WGNE Intercomparison of Tropical Cyclone Forecasts using Operational Global Models

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1. Introduction

The CAS/JSC Working Group on Numerical Experimentation (WGNE) has conducted intercomparison of Tropical Cyclone (TC) track forecasts using operational global models since 1991. WGNE recognizes that the evaluation of TC track forecasts can indicate the performance of such models in the tropics and subtropics.

2. Dataset

The verification area is divided into six regions according to the domains of responsibility for each TC RSMC and the best track data offered by each RSMC is used for verification. This report describes the results for the western North Pacific. Table 1 shows the specifications of the data provided by NWP centers, including model resolutions and the usage of TC bogus data in the analysis system.

Table 1 Specifications of data offered in verification of 2007

NWP center	Model	Data res.	Bogus
JMA (Japan)	TL319L40	1.25×1.25	use
ECMWF (Europe)	TL799L91	0.25×0.25	—
Met Office (UK)	0.38×0.56L50	0.38×0.56	use
CMC (Canada)	0.9×0.9L58	1.0×1.0	—
DWD (Germany)	40kmL40	0.5×0.5	—
NCEP (USA)	T382L64	1.0×1.0	use
BoM (Australia)	TL239L60	0.75×0.75	—
Météo France	TL358L46	0.5×0.5	use
NRL (US Navy)	T239L30	1.0×1.0	use

3. Verification using MSLP(mean sea level pressure) data

The verification method of Sakai and Yamaguchi (2005) is adopted in this study. The performance of TC track forecasts is evaluated using position errors and detection rates. The detection rate is defined as A(t)/B(t).

- A(t) : The number of forecast events in which a TC is analyzed at forecast time T on the condition that the model continuously expresses the TC until the forecast time t.
- B(t) : The number of forecast events in which a TC is analyzed at forecast time t.

The position error growth by forecast time is shown in Fig.1. Figure 2 shows the mean position errors and detection rates of the participating global models for 72-hour forecasts. It can be seen that NCEP is the best in terms of position error, but demonstrates a medium level of performance in detection rate.

We also investigate the prediction of TC genesis. The minimum MSLP point is ascertained from the time of genesis using the backtracking method. Figure 3 shows a bar chart of the forecast lead time of each center for all TCs in 2007. The term *lead time* refers to the length of the forecast that first captures the corresponding TC genesis in advance of the actual TC genesis. NARI(T0711) and TAPAH(T0722) are examples in which genesis forecasting was difficult for all centers. Further investigation will be necessary on the differences in difficulty of forecasting among TC geneses.

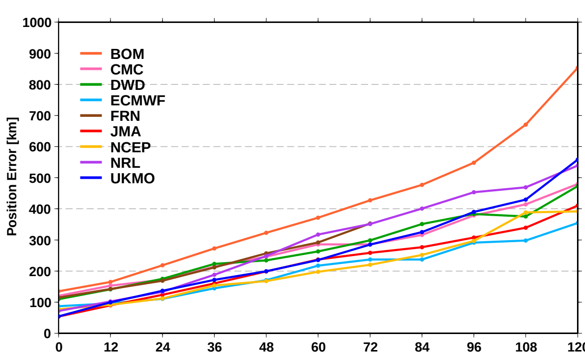

Fig 1 The position error growth in western North Pacific.

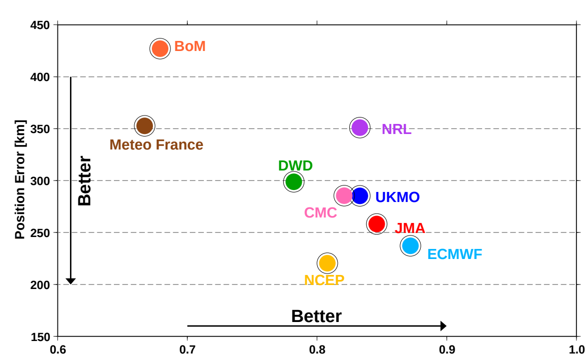

Fig 2 A relation of position error and detection rate of 72-hour forecast.

Reference

Tsuyuki, T. et al., 2002: The WGNE intercomparison of typhoon track forecasts from operational global models for 1991-2000. WMO-BULLETIN, vol.5, No.3, 253-257.

Sakai, R., and M. Yamaguchi, 2005: The WGNE Intercomparison of Tropical Cyclone Track Forecasts by Operational Global Models. CAS/JSC WGNE Research Activities in Atmospheric and Oceanic Modeling, Report No.35, Jul 2005, WMO/TD-No.1276, 2.7-2.8.

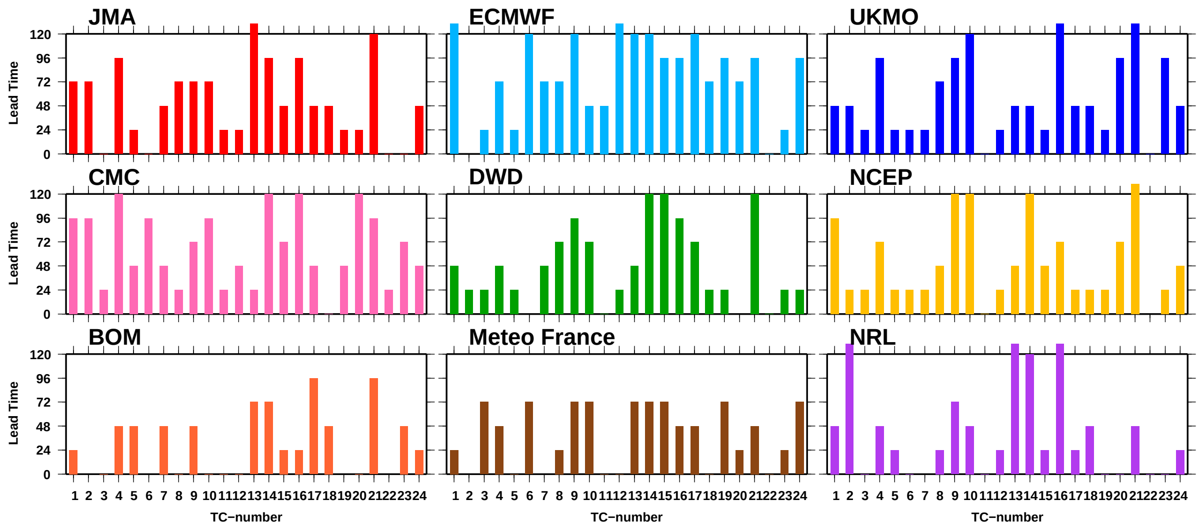

Fig 3 The lead time of the forecast for all TC geneses in western North Pacific in 2007. The protruded bar shows lead time is longer than 120 hours.

4. Verification of the axi-symmetric wind structure of TCs using wind data

We examine the characteristics of the stability structure of TCs using wind data which were offered by seven centers except DWD and NCEP. The average radial wind is calculated by averaging wind data for each point $P(r, \theta)$ (distance r is set every 25km, and angle θ is set every $2°$ from the TC center) in concentric circles. A schematic explaining the averaging method is given in Fig.4. It should be noted that the average depends on the horizontal resolution of the data. KROSA(T0715), which had comparatively concentric circle shapes with minimal topographical influence, was selected for verification. Changes in wind structure by initial time are examined in Fig.5, in which forecasts of TC wind structure from four different initial times with 24-h intervals are compared. Red line shows KROSA's structure in the analysis by each model at 12UTC 5 October 2007. And other colored lines show 24, 48, 72, 96-hour forecasts of wind structure, all valid for the same analysis time. In this particular case, BoM, CMC, JMA and NRL show relatively large changes in TC structure among initial times.

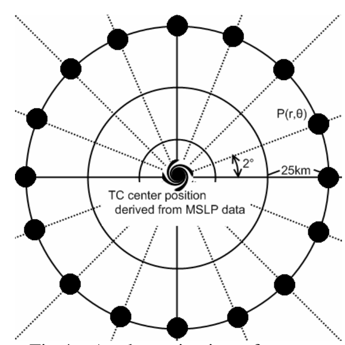

Fig 4 A schematic view of average radial wind.

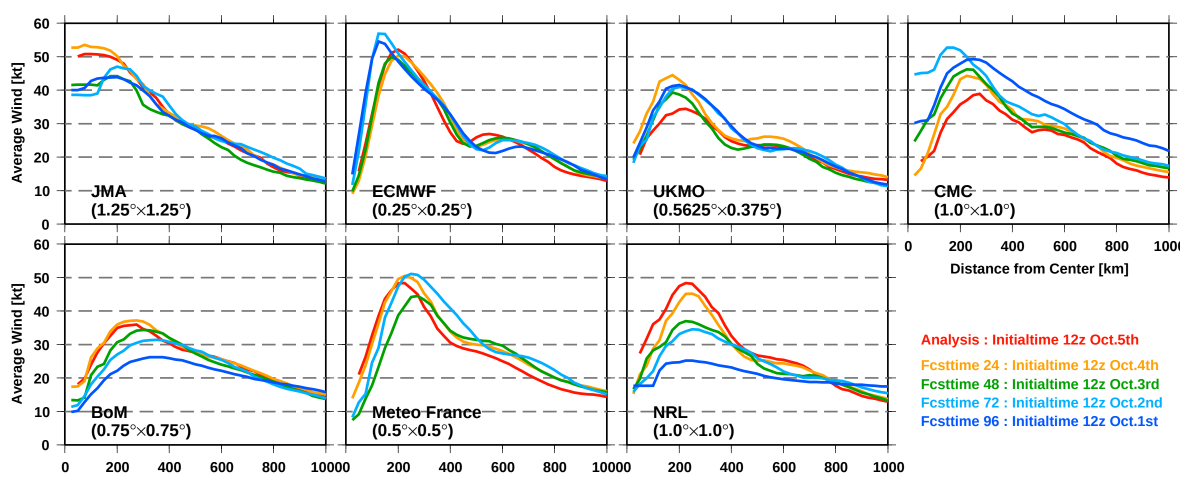

Fig 5 The average radial wind distribution of the radius vector direction of KROSA at 12UTC 5 October 2007. Red line means analysis at 12UTC 5 October, and other colored lines mean forecast from 4 days ago.