Identification and modeling of non-stationary tendencies in extreme rainfall

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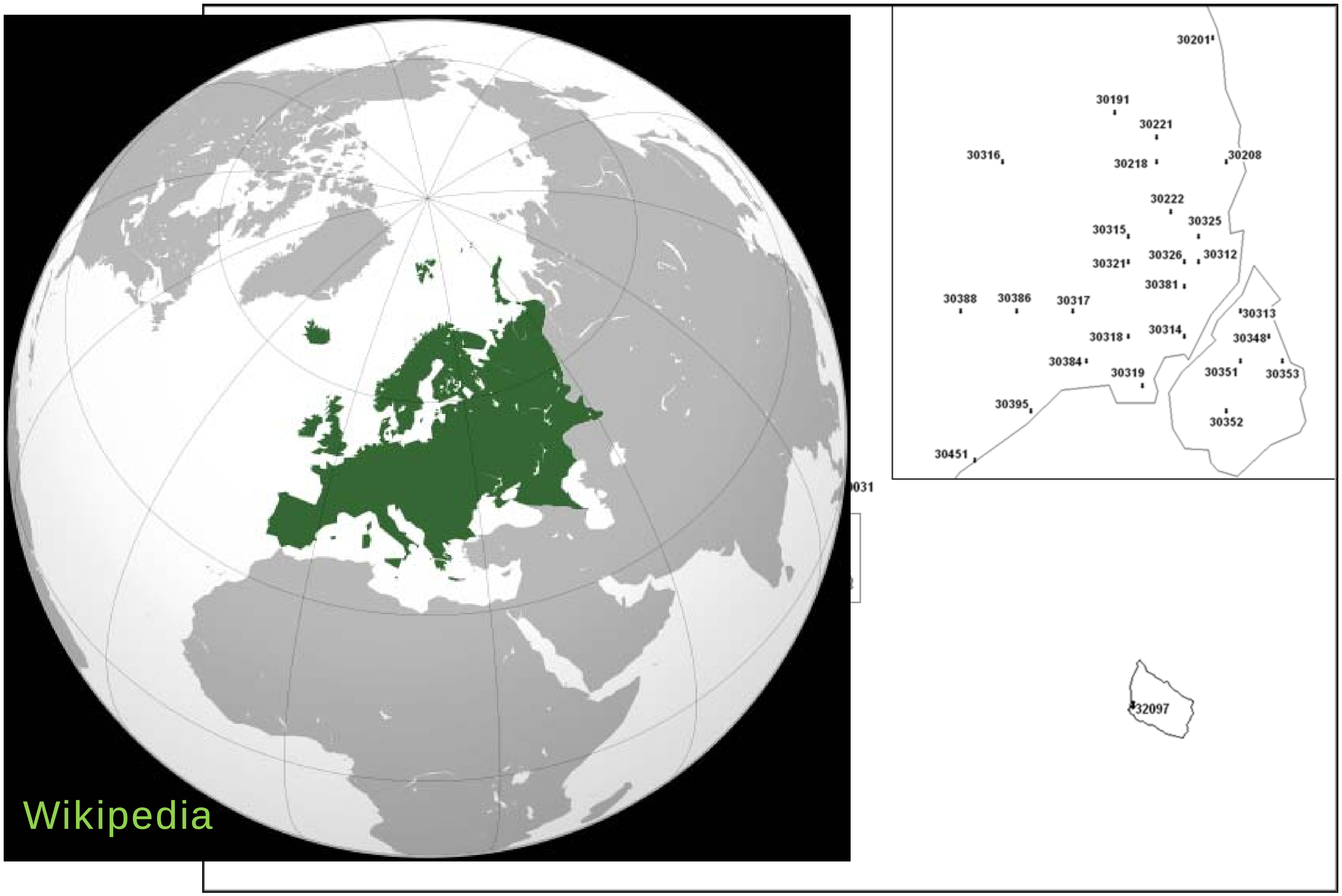
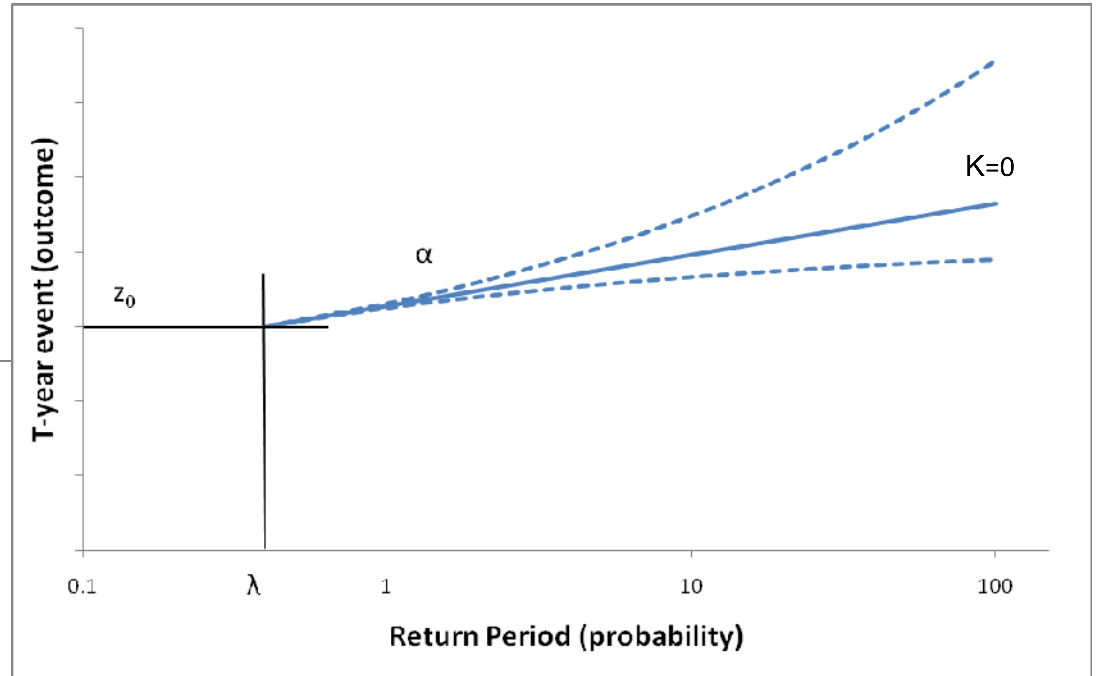
Content

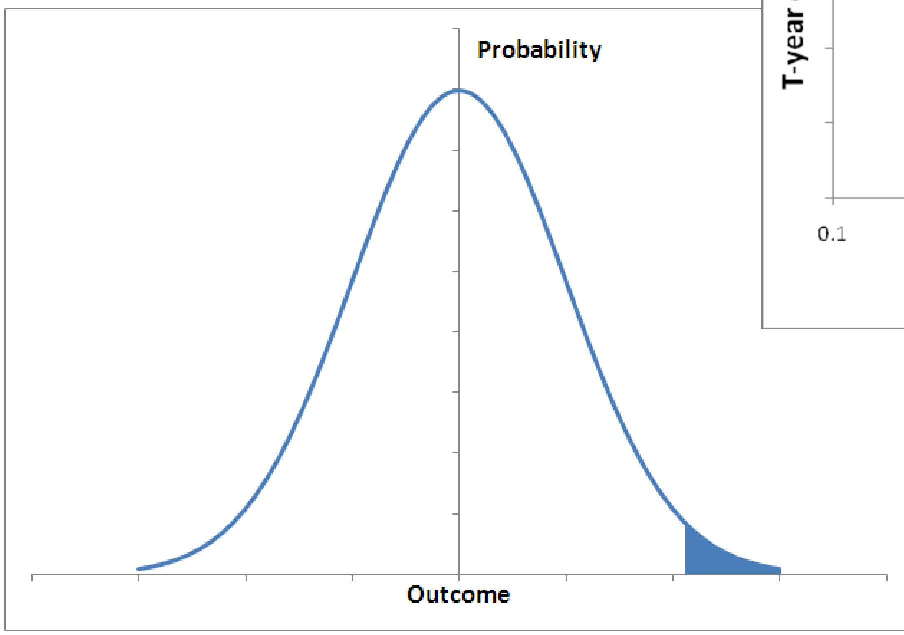
- Data
- Model framework and previous studies
- Temporal development of the extreme rainfall
  - The annual no. of extreme events
  - The α and κ in the Generalized Pareto Distribution
- Conclusion

31 years of observed rainfall from high resolution rain gauges



Model framework





T-year event:

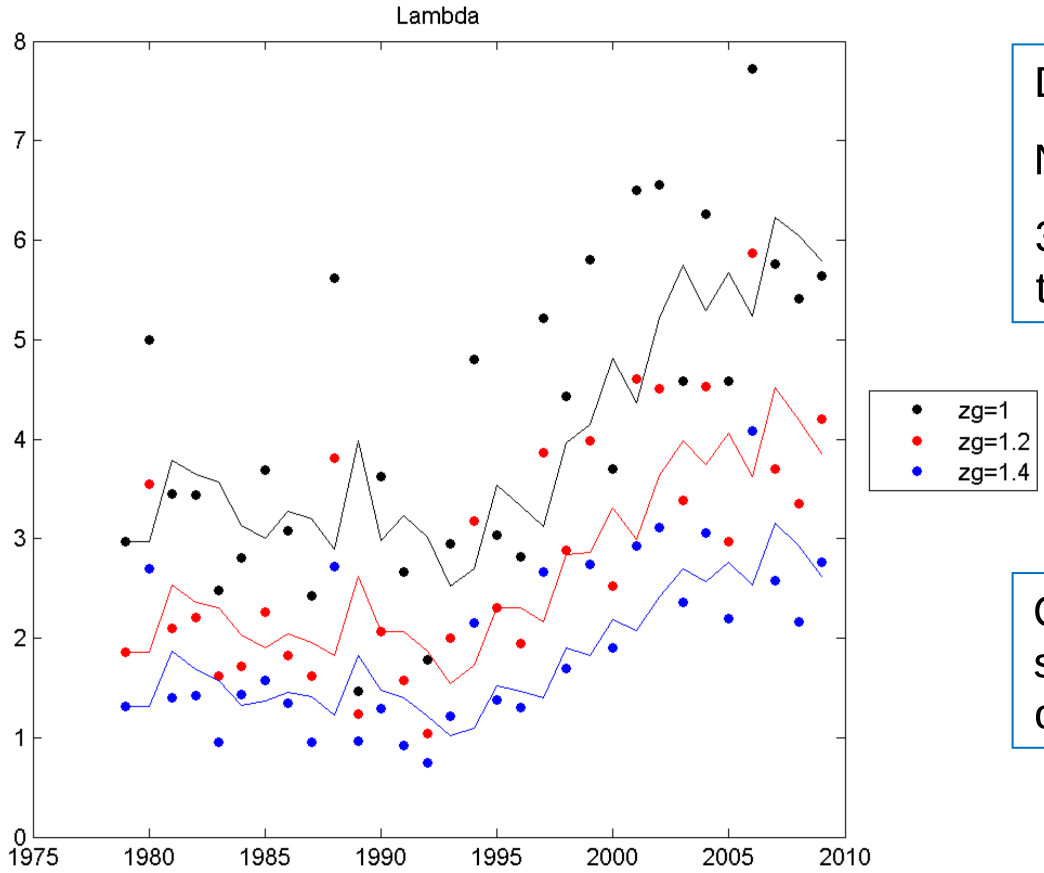
An event that happens on average every T-year (rainfall intensity [μm/s])

T = Return Period

A regional model of extreme rainfall

- Spatial variations of GP-parameters
- Assumes stationarity
- Rainfall duration 1 min – 24 hours
- Model applied in urban drainage design today
- An incorrectly dimension of the drainage system is critical

Temporal variation of λ



Duration 10 min

Non-stationary

30 years is a short time window

Changes in the slope as a function of z0 ?

Modelling variations of λ

$$\frac{N_{ij}}{t_{ij}} = \phi + \varphi \cdot year_i + \tau \cdot NAO_i + \gamma \cdot MAP_j + \upsilon \cdot latitude_j + \varepsilon_{ij}$$

i=1…31 (temporal variable, number of years)

j=1…70 (spatial variable, number of stations)

N= number of extreme events (a count)

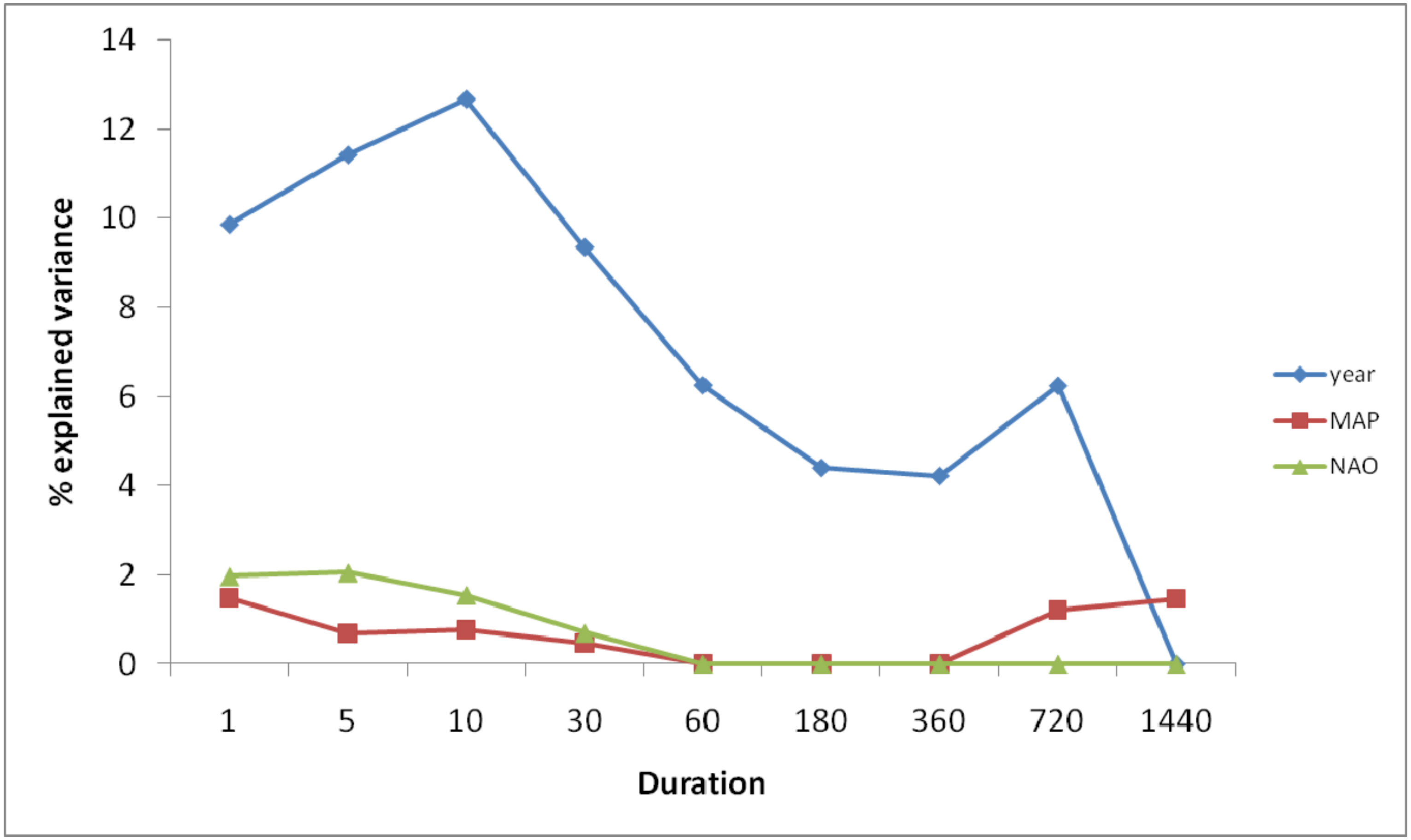
t= active measurement period

λ =N/t

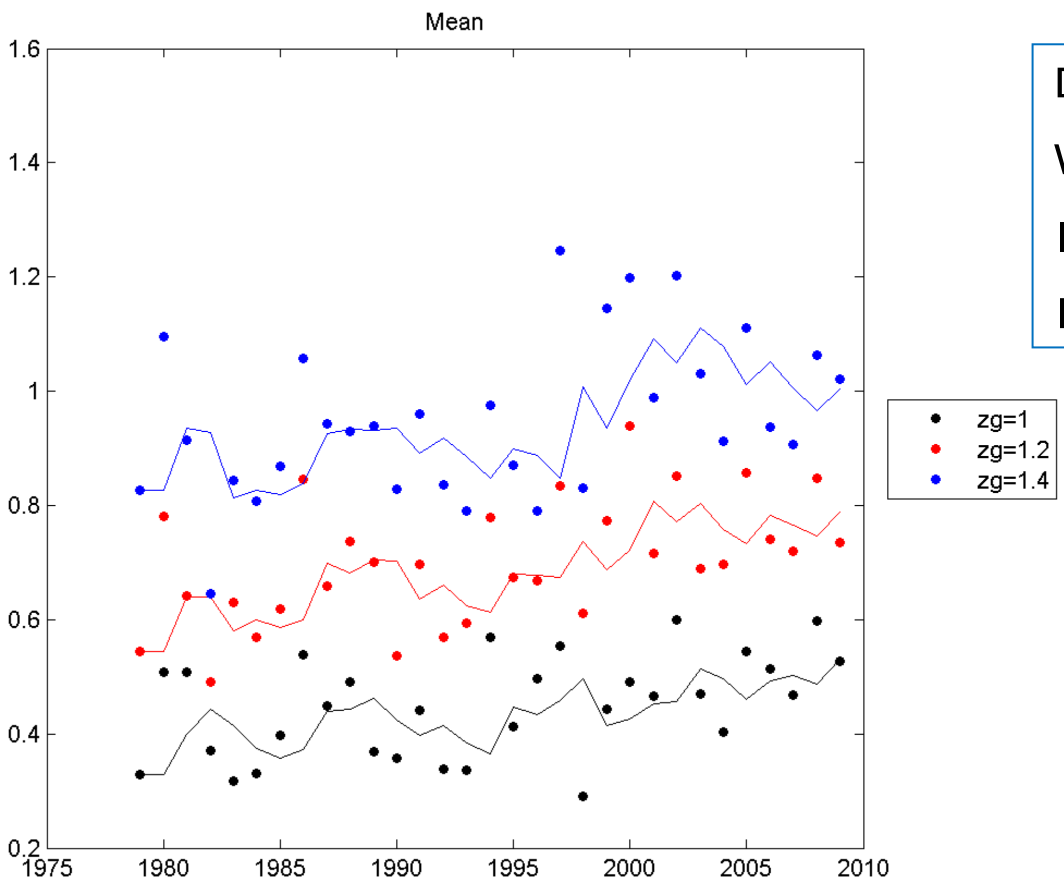
Be aware of:

- Correlations between rain gauge stations
- Correlations between the explanatory variables

Variations in λ – sensitivity analysis



Variations in α and κ



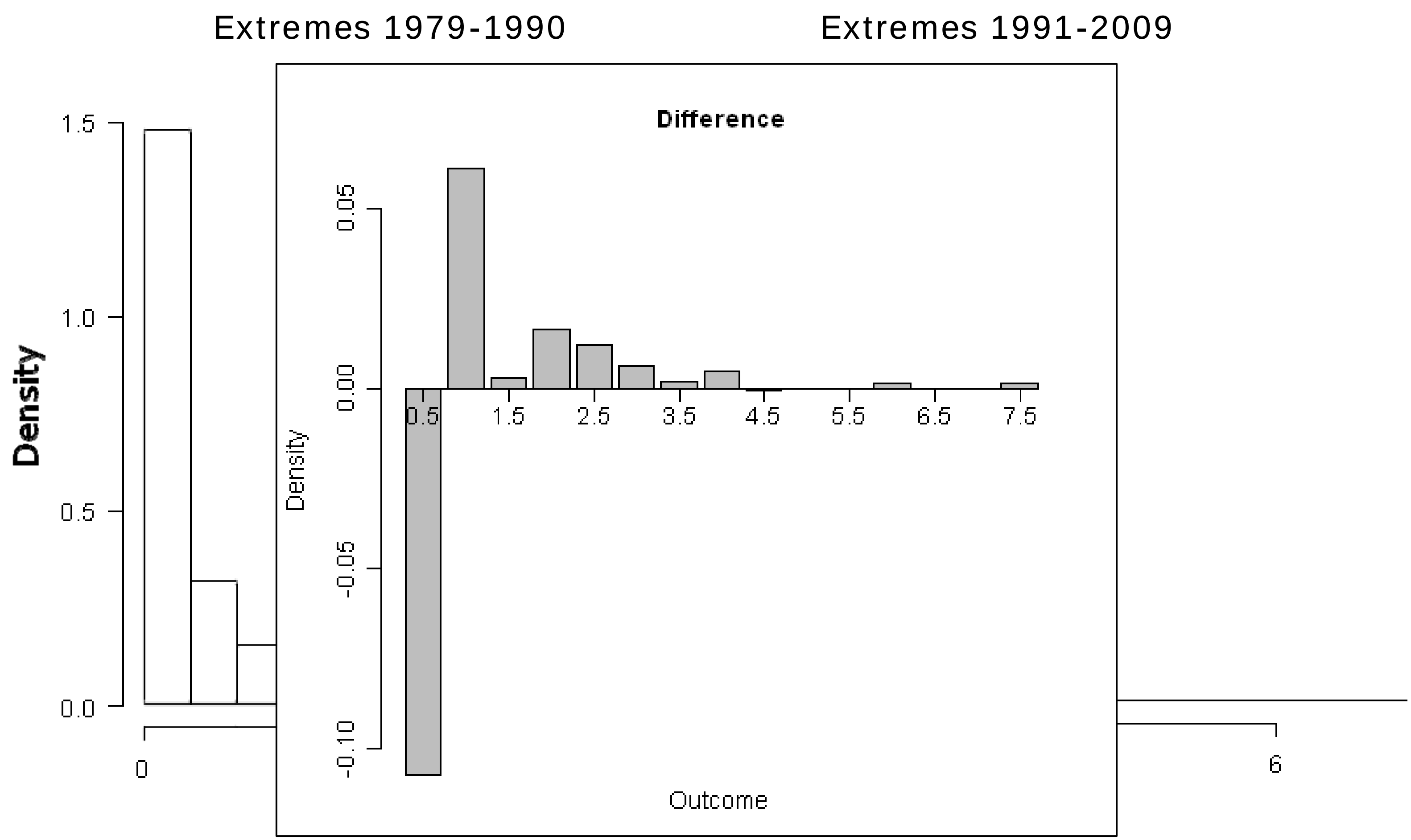
Duration 180 min

Weak non-stationarity

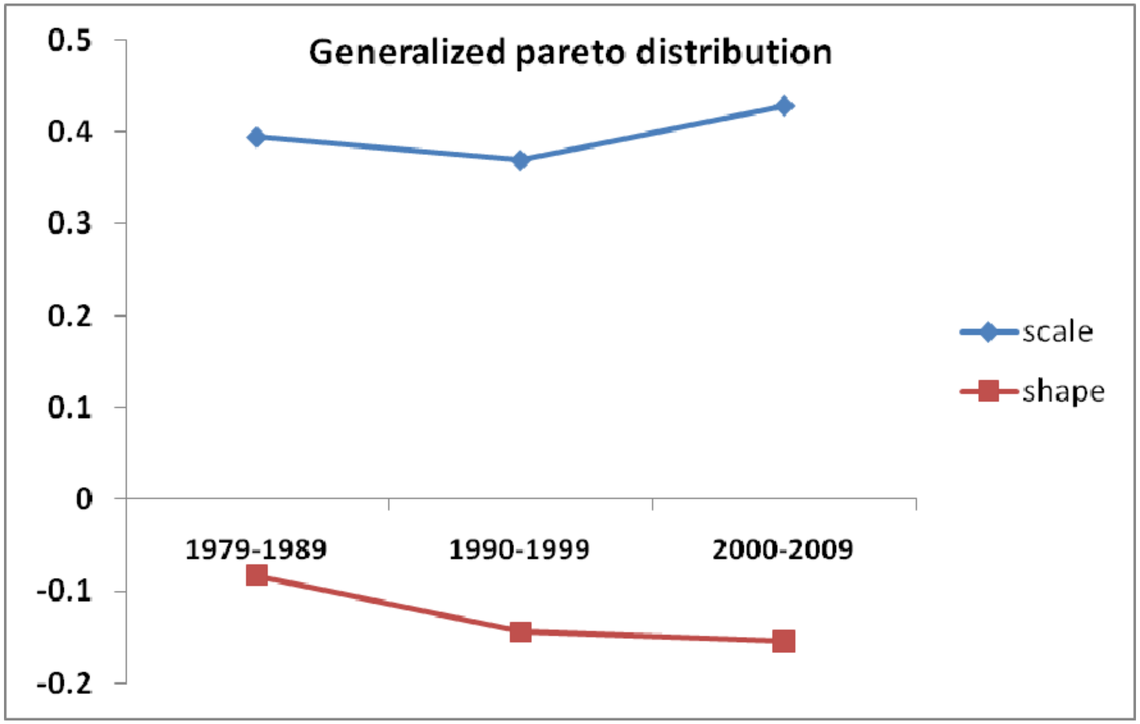
Increasing z0 →

Increase of slope

Variations in α and κ



Variations in α and κ



Duration 180 min

Based on few data

Increase in scale

Decrease in shape

How to get a better understanding of the changes in α and κ?

$$F_t(x) = F(\theta_t, x)$$

$$F_t(x) = \alpha F_1(\psi, x) + (1-\alpha) F_2(\theta_t, x)$$

$$F_t(x) = \alpha_t F_1(\psi, x) + (1-\alpha_t) F_2(\theta, x)$$

$F_1(x)$ Exponential distribution ?

$F_2(x)$ Log-normal distribution ?

Summary and conclusion

- The extreme rainfall is non-stationarity
- When *z0* increase we see a tendency towards:
  - Decreasing slopes for the temporal development of λ
  - Increasing slopes for the temporal development of μ
- Difference for different rainfall durations
  - development of λ most clear for 1–60 min
  - development of μ most clear for 60–720 min
- κ becomes more negative
- Outlook: Possibility for comparison with transient climate simulations