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Orographic Signature on Multiscale Statistics of Extreme Rainfall

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The main objective of this study is to characterize the statistical signature of orography on the spatio-temporal structure of rainfall over a range of scales with the aim of developing a consistent theoretical basis for downscaling satellite precipitation over mountainous regions. Tail value statistics of precipitation distribution are used to track the storm motion and quantify the dynamic effect of the underlying orography. Observing departure from log-normality, the resolution dependence of the storm spatial variability is found to be well parameterized by a generalized lognormal distribution which cannot be collapsed across scales with a simple normalization. Instead, the tail of the distribution becomes increasingly shorter as spatial scale increases. Parametric modeling of the rainfall fluctuation field indicates that the distribution of fluctuations becomes less heavy tailed and more dispersed while the storm moves toward high elevation orographic features. These observations are used to develop a versatile downscaling framework for orographic precipitation which explicitly accounts for the signature of topography on rainfall multiscale statistics.