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Direct Numerical Simulation of a Transient Cumulus Flow PRASANTH PRABHAKARAN, SURESH DESHPANDE, RODDAM NARASIMHA, JNCASR — Clouds play a major role in climate change, and the ability to simulate moist convection patterns is crictical for prediction of tropical weather and climate. Recent laboratory experiments (Narasimha et al. (2011) PNAS 108.39 (2011): 16164-16169) have successfully reproduced a variety of naturally occuring cloud types and shapes, and throw light on the mechanisms responsible for entrainment and detrainment in cloud flows. Based on this work it was proposed that a 'transient diabatic plume' subjected to off-source diabatic heating is an appropriate model for cumulus flow. In the present work we report the first direct numerical simulation of such a transient diabatic plume, by solving the 3D Navier-Stokes-Boussinesq equations. Visualisation of the cloud flow is carried out using a coarse grid of around 4 million grid points. The final simulation was performed using 128 million grid points at a Reynolds number of 2000. We present the evolution of different flow variables for the transient flow and compare it with a stationary state non-diabatic plume. In particluar, we present results on the dramatic effect of off-source heat addition on the vortical structures in the flow field and on the entraining velocity field.

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