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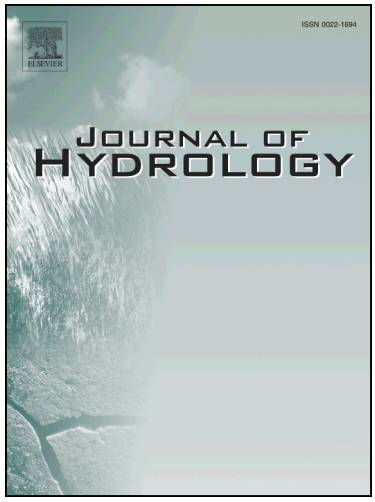

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Uncertainty estimation of Intensity-Duration-Frequency relationships : a regional analysis.

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Abstract

We propose in this article a regional study of uncertainties in IDF curves derived from point-rainfall maxima. We develop two generalized extreme value models based on the simple scaling assumption, first in the frequentist framework and second in the Bayesian framework. Within the frequentist framework, uncertainties are obtained i) from the Gaussian density stemming from the asymptotic normality theorem of the maximum likelihood and ii) with a bootstrap procedure. Within the Bayesian framework, uncertainties are obtained from the posterior densities. We confront these two frameworks on the same database covering a large region of $100,000$ km^2 in southern France with contrasted rainfall regime, in order to be able to draw conclusion that are not specific to the data. The two frameworks are applied to 405 hourly stations with data back to the 1980's, accumulated in the range 3h-120h. We show that i) the Bayesian framework is more robust than the frequentist one to the starting point of the estimation procedure, ii) the posterior and the bootstrap densities are able to better adjust uncertainty estimation to the data than the Gaussian density, and iii) the bootstrap density give unreasonable confidence intervals, in particular for return levels associated to large return period. Therefore our recommendation goes towards the use of the Bayesian framework to compute uncertainty.

1. Introduction

Determining how often a storm of a given intensity is expected to occur requires an evaluation of its probability of occurrence, i.e. its return period. However extremeness of a rainfall event depends at which duration rainfall is considered. For this reason, Intensity-Duration-Frequency (IDF) curves are extensively used in water resources engineering for planning and design (Rantz, 1971; Cheng and AghaKouchak, 2014; Sarhadi and Soulis, 2017; Te Chow, 1988, chapter 14). They provide estimates of return levels for the continuum of durations and return periods. However a difficulty in producing IDF curves is that return periods of interest for risk mitigation amount usually to several hundreds of years, whereas series at disposal are most of the time much shorter. Estimating the 100-year return level, for example, relies then on extrapolating using some statistical model. Uncertainty is inherent to this estimation because no model is perfect. This is

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