POSTER # 3-26

Identifying drivers of hydrological hazards of river basins in spatial heterogeneities of rainfall and catchment attributes

H.-J. Wang[1], S. Yang[2], R. Merz[1], S. Basso[1]

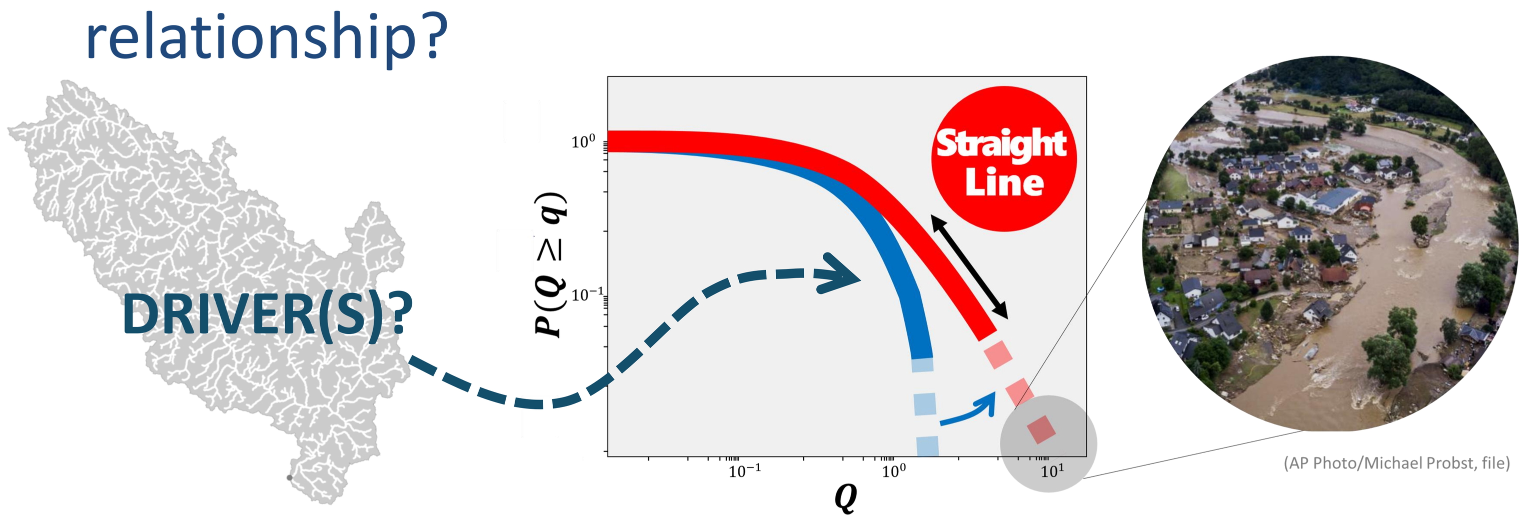
[1]Helmholtz-Centre for Environmental Research - UFZ, Dept. Catchment Hydrology, Halle/Saale

[2]Helmholtz-Centre for Environmental Research - UFZ, Dept. Aquatic Ecosystem Analysis and Management, Magdeburg

hsing-jui.wang@ufz.de

Motivation

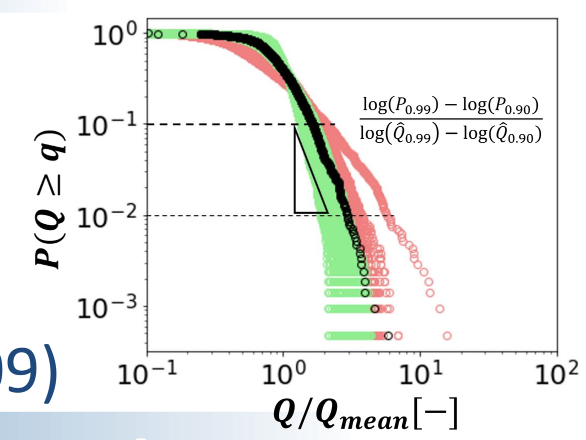
- Heavy-tailed flows as a (long-term) hydrological indicator of hazard in river catchments.
- Does heterogeneous rainfall promote heavy-tailed streamflow? How?
- What roles play catchment attributes in this relationship?



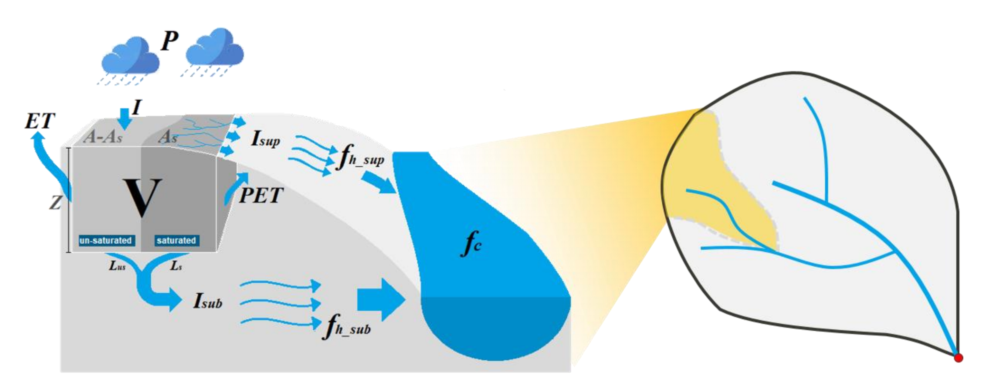
Methods

Indices of tail heaviness

- The slope of the upper tail
  - Smaller slope → heavier
  - Larger slope → lighter
- Robust fitting of power-law distributions (Clauset et al., 2009)



Theory of hydrological transport



Response time distribution in hillslope

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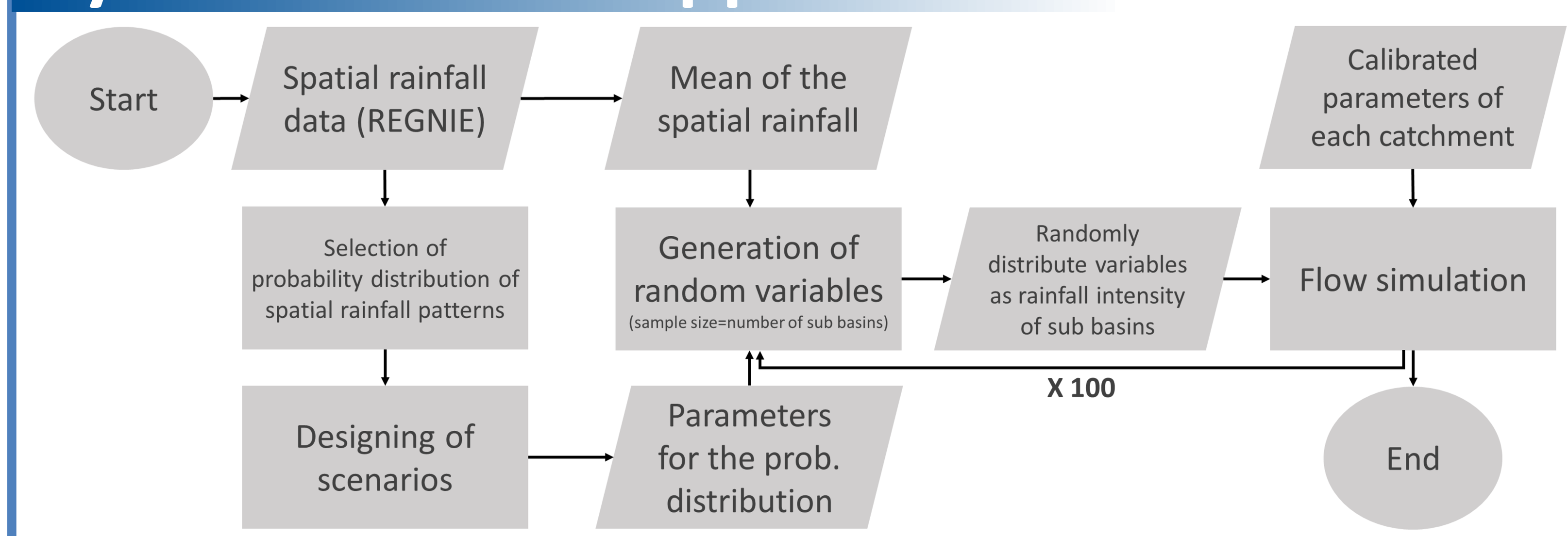
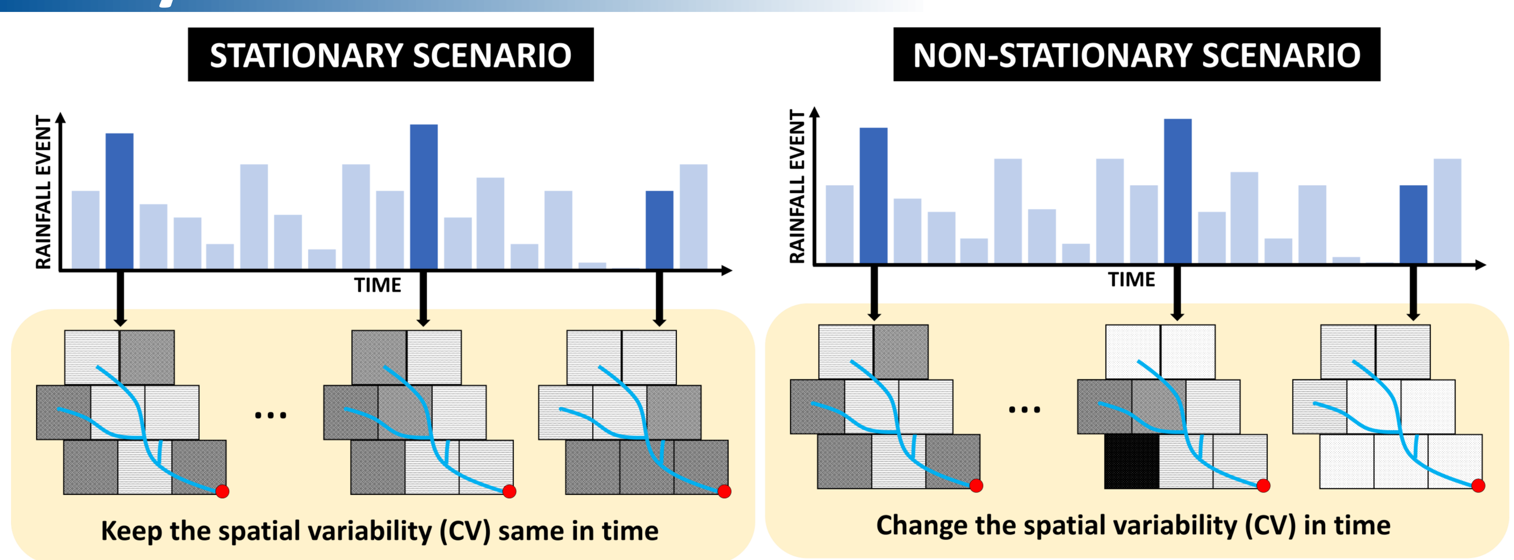
Geomorphological instantaneous unit hydrograph (GIUH)

Synthetic rainfall approach



Analytical scenarios

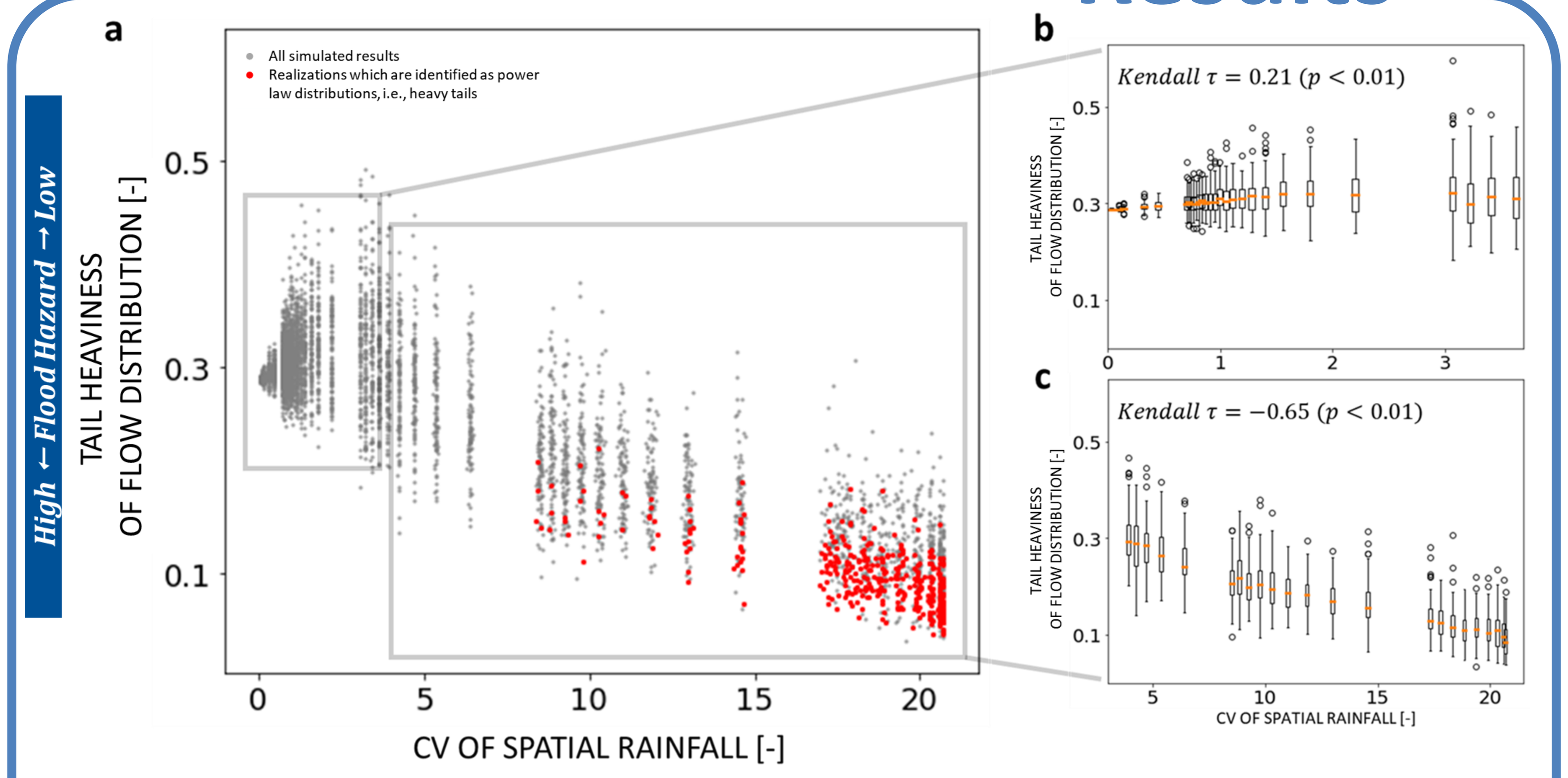


Study Sites in Germany

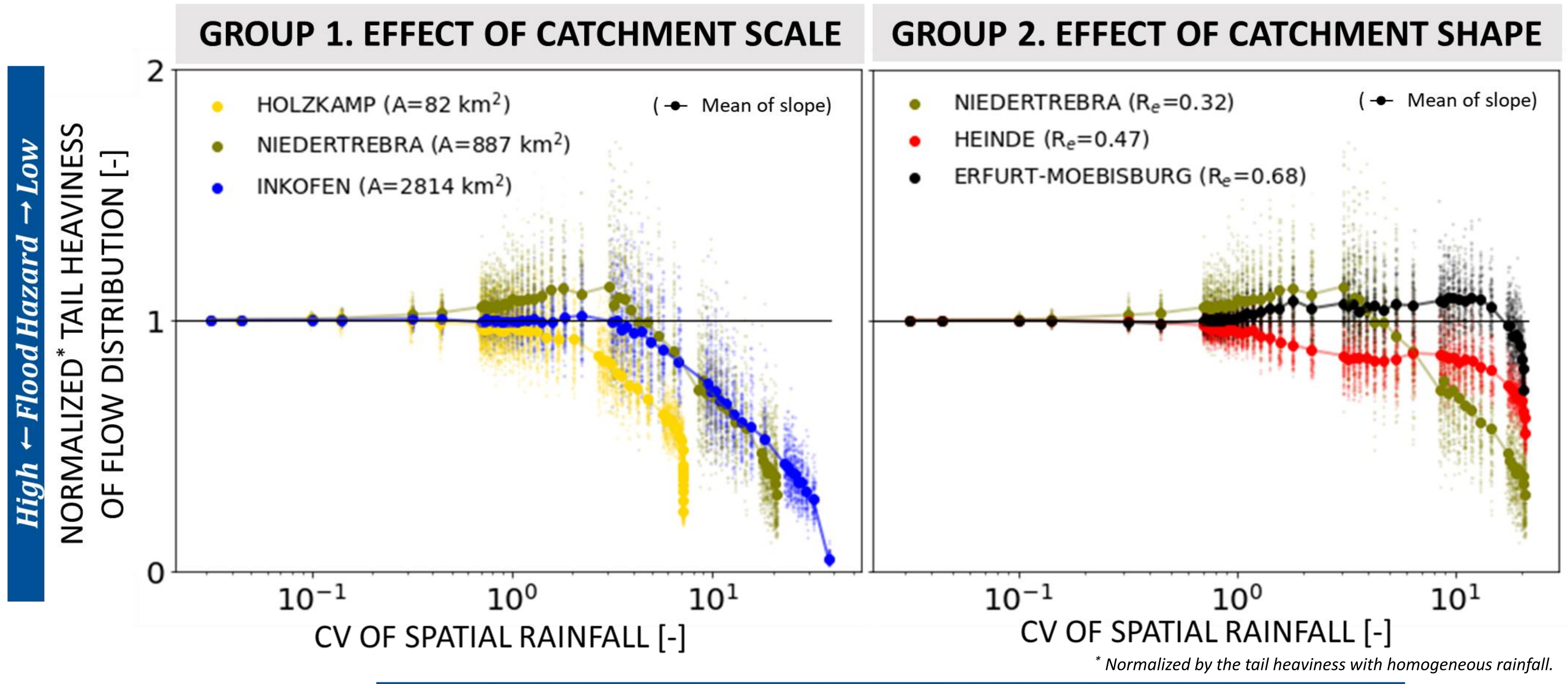
Analysis Group*	Catchment Name	Area (km²)	Mean Elevation (m)	Outlet Elevation (m)	Drainage Density (km/km²)	Elongation Ratio, R_e
1	HOLZKAMP	98	41	9	0.74	0.36
1, 2	NIEDERTREBRA	887	394	133	0.64	0.32
1	INKOFEN	2841	619	415	0.88	0.32
2	HEINDE	898	243	78	0.69	0.47
2	ERFURT-MOEBISBURG	847	441	216	0.71	0.68

** Effects of catchment scale are investigated in group 1; effects of catchment shape are investigated in group 2.*

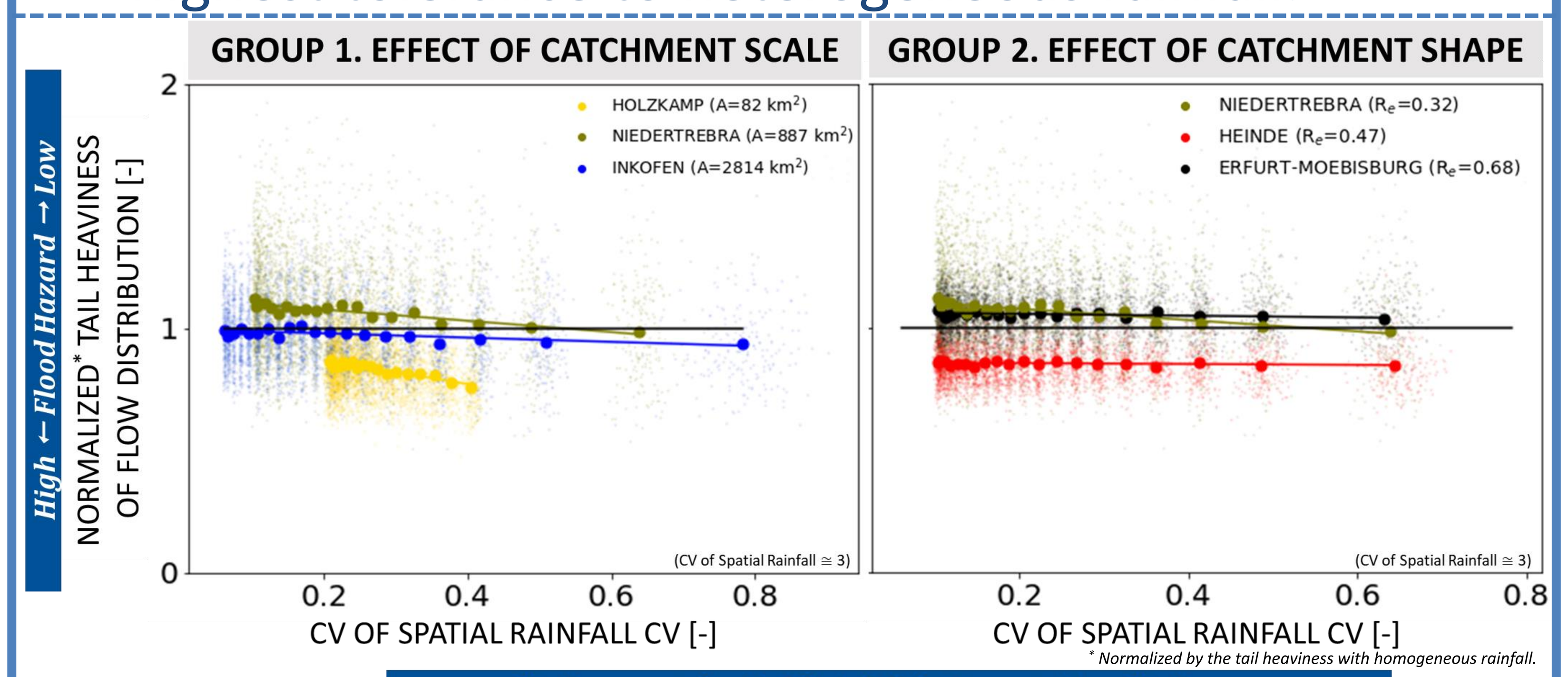
Results



- Heterogeneous rainfall doesn't change the averaged tailed behavior of flow when it is low; but it indeed promotes heavier tails while it is above a certain heterogeneity.



- The small catchment (i.e., yellow dots) has lowest tolerance to heterogeneous rainfall; whereas the circular catchments (i.e., red and black dots) have highest tolerance to heterogeneous rainfall.



- Non-stationarity of rainfall is likely to promote heavier tail, but with different degree by scale and shape of catchments.

Key Points:

- Increasing spatial variability of rainfall determines higher flood hazard (i.e., heavier streamflow tails) only beyond a certain increase threshold.
- This threshold is lower in **smaller catchments**, which are therefore less tolerant to increasing spatial variability of rainfall.
- On the other hand, this threshold is much lower in **elongated catchments** than circular catchments.
- The changing of rainfall spatial variability from event to event only slightly enhances the impacts.

Acknowledgements

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