



California  
**Department of  
Conservation**  
California Geological Survey

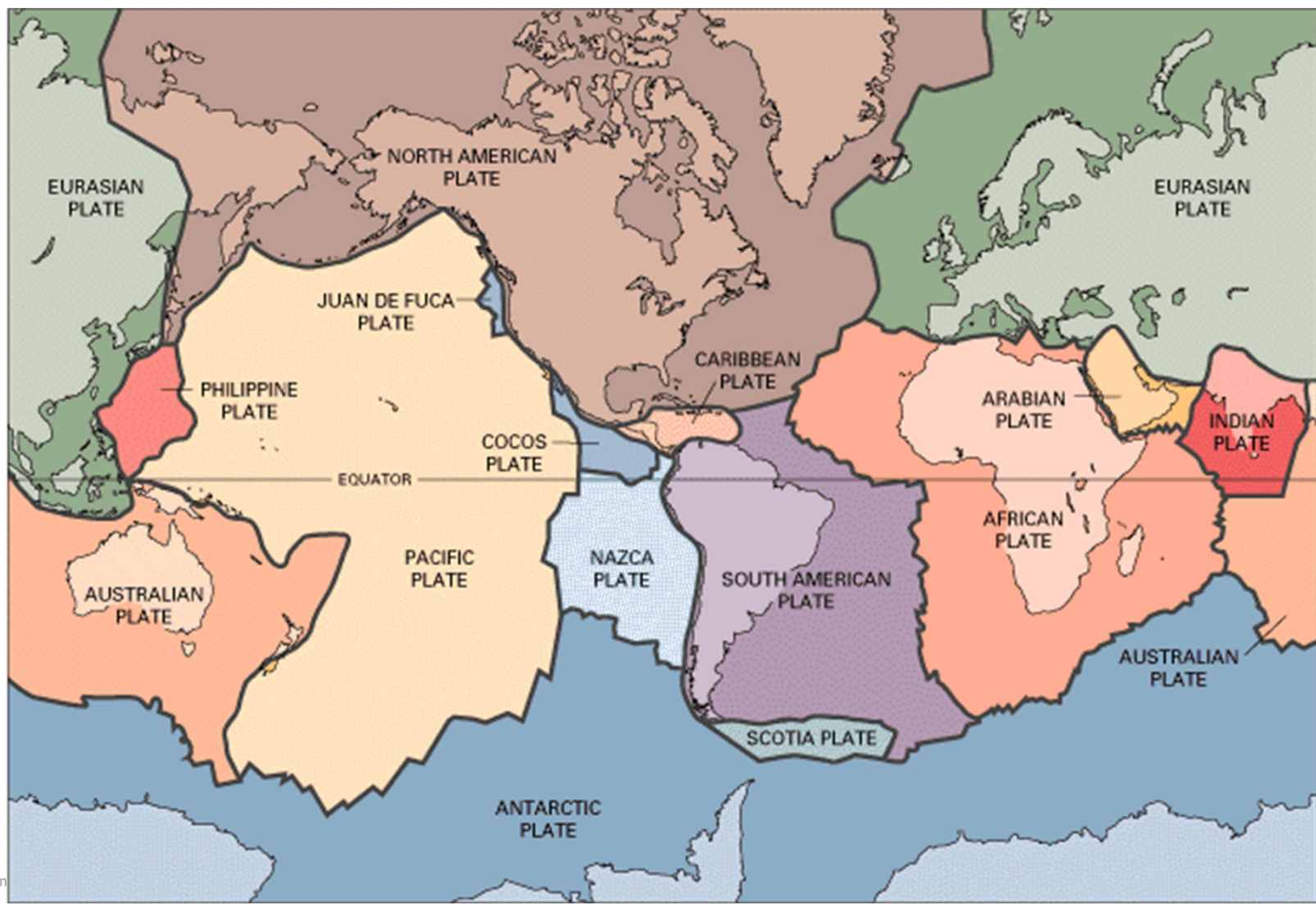
# Seismic Hazards: What's Shaking in Rio Dell

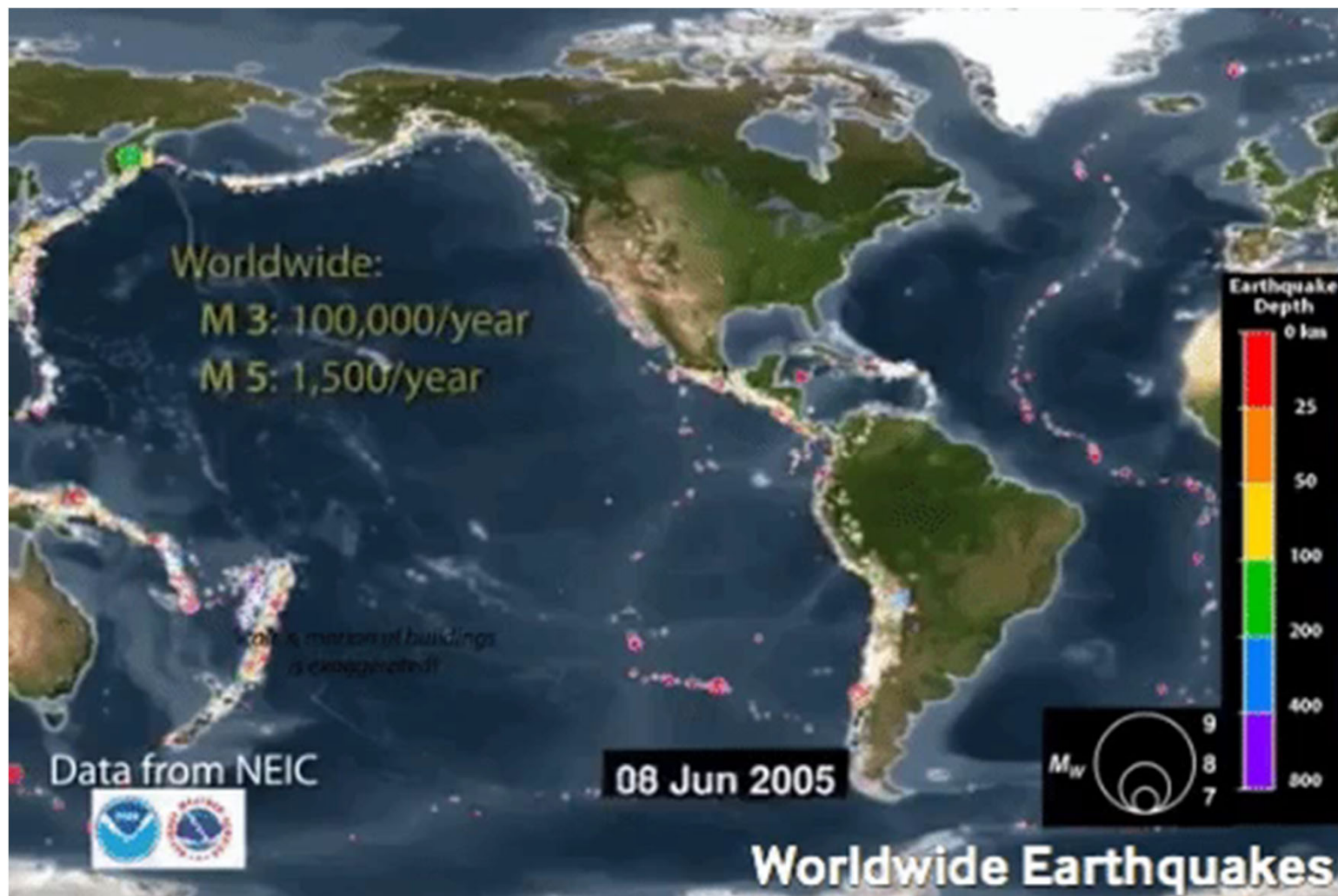
**Dr. Wendy Bohon**

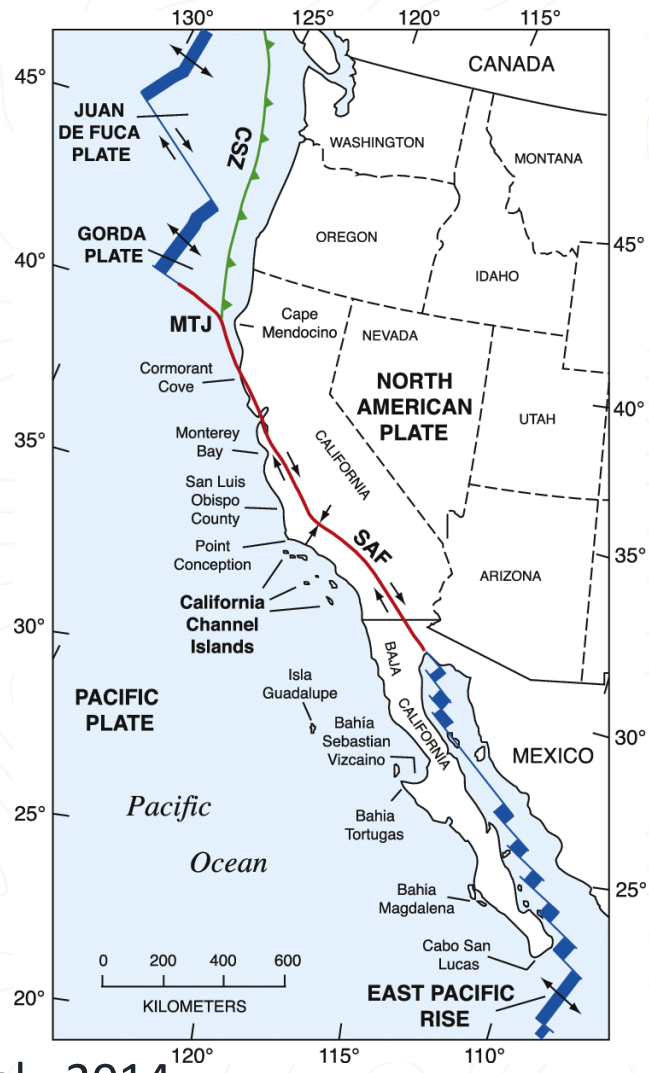
Branch Chief

Seismic Hazards & Earthquake Engineering

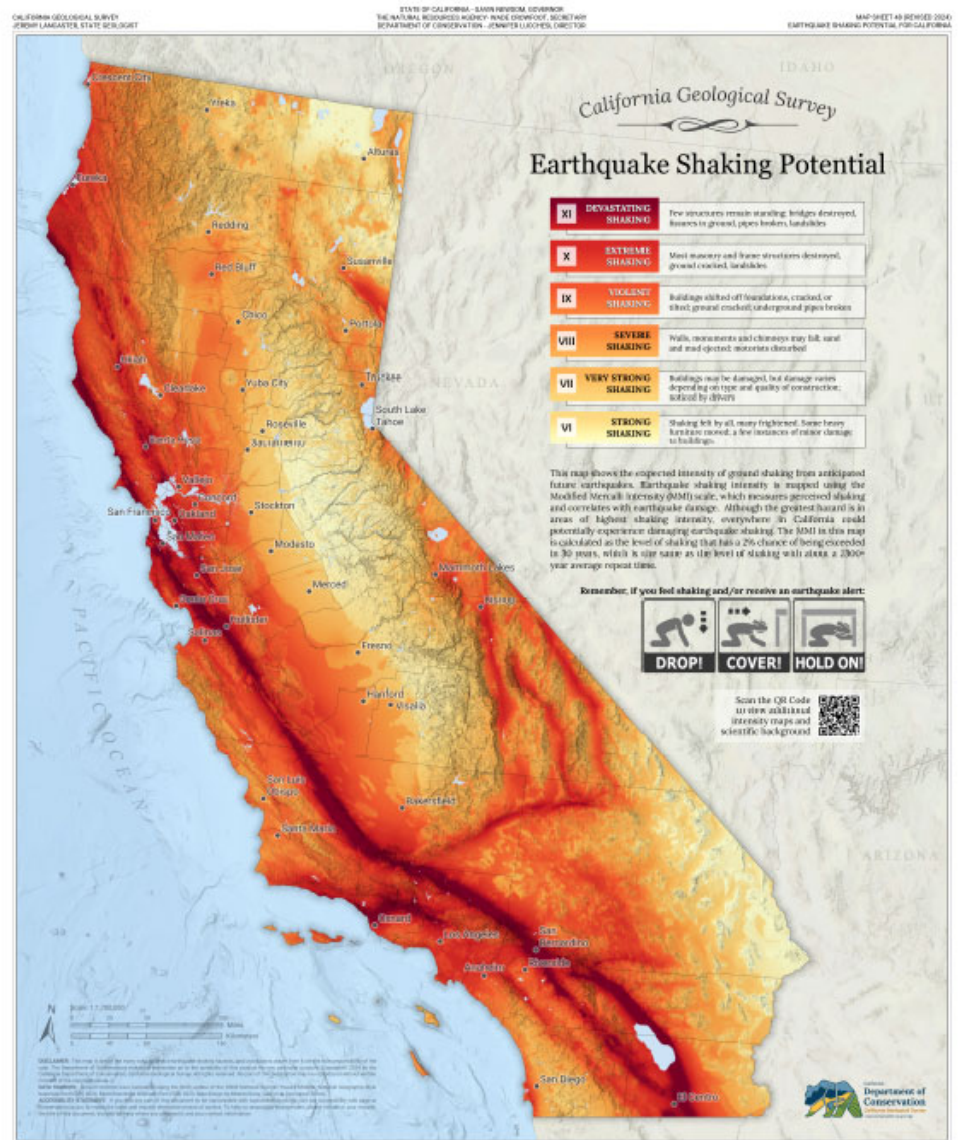


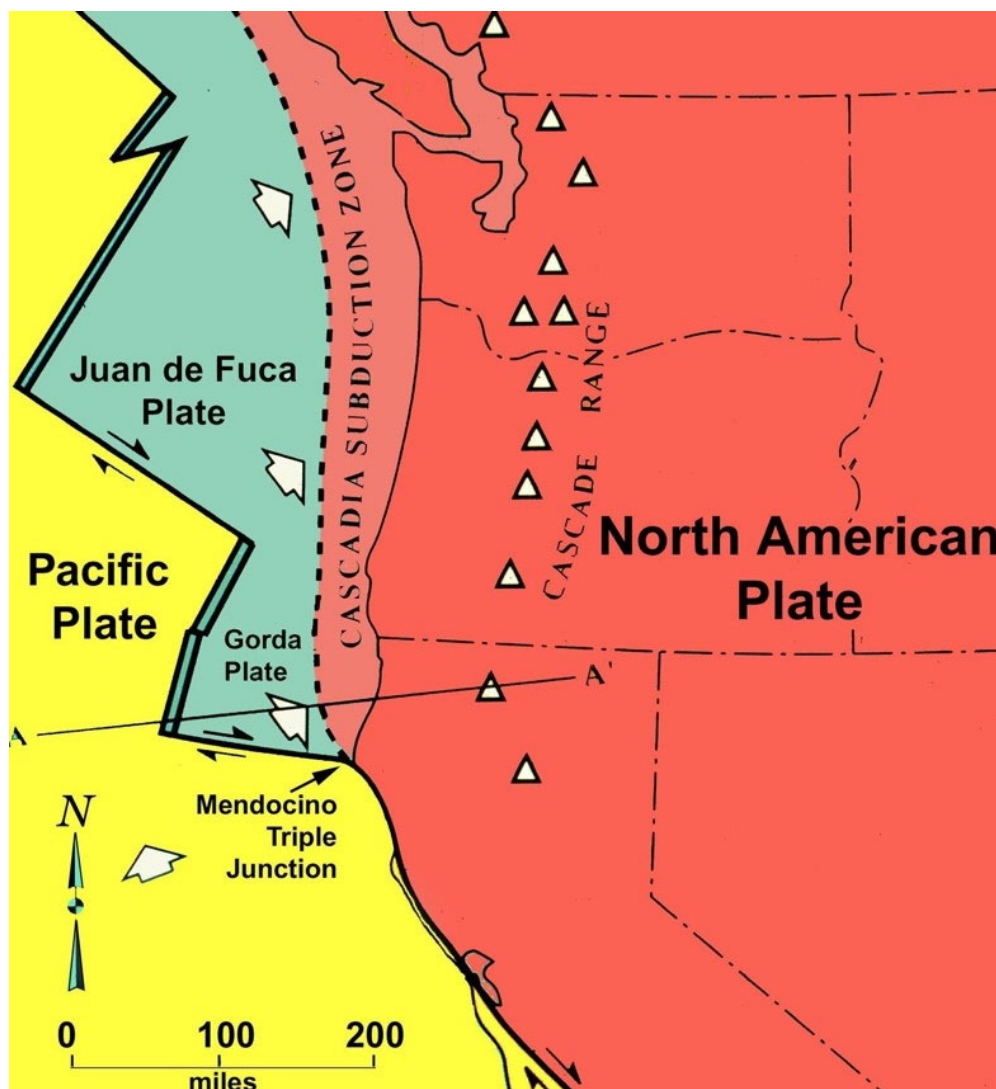


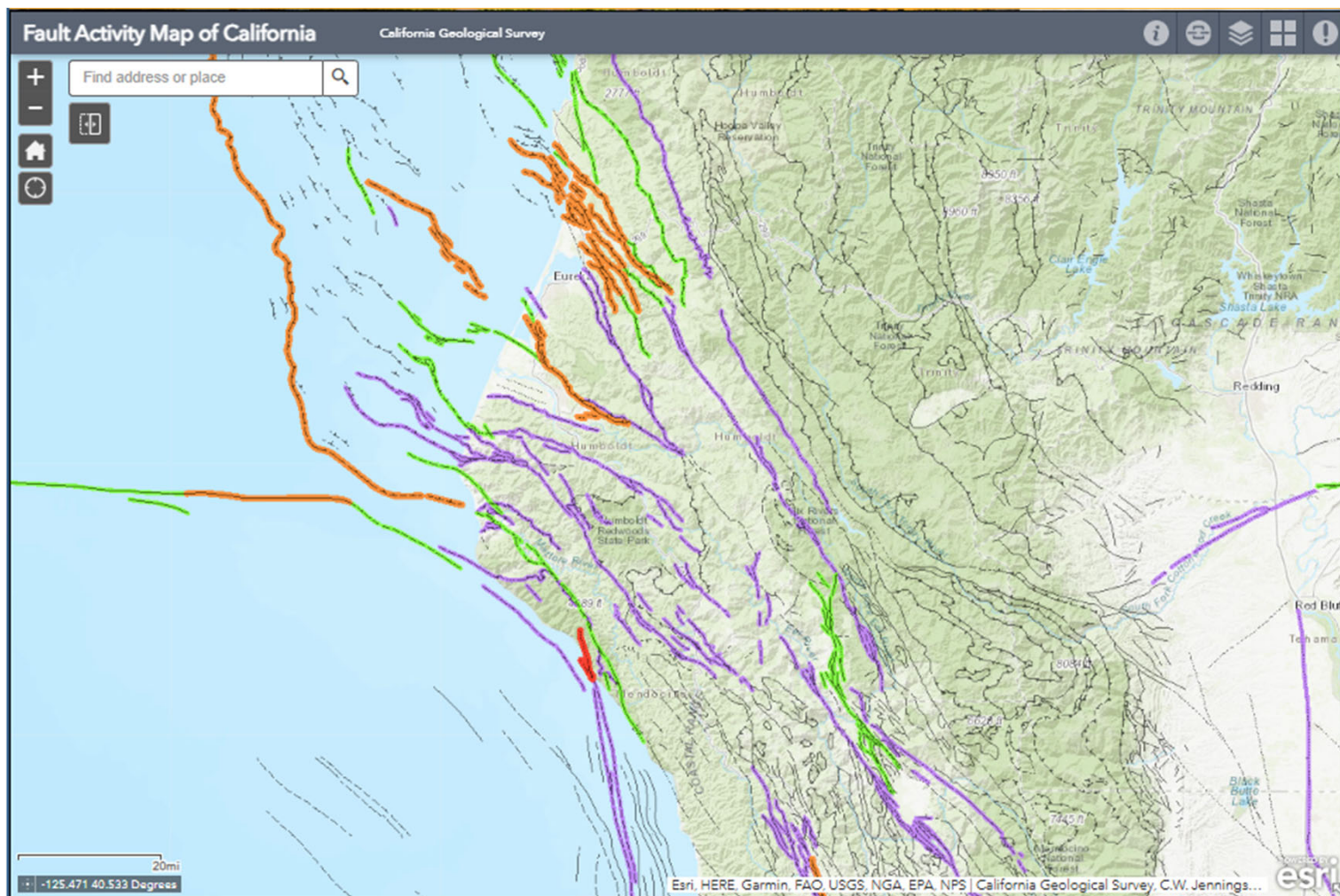


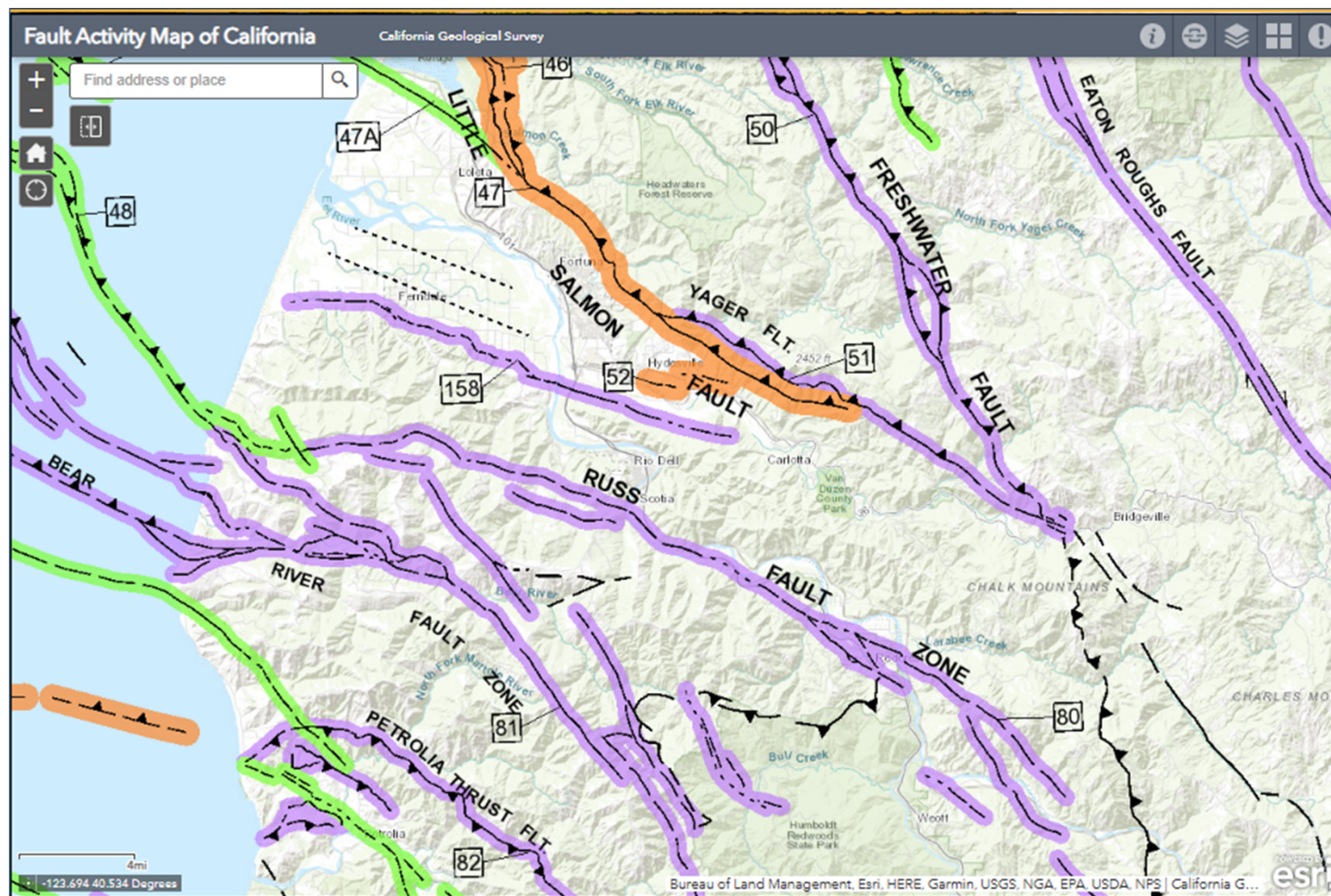


Muhs et al., 2014

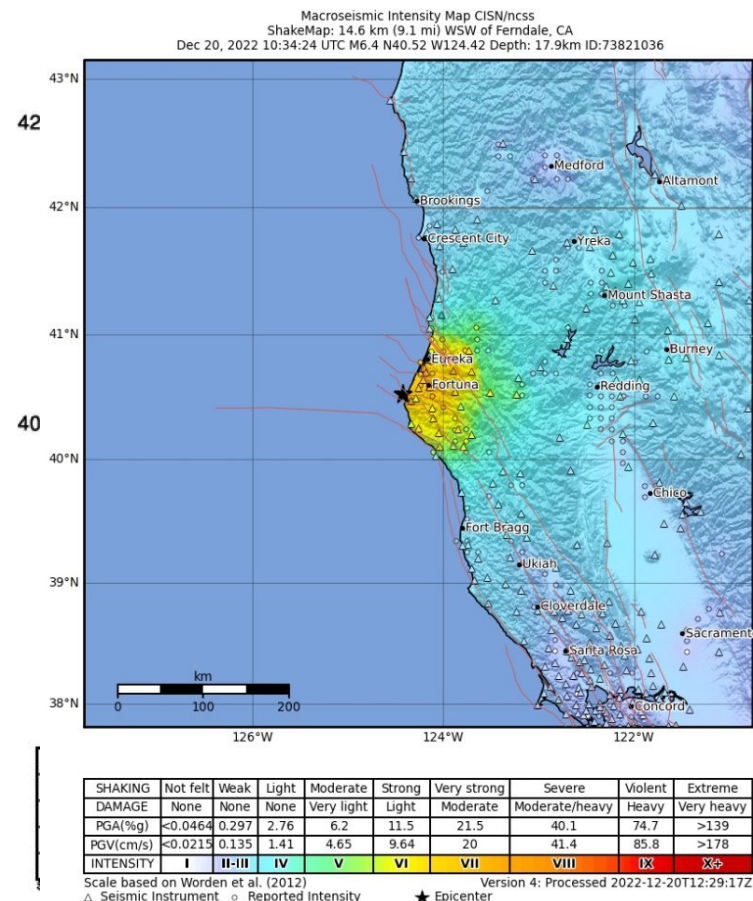






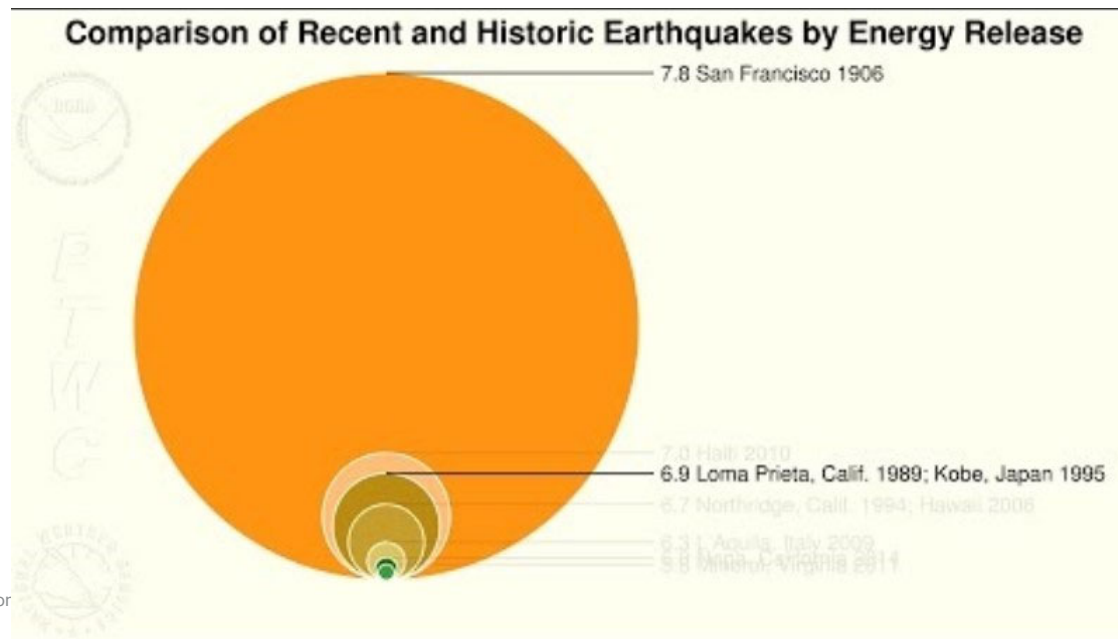


- Of the 11 earthquakes of M7+ in CA since 1900, five occurred in this area.
- The December 5, 2024, earthquake occurred in a similar location to a M7.1 earthquake in 1923 that caused some damage and triggered a small tsunami.
- Further west along the Mendocino fracture zone, a M7.1 earthquake occurred in 1994.
- The most damaging earthquakes in this region have occurred onshore.
  - M7.2 earthquake in April 1992 near Petrolia, California (a reverse faulting earthquake).
  - M7.2 earthquake in November 1980 near Eureka, California (a strike-slip earthquake).
  - Both events caused extensive regional damage, and the 1992 earthquake triggered a small tsunami recorded in California and Hawaii.
  - M6.2 earthquake on December 20, 2021, and a M6.4 earthquake on December 20, 2022.



# Earthquake Magnitude

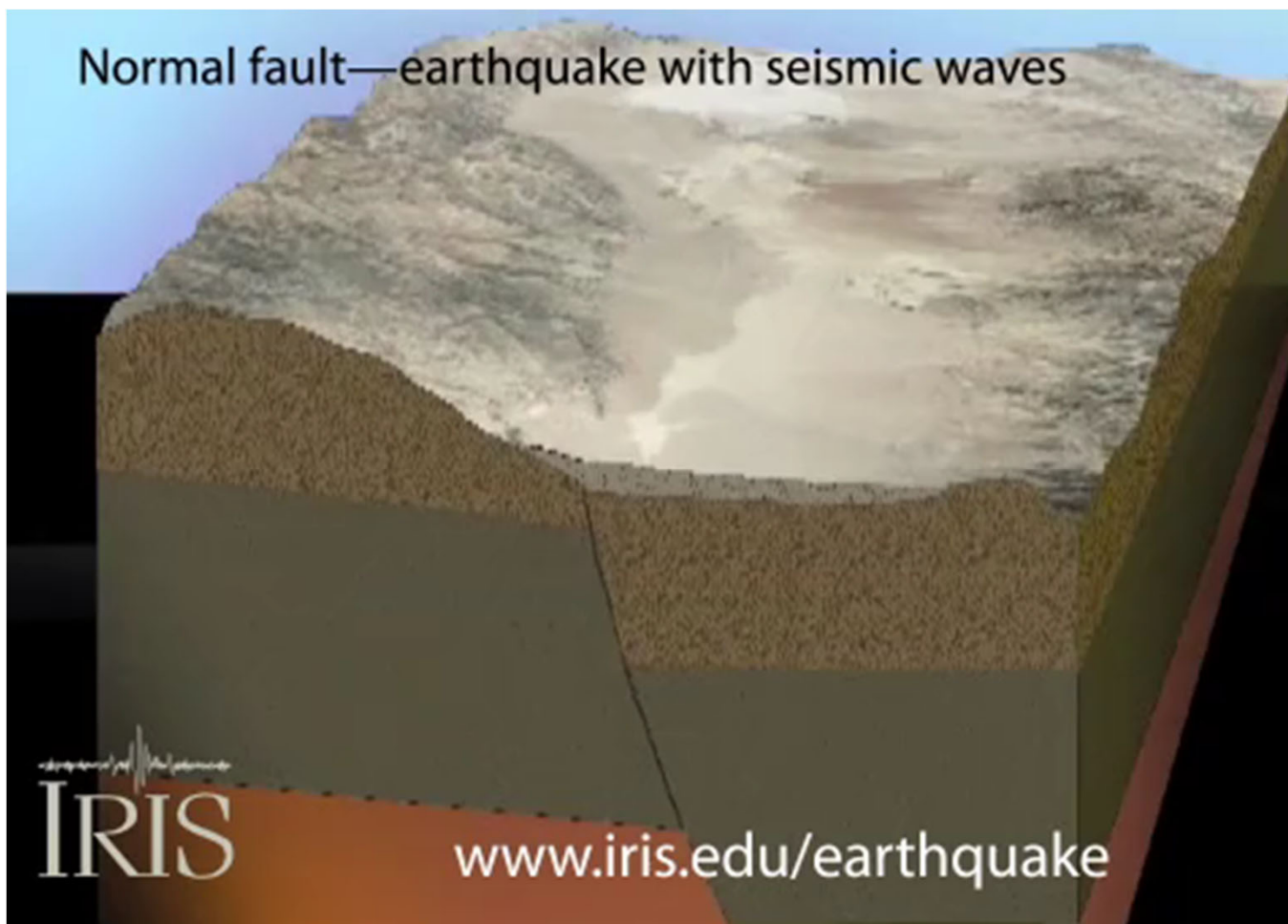
- Every earthquake has **1 magnitude**, which is a measure of the amount of energy released during the earthquake.
- This is described using the **Moment Magnitude Scale (Mw)**. We no longer use the Richter Scale!
- Expect the magnitude to change as we learn more about the earthquake.



- Every earthquake generates **many different intensities** of earthquake shaking.
  - Described using the Mercalli Intensity Scale.

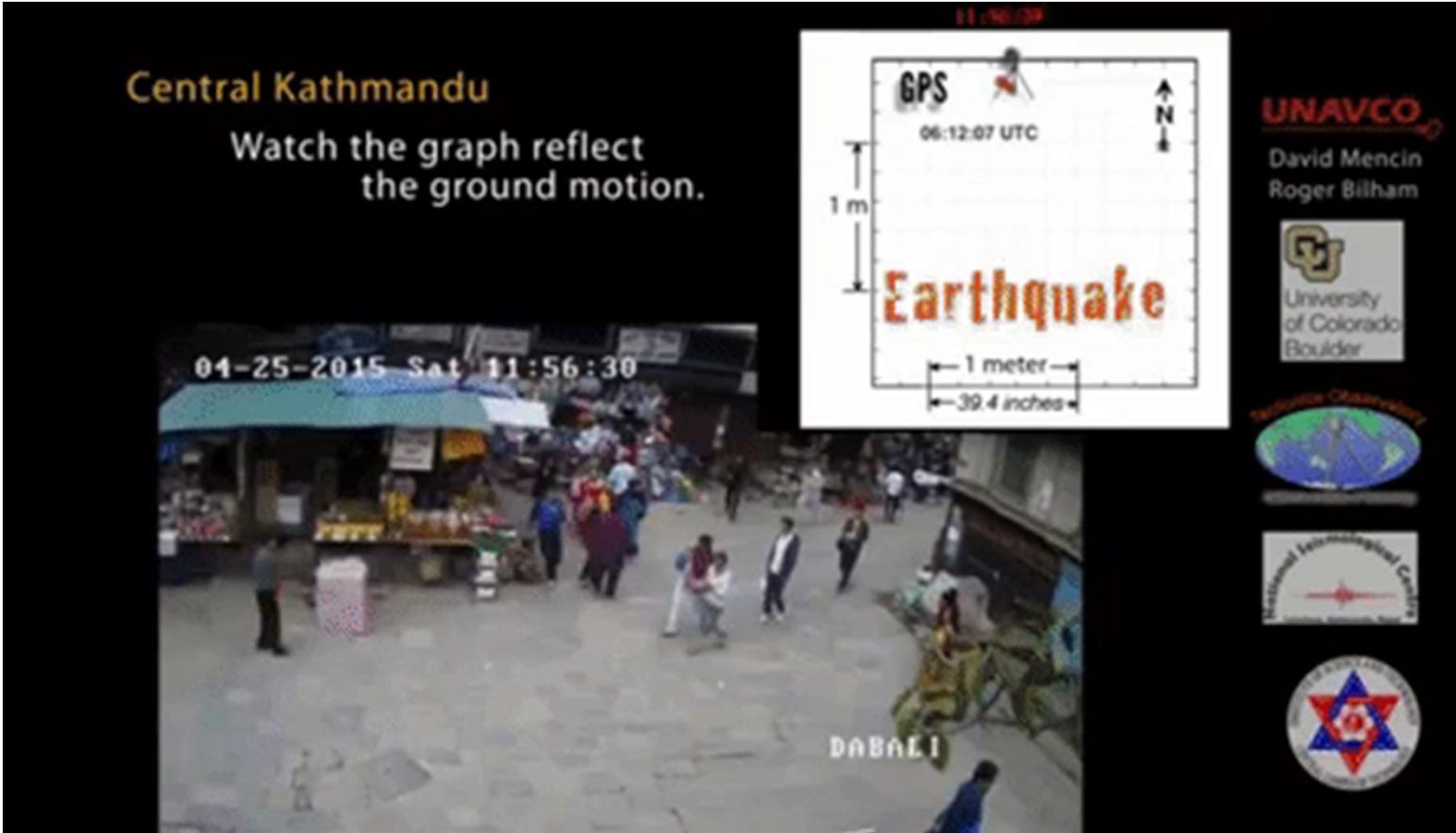
### Modified Mercalli Scale

Intensity	Shaking	Description/Damage
I	Not felt	Not felt except by a very few under especially favorable conditions.
II	Weak	Felt only by a few persons at rest, especially on upper floors of buildings.
III	Weak	Felt quite noticeably by persons indoors, especially on upper floors of buildings. Many people do not recognize it as an earthquake. Standing motor cars may rock slightly. Vibrations similar to the passing of a truck. Duration estimated.
IV	Light	Felt indoors by many, outdoors by a few during the day. At night, some awakened. Dishes, windows, doors disturbed; walls make cracking sound. Sensation like heavy truck striking building. Standing motor cars rocked noticeably.
V	Moderate	Felt by nearly everyone; many awakened. Some dishes, windows broken. Unstable object overturned. Pendulum clocks may stop.
VI	Strong	Felt by all, many frightened. Some heavy furniture moved; a few instances of fallen plaster. Damage slight.
VII	Very Strong	Damage negligible in buildings of good design and construction; slight to moderate in well-built ordinary structures; considerable damage in poorly built or badly designed structures; some chimneys broken.
VIII	Severe	Damage slight in specially designed structures; considerable damage in ordinary substantial buildings with partial collapse. Damage great in poorly built structures. Fall of chimneys, factory stacks, columns, monuments, walls. Heavy furniture overturned.
IX	Violent	Damage considerable in specially designed structures; well-designed frame structures thrown out of plumb. Damage great in substantial buildings, with partial collapse. Buildings shifted off foundations.
X	Extreme	Some well-built wooden structures destroyed; most masonry and frame structures destroyed with foundations. Rails bent.



# Ground shaking

**Central Kathmandu**  
Watch the graph reflect the ground motion.



04-25-2015 Sat 11:56:30

DABALI

GPS  
06:12:07 UTC

1 m

Earthquake

1 meter  
39.4 inches

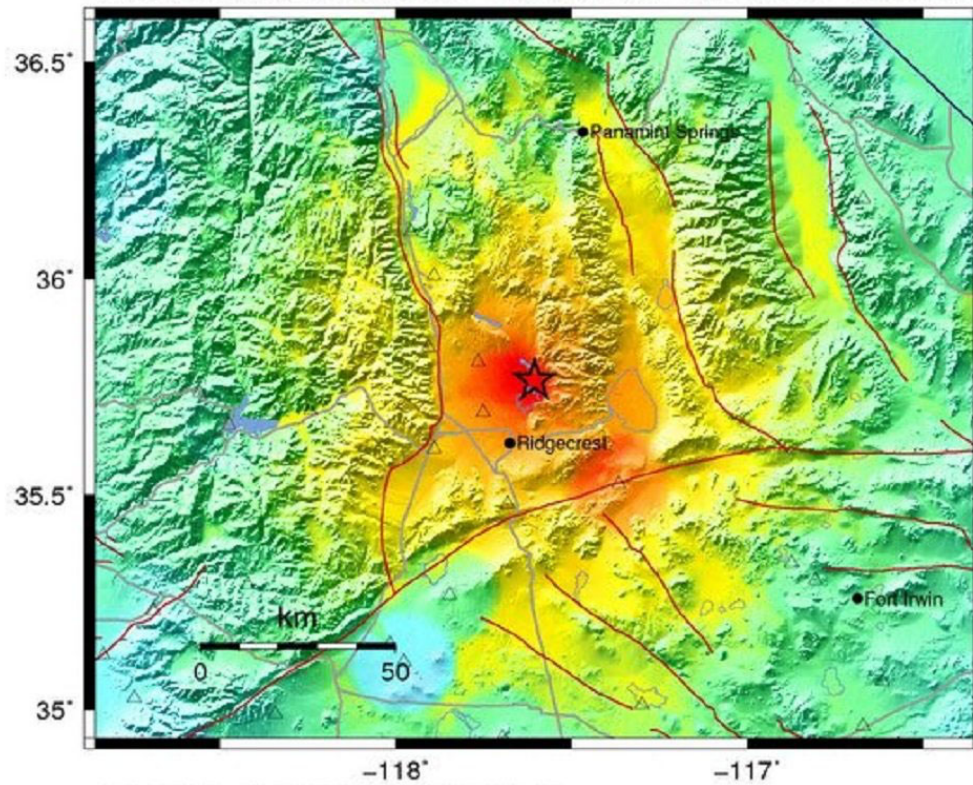
UNAVCO  
David Mencin  
Roger Bilham

University of Colorado Boulder

Geological Observatories

National Geophysical Center

CISN/sc ShakeMap : 17.4 km (10.8 mi) NNE of Ridgecrest, CA  
 Jul 6, 2019 03:19:52 AM UTC M 7.1 N35.77 W117.60 Depth: 17.0km ID:38457511

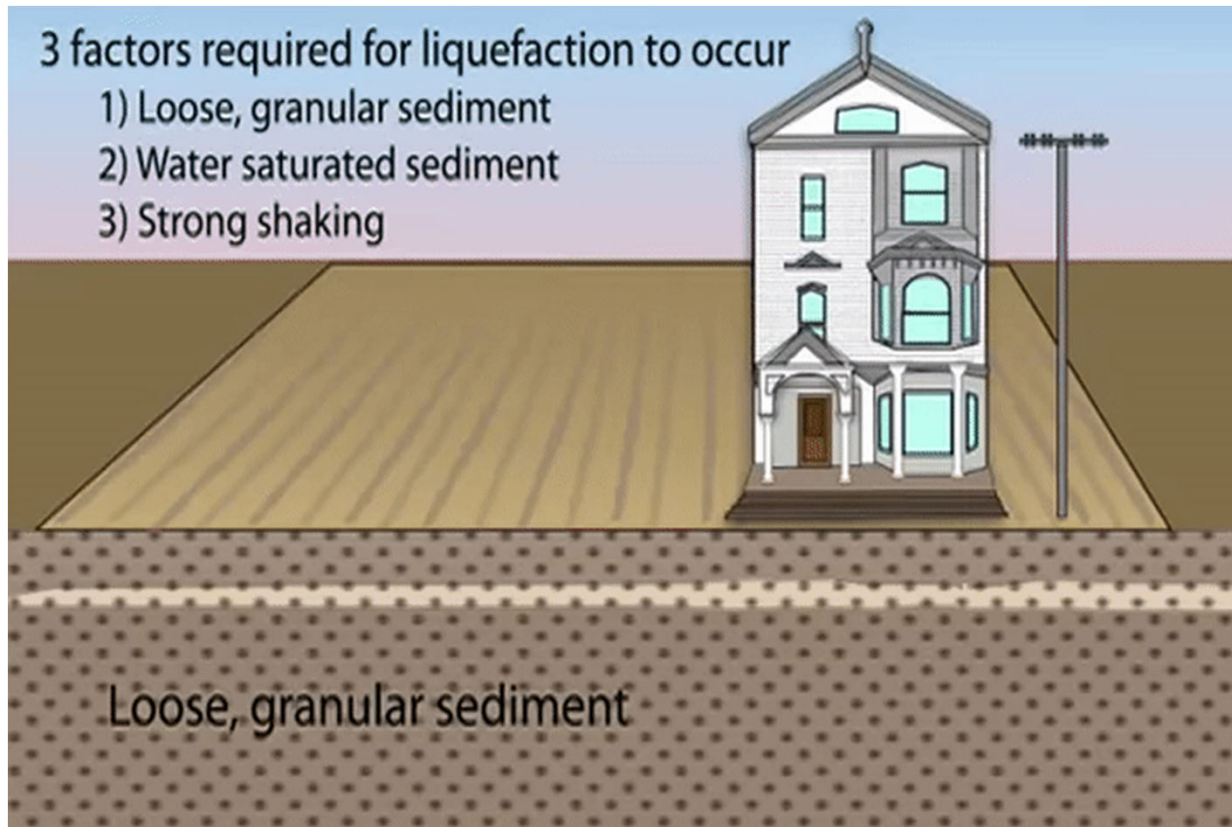


Map Version 3 Processed 2019-07-06 04:43:17 AM UTC

PERCEIVED SHAKING	Not felt	Weak	Light	Moderate	Strong	Very strong	Severe	Violent	Extreme
POTENTIAL DAMAGE	none	none	none	Very light	Light	Moderate	Mod./Heavy	Heavy	Very Heavy
PEAK ACC.(%g)	<0.1	0.5	2.4	6.7	13	24	44	83	>156
PEAK VEL.(cm/s)	<0.07	0.4	1.9	5.8	11	22	43	83	>160
INSTRUMENTAL INTENSITY	I	II-III	IV	V	VI	VII	VIII	IX	X+

Scale based upon Wald, et al., 1999

# Liquefaction



# Earthquake-Induced Landslides

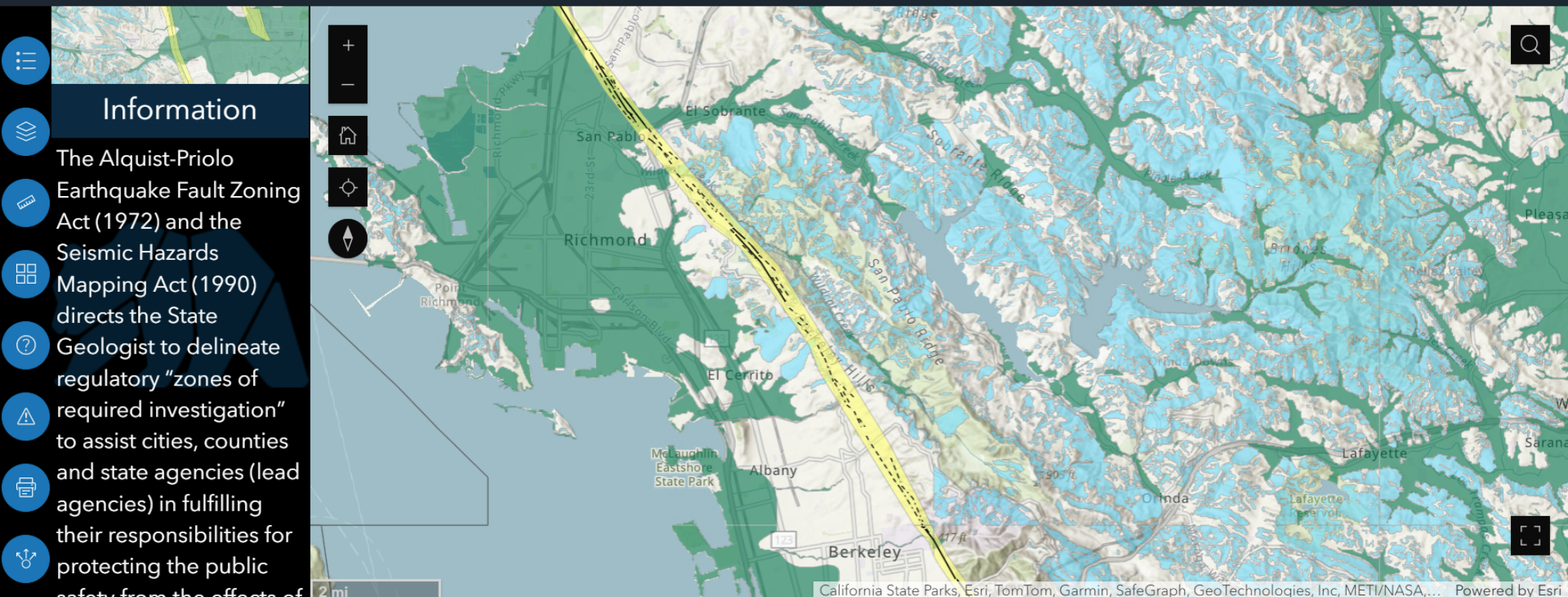
**Landslides** are caused when the strength of the hillslope materials is overcome by the forces from gravity and earthquake shaking.

It requires:

- Steep slopes
- Weak geologic materials
- Moderate to strong ground shaking (~M5.5+)



# Earthquake Zones of Required Investigation



# Earthquake Zones of Required Investigation



# Tsunami

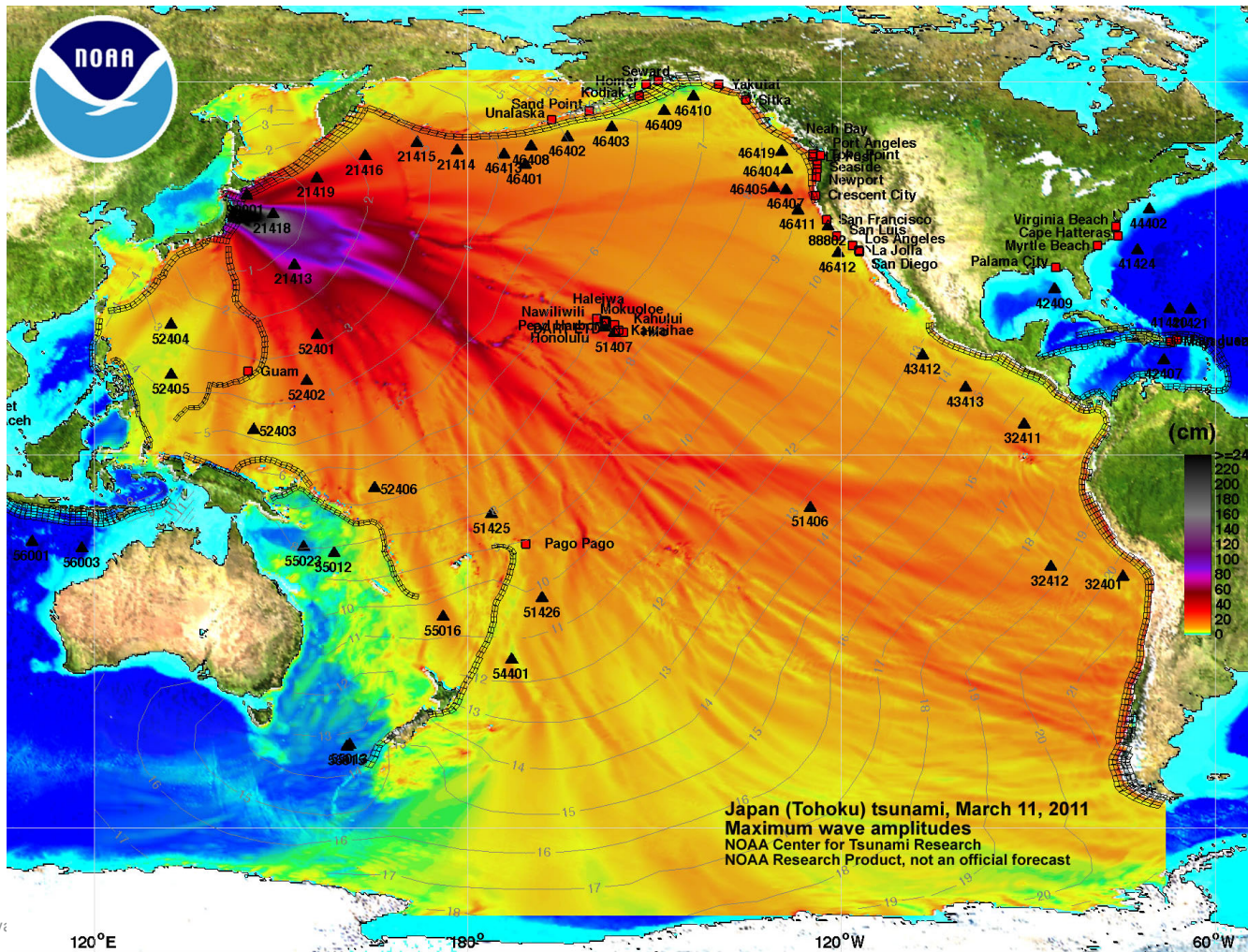


(U.S. Marine Corps photo by  
Lance Cpl. Garry Welch



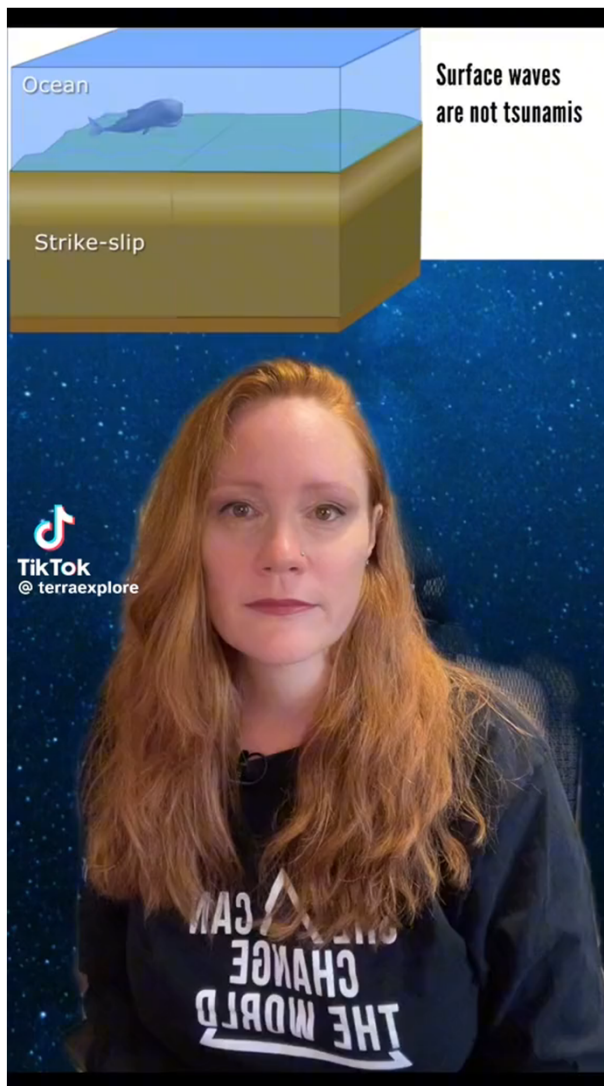
MC3 Dylan McCord

# Tsunami Wave Height



# Tsunami



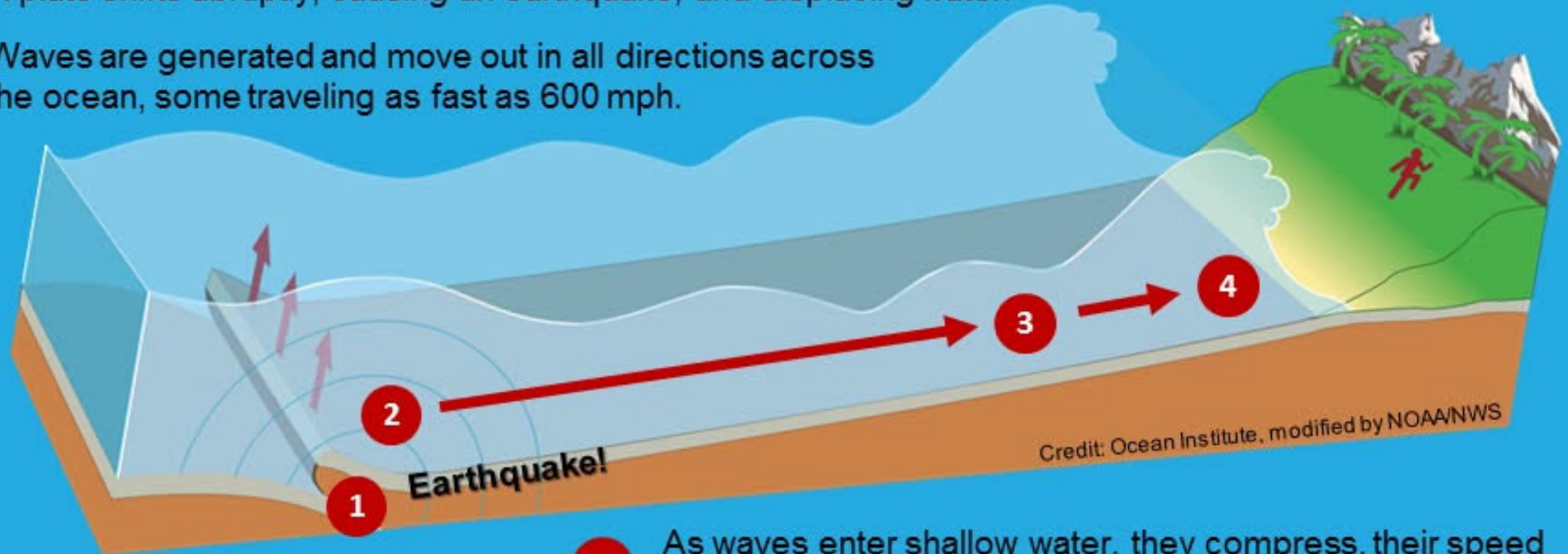


# How a Tsunami Works

Most tsunamis are caused by large earthquakes below or near the ocean floor.

**1** A plate shifts abruptly, causing an earthquake, and displacing water.

**2** Waves are generated and move out in all directions across the ocean, some traveling as fast as 600 mph.



Credit: Ocean Institute, modified by NOAA/NWS

**3** As waves enter shallow water, they compress, their speed slows, and they build in height.

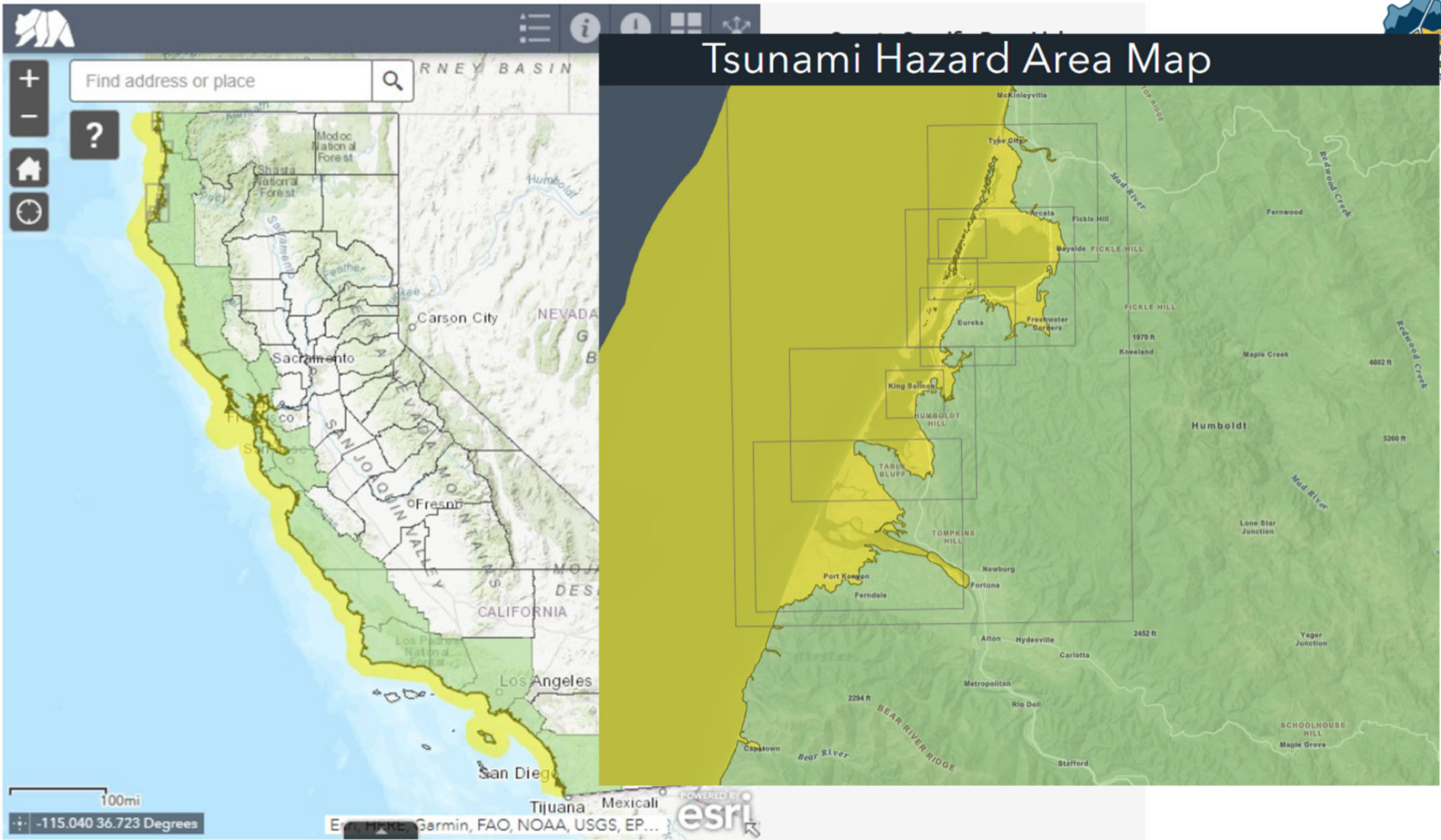
**4** The wave height increases, and associated currents intensify, becoming a threat to life and property.

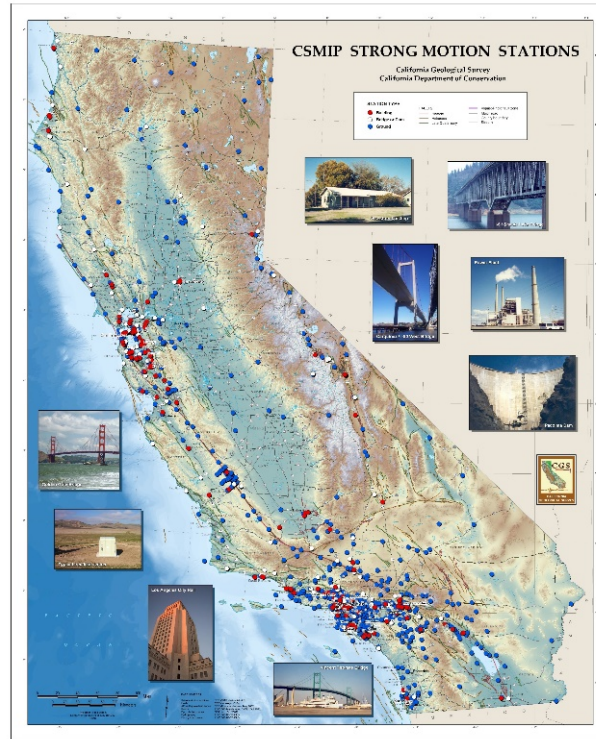


[weather.gov/tsunamisafety](https://www.weather.gov/tsunamisafety)



# Tsunami Hazard Area Map





About CESMD

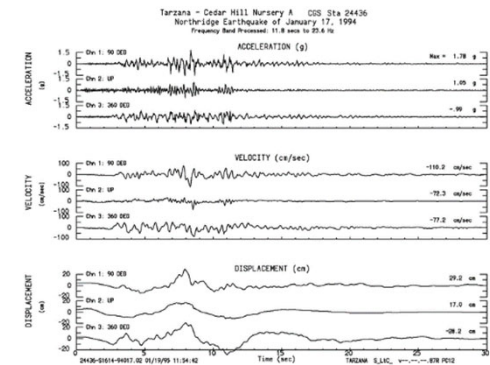
Data for Latest Earthquakes  
Internet Quick Reports (IQR)

Archive

Search for Data  
from Specific Stations or Structure Types

CGSN AEGC PHEN BMV CEUS IRIS COSMOS

Partner Data Centers and Networks

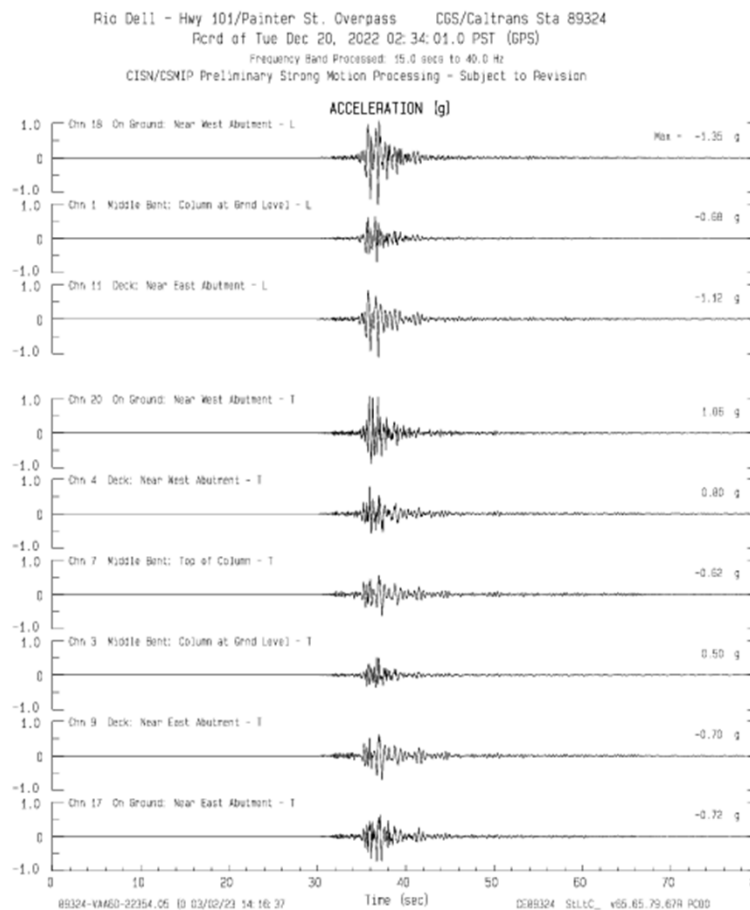
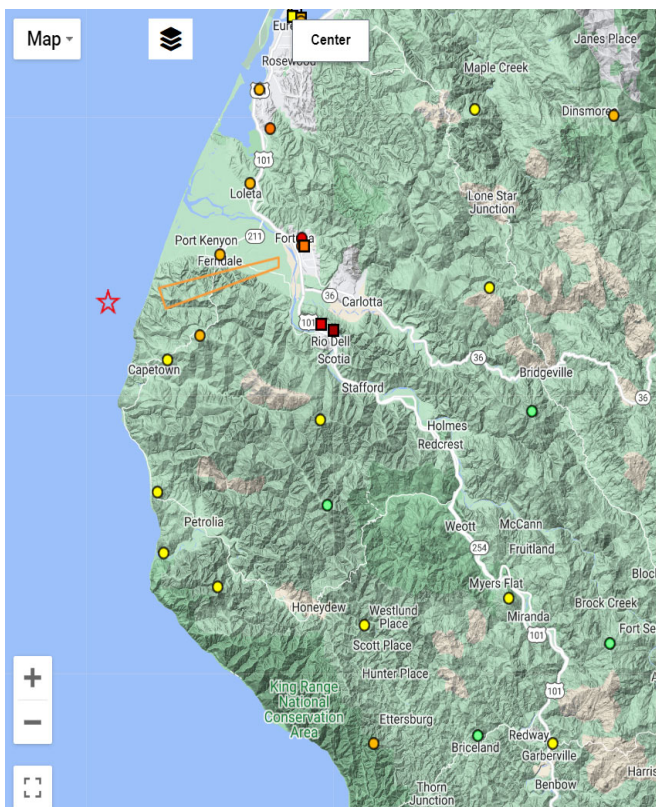


# Strong Motion Instrumentation Program

CSMIP obtains vital earthquake shaking data for the engineering and scientific communities through a statewide network of strong motion instruments.

# M6.4 Ferndale Earthquake of Dec 20, 2022

## Rio Dell – Hwy 101/Painter St.



# Fernbridge Seismic Gate



Constructed in 1911

Connects Fernbridge community to Ferndale

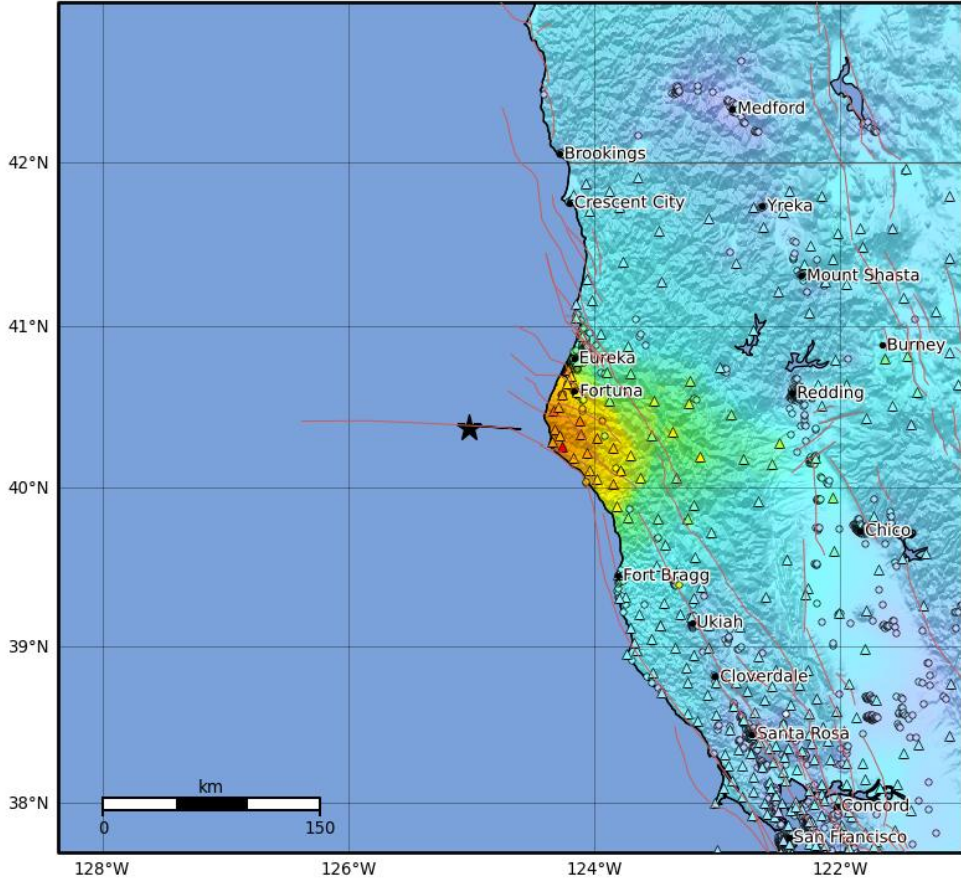
In 1976, the American Society of Civil Engineers designated Fernbridge as an historic civil engineering landmark



# Fernbridge Seismic Gate



Macroseismic Intensity Map CISON/cgs  
 ShakeMap: 63 km (39.375 mi) WNW of Petrolia, CA  
 Dec 05, 2024 18:44:21 UTC M7.0 N40.37 W125.02 Depth: 10.0km ID:75095651

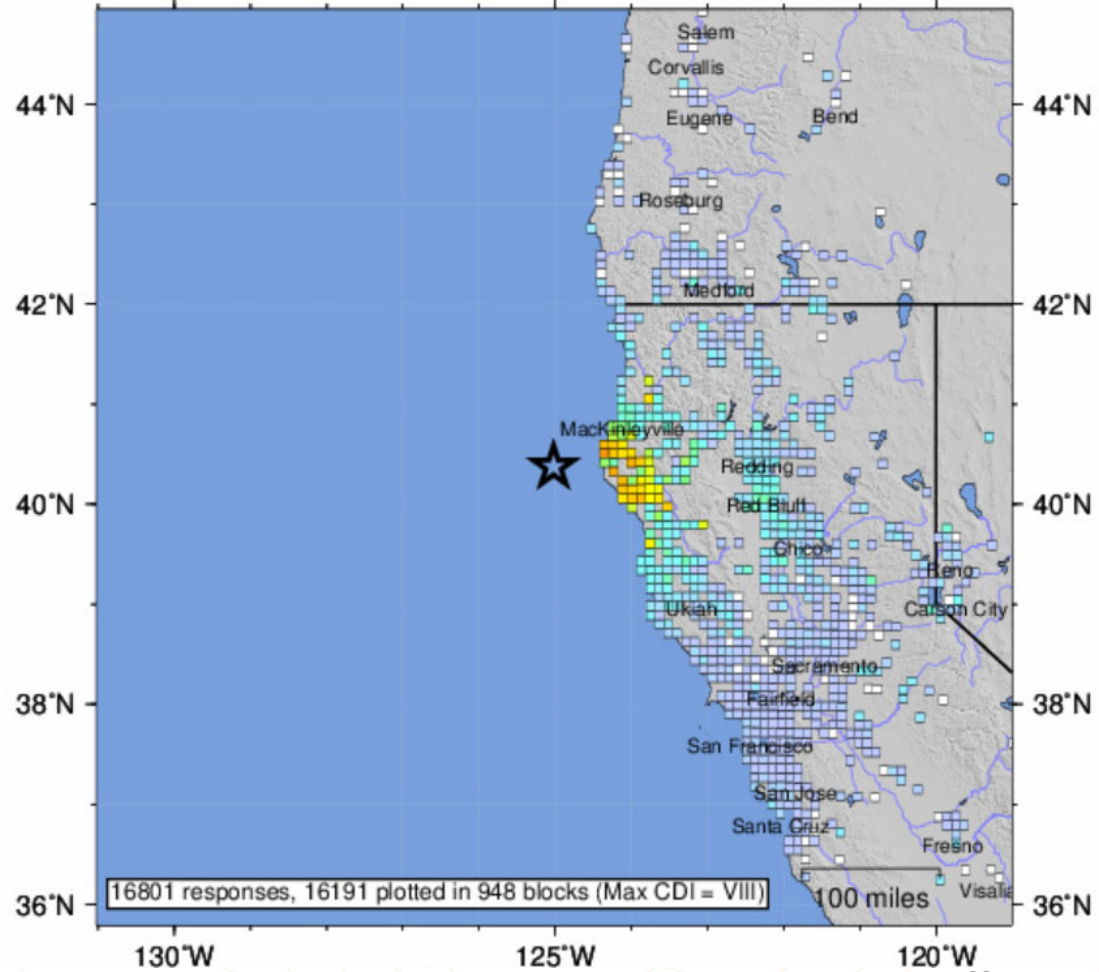


SHAKING	Not felt	Weak	Light	Moderate	Strong	Very strong	Severe	Violent	Extreme
DAMAGE	None	None	None	Very light	Light	Moderate	Moderate/heavy	Heavy	Very heavy
PGA(%g)	<0.0464	0.297	2.76	6.2	11.5	21.5	40.1	74.7	>139
PGV(cm/s)	<0.0215	0.135	1.41	4.65	9.64	20	41.4	85.8	>178
INTENSITY	I	II-III	IV	V	VI	VII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

Scale based on Worden et al. (2012) Version 9: Processed 2024-12-12T22:18:48Z  
 Δ Seismic Instrument ○ Reported Intensity ★ Epicenter □ Rupture

USGS Community Internet Intensity Map  
 OFFSHORE NORTHERN CALIFORNIA

2024-12-05 18:44:21 UTC 40.374N 125.0217W M7.0 Depth: 10 km ID:nc75095651







**@CAGeoSurvey @DrWendyRocks**

**THANK YOU**

Wendy.Bohon@conservation.ca.gov