UNIVERSITEIT GENT

IMPROVING EXTREME VALUE BEHAVIOUR OF FINE-SCALE STOCHASTIC POINT PROCESS MODELS

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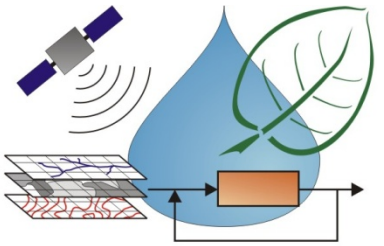

LHWM

LABORATORY OF HYDROLOGY AND WATER MANAGEMENT

KATHOLIEKE UNIVERSITEIT LEUVEN

3RD STAHY International Workshop on Statistical Methods for Hydrology and Water Resources Management

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FINE-SCALE STOCHASTIC POINT PROCESS MODELS

- Simulation of continuous rainfall time series
  - Extreme values!
- Focus on Bartlett-Lewis rectangular pulses models
  - Good general historical statistics
  - Issues with extreme value behaviour

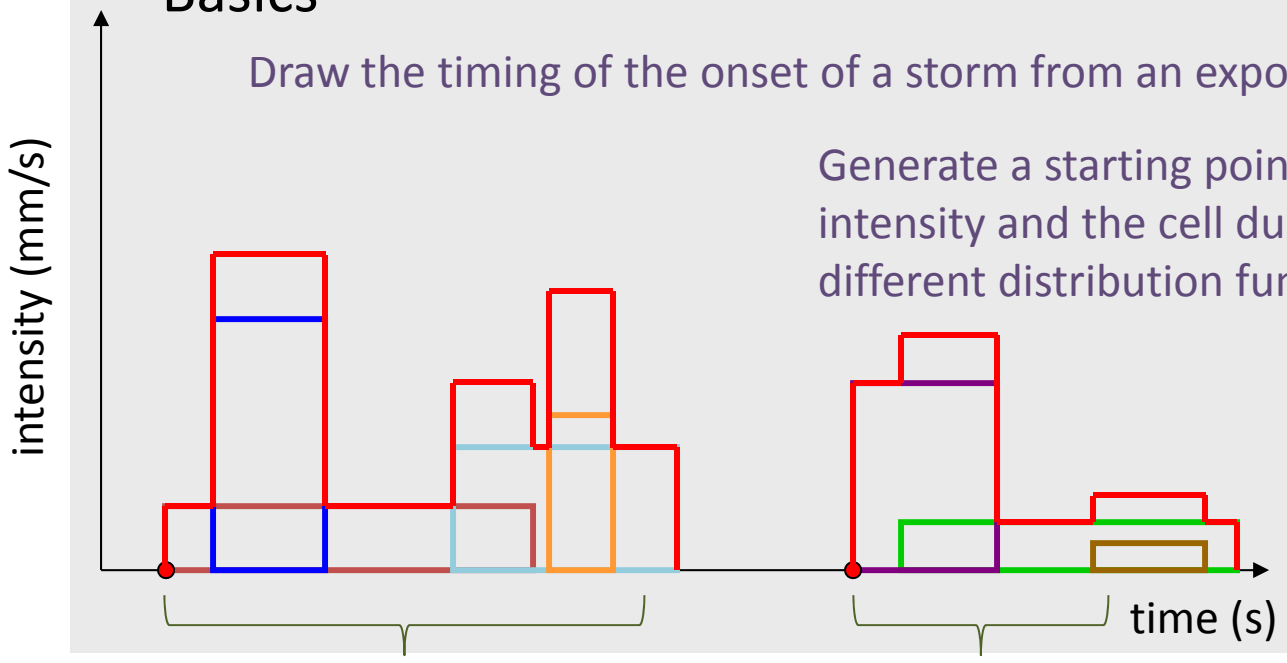
BARTLETT-LEWIS RECTANGULAR PULSES MODELS

- Basics

Draw the timing of the onset of a storm from an exponential distribution

Generate a starting point of a cell, generate the intensity and the cell duration (drawn from three different distribution functions)

Cumulate intensities of all rectangles within a predefined temporal resolution



BARTLETT-LEWIS RECTANGULAR PULSES MODELS

- Calibration – Generalized method of moments

$$f(\boldsymbol{x}) = \sum_{i=1}^{k} \frac{(M_i' - M_i(\boldsymbol{x}))^2}{\mathrm{Var}[M_i']}$$

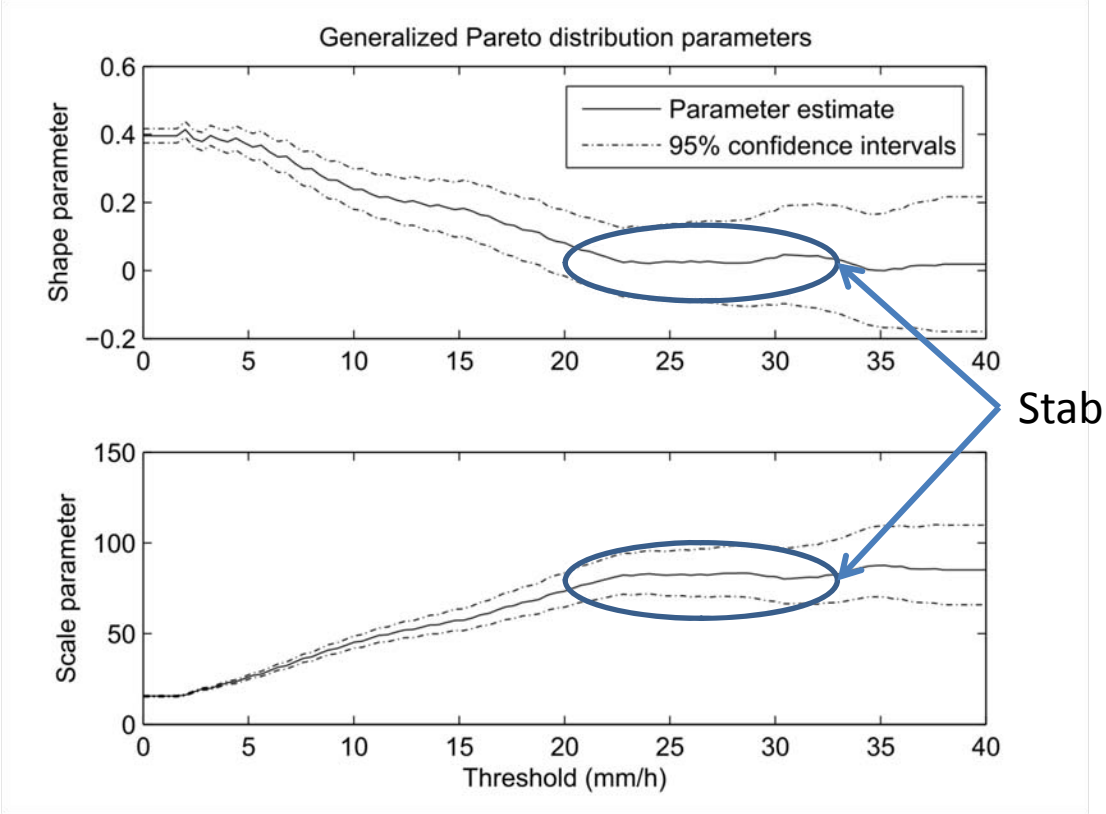
with:

$f(\boldsymbol{x})$	= objective function value
$\boldsymbol{x}$	= parameter vector
M_i'	= observed property *i* of a total of *k* properties
$M_i(x)$	= analytically calculated (in function of $\boldsymbol{x}$) property *i* of at total of *k* properties

Used properties : Mean, variance, covariance, zdp, third central moment.

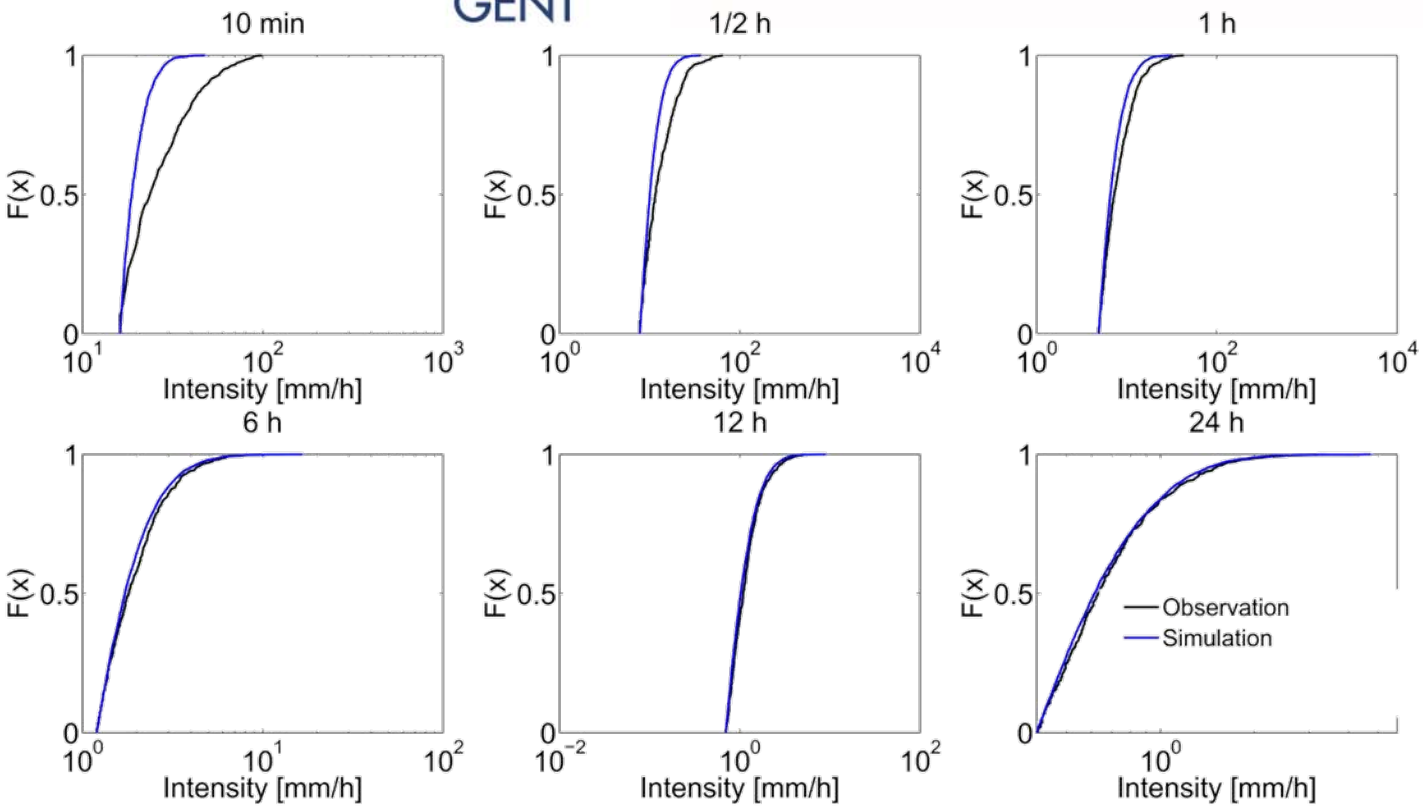
Extreme value behaviour - Framework

- Peak-over-threshold analysis
  - Storm selection (24 h, dry period)
  - Selection of largest peak per storm
  - Threshold selection



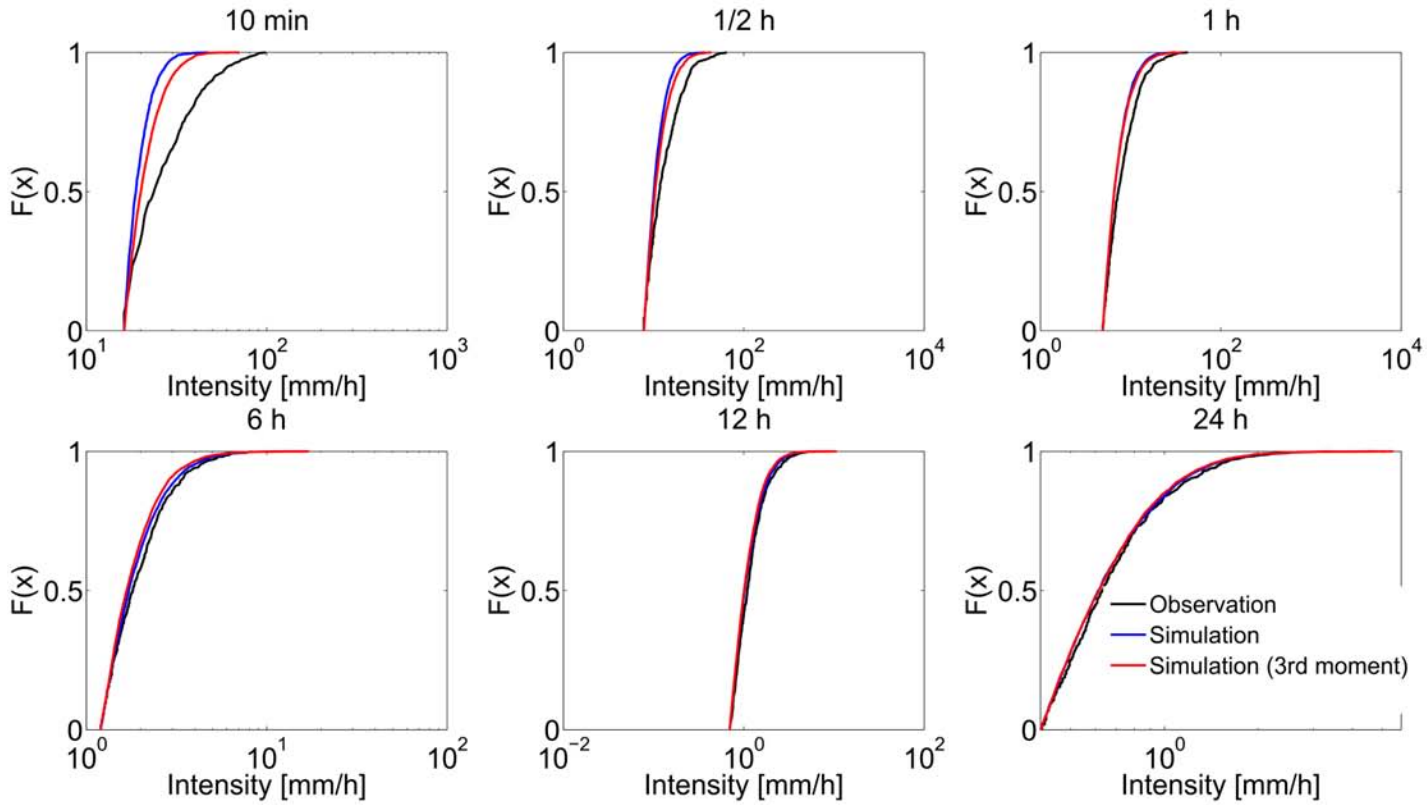
POT framework

Selection of GPD parameters



EXTREME VALUE BEHAVIOUR – 3RD CENTRAL MOMENT IN OBJECTIVE FUNCTION

Fit of POT series (summer) – calibration without third central moment

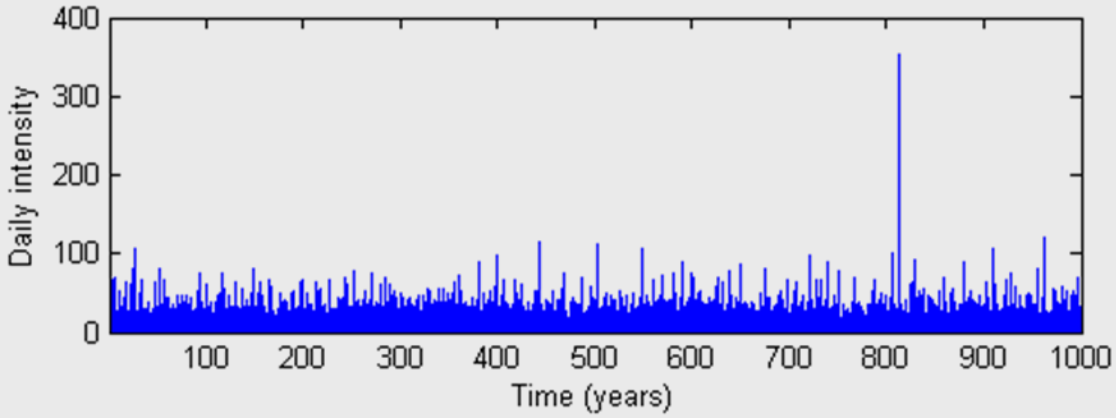


EXTREME VALUE BEHAVIOUR – 3RD CENTRAL MOMENT IN OBJECTIVE FUNCTION

Fit of POT series (summer) – calibration with and without third central moment

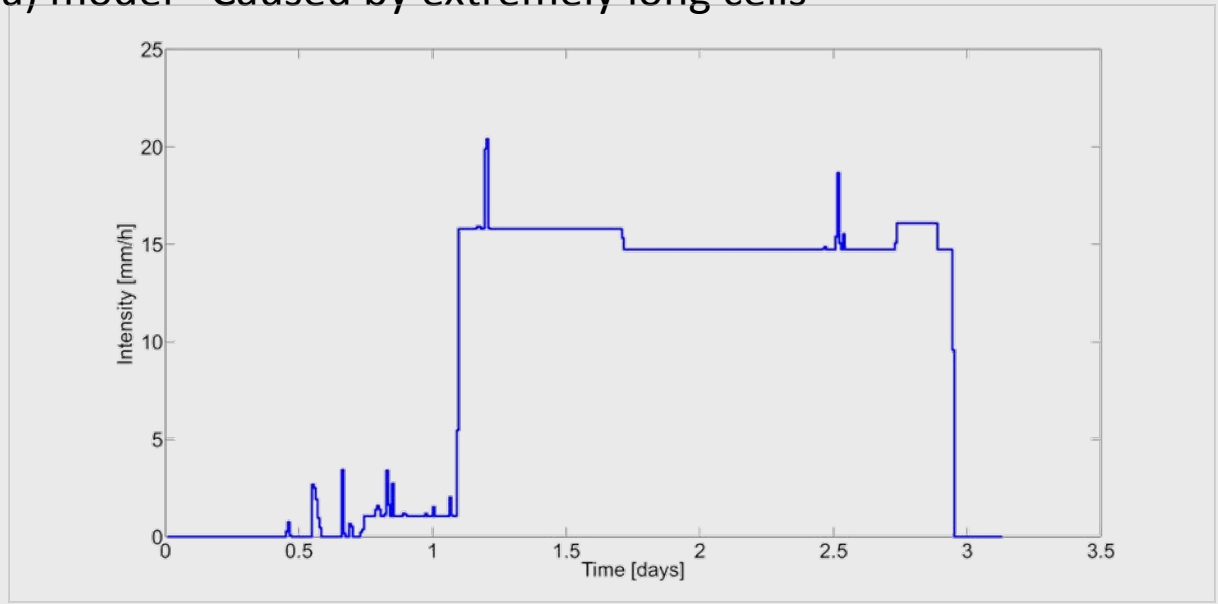
EXTREME VALUE BEHAVIOUR – TRUNCATED MODEL

- Occasional simulation of unrealistic rainfall events by the modified Bartlett-Lewis (Gamma) model



EXTREME VALUE BEHAVIOUR – TRUNCATED MODEL

- Occasional simulation of unrealistic rainfall events by the modified Bartlett-Lewis (Gamma) model - Caused by extremely long cells



EXTREME VALUE BEHAVIOUR – TRUNCATED MODEL

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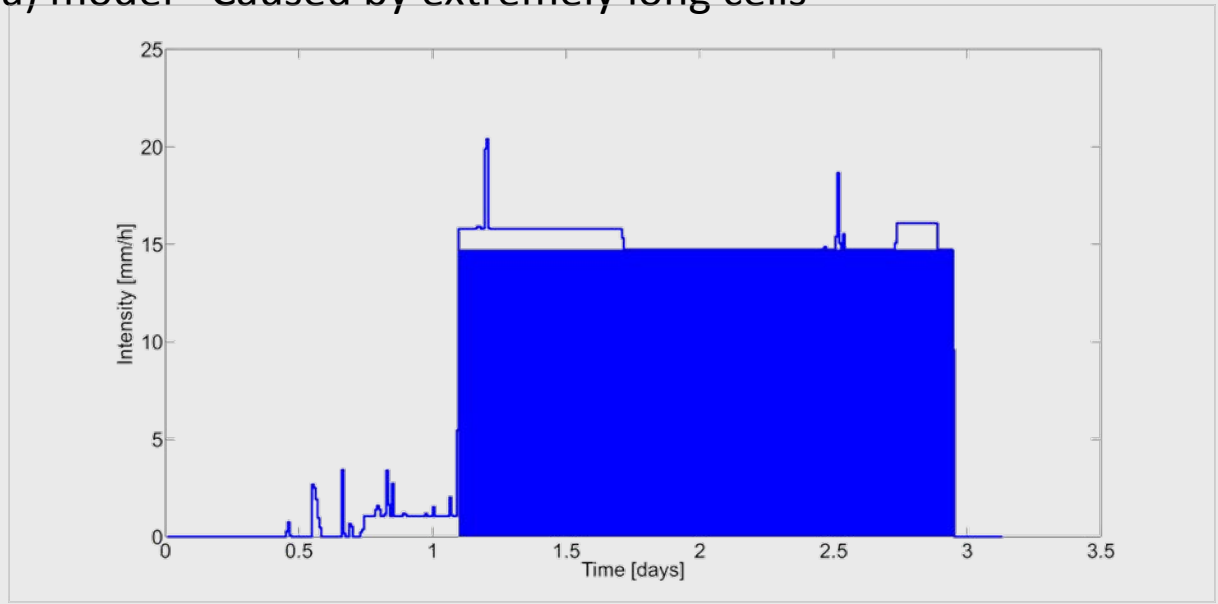
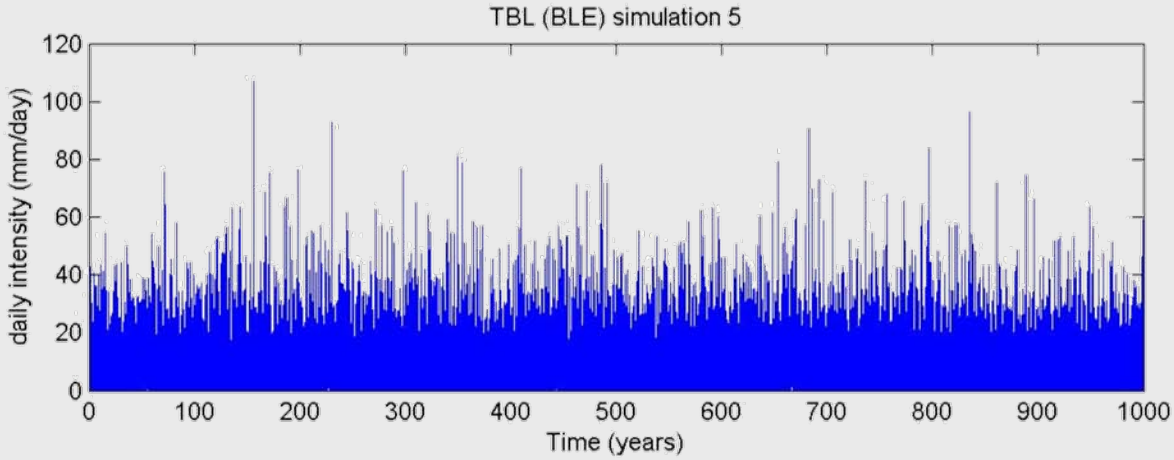
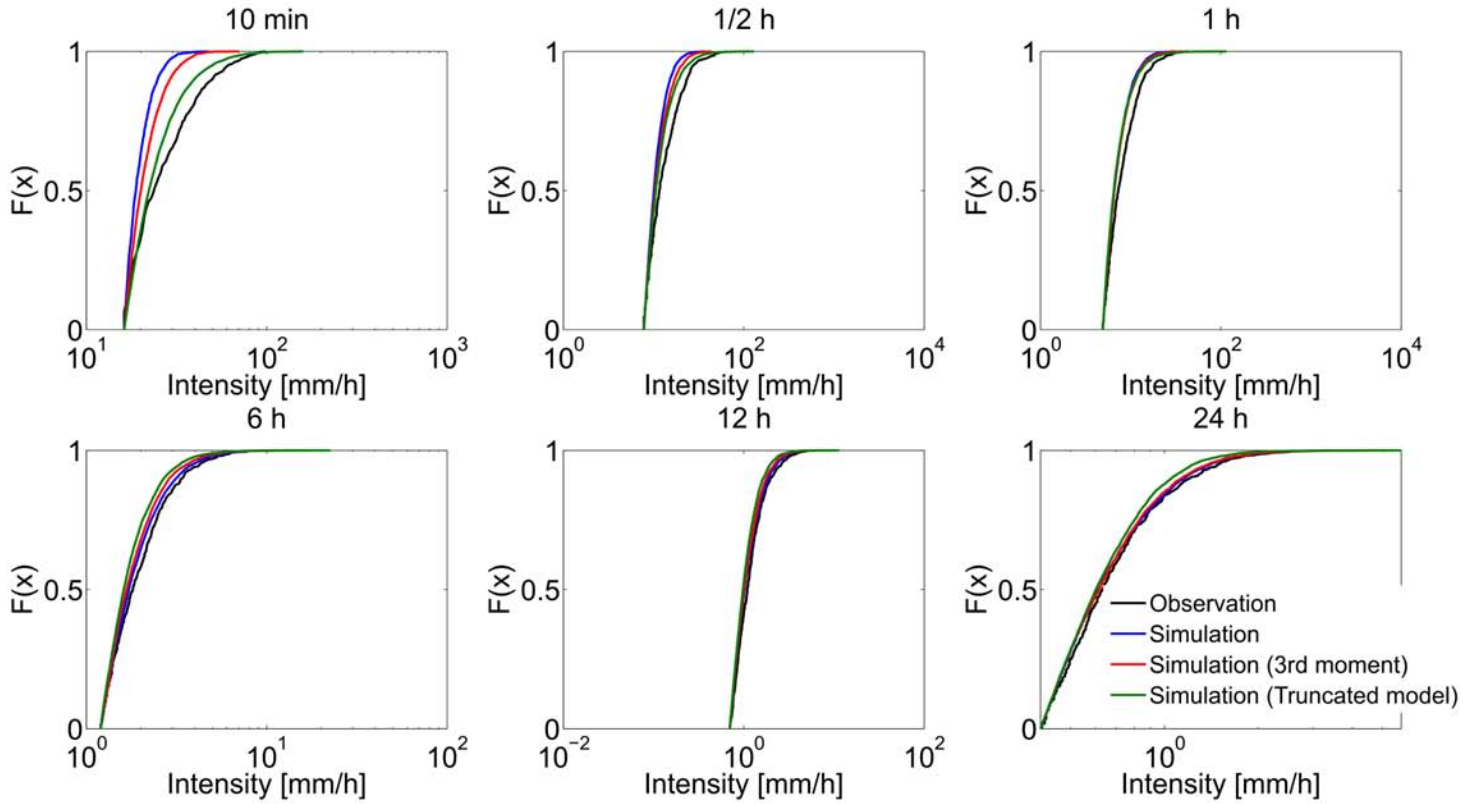


EXTREME VALUE BEHAVIOUR – TRUNCATED MODEL

- Occasional simulation of unrealistic rainfall events by the modified Bartlett-Lewis (Gamma) model – solved by use of a truncated model





EXTREME VALUE BEHAVIOUR – TRUNCATED MODEL

Fit of POT series (summer) – influence of truncation on extreme value behaviour

Conclusions

- Goal : Improve extreme value behaviour of Bartlett-Lewis Rectangular pulses models
  - Including 3rd central moment in the objective function
    - Unsignificant improvement of extreme values
  - Use of a truncated model to avoid simulation of unrealistic events
    - Significant improvement of extreme values
- Further Research
  - Influence on flood forecasts
  - …