Kausch et al 16th Sept 2025

After a careful revisit of the author's responses to the reviewer comments, there are a number of areas that have not been addressed. There are also additional clarifications and modifications needed (with apologies that I did not pick these up the first time around).

Thank you for your additional remarks. We have now revised the manuscript to address all remaining issues. Please find the latest answers below in green. We also numbered the responses here for a better overview. All page and line numbers refer to the track changes version of the manuscript.

In response to the reviewer comments:
'*We agree that there are more complex physics at play and the paper is merely trying to look at correlations and discuss possible mechanisms that could drive them. We don't think that we have a solid physical explanation for the observations and we will try to make it more clear that we are not claiming to have one.*'

I am sorry to say I still cannot find this in the text at P13 L1-2, either in the tracked change or actual version.

1. It was moved to the previous page by later changes. My bad, it is now at P13 L8-9.

'*I Do not think this should be removed? Not sure what to do here?*'

As I have already communicated to you, I agree with the reviewer and already asked for this change. Including this additional sentence, while makes sense to you, makes less sense to the reader. I advise against retaining it, but as you feel so strongly about this I will not insist on this change.

2. Removed the sentence.

'P4L15: I would include the tracks on Fig.1 if you can.
Tracks are shown in Fig.1 but hard to see due to zoomed out view.'

Please could you make the tracks thicker?

3. Doubled line thickness. P5

P8L14-19: Combine with paragraph above.

This has not been done.

4. Done now. (For some reason this is not visible in the track_changes version but only the new manuscript.) P9 L7

P8L16: Not sure this makes sense to me 'obscuring the incidence angle correction'
No change has been made to the text – please clarify

5. *Rephrased the sentence. The point I am trying to make is that by applying it per pixel, spatial variability does no longer play a role.* P9 L10

P9L9-P10L2: This section isn't clear to me e.g. how the AWS data was extended.
Please could you respond to this point

6. *Rewrote the paragraph. P10 L7 - P11 L2*

P16L1-2: This doesn't explain the reason why grain sizes are high on the leeward side & low on the windward side? I would think high SMB would

mean higher density due to greater snow compaction? I am possibly misinterpreting things.

Fresh snow has low density and grain size. With time snow compaction will increase the density and grain size. This means that snow near to the surface will have lower density and grain size in areas of high SMB where the snow had less time for compaction.

Unsure what to add here?

Please add text to the document, but this explains surface discrepancies, not lower in the pack where you might expect higher densities with high SMB. What is the reason for the low density with high SMB? This ties in to a general discussion on whether the snowpack model is representing density and microstructure lower in the pack. If not, the radiative transfer model may not be able to represent the backscatter in a manner that reflects observations.

7. Added some explanation. P17 L1-8

Figure 2: I find it a little confusing to have a distance profile on top then time series below, can you make 2 separate figures?
We will try to separate them more clearly.
This has not been done

8. Separated into 2 figures. P7

Figure 3: What do the dots represent? Average HV/HH for each pixel?

The linear regression between the variables.

I think the reviewer is asking about the processing of data here

9. Yes average HV/HH. Added that its the average there. P9, P12

While I am aware that atmospheric conditions are important for InSAR phase delays I found it hard to find information that shows a non-negligible affect of clouds on C-band backscatter
Please mention this may be source of error and cite the InSAR studies

10. I'm afraid I can not follow. The InSAR studies can not be used as a source to claim that atmospheric conditions may be a source of error, as they only claim this is a problem for InSAR which is a different method and not used in this study.

No speckle filtering was included. We will analyse the impact of a speckle filter on the results
Speckle is only mentioned twice in the document. I see it has now been included, but no analysis of its effect has been included

11. Added in sentence in results that there was a modest but insignificant improvement in correlation due to adding a speckle filter. P12 L6-7

However modelling surface scattering from a rough surface is not currently possible in SMRT, at least to my knowledge
(just a comment – yes this is possible)

Additional corrections
Page 14 line 4. SSA is not a measurement of grain shape – there is no way to recover grain shape from SSA. There are some correlations i.e. fresh crystals generally have high SSA, depth hoar have low SSA, but it's the tail of the correlation function that has more information on the shape. SSA is only related to the correlation function at the origin. See https://doi.org/10.1029/2021AV000630. This ties in with Pg 6, line 7.

12. Rephrased the sentence and clarified that SSA is not a direct measurement of grain shape, but associated with it. P15 L5-7

It is slightly misleading to say high SSA is a sign of a non-spherical grain shape. In any case, high SSA crystals do not scatter much so these are not so important. See also page 17, line 7.

13. Would a sphere not always have the lowest SSA geometrically possible?

Page 13, line 5. SSA is not exclusive to SMP: SSA is mathematically equivalent to optical equivalent grain diameter through equation 1.

14. Sorry, what was meant here is that within the dataset used in this study it is exclusive. It is of course not exclusive to SMP measurements in general. This however, was poorly phrased and I added that info. P14 L1

Page 17, line 2 / figure 9B. I'm not comfortable with the reliance on the SMP relationship with cross-pol as the SMP only extends to the top 1m, and doesn't consider SSA lower in the snowpack where the bulk of the scattering is occurring

15. This is a shortcoming indeed. I added an extra sentence mentioning this. P18 L7-8

Page 17, line 4. 'Therefore we argue...' I'm afraid I simply don't understand this statement. Please could you elaborate?

16. Rephrased the whole paragraph. P17 L9 - P18 L8

Page 18, line 2. Radar sensitivity to grain extent: this does not take multiple scattering into account

17. Added a line that multiple scattering is not considered in this scenario. P19 L7

Page 19, line 9. Fresh snowfall may be anisotropic, but this may quickly evolve. This is not a strong argument.

18. I agree that this is a shortcoming of this argument and added a sentence to mention this. P19 L25-26