MMM SEMINAR SERIES

Broadening of cloud droplet spectra through eddy hopping: Why did we all have it wrong?

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The impact of turbulence on diffusional growth of cloud droplets has a long history in cloud physics research. Cooper (*J. Atmos. Sci.* 1989) argues that droplet spectrum observed at a given location within a cloud comes from different droplet trajectories through a turbulent cloud and thus different droplet growth histories. This is what we refer to as the "eddy hoping" mechanism. This mechanism has been investigated over the last two decades applying theory and numerical simulations using idealized frameworks of stochastic models, DNS, and scaled-up DNS. The theory advanced by Sardina et al. (*Phys. Rev. Let.* 2015), supported by their numerical simulations, suggests that the spectral width should continuously increase in time due to eddy hopping in homogeneous isotropic turbulence, with the spectral width of the radius squared distribution increasing as the square root of time. That scaling has been confirmed in several subsequent studies. However, we show that all those studies feature a fundamental flaw of droplets dispersing in the vertical direction, and the spectral width increase resulting from the correlation of the droplet radius with its vertical position. In fact, the square root of time scaling is the same as the scaling of the droplet position standard deviation in the random walk model. When droplet dispersion is accounted for, the spectral width at a given height or a small height range remains approximately constant in time, with the width dependent on the vertical depth over which droplet statistics are gathered (and arguably on the initial spectral width during cloud droplet formation through activation of cloud condensation nuclei). This presentation will briefly review the theory and past numerical studies showing the square root of time scaling of the droplet radius squared distribution and discuss results of numerical simulations where the impact of the droplet vertical dispersion is accounted for0

Thursday, 08 February 2024, 2:00PM

Refreshments 1:45PM

Please also join colleagues for refreshments and informal discussion after the seminar until 3:30pm

NCAR-Foothills Laboratory, 3450 Mitchell Lane

FL2-1022, Large Auditorium

Seminar will also be live webcast

https://operations.ucar.edu/live-mmm

Participants may ask questions during the seminar via Slido.