Subdaily precipitation extremes in a changing climate

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Estimating changes in precipitation extremes for daily and multi-day durations is a relatively standard task in the climatological literature (eg. Hanel and Buishand, 2009; Hanel and Buishand, 2012), change in sub-daily precipitation extremes however are not commonly performed, but studies dealing with these changes exist (Chan, et al. 2014; Prein, et al. 2017; Lenderink and Meijgaard, 2008).

The procedures used in these studies can be divided into two groups - the first is based on analysis of long observed time-series, the second is the analysis of regional climate models simulations.
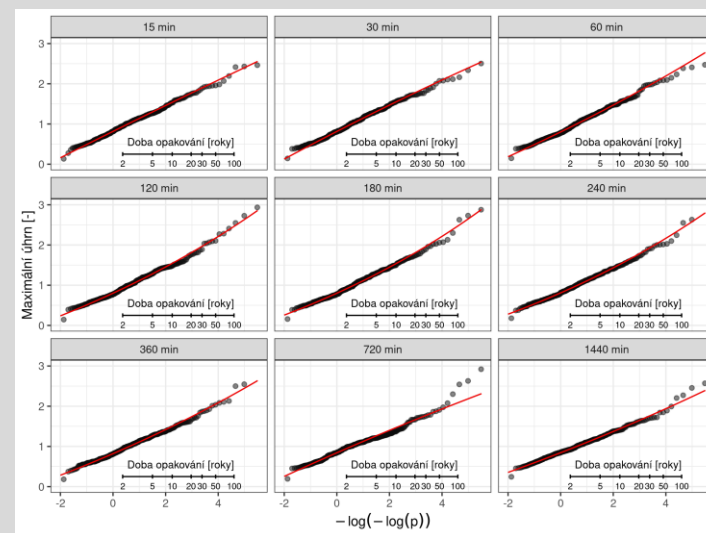

Gumbel plot - representation of the agreement of empirical values (points) and theoretical quantile functions (lines).
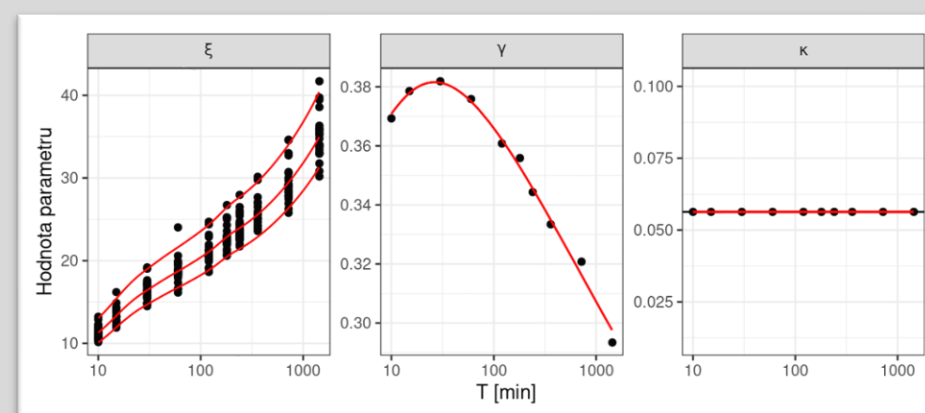

Values of the parameter ξ (location, left panel) for individual stations and durations; regional parameters γ (dispersion coefficient, middle panel) and ϰ (shape, right panel) for different durations. The parameter ϰ is estimated simultaneously for all aggregations. The red lines show the resulting relationship between the individual parameters and the duration of precipitation. In the case of the parameter ξ, the middle line corresponds to the average station, the bottom line to the station with the lowest maxima and the highest line to the station with the highest maxima.

In the present study we describe the application of multiscale index-flood model based on the Generalized Extreme Value distribution describing the characteristics of precipitation extremes from 30 min to daily durations.
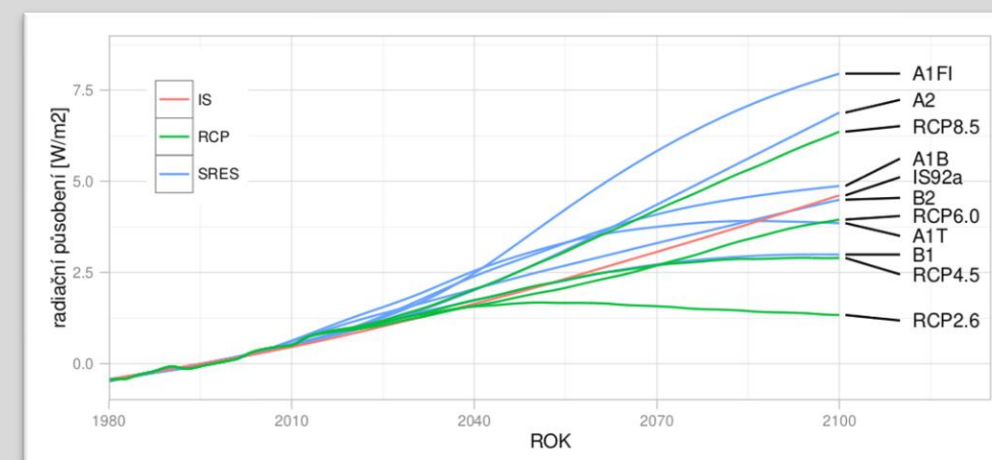

Radiation exposure according to SRES and RCP scenarios.

The model is applied to observed data as well as to an ensemble of hourly regional climate model (RCM) simulations. The changes from the RCM ensemble are then clustered to detect typical changes and extrapolated to durations shorter than 1 hour. The changes in quantiles of simulated sub-daily precipitation extremes are then used to alter estimates for observed data.
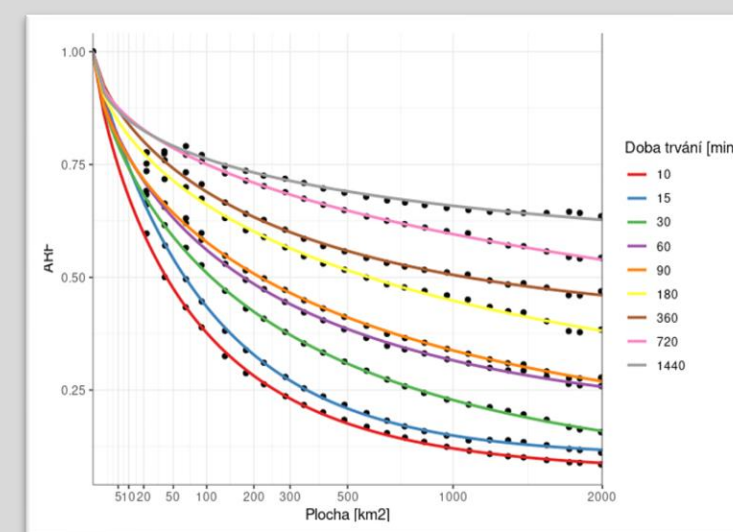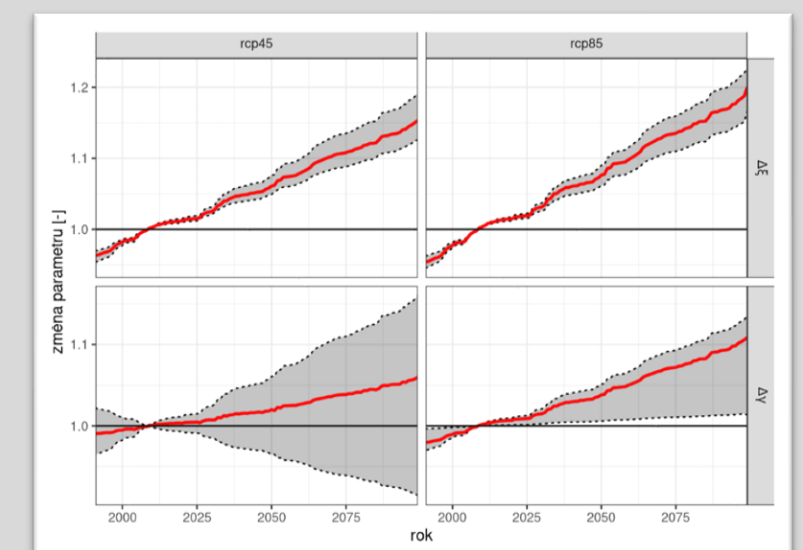

Area reduction factors estimated for the area of interest.

Finally, the area reduction factors are provided to account for spatial smoothing of the extremes. This specific study was performed for the city of Prague. Similar, though not so detailed study, was performed for the whole Czech Republic.
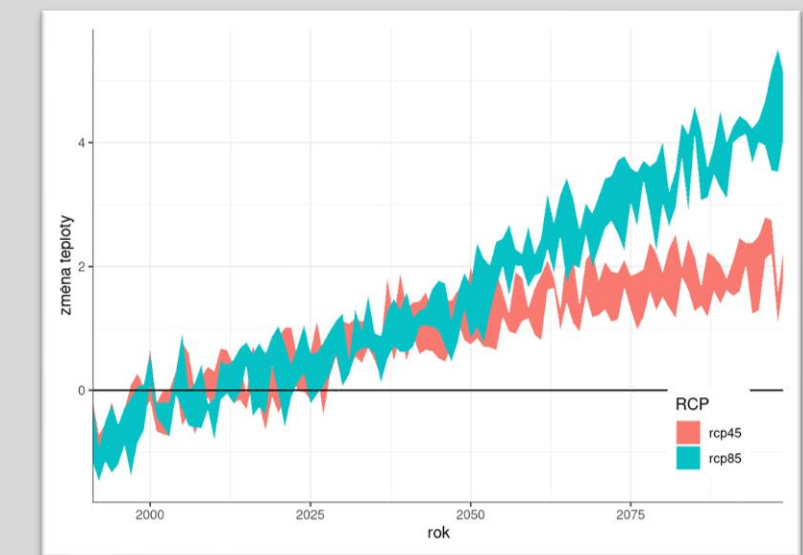
Temperature of the controlling global model for Central Europe.

Change of GEV model parameters for hourly precipitation extremes. The gray area shows the range between 25% and 75% quantile, the red line the average.
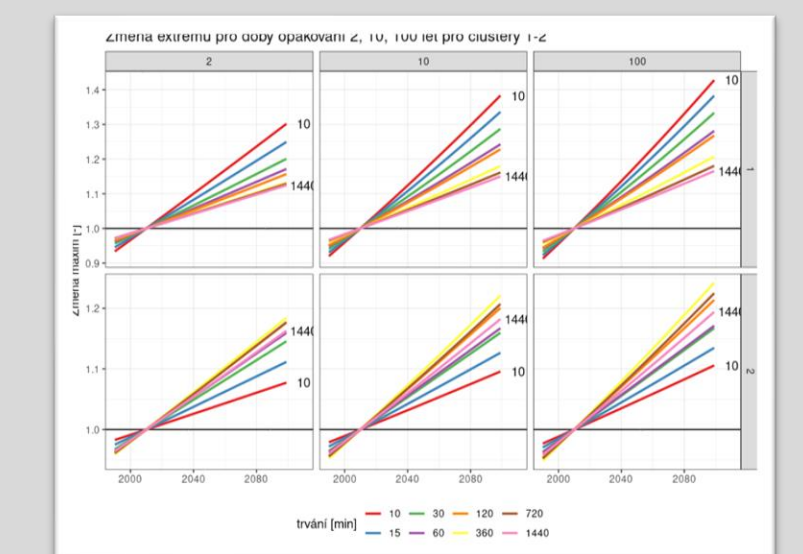
Change of extremes for the resulting clusters by 2100.

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