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Changes in intensity of precipitation extremes in Romania on very hight temporal scale and implications on the validity of the Clausius-Clapeyron relation

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Many observational, theoretical and based on climate model simulation studies suggested that warmer climates lead to more intense precipitation events, even when the total annual precipitation is slightly reduced. In this way, it was suggested that extreme precipitation events may increase at Clausius–Clapeyron (CC) rate under global warming and constraint of constant relative humidity. However, recent studies show that the relationship between extreme rainfall intensity and atmospheric temperature is much more complex than would be suggested by the CC relationship and is mainly dependent on precipitation temporal resolution, region, storm type and whether the analysis is conducted on storm events rather than fixed data.
The present study presents the dependence between the very hight temporal scale extreme rainfall intensity and daily temperatures, with respect to the verification of the CC relation. To solve this objective, the analysis is conducted on rainfall event rather than fixed interval using the rainfall data based on graphic records including intensities (mm/min.) calculated over each interval with permanent intensity per minute. The annual interval with available a such data (April to October) is considered at 5 stations over the interval 1950-2007. For Bucuresti-Filaret station the analysis is extended over the longer interval (1898-2007). For each rainfall event, the maximum intensity (mm/min.) is retained and these time series are considered for the further analysis (abbreviated in the following as IMAX). The IMAX data were divided based on the daily mean temperature into bins 2oC - wide. The bins with less than 100 values were excluded. The 90th, 99th and 99.9th percentiles were computed from the binned data using the empirical distribution and their variability has been compared to the CC scaling (e.g. exponential relation given by a 7% increase per temperature degree rise).
The results show a dependence close to double the CC relation for temperatures less than $\sim$ 220C and negative scaling rates for higher temperatures. This behaviour is similar for all the 5 analysed stations over the common interval 1950-2007. This scaling is more exactly for the 90th percentile, while for the higher percentiles the rainfall intensity in response to warming exceeds sometimes the CC rate. For Bucuresti-Filaret station, the results are similar over a longer interval (1898-2007) showing that these findings are robust. Similar techniques has been previously applied to the hourly rainfall intensities recorded at 9 stations (including the 5 ones) and the results are slightly different: the 90th percentile shows dependence close to the CC relation for all temperatures; the 99th and 99.9th percentiles exhibit rates close to double the CC rate for temperatures between $\sim$ 100C and $\sim$ 220C and negative scaling rates for higher temperatures.
In conclusion, these results show that the dependence between the extreme precipitation intensity and atmospheric temperature in Romania is mainly dependent on the temporal precipitation resolution and the degree of the extreme precipitation event (moderate or stronger); these findings are mainly in agreenment with the conclusions presented by previous international studies (mentioned above), with some regional specific features, showing the importance of the regional studies.
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