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The small spatial scale and rapid evolution of cumulus clouds make them especially difficult to predict. Improving predictability of clouds requires updating cumulus parameterizations used by global weather and climate prediction systems that make numerous assumptions that are not well-founded in observations or high-resolution numerical modeling studies of convection. Many recent studies of numerically simulated convection suggest that cumulus clouds must reach a critical horizontal size before deepening out of the atmospheric boundary layer. This critical size depends on environmental parameters (e.g., humidity, temperature, vertical wind shear). In a changing environment, the critical size could change, decreasing if the environment becomes more favorable. For example, increasing environment humidity can reduce updraft dilution and increase the effective buoyancy acting on an updraft. On the other hand, the critical size could remain constant over a period of time, and deep convective initiation could occur when something drives the cumulus size distribution toward larger values. Therefore, understanding what processes lead to the horizontal of young cumulus clouds is an important piece to unraveling the puzzle of determining exactly when and where deep convection occurs. This study leverages a large eddy simulation (LES) of a tropical, marine cumuliform cloud population to explore various dynamic and thermodynamic processes that impact when and were clouds deepen. Over 10 million Lagrangian “parcel” trajectories were tracked in the simulation, recording properties of fluid before entering into and during its ascent through both growing and non-growing cumuliform updrafts, and the difference between growing and non-growing clouds are identified.
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