Southern California Earthquake Data Center (SCEDC) 2015 Operations

Report for SCEC Award #15061

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I. Project Overview

A. Abstract

In the box below, describe the project objectives, methodology, and results obtained and their significance. If this work is a continuation of a multi-year SCEC-funded project, please include major research findings for all previous years in the abstract. (Maximum 250 words.)

Currently the SCEDC archives continuous and triggered data from nearly 9983 data channels from 507 SCSN recorded stations. On average, the SCEDC archives data from 16,000 earthquakes each year. SCSN/SCEDC operations generate products such as event catalogs, waveform archives, moment tensor solutions, ShakeMaps, ShakeMovies, and Recent Earthquake Maps. These products are vital to emergency response and earthquake research. Advances in information technology and earth science research have produced intriguing possibilities for the future of seismic data archival. With the advent of real-time GPS, the seismological research community is able to view a new bandwidth of data. Cloud computing will change how computational resources are managed.

The Southern California Earthquake Data Center is leading efforts in exploring how these developments can further its core mission of archival and distribution of seismic data and products for earthquake research.

B. SCEC Annual Science Highlights

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C. Exemplary Figure (see next page)

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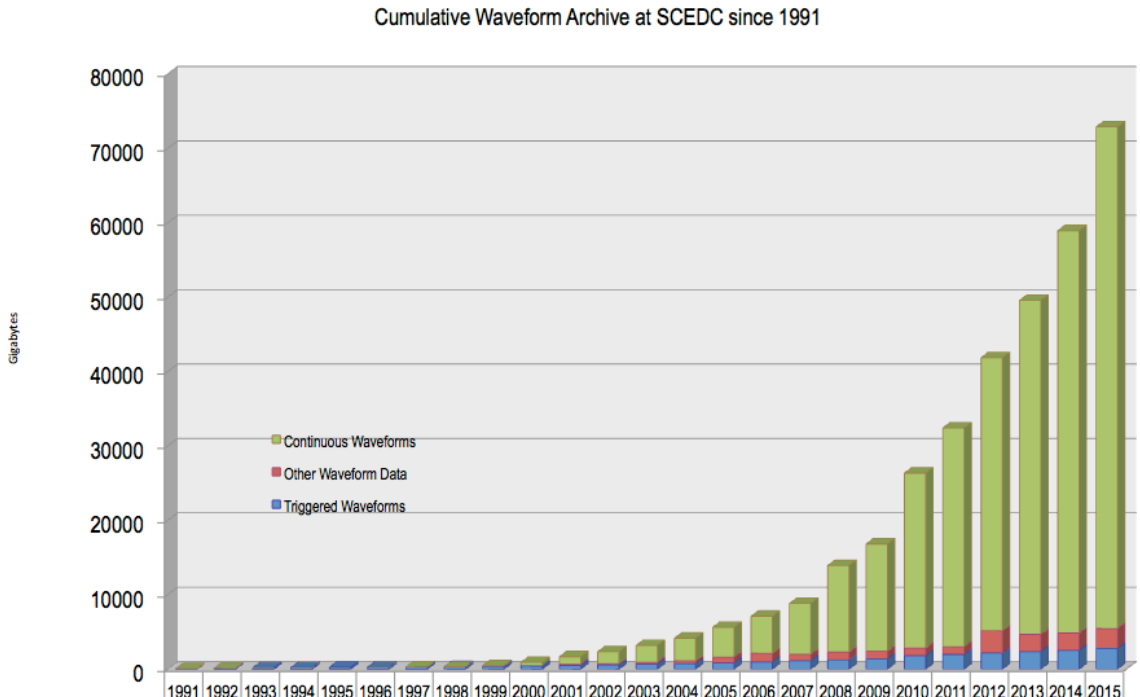
D. SCEC Science Priorities

1c, 2a, 4c

E. Intellectual Merit

The Data Center is a central resource of SCEC and continues to be an integral part of the Center. In 2015, the SCEDC continued to contribute to the SCEC scientific community by providing online access to a stable and permanent archive of seismic waveforms and earthquake parametric data. The seismological data archive held at the SCEDC has contributed significantly to the publication of many scientific papers pertinent to the region, most of which have SCEC publication numbers. The Caltech/USGS catalog archived by the SCEDC is the most complete archive of seismic data for any region in the United States.



	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Continuous Waveforms	0	0	0	0	0	0	0	0	102	485	1004	1596	2273	3012	4007	4969	6849	1163	1439	2351	2941	3671	4489	5409	6745
Other Waveform Data											168	188	272	412	792	1185	854	1035	1035	1035	1035	3000	2326	2326	2669
Triggered Waveforms	76	156	184	230	260	286	311	337	392	438	511	578	659	746	839	975	1142	1281	1409	1817	1994	2184	2371	2543	2799

Figure 1. Data volumes stored at the SCEDC for seismological research.

F. Broader Impacts

How does the project contribute to the broader impacts of SCEC as a whole? *For example: How well has the activity promoted or supported teaching, training, and learning at your institution or across SCEC? If your project included a SCEC intern, what was his/her contribution? How has your project broadened the participation of underrepresented groups? To what extent has the project enhanced the infrastructure for research and education (e.g., facilities, instrumentation, networks, and partnerships)? What are some possible benefits of the activity to society?*

The SCEDC has allowed the data to be distributed to a much broader community of scientists, engineers, technologists, and educators than was previously feasible. The electronic distribution of data allows researchers in the world-wide scientific community to analyze the seismic data collected and archived in southern California and contribute their results to the SCEC community.

II. Technical Report

The technical report should describe the project objectives, methodology, and results obtained and their significance. If this work is a continuation of a multi-year SCEC-funded project, please include major research findings for all previous years in the report. (Maximum 5 pages, 1-3 figures with captions, references and publications do not count against limit.)

1. Added 78 million hours of continuous seismic data for 507 stations and parametric and waveform data for 14,792 local events and 224 teleseismic earthquakes.

2. The Data Center continues its implementation of the Continuous Wave Buffer (CWB) to manage its waveform archive. This software was developed and currently in use at the National Earthquake Information Center. In 2015 we have migrated a number of our post processing applications to use it for waveform retrieval and have moved our past holdings into the system. We anticipate to complete transition in 2016. The new system will not only simplify and streamline waveform archival, it will allow users access to continuous data within minutes of real time.

3. In compliance with QuakeML and ANSS standards, the SCEDC now reports all event depths relative to the WGS84 ellipsoid. Older versions of the catalog which had depths referenced to the model depth datum will be available in the SCEDC repository on GitHub. *https://github/scedc*

4. In an effort to assist researchers accessing catalogs from multiple seismic networks, the SCEDC has entered its earthquake parametric catalog into the ANSS Common Catalog (ComCat). Origin, phase, and magnitude information have been loaded. We will be submitting historical moment tensors and focal mechanisms in 2016. The SCSN is submitting all these products for current events into ComCat.

5. In response to feedback from the SCEC community, the SCEDC began exploring how to assist SCEC researchers in accessing and distributing synthetic seismograms. In 2015 the SCEDC constructed a synthetic dataset registry *http://service.scedc.caltech.edu/research-tools/synthetics/synthetics.php* and met with users at the 2015 SCEC conference for feedback. The SCEDC also sought feedback from IRIS and studied its efforts in managing synthetic data in 2015.

6. As part of a NASA/AIST project in collaboration with JPL and SIO, the SCEDC is archiving seismic and geodetic displacement waveforms and accelerometer waveforms produced by the California Real Time Network (CRTN http://sopac.ucsd.edu/projects/realtime). These waveforms are 1 sps real time GPS solutions and 100 Hz accelerometer data, which will eventually be used to produce velocity solutions. They are archived at regular intervals and converted into miniseed format by SCEDC. These channels are archived at the SCEDC as miniSEED waveforms, and now available to the user community through an STP client (*http://scedc.caltech.edu/research-tools/AIST/AISTstp.html*). This allows seismologists access to real time GPS displacements in the same manner they access traditional seismic data.

7. The SCEDC completed a search interface for its focal mechanism catalog. The SCEDC now hosts a focal mechanism catalog from 1981 to present and a double difference catalog from 1981 to 2014.

8. The SCEDC continued to make improvements to the Station Information System (SIS) with the Southern California Seismic Network (SCSN). We have made substantial progress in storing network information such as telemetry equipment and layout. To date the “first hop” and the “last hop” of the data path is tracked. Efforts continue for loading data paths for the remaining stations and developing code to distribute this information. This information will help researchers in Earthquake Early Warning studies understand the role of telemetry in delays retrieving data from network as well as network detection capability, which will be useful in CSEP testing.

9. The SCEDC continued to host the developmental database SCEC WGCEP group for

UCERF3.

2015 Stats

In 2015, the SCEDC archived:

- 14,792 local events
- 20,495,404 triggered waveforms
- 27,394,671 continuous waveforms
- 660,622 arrivals
- 3,258,179 amplitudes

Magnitude	Number of local events (le):
-1-0	247
0-1	8,172
1-2	5,474
2-3	801
3-4	87
4-5	11
5-6	0

2015 event type break down:

# events:	Event type
14,792	le (local event)
762	qb (quarry blast)
256	re (regional event)
224	ts (teleseism)
2	ex (explosion)
16,036	Total

Data transferred via STP in 2015:

	waveforms	waveforms/day	gigabytes	megabytes/day	kilobytes/sec
2014 Q4	67,210,236	730,546	5,608	62,423	740
2015 Q1	59,491,708	661,091	4,317	49,126	582
2015 Q2	68,091,993	748,264	7,586	85,358	1012
2015 Q3	19,974,089	217,110	3,677	40,925	485
2015 Q4	22,367,900	243,130	2,877	32,018	379

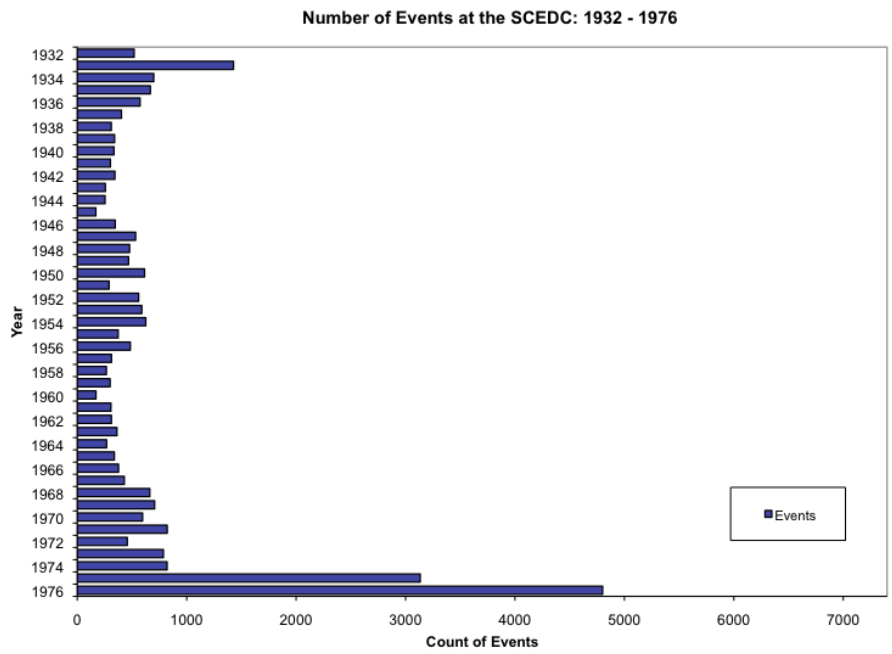
Website Outreach

The SCEDC maintains a web site (scedc.caltech.edu) that has resources for researchers access to the waveform archive, event catalogs, and station metadata, as well as general information about recent and past significant earthquakes that are of interest to the public.

2015 Web Statistics (scedc.caltech.edu)

Quarter	Hits	Page views
2014, Q4	42,551,321	5,479,792
2015, Q1	25,783,427	4,784,978
2015, Q2	23,683,537	4,249,805
2015, Q3	38,438,113	6,324,121
2015, Q4*	NA	NA

* Due to a misconfiguration in our logging code we were not able to retrieve statistics for this quarter before they expired from the AWS s3 bucket. We have taken steps to ensure this does not happen in the future.



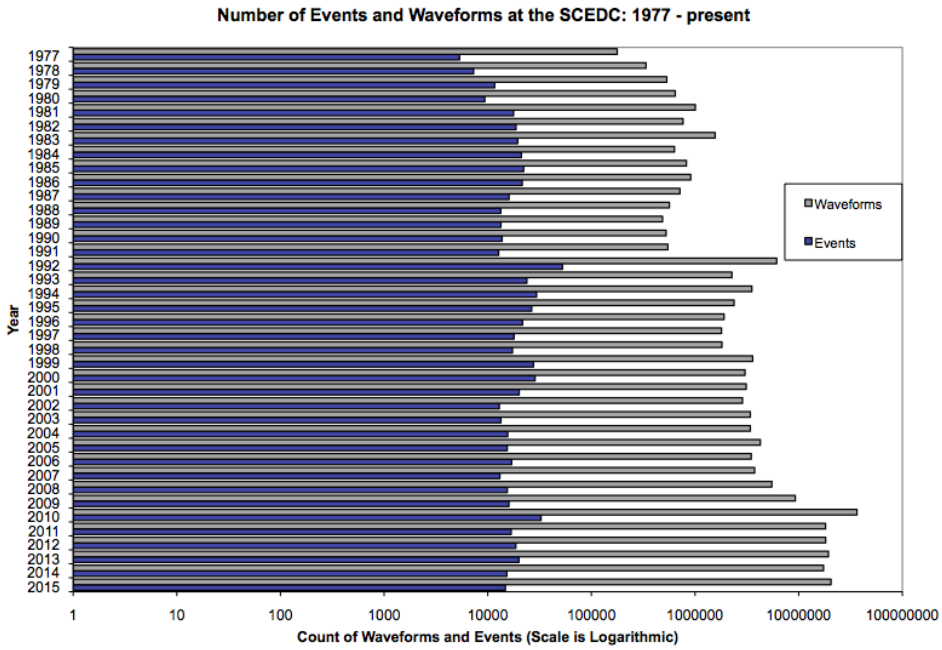


Figure 2. Number of events and event associated waveforms in the archive over time