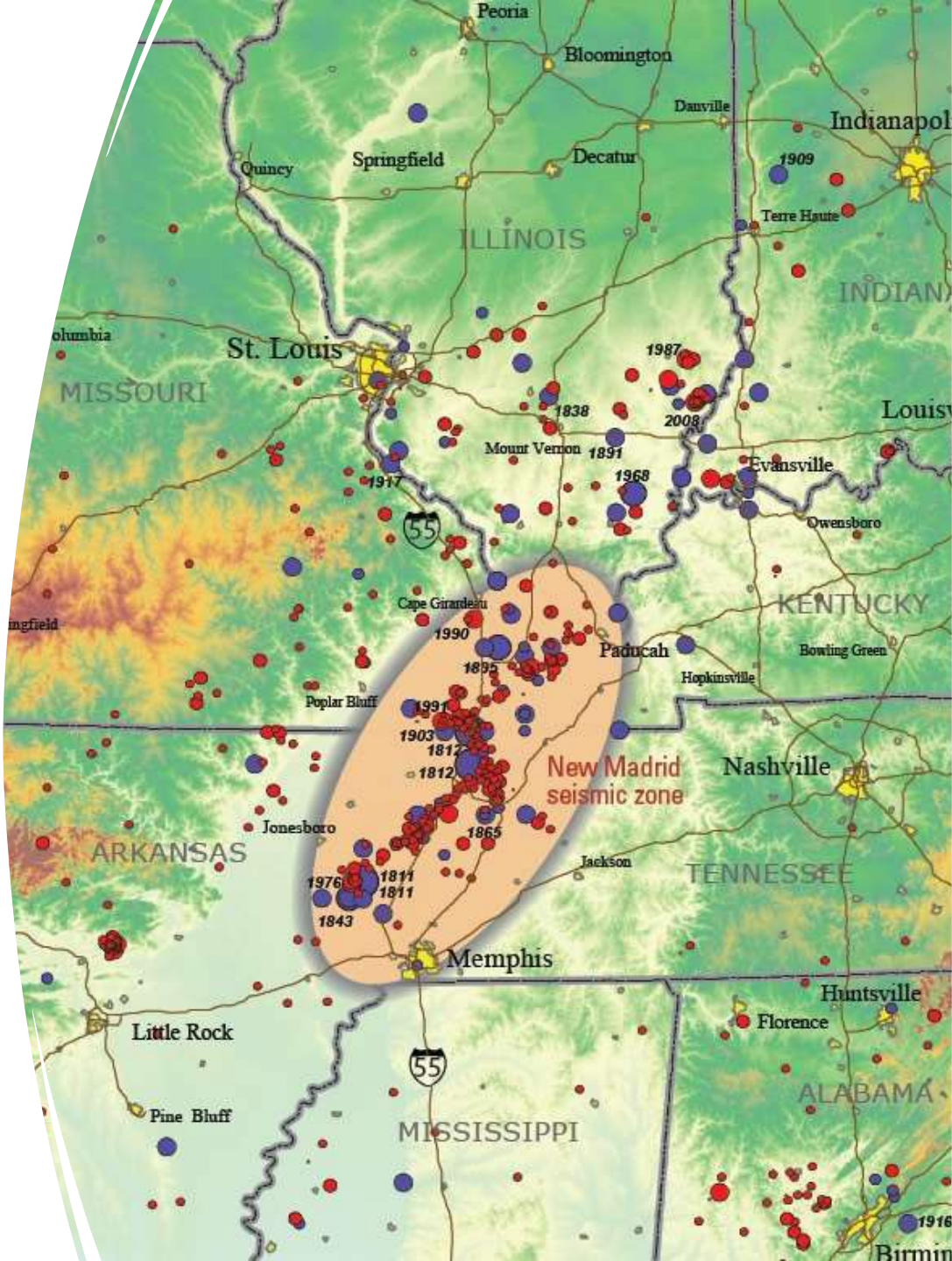
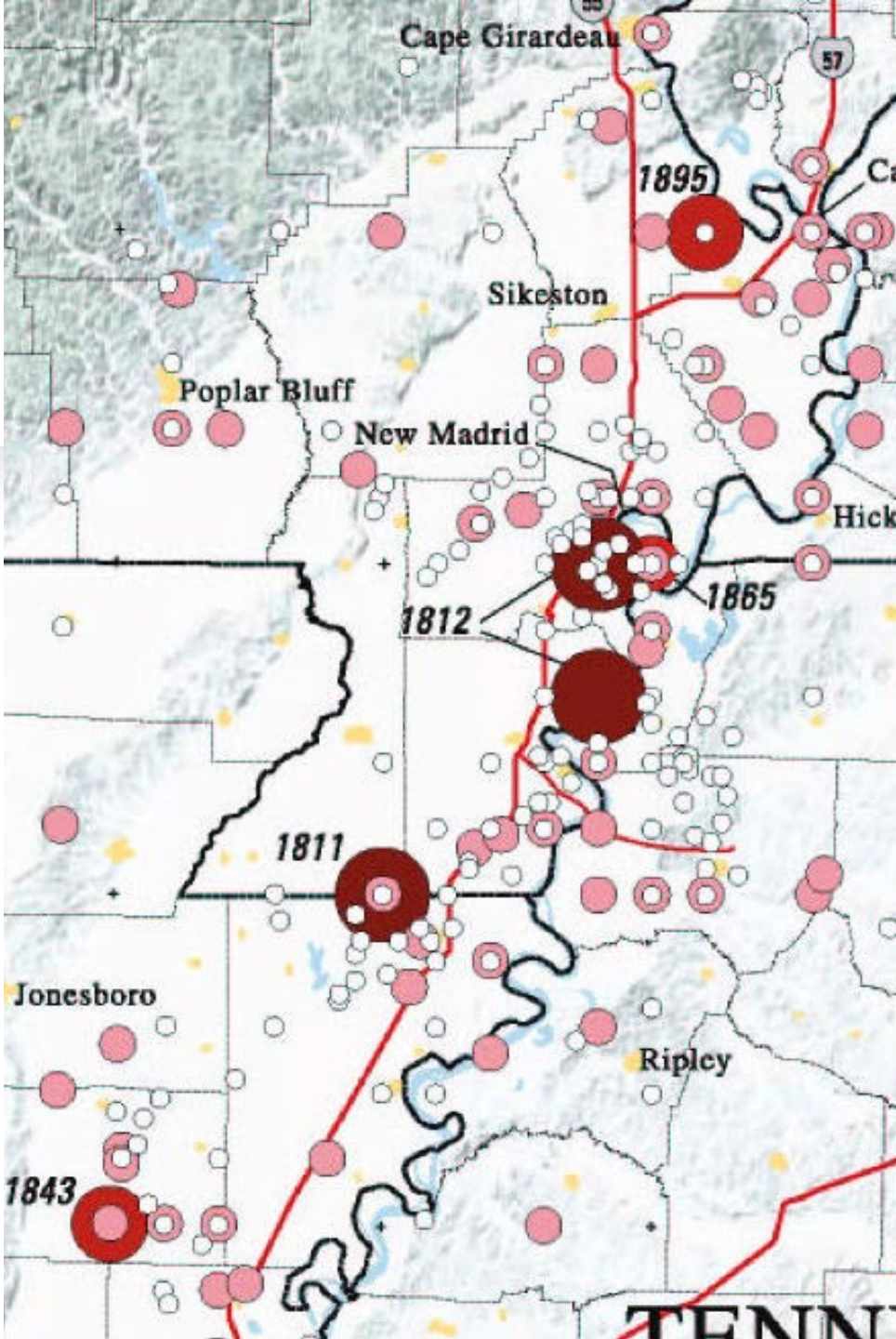
New Madrid Seismic Zone

About 200 earthquakes per year



Danger in the Central U.S.: New Madrid Seismic Zone

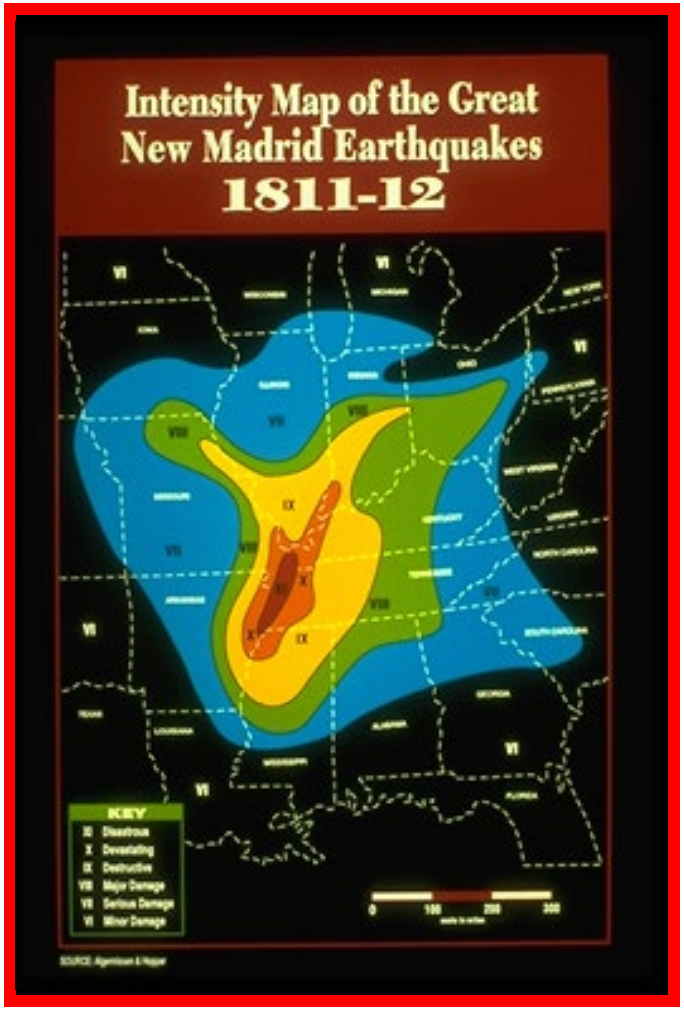
- Winter of 1811-12
- New Madrid area shaken by some of the strongest earthquakes in U.S. history (estimated to have been magnitude 7 to 8)
- Damage reported as far away as Charleston, South Carolina, and Washington, D.C.
- Shaking was felt over 5,000,000 square kilometers.



Earthquakes:

The Great New Madrid Earthquakes

-Widespread Effects from the 1811-12 earthquakes–

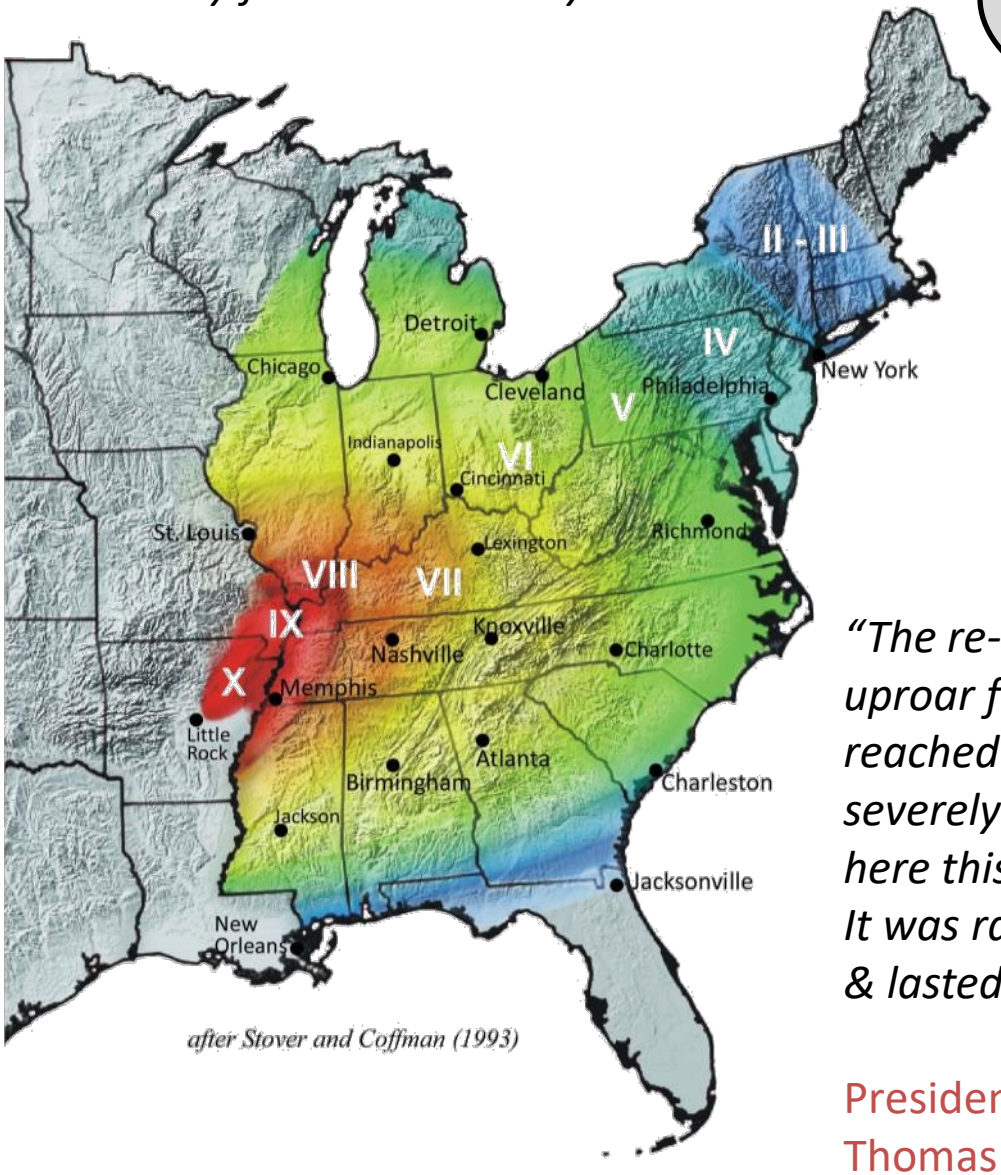


Numerous reports of landslides, ground failures and uplifts, sand blows, etc.

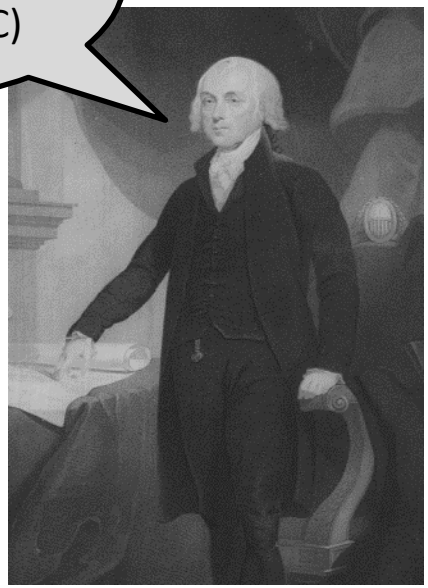
- **Church Bells Rang in Charleston, SC.**
- **New U.S. Capitol in D.C. Damaged.**
- **Sidewalks Cracked in Cleveland.**

Earthquakes were felt as far away as Canada and the Caribbean.

1811-1812 Earthquakes –
The most widely felt in U.S. History



I felt it
(in Wash. DC)

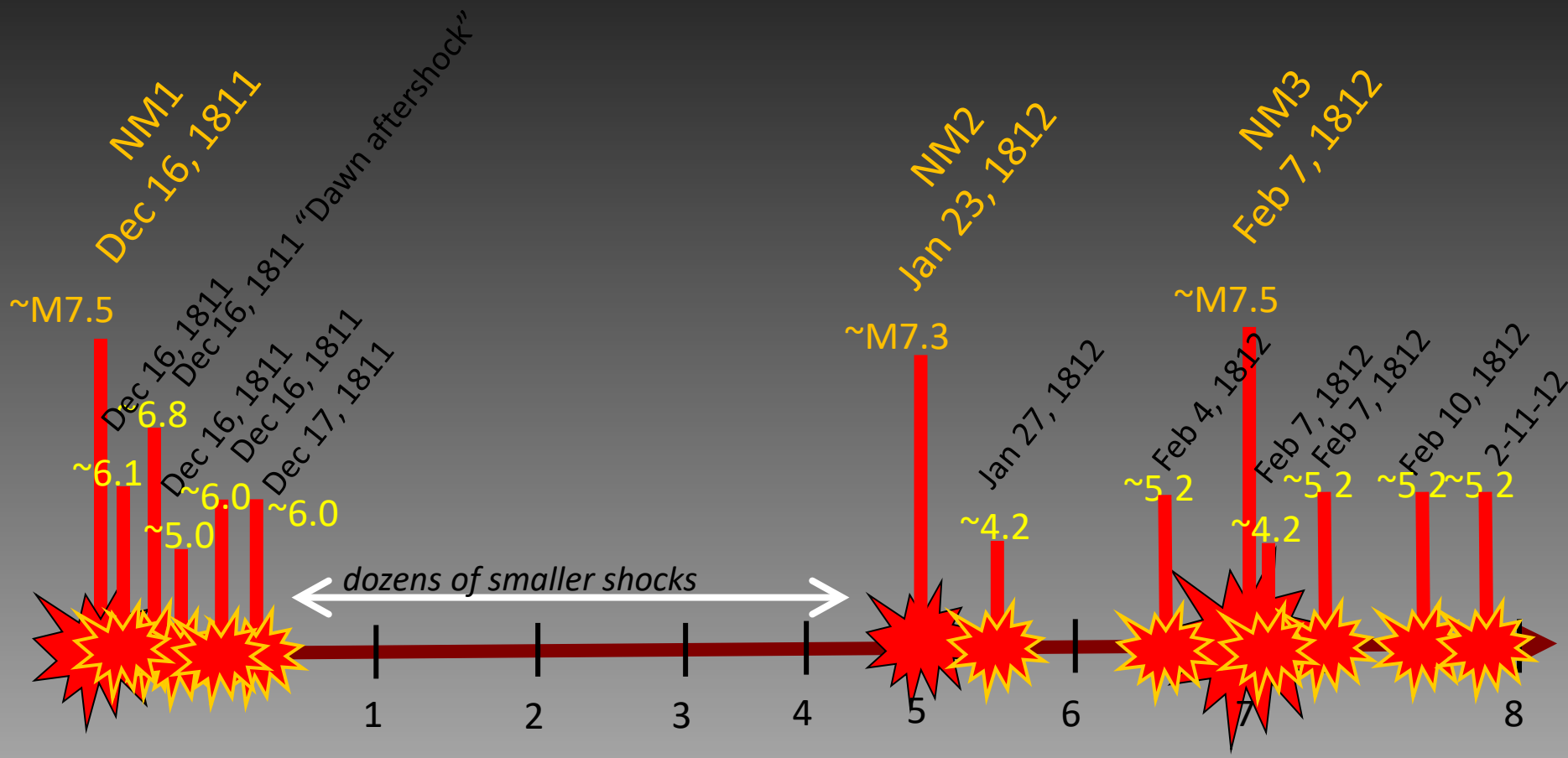


"The re-iteration of earthquakes continues the uproar from certain quarters. They have slightly reached the state of N. Y. and have been severely felt W. & S. Westwardly. There was one here this morning at 5 or 6 minutes after 4 o'C. It was rather stronger than any preceding one, & lasted several minutes…."

President James Madison writing to Thomas Jefferson, Feb 7, 1812
(Library of Congress)

The 1811-1812 New Madrid Sequence

3 Main shocks ~M7.3-7.5: 4 aftershocks ~M6.0-6.3



USGS

After Fuller, 1912; Nuttli, 1973; Hough et al. 2001; Hough and Martin, 2001; Hough 2009

Can't be Predicted

Floods are slow to arrive

Tornadoes have warnings

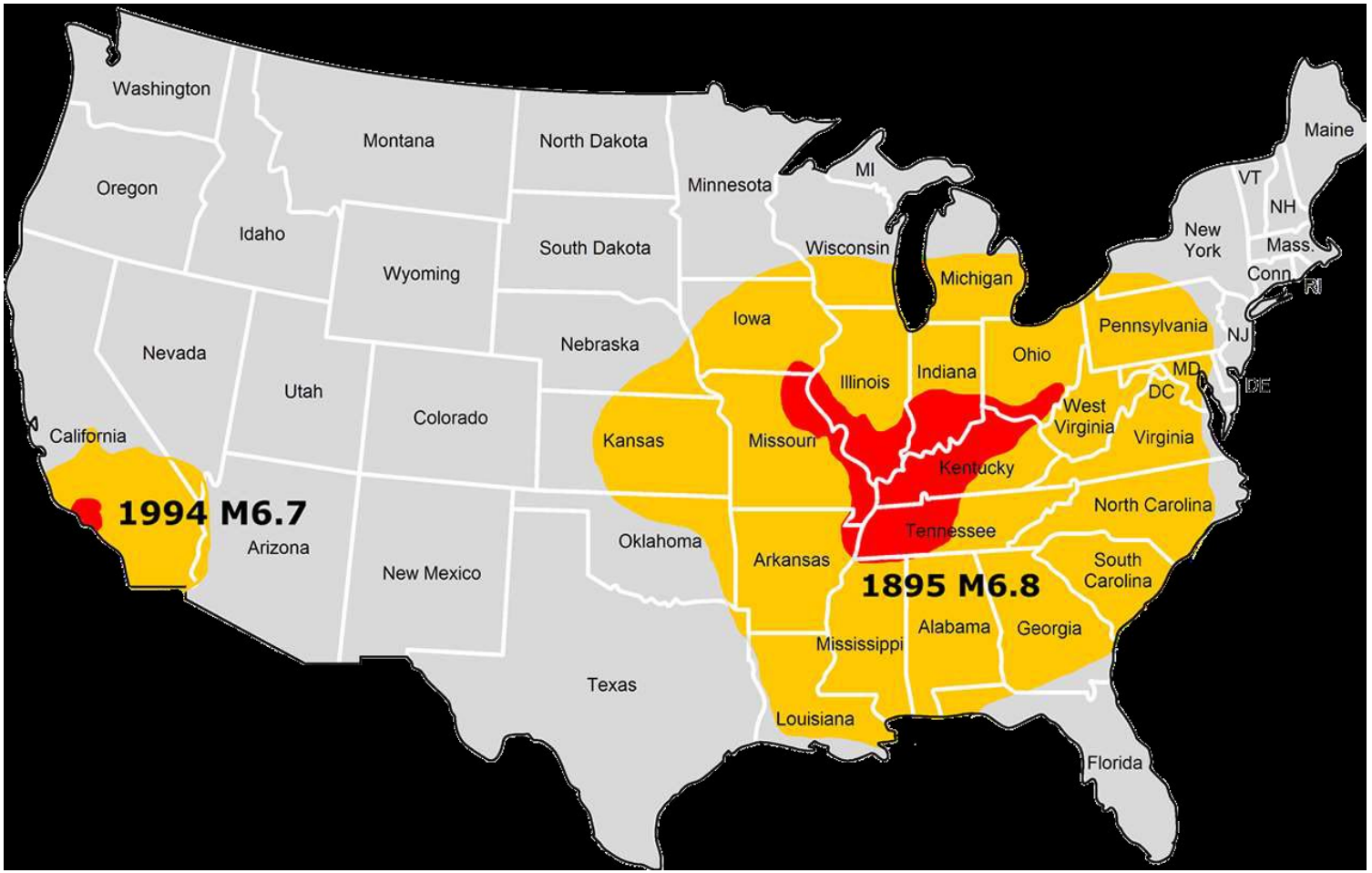
Earthquakes occur without warning

What are the odds?

25-40% chance of M6 or larger in 50 years

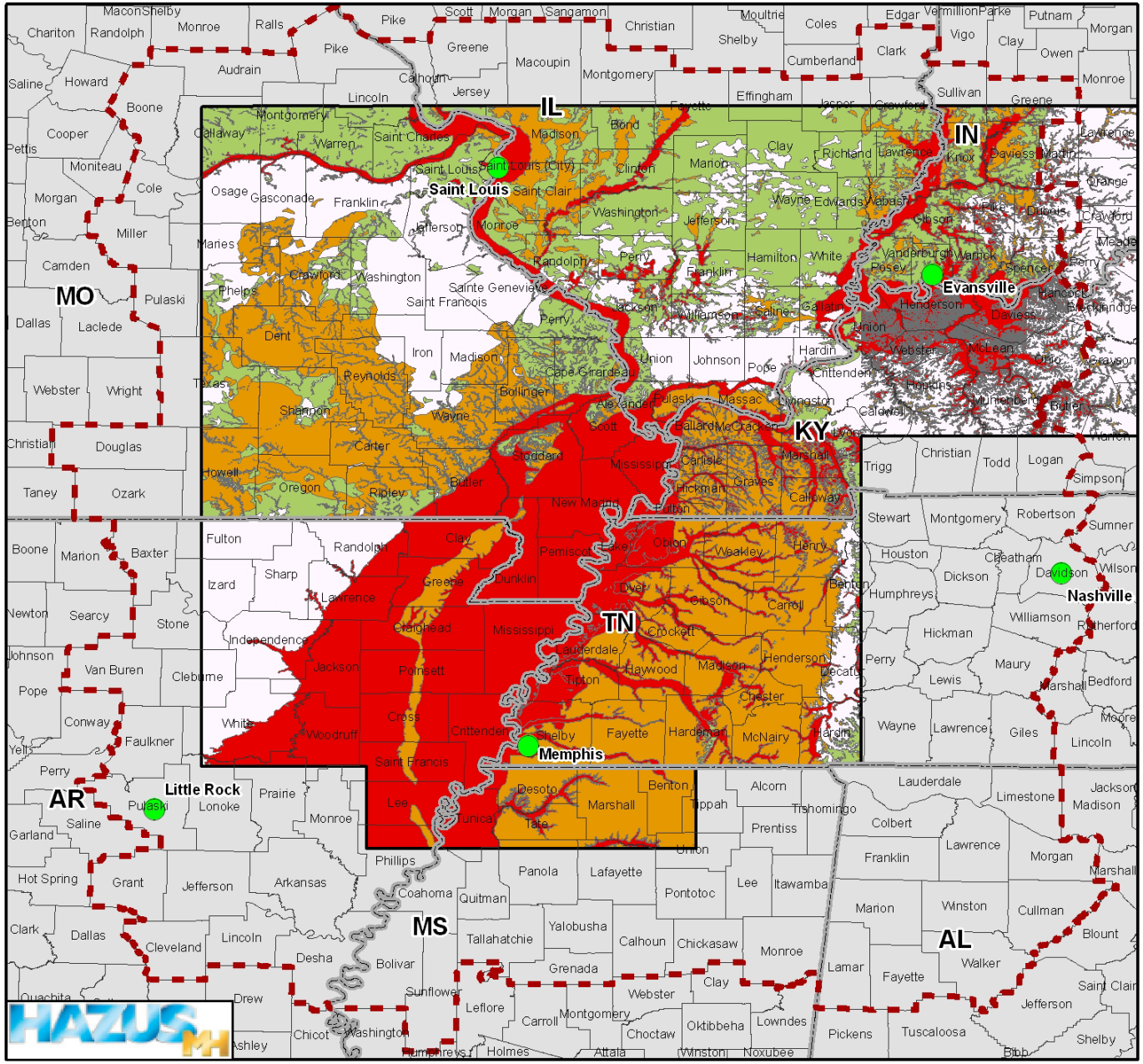
7-10% chance of M7 or larger in 50 years

For similar magnitude earthquakes, shaking area is about 10 times greater in the central and eastern U.S.




AZC590

Liquefaction Susceptibility - Earthquake Scenario: New Madrid Region



New Madrid Scenario
Magnitude 7.7

Liquefaction Susceptibility

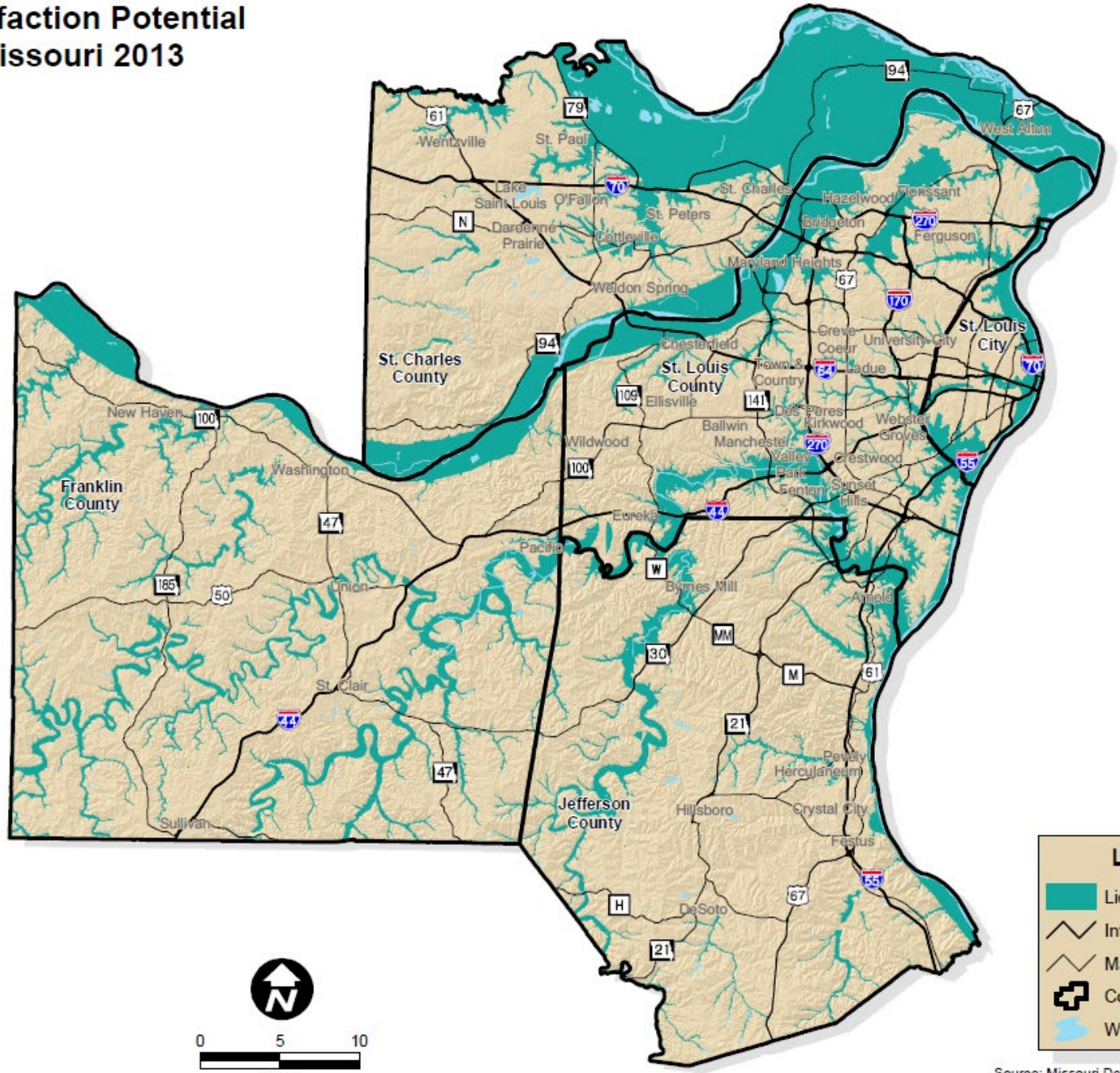
- None
- Very Low
- High
- Very High
- Major Cities
- Study Region Boundary
- County Boundaries
- State Boundaries

N

0 25 50 100 Miles

Location Map

Liquefaction Potential
Missouri 2013



LEGEND

- Liquefaction Potential
- Interstate Highways
- Major Roads
- County Boundaries
- Water Area

0 5 10
Miles

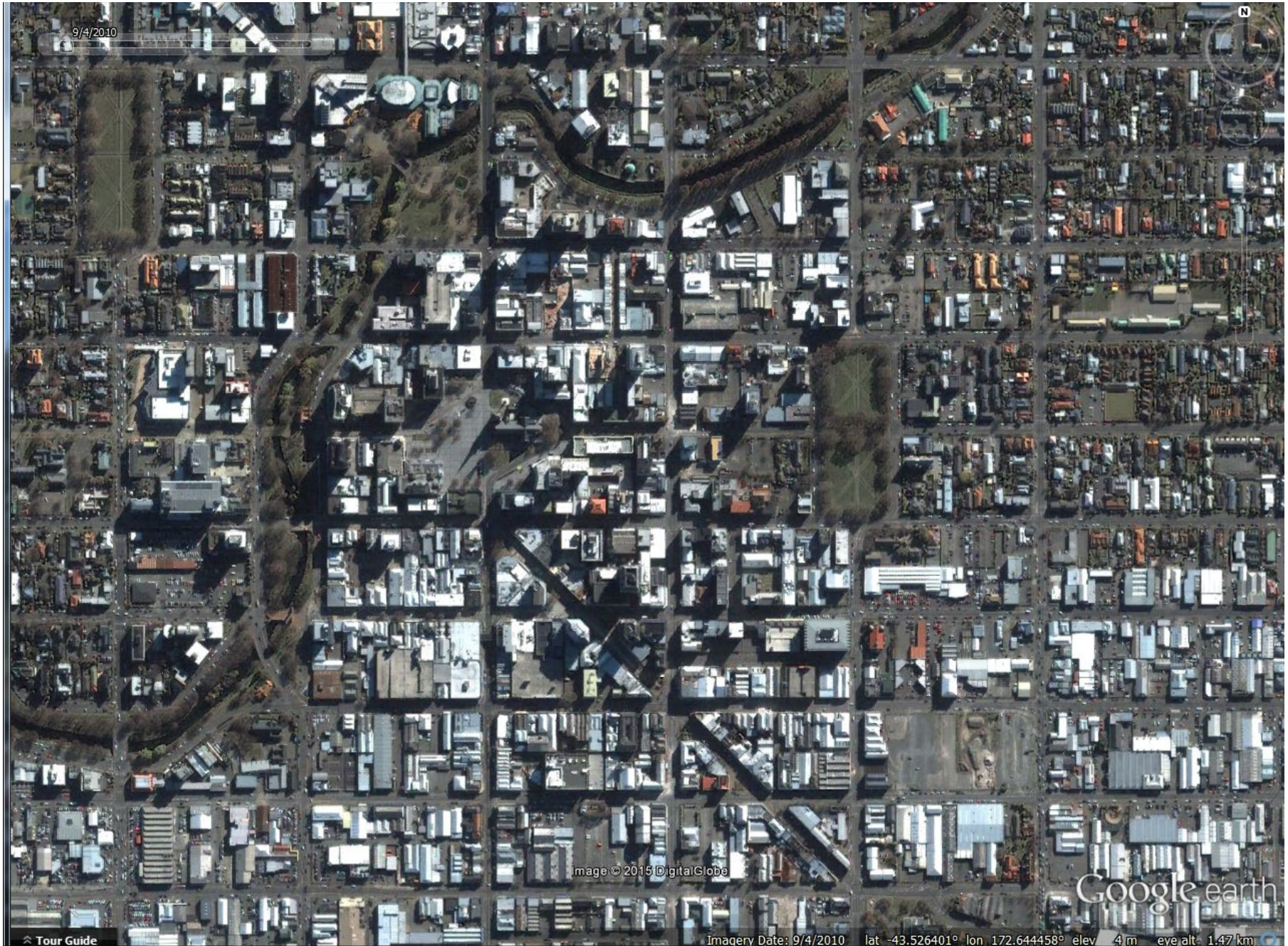
EAST-WEST GATEWAY
Council of Governments
Creating Solutions Across Jurisdictional Boundaries

January 2015

Source: Missouri Department of Natural Resources; East-West Gateway


P
Authorised Construction Zone Vehicles Only

Christchurch in 2010 - before the earthquakes



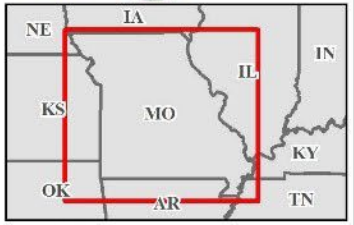
Christchurch in 2014 - after the earthquakes

Earthquake insurance

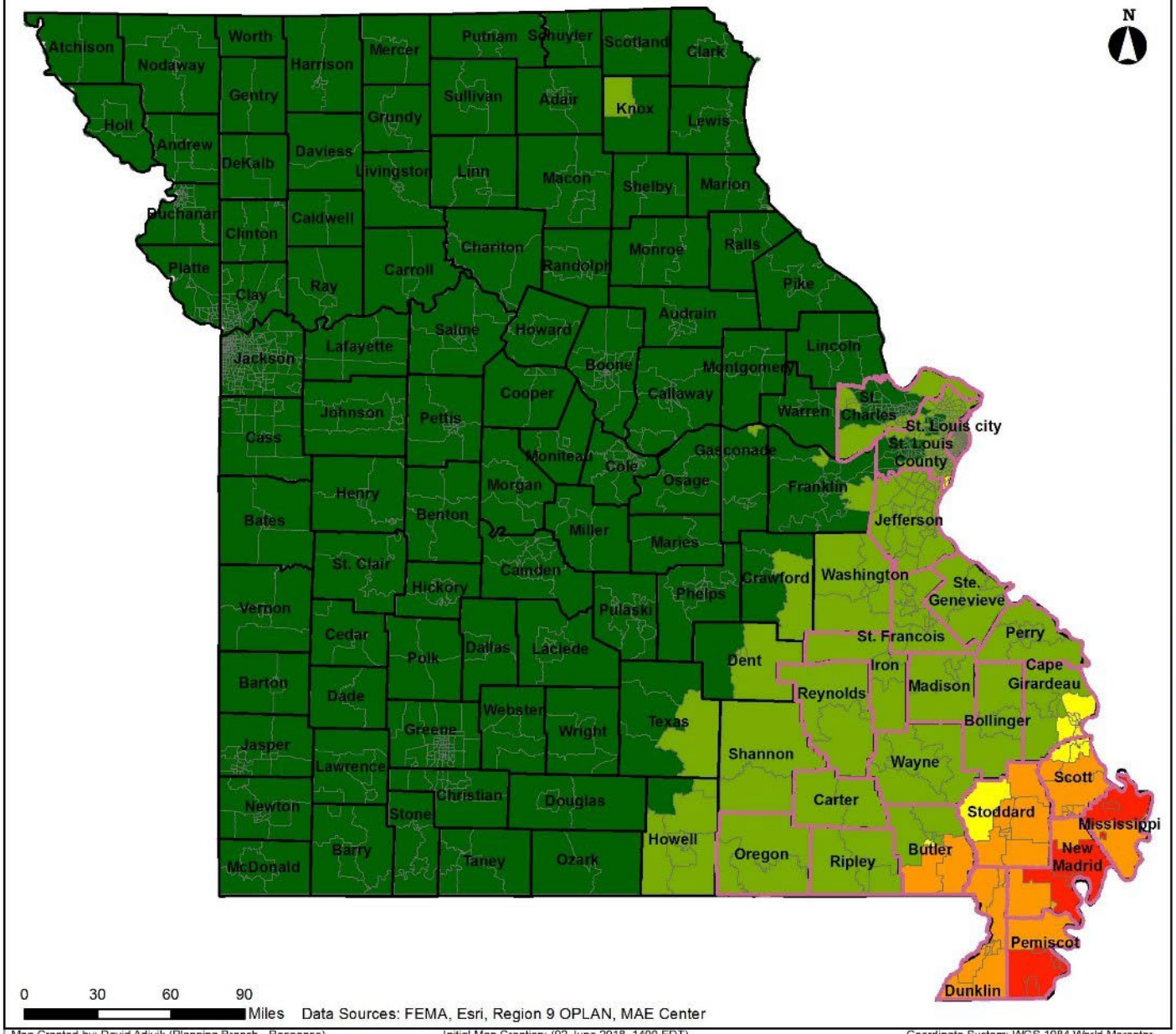
- Most homeowners DO NOT have it
  - **Only 12.7% in NMSZ in Missouri**
- Must be purchased separately – called an "endorsement"
- Prices and deductibles have increased, especially in high-impact areas
- Check with your insurance agent

Missouri Expected Shaking Intensity

SEMA FEMA



Data Layer / Map Description:
Overview of the area affected by the event.



Legend

- X - Extreme
- IX - Violent
- VIII - Severe
- VII - Very Strong
- VI - Strong
- Impacted Area

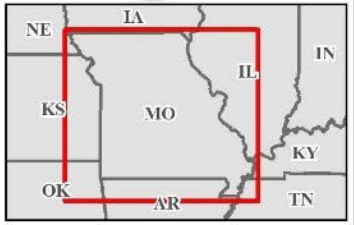
Based on a M7.7 quake centered in the Missouri Bootheel. Produced by FEMA in 2018 based on MAE Center 2009 data.

Map Created by: David Adjuik (Planning Branch - Response)
Initial Map Creation: (02 June 2018, 1400 EDT)
Coordinate System: WGS 1984 World Mercator

Shaking Intensity 6

Missouri Expected Shaking Intensity

SEMA FEMA



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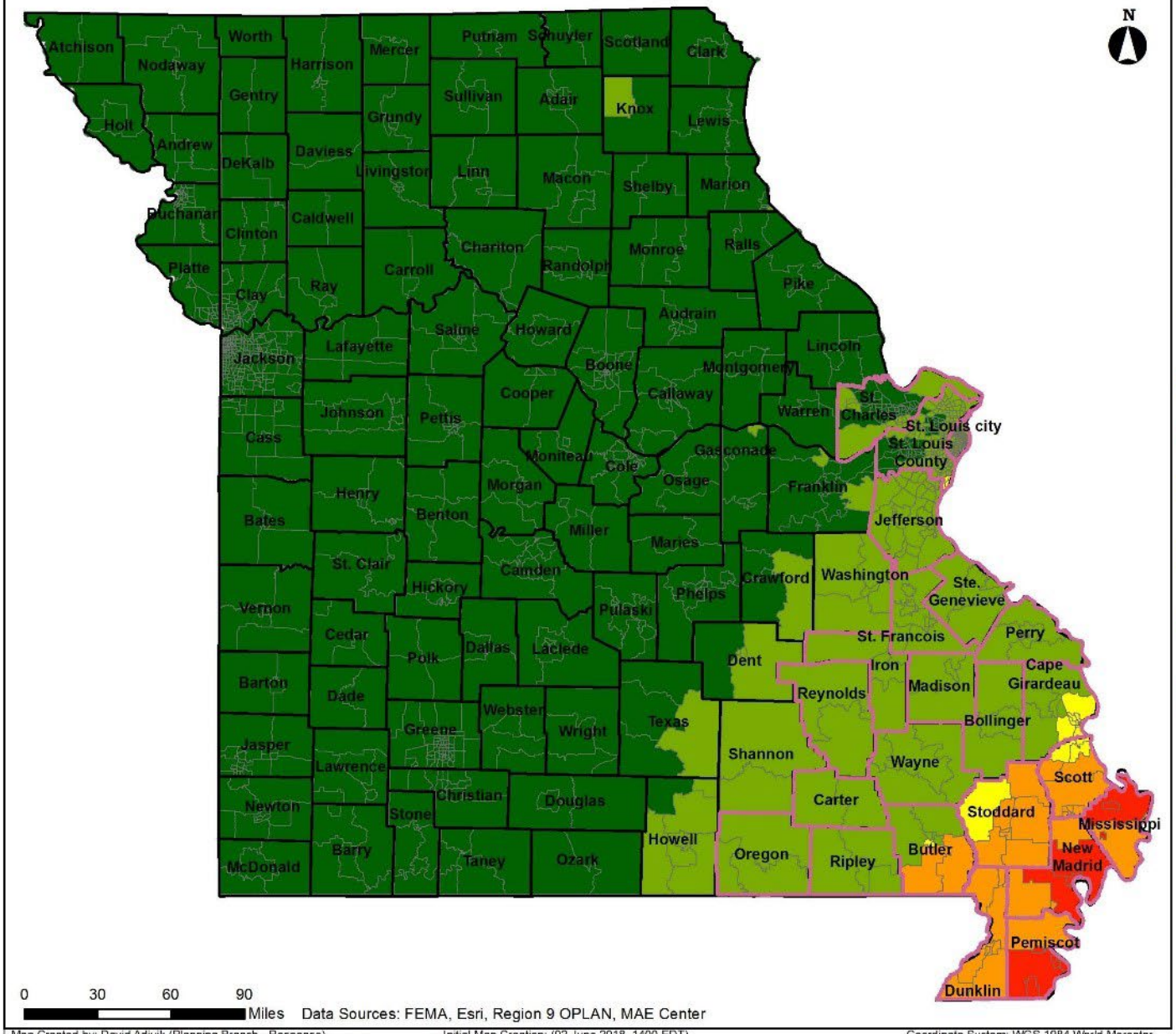

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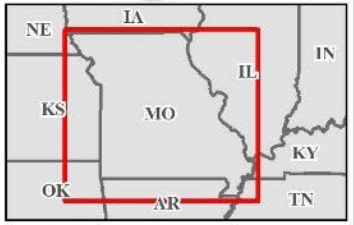
Shaking Intensity 7

Missouri Expected Shaking Intensity

SEMA FEMA



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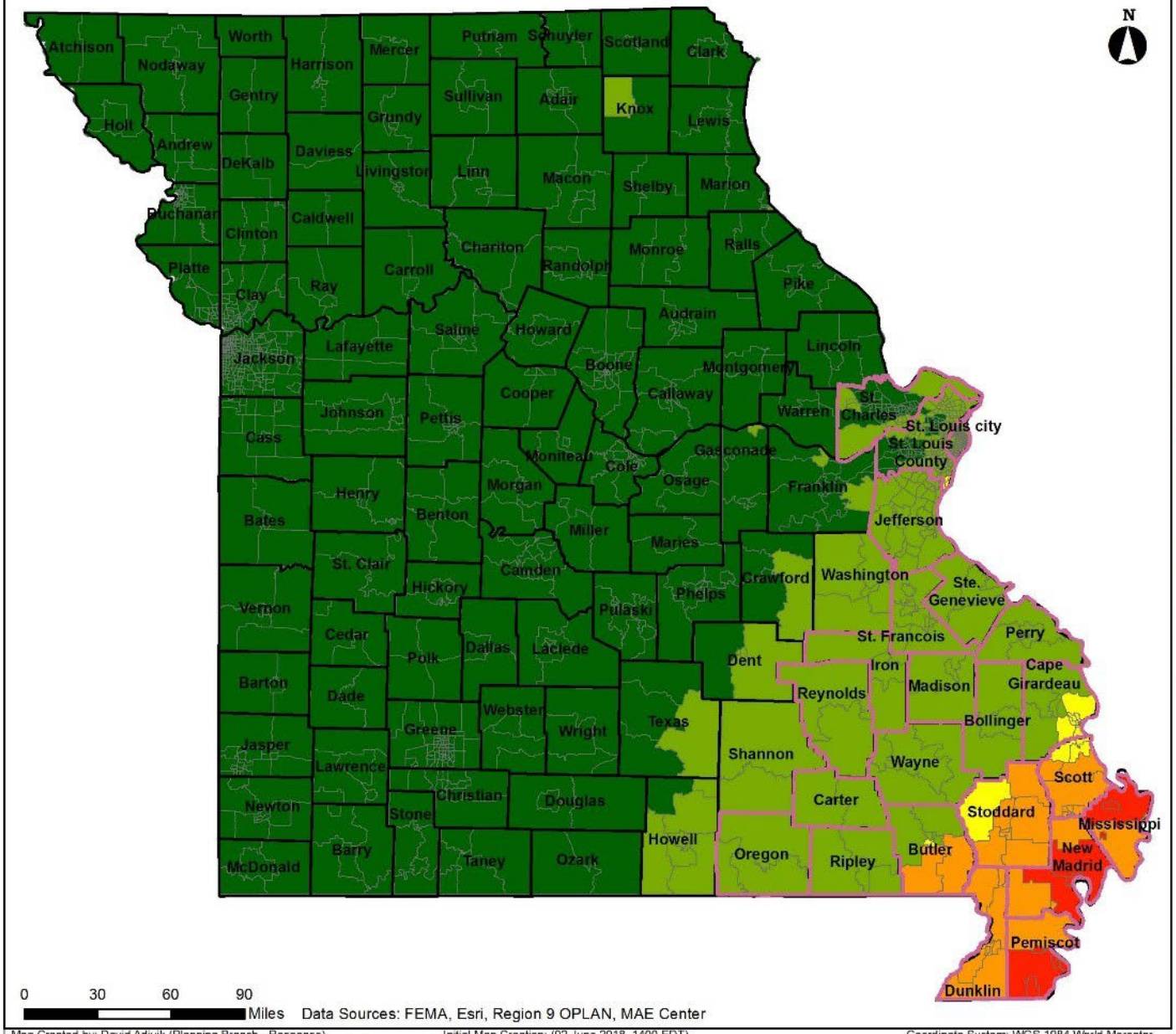

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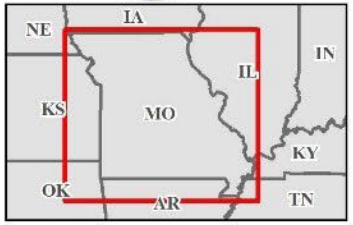
Shaking Intensity 8

Missouri Expected Shaking Intensity

SEMA FEMA



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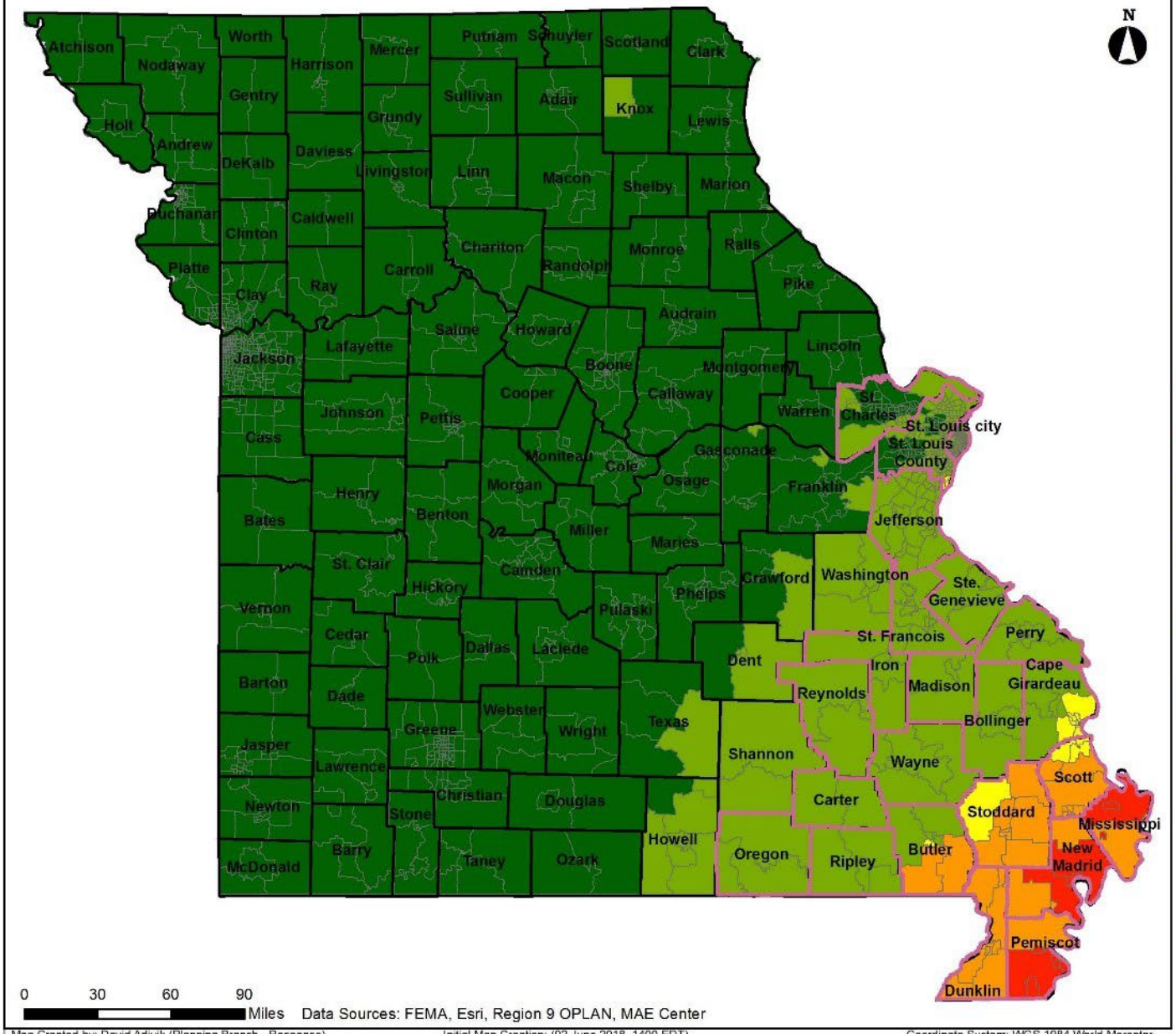

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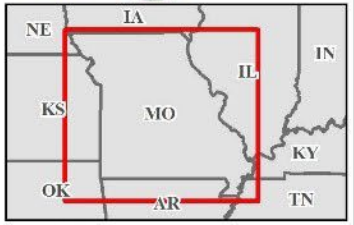
Shaking Intensity 9

Missouri Expected Shaking Intensity

SEMA FEMA



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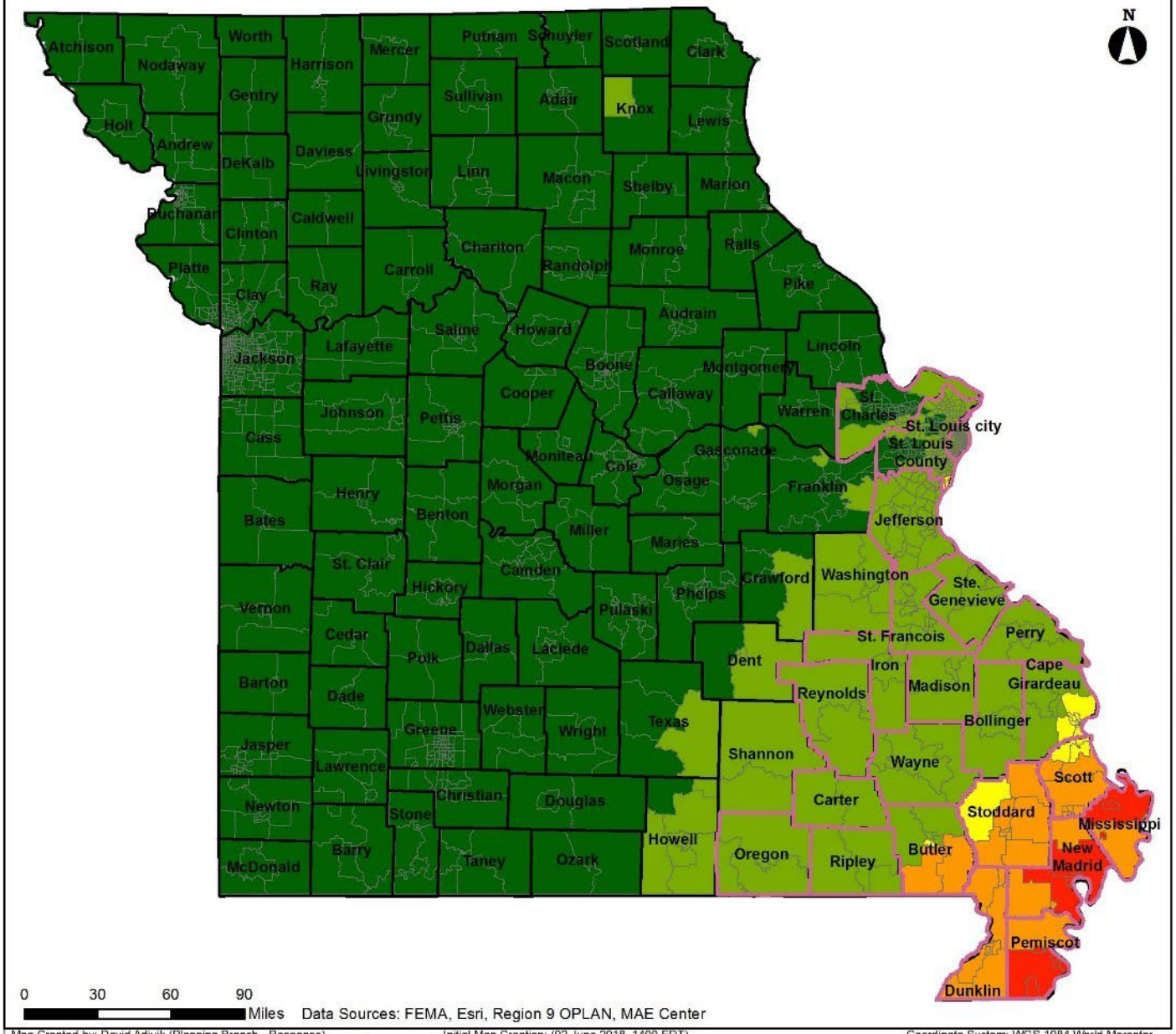

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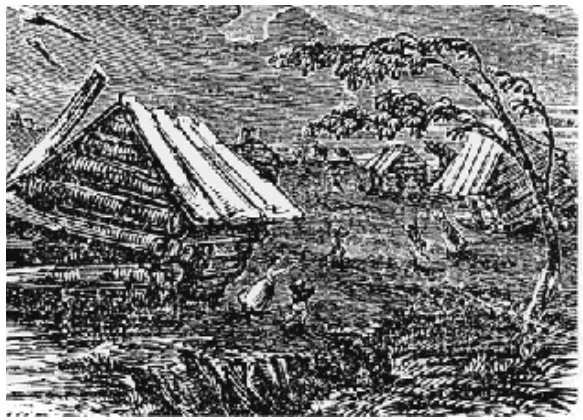
Shaking Intensity 10+

- Fault uplifted downstream land surface
- Natural dam
- Backflow created Reelfoot Lake
- Channel soon reclaimed

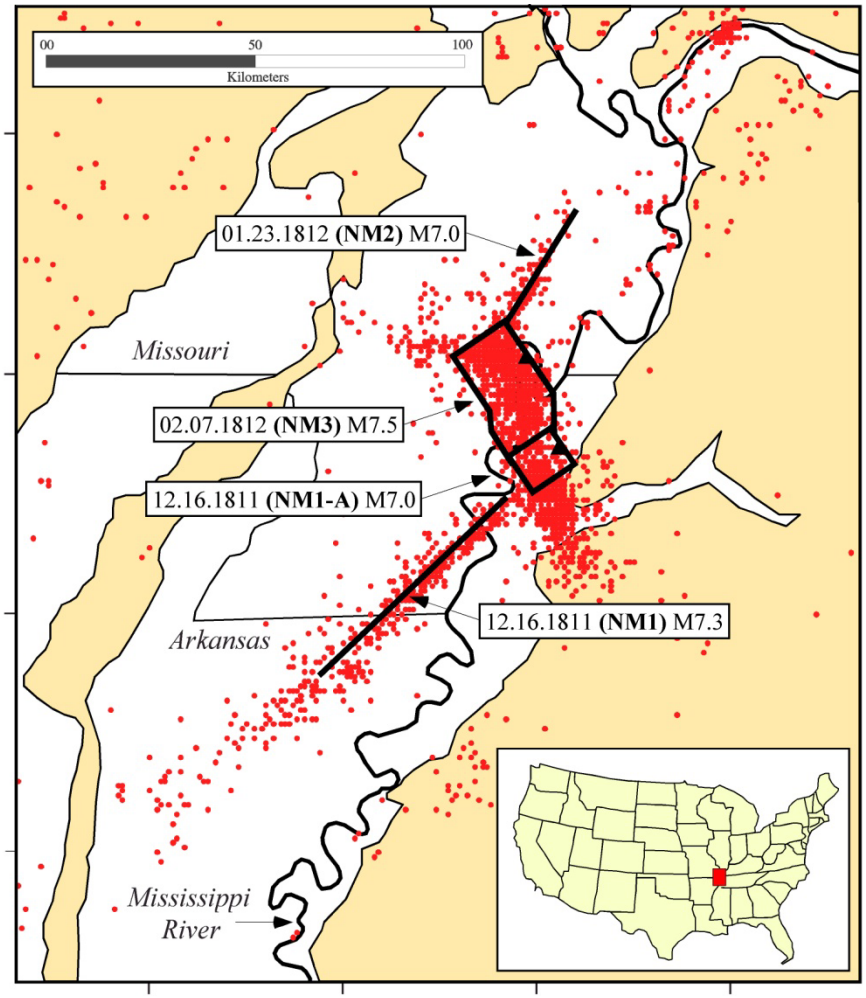
• Evidence still visible today

1811-1812 New Madrid Sequence



Four M>7.0 earthquakes:

Dec. 16, 1811 (2:15 AM)
Dec. 16, 1811 ('dawn')
Jan. 23, 1812 (9:00 AM)
Feb. 7, 1812 (3:45 AM)



Source: J. David Rogers, Ph.D., P.E., P.G.
Missouri University of Science & Technology

Estimated 8 State Impact

HAZUS Report based on a 7.7 M earthquake occurring in the New Madrid Seismic Zone

Casualties	
Injuries	82,269
Fatalities	3,496

Infrastructure Damages	
Buildings Damaged	713,200
Bridge Damage	3,547
Airport Facility Damage	143
Port Damage	232
Railway Bridge Damage	29
Damage to Dams	327
Damage to Levees	96
Hazmat Facility Damage	253
Debris Generated (tons)	50 million

Critical Facility Damages	
Hospitals	129
Schools	1,322
Fire Stations	729
Police Stations	379

Impacts (Day 1)	
Households w/out Power	2.6 million
Households w/out Water	1.1 million

Economic Losses	
Buildings	$113 billion
Transportation	$11 billion
Utilities	$172 billion
Total	*$296 billion*

Source: MAE Center Report 09-03, Oct. 2009

Other Costly Disasters

1994 – Northridge, CA Earthquake

$42 billion 60 deaths

2005 – Hurricane Katrina

$108 billion 1,800 deaths

2011 – Christchurch, NZ Earthquake

$26 billion 181 deaths

2012 – Superstorm Sandy

$50 billion 286 deaths

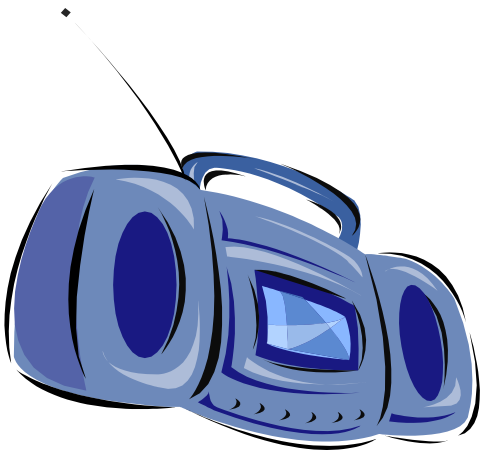
Estimated Missouri Impact

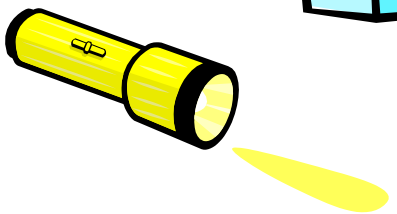
- 1,100 hospital beds in SEMO, only 80 available
- 200 schools in SEMO, most unusable for school or shelter
- 1,000 bridges damaged, inc. 500 impassable
- 310,000 households without power
- 124,000 households without water
- 14,000 injuries
- 700 fatalities

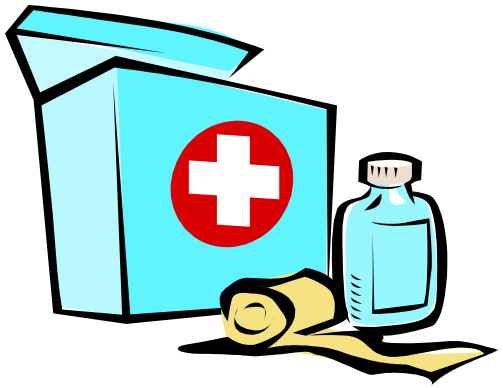
Source: MAE Center Report Volume II part 2, Oct. 2009

Prepare BEFORE an earthquake happens

- Put together an emergency kit – flashlight, first aid kit, radio, drinking water, blankets
- Develop a family communication plan – identify a relative living at least 100 miles away; everyone can call to "check in" to tell family you're safe
- Secure water heater, tall furniture, move heavy objects to lower shelves
- Know how to turn off utilities







How to Protect Yourself During an Earthquake

- If inside, stay inside!
- If outside, stay outside!

- **Drop** to the floor
  - before the earthquake drops you!

- Take **Cover**
  - under a sturdy desk or table
  - Or get down next to a wall and cover your head with your arms

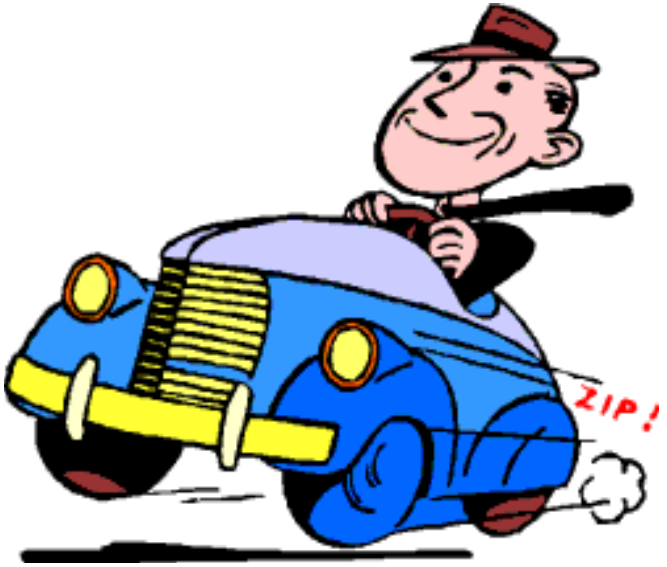
- **Hold On** to it firmly
  - Be ready to move with it until the shaking stops.

An Insider's View:
The Loma Prieta Earthquake Revisited

Earthquake Engineering Laboratory

October 10, 2014

University of Nevada, Reno

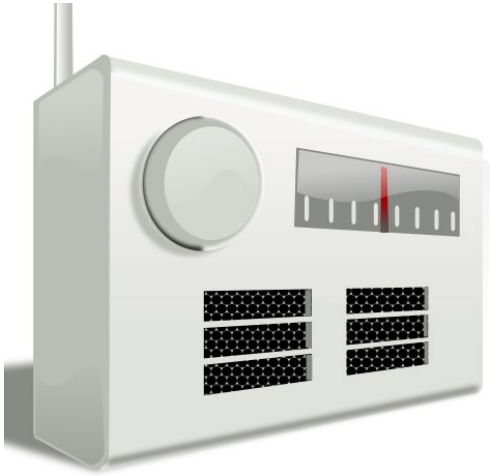


If you're driving, pull off the road, away from buildings and utility poles, and stay in your car.

If you're outside, drop to the ground, away from large objects, and cover your face and head with your arms.

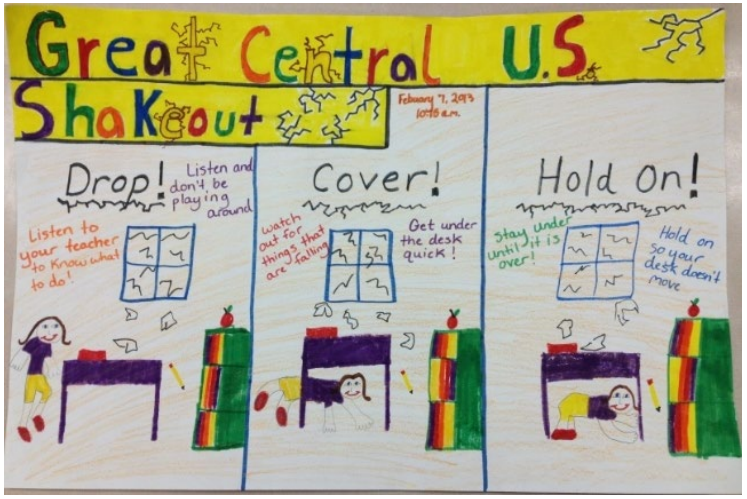
After the quake hits:

1. Find your family; check for injuries
2. If necessary, call 911 for help
3. If you smell gas or hear a hissing sound, go outside – shut off gas valve
4. Be careful to avoid live power lines and broken glass
5. Listen to news for latest emergency information
6. Be ready for aftershocks!

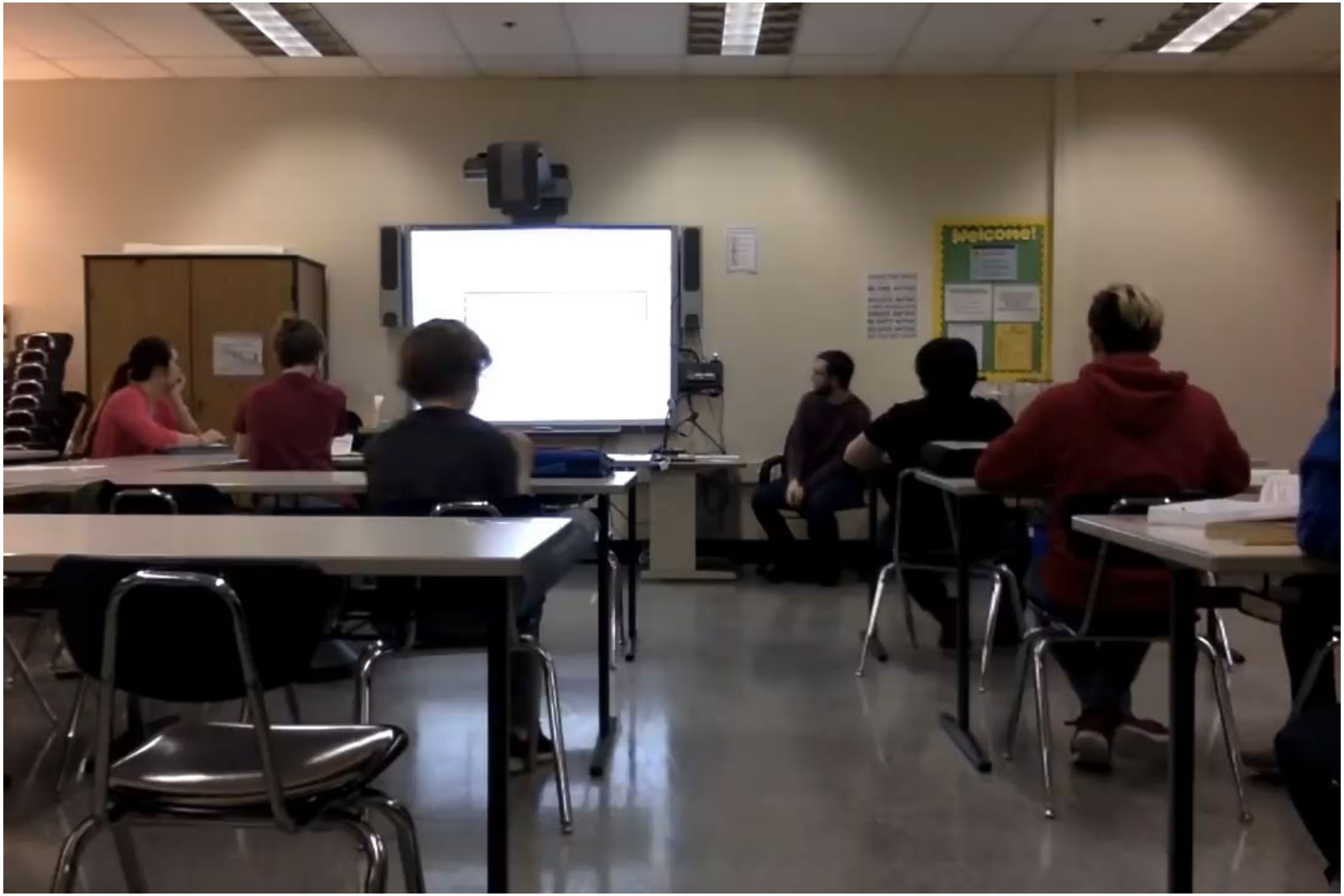


Great Central U.S. ShakeOut

- About 3 million people in 14 states participated in “Drop, Cover and Hold On” earthquake drill
- More than 500,000 participated in Missouri
- **Sign up at shakeout.org**



Anchorage, Alaska
November 30, 2018



Thank You!

- Jeff Briggs, Earthquake Program Manager
- Office: (573) 526-9232
- E-Mail: jeff.briggs@sema.dps.mo.gov