CATASTROPHE MODELING & SOUTHERN CALIFORNIA EARTHQUAKE RISK

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Business, Insurance and Financial Implications Concurrent Session
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1. What are the advancements in catastrophe models since the 1994 Northridge Earthquake?

2. What can catastrophe models tell us about earthquake risk in Southern California?

3. How can we utilize models to explore risk mitigation strategies?
In 1994, exposure data was incomplete and/or inaccurate

In 1994, the probable maximum loss (PML) approach was used to manage earthquake risk

In 1994, only 10%-12% of property insurers used catastrophe models

The Northridge Earthquake definitively marked the end of the loss experience approach to assessing earthquake risk in California
HAZARD AND VULNERABILITY RESEARCH

2002 NSHMP
USGS OFR 2002-420

2008 NSHMP
USGS OFR 2008-1128

2014 NSHMP from USGS

UCERF v2
USGS OFR 2007-1437

UCERF3 from WGCEP
LESSONS FROM OTHER COUNTRIES

1995
Kobe, Japan Earthquake

1999
Kocaeli, Turkey Earthquake

Chi-Chi, Taiwan Earthquake

- Degree of damage clearly differs depending upon combination of hazard, exposure, vulnerability
  - Fire following earthquake
  - Industrial exposure
  - Business interruption
Loss Amplification reflects ways in which the costs incurred for a certain level of original damage become amplified when the damage is situated within a major catastrophe.
EACH EVENT PROVIDES UNIQUE LESSONS

- **2010 Maule, Chile**
  - Success of the Chilean seismic building code
  - Concentration of industrial risks compounds *business interruption (BI)*
- **2011 Christchurch, New Zealand**
  - Some of the strongest ground motions ever recorded (above design levels)
  - Catastrophic *liquefaction* leading to red-zoning of entire suburbs
- **2011 Tohoku, Japan**
  - *Tsunami* peril driving losses, with highest measured tsunami waves in a well-prepared region
  - Devastating economic and social impacts to Japan, with insurance implications worldwide (e.g., contingent BI)
OUTPUTS OF CATASTROPHE MODELS

Who is expected to pay?

Demographics of Risk (Gross/Net)

Probability of Risk (EP Curve)

What is the expectation of risk?

Geography of Risk

Where is the greatest (and least) expectation of risk?
SOUTHERN CALIFORNIA EARTHQUAKE RISK

![Graph showing the probability of exceedance and economic loss for different levels of loss.]

- **Total Loss**
- **Loss borne by L1 (Homeowners)**
- **Loss borne by L2 (Insurer)**
- **Loss borne by L3 (Reinsurer)**

**Axes**:
- **X-axis**: Economic Loss
- **Y-axis**: Probability of Exceedance

**Legend**:
- Black line: Total Loss
- Green line: Loss borne by L1 (Homeowners)
- Blue line: Loss borne by L2 (Insurer)
- Red line: Loss borne by L3 (Reinsurer)
SOUTHERN CALIFORNIA EARTHQUAKE RISK
Catastrophe Model: A Tool to Explore Loss Reduction Strategies

Define Earthquake
Assess Earthquake Ground Motion
Apply Exposure
Calculate Damage
Quantify Financial Loss

Stochastic Event Module
Hazard Module
Geocoding/Exposure Module
Vulnerability Module
Financial Analysis Module

Modify inventory to explore impacts of land use policy
Modify vulnerability to explore impacts of individual mitigation strategies
QUANTIFYING IMPACTS OF WOOD FRAME RETROFIT

- 20% reduction in AAL
- 35% reduction in 250-yr RP loss
CONCLUSIONS

1. Catastrophe models have significantly advanced over the past twenty years
   • In response to new science
   • In response to significant worldwide cat events

2. Catastrophe models can educate various stakeholders on Southern California earthquake risk
   • Through standard outputs (spatially, probabilistically)

3. Models can be used to explore risk mitigation strategies
   • By changing modeling assumptions (exposure, vulnerability, financial)
THANK YOU