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# Intermittency Study of river flow fluctuations by Using Empirical Mode Decomposition and

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A better understanding of river flow fluctuations is of sharp practical importance, for ecosystem studies (transport properties) and for flood understanding and forecasting. River flows fluctuate on many scales: at small scales, river turbulence induces stochastic fluctuations and at larger scales (days or weeks) the river flow fluctuations are the result of complex interactions between rainfall processes, topography and geography. River flow time series thus display fluctuations possessing stochastic properties, as well as deterministic forcing coming from seasonal or annual meteorological and climatic cycles.

In this work we present the analysis of a long (50 years) time series of daily river flow data, recorded in the Seine River (France). We apply on this time series several data analysis techniques coming from turbulence studies and time series analysis. In previous works, we first considered its multifractal properties using structure function analysis. Here we apply two new methods to study the intermittency: one is based on Empirical Mode Decomposition on discrete scale, the other one is arbitrary order Hilbert spectral analysis on continuous scale, which is an extended version of Hilbert spectral analysis, that we developed in order to detect the intermittency effects. The latter is the most interesting and novative: it provides a scale-frequency decomposition of the original time series, giving a joint pdf p(a,omega). When marginal moments of the amplitude are computed, one obtains an intermittency study in the frequency space. Applied to river flow data, this shows the scaling ranges and characterizes the

intermittent fluctuations over these frequency ranges.