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Dynamics of subsiding shells in actively growing clouds with vertical updrafts VISHNU NAIR, Imperial College London — The dynamics of a subsiding shell at the edges of actively growing shallow cumulus clouds with updrafts is analyzed using direct numerical simulations with grid sizes up to 3072 x 1536 x 1536. The actively growing clouds have a fixed in-cloud buoyancy and velocity. Turbulent mixing and evaporative cooling at the cloud edges generate a subsiding shell which grows with time. A self-similarity analysis reveal that contrary to classical self similar flows, the turbulent kinetic energy budget terms and the velocity moments scale according to the buoyancy and not with the mean velocity. The shell accelerates ballistically with a magnitude defined by the saturation value of the buoyancy of the cloud-environment mixture. In this regime, the shell is buoyancy driven and independent of the in-cloud velocity. The shell thickness and the velocity continue to grow indefinitely and could possibly be limited only by the lifetime of the cloud or thermal. The entrainment coefficient is observed to be a function only of the initial state of the cloud and the environment. This coefficient is linked to the fractional entrainment rate used in cumulus parameterization schemes for large scale models and is shown to be of the same order of magnitude.

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