Geophysical Research Abstracts
Vol. 16, EGU2014-4652-1, 2014
EGU General Assembly 2014

Numerical investigation for the effects of the vertical wind shear on the cloud droplet spectra broadening at the lateral boundary of the cumulus clouds

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The vortex-structure circulation at the top of cumulus clouds can result in air entrainment at the lateral sides of them. The entrained air at the early developing stage of cumulus clouds can lead to new cloud droplet activation at their lateral sides due to its upward expansion cooling induced by the gradient force of the dynamic perturbation pressure. The vertical wind shear may strengthen such a mechanism for cloud droplet nucleation at the lateral sides of cumulus clouds. In order to investigate the impacts of the vertical wind shear on the cloud droplet spectra broadening at the lateral sides, we used the Weather Research and Forecasting (WRF) Model coupled with an aerosol-cloud interaction bin model with a high spectrum resolution (90 bins for aerosols, 160 bins for water drops) and a high spatial resolution (25m in vertical, 50m in horizontal). We run the Large Eddy Simulation (LES) case in the Tianhe supercomputer with more than 1000 CPUs. In our simulations, a new aerosol parameterization scheme have been proposed in order to investigate the secondary activation of cloud condensation nuclei (CCN). The activated CCN will not be cleaned as the current approach. CCN coming from the evaporated cloud droplets can be explicitly determined. Our results show that the vertical wind shear can enhance the cloud droplet nucleation at the leeward lateral side.