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Lightning and Thunderstorm events in Greater Metro Manila

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ABSTRACT

LIGHTNING AND THUNDERSTORM EVENTS IN GREATER METRO MANILA

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Lightning activities are used as bases in enhancing prediction of severe convective weather events, particularly nowcasting. Studies showed that lightning activities are highly correlated with precipitation rate. However, linking the occurrence of lighting to the thermodynamics of thunderstorm is not well understood on a localized scale. In the Philippines, there have been a few studies relating lightning with thunderstorm. Precipitation during thunderstorm event can be intense, and the duration of torrential rain can last longer hours resulting to damages in properties, and associated flooding or landslide that may even cause deaths. Thus, developing an early warning system based on lightning activity for severe weather events is of great value. The study aims to evaluate the relationship between lightning and thunderstorm activities in Metro Manila by analyzing their spatiotemporal distribution and investigating the atmospheric profile conditions during thunderstorm across different seasons. Case studies are conducted to identify common features observed from atmospheric profile of thunderstorms that coincided with intense lightning activities.

Daily, monthly, and seasonal patterns of lightning and thunderstorm occurrences are analyzed using the synoptic reports, TRMM Lightning Imaging Sensor, Blizortung and WWLLN lightning detection network, and upper air observations. Variability in the spatiotemporal distribution of lightning was found to be linked with the diurnal cycle with ~ 95% lightning activities observed between late afternoon and early evening. Lightning activities from TRMM LIS (intra-cloud) and WWLLN (cloud-to-ground) depict the high frequency occurrence of thunderstorm in Science Garden station and peak during the southwest monsoon season. Results shows that 57% of lightning occurrences were observed during the southwest monsoon, 25% during transition period, and 18% during northeast monsoon season. High frequency lightning occurrence during southwest monsoon season is associated with atmospheric profiles having large CAPE value of greater than 1000 J/kg, negative lifted index, K index greater than 30°C and precipitable water greater than 41 mm. These implies a high probability of thunderstorm characterized by a strong updraft strength, unstable low-level air parcel, and high precipitation rate. To further demonstrate these results several case studies from the past severe weather events were analyzed. Case studies of severe weather events having high frequency lightning occurrence was due to the thunderstorm having an atmospheric profile initial condition of large CAPE value, negative lifted index, larger K index, and higher precipitable water. It is evident from the case studies that attainment of this initial condition leads to severe form of weather event either during the day or night and regardless of the season.

The relationship of lightning and thunderstorm established in this study can serve as basis for better prediction of thunderstorm in Metro Manila using lightning data. This will be of great value to the different sectors like the government, aviation, insurance, and emergency services.