PNW ShakeAlert overview

- Past and expected performance of ElarmS-2 algorithm
- Bottom line – **should work for all events close enough and big enough to cause damage.**
- But we will do more extensive testing to be sure, and issues with smaller and farther-away events are to be expected.
- Extension to GPS in next year will improve accuracy for biggest events.
- For now, there may be a "no-warning zone" close to shallow events.
- Speed, accuracy, integration with California, and sustainability **require full funding by Congress**.

Three evaluation datasets

Testing ElarmS-2 with configuration as in California

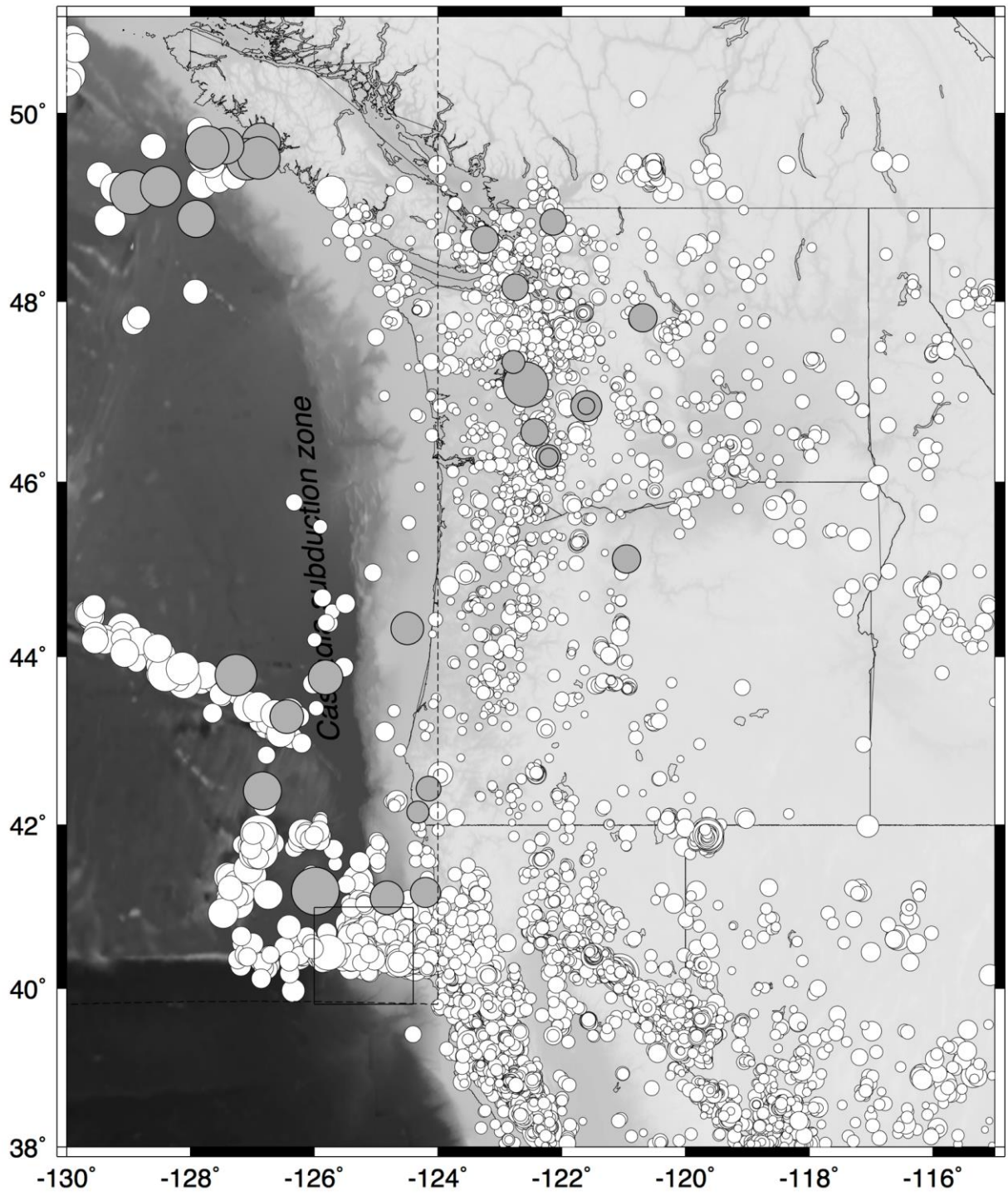
- **~130 alerts generated in real-time**
  - Test period: Feb 2013 to Feb 2015
  - Magnitudes 3+
  - Minus 10% system downtime during development
- **28 past earthquakes** that we can replay:
  - Test period: 2004 to 2014
  - Magnitudes 3.3 to 7.2
  - Caveat - more recent events have more and better data
- In future, we'll test many **scenario quakes**
  - Focusing on large, threatening events that haven't been recorded yet.

Local earthquakes

Magnitude 1+ earthquakes from 2013-02-26 to 2015-01-27 (white circles)

and

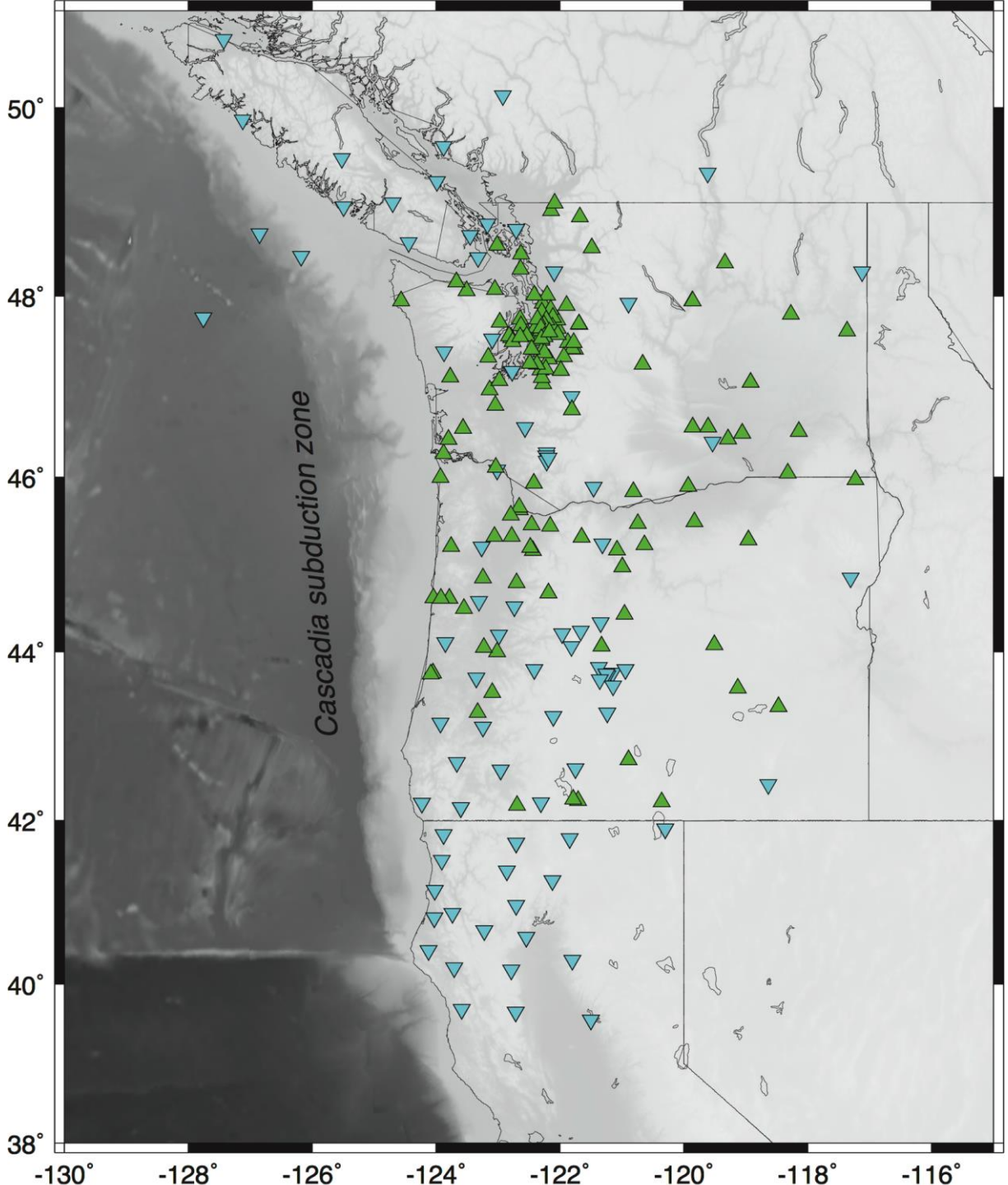
replay events (gray circles)



Seismic Network

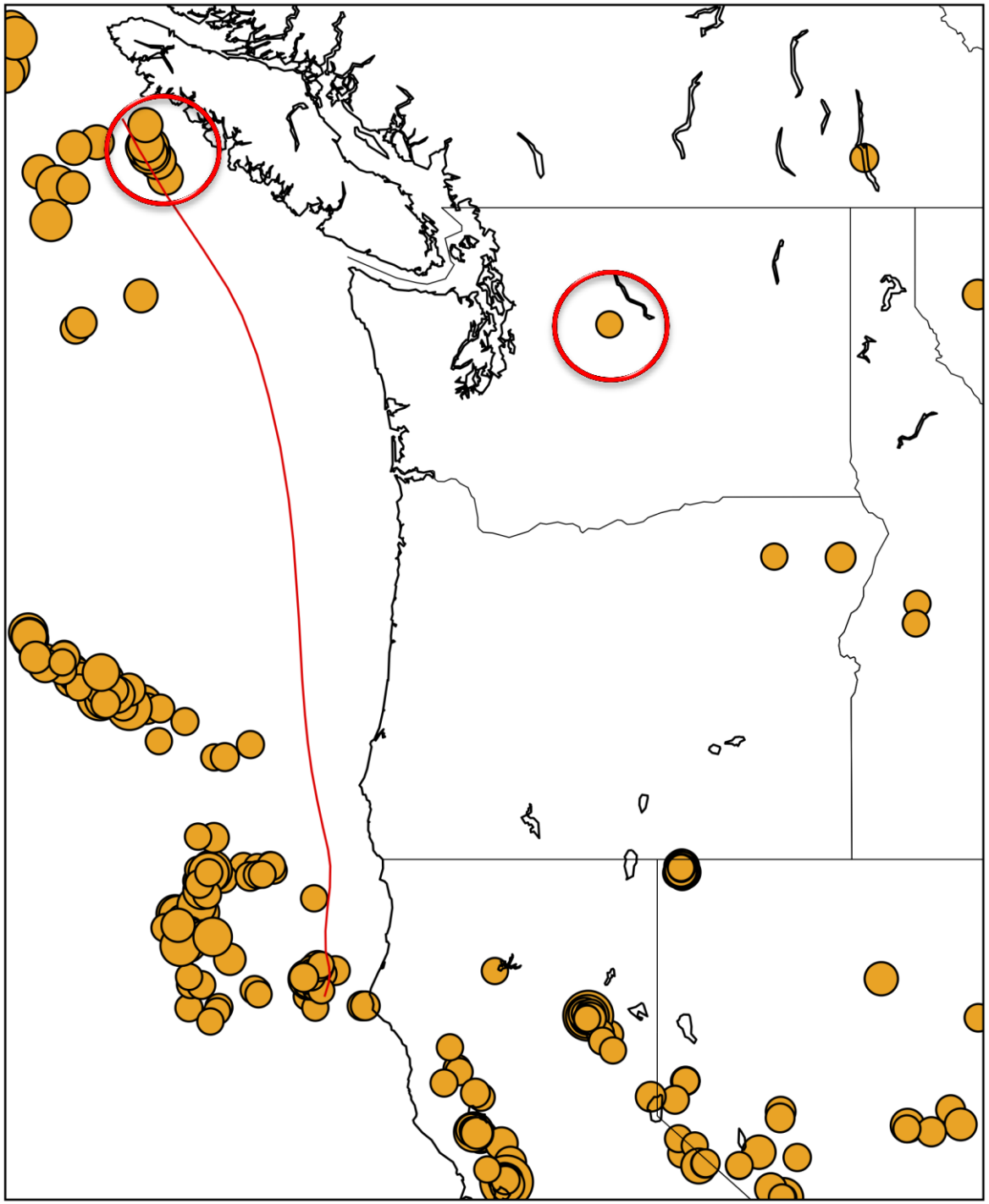
Our stations (green)

Others' stations (blue)



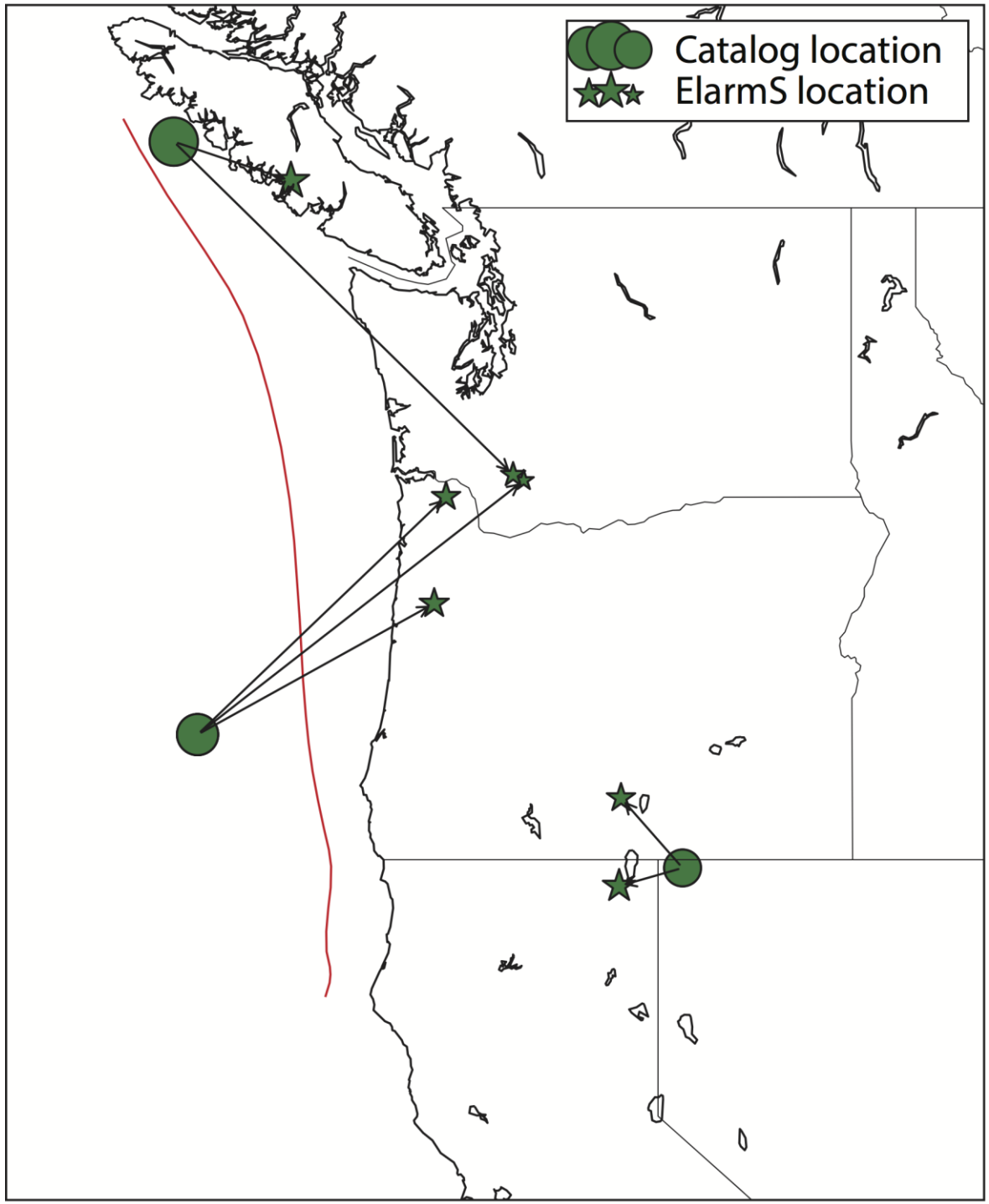
M3+ missed events

Few that we care about, and in the future unlikely to be missed.



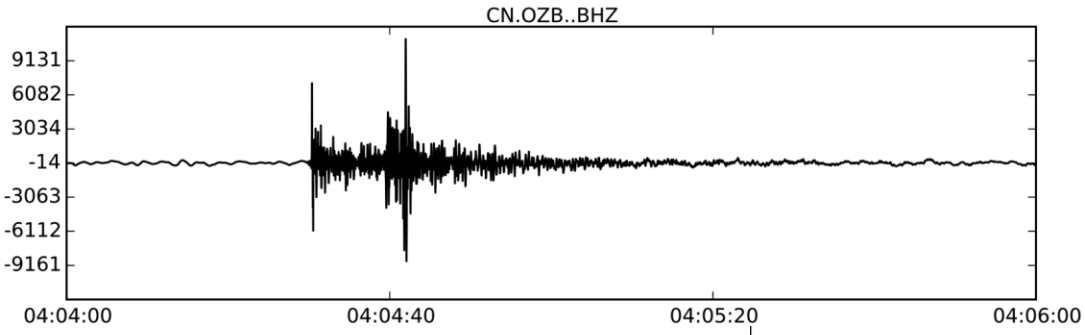
Bloopers: Multiple M3+ Alerts

Again, in the future this problem should not recur.

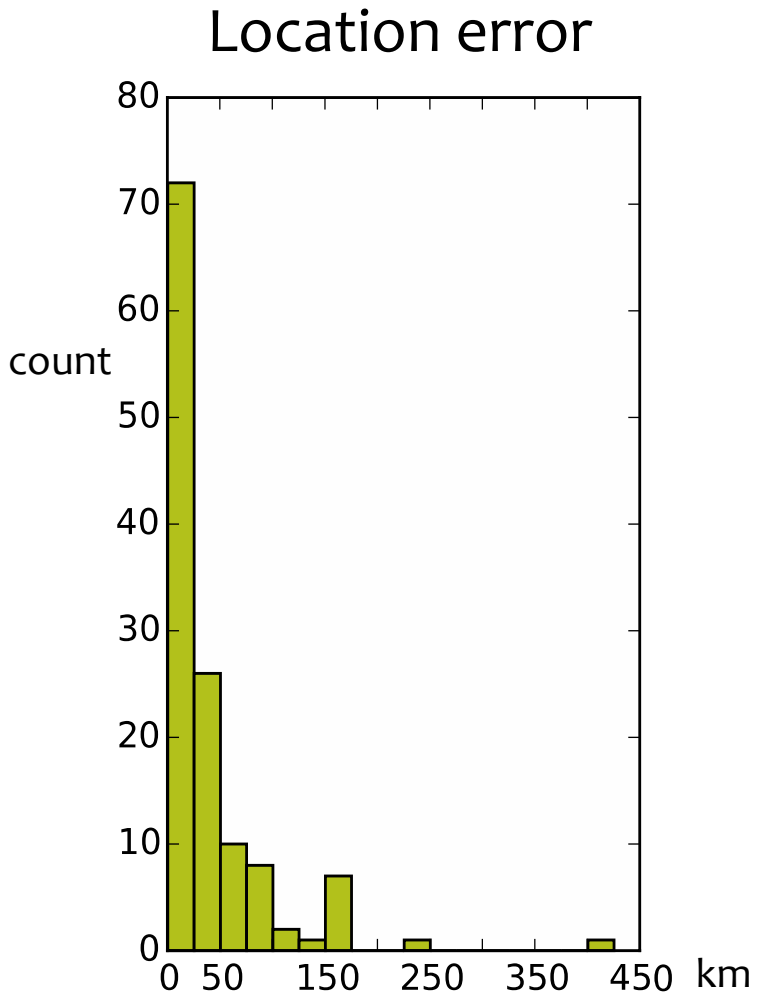


Bloopers: False M3+ Alerts

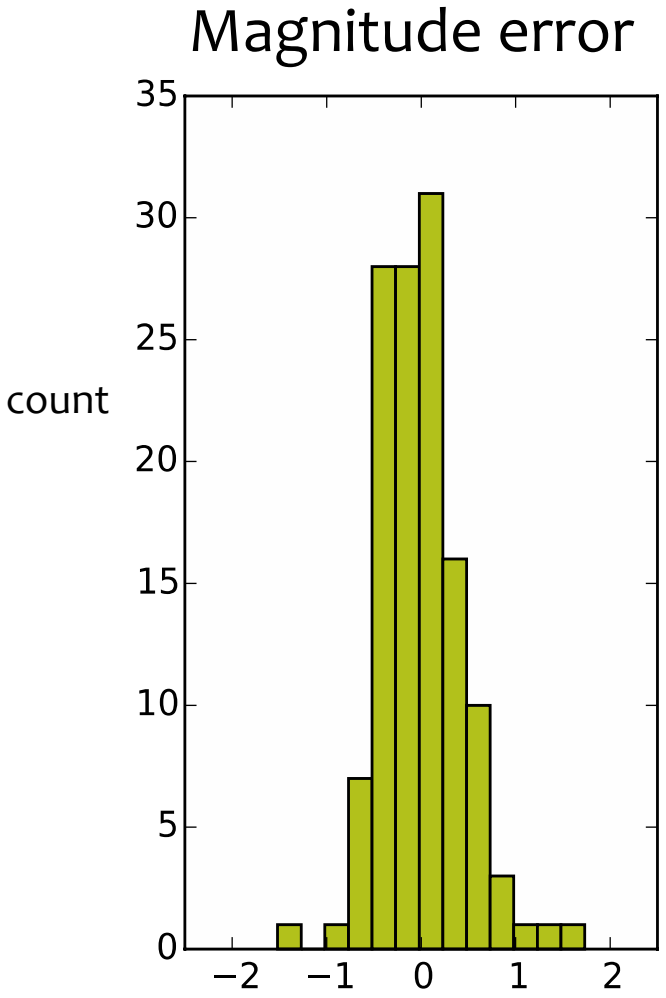
(just 1 for real)



First alert accuracy (N=128)



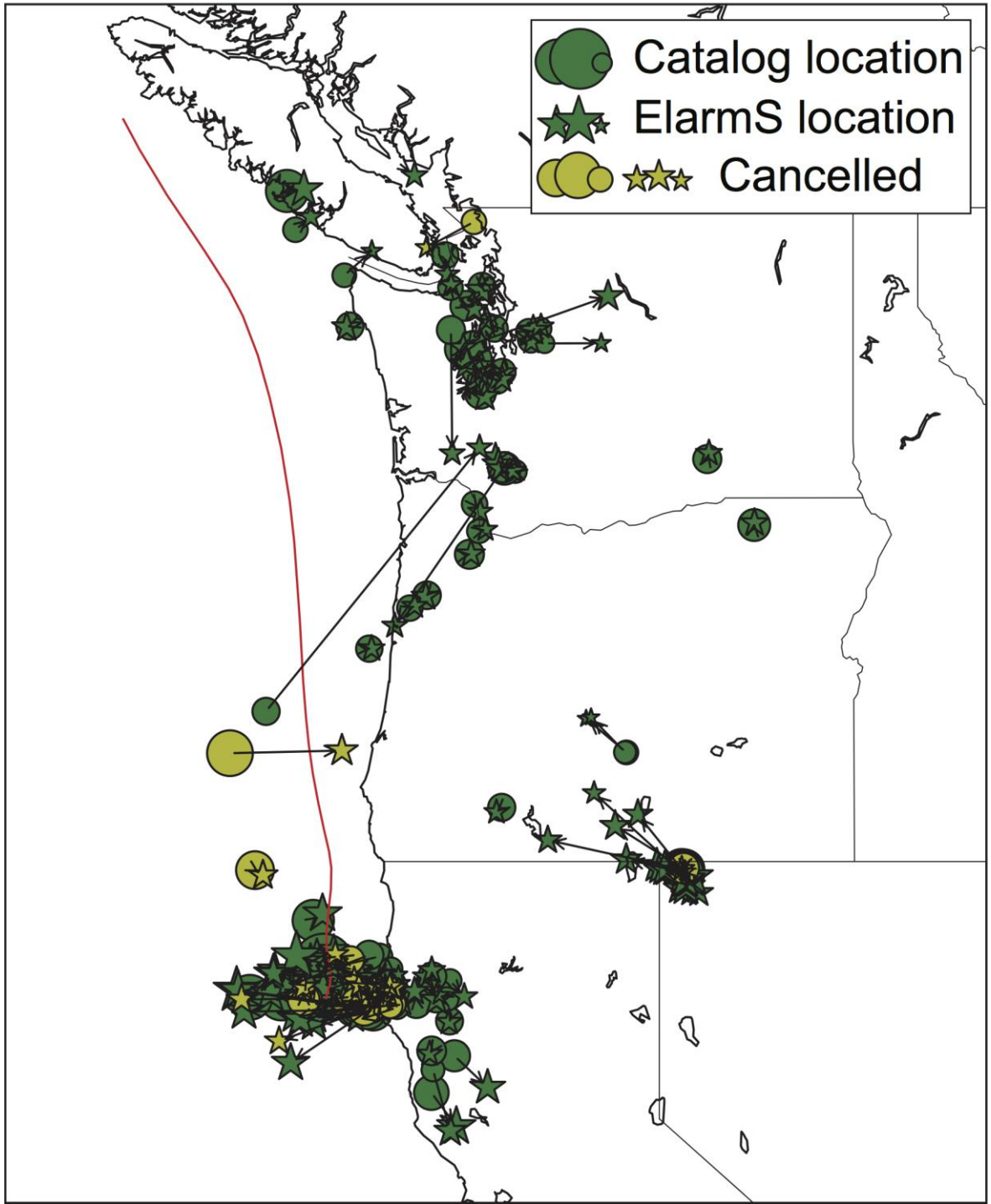
Median: 19.6



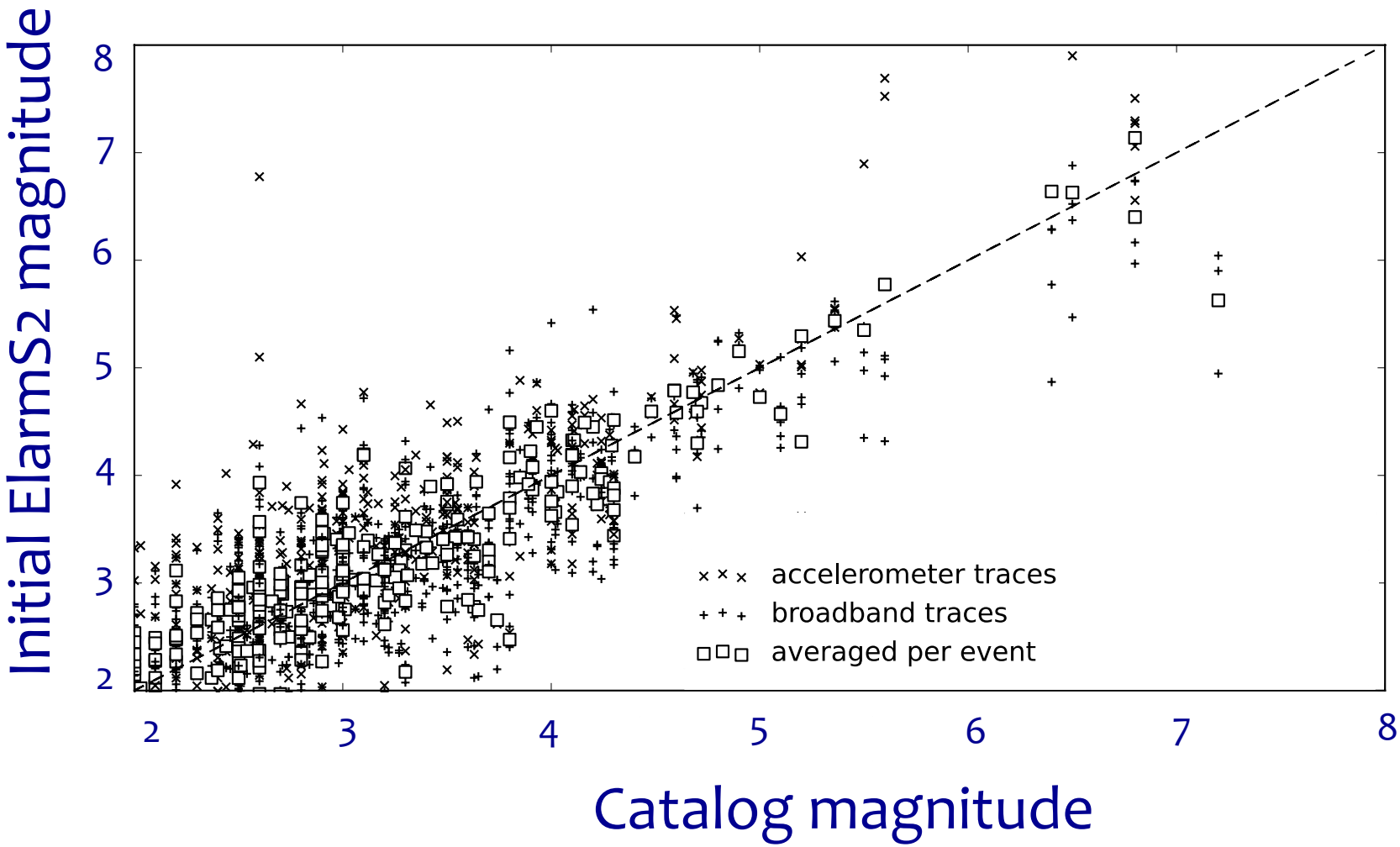
Median: -0.1 std: 0.4

M3+ first alert mislocation vectors

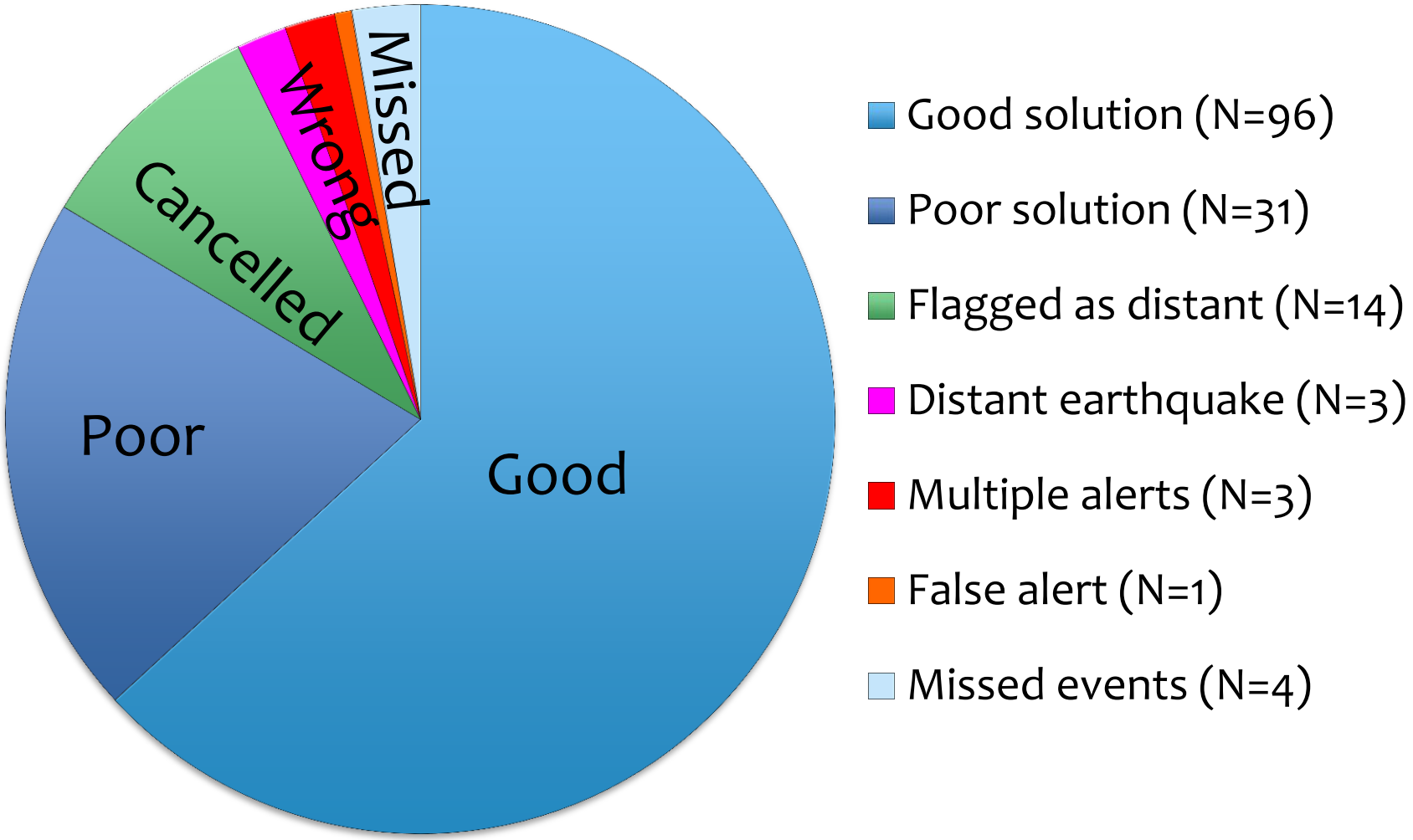
mostly very good



Goodness of magnitude estimate



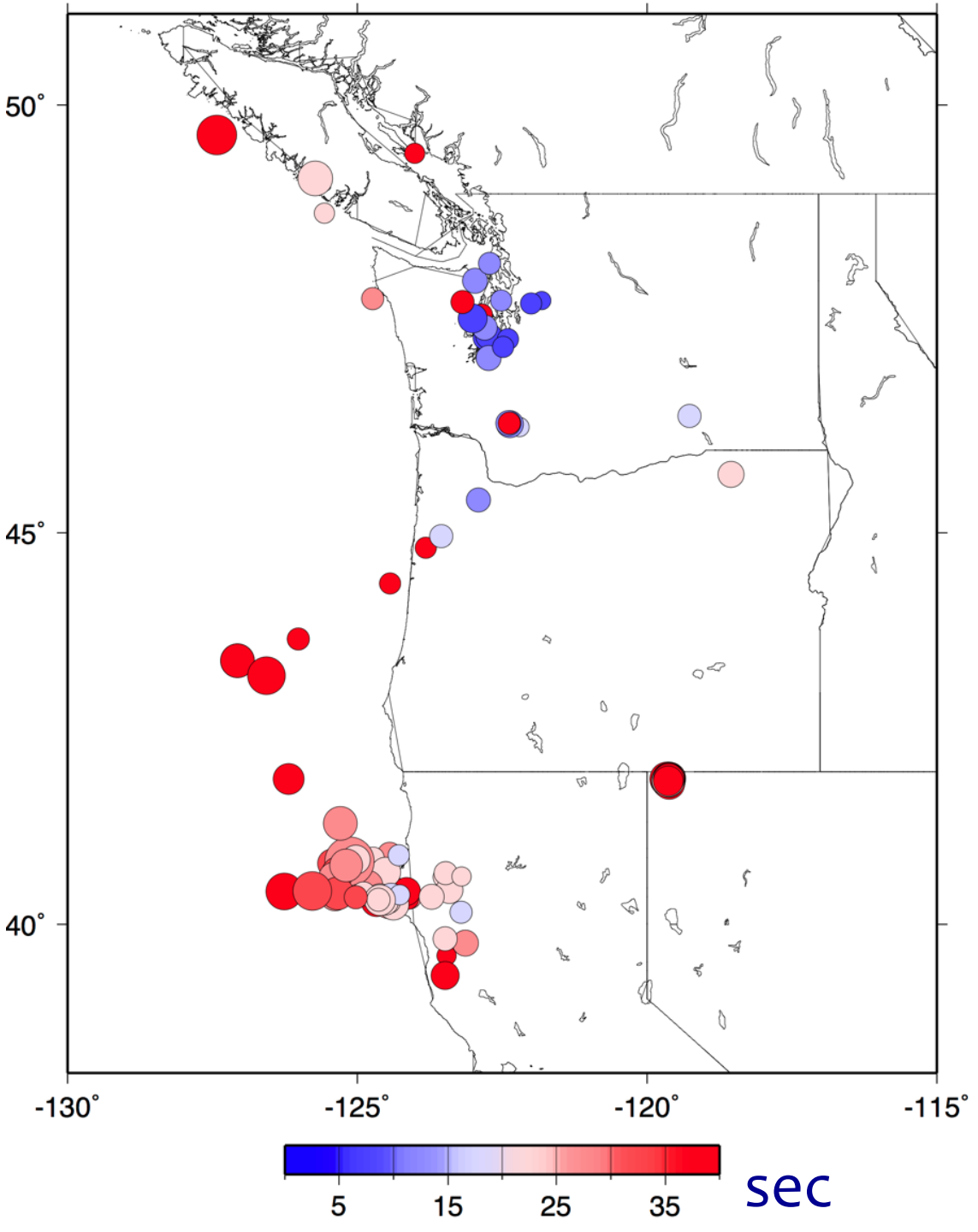
Earthquakes with M3+ alerts



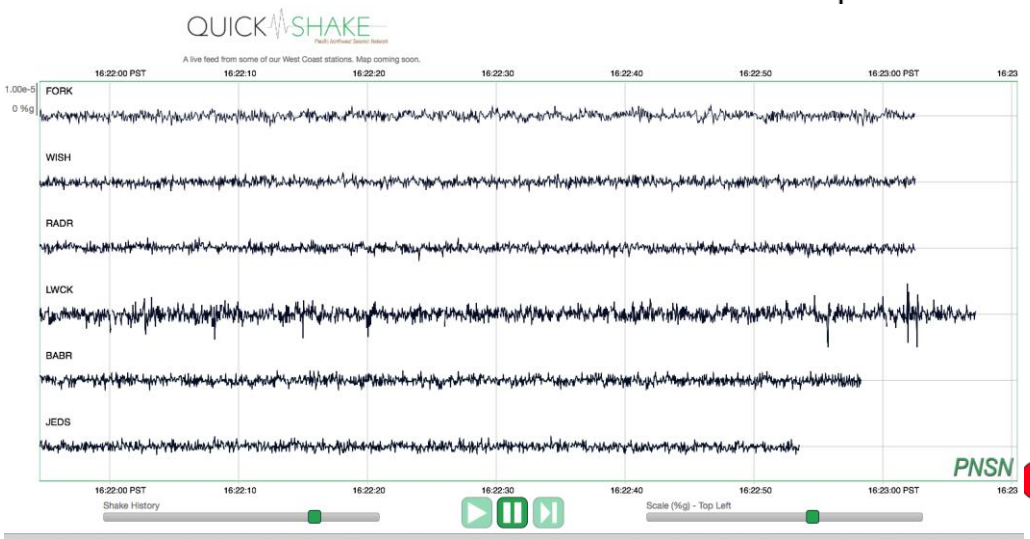
Time to alert

Reasonable detection + alert times (< 15 s) in the Puget Sound region

Alerts many places takes > 30s, will be improved in the future by new instruments with less latency

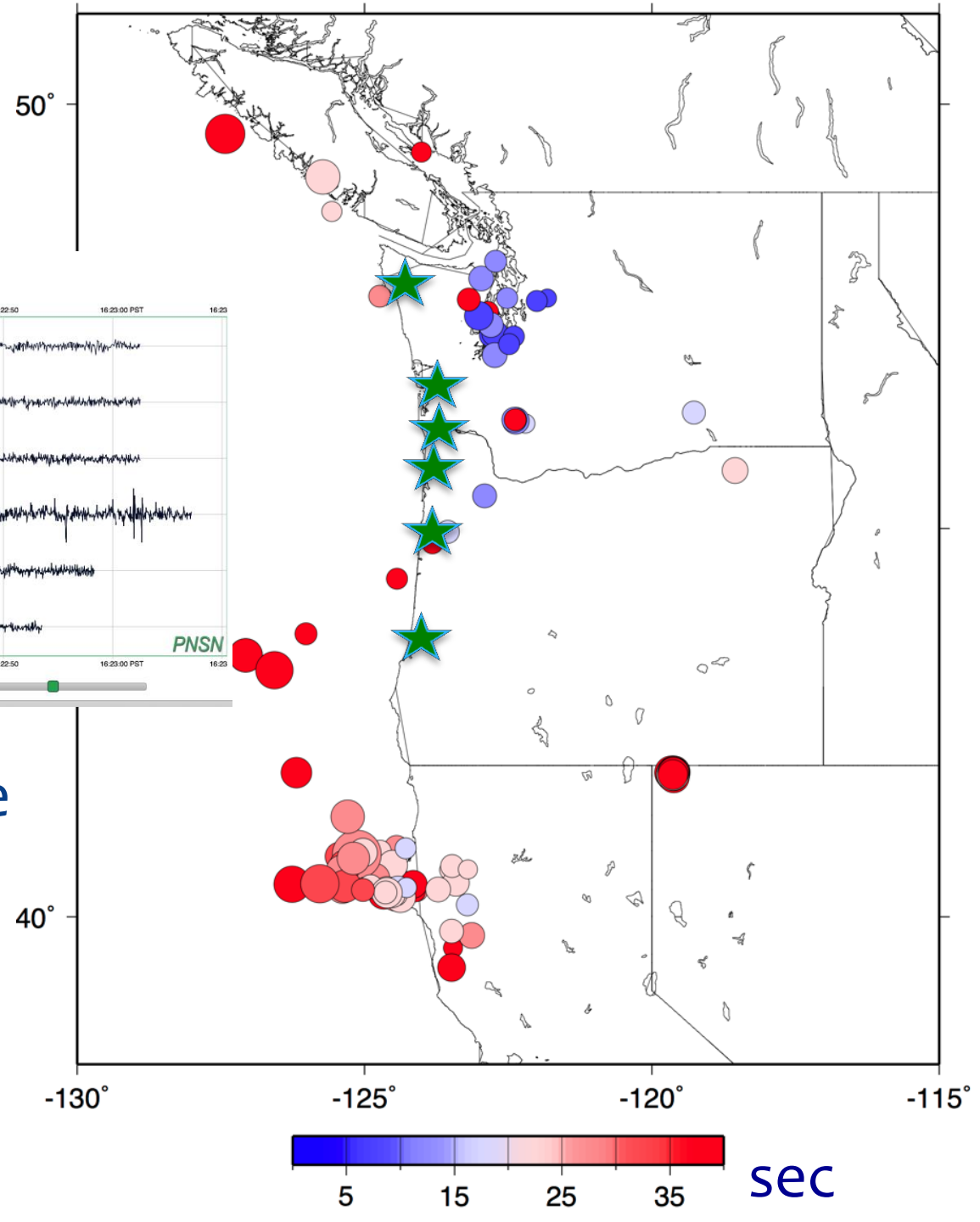


Reality check



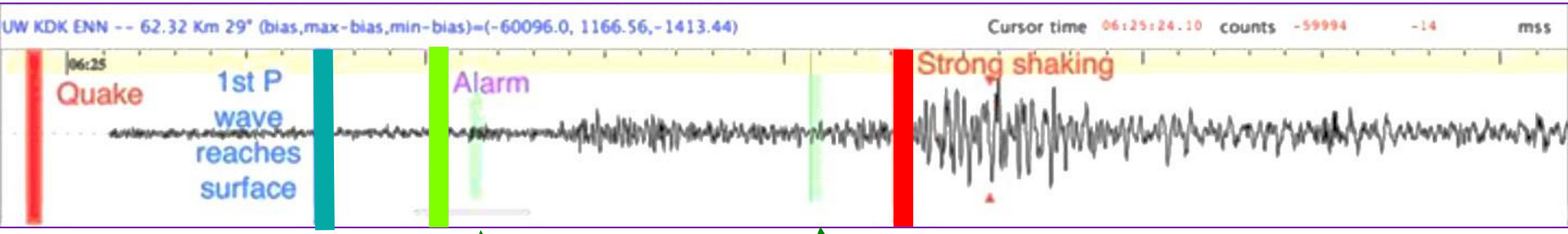
QuickShake – realtime seismograms tested with Seahawks games

Also coming soon for **Portland** and **Seattle**



Recent example of EEW

M3.5 event near Nisqually quake
11s to detect, **13s warning**



Quake

P wave

S wave

Station KDK in South Seattle near stadia

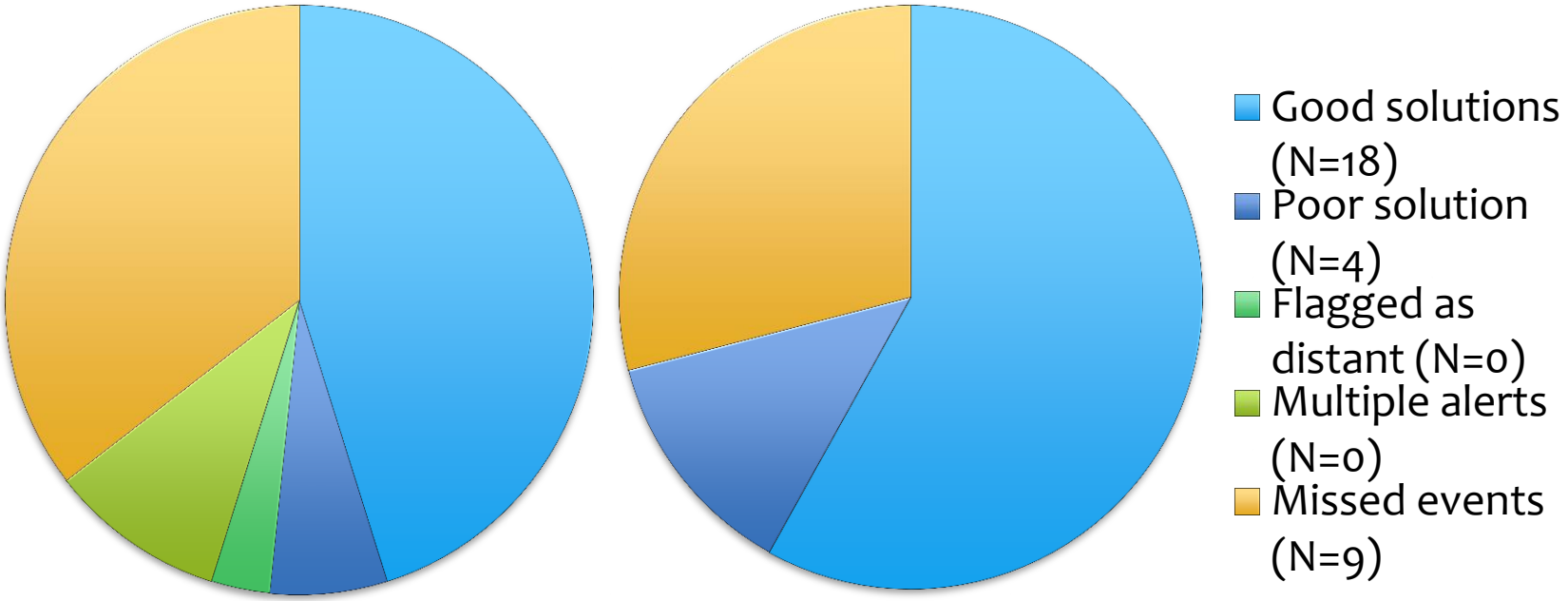
Refinements

- Search larger geographic box for earthquake location.
- Allow a larger inter-station distance when a new event is created (250 km vs. 100 km).
- More sophisticated split-event check to prevent multiple solutions for an event.
- Allow magnitude measurements from farther stations.
- Improved teleseism filter:
  - Assume short period signals are NOT teleseisms, and
  - wait longer before starting TauP measurement.

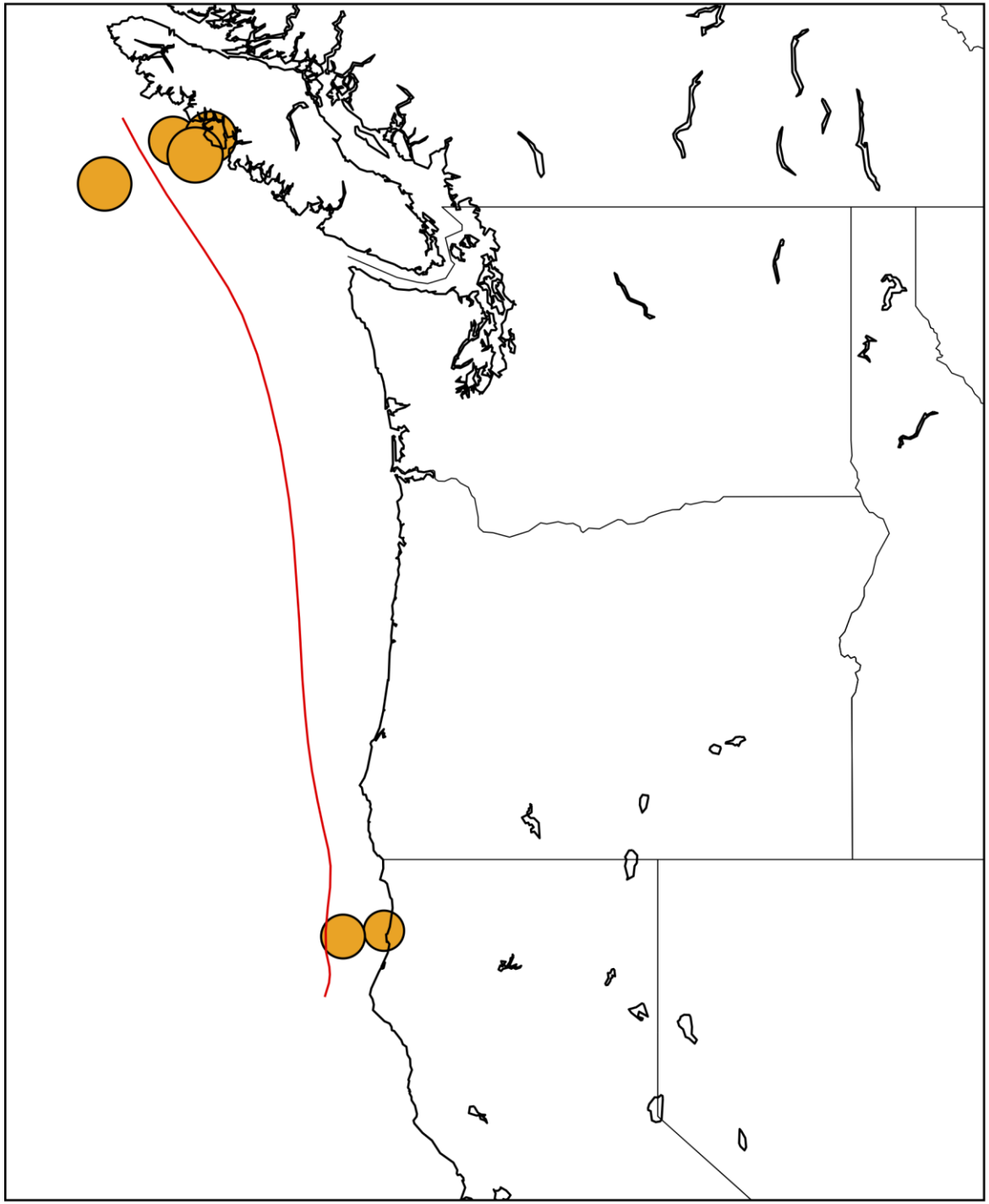
Replay events

Before refinement

After refinement

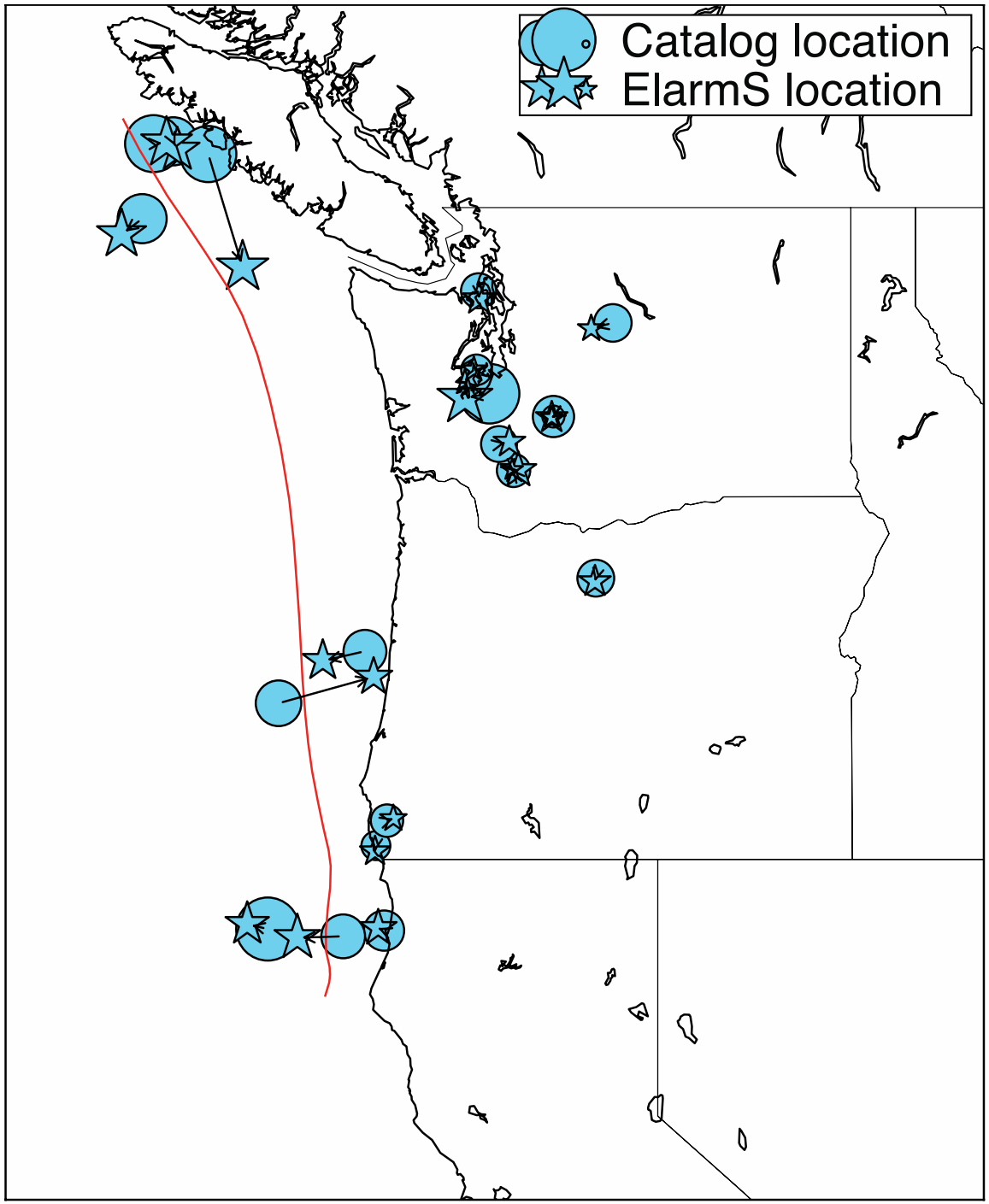


After adjustment, replay events without alert (missed)



After adjustment:

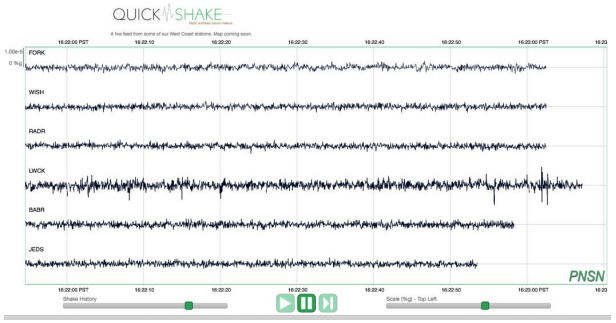
Mislocation vector of replay events with single, correct alert



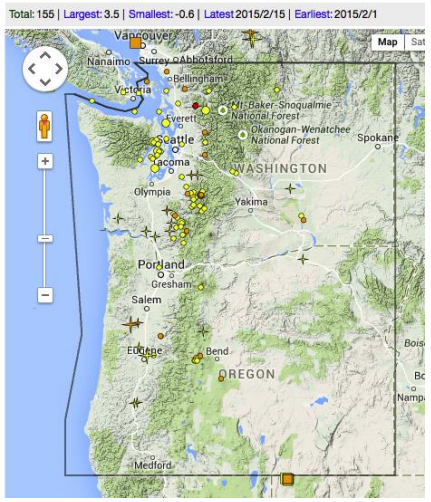
What to expect

- Alerts several times a month with default settings
- Most alerts are for events that too far away to feel
  - Being in "No Warning Zone" (too close to event) also possible
- The system may send a few false alerts (M<5) due to:
  - Distant earthquake (<1/year?)
  - Multiple alerts for a single earthquake (<1/year?)
  - Noise triggers (<1/year?)
- Accurate, quick alerts for earthquakes in dense part of network
  - Less reliable warnings for offshore/CA/NV earthquakes

Thanks



Near-realtime tools to check EEW alerts:

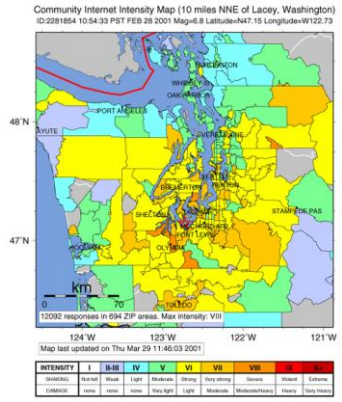


PNSN QuickShake

* http://pnsn.org/quickshake/coastal

PNSN Recent Earthquakes page

* http://www.pnsn.org/earthquakes/recent



USGS Did You Feel It? page

* http://earthquake.usgs.gov/earthquakes/dyfi

Plus tweets, CISN Display, Facebook page.