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Precipitation effects on shallow cumulus convection

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Large-eddy simulation, with both bulk and bin-resolved microphysics, is used to explore the effects of precipitation on the evolution and structure of shallow cumulus clouds. Past work has speculated that precipitation (which may be regulated by cloud droplet concentrations, and hence the atmospheric aerosol) tends to reduce cloudiness. Our simulations show that the evolution and structure of the cloud layer depends on the cloud droplet concentration in myriad ways. Precipitation can actually increase the lifetime of condensate, help initiate secondary convection, or quench the growth of the cloud. Our results suggest that it is unlikely that cloudiness in the trades depends on precipitation efficiency (and hence aerosol concentrations) in simple, or universal, ways; consequently climate studies based on parameterizations which imply such simple relations are likely to be misleading.