Evaluation of deep-learning-based very short-term rainfall forecasts in South Korea

Seok-Geun Oh[1], Chanil Park[1], Seok-Woo Son[1], Jihoon Ko[2], Kijung Shin[2], Sunyoung Kim[3], and Junsang Park[3]

[1]School of Earth and Environmental Sciences, Seoul National University

[2]Kim Jaechul Graduate School of AI, KAIST

[3]National Institute of Meteorological Sciences

This study evaluates the performance of a deep learning model, Deep-learning-based Rain Nowcasting and Estimation (DEEPRANE), for very short-term (1–6 h) rainfall forecasts in South Korea. Rainfall forecasts and in-situ observations from June–September 2020, when record-breaking summer rainfall was observed in South Korea, are particularly considered. It is found that DEEPRANE adequately predicts moderate rainfall events (MREs; $\geq$1 mm h^{-1}) and strong rainfall events (SREs; $\geq$10 mm h^{-1}) with critical success indices of 0.6 and 0.4 at the 1-h lead time, respectively. The probability of detection scores of MRE forecasting are higher than the false alarm rates at all lead times, suggesting that DEEPRANE MRE forecast can be useful even at a long lead time. However, for SRE forecasting, the probability of detection scores become smaller than the false alarm rates at a lead time of 2 h. Localized heavy rainfall events ($\geq$30 mm h^{-1}) are also reasonably well predicted only at a lead time of 2 h. Irrespective of their five types, the forecast scores systematically decrease with lead time. This result indicates that DEEPRANE SRE forecast is useful only for nowcasting. DEEPRANE generally shows better performance in the early morning hours when rainfall events are more frequent than in other hours. When considering synoptic conditions, better performance is found when rainfall events are organized by monsoon rainband rather than caused by extratropical or tropical cyclones. These results suggest that DEEPRANE is especially useful for nowcasting early-morning rainfall events which are embedded in the monsoon rainband.

Key words: deep-learning model, very short-term rainfall forecast, localized heavy rainfall, South Korea