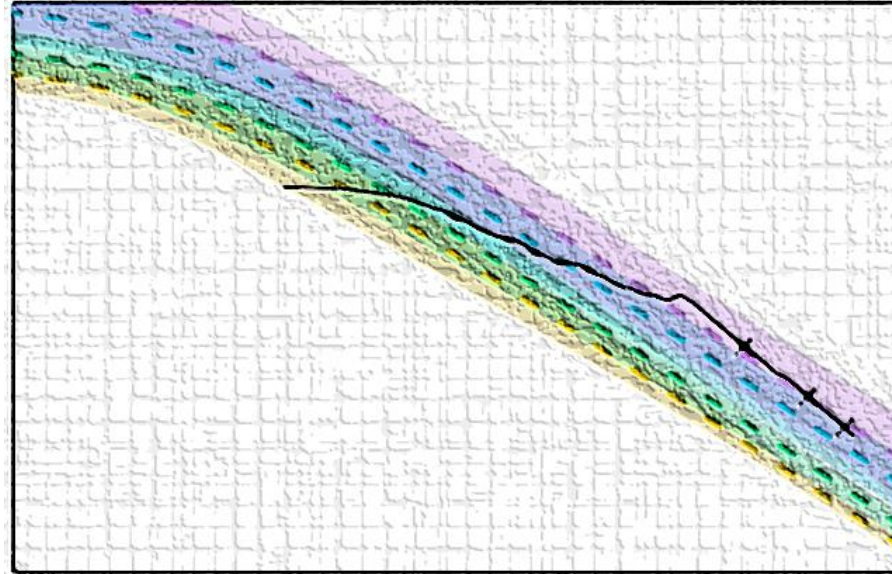


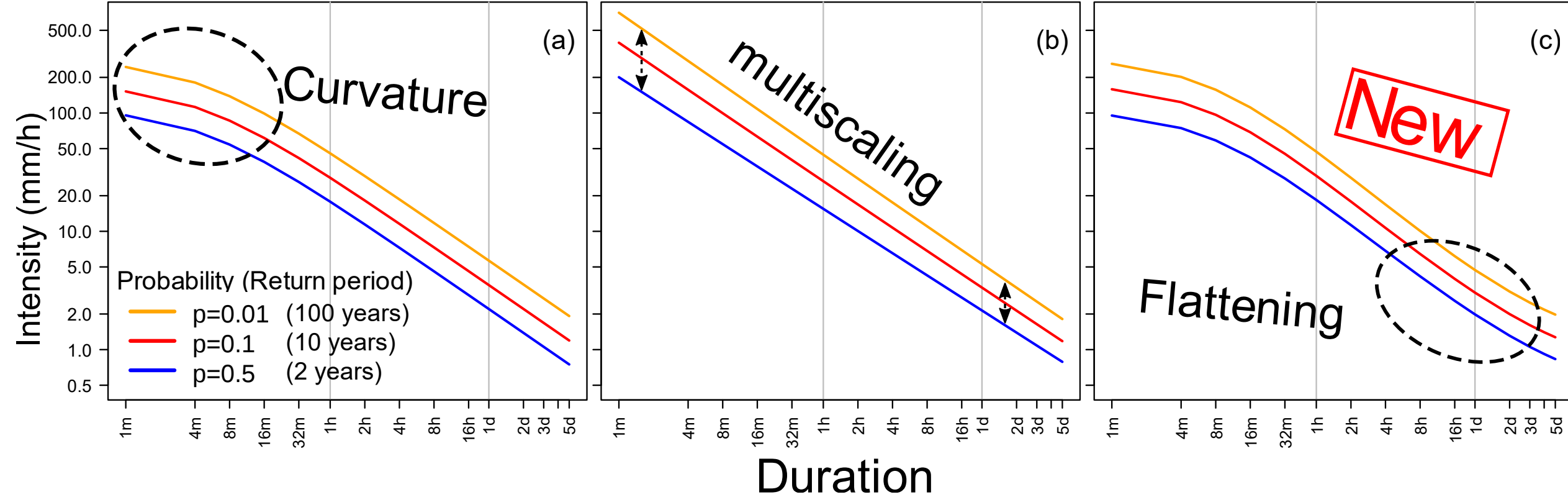
Modeling Precipitation Extremes Large Scale Influence



Intensity
Duration
Frequency

Felix Fauer, Jana Ulrich, Henning Rust

Features of IDF Curves



→ [Koutsoyiannis et al., 1998](#)

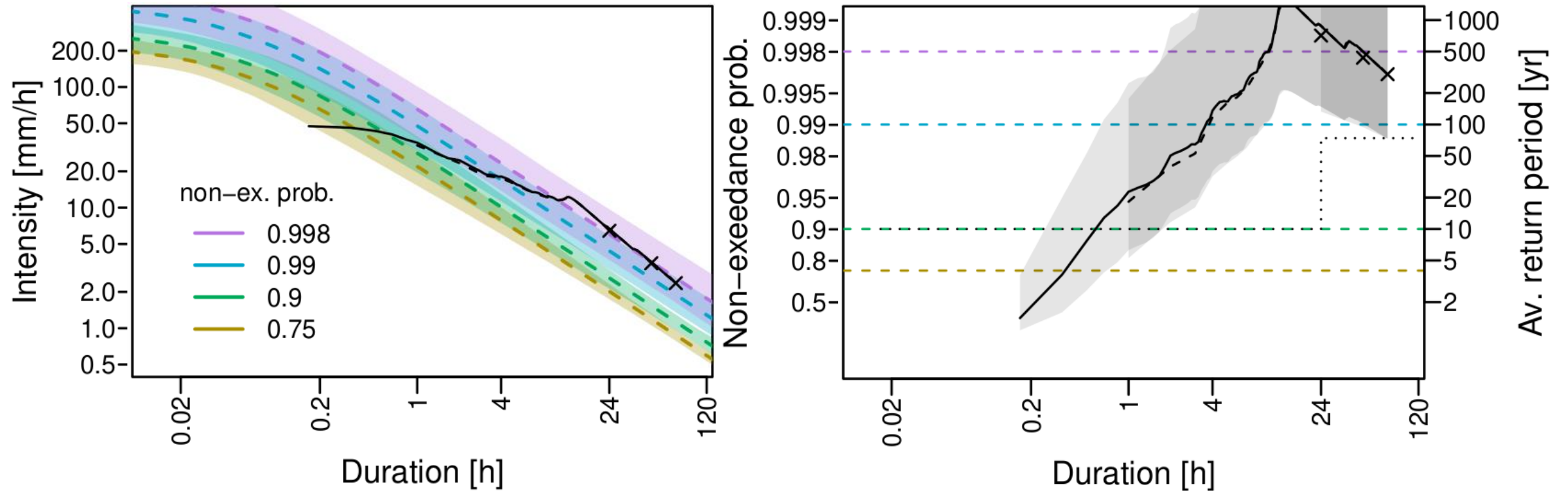
→ [Gupta and Waymire, 1990](#)

→ [Fauer et al., 2021](#)

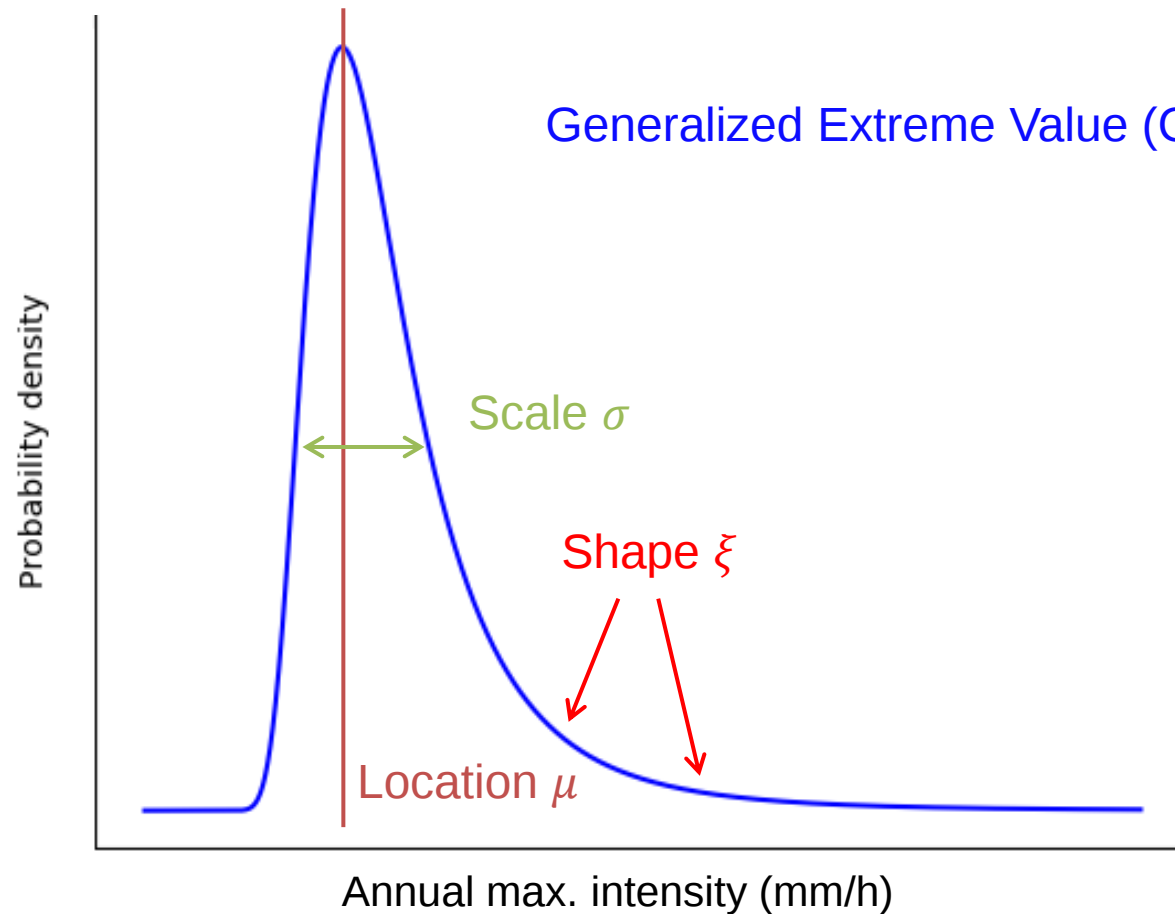
→ [Ulrich et al., 2021](#)

Precipitation Event Köln-Stammheim 14.07.2021

IDF Curve



Distribution of annual maxima:

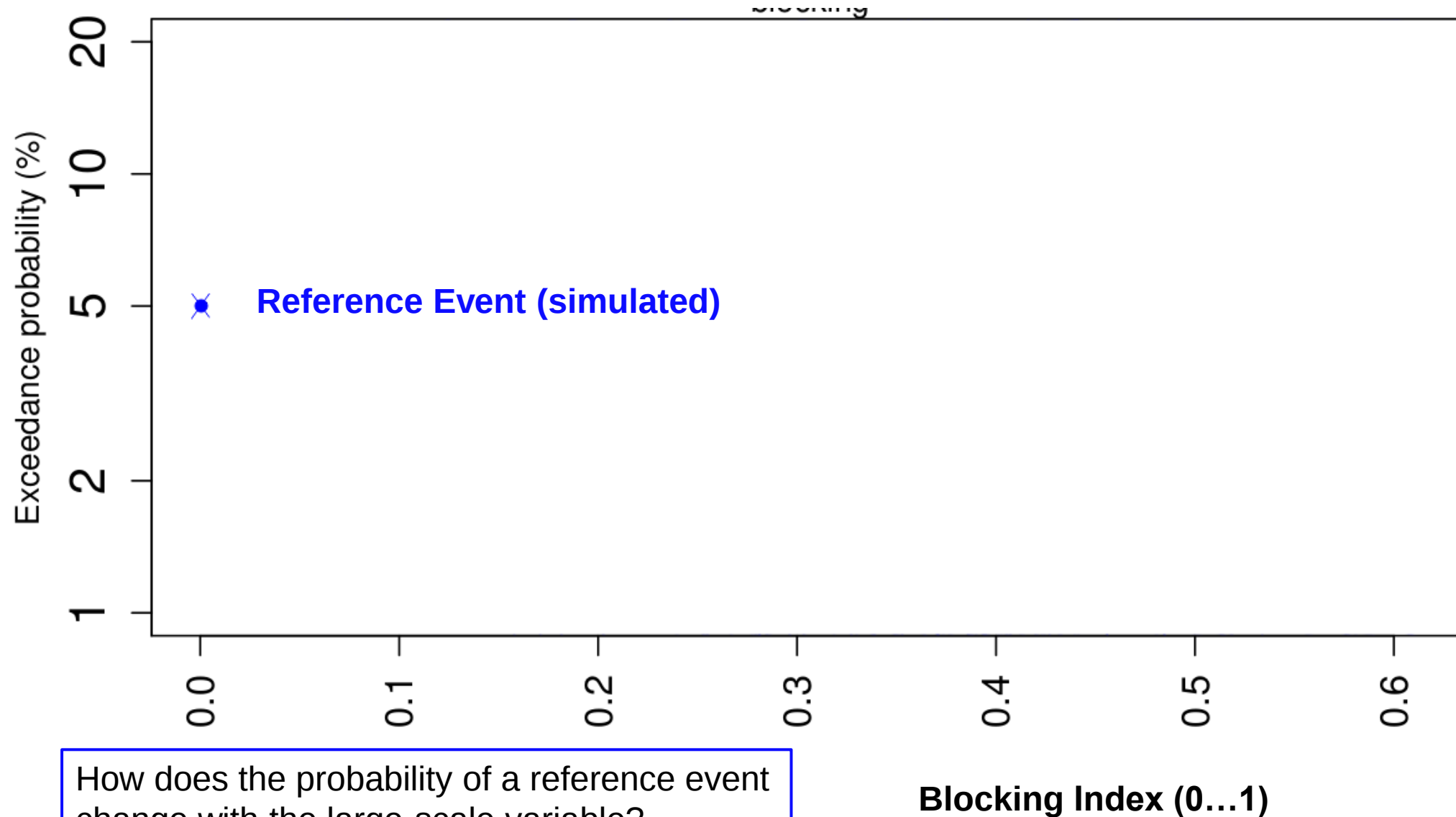


Dependence on:

$$\mu = \mu(d, x_1, x_2, \dots)$$

- d ... duration (time scale)
- x_i ... NAO, blocking, mean temperature year

Location μ
Scale σ
Shape ξ

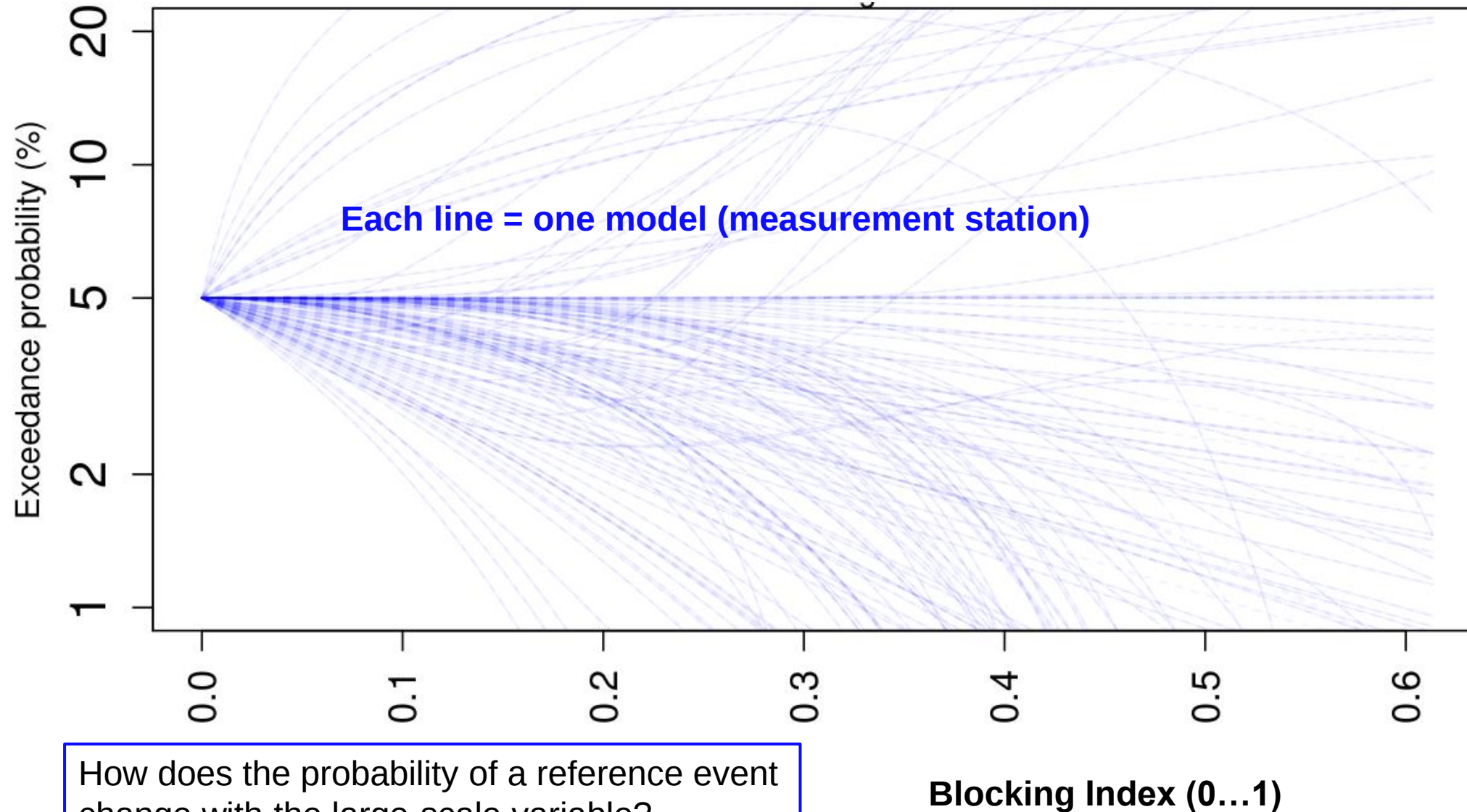


Reference:

- $prob = 5\%$
- $blocking = 0$

How does the probability of a reference event change with the large-scale variable?

Simulated Probability Change

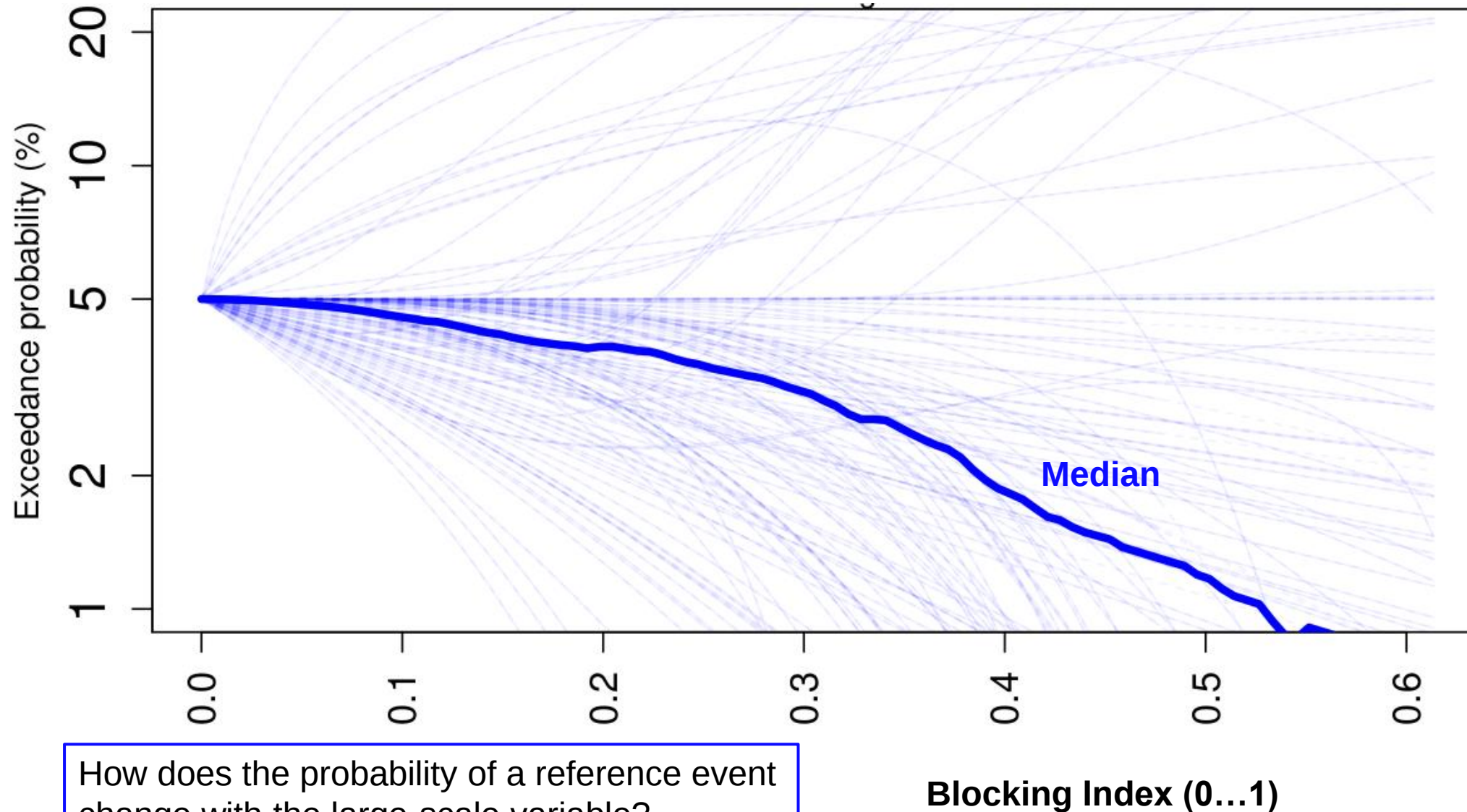


Reference:

- $prob = 5\%$
- $blocking = 0$

— DJF

How does the probability of a reference event change with the large-scale variable?



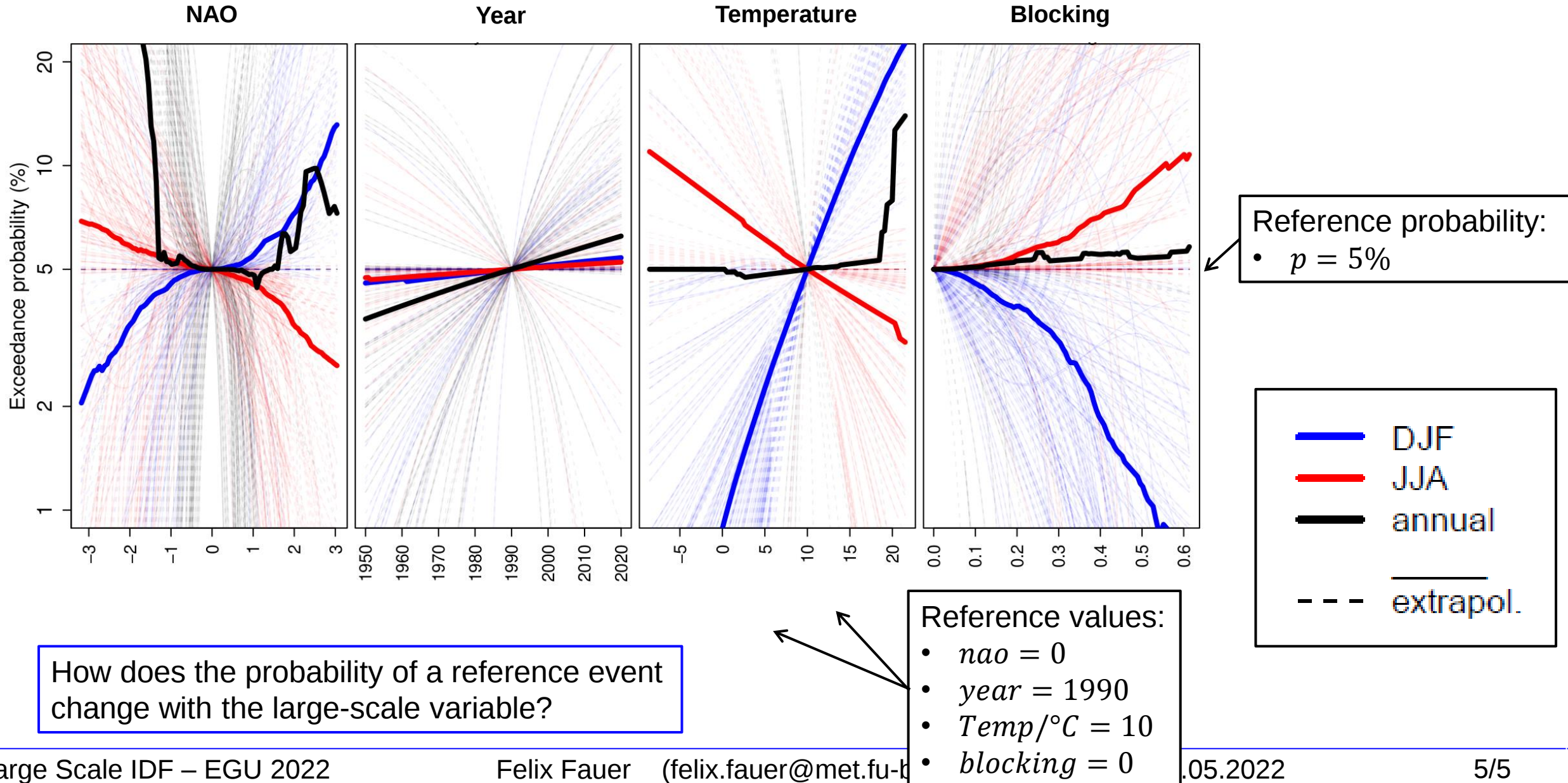
Reference:

- $prob = 5\%$
- $blocking = 0$

— DJF

How does the probability of a reference event change with the large-scale variable?

Simulated Probability Change



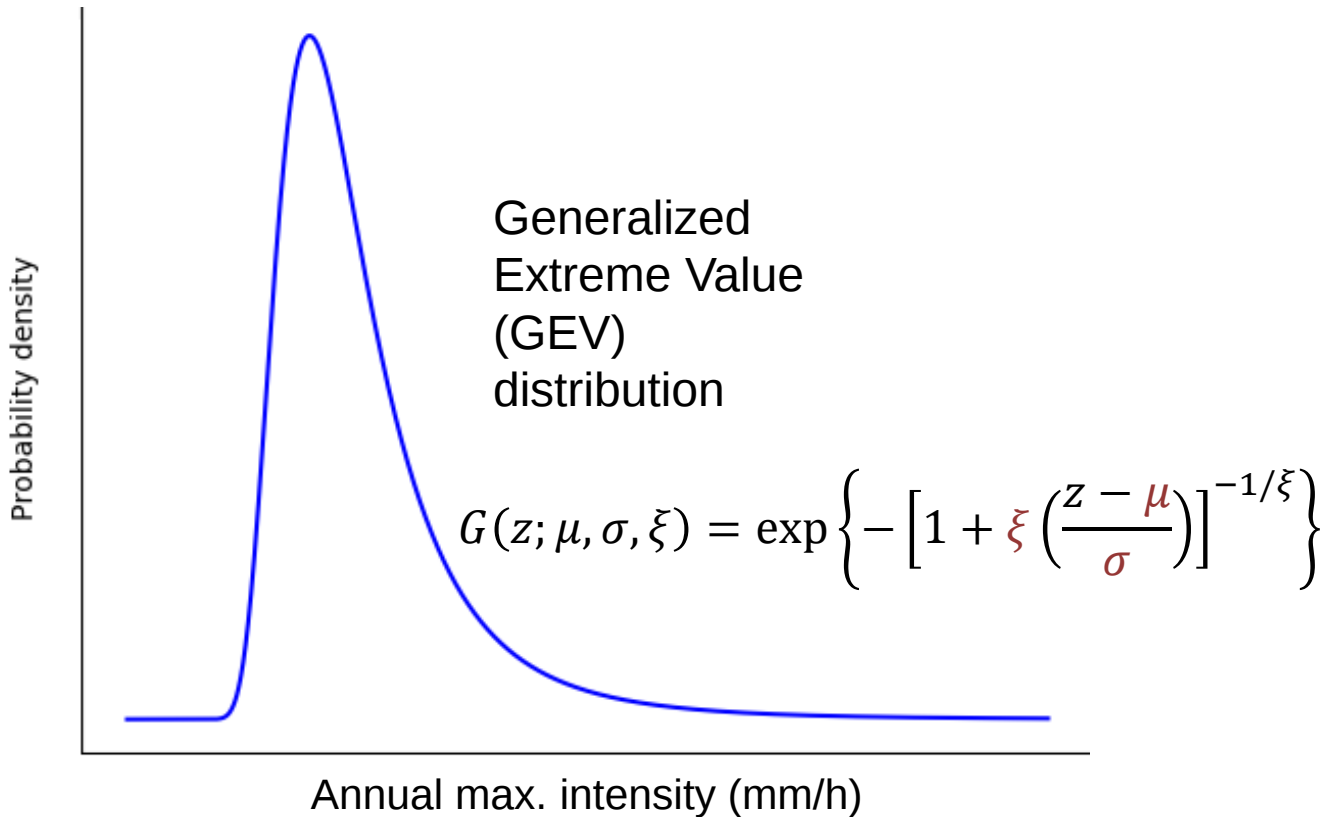
Appendix

Precipitation

Location	199 stations in North-Rhine-Westphalia
Measurement frequency	• minute • hour • day
Time range	1950-2018

Large-Scale

Variable	Notes
NAO	NOAA, 1950-2020, PCA-based
Blocking	IFS-era5, 1950-2020, area mean over SCA
Temperature (TAS)	era5, 1950-2020
Year	



(scale) σ
(location) μ
(shape) ξ

Dependence on:

- Time scale (accumulation duration)
 - Large scale variables
 - NAO
 - Blocking
 - Mean Temperature
 - year
- monthly / annual average

$$G(z; \mu, \sigma, \xi) = \exp \left\{ - \left[1 + \xi \left(\frac{z - \mu}{\sigma} \right) \right]^{-1/\xi} \right\}$$

(scale) $\sigma(d) = \sigma_0 (d + \theta)^{-\eta_1} + \tau$

(location) $\mu(d) = \tilde{\mu} (\sigma_0 (d + \theta)^{-(\eta_1 + \eta_2)} + \tau$

(shape) $\xi(d) = \xi \text{ (const.)}$

new:

d : duration

θ : duration offset (curvature)

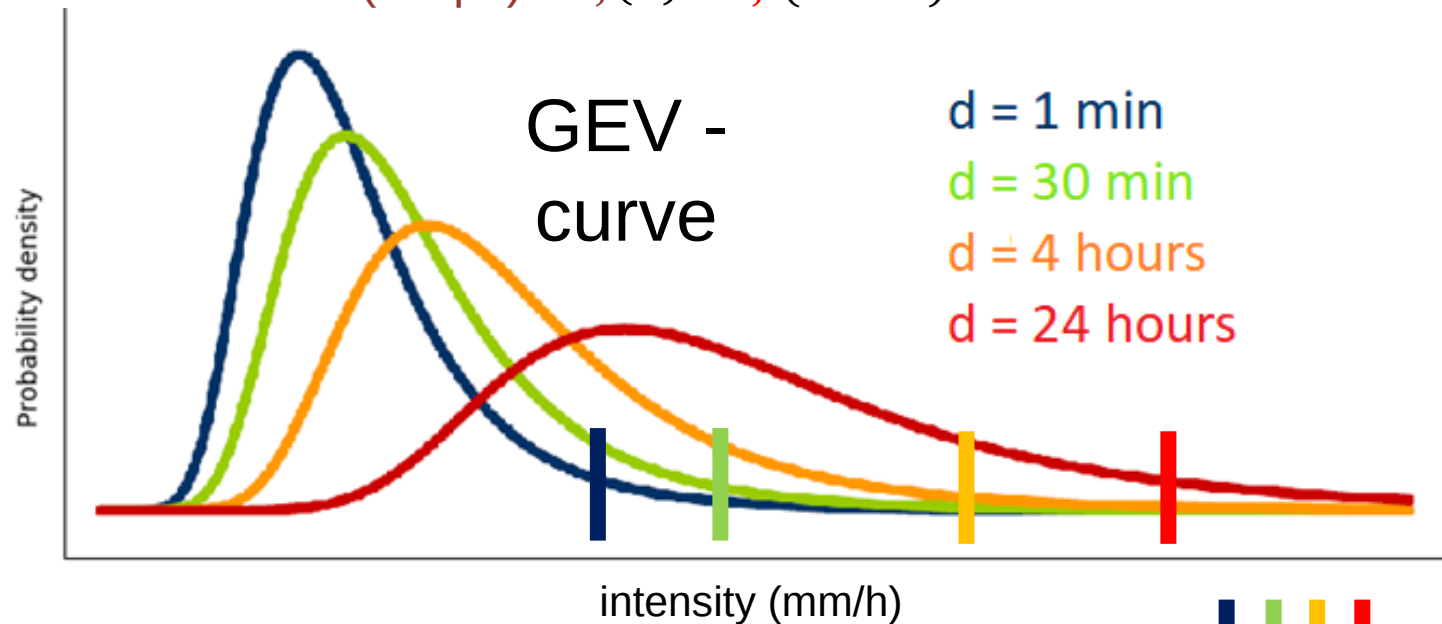
η_1 : duration exponent (first slope)

η_2 : 2nd duration exponent (multiscaling)

τ : intensity offset (flattening)

σ_0 : scale offset

$\tilde{\mu}$: rescaled location



→ Koutsoyiannis et al., 1998
→ Gupta and Waymire, 1990
→ Fauer et al., 2021

 quantiles for different durations