

Earthquake Risk Management in the Insurance Industry – Status Quo and Trends

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What is the Impact of an Earthquake Event?



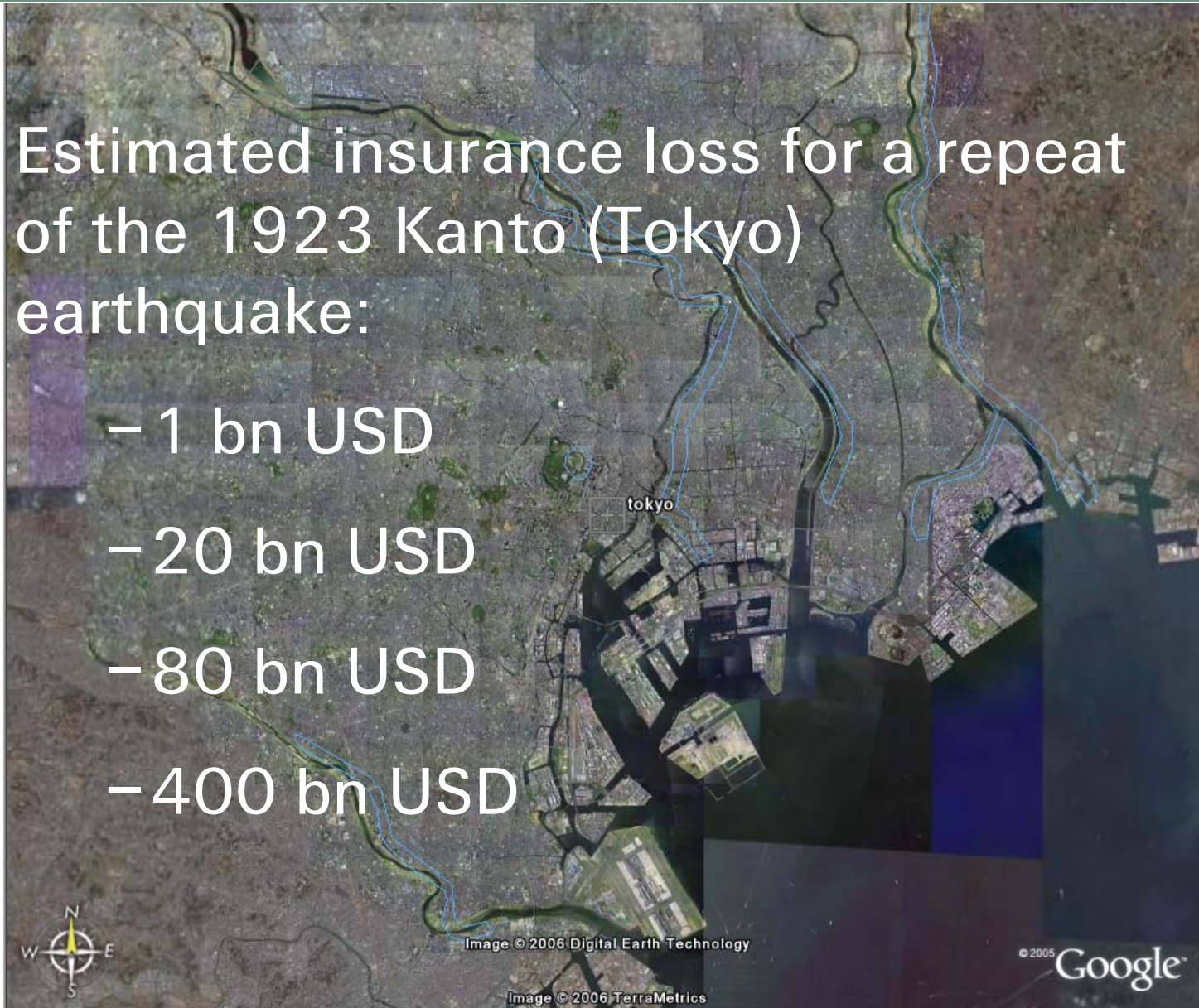
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What is the Impact of an Earthquake Event?

Estimated insurance loss for a repeat of the 1923 Kanto (Tokyo) earthquake:

- 1 bn USD
- 20 bn USD
- 80 bn USD
- 400 bn USD



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What is the Impact of an Earthquake Event?

Estimated insurance loss for a repeat
of the 1906 San Francisco
earthquake:

– 10-20 bn USD

– 45-60 bn USD

– 60-120 bn USD

– 300-500 bn USD

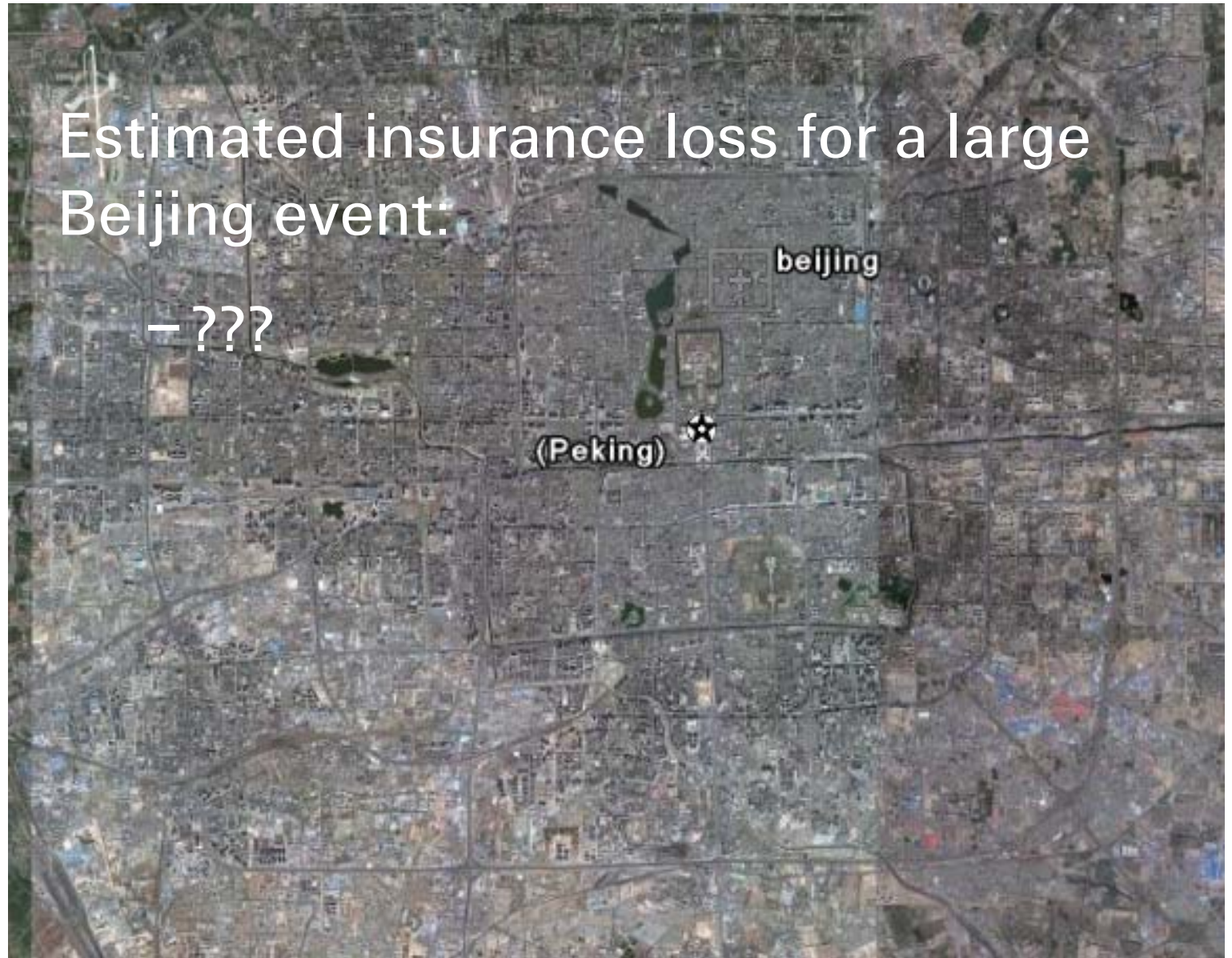
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What is the Impact of an Earthquake Event?

Estimated insurance loss for a large
Beijing event:

–???



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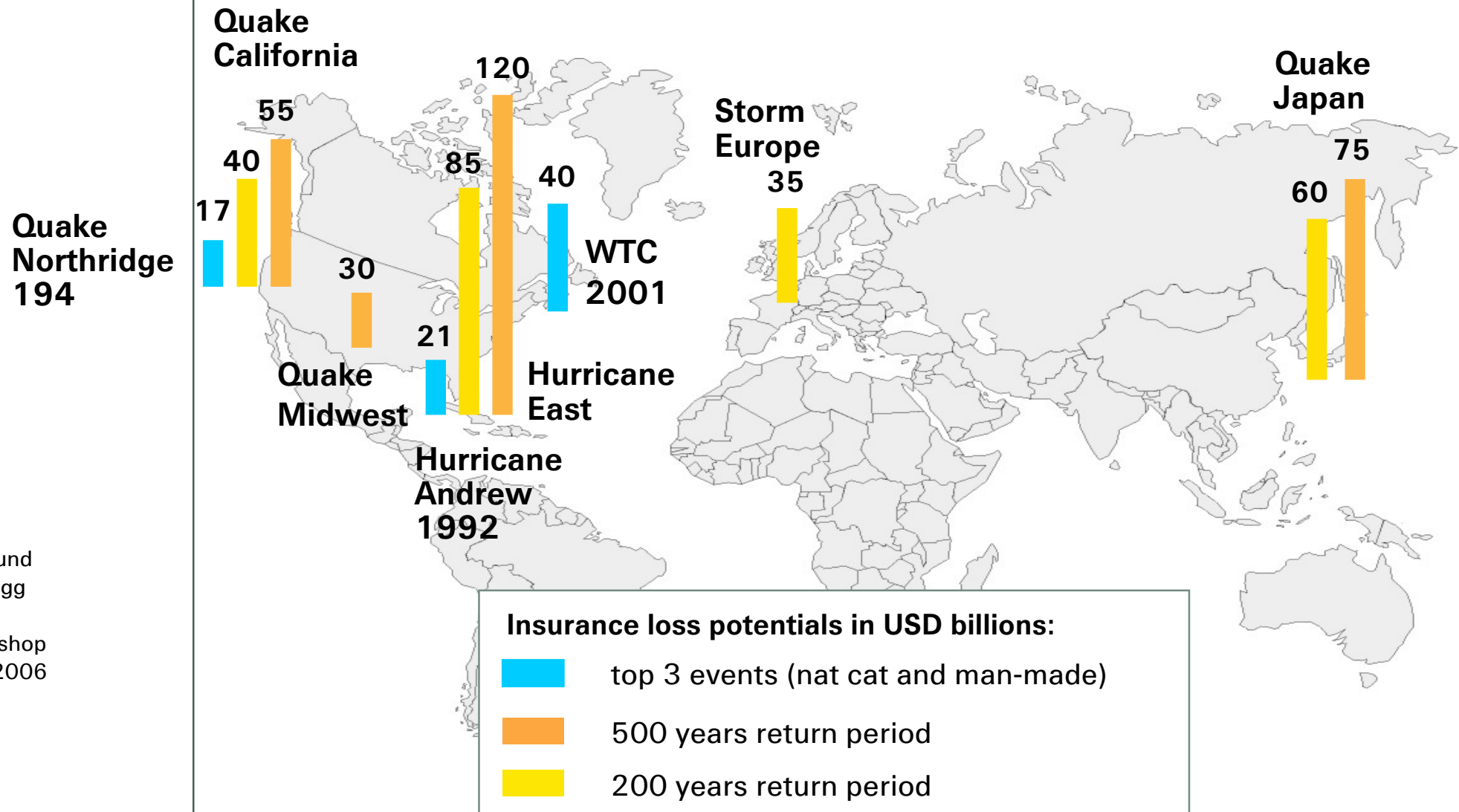
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Outline

- The insurance perspective of earthquake risk
- Risk modelling approach – the 4 boxes
 - Hazard
 - Vulnerability
 - Value Distribution
 - Insurance Conditions
- Main challenges and needed input
- Conclusions – Key needs for improvement

Insurance top loss potentials

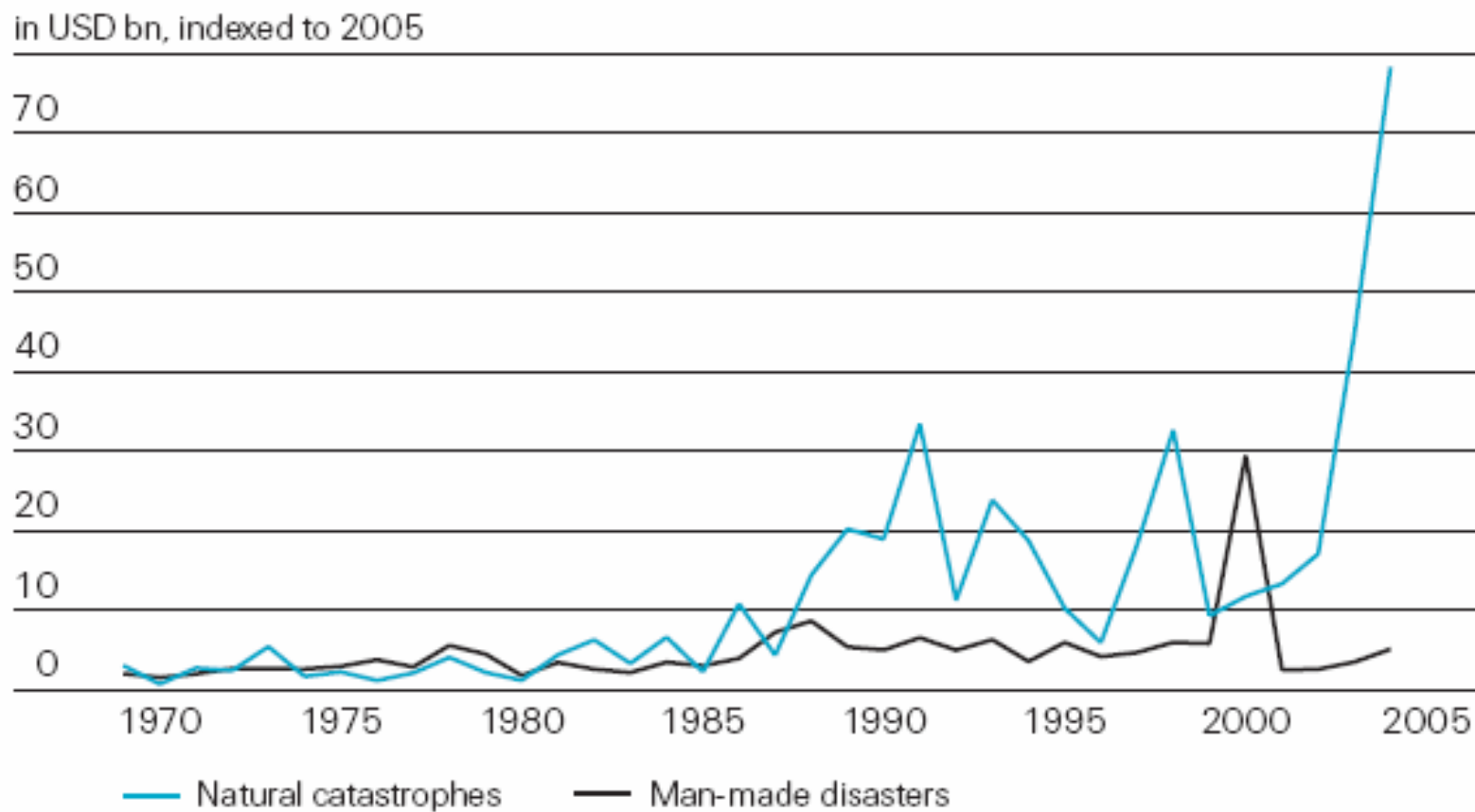
Natural catastrophes



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Insured losses 1970–2005 (property and business interruption)



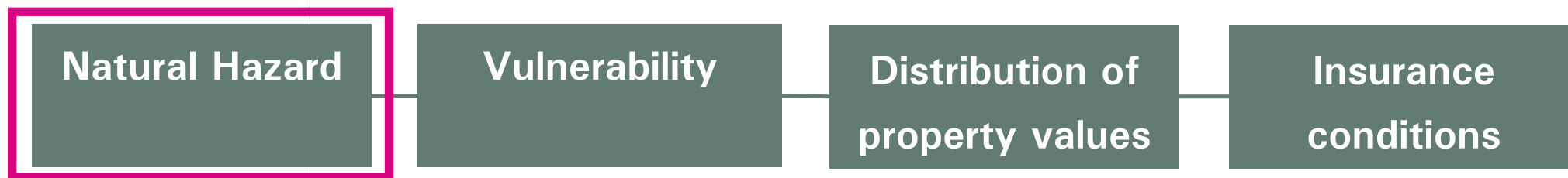
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Insurance Perspective

- How exposed is a certain portfolio of insured buildings to earthquake hazard?
 - Maximum possible loss?
 - How likely is it?
 - What is the annual loss expectation?

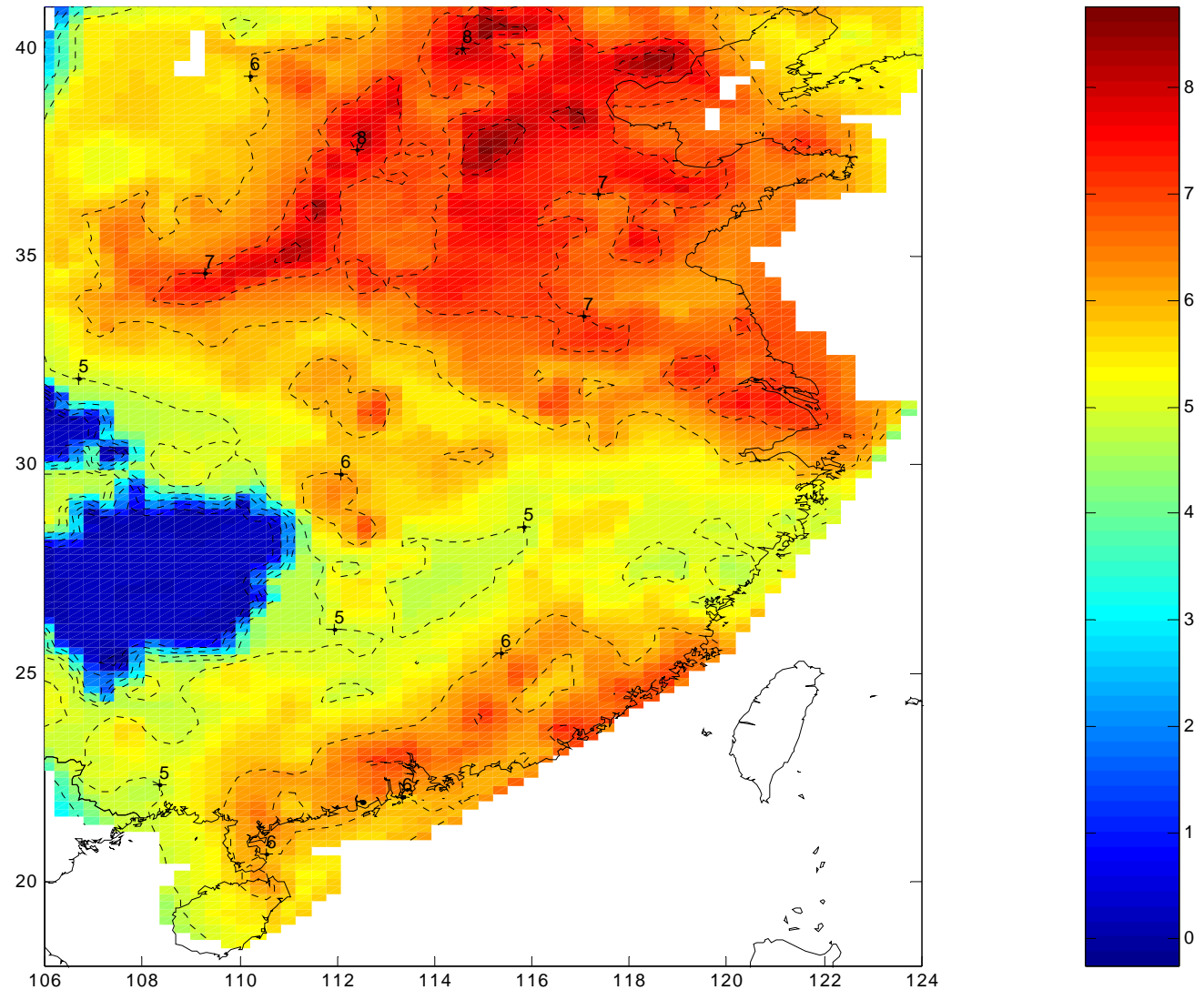
Natural Hazard Modeling: 4 Box Principle



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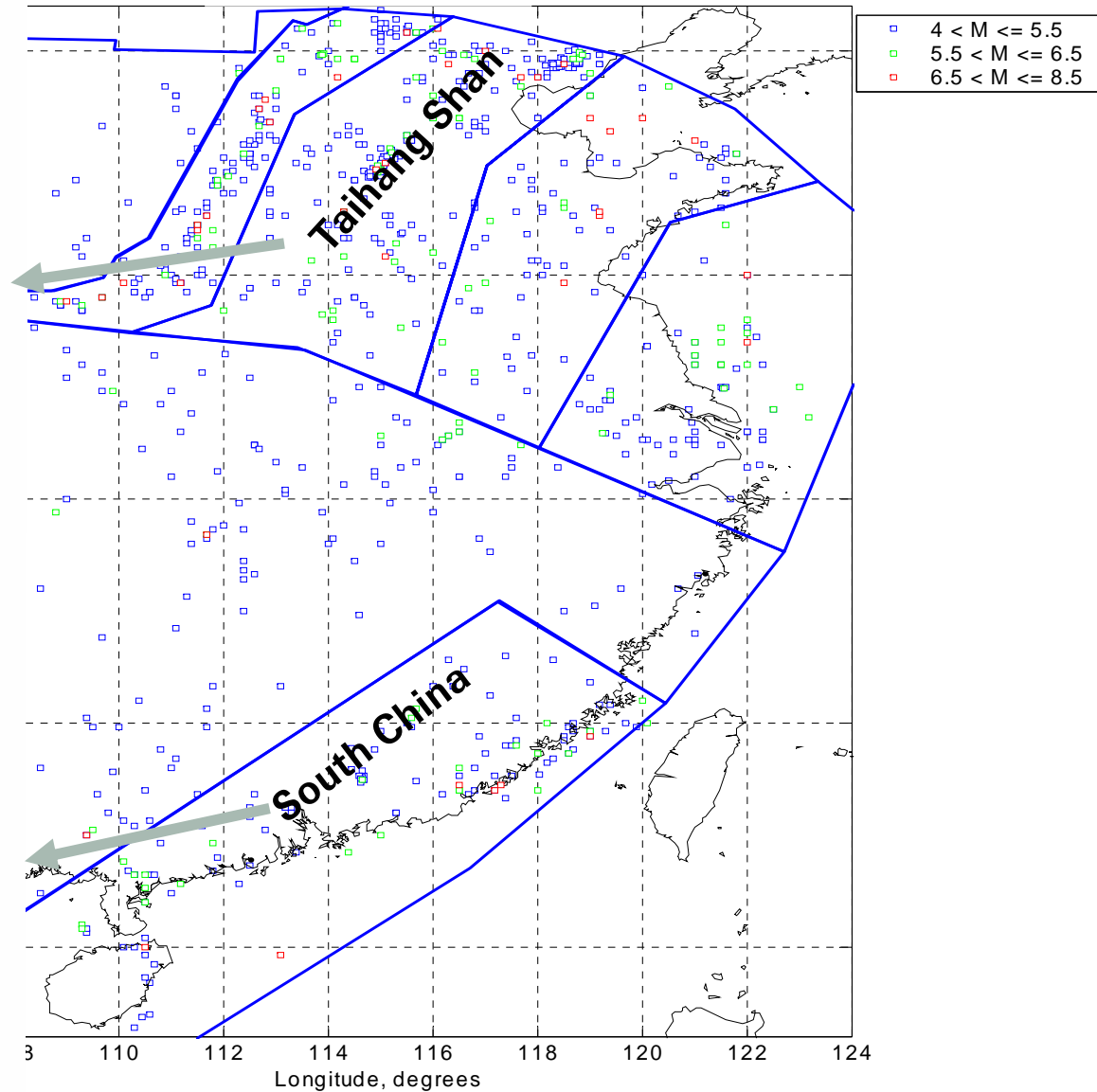
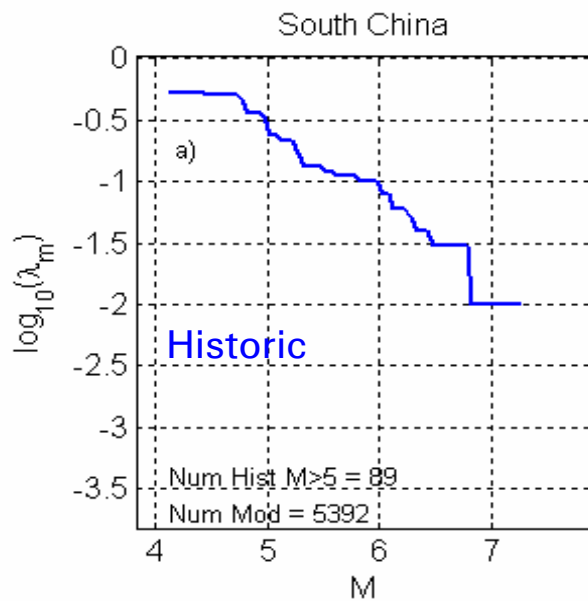
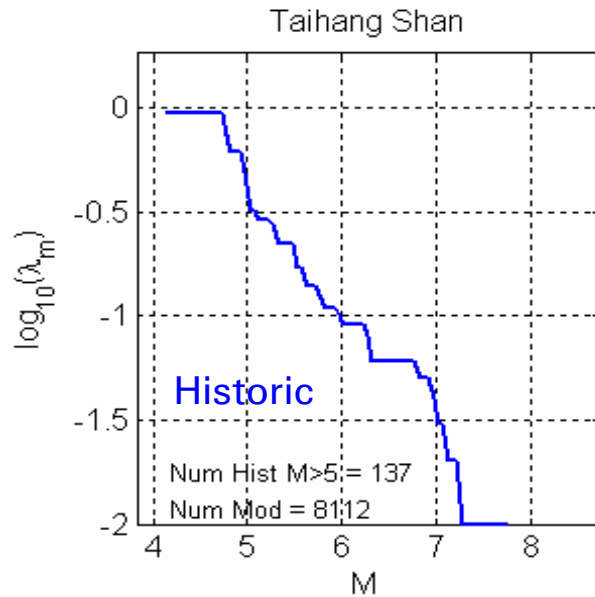
From a seismic catalogue to a hazard map



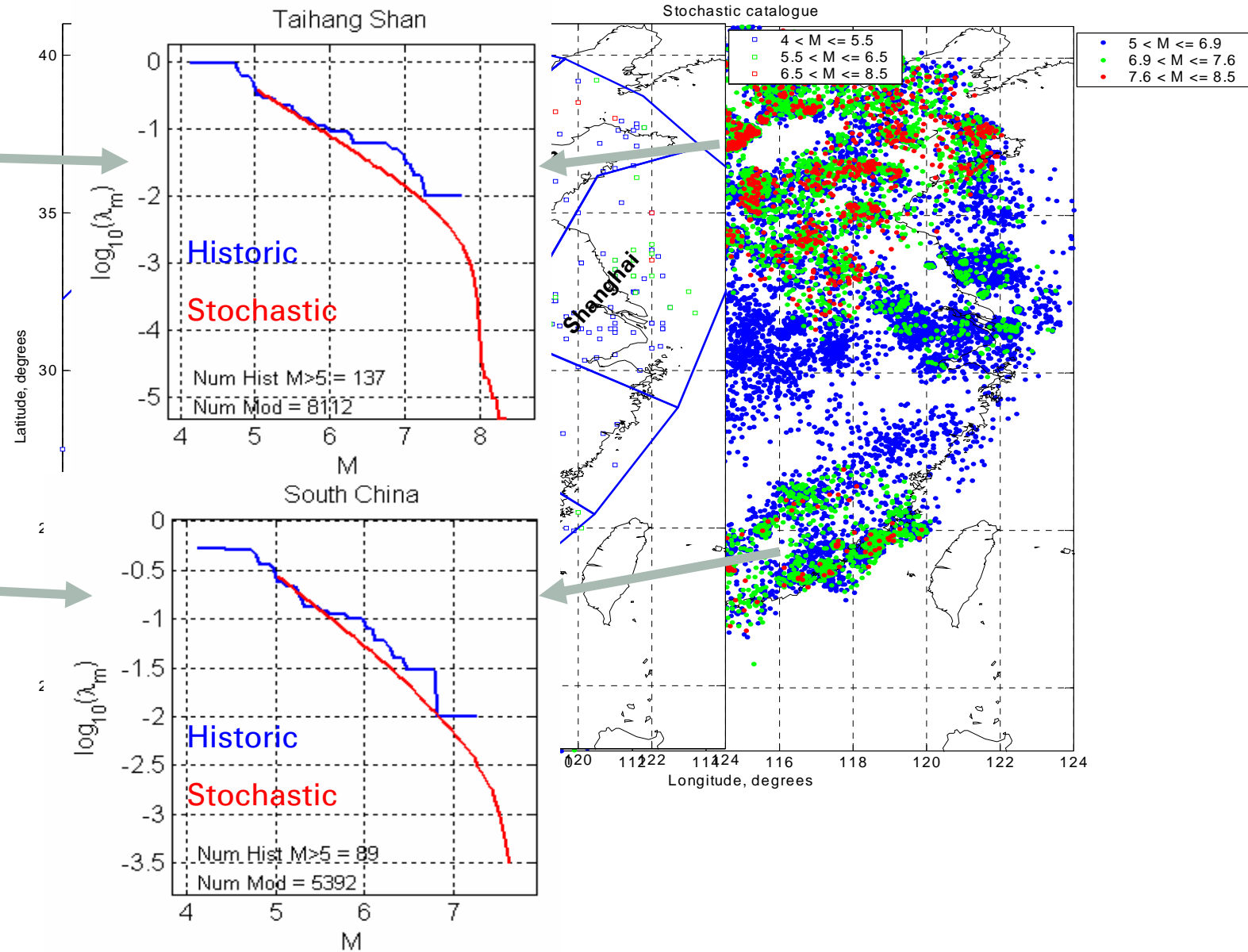
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Background seismic zones



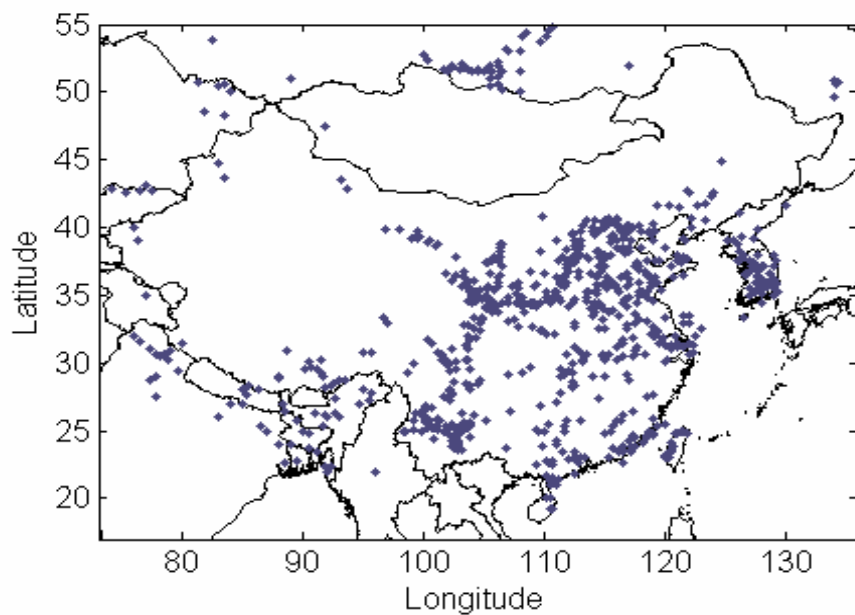
Generation of stochastic event sets



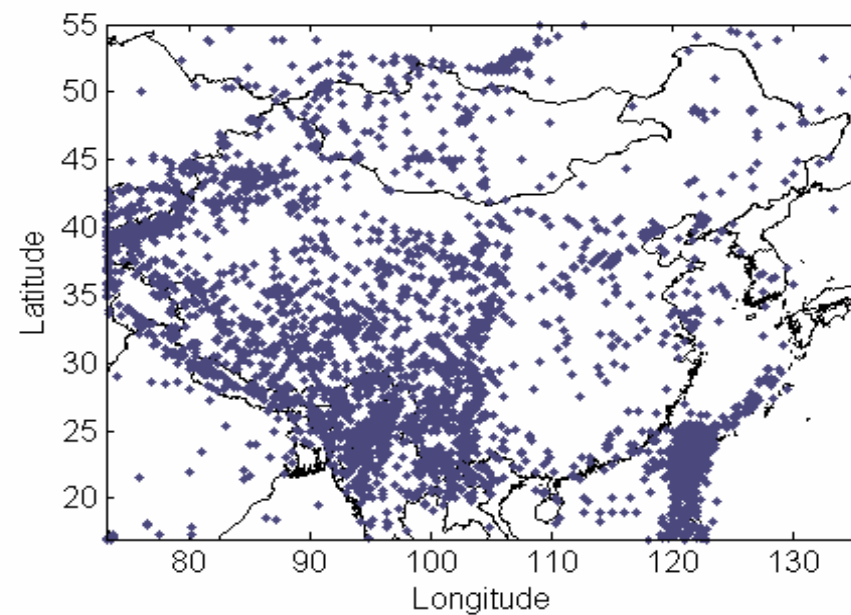
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Challenges – Seismic Catalogue



until 1860



until 1860 until today

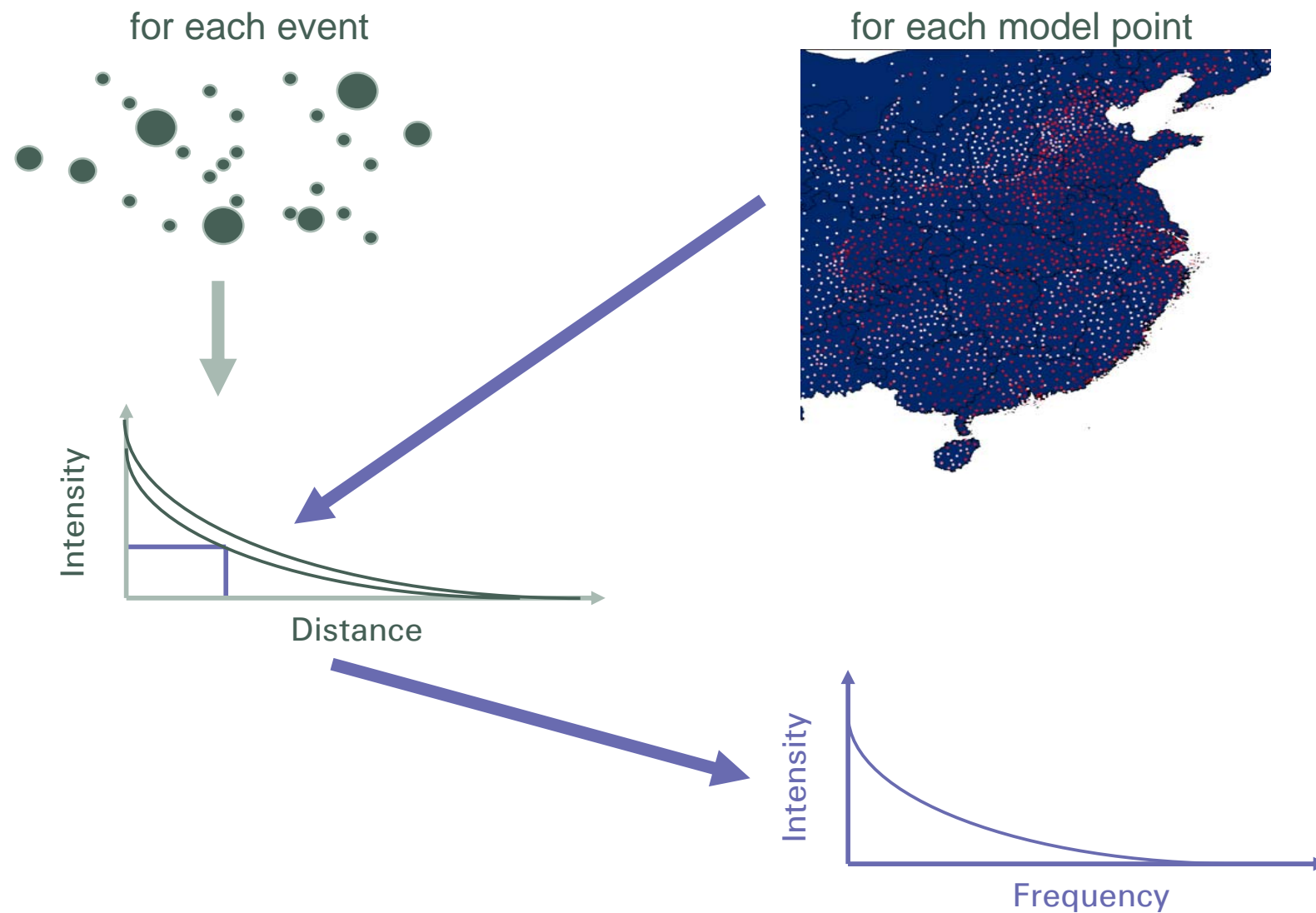
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Challenges – Seismic Catalogue

- Spatially homogenous?
- Temporally homogenous?
- Depth values?
- Published Gutenberg-Richter relationships?
- Stochastic event set representative?

From seismicity to seismic hazard



Earthquake Model Approach: Hazard

Intensity level return periods

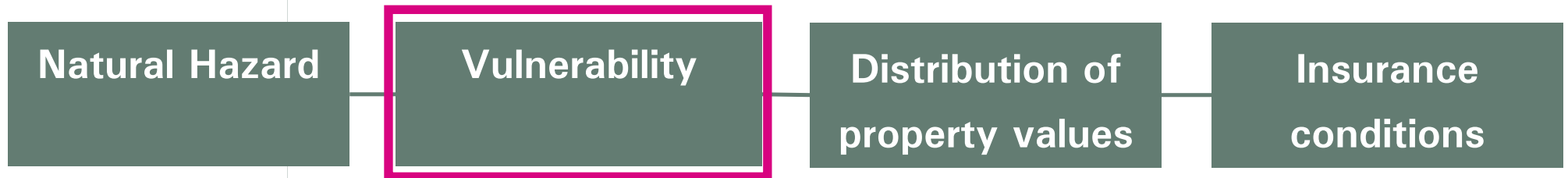
<i>MMI</i>	<i>VI</i>	<i>VII</i>	<i>VIII</i>	<i>IX</i>	<i>X</i>
Tokyo:	2	8	40	330	3400
S. Francisco:	20	70	200	650	2700
Vancouver:	50	200	800	3800	>10000
Jerusalem:	80	320	1300	6400	>10000
Zurich:	75	430	3500	>10000	

For average subsoil conditions

Challenges – Attenuation

- Spatially homogenous?
- Different for deep events?
- Impact of fault rupture process?
- Subsoil conditions – liquefaction?

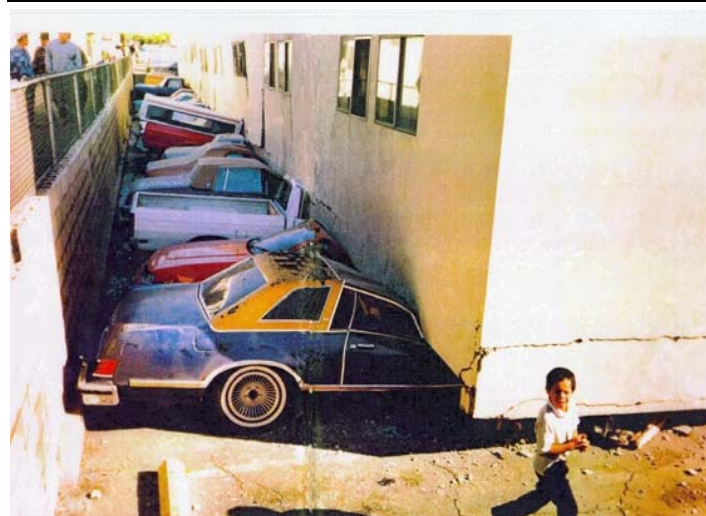
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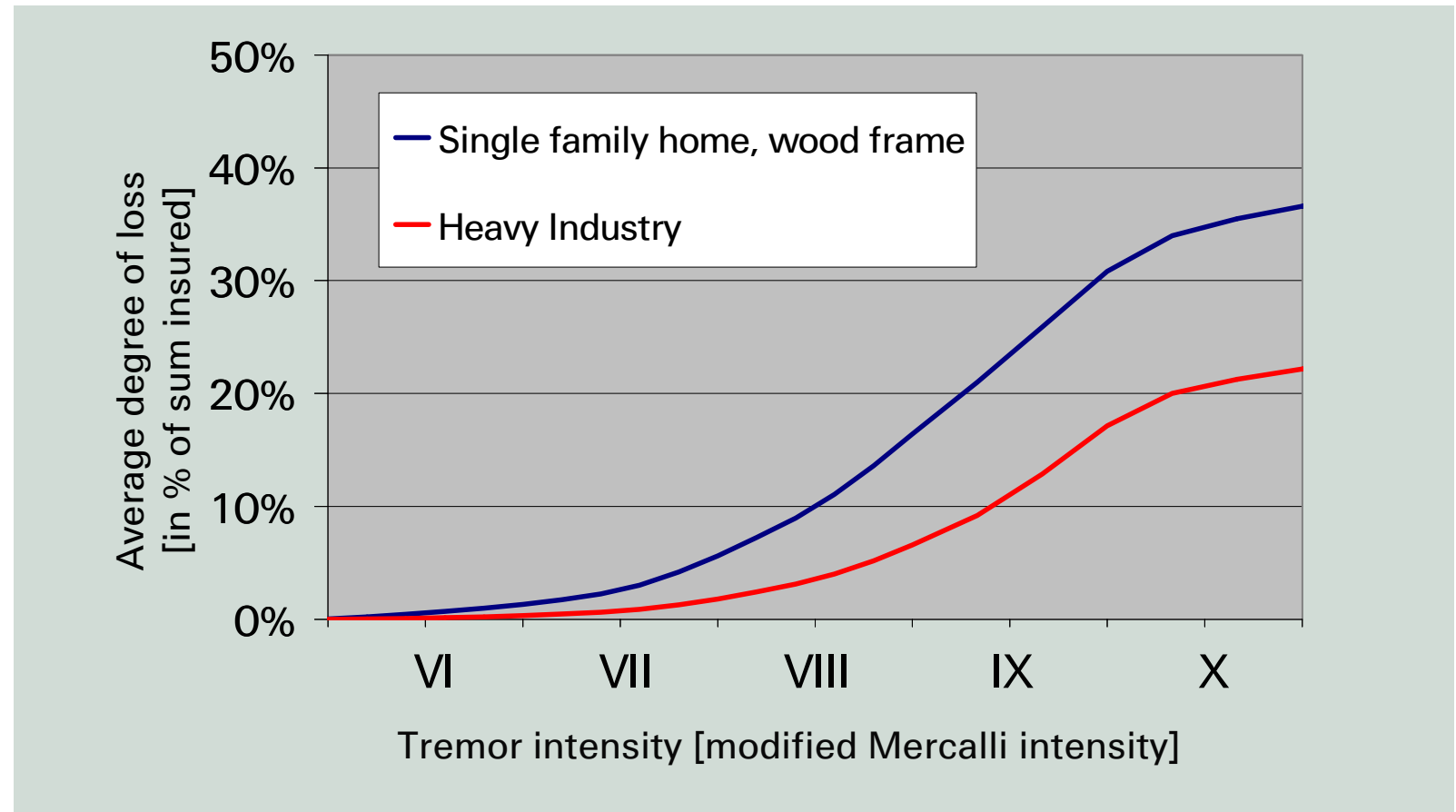
Earthquake Model Approach Vulnerability



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Earthquake Model Approach Vulnerability

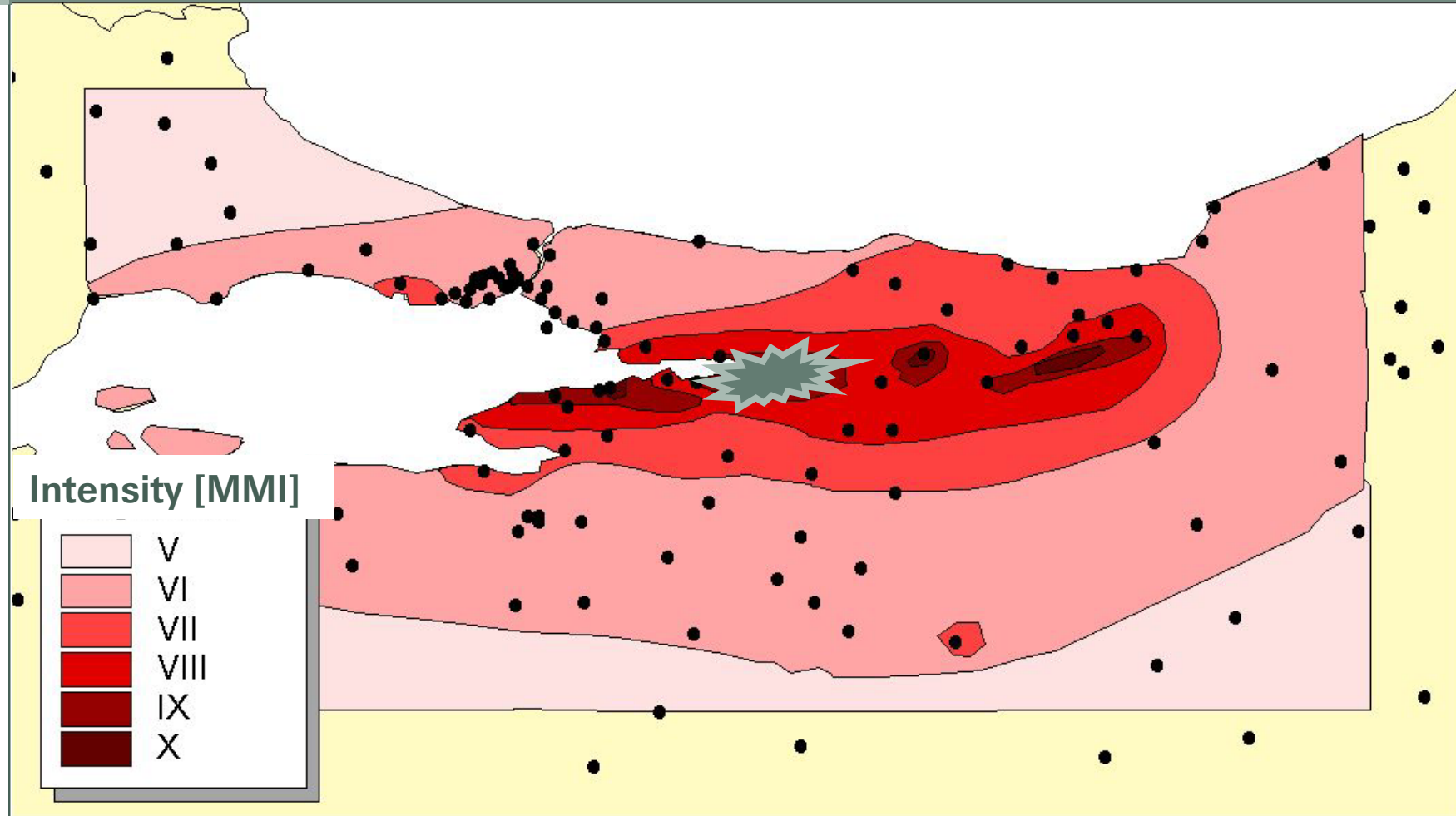


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$$\text{Mean Damage Ratio} = \frac{\text{insurance loss}}{\text{Total sum insured}}$$

1999 Marmara Sea Earthquake M=7.4



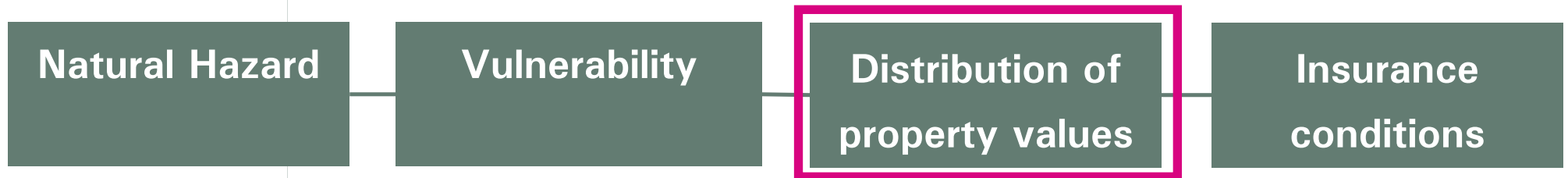
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Challenges – Vulnerability

- Linking observed loss with ground acceleration
- How many buildings affected? – how many intact?
- Quality of building stock?
- Insurance loss not always in line with material loss
- Lack of representative loss data
- Secondary effects – landslides, liquefaction, fire following the earthquake, etc.

Natural Hazard Modeling: 4 Box Principle



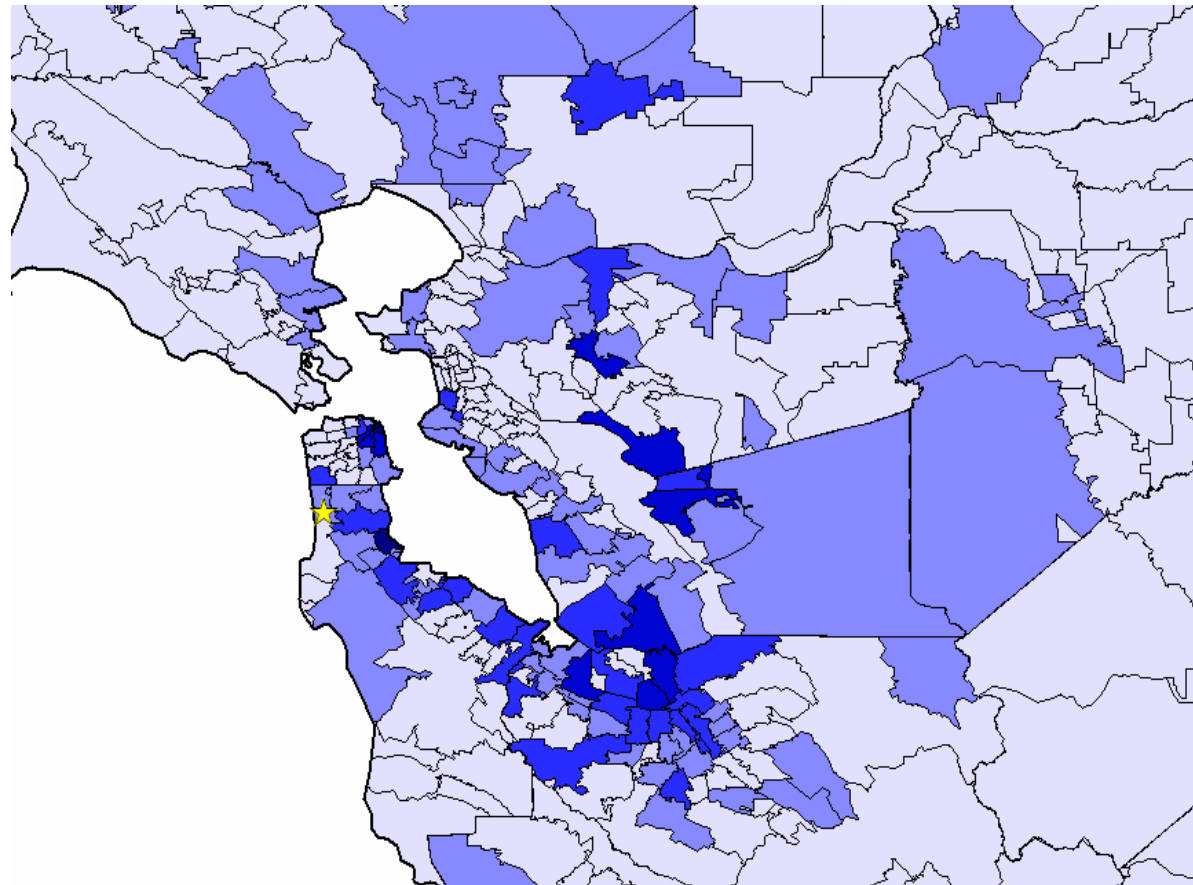
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Earthquake Modeling Approach

Insured Values

Commercial values per Zip code



■ Location of insured
values matters

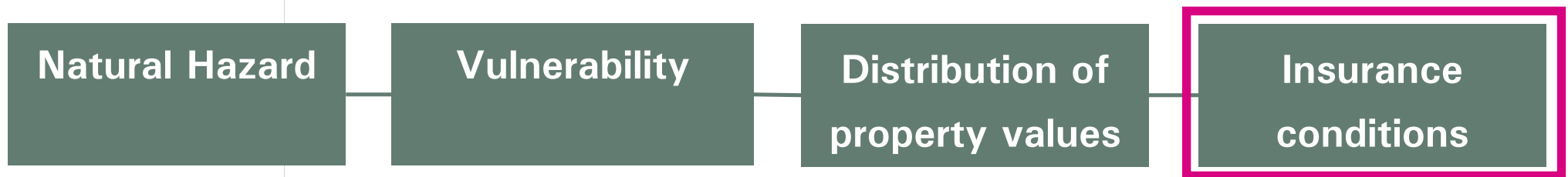
Site Info

Site ID	City	Zip Code	County/District...	State/Province...	CREST A Name	SubCREST A Name	Occupancy SubClass	Year Built	Quality	Coverage	TIV
254	Anaheim	92803	Orange	California	B	B.3	Aircraft Manufacturing			Property Damage	501659000
263	Canoga Park	91304	Los Angeles	California	B	B.2	Aircraft Manufacturing			Property Damage	168380000
264	Canoga Park	91304	Los Angeles	California	B	B.2	Aircraft Manufacturing			Property Damage	387060000
268	Chula Vista	91910	San Diego	California	D	D.1	Aircraft Manufacturing			Property Damage	68660400
270	Culver City	90232	Los Angeles	California	B	B.1	Aircraft Manufacturing			Property Damage	15175200
271	Cypress	90630	Orange	California	B	B.3	Aircraft Manufacturing			Property Damage	12008000
272	Cypress	90630	Orange	California	B	B.3	Aircraft Manufacturing			Property Damage	20172000
275	Downey	90241	Los Angeles	California	B	B.1	Aircraft Manufacturing			Property Damage	37075000
279	El Segundo	90245	Los Angeles	California	B	B.1	Aircraft Manufacturing			Property Damage	11815000
280	El Segundo	90245	Los Angeles	California	B	B.1	Aircraft Manufacturing			Property Damage	14951000
281	El Segundo	90245	Los Angeles	California	B	B.1	Aircraft Manufacturing			Property Damage	15144000
282	El Segundo	90245	Los Angeles	California	B	B.1	Aircraft Manufacturing			Property Damage	28511000
283	El Segundo	90245	Los Angeles	California	B	B.1	Aircraft Manufacturing			Property Damage	38349000
284	El Segundo	90245	Los Angeles	California	B	B.1	Aircraft Manufacturing			Property Damage	40536000
285	El Segundo	90245	Los Angeles	California	B	B.1	Aircraft Manufacturing			Property Damage	43354000
286	El Segundo	90245	Los Angeles	California	B	B.1	Aircraft Manufacturing			Property Damage	99249000
287	El Segundo	90245	Los Angeles	California	B	B.1	Aircraft Manufacturing			Property Damage	459795000
288	El Segundo	90245	Los Angeles	California	B	B.1	Aircraft Manufacturing			Property Damage	1617986000
295	Garden Grove	92641	Orange	California	B	B.3	Aircraft Manufacturing			Property Damage	64563000
300	Hollywood	90038	Los Angeles	California	B	B.1	Aircraft Manufacturing			Property Damage	53622280
302	Huntington Beach	92649	Orange	California	B	B.3	Aircraft Manufacturing			Property Damage	10257000
303	Huntington Beach	92647	Orange	California	B	B.3	Aircraft Manufacturing			Property Damage	36816000
304	Huntington Beach	92647	Orange	California	B	B.3	Aircraft Manufacturing			Property Damage	44301000
305	Huntington Beach	92649	Orange	California	B	B.3	Aircraft Manufacturing			Property Damage	63809000
306	Huntington Beach	92647	Orange	California	B	B.3	Aircraft Manufacturing			Property Damage	1012810000
314	Lompoc	93437	Santa Barbara	California	C	C.3	Aircraft Manufacturing			Property Damage	180823000
315	Lompoc	93437	Santa Barbara	California	C	C.3	Aircraft Manufacturing			Property Damage	979654000
316	Long Beach	90815	Los Angeles	California	B	B.1	Aircraft Manufacturing			Property Damage	40263000

Challenges – Value Distribution

- Enormous amounts of data
- Where exactly are buildings located?
- What is the insured value?
 - Underinsurance
 - Increased replacement costs
 - Policy expansions after large events
 - Claims inflation

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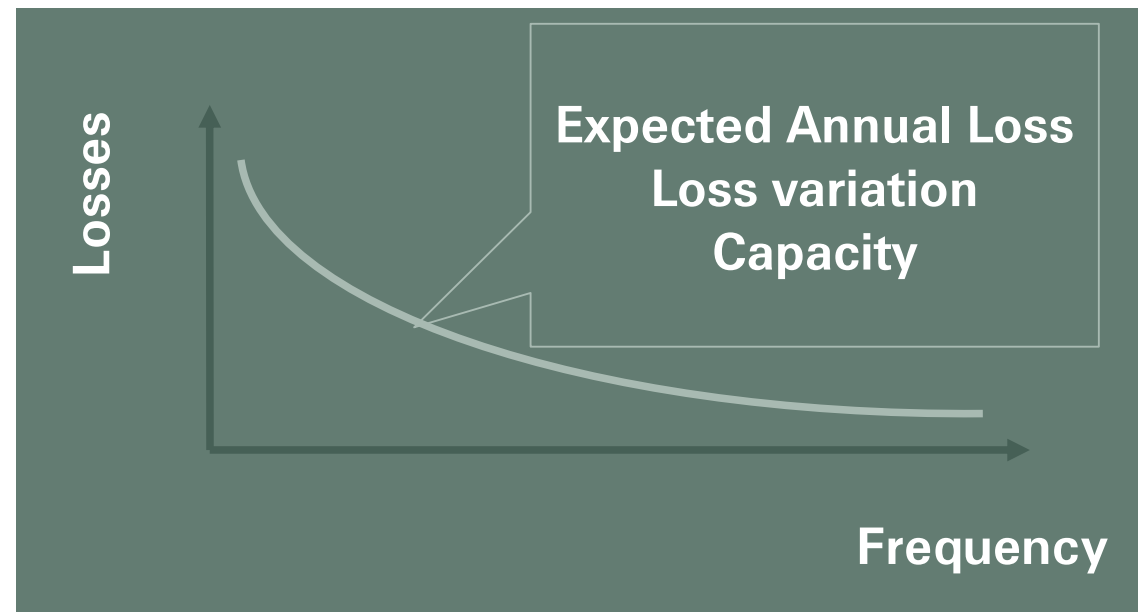
Earthquake Insurance Approach

Insurance Conditions

- Perils covered (shock, fire following, etc.)
- Additional perils (landslide, tsunami, etc.)
- **Deductible**
- Franchise
- Coinsurance, Deductible on Loss
- Cover Limit
- Exclusions
- etc.

=> need for eventset-based hazard modelling

Natural Hazard Modeling: 4 Box Principle



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Conclusions

- Detailed event-based loss modelling yields useful risk assessments

- **Key needs for improvement:**
 - Homogeneous and consistent earthquake catalogues
 - Impact of subsoil conditions – tall buildings
 - Number of affected versus unaffected buildings
 - Precise reporting of insurance values and insurance conditions
 - Understanding of loss-amplifying mechanisms in the aftermath of large events

Discussion...

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