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The Cryosphere Discussions

Interactive comment on "Dynamic changes in outlet glaciers in northern Greenland from 1948 to 2015" *by* Emily A. Hill et al.

Anonymous Referee #2

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This manuscript presents a large volume of data for several glaciers in N. Greenland to draw conclusions about their dynamic behaviour over a significantly long time period. The data presented are of some value, but I'm afraid that this manuscript suffers a bit from explaining everything without really explaining anything. What I mean is that there is a dizzying array of information about climate, topography, glacier behavior to keep track of but not one factor comes across as being important to explaining the behavior of all glaciers. It's a challenge for the reader to keep track of all of the information and to make sense of what facts are important throughout the text.

The other issue I have is with the categorization of glaciers. There are categories 1) grounded terminus; 2) floating ice tongue and 3) potentially surge-type. Two of these reflect the state of the terminus while the last one reflects the inherent dynamics in-

ferred from terminus behavior. Further, several of Category 3 have (or had) floating tongues, making it a challenge to keep up with the author's thoughts at times. Then, there is a second categorization – based on retreat style: 1) steady retreat; 2) rapid retreat; 3) advance. It's just too much to keep track of. In the conclusions, the authors say that "a key conclusion is that the dynamic response of outlet glaciers to perturbations. . ..depends on their terminus type". However, with such poorly organized material and categorization it's unclear how this conclusion is supported.

In addition, the category of "sustained advance" is completely untrue. These glaciers (shown in 6c) undergo periods of advance AND retreat, in some cases, very rapid retreat, which is a far cry from sustained advance. This type of behavior is typical for glaciers with floating tongues – see MacGregor et al., JGlac 2012 58(209) and other tidewater glaciers – see McNabb et al., JGR-ES 2013 for additional examples of this. I feel as though categorizing these glaciers as "surge type" is a bit "getting off too lightly" – there is likely more to explain here. The authors would benefit from a close read of Steiger et al. (Cryosphere 2017) that suggests pinning points having an impact on glacier terminus positions. Also, the authors should examine the tidewater glacier cycle literature which discusses quite broadly the idea of cyclic glacier changes.

The authors use BedMachine v2, when BedMachine v3 has been released now for a year. v3 represents significant improvements, particularly in the terminus regions because of the addition of bathymetry data from the OMG project. It would be useful to know how the authors determined if the bed data were good or not. Some glaciers were not sufficiently sampled with radar data for the mass-conserving solution and thus, are not well-constrained in BedMachine. Finally, very little information is provided about how the authors calculated bed slopes at the glacier termini and how bed topography is used in general. The mention of pinning points and the comparison between slopes of the beds of glaciers is described with no data presented.

In the discussion, the authors invoke processes such as increased ablation rates, water drainage to the ice bed, and the removal of sea ice to explain the timing of glacier

retreat. However, these correlations are presented as anecdotes, with very little in the way of evidence suggesting cause/effect. They discuss topography as well stating that bed topography is a “key control on the behaviour of glaciers in northern Greenland” but provide very little in the way of evidence for the reader to understand how this conclusion came to be. Bed topography is inherently three-dimensional and so presenting the topography in the small-scale images in the figures is not sufficient evidence for the reader.

Some additional edits are made in-line with the text in the attached pdf, but towards the middle I stopped correcting small things.

Please also note the supplement to this comment:
https://www.the-cryosphere-discuss.net/tc-2018-17/tc-2018-17-RC2-supplement.pdf

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