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On return period and probability of failure in a changing environment

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Water related natural hazard that might cause huge damages to the society and the environment are typically quantified in terms of the return period and/or the probability of failure of water system infrastructures. Despite being a commonly applied probabilistic tool, the return period concept has attracted renewed interest stimulated by the need of efficiently dealing with complex processes in a changing environment. Indeed, many hydro-climatological records exhibit some forms of upward or downward tendency over time (trends or local shifts) that are ascribed to human interventions at the local scale, such as land use change because of deforestation and urbanization, river-works construction (e.g. dams for flood regulation), etc., or at the global scale including increasing greenhouse emissions that are expected to affect climate. Since change observed in hydrological time series is often described by assuming a non-stationary framework, several recent literature works discuss the extension of the return period concept to non-stationary conditions. The application of the probabilistic tool of return period to an exceptionally long series of rainfall observation allows to investigate and discuss on trends and long term periodicities and their effect of risk measures.