Development of the Operational Data Assimilation System for Rapid and Frequent Updates of Forecast with the Convection-Permitting Model at JMA

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The Local NWP system is a high-resolution regional weather forecast and data assimilation system, aimed at providing information for aviation operation and disaster prevention. The system is in operation at the Japan Meteorological Agency (JMA) starting from August 2012. In the Local NWP system, the Local Analysis (LA; [1]) produces the initial condition of the 9-hour forecast of the Local Forecast Model (LFM; [1]), a convection-permitting model with a horizontal grid spacing of 2km.

Compared to the Meso-scale Model (MSM; [1]), another operational limited-area model with a lower horizontal resolution of 5km, the LFM puts more emphasis on predicting localized and short-lived severe events. The Local NWP system is thus designed to be suitable for providing rapid forecast guidance and frequent updates of the high resolution very short-range forecast reflecting information from the latest possible observations. Although the current operation runs the LFM every 3 hours on a limited domain covering the eastern part of Japan, the operation is planned to be enhanced in 2013 to become more clearly based on this design, providing hourly updates of the LFM forecast on an extended domain covering whole of Japan and its surrounding area.

In the JMA operation, the LA is scheduled to start at 30 minutes past the hour, and all the LA and the LFM processes are required to complete in 30 minutes, realizing the design of rapid and frequent updates of the forecast. In order to keep this strict schedule, the LA uses a 3D-Var data assimilation scheme, instead of applying 4D-Var, a more advanced but computationally more demanding scheme used to initiate the MSM. In the LA analysis cycle, hourly 3D-Var data assimilations and 1-hour forecasts are iterated in turn for 3 hours at a horizontal resolution of 5km. The analysis cycle uses the latest MSM forecast as the first guess, and assimilates observations received over the latest 4 hours in each operation.

Remote sensing observations including those from weather Doppler radars and ground-based GNSS are assimilated in the LA as important sources of detailed information that can contribute to a better forecast of high impact phenomena. Radar reflectivity data (assimilated as RH pseudo observations) have recently been introduced to show overall improvement in precipitation forecast of the LFM. Taking into account capability of high-resolution NWP to capture small-scale variations of the atmospheric state near the surface, the LA also assimilates surface temperature, wind, and humidity observations from automated weather stations ahead of other JMA operational data assimilation systems in lower resolutions, in order to appropriately reflect effects from local-scale environments near the surface.

The presentation will show details of this LA system characterized as a data assimilation system for a high-resolution and high-frequency NWP, including various developments to improve this system.

References