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Correlation of Cloud Droplet Growth with the Scalar Fluctuations in a Turbulent Moist Convection[1] KAMAL KANT CHANDRAKAR, WILL CANTRELL, KELKEN CHANG, DAVID CIOCHETTO, DENNIS NIEDERMEIER, Michigan Technological Univ, MIKHAIL OVCHINNIKOV, Pacific Northwest National Laboratory, RAYMOND SHAW, FAN YANG, Michigan Technological Univ — Cloud droplet growth in a turbulent environment is studied by creating turbulent moist Rayleigh-Bénard convection in the Michigan Tech Pi Chamber. Cloud formation is achieved by injecting aerosols into the water-supersaturated environment created by the isobaric mixing of saturated air at different temperatures. A range of steady-state cloud droplet number concentration is achieved by supplying aerosols at different rates. As steady-state droplet number concentration is decreased the mean droplet size increases as expected, but also the width of the size distribution increases. This increase in the width is associated with larger supersaturation fluctuations due to the slow droplet microphysical response (sink of the water vapor) compared to the fast turbulent mixing (source of the water vapor). The observed standard deviation of the squared droplet radius is a linear function of the combined time scale of the system $\tau_s^{-1} = \tau_c^{-1} + \tau_t^{-1}$; here, τ_c is the phase relaxation time and τ_t is the turbulence correlation time. A stochastic differential equation approach for supersaturation also predicts the same linear response. This finding has significance for cloud-radiation budgets and precipitation formation.

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