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Rainfall Temporal Variability: Scaling vs. non-Scaling Descriptions

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Theoretical and observational descriptions of the detailed temporal structure of rainfall as a function of the aggregation scale are important both conceptually and operationally. The scaling paradigm, which assumes a power-law structure of the statistical moments, provides quite a natural framework to describe how rainfall statistical characteristics vary across scales and has produced a wealth of important thoeretical results and models. However, non-scaling assumptions, often based on less restrictive hypotheses, can also be used to derive theoretical scale relations, i.e. expressions linking rainfall properties at different aggregation scales, which have not received much attention in the hydrologic literature. Here we review non-scaling scale relations which imply a non-power-law form of the second order moment and apply them to a wide data set representative of different rainfall regimes. We then interpret the commonly observed power-law form of the second order moment in the light of such non-scaling relations, showing that non-trivial scaling exponents may arise as a result of different regimes predicted by the non-scaling theory. Finally, we consider, as a practical benchmark, the common problem of rainfall temporal downscaling, showing that non-scaling procedures outperform those based on power-law expressions of the statistical moments in the estimation of rainfall variance at the hourly scale on the basis of daily observations.