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Multiscaling and log-infinite divisibility in space-time averaged rainfall

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Statistics of rainfall is known to depend in a nontrivial manner on the space-time averaging scale. In particular, extensive observations reveal that both radar and gauge rainfall data possess multiscaling property, i.e. the moments of area- or time-averaged rain rate exhibit power law dependence over a wide range of averaging scales.

In a previous paper [Kundu and Siddani 2006] it was demonstrated that the spatial statistics of area-averaged rain rate derived from radar measurements exhibits multiscaling characteristics and that the scaling exponents can be expressed in terms of a simple algebraic formula. Moreover, it was shown that the formula can be derived as an approximate consequence of the scale dependence of the parameters of an underlying mixed log-infinitely divisible probability distribution that closely fits the observed rain rate histograms.

Here we describe a recent work exploring the applicability of these concepts to time-averaged rain gauge data. Specifically, we examine the statistics of time series of 1-minute averaged rain accumulation data from a large system of tipping bucket rain gauges that is aggregated to various time scales between 1 minute and 5 days. Again we find that the multiscaling behavior holds over a wide range of temporal scales. Also, like their spatial counterparts, the empirical exponents describing the scaling regime naturally arise from the observed scale dependence of a log-infinitely divisible distribution governing the temporal statistics.