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Return period for time dependent processes

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The classical equation of return period, i.e. the inverse of the exceedance probability, can be obtained by defining the return period as the average of the interarrival time between successive critical events; this equation is customary derived under the assumptions of stationarity and independence of the critical events. Notwithstanding this, the classical equation of return period holds also in the case of time-dependent processes. Besides, the time-correlation structure of the process may affect the probability of failure, which is of practical interest in structure/system design and risk assessment.
In this work we analyze how the probability of failure is affected by the correlation structure for some persistent processes (i.e. positively correlated in time). Analyses are performed for synthetic processes resembling some of the characteristics of the hydrological time series, such as rainfall and discharge, i.e. accounting for different correlation structures in time and for different marginal distributions, Gaussian and non Gaussian.