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# Are precipitation amounts and threshold probabilities based on calibrated point forecasts

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Precipitation is one of the most challenging parameters in numerical weather prediction. Probabilistic forecasts based on numerical ensembles like COSMO-DE-EPS (ensemble of the high resolving and convection permitting model COSMO-DE of DWD) account for the restricted predictability of the weather. Probabilities of weather events and expectations of forecast errors are derived from an ensemble of forecasts that consists of multiple forecast computations with slight alterations of initial and boundary values and of physical parameterizations within their estimated uncertainties. This is valuable for many forecast events as strong wind gusts and thunderstorms, but notably also for strong precipitation.

Reduction of systematic errors of the numerical model and calibration of derived precipitation probabilities are carried out using statistical post-processing against synoptic observations. Alternatively, gauge-adjusted radar products can be used that provide increased coverage especially for extreme events. The applied method is a MOS (model output statistics) system that models precipitation amounts by stepwise multiple and linear regression. Probabilities of threshold exceedances of precipitation amounts are modeled by logistic regression using the forecasts of precipitation amounts as predictors. The resulting optimized and calibrated forecasts are downscaled for a grid with a resolution of 1km*1km over Germany.

According to the measurement system, the probabilistic forecast represents the probability that precipitation occurs exactly at the given location. Based on these point forecasts, area-related forecasts are derived using methods of stochastic geometry where precipitation patterns are modeled by circular precipitation cells, which are statistically fitted to the point probabilities. An area probability, i.e. the probability that precipitation occurs at any point within a defined area, is then estimated as relative frequency of coverages of the precipitation patterns with the area in question. Note that it is not possible to interpolate point probabilities, because area probabilities e.g. increase with the size of the area. The model is extended to precipitation amounts by assigning randomly scaled response functions to the circular precipitation cells. The radii of the precipitation cells are derived based on the given point forecasts. The system is fully automated in this way and fits for operational forecasting of precipitation.

Arbitrary areas like rural districts or river catchments can be defined ad hoc, as the evaluation of the statistical model is very fast. According to the limited predictability of precipitation the sizes of the areas can be adapted to and increased with forecasts length, in order to provide meaningful and significant information on all time scales.