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Nowcast of high winds by using X-band doppler radar network

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1. Introduction

In order to reduce wind disasters, development of the wind monitoring and forecasting method is urgently needed. But it is difficult to predict gust winds by the physical meteorological models. So, as a method to compensate for it, an effective method based on monitoring and prediction by using the observed Doppler winds was proposed. For the purpose of short range forecast of high winds, a new high wind nowcasting method was developed, and its results were verified.

2. Methodology

2.1 Outline of the high wind nowcasting method

The input data are the observed wind speed and direction from the X-band Doppler radar network (X-NET). The resolution of wind data is 500m mesh and 5 minute interval. The high wind nowcasting method has the following steps: 1) motion vector calculation, 2) wind area extrapolation in time, 3) estimation of the surface wind speed. The output is the occurrence time and location of high wind areas up to one hour after the initial time. As for the motion vector calculation, the coefficients of the advection model are estimated from the last three time steps observed data. The high wind areas are linearly extrapolated by using the advection model. As for the estimation of the surface wind speed, wind speeds at the 1000m altitude are corrected of its bias from the initial value. If there is no initial observation, the logarithmic law of the wind profile is applied.

The motion vector calculation was applied to the high winds areas (15m/s or more). As a result, we were able to satisfactorily reproduce the moving direction and velocity. In addition, to avoid the risk of missing a high wind prediction by using weak wind observations, we decided to focus on the high wind areas as a prediction target.

2.2 Verification by the case study

Wind disasters on April 18, 2008 in the Kanto district were verified. High winds associated with the front line of the cyclone caused the wind disasters throughout the Kanagawa and Chiba from 7am to 10am. The nowcast method was applied to this case. The figure shows the comparison of the predicted high winds with the observation at the Haneda Airport. The prediction has good correspondence with the observation. Wind speed at around 8:45 becomes 10m/s over, and then suddenly wind speed exceeds 20m/s at 9:00. The phenomena is almost accurately predicted before about an hour. There are remarkable positive correlation between the 50 minute lag prediction and the observation. The correlation coefficient is 0.81, and the RMS error is 3.9m/s. The relative wind speed error is estimated about 20% against 20m/s wind speed. The prediction has sufficient accuracy for the practical use.

3. Conclusion

By this study, the high wind nowcasting method by using the Doppler radar data was found to be effective as a supplement to the short range forecast, where the physical meteorological models have weak points. However, the subjected case in this study due to the movement of the front is easy to calculate the relative motion vector. In the future, accumulation of case studies by the winds of other meteorological events is necessary for the accurate verification of the high wind nowcasting method. In addition, a data assimilation method with the meteorological models is necessary in order to cover the missing area by the Doppler wind observations.

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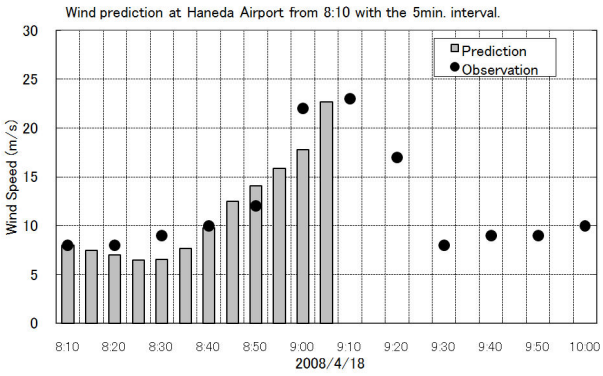

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