Validation of the Extreme Forecast Index for Hungary

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Summary

The forecasting of extreme weather events is of great interest to meteorologists in Hungary. Last several years heavy floods quite often happened in central European region. All year of 2000 and specially summer of 2000 was extremely hot in Hungary. Method of Extreme Forecast Index (EFI) developed at the ECMWF has been implemented at the Hungarian Meteorological Service. Products of EFI have been operationally generated since 1 August 2001. Verification of EFI is also regularly available for forecasters. Usefulness of EFI has been investigated.

Introduction

The Extreme Forecast Index is a measure of the difference between the EPS and the model climate distribution. For a give location on the Earth surface and a given meteorological parameter, one can associate to each proportion p of the ranked climate records a parameter threshold $\alpha_c(p)$. This is known as a percentile of the climate distribution: $\alpha_c(0)$ is the absolute minimum and $\alpha_c(1)$ is the absolute maximum than can be found in the climate history, while $\alpha_c(0.5)$ is the median. If then we define $P_f(x<\alpha_c(p))$ as the probability with which the EPS forecast predicts that the observation will be below $\alpha_c(p)$, we can then define:

$$EFI = 3\int_0^1 \left[p - P_f\left(x-\alpha_c(p)\right)\right]^2 dp \frac{\int_0^1 \left[p - P_f\left(x-\alpha_c(p)\right)\right]^2 dp}{\left| \int_0^1 \left[p - P_f\left(x-\alpha_c(p)\right)\right]^2 dp \right|}$$

as an index than cumulates differences between the climate and the forecast distribution: $P_f(x<\alpha_c(p)) = p$ only in the case when EPS members are below $\alpha_c(p)$ in exactly the same proportion as climate records are.

Validation and verification of EFI for selected Hungarian towns.

The first version of EFI was developed by Francois Lalaurette in 1999. In summer 2000 first comparison extreme forecast index and extreme observation index was made for 2m temperature, 24h precipitation and 10m wind speed for selected Hungarian stations. Empirical distribution functions were derived from long series of Hungarian climatological records.

EPS climatology was calculated from 3-year EPS forecasts (1997-1999). All 2000 and especially summer 2000 was hot in central part of Europe including Hungary. Verification results of 2m temperature at 12 UTC were quite promising in term D3, D4 and D5. Scores of EPS forecasts were significantly better in case of extreme events too.

Wind forecasts were less reliable then temperature forecast in case of extreme events. D4 and D5 precipitation forecasts were relatively poor especially summer.

In first part of 2001 calculation of EFI was successfully adapted at Hungarian Meteorological Service. Since 1 August 2001 EFI for 2m temperature has been calculated and available for forecasters. Time series of previous period, scatter diagram and ROC diagrams are also available for users. During 2001 beside warm periods longer extremely cold periods (like September and December) were also detected. Cold days were also predicted quite well, but in at 12 UTC forecasts are slightly worse at low EFI values than high ones.

Future plans

Calculation of EFI for precipitation and wind speed and wind gust is planned to be done at the Hungarian Meteorological Service. New developments on EFI made at the ECMWF will be implemented too.

Acknowledgements

Francois Lalaurette has played a key role in developing extreme forecast index, he helped me to understand nature of EFI and suggested wide range of methods for validation and verification.

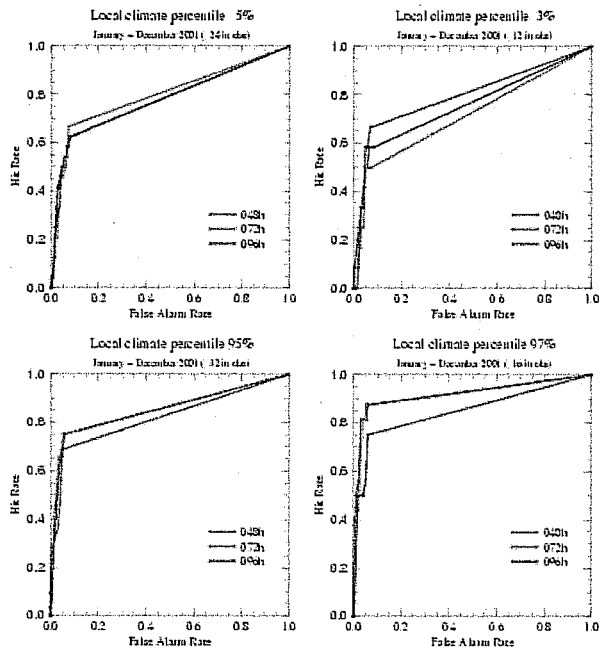

Fig. 1: Relative Operating Characteristic for EFI based on D+2, D+3, D+4 12 UTC 2m temperature forecast. Budapest, Hungary January December 2001.

References

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