Precipitation Nowcasting Improvements based on an Advanced Deep Learning Model using Composited Radar Reflectivity and ERA5 Reanalysis

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Precipitation nowcasting helps in reducing the damage due to heavy precipitation systems by providing forecasts for preparation, decision-making, and management. Recently, deep learning-based precipitation nowcasting approaches were introduced which performed well. However, a single data source – radar is usually used for the results, which is insufficient to predict the sudden initiation and evolution of precipitation systems caused by the interaction between various atmospheric factors. In this study, we introduce a Deep Neural Network that simultaneously uses radar echoes and two European Centre for Medium-Range Weather Forecasts Reanalysis version 5 (ERA5) variables. The selected ERA5 variables are divergence at 925 hPa (DIV925) and total column water vapor, which are key atmospheric variables for the development of precipitation systems over the Korean Peninsula. The network has an encoder-forecaster based on a sequence-to-sequence structure comprising convolutional Long Short-Term Memory and convolution layers. Additionally, we propose a new loss function suitable for this method. In quantitative evaluation, deep learning-based models outperform the quantitative precipitation forecasts from the McGill Algorithm by Lagrangian Extrapolation (MAPLE), and our method with DIV925 further improves predictability in the early stage of prediction for some high rainfall thresholds. A case study qualitatively confirms that the proposed model has the potential to predict the development of new heavy precipitation systems.

Key words: Nowcasting, Deep Neural Network, Encoder-Forecaster, Radar, Reanalysis

※ This research was supported by the Korea Institute of Science and Technology Information (Project No. K-22-L04-C06-S01).