Geophysical Research Abstracts
Vol. 17, EGU2015-2660, 2015
EGU General Assembly 2015

The relationship between latent heating, vertical velocity, and precipitation processes: The impact of aerosol

Wei-Kuo Tao and Xiaowen Li
NASA GSFC, Mesoscale Atmospheric Processes Laboratory, Greenbelt, Maryland, United States (wei-kuo.tao-1@nasa.gov)

In this study, a two-dimensional cloud-resolving model with spectral-bin microphysics is used to investigate the vertical velocity and precipitation associated with three physical processes (i.e. latent heating (LH), cool-pool and ice microphysics) that could determine the aerosol impact on deep convective precipitation. Evaporative cooling in the lower troposphere is found to enhance rainfall under high cloud condensation nuclei (CCN) concentrations versus low in the developing stages of a tropical precipitation system. In contrast, a midlatitude case produced more rainfall under low CCN concentrations. Deep convective invigoration in this case was also via evaporative cooling. Nevertheless, LH release is stronger (especially after initial precipitation) for the case having more rainfall in both the tropical and midlatitude environment. Sensitivity tests are performed to examine the impact of ice and evaporative cooling on the relationship between aerosols, LH and precipitation processes.

Detailed analyses of the individual terms governing convective draft strengths show that temperature buoyancy can enhance updrafts (downdrafts) in the middle/lower troposphere in the convective core region; however, the vertical pressure gradient force (PGF) is the same order and acts in the opposite direction. This suggests that the PGF is as important as the LH term in determining convective updraft strength. Water loading is small but on the same order as the net PGF-temperature buoyancy forcing, suggesting that water loading could also be important for cloud vertical velocities. The balance among these terms determines the intensity of convection.