of order relative to the time series presented in panels d-h, and although the dates of panels d-h are clearly labeled, readers must go searching in the figure caption to find the dates of panels a-b. Interpreting time series is also unintuitive because the march of time zig-zags left and right from panel d through h.

I recommend finding a way to present the panels of Figure 2 in a more linear fashion. One solution may be to combine Figures 1 and 2, to present a time series of images in a line, and tie them directly to events in the velocity timeline. Below is an example from my own paper where I did something similar (https://doi.org/10.5194/tc-12-2869-2018). This example is just one idea, but the authors should feel free to take any approach that might help readers interpret the time-lapse satellite images and link them to the velocity data.