

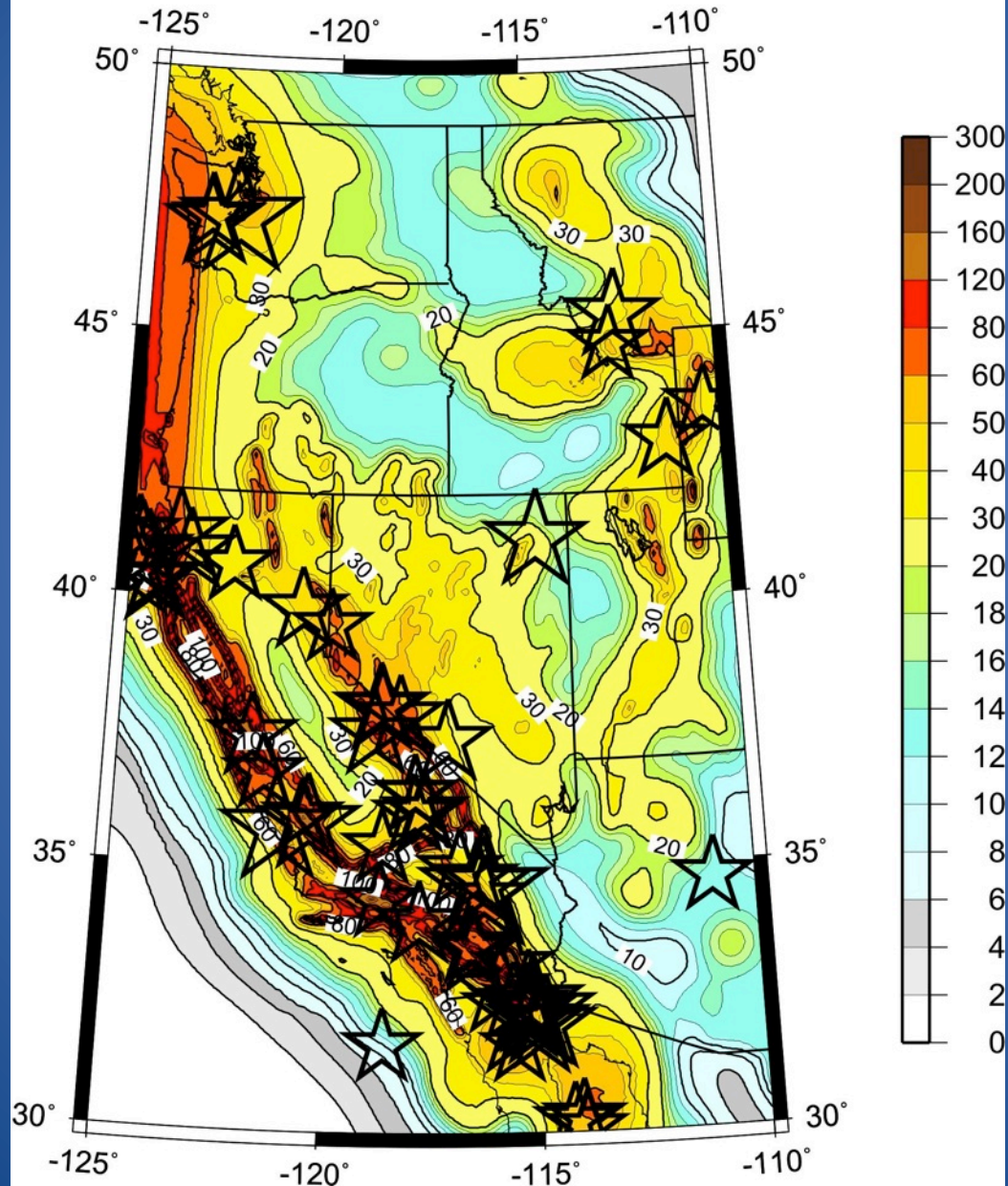
Workshop for Update of Pacific Northwest Portion of the National Seismic Hazard Maps

Seattle, WA
March 21–22

Gather opinions of participants on key input parameters for the NSHMs

- Cascadia subduction zone: recurrence rates of great earthquakes and location of down-dip edge (also for UCERF 3)
- Estimation of hazard from deep intraslab earthquakes in Oregon, southwest WA, and northern CA
- Crustal faults to add to the maps; fault parameters to revise
- Ground Motion Prediction Equations: great subduction zone earthquakes, intraslab events, crustal events. Lessons from Tohoku, Japan and Maule, Chile
- Discussion of earthquake engineering issues in the PacNW

Earthquakes with $M \geq 5.0$ since Jan. 1997 Plotted on 1996 Hazard Map of PGA (%g) with 2% PE in 50 years

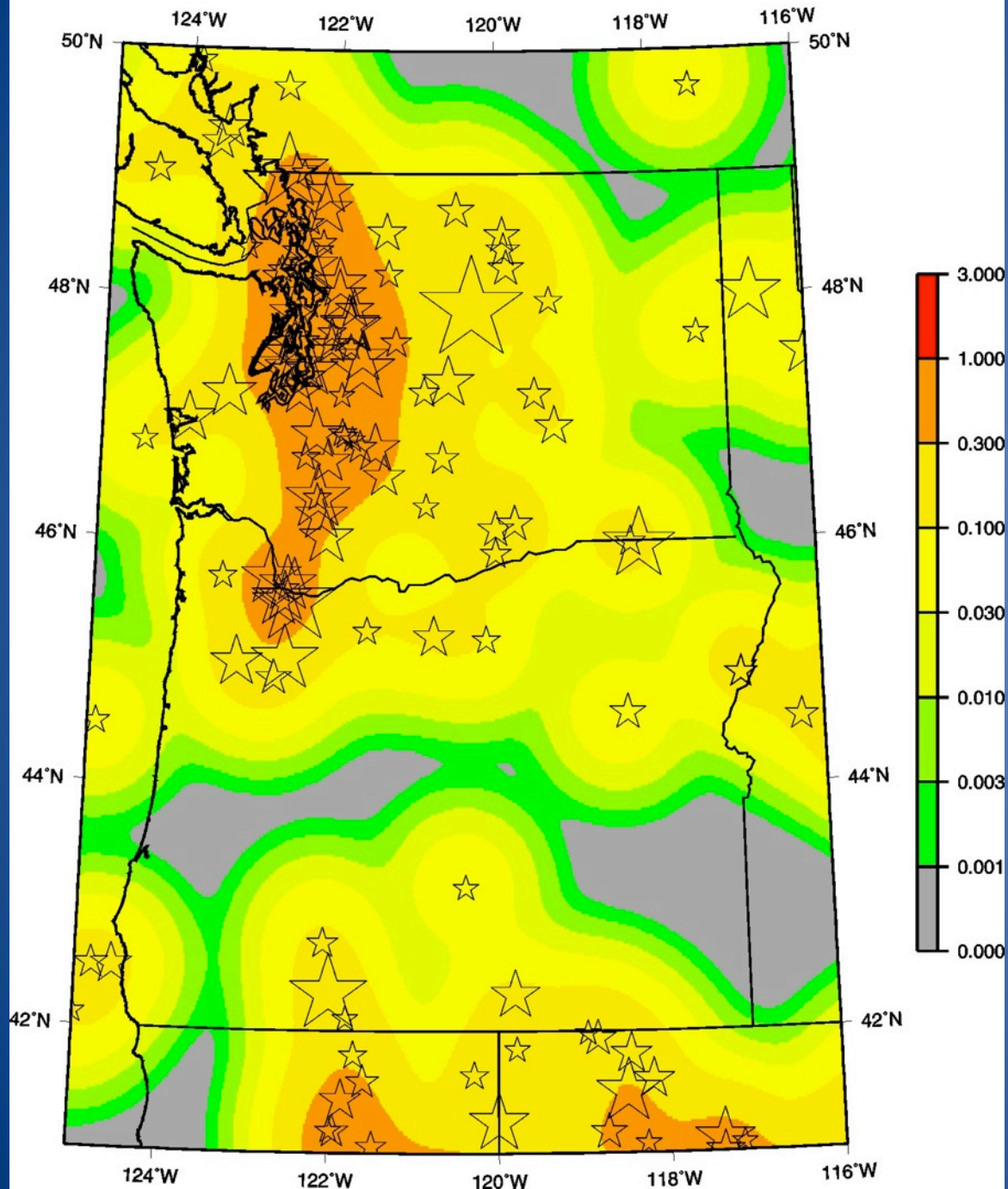


Components of the current National Seismic Hazard Maps, focusing on the Pacific Northwest

Art Frankel, Mark Petersen, Charles Mueller, Kathy Haller, Steve Harmsen, Russ Wheeler, Dave Perkins, Rob Wesson

- With assistance of Brian Sherrod, Craig Weaver, Joan Gomberg

shallow seismicity rate grid

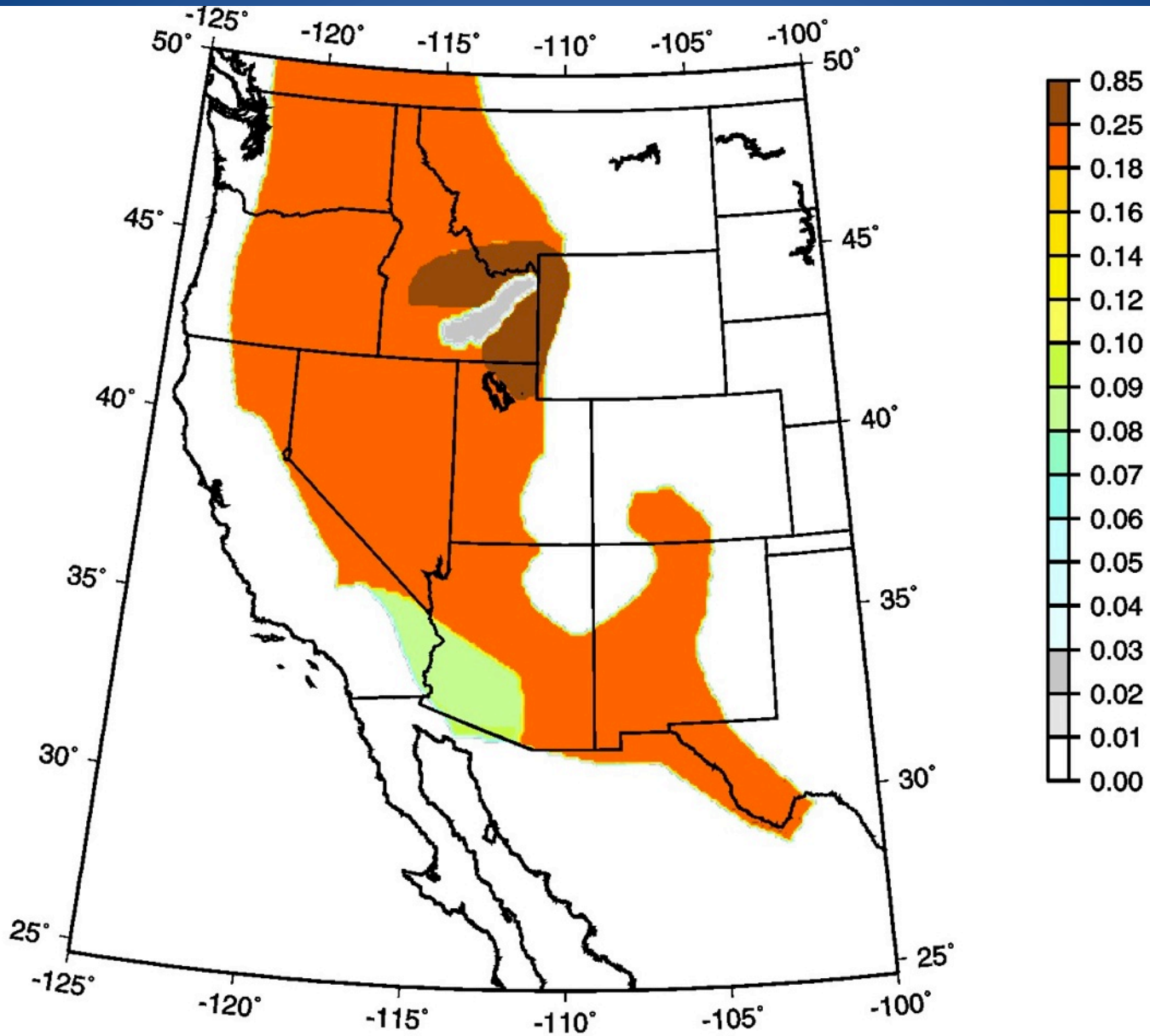


$M \geq 4.0$ since 1963
 $M \geq 5.0$ since 1930
 $M \geq 6.0$ since 1850

< 35 km deep

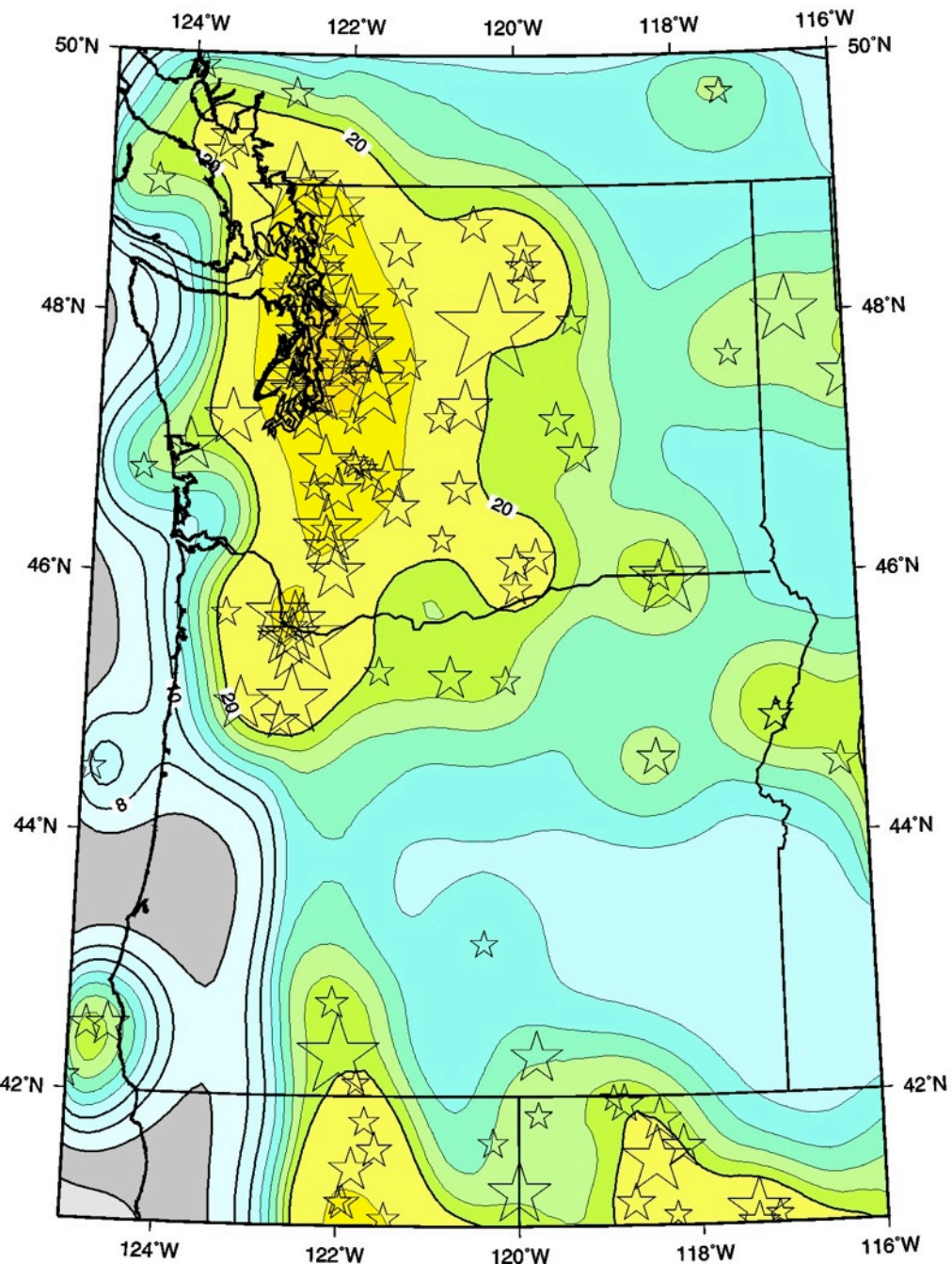
Used Gaussian
smoothing function
With correlation
distance of 50 km

Figure from C. Mueller



Map showing seismicity rates for background zones in WUS.

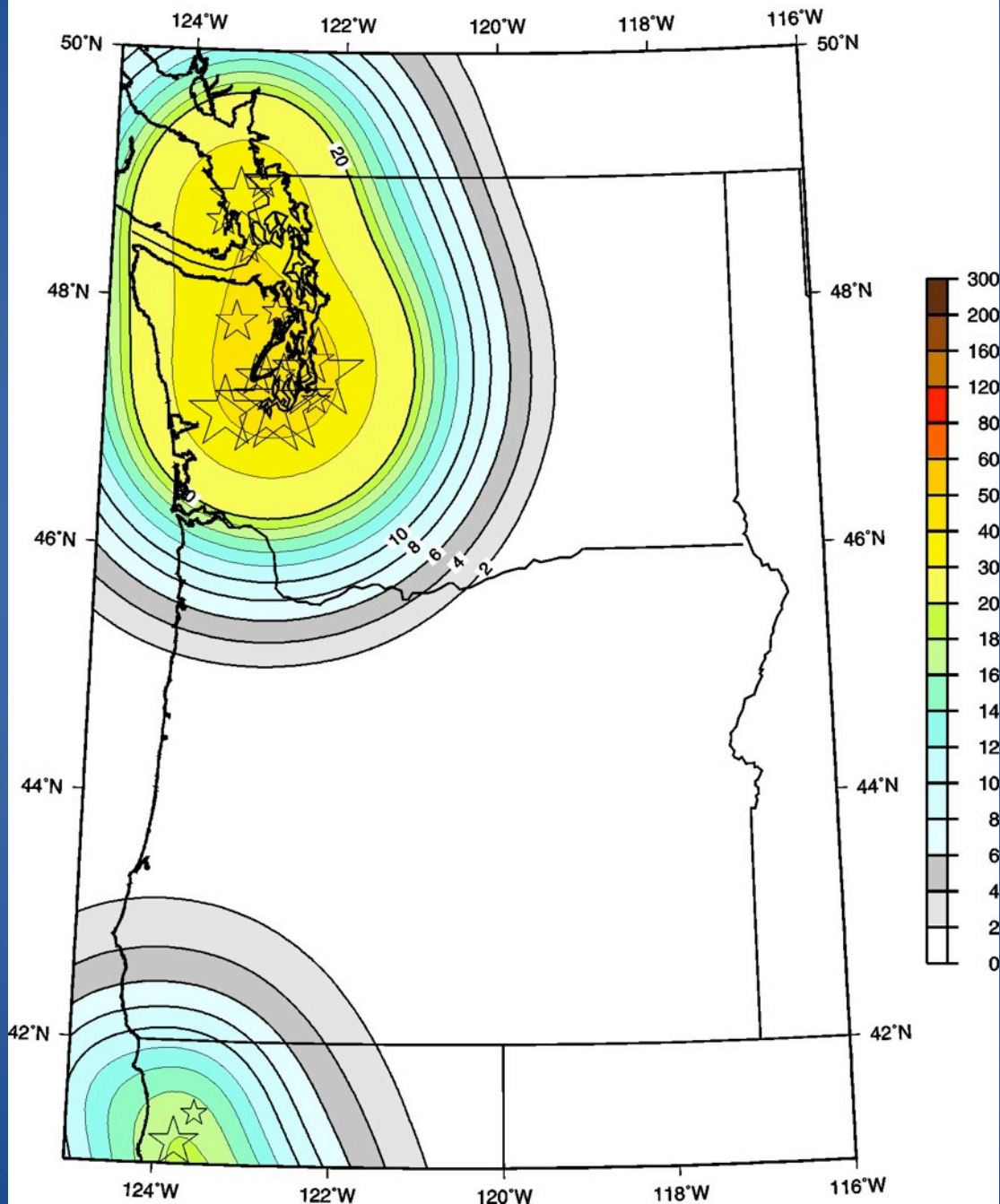
Peak Accel. (%g) with 2% Probability of Exceedance in 50 Years
shallow seismicity and background zones only



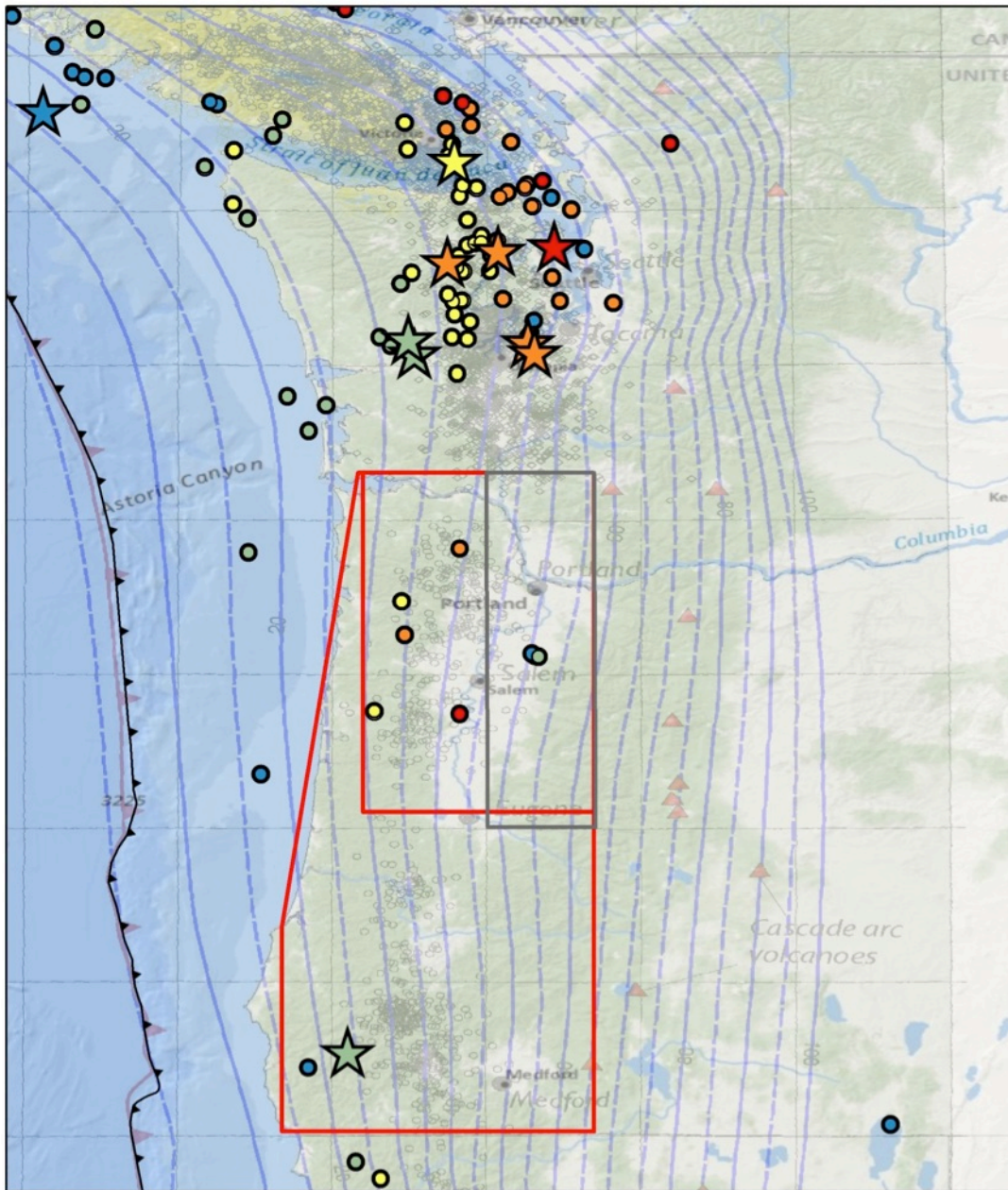
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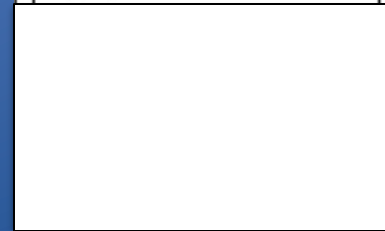
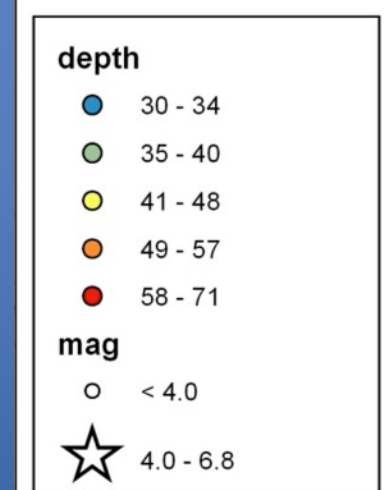
Peak Accel. (%g) with 2% Probability of Exceedance in 50 Years
deep seismicity only

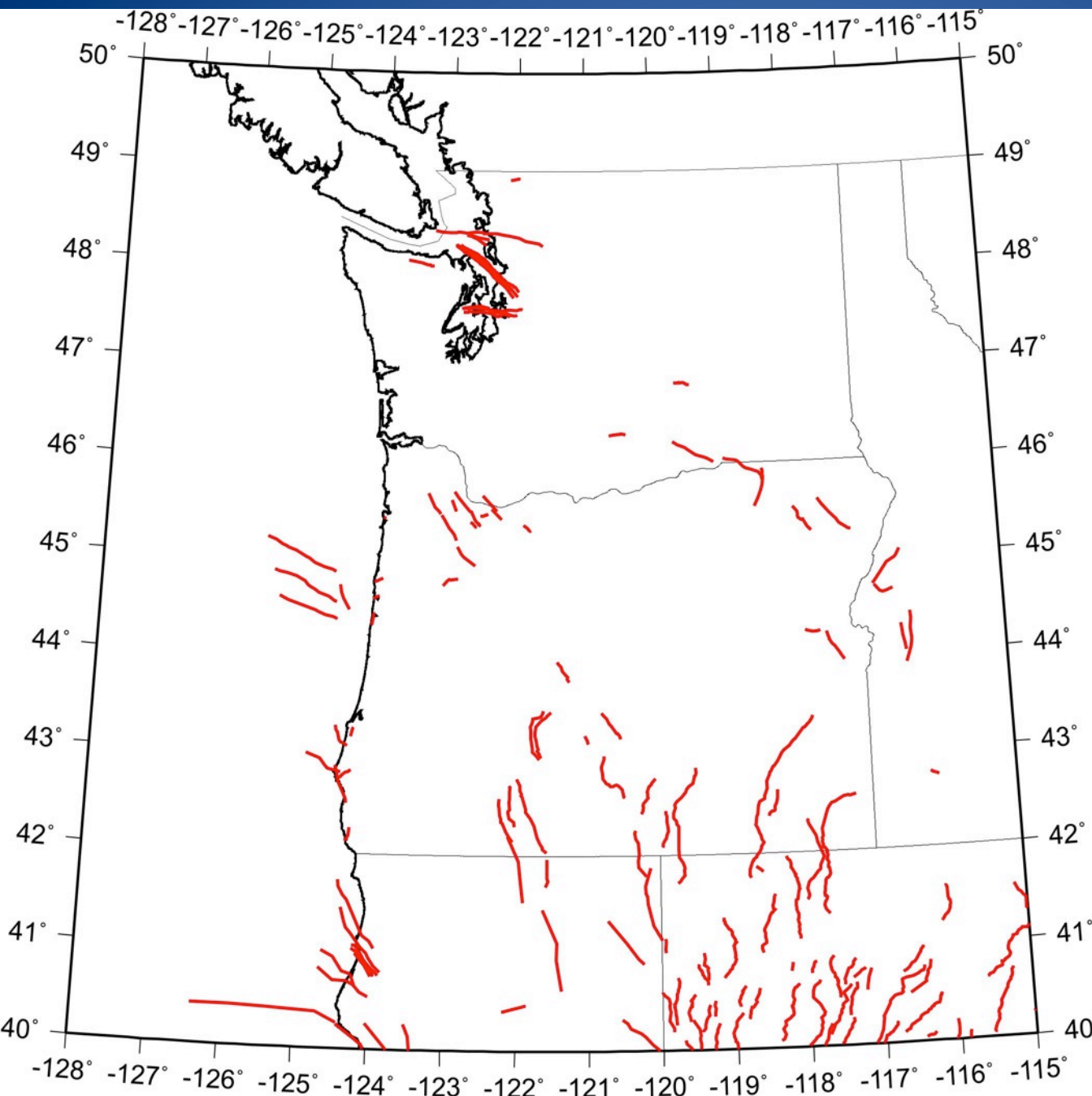


Areal source zone to account for deep-earthquake hazard south of Puget Sound



- Rate determined from earthquakes that are beneath the subduction interface; 7 $M \geq 2.5$ since 1990, 6 events in red zone
 - Accounts for deep earthquakes where few $M \geq 4$ earthquakes have occurred since from Mark Petersen
- Slab depth contours from Pat McCrory

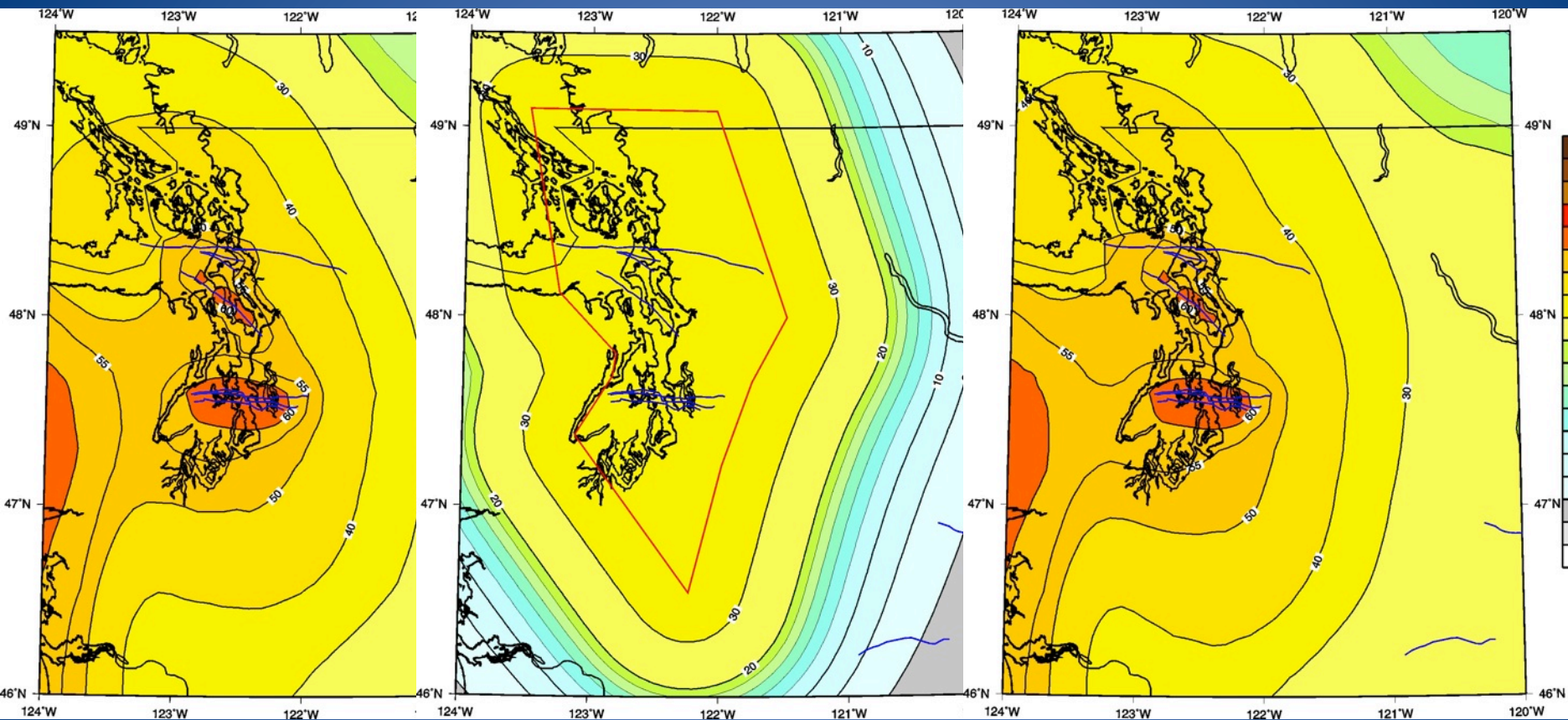




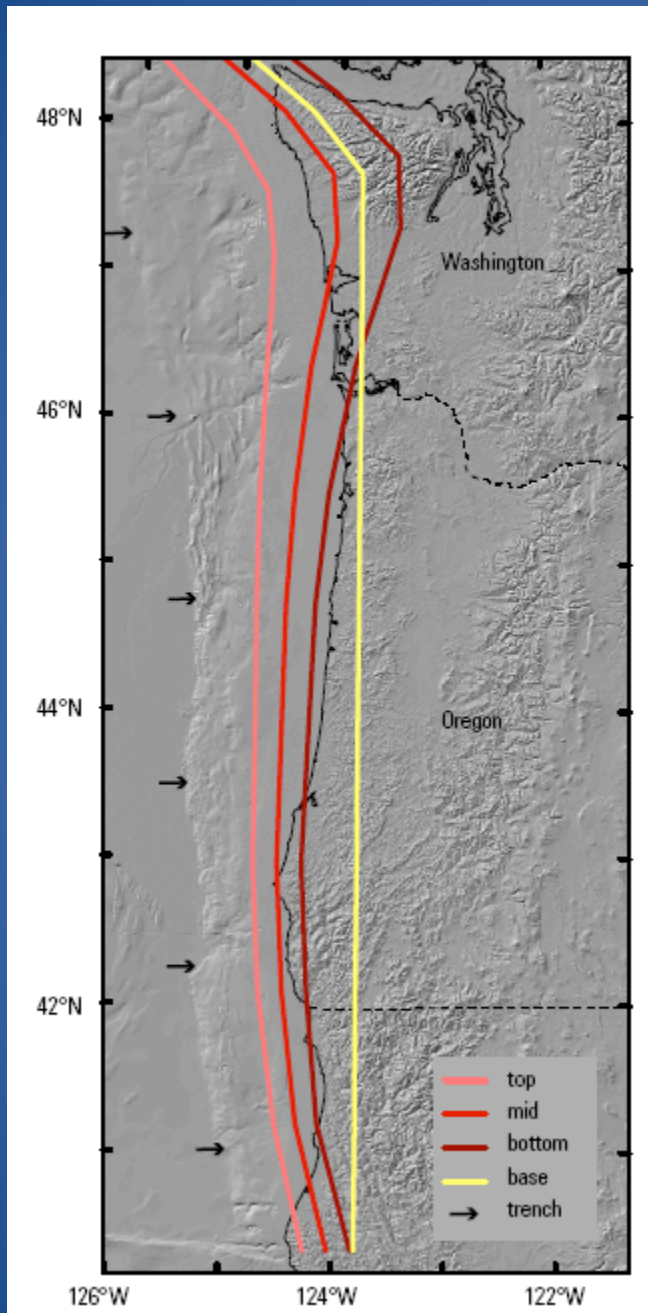
Used Quaternary faults with slip rate determinations and/or paleo-earthquake chronologies

We have an advisory panel to provide recommendations on faults to add or revise (B. Sherrod)

Puget Sound: Effect of including areal source zone accommodating 3 mm/yr N-S convergence measured by GPS (in addition to convergence from faults used in hazard maps)



PGA (%g) with 2% P.E. in 50 Years



Great earthquakes on Cascadia Subduction Zone have been included in NSHM's since 1996, with rates based on paleoseismic studies (e.g., Atwater, 1992)

Figure shows different models for Eastern edge of rupture used in 2002 and 2008 maps

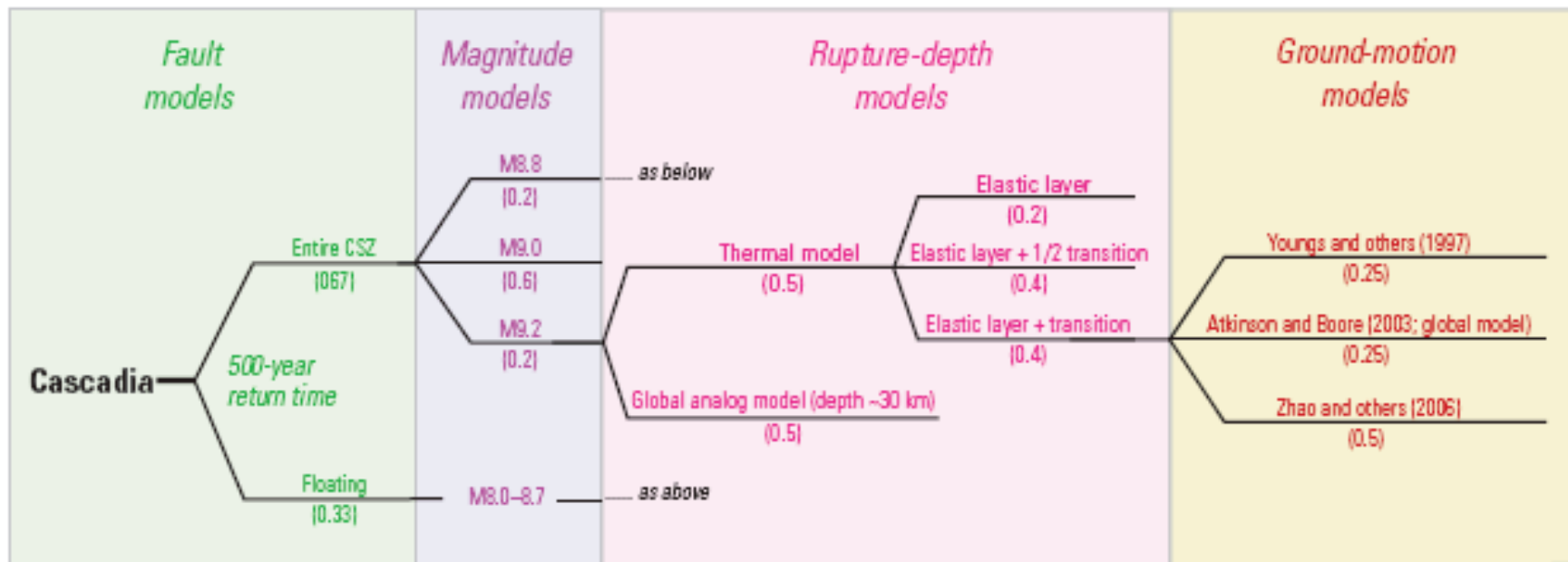


Figure 20. Logic tree for Cascadia subduction zone (CSZ). Parameters in this figure include some aleatory variability as well as depicted epistemic uncertainty. Additional aleatory variability shown in table K-1 in Appendix K.

From 2008 NSHM Documentation (Petersen et al., 2008)

Two Sets of Scenarios for CSZ revised for 2008 Update

- M8.8–9.2 rupturing entire CSZ; 500 year average recurrence time from paleoevent dates, e.g., Atwater, 1992 (probability of 0.67)
- M8.0–M8.7 floating rupture zones; rupture under any location along coast with rate of 1/500, on average (probability of 0.33); designed to address possibility that some of the 500 year earthquakes were actually series of M8's that ruptured CSZ over several years or decades
 - equal probabilities assigned to 8.3, 8.4, 8.5, 8.6, 8.7 scenarios; 8.0,8.1,8.2 assigned half probability of others

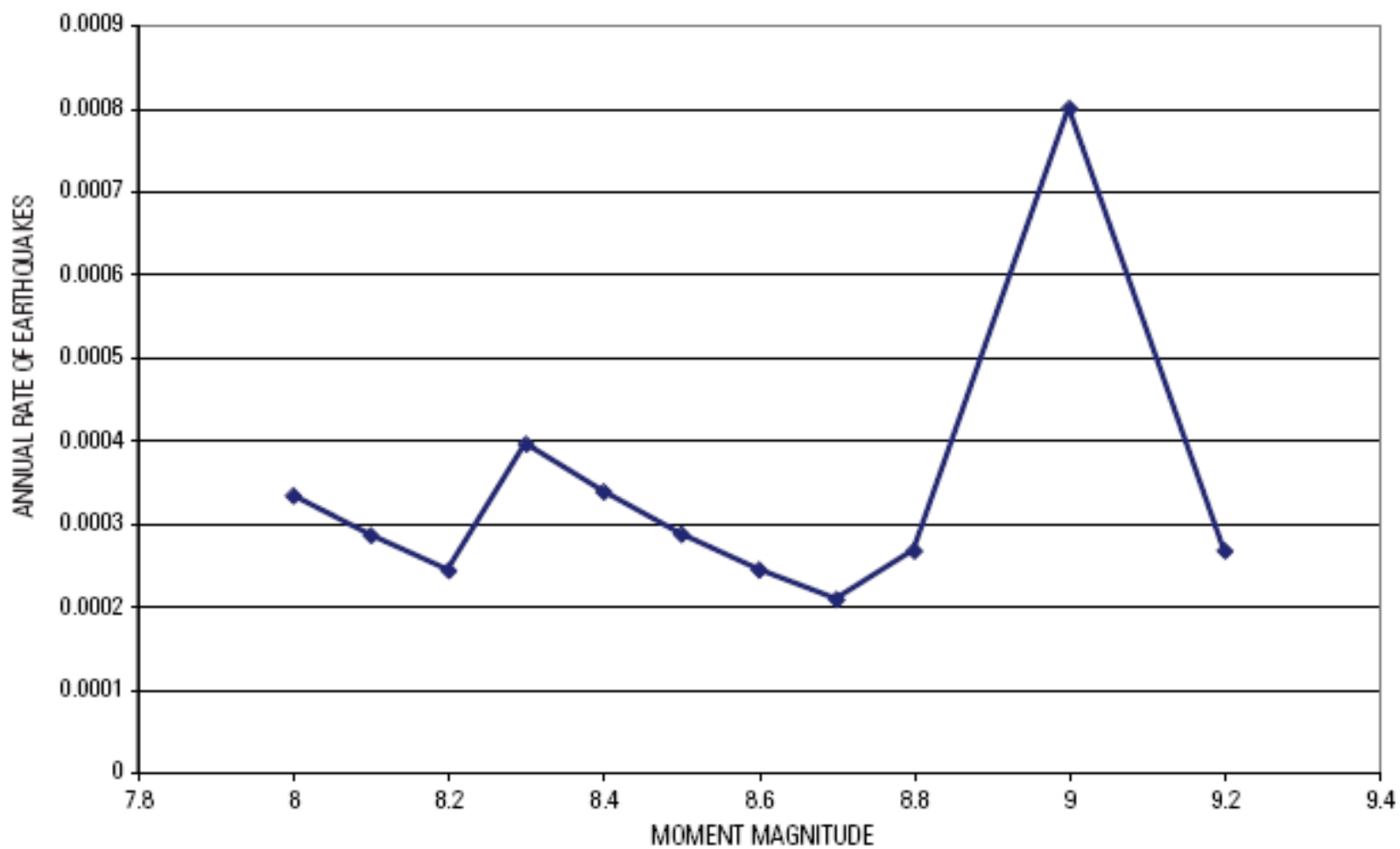
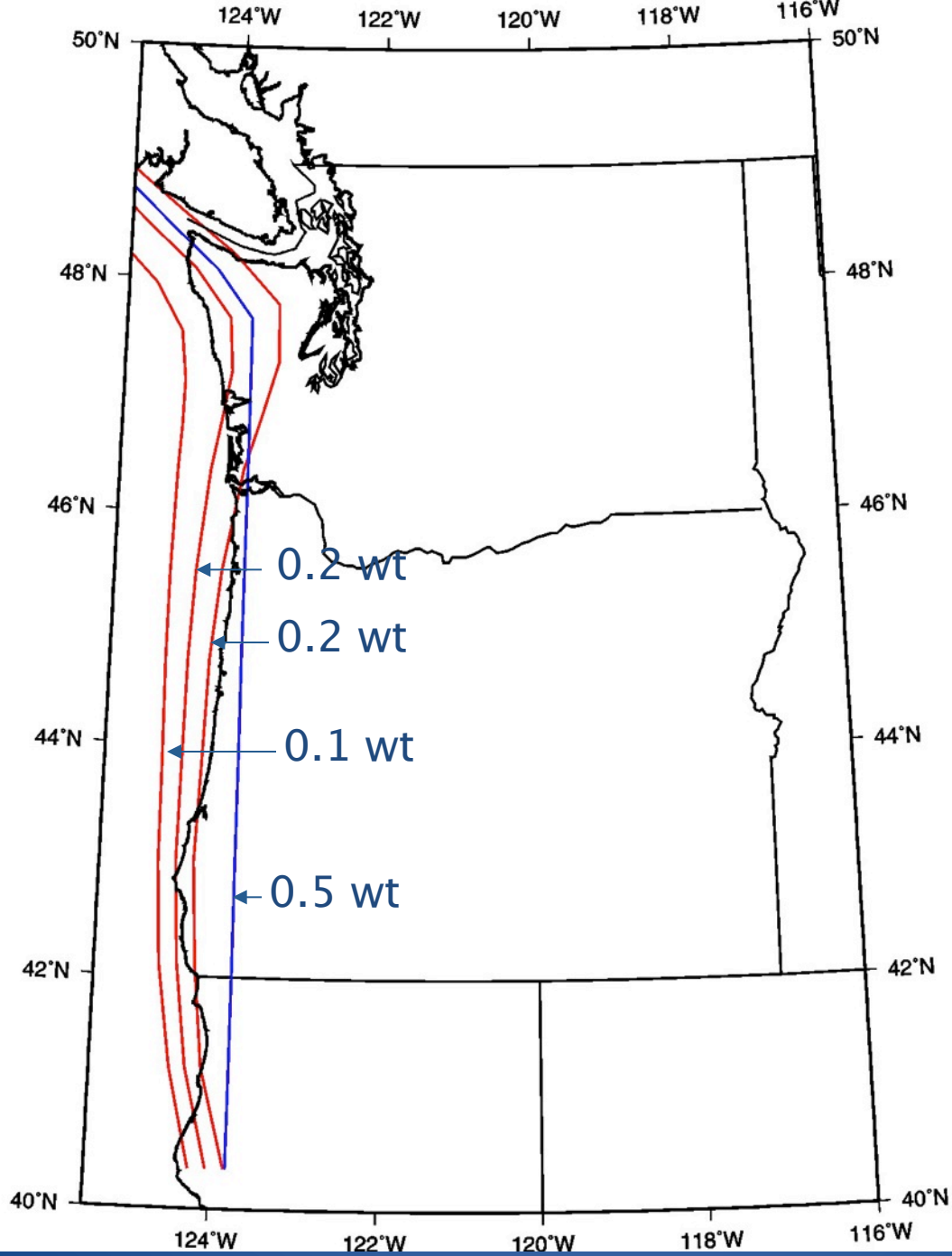
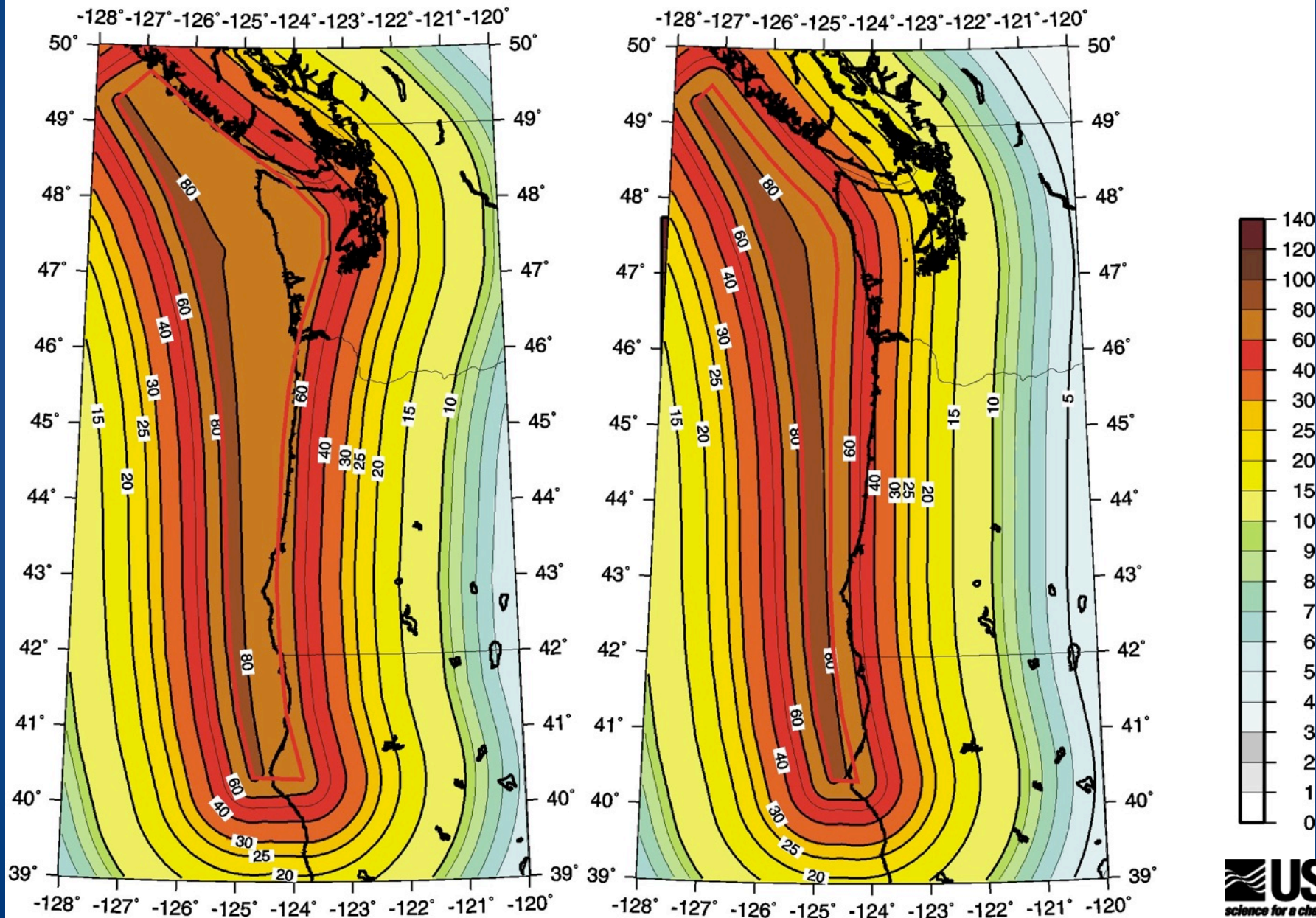


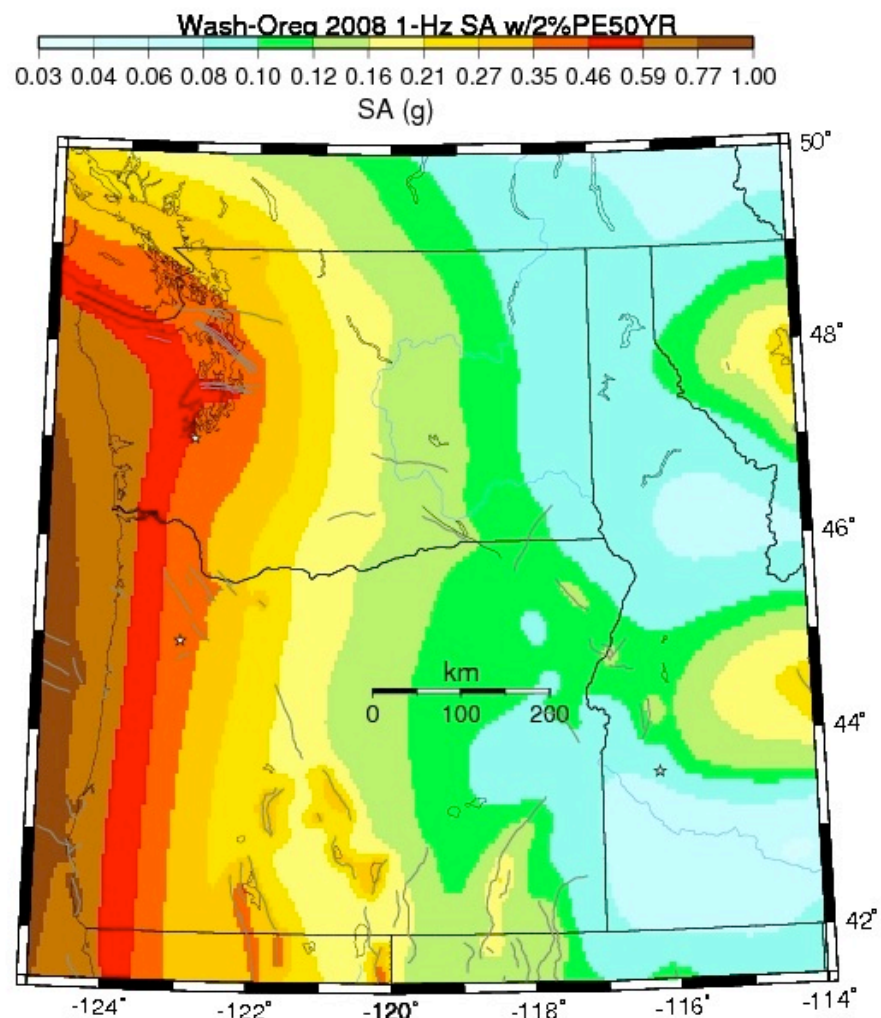
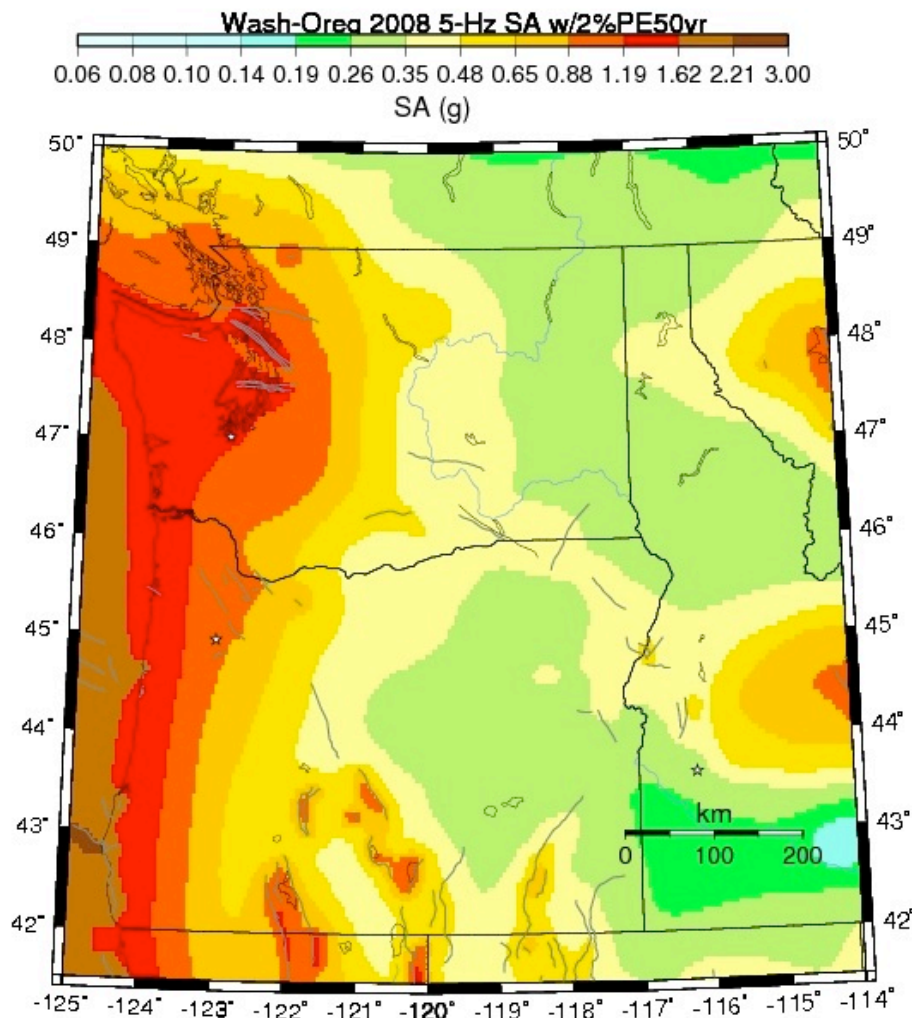
Figure 22. Magnitude-frequency distribution of the Cascadia subduction zone.



Peak Ground Acceleration (%g)

for 2% Probability of Exceedance in 50 Years





We convened two workshops on Cascadia Subduction Zone in 2010 and 2011

- Recurrence relations for great earthquakes

Workshop on turbidite evidence for great earthquakes: Nov 18–19, 2010, Corvallis (hosted by Chris Goldfinger).

Summarized in USGS Open File Report 2011–1310.

- Down–dip edge of rupture

Workshop: Dec 15, 2011, Eugene (co–convened with Ray Weldon)

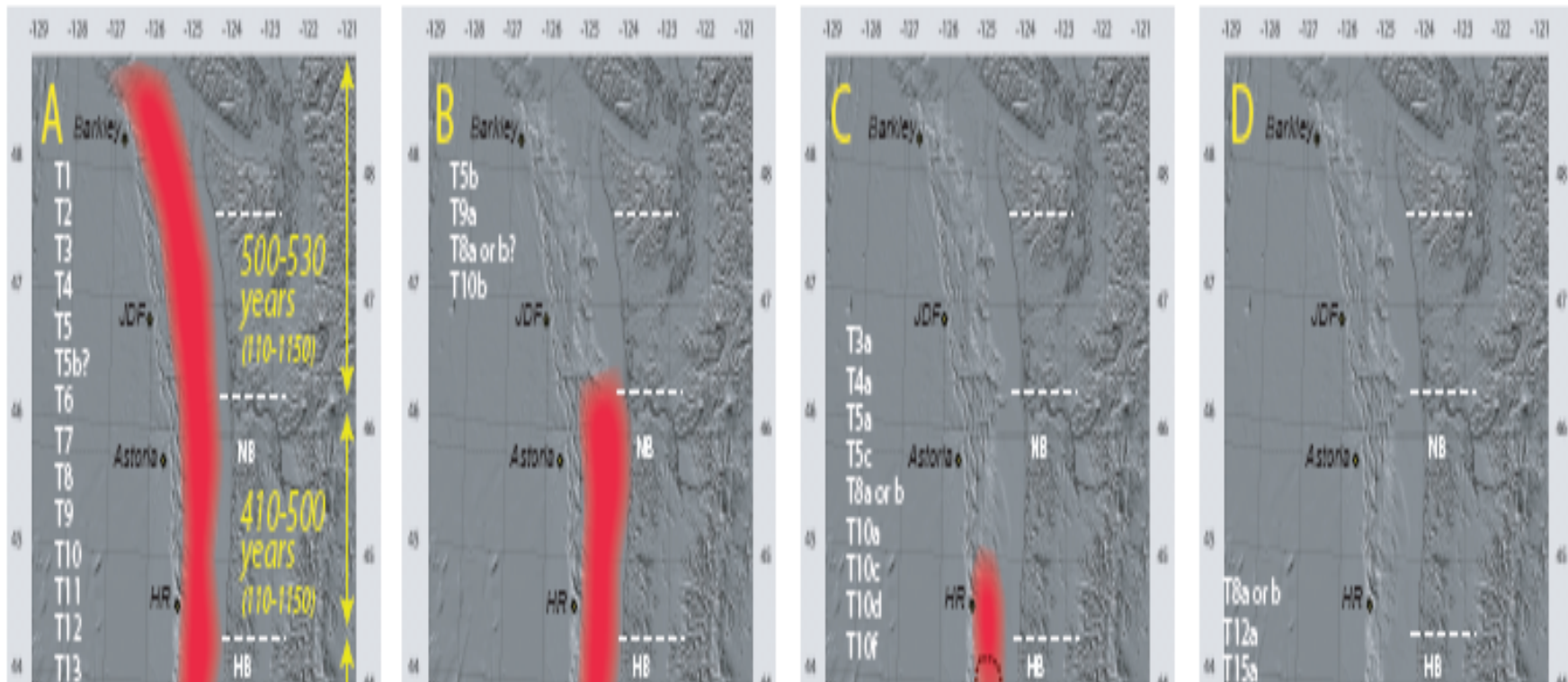


Figure from Goldfinger et al. (in press);
 results from 10,000 year record of turbidites

