The Cryosphere Discuss.,
https://doi.org/10.5194/tc-2017-138-RC2, 2017

The Cryosphere Discussions
Open Access
EGU

Interactive comment on "Extreme temperature events on Greenland in observations and the MAR regional climate model" *by* Amber A. Leeson et al.

Anonymous Referee #2

Received and published: 8 September 2017

This paper investigates the ability of MAR, a widely used regional climate and Greenland ice sheet surface mass balance model, to simulate extreme near surface temperatures. To this end, MAR outputs are compared with data from a network of automatic weather stations known as GC-Net. It is found that MAR can capture the frequency and duration of extreme temperature events, but underestimates the absolute values of extreme temperature events. Furthermore, the impacts of the underestimated extreme events on Greenland ice sheet melt energy is assessed and translate to between 16-40% underestimation of melt energy.

This paper presents a fascinating and important topic. The idea to compare GC-net stations with MAR simulations to examine extreme temperatures is great. The text is easy to read, but some figures are difficult to interpret and are missing basic information

Printer-friendly version

Discussion paper

such as units and scales. There are some additional issues with the analysis and methods in the manuscript as outlined below. With some more work this paper could be an important contribution to better understanding the Greenland ice sheet in a changing climate.

==========

Major comments

==========

1. Using the GC net stations as representative samples of ablation, percolation and dry snow zone is problematic. Rather than being representative of a zone, they can be considered representative for a geographic region of varying sizes. The three stations from the ablation zone are in close proximity of each other on the west coast. All percolation zone stations are in the south, all dry snow zone stations are in the north. Some more rigorous analysis is needed before these stations can be assumed representative of the three regions if at all. I suggest another approach that focuses on model and station comparison rather that generalizing over the three zone. If the authors want to generalize about the three zone a more rigorous analysis of the representability of the stations for each of the zones are needed.

2. Provide information about time span in addition to time series length for each of the GCnet stations and discuss implications of varying time series length and time period span on the extreme value statistics.

3. The analysis of melt energy and extreme temperature events needs some work because extreme temperatures at several of the stations appear to not be associated with melting at all (i.e. Figure 1).

4. A clear presentation of the analysis behind the conclusions that MAR simulates duration of extreme temperature events but not frequency or magnitude of those events are not well supported with figures and tables. It seems that Figure 2 and 4 are indented for

this purpose, but they are not clear (see more comments on the figure design below).

5. The analysis discussed in lines L242 to L248 belongs in the result section and needs some more elaboration to be convincing. First, a figure showing the amount of melt energy during extreme versus average conditions would be really nice to see. Second, you have to address the fact that some stations have extreme temperatures that are not above freezing and therefore no PDDs.

==========

Minor comments

==========

L14: Clarify that you are examining extreme positive temperature anomalies (as opposed to positive and negative)

L92: Clarify what MAR grid cell elevation that lower than the AWS, e.g. the center point?

L105: Explain PDD, the concept may not be widely known outside glaciologist circles.

L108: Provide more background for equation 1. Typically PDD are a function of mean daily temperatures and a temperature to melt conversion factor.

L135: Please write more about Figure 2. It is difficult to interest and draw conclusions from it beyond that MAR data are colder than GC-net station data.

L140-149: Is this data shown in figures or tables? If so clarify how, if not considering adding a figure to clearly illustrate these findings.

L154: Remove the gaps from the total count of data points to give an accurate count of the number of years with data (in table 1).

L170: Explain “raw Era-interim” and how it is different form “Era-interim”

L180: Provide units for PDD here and elsewhere

Figure 1: Show the spatial distribution of the ablation, percolation and accumulation zones

Figure 2: This figure needs work. First, a scale is needed to be able to interpret the height and width of the boxes. Second, it is unclear why the bars are centered in each box. Third, units on the colorbar are needed. Forth, five shades of blue are displayed in the figure, extend the colorbar to capture the darkest blue. Finally, the figure captions says that the figure shows model results, but the colorbar text says it is showing deviations from observations.

Figure 3. Clarify the meaning of the black dotted line. Add units to each axis. It would be useful to also show the RMSE in the plots.

Figure 4. Same comments as Figure 3.

Figure 5: Add units to x-axes

Table 3: Explain the "nyrs" variable. Clarify what spatial domain the data values are calculated for.

Table 4: Provide units for PDD.

Interactive comment on The Cryosphere Discuss., https://doi.org/10.5194/tc-2017-138, 2017.