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Statistical Downscaling of 2D Precipitation Fields with the Analog Ensemble

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Reanalyses provide a valuable source of information on meteorological parameters as retrospective time series. In order to exploit these data, a statistical downscaling approach can be applied. Such an approach acts as a correction of systematic errors in the reanalysis with respect to the parameter (predictand) in consideration.
In our downscaling approach, we use the analog ensemble technique which has up to now been used mainly for statistical downscaling of forecasts, to generate synthetic time series for past time periods. There are advantages of the analog ensemble approach over classic methods: The estimation of a sample of realizations rather than a single value or probabilities for exceeding threshold values which allows for a sound quantification of the uncertainties in the downscaled data set. Further, the realizations are drawn from the correct distribution function of the parameter rather than trying to transform the distribution from the predictor to the predictand space. This minimizes the errors arising from the statistical downscaling model itself.
In our example, we utilize a 20-year reanalysis data set as predictors in order to obtain probabilistic estimates for 2-dimensional high-resolution precipitation fields. The "observations" to be downscaled come from a regional reanalysis at 2km horizontal resolution available only for the period 2007-2013 providing high quality gridded precipitation data. The downscaling is performed by finding analogs in this data for each grid point and time step in the reconstruction period (1995-2006). These analogs are determined as the N best matches in terms of a metric calculated using the predictor reanalysis. These analog ensembles are then validated against independent observations over central Europe and compared to a classic logistic regression approach.