# On the parameterization of evaporation of raindrops below cloud base

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Evaporation of raindrops can lead to a significant reduction of the surface precipitation compared to the precipitation flux at cloud base. A precise parameterization of this process is therefore an important issue in quantitative precipitation forecasts, and even for the estimation of precipitation by radar, since a significant amount of rain can evaporate below the lowest radar elevation.  Evaporation of raindrops provides also an important link between cloud microphysics and cloud dynamics. In mesoscale convective systems the evaporation of raindrops determines the strength of the cold pool and subsequently the organization and life time of convective systems.  For boundary layer clouds, like marine stratocumulus for example, observations show that often more than 80 % of the drizzle drops evaporate below cloud base and the associated cooling of the boundary layer has an important impact on the macroscopic cloud structure.

In cloud-resolving numerical models the evaporation of raindrops received surprisingly little attention up to now. Usually the parameterizations follow Kessler's assumptions, e.g. using an exponential drop size distribution combined with a power law relation for the fall speed. For convection-resolving models these assumptions might be insufficient as the variability of the size distribution in convective situations is much larger than in stratiform rain. Using a multi-moment approach, as it is done in some current research models, does not a-priori solve this problem but poses additional ones, like the question of size effects of evaporation. Does evaporation increase or decrease the mean size of the raindrops?

To shed some light on theses issues the process of evaporation of raindrops below cloud base is investigated by numerical simulations using a idealized one-dimensional rainshaft model with high-resolution bin microphysics. The simulations reveal a high variability of the shape of the raindrop size distributions which has important implications for the efficiency of evaporation below cloud base. A new parameterization of the shape of the raindrop size distribution as a function of the mean volume diameter is suggested and applied in a two-moment microphysical scheme. In addition, the effect of evaporation on the number concentration of raindrops is parameterized. A comparison of results of the revised two-moment scheme and the bin microphysics rainshaft model shows that the two-moment scheme is able to reproduce the results of the reference model in a wide parameter range.