# Impacts of small-scale turbulence on cloud and precipitation processes in maritime shallow convection

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Cloud turbulence has been argued to play a significant role in the development of precipitation through the warm-rain (collision/coalescence) processes. In recent years, we developed collision kernels that include effects of cloud turbulence on collisions between cloud droplets. The kernels apply the theoretical model of the turbulent droplet collisions verified by direct numerical simulation (DNS) of droplet-laden turbulent flows. The impact of cloud turbulence on the collision efficiency was also included and it was assessed using a novel DNS methodology that includes hydrodynamic interactions between droplets carried by the turbulent flow. In general, the turbulent collision kernel depends on the characteristics of the small-scale turbulence, the turbulent dissipation rate in particular. This talk will focus on our recent work applying this new kernel in realistic cloud simulations to quantify its impact.

We shall first review the above developments and discuss application of the new kernel to large-eddy simulations of shallow precipitating convection applying warm-rain bin microphysics. The results will be compared to those based on the traditional gravitational collision kernel. A significant enhancement of the surface precipitation rate was observed and explained as the combination of cloud microphysical and dynamical effects. We further discuss the model results in the context of past studies concerning effects of cloud and precipitation processes on macroscopic cloud characteristics. The question of whether the effects of cloud turbulence on rain formation can be corroborated by remote sensing observations will also be briefly addressed.