

Ground Motion Validation on Your Laptop: The SCEC Broadband Platform and GMSV Toolkit



Kim Olsen (SDSU)
kbolsen@sdsu.edu

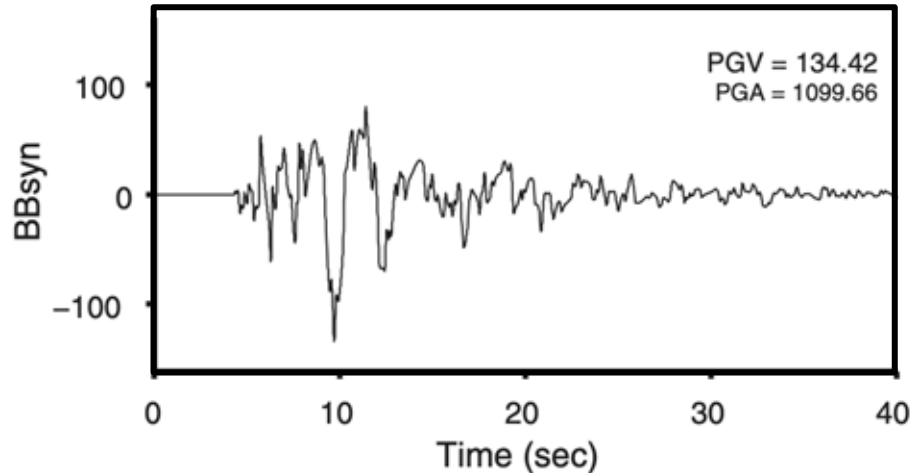
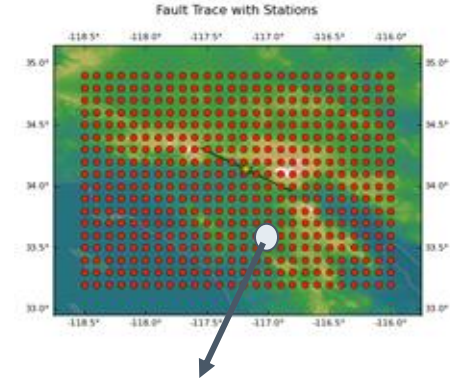
13NCEE, Portland, OR
13 July 2026



Broadband Platform Overview

Collection of scientific software (BBP 22.4)

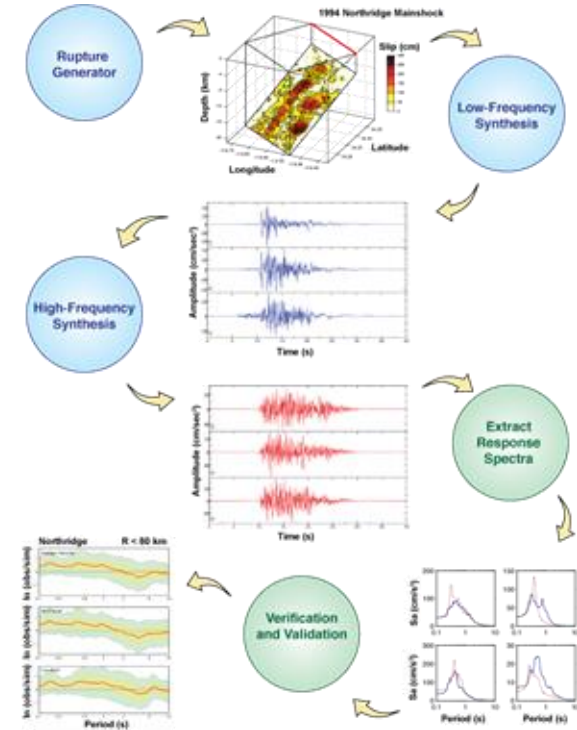
- calculates BB ground motions at specified locations
- integrates complex scientific modules
 - rupture generation
 - 1D deterministic low-frequency seismograms
 - stochastic high-frequency signal
 - seismogram synthesis
 - site effects calculations
 - post-processing, visualization
- features simple command-line interactive use
- runs on Linux/GNU compilers and OS libraries
- is available on GitHub!
- FAST - laptop computations!



Broadband Platform Overview

Collection of scientific software (BBP 22.4)

- calculates BB ground motions at specified locations
- integrates complex scientific modules
 - finite-fault rupture generation
 - 1D deterministic low-frequency seismograms
 - stochastic high-frequency signal
 - seismogram synthesis
 - site effects calculations
 - post-processing, visualization
- features simple command-line interactive use
- runs on Linux/GNU compilers and OS libraries
- is available on GitHub!
- FAST - laptop computations!





Broadband Platform Overview

Collection of scientific software (BBP 22.4)

- calculates BB ground motions at specified locations
- integrates complex scientific modules
 - rupture generation
 - 1D deterministic low-frequency seismograms
 - stochastic high-frequency signal
 - seismogram synthesis
 - site effects calculations
 - post-processing, visualization
- features simple command-line interactive use
- runs on Linux/GNU compilers and OS libraries
- is available on GitHub!
- FAST - laptop computations in hours for 10s of sites

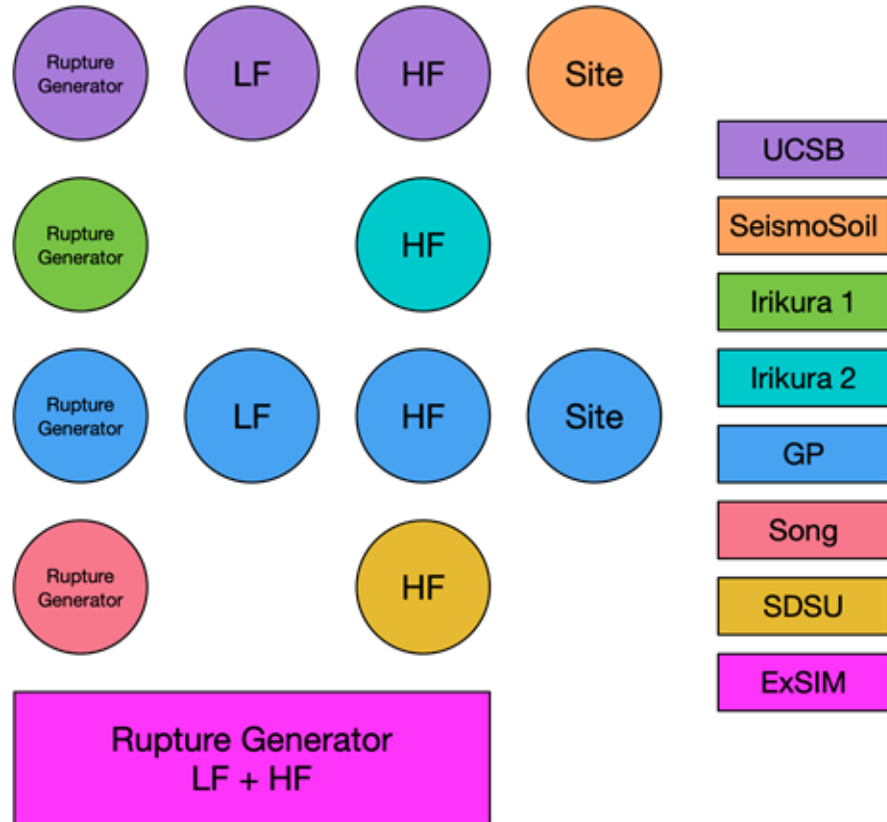
```
fsilva — ssh broadband.usc.edu — 63x12
The Broadband Platform includes several scientific methods that
can be used to calculate synthetic seismograms.

Choose a Method to use in this Broadband scenario simulation:
(1) GP (Graves & Pitarka)
(2) UCSB
(3) SDSU
(4) EXSIM
(5) Song
(6) Irikura Recipe Method 1 (Irikura1)
(7) Irikura Recipe Method 2 (Irikura2)
? █
```

A terminal window with a black background and green text. The window title is 'fsilva — ssh broadband.usc.edu — 63x12'. The text inside the terminal displays a prompt for selecting a scientific method for synthetic seismogram calculation, listing seven options: GP (Graves & Pitarka), UCSB, SDSU, EXSIM, Song, Irikura Recipe Method 1 (Irikura1), and Irikura Recipe Method 2 (Irikura2). A cursor is visible at the bottom, preceded by a question mark.

Connect the Modules

- Graves and Pitarka (GP)
- SDSU
- UCSB
- ExSIM
- Irikura Recipe Method 1
- Irikura Recipe Method 2
- Song RMG





BBP Validation Simulations

- Provides source description (fault area, strike, dip, rake)
- Includes locations where recorded data is available

California

- M_w 5.5 Alum Rock
- M_w 5.4 Chino Hills
- M_w 7.1 Hector Mine
- M_w 7.2 Landers
- M_w 6.9 Loma Prieta
- M_w 6.1 North Palm Springs
- M_w 6.7 Northridge
- M_w 6.0 Parkfield
- M_w 6.5 Ridgecrest A
- M_w 5.4 Ridgecrest B
- M_w 7.1 Ridgecrest C
- M_w 6.6 San Simeon
- M_w 5.9 Whittier Narrows

Japan

- M_w 6.7 Chuetsu-Oki
- M_w 6.9 Iwate
- M_w 6.7 Niigata
- M_w 6.6 Tottori

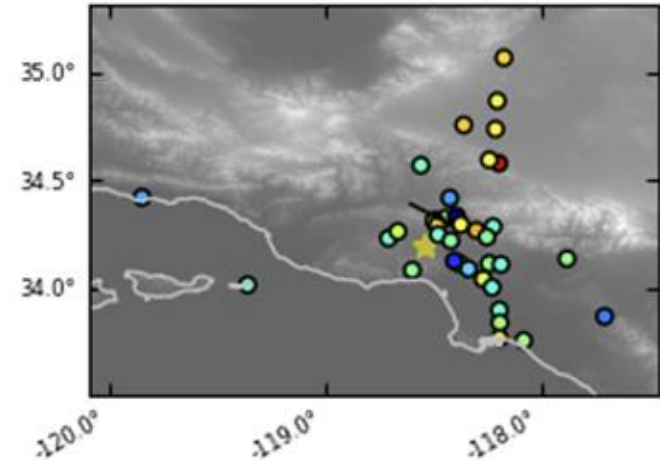
Italy

- M_w 6.3 L'Aquila

Eastern North America

- M_w 5.7 Mineral
- M_w 4.6 Riviere-du-Loup
- M_w 5.8 Saguenay

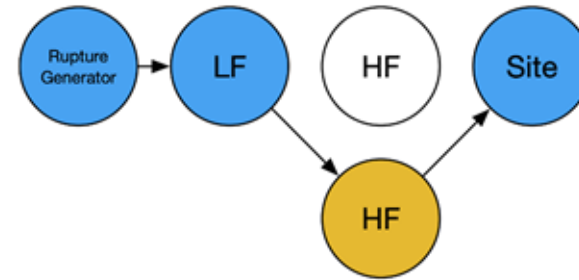
1994 M6.7 Northridge, CA





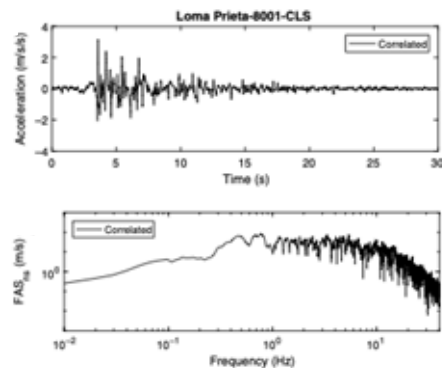
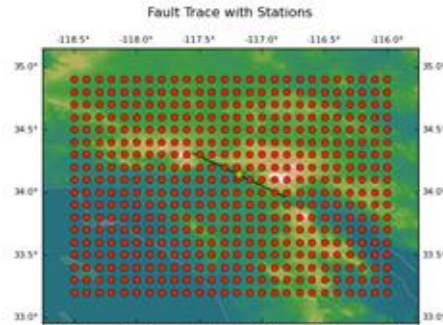
BBP Scenario Simulations

- User input
 - Simulation region, method
 - Source description
 - List of stations
- BBP output
 - Station map
 - Timeseries
 - RotD50



BBP Scenario Simulations

- User input
 - Simulation region, method
 - Source description
 - List of stations
- BBP output
 - Station map
 - Timeseries
 - FAS





Ground Motion Simulation Validation (GMSV) Toolkit

Seismogram pre-processing tools

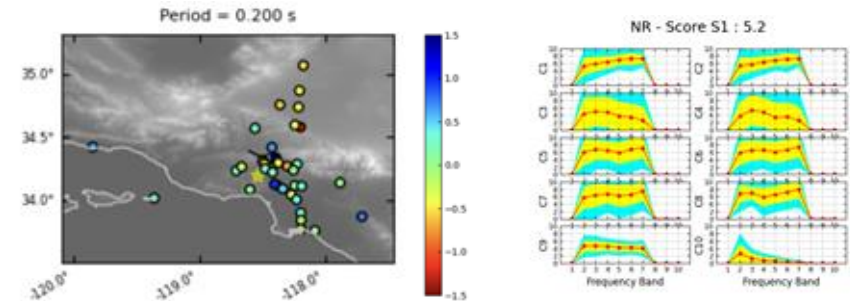
- Timeseries formatting, resampling, rotation, filtering, baseline correction, etc

Metrics Computation

- Anderson 10 IMs - RotD50 PSA, FAS, SEAS, Arias intensity, duration...
- GMM (NGA-West2) Intensity Measures

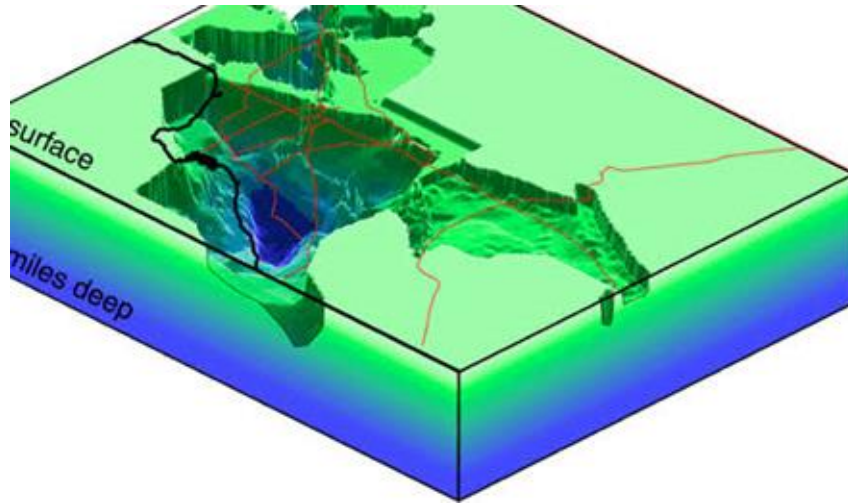
Ground Motion Correlation

- Inter-frequency correlation
- Spatial correlation



BBP in the Future: 3D Green's Functions

- Limitation of 1D velocity models
- Potential for smaller bias using 3D velocity models, topography



Xu, K., and K.B. Olsen (2026).
Toward a SCEC Broadband
Platform With 3D Low-
frequency Synthetics (BBP
3D), *Bull. Seis. Soc. Am.*,
accepted for publication,
4/8/2026.