ON THE VARIABILITY OF BELOW-CLOUD AEROSOL REMOVAL BY PRECIPITATION

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Below-cloud aerosol removal by precipitation is the process by which atmospheric particles are scavenged by falling raindrops. Representation of this process in current aerosol transport models based on mass continuity equations requires accurate average mass scavenging coefficients. This study presents a detailed approach for calculation of below-cloud aerosol mass scavenging coefficients based on the concept of efficiency of collision between an aerosol particle and a raindrop. The model is applied to reported data of aerosol size distributions from recent field experiments in various environments (marine, remote continental, polluted continental, urban, and dust events) for a wide range of precipitation conditions. Results show that below-cloud scavenging coefficient increases with precipitation rate and has a significant dependence on aerosol size distribution parameters. Fine and coarse particles are removed very efficiently even by moderate precipitation while the particles in accumulation mode tend to be less scavenged by this process. The variability of precipitation rate can produce rapid changes in aerosol size distribution in the boundary layer and therefore can produce significant changes in the scavenging coefficients. Implications of these results on the representation of wet removal in aerosol transport models are discussed.