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Interpolation of precipitation under topographic influence at time scales from days to years

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Interpolation of rainfall data, in time intervals ranging from a day to a year, was done using Ordinary Kriging, External Drift Kriging, Gaussian copulas and unsymmetrical v-copulas, with a range of treatments of altitude as an exogenous variable. The dataset chosen for the study comprises 1 262 daily precipitation time series over 41 years in three regions in Germany, which are well maintained, relatively error free and very dense (average spacing of 10 km) over a large area (126 144 sq km), so that this dataset is possibly unique in terms of its length, density and quality. For shorter time aggregations zeros were treated as censored variables - there were no locations with dry months nor dry years in this set of data. For each selected time step the marginal distributions of precipitation amounts were modelled using non-parametric density estimators, while the dependence structures were estimated using a maximum likelihood methodology. Several measures of bias and error structure have been used to assess the efficacy of the methods in a range of comparative split-sampling studies. Among the many findings in the paper, the ones that stand out are:

• correlation between precipitation and topography increases with the length of time interval and is significantly improved by directional smoothing of topography;

• the copula methods are superior to Kriging methods in terms of quality of interpolation (bias and uncertainty estimation);

• the treatment of zeros as censored variables improves interpolation quality for daily and pentad values;

• the copula methods yield full conditional distributions of estimates at a point, improving substantially on the simple uncertainty estimates derived from Kriging, in all time intervals;

• the Gauss copula in particular performs best overall in terms of computational efficiency, combined with useful error profiles in the interpolations, and of all methods is the most realistic in its error estimates.