Understanding Frequent Lightning Environments over the NWS Albany, NY County Warning Area

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Thunderstorms that produce frequent lightning present numerous hazards extending from property and tree damage to even loss of life. Over the ten year period from 2008 to 2017, lightning resulted in four fatalities within the National Weather Service (NWS) Albany, NY County Warning Area (ALY CWA). With increased emphasis on Impact-Based Decision Support Services where NWS forecasters assist emergency manager partners with public safety operations, it is becoming more crucial to anticipate convective environments that will support frequent lightning. Such reasons motivated this research which aims to develop a frequent lightning climatology over the ALY CWA. This research utilized the National Center for Environmental Information's National Lightning Detection Network archive of cloud-to-ground lightning strikes and investigated 60 cases which produced frequent lightning over the ALY CWA between 2008 and 2017. "Frequent lightning" was defined as a calendar day with 5000 lightning strikes or higher.

Undergraduate students from the State University of New York at Albany, NY assisted in analyzing archived data from the North American Mesoscale Model (NAM) using BUFKIT software for each of the 60 events. Values of various parameters from the model forecast profiles near the time of convective initiation were documented. Parameters that previous research has linked to frequent amounts of lightning were evaluated, including the amount and depth of instability, environmental lapse rates, shear and moisture. Key environmental temperature profile data were also recorded to analyze the potential for both liquid water and ice to coexist within towering cumulus clouds.

Preliminary results were mainly commensurate with our initial thoughts but we discovered a few interesting results. First, the normalized convective available potential energy (NCAPE) values typically exceeded 0.15 ms^{-2} with the more impressive lighting days in excess of 0.20 ms^{-2}. As expected, 700-500 hPa lapse rates ranged from 6.0 °C km^{-1} to 7.0 °C km^{-1} but the higher end lightning days featured even steeper lapse rates from 7.5 °C km^{-1} to 8 °C km^{-1}. Interestingly, the freezing heights ranged from 8 kft to 13 kft and the -20 °C heights remained mainly confined between 20 kft and 23 kft. Since frequent lightning typically occurs in moisture rich environments, we hypothesized that precipitable water values would fall on the higher end of the moisture spectrum but our findings presented an interesting result. Values mainly ranged from 1.00 to 1.75 inches and surprisingly rarely exceeded 2 inches. Another notable result was that effective shear values for frequent lightning days were rather low, generally only between 20 and 35 kts. The values of these and the other selected convective parameters will be presented in box and whisker plots to represent the climatology of frequent lightning environments within the ALY CWA. Our intent is that such a climatology will assist operational forecasters anticipate and communicate hazardous lightning situations to our deep core partners.