ABSTRACT

THESIS: An Observational Study of Urban Modified Thunderstorms Across the Nashville Metro Area, 2003-2012

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A ten year analysis was conducted on the ten county Nashville metro area to determine which atmospheric thermodynamic parameters are important for thunderstorm development in North-Central Tennessee. Spatiotemporal patterns of thunderstorm activity around the city were also studied. Two case studies depicting initiation (July 10, 2009) and bifurcation (June 13, 2010) of thunderstorms were additionally discussed. The purpose of the analysis was to determine whether heat from the urban heat island (UHI) or moisture from the Gulf of Mexico was a larger factor in thunderstorm formation. A similar methodology completed by Dixon and Mote (2003) for Atlanta, Georgia was used for Nashville, Tennessee. Two land based weather stations collecting dry-bulb temperatures, twice daily radiosonde measurements, and local NEXRAD weather radar were used to determine where, when, and how thunderstorms developed around Nashville. One-sample t-test hypothesis testing of 24-hour land-surface temperature differences ahead of each event along with average daily radiosondes dry-bulb and dewpoint temperatures at five standard pressure levels were examined to determine if statistically significant mean differences ($\alpha = 0.05$) were found between average study days. Atmospheric stability indices and other moisture parameters such as precipitable water (PWAT), mixing ratio, theta-e, and lapse rates were examined for average differences between average study days. Ultimately, 22 events were found (18 initiations and 4 bifurcating) over the 10-year period with the non-drought years 2005 and 2010

exhibiting the most events. The warm season month of August showed the largest distribution of events with 8 events during diurnal hours (between 2 p.m.-4 p.m. CDT). The analysis also found 12 storm centers (32%) formed within 1km of interstate highways with 77% (23) of initiation locations falling within 3 km of limited access highways. Statistical results showed that moisture, rather than heat from the UHI, were a larger component to thunderstorm formation over the city of Nashville.