March 2014 upgrade of JMA's One-month Ensemble Prediction System

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Introduction

JMA's Ensemble Prediction System (EPS) for operational one-month forecasting (referred to here as the One-month EPS) employs an atmospheric global circulation model (AGCM). JMA implemented a major upgrade of the One-month EPS on 6 March 2014. The main changes are described below.

Main changes

(1) Improvement of the AGCM

The AGCM used for the One-month EPS is a lower-resolution version of JMA's Global Spectral Model (GSM) for short-range deterministic prediction. With the One-month EPS upgrade, the AGCM's horizontal resolution was increased from TL159 (110 km) to TL319 (55 km). Its version was also upgraded from GSM1011 to GSM1304 to include changes in certain physical processes such as stratocumulus parameterization (Shimokobe 2012).

(2) Improvement of AGCM boundary conditions

The horizontal resolution of sea surface temperature (SST) and sea ice distribution for the lower boundary conditions of the AGCM was increased using Merged satellite and in situ data Global Daily Sea Surface Temperature data (MGDSST; JMA 2013) and sea ice concentration data with a higher resolution (0.25 x 0.25 degrees) than that for previous SST and ice data (COBE-SST; 1.0 x 1.0 degrees; Ishii et al., 2005).

Prescribed sea ice distribution estimated using initial anomalies of sea ice distribution and statistics on the frequency of sea ice presence was also applied (Sugimoto and Takaya 2013) in order to produce results more appropriate than those calculated using climatological distribution only.

(3) Improvement of ensemble method

A stochastic physics scheme designed in consideration of model uncertainties associated with physical parameterization was introduced (Buizza et al. 1999; Yonehara and Ujiie 2011).

The results of a full set of hindcasts executed using the new system indicated enhanced prediction skill. For details, see Sato et al. (2014) in Section 6 of this issue.

Table 1 Specifications of JMA's old and new one-month EPSs

		Old system (operated until Feb. 2014) V1103	New system (from Mar. 2014) V1403
Model	Atmospheric model (version)	JMA's Global Spectral Model (GSM 1011)	JMA's Global Spectral Model (GSM 1304)
Model	Resolution	Horizontal: TL159 (approx. 1.125°) Vertical: 60 levels up to 0.1 hPa	Horizontal: TL319 (approx. 0.5625°) Vertical: 60 levels up to 0.1 hPa
Boundary condition	Sea surface temperature	Persisted anomaly with COBE-SST (1.0° x 1.0°)	Persisted anomaly with MGDSST (0.25° x 0.25°)
Boundary condition	Sea ice	Climatology of sea ice analysis (1.0° x 1.0°)	Prescribed sea ice distribution estimated using initial anomalies of sea ice (0.25° x 0.25°)
Ensemble method	Initial perturbation method	Combination of: - Breeding of Growing Modes (BGM) - Lagged Average Forecast (LAF) (25 BGMs and 2 initial dates with 24-hour LAF)	
Ensemble method	Model ensemble method	None	Stochastic physics scheme
Ensemble method	Ensemble size	50	
Operation	Initial time	12 UTC on Wednesday and Thursday	12 UTC on Tuesday and Wednesday
Operation	Forecast range	816 hours (34 days)	

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.

JMA, 2013: Merged satellite and in-situ data global daily sea surface temperature. *Outline of the operational numerical weather prediction at the Japan Meteorological Agency. Appendix to WMO Technical Progress Report on the Global Data-processing and Forecasting System (GDPFS) and Numerical Weather Prediction (NWP) Research*, Japan Meteorological Agency, Tokyo, Japan, 138. Available online at http://www.jma.go.jp/jma/jma-eng/jma-center/nwp/outline2013-nwp/index.htm.

Sato, H. and coauthors, 2014: Performance of JMA's new One-month Ensemble Prediction System. CAS/JSC WGNE Research Activities in Atmospheric and Oceanic Modelling, submitted.

Shimokobe, A., 2012: Improvement of the Stratocumulus Parameterization Scheme in JMA's Operational Global Spectral Model. *CAS/JSC WGNE Res. Activ. Atmos. Oceanic Model.*, **42**, 4.17-18.

Sugimoto, H. and Y. Takaya, 2013: A Method of Predicting Sea Ice Boundary Conditions for the One-month Ensemble Prediction System, *CAS/JSC WGNE Res. Activ. Atmos. Oceanic Model.*, **43**, 6.13-14.

Yonehara, H. and M. Ujiie, 2011: A Stochastic physics scheme for model uncertainties in the JMA one-week Ensemble Prediction System, *CAS/JSC WGNE Res. Activ. Atmos. Oceanic Model.*, **41**, 6-9-10.