The long-range dependence of hydrological processes as a result of the maximum entropy principle

D. Koutsoyiannis

Department of Water Resources, National Technical University of Athens

It is well known that the principle of maximum entropy (ME), when applied to a Gaussian stochastic process with known lag one autocorrelation, results in Markovian (short-range) dependence, if the maximization is done in terms of the conditional entropy on a single time scale. However, if the maximization is done on multiple time scales simultaneously, the application of the ME principle becomes more complicated and the results more interesting. Specifically, it is shown that this principle, under the general conditions that the process autocorrelation should be mathematically feasible and physically reasonable and that all time scales are of equal importance, results in long-range dependence or the Hurst phenomenon, which is characterised by scaling in time. The omnipresence of the time scaling behaviour in numerous long hydrological time series, validates the applicability of the ME principle, thus emphasizing the dominance of uncertainty in hydrological processes, given that entropy is a measure of uncertainty.