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A stochastic model for the analysis of the occurrence probabilities of wet and dry periods in southern Italy

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Rainfall anomalies, as very wet or dry periods, can be quantitatively assessed through indices, which are useful to characterize the severity of the events in terms of intensity, duration, frequency, recurrence probability and spatial extent. With reference to both dry and wet periods, very often the limited number of events in the historical series prevents scientists from the investigation of their probabilistic structure. In fact, missing values may significantly influence duration and variability of these events. To overcome these difficulties, various stochastic models have been developed by assuming a given structure of the underlying hydrological series, thus generating the intrinsic variability of the rainfall process, and deriving the probabilistic behavior of dry and wet periods. In this work, a procedure for the stochastic modeling of monthly rainfall is applied to a high quality data base of monthly rainfall values observed in rain gauges of a large portion of southern Italy. The model adopts variable transformations, which are finalized to the deseasonalisation and the gaussianisation of the monthly rainfall process. The residual correlative structure of the normalized, deseasonalised monthly rainfall variate has been modeled by means of an autoregressive process, including a final procedure to test the autocorrelation of the series. After the estimation procedure of the model parameters, a Monte Carlo technique is applied for generating synthetic worlds to simulate the monthly rainfall of each rain gauge. Then, dry and wet periods were analyzed through the application of the Standardized Precipitation Index (SPI). The results showed that the proposed model provided a good representation of the monthly rainfall for the considered rain gauges. In particular, the results provided by the SPI application at different time scales indicate greater probability of dry conditions than wet conditions, especially when long-term precipitation patterns are considered.