This manuscript describes an approach for triple frequency radar retrievals of precipitating ice microphysical parameters. It is overall an interesting study worth of publishing after the authors address comments below.

Comments.

1. Equation (2): m-D relations. Usually, size of particles is defined in terms their major dimension. Since you define it here differently, it would be useful if you briefly discuss what typical differences can be expected between your size definition and that which uses the major dimension. You are suggesting on line 68 that your relation agrees with the one from Leinonen and Szyrmer (2015) but these authors (unlike you) use maximum size for D, so discussion about differences in size definition would be helpful. Also, it appears that your relation m=0.015D^2.05 [SI units] provides particle mass values, which are quite a bit different than many existing relations for aggregates (see for example, Mitchell JAS 1996, p.1716, relations from Heymsfield et al. JAS 2010, p.3303 and many others). Again, Fig. 1 shows mass dependence on Dmax not the size you use according the statement on line 61. Can you address these issues?

We state explicitly what we understand by the maximum diameter because the definition is ambiguous and it differs between the studies, e.g., McFarquhar and Heymsfield (1996) defined the Dmax as the largest particle dimension along the main flow; Leroy et al. (2016) defined Dmax as the largest length through the center of the particle image. The definition of particle size used in our article coincides with this one used by Leinonen and Szyrmer (2015) as it is written in the last sentence of their Section 2.4. The same definition is also used by Heymsfield et al. (JAS 2010) in a two-dimensional setting for analysis of images of ice crystals. Because the scattering simulations and the in-situ PSD datasets both use this definition we adopted it for our study. Regarding the mass-size formula it must be noted that it is only the beta parameters that is constant throughout the manuscript and its value of 2.05 is in agreement with commonly used values in literature where it ranges from 1.8 to 2.2. The value of 0.015 for alpha is just a baseline. If smaller values of alpha are retrieved this is interpreted as less dense particles; if alpha is larger more dense/rimed snowflakes are expected in the radar volume.

2. Do you account for particle orientations and shapes? Observations show that DWR depends quite strongly on particle shape and orientation (e.g., Matrosov et al. JAMC 2019 p. 2005). For vertical beam measurements, more spherical particles produce larger DWR than less spherical particles.

We do not account for particle orientations and shapes. Two of the scattering models we use (ARTS and OpenSSP) assume random orientation of particles whereas in the dataset of Leinonen and Szyrmer (2015) snowflakes are horizontally aligned along the major-axis dimension. Despite this inconsistency these datasets are combined to form a scattering table that covers a wide range of snowflake sizes and masses. The expected scattering properties of a snowflake for a given mass and size are computed as an average of scattering properties of particles from the database in the neighbourhood of that point, regardless of particle shape or orientation. This approach provides an approximation for an ensemble of snowflakes which mimics somewhat radar measurements of large air volumes where different ice habits can mix together.

3. I think the NRC aircraft can also provide measurements with side view radar beams. Did you compare side and vertical measurements?

The NRC W-band and X-band radars have side-looking antennas but the triple frequency radar data are only available in nadir and zenith directions therefore we didn't use side view measurements in the analysis.

4. From what I know, the NRC aircraft microphysical suite has two Nevzorov probes (at least it was the case with the flights I know about). The IWC estimates form the two probes can differ. Did the flights, which you analyzed, have measurement from two Nevzorov probes? If yes, what were the differences?

Yes, we had two Nevzorov probes installed for the RadSnowExp project. One is own by NRC and the other owned by ECCC. At this moment, the processed data from the ECCC Nevzorov probe are not available to us.

5. Did you try to calculate X, Ka, and W reflectivities using your scattering data base and compare them to the radar observed values?

Yes, we simulated them and they are plotted in Figure 3, panels d, e, f. The red (blue) lines show the measurements below (above) the airplane while the black line is the simulated reflectivity at the flight level. As you can see, the simulations are in good agreement with the measurements. To make these panels more readable and consistent with the other panels we plot reflectivities above and below the plane as the shading limits. This reflects how we estimated an uncertainty of radar reflectivity reflectivity at the flight level.

6. Please clarify in more details how the "truth" in Fig. 4c was obtained.

We modified the caption of Figure 4 and added the following statement at the beginning of Sect. 3.3: "Finally, the retrieval results are evaluated against the microphysical properties of snow at the flight level determined using the optimal estimation framework (see Sect. 3.2) These validation data serve as an in-situ "truth"."

7. Line 229: what are the uncertainties of estimating Doppler velocity from a moving aircraft?

The following statement was added in the manuscript for clarity: "Note that, the Doppler velocities as well as the radar reflectivity values at the flight level are not directly measured. They are estimated from the radar measurements below and above the airplane and in-situ probe data using the data assimilation technique that exploits the radar simulator described in Sect. 3.2. Their uncertainties are estimated by propagating the errors on the state vector, x"

Editorial comments:

1. Line 10 and elsewhere: provide units for Dm and IWC to better understand RMSE values here and statistical metrics results given in terms of logarithmical values.

The state vector is in logarithmic units therefore the RMSE values are in bels i.e. they show relative errors (0.15 ~ 40% relative error).

2. Equation (1): provide integration limits.

The integration limits are provided now. We also added this comment:

"Note that the PSD is a positive function only over a limited set of particle sizes so the effective integration limits are finite."

3. Line 270: If only one frequency (W) has non-Rayleigh scattering it is already dual-frequency not triple-frequency approach.

We modified this sentence accommodating your comment: "This pinpoints at the shortcomings of the dual- and multi-frequency radar-based approaches…"