Data assimilation experiments with LETKF: the case of Niigata - Fukushima heavy rainfall event

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1. Introduction

Heavy rainfall took place in Niigata and Fukushima in the end of July 2011. The forecasts based on the analyses from JMA's non-hydrostatic 4DVAR system (JNoVA) produced the good results, as depicted in Fig. 1. However, the forecasted rainfall location slightly shifts to the southwest and the rainfall amount is somehow underestimated. In this study we approach this heavy rainfall case by using LETKF to see whether LETKF can improve the rainfall forecast in comparison with 4DVAR.

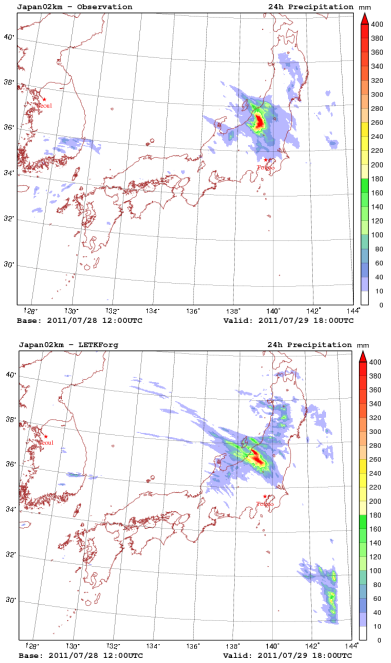

Fig. 1. Observed precipitation (upper-left) in 1-day (29 July 2011) and the corresponding forecasts by NHM with a horizontal resolution of 2 km using JNoVA (upper-right) and LETKF (lower-left) analyses as the initial conditions.

2. Experiments

The NHM-LETKF system developed at JMA was used with some modifications. The system was run at the resolution of 10 km using the same domain as the operational mesoscale model of JMA. This domain had 361x289 horizontal grid points and 50 vertical levels. The assimilation cycle was set to 3 hours. The ensemble forecast in NHM-LETKF used 50 NHM members. The boundary perturbations were interpolated from JMA's one-week global ensemble forecasts. Except the precipitation analyses and retrieved water vapors from radar reflectivity the assimilated observations were

analogous to the ones used in JNoVA. The system was started two days before the day of the heavy rainfall event. The resulting analysis was used as the initial condition for a 30-hour extended forecast at a resolution of 2 km.

3. Results

The 24-hour forecasted precipitations using JNoVA and LETKF analyses together with the observation are shown in Fig. 1. The southwest bias in location associated with the forecast based on JNoVA is reduced when using LETKF analysis. The forecasted rainfall amount is also improved. However, the new forecast produces false-alarm areas of light rains along the western coast of northern Japan. This is quantified in the intensity-scale diagrams of Fractions Skill Score (FSS) for both forecasts (Fig. 2). These diagrams show that the forecasted precipitation based on JNoVA is slightly better than that based on LETKF at light rains up to 2 mm hr^{-1}, whereas the latter outperforms the former at moderate and heavy rains of 5 mm hr^{-1} and over.

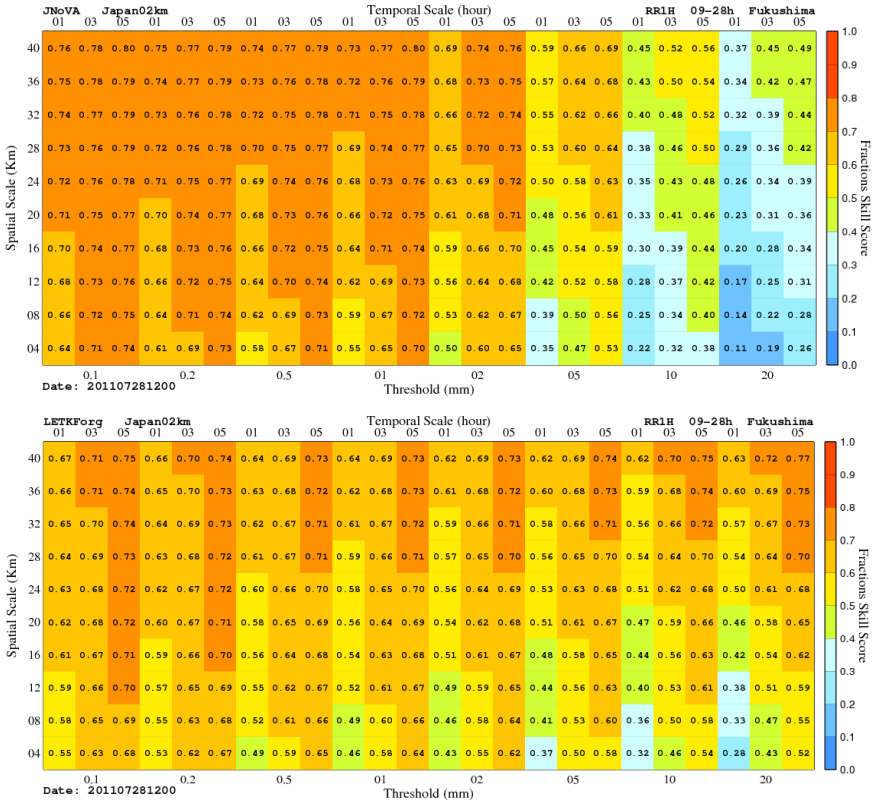

Fig. 2. Intensity scale diagrams of FSSs of precipitation forecasts using JNoVA (top) and LETKF (bottom) analyses.

4. Conclusion

For high-resolution precipitation forecasts the probabilistic information is necessary, and the ensemble forecast based on LETKF is underway. The inclusion of hydrometeors in the control variables and variable localization are the other future subjects.