Estimating Losses from "Super" Catastrophes

Tuna Onur, Auguste Boissonnade, Guy Morrow, Weimin Dong

Risk Management Solutions, Inc.

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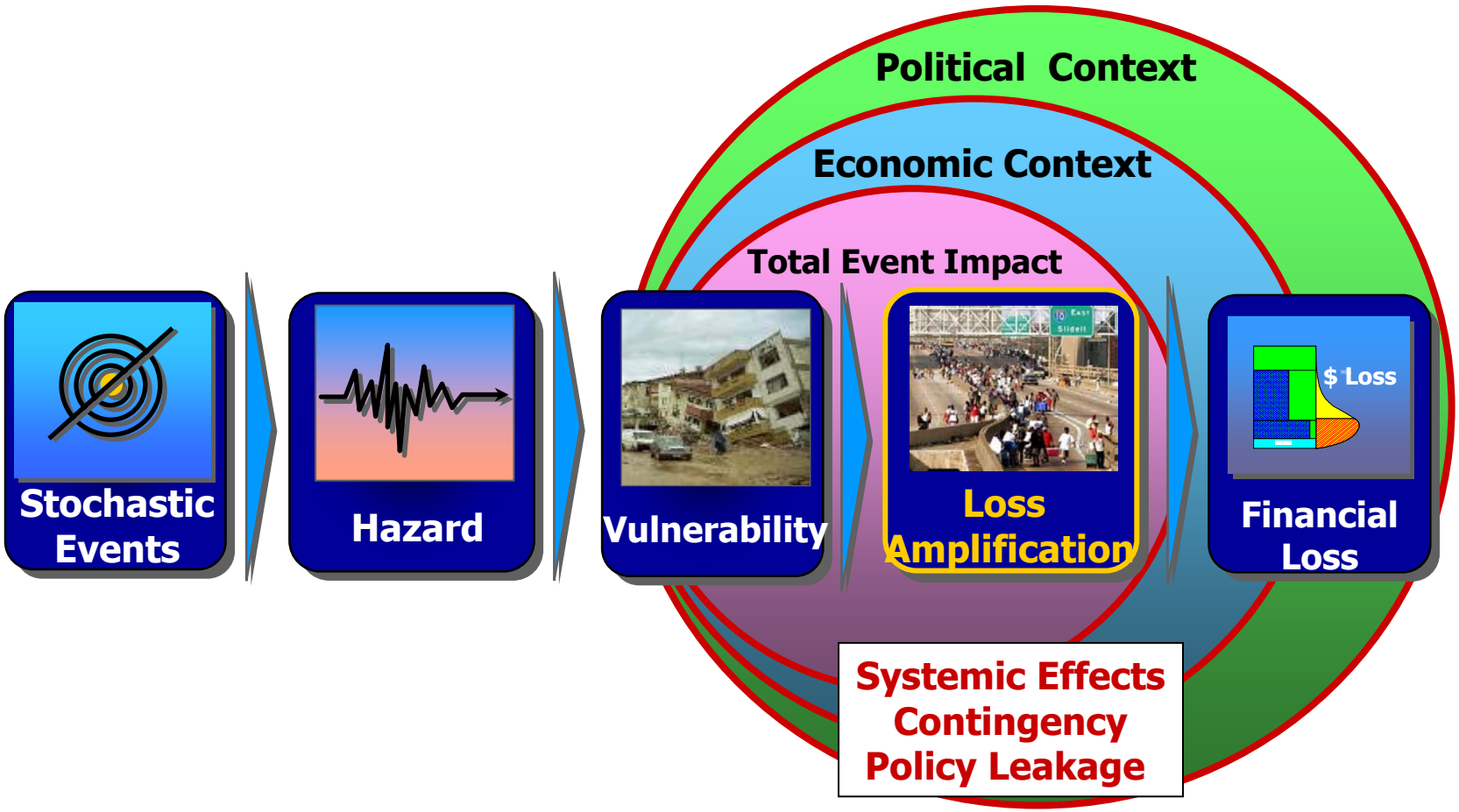
Insurance and Catastrophe Risk

- Insurance is founded on the principle of risk diversification
  - When the magnitude of a potential loss is considered too great to bear, risk is transferred to an insurer (in exchange for a premium) to be pooled with other uncorrelated risks
  - Insurers buy insurance from reinsurers to protect themselves against catastrophic (Cat) losses
- Key challenge to the insurance industry is risk correlation = Catastrophe (Cat) Risk

Catastrophe Modelling

- Traditionally, two conditions must be met to make a risk 'insurable':
  - (1) ability to estimate the risk; and
  - (2) ability to set premiums for a class of customers.
- Catastrophe modelling helps to satisfy condition (1) – estimating catastrophe risk.
- Treatment of uncertainty is central to risk modelers

Loss Amplification reflects all those ways in which the costs incurred for a certain level of original damage become amplified when the damage is situated within a major catastrophe



Loss Amplification

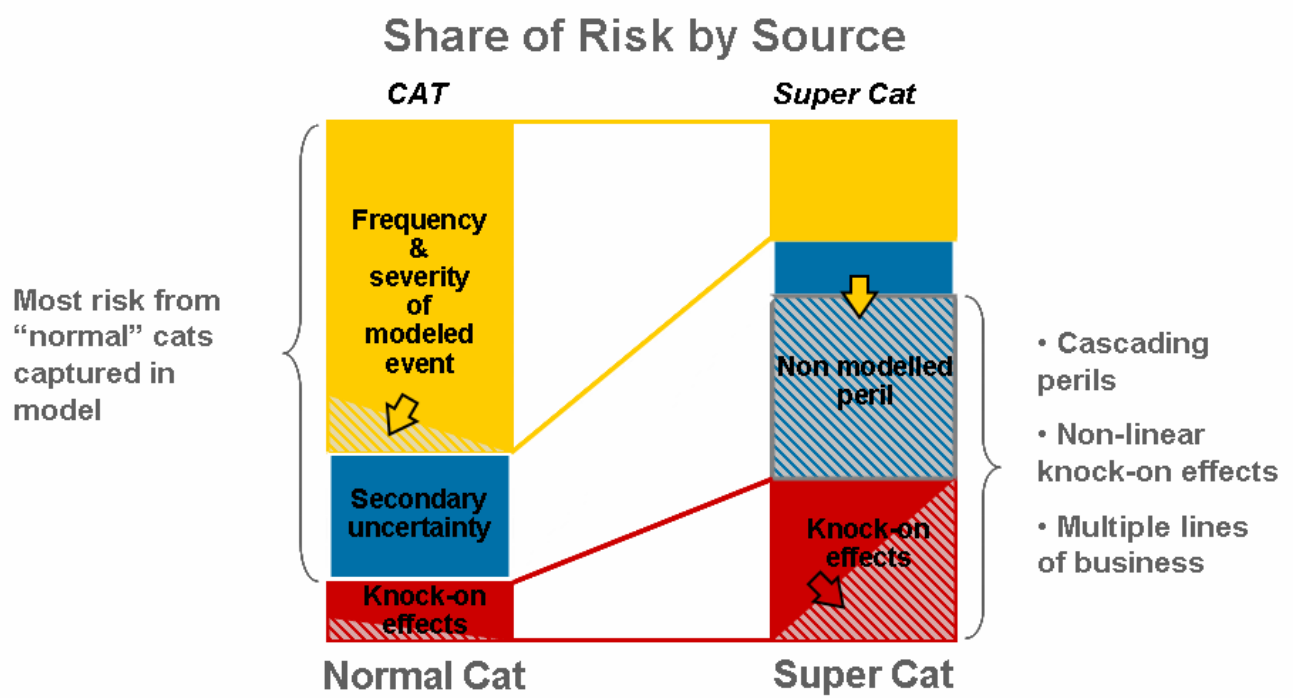
- **Economic Demand Surge**
  - Time stepping worker migration models capture spatiotemporal changes in construction rates
- **Deterioration Vulnerability/Delay Inflation**
  - Time dependent damage escalation and damage (eg. mold or freeze) from property abandonment,
  - Delay - includes ALE/BI
- **Claims Inflation**
  - Models as to how alternative claims assessment procedures will affect the amount of exaggerated/fraudulent claiming
- **Coverage Expansion**
  - Modelling the magnitude of uninsured loss at each location and stress testing leakage into policy
- **Super Cat**
  - Systemic effects of large disruption

What is a "Super" Cat?

- Significant component of loss amplification
- Characterized by:
  - Containment failures
  - Widespread long-term evacuation
  - Systemic macroeconomic impacts such as hotels/stores staying closed because there are no customers

What is a "Super" Cat?

- Secondary consequences are a major proportion of the loss; and often can be larger than the original event
- Time-element losses such as business interruption (BI) escalate significantly



Super Cat Examples

- 1906 San Francisco earthquake
  - Urban conflagration, mass evacuations
- 2004 December Sumatra earthquake
  - Tsunami
- 2005 Hurricane Katrina
  - Levee failures, mass evacuations

Methodology – Identify locations

- High concentration of population and exposure:
  - Metro areas with high-density of population
  - Areas of high concentration of exposures
- Areas that have potential for escalation of secondary effects:
  - Fragile infrastructure: Utilities, pipeline & tank breakage/damage
  - Limited access due to collapsed/damaged bridges, highways, ports, airports. Limited communication with the affected area.
  - Tsunamis, flooding from failures of dams/levees, landslides, etc.
  - Release of toxic chemicals/contaminants
  - Shut-down of nuclear power plants and other power failure related problems

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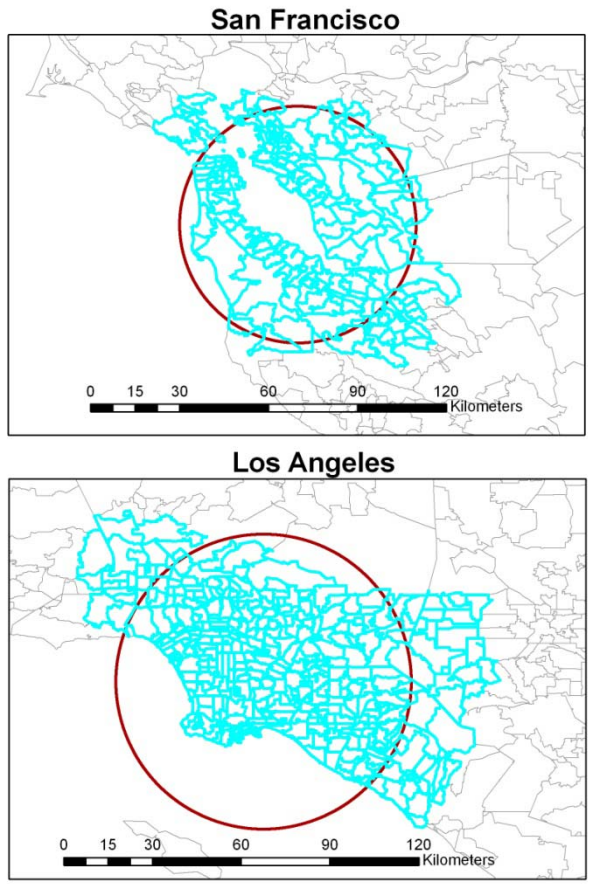
Methodology – Quantification

- Select the highest density portions of a metro area based on population and exposure
- Calculate losses from modeled hazards such as earthquake ground shaking, fire following, and landslides for the selected area
- Calculate loss ratios defined as monetary loss divided by total exposure
- Based on a threshold of loss and loss ratio, select events that are likely to turn into Super Cats
- Quantify how much losses will increase by coverage (structures, contents, BI)



Impact on Results

- Increased losses for all coverages with biggest impact on time-element losses
- Increased correlation of losses
- Increased coefficient of variation

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Example from Europe

- Vienna
  - Metro population: 2 million +
  - Many faults near Vienna:
    - Leopoldsdorf Fault
    - Obersieben-Brunn Fault
    - Engelhartstetten Fault
    - Steinberg Fault
  - Large chemical plants and hydroelectric power plants

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Example from Europe

- Vienna
  - Metro exposure value in high-density area: € 250 billion
  - Super Cat threshold: About 10% loss ratio
  - ~ 20 Super Cat events in the stochastic event set (depends on event sampling)

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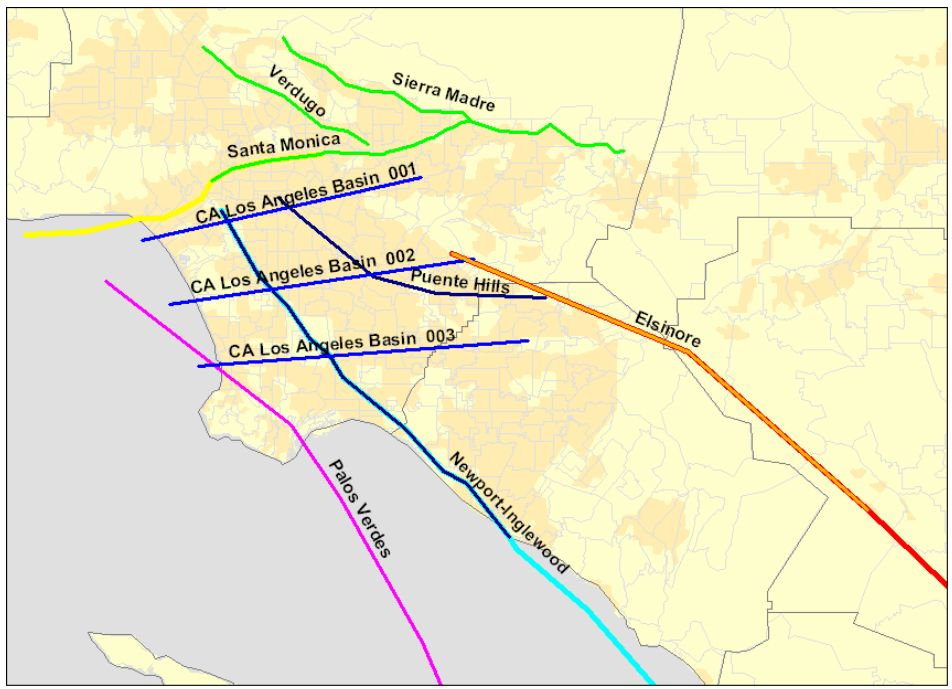
Example from the US

- Los Angeles
  - Metro population: 15 million +
  - Many faults near Los Angeles:
    - Newport-Inglewood Fault
    - Puente Hills Fault
    - Elsinore Fault
    - Santa Monica Fault
    - Sierra Madre Fault
    - Verdugo Fault
    - Palos Verdes Fault



Example from the US

- Los Angeles
  - Metro exposure value in high-density area: $ 2.35 trillion
  - Super Cat threshold: About 7.5% loss ratio
  - ~ 35 Super Cat events in the stochastic event set (depends on event sampling)

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Conclusions

- Loss amplification is a real phenomenon and needs to be included in catastrophe risk models
- Super Cats are significant contributors to loss amplification
- Traditional catastrophe risk modelling techniques are inadequate in characterizing losses from Super Cats

- Presented simplified approach
- Current research on explicit modelling and simulation of cascading impacts of Super Cats:
  - Explicit quantification through Index of Disruption

Thank You!

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