Incorporating distributions of insurance loss data into a stochastic hail loss model

2nd European Hail Workshop, Bern

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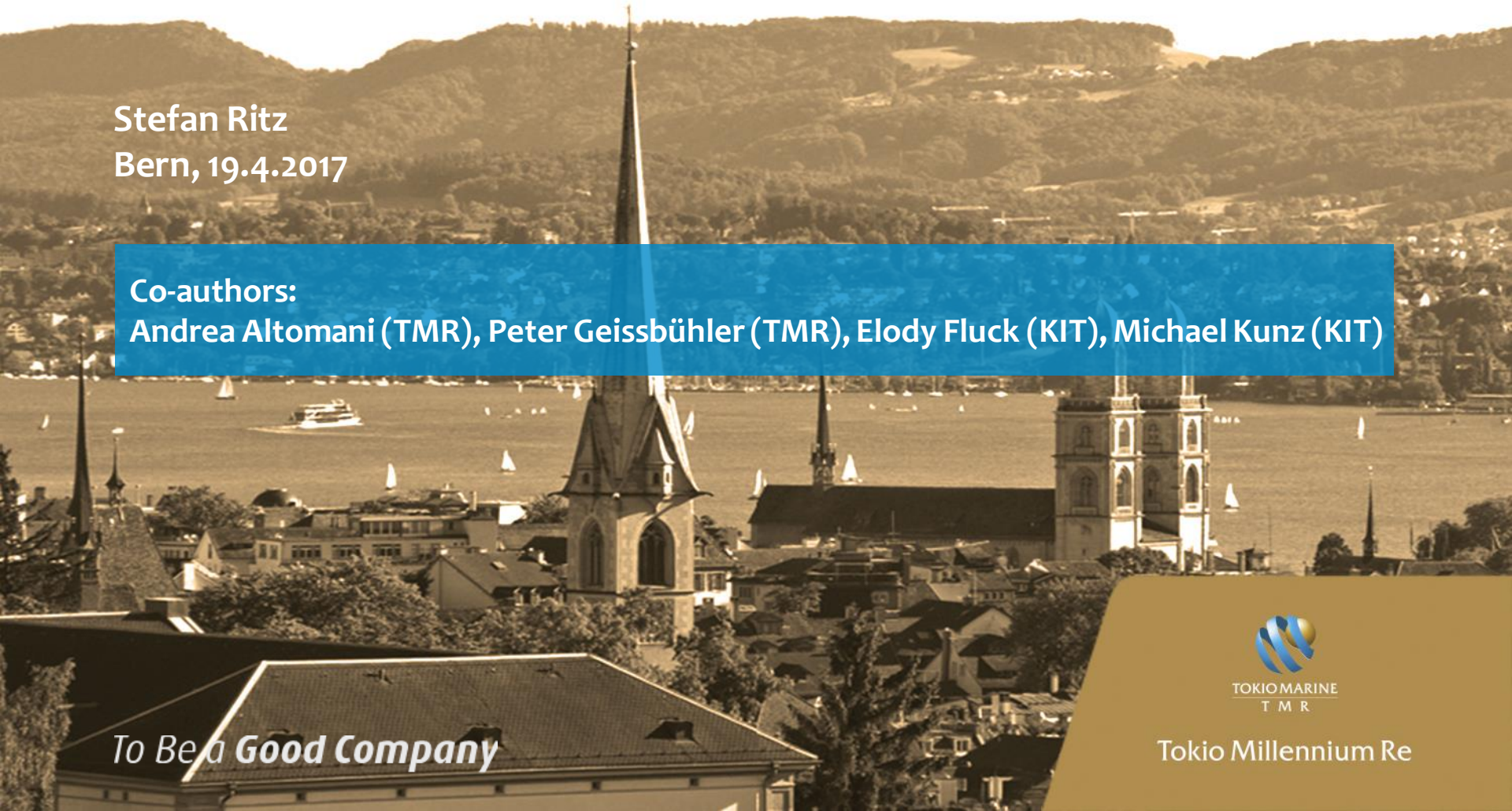

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NAT CAT loss model components

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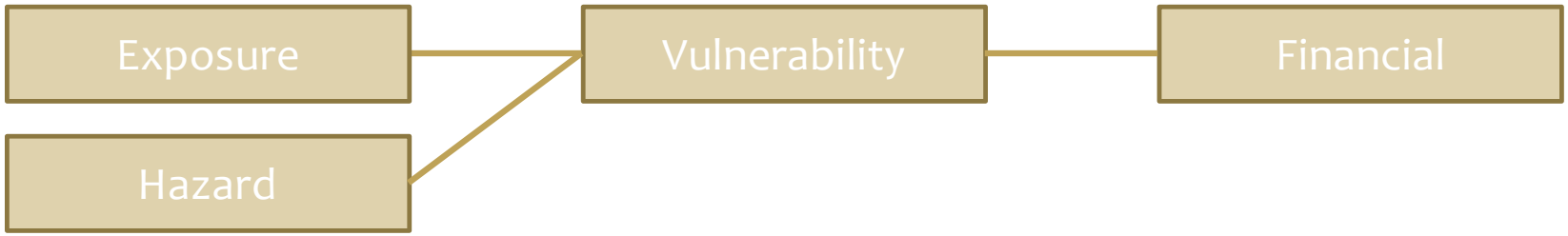

NAT CAT loss model components

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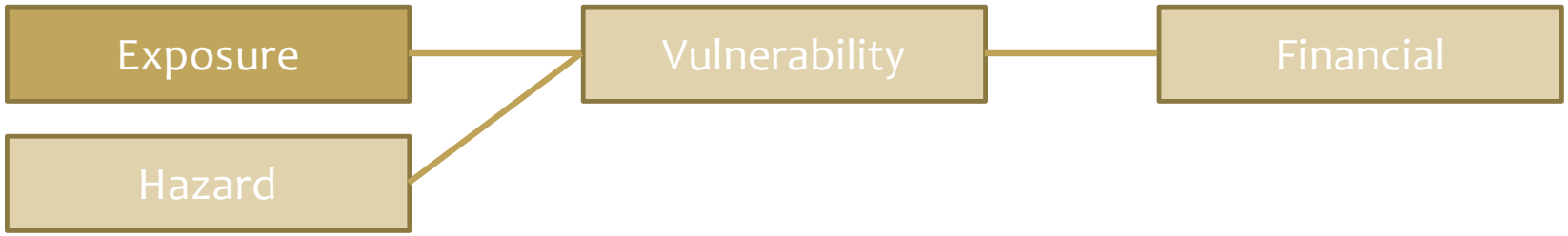
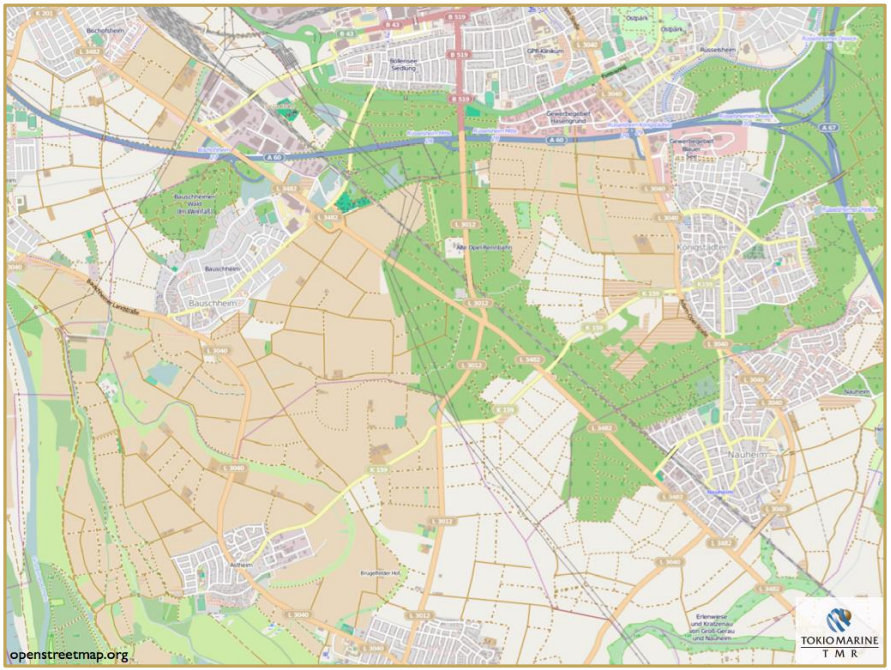


Exposure

- Buildings
  - Insured value
  - Location
  - Characteristics
    - Construction type (wood, concrete, …)
    - Number of stories
    - Year built
- Cars
  - Location of owner



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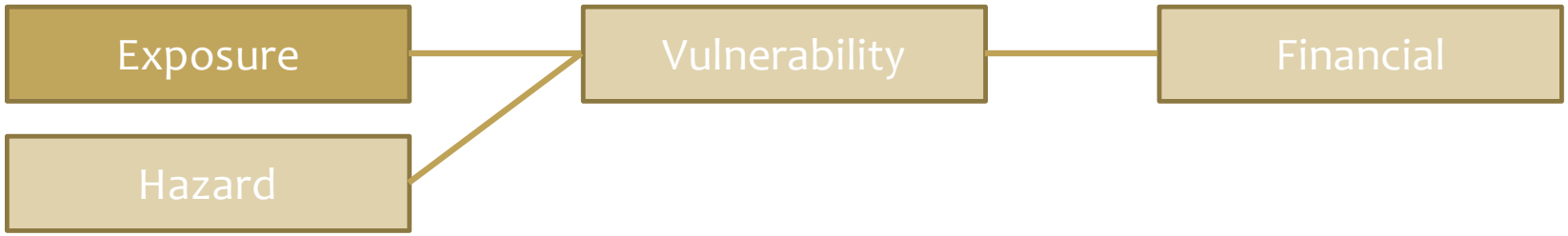

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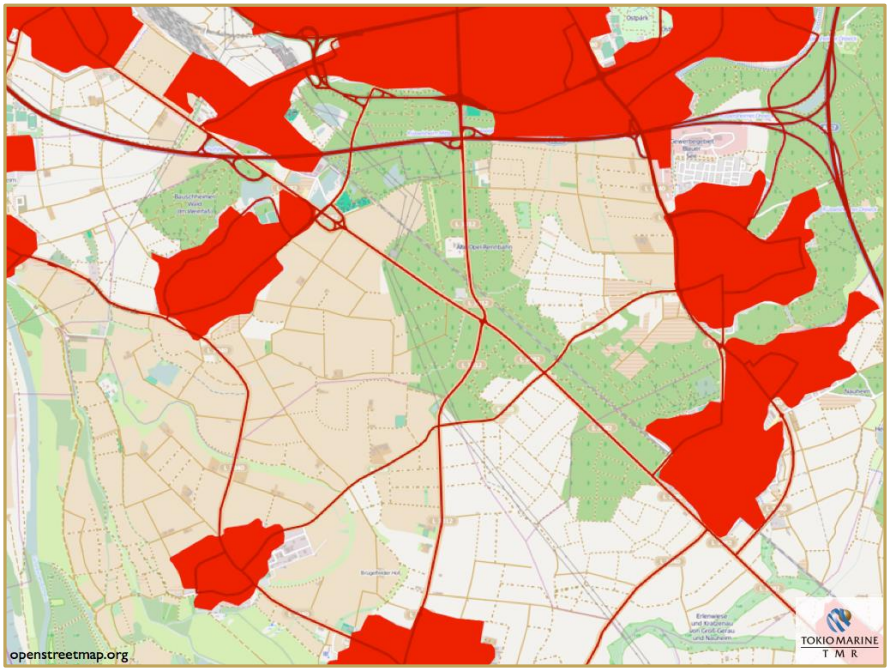

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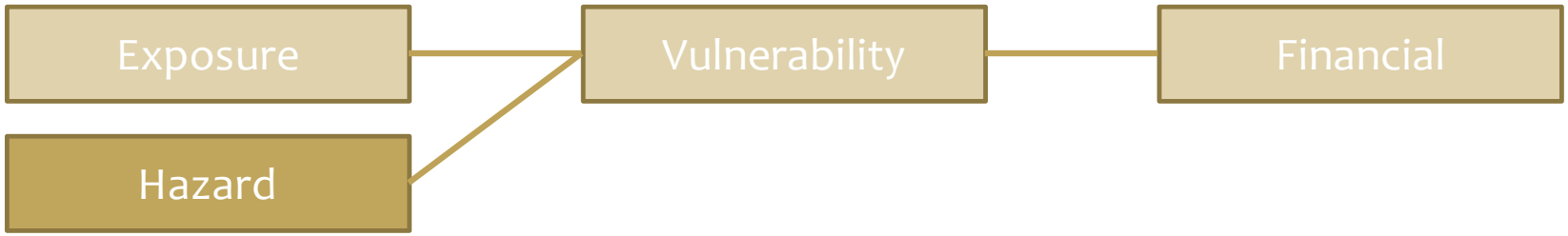
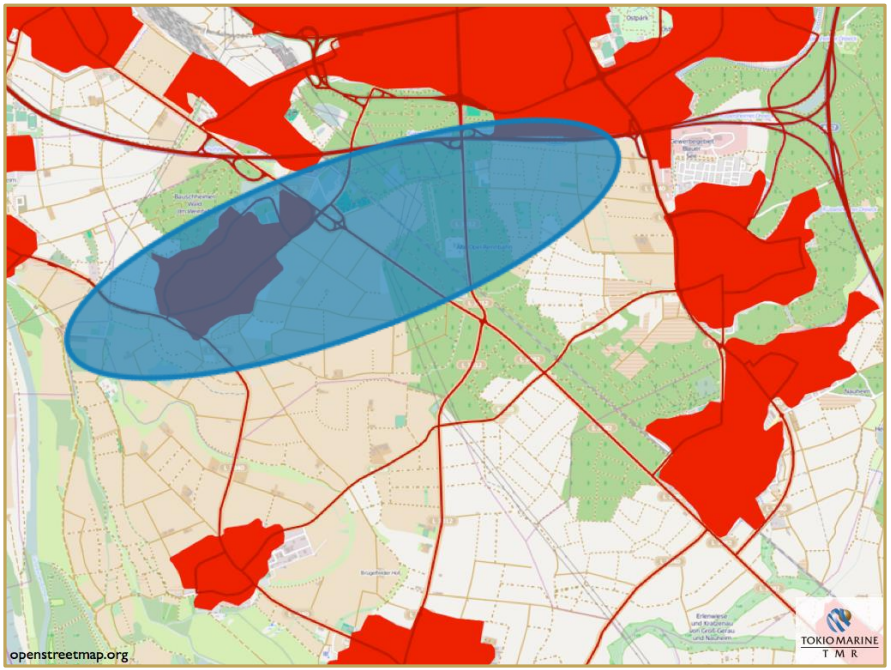


Hazard

Event: Hail / Windstorm / Earthquake / Flood / …

- Event Severity
  - Extent of event
  - Hailstone size
  - Number of hailstones per m^2 and second
- Event Frequency
  - Number of events per year



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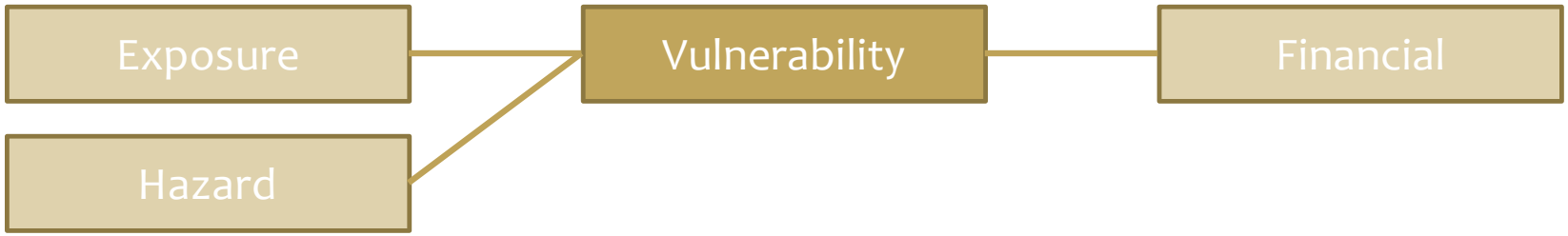


Vulnerability

Given building and event characteristics

- What is the probability of a damage?
- How large is the damage?

Example:

Exposure: Greenhouse

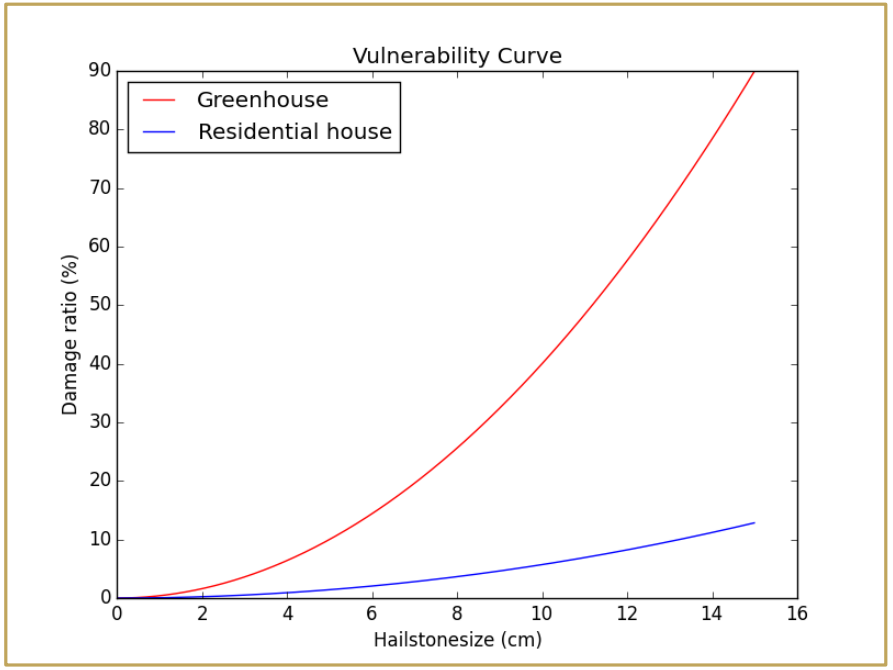
Insured value: EUR 3000.-

Material: 2 mm thick PVC

Age: 10 years (→ PVC becomes brittle)

Event: 7 cm hailstones

→ 20% damage → EUR 600.-



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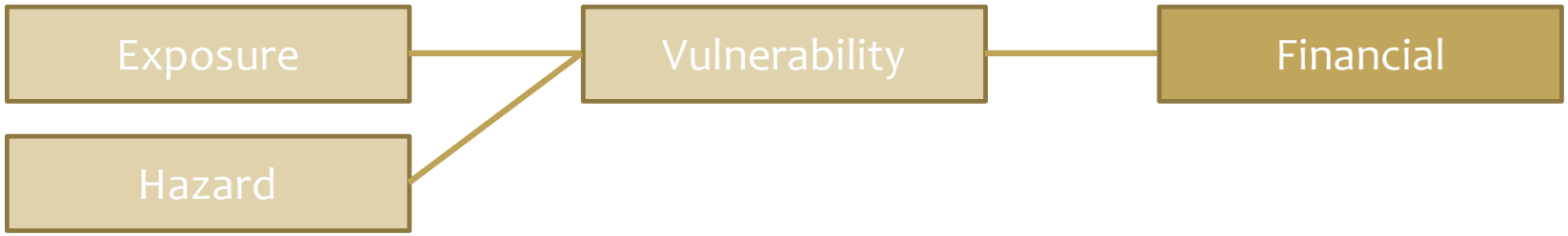

Financial

- Sum up losses for every simulated event
- Account for deductibles and limits
- Calculate probabilities of loss of certain amount
- Apply reinsurance terms

Example:

- The average annual loss (risk premium) is EUR 500,000
- There is a 1% chance that the insurer will have a loss that exceeds EUR 255 million

Exceedance probability	Return Period	Loss (EUR)
0.4 %	250 yr	380 m
1 %	100 yr	255 m
4 %	25 yr	135 m
10%	10 yr	42 m
20%	5 yr	25 m

Tokio Millennium Re hail loss model

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- Hazard from radar data → radar reflectivity on 1km² grid and 15min resolution
  Difficulty: reflectivity cannot be converted to hailstone size
- Exposure information available from clients
  - Building type: single-family house / apartment block / industrial building
  - Insured value
  - Postal code of location

→ Vulnerability functions cannot be used

Conclusions from insurance loss data

- Distribution of individual motor/building losses is event-independent
- Radar reflectivity and probability of damage are correlated

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Distribution around individual motor losses

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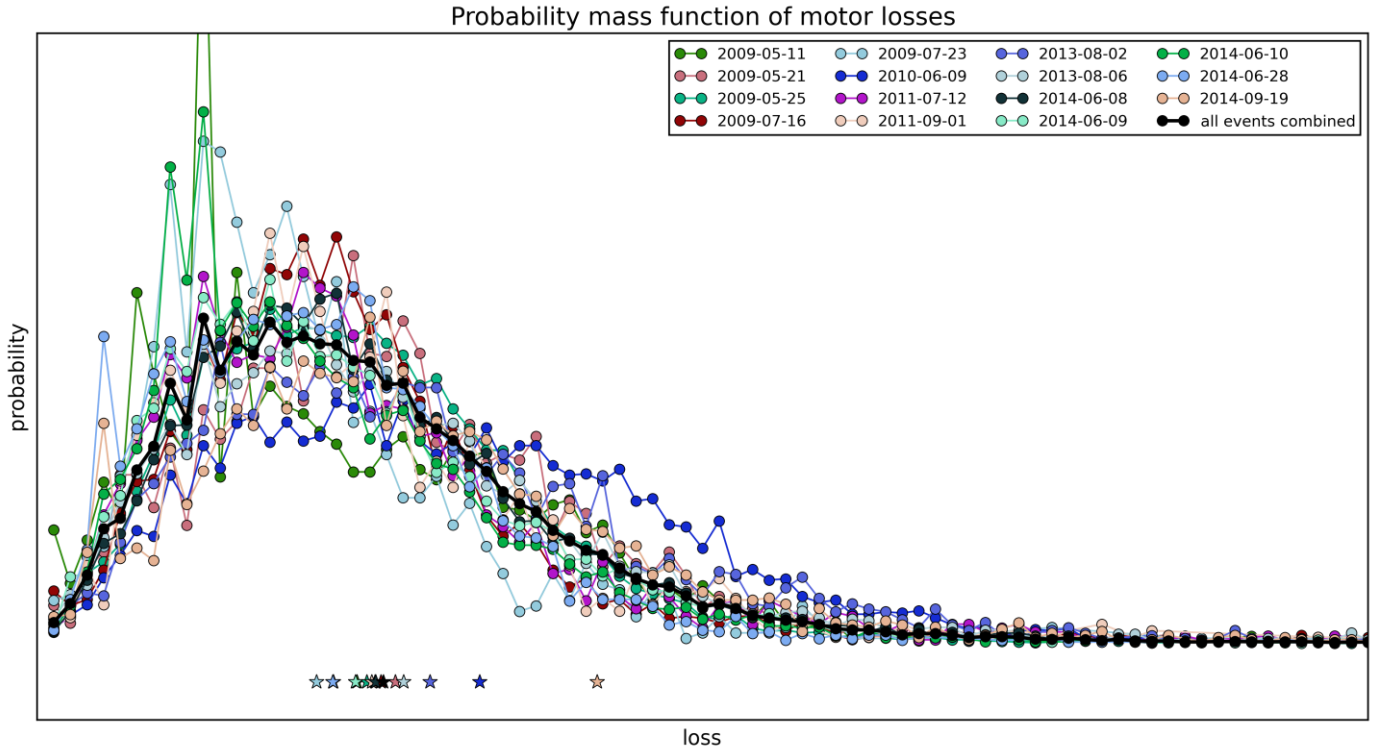
Mean damage: **EUR ~2000**

Distribution



- Distribution is independent of event.
- Variation of mean damage per event (stars) mostly due to sampling error

Measure of hail severity (e.g. hailstone size) is not required

Distribution around individual motor losses

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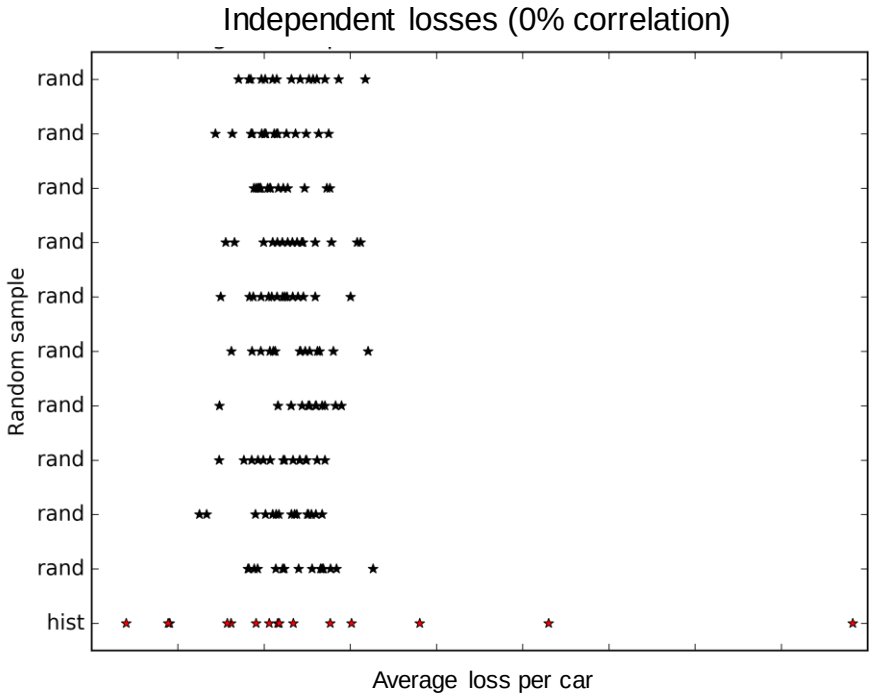
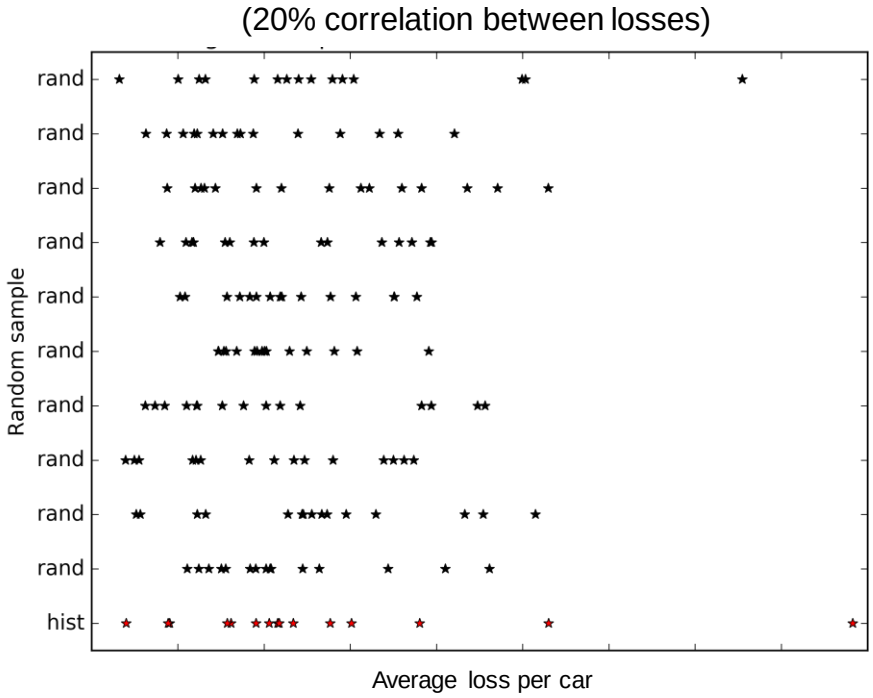
Visualization of the sampling error assuming independence between losses

- Sample: 250 losses per event
- 15 events per row





Distribution around individual building losses

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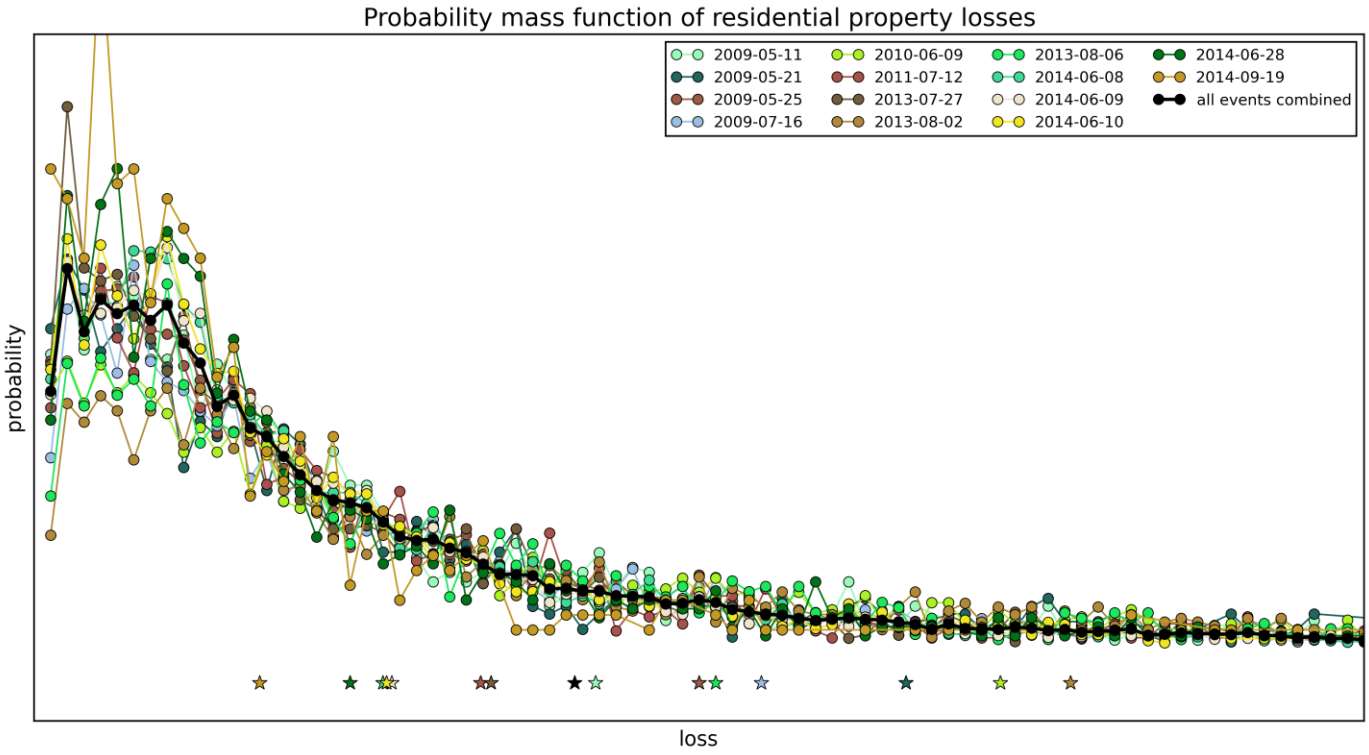
Distribution around residential building losses



The same conclusions can be drawn for building losses

Distribution around individual building losses

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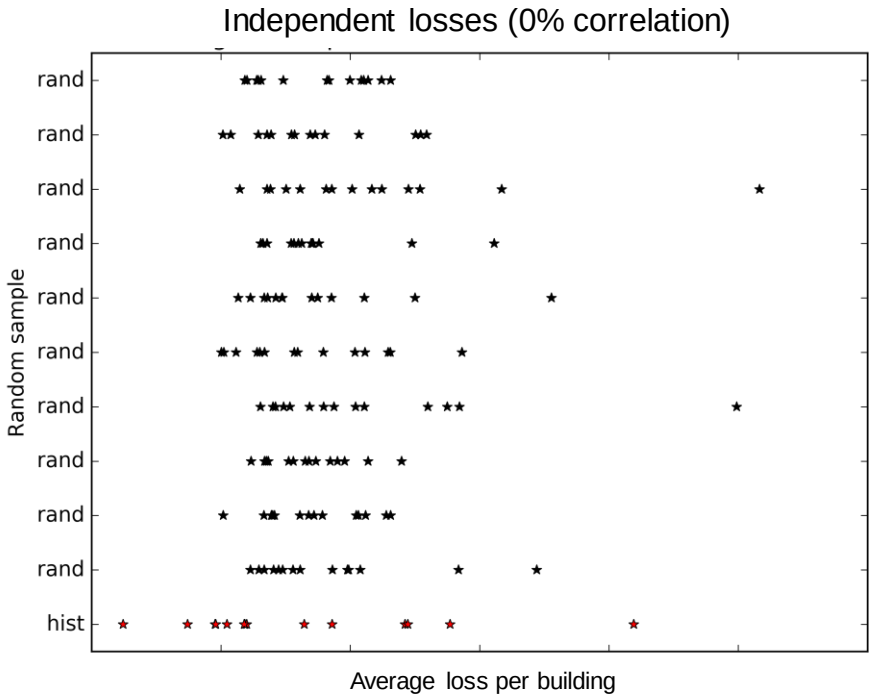

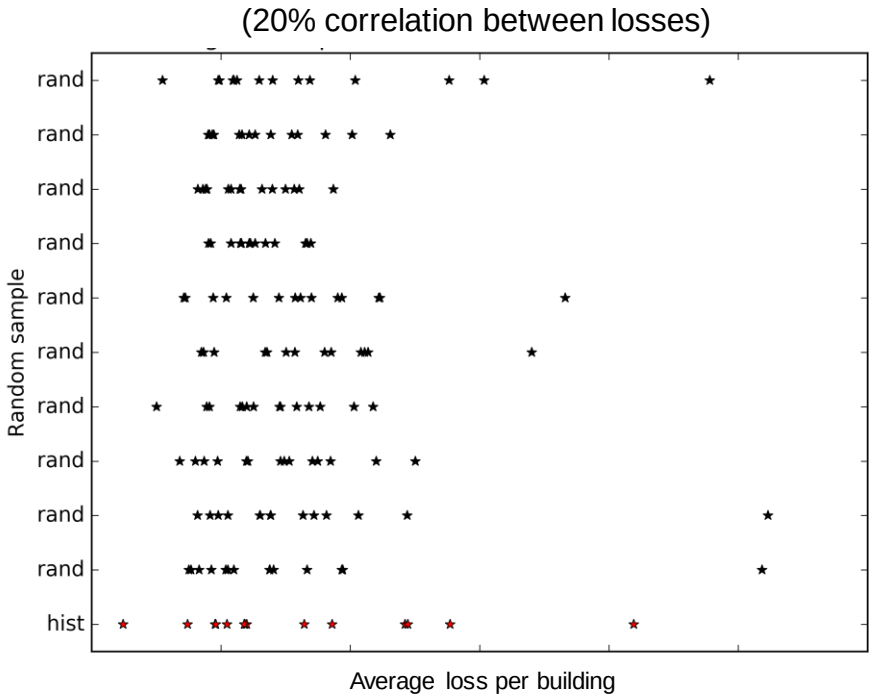

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Probability of damage

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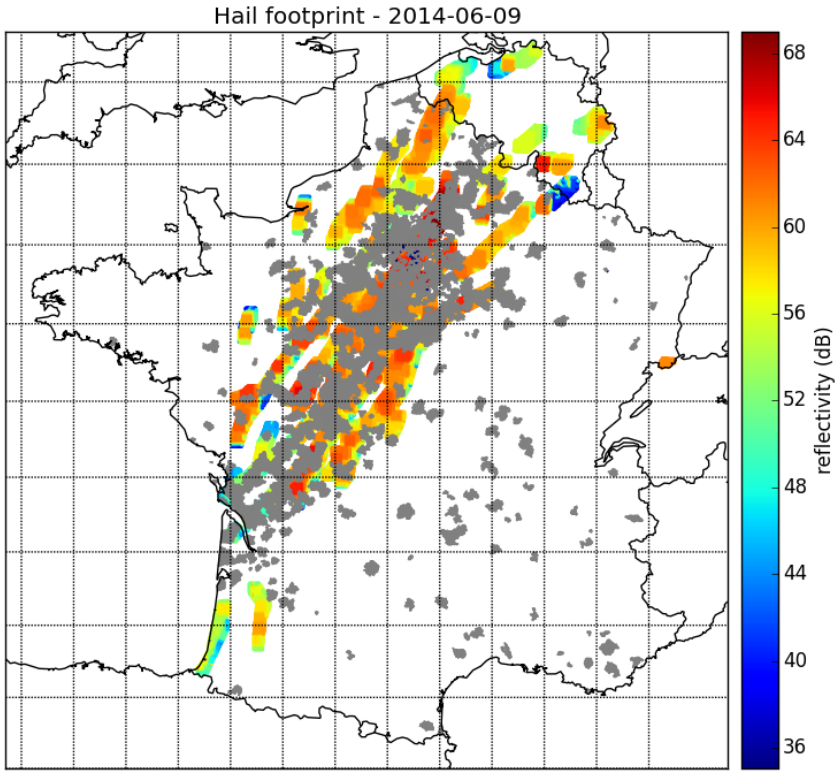
Probability of damage = (number of damaged cars) / (number of car policies)
→ Derive for each postal code and event and compare with radar reflectivity



Gray areas: postal codes with reported losses

Probability of car damage

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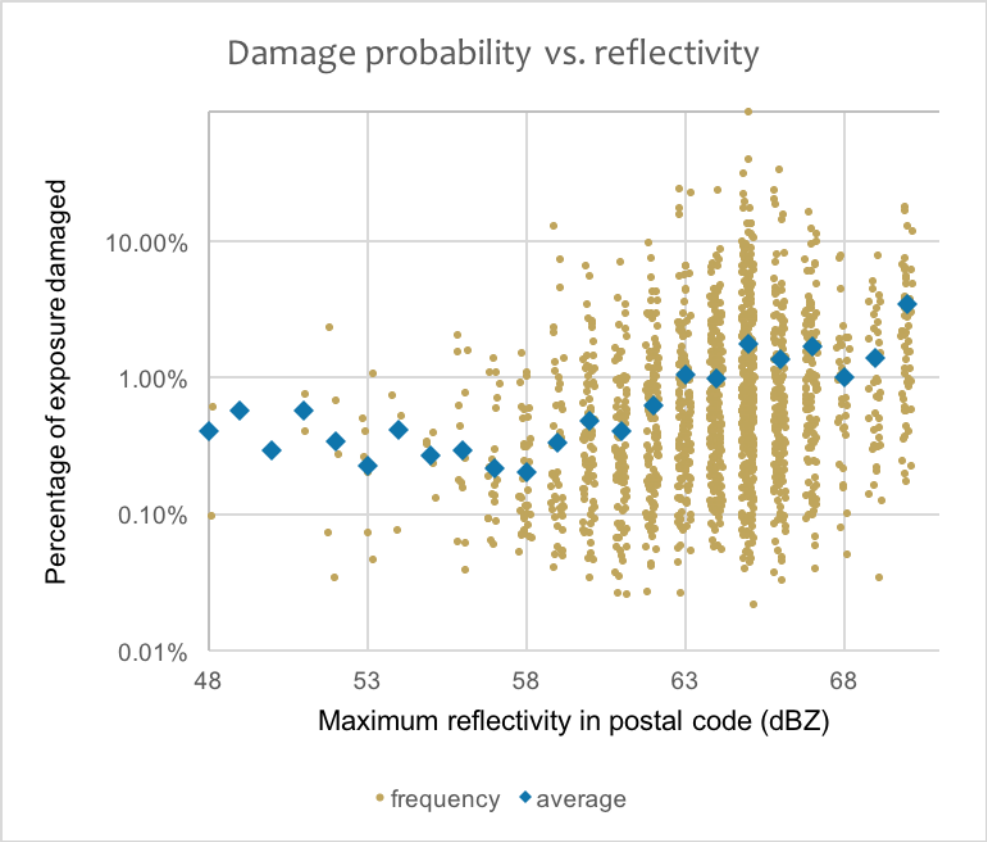

Every point represents a postal code in an event between 2009 and 2014 where damage occurred

Probability of damage increases with radar reflectivity

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Conclusions

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- It does not make sense to use vulnerability curves if the hail severity is unknown and exposure information is sparse
- Severity-independent loss distributions can be used to model hail losses
- Probability of damage increases with radar reflectivity