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Cloud Microphysical Structure Analysis Based on High-Resolution In Situ Measurement

Abstract

This study analyzes the microphysical properties and shapes of droplet size distributions (DSDs) based on aircraft observations collected at 25 Hz during three transects through developing convective clouds in the CAIPEEX campaign. The results show that droplet number concentration (N_c) and liquid water content (LWC) exhibit sharp variations near cloud edges, while changing more gradually in strong updraft regions. In some cases, the horizontal LWC distribution appears trapezoidal with particularly steep gradients at the edges. The observed maximum LWC is lower than the adiabatic value, but a high adiabatic fraction in the cloud core suggests limited dilution. Strong updraft regions are associated with higher LWC/LWC_{max} ratios, larger droplets, and narrower, more uniform DSDs, whereas areas near cloud edges with low LWC/LWC_{max} display highly variable DSDs containing both small and large droplets. Mixing analysis further indicates significant in-phase turbulent fluctuations between LWC and N_c ; the effective radius remains relatively constant in updraft zones but decreases near cloud edges, and the spectra of LWC and N_c follow the Kolmogorov $-5/3$ law.

Keyword

Droplet size distribution (DSD)

Entrainment

Reference

Konwar, M., T. Prabhakaran, A. Khain, and M. Pinsky, 2021: Cloud microphysical structure analysis based on high-resolution in situ measurements. *J. Atmos. Sci.*, **78**, 2265–2285, <https://doi.org/10.1175/JAS-D-20-0229.1>.