# CyberShake Progress Update
## 3 November 2014 through 4 May 2015

## UGMS May 2015 Meeting

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**4 May 2015**

# *November 2014 UGMS Meeting*

- **Reviewed CyberShake Study 14.2 Results Using:**
  - **UCERF2**
  - **No Background Seismicity**
  - **3D Velocity Model: CVM-S4.26**
  - **Min Vs: 500 m/s**
  - **Velocity Meshing: 200m**
  - **Fault Meshing: 1000m**
  - **Rupture Generator: genslip v3.2 (Graves & Pitarka 2010)**
  - **Maximum Frequency: 0.5Hz**
  - **PSHA 3.0s, 5.0s, 10.0s curves**
  - **RotD100 3.0s, 5.0s, 10.0s curves**
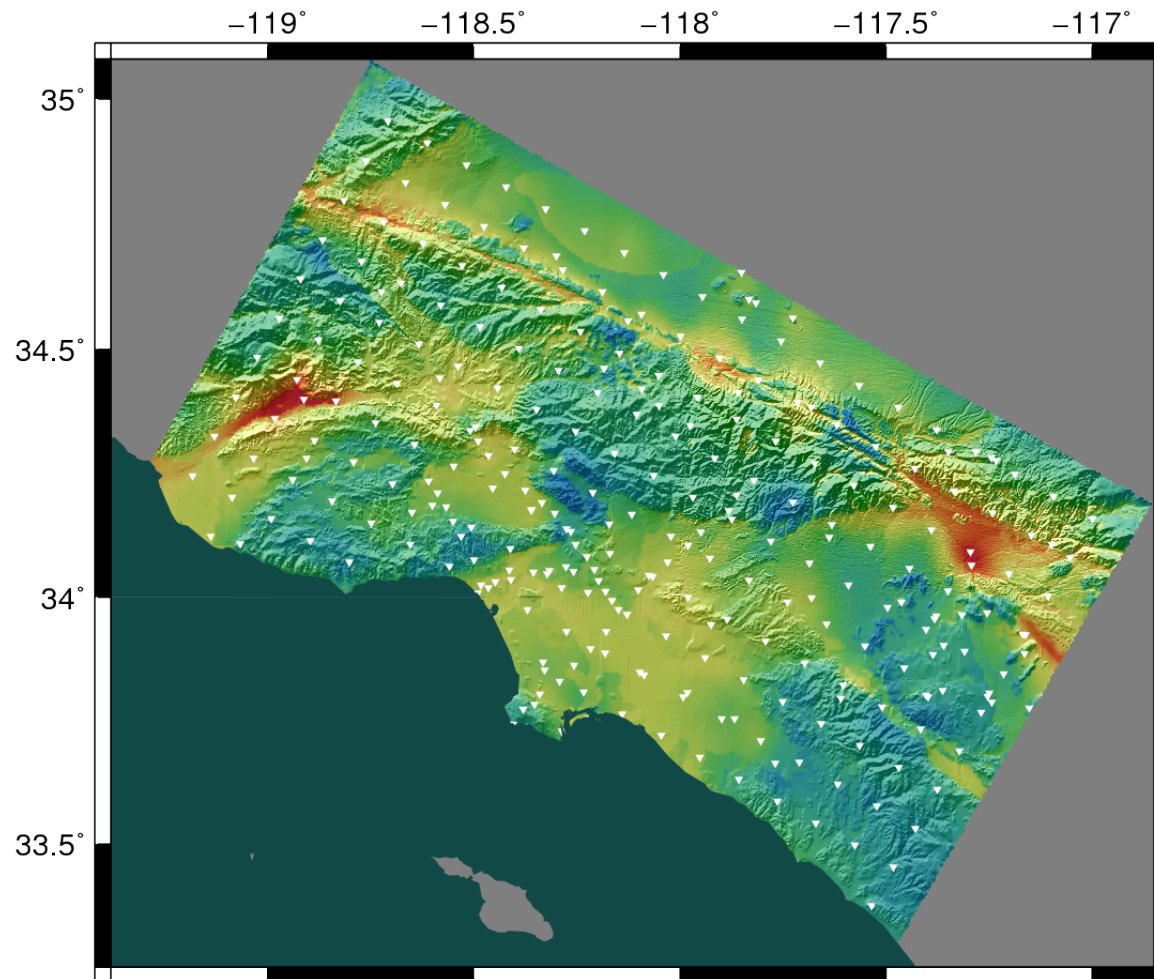
CyberShake Hazard Map, 3sec SA, 2% in 50 yrs

# *November 2014 UGMS Meeting*

- **CyberShake 14.2 Results Reviewed**
  - **PSA3.0, PSA5.0, PSA10.0 hazard curves and maps**
    - **Results from 286 Sites**
  - **RotD100 3.0s, 5.0s, 10s hazard curves**
    - **Results from 14 sites**
  - **MCER Probabilistic, Deterministic, Combined, Overall Curves**
    - **Results from 14 Sites**

- **CyberShake 14.2 Results Posted:**
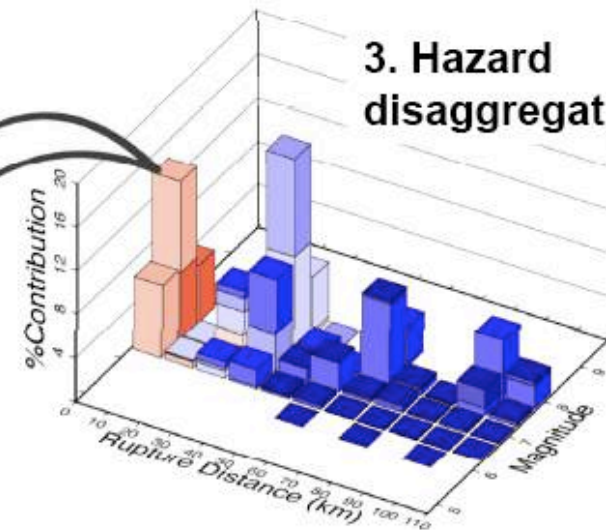  - **http://scec.usc.edu/scecpedia/CyberShake_MCER**

# *November 2014 UGMS MCER Sites*

# CyberShake Platform: Physics-Based PSHA
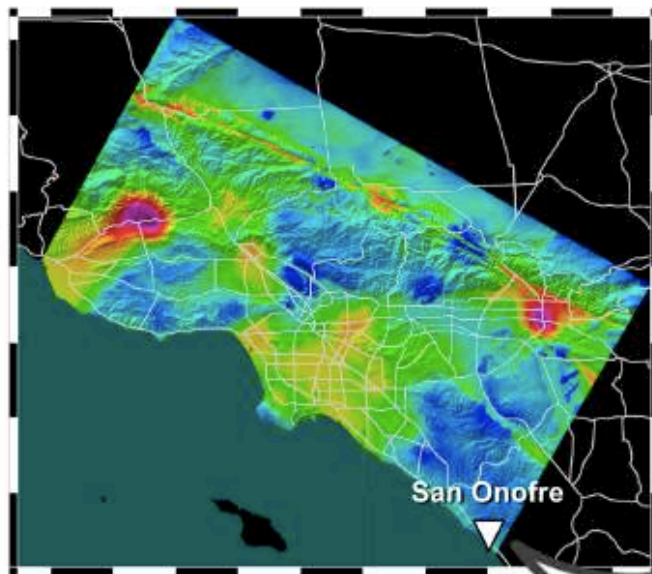


1. Hazard map
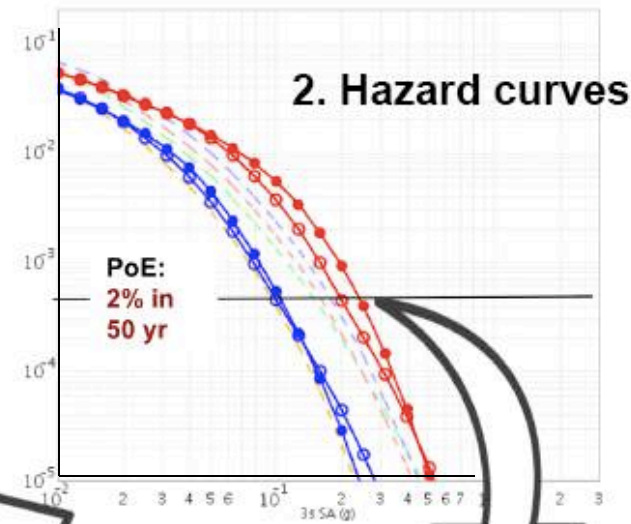
2. Hazard curves

3. Hazard disaggregation

4. Rupture model
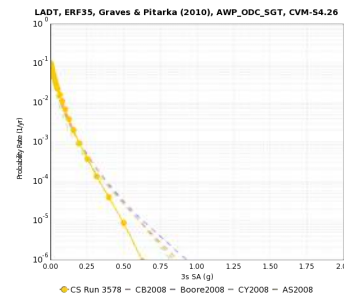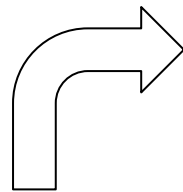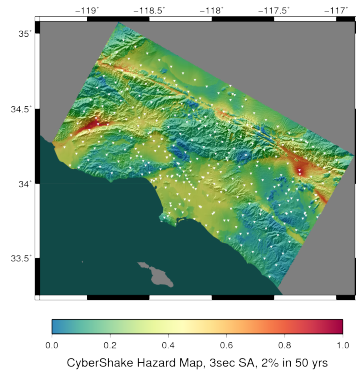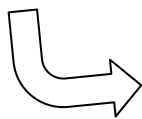
5. Seismograms
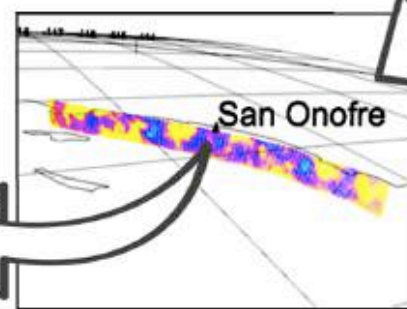
# CyberShake 14.2 Probabilistic Hazard Model Products

*CS 14.2 PSA3.0
Hazard Model (286 sites)*



CyberShake Hazard Map, 3sec SA, 2% in 50 yrs



LADT, ERF35, Graves & Pitarka (2010), AWP_ODC_SGT, CVM-S4.26



LADT Spectrum
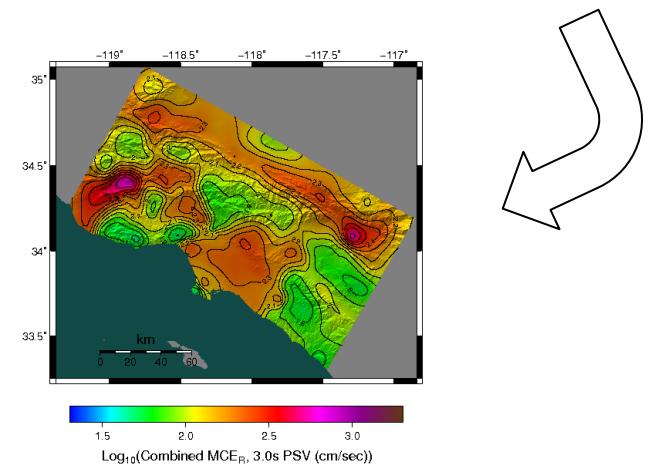
*CS 14.2 RotD100 3.0s
Probabilistic Hazard Curve
(LADT)*
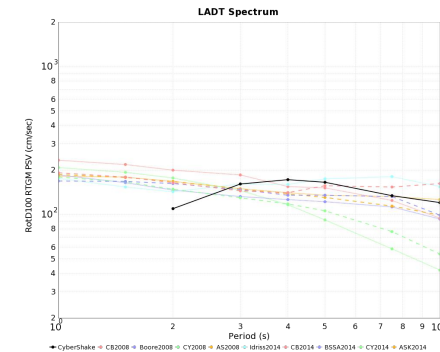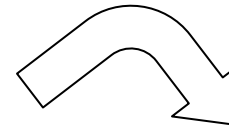
*CS 14.2 RotD100 3.0s Probabilistic,
Deterministic, Combined, Overall
MCER Curves (LADT)*



*GMPE Comparison Maps
Ratio (CS 14.2/ NGA-2)
RotD100 3.0s (286 Sites)*

CyberShake/GMPE MCE$_R$ Ratio, 3.0s PSV (cm/sec)



Log$_{10}$(Combined MCE$_R$, 3.0s PSV (cm/sec))
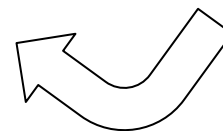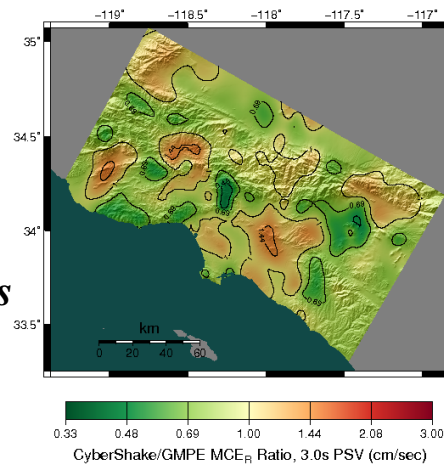
*CS 14.2 RotD100 3.0s
Probabilistic, Deterministic, Deterministic Lower
Limit, Combined  MCER Contour Maps (286 Sites)*

# CyberShake 14.2 RotD100 3s Probabilistic Hazard Curve (LADT)



LADT, ERF35, Graves & Pitarka (2010), AWP_ODC_SGT GPU, CVM-S4.26
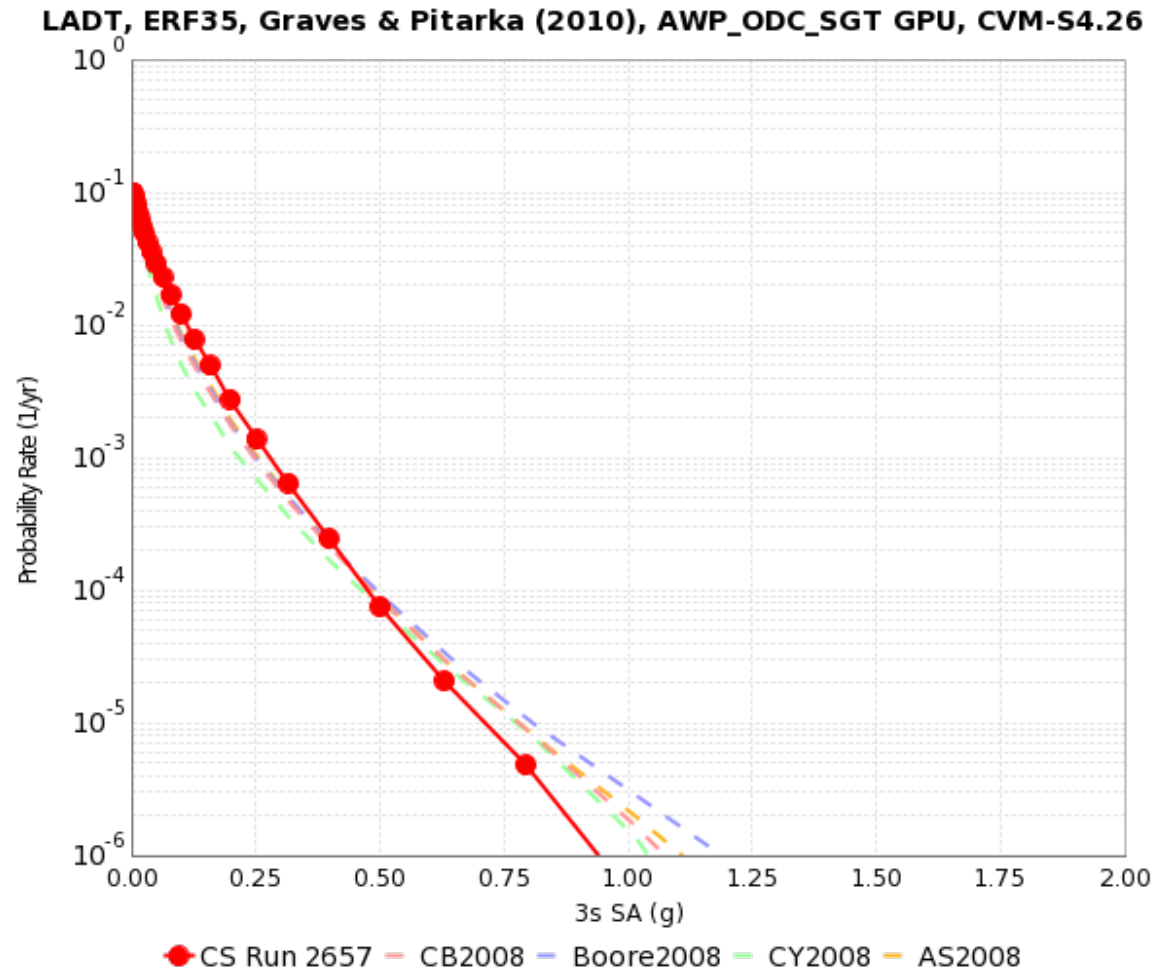
# CyberShake 14.2 Probabilistic MCER Curve (LADT)



LADT Spectrum
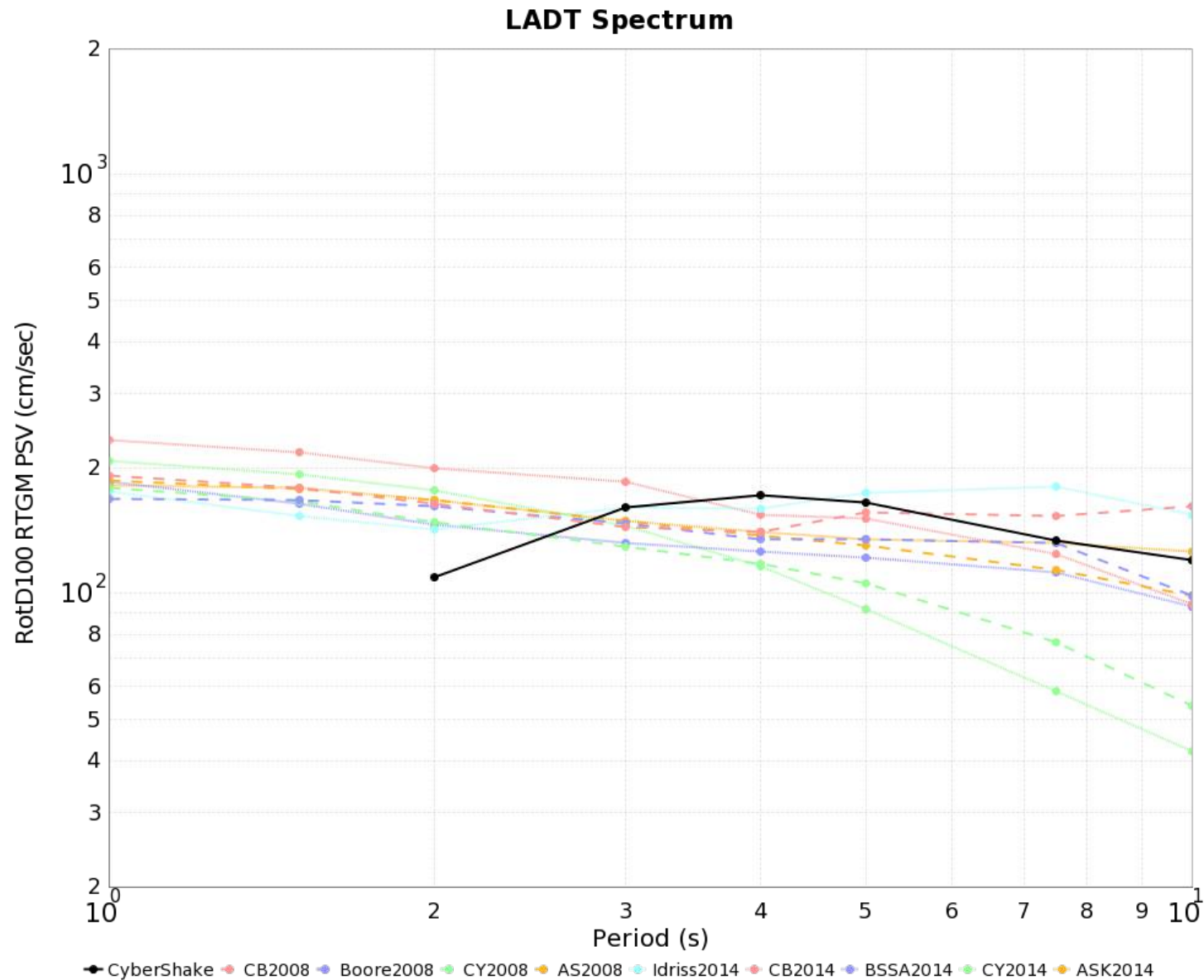
# *CyberShake 14.2 Deterministic MCER Curve (LADT)*



**LADT Spectrum**

Legend: CyberShake, CB2008, Boore2008, CY2008, AS2008, Idriss2014, CB2014, BSSA2014, CY2014, ASK2014
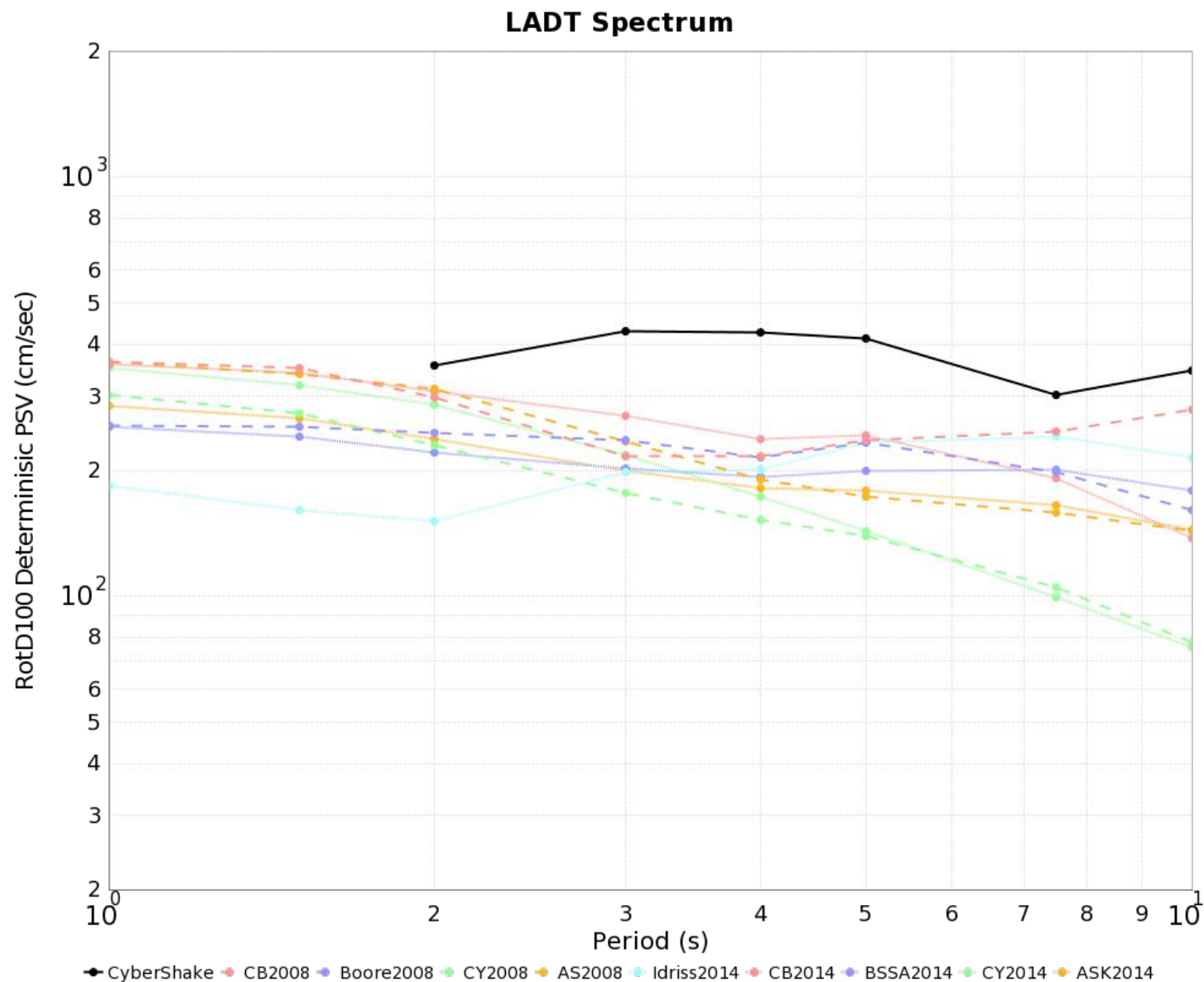
# CyberShake 14.2 Combined MCER Result (LADT)
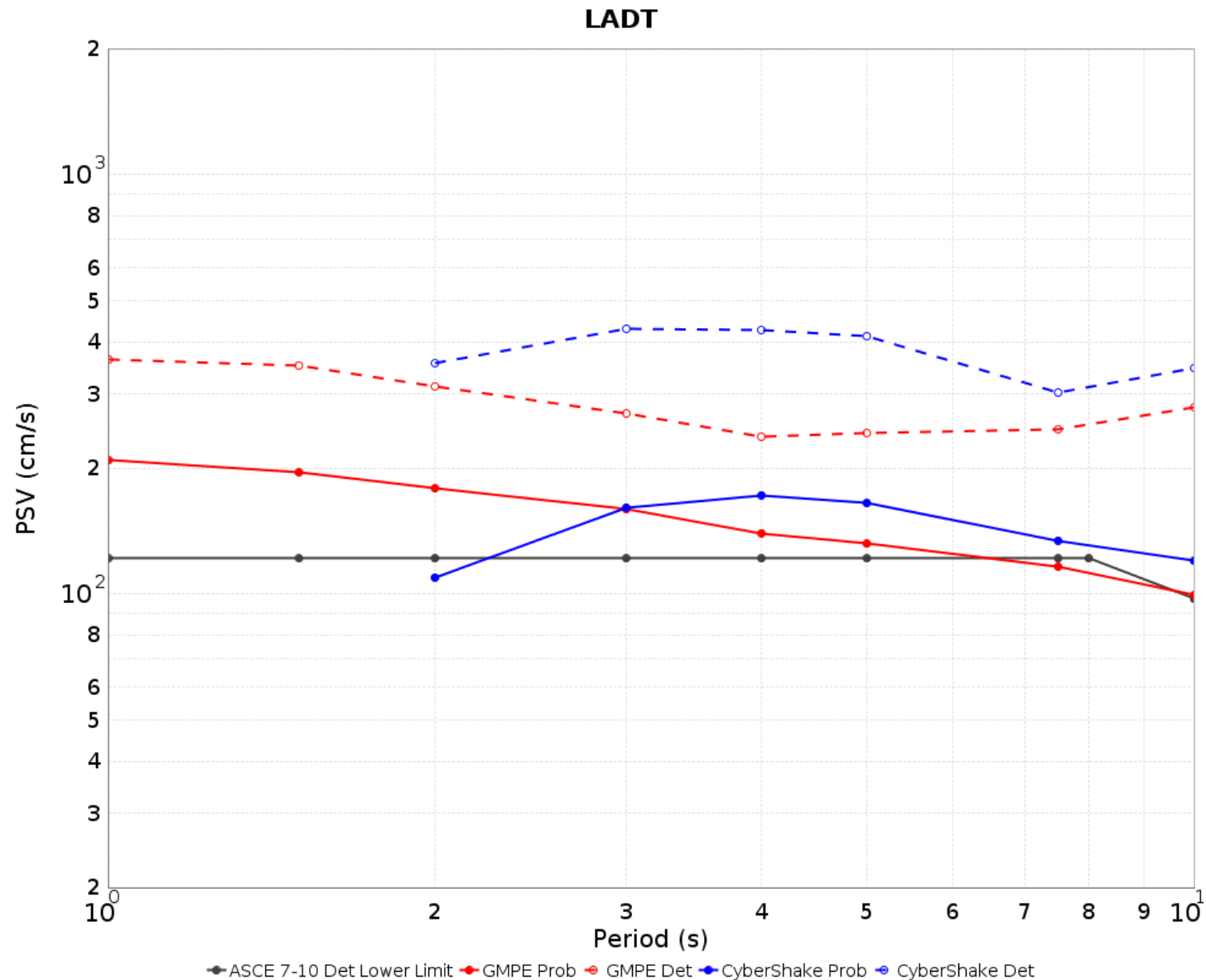
# CyberShake 14.2 Overall MCER Result (LADT)



**LADT MCER**
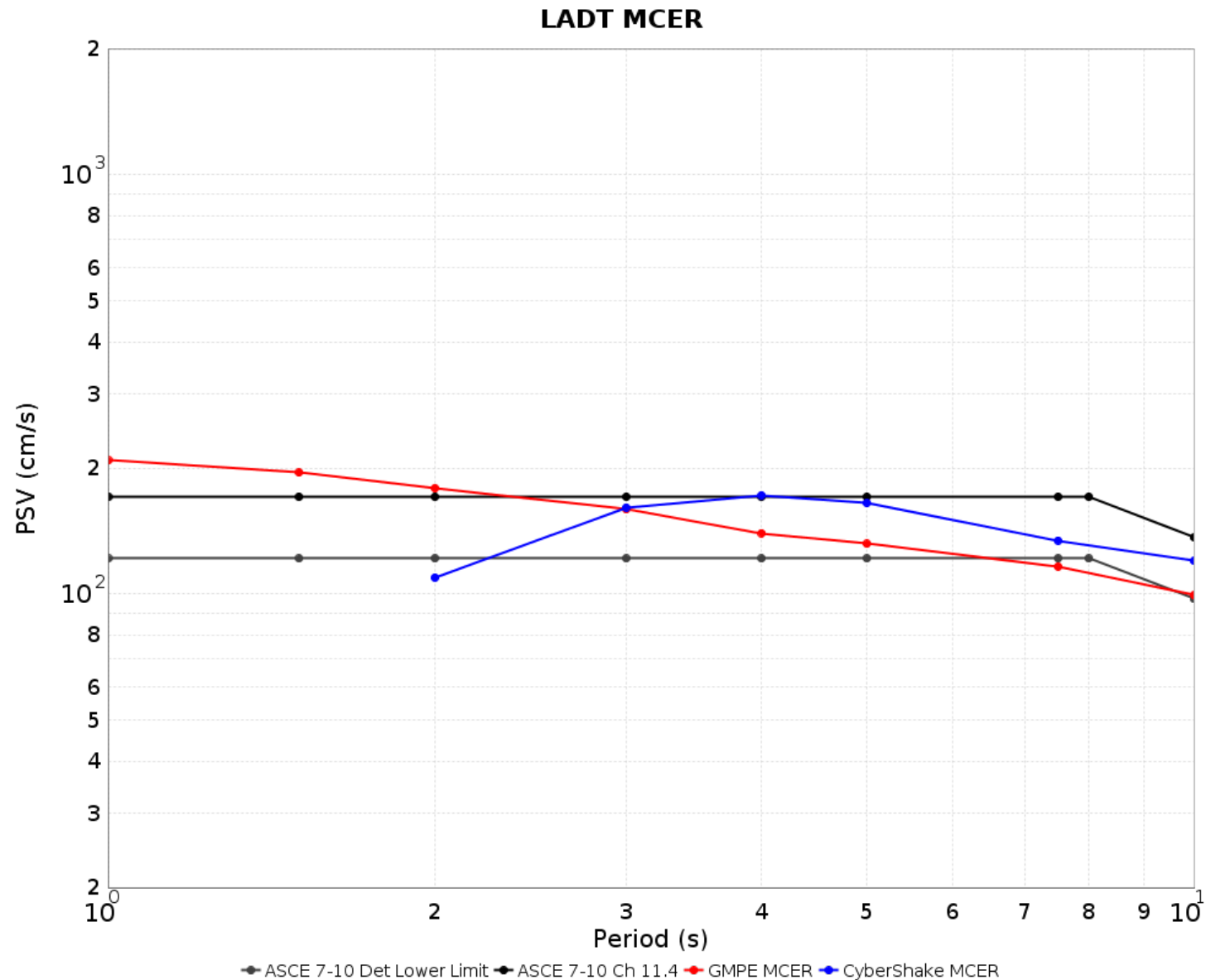
# *CyberShake 14.2 Probabilistic MCER 3s RotD100 (286 Sites)*
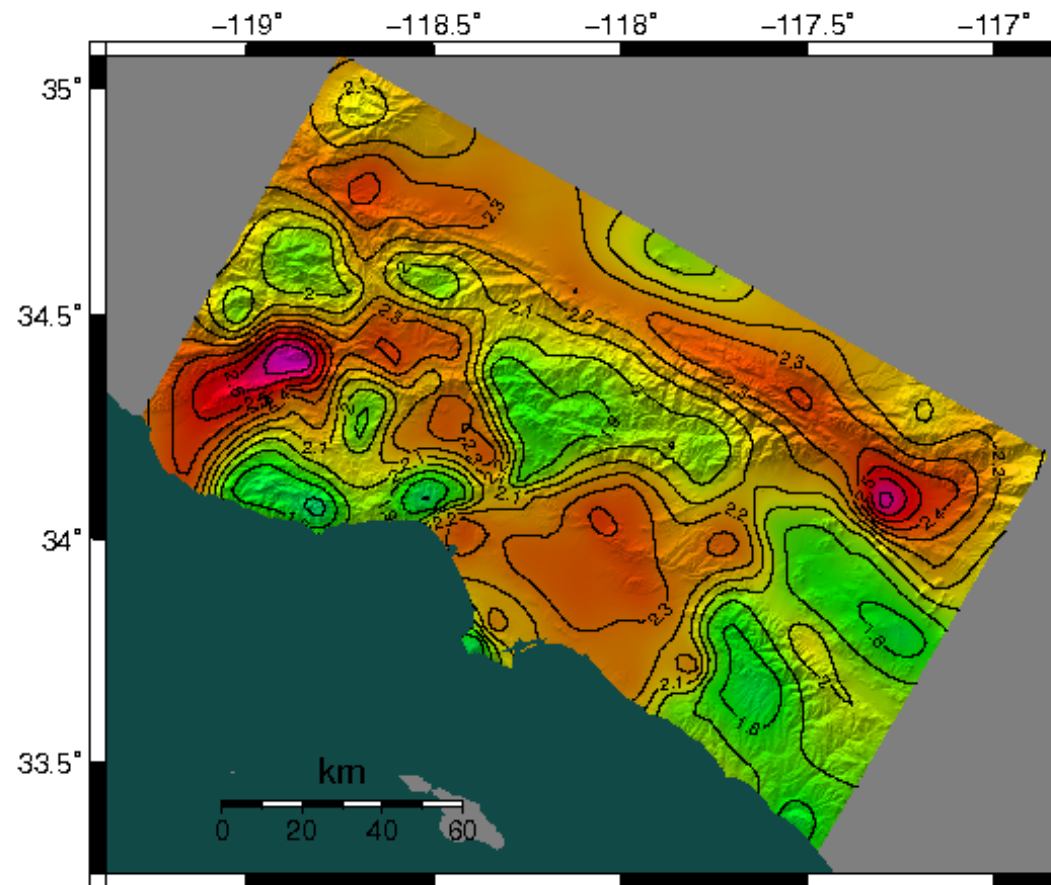


Log$_{10}$(Prob. MCE$_R$, 3.0s PSV (cm/sec))

# CyberShake 14.2 Deterministic MCER 3s RotD100 (286 Sites)
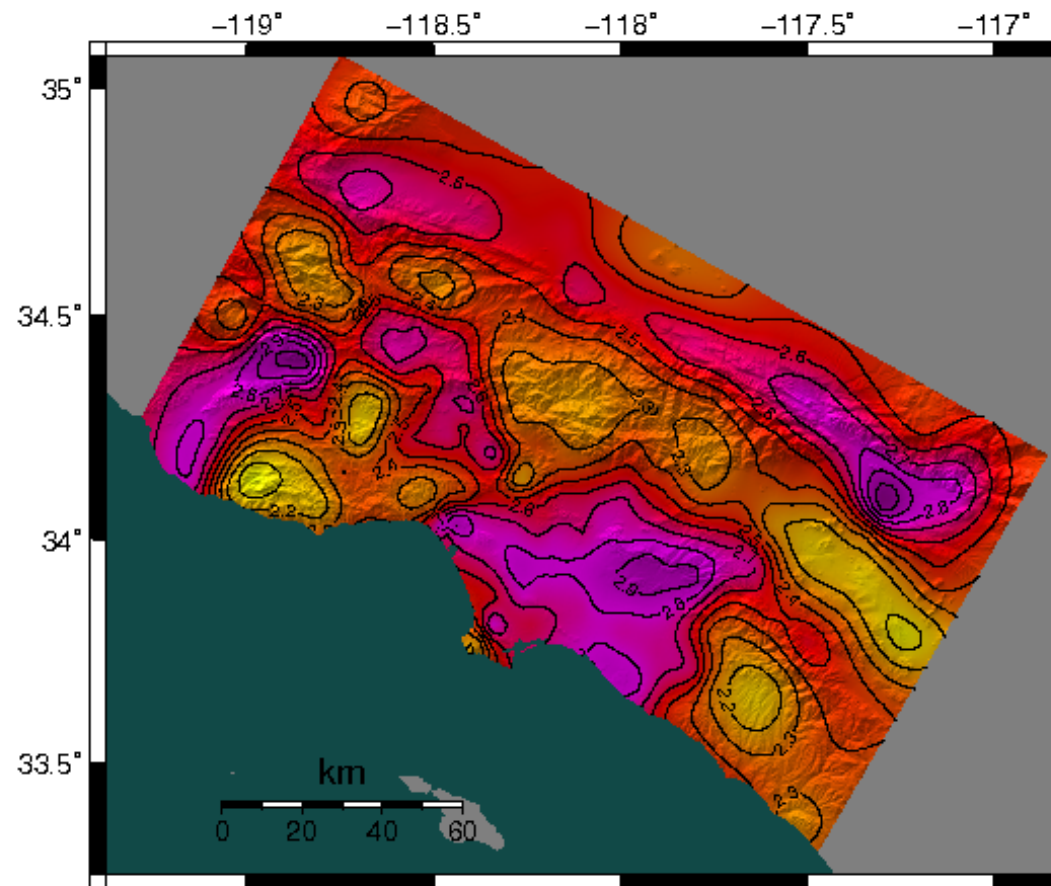


Log₁₀(Det. MCE_R, 3.0s PSV (cm/sec))

# CyberShake 14.2 Deterministic Lower Limit MCER 3s RotD100 (286 Sites)
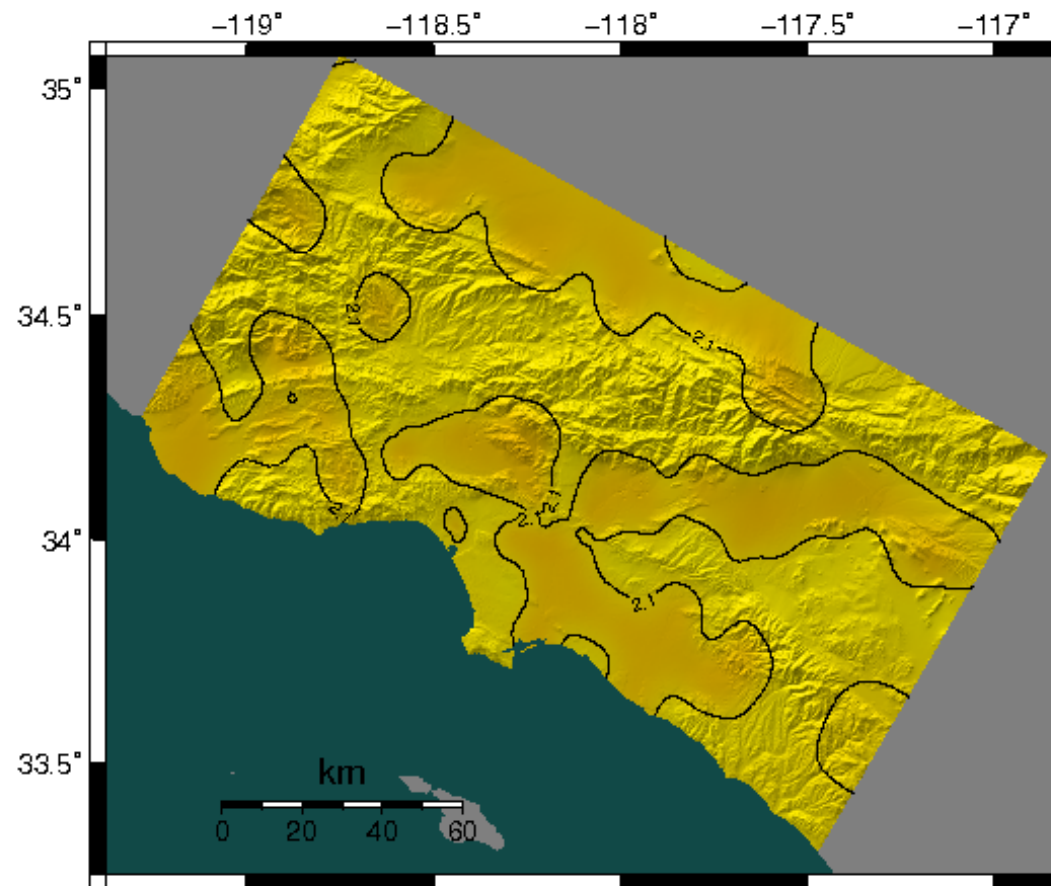


Log$_{10}$(Det. Lower Limit, 3.0s PSV (cm/sec))

CyberShake 14.2 Combined MCER Results
3s RotD100 (286 Sites)
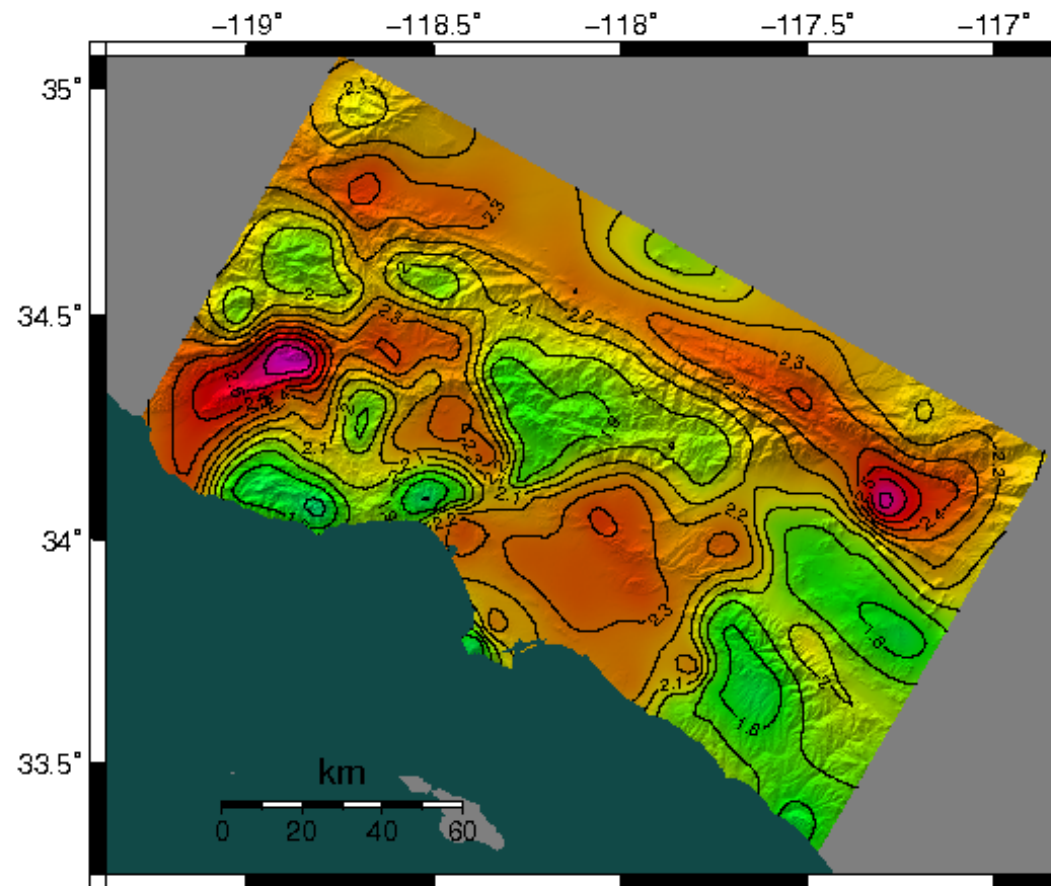
# GMPE (NGA-2) Combined MCER Results
## 3s RotD100 (286 Sites)
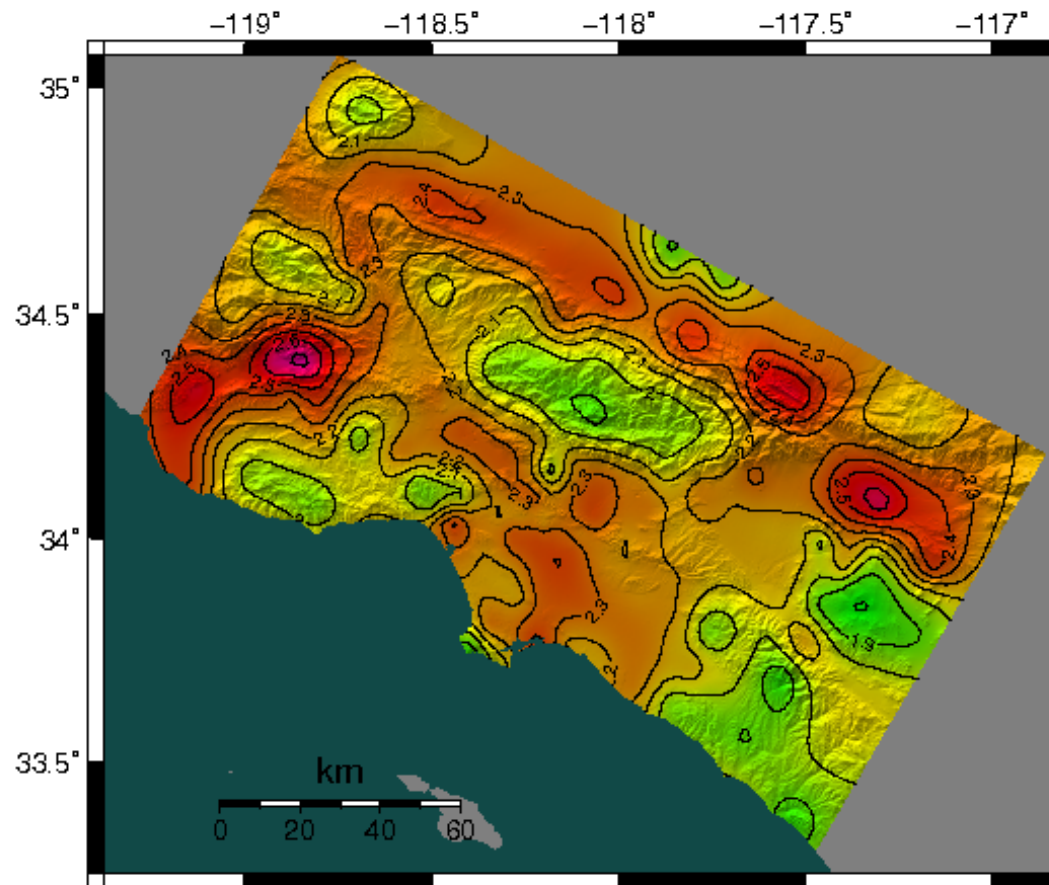


$Log_{10}$(GMPE Combined MCE$_R$, 3.0s PSV (cm/sec))

# GMPE Comparison Map
# Ratio (CyberShake 14.2 / NGA-W2) MCER Results
# 3s RotD100 (286 Sites)

CyberShake/GMPE MCE$_R$ Ratio, 3.0s PSV (cm/sec)

0.33   0.48   0.69   1.00   1.44   2.08   3.00
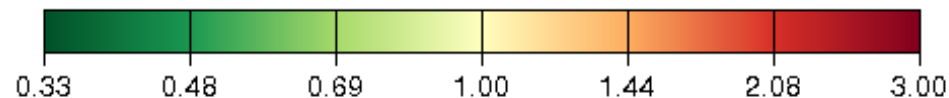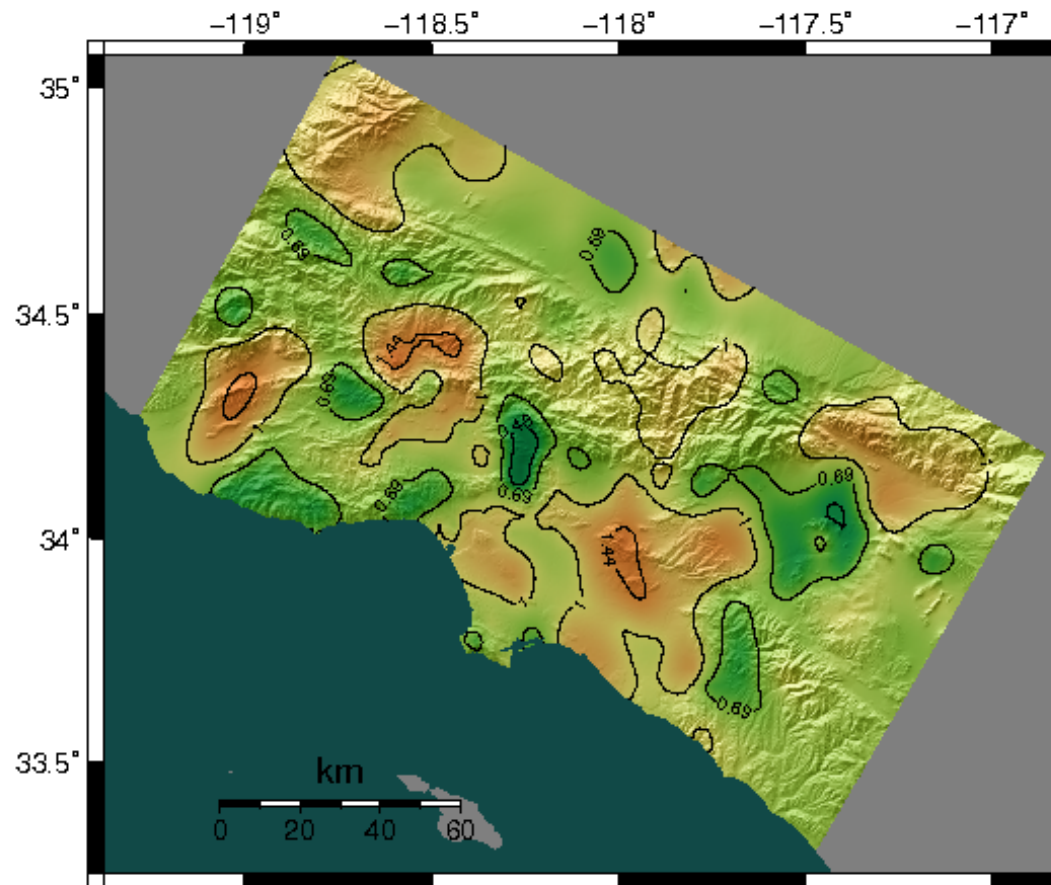
# *New CyberShake Computational Results*
# *May 2015*

1. **RotD100 3S, 5S, 10S amplitudes calculated for all 286 CyberShake 14.2 sites**

2. **MCER RotD100 3S, 5S, 10S Contour Maps using 286 CyberShake 14.2 sites**

3. **Comparison Maps CyberShake MCER 14.2 versus GMPE MCER NGA-2**

4. **Started CyberShake 15.4 Study to calculate 1Hz CS results for 336 sites in Los Angeles Region**

5. **Preliminary CyberShake 15.4 results for 14 sites**

# *November 2014 UGMS Meeting*

- **CyberShake Study 14.2**
  - **UCERF2**
  - **No Background Seismicity**
  - **3D Velocity Model: CVM-S4.26**
  - **Min Vs: 500 m/s**
  - **Velocity Meshing: 200m**
  - **Fault Meshing: 1000m**
  - **Rupture Generator: genslip v3.2 (Graves & Pitarka 2010)**
  - **Maximum Frequency: 0.5Hz**
  - **PSHA 3.0s, 5.0s, 10.0s curves**
  - **RotD100 3.0s, 5.0s, 10.0s curves**

# *May 2015 UGMS Meeting*

- **CyberShake Study 15.4**
  - **UCERF2**
  - **No Background Seismicity**
  - **3D Velocity Model: CVM-S4.26**
  - **Min Vs: 500 m/s**
  - **Velocity Meshing: 100m**
  - **Fault Meshing: 200m**
  - **Rupture Generator: genslip v3.3.1 (Graves & Pitarka 2014)**
  - **Maximum Frequency: 1.0Hz**
  - **PSHA 2.0s, 3.0s, 5.0s, 10.0s curves**
  - **RotD100 2.0s, 3.0s, 5.0s, 10.0s curves**

# CyberShake Study 15.4 sites (336)

Southern California Earthquake Center
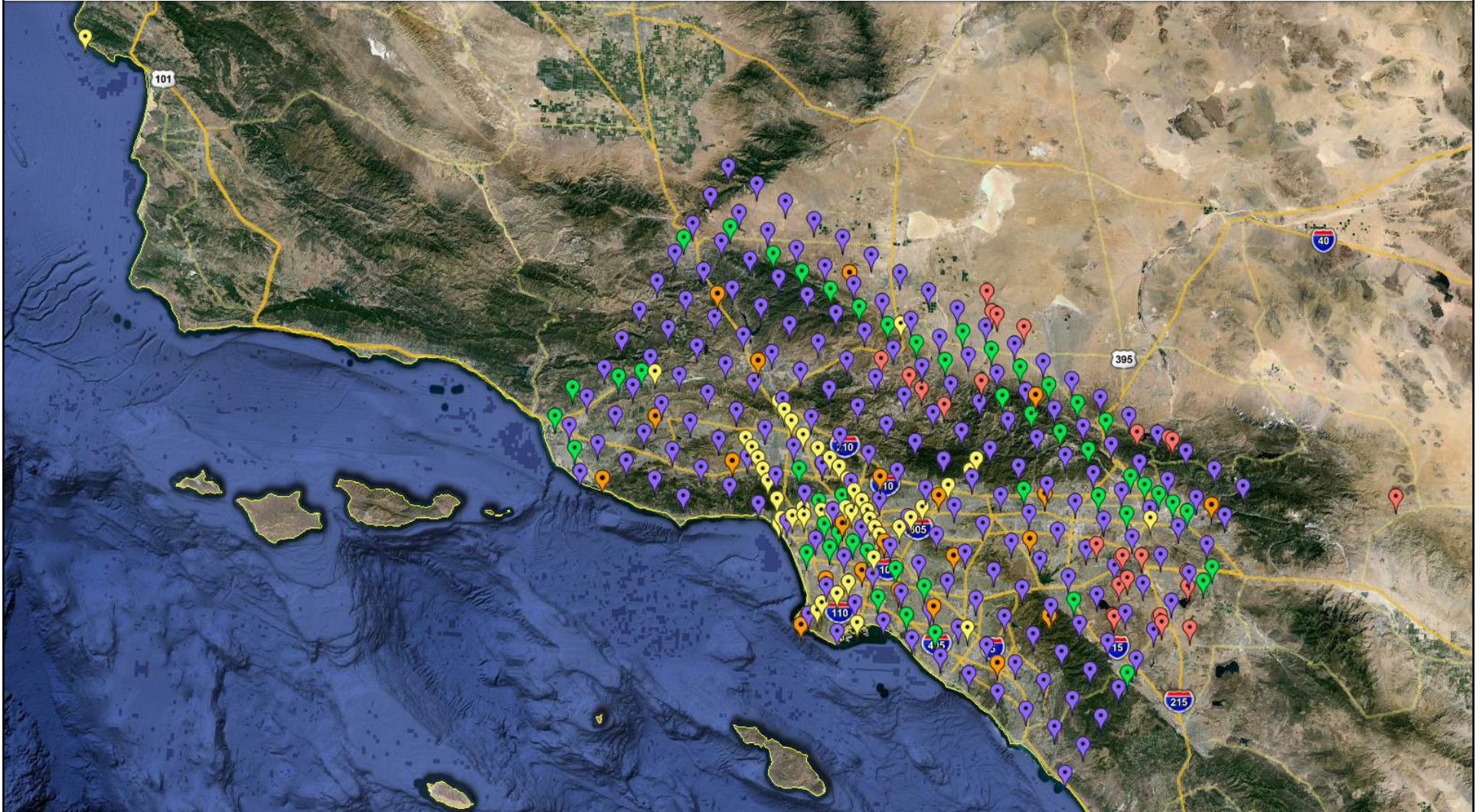
336 sites (10 km mesh + points of interest + "gap" sites) Green sites are the 50 new "gap" sites (Run 14 UGMS sites first )

# *Study 15.4 Parameters*

- **1.0 Hz deterministic**
  - **100 m spacing**
  - **dt=0.005 sec**
  - **nt=40000 timesteps**
- **CVM-S 4.26**
  - **Vs min = 500 m/s**
- **UCERF 2**
- **Graves & Pitarka (2014) rupture variations**
  - **200 m rupture grid point spacing**
- **Source filtered at 2.0 Hz**

# *Expected Study 15.4 Data Products*

- **CVM-S4.26 Los Angeles-area hazard maps**
  - **RotD100 2, 3, 4, 5, 7.5, 10 sec**
  - **RotD50 2, 3, 4, 5, 7.5, 10 sec**
  - **Geometric mean 2, 3, 5, 10 sec**
- **Hazard curves for 286 sites, at 2s, 3s, 5s, 10s**
- **336 sets of 2-component SGTs**
- **Seismograms for all ruptures (~160M)**
- **Peak amplitudes in DB for 2s, 3s, 5s, 10s**
  - **RotD100, RotD50 and geometric mean SA**

# *New Computational Results For May 2015*

- **Initiate CyberShake 15.4 Study using NSF and DOE Computers**
  - Los Angeles region Hazard Model based on 336 sites at 1Hz
  - Estimated 40M Computer Hours
  - Estimated 500TB+ temporary data at DOE,NSF Computers
  - Estimated 11TB persistent data at SCEC

# *Estimated CyberShake 15.4 Computational Duration*

- **Estimated computational run-time is 12 weeks (11 running + 1 downtime)**
  - **Using DOE Titan (Oak Ridge Leadership Computing Facility)**
  - **Using NSF Blue Waters (NCSA)**

- **Current Status: Preliminary results for 40 of 336 Sites Completed**

# *May 2015 UGMS Meeting Discussion Topics*

- **Review of new CyberShake 14.2 Computational Data Products (0.5Hz Results)**
  - **RotD100 MCER results for 286 sites**
  - **MCER Contour Maps using 286 sites**
  - **CyberShake / GMPE Comparison Maps using 286 Sites**

- **Preliminary Analysis of CyberShake 15.4 results for 14 Sites (1.0Hz Results)**
  - **RotD100 MCER results for 14 sites**

End