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Improving non-homogeneous regression for probabilistic precipitation forecasts

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Non-homogenous regression is a state-of-the-art ensemble post-processing technique that statistically corrects ensemble forecasts and predicts a full probability distribution. Originally, a Gaussian model is employed that linearly links the predicted distribution mean and variance to the ensemble mean and variance, respectively. Regarding non-normally distributed precipitation data, this model can be censored at zero to account for periods without precipitation. We improve this regression approach in several directions. First, we consider link functions in the variance sub-model that assure positivity of the model variance. Second, we consider a censored Logistic (instead of censored Gaussian) distribution to accommodate more frequent events with high precipitation. Third, we introduce a splitting procedure, which appropriately accounts for perfect prediction cases, i.e. where no precipitation is observed when all ensemble members predict no precipitation. This study is applied to different accumulation periods (3, 6, 12, 24 hours) for short-range precipitation forecasts in Northern Italy. The choice of link function for the variance parameter, the splitting procedure, and an appropriate distribution assumption for precipitation data significantly improve the probabilistic forecast skill, especially for shorter accumulation periods.
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