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Do citizen science data improve the reconstruction of heavy rainfall events?

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Rainfall-runoff processes are highly dynamic in urban areas. For flood risk management an accurate estimation of spatial and temporal rainfall distribution are essential. In view of increasingly available data sources for rainfall observations we investigate the benefits that additional data sources can bring to the reconstruction of convective heavy rainfall. In this study we focus on the heavy rainfall event in Brunswick (Germany, 205 km²) during storm Lambert in June 2023 and compare rainfall data from different sensors: the German Weather service (DWD, 1 rain gauge), the municipal wastewater management and the university (BS, 8 rain gauges), citizen scientists (CS, 4 rain gauges) and rain gauge-corrected radar (YW). Rainfall information are compared regarding estimates of the spatial distribution of absolute rainfall intensities and resulting return periods for durations ranging from 5 minutes to 24 hours. As 'truth'we consider the interpolated rainfall product derived from all rain gauges. With ordinary kriging an areal rainfall of 113 mm over 24 hours is estimated. Since the rainfall field of the storm event did not hit the only DWD rain gauge located in the region directly, the derived areal rainfall is 72 mm only. Since the radar data is routinely corrected with the closest DWD rain gauges, the radar-based areal rainfall is even smaller (69 mm). Considering the CS rain gauges only leads to higher areal rainfall estimate (91 mm).

Also the spatial representation of the rainfall intensities is superior using CS data in comparison to DWD data or radar data alone. For each raster field (1 km x 1 km) the maximum rainfall intensities for durations D={5, 10, 30, 60, 360, 720, 1440 min} were determined and return periods T based on the national extreme value catalogue assigned. For D=30 min, using all rain gauges results in T=100 yrs, while using CS rain gauges only leads to a slight underestimation with T=50 yrs. However, strong underestimations are identified for the usage of the sole DWD rain gauge leading to T=2 yrs, and for radar leading to T=<1 yr.

The study underlines that CS data may add useful information for the reconstruction of heavy precipitation events and should be used to increase the spatial density of rainfall information particularly in data sparse regions.

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