Flood Damage Frequency Estimation for Flood Risk Analysis

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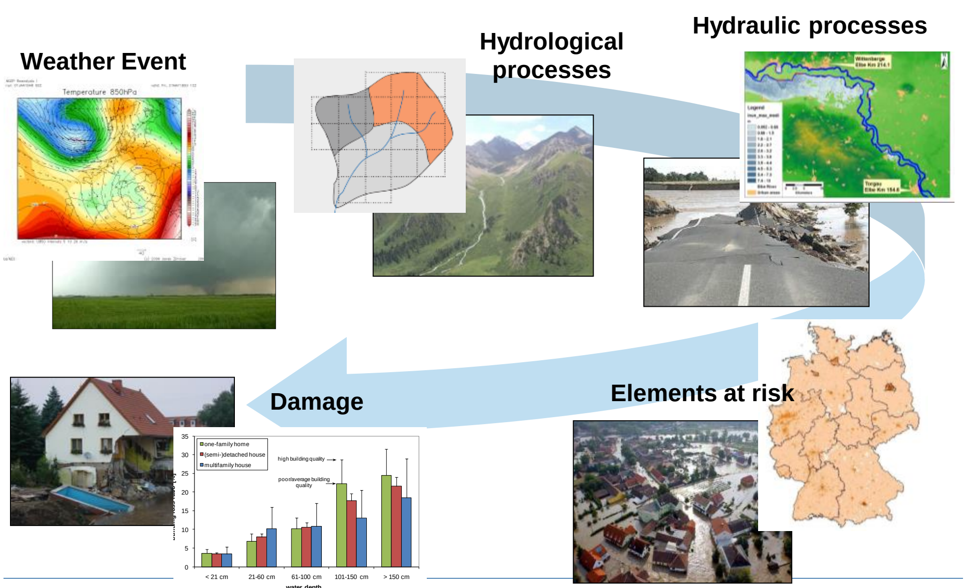
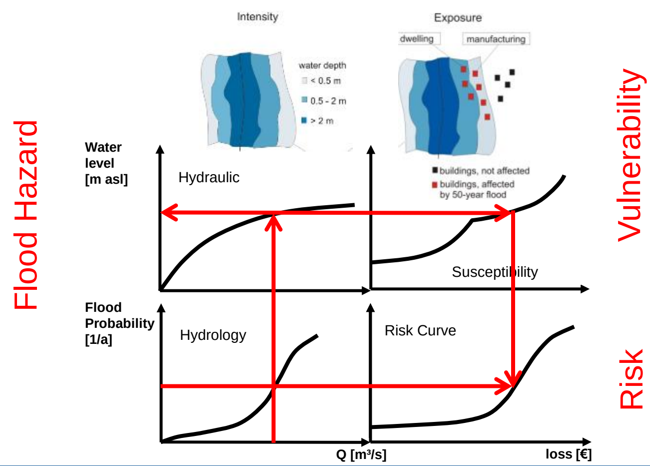
Flood Risk Chain



Flood Risk Assessment

Flood Risk = Probability x Damage



Flood risk assessments

***F**lood **R**isk = **P**robability x **D**amage*

How to estimate the probability in flood risk?

FR = P(Q) x D

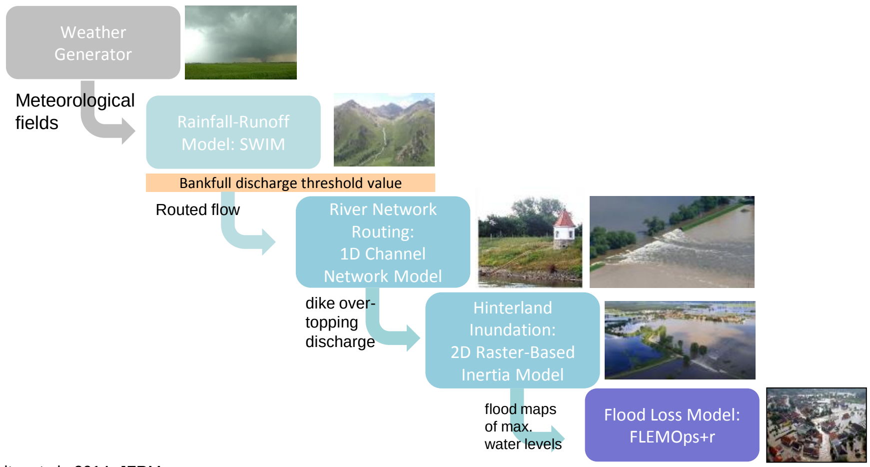
P(Q) derived from statistical analysis of Q-AMS at a gauge 'nearby'

FR = P(D) x D

P(D) derived from statistical analysis of flood damage

Is probability of flood peak discharge a suitable proxy for probability of damage?

Continuous simulation of flood risk chain: Regional Flood Model (RFM)

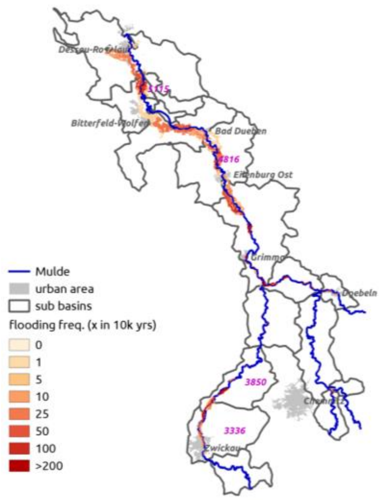


Falter et al., 2014, JFRM

Study Region: Mulde Catchment

- Elbe tributary
- Catchment area of about 6,000 km^2
- River network of about 380 km
- spatial resolution 100 m grid
- Simulation of a virtual period of 10,000 years

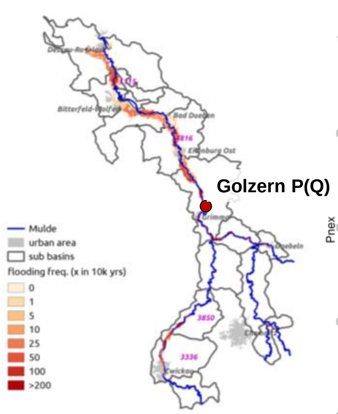
Application to the Mulde Catchment

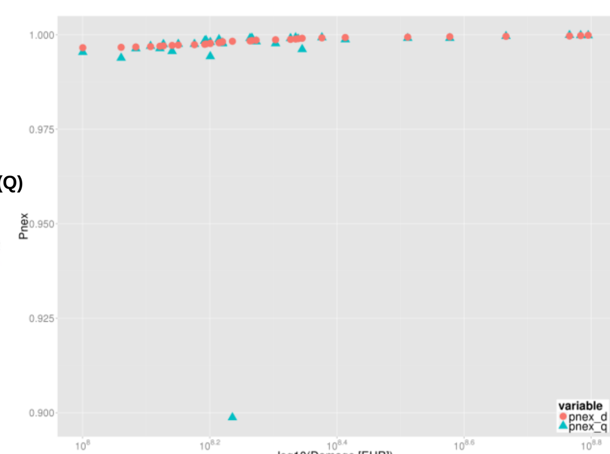


Long term simulation results: flood risk in the Mulde catchment

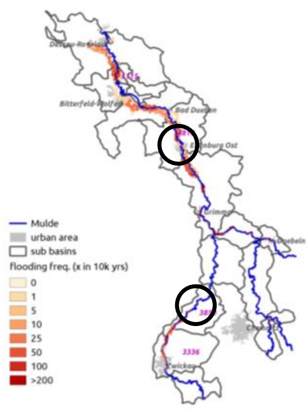
- Record of around 2,000 inundation events affecting the study area in 10,000 years simulation
- 1028 damaging events
- Flood risk for residential buildings can be calculated directly on damage simulations

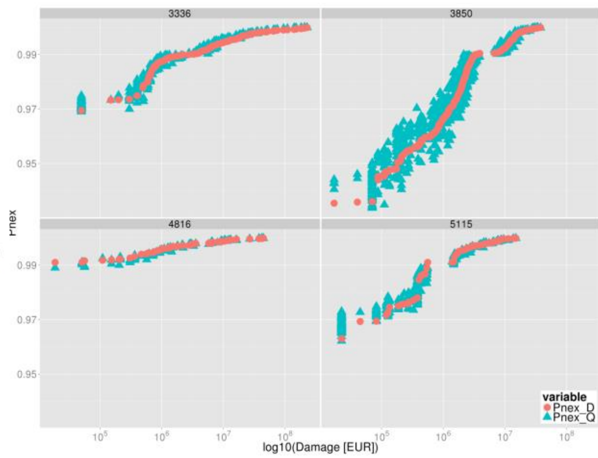
Regional Flood Risk: Mulde catchment



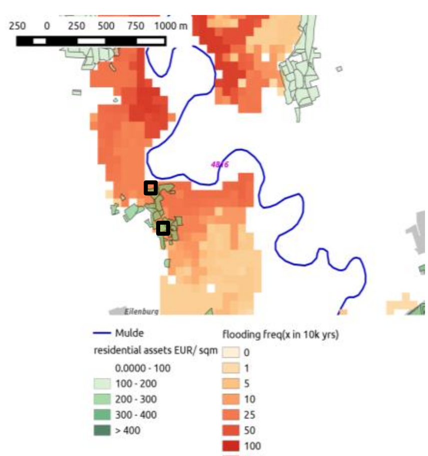


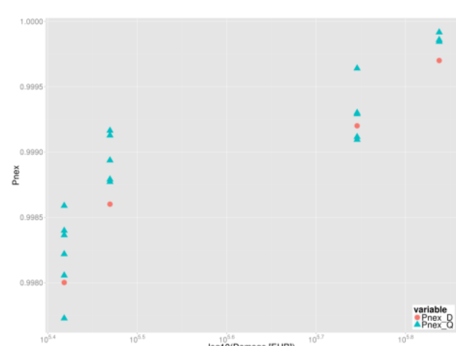
Local Flood Risk: subbasin level





In situ Flood Risk: Pixel Scale





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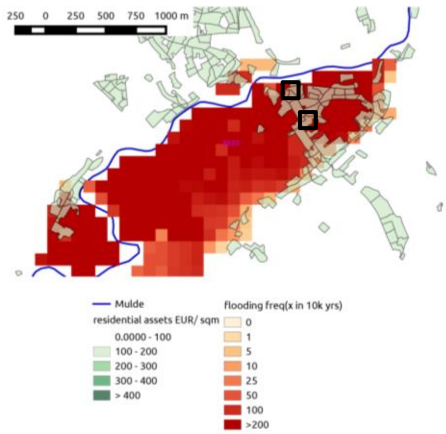

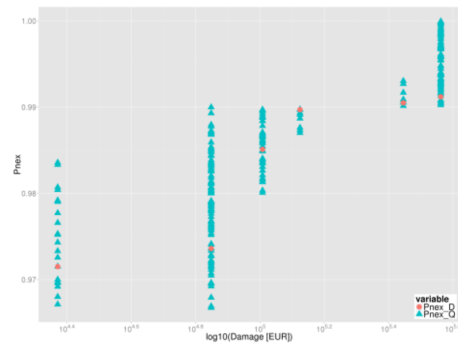

Results

- P(Q) as a proxy for Probability in flood risk analysis is of limited value
- Marked spatial variability of floods
- Ambiguos relation between P(Q) and damage
- Local characteristics control inundation pathways affecting spatially distributed assets
- Spatial variability of risk
- Visible over a range of scales (varying importance)
- P(D) overcomes most of these problems
  - requirements of sample size
  - Need to represent local characteristics and pathways

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Conclusion and Outlook

- RFM in combination with long term climate input data provided by a weather generator, enables long term simulations of the entire flood risk chain for spatially consistent flood risk assessments
- Flood risk can be calculated directly from damage simulations and circumvents problems related to P(Q) proxy
- Useful insights to spatial risk patterns

! Include probabilistic dike breach mechanisms

! Long term simulation and flood risk estimation for larger regions (e.g. entire Elbe-catchment) considering present and future climate

Thank you very much!

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References:

Falter, D., Dung, N.V., Vorogushyn, S., Schröter, K., Hundecha, Y., Kreibich, H., Apel, H., Theisselmann, F. and Merz, B. (2014), Continuous, large-scale simulation model for flood risk assessments: proof-of-concept. Journal of Flood Risk Management. doi: 10.1111/jfr3.12105

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