

Assimilation of Radial Wind measured by Doppler radar to Typhoon HIGOS

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1. Introduction

It is important to produce the accurate initial fields to improve the forecast of typhoons. Because the number of observation data near the typhoon center is not always large, the typhoon bogus data, which was produced empirically, has been used in producing initial fields. The typhoon bogus data improves the forecast effectively so that it is adopted in the 4-dimensional variational data assimilation (4DVAR) system for meso-scale model (MSM) of the Japan Meteorological Agency (JMA). However, there is some arbitrariness in setting the bogus parameters and thus the bogus data don't always express the actual state of the atmosphere. When the parameters are set improperly, the initial fields assimilated by actual observational data are contaminated by the typhoon bogus data. Conversely, when the large number of observed wind data is available the forecast of the typhoons is expected to be improved by assimilating the actual wind data into the models.

In this study, the radial wind (RW) data of Doppler radar, which are deployed by JMA for safety service of Airlines, are used as assimilation data. The impact of the RW data was investigated by comparison of typhoon tracks predicted from each analysis field.

2. Experiment design

In October 2002, the typhoon HIGOS passed by Narita and Haneda Doppler radars and thus the large number of radial wind data around the center of the typhoon was obtained. The observed RW data was assimilated into MSM by 4DVAR system of JMA. In this study, the assimilation method followed that of Seko *et al.* (2004). Namely, "super observation method" was adopted because the number of RW data was much larger than that of the model grids.

3. Impact of RW data

Figure 1 shows the RW at the elevation angle of 1.1 degree. The boundary between the negative and positive radial winds, namely zero velocity line, in the assimilated fields was similar to the observed ones. This similarity indicates that the RW data was assimilated appropriately. Figure 2 shows the typhoon tracks predicted from each analyzed fields. The track predicted from the RW-assimilated field was close to that of the typhoon bogus case. This result indicates that actual observed RW data can improve the forecast as much as the

typhoon bogus data.

However, there are two problems to be solved. One is the observational error of the RW data. The observation error was estimated by comparison of the observed RW and the predicted RW in a few case studies. More data assimilation experiments should be performed to get statistically appropriate observational errors. The other is the height fluctuation of RW data in an assimilation window. The locations of the observed RW data are geometrically determined. On the other hand, the MSM adopts σ -p coordinates system. Thus, the conversion is needed between these data. In this study, height is assumed to be constant for a period of an assimilation window (3-hour), and the position of RW data was converted with the first guess value. This assumption is acceptable when the change of height is much smaller than the width of radar beam. In this case study, the typhoon passed near the radar sites. Therefore the change of height should have been taken into account.

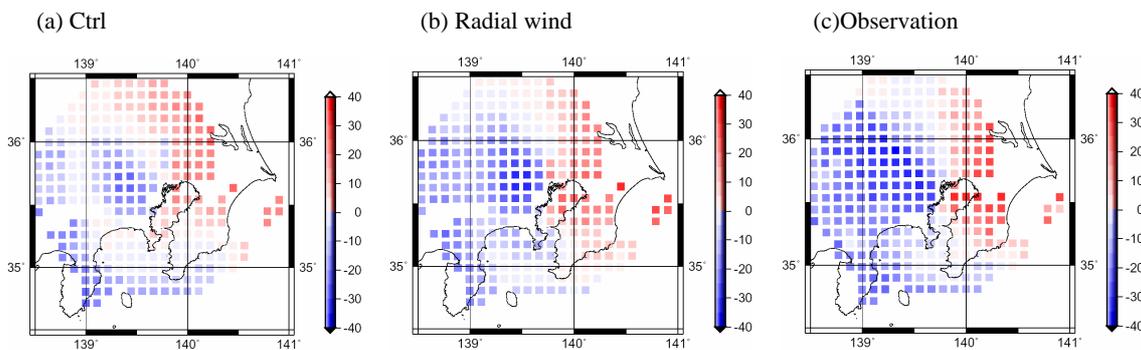


Fig. 1 Radial wind of the elevation angle of 1.1 degree. (a)Control run case in which the RW data and typhoon bogus data was not assimilated. (b)Radial wind case in which RW was assimilated. (c)Observed RW.

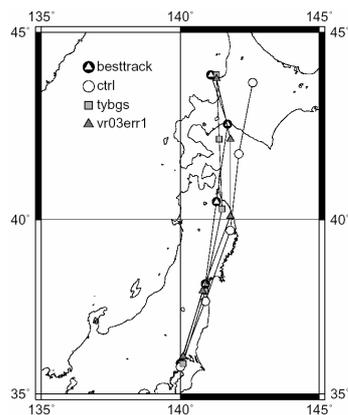


Fig. 2 Typhoon tracks predicted from each initial field and the best-track. "ctrl" is control run case in which the RW data and typhoon bogus was not assimilated. In the cases of "tybgs" and "vr03err1", the typhoon bogus and RW data were used, respectively. RW data were assimilated under the assumption that the variation of the height field for 3 hours (assimilation window length) had been trivial. The observational error of the RW data was tentatively set to actual Doppler radar error.

References

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[2]JAPAN METEOROLOGICAL AGENCY 2002: OUTLINE OF THE OPERATIONAL NUMERICAL WEATHER PREDICTION AT THE JAPAN METEOROLOGICAL AGENCY. p15.