A mesoscale ensemble prediction system using a blended mesoscale and global singular vector method

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1. Introduction

We have been developing a mesoscale ensemble prediction system using singular vector (SV) methods since April 2007. In order to investigate the feasibility to provide probabilistic or reliability information for operational mesoscale forecasting, we have been implementing the daily mesoscale ensemble prediction experiments with SVs since June 2010. We report the details of its configuration and the preliminary results of the experiments.

2. Configuration of the System

Table 1 shows the details of the SV calculation and the subsequent ensemble forecast. Initial perturbations are constructed by blending mesoscale SV (MSV) and global SV (GSV) in order to avoid localization of MSV and coarse structure of GSV (Ono *et al*. 2010). MSVs are calculated by tangent linear and its adjoint model (TL/AD) based on JMA nonhydrostatic model (JMA-NHM). GSVs are calculated by the TL/AD of the JMA global spectral model. In order to generate initial perturbations, we rotate all SVs so that they have broad structure. Lateral boundary perturbations are also made by using JMA operational weekly ensemble prediction. In ensemble forecast, ensemble size is 11 (including control forecast). To save the computational cost, the horizontal resolution of JMA-NHM is taken to be 20 km (We will implement higher resolution system at operation).

Table 1 configuration of the system

SV calculation				Ensemble forecast	
Type	MSV40	MSV80	GSV	Model	JMA-NHM
dx	40 km	80 km	180 km	dx	20 km
Optimization time	6 h	15 h	24 h	Ensemble size	11
Norm	Moist total energy	Moist total energy	Dry total energy	Forecast time	36 h
Number	10	5	5	Initial time	18 UTC

3. Practicality of the system to heavy rain

Figure 1 shows the heavy rain case caused by Baiu front at 00 UTC 03 July 2010. Some ensemble members forecast the heavy rain near the front that was not forecasted by the control forecast. But at the southern side of the front, every member did not forecast the heavy rain (near Kyushu district). From the experiments so far, it seems that the ensemble prediction system forecasts well heavy rain close to disturbances like front.

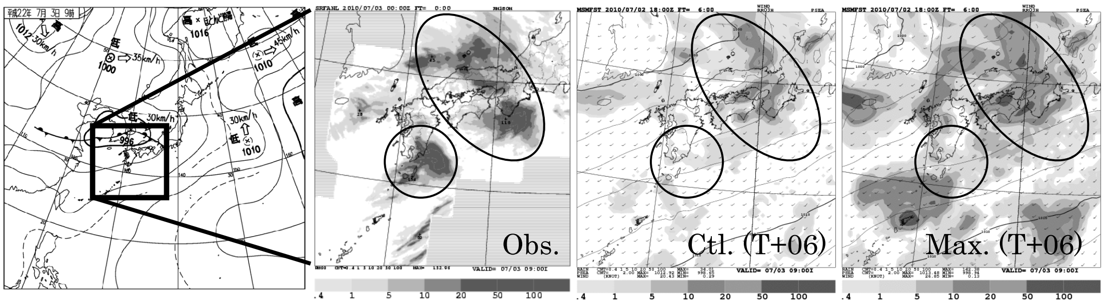

Fig. 1 Weather chart and 3hour accumulated rain at 00 UTC 03 July 2010 (observation, control forecast and maximum precipitation in all ensemble members).

4. Performance as an ensemble prediction system

Figure 2 shows the rank histograms of wind speed at the surface and 850 hPa against observations around Japan. Verification period is 03-14 July 2010. Ensemble spread at the surface is too small over the forecast period. Its reason is that MSVs have no perturbations at the surface. On the other hand, ensemble spread at 850 hPa is more appropriate than that at the surface, especially at T+30. This is because initial perturbations spread over the whole Japan region at this level with time. Meanwhile, the effect of the lateral boundary perturbations is small because the speed of upper air flow is small in this season. Corresponding to these spread, improvement of ensemble mean against control forecast at 850 hPa (not shown) is better than that at the surface.

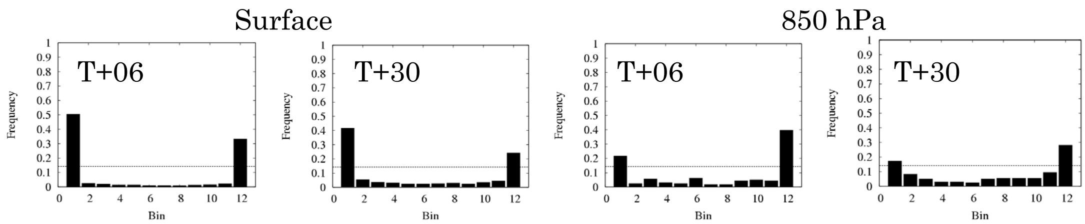

Fig. 2 Rank histograms of wind speed at the surface and 850 hPa

References

Ono, K., Y. Honda and M. Kunii, 2010: Development of a mesoscale ensemble prediction system using a singular vector method. *CAS/JSC WGNE Res. Activ. Atmos. Oceanic Modell.,* **40,** 5.17 – 5.18.