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An all-timescales rainfall probability distribution

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The selection of a probability distribution for rainfall intensity at many different timescales simultaneously is of primary interest and importance as typically the hydraulic design strongly depends on the rainfall model choice. It is well known that the rainfall distribution may have a long tail, is highly skewed at fine timescales and tends to normality as the timescale increases. This behaviour, explained by the maximum entropy principle (and for large timescales also by the central limit theorem), indicates that the construction of a "universal" probability distribution, capable to adequately describe the rainfall in all timescales, is a difficult task. A search in hydrological literature confirms this argument, as many different distributions have been proposed as appropriate models for different timescales or even for the same timescale, such as Normal, Skew-Normal, two- and three-parameter Log-Normal, Log-Normal mixtures, Generalized Logistic, Pearson Type III, Log-Pearson Type III, Wakeby, Generalized Pareto, Weibull, three- and four-parameter Kappa distribution, and many more. Here we study a single flexible four-parameter distribution for rainfall intensity (the JH distribution) and derive its basic statistics. This distribution incorporates as special cases many other well known distributions, and is capable of describing rainfall in a great range of timescales. Furthermore, we demonstrate the excellent fitting performance of the distribution in various rainfall samples from different areas and for timescales varying from sub-hourly to annual.