

UCERF3: Hazard Implications

- Code comparison
- Hazard comparison metrics
- Hazard curves at sites
- Initial hazard maps

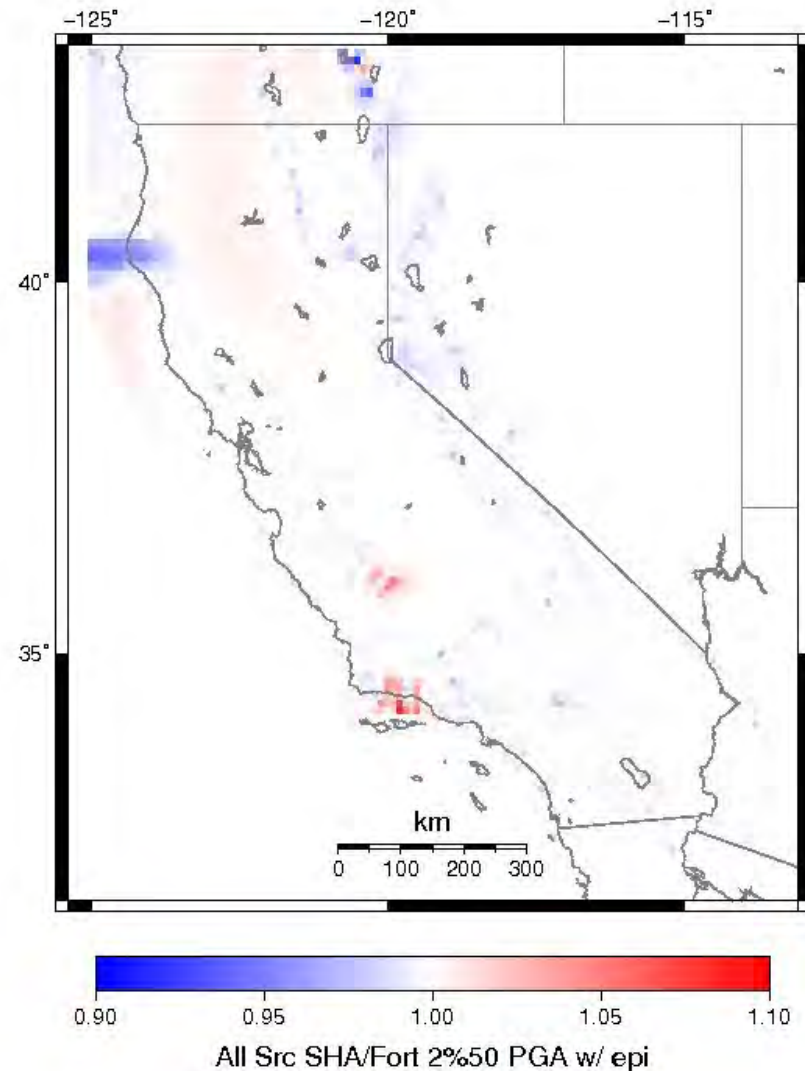
Hazard Evaluation: Code Comparison

- Code comparison: USGS & OpenSHA
- NSHMP uses Fortran codes
- UCERF2 built on OpenSHA; delivered to USGS
- Grid sources handed back to OpenSHA
 - Back and forth and updates introduced inconsistencies
- UCERF3 built on OpenSHA
- Comparison also serves as verification

- Ultimately, if UCERF3 is to be used in the NSHMP, OpenSHA must replicate NSHMP results

Hazard Evaluation: Code Comparison

- Have implemented and verified 2008 NSHMP model in OpenSHA for entire US
- Ratio of two codes (OpenSHA/NSHMP)
- Looking forward to UCERF3 comparisons, some hazard sources have been removed
 - Cascadia
 - CA deep seis
 - Non-CA b-Faults
 - Epistemic uncertainty on NGA ground motions



Hazard Evaluation: Metrics

- Ground motion values:
 - 2% in 50 years
 - 10% in 50 years
 - RTGM
- Frequencies
 - PGA
 - 5Hz
 - 1Hz
- Curves: NEHRP (2009) Test Cities
- Maps: CA statewide hazard maps are difficult to compare at this early stage due to computational requirements of UCERF3

Hazard Metrics: RTGM

- Risk Targeted Ground Motion (RTGM)
- Adopted by BSSC in conjunction with 2009 NEHRP provisions
- Ground motion for 1% probability of collapse in 50 years
- Computed at frequencies: 5Hz and 1Hz
- Scalar valued
- Considers entire hazard curve

Hazard Metric: NEHRP Test Cities

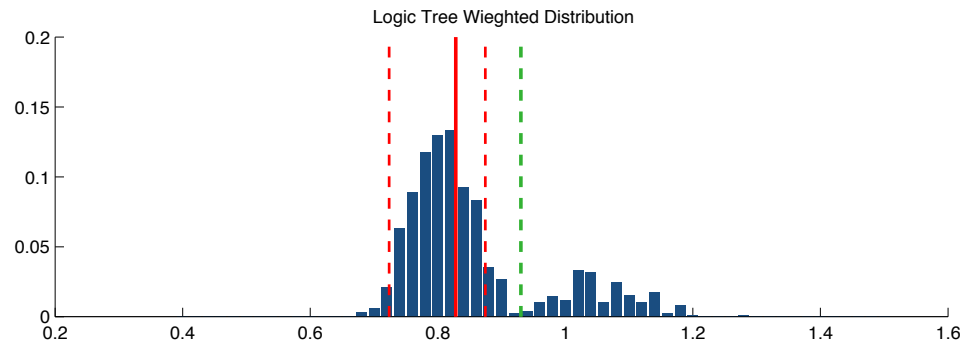
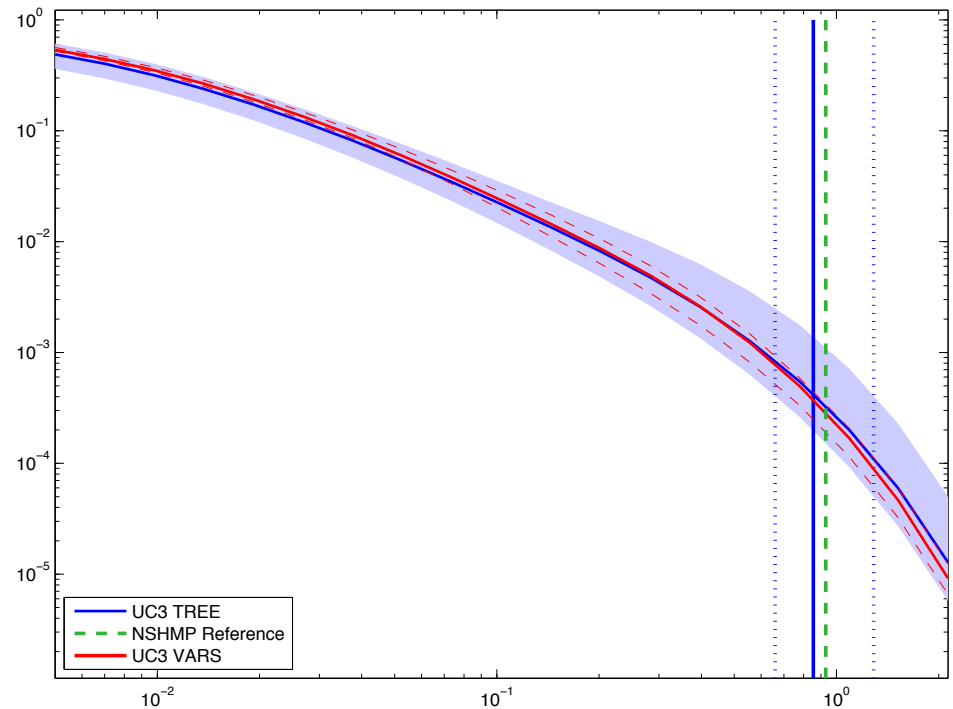
34 Cities, 21 in California

- Los Angeles
- Century City
- Northridge
- Long Beach
- Irvine
- Riverside
- San Bernardino
- San Luis Obispo
- San Diego
- Santa Barbara
- Ventura
- Oakland
- Concord
- Monterey
- Sacramento
- San Francisco
- San Mateo
- San Jose
- Santa Cruz
- Vallejo
- Santa Rosa
- Seattle
- Tacoma
- Everett
- Portland
- Salt Lake City
- Boise
- Reno
- Las Vegas
- St Louis
- Memphis
- Charleston
- Chicago
- New York

Hazard Curves: Plots

- **Blue:** Logic tree weighted mean hazard curve (UC2 | UC3)
- **Light Blue:** Logic tree min max hazard curve range
- **Red:** 2nd Hazard curve set mean (solid), min and max (dashed)
- **Green:** NSHMP reference value
- **Dark blue bars:** ground motion histogram of logic tree branches summed over weights

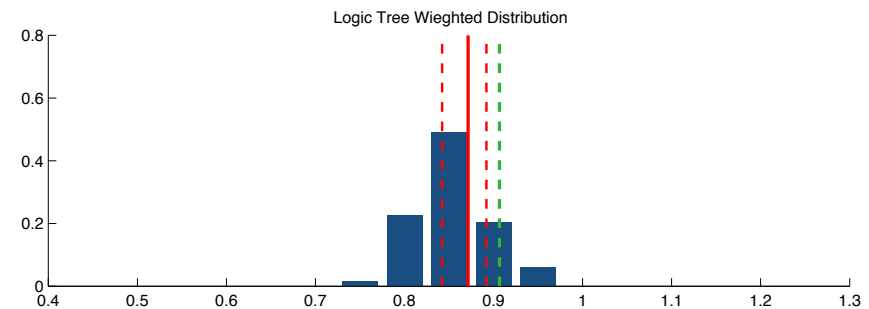
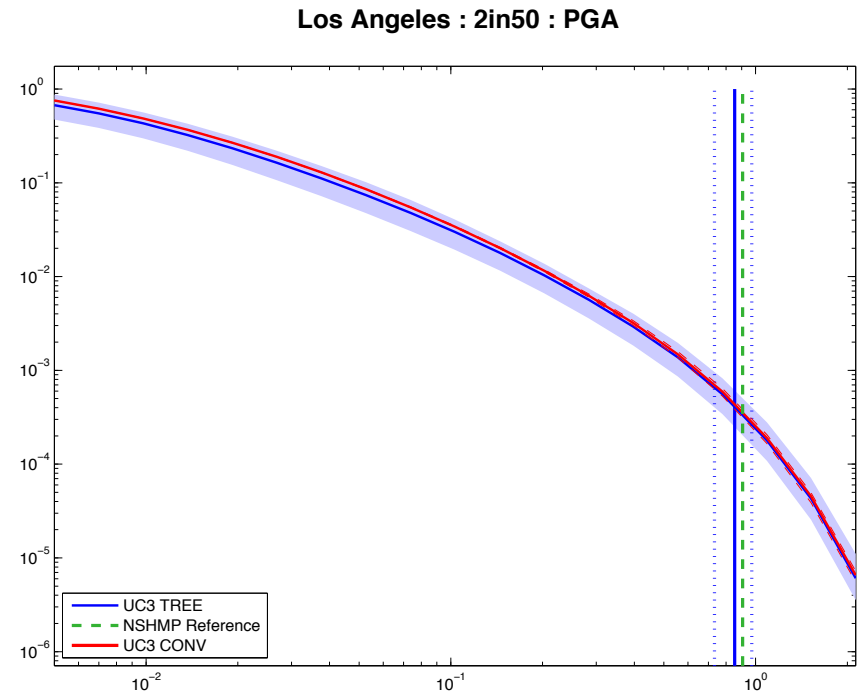
Ventura : 2in50 : PGA



Hazard Curves: Inversion Convergence

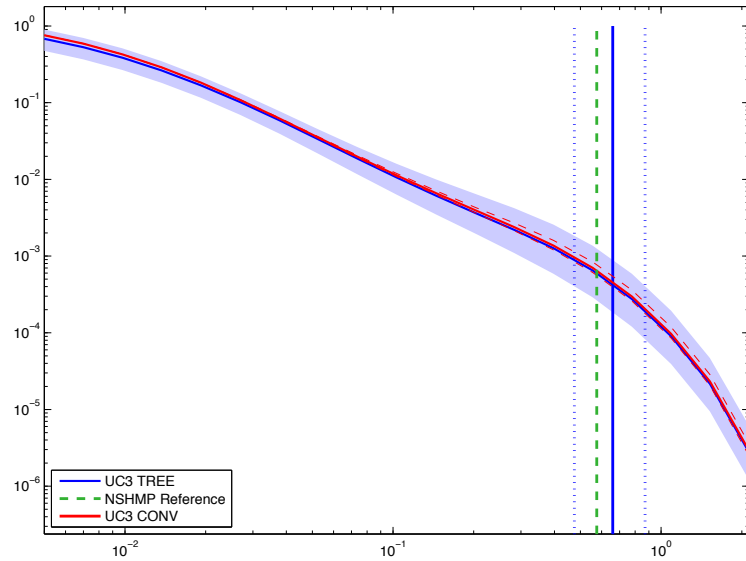
- Examine variation over repeated inversion runs
- Single “reference” branch
- 100 runs

Los Angeles
2% in 50 PGA

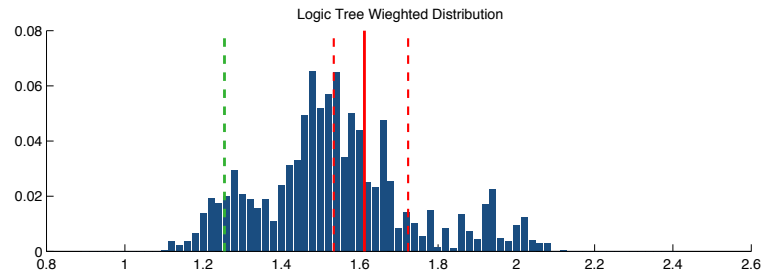
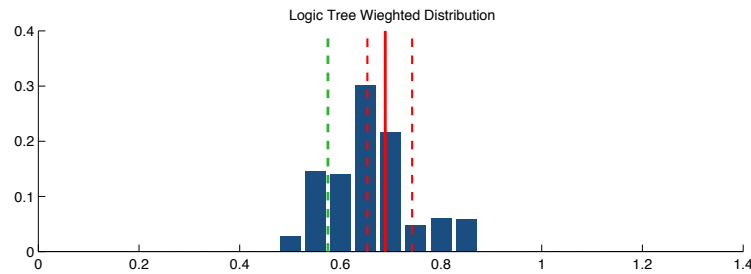
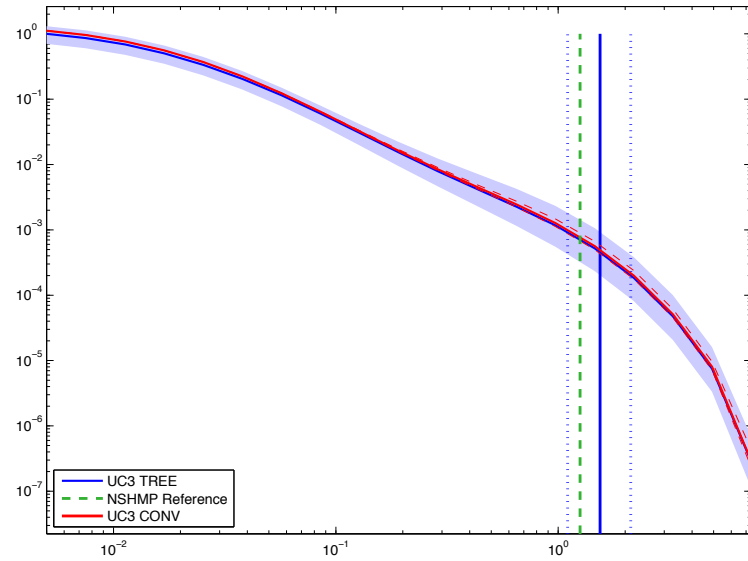


Hazard Curves: Inversion Convergence

San Diego : 2in50 : PGA



San Diego : RTGM : 5Hz



2% in 50 @ 5Hz

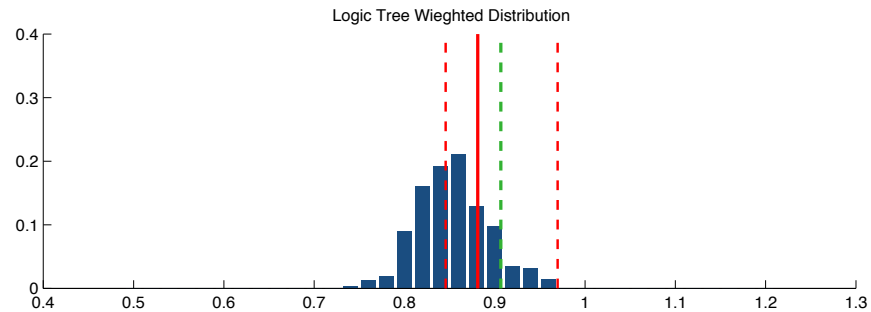
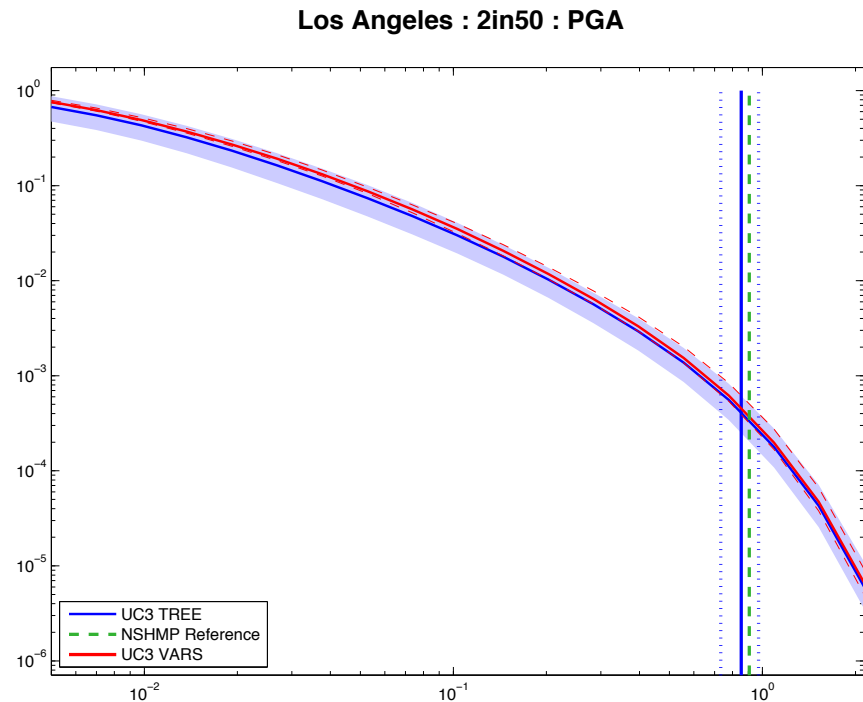
San Diego

RTGM @ 1Hz

Hazard Curves: Inversion Eqn. Weights

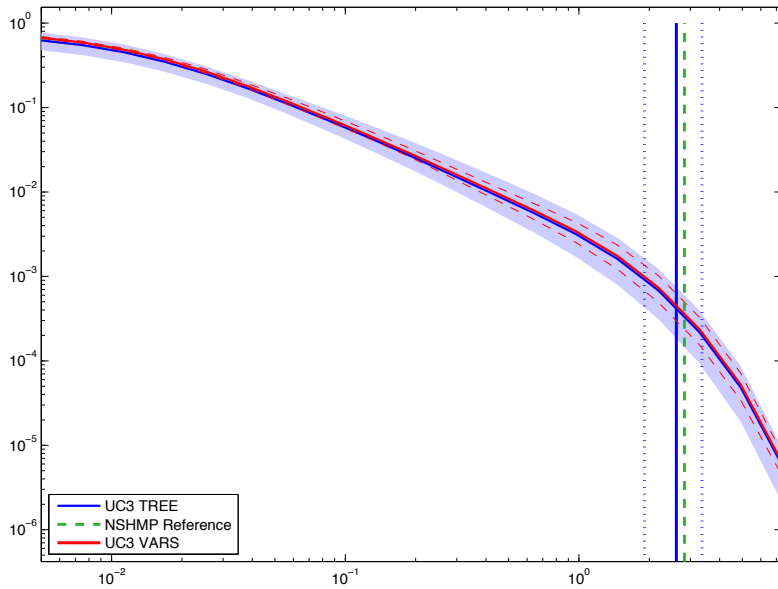
- Examine effect of varying inversion equation weights
- 11 weight variants

Los Angeles
RTGM PGA

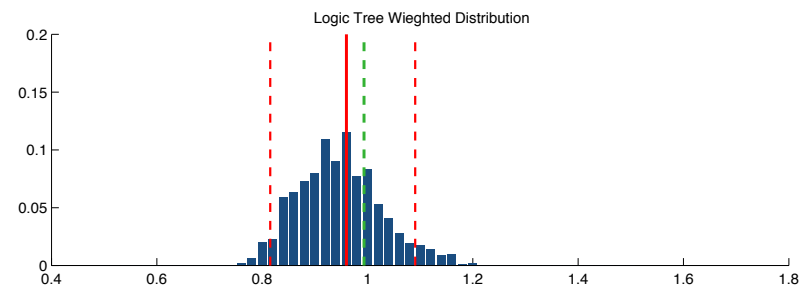
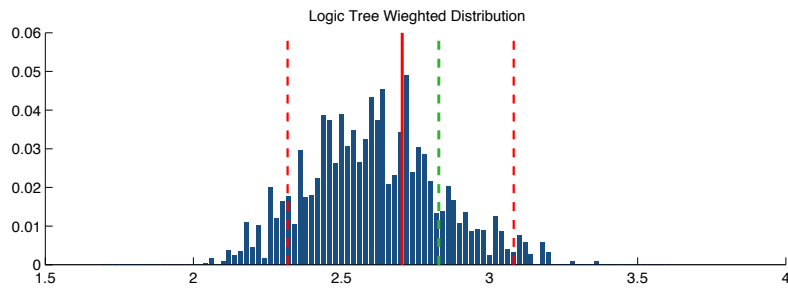
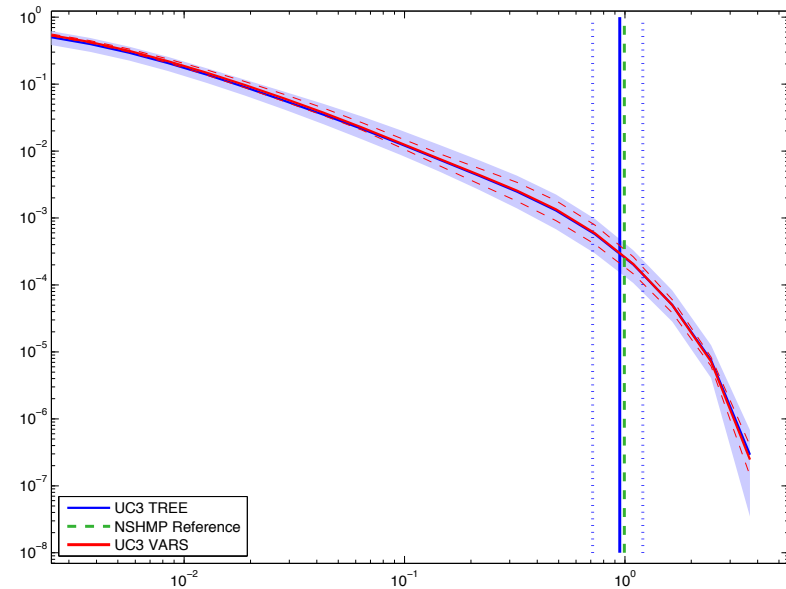


Hazard Curves: Inversion Eqn. Weights

Santa Barbara : RTGM : 5Hz



Santa Barbara : RTGM : 1Hz



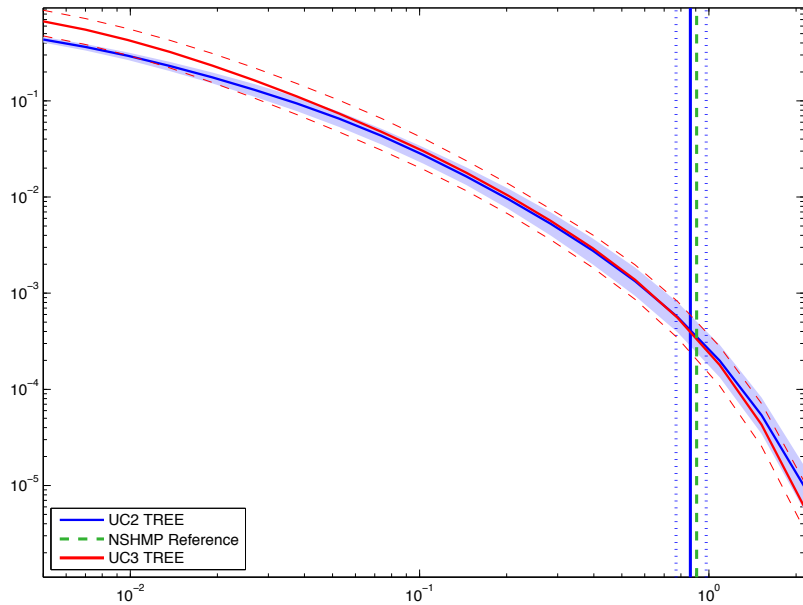
5Hz

Los Angeles RTGM

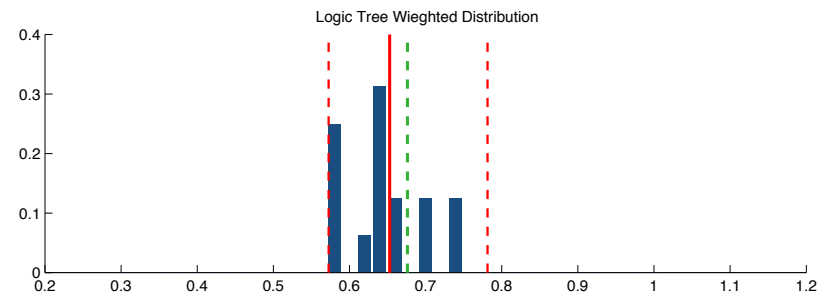
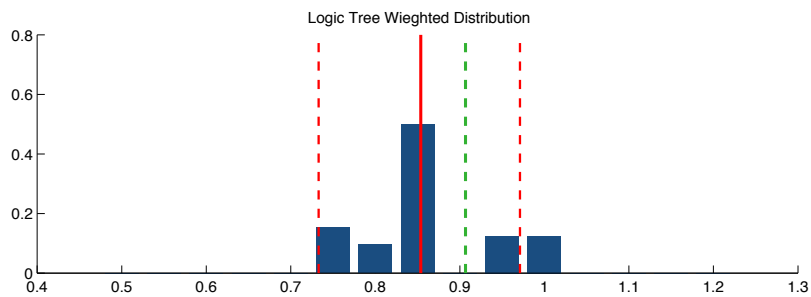
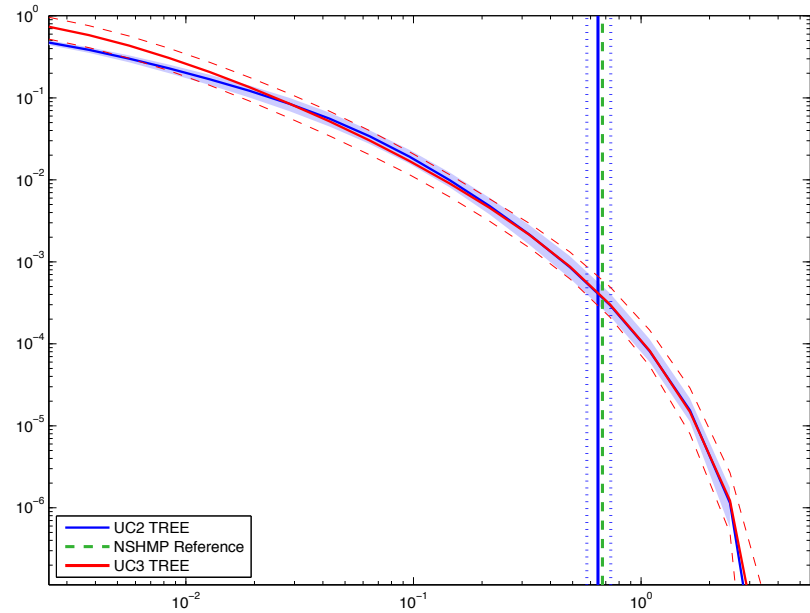
1Hz

Hazard Curves: UCERF3 vs. UCERF2

Los Angeles : 2in50 : PGA



Los Angeles : 2in50 : 1Hz



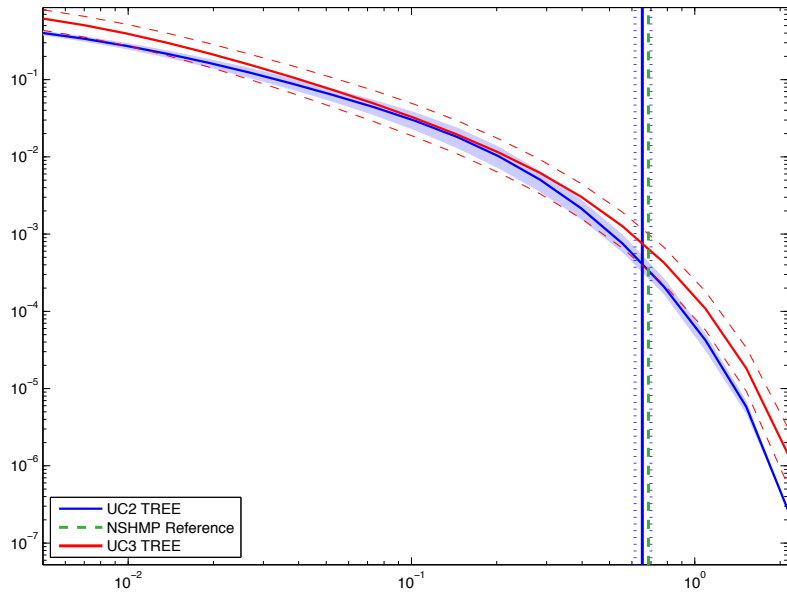
PGA

Los Angeles 2% in 50

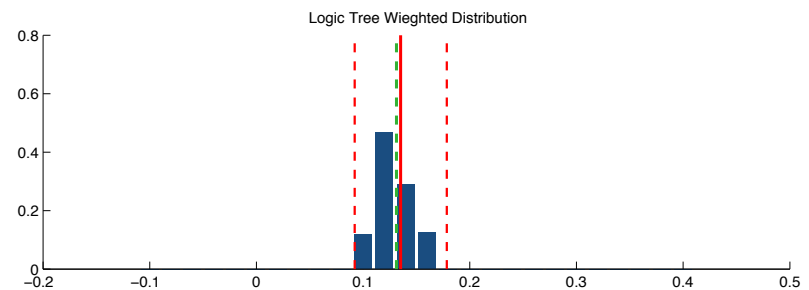
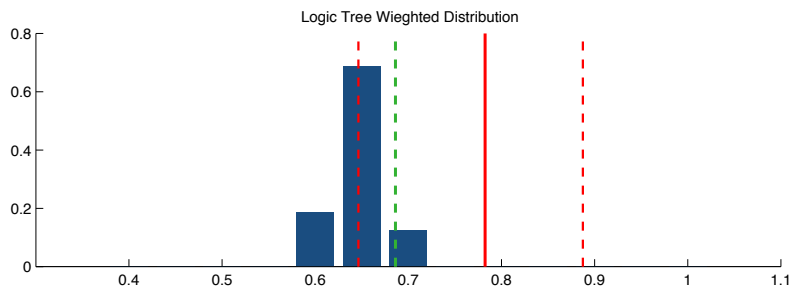
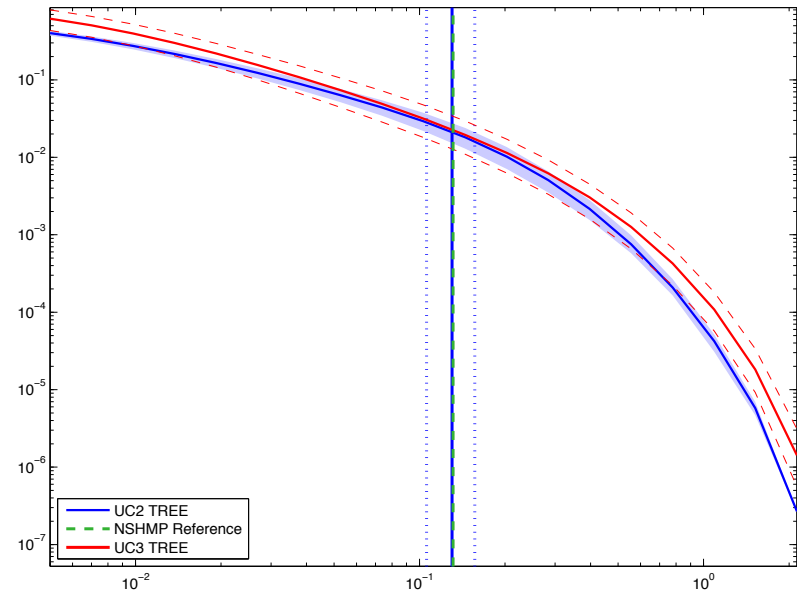
1Hz

Hazard Curves: UCERF3 vs. UCERF2

Northridge : 2in50 : PGA



Northridge : 10in50 : PGA



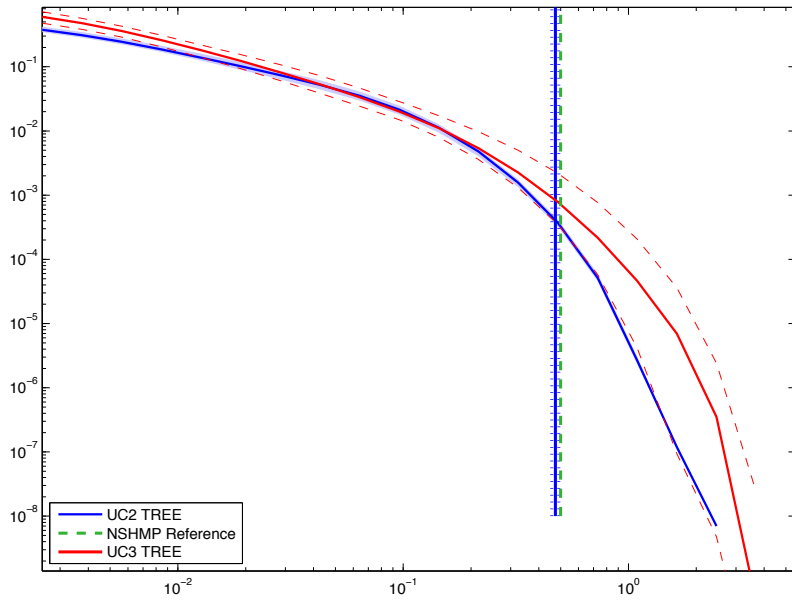
2% in 50

Northridge PGA

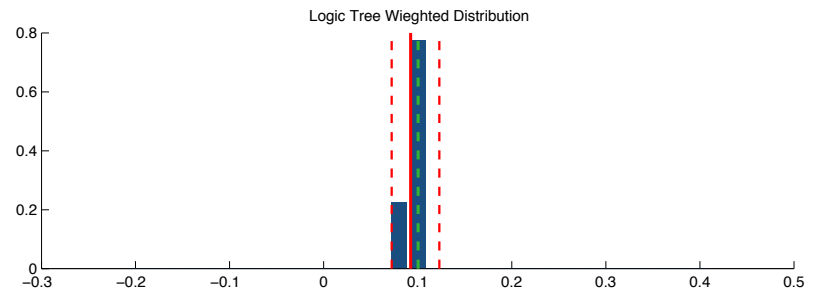
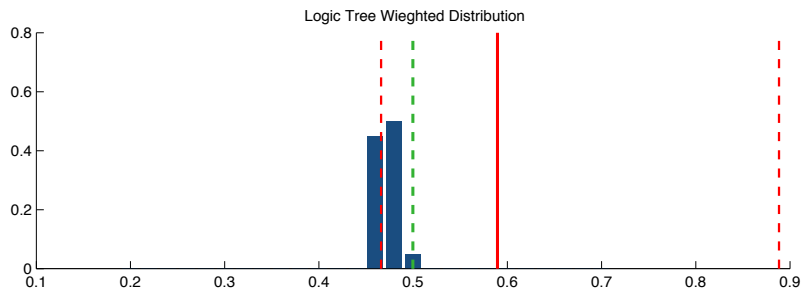
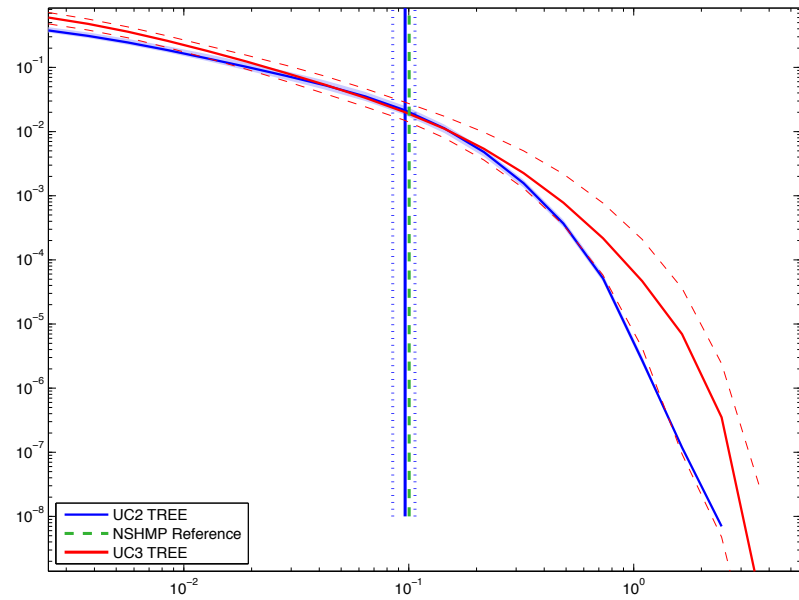
10% in 50

Hazard Curves: UCERF3 vs. UCERF2

Vallejo : 2in50 : 1Hz



Vallejo : 10in50 : 1Hz



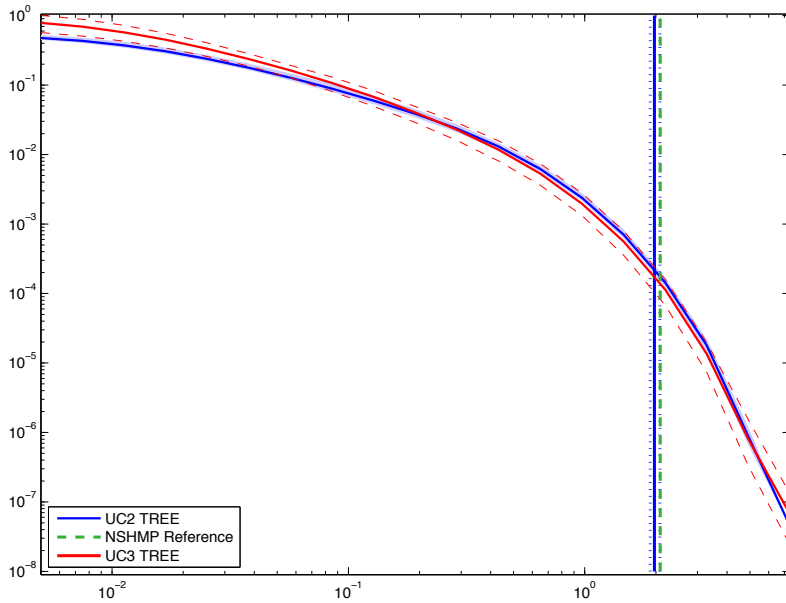
2% in 50

Vallejo 1Hz

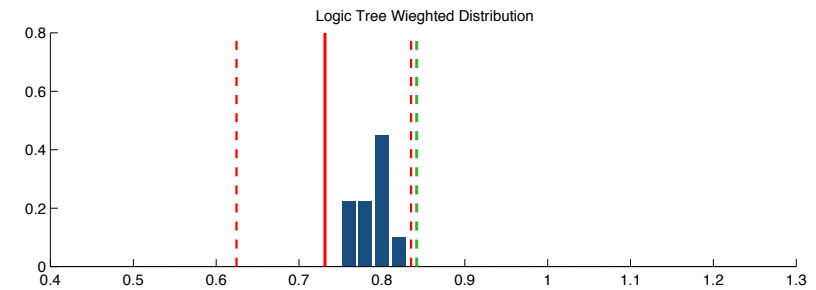
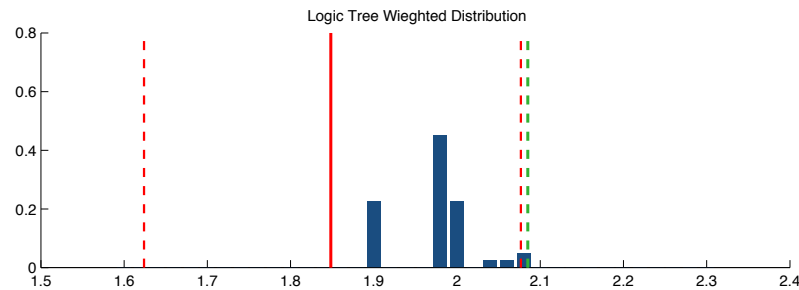
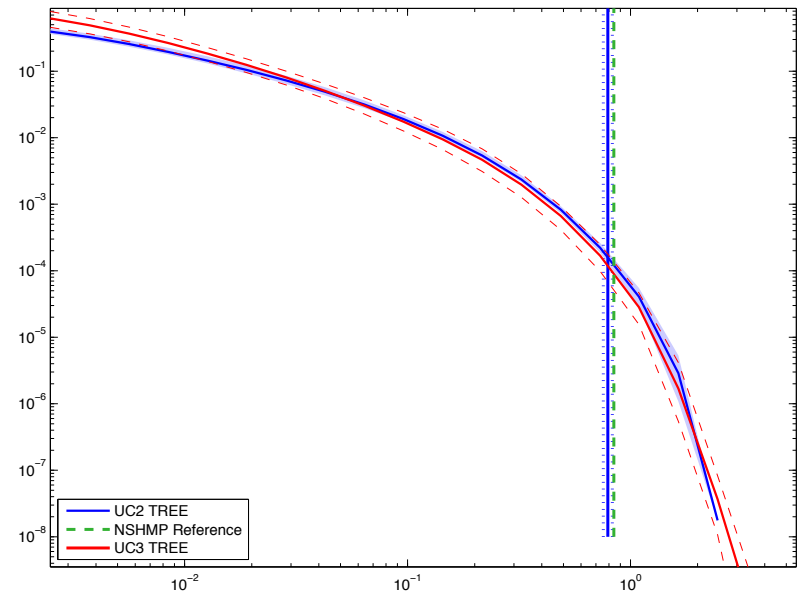
10% in 50

Hazard Curves: UCERF3 vs. UCERF2

San Francisco : RTGM : 5Hz



San Francisco : RTGM : 1Hz

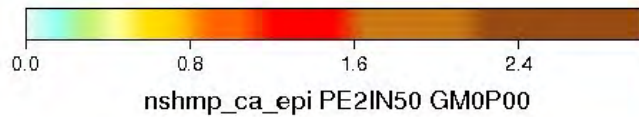
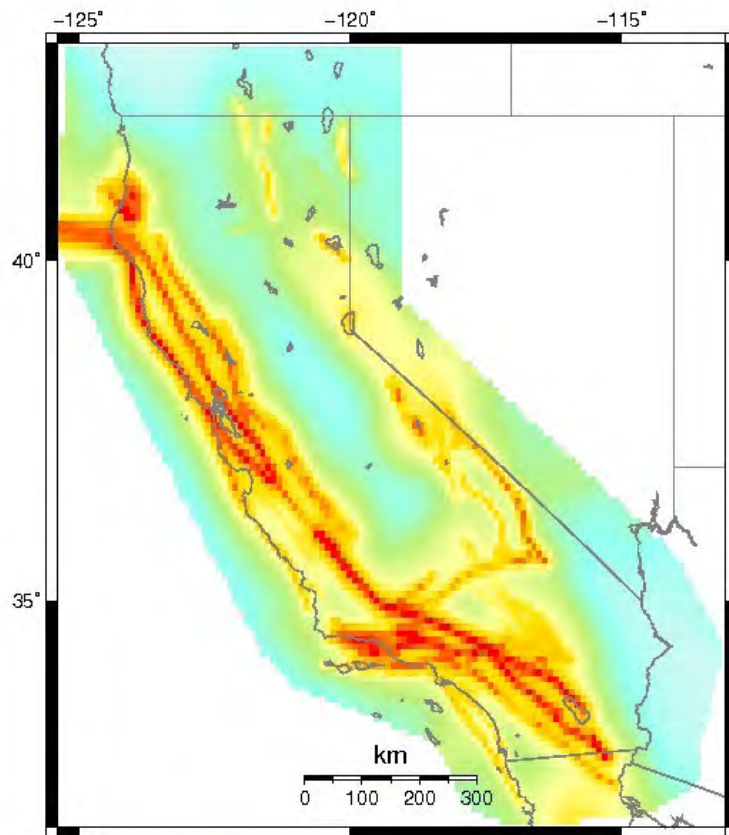


5Hz

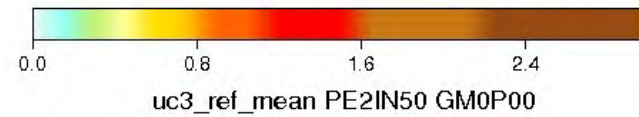
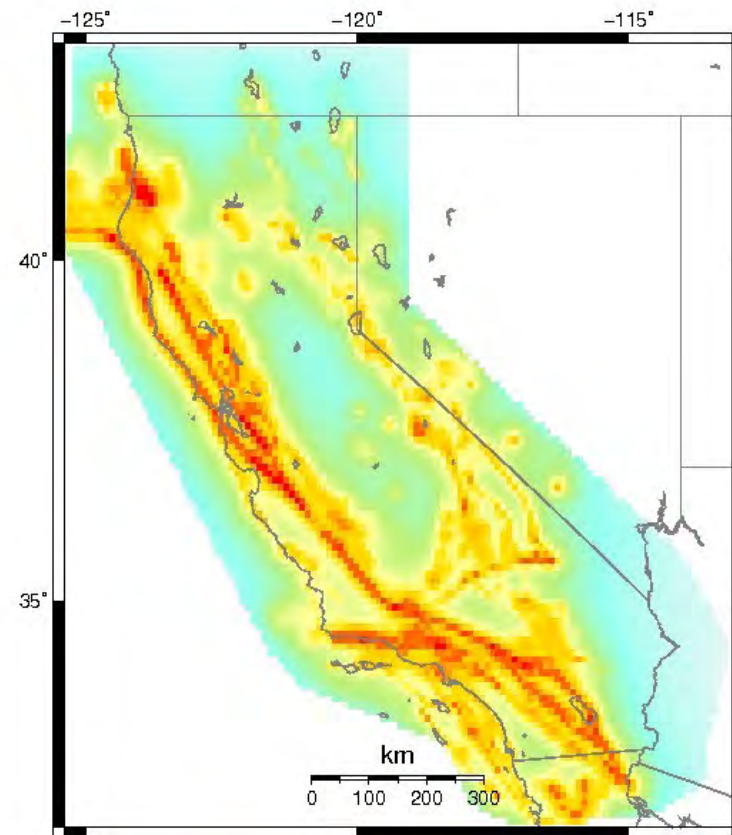
San Francisco RTGM

1Hz

Hazard Maps: UC2 vs. UC3 Reference



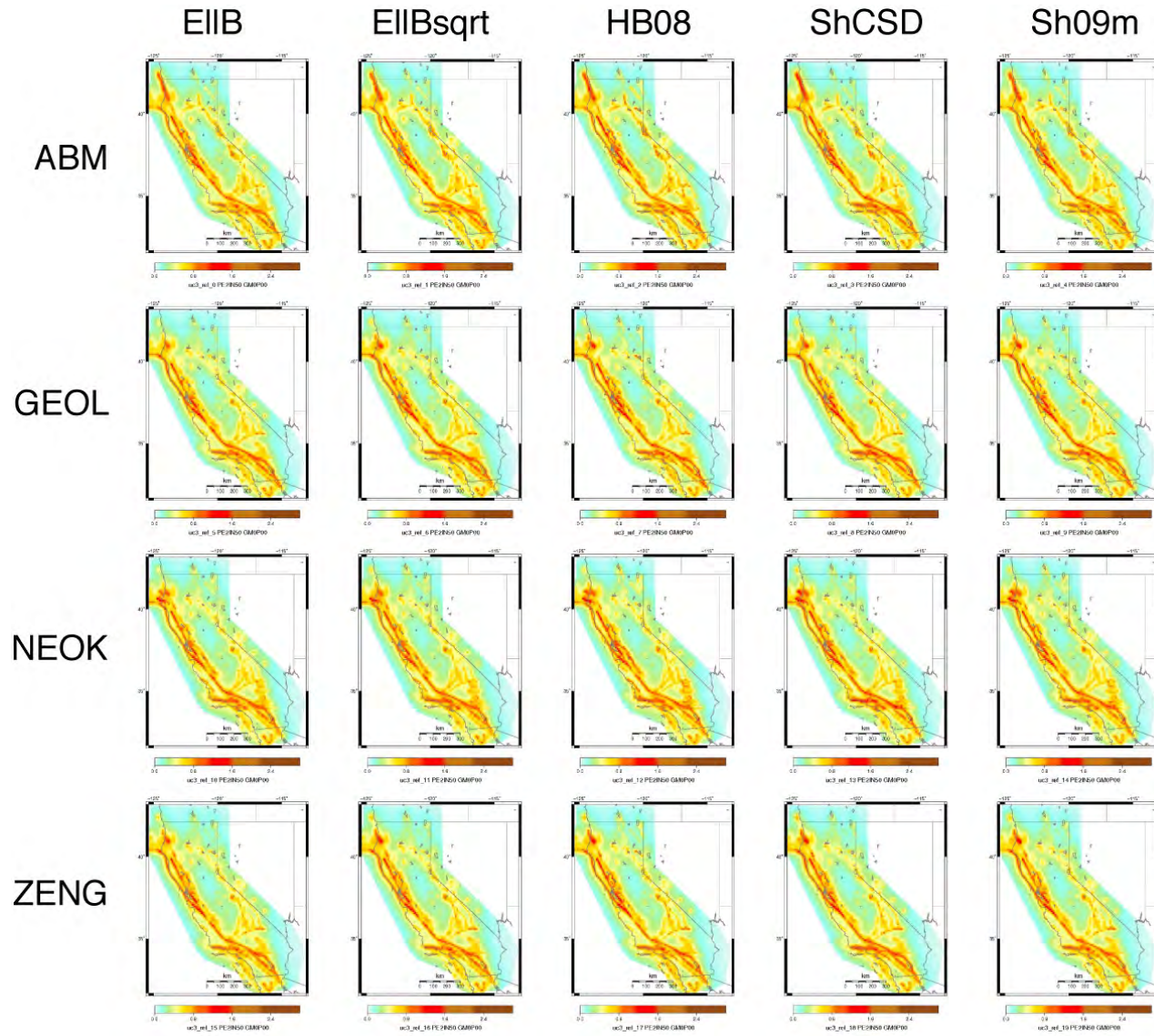
NSHMP/UCERF2



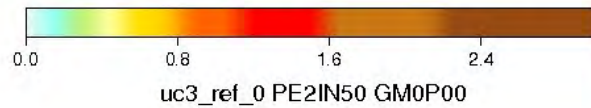
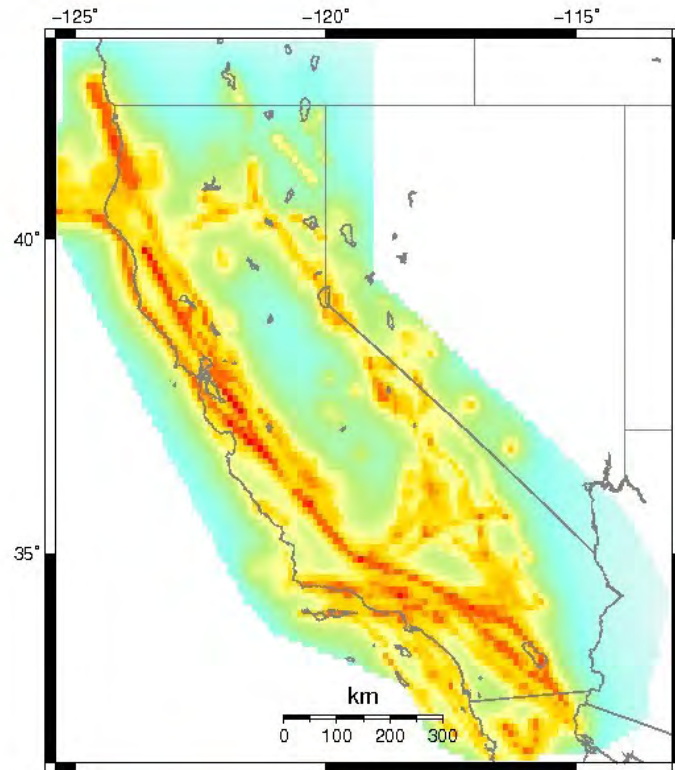
UCERF3

Hazard Maps: Ref. Branch Variations

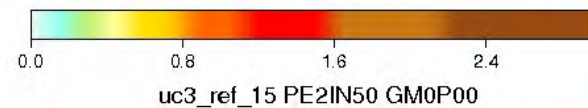
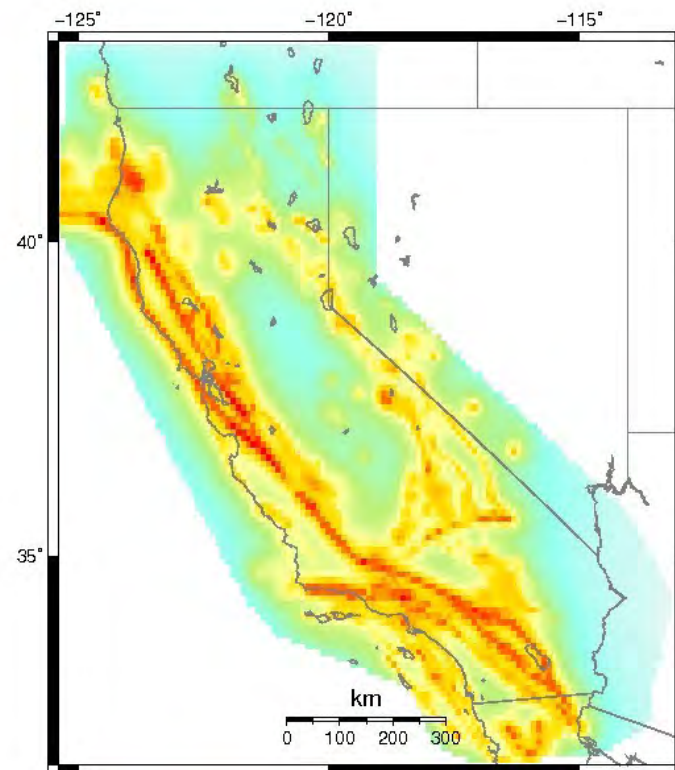
Variables:
 Deformation model
 Mag-Scaling relation



Hazard Maps: Ref. Branch Variations



ABM



ZENG

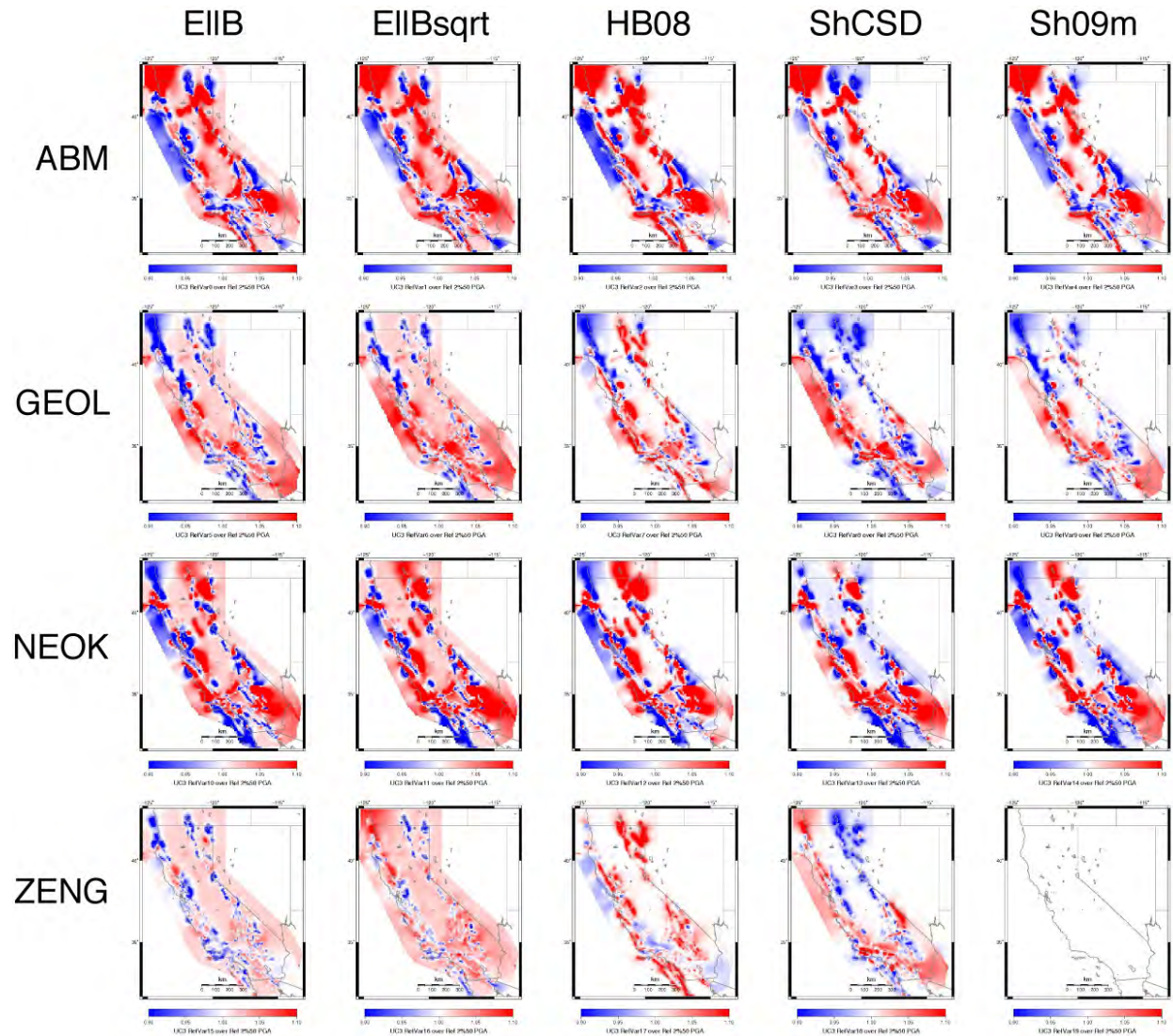
(both use EIB mag-scaling)

Hazard Maps: Ref. Branch Variations

Ratio of variant to reference branch

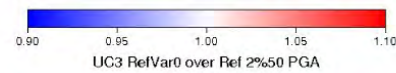
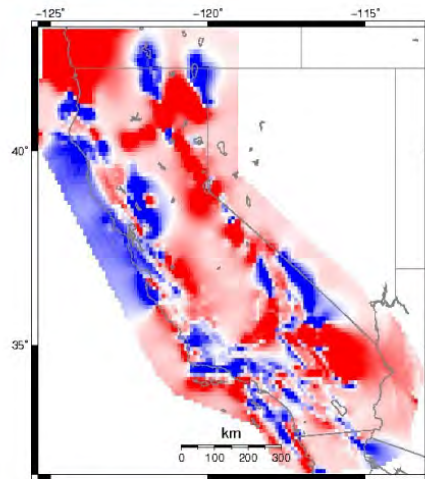
Variables:
Deformation model
Mag-Scaling relation

Scale: Ratio
(saturates at $\pm 10\%$)

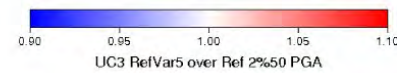
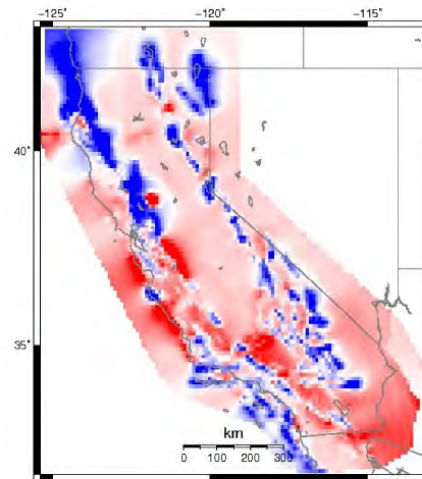


Hazard Maps: Ref. Branch Variations

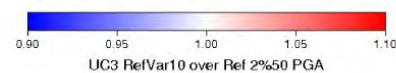
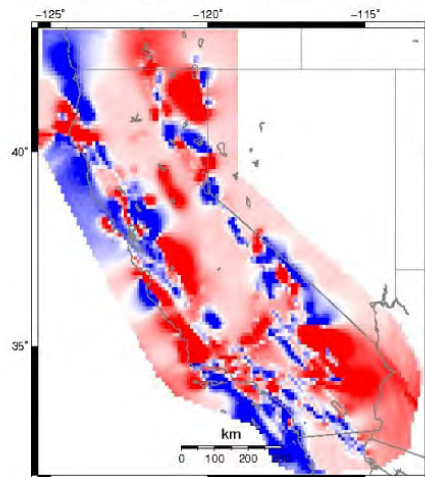
ABM



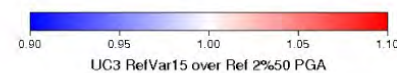
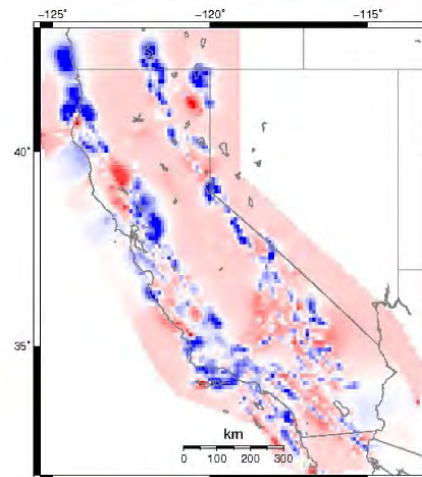
GEOL



NEOK



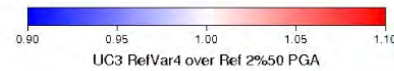
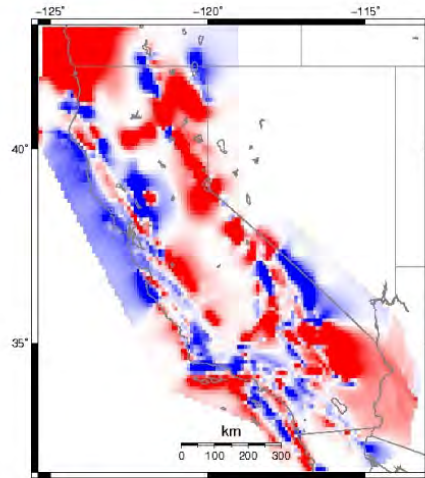
ZENG



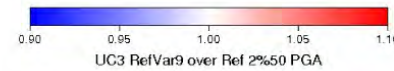
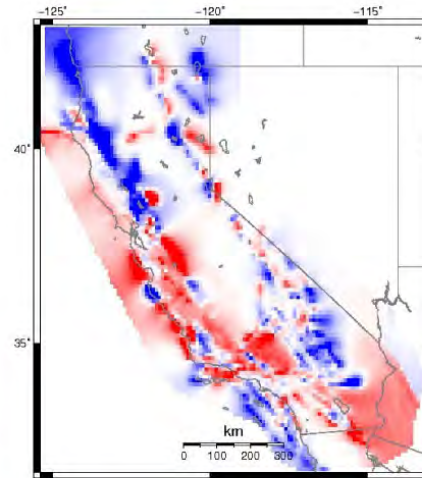
(EIBB mag-scaling)

Hazard Maps: Ref. Branch Variations

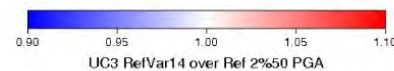
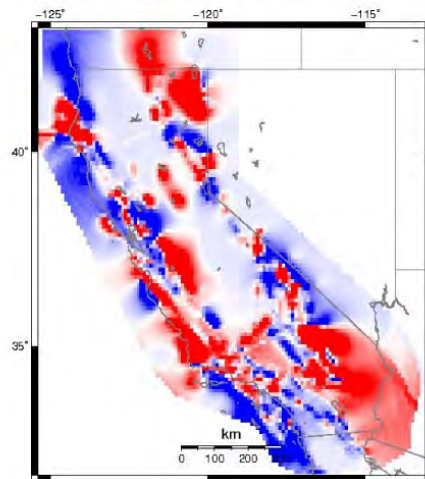
ABM



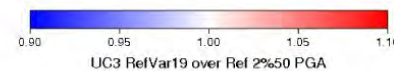
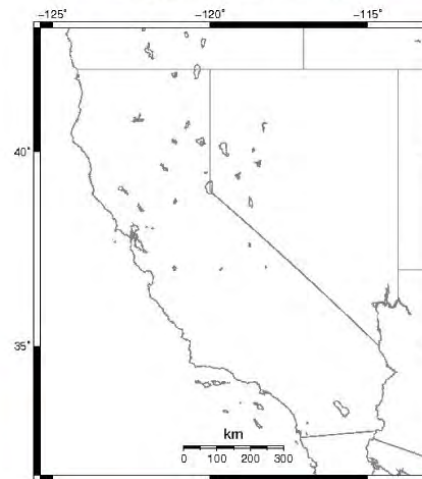
GEOL



NEOK



ZENG

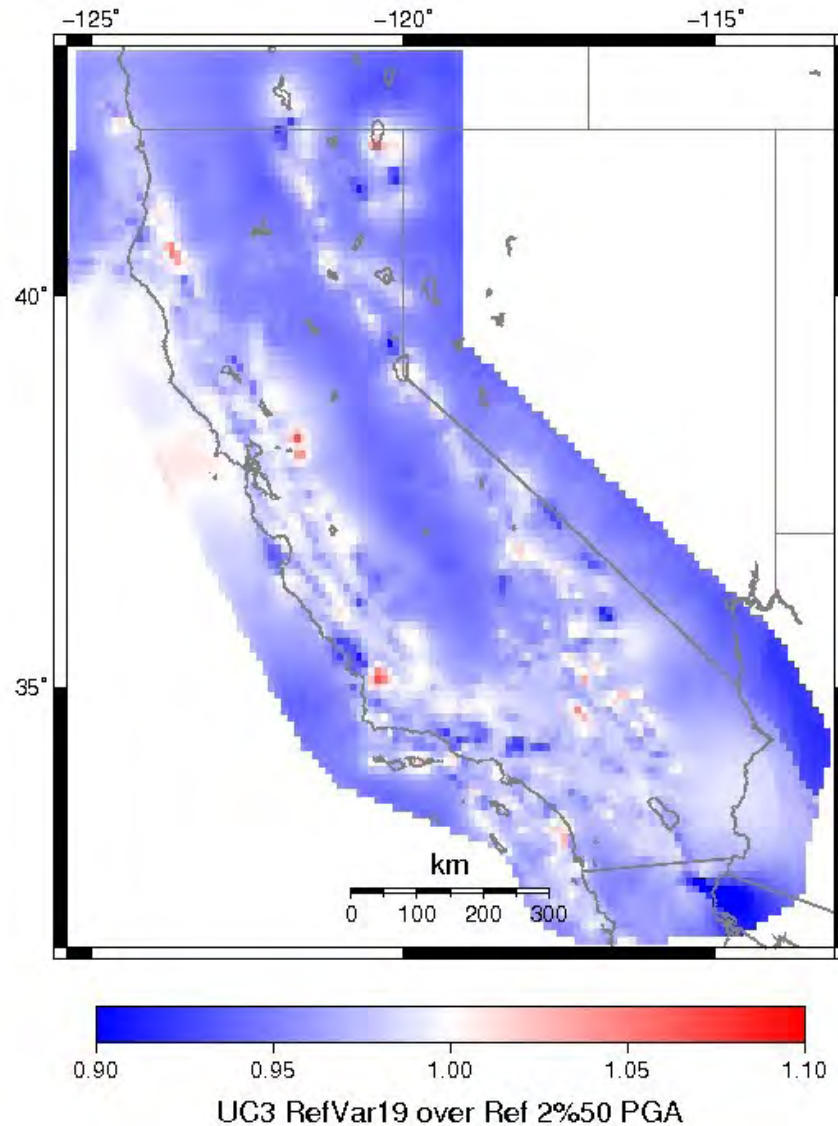


(SH09m mag-scaling)

Hazard Maps: Ref. Branch Variations

Effect of toggling rate of
M>5 earthquakes:

a=7.6 over a=8.7



Continued UCERF3 analysis...

- Map based comparisons of logic tree branches
 - Map matrices
 - Spatial evaluation of ground motion mean and std. dev.
- Repeat convergence and equation weight tests
- Deaggregation at sites
- Use multiple “reference” branches
- Provide comparisons online