

UPDATE AND NEW FEATURES OF THE CENTER FOR ENGINEERING STRONG MOTION DATA (CESMD)

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Abstract

The Center for Engineering Strong-Motion Data (CESMD) has been established by the U.S. Geological Survey (USGS) and the California Geological Survey (CGS) to provide a single access point for earthquake strong-motion records and station metadata from the CGS California Strong-Motion Instrumentation Program, the USGS National Engineering Strong-Motion Program, and the US Advanced National Seismic System (ANSS). This paper briefly summarizes the CESMD functions, describes the new developed features at the Center and gives an update on the data recently added to the CESMD database. Users can now download multiple records from different earthquakes and stations in zip file(s) that are separated by earthquake name and date and recording station. Registered users are notified of new significant earthquakes with strong-motion data. Highlights are added to the Internet Data Reports of significant earthquakes that summarize earthquakes details and give an overview of available strong-motion data. The CESMD Internet Data Reports for major earthquakes provide access to the references, such as papers and reports that were published on the earthquakes. For each earthquake, a summary of records parameters including station location, peak ground acceleration, velocity, displacement, and peak response spectral values are downloadable as a table that can be imported to a spreadsheet. All the functions and features of the Center are organized in a page named "About CESMD". Also, in this paper major earthquakes with strong ground motion data in CESMD that occurred since the SMIP 2007 seminar, in September 2007 are summarized.

Introduction

The Center for Engineering Strong Motion Data (CESMD) was established to provide timely, well-documented, and easily accessible data from domestic and international earthquakes of engineering interest. The CESMD was established by the USGS Earthquake Hazards Program and its National Engineering Strong-Motion Program (NESMP) and Advanced National Seismic System (ANSS), and the CGS Strong Motion Instrumentation Program (CSMIP). The Center is responsible for receiving US data from field stations, uniformly processing the data, rapidly releasing it through the Web, and archiving the data. In addition to strong-motion records, the Center provides information about site characteristics of stations (e.g., Vs30 and near-surface geology), and station characteristics such as structure type, height, and seismic design for instrumented structures, and a photograph showing the station surroundings.

The Center is engaged with the Consortium of Strong Motion Observation System (COSMOS) in the process of transitioning the COSMOS Virtual Data Center (VDC) to integrate it with the CESMD for improved efficiency of operations and to provide all users with a more convenient one-stop portal to both US and international strong motion data. The Center is working with COSMOS and international and US data providers to improve the completeness of site and station information, which are needed to most effectively use the recorded data.

CESMD Operation

The Center is managed by a Center Management Group (CMG), which consists of representatives from the CGS and USGS to coordinate policies and to oversee operation, coordination, and standardization of the CESMD. The Center Advisory Committee consists of researchers and practitioners from the engineering, science, and emergency response fields, and provides advice to the CMG on directions, goals and services.

CESMD Threshold for Data Inclusion

The threshold for including earthquakes in the Center's database depends on earthquake magnitude, peak ground acceleration and the seismic region (Figure 1). An earthquake in the US with magnitude 4.5 and larger that has a record with peak ground acceleration exceeding 5%g is included in the data center. However, the threshold for including earthquake is lowered to magnitude 4.0 in Center and East US. International earthquakes with magnitude 5.5 and larger that have records with peak ground accelerations of minimum 10%g are included in the CESMD.

CESMD Web Site

The CESMD provides strong-motion data, metadata about stations and sites, and other services such as a search engine and interactive maps of events and stations through its web site. The web site is also the means of communicating between the Center and users in order to get feedback, answer questions regarding the data, and inform users about the updates at the Center. The web site, hosted by CGS and USGS at <http://www.strongmotioncenter.org>, consists of three major sections: Internet Quick Reports (IQR), Archive, and Search Engine. The front page of the Center's web site is shown in Figure 2. In addition to serving as a data source, the Center notifies users when new data from earthquakes with magnitude 5.0 and larger are available, and when pages are significantly updated.

The CESMD's web site is a dynamic web site in which all the web pages are generated on-the-fly upon a user's request. Data are retrieved from a database in real time when a user opens a web page. The dynamic nature of the database-driven system ensures that tables and maps will always contain the most updated information.

The Internet Quick Reports

The CESMD provides the most current strong-motion data of engineering interest through the Internet Quick Reports (IQR) that are generated shortly after earthquakes. The first version of the IQR is often released within 30 minutes after the event. More complete IQR pages are posted as data are recovered and received by the Center. The Center plans to automate preliminary data processing and dissemination in the near future, which will make the information available more rapidly. An example of an IQR event summary page is shown in Figure 3. The user can access the Internet Quick Report for individual events by clicking on the event name on an event summary page of the IQR web page.

Archive

The Archive pages are sorted by event date (most recent on top). The layout of the Archive pages is the same as that of the IQR pages, so a user familiar with the IQR will find it easy to use the Archive pages. Concurrent with the accumulation of data from new and recent events, the CESMD also is loading additional significant strong-motion records for historic earthquakes to the Archive.

Searching for Data

Strong motion records of the Center are searchable using the “Search for Data” button on the Center’s front page. Clicking on this button will display a search page that currently includes two search options, one for the CESMD and one for the COSMOS Virtual Data Center (VDC). Currently these two options are needed because the extent and scope of data holdings as well as the search options of these two data centers are incongruent (presently the VDC provides access to worldwide data). Future plans include incorporation of the VDC into the CESMD so that users will be able to access both U.S. and significant international data through the CESMD web site.

The current search page of the CESMD for U.S. structural and ground response data is shown in Figure 4. The records in the CESMD archive are searchable in several ways, depending upon a user’s interests. In general, the search parameters can be a combination of earthquake, station, and record parameters. The searchable earthquake parameters are currently earthquake name, magnitude and date. The station parameters are station city, station name, number, and type. The station types include ground stations, buildings, bridges, dams, geotechnical arrays, and others. For building stations, additional search parameters include material of construction (such as steel, concrete, masonry and wood), whether or not there is base-isolation, and the height (low, mid, and high rise). The search table can be sorted in the same way as an IQR or Archive table. The records found are directly viewable and downloadable from the search result table as shown in Figure 5.

The Center provides ambient vibration data recorded at some of the requested CGS stations through the search engine. The ambient data are loaded at the ftp site, linkable through a button at the bottom of the CESMD link on the Search for Data page.

Interactive Map for Earthquake

The CESMD includes interactive Google Maps that allow users to view maps of strong motion stations and events. This feature makes use of the Google Maps web service. An example of the map interface for an IQR page is shown in Figure 6. The map shows the earthquake epicenter and the stations that recorded the Inglewood earthquake of May 17, 2009. The station symbols (circles for ground sites, squares for structures) are colored according to maximum horizontal acceleration (PGA), so a user can see at a glance where the highest ground motions were recorded. The corresponding legend of PGA values appears in the upper right corner of the map. For consistency and ease of use, the colors used in the symbols correspond to the coloring used on ShakeMap for that acceleration. Many standard features of Google Maps are also present. For example, the inset at the lower right corner of the map provides regional context, a distance scale is displayed at the lower left corner of the map, standard navigation tools (zoom, translation) appear in the upper left of the map, and the base map view (Map, Satellite, Terrain) can be selected at the upper right. These features allow the user to interactively drag or pan the map around using either the left mouse button (click and drag), or the arrows at the upper left corner of the map. The button in the middle of those arrows (with four arrows pointing inward) will bring the user back to the previous map coverage. The map can also be panned by clicking and dragging the blue rectangle inside the regional overview map.

When the mouse hovers over a station on the map, a photo of the station appears beside the map at the lower right, along with some information about the station. The user can also click on the station to open a pop-up window containing basic information about the station and links to view the time histories and download the strong-motion data. Clicking on the epicenter opens a pop-up window providing the basic information on the earthquake.

A feature has been added in the Interactive Map that allows users to download a file with station information in KML format so that it can be viewed in three dimensions in the Google Earth viewer.

New Developments

The CESMD is working to implement modifications and enhancements to existing search options and display features in response to suggestions from the Center Advisory Committee, and also working to implement automatic data collection and preliminary processing and dissemination. The goal is to provide at least preliminary versions of US strong-motion data through the Center within a few minutes after a significant event and fully verified data soon afterwards. The records from all ANSS strong-motion networks will be uniformly processed and provided. The new developments at the Center from the time of the September 2007 annual SMIP seminar to now are described briefly in the following.

About CESMD

For users who visit the CESMD web site for the first time, it may be useful to start with the page linked through the front page named “About CESMD” (Figure 7). This page provides a

summary of the CESMD history and background, the Center's functions and features, information such as data formats, contact information, questions about the Center, etc. Also, this page may be useful for the returning users as a reference and one stop page that provides links to all CESMD pages and information about the Center.

Users Notification

The Center notifies registered users when new earthquakes with magnitude 5.0 and larger are posted and when an existing page is significantly updated. Users can register at the CESMD by going to "About CESMD" link through the front page.

Stations and Earthquakes Maps

The Interactive Station Maps provide maps of all network stations. In the time being, the station maps are available for the Northern California and Southern California areas. The maps also include stations that are planned or underway. Each station on the map is color coded to represent its seismic network. Also, users can access all data from different events recorded at any station by clicking on the station button on the map. Figure 8 shows the station map for the Southern California area.

The Interactive Earthquake Event Map (Figure 9) is another new tool using Google Map that shows all the earthquakes with strong-motion records available in the CESMD. The events are color coded to easily distinguish the significant events that have important strong-motion records from smaller events. By clicking on an event a pop-up window will provide a link to the list of all stations that have strong-motion records for that event. Thus all the data recorded and loaded in the CESMD for a station is easily downloadable and viewable through the Interactive Event Map.

Multiple Records Download

Users are able to select multiple files of processed or raw data to download through Internet Quick Report, Internet Data Report, and Search for Data pages. Figure 10 shows an example of a download page. The page summarizes availability of data for download. Data are downloaded in zip files, as shown in Figure 11, with standard identifiers including earthquake name and date, network code and station number/code.

Earthquake Highlight

For earthquakes with significant strong ground motion records in the Center, the earthquake and available records are summarized in an Earthquake Highlight. Figure 12 shows the Highlight for the 17 May, 2009 Inglewood earthquake. For the recent earthquakes, Highlights include a figure that shows variation of peak ground acceleration versus distance that would provide an overview about the records and also attenuation of ground motion with distance.

Data References and Reports

For the major earthquakes in CESMD, there are reports and papers available about strong motion data and processing that are helpful for users to understand recorded data and facilitate data application. In the CESMD Data Reports, the reports and references are available through a link on the upper left side of the major earthquakes pages named “Reports”. Users are recommended to review the reports, when available, before using data in their research or project. Figure 13 shows the reference page for Northridge earthquake of January 17, 1994. It is worth noting that the purpose for the Report page is not to list and give reference to all research papers available about an earthquake, but to highlight points about strong-motion data and processing of data.

Summary of Records in Table

In each earthquake page of the CESMD, there is a link, on the upper left, named “Download Text Table”. This link provides a text table of all stations records with information about station latitude and longitude, maximum recorded ground acceleration, velocity, displacement, and maximum response spectral acceleration at periods 0.3, 1.0 and 3.0 seconds. For structures, the peak ground acceleration at structure is also given in the table. This table is useful for users who need to import the information to a spreadsheet.

Update on Available Data

As of November 2009, 4855 station records from 174 earthquakes in the US and other countries with magnitudes 4.0 and larger have been loaded into the CESMD database. Figure 14 shows number of earthquakes and station records in different magnitude ranges. Each station record consists of 3 components for ground response stations and more, up to over 100 components for some structural stations.

Earthquakes loaded to the CESMD database from the time of SMIP07 seminar, in September 2007 to now are summarized in Table 1. As shown in the table, 61 earthquakes with magnitude 4.0 and larger that were recorded at 1740 stations in the ANSS seismic regions were processed and loaded to the CESMD in this time interval. Among the US earthquakes, M5.4 Alum Rock earthquake of 30 October 2007 has records at 224 stations and M5.4 Chino Hills earthquake that occurred on 29 July 2008 was recorded widely in southern California at over 420 stations.

During the time period of SMIP07 to SMIP09, 5 international earthquakes with magnitude 5.8 to 8.4 were added to the CESMD. The largest one was M8.4 Sumatra earthquake that occurred on 12 September 2007 with 2 aftershocks with magnitudes 7.9 and 7.0. The earthquake and aftershocks were recorded at Caltech Tectonics Observatory (CTO) station PSKI. The records were processed by the USGS National Strong Motion Project (NSMP) staff and are available at the CESMD. Figure 15 shows acceleration, velocity and displacement of the M7.9 aftershock that occurred at distance 164 km from the epicenter on September 12, 2007 with maximum peak ground acceleration of about 13%g and peak ground displacement of about 16

cm. Due to long period contents of ground motion, periods up to 50 seconds were allowed to pass in the processing of this records' data.

An earthquake with magnitude 5.8 ML (6.3 Mw) occurred on April 6, 2009 in Central Italy about 5 km southwest of the city of L'Aquila (about 85 km northeast of Rome), causing extensive damage in the area. The earthquake strong motion was recorded by 55 modern stations of the Italian National Strong Motion Network (RAN) managed by the Department of Civil Protection (DPC). Teams of U.S. earthquake researchers, sponsored by EERI, PEER, and GEER and others visited the area to document scientific and engineering effects of the earthquake, and assisted CESMD in receiving the strong motion data and background information. The largest acceleration, about 65%g, was recorded at about 5 km from the epicenter. The largest velocity, about 42 cm/sec, was obtained at this station. There are 4 strong motion stations within about 6 km of the epicenter, and they all recorded over about 35%g. The peak ground velocity at these stations ranges from 32 to 42 cm/sec.

An earthquake with magnitude 8.0 occurred on 29 September 2009 in Samoa Islands region. Peak ground acceleration of about 10%g was recorded at distance 179 km at station AFI by IRIS/USGS Global Seismograph Network. This record is also among the few records available from very large earthquakes.

Summary

- The Center for Engineering Strong Motion Data, CESMD, is a cooperative effort of the California Geological Survey and the US Geological Survey to establish a unified strong-motion data center for engineering applications.
- Nationwide records with threshold magnitude of 4.5 and peak ground acceleration of 5%g are included in the CESMD. For the ANSS region of Center and East US only, the threshold magnitude is lowered to M4.0
- Users are notified by the Center when new significant earthquakes are loaded to the Center.
- New station maps are available for the southern and northern California regions. Data is viewable and downloadable from the station maps.
- The All Earthquakes Map includes all the earthquakes loaded into the Center's database. Users can access to the Internet Report pages and station maps of earthquakes from the All Earthquakes Map.
- Multiple records can be downloaded in zip files that are named by earthquake date, earthquake time and station name/code. This format allows users to search earthquakes and records and download and organize the files locally on the user's computer.

- Earthquake Highlights provide information about significant earthquakes and plots of recorded acceleration versus distance.
- A new button named “Report” links to the references and reports published about records and data processing of the major earthquakes records.
- Since the SMIP 2007 annual seminar in September 2007, the CESMD has loaded records from over 1760 stations from earthquakes in the US and other countries.

Acknowledgement

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References

Haddadi, H., A. Shakal, C. Stephens, W. Savage, M. Huang, W. Leith, R. Borchardt and J. Parrish (2008). Center for Engineering Strong-Motion Data (CESMD), 14th World Conference of Earthquake Engineering, Beijing China.

Lin, Kuo-wan, A. Shakal, M. Huang, C. Stephens, and W. Savage (2002). Dissemination of Strong-Motion Data Via the Internet Quick Report and the Internet Data Report at the CISN Engineering Data Center, Proceedings of SMIP2002 Seminar on Utilization of Strong-Motion Data, p. 115-126.

Shakal, A., and C. Scrivner (2000). TriNet Engineering Strong-Motion Data Center, Proceedings of SMIP2000 Seminar on Utilization of Strong-Motion Data, p. 115-124.

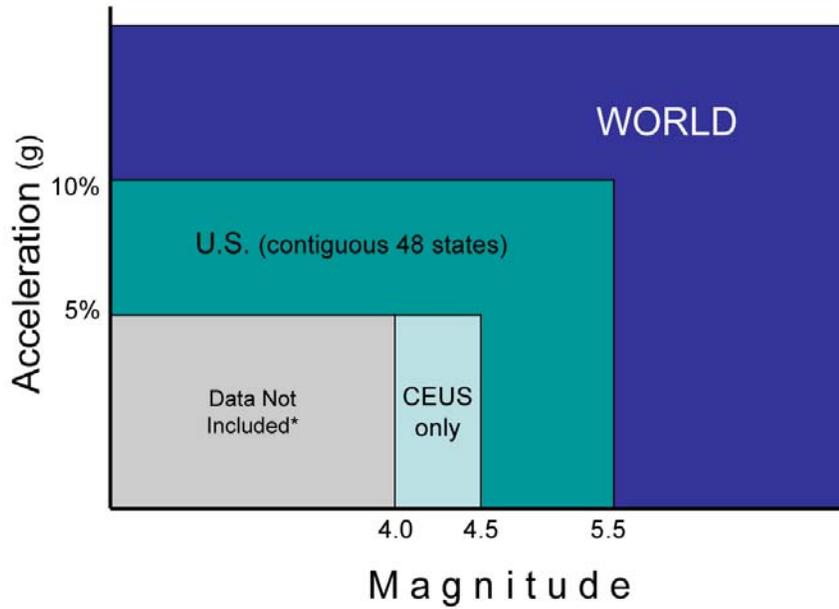


Figure 1. The CESMD thresholds for earthquake magnitude and acceleration.

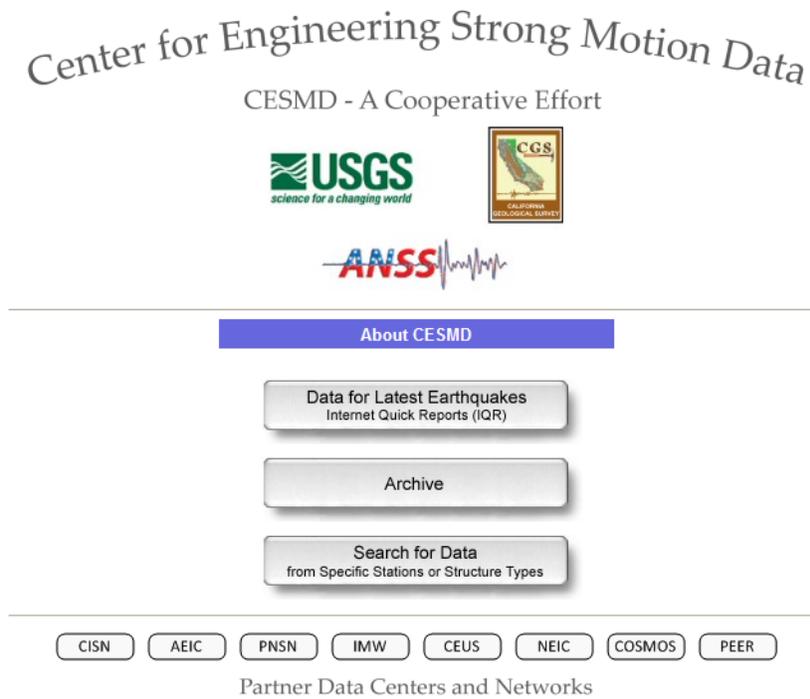


Figure 2. The CESMD web site front page at strongmotioncenter.org

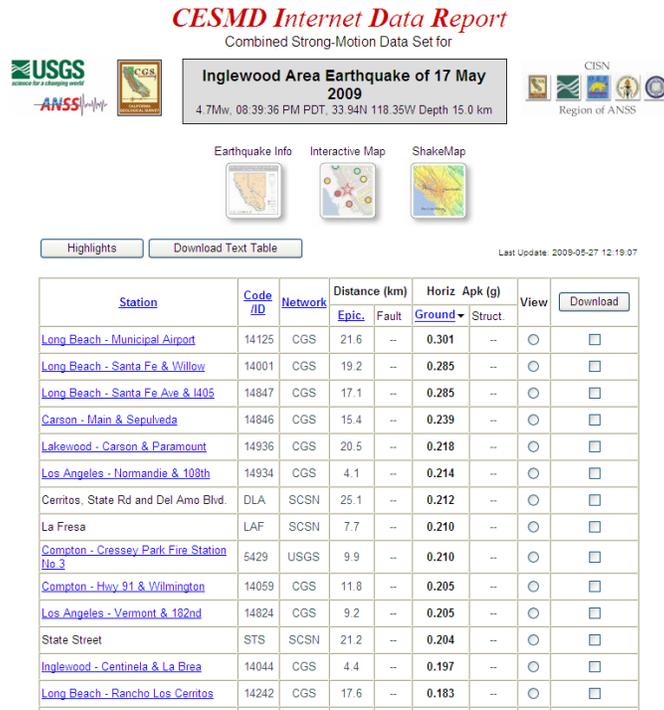


Figure 3. The Internet Data Report web page for the Inglewood earthquake of 17 May 2009.

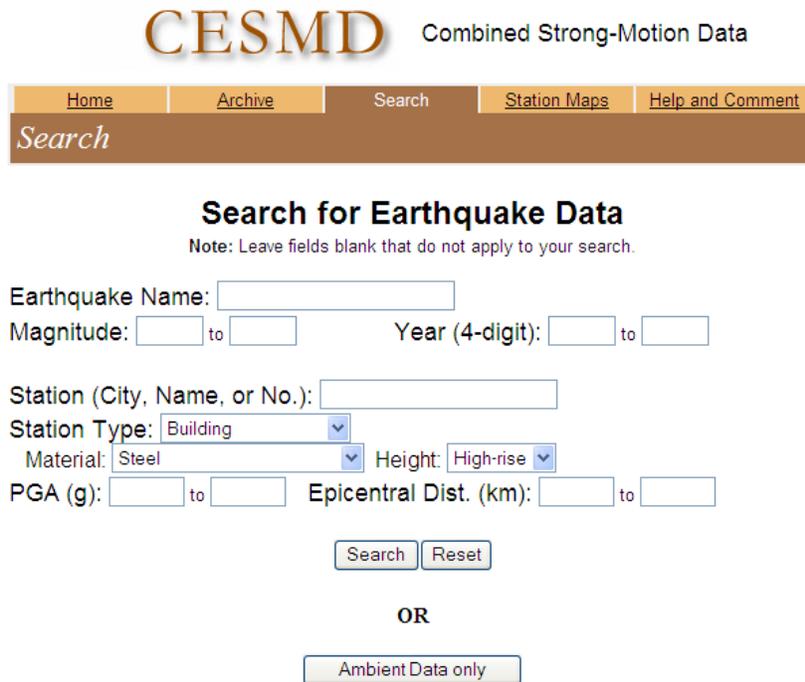


Figure 4. CESMD search page shows a search request for steel high-rise buildings data.

CESMD Combined Strong-Motion Data

Home Archive Search Help and Comment

Search

101 records match the following search parameters

Station (City, Name or No): Any Station type: Building
 Station Material: Steel Station Height: High-rise
 PGA (g): Any Epicentral Dist. (km): Any

StaNo	Station	Network	Epic (Fault) Dist.(km)	Horiz Apk (g)		Earthquake	View	Download
				Ground	Struct.			
14654	El Segundo - 14-story Office Bldg	CGS	4.6(-)	0.047	0.060	Inglewood 17May2009	<input type="radio"/>	<input type="checkbox"/>
58675	Oakland - 18-story City Hall	CGS	7.3(-)	0.017	0.068	Piedmont 20Jul2007	<input type="radio"/>	<input type="checkbox"/>
58312	Oakland - Harris State Building	CGS	7.6(-)	0.016	0.033	Piedmont 20Jul2007	<input type="radio"/>	<input type="checkbox"/>
58638	Concord - 9-story Office Bldg	CGS	9.8(-)	0.044	0.128	Lafayette 01Mar2007	<input type="radio"/>	<input type="checkbox"/>
24713	Los Angeles - 8-story Hospital	CGS	10.8(-)	0.090	--	W/Hollywood 9Sep2001	<input type="radio"/>	<input type="checkbox"/>
58638	Concord - 9-story Office Bldg	CGS	12.5(-)	0.006	0.015	Alamo 05Sep2008	<input type="radio"/>	<input type="checkbox"/>
57318	San Jose - 18-story City Hall	CGS	14.2(-)	0.072	0.152	AlumRock 30Oct2007	<input type="radio"/>	<input type="checkbox"/>
57357	San Jose - 13-story Govt Office Bldg	CGS	14.3(-)	--	0.084	AlumRock 30Oct2007	<input type="radio"/>	<input type="checkbox"/>
24288	Los Angeles - 32-story Residential Bldg	CGS	15.8(-)	0.016	0.011	Inglewood 17May2009	<input type="radio"/>	<input type="checkbox"/>
14654	El Segundo - 14-story Office Bldg	CGS	17.2(-)	0.007	--	W/Hollywood 9Sep2001	<input type="radio"/>	<input type="checkbox"/>
24249	Los Angeles - 8-story County Hospital	CGS	18.4(-)	0.010	0.018	Inglewood 17May2009	<input type="radio"/>	<input type="checkbox"/>
24248	Los Angeles - 9-story County Hospital	CGS	18.5(-)	0.012	0.024	Inglewood 17May2009	<input type="radio"/>	<input type="checkbox"/>

Figure 5. A part of the search result for steel high-rise building data.

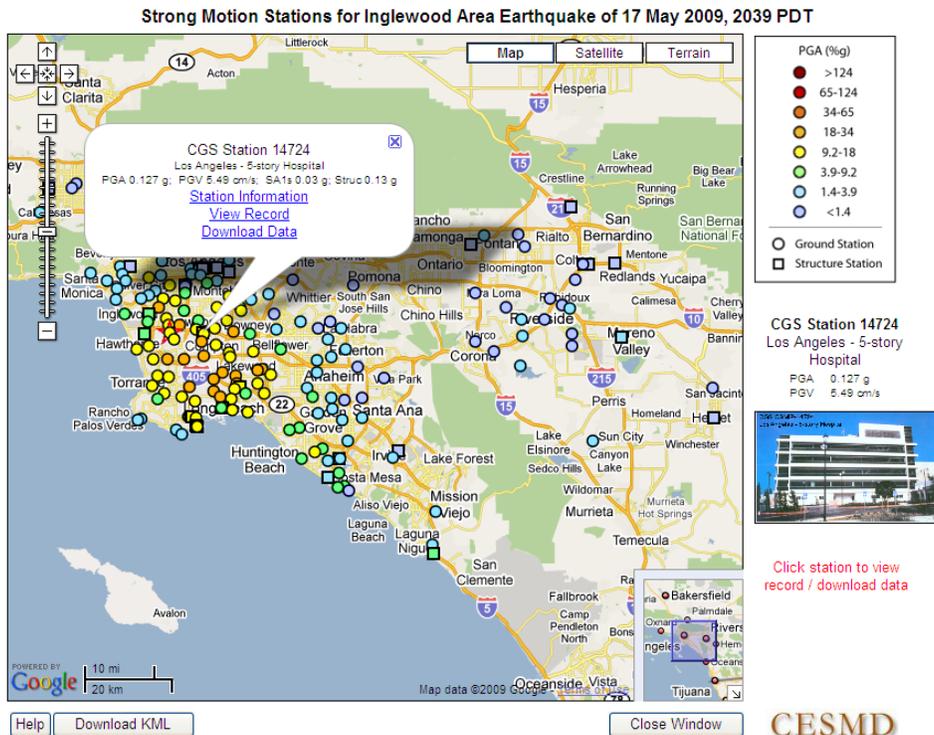


Figure 6. Station map for Inglewood earthquake of May 17, 2009.

About CESMD

Our Products	Data Format
Internet Quick Report Archive Search Engine Stations Map Earthquakes Map Notification	COSMOS Format COSMOS Tables CGS Format SMC Format
CESMD Center	Tools
History CMG & Advisory Committee ANSS Regions	COLUMIZE for input to Excel!
More	
Register at CESMD Contact us Questions and Answers Seismic Networks and Centers	



Figure 7. The “About CESMD” page summarizes the CESMD.

Strong Motion Stations in Southern California

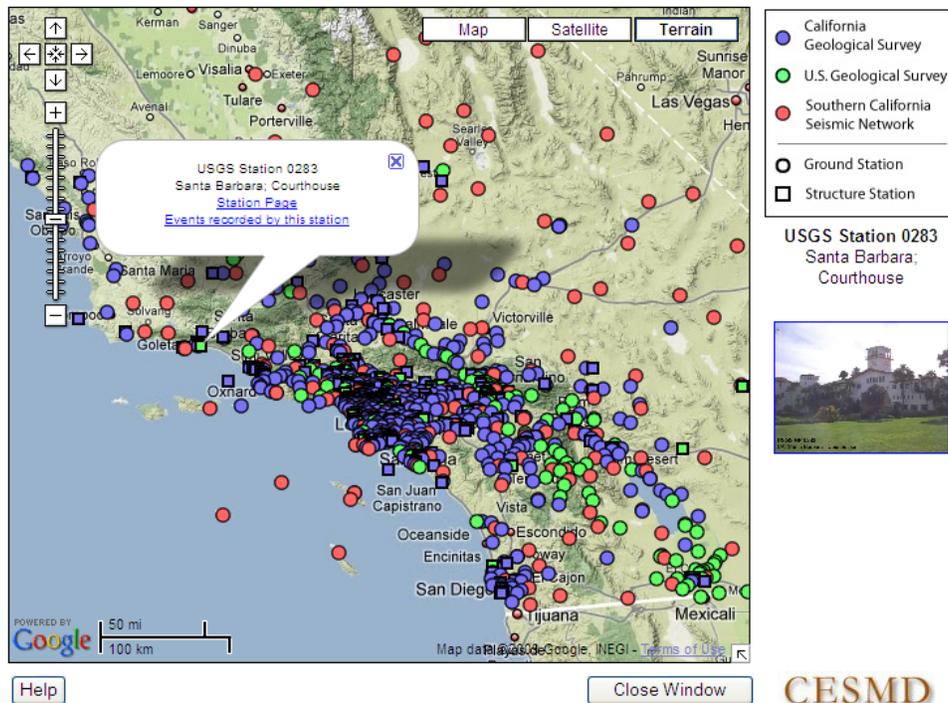


Figure 8. Station map of the Southern California area.

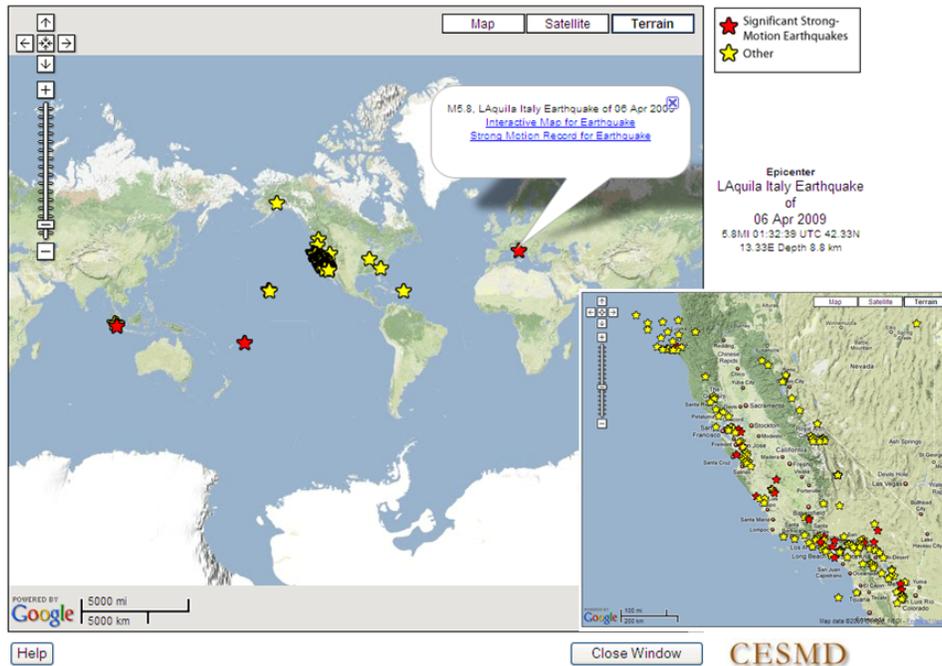


Figure 9. Interactive map of All Earthquakes.



Figure 10. Multiple download of records. Stations are check marked to be downloaded.

Name	Type	Modified	Size	Ratio	Packed	Path
Inglewood_17May2009_CE14001P.ZIP	WinZip File	5/18/2009 2:55 PM	265,216	0%	265,140	
Inglewood_17May2009_CE14044P.ZIP	WinZip File	5/18/2009 11:56 AM	240,356	0%	240,150	
Inglewood_17May2009_CE14059P.ZIP	WinZip File	5/18/2009 11:56 AM	245,632	0%	245,496	
Inglewood_17May2009_CE14125P.ZIP	WinZip File	5/19/2009 4:54 PM	235,158	0%	235,027	
Inglewood_17May2009_CE14824P.ZIP	WinZip File	5/18/2009 2:55 PM	244,576	0%	244,138	
Inglewood_17May2009_CE14846P.ZIP	WinZip File	5/18/2009 2:55 PM	248,294	0%	247,971	
Inglewood_17May2009_CE14847P.ZIP	WinZip File	5/18/2009 11:56 AM	250,367	0%	250,129	
Inglewood_17May2009_CE14934P.ZIP	WinZip File	5/18/2009 11:56 AM	233,891	0%	233,658	
Inglewood_17May2009_CE14936P.ZIP	WinZip File	5/18/2009 2:56 PM	235,763	0%	235,588	
Inglewood_17May2009_CIDLAP.ZIP	WinZip File	5/18/2009 11:59 AM	321,070	0%	320,461	
Inglewood_17May2009_CILAFP.ZIP	WinZip File	5/18/2009 12:00 PM	322,608	0%	322,475	
Inglewood_17May2009_CIST5P.ZIP	WinZip File	5/18/2009 12:00 PM	321,849	0%	321,552	
Inglewood_17May2009_np05429P.ZIP	WinZip File	6/25/2009 6:10 PM	616,822	0%	614,241	

Figure 11. Data downloaded in zip files. The files are named in a standard format of earthquake name_Earthquake date_Network+station number/code+data type (Processed or Raw).

Inglewood Earthquake of 17 May, 2009

The earthquake magnitude 4.7Mw occurred in a densely populated part of Los Angeles area about 2 km south of Inglewood at 8:39 PM PDT, on May 17, 2009. According to the [Southern California Seismic Network](#), it is likely that this earthquake is associated with the Newport-Inglewood fault. The right lateral strike slip focal mechanism of this earthquake is consistent with slip on the Newport-Inglewood fault. The damaging 1933 M 6.4 Long Beach earthquake was located 40 km to the southeast, also on the Newport-Inglewood fault.

The earthquake of 17 May was recorded widely by the strong motion stations of the CISN network. The largest acceleration was about 30% g at Long Beach Municipal Airport, about 22 km south east of the epicenter. The variation of Peak Ground Acceleration (PGA) versus epicentral distance is shown in the following figure. The figure shows significant variation of PGA at distances of 10 to 30 km from the epicenter.

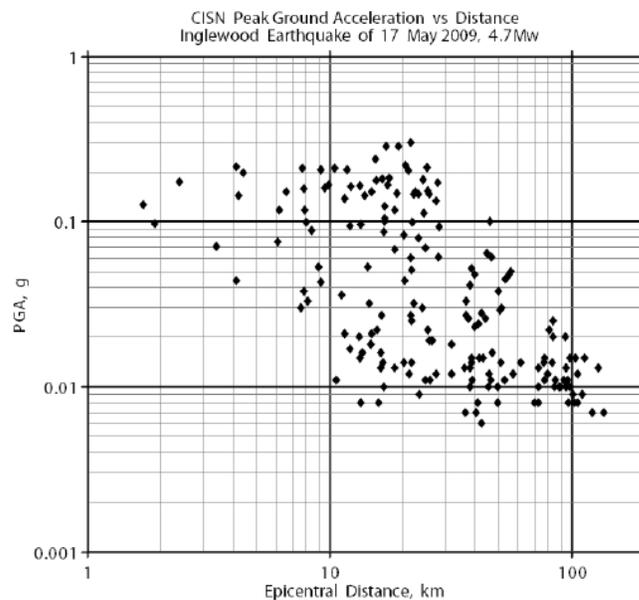


Figure 12. Earthquake highlight page for 17 May 2009, Inglewood earthquake.

References for Northridge Earthquake of January 17, 1994

- General Reports

- [CSMIP Strong-Motion Records from the Northridge Earthquake of January 17, 1994, CGS Publication OSMS 94-07.](#)
- Accelerograms Recorded at USGS National Strong-Motion Network Stations During the Ms=6.6 Northridge California Earthquake of January 17, 1994, R. L. Porcella, E. C. Etheredge, R. P. Maley, and A. V. Acosta, USGS Open File Report 94-141.
- [Interpretation of Significant Ground-response and Structure Strong Motions Recorded During the 1994 Northridge Earthquake, A. F. Shakal, M. J. Huang, and R. B. Darragh, BSSA, vol. 86, pp. S231-S118, 1996.](#)

- Processed Data Reports

- [Processed CSMIP Strong-Motion Data from the Northridge California earthquake of 17 January 1994: Release No. 1, CGS Publication OSMS 94-06B.](#)
- [Processed CSMIP Strong-Motion Data from the Northridge California earthquake of 17 January 1994: Release No. 2, CGS Publication OSMS 94-08.](#)
- [Processed CSMIP Strong-Motion Data from the Northridge California earthquake of 17 January 1994: Release No. 3, CGS Publication OSMS 94-09.](#)
- [Processed CSMIP Strong-Motion Data from the Northridge California earthquake of 17 January 1994: Release No. 4, CGS Publication OSMS 94-10.](#)
- [Processed Data for Pacoima - Upper Left Abutment from the Northridge Earthquake of 17 January 1994, CGS Publication OSMS 94-12A.](#)
- [Preliminary Processed Data for Tarzana - Cedar Hill Nursery A from the Northridge California Earthquake of 17 January 1994, CGS Publication OSMS 94-12B.](#)
- [Processing of the Upper Left Abutment Record from Pacoima Dam for the Northridge Earthquake, CGS Publication OSMS 94-13.](#)
- [Processed CSMIP Strong-Motion Data from the Northridge California earthquake of 17 January 1994: Release No. 9, CGS Publication OSMS 94-16.](#)
- [Los Angeles Code-Instrumented Building Records from the Northridge, California Earthquake of January 17 1994: Processed Release No. 1, CGS Publication OSMS 94-17.](#)

Figure 13. References for Northridge earthquake available from the “Report” button on the Data Report Page of Northridge earthquake.

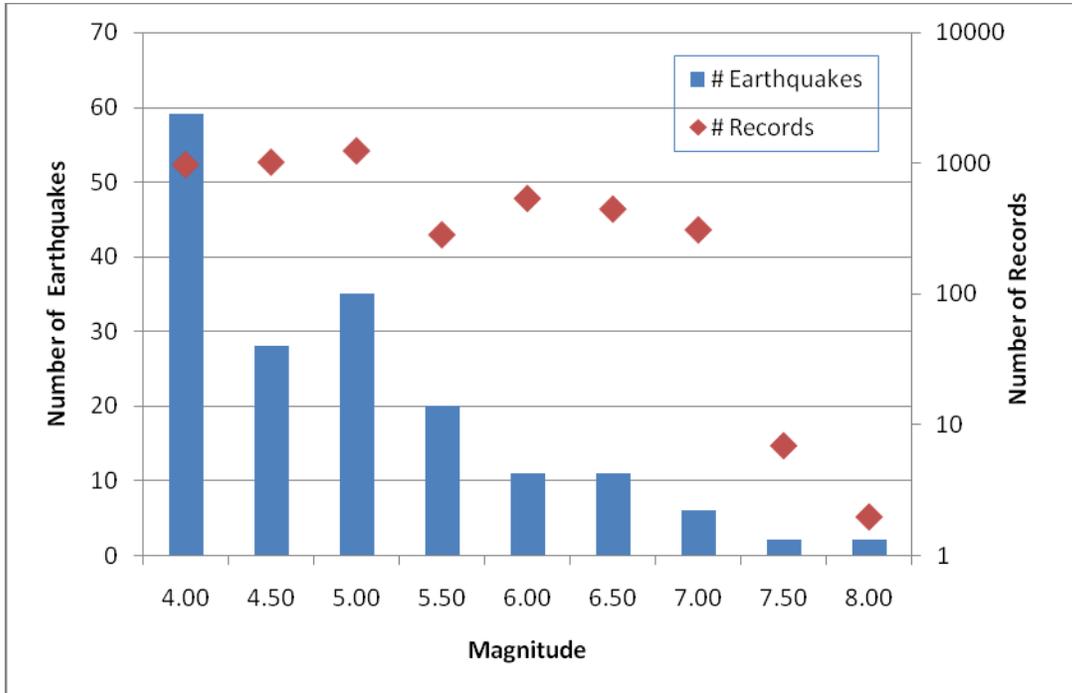


Figure 14: Total number of earthquakes and records in the CESMD database

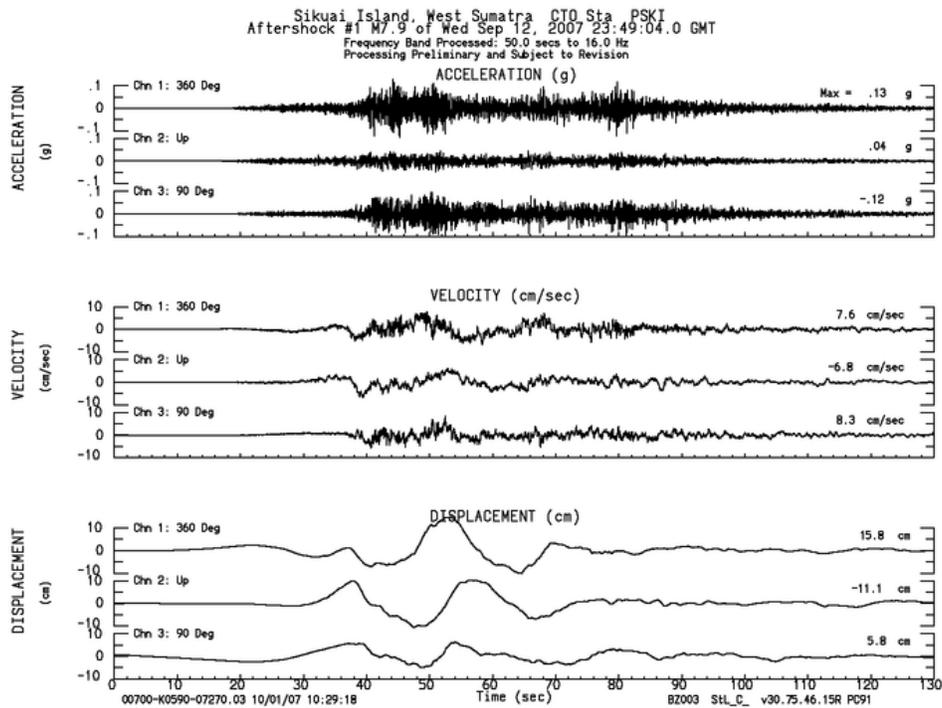


Figure 15. Acceleration, velocity and displacement time histories of the record from M7.9 aftershock of Sumatra earthquake of 12 September 2007 at Caltech Tectonics Observatory (CTO) station PSKI.

Seismic Region	No. of Events	Magnitude	No. Stations
California	53	4.0 - 5.4	1655
Pacific Northwest	1	4.5	14
Inter-Mountain West	3	4.2 – 6.0	31
Mid-America	1	5.2	7
Alaska	1	5.5	15
Hawaii	1	5.0	16
Puerto Rico	1	5.9	2
International	5	5.8 – 8.4	21

Table 1. Update on the records added to the CESMD database since SMIP annual seminar in September 2007.

