SCEC Perspective on Simulation Validation in SCEC5

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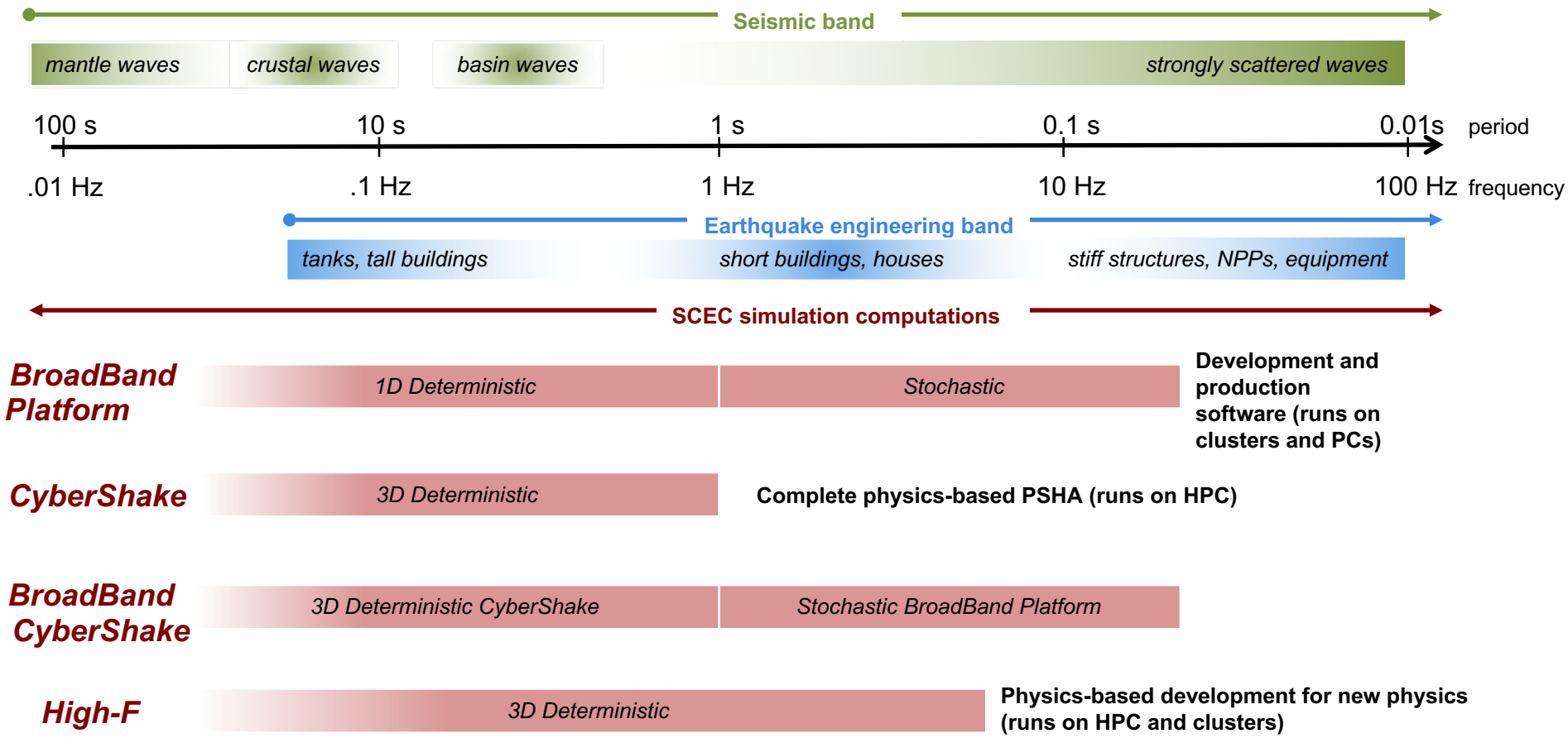
SCEC
an NSF + USGS center

SCEC ground-motion simulation platforms



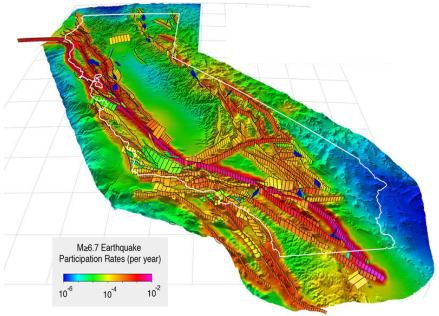
Key lessons learned – past validations

Need transparent validation for forward simulations for source, wave propagation, site effects!

Validation objective and process needs to consistent with application.

- Requires non-modelers to run the codes, tie-in to versioned code.
- Need clear documentation of fixed and optimized parameters from modelers for each region (M-A scaling, stress drop/parameter, etc.)
- Need source description that is *consistent* between methods, or defined as part of the rules.
- Need to allow for randomization of parameters (source realizations, hypocenter locations, etc.)
- Need to validate against many events
- Make all validation metrics computation and plots part of processing pipeline.

Ingredients for ground motion simulations



Earthquake Rupture Forecast
(e.g. UCERF)

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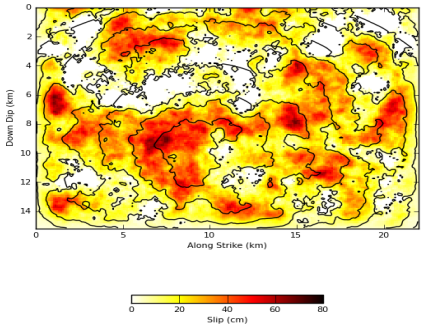

Source model

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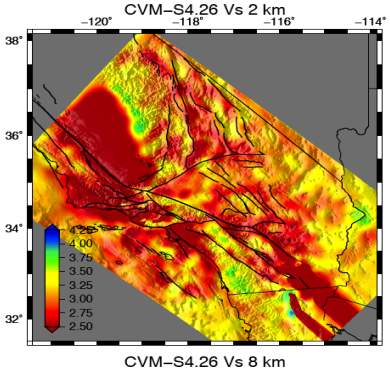

Velocity model

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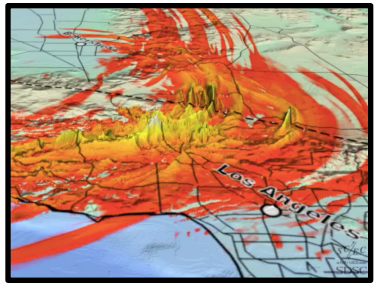

Wave propagation code

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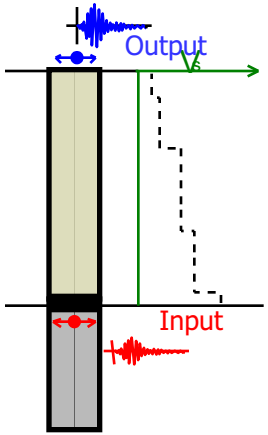

Site response code

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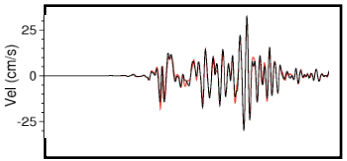
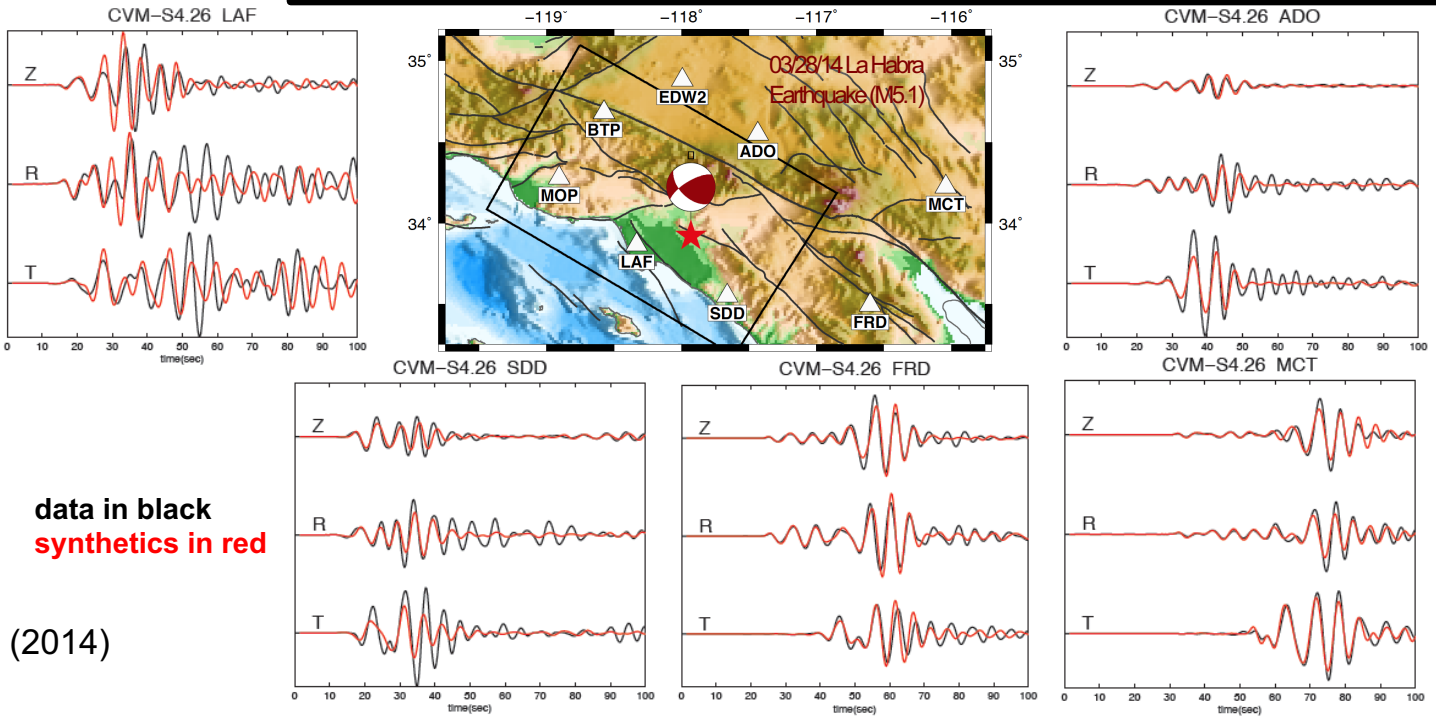


Seismograms
and intensity measures

Validation of CVMs

Validation of CVM-S4.26 synthetics against data from the 03/28/14 La Habra Earthquake (M5.1)
f≤0.2 Hz

- Validate against waveforms not used in model inversion/model development
- Use of optimized source ok



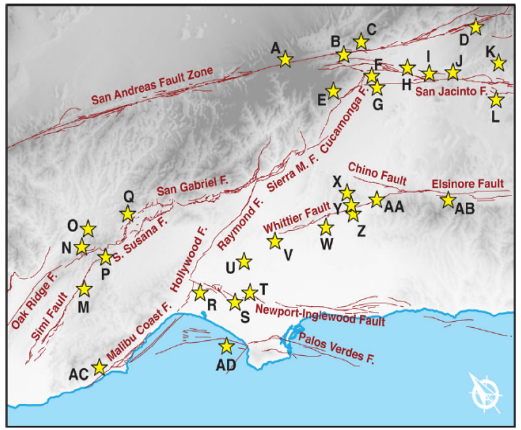
data in black
synthetics in red

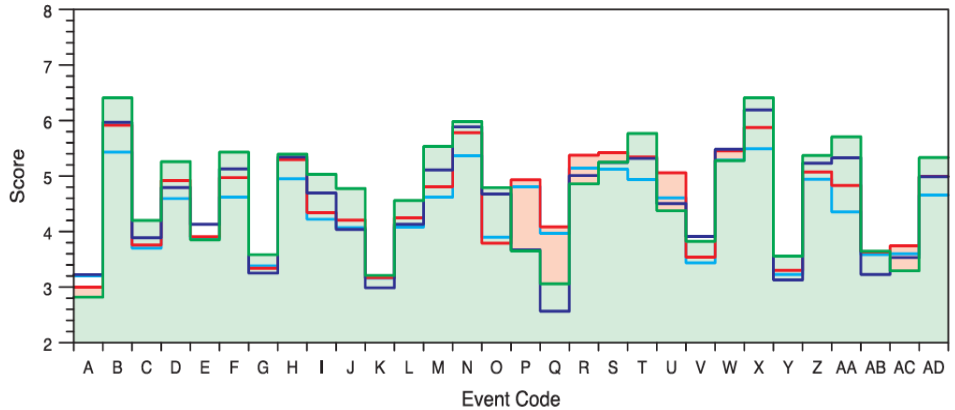
Lee et al. (2014)

F3DT

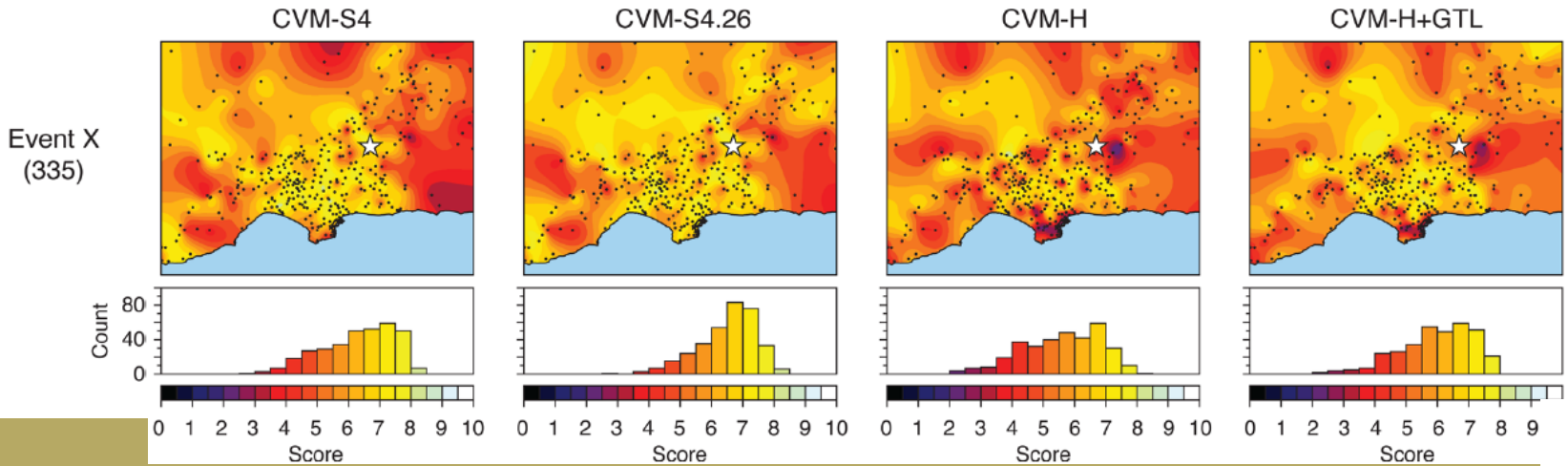
Validation of velocity models

Taborda et al. (2016) *Geophys. J. Int.*





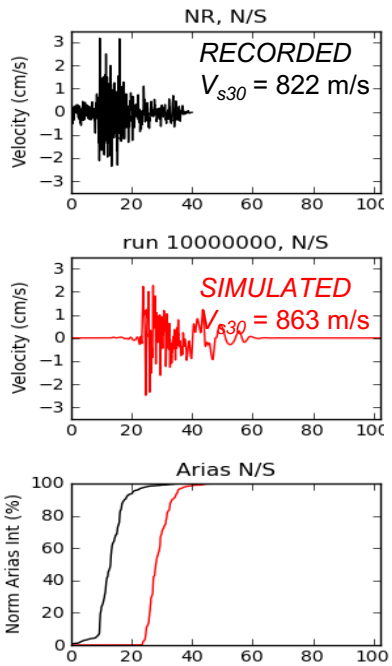
Model	Mean FS
S4.26	4.87
S4	4.75
H+GTL	4.82
H	4.60

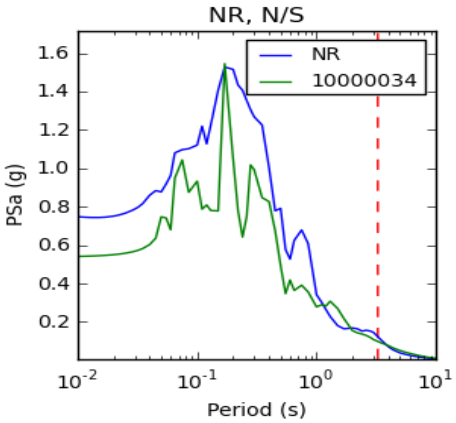


High-F

Validation of ground motions (qualitative)

- Validation of ground motions – from the source to the surface
  - Visual/qualitative assessment of waveforms, Husid plots, FAS plots
  - Validation performed with “forward sims” in mind
  - Multiple realizations, can span various geometries/areas, hypocenter location, slip displacement and velocity distributions

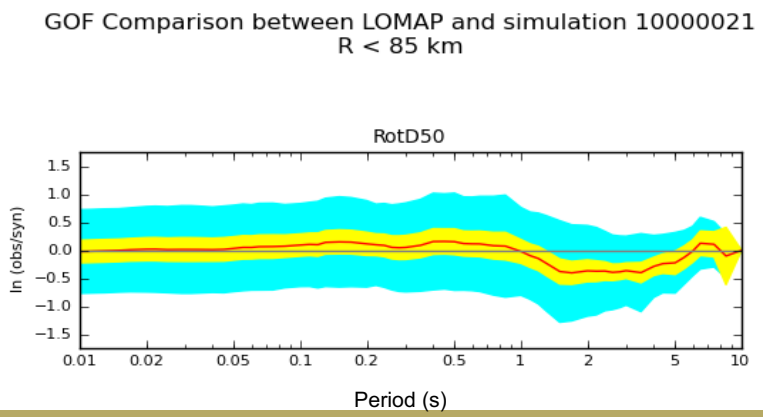


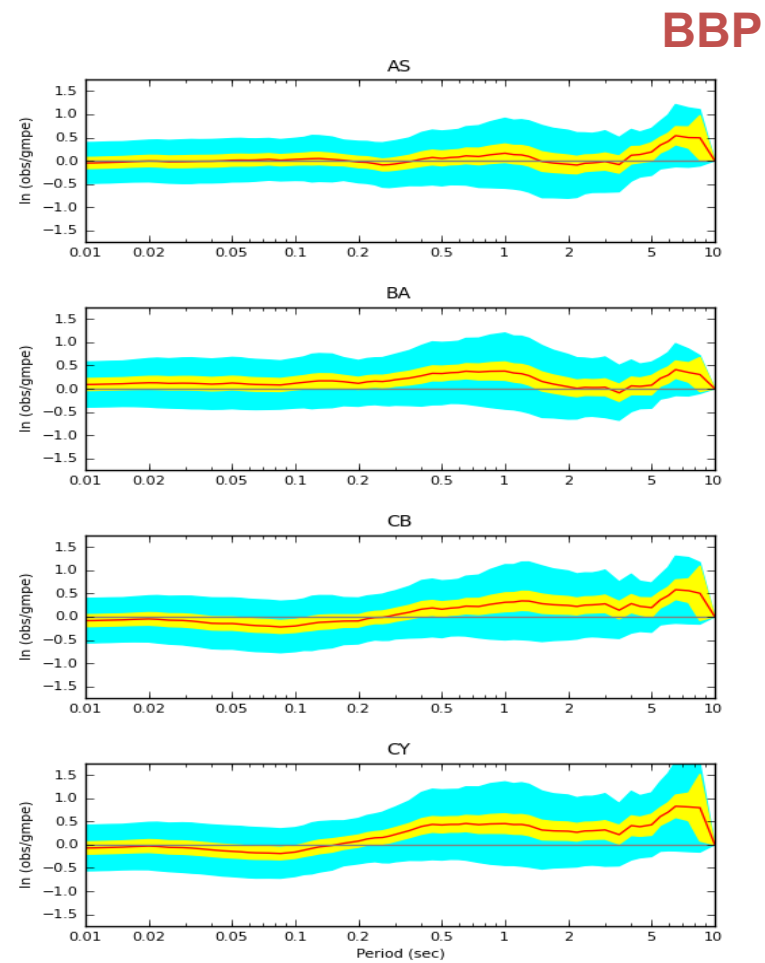


BBP

Validation of ground motions (quantitative)

- Part A – Against recorded events - think “forward” sims
  - Not tuned for a specific event – provide regional rules
  - Provide randomization of parameters
  - Aggregate evaluation over multiple events
  - Benefit to compare performance of sims relative to GMPEs





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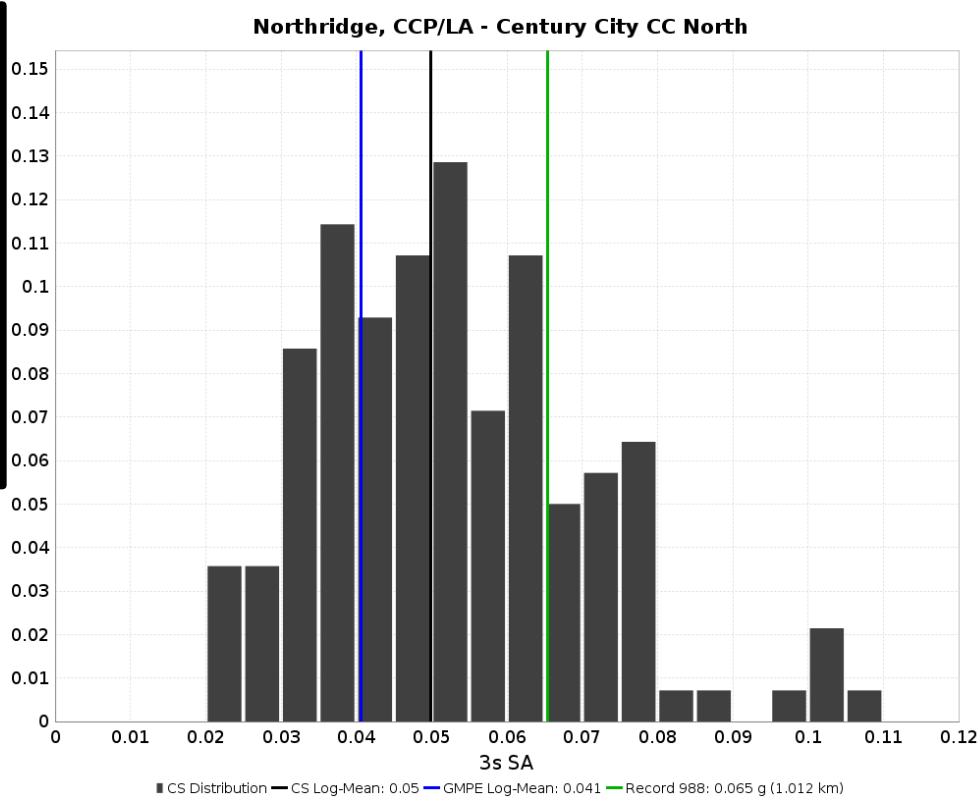
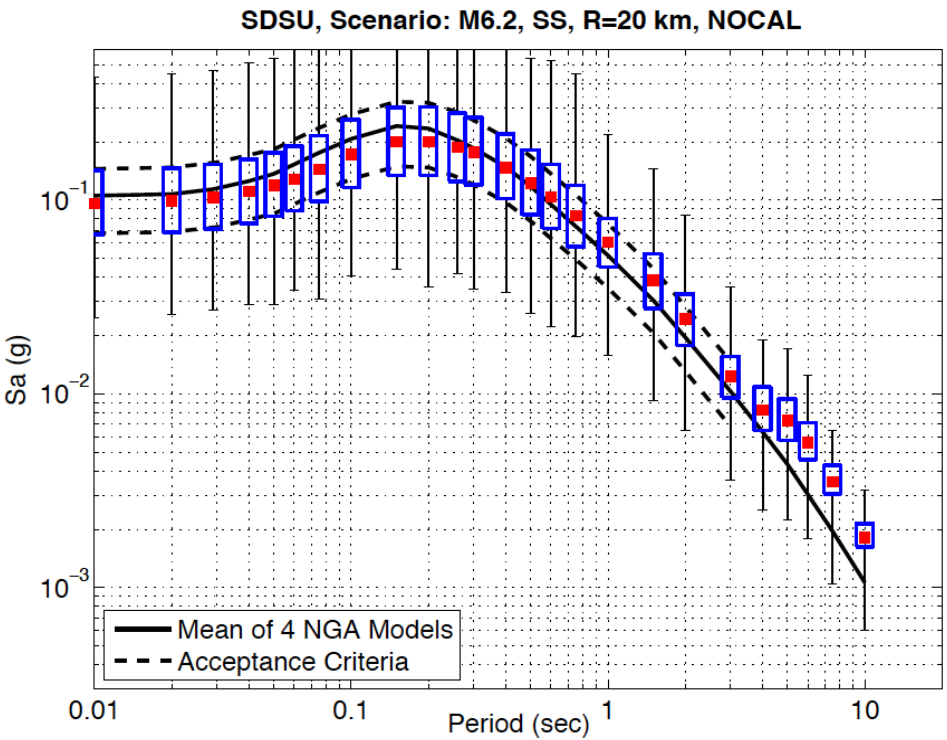


CyberShake

Validation of ground motions (quantitative)

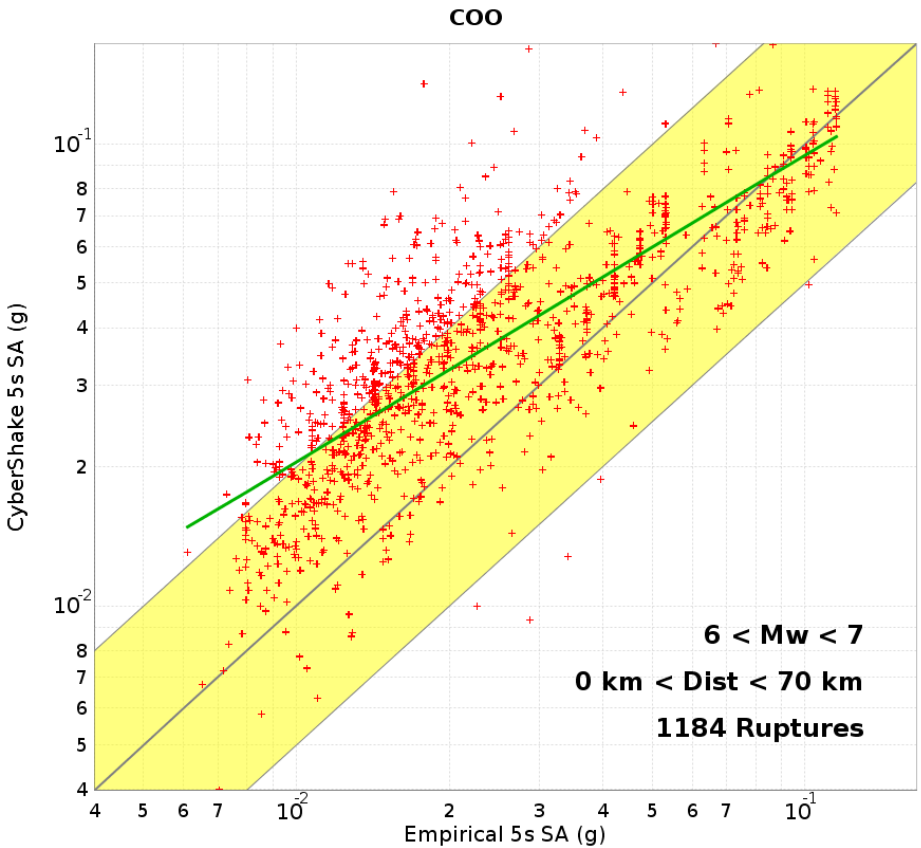
- Part B – against GMPEs
  - Is “validation” only for range of M, R at which the GMPEs are well constrained
  - Allows evaluation of model centering in a global sense



BBP

Validation of ground motions (quantitative)

- Part B – against GMPEs
  - Is “validation” only for range of M, R at which the GMPEs are well constrained
  - Allows evaluation of model centering in a global sense
  - Need to understand differences that may be due to parameterization (3D model Vs. basin depth proxies)



CyberShake

Validations in SCEC5

- On-going collaboration with users (engineers)
  - EEII, GMSV-like groups
  - Develop validation metrics
  - Implement pass/no pass gauntlets
- Integration of platform-specific tools on all relevant platforms