



CATASTROPHE MODELING & SOUTHERN CALIFORNIA EARTHQUAKE RISK

Dr. Patricia Grossi

Northridge Earthquake Symposium

Business, Insurance and Financial Implications Concurrent Session

January 17, 2014



OVERVIEW

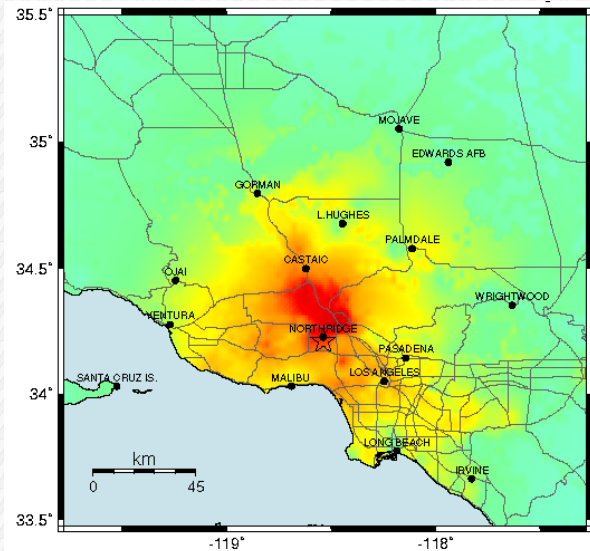
1. What are the advancements in catastrophe models since the 1994 Northridge Earthquake?
2. What can catastrophe models tell us about earthquake risk in Southern California?
3. How can we utilize models to explore risk mitigation strategies?

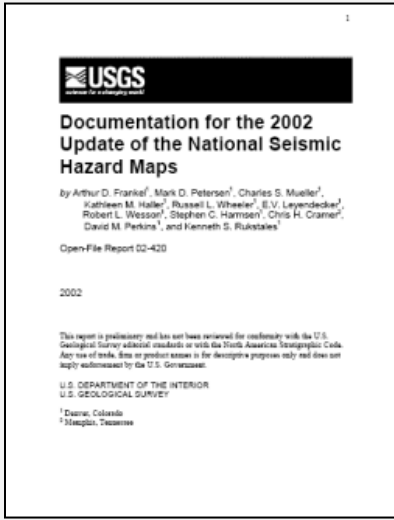


THE LEGACY OF THE NORTHRIDGE EARTHQUAKE

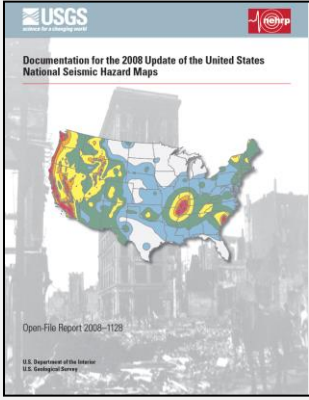
- In 1994, exposure data was incomplete and/or inaccurate
- In 1994, the probable maximum loss (PML) approach was used to manage earthquake risk
- In 1994, only 10%-12% of property insurers used catastrophe models

➤ The Northridge Earthquake definitively marked the end of the loss experience approach to assessing earthquake risk in California

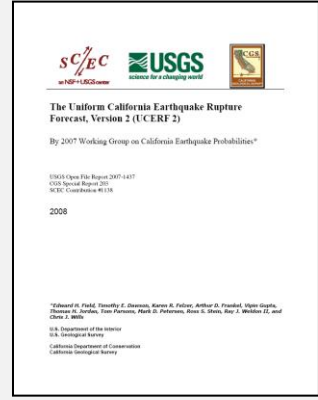




2002 NSHMP
USGS OFR 2002-420

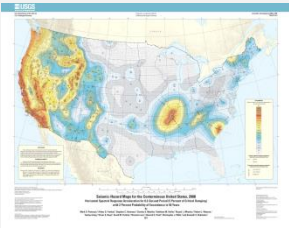



2008 NSHMP
USGS OFR 2008-1128



UCERF v2
USGS OFR 2007-1437

2014 NSHMP from USGS

UCERF3 from WGCEP

Fault Models

Specifies the spatial geometry of larger, more active faults.

Deformation Models

Provides fault slip rates used to calculate seismic moment release.

Earthquake-Rate Models

Gives the long-term rate of all possible damaging earthquakes throughout a region.

Probability Models

Gives the probability that each earthquake in the given Earthquake Rate Model will occur during a specified time span.

HAZARD AND VULNERABILITY RESEARCH



The SAC Steel Project


is funded by FEMA to solve the problem of brittle behavior of welded steel frame structures that surfaced in the January 17, 1994 Northridge, California (Los Angeles) Earthquake.

The SAC Steel Project was funded by the Federal Emergency Management Agency (FEMA)



The SAC Steel Project is a joint venture of:



Structural Engineers Association of California


Applied Technology Council


Consortium of Universities for Research in Earthquake Engineering

CUREE Publications

CUREE-Caltech Woodframe Project Publications



TBI


Tall Buildings Initiative

Guidelines for Performance-Based Seismic Design of Tall Buildings

Version 1.0
November 2010

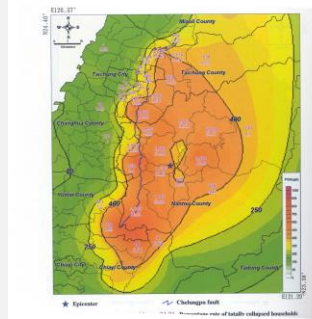
Developed by:
Pacific Earthquake Engineering Research Center
(Report No. 2010-03)

Sponsored by:
Charles P. Perrow Foundation
California Seismic Safety Council
California Emergency Management Agency
Los Angeles Department of Building and Safety



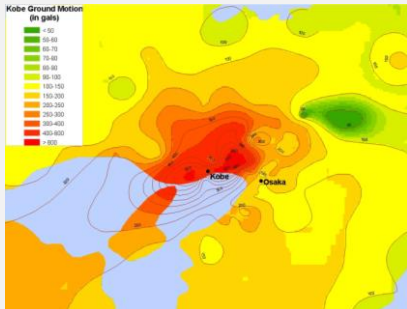
LESSONS FROM OTHER COUNTRIES

Chi-Chi,
Taiwan
Earthquake



1995

Kobe, Japan
Earthquake



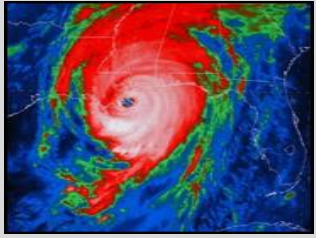
1999

Kocaeli, Turkey
Earthquake



- Degree of damage clearly differs depending upon combination of hazard, exposure, vulnerability
 - Fire following earthquake
 - Industrial exposure
 - Business interruption

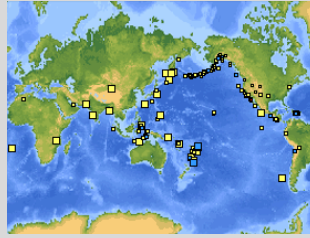
LESSONS FROM OTHER PERILS



Define Event



Assess Hazard



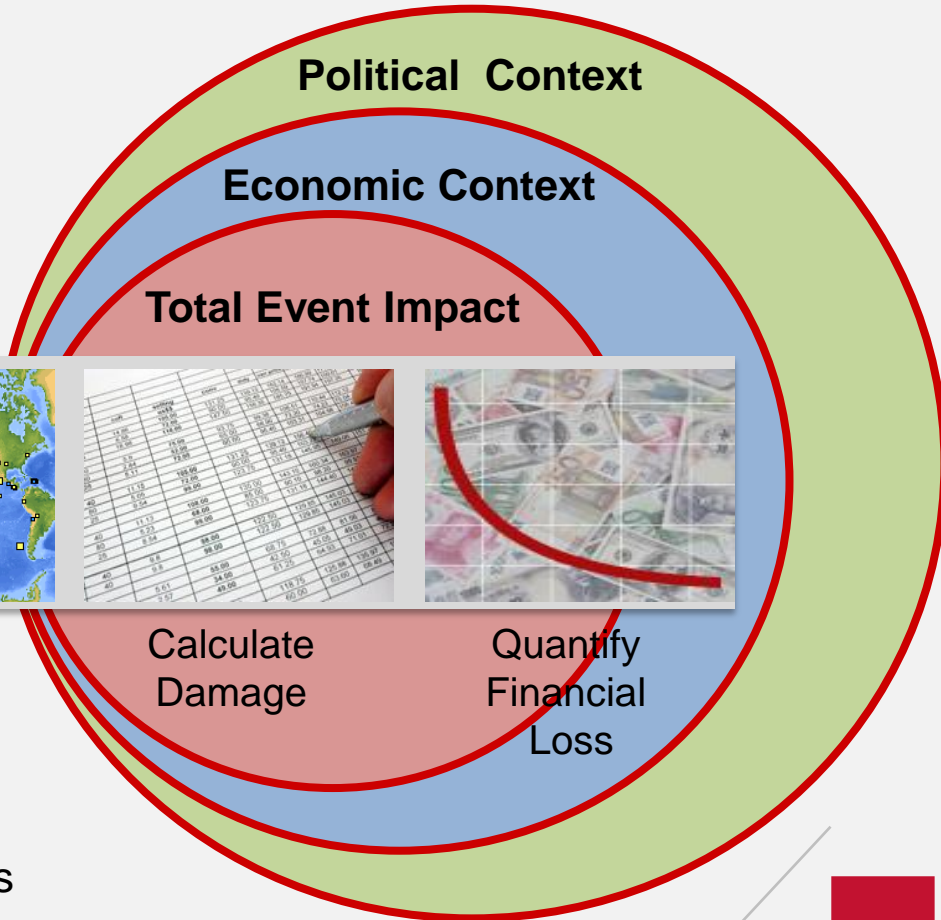
Apply Exposure



Calculate Damage



Quantify Financial Loss

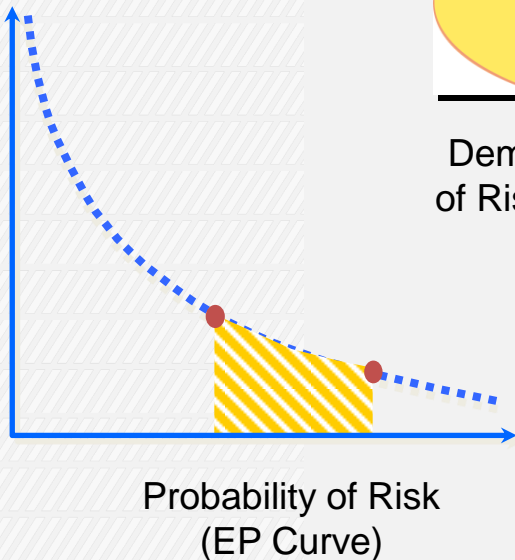


Loss Amplification reflects ways in which the costs incurred for a certain level of original damage become amplified when the damage is situated within a major catastrophe

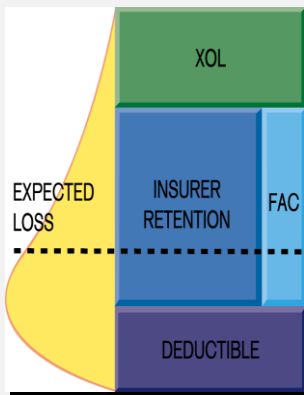
EACH EVENT PROVIDES UNIQUE LESSONS

- 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

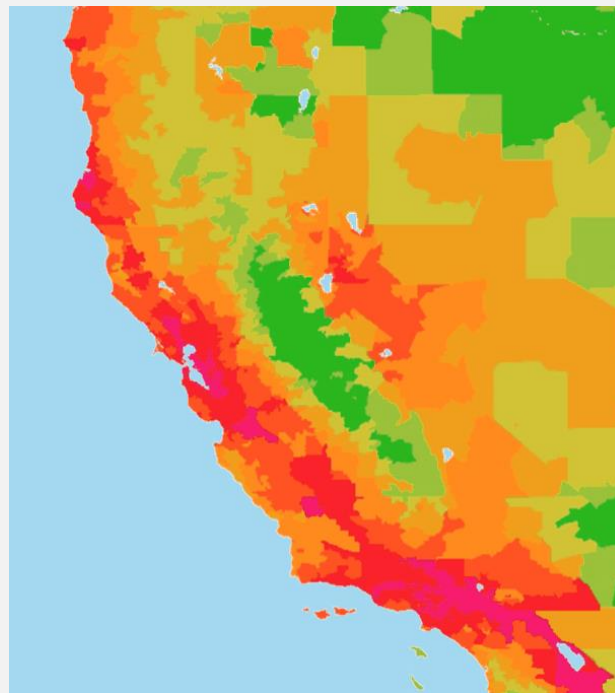


Who is expected to pay?



Demographics of Risk (Gross/Net)

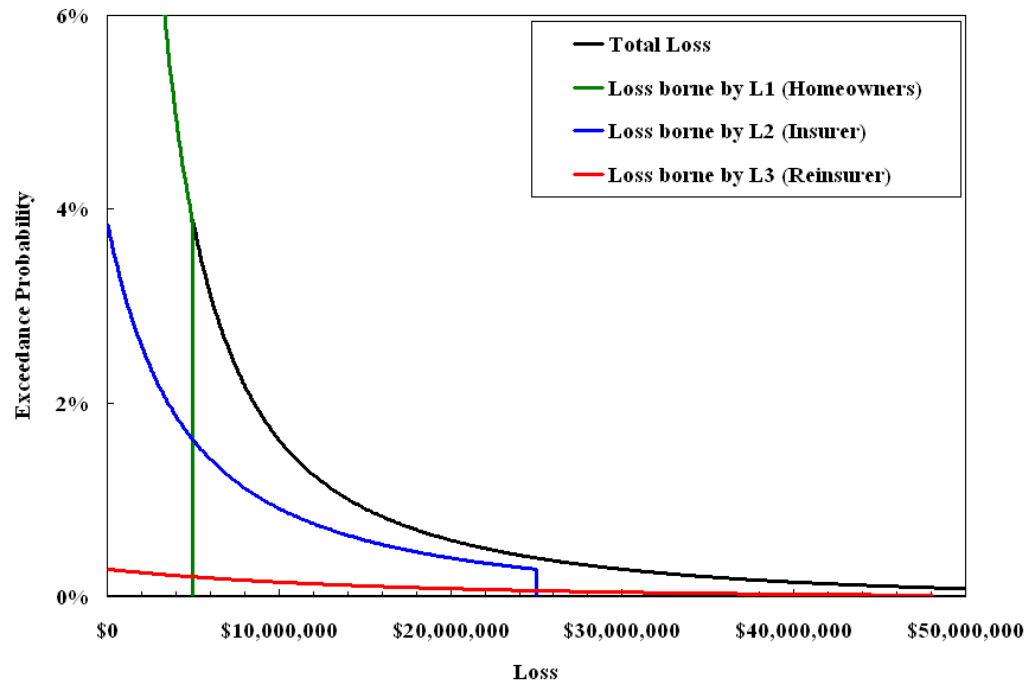
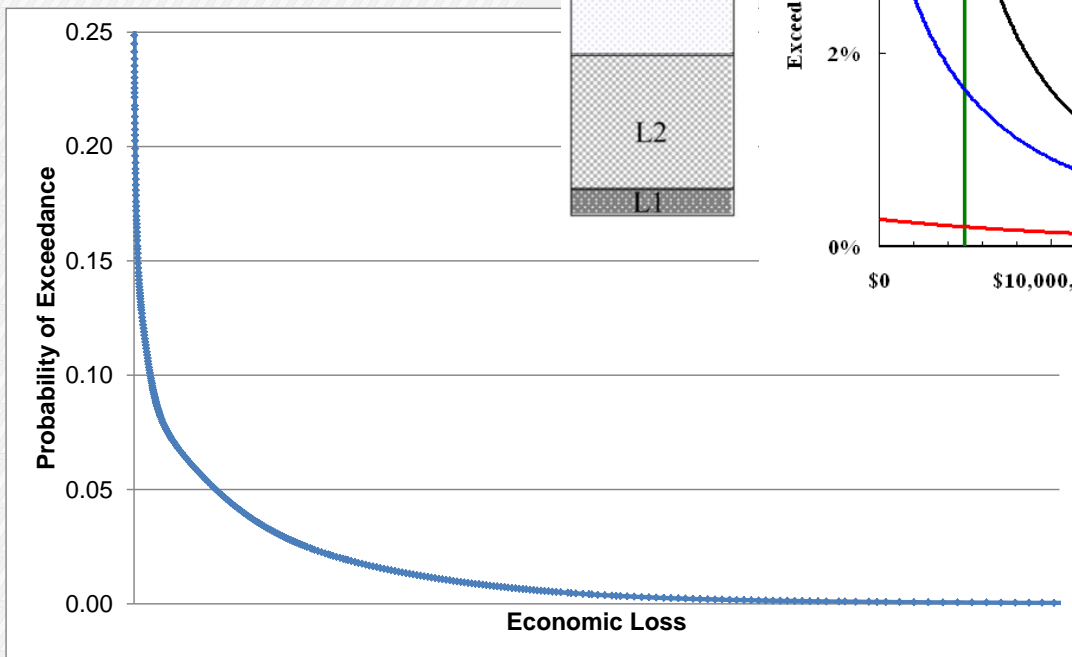
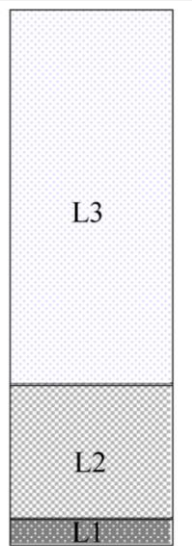
What is the expectation of risk?



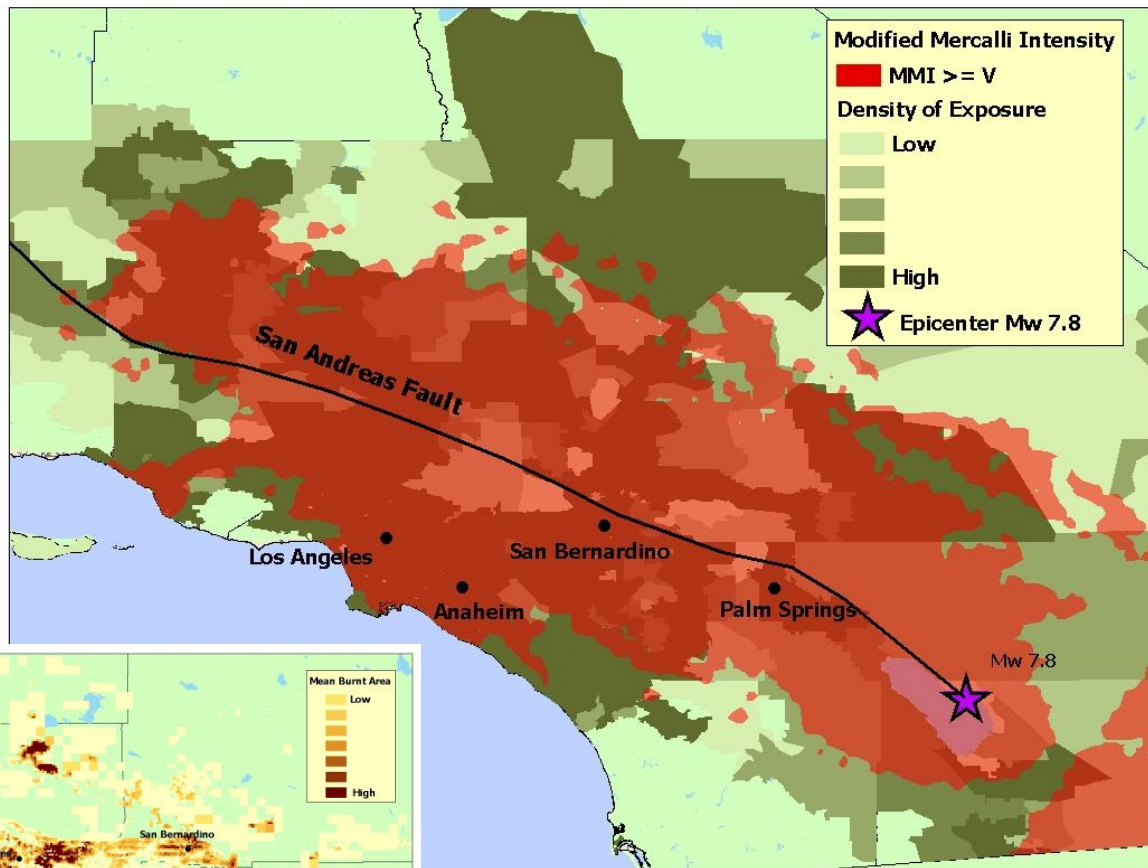
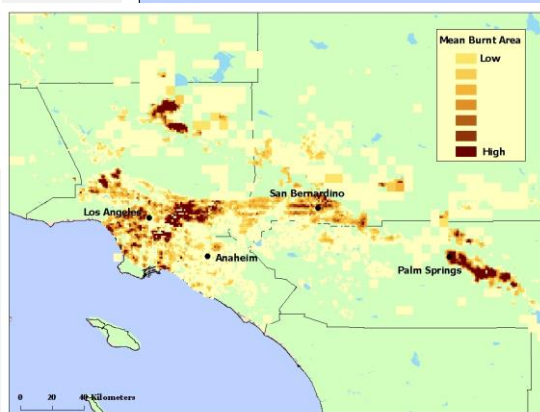
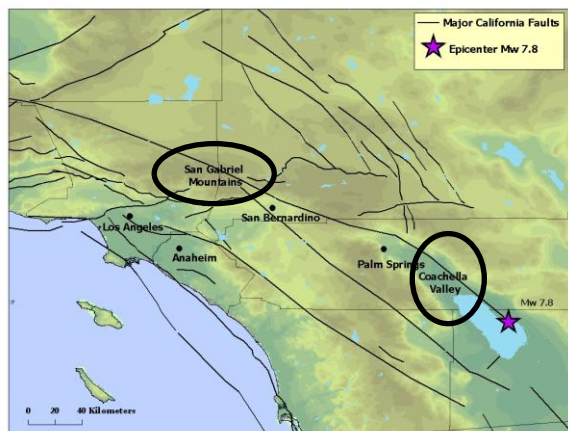
Geography of Risk

Where is the greatest (and least) expectation of risk?

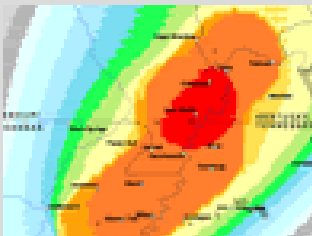
SOUTHERN CALIFORNIA EARTHQUAKE RISK



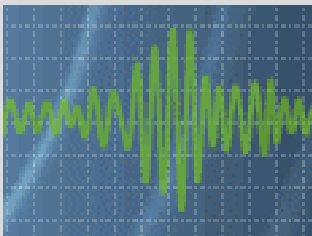
SOUTHERN CALIFORNIA EARTHQUAKE RISK



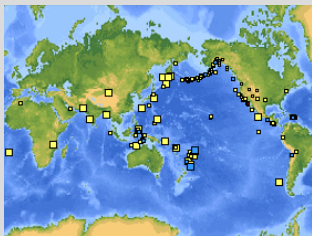
Catastrophe Model: A Tool to Explore Loss Reduction Strategies



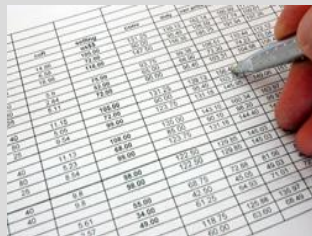
Define Earthquake



Assess Earthquake Ground Motion



Apply Exposure



Calculate Damage



Quantify Financial Loss

Stochastic Event Module

Hazard Module

Geocoding/ Exposure Module

Vulnerability Module

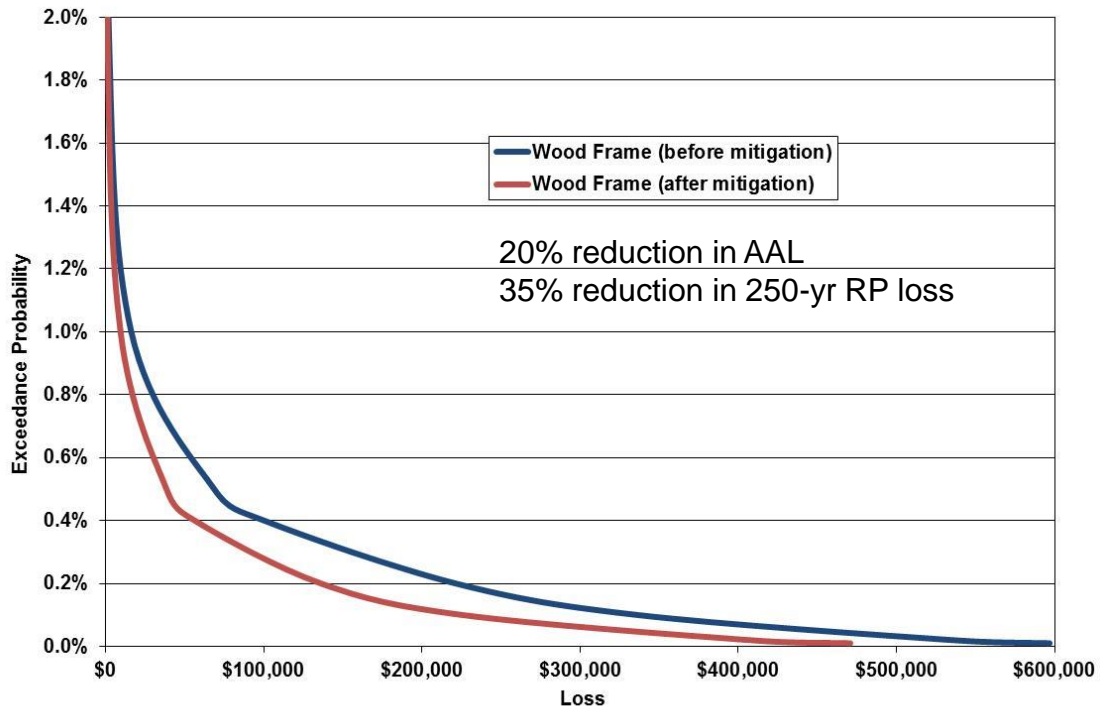
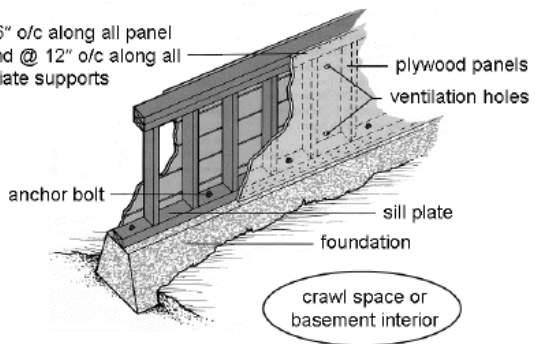
Financial Analysis Module

Modify inventory to explore impacts of land use policy

Modify vulnerability to explore impacts of individual mitigation strategies

QUANTIFYING IMPACTS OF WOOD FRAME RETROFIT

nails @ 6" o/c along all panel edges and @ 12" o/c along all intermediate supports



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