

Floods in a Changing World

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Aug 2011

Thailand floods: Bangkok evacuation widens



Jan 2011

Brazil flood and mudslide deaths rise as rescue goes on



More than 420 people killed

Jan 2011

Australia's Queensland faces 'biblical' flood



Aug 2010

Pakistan flood death toll passes '1,100'



Floods

- What **types** of floods are there?
- What are the **processes** causing river floods?
- Have river floods **increased**? Will they increase?
- How to **protect** us from floods in the future?

Flood types



River Floods: Heavy rainfall (wet soils), snowmelt, ice jams
Example: Aug. 2002 Elbe Flood, Germany



Flash Floods: Sudden thunder storms, in cities and mountain areas (often causing landslides)

Example: Oct. **2011 Cinque Terre Flood**, Italy
500 mm of rain in one day, mudslides



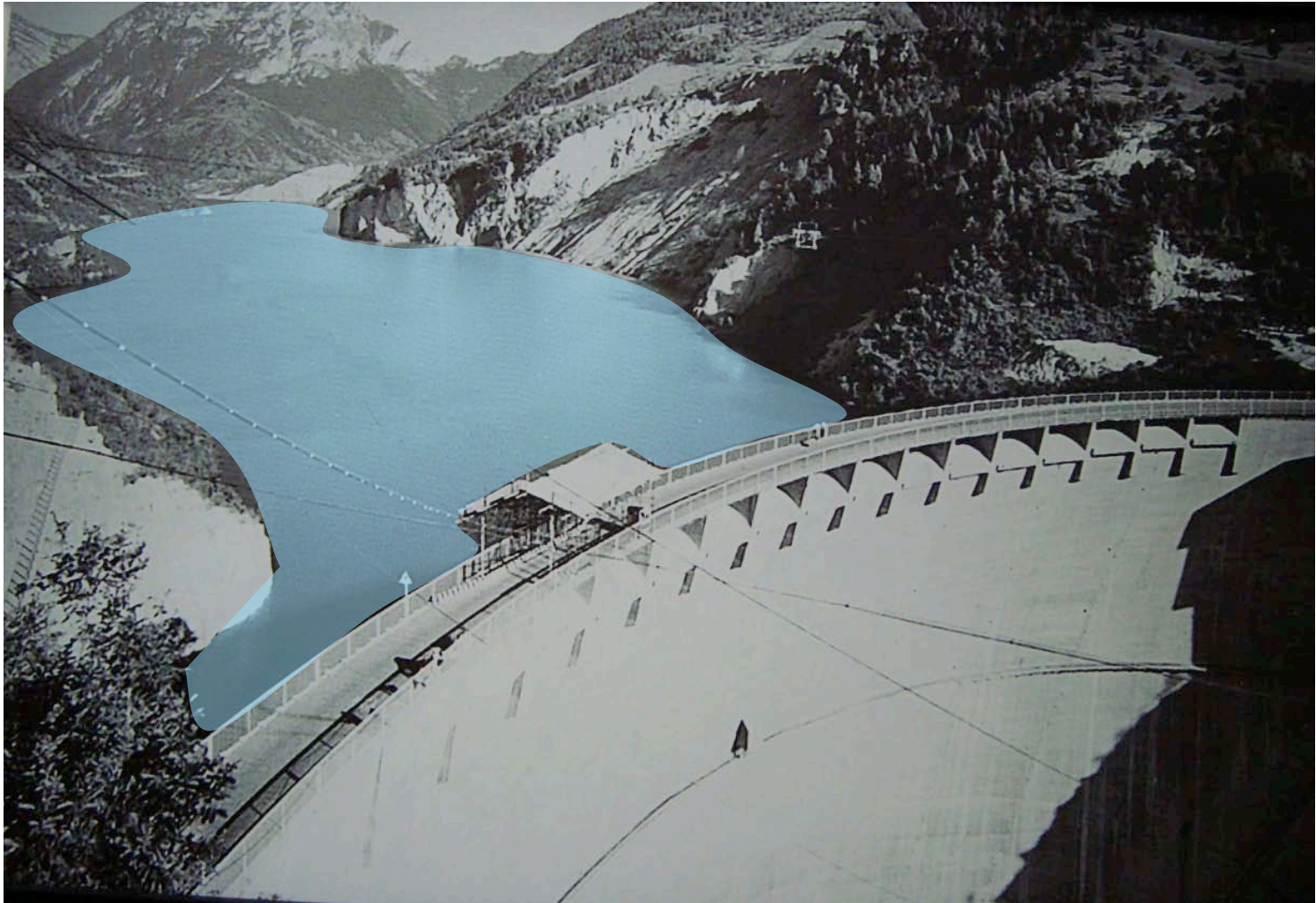
Coastal floods: Storms blowing waves onto land, high tides, tsunamis

Example: **1717 Christmas Flood**, the Netherlands
Northwesterly storm hit the coast, 14 000 people drowned

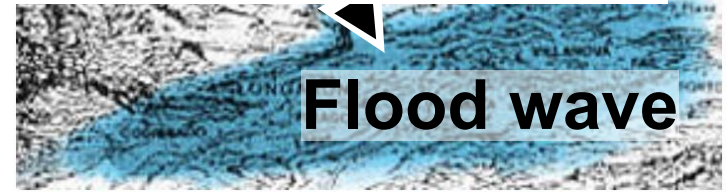


Human induced floods: Dam failure, landslide into lakes, ..

Example: Oct. 1963 **Vajont Flood**, Italy



Example: Oct. 1963 Vajont Flood, Italy

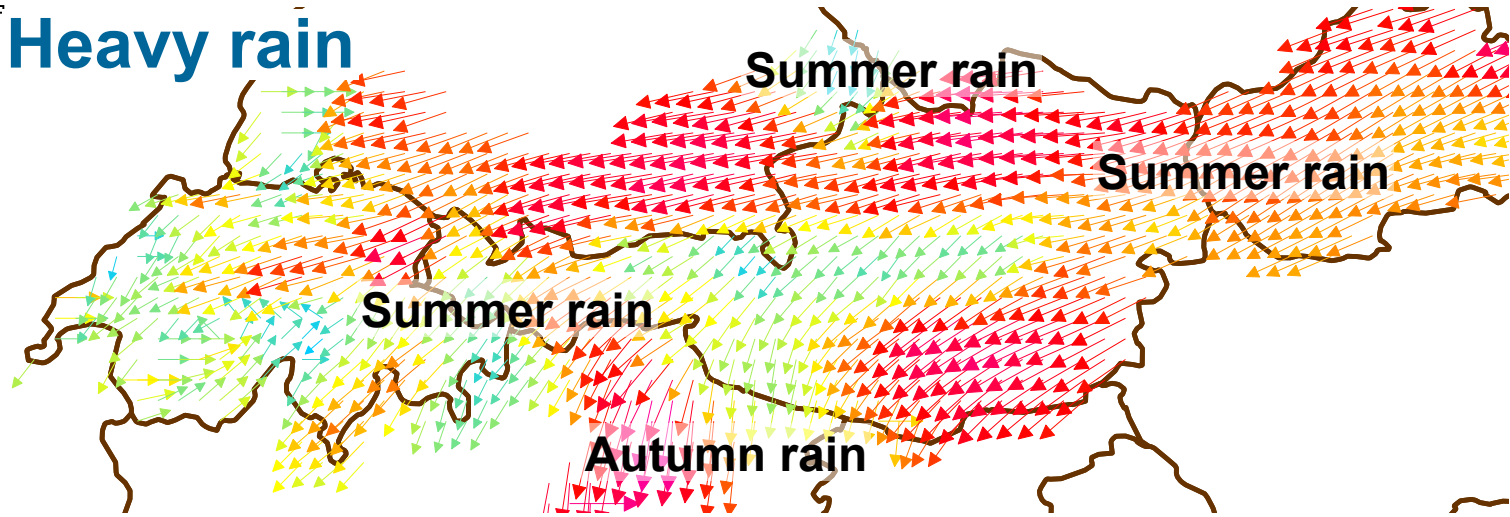


Flood processes

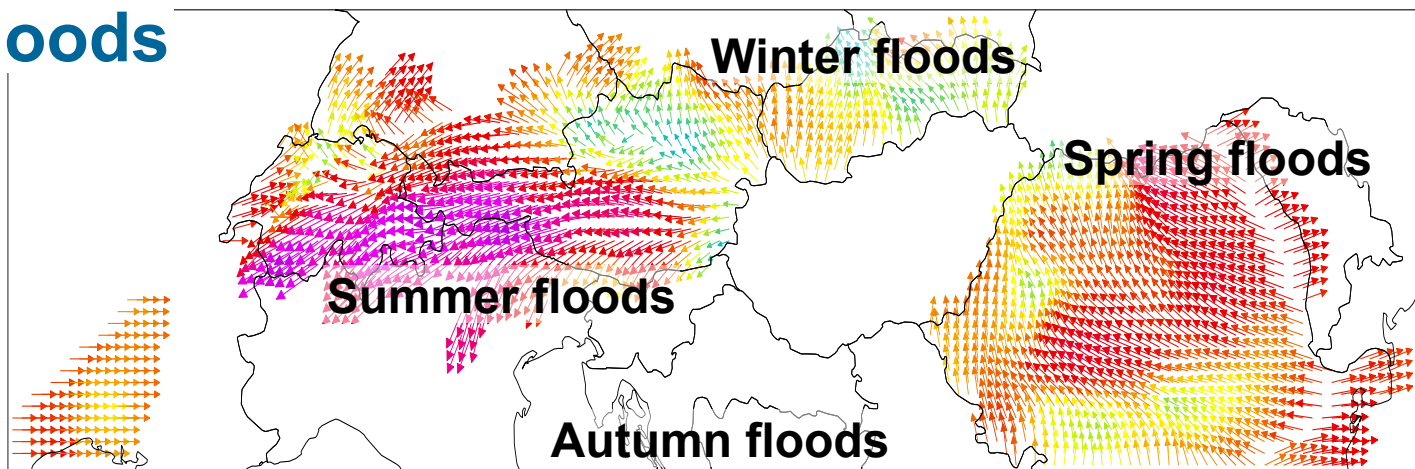


Seasonality of heavy rain and floods

Heavy rain



Floods



Colour: strength of seasonality



weak

strong

Direction: month of maximum

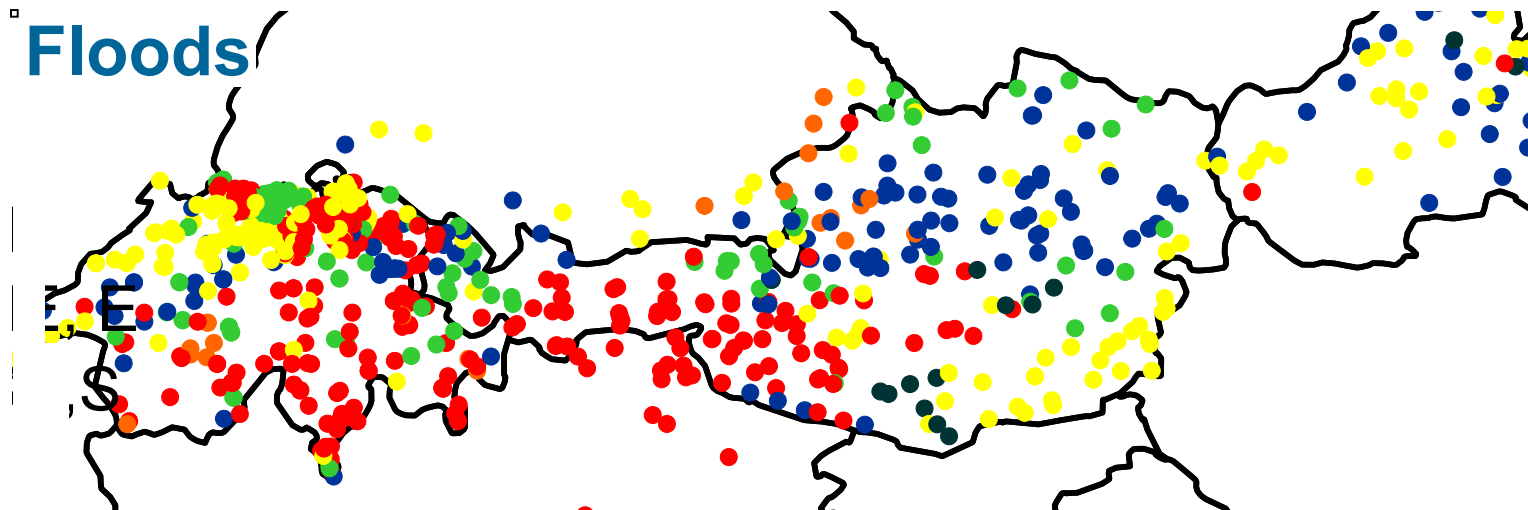
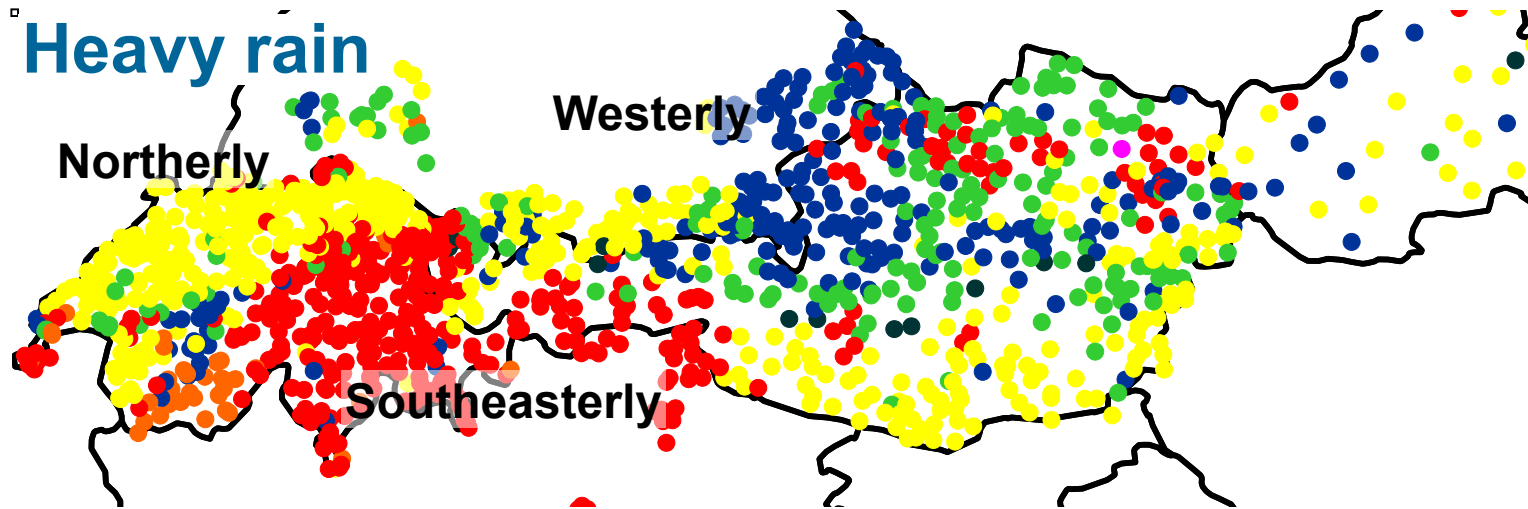
→ Jan

↑ Apr

← Jul

↓ Oct

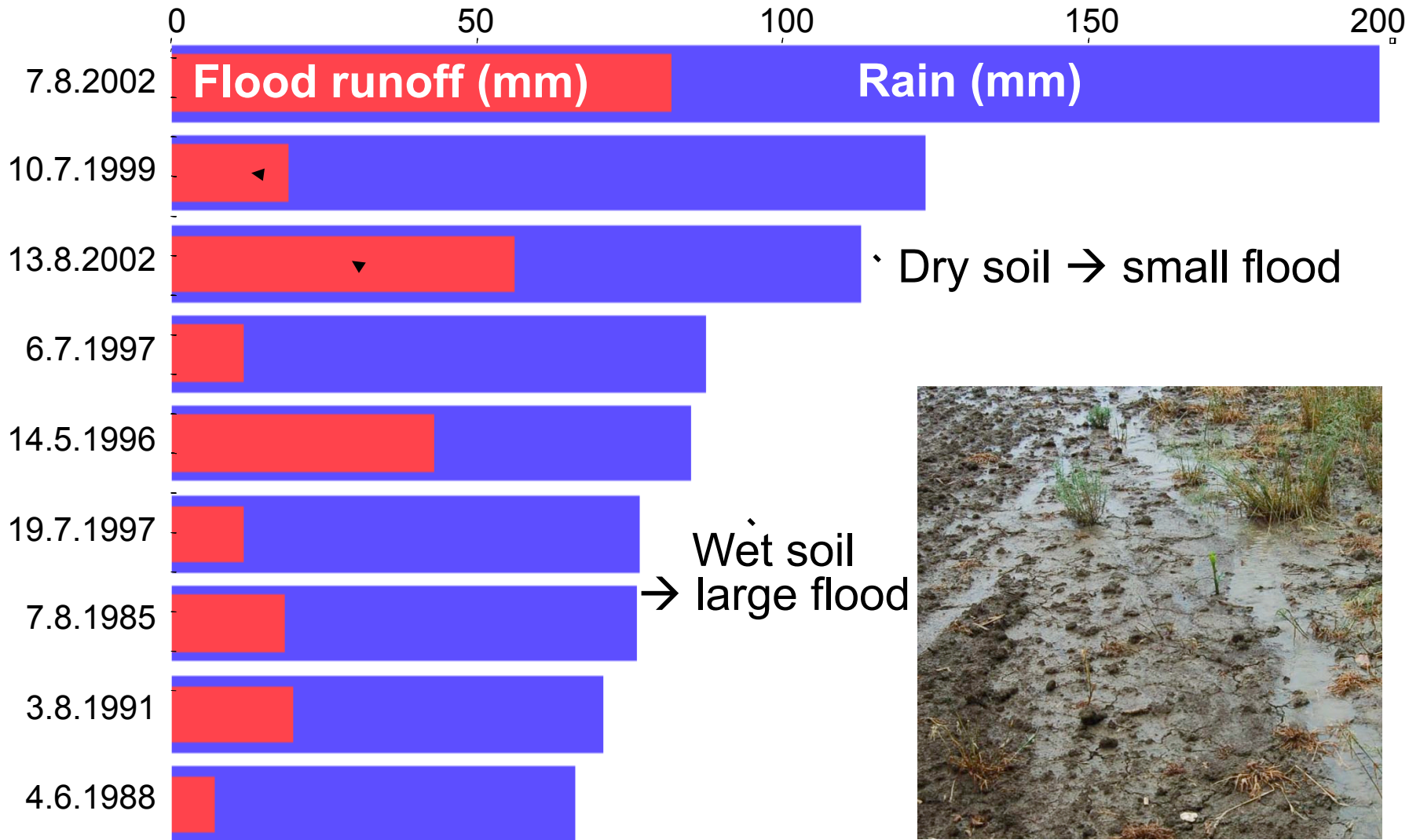
Effect of weather patterns



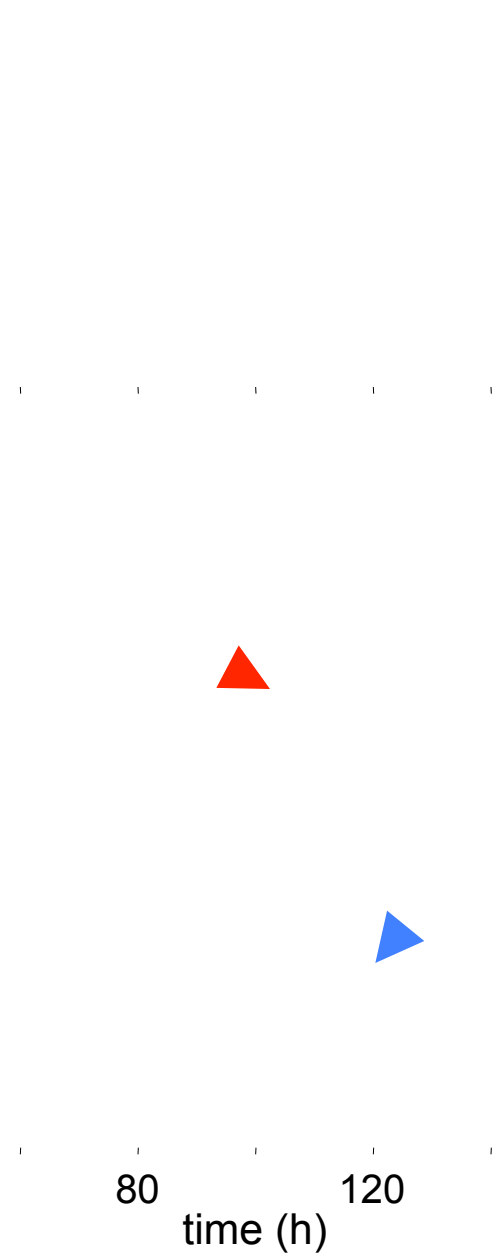
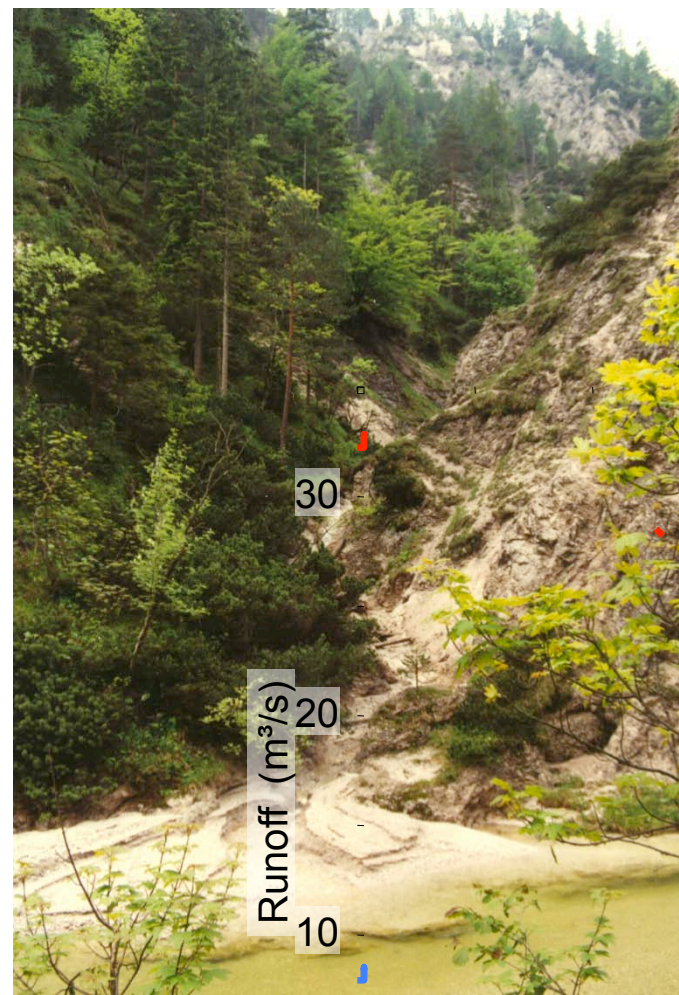
- 1 zonal West
- 2 mixed
- 3 mixed CE
- 4 meridional N
- 5 meridional NE
- 6 meridional SE

Effect of soil moisture:

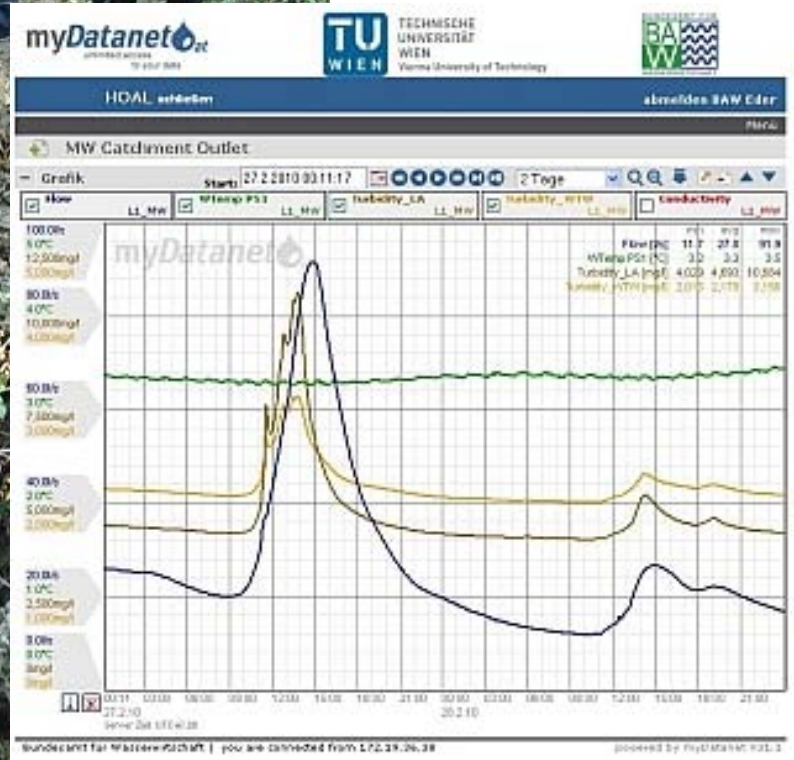
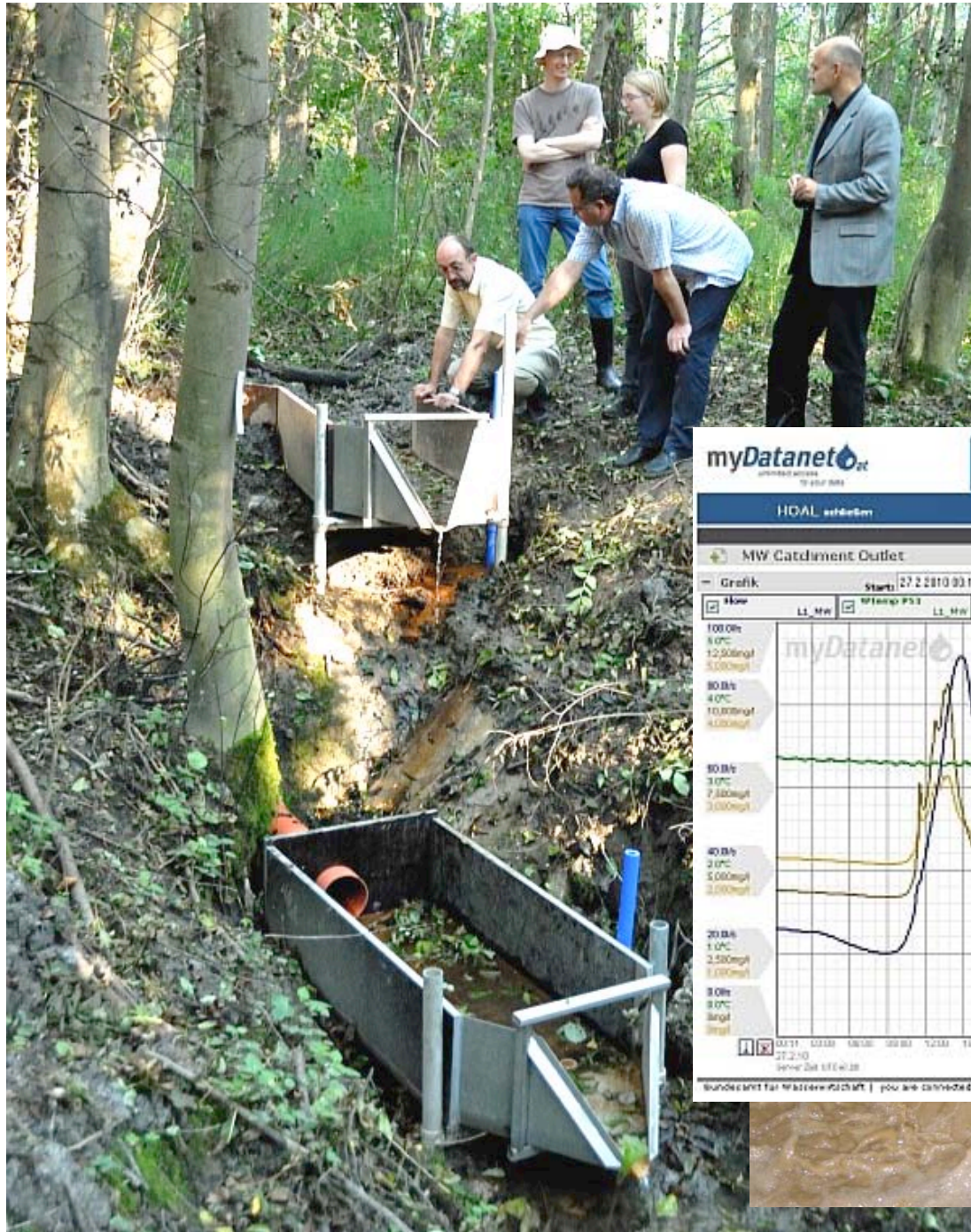
Rainfall and runoff of flood events in the Kamp



Effect of **topography and soils**



Monitoring runoff processes in the Hydrological Open Air Laboratory, Austria



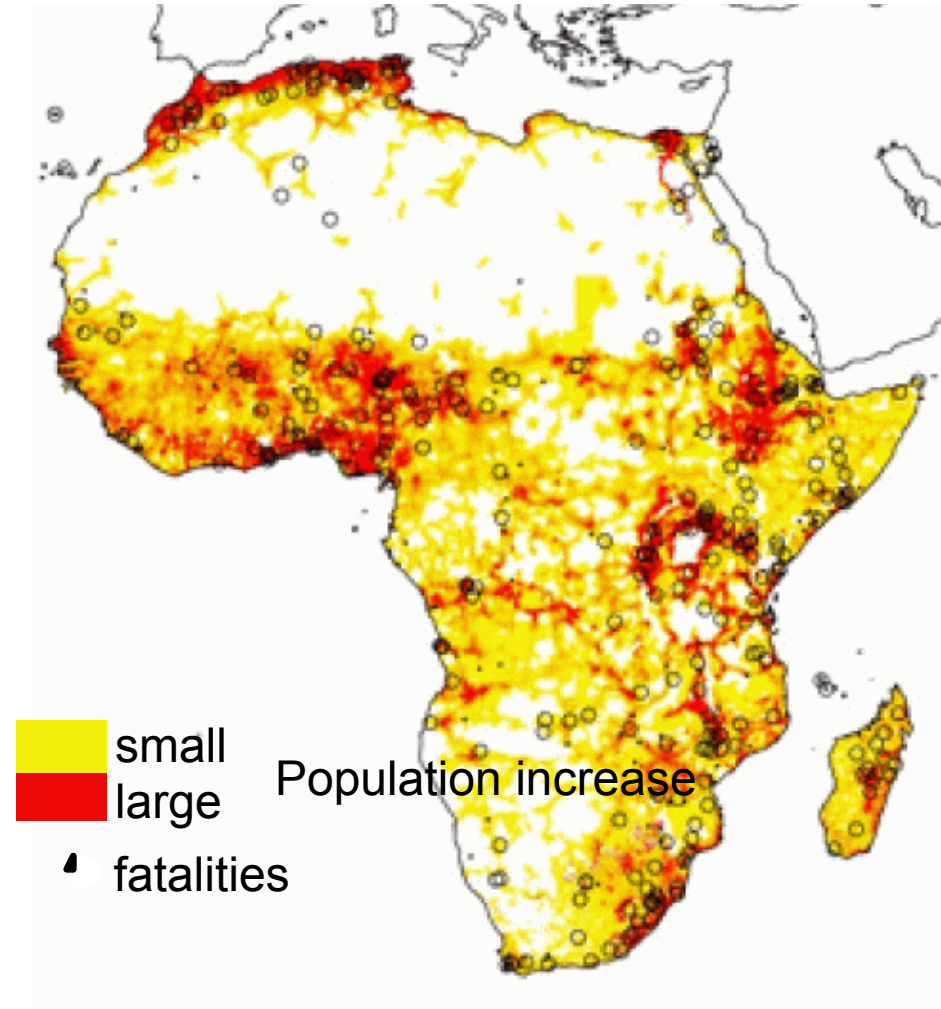
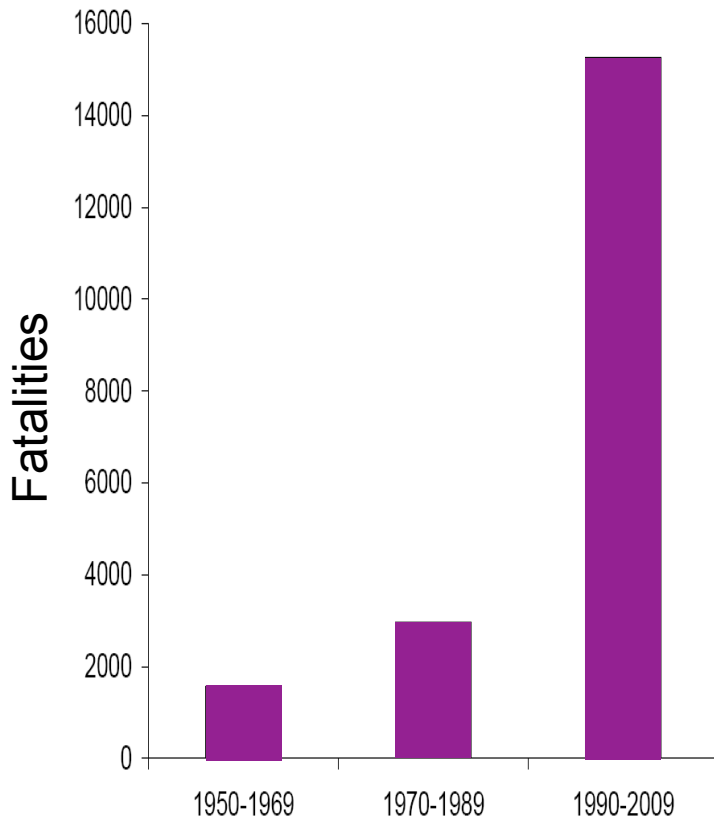


Increasing floods?

Increasing number of people died from floods in Africa

Reason: urbanisation (not increase in floods)

8 fold increase of flood fatalities



Fatalities correlates with areas of population increase

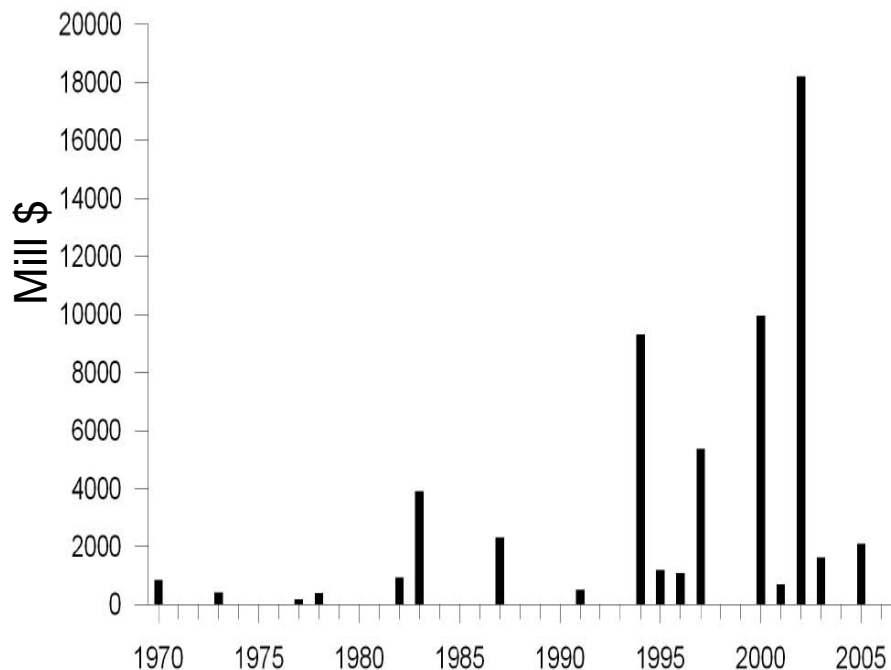
Di Baldassarre et al. (2010)

Increase in losses

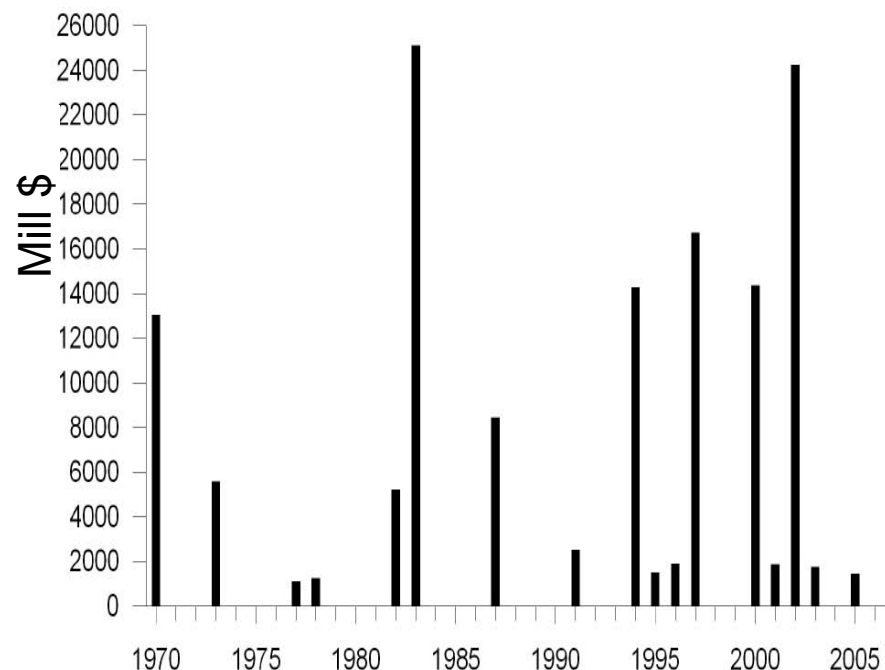
Reason: increase in assets (houses, vehicles) and building in flood-prone areas

Flood damage in Europe: 1970–2006

Normalised (inflation)

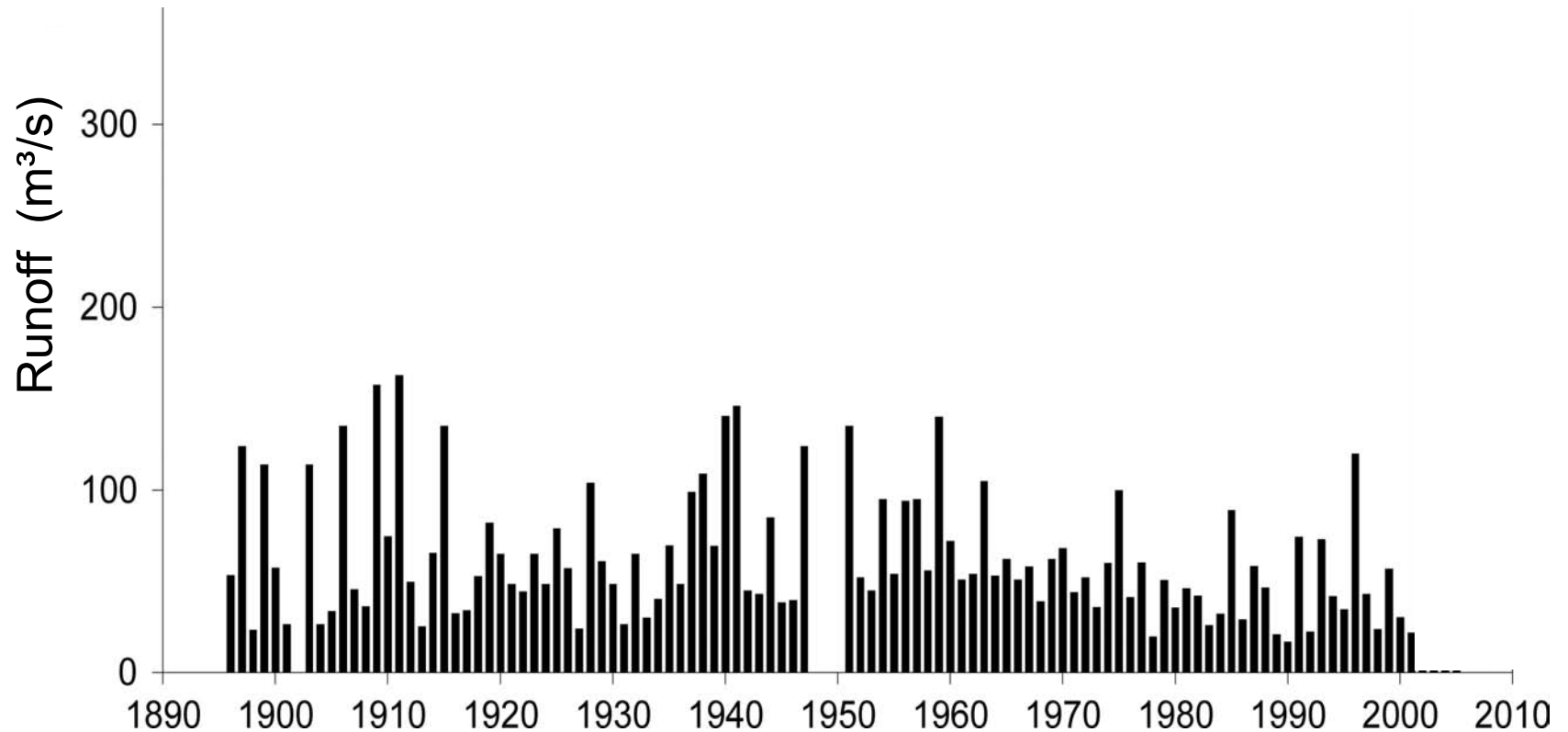


Normalised (inflation and assets)



Floods in Austria

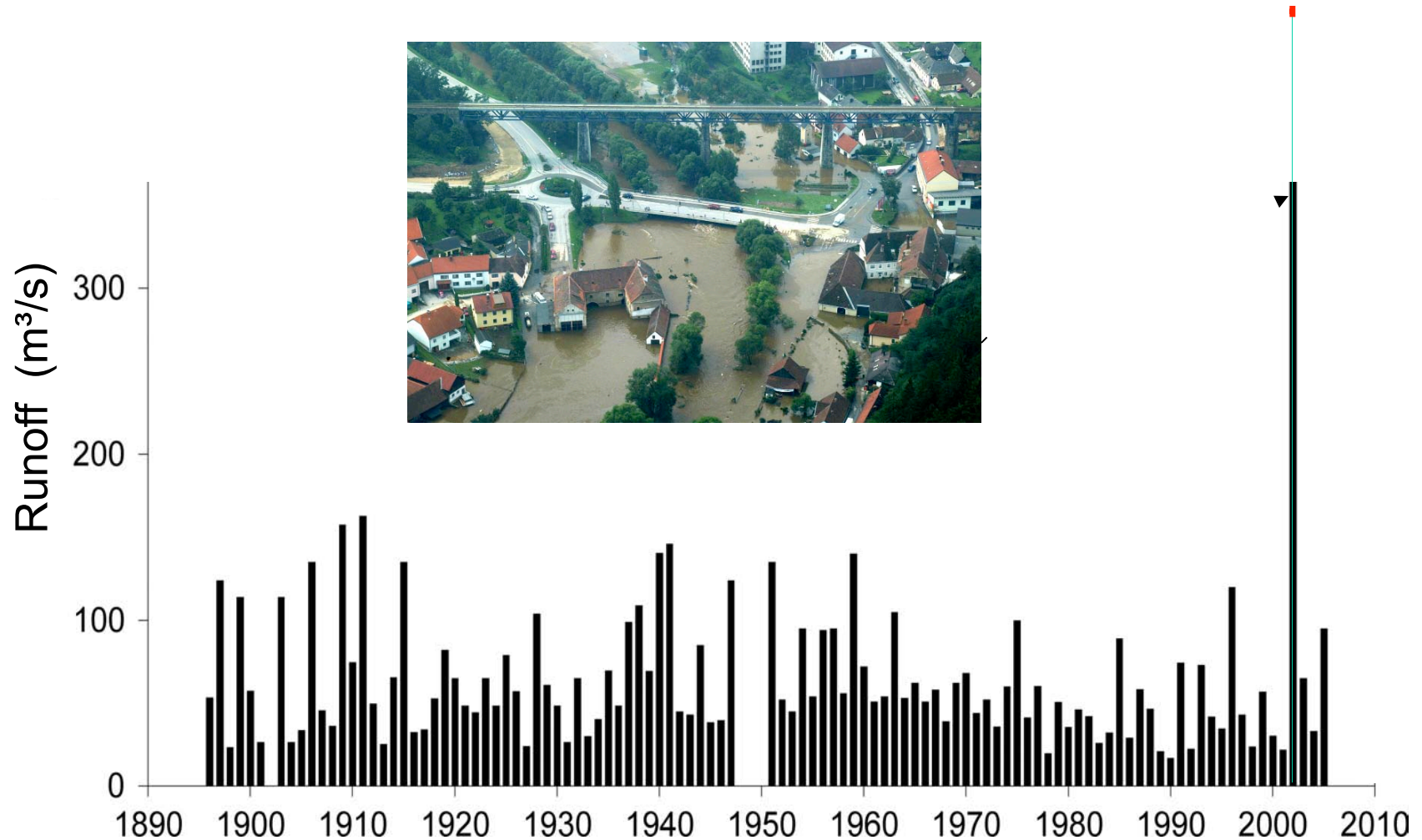
Example: Kamp river



Floods in Austria

Example: Kamp river

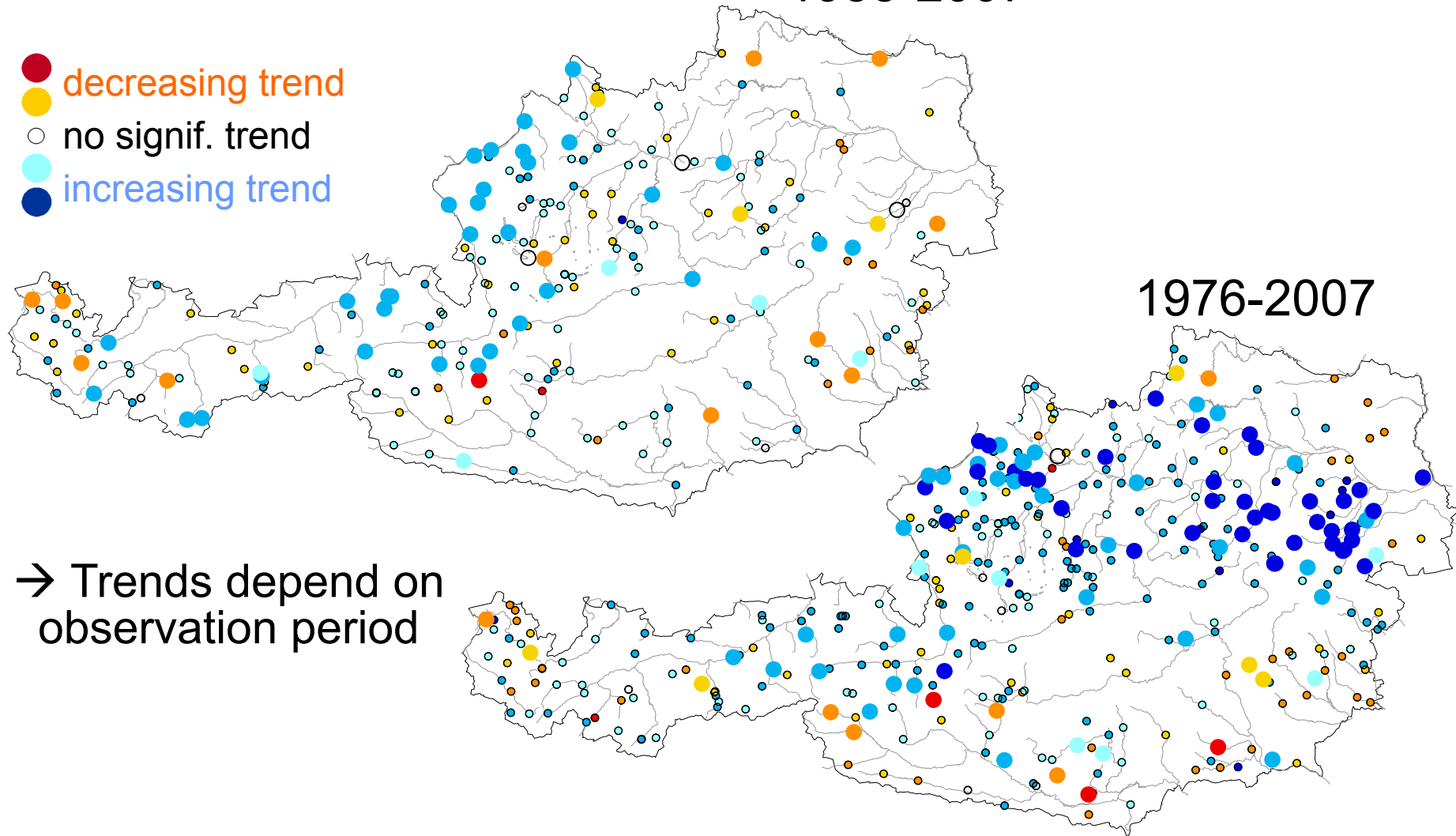
August 2002



Observed **flood trends** in Austria (based on runoff data)

1955-2007

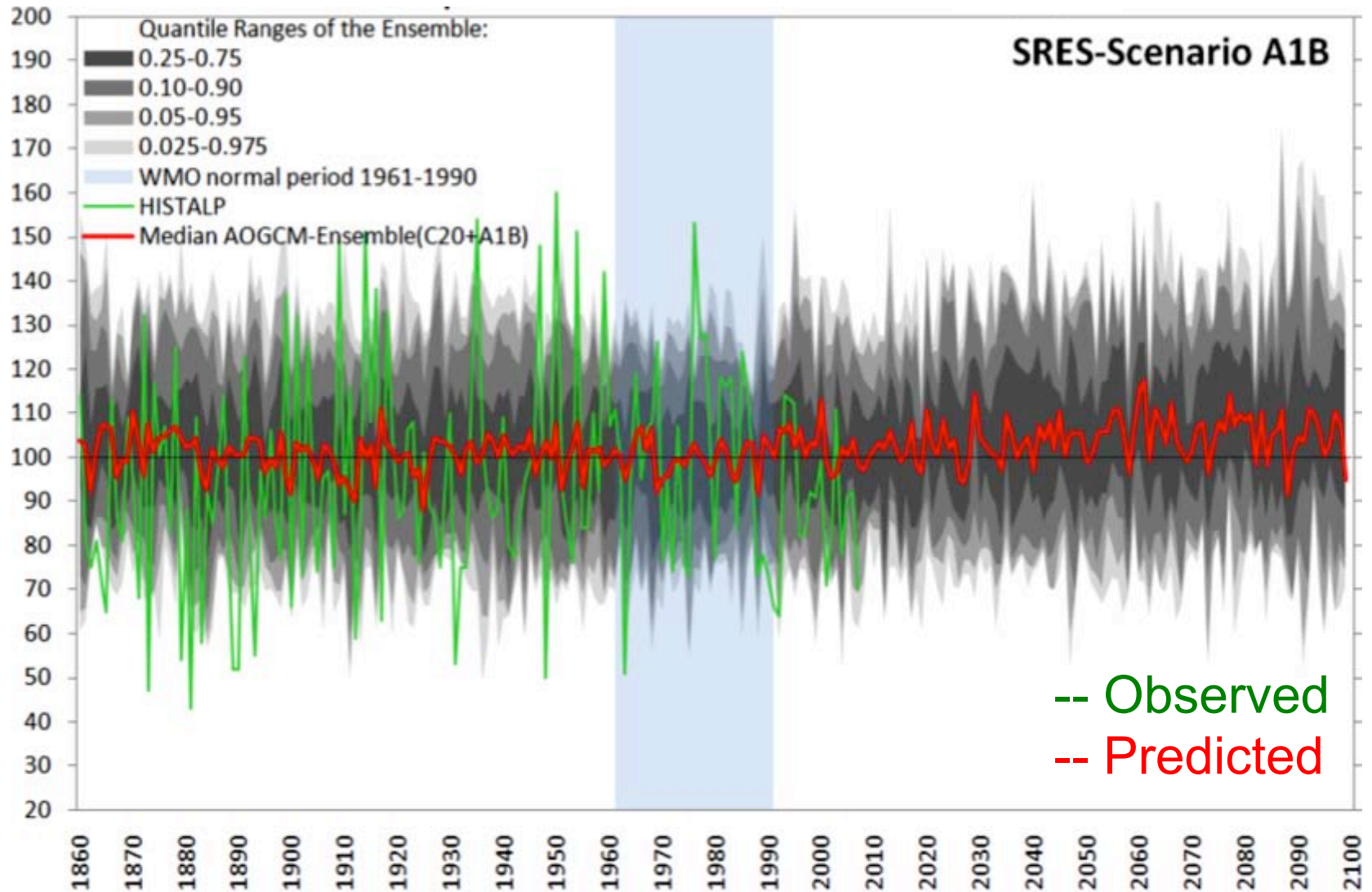
- decreasing trend
- no signif. trend
- increasing trend



Area < 500 km²

Predicted winter rainfall

Greater Alpine region, IPCC scenarios



How will **floods** change in the **future**?

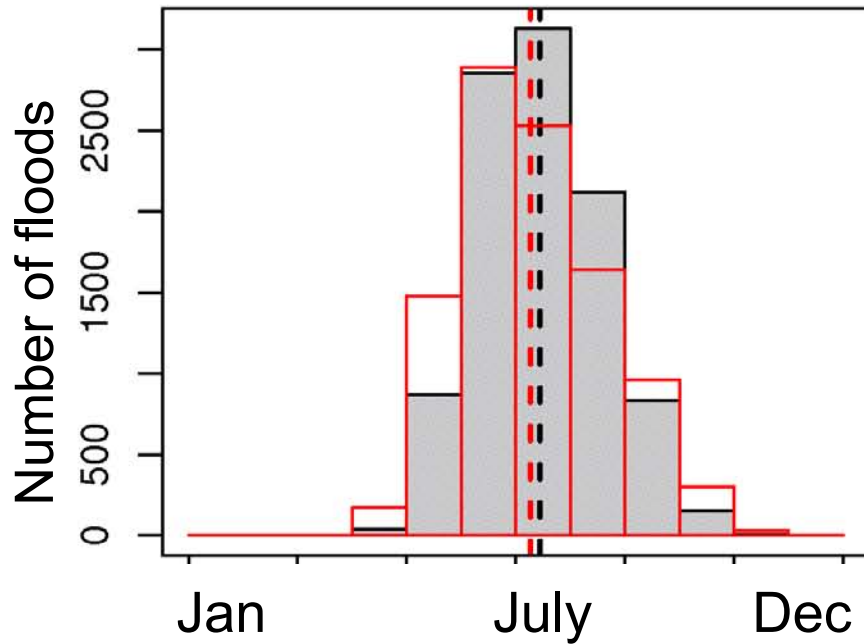
→ Monte Carlo Simulations of future flood probabilities

- Rising snow fall line (**likely**)
- Earlier snow melt (**likely**)
- Change in seasonal precipitation (**probable**)
- Increased evaporation (**probable**)
- Increased convective precipitation (**possible**)

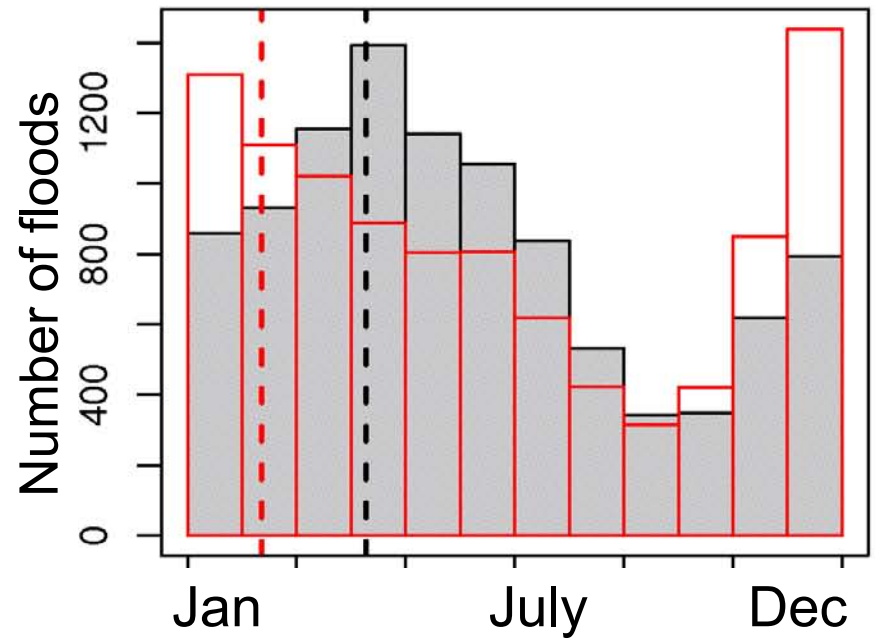
Allows us to attribute **level of confidence** to results

Simulation results: **Seasonality** of floods in Austria all Mechanisms; 100 000 years of simulation

Alps: Tyrol



Low lands: Mühlviertel



- Present

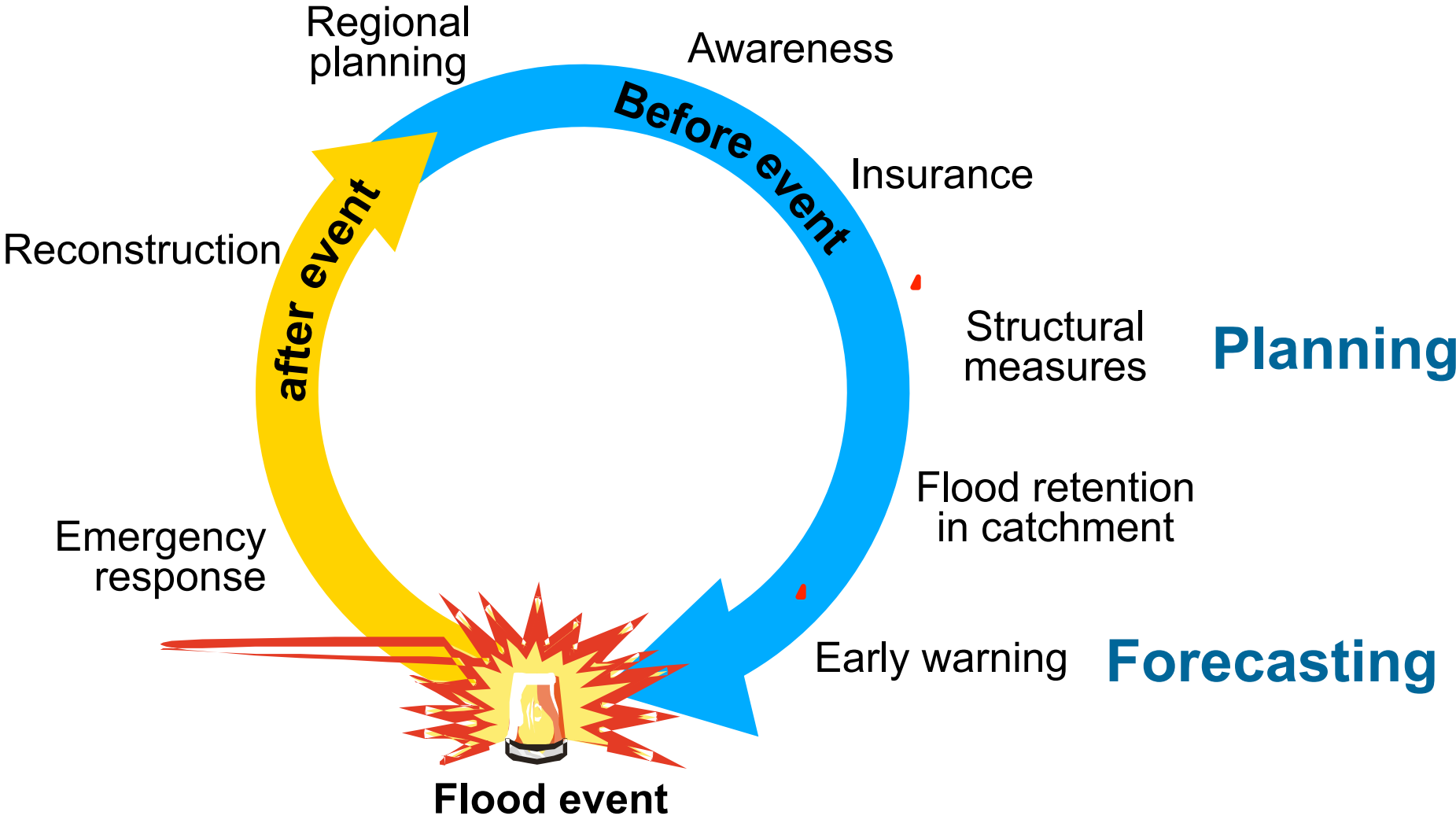
- Future (2021-2050)

→ Larger number of winter floods

Flood management

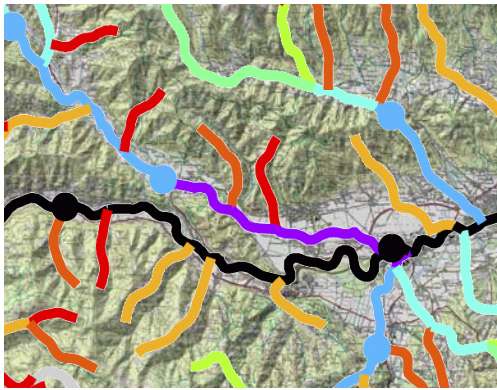


Integrated Flood Risk Management

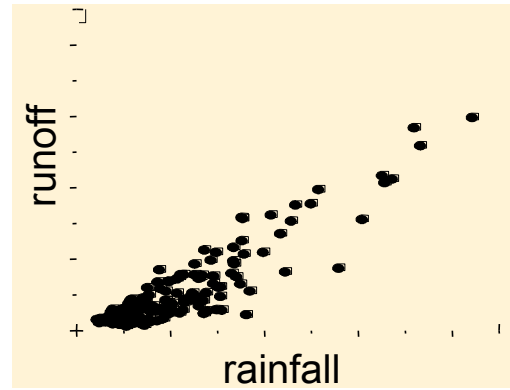


Planning: Estimating flood probabilities

Combination of information:



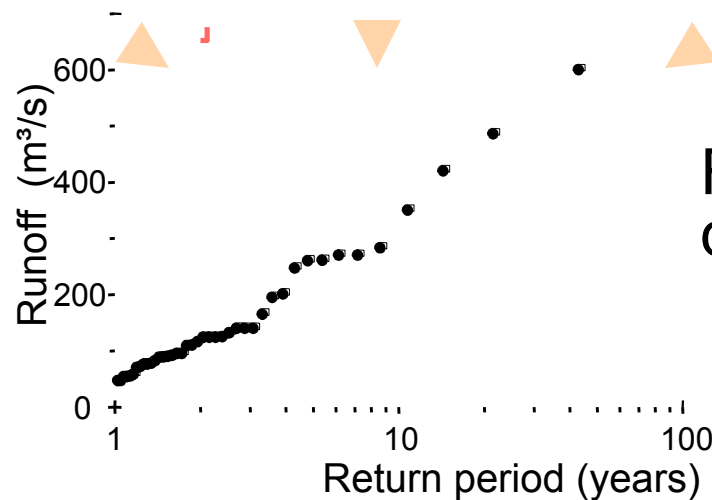
Regional Info.



Process Info.



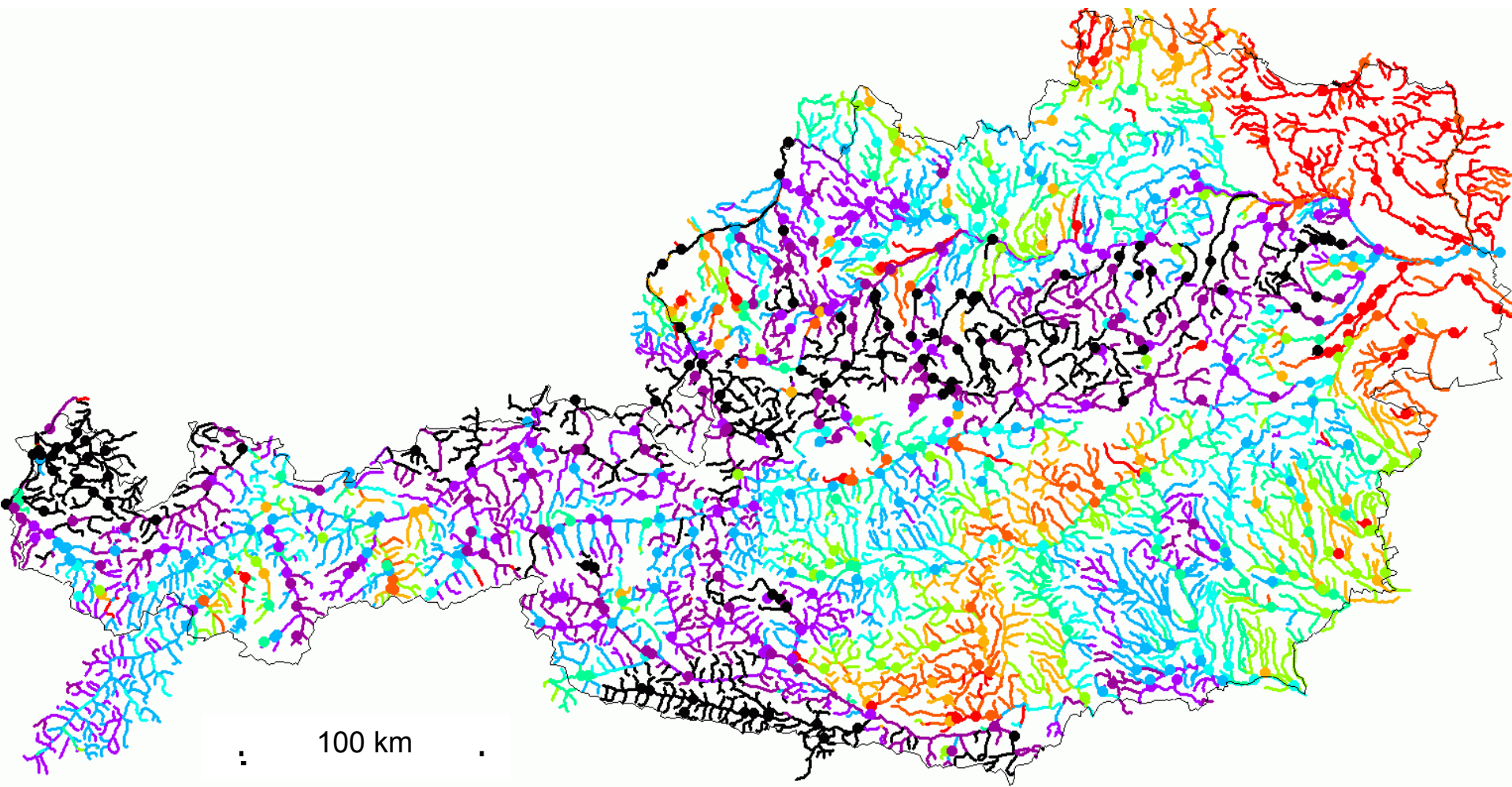
Historic Information



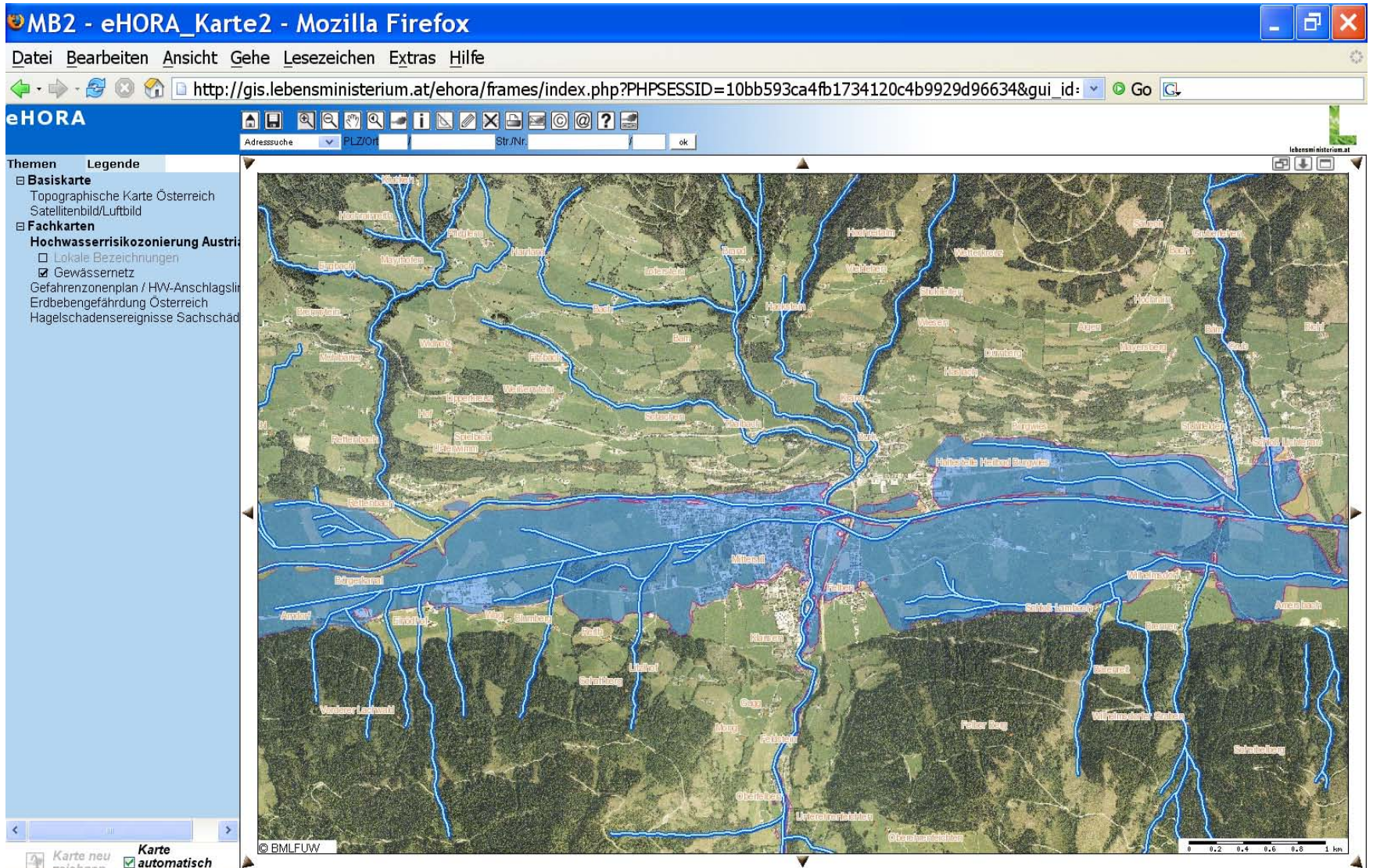
Flood data

Planning: 100 year flood

Estimated from combined information



Planning: Flood risk maps (required by the EU Flood Directive)



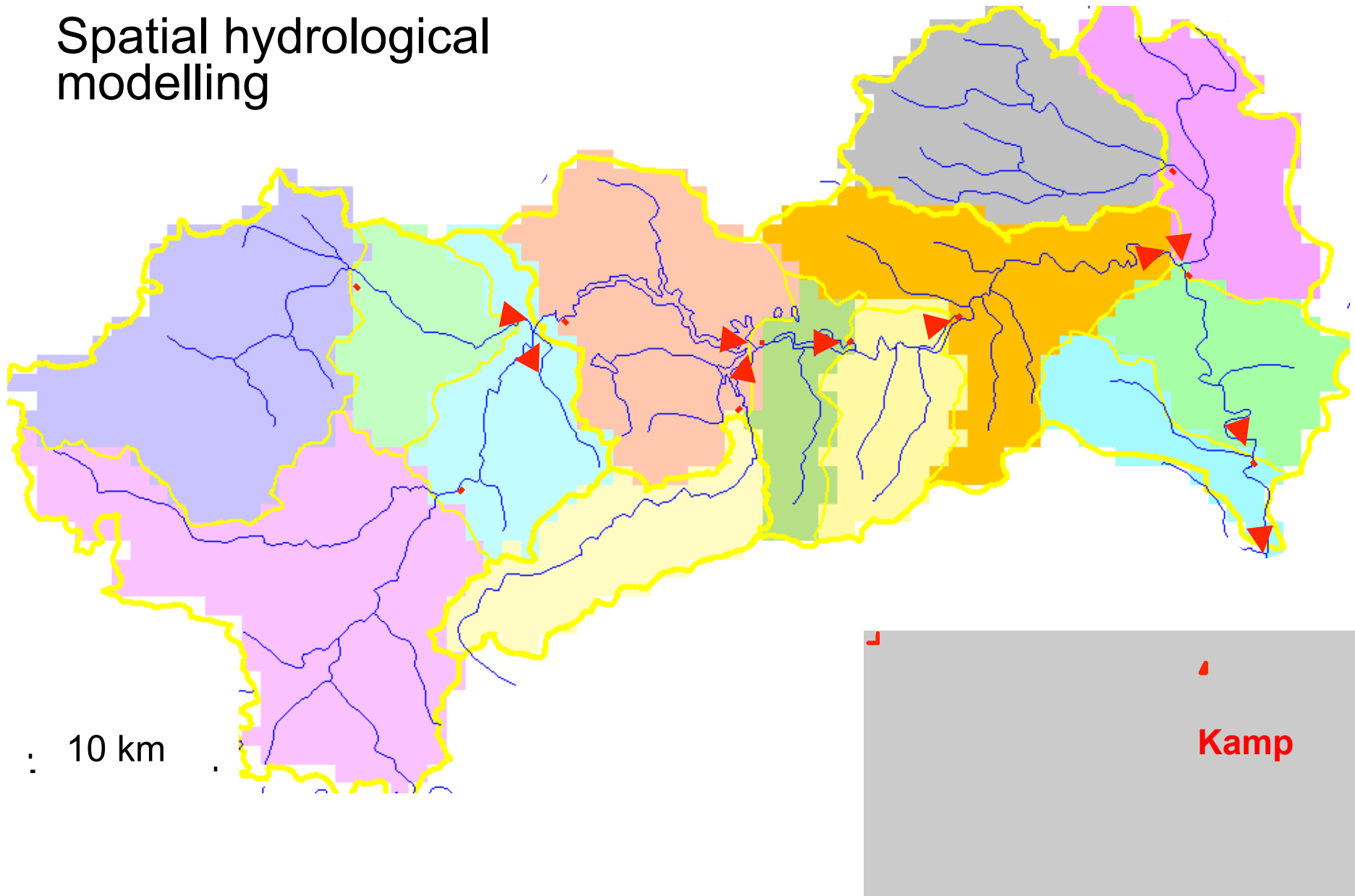
Flood risk zone



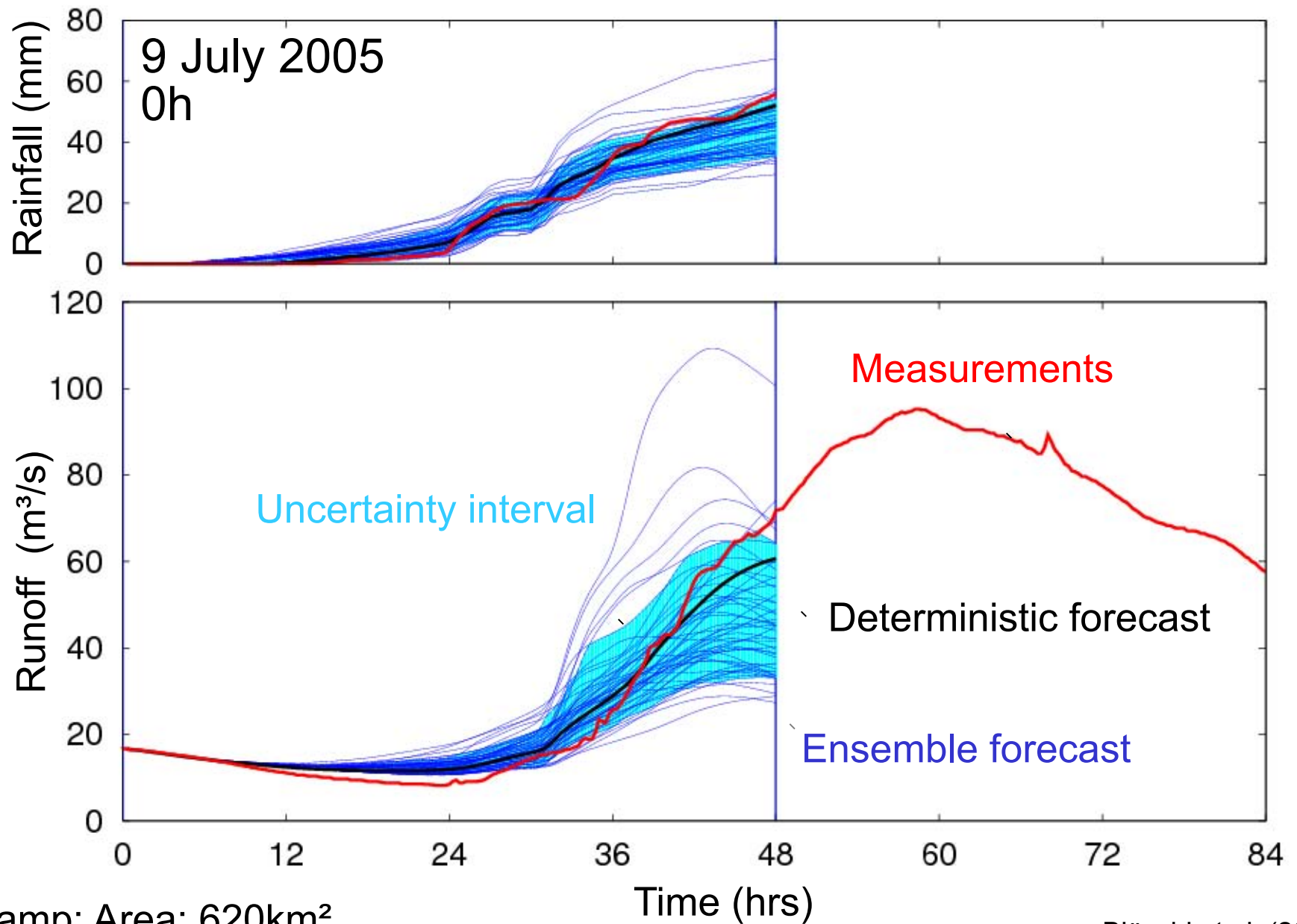
HORA project - www.hochwasserrisiko.at

Forecasting: Floods in the Kamp catchment

Spatial hydrological modelling



Flood forecasts with uncertainty



Kamp; Area: 620km²



Conclusions

Flood types:

- River floods, flash floods, coastal floods, human induced floods

Flood processes:

- Climate drivers: Seasonality, weather patterns, ..
- Catchment drivers: soils and topography, soil moisture
- Process studies needed (both local and regional)

Have river floods increased? Will they increase?

- Urbanisation, increased values → Fatalities, damages
- Climate signal not clear as of yet – more research needed
- Future floods: changes in seasonality likely

How to protect us from floods in the future?

- Integrated flood risk management → Combination of
 - structural measures (e.g. dams) and
 - non-structural measures (e.g. flood warning, regional planning)

Process understanding is key to better flood risk management