

- TransParcNet Meeting 2023, 22 June 2023

## Heavy rain induced Floodings in 2021

Foto: Schüttrumpf, 2021



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# Germany

Flood area



■ <b>Hamburg</b>	über 1.000.000 Einwohner	■ <b>Berlin</b>	Hauptstadt eines Staates	— Eisenbahn
□ <b>Nürnberg</b>	500.000 – 1.000.000 Einwohner	□ <b>Düsseldorf</b>	Landeshauptstadt	— Autobahn
○ <b>Karlsruhe</b>	100.000 – 500.000 Einwohner	—	Staatsgrenze	— sonstige Straße
○ <b>Stralsund</b>	unter 100.000 Einwohner	—	Ländergrenze	— schiffbarer Kanal

Why does it make sense to give a presentation on a flood event at an international conference, when there are many flood events worldwide every year?

Return Interval  $T_R > 10.000$  years!

# Flood documentation



photo: Winandy, 2022

# Flood documentation of IWW

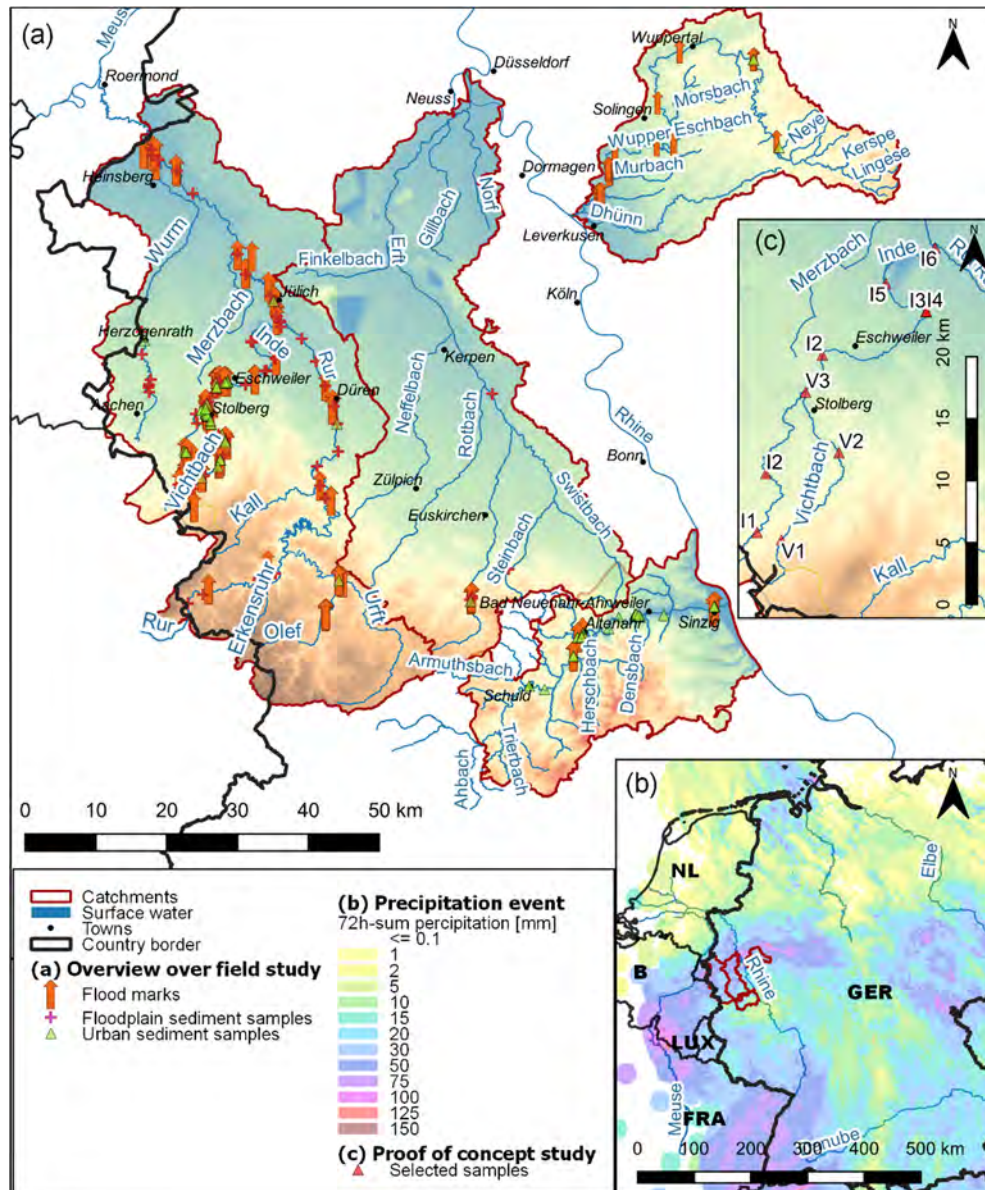


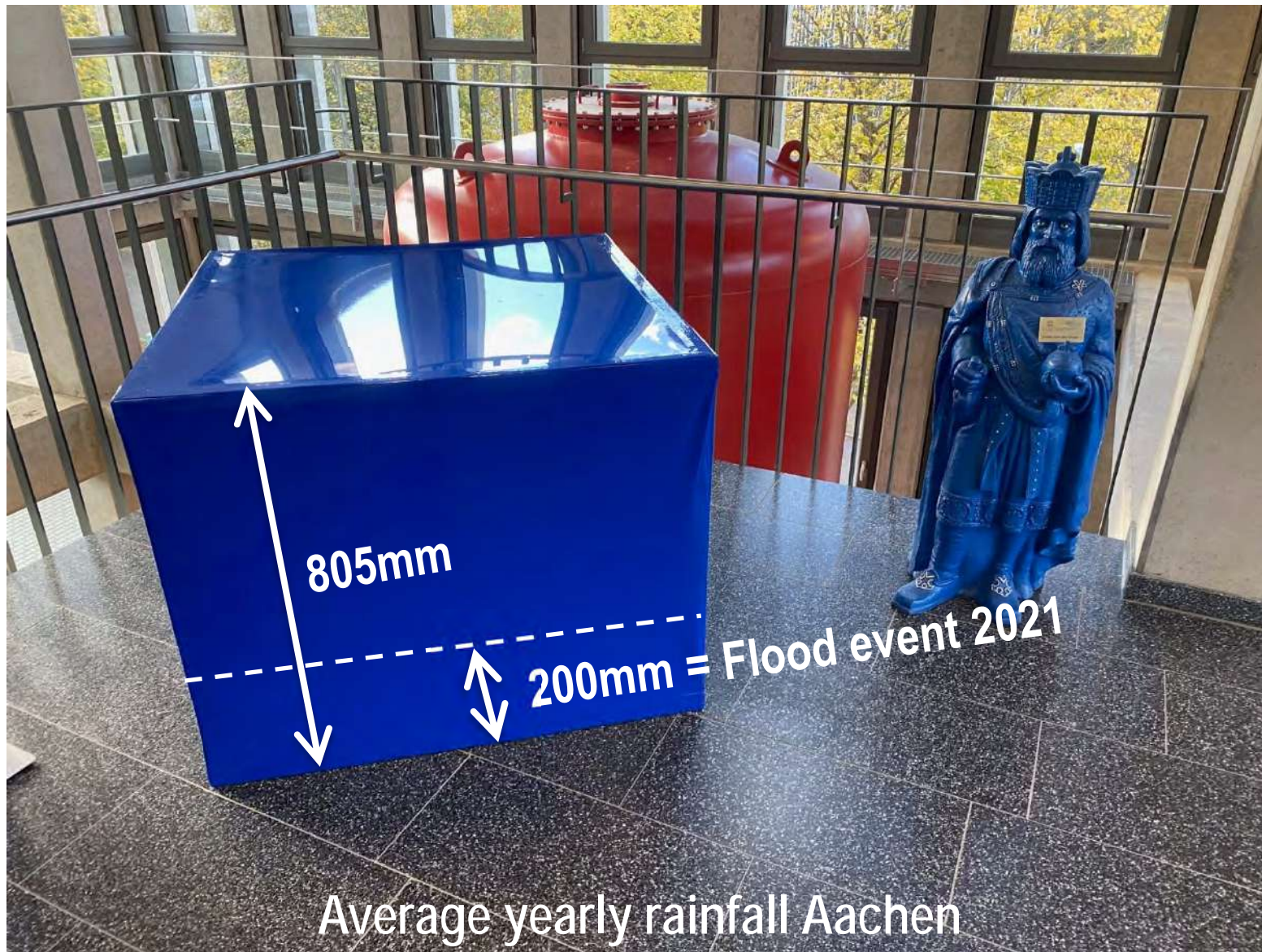
photo: Winandy, 2022

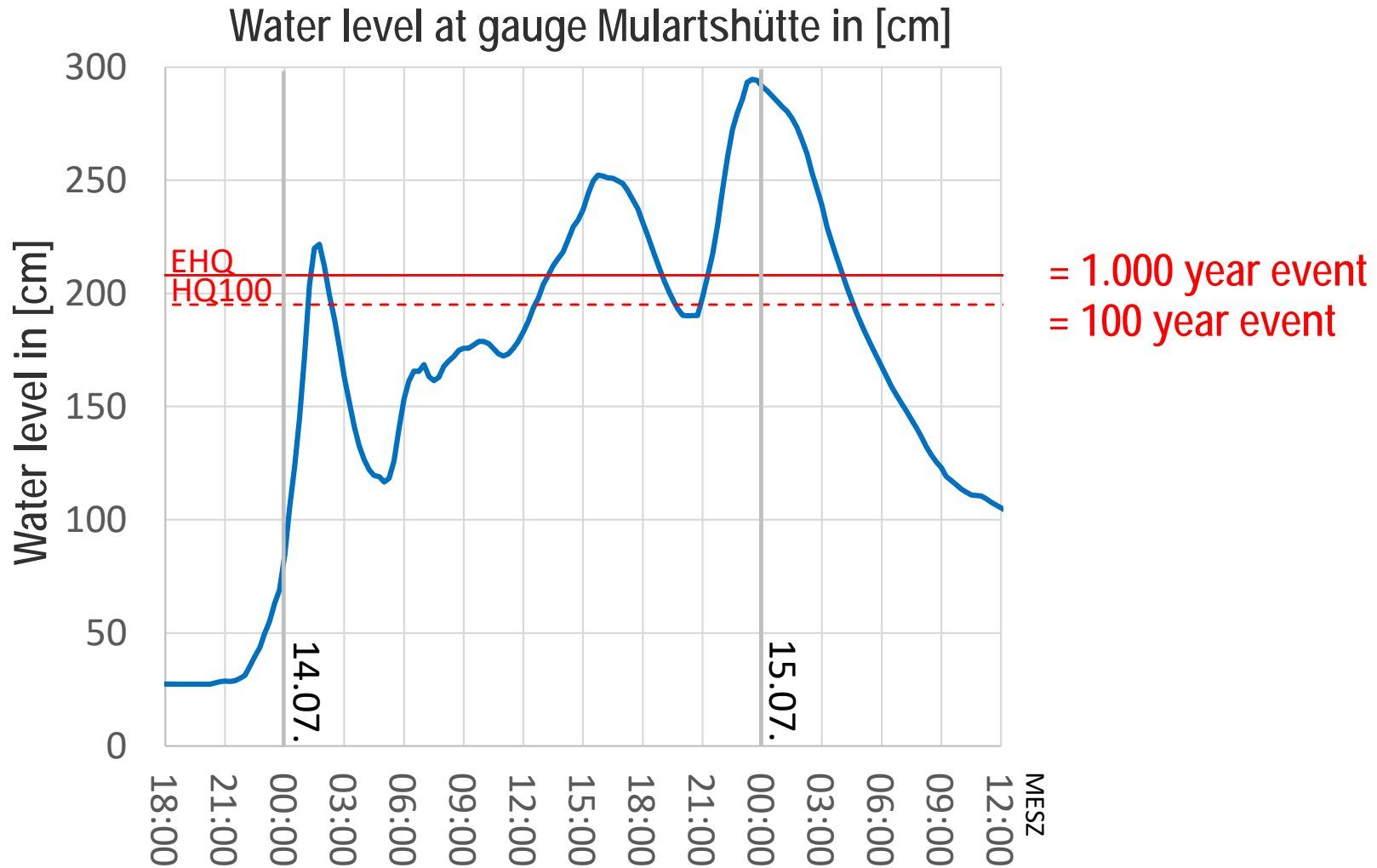


photo: Schüttrumpf, 2022

# Precipitation

photo: Schüttrumpf, 2020

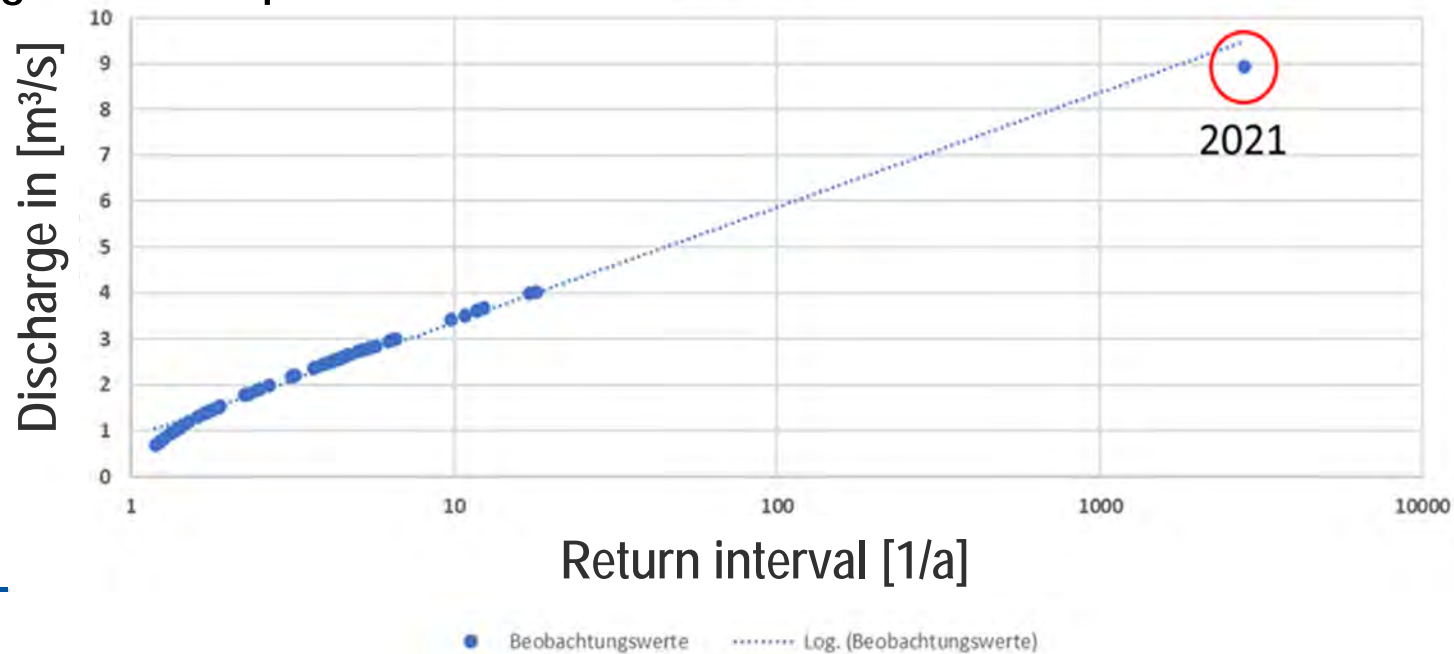




# Flood statistics

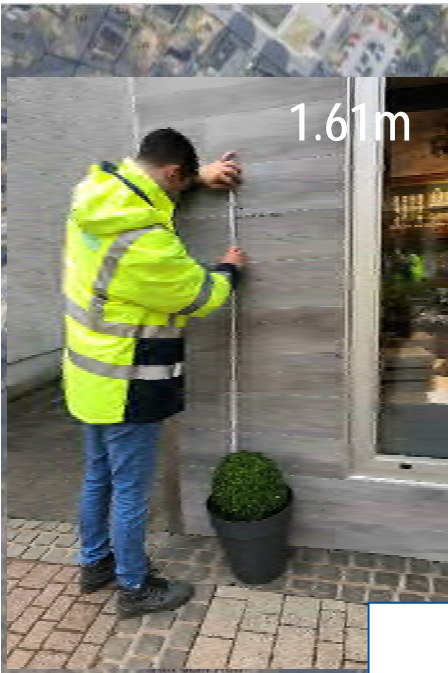
Reservoir	BHQ1 [m <sup>3</sup> /s] (HQ1.000)	BHQ2 [m <sup>3</sup> /s] (HQ10.000)	Outflow Discharge [m <sup>3</sup> /s]	Inflow Discharge [m <sup>3</sup> /s]
Schevelinger-TS	10.02	10.77	Ca. 10.8	Ca. 10.8
Neye-TS	14.0	16	Ca. 17	Ca. 37
Bever-TS	19.4	29.5	Ca. 25	Ca. 65
Wupper-TS	143.6	165.1	Ca. 190	Ca. 250

Gauge Müllensiepen Return interval





Comparison with 1.000 year even

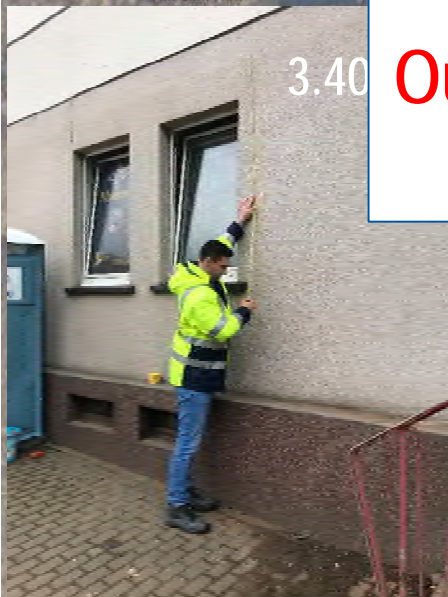


1.61m

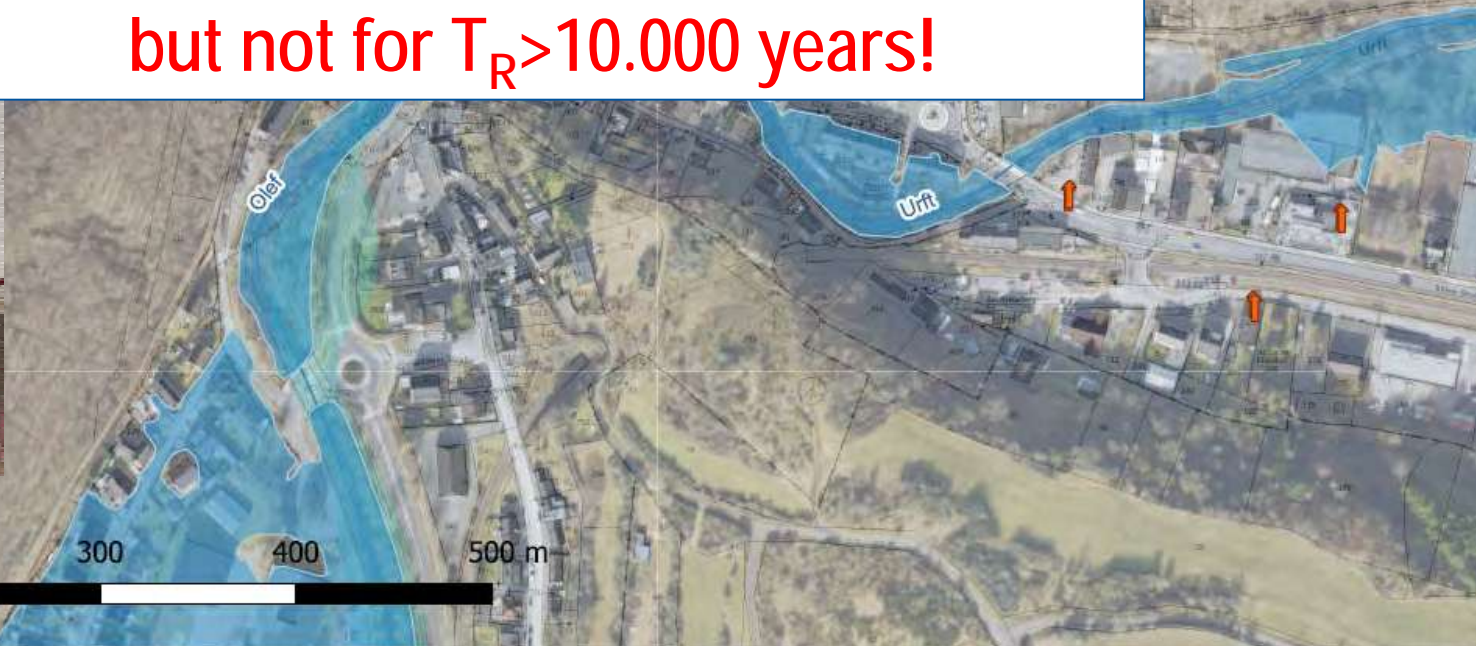


1.18m

**Challenge:**  
Our flood protection is for  $T_R=100$  years  
but not for  $T_R>10.000$  years!



3.40



100

200

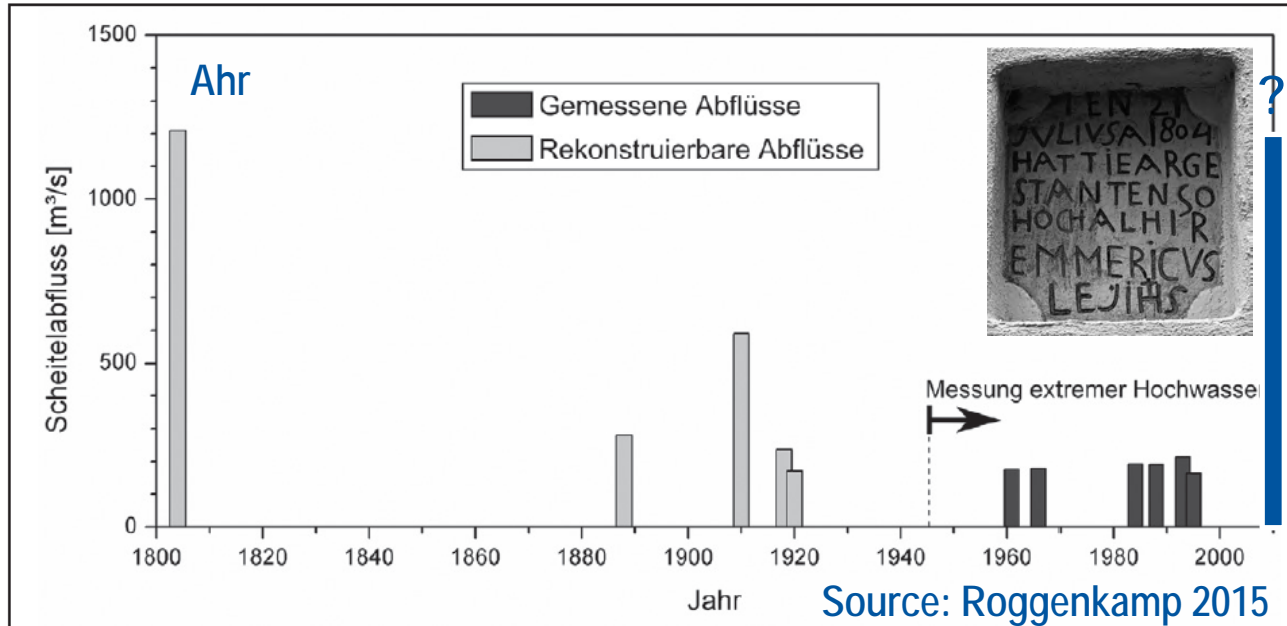
300

400

500 m



# Historical Flood events



photos: Schüttrumpf, 2021



Anno 1416, 6. Juli, fuit hic Monasterii tanta inundatio aquarum, quod periere 1500 homines et circiter 7000 (3000?) pecora dextenditque se aqua ad crucem hic positam.



# Comparison 1804 - 2021

photos: Oetjen, 2021



**Challenge:  
Search for historical events!**

Foto: Winandy, 2022

# Documentation of Damages

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- Comparison of different areas
  - With/without dams
  - With/without recultivation
  - In/Out mountains
- Damages to critical infrastructures
  - Hospitals
  - Police stations / fire departments
  - Kindergärten, Schools
- Damages to infrastructures
  - Roads and railways
  - Sewer systems, electricity supply, gas supply
  - Telecommunication
- Damages to buildings
  - Water / mud / oil
  - Structural damages
- Clogging of bridges
- Morphodynamic processes
  - Erosion
  - Sedimentation
  - Contaminants
- Personal damages
  - Physical
  - Psychological

# The Urft dam

Film: Vonden, 2021



Characteristics (Source: WVER):

Inflow (estimated): 500 m<sup>3</sup>/s

Design data (Quelle: WVER):

EHQ: 238 m<sup>3</sup>/s

HQ<sub>100</sub>: 172 m<sup>3</sup>/s

13 Outflow over spillway (gauge failure): 350 m<sup>3</sup>/s

# Damages to critical infrastructures

## Fire brigade Bad Münstereifel



## Wastewater treatment plant Altenahr



- Police stations
- Hospitals
- Power supply
- Water supply
- Gas supply
- Telecommunication

Everything was interrupted!

# Damages Ahr

Water level

photo: Schüttrumpf, 2021



# Damages Vichttal

Wasserstand



40.000 cars  $\approx$  200.000.000 Mio. € Schaden (Quelle: [www.24auto.de](http://www.24auto.de))

Foto: Schüttrumpf, 2021



# Damages Vichttal



Foto: Brüll, 2021

# Damages Stolberg



Foto: Brüll, 2021

# Damages Ahr



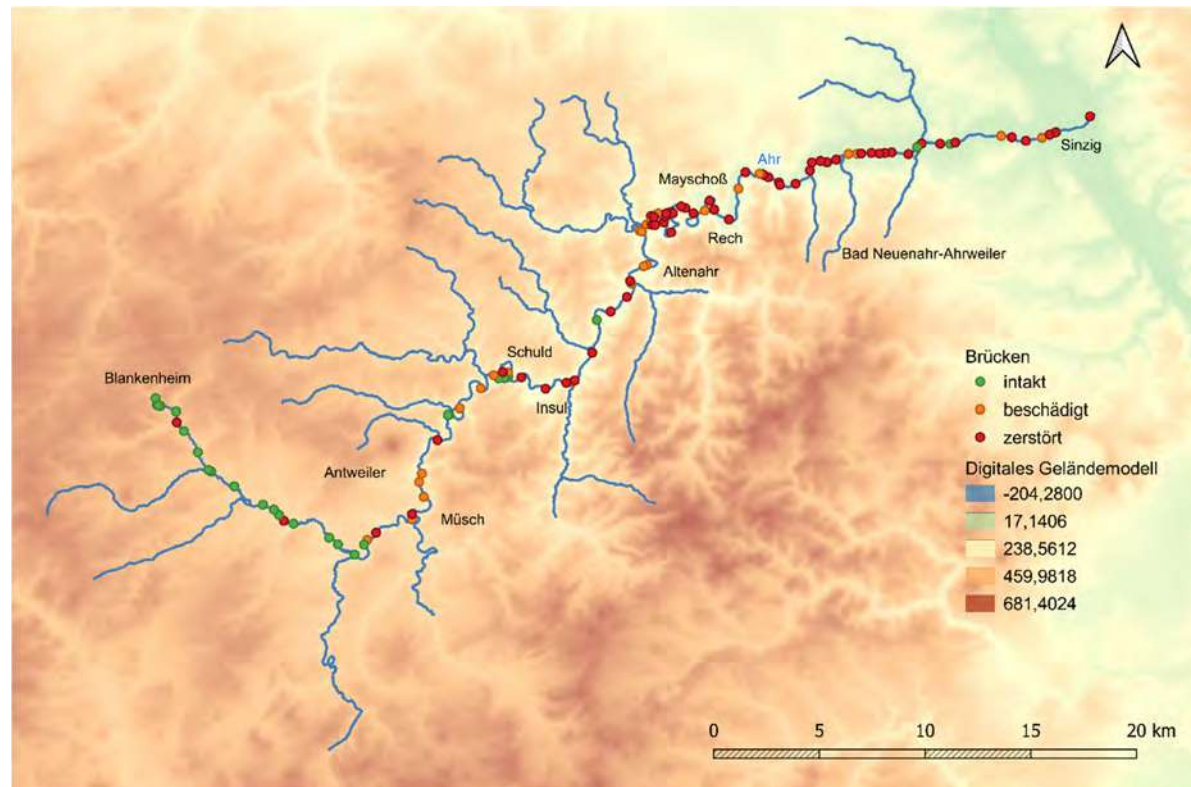
Foto: Schültrumpf, 2021

# Damages Bridges



Foto: Schüttrumpf, 2021

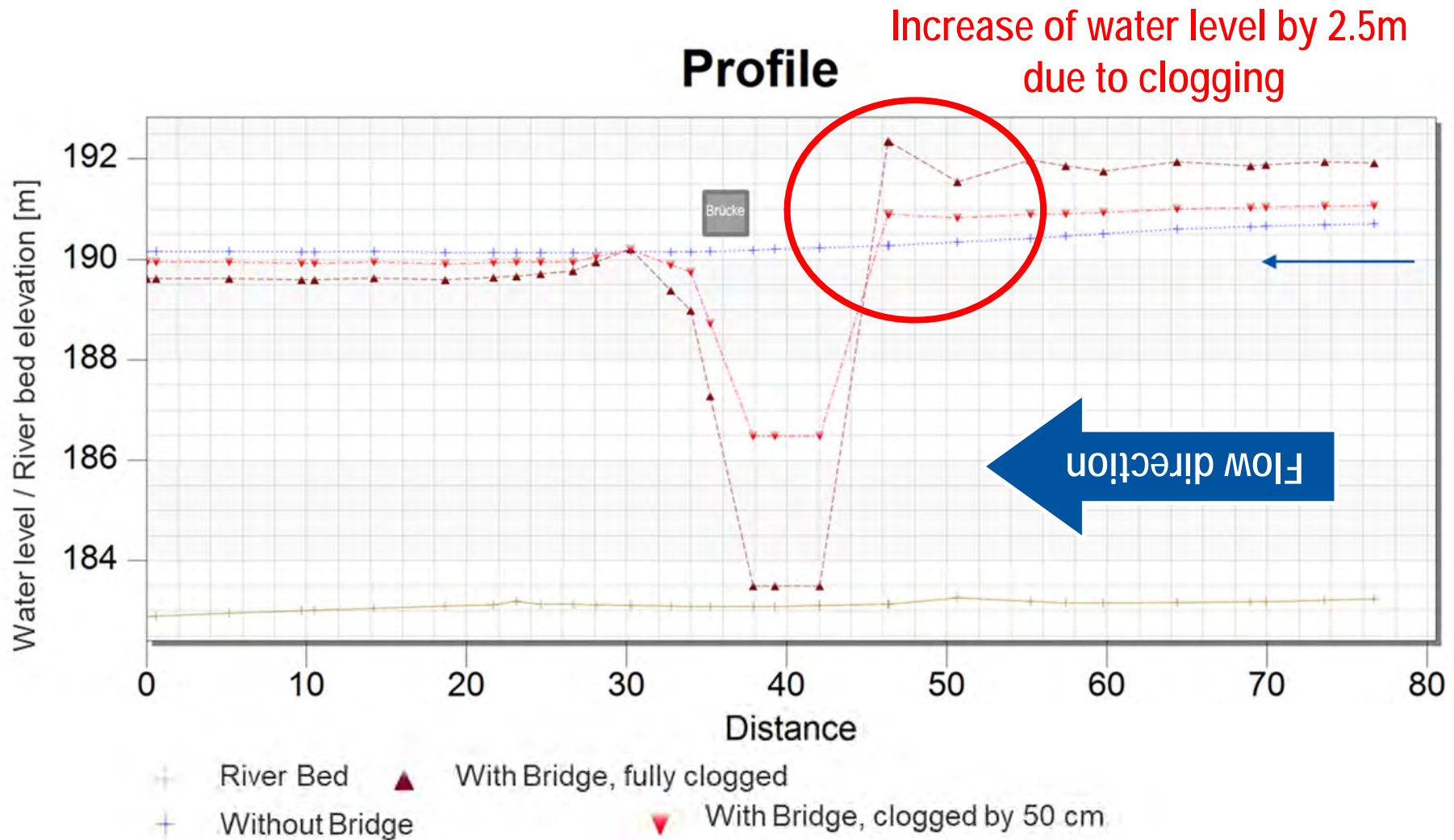
- Damages
- ~ 70% of all bridges damaged or destroyed (~84 from 114 bridges)
- Increased damages downstream
- ~ 50% destroyed
- ~ 20% damaged



# Clogging of bridges



# Clogging of bridges

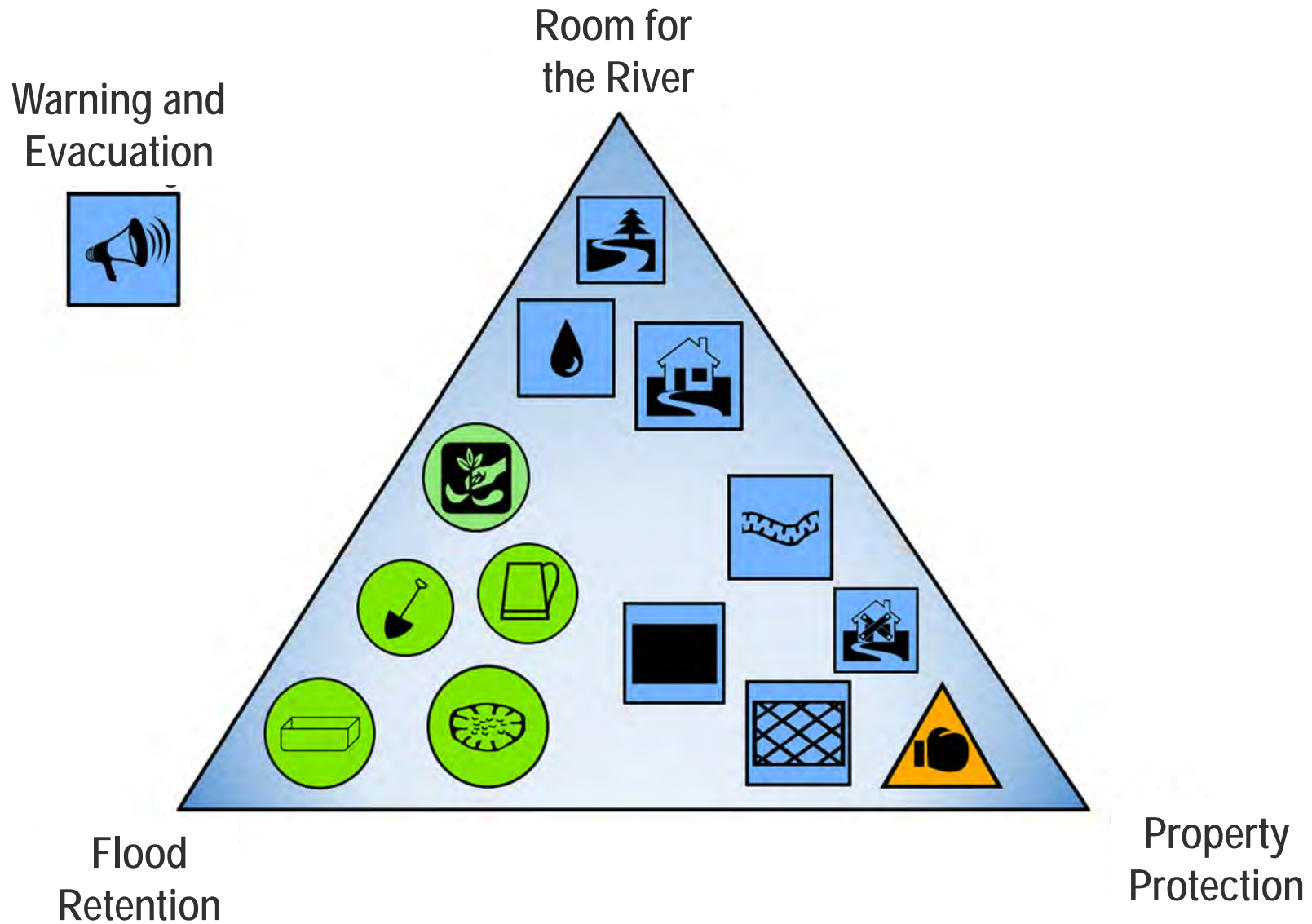


# Lignite mine Inden

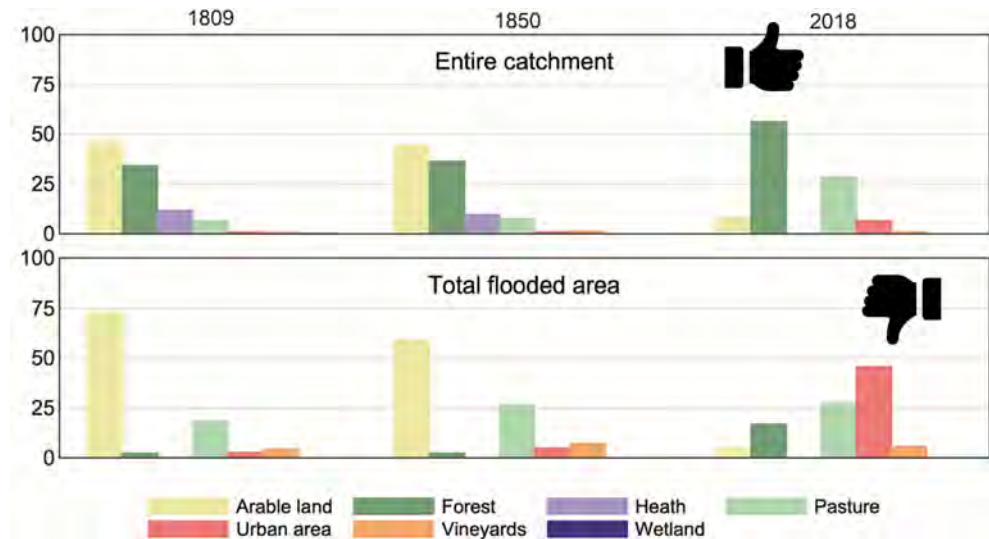
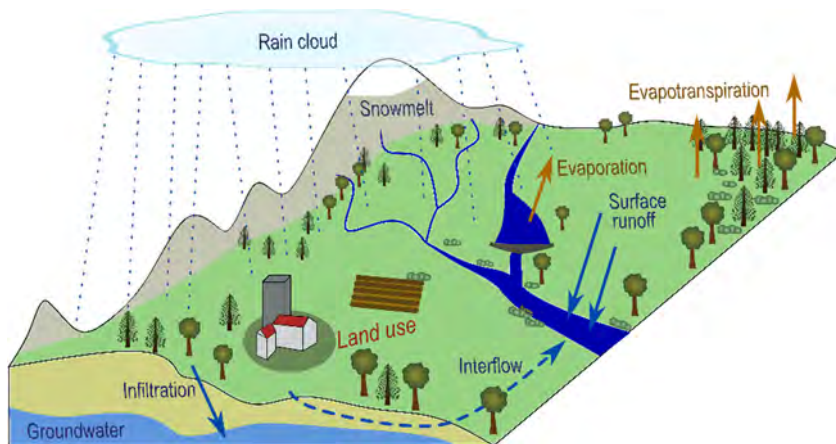




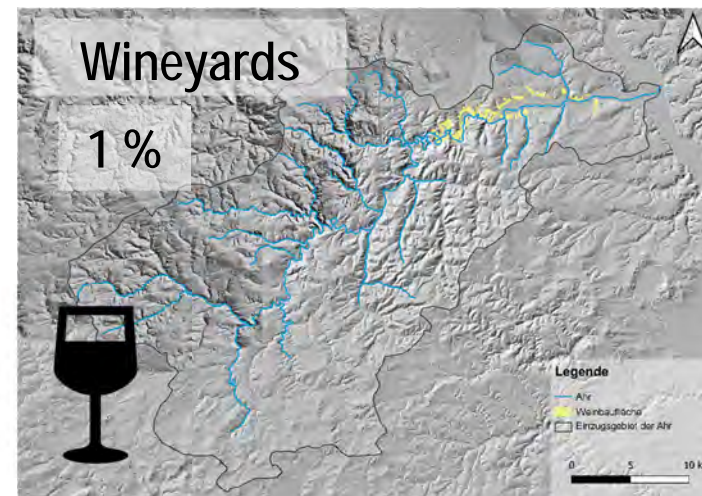
# Flood protection strategies



# Natural Flood Retention



**Ahr:** type of soil: silt-loam  
 low retention potential  
 (~> 1 mm/h),





**Challenge:  
Sponge and bath are full during extreme events!**





Source: Hofmann, IWW, 2022

## Room for the river

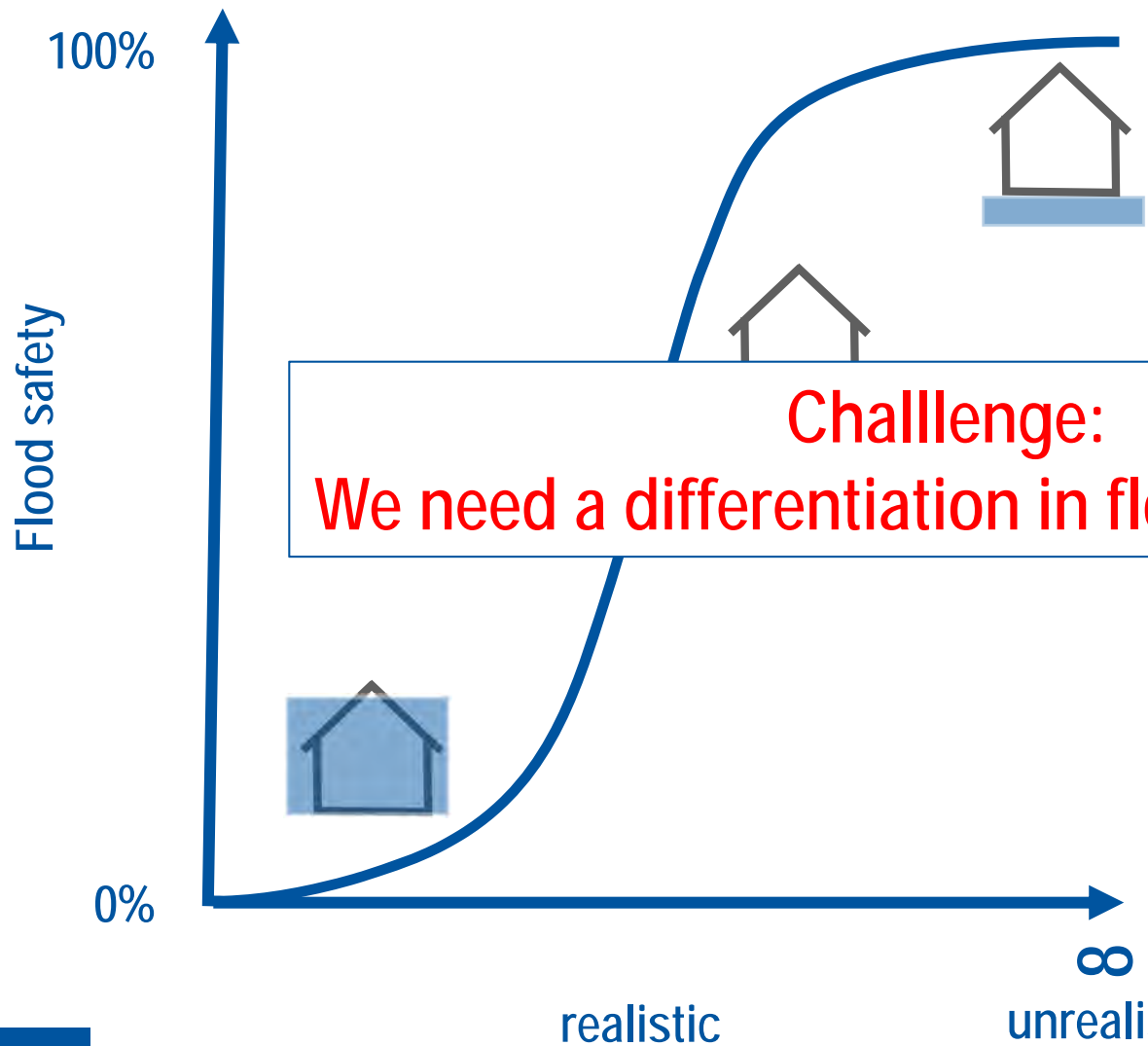
**Challenge:  
We need room for the rivers!**

Foto: Schüttrumpf, 2021

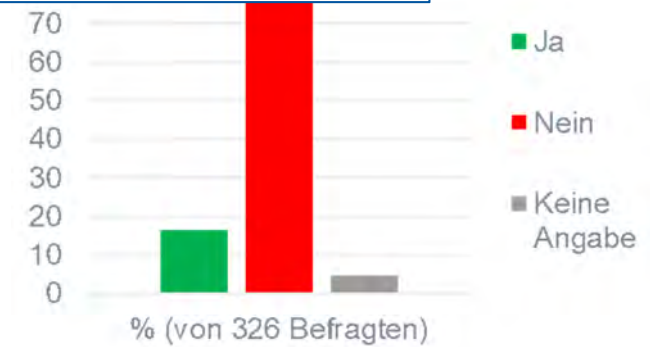


Foto: Winandy, 2022

# Which risk is acceptable?



Wussten Sie vor dem Hochwasserereignis im Juli 2021, dass Sie in einem ... en Gebiet



- Saving human lives has priority! Warning and evacuation!
- Room for the river!
- Dams reduce damage!
- Bridges increase the risk of flooding
- Critical infrastructures need special attention!
- Consideration of historical flood events!
- Discharge obstacles must be removed!
- Oil is a problem!
- Reconstruction creates facts!

**We have to learn from the flood disaster in 2021!**

**We will never have 100% safety!**

Foto: Schütterumpf, 2022

Thank you very much for your attention!

