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Multifractal flood frequency analysis

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Hydrology and more generally sciences involved in water resources management, researches and technological or operational development face a fundamental difficulty: the extreme variability of hydrological fields. It clearly appears today that this variability is a function of the observation scale and yield natural hazards such as floods or droughts. The estimation of return periods for extreme precipitation and flooding events requires a model of the natural (unperturbed) statistical behaviour of the probability tails and the possible clustering (including possible long-range dependencies) of the extremes. Appropriate approaches for handling such non classical variability over wide ranges of time and space scale do exist. They are based on a fundamental property of the non-linear equations: scale invariance. Its specific framework is that of multifractals. In this framework hydrological variability builds up scale by scale leading to non-classical statistics; this provides the key element needed to better understand and predict floods. Scaling is a verifiable physical principle which can be exploited to model hydrological processes and estimate their statistics over wide ranges of space-time scales. We first present the Multifractal Flood Frequency Analysis (MFFA) tool and illustrate some results of its application to a large database (for more than 16000 selected stations over USA and Canada). We then discuss its efficiency by showing how the mean flow information - coupled with universal multifractal parametrizations with power law tails - can be used to estimate return times for extreme flood events.