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Hydrology of Extreme Values

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Content & Structure

1. Introduction

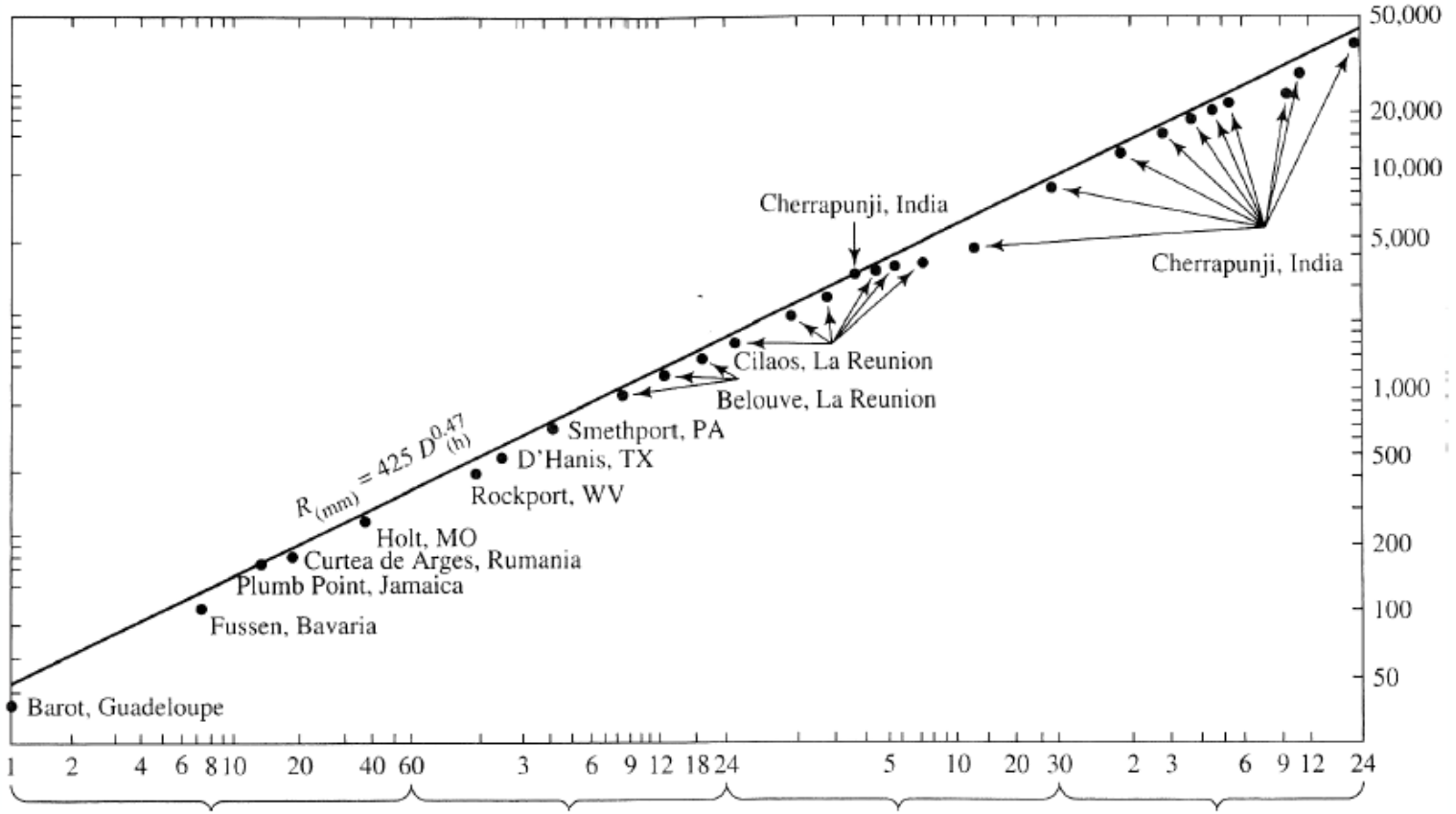
2. Extreme precipitation values

You are going to learn about ...

- Maximum values of rainfall
- Empirical extreme value statistics
- Calculation of rainfall of given recurrence intervals
- Theoretical distributions
- Area reduction
- Design storms

Extremes

Most extreme precipitation events



Dyck & Peschke, 1995

- x-scale logarithmic
- y-scale logarithmic

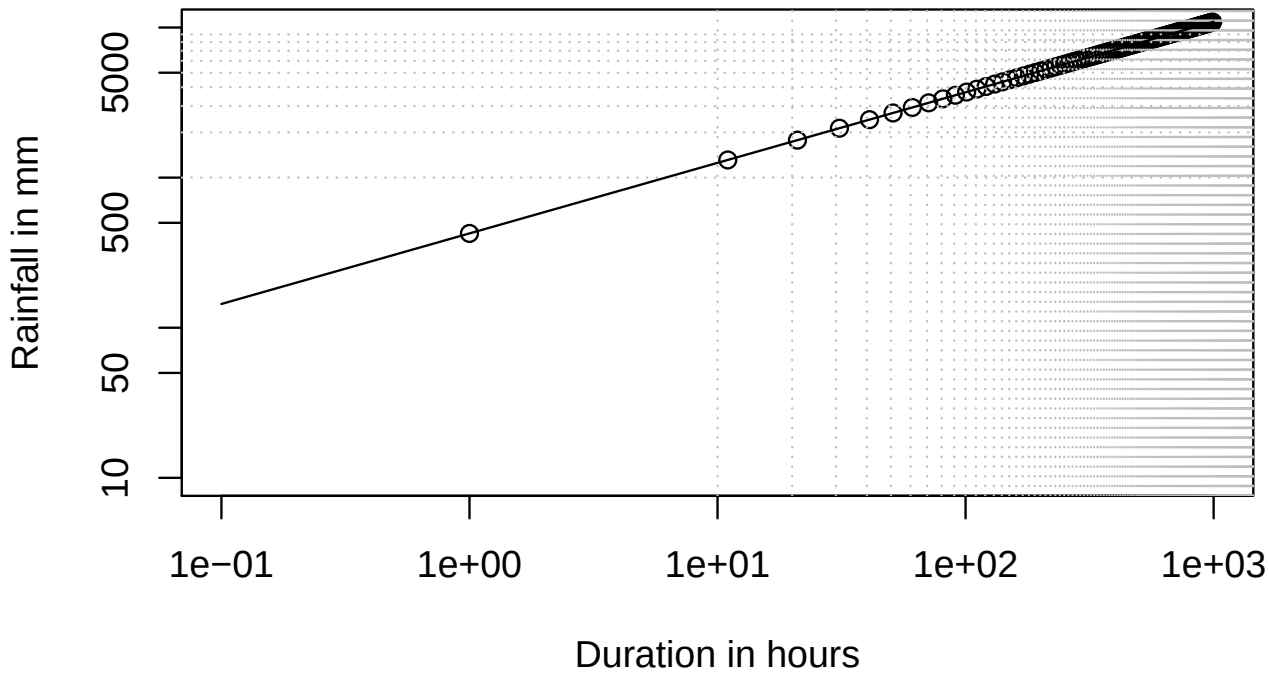
Maximum Values Precipitation

The maximum values of precipitation – ever – can be described by the equation:

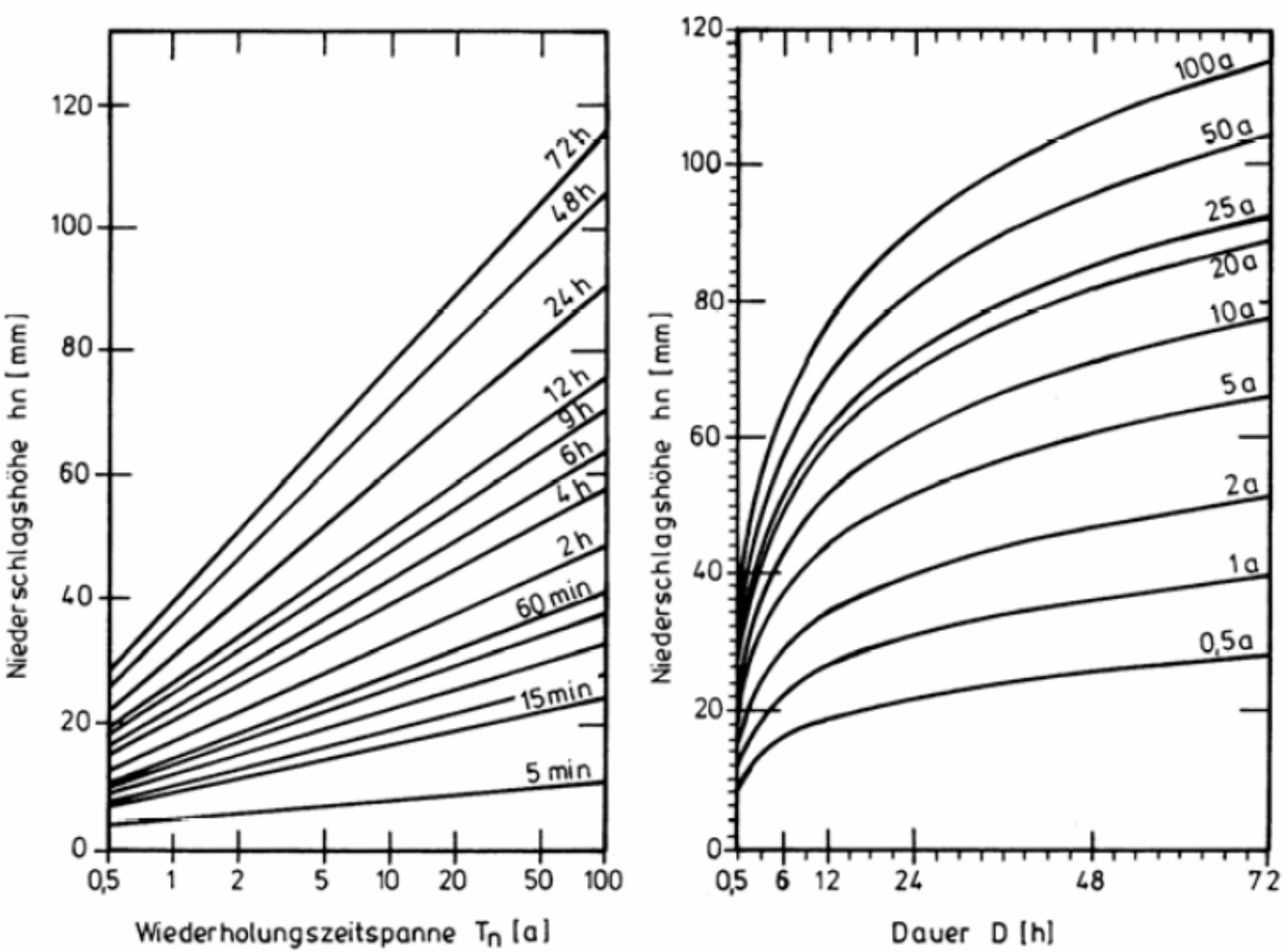
$$P_{max} = 425 * D[h]^{0.47}[mm]$$

Duration is given in hours. The maximum precipitation in mm grows – more or less – to the power of 0.5 or with the square root of the duration in hours.

Maximum Precipitation Graph



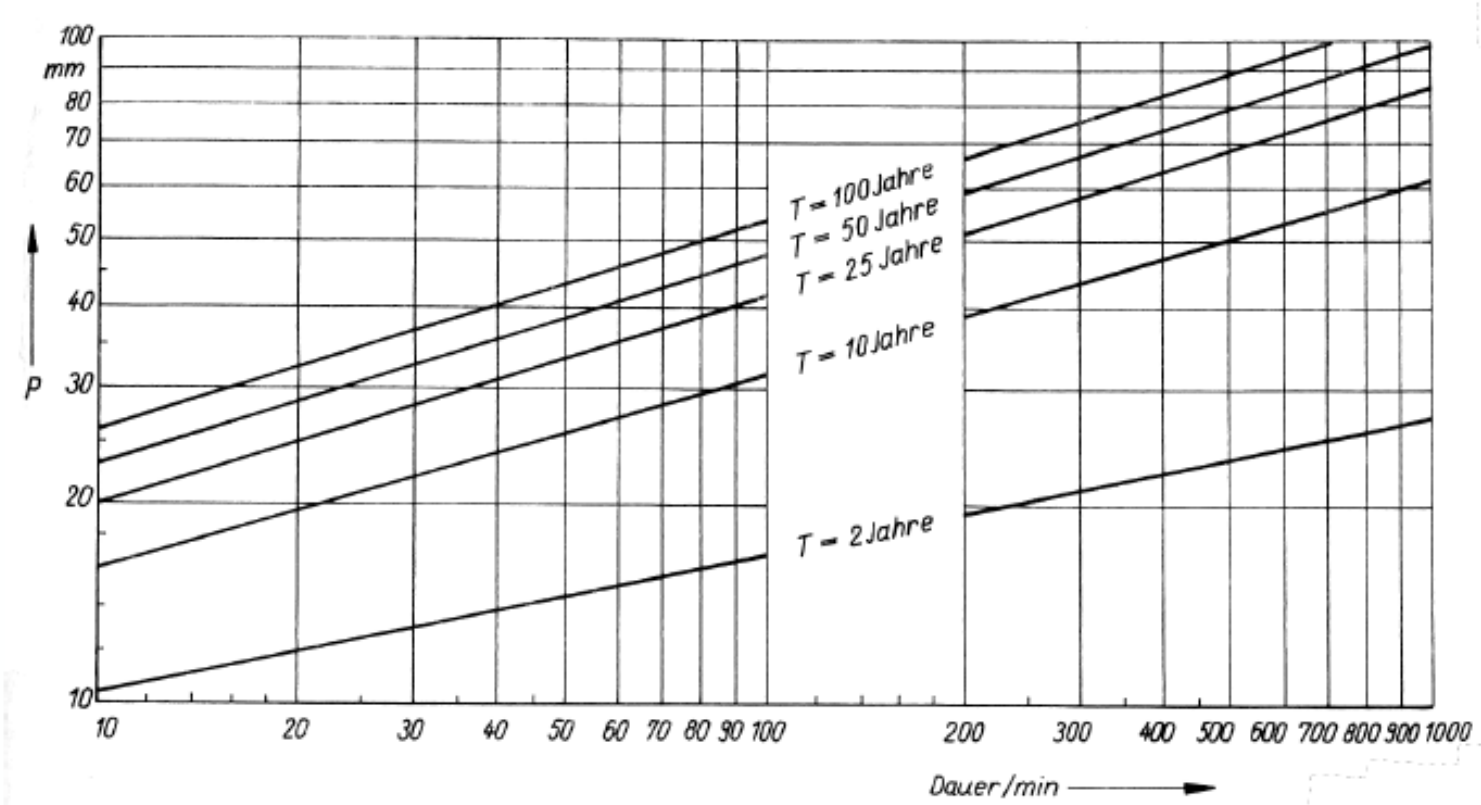
Time-Depth vs. Time-Intensity



Maniak, 2016

Duration vs. Amount

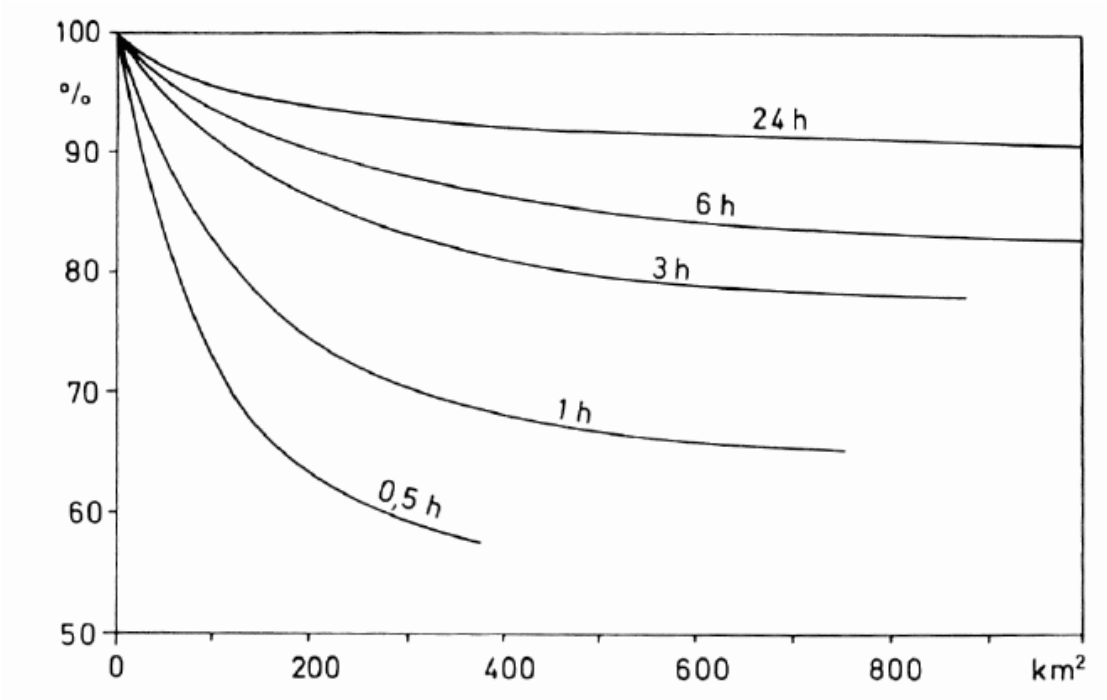
D



Dyck & Peschke, 1995

- Amount increases with recurrence intervall
- log-log graph

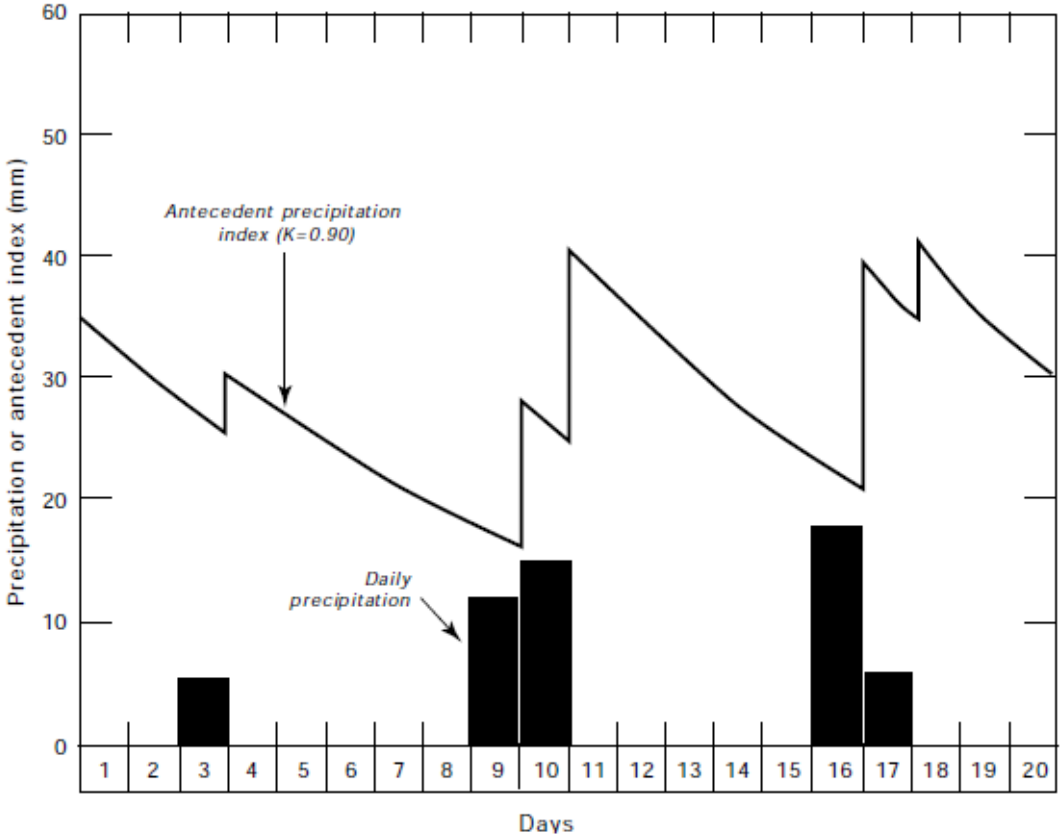
Area Reduction



Dyck & Peschke, 1995

- Amount decreases with increasing area
- Decrease is more pronounced for short durations

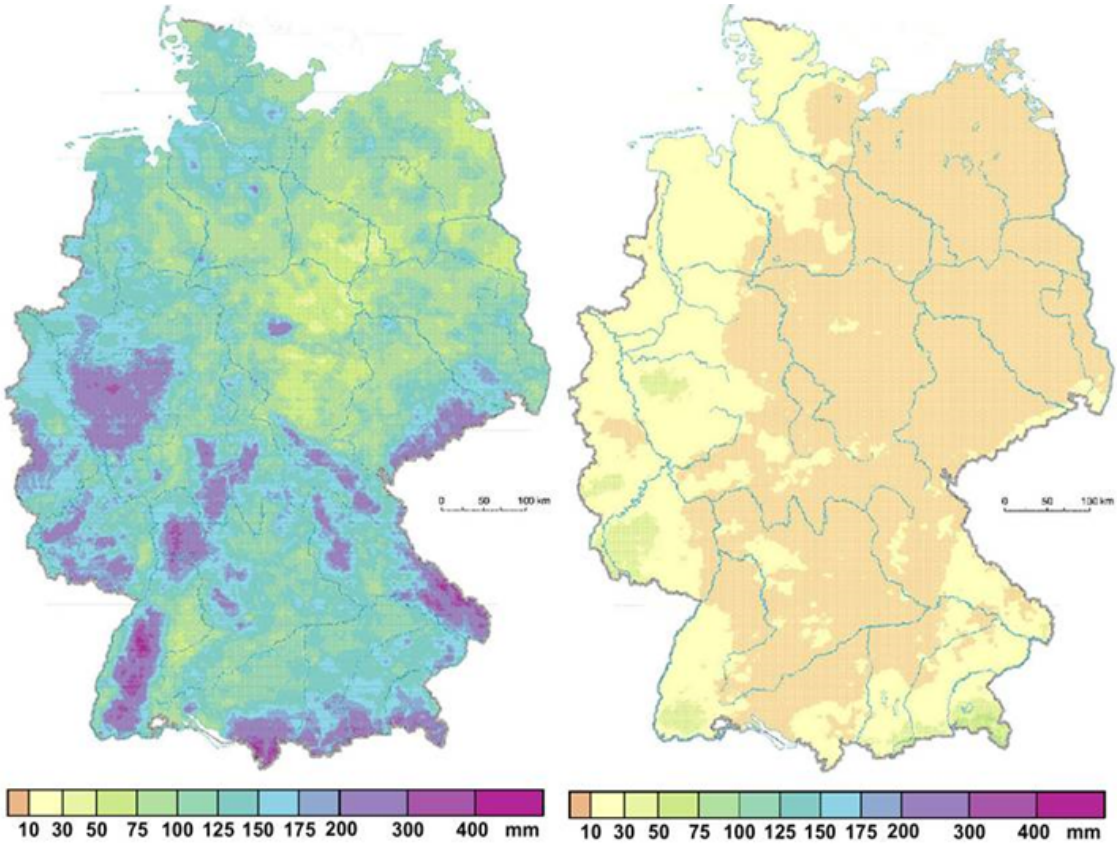
Antecedent Moisture



Guide to Hydrological Practice, 1994

- Controls runoff production
- Can be calculated from moving average
- Time loss function (exponential)

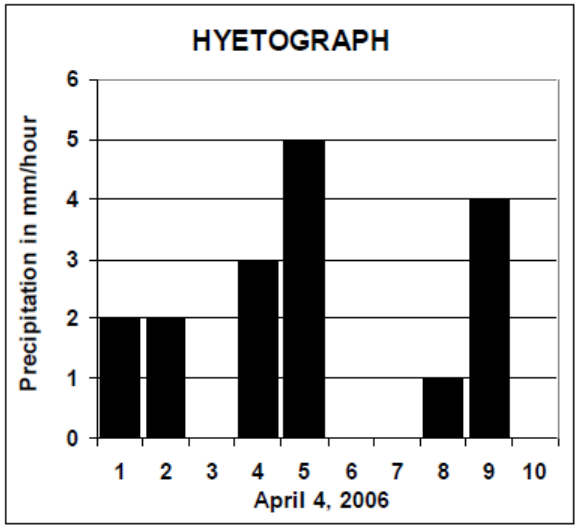
Dry and wet periods
Variability

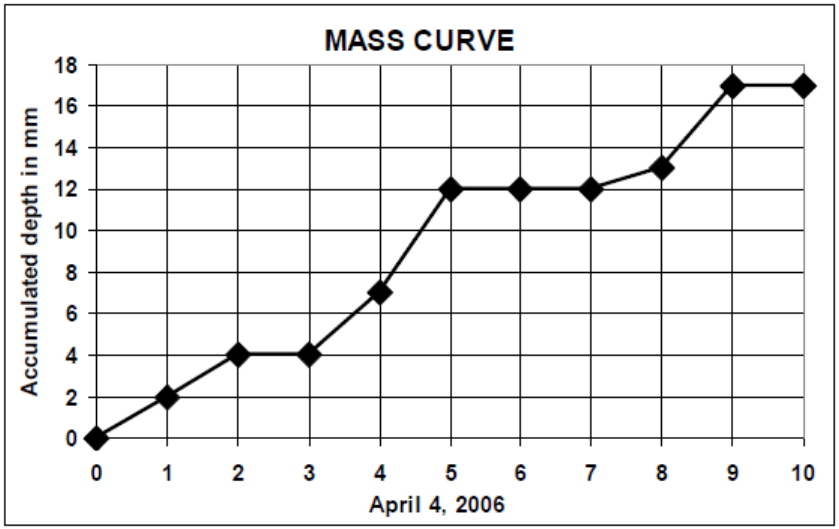


Deutscher Hydrologischer Atlas, 2015

- Dry and wet spells
- Variability increases with aridity
- Climatological factors (generic)

Hyetograph
Time function

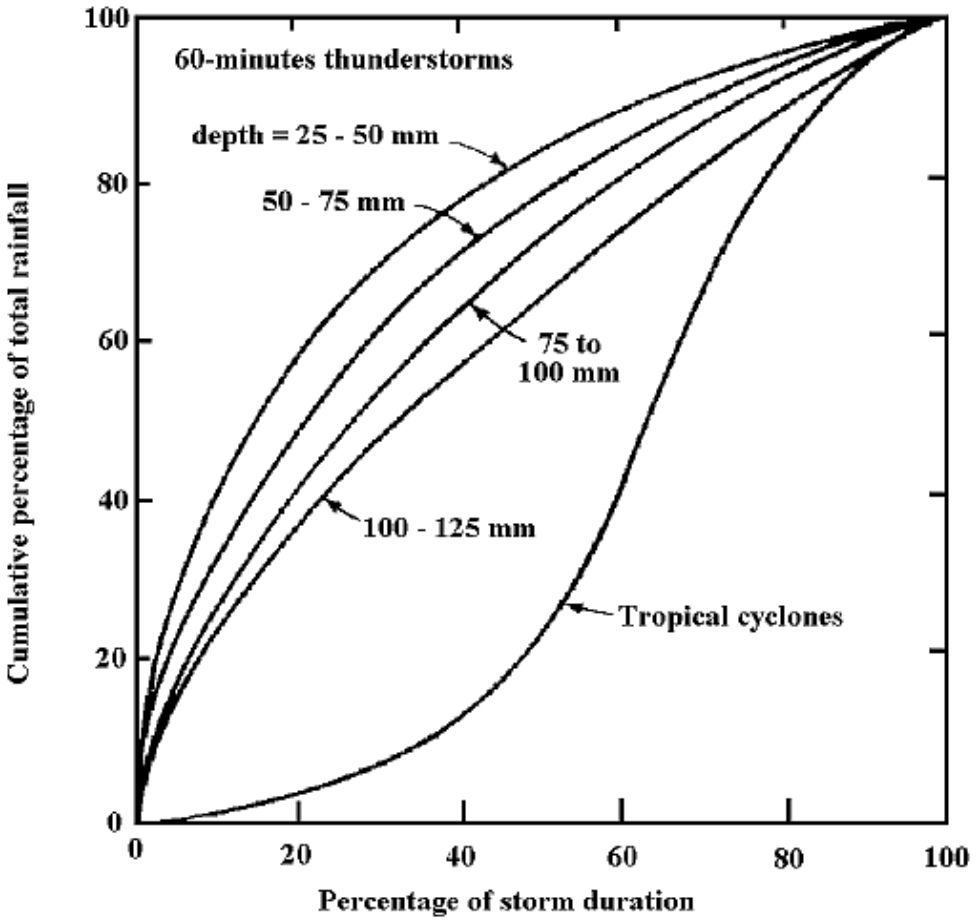




Savenje, 1992

- Intensity vs. time
- Important for runoff generation
- Sum curve a good indicator

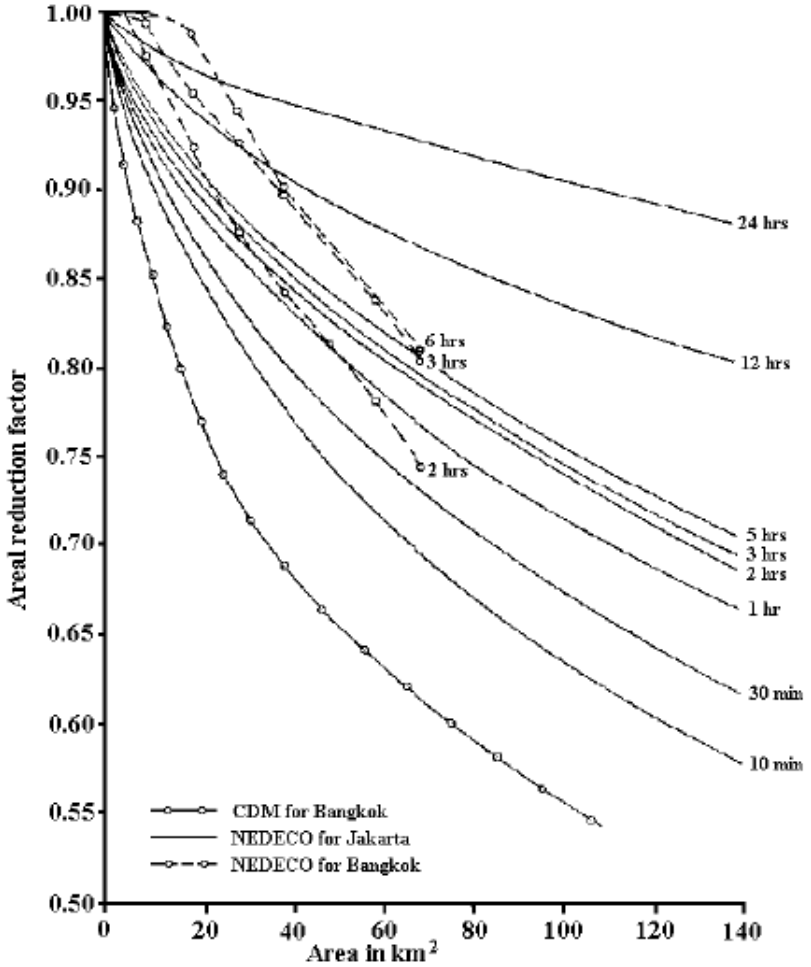
Hyetograph
Time function



Savenje, 1992

- Intensity vs. time
- Depends on rainfall type

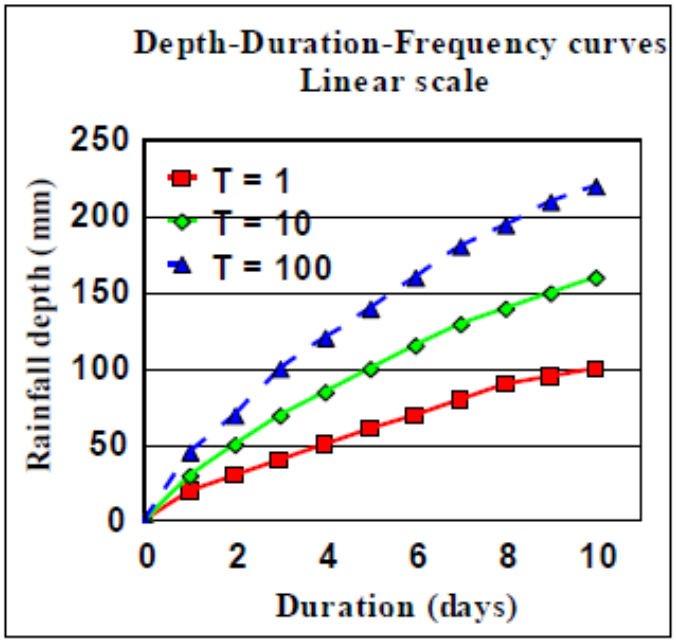
Areal Reduction

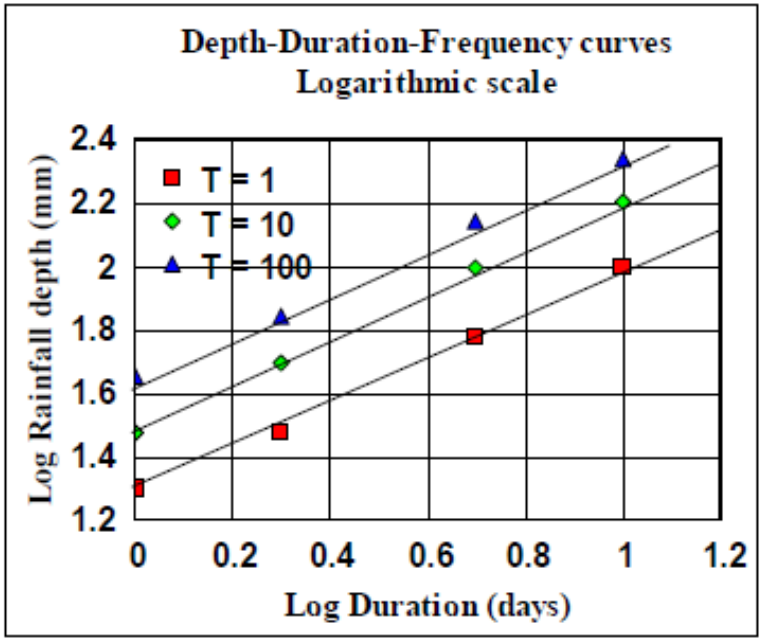


Savenje, 1992

- No complete cover of larger areas
- Depends on rainfall type (generic)
- Stronger decrease for shorter events

Depth Duration

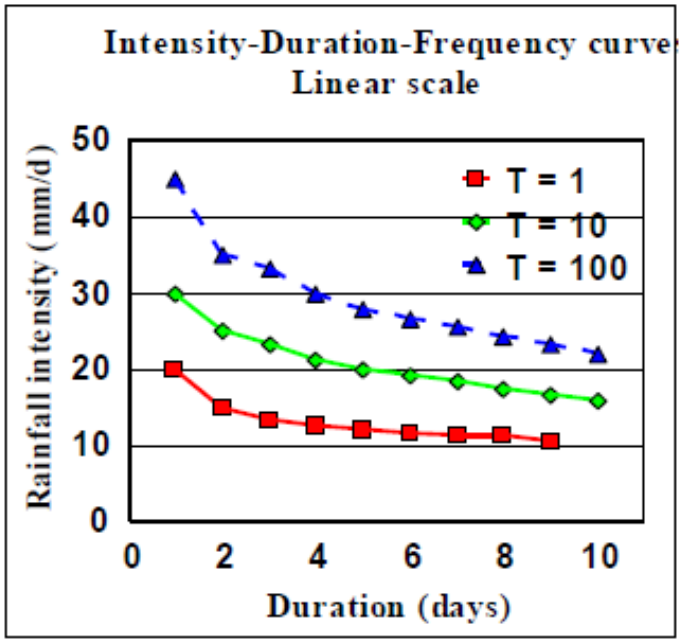


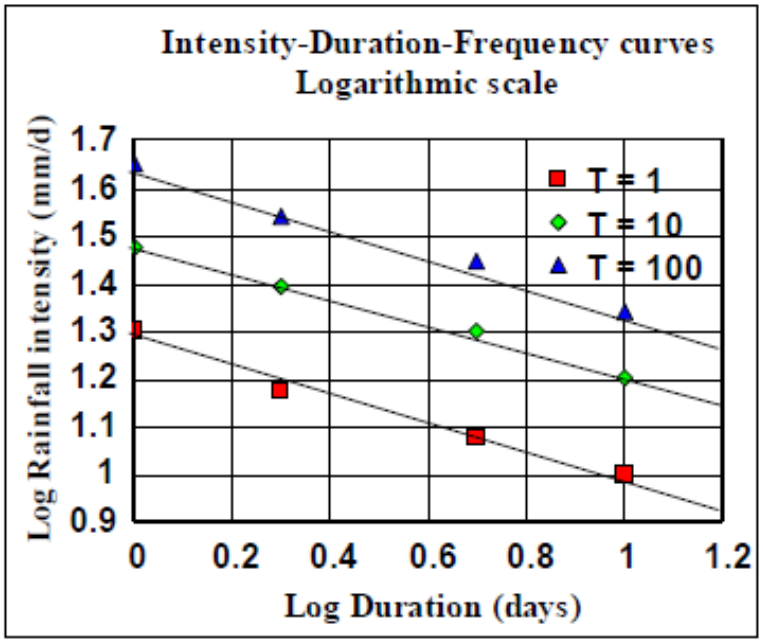


Savenje, 1992

- Functions can be derived from tipping buckets
- Moving averages for 5min, 10 min, 15 min etc.
- log-log plotting

Depth Intensity





Savenje, 1992

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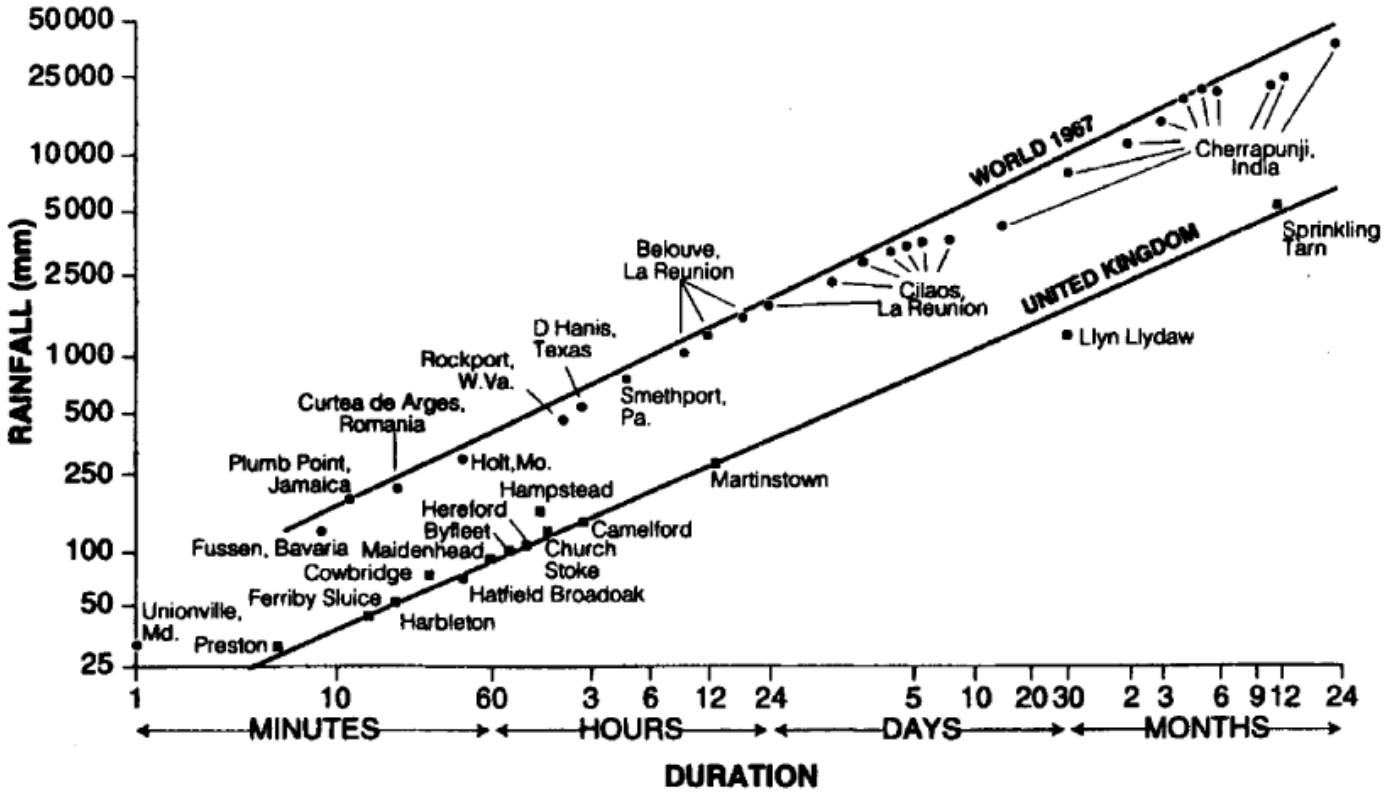
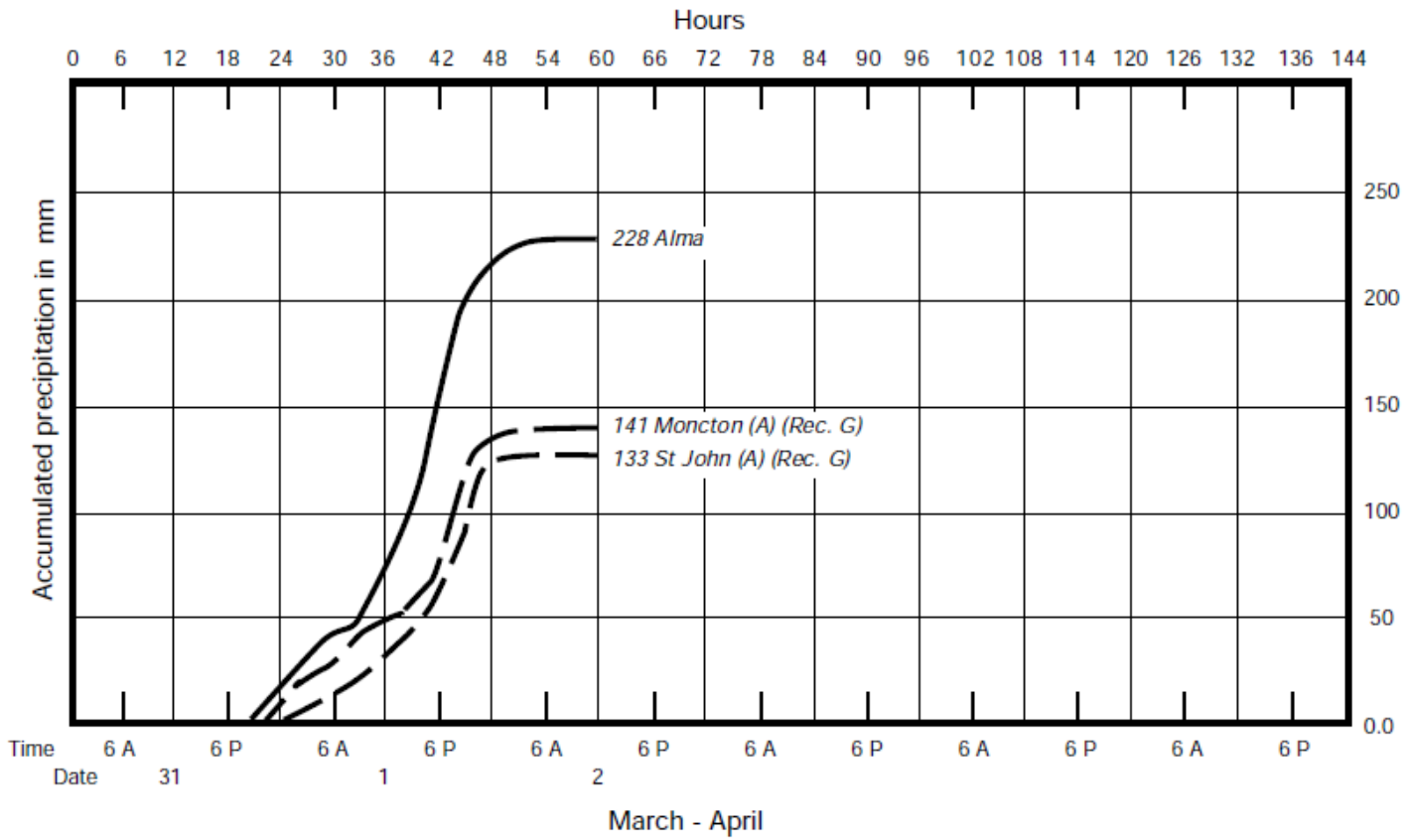
Maximum Probability



Savenje, 1992

- Highest in monsoon area
- Regional curves

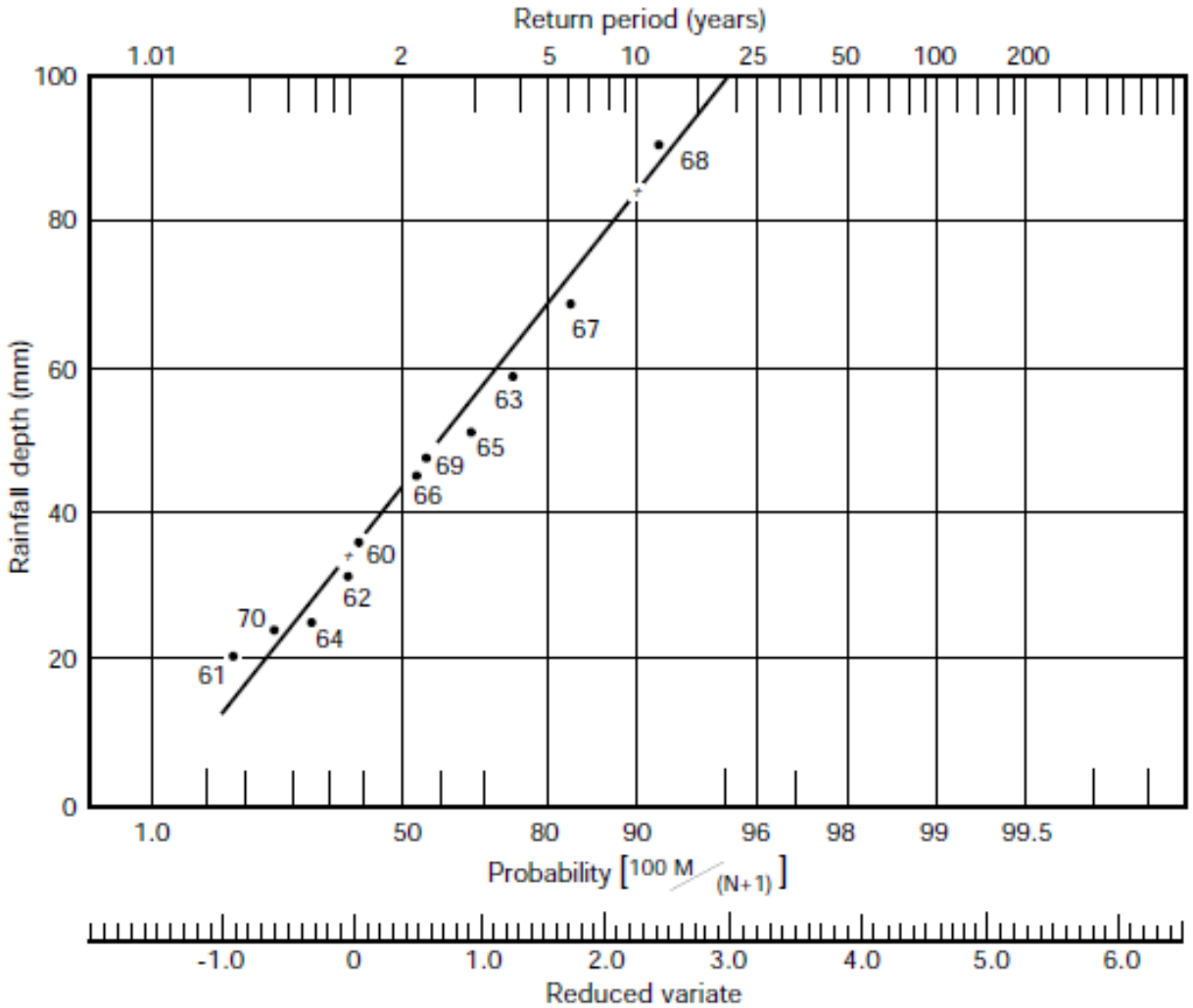
Mass Curve of Rainfall



Guide to Hydrological Practice, 1994

- Analysis of rainfall events (post)
- Type curves

Rainfall Depth Probability



Guide to Hydrological Practice, 1994

Statistics

The probability $P(x > X)$ of an event can simply be derive from non-parametric statistics.

$$P(x > X) = \frac{m}{N+1}$$

With m the rank of a sorted series and N the total number of annual events.