

The Cryosphere Discuss., referee comment RC1  
<https://doi.org/10.5194/tc-2022-16-RC1>, 2022  
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## **Comment on tc-2022-16**

Anonymous Referee #1

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Referee comment on "Ongoing grounding line retreat and fracturing initiated at the Petermann Glacier ice shelf, Greenland, after 2016" by Romain Millan et al., The Cryosphere Discuss., <https://doi.org/10.5194/tc-2022-16-RC1>, 2022

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The authors present an interesting combination of data to visualize the timeline of the Petermann glacier's retreating grounding line, which fits within the scope of TC. The novelty of the research is the long time series of grounding line mapping which has not yet been done on the Petermann glacier. However, the methods used in the study are not very novel and much of the reported findings are a temporal extension of other studies. Based on the findings the conclusion is that the grounding line is retreating following an increase in the ocean water temperature in the nearby Nares Strait. The authors could improve on the clarity of the conclusion by providing a clear timeline of events with an explanation of the causality that precedes them. Additionally the conclusions would carry more weight when an error estimation is provided with each result. Therefore, with some minor revision the paper could be published.

General comment:

As stated earlier a more clear timeline (perhaps even with an actual timeline) would immediately get the message of the paper across. Additionally, considering the signal-to-noise was too low in earlier studies to visualize grounding line migration, a confidence interval has to be provided with the reported findings.

Specific comments:

Abstract:

L22: As a result of the warming or the grounding line retreat? Rückamp et al. (2019) suggest that the speed-up is due to calving. This in turn can be due to an increase of ocean water temperature, but is a bit more complicated (see Shroyer et al. "Seasonal control of Petermann Gletscher ice-shelf melt by the ocean's response to sea-ice cover in Nares Strait," 2017).

L24: change "accentuate" to speed-up/enhance

From L32-45 From the text it seems there is no reason at all to do this study, as everything appears to be stable. Therefore, the reason for this study should be stated more clearly: i.e. "earlier it was not possible to map the grounding line migration, due to a low signal-to-noise ratio. Considering the importance of grounding line migration to glacier stability we now show its evolution and provide additional data to explain its behaviour".

L46-57: This is data/method description and therefore doesn't fit in the introduction. Or if this is new data that now allows you to do this study then mention it shortly.

L59-60: Do you combine these data sources or do you use them separately for two different things?

L61: expand a bit on how you get to those conclusions. Just showing data is not enough, you also need to explain how they are related and what explanatory features they provide.

L109-117: Note that it is not strain, but stress that causes ice shelves to fracture. Strain is

of course related to stress, but ice rheology is an important factor as well. Additionally note that movement of decoupled ice does not suggest high strain rates, but just shows relative movement.

L135: Can you include some form of confidence interval for the estimations of the grounding line retreat?

L163-164: Do you have data or reference supporting this statement?

L187: You state that an increase in flow leads to enhanced thinning which causes the grounding line to retreat. Although there is some truth in that statement it would be better to rephrase it a bit, as grounding line retreat is also related to the fjord topography. When warm water can flow along a retrograde slope the grounding line will retreat much faster than when presented with a prograde slope. Additionally I can imagine a scenario where a reduction in buttressing increases the discharge of the glacier and causes an advancement of the grounding line. One not necessarily follows the other.

L197: Can you explain a bit more about this model, so the reader does not have to read the paper of Rignot et al. (2016)?

L199: Is this  $q_m$  part of a formula? If so, please provide the whole formula.

L200-205: Considering you are an order of magnitude off the observed grounding line retreat, is this a really useful calculation to make? Indeed subglacial water discharge can influence the basal melt rate, but make sure to provide how much this effect can be. Same for pressurized seawater. If these effects can explain the discrepancy between observed and calculated than your argument for making the calculation is a lot stronger.

L218: consider replacing "accentuate" with promote/increase/further

Conclusion:

The conclusion is basically repeating the abstract. Consider leaving it out as it does not add anything to the paper and allows for more space to explain the methods a bit further.

FIG1:

Where is cross section D-D' used? Pane 1c is quite difficult to interpret and doesn't make the situation more clear than 1b. Consider replacing it by an along fjord cross section. Here as well some notion of confidence interval with the visualized data would help.