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Investigation on rainfall extremes events trough a geoadditive model

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Rainfall can be considered a very important variable, and rainfall extreme events analysis of great concern for the enormous impacts that they may have on everyday life particularly when related to intense rainfalls and floods, and hydraulic risk management. On the catchment area of Arno River in Tuscany, Central Italy, a geoadditive mixed model of rainfall extremes is developed. Most of the territory of Arno River has suffered in the past of many severe hydro-geological events, with high levels of risk due to the vulnerability of a unique artistic and cultural heritage. The area has a complex topography that greatly influences the precipitation regime. The dataset is composed by the time series of the annual maxima of daily rainfall recorded in about 400 rain gauges, spatially distributed over the catchment area of about 8.800 km2. The record period covers mainly the second half of 20th century. The rainfall observations are assumed to follow generalized extreme value distributions whose locations are spatially dependent and where the dependence is captured using a geoadditive model. In particular, since rainfall has a natural spatial domain and a significant spatial variability, a spatial hierarchical model for extremes is used. The spatial hierarchical models, in fact, take into account data from all locations, borrowing strength from neighbouring locations when they estimate parameters and are of great interest when small set of data is available, as in the case of rainfall extreme values. Together with rain gauges location variables further physiographic variables are investigated as explanation variables. The implemented geoadditive mixed model of spatially referenced time series of rainfall extreme values, is able to capture the spatial dynamics of the rainfall extreme phenomenon. Since the model shows evidence of a spatial trend in the rainfall extreme dynamic, the temporal dynamic and the time influence can be also taken into account. The implemented spatial hierarchical model can be used to produce maps of potential risk for extreme rainfall events to be used in the definition of protection measures as well as to design risk mitigation interventions.