Statistical post-processing of ECMWF forecasts at the Belgian met service

Stéphane Vannitsem, Jonathan Demaeyer (both Royal Meteorological Institute of Belgium & EUMETNET)

The Royal Meteorological Institute (RMI) of Belgium has recently implemented a post-processing system for ECMWF's medium-range ensemble forecasts. First tests show that the system performs well.

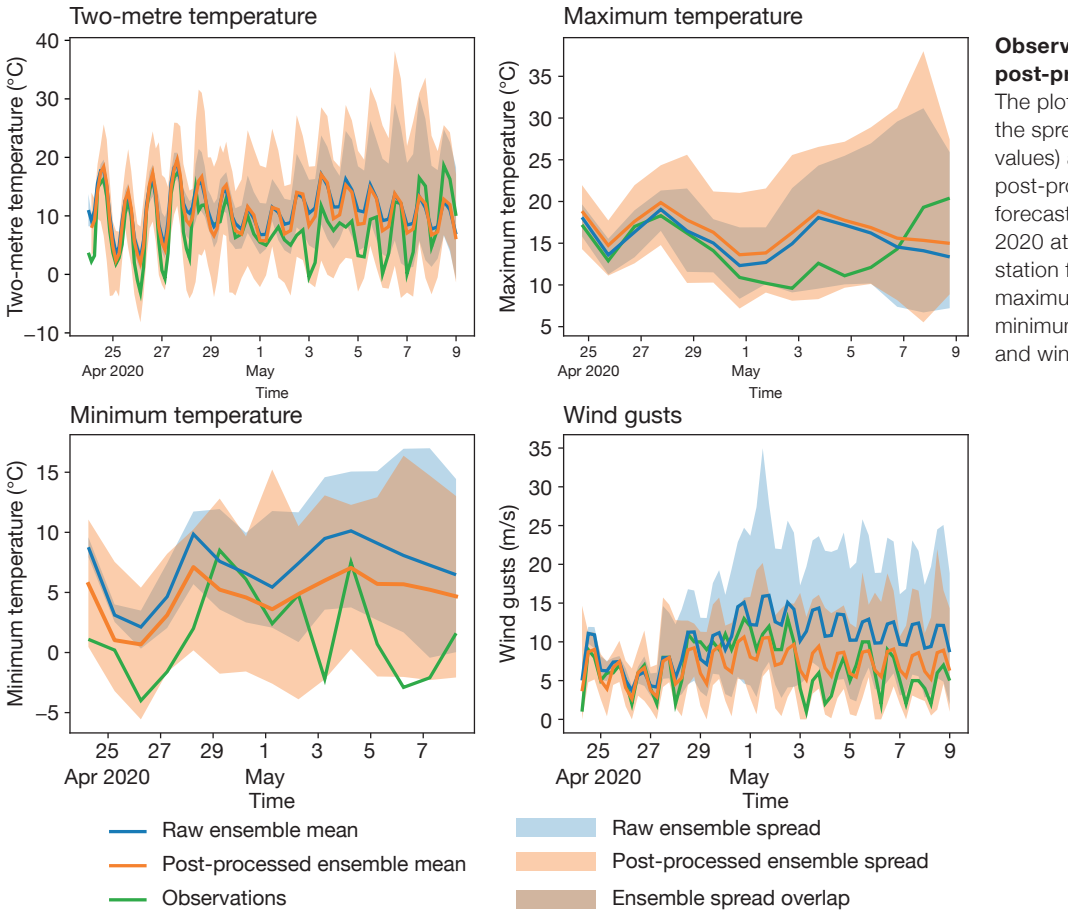
Motivation

Statistical post-processing techniques have been used since the sixties to partly correct forecasting errors or to predict observables not represented in models. The first attempts used linear regression to model the relationship between past forecasts and observations. The results were then used to adjust new forecasts. Since then, many other techniques have been developed, in particular for ensemble forecasts. Such techniques have been shown to be necessary to optimise weather forecasts whatever the quality of the model. That is why RMI has been working on a technique that can be applied to ECMWF medium-range ensemble forecasts.

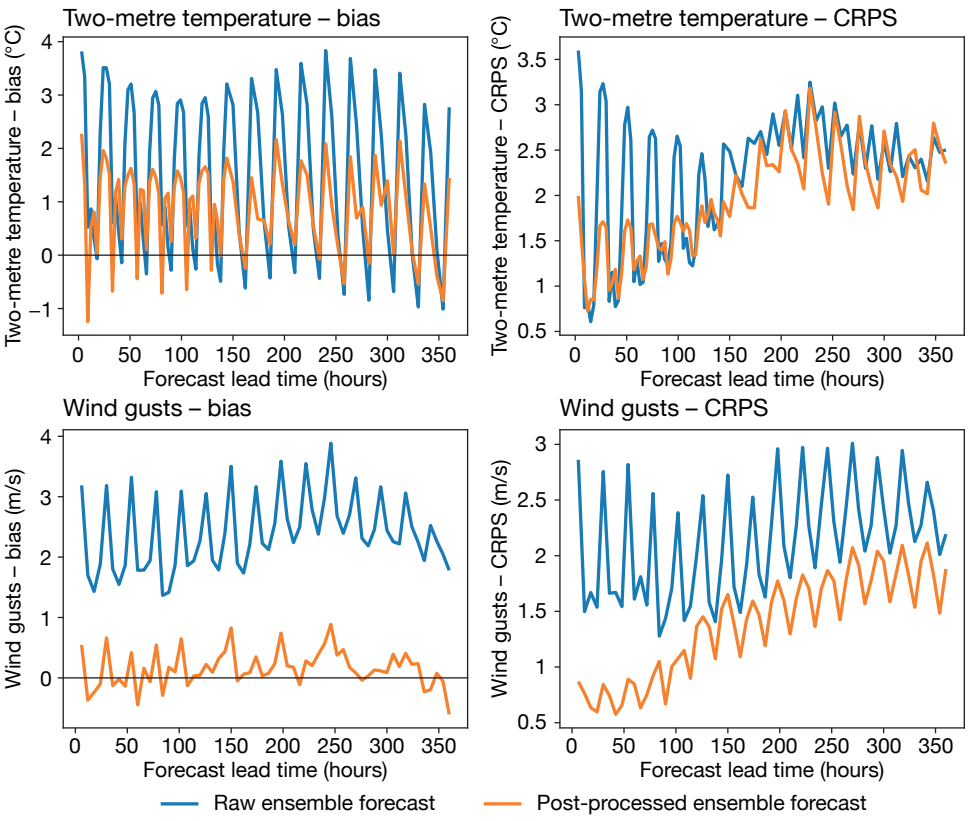
Implementation

In statistical post-processing, statistics are calculated to determine the relationship between forecasts and observations. This means that a set of past forecasts and observations have to be available for an appropriate correction scheme to be developed. As models are often upgraded by changing the model physics or dynamics, the biases present in successive model versions are likely to change. This can degrade the quality of the statistical correction scheme. To avoid such a degradation, ECMWF produces re-forecasts based on the latest model version and on initial conditions supplied by a suitable reanalysis.

At RMI, as in most operational weather forecasting centres, statistical post-processing is recognised as a priority for future development of the forecasting suite. A sophisticated linear post-processing scheme for ensemble forecasts, known as the Member-by-Member approach (MBM), has been implemented for ECMWF ensemble forecasts, taking advantage of the re-forecasts produced by the Centre. The system generates adjusted ensemble forecasts for 2-metre temperature, maximum and minimum temperature, and wind gusts at 11 weather stations in Belgium. Those are reference stations of 11 coherent climatological regions covering Belgium. Pre-operational and operational implementation started in mid-February 2020 and mid-May 2020, respectively.



Observations and raw/ post-processed forecasts. The plots show observations and the spread (minimum to maximum values) and the mean of raw and post-processed ensemble forecasts starting from 24 April 2020 at the Elsenborn weather station for 2-metre temperature, maximum 2-metre temperature, minimum 2-metre temperature and wind gusts.



Forecast skill comparison. The plots show forecast skill for raw and post-processed ensemble forecasts for April 2020 as verified by in-situ observations at the Elsenborn weather station in terms of 2-metre temperature forecast ensemble mean bias, 2-metre temperature forecast CRPS, wind gust forecast ensemble mean bias and wind gust forecast CRPS. Smaller CRPS values indicate better forecasts.

Technically, the system is implemented within a Docker app written in Python and maintained using Anaconda. These modern tools enable an easy transfer from research to operations. The core of the app is a new Python post-processing module implementing various MBM approaches, which can easily be re-used for other projects. The output of the correction scheme for the ensemble forecast at 00 UTC is provided to the forecasters of the RMI weather office in parallel with the raw forecasts. This is done by filing a preliminary meteorological report, which can still be modified by the forecasters. The post-processed output will also soon be available in RMI's INDRA information system.

Results

A typical ensemble forecast produced by the scheme is shown in the first figure for the Elsenborn weather station located in eastern Belgium. For most variables, the forecast is improved, in particular the wind gust forecast, which is considerably shifted to smaller values closer to observations.

Figure 2 shows two scores for two of the variables. Biases are shown in the left-hand panels and the continuous ranked probability score (CRPS) in the right-hand panels, for the month of April 2020 for Elsenborn. The biases are reduced for both variables and the CRPS scores show a good improvement.

The statistical post-processing scheme is already delivering large corrections, and new developments are expected to add other variables and to implement the scheme on a grid. In a future Newsletter article, a detailed evaluation of the scheme will be presented together with upcoming operational developments.

Croatian met service backs up its production at ECMWF after earthquake

Xavier Abellan (ECMWF), Kristian Horvath, Antonio Stanešić, Izidor Pelajić (all DHMZ)

The Croatian Meteorological and Hydrological Service (DHMZ) has successfully backed up its operational production and essential services on ECMWF's High-Performance Computing Facility (HPCF) and the European Weather Cloud, following an earthquake that severely damaged DHMZ's headquarters in March this year. Despite the emergency situation, and without previous preparation, the backup system was put together in just a matter of days. The success of this project was made possible thanks to a joint effort by a number of staff from DHMZ together with many others at ECMWF, EUMETSAT and the weather software company IBL.

The IT infrastructure at DHMZ survived the earthquake, but it was clear that an alternative arrangement was