Using Geospatial Analysis to Reconstruct the Thunderstorm Climatology for the Washington DC Metropolitan Region

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Abstract : Air pollution has the potential to modify the lifespan and intensity of thunderstorms and the properties of lightning. Using data mining and geovisualization, we investigate how background climate and weather conditions shape variability in urban air pollution and how this, in turn, shapes thunderstorms as measured by the intensity, distribution, and frequency of cloud-to-ground lightning. A spatiotemporal analysis was conducted in order to identify thunderstorms using high-resolution lightning detection network data. Over seven million lightning flashes were used to identify more than 196,000 thunderstorms that occurred between 2006 - 2020 in the Washington, DC Metropolitan Region. Each lightning flash in the dataset was grouped into thunderstorm events by means of a temporal and spatial clustering algorithm. Once the thunderstorm event database was constructed, hourly wind direction, wind speed, and atmospheric thermodynamic data were added to the initiation and dissipation times and locations for the 196,000 identified thunderstorms. Hourly aerosol and air quality data for the thunderstorm initiation times and locations were also incorporated into the dataset. Developing thunderstorm climatologies using a lightning tracking algorithm and lightning detection network data was found to be useful for visualizing the spatial and temporal distribution of urban augmented thunderstorms in the region.

Keywords : lightning, urbanization, thunderstorms, climatology
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