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Interactive comment on “Record mass loss from Greenland’s best-observed local glacier” by S. H. Mernild et al.

Anonymous Referee #2

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The manuscript “Record mass loss from Greenland’s best-observed local glacier by Mernild and 6 others concerns measurements of mass balance and volume change from a glacier in the proximity of the Greenland ice sheet and in an area where such measurements a few. The authors are to be commended for maintaining and performing such studies. The paper provides some excellent insights into the on-going mass balance and volume changes of smaller glaciers in Greenland. The paper contains much information that deserves publication but only after some short-comings, detailed below have been rectified.

Scope. First, but perhaps not the most vital point, the title of the paper is not providing much information about the major conclusions drawn in the paper, it sounds as a desperate attempt to attract attention. Mittivakkat may be the “best”-observed local glacier

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on Greenland but with very few studies done that does not say much. Record mass loss is of course sensational but such records are an effect of the length of the record, the longer the record the more significant are large aberrations in terms of their meaning. I suggest the paper is provided with a reasonably balanced title that describes the scientific gains provided by the study; compare with your conclusions presented in the abstract. This point also reflects my next main issues with the paper, that it is not providing enough detail.

Structure. The paper suffers from its current organization. It seems to follow the short contribution format of GRL or some similar journal. Since TC does not have such extreme limitations, the paper can and should be expanded to better explain and present the data and their interpretation. The methods and results chapter should be split into three chapters. Methods: present the methods used for new data presented in this study; Results: present the new data introduced in this study; and a general “Mittivakkat Glacier” chapter that presents earlier studies and older published data included in this study. Such a division also provides an additional benefit in that the glacier is properly described and existing data presented for readers. I think that a contour map of the glacier and examples of the mass balance measurement setup would be very welcome additions. Such a map could also include equilibrium lines from different years and other useful information.

Glacier setting and history. I think it would be useful to get a more in-depth description of the climatological setting of the glacier. What are dominant weather patterns for summer and winter? This would provide further insights into how the glacier (which is on the coast of the north Atlantic) is affected by the general circulation. The historical aspects of the glacier are also of interest. There are studies from the 1930s indicating a wide spread retreat of glaciers around the north Atlantic but none are referenced. I think it would be useful to know if there exist late maximum extent moraines, if they are dated and how large the glacier was at the Little Ice Age or whenever the moraines were formed. When discussing record melts and longer-term retreat patterns it is use-

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ful to know what the base line was to which all comparisons are compared. The reason for bringing up this historical perspective is simply the inclusion of older front measurements in the paper, which in my opinion need to be put in some perspective. You have also included the longer temperature anomaly record that dates back to 1900. Therefore, an approximate extent of the max LIA or equivalent extent should be included in the map.

Figures. The paper lacks a figure that shows the glacier in map view with elevation contours and where the local met station and the stake system is shown. Such a figure would greatly improve the understanding of the glacier and the experimental setup. It would also reduce the text describing the stake system. It is also possible to show a measured balance and the location of the ELA.

Specific comments on content:

P. 463, l. 15, you state that GIC can equilibrate to climate changes on time scales of a few decades. This to me seems unsubstantiated. First, I would argue it is too small and it would certainly be a function of the climate in which the glacier is located. You need to provide some references to back up this statement. I also like to see how you justify it for Mittivakkat.

P. 464, l. 23, you state that the observed mass balance is “considered” (by whom?) to be accurate to within ~15%. First, you need to back this up with some hard data or point at some reference where this error estimate is evaluated. In short, the paper completely lacks an error discussion.

P. 464, l. 27-28, you need to be careful about the terminology of equilibrium line and ELA (as implicitly stated in the parenthesis). The equilibrium line is the “set of points on the surface of the glacier where the climatic mass balance is zero at a given moment”; ELA is “the spatially averaged altitude of the equilibrium line” and may be observed in the field but is commonly determined by fitting a curve to the mass balance curve established from measurements. Please correct the text to correctly state what it is

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you refer to. See (and correct) also your def on p. 467, l. 3-4. In addition, you seem to provide elementary definitions for a number of elementary textbook terms such as winter balance and nunatak. I suggest deleting these and as stated above some are not even completely accurate.

P 465, l. 6, “water equivalent” is abbreviated “w.e.”

P. 465, l. 23-24, you state that high winter temperatures would decrease the “cold content of the snow and thereby increase the melt. I think that if you do the calculation you will see that this does not significantly affect the total balance of the glacier and I believe the end result is well within the errors of your measurements. Hence there is an effect but it is not significant unless you can show it is on the order of 15% of the mass balance. Remember the difference in energy content of the latent heat of fusion of liquid to solid water and the heat capacity of ice (snow) of approx. 160:1.

P. 465, l. 26-27, There are many excellent glaciological studies on the effects of albedo on melting so I do not see why you reference Douville et al. In general I find the paper lacking references to glaciological literature where applicable.

P. 466, l. 5, I am curious to see how the measured precipitation correlates with winter balance for the years you have such measurements. I would expect some correlation but not necessarily a strong one. A plot would provide some additional perspective on your discussion of the data.

P. 467, l. 9, you state that Aar is not related to ELA when ablation occurs over the entire glacier but surely you mean “net ablation” or negative mass balance over the entire glacier?

In summary, I think the manuscript delivers interesting data and observations from a glacier in an area where few such measurements are made. The study thus fills an important gap. The manuscript is however, lacking in details and contains several weaknesses that need to be resolved. It needs to be expanded and reorganized.

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