Performance of JMA's new One-month Ensemble Prediction System

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1. Introduction

The Japan Meteorological Agency (JMA) upgraded its operational One-month Ensemble Prediction System (EPS) in March 2014 (for details, see Hirai et al. 2014). The main changes include a horizontal resolution increase from TL159 to TL319, a revision of the SST/sea-ice specifications prescribed as lower boundary conditions, and the introduction of a stochastic physics scheme.

The performance of the new One-month EPS (referred to here as V1403) was evaluated via hindcast experiments carried out for the 30-year period from 1981 to 2010.

2. Hindcast experiments

Atmospheric and land initial conditions for the experiments conducted with V1403 were provided from the Japanese 55-year Reanalysis (JRA-55; Ebita et al. 2011), which is the latest atmospheric reanalysis dataset produced by JMA. In contrast, those for the experiments conducted with the previous EPS (V1103) were provided from JRA-25/JCDAS (Onogi et al. 2007). A summary of the experiments is given in Table 1.

3. Verification results

The impact on one-month forecast skill scores was examined based on the outcomes of the hindcast experiments. The anomaly correlation for 30-day mean 500-hPa geopotential height (Z500) during boreal winter (December – February) shown in Figure 1 suggests an improvement for most parts of the extratropics. V1403 has a positive impact on skill scores for most variables in all regions and forecast ranges. Significant improvement is seen in the early forecast range (Figure 2).

The bias of the 28-day mean Z500 in the Northern Hemisphere (20˚N – 90˚N) during boreal winter is shown in Figure 3. Although the spatial pattern of the bias is similar with both V1103 and V1403, its magnitude with V1403 is reduced for most parts of the Northern Hemisphere, especially over northern Europe. Model biases in the extratropics are generally improved, while the impact on biases in the tropics is relatively small. For the Asian summer monsoon, the weaker circulation bias is strengthened in V1403.

The new configuration's capacity to represent atmospheric phenomena was verified. The frequency of blocking is underestimated (particularly in the Euro-Atlantic sector) with V1103, while the frequency of wintertime blocking in the sector is increased with V1403 (for details, see Shimpo 2014).

The impact on synoptic eddy activity based on 10-day high-pass filtered wind at 300 hPa is positive, with improvement of overly weak eddy activity in the extratropics.

Madden-Julian oscillation (MJO) prediction skill was assessed using the method detailed by Matsueda and Takaya (2012). The results suggested a neutral impact on MJO forecast skill and a slightly negative impact on MJO amplitude (i.e., smaller values).

4. Conclusions

The impact of the new One-month EPS on forecast skill was verified using hindcast experiments. Forecast skill scores showed significant improvement, especially in the early forecast range. Model biases are generally reduced in the extratropics, while the impact on biases in the tropics is relatively small. Representation of blocking frequency and synoptic eddy activity in the extratropics is also improved, while the impact on MJO prediction ability is close to neutral.

References

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Table 1 Specifications of one-month hindcast experiments

	V1103 (operated until February 2014)	V1403 (since March 2014)
Atmospheric model	GSM 1011	GSM 1304
Resolution (model top)	TL159 L60 (0.1 hPa)	TL319 L60 (0.1 hPa)
Initial conditions Atmosphere Land surface	 JRA-25/JCDAS Climatology	 JRA-55 JRA-55
SST	COBE-SST, persisted anomaly	MGDSST, persisted anomaly
Sea ice distribution	Climatology	Statistical prediction
Ensemble method	Breeding of Growing Modes (BGM)	BGM + Stochastic physics scheme
Ensemble size	5	
Period	1981 – 2010 (3 initial dates a month)	
Verification data	JRA-55	

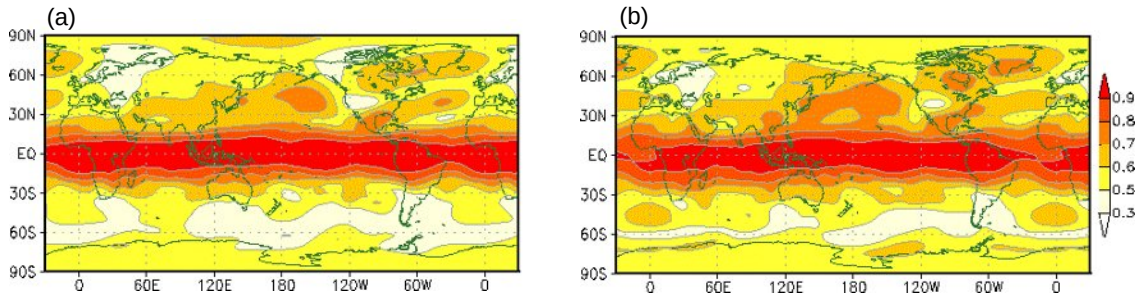

Figure 1 Anomaly correlation of 30-day (days 1 – 30) mean 500-hPa geopotential height for boreal winter during the period from 1981 to 2010 with (a) V1103 and (b) V1403

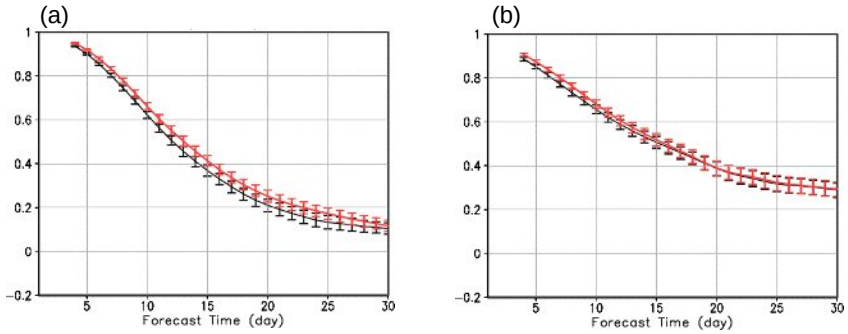

Figure 2 Anomaly correlation of (a) 500-hPa geopotential height in the Northern Hemisphere (20˚N – 90˚N) and (b) mean sea level pressure in the tropics (20˚S – 20˚N) for boreal winter during the period from 1981 to 2010. Scores are based on seven-day mean fields with V1103 (black) and V1403 (red). The vertical bars indicate 95% confidence intervals.

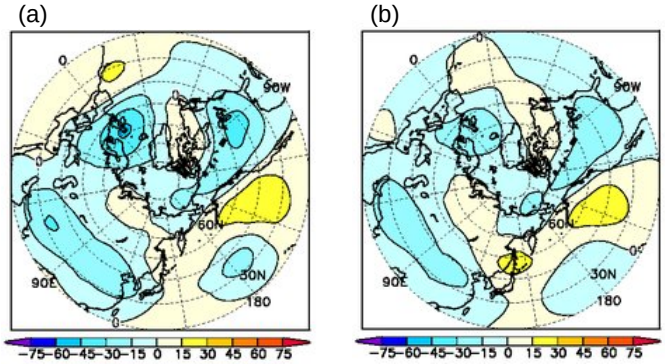

Figure 3 Bias of 28-day (days 3 – 30) mean 500-hPa geopotential height (m) for boreal winter during the period from 1981 – 2010 with (a) V1103 and (b) V1403