Local refinement and bias-correction of regional climate scenarios

In the light of global warming there is a growing concern on regional and local scale climate change impacts. Even high resolution regional climate models are usually not capable to reproduce observed small scale climate characteristics, particularly in mountaineous regions. Significant biases in simulated meteorological fields, like e.g. precipitation and temperature, omit the direct use of model output in subsequent impact models, like from hydrology, agriculture, or others. We investigate into the possibility to use Copula-based multivariate statistics to further downscale and bias-correct regional climate model output.

Contrarily to traditional approaches of correlation based statistical downscaling, Copula based methods allow for a highly flexible consideration of the dependence between local, small scale climate characteristics and regional or global formation. The approach allows to model dependencies between variables without being fixed to normal distributions. Moreover, the dependence of variables can be analyzed independently from the marginal distributions. Our analysis focuses on the dependence structure between observed and dynamically downscaled fields of precipitation and temperature.

For the first time, we apply the Copula based analysis on continuous time series, for which we applied an ARMA-GARCH transformation to obtain *iid* (independent and identically distributed) datasets.

Different theoretical Copula families are investigated and goodness-of-fit tests are carried out to find the optimum representation. Based on the derived theoretical Copula models, stochastic simulations are performed to quantify the uncertainties of the obtained results.
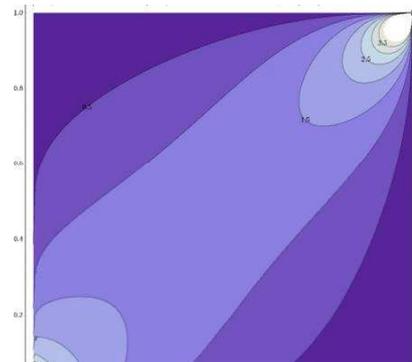
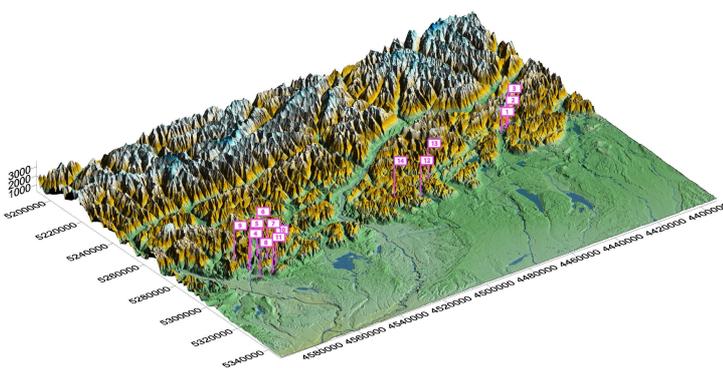**Fig. 1: Probability density function (PDF) of the Gumbel-Hougaard Copula**

Fig. 2: Research area showing the location of meteorological stations used for the Copula analysis

In the course of the project, the developed new method is applied for the local refinement and bias correction of recent RCM simulations for Germany and the Alpine Space (see Laux et al., 2011). A comparison of the results with traditional bias-correction methods such as quantile mapping now has to show the merit of the Copula based approach.

Bibliography:

P. Laux, S. Vogl, W. Qiu, H.R. Knoche and H. Kunstmann, (2011): Copula-based statistical refinement of precipitation in RCM simulations over complex terrain, Hydrol. Earth Syst. Sci., **15**, 1-19