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Quantification of unusual end extreme events changes in different temporal dimensions

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An important field of research at present time is the analysis of extreme events (e.g. floods, droughts) and the quantification of their changes in the next decades. This study characterizes extreme events in the recent past and investigates how those events will change in the next decades due to projected changes in climatological patterns in Germany. The main objective is to investigate the change of climatological extreme events in magnitude, occurrences and dynamics in climate change scenarios.

The analysis is based on the geometrical properties of the observed and projected time series seen as a multivariate data set. We apply the concept of depth function that can be seen as a quantitative measure of the centrality of a vector in the d-dimensional space. Extreme events are identified by imposing constraints on the depth function. Based on these constraints, different categories of unusual events are defined, for example, extreme and new events. To compare projected and historical time series, cross depth is carried out. This means, the depth of each element in the projected time series is calculated with respect to historical time series and vice versa. This permits, among others, to identify new occurrences which are projected for the future but not observed in the past.

In order to gain knowledge on the dynamics of change of extreme events, a dynamical analysis is addressed in which appearances and occurrences of these events are calculated as a function of time on daily time steps. Different temporal dimensions are considered in which consecutive daily events are analyzed. To quantify uncertainty in model projections, data from different regional climate models are used. Spatial discretizations of the identified extreme events are dependent on regional climate model discretization of each particular case. In our study we investigate the projected extreme event for two future time periods (2021-2050 and 2071-2100) for Germany.