The USGS National Seismic Hazard Mapping Project: Issues and Improvements

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ATC/USGS Seismic Hazard User-Needs Workshop
September 21-22, 2015

NEHRP-2009 (ASCE_7-10) Design Ground Motion

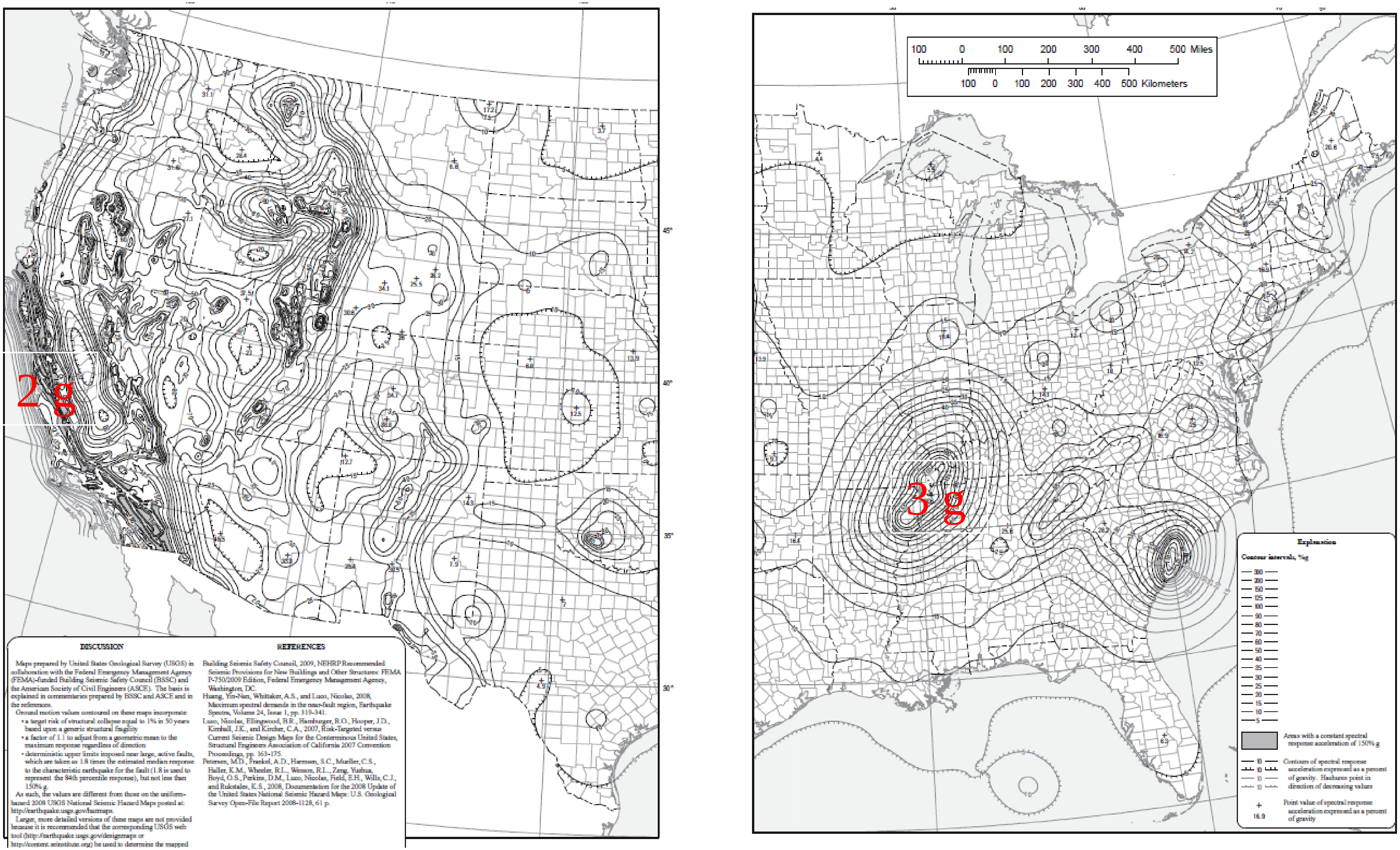

Figure 22-1 Ss Risk-Targeted Maximum Considered Earthquake (MCER) Ground Motion Parameter for the Conterminous United States for 0.2 s Spectral Response Acceleration (5% of Critical Damping), Site Class B.

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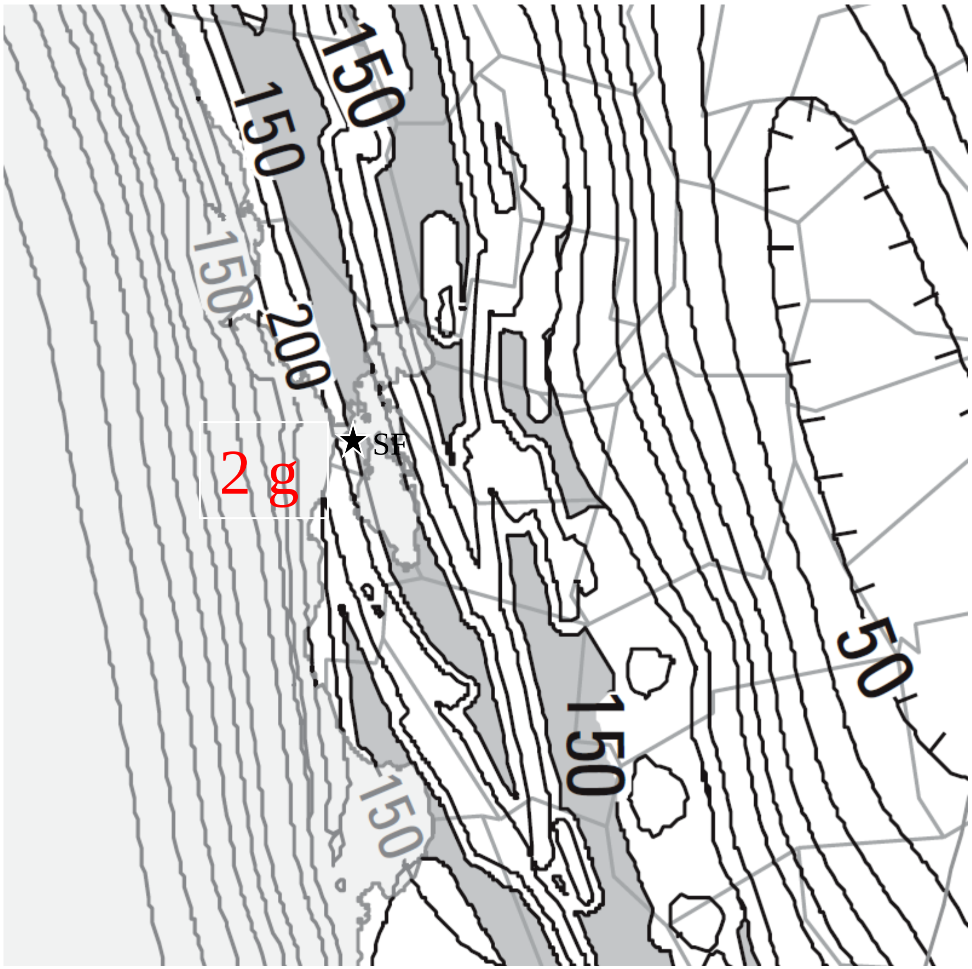
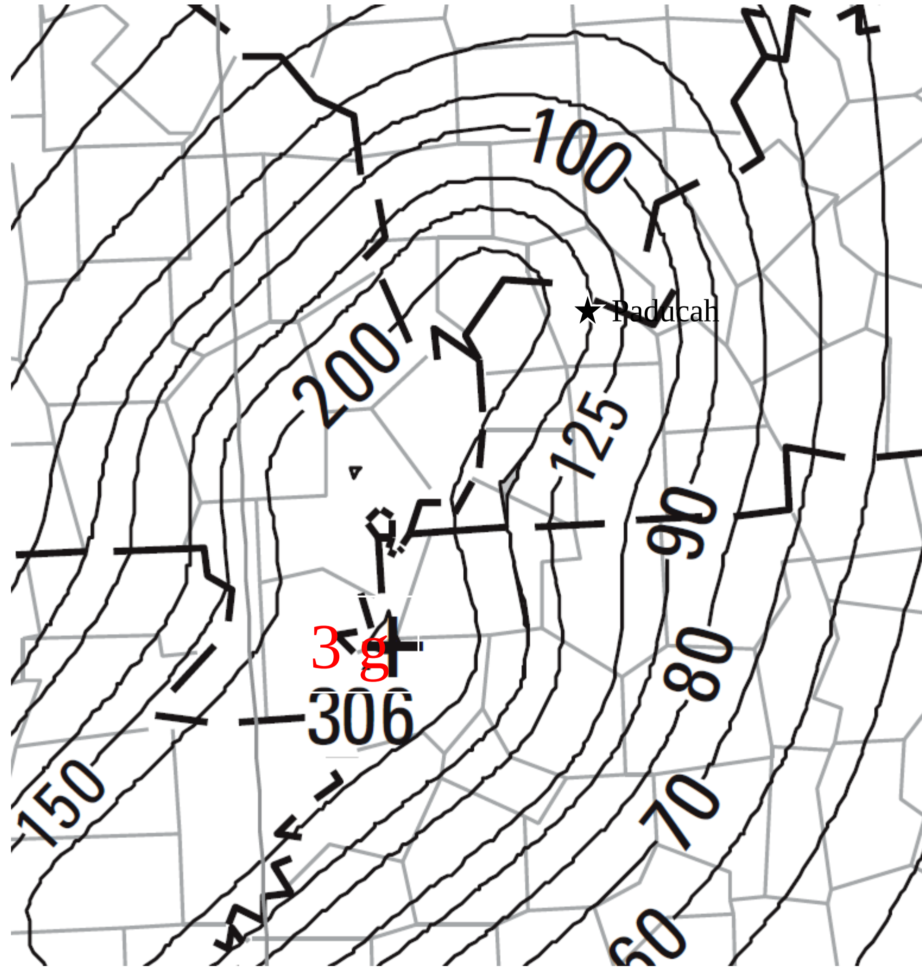
NEHRP-2009 (ASCE_7-10) Design Ground Motion





Development of Design Ground Motion (Policy)

Science

Seismic Hazard Map (USGS)

BSSC – Seismic Design Procedures Reassessment Group (SDPRG)

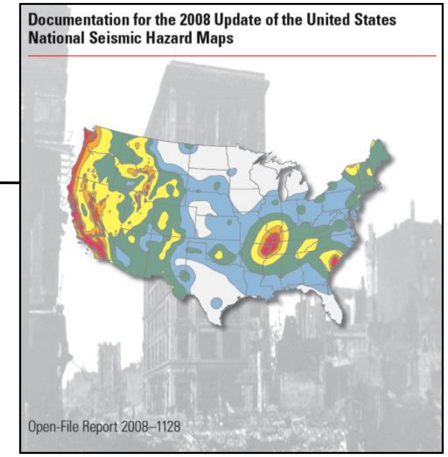
Seismic *Design Ground Motions* (FEMA)

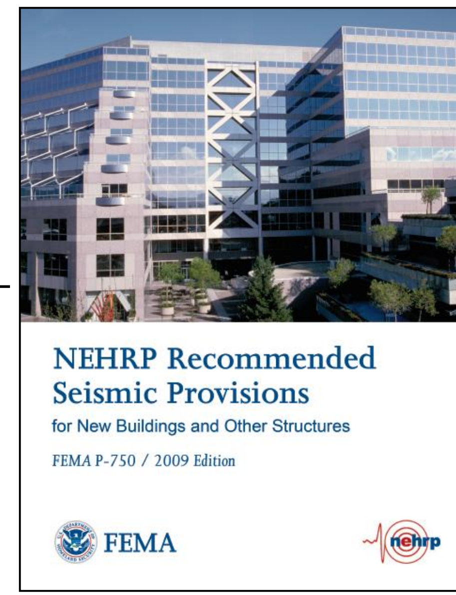
Policy

Federal agencies

State Agencies

Other organizations





NEHRP 0.2 sec Spectral Response Acceleration for the U.S. (2% PE in 50 yrs.) – the 2008 USGS hazard map

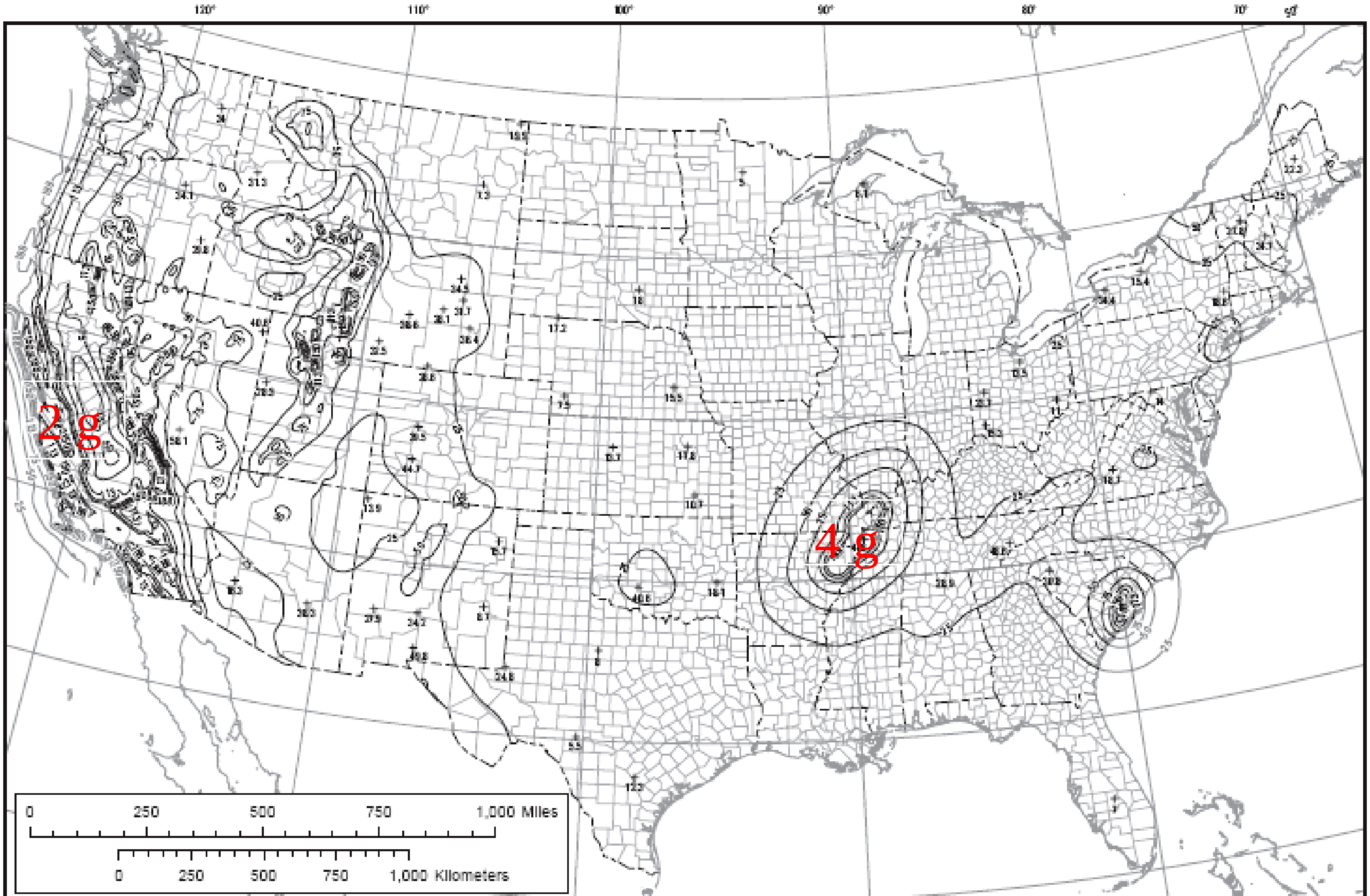


Figure 22-1 Uniform-hazard (2% in 50-Year) ground motions of 0.2-second spectral response Acceleration (5% of critical damping), Site Class B

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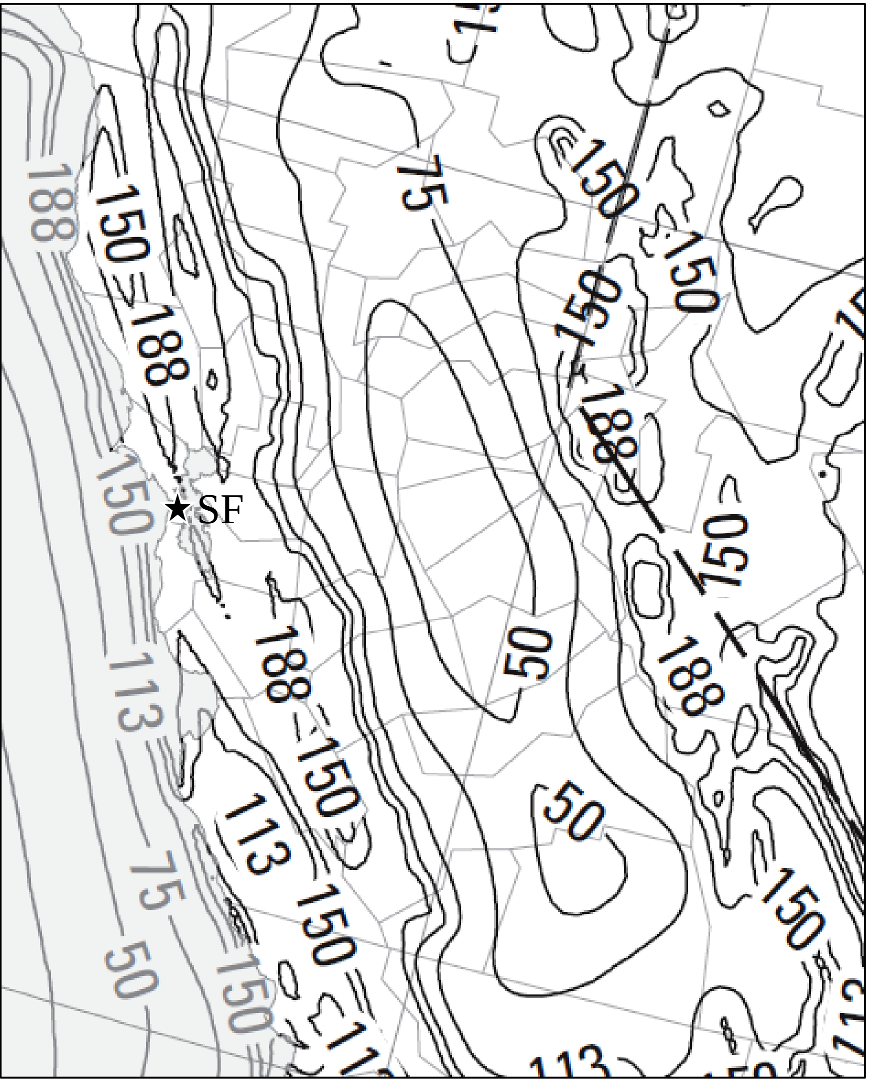
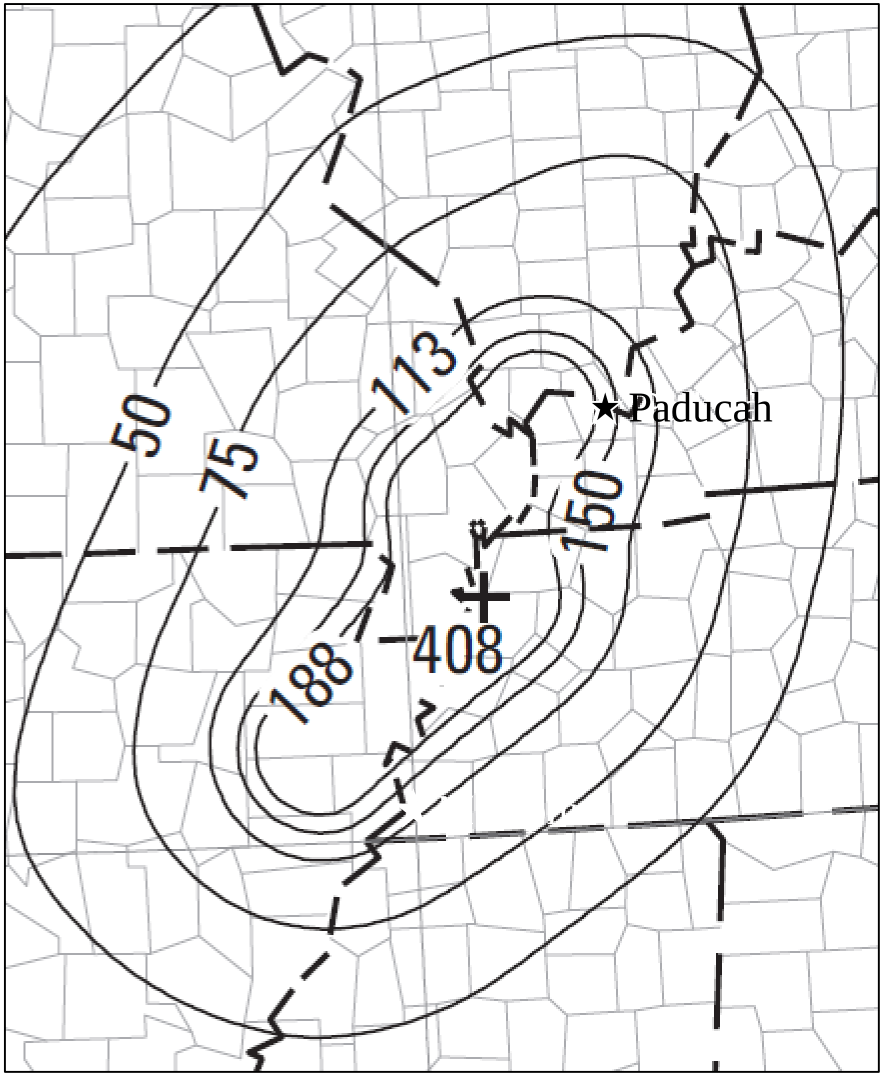




(USGS, 2008)

The US National Seismic Hazard Mapping

Inputs	Modeling (computer)	Outputs
Scientific data	PSHA	Hazard curves and maps

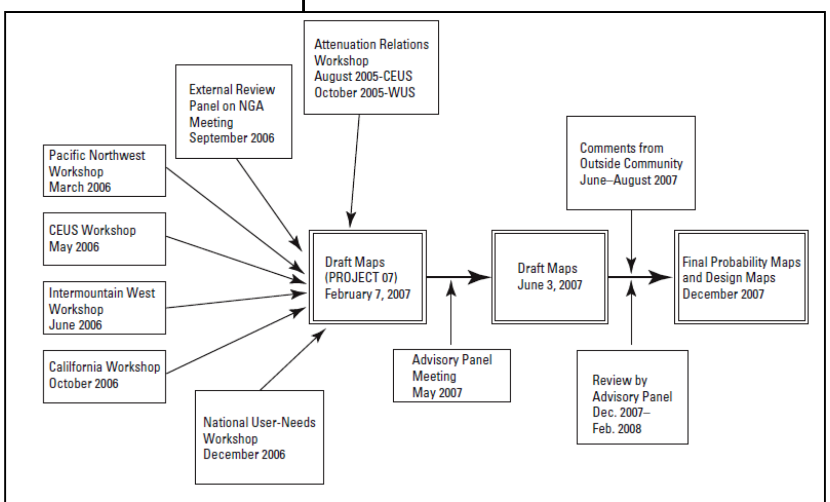
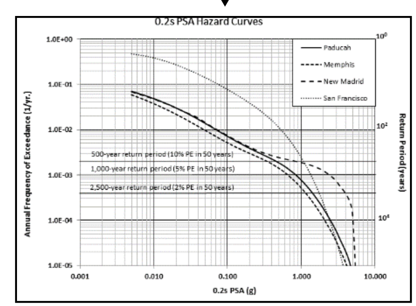
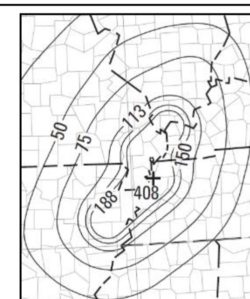


Figure 1. Process for developing the 2008 USGS National Seismic Hazard Maps. CEUS, Central United States; WUS, Western United States.





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In PSHA, probability (dimensionless) = frequency (dimensional, 1/yr.)

(Cornell, 1968)

$$P[I_{\max}^{(t)} \leq i] = P[N = 0] = e^{-p_i \nu t}. \qquad (21)$$

If we let $I_{\max}$ equal $I_{\max}^{(1)}$, the *annual* maximum intensity, $t = 1$, and

$$F_{I_{\max}^{(i)}} = e^{-p_i \nu} = \exp\left[-\nu CG \exp\left(-\frac{\beta}{c_2} i\right)\right] \qquad i \geq i' \qquad (22)$$

If the annual probabilities of exceedance are small enough (say ≤ 0.05), the distribution of $I_{\max}$ can be approximated by

$$1 - F_{I_{\max}^{(i)}} = 1 - e^{-p_i \nu} \cong 1 - (1 - p_i \nu)$$

$$\cong p_i \nu \qquad \text{(Ergodic assumption)}$$

$$\cong \nu CG \exp\left(-\frac{\beta}{c_2} i\right) \qquad i \geq i'. \qquad (23)$$

the math is incorrect

The US National Seismic Hazard Mapping

Inputs

Scientific data

Modeling (computer)

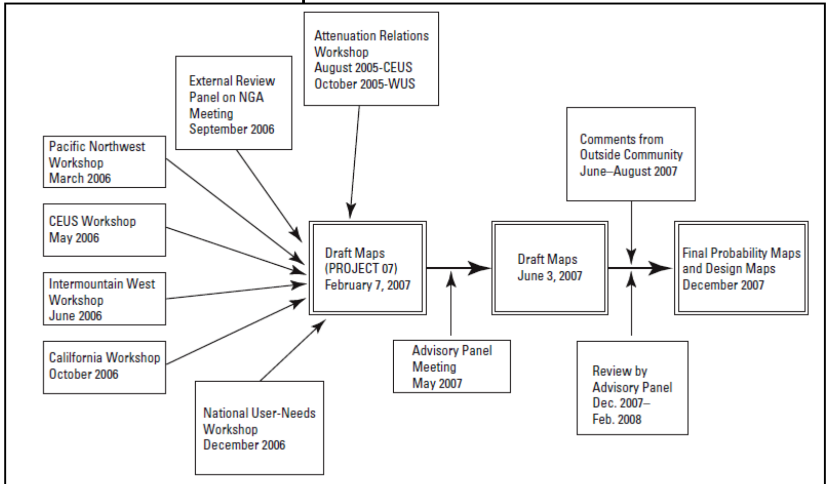
PSHA

Invalid model

Outputs

Hazard curves and maps

Artifacts



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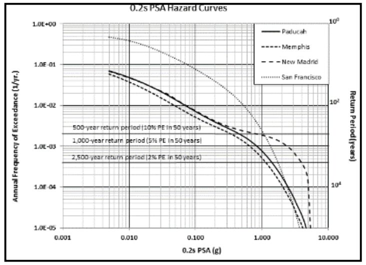
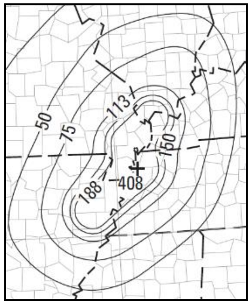
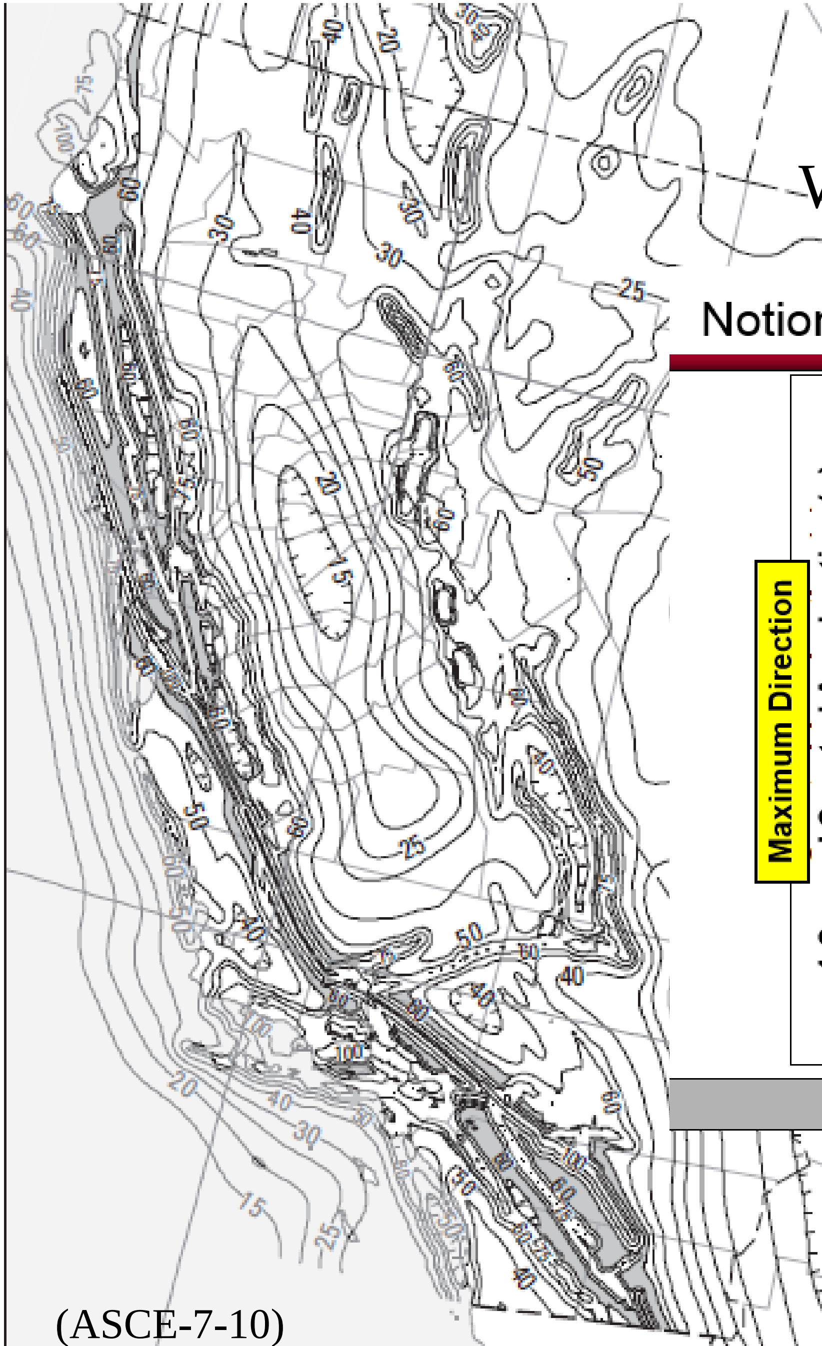
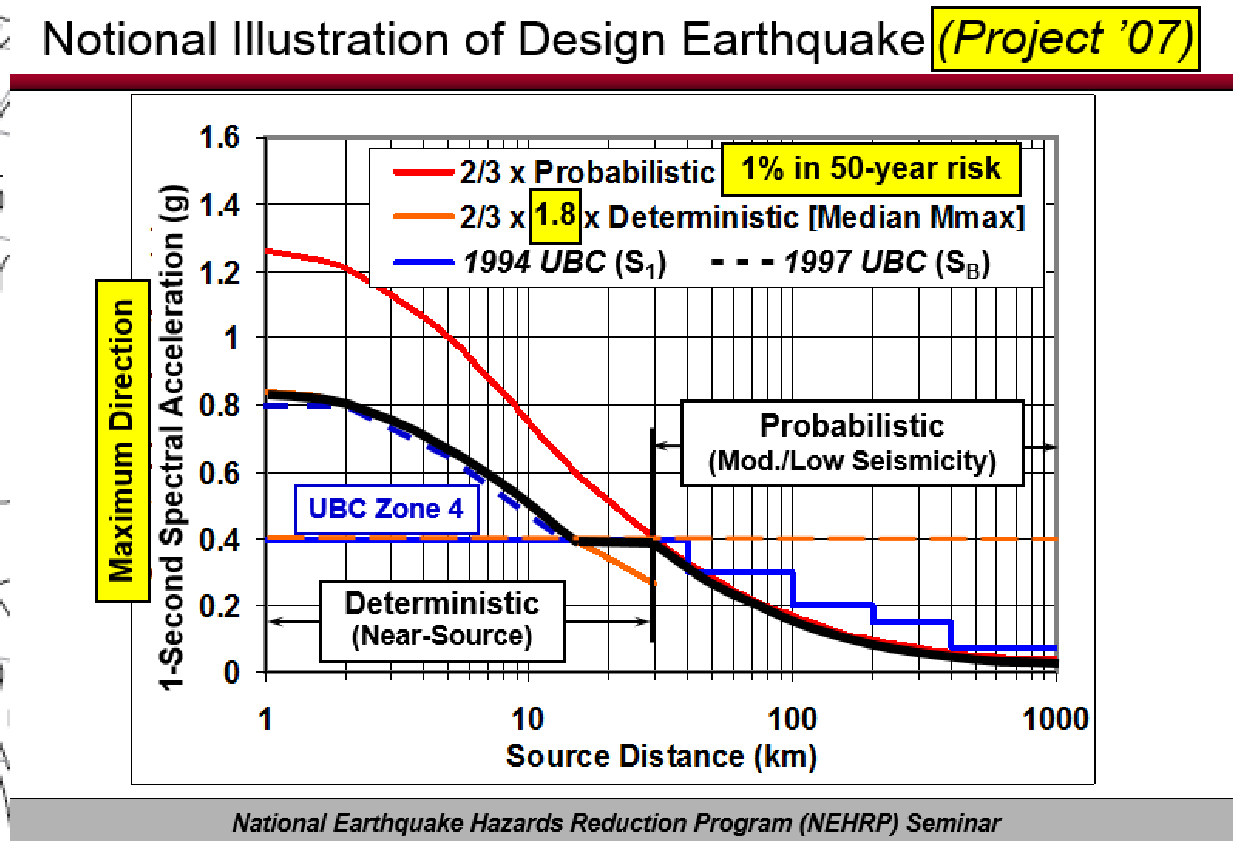




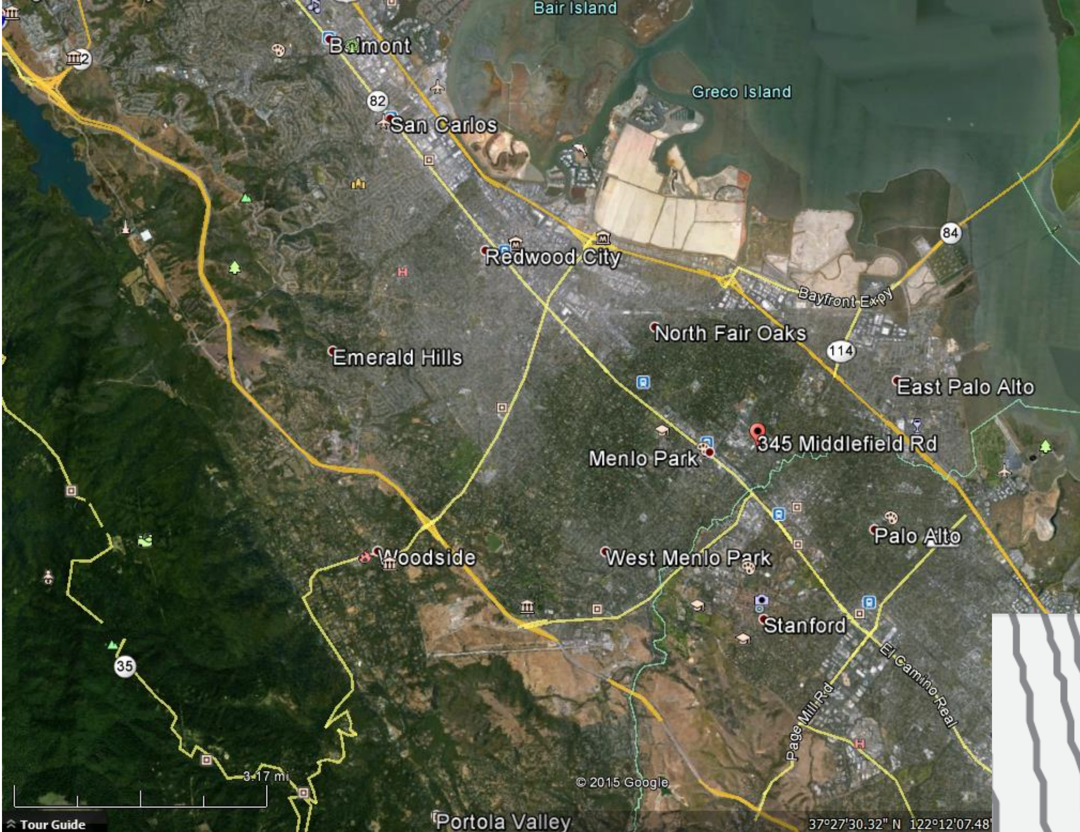
What is working in Coastal California?



(ASCE-7-10)



(Kircher, 2010)



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San Francisco Bay Area: DSHA

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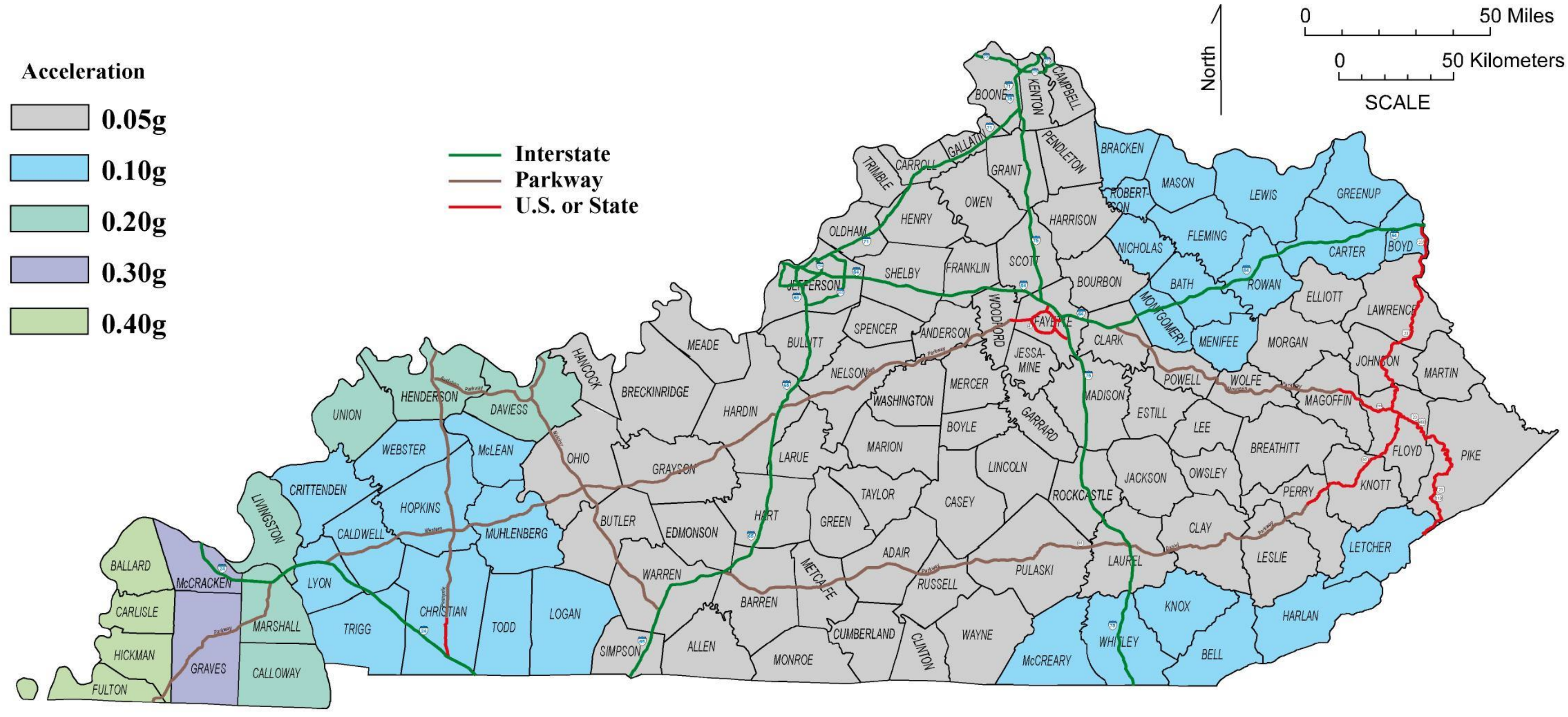
The KGS Scenario/Deterministic Ground Motion Hazard Maps

Maximum Credible Earthquake Ground Motion: Peak Ground Acceleration on Hard Rock



1. Seismic design of bridge and highway facilities
2. Seismic design of Landfills and other facilities
3. Basis for revision of the Kentucky Residential Code

Summary

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- The U.S. National Seismic Hazard Mapping Project has built a good scientific database.

- However, the hazard curves and maps produced are not scientifically sound because the methodology being used – PSHA
  - The math is simply incorrect
  - Not transparent (difficult to understand and communicate)

- Scenario or deterministic seismic hazard analysis is a good alternative for the national hazard mapping
  - Proven in Coastal California
  - Transparent (easy to understand and communicate)

Thank You!