Investigating Raindrop Evaporation, Breakup, and Coalescence in Stratiform Rain

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This presentation will describe an investigation of raindrop evaporation, breakup, and coalescence in stratiform rain using vertically pointing radars during the U.S. Department of Energy (DOE) Atmospheric Radiation Measurement (ARM) GoAmazon field campaign in Amazonia, Brazil.

The first step of this study exploits the Rayleigh and non-Rayleigh scattering signatures in 1.29- and 95-GHz (UHF and W-band) vertically pointing radar Doppler velocity spectra observations to retrieve profiles of vertical air motion and raindrop size distributions (DSDs). These radar-based DSD retrievals are referenced to surface disdrometer observations. Retrievals are limited to profiles with rain rates less than approximately 10 mm hr⁻¹ due to W-band signal attenuation and extinction at larger rain rates.

The second step of this study quantifies the intensity of the precipitation using liquid water content (LWC) and describes the DSD using the total number concentration (Nt) and characteristic mean size and breadth. Using decomposition diagrams (Williams 2016), evaporation is quantified by the change in LWC with height. If evaporation is negligible, then changes in Nt and DSD shape on the decomposition diagram show how raindrop mass is rearranged between raindrop number and size. These changes provide a signature due to breakup and coalescence processes. If evaporation is not negligible, then DSD changes with height are due to rearranging of raindrop mass and due to the loss of raindrop mass.

Results from two GoAmazon campaign rain events will be highlighted in this presentation to contrast when evaporation is negligible and when evaporation is not negligible.


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