

# Products and Tools from the National Seismic Hazard Model (NSHM)

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2015 ATC-USGS User Needs Workshop

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# Overview

- Introduction & Background
  - Conterminous US Map Releases: 1996, 2002, 2008, 2014
  - Web Service Development as Requested or Possible
- Product overview
  - Primary Products: Hazard Models & Data
  - Secondary Products: Design
  - Secondary Products: Hazard
  - Other Data Products
- Current Issues
- Solutions
- Scientific Issues
- Poll

# Primary Products: Hazard Models & Data

The screenshot shows the USGS Earthquake Hazards Program website. The top navigation bar includes the USGS logo, a search bar, and links to Home, About Us, and Contact Us. The main navigation bar lists categories: EARTHQUAKES, HAZARDS (selected), DATA & PRODUCTS, LEARN, MONITORING, and RESEARCH. The Hazards section features a news banner about updated 2014 seismic hazard maps. Below this, there are three main columns of content. The first column, 'Seismic Hazard Maps and Data', is highlighted with a red box and contains a list of map categories: Lower 48, Alaska, Hawaii, Puerto Rico & U.S. Virgin Islands, Guam & Marianas, Samoa & Pacific Islands, Urban & Regional, Scenarios, Time-Dependent EQ Probability Maps, and Foreign. The second column, 'Seismic Hazard Analysis Tools', includes links for Custom Hazard Maps, Custom Earthquake Probability Maps, Hazard Curves, Vs30, Interactive Deaggregations, and Banded Deaggregations. The third column, 'Seismic Hazards Primers', lists links for Earthquake Hazards 101-The Basics, Earthquake Hazards 201-Technical Q&A, Fact Sheet, and FAQ. Below the red box is a section for 'Seismic Design Maps, Data, and Tools for Engineers'. To the right of the analysis tools is a section for 'Faults'. The bottom of the page features the USGS logo and a footer with the text 'USGS/ATC User Needs Workshop, Menlo Park, CA' and the date '9-20-2015'.

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**Earthquake Hazards Program**

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**EARTHQUAKES HAZARDS DATA & PRODUCTS LEARN MONITORING RESEARCH**

## Hazards

The USGS has recently released updated 2014 seismic hazard maps for the conterminous U.S. The maps, documentation, and data will be posted here as they become available.

### Seismic Hazard Maps and Data

Probabilistic and scenario ground-motion hazard maps, input and output data, and documentation. [More...](#)

- Lower 48
- Alaska
- Hawaii
- Puerto Rico & U.S. Virgin Islands
- Guam & Marianas
- Samoa & Pacific Islands
- Urban & Regional
- Scenarios
- Time-Dependent EQ Probability Maps
- Foreign

### Seismic Hazard Analysis Tools

Create customized hazard and probability maps with additional options to assess individual source-contributions to overall hazard. [More...](#)

- Custom Hazard Maps
- Custom Earthquake Probability Maps
- Hazard Curves
- Vs30
- Interactive Deaggregations
- Banded Deaggregations

### Seismic Hazards Primers

- [Earthquake Hazards 101-The Basics](#)
- [Earthquake Hazards 201-Technical Q&A](#)
- [Fact Sheet](#)-what are hazard maps?
- [FAQ](#)

### About the NSHM Project

- [Publications](#)
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- [Personnel](#)

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Ground motion parameter values for building and bridge design. [More...](#)

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Where are the faults in my area, and when did they last have a large earthquake? Find maps and comprehensive geologically based information on known or suspected active faults and folds in the United States. [More...](#)

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**EARTHQUAKES** **HAZARDS** DATA & PRODUCTS LEARN MONITORING RESEARCH

**Hazard Maps & Data**  
**Lower 48**  
Alaska  
Hawaii  
Puerto Rico & U.S. Virgin Islands  
Guam & Marianas  
Samoa & Pacific Islands  
Urban & Regional  
Scenarios  
Time-Dependent EQ Probability  
Foreign

## Lower 48 Maps and Data

### 2014

The 2014 U.S. Geological Survey (USGS) National Seismic Hazard Maps display earthquake ground motions for various probability levels across the United States and are applied in seismic provisions of building codes, insurance rate structures, risk assessments, and other public policy. The updated maps represent an assessment of the best available science in earthquake hazards and incorporate new findings on earthquake ground shaking, faults, seismicity, and geodesy. The USGS National Seismic Hazard Mapping Project developed these maps by incorporating information on potential earthquakes and associated ground shaking obtained from interaction in science and engineering workshops involving hundreds of participants, review by several science organizations and State surveys, and advice from expert panels and a Steering Committee. The new probabilistic hazard maps represent an update of the seismic hazard maps; previous versions were developed by Petersen and others (2008) and Frankel and others (2002), using the methodology developed Frankel and others (1996). Algermissen and Perkins (1976) published the first probabilistic seismic hazard map of the United States which was updated in Algermissen and others (1990).

The National Seismic Hazard Maps are derived from seismic hazard curves calculated on a grid of sites across the United States that describe the annual frequency of exceeding a set of ground motions. Data and maps from the 2014 U.S. Geological Survey National Seismic Hazard Mapping Project are available for download below. Maps for available periods (0.2 s, 1 s, PGA) and specified annual frequencies of exceedance can be calculated from the hazard curves. Figures depict probabilistic ground motions with a 2 percent probability of exceedance. Spectral accelerations are calculated for 5 percent damped linear elastic oscillators. All ground motions are calculated for site conditions with  $V_{s30}=760$  m/s, corresponding to NEHRP B/C site class boundary.

- [Simplified 2014 Hazard Map \(PGA, 2% in 50 years\)](#)
- [Maps: Conterminous US](#)
  - [PGA 2% in 50 yrs](#)(1.3MB PDF)
  - [PGA 10% in 50 yrs](#)(1.1MB PDF)
  - [5 Hz 2% in 50 yrs](#)(1.3MB PDF)
  - [5 Hz 10% in 50 yrs](#)(1.0MB PDF)
  - [1 Hz 2% in 50 yrs](#)(1.0MB PDF)
  - [1 Hz 10% in 50 yrs](#)(0.8MB PDF)
- [Data](#)
- [GIS Shapefiles](#) (PGA, 2% in 50yrs) (5MB Zip)
- [Source code](#)

# Primary Products: Hazard Models & Data

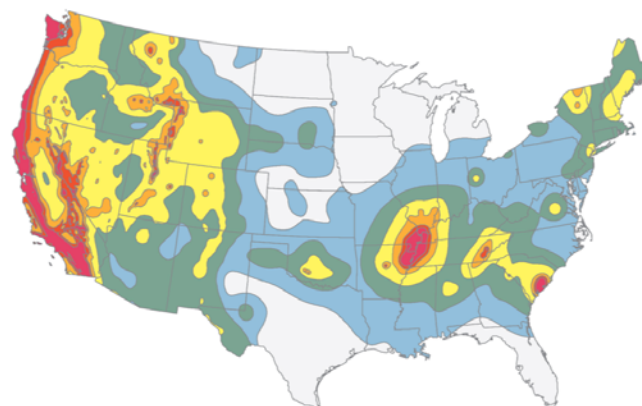


- Open-File Reports



## Documentation for the 2014 Update of the United States National Seismic Hazard Maps

Mark D. Petersen, Morgan P. Moschetti, Peter M. Powers, Charles S. Mueller, Kathleen M. Haller, Arthur D. Frankel, Yuehua Zeng, Sanaz Rezaeian, Stephen C. Harmsen, Oliver S. Boyd, Ned Field, Rui Chen, Kenneth S. Rukstales, Nico Luco, Russell L. Wheeler, Robert A. Williams, and Anna H. Olsen



Open-File Report 2014-1091

U.S. Department of the Interior  
U.S. Geological Survey

# Primary Products: Hazard Models & Data



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### Hazard Maps & Data

Lower 48

Alaska

Hawaii

Puerto Rico & U.S. Virgin Islands

Guam & Marianas

Samoa & Pacific Islands

Urban & Regional

Scenarios

Time-Dependent EQ Probability

Foreign

### 2014 NSHM Gridded Data

These files contain space-delimited, rectangular gridded data over the Conterminous 48 States in 0.05 degree increments in longitude (x-value) and latitude (y-value). See below for more information about the format of these data files.

#### Download Data Files

Data Type	Spectral Acceleration	Probability of Exceedance	Download
Gridded Hazard Map	Peak Ground Acceleration	2% in 50 years	<a href="#">Text</a> (3.9MB)
Gridded Hazard Map	Peak Ground Acceleration	10% in 50 years	<a href="#">Text</a> (3.6MB)
Gridded Hazard Map	1 Hz (1 sec)	2% in 50 years	<a href="#">Text</a> (3.7MB)
Gridded Hazard Map	1 Hz (1 sec)	10% in 50 years	<a href="#">Text</a> (3.7MB)
Gridded Hazard Map	5 Hz (0.2 sec)	2% in 50 years	<a href="#">Text</a> (3.8MB)
Gridded Hazard Map	5 Hz (0.2 sec)	10% in 50 years	<a href="#">Text</a> (3.7MB)
Hazard Curve Data	Peak Ground Acceleration	N/A	<a href="#">Text</a> (34.5MB)
Hazard Curve Data	5 Hz (0.2 sec)	N/A	<a href="#">Text</a> (30.1MB)
Hazard Curve Data	1 Hz (1 sec)	N/A	<a href="#">Text</a> (32.9MB)

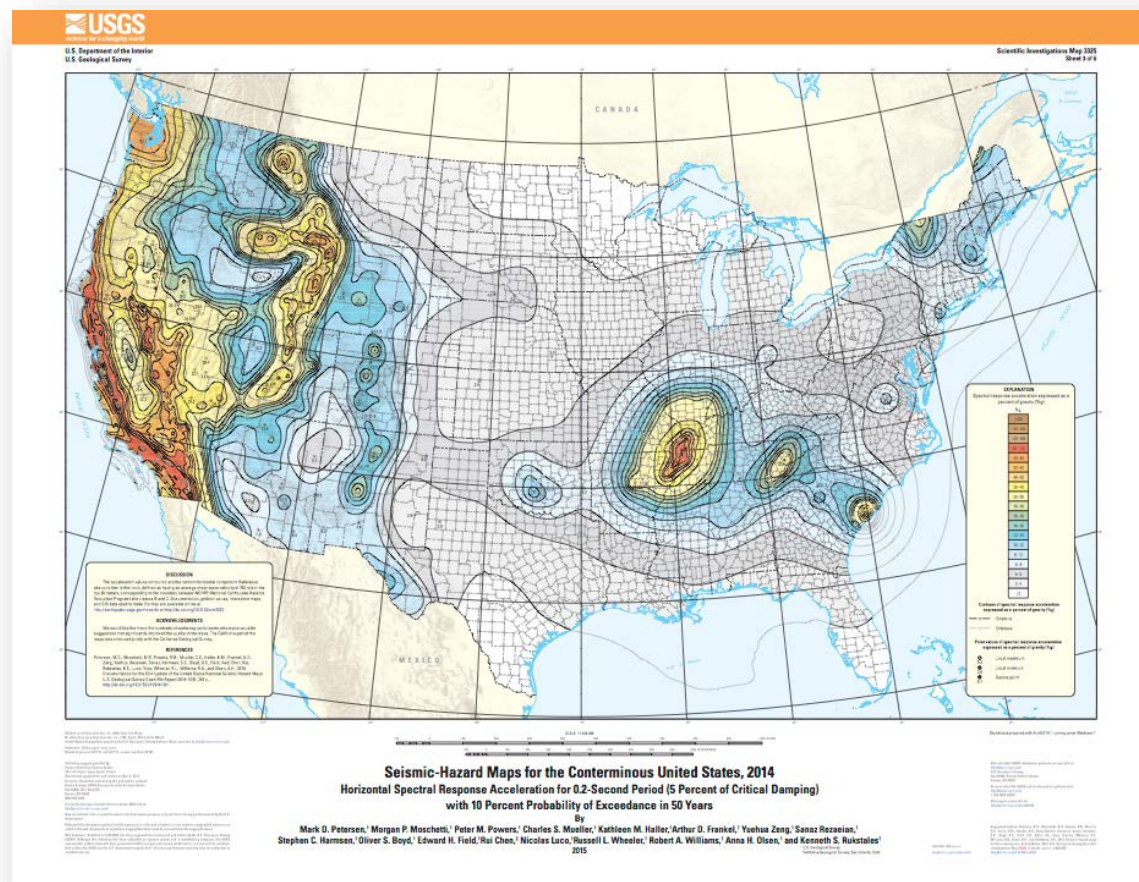
#### Data File Formats

##### "Hazard Curves" Files

These files contain hazard curves for the gridded geographic points described above. All the hazard curves in the file share the same set of intensity measure levels or ground motion levels (x-values). Line 1 is a header line. The final field of line 2 contains the spectral period in seconds. The period convention for PGA is to present results as 0.0 s period. The last field of line 3 indicates the number of ground motion levels for the given period. The following lines (with 1 value per line) contain the x-values (intensity measure levels) for all the curves in the file, in units of g. Subsequent lines contain hazard values for a single geographic point. The first two values specify the latitude and longitude (respectively) for the curve while subsequent values (on that same line) contain mean annual frequencies of exceedance ordered sequentially to the number of the values at the top of the file.

- Open-File Reports
- Data: Curves and Maps

# Primary Products: Hazard Models & Data

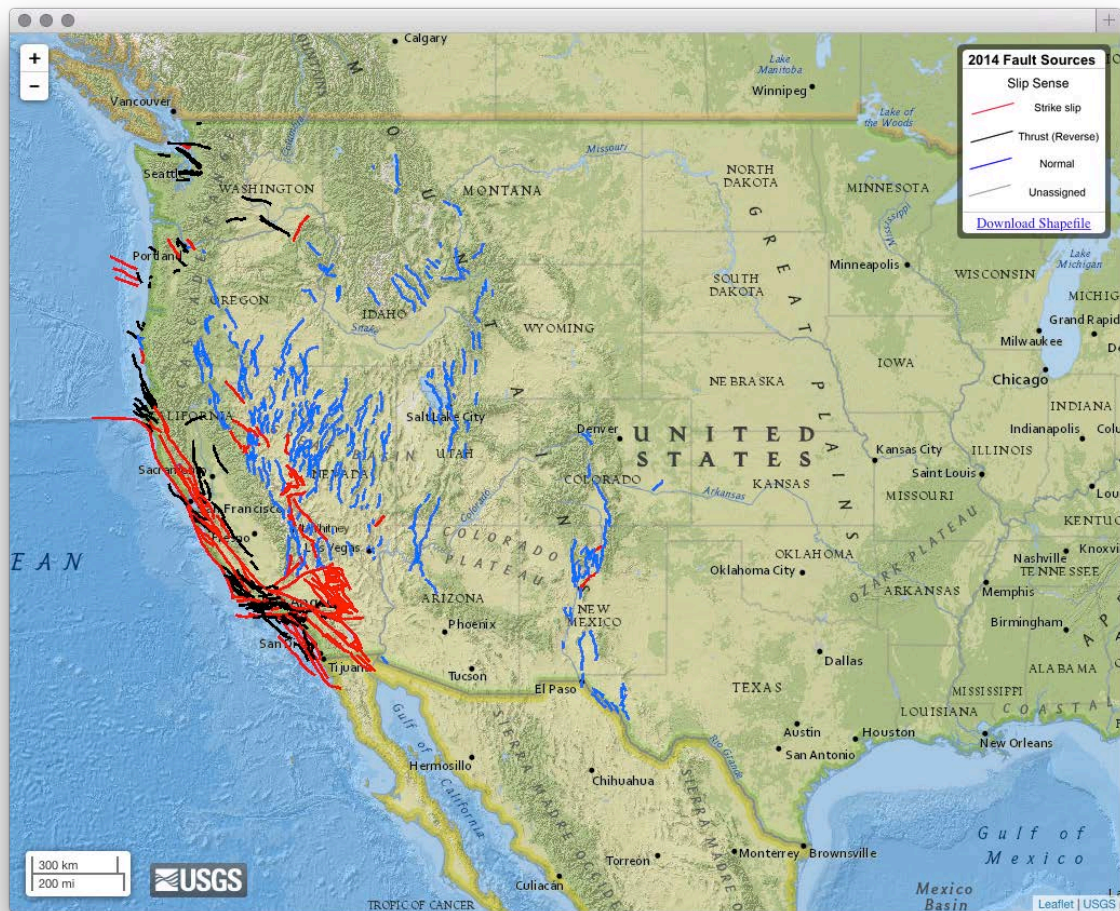


- Open-File Reports
- Data: Curves and Maps
- Print Maps

## Primary Products: Hazard Models & Data

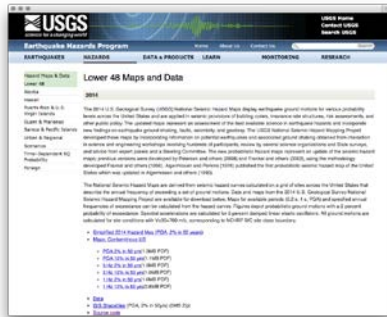


- Open-File Reports
- Data: Curves and Maps
- Print Maps
- **Fault Source Tool**



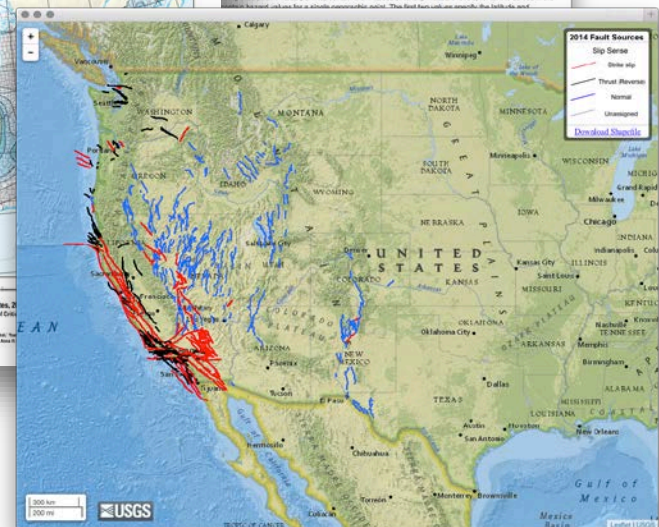
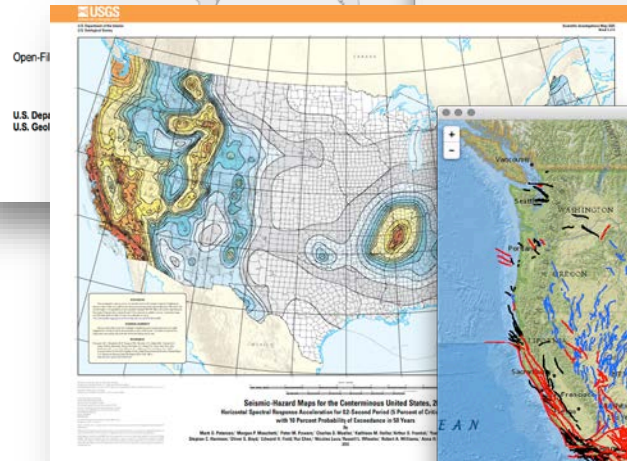
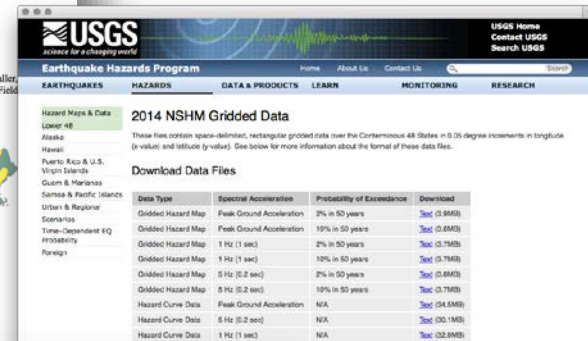
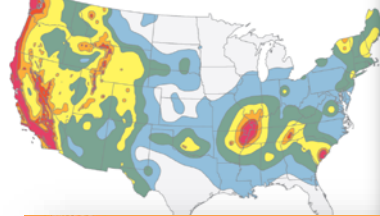
# Primary Products: Hazard Models & Data

- Open-File Reports
- Data: Curves and Maps
- Print Maps
- Fault Source Tool
- Source Code
- EQ Catalogs
- GIS Data



## Documentation for the 2014 Update of the United States National Seismic Hazard Maps

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# Secondary Products: Design Maps & Data

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## Hazards

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### Seismic Hazard Maps and Data

Probabilistic and scenario ground-motion hazard maps, input and output data, and documentation. [More...](#)

Lower 48 Alaska  
Hawaii Puerto Rico & U.S. Virgin Islands  
Guam & Marianas Samoa & Pacific Islands  
Urban & Regional Scenarios  
Time-Dependent EQ Probability Maps Foreign

### Seismic Hazard Analysis Tools

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Custom Hazard Maps Custom Earthquake Probability Maps  
Hazard Curves Vs30  
Interactive Deaggregations Banded Deaggregations

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- [Earthquake Hazards 101-The Basics](#)
- [Earthquake Hazards 201-Technical Q&A](#)
- [Fact Sheet](#)-what are hazard maps?
- [FAQ](#)

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Ground motion parameter values for building and bridge design. [More...](#)

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Where are the faults in my area, and when did they last have a large earthquake? Find maps and comprehensive geologically based information on known or suspected active faults and folds in the United States. [More...](#)

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**Seismic Design Maps & Tools**

US Seismic Design Maps

Use the Tool

Recent Changes

Documentation & Help

Risk Targeted Ground Motion Calculator

Use the Tool

Documentation & Help

Worldwide Seismic Design Tool

Use the Tool

Documentation & Help

## Seismic Design Maps & Tools

Engineers should use these maps and tools for seismic design, not the hazard maps available elsewhere on the USGS website.

### Sites in the U.S. and its Territories

[U.S. Seismic Design Maps](#)

The USGS collaborates with organizations (such as the Building Seismic Safety Council) that develop model building and bridge design codes to make seismic design parameter values available to engineers. The design code developers first decide how USGS earthquake hazard information should be applied in design practice. Then the USGS calculates gridded values of seismic design parameters based on USGS hazard values in accordance with design code procedures. The *U.S. Seismic Design Maps* application provides seismic design parameter values from the following design code editions:

- 2013 ASCE/SEI 41
- 2012/09/06 International Building Code
- 2010/05 ASCE/SEI 7 Standard
- 2009/03 NEHRP Recommended Seismic Provisions
- 2009 AASHTO Guide Specifications for LRFD Seismic Bridge Design

The USGS also provides [data files](#) and [maps](#) of these gridded design values.

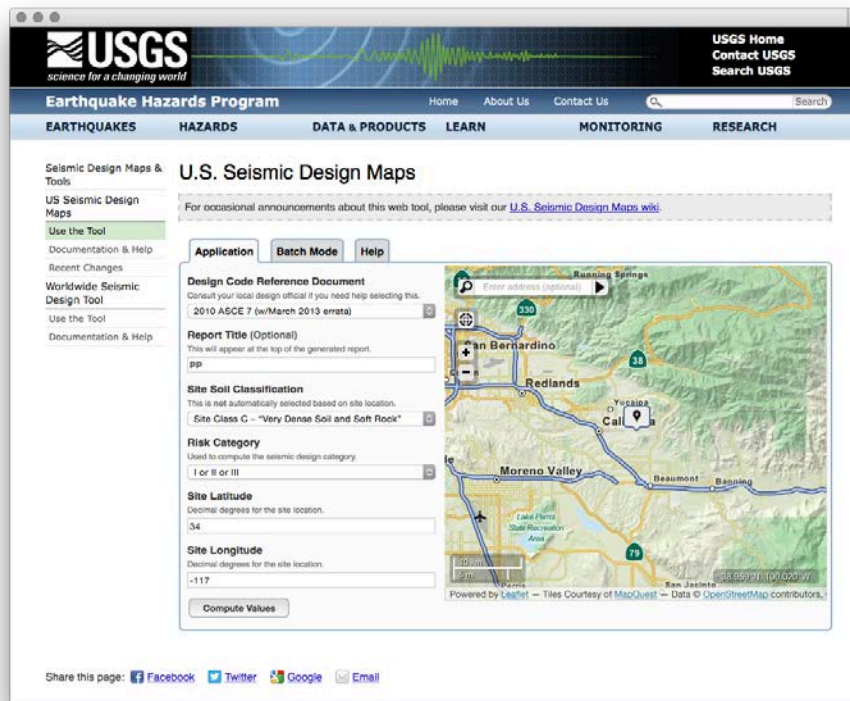
[Risk Targeted Ground Motion Calculator](#)

This tool is used to calculate risk-targeted ground motion values from probabilistic seismic hazard curves in accordance with the site-specific ground motion procedures defined in "Method 2" of 2010 ASCE 7 Standard Section 21.2.1.2.

The vast majority of engineering projects in the U.S. will require the use of the *U.S. Seismic Design Maps* application (see above) rather than the *Risk Targeted Ground Motion Calculator*.

### Sites outside the U.S. and its Territories

# Secondary Products: Design Maps & Data



- US Design
- Worldwide Design
- RTGM Calculator

# Secondary Products: Design Maps & Data



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## Earthquake Hazards Program

### Design Maps Summary Report

[View Detailed Report](#)

**User-Specified Input**

**Report Title** PP  
Sun September 20, 2015 20:35:22 UTC

**Building Code Reference Document** ASCE 7-10 Standard  
(which utilizes USGS hazard data available in 2008)

**Site Coordinates** 34°N, 117°W

**Site Soil Classification** Site Class C – “Very Dense Soil and Soft Rock”

**Risk Category** I/II/III

**USGS-Provided Output**

$S_s = 1.728 \text{ g}$	$S_{HS} = 1.728 \text{ g}$	$S_{DS} = 1.152 \text{ g}$
$S_1 = 0.822 \text{ g}$	$S_{M1} = 1.068 \text{ g}$	$S_{D1} = 0.712 \text{ g}$

For information on how the  $S_s$  and  $S_1$  values above have been calculated from probabilistic (risk-targeted) and deterministic ground motions in the direction of maximum horizontal response, please return to the application and select the “2009 NEHRP” building code reference document.

**MCE<sub>R</sub> Response Spectrum**

Y-axis:  $S_a \text{ (g)}$  (0.00 to 1.98)  
X-axis: Period, T (sec) (0.00 to 2.00)

**Design Response Spectrum**

Y-axis:  $S_a \text{ (g)}$  (0.00 to 1.20)  
X-axis: Period, T (sec) (0.00 to 2.00)

- US Design
- Worldwide Design
- RTGM Calculator
- Reports

# Secondary Products: Hazard Data & Services

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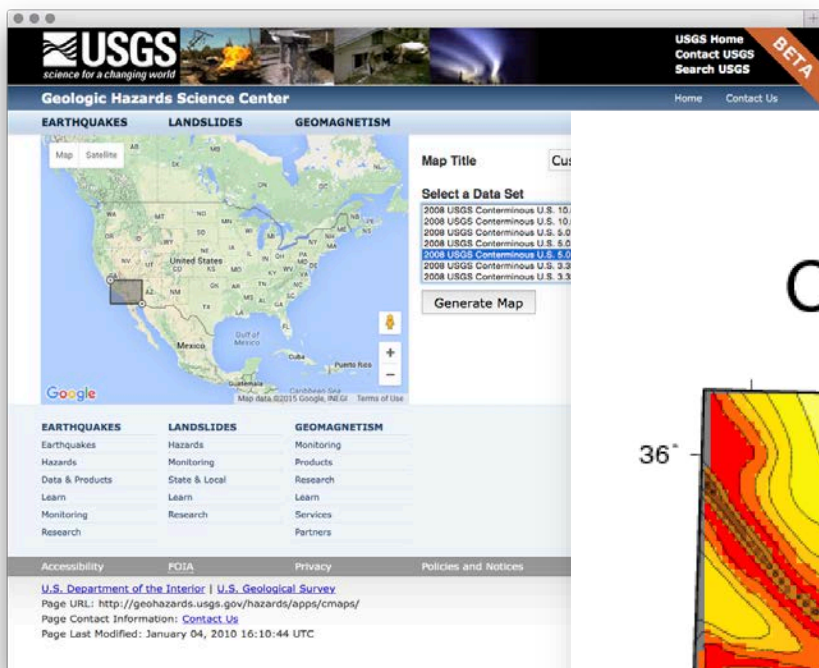
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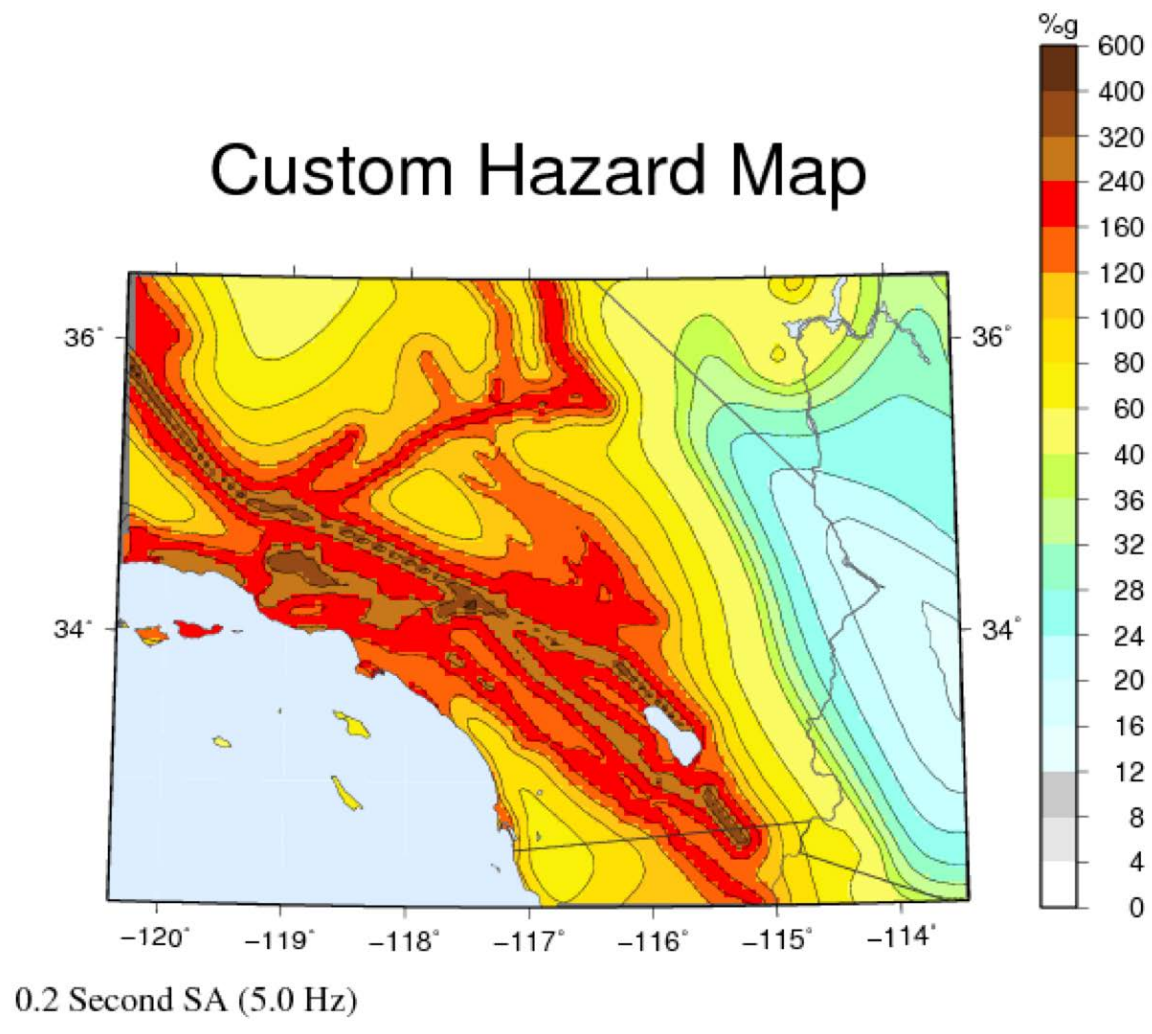
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# Secondary Products: Custom Hazard Map



## Custom Hazard Map



# Secondary Products: Custom EQ Probability Map

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**EARTHQUAKES** LANDSLIDES GEOMAGNETISM

2002 Earthquake Probability Mapping  
2009 Earthquake Probability Mapping  
Application  
Documentation  
FAQ

## 2009 Earthquake Probability Mapping

**Please Note:** This feature does not include potentially induced seismicity calculated for a location that is currently experiencing induced earthquake probability because it is based on the 2008 National Seismic Hazard Map.

**New Feature:** This application now supports Alaska locations. Please see the documentation for details.

This web site was designed to display earthquake probabilities that are for the Seismic Hazard Mapping Project (NSHMP) update. The region of model valid locations in the conterminous 48 states range from [24.6, 50.0] degree locations in Alaska range from [50.0, 72.0] degrees latitude and [-200.0, -115.0] degrees longitude.

The generated maps will show the probabilities of earthquakes within a radius selected radius can also be generated.

Latitude:   
Decimal degrees. See above for valid range.

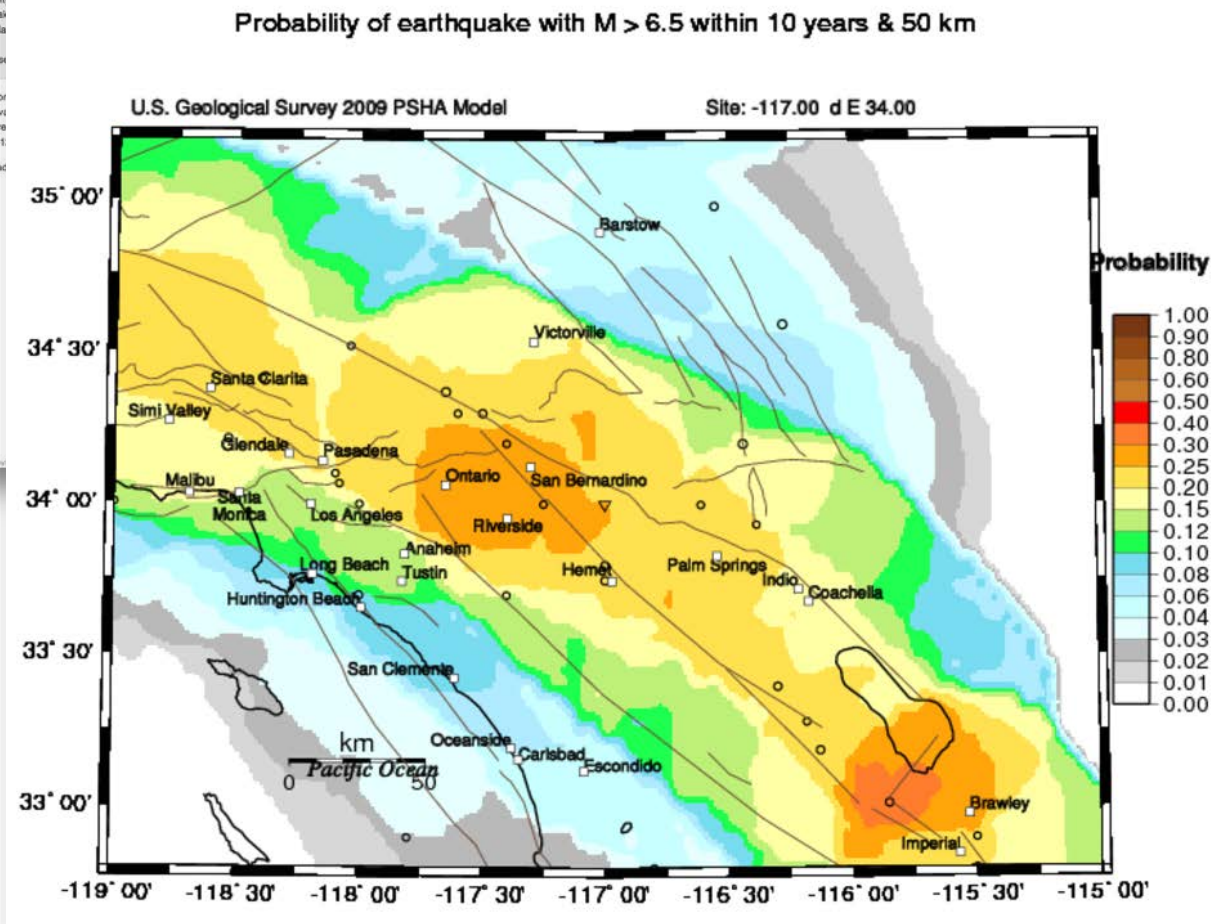
Longitude:   
Decimal degrees. See above for valid range.  
[Input location using zip code instead.](#)

Time Span:   
Number of years to consider (integer)

Magnitude:   
Minimum magnitude to consider

Text Report: ☐ Yes ☒ No  
Generate an ASCII text report of probabilities

Although this information is a product of the U.S. Geological Survey, we provide no warranty for its use.



## Secondary Products: Hazard Curve Service

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Hazard Curve Application

- Web Application
- FAQ
- Change Log

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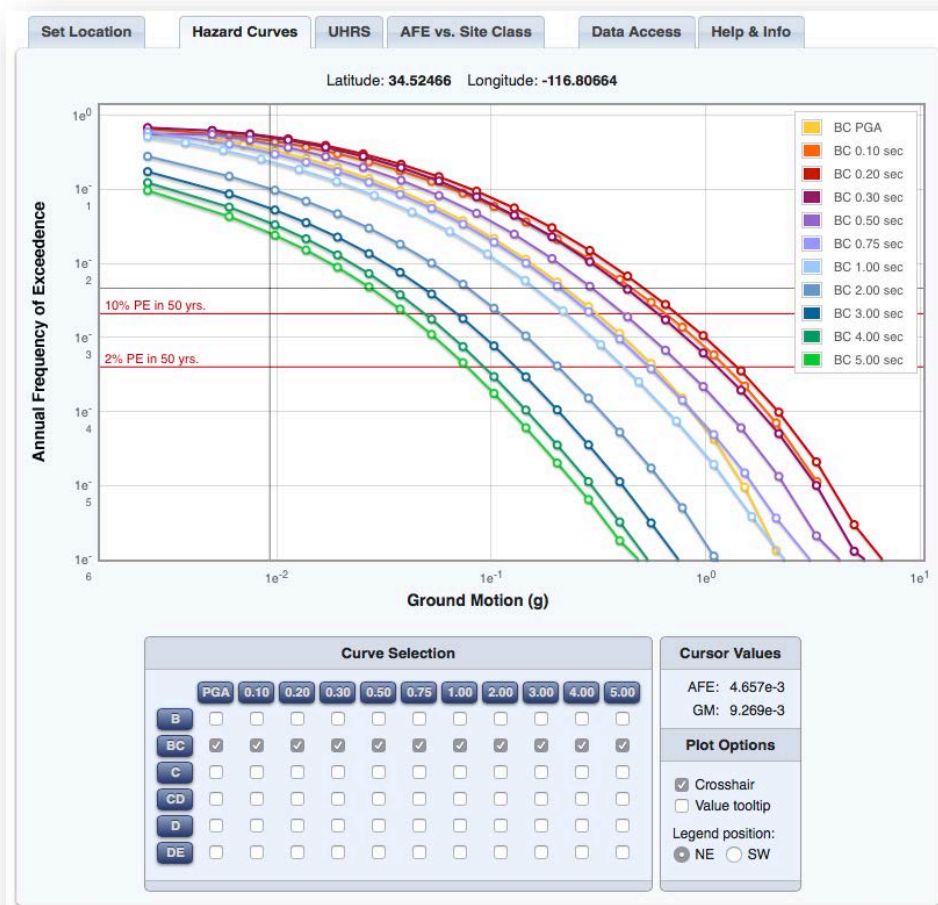
**Related Tools**

- U.S. Design Tool
- Interactive Deaggregations
- Global Vs30 Map Server

## Hazard Curve Application

Please do not use this application to obtain ground motion parameter values for use with the design code reference documents covered by the [U.S. Seismic Design Maps web application](#) (e.g., the *International Building Code* and the *ASCE 7 or 41 Standard*). The values returned by the two applications are not identical; please see our [documentation](#) and the referenced codes, standards, and guidelines for more information.

# Secondary Products: Hazard Curve Service

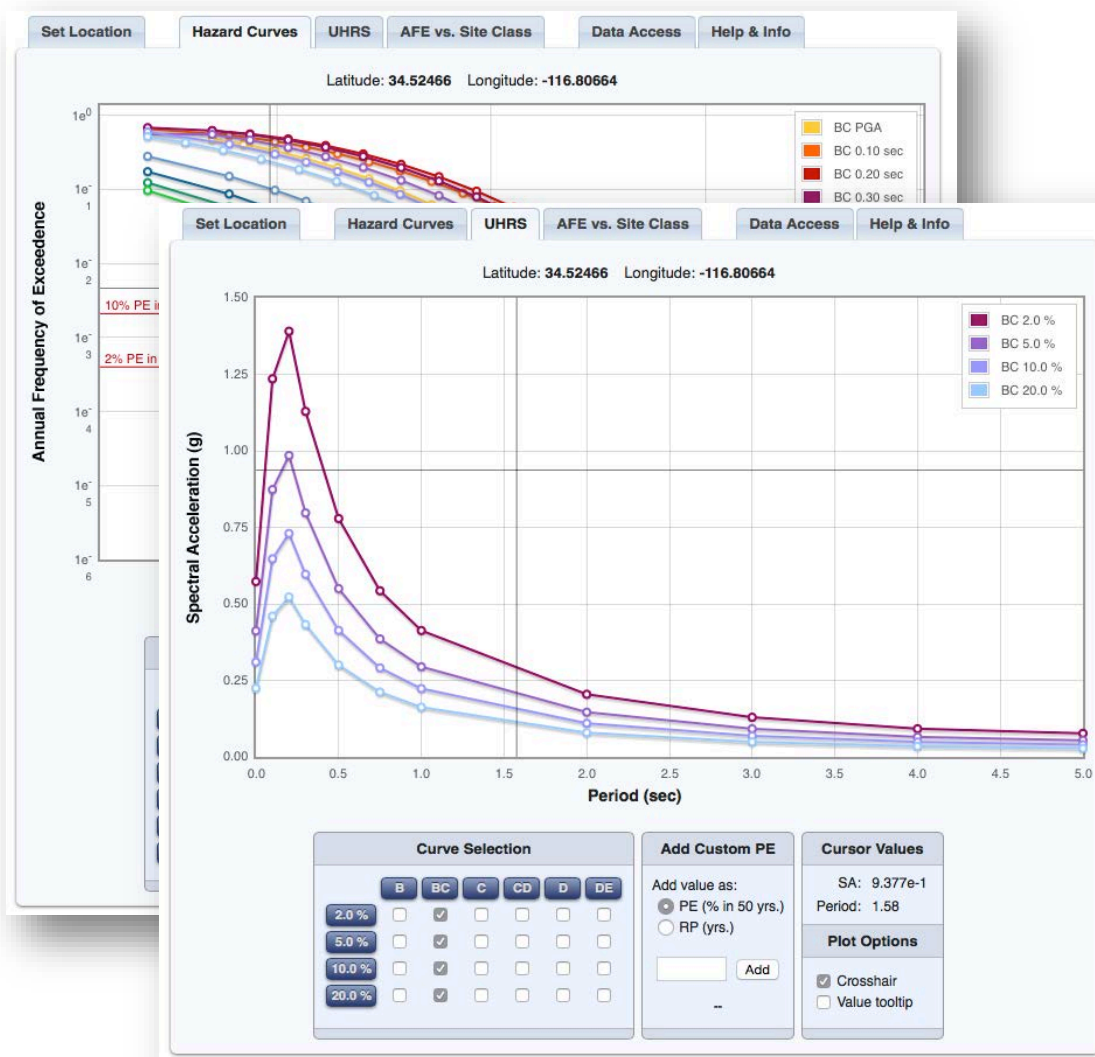


- Hazard Curves

# Secondary Products: Hazard Curve Service



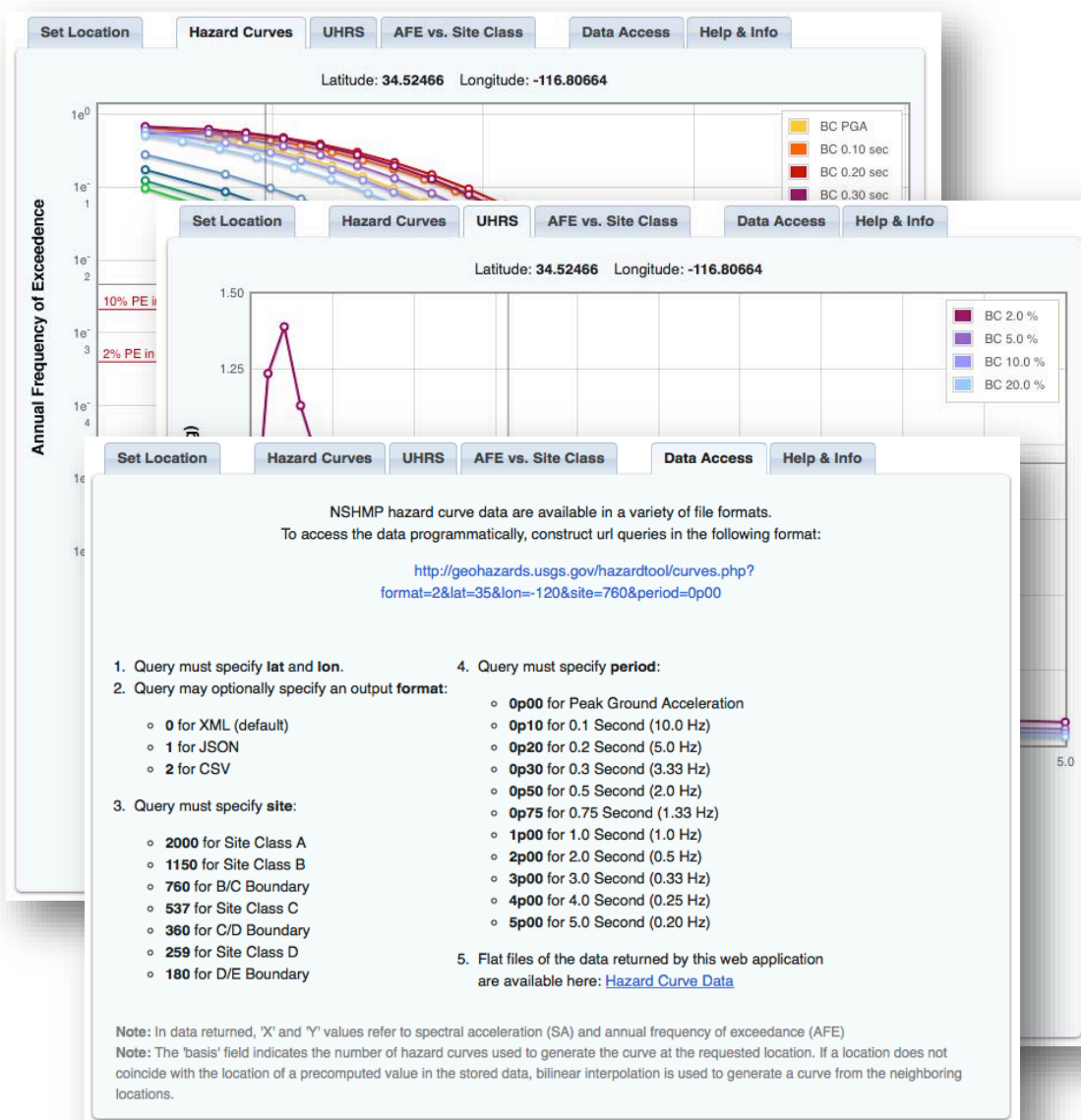
- Hazard Curves
- Response Spectra





# Secondary Products: Hazard Curve Service



- Hazard Curves
- Response Spectra
- HTTP Data Access



# Secondary Products: Hazard Deaggregation



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[Seismic Hazard Analysis Tools](#)  
[Custom Hazard Maps](#)  
[Custom EQ Probability Maps](#)  
[Hazard Curve Application](#)  
[Vs30](#)  
**Interactive Deaggregation**  
[2008-US](#)  
[2008-Samoa](#)  
[2002-US,Puerto Rico](#)  
[1996-US,AK,HI](#)  
[Banded Deaggregation-2009](#)

## 2008 Interactive Deaggregations

This is a preliminary version of the 2008 NSHMP PSHA Interactive Deaggregation web site. In this initial release, the 2008-update source and attenuation models of the NSHMP (Petersen and others, 2008) are used with just one exception. For the New Madrid Seismic Zone (NMSZ), the deaggregation source model is set up for the "unclustered" event branches only. These unclustered New Madrid sources are given full weight (90% weight to the 500 year mean recurrence models; 10% weight to the 1000-year mean recurrence models) whereas in the 2008 NSHMP PSHA they are only given 50% weight. Clustered-source models receive the other 50% weight in 2008 NSHMP PSHA. This is a temporary difference. The interactive deaggregation will include the NMSZ clustered-source models when a few software checkups are completed.

Seismic-hazard deaggregations are available for the following spectral periods anywhere in the conterminous U.S: 0.0 s (PGA), 0.1 s, 0.2 s, 0.3 s, 0.5 s, 1.0 s, and 2.0 s. This is the same set of periods that has been available at the USGS interactive deaggregation web sites since 1996 (for sites in the conterminous United States).

In the western US, long-period seismic-hazard deaggregations at 3.0 s, 4.0 s, and 5.0 s are also available at this web site. [More...](#)

**FAQ** **Documentation** **1996 Update** **2002 Update** **Feedback**

Site Name   
[Enter address instead](#)

Latitude  Longitude

Exceedance Probability  in

Spectral Period


Vs30 (m/s)  [What values can I use at various locations?](#)

Run GMPE Deaggs? ☒ Yes ☐ No [What's this?](#)

Additional Output ☒ Geographic Deagg [What's this?](#) ☐ Conditional Mean Spectra ☐ None

[\(Show Map\)](#)

References to non-U.S. Department of the Interior (DOI) products do not constitute an endorsement by the DOI. By viewing the Google Maps API on this web site the user agrees to these [Terms of Service set forth by Google](#).



USGS/ATC User Needs Workshop, Menlo Park, CA

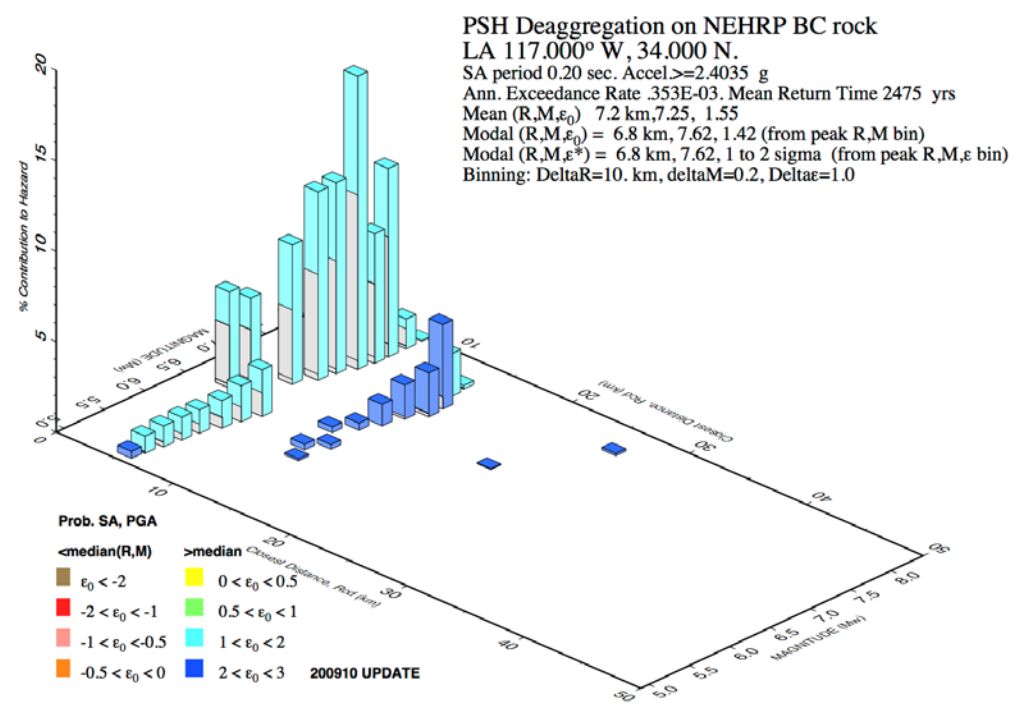
9-20-2015

21

# Secondary Products: Hazard Deaggregation



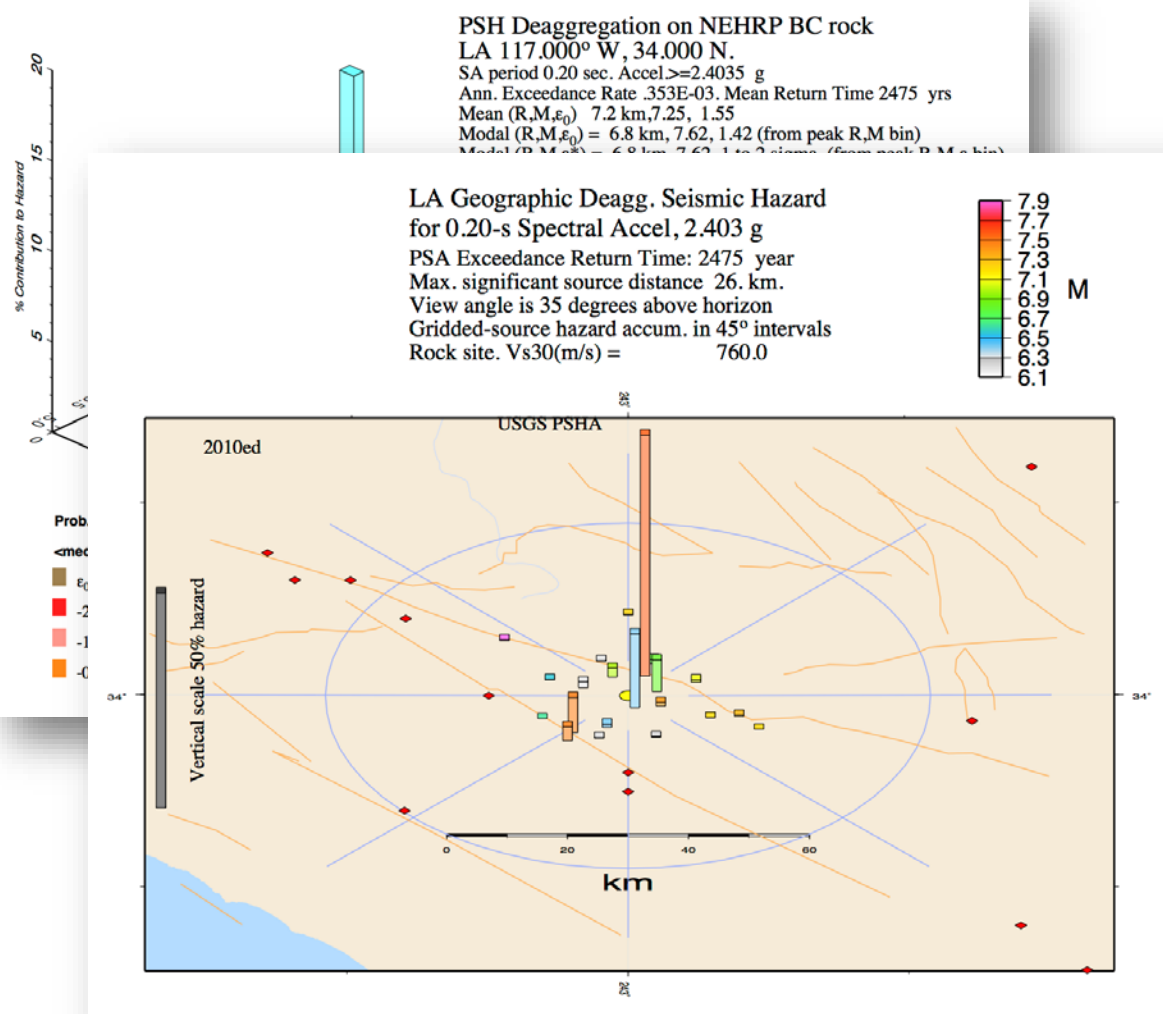
- Deaggregation
- Text (tabular) results



# Secondary Products: Hazard Deaggregation



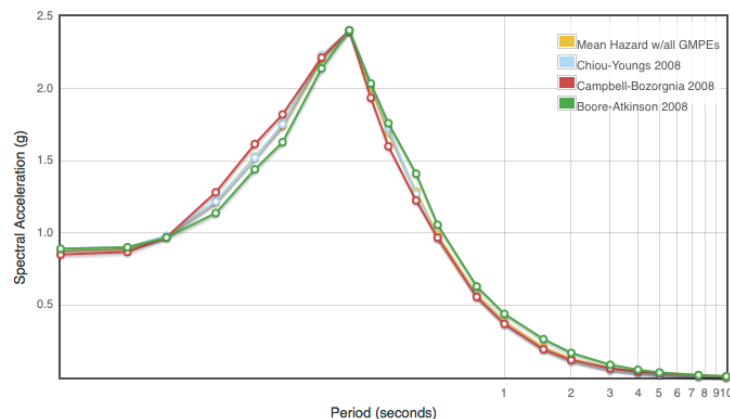
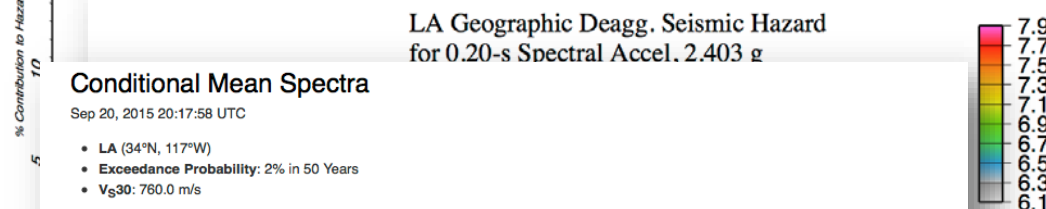
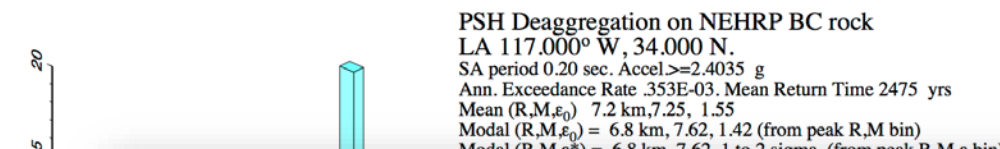
- Deaggregation
- Text (tabular) results
- Geographic



# Secondary Products: Hazard Deaggregation

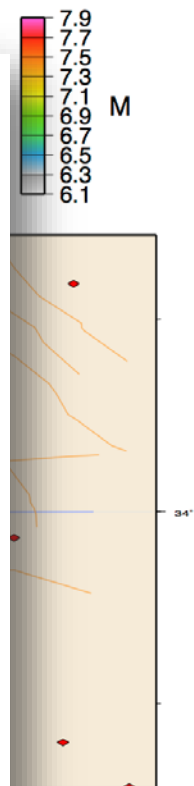


- Deaggregation
- Text (tabular) results
- Geographic
- Conditional Mean Spectra



☒ Plot in Log-X ☐ Plot in Log-Y

Period (s)	Mean Hazard w/all GMPEs Distance: 4.6km Magnitude: 6.60 Epsilon: 1.59	Chiou-Youngs 2008 Distance: 4.8km Magnitude: 6.51 Epsilon: 1.52	Campbell-Bozorgnia 2008 Distance: 5.2km Magnitude: 6.61 Epsilon: 1.77	Boore-Atkinson 2008 Distance: 3.2km Magnitude: 6.78 Epsilon: 1.51
0.010	0.87775	0.88731	0.85012	0.89155
0.020	0.89217	0.90155	0.86828	0.90151
0.030	0.97566	0.98143	0.97077	0.96887
0.050	1.2175	1.2192	1.2819	1.1381
0.075	1.5281	1.5207	1.6159	1.4406



# Secondary Products: Banded Deaggregation

**USGS**  
science for a changing world

**Geologic Hazards Science Center**

**EARTHQUAKES** **LANDSLIDES** **GEOMAGNETISM**

Seismic Hazard Analysis Tools  
Custom Hazard Maps  
Custom EQ Probability Maps  
Hazard Curve Application  
V630  
Interactive Deaggregation

**2009 Banded Deaggregation**

**Site Name** Any name identifying your location.  
LA

**Latitude** Decimal degrees. [24.6, 50.0]  
34

**Longitude** Decimal degrees. [-125.0, -65.0]  
-117

**Spectral Acceleration** The period/frequency to consider.  
0.2 Second (S Hz) SA

**Site Conditions** Vs30 (m/s). Which values can I use where?  
760.0

**Deaggregation Type** Select "Mean" to combine the deaggregation into a single output, use "All" to view individual deaggregations.  
☒ Mean ☐ All

**Ground Motions** Binning method. Select high (< 6g) or low (< 0.7g) to bin values appropriately.  
☒ High ☐ Low

**Compute**

**SHARE**

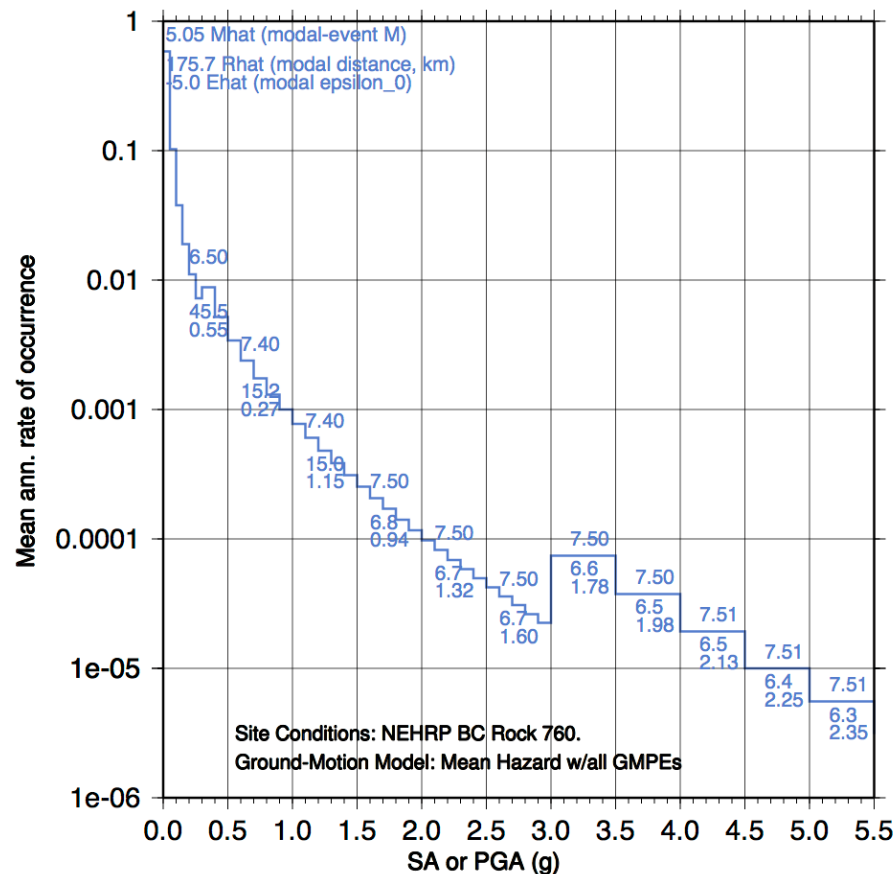
**EARTHQUAKES** **LANDSLIDES** **GEOMAGNETISM**

Earthquakes  
Hazards  
Data & Products  
Learn

Hazards  
Monitoring  
State & Local  
Learn

Monitoring  
Products  
Research  
Learn

## 0.20s SA



GMT 2015 Sep 20 20:20:26 Incremental PSH curve at LA 34.000 -117.0000 USGS NSHMP 2008 model. Bin width changes at 0.3g and 3.0g.

# Other Data Products

The screenshot displays the USGS Earthquake Hazards Program website. The header features the USGS logo with the tagline "science for a changing world" and navigation links for "USGS Home", "Contact USGS", and "Search USGS". Below the header is a blue navigation bar with links for "Home", "About Us", "Contact Us", and a search bar. The main navigation bar includes categories: "EARTHQUAKES", "HAZARDS", "DATA & PRODUCTS", "LEARN", "MONITORING", and "RESEARCH".

## Hazards

The USGS has recently released updated 2014 seismic hazard maps for the conterminous U.S. The maps, documentation, and data will be posted here as they become available.

### Seismic Hazard Maps and Data

Probabilistic and scenario ground-motion hazard maps, input and output data, and documentation. [More...](#)

- Lower 48
- Hawaii
- Guam & Marianas
- Urban & Regional
- Time-Dependent EQ Probability Maps
- Alaska
- Puerto Rico & U.S. Virgin Islands
- Samoa & Pacific Islands
- Scenarios
- Foreign

### Seismic Hazard Analysis Tools

Create customized hazard and probability maps with additional options to assess individual source-contributions to overall hazard. [More...](#)

- Custom Hazard Maps
- Hazard Curves
- Interactive Deaggregations
- Custom Earthquake Probability Maps
- Vs30**
- Banded Deaggregations

### Seismic Hazards Primers

- [Earthquake Hazards 101-The Basics](#)
- [Earthquake Hazards 201-Technical Q&A](#)
- [Fact Sheet](#)-what are hazard maps?
- [FAQ](#)

### About the NSHM Project

- [Publications](#)
- [Workshops](#)
- [Personnel](#)

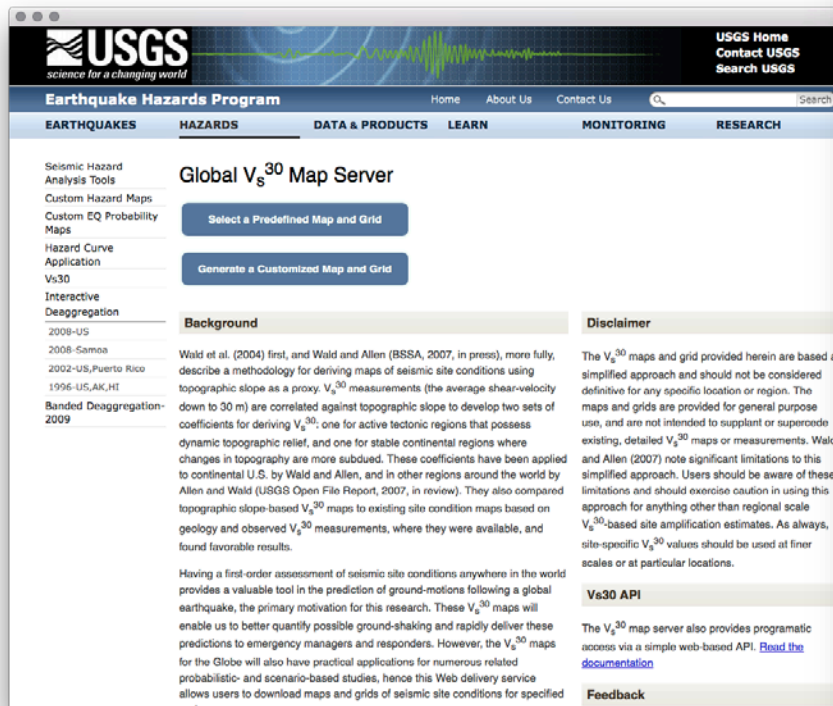
### Seismic Design Maps, Data, and Tools for Engineers

Ground motion parameter values for building and bridge design. [More...](#)

### Faults

Where are the faults in my area, and when did they last have a large earthquake? Find maps and comprehensive geologically based information on known or suspected active faults and folds in the United States. [More...](#)

# Other Data Products: Global Vs30 Map Server



**USGS**  
science for a changing world

**Earthquake Hazards Program**

Home About Us Contact Us  Search

**EARTHQUAKES HAZARDS DATA & PRODUCTS LEARN MONITORING RESEARCH**

Seismic Hazard Analysis Tools  
Custom Hazard Maps  
Custom EQ Probability Maps  
Hazard Curve Application  
Vs30  
Interactive Deaggregation

**Global Vs<sup>30</sup> Map Server**

Select a Predefined Map and Grid

Generate a Customized Map and Grid

**Background**

Wald et al. (2004) first, and Wald and Allen (BSSA, 2007, in press), more fully, describe a methodology for deriving maps of seismic site conditions using topographic slope as a proxy.  $V_s^{30}$  measurements (the average shear-velocity down to 30 m) are correlated against topographic slope to develop two sets of coefficients for deriving  $V_s^{30}$ : one for active tectonic regions that possess dynamic topographic relief, and one for stable continental regions where changes in topography are more subdued. These coefficients have been applied to continental U.S. by Wald and Allen, and in other regions around the world by Allen and Wald (USGS Open File Report, 2007, in review). They also compared topographic slope-based  $V_s^{30}$  maps to existing site condition maps based on geology and observed  $V_s^{30}$  measurements, where they were available, and found favorable results.

Having a first-order assessment of seismic site conditions anywhere in the world provides a valuable tool in the prediction of ground-motions following a global earthquake, the primary motivation for this research. These  $V_s^{30}$  maps will enable us to better quantify possible ground-shaking and rapidly deliver these predictions to emergency managers and responders. However, the  $V_s^{30}$  maps for the Globe will also have practical applications for numerous related probabilistic- and scenario-based studies, hence this Web delivery service allows users to download maps and grids of seismic site conditions for specified regions.

**Disclaimer**

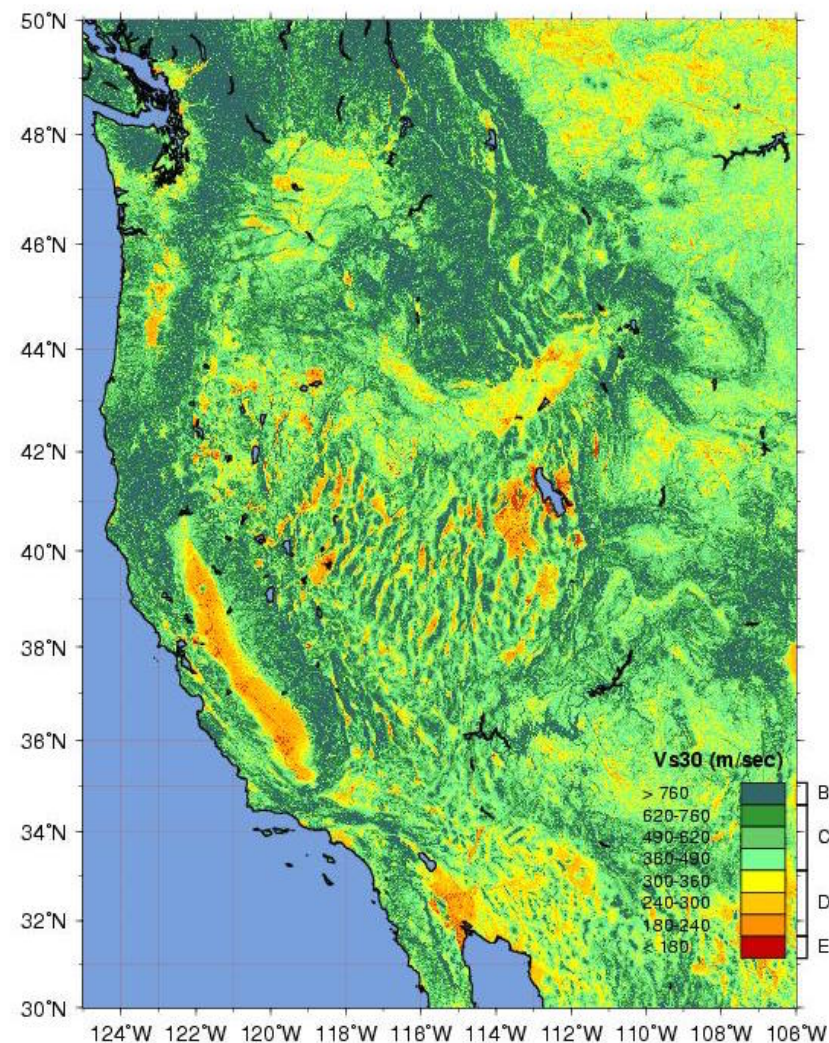
The  $V_s^{30}$  maps and grid provided herein are based a simplified approach and should not be considered definitive for any specific location or region. The maps and grids are provided for general purpose use, and are not intended to supplant or supercede existing, detailed  $V_s^{30}$  maps or measurements. Wald and Allen (2007) note significant limitations to this simplified approach. Users should be aware of these limitations and should exercise caution in using this approach for anything other than regional scale  $V_s^{30}$ -based site amplification estimates. As always, site-specific  $V_s^{30}$  values should be used at finer scales or at particular locations.

**Vs30 API**

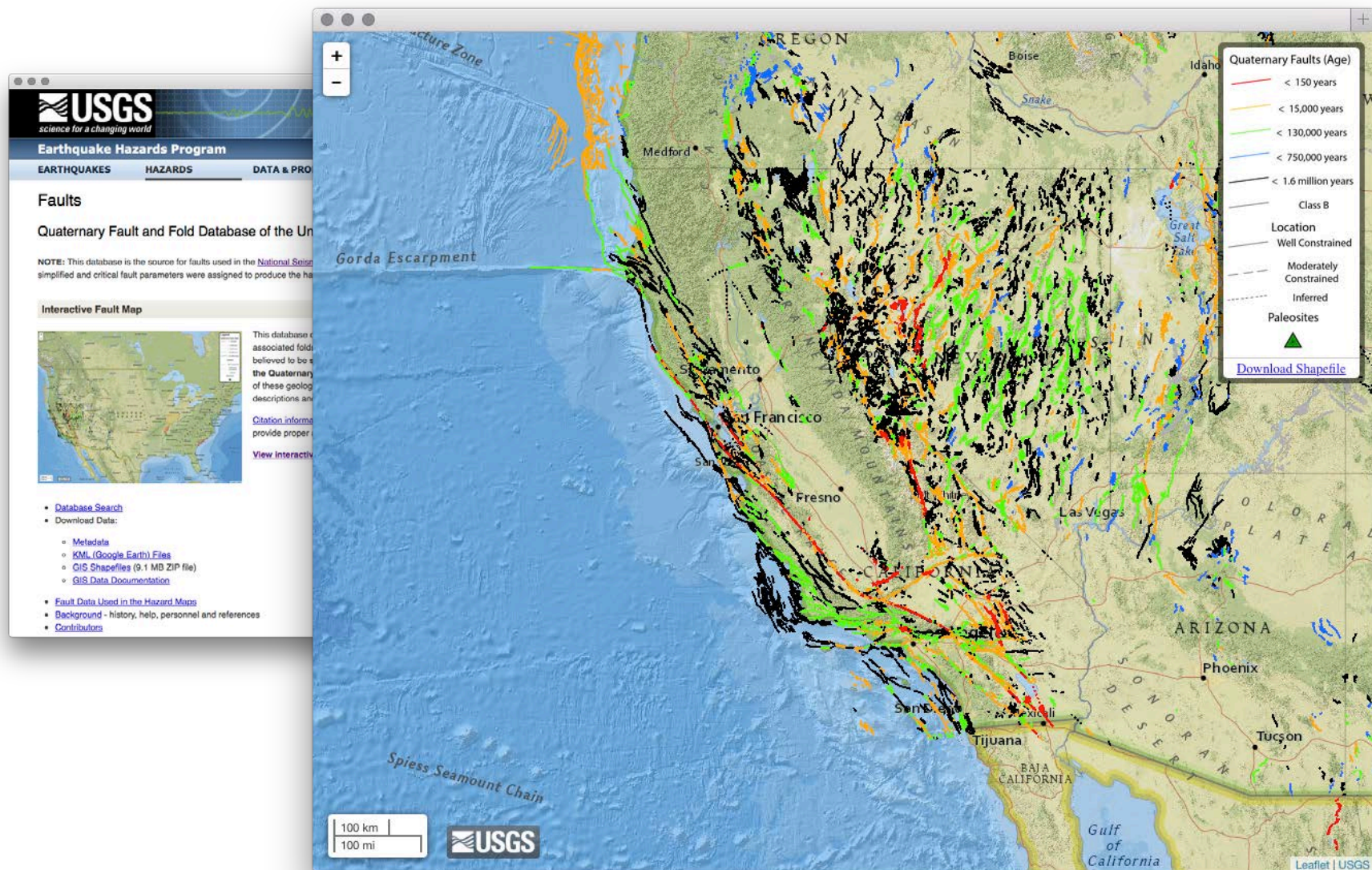
The  $V_s^{30}$  map server also provides programmatic access via a simple web-based API. [Read the documentation](#)

**Feedback**

2008-US  
2008-Samea  
2002-US, Puerto Rico  
1996-US, AK, HI  
Banded Deaggregation-2009



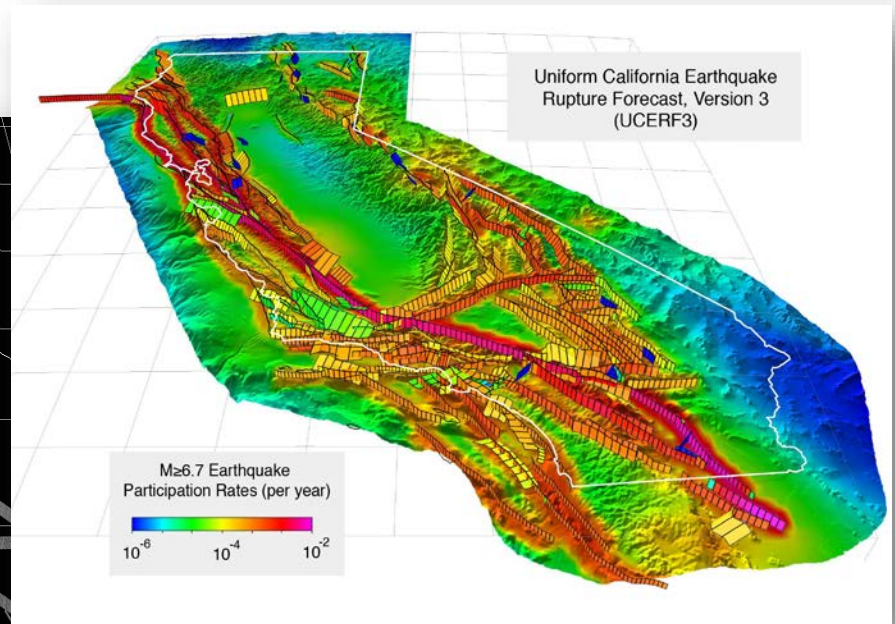
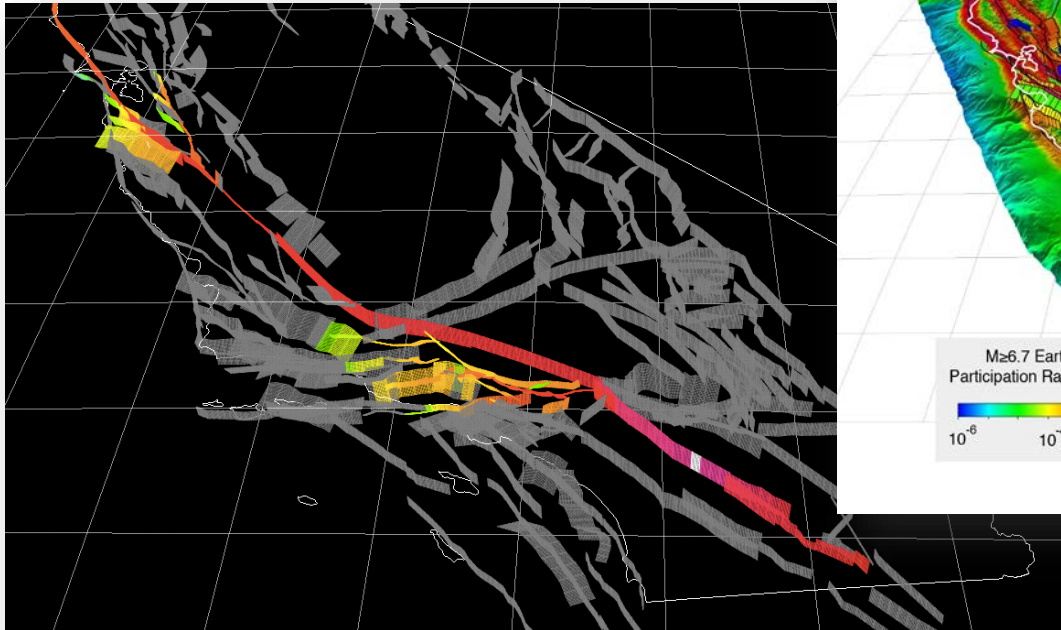
# Other Data Products: Q-Faults Database



# Current Issues

Slow to update products and services with the 2014 model

- Increasing epistemic uncertainty and model complexity
  - WUS: UCERF3 for California (fault system approach)
  - CEUS: adopted elements of CEUS-SSC



# Current Issues

Slow to update products and services with the 2014 model

- Increasing epistemic uncertainty and model complexity
  - WUS: UCERF3 for California (fault system approach)
  - CEUS: adopted elements of CEUS-SSC
- Current products and services backed by different codes
  - OpenSHA, USGS Fortran
- Maps for increased periods and site classes
  - Data management issue; multiple model releases
- Must support estimation of uncertainty moving forward
- Larger models; computationally intensive

# Solutions: nshmp-haz (backend)

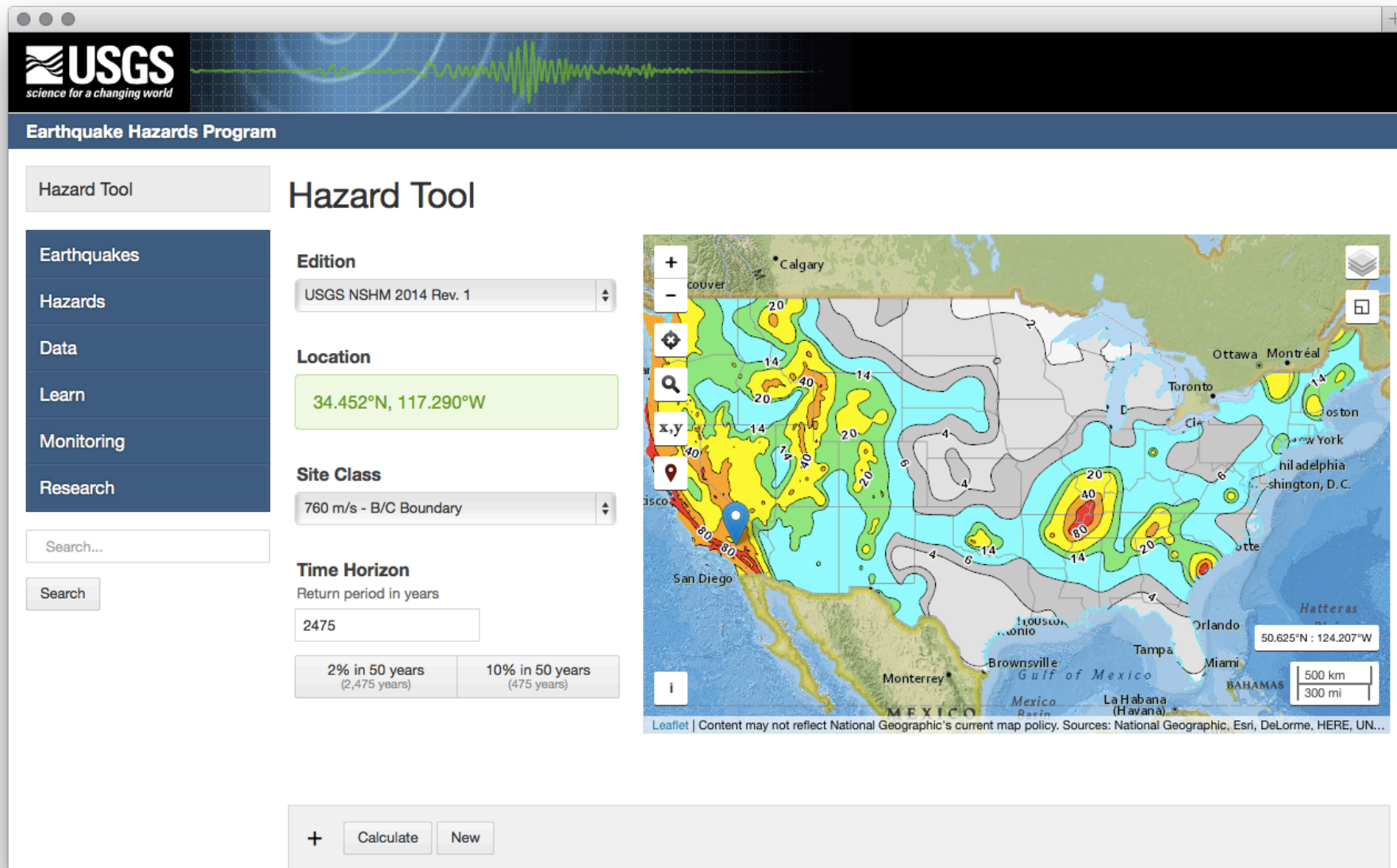
Recognizing our resources and capabilities:

- Near-term focus on unifying software used to generate and serve hazard data and products: [nshmp-haz](#)
- Implemented in Java; adopts best elements of OpenSHA and USGS Fortran
- Generalized source model format (XML)
- Versioning: GitHub ([usgs/nshmp-haz-\\*](#))
- Data releases keyed to software
- Functional PSHA: Emphasis on
  - Immutability
  - Concurrency
- Round trip consistency between:
  - nshmp-haz, source models
  - GIS databases and services
  - Web services and applications

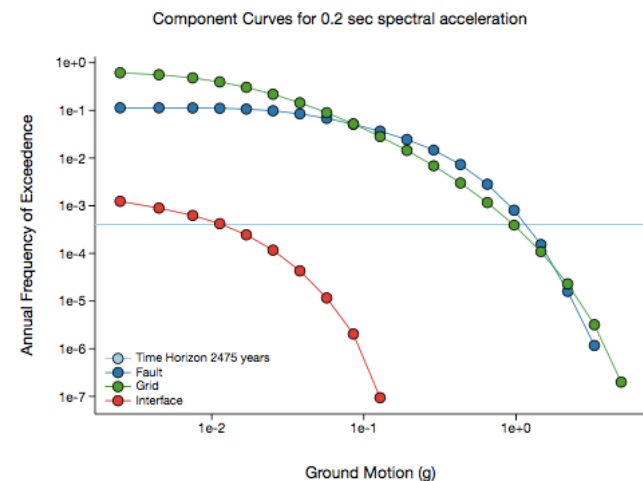
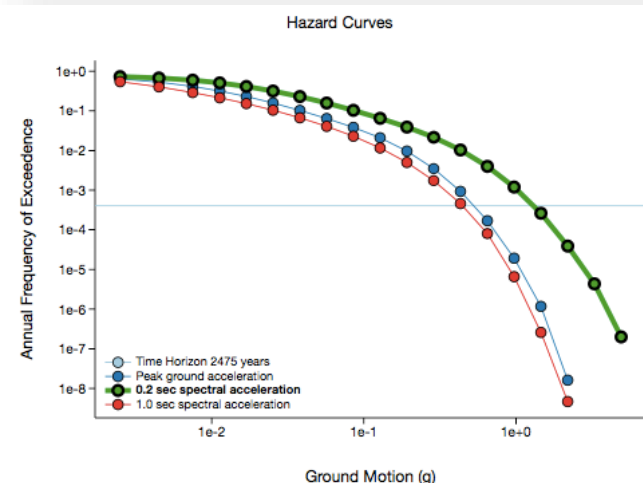
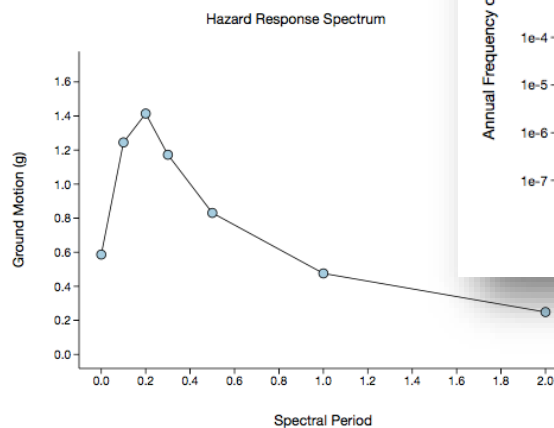
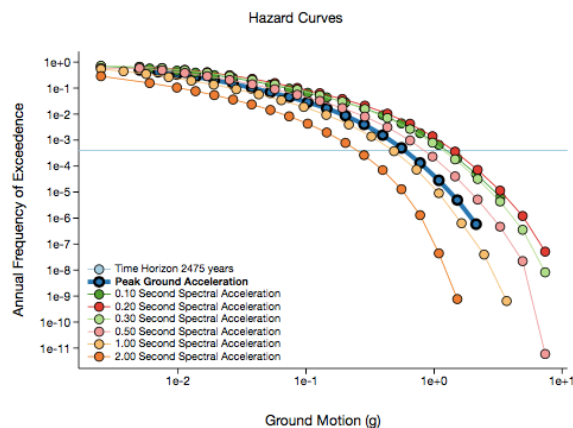
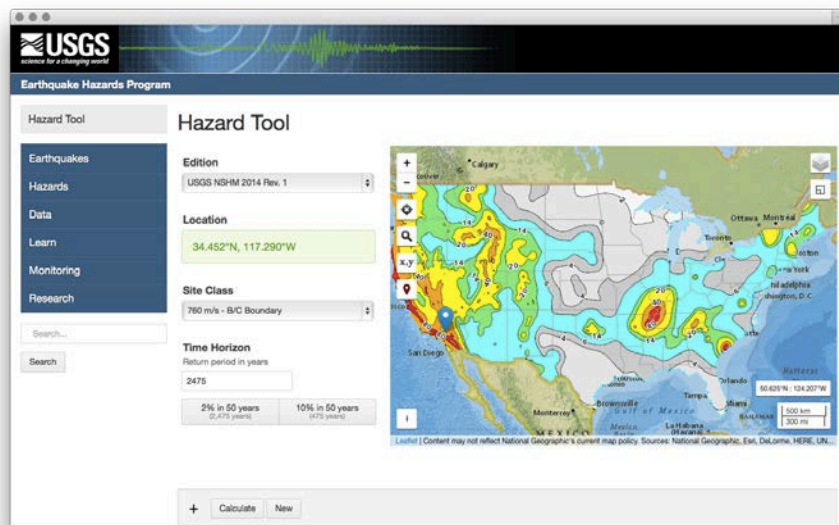
# Solutions: Unified Hazard Tool (in development)

- Leverages nshmp-haz
- Integrates in a single web application:
  - Custom hazard maps
  - EQ probability maps
  - Hazard Curve Service
  - Deaggregation
  - Source model maps
- Supports new services
  - Source MFD plotter
- Integrates static and dynamic data
  - Static data keyed to releases (i.e. building code)
  - Dynamic always serves most up-to-date model
- Data representations: tabular, SVG plots

# Solutions: Unified Hazard Tool (in development)

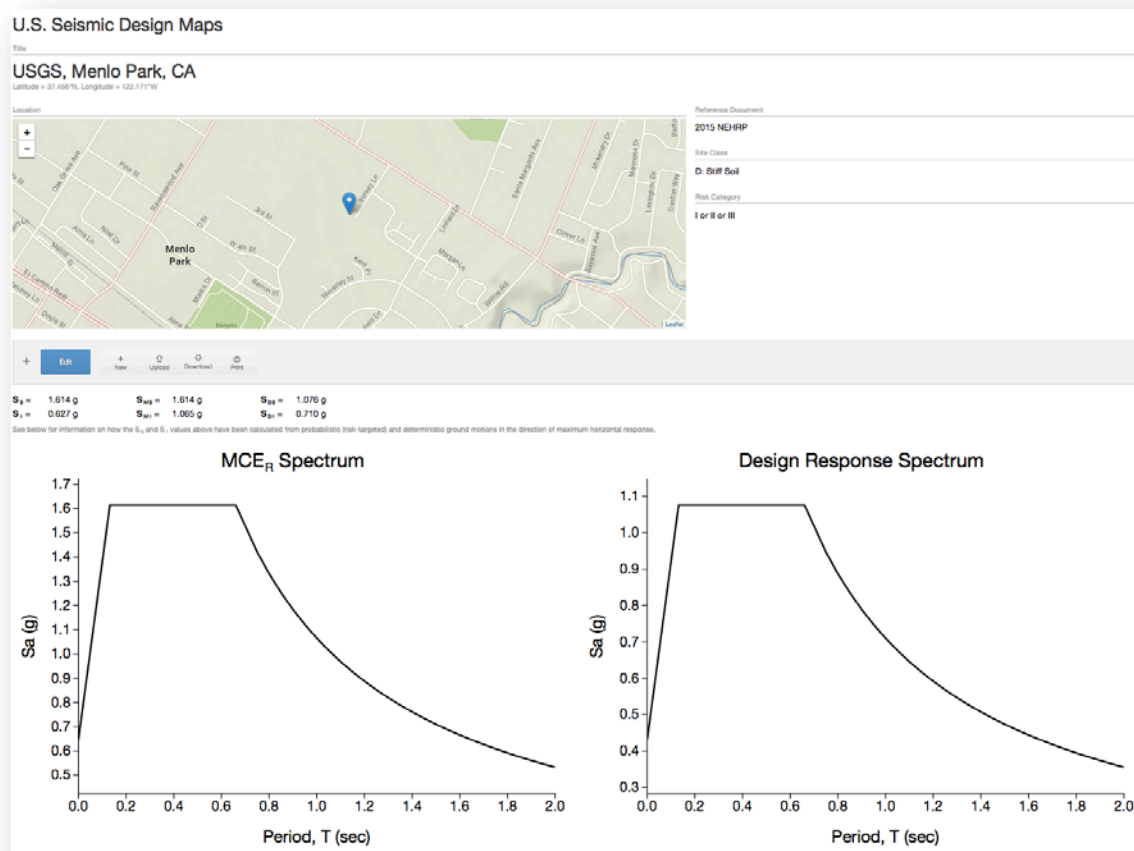


# Solutions: Unified Hazard Tool (in development)



# Solutions: New U.S. Seismic Design Maps Tool

- Features design ground motion values from the 2015 NEHRP Recommended Seismic Provisions
- Other design codes to come, e.g. 2015 IBC
- Mobile-friendly design
- Anticipated launch: end of September



# Scientific Issues

- Induced seismicity and hazard
- Operational earthquake forecasting (OEF)
- Urban and regional hazard maps
- Uncertainty, uncertainty, uncertainty
- Basin depth maps
- Time-dependent hazard models
- Liquefaction potential
- Directivity and directionality
- Hazard map testing
- Single station sigma
- Vertical ground motions
- Others?

# Questions

- Are we making more work for ourselves?
  - Unused products?
  - Inadequate documentation?
- Who is required to use the latest published source model?
- How to deal with deterministic events in light of UCERF3?

User-Needs Poll...