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Temporal multifractal signature of river discharge

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Climatic regimes (namely the rainfall input) and complex rainfall-runoff processes occurring at a variety of scales in time and across the drainage basin, among other factors, lead to extremely variable river discharge processes. Nevertheless, different practical problem-solving issues in hydrological studies, engineering design and water resources management often require that dominant hydrological drainage basins characteristics are identified; usually, statistical tools are used for this purpose. In particular, the characterization of extreme discharge is a challenging task: on the one hand discharge records are often lacking for high flood events; and, on the other hand, the violent behaviour of river discharge is not adequately described by many models.

In this work the multifractal signature of river discharge is investigated using high-resolution and daily data from drainage basins having different geometric, geological and climatic characteristics, as well as land use, from Mainland Portugal. The time span of the records is more than 70 years for some of the data sets. The study focuses on the statistics of extreme river discharge events, which are explored across a wide range of scales.

Multifractals predict heavy tails (i.e., power-law tails) in the flow rate probability distributions, whereas models based on non-scaling type processes usually involve only weak variability (e.g. exponential probability tails). This has important implications for the estimation of the probability of exceeding certain large events. Moreover, the differences in the statistics determined for the various cases studied indicate that multifractals can assist in understanding the temporal behaviour of river discharge that result from the combined effect of the various non-linear processes involved in the

rainfall-runoff transformation.