Precipitation Nowcasting Based on a Deep Learning Model Trained with Heterogeneous Weather Data

Dian-You Chen[1], Pei-Hsin Liu[1], Chia-Tung Chang[1], and Buo-Fu Chen[2]

[1]Center for Weather and Climate Disaster Research,
[2]National Taiwan University, Taipei, Taiwan

Due to the threat of extreme rainfall associated with mesoscale convective systems and summer afternoon thunderstorms, very short-term quantitative precipitation forecasting during 0−3 h is critical in Taiwan. In this study, deep learning models are developed for high-resolution quantitative precipitation nowcasting in Taiwan up to 3 h ahead. The baseline model based on the convolutional recurrent neural network is trained with a dataset containing radar reflectivity and rain rates at a granularity of 10 min. As previous works tend to produce overprediction in low-rainfall regions, the currently proposed model is improved and further driven by highly related heterogeneous weather data, including visible channel satellite observation, environmental winds, and environmental thermo-dynamical profiles. **Note that an innovative "PONI module" is added to the deep learning model to integrate a variety of heterogeneous data with various spatial and temporal characteristics.** Statistical verification shows that the prediction of the new model outperforms the previous model at a larger lead time. The new model integrated with heterogeneous data selected upon domain knowledge can restrain the nowcasts that overestimate in drizzle regions. Finally, quasi-operational verifications against other state-of-the-art techniques in Taiwan Central Weather Bureau are presented as follow: (1) the CSI of the first-hour prediction from deep learning model is comparable with QPESUMS-QPF and better than RWRF and iTeen. (2) 3h ahead prediction CSIs of RWRF and iTeen are inferior to the performance of deep learning model owing to the misprediction of rainfall regions.

Key word: Deep learning model, Convolutional neural network, Nowcast