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Are the short and intense precipitations in North of Italy affected by a significant trend?

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The upward trend of temperatures is acknowledged and well documented, this increase in temperature is strictly connected to the rate of change in saturation vapour pressure as described by the Clausius-Clapeyron equation. According to this relationship for every rise of 1°C in the temperature, 7% more water vapour is contained in the saturated air that under the right circumstances may turn into rainfall, enhancing an increase in precipitation intensity.

This study scope is to identify any statistically significant trend in extreme rainfall and its spatial and temporal patterns and detect which morphological and climatic variables are the main drivers of the variation in the frequency and intensity of extreme rainfall events. The study focuses on the northern part of Italy, this area is of particular interest given by the diverse orography of the territory. After quality checks on the data (record length, missing values and presence of outliers), 382 meteorological stations were selected that provided annual maximum rainfall series (AMS) for different durations, 1,3,6,12 and 24 hours over the period spanning from 1930 to 2017. Trying to maximize the reliability of the data and focusing on the period during which the global warming seems to rise markedly, we decided to focus the analysis on the period of observation going from 1960 to 2017. Also, the date of occurrence of each observation were retrieved enabling the possibility to perform a seasonality analysis on the precipitation extremes.

The presence and the significance of trends was investigated through a modified version of the non-parametric test Mann-Kendall that takes into account the effect of autocorrelation in the time series. The magnitude of the trend is instead quantified with the Theil -Sen estimator, a reliable method insensitive to outliers. The trend was also assessed through the innovative trend analysis, a graphical method able to detect also non-linear trend.

A preliminary assessment of the results returned by the Mann-Kendall test displayed an overall larger presence of stations exhibiting increasing trend rather than decreasing (ratio 4:1). Moreover, the difference between the number of statistically significant increasing and decreasing trends seems to grow with the duration. These results are, in the vast majority of the cases, in accordance with the outcome returned by the ITA. The relationship between trend and elevation of the stations was investigated through means of scatterplots and non-linear tools, every technique adopted confirmed no correlation between the increasing trend in annual maxima and the altitude of the rain-gauge. The seasonality was studied through boxplots and by observing the frequency of occurrences in each month. At first glance, no clear trend or shift in the period of

occurrences are observed. Instead, it is pretty clear how the dates of occurrence of shorter events (i.e. 1,3 hours) are concentrated in the summer months (convective events), while for longer duration the frequency of occurrence move towards the autumn months. Lastly, temperature data are getting gathered in order to investigate the possible link between annual maxima series of extremes precipitation and temperature as suggested by the Clausis-Clapeyron relationship.