The Cryosphere Discuss.,
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The Cryosphere Discussions

Interactive comment on "Energetics of Surface Melt in West Antarctica" *by* Madison L. Ghiz et al.

Anonymous Referee #3

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General comments:

This paper presents a very interesting piece of work. It is innovating and brings together existing technologies. The methods are clear and the analysis is thorough. The paper applies the method of Scott et al. 2019 to identify large-scale meteorological drivers of surface melt to classify melt events at three locations. The mechanisms are thermal blanketing, all wave radiative enhancement and föhn effect. The satellite PMW technique reveals brightness temperature that enable to detect surface melt based on the mean base temperature of the last season exceeded by 30K developed and refined previously.This is complemented by SEB budget from ERA 5. Finally the LWP and IWP are used to infer the presence and type of clouds. This paper classify events to three mechanisms with a future aim to predict future atmospheric stress on Antarctic ice shelves. Some of the sensor suffer from known bias and the distinction between the different mechanisms is not always straightforward, which leads to inconclusive re-

sults. None of the cases is clearly classified and some are mixed type of events, which prohibits a long term forecast of the type and frequency of surface melt.

Overall, the paper is good but I have experienced difficulties to grasp the importance of the biases as they are not explained but only a reference is given. Could you quickly explain the biases/known issues of the sensors... for the readers unaware of the literature? The paper lacks a bit of precision in the terms used, as well as consistency. Then, the structure of the results and discussion part could be improved for an easier and more straightforward read. Specifically, I think that a map of the locations with air masses direction superimposed could help. Then, consider grouping the cases by location or by driving mechanism, or by temporal period? In its current state, the results and discussion section is very lengthy and repetitive and it is difficult to have the results emerge. Finally, I think that you could split the results and discussion section in two separate sections. That would allow for clarity as you could describe the events individually and then discuss them in relation to the others and in light of the different mechanisms in the discussion section.

Specific comments:

P2 L40-43 : you talk about surface melt then end with tropospheric warming but there is no link established between the warming and the surface melting.

P2 L70: could you give a magnitude instead? (e.g. a magnitude x times smaller than...)

P3 L73: what do you mean with "the SEB does not close" and in general, this paragraph could be rephrased: explaining eq 1, then what a positive or negative ME entails, then mentioning SH and LH, then G (currently SH is mentioned, then G then SH again).

P3 L86: can you rephrase "at some point during the episode" ?

P4 L104-106: please rephrase

P4 L109-110: either leave this out or comment on the link with what you are studying

P4 L112-119: link your description of föhn winds to surface melt. (e.g. brings a large positive turbulent flux input to the surface, great enough to initiate surface melt)

P4 L124-129: this is great but is never exploited afterwards, mention this also in your conclusion

P5 L146: Add a general map of Antarctica with an inset indicating your location. Add meridians and parallels of reference. Also, delimit the areas of study (the pixels used for each of the regions for instance)

P5 L146-147: The Pine Island and Thwaites Glacier region presents the greatest concern for the West Antarctic Ice Sheet : please support with a reference

P7 L180: please rephrase, it is not clear whether ERA5 or the AWARE data is over/underestimating

P7 L183: what are "ERA5 cloud microphysical discrepancies" and how they can impact a ME time series? please rephrase

P7 L205: why do you change location

P7 L208: please expand the sentence on errors: what are these errors, what cause them and of what magnitude are they?

P8 L222: please support this with a reference

P11 onwards: I suggest you group together by area of study, per month or per driving mechanism or per area as this section is long and tedious to read. A second suggestion is to separate the results from the discussion, having the melt occurrence in the results and the determination of the mechanism in the discussion

P11 L244-249: a map or adding these locations to Fig1 could help here

P11 L249: what is the Bennartz and al. thin cloud range? could you give numbers or a short explanation?

P11 L251: what is "satellite melt"? change to " surface melt detected by the satellite"

P11 L252: begins in some of the region: can you be more precise

P11 L254: can you please explain your sampling method: how fare away are these cells from the others?

P11 L255 + 262: what is a "recovery"? what/whose recovery?

P11 L259: if worth mentioning, also worth giving a possible explanation why?

P11 L264-268: there is no real description of the figure, but a direct jump to explanations

P11 L272 can you please quickly explain what Silber et al defines as unrealistic?

P15 L306-310 not all the locations mentioned here are indicated on Figure1, it would be nice to have a visual illustration of this paragraph or add the locations on Figure 1

P19 L351: refer to case 3.2 explicitly (or merge the discussion of the two cases together)

P19 L354: you mention the "dry snow range", can you quickly explain what this means, and do the same for the "dry surface range" mentioned on P15 L315?

P19 L359-361: There are no plots of spatial variability of the melt components, what are you referring to? I do not understand this sentence: are you describing Figure 12 (no spatial component)? then consider adding the figure number explicitly. And what are the three regions considered here?

P19 L363: what does "At this location" refer to? Pine Island or Thwaites Glacier? or both?

P19 L377: do you have a reference for the difficulties for phase discrimination by MODIS?

P19 L447: The Amundsen-Bellingshausen Sea region could be added in Fig 1, same

for the Amundsen sea embayment P28 L459: why "new" SW flux?

P35 Fig 24 : why not plot both stations on the same graph? and maybe also ERA5 (Figure 21) for the near surface wind speed. that would allow for a direct comparison of the two datasets

P32 L521: I could not find a Figure of ERA5 2m surface temperature that you mention. Consider adding it and plotting AWS data and ERA5 on the same graph for near surface wind speed and temperature (see previous comment)

P34 L548- P36 L560: consider grouping the events by mechanism rather than event/date

P36 L566 to P37 L586: this looks to me more a discussion than a conclusion paragraph

P37 L594-595: I do not understand this sentence: "the number of melt events is a reasonal [...] number for this type of analysis": what are you trying to express?

Technical corrections:

P1 L31: no need to add the MISI acronym you do not use it subsequently

P3 L85: "of an episode"

P7 L185: please rephrase "except often"

P7 L202: Replace "so we examine" by "we therefore examine" or "So, we examine"

P7 L206: remove the "," between melt and event

P8 Fig 2: please rephrase the legend, it is a time-series comparison between two datasets

P8 L217: "if cloud microphysics are" or "the cloud microphysics scheme is"

P11 L261: consider changing "region of interest" by "period of interest/investigated" as region is spatial, not temporal

P11 L263: add a "." at the end of your sentence (Figure6a)

P11 L263: is Figure 4b meant to be Figure 6b?

From page 13 on, there are no a) b) c) in the figures any more

P19 L356: "Figure 9b": do you mean "Figure 11b"?

P19 L369: consider replacing "the result" by "this induces a ..."

P28 L466+467: "freezing point"

P28 L474: "may be overestimated"

P28 L480: remove one of the mentions to "Figure 10"

P30 L502: "increased by nearly 10K"

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