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Spatial and temporal long-range dependence in the scale domain

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Long-range dependence (LRD) estimators are traditionally applied in the lag domain (e.g., through the autocovariance or variogram) or in the frequency domain (e.g., through the power-spectrum), but not as often in the scale domain (e.g., through variance vs. scale). It has been contended that the latter case introduces large estimation bias and thus, corresponds to "bad estimators" of the LRD. However, this reflects a misrepresentation or misuse of the concept of variance vs. scale. Specifically, it is shown that if the LRD estimator of variance vs. scale is properly defined and assessed (see literature studies for the so-called climacogram estimator), then the stochastic analysis of variance in the scale domain can be proven to be a robust means to identify and model any LRD process ranging from small scales (fractal behavior) to large scales (LRD, else known as the Hurst-Kolmogorov dynamics) for any marginal distribution. Here, we show how the above definitions can be applied both in spatial and temporal scales, with various applications in geophysical processes, key hydrological-cycle processes, and related natural hazards.