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A new approach to effectively utilize the ensemble spread in extended logistic regression

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Post-processing forecasts from numerical weather prediction models with model output statistics (MOS) has become an important part of nowadays weather forecast routine. With an increasing demand for accurate probabilistic forecasts, several MOS methods to post-process ensemble forecasts have been proposed recently. One popular method is logistic regression which is originally a non-linear regression model for binary responses. When separate logistic regressions are applied to the binary variables that are defined by several thresholds, many coefficients have to be estimated and nonsense negative probabilities can occur. To solve these problems, logistic regression recently has been extended to provide full predictive distributions by including the threshold as additional regressor variable.

Although this model is mostly used to post-process ensemble forecasts, information on the ensemble spread is often disregarded because it does not improve the forecasts when it is included as additional regressor variable. We show that this is mainly because the regressor variables can only control the location but not the width of the predictive distribution. As a solution we propose a new approach that allows to directly incorporate the ensemble spread as predictor for the width of the predictive distribution.

With wind speed data from several Austrian weather stations and ensemble forecasts from the European Centre for Medium-Range Weather Forecasts (ECMWF) we show that this new approach provides significantly improved probabilistic forecasts compared to extended logistic regression without using the ensemble spread.