

Interactive comment on “The importance of particle size distribution shape for triple-frequency radar retrievals of the morphology of snow” by Shannon L. Mason et al.

Anonymous Referee #3

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Review of AMTD – amt-2019-100

The importance of particle size distribution shape for triple-frequency radar retrievals of the morphology of snow

Overall this is a well-written paper and an interesting study that falls within the scope of the AMT journal. The work focuses on assessing the quality of triple-frequency retrievals with specific aims at better constraints on snow particle characteristics – especially with regard to snow particle size distribution (PSD). This work builds from

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previous triple-frequency work with nice results contrasting rimed and aggregate snow particles. In general, I have only minor comments and some technical suggestions.

General Comments:

* Why do you use the mean Doppler velocity at 35 GHz in the retrieval? I was unable to find why this frequency is optimal for the retrieval methodology. Please add some information.

* PIP PSDs and other products are available at 1 min resolution. Why do you choose 5 min? If it is for better statistics through averaging, please make that point. Also, if you are using these values during the 25 minutes of the event, this essentially leaves 5 points for comparison with the retrieval. Could you expand on why you feel this is enough in situ data for assessment of aspects of the retrieval?

* How did the prefrontal versus frontal period get defined? Is it purely from radar features? Maybe something more rigorous or not from the radar would be more appropriate (since you are using the radar to evaluate the method). Is there collocated met equipment that can be used to determine the onset of the front? You have collocated radiosondes – are those used to determine the timing of the front? Or maybe could help justify the time chosen.

* Since one event is being used to test the efficacy of this method, I think this needs to be emphasized. Also, would be good to argue why this one event may be applicable to other similar particles or events in different locations.

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Specific Comments:

Page 2, Lines 7 – 11: Split into two sentences

Page 2, Lines 26 – 27: “but it remains to explore. . .” does not make sense

Page 2, Line 31: Be consistent with your “-“ or not for frequencies (either all should be 35-GHz or should be 35 GHz)

Page 3, Line 12: replace the “measurements;” with “measurements.”

Page 3, Line 14: “advantages” should be “advantage”

Page 4, Line 1: Define CAPTIVATE

Page 4, Line 23: Make mass-size equation on own line with equation number

Page 4, Line 27: “AR” should be in parentheses. Also, the author goes between saying AR, axial ratio, and aspect ratio throughout the document. Be consistent (I recommend “AR” since you define it)

Page 5, Line 5: Should measurement vectors be numbered as well?

Page 7, Line 28: aspect ratio “AR”

Page 7, Line 34: “The range of radar signatures is overlaid with the measured triple-frequency radar data from Hyytiälä. . .” You already talk about the shape of the data (the hook feature) earlier. I think you should introduce the overlaying of this data before getting into the description above.

Page 9, Line 2: 3mm for the spheroids but maybe more like 4mm for the fractal particles?

Page 9, Lines 10 – 11: Reference needed.

Page 9, Line 34: “We may therefore. . .”

Page 12, Lines 3 – 5: Please add some details about the frontal passage – i.e., met data or observations that are not radar or particle focused. This will justify better your distinction of the two regimes (since you are using radar and in situ particle obs to test and assess the retrieval).

Page 12, Lines 20 – 22: Reference needed

Page 14, Lines 2 – 3: “. . .suggesting that some rimed particles persist after 23:03

UTC.”

Could it be the choice of timing of the prefrontal versus frontal is off? Would using collocated met data clarify this?

Page 14, Line 7: “. . .in situ measurements at the surface.” Please specify what this is from – I assume the PIP measurements?

Page 18, Lines 12 – 13: I do not understand “A significant difference between the frontal and the prefrontal profiles is that all retrievals are able to represent the observed profile of mean Doppler velocity below about 1.5 km,” as I am not see this. Could you please add some details as to what you are referring?

Page 19, Lines 9 – 11: The truncation you refer to here – are you talking about the PIP or the method? Both have lower limits. And technically snow is always dominated by small particles – just less so or more so depending on the shape of the PSD. So I do not think this is the correct sentiment here (i.e., even when a PSD is quite broad with lots of large aggregates, there still tends to be 1 to 2 orders of magnitude more small particles. When the PSD is quite narrow that is more like a factor of 3 to 4 orders of mag. . . but still lots of small particles in a broad distribution).

Pages 19 – 23: This section almost feels a bit out of order. It is like there are conclusions at the beginning and the discussion of application shown in Fig. 9 further into the section. It may help potential readers to move the discussion of the Fig. 9 to earlier in this section and move the verbiage in the beginning of the section to later – as a transition to conclusions.

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