Discussion of 'Water Extremes'

Anthony Davison

http://stat.epfl.ch

Funded by the Swiss National Science Foundation

Classical paradigm

- Max-stability

$$H^m(b_m + a_m x) = H(x), \quad x \in \mathbb{R}, \tag{1}$$

leads to the generalized extreme-value distribution (GEV)

$$H(y) = \begin{cases} \exp\left[-\{1+\xi(y-\eta)/\tau\}_+^{-1/\xi}\right], & \xi \neq 0, \\ \exp\left[-\exp\{-(y-\eta)/\tau\}\right], & \xi = 0, \end{cases} \tag{2}$$

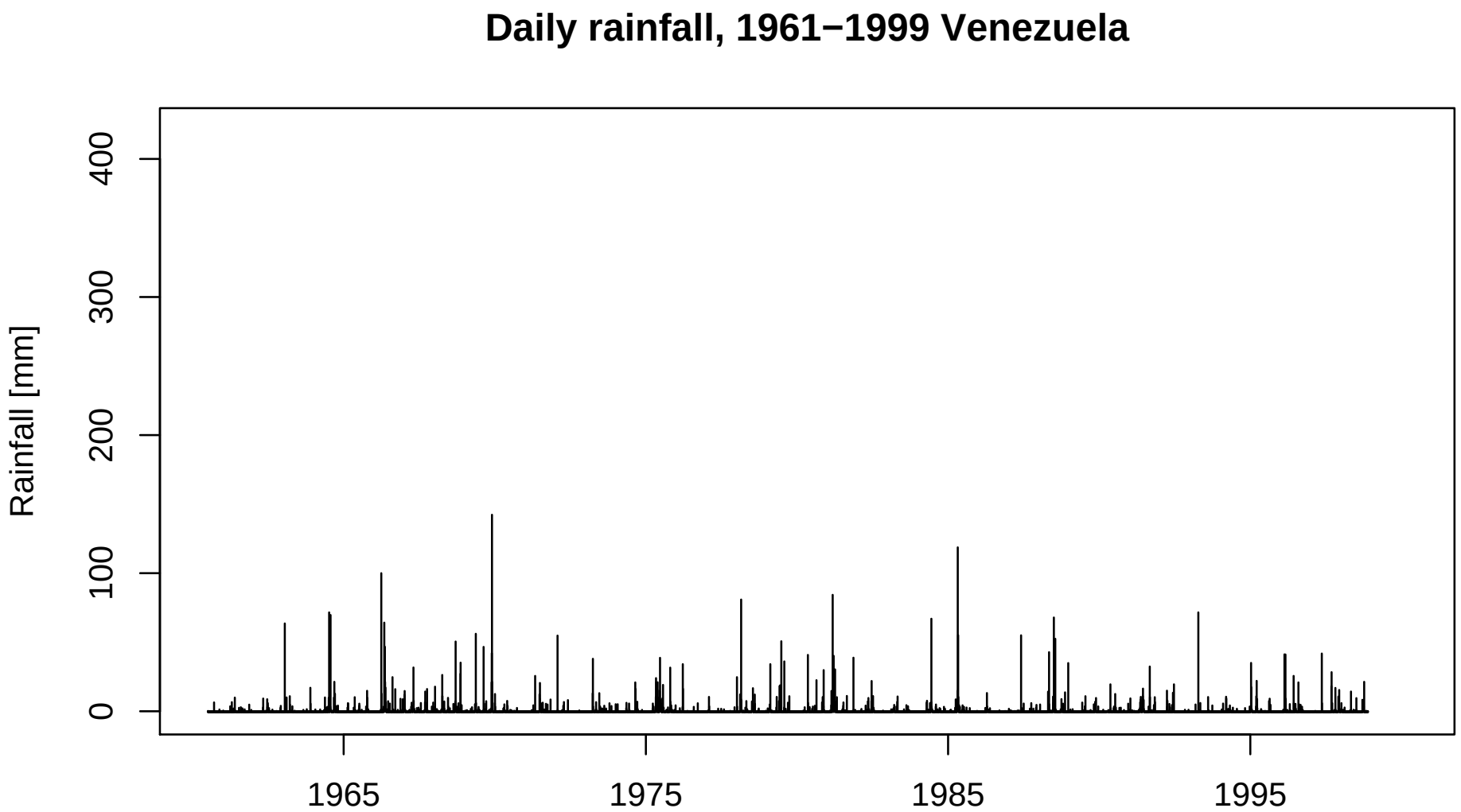
with analogous limits arising for exceedances of high thresholds (GPD) and multivariate/functional settings

- The shape parameter ξ is key

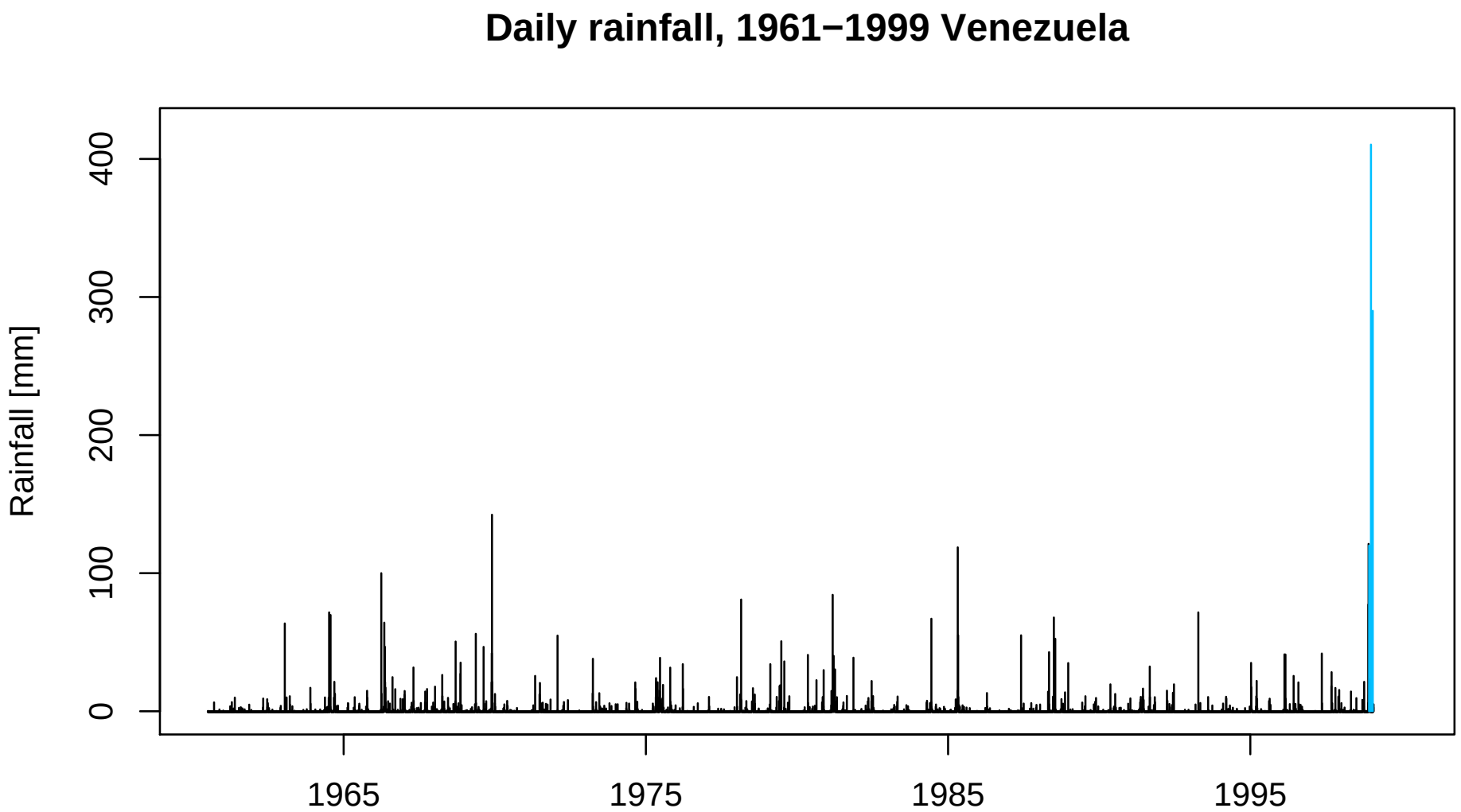
Some issues

- Large uncertainty
  - should be honest about this, and not attempt to minimise it, e.g. by setting $\xi = 0$ (D&F)
  - pooling of information—through covariates (C), hierarchical models (C), multivariate modelling (C, K)
- Does a limiting distribution **really** exist?
- Models derived from the classical paradigm (C, K)—but how far can we go?
- Regime change—'black swans' and 'dragon kings'
  - mixtures and Maiquetia
  - climate patterns as explanatory variables

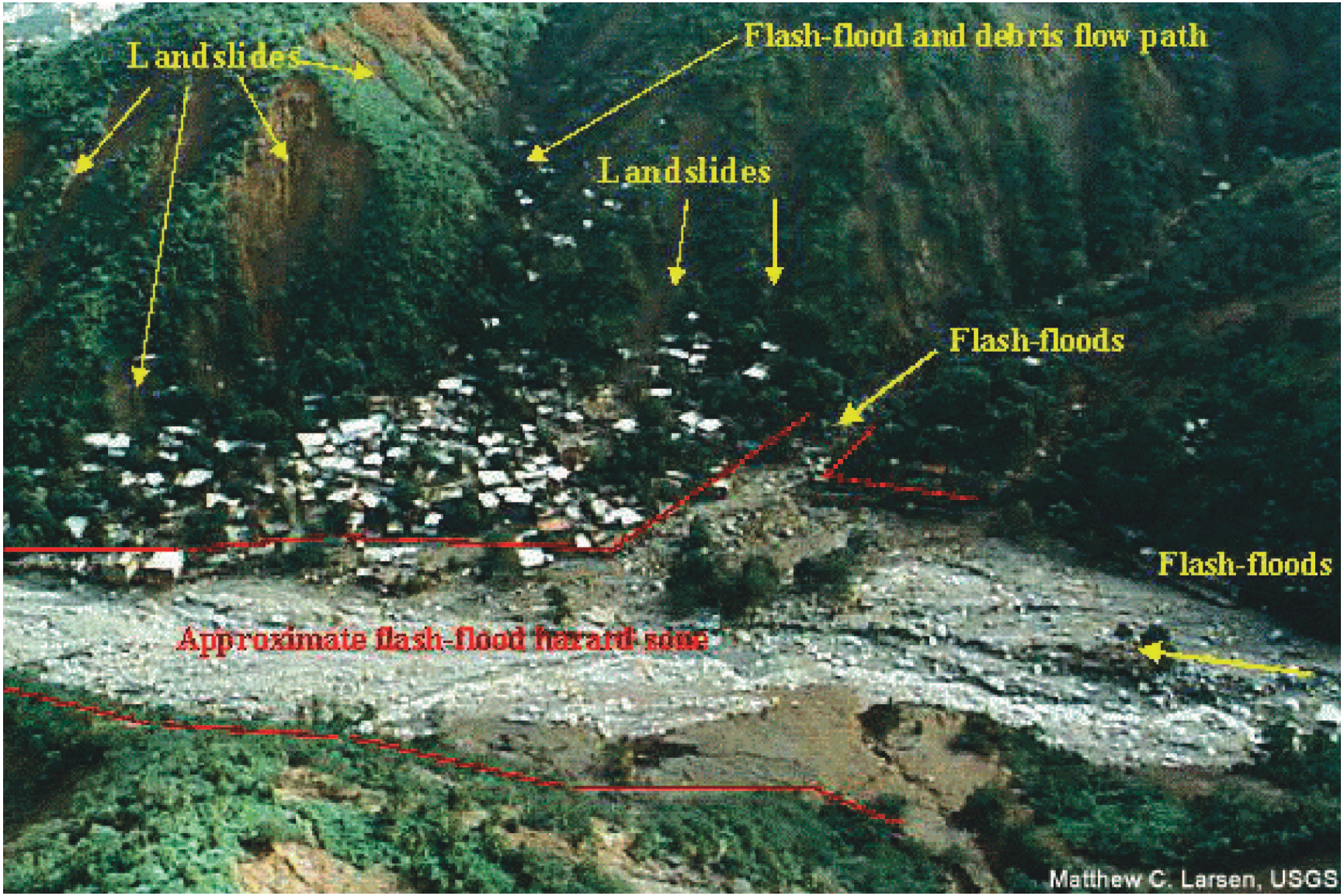
Rainfall at Maiquetia



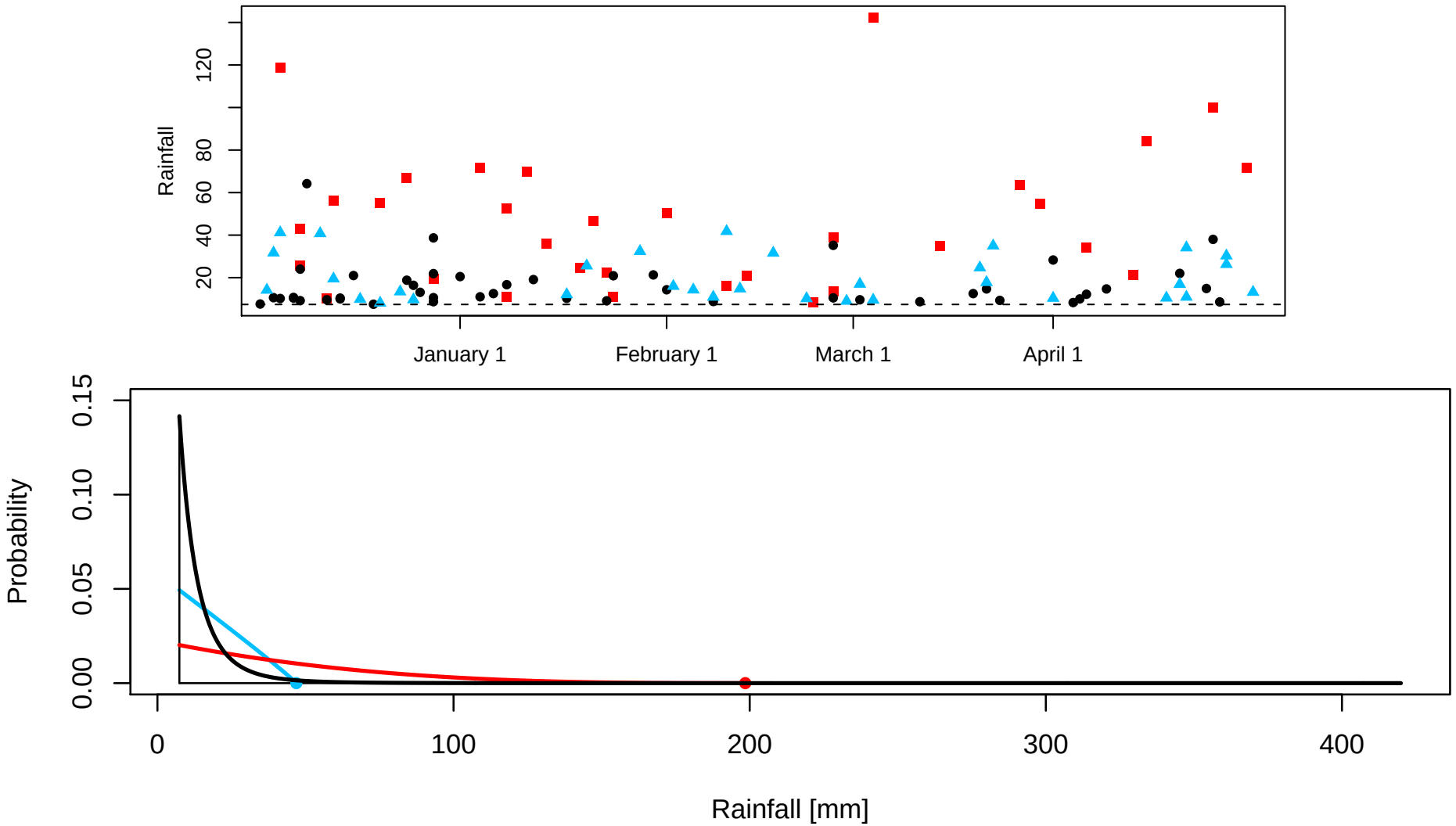
Rainfall at Maiquetia



Tanaguarena



Analysis of clusters of rare events suggests a mixture of three GPDs:



Some more issues

- Data quality—the information in the tail, robustness, measurement error and ad hockery (K)
- Physical models
  - RCMs don't capture extremes well—calibrate to observations? Up- and down-scaling! (C, D&F)
  - computer modelling of extremes of physical systems
- Inappropriate application of 'vanilla' analysis
  - trend, dependence due to downscaling (D&F)
  - need for spatial analysis, for realistic uncertainty estimation (C)
  - statisticians have not kept up with needs of applications
- Near-independence (K)
- Space-time (C, D&F, K)