

**Multi-Moment Formulation of Autoconversion Process and  
Threshold Radar Reflectivity**

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**ABSTRACT**

The analytical formulation previously derived for the autoconversion rate of the cloud liquid water content (mass autoconversion rate) is generalized to consider the rate of change of any moment of the cloud droplet size distribution caused by the autoconversion process. The theoretical expression for the autoconversion rate of the cloud droplet concentration (number autoconversion rate) is examined in detail as a function of the liquid water content, droplet concentration and relative dispersion of the cloud droplet size distribution, revealing that the number autoconversion rate is not linearly proportional to the mass autoconversion rate as commonly assumed in existing multi-moment parameterization schemes of cloud microphysics. Including the previous formulation for mass autoconversion rate as a special case, the generalization provides a consistent theoretical framework for developing a multi-moment parameterization of the autoconversion processes. We further apply the autoconversion formulation to examine the threshold of radar reflectivity that separates precipitating clouds from nonprecipitating clouds. An analytical expression that relates the reflectivity threshold to droplet concentration is presented.