JMA's ensemble prediction system for one-month and seasonal predictions

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The Japan Meteorological Agency (JMA) operates an ensemble prediction system (EPS) for one-month and seasonal predictions. For one-month prediction, horizontal resolution is about 110 km with 40 levels for vertical (TL159L40). Ensemble size is 50 with Breeding of Growing Modes (BGM) method and lagged averaged forecast (LAF) method. For seasonal prediction, same atmospheric model is used, but with coarser horizontal resolution, which is about 180 km (TL95L40). Ensemble size is 51 with Singular vector (SV) method. Noted that tier-two method is adopted for seasonal prediction and SSTs are prescribed using persisted anomaly, climatology and ENSO prediction by JMA's coupled prediction model.

Products from the EPS are used for the monthly and seasonal outlooks for Japan. The maps and data from the EPS are also provided to other countries on Tokyo Climate Center (TCC) web site (http://ds.data.jma.go.jp/tcc/tcc/index.html).

For one-month prediction, hindcast experiments have been performed for 20 years between 1982 and 2001 and initial dates are three times per every month to get more accurate estimation of bias. For seasonal prediction, hindcast for 22 years between 1984 and 2005 have been performed with the 10th of each month as initial dates. Ensemble size is 5 for one-month prediction and 11 for seasonal prediction. This setting of hindcast for seasonal prediction is satisfied with the Standardized Verification System for Long Range Forecast (SVS-LRF). Commonly, initial conditions were from Japanese 25-year Reanalysis (JRA-25; Onogi et al. 2007), and Centenial in-situ Observation Based Estimates of variability of sea surface temperature (SST) and marine meteorological variables (COBE; Ishii et al. 2005) daily data were used for SSTs.

The skills of the EPS for one-month and seasonal predictions were examined using the hindcast experiments and the operational prediction results. Figure 1 shows the anomaly correlations for 500hPa geopotential height (Z500) over Northern Hemisphere (NH). It is shown that anomaly correlations for the first week for both January and July are over 0.8, around 0.4 for the second week, and around 0.5 for monthly average. Figure 2 shows time sequences of Relative Operating Characteristic (ROC) scores of positive anomalies of Z500 over NH. It is shown that, averagely, the score is about 0.7, 0.65 and 0.5 for monthly average, the second week, and the average of the third and the fourth weeks, though they are different for each season and each year. For the seasonal prediction, ROC curves for three-averaged surface temperature (2m temperature) and precipitation for upper tercile are shown in Figures 3 and 4. ROC scores for surface temperature are 0.691 for one-month lead and 0.658 for four-month lead time, which means that JMA's seasonal prediction model seems to be useful. Though prediction skills are lower than for surface temperature, it can be said that JMA's seasonal prediction model also has skills for prediction of precipitation.

In 2010, JMA plans to introduce a coupled model into seasonal prediction, which is a new version of JMA's operational ENSO prediction model (JMA/MRI-CGCM) from March 2008. From the preliminary assessment of the skills of JMA/MRI-CGCM, it is shown that JMA/MRI-CGCM seems to have better skills than the current seasonal prediction model. More detailed verifications are needed and developments should be continued to improve the EPS for not only one-month and also seasonal prediction.

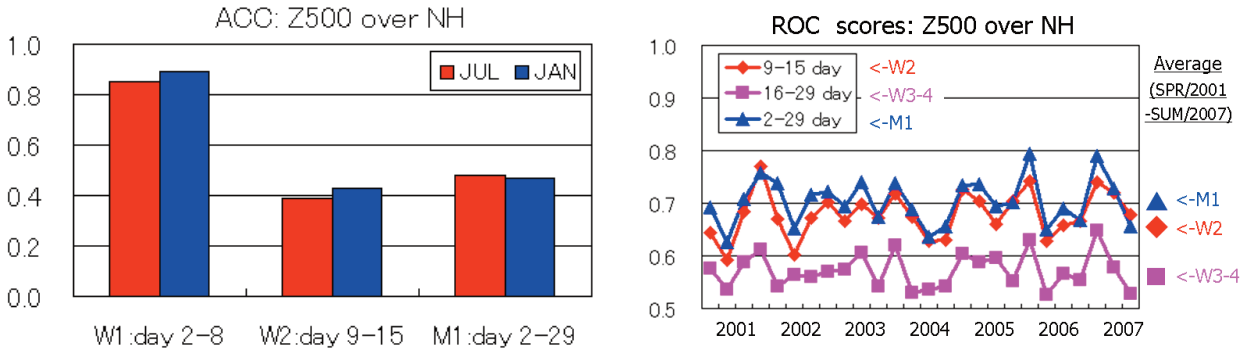

Fig. 1 (Left panel) anomaly correlations for 500hPa geopotential height over Northern Hemisphere (NH) based on the hindcast experiments for one-month prediction between 1982 through 2001. W1 (W2) means the first (second) week, and M1 means the monthly average. Red (blue) bar is for July (January). (Right panel) time sequences of Relative Operating Characteristic (ROC) scores for 500hPa geopotential height over NH based on JMA's operational prediction system for one-month prediction between 2001 spring through 2007 summer. Scores are calculated for positive anomalies in each season. Orange line is for the second week, pink line is for the average of the third and fourth weeks, and blue line is for monthly average. Averages for each term between 2001 spring through 2007 summer are shown at the right side of graph

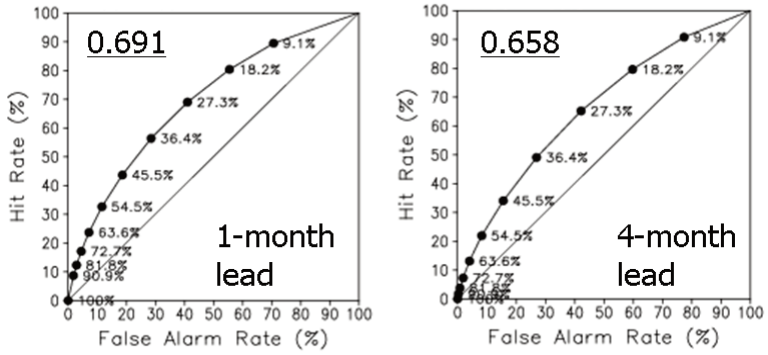

Fig. 2: ROC curves for upper tercile for three-month averaged surface temperature (2m temperature) over NH based on the hindcast experiments for seasonal prediction between 1984 through 2005. (Left) one-month lead and (right) four-month lead time. ROC score is shown at upper left in each panel.

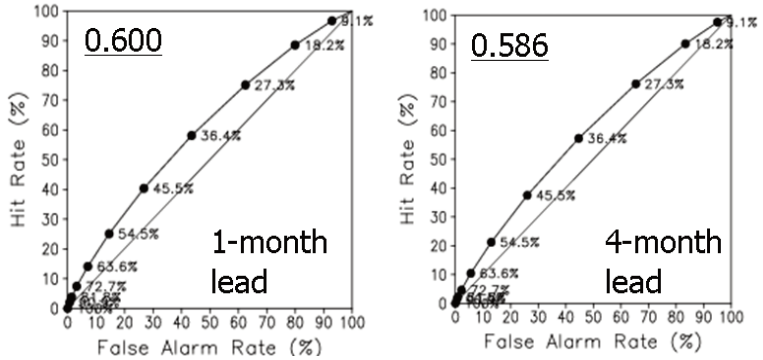

Fig. 3 Same as Figure 2, but for precipitation.

References

Ishii, M., A. Shouji, S. Sugimoto, and **T. Matsumoto**, 2005: Objective analyses of SST and marine meteorological variables for the 20th century using ICOADS and the Kobe Collection. *Int. J. Climatology*, **25**, 865-879.

Onogi, K., J. Tsutsui, H. Koide, M. Sakamoto, S. Kobayashi, H. Hatsushika, T. Matsumoto, N. Yamazaki, H. Kamahori, K. Takahashi, S. Kadokura, K. Wada, K. Kato, R. Oyama, T. Ose, N. Mannoji and **R. Taira**, 2007: The JRA-25 Reanalysis. *J. Meteorol. Soc. Japan*, **85**, 369-432.