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Variation of rain intensity and drop size distribution with General Weather Patterns (GWL)

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Short-duration rainfall extremes may cause flash floods in certain catchments (e.g. cities or fast responding watersheds) and pose a great risk to affected communities. In order to predict their occurrence under future climate change scenarios, their link to atmospheric circulation patterns needs to be well understood. We used a comprehensive data set of meteorological data (temperature, rain gauge precipitation) and precipitation spectra measured by a disdrometer (OTT PARSIVEL) between October 2008 and June 2010 at Freising, southern Germany. For the 21 months of the study period, we integrated the disdrometer spectra over intervals of 10 minutes to correspond to the temporal resolution of the weather station data and discarded measurements with air temperatures below 0°C. Daily General Weather Patterns ("Großwetterlagen", GWL) were downloaded from the website of the German Meteorological Service. Out of the 29 GWL, 14 were included in the analysis for which we had at least 12 rain events during our study period. For the definition of a rain event, we tested different lengths of minimum inter-event times and chose 30 min as a good compromise between number and length of resulting events; rain events started when more than 0.001 mm/h (sensitivity of the disdrometer) were recorded. The length of the rain events ranged between 10 min and 28 h (median 130 min) with the maximum rain intensity recorded being 134 mm/h on 24-07-2009. Seasonal differences were identified for rain event average intensities and maximum intensities per event. The influence of GWL on rain properties such as rain intensity and drop size distribution per time step and per event was investigated based on the above mentioned rain event definition. Pairwise Wilcoxon-tests revealed that higher rain intensity and larger drops were associated with the GWL "Low over the British Isles" (TB), whereas low rain intensities and less drops per interval were associated with the GWL "High over Central Europe" (HM). "Trough over Central Europe" (TRM) was linked to smaller drops and "High Scandinavia-Iceland, Trough C. Europe" (HNFZ) had fewer drops per time step when compared to other GWL types. We also investigated the intra-event behavior regarding fluctuations in rain intensity, rain drop counts, and drop size distribution with time. When combined with predictions of circulation patterns, our analysis provides a detailed insight into the characteristics of rain events under different future climate scenarios, but definitively an extended measurement period and more measurement locations are needed for validation.