The Cryosphere
Discussions

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Interactive comment on "Spatiotemporal variation of snow depth in the Northern Hemisphere from 1992 to 2016" by Xiongxin Xiao et al.

Anonymous Referee #2

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I reviewed the paper titled, tc-2019-33-AC1-supplement.pdf, which was a revision of the paper after the previous reviewer pointed out a calculation error.

In this study, SWE and snow depth data over North America are developed over a long period of record, 1992-2016, to evaluate spatial and temporal trends in snow mass and snow cover duration during that time. The study uses a SVR method which combines passive microwave data with other variables to estimate snow depth. They compute SWE using seasonally varying density estimates developed for different snow classes. They find overall decreasing trends in snow mass during the study period, particularly after 2002, though results vary regionally and at different rates seasonally.

The paper needs a thorough English language review. The developed data and analysis are interesting and important, but at times it is difficult to understand exactly what

was done. In particular, the variation rate analyses are unclear. I suggest adding equation for this metric, and maybe all of them, to make it obvious what was done. Beyond that, my main feedback is to provide additional high-level details about the SVR method. The way the paper is written it is mandatory that the reader refers to Xiao et al. 2018 in order to understand the process. Enough detail should be given here that the reader has a high-level understanding of the SVR algorithm and the process steps involved.

Specific comments:

Page 6, Line 29: SSM/I is listed twice.

Page 8, line 11: "SVR" hasn't been defined in article yet.

Page 9, lines 15-18: If only 9000 stations are valid, why were 17000 used? How were they selected? Does the map (figure 1) show all the stations, or just the ones used in this study? I would recommend only showing the stations used.

Page 11, line 4: ""SD", which actually is SWE" Can you explain what this means?

Page 11, line 24: List of parameters (DS, A, T, G, L, D) are used in sentence but not defined until later. They should be defined when first used. I would recommend revising the sentence to something like "The snow retrieval process uses various parameters to yield snow depth (Xiao et al. 2018).

Page 13, lines 13-23: I'm not sure what is meant by layers. Do you mean layers within the snowpack? Or are you referring to observations of snow at low, medium and high depths?

Page 13, line 29: the part of the sentence, "or medium-to-deep" doesn't seem like it fits. Should this be removed?

Page 14, equation 2: units of density are wrong if you want SWE in mm. Should use a density ratio (snow density/water density) to keep units consistent. (since density of

water is 1 g/cm3, values will be the same)

Page 14, line 21. Why do you have "(decrease)" here?

Page 16, line 24: I think "shadow" should be "shallow"

Page 17, line 26: Switch the order of "extremely significant decrease" and "significant decrease" so that the 5 grades are listed in order from largest increase to decrease. Same with Figure 8 and Table 5.

Page 18, line 25-26: Can you provide the equation for this metric: "Seasonal average SD was defined as the cumulative SD divided by the days in one snow cover season"? It's not clear to me what is being computed.

Page 20, lines 9-11: Maximum snow mass is occurring later in the year? This is in contrast to most recent literature that is finding max SWE occurring earlier.

Page 20, line 27 (and Table 7): it seems strange that February average snow mass rate decreases significantly, while March increases slightly. Is this snow that accumulated during each month or average snow mass at the time? Can you add text stating why you think that is? It would also be nice to see the data and how the months compare. You could create a figure like Figure 10, showing the time series for all the months in different colors.