

Trend of inter-arrival times of rainfall events for Italian Sub-Alpine and Mediterranean areas

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Rainfall modelling represents an important issue in several research areas, that hydrology, meteorology and climatology, because of both its theoretical and practical implications. In particular, the assessment of probabilistic structure of time occurrence (day) of rainfall, allows estimating the probability of both rainy periods and drought events.

Usually, the probabilities of wet days and dry days are analysed separately; particularly, dry spells are defined as the number of days in between two rainy days (also denoted as “waiting times” in statistic literature). Alternatively, in this work the probabilistic structure of inter-arrival times, T , is analysed with the aim to account for statistics of both rainfall clustering and drought persistence in a single distribution.

Under the hypothesis that the T s are independent and identically distributed random variables (that generating a renewal process), some discrete distributions have been tested, able to explain main characters of rainfall occurrence; we selected the one-parameter log-series, zeta and Yule distributions, and the two-parameters E-Yule and Polylog distributions (Martinez-Rodriguez A.M. et al., CSDA: 55, 2011; Gupta P.L. et al., Appl. Math. Comput.: 196, 2008). Particularly, zeta and Yule distributions have “heavy tail”, for which not all moments exist, while log-series, E-Yule and Polylog distributions have a “long tail”, for which moments of all orders exist, but they grow very quickly.

Parameters of the above mentioned distributions have been estimated by using the maximum likelihood method.

A set of long time-series of inter-arrival times of some Sub-Alpine and Sicilian rain gauge stations have been studied. Firstly, statistical Kolmogorov – Smirnov and chi-square tests have been performed. Then, the suitability of each chosen distribution to reproduce main statistics (first and second order moments, skewness, etc.) and some derived properties (mean cluster dimension, extremes of fixed quantiles, etc.) of observed time-series has been investigated. Significant differences between Sub-Alpine and Sicilian distribution tails were observed, probably due to the different rainfall regime.

Finally, the study has been extended to the trend analysis, with the aim to verify the reliability of drought periods increase, especially in the Mediterranean environment in which previous studies have yet emphasized the relevance of this topic.