

## **EZ-FRISK ver. 7.3 Release**

In April 2008 the USGS released their 2008 national seismic hazard maps, produced using a seismic hazard model developed by the USGS. The 2008 USGS seismic hazard model has been implemented into EZ-FRISK ver. 7.3 and model version 1.00. Testing was performed, using selected test sites across the United States, to determine if the ground motions calculated at these locations by EZ-FRISK were the same as those calculated by the USGS. Our validation shows matches within 5% of the USGS code in 89% of cases we tested.

A seismic hazard analysis was performed, using EZ-FRISK ver. 7.3 and model version 1.00, for 148 test sites selected throughout the United States (Figure 1 and Table 1). The return periods analyzed in the seismic hazard analysis were 475 and 2475 years. The spectral periods analyzed were PGA, 0.2 seconds and 1 second. The ground motions calculated for these test sites were compared to the ground motions at these test sites determined by the USGS 2008 seismic hazard model. The USGS ground motion values were found using the latitude and longitude feature of the interactive maps on the USGS website:

<http://gldims.cr.usgs.gov/nshmp2008/viewer.htm> (values retrieved from September –November 2008) and from data files available to download from

[http://earthquake.usgs.gov/research/hazmaps/products\\_data/2008/data/](http://earthquake.usgs.gov/research/hazmaps/products_data/2008/data/) (files dated 5/6/08). For each return period and spectral period, the EZ-FRISK ground motions vs. USGS ground motions at each test site have been plotted (Figures 2-7). The percent difference between the ground motions are shown in Table 1.

The results show that for a return period of 475 years and a spectral period of PGA, 90% of the test sites have less than 5% difference in ground motions between EZ-FRISK and the USGS. For a return period of 475 years and spectral periods of 0.2 seconds and 1.0 seconds, 96% and 79% of the test sites have less than 5% difference, respectively. For a return period of 2475 years and a spectral period of PGA, 93% of the test sites have less than 5% difference in ground motions between EZ-FRISK and the USGS. For a return period of 2475 years and spectral periods of 0.2 seconds and 1.0 seconds, 91% and 84% of the test sites have less than 5% difference, respectively.

For a return period of 475 years and a spectral period of PGA, the difference in ground motion calculated by EZ-FRISK and the USGS at the northeastern Minnesota site was 18%. For a return period of 475 years and a spectral period of 1.0 seconds, the difference in ground motions were 11%, 12%, 10%, 13%, 14% and 15% for the Shoshoni, WY, north/central North Dakota, Pierre, SD, Lubbock, TX, northwestern Minnesota, and northeastern Minnesota test sites, respectively. There does not appear to be any trend in the differences with respect to return period or spectral period (see Table 1). For a return period of 2475 years and a spectral period of PGA, the difference in ground motion calculated by EZ-FRISK and the USGS at the Blytheville, AR test site was 14%. For return period of 2475 years with a spectral period of 0.2 seconds, the difference in ground motions at the New Madrid, MO and Blytheville, AR test sites were both

25%. Due to the high hazard in this area, this discrepancy may be due to how the ground motion values were extrapolated by EZ-FRISK and the USGS. For a return period of 2475 years and a spectral period of 1.0 seconds, the difference in ground motions at the northwest coast Oregon, east/central Oregon, and Blytheville, AR test sites were 10%, 11%, and 15%, respectively. At the Death Valley, CA test site, for a return period of 475 years with spectral periods of PGA, 0.2 seconds, and 1.0 seconds and a return period of 2475 years with spectral periods of PGA, 0.2 seconds, and 1.0 seconds, the difference in ground motions calculated by EZ-FRISK and the USGS were 16%, 16%, 17%, 11%, 11%, and 12%, respectively.

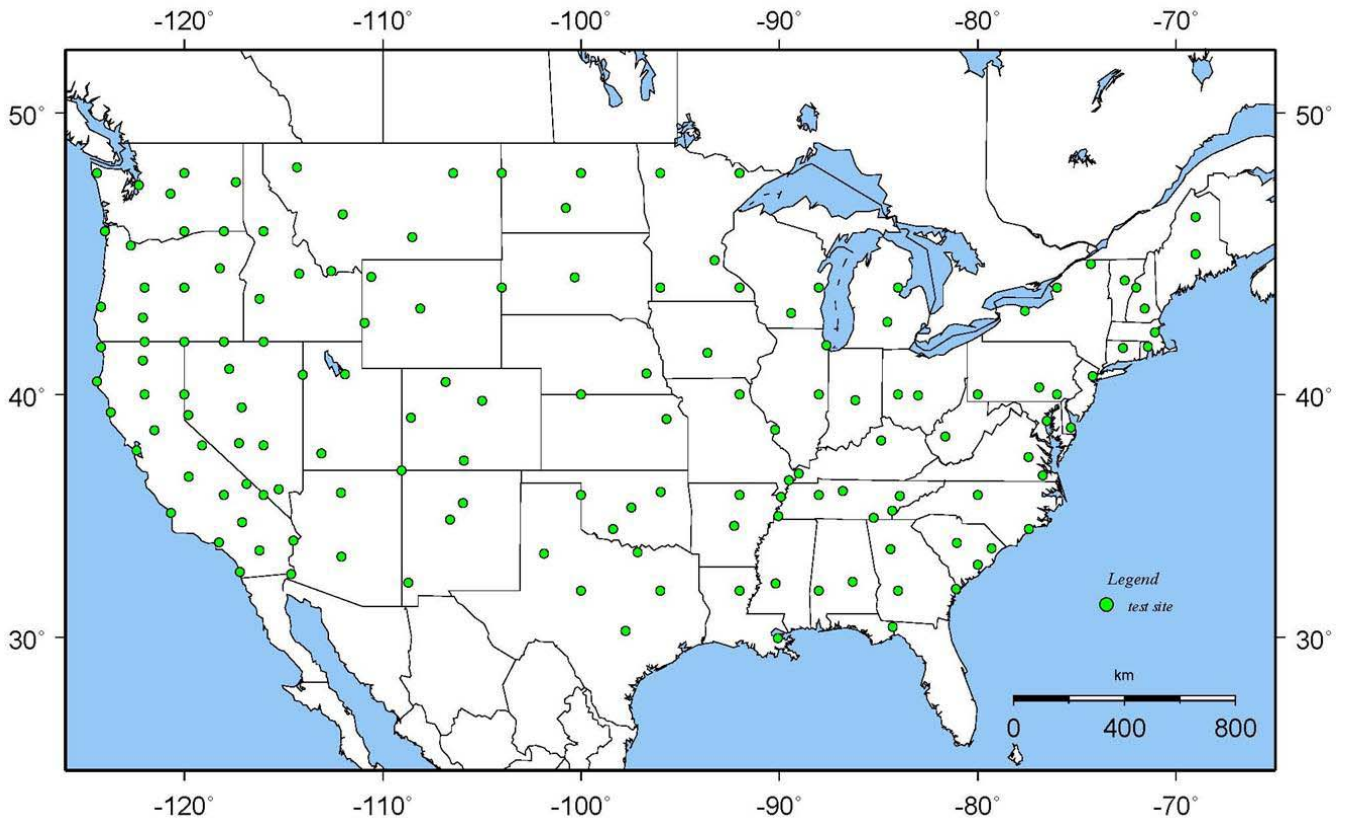


Figure 1. Test site locations for EZ-FRISK vs. USGS ground motion comparisons. See Table 1 for locations and names of test sites.

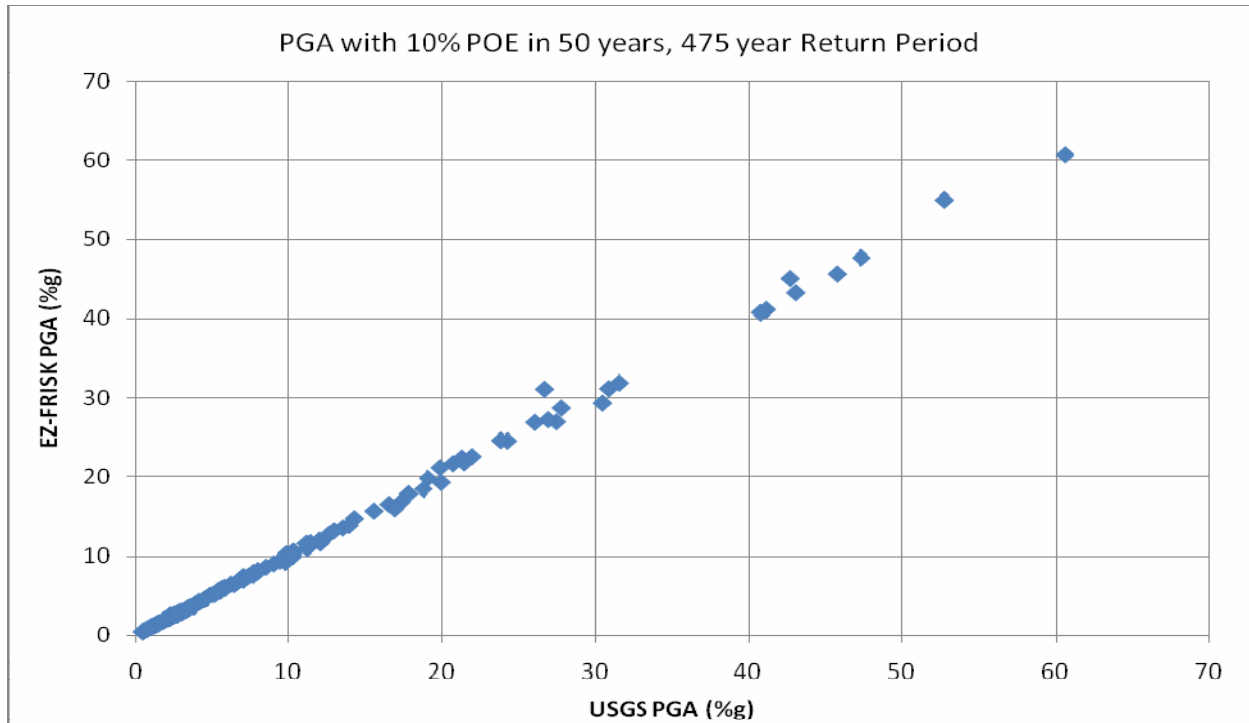


Figure 2. EZ-FRISK vs. USGS ground motions for 148 test sites, return period of 475 years at a spectral period of PGA.

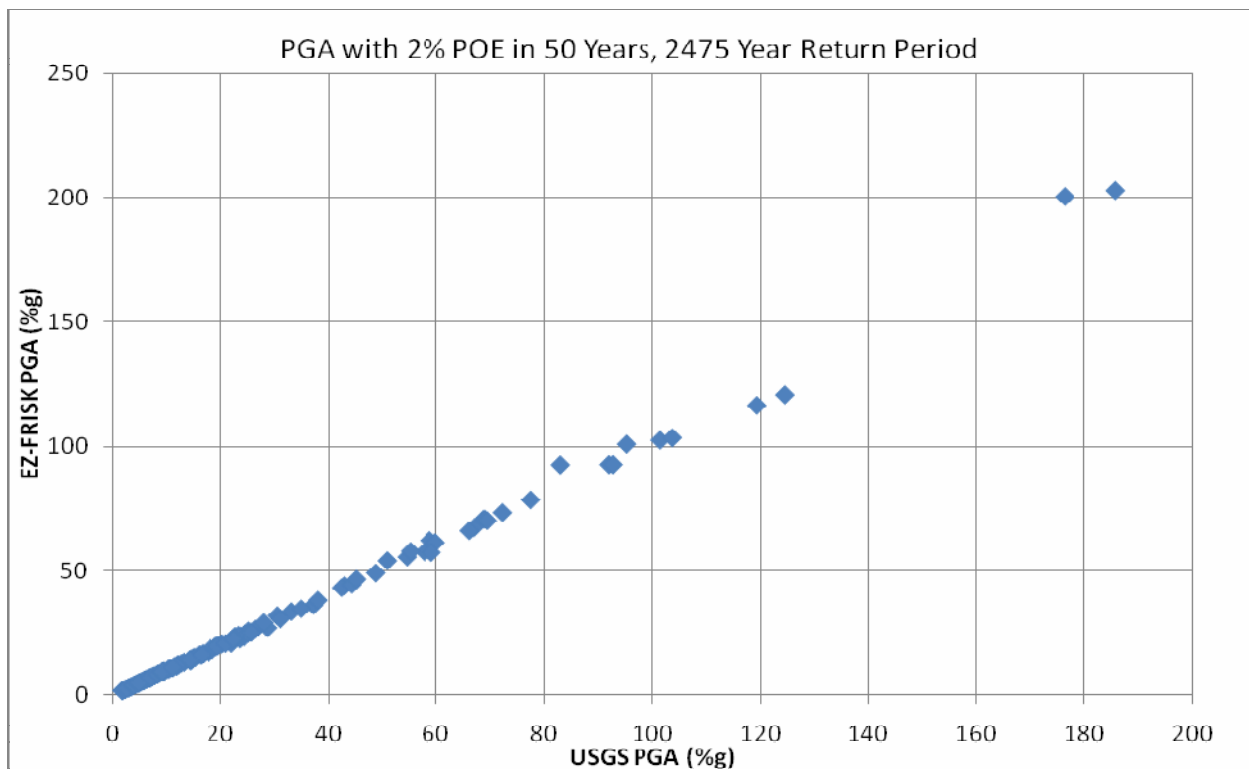


Figure 3. EZ-FRISK vs. USGS ground motions for 148 test sites, return period of 2475 years at a spectral period of PGA.

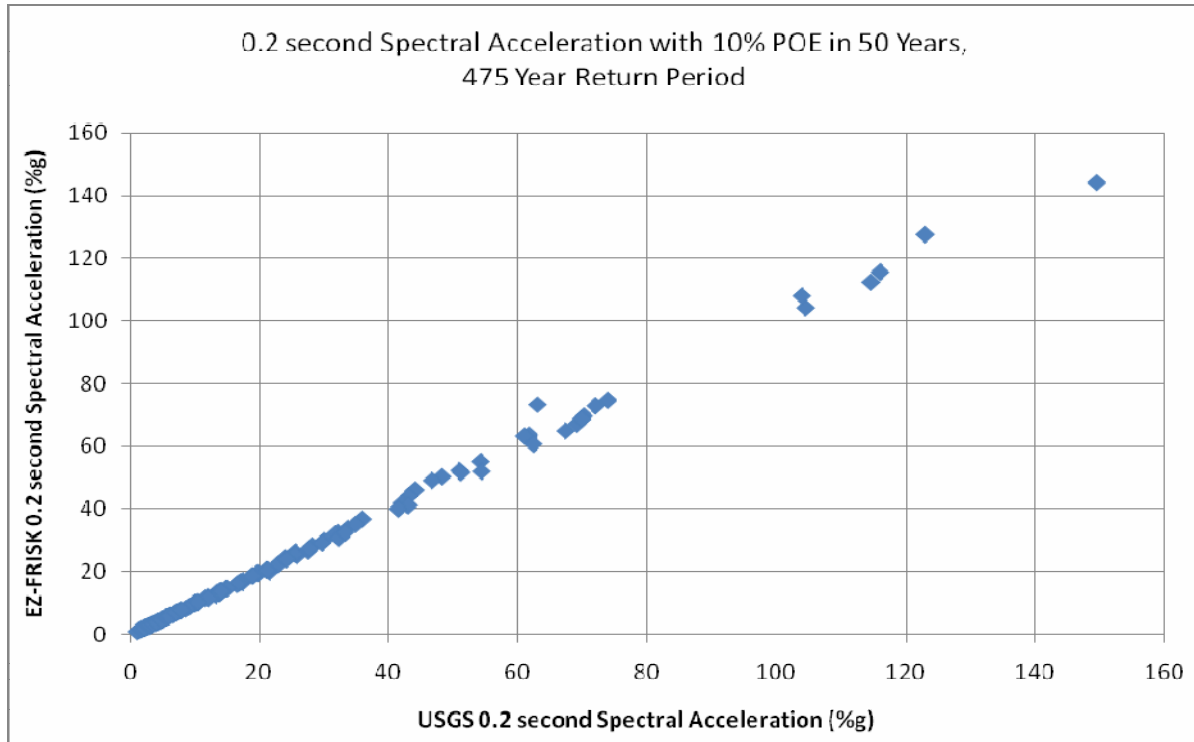


Figure 4. EZ-FRISK vs. USGS ground motions for 148 test sites, return period of 475 years at a spectral period of 0.2 seconds.

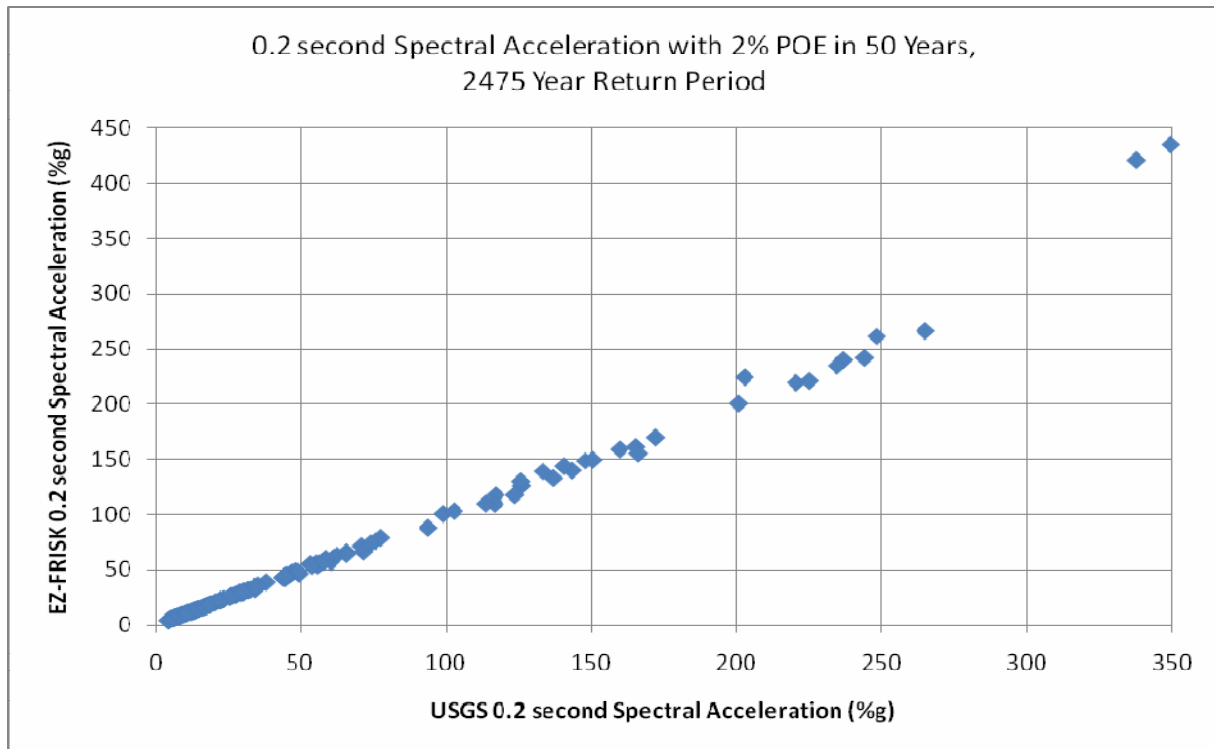


Figure 5. EZ-FRISK vs. USGS ground motions for 148 test sites, return period of 2475 years at a spectral period of 0.2 seconds.

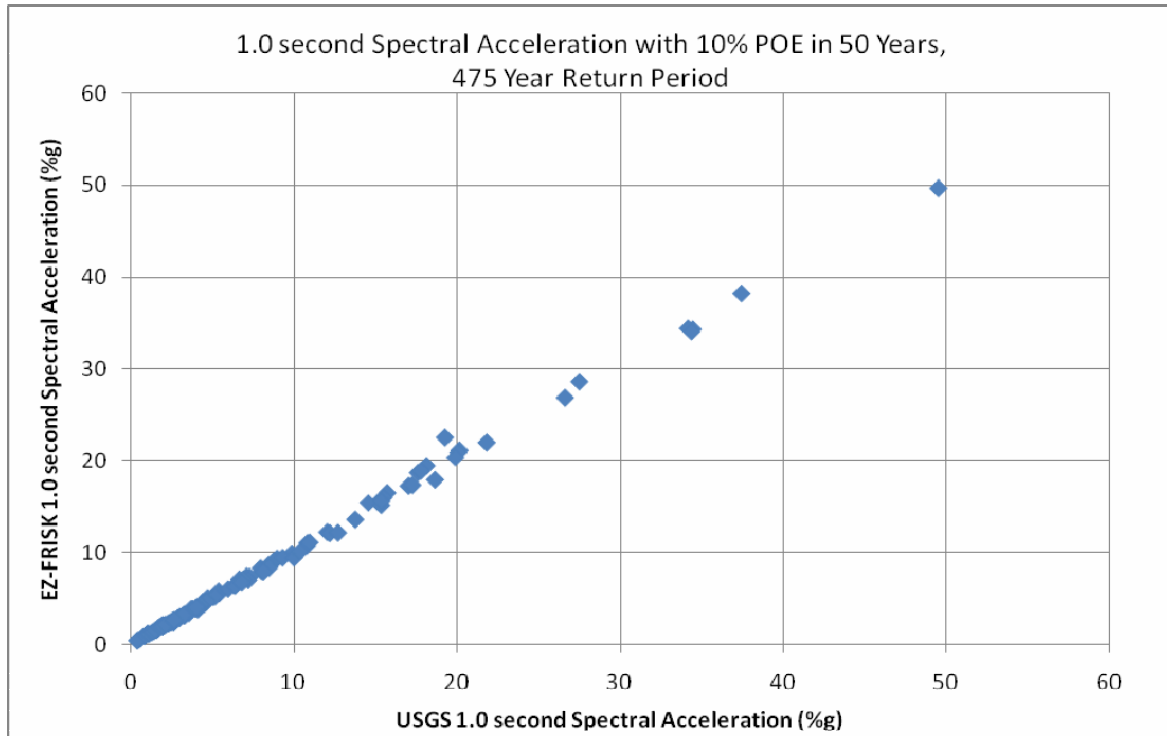


Figure 6. EZ-FRISK vs. USGS ground motions for 148 test sites, return period of 475 years at a spectral period of 1 second.

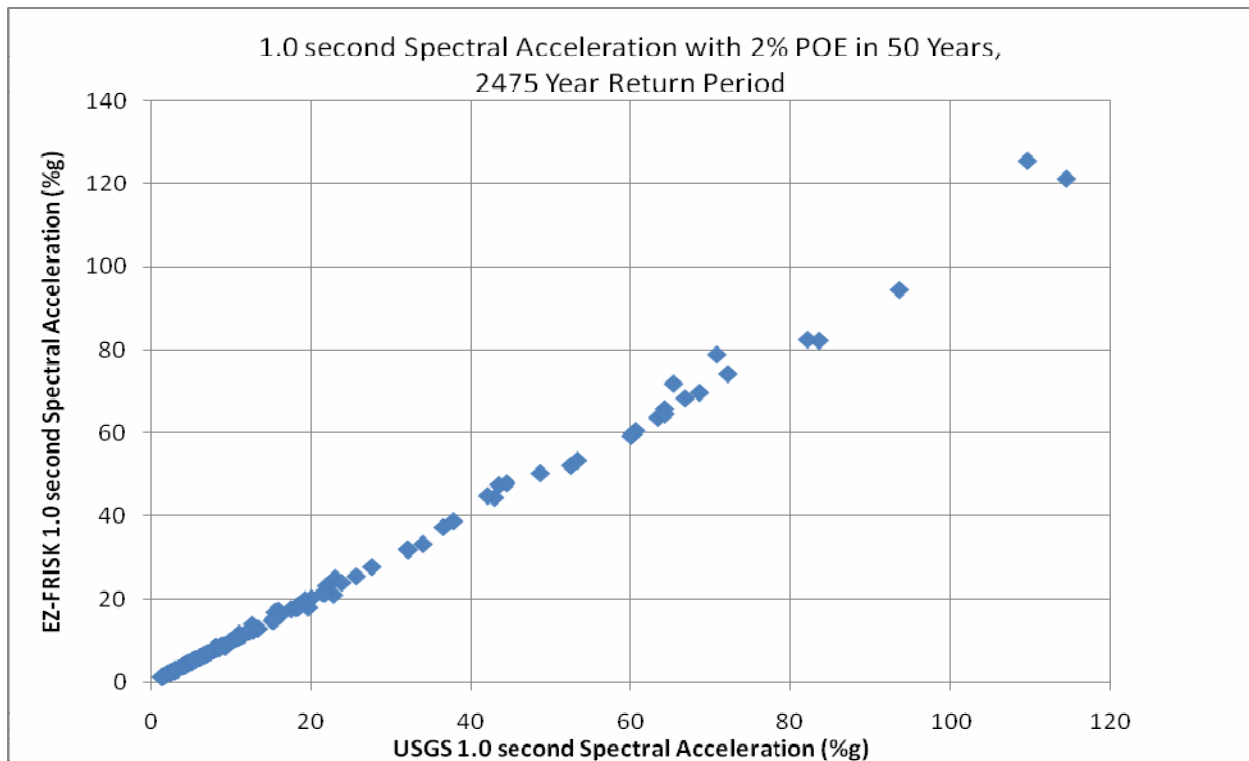


Figure 7. EZ-FRISK vs. USGS ground motions for 148 test sites, return period of 2475 years at a spectral period of 1 second.

Table 1. Percent difference between EZ-FRISK ver. 7.3, model version 1.00, and USGS calculated ground motions.

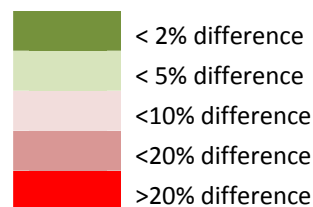
				Percent		10	10	10	2	2	2
				Time Period (Years)		50	50	50	50	50	50
				Return Period (Years)		475	475	475	2475	2475	2475
				Spectral Period		PGA	0.2 Sec	1 Sec	PGA	0.2 Sec	1 Sec
Site Name	State	Latitude	Longitude	Percent Difference							
Forks	WA	48.0	-124.4	4.2	4.7	6.0	0.3	-2.3	0.6		
North/Central WA	WA	48.0	-120.0	-0.7	-1.7	4.0	1.1	1.0	7.9		
Spokane Falls	WA	47.7	-117.4	2.5	0.2	-2.1	1.2	1.6	-0.1		
Seattle	WA	47.6	-122.3	3.2	3.1	5.1	1.7	0.1	3.8		
Liberty	WA	47.3	-120.7	3.3	3.5	3.6	3.5	3.5	2.9		
South/Central WA	WA	46.0	-120.0	0.2	-1.3	6.3	1.5	1.2	8.6		
Southeast WA	WA	46.0	-118.0	1.8	-0.8	6.2	1.6	1.6	6.9		
NW Coast OR	OR	46.0	-124.0	-3.7	-3.1	7.1	2.8	0.4	10.2		
Portland	OR	45.5	-122.7	3.5	2.6	2.2	2.2	1.6	2.8		
Sumpter	OR	44.7	-118.2	2.3	-0.2	-1.3	1.1	1.3	-0.1		
West/Central OR	OR	44.0	-122.0	-6.4	-6.9	2.8	-5.9	-6.8	8.8		
East/Central OR	OR	44.0	-120.0	-0.9	-3.7	7.3	-0.2	-0.8	10.9		
Coos Bay	OR	43.3	-124.2	1.0	1.9	4.0	1.4	-0.4	2.6		
Crater Lake	OR	42.9	-122.1	-2.4	-2.6	-0.3	-0.2	-0.6	0.5		
OR/CA Border		42.0	-122.0	0.1	-0.1	5.6	6.2	3.5	9.5		
OR/CA/NV Border		42.0	-120.0	-0.9	-1.9	3.7	-5.0	-5.7	0.7		
OR/NV Border		42.0	-118.0	-2.6	-4.3	0.6	-5.3	-5.2	-3.8		
Crescent City	CA	41.8	-124.2	4.8	4.5	6.0	2.2	-0.7	2.6		
McCloud (Mt. Shasta)	CA	41.3	-122.1	0.7	2.7	1.3	1.1	1.7	0.7		
Cape Mendocino	CA	40.5	-124.4	4.2	3.8	2.1	0.9	1.4	-1.4		
North/Central CA	CA	40.0	-122.0	-4.1	-3.1	2.1	-4.5	-3.3	5.7		
Northern CA/NV Border	CA	40.0	-120.0	0.9	1.3	0.8	-0.3	-2.5	-0.6		
Mendocino	CA	39.3	-123.7	1.0	1.4	0.9	-0.5	-2.9	0.2		
Sacramento	CA	38.6	-121.5	-0.3	1.2	-0.9	1.2	1.0	0.5		
San Francisco	CA	37.8	-122.4	0.4	-0.2	-0.2	0.8	-1.3	0.0		
Mono Lake	CA	38.0	-119.1	5.5	3.9	3.9	6.0	5.3	3.1		
Fresno	CA	36.7	-119.8	0.5	0.4	-1.2	-0.9	-0.5	-2.0		
San Luis Obispo	CA	35.3	-120.7	2.5	2.8	1.3	0.8	0.5	2.4		
South/Central CA	CA	36.0	-118.0	1.2	1.0	-1.5	1.5	0.3	-0.5		
Death Valley	CA	36.5	-116.9	16.4	16.5	16.9	11.4	10.7	11.7		
Los Angeles	CA	34.1	-118.2	0.7	-0.3	0.9	0.7	0.1	1.9		
Barstow	CA	34.9	-117.1	3.0	3.8	2.2	4.7	4.3	7.0		

Southern CA/NV Border	CA	36.0	-116.0	1.9	2.1	2.0	1.4	0.9	-0.4
Coachella	CA	33.7	-116.2	0.2	-3.6	0.4	-0.4	0.5	1.1
Vidal	CA	34.1	-114.5	1.3	-0.1	0.8	1.7	1.7	0.0
San Diego	CA	32.8	-117.2	5.9	5.4	5.0	5.7	2.3	8.1
Yuma	AZ	32.7	-114.6	-0.8	0.7	1.3	0.1	-0.4	0.0
Phoenix	AZ	33.4	-112.1	0.0	0.5	-3.1	2.6	0.5	-0.5
Grand Canyon	AZ	36.1	-112.1	2.1	-0.2	1.3	2.2	1.1	-0.3
Las Vegas	NV	36.2	-115.2	1.4	0.1	0.1	0.2	-0.4	0.2
Tonopath	NV	38.1	-117.3	1.3	1.2	0.7	-0.3	0.0	0.0
Southeast NV	NV	38.0	-116.0	1.5	0.6	0.7	1.9	0.8	-0.4
Carson City	NV	39.2	-119.8	-0.2	-1.9	-1.0	-0.1	-0.8	0.6
Austin	NV	39.5	-117.1	-0.6	-1.3	-2.0	-6.2	-7.1	-8.3
Winnemucca	NV	41.0	-117.7	1.5	0.6	-3.2	2.5	2.5	0.0
Wendover	UT	40.7	-114.0	1.5	-0.7	-3.8	0.8	0.4	-0.9
Salt Lake City	UT	40.8	-111.9	-2.0	-3.5	-4.0	1.2	0.0	-0.6
Cedar City	UT	37.7	-113.1	2.1	-0.9	2.6	3.6	0.9	-0.5
ID/NV Border		42.0	-116.0	2.4	0.0	0.6	2.1	1.1	3.9
Boise	ID	43.6	-116.2	2.5	-0.2	-9.1	2.7	1.6	-4.0
Challis	ID	44.5	-114.2	-2.8	-4.2	-6.3	-3.2	-6.3	-7.9
Northern ID	ID	46.0	-116.0	2.8	0.7	2.5	2.2	1.7	5.4
Kalispell	MT	48.2	-114.3	2.8	0.9	-1.4	4.3	0.5	-1.6
Fort Peck	MT	48.0	-106.5	0.8	-1.0	0.5	-1.0	0.0	0.3
Helena	MT	46.6	-112.0	3.3	-0.5	0.3	1.6	-2.1	-3.9
Billings	MT	45.8	-108.5	9.1	3.8	5.4	1.5	0.0	1.7
Lima	MT	44.6	-112.6	-0.1	-3.1	-3.0	0.1	-6.0	-0.9
Yellowstone NP	WY	44.4	-110.6	3.1	-2.5	-1.7	3.1	-4.8	0.1
Shoshoni	WY	43.2	-108.1	-1.0	-2.2	-11.1	-2.0	-1.6	-1.8
Afton	WY	42.7	-110.9	0.9	-2.8	0.4	2.3	-6.5	3.4
Steamboat Springs	CO	40.5	-106.8	-0.3	-0.5	-2.0	-0.3	-0.5	-0.8
Denver	CO	39.8	-105.0	-4.7	-4.4	-4.1	-2.0	-3.3	-5.2
Grand Junction	CO	39.1	-108.6	-1.4	-1.2	-3.4	-0.4	-0.6	-0.7
4 corners		37.0	-109.0	-3.1	-2.9	-6.4	-0.6	-2.0	-4.1
Alamosa	CO	37.4	-105.9	-1.9	-5.0	-5.6	-5.1	-6.4	-7.8
Santa Fe	NM	35.7	-105.9	4.1	-1.0	2.9	3.3	-1.3	-0.9
Albuquerque	NM	35.0	-106.6	2.1	-0.9	-0.7	1.1	-1.8	-0.3
Lordsburg	NM	32.3	-108.7	1.7	0.9	-4.0	2.0	0.9	0.0
MT/ND Border	ND	48.0	-104.0	-0.8	-2.3	-4.0	-0.6	-0.7	-0.8
North/Central ND	ND	48.0	-100.0	-8.0	-1.3	-11.9	0.0	-1.1	-0.5
Bismarck	ND	46.8	-100.8	-1.4	1.6	5.8	2.4	1.4	5.4
WY/SD Border	SD	44.0	-104.0	-0.2	0.1	-0.9	0.1	-0.6	-1.1
Pierre	SD	44.4	-100.3	1.4	-0.6	10.5	0.4	0.1	3.6

KS/NE Border		40.0	-100.0	-3.4	-4.6	-4.6	-1.6	-2.7	-4.5
Lincoln	NE	40.8	-96.7	-1.2	-2.4	-4.9	0.2	-0.8	-3.2
Topeka	KS	39.0	-95.7	-1.3	-3.5	-4.6	-0.4	-1.0	-1.1
TX/OK Border		36.0	-100.0	-1.6	-2.8	-3.7	0.4	-1.4	-2.0
Tulsa	OK	36.1	-96.0	-3.4	-1.2	-4.0	-0.3	-1.4	-1.1
Oklahoma City	OK	35.5	-97.5	-1.0	-0.9	-3.4	-2.0	-1.1	0.1
Lawton	OK	34.6	-98.4	-0.2	-1.1	-2.0	-0.9	-2.5	-1.6
Lubbock	TX	33.6	-101.9	-2.6	-5.7	12.7	-5.2	-4.0	-1.2
Gainesville	TX	33.6	-97.2	-0.9	-1.4	-2.4	-0.4	-1.5	0.2
Central TX	TX	32.0	-100.0	0.0	-1.2	-0.9	0.3	0.3	-2.7
East/Central TX	TX	32.0	-96.0	-2.8	-4.5	-3.7	-0.5	-1.0	-2.4
Austin	TX	30.3	-97.7	-1.9	-3.0	-0.8	-1.4	-0.8	-2.9
Northwestern MN	MN	48.0	-96.0	-8.5	-1.2	-14.1	-0.4	-1.6	-0.7
Northeastern MN	MN	48.0	-92.0	-17.8	-0.4	-14.9	-0.4	-2.1	-0.7
Minneapolis	MN	45.0	-93.3	-5.2	-1.0	1.3	1.4	1.2	1.9
Southwestern MN	MN	44.0	-96.0	-0.6	-2.4	-1.7	-0.7	-0.3	-2.5
Southeastern MN	MN	44.0	-92.0	-5.9	-3.2	-4.5	-0.9	-1.6	-5.7
Des Moines	IA	41.6	-93.6	-3.9	-5.4	-4.8	-1.8	-1.6	-5.6
Northeastern MO	MO	40.0	-92.0	-3.8	-1.6	-4.9	-1.2	-3.7	-0.9
St. Louis	MO	38.6	-90.2	-0.6	-1.9	-0.1	0.6	0.3	-2.9
New Madrid	MO	36.6	-89.5	-0.1	-0.7	3.2	9.0	24.5	6.0
North/Central AR	AR	36.0	-92.0	-2.5	-2.9	-0.5	-1.7	-0.6	-1.5
Blytheville	AR	35.9	-89.9	-0.1	-1.4	1.4	13.5	24.7	14.8
Little Rock	AR	34.7	-92.3	-2.3	-4.7	-2.4	-1.4	-1.5	-3.9
North/Central LA	LA	32.0	-92.0	-3.7	-1.1	-4.2	-0.8	-2.8	-0.8
New Orleans	LA	30.0	-90.1	-3.4	-5.1	-4.3	-0.8	-1.3	-2.6
East/Central WI	WI	44.0	-88.0	-2.0	-2.4	-4.9	-0.9	-1.5	-5.2
Madison	WI	43.1	-89.4	-3.8	-4.4	-4.4	-0.6	-1.4	-5.0
Chicago	IL	41.9	-87.6	-3.0	-4.3	-3.6	-4.5	-4.1	-2.0
East/Central IL	IL	40.0	-88.0	-6.0	-3.0	-5.8	-1.6	-1.7	-2.0
Northern MI	MI	44.0	-84.0	-1.0	-1.9	-3.4	-0.5	-1.1	-3.8
Lansing	MI	42.7	-84.5	-2.5	-2.9	-3.2	0.3	-0.9	-3.8
Indianapolis	IN	39.8	-86.2	-5.6	-0.9	-5.9	-0.7	-2.1	-0.8
West/Central OH	OH	40.0	-84.0	-1.1	-1.3	-4.4	-0.6	-0.9	-1.0
Columbus	OH	40.0	-83.0	-1.0	-1.5	-3.0	-0.4	-1.2	-0.2
Bardwell	KY	36.9	-89.0	-3.7	-4.2	-4.4	-2.5	-0.5	0.6
Frankfort	KY	38.2	-84.9	-4.8	-0.8	-5.0	-0.2	-1.2	-0.5
Memphis	TN	35.1	-90.1	-5.6	-4.3	-3.2	-3.1	-3.3	-2.0
Western TN	TN	36.0	-88.0	-3.4	-2.8	-1.6	-1.7	-2.6	-2.0
Nashville	TN	36.2	-86.8	-2.3	-3.7	-1.2	-4.9	-1.3	-4.0
Chattanooga	TN	35.1	-85.3	-1.8	-0.4	-4.2	-0.8	-0.9	-0.7



Tellico Plains	TN	35.4	-84.3	-0.6	-1.4	-3.9	-2.2	-1.9	-0.3
Knoxville	TN	36.0	-83.9	-0.8	-1.6	-3.9	-2.6	-2.3	-0.6
Jackson	MS	32.3	-90.2	-7.0	-2.4	-5.9	-1.1	-2.9	-1.2
Southwestern AL	AL	32.0	-88.0	-5.0	-2.2	-5.4	-1.0	-1.7	-0.9
Montgomery	AL	32.4	-86.3	-3.3	-1.8	-6.0	-0.9	-1.7	-1.4
Tallahassee	FL	30.4	-84.3	-3.0	-4.3	-2.0	-0.2	-1.2	-2.0
Southwestern GA	GA	32.0	-84.0	-1.3	-1.0	-4.7	-0.5	-6.0	-0.5
Savannah	GA	32.1	-81.1	-0.6	-1.0	-2.4	-2.7	-0.4	-0.8
Atlanta	GA	33.8	-84.4	-3.0	-0.9	-5.6	-0.8	-1.3	-0.3
Columbia	SC	34.0	-81.0	-0.1	-1.9	-1.5	-0.3	-0.3	-1.2
Central/East Coast SC	SC	33.1	-80.0	-2.0	-2.2	-1.8	-3.2	-1.8	-1.1
Northeast Coast SC	SC	33.8	-79.3	-0.6	-1.5	-3.7	0.0	-0.1	-0.3
North/Central NC	NC	36.0	-80.0	-3.4	-0.1	-4.1	-0.3	-1.5	0.4
Southeast Coast NC	NC	34.6	-77.4	-1.6	-0.4	0.1	-0.4	-2.1	0.5
Norfolk	VA	36.8	-76.7	-0.9	-3.4	-0.7	-0.2	-0.6	-0.9
Richmond	VA	37.5	-77.4	1.2	0.6	7.4	-0.1	-0.5	2.1
Charleston	WV	38.4	-81.6	-1.1	-1.2	-3.9	-0.8	-1.5	-0.5
Annapolis	MD	39.0	-76.5	1.2	-0.4	6.2	-0.1	-0.9	1.2
Southern Delaware	DE	38.7	-75.3	-0.8	-2.4	-1.3	-0.8	-0.8	-1.7
Southwestern PA	PA	40.0	-80.0	-0.7	-2.0	-0.2	-0.4	-0.7	-1.3
Harrisburg	PA	40.3	-76.9	1.1	0.6	5.7	0.9	-0.1	1.9
Southeastern PA	PA	40.0	-76.0	-0.4	-0.6	-0.4	-0.2	-0.3	0.1
Northern NJ	NJ	40.7	-74.2	-0.7	-0.3	0.0	-0.5	-0.4	-0.1
Rochester	NY	43.2	-77.6	0.4	0.0	3.5	-0.2	-0.6	1.3
Upstate NY	NY	44.0	-76.0	-1.5	-0.5	-1.4	-0.1	-0.7	0.0
Malone	NY	44.8	-74.3	-0.5	-1.0	-1.0	-1.0	-1.2	-0.5
Hartford	CT	41.8	-72.7	-1.0	-0.7	0.8	-0.9	-1.4	-0.2
Providence	RI	41.8	-71.4	-1.7	-2.0	-1.0	3.0	0.9	-1.1
Boston	MA	42.4	-71.1	-1.3	-0.5	0.0	-2.1	-1.8	-0.6
Montpelier	VT	44.3	-72.6	-0.2	-0.2	-1.9	0.1	-0.1	0.6
VT/NH Border		44.0	-72.0	-0.2	-0.4	-2.3	-0.6	-0.5	0.4
Concord	NH	43.2	-71.6	-0.5	-0.8	-1.3	-1.9	-1.5	-0.3
North/Central Maine	ME	46.5	-69.0	-0.6	-0.7	-2.4	-1.3	-1.1	-0.2
South/Central Maine	ME	45.2	-69.0	-1.2	-0.9	-2.2	-0.2	-0.8	0.1



Note: A positive percent difference value indicates that EZ-FRISK calculated a higher ground motion value than the USGS.