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A maximum likelihood approach to jointly estimating seasonal and annual flood frequency distributions

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Flood frequency analysis is often used by practitioners to support the design of river engineering works, flood mitigation procedures and civil protection strategies. It is often carried out at annual time scale, by fitting observations of annual maximum peak flows. However, in many cases one is also interested in inferring the flood frequency distribution for given intra-annual periods, for instance when one needs to estimate the risk of flood in different seasons. Such information is needed, for instance, when planning the schedule of river engineering works whose building area is in close proximity to the river bed for several months. A key issue in seasonal flood frequency analysis is to ensure the compatibility between intra-annual and annual flood probability distributions.
We propose an approach to jointly estimate the parameters of seasonal and annual probability distribution of floods. The approach is based on the preliminary identification of an optimal number of seasons within the year,which is carried out by analysing the timing of flood flows. Then, parameters of intra-annual and annual flood distributions are jointly estimated by using (a) an approximate optimisation technique and (b) a formal maximum likelihood approach. The proposed methodology is applied to some case studies for which extended hydrological information is available at annual and seasonal scale.