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Assessment of spatial uncertainty of heavy rainfall at catchment scale using a dense gauge network

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Heavy rainfall events

Table S1 gives brief information about the selected heavy rainfall events studied in Sect. 4 and Sect. 5. The heavy rainfall events are corresponding to the days when total rainfall is greater than the 90th percentiles of daily rainfall (06-06 UTC), during the warm season. Rainfall in the region during the summer months is triggered by the advection of humid air masses from the Adriatic Sea. Heavy rainfall events are also closely linked with local thunderstorms (see also Sect. 2). The rain type is not explicitly considered for the event selection.

Table S1. Information of selected heavy rainfall events

	Min	Median	Max
Total rainfall ($\mathrm{mm\,d^{-1}}$)	19.8	28.1	64.1
Peak hourly rainfall ($\mathrm{mm\,h^{-1}}$)	2.6	8.6	26.2
Peak ratio (Peak hourly rainfall/Total rainfall)	7.8	25.4	91.0
Duration (h)	2.0	9.5	22.5

Rain-gauge sub-networks

Figure S1 shows the selection order of WEGN gauges for defining the low-density sub-networks that were used in Fig. 7 of Sect. 4. Priority consideration was given to the actual location of operational weather stations within the WEGN network; the selected gauges 1 and 2 are located nearest to the member stations of the Austrian weather service (ZAMG) and the gauges 3, 4, and 5 are nearest to the rain gauges operated by the Austrian hydrographic services (AHYD). The gauges afterward were arbitrarily selected, ensuring a spatially uniform distribution. Normalized standard deviation of area-of-influence was used as an index for the uniformity of gauge configuration, which fluctuated between 0.37 and 0.23 with a decreasing trend as the number of the selected gauges increases. The area-of-influence is defined as follows: small grid boxes (approx. $0.01^\circ \times 0.01^\circ$, a total of 406 boxes) were defined over the WEGN network and each box is assigned to the nearest gauges of a given sub-network. Then, with an assumption that the most regular gauge configuration would share the same number of boxes, standard deviation of the area-of-influence of n-gauges is calculated. For instance, for the $five$-gauges sub-network, each gauge is expected to share around 80 boxes under an ideal situation. However, in this study, the five gauges share 71 to 113 boxes each, resulting in the uniformity index of 0.35. Note that this simple method does not consider the degree of centralization. The uniformity index defined here is also used for Fig. 6 to select well- and badly-distributed n-gauge networks.

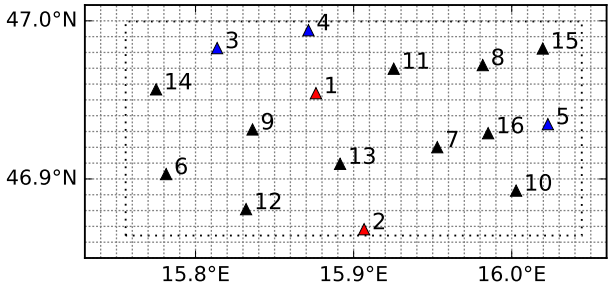

Figure S1. Selected WEGN gauges for Fig. 7. The gauges nearest to operational weather stations of the ZAMG and AHYD are in red and blue, respectively.