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Increasing rainfall data density in Northern Italy through daily extremes and the Hershfield factor

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The majority of rainfall measurements in the world is at the daily scale, i.e. expressed over fixed 24-hours. It is then evident that the 24-hour annual maximum rainfall depths, which refer to a period starting at any instant, must not be less than the daily extremes, and are generally higher. The ratio between these extremes, called Hershfield factor (HF), has been studied to correct the errors between fixed time interval and sliding maxima, allowing to take advantage of the relevant amount of information included in historical records of daily extremes. For instance, before 1980, in the Italian Hydrological Yearbooks only a subset (< 50%) of the rain gauges was equipped with a recording device, from which annual maxima over 1, 3, 6, 12 and 24 consecutive hours can be derived.
In our study we investigated the possibility of using the daily data to enrich the availability of sliding maxima rainfall measurements included in the Improved Italian – Rainfall Extreme dataset (I^2-RED), by selecting the Po river basin (North of Italy) as a case study. We retrieved from SCIA (http://www.scia.isprambiente.it/wwwrootscia/Home_new.html) and then we quality-controlled all the daily rainfall measurements available over this area from early 1900 until today. We computed the annual HF for all the stations and all the years where both the daily and the hourly extremes were available, to obtain data that can be analyzed in their interannual and spatial variability.
Analyzing the HF spatial distribution within the Po basin we found values similar to the ones suggested in the literature. Hershfield himself originally estimated a mean value of about 1.13 for the United States, while further studies suggested values in the range of 1-1.2. The spatial distribution of the average HF values turns out to be related to the geographic position of the stations and entails the possibility to identify some distinct areas with a positive or negative anomaly. This map allowed us to reconstruct the missing 24-hour extremes in stations with only daily data, and improve the knowledge of the spatial variability of sub-daily rainfall extremes.