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D-Vine Copula based Postprocessing of Wind Speed Ensemble Forecasts

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Statistical postprocessing of ensemble forecasts has become a common practice in research to correct biases and errors in calibration. Meanwhile, machine learning methods such as quantile regression forests or neural networks are often suggested as promising candidates in literature. However, interpretation of these methods is not always straightforward.
Therefore, we propose the D-vine (drawable-vine) copula based postprocessing, where for the construction of a multivariate conditional copula the graphical D-vine model serves as building plan. The conditional copula is based on this tracetable model using bivariate copulas, which allow to describe linear as well as non-linear relationships between the response variable and its covariates. Additionally, our highly data-driven model selects the covariates based on their predictive strength and thus provides a natural variable selection mechanism, facilitating interpretability of the model. Finally, (non-crossing) quantiles from the obtained conditional distribution can be utilized as postprocessed ensemble forecasts.
In a case study for the postprocessing of 10 m surface wind speed ensemble forecasts with 24 hour lead time we compare local and global D-vine copula based models to the zero-truncated ensemble model output statistics (tEMOS) for different sets of predictor variables at 60 surface weather stations in Germany. Furthermore, we investigate different types of training periods for both methods. We observe that the D-vine based postprocessing yields a comparable performance with respect to tEMOS models if wind speed ensemble variables are included only and a significant improvement if additional meteorological and station specific weather variables are integrated. The case study indicates that training periods capturing seasonal patterns are performing best for both models. Additionally, we provide a criterion for calculating the variable importance in D-vine copulas and utilize it to outline which predictor variables are the most important for the correction of 10 m surface wind speed ensemble forecasts.