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Model Related Estimates of time dependent quantiles of peak flows - case study for selected catchments in Poland

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Under Polish climate conditions the series of Annual Maxima (AM) flows are usually a mixture of peak flows of thaw- and rainfall- originated floods. The northern, lowland regions are dominated by snowmelt floods whilst in mountainous regions the proportion of rainfall floods is predominant. In many stations the majority of AM can be of snowmelt origin, but the greatest peak flows come from rainfall floods or vice versa. In a warming climate, precipitation is less likely to occur as snowfall. A shift from a snow- towards a rain-dominated regime results in a decreasing trend in mean and standard deviations of winter peak flows whilst rainfall floods do not exhibit any trace of non-stationarity. That is why a simple form of trends (i.e. linear trends) are more difficult to identify in AM time-series than in Seasonal Maxima (SM), usually winter season time-series. Hence it is recommended to analyse trends in SM, where a trend in standard deviation strongly influences the time -dependent upper quantiles. The uncertainty associated with the extrapolation of the trend makes it necessary to apply a relationship for trend which has time derivative tending to zero, e.g. we can assume a new climate equilibrium epoch approaching, or a time horizon is limited by the validity of the trend model.
For both winter and summer SM time series, at least three distributions functions with trend model in the location, scale and shape parameters are estimated by means of the GAMLSS package using the ML-techniques. The resulting trend estimates in mean and standard deviation are mutually compared to the observed trends. Then, using AIC measures as weights, a multi-model distribution is constructed for each of two seasons separately. Further, assuming a mutual independence of the seasonal maxima, an AM model with time-dependent parameters can be obtained. The use of a multi-model approach can alleviate the effects of different and often contradictory trends obtained by using and identifying different candidate models.
A conservative assessment of the return period under non-stationarity is used as the basis of our actual best knowledge. The methods described are applied to selected catchments in Poland.

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