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Intensity dependence of cascade generators of rainfall time series

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The multiplicative random cascade model has been viewed as a promising tool for simulating rainfall time series because of its ability to reproduce with very little parameterization what some have observed to be scaling and multi-scaling phenomena. Strictly speaking, the random cascade model employs a time-scale invariant frequency distribution for the cascade generators W, which define how the amount of rain falling over any given time interval is partitioned into two or more subintervals. However, many have noted that the frequency distribution of W: $0 < \quad W \quad < 1$, is time-scale dependent, and in particular, that the distribution of W becomes more centered about 0.5 as the time scale decreases from days to minutes or seconds. It has also been observed that the distribution of W becomes more centered about 0.5 as the time scale increases from days to decades. While this property of the cascade generators has been well acknowledged, less attention has been given to the dependence of W on rainfall intensity in time series data. We show that W has a strong dependence on rainfall intensity at all time scales for time series data collected in western Oregon. There appears to be a clear structure to this dependency, though the apparent behavior at low intensities is to some degree an artifact of instrument precision. Explicitly accounting for both time-scale dependence and intensity dependence within the random cascade model may defeat the purpose of employing what was originally looked to as a very simple model capable of simulating the complex structure of rainfall time series. At the same time, a non-multi-fractal modeling framework derived from the random cascade approach reveals several fundamental features of the stochastic structure of rainfall.