Large Charge Moment Change Lightning in an Oklahoma Mesoscale Convective System

Intended for the "Lightning Effects on the Middle and Upper Atmosphere (including TLEs)" Session Topic

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On 31 May 2013, a line of severe thunderstorms developed during the local afternoon in central Oklahoma, USA. One of the supercells produced the El Reno tornado, which caused significant damage and killed several people. During the 2300 UTC hour (during the mature supercell stage and just after the tornado began), the storm produced several positive cloud-to-ground (+CG) lightning strokes that featured large (> 75 C km) impulse charge moment changes (iCMCs - charge moment during the first 2 ms after the return stroke). These discharges occurred mainly in convection, in contrast to the typical pattern of large-CMC and sprite-parent +CGs occurring mainly in stratiform precipitation regions.

After this time, the line of thunderstorms evolved over several hours into a large mesoscale convective system (MCS). By the 0700 UTC hour on 1 June 2013, the large-CMC pattern had changed markedly. Large-CMC negative CGs, which were absent early in the storm's lifetime, occurred frequently within convection. Meanwhile, large-CMC +CGs had switched to occurring mainly within the broad stratiform region that had developed during the intervening period.

The evolution of the large-CMC lightning in this case will be examined using a mix of polarimetric data from individual radars, national mosaics of radar reflectivity, the Oklahoma Lightning Mapping Array (OKLMA), the Charge Moment Change Network (CMCN), and the National Lightning Detection Network (NLDN). A major goal of this study is understanding how storm structure and evolution affected the production of large-CMC lightning. It is anticipated that this will lead to further insight into how and why storms produce the powerful lightning that commonly causes sprites in the upper atmosphere.