Thunderstorms and Total Lightning Characteristics Causing Heavy Precipitation in Japan: Early Prediction Possibility

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Abstract

In 2021, the flood events increased about 36% then last two decades average and the fatalities accounted for nearly 40% of all weather-related hazards worldwide (CRED 2022). The heavy rainfall events in Japan also caused most fatalities due to floods (43.9%) and landslides (53.8%). According to World Meteorological Organization (WMO), the number of natural disasters is increasing worldwide (5 times in last 50 years) but improved early warnings and disaster management reduced the deaths caused by 3 times.

Recent studies found total lightning monitoring can be very effective in predicting / now-casting heavy rainfall. We have analyzed some isolated and multicellular thunderstorm events with extremely heavy precipitation (~100 mm) that occurred in Japan. The Japanese Total Lightning Network (JTLN) is used to study the lightning characteristics (occurrence, type of strokes, polarity etc.) from 16 stations. The 3D volume scan data from the X-band multi-parameter radar (1-minute time resolution, 250 m spatial resolution, covering most of Japan) are used to analyze the development of precipitation cores. The dependence of ground rainfall with associated different types of lightning (in-cloud, cloud to ground) of the thunderstorms are analyzed and the possible precursory parameter is discussed.

10-20 minutes lead time before the occurrence of the ground torrential rain will give the opportunity to mitigate the casualties as well as infrastructure damage.