Similarities and scaling of extreme rainfall worldwide

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Long records of annual maximum daily rainfall from 169 stations from Europe and the USA, with lengths exceeding 100 years, are statistically analyzed. It is observed that several dimensionless statistics of the annual maximum series are virtually constant worldwide, except for an error that can be attributed to a pure statistical sampling effect. Thus, if all series are standardized by their mean, they can be described by practically the same statistical law. From the study of the compound series from all stations with length 17922 station-years it becomes clear that this extreme value law is of type II rather than type I (Gumbel) as thought before. This implies a power-type (Pareto) parent distribution, which has scaling properties for low probabilities of exceedence. Two major questions arise from this research: (1) Why the statistical law of standardized extreme rainfall is virtually the same over a wide range of geographical areas and climates? (2) Why is this law power-type? The second question is answered using the principle of maximum entropy. Specifically, it is shown that this principle, which corresponds to maximum uncertainty, results in a Pareto type distribution, if the coefficient of variation is high, and also predicts the scaling exponent, which is verified by the historical data.