Spatial dependence and space-time trend in extreme events

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Within the domain of attraction of an extreme value distribution one can distinguish equivalence classes via the concept of scedasis (Einmahl et al., 2016; de Haan et al., 2015). The present paper sets out to extend the results to a situation with spatial dependent observations. Our leading example is rainfall in Northern Germany. Rainfall has been monitored daily at 49 stations over 12600 days (150 days across 84 years, either in the summer or in the winter). The distribution functions of all 49×12600 observations are assumed to be in one scedasis class, but can be different across time and space. We assume independence in time, but the distribution of the rainfall across the 49 stations on any day is assumed to be in the domain of attraction of a multivariate extreme value distribution, with the same tail dependence structure. In other words, spatial dependence across the 49 stations is allowed. For each station we test whether the scedasis is changing over time. We also test whether the scedases are different across stations, i.e. if there are real differences in extreme rainfall over space. Last but not least, we estimate the common extreme value index of all distributions. We establish asymptotic theories for the conducted statistical analyses in the presence of spatial dependence.