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Spectra of turbulent flow in cumulus cloud[1] TOSHIYUKI GOTOH, IZUMI SAITO, TAKESHI WATANABE, Nagoya Institute of Technology — We have seamlessly simulated evolution of droplets and turbulence for about ten minutes in a small box which is ascending inside the maritime cumulus cloud. Under the prescribed vertical structure of the mean temperature and water vapor mixing ratio and the periodic boundary condition, the turbulence is computed by the DNS and the particles evolve obeying the condensation-evaporation, collision-coalescence with the hydrodynamic interaction, the Reynolds number dependent drag, and the gravitational sedimentation. It is found that the kinetic energy spectrum obeys nearly Kolmogorov spectrum $k^{-5/3}$ while the spectra of the temperature and water vapor mixing ratio are much shallower than $k^{-5/3}$. An explanation of modification of the spectra is explored by examining the droplet number density spectrum $E_n(k,t)$ and the condensation rate spectrum $E_{C_\mathrm{d}}(k,t)$. Two spectra are very similar to each other, nearly k^1 at low wavenumber range and $k^{-\alpha}, 1<\alpha<2$ at high wavenumber range. It is argued that the coupling between droplets and temperature and water vapor mixing ratio through the condensation-evaporation yields the shallow spectra. Comparison with the data observed at mountain top is also made.

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