An Analysis of Operational Total Lightning Data During Long-Track Tornadoes

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The 27 April 2011 tornado outbreak brought three distinct waves of tornadic thunderstorms to portions of Mississippi, Alabama, Tennessee, and Georgia, striking the Tennessee Valley of north Alabama and southern Tennessee particularly hard. A total of 42 tornado paths were surveyed across the fourteen county area covered by the National Weather Service (NWS) forecast office in Huntsville, Alabama. Ten of these tornadoes were on the ground for at least 20 miles, two had total path lengths over 130 miles, and six tornadoes were classified as "violent" (EF-4 or EF-5 on the Enhanced Fujita Scale). Many of these tornadoes occurred within the domain of the North Alabama Lightning Mapping Array (NALMA), a ground-based total lightning detection network owned and operated by the NASA Marshall Space Flight Center. Since 2003, the NASA Short-term Prediction Research and Transition Center has supplied data from NALMA in real time to NWS forecast offices in Huntsville, Knoxville/Tri-Cities, Birmingham, and Nashville.

Previous research has documented the utility of total lightning information in predicting tornadogenesis, particularly when combined with other remote sensing tools. Basic warning decision-making during events such as 27 April is not the most difficult part of the process; instead, the focus of warning meteorologists shifts to looking for changes in intensity or possible particularly dangerous situations, since doppler radar velocity data often cannot distinguish between weak and strong tornadoes. To that end, this research attempts to determine if any correlation exists between flash densities of the longest-tracked tornadoes over time, and the surveyed wind speeds of the tornadoes. The long-track EF-5 tornado which struck the Hackleburg, Phil Campbell, and Tanner communities in north Alabama was the primary focus of this research due to its intensity and extended life cycle. However, not all tornadoes were available for total lightning analysis due to widespread power outages which negatively affected the detection efficiency and operation of the NALMA. Therefore, additional storms from 2008-2010 with tracks of at least 20 miles were analyzed for comparison purposes.