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# Spatially smooth regional estimation of the flood frequency curve (with uncertainty)

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The problem of the identification of a suitable flood frequency curve in ungauged basins is usually approached by means of regional models based on some grouping of data recorded in various gauging stations, with the aim of identifying parameters of a pre-defined distribution. Most of the efforts have been put in the grouping techniques and parameter estimation methods, but various issues are still to be clarified. The present work aims at implementing a regional procedure that overcomes some of the limitations of the classic approaches and that adds a clearer description of the uncertainty components of the estimation.
To do so, the at-site data are not used to build up a locally valid parametric model, but the information in the sample record is summarized by a set of sample L-moments, that become themselves the variables to be regionalized. This approach allows one to eliminate the uncertainty related to the choice of the distribution function, in particular when short samples are involved. As a consequence short samples, that are usually discarded, can still be used to contribute to the improvement of the consistency of the database. To transfer the information to the ungauged basins, we adopt a regional model for each of the L-moments considered based on a comprehensive multiple regression approach, selecting the independent variables among many geomorpholoclimatic catchment descriptors. Each regression model is calibrated using non-standard least-squares techniques over the whole dataset, without resorting to any grouping procedure to create sub-regions. The flood frequency features related to each catchment are thus allowed to vary smoothly from site to site, following the variation of the descriptors selected in the regression models. This approach allows one to overcome the subjectivity affecting the techniques for the definition and verification of the homogeneous regions. In addition, the reliability of the regional curves is easily estimated, based on the L-moments estimation variance and on the prediction intervals obtained for the regression models.
The procedure has been applied to North-Western Italy (ARPIEM project), based on a set of 70 basins for which many catchment descriptors are available, leading to simple formulas to compute the regional L-moments. Cross-validation results show the ability of this approach in reconstructing the flood frequency curve. Moreover, the model can be easily applied to map the final flood estimate along the drainage network, as well as its uncertainty.