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## A conceptual investigation of process controls upon flood frequency: role of thresholds

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**Abstract.** Traditional statistical approaches to flood frequency inherently assume homogeneity and stationarity in the flood generation process. This study illustrates the impact of heterogeneity associated with threshold non-linearities in the storage-discharge relationship associated with the rainfall-runoff process upon flood frequency behaviour. For a simplified, non-threshold (i.e. homogeneous) scenario, flood frequency can be characterised in terms of rainfall frequency, the characteristic response time of the catchment, and storm intermittency, modified by the relative strength of evaporation. The flood frequency curve is then a consistent transformation of the rainfall frequency curve, and could be readily described by traditional statistical methods. The introduction of storage thresholds, namely a field capacity storage and a catchment storage capacity, however, results in different flood frequency "regions" associated with distinctly different rainfall-runoff response behaviour and different process controls. The return period associated with the transition between these regions is directly related to the frequency of threshold exceedence. Where threshold exceedence is relatively rare, statistical extrapolation of flood frequency on the basis of short historical flood records risks ignoring this heterogeneity, and therefore significantly underestimating the magnitude of extreme flood peaks.

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