

Regional Seismic Networks: Official Catalogs and Data Access

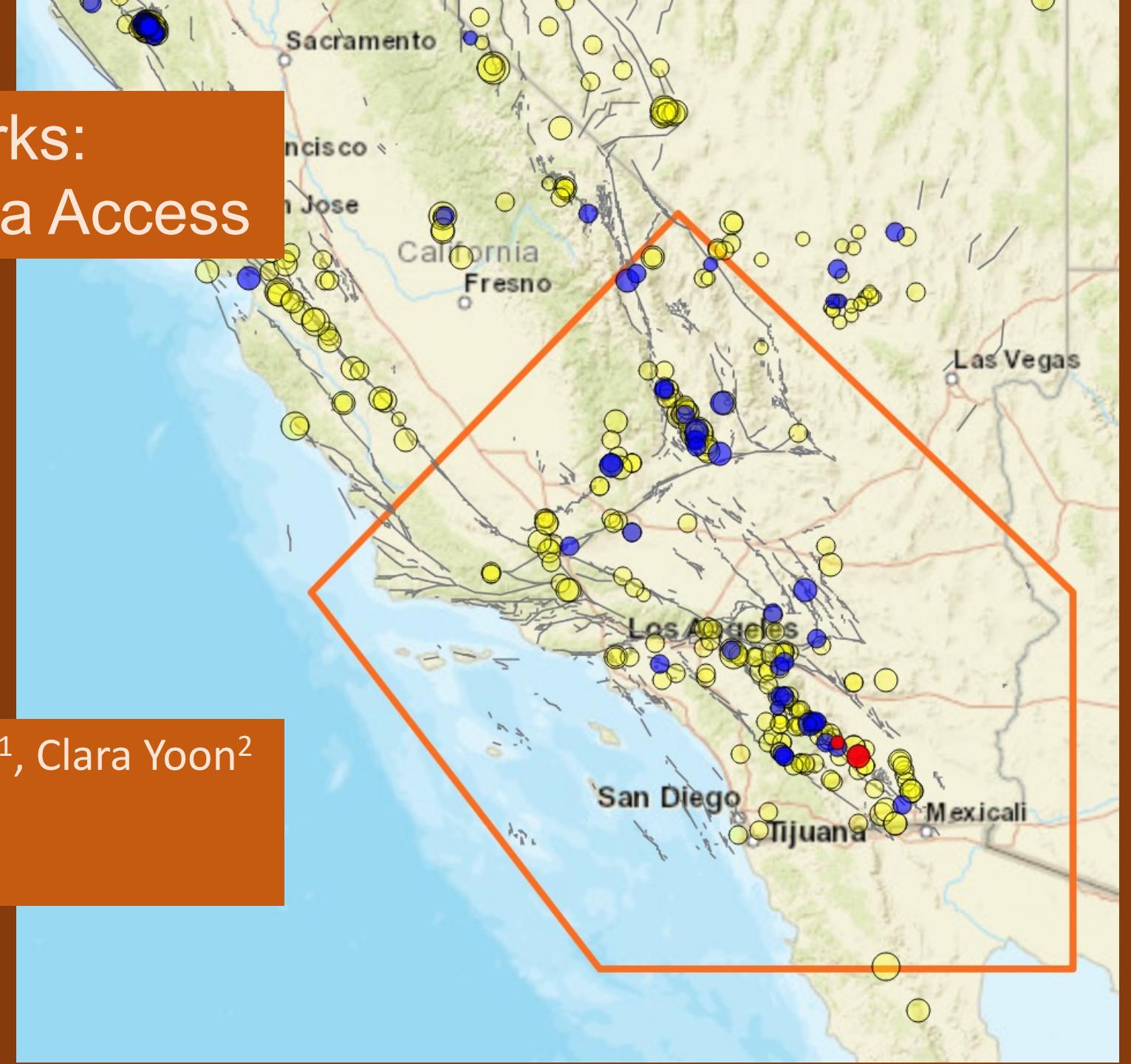
Instructors: Ellen Yu¹, Gabrielle Tepp¹, Clara Yoon²

¹ Caltech, Southern California Seismic Network

² USGS Pasadena



Caltech



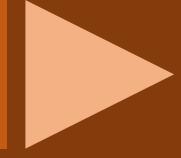
What We Will Cover

Who Produces Reference Catalogs in the US?

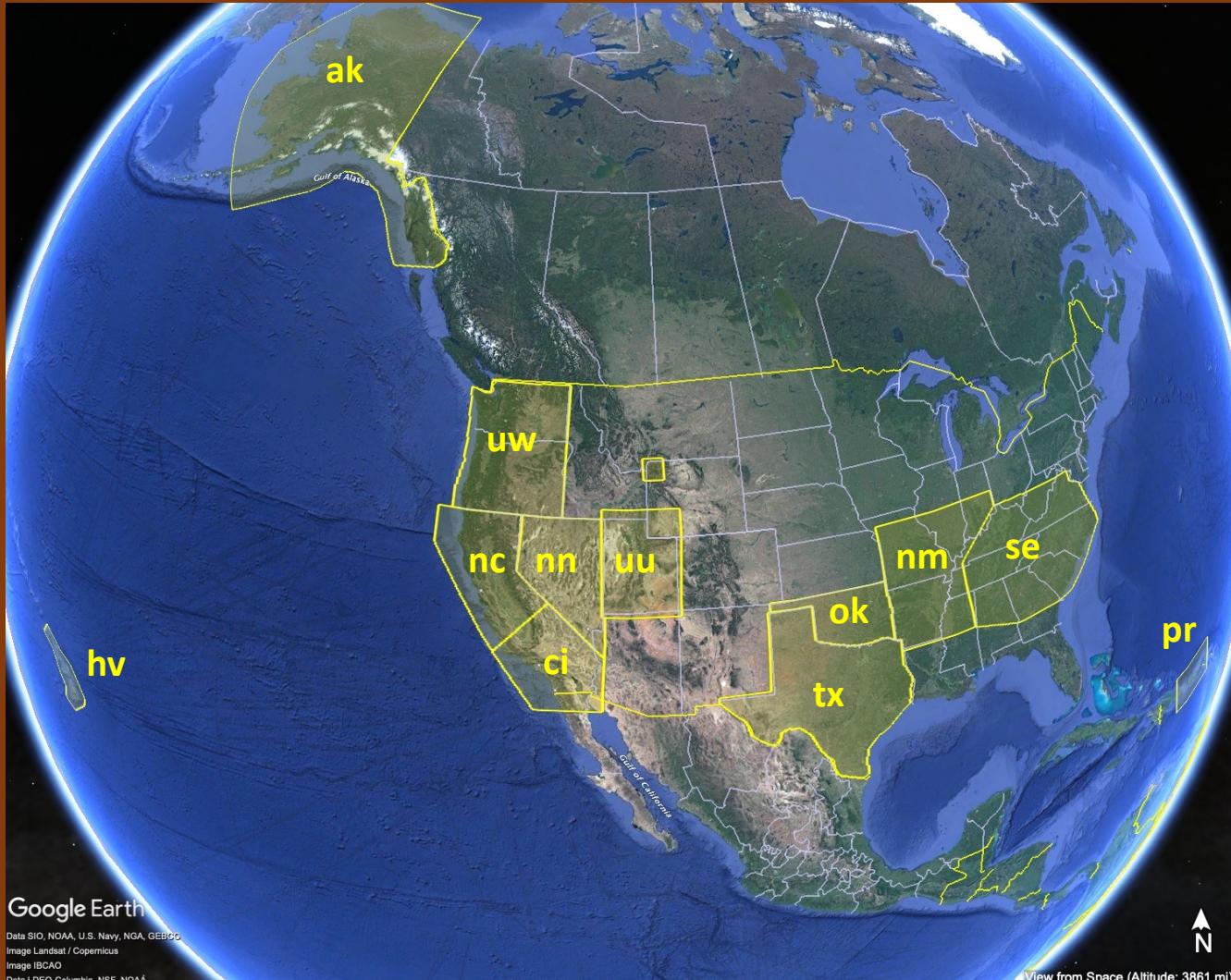
How Are Catalogs Produced? What Data is Collected?

How Can I Access Catalogs and Source Data?

US Regional Seismic Networks



Advanced National Seismic System:



- Group of 12 US **regional seismic networks** (RSNs)
 - Headed by USGS
 - Part of NEHRP (*National Earthquake Hazards Reduction Program*)
- What it entails:
 - > Meet certain operational & data standards, so the catalog is high-quality
 - > Contribute **authoritative** earthquake information in their region to ComCat (common catalog)
 - > Share resources & collaborate with other RSNs

Example: Southern California Seismic Network

Southern California Seismic Network

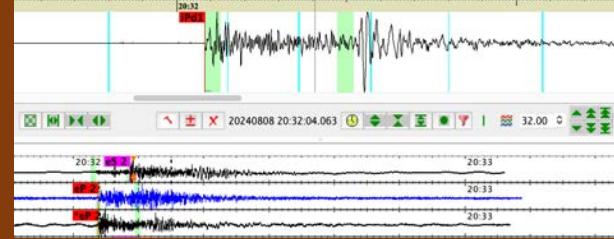


Network Operations



- Seismic station installation and maintenance
- Telemetry
- Networking & Security
- Servers & real-time systems

Data Analysis & Seismology



- Event analysis
- Data quality checks
- Real-time system maintenance & development
- Earthquake response*
- Social media & outreach*

So. Cal. Earthquake Data Center (SCEDC)

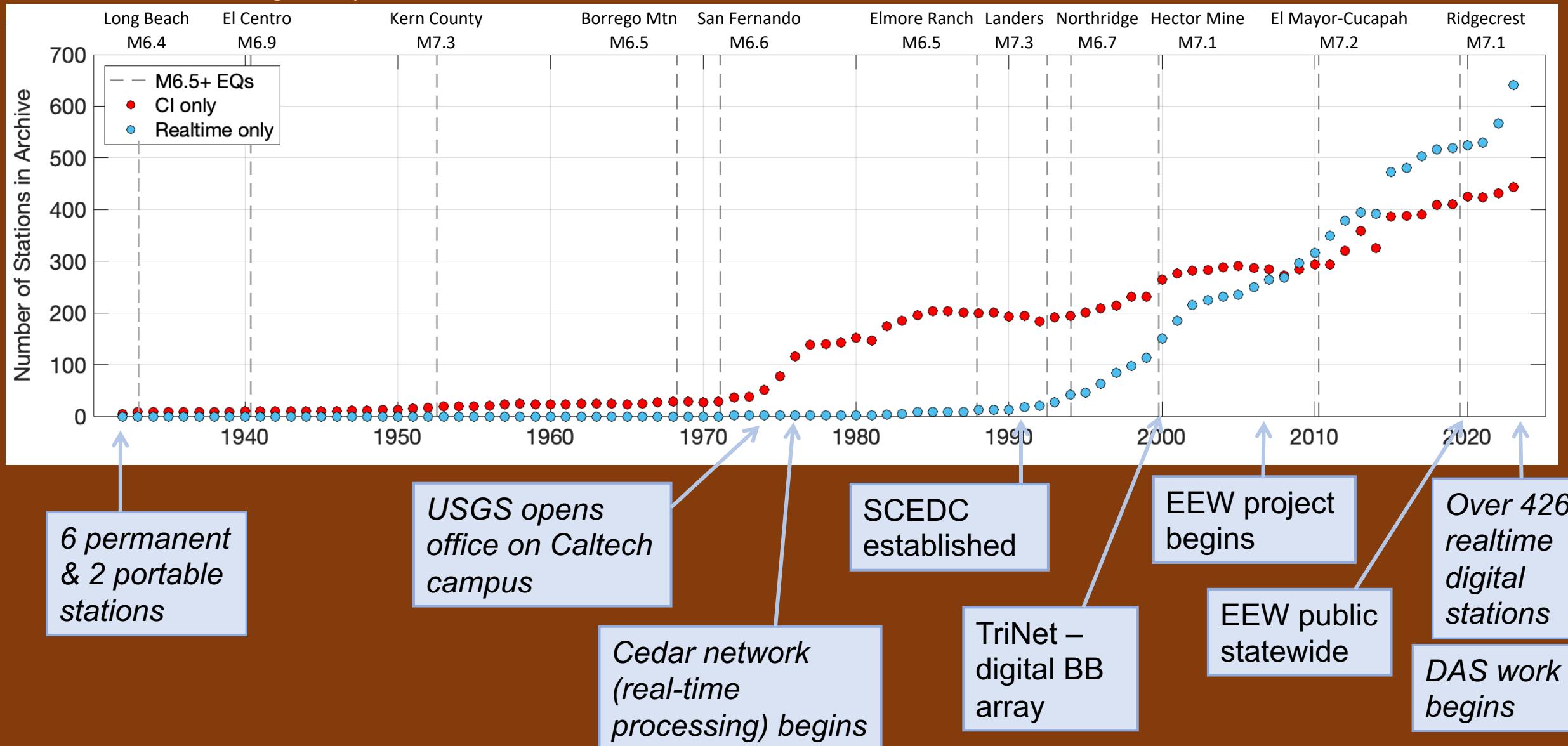
A screenshot of the SCEDC website. The header reads "SCEDC Southern California Earthquake Data Center". Below the header, there's a search bar titled "Earthquake Catalogs" with the sub-instruction "SCSN Catalog Search (1932-Present)". The main content area contains links for "Home", "Cite the SCEDC", "Recent Earthquakes", "Earthquake Info", "EQ Catalogs", "Access Data", "FAQ", and "About". There's also a note about the catalog's history and a search form for "Search by: Location, Mag, and Time", "Event ID", "Polygon", "Radius", "Multi-Mags", "Moment Tensors", and "Focal Mechanisms".

- Waveform & event data archival
- Software development (real-time systems + others)
- Data quality & system checks

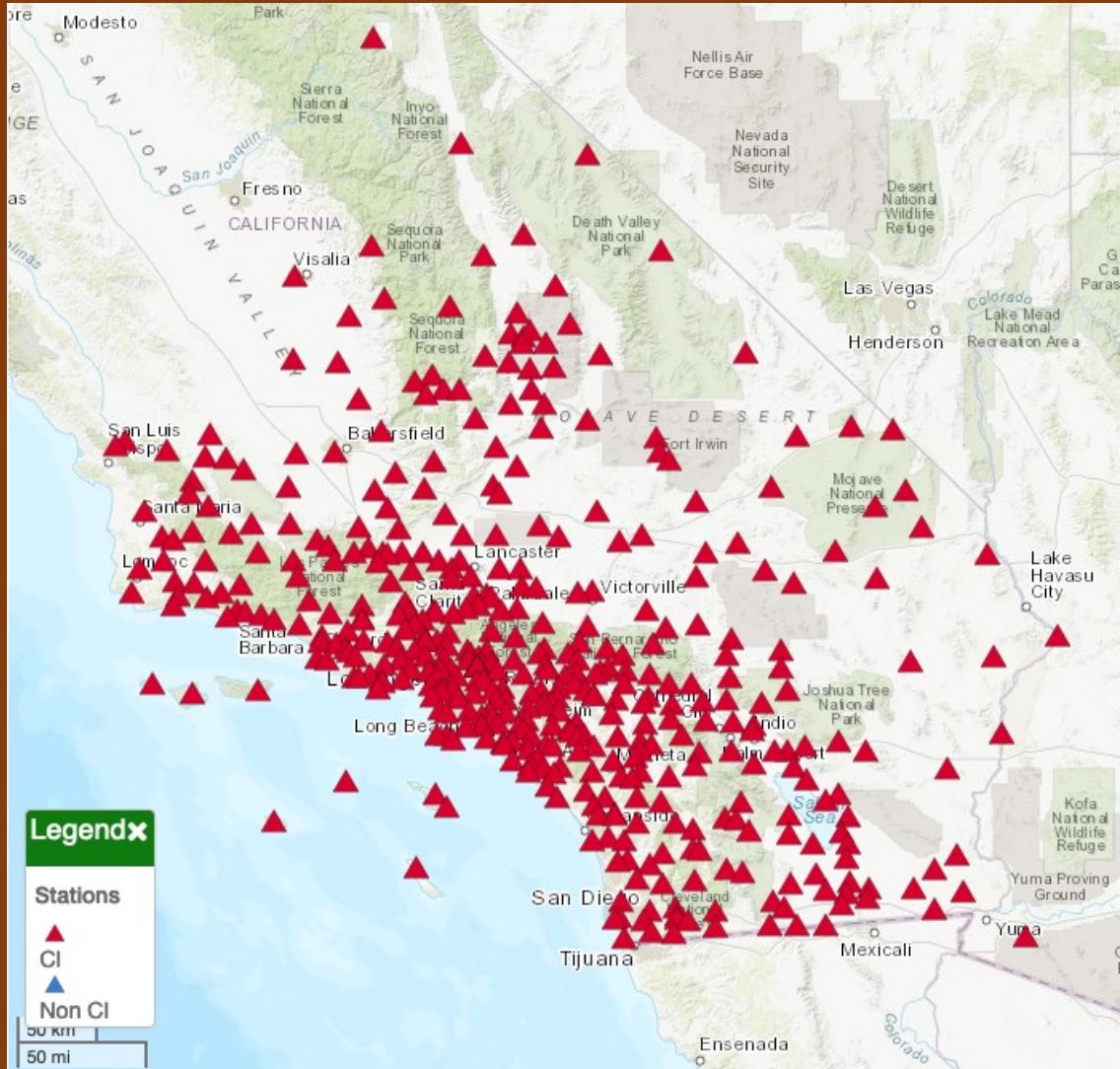
+ ShakeAlert EEW

SoCal Earthquakes and Monitoring History

Stations listed active during entire year

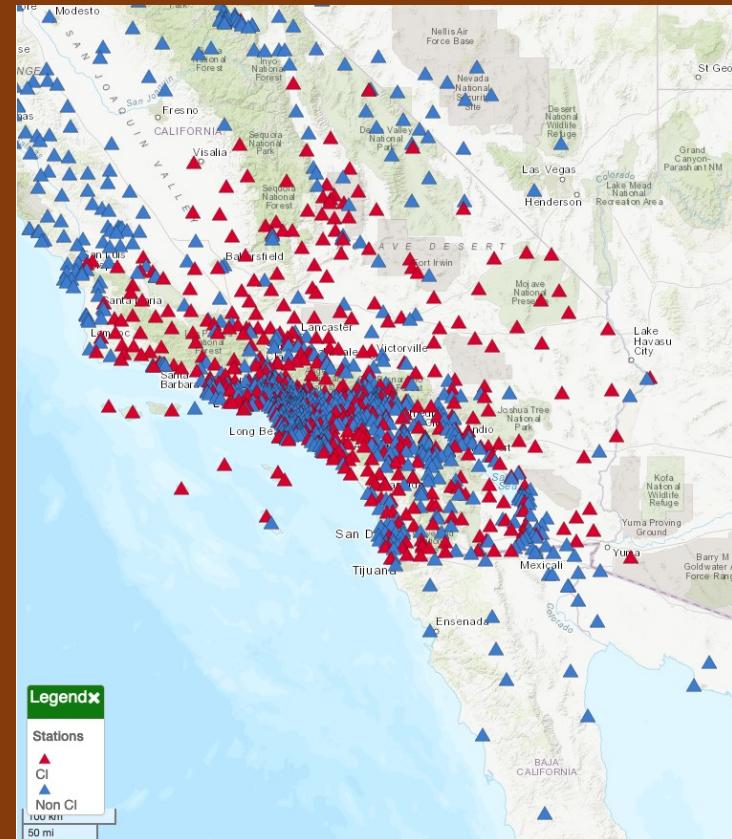


Seismic Network



- ~662 stations used
 - 438 CI stations
 - 224 imported from other networks
- CI Stations
 - 312: broad-band & strong motion
 - 43: strong motion & vertical short-period
 - 83: strong motion only

* Stations not always available



* As of spring 2024

Citing SCSN/SCEDC Data & Services

Can also find here:

<https://www.scsn.org/>

- > Seismologists' Tools
- > Acknowledgment Policy

For DOIs of other networks:

<https://www.fdsn.org/networks/>

Cite the SCSN:

“California Institute of Technology (Caltech) (1926): Southern California Seismic Network. International Federation of Digital Seismograph Networks. Other/Seismic Network. [doi:10.7914/SN/CI](https://doi.org/10.7914/SN/CI)”

Acknowledge the SCSN:

“Data were provided by the Caltech/USGS Southern California Seismic Network (SCSN), [doi:10.7914/SN/CI](https://doi.org/10.7914/SN/CI), operated by the Caltech Seismological Laboratory and USGS, which is archived at the [Southern California Earthquake Data Center](#) (SCEDC), [doi:10.7909/C3WD3xH1](https://doi.org/10.7909/C3WD3xH1)”

Cite the SCEDC:

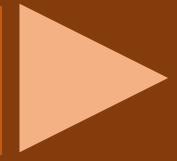
“SCEDC (2013): Southern California Earthquake Center. Caltech. Dataset. [doi:10.7909/C3WD3xH1](https://doi.org/10.7909/C3WD3xH1)”

Acknowledge the SCEDC:

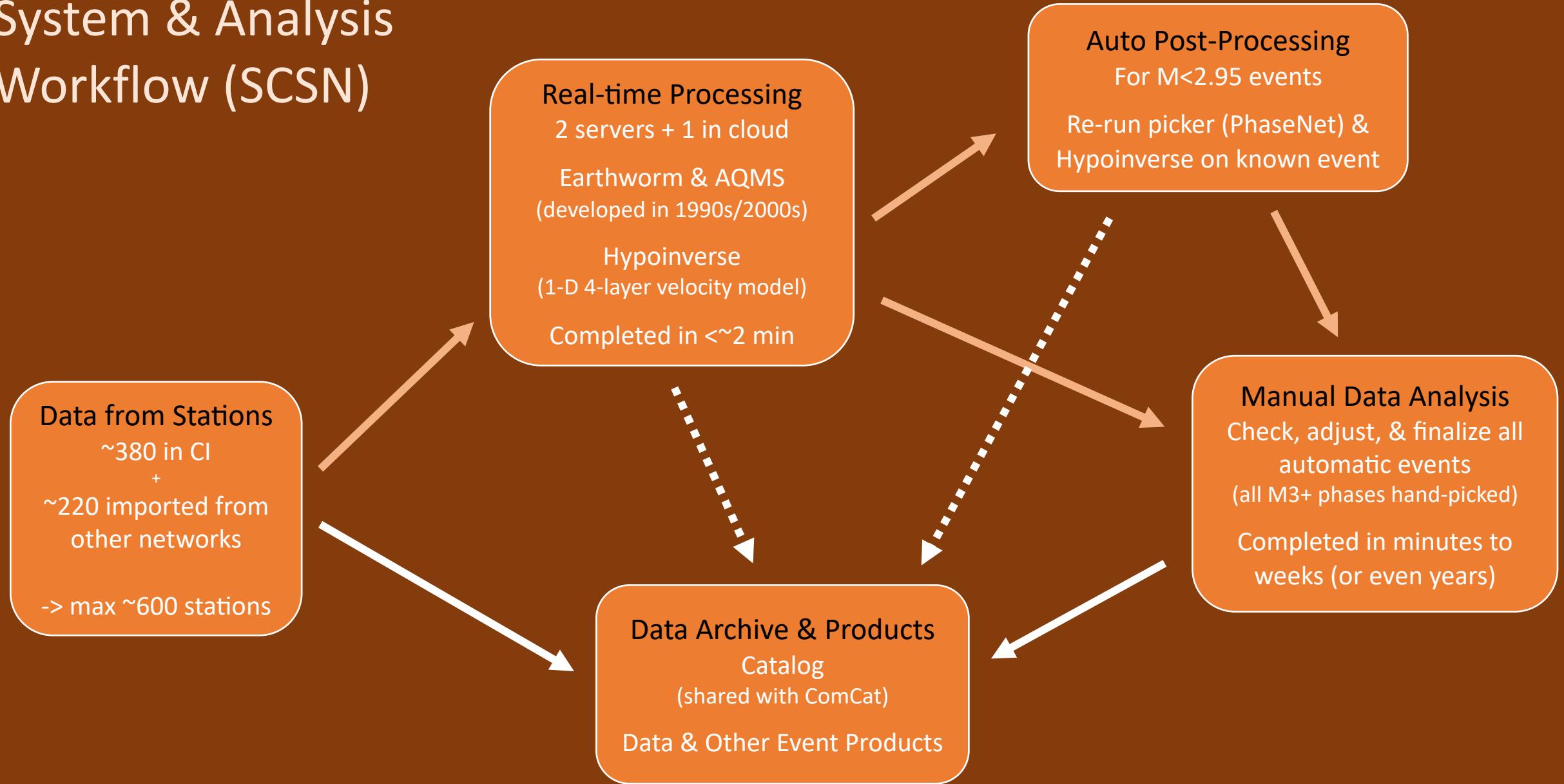
“Waveform data, metadata, or data products were accessed through the [Southern California Earthquake Data Center](#) (SCEDC), [doi:10.7909/C3WD3xH1](https://doi.org/10.7909/C3WD3xH1)”
“The SCEDC and SCSN are funded through U.S. Geological Survey Grant G10AP00091, and the Southern California Earthquake Center, which is funded by NSF Cooperative Agreement EAR-0529922 and USGS Cooperative Agreement 07HQAG0008.”

Please insert the preceding sentences into your publication acknowledgments.

EQ Monitoring & Catalog Data



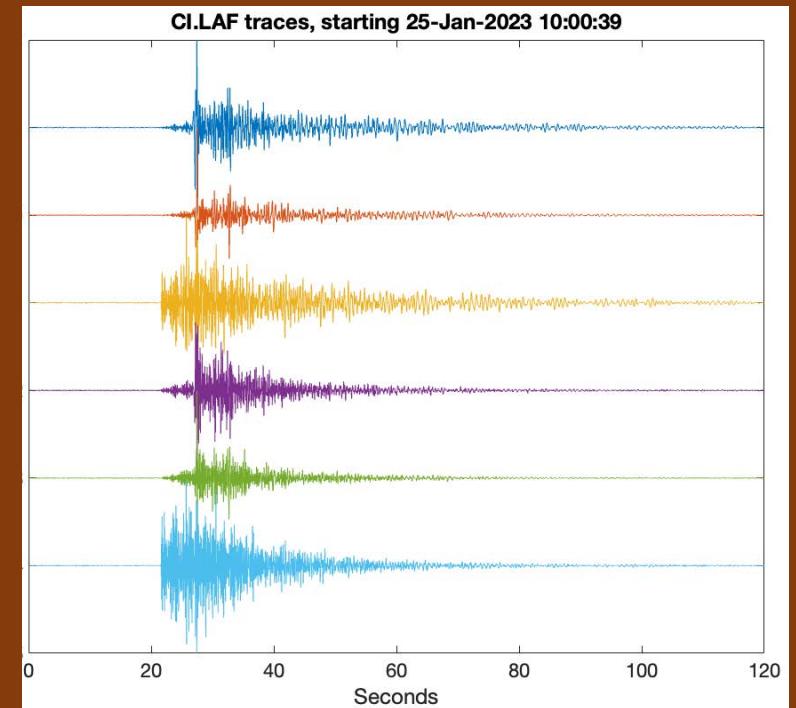
Current Real-time System & Analysis Workflow (SCSN)



Waveforms

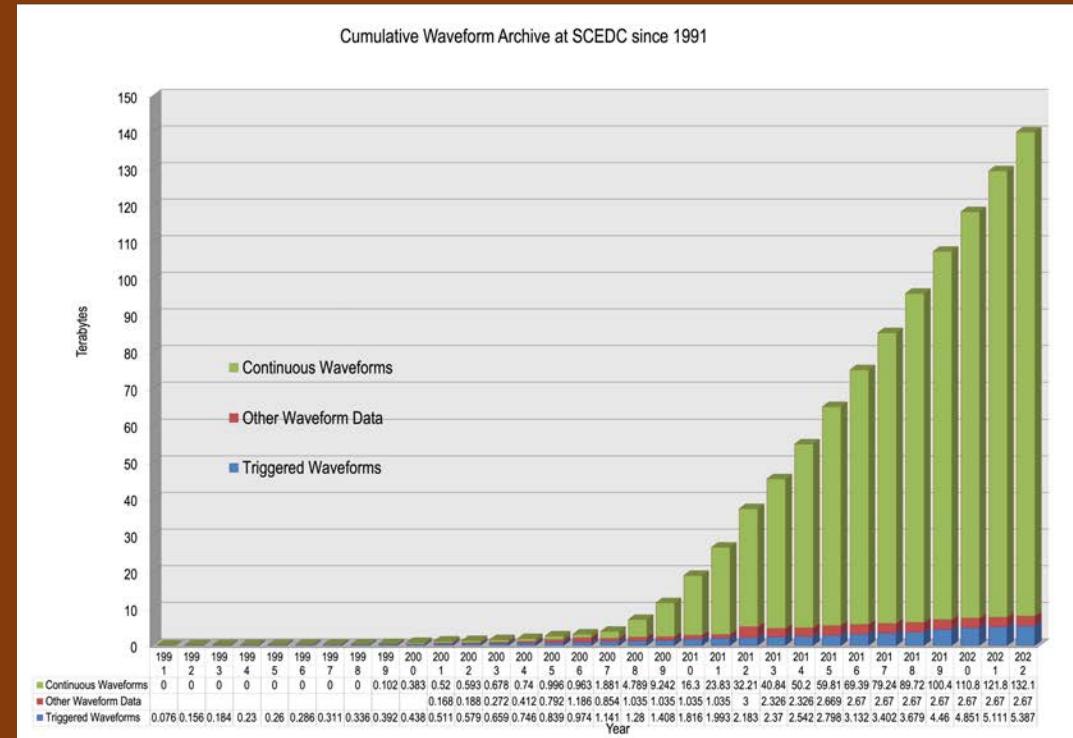
- Collected in real-time
 - CI network code (SCSN)
 - continuous data
 - stations not always available/running
 - data completeness is variable
 - buffers can fill in data up to ~1 week - ~1 month
- Data types (SCSN)
 - Strong motion: most common sensor in network
 - sampled at 100 sps
 - Broad-band: second most common
 - sampled at 40 & 100 sps
 - Short-period: few remaining, more common in past
 - sampled at 100 sps

* Some networks may have other data types (e.g., GNSS, infrasound)

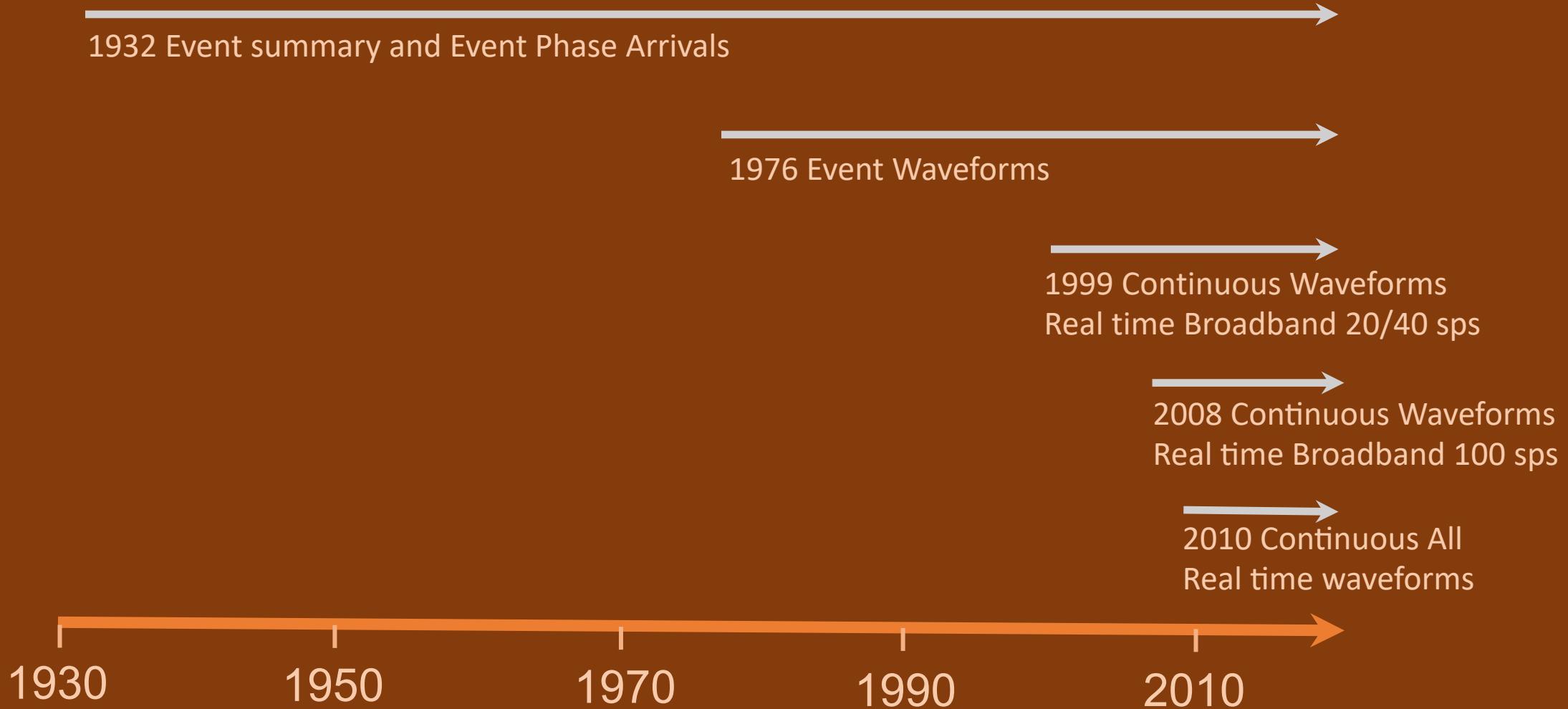


Waveforms - Archival

- Archived at SCEDC (subset of this data is at Earthscope)
 - miniSEED is our native archival format
 - An automated process detects gaps and tries to contact the digitizer to fill them in
 - Data for some stations are triggered only (i.e., only event waveforms)
 - Typically non-CI stations (e.g., NP, CE)
 - No other processing done
 - ~33 GB/day -> 12TB/yr
 - Over 280 TB distributed in 2023: 23+ bytes distributed for every byte recorded

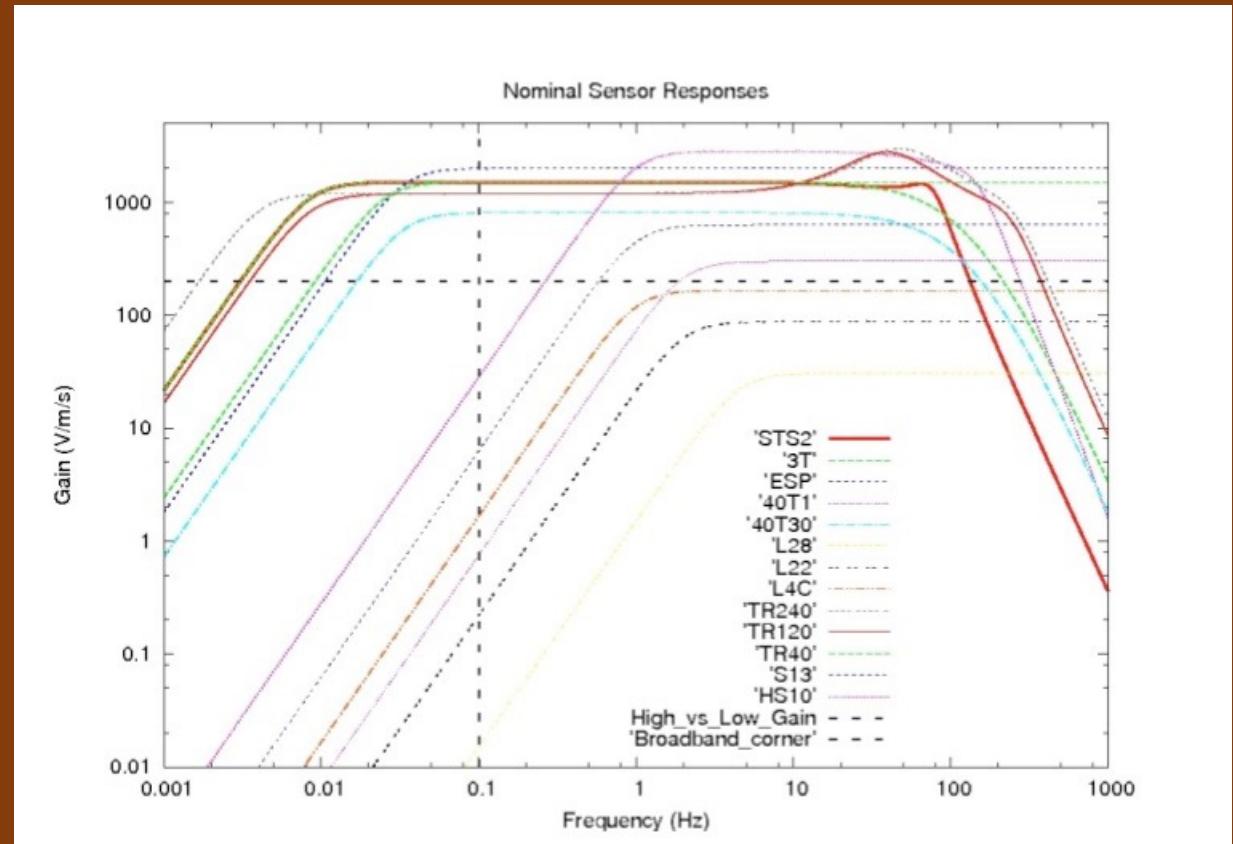


SCEDC/SCSN Archival Policy Over Time



Station Metadata

- FDSN* StationXML, dataless SEED, one line summary formats
- Most broadband sites use nominal response from Nominal Response Library
- Quality control
 - ensure correct format and internally consistent
 - passes the IRIS/EarthScope validator
 - flag any change of response for channels contributing to early warning systems



From Passcal Instrument Center

FDSN* = International Federation
of Digital Seismograph Networks



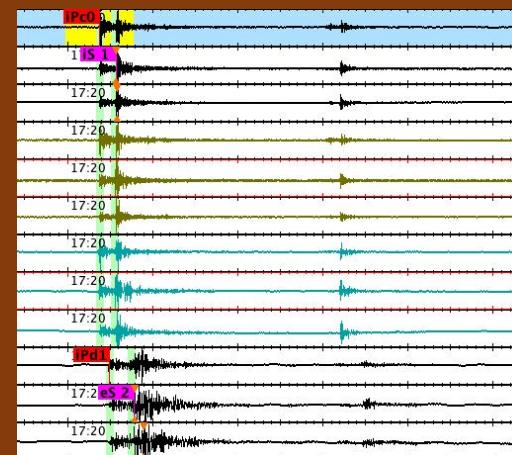
<https://www.fdsn.org/>

Most Common seismic channel names
HH – 100 sps, broadband
HN – 100 sps strong motion
EH – 100 sps short period
BH – 40 sps broadband
LH – 1 sps broadband

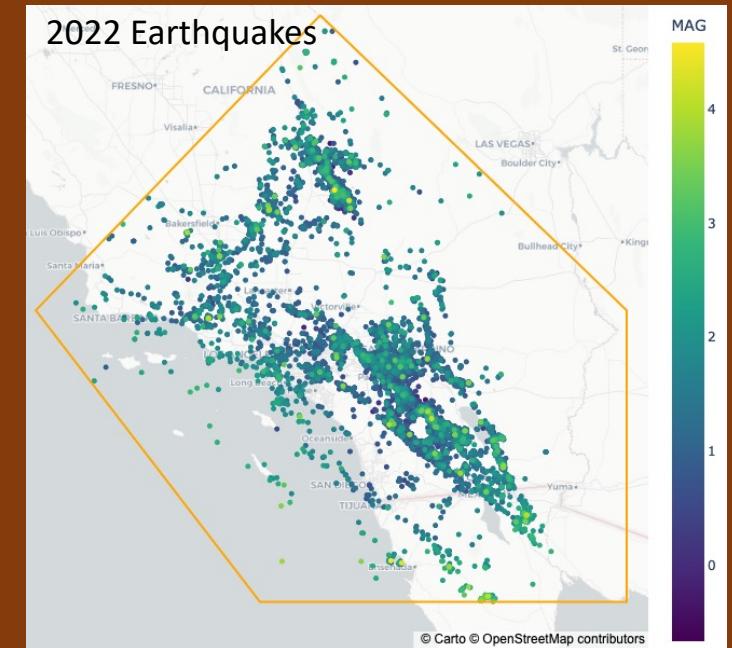
Earthquake Catalog

- Mostly consists of events found with STA/LTA
 - full network & subnet triggers (i.e., collections of nearby unassociated picks)
 - analysts can manually add events (generally by “cloning” other events in window)
 - All events are reviewed by analysts
 - not regularly reviewed outside work hours or during holiday breaks
 - M2.5+ prioritized
 - note: this may change in the future
 - Note: Different networks may have different procedures!
 - Example: see R. Hartog talk, 2:30p 4/15

STA/LTA
event “clone”



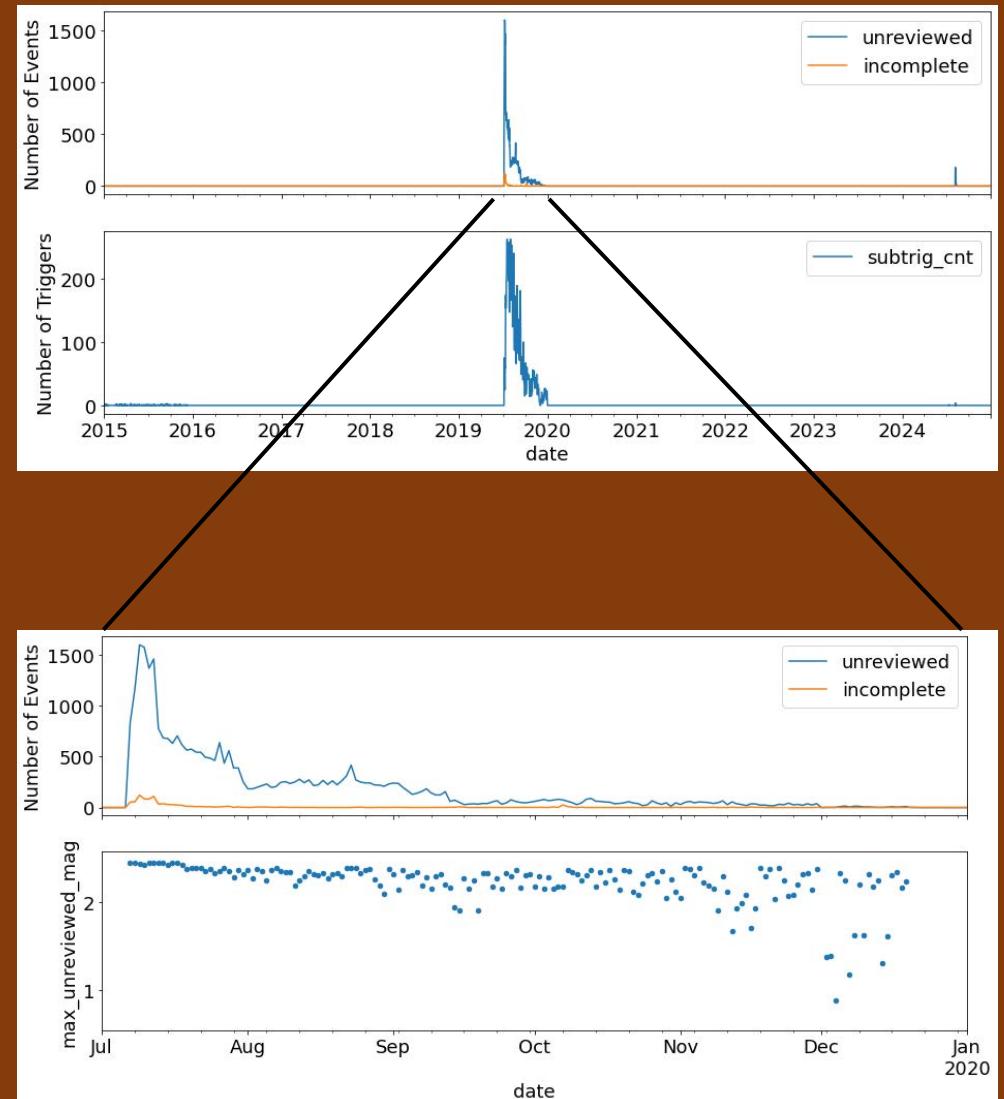
2022 Earthquake



Earthquake Catalog

- Full catalog goes back to 1932
 - “modern” catalog starts around 1990s/2000s
 - multiple catalog transitions
 - 961,000+ events
 - For more info, check out Poster #32 on 4/15!
- Incomplete: July – December 2019
 - Ridgecrest sequence approx. complete to M2.5
 - July 4-6 fully reviewed
 - current focus is to finish late 2019
 - review status files available from SCEDC:
 - https://service.scedc.caltech.edu/ftp/catalogs/catalog_status/
 - <https://github.com/SCEDC/SCEDC-catalog-status/>

** Regional catalogs (including ComCat) change over time – when using, be sure to note the download date!



Earthquake Catalog (SCEDC)

https://service.scedc.caltech.edu/eq-catalogs/date_mag_loc.php

Event type (ET)
eq: earthquake
qb: quarry blast
nt: nuclear test
uk: unknown
+ others

Origin time
(UTC)

Geographic type (GT)
l: local
r: regional
t: teleseism

Magnitude (MAG & M)

l: local
lr: corrected local (SCSN M>3.5)
w: moment
d: duration
e: energy

Hypocenter

(LAT [deg], LON [deg], DEPTH [km])

Quality (Q)
A is best

Event ID
(EVID)

Comments from analyst

Number of
phases (NPH)
- P & S picks

Number of event
waveforms available

#	YYYY/MM/DD HH:mm:ss.ss	ET	GT	MAG	M	LAT	LON	DEPTH	Q	EVID
2023/03/06	04:37:29.14	eq	l	0.35	l	33.486	-116.400	12.5	A	40421392
2023/03/06	04:38:43.63	eq	l	1.95	l	32.643	-115.724	9.9	A	40421400
2023/03/06	04:50:21.47	eq	l	0.51	l	33.765	-116.929	10.7	A	40421408
2023/03/06	06:11:39.95	eq	l	0.64	l	33.468	-116.553	8.6	A	40421416
2023/03/06	08:25:38.38	eq	l	1.36	l	34.045	-118.937	10.7	B	40421424
2023/03/06	09:17:14.03	eq	l	1.41	l	34.324	-118.500	7.3	A	40421432
2023/03/06	09:27:07.06	eq	l	1.07	l	33.399	-116.386	2.4	A	40421440
2023/03/06	09:34:43.69	eq	l	1.25	l	33.991	-118.339	9.2	A	40421448
2023/03/06	09:48:56.80	eq	l	1.17	l	34.457	-117.954	8.9	A	40421456
2023/03/06	12:05:54.76	eq	l	1.51	l	32.983	-115.525	6.0	A	40421480
2023/03/06	12:46:15.72	eq	l	1.36	l	34.023	-116.740	15.9	A	40421488
2023/03/06	13:01:37.18	eq	l	1.26	l	35.506	-118.391	8.6	A	40421496
2023/03/06	17:29:52.47	eq	l	1.29	l	35.804	-117.627	6.1	A	40421512
2023/03/06	17:40:07.96	eq	l	0.31	l	33.671	-116.686	16.1	A	40421520
2023/03/06	18:11:35.09	eq	l	1.43	l	35.644	-117.385	10.3	A	40421528
2023/03/06	18:20:11.62	eq	l	2.72	l	35.617	-117.537	7.6	B	40421536
2023/03/06	19:34:27.21	eq	l	0.63	l	33.502	-116.779	4.3	A	40421552
2023/03/06	19:34:50.65	eq	l	1.20	l	33.930	-116.788	18.6	A	40421560
2023/03/06	22:45:51.61	eq	l	0.66	l	33.528	-116.727	4.8	A	40421576

REMARKS

NPH NGRM

31	1281
33	1961
14	991
26	1401
16	1797
33	2373
53	1761
31	2603
30	2233
12	1294
56	2347
20	1793
23	2611
8	1988
19	1962
6	2157
13	1098
52	2197
30	1340

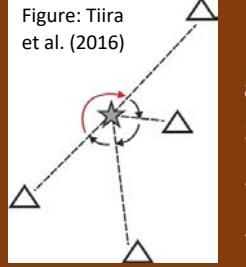
OR

SCSN with comments

SCEDC

Other formats
also available!

Earthquake Catalog (ComCat)



Largest azimuthal gap between stations (gap)
- in degrees
- lower is better

Number of stations with phase picks (nst)

Root mean square error of origin (rms)

- overall indicator of event/pick quality
- aim to keep this below ~0.3

Distance to closest station (dmin)
- in degrees
- lower is better

Preferred/authoritative network (net), first 2 letters of event id (id)
- ci is SCSN

Time of last event update (UTC)

Hypocenter errors

- aim to keep below 1-2 km
- depth error often higher, especially if depth is fixed

Number of stations used for mag

Event status
- automatic
- reviewed

Contributor of hypocenter & magnitude

time	latitude	longitude	depth	mag	magType	nst	gap	dmin	rms	net	id	updated	place	type	horizontalErr	depthError	magError	magNst	status	locationSour	magSource
2023-03-05T 32.9391667	-115.82683		11.02	2.09	ml	49	41	0.01571	0.25	ci	ci40421224	2023-03-06T23:36:34.900	22km WSW	earthquake	0.26	0.53	0.23	24	reviewed	ci	ci
2023-03-05T 33.4031667	-116.39567		6.31	2.13	ml	91	30	0.07988	0.16	ci	ci40421056	2023-03-06T20:31:24.210	16km N of B	earthquake	0.13	0.37	0.147	26	reviewed	ci	ci
2023-03-04T 36.2491667	-117.86433		-1.45	2.39	ml	27	56	0.1315	0.19	ci	ci40420784	2023-03-05T20:50:17.382	13km ESE of	earthquake	0.21	0.5	0.133	38	reviewed	ci	ci
2023-03-03T 33.018	-116.35267		9.49	2.1	ml	64	47	0.06705	0.23	ci	ci40420560	2023-03-04T01:54:43.330	24km ESE of	earthquake	0.22	0.67	0.188	25	automatic	ci	ci
2023-03-03T 33.489	-116.78683		3.71	2.16	ml	85	17	0.0259	0.19	ci	ci40420528	2023-03-04T01:45:36.420	9km NE of A	earthquake	0.13	0.4	0.149	26	reviewed	ci	ci
2023-03-01T 33.4858333	-116.47817		11.19	2.33	ml	80	35	0.05767	0.19	ci	ci40419944	2023-03-02T16:07:38.020	20km ESE of	earthquake	0.13	0.34	0.143	66	reviewed	ci	ci
2023-02-28T 35.6128333	-117.4165		8.15	3.56	ml	37	41	0.09739	0.15	ci	ci40419496	2023-03-02T12:35:13.585	17km SSW o	earthquake	0.15	0.53	0.187	120	reviewed	ci	ci
2023-02-28T 32.7465	-117.38233		15.73	2.37	ml	44	220	0.1185	0.14	ci	ci40419488	2023-02-28T19:48:47.624	15km SW of	earthquake	0.35	0.28	0.158	61	reviewed	ci	ci
2023-02-28T 35.6136667	-117.4145		7.92	3.15	ml	38	41	0.04739	0.16	ci	ci40419408	2023-03-01T03:08:40.040	17km S of Tr	earthquake	0.18	0.39	0.169	90	reviewed	ci	ci

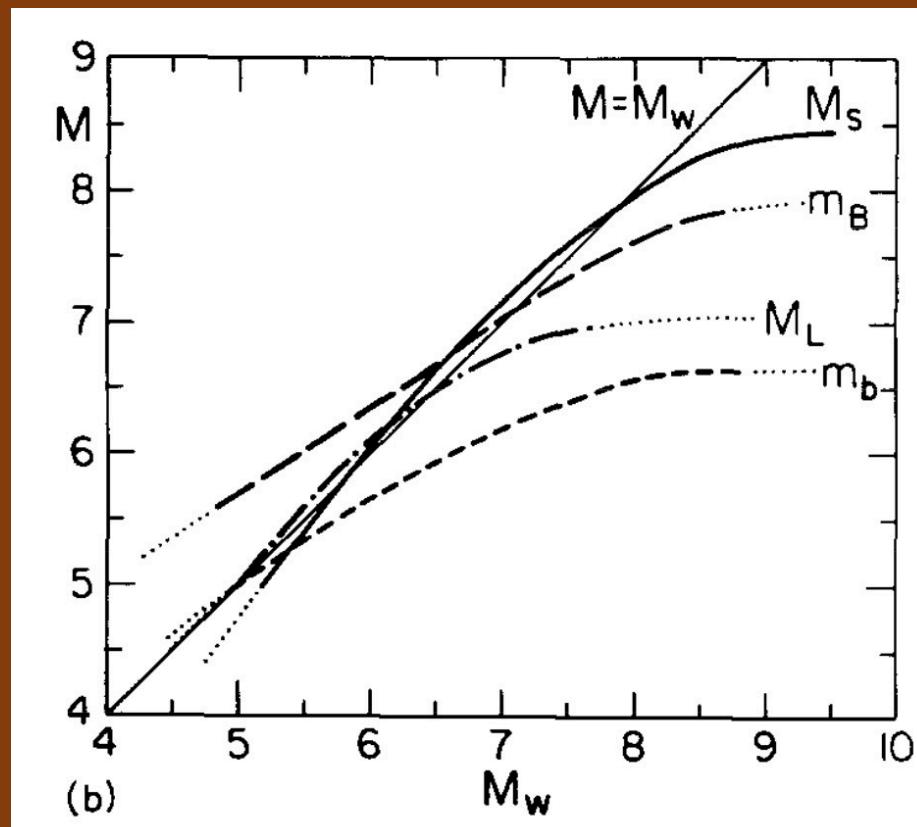
Magnitudes: Many different scales

- M_L : local magnitude (preferred for $M < 3.5$ at SCSN)
 - Measure peak amplitude; for small nearby earthquakes
 - SCSN uses California Integrated Seismic Network M_L (Uhrhammer et al. 2011, BSSA)
- M_d : duration magnitude (preferred for $M < 3$, selected regions)
 - Measure shaking duration from time decay of coda; useful for clipped records
 - Sometimes only available magnitude for smaller earthquakes ($M < 3$ Northern CA)
- M_w : moment magnitude (preferred for $M > 3.5$ at SCSN)
 - Measure low-frequency from larger earthquakes; often from moment tensor inversion
- M_{ww} : W-phase moment magnitude ($M > 6$ for ANSS networks)
 - Very low-frequency, early arrival (before S-wave), stable measurement: rapid magnitude for largest earthquakes (helpful for tsunami warning)
 - Authoritative M_{ww} calculated by USGS National Earthquake Information Center
- M_e : energy magnitude
 - Measure radiated energy from integrated waveform; automatic at SCSN but not preferred
- M_h : hand-edited magnitude (placeholder to modify later)
- Others (mostly for regional/teleseismic distances)
 - M_s : magnitude from surface waves
 - m_b : magnitude from body waves
 - M_{wc} , M_{wb} , M_{wr} , M_{fa} , M_{wp}
- “Preferred” magnitude reported in ComCat: check magnitude type!
 - But ComCat also has non-preferred magnitudes.

M_{Lr} : revised local magnitude for SCSN

$$M_{Lr} = 0.853M_L + 0.40125, \quad 3 < M_L < 6$$

* don't use this for research



Magnitude saturation

Kanamori (1983)

Magnitudes

<https://earthquake.usgs.gov/earthquakes/eventpage/ci40161279/origin/magnitude>



preferred magnitude: M_w

4.19
Mag

Err

6 Stations

CI
Source

Station information?

See moment tensor

No station details contributed

Ml

4.46
Mag

0.161

260 Stations

CI
Source

Station Details**Mlr**

4.19
Mag

0.168

279 Stations

CI
Source

Non-preferred magnitude: M_{Lr}

Download

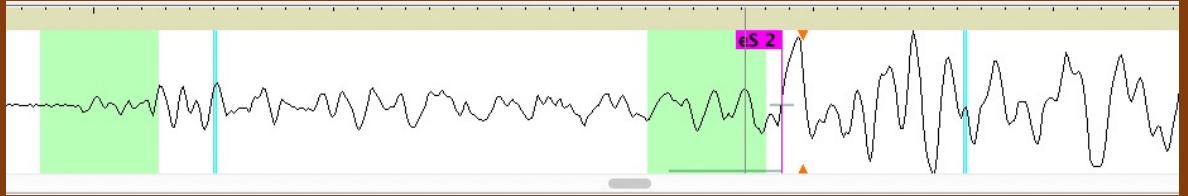
← Download station amplitudes & magnitudes in csv format

Notice variation in station-specific magnitude values

Station Magnitude Details

Channel	Type	Amplitude	Period	Status	Magnitude	Weight
CI BTP HHE	MLR	-	-	automatic	4.38	1
CI HOL HHN	MLR	-	-	automatic	4.88	1
CI CYP HHE	MLR	-	-	automatic	4.06	0
CI MSJ HHN	MLR	-	-	automatic	4.89	1
CI TOW2 HHE	MLR	-	-	automatic	4.40	1
PG EFD HNN	MLR	0.0032570 m	-	manual	4.40	0
CI STG HHE	MLR	-	-	automatic	4.44	1
CI DTP HHN	MLR	-	-	automatic	4.68	1
CI GLA HHN	MLR	0.00081037 m	-	manual	4.21	1
CI VDJ HHN	MLR	0.0037160 m	-	manual	4.83	0
CI DGR HHE	MLR	-	-	automatic	4.46	1

Phase Picks



Analyst approach:

- make as many phase picks as possible
- stop at ~100 km distance
- skip low quality picks, unless necessary

*Note – not all stations that recorded the event may have picks

HYPOINVERSE format

Event info

202301251000546833	5310118	4227	1471	262134	16	2434185	35220	2	25	13	107	25	35	83	0	287	w419	40161279w419
PTD	CI	VHHZ	iPU1202301251000	5822	-20	02	00	00	00	00	00	162				000	000H	
PTD	CI	NHHN	202301251001				95eS	2	-07	02	00	162				000	000H	
24396CE	VHNZ	eP	2202301251000	5837	04	02	00	00	00	00	00	167				000	000H	
24396CE	NHNN		202301251001				123eS	2	23	02	00	167				000	000H	
LAT	CI	VHHZ	iPD1202301251000	5857	-04	02	00	00	00	00	00	189				000	000H	
LAT	CI	NHHN	202301251001				169iS	1	11	02	00	189				000	000H	
5081	NP	VEHZ	iPD1202301251000	5923	-16	02	00	00	00	00	00	241				000	000H	
5081	NP	NHNN	202301251001				264eS	2	-08	02	00	241				000	000H	
24014CE	VHNZ	iPD1202301251000	5963	12	02		00	00	00	00	00	244				000	000H	
24014CE	NHNN		202301251001				365eS	2	69	02	00	244				000	000H	
24048CE	VHNZ	iPD1202301251001	02	28	02		00	00	00	00	00	260				000	000H	
24048CE	NHNN		202301251001				426iS	1	93	02	00	260				000	000H	
PDR	CI	VHHZ	iPD0202301251000	5994	-03	02	00	00	00	00	00	261				000	000	
PDR	CI	EHHE	202301251001				422eS	2	38	02	00	261				000	000H	

SNCL* info

SNCL*= Station Network Channel Location

Pick time (UTC)

Phase pick info

- type P or S
- quality 0-3 (each w/ error bound, 0=best)
- impulsive/emergent usually automatic
 - Q 0-1 gets i, Q 2-3 gets e
- for Q 0-1 P picks, also 1st motion
 - U (up) or D (down)

Details

Download phases in csv format

Sorted by distance to nearest station

Phases

Magnitudes

Downloads

preferred origin: phases (ComCat view)

<https://earthquake.usgs.gov/earthquakes/eventpage/ci40161279/origin/phase>

Earthquake XML (Quakeml)

- XML 2.7 MB

Channel	Distance	Azimuth	Phase	Arrival Time	Status	Residual	Weight
CI PTD HHZ	0.15 °	324.60 °	P	3.5.s	manual	-0.20	0.16
CI PTD HHN	0.15 °	324.60 °	S	6.3.s	manual	-0.07	0.05
CE 24396 HNZ	0.15 °	327.50 °	P	3.7.s	manual	0.04	0.11
CE 24396 HNN	0.15 °	327.50 °	S	6.6.s	manual	0.23	0.05
CI LAT HHZ	0.17 °	339.50 °	P	3.9.s	manual	-0.04	0.16
CI LAT HHN	0.17 °	339.50 °	S	7.0.s	manual	0.11	0.08
NP 5081 EHZ	0.22 °	23.70 °	P	4.6.s	manual	-0.16	0.16
NP 5081 HNN	0.22 °	23.70 °	S	8.0.s	manual	-0.08	0.05
CE 24014 HNZ	0.22 °	43.30 °	P	5.0.s	manual	0.12	0.16
CE 24014 HNN	0.22 °	43.30 °	S	9.0.s	manual	0.69	0.04
CE 24048 HNZ	0.23 °	52.00 °	P	5.3.s	manual	0.29	0.16
CE 24048 HNN	0.23 °	52.00 °	S	9.6.s	manual	0.93	0.03
CI PDR HHZ	0.24 °	70.60 °	P	5.3.s	automatic	-0.03	0.21
CI PDR HHE	0.24 °	70.60 °	S	9.5.s	manual	0.38	0.05
NP 5499 HNZ	0.24 °	76.70 °	P	5.4.s	manual	0.06	0.16
NP 5499 HNN	0.24 °	76.70 °	S	9.8.s	manual	0.59	0.04
CI SMF2 HHZ	0.25 °	57.30 °	P	5.7.s	manual	-0.07	0.16
CI SMF2 HHN	0.25 °	57.30 °	S	10.1.s	manual	0.24	0.05

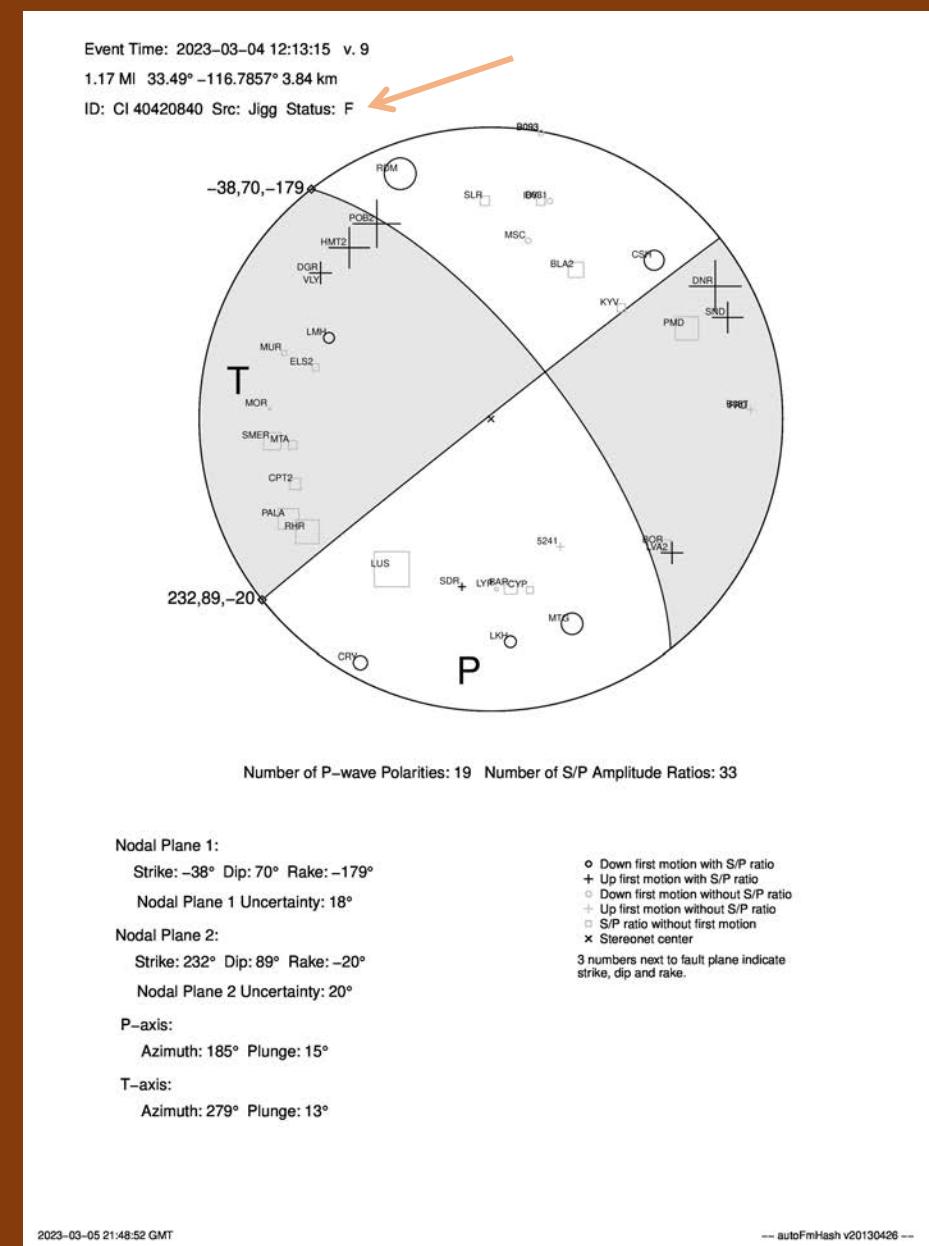
Focal Mechanisms

<https://service.scedc.caltech.edu/eq-catalogs/ FMsearch.php>

EVID	#YYYY/MM/DD HH:mm:ss	ET	GT	MAG	M	LAT	LONG	DEPTH	Q	NPH	WRMS	ERHOR	ERDEP	ERTIME	STRIKE	DIP	RAKE	FPUC	APUC	NPPL	MFRAC	FMQ	PROB	STDN	NSPR	MAVG
40411064	2023/02/05 00:23:12.16	eq	l	2.17	l	34.438	-119.191	12.4	A	108	0.290	0.250	0.530	0.000	352	27	61	36	38	10	11	C	68	35	32	127
40411192	2023/02/05 06:59:55.59	eq	l	2.08	l	32.334	-115.348	15.9	A	34	0.270	0.580	1.280	0.000	345	43	-144	40	41	8	22	D	39	28	8	139
40411216	2023/02/05 09:25:44.97	eq	l	2.01	l	33.673	-116.720	15.8	A	189	0.180	0.110	0.220	0.000	326	37	-176	8	8	39	3	A	100	48	57	80
40411320	2023/02/05 14:22:14.64	eq	l	2.20	l	35.551	-117.315	8.5	A	53	0.130	0.180	0.380	0.000	160	87	-163	16	20	8	0	A	83	23	23	153
40411480	2023/02/05 22:33:59.93	eq	l	2.09	l	35.664	-117.565	6.9	A	63	0.120	0.150	0.390	0.000	310	86	176	28	33	13	5	B	69	23	21	145
40411584	2023/02/06 03:44:33.38	eq	l	2.23	l	35.501	-118.396	6.5	A	70	0.140	0.130	0.700	0.000	321	67	-136	32	28	12	5	B	72	17	20	145
40412080	2023/02/08 01:21:26.67	eq	l	2.04	l	33.212	-116.061	9.7	A	122	0.210	0.150	0.490	0.000	46	24	83	43	37	14	27	C	64	28	35	129
40412288	2023/02/08 18:58:08.26	eq	l	2.03	l	35.262	-119.067	19.2	A	87	0.210	0.200	0.530	0.000	120	82	-176	25	22	15	7	A	89	45	30	74
40412640	2023/02/09 10:52:51.83	eq	l	2.50	l	35.678	-117.553	7.4	A	64	0.120	0.140	0.620	0.000	336	74	169	24	13	22	3	A	94	23	28	133
40413576	2023/02/11 19:45:40.61	eq	l	2.50	l	32.889	-116.238	5.6	A	133	0.210	0.150	0.610	0.000	145	81	-158	14	16	20	11	A	100	39	47	89
40413800	2023/02/12 13:31:20.04	eq	l	2.61	l	33.179	-115.612	2.3	A	80	0.230	0.240	0.250	0.000	266	16	149	28	19	20	8	A	86	63	37	61

- Available from Sep 1999 to present
- Input: First motions determined for Q 0-1 P-picks: U (up) or D (down)
- Input: S/P amplitude ratio
- Calculated for most events using HASH method (Hardebeck & Shearer, 2003, BSSA)
 - Prior to 2013, used fpfit method (Reasenberg & Oppenheimer, 1985)
- For more info, see Yang et al., BSSA, 2012: <https://doi.org/10.1785/0120110311>
- Quality criteria:

Quality Grade	Probability	Average Fault Plane Uncertainty	Min #Polarities
A	>0.8	<= 25°	>= 8
B	>0.6	<= 35°	>= 8
C	>0.5	<= 45°	>= 8
D	<=0.5	> 45°	>= 8
F	<=0.5	> 45°	< 8



Moment Tensors

Determines moment magnitude Mw for M3.5+ earthquakes

<https://service.scedc.caltech.edu/eq-catalogs/CMTsearch.php>

Available from
Sep 1999 to present

```
# EventID : Unique numeric identifier assigned to each earthquake event cataloged at SCSN.
# Lat : Latitude of the event origin.
# Long : Longitude of the event origin.
# Date/Time: Origin time of the event in UTC.
# Dep : Depth of the preferred origin.
# MDep : Depth of the MT solution.
# Mp : Preferred Magnitude.
# Ty : Preferred magnitude type.
# VR : Variance Reduction.
# Str1 : Strike of Nodal Plane 1.
# Dip1 : Dip of Nodal Plane 1.
# Rake1 : Rake of Nodal Plane 1.
# Str2 : Strike of Nodal Plane 2.
# Dip2 : Dip of Nodal Plane 2.
# Rake2 : Rake of Nodal Plane 2.
# Mo : Scalar Moment.
# DC : Percent double couple of the seismic moment tensor.
# CLVD : Percent compensated linear vector dipole of the seismic moment tensor.
# ISO : Percent isotropic of the seismic moment tensor. This is always 0 for SCSN solutions due our software configuration.
# Solution Link: URL link to the complete MT solution. The solution page provides
# 1) Variance Reduction graph plotted against depths.
# 2) Waveforms of the stations selected for MT calculations.
#
# Output is sorted by date/time in descending order.
#
#EventID Lat Lon Date Time Dep MDep Mp Ty VR Str1 Dip1 Rake1 Str2 Dip2 Rake2 Mo DC CLVD ISO Solution Link
40161279 33.88500 -118.70450 2023/01/25 10:00:55 14.71 11.00 4.19 w 85 292 50 86 118 41 95 2.44e+22 88 12 0 Solution
40151807 33.39750 -116.39333 2022/12/31 12:12:27 3.88 5.00 4.14 w 88 238 57 45 119 54 137 2.01e+22 45 55 0 Solution
40142983 35.50867 -118.39150 2022/12/07 14:13:23 5.07 14.00 3.56 w 72 16 75 -31 115 60 -162 2.73e+21 89 11 0 Solution
40129847 31.55717 -115.69933 2022/11/07 04:59:03 7.04 5.00 4.04 w 86 15 80 -19 109 72 -170 1.42e+22 65 35 0 Solution
```

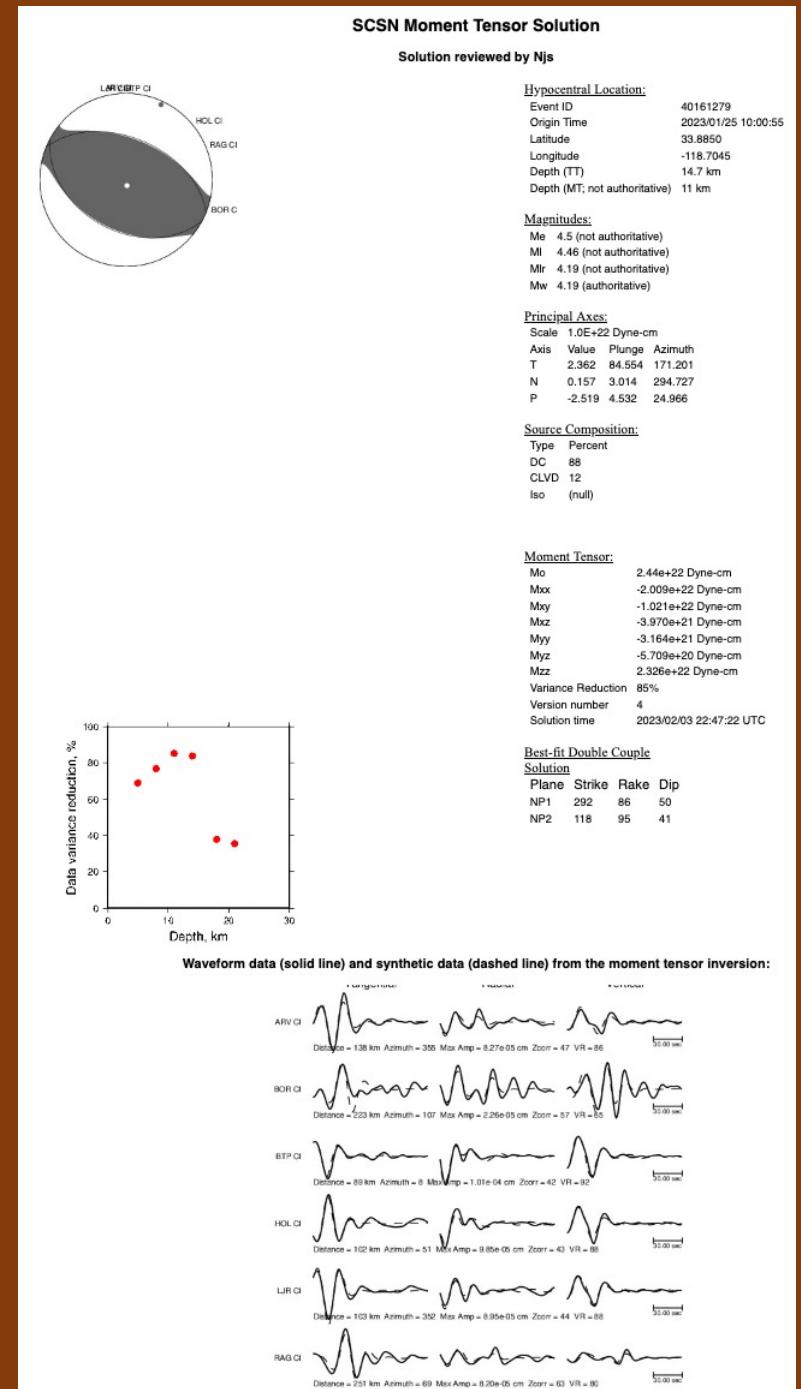
- Quality A
 - 6 stations (with azimuthal constraints)
 - Variance Reduction (VR) >=70%
 - each station has IVR >=60% AND IVR >= (VR-10%)

-> Mw, MT good enough to be immediately distributed

- Quality B
 - 4 stations (with azimuthal constraints)
 - VR >=40%
 - each station has IVR >=25% AND IVR >= (VR-15%)

-> only Mw good enough to be immediately distributed, MT needs review

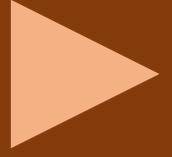
- Quality C
 - 3 stations (with NO azimuthal constraints)



Summary & Tips

- Take the time to know and understand the data that you're using
- Official catalogs do change over time
 - > don't forget to note the date when you download data
- Networks may use different processing procedures
 - check with the specific network for details
 - especially important to consider for composite catalogs (like ComCat)
- Catalogs may have multiple origins or magnitudes for a single event
 - the one of interest to you may not be the “preferred” option from standard catalog access
- Catalog events may or may not be manually reviewed and/or adjusted
- Please cite the contributing networks & data centers of the data you use

Data Repositories & Access



Multiple Event Catalog Repository – ANSS Comprehensive Earthquake Catalog (ComCat)



<https://earthquake.usgs.gov/earthquakes/search/> (web form)

<https://code.usgs.gov/ghsc/esi/libcomcat-python> (python api)

- All ANSS networks submit their event detections to ComCat*
- Allows for customizable searches over all ANSS RSN catalogs
 - magnitude, time, location, review status, event type, contributor/catalog, etc.
- Multiple output formats available

* Remember: not all RSNs use the same methods/approaches!

Search Earthquake Catalog

Search results are limited to 20,000 events. To get URL for a search, click the search button, then copy the URL from the browser address bar.

- [Help](#)
- [ANSS Comprehensive Earthquake Catalog \(ComCat\) Documentation](#)
- [Developer's Corner - Library of functions and wrapper scripts for accessing and using tools for the NEIC's ComCat data](#)
- [Significant Earthquakes Archive](#)

Basic Options

Magnitude	Date & Time	Geographic Region
<input checked="" type="radio"/> 2.5+	<input checked="" type="radio"/> Past 7 Days	<input checked="" type="radio"/> World
<input type="radio"/> 4.5+	<input type="radio"/> Past 30 Days	<input type="radio"/> Conterminous U.S. ¹
<input type="radio"/> Custom	<input type="radio"/> Custom	<input type="radio"/> Custom

Minimum: 2.5 Start (UTC): 2025-03-10 00:00:00 Worldwide

Maximum: End (UTC): 2025-03-17 23:59:59 Draw Rectangle on Map

Advanced Options

Output Options

Search

¹Conterminous U.S. refers to a rectangular region including the lower 48 states and surrounding areas which are outside the Conterminous U.S.

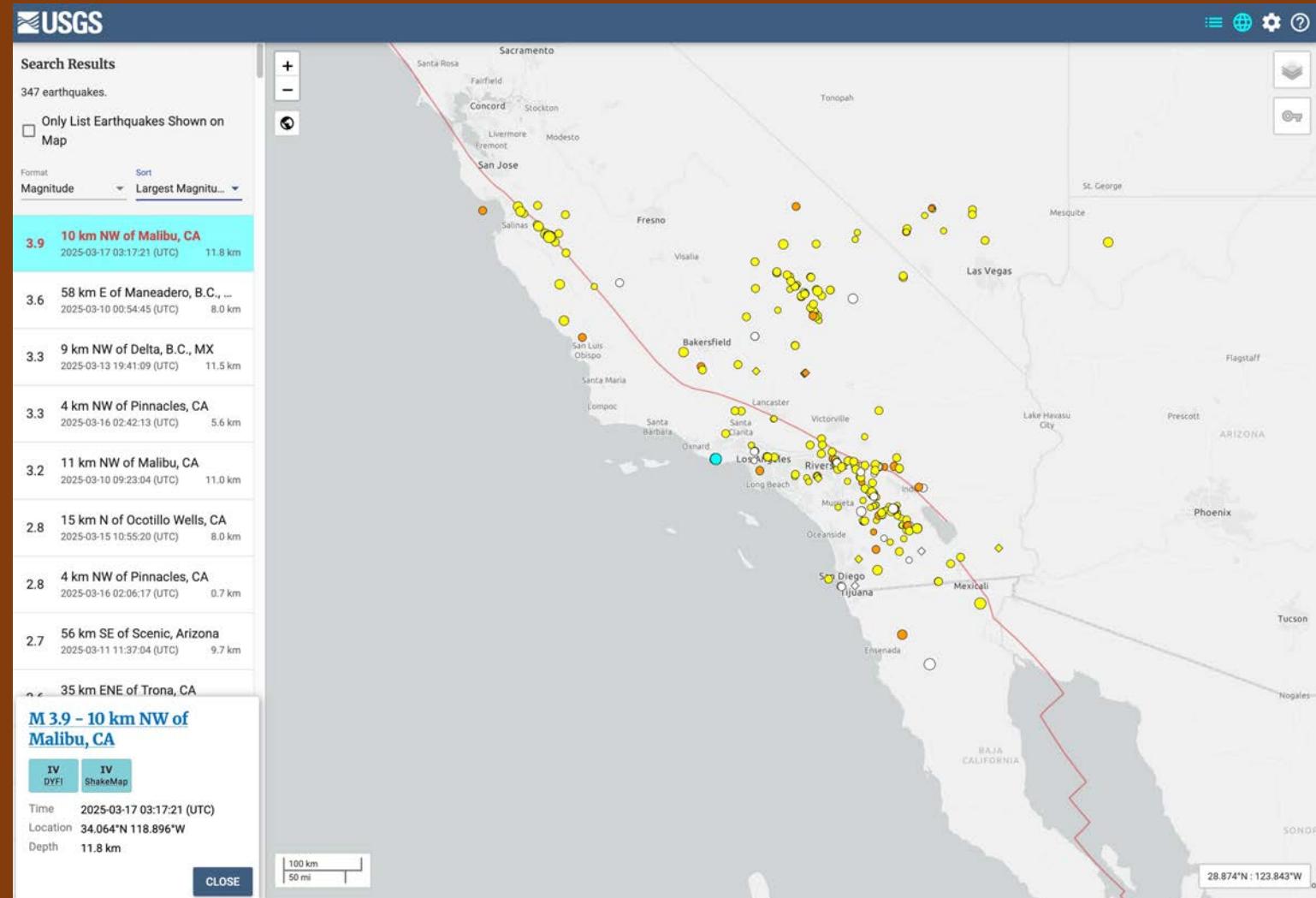
USGS/ComCat Data Access



“Map” output of search

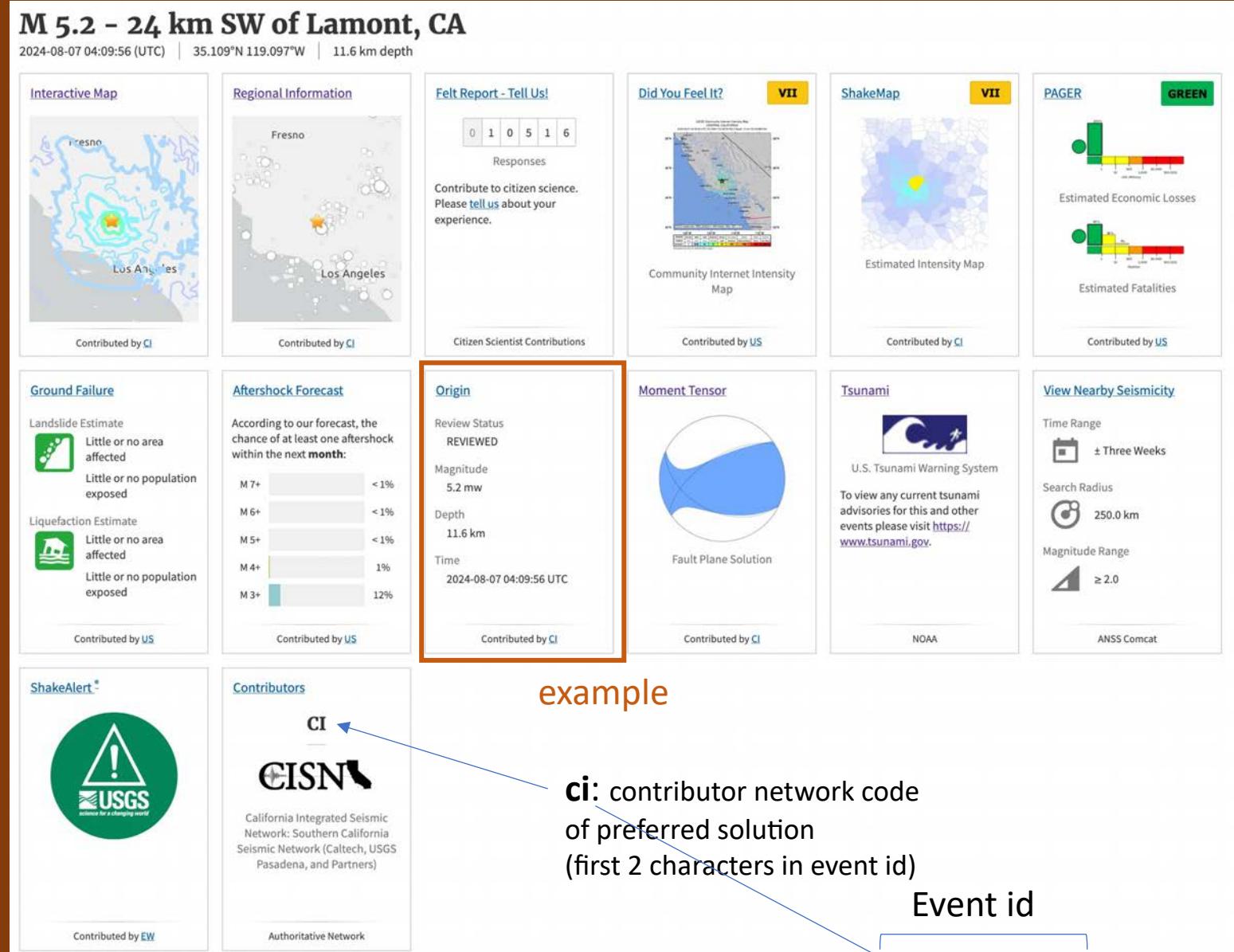
Similar to “Latest Earthquakes” map

Click on event to get more details



USGS/ComCat Event Pages

- Useful for getting detailed info about a single event
- Panels will vary based on info available
 - after event, panels updated as products added
 - smaller events have fewer products/panels
- Note data contributor at bottom of panel
 - “preferred” info shown
- Click on panel titles for more info



USGS/ComCat Event Pages

- Dropdown at top gives info submitted by all contributes
 - green check denotes “preferred”
 - multiple other non-preferred solutions also available
- Origin details, phase picks, and magnitude details available by clicking on lower headers
- Bottom dropdown gives files available for download

M 5.2 - 24 km SW of Lamont, CA
2024-08-07 04:09:56 (UTC) | 35.109°N 119.097°W | 11.6 km depth

Origin

[View all origin products \(4 total\)](#)

Available Origin Products

Catalog	Magnitude	Time	Depth	Review Status	Location	Source
CI ✓	5.2 mw	04:09:56	11.6 km	REVIEWED	35.109°N 119.097°W	CI
US	5.4 mww	04:09:55	16.0 km	REVIEWED	35.112°N 119.064°W	US
AT	5.5 Mi	04:09:55	11.0 km	REVIEWED	35.046°N 119.134°W	AT
EW	5.7 mw	04:09:57	9.0 km	AUTOMATIC	35.072°N 119.072°W	EW

Contributed by CI last updated 2024-08-07 18:17:10 (UTC)
✓ The data below are the most preferred data available
✓ The data below have been reviewed by a scientist

Details

Magnitude	5.22 mw
Location uncertainty	35.109°N 119.097°W ± 0.2 km
Depth uncertainty	11.6 km ± 0.8
Origin Time	2024-08-07 04:09:56.760 UTC
Number of Stations	101
Number of Phases	136
Minimum Distance	5.7 km (0.05°)
Travel Time Residual	0.26 s
Azimuthal Gap	21°
FE Region	Central California (39)
Review Status	REVIEWED
Catalog	CI (ci40865104)
Location Source	CI
Magnitude Source	CI
Contributor	CI

Phases

Magnitudes

Downloads

Earthquake XML (Quakeml)

- [XML 2.3 MB](#)

USGS/ComCat– Python Library: libcomcat

<https://code.usgs.gov/ghsc/esi/libcomcat-python>

- python wrapper for accessing ComCat.
- Demo notebooks available
- Command line interface

Introduction

libcomcat is a project designed to provide a Python equivalent to the ANSS ComCat search API. This includes a Python library that provides various classes and functions wrapping around the ComCat API, and a number of command line programs that use those:

- `findid` Find the ID of an event closest to input parameters (time, latitude, longitude). Also can provide the authoritative ID if an event id is provided.
- `getcsv` Generate csv or Excel files with basic earthquake information.
- `geteventhist` Generate csv or Excel files with a history of product submission for an event. Can also create a timeline demonstrating when different product versions were released along with their summaries.
- `getmags` Download all available magnitudes from all sources.
- `getpager` Download information that represents the PAGER exposure and loss results.
- `getphases` Generate csv or Excel files with phase information.
- `getproduct` Download ComCat product contents (shakemap grids, origin quakeml, etc.)

Motivation

libcomcat is a python wrapper for the Comprehensive Catalog (ComCat), which has a [web page interface](#) and [API](#). ComCat contains information in **Events** which contain **Products**. Products contain **Contents** in the form of files, maps, etc.

The ComCat interface is very user friendly, but does not support automation. The API supports automation, but limits the number of events that can be returned to 20,000. libcomcat uses the API in a way that allows for:

- Searches returning more than 20,000 eventsource
- Automation of product file downloads
- Extraction of information in product content files

Documentation

Documentation can be found in the docs folder:

- [API Documentation](#)
- [Command Line Interface Documentation](#)

Example Jupyter notebooks show how the API can be

Note: The ShakeMap/DYFI Station Pairs Notebook requires
`pip install geopy`

- [Classes Notebook](#)
- [Dataframes Notebook](#)
- [Event Notebook](#)
- [Magnitude Notebook](#)
- [ShakeMap Notebook](#)
- [Station Comparison Notebook](#)
- [Station Magnitude Notebook](#)
- [Station Pairs Notebook](#)
- [ShakeMap/DYFI Station Pairs Notebook](#)

`get_phase_dataframe`

To use the `get_phase_dataframe()` method, first retrieve a `DetailEvent` object (see the [Classes notebook](#)) and it is passed as the positional argument to `get_phase_dataframe`, along with the desired catalog (`us`, `ci`, etc.).

In [3]:

```
eventid = 'nc73201181'
regional = 'nc'
detail = get_event_by_id(eventid, includesuperseded=True)
```

Inspect the ComCat event page [Origins](#) tab to see which catalogs have provided origins for the event. Here we see one solution and one from Northern California (NC).

Note that some data cleaning is done after retrieving the dataframe - removing automatic picks and making them with an empty string instead of "--".

In [4]:

```
usframe = get_phase_dataframe(detail, catalog='us')
usframe = usframe[usframe['Status'] == 'manual']
usframe['Channel'] = usframe['Channel'].str.replace('--', '')
# note that the line below merely prints the sorted dataframe,
# it does not modify the dataframe to be sorted by Channel.
usframe.sort_values('Channel')
```

Out [4]:

Type to search					
	Channel	Distance	Azimuth	Phase	Arrival Time
145	AK.CHN.BHZ.	27.56120	313.7820	P	2019-06-23 03:58:50.960
118	AK.UNV.BHZ.	31.29330	310.0130	P	2019-06-23 03:59:25.280
146	AT.AKUT.BHZ.	30.91080	310.6970	P	2019-06-23 03:59:21.530

USGS/ComCat– Catalog Contributors

<https://earthquake.usgs.gov/data/comcat/catalog/>

Catalogs

- [AK - Alaska Earthquake Center](#)
- [AT - National Tsunami Warning Center](#)
- [ATLAS - ShakeMap Atlas](#)
- [AV - Alaska Volcano Observatory](#)
- [CHOY - Energy Magnitude and Broadband Depth](#)
- [CI - California Integrated Seismic Network: Southern California Seismic Network \(Caltech/USGS Pasadena and Partners\) and Southern California Earthquake Data Center](#)
- [DUPUTEL - Duputel et al. W phase catalog](#)
- [EQH - EQH - Coffman, von Hake and Stover, Earthquake History of the United States](#)
- [GCMT - Lamont-Doherty Earth Observatory Global CMT project, New York, USA](#)
- [HV - Hawaiian Volcano Observatory](#)
- [ISCGEM - ISC-GEM Main Catalog](#)
- [ISCGEMSUP - ISC-GEM Supplementary Catalog](#)
- [ISMPKANSAS - USGS Induced Seismicity Project \(Kansas\)](#)
- [LD - Lamont-Doherty Cooperative Seismographic Network](#)

California Integrated Seismic Network: Southern California Seismic Network (Caltech/USGS Pasadena and Partners) and Southern California Earthquake Data Center

(Caltech/USGS Pasadena and Partners)

<http://scedc.caltech.edu>

Citation

doi:10.7909/C3WD3xH1

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Extent

1932 to present

Latitude

[31.3, 37]

Longitude

[-121, -114]

Magnitude

[-1.0, 7.5]

Contributors

- [CI \(Contributor\)](#)

Multiple RSN Waveform and Metadata – NSF SAGE (Earthscope)



<https://ds.iris.edu/ds/nodes/dmc/data/>

- Several RSNs archive waveform and metadata at Earthscope (formerly IRIS).
- Notable exceptions: NCEDC, and SCEDC. SCEDC sends a subset to Earthscope.

Takeaway – do your due diligence. Make sure you understand the availability of the network data in your project.

MetaData Aggregator
Network Summary

Filter ▾ Context ▾ Legend: A P R X ?

CI (1900-01-01 - 2999-12-31)

Network	CI	Map	DOI
Description	Southern California Seismic Network		
Start	1926-01-01 (001)	1926-10-19 (292)	1900-01-01 (001)
End	2599-12-31 (365)	2999-12-31 (365)	
Data Center	IRISDMC A	NCEDC ?	SCEDC ?
# Stations	837		

A red circle highlights the "Data Center" column for station ABL, showing IRISDMC X, NCEDC ?, and SCEDC ?.

Station	Data Center	Start	End	Site	Latitude	Longitude	Elevation
ABL	IRISDMC X NCEDC ? SCEDC ?	1976-07-23	2599-12-31 3000-01-01	Mount Abel	34.84845 34.84843	-119.22497 -119.224965	1975.0
ACP	IRISDMC X SCEDC ?	2014-12-31	2599-12-31 3000-01-01	Agua Caliente County Park	32.9546	-116.30338	392.25 392.2
ADL	SCEDC ?	1975-02-11	1997-02-14	Adelanto	34.55581	-117.41804	868.0
ADO	IRISDMC A SCEDC ?	2000-08-09	2599-12-31 3000-01-01	Adelanto Receiving	34.55046	-117.43391	908.0
AGA	IRISDMC A SCEDC ?	1999-11-16	2005-05-11	Agave Hill	33.63838	-116.40111	809.0

SAGE Data Access

<https://ds.iris.edu/ds/nodes/dmc/data/>

<https://ds.iris.edu/ds/nodes/dmc/manuals/>

- FDSN* webservices – standard used by many data centers.
- APIs in common programming languages. (Python, Java, Julia, Matlab, and more!)
- Software for reading common formats.
- Manuals and tutorials available.

*FDSN = “International Federation of Digital Seismograph Networks”

Manuals

The following packages have online manuals. You can also view different manual [categories](#).

AutoDRM Service

AutoDRM data formats provide a common format for data and data product exchange. The data formats all contain ASCII options that allow the exchange of information via email (even for waveforms). Waveforms in binary format may also be sent using the AutoDRM message format, but the transmission of data messages with binary information must be via FTP.

Categories: [APIs and Toolkits](#), [Data Access](#), [Data Collection Utilities](#), [Data Extraction](#), [Processing Programs](#)

BREQ_FAST

Batch access to the IRIS DMC archive can be obtained by electronically mailing a specially formatted file to the IRIS DMC in Seattle. These are BREQ_FAST files and provide a base level access to the DMC needed by any user.

Categories: [Data Access](#), [Data Extraction](#)

BUD

The Buffer of Uniform Data (BUD) concept was created to provide a single point of entry into the DMC for (real time) data from disparate sources. Data flowing out of the BUD system include data from SPYDER®. An AutoDRM link is being developed and the BUD file system is available to others who may want to take advantage of this system.

Categories:

evalresp

evalresp can be used to calculate either the complex spectral response or the frequency-amplitude-phase response for a specified station or set of stations, channel or channels, and network, for a specified date, time and frequency, using the SEED ASCII response (RESP) files produced by the program **rdseed** as input.

Categories: [SEED Readers](#), [SEED Response Evaluation Tools](#), [SEED Tools](#)

ewexport_plugin

[Earthworm](#) export server (TCP/IP)

Categories: [SeedLink Utilities](#)

Google Earth Files

Google Earth combines the power of Google Search with satellite imagery, maps, terrain and 3D buildings to put the world's geographic information at your fingertips. Using the IRIS Google Map Service, you can create custom maps based on IRIS DMC metadata.

Categories: [Data Access](#), [Plotting and Display](#)

irisFetch.m

A [MATLAB®](#) interface to the IRIS archive

Categories: [Plotting and Display](#)

IRIS-WS

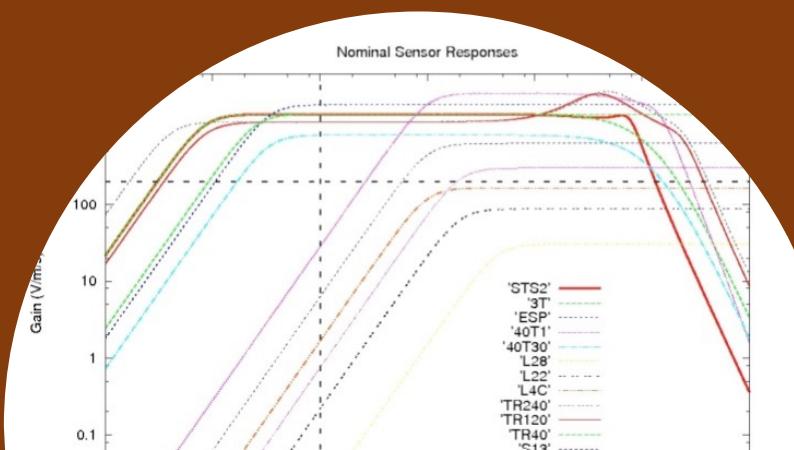
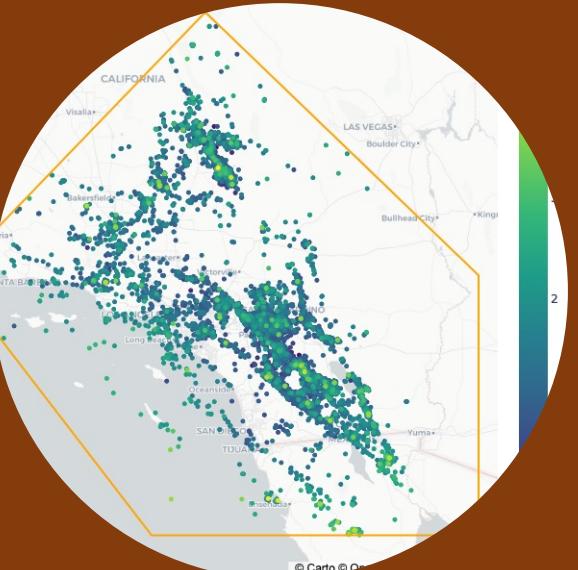
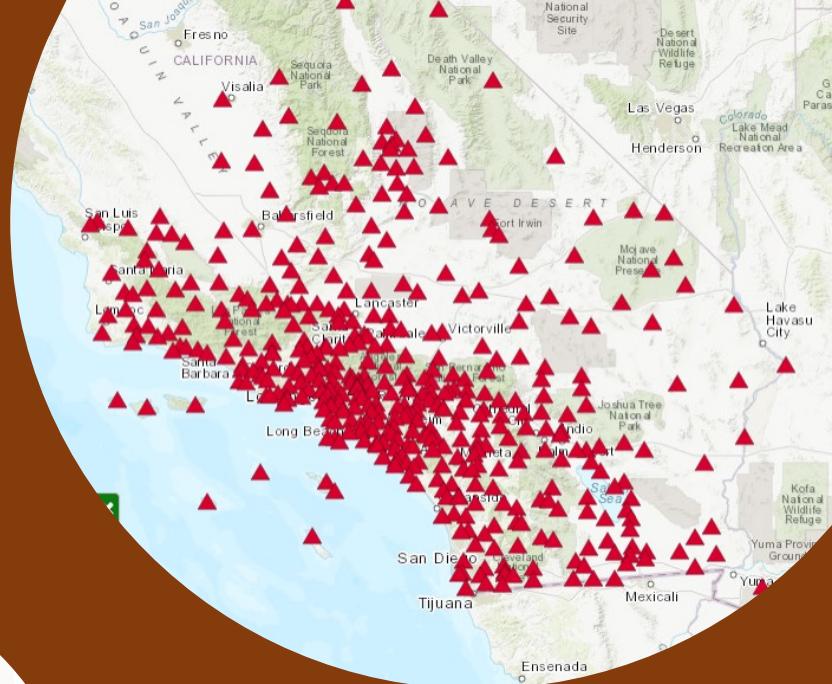
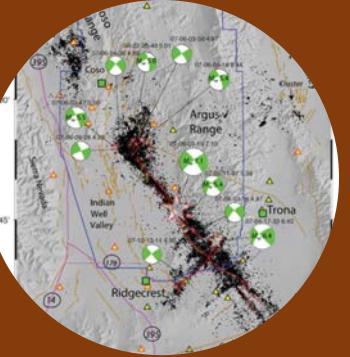
Access station, event, and time series (waveform) data from IRIS using the Java Web Service Library.

Categories: [APIs and Toolkits](#)

SCEDC Data Access

The SCEDC is the primary archive of SCSN

- Waveform Data – raw waveform traces – continuous and triggered (event-based)
- Station Metadata – instrument response and location of SCSN stations.
- Event Parametric Catalog – event location, arrivals etc
- Special Datasets
- User generated catalogs based on SCSN waveform data
- Additional data types for major event sequences within the SCSN region



DEPTH	Q	NPH	
9.191	12.4 A	108	0.290
-115.348	15.9 A	34	0.270
-116.720	15.8 A	189	0.180
-117.315	8.5 A	53	0.130
4 -117.565	6.9 A	63	0.120
1 -118.396	6.5 A	70	0.140
2 -116.061	9.7 A	122	0.210
2 -119.067	19.2 A	87	0.210
3 -117.553	7.4 A	64	0.120
-116.238	5.6 A	133	0.210
-115.612	2.3 A	80	0.230

SCEDC Data Access – Methods

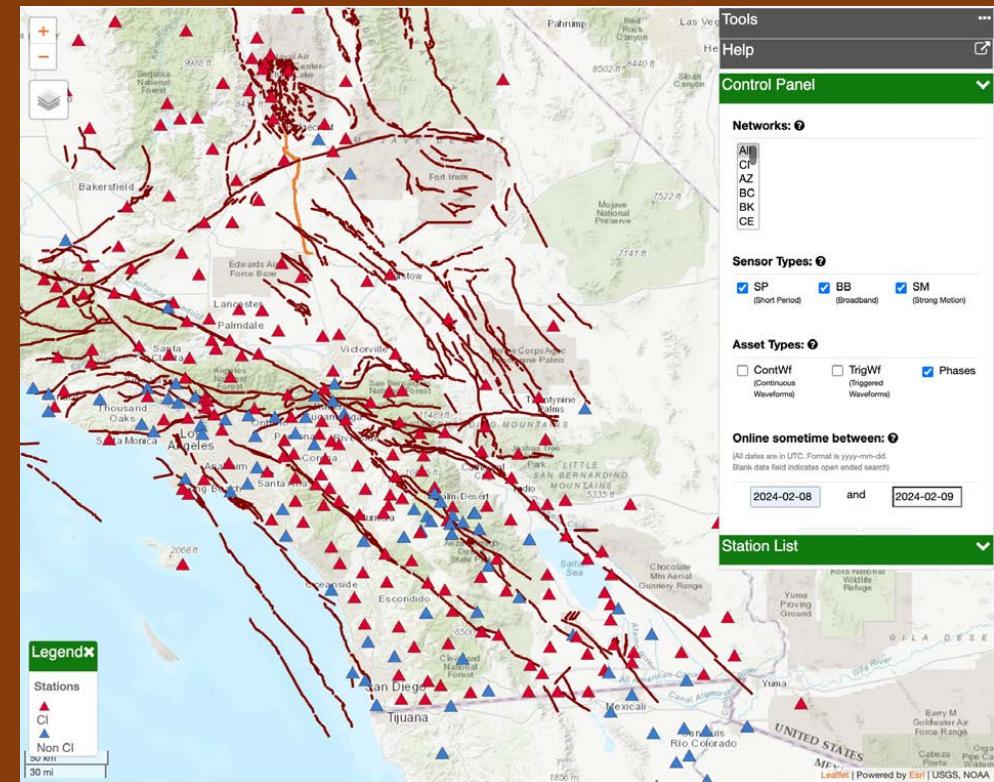
There are *many* ways to retrieve data. You can mix and match methods to suit your investigation.



- SCEDC website – best for quick look, summary level, human review, documentation, special datasets
- AWS Open Dataset – if you are looking to retrieve lots of data (fastest download speed for continuous data), please look here.
The AWS logo, which includes the word "powered by" above the "aws" logo, with the "a" having a blue arrow underneath it.
- Webservices – programmatic, FDSN standard – many libraries, multiple datacenters. Can retrieve using ObsPy scripts.
The FDSN logo, featuring two stylized blue and green globe icons followed by the acronym "FDSN" in a bold, black, sans-serif font.
- STP – programmatic, integrated between event, waveform, metadata
The STP logo, which includes the acronym "STP" in a large, bold, black, sans-serif font, with a green horizontal bar below it containing four white right-pointing arrows, and the full name "SEISMOGRAM TRANSFER PROGRAM" in a smaller, black, sans-serif font at the bottom.

SCEDC Data Access Tips

- Determine availability first, then retrieve data based on the results.
- If you are looking at catalog near Ridgecrest 2019 sequence be aware active processing is still happening.
- Consider using the AWS Open Data set.
- If looking for “integrated products”, such as event waveforms, phases or gain applied waveforms, consider using STP or PySTP
- If your area of study spans multiple seismic networks or data centers: Consider FDSN web services, or ComCat for event catalogs.
- Questions? Feedback? We are happy to help and we LOVE feedback.



```
eyu -- bash - 80x24
[your-workstation>aws s3 ls s3://scedc-pds/ --no-sign-request
PRE FDSNstationXML/
PRE Ridgecrest_DAS/
PRE continuous_waveforms/
PRE earthquake_catalogs/
PRE event_phases/
PRE event_waveforms/
PRE indexmap/
PRE README
2019-12-18 09:50:20
your-workstation>
```

Data Access - Website

<https://scedc.caltech.edu/>

These are the menu links to get to the data – useful for researchers

If you use any data in your published research, please cite!

The screenshot shows the SCEDC website homepage. At the top, there is a navigation bar with links: Home, Cite the SCEDC, Recent Earthquakes, Earthquake Info, EQ Catalogs, Access Data, FAQ, About, and a search icon. Below the navigation bar, a large blue arrow points from the text "If you use any data in your published research, please cite!" to the "Home" link in the menu. To the right of the menu, another set of blue arrows points to the "Access Data" link in the menu and the "Access Data" section below it. The "Access Data" section is highlighted with a blue background. To the right of the "Access Data" section, there are two other sections: "Earthquake Updates" and "Worldwide Earthquakes". The "Earthquake Updates" section lists recent earthquakes in the Southern California region, and the "Worldwide Earthquakes" section lists recent earthquakes worldwide. The main content area features a map of the Southern California region showing recent earthquake locations.

SCEDC

Southern California Earthquake Data Center

For the SCSN Visit

SCSN

Welcome

The Southern California Earthquake Data Center (SCEDC) is the archive of the Caltech/USGS Southern California Seismic Network (SCSN). It is funded by the U.S. Geological Survey (USGS) and the Southern California Earthquake Center (SCEC). Its primary mission is to distribute data recorded or processed by the SCSN, a component of the California Integrated Seismic Network (CISN).

Recent Earthquakes in the Southern California Region

03/18/2023, M3.6 near Bombay Beach
02/28/2023, M3.6 near Trona
01/25/2023, M4.2 near Malibu Beach
12/31/2022, M4.2 near Borrego Springs
12/31/2022, M3.5 near Lucerne Valley

M 5.6 - 13 km SW of Khowy, Iran

USGS science for a changing world

Data Access – Website – EQ catalogs

https://service.scedc.caltech.edu/eq-catalogs/date_mag_loc.php

IMPORTANT!
Documentation
about the catalog
itself

The screenshot shows the SCEDC website with the URL https://service.scedc.caltech.edu/eq-catalogs/date_mag_loc.php. The page title is "Earthquake Catalogs" and the subtitle is "SCSN Catalog Search (1932-Present)". It includes sections for "Information about the catalog", "Change History", and "General catalog information". Below these are instructions about search limits and output formats. The "Search by:" section contains several buttons: "Location, Mag, and Time", "Event ID", "Polygon", "Radius", "Multi-Mags", "Moment Tensors", and "Focal Mechanisms". A dropdown menu for "Output Format" is set to "SCEDC". A "Search Parameters" button is also present. A callout box highlights the "Focal Mechanisms" button with the text: "Easiest method for focal mechanism and moment tensor searches". A blue arrow points from the "IMPORTANT!" text to the "Search by" section. Another blue arrow points from the "Focal Mechanisms" button to the callout box.

Basic versioning

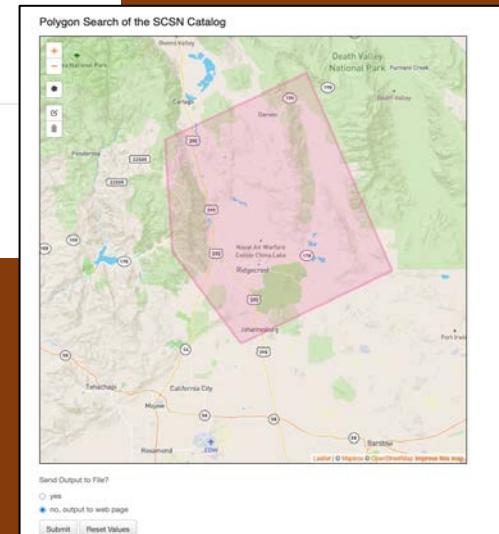
Year files, sent to GitHub daily

Processing status at

https://service.scedc.caltech.edu/ftp/catalogs/catalog_status/

Select tabs to search by

- Location, magnitude, time
- Known SCSN catalog id
- Geographical boundary provided by user on map
- Distance range of a point provided by user



Data Access – Website – Station Metadata

<https://scedc.caltech.edu/data/station/index.html>

The screenshot shows the SCEDC website's "Station Metadata and Maps" page. At the top, there's a navigation bar with links like Home, Cite the SCEDC, Recent Earthquakes, Earthquake Info, EQ Catalogs, Access Data, FAQ, About, and a search icon. A dropdown menu under "Access Data" is open, showing options like Web Services, Special Data Sets, Cloud Hosted Archive, Downloads, Waveform Data, Training and Validation, Station Metadata and Maps (which is highlighted), Data Sets for Deep Learning, and About SCEDC Catalogs. Below the navigation, there's a section titled "Station Metadata and Maps" with a brief description of what the SCEDC archives and distributes. A large red box highlights a table of station metadata. To the left of the table, a blue arrow points from a list of links to the "Station Metadata and Maps" section. Another blue arrow points from another list of links to the table.

Station Metadata and Maps

The SCEDC archives and distributes station metadata for all SCSN seismic stations. For where we have the instrument response so that users can derive ground motion. For the era prior to digital waveforms from surrounding regional seismic networks, whose stations might be used in SCSN processing to help our web services and station lists, but we encourage the user to go to the regional seismic network for the [ANSS Station Information System](#), which is used by a number of ANSS regional seismic networks, funded by the [ANSS](#), and maintained and developed by SCEDC staff.

Station Lists and Naming Conventions

Current lists of stations used by the SCSN, naming practices for station data, and description of how station info

- [Analog and Digital Station List](#) - A list of any channels that exist in SCEDC archive
- [Analog and Digital Station List: Vertical Components Only](#)
- [FDSN Station Web Service](#)
- [Strong-Motion Station Aliases Used Prior to 2012](#)
- [SEED Channel Descriptions](#)
- [Site Characterizations](#)
- [Overview of SCSN stations \(to www.scsn.org\)](#)

Station Maps

Maps of SCSN stations

- [Clickable Station Map](#)
- [Entire Array](#)
- [Entire Array - Los Angeles Region](#)
- [BH_Station Map](#)
- [BH_Stations - Los Angeles Region](#)

Instrumentation

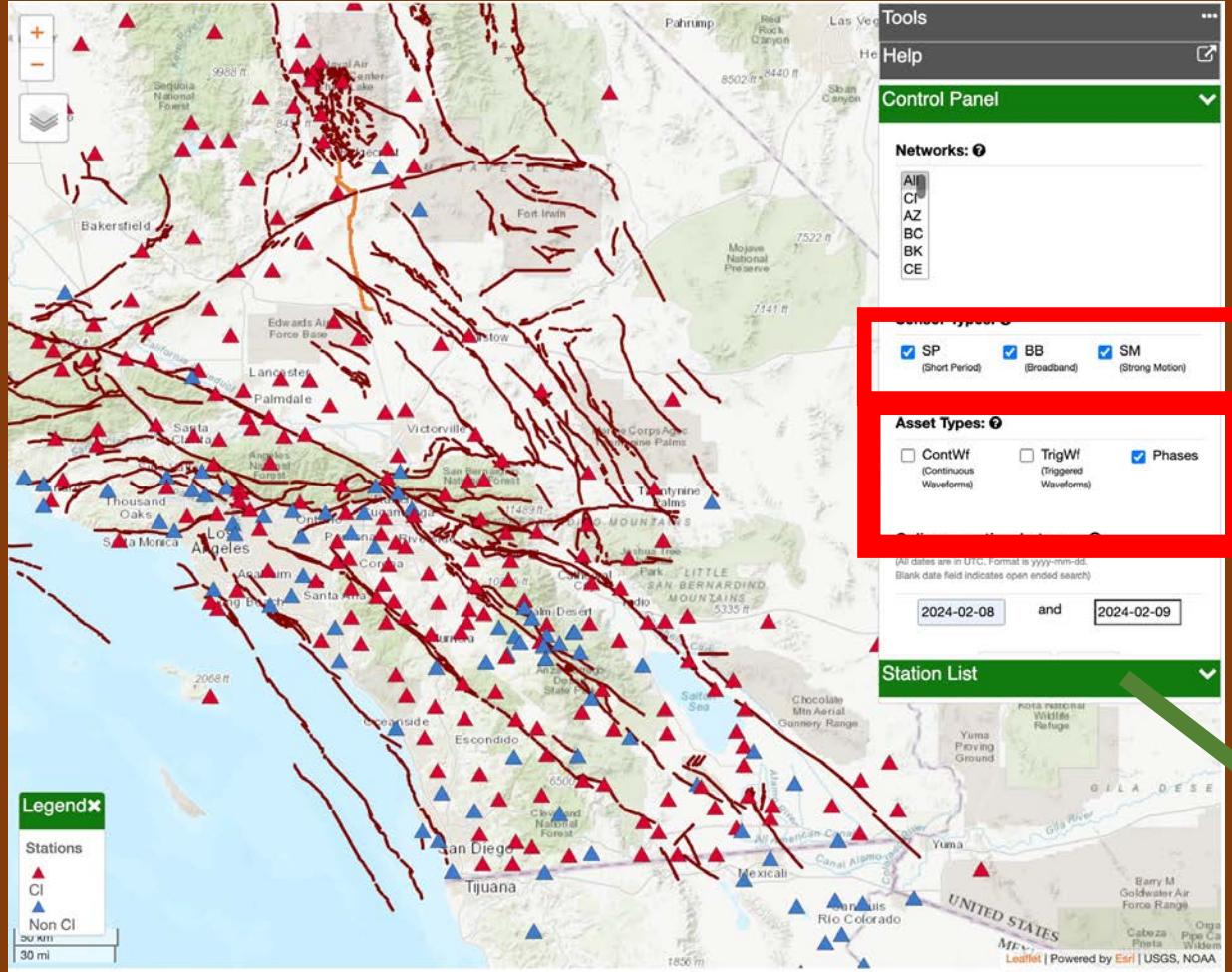
Hardware and response information of SCSN stations

- [Instrument Responses \(Simple Response or "Stage 0" gain for a seismic channel\)](#)
- [FDSN StationXML for SCSN Stations](#) - A directory of files for CI stations in FDSNStationXML format. Contains stage sensitivities if available
- [Dataless SEED Volumes for SCSN Stations](#) - A directory of files for CI stations in dataless SEED format. Contains stage sensitivities if available

NET	STA	CHA	LOC	STANAME	LAT	LON	ELEV	ONDATE	OFFDATE	EDEPTH	REALTIME
CE	00022	HNE	--	Winterhaven - Sheriff Substation	32.73900	-114.63570	40	1999/12/01	2021/04/01		0
CE	00022	HNN	--	Winterhaven - Sheriff Substation	32.73900	-114.63570	40	1999/12/01	2021/04/01		0
CE	00022	HNZ	--	Winterhaven - Sheriff Substation	32.73900	-114.63570	40	1999/12/01	2021/04/01		0
CE	01711	HNZ	--	El Centro - Imperial & Ross	32.77970	-115.56750	-7	2002/12/10	2022/03/09		0
CE	01711	HNZ	--	El Centro - Imperial & Ross	32.77970	-115.56740	-7	2022/03/09	3000/01/01		0
CE	01794	HNE	--	El Centro - Meloland Geotechnical	32.77380	-115.44860	-4	2007/02/06	3000/01/01		0
CE	01794	HNN	--	El Centro - Meloland Geotechnical	32.77380	-115.44860	-4	2016/05/24	3000/01/01		0
CE	01794	HNZ	--	El Centro - Meloland Geotechnical	32.77380	-115.44860	-4	2016/05/24	3000/01/01		0
CE	02140	HNE	--	El Cajon - Marshall & Vernon	32.81350	-116.97540	119	2002/11/06	3000/01/01		0
CE	02140	HNN	--	El Cajon - Marshall & Vernon	32.81350	-116.97540	119	2002/11/06	3000/01/01		0
CE	02140	HNZ	--	El Cajon - Marshall & Vernon	32.81350	-116.97540	119	2002/11/06	3000/01/01		0
CE	02143	HNE	--	Santee - Mission Gorge & Cotto	32.84000	-116.97400	108	2001/08/20	2002/11/06		0
CE	02143	HNE	--	Santee - Mission Gorge & Cotto	32.83990	-116.97410	108	2002/11/06	3000/01/01		0
CE	02143	HNE	10	Santee - Mission Gorge & Cotto	32.83990	-116.97410	108	2017/11/15	3000/01/01		0 *realtime

NET	STA	SEED	LOC	CORNER	DAMPING	GAIN	GAIN UNITS	ONDATE	OFFDATE
CHAN	CODE	FREQ	CONST						
CE	00022	HNE	--	96.4999795	0.670	2140.800	counts/(cm/sec2)	1999/12/01	2021/04/01
CE	00022	HNN	--	91.1000135	0.660	2147.510	counts/(cm/sec2)	1999/12/01	2021/04/01
CE	00022	HNZ	--	91.1999370	0.660	2140.800	counts/(cm/sec2)	1999/12/01	2021/04/01
CE	00726	HNE	--	204.0000460	0.700	4281.550	counts/(cm/sec2)	2022/03/22	3000/01/01
CE	00726	HNE	10	204.0000460	0.700	4281.550	counts/(cm/sec2)	2022/03/22	3000/01/01
CE	00726	HNN	--	221.9999568	0.700	4274.840	counts/(cm/sec2)	2022/03/22	3000/01/01
CE	00726	HNN	10	221.9999568	0.700	4274.840	counts/(cm/sec2)	2022/03/22	3000/01/01
CE	00726	HNZ	--	205.9999739	0.700	4274.840	counts/(cm/sec2)	2022/03/22	3000/01/01
CE	00726	HNZ	10	205.9999739	0.700	4274.840	counts/(cm/sec2)	2022/03/22	3000/01/01

SCEDC Data Discovery Map



<https://service.scedc.caltech.edu/SCSNStationMap/station.html>

The screenshot shows the SCEDC website's main page. It features a navigation bar at the top with links to various sections like Home, Recent Earthquakes, and EQ Catalogs. On the right, there's a sidebar with links for different data types and services. The central content area includes a 'Welcome' message and some descriptive text about the SCEDC's mission.

- Shows stations that have data in the SCEDC archive.
- Can filter by time, sensor type, and network code
- Can filter by if site has continuous or triggered waveforms, or if phase arrival in catalog exists.
- Can produce csv files to feed into other scripts.
<https://github.com/scedc/tutorials>

SCEDC
Open Dataset


Data Access – Website - Special Datasets

The screenshot shows the SCEDC website with a navigation bar at the top. The 'Access Data' dropdown menu is open, revealing options like 'Web Services', 'Cloud Hosted Archive', 'Waveform Data', 'Station Metadata and Maps', and 'About SCEDC Catalogs'. A callout box highlights the 'Special Data Sets' option. Below the navigation, there's a section titled 'Access Data' with a 'Special Data Sets' heading and a list of links.

SCEDC Southern California Earthquake Data Center

Home Cite the SCEDC Recent Earthquakes Earthquake Info EQ Catalogs Access Data FAQ About

Access Data

Special Data Sets

- California-Mexico Border Catalog
- W Phase Catalog (2016-2021)
- Cahuilla Swarm Catalog (2016-2019)
- Data Sets and Information for M7.1 Ridgecrest Sequence
- Quake Template Matching (QTM) seismicity catalog
- Test Events for Earthquake Early Warning and General Seismological Algorithm Testing
- Training and Validation Data Sets for Deep Learning
- Data Sets and Information for M7.2 Sierra El Mayor Cucapah Earthquake
- Interactive Tomographic Map
- Synthetic WFS for ShakeOut M7.8 Scenario
- Alternate Catalogs -- refined catalogs based on further postprocessing by researchers
- 3D Velocity Model for Southern California
- LARSE Experiment Data
 - LARSE II 1993 Passive Experiment
 - LARSE II 1994 Experiments
 - LARSE II (1999) Experiment
- Survey-mode GPS Data
- Fault-zone Trapped Waves Data
- Compression Directions in Southern California
- NARS-Baja Seismic Network Baja-California 2002-2007

Please cite authors!

<https://scedc.caltech.edu/data/datasets.html>

SCEDC Archive as AWS Open Dataset

Or “What if the data was already downloaded?”

AWS Open Dataset - About

Bucket name: s3://scedc-pds

Region: us-west-2

Data Types-

- Waveforms – Cont/Trig (*mSEED*)
- Event Catalog (*ascii SCSN catalog files*)
- Phase (*ascii STP phase format*)
- Station Metadata (*ascii FDSN StationXML – only CI stations*)
- DAS (Ridgecrest array –*PASSCAL SEG-Y*)

The screenshot shows a web browser window with the AWS Data Exchange interface. At the top, there's a dark header bar with the AWS logo and a blue navigation bar with the text "Explore the catalog" and a close button ("X"). Below this, a blue banner displays the text "5,000+ existing data products from category-sets. Learn more about AWS Data Exchange". The main content area has a white background and features a section titled "Southern California Earthquake Data" with a sub-section "earth observation" and "earthquakes" under "seismology". A detailed description follows: "This dataset contains ground motion velocity and acceleration seismic waveforms recorded by the Southern California Seismic Network (SCSN) and archived at the Southern California Earthquake Data Center (SCEDC). A Distributed Acoustics Sensing (DAS) dataset is included." Below the description is a "Details →" link. Under "Usage examples", there's a list of six items, each with a link to a tutorial or example. At the bottom of the list is a link "See 8 usage examples →".

NCEDC also has one – s3://ncedc-pds

AWS Open Dataset looks very similar to file system

```
your-workstation>aws s3 ls s3://scedc-pds/ --no-sign-request
PRE FDSNstationXML/
PRE Ridgecrest_DAS/
PRE continuous_waveforms/
PRE earthquake_catalogs/
PRE event_phases/
PRE event_waveforms/
PRE indexmap/
2041 README
2019-12-18 09:50:20
your-workstation>
```

Need aws cli (cmd line interface)
or SDK in your favorite coding language
Ex Python: boto3
There are many

```
your-workstation> aws s3 ls s3://scedc-pds/continuous_waveforms/2025/2025_094/
2025-04-05 00:41:06 3104256 AZCRY__BHE__2025094.ms
2025-04-05 00:41:06 3020800 AZCRY__BHN__2025094.ms
2025-04-05 00:41:06 3229696 AZCRY__BHZ__2025094.ms
2025-04-05 00:41:06 8655360 AZCRY__HHE__2025094.ms
2025-04-05 00:41:06 7872000 AZCRY__HHN__2025094.ms
2025-04-05 00:41:06 9445376 AZCRY__HZZ__2025094.ms
2025-04-05 00:41:07 6409728 AZCRY__HNE__2025094.ms
2025-04-05 00:41:07 6286848 AZCRY__HNN__2025094.ms
2025-04-05 00:41:09 6733824 AZCRY__HNZ__2025094.ms
2025-04-05 00:41:09 2657280 AZFRD__BHE__2025094.ms
2025-04-05 00:41:09 2633728 AZFRD__BHN__2025094.ms
```

Object and prefixes have meaningful names to help search



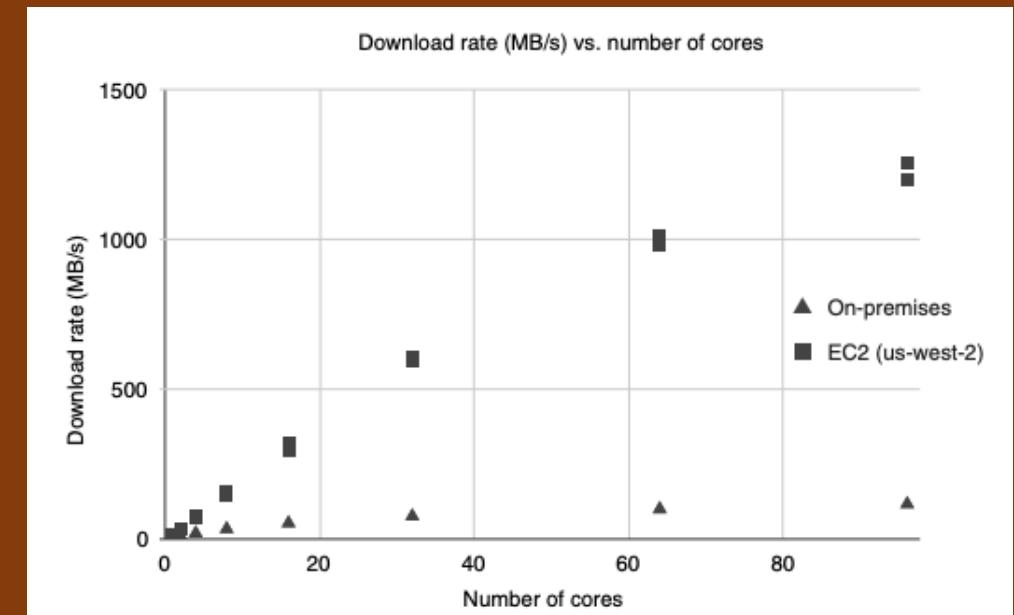
s3://scedc-pds

(no AWS account required) but
you will need aws cli or sdk like
boto3

Why you should use it:

- Access rates as high as 2GB/s
- 5,500 GET/HEAD requests /second/prefix
- The data is already there, why do you want to download it again?
- <https://scedc.caltech.edu/data/cloud.html>

A screenshot of the SCEDC (Southern California Earthquake Data Center) website. The header includes the SCEDC logo, the text "Southern California Earthquake Data Center", and a search bar. The main content area is titled "Welcome" and provides a brief overview of the center's mission and funding.



Web Services at the SCEDC

SCEDC webservices are classified into FDSN and SCEDC

<https://service.scedc.caltech.edu/>

FDSNWS			
Service interface	Version	Summary	Return options
station	v1.1	metadata for waveform time series stored	FDSN StationXML text
dataselect	v1.1	waveform time series	miniSEED
event	v1.1	event catalog webservice	QuakeML text
availability	v1.0	waveform availability webservice	text geocsv json request

SCEDCWS			
Service interface	Version	Summary	Return options
webstp	v1.0	SCEDC earthquake catalog SCEDC phase data continuous waveform time series triggered waveform time series	miniSEED SAC ASCII text
sacpz	v1.0	Poles and zeros of instrument response in SAC ASCII format.	SAC
resp	v1.0		RESP

} These are available for other RSNs:

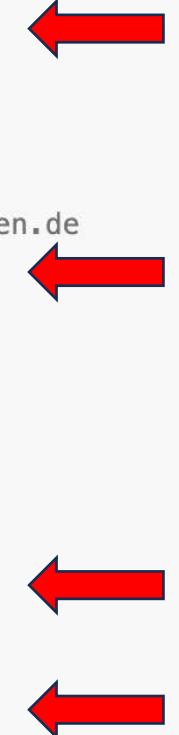
EarthScope:
<https://service.iris.edu/>

NCEDC (Nor Cal):
<https://service.ncedc.org/>

FDSN Web Services

- The most common standard amongst seismic data centers
- Web form url builder: ex
<https://service.scedc.caltech.edu/fdsnws/datasetselect/1/>
- Automated or scripted requests can be made using programs such as wget or curl or libraries for HTTP access in the programming language of your choice.
- ObsPy - The ObsPy project provides a Python framework for processing seismological data. Included in this framework is the capability to retrieve data from FDSN web services. *Most Popular*
- IrisFetch.m - A MATLAB library created by IRIS that allows seamless access to data via FDSN web services. (note – deprecated, requires Matlab 2022b or older)

```
>>> from obspy.clients.fdsn.header import URL_MAPPINGS
>>> for key in sorted(URL_MAPPINGS.keys()):
...     print("{0:<11} {1}".format(key, URL_MAPPINGS[key]))
AUSPASS      http://auspass.edu.au
BGR          http://eida.bgr.de
EIDA         http://eida-federator.ethz.ch
EMSC          http://www.seismicportal.eu
ETH           http://eida.ethz.ch
GEOFON        http://geofon.gfz-potsdam.de
GEONET        http://service.geonet.org.nz
GFZ           http://geofon.gfz-potsdam.de
ICGC          http://ws.icgc.cat
IESDMC        http://batsws.earth.sinica.edu.tw
INGV          http://webservices.ingv.it
IPGP          http://ws.ipgp.fr
IRIS          http://service.iris.edu
IRISPH5       http://service.iris.edu
ISC            http://www.isc.ac.uk
KNMI          http://rds.knmi.nl
KOERI         http://eida.koeri.boun.edu.tr
LMU           https://erde.geophysik.uni-muenchen.de
NCEDC         http://service.ncedc.org
NIEP          http://eida-sc3.infp.ro
NOA           http://eida.gein.noa.gr
ODC           http://www.orfeus-eu.org
ORFEUS        http://www.orfeus-eu.org
RASPISHAKE    https://data.raspberryshake.org
RESIF          http://ws.resif.fr
RESIFPH5      http://ph5ws.resif.fr
SCEDC         http://service.scedc.caltech.edu
TEXNET        http://rtserve.beg.utexas.edu
UIB-NORSAR    http://eida.geo.uib.no
USGS          http://earthquake.usgs.gov
USP           http://sismo.iag.usp.br
```



Ridgecrest 7.1 via SCEDC web services + ObsPy :

<https://github.com/SCEDC/tutorials>

```
In [1]: # We will use obspy for this tutorial.  
from obspy import UTCDateTime  
from obspy.clients.fdsn import Client  
  
In [2]: # Connect to the SCEDC web services.  
# Use this connection for event, station and waveform web services  
  
client = Client('SCEDC', debug=True)  
  
Installed new opener with handlers: [obspy.clients.fdsn.client.CustomRedirectHandler object at 0x7fd97fecd8e0]  
Base URL: http://service.scedc.caltech.edu  
Request Headers: {'User-Agent': 'ObsPy/1.4.0 (Linux-4.18.0-425.3.1.el8.x86_64-glibc2.28, Python 3.10.5)'}  
Downloading http://service.scedc.caltech.edu/fdsnws/dataselect/1/application.wadl with requesting gzip compression  
Downloading http://service.scedc.caltech.edu/fdsnws/event/1/application.wadl with requesting gzip compression  
Downloading http://service.scedc.caltech.edu/fdsnws/station/1/application.wadl with requesting gzip compression  
Downloading http://service.scedc.caltech.edu/fdsnws/event/1/catalog with requesting gzip compression  
Downloading http://service.scedc.caltech.edu/fdsnws/event/1/contributors with requesting gzip compression  
Downloaded http://service.scedc.caltech.edu/fdsnws/station/1/application.wadl with HTTP code: 200  
Downloaded http://service.scedc.caltech.edu/fdsnws/dataselect/1/application.wadl with HTTP code: 200  
Downloaded http://service.scedc.caltech.edu/fdsnws/event/1/application.wadl with HTTP code: 200  
Downloaded http://service.scedc.caltech.edu/fdsnws/event/1/catalogs with HTTP code: 200  
Downloaded http://service.scedc.caltech.edu/fdsnws/event/1/contributors with HTTP code: 200  
Discovered dataset service  
Discovered station service  
Discovered event service  
Storing discovered services in cache.  
  
In [3]: # First, retrieve event information  
  
# set start and end times, we will use these throughout this tutorial  
  
t1 = UTCDateTime('2019-07-04T00:00:00-07:00')  
t2 = UTCDateTime('2019-07-05T20:21:00-07:00')  
  
cat = client.get_events(starttime=t1, endtime=t2,  
                         minmagnitude=7.0, catalog='SCEDC')  
  
Downloading http://service.scedc.caltech.edu/fdsnws/event/1/query?starttime=2019-07-04T07%3A00%3A00.000000&endtime=2019-07-06T03%3A21%3A00.000000&minmagnitude=7.0&catalog=SCEDC with requesting gzip compression  
Downloaded http://service.scedc.caltech.edu/fdsnws/event/1/query?starttime=2019-07-04T07%3A00%3A00.000000&endtime=2019-07-06T03%3A21%3A00.000000&minmagnitude=7.0&catalog=SCEDC with HTTP code: 200  
  
In [4]: # Retrieve the lat and lon for the event  
  
print(cat)  
ev_lat, ev_lon = cat[0].preferred_origin().latitude, cat[0].preferred_origin().longitude  
  
1 Event(s) in Catalog:  
2019-07-06T03:19:53.040000Z | +35.770, -117.599 | 7.1 Mw | manual  
  
In [5]: # Next, retrieve closest CI stations for HH[ENZ] channels associated with this event  
  
channels='HH*'  
inv = client.get_stations(network="CI", channel=channels,  
                          lat=ev_lat, lon=ev_lon,  
                          minradius=0, maxradius=0.2,  
                          starttime=t1, endtime=t2,  
                          level='channel')  
print(inv)
```

```
In [6]: # Get the list of station codes  
inv_stations = inv.get_contents()['stations']  
inv_closest_ci_stations = ",".join([item.split(' ')[0].split('.')[1] for item in inv_stations])  
print(inv_closest_ci_stations)  
  
CLC,SRT,TOW2,WRC2  
  
In [7]: # Retrieve the waveforms for the closest CI stations  
  
ev_waveforms = client.get_waveforms(network="CI",  
                                     station=inv_closest_ci_stations,  
                                     channel=channels, location="*",  
                                     starttime=t1, endtime=t2)  
  
Downloading http://service.scedc.caltech.edu/fdsnws/dataselect/1/query?starttime=2019-07-04T07%3A00%3A00.000000&endtime=2019-07-06T03%3A21%3A00.000000&network=CI&station=CLC%2CSRT%2CTOW2%2WCRC2&location=%2A&channel=H%2A without requesting gzip compression  
Downloaded http://service.scedc.caltech.edu/fdsnws/dataselect/1/query?starttime=2019-07-04T07%3A00%3A00.000000&endtime=2019-07-06T03%3A21%3A00.000000&network=CI&station=CLC%2CSRT%2CTOW2%2WCRC2&location=%2A&channel=H%2A with HTTP code: 200  
  
In [8]: print(ev_waveforms)  
  
12 Trace(s) in Stream:  
CI.CLC..HHE | 2019-07-04T06:59:59.998300Z - 2019-07-06T03:20:59.998300Z | 100.0 Hz, 15966001 samples  
CI.CLC..HHN | 2019-07-04T06:59:59.998300Z - 2019-07-06T03:20:59.998300Z | 100.0 Hz, 15966001 samples  
CI.CLC..HHZ | 2019-07-04T06:59:59.998300Z - 2019-07-06T03:20:59.998300Z | 100.0 Hz, 15966001 samples  
CI.SRT..HHE | 2019-07-04T06:59:59.998300Z - 2019-07-06T03:20:59.998300Z | 100.0 Hz, 15966001 samples  
CI.SRT..HHN | 2019-07-04T06:59:59.998300Z - 2019-07-06T03:20:59.998300Z | 100.0 Hz, 15966001 samples  
CI.SRT..HHZ | 2019-07-04T06:59:59.998300Z - 2019-07-06T03:20:59.998300Z | 100.0 Hz, 15966001 samples  
CI.TOW2..HHE | 2019-07-04T06:59:59.998300Z - 2019-07-06T03:20:59.998300Z | 100.0 Hz, 15966001 samples  
CI.TOW2..HHN | 2019-07-04T06:59:59.998300Z - 2019-07-06T03:20:59.998300Z | 100.0 Hz, 15966001 samples  
CI.TOW2..HHZ | 2019-07-04T06:59:59.998300Z - 2019-07-06T03:20:59.998300Z | 100.0 Hz, 15966001 samples  
CI.WRC2..HHE | 2019-07-04T06:59:59.998300Z - 2019-07-06T03:20:59.998300Z | 100.0 Hz, 15966001 samples  
CI.WRC2..HHN | 2019-07-04T06:59:59.998300Z - 2019-07-06T03:20:59.998300Z | 100.0 Hz, 15966001 samples  
CI.WRC2..HHZ | 2019-07-04T06:59:59.998300Z - 2019-07-06T03:20:59.998300Z | 100.0 Hz, 15966001 samples  
  
In [9]: ev_waveforms.label='Ridgecrest 7.1 earthquake, 05-July-2019'  
ev_waveforms.plot(equal_scale=False)  
  
Ridgecrest 7.1 earthquake, 05-July-2019  

```

Please be aware when using web services

- Please be a good digital citizen and request
 - reasonable amounts of data per request
 - Requested time windows that don't fit this formula will return no data.
$$(\text{timewindow} * \text{sr} + 100) \leq 400 * 1024 * 1024 / 4$$
where timewindow is end-start in seconds, sr is sample rate of the channel.
 - Max 3 concurrent sessions
 - Check the HTTP status code returned for your request.
- Requesting too much data may result in not receiving your full request.
- Flooding web services with requests may result in your IP's being temporarily blacklisted.

STP (Seismogram Transfer Program)

STP Overview

- The engine behind SCEDC's on-premises data access
- C client
- STP is scriptable – put commands in a file and feed them to the client
`cat commands.txt | stp`
- Provides access to:
 - SCSN event catalog
 - SCSN event triggered waveforms and phase picks
 - Station metadata
 - Continuously archived waveform data

PySTP Python Module for STP

```
In [6]: waveforms = stp.get_trig(evid, net='CI', sta='BAK')
waveforms
Processed 9 waveform traces

Out[6]: {40161279: 9 Trace(s) in Stream:
CI.BAK..BHE | 2023-01-25T10:00:47.169538Z - 2023-01-25T10:06:06.569538Z | 40.0 Hz, 12777 samples
CI.BAK..BHN | 2023-01-25T10:00:49.369538Z - 2023-01-25T10:06:05.394538Z | 40.0 Hz, 12642 samples
CI.BAK..BHZ | 2023-01-25T10:00:45.069538Z - 2023-01-25T10:06:03.969538Z | 40.0 Hz, 12757 samples
CI.BAK..HHE | 2023-01-25T10:00:49.318393Z - 2023-01-25T10:06:03.598393Z | 100.0 Hz, 31429 samples
CI.BAK..HHN | 2023-01-25T10:00:48.338393Z - 2023-01-25T10:06:05.348393Z | 100.0 Hz, 31702 samples
CI.BAK..HHZ | 2023-01-25T10:00:50.318394Z - 2023-01-25T10:06:04.688394Z | 100.0 Hz, 31438 samples
CI.BAK..HNE | 2023-01-25T10:00:46.238393Z - 2023-01-25T10:06:03.268393Z | 100.0 Hz, 31704 samples
CI.BAK..HNN | 2023-01-25T10:00:49.238393Z - 2023-01-25T10:06:03.368393Z | 100.0 Hz, 31414 samples
CI.BAK..HNZ | 2023-01-25T10:00:45.788393Z - 2023-01-25T10:06:07.388393Z | 100.0 Hz, 32161 samples}

waveforms is a dictionary that maps the event ID to an ObsPy stream.

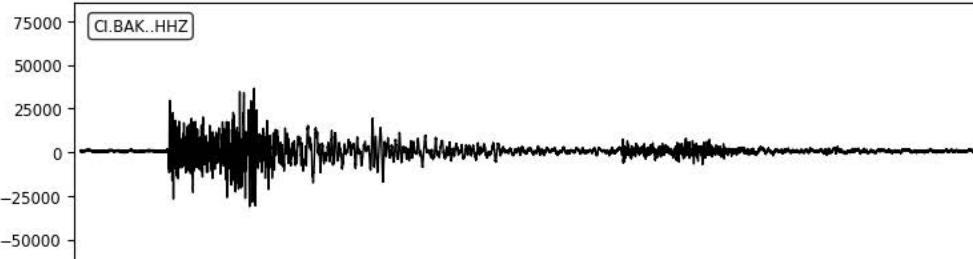
ObsPy stream methods can be used to select traces from the stream and to do processing and plotting. The following line returns a new Stream that only contains data from CI.BAK.HH channels.

In [ ]: waveforms[evid].select(network='CI', station='BAK', channel='HH*')

Let's use ObsPy's 'plot()' function to plot the waveforms from CI.BAK.HH.

In [6]: waveforms[evid].select(channel='HH*').plot()

2023-01-25T10:00:48.338393 - 2023-01-25T10:06:05.348393
```



<https://github.com/SCEDC/tutorials>

- Connects to the same STP servers as the C clients
- Reads waveforms into ObsPy Stream objects and events and phase picks into Catalog objects
- Currently supports triggered downloads, event catalogs, triggered waveform availability, and phase picks
- Don't need to know STP's query language
- Use in Python programs or Jupyter Notebooks

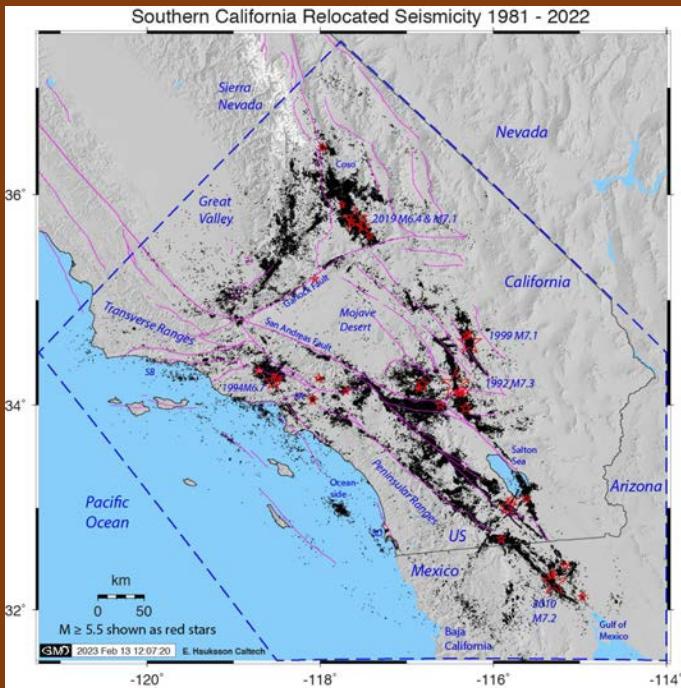
Data Access Tips

- Study availability first, then retrieve data based on the results.
- If you are looking at catalog near Ridgecrest 2019 sequence, be aware active processing is still happening.
- Consider using the AWS Open Data set, especially if your study spans months or years
- If looking for “integrated products”, such as event waveforms, phases or gain applied waveforms, consider using STP or PySTP
- If your area of study spans multiple seismic networks or data centers: Consider FDSN web services, or ComCat for event catalogs.
- If you use CI data in your research, please cite the SCSN and SCEDC (see citation slide)
 - Generalizing – please cite the network if you use their data.
- Questions? Feedback? We are happy to help and we LOVE feedback.

What Will YOU Do With 90+ Years of Seismic Data?

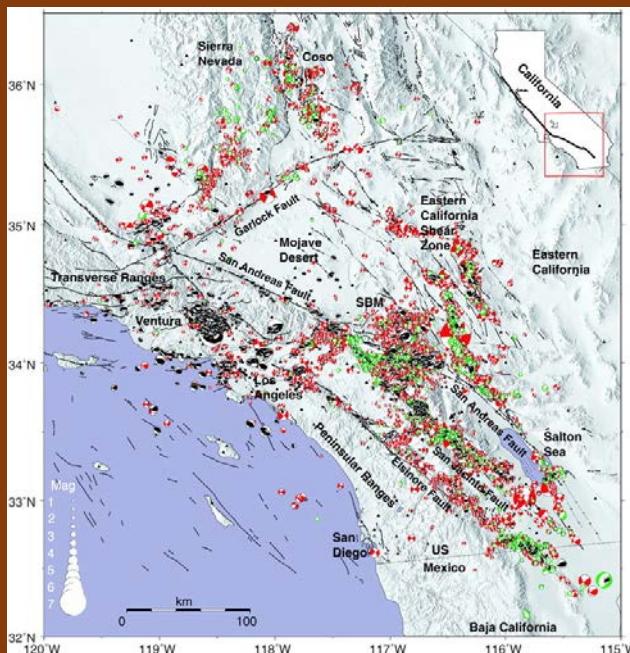
Double-difference Catalog

- updated yearly
- two formats
- available for 1981-2024
- maintained by E. Hauksson



Refined FM Catalog

- updated yearly
- available for 1981-2024
- maintained by E. Hauksson



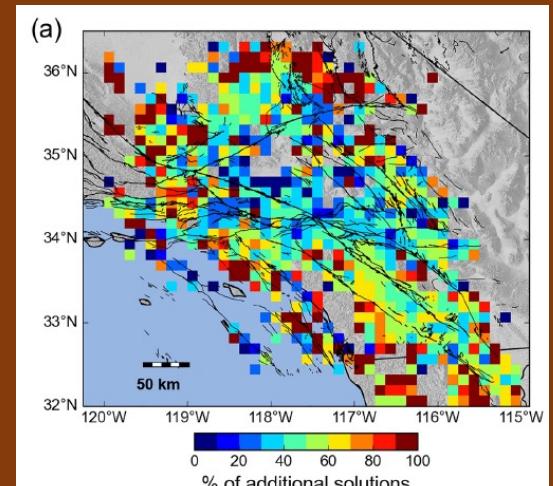
And others!

Template Matching (QTM) Catalog

- available for 2008-2017
- contains >1.8 million events
- produced by Z. Ross

Deep Learning FM Catalog

- available for 1981-2021
- uses HASH method with additional phases & polarities from DL
- produced by Y. Cheng



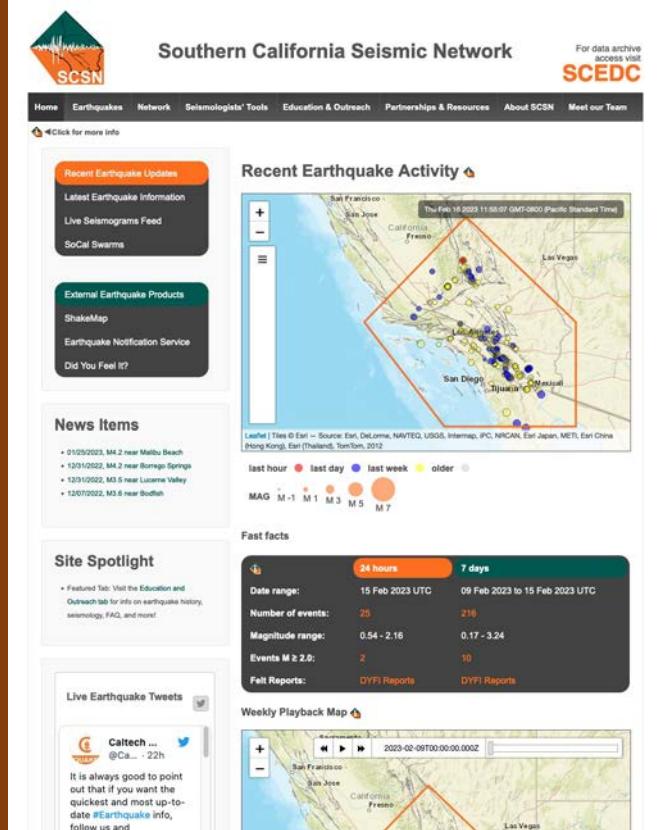
Tutorials

- available on github : <https://github.com/SCEDC/tutorials>
- Ridgecrest 7.1 via SCEDC web services + ObsPy
 - https://bit.ly/scedc_ws_ridgecrest7_1
- Retrieve waveform data from SCEDC PDS, leveraging the availability web service
 - https://bit.ly/scedc_pds_fetch_waveforms_parallel
- PySTP download and demos: <https://github.com/SCEDC/pystp/>

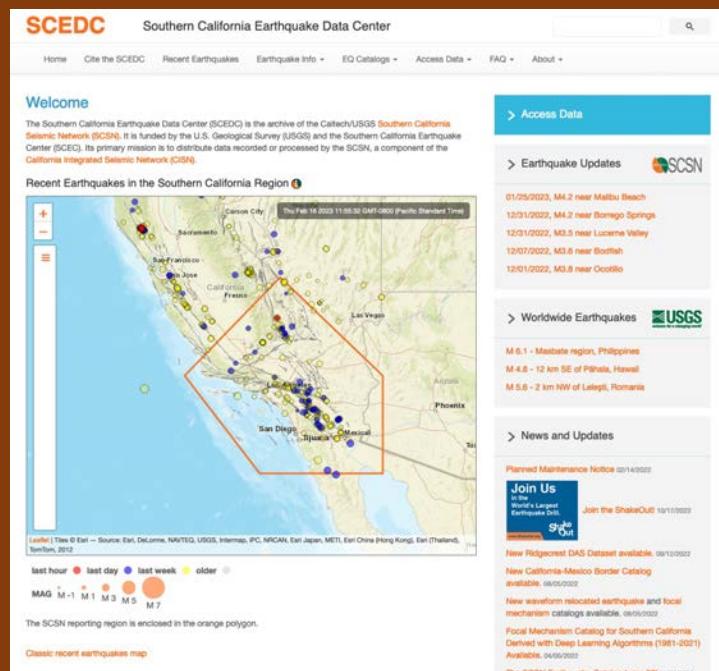
Resources

- SCEDC web services : <https://service.sciedc.caltech.edu/>
- ObsPy : <https://docs.obspy.org/>
- IRIS Fetch scripts : https://seiscode.iris.washington.edu/projects/ws-fetch-scripts/wiki/Use_with_other_data_centers
- IrisFetch.m : <http://ds.iris.edu/ds/nodes/dmc/software/downloads/irisFetch.m/> (note – irisFetch.m is deprecated. ☺)
- FDSN web service specification : <https://www.fdsn.org/webservices/>
- STP client download links and manual: <https://scedc.caltech.edu/data/stp/>
- SCEDC AWS Open Dataset: <https://scedc.caltech.edu/data/cloud.html>
- Comcat search (web form) : <https://earthquake.usgs.gov/earthquakes/search/>
- Comcat python api : <https://code.usgs.gov/ghsc/esi/libcomcat-python>
- ComCat contributor: <https://earthquake.usgs.gov/data/comcat/catalog/>
- Earthscope Metadata Aggregator: <https://ds.iris.edu/mda/>

<https://www.scsn.org>



<https://scedc.caltech.edu>



Twitter/X: @CaltechSeismo
(and Facebook, Bluesky,
Instagram, LinkedIn)



Extra Slides

Web STP serves as a web interface to the STP client; serves continuous waveform data as well as event waveform and phase data

<https://service.scedc.caltech.edu/webstp/>

The screenshot shows two identical-looking web forms side-by-side, separated by a central vertical bar. Both forms have a white background and gray borders for input fields.

Left Form (Left of Vertical Bar):

- Header: "Empty lines and lines beginning with the # character are ignored."
- Section: "Select o/p format:" with a dropdown menu set to "MiniSEED". A yellow arrow points from the right side of this section towards the central list of formats.
- Section: "Select o/p options:" with several checkboxes:
 - Swap byte order
 - Correct for station gain
 - Use true start time in headers
 - Zero fill off
 - Sort off
- Radio buttons: Continuous Triggered STP Phase
- Section: "Select window(s):" with a text input field containing:

```
CI BAK BHE -- 2019/01/01,00:00:00 2019/01/01,01:00:00;
CI PASC HHE 00 2018/02/02,22:00:00 +1h;
```
- Buttons: "Submit" and "Reset Values"

Central List: A large black rectangular box contains a list of output formats:

- MiniSEED
- SAC
- INT32
- FLT32
- ASCII
- COSMOS-V0
- COSMOS-V1

Right Form (Right of Vertical Bar):

- Header: "Empty lines and lines beginning with the # character are ignored."
- Section: "Select o/p format:" with a dropdown menu set to "MiniSEED". A yellow arrow points from the left side of this section towards the central list of formats.
- Section: "Select o/p options:" with several checkboxes:
 - Swap byte order
 - Correct for station gain
 - Use true start time in headers
 - Zero fill off
 - Sort off
- Radio buttons: Continuous Triggered STP Phase
- Section: "Select event(s):" with a text input field containing:

```
37509232
37301679
37352384
```
- Buttons: "Submit" and "Reset Values"

Note: Requested time windows that don't fit this formula will return no data.
 $(\text{timewindow} / 1 / \text{sr} + 100) \leq 400 * 1024 * 1024 / 4$
where timewindow is end-start in seconds, sr is sample rate of the channel

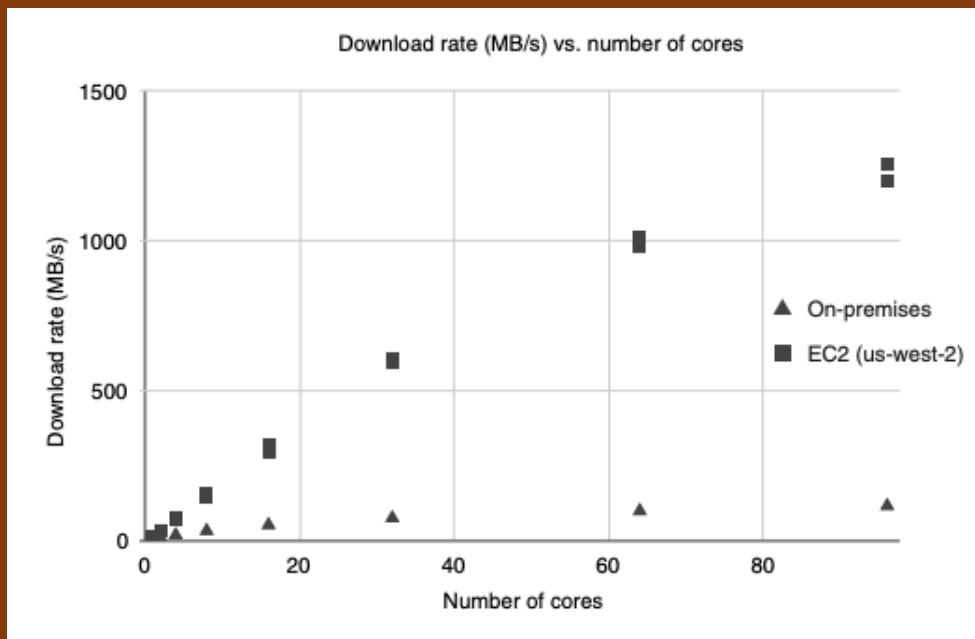
How to take advantage of cloud hosted data

*** Use parallel processing (remember 5,500 GET/HEAD requests /second/prefix!) ***

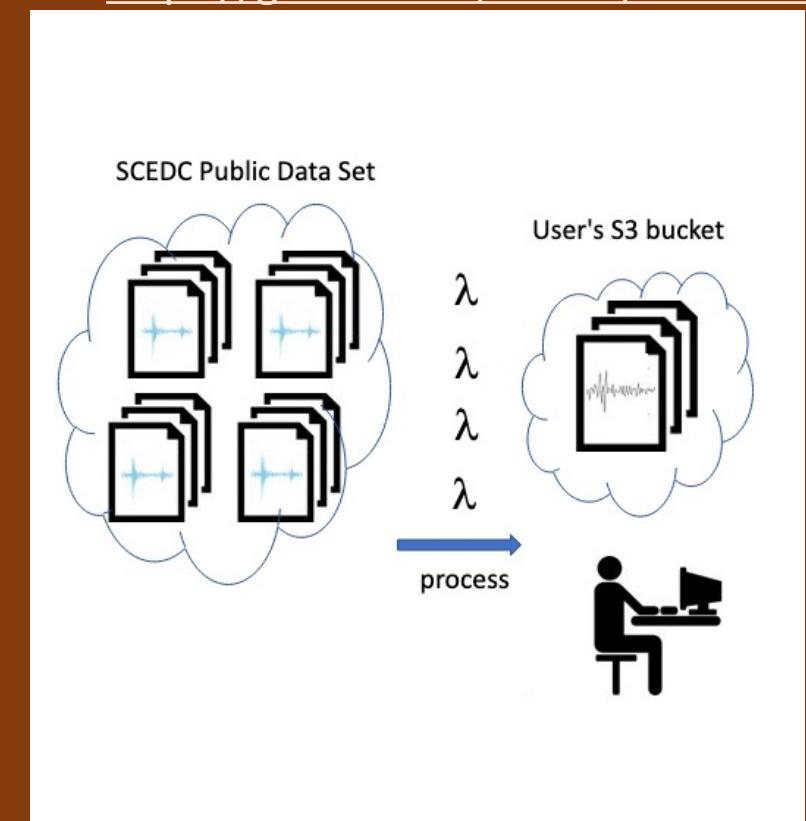
Take advantage of cloud services where appropriate

- Use the same region (us-west-2)
- Pay as you go
- Read the file in place for processing, store results in s3.

(Instead of downloading file and then process)



See <https://github.com/SCEDC/tutorials>



Data Access – AWS Open Dataset Program

AWS Open Dataset Program – Amazon covers the cost of storage for scientific datasets for providers whose goals are to:

- Democratize access to data by making it available for analysis on AWS
- Develop new cloud-native techniques, formats, and tools that lower the cost of working with data
- Encourage the development of communities that benefit from access to shared datasets
- SCEDC dataset currently in program – current agreement is until 2027.

The screenshot shows the 'Registry of Open Data on AWS' homepage. At the top, there's a banner with the AWS logo and a button to 'Explore the catalog'. Below the banner, a section titled 'About' explains the purpose of the registry. It mentions recent additions and provides links to tutorials and usage examples. A search bar at the bottom is populated with the word 'seismology'. An arrow points from this search bar to a callout box in the foreground containing the text 'Other datasets available! NCEDC also has one!!!!'. At the bottom of the page, there's a link to 'https://ncedc.org/aws-public-dataset.html'.

Registry of Open Data on AWS

The Registry of Open Data on AWS is now available on AWS Data Exchange. All datasets on the Registry of Open Data are now discoverable on AWS Data Exchange alongside 3,000+ existing data products from category-leading data providers across industries. Explore the catalog to find open, free, and commercial data sets. [Learn more about AWS Data Exchange](#)

About

This registry exists to help people discover and share datasets that are available via AWS resources. See [recent additions](#) and [learn more about sharing data on AWS](#).

Get started using data quickly by viewing [all tutorials with associated SageMaker Studio Lab notebooks](#).

See [all usage examples for datasets listed in this registry](#).

See datasets from Allen Institute for Artificial Intelligence (AI2), Digital Earth Africa, Data for Good at Meta, NASA Space Act Agreement, NIH STRIDES, NOAA Open Data Dissemination Program, Space Telescope Science Institute, and [Amazon Sustainability Data Initiative](#).

Search datasets (currently 4 matching datasets)

seismology

Add to this registry
If you want to add

Other datasets available!
NCEDC also has one!!!!

<https://ncedc.org/aws-public-dataset.html>

Southern California Earthquake Data

earth observation, earthquakes, seismology

This dataset contains ground motion velocity and acceleration seismic waveforms recorded by the Southern California Seismic Network (SCSN) and archived at the Southern California Earthquake Data Center (SCEDC). A Distributed Acoustics Sensing (DAS) dataset is included.

[Details →](#)

Usage examples

- [Jupyter Notebook tutorial on Ridgecrest DAS dataset by Jiuxun Yin](#)
- [Cactus to Clouds: Processing The SCEDC Open Data Set on AWS by Tim Clements](#)
- [SeisNoise.jl GPU Computing Tutorial - Another example of accessing data s3://scedc-pds for ambient noise cross-correlation by Tim Clements](#)
- [Using Amazon API Gateway and Lambda to window and decimate waveforms by Shang-Lin Chen](#)
- [Getting Started with SCEDC AWS Public Dataset by Ellen Yu](#)

See 8 usage examples →

AWS Open Dataset - S3 Object Storage

S3 = “Amazon Simple Storage Service”

Object storage vs file system

- Technically, object storage is very flat, there are no directories – objects are organized by prefixes – but to the user it looks a lot like a directory
 - Ex: s3://scedc-pds/continuous_waveforms/2023/2023_078/CIPASC_BHE10_2023078.ms
 - Also means an API is required to access this data
- specialized for parallel requests – 5,500 GET/HEAD requests /second/prefix
- If you have to work with a file system – you can use something like s3fs

SCEDC SACPZ web service serves instrument response data in SACPZ format

<https://service.scedc.caltech.edu/scedcws/sacpz/1/>

Station

net sta cha loc

Time (Date format :YYYY-MM-DDThh:mm:ss)

start end

time

URL: [/scedcws/sacpz/1/query?net=CI&sta=AGO&cha=HNE&loc--&start=2020-01-01T00:00:00&end=2023-01-01T00:00:00&nodata=404](https://service.scedc.caltech.edu/scedcws/sacpz/1/query?net=CI&sta=AGO&cha=HNE&loc--&start=2020-01-01T00:00:00&end=2023-01-01T00:00:00&nodata=404)



```
* ****
* NETWORK (KNETWK): CI
* STATION (KSTNM): AGO
* LOCATION (KHOLE):
* CHANNEL (KCHPM): HNE
* CREATED : 2023.052,12:11:54
* START : 2016.078,16:30:00
* END : 2021.349,21:00:00
* DESCRIPTION : Agoura
* LATITUDE : 34.14647
* LONGITUDE : -118.76699
* ELEVATION : 259
* DEPTH : 0
* DIP : 0
* AZIMUTH : 90
* SAMPLE RATE : 100
* INPUT UNIT : M
* OUTPUT UNIT : COUNTS
* INSTTYPE : EPISENSOR ES-T,Accelerometer,KINEMETRICS
* INSTGAIN : 5.083100E-01 (M/S**2)
* COMMENT : N/A
* SENSITIVITY : 2.131990E+05 (M/S**2)
* A0 : 2.459570E+13
* ****
ZEROS 2
+0.00000E+00 +0.00000E+00
+0.00000E+00 +0.00000E+00
POLES 4
-9.81000E+02 +1.00900E+03
-9.81000E+02 -1.00900E+03
-3.29000E+03 +1.26300E+03
-3.29000E+03 -1.26300E+03
CONSTANT +5.243779E+18
* ****
* NETWORK (KNETWK): CI
* STATION (KSTNM): AGO
* LOCATION (KHOLE):
* CHANNEL (KCHPM): HNE
* CREATED : 2023.052,12:11:54
* START : 2016.078,16:30:00
* END : 2021.349,21:00:00
* DESCRIPTION : Agoura
* LATITUDE : 34.14647
* LONGITUDE : -118.76699
* ELEVATION : 259
* DEPTH : 0
* DIP : 0
* AZIMUTH : 90
* SAMPLE RATE : 100
* INPUT UNIT : M
* OUTPUT UNIT : COUNTS
* INSTTYPE : EPISENSOR ES-T,Accelerometer,KINEMETRICS
* INSTGAIN : 5.083100E-01 (M/S**2)
* COMMENT : N/A
* SENSITIVITY : 2.131990E+05 (M/S**2)
* A0 : 2.459570E+13
* ****
ZEROS 2
+0.00000E+00 +0.00000E+00
+0.00000E+00 +0.00000E+00
POLES 4
-9.81000E+02 +1.00900E+03
-9.81000E+02 -1.00900E+03
-3.29000E+03 +1.26300E+03
-3.29000E+03 -1.26300E+03
CONSTANT +5.243779E+18
```

SCEDC RESP web service serves instrument response data in RESP format

<https://service.scedc.caltech.edu/scedcws/resp/1/>

Station

net sta cha loc

Time (Date format :YYYY-MM-DDThh:mm:ss)

start end

time

URL: /scedcws/resp/1/query?net=CI&sta=AGO&cha=HNE&loc=-&start=2020-01-01T00:00:00&end=2023-01-01T00:00:00&nodata=404

```
#  
#####
#  
B050F03 Station: AGO  
B050F16 Network: CI  
B052F03 Location: ??  
B052F04 Channel: HNE  
B052F22 Start date: 2021,349,21:00:00  
B052F23 End date: 3000,001,00:00:00  
  
#  
#  
#| Response (Poles and Zeros) |  
#| CI AGO HNE |  
#| 12/15/2021 to 01/01/3000 |  
#  
#  
B053F03 Transfer function type: A  
B053F04 Stage sequence number: 1  
B053F05 Response in units lookup: M/S**2 - ACCELERATION  
B053F06 Response out units lookup: V - VOLTAGE  
B053F07 A0 normalization factor: +2.45957E+13  
B053F08 Normalization frequency: +1.00000E+00  
B053F09 Number of zeroes: 0  
B053F14 Number of poles: 4  
#  
#| Complex poles: |  
#| i real imag real_error imag_error |  
B053F15-18 0 -9.81000E+02 +1.00900E+03 +0.00000E+00 +0.00000E+00  
B053F15-18 1 -9.81000E+02 -1.00900E+03 +0.00000E+00 +0.00000E+00  
B053F15-18 2 -3.29000E+03 +1.26300E+03 +0.00000E+00 +0.00000E+00  
B053F15-18 3 -3.29000E+03 -1.26300E+03 +0.00000E+00 +0.00000E+00  
  
#  
#| Channel Sensitivity/Gain |  
#| CI AGO HNE |  
#| 12/15/2021 to 01/01/3000 |  
#  
#  
B058F03 Stage sequence number: 1  
B058F04 Sensitivity: +5.08310E-01  
B058F05 Frequency of sensitivity: +1.00000E+00  
B058F06 Number of calibrations: 0
```

FDSN Event web service serves earthquake or event parametric information

<https://service.scedc.caltech.edu/fdsnws/event/1/>

URL Builder

Earthquake Parameters

Start Time	2019-07-06T00:00:00	End Time	2019-07-07T00:00:00
Min Mag	4	Max Mag	9
Min Depth		Max Depth	
Contributor	SCEDC		
Catalog	SCEDC		

Location (all inputs are in decimal degrees) ▶

Ring Radius (all inputs are in decimal degrees) ▶

Min Lat	Max Lat
Min Lon	Max Lon
Lat	Lon
Min Radius	Max Radius

Event ID ▶

Others ▶

Output ▶

Event Types	Any
Geographic Types	Any
Mag Types	All
<input type="checkbox"/> Include all magnitudes	
<input type="checkbox"/> Include arrivals	
<input type="checkbox"/> Include mechanisms	

Offset

Limit

Order By time (descending)

Format xml

URL: /fdsnws/event/1/query?starttime=2019-07-06T00:00:00&endtime=2019-07-07T00:00:00&minmag=4&maxmag=9&catalog=SCEDC&etype=any>ype=any&magtype=all&orderby=time&format=xml&nodata=404

• SCEDC
• DS2000
• HAU2003
• HAU2004
• SHLK2005
• YHS2011

• QuakeML
• Text

ObsPy Support



obspy.clients.fdsn.client.Client.get_events

```
Client.get_events starttime=None, endtime=None, minlatitude=None, maxlatitude=None, minlongitude=None, maxlongitude=None, eventtype=None, includesorigins=None, includemagnitudes=None, eventid=None, limit=None, orderby=None, catalog=None, contributor=None, updatedafter=None, filename=None, json=False
```

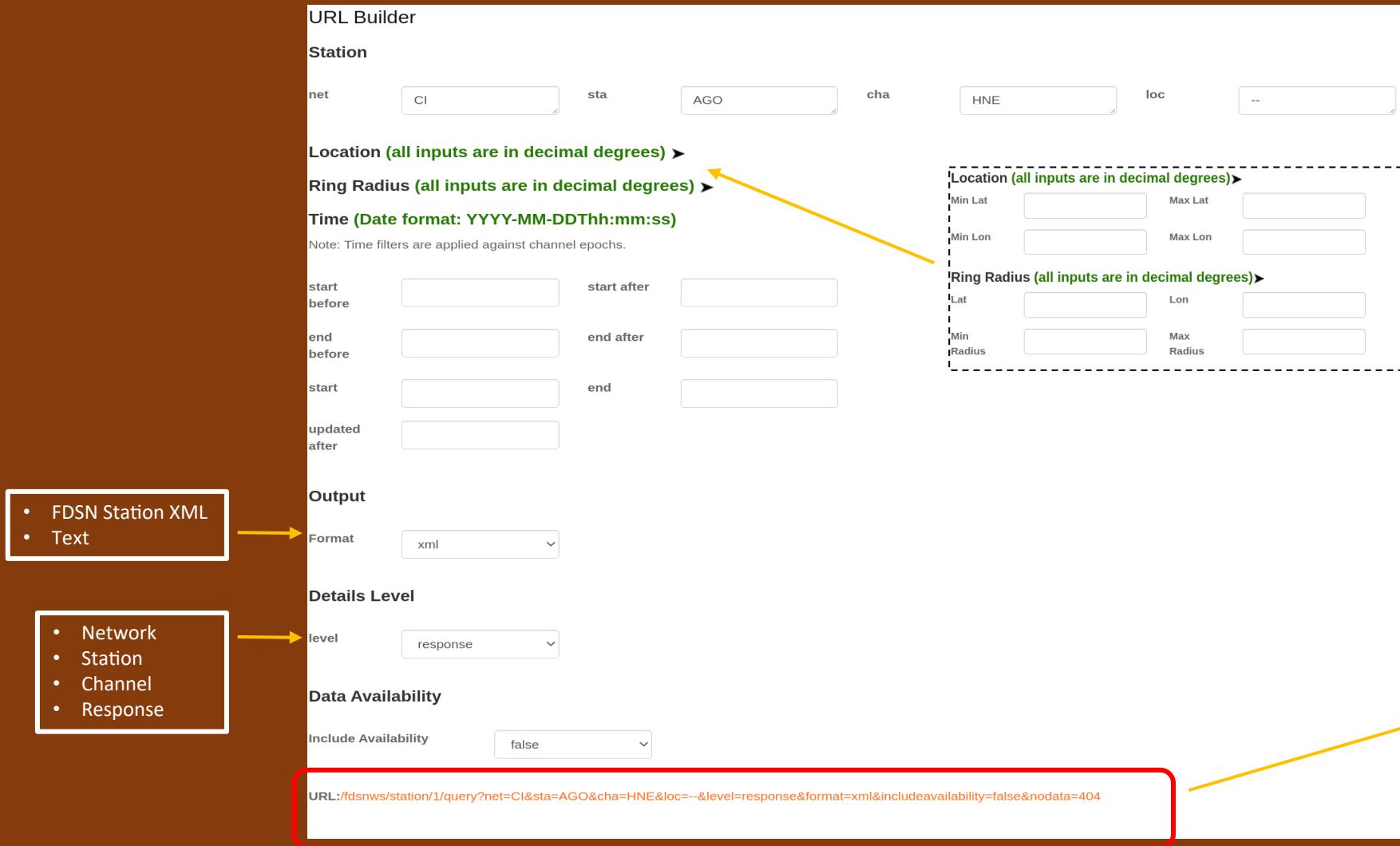
Query the event service of the client.

```
>>> client = Client('FDSN')
>>> cat = client.get_events(eventid=609303)
>>> print(cat)
1 Event(s) in Catalog:
1997-10-14T09:53:11.070000Z | -22.145, -176.720 | 7.8 ...
```

```
<?xml version="1.0" encoding="UTF-8"?>
<q:quakeml>
  <eventParameters publicID="quakeml:service.sciedc.caltech.edu/fdsnws/event/1/query?eventid=38469375">
    <creationInfo>
      <agencyID>CI</agencyID>
      <agencyURI>quakeml:doi.org/10.7909/C3WD3xH1</agencyURI>
      <creationTime>2023-03-24T16:01:24.77</creationTime>
    </creationInfo>
    <event publicID="quakeml:service.sciedc.caltech.edu/fdsnws/event/1/query?eventid=38469375" catalog:dat...
      <preferredOriginID>
        quakeml:service.sciedc.caltech.edu/fdsnws/event/1/query?originid=105212909
      </preferredOriginID>
      <preferredMagnitudeID>
        quakeml:service.sciedc.caltech.edu/fdsnws/event/1/query?magnitudeid=108603173
      </preferredMagnitudeID>
    </event>
    <creationInfo>
      <agencyID>CI</agencyID>
      <agencyURI>quakeml:doi.org/10.7909/C3WD3xH1</agencyURI>
      <creationTime>2019-07-10T22:33:16.00</creationTime>
    </creationInfo>
  </eventParameters>
</q:quakeml>
```

FDSN Station web service serves metadata for waveform time series

<https://service.sciedc.caltech.edu/fdsnws/station/1/>



ObsPy Support



```

osbspy.clients.fdsn.client.Client.get_stations

Client.get_stations(stations=None, network=None, latitude=None, longitude=None, endtime=None, starttime=None, interval=None, station=None, channel=None, minlatitude=None, maxlongitude=None,
                     minnetwork=None, maxnetwork=None, minstation=None, maxstation=None, intervaltype='None',
                     format='text', **kwargs)

Query the station service of the FDSN client.

    >>> client = Client('USGS')
    >>> client.get_stations()
    >>> eventime = ETDEventTime("2010-01-01T00:00:00", "2010-01-01T00:00:00")
    >>> inventory = client.get_stations(network="US", station="*", intervaltype="interval",
                                         starttime=eventime,
                                         endtime=eventime)
    >>> print(inventory)
    <Inventory>
    Created by: IEDS WEB SERVICE - Fdsn-station | version: ...
    ...
    Network: US
        Station: 21
            Latitude: 31.000
            Longitude: -160.000
            Depth: 0.000
            Location: 21.000 (Alabamas, Alabama)
            Site: 21.000 (Albuquerque, New Mexico)
            Phase: 21.000 (Albuquerque, New Mexico)

```

```
<Network code="CI" startDate="1900-01-01T00:00:00" endDate="3000-01-01T00:00:00">
  <Description>Southern California Seismic Network</Description>
  <TotalNumberStations>812</TotalNumberStations>
  <SelectedNumberStations>1</SelectedNumberStations>
  <Station code="AGO" endDate="2000-01-01T00:00:00" startDate="1995-10-24T00:00:00">
    <Latitude>34.14647</Latitude>
    <Longitude>-118.76699</Longitude>
    <Elevation>259.0</Elevation>
    <Site>
      <Name>Agoura</Name>
    </Site>
    <CreationDate>1995-10-24T00:00:00</CreationDate>
    <Channel code="HNE" endDate="2014-03-28T18:00:00" locationCode="" startDate="2008
      <Latitude>34.14647</Latitude>
      <Longitude>-118.76699</Longitude>
      <Elevation>259.0</Elevation>
      <Depth>0.0</Depth>
      <Azimuth>90.0</Azimuth>
      <Dip>0.0</Dip>
      <Type>TRIGGERED</Type>
      <SampleRate>100.0</SampleRate>
      <ClockDrift>0.01</ClockDrift>
```

FDSN Datasel ect web service serves continuous waveform time series data in miniSEED

<https://service.sciedc.caltech.edu/fdsnws/daselect/1/>

URL Builder

Station

net

sta

cha

loc Use dashes (-) instead of blank spaces.
For e.g. loc=--

Time & Quality

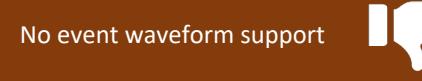
start end

Quality

Output

Format

URL: [/fdsnws/dataseries/1/query?net=CI&sta=AGI&cha=HNE&loc=--&start=2023-01-01T00:00:00&end=2023-01-01T00:10:00&format=miniseed&nodata=404](https://fdsnws/dataseries/1/query?net=CI&sta=AGI&cha=HNE&loc=--&start=2023-01-01T00:00:00&end=2023-01-01T00:10:00&format=miniseed&nodata=404)



`obspy.clients.fdsn.client.Client.get_waveforms`

```
Client.get_waveforms(network, station, location, channel, starttime, endtime, quality=None, minmagnitude=None, beginonly=None, filerestrict=None, attach_response=False, **kwargs) [source]

Query the data service for the client.

>>> client = Client('IRIS')
>>> x = client.get_waveforms('US', 'AD01', '00', 'BHZ', startime='2014-02-27T00:00:00Z')
>>> x[0].id
>>> x[0].startime
>>> x[0].endtime
>>> x[0].quality
>>> print(x[0])
<WadlResponse object at 0x10700000>
2014-02-27T00:00:00Z samples
```

Note: Requested time windows that don't fit this formula will return no data.
 $(\text{timewindow} / 1 / \text{sr} + 100) <= 400 * 1024 * 1024 / 4$
where timewindow is end-start in seconds, sr is sample rate of the channel

FDSN Availability web service serves time span information for what time series data are available (miniSEED only)

<https://service.scedc.caltech.edu/fdsnws/availability/1/>

The screenshot shows the FDSN Availability web service interface. At the top, there are tabs: Description, Extent (which is highlighted with a red box), Query, and Help. Below the tabs, there is a note: "Please see Help for available query parameters." and "Note: At this stage, triggered records from Jan 1977 - present and continuous records from Oct 1999 - present are available for queries." Under "Sample queries", there are sections for "Continuous waveforms" and "Triggered waveforms". The "Continuous waveforms" section includes links for network CI at station AGO in geocsv and json formats. The "Triggered waveforms" section includes a link for network CI at station PASC, channel HHE. A yellow arrow points from the "Extent" tab in this screenshot to the "Extent" tab in the URL Builder screenshot below.

The screenshot shows the URL Builder interface. At the top, there are tabs: Description, Extent (which is highlighted with a red box), Query (which is also highlighted with a red box), and Help. Below the tabs, there is a note: "Input form parameters and notice the URL field at the bottom change dynamically. Click on the URL to run your query." and "Note: Query end point updates are made on a daily basis but they are made at a delay to allow gaps in the archive to be filled. The most recent records are 56 days from today. This means that today, continuous data for seismic channels ('*H*', '*N' and '*L') from 2011/01/01 - 2022/12/27 are available for queries." Under "Channel", there are dropdown menus for net (CI), sta (AGO), loc (--), and cha (HNE). There are also input fields for start (2019-01-01T00:00:00) and end (2023-01-01T00:00:00). Under "Output", there is a dropdown menu set to "text". A yellow box highlights the "Format" dropdown. A yellow arrow points from the "Query" tab in the first screenshot to the "Query" tab in this screenshot. Another yellow arrow points from the "Format" dropdown in this screenshot to the "Format" dropdown in the first screenshot.

Extent produces lists of available time extents (earliest to latest) for selected channels (network, station, channel, location) and time ranges. Extents can be queried for both continuous and triggered waveform data.

/extent:

- triggered records from Jan 1977 - present
- continuous records from Oct 1999 - present

#dataset	Network	Station	Location	Channel	Quality	SampleRate	Earliest	Latest	Updated	TimeSpans	Restriction
CI	AGO	--	EHZ	D	100..00	2003-02-22T05:59:00-02:00	0600000Z	2023-03-20T05:55:01	0000000Z	NA	OPEN
CI	AGO	--	HLE	D	100..00	2003-02-22T05:59:59-02:00	7200000Z	2006-05-24T06:00:00	9900000Z	NA	OPEN
CI	AGO	--	HLW	D	100..00	2003-02-22T05:59:58-02:00	3600000Z	2006-05-24T06:00:00	9900000Z	NA	OPEN
CI	AGO	--	HLZ	D	100..00	2003-02-22T05:59:58-02:00	4400000Z	2006-05-24T06:00:00	9900000Z	NA	OPEN
CI	AGO	--	HNE	D	100..00	2010-01-01T00:00:00-00:00	4400000Z	2023-03-20T05:57:04	0000000Z	NA	OPEN
CI	AGO	--	HNZ	D	100..00	2010-01-01T00:00:00-00:00	3800000Z	2023-03-20T05:54:48	0000000Z	NA	OPEN
CI	AGO	--	HZD	D	100..00	2010-01-01T00:00:00-00:00	5600000Z	2023-03-20T05:54:44	0000000Z	NA	OPEN
CI	AGO	--	LCE	D	1..00	2014-03-31T23:52:52-00:00	0000000Z	2023-03-20T05:55:00	0000000Z	NA	OPEN
CI	AGO	--	LCO	D	1..00	2014-03-31T23:54:55-00:00	0000000Z	2023-03-20T05:55:00	0000000Z	NA	OPEN
CI	AGO	--	LEB	D	1..00	2014-03-31T23:54:35-00:00	0000000Z	2023-03-20T05:55:00	0000000Z	NA	OPEN
CI	AGO	--	LEP	D	1..00	2014-03-31T23:54:46-00:00	0000000Z	2023-03-20T05:55:00	0000000Z	NA	OPEN
CI	AGO	--	LIT	D	1..00	2014-03-31T23:55:06-00:00	0000000Z	2023-03-20T05:55:00	0000000Z	NA	OPEN
CI	AGO	--	LKD	D	1..00	2014-03-31T23:54:21-00:00	0000000Z	2023-03-20T05:55:00	0000000Z	NA	OPEN
CI	AGO	--	LNE	D	1..00	2014-03-30T23:59:27-00:00	0000000Z	2023-03-20T05:55:00	0000000Z	NA	OPEN
CI	AGO	--	LNW	D	1..00	2014-03-30T23:59:09-00:00	0000000Z	2023-03-20T05:55:00	0000000Z	NA	OPEN
CI	AGO	--	LNZ	D	1..00	2014-03-30T23:51:08-00:00	0000000Z	2023-03-20T05:55:00	0000000Z	NA	OPEN

#dataset	Network	Station	Location	Channel	Quality	SampleRate	Earliest	Latest	Updated	TimeSpans	Restriction
CI	AGO HNE D 100..00 2022-01-01T00:00:00.000000Z 2022-01-01T23:59:9900000Z NA NA OPEN										
CI AGO HNE D 100..00 2022-01-02T00:00:00.000000Z 2022-01-02T23:59:9900000Z NA NA OPEN											
CI AGO HNE D 100..00 2022-01-03T22:01:00.000000Z 2022-01-03T22:01:06.992000Z NA NA OPEN											
CI AGO HNE D 100..00 2022-01-03T22:01:11.999000Z 2022-01-03T22:01:12.992000Z NA NA OPEN											
CI AGO HNE D 100..00 2022-01-03T22:01:13.999000Z 2022-01-03T22:01:14.992000Z NA NA OPEN											
CI AGO HNE D 100..00 2022-01-03T22:01:16.999000Z 2022-01-03T22:01:17.992000Z NA NA OPEN											
CI AGO HNE D 100..00 2022-01-04T00:00:00.000000Z 2022-01-04T23:59:9900000Z NA NA OPEN											
CI AGO HNE D 100..00 2022-01-05T00:00:00.000000Z 2022-01-05T23:59:9900000Z NA NA OPEN											
CI AGO HNE D 100..00 2022-01-06T00:00:00.000000Z 2022-01-06T23:59:9900000Z NA NA OPEN											
CI AGO HNE D 100..00 2022-01-07T00:00:00.000000Z 2022-01-07T23:59:9900000Z NA NA OPEN											
CI AGO HNE D 100..00 2022-01-08T00:00:00.000000Z 2022-01-08T23:59:9900000Z NA NA OPEN											
CI AGO HNE D 100..00 2022-01-09T00:00:00.000000Z 2022-01-09T01:14:32.992000Z NA NA OPEN											
CI AGO HNE D 100..00 2022-01-09T01:15:53.999000Z 2022-01-09T23:59:9900000Z NA NA OPEN											
CI AGO HNE D 100..00 2022-01-10T00:00:00.000000Z 2022-01-10T00:00:00.000000Z NA NA OPEN											

Query produces lists of continuous time spans for selected channels (network, station, channel, location) and time ranges. Query is available only for continuous waveform data.

/query

- continuous records (*H*, *N* and *L*) from Jan 01, 2011 - Jan 23, 2023

Other STP Commands

- eavail – list available waveforms for an event
 - avail – list stations channels
 - phase – search for phase picks by event, net/sta/channel, or time
 - in – read and run commands from an input file
 - help
-
- STP is scriptable – put commands in a file and feed them to the client
`cat commands.txt | stp`

STP Query Language

- Search for events between magnitudes 3 and 5 on a particular day:

```
event -t0 2023/01/25,00:00:00 +1d -mag 3 5
```

- Download waveforms for event ID 12345 from a CI.AGO.HH* channels:

```
trig -net CI -sta AGO -chan HH_ 12345
```

- Download continuous waveforms from CI.AGO.H* for the last two hours:

```
win -net CI -sta AGO -chan HH_ -2h +2h
```

STP Etiquette

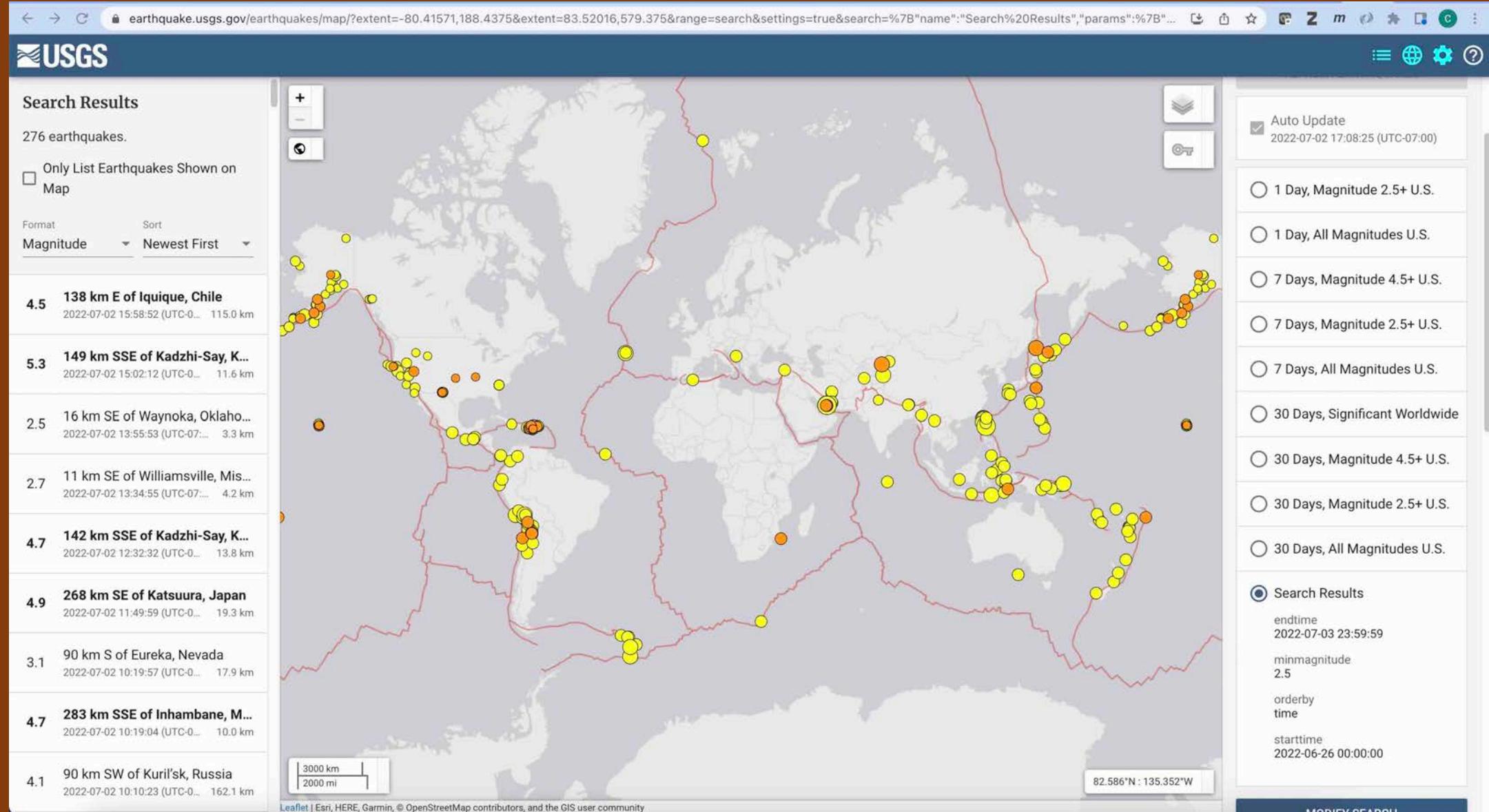
- STP servers support a limited number of simultaneous clients
- Don't run more than a few (2-3) parallel client processes
- Client processes running more than 4 hours may be turned off
- Check the message of the day for announcements when you log in
- For large downloads, use the SCEDC AWS Public Dataset

C Client

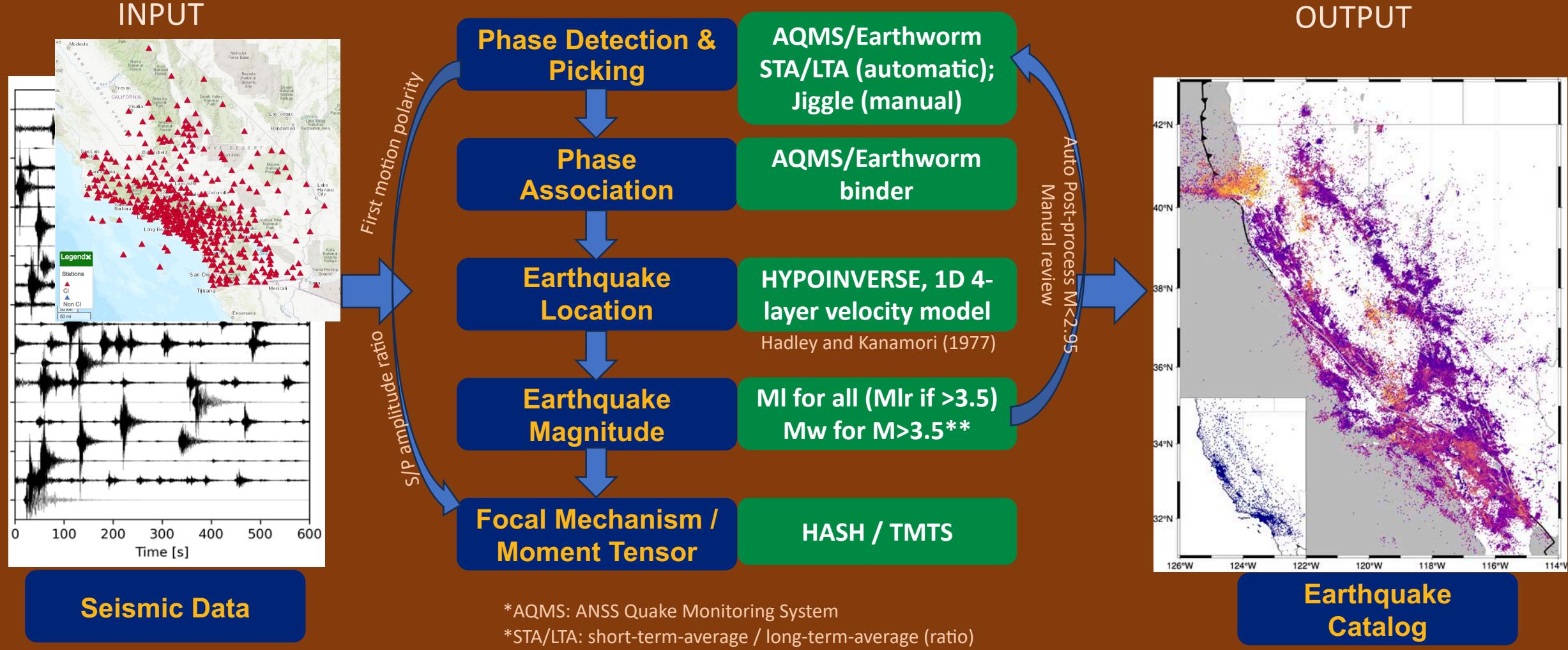
- Classic STP client is a user-downloadable C program
- Compiled with Make and gcc compiler
- Mac, Linux, Windows (WSL, Cygwin)
- Precompiled Cygwin executable is also available

ComCat: Global Earthquake Catalog

<https://earthquake.usgs.gov/earthquakes/search/>



Earthquake Catalog Workflow Steps



*AQMS: ANSS Quake Monitoring System

*STA/LTA: short-term-average / long-term-average (ratio)

**When available (sometimes can't be determined reliably)

Waveforms – Instrumentation (SCSN)

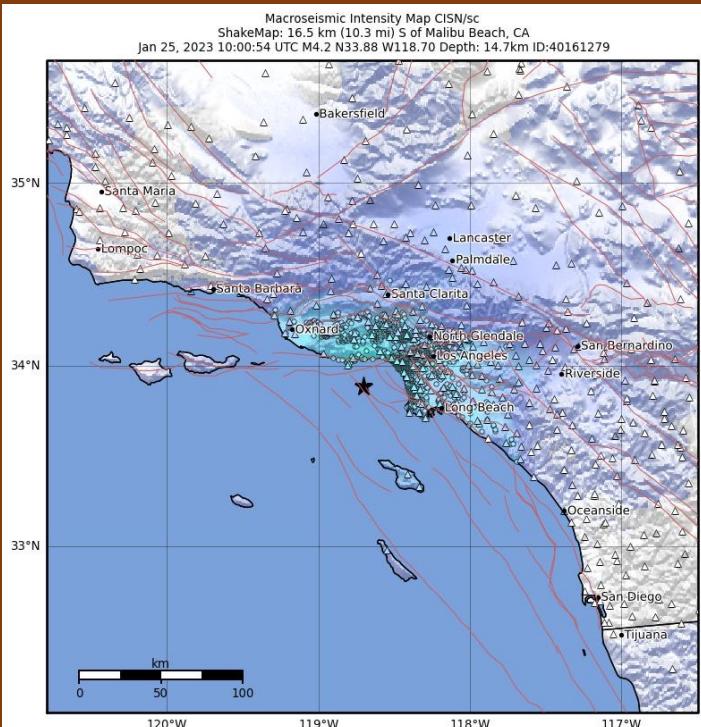
- Most common set-up
 - data logger: Quanterra Q330S or Q8
 - broadband seismometer: STS-2 (typical), Guralp CMG-3T, MBB-1/2, Kinematics OMNISensor, PBB-200S, STS-1
 - triaxial strong motion accelerometer: Episensor EST
- Alternate (on the way out)
 - data logger: Basalt/Obsidian 4 channel
 - strong motion: Episensor
 - short period vertical: usually an L4
- Previous (no longer used)
 - short-period (L4) only
 - STS-1 seismometer + pressure sensor
- Other Notes
 - GSN station: PASC
 - a few borehole stations & building arrays
 - one borehole (MIK/MIKB) has a rotational sensor
 - NetQuake stations (Q*): digitizer+strong motion



Other Products & Special Datasets

Interactive Tomographic Map
& 3D Velocity Model

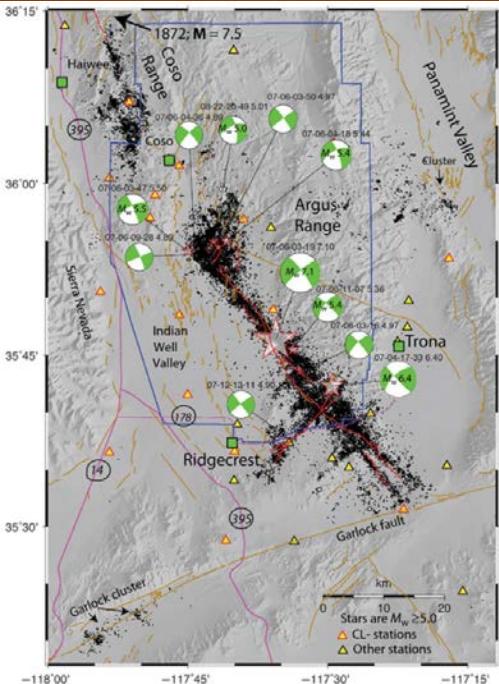
ShakeMaps



SHAKING	Not felt	Weak	Light	Moderate	Strong	Very strong	Severe	Violent	Extreme
DAMAGE	None	None	None	Very light	Light	Moderate	Moderate/heavy	Heavy	Very heavy
PGA(%g)	<0.0464	0.297	2.76	6.2	11.5	21.5	40.1	74.7	>139
PGV(cm/s)	<0.0215	0.135	1.41	4.65	9.64	20	41.4	85.8	>178
INTENSITY	I	II-III	IV	V	VI	VII	VIII	IX	X+

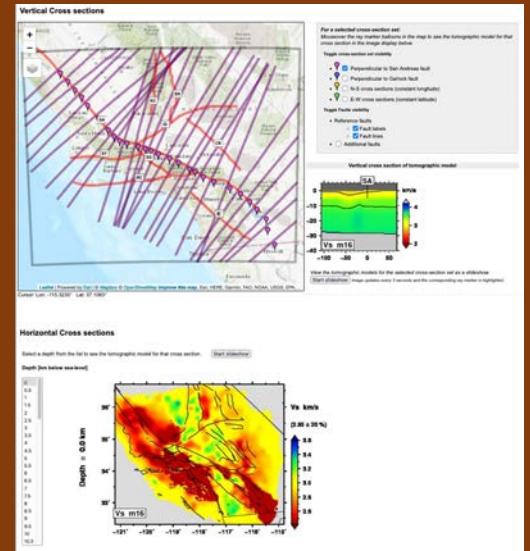
Scale based on Worden et al. (2012)
△ Seismic Instrument ○ Reported Intensity ★ Epicenter

Ridgecrest Datasets

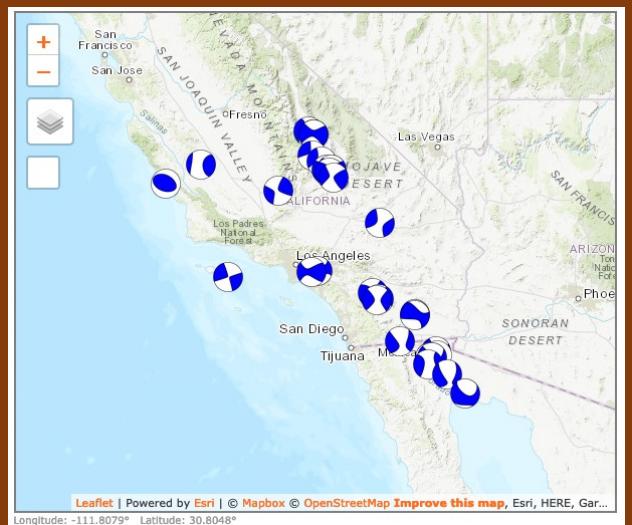


ML Training & Validation Datasets

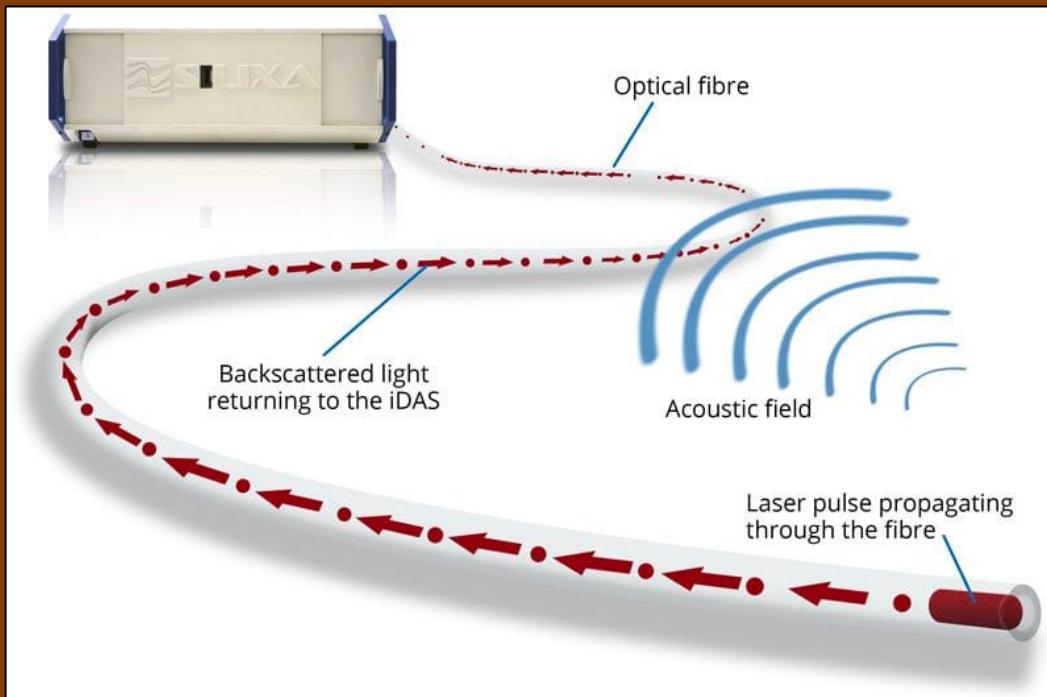
And more!



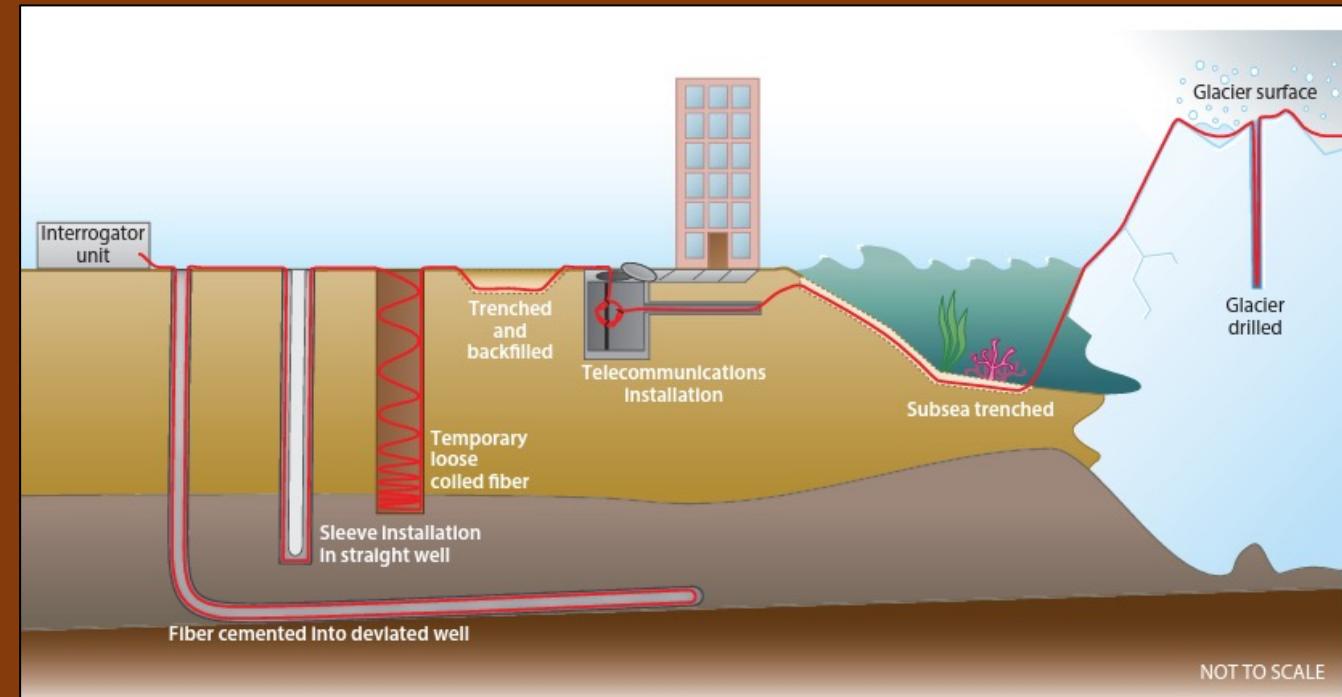
W Phase Moment Tensors



Special Datasets: Distributed acoustic sensing data

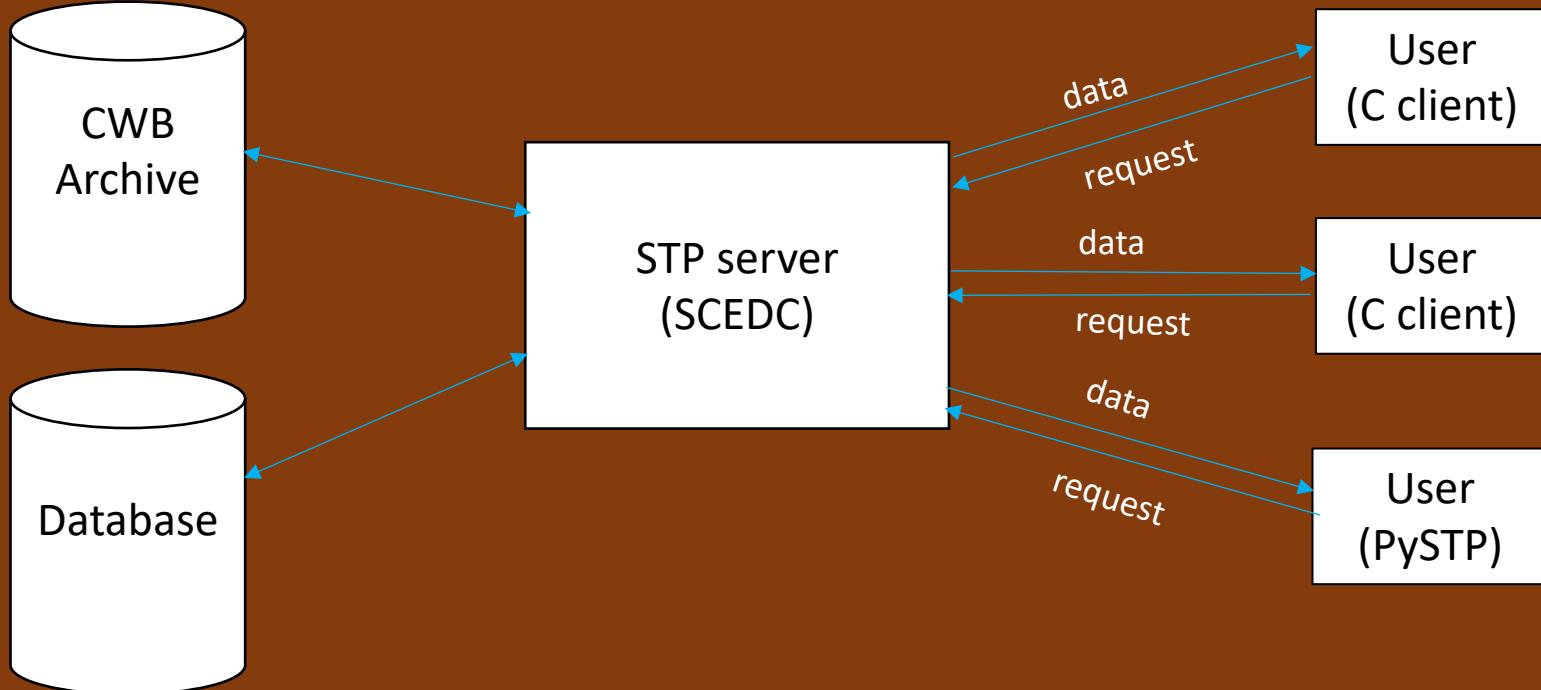


Shatalin et al., 2020

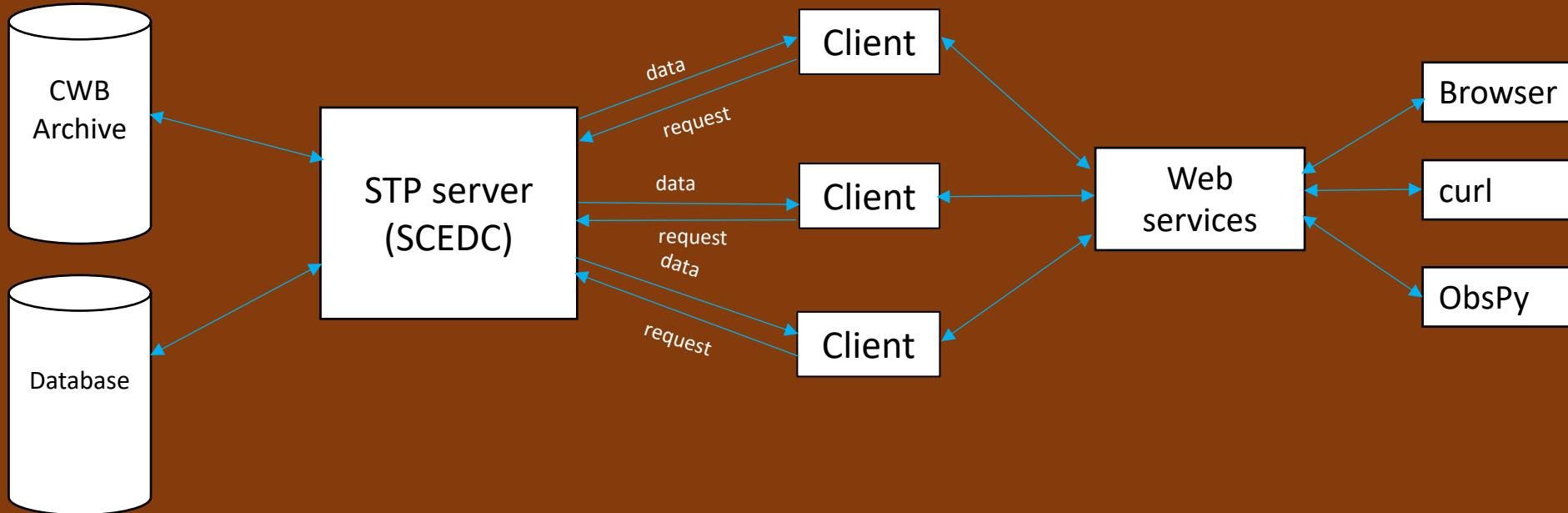


Lindsey and Martin, 2021

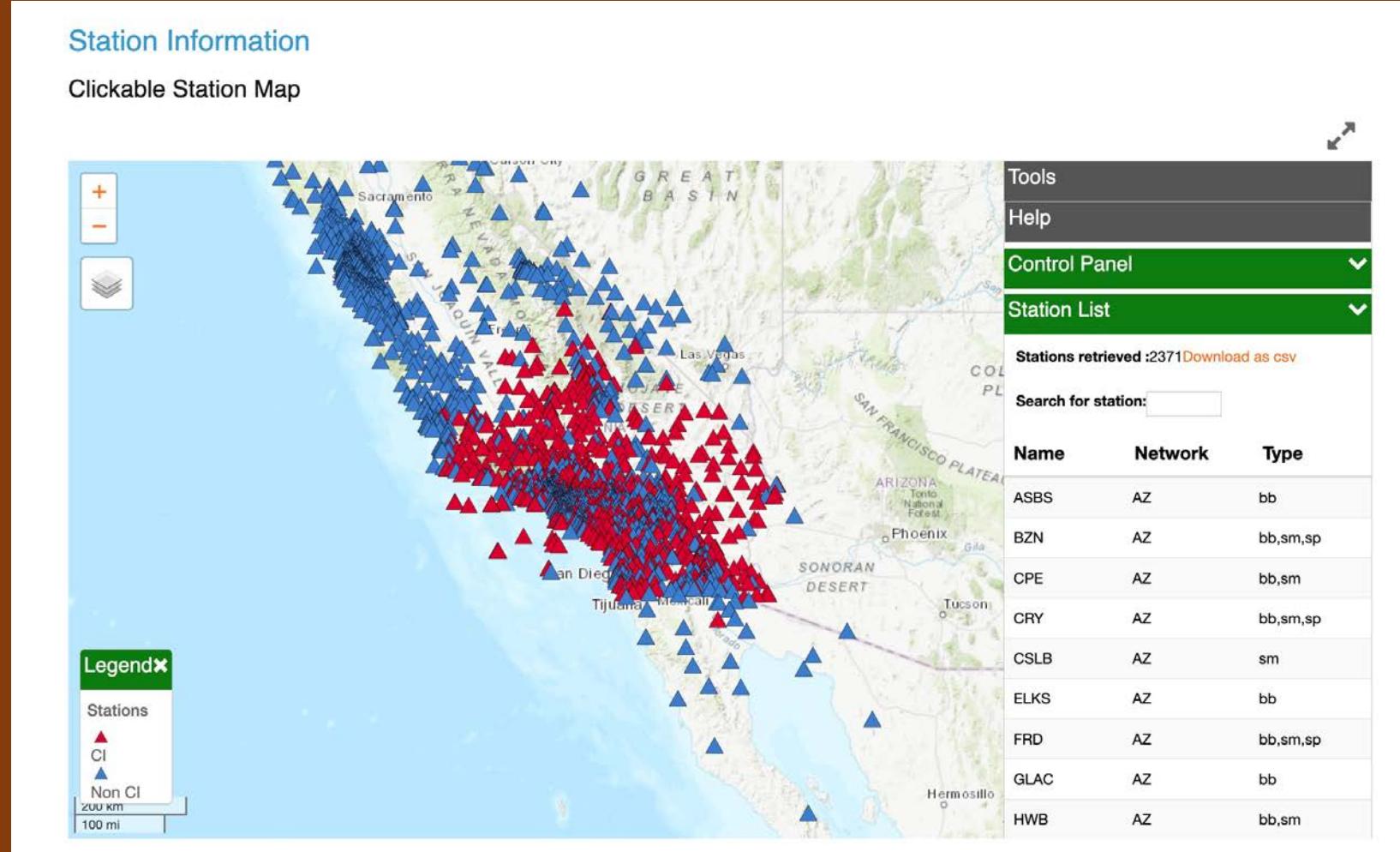
Client/Server Model



STP and Web Services



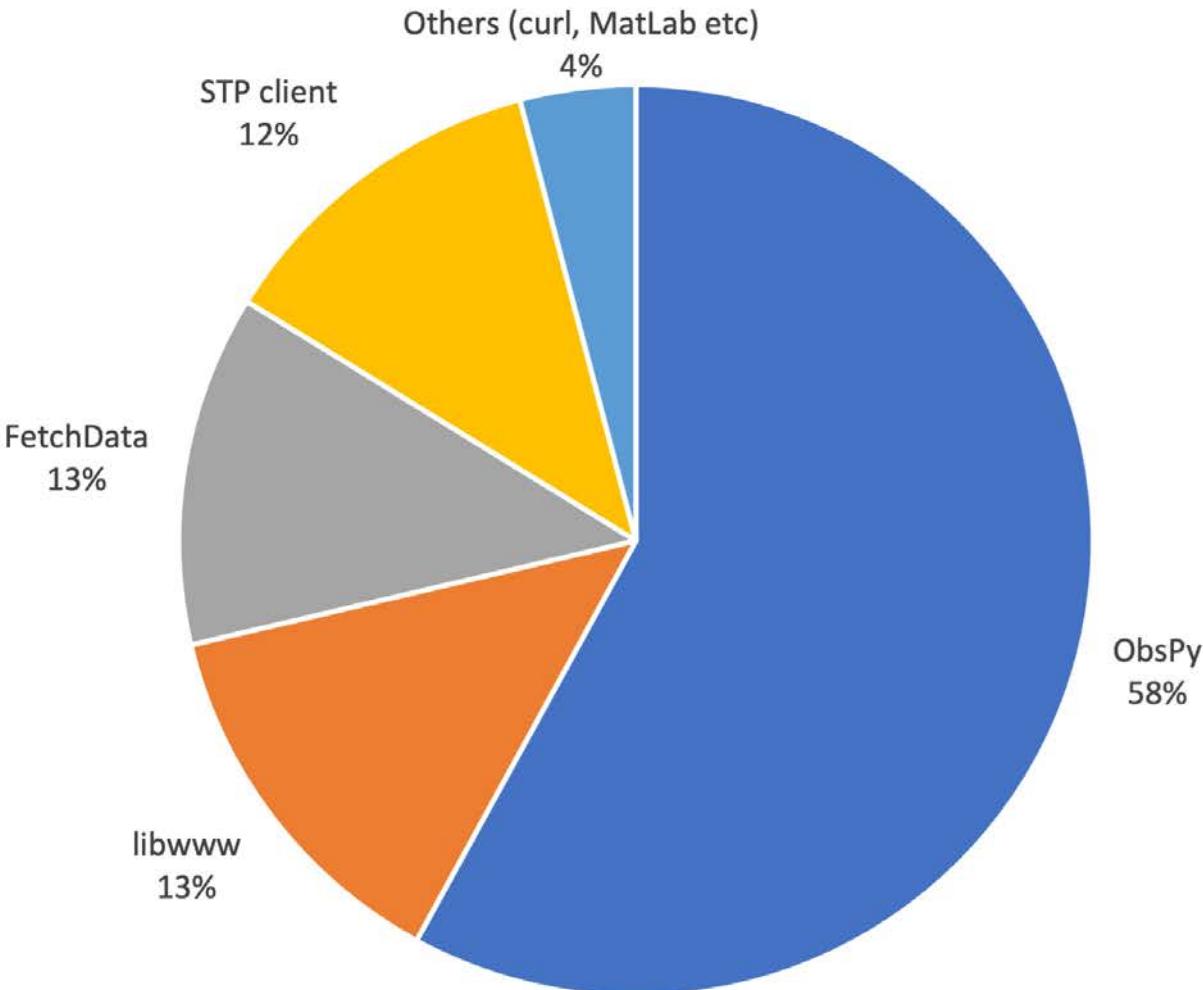
Data Access – Website – Station Metadata



Clickable Station Map

- Good for data discovery
- Shows stations that have an entry in SCEDC archive.
- Can filter by time, sensor type, and network code.
- Can output results to csv.

SCEDC On-Premises Requests by Method for 2022



PySTP Usage

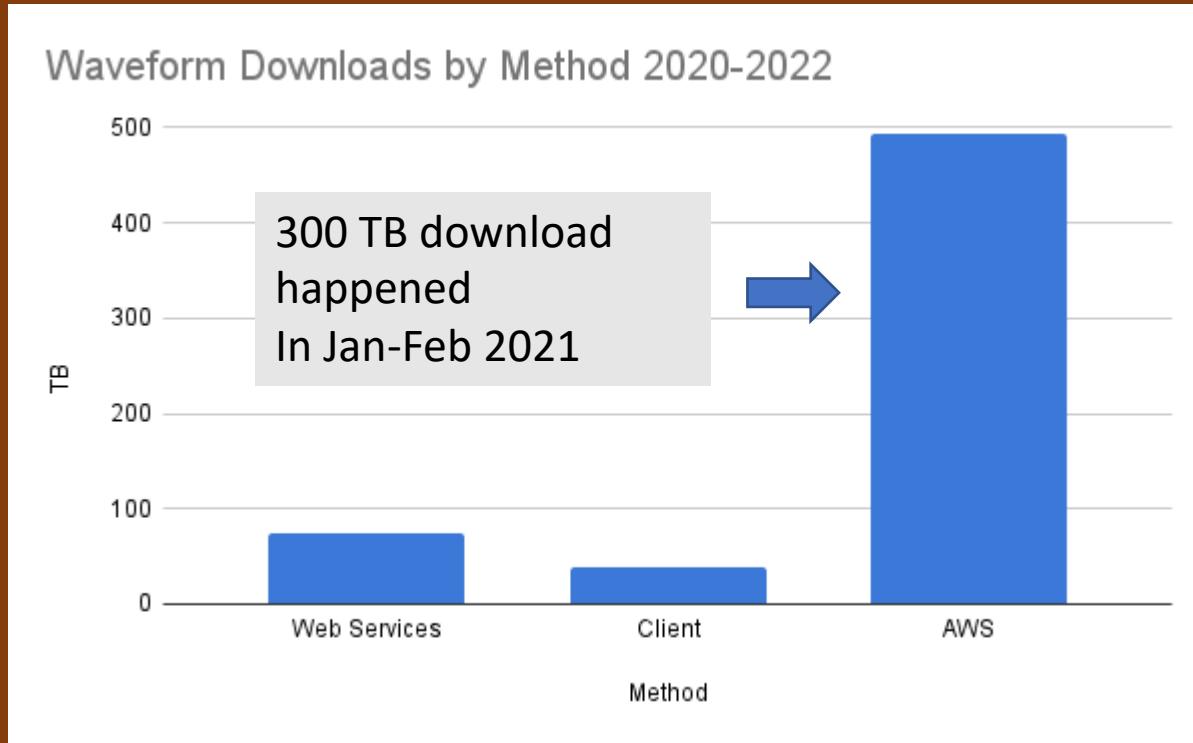
```
from pystp import STPClient
import datetime

stp = STPClient()
stp.connect()

# Get catalog of M4-5 events on Jan. 25, 2023.
events = stp.get_events(times = [datetime.datetime(2023, 1, 25), datetime.datetime(2023, 1, 26)], mags=[4, 5])

# Get the event ID of the first event in the catalog.
evid = events[0].resource_id
# Download waveforms.
waveform = stp.get_trig([evid], net='CI', sta='BAK', chan="HH_")
waveform[evid].plot(outfile='CI_BAK_HH.png')
stp.disconnect()
```

Cloud access stats



We've seen file access rates as high as 2GB/s!

M 7.0 - 2024 Offshore Cape Mendocino, California Earthquake

2024-12-05 18:44:21 (UTC) | 40.374°N 125.022°W | 10.0 km depth

Moment Tensor

[View all moment-tensor products \(2 total\)](#)

Preferred moment tensor

Contributes preferred magnitude: Mww 7.0

Available Moment Tensor Products

Catalog	Tensor	Magnitude	Depth	% DC	Source
US ✓		7.0 Mww	11.5 km	87 %	US
US		6.9 Mwb	16.0 km	92 %	US

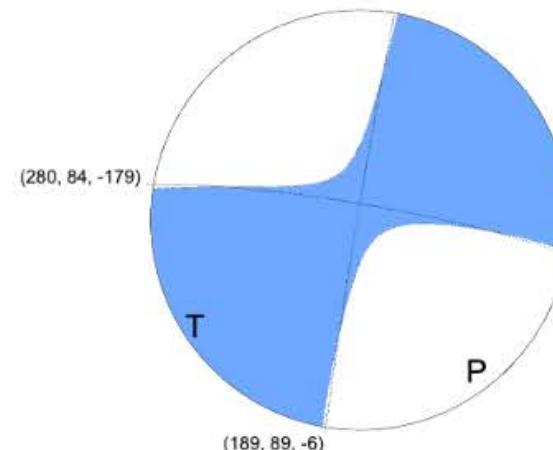
Contributed by [US](#) last updated 2025-02-15 18:29:50 (UTC)

✓ The data below are the most preferred data available

✓ The data below have been reviewed by a scientist

W-phase Moment Tensor (Mww)

Moment	4.028e+19 N·m
Magnitude	7.00 Mww
Depth	11.5 km
Percent DC	87%
Half Duration	7.50 s
Catalog	US
Data Source	US
Contributor	US



Nodal Planes

Plane	Strike	Dip	Rake
NP1	280°	84°	-179°
NP2	189°	89°	-6°

Principal Axes

Axis	Value	Plunge	Azimuth
T	3.888e+19	4°	235°
N	0.267e+19	84°	359°
P	-4.155e+19	5°	144°

Downloads

[Earthquake XML \(Quakeml\)](#)

- [XML 65.3 KB](#)

M 7.0 - 2024 Offshore Cape Mendocino, California Earthquake

2024-12-05 18:44:21 (UTC) | 40.374°N 125.022°W | 10.0 km depth

Preferred focal mechanism

Focal Mechanism

[View all focal-mechanism products \(2 total\)](#)

Available Focal Mechanism Products

Catalog	Mechanism	Nodal Plane 1	Nodal Plane 2	Source		
NC ✓	NC ✓		285°, 80°, 180°	14°, 90°, 10°	NC	NC
NC ✓	NC ✓		135°, 10°, -60°	284°, 81°, -95°	NC	NC

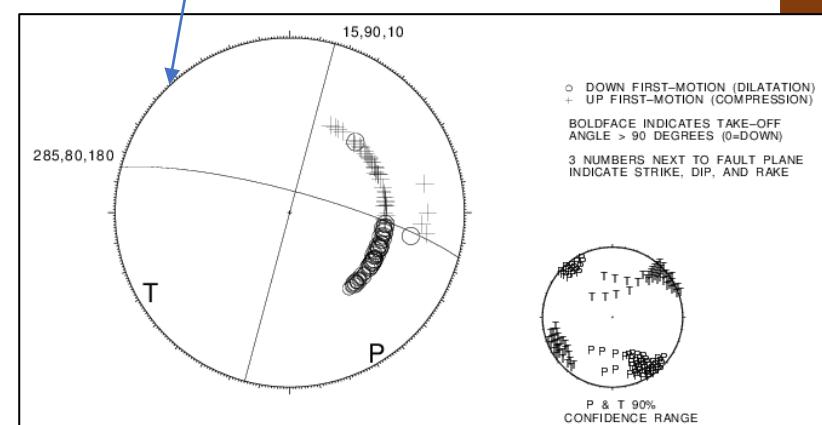
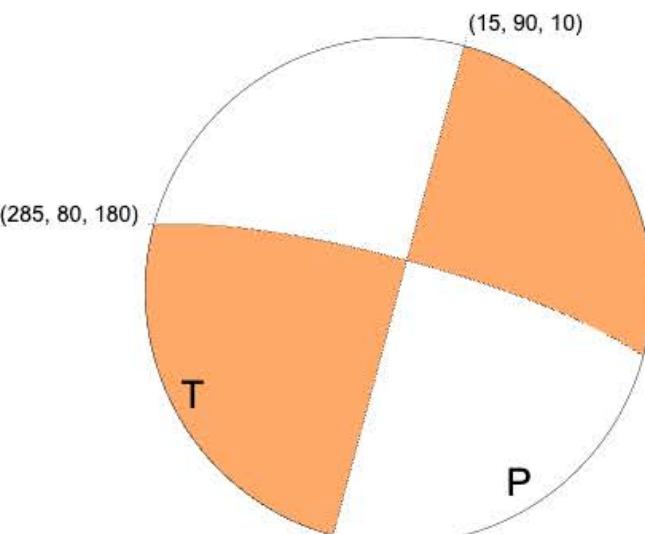
Contributed by [NC](#) last updated 2024-12-06 00:11:11 (UTC)

- ✓ The data below are the most preferred data available
- ⌚ The data below have NOT been reviewed by a scientist.

Catalog	NC
Data Source	NC
Contributor	NC

Nodal Planes

Plane	Strike	Dip	Rake
NP1	285°	80°	180°
NP2	15°	90°	10°



Downloads

NCSN First Motion Mechanism 2

NCSN First Motion Mechanism 2

- [GIF 14.2 KB](#)
- [XML 13.0 KB](#)

Polarity at each station: see xml