

Lightning Geolocation using a Ground-based Lightning Observation Network in the Western North Pacific

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The Philippines sits in the western North Pacific (WNP), which is the region where most of the strongest typhoons originate. An average of 20 tropical cyclones (TC) crosses and/or makes landfall in the Philippines each year. This makes the archipelago susceptible to the damages brought about by TCs. There has been a significant development in the accuracy of TC track forecast within the Philippine Area of Responsibility (PAR) over the years with the use of ground-based synoptic observations, weather radars, and meteorological satellites. However, prediction of TC intensity remains a significant challenge. Lightning activity is the indicator of the dynamics and microphysics in thunderstorms, TCs and torrential rainfall. Recent studies suggest that lightning activity in tropical cyclones can give predictive information about its intensity development. Thus, a ground-based lightning observation system (V-POTEKA) has been developed, and it has been installed at four stations in the Philippines, Guam, Palau and Okinawa. The V-POTEKA system uses the event-trigger method and can detect radio wave pulses from lightning discharges in the very low frequency (VLF) range of 1-50 kHz. It also consists of the automatic weather station (AWS), the VLF sensors, and the automatic data-processing unit. The V-POTEKA system analyzes lightning data, extracts pertinent information, i.e., peak amplitude and time of the triggered waveform, and transmits data to a server in Japan and the Philippines through 3G communication. Lightning locations from the V-POTEKA data are calculated using the difference in time-of-arrival (TOA) method. Lightning activity in TCs along the WNP region was investigated using the V-POTEKA lightning locations. In comparison with blizortung.org, an open-access collaborative lightning detection network, a geolocation error of 48 km was computed for V-POTEKA network. Select TCs in 2019 were examined using NASA Cyclone Global Navigation Satellite System (CYGNSS) ocean winds and best track data from the Japan Meteorological Agency and Joint Typhoon Warning Center. Correlation analyses among lightning activity and maximum winds in TCs showed a 30-hour lag time, calculated using lightning and TC data of Typhoon Fengshen in 2019.

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