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EXPRESSION FOR CRITICAL RADIUS AND GENERALIZATION TO CONSIDER SPECTRAL DISPERSION

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ABSTRACT

A key process that must be parameterized in models of various scales is the autoconversion process whereby large cloud droplets collect small ones and become embryonic raindrops. Accurate parameterization of this process is especially important for studies of the second indirect aerosol effect. The later Kessler-type parameterizations can be generically written as $P = fH(r_m - r_c)$, where P is the autoconversion rate; f is a function of L and N; r_m is the characteristic radius; r_c is the critical radius; the Heaviside function $H(r_m - r_c)$ is introduced to describe the threshold process such that there is no autoconversion when $r_m < r_c$.

The critical radius r_c has been largely considered an empirical parameter that is arbitrarily tuned to match model simulations with observations. Recently, we formulated a kinetic potential theory on rain formation, and derived analytical expression that relates r_c to the liquid water content and droplet concentration. The primary objective of this work is to generalize the formulation to consider the effect of the relative dispersion of the cloud droplet size distribution. The effect of relative dispersion on precipitation and second indirect aerosol effects are also explored using the generalized expressions.

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