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Spatial interpolation of precipitation distributions using copulas

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The interpolation of precipitation distributions is important for example for climatological studies, interpolation of precipitation on different time scales and extreme value analyses. Spatial interpolation requires a certain degree of spatial continuity. This is in our case measured with the help of a Cramer- von Mises type statistic. Examples of daily precipitation measured over 4 regions with the number of stations ranging from 222 to 748 in South Germany, show a high degree of spatial continuity of the distributions. As a further step, the interpolation itself can be carried out by interpolating

• The parameters of fitted Gamma or Weibull (or other appropriate) distributions
• The moments of the distributions with a subsequent fit of parametric distributions
• The quantiles of the distributions directly

The interdependence between the variables to be interpolated makes this task extremely difficult in all three of the above cases. However a straightforward analysis of the higher quantiles shows that their interdependence is extremely strong, allowing simultaneous interpolation of quantiles using copulas. Lower quantiles are less well structured, but they are subject to higher observation errors and are likely to be of less importance in hydrology. Thus the interpolation was carried out on the basis of the quantiles corresponding to greater than 1mm/day values. Topographical influence on precipitation is considered as a covariate. The applied copula is a mixed truncated-Gaussian and Gaussian copula, which reflects the asymmetrical dependence between topography and precipitation quantiles. A split sampling and a cross validation methodology are used to evaluate the quality of the interpolation.