

Responses to the reviewer 1 follow-up comments (AMT-2022-174)

Thank you for your comments. Our responses are below.

Minor Comments

Comment 1. L88: Can you cite the microphysics processing software used (DOI or previous paper)? The microphysics data readme for that dataset (L432) doesn't seem to specify this.

Response: The ICICLE data was processed using the Environment and Climate Change Canada (ECCC) D2G software. Currently, no formal reference for this software is available.

Comment 2. L93–L94: Are these the bin midpoints? As it reads, there is a gap in PSD sizes. Specifying the bin left (right) endpoint for the lowest (highest) size used for each probe might avoid confusion.

Response: These are midpoints of size bins (not left endpoints). Numerical simulations performed by the second author (not published, in preparation for publication) showed that for OAPs the midpoints of the size bins, starting from the third bin, with a high accuracy can be presented as $D_{\text{mid}} = kd$, where k is the size bin number, and d is the width of the size bin. There appears to be no gaps in combined PSDs.

Comment 3. L189: This may be true for the DWR pair used here based on the ICICLE observations, but other studies (Kneifel et al. 2015; Chase et al. 2018; Mason et al. 2019), albeit triple-frequency studies, do suggest sensitivity in particular DWR pairings as the result of riming or effective density. Maybe specify that your statement is valid for the radar frequencies and types of cloud sampled in this study?

Response: We specified the cloud conditions considered in this study. We specifically mentioned that we sampled volumes with only traces of supercooled LWC. The influence of effective density on individual DWR is not expected to be very significant given uncertainties of measurements.

Technical Corrections

Comment 1. L82–L84: “(CDP)(Lance et al. 2010)” -> “(CDP, Lance et al. 2010)” and elsewhere to be consistent with nomenclature on L96.

Responses: corrected as suggested.

Comment: 2. L108: There should be a space between “mm⁶” and “m⁻³”.

Response: the space was added.

Comment: 3. L234: re should be a space between “g” and “m⁻³”.

Response: the space was added.

Comment: 4. L345: Do you mean to say “numerator”?

Response: Yes, “numerator”.

Responses to the reviewer 2 follow-up comments (AMT-2022-174)

Thank you for your comments. Our responses are bellow.

Minor comments:

Comment1: l. 152-156: Regarding the observation that (because of non-Rayleigh scattering) reflectivity is lower in the horizontal than in the vertical beam measurements: is this also related to the fact that horizontal polarization is used? If a vertical polarization were used, would this also be expected?

Response: Yes, and the magnitude of the zenith enhancement increase is expected to be even higher for vertically polarized signals (because vertical dimensions of particles are generally smaller than the horizontal ones). In the earlier study (Matrosov et al. 2012), the slant linear 45 deg polarization was used, rather than the horizontal polarization. The corresponding zenith reflectivity enhancements were present and for highly non-spherical particles they were greater than 10 dB.

Comment 2.- Fig. 7: Any specific reason why this plot is semi-log, compared to the previous ones? It makes it more difficult to compare directly the quality of the relations (especially for small particles, since there are very few Dv values below 1mm).

Response: For the most part it is because the characteristic size – reflectivity relations were first published in the log scale (e.g., Matrosov and Heymsfield 2017, DOI: 10.1175/JAMC-D-170076.1). The use of similar scales could facilitate comparisons of relations from this study and the earlier ones obtained for different wavelengths. We added this earlier paper to the reference list.

Technical corrections:

Comment: l. 15 "predominantly"

Response: corrected.

Comment: l. 19 "W-band band"

Response: corrected.

Comment: l. 25->28 the sentence feels a bit clumsy. Consider rewording it.

Response: This sentence was modified.

Comment: l. 112 "the influence"

Response: corrected as suggested.

Comment: l. 164 "irregularly shaped"

Response: corrected as suggested.

Comment: l. 167 "The habit recognition was tuned so that".. or "in a way that.."

Response: corrected as suggested.

Comment: l. 170 "vertically" and "horizontally"

Response: corrected as suggested.

Comment: l. 176 "The amplitude/ magnitude of these differences"?

Response: The W-band bright band enhancement in this example was ~ 3dB while at X-band it was ~10 dB or so. The corresponding information was added in the paper.

Comment: l. 206 reference to fig 3 is to give an example where we see dendrites corresponding to a high DWR values, and not a general statement. To avoid confusion, I would include "see for example the images in Fig. 3" (or alike)

Response: It is now specified in the paper that this statement refers to this particular example.

Comment: l. 341 "i.e., it is proportional.."

Response: corrected as suggested.