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Laboratory simulations of cumulus cloud flows explain the entrainment anomaly RODDAM NARASIMHA, SOURABH S. DIWAN, JNCASR, Bangalore, DUVVURI SUBRAHMANYAM, CALTECH, K.R. SREENIVAS, JNCASR, Bangalore, G.S. BHAT, IISc, Bangalore — In the present laboratory experiments, cumulus cloud flows are simulated by starting plumes and jets subjected to off-source heat addition in amounts that are dynamically similar to latent heat release due to condensation in real clouds. The setup permits incorporation of features like atmospheric inversion layers and the active control of off-source heat addition. Herein we report, for the first time, simulation of five different cumulus cloud types (and many shapes), including three genera and three species (WMO Atlas 1987), which show striking resemblance to real clouds. It is known that the rate of entrainment in cumulus cloud flows is much less than that in classical plumes - the main reason for the failure of early entrainment models. Some of the previous studies on steady-state jets and plumes (done in a similar setup) have attributed this anomaly to the disruption of the large-scale turbulent structures upon the addition of off-source heat. We present estimates of entrainment coefficients from these measurements which show a qualitatively consistent variation with height. We propose that this explains the observed entrainment anomaly in cumulus clouds; further experiments are planned to address this question in the context of starting jets and plumes.

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