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Adaptive correction of ensemble forecasts

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Forecasts from numerical weather prediction (NWP) models often suffer from both systematic and non-systematic errors. These are present in both deterministic and ensemble forecasts, and originate from various sources such as model error and subgrid variability. Statistical post-processing techniques can partly remove such errors, which is particularly important when NWP outputs concerning surface weather variables are employed for site specific applications.

Many different post-processing techniques have been developed. For deterministic forecasts, adaptive methods such as the Kalman filter are often used, which sequentially post-process the forecasts by continuously updating the correction parameters as new ground observations become available. These methods are especially valuable when long training data sets do not exist. For ensemble forecasts, well-known techniques are ensemble model output statistics (EMOS), and so-called "member-by-member" approaches (MBM).

Here, we introduce a new adaptive post-processing technique for ensemble predictions. The proposed method is a sequential Kalman filtering technique that fully exploits the information content of the ensemble. One correction equation is retrieved and applied to all members, however the parameters of the regression equations are retrieved by exploiting the second order statistics of the forecast ensemble. We compare our new method with two other techniques: a simple method that makes use of a running bias correction of the ensemble mean, and an MBM post-processing approach that rescales the ensemble mean and spread, based on minimization of the Continuous Ranked Probability Score (CRPS).

We perform a verification study for the region of Campania in southern Italy. We use two years (2014-2015) of daily meteorological observations of 2-meter temperature and 10-meter wind speed from 18 ground-based automatic weather stations distributed across the region, comparing them with the corresponding COSMO-LEPS ensemble forecasts. Deterministic verification scores (e.g., mean absolute error, bias) and probabilistic scores (e.g., CRPS) are used to evaluate the post-processing techniques.

We conclude that the new adaptive method outperforms the simpler running bias-correction. The proposed adaptive method often outperforms the MBM method in removing bias. The MBM method has the advantage of correcting the ensemble spread, although it needs more training data.