Bivariate modelling of rainfall events and the relationship with extreme values

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The stochastic simulation of rainfall time series can profit from the application of multivariate models called copulas. One of these applications is based on events and copulas are used for modelling the joint behaviour of characteristics such as duration, amount, intensity and peak. Properly modelling the dependence structure between amount and duration is essential for reproducing the observed properties of all rainfall events, especially for the extreme ones. However, the non-exchangeable property between these two characteristics is a crucial aspect to be considered during the simulation.

The aim of this work is to analyze the relationship between the bivariate behaviour of rainfall event characteristics and the extreme values. For this purpose, different statistics used to describe the dependence structure are estimated, namely Kendall's Tau correlation coefficient, asymmetry measure and tail dependence coefficients. The extreme values are described by the Intensity-Duration-Frequency (IDF) curves. The properties of these curves should be related to the dependence structure.

A total of 800 rainfall stations covering the whole extent of Germany are used for this analysis. The stations consist of high temporal resolution records, i.e. rainfall data every 5 minutes. The length of the available data ranges from 10 to 25 years. Continuous time series of rainfall events are identified for each station to estimate the bivariate measures. Extreme value analysis is performed to define the IDF curves. Furthermore the spatial variability of joint behaviour and extreme values is assessed.

Keywords: copulas, rainfall events, extreme values, high temporal resolution