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Climatic and basin factors affecting the flood frequency curve: PART I – A simple sensitivity analysis based on the continuous simulation approach

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Abstract. Regionalized and at-site flood frequency curves exhibit considerable variability in their shapes, but the factors controlling the variability (other than sampling effects) are not well understood. An application of the Monte Carlo simulation-based derived distribution approach is presented in this two-part paper to explore the influence of climate, described by simulated rainfall and evapotranspiration time series, and basin factors on the flood frequency curve (ffc). The sensitivity analysis conducted in the paper should not be interpreted as reflecting possible climate changes, but the results can provide an indication of the changes to which the flood frequency curve might be sensitive.
A single site Neyman Scott point process model of rainfall, with convective and stratiform cells (Cowpertwait, 1994; 1995), has been employed to generate synthetic rainfall inputs to a rainfall runoff model. The time series of the potential evapotranspiration (*ETp*) demand has been represented through an AR(*n*) model with seasonal component, while a simplified version of the ARNO rainfall-runoff model (Todini, 1996) has been employed to simulate the continuous discharge time series. All these models have been parameterised in a realistic manner using observed data and results from previous applications, to obtain 'reference' parameter sets for a synthetic case study. Subsequently, perturbations to the model parameters have been made *one-at-a-time* and the sensitivities of the generated annual maximum rainfall and flood frequency curves (unstandardised, and standardised by the mean) have been assessed. Overall, the sensitivity analysis described in this paper suggests that the soil moisture regime, and, in particular, the *probability distribution of soil moisture content at the storm arrival time,* can be considered as a unifying link between the perturbations to the several parameters and their effects on the standardised and unstandardised ffcs, thus revealing the physical mechanism through which their influence is exercised. However, perturbations to the parameters of the linear routing component affect only the unstandardised ffc.
In Franchini *et al.* (2000), the sensitivity analysis of the model parameters has been assessed through an analysis of variance (ANOVA) of the results obtained from a formal experimental design, where all the parameters are allowed to vary *simultaneously,* thus providing deeper insight into the

interactions between the different factors. This approach allows a wider range of climatic and basin conditions to be analysed and reinforces the results presented in this paper, which provide valuable new insight into the climatic and basin factors controlling the ffc.

Keywords: stochastic rainfall model; rainfall runoff model; simulation; derived distribution; flood frequency; sensitivity analysis

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