An Observing System Experiment on the Special Observations of T-PARC for Typhoons Sinlaku and Jangmi using the Operational NWP System at JMA

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1. Introduction

A special observation experiment project that examined the effectiveness of the next-generation forecast technology known as the *interactive forecast system* was performed as part of the THORPEX Pacific Asian Regional Campaign (T-PARC) for track forecasts of three typhoons (Nuri, Sinlaku and Jangmi) in the summer of 2008 at JMA (T-PARC 2008). The special observations performed for T-PARC 2008 were dropwindsonde observations, extra radiosonde observations at JMA observatories and ships observations (Komori et al., 2009). JMA's Meteorological Satellite Center also produced MTSAT-2 Rapid Scan Atmospheric Motion Vectors for T-PARC 2008. As one of the research projects, typhoon-track and intensity forecast experiments for Sinlaku and Jangmi were performed using special observational data in the operational NWP system at JMA.

2. Overview of the experiments

To evaluate the impact of the special T-PARC 2008 observations, we carried out experiments using the operational global 4D-Var data assimilation system (GSM-DA). Global 4D-Var data assimilation cycles were run every 6 hours, and 84-hour forecasts were executed from 00, 06 and 18 UTC and 216-hour forecasts from 12 UTC using the operational global spectral model (JMAGSM). The JMAGSM is a hydrostatic spectral model with a horizontal resolution of 20 km (the inner-loop model for the GSM-DA is 80 km) and 60 levels in the vertical direction, with the top level at 0.1 hPa.

The two typhoons were spawned in September 2008. The experimental periods were from 00 UTC on 9 September (0900; hereafter the date and time are abbreviated as *ddhh* without the month) to 1818 for Sinlaku and from 2500 to 2818 for Jangmi. We performed two kinds of numerical experiments that differed in their use of special observations: (I) special observations were assimilated (TEST), and (II) special observations were not assimilated (CNTL).

JMA assimilates bogus data to generate realistic typhoon structures in the analysis fields of the operational system (JMA, 2007). Bogus data were not used in the observing system experiment (OSE) for Sinlaku, but were assimilated in the OSE for Jangmi.

3. Impact of special observations on typhoon-track and intensity predictions

The typhoon-track forecasts from the OSEs were verified against the best track data analyzed by JMA (OBS). Since the special observations were concentrated both in the before-recurvature stage and the after-recurvature stage, the results were separately validated for each.

In many cases, positive impacts were found on typhoon-track and intensity forecasts using the special observations in each stage. These results suggest that the special observations contributed to reducing track and intensity errors. The details for each typhoon are outlined below.

A. Sinlaku

In the before-recurvature stage from 0900 to 1418, the track errors of TEST were reduced by between 23 and 30% for 12-hour forecasts, and by approximately 10% for 18- to 48-hour forecasts compared to the results of TEST for CNTL (Fig. 1). A forecast initialized at 0912 is shown in Fig. 2. Intensity forecast errors were also reduced in this case. In the after-recurvature stage, the track errors of TEST were reduced by about 10% for 66- to 84-hour forecasts. However, the impact on the intensity forecasts was neutral.

B. Jangmi

In the before-recurvature stage from 2500 to 2818, the track errors of TEST were reduced for forecasts of up to 84 hours (Fig. 3). The mean reduction rate of track errors was 25%. The maximum reduction rate was 36% for 12-hour forecasts. A forecast initialized at 2500 is shown in Fig. 4. In the after-recurvature stage from 2900 to 3018, the track errors of TEST were reduced by between 12 and 20% for 18-hour forecasts.

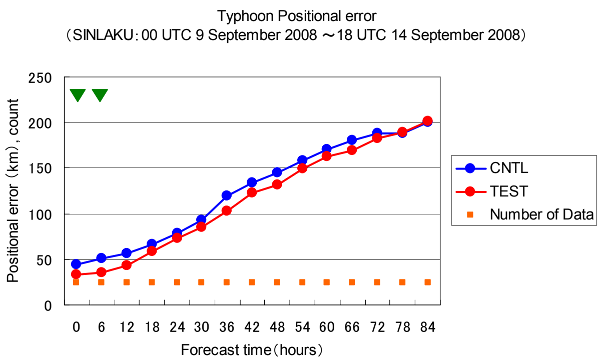

Figure 1. Positional errors for Typhoon Sinlaku in the before-recurvature stage from 0900 to 1418. The red line with dots is for TEST, which assimilated special observations. The blue line with dots is for CNTL, which did not assimilate special observations. The orange squares indicate the number of cases, and the green triangles denote that the difference is statistically significant with a 95% confidence level.

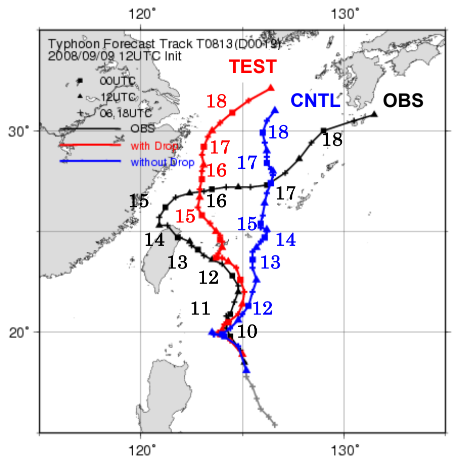

Figure 2. Typhoon track forecasts by OSEs with (red markers: TEST) and without (blue markers: CNTL) special observations for Typhoon Sinlaku, initialized at 0912. The numbers indicate the date of the typhoon's location at 00 UTC.

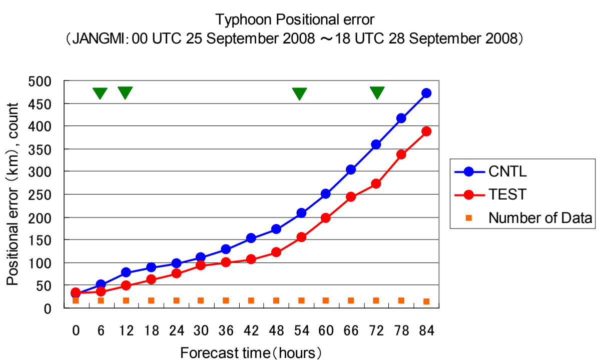

Figure 3. Positional errors for Typhoon Jangmi in the before-recurvature stage. The legend details are the same as those in Fig. 1, but the period is from 2500 to 2818.

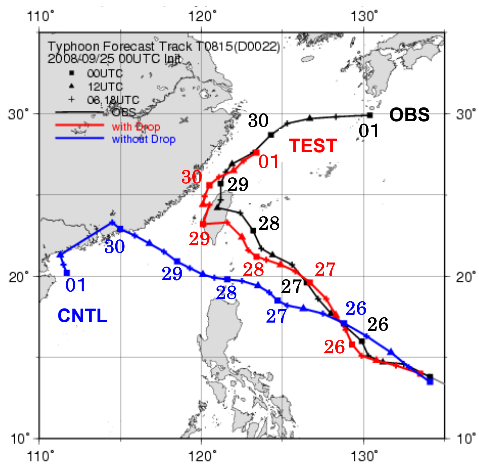

Figure 4. Typhoon track forecasts by OSEs with (red markers: TEST) and without (blue markers: CNTL) special observations for Typhoon Jangmi, initialized at 2500

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