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Statistical post-processing and multivariate structuring of high-resolution ensemble precipitation forecasts

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A calibrated radar data set is used to post-process and downscale forecasts from the short-range Grand Limited Area Model Ensemble Prediction System (GLAMEPS) for each location in the Netherlands, leading to more skillful probabilistic precipitation forecasts for 3-h accumulation periods and small (3×3 km2) grid-cells.
For the post-processing a comparison is made between a parametric method (zero-adjusted Gamma distribution; ZAGA) and a non-parametric method (quantile regression forests; QRF), with the latter performing better, particularly at high quantiles.
For many end-users, the probability distributions need not only be improved marginally but also need to preserve joint spatio-temporal trajectories, especially for use in hydrological models. Three multivariate methods, namely the Schaake Shuffle (SSh), Ensemble Copula Coupling (ECC) and a recent minimum-divergence sophistication of the Schaake Shuffle (MDSSh), are for the first time applied and compared in this high-dimensional setting. Their performance is similar with both the multivariate variogram skill score and when aggregated spatially and assessed with the continuous ranked probability score. ECC and MDSSh were consistently more skilful than SSh in terms of the CRPS, while SSh (MDSSh) was somewhat more (less) skilful than ECC in terms of the variogram score. Some reasons for these conflicting results are discussed.
Overall, the post-processing improves skill for local precipitation amounts up to the 98th percentile in both the summer and winter season. With the multivariate methods, desired aggregations for multiple end-users can be easily derived.