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Atmospheric Measurement Techniques Discussions

Interactive comment on "Snowfall retrieval at X, Ka and W band: consistency of backscattering and microphysical properties using BAECC ground-based measurements" *by* Marta Tecla Falconi et al.

Anonymous Referee #3

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This manuscript presents Ze-S relations derived based on observational data of radar reflectivities at three frequencies and concurrent measurements of snowflake size distributions and snowfall accumulation rates. The observationally-based Ze-S relations are compared to the modeled ones using different scattering models and snowflake shape assumption. The paper contains useful practical information about multi-frequency Ze-S relations and also provides interesting results on comparing TMM and DDA based approaches for deriving backscatter properties of snowflakes. I would recommend the manuscript for publication after revision. During the revision process,

please address the comments given below.

General comments

1. You consider several rimed snowfall cases, but only one fluffy snowfall. I think that based on only one case, it is premature to make a conclusion that the coefficients in the fluffy snowfall Z-S relations have different from rimed snowfall frequency tendencies (Page 11, lines 29-31).

2. Radar calibration issues. Section 2.3. How did you ensure resolution volume collocation from the vertically pointing radars and the scanning C-band radar at cloud top where Rayleigh scattering is assumed for all frequencies? What about the absorption in supercooled liquid which is different at different frequencies?

3. Why did you use the gamma size distribution model (Page 8) rather than directly using PIP observed size distributions expressed in snowflake size bins?

4. It would be helpful if, for each frequency, the authors provide figures showing your best Ze-S relations (given in bold font in Table 3 for individual snowfall events) and some previous relations from literature. You cite a number of such relations for W and Ka-bands. For X-band also there have been a fair amount of previous studies (for example, Boucher and Wieler Journal of Climate and Applied Meteorology 1985, p.68; Fujiyoshi et al. JAM 1990, p. 147; Matrosov et al. JTECH 2009, p.2324; Huang et al., C-band, JTECH 2010, p. 637).

5. It would be interesting to know if Ze-S relations derived for the IKA C-band frequency would be much different from those at X-band?

Specific comments

1. Page 5 line 16: It is stated that ARM radar measurements were corrected for attenuation. Is it attenuation due to accumulated snow on the radome or attenuation in falling snow?

2. It is not clear if in your modeling you assumed the preferential orientation of the particles (Page 8, lines 1-5) or random orientation (Page 9, lines27-31). I do not understand your term “randomly orientated particles at fixed orientation”. Please clarify.

3. Fig. 8: What coefficients are shown in Fig. 8? Are those corresponding to the dashed black lines in Figs. 3-7? Or something else?

4. Can you provide in Table 2 coefficients corresponding to the dashed black lines in Figs. 3-7?

5. How did you obtain Dmax from the disk equivalent PIP measurements of Ddeq ?

6. Fig. 9. What is D0 in this figure? Is it the same as given by eq. (6)?

7. Page 4 line 23: mm of water?

8. Radar calibration: As the IKA radar has a vertical resolution of about 1 km at the ARM site ($\sim$1 deg @ 64 km) did you averaged vertically ARM radar measurements in vertical to match this resolution?

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