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Trends and extremes in observed temperature series: a non stationary statistical analysis

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The aim of the study is to analyze the link between the trends in mean and variance of observed temperature series and the trends in the extremes of the same series. In a first step, the link between mean and variance of summer and winter temperature series is investigated in details, using non parametric statistical modeling. Although parametric modeling is widely used to analyze the mean, variance and even trends in extremes, it can constrain to much the range of possible fits for exploratory modeling and, except for very particular situations, it is not well adapted to the study of climate series. The idea behind non-parametric methods is to avoid any assumption on the analytical structure of the parameters. This approach needs to choose a smoothing parameter using an empirical and efficient way based on learning. For the modeling functions of mean and variance of the observation series, local regression (loess) has been found to be the most convenient. Then, in defining a distance between time functions, the link between trends in mean and variance of the whole series and trends in extremes is carefully assessed. Using again a non parametric approach, the time evolutions of the parameters of the two extreme value models are statistically derived. Loess and cubic spline are used for the modeling of the GEV parameters whereas cubic spline and kernel methods are used for the parameters of the POT model. Trends in extremes do not seem to be solely explained by those in mean and variance of the whole series, and the previously established link between trend in mean and in variance may explain the observed departures. The methodology will be exposed and illustrated for two rather long temperature series in France.