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Vine copula based post-processing of ensemble forecasts for temperature

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To account for forecast uncertainty in numerical weather prediction (NWP) models it has become common practice to employ ensemble prediction systems generating probabilistic forecast ensembles by multiple runs of the NWP model, each time with variations in the details of the numerical model and/or initial and boundary conditions. However, forecast ensembles typically exhibit biases and dispersion errors as they are not able to fully represent uncertainty in NWP models. Therefore, statistical postprocessing models are employed to correct ensembles for biases and dispersion errors in conjunction with recently observed forecast errors. We propose a novel postprocessing approach for temperature forecasts based on D-vine copula quantile regression.

It is a multivariate regression approach predicting quantiles of the response (temperature observations) conditioned on a set of predictor variables (the ensemble forecasts), while not making specific assumptions about the shape of the conditional quantiles. It exploits the dependence between observation and predictors, accounting for non-gaussian dependencies in a flexible and data driven way. In a comparative study with temperature forecasts of different forecast horizons from the European Center for Medium Range Weather Forecast (ECMWF) the D-vine postprocessing approach shows to be highly competitive to the state-of-the-art EMOS model, improving over standard EMOS especially for larger forecast horizons. Furthermore, an exploratory data analysis revealed that the dependency between temperature observations and its ensemble forecasts is indeed non-Gaussian, pointing to the need to employ vine copula models for postprocessing, as they allow for more flexibility in the dependence structure than state-of-the-art models.