

Numerical Modelling of Small-Scale Turbulence in Clouds

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This paper discusses results from a series of idealized numerical simulations of decaying moist turbulence accompanying the microscale cloud/clear-air mixing. In the moist case, kinetic energy of microscale motions comes not only from the classical downscale energy cascade, but it can also be generated internally due to the evaporation of cloud droplets. Three sets of numerical simulations are performed for three intensities of initial large-scale eddies. In each set, a control dry simulation is performed, as well as two moist simulations applying either bulk or detailed representation of cloud microphysics. Model results suggest that, as far as the evolutions of enstrophy and turbulent kinetic energy are concerned, significant impact of moist processes occurs at low intensities of initial large-scale eddies. In such a case, mixing and homogenization are dominated by the kinetic energy generated as a result of evaporation of cloud water and its impact on the microscale buoyancy. Detailed microphysics, which explicitly treat the size-dependence of cloud droplet sedimentation and evaporation, appear to have a comparatively small effect, although this result might be an artifact of a coarse grid-resolution used in the simulations. High anisotropy, also observed in laboratory experiments with mixing between cloudy and cloud-free air, prevails even at high intensities of initial large-scale eddies, despite the fact that mixing and homogenization proceed in a similar manner in moist and dry simulations.

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