



The effect of rainfall trends in the estimation of intensity-duration-frequency curves

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Intensity-duration-frequency (IDF) curves are extensively used as tools for the planning and design of many engineering projects. The design of urban drainage systems is an example where short-duration extreme rainfall has particular importance. The estimation of IDF curves is based on the assumption that the rainfall time series are stationary. However, the observed intensity-frequency relation in rain does not stay unchanged over time. Recent studies are stressing that in the next decades more frequent extreme rainfall events, of a given magnitude, could be expected. Thus, it is pertinent to understand the information in the IDF curves in the context of a changing climate.

This work focuses on characterizing the effect of trends in short-term rainfall on the estimation of IDF curves. The study uses rainfall-intensity annual maxima for 5, 10, 15, 30 and 60 minutes events. The data are from 11 meteorological stations, located in Mainland Portugal; the record lengths range from 29 to 41 years.

Two versions of IDF curves were obtained: one was estimated from the original series and the other one from the series obtained after the trend component was removed. For each rainfall event-duration, the intensity trend was studied using the Mann-Kendall nonparametric test and the Sen's nonparametric method. Although the majority of the rainfall series did not exhibit any sign of statistically significant trends, the characterization of the effect of those trends (or changes of behaviour over time) on the IDF curves suggests that there is a need to revise and update the existing formulation of the intensity-duration-frequency relationships. Whilst, in general, the analyses reveal no simple pattern for changes in the rainfall process over time and for different geographical locations, we are led to conclude that hydrological risk assessment should pay attention to the increased uncertainty in rainfall intensity-duration-frequency estimations.