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The Impact of Size Sorting on the Polarimetric Radar Variables

Abstract

Hydrometeor size sorting occurs because large and heavier drops fall faster than smaller and lighter drops. Factors such as updraft and vertical wind shear can maintain this size sorting phenomena. This study quantifies the effect of size sorting to polarimetric radar variables such as Z_H (radar reflectivity factor at horizontal polarization), Z_{DR} (differential reflectivity), K_{DP} (specific differential phase) and ρ_{hv} (correlation coefficient). These polarimetric variables are computed from two idealized bin models: pure sedimentation and vertical wind shear. Errors in radar variables simulated by single-, double-, and triple-moment bulk microphysics parameterizations are quantified for the same size sorting mechanisms.

Results show that size sorting produces regions of sparsely concentrated large drops lacking small drops. This causes large Z_{DR} values along a gradient of relatively low values of Z_H. Single moment schemes are unable to produce size sorting which leads to underestimations compared to the bin models. Double-moment schemes excessively produce size sorting which in turn produces huge overestimations. On the other hand, triple-moment schemes, which prognose the shape parameter better capture the narrowing drop size distribution. Such results and their implications to radar data assimilation in storm-scale numerical weather models were discussed.

Keywords

Size sorting

Drop size distribution

Reference

Kumjian, M.R. and Ryzhkov, A.V. (2012) 'The impact of size sorting on the polarimetric radar variables', *Journal of the Atmospheric Sciences*, 69(6), pp. 2042–2060. doi:10.1175/jas-d-11-0125.1.