

***Interactive comment on* “Satellite Observations of Snowfall Regimes over the Greenland Ice Sheet” by Elin A. McIlhattan et al.**

Anonymous Referee #1

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major comments...

At the highest level, the article would benefit by being shortened, streamlined to emphasize whatever new it brings, avoid re-stating what is already well known, condense text where possible. I have pointed out some novelties I recommend get more emphasis.

The main value of the study is to "look beyond Summit station", so please 1.) streamline the Summit text 2.) add more discussion emphasis to other regions that goes beyond synoptic climatology (discussion of obvious and already documented precipitation being associated with troughs)... There has to be something about the satellite perspective that brings much more than synoptic climatology does; for example, why not use a heavy precipitation event case to make some new points?

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I don't entirely agree with the statement "Snowfall accumulation is the only significant, positive term in the surface mass balance of the GIS" ... surface water vapor deposition can be, as Box and Steffen (2001) abstract: "At high-elevation sites; the annual water vapor flux is positive, up to $+32 \pm 9$ mm at the North Greenland Ice core Project (NGRIP) and $+6 \pm 2$ mm at Summit." or above 25 mm near Summit which is roughly 10% of the accumulation rate (see Fig. 6.2 Level method). ... so the issue of the remote sensing technique not observing? water vapor deposition needs some treatment in this study if not just clear recognition water vapor deposition is one of the underestimates of precipitation. similarly, I am not that comfortable with "evaporation over the snow- and ice-covered regions of the Arctic is negligible"... the issue of how much moisture is recycled from daytime sublimation and nighttime deposition deserves at least some mention.

Move discussion text (for example page 17 lines 3-22) out of conclusions section. In conclusion section, limit text to what new this study finds, little more please. How to accomplish is to make a list of new insights in this section, simple as that!

By the way, I think you probably agree, it would be helpful to have all the fancy equipment lower on the ice sheet, for example, near DYE-2 and much closer to the airport! You're welcome to pass my comment to your science foundation.

about my comments... io means instead of comments, if two numbers, first number is page number, second is line number

minor comments...

throughout consider "study" io "paper"

page 1 abstract "due to increasing surface melt" io "due to surface melt"

After it is soon obvious the region is the Greenland ice sheet, use "ice sheet" io "GIS"

11-12 "Overall, most CPR observations of snowfall over the GIS come from IC events (70 %), however, during the summer months, close to half of the snow observed is

produced in CLW events (45 %)." ... really depends where and as the next sentence puts it, when, i.e. "summer", so what is the point?

17 "growth" of ___? be clearer

18 how is "large scale anomalous high pressure" different from "large scale high pressure"? The latter is less ambiguous IMO

18 "Ground-based data" be more specific; location, sensor

22 "key role in both the global energy budget (e.g. Box et al., 2012)" that study is not exemplary of global energy budget and "key" here is vague, pls rephrase

24 "year-round" actually not in winter or at night

page 2

Bamber et al 2013 have a more accurate number than "7.2 m (Church et al., 2001)"

7 "Recent mass loss" add time interval(s)

"shortwave" io "SW"

"summer" is not the right word, non-summer months can matter. More meaningful can be to write of "sunlit periods" or "period of positive net radiation"

21 "surface height" worth having a look at PROMICE.org data and associated publications

24-25 "wide range of GIS snowfall estimates" see work of Lewis in Cryosphere, a paper from 2018? and another now in review 2019 TCD

26 "ground-based snow observations" io "ground-based observations" 26 "can be useful to examine" io "are needed to look at" 27 "from space"... "remotely" o 31 "an attractive " io "currently the best "

6 19 "explore the contents of clouds" rephrase to be more explicit re: "contents" ..."ex-

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amine" may be better than "explore"] 8 15 and throughout the paper, I suggest replacing "look" with "examine" ... "examined" io "looked specifically at" 10 30 remove "(1.2 million)" un-needed and arbitrary 9 16 "The frequency of detected snowfall events" io "The frequency of snowfall" 9 22-23 "more CLW cases along the western side of the GIS than the eastern" a point may be worth emphasizing as a new result this study brings forward. The previous information in the paragraph is already common knowledge in the field 9 25 winter "stronger north-south gradient compared to the annual distribution" also deserving some highlight, perhaps buried here, put it in conclusions if not also in abstract 10 5 "83 % of its annual incoming solar insolation." according to what info? 10 8 not in full agreement with "Snowfall accumulation is the only significant, positive term in the surface mass balance of the GIS" see major comments 10 34 "hydrometeor" mean rain? be clear or use less jargon 11 1-2 "while the common summer events are snowing at slightly higher rates on average, it is in winter that the less frequent, highest-intensity snowfall occurs." interesting point worth emphasizing in conclusions 11 13 "determine" io "see", modify throughout 13 31-32 "Excluding a minor moisture recycling in the surface boundary layer that delivers frost during net surface radiative cooling events, the moisture required to produce GIS snowfall is not produced locally" io "The moisture required to produce GIS snowfall is not produced locally" ... actually the first sentence in 4.3 can be removed, the following sentence makes the point and there you might as well mention temperature inversion and PBD moisture recycling

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