On the Detection of Statistical Heterogeneity in Rain Measurements

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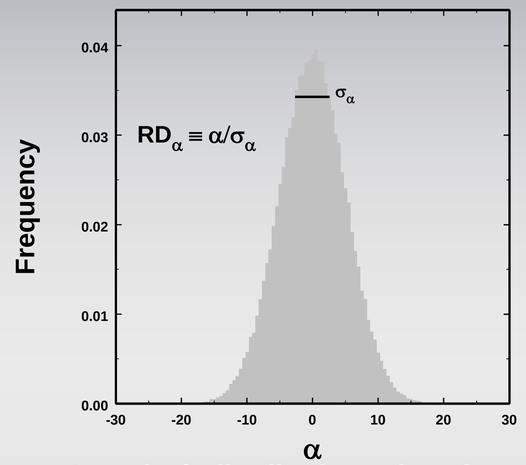
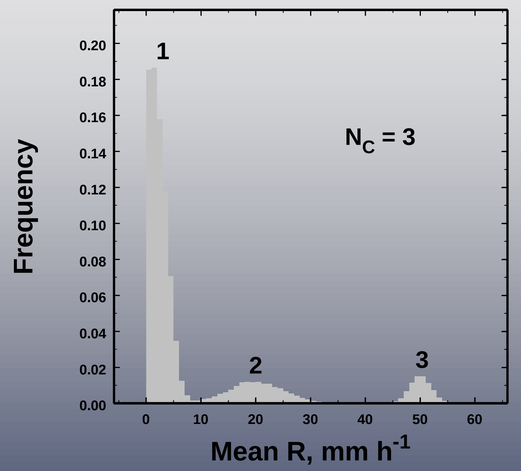
Scaling studies of rain of use the Wiener-Khitchine theorem to Fourier transform an autocorrelation function, ρ, into a power spectrum, S. This requires that the data be wide-sense statistically stationary (WSS) in order to avoid location dependence and cross-correlations among more than one component mean value. It is then necessary that (1) the variance remain constant through out a domain and that (2) there only be one component mean value. This work presents a model independent method for determining whether data are WSS or not.

The constancy of the variance is determined using counting statistics (Anderson and Kostinski, 2010; 2011) while the number of component mean values is determined using a Bayesian inversion method (Jameson, 2007; 2015)

RH = number of record highs; RL=number of record lows; α = $(RH+RL)_{Forward}$ – $(RH+RL)_{Backward}$



A typical distribution of α for 2000 observations of a variable.



Number of contributing mean value components N_C = 3.

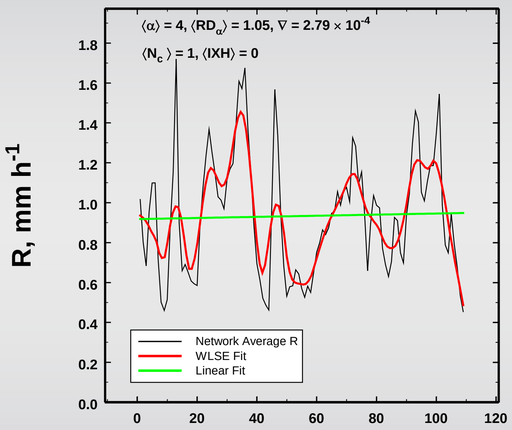
Index of Statistical Heterogeneity

$$IXH = \left\{ \frac{H\left(\frac{RD_\alpha}{1.5} - 1\right)\left(\frac{RD_\alpha}{1.5} - 1\right) + (N_c - 1)}{2} \right\}$$

where *H* is the unit step function

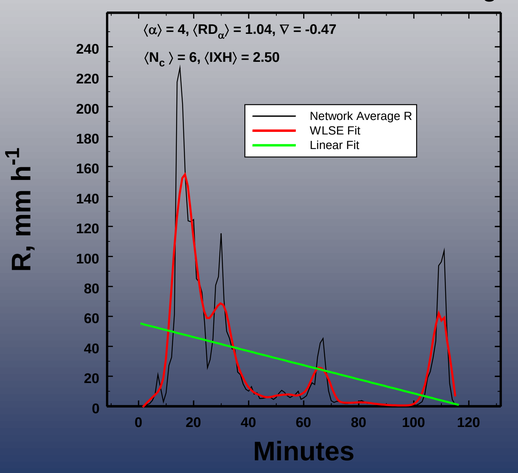
Example of WSS

Stratiform Rain - Network Average



Examples of non-WSS

Convective Rain - Network Average



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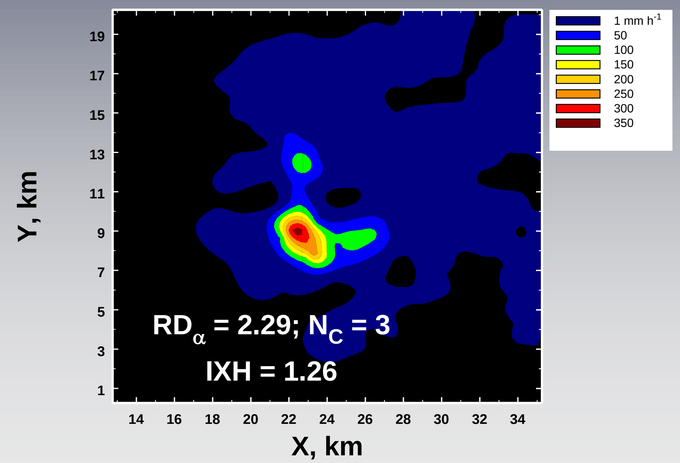

Implication

It is necessary to determine whether or not data are WSS in order to avoid misleading scaling using the Wiener-Khitchine theorem or inaccurate kriging.

References

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