Replacement of the JMA's EPS for Long Range Forecasting in February 2010

Masayuki Hirai[1], Ichiro Ishikawa[1], Akihiko Shimpo[1], Hitoshi Sato[1], Taizo Soga[1], Hirotoshi Mori[1], Noriyuki Adachi[1], Yosuke Fujii[2], Satoshi Matsumoto[2] and Tamaki Yasuda[3]
[1] Climate Prediction Division, Japan Meteorological Agency, Tokyo, Japan
[2] Oceanographic Research Department, Meteorological Research Institute, Tsukuba, Japan
[3] Climate Research Department, Meteorological Research Institute, Tsukuba, Japan
(E-mail: m –hirai @ met.kishou.go.jp)

1. Introduction

The ensemble prediction system (EPS) for long range forecasting in Japan Meteorological Agency (JMA) was replaced. The old system employed a two-tier method, in which an atmospheric global circulation model (AGCM) was executed using the prescribed SSTs obtained by a combination of persisted SST anomalies in the preceding month and statistically derived ones based on the ENSO prediction with the coupled ocean-atmosphere general circulation model (CGCM) operated for JMA's El Niño prediction. The new system employs a one-tier method using the CGCM. The CGCM is based on the one used as the El Niño prediction system. Accordingly, the new system is used for both long range forecasting and the El Niño outlook. The operational information of the seasonal prediction and the El Niño outlook has been produced with the new system since February and March 2010, respectively. This paper reports the outline of the new system.

2. Major changes in this update

Table 1 shows the specifications of the old and the new system. The major changes are as follows.

(1) Change from AGCM to CGCM (Figure 1)

The forecasting model is changed from the AGCM to the CGCM. The atmospheric part of the CGCM is basically same as the AGCM, which is a low-resolution version of the JMA's AGCM for short- and medium-range forecasting. The oceanic part of the model is called MRI.COM (Tsujino et al. 2010)[1], which has been developed at the Meteorological Research Institute/JMA.

The coupling between the ocean and the atmosphere is performed every hour. The atmospheric component supplies hourly-mean heat, momentum and freshwater fluxes to the ocean component, while the oceanic component supplies the SSTs to the atmospheric component. Simulated fields in the CGCM tend to approach the model climate state, which differs substantially from the real states. In order to suppress this climate drift, adjustment is made to both the heat and momentum fluxes. The adjustment amount is the statistics depending on a target month.

[1] http://www.mri-jma.go.jp/Publish/Technical/DATA/VOL_59/59.html

(2) Initial conditions and perturbations

Initial conditions for atmosphere are obtained from the result of analysis by the JMA Climate Data Assimilation System (JCDAS; Onogi et al. 2007), which is a quasi-real-time climatic assimilation system under the same conditions as that for JRA-25. Initial conditions for ocean are obtained from the global ocean data assimilation system (MOVE/MRI.COM-G; Usui et al. 2006).

In the new system, initial perturbations for both atmosphere and ocean are generated. Atmospheric initial perturbations are obtained using the Breeding of Growing Modes (BGM) method, estimating for the Northern Hemisphere (20°N-90°N) and the tropics (20°S-20°N) separately. Oceanic initial perturbations are obtained through MOVE/MRI.COM-G, in which perturbed surface heat and momentum fluxes in the tropics adopted.

(3) Ensemble method

The new system adopts a combination of the initial perturbation method and the Lagged Average Forecasting (LAF) method. The purposes of adoption of the LAF method are to avoid the intensive use of computing resources and to ensure ensemble spread in ocean. According to the hindcast experiment, ensemble spread in ocean is underestimated if the LAF method is not adopted. Nine members are run every five days, and the EPS consists of fifty-one members for the latest six initial dates (Figure 2).

References

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Table 1 Specifications of the old and the new system for long range forecasting in JMA

		Old system (AGCM)	New system (CGCM) (from Feb. 2010)
Outline of the system		AGCM with two-tier method	CGCM (one-tier method + flux adjustment)
Model	Atmospheric component	JMA-GSM (TL95 (~1.125°), 40 levels (up to 0.4 hPa))	
	Oceanic component	---	MRI.COM (1.0° in longitude, 0.3°-1.0° in latitude, 50 levels, 75°N-75°S)
Initial condition	Atmosphere	JMA's global analysis**	JCDAS
	Ocean	---	MOVE/MRI.COM-G
Boundary condition	Land surface	numerical prediction initialized from climatology	
	SST	two-tier method (persisted anomaly + statistical prediction)	numerical prediction with flux adjustment, climatology out of the oceanic model domain (polar region)
	Sea ice	climatology	
Parameter	CO_2	constant	trend*
Ensemble method	Ensemble size	51	51 (9 BGM and 6 initial days with 5-day LAF)*
	Perturbation method	singular vector (SV) method	combination of initial perturbation (atmospheric breeding growing mode (BGM) method and oceanic initial perturbation) and lagged average forecast (LAF) method

* Specification of the old El Niño prediction system operated until January 2010 is similar to the new system (right), except the items marked by '*'. In the old El Niño prediction system, CO_2 concentration was regarded as constant and ensemble size was 30 (5 BGM and 6 initial days with 5-day LAF).
** Operational atmospheric data assimilation system for a short-range forecasting in JMA.

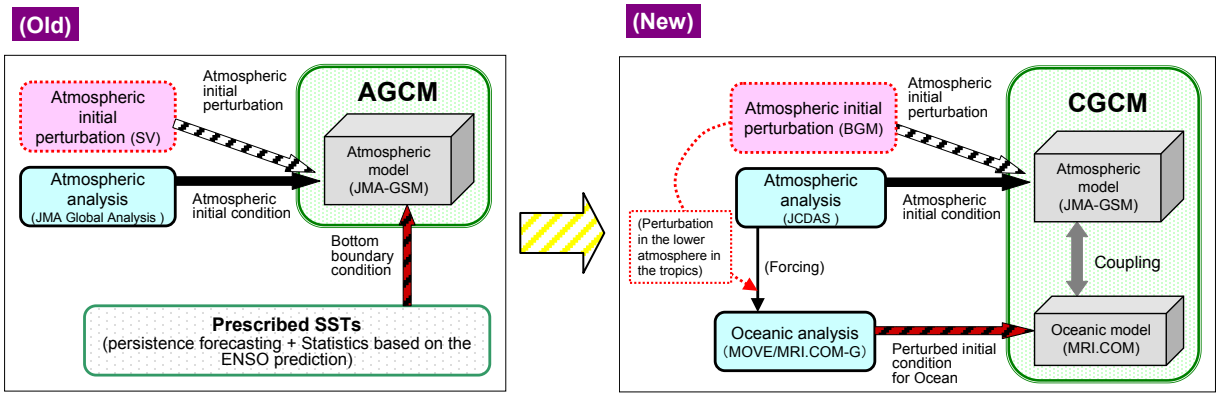

Figure 1 Schema of the old (left) and new (right) prediction system for long range forecasting
The green, aqua and red boxed processes denote the forecasting model, the data assimilation and the initial perturbation, respectively.

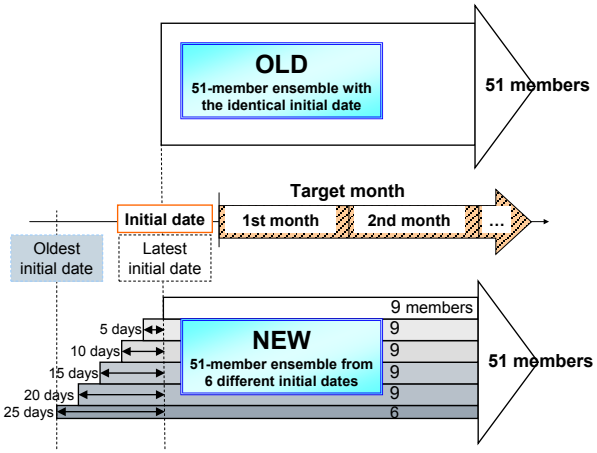

Figure 2 Schema of aggregation for the ensemble members in the old (top) and new (bottom) ensemble prediction system for long range forecasting.