Atmos. Meas. Tech. Discuss.,
doi:10.5194/amt-2017-485-RC2, 2018


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 #2**

Received and published: 30 January 2018

The author developed the observed relationships between snow rate (S) and radar reflectivity factor (Ze) by combing in situ measurements and radar measurements at X, Ka and W bands. From the selected four snow cases, it was found that the Ze-S relationships for fluffy snowflakes are different from those for rimed snowflakes. The scattering simulations were also conducted using the TMM and DDA methods. The author concluded that the TMM method is suitable for radar reflectivity simulations by choosing the optimal aspect ratio which is shown in this paper for different frequencies and snowflake habits. The most contribution from this paper is to find the optimal



aspect ratio for fluffy and rimed snowflakes at X, Ka and W bands, which can be used in developing the snowfall retrieval algorithms using radar measurements. However, some methods in processing the data and discussions need improvements or revisions.

Major Comments: 1. The author used the fixed calibration offsets for the snowfall experiments, which is not reasonable. Since those observed Ze-S relationships are the reference relationships for selecting the optimal aspect ratios, it is important to correct the errors in radar reflectivity considerably. The attenuation at Ka and W bands due to the liquid water and snow can be significant and is heavily profile-dependent. We need to calculate the attenuation at Ka and W bands due to the cloud liquid water and snow for each profile, even the author only used the near-surface bin. I understand that the reliable source of cloud liquid water profile might not be available for the datasets used in this paper, but we should at least correct the attenuation due to the snow using a better method. See the reference: Kulie, M. S., M. J. Hiley, R. Bennartz, S. Kneifel, and S. Tanelli (2014), Triple frequency radar reflectivity signatures of snow: Observations and comparisons to theoretical ice particle scattering models, J. Appl. Meteorol. Climatol., 1080–1098, doi:10.1175/JAMC-D-13-066.1.

2. Please clarity the definitions of "fluffy" and "rimed" snowflakes and why the author separated the snow events into these two types? Did the author try to study the "unrimed" and "rimed" snowflakes"? the "rimed" snowflakes are usually associated with high density, while the "unrimed" snowflakes can be considered as low-density particles. In this way, it is better to explain why two snowflake habits have different Ze-S relations.

3. Do you have the Ze-S relationships for DDA results? Since you choose the riming particle model, it is good to compare the DDA results using the riming particle model with the TMM results and the observations. Please add the DDA results for Fig. 3 to 6.

4. "The latter consideration leads to the conclusion that the soft spheroid approximation may work rather well for computing radar reflectivity since the errors for larger particles

are compensated by those for smaller particles". This conclusion is not correct, if you restrict the particle size range, you usually don't see this compensation.

Minor Comments: 1. Page 2, line 35, "from from", delete one 2. Page 3, line 31, change "64x48" to "64$\times$48"

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Interactive comment on Atmos. Meas. Tech. Discuss., doi:10.5194/amt-2017-485, 2018.