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Understanding the unexpectedly high increase of observed (sub-)hourly precipitation extremes with temperature

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Events of extreme precipitation are highly disruptive to society, and are likely to intensify with global warming. When sufficient moisture is available, precipitation extremes are expected to be related to temperature through the Clausius-Clapeyron (CC) relation of a $\sim$7%/$^{\circ}$C increase. However, several processes may influence precipitation intensity leading to deviations from CC scaling. Recently, Lenderink & van Meijgaard (2008) found an intensity increase consistent with two times CC (2CC) scaling for temperatures above approximately 12°C, using hourly precipitation extremes in De Bilt, The Netherlands. At lower temperatures CC scaling applied.

To study this, we first distinguish between convective and frontal precipitation based on the different time-scales of these regimes using observations from 27 weather stations in the Netherlands. By analyzing sub-hourly precipitation, convective extreme events are selected from the dataset, leading to a 2CC trend over the entire range of dewpoint temperatures. This places previous scaling relations of hourly extremes into context, showing that 2CC scaling is a robust relation for convective precipitation extremes.

To understand the origin of this 2CC relationship, we use a conceptual model based on idealized deep convective profiles based on soundings at De Bilt. The results of this conceptual model indeed provide support for a 2CC trend for extreme precipitation intensities.

Lenderink, G. & van Meijgaard, E., Increase in hourly precipitation extremes beyond expectations from temperature changes. *Nature Geosci.* **1**, 511-514 (2008).