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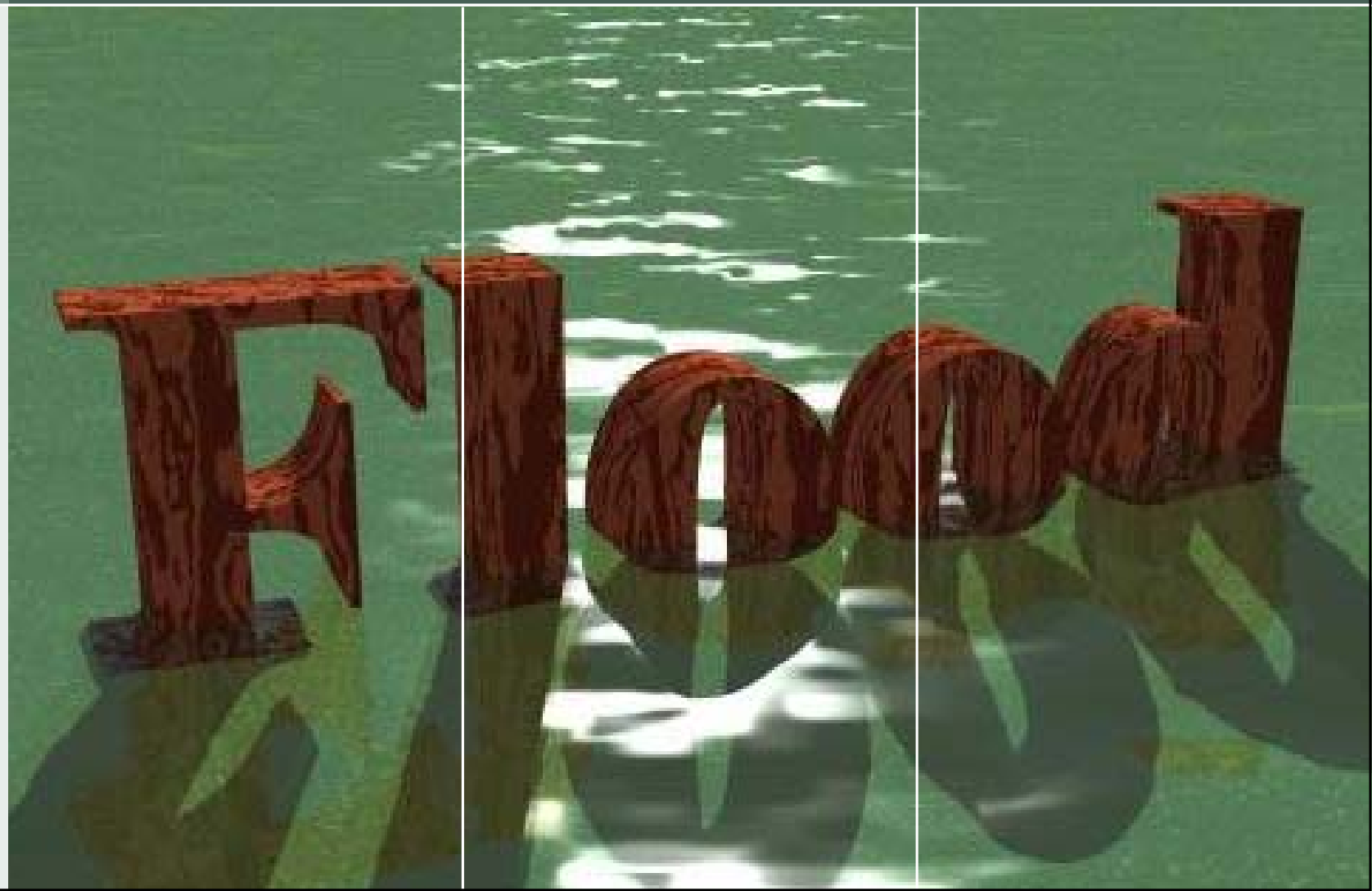
Modelling series of extreme flood events



Dr. Jens Mehlhorn
Head of Flood Group
Chief Underwriting Office

Modelling series of extreme flood events for reinsurance purposes

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- General approach of natural catastrophe risk assessment
- Flood risk assessment models
- Example of flood risk model
  - used approaches
  - limitations
- Conclusions

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Flood Loss Calculation

Standard Approach

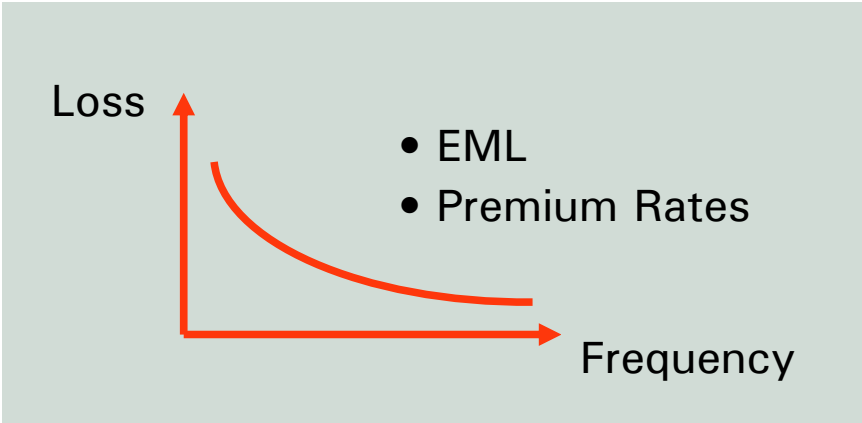
Hazard

Vulnerability

Value Distribution

Insurance Conditions

Combine



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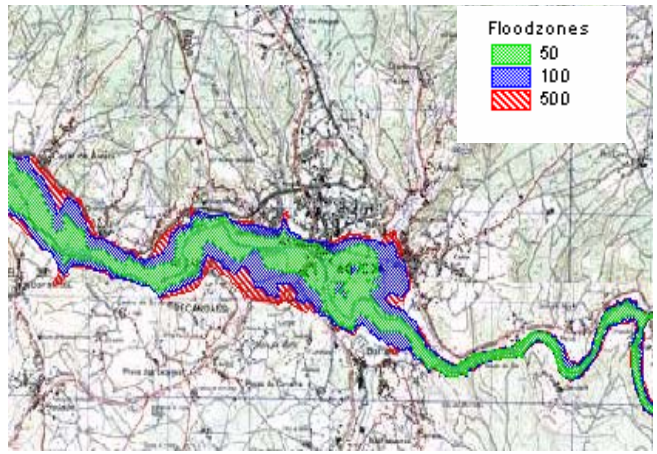
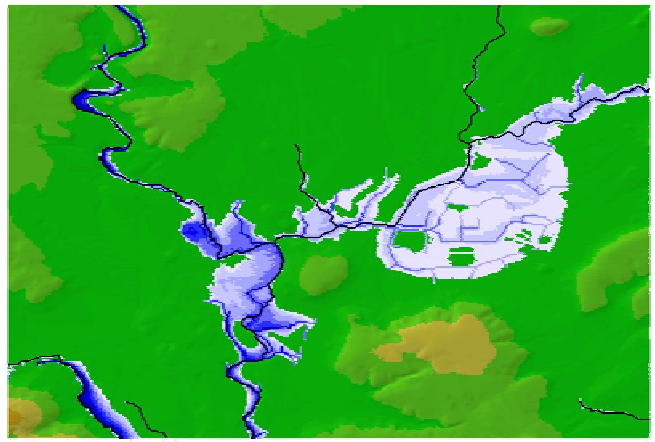
Zoning versus Event Model

- Zoning Model
  - zones for defined return periods along all rivers
  - single location risks
  - basis for UW tool for insurers

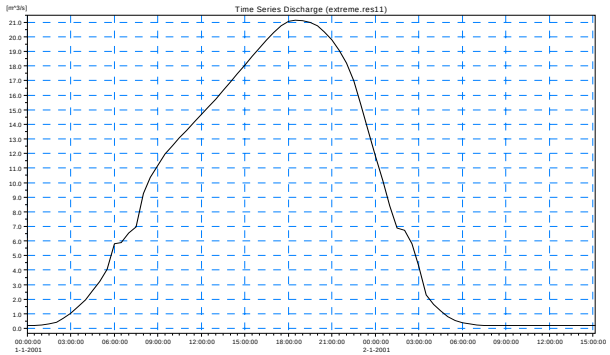


- Event / Probabilistic Model
  - areas affected during one and the same event: flood PML, event covers
  - spatial correlation of high water

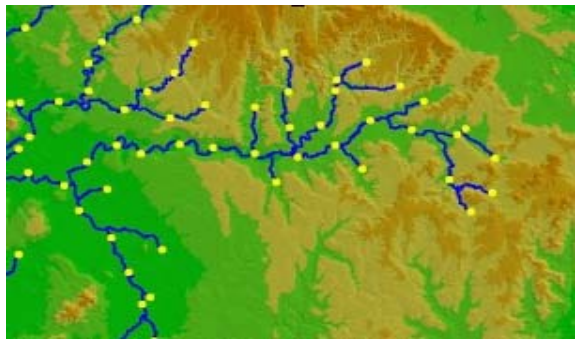


Probabilistic Hazard Modeling
Main Steps

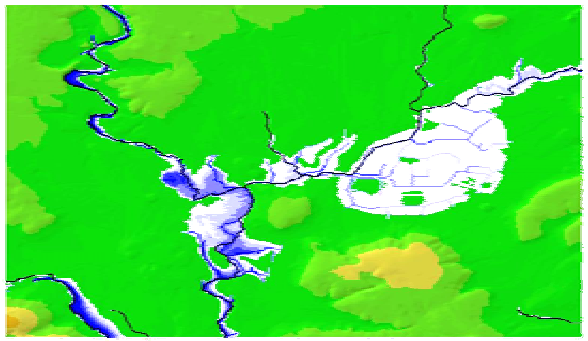
- Generate a probabilistic set of discharge regimes



- Model flood wave propagation using a hydraulic model

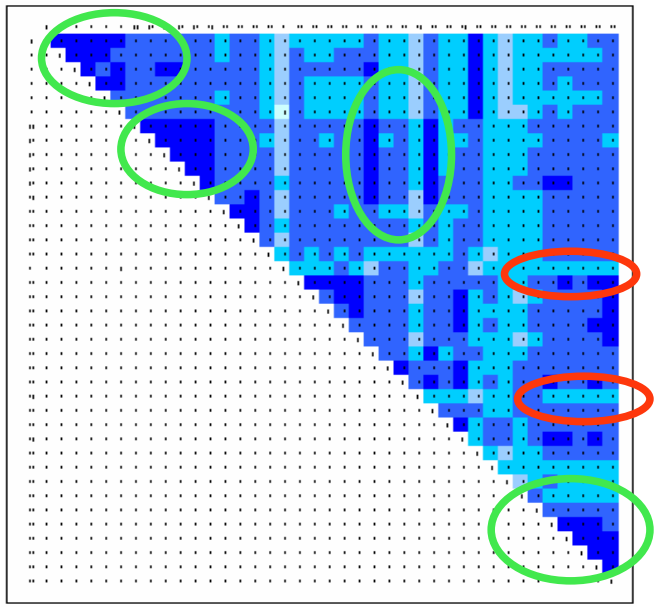


- Calculate flood footprints

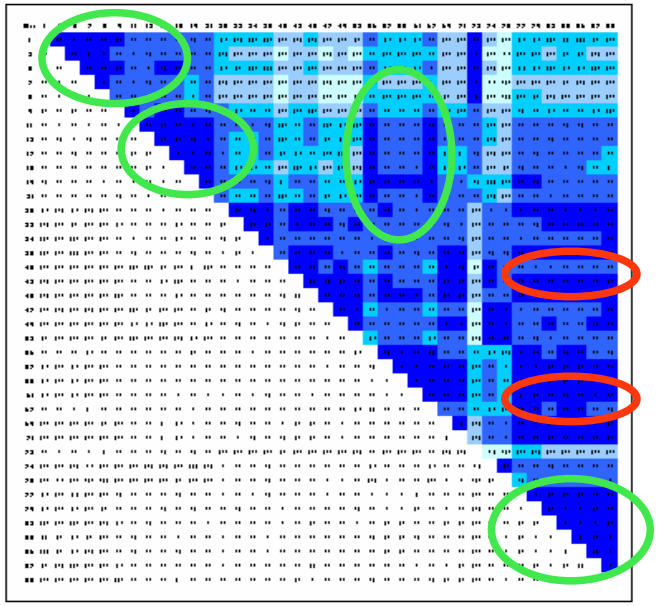


Probabilistic Hazard Modeling
Probabilistic Discharge Set

- It is important to generate new events with the same ‘where and when’ properties as the original events
- Calculate the covariance of the discharge for all gauging stations



correlation matrix



distance matrix

Probabilistic Hazard Modeling
Probabilistic Discharge Set

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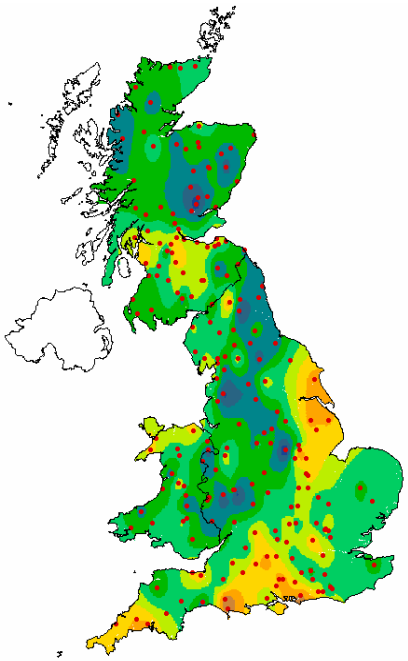
- Create a set of new events
- Given the covariance properties of the historical events at gauging stations
- By means of Monte Carlo on a multivariate normal distribution, create new events (return periods) with the same covariance properties as the original events
- Adjust time lags between the stations
- calculate hydrographs depending on return periods and catchment characteristics

Probabilistic Hazard Modeling
UK River Flood Event Set



- covers entire UK mainland
- fully probabilistic
- fully accounts for spatial correlation
- comprises 973 biggest simulated river flood events covering a period of 1000 years
- more than 1000 river branches modelled
- fully accounts for flood protection
- simulated flood flows successfully validated at more than 100 gauging stations

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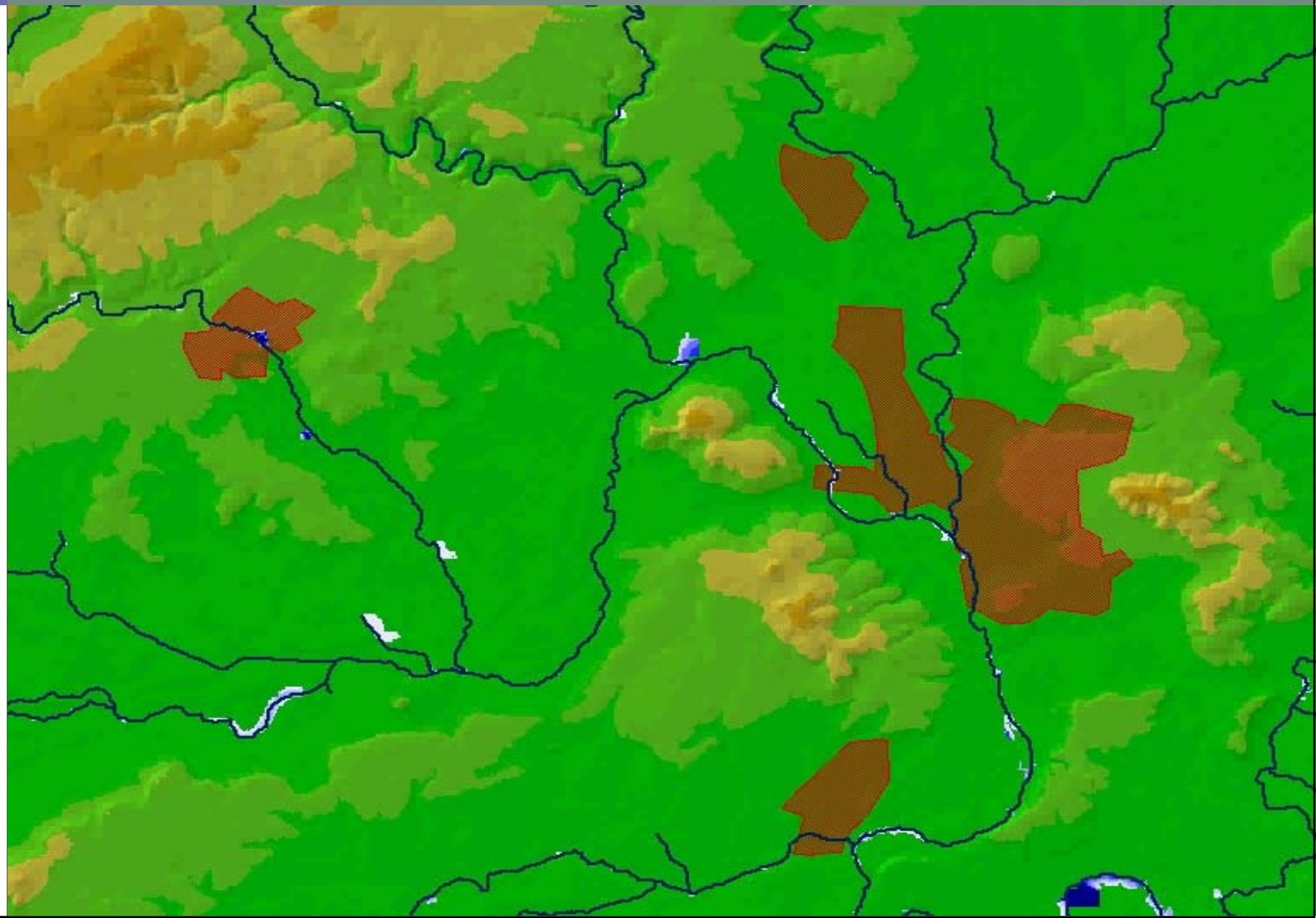
Example: UK Event Model



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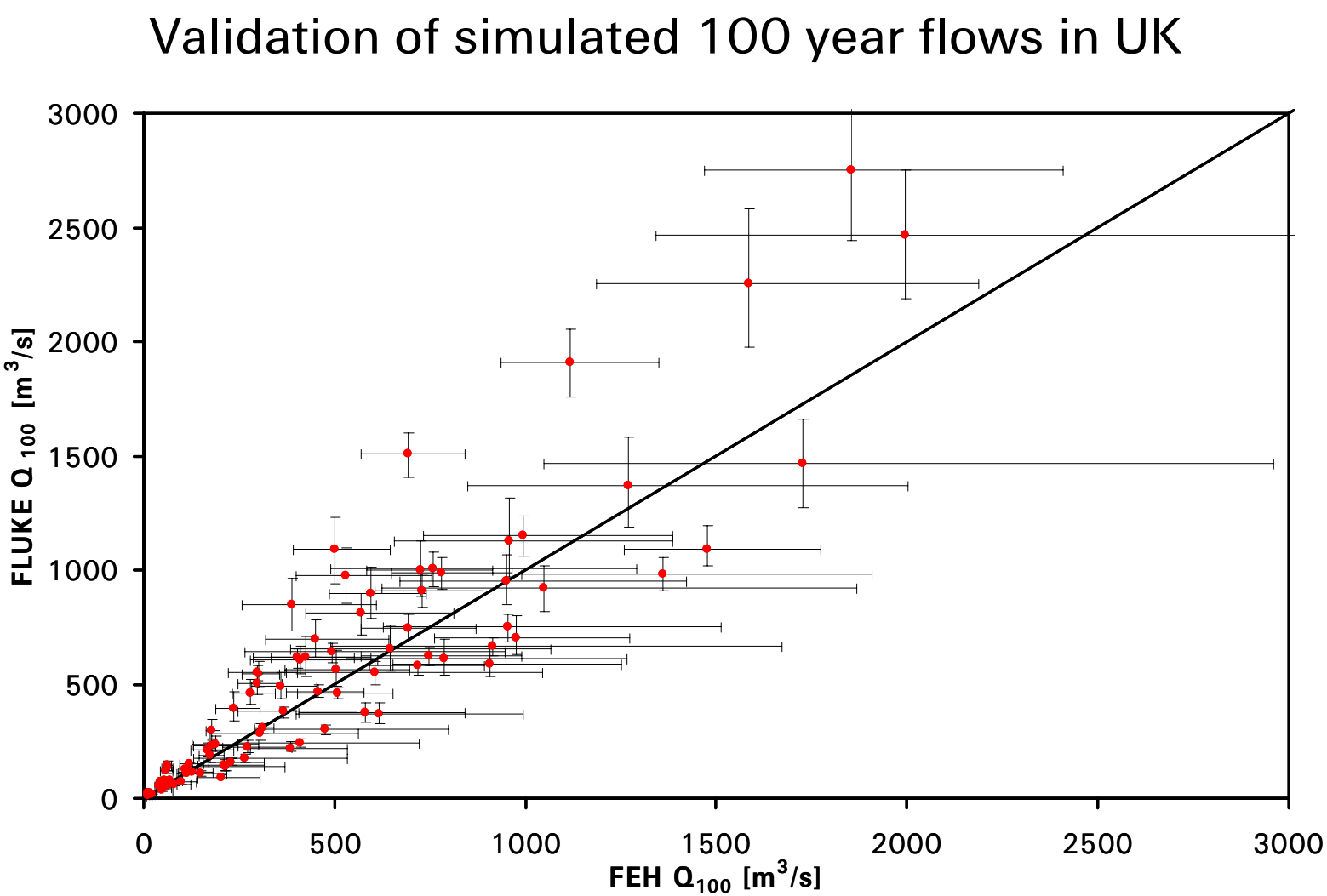
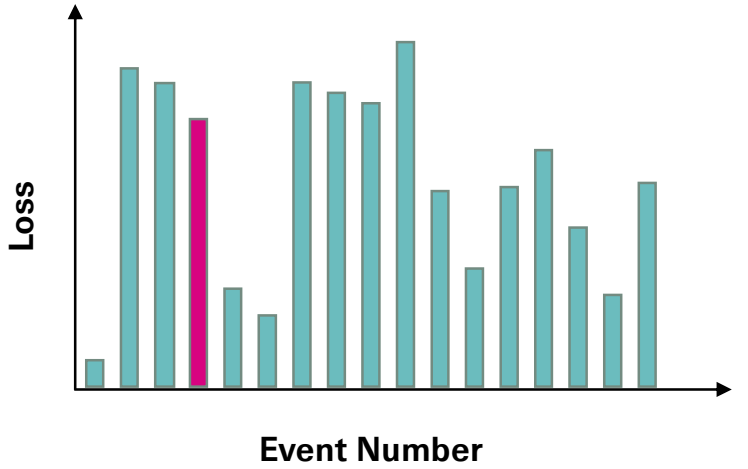
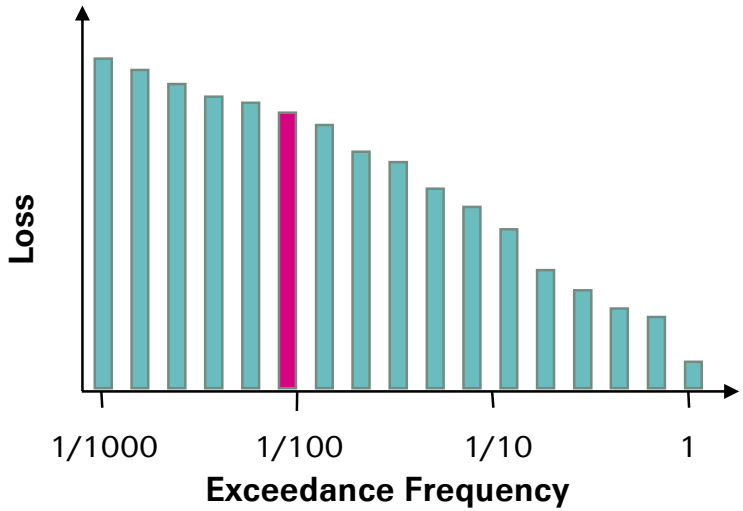
Example: UK Event Model



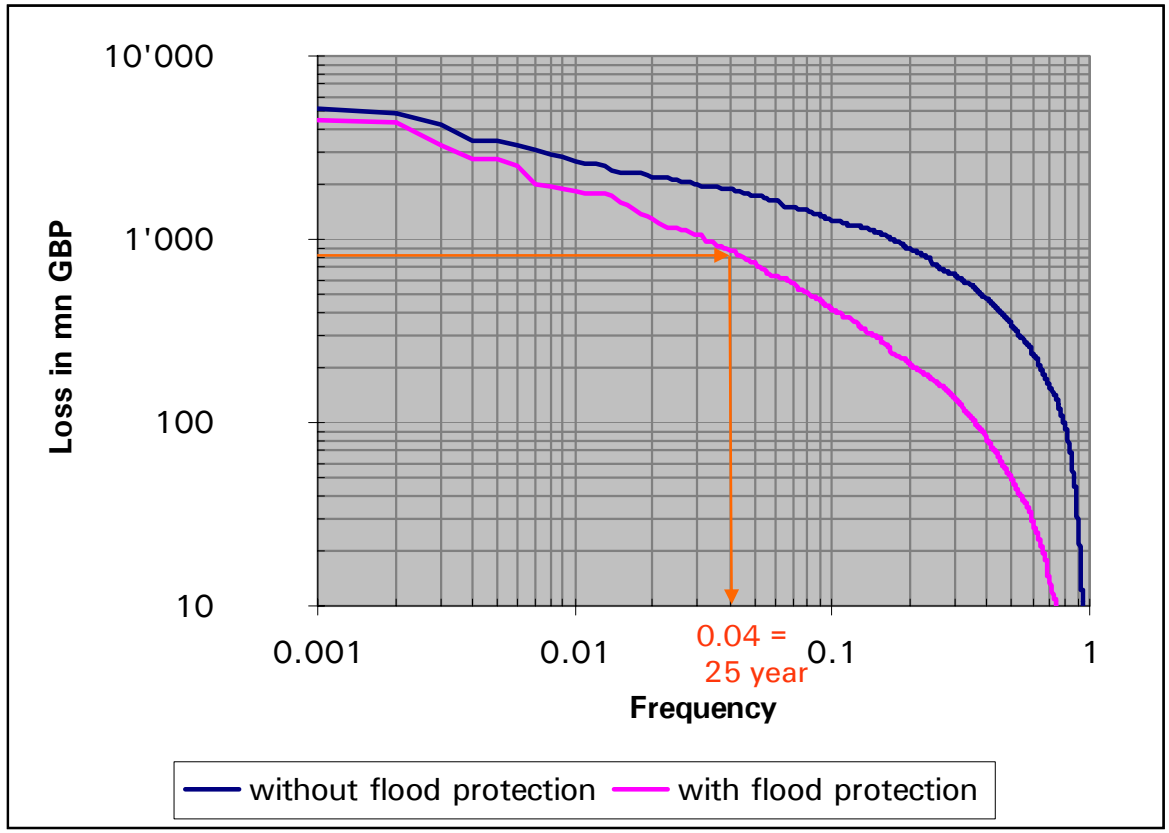
Event Loss Set





- Calculate for each event according loss
- Rank losses by size
- Sum up event probabilities in order to get exceedance frequencies per loss

Loss Frequency Curve for UK Market PTF



Total Insured Property Values: **4'500 bn GBP**

Insured Maximum Possible Loss (1000 year event): **4.5 bn GBP**

Event Autunm 2000: **770 mn GBP at 2004 prices**

Autunm 2000 without flood protection: **1'800 mn GBP at 2004 prices**

average benefit of flood protection per year: **> 500 mn GBP**

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Conclusions

- for a long time flood was meant as an uninsurable risk since risk assessment was not possible
- flood risk assessment tools can be develop
- however, such models are only available for very few countries
- and mainly for (re)-insurance purposes