Author Response to Reviewer #1 (Reviewer's comments are in black and author responses are highlighted in blue).

Overall Review: The article provides a comparison between 10 different wet-snow dielectric mixing models and how the choice can influence the retrievals of liquid water content at L-band frequency. The study was conducted for Greenland's percolation zone, utilizing SMAP (rSIR) brightness temperature and two in-situ forced surface-energy mass balance models to assess robustness. The combination of models and satellite observations is unique and novel and answers an important question about the choice of wet-snow dielectric models for the estimation of liquid water amount. The manuscript is generally well organized and richly referenced, but a careful read reveals several minor errors that should be addressed before publication.

Major Strengths & Novelty

1. First side-by-side comprehensive comparison of ten-dielectric formulations (Debye-like, power-law, empirical, etc.) explicitly focused on the retrieval of LWC.
2. Link to operational satellite – SMAP rSIR Tbs
3. Quantitative assessments against the surface energy models.

- The authors thank the reviewer for careful review and thoughtful comments. Below is our point-by-point response to the reviewer's 'Specific Questions and Technical Errors'.

1. Abstract – "Sihvola power-law mixing model showed an overall better performance than the other models for the 2023 melt season" – consider including metrics.

   - We will consider including quantitative metrics in the abstract of the revised manuscript.

2. Which SMAP product was used (rSIR) can be mentioned in the introduction, in the last paragraph.

   - The SMAP data product used (rSIR enhanced resolution) will be mentioned in the last paragraph of the introduction.

3. Duplicate equation number (for eq. 8 – mentioned at L137 and L155), and then subsequent equation numbers should be changed.

   - Thanks for noticing this. Duplications for equation numbers have been corrected for the equations as well as in the text throughout the revised manuscript.

4. Typo in L273 Ks<<Ks, instead of Ks<<Ka.

   - The typo has been corrected in the revised manuscript.

5. Methods – The Hallikainen model was derived at 3-37 GHz; authors can justify its usage/extrapolation to 1.4GHz

   - While the Hallikainen model was derived using measurements made at 3-37 GHz, our purpose was to test its application at 1.4 GHz to see how it performs against the other models. As it was shown in the results, the agreements of the model were very close to the Tiuri model which was derived from in situ measurements made at 859 MHz – 12.6 GHz, justifying its applicability to L-band. We will mention this justification in the discussion section.

6. Typo – Table 1: Key Parameters – "Depolarizaion" should be "Depolarization".

   - The typo has been corrected.

7. Sihvola, misspelled at L99, L123, L166 as Sihivola.

   - The typos have been corrected.

8. Eq 20 refers to both e-folding depth and attenuation coefficient.

   - The duplications for Equations 20 have been corrected.

9. Hallikainen et. al. 1984 (L344) is not mentioned in the bibliography; are the authors referring to Hallikainen et. al. 1986? If so, the date should be changed.

   - Yes, we referred to Hallikainen et. al. (1986). The citation has been corrected in the revised manuscript.

10. I suggest making the zoomed-in version on the right in Fig. 2

    - We will change the zoomed-in version to the right in Fig. 2, consistent with Fig. 1, in the revised manuscript.

11. L427 "The Colbeck model provides the lowest estimates for the entire LWA range," referencing Fig. 4. However, in Fig. 4f, the Colbeck model appears to provide a higher estimate than Hallikainen. (A zoomed-in inset for Figs. 4, and 5,6 would be helpful).

- We tried to highlight the general trends for most of the cases. But it's true that the Colbeck model appears to provide a higher estimate than Hallikainen in Fig. 4f. We will revise the statement accordingly.

12. Table 3 GEMB column is missing.

- GEMB results have been included in Table 3 of the revised manuscript.

13. Line 550, "All three methods…", is it referring to Fig.9?

- Yes, it refers to Figure 9. We explicitly included the figure number at the end of the line.

14. Can include a plot of observed and simulated tb, to check the loss.

- We plan to include simulated TBs with the observed TBs given in Figure 8, as recommended.

15. Line 885 (+more) Miller, J.Z. has year 2020a, but 2020b is missing, I see that at Line 897 Miller, O., et. al, has the year 2020b. but no corresponding 2020a.

- The references were previously processed incorrectly and have now been corrected as follows: 'Miller, J.Z. 2020a' has been changed to 'Miller, J.Z. (2020)', and 'Miller, O., et al. (2020b)' has been changed to 'Miller, O., et al. (2020).