Threshold Radar Reflectivity Separating Precipitating from Non-Precipitating Clouds

Contributors

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Research Highlight

Precipitating clouds exhibit different properties from their nonprecipitating counterparts. Although many of the differences between the two types of clouds are obvious from cursory observation, how to accurately separate precipitating from non-precipitating clouds is anything but trivial, and much effort has been devoted to this endeavor. Empirical studies suggest the existence of a threshold of radar reflectivity between nonprecipitating and precipitating clouds; however, there has been neither a rigorous theoretical basis for the threshold reflectivity nor a sound explanation as to why empirically threshold reflectivities differ among studies.

In a paper published in the February 6 issue of the Geophysical Research Letters, Yangang Liu and coauthors present a general theory for the threshold reflectivity by relating it to the autoconversion process. This theory not only demonstrates the sharp transition from cloud to rain when the radar reflectivity exceeds some value (threshold reflectivity) but also reveals that the threshold reflectivity is an increasing function of the cloud droplet concentration (see the accompanying figures). The dependence of threshold reflectivity on droplet concentration suggests that the differences in empirically determined threshold reflectivity arise from the differences in droplet concentration. The theoretical prediction compares favorably with measurements collected over a wide range of conditions, further providing observational support for the theoretical formulation.

This work is expected to have many potential applications, especially to remote sensing of cloud properties and studies of the second aerosol indirect effect.

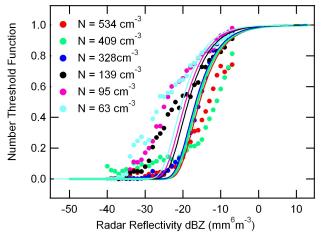

Figure 1 shows the comparison of the theoretical threshold function (representing the frequency of drizzle occurrence over the corresponding reflectivity) to the observational results. The dots and curves represent the measurements and the results derived from the theoretical expression, respectively. The different colors represent the cases with different observed cloud droplet concentrations given in the figure Legend.

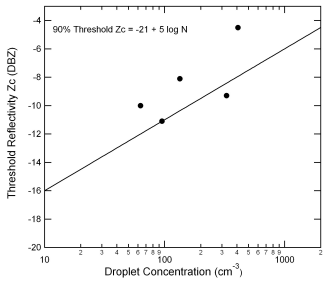

Figure 2 shows the dependence of threshold reflectivity on droplet concentration. The dots and solid represent the measurements and theoretical prediction, respectively.

Reference(s)

Liu, Y, B Geerts, PH Daum, R McGraw, and M Miller. 2008. "Threshold radar reflectivity for drizzling clouds." Geophysical Research Letters 35, L03807, doi:10.1029/2007GL031201.

Working Group(s)

Cloud Properties