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Probabilistic analysis of drought characteristics and related return periods at European level

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A reliable assessment of the probability of occurrence or of the corresponding return periods of the most harmful drought events, is essential within a drought risk management approach aiming to help decision makers in setting effective drought preparedness and mitigation tools. In particular, a probabilistic characterization of droughts can play a key role in evaluating drought hazard over a region, which combined with drought vulnerability yields to the corresponding drought risk.
At local level drought events can be objectively identified through the theory of runs (Yevjevich, 1967) by three main characteristics, namely: drought duration, accumulated deficit and drought intensity. In addition, if the analysis is carried out at regional level, the areal extent of a drought event must be taken into account.
Generally, due to the limited number of drought events that can be observed from the historical records, an inferential approach (i.e. fitting parametric distributions on sample series) is often unsuitable to derive the probability distributions (pdf 's and cdf's) of drought characteristics. As an alternative, following previous researches (Bonaccorso et al., 2003, Cancelliere and Salas, 2010), the marginal and multivariate probability cdf's of drought characteristics can be derived as functions of the stochastic characteristics of the underlying variable (e.g. precipitation, streamflow, etc.), whose sample series is usually long enough to get reliable results in a statistical sense.
In this study, this methodology is applied to investigate the space-time variability of drought over Europe by using the National Center for Environmental Prediction/National Center for Atmospheric Research (NCEP/NCAR) reanalysis data for the period 1948–2010. Furthermore, the derived cdf's of drought characteristics are applied to determine the return period of critical droughts, computed as the expected value of the interarrival time between consecutive critical droughts.