

Kinematic and Microphysical Control of Lightning Flash Rate over Northern Alabama

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The Deep Convective Clouds and Chemistry (DC3) experiment seeks to examine the relationship between deep convection and the production of nitrogen oxides (NO_x) via lightning (LNO_x). A critical step in estimating LNO_x production in a cloud-resolving model (CRM) without explicit lightning is to estimate the flash rate from available model parameters that are statistically and physically correlated. As such, the objective of this study is to develop, improve and evaluate lightning flash rate parameterizations in a variety of meteorological environments and storm types using radar and lightning mapping array (LMA) observations taken over Northern Alabama from 2005-2012, including during DC3. UAH's Advanced Radar for Meteorological and Operational Research (ARMOR) and the Weather Surveillance Radar - 1988 Doppler (WSR-88D) located at Hytop (KHTX) comprises the dual-Doppler and polarimetric radar network, which has been in operation since 2004. The northern Alabama LMA (NA LMA) in conjunction with Vaisala's National Lightning Detection Network (NLDN) allow for a detailed depiction of total lightning during this period. This study will integrate ARMOR-KHTX dual-Doppler/polarimetric radar and NA LMA lightning observations from past and ongoing studies, including the more recent DC3 results, over northern Alabama to form a large data set of 15-20 case days and over 20 individual storms, including both ordinary multicell and supercell convection. Several flash rate parameterizations will be developed and tested, including those based on 1) graupel/small hail volume; 2) graupel/small hail mass, and 3) convective updraft volume. Sensitivity of the flash rate parameterizations to storm intensity, storm morphology and environmental conditions will be explored.