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Spectral multiscaling for downscaling processes of regional averages with a diagnostic study.

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Spectral multi-scaling postulates power-law scaling of (normalized) spectral distribution functions of stationary processes of spatial averages, over nested and geometrically similar sub-regions of the spatial parameter space of a given spatio-temporal random field. In the present paper we formulate a new framework for down-scaling processes of spatial averages, following naturally from the postulate of spectral multi-scaling, and describe the key ingredients required for its implementation.
We also present results from an extensive diagnostic study seeking statistical evidence to support spectral multi-scaling. This evidence emerges from two sources of data. One is a 13-year long historical record of radar observations of rainfall in southeastern UK (Chenies radar), with high spatial and temporal resolution. The other is an ensemble of rain rate fields simulated by a spatio-temporal random pulse model fitted to the historical data. The results are consistent between historical and simulated rainfall data, indicating frequency-dependent scaling relationships that could be interpreted as evidence of spectral multi-scaling across a range of spatial scales.
Catalytic role in diagnosing spectral multi-scaling for spatial averages of rain rate (SARR) has played an interesting in itself linear relationship between contemporary processes of SARR and regional proportion where rain rate exceeds a given threshold level τ. The latter process is referred to as τ-COVER, and the linear relationship between contemporary SARR and τ-COVER processes is referred to as "Intensity-Coverage" link. In light of this link we argue that, under certain conditions, evidence of spectral multi-scaling based on τ-COVER processes is sufficient to infer spectral

multi-scaling for contemporary SARR processes on the same regions.