Earthquakes and Historic Buildings

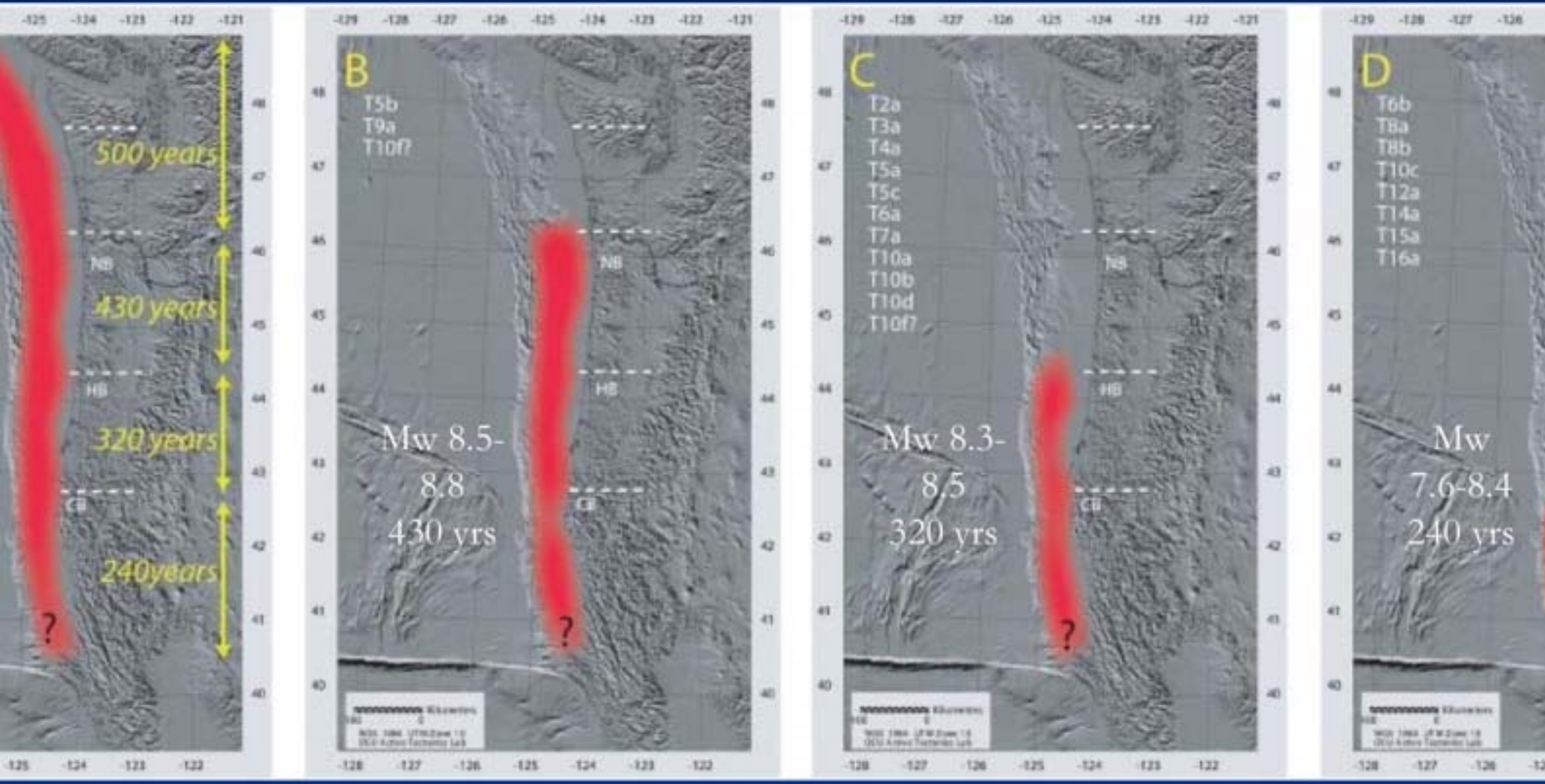
Oregon Main Street Conference
October 4, 2012

Preserving Historic Buildings

- Until now the major danger to historic buildings has been disinterest and neglect.
- For the Pacific Northwest the newly understood danger is earthquakes, especially the Cascadia earthquake.

How Big?

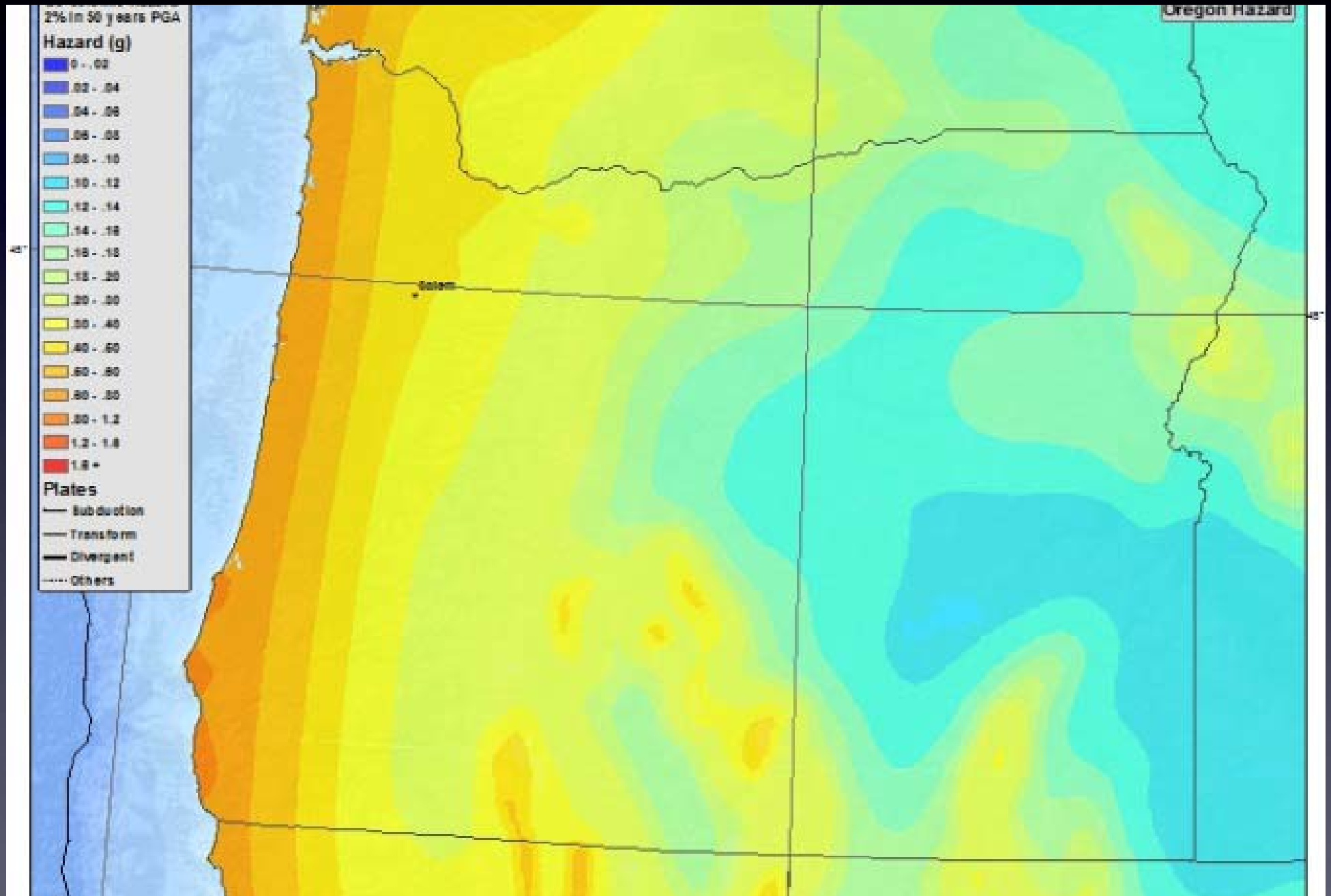
Could be magnitude 8, or magnitude 9.2



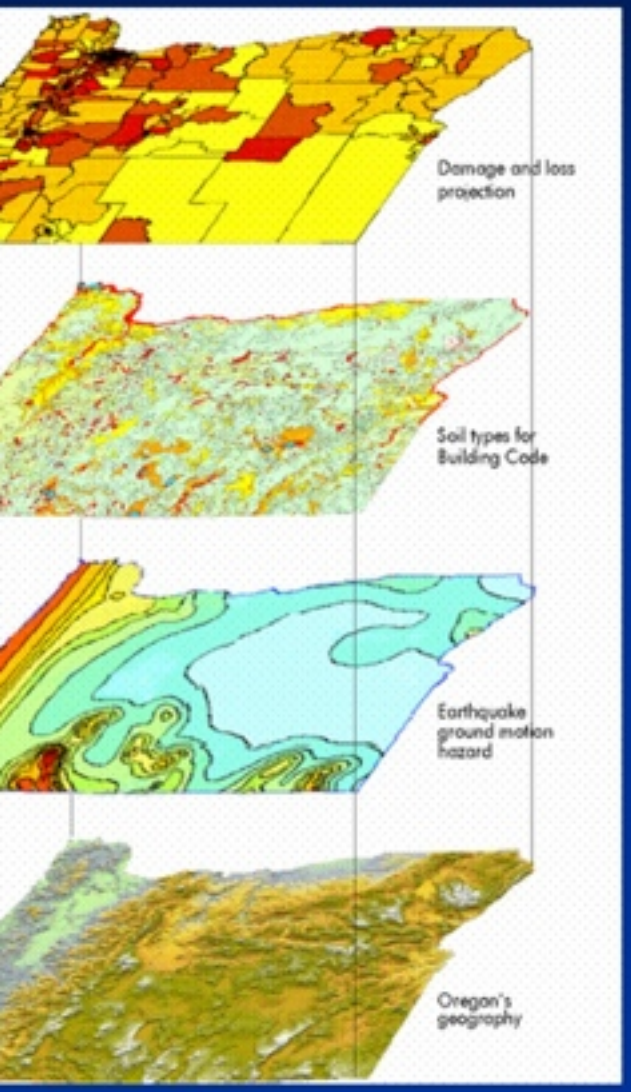
(Research by Goldfinger et al. in pres

0 full or nearly full length ruptures

How much shaking?



Deaths, dollars & downtime



2010 Haiti (220k)

23 per 1,000

2011 Japan (25k/3M)

~8 per 1,000

Oregon Estimates (>5,000)

>3 per 1,000

World War II (420k in US)

2 per 1,000

2010 Chile (500)

Deaths: Concentrated Fatalities

Weak buildings that collapse

- Historic districts
  - Unreinforced masonry (URMs)
  - High risk school buildings
  - 300,000 students exposed

Tsunami flood zones

- Seaside High School

Deaths, dollars & downtime

apan's Damage

$600 Billion (US)

12% GDP

hile's Damage

30 Billion (US)

3% GDP

Oregon Estimates

>$36 Billion direct damage

(22% OR GSP)

- > 35,000 Buildings Destroye
- > 250,000 Buildings Damag

Cascadia Earthquake: Likelihood

- USGS: 15% for full rupture
- USGS: 37% for partial rupture *
- Failure Analysis: 25% for full rupture *
- Failure Analysis: 85% for partial rupture*

* Per Dr. Chris Goldfinger's research and proposal

Historic Buildings: Wood

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enerally fare well in rthquakes but can be proved by:

- Tying building to foundation
- Creating continuous load path

Historic Buildings: Masonry

Historic Buildings: Mixed Masonry/Concrete

Historic Buildings: Concrete

Historic URM Buildings: Christchurch, NZ

Historic Buildings: Seismic Code

- Collapse prevention
- Life Safety (damaged but no insurance building is repairable)
- Essential Facility (operational after event)

Historic Buildings: Seismic Performance

- Collapse prevention
  - tie parapets to roof diaphragm
- Damaged but repairable, unoccupiable
  - steel or concrete moment frames
- Damaged but repairable, occupiable
  - steel or concrete moment frames , base isolation, hydraulic dampers
- Undamaged, fully operational
  - base isolation, hydraulic dampers

Historic Buildings: Resiliency

- Historic buildings are an important part of Main Street economies, what would their loss mean?
- Can historic buildings be upgraded to survive an earthquake, to what level, at what cost?
- Will historic buildings, if they survive, be more valuable after the earthquake?
- HPLO Roundtable: Oregon's Historic Masonry Buildings: Resilience, Access, and Economics. Report will be released October 25th in Portland