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MMM SEMINAR *NCAR*

Effects of Cloud Turbulence on Warm-Rain Processes in Maritime Shallow Convection

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This presentation will discuss cloud field simulations aiming at quantitative assessment of the effects of cloud turbulence on rain development in shallow ice-free convective clouds. We compare large-eddy simulations (LES) of cloud fields applying the bin microphysics scheme and either the standard gravitational collision kernel or the kernel that includes enhancement of droplet collisions due to cloud turbulence. Simulations for a range of cloud condensation nuclei (CCN) concentrations are contrasted. Details of the turbulent kernel and how it is used in LES simulations will be explained. Because of the disparity in spatial scales between DNS studies guiding the turbulent kernel development and the LES simulations of cloud dynamics, we address the issue of the turbulence intermittency in the unresolved range of scales on the mean collision kernel applied in LES. We show that intermittency effects are unlikely to play a significant role in current simulations. Highly-idealized single-cloud simulations are used to illustrate two mechanisms that operate in cloud field simulations. First, the microphysical enhancement leads to an earlier formation of drizzle through faster autoconversion of cloud water into drizzle, as suggested by previous studies. Second, more efficient removal of condensed water from cloudy volumes when turbulent collection kernel is used leads to an increased cloud buoyancy and enables clouds to reach higher levels. This is the dynamical enhancement. Both mechanisms seem to operate in the cloud field simulations and they lead to an impressive surface precipitation enhancement when turbulent kernel is used. Implications of these results for future modeling and observational studies of shallow convection, as well as for the parameterization of these clouds in larger-scale models will be discussed.

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Refreshments 3:15 PM
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