

Snow Water Equivalent (SWE) is a key parameter in hydrological, climatological and meteorological applications. New efforts for spaceborne radar-based SWE retrieval algorithms are under development and this paper shows the capability of such retrievals using snow-physical model driven by meteo data, radiative transfer and Bayesian inference. This paper focuses on the SWE retrieval framework leveraging previous work. The paper shows the readiness and capabilities of combining existing models and products to produce a SWE retrieval for RADAR data. The paper is well constructed and provides great results for SWE retrievals using Ku band radar. The method is repeatable elsewhere and estimating the background with X-band is clever.

Refining and thinning the results section would help clarify the take home message. Most of the figures are almost duplicates and I'm not sure I see the benefit in most cases. Or it is not well explained in the text. I have specific comments throughout the paper.

Specific comments:

Line 73-75 : This is a key sentence in setting the objective but it's complicated to understand. I suggest reformulating.

Line 76: Do you need all the verb? I feel like *propose* and *evaluate* were enough. Previous studies already implemented and demonstrated.

Line 83: temporal variability relates to temporal resolution of the orbit or revisit time of the satellite. I suggest removing or adding high temporal resolution higher.

Line 86 : "a coupled multi-layer snow hydrology model"? add model

Line 127 and line 130: Should it be y not x for the retrieved variable?

Line 148 and Line 150: do we maximize $P(n|y)$ or $P(y|n)$?

Line 164 : I suggest a bit more detail in the paragraph. Is y the snow depth, SWE or backscatter? Did you use the likelihood ratio to iterate in the MCMC like Pan et al?

Line 246. Wrong figure number. Should be 6.

Figure 5 : Is this the layer index? What does 15 layers mean? Top or bottom? Height or normalized height would be better. Put density on the x-axis.

Line 267: Why this value? Can you explain more this parameter. "This is an empirical factor that ..."

Line 271: replace microphysics for microstructure.

Line 272: add the symbol (l_{ex}) that represent the correlation length in MEMLS.

Table 2: Relates to the previous comment. Why use D?. D is the equivalent grain size used in DMRT. Replace D for l_{ex} .

Line 298: "for each layers"

Figure 6: The figure could be clearer. Later you refer to steps, but no steps are indicated in the figure. Pretty hard to understand even if you know Bayesian SWE retrieval. This could improve the understanding of the reader.

Line 317: It is not clear how the background is estimated. Maybe Specified that the volume is modelled from MSHM in the text not just in figure 6. Then explain why only using X band. It might not be obvious to someone not familiar with the fact that X band is more sensitive to the background than Ku.

Line 358 : "toweak" change "to a weak"

Figure 8 : I don't see the point of having 4 columns in the figure and then another figure for Ku. Can your aggregate heatmap for all dates and have x and ku in the same figure? They all look the same. I think we get the idea that the backscatter converges to the observed.

Line 471: remove in after between.

Line 475: add a coma after "In all cases".

Table 6: change title to " Same as Table 5 but for resolution = 90 m".

Line 529 – 530: Can you add the mean values stated here in the table as the last row?

Table 5, 6, 7 and 9: Any benefit in having the same table but with different resolutions? We get the idea in Table 4 regarding the resolution. Just make the point you want and move on. There is no point in having both figure 12 and 13. Just show one. I don't see any big conclusion regarding the resolution so there is no point in adding extra figures and tables.