



Seismological Laboratory, California Institute of Technology Pasadena, CA 91125

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southern california

earthquake data center



# ObsPy, Web Services, and Big Data – Using the Southern California Earthquake Data Center (SCEDC) and Southern California Seismic Network (SCSN) for Earthquake Research

Ellen Yu, Prabha Acharya, Aparna Bhaskaran, Shang-Lin Chen, Jennifer Andrews, Valerie Thomas, Egill Hauksson and Robert Clayton

The Southern California Seismic Network is one of the largest regional seismic networks in the United States. The Southern California Earthquake Data Center is the SCSN data archive. SCSN/SCEDC operations generate products vital to emergency response and earthquake research such as event catalogs, focal mechanisms, moment tensors, ShakeMaps, ShakeMovies, and Recent Earthquake Maps.

## Waveforms

Currently the SCEDC archives continuous and triggered seismic waveforms from nearly 10578 data channels from 528 SCSN recorded stations. The archive provides a valuable resource for research topics benefiting from large datasets such as template matching, noise correlation, and earthquake detection algorithms to name a few.

### Continuous Waveforms in Near Real Time

The SCEDC now uses the Continuous Wave Buffer (CWB) archival system resulting in availability within seconds of real time. The CWB was developed by the National Earthquake Information Center.

### Automated Gap Retrieval

To ensure maximum data completeness, the SCEDC has automated a process which detects gaps, and then makes requests to sites with Q330 loggers and balers, retrieves the data, and then back fills the gaps. Work is being done to add Basalt logger retrieval as well. This will benefit studies sensitive to data completeness.

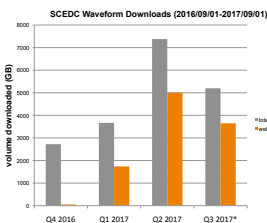
### SCEDC Fetch Scripts

https://service.scedc.caltech.edu

Do you love not having to download a client but don't want to type long URLs? The SCEDC now has scripts that use the IRIS web service fetch scripts to facilitate batch retrieval. They are available for Dataselect, Event and Station web services.

## Web Services Increasing in Popularity

Figure 1. The plot on the right shows how the number of waveform downloads done via web services has increased as a percentage of total downloads in the past year. The SCEDC strives to maintain standards used by seismic data centers. We will continue to improve performance and robustness of these services as we expect usage will only increase in the 'Big Data' era.



## Earthquake Catalogs

The SCEDC catalog of earthquakes detected by SCSN spans 1932-present. On average SCSN processes on average 16,000 events a year.

### Access Alternate Catalogs via FDSN Web Services

The SCEDC also distributes Southern California earthquake catalogs where location, magnitude, and mechanisms are derived from different methods than routine SCSN processing. The standard SCSN catalog does not account for local variations in the seismic velocity structure, which limits the accuracy of its event locations. In addition to the STP client, the SCEDC has now made its alternate location catalogs available via FDSN web services at https://service.scedc.caltech.edu/fdsnws/event/1/

Use the web form or command line methods. Includes a screenshot of a web form for 'Southern California Relocated Seismicity 1981-2016' and a terminal window showing command line usage for the obspy-client.

Figure 2. Waveform relocated southern California seismicity from 1981 to June 2016 (black color) and 3D model only relocated events (tan color). Red stars are events of M>=5.5. Data recorded by SCSN and distributed by SCEDC.

### Improved Polygon Search

Screenshot of the polygon search interface showing a map of California with a search polygon and a legend for magnitude ranges. Includes text explaining how users can set a polygon and refine results.

Figure 3. Screenshot of polygon search interface https://service.scedc.caltech.edu/eq-catalogs/poly.php

## Metadata

The SCEDC releases updates to metadata for stations operated by SCSN within 24 hours of the field operation in FDSN StationXML and dataless SEED formats.

### New Web Services: RESP and SACPZ

https://service.scedc.caltech.edu/scedcws/sacpz/1/ https://service.scedc.caltech.edu/scedcws/resp/1/

The SCEDC now offers web services that serve out instrument response in SACPZ and the SEED RESP formats.

### ObsPy Preferred Method for Web Service Access

https://docs.obspy.org

To access SCEDC web services by ObsPy:

```
from obspy.clients.fdsn import Client
Client = Client("SCEDC")
```

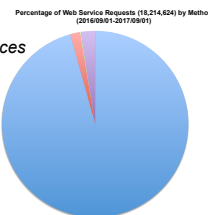


Figure 4. This chart shows the ObsPy framework is the dominant method for users accessing SCEDC web services. The SCEDC continues to work towards the goal of making as many functionalities in the STP-client available in ObsPy as possible.

## Cloud Computing

Historically, one of the greatest challenges in planning our infrastructure is being able to distribute information immediately after a felt event, where demand, although short in duration, is several magnitudes higher than average. To address this problem, the SCEDC has moved portions of its website that experience high demand to Amazon S3 web services. A comparison of SCEDC website response for an event prior to the cloud migration (El Mayor Cucapah, Mw 7.2 2010) and after migration (Borrego Springs, Mw 5.4 2016) is shown in the figure 5. As a result we are able to serve much higher traffic loads than our legacy system. The SCEDC will continue to explore ways to use cloud computing to fulfill its mission.

### SCEDC/SCSN Web Response Time

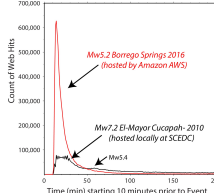


Figure 5. Plot of SCEDC web response for the 2010 Mw 7.2 El Mayor Cucapah event (black) and the 2016 Mw 5.4 Borrego Springs event (red)

## Acknowledgements

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## Citing the Data

Please cite SCEDC doi:10.7909/C3WD3xH1 and SCSN doi:10.7914/SN/CI when using SCSN data downloaded from the SCEDC