Globally estimated precipitation extremes

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Research aim

Develop a consistent and coherent benchmark dataset of extreme precipitation return levels on a global scale

Analyse multiple extreme value distributions and the spatial patterns in the data

Research method

Data: Multi-Source Weighted-Ensemble Precipitation: MSWEP-V2.2[1]

Jan 1979 – Oct 2017, 0.1 arc degree resolution

Extreme Value Distributions:

GEV – Generalized Extreme Value distribution

Annual Maxima

GP – Generalized Pareto distribution

Peak over threshold: different thresholds

MEV – Metastatistical Extreme Value distribution[2]

Fit Weibull for each hydrological year

[1] Beck, et al. (2018, BAMS)
[2] Zorzetto et al., (2016, GRL)

Results

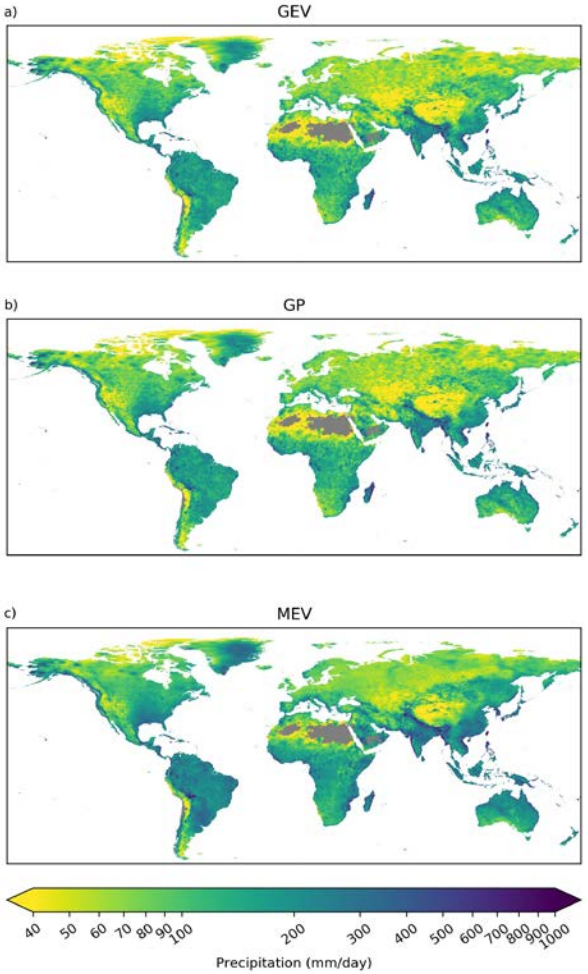
100-year precipitation return levels for a 24-hour duration for 3 distributions.

GEV & GP

- Lower extremes
- Spatially inconsistent patterns

MEV

- Higher extremes
- Spatially smooth patterns



Results

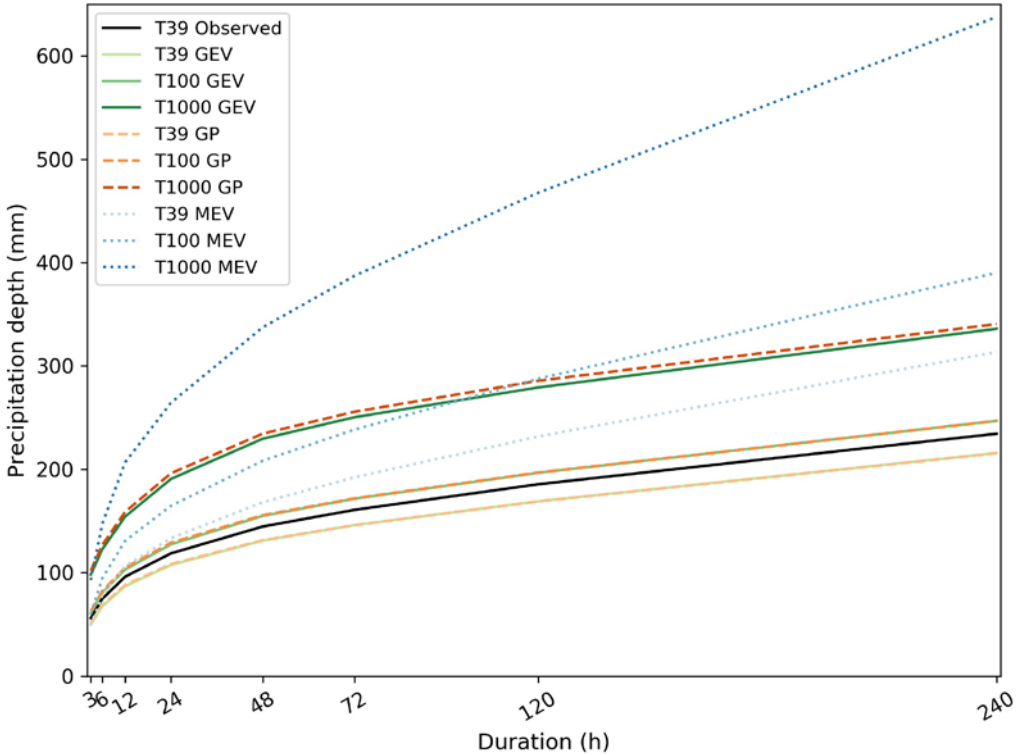
Depth-duration-frequency curves of the mean weighted precipitation worldwide.

GEV & GP

- Similar, lower extremes
- Underestimate observed

MEV

- Higher extremes
- Overestimates observed



Results

Shape parameter for 24-hour precipitation for the 3 distributions.

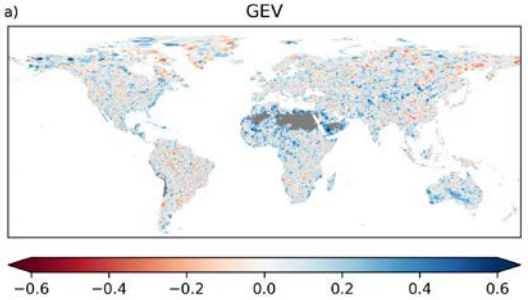
Red	thin tail
White	exponential tail
Blue	heavy tail

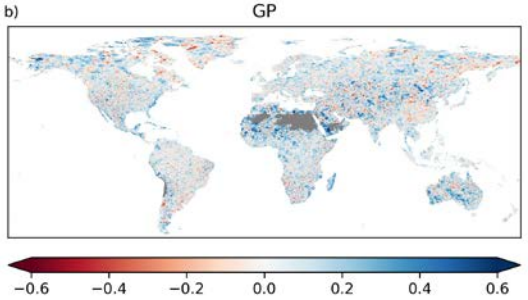
GEV & GP

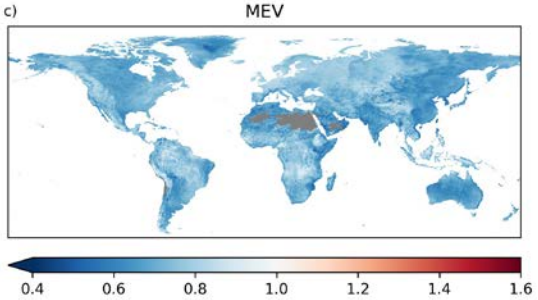
- Large variability, heavy and thin tails
- Low sptial coherence

MEV

- Heavy tails
- Spatial patterns (elevation)







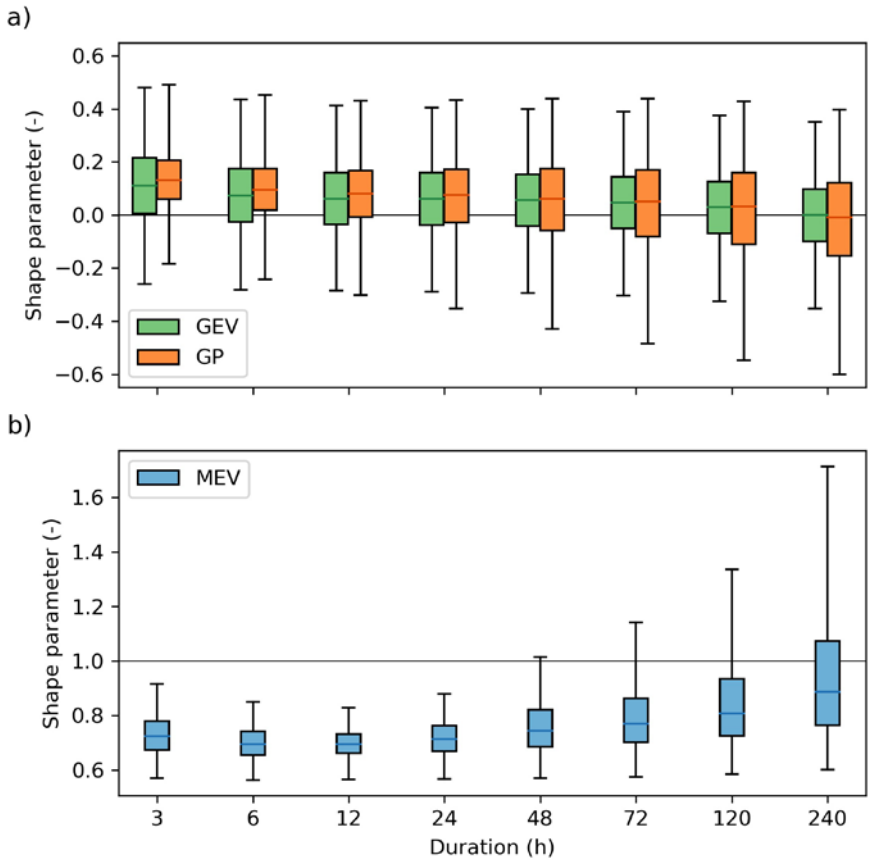
Results

Boxplots with global shape parameter for different durations.

All 3 distributions:

Short duration → heavier tail

Long duration → thinner tail



Results

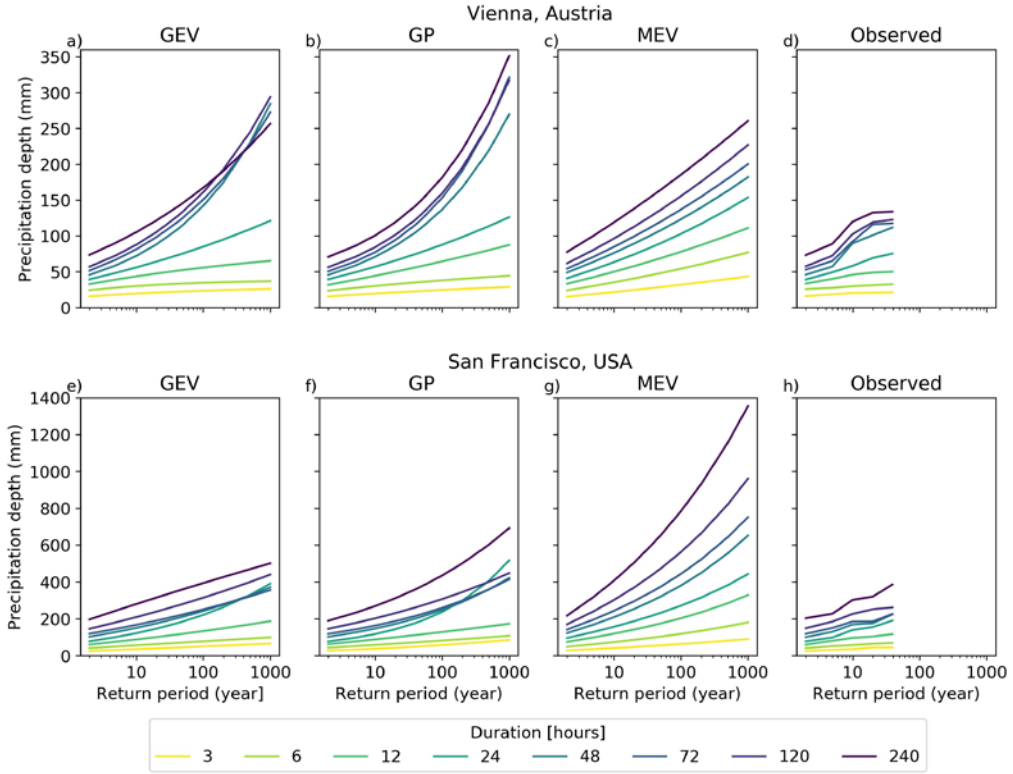
Return level plots for 2 locations

Short duration and small return period:

- good agreement with observed

Long duration and large return period:

- Estimated extremes deviate from observe.
- Lines are crossing over (a,e,f), which is physically impossible.



Conclusion

Global design storms

Detailed resolution (~10 km)

Several durations

Multiple return periods

Usefull for global/large scale & single cell scale

Dataset openly available

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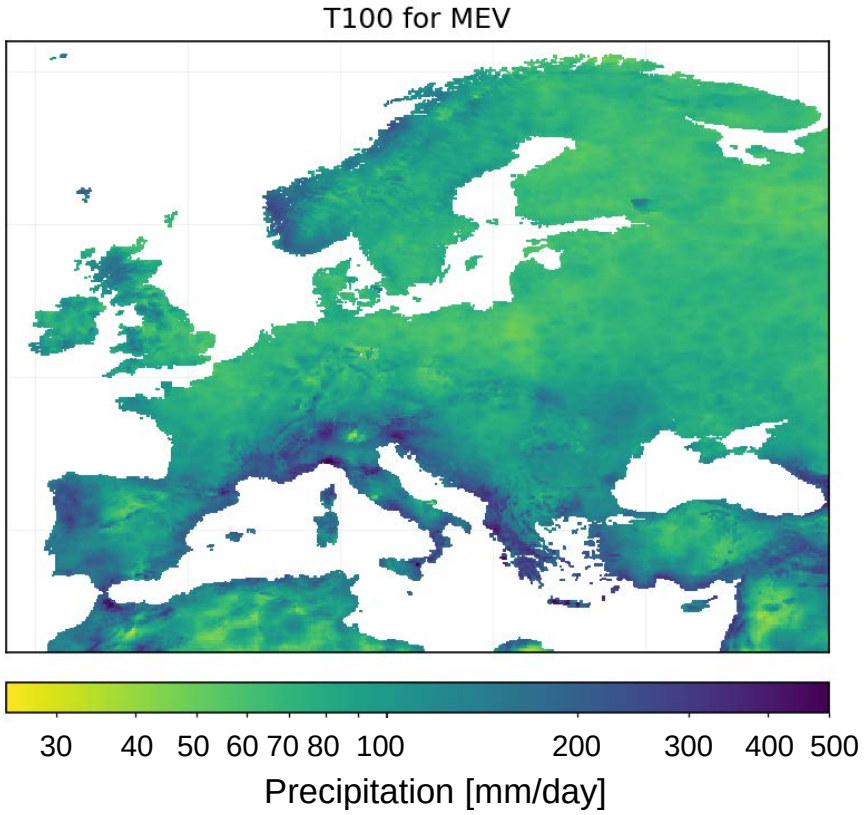
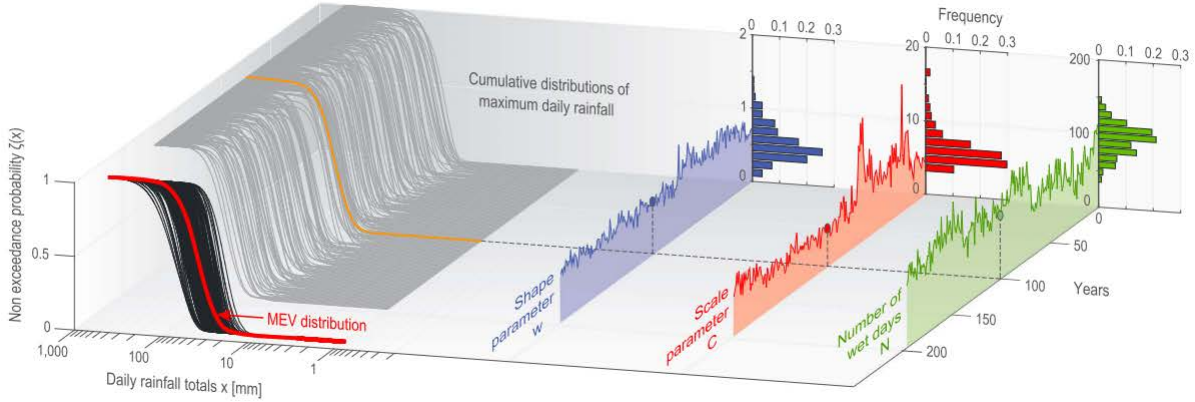


EXTRA INFO - MEV

Metastatistical Extreme Value Distribution[1]

$$\zeta_m(x) = \frac{1}{M}\sum_{j=1}^{M}\left[1 - e^{-\left(\frac{x}{c_j}\right)^{w_j}}\right]^{n_j}$$

ζ_m = MEV cumulative distribution function
c = Weibull scale parameter
w = Weibull shape parameter
n = number of wet days in year j
M = number of years



[1] Zorzetto et al., (2016, GRL)

EXTRA INFO – SHAPE PARAMETER

Shape parameter