A Newly Developed Multiple-parameter Bulk Cloud Scheme. Part I: A New triple-moment condensation scheme

List of Authors

Jun Zhang (Chinese Academy of Sciences), Jiming Sun (Chinese Academy of Sciences)

Abstract

The cloud droplet spectra are spuriously broadened in the simulations with the double-moment condensation schemes. A new triple-moment condensation scheme has been developed for correctly describing the evolution of the cloud droplet spectra. In this scheme, the three-parameter gamma distribution function of cloud droplet mass was adopted. The prognostic equations of the spectral shape parameter and the slope parameter were derived by means of the number mixing ratio, the mass mixing ratio and the radar reflectivity mixing ratio. The new parameterization scheme were validated through comparison with a bin scheme, a double-moment scheme and the analytical approach. The new scheme can overcome the spurious cloud droplet spectrum broadening induced by the fixed shape parameter of the double-moment scheme. The error of the new scheme is within 2% for the mean-volume radius, the mass mixing ratio and the radar reflectivity mixing ratio, but using only two-moments to describe the gamma distribution leads to 6% underestimation for the mean-volume radius and 17% underestimation for the mass mixing ratio compared with analytical results. The new scheme is able to accurately describe the evolution of the cloud droplet spectra and predict the mean-volume radius, the mass mixing ratio and the radar reflectivity mixing ratio during condensation.

Jun Zhang
40# huayanli, Qijiahuozi, Deshengmenwai, Chaoyang District, Beijing, China
zhangjun@mail.iap.ac.cn