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Extreme convective rainfall at the event scale: results from high resolution rain radar data

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In the past decade evidence was found that the response of extreme precipitation to a warming atmosphere, which is generally referred to as precipitation scaling, can be twice as high as expected from the Clausius-Clapeyron (CC) relation. The Clausius-Clapeyron equation describes the water holding capacity of the atmosphere as a function of temperature: a warmer atmosphere can hold more water. Several studies showed that the so-called double CC scaling (2CC) is present in sub-daily observations of precipitation extremes and even stronger pronounced in sub-hourly data, e.g. in the Netherlands. However, potential mechanisms are still under debate.

Keeping in mind that extreme precipitation events take place at small spatial and temporal scales this study aims at exploiting high resolution rain radar data. The properties of extreme rainfall events are analyzed using nine years of radar derived 5-minute precipitation amounts over the Netherlands with a resolution of 1 km. The data set covers a total area of 57,000 km^2. A self developed rain cell tracking algorithm allows following rainfall events and reveals their spatio-temporal characteristics. This method enables a detailed examination of individual convective rainfall events. The algorithm reports the duration, peak intensity and the rainfall area at the corresponding time step for each detected event. A dew point temperature record is extracted from observations at the closest station with data available. The dew point temperature is a direct measure of humidity and gives more robust scaling results than temperature. Using this combination of data, the relation between event size, intensity and moisture availability is investigated. The result is a deeper insight into the potential causes of an exceedance of CC scaling of convective extreme precipitation and the mechanism behind.

Reference:

Lochbihler, K., G. Lenderink, and A. P. Siebesma (2017), The spatial extent of rainfall events and its relation to precipitation scaling, Geophys. Res. Lett., 44, 8629–8636, doi:10.1002/2017GL074857.