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An application of the Bivariate Generalized Pareto Distribution for determining the probability of low flow extremes

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The most frequently applied method for identifying drought events is a threshold one. Putting the threshold on the given run off magnitude Q_0 two low flow indices can be determined. The first – D denotes deficit volume, second one – T its duration. Random variables D, T are obviously dependent, and in many reported cases their linear correlation coefficient exceeds 90 percent.

Consider two-dimensional random variable (D, T), and assume that its distribution is Bivariate Generalized Pareto (BGPD) (*Tajvidi 1996*) with the tail distribution

$$\bar{H}(d,t) = 1 - H(d,t) = \left(\frac{\bar{F}^p(d) + k\bar{F}^{\frac{p}{2}}(d)\bar{G}^{\frac{p}{2}}(t) + \bar{G}^p(t)}{\bar{F}^p(0) + k\bar{F}^{\frac{p}{2}}(0)\bar{G}^{\frac{p}{2}}(0) + \bar{G}^p(0)} \right)^{\frac{1}{p}}$$

$$0 < k \leq 2(p-1), \quad p \geq 2$$

where: $\bar{F}, \bar{G}$ are shifted Univariate Generalized Pareto Tail Distributions (UGPD) for deficit volume and duration. Note, that marginal distribution functions of $H(d,t)$ are also Generalized Pareto.

To fit observed low flows to BGPD two stage procedure is carried out. First, for UPGDs, the standard maximum likelihood method is applied. Next for obtained $\bar{F}, \bar{G}$ tail distributions two parameters p, k are estimated also using the maximum likelihood method. Results of applying above distribution to low flow data from the global data set (*Tallaksen*, *van Lanen 2004*) are presented. Finally the comparison of BGPD method and *Zelenhasic and Salvai (1987)* model for probability of minimal streamflow estimation is shown.

References

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