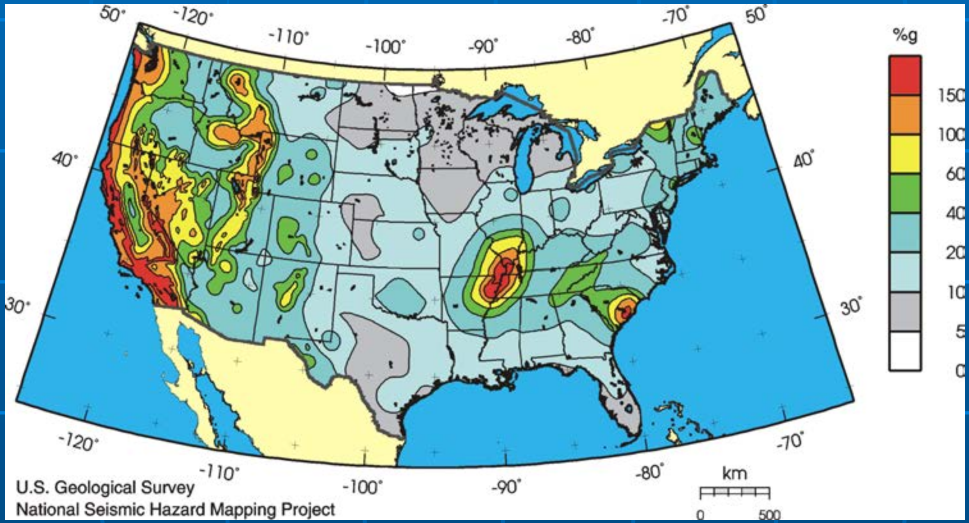
Overview of Input from Regional USGS Workshops



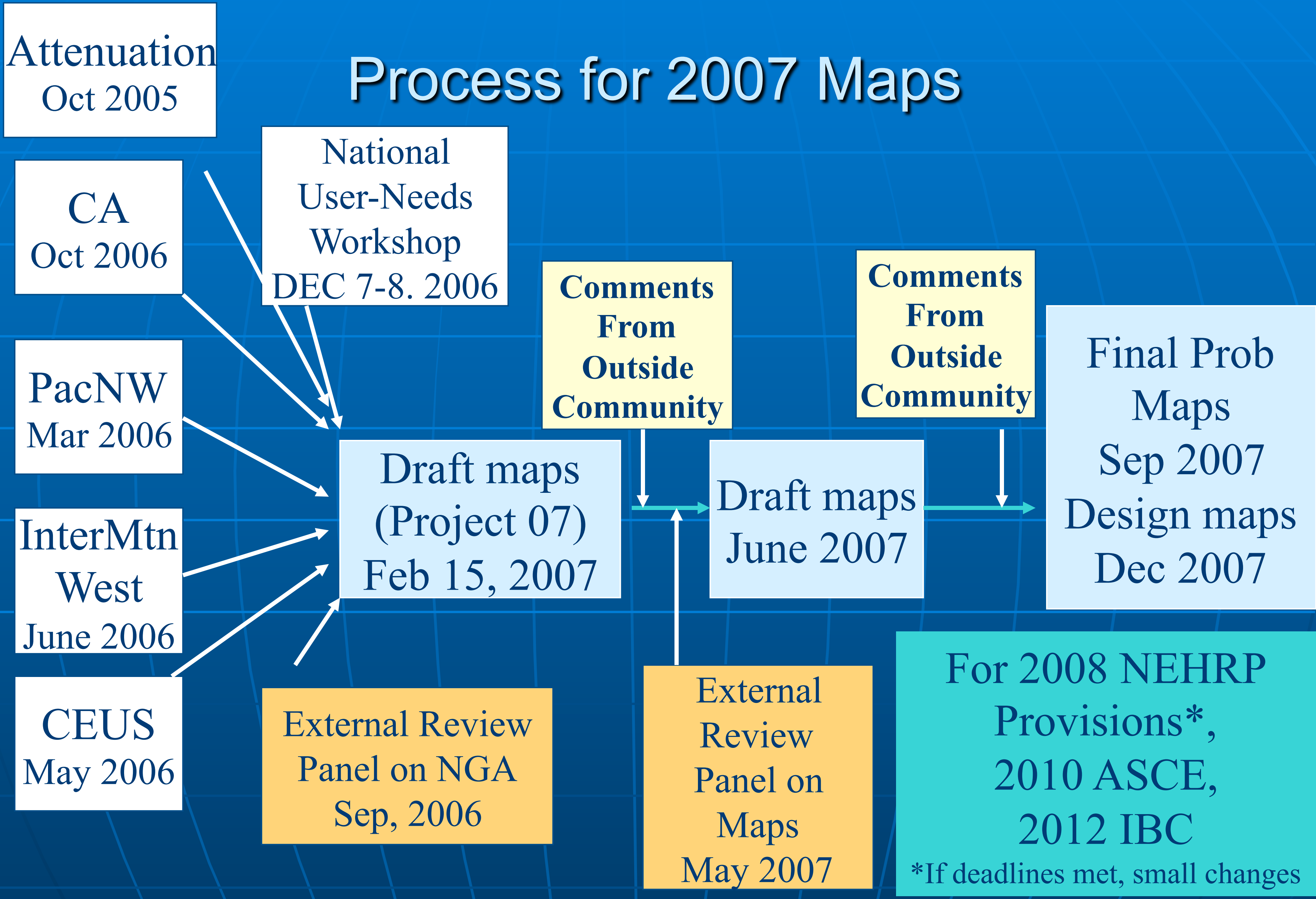
National Seismic Hazard Mapping Project

December 7-8, 2006

San Mateo, CA

http://earthquake.usgs.gov/hazmaps/

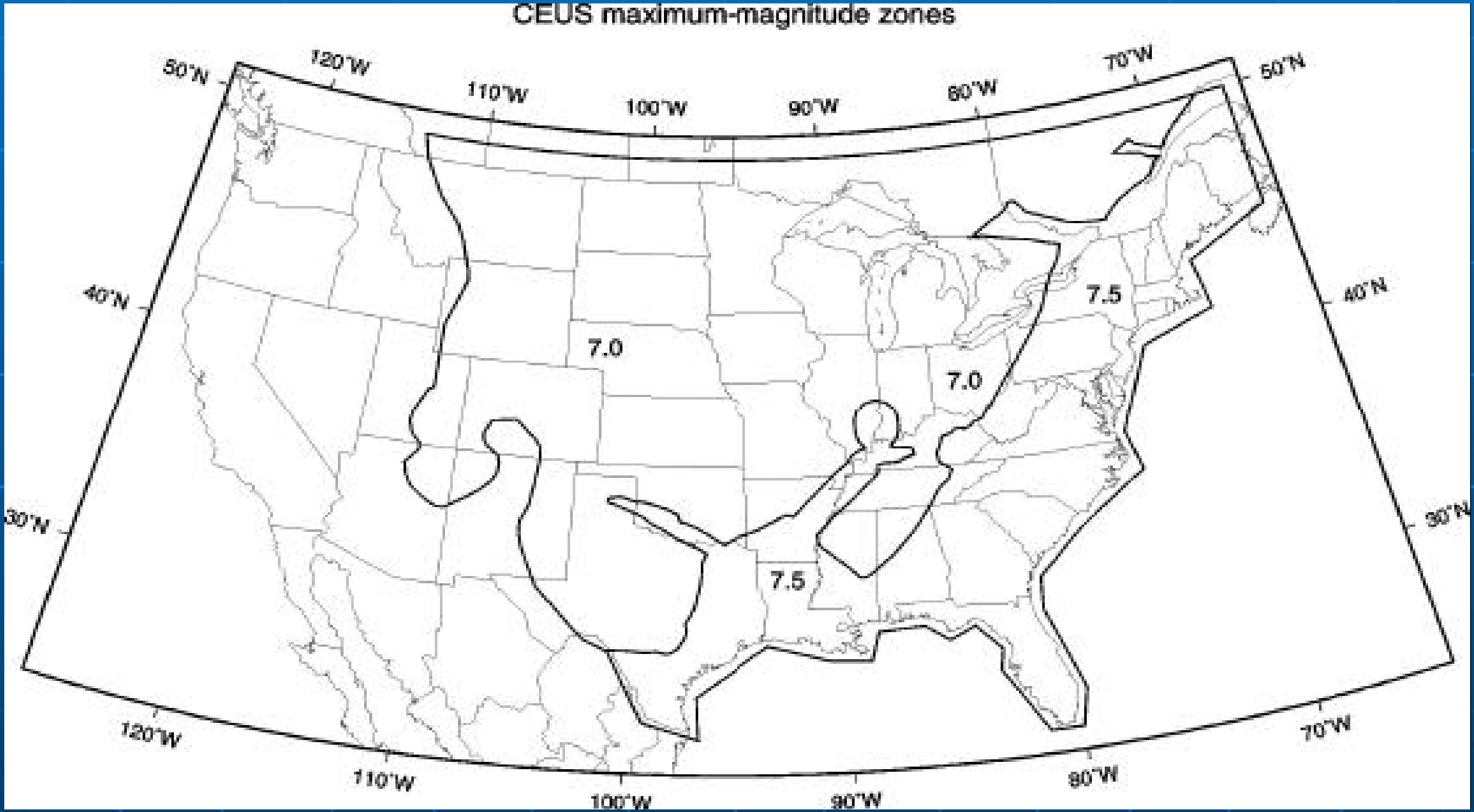
Process for 2007 Maps

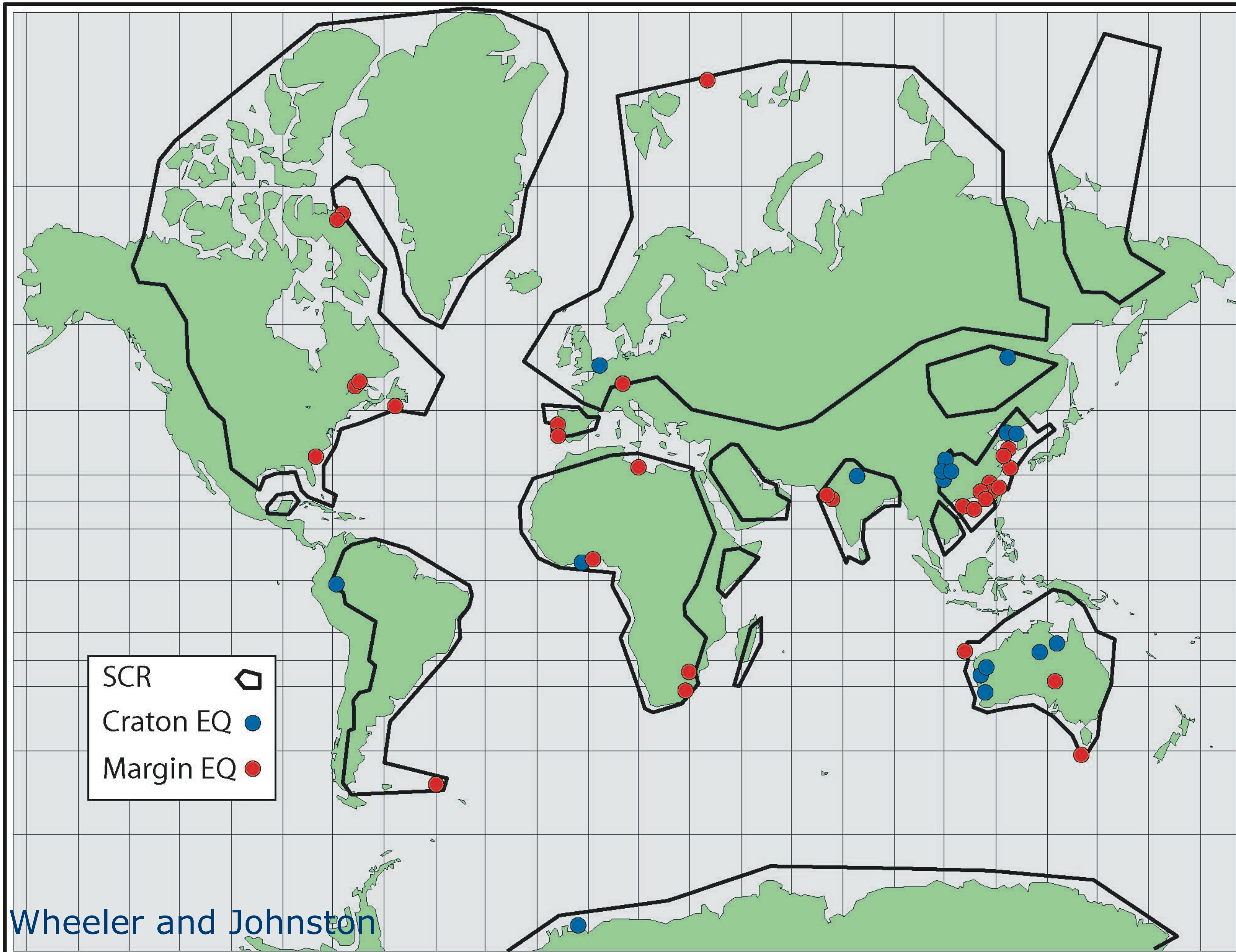


CEUS Issues

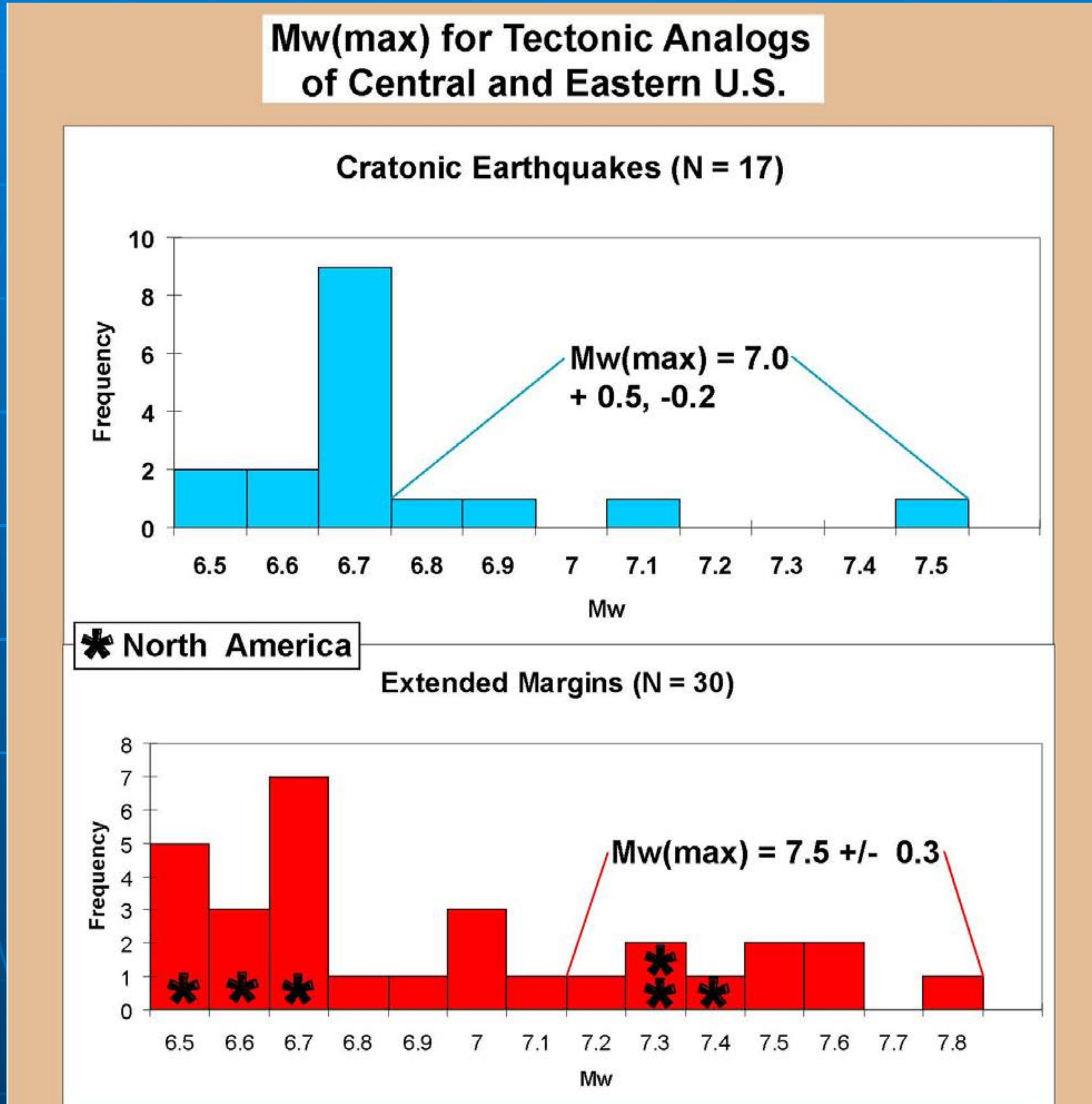
- Develop logic tree for maximum magnitude in craton and extended margin
- Develop logic tree for northern arm of Madrid
- Develop New Madrid clustering models
- Evaluate new attenuation relations
- Update catalog (consider magnitude uncertainty)

BACKGROUND SOURCE ZONES



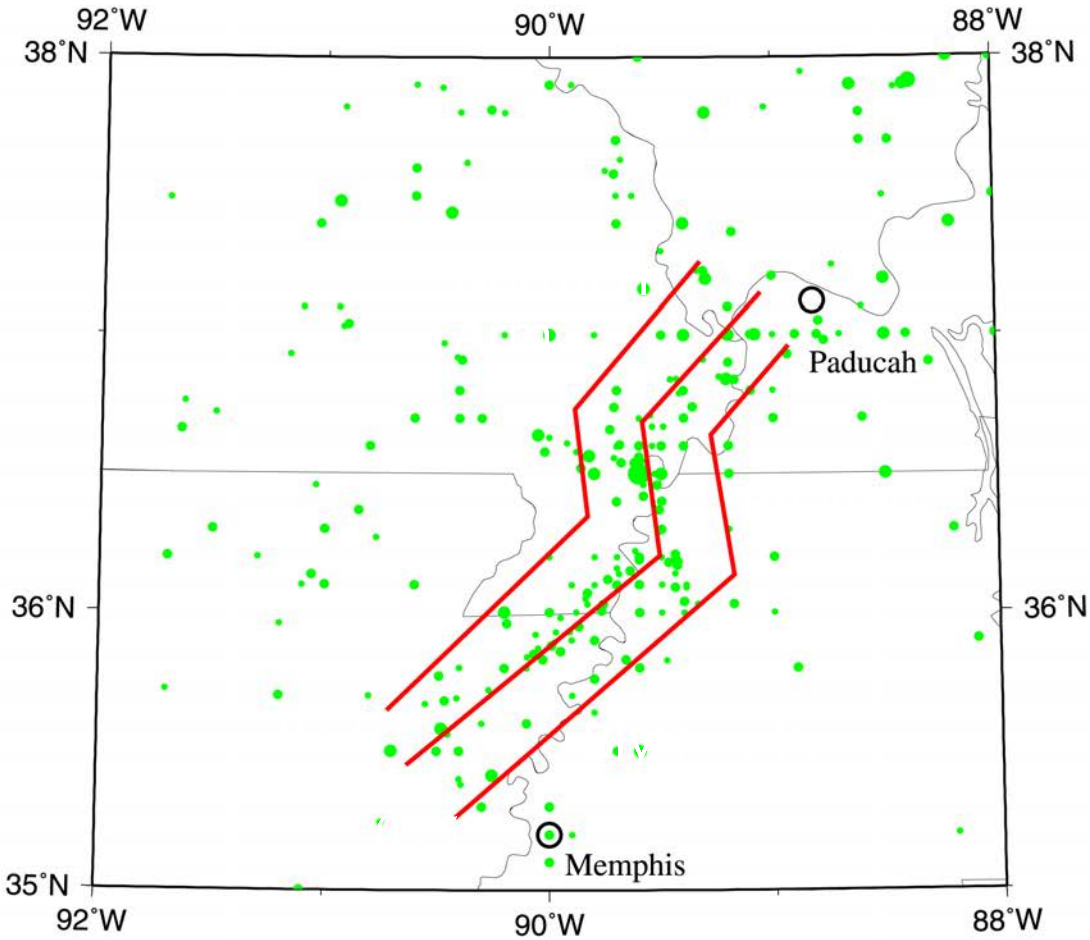


Wheeler and Johnston



Wheeler and Johnston

Eastern U.S. faults – Example New Madrid



M7.3-8.0, 500 yr

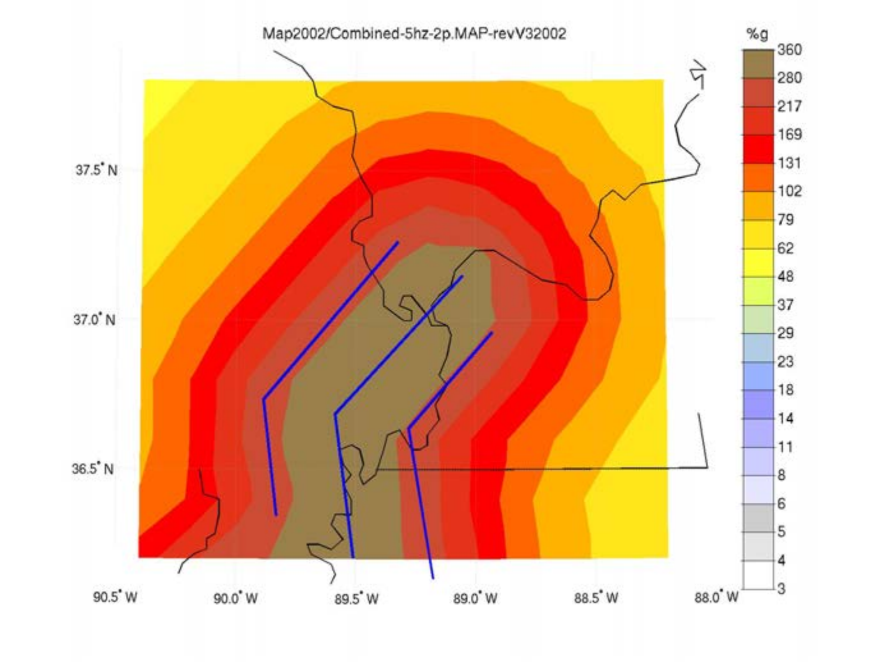
Mag (wt)

M7.3 (0.15)
M 7.5 (0.2)
M 7.7 (0.5)
M 8.0 (0.15)

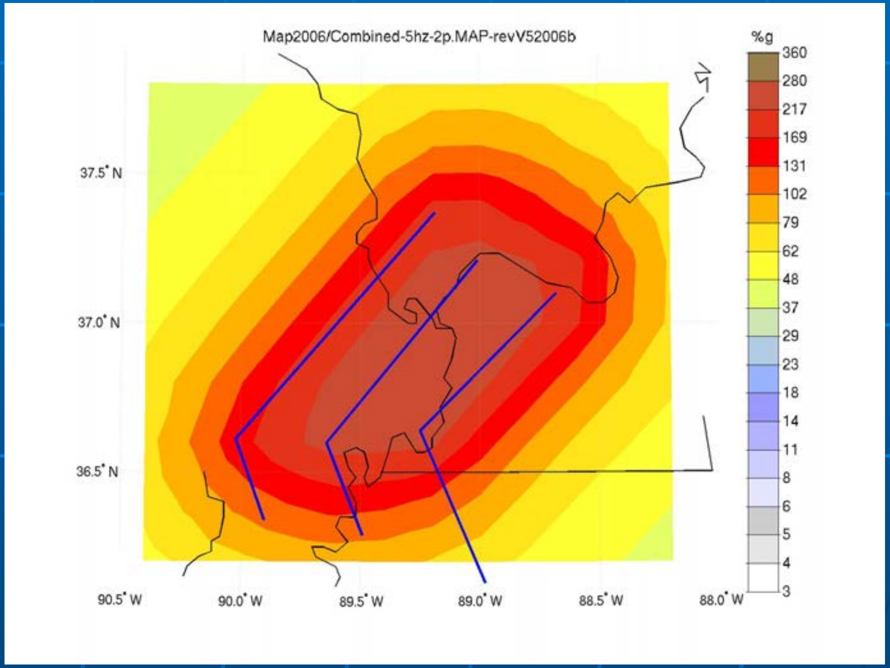
LOGIC TREE: Northern Arm New Madrid

Changes to magnitude distribution, recurrence and fault geometry

2002 5hz



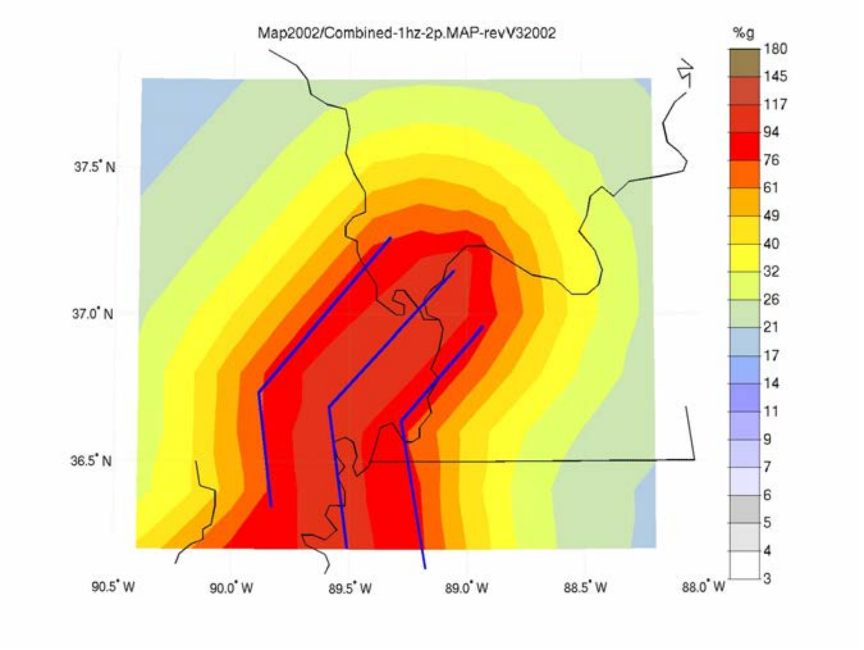
2007 5hz



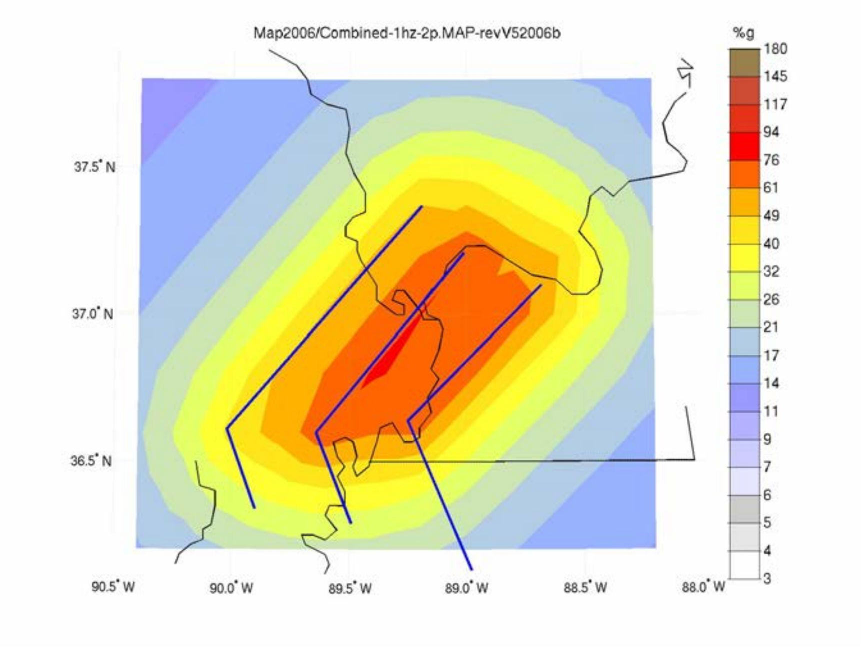
Clustering causes more ground motion variability
will increase ground motions near intersection of faults.

LOGIC TREE: Northern Arm New Madrid

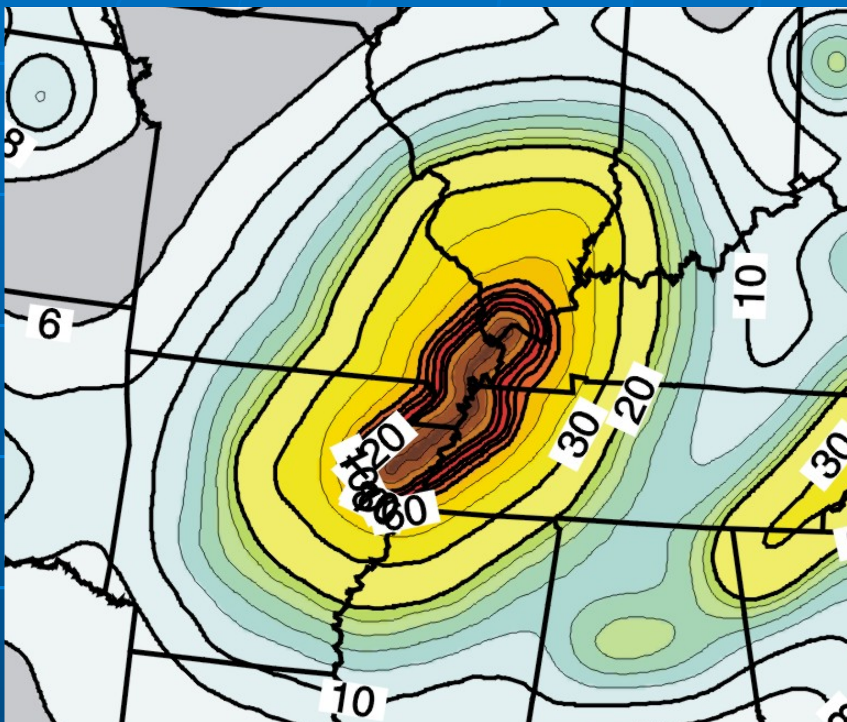
2002 1hz



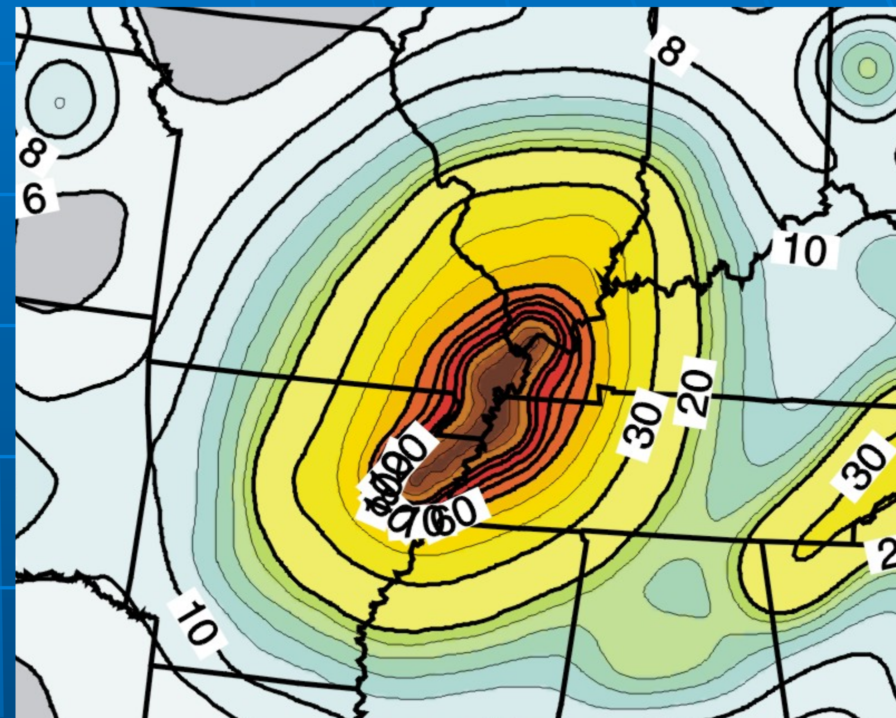
2007 1hz



1 source

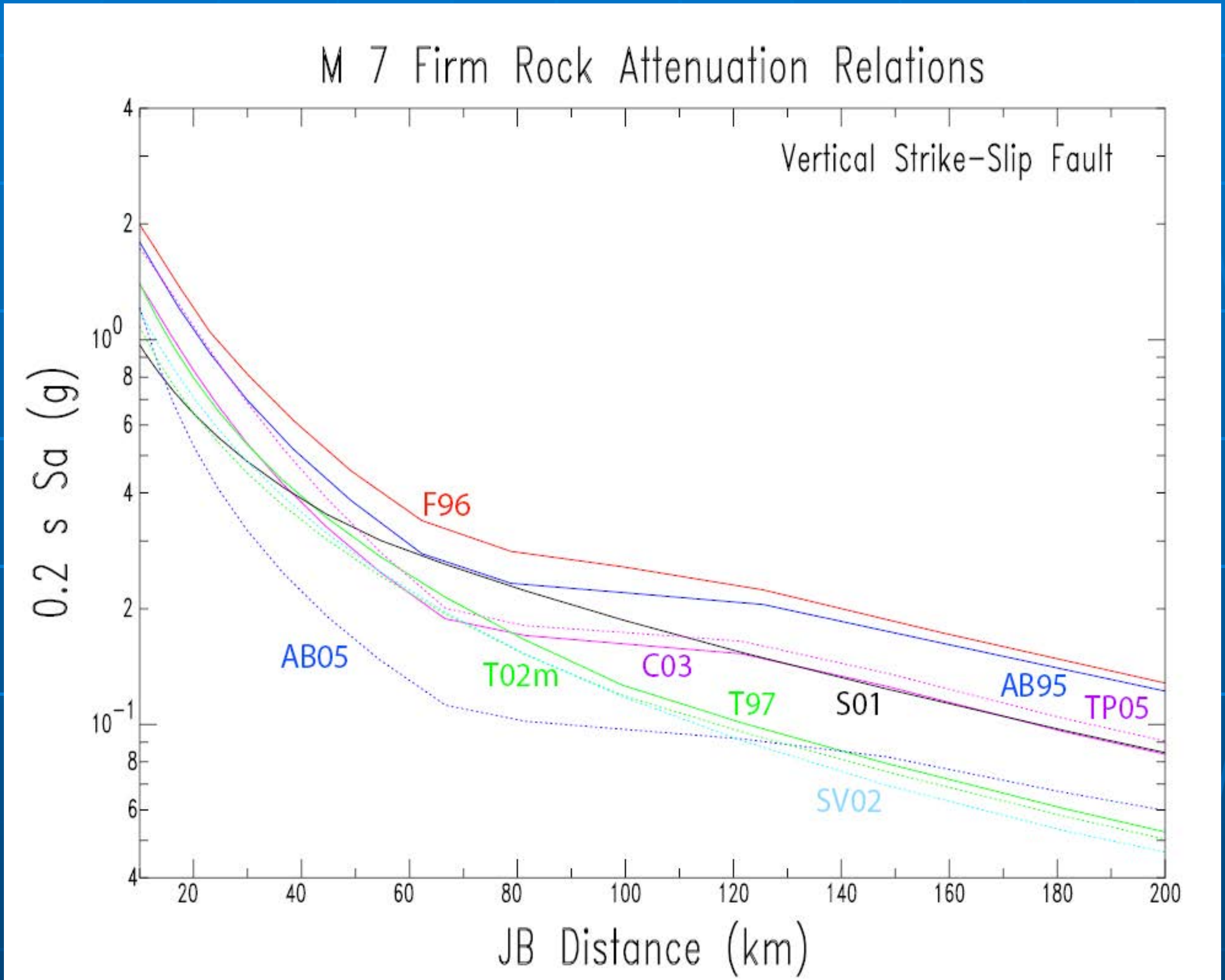


temporal cluster



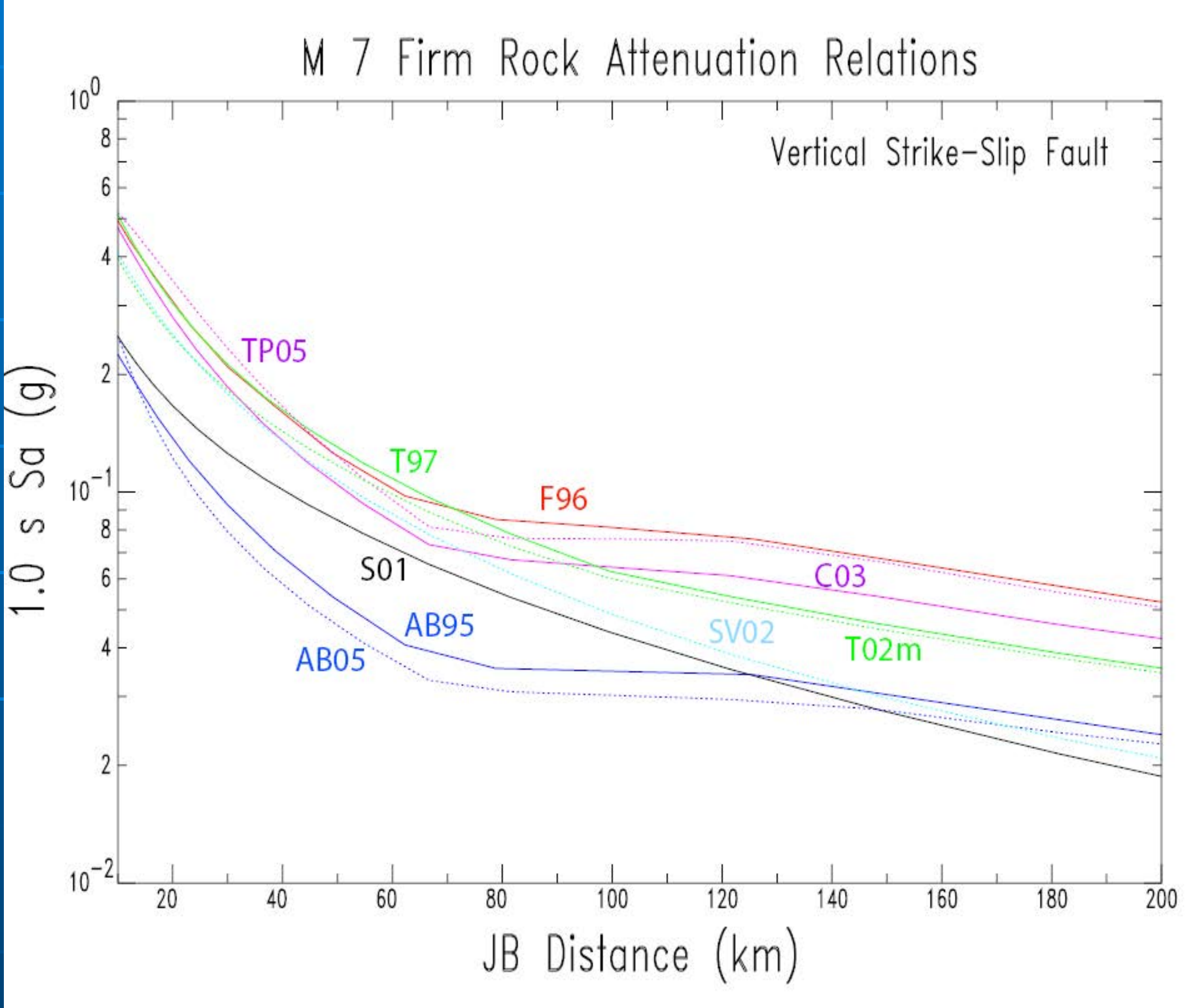
PGA (%g) with 2% PE in 50 years

Frankel



M 7 Firm Rock Attenuation Relations
Vertical Strike-Slip Fault
0.2 s Sa (g)
JB Distance (km)
F96
AB05
T02m
C03
T97
S01
AB95
TP05
SV02

Cramer


M 7 Firm Rock Attenuation Relations
Vertical Strike-Slip Fault
1.0 s Sa (g)
JB Distance (km)
TP05
T97
F96
S01
C03
AB95
AB05
SV02
T02m
10^{0}
10^{-1}
10^{-2}
8
6
4
2
20
40
60
80
100
120
140
160
180
200

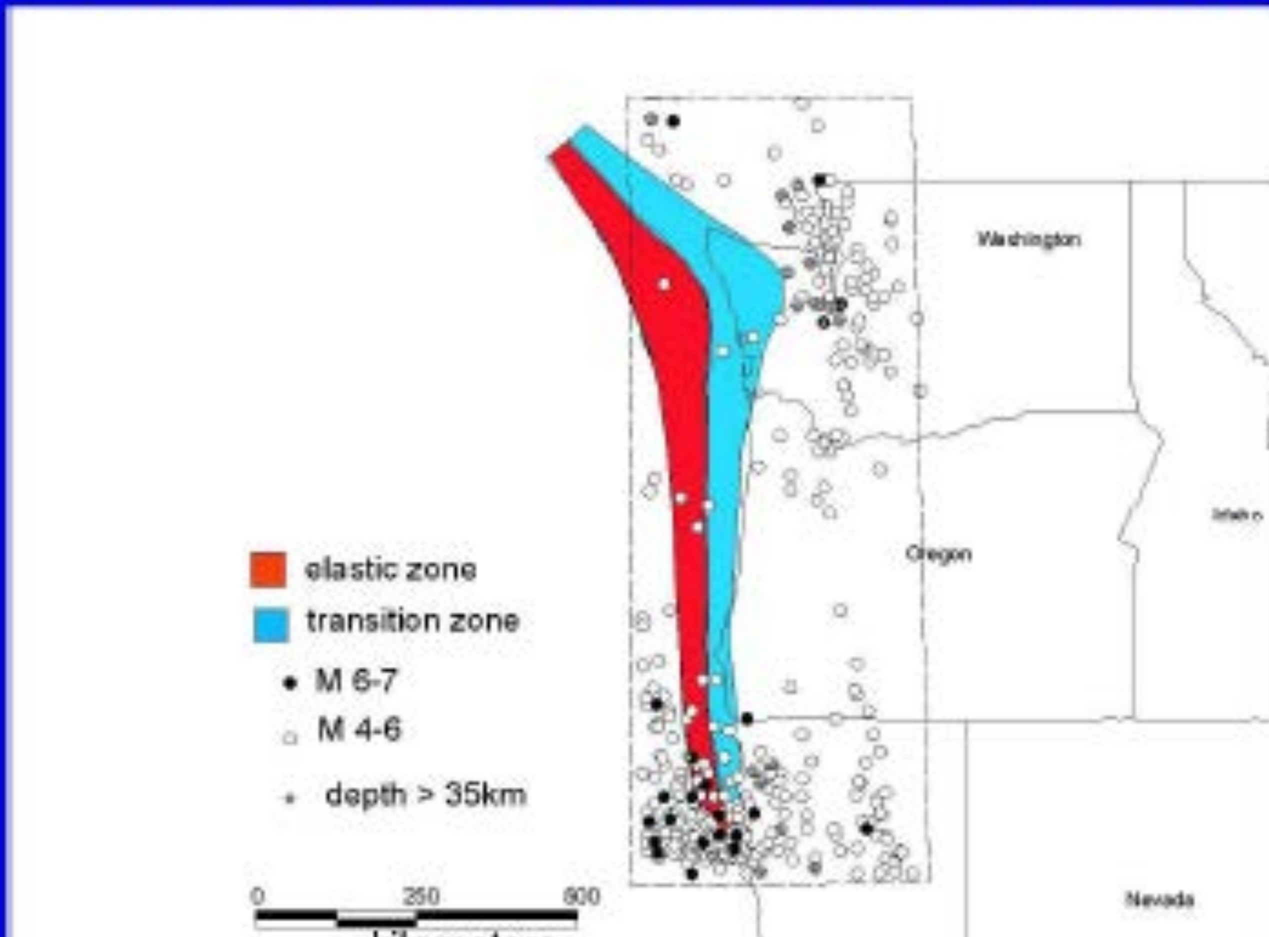
Types of models used in development of ENA ground motion relations

- Stochastic point source - single corner (Frankel et al., 1996)
- Dynamic corner frequency (Atkinson and Boore, 2005)
- Single corner - finite fault (Toro et al., both empirical and simulated equations)
- Magnitude saturation – single corner (Silva et al.)
- Simulation based (Somerville et al.)
- Hybrid (Campbell –updated 2006; Tavakoli and Pezeshk)

PACNW Issues

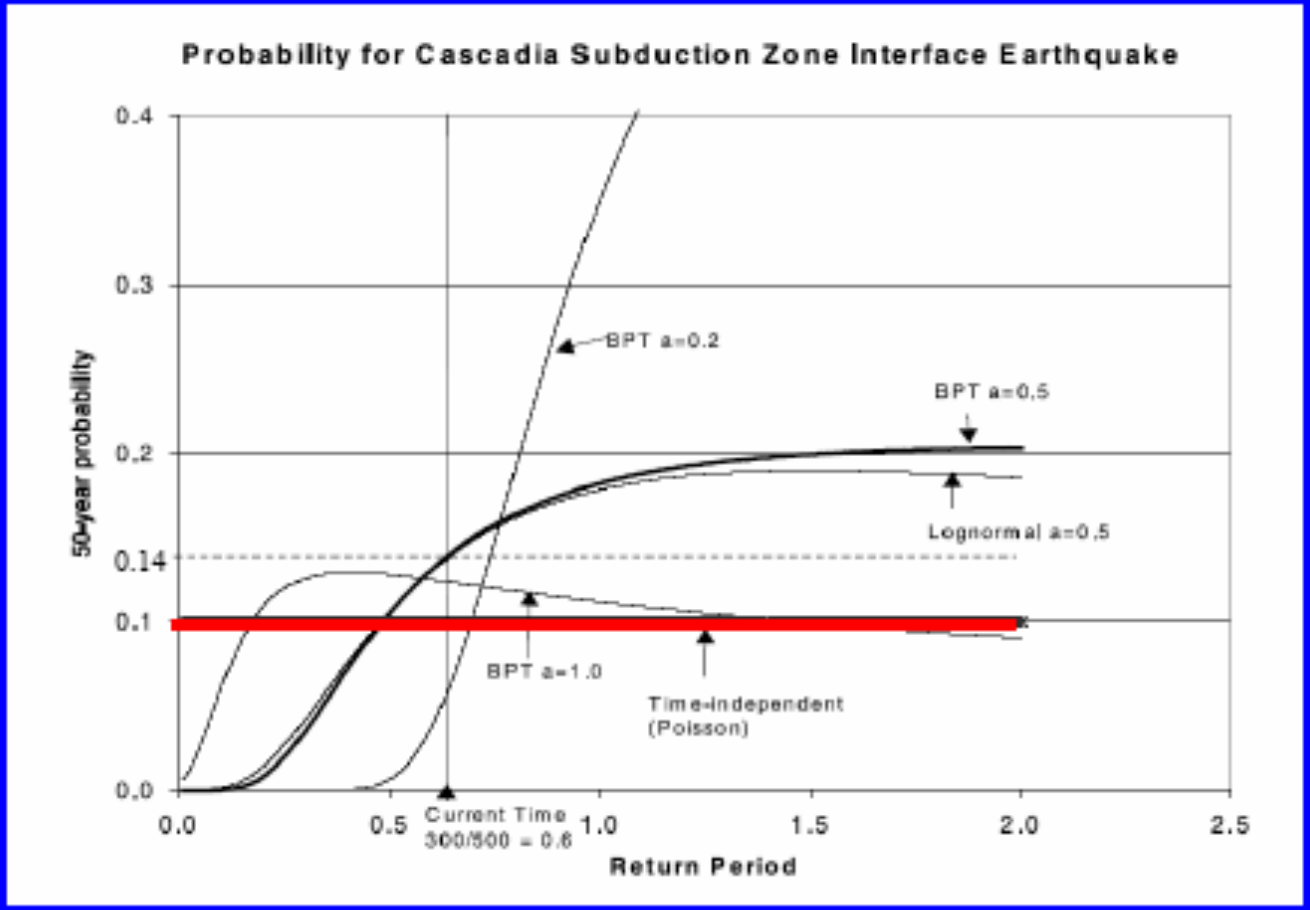
- Update fault slip rates and uncertainties with working group
- Cascadia Magnitude-frequency distribution M8-9, time dependent M9
- Evaluate attenuation relations – Atkinson and Boore, Gregor et al.
- Evaluate deep seismicity zone near Portland, OR
- Update catalog (include magnitude uncertainty)

Possible configurations for rupture zone of great Cascadia Earthquakes

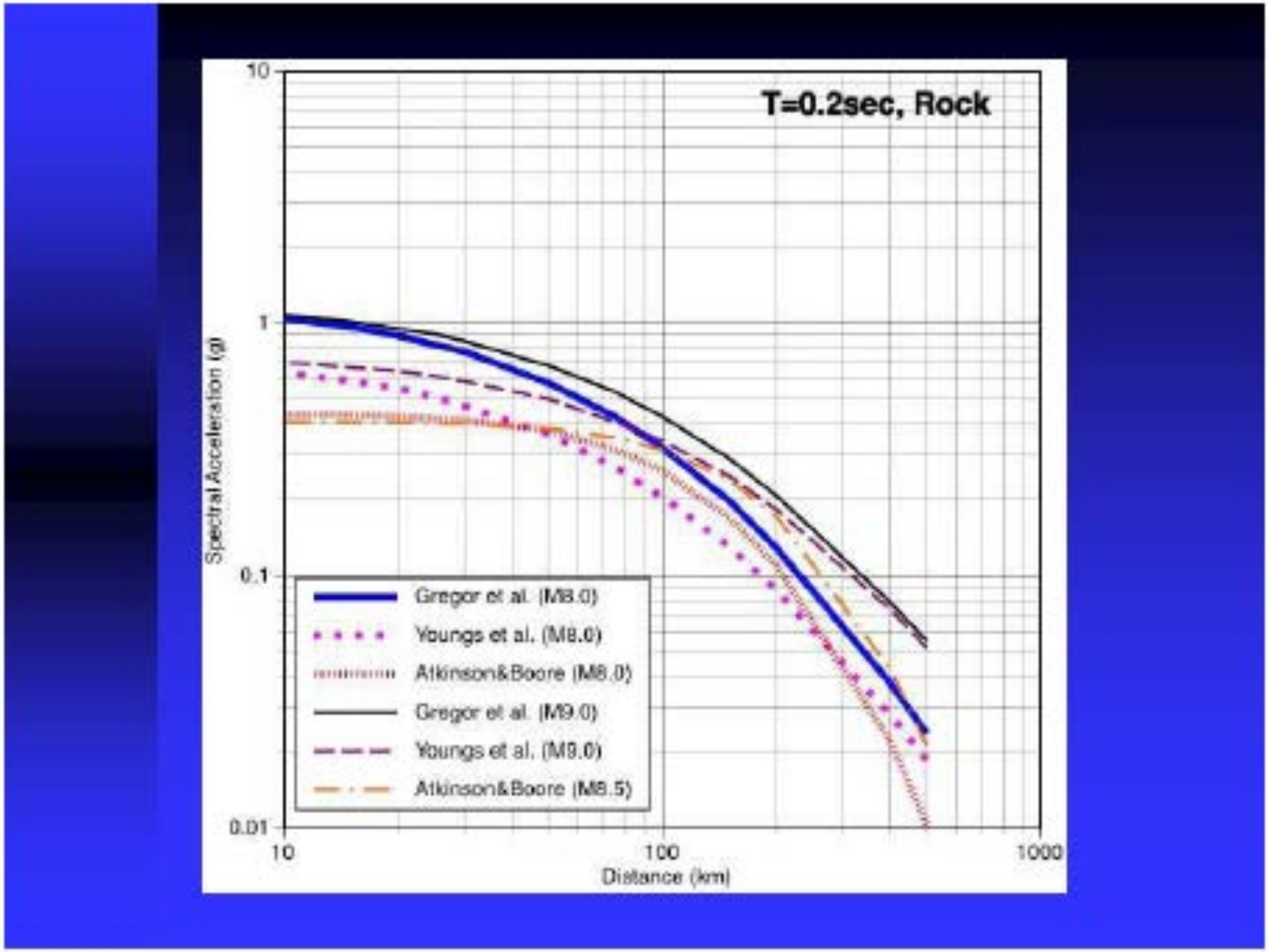


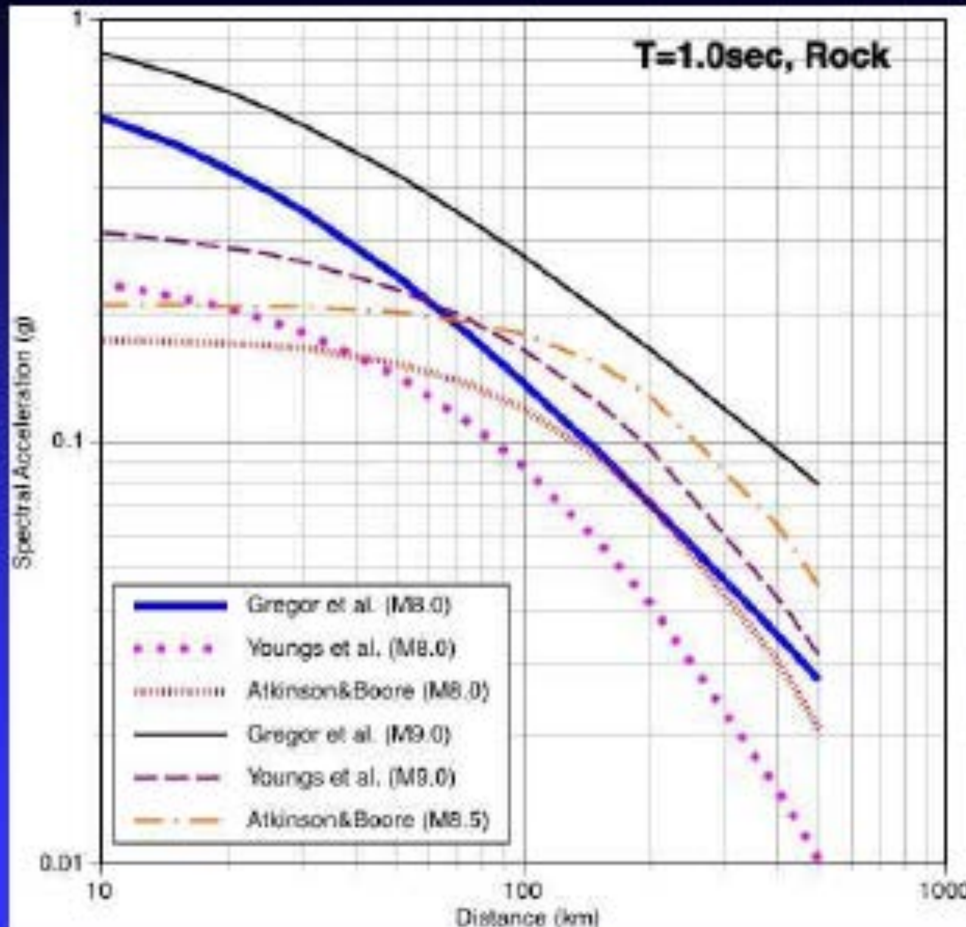
From Flueck et al. (1997)

Downdip width, deep eqs, recurrence, magnitudes



from Petersen et al. (2002)


T=0.2sec, Rock
Spectral Acceleration (g)
Distance (km)
10
1
0.1
0.01
10
100
1000
Gregor et al. (M8.0)
Youngs et al. (M8.0)
Atkinson&Boore (M8.0)
Gregor et al. (M9.0)
Youngs et al. (M9.0)
Atkinson&Boore (M8.5)

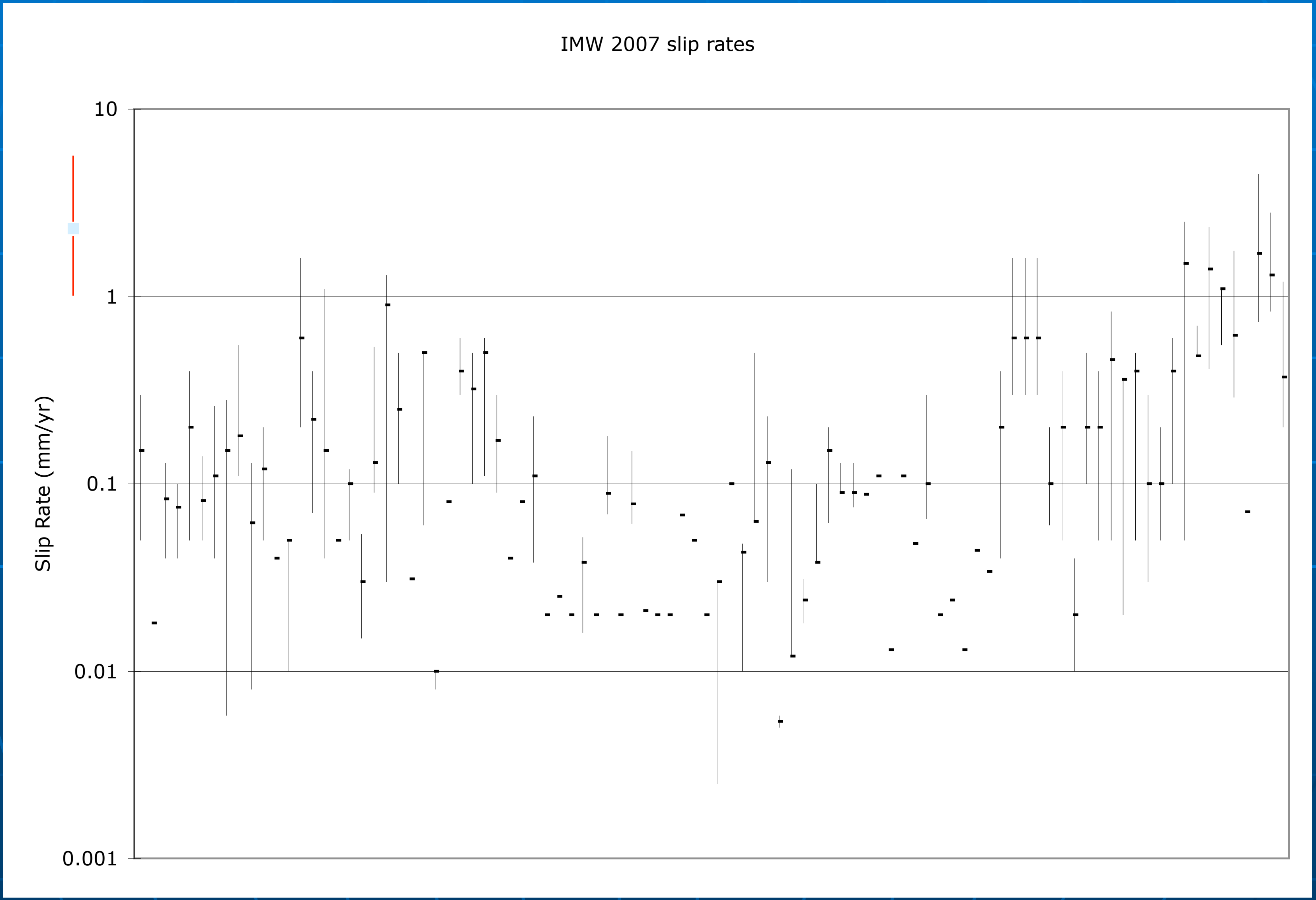


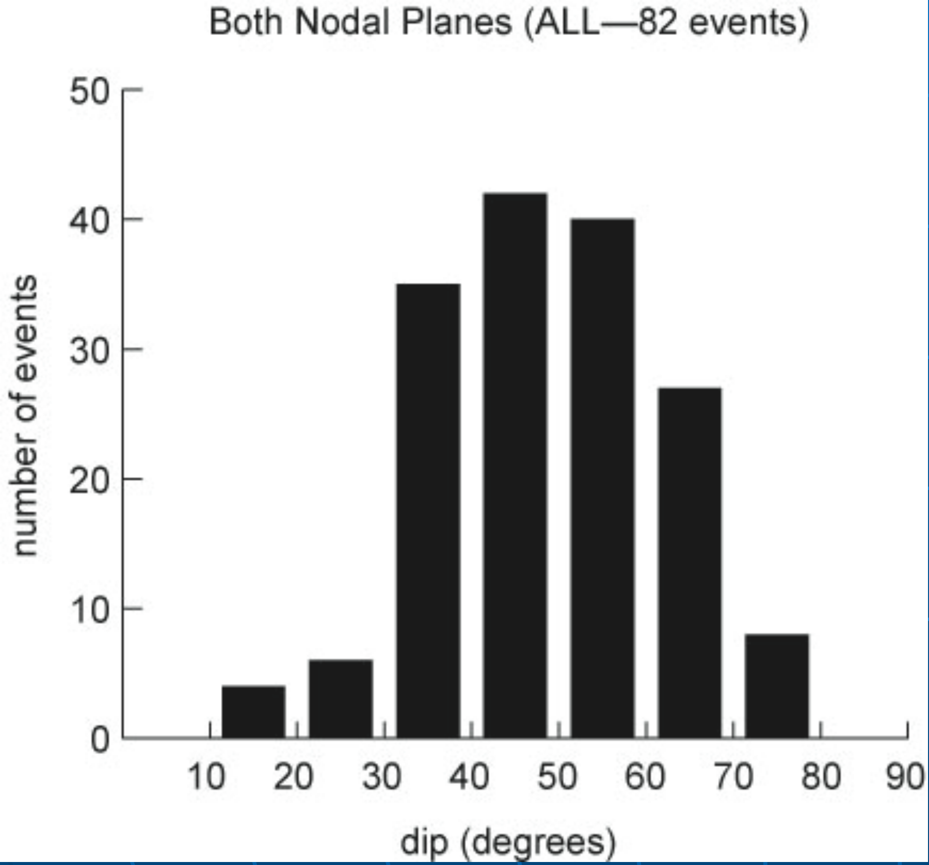
T=1.0sec, Rock
Spectral Acceleration (g)
1
0.1
0.01
10
100
1000
Distance (km)
Gregor et al. (M8.0)
Youngs et al. (M8.0)
Atkinson&Boore (M8.0)
Gregor et al. (M9.0)
Youngs et al. (M9.0)
Atkinson&Boore (M8.5)

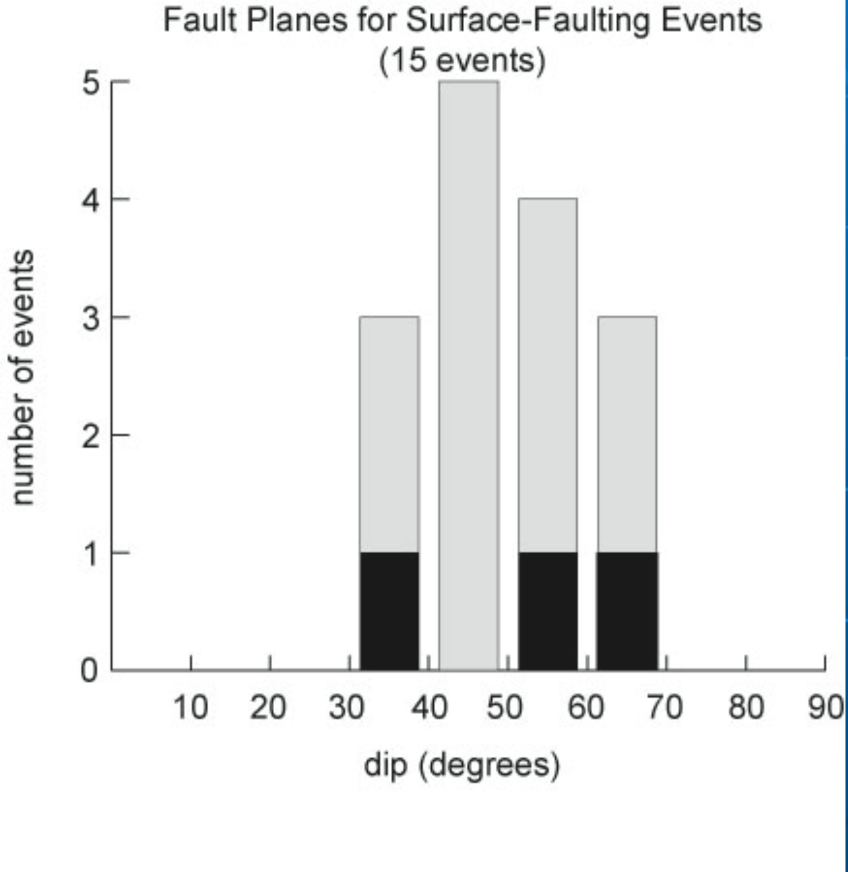
Intermountain West Issues (WSSPC workshop)

- Update fault slip rates and uncertainties – Use 3-branch logic-tree for slip rates
- Update catalog (consider magnitude uncertainty)
- Evaluate dip of 50 +/- 10 degrees
- Revise shear zones – C zones
- Develop rationale for characteristic vs exponential GR magnitude-frequency distribution
- Evaluate Somerville et al. simulated attenuation relation (unpublished)

Uncertainty in slip rates in the Intermountain West region



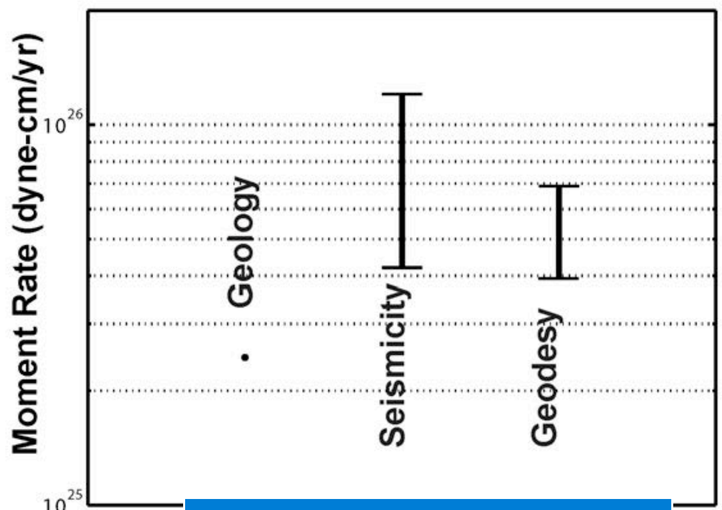




(from Jackson, 2002)

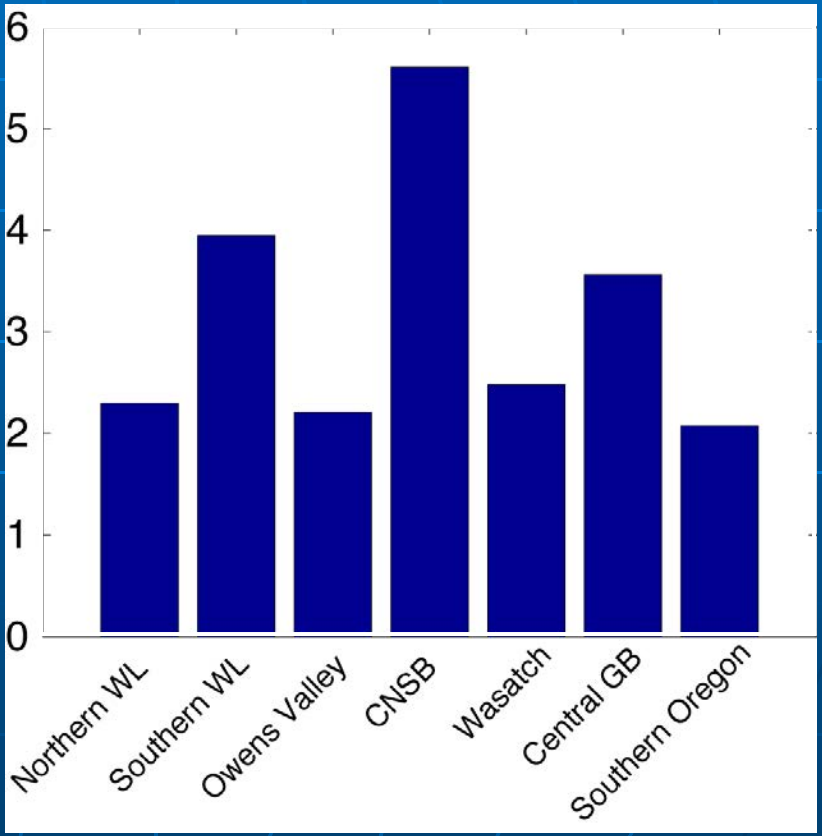
Kathy Haller

Geodesy Sees More Moment than Geology



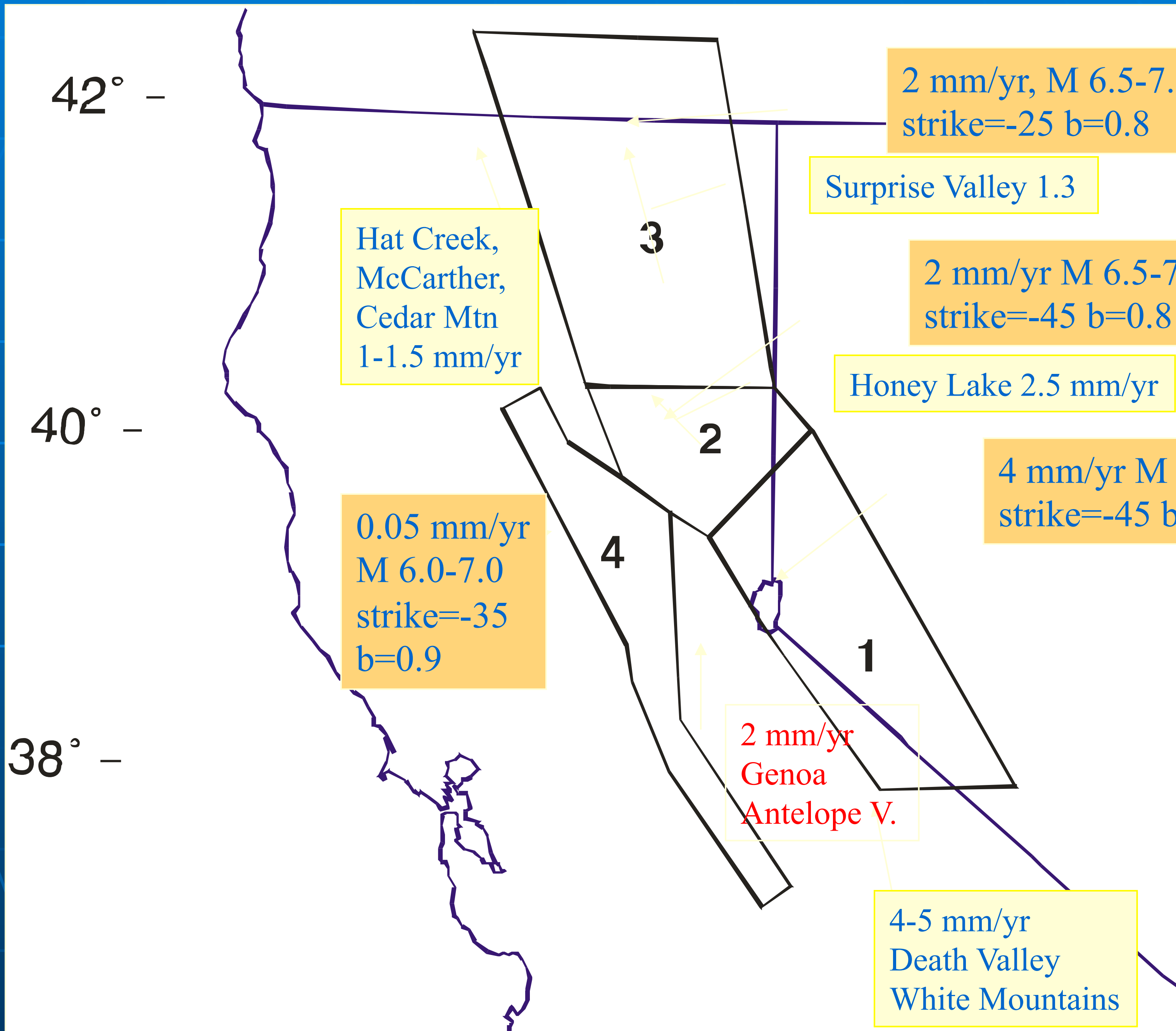
Pancha et al., 2006

Ratio of Geodetic to Geologic Moment by Sub-Region

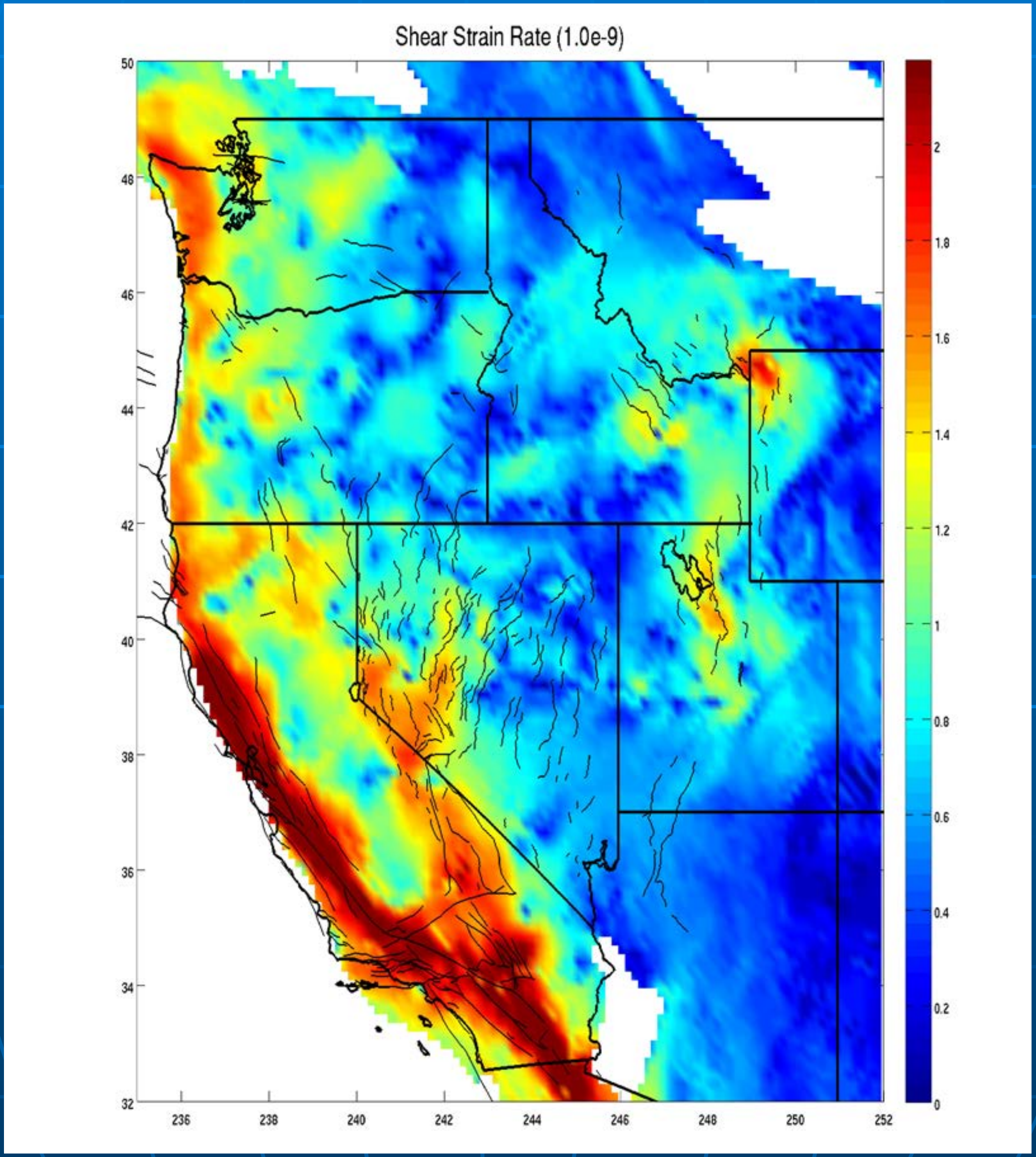


Pancha

Geodetic based shear zones



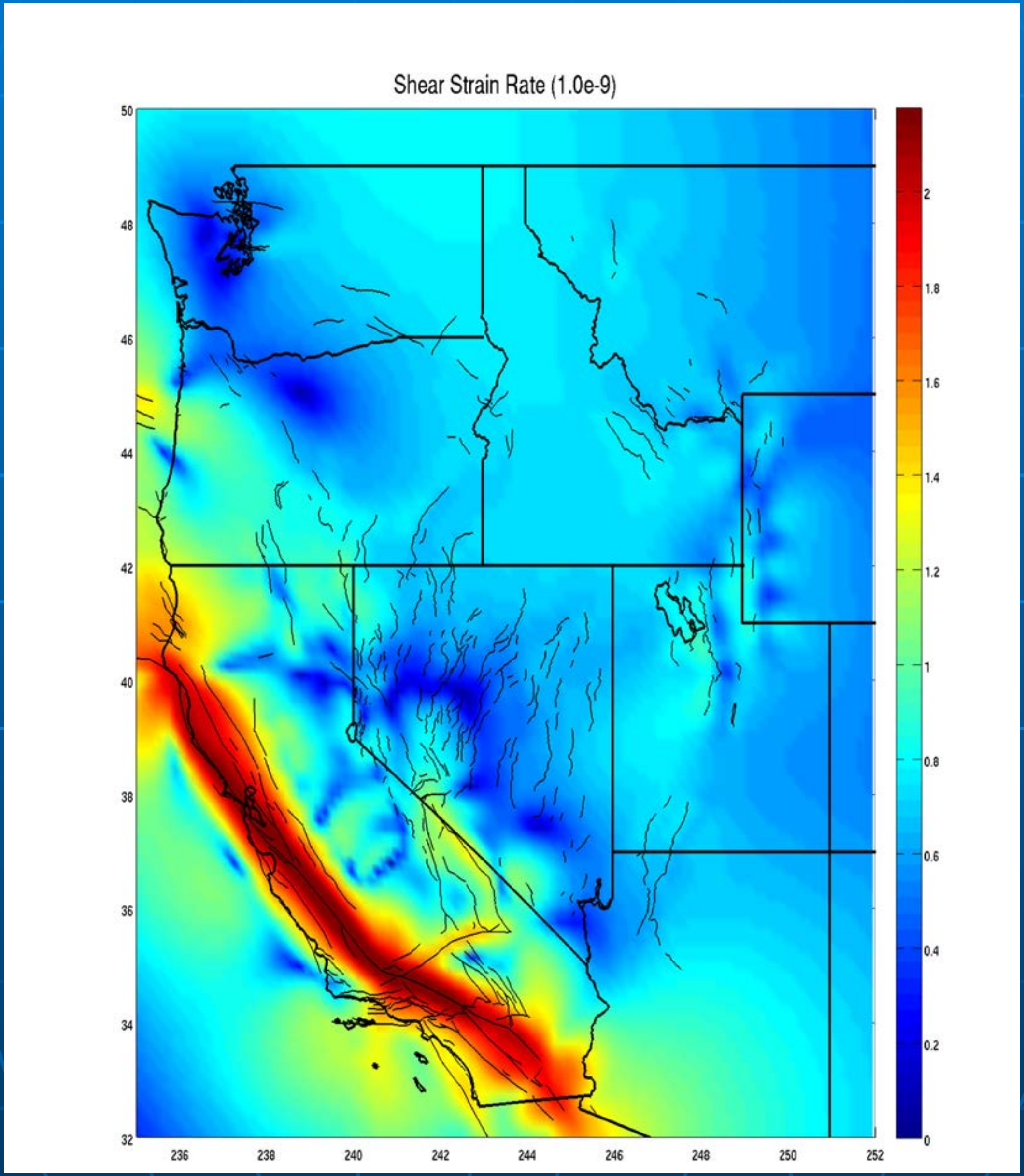
GPS



Shear Strain Rate (1.0e-9)
50
48
46
44
42
40
38
36
34
32
236
238
240
242
244
246
248
250
252
2
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0

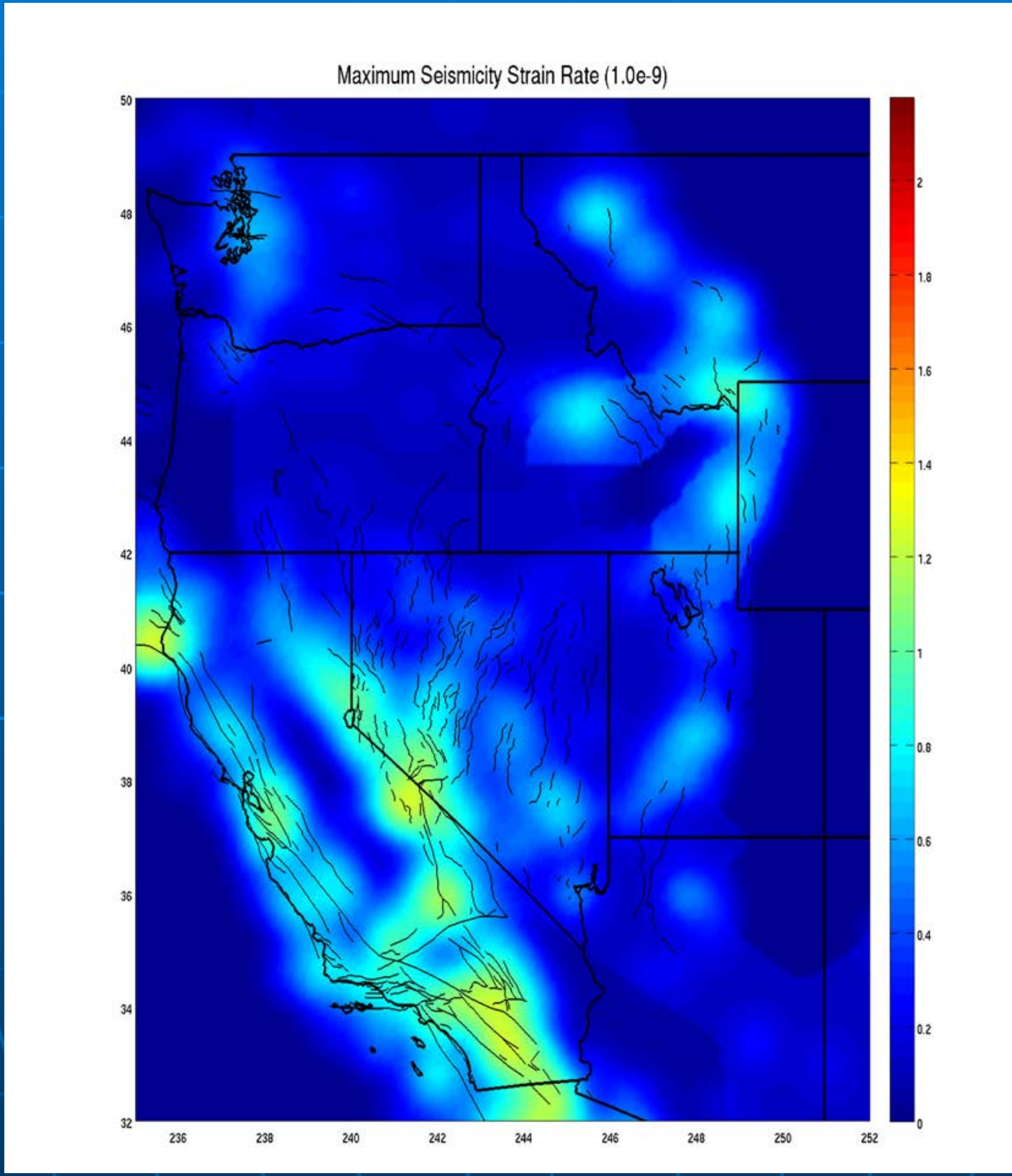
Zeng

GEOLOGY



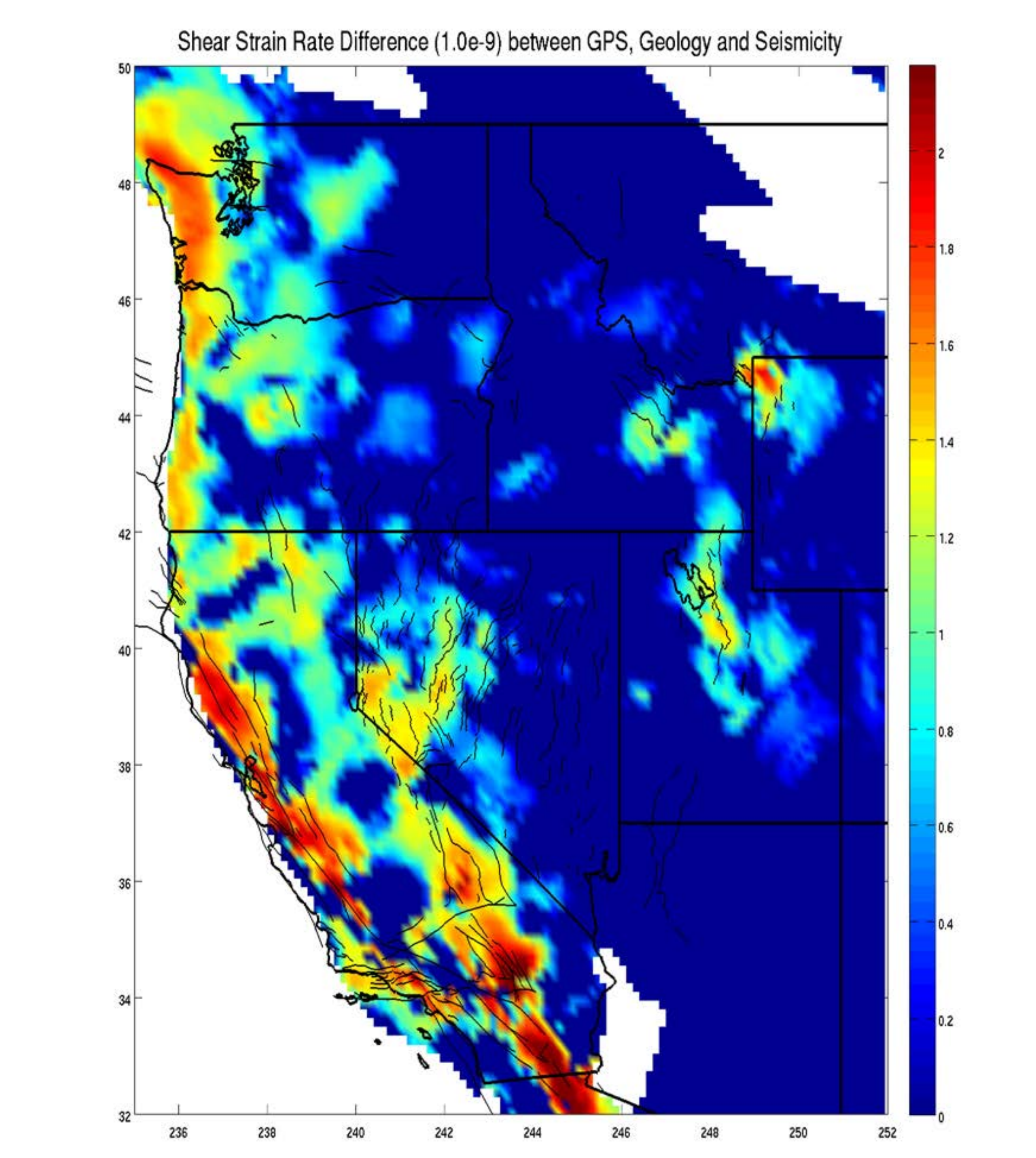
Zeng

SEISMICITY



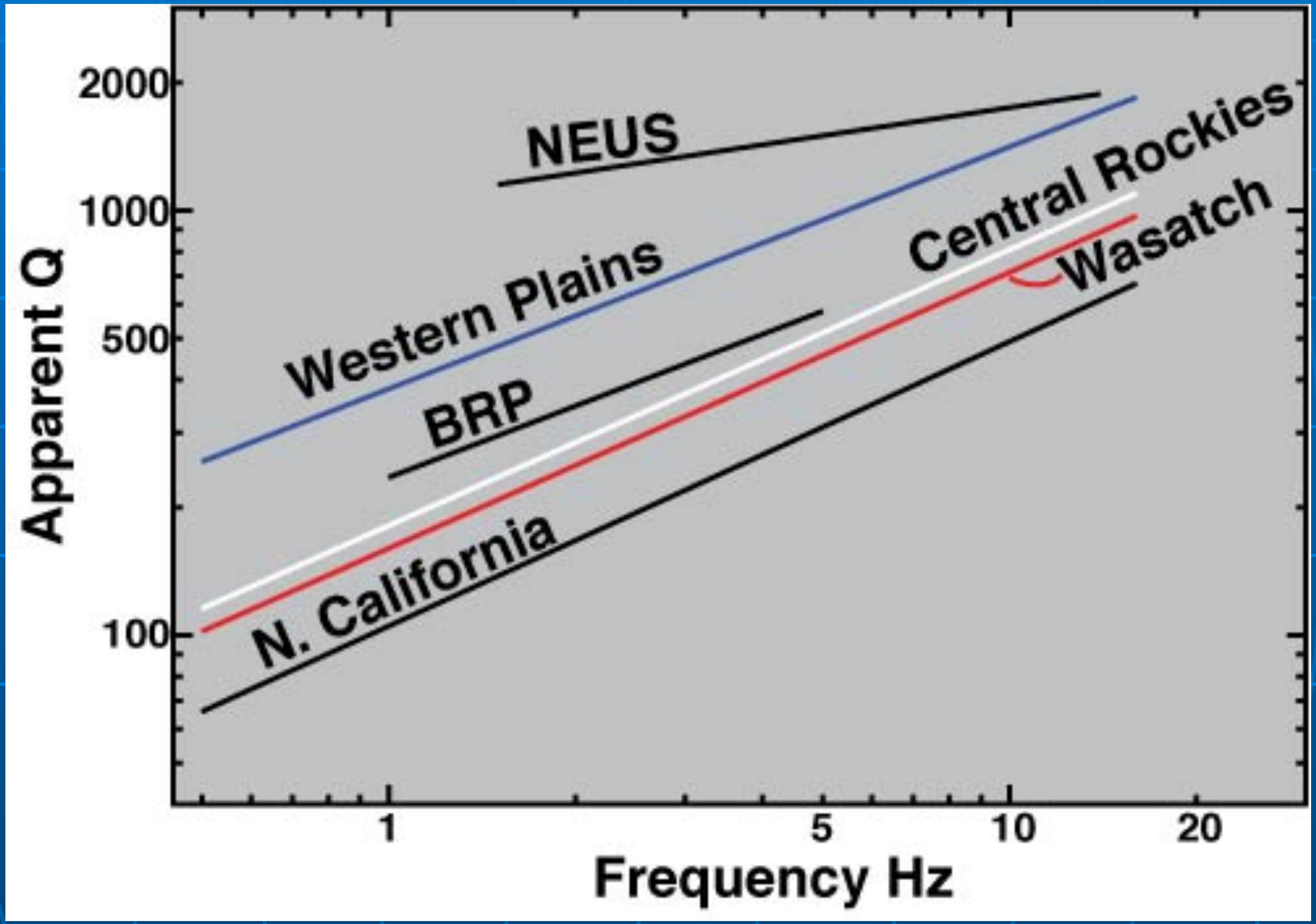
Zeng

DIFFERENCE BETWEEN GPS AND COMBINED GEOLOGY, SEISMICITY



Zeng

From McNamara et al.



northeastern United States (NEUS) [Benz et al., *1997*],
Basin and Range (BRP) [Benz et al., *1997*],
northern California (N. California) [Erickson, et al., *2004*].

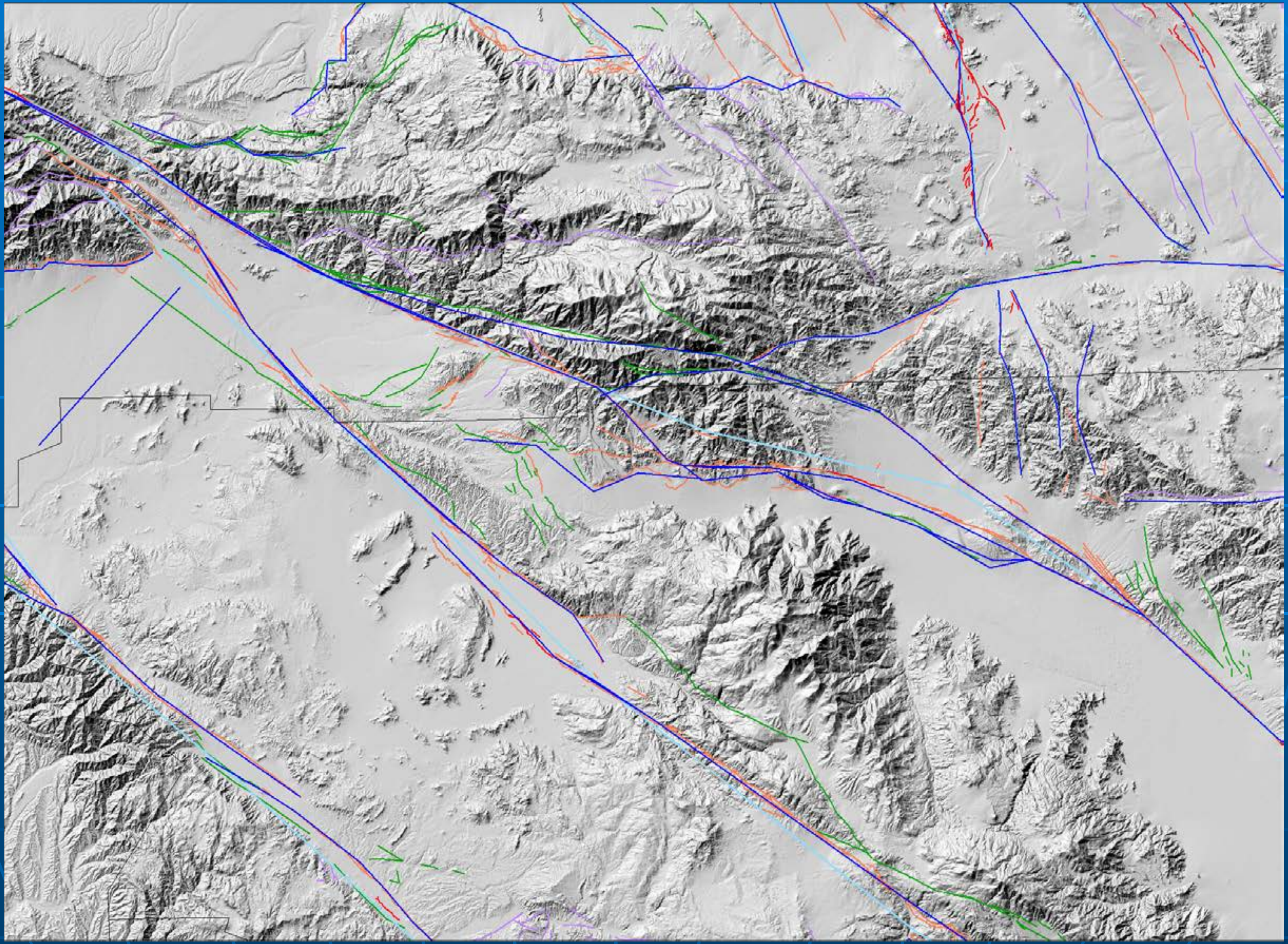
California

- Update fault geometry (consider magnitude uncertainty)
- Incorporate three new PEER NGA equations
- Calculate rupture area using 2 magnitude-area relations
- Consider over-prediction of M 6-7 events compared to historical catalog
- Update fault slip rates (alternate models for San Andreas, San Jacinto)
- Develop new A-fault parameters from 2007 WGCEP

California model

- Best available science
- Consistent with historic rate of earthquakes in California (within some probability level)
- Consistent with historical earthquake rupture data (e.g., 1857, 1906)
- Consistent with published paleoseismic data
- Consistent with published slip rate data
- Contains major sources of epistemic uncertainty (uncertainty in knowledge of which model is correct) and aleatory variability (random)
- Contains the best estimation of ground motion for earthquakes in California
- Northern and southern San Andreas use consistent methodology

New fault geometry in southern California



Wills

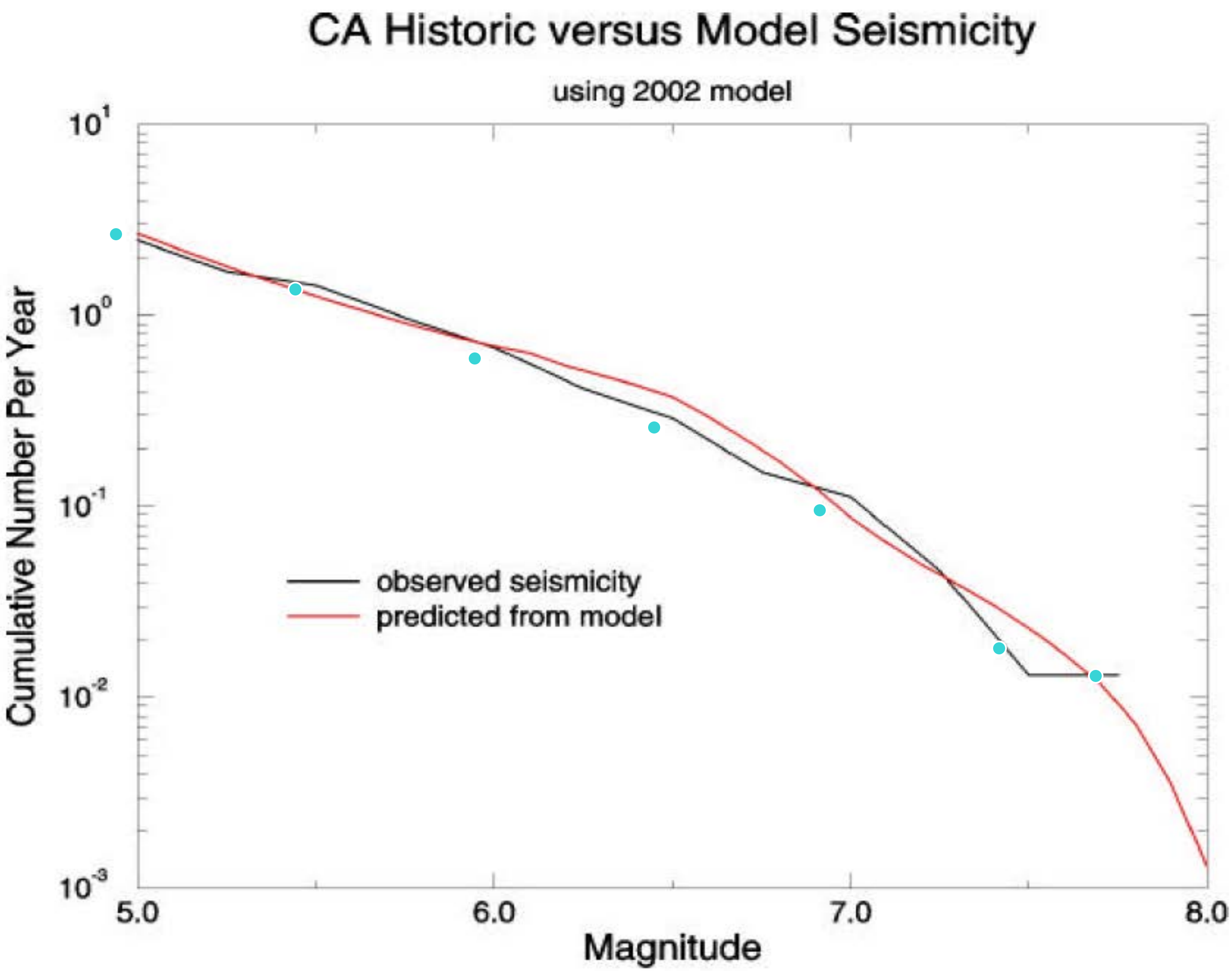
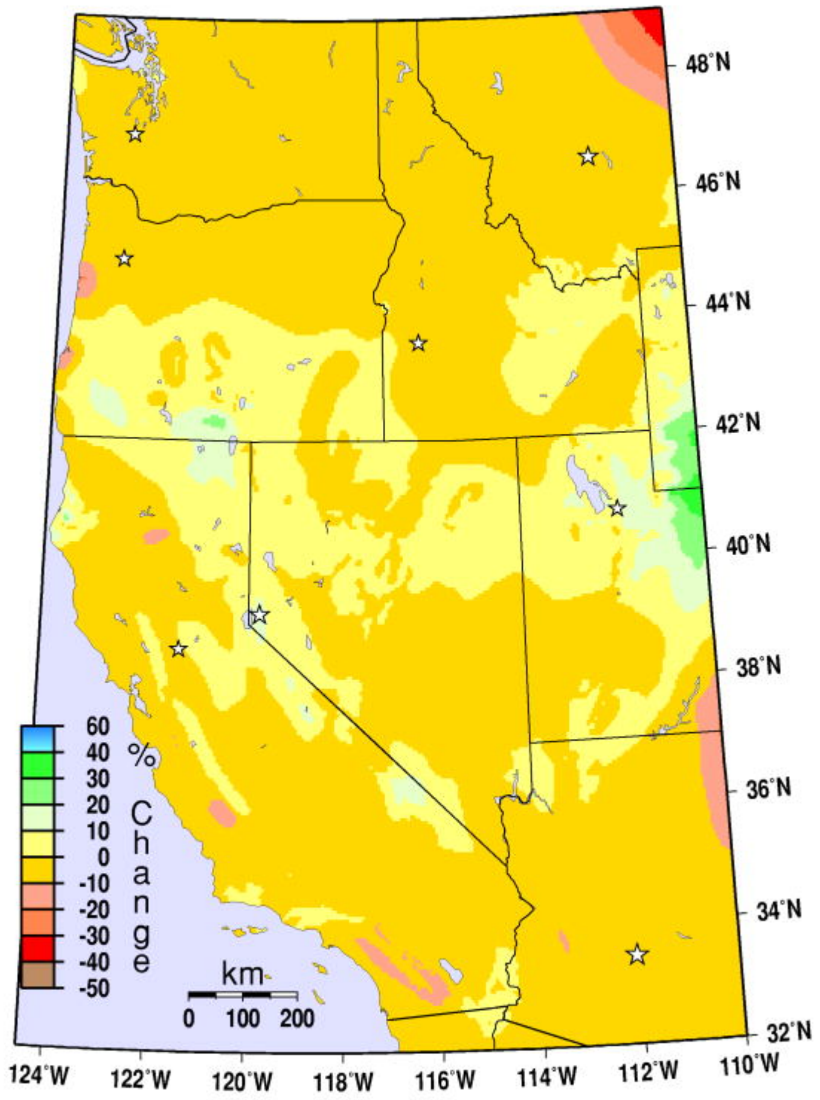


Figure 6. Comparison of predicted and historic seismicity rates for most of California.

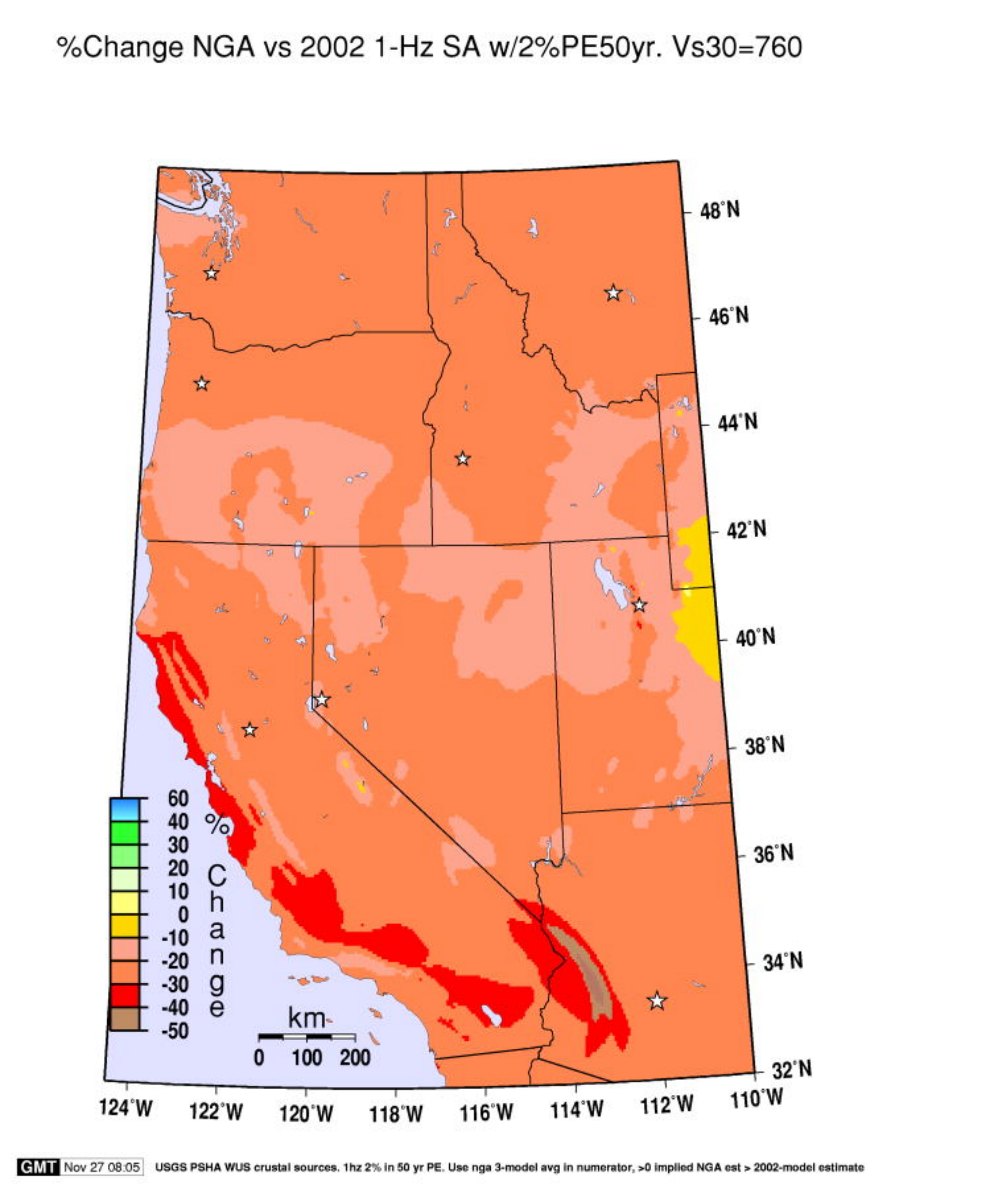
Attenuation Relations- Expert Panel Recommendations

- Crustal interplate: 3 NGA equations (A&B, C&B, C&Y)
- Add epistemic uncertainty
- Do not consider directivity
- Get advise from modelers on how to treat depth of rupture, depth of sediments
- Make comparisons of NGA soil amplification factors compared to NEHRP amplification factors.

%Change NGA vs 2002 5-Hz SA w/2%PE50yr. Vs30=760



GMT Nov 27 08:06 PSHA WUS crustal sources. 5hz 2% in 50 yr PE. Use nga 3-model avg in numerator, >0 implied NGA est > 2002-model estimate


%Change NGA vs 2002 1-Hz SA w/2%PE50yr. Vs30=760
48°N
46°N
44°N
42°N
40°N
38°N
36°N
34°N
32°N
124°W
122°W
120°W
118°W
116°W
114°W
112°W
110°W
60
40
30
20
10
0
-10
-20
-30
-40
-50
% Change
km
0 100 200
GMT Nov 27 08:05
USGS PSHA WUS crustal sources. 1hz 2% in 50 yr PE. Use nga 3-model avg in numerator, >0 implied NGA est > 2002-model estimate

Conclusions

- Several significant changes to maps, mostly due to attenuation changes
- In west changes are largest for 1 s SA (-20% to -40%) and moderate for 0.2 s (+/-10%)
- In east changes are about 15%