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# DEPENDENCE OF CLOUD DROPLET EFFECTIVE RADIUS ON SPECTRAL DISPERSION OF CLOUD DROPLET SIZE DISTRIBUTIONS AND ITS IMPLICATIONS

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Cloud droplet effective radius $r_e$ (defined as the ratio of the third to second moment of the droplet size distribution) is critical for studying cloud effects in climate models. It needs to be parameterized in terms of variables predictable in climate models. The parameterization of $r_e$ as the cubic root of the ratio of the cloud liquid water content (L) to the total droplet concentration (N), i.e., $r_e = \alpha(L/N)^{1/3}$, is becoming widely accepted. The principal distinction between different parameterization schemes lies in the specification of the prefactor $\alpha$, which depends on the spectral dispersion of the cloud droplet size distribution. This work focuses on the dependence of $\alpha$ on the spectral dispersion d. Existing $\alpha$d relationships are reviewed, and new ones are derived assuming the widely used gamma and lognormal cloud droplet size distributions. These expressions are compared to each other, and to the cloud microphysical data collected during two recent field studies conducted in Oklahoma. The results suggest the necessity of predicting $\alpha$ in climate models in addition to L and N. The results also facilitate the judgement over which analytical expression is most suitable for describing cloud droplet size distributions for evaluating the effective radius, which has many practical applications such as remote sensing of effective radius.

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