



## **Trend analysis of rainfall characteristics for the period 1992-2011 related to the runoff in a hilly area in Northern Italian Apennines.**

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In this study we elaborated meteorological and hydrological data recorded in the Centonara watershed (44°28'N, 11°28'E), a small semi-agricultural watershed in the Italian Apennines, during a period of 20 years. Specifically we examined the characteristics of rainfall and counted the extreme events, to verify the presence of a significant trend in the annual and seasonal rainfall amount, duration, number of events and number of extreme events.

The number of extreme events was calculated using diverse indexes:

- the frequency of rainfall amount exceeding the 95th percentile computed for the 1992–2011 period (rainfall extreme frequency);
- the frequency of rainfall duration exceeding the 95th percentile computed for the 1992–2011 period (duration extreme frequency);
- the maximum intensity of events greater than or equal to the 95th percentile each year (max extreme intensity);
- the average intensity of events greater than or equal to the 95th percentile each year (mean extreme intensity);
- the frequency of days with at least 2 mm of rain (rain days).

The Mann-Kendall non parametric statistical test as described in Sneyers (1990) was applied to find a trend. All trends noted as significant were significant at the 95% level.

Annual rainfall amount presented a high variability (from 420 mm in 1994 to 964 in 2002). The Mann-Kendall test indicated that these data have not a significant trend.

Among the indexes of the extreme events there were a decreasing trend for the mean extreme intensity and increasing trend of the duration extreme intensity, which means that, during the studied period, rainfall events were more and more lasting.

There was no significant variation in the season distribution of the rainfalls, considering both the amount of rain and the number of events per season, apart from the winter season, where there was a significant positive trend. Considering the extreme events within each season, there were the following positive trends: in spring and summer for the maximum extreme intensity, in winter for the rainfall extreme frequency and duration extreme frequency, while in autumn for the duration extreme frequency. In autumn the rainfall extreme frequency presented a positive trend but not statistically significant. No significant trend were found using the rain days index.

The paper includes analysis and interpretation of the relationships between rainfall events and runoff, especially the response to the extreme events.