Analysis and stochastic modelling of Intensity-Duration-Frequency relationship from 88 years of 10 min rainfall data in North Spain

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Frequently, when we are trying to solve certain hydrological engineering problems, it is often necessary to know rain intensity values related to a specific probability or return period, T. Based on analyses of extreme rainfall events at different time scale aggregation, we can deduce the relationships among Intensity-Duration-Frequency (IDF), that are widely used in hydraulic infrastructure design. However, the lack of long time series of rainfall intensities for smaller time periods, minutes or hours, leads to use mathematical expressions to characterize and extend these curves. One way to deduce them is through the development of synthetic rainfall time series generated from stochastic models, which is evaluated in this work.

From recorded accumulated rainfall time series every 10 min in the pluviograph of Igueldo (San Sebastian, Spain) for the time period between 1927-2005, their homogeneity has been checked and possible statistically significant increasing or decreasing trends have also been shown. Subsequently, two models have been calibrated: Bartlett-Lewis and Markov chains models, which are based on the successions of storms, composed for a series of rainfall events, separated by a short interval of time each. Finally, synthetic ten-minute rainfall time series are generated, which allow to estimate detailed IDF curves and compare them with the estimated IDF based on the recorded data.