

Why you need an umbrella on hot days



Master thesis defense Berry Boessenkool, May 2015

Title: Statistical Analysis of Temperature Effects on Extreme Precipitation Intensities

Supervisors: Dr. Maik Heistermann, Dr. Gerd Bürger

- ▶ Motivation

Overview

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- ▶ Data, quantiles, logtransformation

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 - ▶ Fit distributions
 - ▶ Simulations to quantify sample size effect

Motivation: Flash floods

India, Indore, Patalpani waterfall



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famous picnic spot

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famous picnic spot 2011: Flash flood

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India, Indore, Patalpani waterfall



famous picnic spot 2011: Flash flood
small scale, sudden, dangerous (Boessenkool, 2013)

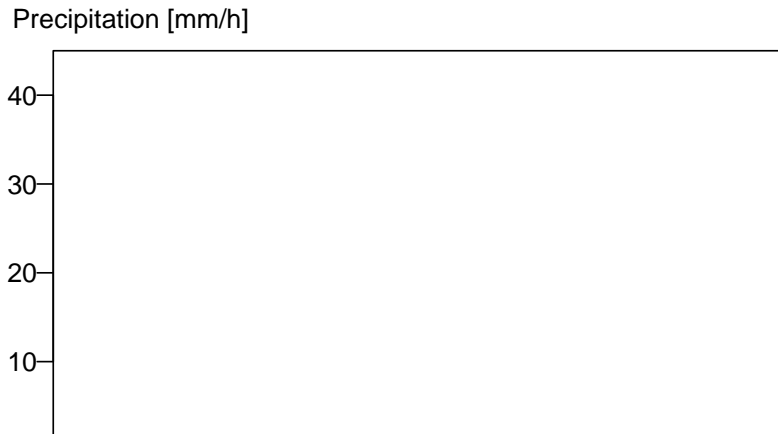
Motivation: Flash floods

[Open video in external viewer](#)

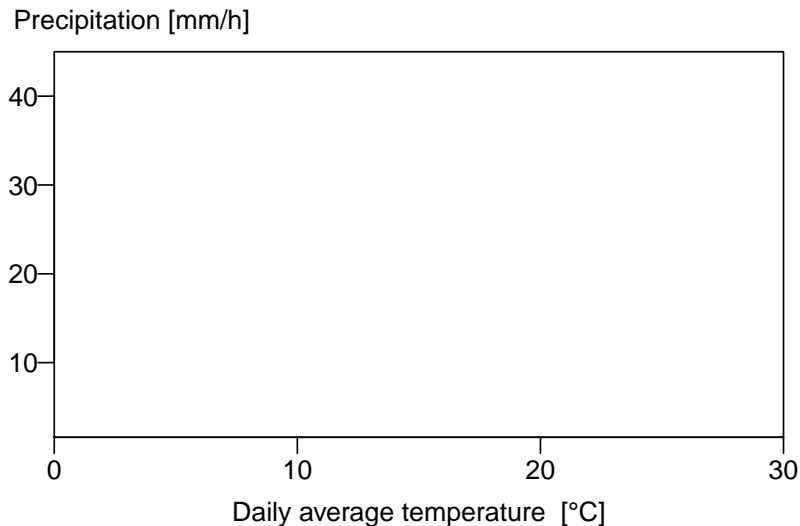
[Watch complete video on youtube](#)

For once, we don't complain about data shortage

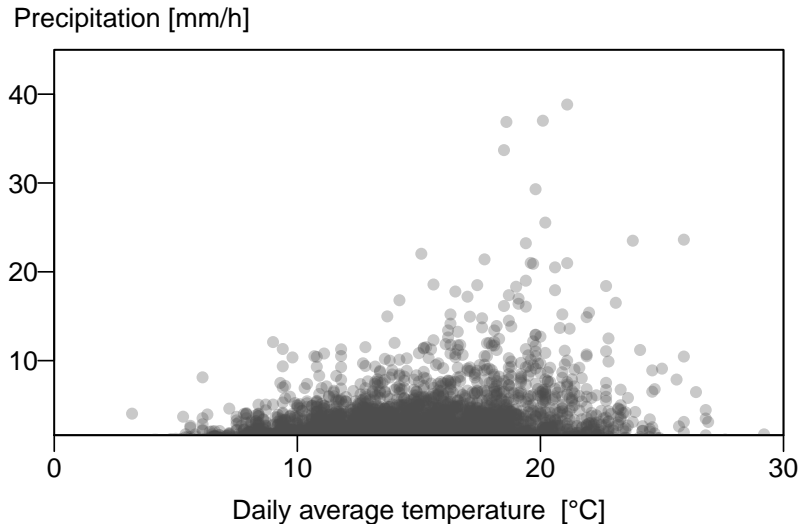
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Summer data from May to September, 1951-2010

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hourly rainfall depth: recorded by Hellmann gauges, resolution:
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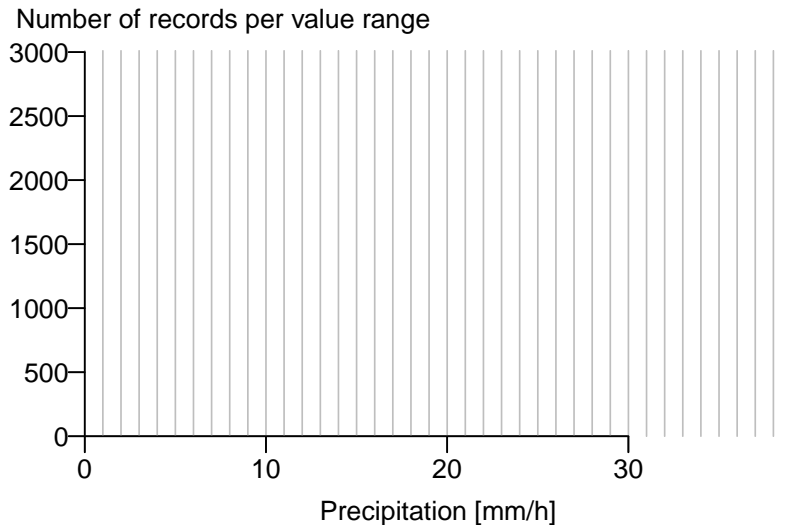
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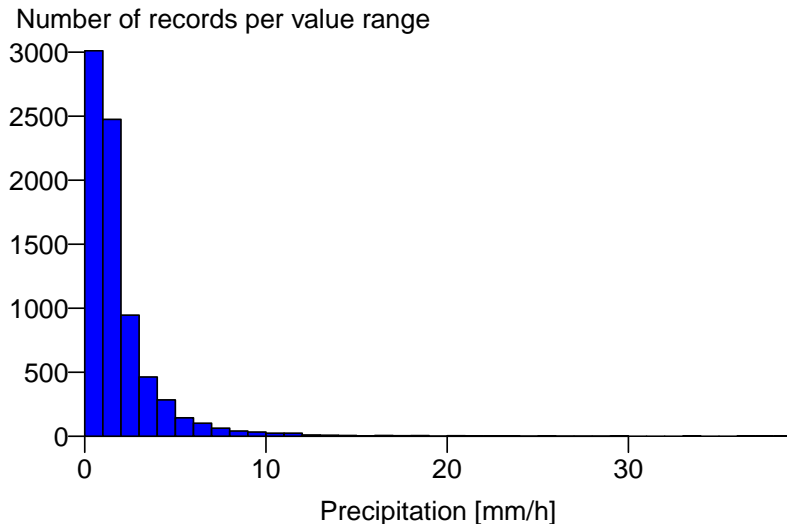
daily temperature average: computed from hourly measurements at
2 m above ground

Logtransformation is the best thing since sliced bread

Logtransformation is the best thing since sliced bread - Reason 1



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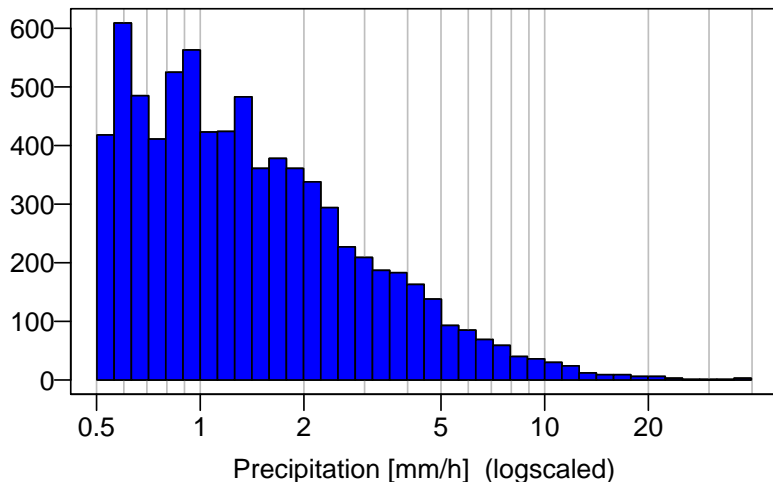


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[Open histogram animation in external viewer](#)
credits: [FFmpeg](#) + R package [animation](#) (Yihui)

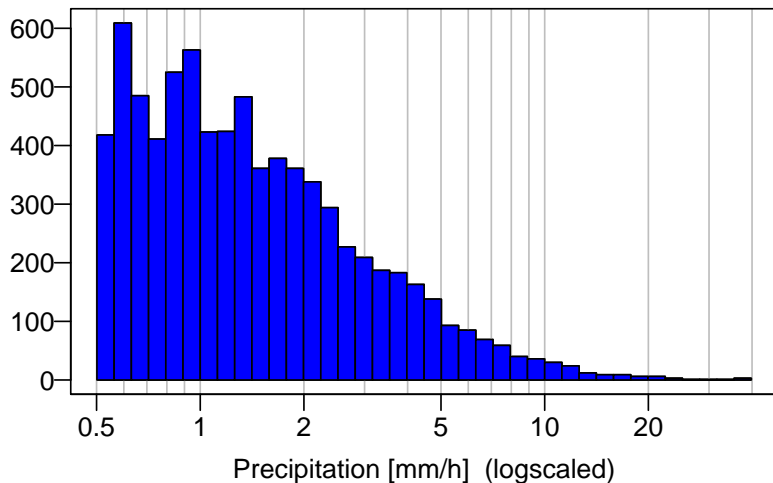
Logtransformation is the best thing since sliced bread - Reason 1

Number of records per value group



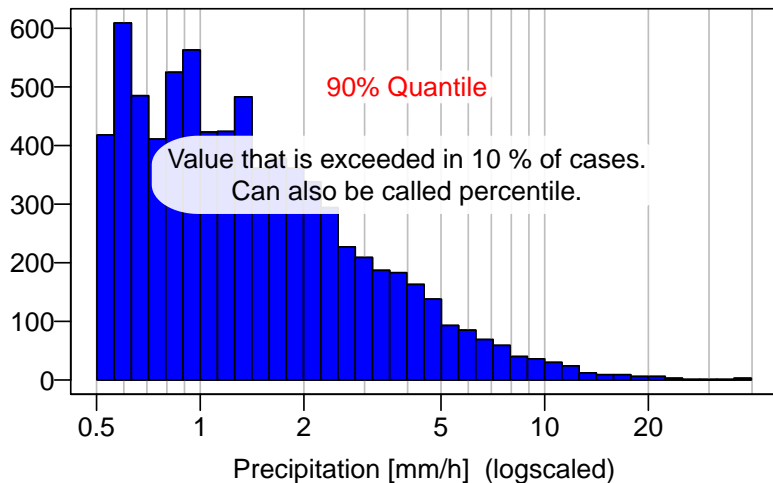
Quantile explanation

Number of records per value group



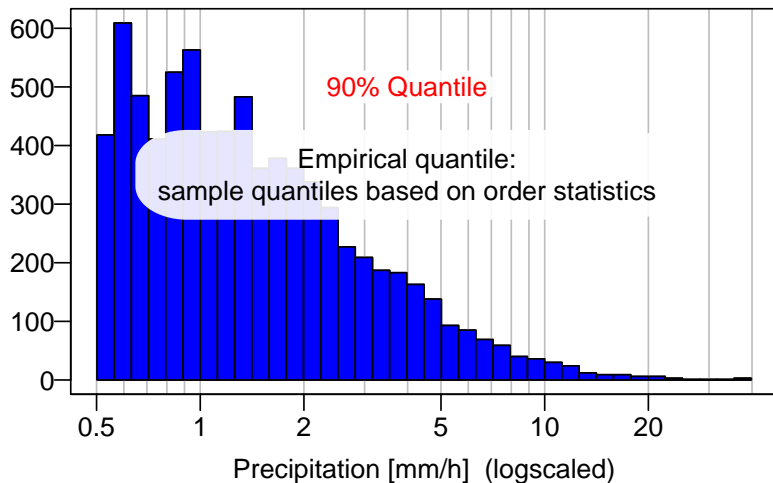
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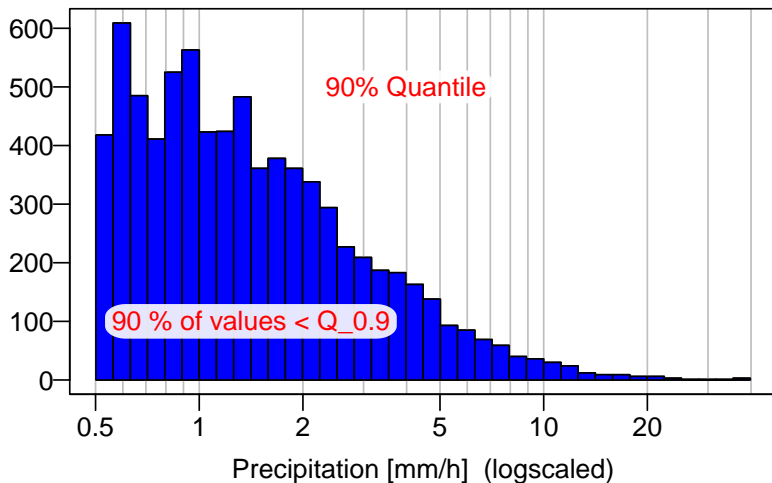
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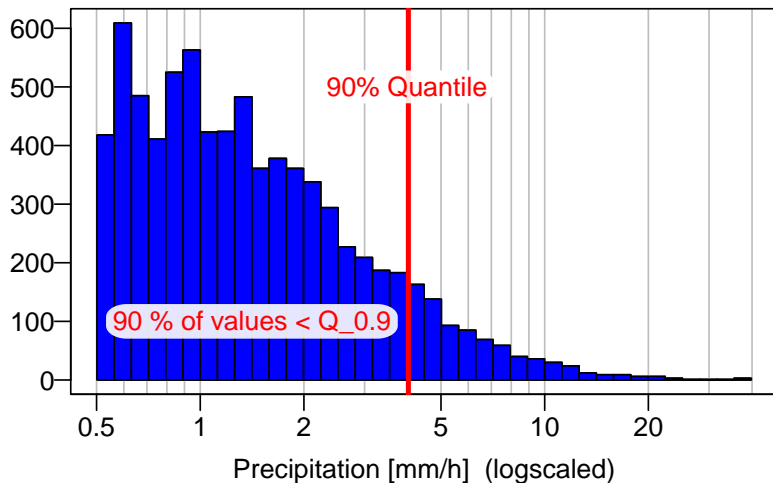
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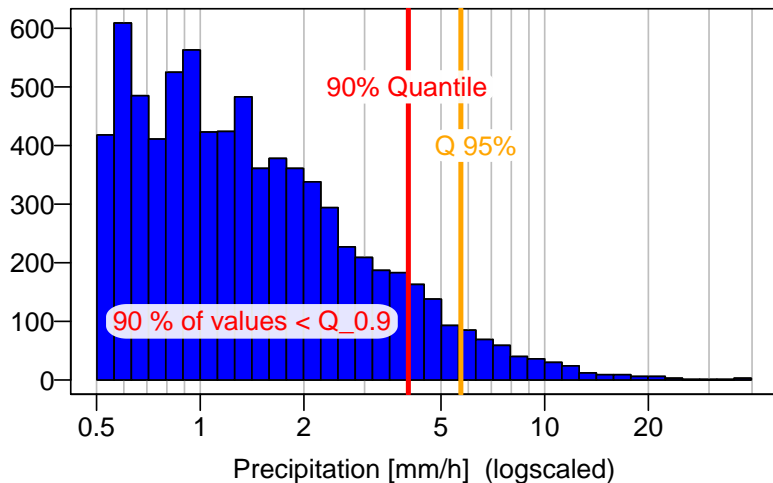
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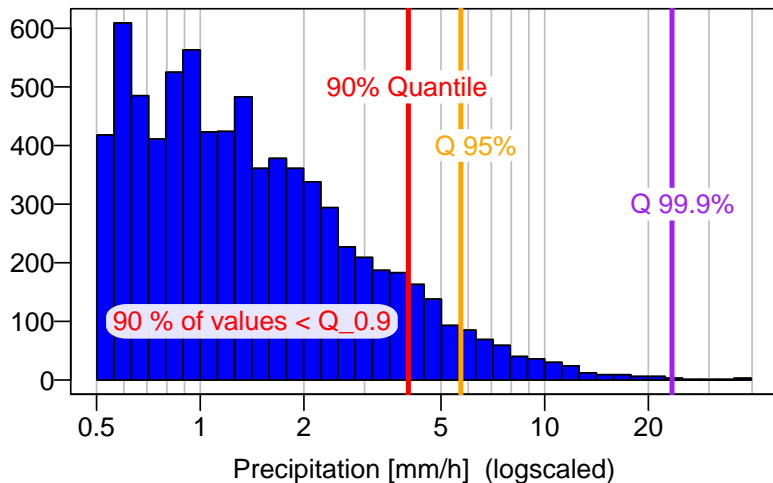
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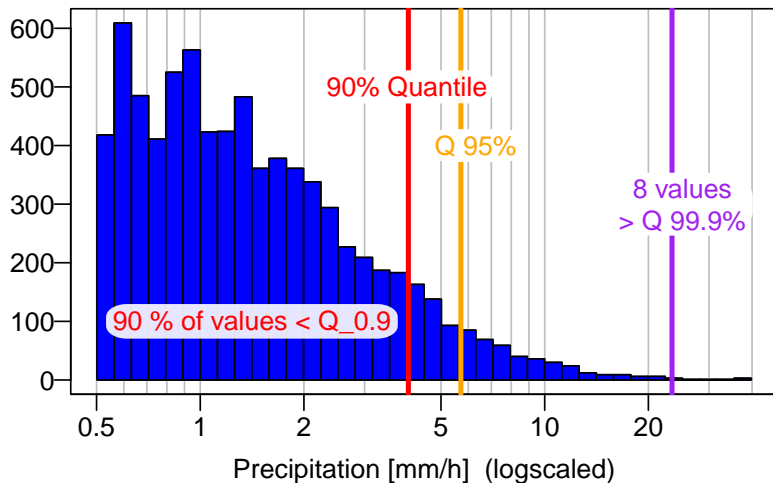
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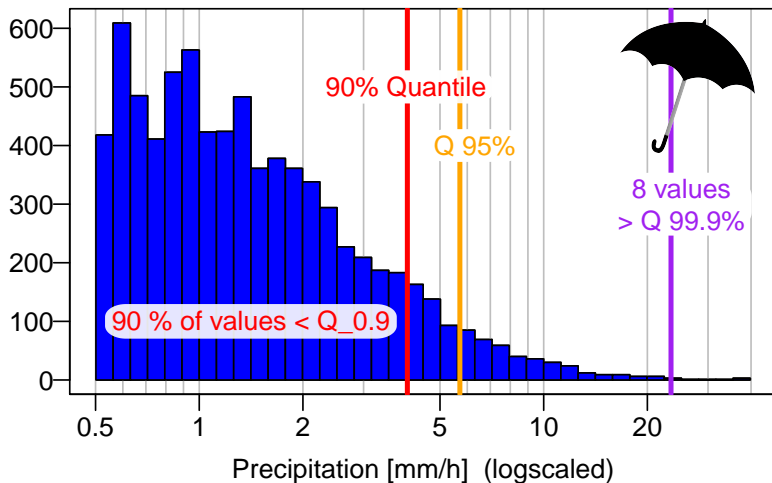
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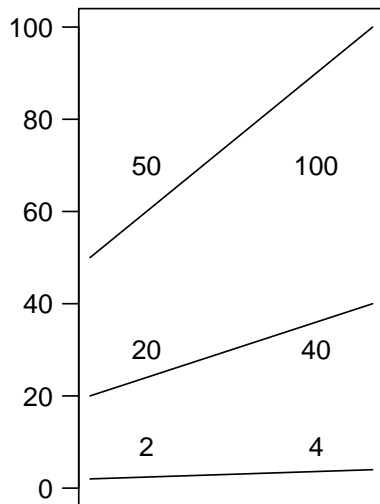


Logtransformation is the best thing since sliced bread - Reason 2

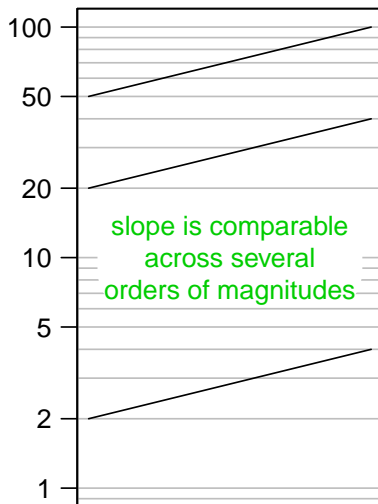
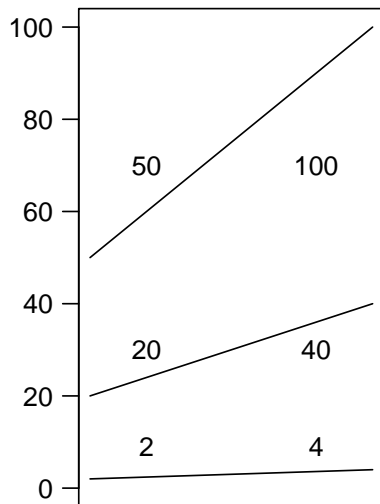
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It's the only way to compare rates of change.

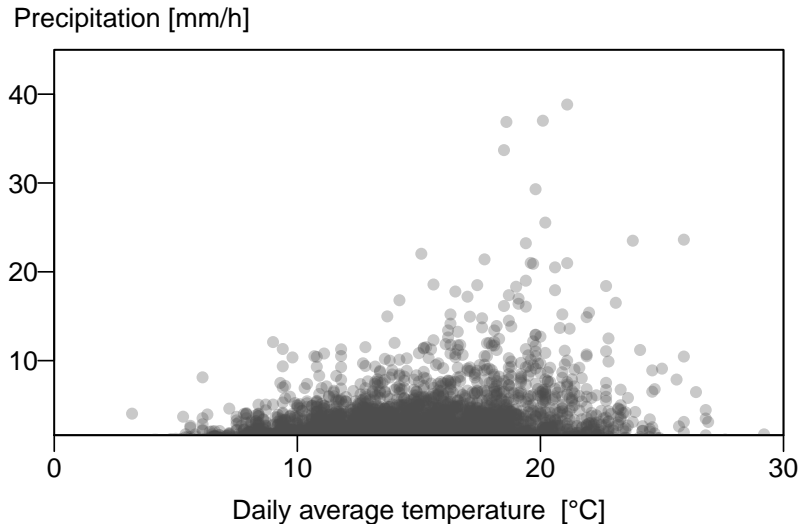
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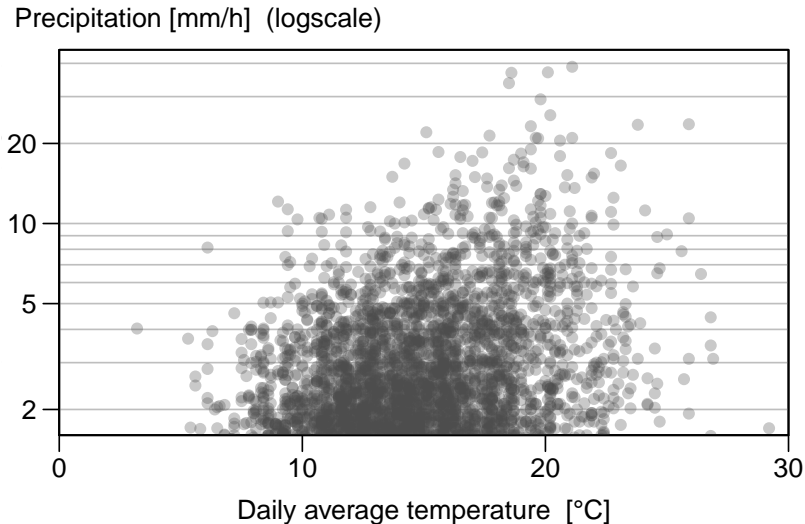
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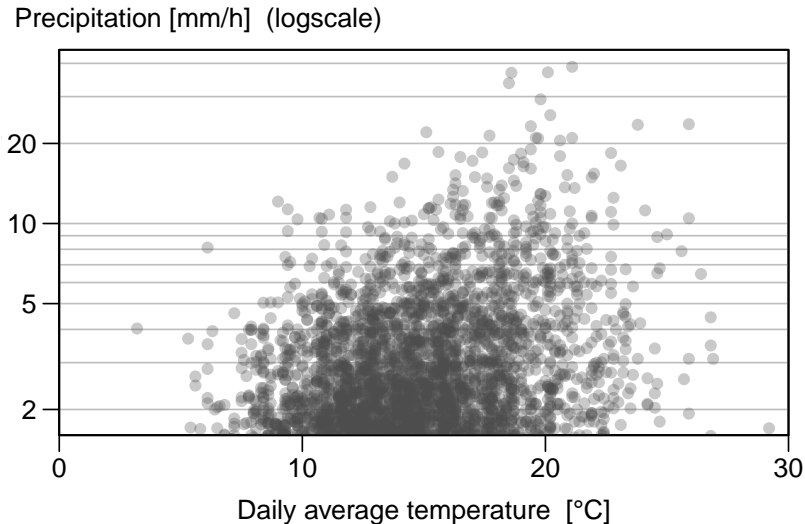
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[Open scatterplot animation in external viewer](#)
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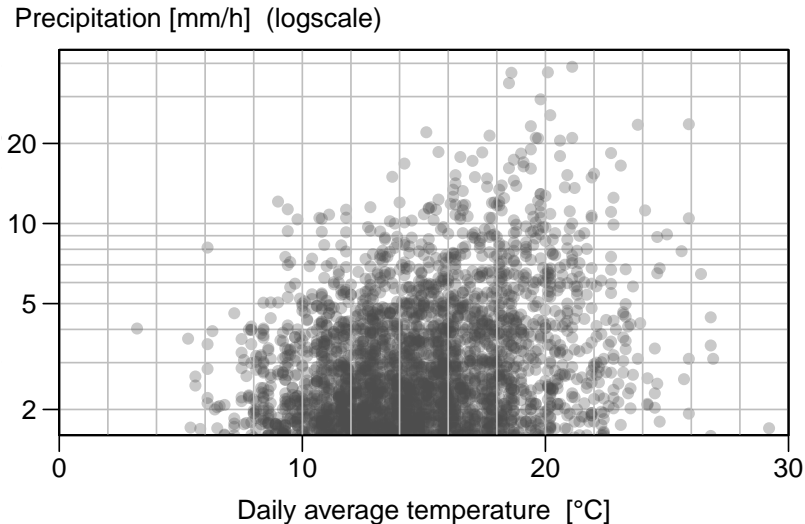
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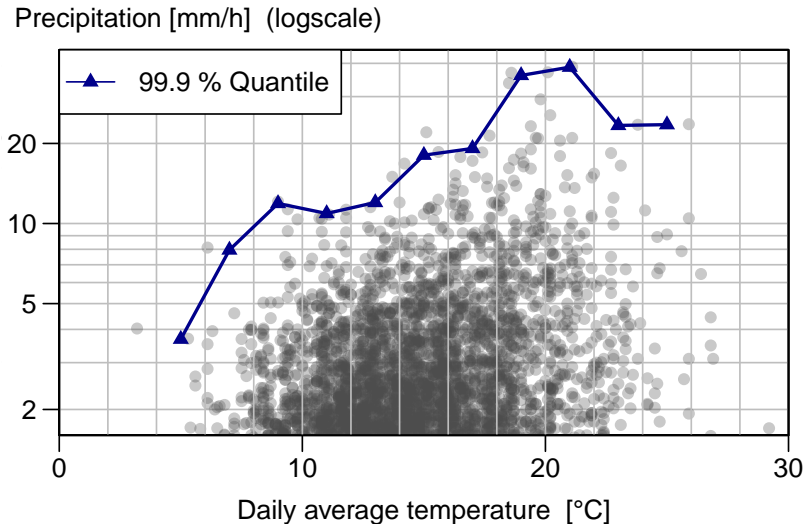
High precipitation quantiles drop at high temperatures



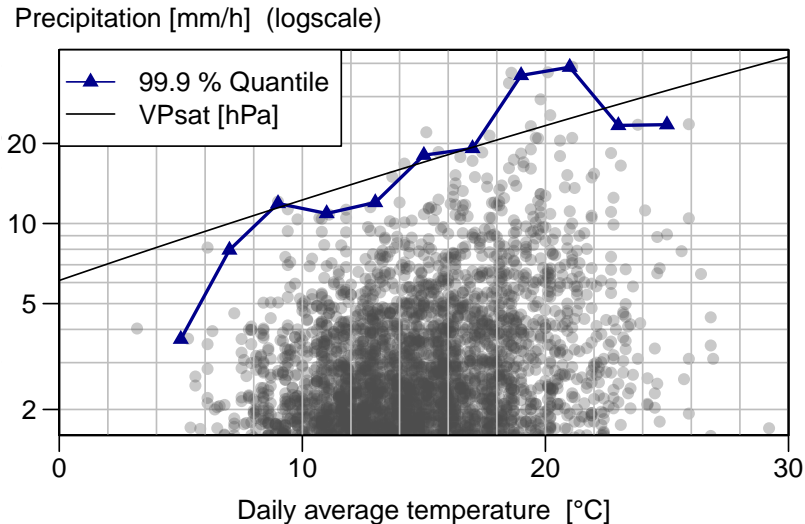
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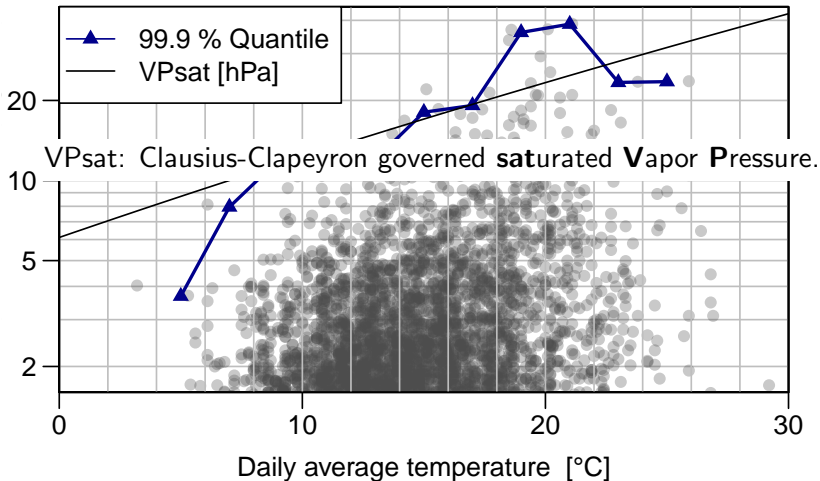


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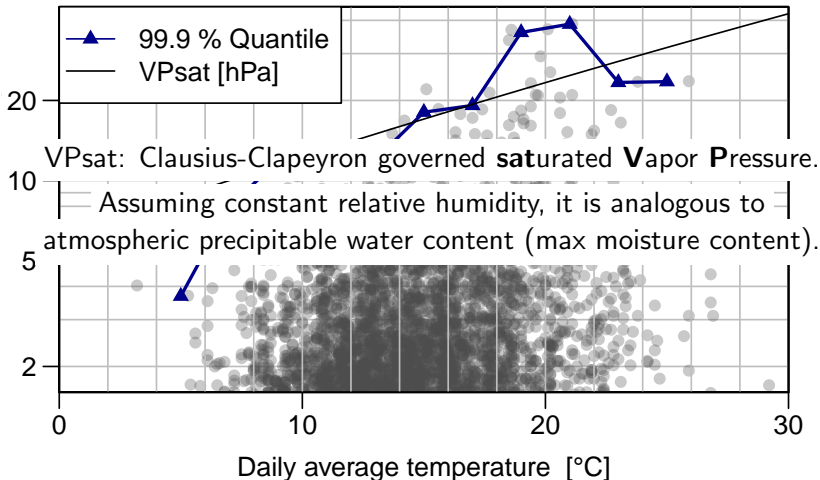
High precipitation quantiles drop at high temperatures

Precipitation [mm/h] (logscale)

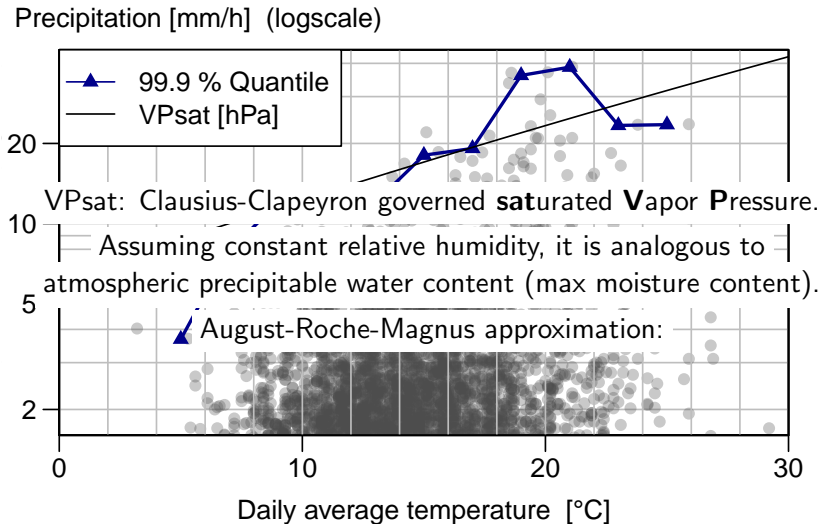


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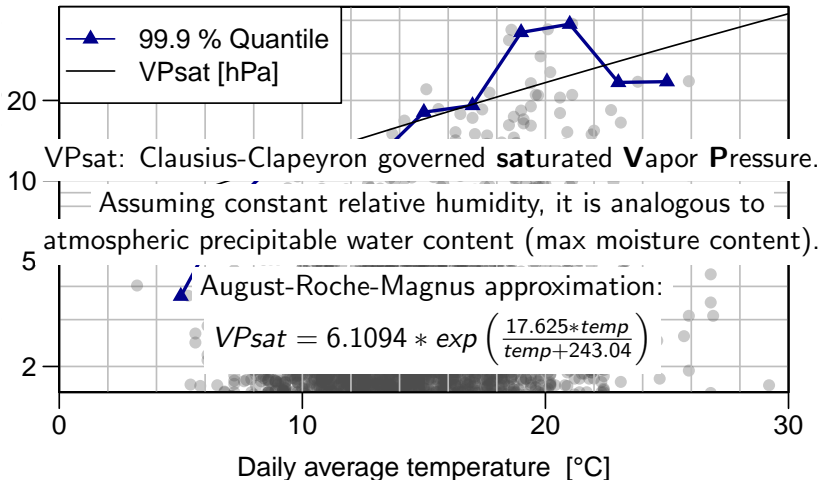


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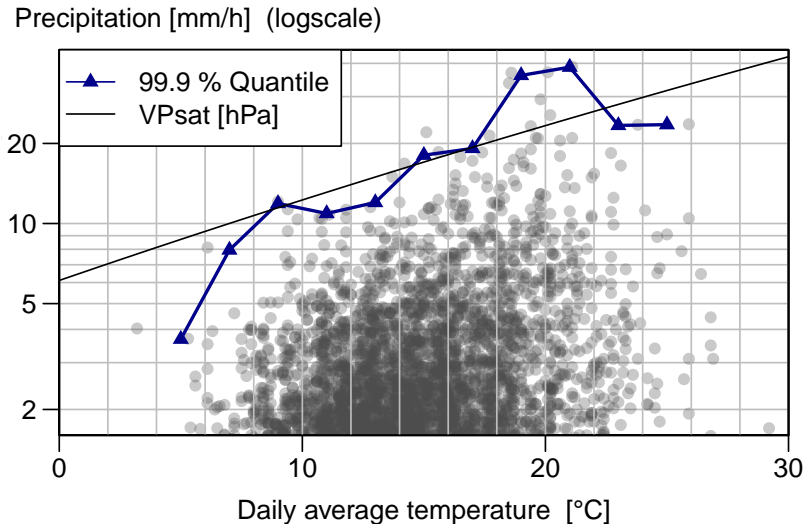


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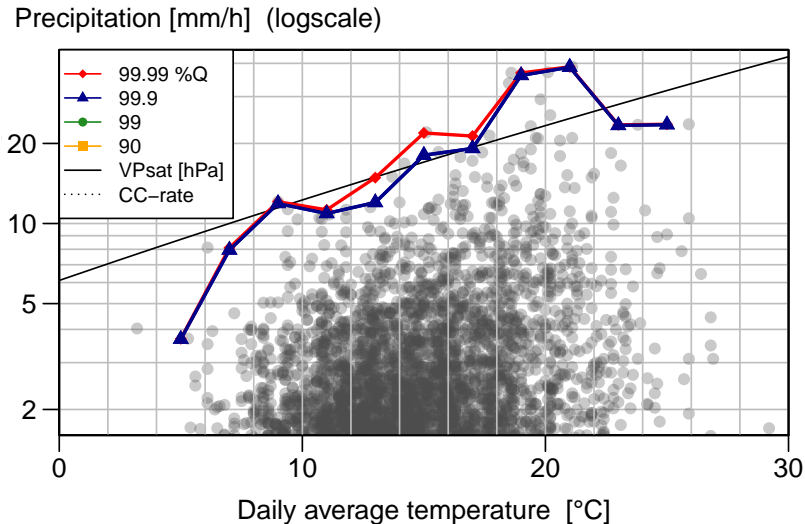
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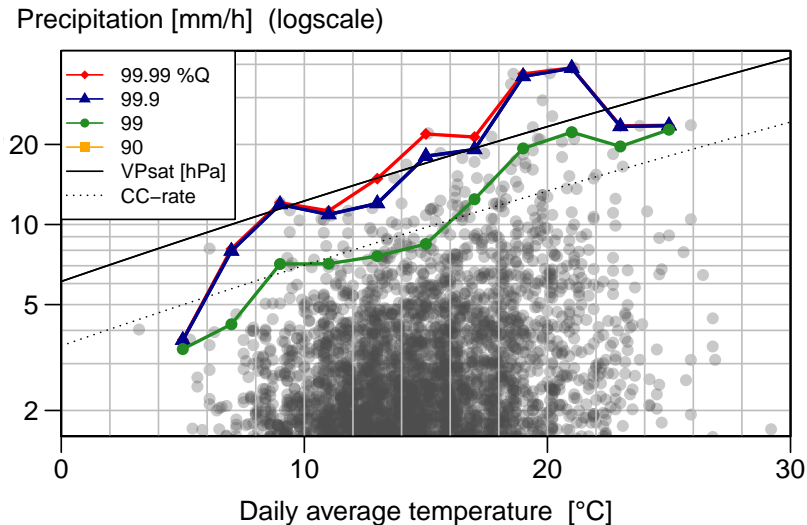
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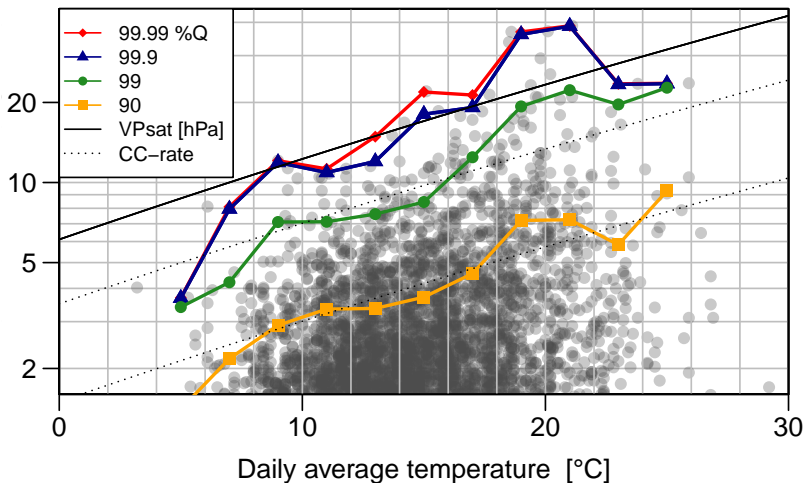


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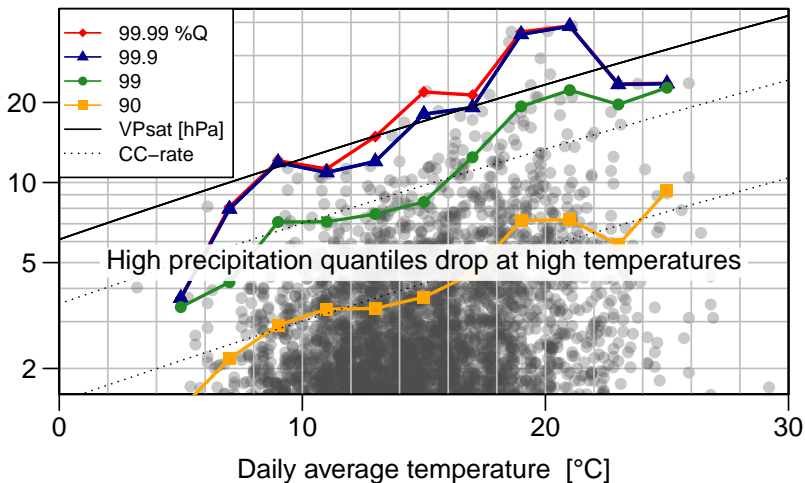
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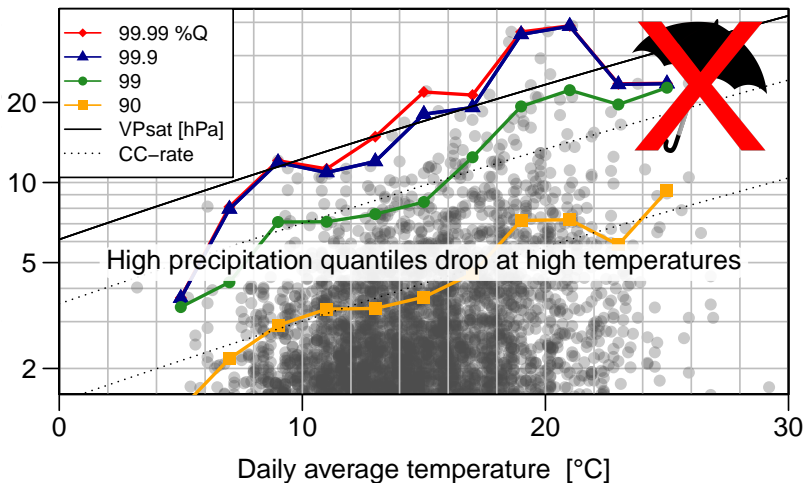
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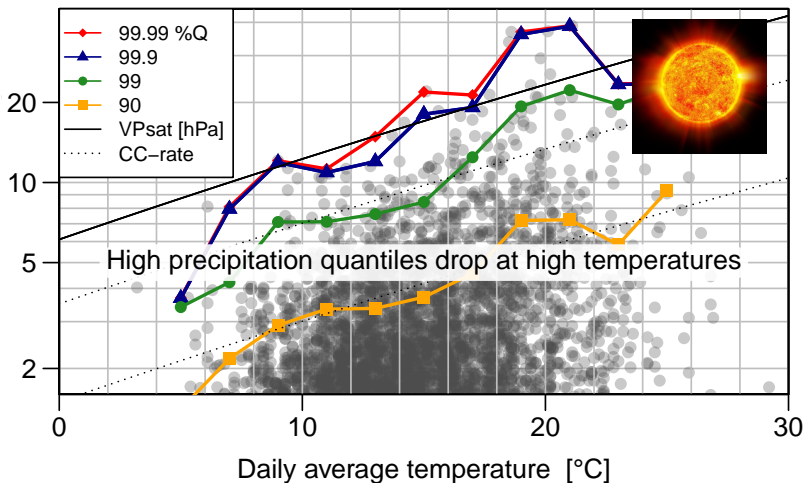
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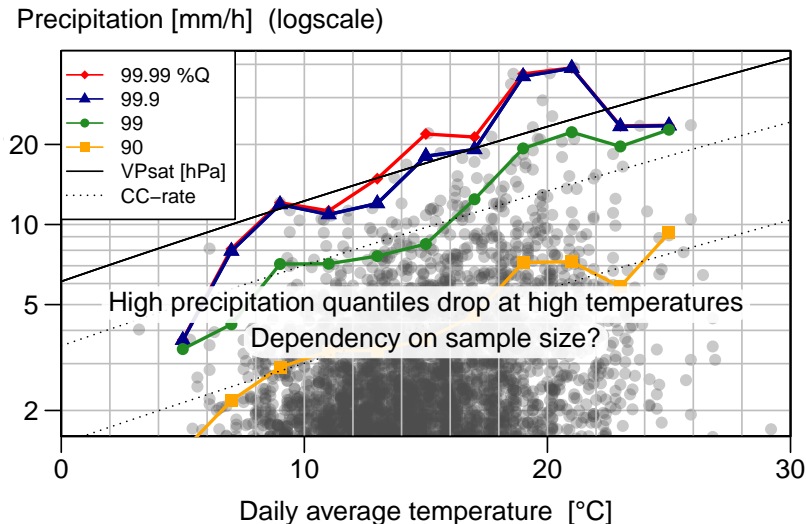


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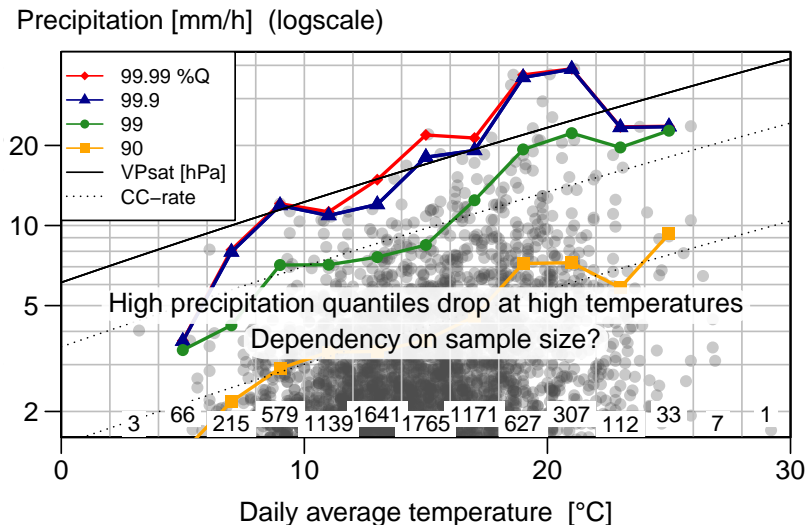
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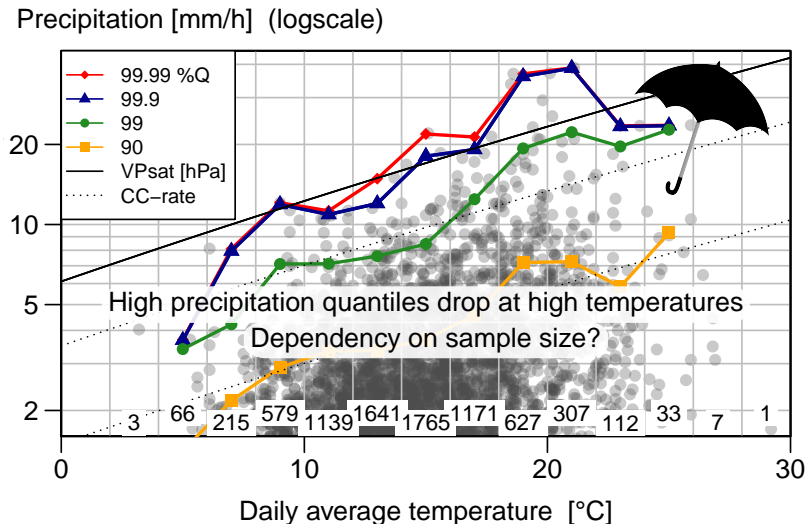
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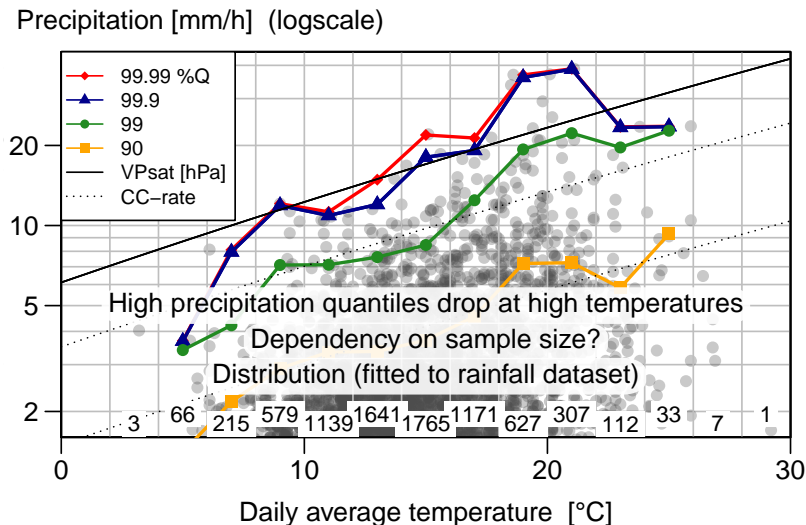
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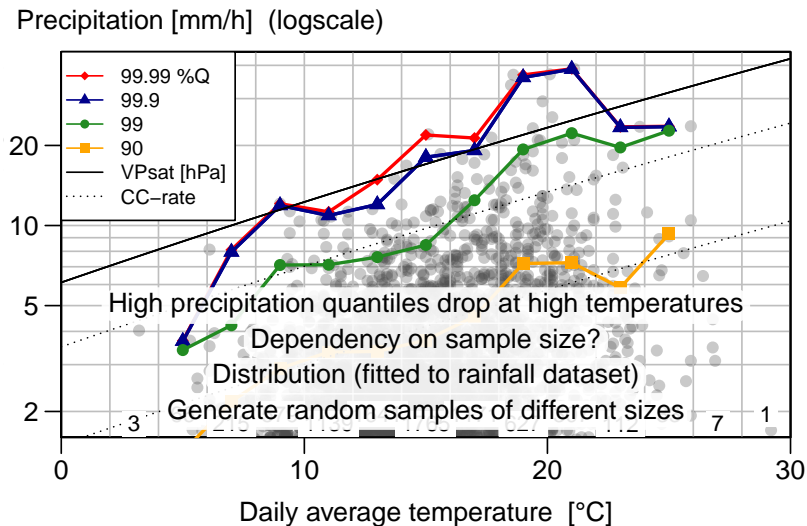
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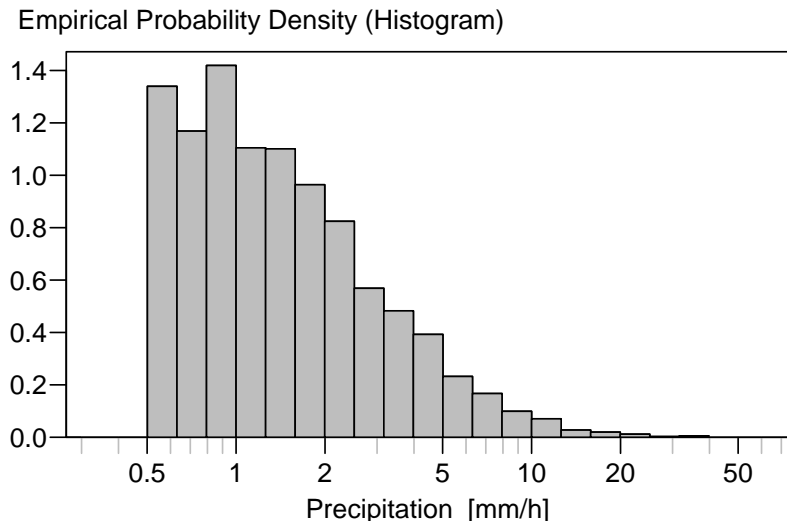


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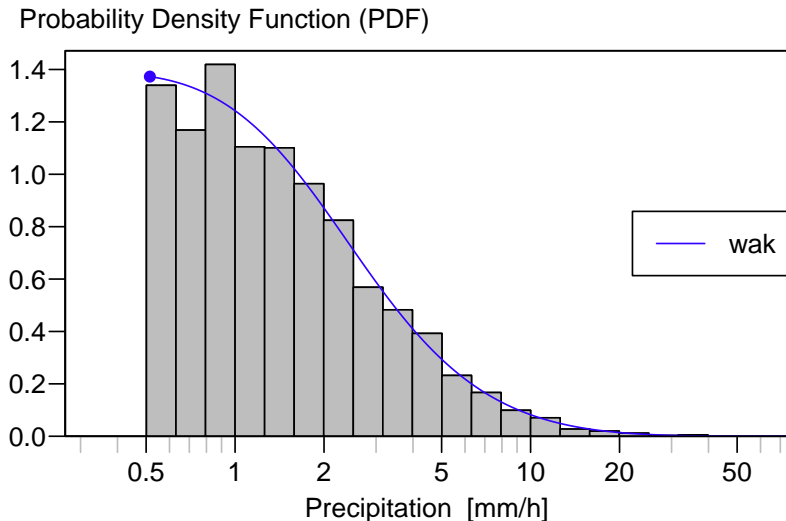


Distributions must be fitted carefully

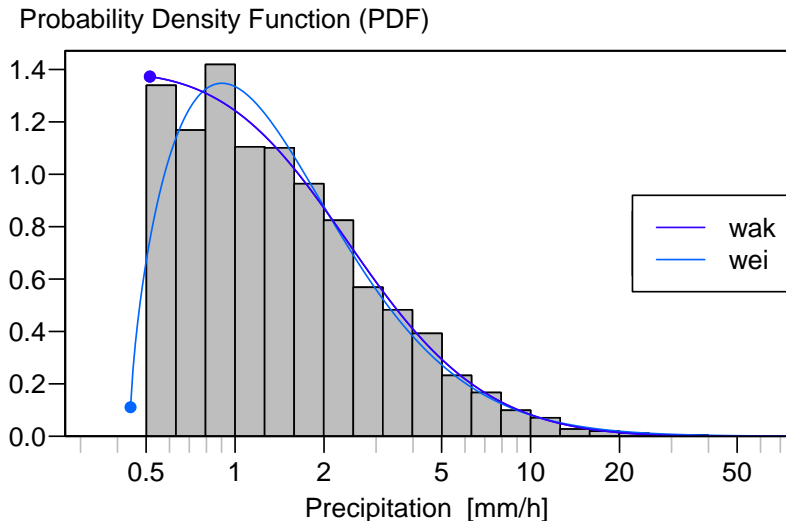
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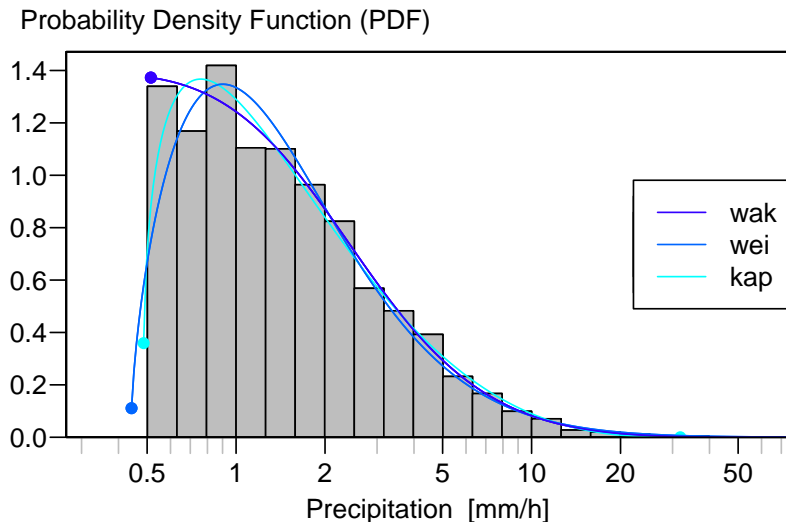
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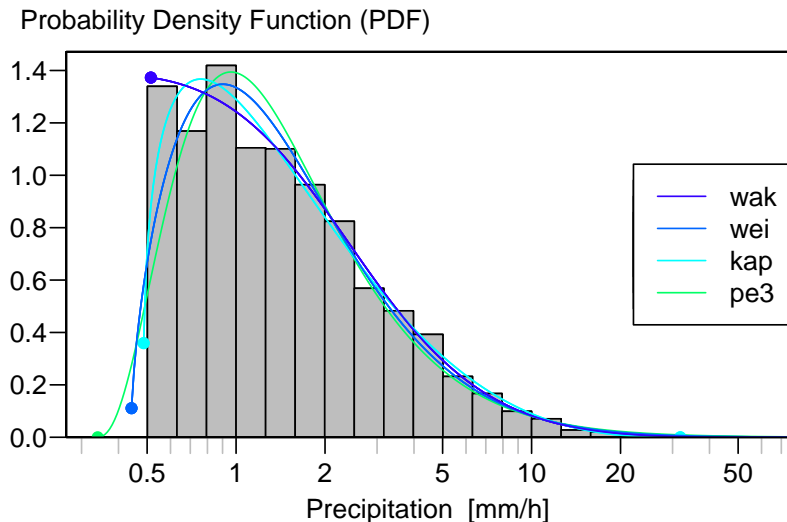
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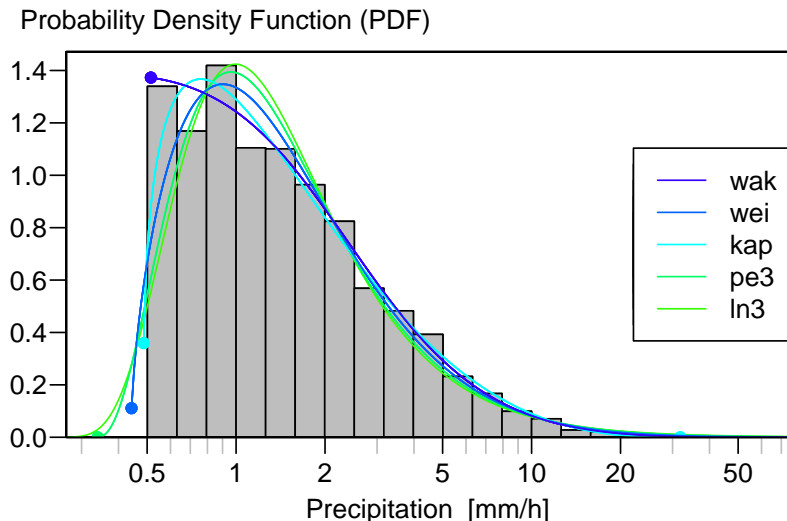
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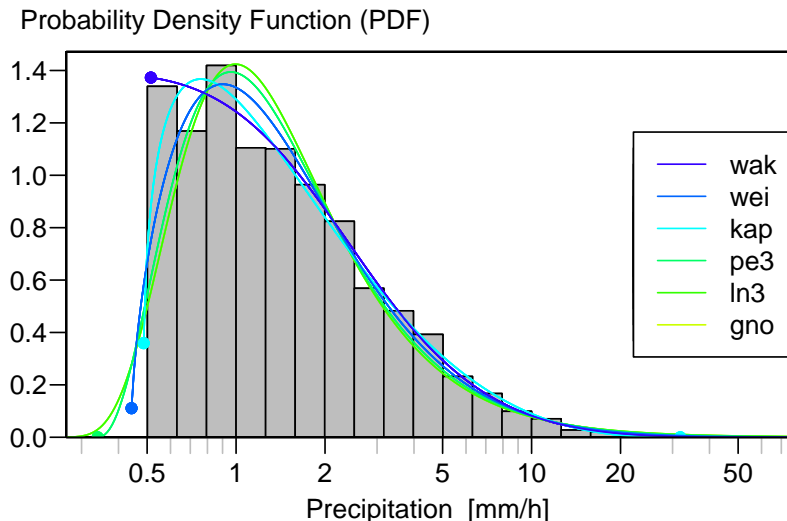
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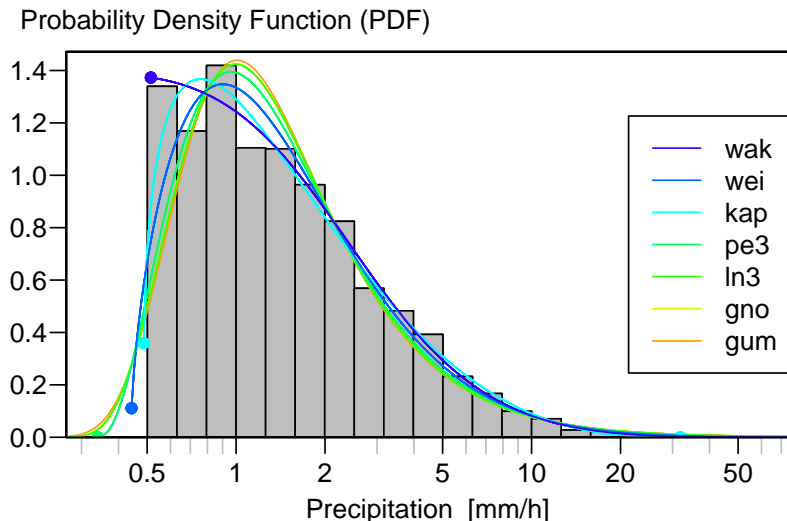
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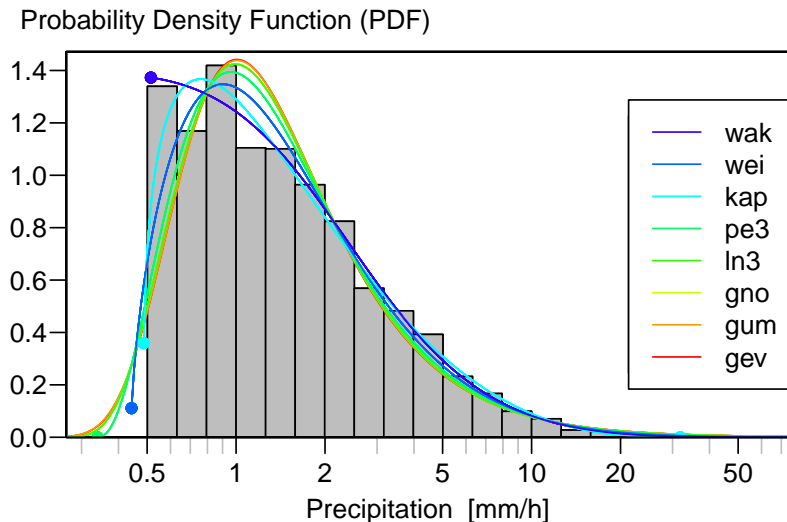
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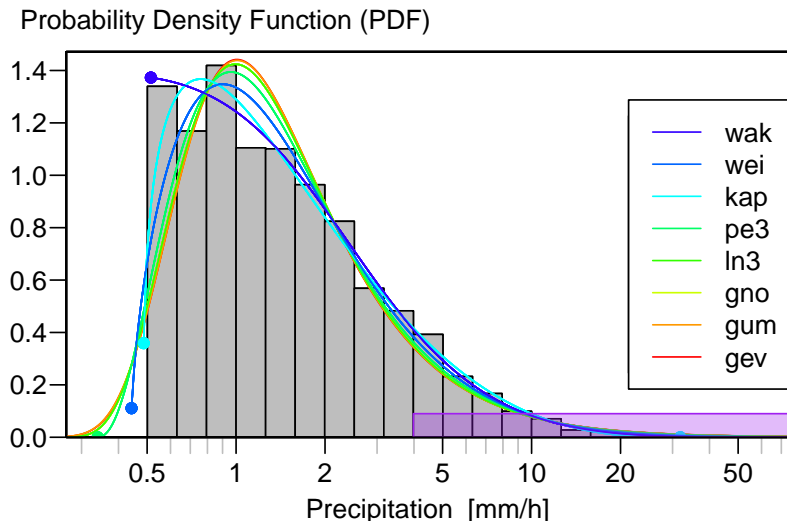
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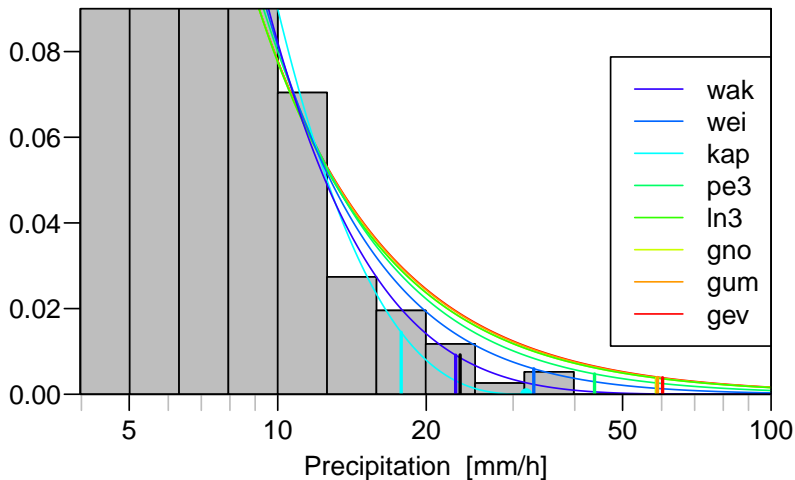


Distributions must be fitted carefully



Distributions must be fitted carefully

Probability Density Function (PDF)

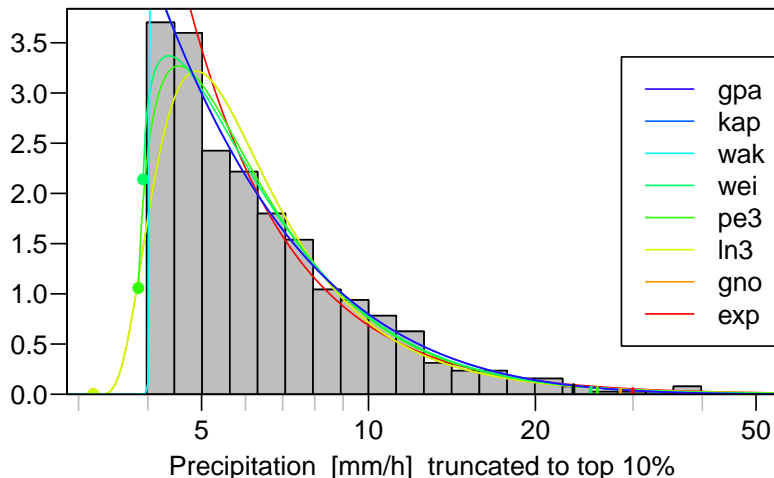


Distributions must be fitted carefully

Extreme value statistics to the rescue!

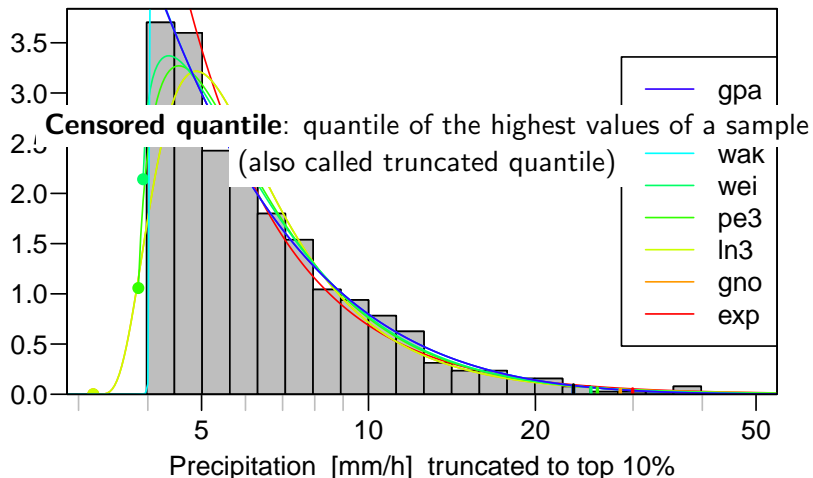
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Probability Density Function (PDF)



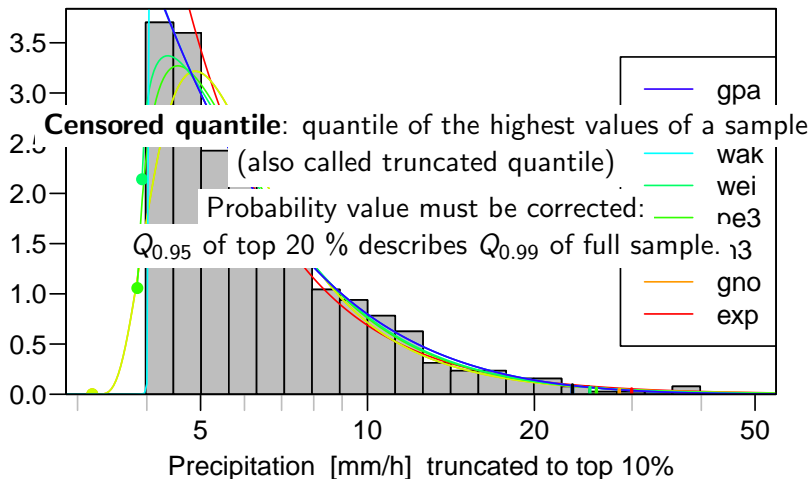
Distributions must be fitted carefully

Probability Density Function (PDF)



Distributions must be fitted carefully

Probability Density Function (PDF)



Distributions must be fitted carefully

Science should strive for reproducibility:



Fit, plot and compare several (extreme value) distributions by means of a plot with return periods on a linear scale — Edit

71 commits

1 branch

0 releases

1 contributor



branch: master

extremeStat / +



links updated in readme



brry authored 32 seconds ago

latest commit f8c3b5a9cf



R distLgof: ellipsis option for customizing distLgofPlot

12 days ago



man distLextreme: Examples improved significantly, Goodness-of-fit stuff ...

12 days ago



.Rbuildignore Moving development of extremeStat to github.

7 months ago



.gitignore Moving development of extremeStat to github.

7 months ago



ChangeLog quiet argument added throughout the package

25 days ago



DESCRIPTION distLextreme: Examples improved significantly, Goodness-of-fit stuff ...

12 days ago



NAMESPACE dependency instead of a bunch of functions in two packages, which is ...

5 months ago



README.md links updated in readme

31 seconds ago



extremeStat.Rproj Moving development of extremeStat to github.

7 months ago

README.md

extremeStat

Fit, plot and compare several (extreme value) distributions and draw a plot with return periods on a linear scale.

<> Code

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Wiki

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Settings

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<https://github.com/t>

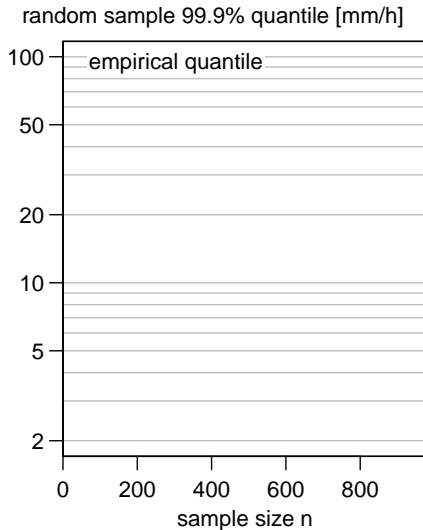
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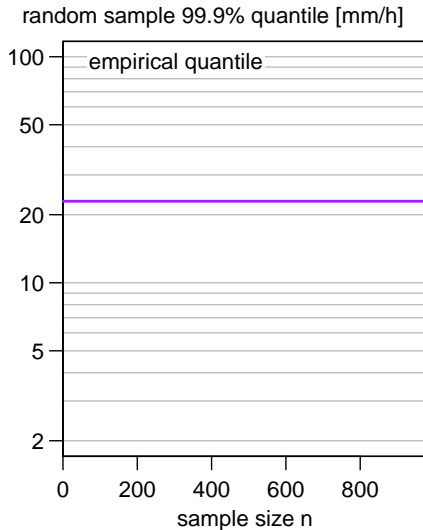
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Low sample size could explain quantile drop

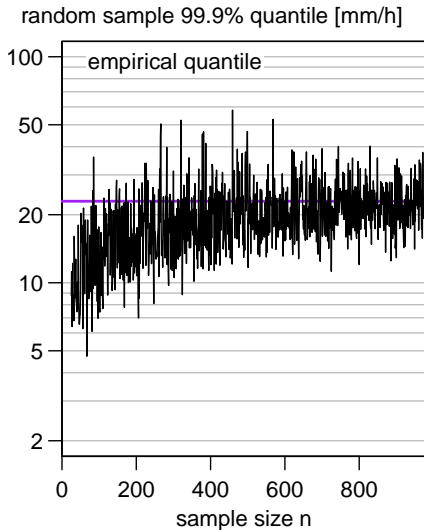
Low sample size could explain quantile drop



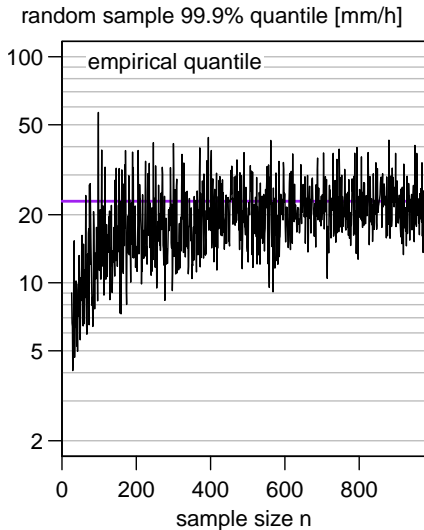
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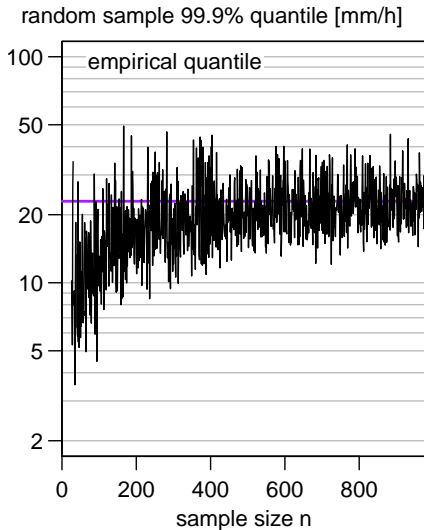
Low sample size could explain quantile drop



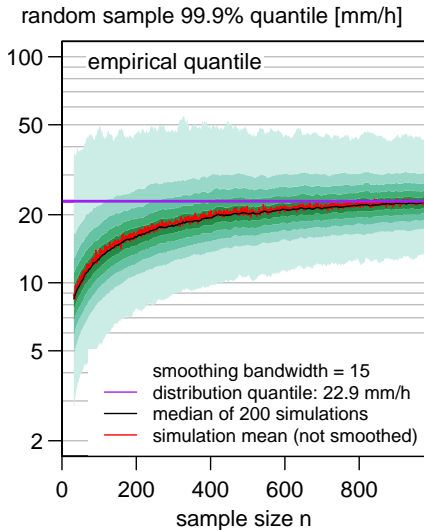
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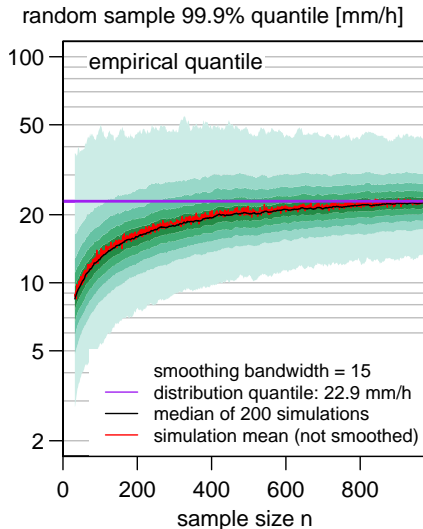
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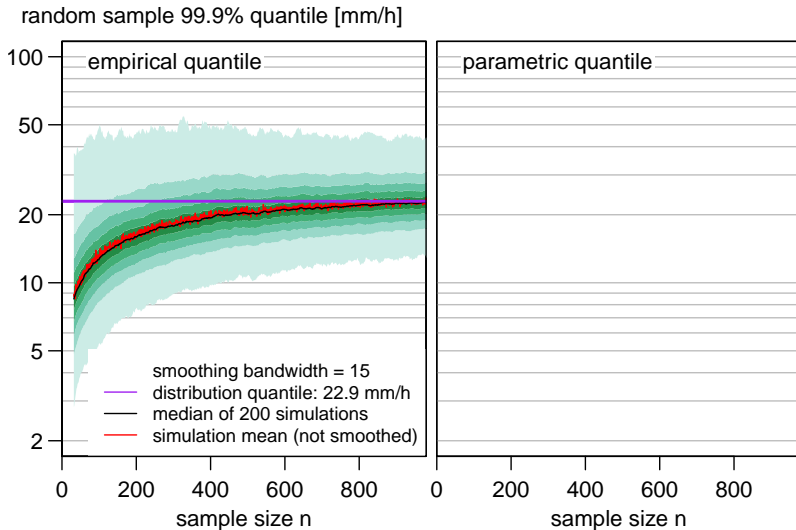


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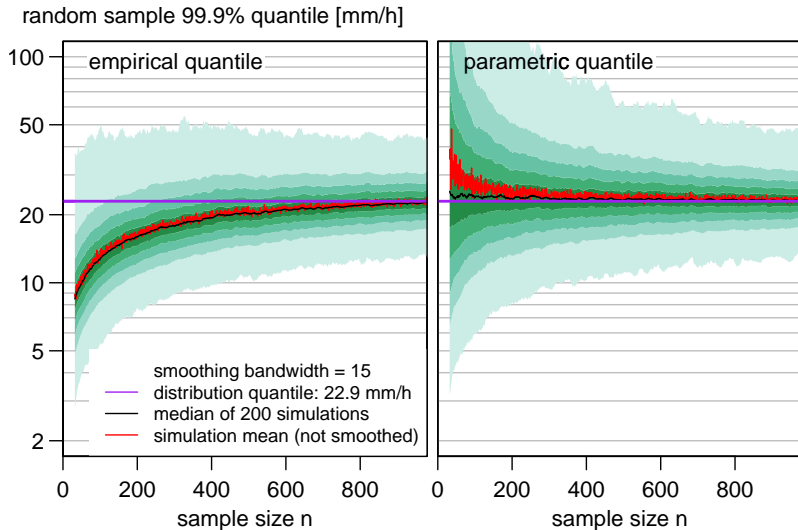


Parametric quantile:
quantile from distribution
fitted to sample

Low sample size could explain quantile drop

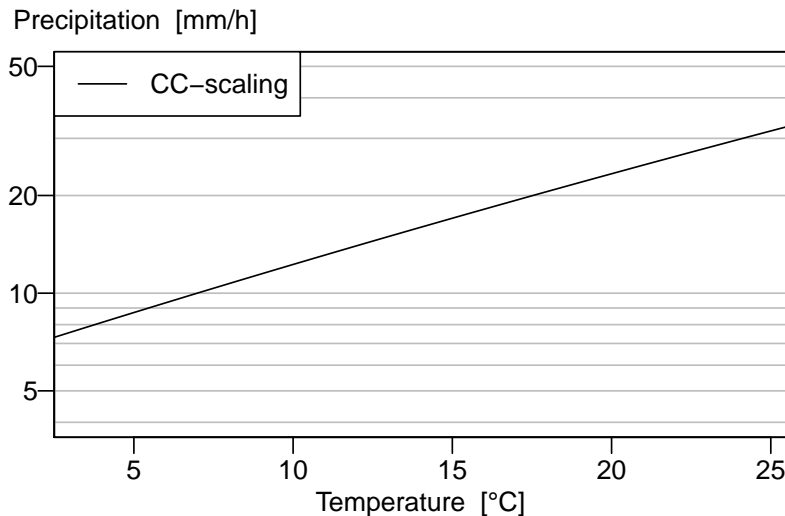


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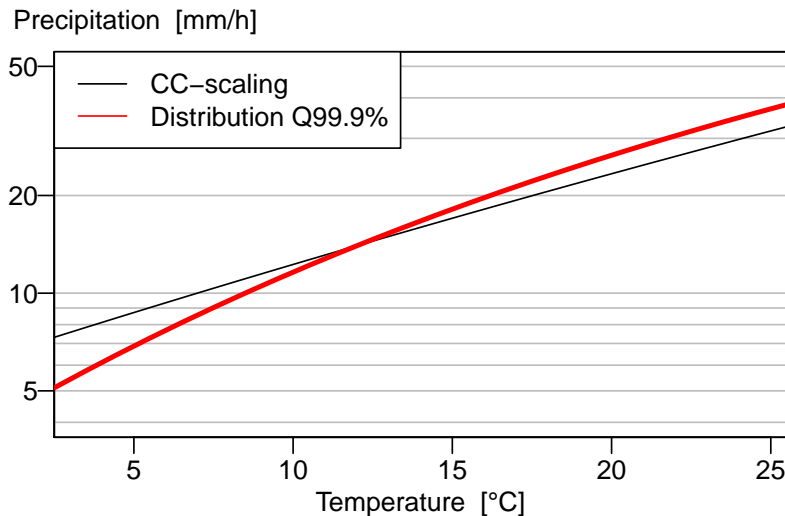


Low sample size could explain quantile drop

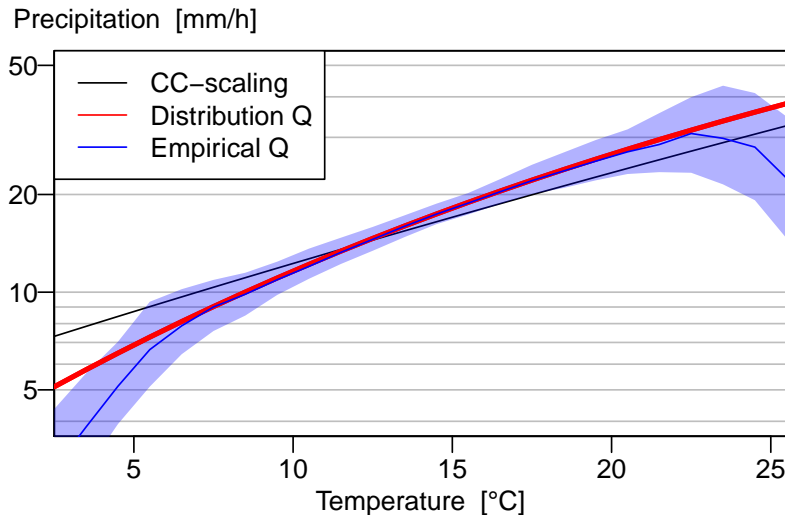
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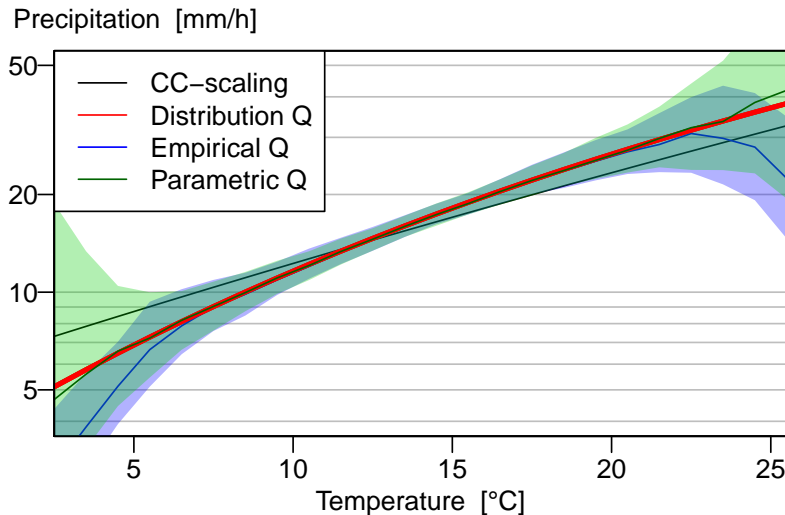
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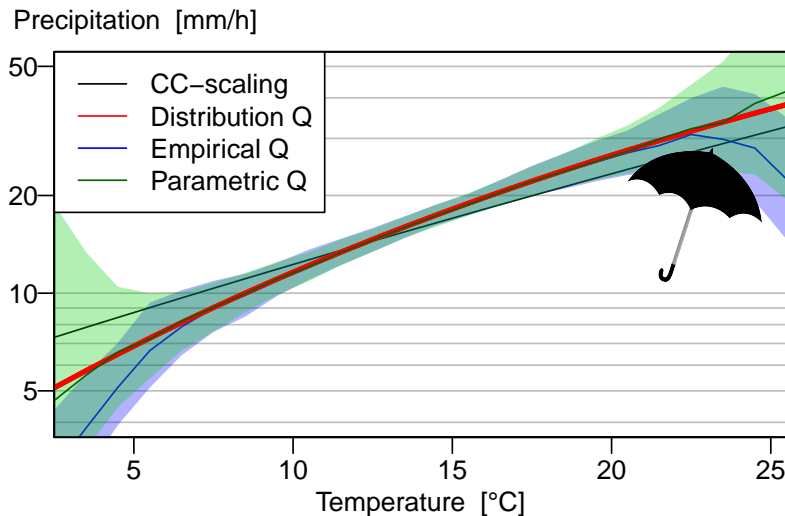
Low sample size could explain quantile drop



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Low sample size could explain quantile drop



That's why you need an umbrella on hot days

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That's why you need an umbrella on hot days

precipitation intensity quantile drop at high temperatures
may be an effect of sample size

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That's why you need an umbrella on hot days

precipitation intensity quantile drop at high temperatures
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use parametrical quantiles for extreme rainfall intensity estimation

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That's why you need an umbrella on hot days

precipitation intensity quantile drop at high temperatures
may be an effect of sample size

use parametrical quantiles for extreme rainfall intensity estimation

source code slides, references and materials: github.com/brry/prectemp

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Image credits:

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<http://pngimg.com/download/494>

http://dreamatico.com/data_images/sun/sun-5.jpg

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Thanks to many proofreaders

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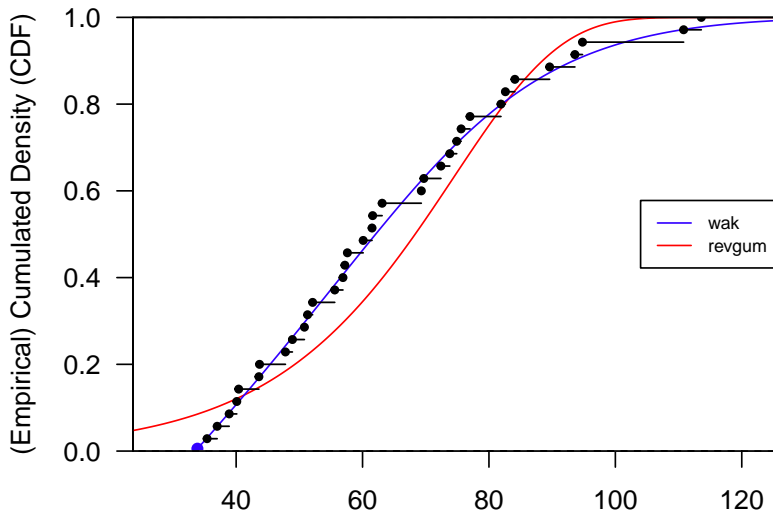
http://dreamatico.com/data_images/sun/sun-5.jpg

Thanks to many proofreaders
and my supervisors

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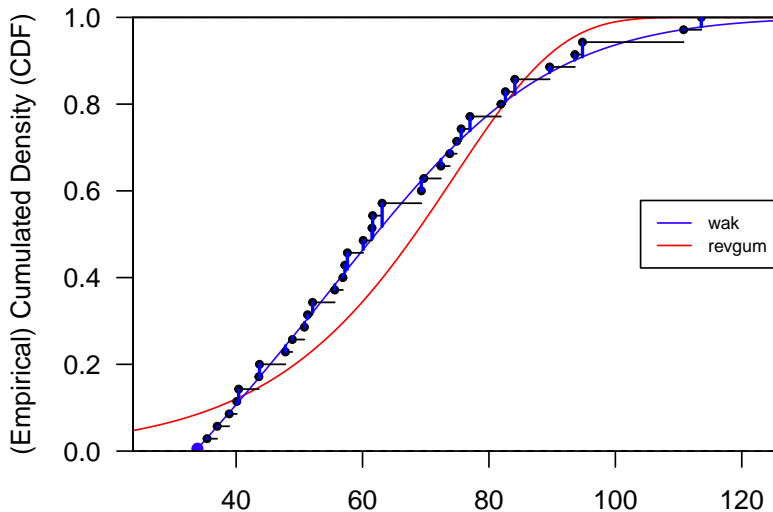


Goodness of Fit measured by RMSE of cumulated distribution function and ecdf



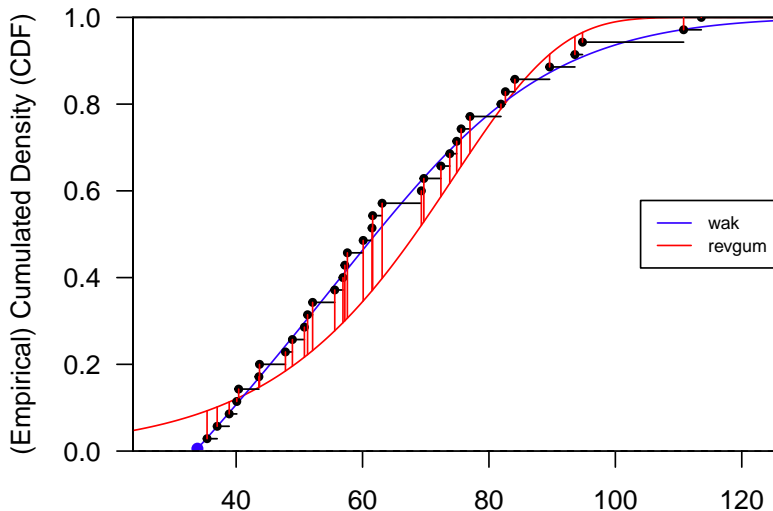
Goodness of Fit

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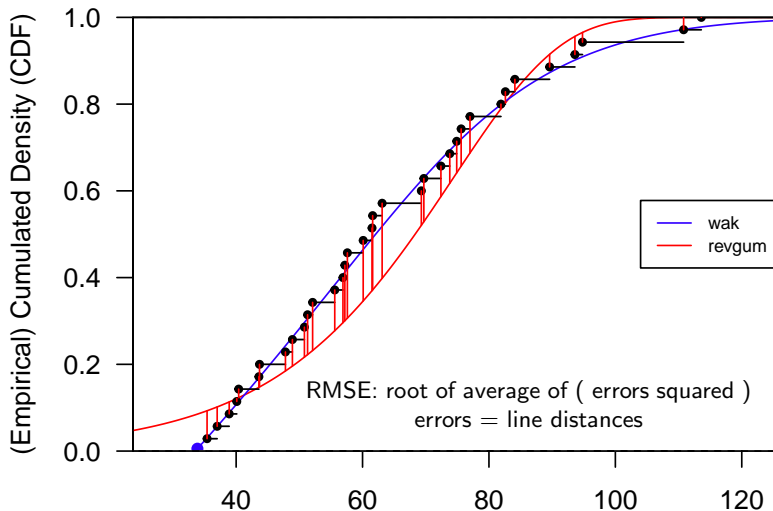
Goodness of Fit

measured by RMSE of cumulated distribution function and ecdf



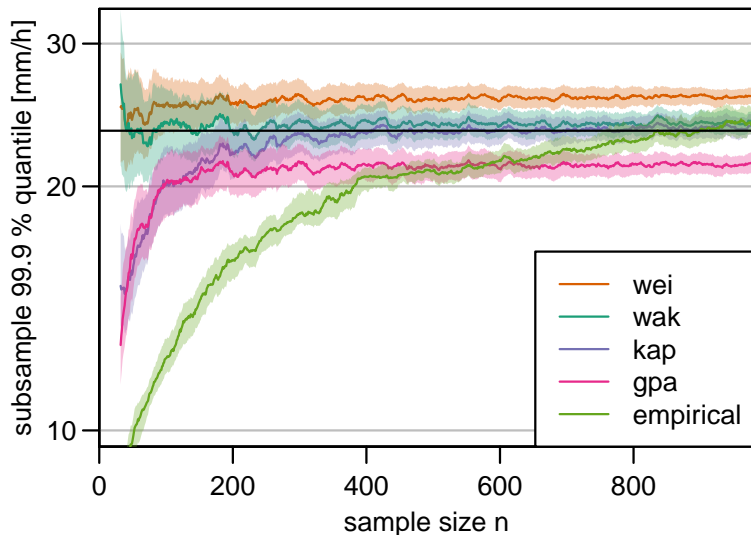
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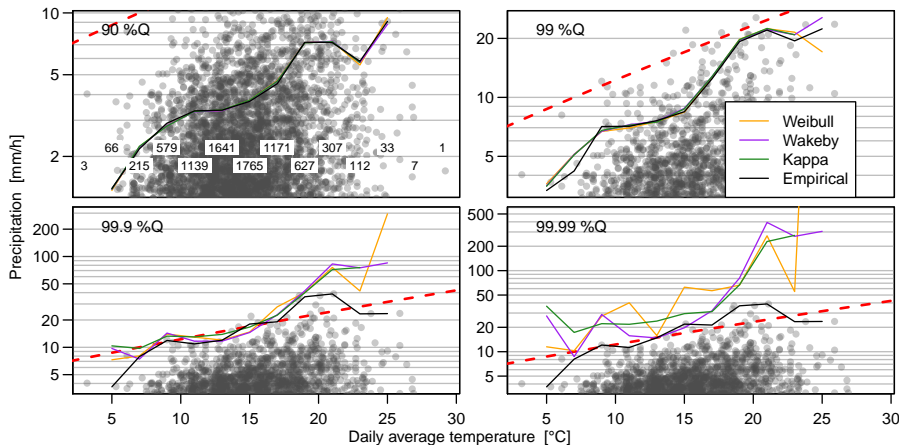


Random subsamples drawn from real data (observations)

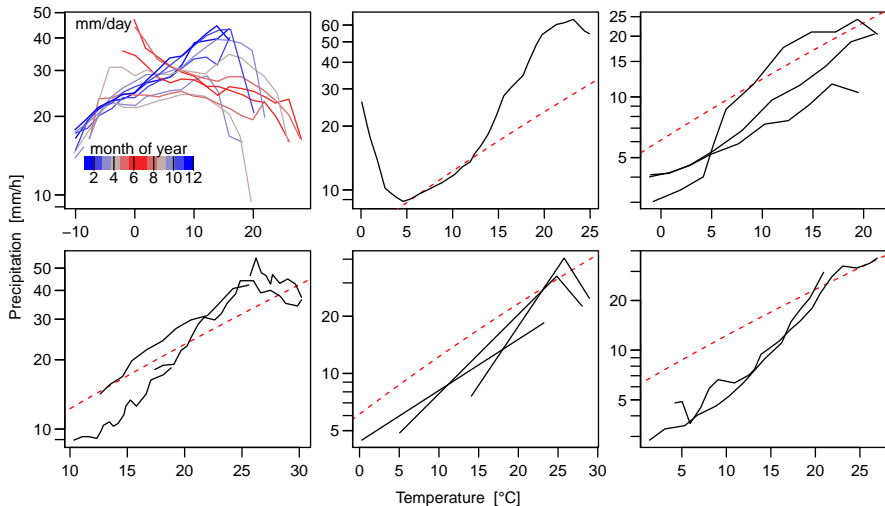
Truncated parametric quantiles (fitted to top 20%) still depend (a little bit)



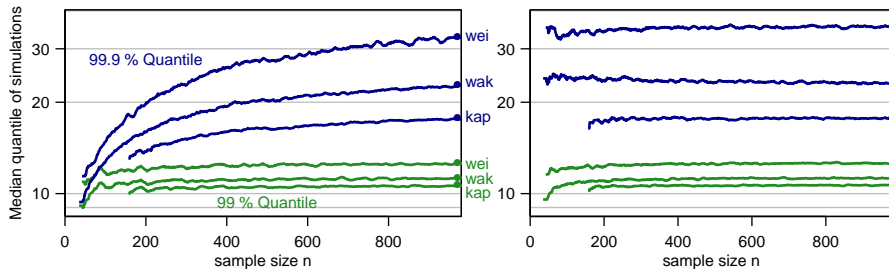
parametric truncated quantiles applied to original Potsdam dataset



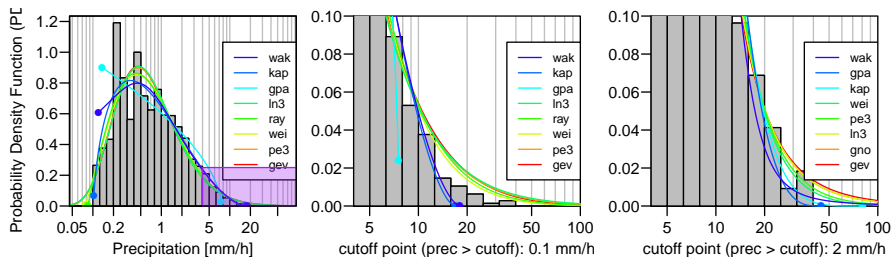
PT relationships in literature



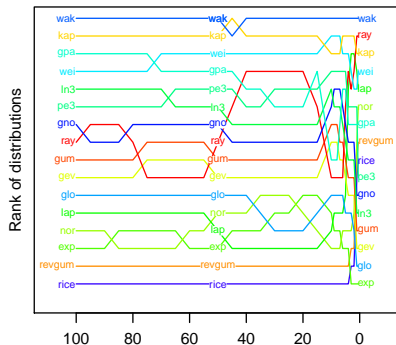
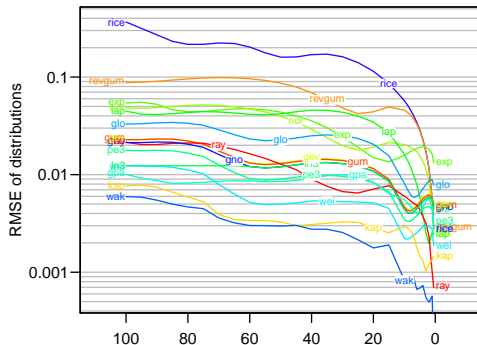
simulations with other distributions



cutoff effect

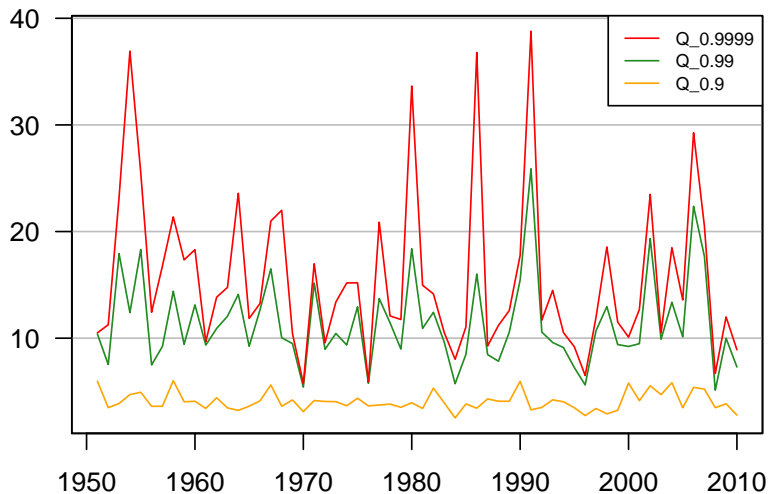


gofprop effect



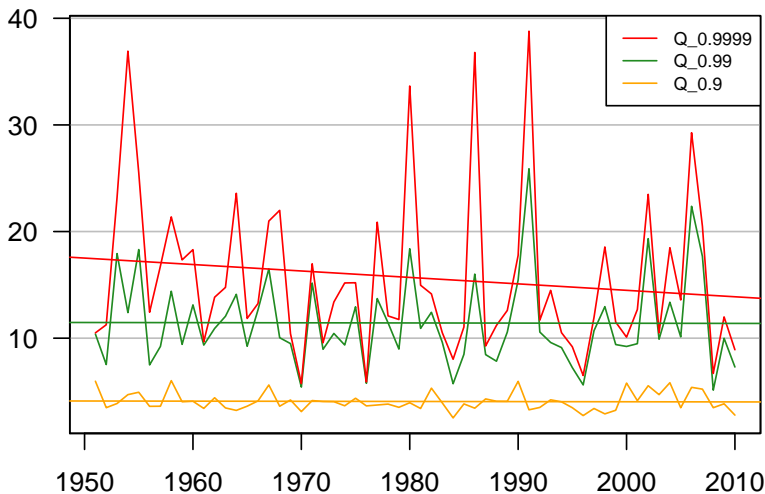
No real temporal trend observed with empirical quantiles

annual precipitation quantiles [mm/h]



No real temporal trend observed with empirical quantiles

annual precipitation quantiles [mm/h]



parametric Quantiles (Average of 3 closest dists)

annual precipitation quantiles [mm/h]

