ABSTRACT

Philippines is one of the places on Earth with high lightning flash frequency according to the global lightning strikes map, however, lightning research is yet to be explored in the country. With the untapped lightning data from the Tropical Rainfall Measuring Mission (TRMM) lightning imager sensor (LIS), this study characterized spatiotemporal variability, trend, and lightning response to large-scale climate factors such as ENSO, MJO, and monsoon index of the 17-year lightning events in the Philippines. Data used in this study were gridded over the study domain with a 10 km by 10 km horizontal resolution before analysis.

Most lightning were found to be generated in diurnal cycle by mesoscale circulations, peaking at the afternoon at 3-5 PM (LST). Monthly variation of lightning showed that lightning activity peaked during the month of May and was least active during the month of January. Seasonal variability showed that lightning events were high during southwest monsoon period (SWM) and transition period (TP). This study found a decreasing trend of lightning in the Philippines over the whole study period. There was also high spatial variability of lightning distribution in the Philippines, with frequent lightning on the western side and less frequent on the eastern side of the country. A lightning hot-spot map was constructed where high lightning event locations were seen in regions of northwestern Luzon, Metro Manila, western Visayas, Zamboanga Peninsula and Central Mindanao. Further examinations of these hot-spot regions showed that lightning was affected by factors such as mesoscale heating leading to land/sea breeze and mountain-valley breeze, seasonality, urbanization, and orography.

In terms of large-scale variability, lightning was inversely correlated to ENSO only during the TP. Results showed a 46.37% more intense lightning activity during May of a La Niña year from normal. In the intraseasonal and seasonal time-scale, lightning is inversely correlated to MJO ($r = -0.6746$) and directly correlated to the Western Pacific monsoon index ($r = 0.6047$). More (less) lightning was observed during wet (dry) phase MJO and stronger (weaker) monsoon forcing over the country. Lastly, lightning and rainfall were found to have moderately significant correlation only during TP where the rainfall was not induced by tropical cyclones. Rain-yields per flash (RPF) parameter was then found to be a reliable indicator for rainfall regions only during TP, over the Mindanao area and some of spots over the western Visayas. This relationship between lightning and rainfall still needs further examination in future researches wherein reducing the effects of typhoon-related rain would most clearly show lightning and rainfall variability. The results of this study were mainly done to improve the knowledge of lightning phenomenology in the country and initiate the development of a lightning climatology map that could aid in mitigating risks associated with lightning hazards and could be further be used in assessing weather surveillance tasks.