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Operational machine learning post-processed ensemble forecast system in France

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In recent years, meteorologists have seen the rise of ensemble forecast in numerical weather prediction and its development in national meteorological services. Ensemble forecast is clearly a necessary tool that complements deterministic forecast. Ensemble forecasts seek to represent and quantify different uncertainty sources in the forecast : observation errors or a mathematical representation of the atmosphere still incomplete. In practice ensemble forecasts tend to be biased and underdispersed.
According to previous studies showing the good performance of the machine learning based method Quantile Regression Forests (QRF) and using high-performance computation, the QRF method is applied to the Météo-France 35-members ensemble forecast PEARP for surface temperature on several thousand stations in western Europe for all available lead times and initialization times. QRF provides sharp and reliable probabilistic forecasts. This method does not fit a parametric probability density function like in Ensemble Model Output Statistics (EMOS) but provides an estimation of desired quantiles. To square up a potential issue of the QRF method, we do not work on the temperature parameter itself but on the anomaly of temperature with respect to the mean of the PEARP raw ensemble.
Two other steps are made. The first is a technique of Ensemble Copula Coupling, restoring the consistency between members. The other step is a downscaling step using geostatistical analysis and thin plate splines. Moreover, a new graphical tool of decision theory completes this ensemble in order to take the best decisions according to the specificities of forecast users.
This work is intended to be extended to other parameters such as wind speed and to the French high-resolution limited area ensemble forecast system PEAROME.