ECMWF Feature article

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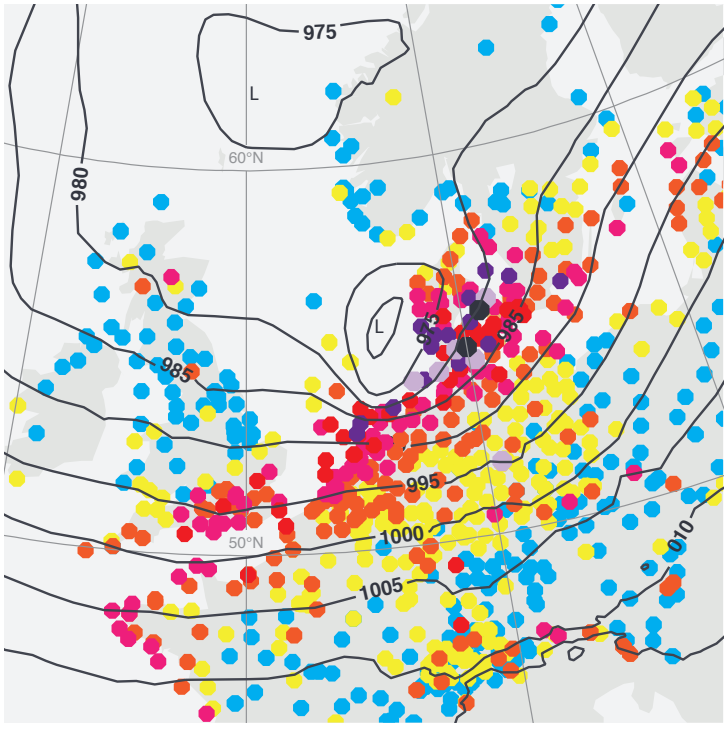
METEOROLOGY

Forecast performance 2013



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Forecast performance 2013

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ECMWF maintains a comprehensive range of verification statistics to evaluate the accuracy of the forecasts. Each year, a summary of verification results is presented to ECMWF's Technical Advisory Committee (TAC). Their views about this year's performance of the operational forecasting system are given in Box A.

The overall performance of the operational forecasts is summarised using a set of headline scores endorsed by the TAC, which highlight different aspects of forecast skill. Upper-air performance of the high-resolution forecast (HRES) in the extra-tropics is monitored through the anomaly correlation of 500 hPa geopotential. In 2013, HRES skill has further increased relative to ERA-Interim, which is used a reference to mitigate the effect of inter-annual atmospheric variability (see article by *Thorpe et al.* on page 15 of this edition of the *ECMWF Newsletter)*. In the case of the ensemble forecast (ENS), where a similar reference does not exist, forecasts from other centres, available from the TIGGE archive, are used for comparison. Verification results for the probabilistic forecasts of 850 hPa temperature (the second upper-air headline score) show that ECMWF has maintained its lead over the other centres. The headline scores for precipitation also indicate an improvement of the HRES and ENS compared to the benchmark systems.

The two supplementary headline scores that address forecast skill for severe weather are the HRES tropical cyclone position error at forecast day 3 and the Extreme Forecast Index (EFI) skill of 10-metre wind speed at forecast day 4. The tropical cyclone position error has further decreased and reached its lowest value so far. The EFI skill of 10-metre wind speed has slightly dropped in 2013 but remains at a high level compared to the last ten years as shown in Figure 1. There is no available benchmark for the EFI so it is difficult to account for year-to-year variations in atmospheric predictability.

ECMWF continues to develop verification procedures appropriate for severe weather events. The skill of HRES in predicting extreme 10-metre wind speeds has recently been evaluated using the Symmetric Extremal Dependency Index (SEDI) which has been designed specifically for verification of rare events. Figure 2 shows that the operational forecast represents an improvement over ERA-Interim of around two forecast days, mainly due to a reduction in the false alarm rate. This improvement indicates the significant progress made in recent years in predicting extreme events in the IFS and is consistent with the substantial increase seen in the EFI skill.

The complete set of annual results is available in *ECMWF Tech. Memo. No. 710* on 'Evaluation of ECMWF forecasts, including 2012-13 upgrades', downloadable from http://www.ecmwf.int/publications/library. This document presents recent verification statistics and evaluations of ECMWF forecasts (including weather, waves and severe weather events) along with information about changes to the data assimilation/forecasting and post-processing system. Also the performance of the monthly and seasonal forecasting systems is assessed.

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Assessment of ECMWF's Technical Advisory Committee, 17–18 October 2013 A

With regard to its assessment of the performance of the operational forecasting system, the Committee:

i. congratulated ECMWF on its world leading position in global medium-range weather forecasting;

ii. noted the very high performance level of its weather forecasts and encouraged ECMWF to maintain this lead;

iii. acknowledged the benefit of the ECMWF forecasting system, particularly the EFI, in the timely and accurate forecasting of high impact weather events such as the cold spell and snow events in March and April 2013 over northern Europe, and the severe flooding in Central Europe in May and June 2013;

iv. recommended further development of severe weather indicators (such as the EFI and SOT) and combined probabilities of extreme values to support the decision-making activities in NMSs;

v. welcomed the improvements in the precipitation forecast, but noted the continued bias in 2m temperature at high latitudes in winter and spring, and the over-prediction of light precipitation; welcomed efforts at ECMWF to address these issues;

vi. welcomed the development of additional scores specifically related to surface weather; noted the importance of feedback from the Member States to identify forecast performance issues and encouraged ECMWF to develop more interactive feedback procedures with users on these issues;

vii. appreciated the use of ERA-Interim as a benchmark for identifying improvements in HRES forecast performance; recommended to consider this approach to help to set targets and monitor progress towards the principal goals of the ECMWF strategy, and emphasised the need to continue to update the re-analysis to reflect recent improvements;

viii. noted the lack of a corresponding benchmark for the ENS and the current use of the TIGGE archive to provide an alternative benchmark; recommended the development of further ENS benchmarks, based for example on the HRES or on an enhanced reforecast data set;

ix. welcomed ECMWF efforts to develop an approach to forecasting weather regimes and flow-dependent verification, and encouraged ECMWF to improve the performance of the monthly forecasting system with regard to regime transitions;

x. expressed its appreciation with regard to the introduction of IFS cycle 38r2 with an improvement of the vertical resolution to 137 levels and noted that this increase of vertical resolution will enable further scientific improvements;

xi. welcomed the upcoming improvements to the model, in particular the coupling with the ocean model from the first forecast day for the ENS and the improvements in the timing of the diurnal cycle of convection;

xii. with respect to the assimilation system, noted the large number of satellite instruments being monitored and assimilated (75 and 50 respectively), noted with interest the improvements resulting from the use of new satellite data, such as ATMS micro-wave data from Suomi NPP, improved use of micro-wave data, Meteosat 10 AMV data, and all-sky radiances;

xiii. encouraged the introduction of radar data, space-based lidar data, and supplementary satellite data (e.g. AMSU-A, NOAA MHS data over sea-ice, CrIS, and IASI on MetOp B) in the assimilation system;

xiv. welcomed the actions conducted by ECMWF to improve the scalability and flexibility of the IFS code and to process observations in a continuous mode and noted with interest that such improvements will facilitate other forecasting system improvements, particularly the dynamical core and the 4DVAR weak-constraint and long window assimilation, enabling the use of the IFS on massively parallel computers;

xv. appreciated ECMWF's user consultation processes regarding forecast products and skill through the Using ECMWF's Forecasts (UEF) meeting, regular Member State visits, and other exchanges with Member States;

xvi. welcomed the report on calibration, and encouraged ECMWF to further assess the benefits of forecast calibration.

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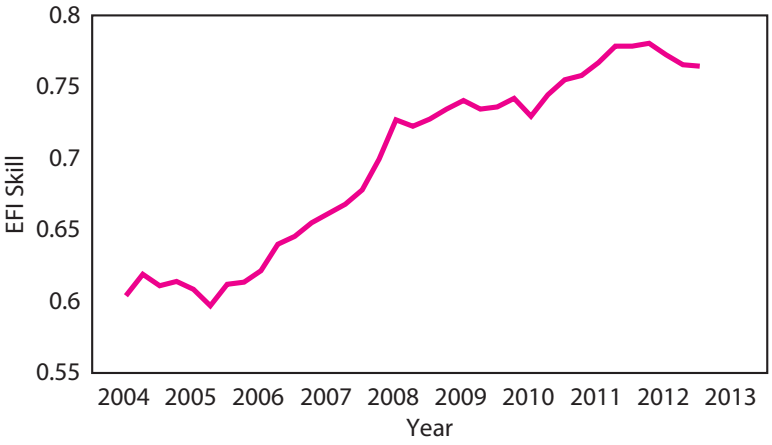

Figure 1 Skill of the Extreme Forecast Index (EFI) for 10-metre wind speed in Europe at forecast day 4. This is one of the supplementary headline scores. Shown are 12-month running average values.

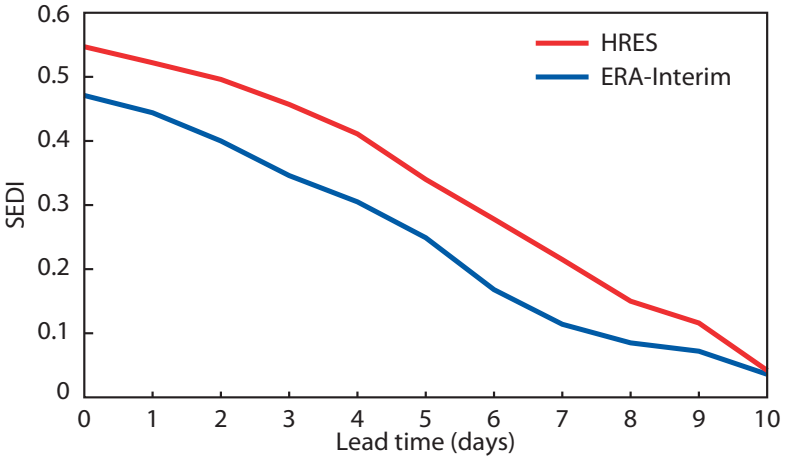

Figure 2 Symmetric Extremal Dependency Index (SEDI) for the 98th percentile of 10-metre wind speed in Europe as a function of forecast day for HRES and ERA-Interim. The verification period is July 2011 to June 2013.

Further reading

Verification pages have been created on the ECMWF web server and are regularly updated. Currently they are accessible at the following addresses:

- **Medium range:** http://www.ecmwf.int/products/forecasts/d/charts/medium/verification/
- **Monthly range:** http://www.ecmwf.int/products/forecasts/d/charts/mofc/verification/
- **Seasonal range:** http://www.ecmwf.int/products/forecasts/d/charts/seasonal/verification/

Note: All forecasting system cycle changes since 1985 are described and updated at: http://www.ecmwf.int/products/data/operational_system/index.html

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