Abstract

Deep convective clouds (DCCs) associated with tropical convection, are significant sources of precipitation in Equatorial East Africa. The DCCs play a fundamental role in hydrological and energy cycle. Weather Research and Forecasting (WRF) model with detailed bin-resolved microphysics are used to explore the diurnal variation of DCCs under maritime/clean and continental/polluted conditions. The sign and magnitude of the Twomey effect, droplet dispersion effect, cloud thickness effect, Cloud Optical Depth (COD) susceptibility to aerosol perturbations, and aerosol effects on clouds and precipitation is evaluated. Twomey effect emerges as dominant in total COD susceptibility to aerosol perturbations. The dispersion effect is positive and accounts for 3-10% of the total COD susceptibility at nighttime, with greater influence on heavier drizzling clouds. The cloud thickness effect is positive (negative) for a moderate/heavy drizzling (light thickness) clouds. The cloud thickness effect results in 5-22% of the nighttime total cloud susceptibility. Cloud microphysical properties and accumulated total precipitation show a complex relationship under varied aerosol conditions. The mean of core updraft and maximal vertical velocity increased (decreased) under low (high) CCN scenarios. Overall, the total COD susceptibility ranges from 0.28-0.53 at night; an increase in aerosol concentration enhances COD, especially with heavier precipitation and in a clean environment. During the daytime, the range of magnitude of each effect is more variable owing to cloud thinning and decoupling. The ratio of the magnitude of cloud thickness effect to that of the Twomey effect depends on cloud thickness and base height in unperturbed clouds while the response of precipitation to increase in aerosol concentration was non-monotonic