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Regional Frequency Analysis of Annual Maximum Streamflow in Gipuzkoa (Spain)

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Extreme streamflow events have been an important cause of recent flooding in Gipuzkoa, and any change in the magnitude of such events may have severe impacts upon urban structures such as dams, urban drainage systems and flood defences, and cause failures to occur. So a regional frequency analysis of annual maximum streamflow was developed for Gipuzkoa, using the well known L-moments approach together with the index-flood procedure, and following the four steps that characterize it: initial screening of the data, identification of homogeneous regions, choice of the appropriate frequency distribution and estimation of quantiles for different return periods.

The preliminary study, completed in 2009, was based on the observations recorded at 22 stations distributed throughout the area. A primary filtering of the data revealed the absence of jumps, inconsistencies and changes in trends within the series, and the discordancy measures showed that none of the sites used in the analysis had to be considered discordant with the others.

Regionalization was performed by cluster analysis, grouping the stations according to eight physical site characteristics: latitude, longitude, drainage basin area, elevation, main channel length of the basin, slope, annual mean rainfall and annual maximum rainfall. It resulted in two groups – one cluster with the 18 sites of small-medium basin area, and a second cluster with the 4 remaining sites of major basin area - in which the homogeneity criteria were tested and satisfied.

However, the short lenght of the series together with the introduction of the observations of 2010 and the inclusion of a historic extreme streamflow event occurred in northern Spain in November 2011, completely changed the results. With this consideration and adjustment, all Gipuzkoa could be treated as a homogeneus region.

The goodness-of-fit measures indicated that Generalized Logistic (GLO) is the only suitable distribution to characterize Gipuzkoa. Using the regional L-moment algorithm, quantiles associated with return periods of interest were estimated, and Monte Carlo simulation was used to compute RMSE, bias and error bounds for the estimates.