

# The WGNE Intercomparison of Tropical Cyclone Track Forecasts by Operational Global Models

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## 1. Introduction

WGNE has conducted an intercomparison of Tropical Cyclone (TC) track forecasts by operational global models since 1991 (Tsuyuki et al. 2002). JMA collects forecast data from participating NWP centers, verifies TC track forecasts and reports the verification results at the WGNE meeting every year. At the beginning of this intercomparison, the verification was carried out only for the western-North Pacific region with three NWP centers; JMA<sup>1</sup>, ECMWF<sup>2</sup>, UKMO<sup>3</sup>. At present, the verification area is expanded to all regions where TCs are analyzed under the WMO Tropical Cyclone Programme. CMC<sup>4</sup>, DWD<sup>5</sup>, BoM<sup>6</sup> and NCEP<sup>7</sup> have participated since 1994, 2000, 2003, 2003, respectively.

In this paper, the verification results for the western-North Pacific region, the eastern-North Pacific region, the North Atlantic region and the Southern Hemisphere region are shown.

## 2. Dataset and method

Analyzed TC position data (besttrack) distributed by various organizations (Table 1) are used in this verification. Table 2 shows the specification of dataset provided by participating NWP centers. The TC position error is defined as an absolute distance between a predicted TC position and the besttrack. The predicted TC position is detected from the mean sea level pressure (MSLP) of prediction at 12 hour intervals. Each position is the nearest point from a "guess" point among minimum MSLP points within 500 km from the guess point. The guess point for each forecast time is decided as follows:

- (1) Initial time: Besttrack position.
- (2) FT+12: The initial TC position.
- (3) FT+24 or later: A linearly extrapolated position by the last 2 forecast positions.

In case there are no minimum MSLP points satisfying above condition, tracking is terminated. The verification is carried out for the TCs analyzed in the besttrack.

## 3. Western-North Pacific region

The time series of position error for 72 hour forecast from 1991 to 2003 is shown in Figure 1(a). In this verification, the samples which all NWP centers can track are selected. Although there is an interannual variation, significant improvement is seen in all NWP centers. Figure 1(b) indicates the position error in 2003. The minimum position error in all NWP centers is approximately 120, 220, 320 km at 24, 48, 72 hour forecast, respectively. The NWP centers which have adopted TC bogus technique (i.e. JMA, UKMO and NCEP) have smaller position error at all forecast times. Although ECMWF doesn't adopt TC bogus technique, its position error is relatively small after 12 hour forecast. This result shows that ECMWF produces initial fields of high quality for TC forecast without TC bogus technique.

Figure 2 shows the scattering diagram of position error for 72 hour forecast. The Y-axis represents position error of Along Track (AT) direction and the X-axis does Cross Track (CT) direction. According to the direction of TC movement estimated by predicted TC positions, the plotted marks are classified into three categories, "Before Recurvature" (red), "During Recurvature" (green) and "After Recurvature" (blue). The two systematic errors are seen in almost all NWP centers. One is CT direction's positive error in "Before" stage. As TCs move toward west in "Before" stage, this error indicates northward bias against analyzed TC position. The other is a large spread of AT direction's error in "After" stage. This shows that error concerned with TC speed forecast is dominant in "After" stage.

## 4. Eastern-North Pacific, North Atlantic and Southern Hemisphere regions

Figures 3, 4 and 5 show the verification results for the eastern-North Pacific, the North Atlantic and the Southern Hemisphere regions, respectively. Since the number of samples are not enough for significant statistics, the samples which each NWP center can track are selected for its verification and the result of the eastern-North Pacific region is shown up to 72 hour forecast. The position error of UKMO and NCEP, which have adopted TC bogus technique, is smaller than that of the other NWP centers at initial time. After 24 hour forecast, however, there is no noticeable difference between the position error of the NWP centers with TC bogus and that of the NWP centers without TC bogus.

## Reference

Tsuyuki, T. et al., 2002: The WGNE intercomparison of typhoon track forecasts from operational global models for 1991-200. WMO-BULLETIN, vol.5, No.3, 253-257.

<sup>1</sup>Japan Meteorological Agency, <sup>2</sup>European Centre for Medium-range Weather Forecasts, <sup>3</sup>United Kingdom Meteorological Office,

<sup>4</sup>Canadian Meteorological Centre, <sup>5</sup>Deutscher Wetterdienst, <sup>6</sup>Australian Bureau of Meteorology, <sup>7</sup>National Centers for Environment Prediction

Table 1 Specification of verification data provided by NWP centers

NWP center	Since	Horizontal Resolution of Provided Data [degree]	TC bogus
JMA	1991	2.5 x 2.5 (1991-1995), 1.25 x 1.25 (1996-2003)	Use (Only the western-North Pacific region)
ECMWF	1991	2.5 x 2.5 (1991-1997), 1.0 x 1.0 (1998), 0.5 x 0.5 (1999-2002)	No
UKMO	1991	2.5 x 2.5 (1991-1996), 0.83 x 1.25 (1997), 1.25 x 1.25 (1998-2001), 0.83 x 0.56 (2002-2003)	Use
CMC	1994	1.0 x 1.0 (1994-2003)	No (1995-1999: Use around the North America)
DWD	2000	0.75 x 0.75 (2000-2003)	No
BoM	2003	1.0 x 1.0 (2003)	No
NCEP	2003	0.75 x 0.75 (2003)	Use

Table 2 Besttrack Data

Region	Data Source
western-North Pacific	RSMC-Tokyo
eastern-North Pacific	RSMC-Miami
Central Pacific	RSMC-Honolulu
North Atlantic	RSMC-Miami
North Indian	JTWC
Southern Hemisphere	JTWC

RSMC: Regional Specialized Meteorological Centre  
JTWC: Joint Typhoon Warning Center

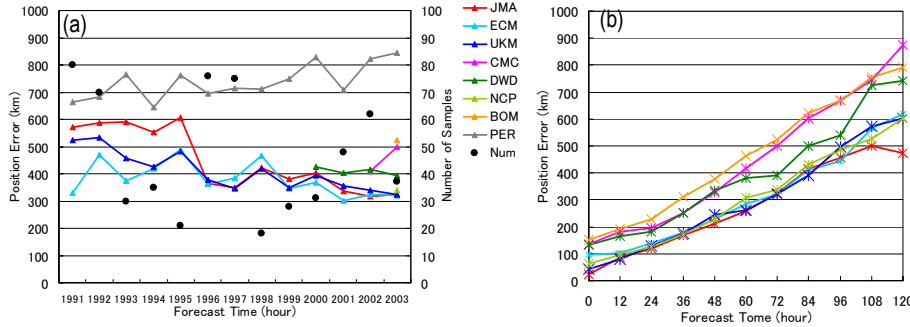


Fig. 1(a) Time series of position error for 72 hour forecast in the western-North Pacific region (1991-2003).

PER: Persistency forecast, Num: Number of samples, JMA: JMA, ECM: ECMWF, UKM: UKMO, CMC: CMC, DWD: DWD, NCP: NCEP, BOM: BoM. (b) Position error in western-North Pacific region in 2003.

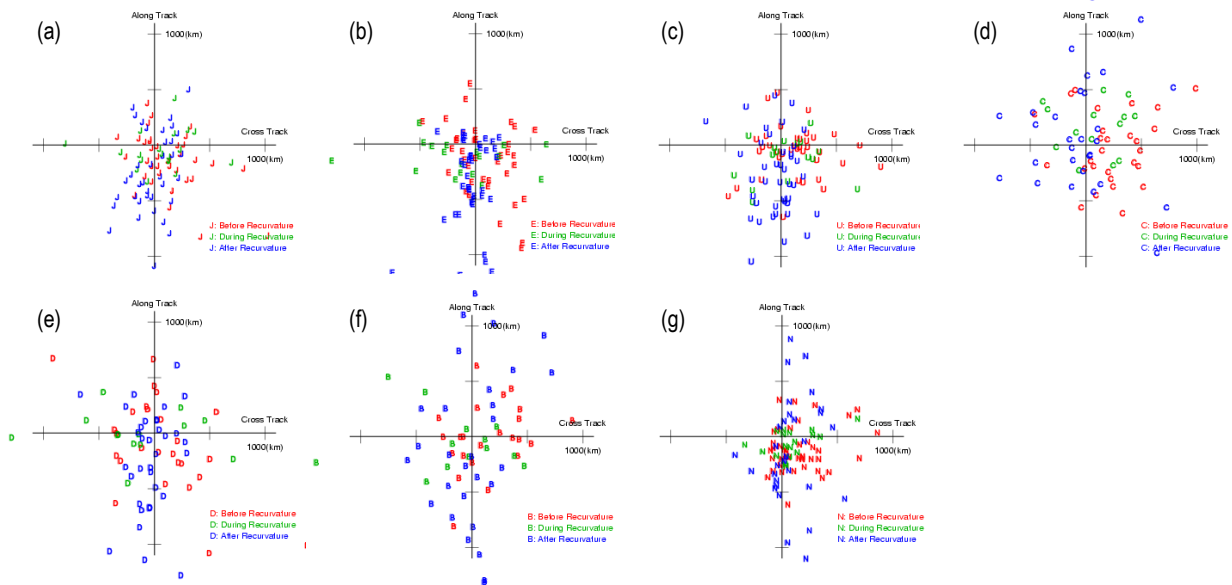


Fig. 2 Scattering diagram of TC positions at 72 hour forecast in 2003. (a) JMA, (b) ECMWF, (c) UKMO, (d) CMC, (e) DWD, (f) BoM, (g) NCEP. Red mark: Before recurvature, Green mark: During recurvature, Blue mark: After recurvature.

Each mark means a relative forecast TC position as seen from the besttrack (the origin). Y-axis represents position errors in Along Track (AT) direction and X-axis does that in Cross Track (CT) direction. Unit: km.

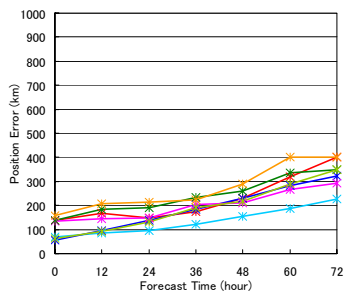


Fig. 3 Position error in the eastern-North Pacific region in 2003. Legend is the same as Fig. 1.

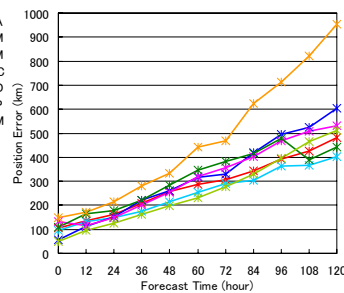


Fig. 4 Position error in the North Atlantic region in 2003. Legend is the same as Fig. 1.

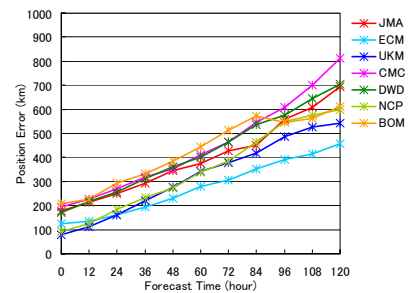


Fig. 5 As in Fig.4 but for the Southern Hemisphere region.