Japan Area Mesoscale Ensemble Experiments using JMANHM

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1. Introduction Even if weather forecast is performed using perfect models, analysis error increases with time because the chaos of atmosphere increases the observation error and analysis error. Thus, the state of atmosphere should be seen as the existing probability. Ensemble forecast adds the information of the probability to the deterministic weather forecast. Moreover, the forecasts of members can reduce the risk of the undetected heavy rainfalls. Therefore, the ensemble forecast is expected to be useful for the disaster prevention. With collaborating with Japan Meteorological Agency (JMA), Meteorological Research Institute participates in the meso-scale ensemble forecast component of WWRP Beijing 2008 Forecast Demonstration / Research and Development Project (hereinafter, Beijing project). It is instructive to apply the techniques, which have been developed in the Beijing project, to other regions in order to confirm of their validity. The result of Japan area ensemble experiments using the technique developed by Saito et al. (2006) is explained in this study.

2. Specification of ensemble experiments The numerical model and the producing method of the initial perturbation were the same as those of WWRP Beijing project. The domain of the model is set to be 3000 km x 3300 km. The horizontal grid interval is 15 km. The initial perturbation was produced by adding the normalized perturbation of one-week ensemble of JMA to the initial fields of the JMA Regional Spectrum Model (RSM) (Saito et al. 2006). The period of ensemble experiment is from 8 to 20 August of 2006, which is around the same time of the Beijing project. Numerical predictions of 11 members were performed from the initial time of 21 JST. Figure 1 shows the examples of the forecast. On 18 August, typhoon 0610 passed the southern part of Japan. The intense rainfalls occurred near the typhoon and along the Pacific side. Results of ensemble experiments were evaluated by comparing 2m temperature and 3hour accumulated rainfall with the observation data of Automated Data Acquisition System of JMA.

3. Results of ensemble experiments Figure 2 shows the comparison of easterly wind at 24hour forecast between the control run and the ensemble mean. The control run is the forecast from the initial condition without initial disturbances. Namely, the initial condition of control run was produced by the interpolation of RSM outputs. These forecasts were compared with the next day's initial fields of which the valid time is the same as 24hour-forecasts. Error of the ensemble mean was smaller than those of the control run (fig. 2). The ensemble mean of other forecast variables, e.g. southerly wind and temperature, are also smaller than those of control runs. This feature was also recognized in Beijing project (fig. 3 in Saito et al. in this volume). The error of Japan area experiment (Japan case) was larger than those of Beijing project, because the typhoons 0607 and 0610 passed the Japan during the ensemble experiment period. Figure 3 shows the temporal variation of ensemble spreads. The spreads of surface pressure and horizontal wind had increased during the forecast period (36 hour). On the other hand, the spreads in Beijing project stopped increasing at about 27 hour (fig. 4 in Saito et al. in this volume). This difference was produced by the relative position of verification area to the boundary. The verification area of the Japan case is located at more inside of the simulation domain. Then, the influence of boundary, which did not contain the perturbation in this experiment, became weaker than that in the Beijing project. Diurnal variation is clearly seen in temperature, relative humidity and precipitation. However, the diurnal variation of temperature is much smaller than that of Beijing project, because the ocean occupies the large area of the experiment domain. Figure 4 shows the bias score of 3hour accumulated rainfall in the control run and ensemble mean. When the threshold value is 0.1 mm, the bias score of ensemble mean is much larger than that of the control run because of the expansion of the weak rainfall region. When the threshold is larger than 2 mm, there is no large difference in both scores. The threat score was also compared with the threshold of 3 mm, where the bias score is close to 1. The score of ensemble mean is larger than the control run, except 0.1 mm (fig. 5). These scores mean that the ensemble mean is closer to the observation. This comparison indicates the usefulness of the ensemble forecast.

4. Summary The technique developed in Beijing project is useful for the prediction. The technique, which will be developed in Beijing project, will be checked using Japan area experiments to confirm its validity.

References

Saito, K. M. Kyouda and M. Yamaguchi, 2006: Mesoscale Ensemble Prediction Experiment of a Heavy Rain Event with the JMA Mesoscale Model. CAS/JSC WGNE Research Activities in Atmospheric and Oceanic Modelling. **36**, 5.49-5.50.

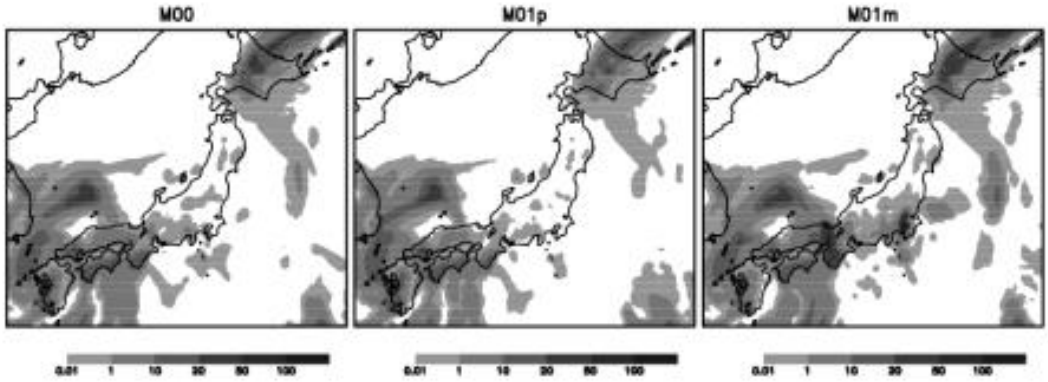

Fig. 1. 3 hour accumulated rain for 6 hour forecast of JMA-NHM with the control run (Left), member M01p (center), and member M01m (Right). Initial time is 21 JST 18 August 2006.

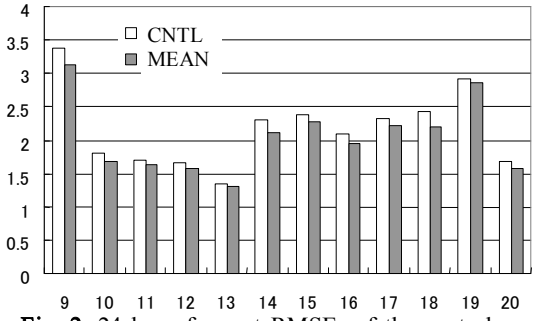

Fig. 2. 24 hour forecast RMSEs of the control run and the ensemble mean against initial condition over the verification domain. Verification period is 12 days from 8 to 20 August.

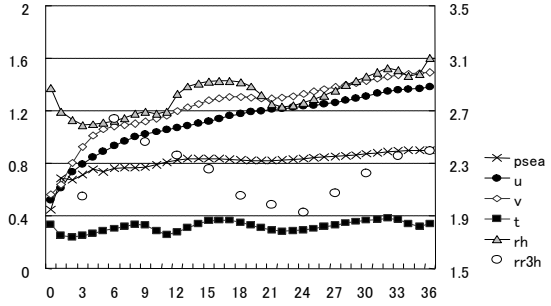

Fig. 3. Time sequences of the ensemble spreads. Unit of the left vertical axis is 'hPa' for MSL pressure (PSEA), 'm/s' for horizontal winds (U and V), 'K' for 2m temperature (T), respectively. Unit of the right vertical axis is '%' for relative humidity (RH) and 'mm' for 3 hour accumulated rain (RR3H), respectively.

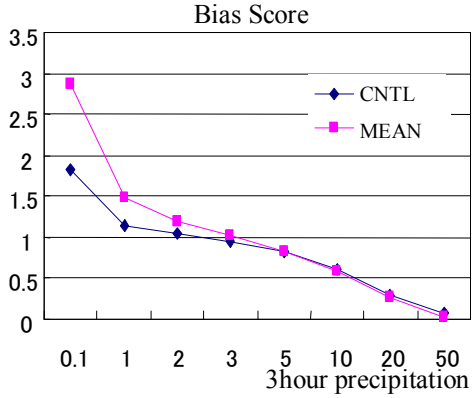

Fig. 4. Bias score of the control run and the ensemble mean. Verification period is 12 days from 8 to 20 August.

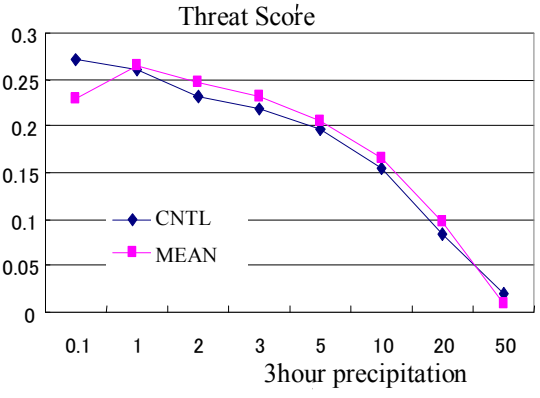

Fig. 5. Threat score of the control run and the ensemble mean with threshold of 3mm. Verification period is 12 days from 8 to 20 August.