This manuscript addresses the spatial variation in the density of snow on sea ice through use of an extensive in-situ dataset from SMP and density-cutters. The paper is well written and highly rigorous; I believe it makes a significant contribution to the study of snow on sea ice and I recommend it for publication in The Cryosphere after some minor changes and clarifications.

On a side note, it was particularly pleasing to see the authors publishing their data and analysis code in an interactive, browser-based environment. As well as making the research output easier to review, it is likely to add to the impact of the work.

Thank you for your review and comments to improve the quality of the manuscript. We sincerely hope that the methods and code presented here can be made better through community application and adaptation. **Thank you for your note regarding our efforts to ensure reproducible and open science.**

L57: "were used to address this problem"

Corrected as suggested.

L58/339/471: Perhaps 'mm-scale' should be replaced with 'milimeter-scale' for readability.

We have made the units explicit as suggested.

L129: "SMP transects **were** established"

Corrected as suggested.

*L184: "Eureka had a higher RMSE ...**than** measurements at AO sites"*

Corrected as suggested.

You'll presumably update your coefficient names to reflect the year of publication (K19a→K20a) in the final copy.

Updated throughout to reflect the current year.

L223: I think the reporting of the classifier's accuracy evaluation could be reworded for clarity. Presumably the 'prediction accuracy of 76%' means that 76% of the samples were assigned the correct layer type? Or does it mean that of the bulk layers that it identified (e.g. depth hoar, slab etc), they were right 76% of the time?

Added text to clarify what accuracy means (True positive or true negative predictions on line 224). We have also added an evaluation of errors by layer type and reported classification errors as a confusion matric (Table 3).

Since the SMP makes measurements of F & L a couple of hundred times per mm, then does your classifier make a classification of the snow type with similar frequency, or is it as the frequency of your 2.5 mm density estimates? Or does it just identify boundaries between layers of different snow type?

The classifier is trained on the 3-cm averaged SMP data extracted at the height of each density cutter measurement. We added text to make it clear that the classifier was applied at vertical resolution of the SMP despite training on density cutter averages.

I think it would also be particularly valuable to break down the performance by layer-type. The average was 76%, but did the classifier do a better job of identifying different types? Were there some types that were particularly hard to identify?

Agreed, see previous response regarding the introduction of the confusion matrix.

L326: As you subsequently mention, the primary scattering surface for radar altimetry may not be the ice surface. As such, I think this should be rephrased as 'radar measured distance to the primary scattering horizon may be overestimated'. On that note, I think you should mention explicitly in this section that calculations ofδp assume (in line with convention for radar altimetry) that the ice surface is the dominant scattering horizon.•

Agreed, more careful wording was needed to acknowledge penetration uncertainty. We've modified the text to establish that our assumption is that the primary scattering interface is the ice surface. See further points below where additional details have been added on why that assumption may be invalid.

L327: This reference is now quite challenging for many readers to track down, I suggest updating tothe more recent edition: Ulaby and Long (2014).•

Thanks for your suggestion but we have kept the original given differences in authorship.

L332: I think it would be good to cite this equation (as it's reported differently in some literature),consider Tilling et al. (2018) or Mallett et al. (2020).

A reference to Tilling et al. (2018) has been added as suggested to establish linage.

L444: Consider pointing out in this section that as well as brine over FYI, morphological features in the snow or higher snow temperatures (Willatt et al., 2011) may also raise the primary scattering horizon, limiting the applicability of your path difference calculation.

Yes, important to mention this even if assumed. We added a point to clarify that snow conditions were dry and temperature was not considered. We will leave the final sentence as is using microstructure to address the influence of layering.