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Changes in extreme precipitation and their dependence on temporal resolution and precipitation classification

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At short temporal resolutions it has been found in the literature that the rate of increase of heavy precipitation with temperature may well exceed the increase of moisture holding capacity of the atmosphere, as described by the Clausius-Clapeyron relation. While this may point towards strong dynamical processes in the atmosphere leading to dramatic moisture convergence and subsequent rapid lifting of moist air, the explanation may also lie in a statistical superposition of distinct meteorological phenomena, namely the dominance of large-scale (frontal) precipitation at lower temperatures and in the winter months, and convective (thunderstorm like) events at high temperatures.
A high resolution data set of precipitation measurements are used to study the scaling relations of probability distributions of precipitation intensity and the dependence on the temporal resolution of the data. We use a data set of five-minute resolution precipitation observations from six German stations, each with over 30 year long measurement records.
In a first step, a cascade of averaging intervals is computed to obtain the behaviour of precipitation intensity from the instantaneous to the daily resolution. While the distribution of the shortest timescale displays a strict power-law tail, it acquires a more elaborate scaling when precipitation and dry periods are mixed at longer averaging intervals. The typical event size of all events are found to be between 30 and 60 minutes.
Next, the precipitation data is classified into stratiform and convective precipitation types using the EECRA data base of WMO station synoptic observations, corresponding to the exact locations of our precipitation data. The synoptic observations are available at three hourly time steps, and the classification is assumed to be valid for one hour before and after the time of the observation. Statistical properties - such as the probability density function for precipitation intensities and event statistics and the diurnal cycle - are then obtained separately for the two precipitation types.
These results may offer new insight into the distinct roles of dynamical and thermodynamic processes involved in precipitation formation as a function of temperature and timescale and may help understand the future development of the hydrological cycle and shifting precipitation extremes in a changing climate.