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Implications of the shape of design hyetograph in the derived flood frequency distribution

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Hydrometeorological methods for rainfall-runoff transformation are frequently used when the hydrological design of hydraulic infrastructures is considered. These methods imply to determinate the design storm which is usually characterised by the return period of its total depth of precipitation. In the other hand, the shape of the hyetograph, i.e. the temporal pattern of the storm, has a relevant implication in the resulting hydrograph.

In this work we analysed the influence that the within-storm rainfall intensity distribution has on the derived flood frequency (DFF) law. This was addressed by comparing the DFF's obtained from two different ensembles of hyetographs with the same total depth frequency distribution and constant total duration. One ensemble of hyetograph (BA) was determined using the alternating blocks method which is usually assumed to provide more adverse hydrological load. The second ensemble (MC) was obtained using a stochastic storm generator developed in a Monte Carlo framework. The ratios between corresponding maximum flows were calculated for selected return periods (RP) as a measure of the difference between both DFF's. The variation of this quotient was analysed regarding the return period and basin configuration.

We considered three different discretization scales for the 1241-km2 Manzanares River basin with outlet near Rivas-Vaciamadrid, in the Region of Madrid (Spain). The three levels correspond to high resolution (HR, basin divided into 62 sub-catchments), medium resolution (MR, 33 sub-catchments), and low resolution (LR, 14 sub-catchments).

For the case studied, and for the three configuration considered, the DFF obtained from the alternating blocks hyetograph was not such adverse as it was expected to be. The flow peak ratio kept practically constant across the RP range. While the BA-quantiles for each subbasin's DFF were higher than MC-quantiles in a 10% to 40%; the peak flow ratios at the catchment outlet took values close to one (0.98-1.06).