Power-Law Behavior of Hourly Precipitation Intensity and Dry Spell Duration over the United States

Lichao Yang, Christian L.E. Franzke, Zuntao Fu

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Precipitation is an important meteorological variable which is critical for weather risk assessment.

- Most statistical modeling studies assume that the occurrence of precipitation events is based on a Poisson process with exponentially distributed waiting times while precipitation intensities are typically described by a gamma distribution or a mixture of two exponential distributions.
- Here, we show by using hourly precipitation data over the United States that the waiting time between precipitation events is non-exponentially distributed and best described by a fractional Poisson process. The intensities are best represented by a two-distribution model consisting of (i) a Generalized Pareto Distribution (GPD) model for bulk precipitation event sizes and (ii) a power-law distribution for large and extreme events.
- We also analyze the regional climate model output to evaluate how the climate models represent the high-frequency temporal structure of United States precipitation. Our results reveal that these regional climate models fail to accurately reproduce the power-law behavior of intensities and severely underestimate the long durations between events.