The Cryosphere Discussions

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Comment on tc-2021-156

Anonymous Referee #2

Referee comment on "Characterizing Tundra snow sub-pixel variability to improve brightness temperature estimation in satellite SWE retrievals" by Julien Meloche et al., The Cryosphere Discuss., https://doi.org/10.5194/tc-2021-156-RC2, 2021

general commentsï¼☐

This paper conducted an interesting simulation work to study the influence of subpixel variability of snow parameters on the brightness temperature. The paper is well written, and the overall quality of the manuscript is high. I have only the following points to be addressed for the further improvement of this paper.

specific commentsï¼☐

1. Line 120, could you provide more details in the ocean/lake effect removal? Although the SSMIS observations has been downscaled to 3.125 km resolution, however considering the bigger footprint of 36.5 GHz (4*6 km^2), can the water effect truly be excluded in the pixels near the ocean/lake? As can be seen from Figure 1, at CB for example, there are truly only a few grids that are lake free. How the influence of lake was considered?

2. Line 120, also, the snowpit measurements were at point scale whereas the Tb data is at 3.1.25 km. Why and how the Tb data was averaged to match the point scale measurements? To which resolution was it averaged?

3. Line 249: this line reads like the density and SSA of each of the two layers were estimated as a function of snow depth and DHF, too.

4. To my understand, the DHF was determined only by one parameter, i.e., the snow depth. The prior information is the probability distribution of snow depth and the relationship between DHF and snow depth described in Figure 5. Therefore, the generated DHF (posterior DHF field) described in Figure 6 has also some random characteristics. In other words, Figure 6 is only a realization of DHF, one of the possibilities. The scatter points are not fixed, determined values. Therefore, will a different realization influence your $T_B$simulation results?

5. Figure 7, it will be more interesting to provide an estimation of distribution of TB difference between 18.7 and 36.5 GHz. The authors need to explain why the $T_B$that considers the sub-pixel variability is higher when the standard deviation of snow depth is

higher. Is it because when the snow depth is higher, the reduced variability of DHF will result in less samples of strong volume scattering, such that the T_B at 36.5 GHz will increase? In addition, will this result be influenced by the soil emission background?

6. How the effect of vegetation was considered in the simulation?

technical correctionsï¼□

Line 25: Snow depth simulations ---> do you mean the retrieved snow depth, or the brightness temperature simulations?

Line 40: dielectric properties ---> suggested to change to radiometric properties

Line 75: More words is need to explain the Gaussian Process (GP) when this term first appears here. Maybe it is better to first mention it between lines 60-65.

Line 81, are the snow microstructure and density values used here single values or probability distributions? Are they determined according to the in-situ snowpit observations?

Figure 5(b) was not described in the caption.