General Comments

The authors of this manuscript use a Bayesian physical-statistical model to retrieve snow depth using data that was acquired during SnowEx'17, including pit data, ASO lidar acquisitions and the X- and Ku-band SnowSAR data. The methods presented by the authors are clearly defined, with encouraging results with error ranges of about 20cm SWE. The paper is methodologically and analytically sound, but does lack context of why certain methods are being employed, and the representation of results in figures need to be improved. For instance, in the Introduction it was overall well written to describe the need for remote sensing of snow and how SnowEx'17 is an attempt to address this concern. I do feel that the end of this section needs to be improved to detail to the reader what the specific objectives of this manuscript are. For instance, the authors provide an indication that they are looking to test a physical-statistical framework to derive SWE – but what are the objectives that can be completed to evaluate this?

The paper is very detailed in its methods of preparing the data for the model, and the modeling itself. What I think is lacking here is the reason that you are completing some of these steps. For instance, in section 4.1.1. you discuss in detail how you divide the snowpack with multiple layers into a snowpack with 1 or 2 layers, but never state why a 2 layer pack would be useful (that snowpack generally has a wind slab and depth hoar layer).. The justification for many of the steps in this paper need to have a bit better context provided.

Overall the paper is of publication quality in terms of its research, but the presentation could be improved, with my general and specific comments provided here.


**Section 2. Previous Work**

Line 55: "Time-series observations are available presently from tower measurements, albeit at the point scale of the tower footprint". *I think I know what study/setup you're referring to here, but you have not referenced the papers that have been published based on them. Also, a sentence that states why you are not using a tower approach in this work would be useful.*

Line 86: "demonstrated the utility of a couple multi-layer snow hydrology coupled with a.." – *do you mean "snow hydrology model coupled…"?*

Line 133-134: "the second is the prior of the backscatter… the prior of the snowpack physical…" *this sentence is a little unclear, please revise.*

Line 144: "assuming that we have good understanding" *grammar issue here "assuming that we have a good understanding".*

Table 1: I may have missed it, but why are all the datasets being upscaled to 90m? I also noticed this discussed in lines 175-176, but there was no justification as to why – please include.

Line 299: "from the multilayer snowpack simulated by MSHM as for the single layer case" *I'm not sure what you are trying to say here*.

Line 366: "restructingthe" – *restricting the*

Figure 7 – None of the panels have a letter denoting which panel they are. The panels with the red box should be made into a new figure that zooms into the distribution of values within the red box – there are discussions in the Results section of what's happening here, but it is difficult for the reader to confirm what the text is saying graphically because it is far too small.

Figure 8, 9, 10, 11 also has no panel labels.

Line 433: "Fig. A7" – where is A7?

Line 445: "Fig A8" – where is A8? Be specific when referring to the appendix.

Line 477: "Fig A11" – where?

Line 534: "including water, forest (4500) and proximity" – *what does 4500 refer to?*

Table 7: *There is a note in the caption that "shaded rows correspond to large local MARE" – however there are no shaded rows in the table.*