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Development of short range analysis and prediction system

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Precipitation forecast for the short range period is one of the most challenging issues due to the spin-up of cloud systems in numerical weather prediction models. The diabatic initialization can improve precipitation initiation and evolution of precipitation (Shaw et al., 2001). In this study, short range analysis and prediction system (SRAPS) was developed for the supporting operational weather forecast.

The SRAPS consists of two main components, analysis tools and prediction model. A 3-dimensional analysis is made from the Local Analysis and Prediction System (LAPS), which was originally developed by NOAA/GSD. The LAPS analysis modules include 3D wind, surface variables, 3D temperature, cloud, humidity, and some other derived variables. A diabatic initialization technique was applied to the SRAPS with the additional use of radar reflectivity and lightning data. Analysis strategy was improved to supply the analysis field within about 15 minutes after analysis time. Available all data sets were brought into the use in analysis: surface observation data, the upper wind data of wind profilers, the images of geostationary satellite, radar reflectivity data, lightning observation data, Aircraft Meteorological Data Relay (AMDAR), Aviation Routine Weather Report (METAR). The short range prediction system was initialized by hot start with active cloud component such as cloud water, cloud ice, rain water.

Analysis fields from the LAPS are then used as initial conditions for meso-scale prediction model. The domain is nested with 15 and 5 km resolutions and 15 km domain is updated every 6 h giving the boundary data to 5km resolution domain. The boundary data of 15km resolution model come from global forecast data. In 2008 we replaced Mososcale Model version 5 (MM5) with Weather Research and Forecasting (WRF) modeling system for short-range forecasting. The resolution of model grid is 5 km in the horizontal, and the model has 40 vertical levels with its top at 50 hPa. The number of the model grids is set to 235×283. The WRF Single-Moment 6-class microphysics scheme, no cumulus parameterization, and the YSU planetary boundary layer parameterization were applied in the forecast model. The system was designed to update the forecasts every 3 hours. The strategy of frequent forecast made the convective system developed suddenly in summer time detectable. This system forecast integrates up to 18 hours. The lateral boundary conditions are provided by 15 km resolution forecast model. The frequency of output of model is 1 hour.

Real time experiments were conducted in the super computer system of Korea Meteorological Administration. The optimization of operating this system can support the model results to the forecasters within about 40 minutes. This process makes the results more useful for the heavy rain case which evolved rapidly. The quantitative precipitation forecasts (QPF) were verified against the data of Automatic Weather System installed in Korea Peninsula. The number of observations is about 600. The results show that the diabatic initialization method is efficient to improve the short-range QPF skill of warm season precipitation events over Korea Peninsula. Explicit initialization of microphysical species would be a good approach to alleviate the spin-up problem. In the meantime, a series of sensitivity tests indicate that diabatic balance procedure of the method is essential component for sustaining initial cloud and describing relevant precipitation distribution.

We established display system for supporting the results of forecast by homepage basically. And another method using GIS information was developed. The outputs from 2-Dimensional graphic package are converted to 3-Dimensional virtual globe data files. Because these are not the bitmap images but the vector images, users can zoom-in or rotate the results with no reducing resolution. So the forecaster can use the output of short range forecast very efficiently.