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Return interval statistics in precipitation and river flow records

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We study the return intervals between events exceeding a certain threshold Q in precipitation and river flow records from 32 stations all over the world. Using multifractal DFA for the original and for the shuffled data, we find that the precipitation records are only slightly long-term correlated with Hurst exponents h(2) typically around 0.55, and exhibit only weak nonlinear memory. Due to the weak linear and nonlinear memory, the distribution of the return intervals is only slightly broader than the exponential distribution characterizing a random Poisson process. For river flows, linear correlations are pronounced and characterized by h(2)≈0.8, and nonlinear memory is apparent. While in the precipitation data the return interval distributions approximately scale for different thresholds Q, in the river flows there is a slight violation of scaling with increasing Q, due to the nonlinear memory. We model both the precipitation and the river flows by a multiplicative cascade model, and obtain substantial agreement in the return interval statistics between the observational and in the simulated data. In both cases the distributions of the return intervals can be approximated by the gamma distribution $P = [\lambda^{\alpha}/\Gamma(\alpha)]\, r^{\alpha-1}\exp(-\lambda r)$with $\alpha = \lambda \approx 2/3$ for the precipitation records and $\alpha = \lambda \approx 0.1$ for the river flow records, which for the precipitation records resembles the return interval distribution in seismic records proposed in [Corral 2004].