5.8 Products of Ensemble Prediction System

5.8.1 One-week forecast

(a) 'Central cluster' and schematic chart

The 'central cluster' is constituted of the six most similar members to the ensemble mean, which facilitates to extract information on meteorological features from the ensemble prediction system (EPS). Ensemble mean fields, which provide the best forecast in terms of RMSE, tend to lose detailed information on synoptic systems due to smoothing caused by ensemble averaging. Therefore, they are not very useful in interpreting meteorological fields. The central cluster provides more detailed information on meteorological features than the ensemble mean.

Fig. 5.8.1 shows a product of daily sea level pressure fields and precipitation areas from day 2 to 7. This schematic chart (FEFE19) is produced by averaging over the central cluster.

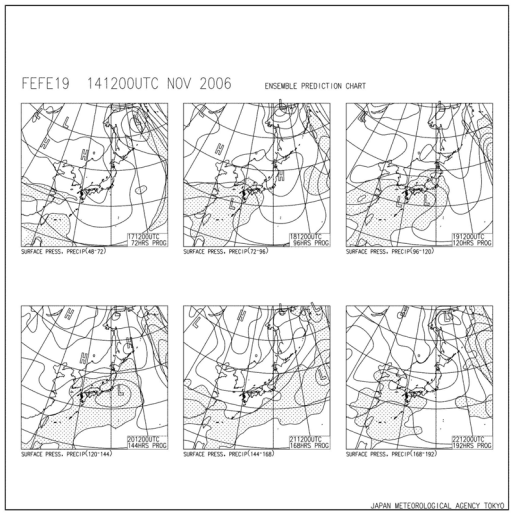

Fig. 5.8.1 schematic chart of day 2 to 7

(b) Reliability index

One of the most notable advantages of the EPS is the availability of information on the reliability of forecasts. In the current one-week forecast, the reliability indices A, B and C are informed to the public along with the categorical forecast. The indices A and B mean that the forecast is expected to be much more and slightly more skillful than the climatological forecast, respectively. The index C means that the skill of the forecast is expected to be equal to or worse than the climatological forecast. The index is calculated from the spreads of EPS members of 500hPa geopotential height (110-150E, 30-60N) and sea level pressure (selected four regions). The spreads are normalized by the standard deviation of 30-year climatology to remove the influence of seasonal variations.

(c) Forecast guidance

Forecast guidance for the probabilistic forecast and its error information are obtained directly from the output of the EPS. Unlike the conventional MOS guidance, they can be calculated without a long-term data set. However, they could be strongly affected by the model biases.

Daily maximum/minimum temperature guidance and its error estimation are calculated using the ensemble mean and the spread of the members. A Kalman filter technique is employed to reduce the model biases.

For the precipitation forecast, probability of precipitation of at least 1mm/day is directly calculated from the output of the EPS. It has replaced the previous MOS guidance since 2002.

5.8.2 Products of the EPS for one-month forecasting

The EPS for one-month forecasting provide two types of products; one is the direct output of the model, and the other is the down-scaled information called 'Guidance', which is derived by the statistical method from the grid point value of the direct model output. Various kinds of charts and tables are distributed to operational forecasters.

(a) Direct output from the model

Products are listed in Table 5.8.1 and an example of temperature time series is shown in figure 5.8.2.

Table 5.8.1 Direct output from the model

Contents	**Average Period**
Ensemble average chart of 500hPa height	1st week, 2nd week, 3rd-4th week, 28-day mean
Ensemble average chart of 850hPa temperature	1st week, 2nd week, 3rd-4th week, 28-day mean
Ensemble average chart of mean sea level pressure and precipitation	1st week, 2nd week, 3rd-4th week, 28-day mean
Spread chart of 500hPa height	1st week, 2nd week, 3rd-4th week, 28-day mean
Large anomaly probability chart of 500hPa height	1st week, 2nd week, 3rd-4th week, 28-day mean
Time series of ensemble average and individual forecast of area mean 850hPa temperature	7-day running mean
Time series of ensemble average and individual forecast of circulation indices	7-day running mean
Time series of the Northern Hemisphere mean spread of 500hPa height	7-day running mean, 28-day running mean
Time series of Japan area mean spread of 500hPa height	7-day running mean, 28-day running mean

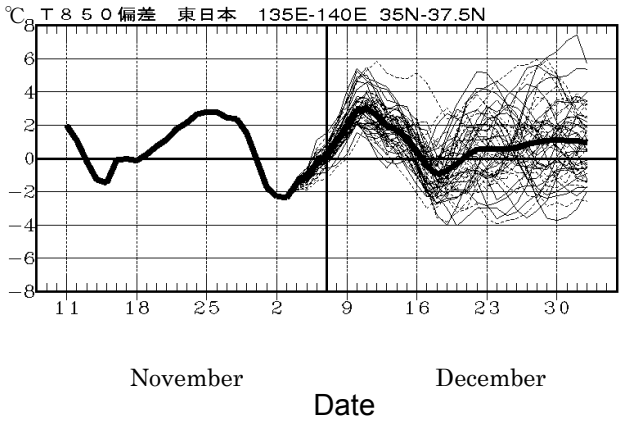

Fig. 5.8.2 7-day running mean time series of 850 hPa temperature anomaly averaged over Eastern Japan. Thin solid and dashed lines show individual forecast. Thick lines before and after 7 December show observation and ensemble average, respectively.

(b) Guidance products

The one-month forecast offers probabilistic prognoses on temperature , precipitation, and sunshine duration in three categories: "above normal", "near normal", and "below normal". The Guidance products for those elements are produced with Perfect Prognosis Method (PPM) by multiple linear regression. The products are listed in Table 5.8.2.

Table 5.8.2 Guidance products

Contents	Average Period
Surface temperature	1st week, 2nd week, 3rd-4th week, and 28-day mean
Precipitation ratio to the normal	28-day mean
Sunshine duration ratio to the normal	28-day mean
Occurrence probability of the three categories of surface temperature	1st week, 2nd week, 3rd-4th week, and 28-day mean
Occurrence probability of the three categories of precipitation	28-day mean
Occurrence probability of the three categories of sunshine duration	28-day mean
Histogram of surface temperature	28-day mean
Histogram of precipitation	28-day mean
Histogram of sunshine duration	28-day mean

5.8.3 Products of the EPS for seasonal forecasting

The EPS for seasonal forecasting (three-month forecasting, winter season forecasting, and summer season forecasting) also provides the direct output of the model, and the Guidance products. The products for three-month forecasting are listed in Table 5.8.3 and 5.8.4.

Table 5.8.3 Direct output from the model

Contents	Average Period
Sea surface temperature	3-month mean
Ensemble average chart of precipitation	3-month mean
Ensemble average chart of 200hPa velocity potential	1st month, 2nd month, 3rd month, and 3-month mean
Ensemble average chart of 200hPa stream function	1st month, 2nd month, 3rd month, and 3-month mean
Ensemble average chart of 850hPa stream function	1st month, 2nd month, 3rd month, and 3-month mean
Ensemble average chart of 500hPa height	1st month, 2nd month, 3rd month, and 3-month mean
Ensemble average chart of 850hPa temperature	1st month, 2nd month, 3rd month, and 3-month mean
Ensemble average chart of mean sea level pressure	1st month, 2nd month, 3rd month, and 3-month mean
Spread chart of 500hPa height	1st month, 2nd month, 3rd month, and 3-month mean
Large anomaly probability chart of 500hPa height	1st month, 2nd month, 3rd month, and 3-month mean
Time series of ensemble average and individual forecast of area mean 850hPa temperature and circulation indices	30-day running mean
Histogram of circulation indices	3-month mean

Table 5.8.4 Guidance products

Contents	Average Period
Surface temperature	1st month, 2nd month, 3rd month, and 3-month mean
Precipitation ratio to the normal	1st month, 2nd month, 3rd month, and 3-month mean
Sunshine duration ratio to the normal	1st month, 2nd month, 3rd month, and 3-month mean
Occurrence probability of the three categories of surface temperature	1st month, 2nd month, 3rd month, and 3-month mean
Occurrence probability of the three categories of precipitation	1st month, 2nd month, 3rd month, and 3-month mean
Occurrence probability of the three categories of sunshine duration	1st month, 2nd month, 3rd month, and 3-month mean
Histogram of surface temperature	3-month mean
Histogram of precipitation	3-month mean