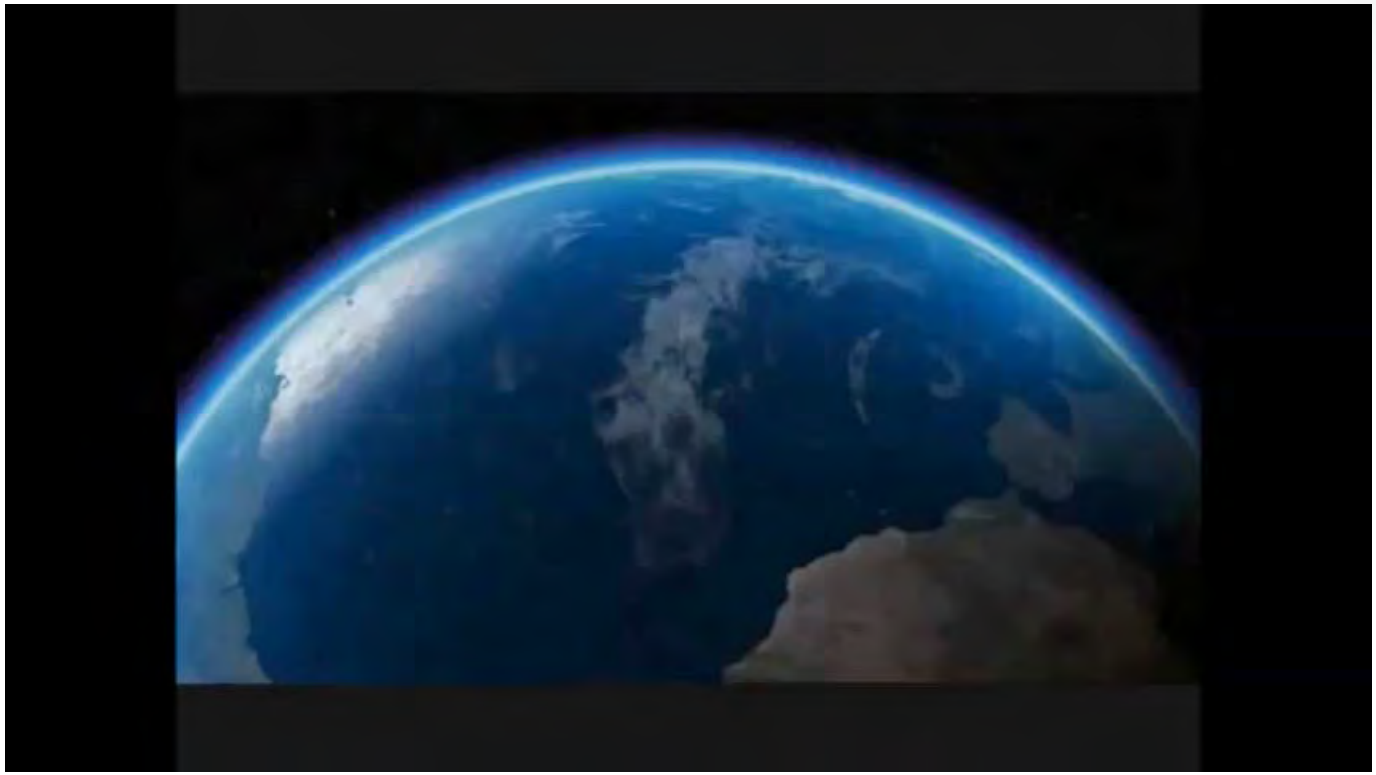
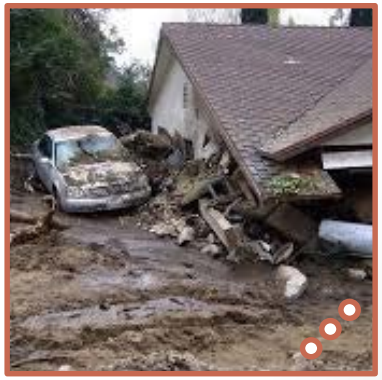


The Impacts of the Cascadia Subduction Zone Earthquake on Oregon

Dr. Althea Rizzo
Oregon Military Department
Office Of Emergency Management



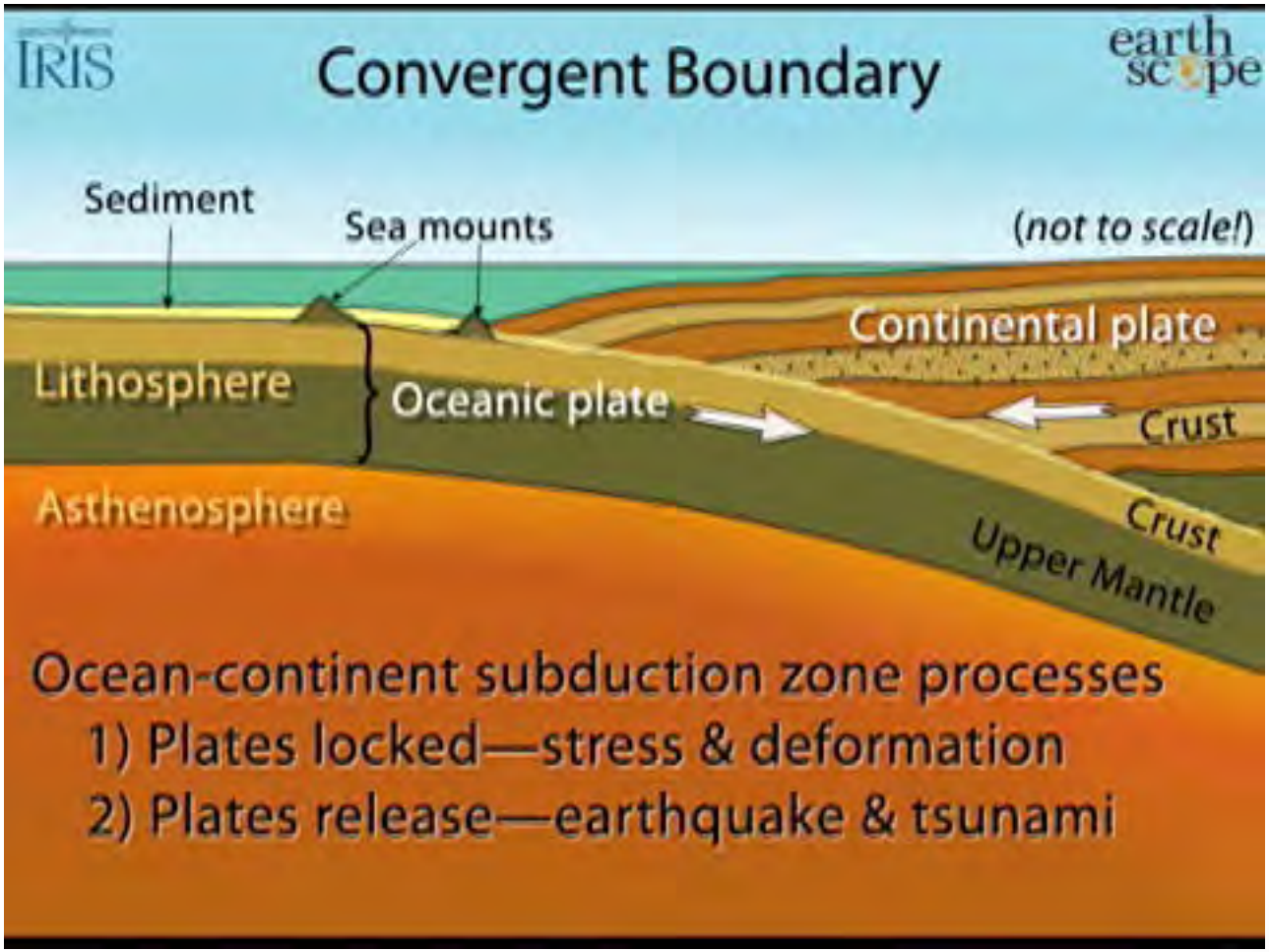
What are the geologic hazards in Oregon?

Earthquakes

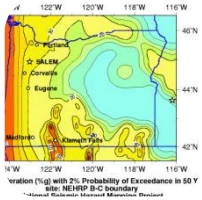
Tsunami

Volcanos

Subduction Zone

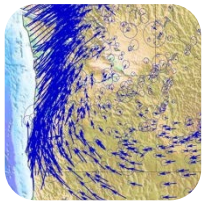


Know your Cascadia Subduction Zone

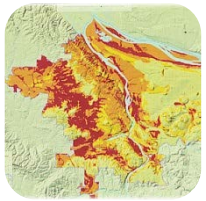


Over 600 miles long, from northern California to British Columbia

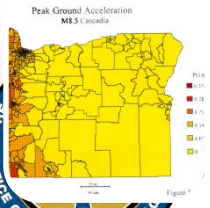
Capable of producing very large earthquakes (M9+) that impact a wide area



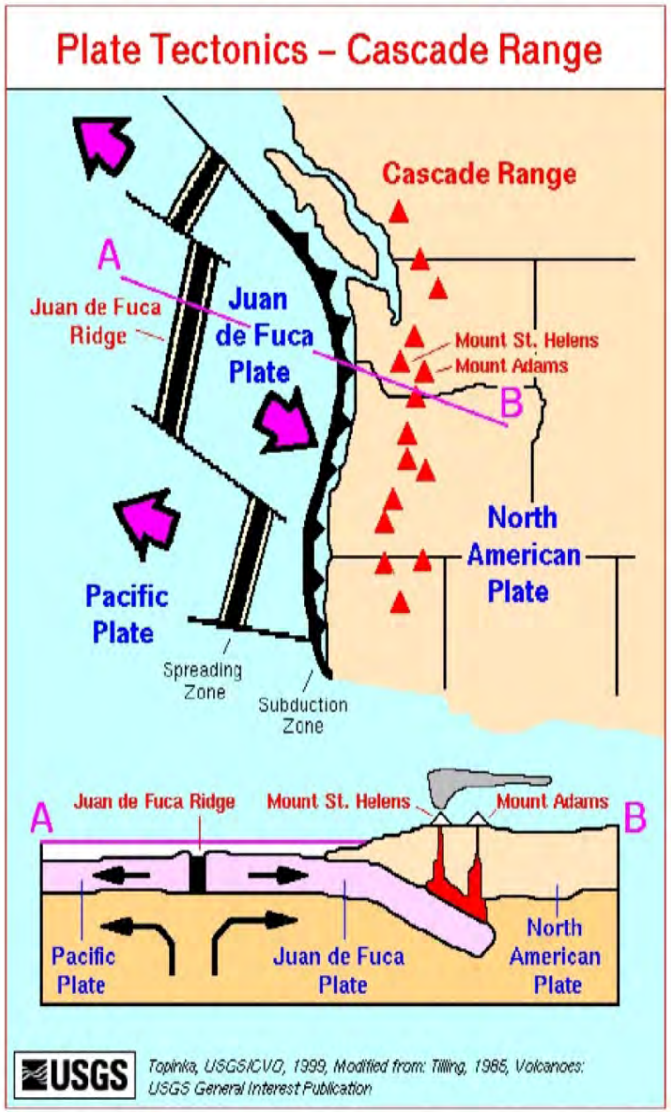
Similar in size and impact to the 2004 Sumatra earthquake



Can produce devastating tsunamis



37% chance of a mega-thrust earthquake in the next 50 years *



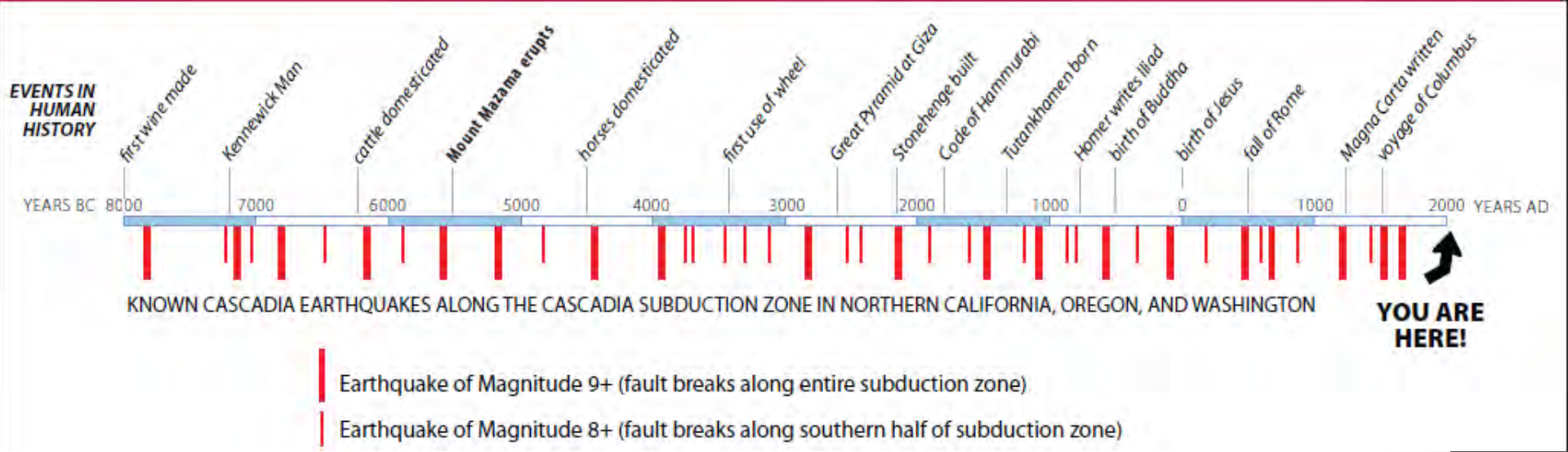
Last Cascadia Subduction Zone earthquake occurred in 1700

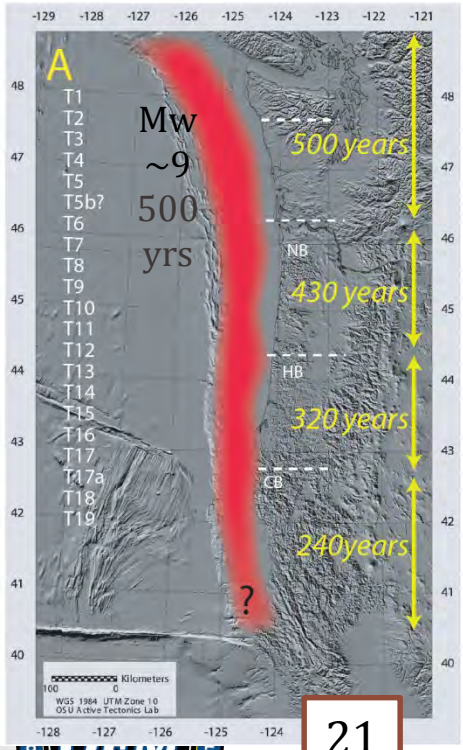
When will the next one occur?

- We just don't know

Average recurrence:

- 240 years (south of Cape Blanco)
- 5-600 years (entire length)
- 190-1,200 years between EQ





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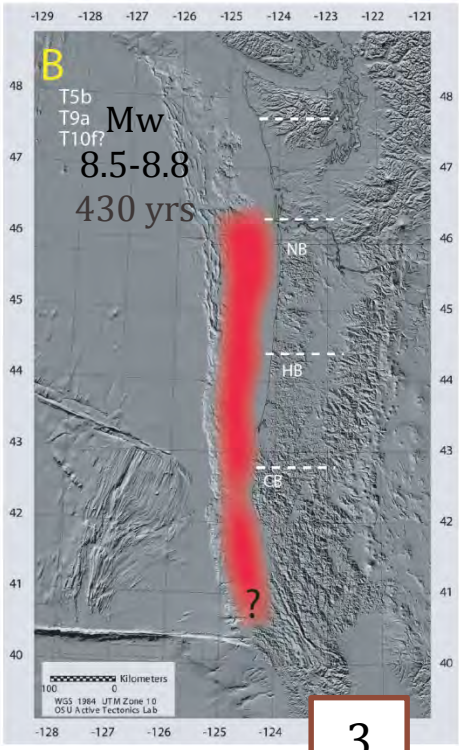

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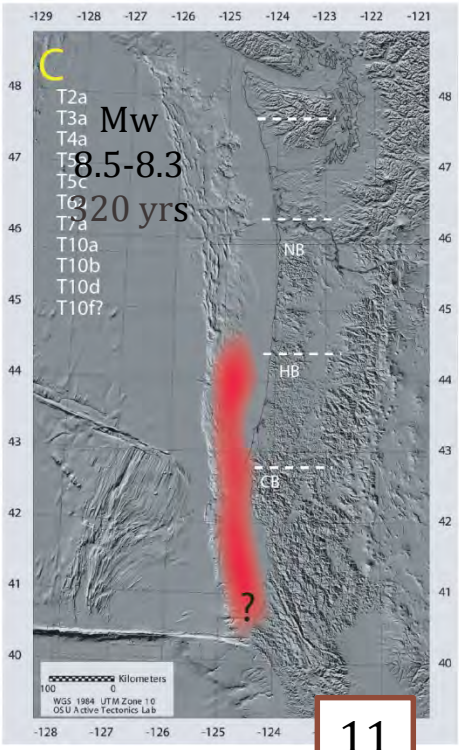

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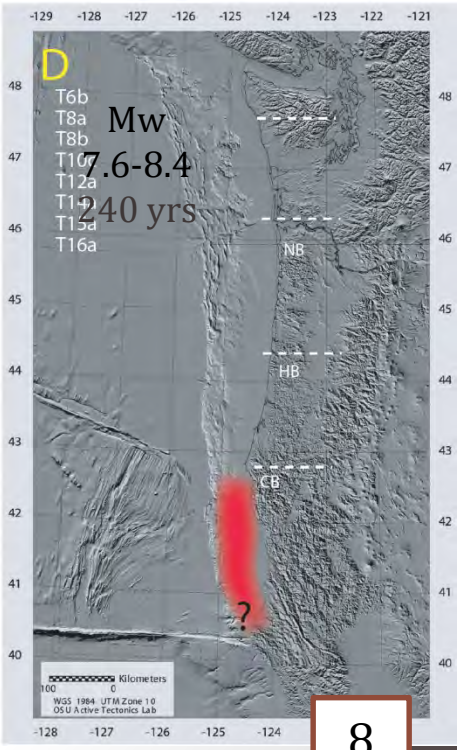
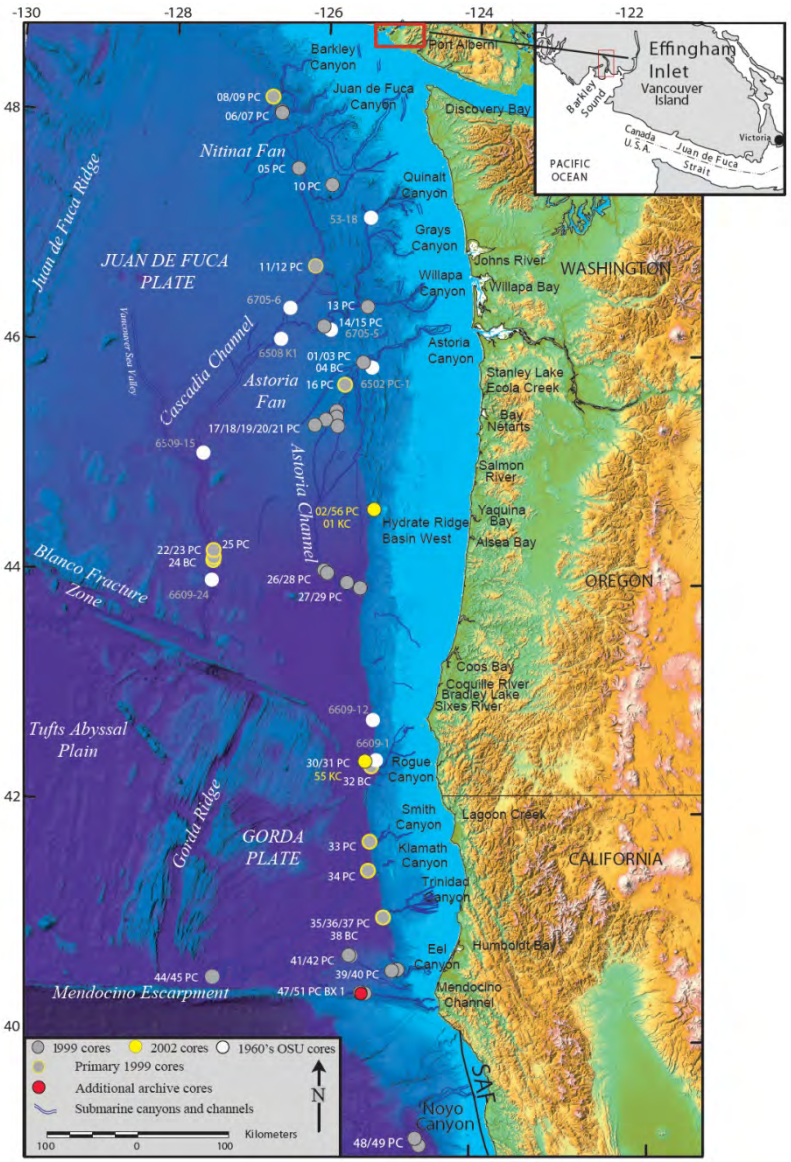


8

(Modified from [illegible]inger et al. (in press) by addin[illegible] magnitude estimates and some labels)

Cascadia = Strong Shaking and Tsunami



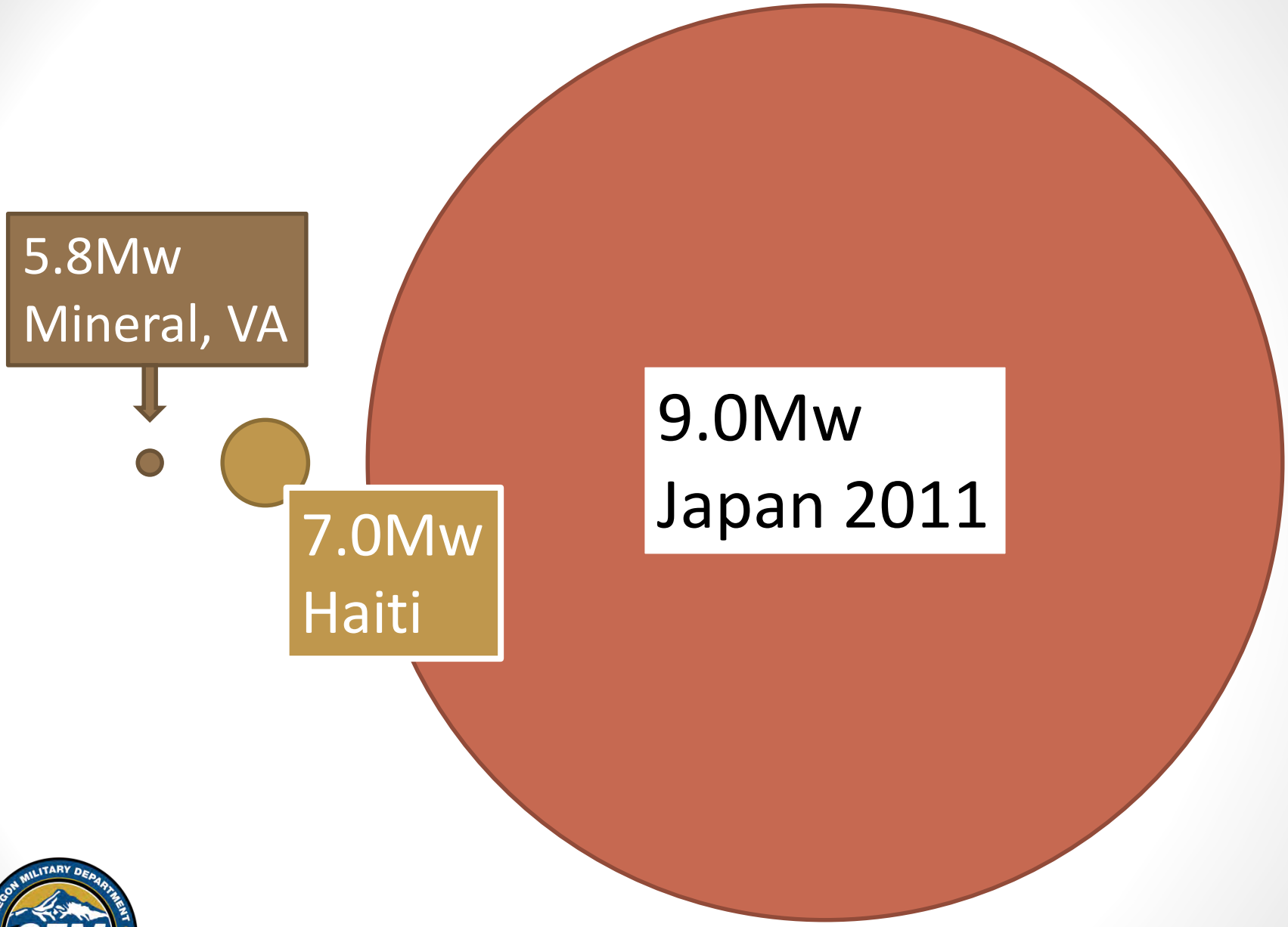
- Strong Ground Shaking
  - >8.0 Mw
  - >2 min. shaking
- Tsunami
  - within 15 to 25 minutes

What happens during a Cascadia Subduction Zone earthquake?

Strong ground shaking

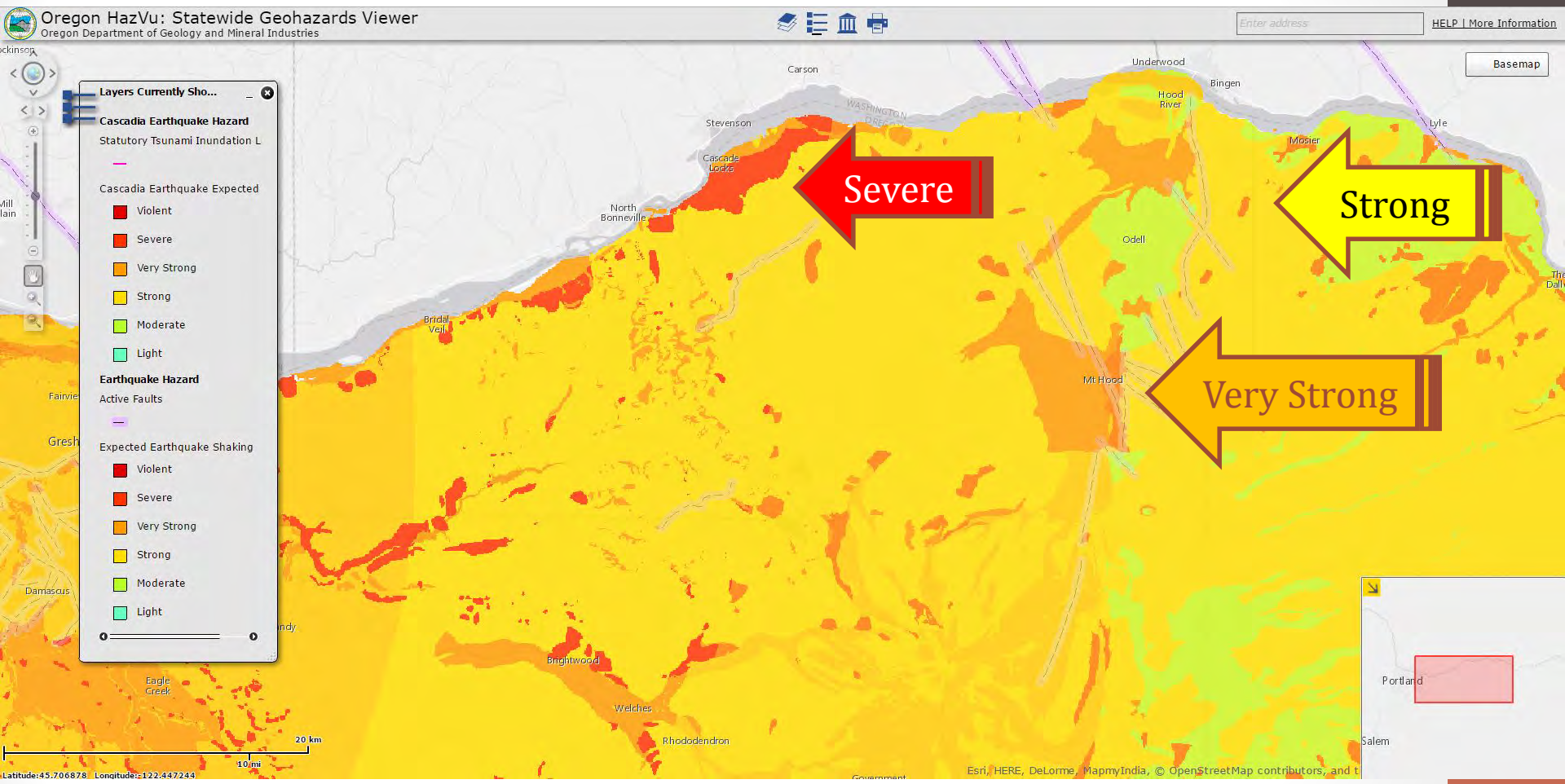
Moment Magnitude

- Moment is a product of the distance a fault moved and the force required to move it.
- Proportional to the fault area multiplied by the average displacement on the fault.
  - The **SHAKING** of a 6.0 Magnitude quake is 10x greater than a 5.0 Mw
  - The **AMOUNT of ENERGY RELEASED** is 32x greater


5.8Mw
Mineral, VA
7.0Mw
Haiti
9.0Mw
Japan 2011

I	Instrumental	Not felt.
II	Just Perceptible	Felt by people sitting or on upper floors of buildings.
III	Slight	Felt by almost all indoors. Hanging objects swing. May not be recognized as an earthquake..
IV	Perceptible	Vibration felt like passing of heavy trucks. Windows, dishes, doors rattle. In the upper range of IV, wooden walls and frames creak.
V	Rather Strong	Felt outdoors. Sleepers wakened. some spilled. Pictures move.
VI	Strong	Felt by all. People walk unsteadily. Windows crack. Weak buildings cracked.
VII	Severe	Difficult to stand or walk. Damage to poorly built masonry buildings. Some cracks in better masonry buildings.
VIII	Destructive	Extensive damage to unreinforced masonry buildings. Fall of some masonry walls. Wood-frame houses moved on foundations if not bolted
IX	Violent	General panic. Damage to masonry buildings ranges from collapse to serious. Wood-frame structures rack, and, if not bolted, shifted off foundations. Underground pipes broken.
X	Very Violent	Poorly built structures destroyed with their foundations. Even some well-built wooden structures and bridges heavily damaged and needing replacement.
XI	Extreme	Rails bent greatly. Underground pipelines completely out of service.
XII	Catastrophic	Damage nearly total.

Shaking intensity – CSZ in Hood River



Source: http://www.oregongeology.org/hazvu

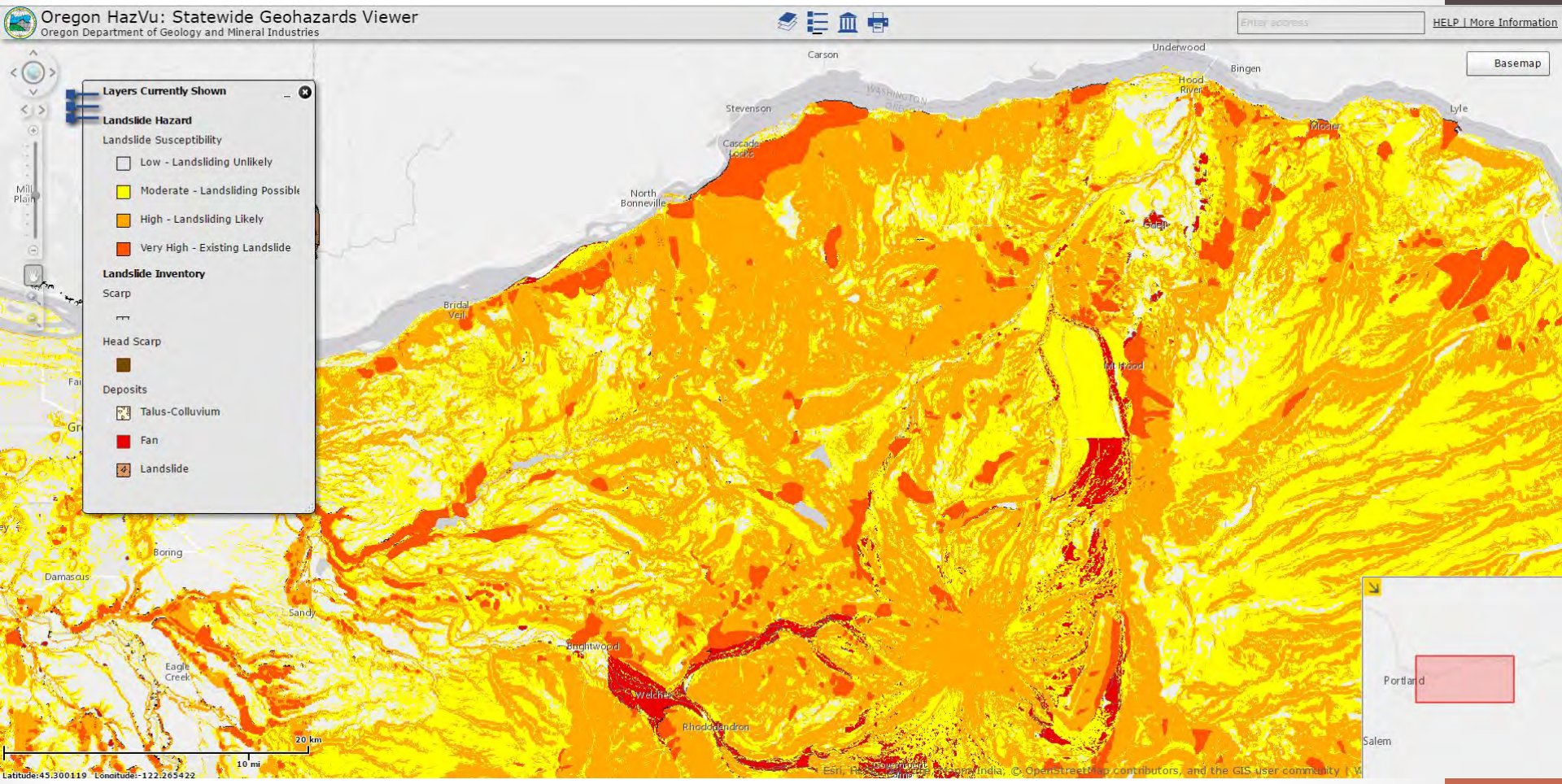
Landslides

Landslides in Ferndale, WA

Japan

2010 Taiwan

Landslides in Hood River County



Liquefaction

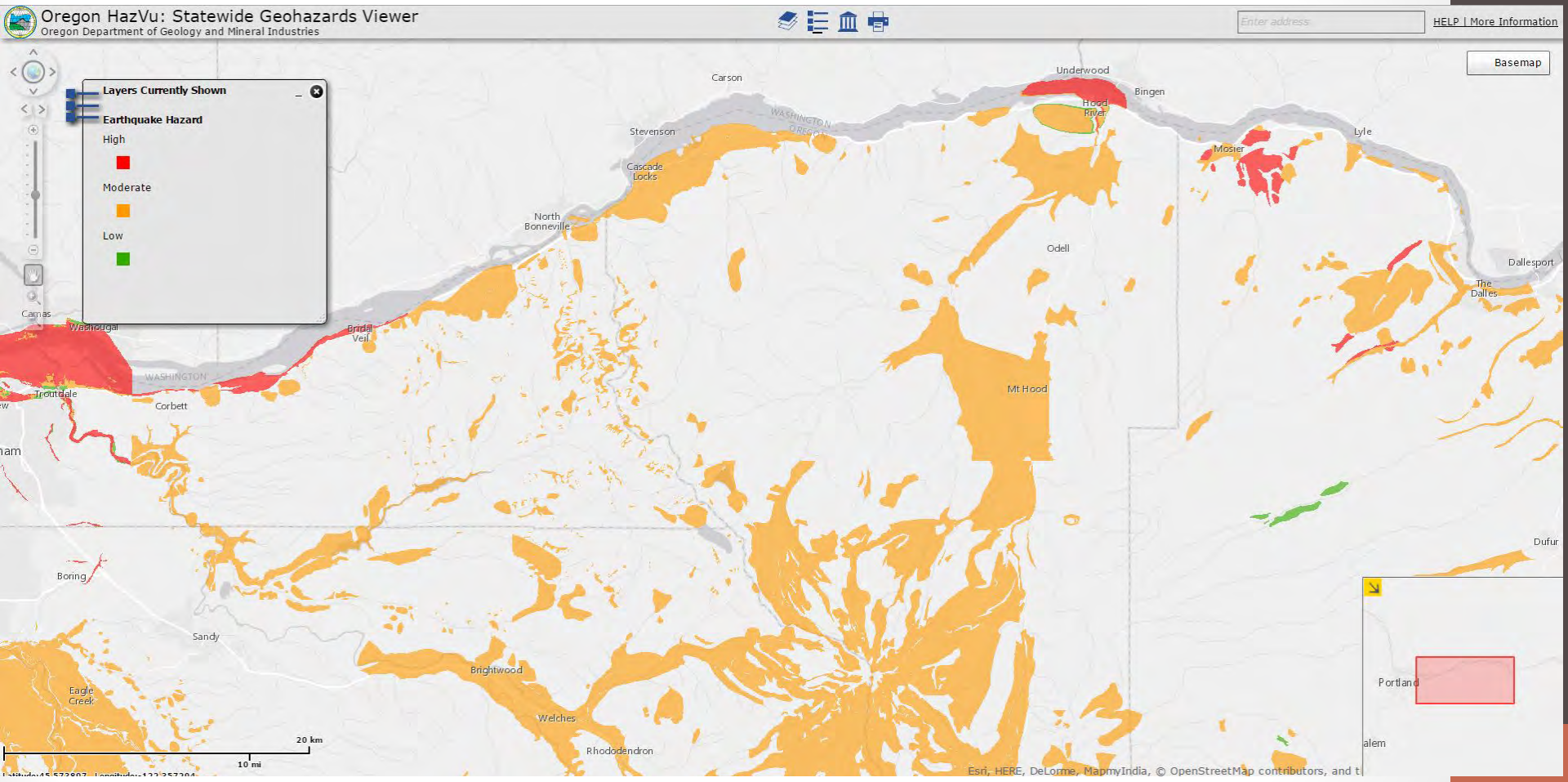
1964 Niigata Liquefaction

Source: unknown

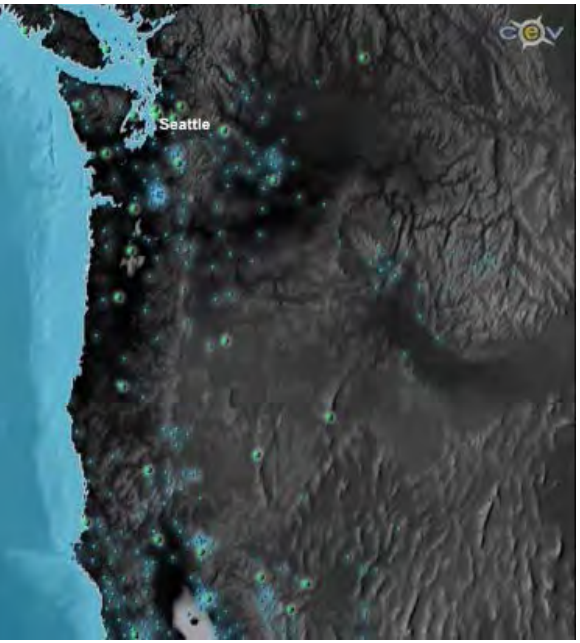
2011 Christchurch

1964 Alaska

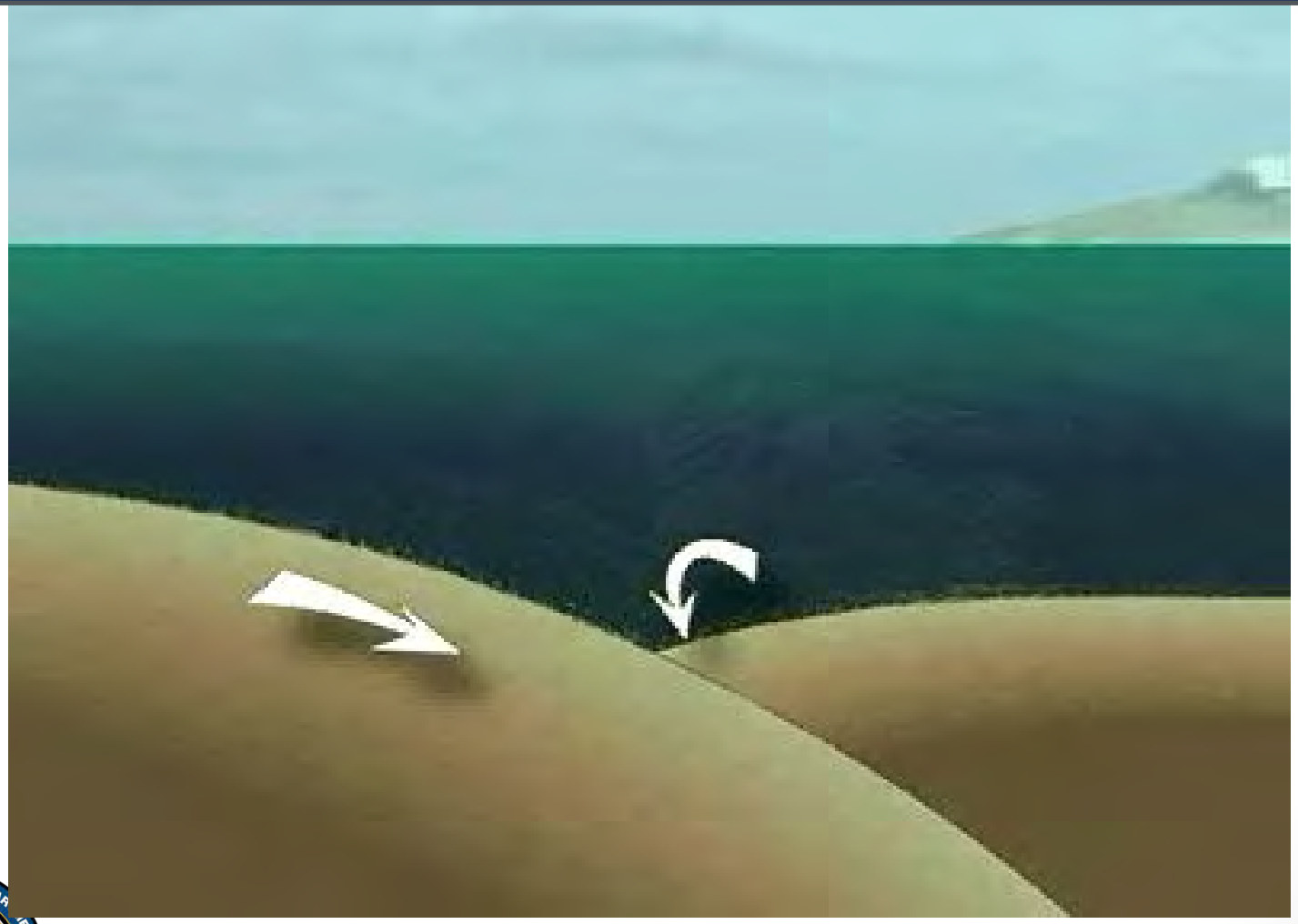
Liquefaction in Hood River County



Tsunami



Tsunami



Tsunami

Local – Caused by a subduction zone earthquake near the Oregon shore

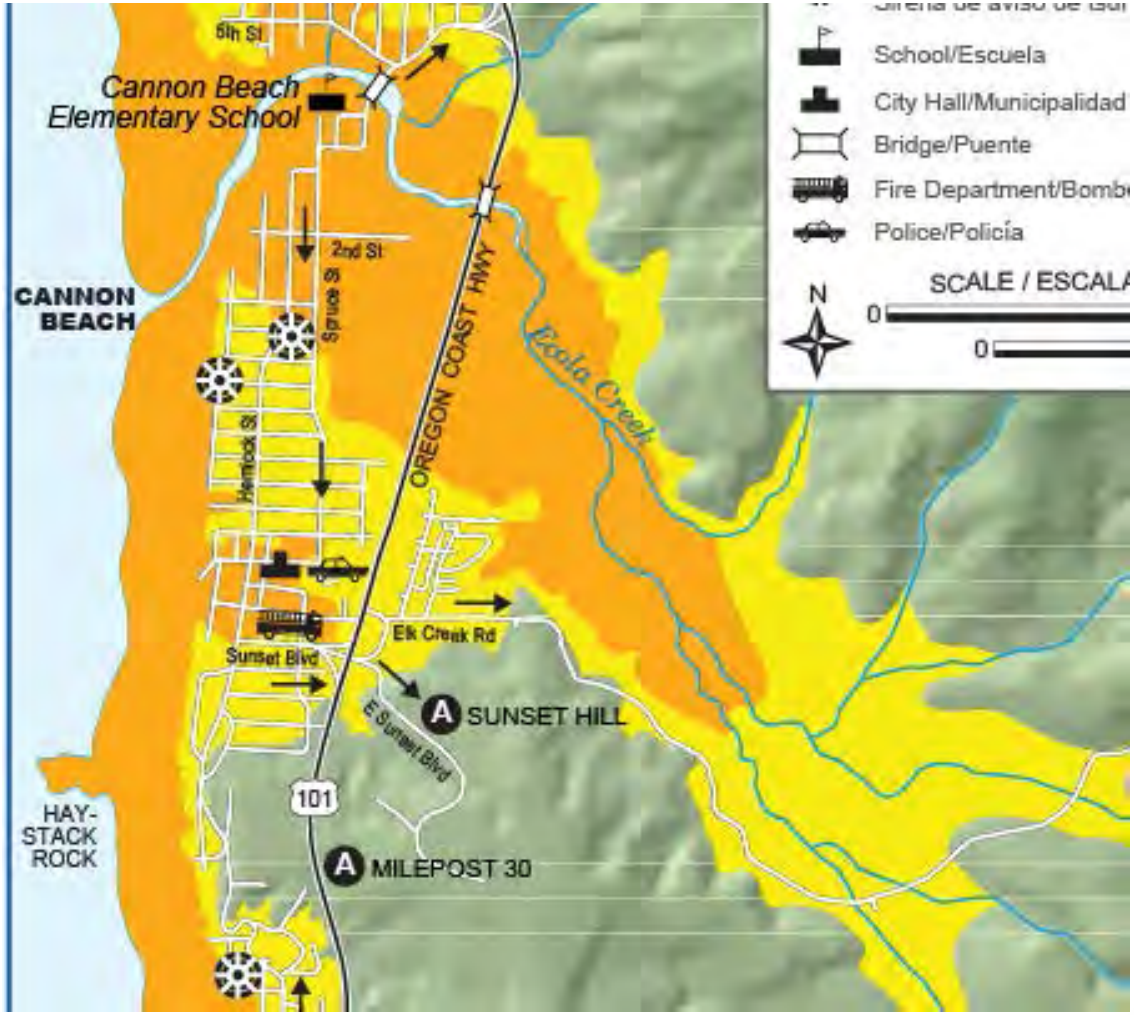
Distant – Caused by a subduction zone earthquake far away from the Oregon shore

Distant Tsunami

- **Arrives 4 + hours after the earthquake**
- Lower damage and flooding than local tsunamis
- National Tsunami Warning System can warn you
  - Warning and Advisory require protective action
- National Tsunami Warning Center
  - **http://wcatwc.arh.noaa.gov/**

hrs

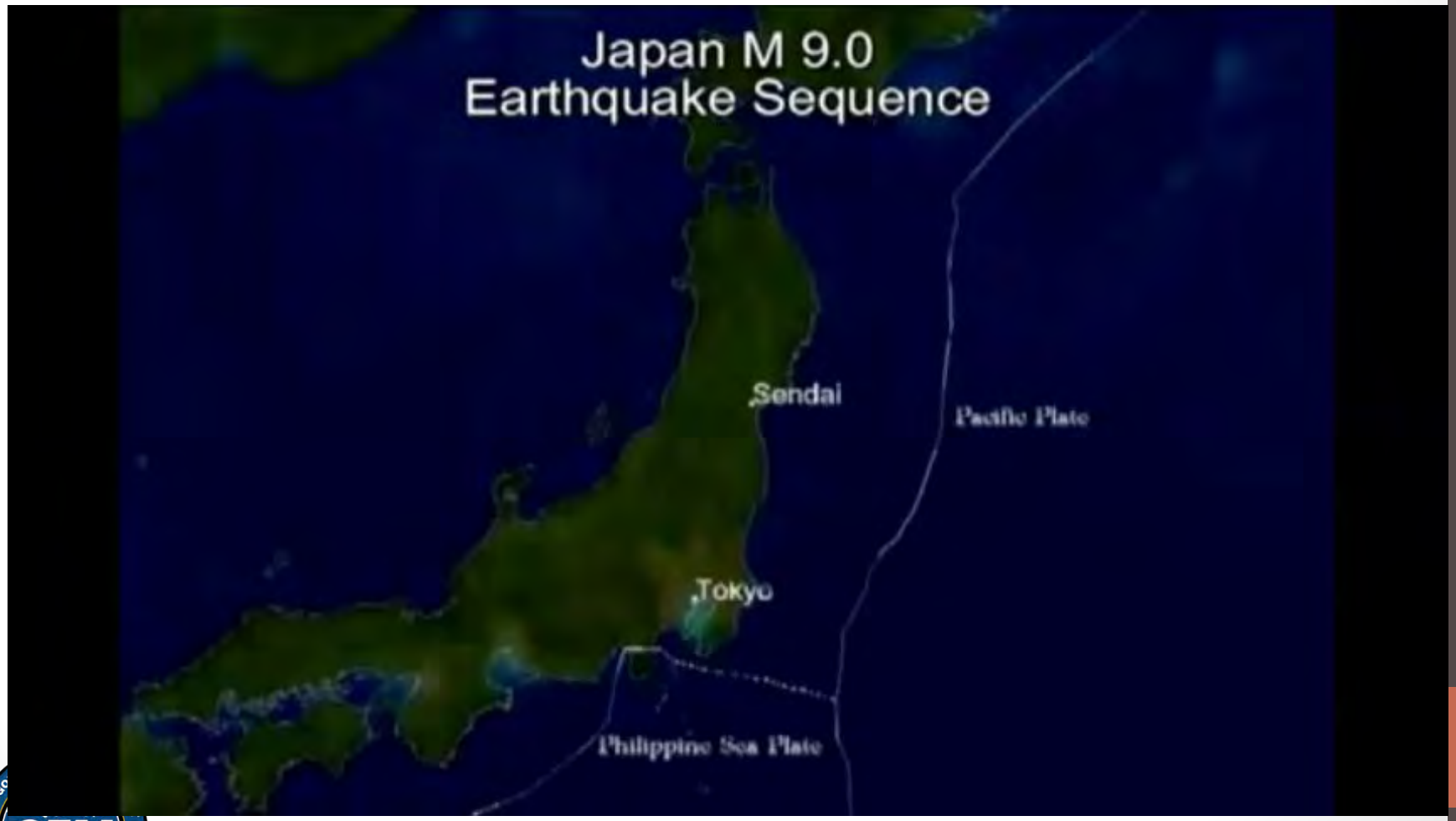
Tsunami Evacuation Maps



Local Tsunami

- **Arrives minutes after the earthquake**
- Much higher waves
- Much further inland penetration
- NOAA Tsunami Warning System ineffective
- **Earthquake = Only Warning**
  - **NO OFFICIAL WARNING!**
  - **Self Evacuation required**

Aftershocks



www.scec.org/scecvdo

Oregon is at risk

from an earthquake and tsunami that can significantly **impact our people and economy for decades.**

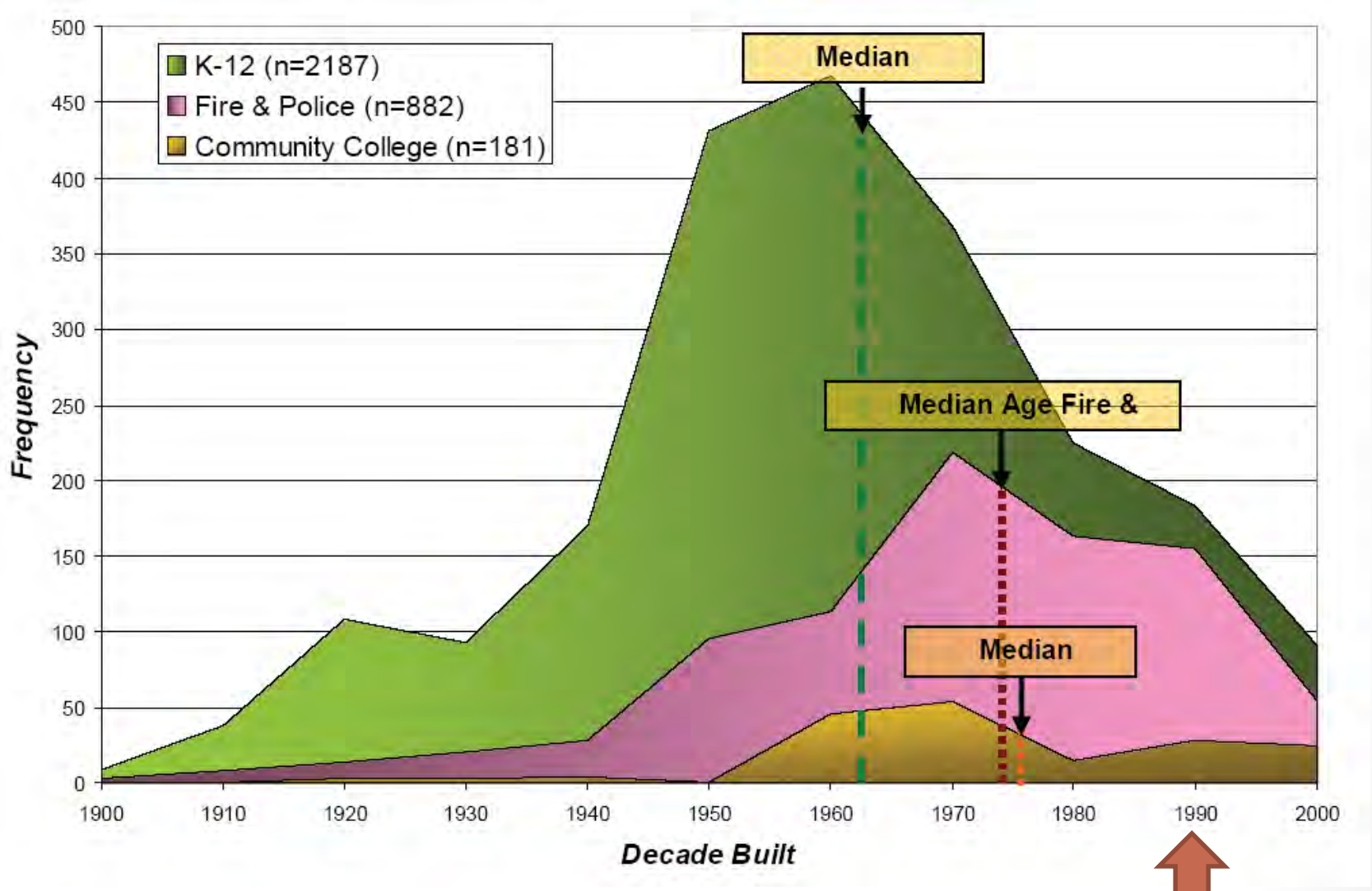
Cascadia Planning Assumption

Three metropolitan cities in impact zone

- Portland
- Seattle
- Vancouver, B.C.

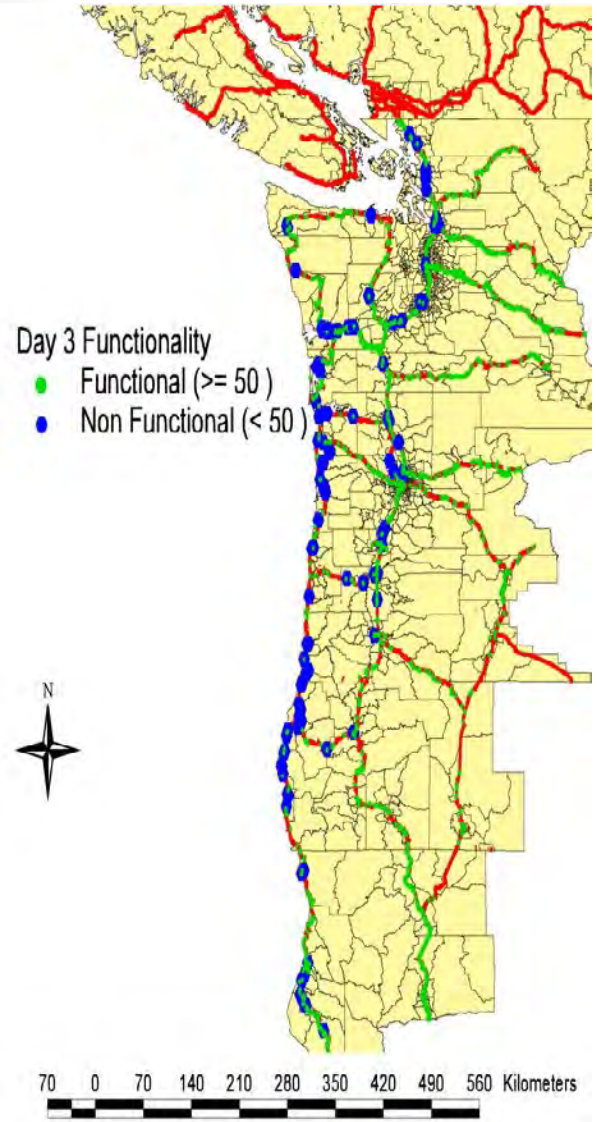
15 million people live in the impact zone

- No power for weeks/months/years
- No fuel for weeks/months/years
- No deliveries of food/water for weeks/months
- No running water for weeks/months/years
- No sewer system for weeks/months/years



First significant seismic building codes in Oregon

Bridge Damage



Cascadia Scenario Bridge Functionality

621 bridges heavily damaged.

399 bridges totally or partially collapsed

Routes connecting Interstate I-5 with the HWY 101 would be closed.

Closure could be **3 to 12 months**.

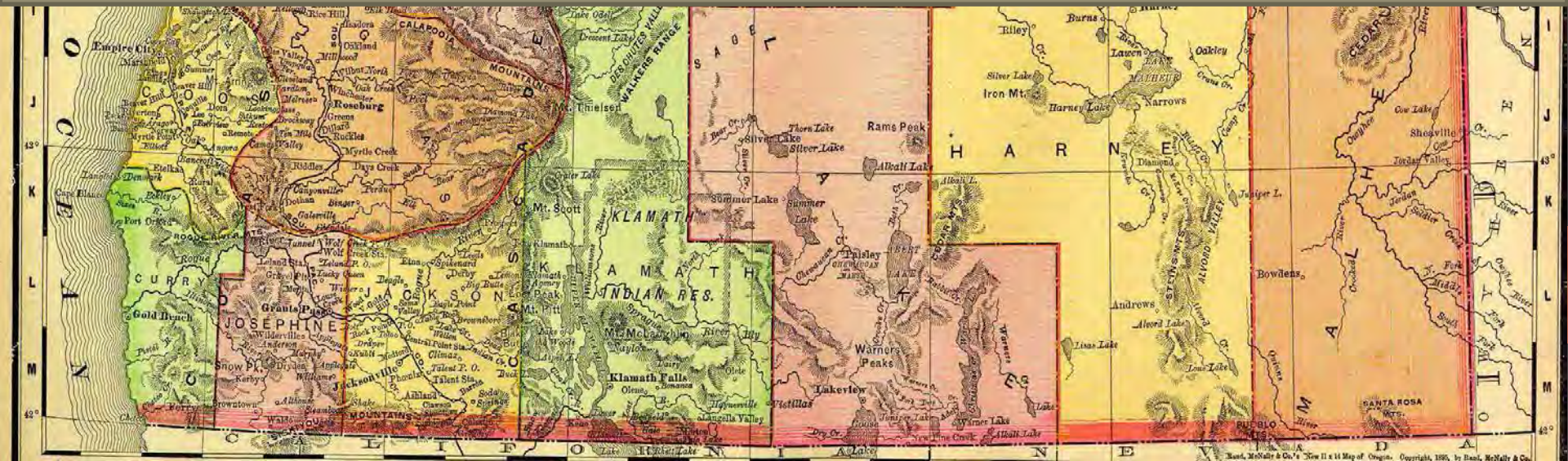
Restoration could take **3 to 5 years**

$5.1 Billion to seismically retrofit bridges

It doesn't take a building collapsing to cause injury

Pendant light fixtures failed in this elementary school library during the 1983 M6.5 Coalinga, California earthquake. If the room had been occupied, this could have caused injuries.
Bracing nonstructural elements in homes, schools, and offices can often be done easily and relatively inexpensively. (Source: NOAA/NGDC, Earthquake Engineering Research Institute)

What are the Implications for Oregon if Cascadia happened today?



Compact for Resilience
A 50-year journey

Residents, communities, and businesses strive to be ***self-sufficient*** for at least two weeks.

Public, Private and Non-Profit organizations strive to be back at ***90% by two weeks*** after a Cascadia subduction zone earthquake. (ORP, SPUR)

Building the Oregon Resilience Legacy

You're more prepared than you think.	Think about it. Talk about it.	I'm an Oregonian. I'm resilient.

Prepare to stay safe

Is this what you are choosing?

Or is this what you are choosing?

Prepare in Seven steps

1- Identify Hazards

2- Create a disaster plan

3- Prepare disaster kits

4- Identify and fix weaknesses

5- Protect yourself during earthquake

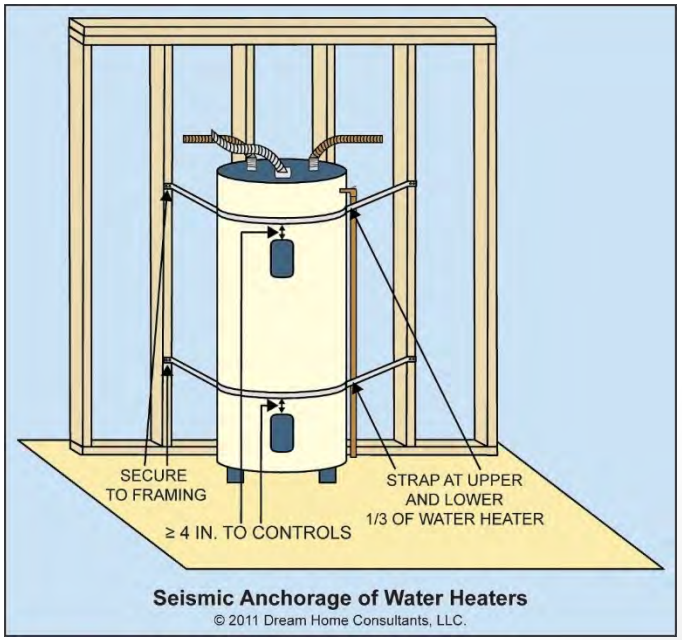
6- Evacuate if necessary

7- Follow your earthquake plan

Prepare in 7 Steps

Identify the Hazards

Do the easy stuff first.



Prepare in 7 Steps

Emergency Plan

Who?

Where?

How?

When?

Prepare in 7 Steps

Emergency Plan

Tools you can use to create an emergency plan

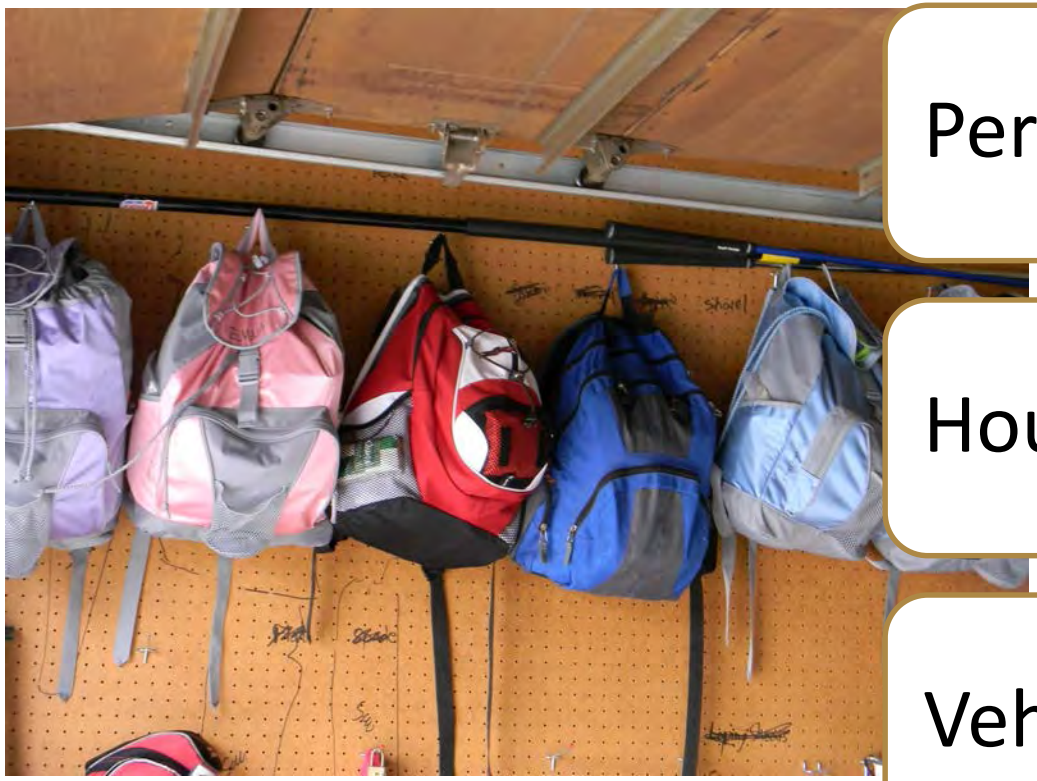
Living on Shaky Ground

Smart phone apps

Tsunami evacuation maps

Prepare in 7 Steps

Supplies



Personal/Office

Household

Vehicle

Injuries: First Aid & Medications

Medical Needs

- Less than 30% U.S. trained in first aid
  - 90% in Norway
  - 80% in Germany

Shelter & Warmth

Japan 2011

Water

Water Filter Straw

55-Gallon Barrel of Water

Food

MAYDAY
EMERGENCY FOOD RATIONS
RATION D'URGENCE
3600
RATION D'URGENCE
2400
– High In All Recommended Vitamins –
Riche en toutes les vitamines recommandées

Sanitation

Prepare in 7 Steps

Identify & fix weaknesses

Common building problems

- Inadequate foundations
- Un-braced cripple walls
- Soft first stories
- Unreinforced masonry

Prepare in 7 Steps

Protect yourself during earthquake

Prepare in Seven steps

6- Evacuate if necessary

- Know if you are in the Zone
- Do not wait for an official warning
- Check for injuries
- Check for damage

Prepare in 7 Steps

Follow your earthquake plan

Once safe, continue your disaster preparedness plan.

Stay away from the beach.

Be in communication

If you cannot stay in your home…

- Tell a neighbor and your out-of-state contact where you are going

Prepare in Seven steps

Three things you can do today…. (Pick two!)

Start a conversation	Out of state contact	Old Shoes under bed
• In-person, social media	• Put into Contacts • 1EQText	• Shoes • Gloves • Flashlights

A new normal?

WE CAN
DO THIS!

Contact Information

Geological Hazard Program Coordinator

Althea Rizzo

(503) 378-2911 ext. 22237

Althea.rizzo@state.or.us