EMS Annual Meeting Abstracts
Vol. 16, EMS2019-648, 2019

Evaluation of extreme precipitation events at the sub-daily scale

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Exact evaluation of extreme precipitation events (EPEs) is necessary mainly for climatological and hydrological purposes. However, differences among EPEs in their spatial extent, intensity distribution, and duration make their comparison extremely difficult. Therefore, there is no universal criterion for evaluation of EPEs. Everybody who analyzes a set of EPEs within a region, must look for a proper tool for their selection and evaluation.

Frequently, EPEs are simply characterized either by maximum daily precipitation totals or by the areal means of precipitation (usually for a fixed number of days). While the first criterion does not represent the size of the affected area, the other one does not reflect the spatial concentration of precipitation within the considered region. Using daily precipitation data from Central-European rain gauges (since 1961), we present significant differences between the two sets of EPEs selected by the two criteria at several spatial levels. Moreover, we demonstrate the fact that EPEs produced by convective storms tend to be significantly underestimated as they frequently last only several hours in fact.

Therefore, we suggested the Weather Extremity Index (WEI) which combines the areal extent of the affected area with return periods of precipitation totals there. Using daily precipitation totals, the index enables to compare EPEs with different duration of several days because it can employ return periods of precipitation totals during up to 5 or even more days. However, torrential rains remained underestimated in studies based on the WEI because precipitation totals recorded even in one hour were considered as daily totals.

The presented study is based on two types of hourly precipitation data from Czechia. For selected historical EPEs, hourly data were disaggregated from recorded daily totals by the NWP model COSMO. For the evaluation of EPEs since 2002, we used radar-derived precipitation estimates adjusted by daily rain-gauge data. The latter dataset was also used for the estimation of return levels of precipitation totals from 1 to 24 hours. The study proofs the improvement of the evaluation procedure by the WEI when sub-daily precipitation totals and respective return periods are employed.