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Quantifying uncertainty in modelled estimates of annual maximum precipitation: confidence intervals

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The possible nonstationarity of the GEV distribution fitted to annual maximum precipitation under climate change is a topic of active investigation. Of particular significance is how best to construct confidence intervals for items of interest arising from stationary/nonstationary GEV models.We are usually not only interested in parameter estimates but also in quantiles of the GEV distribution and it might be expected that estimates of extreme upper quantiles are far from being normally distributed even for moderate sample sizes.Therefore, we consider constructing confidence intervals for all quantities of interest by bootstrap methods based on resampling techniques. To this end, we examined three bootstrapping approaches to constructing confidence intervals for parameters and quantiles: random-t resampling, fixed-t resampling and the parametric bootstrap. Each approach was used in combination with the normal approximation method, percentile method, basic bootstrap method and bias-corrected method for constructing confidence intervals. We found that all the confidence intervals for the stationary model parameters have similar coverage and mean length. Confidence intervals for the more extreme quantiles tend to become very wide for all bootstrap methods. For nonstationary GEV models with linear time dependence of location or log-linear time dependence of scale, confidence interval coverage probabilities are reasonably accurate for the parameters. For the extreme percentiles, the bias-corrected and accelerated method is best overall, and the fixed-t method also has good average coverage probabilities.

Reference: Panagoulia D., Economou P. and Caroni C., Stationary and non-stationary GEV modeling of extreme precipitation over a mountainous area under climate change, Environmetrics, 25 (1), 29-43, 2014.