

Building earthquake early warning for the west coast



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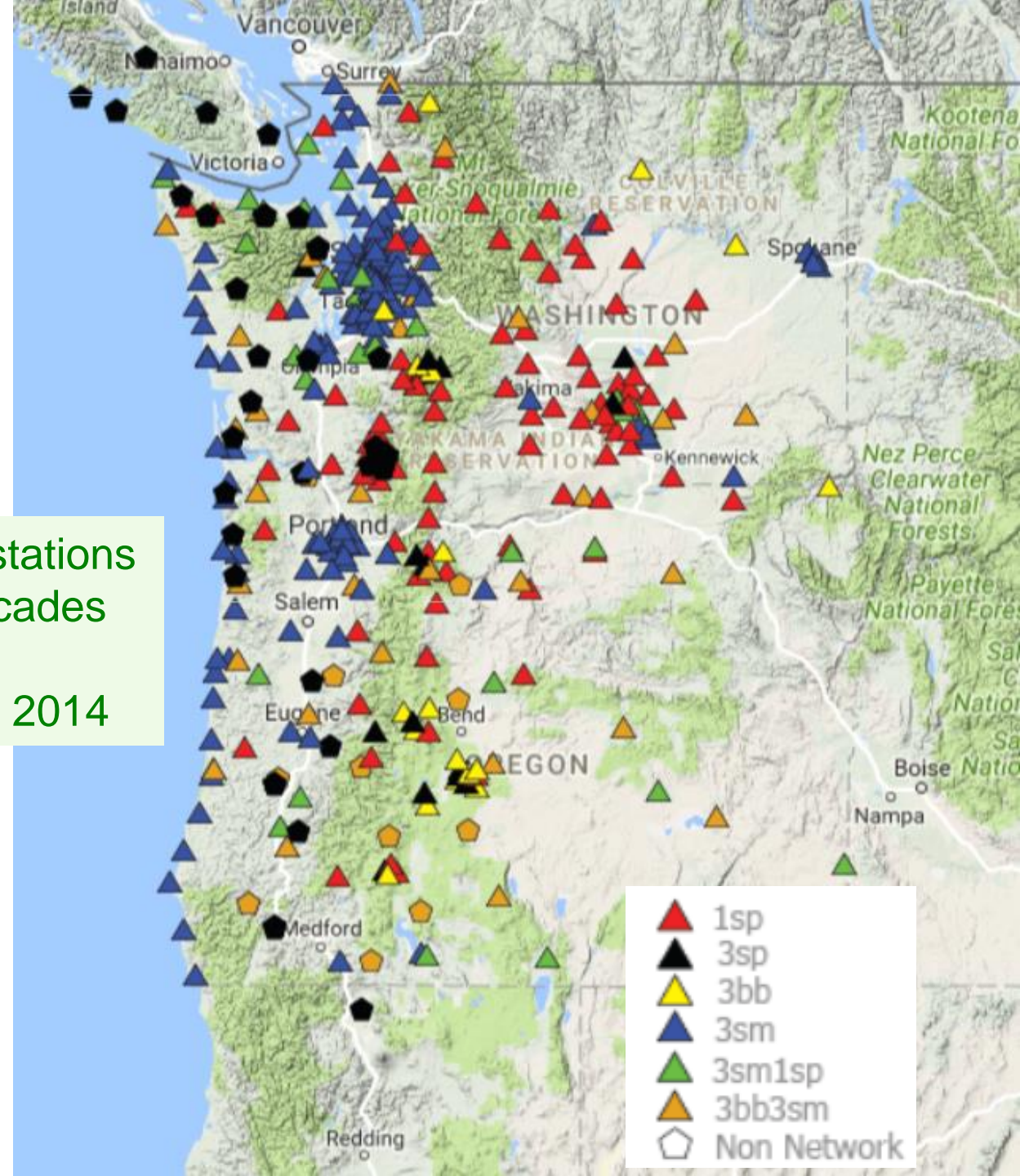
College of the

Environment

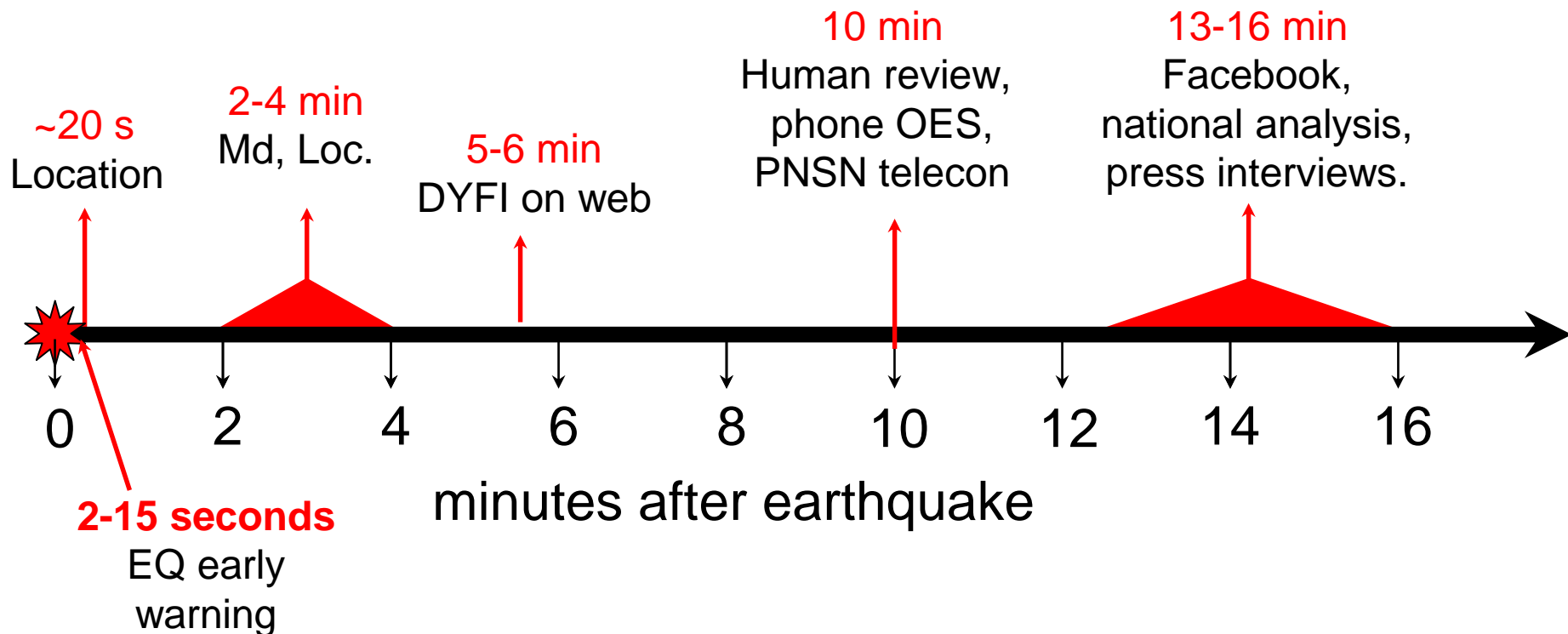
Pacific Northwest Seismic Network

PNSN created 1969 with 5 stations
UO has been partner for decades
EEW doubling network
UO stepped up with EEW in 2014

- Monitoring
- Risk assessment
- Research
- Education



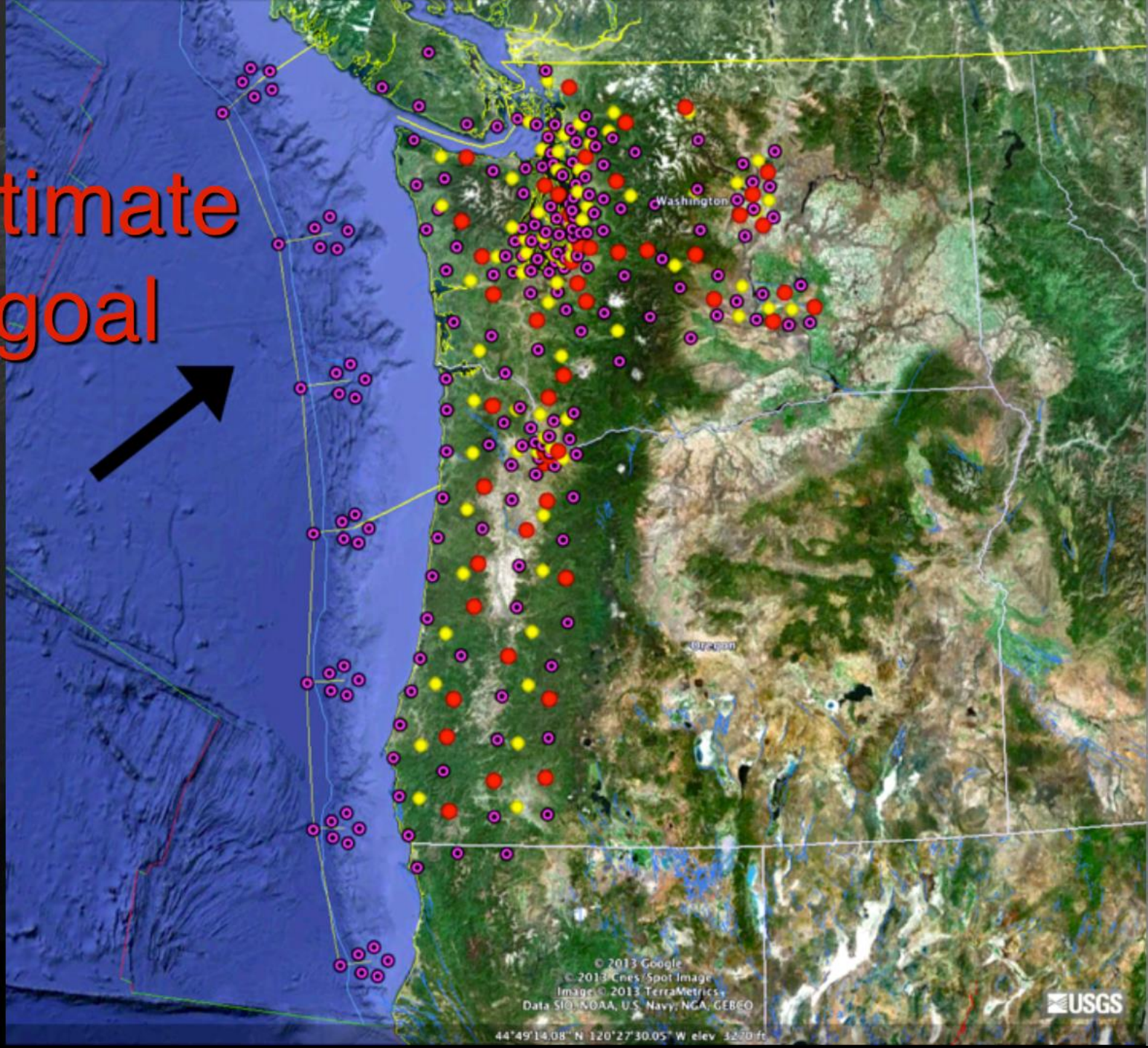
Event timeline



How Earthquake Early Warning works:



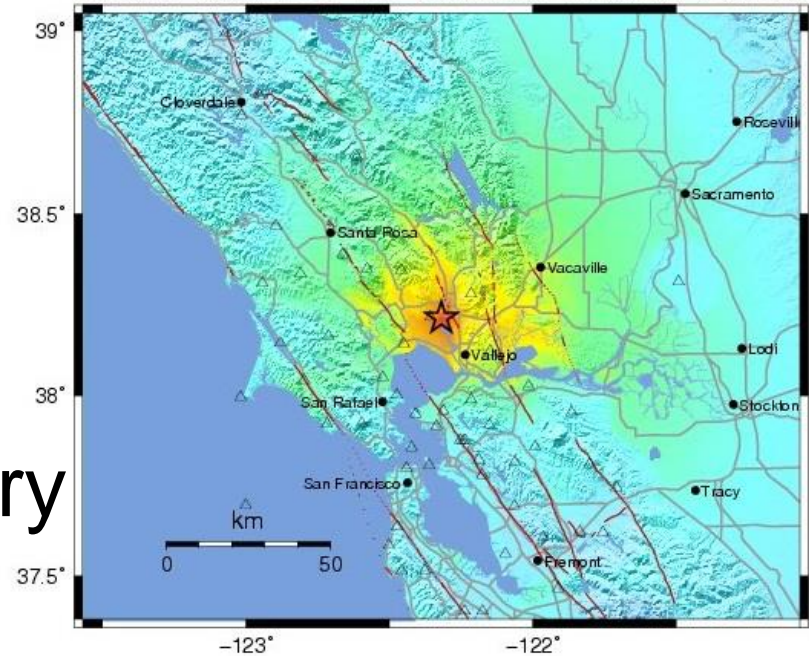
Ultimate
goal



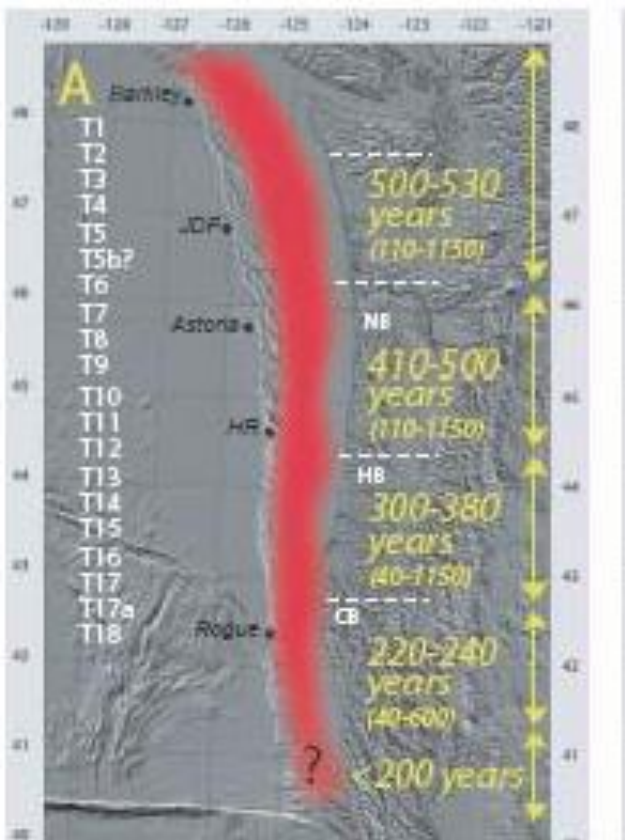
2014 Napa M6.0

- \$1B cost for an M6!
- Not a main fault strand
- Complicated fault geometry
- EEW performed well
- California EEW momentum

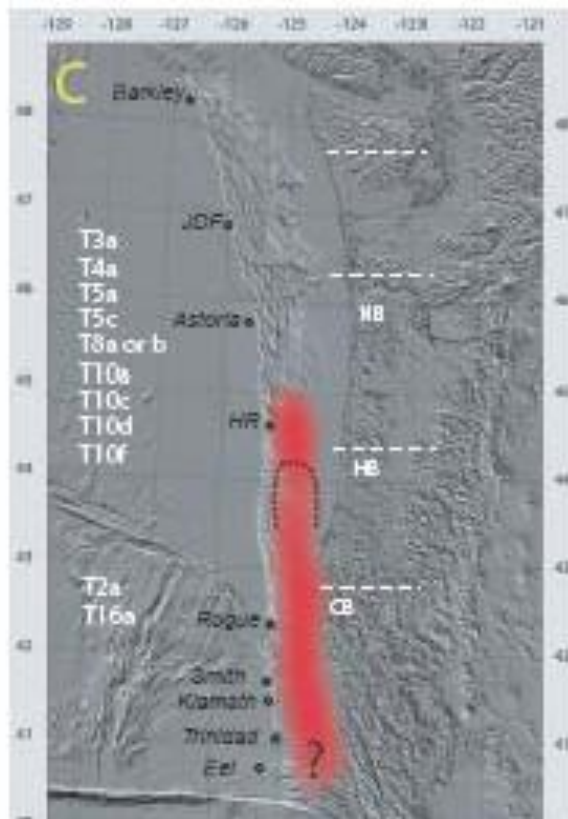
CISN ShakeMap : 6.7 km (4.2 mi) NW of American Canyon, CA
Aug 24, 2014 10:20:44 AM UTC M 6.0 N38.21 W122.32 Depth: 10.8km ID:72282711



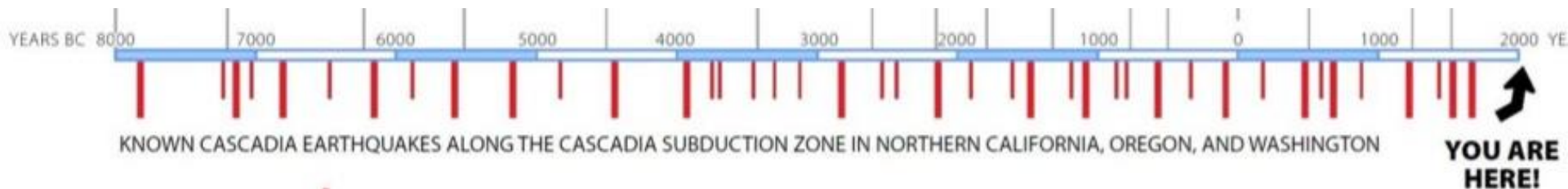
Last 10,000 years of M8+ earthquakes from offshore geology – Type 1



20 ~M9 events



20 ~M8 to M8.5 events



EEW considerations

- Earthquake early warning
 - Slowing traffic, trains, airports,
 - Hospitals, jump-starting emergency operations,
 - Warning delicate industrial operations.
- Modest expense – our plan \$16M/yr.
- Everybody that's anybody is doing it:
 - Japan (~\$1B), China (~\$300M+), Mexico, Korea, Romania, Taiwan, Mongolia, ... are doing it now.
- It's not hard:
 - Basic physics known for more than a century.

Trains

Automatically slow and stop trains – takes 24 sec

Why – 3 reasons

Rush-hour:

- 10 car train: 1000 **passengers**
- 64 trains operating
- 40-45 traveling at 70 mph
- How many might derail?
- Automatic deceleration reduces risk



One 10-car train = \$33 million

Post-earthquake recovery:

- \$2.1B retrofit so BART remains operational
- **Evacuate people + Bring in supplies**
- Only if derailed trains are not blocking the tracks



Reducing costs



Loma Prieta 50% of injuries were linked to falls.



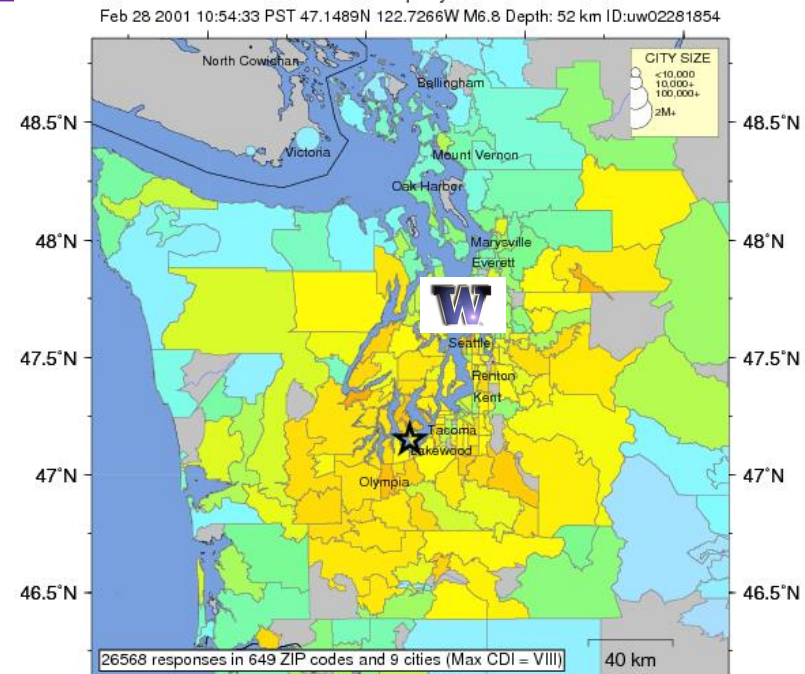
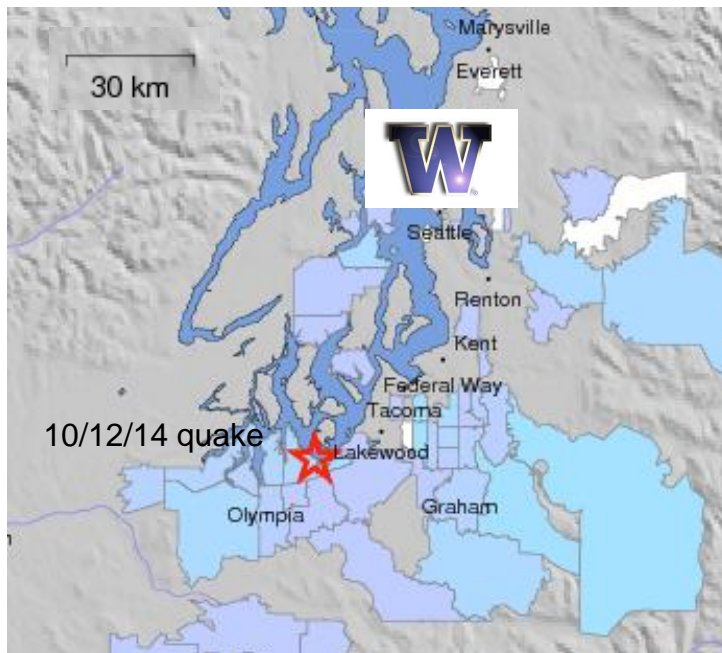
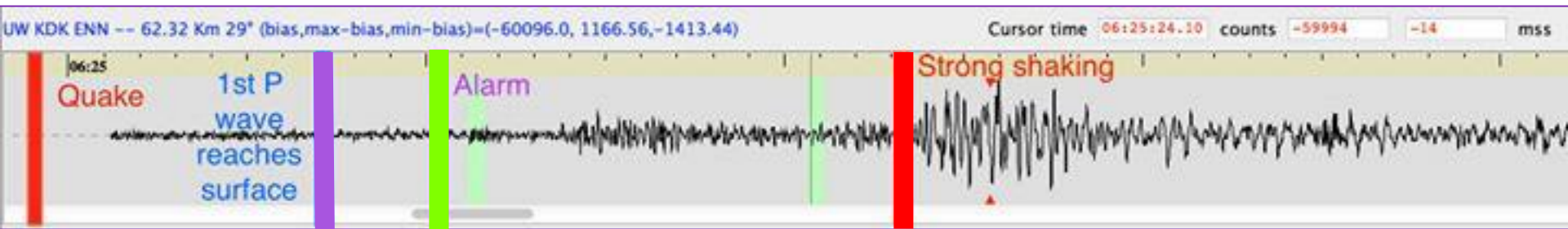
Northridge 50% of injuries were non-structural (falling) hazards.

Cost of injuries: **\$2-3B**

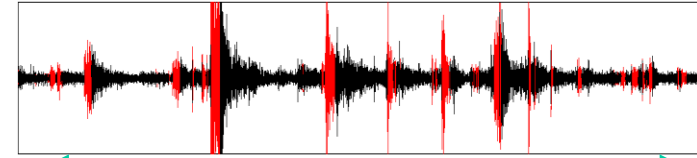
If everyone received a few seconds warning, and if everyone dropped, took cover, and held on, then **EEW could reduce injuries by 50%**.

Example of EEW

M3.5 event near Nisqually quake, 13 s warning, magnitude estimated correctly



Challenge – deciphering chaos, large fault, aftershocks

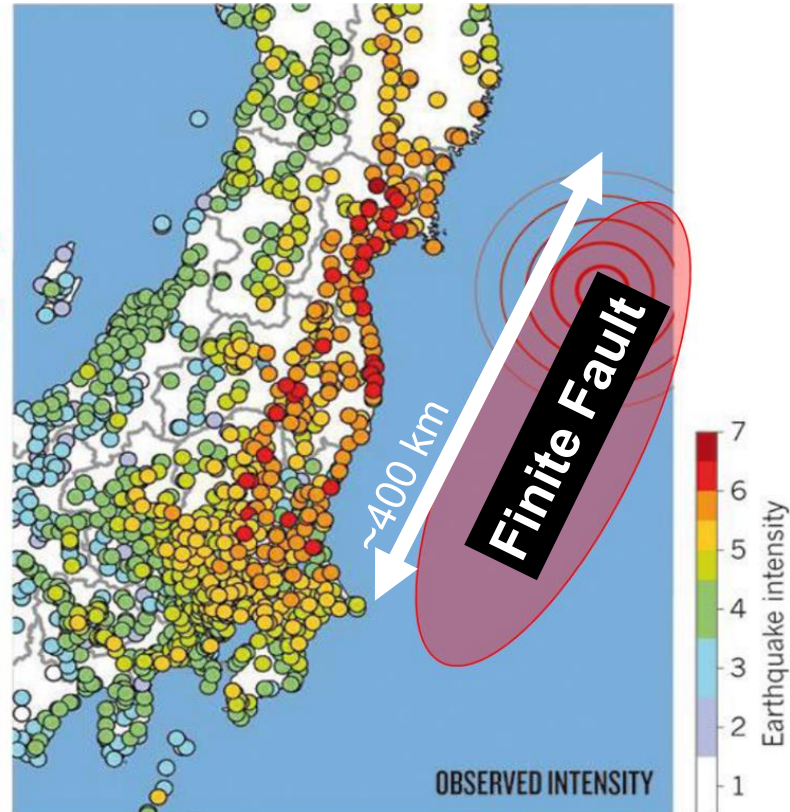


← 10 minutes →

2011 M9 Tohoku-Oki earthquake (Japan)



Predicted by EEW



Observed

Start of ShakeAlert

- Feb 2015, distributed to 40 test users,
 - groups with emergency managers.
- April 2017, PNSN pilot projects can use EEW.
- Then see how funding evolves.
 - Currently only half funded, \$8M out of \$16M/yr
 - Budget this week proposes \$10M/yr
 - Challenging to stay abreast of California
- Current software runs on hardwired computers
 - 24/7 notifications hard to make instantly
- To general public in a few years
 - “limited public roll-out” next year

