4–8 November 2019, Kraków, Poland
ECSS2019-96
© Author(s) 2019. CC Attribution 4.0 License.

Entrainment in Supercells

Enoch Jo and Sonia Lasher-Trapp
University of Illinois at Urbana-Champaign, Atmospheric Sciences, United States

The dynamic, thermodynamic, and microphysical properties of turbulent clouds are partially controlled by entrainment, a process that introduces environmental air into a cloud through overturning eddies at the cloud edge. Entrainment typically results in the dilution of the cloud buoyancy and liquid water content which can reduce the updraft speed, cloud top height, and precipitation. While numerous studies have investigated its effects in smaller cumuli, none have examined it in detail in thunderstorms. This study examines the effects of entrainment on a numerically-simulated, right-moving mature supercell thunderstorm. Entrainment is calculated based on the flux of air into the surface of a thunderstorm core, defined as a contiguous volume of 2 g/kg of total hydrometeor mixing ratio and 15 m/s of updraft. A separate algorithm ensures that the entrainment calculations are only performed upon the main core, by eliminating smaller regions that also meet the core criteria. The effects of entrainment upon precipitation processes within the core are quantified using the time histories of the mass of condensate and hydrometeors within the core. The precipitation efficiency of the storm is also examined.

Analysis shows that the rotating storm core entrains and dilutes significantly at all stages of development (contrary to some theoretical predictions), and that the amount of entrainment (and dilution) is highly dependent on the continuously evolving structure of the mesocyclone. Results of examining the role of different environmental vertical wind shear profiles on entrainment, and its effects on precipitation production, will also be presented.