Verification of Dynamical One-month Forecast at the JMA

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1. Introduction

The JMA has been issuing a one-month forecast with dynamical method since 1996. Here we introduce JMA one-month forecast system and verification of the forecast.

2. Operational dynamical one-month forecast system

The JMA issues a one-month forecast every Friday with a lead-time of one day. The forecast elements are area mean temperature anomaly, precipitation amount ratio and sunshine duration ratio compared with normal. Forecasts are expressed by three categories i.e. below normal, normal, and above normal which are of top 30%, middle 40%, and bottom 30% in the 1961-1990 historical data. Forecasts are issued in deterministic or probabilistic form.

For these issues, a dynamical ensemble forecast system is used. The model used in this operational forecast is T63, 30-level version of the JMA NWP model (GSM9603) with Arakawa-Schubert cumulus scheme. The sea surface temperature anomalies are fixed to the initial value during time integration. Using this model, 5-member forecasts based on singular-vector method (Mureau et al. 1993) are carried out every Wednesday and Thursday starting from analyses of respective days and 10 forecasts in total are prepared for an ensemble forecast.

As post-processing products of this system, some kinds of maps are produced. Ensemble mean 500hPa height and anomaly maps, spread distribution maps and time-series graphs of 850hPa temperature anomalies over Japan are directly produced from model output. The objective surface temperature, precipitation and sunshine duration forecasts over Japan are produced by multiple regression equation from model output. The perfect prognosis method (PPM) that is commonly used in short-range forecast is adopted.

3. Verification of forecast

3-1 500hPa geopotential height over the Northern Hemisphere

Fig. 1 shows a time-series of 28-day mean 500hPa geopotential height anomaly correlation coefficient (ACC) over the Northern Hemisphere with 1-day lead. The average ACC is

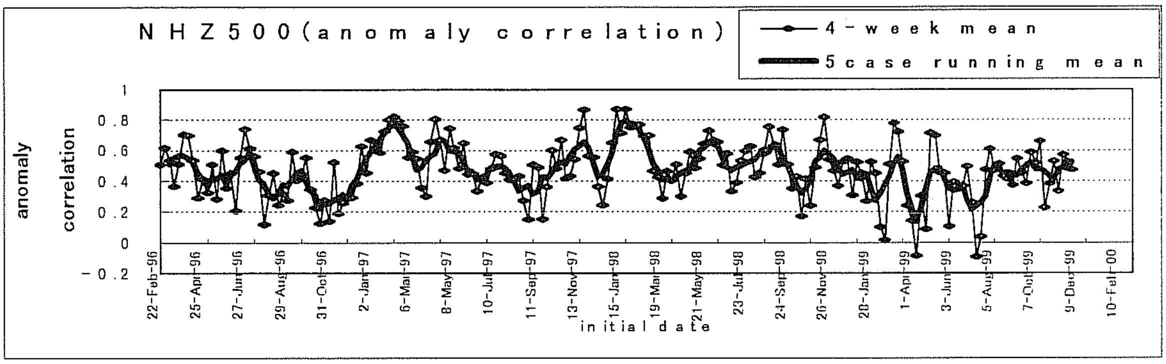

Figure 1. Time series of anomaly correlation of 28 day mean 500hPa geopotential height (Northern Heimisphere)

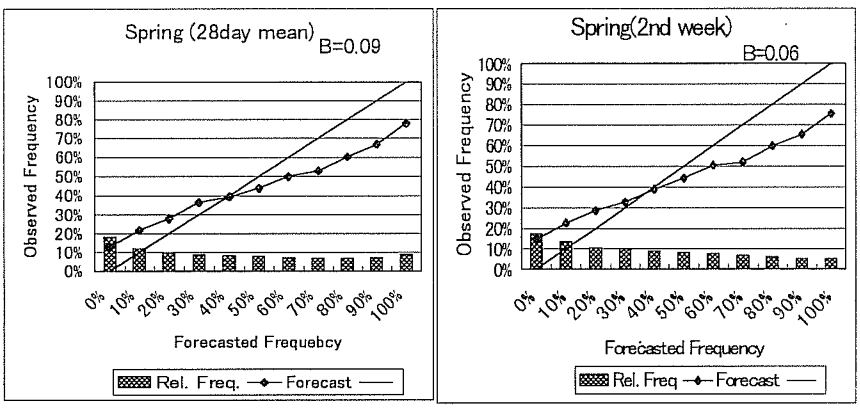

Figure 2.
Reliability diagram for positive high anomaly (greater than half of standard deviation of natural variability) probability of 500hPa geopotential height.

Left :28 day mean field
Right: 2nd week mean field
Both are for Northern Hemisphere and for spring.
B: Brier skill score

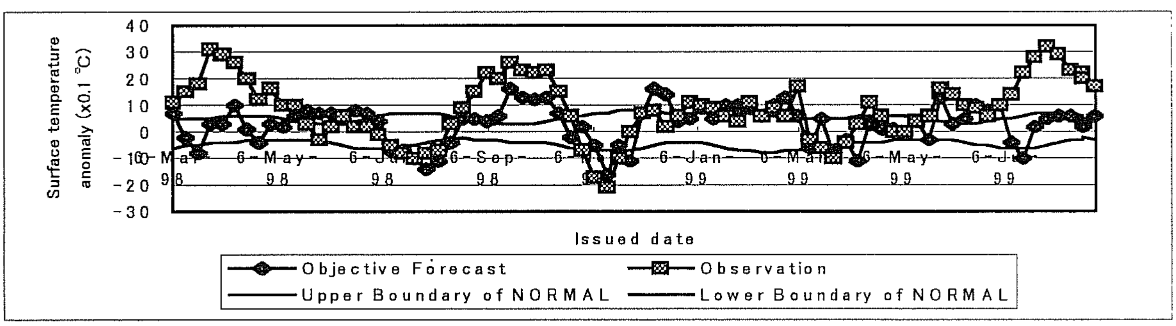

Figure 3. Time series of surface temperature anomaly forecast and corresponding observation. (28 day mean, the northern part of Japan)

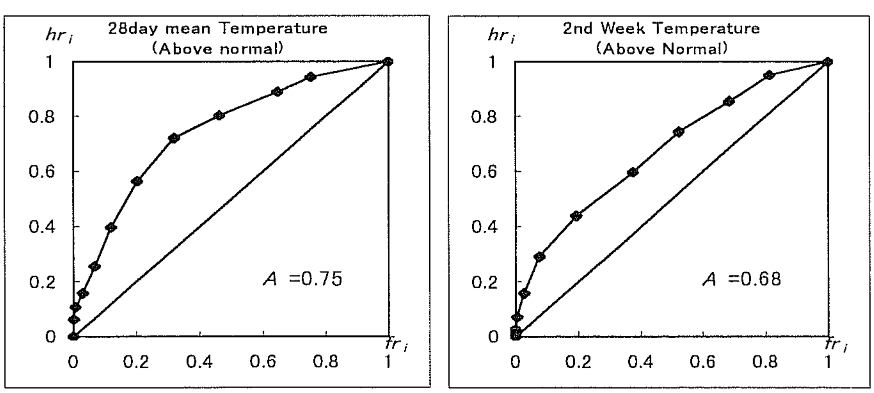

Figure 4.
ROC curve for above normal surface temperature probabilistic forecast in Japan.
Left: 28day mean
Right: 2nd week mean
A: area

about 0.5. The forecast skills in winter are better than in other seasons although there are large case-to-case and year-to year variations. Fig.2 shows reliability diagrams of positive high anomaly (greater than 0.5 σ, σ :standard deviation of natural variability) probability of NH Z500. Both for 28day mean and 2nd week mean field probability have good reliability. These figures are for in spring. In summer and autumn, the probability forecasts have almost the same reliability compared with in spring and they are more reliable in winter.

3-2 Forecast in Japan

Fig.3 shows the time series of 28-day mean surface temperature anomaly objective forecasts and corresponding observations in the northern part of Japan. The forecasts agree rather well with observations (correlation coefficient =0.46), although there are some discrepancies in some periods.

Fig.4 shows the ROC curves for the above normal probability of 28-day mean and 2nd week mean surface temperature. These show that the probabilistic forecast provides useful information to the users.

4. Summary and Future Plan

We briefly introduced a dynamical one-month forecast system at the JMA and showed some results of forecast verifications. Our system can provide useful information, although there is room for improvement. Our dynamical one-month forecast system will be upgraded in 2001. In new system, the dynamical one-month forecast system will be integrated with a dynamical medium-range forecast system into an extended-range forecast system. The horizontal model resolution will increase to T106L40 from T63L30 and ensemble size will increase to 30 from 10. Now, we are investigating the effect of increasing of ensemble size and method to generate initial perturbations. Of course, model improvements will be done to improve the forecast skill.

Reference

Mureau, R., F. Molteni, and T. Palmer 1993: Ensemble prediction using dynamically conditioned perturbations. *Quart. J. Roy. Meteor. Soc.* **119** 299-323