GROUND MOTION MAPS

How To Obtain the Basic Values

Seismic Ground Motions

1 **Determine basic values from maps for bedrock conditions**

2, 3 Classify soil conditions at site and determine site coefficients

4 Determine site-adjusted values

4 Take two-thirds for use in design

5 Construct design response spectrum

7 Site-specific studies permitted/required

Mapped Acceleration Parameters

- Two sets of maps; acceleration parameter is in units of gravity
- S_S for spectral response acceleration at 0.2 sec
- S_1 for spectral response acceleration at 1.0 sec
- Shortcut to Seismic Design Category A:
  - $S_S < 0.15$ and $S_1 < 0.04$

Ground Motion Parameters & Seismic Hazard

Mapped Contours of S_S

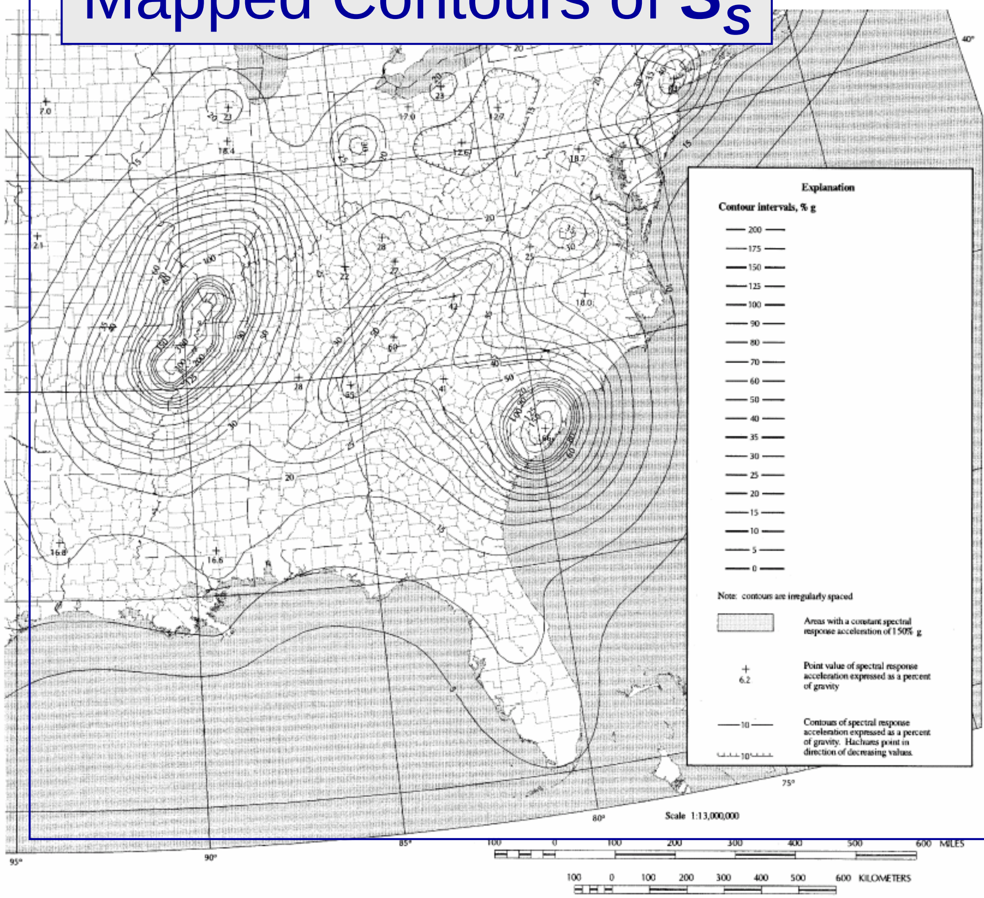


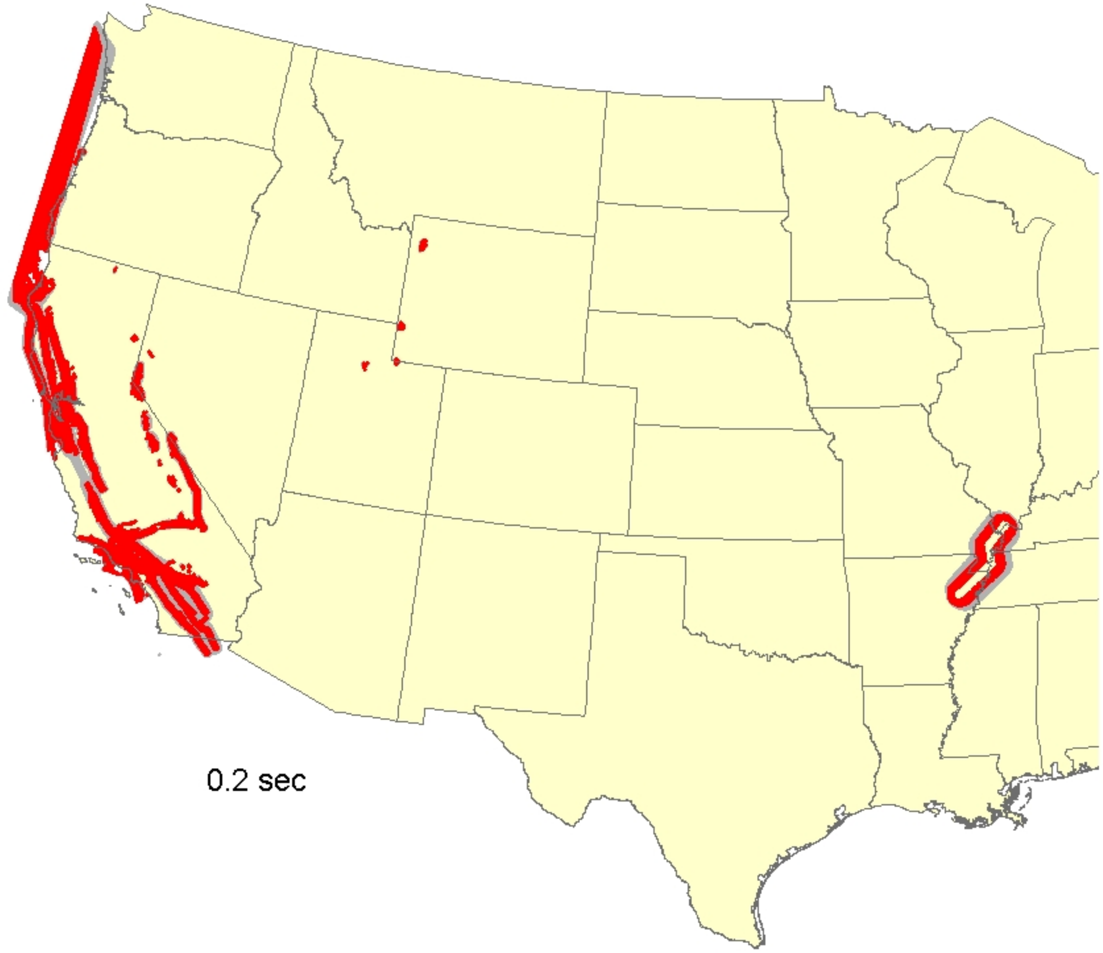
FIGURE 9.4.1.1(a) — continued
MAXIMUM CONSIDERED EARTHQUAKE GROUND MOTION FOR CONTERMINOUS UNITED STATES. OF 0.2 s SPECTRAL RESPONSE ACCELERATION (5% OF CRITICAL DAMPING), SITE CLASS B

S_S and S_1 are the mapped 2% in 50 year spectral accelerations for firm rock

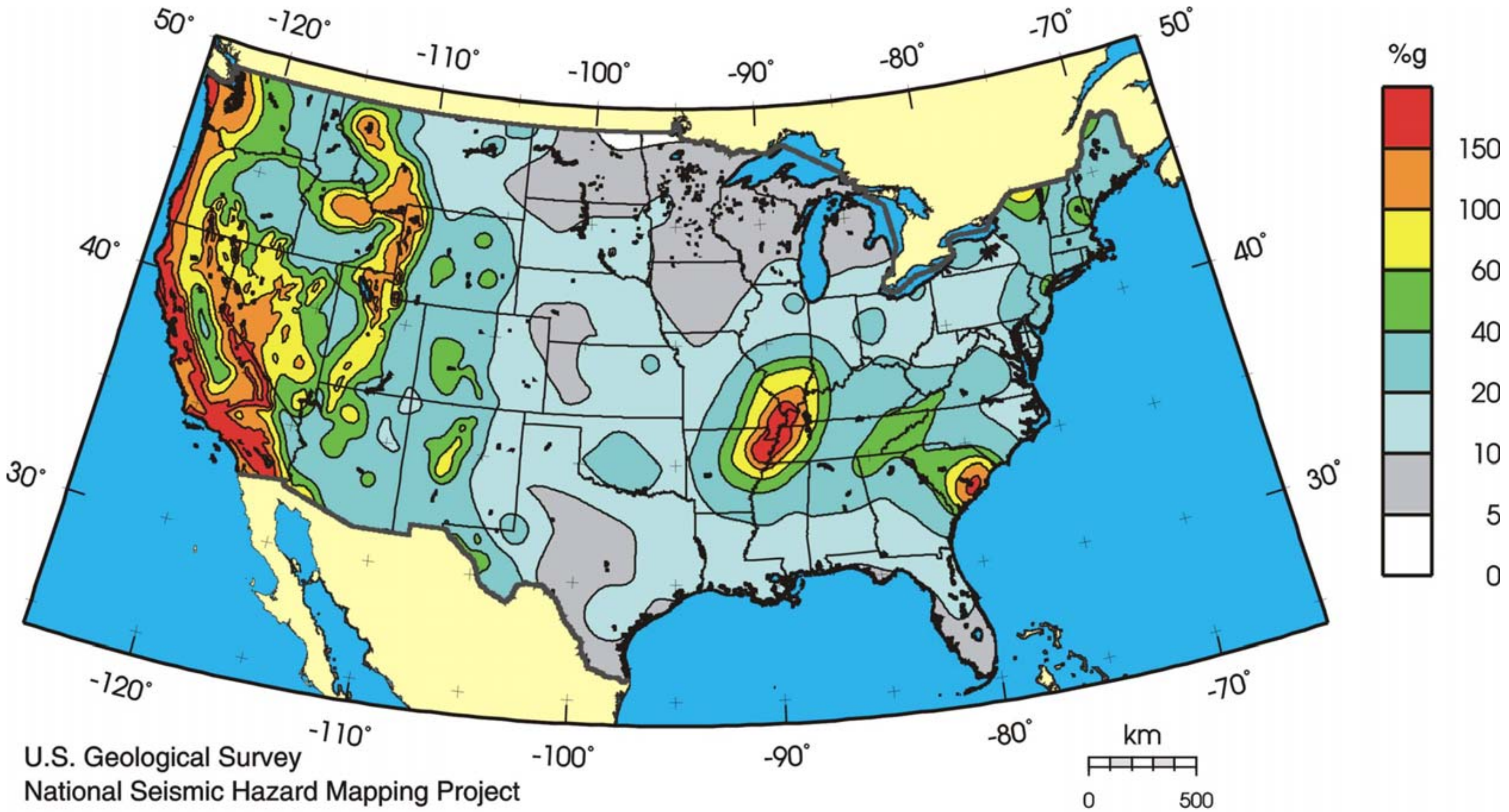
S_{DS} and S_{D1} are the design level spectral accelerations (modified for site and “expected good performance”)

Long-Period Transition Maps

Location of Deterministic Areas



Typical Probabilistic Map



S_S - 0.2 Spectral Response Acceleration

CD vs Internet

- Internet
- CD
- Both sources give the same answers
- Both sources have a similar user interface
- The graphics are somewhat different

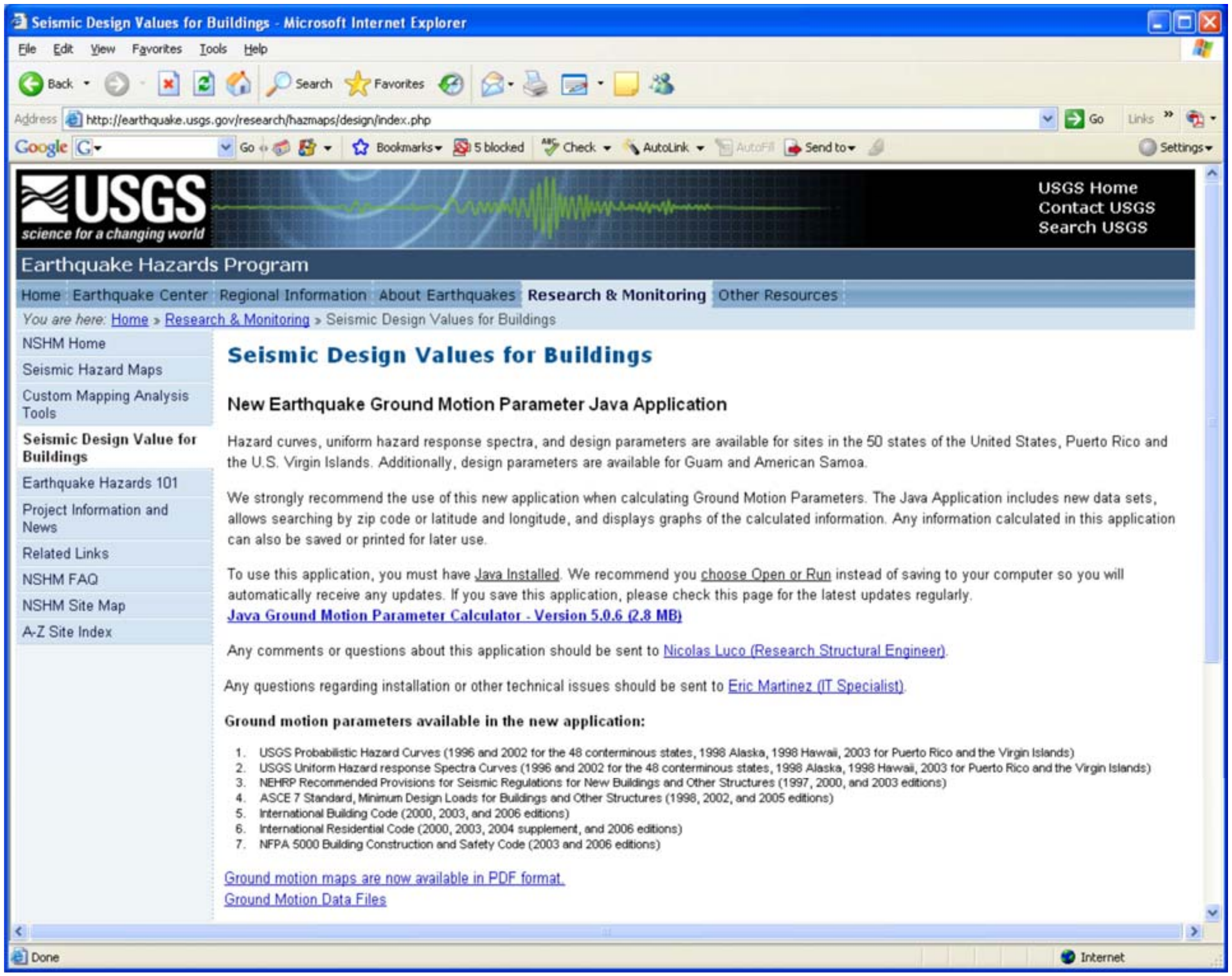
Internet Ground Motion Tool

http://earthquake.usgs.gov/research/hazmaps/

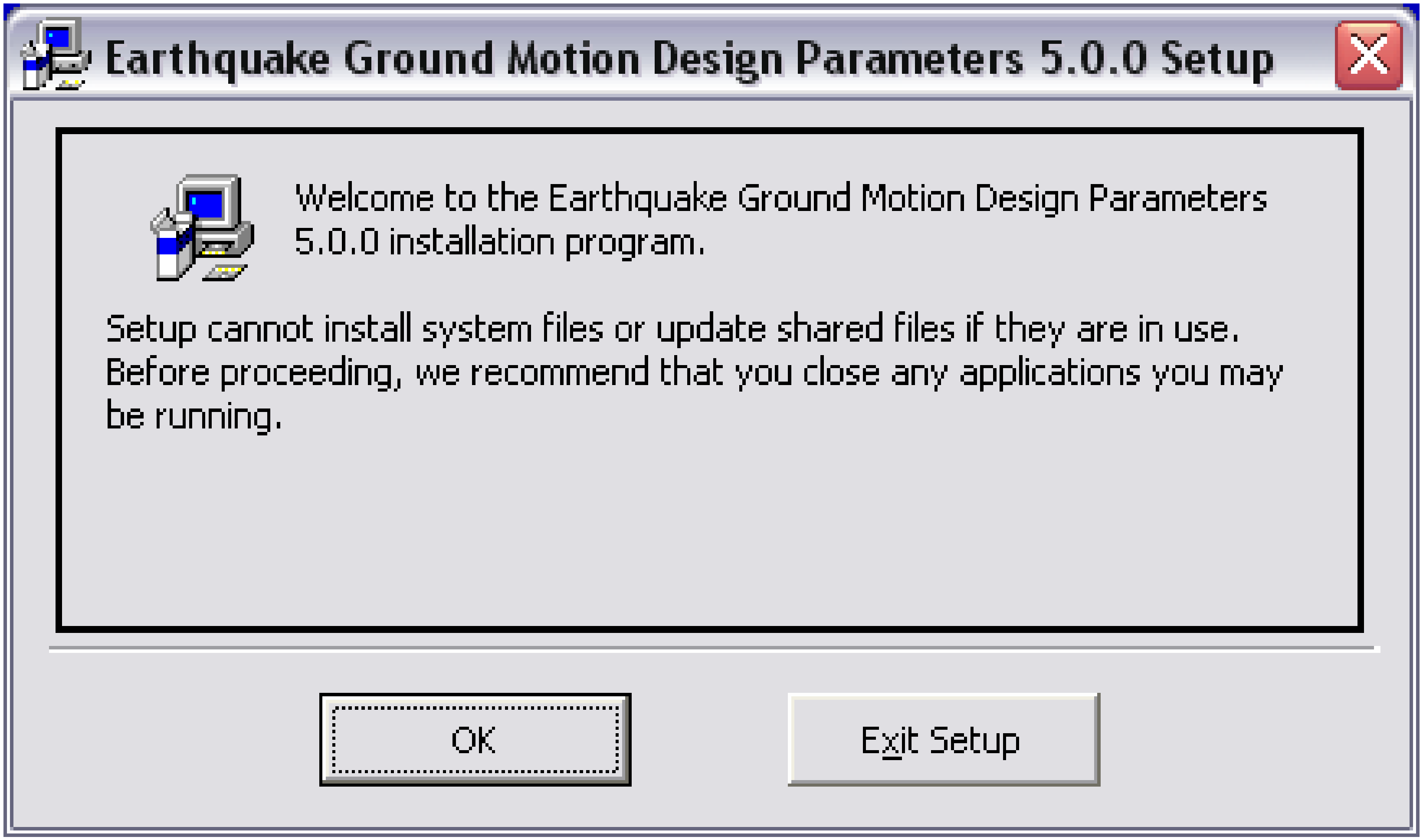
SEISMIC DESIGN VALUES FOR BUILDINGS

S_s and S_1, Hazard Curves, Uniform Hazard Spectra, and Residential Design Category

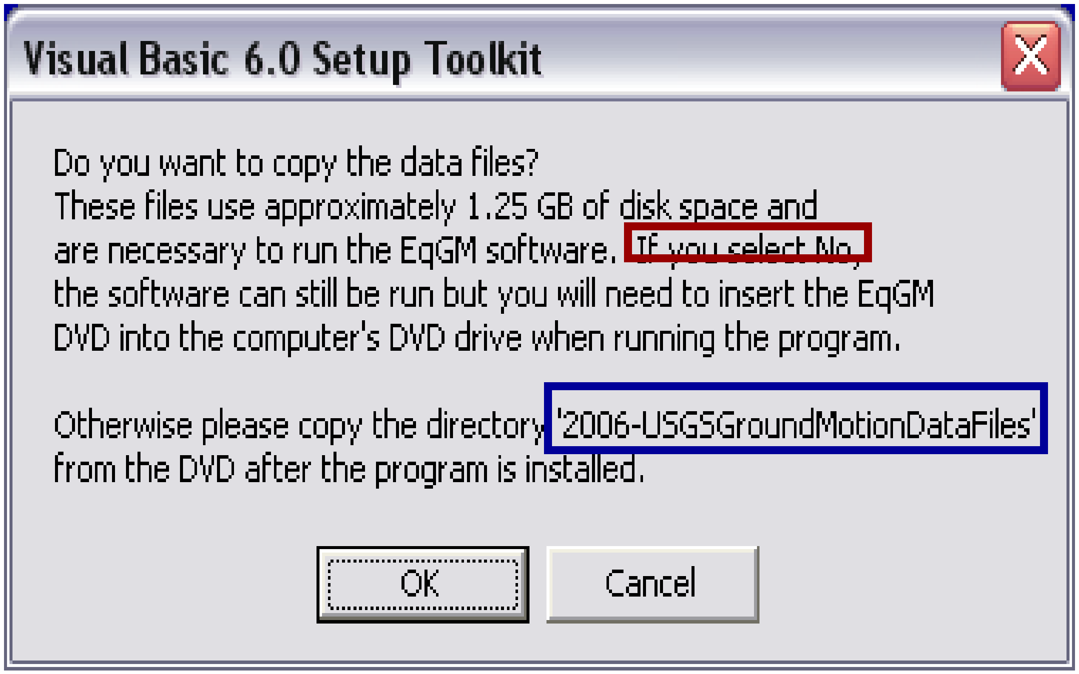
USGS Ground Motion Calculator



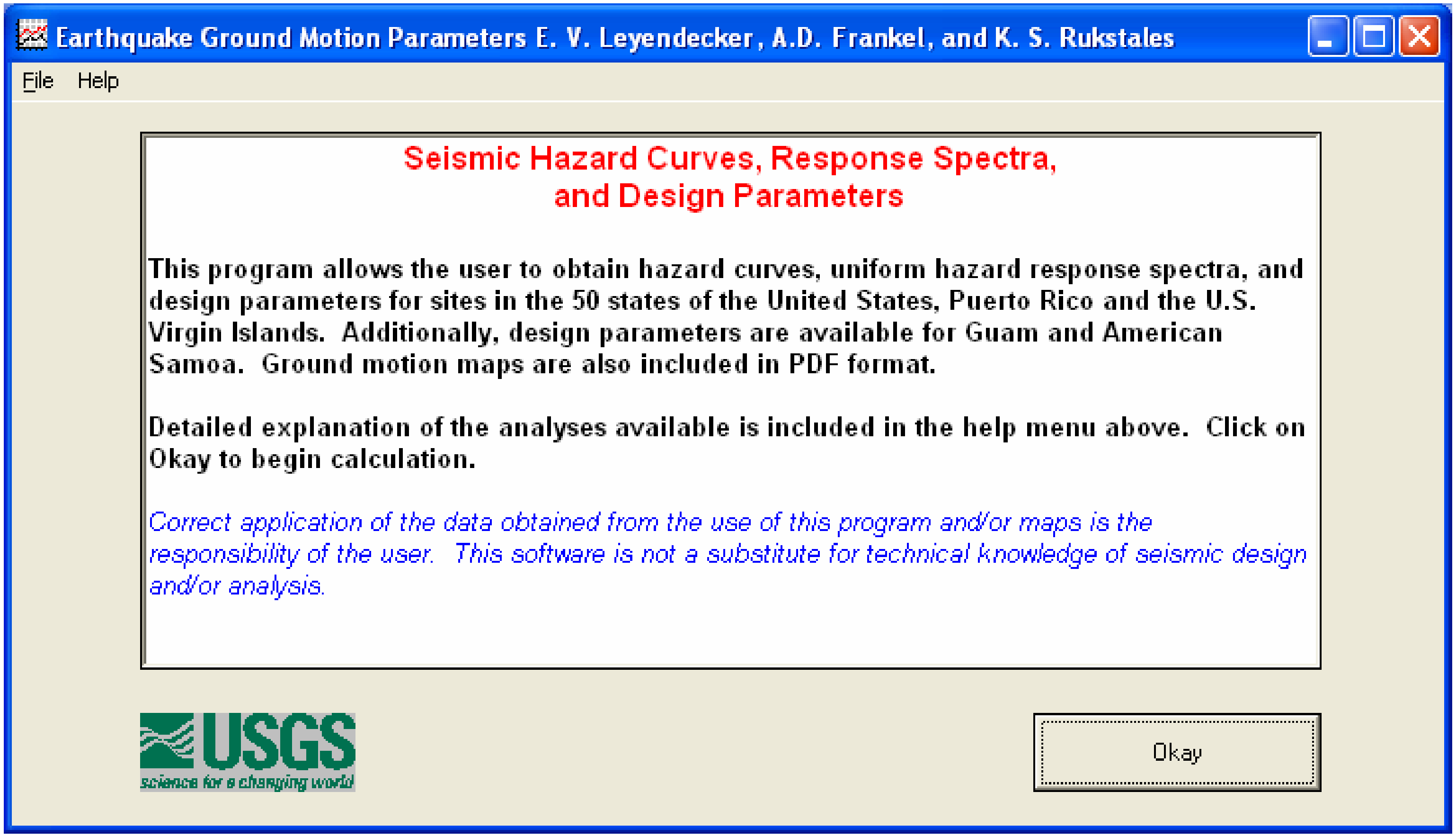
Installation



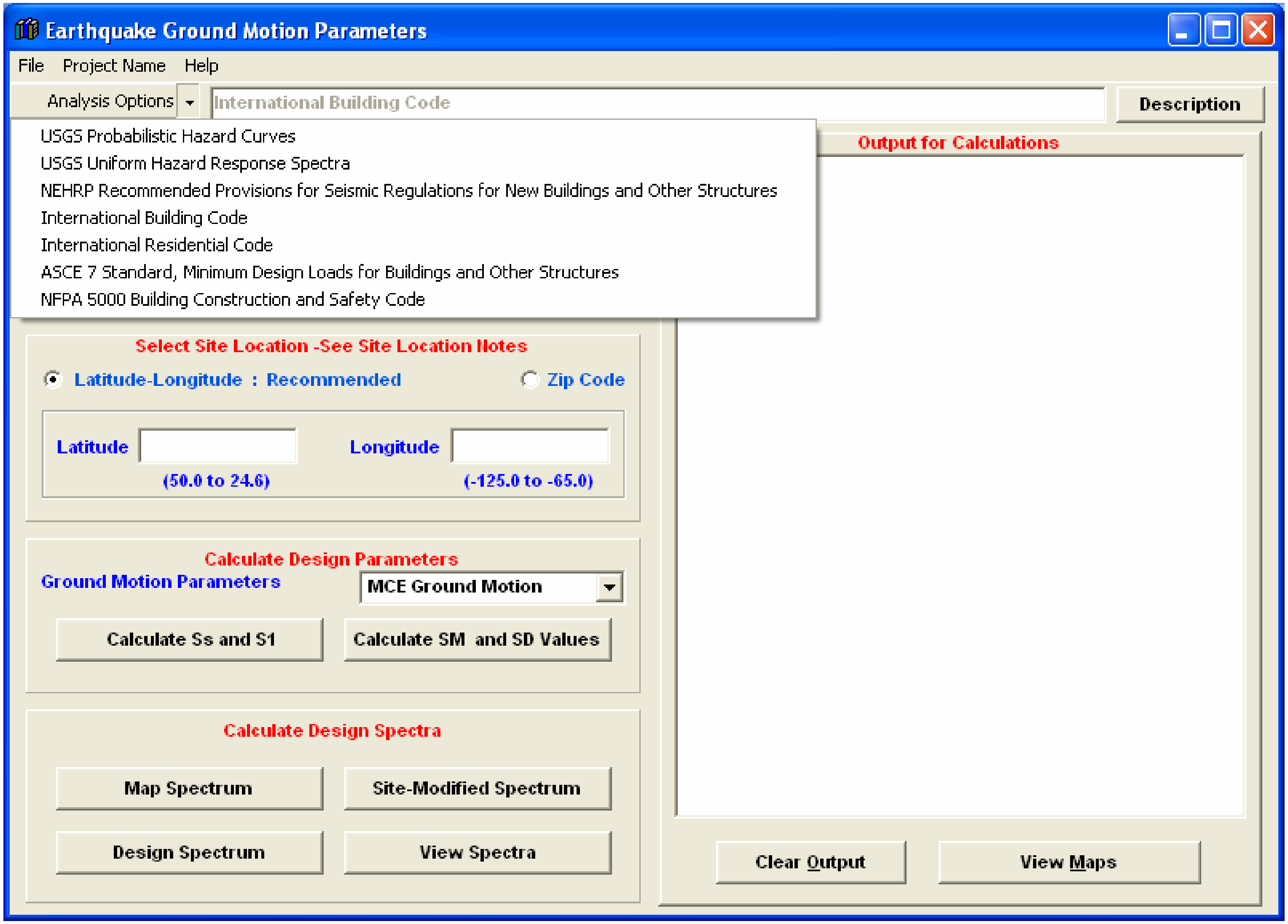
Installation Caution



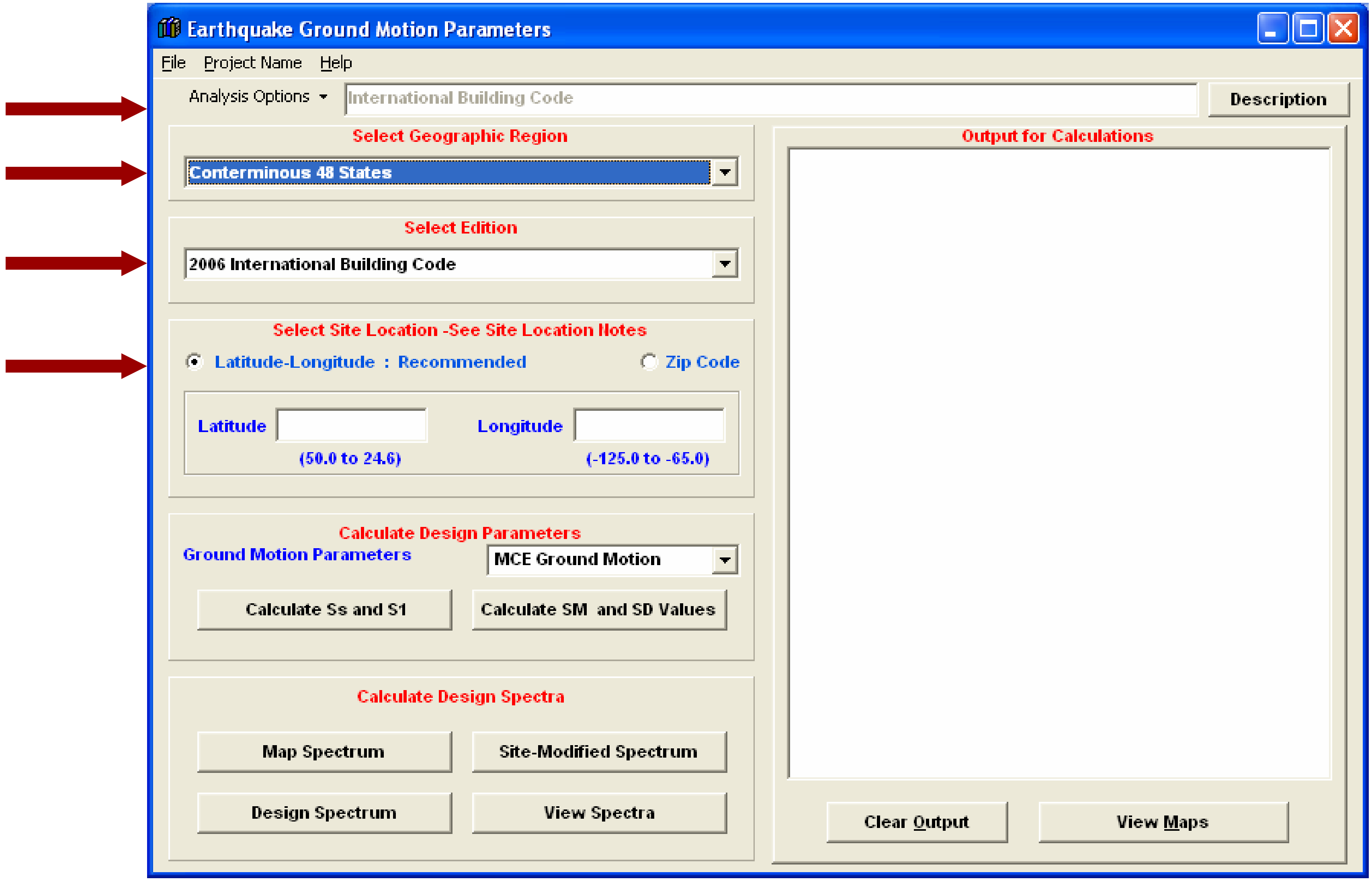
Opening Screen



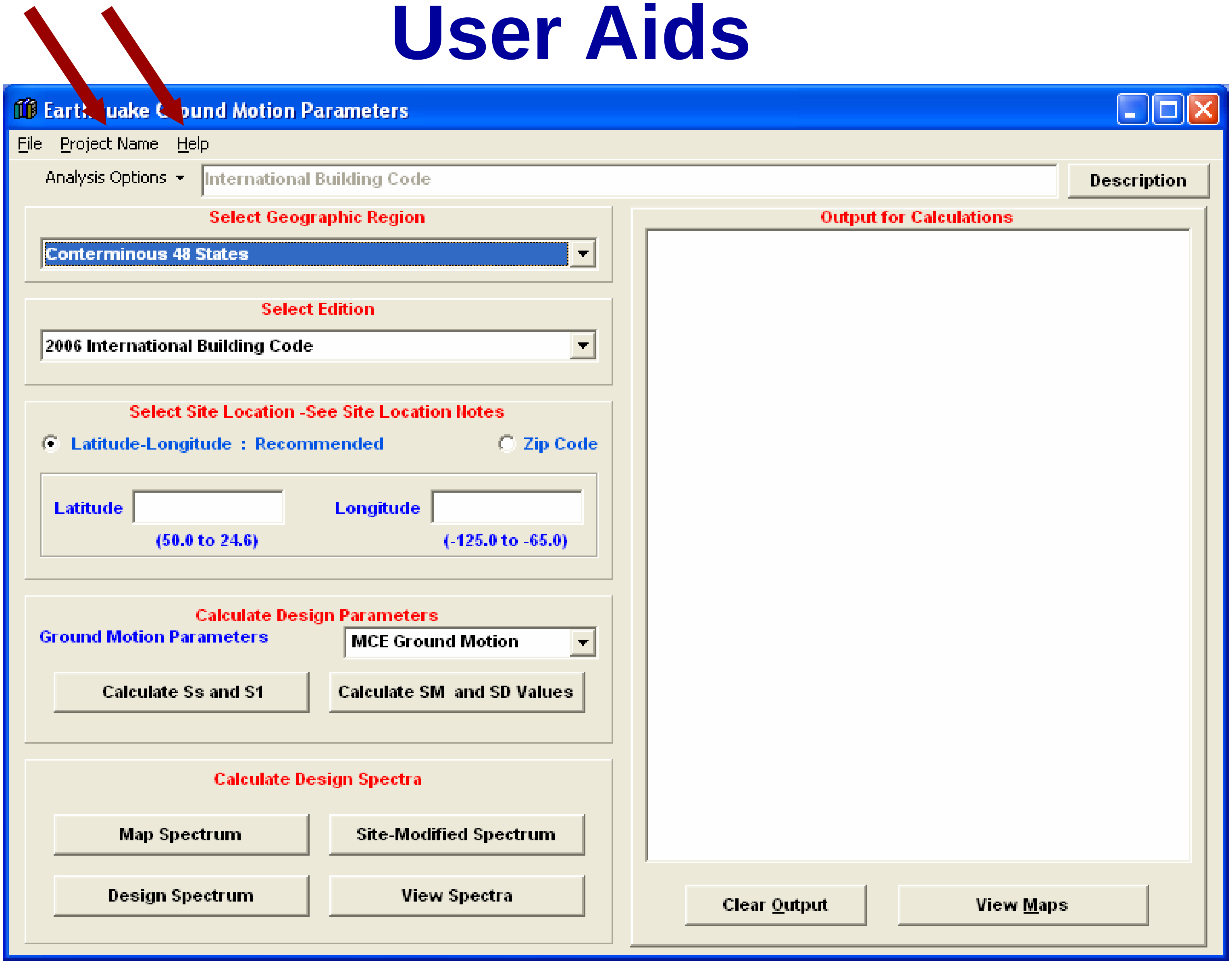
Analysis Options



IBC Option


Earthquake Ground Motion Parameters
File
Project Name
Help
Analysis Options
International Building Code
Description
Select Geographic Region
Conterminous 48 States
Select Edition
2006 International Building Code
Select Site Location -See Site Location Notes
Latitude-Longitude : Recommended
Zip Code
Latitude
Longitude
(50.0 to 24.6)
(-125.0 to -65.0)
Calculate Design Parameters
Ground Motion Parameters
MCE Ground Motion
Calculate Ss and S1
Calculate SM and SD Values
Calculate Design Spectra
Map Spectrum
Site-Modified Spectrum
Design Spectrum
View Spectra
Output for Calculations
Clear Output
View Maps

User Aids



File
Project Name
Help
Analysis Options
International Building Code
Description
Select Geographic Region
Conterminous 48 States
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2006 International Building Code
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Latitude-Longitude : Recommended
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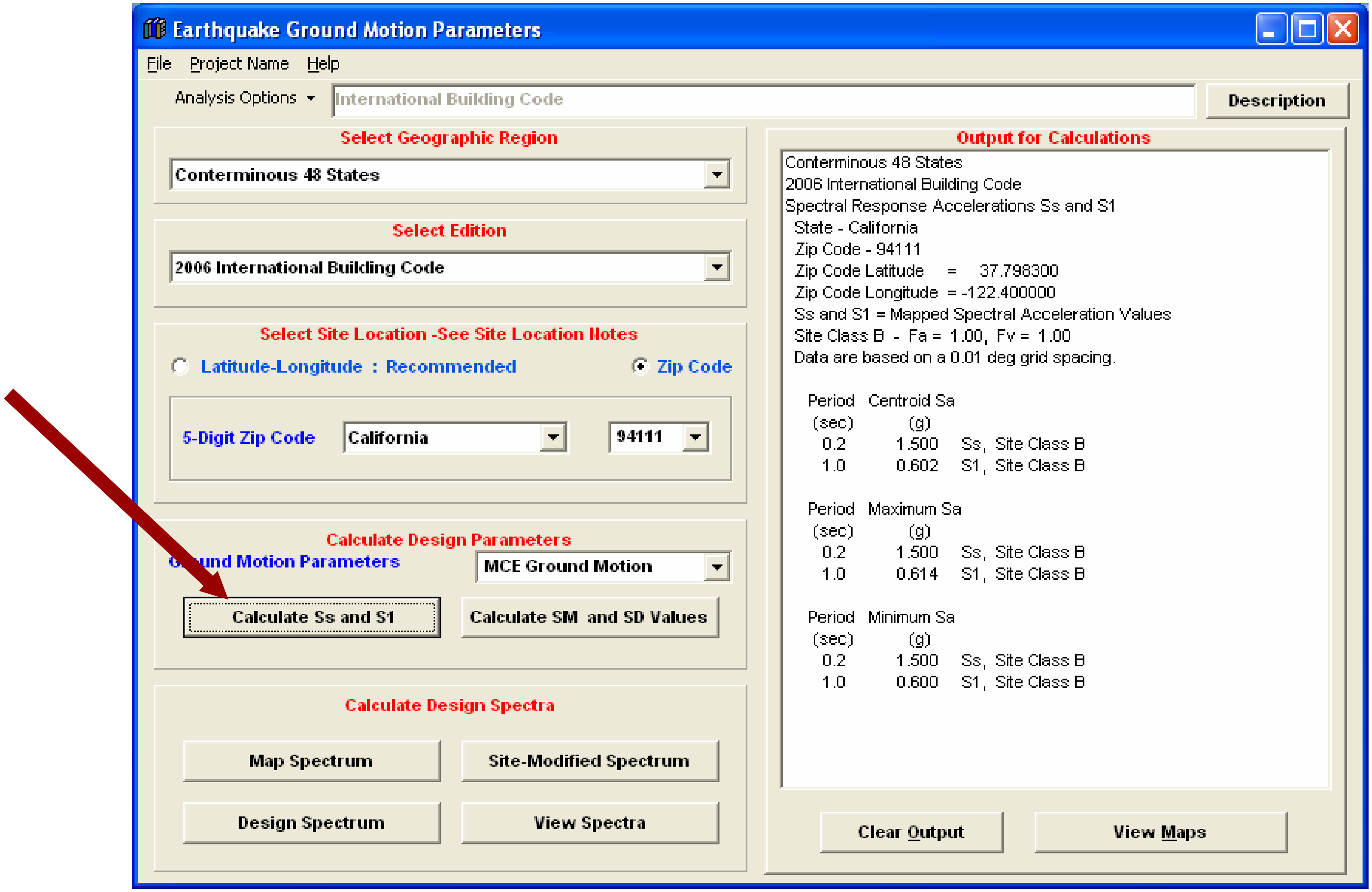
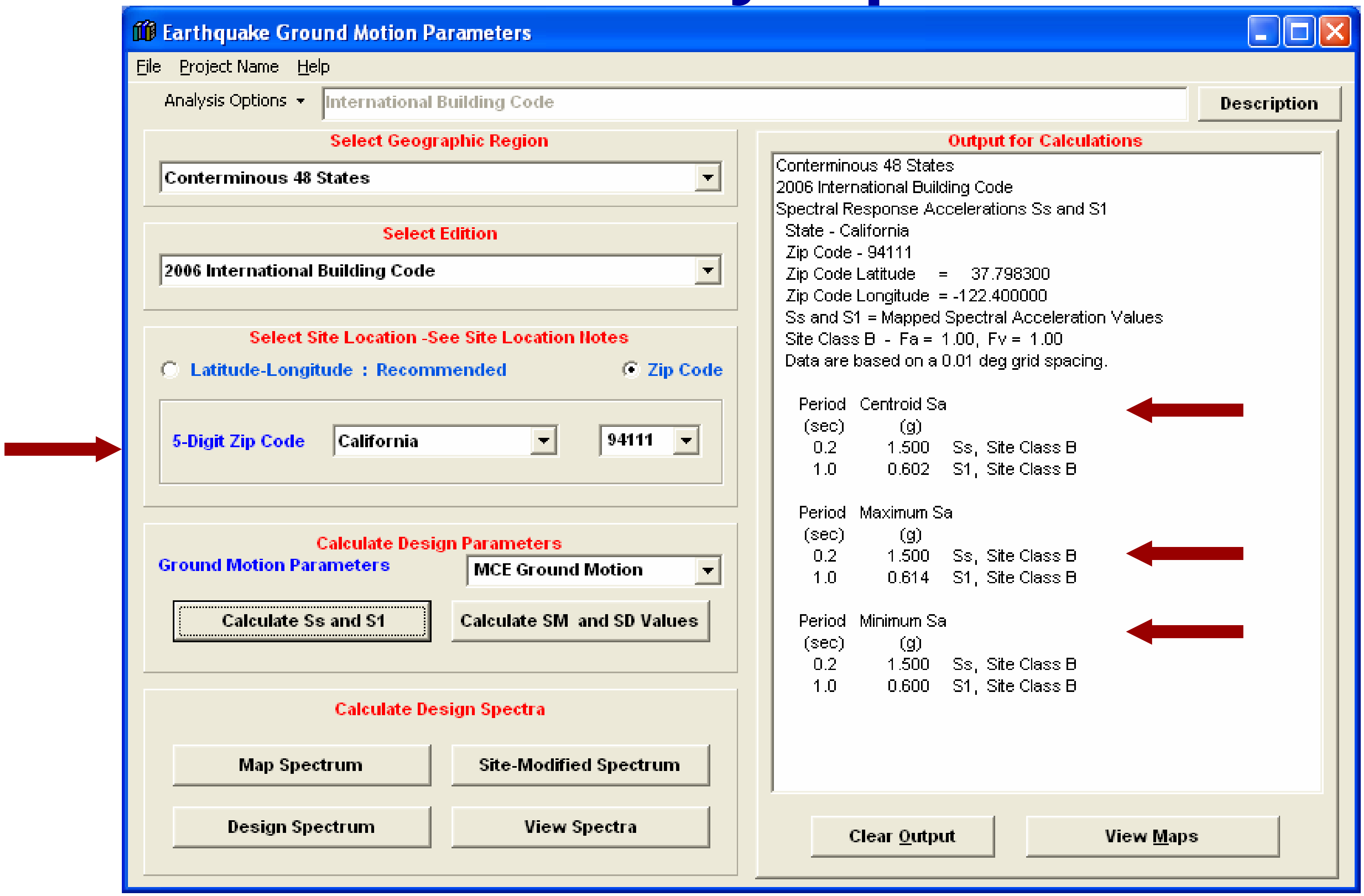
Calculate Design Parameters
Ground Motion Parameters
MCE Ground Motion
Calculate Ss and S1
Calculate SM and SD Values
Calculate Design Spectra
Map Spectrum
Site-Modified Spectrum
Design Spectrum
View Spectra
Output for Calculations
Clear Output
View Maps

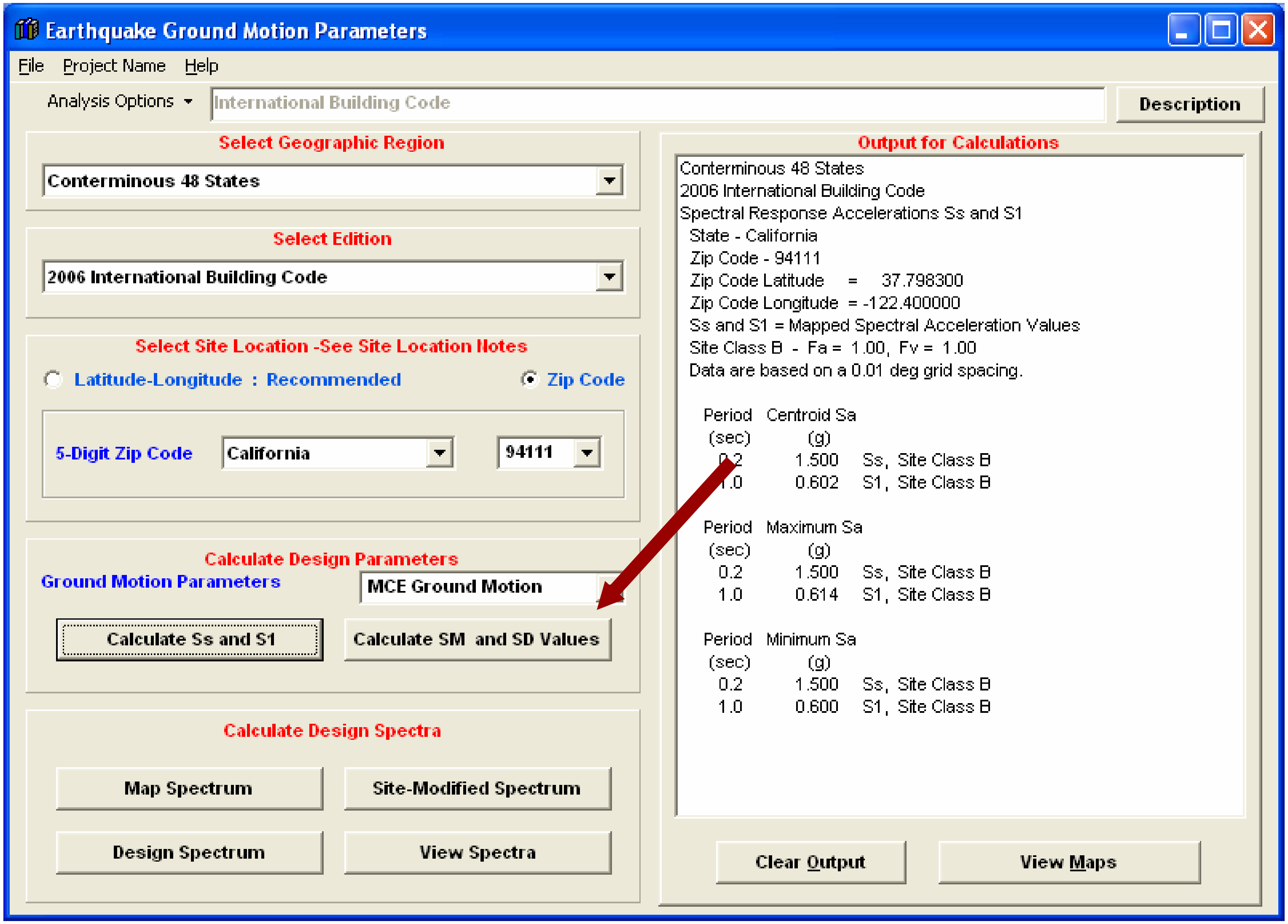
Calculate S_S AND S_1



Location By Zipcode



Calculate S_{MS}, S_{M1}, S_{DS}, S_{D1}



Calculate Site Coefficients

Site Coefficients

Soil Factors as a Function of Site Class and Spectral Accelerations

Values of Fa as a Function of Site Class and 0.2 sec MCE Spectral Acceleration

Site Class	Ss <= 0.25	Ss = 0.50	Ss = 0.75	Ss = 1.00	Ss >= 1.25
A	0.8	0.8	0.8	0.8	0.8
B	1.0	1.0	1.0	1.0	1.0
C	1.2	1.2	1.1	1.0	1.0
D	1.6	1.4	1.2	1.1	1.0
E	2.5	1.7	1.2	0.9	0.9
F	a	a	a	a	a

Values of Fv as a Function of Site Class and 1.0 sec MCE Spectral Acceleration

Site Class	S1 <= 0.10	S1 = 0.20	S1 = 0.30	S1 = 0.40	S1 >= 0.50
A	0.8	0.8	0.8	0.8	0.8
B	1.0	1.0	1.0	1.0	1.0
C	1.7	1.6	1.5	1.4	1.3
D	2.4	2.0	1.8	1.6	1.5
E	3.5	3.2	2.8	2.4	2.4
F	a	a	a	a	a

Notes:

Use straight-line interpolation for intermediate values of Sa and S1.

Note a: Site-specific geotechnical investigation and dynamic site response analyses shall be performed.

Calculate Site Coefficient

Spectral Accelerations

Ss, g: 1.500

S1, g: 0.602

Site Class

- Site Class A
- Site Class B
- Site Class C
- Site Class D
- Site Class E
- Site Class F

Discussion

Site Coefficients

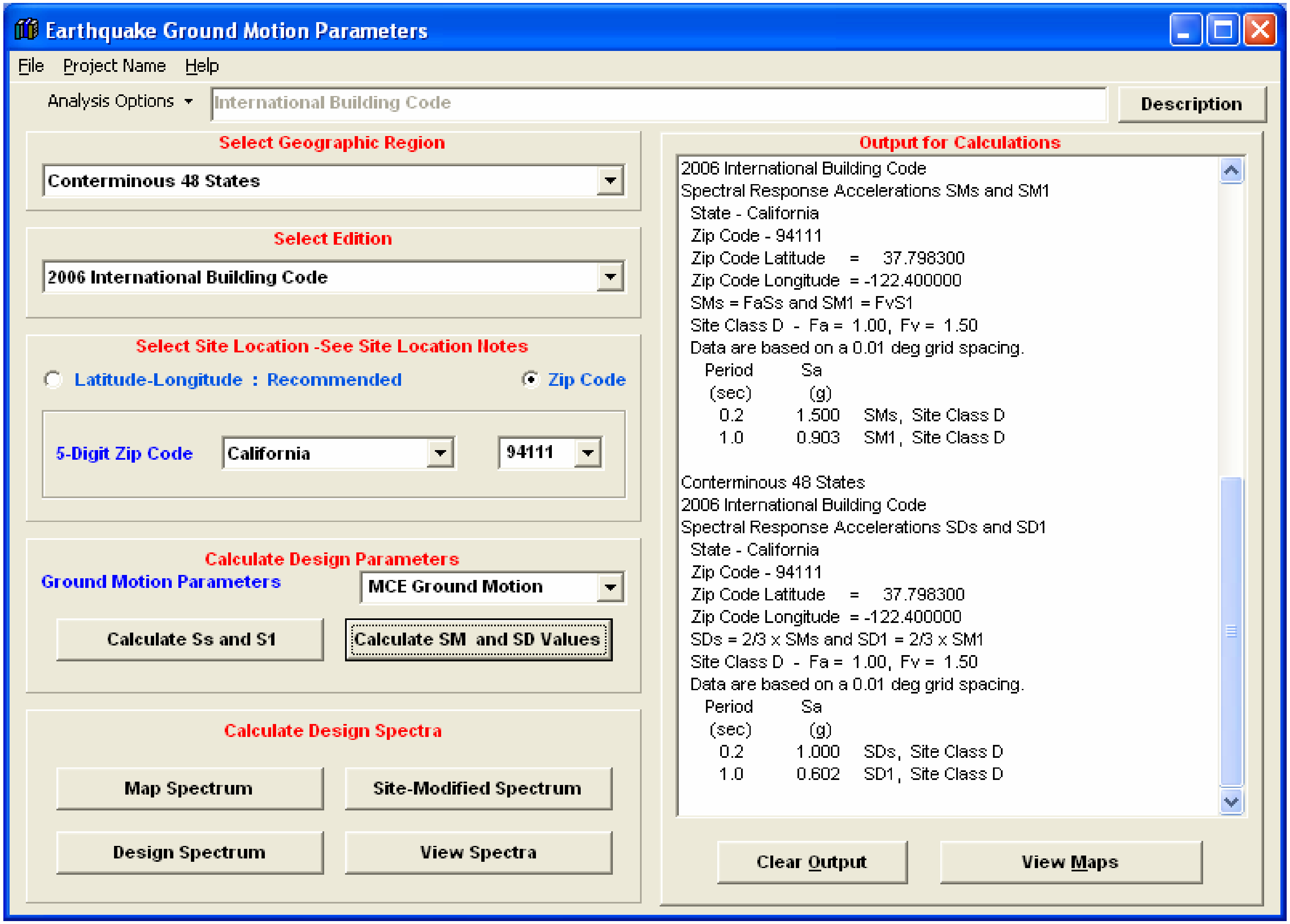
Interpolated soil factors for the conditions shown. Values may also be entered manually.

Fa: 1.00

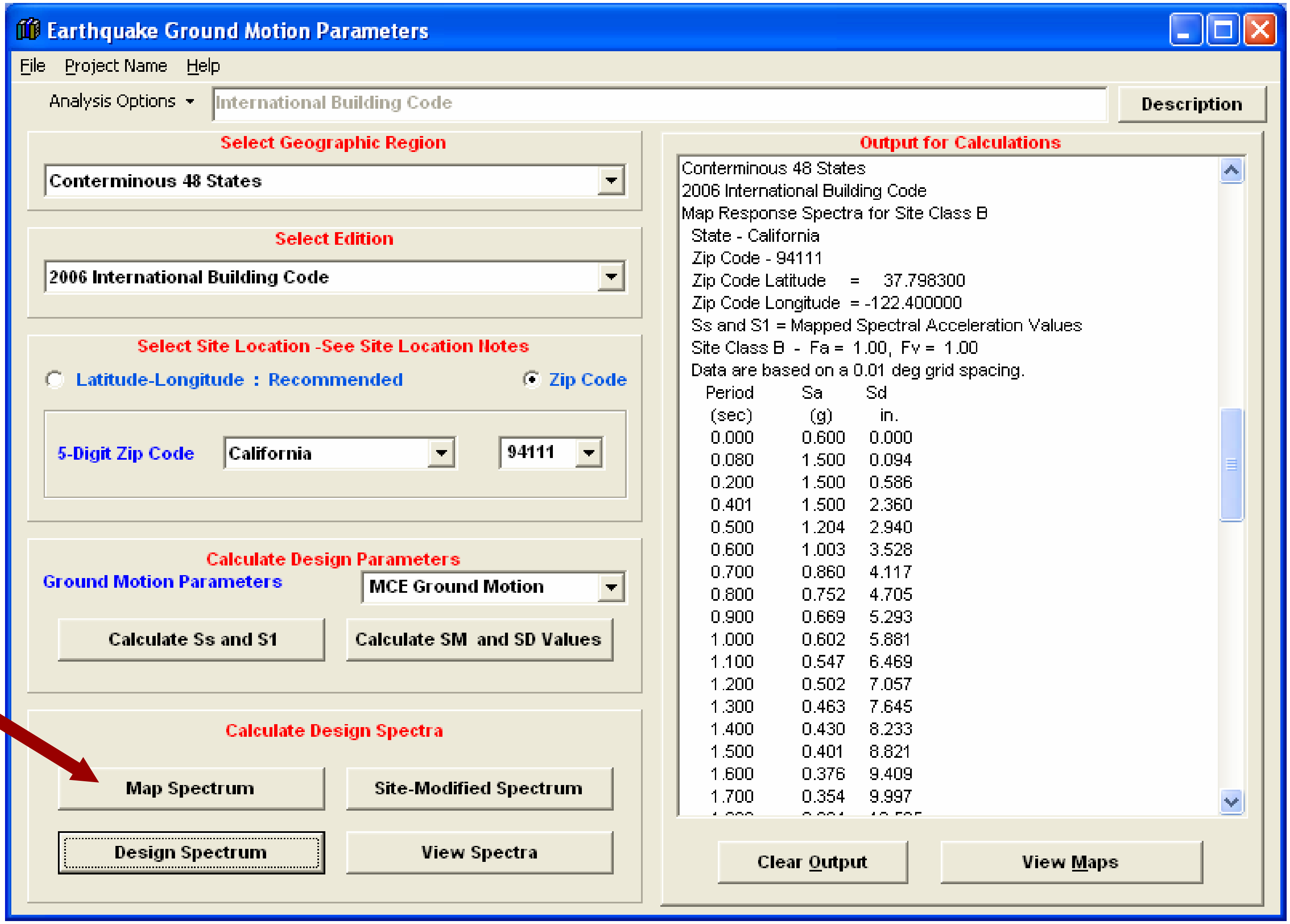
Fv: 1.50

OK

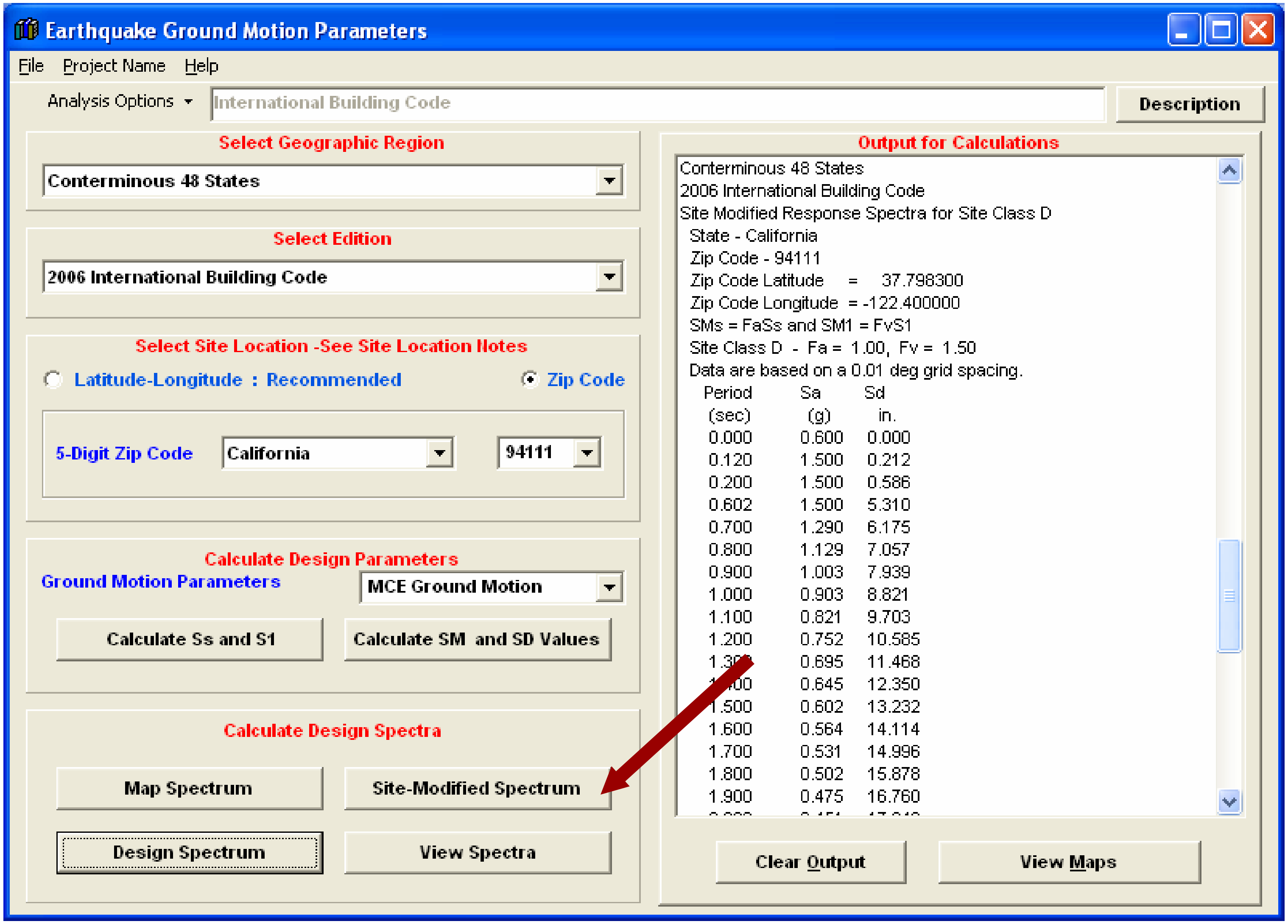
S_{MS}, S_{M1}, S_{DS}, S_{D1} Values



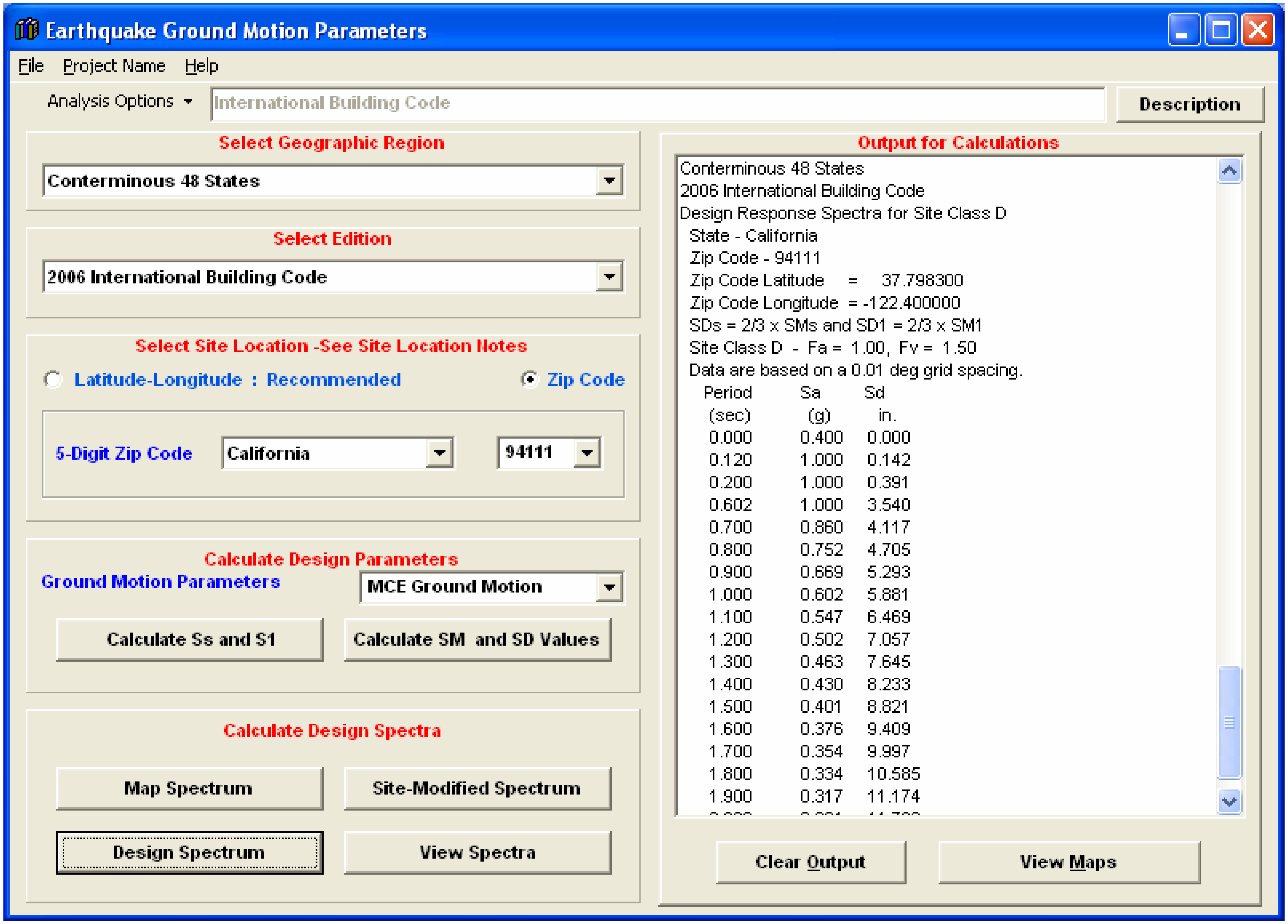
Calculate MCE Spectrum



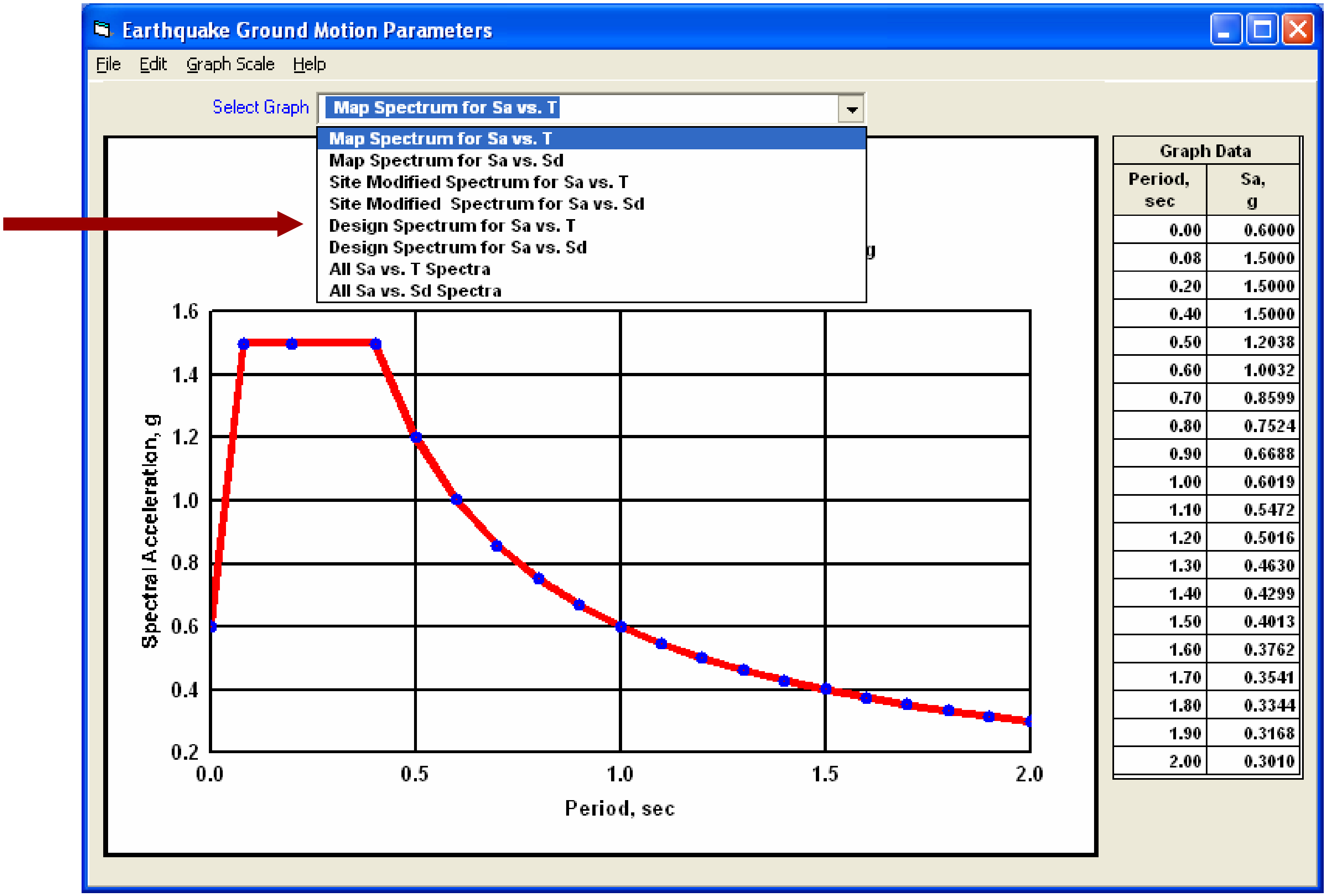
Calculate S_M Spectrum



Calculate S_D Spectrum



Graphic Options

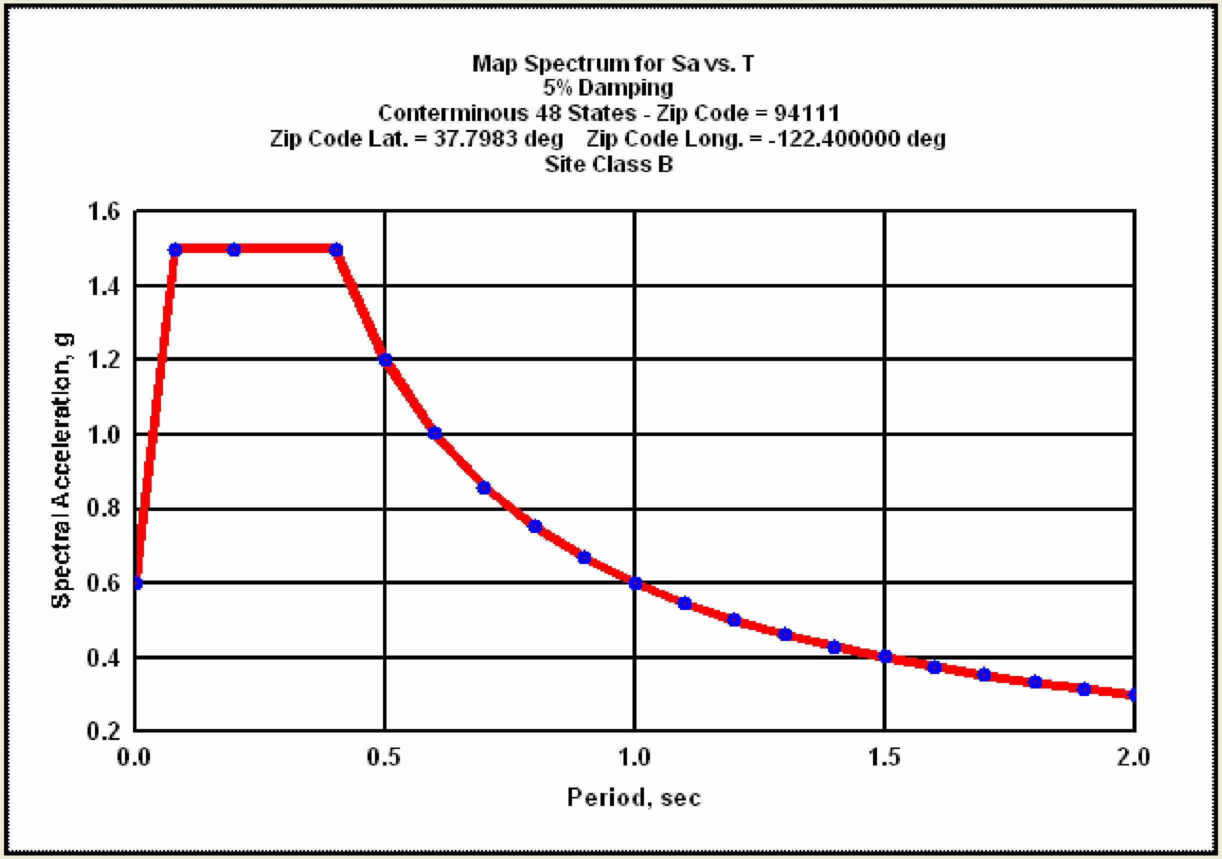


Map Spectrum: S_a - T

Earthquake Ground Motion Parameters

File Edit Graph Scale Help

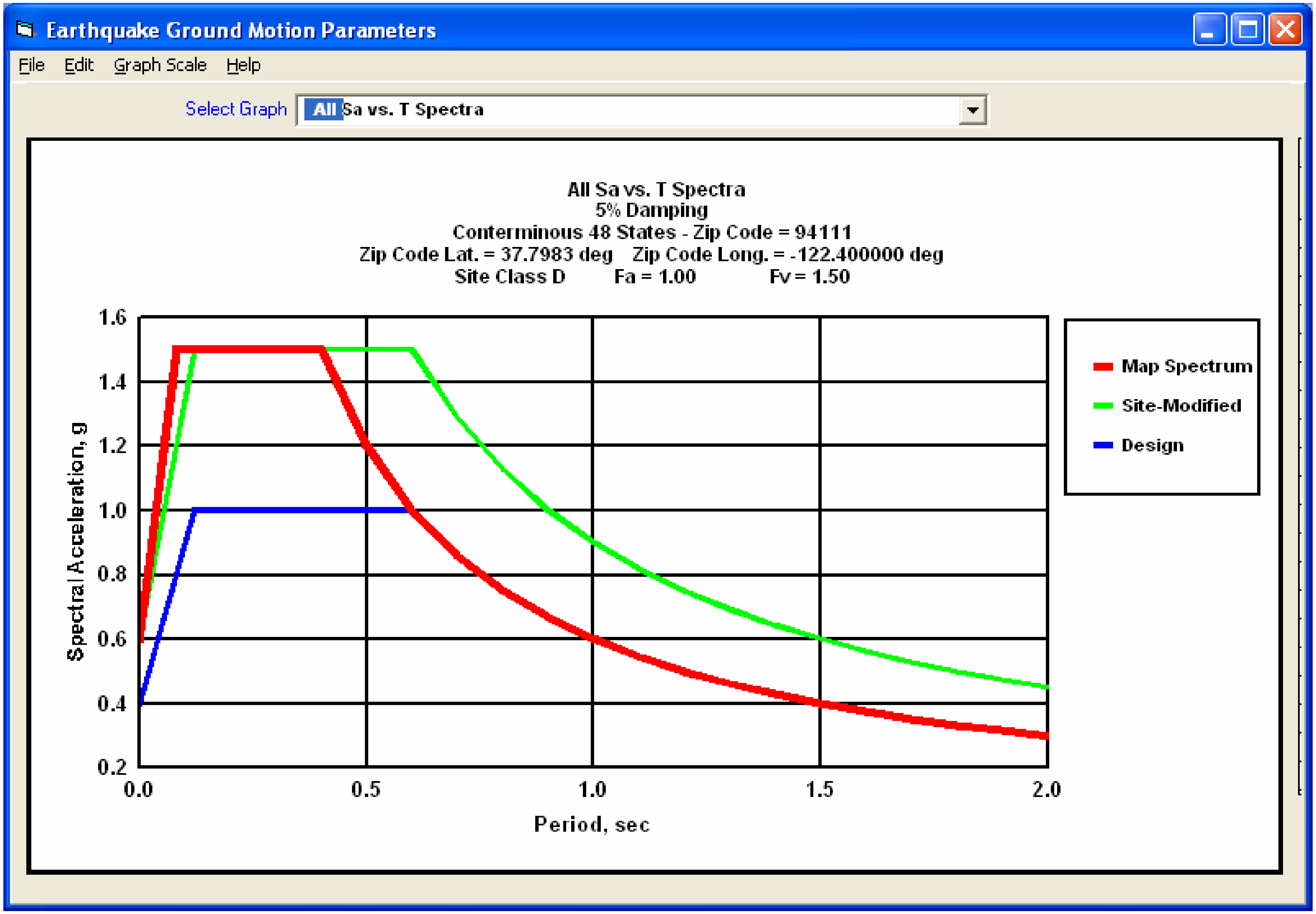
Select Graph: Map Spectrum for Sa vs. T



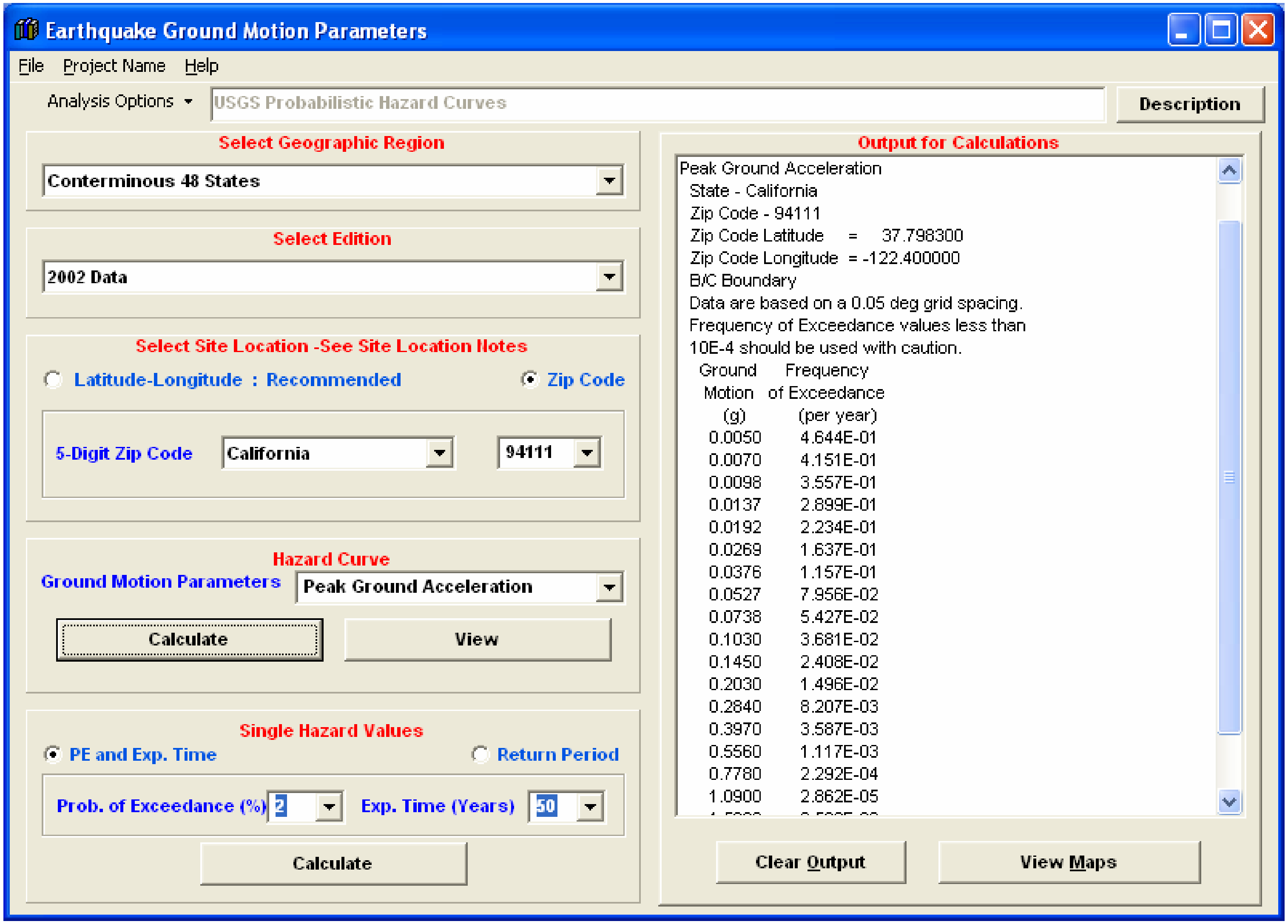
Graph Data

Period, sec	Sa, g
0.00	0.6000
0.08	1.5000
0.20	1.5000
0.40	1.5000
0.50	1.2038
0.60	1.0032
0.70	0.8599
0.80	0.7524
0.90	0.6688
1.00	0.6019
1.10	0.5472
1.20	0.5016
1.30	0.4630
1.40	0.4299
1.50	0.4013
1.60	0.3762
1.70	0.3541
1.80	0.3344
1.90	0.3168
2.00	0.3010

All Spectra: S_a - T



Calculate Hazard Curves

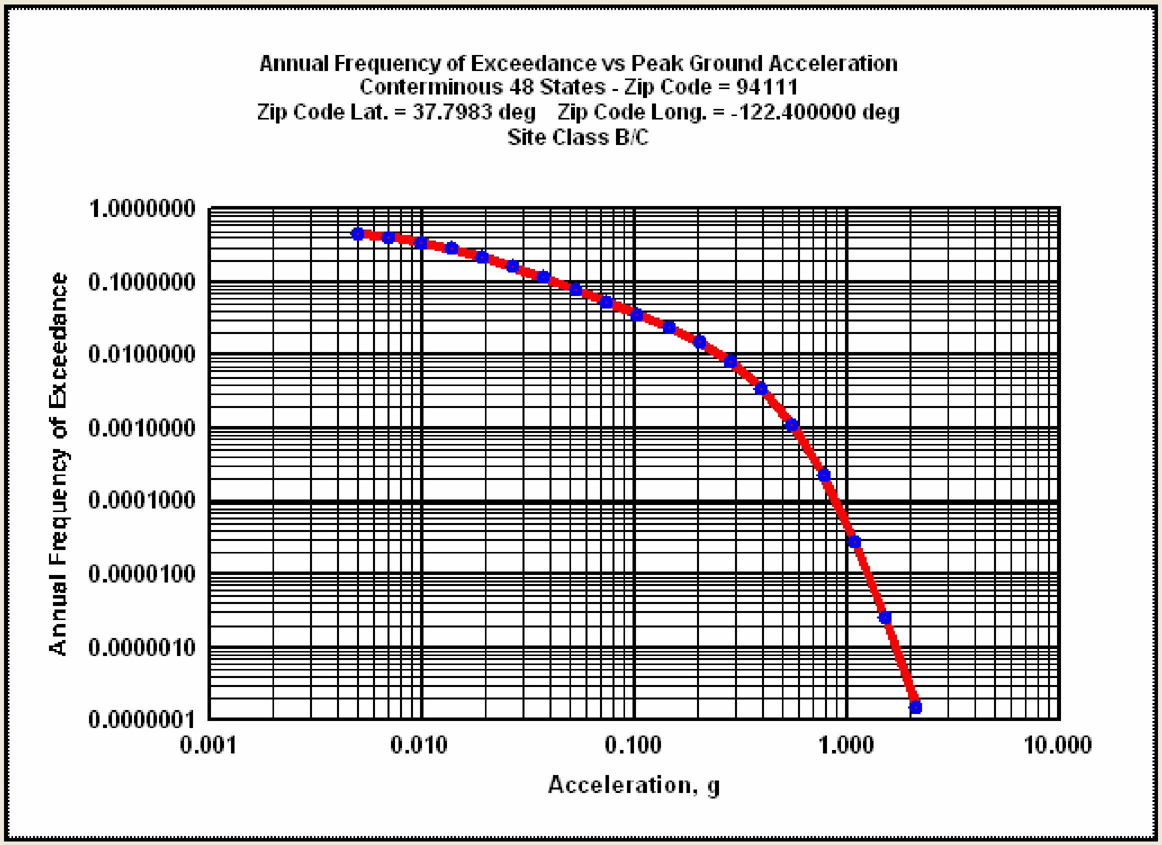


Annual Frequency of Exceedance

Earthquake Ground Motion Parameters

File Edit Graph Scale Help

Select Graph: Hazard Curve of Annual FEX vs Acceleration



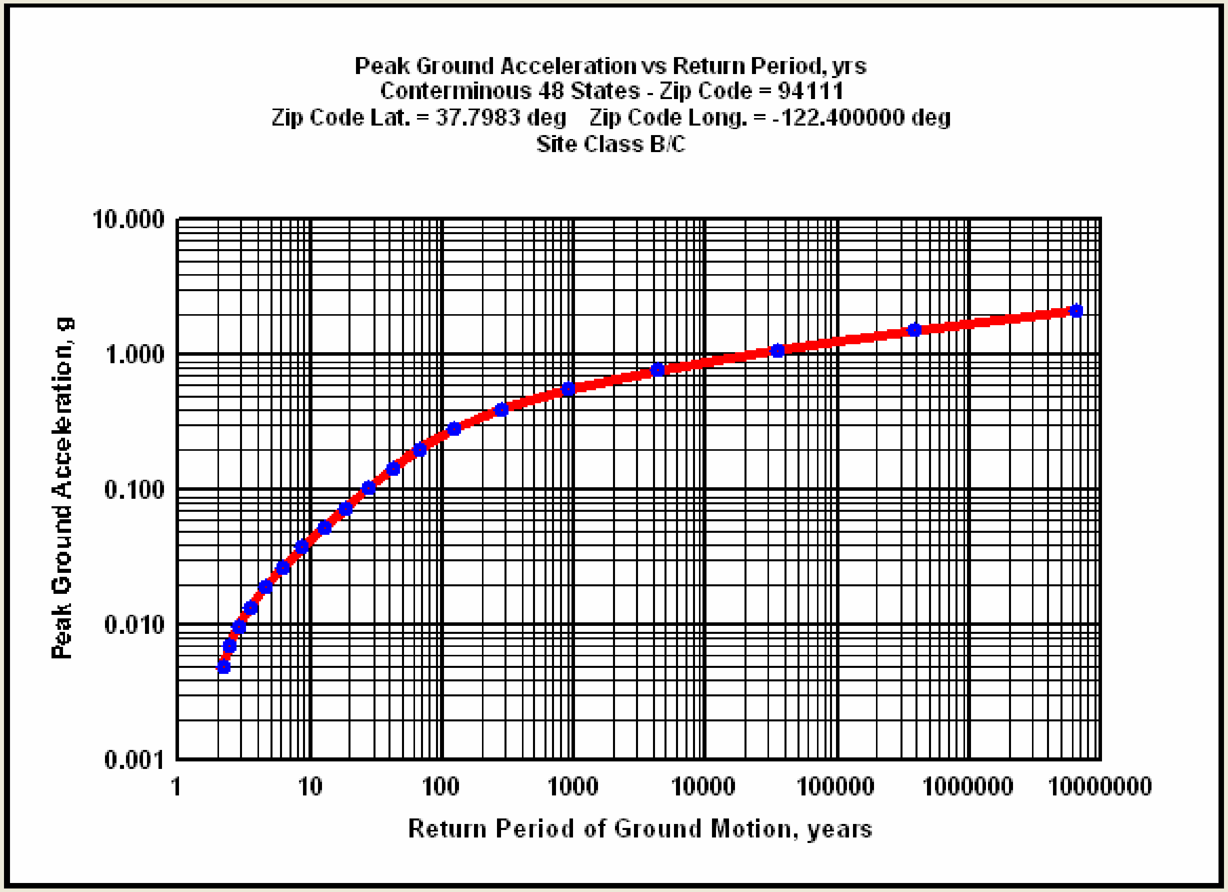
Graph Data	
Sa, g	Annual FEX
0.0050	4.644E-01
0.0070	4.151E-01
0.0098	3.557E-01
0.0137	2.899E-01
0.0192	2.234E-01
0.0269	1.637E-01
0.0376	1.157E-01
0.0527	7.956E-02
0.0738	5.427E-02
0.1030	3.681E-02
0.1450	2.408E-02
0.2030	1.496E-02
0.2840	8.207E-03
0.3970	3.587E-03
0.5560	1.117E-03
0.7780	2.292E-04
1.0900	2.862E-05
1.5200	2.589E-06
2.1300	1.523E-07

Return Period

Earthquake Ground Motion Parameters

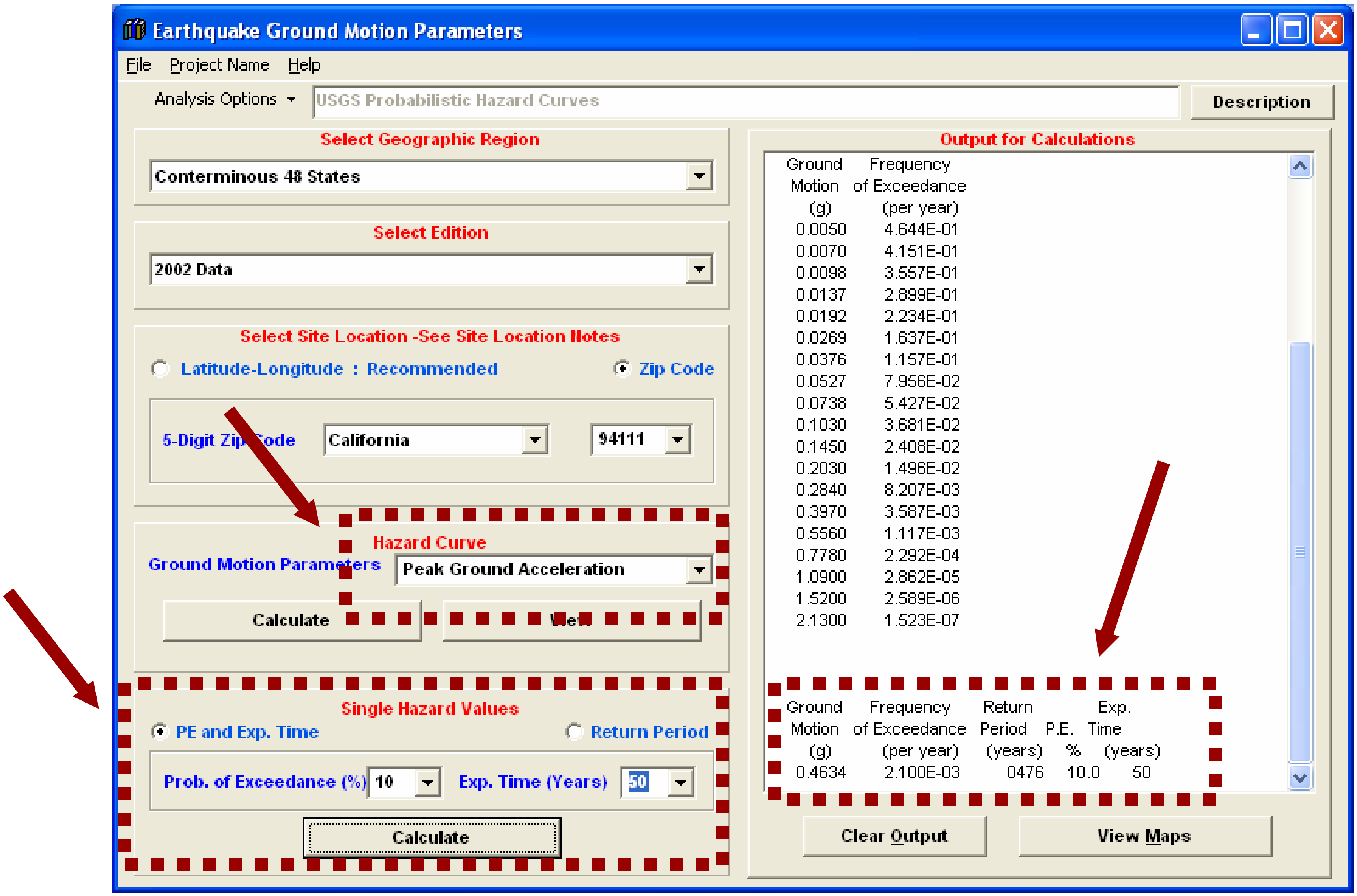
File Edit Graph Scale Help

Select Graph: Hazard Curve of Acceleration vs Return Period



Graph Data	
Return Period	Sa, g
2.153E+00	0.0050
2.409E+00	0.0070
2.812E+00	0.0098
3.449E+00	0.0137
4.477E+00	0.0192
6.107E+00	0.0269
8.643E+00	0.0376
1.257E+01	0.0527
1.843E+01	0.0738
2.717E+01	0.1030
4.154E+01	0.1450
6.686E+01	0.2030
1.218E+02	0.2840
2.788E+02	0.3970
8.952E+02	0.5560
4.363E+03	0.7780
3.494E+04	1.0900
3.863E+05	1.5200
6.564E+06	2.1300

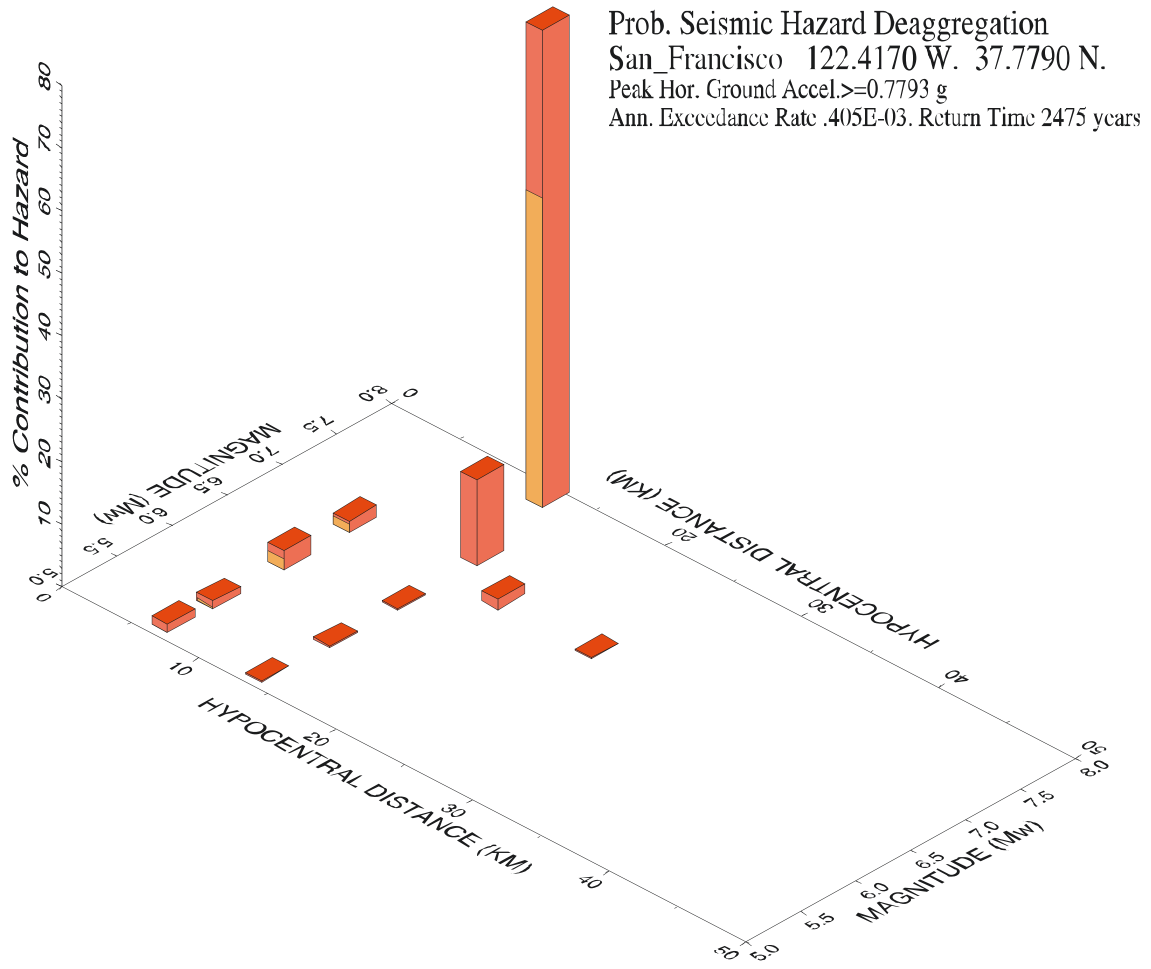
Single Values



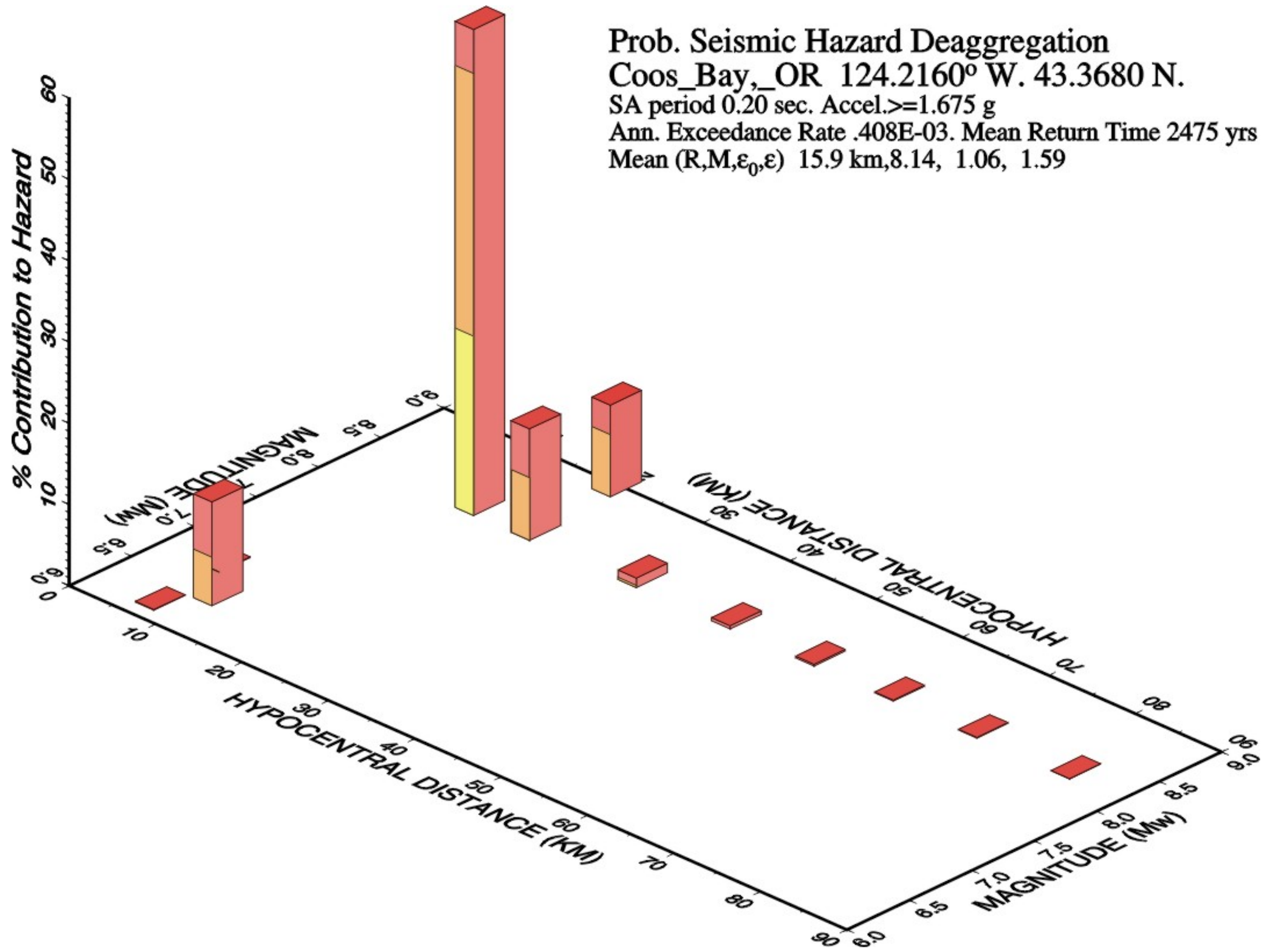
Deaggregation

- Breaking apart of the probabilistic hazard analysis
- Helps remove some of the "black box" effect
- Helps visualize the source of the hazard
- Many uses, e.g. liquefaction analysis, time history determination

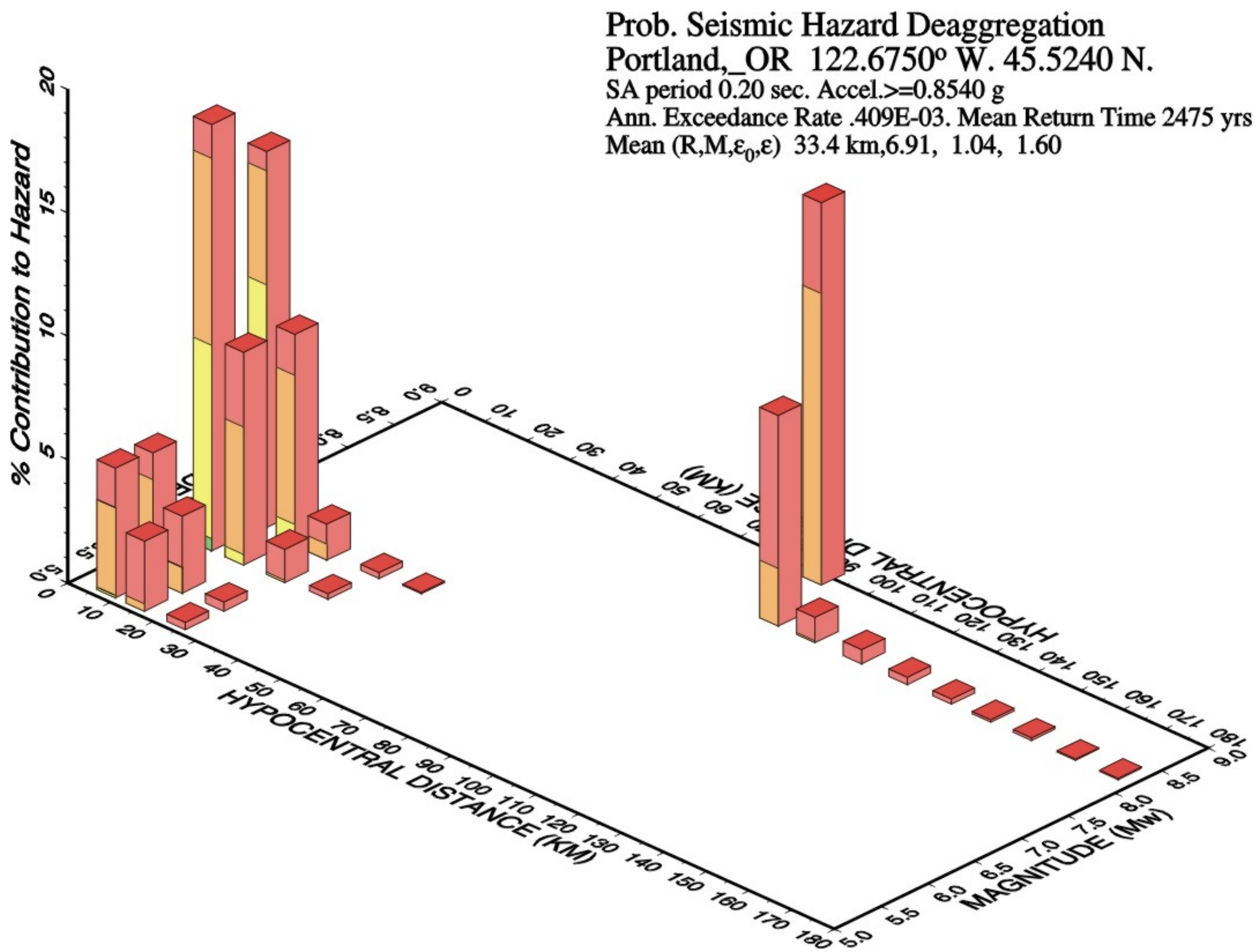
Deaggregation – San Francisco



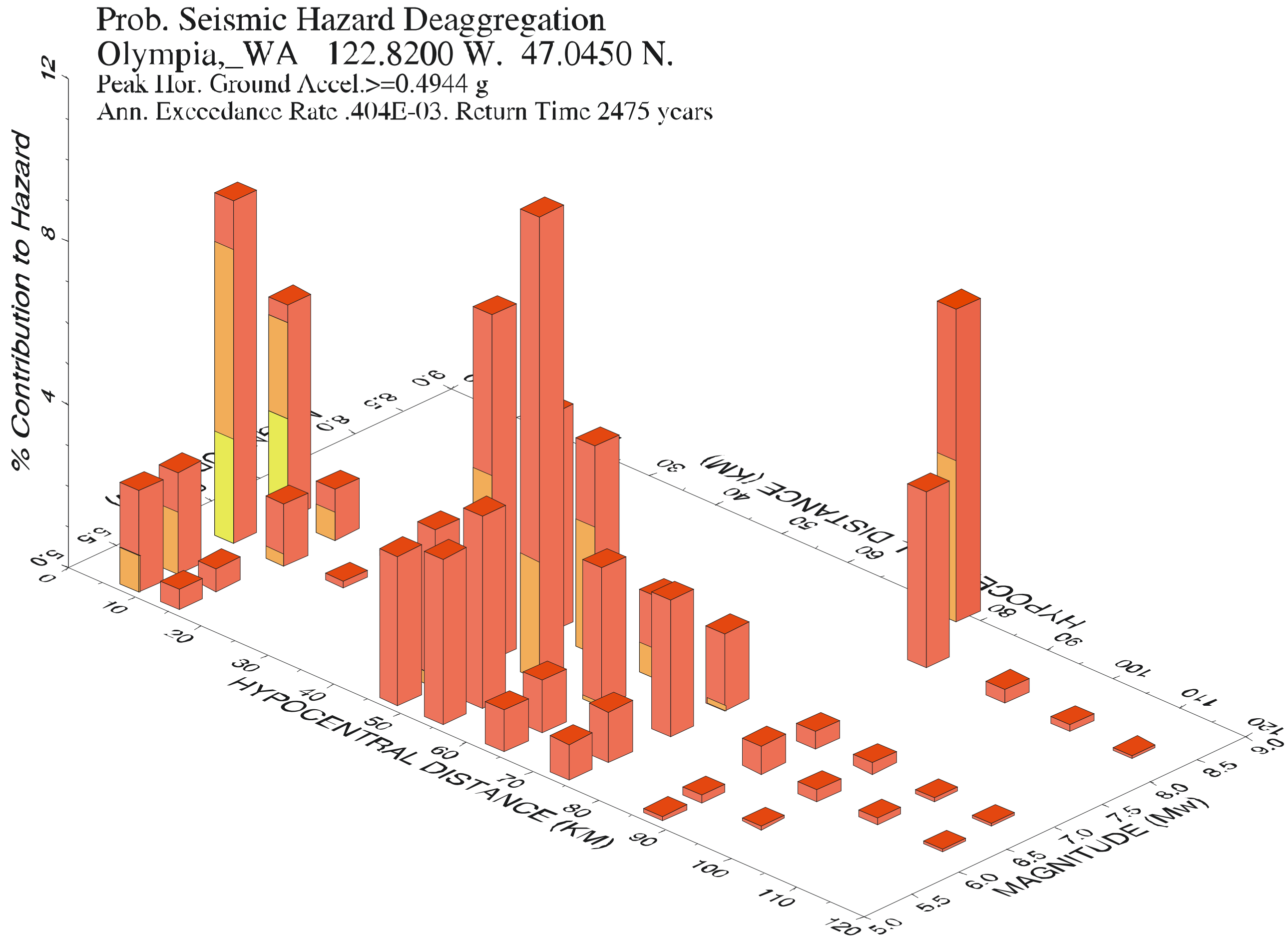
Deaggregation - Coos Bay, Oregon



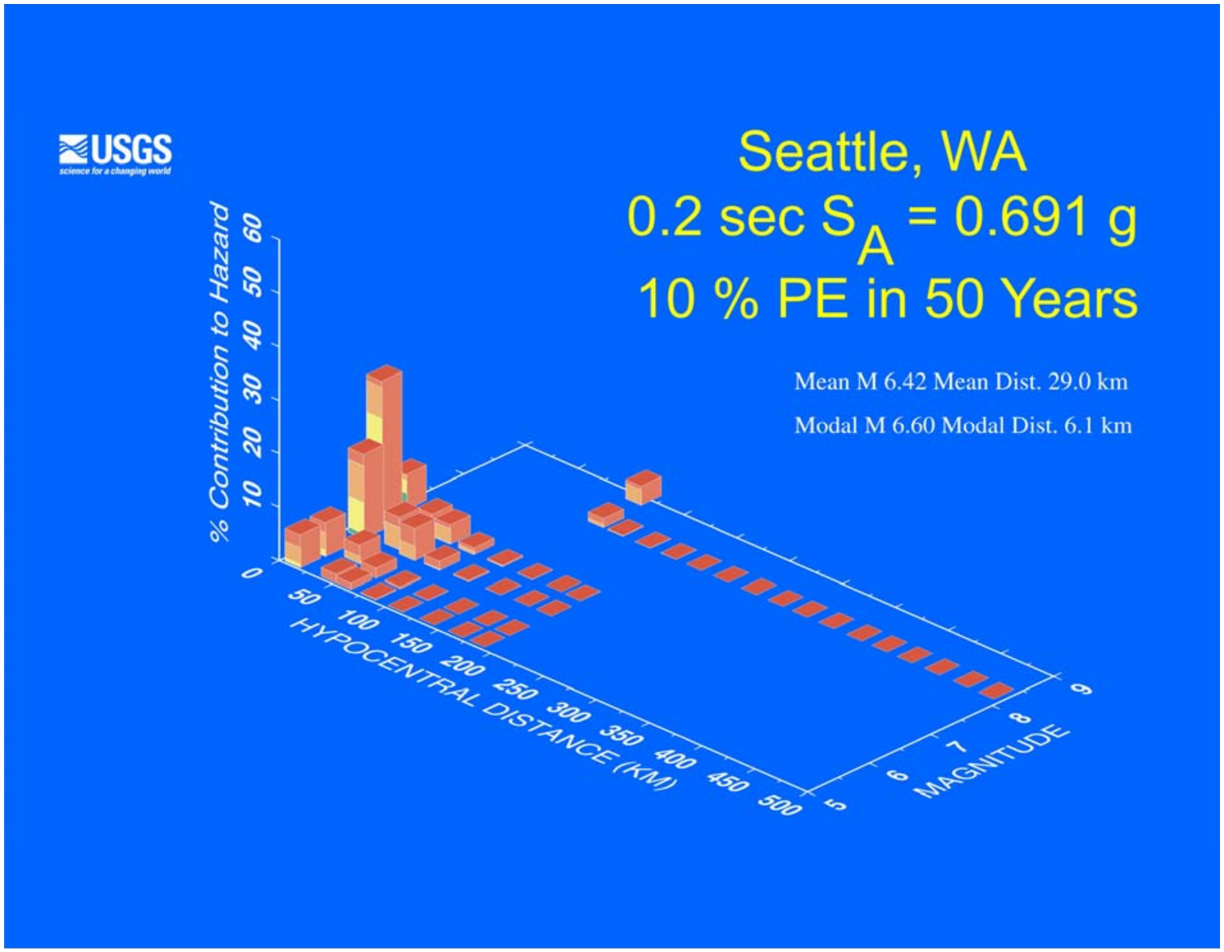
Deaggregation - Portland, Oregon



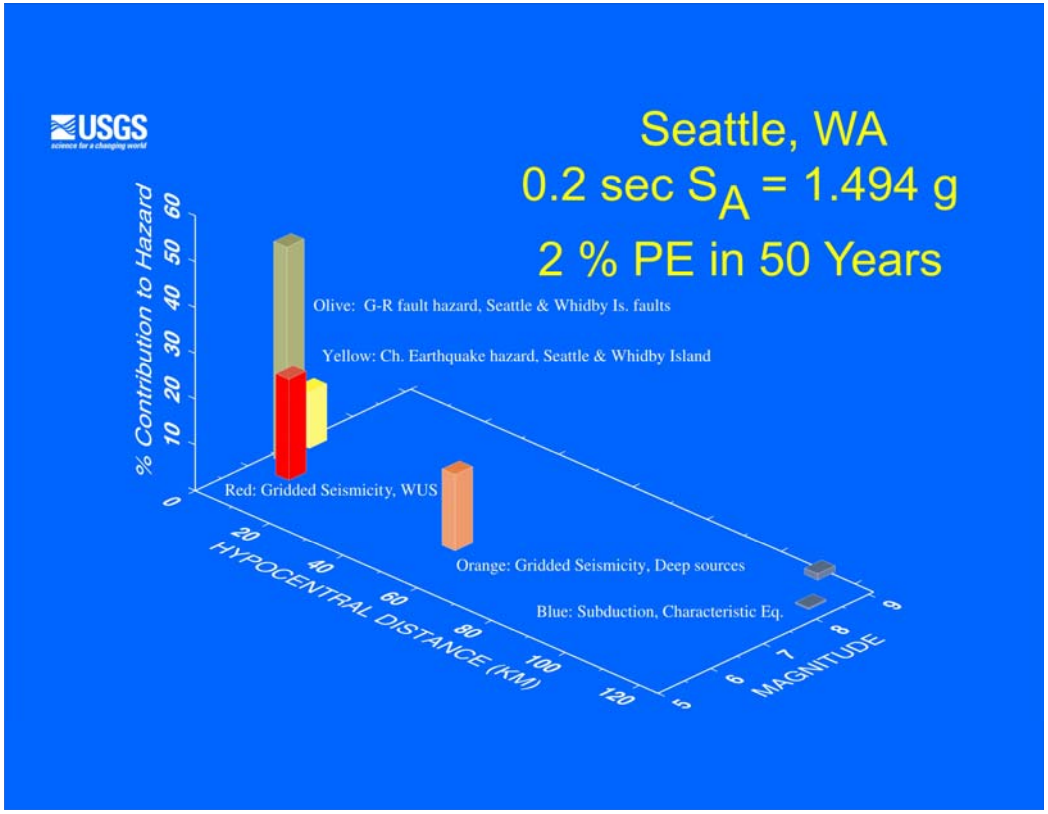
Deaggregation – Olympia, Washington



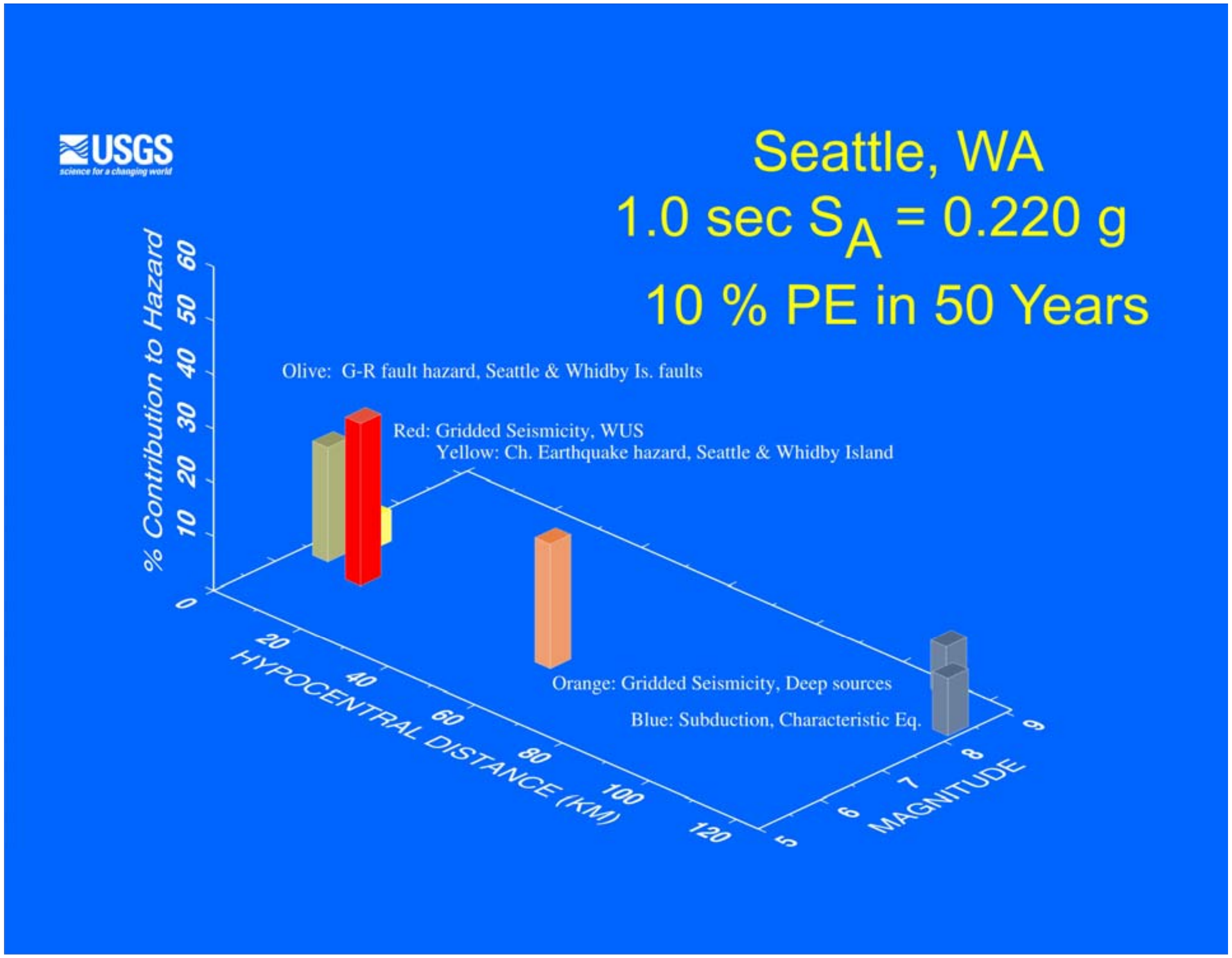
Seattle – 0.2 sec, Detailed



Seattle – 0.2 sec



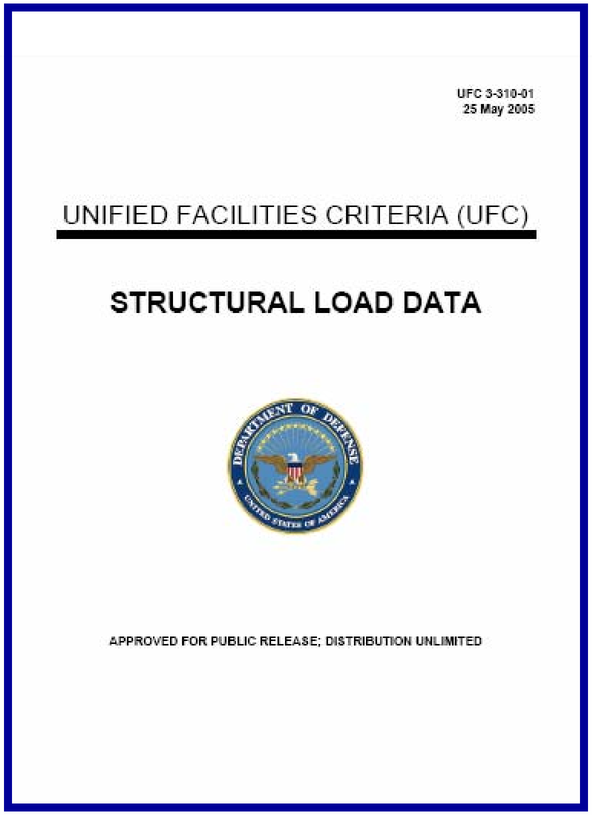
Seattle – 1.0 sec



Design Values Outside the United States

- Based on GASHAP Data
- 10% PE in 50 years
- PGA only
- Estimate 2% from 10% PE by multiplying by 2.0
- S_s = 2.5xPGA
- S_1 = PGA
- Use site-specific studies where available
- USGS studies where available

UFC 3-310-1



UFC 3-310-01
25 May 2005

UNIFIED FACILITIES CRITERIA (UFC)

STRUCTURAL LOAD DATA

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What is GSHAP?