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Spatiotemporal patterns of short-duration heavy precipitation in Germany

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Heavy rainfall events and the high variability of their occurrence have a significant effect on the urban water cycle and are commonly thought to increase in the future. The increasing risk of urban flash floods is a problem jointly faced by the urban infrastructure, water networks and -systems. A better understanding of the diurnal and seasonal precipitation cycles of short-duration heavy rainfall events is therefore required. This study presents the diurnal and seasonal distribution of those events (10-minute and one-hour) in Germany and puts them into a spatial context. Precipitation data from 22 weather stations of the German Weather Service were statistically examined for the period 2000 - 2018. In addition, the spatial and temporal distribution patterns were compared to spatiotemporal patterns of various controlling factors. Three diurnal distribution patterns can be identified: 1) a homogeneous distribution of events over a maximum period of 24 hours in the S-SW, 2) a non-uniform grouping of events in the morning and afternoon predominantly in the NE and 3) an occurrence of heavy rainfall events in the afternoon in a much shorter time interval in the North. These patterns are not necessarily identical for both event durations and suggest different forms and degrees of drivers. From a seasonal perspective, events of both durations occur exclusively between May and September, with the majority occurring in July and August. Temporal distributions can mainly be explained by controlling factors such as sunshine duration and intensity of radiation whereas spatial differences are also linked to geographical altitudes and typical, summery large-scale weather conditions with the main wind direction from the SW.