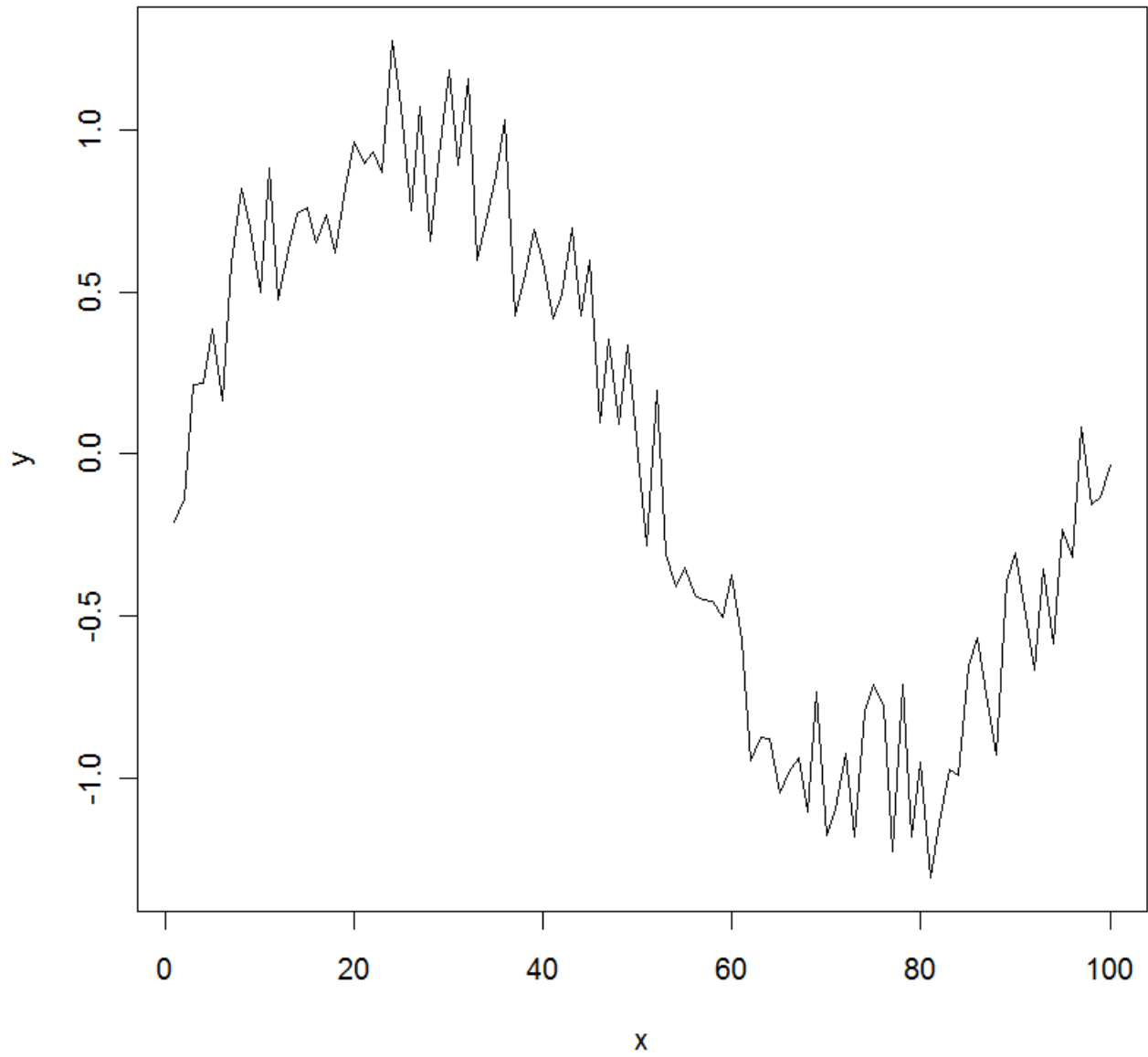


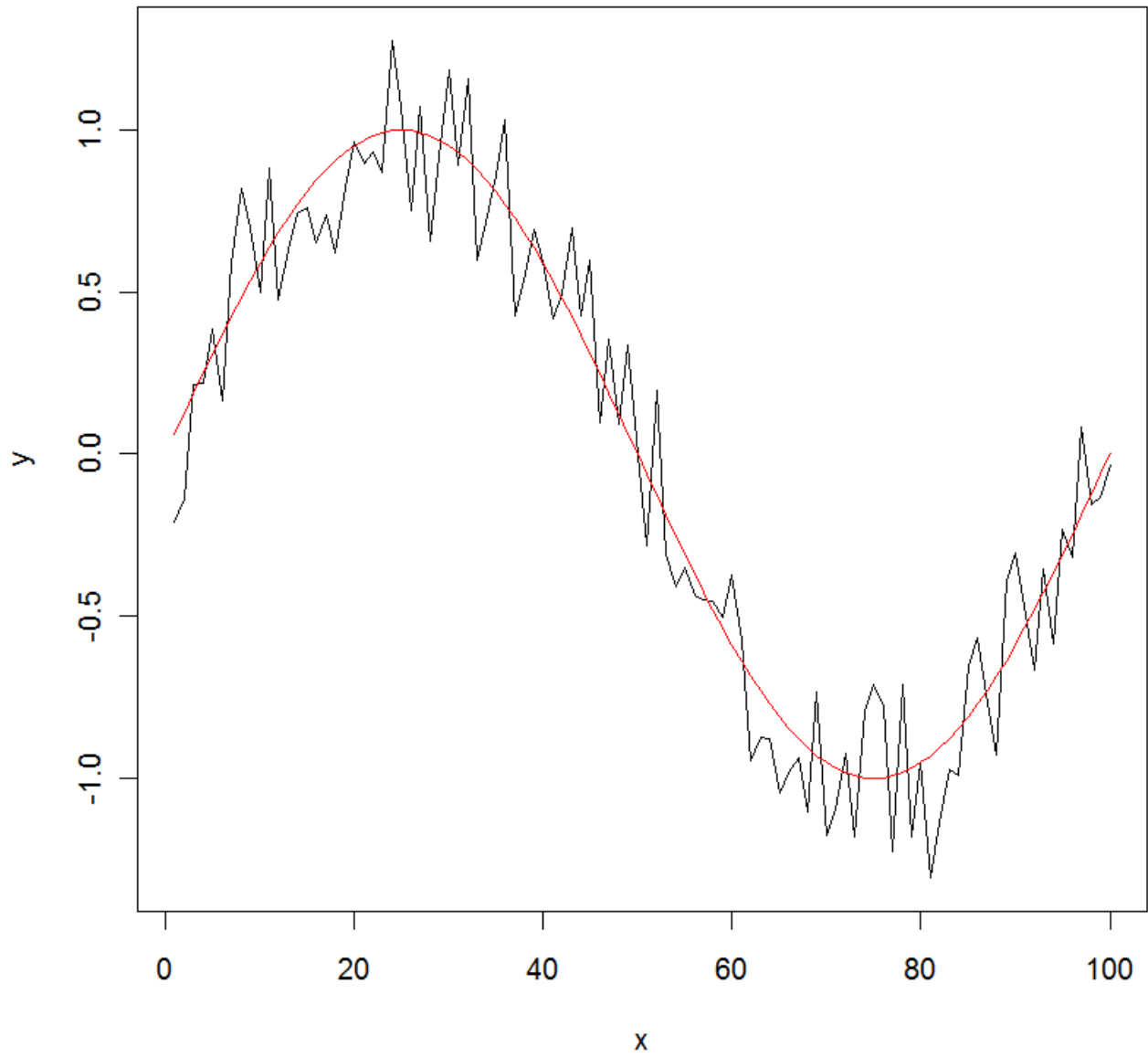
Malcolm Haylock and Paul Della-Marta
PartnerRe

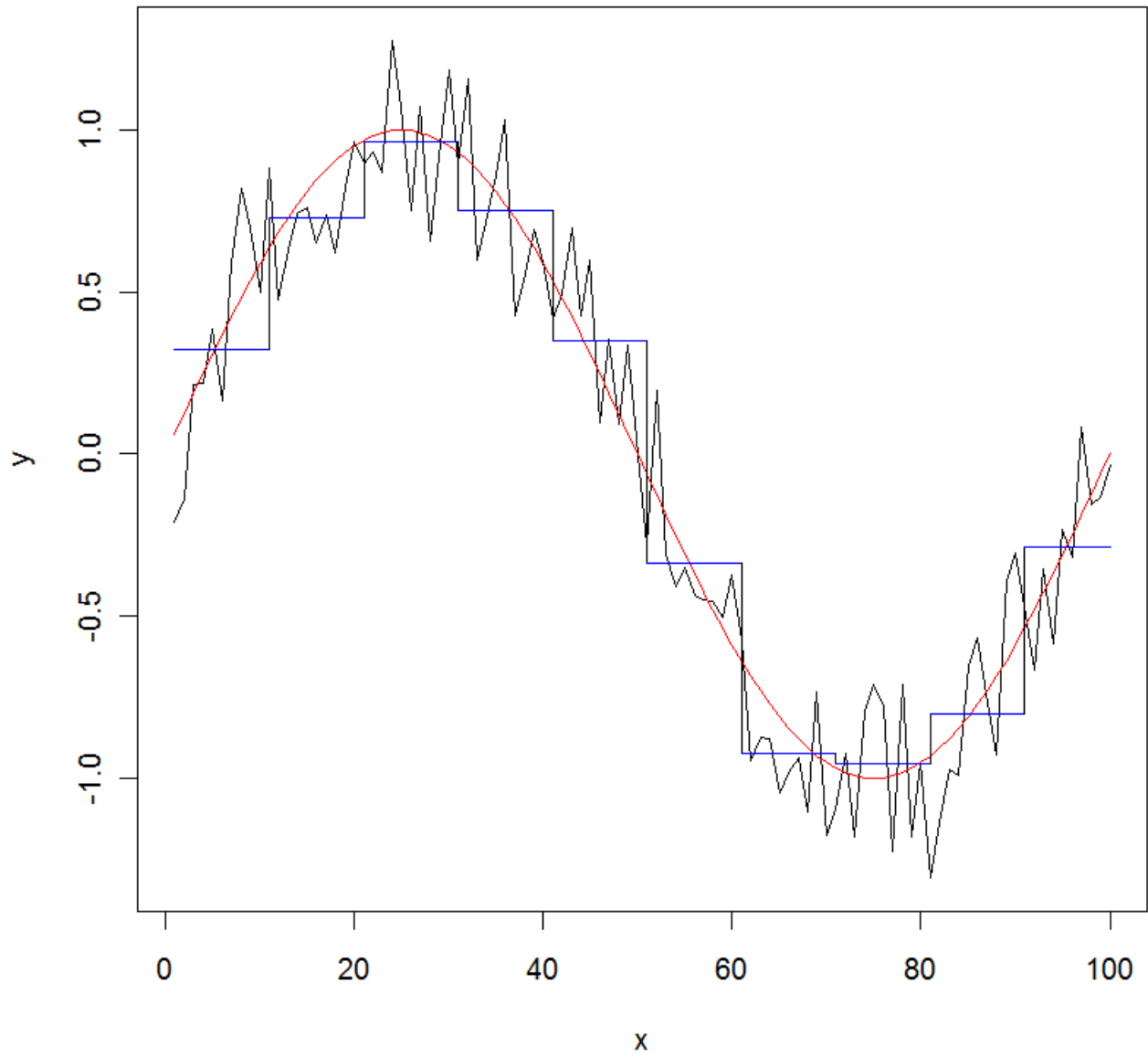
Considerations when analysing extremes in gridded observational data

Outline

- Point or box?
- Interpolation
- Stochastic sampling





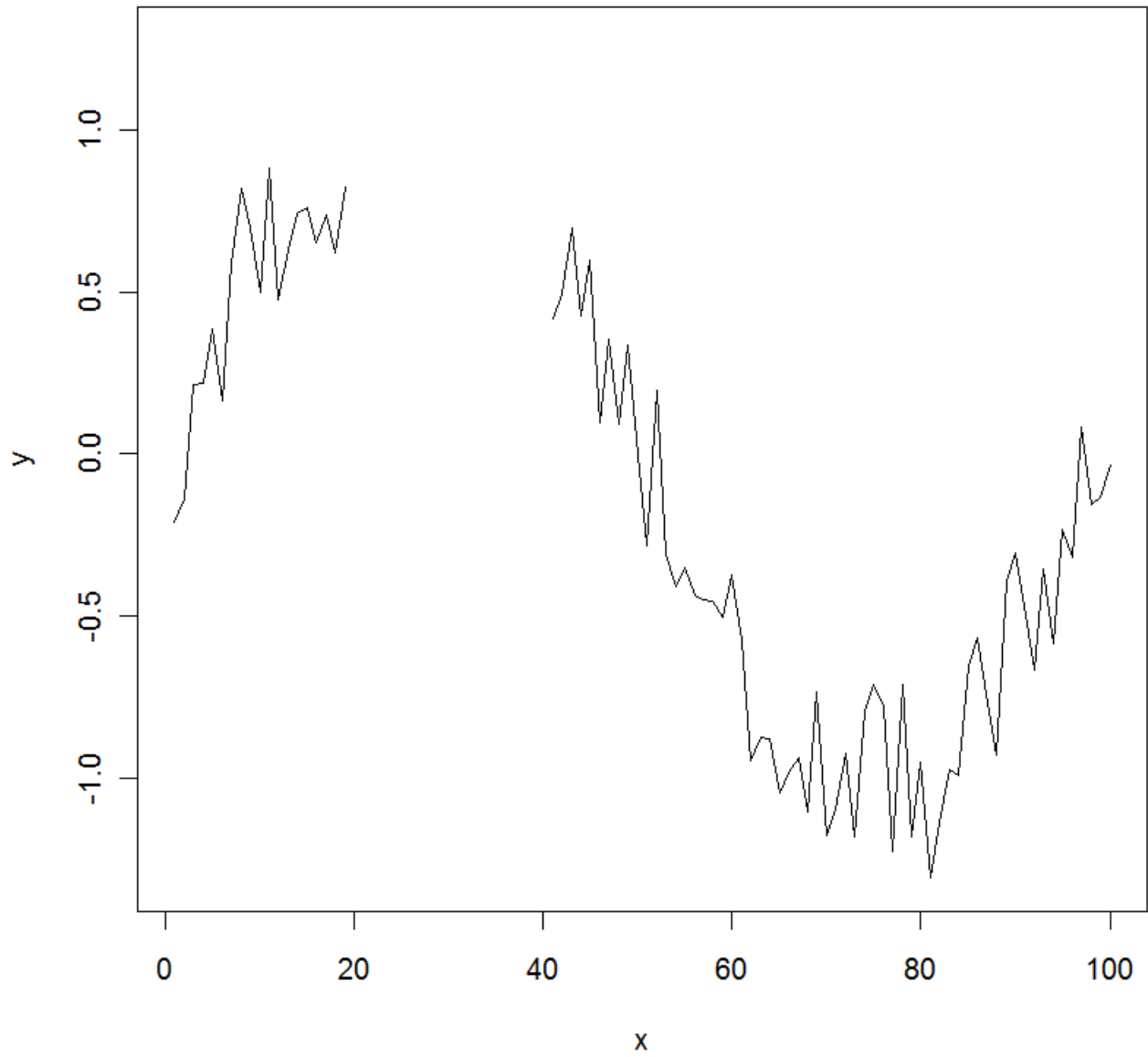


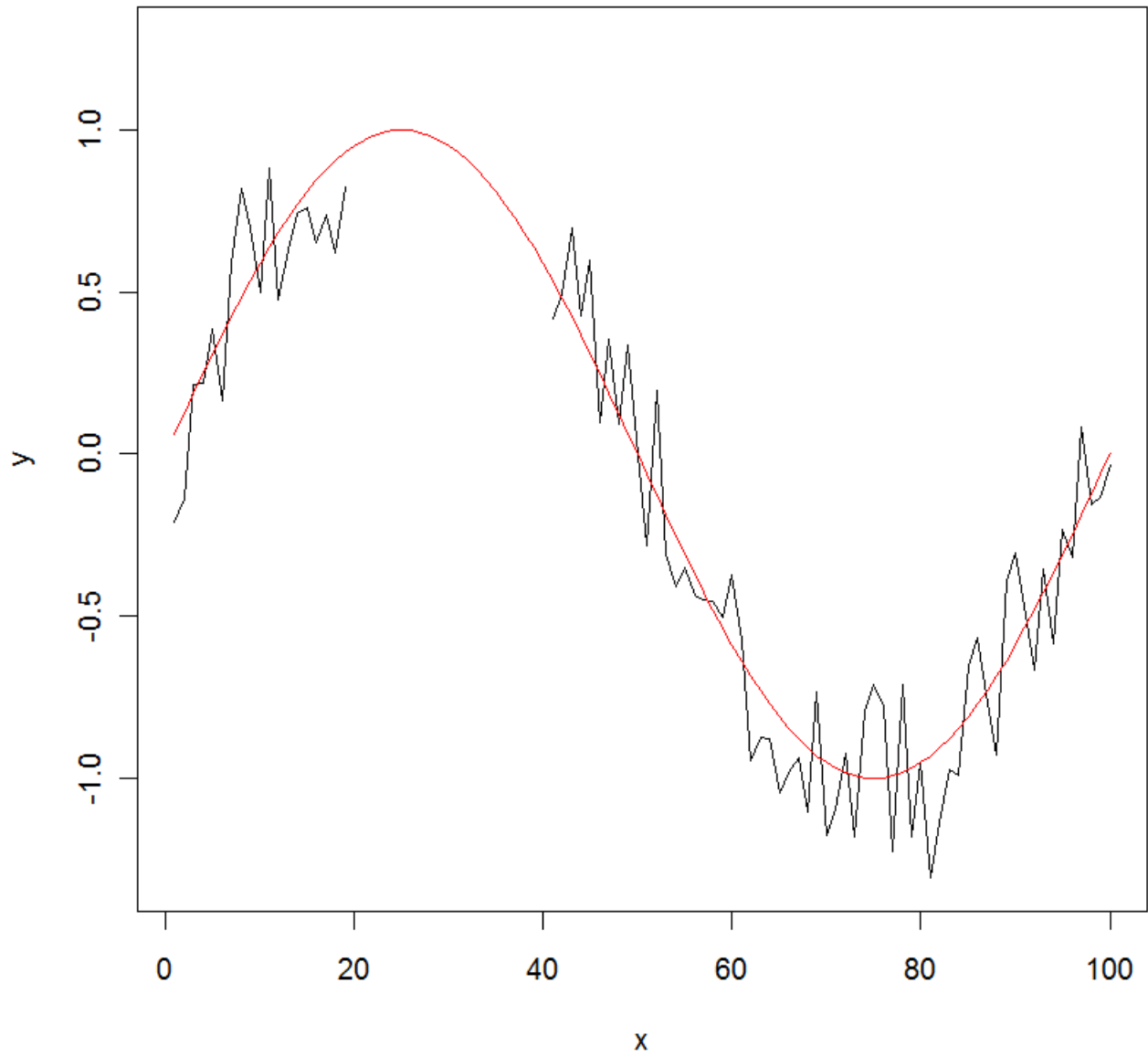
Point or box?

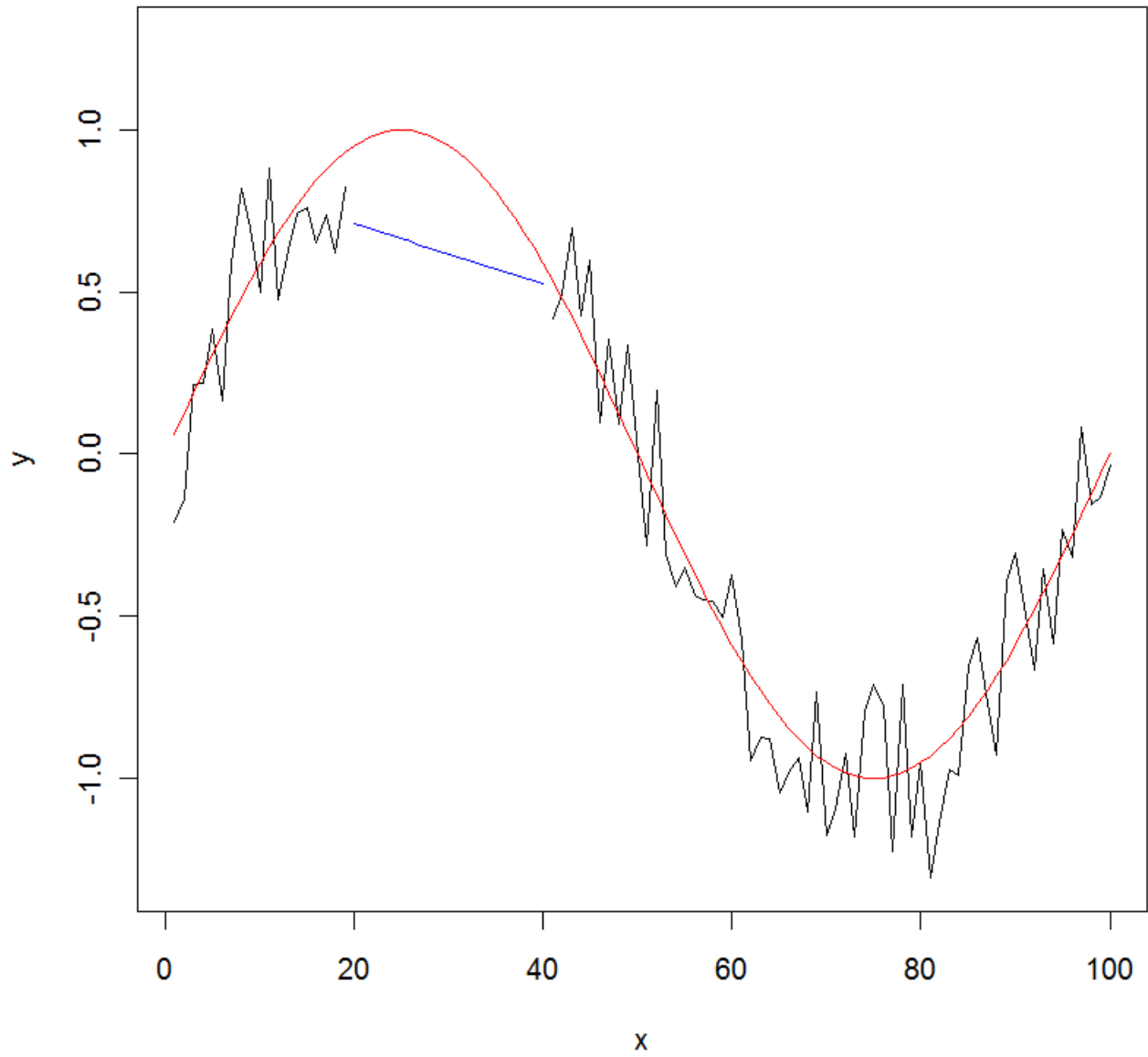
- For independent random variables we can use the Bienaymé formula to determine the degree to which a sample mean is reduced in a grid box average

$$\text{Var}\left(\sum_{i=1}^n X_i\right) = \sum_{i=1}^n \text{Var}(X_i)$$

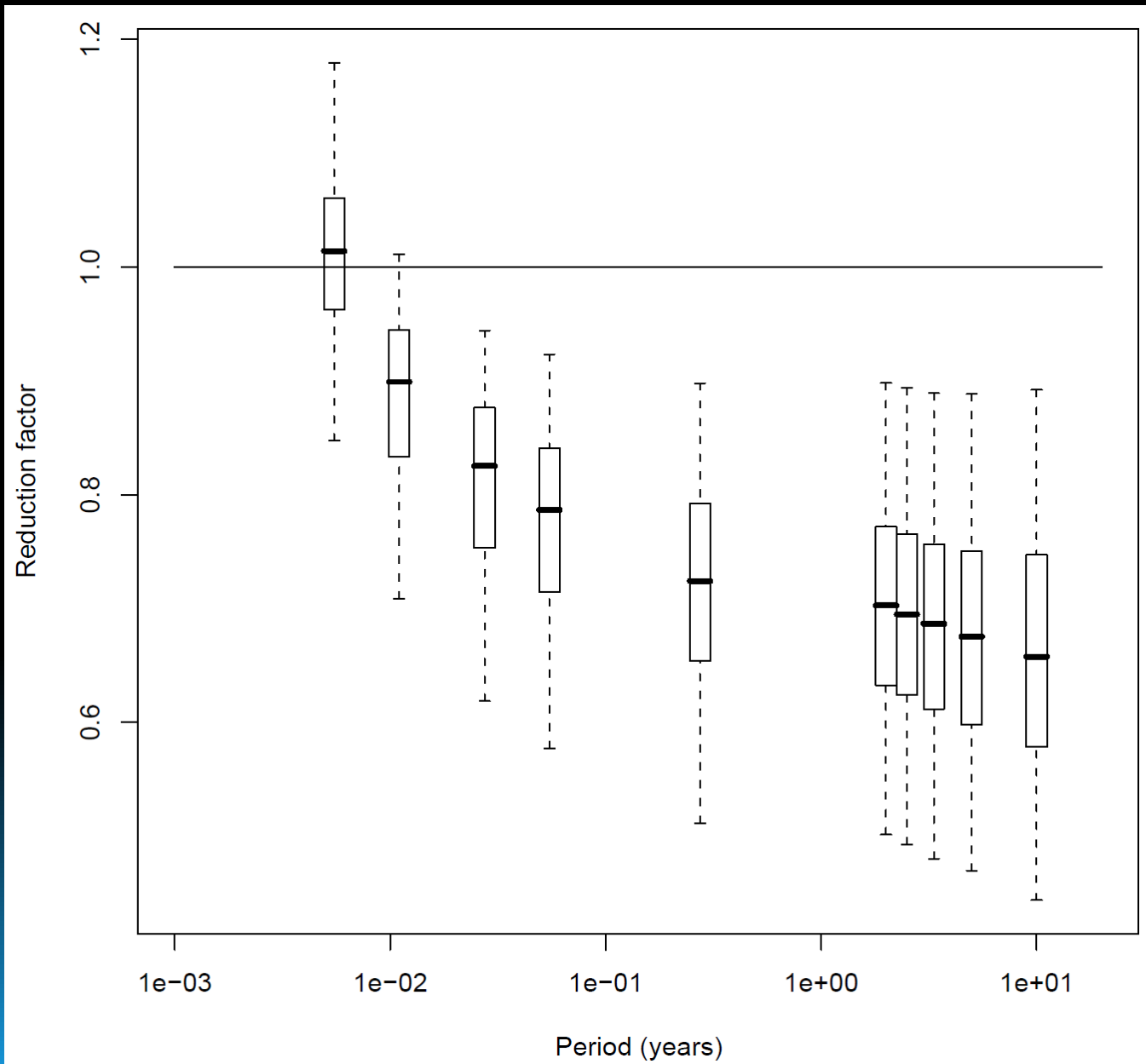
$$\text{Var}(\bar{X}) = \text{Var}\left(\frac{1}{n} \sum_{i=1}^n X_i\right) = \frac{1}{n^2} \sum_{i=1}^n \text{Var}(X_i) = \frac{\sigma^2}{n}$$

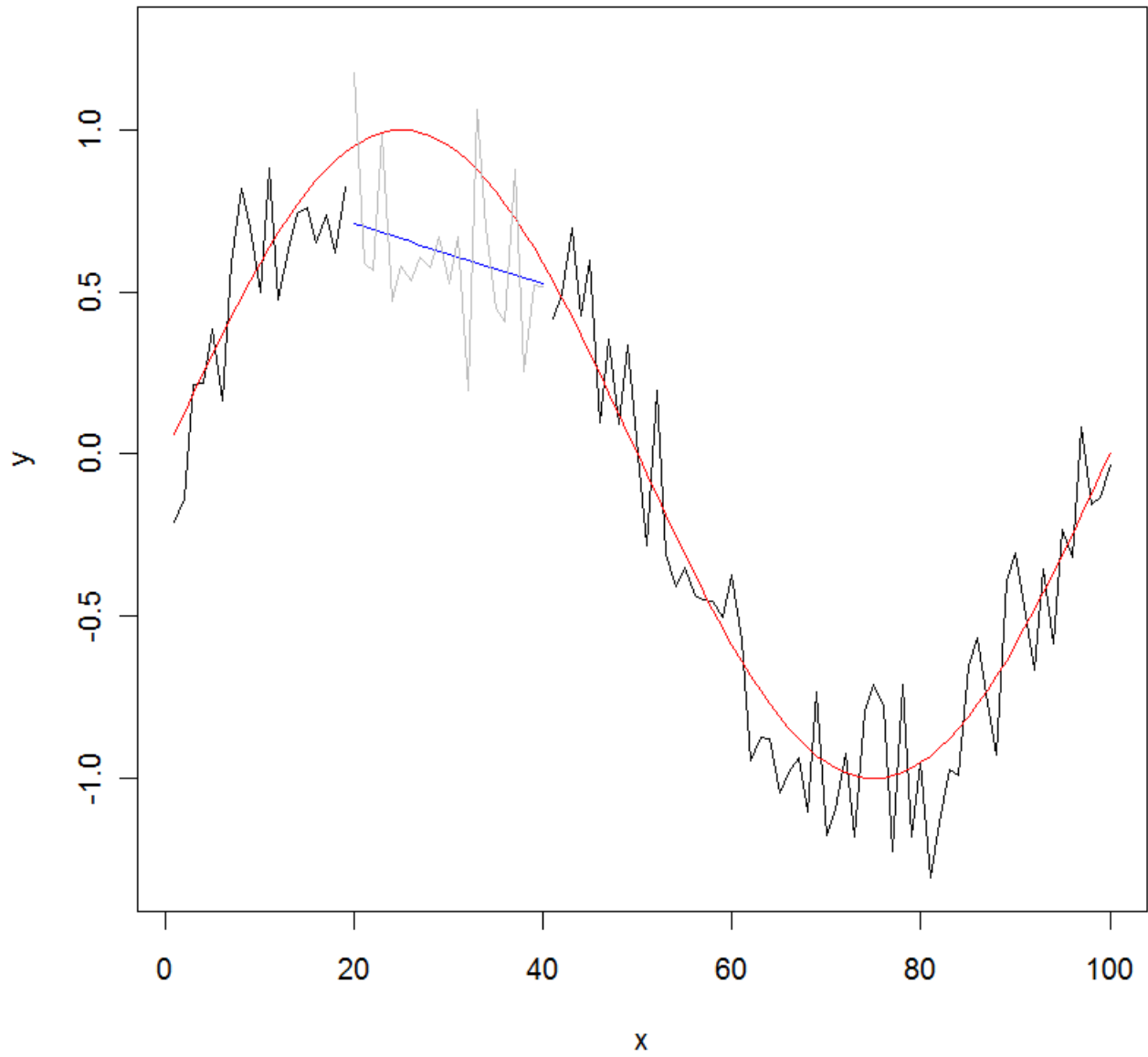


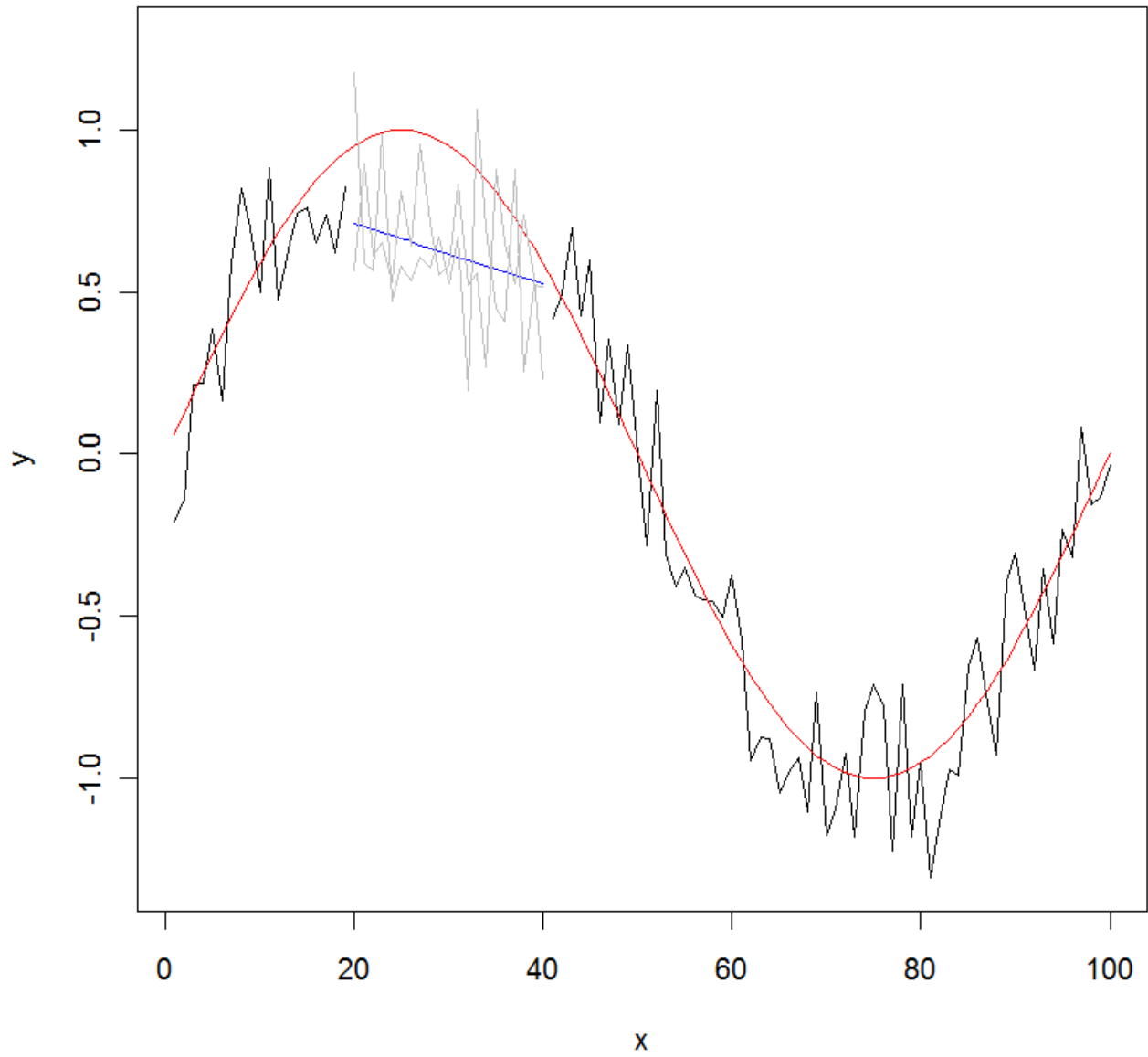


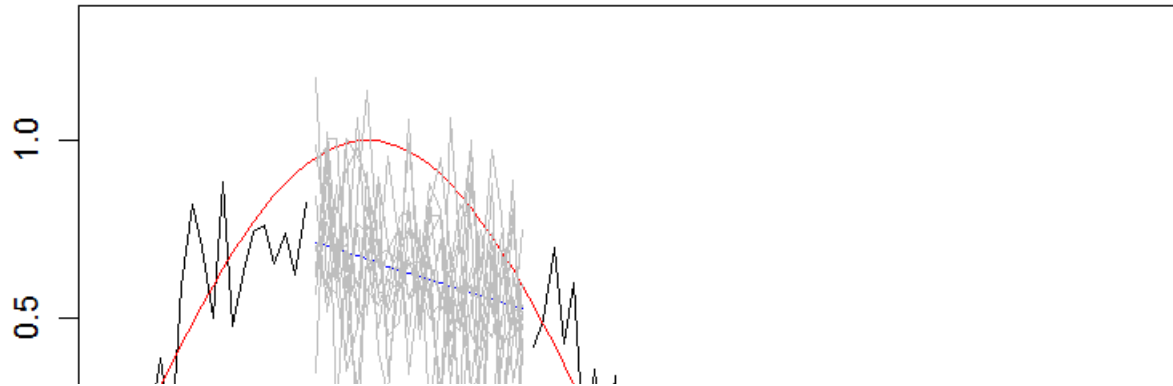


Extreme precipitation reduction factor



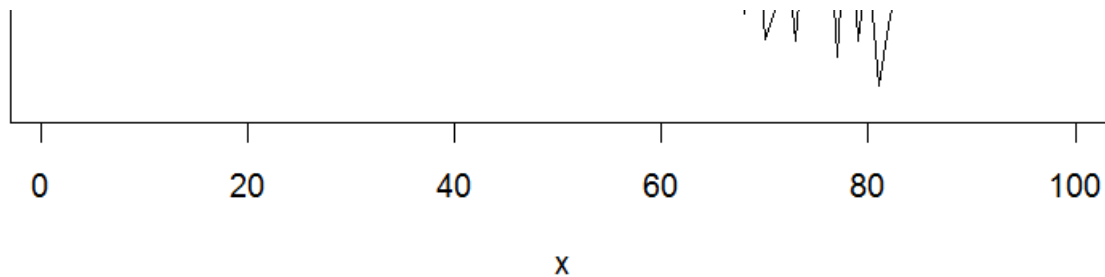




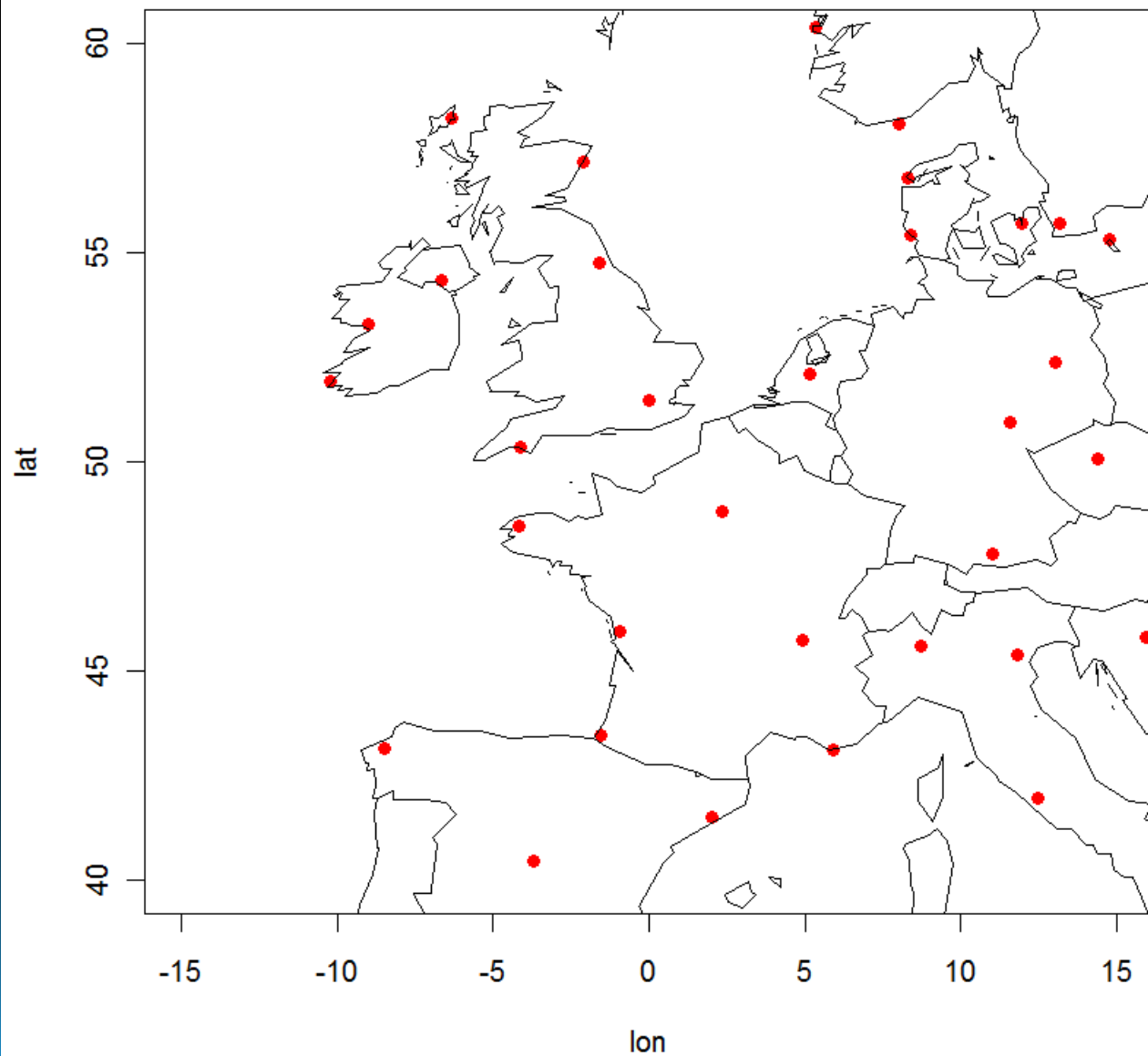


Simulations have no spatial autocorrelation

Can't use this method for analysing spatial extremes



EMULATE dataset

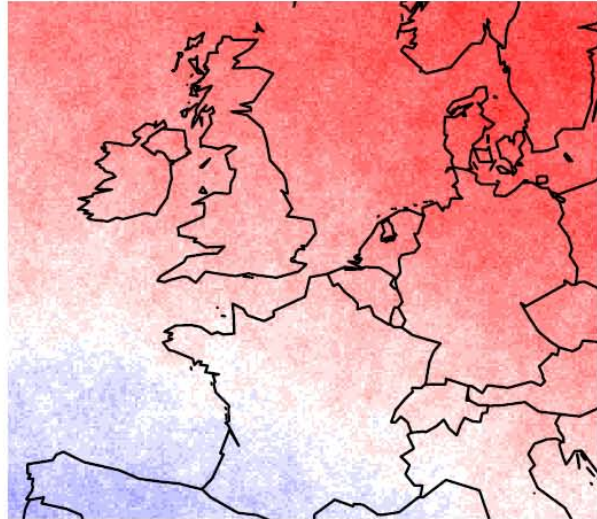


Sequential Gaussian Simulation

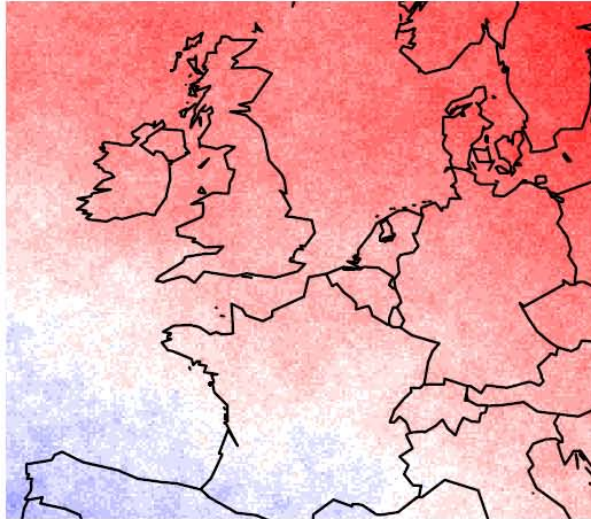
- Creates a set of possible realisations that honour the observations and the spatial correlation structure
- Gives individual simulations that look more realistic than the smoother best guess (mean).
- Performed by a random walk through the grid space, randomly drawing a value from the probabilistic interpolations
- Conditions successive randomisations on both observations and previously generated grid points

Storm Lothar 1999-12-26 (10km grid)

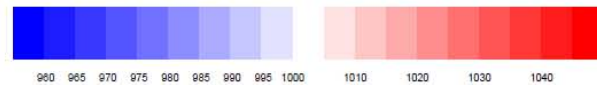
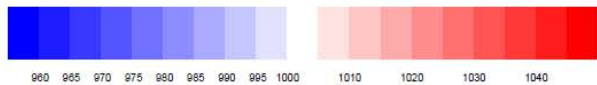
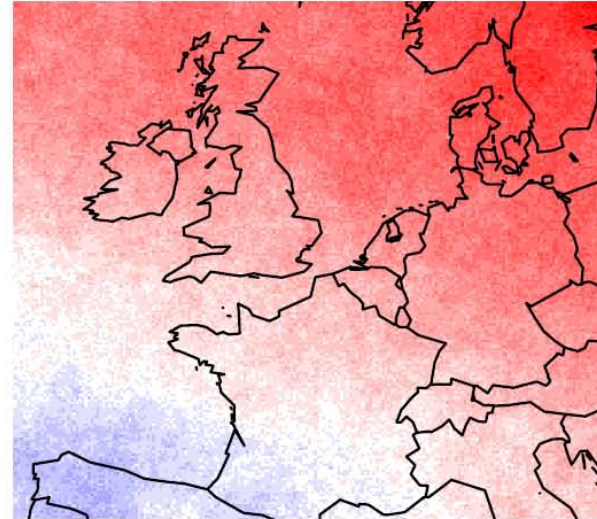
19991223 1



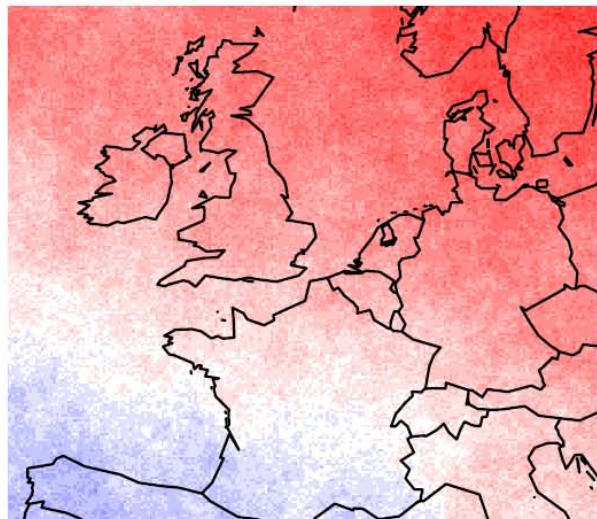
19991223 2



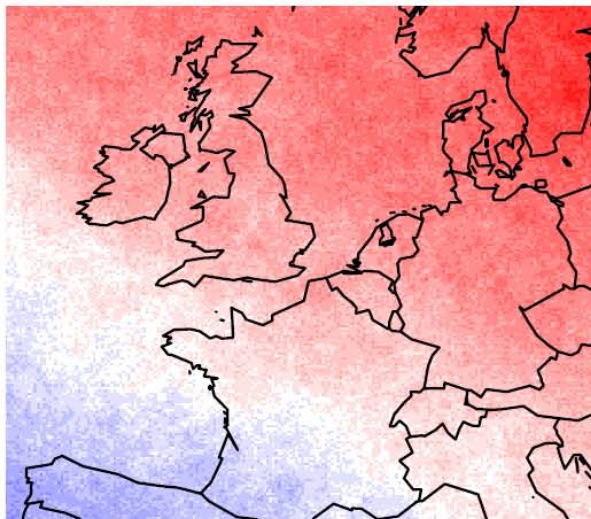
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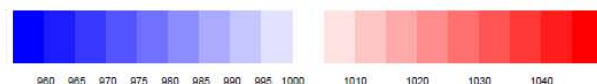
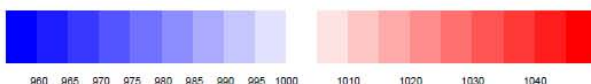
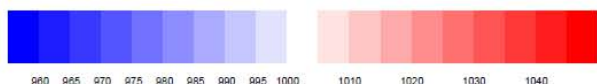
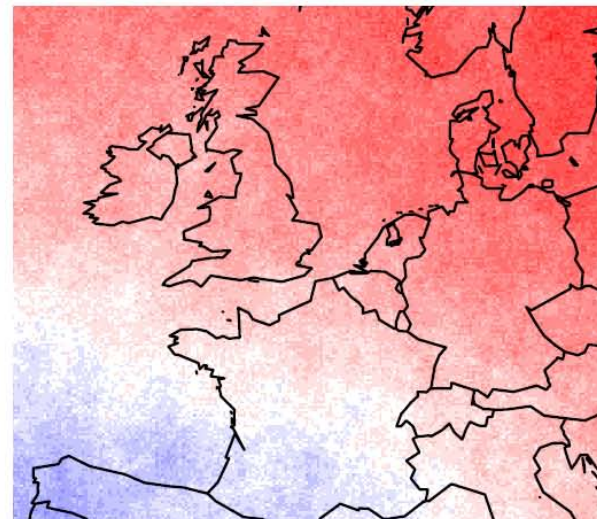
19991223 4



19991223 5



19991223 6

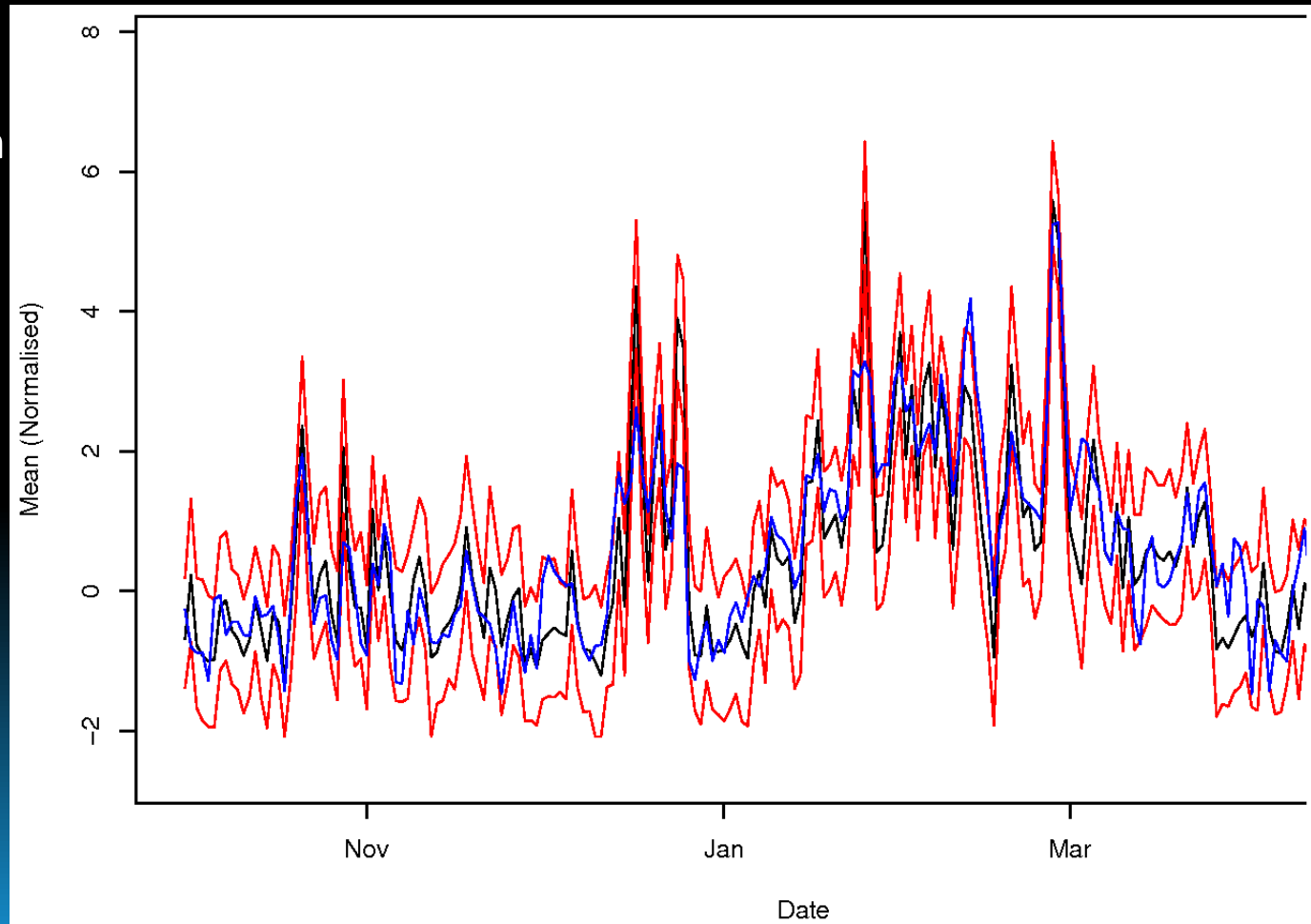


Extreme Wind Indices

- Use the sequential Gaussian simulation to generate 100 daily MSLP gridded fields from 1882-2000
- Calculate geostrophic wind speed
- Calculate EWI based on method in Della-Marta et al (2009)
 - Mean: Magnitude based
 - Q95: Magnitude based
 - Sw3q90: Magnitude based
 - Sfq95: Relative to local climatology
 - Sfq95q99: Relative to local climatology

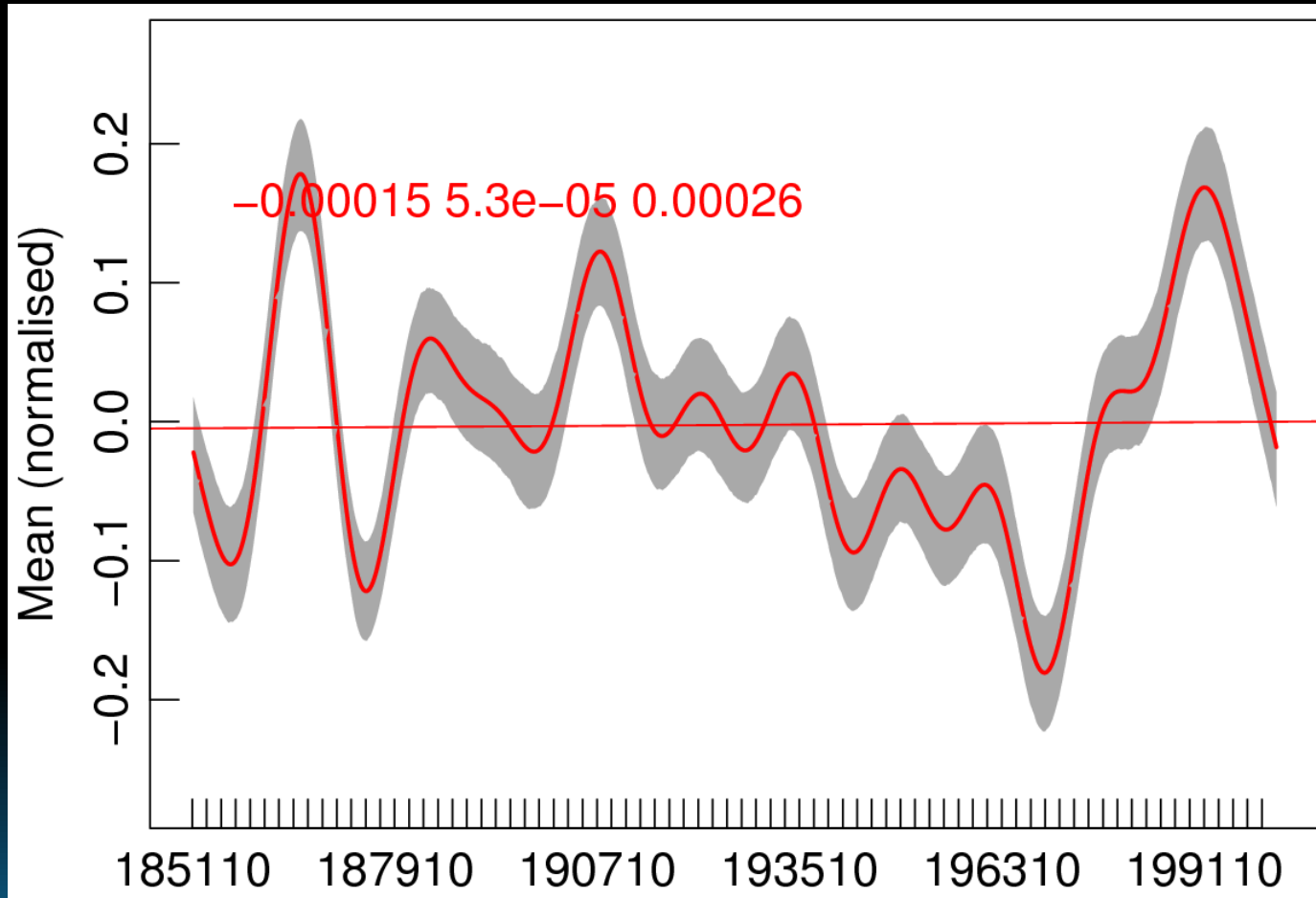
EWI example: October-April 1989/1990

- **Red:** 95% CI
- **Blue:** EMULATE (original)
- **Black:** Median of 100 simulations
- Daily variability of strongest storms captured within error
- Well documented storms identified



Decadal storminess 1882-2000

- Decadal smoothed
- Grey: 95%CI, Daily error propagated to decadal scale
- Some evidence of a positive trend (not considering recent years)
- Variability well captured within CI



Uncertainty reflects changing network

