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Analysis of Clear-Air Lightning using the KMA Operational LINET (Lightning NETWORK) System

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Abstract

Korea Meteorological Administration (KMA) has been operating the LINET (Lightning NETWORK) system (Nowcast, Germany) in real time at 21 locations since September 2015. The LINET system uses TOA(Time-Of-Arrival) method to detect lightning. The LINET lightning system observes CG (cloud-to-ground lightning) and CC (cloud-to-cloud lightning) using the VLF/LF(5~500kHz) frequency and records only the lightning data detected at five or more points simultaneously. The reliability of the lightning detection observed on the Korean Peninsula is about 95%, and the accuracy of minimum detection location is 150m to 250m (Han et al. 2017).

Lightning strikes were known to be detected with radar echoes, but also the lightning strike can occur when a strong precipitation is accompanied within the radar observation range. Therefore, sometimes the lightning strikes observed in the cloudless atmosphere. So, it is necessary to analyze the reliability of the lightning data observed in the clear-air.

In this study, we analyzed lightning events observed in the clear-air during summer of 2019 using the various weather observation data (numerical model, weather chart, satellite, dual-pol radar, etc.). In order to analyze the clear-air lightning, we categorized the conditions under which lightning strike occurred. In general, lightning strikes occur in deep convection clouds, so we first check the cloud types and conditions for deep convection. Second, the possibility of lightning strikes was analyzed by categories such as instability indexes (SSI, LI, KI, CAPE etc.), temperature-humidity profile, ascending air current, an overpopulated cumulus cloud containing hailstones, radar echoes and wind data, and cloud information from satellite data.

As a result, the lightning strikes tended to occur when the ground humidity, the temperature difference between the upper and lower layers were high, and fog or low clouds were existing. In addition, lightning was observed under conditions that met the atmospheric instability index. In the future work, we plan to develop the quality control method for lightning data to conduct long-term statistical analysis of the lightning data observed on Korean Peninsula.

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