Approach for Computing Long Period S_a

Use 3-D Numerical Models

Application: Urban Areas

End Product

Long Period S_a Maps

Next Generation Seismic Codes

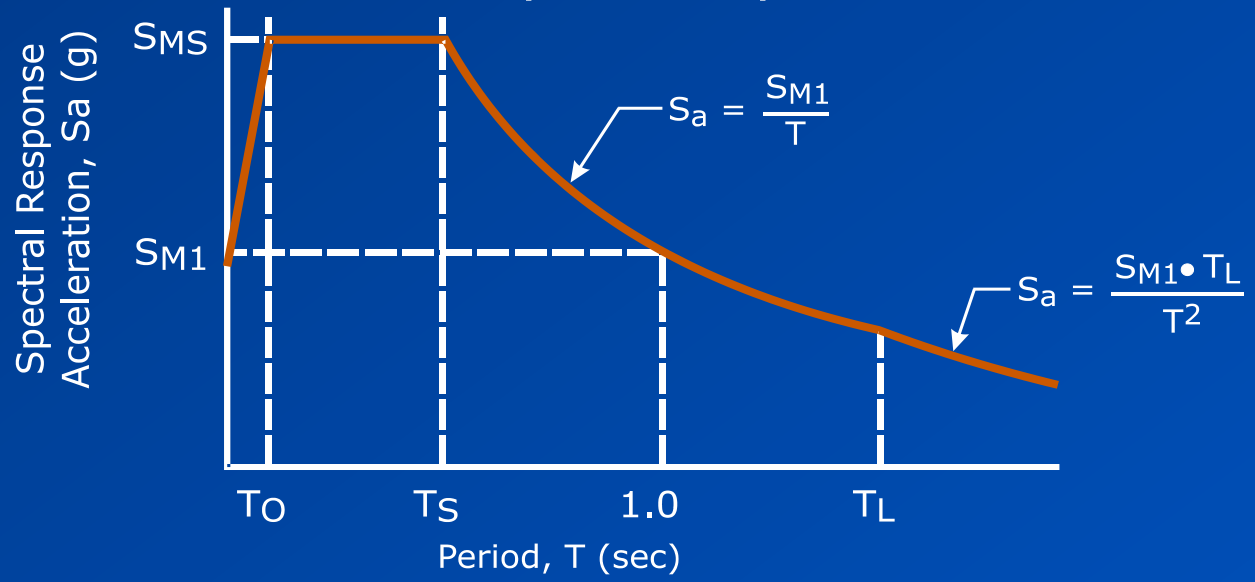
Two Seismic Hazard Analysis (SHA) Approaches in ASCE 7-05

1. General Procedure – Ch. 11

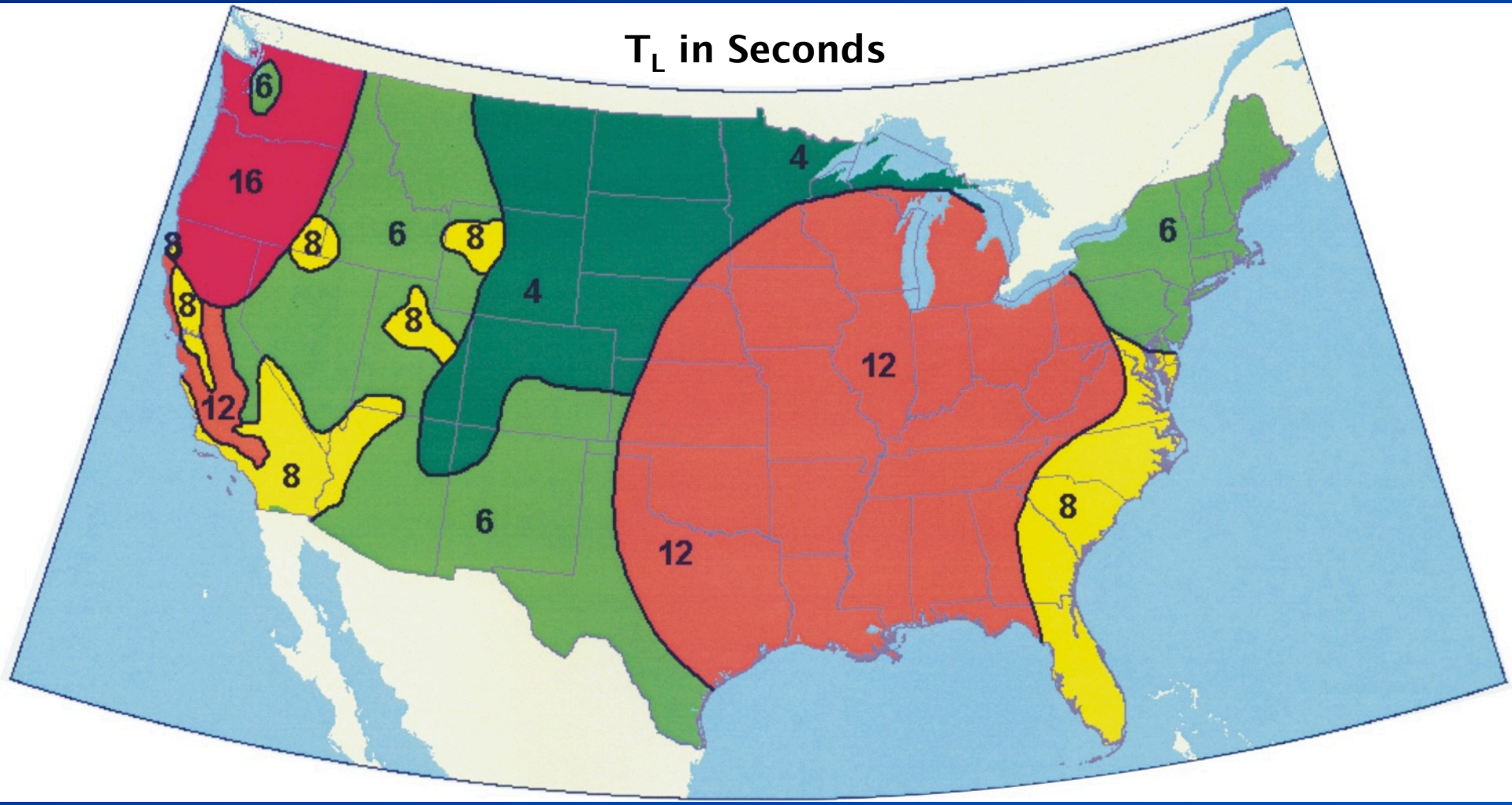
USGS MCE Maps & Site Coefficients

S_S, S_1, T_L $\qquad$ F_a, F_v

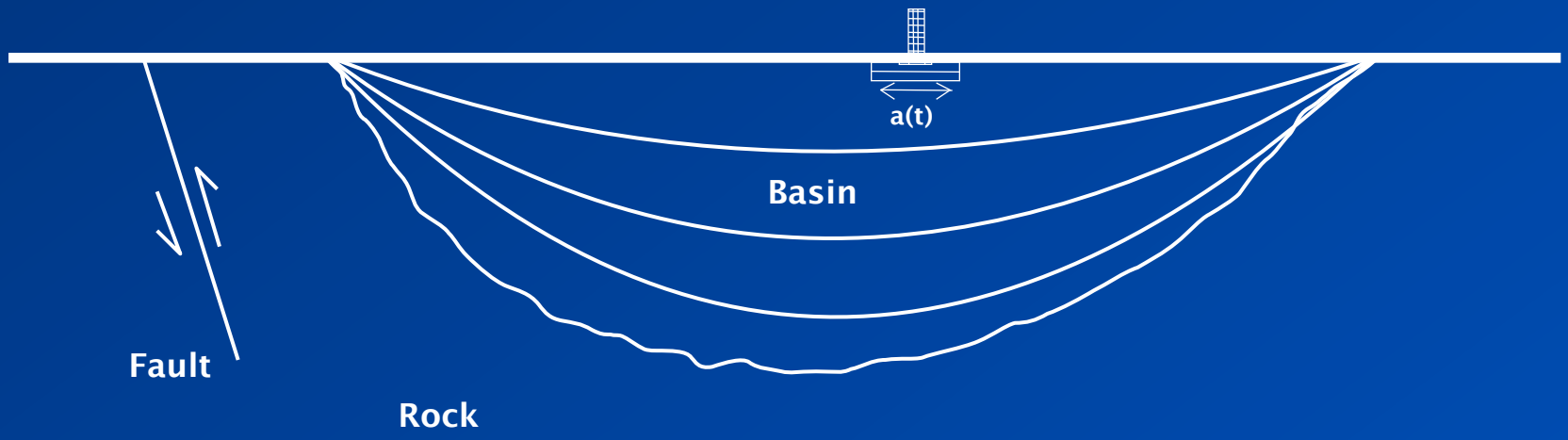
MCE Response Spectrum



T_L Map in ASCE 7

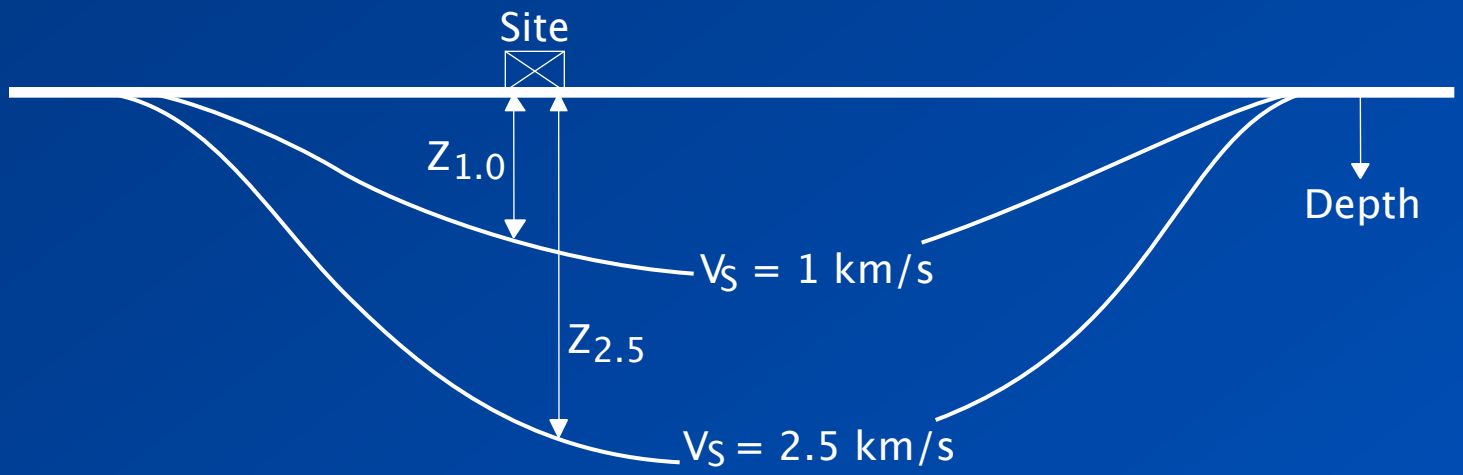


Modeling Regional Effects on Long Period Motions



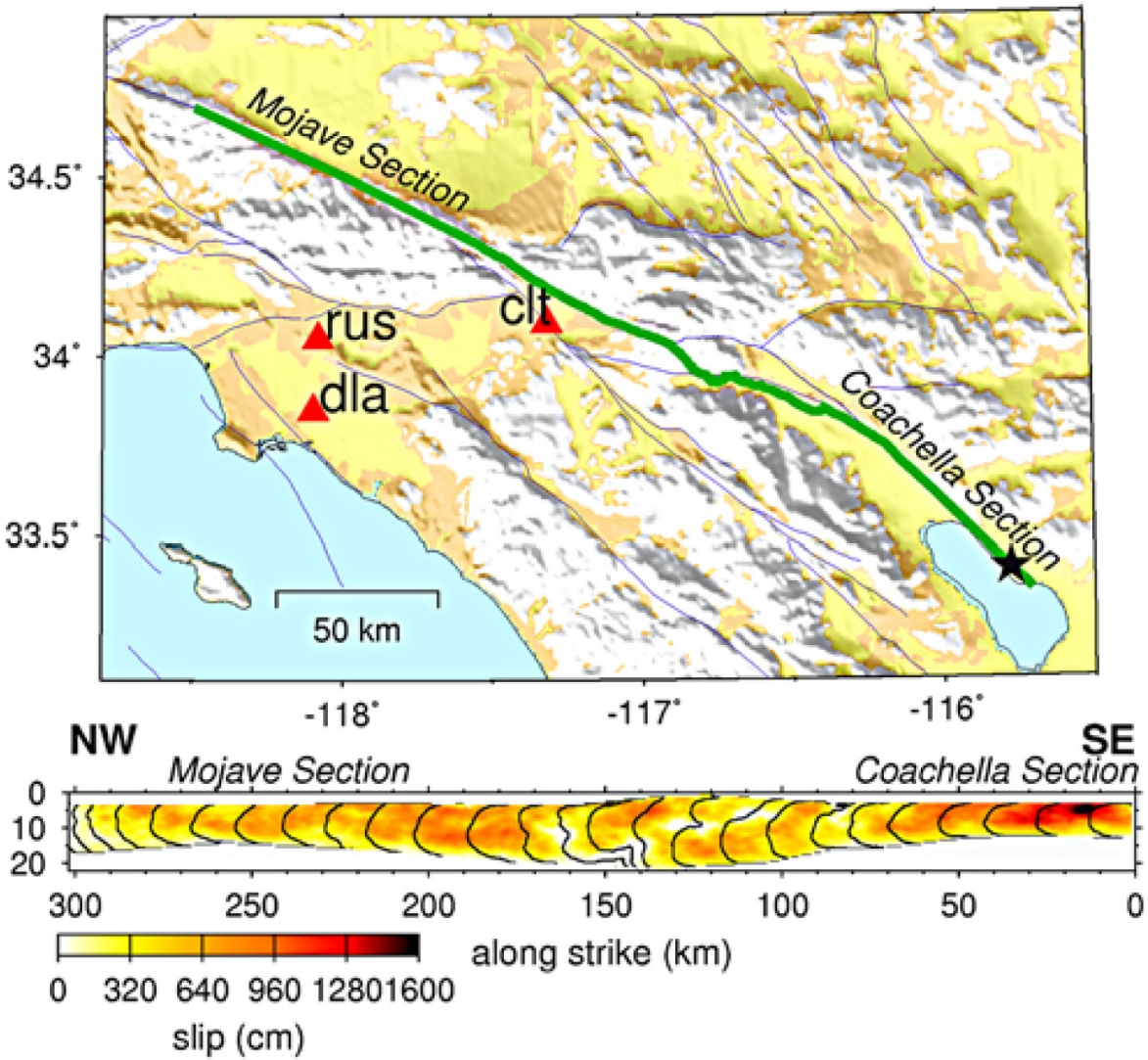
NGA Equations with Basin Depth Terms

- Abrahamson & Silva – Z1.0
- Campbell & Bozorgnia – Z2.5
- Chiou & Youngs – Z1.0



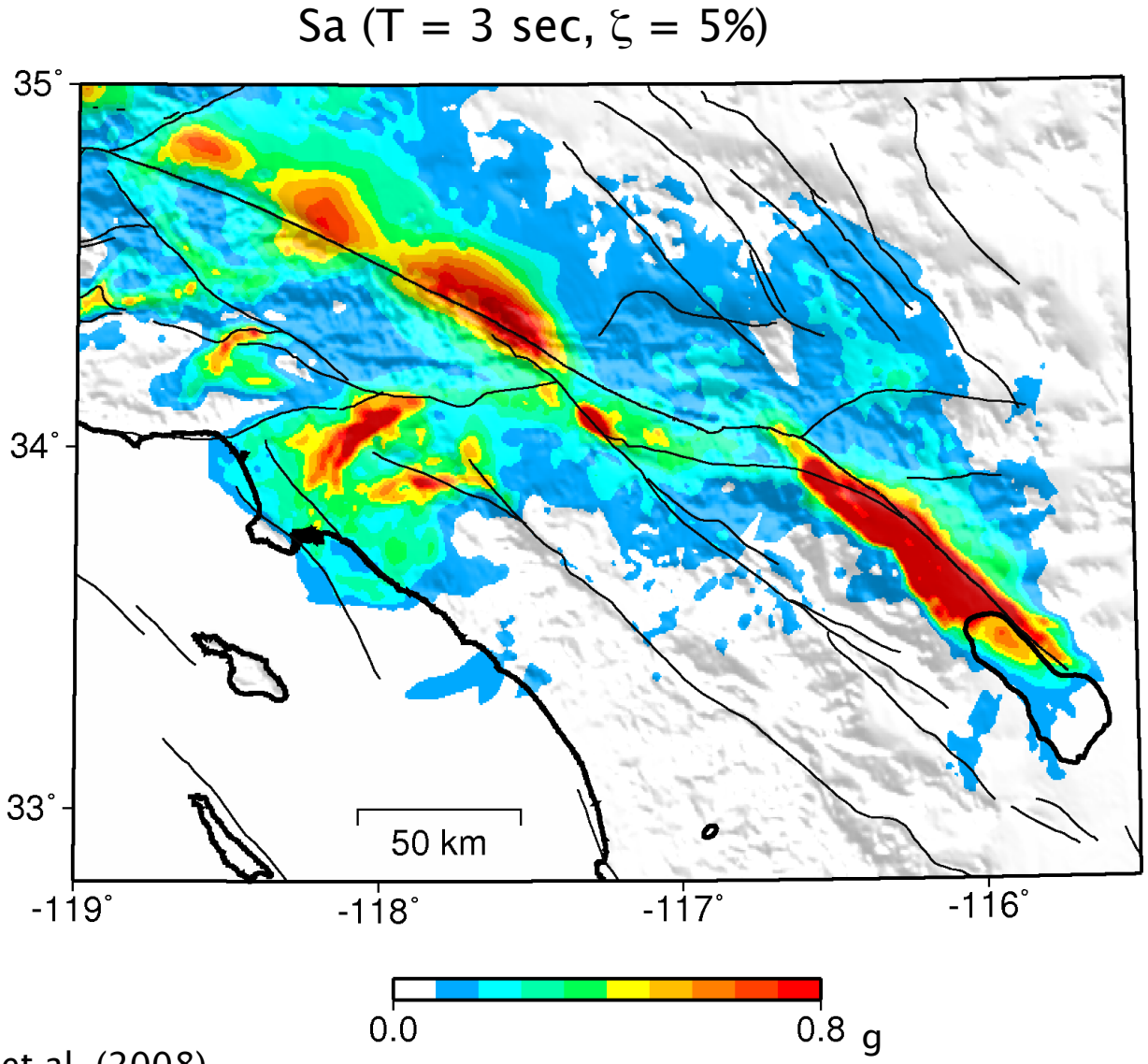
Basin Profile

M 7.8 San Andreas Earthquake Simulations



Graves et al. (2008)

M 7.8 San Andreas Earthquake Simulations



Graves et al. (2008)

Recommendation

- Conduct pilot study for L.A. Basin
- Objective – Generate Long-Period Ground-Motion Maps per PSHA/DSHA Procedures in Ch. 21, ASCE 7-10
- Substitute Simulations for GMPEs

Approach

1. Identify faults
2. Perform simulations
   - 3-comp. accelerograms
   - response spectra, S_a (T)
   - median S_a(T)
3. Select σ_{ln}
4. Proceed with PSHA/DSHA

PSHA for Fault i, Magnitude j

Simulated $S_a(T)$ ➡ $P_i\ (S_a > A\ I\ M_j)$

V_{ij} = Rate/yr of M_j on Fault i

$V_{ij} \cdot P_i\ (S_a \geq A\ I\ M_j)$

Rate/yr of $S_a \geq A$ for Fault i & M_j

Total Ground-Motion Hazard

$$\sum_{\text{all Mj}} V_{ij} \cdot P_i(S_a \geq A \mid M_j)$$

$$\underbrace{\sum_{\substack{\text{all} \\ \text{faults}}} \sum_{\text{all Mj}} V_{ij} \cdot P_i(S_a \geq A \mid M_j)}$$

Total Rate/yr of $S_a \geq A$

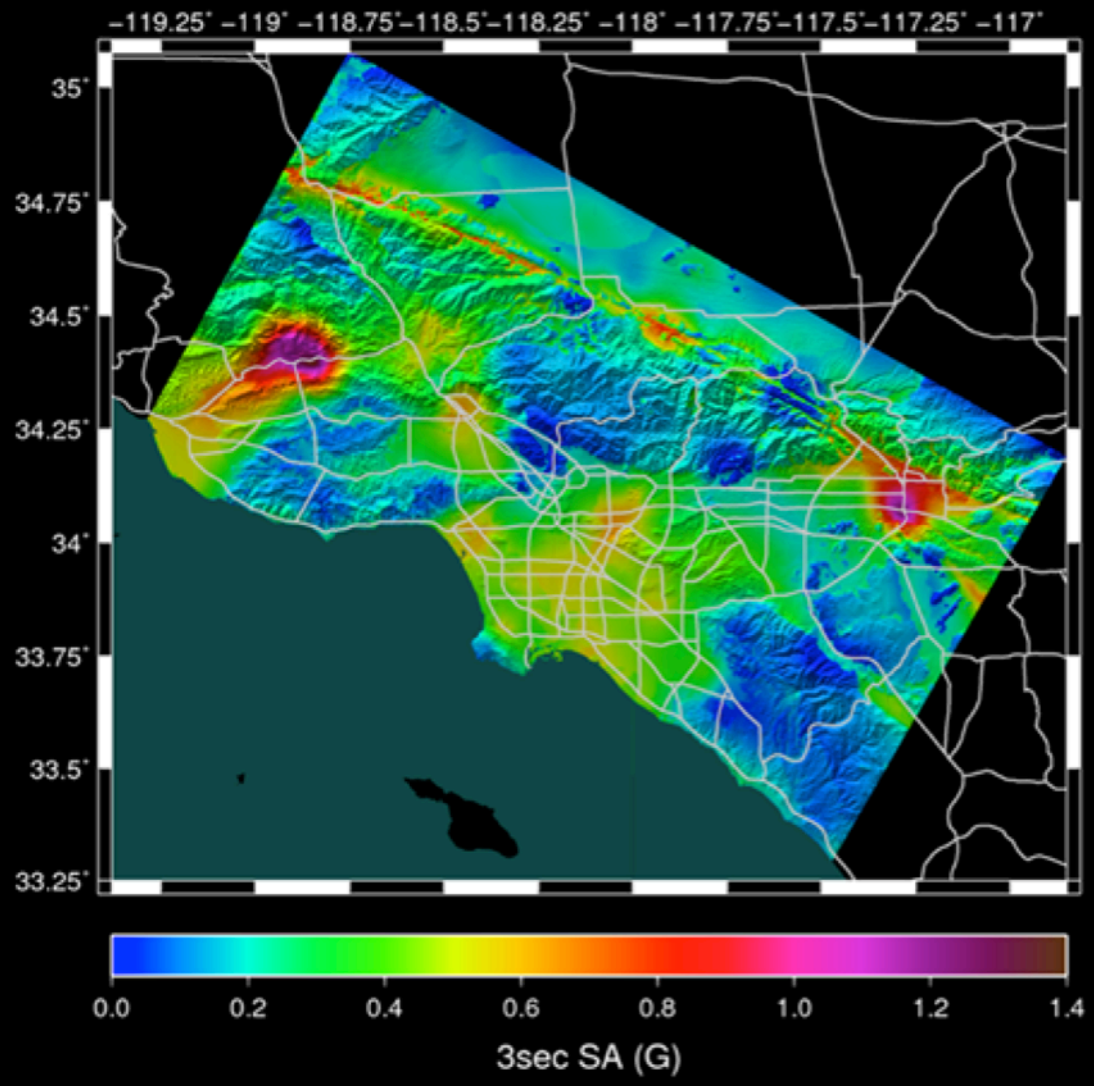
L.A. Pilot Study End Poducts

Contour Maps of $S_a(T)$

for

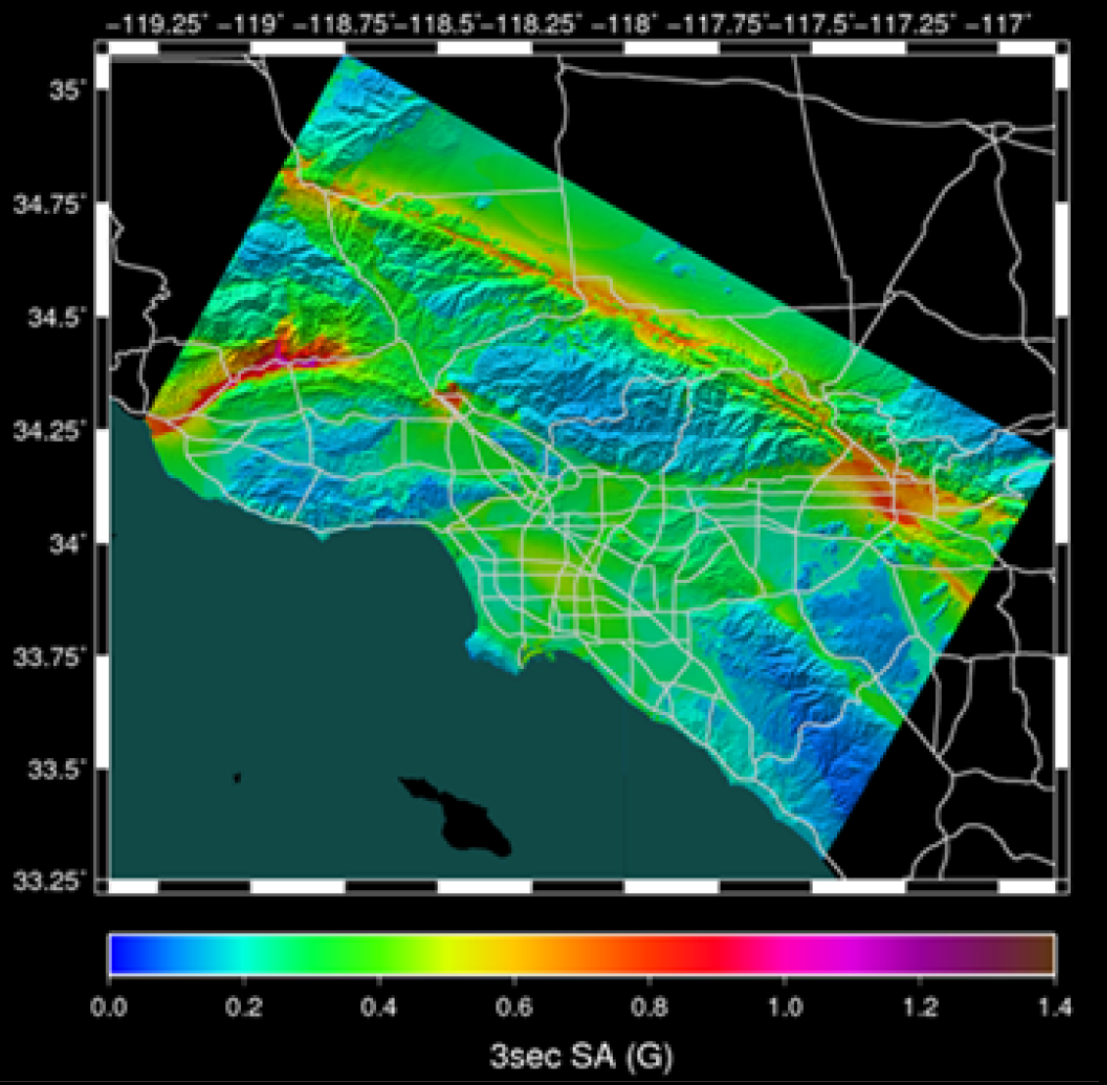
Selected T in ~3 ≤ T ≤ 10 sec range

Los Angeles Region Hazard Map, 2% in 50-yr SA (3 sec)
Graves et al. (2010) Simulations



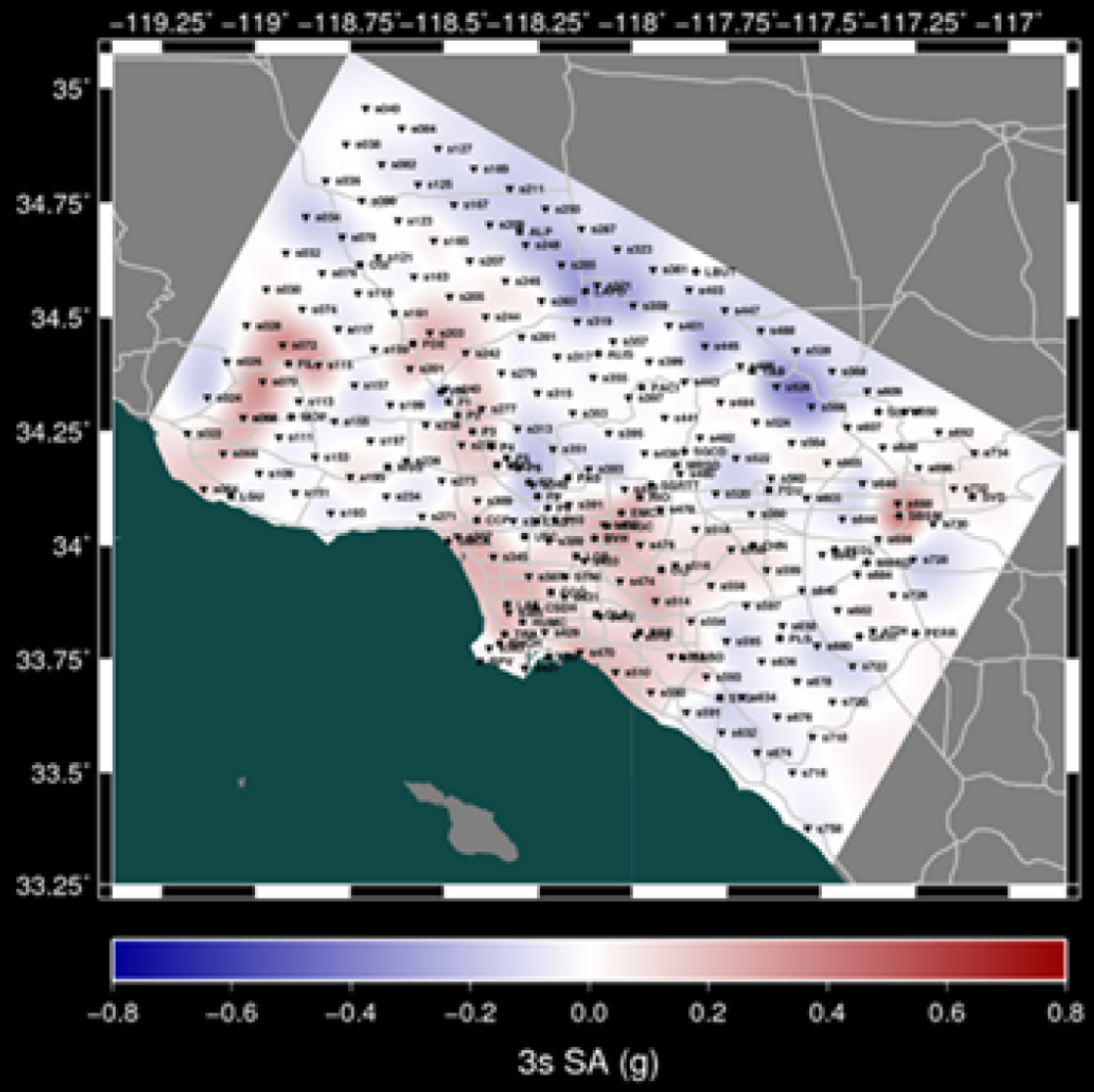
Graves et al. (2010) – Fig. 9

Los Angeles Region Hazard Map, 2% in 50-yr SA (3 sec)
Campbell & Bozorgnia (2008) NGA eqn.



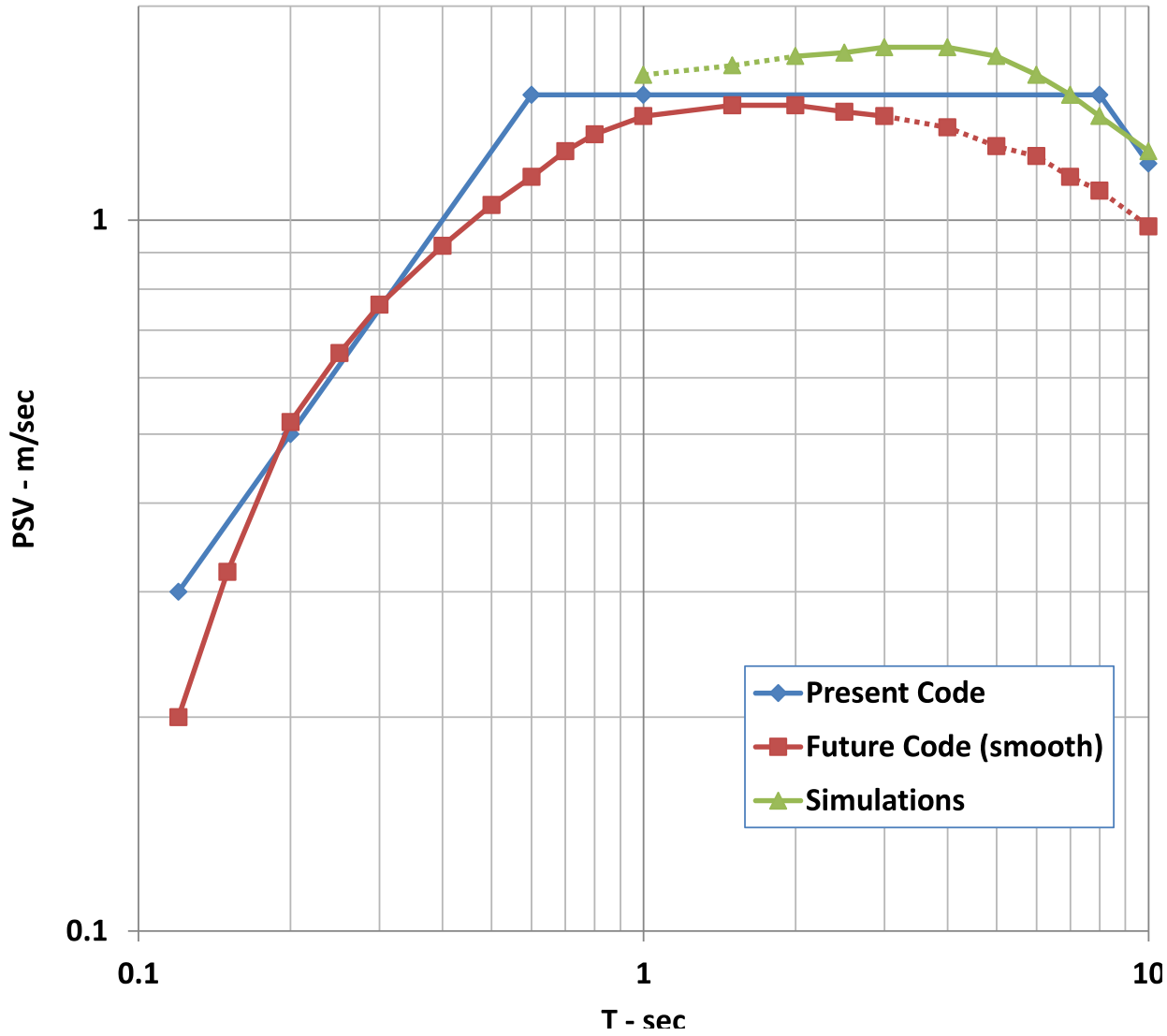
Graves et al. (2010) – Fig. 9

Contoured Residuals



Graves et al. (2010) – Fig. 9

MCE Response Spectra, Site X, L.A. Pilot Study



Probabilistic Seismic Hazard Maps for Seattle: 3D Sedimentary Basin Effects, Nonlinear Site Response, and Uncertainties from Random Velocity Variations

Arthur Frankel, William Stephenson, David Carver, Jack Odum, Robert Williams, and Susan Rhea

U.S. Geological Survey

Presentation for 4th IASPEI/ IAEE International Symposium on the Effects of Surface Geology on Seismic Motion

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