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A spatial and seasonal description of return-levels for the Berlin-Brandenburg region (Germany)

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Extreme precipitation events have a strong impact on the environment, society and economy. Besides the direct effect, e.g. damage due to hail, extreme precipitation can cause flood events, mudslides and increased erosion, which in turn lead to serious damage. Typically, return levels derived from annual maxima of daily precipitation sums are used for the design of hydraulic structures or for risk assessment in insurance companies. Seasonally or monthly resolved return levels are rarely considered, although they provide additional information: the higher temporal resolution can be beneficial for risk management, e.g. for agriculture or tourism sector. In addition, annual return levels derived from monthly maxima offer lower uncertainties, since a larger data basis are used for estimation. Here, the generalized extreme value distribution (GEV) is used to calculate monthly resolved return levels for 323 stations in the region Berlin-Brandenburg (Germany). Instead of estimating the parameters of the GEV for each month separately, the seasonal variation is captured by harmonic functions. This natural approach is particularly suitable for an efficient characterization of the seasonal variation of extreme precipitation. In a first step, a statistical model is developed for each station separately to estimate the monthly return levels. Besides the seasonal smoothness, also smoothness in space is exploited here. We use functions of longitude, latitude and altitude to describe the spatial variation of GEV parameters in the second step. Thus, uncertainty is reduced at gauges with short time series and estimates for ungauged sites can be obtained in a meaningful way.