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Partial Support of Joint USGS-CALTECH Southern California Seismographic Network

USGS Award No. 04HQAG0010

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INVESTIGATIONS

This Cooperative Agreement provides partial support for the joint USGS-Caltech Southern California Seismic Network (SCSN) and the Southern California Earthquake Data Center (SCEDC). The purpose is to record and analyze data from more than 35,942 local earthquakes, from 1 October 2003 to 30 November 2006, and generate a database of phase data and digital seismograms (Figure 1). The primary product derived from the database is a joint USGS-Caltech catalog of earthquakes in the southern California region and the associated waveforms. We maintain the SCSN and SCEDC infrastructures. We also provide rapid response to emergency services, the media, and public inquiries about earthquakes and data for seismological research.

For more detailed information about data access, please contact:
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RESULTS

Network Operation

The SCSN operation of network infrastructure consists of: 1) operating computer and communications hardware/software and other instrumentation for data acquisition at the central site; 2) installation and field maintenance of new and existing digital stations; and 3) population and maintenance of earthquake databases. Caltech and USGS personnel share these operations

responsibilities. Because the SCSN is a cooperative project of Caltech and USGS, all the facilities listed below are jointly operated and contribute to the overall project mission.

Central Site. The SCSN (formerly TriNet and TERRAscope) differs from most regional networks in both size and data processing approach. Most of the data are transmitted using digital communications, products are generated in near-real-time, and automatically archived in an Oracle database.

We lease frame relay from SBC and Verizon for data communications. This includes more than 120 frame relay drops, over 30 "last mile" radio links, 20 "last mile" optical fiber links, and three T1 lines transmitting the data from the frame relay cloud into the Caltech campus. Through agreements with the local utilities, we operate three T1 microwave links that provide wireless data transmission for about 40 stations using their statewide microwave systems.

The data from approximately half of the analog short period stations are digitized at six different remote earthworm hubs. The remaining stations are transmitted via analog phone lines and the USGS microwave to Caltech and digitized at the central site.

Two SUN servers, with 4 CPUs each, operating in primary and backup mode, perform the real-time data acquisition and processing. To improve robustness, these two servers and related equipment are located in two different buildings on campus, the Seismo Lab and the USGS building (525 So. Wilson Ave). Two SUN servers are used for software testing and development. ShakeMap is generated using a SUN server and will also be produced in the future using a 2 CPU LINUX server.

Both parametric and waveform data are archived automatically in the oracle database. The data analysts review and modify the already archived data in the Oracle database. A significant part of our effort is also the maintenance of existing data archives and station metadata for the stations recorded by SCSN.

The major software components used by SCSN are TriNet C++, Perl scripts, and Java software, earthworm modules, and commercial software such as Oracle, and SmartSockets. This software requires extensive maintenance because software and hardware need to be upgraded simultaneously, requirements such as station metadata may change and send ripples through the software. Further, improvements in seismological algorithms may need to be incorporated as errors or improvements are discovered.

SCSN. The SCSN operates 160 broadband and strong motion real-time digital stations, 30 real-time strong motion stations, and about ~120 short period stations to maintain the detection threshold of M1.8 in southern California (Figure 2). The existing digital stations of TERRAscope are part of SCSN.

Broadband and strong motion sites, provide flat instrument response from 50 Hz-30 seconds or greater. Approximately two thirds of the broad sensors have low frequency response to 120 or 360 seconds. They are sited, away from structures of two or more stories, and preferentially at sites with low ambient ground noise. At present we operate 155 broadband and strong motion stations and record data from 10 Anza network stations, 3 University of California borehole stations located on the major campuses, and 4 SCEC borehole strong motion stations.

Strong motion reference sites, differ from traditional free field sites. The reference sites must provide flat instrument response in acceleration and on scale recording up to 2 g. In some cases these sites will also have a broadband seismometer. They will be sited away from structures of 2 or more stories but are located near major facilities or near groups of significant structures. Nearly all of the SCSN stations are either reference sites or free field sties. All strong motion sites have local recording. At present we receive signals from 15 Caltech operated strong motion recorders (K2's).

Short period sites, that have a single vertical component seismometer, are needed to ensure the minimum magnitude threshold of M1.8. These are quiet sites that provide resolution down to ambient ground noise.

State of health, we monitor the state of health of the network using SeisNetwatch. SeisNetwatch can be operated remotely using a regular web browser and field engineers can be notified via paging or email in case problems develop. SeisNetwatch is a good example of how the seismic network community has benefited from TriNet development. Initially, it was developed as TriNetwatch and was made available to the community as SeisNetwatch at the request of the USGS earthworm group in Golden Colorado.

Data transmission. The SCSN data are transmitted to Caltech via frame relay, digital microwave, Internet, and spread spectrum radio. We lease three T1 frame relay lines from Pacific Bell, which terminate at Caltech. At six locations, we collect several stations before the data are put onto frame relay lines, with three stations sharing a single frame relay line. Connecting to remote sites, we lease more than 120 frame relay circuits. For communications, we operate two 3 T1 capacity CISCO routers, a Motorola router, and several terminal servers. We also operate a 2 T1 capacity digital microwave link to Mt. Lukens to connect to the So Cal Edison and City of Los Angeles Department of Water and Power wide area networks. Further, we operate a third last mile microwave link to Verdugo Peak for data transmission from sites located at Southern California Gas Co. sites.

Seismicity Summary for Southern California

Southern California events processed & distributed:
During the reporting period (October 1, 2003 through November 30, 2006), we recorded & processed:

35,942 local earthquakes (inside & just outside of our region)
4,337 were magnitude 2.0 or larger, of which
448 were magnitude 3.0 or larger, of which
46 were magnitude 4.0 or larger, of which
6 were magnitude 5.0 or larger, of which
none were magnitude 6.0 or larger.
We also recorded & processed: 2,032 mine & quarry blasts.

The magnitude 4+ quakes, which were inside our coverage area are listed below:

Mag.	Local date	Local time	Lat.	Long.	Depth	Descriptive location
4.3	2003/10/08	04:26:22	32 10.1 N	115 25.5 W	6.0	56 km (35 mi) S of Calexico
4.3	2004/02/14	04:43:11	35 2.3 N	119 7.9 W	11.7	18 km (11 mi) WNW of Wheeler Ridge
4.4	2004/05/09	01:57:17	34 23.7 N	120 1.3 W	4.4	16 km (10 mi) W of Isla Vista
5.0	2004/06/15	15:28:48	32 19.7 N	117 55.1 W	10.0	68 km (42 mi) SE of San Clemente Is.
4.0	2004/07/13	17:53:52	33 42.7 N	116 3.3 W	12.9	15 km (9 mi) E of Indio
4.3	2004/07/24	05:55:19	34 22.8 N	119 26.2 W	3.6	8 km (5 mi) ESE of Carpinteria
4.2	2004/08/21	18:25:12	32 20.5 N	115 13.5 W	6.0	44 km (28 mi) SE of Calexico
5.0	2004/09/29	15:54:54	35 23.4 N	118 37.4 W	3.5	28 km (17 mi) NE of Arvin
4.2	2004/11/13	09:39:16	34 21.2 N	116 50.7 W	9.6	10 km (6 mi) N of Big Bear City
4.0	2005/01/02	12:58:48	32 20.8 N	115 13.4 W	6.0	44 km (27 mi) SE of Calexico
4.4	2005/01/06	06:35:27	34 7.5 N	117 26.3 W	4.2	2 km (1 mi) N of Fontana
4.3	2005/01/12	00:10:46	33 57.2 N	116 23.7 W	7.6	10 km (6 mi) E of Desert Hot Springs

5.2 2005/04/16 12:18:13 35 1.6 N 119 10.7 W 10.3 22 km (13 mi) W of Wheeler Ridge
4.0 2005/04/20 23:36:19 33 39.4 N 120 2.0 W 6.0 33 km (20 mi) SSE of Santa Rosa Is.
4.1 2005/05/05 19:29:09 35 1.8 N 119 10.9 W 11.6 22 km (14 mi) W of Wheeler Ridge
4.1 2005/05/20 17:39:32 33 13.4 N 116 12.3 W 15.1 11 km (7 mi) NW of Ocotillo Wells
5.2 2005/06/12 08:41:46 33 31.7 N 116 34.4 W 14.2 10 km (6 mi) ESE of Anza
4.9 2005/06/16 13:53:26 34 3.5 N 117 0.7 W 11.6 3 km (2 mi) NE of Yucaipa
4.0 2005/06/27 15:17:33 34 3.3 N 117 1.8 W 12.1 2 km (1 mi) N of Yucaipa
4.1 2005/07/24 05:59:42 33 40.4 N 119 45.7 W 6.0 44 km (27 mi) SE of Santa Rosa Is.
4.3 2005/08/05 22:40:33 36 8.4 N 118 2.7 W 0.0 14 km (8 mi) NW of Coso Junction
4.6 2005/08/31 15:47:45 33 9.9 N 115 38.1 W 4.0 1 km (0 mi) S of Obsidian Butte
4.5 2005/08/31 15:50:24 33 10.3 N 115 36.7 W 2.0 2 km (1 mi) E of Obsidian Butte
4.1 2005/08/31 16:07:16 33 10.5 N 115 37.1 W 4.6 2 km (1 mi) ENE of Obsidian Butte
4.3 2005/08/31 16:27:32 33 11.9 N 115 35.4 W 2.9 5 km (3 mi) NE of Obsidian Butte
4.5 2005/08/31 16:32:11 33 11.4 N 115 36.2 W 4.2 4 km (2 mi) NE of Obsidian Butte
4.0 2005/08/31 16:33:38 33 12.0 N 115 36.4 W 3.7 4 km (3 mi) NE of Obsidian Butte
4.4 2005/09/01 06:50:20 33 10.7 N 115 38.0 W 0.0 1 km (1 mi) NNE of Obsidian Butte
4.5 2005/09/01 18:27:18 33 10.5 N 115 37.9 W 4.9 1 km (0 mi) NE of Obsidian Butte
5.1 2005/09/01 18:27:19 33 9.6 N 115 38.2 W 9.8 1 km (1 mi) S of Obsidian Butte
4.7 2005/09/22 13:24:48 35 2.6 N 119 0.9 W 11.0 8 km (5 mi) WNW of Wheeler Ridge
4.9 2005/10/16 14:11:35 32 27.3 N 118 9.8 W 10.0 44 km (27 mi) SSE of San Clemente Is.
4.1 2005/10/17 21:08:41 34 0.9 N 116 46.5 W 16.7 10 km (6 mi) N of Cabazon
4.4 2005/10/18 00:31:03 34 0.7 N 116 46.5 W 18.6 10 km (6 mi) N of Cabazon
4.2 2005/10/19 01:51:26 32 29.8 N 118 8.7 W 10.0 41 km (25 mi) SSE of San Clemente Is.
4.1 2005/12/02 23:49:34 34 19.7 N 116 50.0 W 5.1 7 km (5 mi) NNE of Big Bear City
4.0 2006/03/28 17:36:23 35 37.3 N 117 35.3 W 8.8 7 km (4 mi) E of Ridgecrest
5.4 2006/05/23 21:20:26 32 18.4 N 115 13.7 W 6.0 47 km (29 mi) SSE of Calexico
4.2 2006/05/27 03:21:34 32 16.7 N 115 12.3 W 10.0 51 km (32 mi) SSE of Calexico
4.2 2006/05/28 00:40:17 32 14.6 N 115 8.1 W 6.0 58 km (36 mi) SE of Calexico
4.4 2006/05/28 04:55:23 32 20.8 N 115 13.1 W 6.0 44 km (27 mi) SE of Calexico
4.3 2006/06/29 17:28:06 33 14.4 N 116 2.2 W 3.6 8 km (5 mi) WSW of Salton City
4.0 2006/09/13 17:11:06 32 41.7 N 116 3.2 W 10.2 7 km (4 mi) SW of Ocotillo
4.4 2006/11/03 07:56:43 32 40.6 N 116 2.9 W 13.7 8 km (5 mi) SW of Ocotillo
4.0 2006/11/27 20:06:40 35 38.1 N 120 45.1 W 4.2 6 km (4 mi) W of Paso Robles
4.0 2006/11/29 13:10:55 32 49.2 N 115 58.3 W 3.9 10 km (6 mi) NNE of Ocotillo

The magnitude 5.4 earthquake on 2006/05/23, located 29 mi. SSE of Calexico was the largest earthquake in our coverage area during this report time period. It occurred south of the U.S./Mexico border, but was felt widely in the Yuma AZ area and in Imperial Valley. Some public reports came from San Diego and even Barstow. The peak intensity in the U.S. was MMI IV; we do not collect reports from Mexico.

Other M5+ quakes include:

<u>M5.0 on 2004/06/15, 42 mi. SE of San Clemente Island.</u>
Although quite a distance offshore, about 4 mi. from San Diego, this earthquake was one of the most widely felt during the reporting period. We received over 10,000 felt reports from 447 different zip codes, from as far away as Twentynine Palms and Ventura. Peak intensity was MMI IV, although there were no land areas closer than 42 mi. from the epicenter.

<u>M5.0 on 2004/09/29, 17 mi. NE of Arvin</u>
This earthquake occurred one day after the Mw6.0 Parkfield earthquake and may have been triggered by it. The Arvin quake was widely felt from Bishop and Madera to Yucca Valley. The peak reported intensity was MMI V.

<u>M5.2 on 2005/04/16, 13 mi. W of Wheeler Ridge</u>

This earthquake was felt from Madera to Borrego Springs, with a peak intensity of MMI IV.

M5.2 on 2005/06/12, 6 mi. ESE of Anza
Although this earthquake occurred in a fairly sparsely populated area, it was reported felt by over 29,000 people in 684 zip codes. Peak intensity was MMI VI in Anza and surrounding communities.

M5.1 on 2005/09/01, 1 mi. S of Obsidian Butte
This quake was widely felt in the Imperial Valley and San Diego County, with a few reports from Ridgecrest and Parker AZ. Peak intensity was MMI VI in nearby Calipatria.

Other widely felt earthquakes:

M4.9 on 2005/06/16, 2 mi. NE of Yucaipa; over 15,000 people in 652 zip codes reported feeling this earthquake, which occurred four days after the M5.2 Anza quake. Peak intensity was MMI VI in the epicentral area.

Processing of Backlog of SCSN Data

We have made more progress in processing earlier backlogs. Events from 1932 through 1976 now have computerized locations and magnitudes consistent with our current calibrations. All data from 1932 onward has been written to the Oracle database, although some time periods from 1977 to 1981 have not been completely processed. All of the CEDAR system data (1977 through 1980) that are readable from the tapes of that period have been translated from CEDAR format to CUSP & are being converted into the Oracle database.

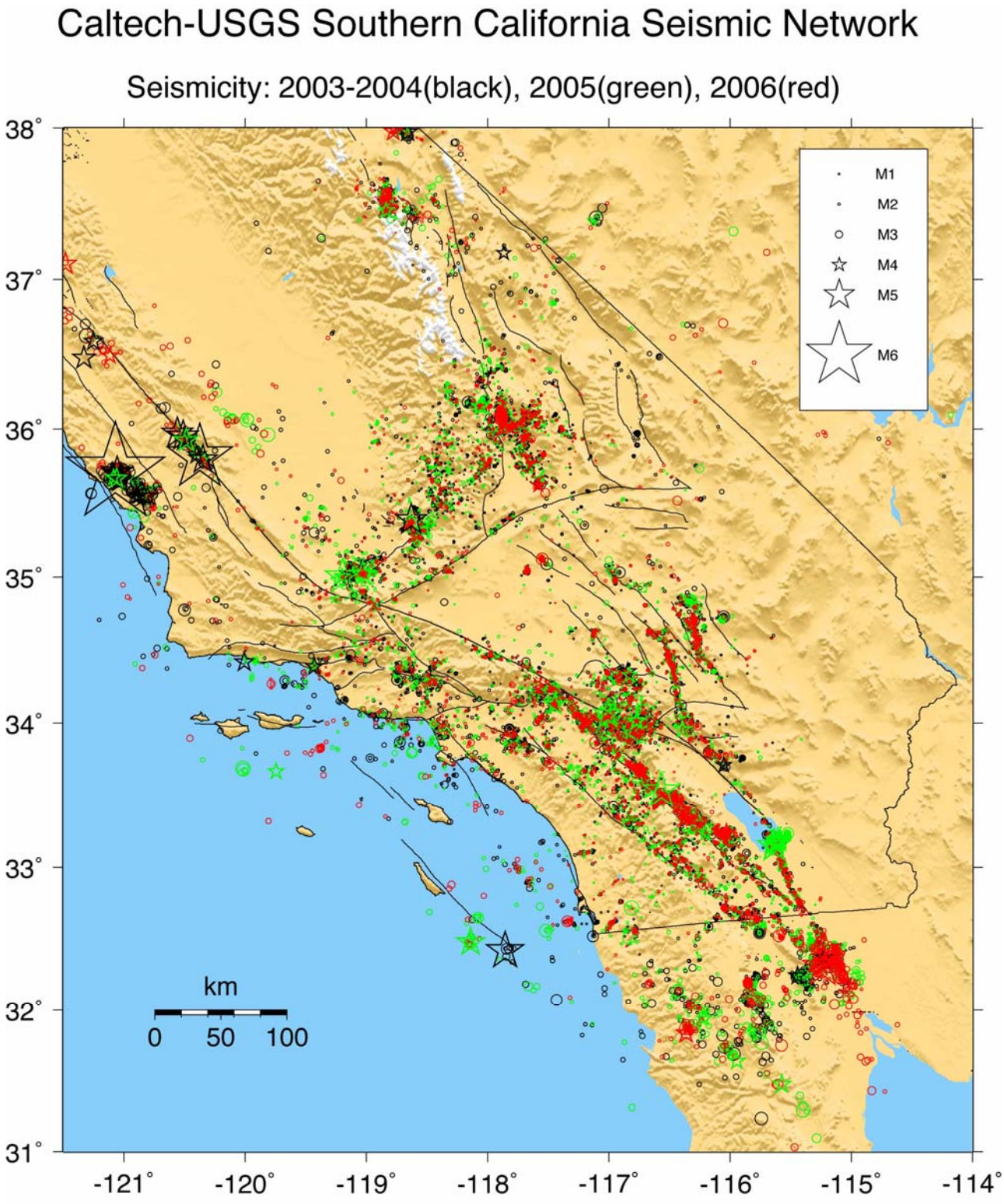


Figure 1. Southern California seismicity recorded by SCSN and archived by SCEDC: 1 Oct. 2003 to 30 Nov. 2006.

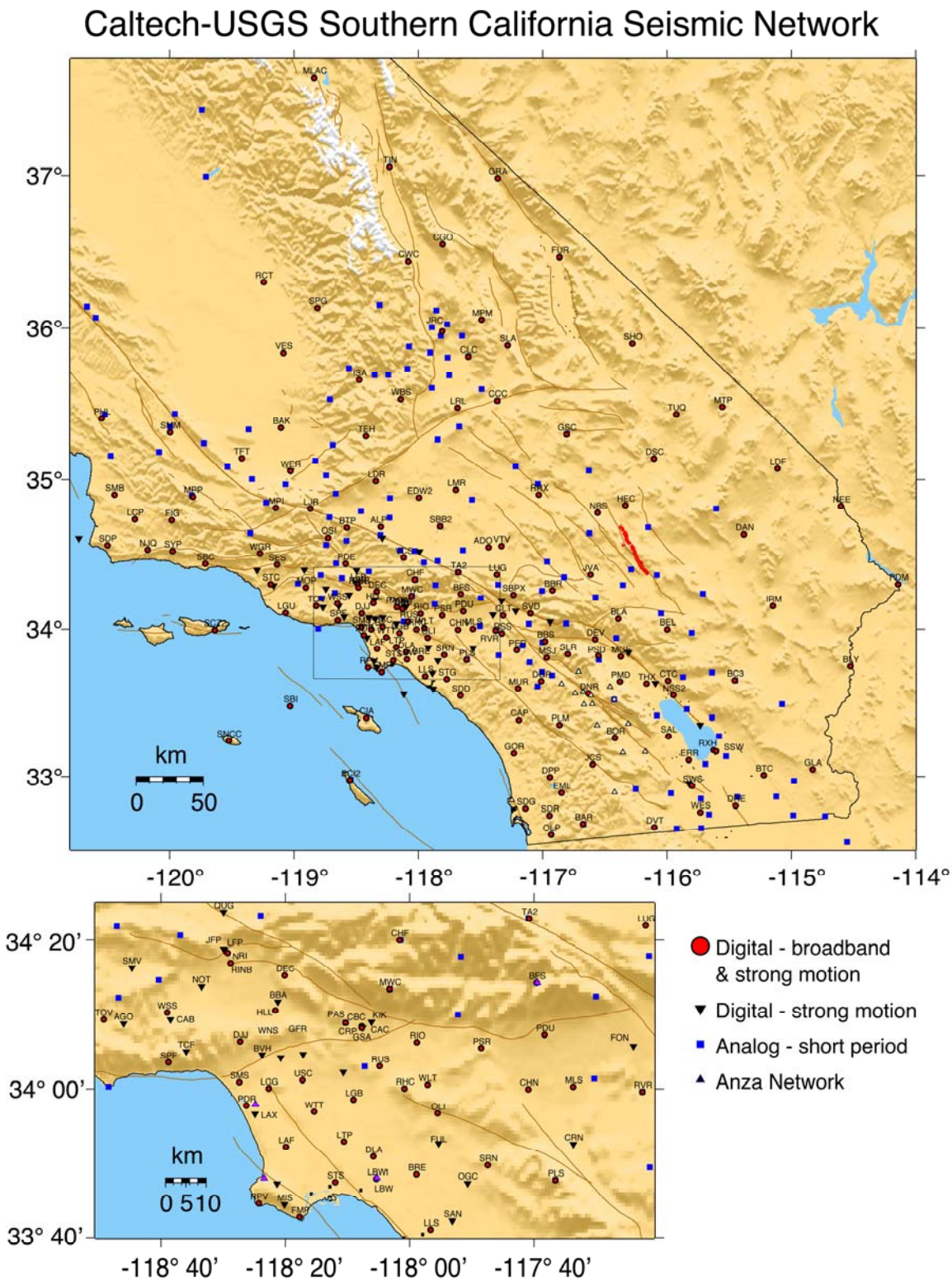


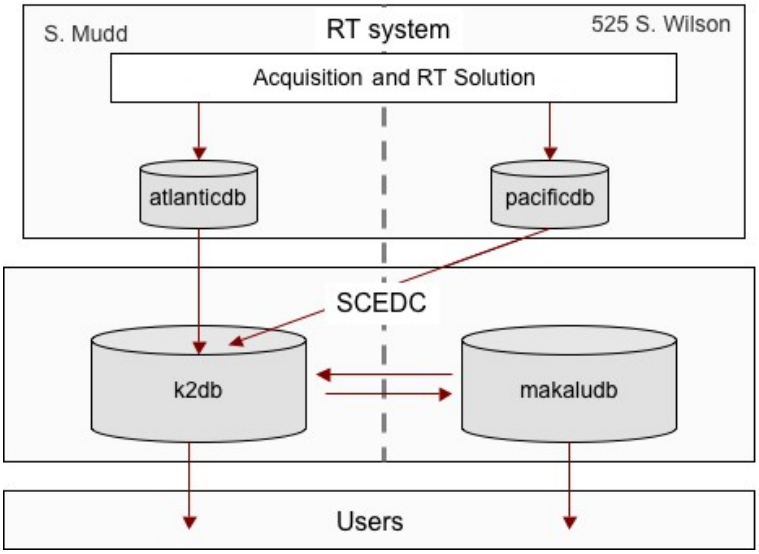
Figure 2. Southern California seismic stations recorded and operated by the SCSN. Not shown are an additional 50 stations recorded by SCSN but operated by other agencies.

The Southern California Earthquake Data Center

southern california earthquake data center

This center has significantly increased the use of the data from SCSN/CISN for scientific research. The SCEDC currently has 6.7 Tbytes of waveform storage in the form of 315,000 station-days of continuous recordings and 56.5 million triggered waveform segments. In the past year, we have shipped in excess of two Tbytes of waveform data. These data, including, 74 years of catalog, 75 years of parametric data, and 25 years of digital seismograms are available online through the Internet or client and web-services in near real-time.

- The Data Center distributes parametric information from an Oracle database; waveform data in mSEED from Linux storage devices.
- The SCEDC currently archives nearly 3,000 data channels from 375 stations, processing and archiving an average of 15,000 earthquakes each year.
- The SCSN data acquisition system (Real-Time system) generates a location and magnitude within approximately 2-3 minutes of an event, and 4 seconds later pushes the result to the Data Center. Data is available at that point, and post-processing can be performed.



Data Processing and Production of Earthquake Information

In the last year, the SCEDC:

- exported 29.3 million waveforms (2,085 GB) via STP
  = 55.7 waveforms every minute.
- had 1,656,047 requests for catalog information
- archived 19,140 new events
- archived 10,032,952 seismograms.
- 2006 Q3 (June 1 to Sept. 30):
  - waveforms: 1,634,989
  - waveforms/day: 17,966.82
  - gigabytes: 268.26
  - MB/day: 3,020.95
  - kb/sec: 35.77

Statewide Network Integration

- Chaired the schema-change CISN working group, which evaluates requests to change the NCEDC/TriNet database schemas. The working group has been evaluating and implementing medium- and low-priority requests for changes to the NCEDC/TriNet Parametric Information schema.
- Met with the NCEDC for a 1-day meeting in Berkeley to develop a plan for access to common, complete statewide metadata. SCEDC presented a plan for an Integrated Station Information System whereby each Data Center could maintain its current metadata system i.e., the NCEDC would continue with their HT/IR schema and the SCEDC would continue to develop our Station Information System (SIS). It was determined that more guidance was required from the PMG.
- Contacted the NCEDC and ANZA network to propose the creation a web source where all CISN partners' dataless volumes would be available from a single source on the CISN website. This source would not replace the current locations for NCEDC/SCEDC/ANZA volumes, but would be a central repository where all of the CISN partner networks could publish their dataless SEED volumes. The NCEDC and ANZA agreed to publish their metadata at this location when it was created on the cisn.org site.
- Set up accounts for Hamid Haddadi, Tony Shakal and Carl Petersen from the CGS for the Station Information System (SIS) development database. CGS is interested in exploring the next steps required to make it usable at the CGS, like porting our Oracle database schema into a MySQL database (free) for CGS use.

Database

2006 Hardware/Oracle Upgrade

- Oracle's Real Application Clusters (RAC) allows database servers to be built across multiple low-cost computers to serve as a single, highly available and highly-scalable database processing system.
- Oracle 10g is the first database to be "grid-enabled" i.e., the database runs across a clustered group of servers that can be managed as a single entity.
- An Oracle RAC database appears as a single standard Oracle database to end users and all standard backup and recovery operations work transparently with Oracle RAC.

- The SCEDC worked with technical representatives from Oracle to evaluate opportunities for the Data Center to upgrade to Oracle 10g. Coordinated with Caltech's Oracle liaison to verify that Caltech has a site license for Real Application Clusters (RAC) and Data Guard. We also worked with sales and technical representatives from Dell to determine the hardware necessary to create new, robust hardware architecture for the Data Center to run Oracle 10g's RAC and Data Guard.
- Designed a new architecture for the Data Center to utilize Oracle 10g and purchased hardware. We are currently undergoing installation and testing for a 2007 production roll-out.

Information Distribution and Product Development

- Continuous Data: SCSN BH_ channels have been upgraded to 40 sps to conform with USArray station standard. All 40 sps, 1 sps and 0.1 sps waveform data is archived continuously and available via STP
- Continued working with ISTI to 1) Move the DHI interface from the server "k2" to the server "logan" computer. 2) Provide logging of user requests, so we can track use and report to funding agencies 3) Interface DHI to SIS as its metadata source.

- Converted 1990-1999 RTP TERRAscope data from its original format to mSEED, matched the TERRAscope events with modern events and integrated the waveforms into the current events' holdings by modern EVID.
- Completed development of software that uses QDM catalog information to archive teleseism data. The archiving software currently in production updates the parametric data in the SCEDC database if updates are made in the QDM catalog and makes requests for the appropriate waveform time windows.
- After extensive Data Center webserver testing, the performance of the server under heavy traffic needed improvement. We upgraded the webserver from Red Hat Enterprise Linux 2.1 AS to Red Hat Enterprise Linux 4 AS. The upgrade improves memory usage and takes advantages of the CPU's hyperthreading capabilities.
- Upgraded the wavearchiver software that transfers waveforms from the real-time servers to the Data Center servers. The new version is multithreaded and runs more efficiently. Following this upgrade, we installed another upgraded waveform archiver that utilizes percent retrieved and will continue to request missing waveform packets if threshold completion level is not achieved.
- Reworked and optimized procedure for uploading "sync files" to syncronize our data holdings with IRIS. The web interface is available at http://www.data.scec.org/sync/sync.html.
- Developed scripts and procedures for removing duplicate and erroneous waveform entries from the SCEDC database as a result of having multiple waveform archivers running.
- Developed software for archiving special data that does not arrive through our normal procedures.
- Generated quality control reports of parametric data back to 01/01/2000 for:
    - SCSN Reporting area events with event types other than 'le,' 'qb,' 'sn' or 'ts'
    - 're' events in the SC reporting area
    - 'le' events outside of the SC reporting area
    - Events with depth > 25 km (excluding teleseisms)
    - Daily breakdown of the number of events captured vs. events timed
- Deployed a new short-term backup system for Data Center computers using hard drive-based backup software.
- Upgraded Google Map catalog output to version 2.0
- Developed and implemented a new plan for waveform storage with a single server managing several RAID units – will save on initial purchase price and administration overhead.
- Worked with data analysts to clarify what events should be deleted and which events should be virtually deleted (e.g., selectflag=1; bogusflag=1).
- Sent IRIS/USArray regenerated dataless SEED volumes that contain full site descriptions, including city name, state and country in 60 character site descriptor blockette.

Website

- Developed a PHP web application at www.data.scec.org/recenteqs/relative2me/ that allows a user to set her own location as latitude/longitude coordinates and view how far recent earthquakes are from her.
- Developed interactive PHP pages for displaying network, station, channel, and hardware information from the SIS at http://www.data.scec.org/stations/views/sta_hardware.php. Using the new pages, website visitors can search for their desired information, sort the results, and link to related information directly from the search results.
- Tested performance of the Data Center website under heavy traffic. At its peak the web server handled over 45,000 hits a minute, but the success rate was less than optimal. Since adjusting server settings did not result in any consistent or significant improvement, the plan is to test

again after upgrading the web server to Red Hat Enterprise Linux AS 4 and the 2.6 kernel in the beginning of quarter 2.

- Installed new web statistics software on the web server that will allow for more flexible processing and more customizable reports.
- Updated PHP pages for displaying continuous data availability so that they now display up-to-date availability in an automated manner and include an option for displaying network-wide data availability by year: http://www.data.scec.org/about/cont_wf_station.php

STP

STP is based on the "Google Model" of data-on-demand.
A test of STP retrieval of 10 events ranging in magnitude from 2.0-6.7 :

  - < 2 minutes (1:58)
  - 5985 waveforms
  - 556.78 MB = 0.212 sec/MB

- Development is underway on two STP projects:
  - Full SEED volumes
  - New .pdf user manual for all versions (Unix, Linux, Web, Mac and Windows)

- Modified STP's phase command to accommodate 5 character station names.
- Released a location-code aware version of STP.
- Added a radius search feature for the trig command in STP. e.g.,
  STP> trig -net CI -radius 50 14189140
  will download waveforms from stations within a 50-km radius around the location of 14189140.
- Moved all of SCEDC's computing facilities to a new power source to balance the power load in the telemetry room. All machines needed to be powered down and the RAID "thomas" suffered a disk failure and needed to be completely rebuilt and the data copied over from its mirror "sally."
- Developed an rsync system to immediately copy dataless SEED volumes upon creation via the SIS stored procedure from k2 to the ftp server at:
  http://www.data.scec.org/ftp/stations/seed/

Station Information System (SIS)

- All SCSN dataless SEED volumes are produced from the SIS – this process takes < 5 seconds where it used to take a full workday.
- Historic data population i.e., knowing only that a station existed, but not the instrumentation, is nearly complete. The next phase will research station instrument history to provide a more complete view of waveform data.
- Developed a plan to move all Data Center and post-processing activities to use metadata from the SIS. RTS use will follow – bottleneck is current use of nominal gains and need for new station corrections to accommodate the actual, calculated gains from the SIS.
- The SCEDC prepared a report comparing the gains that are currently being used by the real-time and post processing systems and the calculated gains from SIS for the same channel. Presented it to the SCSN group for further guidance.
- All data from broadband stations have been migrated to SIS database.
- New updates to data are done through SIS GUI (graphical user interface) in parallel with the legacy database.
- Developed PHP scripts for checking the completeness and consistency of historical information in the SIS.

- Worked extensively with the historic station archives to populate the SIS with the remaining online and much of the historic station information to provide users with improved access to complete and accurate station metadata.
- Created a page for tracking changes requested for the SIS at http://www.data.scec.org/stations/SIS/ongoing_development.html. Solicited for change requests, functionality that users like to see, improvements, or additions to the SIS GUI

Catalogs

- Added Google Earth and Google Map support to the catalog searches at http://www.data.scec.org/catalog_search/date_mag_loc.php. Users can download KML files containing the output of searches by event ID, polygon, radius, and date, magnitude, and location. When the KML files are opened in Google Earth, users can zoom in on locations of events down to a few meters above the ground and manipulate surrounding 3D-rendered terrain. If Google Map output is selected as the output format, the result of the catalog search is plotted on a Google Map.
- Developed a PHP web application at www.data.scec.org/recenteqs/relative2me/ that allows a user to set her own location as latitude/longitude coordinates and view how far recent earthquakes are from her.
- In response to internal and external users, produced a new catalog output to show the SCSN catalog with remarks. Users select "SCSN with comments" from the "Output format" drop-down list on the catalog search at http://www.data.scec.org/catalog_search/date_mag_loc.php.

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For up-to-date earthquake information, see our home page:
http://pasadena.wr.usgs.gov/scsn.html
http://www.scsn.org
http://www.cisn.org

This Cooperative Agreement provides partial support for the joint USGS-Caltech monitoring of earthquakes in southern California. We recorded and analyzed data from more than 35,942 local earthquakes during the reporting period (October 1, 2003 through November 30, 2006). We also maintain field equipment located at remote sites and equipment and software at the central site in Pasadena. The primary product is a database of earthquake data, which includes a joint USGS-Caltech catalog of earthquakes in the southern California region. We also provide rapid response to emergency services, the media and public inquiries about earthquakes, and archive earthquake data at the Southern California Earthquake Data Center. For information about data access, please contact visit: http://www.data.scec.org or http://www.scsn.org.

NON-TECHNICAL SUMMARY