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Toward post-processing ensemble forecasts based on hindcasts

B. Van Schaeybroeck and S. Vannitsem
Konlinklijk Meteorologisch Instituut, Brussel, Belgium (bertvs@meteo.be)

Having in mind an operational implementation of post-processing at the Royal Meteorological Institute of Belgium (RMI), we study possible approaches of correcting the ECMWF ensemble forecast for stations in Belgium using the ensemble hindcast data set. This data set is each week enlarged by eighteen independent five-member ensemble forecasts using the current operational system. Therefore, the hindcasts constitute an ideal basis for the training cycle of post-processing. Combined with a forward predictor-selection procedure we propose to use a post-processing technique called error-in-variables model output statistics or EVMOS. This technique was recently proposed and is based on linear regression and suited for correcting ensemble forecasts. The corrected forecasts are produced for nine synoptic stations in Belgium.

Different factors which influence the correction quality and which we aim to optimize are the number of weeks of training data, the number of predictors and the clustering of daily training data. We also investigate the influence of the training period, that is, the period of days over which the training forecasts are initialized. More specifically, we compare a training window which is centered around the forecast day with the case where the days of training precede the forecast day. Different results for the different training periods arise due to seasonal effects. We validate the different approaches against the bias-corrected forecasts using observations at nine stations for the ten-meter zonal and meridional wind speed and the two-meter temperature and for lead times up to one week. This is performed by cross-validation for a period of fourteen weeks.

For the inland stations and for all lead times, a mean-square-error (MSE) improvement of around 1.5 m^2/s^2 and 0.5 $(^\circ C)^2$ for wind and temperature, respectively, is obtained. The MSE gain for wind at the two coastal stations is lower, especially for the meridional wind. Systematic biases are negligible for wind and thus most of the EVMOS post-processing is obtained by a variability correction. For two-meter temperature, on the other hand, systematic biases dominate the EVMOS corrections evidencing the correct variability representation of the model. For forecasting the day-time (12h) two-meter temperature, the best forecast is obtained by a simple bias correction whereas EVMOS post-processing turns out most effective for predicting the night-time (0h) forecast. In order to utilize EVMOS post-processing operationally, we propose the use of three predictors, a training period of at least seven weeks and preferably a training period centered around the forecast date.

Initially more than eighty candidate predictors are considered from the hindcast data set, based on which we construct eleven additional predictors. From the set of selected predictors during validation we isolate the most prominent ones. Except for the corresponding variables, by far the most frequently-used predictors for the ten-meter wind are North-South and East-West surface stresses as well as the boundary layer height. For the two-meter temperature, temperature at 850 hPa and maximal temperature in the last 6 hours are the most crucial predictors.