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Diagnostics of changing threshold probabilities in observed german temperature and precipitation from 1901 to 2000

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To evaluate the time development of climate extremes, usually a fixed threshold is defined. The values which exceed this threshold are thereafter used to gain information about the changes of the probability for their occurrence. Hereby much information of the time series under consideration is not used. Therefore an alternative approach is performed in this study: The time series are seen as realizations of a stochiastic process characterized through a probability distribution with time dependent parametres. By estimating the time functions of these parameters (linear and progressive/degressive trends and polynomials to a maximum order of 5) with the aid of a model selection strategy (stepwise regression), one is able to obtain time dependent probabilities for the exceedence of any threshold while using all available information.

For monthly and seasonal mean temperature (from station data) a gaussian distribution with time dependent mean and standard deviation fits best, while for monthly and seasonal precipitation sums gumbel distribution with time dependent location and scale parameters is used. Out of daily data, time series of monthly and seasonal frequencies for exceeding or falling below (in case of temperature only) the 10%-percentiles are derived. These time series are analyzed using the Weibull distribution with time dependent scale and form parameters and fixed location.

In case of monthly and seasonal mean temperature positive trends in the mean is most frequent while trends in the standard deviation are more or less exceptional. This leads to increasing (decreasing) probabilities for the exceedence (falling below) of upper (lower) thresholds. In case of monthly and seasonal precipitation sums there exists a clear seasonal dependency: in summer a negative trend in location of the gumbel distribution is detected in the majority of the data, while in winter positive trends in location and in scale are most common in the western part of Germany. The time series obtained from daily data show qualitatively similar results. This behaviour is even better visible in data sets from 1951 to 2000 where the spatial covering is much better than for the longer time period (1901 - 2000).

The resluts suggest that changes in the distribution parameters of the analyzed data lead to even more pronounced changes in the probabilities for exceeding upper or lower thresholds. This means that climate change leads to a strong response in the extreme behaviour of climate elements such as temperature and precipitation.