

Simulating heavy rain damage in an insurance context

Stefanie Busch

- Introduction
- Hazard: Rain Gauge and Radar Data
- Vulnerability and Exposure: Fire Department and Insurance Data
- Application: Loss model
- Conclusion

Simulating Heavy Rain Damage

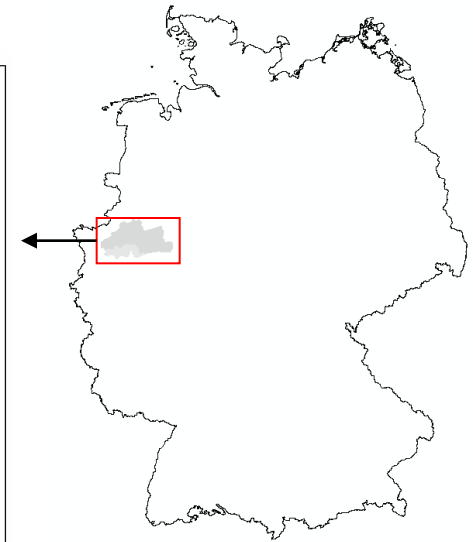
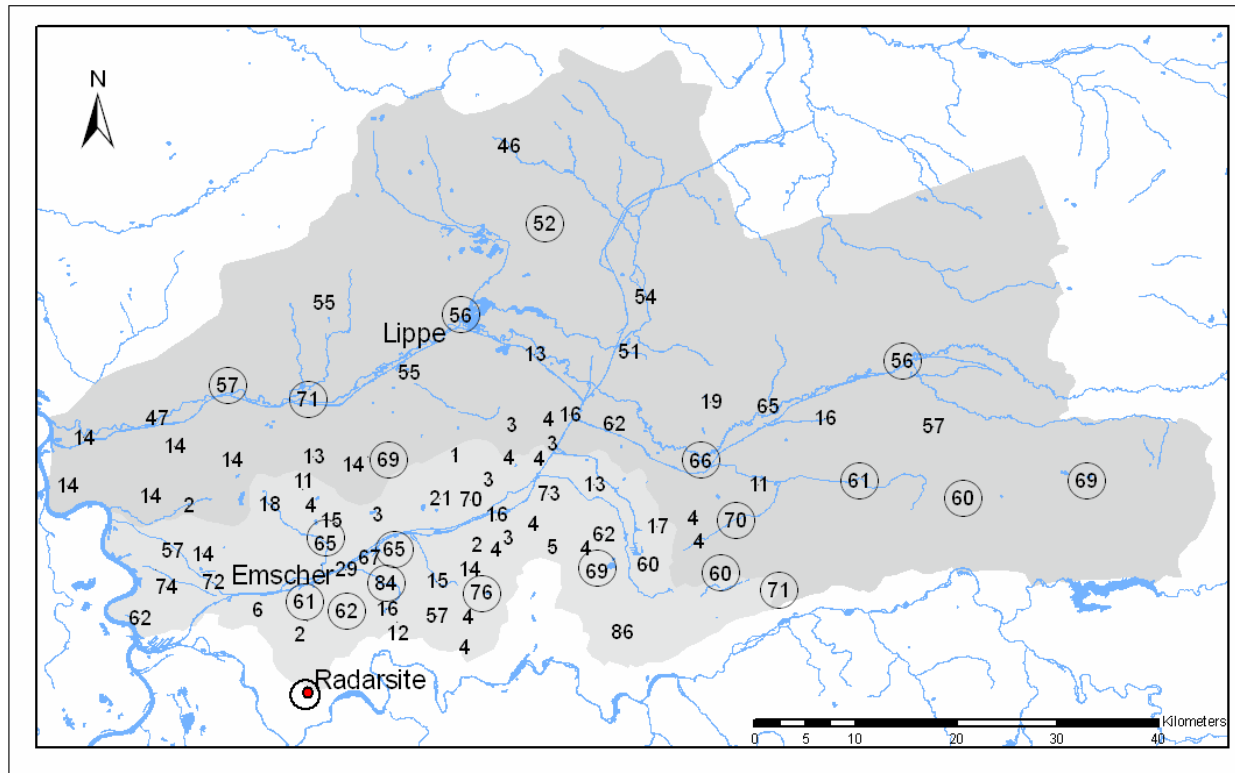
Introduction

- urban flooding is a multidisciplinary challenge
- costs for insurance companies due to flash floods are increasing on account of a higher living standard
- risk maps quantify the flood risk due to river flooding (fluvial flooding)
- local flooding (pluvial flooding) is independent from river courses (> 90% in risk zone 1 = statistically less than every 200 years inundated)
- Aim: to provide the basis for the development of a tool that allows for calculating monetary damage due to heavy precipitation.

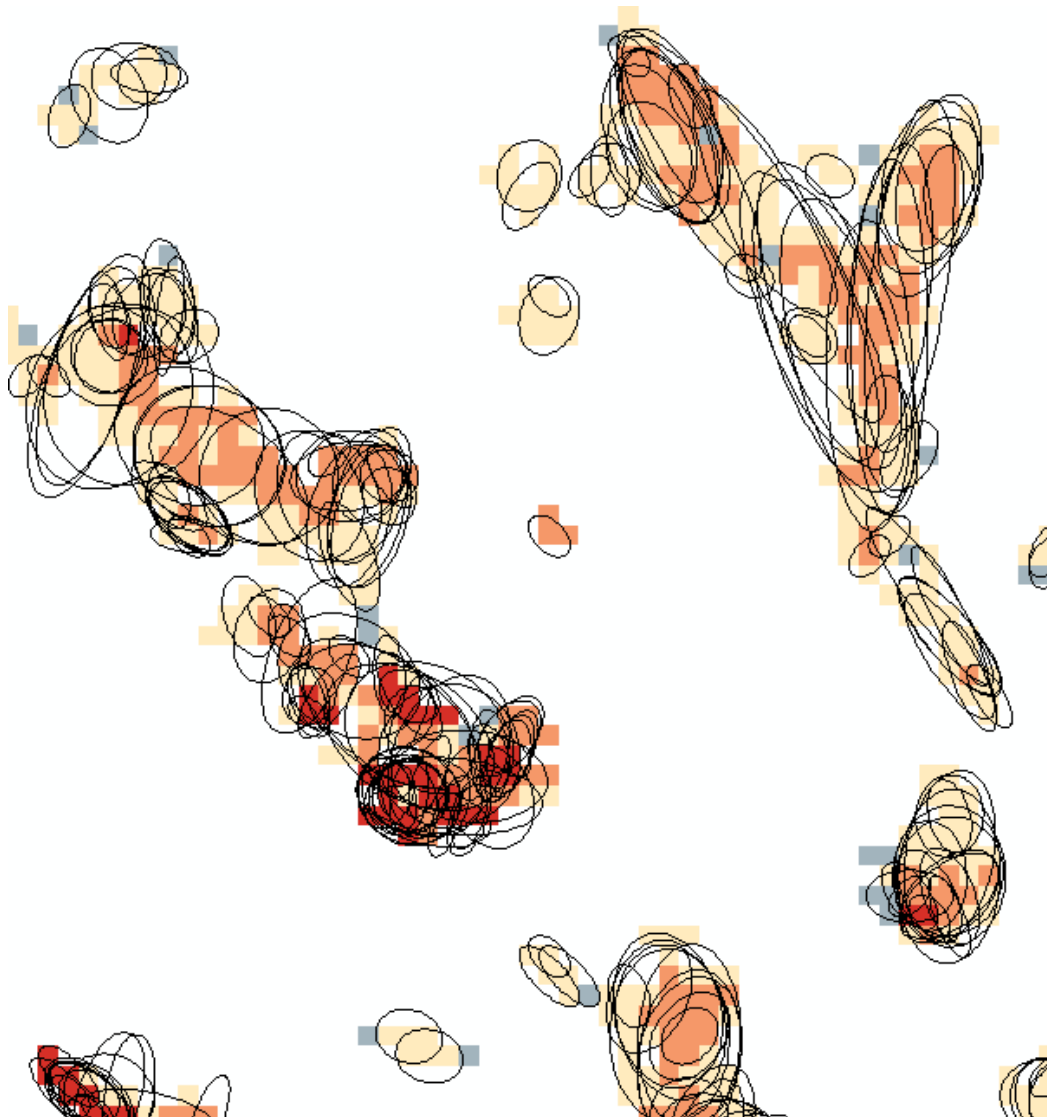
Simulating Heavy Rain Damage

Hazard: rain gauges and radar imagery

- 92 rain gauges with up to 86 years of recording (provided by Emschergenossenschaft/Lippeverband)
- 3 sets of radar imagery from 1 to 4 km² and 5 to 15 minutes (German Weather Service, DWD)



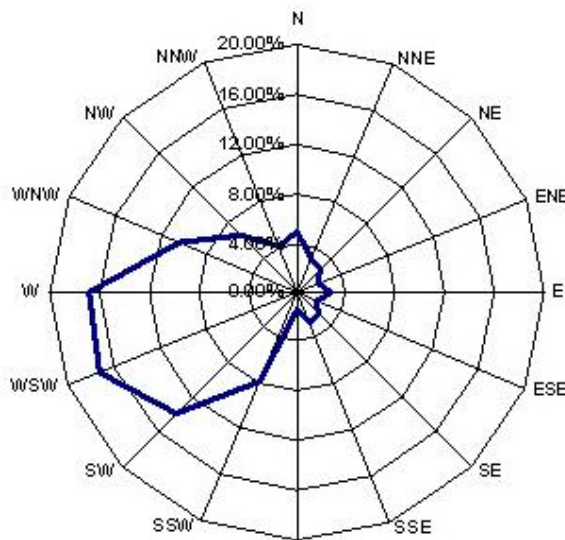
Simulating Heavy Rain Damage Hazard: radar images



- the centroid of each cell and its orientation was extracted
- an algorithm was used to mimic the cells as ellipses
- major and minor axes are chosen in a way that the area of the cell remains unchanged
- all individual cells were then imported to a GIS for a synopsis of the complete event

event 1 May 2004

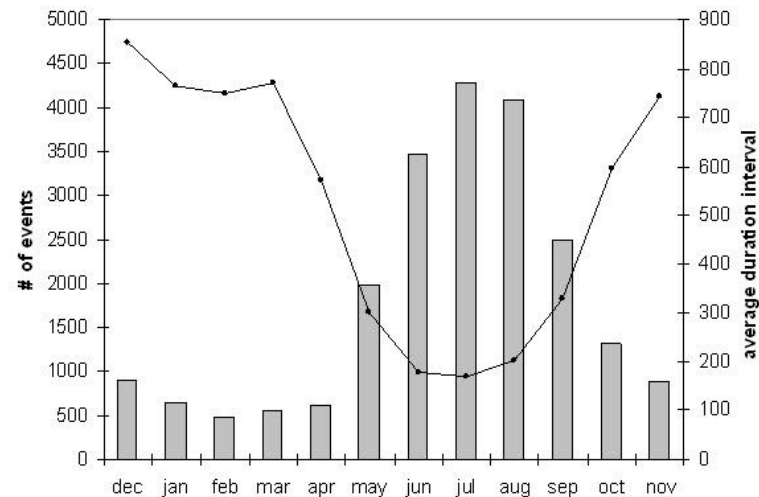
Simulating Heavy Rain Damage Hazard: analysis of spatial and temporal patterns



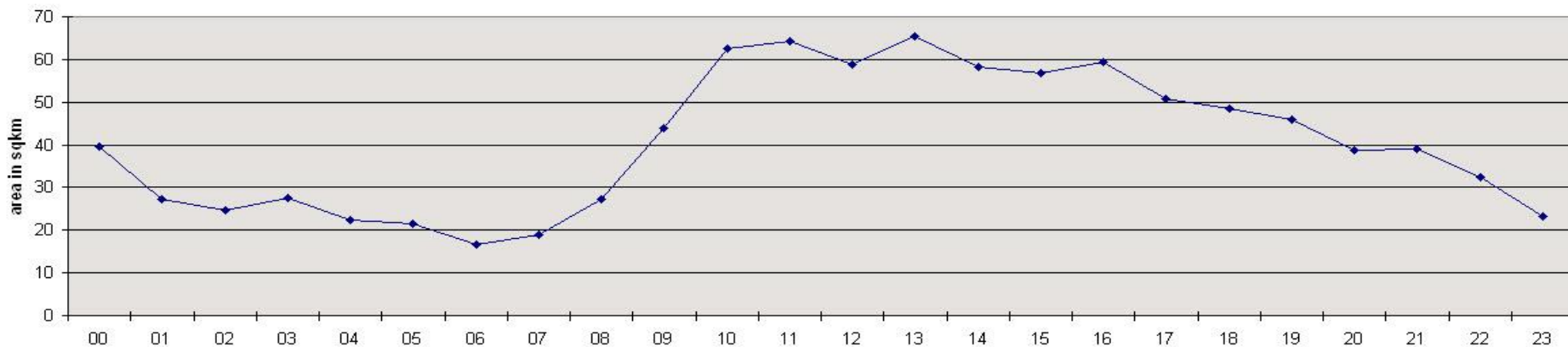
prevailing wind direction

pattern analysis

- diurnally
- monthly
- seasonally
- yearly



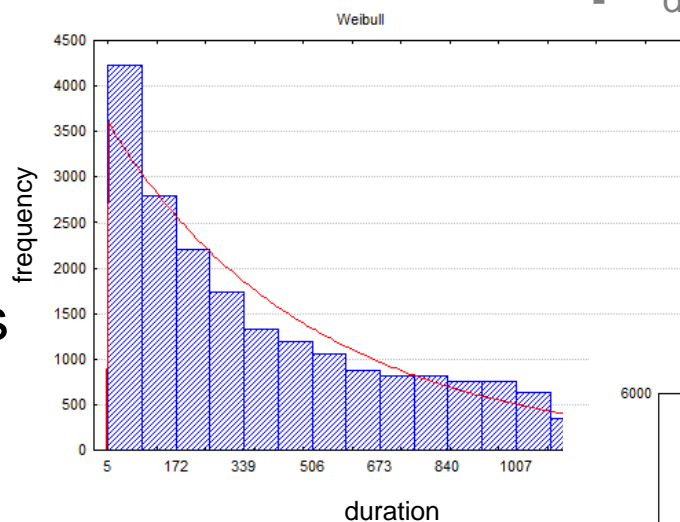
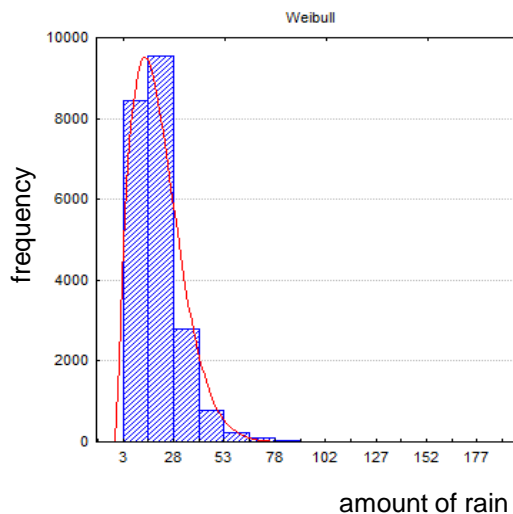
of events and average IED



area covered by heavy rain cells throughout the day

Simulating Heavy Rain Damage

Hazard: determination of distribution functions

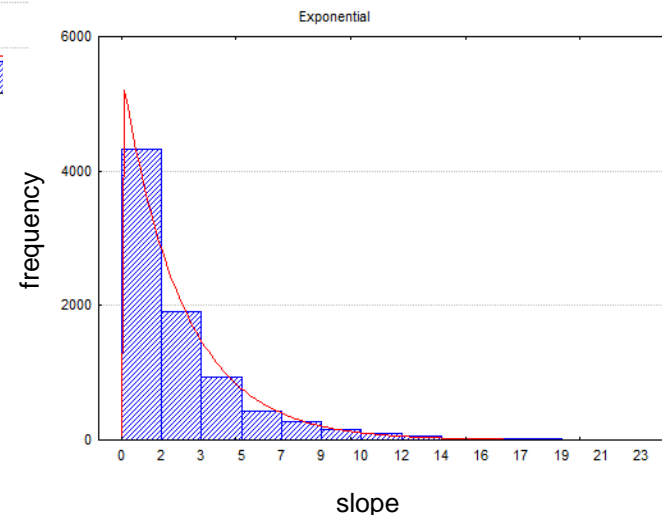


vulnerability parameters

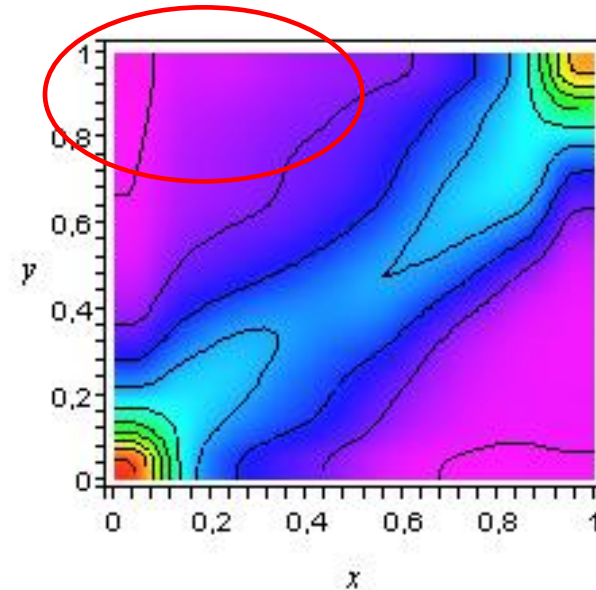
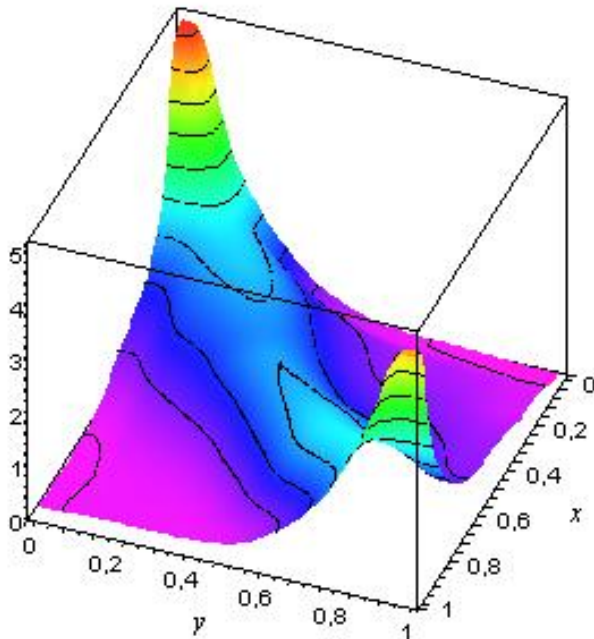
- slope of underlying terrain
- sum insured
- degree of affected risks

hazard parameters

- volume
- duration
- speed
- prevailing wind direction
- start of the maximum intensity
- extent
 - ellipticity
 - orientation
 - long and short axis



Simulating Heavy Rain Damage Hazard: account for dependencies

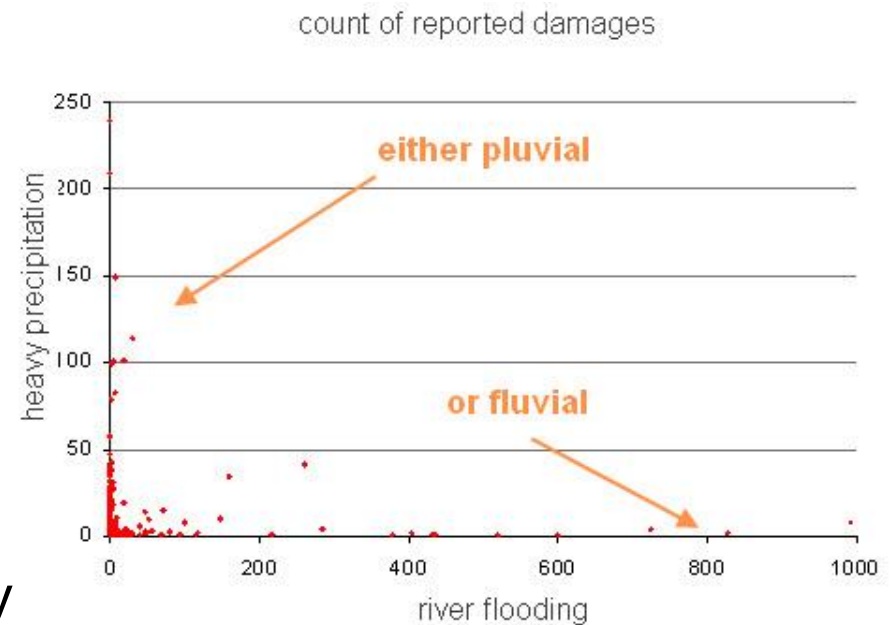


- dependent parameters:
 - duration (x) and amount of rain (y)
 - visualized via an empirical copula

Simulating Heavy Rain Damage

Vulnerability: emergency calls and insurance claims

- 16 fire departments provided data of their emergency calls (7337 addresses)
- 5 insurance companies supplied damage information (13,137 addresses, 899 in the study area)
- Emergency calls and insured damages have been linked to the rain gauge and radar data
- Emergency calls can only give a qualitative notion
- Insurance data allow for a better understanding of the extent of loss caused by heavy rain events



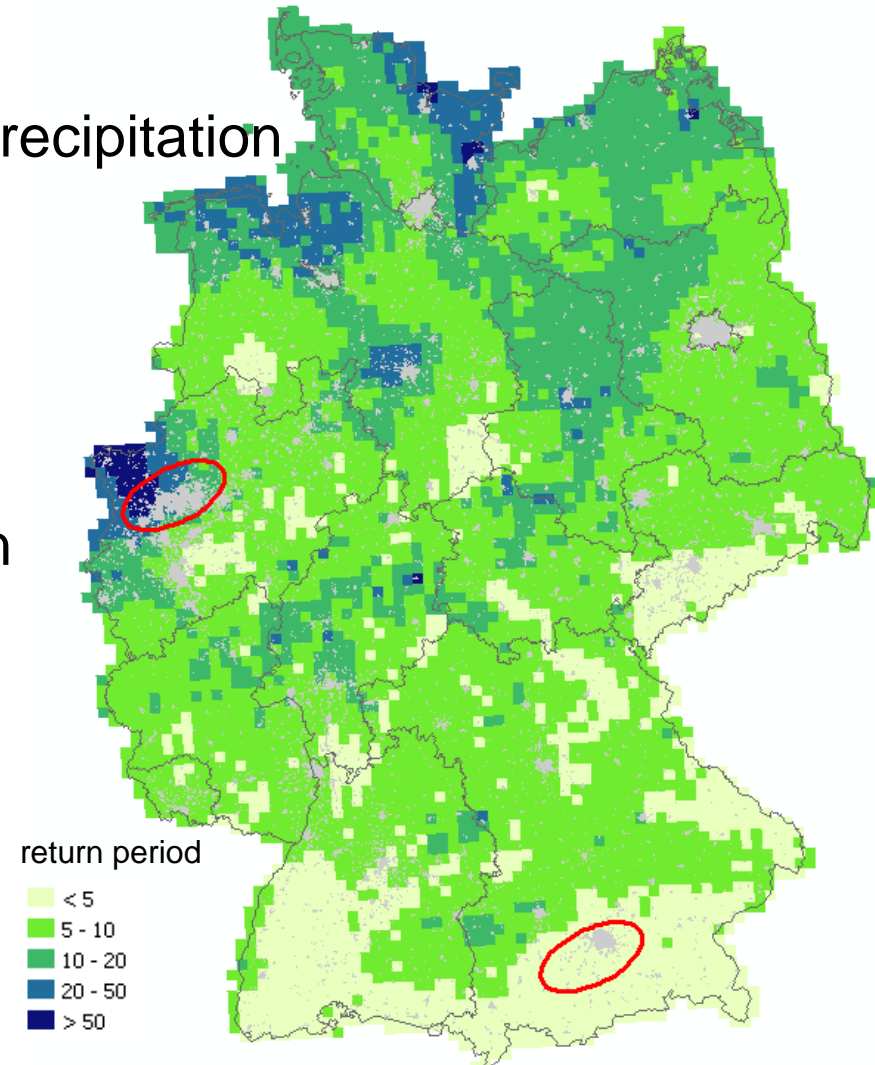
Simulating Heavy Rain Damage Simulation

- simulation of synthetic events
- large number of event years necessary to cover all of the country
- ...and to cover all possible realizations



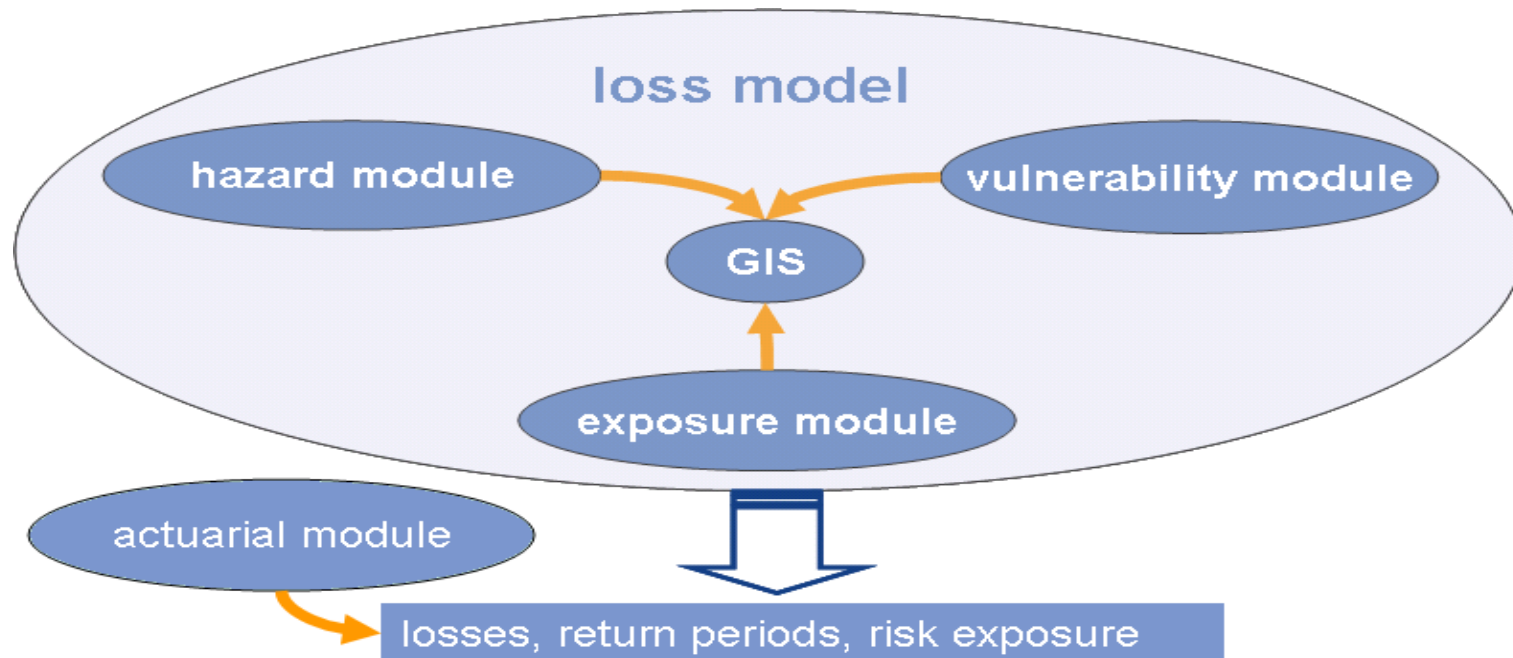
Simulating Heavy Rain Damage Vulnerability: return period

- loss affecting parameters:
 - return period of simulated precipitation
 - dimension of sewer system
 - terrain
 - built-up areas
- base map KOSTRA:
coordinated heavy precipitation
regionalisation analysis



Simulating Heavy Rain Damage

Application: The Loss Model



- Advantage of module principle: possibility of updating, adjusting and improving each module separately when new data is available or scientific knowledge advances

Simulating Heavy Rain damage

Conclusion

- introduction of a fully probabilistic model
- return period of loss not of meteorological event is important
- hazard data are linked to damage information of fire department runs and insurance losses
- almost none of the considered parameters can be assumed independent of the others (Copula concept is used)
- model developed will aid insurance companies to quantify monetarily the risk of heavy precipitation (loss seems additive)
- hope is, to allow for the detection of highly exposed portfolios and to impose impeding flood measures if insurance coverage is sought

Thank you for your attention!