Mesoscale ensemble forecasts of strong wind caused by typhoon 0709

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1. Introduction

Ensemble prediction system (EPS) for mesoscale phenomena have been developed at the Meteorological Research Institute. As applications of the mesoscale EPS, probability forecasts of the potential parameter of tornado outbreaks and the method that extracts the factors of heavy rainfalls have been proposed. In this study, ensemble forecasts in a strong wind case caused by a typhoon are performed and of its probability application is investigated.

2. Ensemble method

We focus on the typhoon 0709 that passed through Aomori Prefecture on 7th Sep. 2007. This typhoon caused the agricultural damages exceeding 5 hundred million yen. Thus, probability forecasts of strong winds are expected to reduce the economical damages. In the ensemble forecast in this study, the Local Ensemble transform Kalman Filter (LETKF) (Miyoshi and Aranami, 2006) system that was developed in Beijing 2008 Olympic project was used. The horizontal grid interval was 20 km and Domain size was 3600×2880 km. Ensemble size was fixed at 20. Surface and upper sounding data were assimilated by the LETKF system. Because the topography affects the horizontal wind, the downscale forecast experiments using the non-hydrostatic model with 5 km and 1.6 km grid intervals were performed. The horizontal winds that were reproduced by downscale forecast experiment (forecast winds) were compared with the wind observation data from the Automated Meteorological Data Acquisition System (AMeDAS).

3. Results of ensemble experiments

Figure 1a shows horizontal wind distribution at 15 JST 7th Sep. 2007. The strong winds were observed along the eastern coastline of Aomori prefecture and Tsugaru Peninsula. The wind speed of 15 m/s was used as the threshold in this study. The wind speed exceeded 15 m/s at a few points. Figure 1b shows the probability from ensemble

members that the forecast wind speed exceeded 15 m/s. The pattern of high probability was similar to the observed strong wind distribution, although the forecast winds exceeded 15 m/s at many points. Figure 2a shows the scatter diagram of the forecast wind speeds and the observations. As shown in Fig. 1b, the forecast wind speeds were stronger than the observations, because the lowest layer's height of the model was higher. Because the difference between the observed and forecast winds became larger when the forecast wind was stronger (Fig. 2b), the statistical formula that modifies the forecast wind was derived to remove the systematic error. When the statistical formula was applied, the wind speed became closer to the observations (Fig. 2c). The number of the points where the wind speeds exceeded 15 m/s became also similar to observed one (Fig. 1c). The results suggest that mesoscale ensemble forecast be useful for probability forecast of strong winds, especially when the systematic error is removed by statistical post processing.

References

Miyoshi, T. and K. Aranami, Applying a Four-dimensional Local Ensemble Transform Kalman Filter (4D-LETKF) to the JMA Nonhydrostatic Model, 2006, *SOLA*, 2, 128-13.

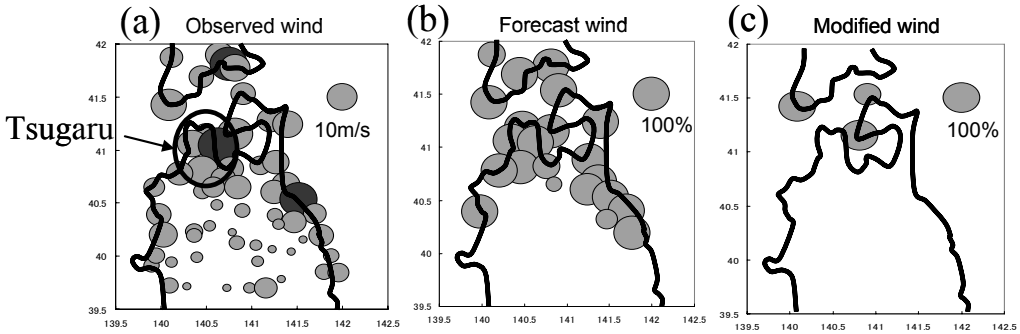

Fig. 1. (a) Observed wind speeds at 15 JST. Dark circles indicate the points where wind speeds exceeded 15 m/s. (b) Probability that forecast wind speeds exceed 15 m/s. (c) Same as (b) except using the modified wind speeds.

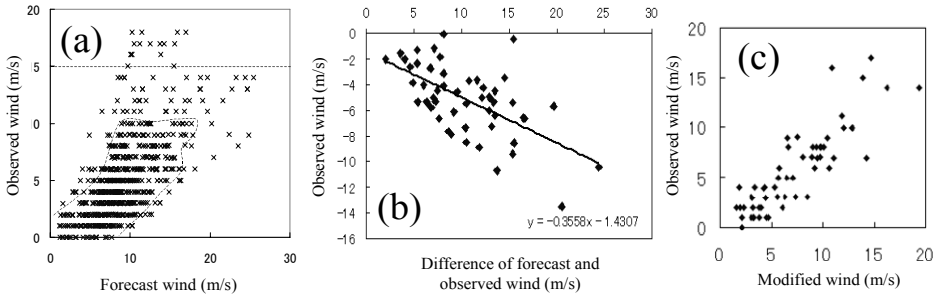

Fig. 2. (a) Scatter diagram of the observation and forecast wind speeds from 09 JST to 18 JST. (b) Scatter diagram of the forecast wind speeds and of difference (forecast wind speeds - observation) at 15 JST. (c) Scatter diagram of the observation and modified wind speeds at 15 JST.