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Discussions

Interactive comment on "Unprecedented atmospheric conditions (1948–2019) drive the 2019 exceptional melting season over the Greenland ice sheet" *by* Marco Tedesco and Xavier Fettweis

Anonymous Referee #1

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This paper focuses on the atmospheric conditions in summer 2019 over Greenland that led to record or close-to-record values of SMB, runoff and snowfall. The topic is of great contemporary interest as these extreme melt events greatly impact the mass balance of Greenland and thus sea level rise. The authors are the first to present this kind of data for the year 2019.

Overall, I highly appreciate the rapid investigation of this recent event. The paper is well written but some small parts in the result section need clarification (see comments). The authors show very well the exceptional character of the 2019 melt season for

different properties (runoff, SMB, melt extent, etc).

However, as the authors write themselves, that anticyclonic conditions increase SMB loss is known so a more detailed comparison to the 2012 melt season and the melt seasons in general to post 1990 would improve this paper and add to our scientific understanding. Possibly there can be drawn some more conclusions.

Main comment:

For instance (see comments below): How does Figure 10 differ in the case for 2012, JJA or averaged post 1990, JJA. This anticyclone on the west of Greenland seems to be typically for the time post 1990, (Fig, 4 Noël et al., Sci. Adv. 2019) also prominent in the year 2012 (Tedesco, 2013). Noel et al. describe similar changes in cloud anomaly for the post 1990 as the authors did for the 2019 event. How does the 2019 event compare to that. Is it "just" more persistent or does it differ in position? How to the year 2012? The authors write that persistence was a major driver in 2019, so a comparison to the persistence of the other years would be beneficial (e.g. Plot of a timeline). Can we see a general trend in persistence there? How persistent was 2012?

Minor comments:

P3, L 92. What do you mean by that: The overall integrity of the long- term GBI time series is ensured by using homogeneity adjustments (Hanna et al. 2016). Please explain in the text.

P4, L l00. Since you refer to Fig2a, could you please either mention the day number in brackets for the dates in the text or change the axis label to actual dates.

P4, L100-102. Maybe make 2 sentences of this one? The explanation in the brackets is too lengthy and reduces the readability. And how do you come to the statements that the MI ranked 2nd . From Figure 2b red line it doesn't look like that. Or isn't it showing the MI? Please clarify.

P4, L 102-103. How do you see that? From Figure 2b I can only see the seasonal

value.

P4, L 108-110. I think the phrasing is a bit confusing and I needed to read the sentence several times. So are you saying that end of July 73% of the ice surface were melted and the following two days the remaining ∼ 23%? What do you mean by the same atmospheric conditions? Is the anticyclone moving or are the feedbacks increasing the melt area? Please clarify.

P4, L 111 -113. Please make a reference here.

P4. L113-114. You write the air masses in 2019 came from the east. For completeness, can you please add, where did the air masses in 2012 come from?

P4, L115-118. Interesting, but, -since it is in the result section- do you have the data or Figures showing that?

P6, L177- P7, L135. You say that persistence was a major driver in 2019.Was is more than in 2012? I like your definition of persistence showing a time line for 1948-2019 would be interesting. Can we see a trend?

Also how does Figure 10 differ in the case for 2012 or post 1990 JJA. This anticyclone on the west of Greenland seems to be typically for the time post 1990, (Fig, 4 Noël et al., Sci. Adv. 2019) also prominent in the year 2012 (Tedesco, 2013). It would be nice to see how the position of the anticyclone differs in respect to post 1990 or 2012.

Is it possible to check, whether the occurrence of any of the 28 classes correlated with the GBI anomaly or the SMB anomaly? Could you identify any significant trend?

Figures:

Fig 3a: Maybe put " ≤ 5" on the color bar, otherwise the reader might get the impression there are only 5 melting days.

Fig 14a: Could you please add a grid, otherwise the reader gets lost when searching for a specific class in a specific year.

C3

Typos:

P3, L l76. "." after "("

P3, L l77. check "); ."

P6, L167. Something went wrong in the sentence order.

References:

Noël et al., Rapid ablation zone expansion amplifies north Greenland mass loss, Science Advances, 5, doi: 10.1126/sciadv.aaw0123