Review of tc-2021-256: Unravelling the long-term, locally-heterogeneous response of Greenland glaciers observed in archival photography

In this revised manuscript, the authors develop a processing pipeline for archival aerial and satellite images and use these images to create a record of nearly a century of glacier terminus variations in central eastern Greenland. They compare the record of glacier terminus change to climatic datasets (air and sea-surface temperatures and surface mass balance) and some bathymetric data. The results demonstrate substantial heterogeneity in glacier terminus behavior and response to climatic forcings, and the authors suggest that bathymetry may play an important role in pacing glacier retreat.

Processing the archival aerial and satellite imagery is a huge effort and I commend the authors for doing that work to substantially extend the record of glacier change in this region back in time. In addition to that work, I think the main strength of this paper is the exploration of heterogeneous glacier behavior between different glacier types, between neighboring (and climatically similar) glaciers, and through time. As the manuscript has already been through a productive round of review, I have only minor further suggestions for changes before publication.

Comments:

- L61: The "data sparseness" mentioned here is nicely illustrated by Goliber et al. preprint in TC (https://tc.copernicus.org/preprints/tc-2021-311/).
- L260: Clarify that these are mean annual max/min temperatures. I was unclear on this until I saw Figure 7. Also, how are the positive degree days calculated?
- 2.4: First there is a description of manually delineated margins, then a description of centerline positions. Clarify, were both methods used, and what was the purpose of each?
- Figure 5/Table 2: In Table 2, southern glaciers 22-24 have advance/retreat listed in 1966-1985, but that is not shown for these glaciers in Figure 5. Also, L301-302 state that the southern glaciers have no data from 1930-1985, which is contradicted by Table 2.
- Figure 6: It took me several minutes to figure out that the plots in the center were showing the same data as those at the left, but with an extended y-axis to show the full error bars. Please clarify this in the figure caption.
- L437: Specify that warming waters could contribute to the mass loss of *marine-terminating* glaciers (not all glaciers in your study).
- L446/generally: Many studies that have looked at the effect of warming ocean temperatures on glacier behavior have assessed temperatures at depth, not just SST. While your data focus on SST, it would be good to mention this as well.
- L458-460: the items listed here would benefit from supporting citations as there has been much work on all of these topics as pertains to glacier response.
- Figures 8, 9: Use a perceptually uniform colormap for velocities (see https://matplotlib.org/stable/tutorials/colors/colormaps.html for Matplotlib examples; see

doi.org/10.1038/s41467-020-19160-7 for reasoning). Also it appears that the colormap is not discretized although the colorbar is, which makes interpretation more difficult.

- L560-567: I think that you state the importance of bed topography too strongly in the conclusions given the highly speculative nature of your discussion. The reference to Catania et al. (2018) is important, but unlike here, that paper specifically focused on the influence of bed topography on glacier behavior, as have others (e.g. Carr et al., 2015; Felikson et al., 2021).
- Generally, this manuscript would also benefit from introduction/discussion of past studies that have also highlighted heterogeneous glacier behavior.
- There are a number of typographical errors throughout the manuscript. I've listed those that I identified below; please review the manuscript for any further changes.
    - L57: ETRS1 → ERTS1 (may also mention that this mission is now known as Landsat-1 to improve name recognition)
    - L70: utilse → utilize
    - L79: "poorly understudied" is redundant; use "poorly studied" or "understudied"
    - L128 and elsewhere: use CORONA consistently
    - L125: lead → led
    - L189 and L214: ArcticDEM
    - L282 and elsewhere: I think, Bjork → Bjørk (per other references in the manuscript)
    - L297 and L303: terminii → termini
    - L334: temperature remain → temperatures remain
    - L529: it's → its; to just to → just to
    - L568: reagion → region