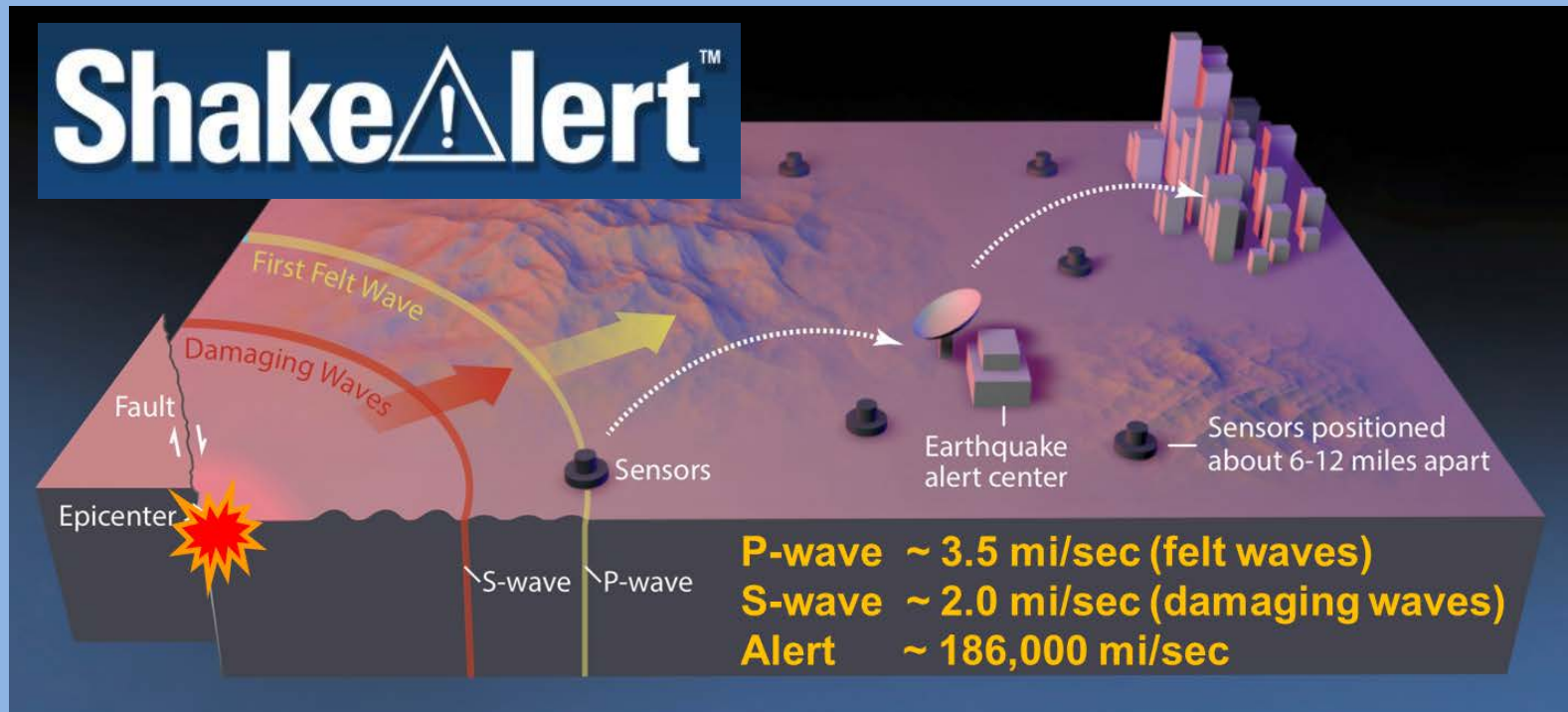


ShakeAlert West Coast Earthquake Early Warning



Caltech

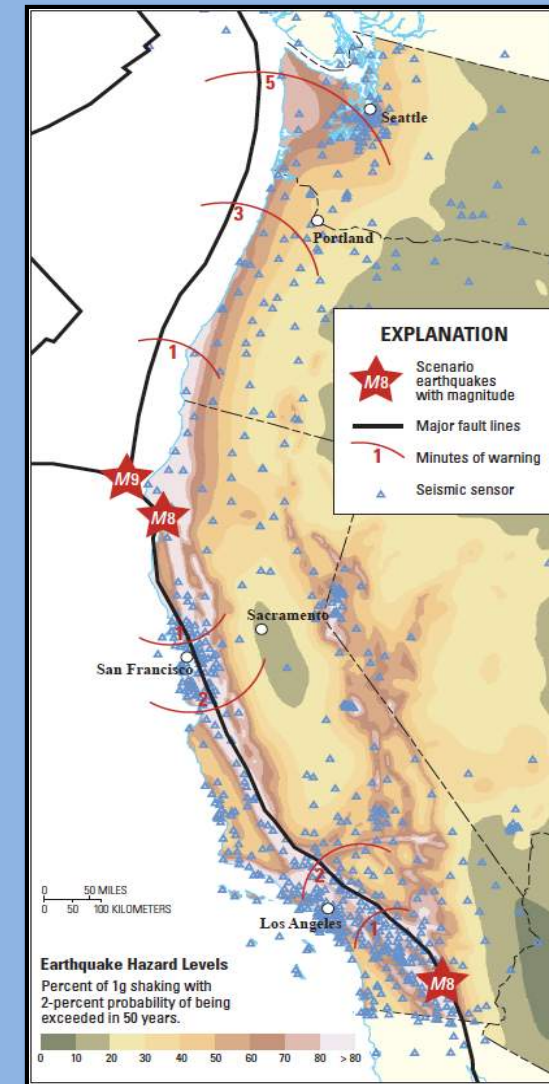


*Margaret Vinci, Caltech
ShakeAlert SoCal Regional Coordinator*

What is ShakeAlert™ ?

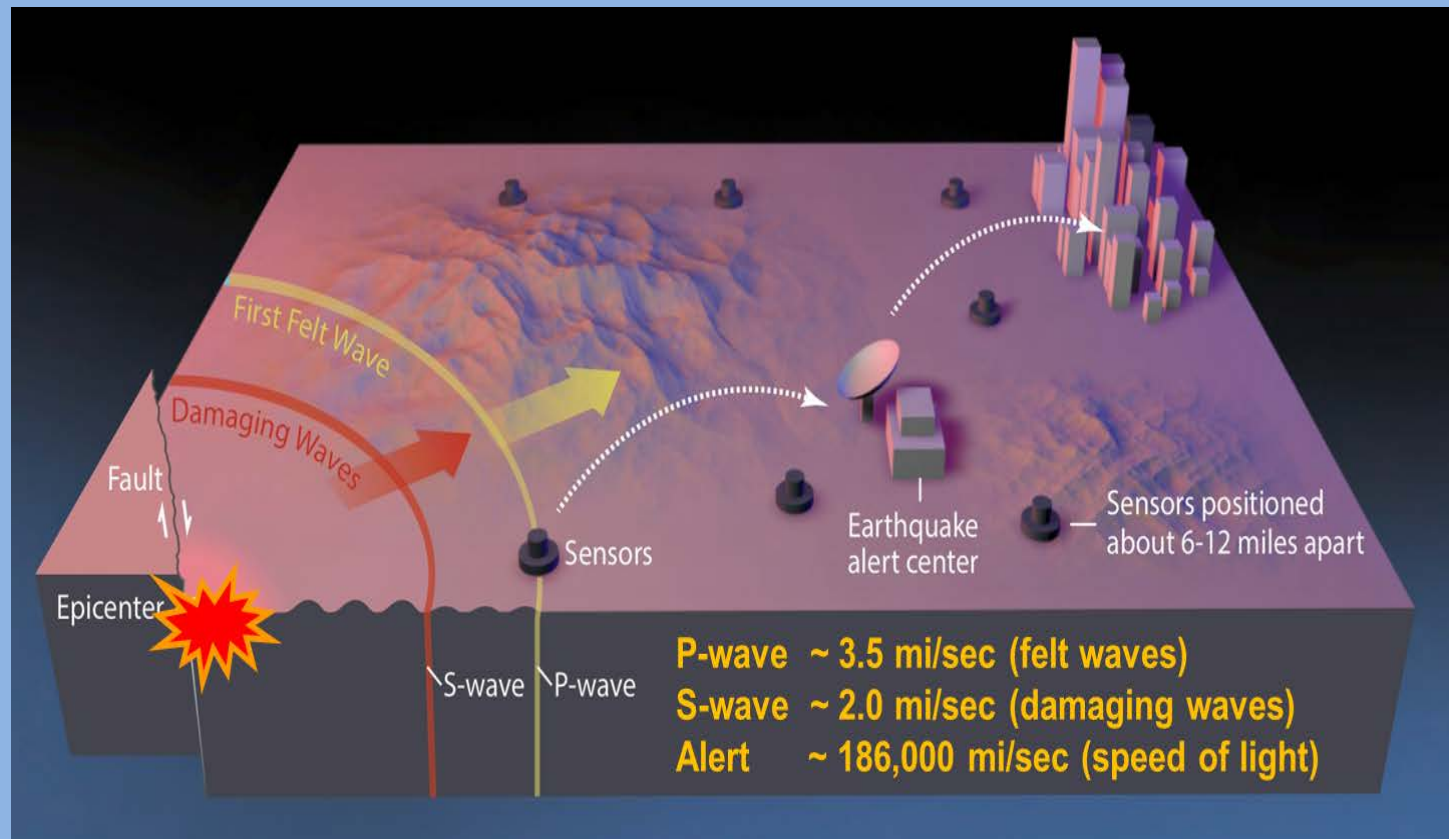


- ShakeAlert™ is the name of the West Coast Earthquake Early Warning System (EEW)
- Developed by USGS, Caltech, UC Berkeley, University of Washington and University of Oregon
- ShakeAlert™ is not earthquake prediction; the earthquake has already started
- Today, technology exists to detect earthquakes so quickly that an alert can reach some areas before strong shaking arrives



How Does **Shake!ert**TM Work?

- Simply, sensors in the ground quickly detect seismic waves as an earthquake happens, computers calculate the maximum expected shaking intensity, and centers deliver alerts to surrounding communities before damaging shaking arrives.



Farther away from the earthquake = more warning time

Two Categories of End Users

— People :

- Drop, cover, and hold on –take protective action
- Move away from hazardous areas
- Secure delicate medical procedures



— Things (automated systems machine to machine delivery)

- Slow and stop trains, traffic, air traffic
- Close valves, stop pumps, reduce spills
- Park delicate machinery in safe mode
- Two-way radio alerts for people in hazardous or confined areas
- Open gates and doors



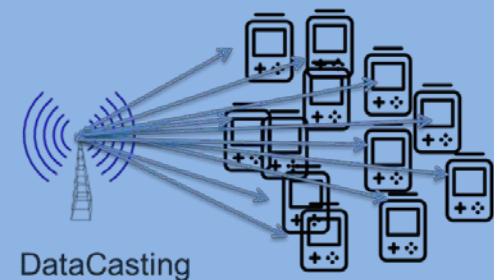
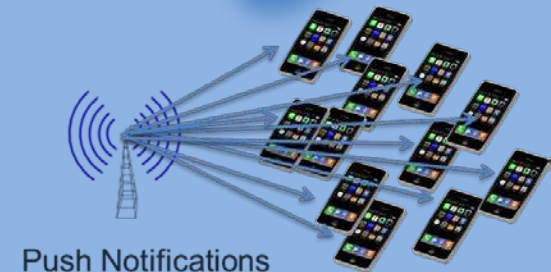
SoCal Approved Projects

- Valcom Mass Notification
- City of Beverly Hills City Hall
- City of Los Angeles (App and City Hall alert)
- Cedars-Sinai Hospital (voice activated fire alarm)
- Northridge Hospital (speaker boxes)
- Biola University (campus-wide speakers)
- Various (turn off valves)
- LA Metro (slow trains)
- LAUSD (VOIP phones)
- Metrolink (PTC -slow trains)
- NBC Universal (two-ways radios; open fires station doors)
- Pro-Lite (Notification boxes)
- Regatta Condo (gates/intercom)
- Santa Monica Library (overhead paging)
- SCADA Systems (turbine shut down)
- City of Ontario (city-wide speakers)



Public Mass Alerting Technologies Under Testing

- Cell-broadcast, IPAWS & WEA
 - Speed uncertain
 - No EEW-specific sound
- Cell apps, push notifications
 - Scalability & speed unknown (Tests by City of L.A. and others)
 - Someone must provide the service
- DataCasting, alert encoded in TV broadcast signal
 - Crude geotargetting
 - Requires special receiver (not displayed on TV)



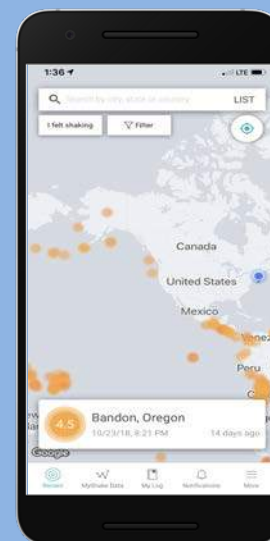
ShakeAlert Partner Apps (testing)

- **ShakeAlertLA**
LA/AT&T/Colwox
- **MyShake**
Cal OES/UC Berkeley
- **QuakeAlert**
Early Warning Labs
- Others coming....

Need multiple modalities to
insure an alert is received



ShakeAlertLA
(LACounty)



MyShake
(California)



QuakeAlertUSA
(California)



What is the Message You Will Receive?

- When an earthquake is detected and reaches the alerting threshold an alert will be activated
 - Current Pilot threshold for public alerting = shaking intensity III and earthquake magnitude 4.5+
- You will receive an alert tone and a voice activated message broadcast over the audio system:
 1. Short alert tone
 2. Voice message
 - “Earthquake! Earthquake!”
 - “Expect shaking”
 - “Drop, Cover, Hold On”
 - “Protect Yourself Now!”



When Will You Receive an Alert?

- You may receive a ShakeAlert before, during or after shaking arrives at your location depending on your distance from the earthquake and the alert delivery mechanism you are using.
- In general, the farther you are from the earthquake the more alert time you are likely to receive. You can receive seconds to tens of seconds of advanced warning.
- The USGS and its partners are in the process of determining appropriate thresholds that define when and how ShakeAlerts will be delivered.
- You may feel shaking and not get a ShakeAlert because the shaking level at your location was below the set thresholds. Still take protective action when you feel shaking.
- In rare instances you may receive an alert for non-earthquake shaking like a quarry blast or other large explosion. Still take protective action when you receive a ShakeAlert.



Earthquake Basics

Why do we need ShakeAlert?

Earthquake

- Can happen anywhere
- Happen without warning
- Can cause
 - Building collapses and property damage
 - Injuries caused by heaving items to fall
 - Utility disruptions
 - Damage to machinery and loss of data
 - Fires
 - Damage to roads
 - Downed electrical wires
- Can lead to tsunamis and landslides

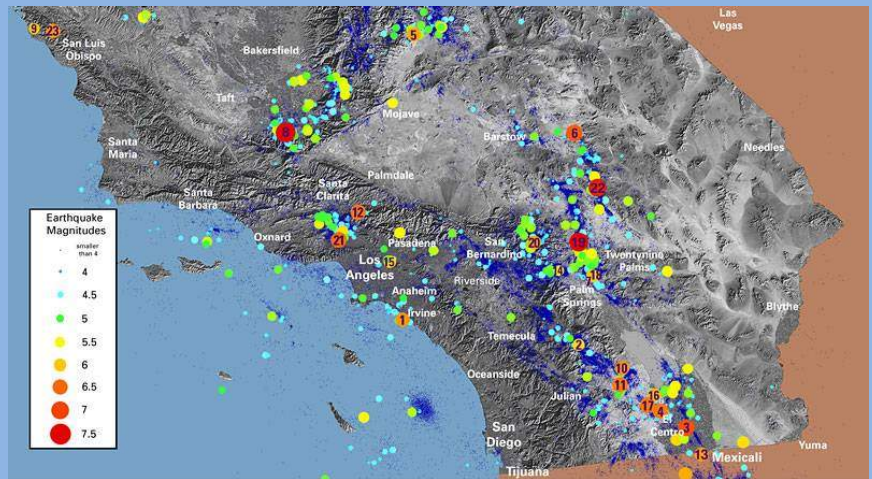


Why do we need Earthquake Early Warning?



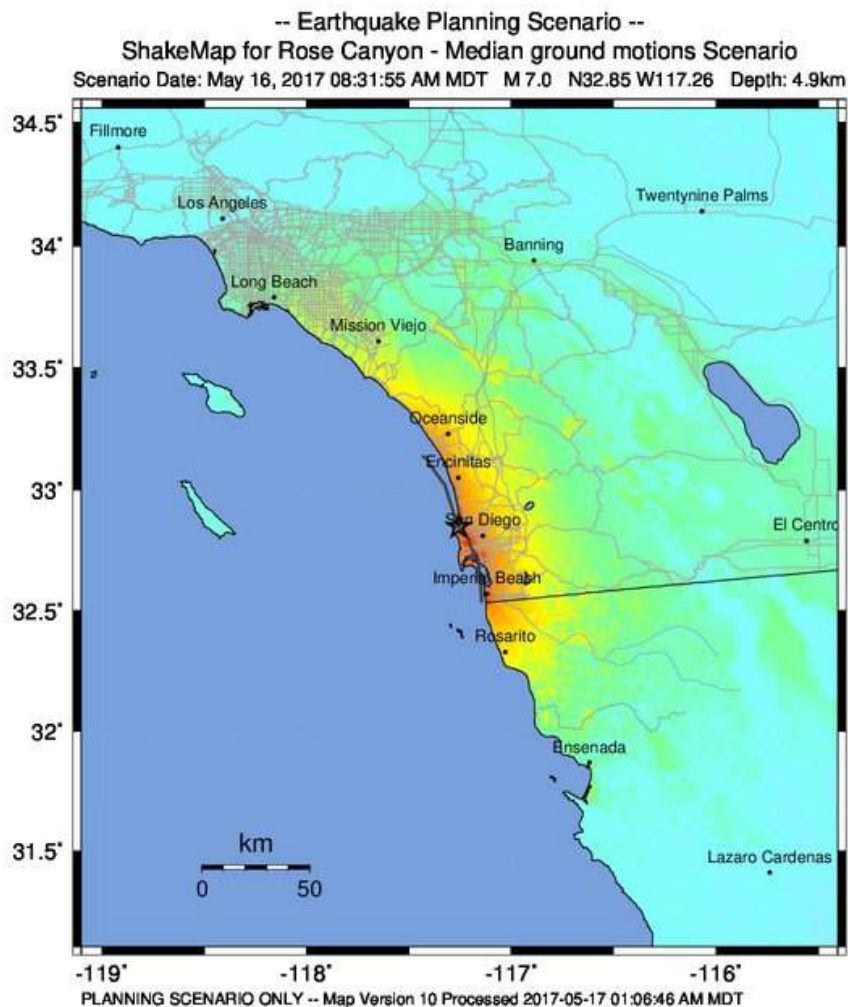
There are 300 known earthquake faults in SoCal

- 24 faults capable of producing a large, damaging earthquake
- 12 faults within LA Basin are capable of producing large earthquakes



On average over 30 - 55 earthquakes a day in SoCal

- Over 30 earthquakes a day in southern California
- Most small and not felt but at anytime can become the M5, M6, M7 or M8
- Magnitude 6.0+ on average every 5 years
- Magnitude 7 every 30 years and M7.7 every 150 years



Rose Canyon M6.9 Scenario

- \$38 Billion in damages
- 8,000 bldgs beyond repair
- 120,000 moderate damage
- 36,000 households displaced
- Disruption to utilities, transportation, lifelines, airport, port of San Diego, trade with Mexico, fire
- Critical infrastructure – Military, tourism
- Coastal communities cut off
 - Hwys 5 and 15

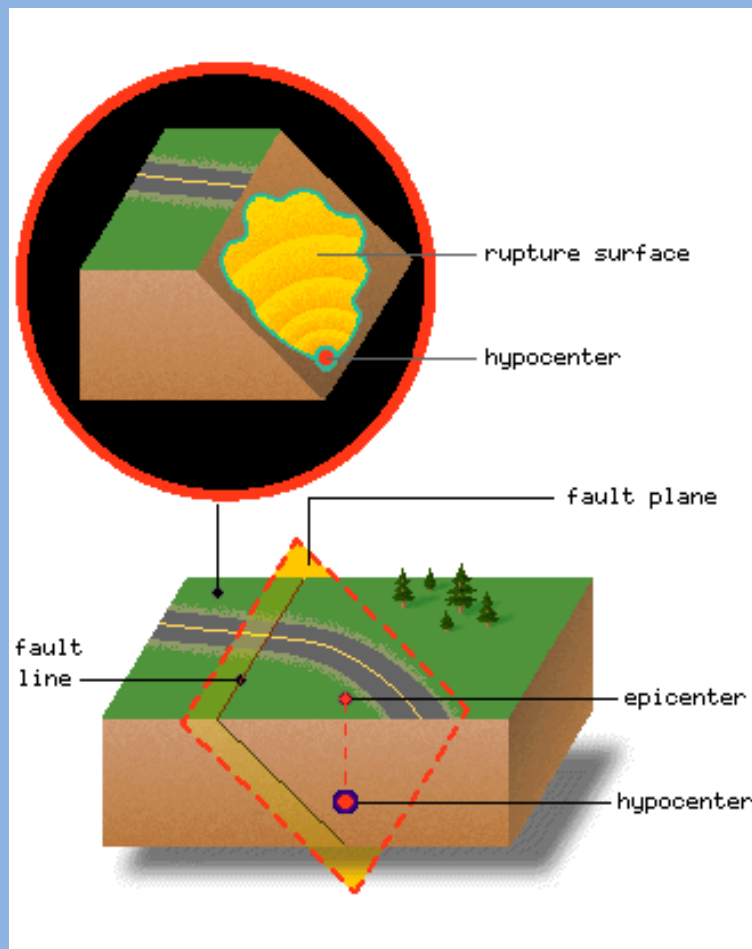
Issues:

- Liquefaction
- Severe shaking
- Surface fault rupture 6 feet
- Landslides

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)	<0.05	0.3	2.8	8.2	12	22	40	75	>139
PEAK VEL. (cm/s)	<0.02	0.1	1.4	4.7	9.6	20	41	86	>178
INSTRUMENTAL INTENSITY	I	II-III	IV	V	VI	VII	VIII	IX	X+

Scale based upon Worden et al. (2012)

What is an Earthquake?

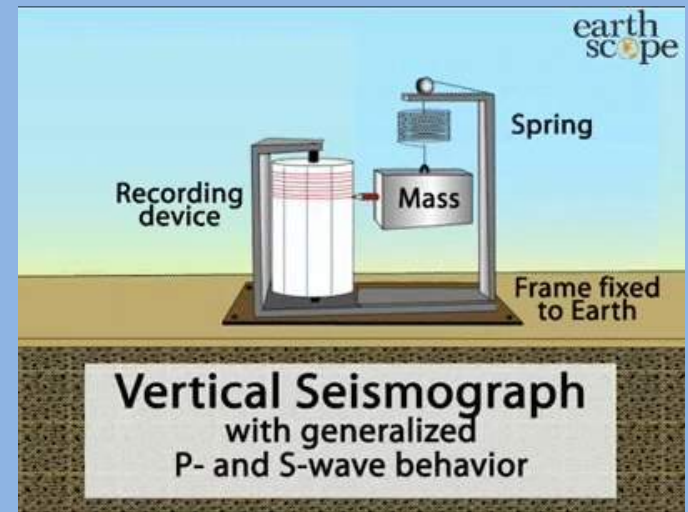
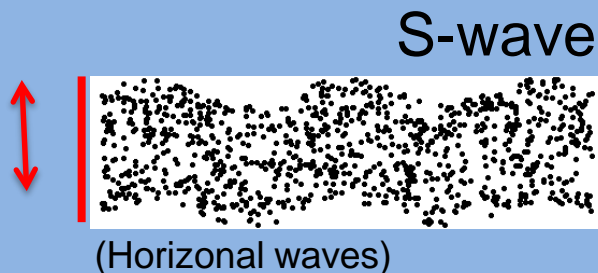
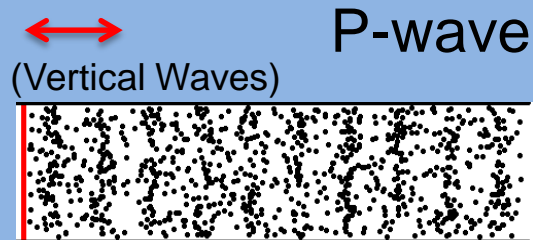


- Sudden movement of two blocks of the Earth slipping past one another releasing energy in the form of seismic waves that radiate across the surface
- Every point on the rupture surface releases energy
- The longer the rupture the more shaking lasts
- A bigger fault rupture means a bigger earthquake

Earthquake Physics:

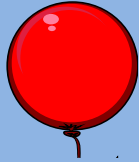
Earthquake waves

- **P-wave**
 - Faster @ 3.5 mi per sec
 - Less destructive
- **S-wave**
 - Slower @ 2 mi per sec
 - More destructive

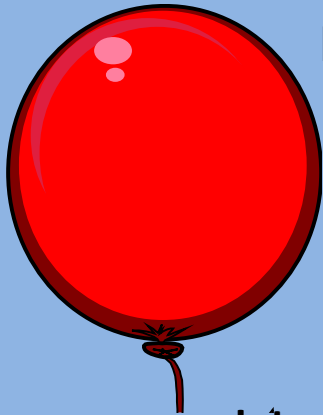




M5



M6



M7

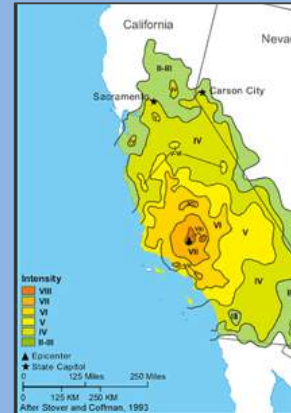
Earthquake Physics:

Magnitude is NOT Intensity

Magnitude describes the relative size of earthquakes (how much energy released). The scale is arbitrary, has no physical units, and uses a logarithmic scale (10x) & depends on length of rupture. Size of earthquake does not change

Richter Scale

Intensity describes the severity of shaking at a place. How much you will shake depends on magnitude, distance to the fault, and the local soil/rock type. Different areas will have a different intensity of shaking.



Intensity	Shaking	Description
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 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 objects 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.

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)	<0.05	0.3	2.8	6.2	12	22	40	75	>139
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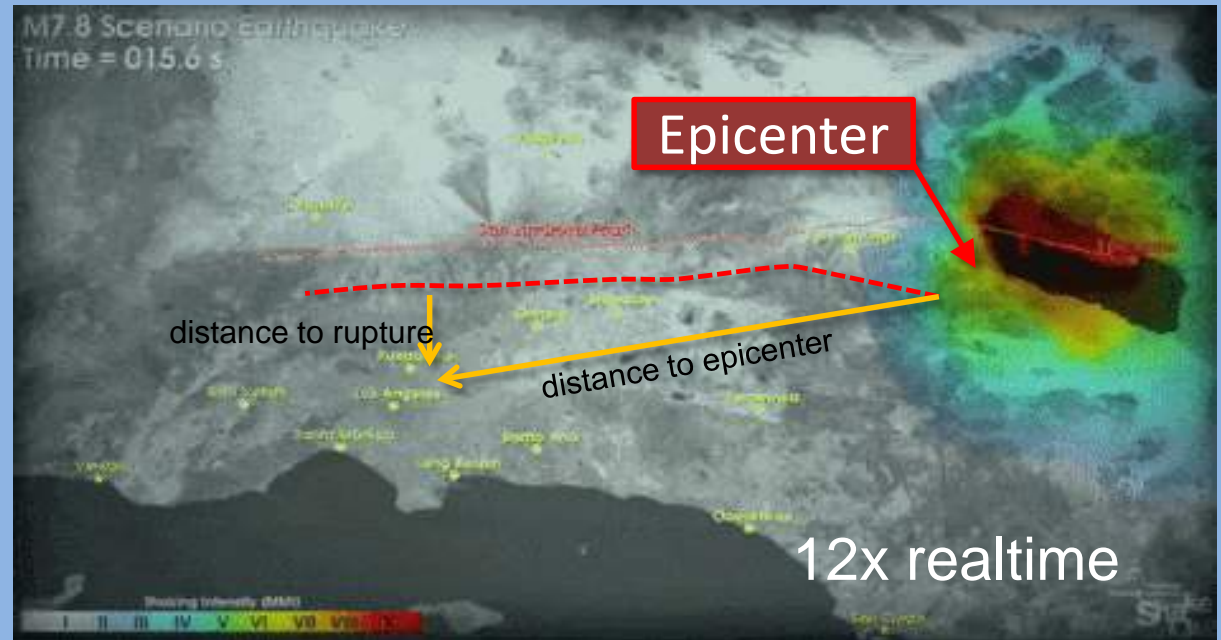
Modified Mercalli Scale (MMI)

ShakeAlert

What Makes a Big Earthquake?

Big Earthquakes Rupture Long Faults

- Big earthquakes are not points (epicenter)
- Fault rupture & magnitude grow with time
- Each point along the fault rupture releases energy
- We can't predict how far the rupture will go
- Shaking intensity depends on distance to the fault rupture NOT the epicenter



M7.8 - Shakeout Scenario Simulation

- Rupture length = 180 miles
- Rupture duration = ~1:40 min.



We Need Technical Partners

The USGS provides the ShakeAlert but the delivery mechanism is provided by public and private industry



Technical Partners

- Partners that can deliver ShakeAlerts internally within their facility (two-way radios; PA systems; shut down valves and machinery; open gates/doors)
- Partners to develop the interface to deliver the ShakeAlert to the public or trigger an automated operation
- Partners to provide lessons learned/benefits
- Generally, increased awareness across all states

We are all in this together...

When you receive an alert or feel shaking...

- **Drop! Cover! And Hold On!**
 - Alert staff and patrons nearby of impending earthquake
 - Move away from dangerous situations
 - Move away from windows, bookcases and falling hazards
 - Find a sturdy table, desk or open area
 - Stay sheltered until shaking stops



Additional scenario responses...

Driving

- If you are in a car, stay in the car. Put the car in park, use parking break, and stay in car until shaking stops and lay down on front seat
- If you are not in a car, stay away from cars and any other objects that may move or fall



Persons in Wheelchairs

- Lock! Cover! And Hold On!
- Activate wheelchair locks. Cover head with hands

In Bed

- Stay in bed, pull covers/pillow over head
- Stomach to mattress
- Shoes/flashlight under bed



After an Earthquake

First:

- Check self and others for injuries
- Protect self from further danger – put on protective clothing (hard soled shoes, hardhat with miner's light, long pants and shirt)



Then:

- Sweep assigned areas for injured/trapped persons and damage
- If evacuation is needed, direct evacuation flow to assigned exits
- Check for leaking gas, turn off if needed
- Turn off water to the house or building
- Be aware of aftershocks and secondary affects
- Extinguish small fires
- Expect aftershocks and secondary affects



Make a Kit! **work, home, car**



FOOD & WATER

- Non-perishable, easy to prepare food
- 1 gallon H2O per person per day



PREPAREDNESS SUPPLIES

- Radio & Batteries
- Flashlight & Batteries
- First Aid Kit



TRAINING

- CERT Course
- First aid class
- Map Your Neighborhood Class

YOUR ESSENTIALS

- Medications and hygiene items
- Eyeglasses/contacts
- Cell phone charger
- Baby, pet, senior supplies
- Gas tank always ½ full



MONEY

- Cash in small bills
- Bank account information



CLOTHING & BEDDING

- Change of clothes
- Sleeping bag, sheets
- Sturdy shoes



IMPORTANT DOCS & CONTACTS

- List of contact phone numbers/e-mails
- Out-of-state contact
- Copies of identification and documents



Thank You

Margaret Vinci

*ShakeAlert SoCal Regional
Coordinator for Communication,
Outreach, and Technical Partner
Engagement*

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