Verification of the Extreme Forecast Index in JMA's Operational One-month Ensemble Prediction System

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Introduction

The European Centre for Medium-Range Weather Forecasts (ECMWF) developed the Extreme Forecast Index (EFI; Lalaurette 2002; 2003) and a revised version (EFIR; Zsótér, 2006) with weighted tails of probability distribution. Both types are capable of indicating the potential scale of extreme weather events. EFI and EFIR values are applied in JMA's operational one-month ensemble prediction system (EPS) (Harada and Takaya 2012). This report describes 850-hPa temperature (T850) verification for both forecasts, which are expected to help users clarify the risks posed by extreme climate events.

Data and verification methods

EFI and EFIR values are calculated for JMA's one-month 25-member ensemble prediction, which is performed every Sunday, Monday, Wednesday and Thursday. JRA-25/JCDAS (Onogi et al. 2007) data are used for verification. Extreme climatic events are defined as occurring when analysis data exceeds the 90th climatological percentile or falls below the 10th percentile. These percentiles are estimated from the analysis of 1981 – 2010 data.

To investigate the skill of EFI and EFIR in detecting extreme climatic events, focus was placed on scatter plots for analysis anomalies and EFI or EFIR, and on hit rates and the number of false alarms. Reference was made to the verification method of Petroliagis and Pinson (2012).

Verification results

The results presented here are for seven-day-mean forecast fields initialized from 1 March, 2011, to 31 December, 2012. It is important to understand the relationship between predicted EFI (or EFIR) values and actual anomalies. Figure 1 shows scatter plots for T850 analysis anomalies and EFI/EFIR values for Kobe, Japan (35°N, 135°E) with lead times of 5 – 11 days. The greater index amplitudes corresponding to larger analysis anomalies suggest that EFI and EFIR are useful in predicting extreme climatic events. However, the values of these indices do not always relate to large analysis anomalies (e.g., when the EFI and EFIR figures are –0.6, analysis anomalies could be in the range from –6 to 0 K). Forecast errors also result in a wide range of EFI and EFIR values. The amplitude of EFIR is often larger than that of EFI because the former is highly sensitive to the tails of forecast probability distribution as reported by Zsótér (2006).

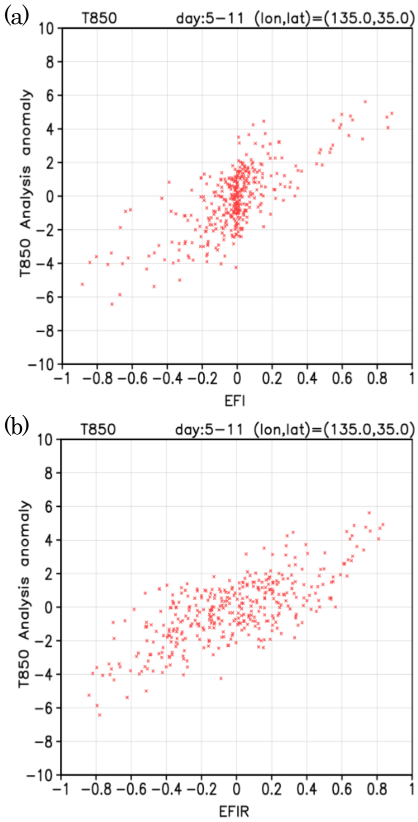

Figure 1 Scatter plots of (a) EFI and (b) EFIR values and analysis anomalies for T850 in Kobe, Japan (35°N, 135°E) with lead times of 5 – 11 days.

Figure 2 shows hit rates and the number of false alarms with EFIR for T850 extreme climatic events in Kobe. For example, the hit rate and false alarm rate for extremely high T850 values defined with an EFIR threshold of 0.6 are approximately 0.33 and 0.22, respectively. The hit rates for extremely low T850 values are higher than those for extremely high values, but the false alarm rates are also higher. These scores vary considerably depending on areas, lead times and forecast variables (not shown).

Summary

The results of verification for the EFI and EFIR judgments used in JMA's one-month EPS are expected to help users understand levels of forecast skill depending on areas, lead times and forecast variables. The risk of extreme climatic events can be determined based on the selection of an appropriate EFI/EFIR threshold, and more detailed information can be obtained from other EPS products (e.g., EPS meteogram (Harada and Takaya 2012)).

References

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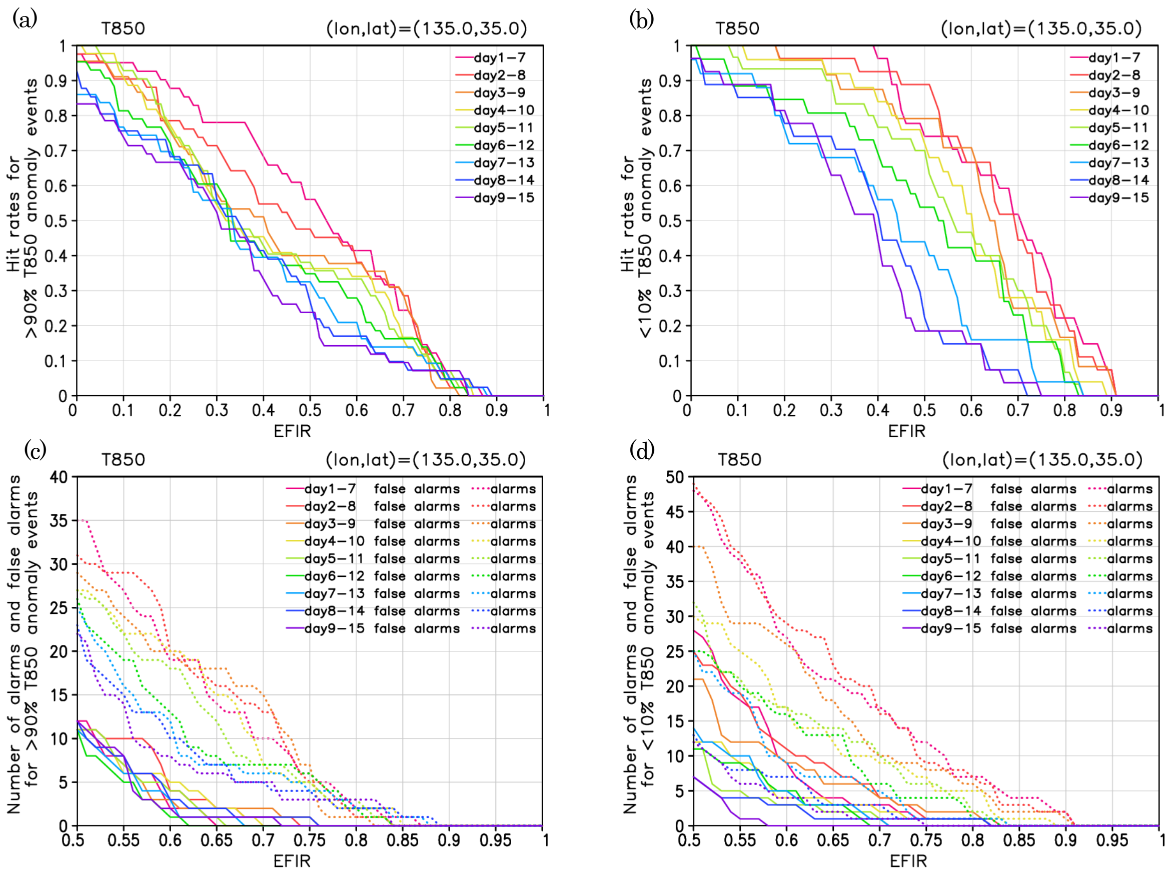

Figure 2 (a), (b) Hit rates and (c), (d) numbers of false alarms (solid lines) and valid alarms (dotted lines) based on different EFIR thresholds for T850 extreme events in Kobe, Japan (35°N, 135°E) defined with the thresholds of (a), (c) > 90th percentile and (b), (d) < 10th percentile. The line colors indicate different forecast lead times.