PNW Seismicity Catalogs and Waveform Data

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Focus (by request)

Available seismicity catalogs, waveform data, and associated considerations for contributing to future ground-motion model databases or validation events.

What is available since the NGA-Subduction database was developed over 5 years ago now?

There is a lot more data, including full waveforms that can be used for validation of simulations

Earthquake Catalogs

For the Pacific Northwest

- Official Catalogs, including historical events → complete for events large enough to produce felt shaking

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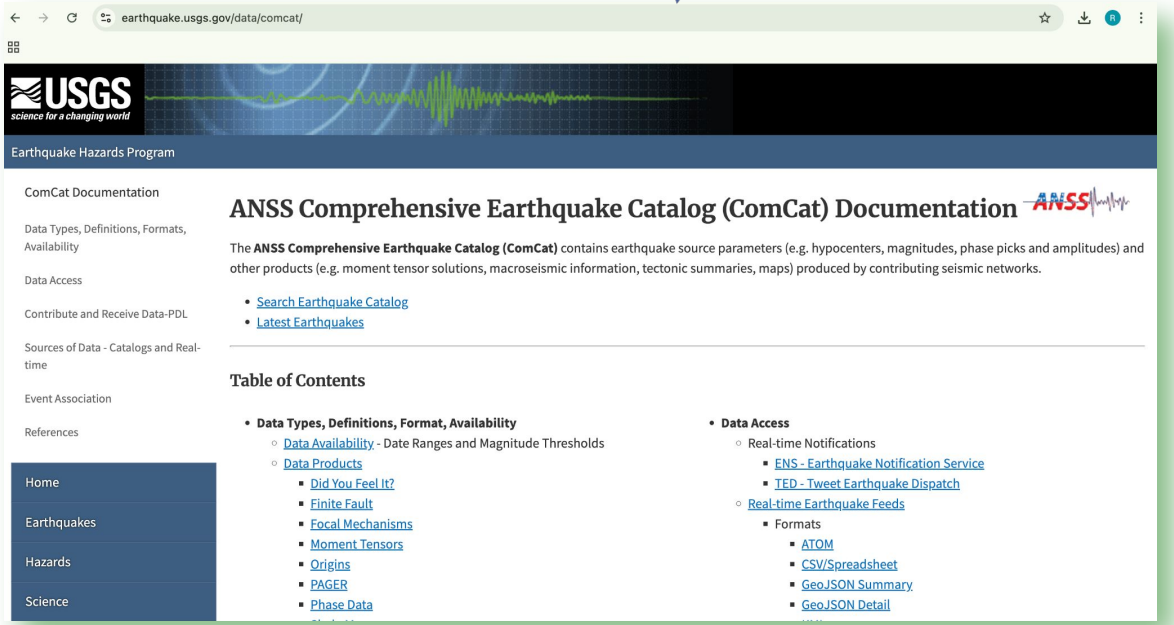
- Strong-motion Catalogs → processed for engineers
- Research Catalogs → may include smaller magnitudes or **more accurate event parameters**

ANSS ComCat

- Official catalog for the USA, also has global events
- In the USA: several “authoritative” contributors → ANSS ComCat will serve the “preferred” solutions



earthquake.usgs.gov

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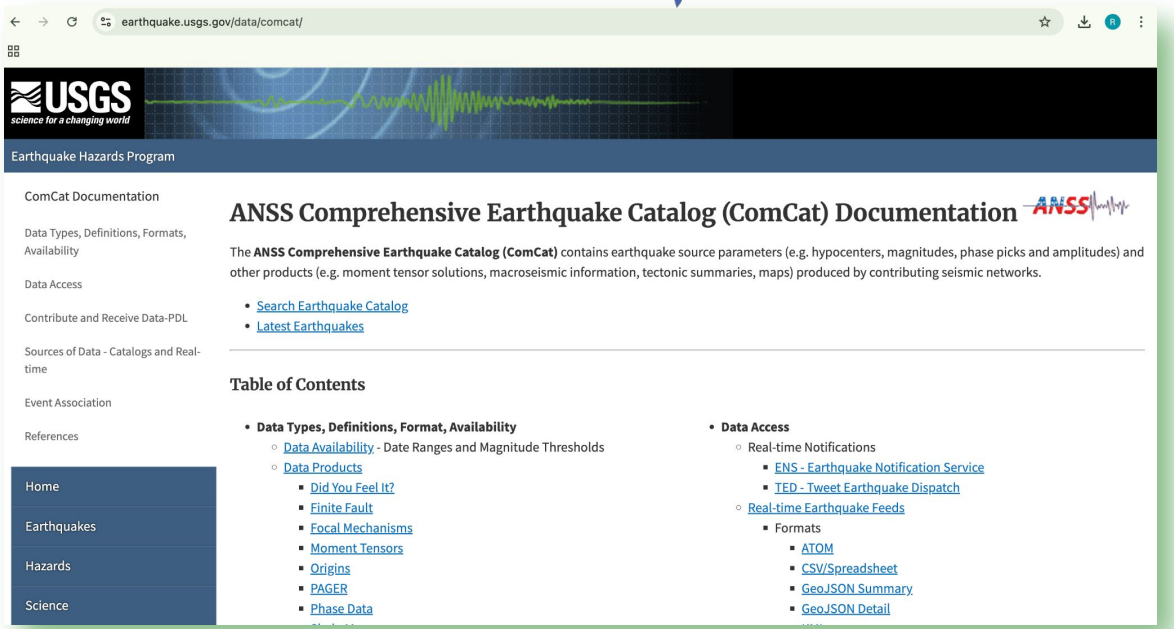

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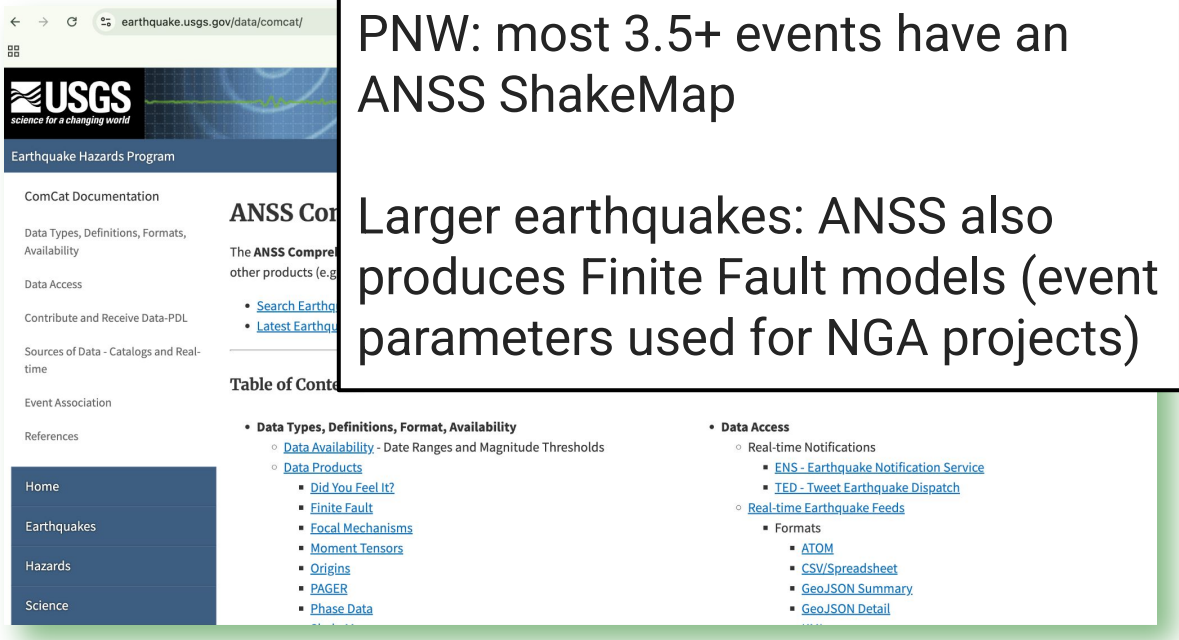


PNW: most 3.5+ events have an ANSS ShakeMap

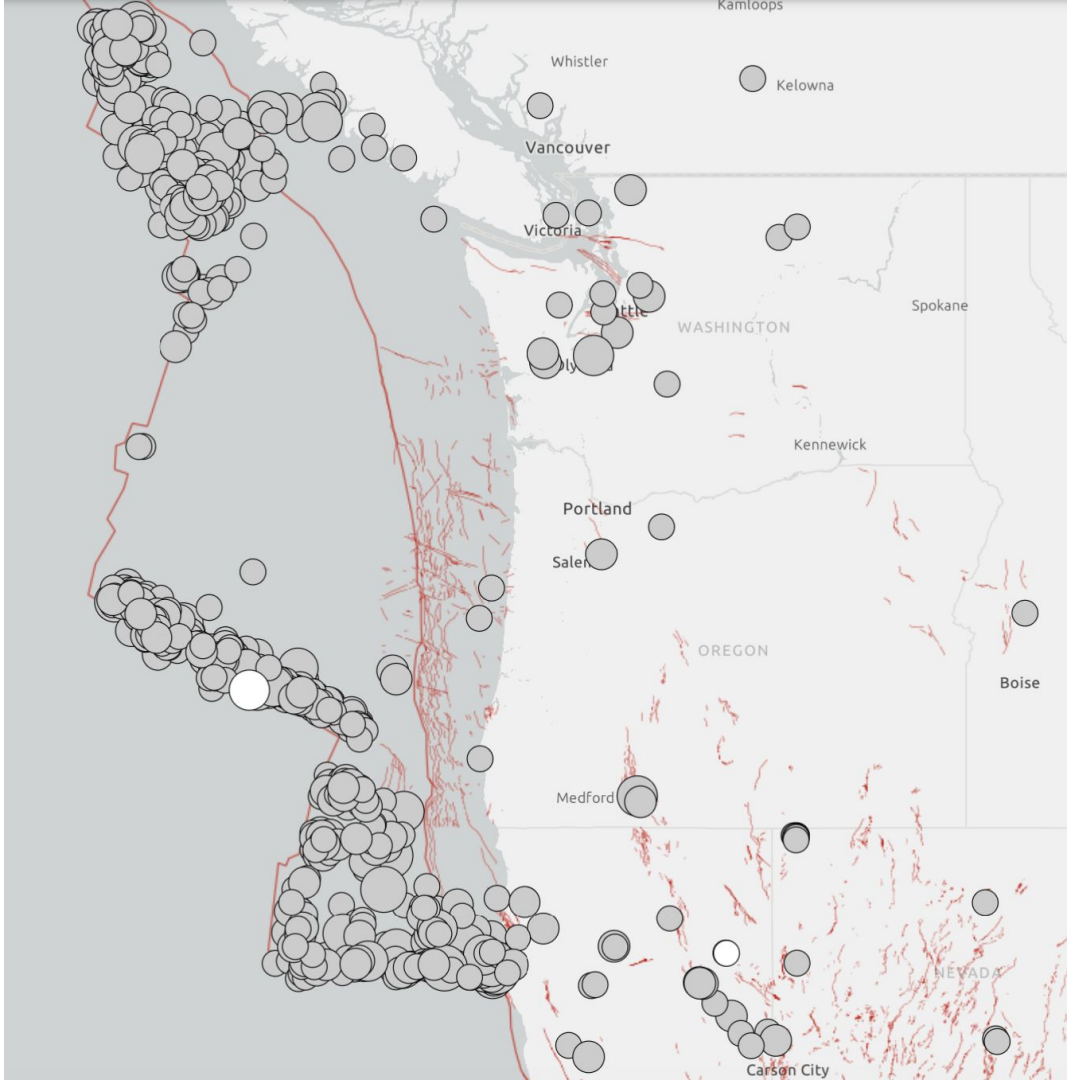
Larger earthquakes: ANSS also produces Finite Fault models (event parameters used for NGA projects)

earthquake.usgs.gov

Natural Resources Canada https://www.earthquakescanada.nrcan.gc.ca/

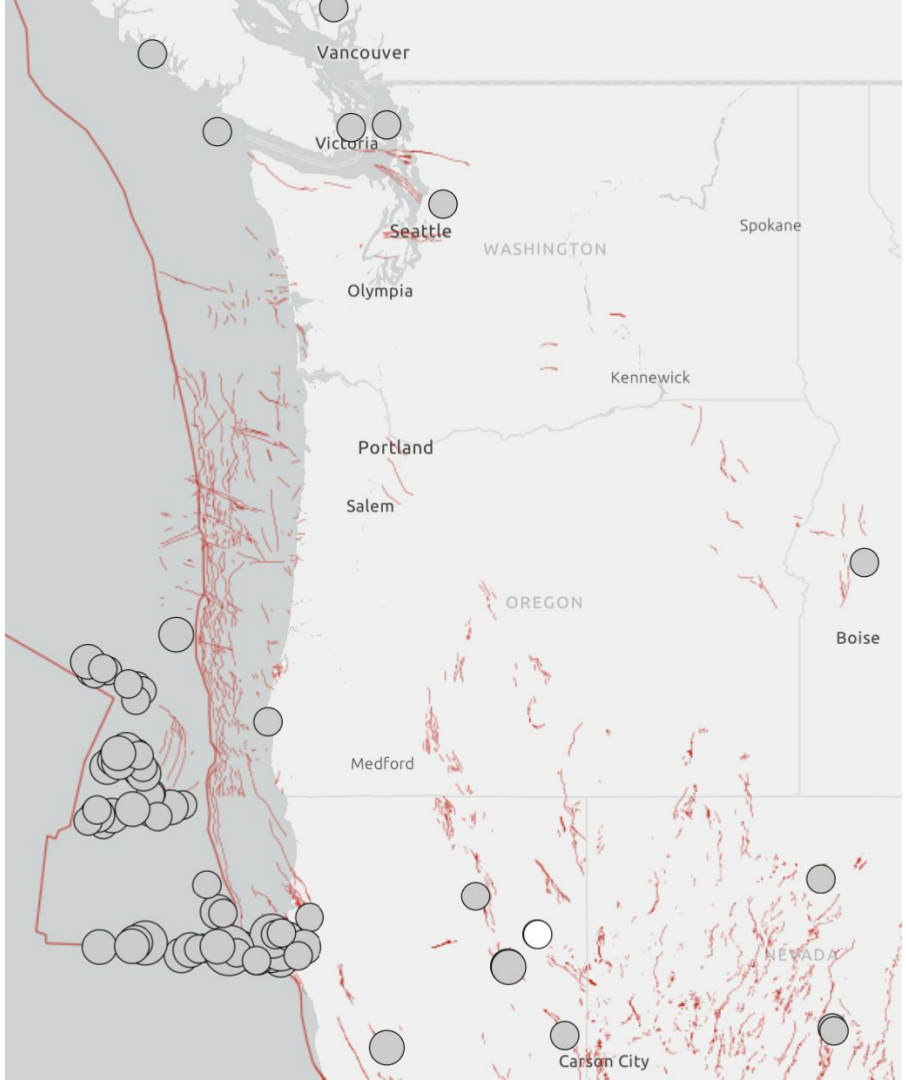
ANSS ComCat M4.5+ since 1990

- *Many* within Gorda and Explorer plates
- *Many* associated with the ridges and fracture zones
- *Few* near and east of the Cascadia Deformation Front, except near Nootka FZ and Mendocino



ANSS ComCat M4.5+ since 2015

- 6 M4.5+ events in the NW
- 37 off Oregon/Northern California, including 2 at/near the coast
- 39 in the Mendocino area



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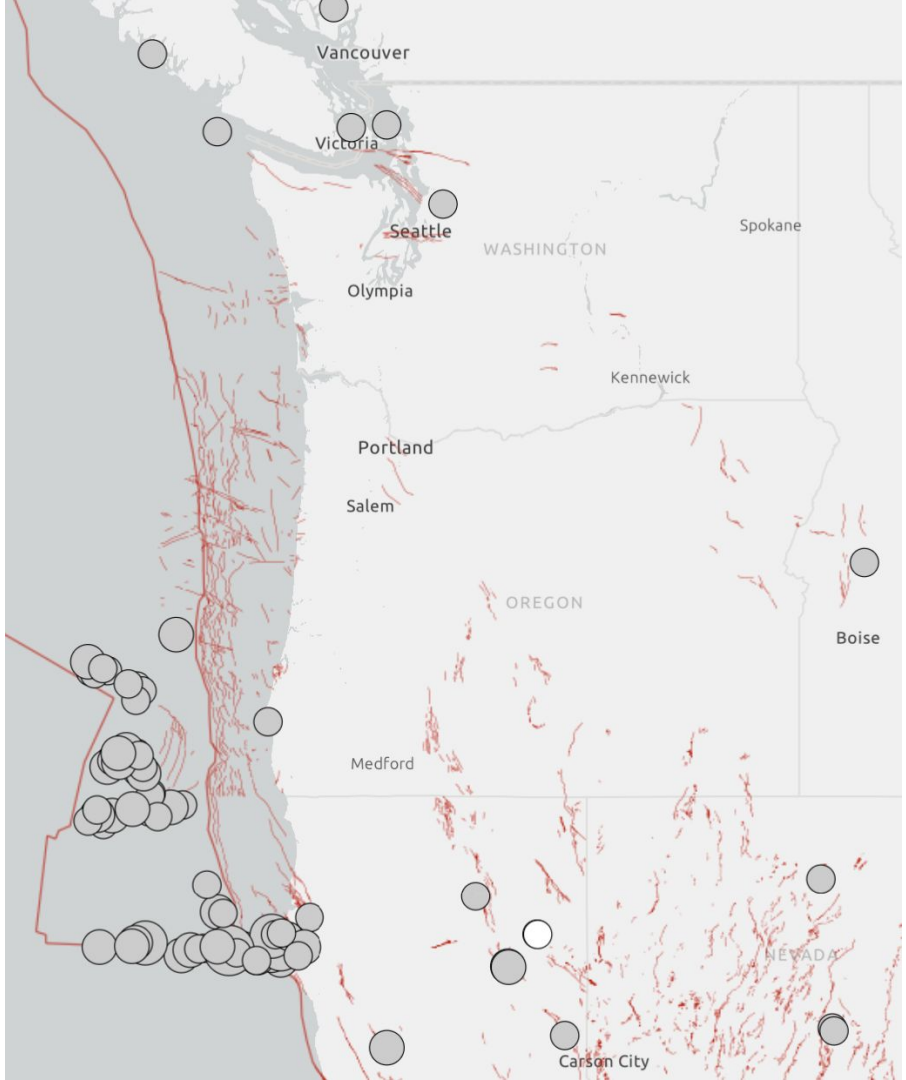
Get familiar with the search tools!



Event-associated strong-motion parameters

- Data used in ANSS ShakeMaps archived in ComCat or available from RSNs

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- NGA databases → combines ground motion measurements with more extensive event and site parameters

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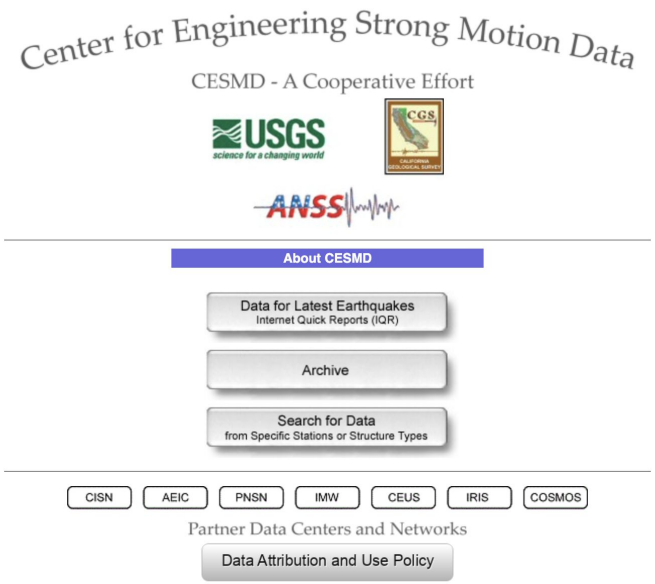
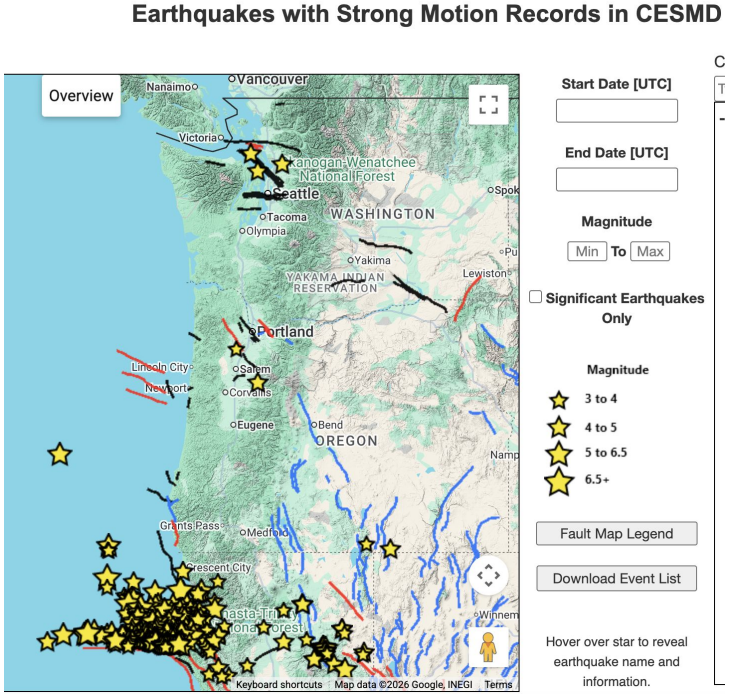
- Data archived at the Center for Engineering Strong Motion Data (CESDC)
- NGA databases → combines ground motion measurements with more extensive event and site parameters
- Measure them yourself from full waveforms!

Center for Earthquake Strong Motion Data

strongmotioncenter.org





NGA-subduction Cascadia

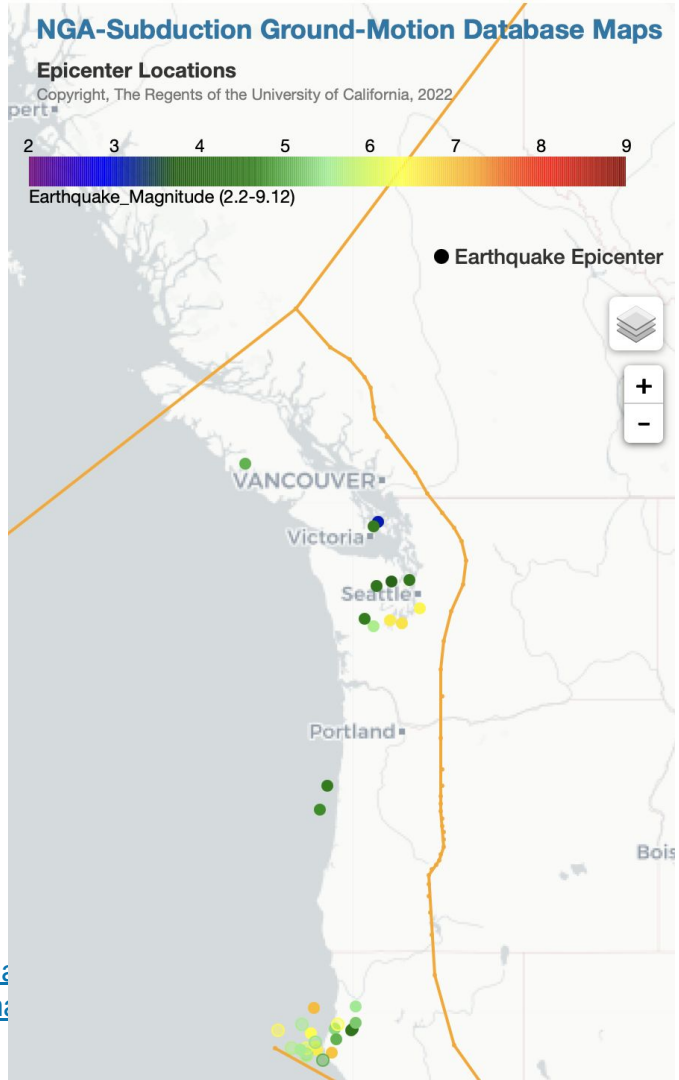
- 35 earthquakes
- M3.3-M6.8
- 1937 - 2015
- PGA, PGV, PGD
- SA 0.01s to 20s period

Many M4.5+ events and stations since 2015.

Before 2015: NGA event selection, strict criteria?

Silvia Mazzoni (2022): NGA-Subduction GM Database Interactive Maps. The B. John Garrick Institute for the Risk Sciences. Dataset. https://doi.org/10.34948/N3NP49

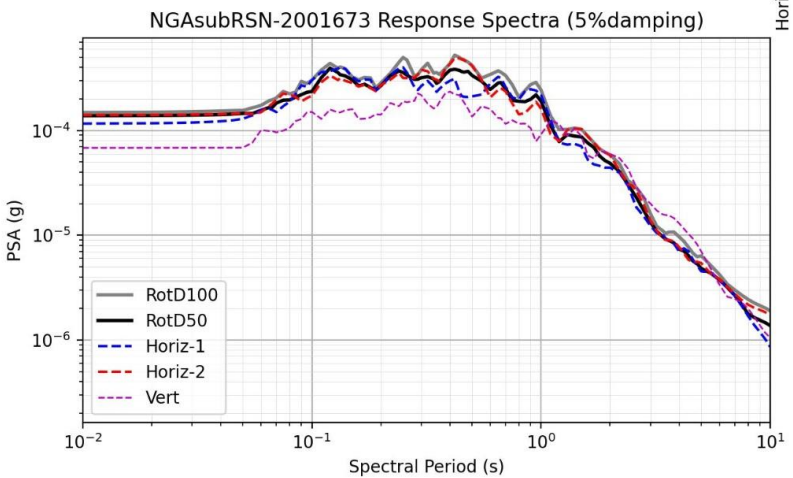
https://www.risksciences.ucla.edu/nhr3/nga-subduction/maps

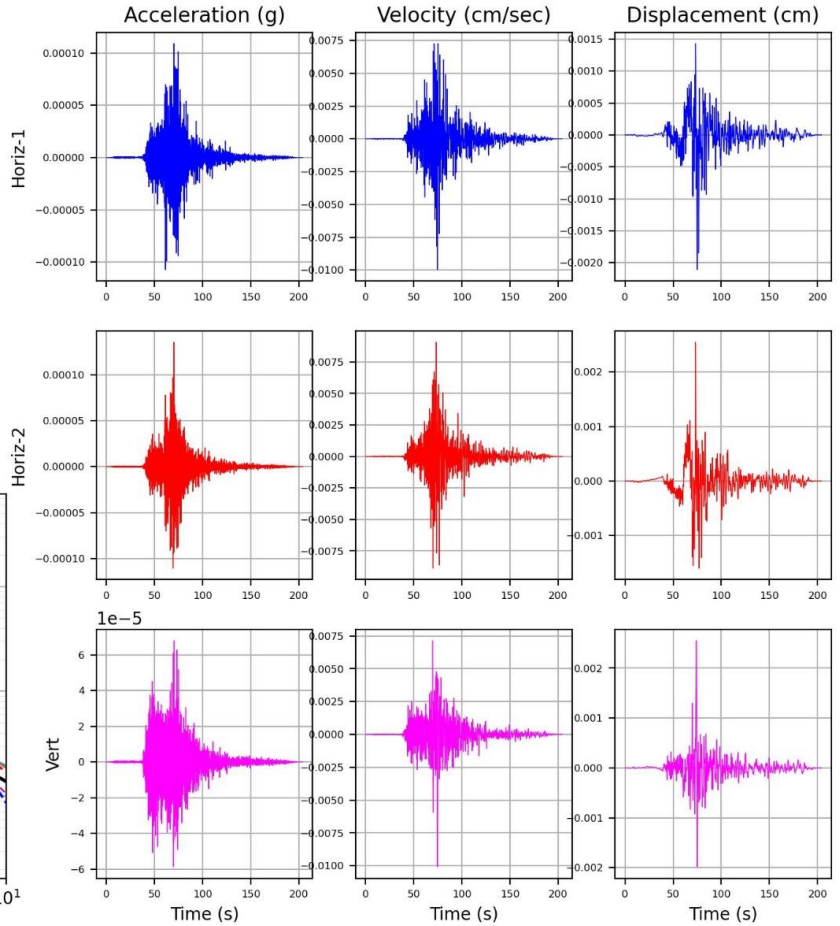


Example of NGA-Subduction data processing

NGA-SUBDUCTION GROUND-MOTION DATABASE

NGAsubRSN: 2001673
DatabaseRegion: Cascadia
NGAsubEQID: 2000007
Earthquake_Name: 930039
EQYear: 2000
Earthquake_Magnitude: 5.2
Hypocenter_Depth_km: 41.3
Intra_Inter_Flag (0=Interface,1=Intraslab): 1
NGAsubSSN: 2000972
StationDatabaseRegion: Cascadia
Station_Name: PGC
Vs30_Selected_for_Analysis_m_s: 455
ClstD_km: 217.839
Lowest Useable Period (s): -999.0
Highest Useable Period (s): 30.348
Filename Horiz-1: NGAsubRSN2001673_PGCBHE
Filename Horiz-2: NGAsubRSN2001673_PGCBHN
Filename Vert: NGAsubRSN2001673_PGCBHZ

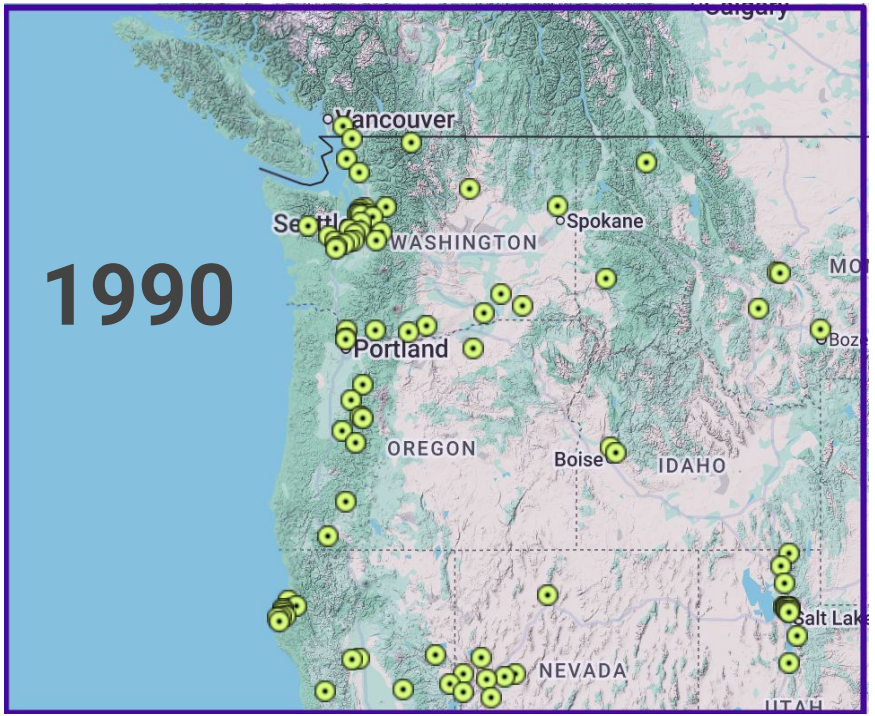




Seismic data density and quality has dramatically improved over time

Broadband sensors

Strong-motion sensors



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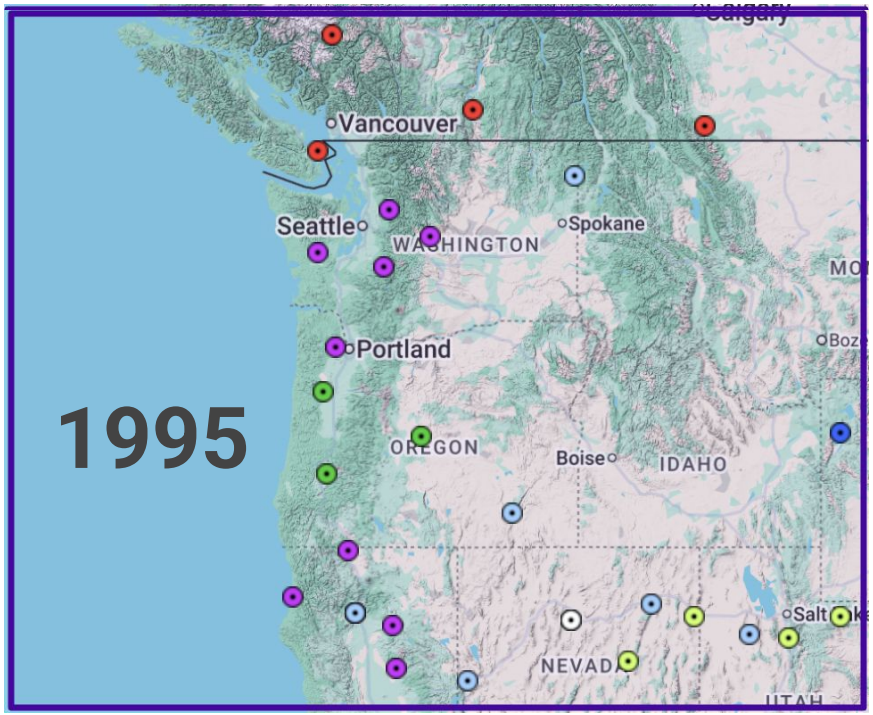

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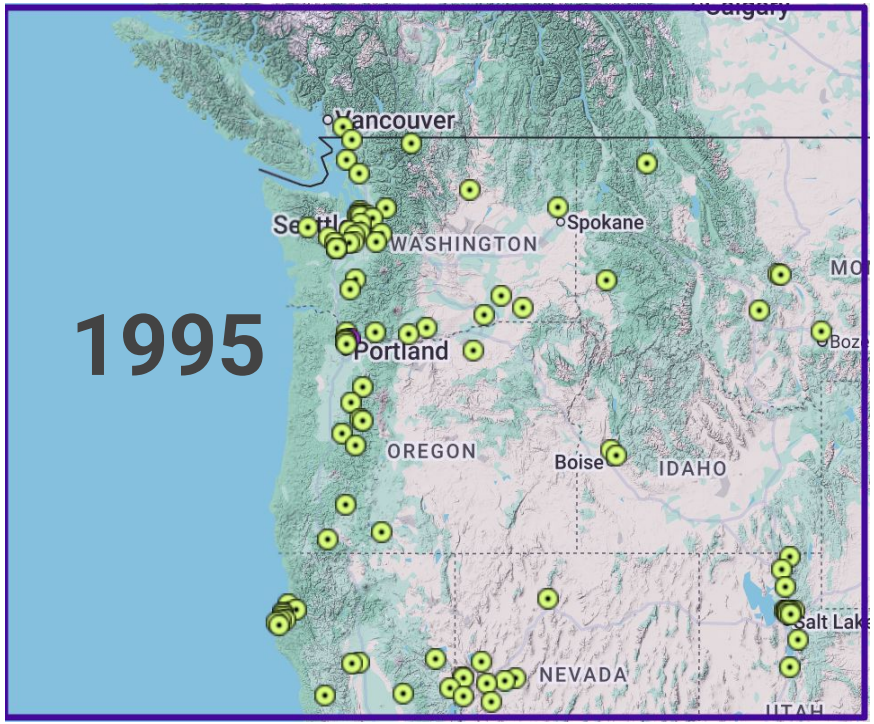

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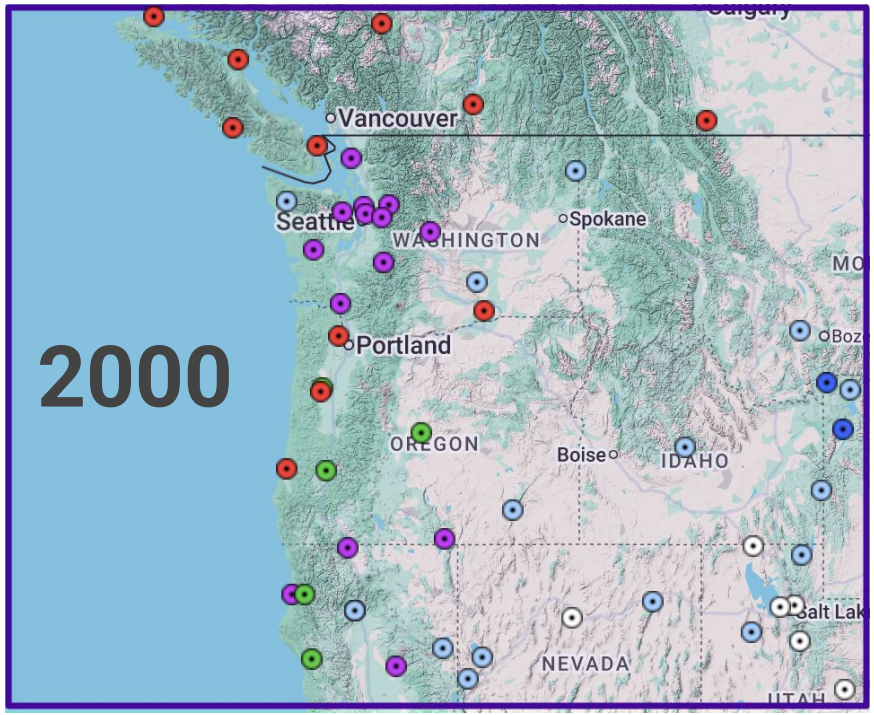

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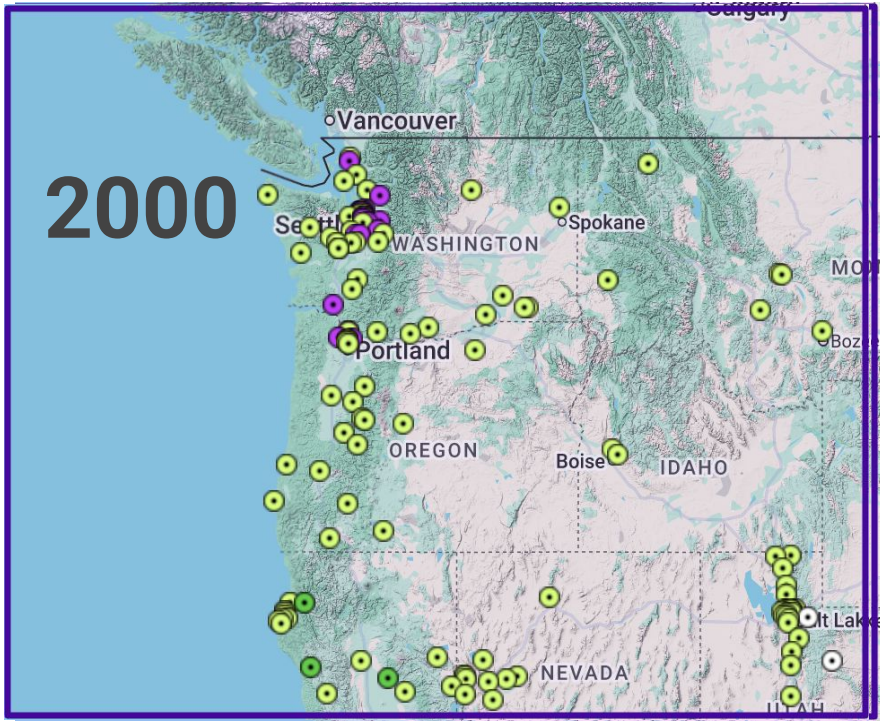

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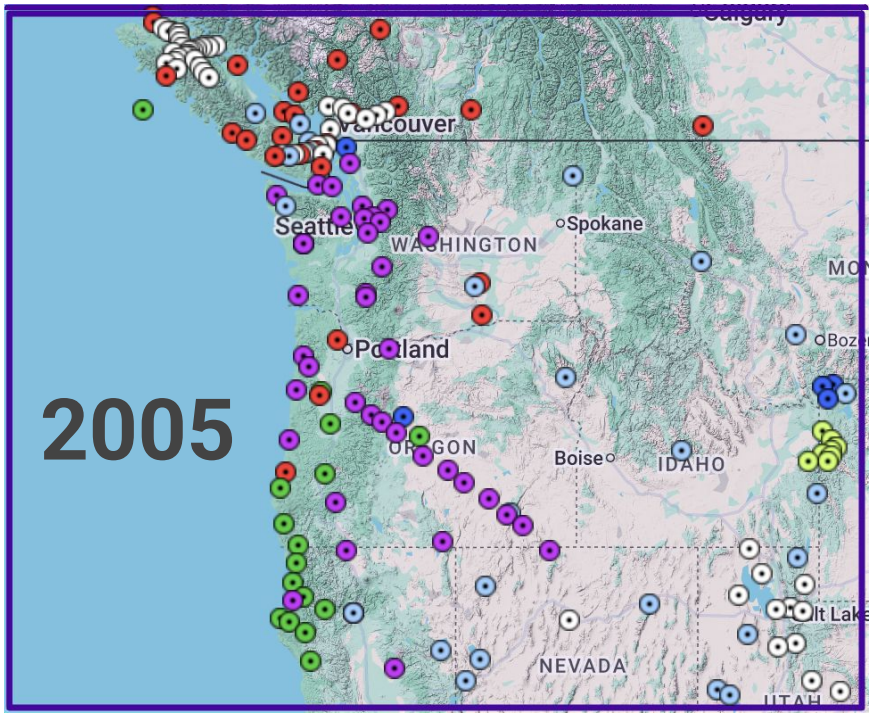

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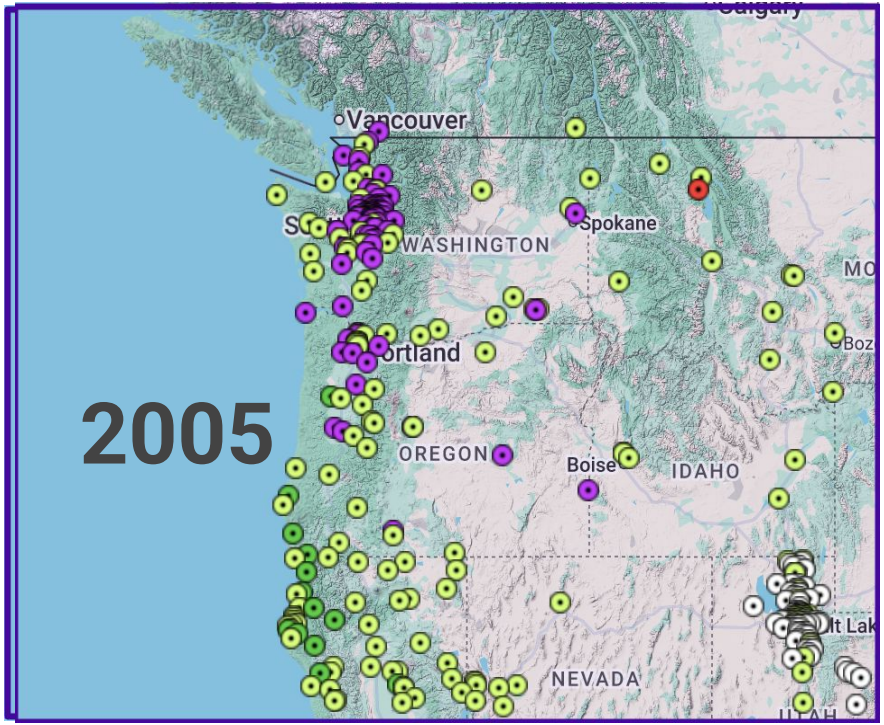

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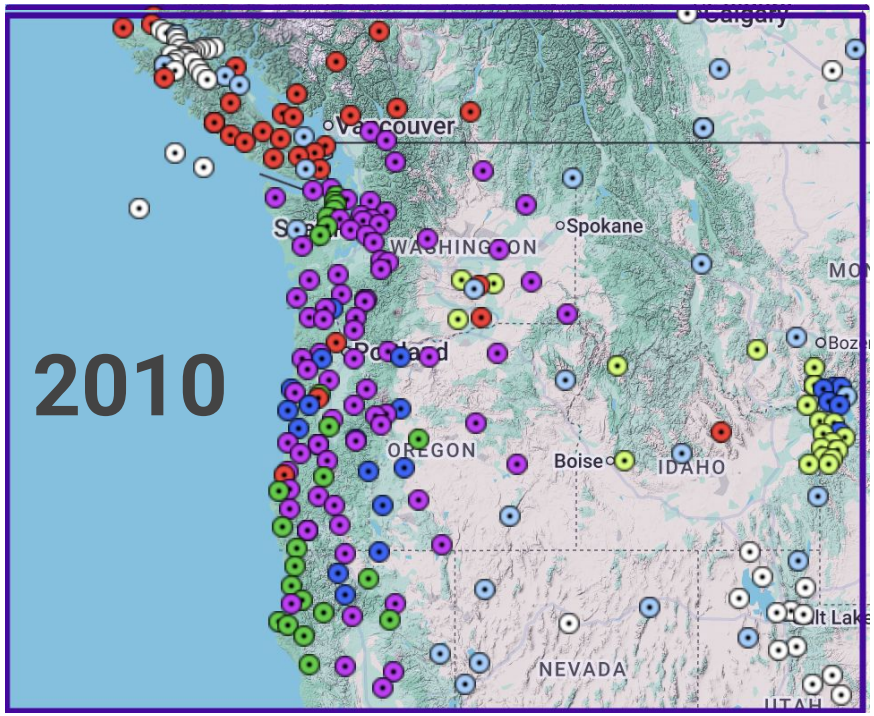

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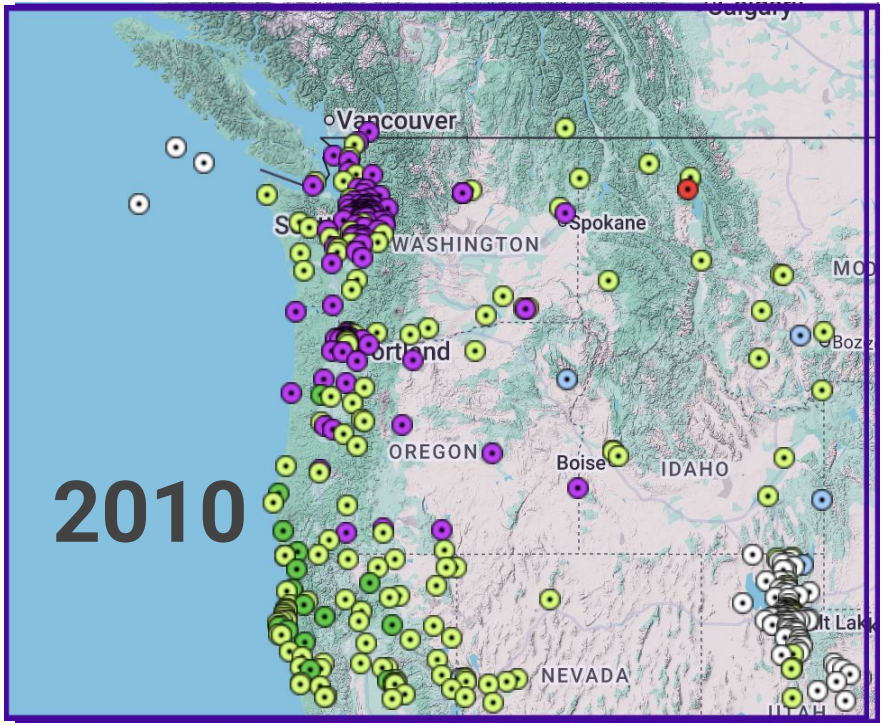

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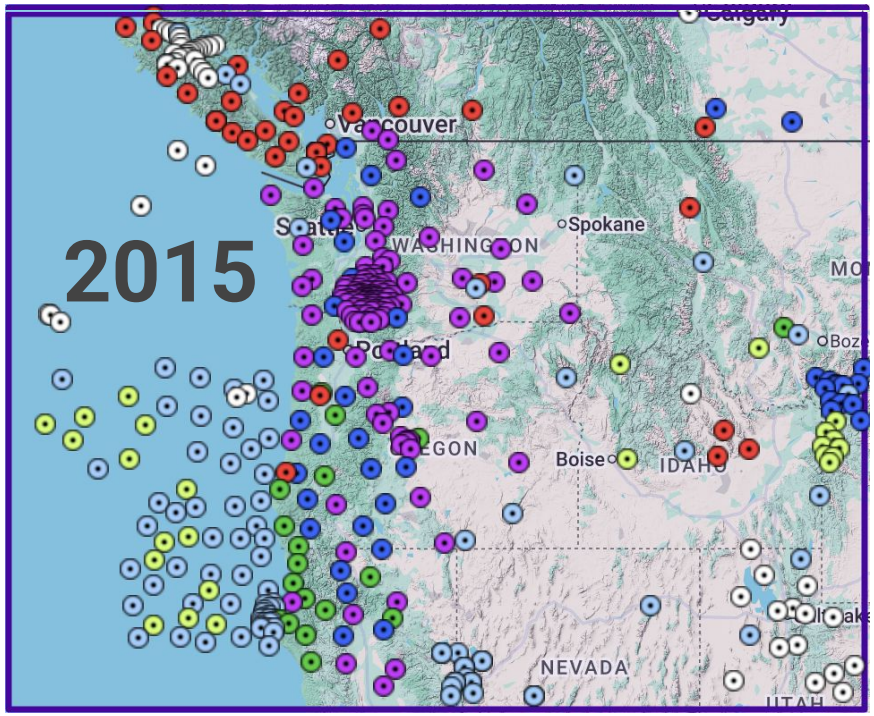

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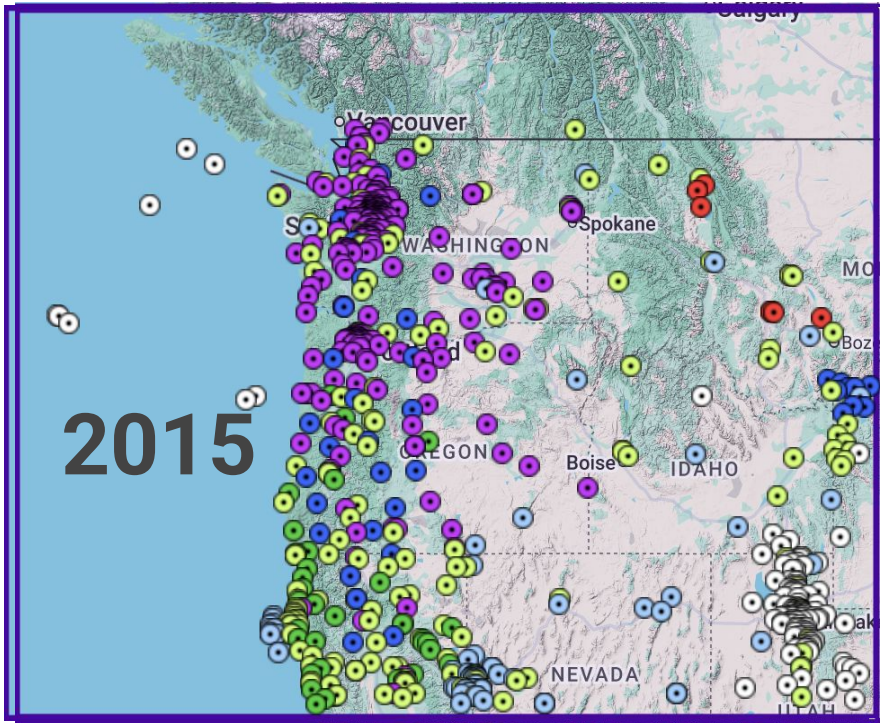

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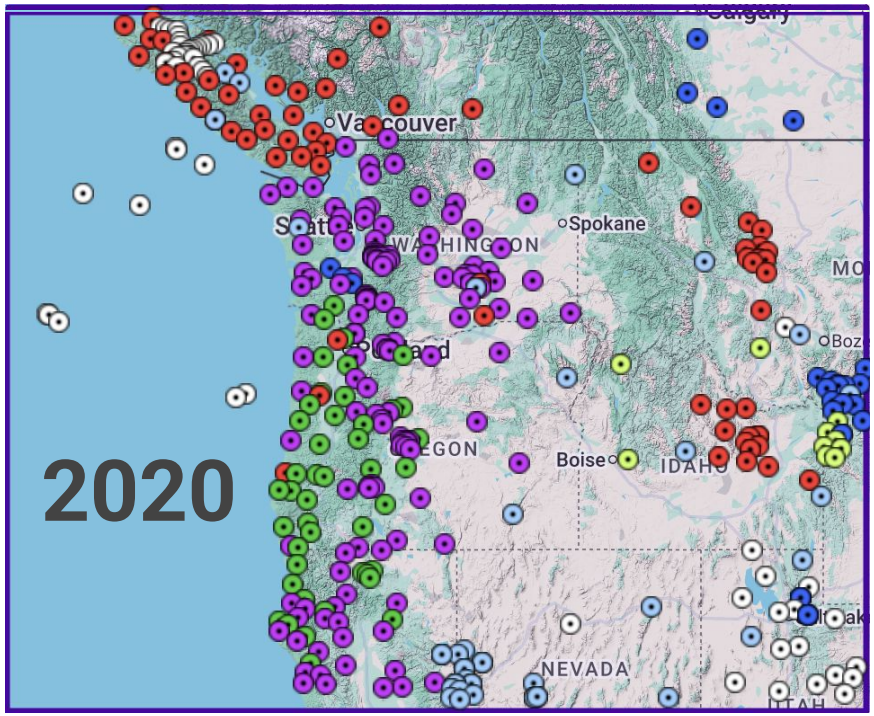

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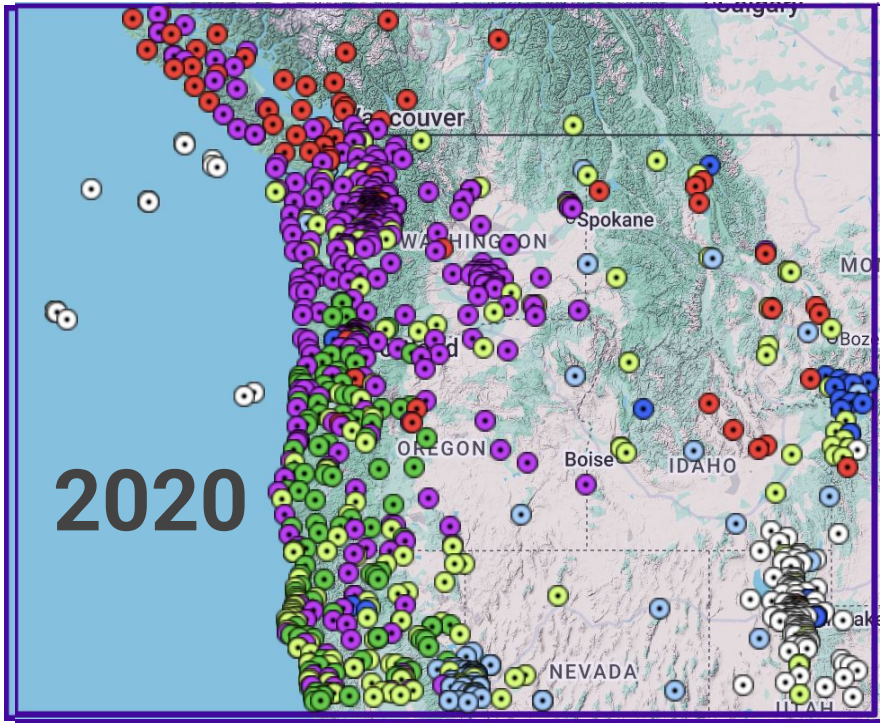

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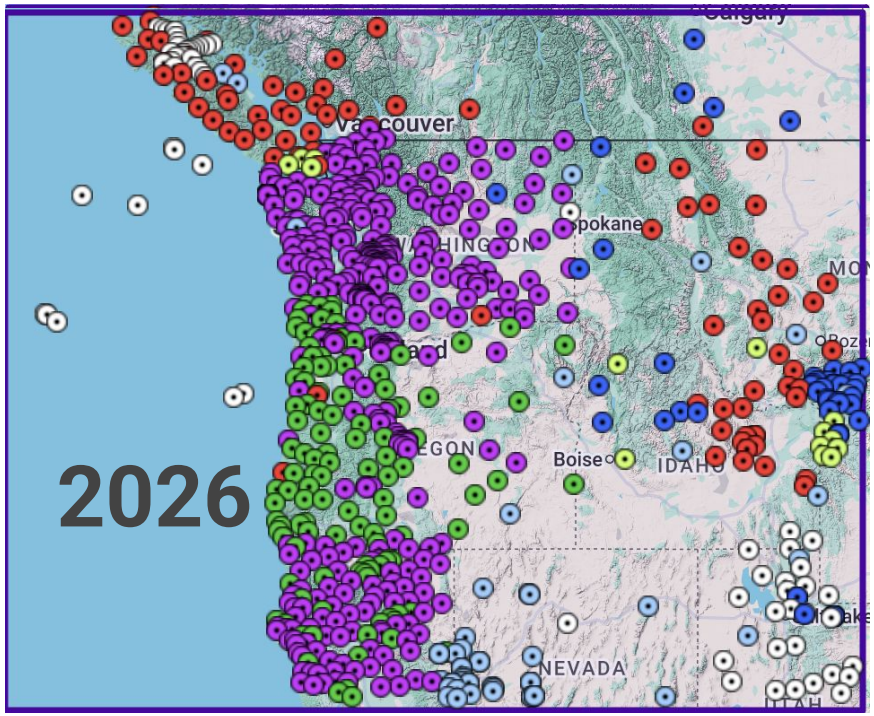

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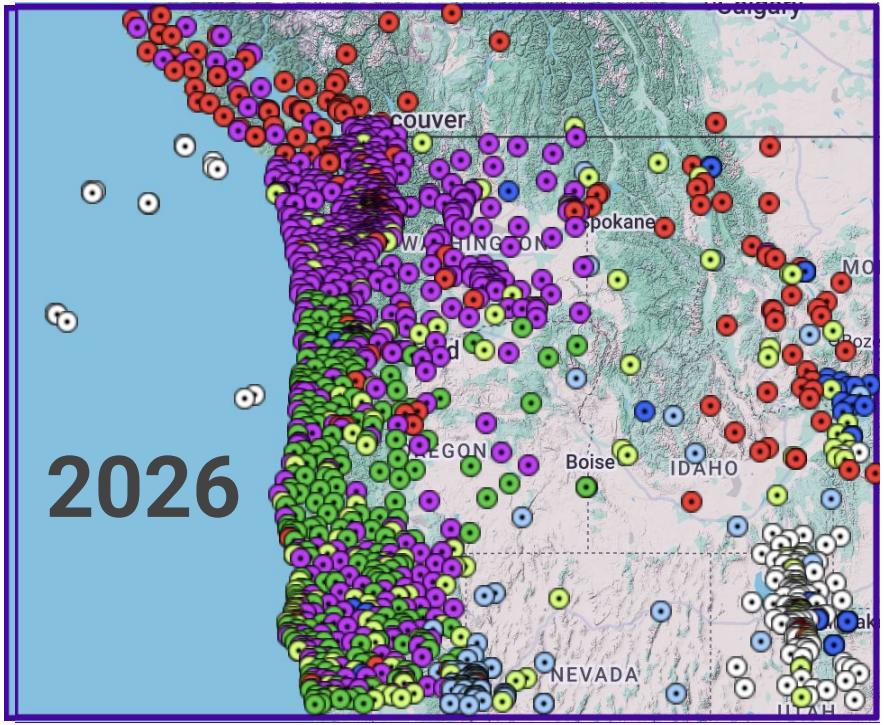

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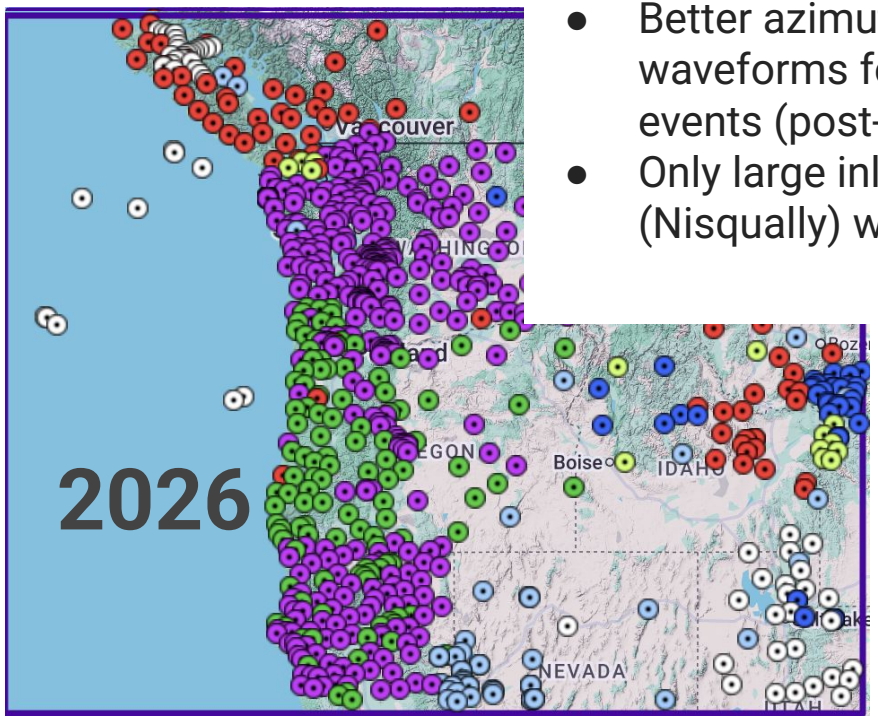
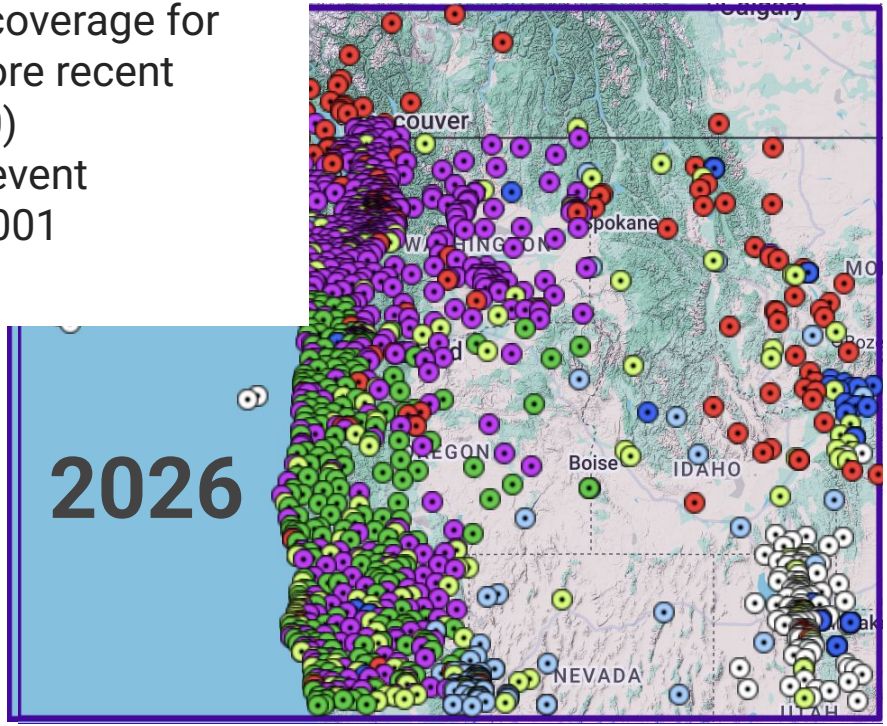
Strong-motion sensors

In summary:

- Better azimuthal coverage for waveforms for more recent events (post-2000)
- Only large inland event (Nisqually) was 2001





Broadband sensors

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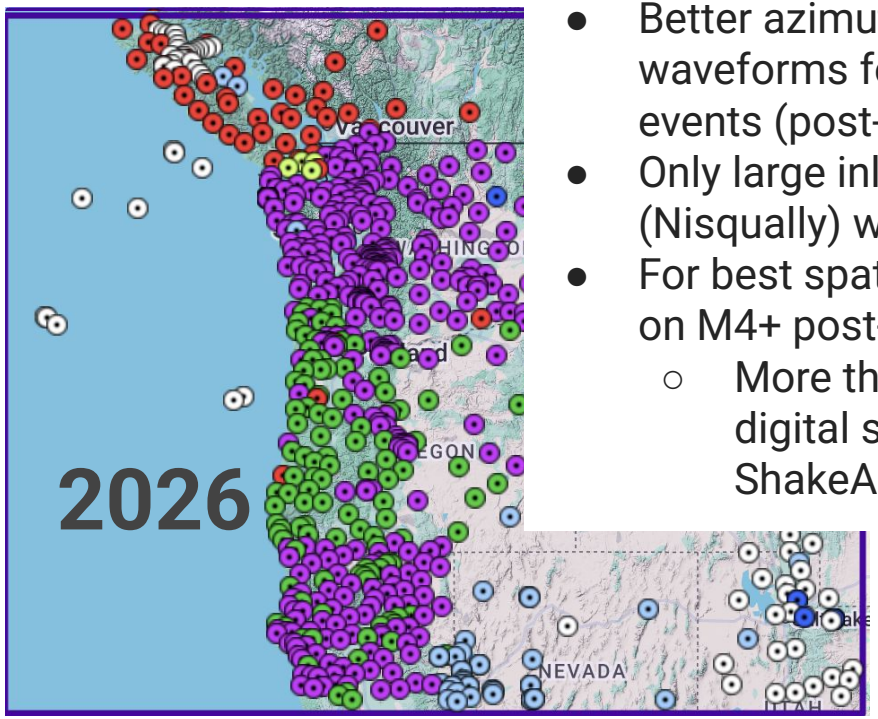
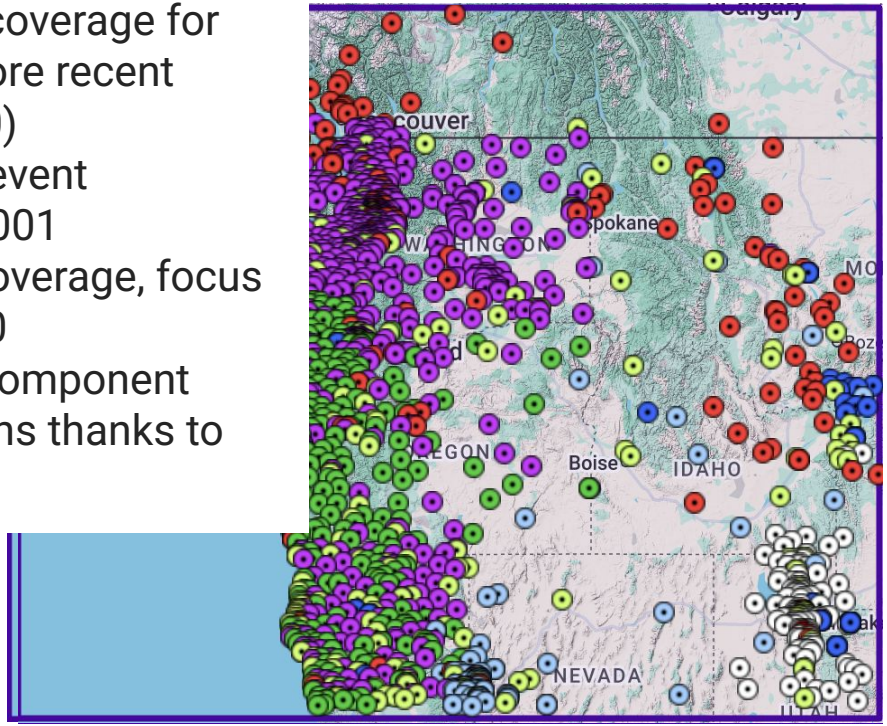
In summary:

- Better azimuthal coverage for waveforms for more recent events (post-2000)
- Only large inland event (Nisqually) was 2001
- For best spatial coverage, focus on M4+ post-2020
  - More three-component digital stations thanks to ShakeAlert





Waveform data access

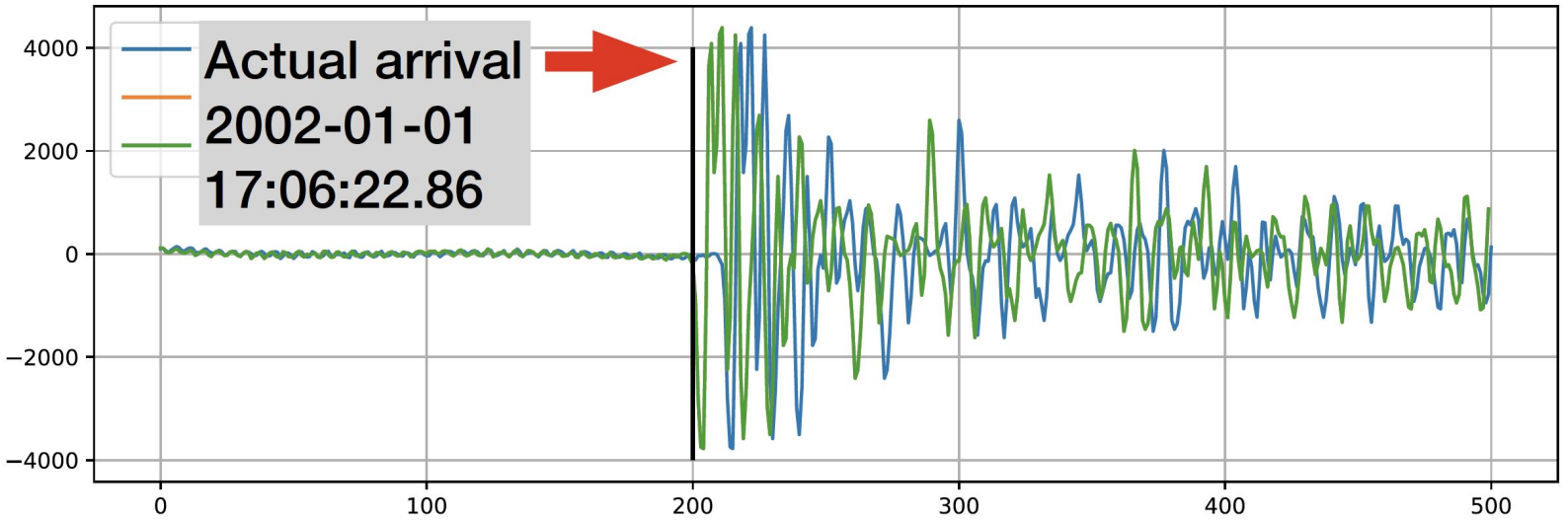
- All ANSS and Canadian data can now be retrieved via FDSN-standardized dataselect web services
- Most US data are archived at EarthScope Data Services
- Northern California data can be retrieved from NCEDC
- Canadian data can be retrieved from https://www.earthquakescanada.nrcan.gc.ca/fdsnws/

THANKS!
Questions to: jrhartog@uw.edu

Data questions? Contact the network!

Caution: Obspy Stream object and unsteady clocks!

```
# read short time windows from a larger miniSEED file
s3 = obspy.read("./OBC.UW.2002.001", starttime = starttime, endtime
= endtime, nearest_sample=False)
```



National Strong-Motion Program (NSMP)

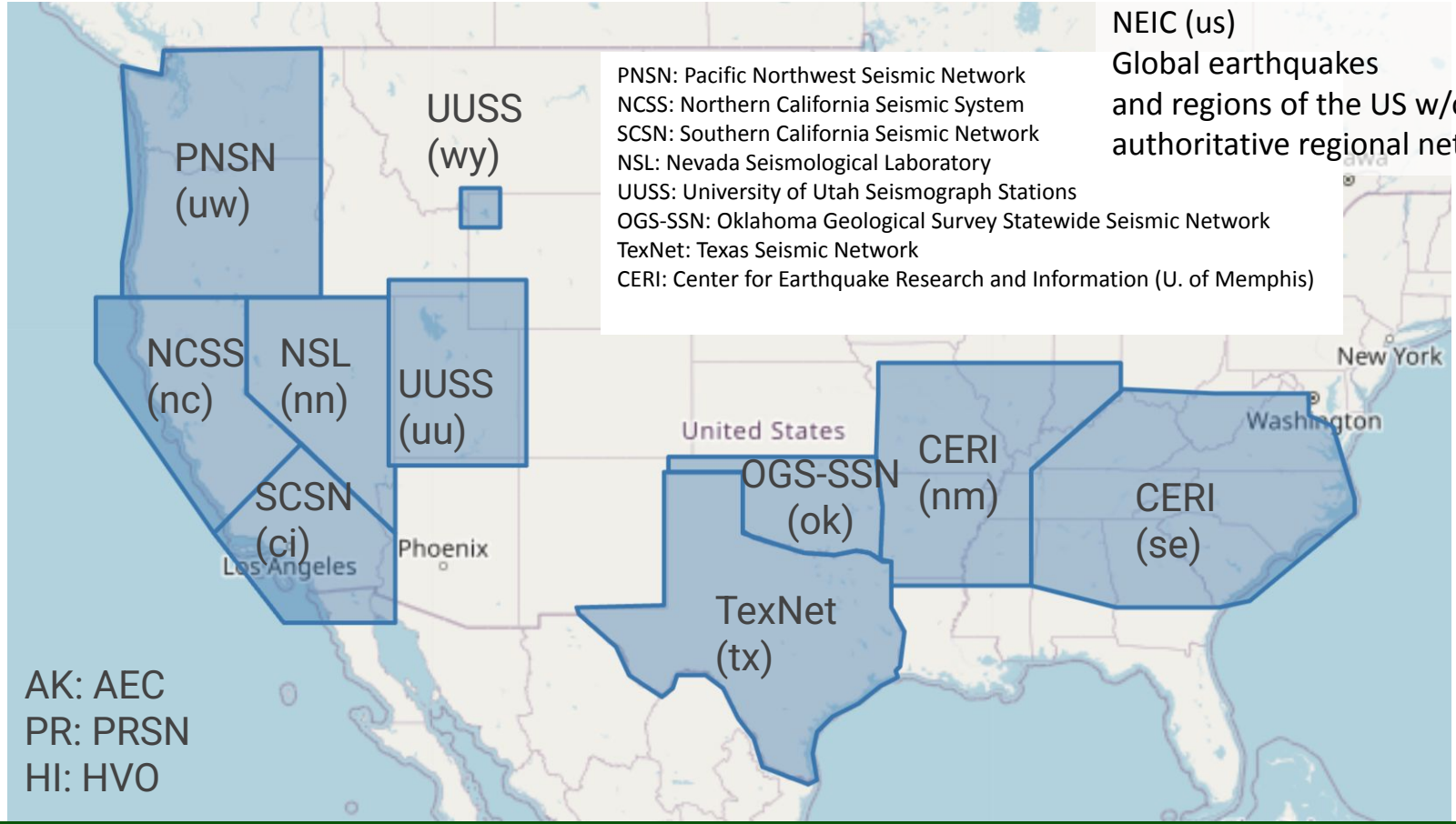
https://earthquake.usgs.gov/monitoring/nsmp/stations.php

- Long-lived
- Only some stations report continuously
- Most are event-triggered

Bridge, overpass Building Dam Free-field and reference Geotechnical Array Miscellaneous

USGS site non-USGS site

Authoritative regions of the ANSS US contributors



PNSN: Pacific Northwest Seismic Network
NCSS: Northern California Seismic System
SCSN: Southern California Seismic Network
NSL: Nevada Seismological Laboratory
UUSS: University of Utah Seismograph Stations
OGS-SSN: Oklahoma Geological Survey Statewide Seismic Network
TexNet: Texas Seismic Network
CERI: Center for Earthquake Research and Information (U. of Memphis)

NEIC (us)
Global earthquakes
and regions of the US w/o
authoritative regional network