CyberShake Study 24.8 PSHA Model for Northern California

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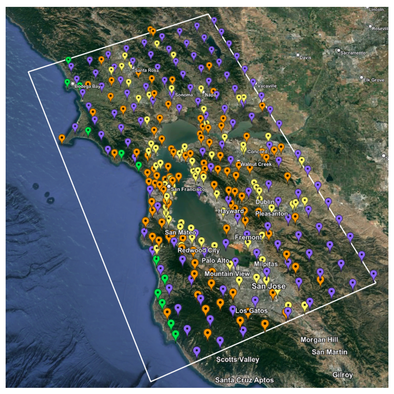
We have completed a CyberShake PSHA study for Northern California, with data products available for download through the CyberShake Data Access Tool (https://github.com/SCECcode/cs-data-tools/)

CyberShake Overview

The CyberShake platform implements a repeatable scientific workflow to perform 3D physics-based probabilistic seismic hazard analysis (PSHA). CyberShake uses the AWP-ODC-SGT wave propagation code to produce Strain Green tensors, which are convolved with individual event realizations to synthesize seismograms. Seismograms are processed to create derived data products such as intensity measures. CyberShake combines 3D low-frequency deterministic (≤1 Hz) simulations with high-frequency calculations using stochastic modules from the Broadband Platform to produce results up to 25 Hz.

Study Parameters

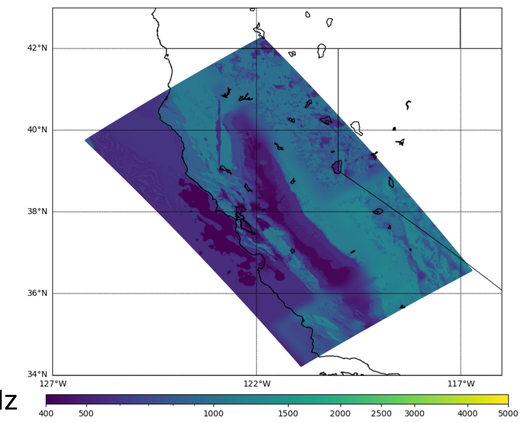
Map of 315 sites in this study.



Other key parameters:

- Minimum Vs = 400 m/s
- Deterministic simulations to 1 Hz
- Broadband simulations to 25 Hz
- About 200,000 events per site

The velocity model was constructed by tiling SFCVM (geologic), CCA-06 (tomographic), and a 1D model, with the addition of a near-surface low-velocity taper.



Velocity model horizonal slice showing Vs at 80m (1 grid point) depth.

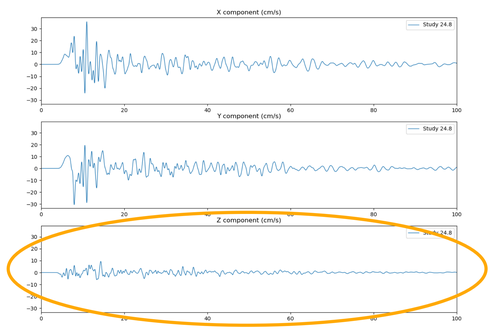
Study Execution

Study 24.8 was run on OLCF *Frontier* and TACC *Frontera,* over a period of 45 days.

- 27,720 jobs run by Pegausus-WMS and HTCondor workflow tools
- 1 PB of data managed (350 TB transferred)
- 36 TB in data products generated
- 127 million three-component seismograms
- 34 billion intensity measures

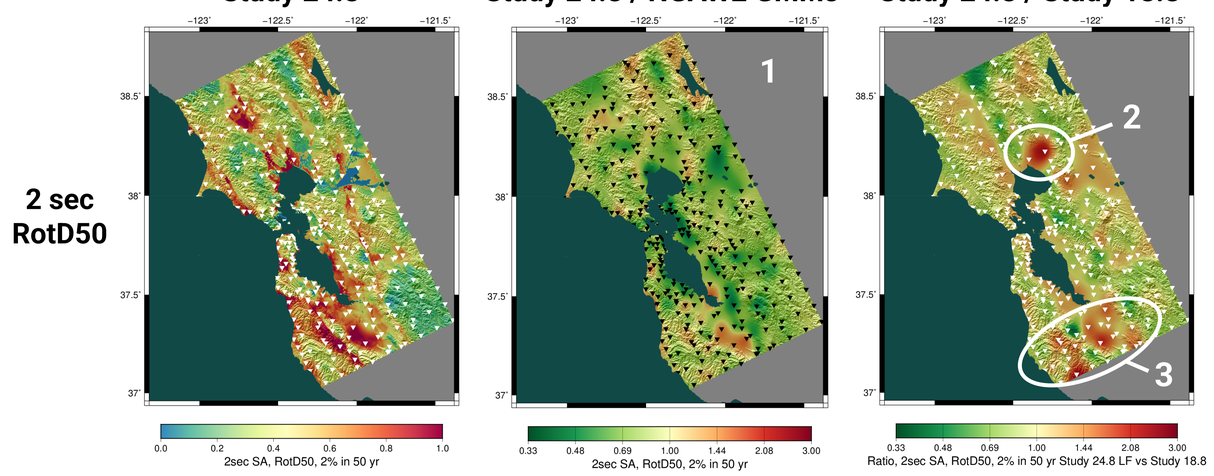
New CyberShake data products produced:

- **Vertical component seismograms**
- Period-dependent significant durations
- Vertical response spectra



Seismogram at s3240 (Moffett Field) for a M7.25 Hayward event.

Hazard Products



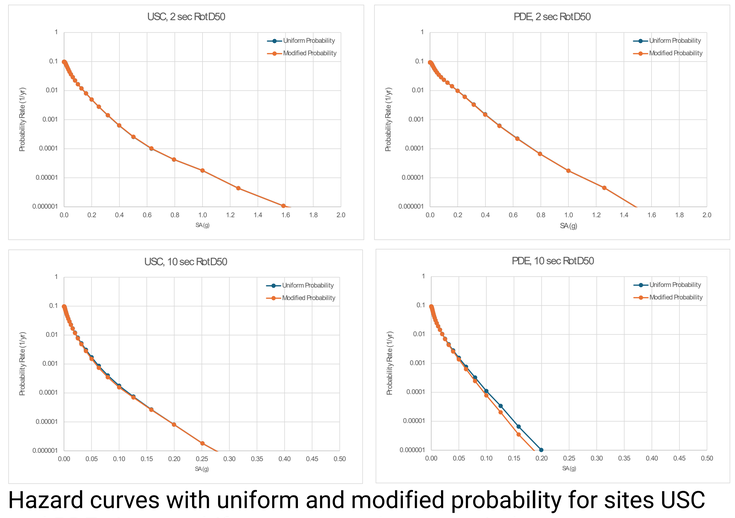
Features

(1) 24.8 shows generally lower hazard than the GMMs.
(2) 24.8 has higher hazard in the San Pablo bay due to changes in the velocity model.
(3) The changes south of San Jose are due to removing velocity tiling artifacts which were present in 18.8.
(4) 24.8 shows higher hazard in the Livermore basin, due to deepening of the basin in the SFCVM model.
(5) Applying the near-surface low velocity taper results in higher 24.8 hazard in the Santa Cruz mountains.

Preferred Rupture Directivity

By default, PSHA hazard products assume all events with a given magnitude and fault surface have equal probability. However, we can investigate the impact of preferred fault rupture directions on hazard by varying probabilities based on the hypocenter location. We have begun proof-of-concept work.

(left) Preferred rupture directions on the Mojave and Coachella segments of the San Andreas. CyberShake events which included one of these segments had their probabilities modified.



Hazard curves with uniform and modified probability for sites USC and PDE. Larger shifts are seen at longer periods.

Acknowledgements

This research was supported by the Statewide California Earthquake Center. SCEC is funded by NSF Cooperative Agreement EAR-2225216 and USGS Cooperative Agreement G24AC00072. Additional support was provided by the Pacific Gas and Electric Company. The computational work described was performed at the Center for Advanced Research Computing at USC, the Texas Advanced Computing Center (TACC) at The University of Texas at Austin, and the Oak Ridge Leadership Computing Facility at the Oak Ridge National Laboratory, which is supported by the Office of Science of the U.S. Department of Energy under Contract No. DE-AC05-00OR22725.