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Development and evaluation of community model-based short-range precipitation forecast system using radar and AWS

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The Korean Peninsula experiences lots of rain every summer due to typhoons, rainstorms, and a localized heavy rain, etc. To predict those severe weather events, weather forecasts need to be accurate. High-resolution numerical weather prediction (NWP)-based approach is one of available methods to fulfill such a task. However, operational weather centers have generally produced forecasts at regular intervals (e.g. 00, 06, 12, and 18 UTC), which implies that those forecasts could not be optimal to make an accurate prediction when considering the high spatio-temporal variability of summer rainfall events in the Korean Peninsula.

In recent years, many high-performance community models have been developed and have become available. Moreover, availability of observational data and global model products also increases due to the advance in technology. Thus, the local-scale rainfall prediction system that produces short-range precipitation forecasts for specific regions can be built using the aforementioned data and models.

In this study, the community model-based short-range precipitation forecast system was developed and the system performance was evaluated. Radar and surface automated weather station (AWS) observation data of the Korea Meteorological Administration (KMA) were assimilated into the developed NWP system which consists of Advanced Research Weather Research and Forecasting (WRF-ARW) model and Local Transform Ensemble Kalman Filter (LETKF) data assimilation to produce short-range precipitation forecasts. Observation operators for radar observation were also developed. Compared to the operational model with regular initiation times of model integration, the system developed has the advantage of being able to start model integration from any time when the user wants. WRF simulations were conducted for two weeks of summer for the Korean Peninsula and simulation results were verified against observed precipitation data of AWS.

Simulation results reveal that performance of short-range precipitation forecasts from the community model-based NWP system is comparable with that of the KMA Unified Model (UM) Local Data assimilation and Prediction System (LDPS). In particular, a higher level of rain detection exists in this system when compared to the KMA UM LDPS.

This study is worthwhile because it proves that the performance of the community model-based NWP system using WRF and LETKF can be comparable to that of operational NWP system, which provides opportunities for a near-real-time forecasts targeting severe precipitation weather events.

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