16C.1 **RE-ANALYSIS/PREDICTION OF TYPHOON VERA (1959) PROJECT: REVERA -ISEWAN TYPHOON LIKE A KATRINA HITTING JAPAN 50 YEARS AGO-**

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1. INTRODUCTION

Fifty years ago, Super Typhoon Vera (1959) made landfall in Kii peninsula in Japan around 0900 UTC on 26 September in 1959. It brought tremendous disasters such as storm surge to Japan, especially around the Ise Bay area. It was the most tragic meteorological disaster in Japan after the World War II. Indeed, total amount of death toll was more than 5,000. Because of its massive damage for the Japanese society, Vera is one of the memorable typhoons in Japan, given a special name as 'Isewan (Ise Bay) Typhoon' from Japan Meteorological Agency (JMA). After Vera, Japanese government enacted a law of Disaster Countermeasure Basic Act, and Vera is regarded as a baseline for bank construction, wind resistant design, evacuation plan, and so on. In the view point of changing the national disaster planning drastically, Vera is rated on par with Katrina (2005) landfalling in United States. The track forecast for Vera was accurate. However, the forecast of the moving speed of Vera at fifty years ago was much lower than the analysis. In addition, the forecast of sea-level height at the Ise Bay was at most 100 to 150 cm, while the observation was 389 cm that was mush higher than the forecast.

Recent advances of objective numerical reanalysis system enable us to obtain long-term reanalysis data. JMA starts the project associated with the long-term re-analysis during the period from 1958 to 2012, called as the 'JRA-55' project. This is a follow-on project for the 'JRA-25' project, focused on the period from 1979 to 2003. Using the reanalyzed dataset and sophisticated numerical models, we can simulate past remarkable meteorological phenomena such as typhoons. Here we performed numerical predictions for validating the Vera's predictability using the latest forecast technique. We used an interim version of JRA-55 as initial conditions for the track, intensity and storm surge predictions of Vera.

2. TRACK FORECAST EXPERIMENT

Using the global model with spatial resolution of 60 km, track forecast was executed with the initial value of every 12 hours from 4 days before landfalling to Japan of Vera. In the results, every case can predict the landfalling to Japan of Vera. Especially, the forecast with the initial of 09 JST 24 Sep. 1959 showed closest track to the observation. Then ensemble forecast of 11 members was executed using the system, which is very similar to the current JMA operational one (Yamaguchi et al. 2009). From Figure 1, it is found that all members show landfall to Japan. The landfalling points are widely distributed from Kyushu Island to Kanto Plain of Japan. Before Vera approached to the latitude of 30^{o} N, the spread of the tracks was small and close to the best track.

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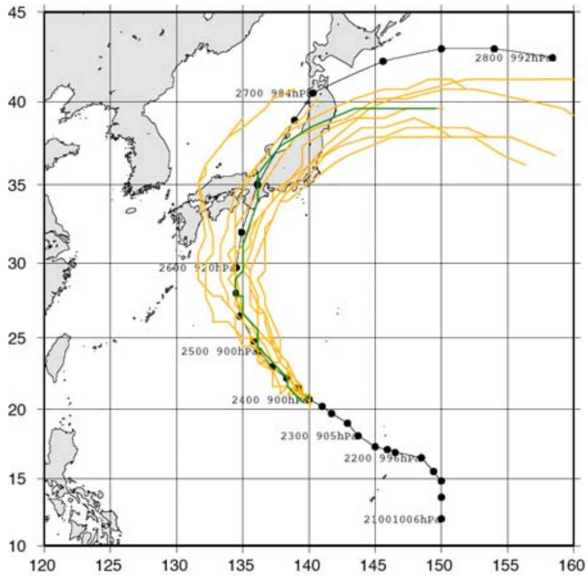

Figure 1. Track forecast result from global ensemble model with 11 members. The line with dots shows best track. Green line is control run, and yellow lines are derived from ensemble members.

3. INTENSITY AND STORM SURGE EXPERIMENT

To predict the intensity and storm surge of typhoon in high accuracy, it is needed to prepare the initial state for a mesoscale model with high resolution, which should be close to the observation. For this purpose, JNoVA (JMA Non-hydrostatic model Variational data Assimilation system, Honda et al. 2005) was applied to the mesoscale analysis for 24 hours from 09 JST 25 Sep. 1959 with 3 hours assimilation window. In this analysis, dropsonde data obtained from US military aircraft reconnaissance for Vera, which were archived in the JMA special report for Vera, were assimilated. Using this analysis result, 36-hour forecast experiment was executed by a JMA non-hydrostatic model (Saito et al. 2007) with 5 km resolution from 09 JST 26 Sep. 1959. The results of the experiment are shown in Figure 2. It is understood that

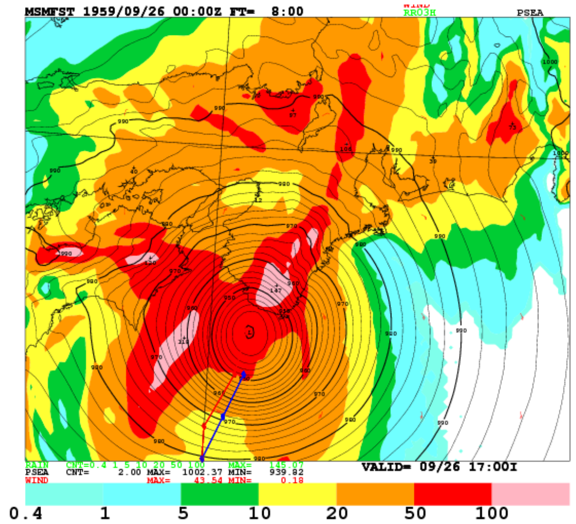

Figure 2. Forecast of intensity of Vera by JMA nonhydrostatic model at 17 JST 26 Sep. 1959. Shading denotes the 3 hourly accumulated rainfall amount (mm) and contours are the surface pressure.

the track before landfall and precipitation amount induced by Vera were simulated very well, and the time lag from the landfalling in this experiment was within one hour. The forecast pseudo-satellite image is also shown in Figure 3. This image looks like an actual infrared satellite image, which was not available in 50 years ago. The first geostationary satellite, GMS, over the Pacific was launched in 1977.

After the meso-scale forecast, a storm surge forecast with the Princeton Ocean Model (Blumberg and Mellor 1987) was executed using the forecast result as an atmospheric forcing field. The forecast height of storm surge at Nagoya Port was very close to the observational result (Figure 4).

4. SUMMARY

From these experimental results mentioned above, we can get a good prediction of Vera with high accuracy using latest forecast technique. In these experiments, the numerical model is very similar to the operational one in JMA. These experimental results suggest that we have high potential capability to forecast typhoons like Vera by using the JMA operational prediction system.

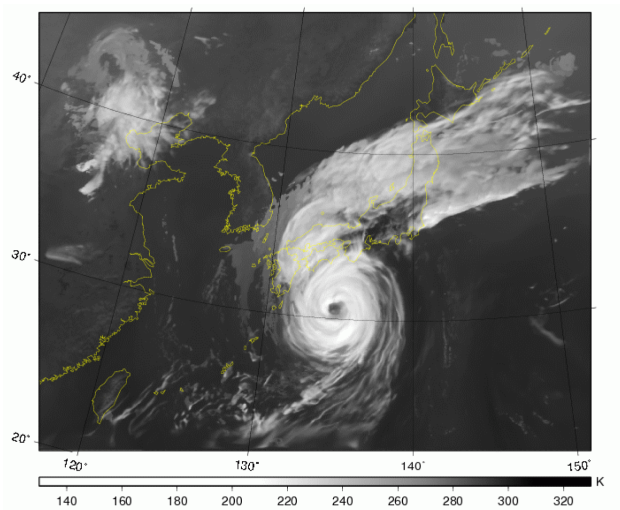

Figure 3. Pseudo-satellite image of Vera came from JMA non-hydrostatic model.

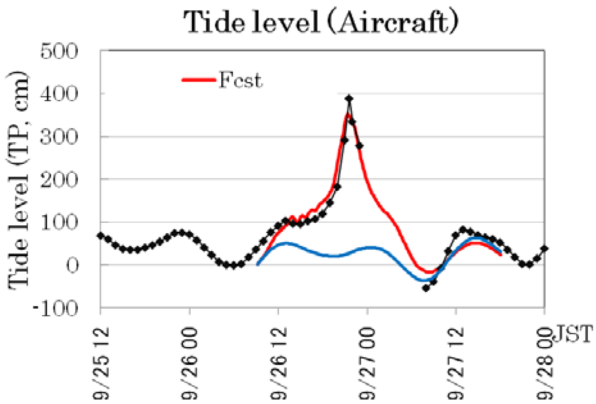

Figure 4. Forecast of sea-level height of storm surge at port of Nagoya. Black line with dots is the observation, red line shows the forecast, blue line for the astronomical tide level.

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