The US Earthquake Model Update: Drivers and Impact

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CAS

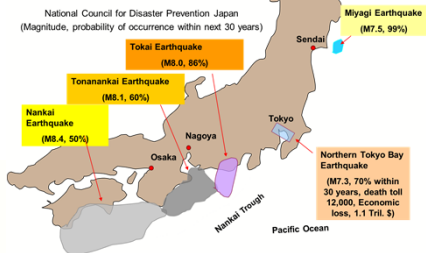# Why do the models change?

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2

Evolution of risk over time
Perception

Pre-Tohoku perception of risk in Japan

National Council for Disaster Prevention Japan
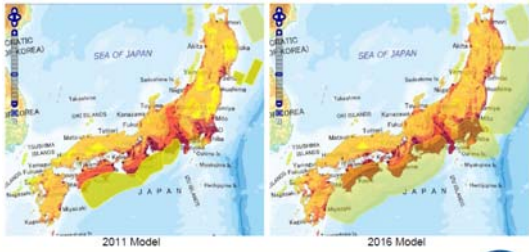(Magnitude, probability of occurrence within next 30 years)

Miyagi Earthquake
(M7.5, 99%)

Sendai

Tokai Earthquake
(M8.0, 86%)

Tonanankai Earthquake
(M8.1, 60%)

Nankai Earthquake
(M8.4, 50%)

Tokyo

Nagoya

Osaka

Northern Tokyo Bay Earthquake
(M7.3, 70% within 30 years, death toll 12,000, Economic loss, 1.1 Tril. $)

Nankai Trough

Pacific Ocean

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3

Evolution of risk over time
Perception

2011 Model | 2016 Model

* J-SHIS (2017)

Evolution of risk over time
Time Dependency

Nankai Trough: 71 years since last event (M8.1)

* J-SHIS (2017)

Evolution of risk over time
Time Dependency

Uniform California Earthquake Rupture Forecast, Version 3 (UCERF3)

Evolution of risk over time
Time Dependency
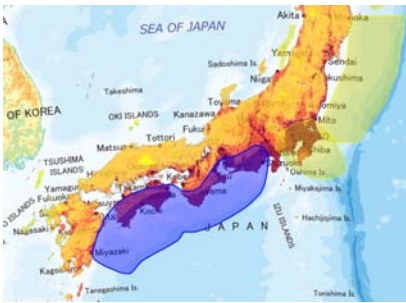
Evolution of risk over time
Change in view for California
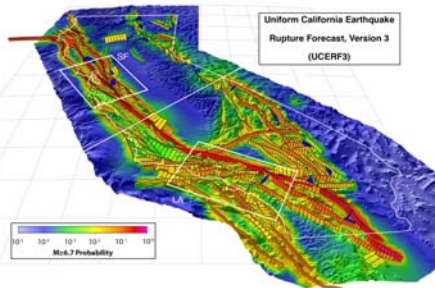
AIG Study
(2016)
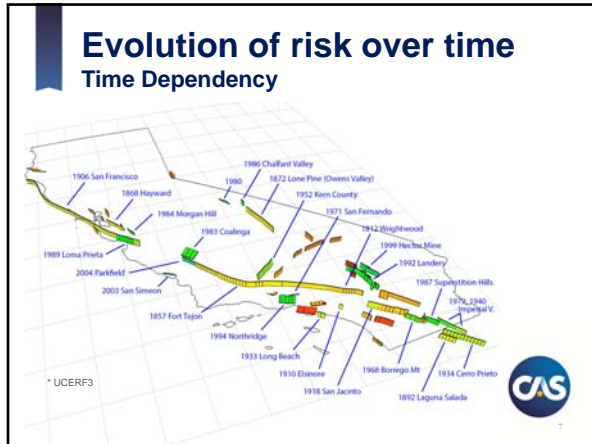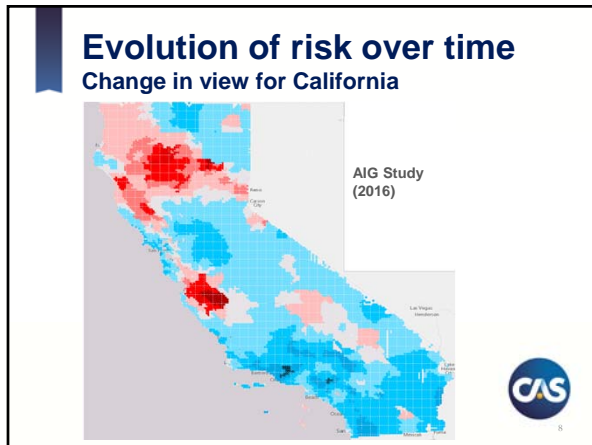
Do models consider all uncertainties?

Should you trust the mean?
Ground Motion Prediction Equations

Uncertainties

What is lurking in the tail?
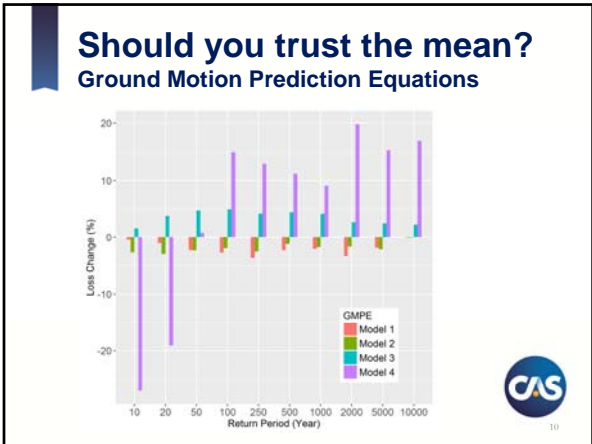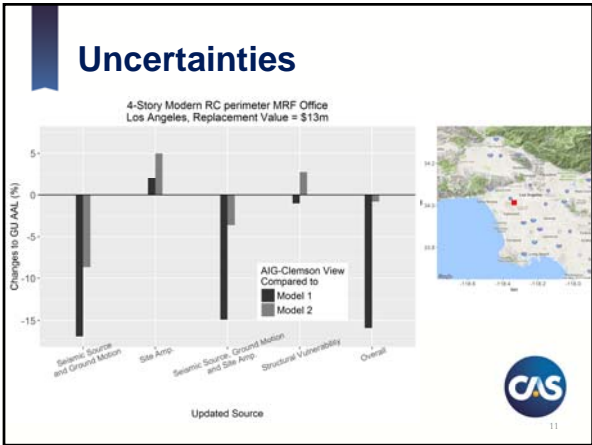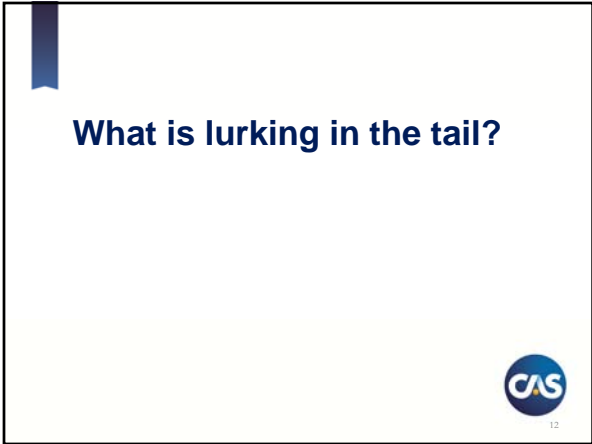
HayWired Scenario

The perception of risk for the San Francisco Bay Area has increased.

* USGS (2017): The HayWired Earthquake Scenario-Earthquake Hazards

HayWired Scenario

M7.0 event on the Hayward fault, San Francisco Bay Area

* USGS (2017): The HayWired Earthquake Scenario-Earthquake Hazards

Tsunamis in Seattle

Tacoma Fault

Tacoma-Rosedale Fault

Elliott Bay Tsunami inundation map

Depth of inundation: 0–.5 meters | .5–2 meters | 2–5 meters

* Walsh et al. (2013)

Tsunamis in California

Offshore bathymetric depths off the coast of San Diego Bay

Offshore Maritime Safety Map for San Diego Bay

DEPTH VALUE (fathoms)

Land
0-50
50-100
100-200
> 200

* The SAFFR Tsunami Scenario

https://pubs.usgs.gov/of/2013/1170/l/pdf/of2013-1170l.pdf

16

Tsunamis in New York?

Events off the coast of Africa can cause tsunamis which may hit the US East Coast.

A Warning About East Coast Tsunamis

By WILLIAM J. BROAD DEC. 3, 2007

The risk is low. But the consequences could be high, with deadly waves striking the coastal communities of Long Island, Connecticut and New Jersey and killing thousands of people.

Today, the federal government is announcing that it has completed the mid-Atlantic region's risk assessments for the killer mounds of water known as tsunamis, or tidal waves.

* The New York Times, Dec. 3, 2011

17

Unknown Unknowns
Vulnerability to tsunamis

Tohoku (2011): Fukushima Daiichi hydrogen-air explosion
Redundancy plans failed to imagine the risk to the back up generators

18

Unknown Unknowns
Can earthquakes cause flooding?

Christchurch (2011): dislodging of the 40 million ton Tasman Glacier

Known Unknowns

- The frequency of seismic events in the east coast

- Landslides, sinkholes, liquefaction

Summary

- Seismic risk evolves over time, either due to a change in our perception or the geophysics of the seismic sources
- There are large uncertainties in modeled prediction of losses due to known and unknown sources
- Model Validation customizes the models to the specifics of the organization and enhance the organization' view of the risk