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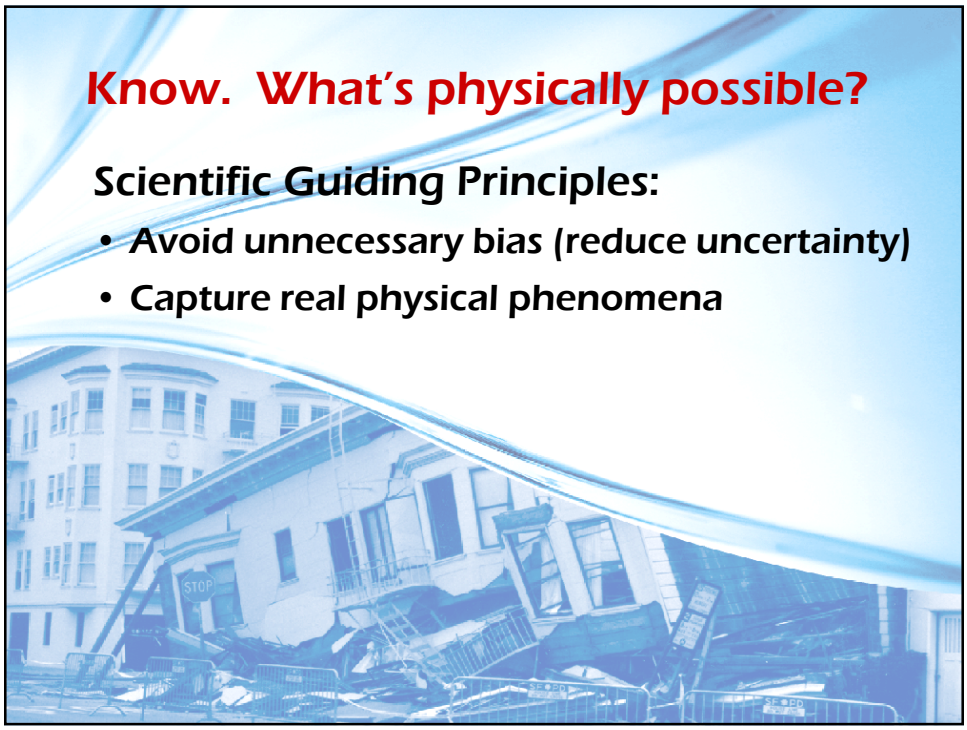
EQECAT: Rational Expectations
US Quake Release July 2010


Know. What's physically possible?
Scientific Guiding Principles:
• Avoid unnecessary bias (reduce uncertainty)
• Capture real physical phenomena

Avoid Unnecessary Bias: SBA – Soil-Based Attenuation

- Captures exposure
  - more people are located on soil
- Reflects the data
  - more recordings are located on soil
- Smaller amplification factors (1.0 vs. 2.0)
  - Less uncertainty in losses
- Modest changes for future releases

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Capture the Physical Phenomena: "Pulse" vs. "Sway" damage

Houses are vulnerable to *both measures* of shaking intensity.

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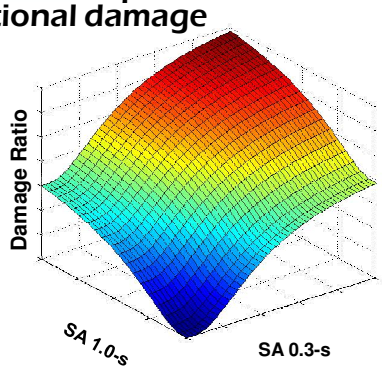
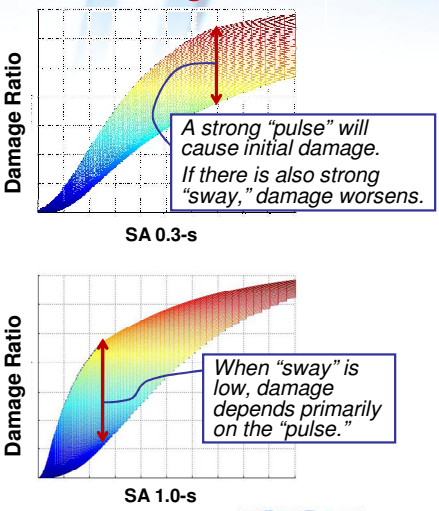
Capture the Physical Phenomena: 3-D Residential Vulnerability

Once damaged, a building is more susceptible to additional damage





Both short-period (pulse) and long-period (sway) accelerations affect the amount of damage incurred.

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Principled Science: Rigorous Peer-Review

CA Insurance Code § 10089.40.
…Rates shall be established based on the best available scientific information for assessing the risk of earthquake … loss.

- **Hazard Model: Reviewed by USGS scientists including Dr. Ned Field, primary author of UCERF**
- **Vulnerability and damage modules reviewed by PEER**

Pacific Earthquake Engineering Research Center (PEER)

Cal · Stanford · UCLA · UCI · USC · UCSD · UW · UC DAVIS

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USQuake Innovations relative to USGS

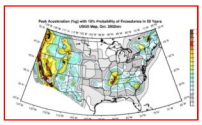
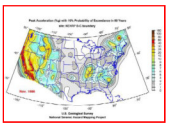
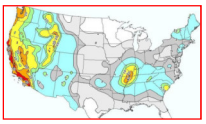
USQUAKE		
1997	2005	2010
V 2.x	V 3.x	v3.15 & beyond

USGS 1996 + Innovations
- Reviewed by CGS/USGS
- 3 D Modeling
- **Time Dependent Hazard (WGCEP 1988-1995)**

USGS 2002/03 + Innovations
- Reviewed by CGS/USGS
- 3 D Modeling
- Reviewed by PEER
- Time Dependent Hazard
- **Remove Hazard Bias**
- **Detailed NMSZ Flt. Model**
- **Earthquake Clustering**

USGS 2008/09 + Innovations
- Reviewed by CGS/USGS
- 3 D Modeling
- Reviewed by PEER
- Time Dependent Hazard
- NGA relationships
- NMSZ Faults + Clustering
- **Soil-Based Attenuation: all US**

USGS			
1996	2002/03	2008/09	2013

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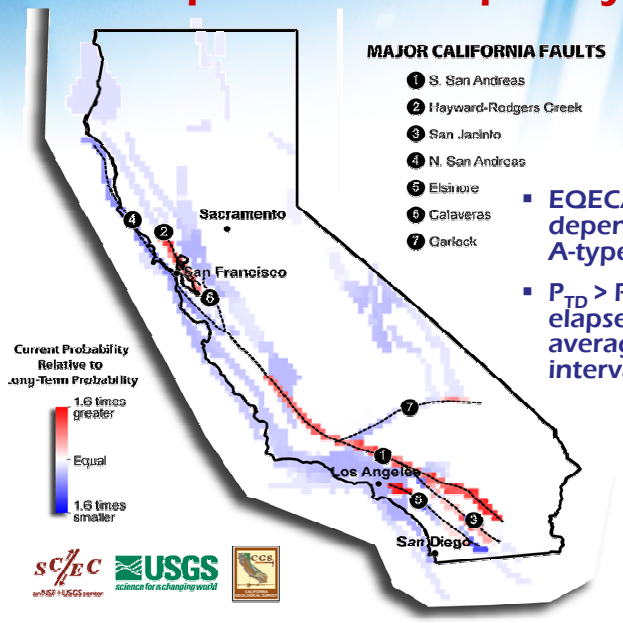
Time-Dependence Explicitly Treated



- EQECAT models time dependence for both A-type and B-type faults.
- $P_{TD} > P_{TI}$ when the time elapsed is 2/3 through the average recurrence interval.

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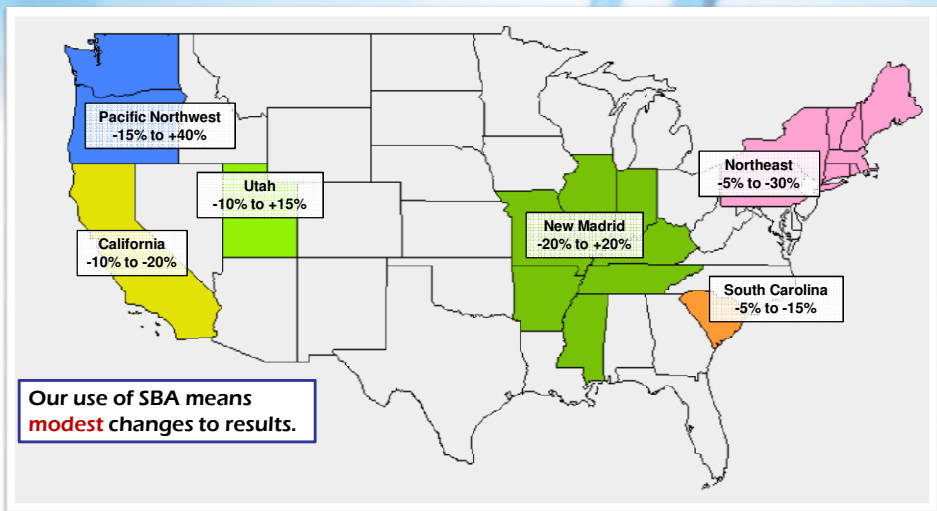
New Results by Region: Market Portfolio



Ratio between losses from new model and WCe 3.13, for the market portfolio.
Return periods range from 100 to1000 years.

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The Chilean Earthquake in Numbers

Magnitude (M_w) 8.8

Feb. 27, 2010; 3:30am local time

Depth 35 km

70% of Chile's 17.7 m people affected

Waves 2 to 3 meters

Loss Estimates:	EQECAT 1 March	Chilean Gov't 30 March
Economic Damage	$15 to $30 bn	$29.7 bn
Insured Loss	$3 to $8 bn	$4.9 bn

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Rupture Mechanism: Map View

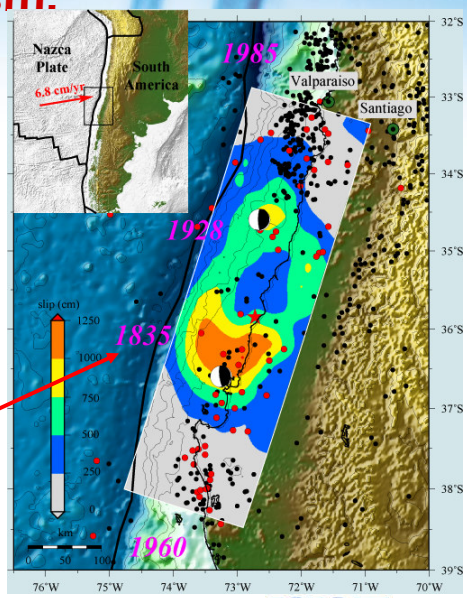
Red Dots = 1 day aftershocks
Black Dots = background 1964-2004

Thrust mechanisms of two asperities that ruptured in the Maule earthquake are shown.

(from U.C. Santa Barbara)

DO THE MATH:

2010 - 1835 = 175 Yrs.
175 Yrs. x approx. 7 cm/yr = 1,225 cm
Expected Displacement = 12.25 m



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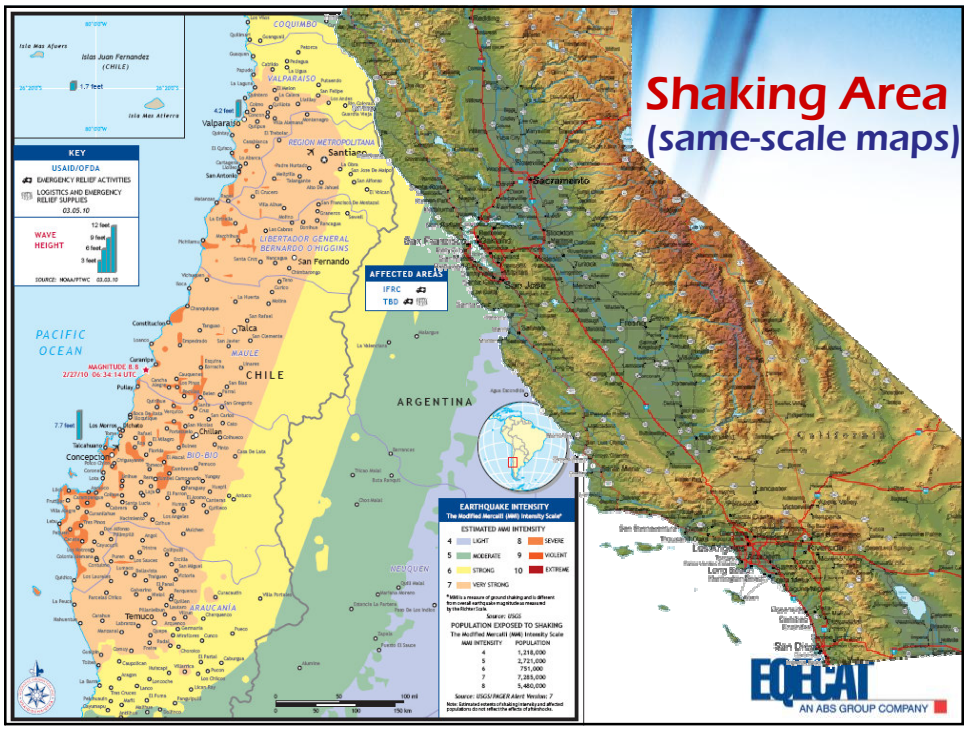
Shaking Area (same-scale maps)



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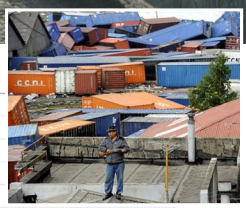
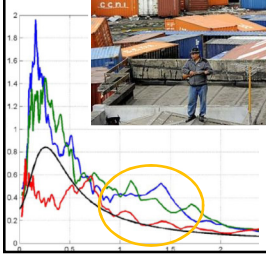
Main Lessons

- Use of Building Codes Reduces Risk





- Uninsured Damage Affects Insured Losses
  - transportation & energy
  - recovery time & BI
- Duration Affects Damage
- Tsunami Effects can be Significant

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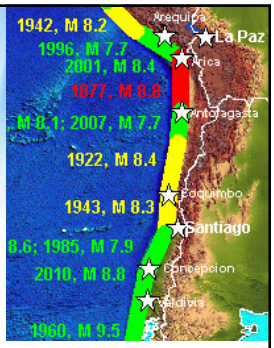
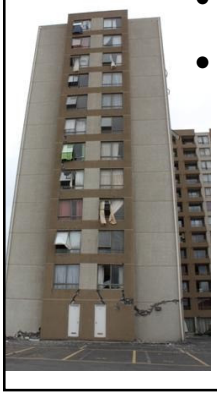
Surprises?



- Time-dependent probability:
  - captured by EQECAT Latin Quake for this fault segment
- Fast recovery
- Damage in new condos: repairable?
  - What is the threshold of damage beyond which a building is "totaled"?
  - "Social" loss amplification?



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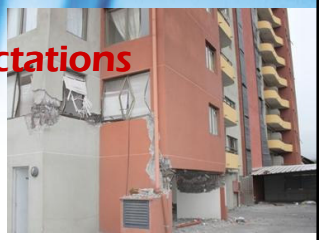
Condominiums:
Code-Compliance vs. Social Expectations

Viña del Mar: MMI 7
Concepción: MMI 8



Concepcion. Edificio Centro Mayor, 17 stories. Transverse wall at second floor.

Viña del Mar. Edificio Toledo, 11 Stories. Transverse basement walls.

- 9 to 20 story concrete buildings
- Built in last 15 years
- No utilities, jammed doors
- Rents have doubled
- Similar issues for a US quake

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On the Horizon

- How to capture earthquake duration?
- Alternate vulnerability formulations?
- Network effects on time element loss?
- "Non-modeled" risks? (e.g. Tsunami)
- Attenuations for intra-plate and deep subduction earthquakes

Thank you!

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