Introduction of a Stochastic Physics Scheme for Representation of Model Uncertainties to JMA's Typhoon Ensemble Prediction System

Yoichiro Ohta*, Hitoshi Yonehara**, and Masayuki Kyouda**
*Environmental Modeling Center, National Oceanic and Atmospheric Administration
**Numerical Prediction Division, Japan Meteorological Agency
e-mail:Yoichiro.Ota@noaa.gov

Since February 2008, the Japan Meteorological Agency (JMA) has operated the Typhoon Ensemble Prediction System (TEPS), which is designed to improve track forecast targeting for tropical cyclones (TCs) in the Regional Specialized Meteorological Center (RSMC) Tokyo - Typhoon Center's area of responsibility within the framework of the World Meteorological Organization. The forecast model employed in TEPS is a low-resolution version (TL319L60) of JMA's Global Spectral Model (GSM) at TL959L60. TEPS adopts a singular vector (SV) method to generate its initial perturbations and calculates dry SVs targeting the mid-latitude area in the center's area of responsibility. It also calculates moist SVs targeting TC surroundings where moist processes are critical. A detailed description of the TEPS is given by Yamaguchi and Komori (2009) and Ohta (2011).

A stochastic physics scheme was introduced into TEPS as well as JMA's one-Week EPS (WEPS) in December 2010 after a related numerical experiment. (Yonehara and Ujiie, 2011) The scheme, which is based on Buizza et al. (1999), stochastically perturbs tendencies of parameterized physical processes.

As a result of this introduction, TEPS started representing model uncertainties in addition to initial data uncertainties. The experimental results show that the introduction makes the ensemble spread more appropriate in terms of the spread-skill relationship and improves forecast skill, especially over the tropics, in a very similar to WEPS. On the other hand, the results of experiments regarding the TC track forecast show that the introduction has a neutral impact on the size of forecast errors for the ensemble mean TC track (as shown in Figure) and the spread-skill relationship.

REFERENCES
Buizza, R., M. Miller, and T.N. Palmer, 1999: Stochastic representation of model uncertainties in the ECMWF Ensemble Prediction System. Quart. J. Roy. Meteor. Soc., **125**, 2887-2908.
Ohta, Y., 2011: Modification to Initial Perturbations of JMA's Typhoon Ensemble Prediction System. WMO CAS/JSC WGNE 2011 Blue Book.
Yamaguchi, M. and T. Komori, 2009: Outline of the Typhoon Ensemble Prediction System at the Japan Meteorological Agency. RSMC Tokyo-Typhoon Center Technical Review, **11**, 14 – 24.
Yonehara, H. and M. Ujiie, 2011: Stochastic physics scheme for model uncertainties in the JMA one-week ensemble prediction system. WMO CAS/JSC WGNE 2011 Blue Book.
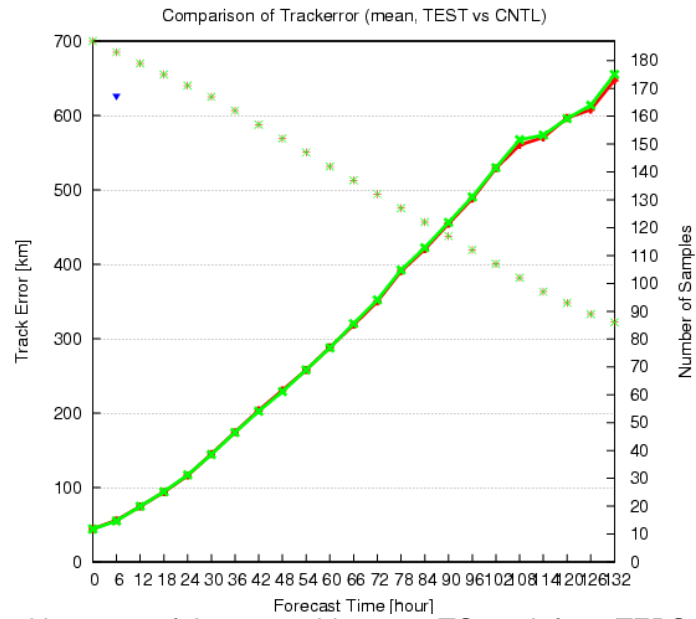
Figure : Mean position error of the ensemble mean TC track from TEPS. The horizontal axis shows the forecast range up to 132 hours ahead, and the green and red lines represent the results of verification for the current and previous systems, respectively. The crosses indicate the numbers of verified samples based on the vertical scale on the right.