

# 2023 Joint Regional Response Team (RRT) 5 and 7 Spring Meeting

Presentation by:

Jim Wilkinson, CUSEC Executive Director

April 5-6, 2023

St. Charles, MO



# Presentation Overview

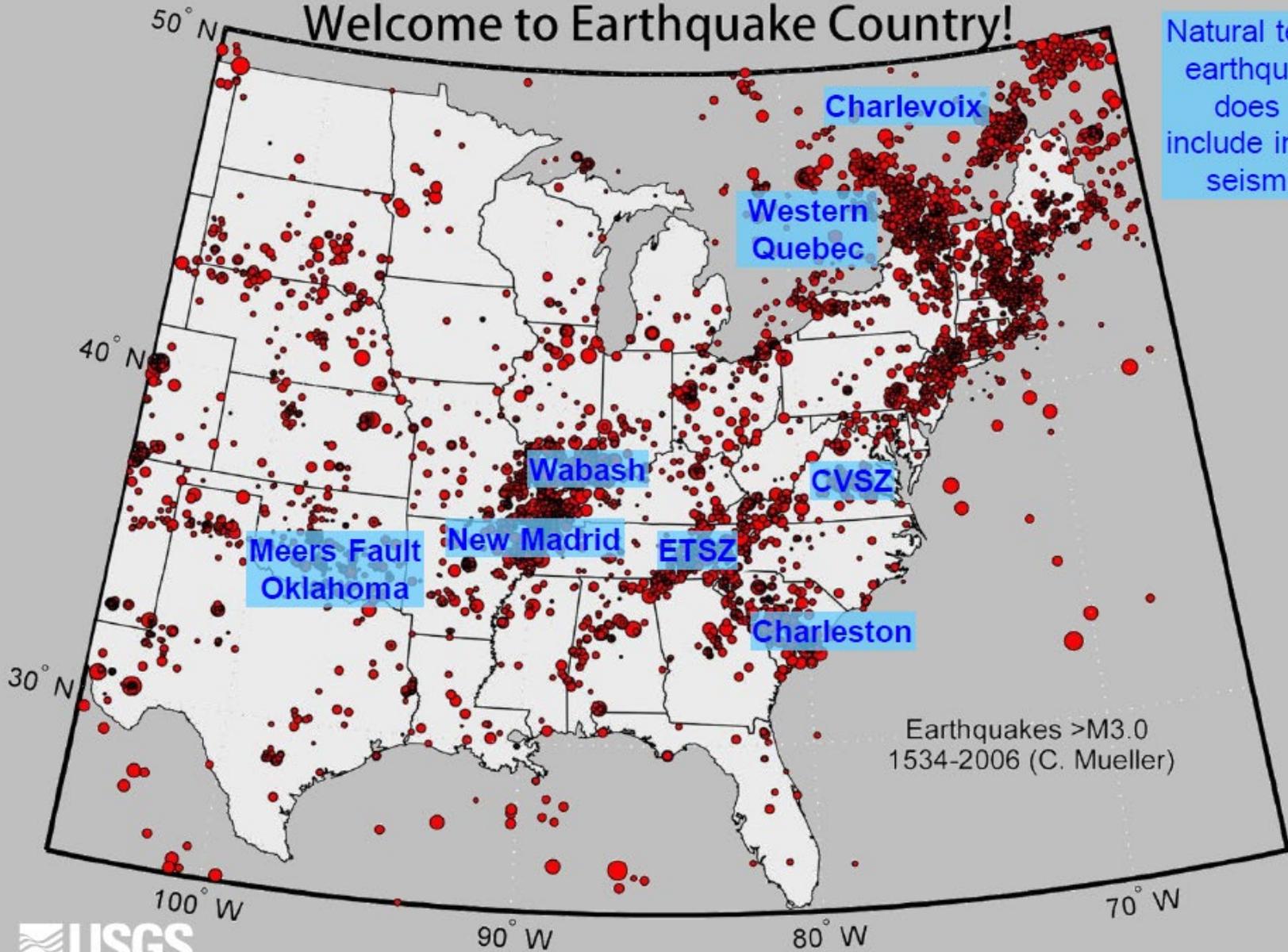
- Earthquake Hazard – Earthquakes occurring every day, which one will be the one?
- Seismic Risk –
  - Response Challenges
  - Long Term Recover
- Questions?

# Earthquake Hazard

- New Madrid Seismic Zone – Most active region east of the Rockies
  - Wabash Valley Seismic Zone
  - East TN Seismic Zone
  - Oklahoma, Kansas, Texas, - induced earthquakes
    - 2,130 earthquakes in the past year in OK
    - 88 earthquakes in the past year in Dallas, TX area
- NMSZ – starts about 35 miles north west of Memphis and extends into southern IL. – Is comprised of 3 segments
- NMSZ averages 150 – 200 earthquakes a year
- Largest area of *Liquefaction* in the world

# Welcome to Earthquake Country!

Natural tectonic earthquakes;  
does not include induced seismicity



# RESEARCH:

Large earthquakes in 1450 and 900 A.D.

The average time between the large earthquakes is about 500 years

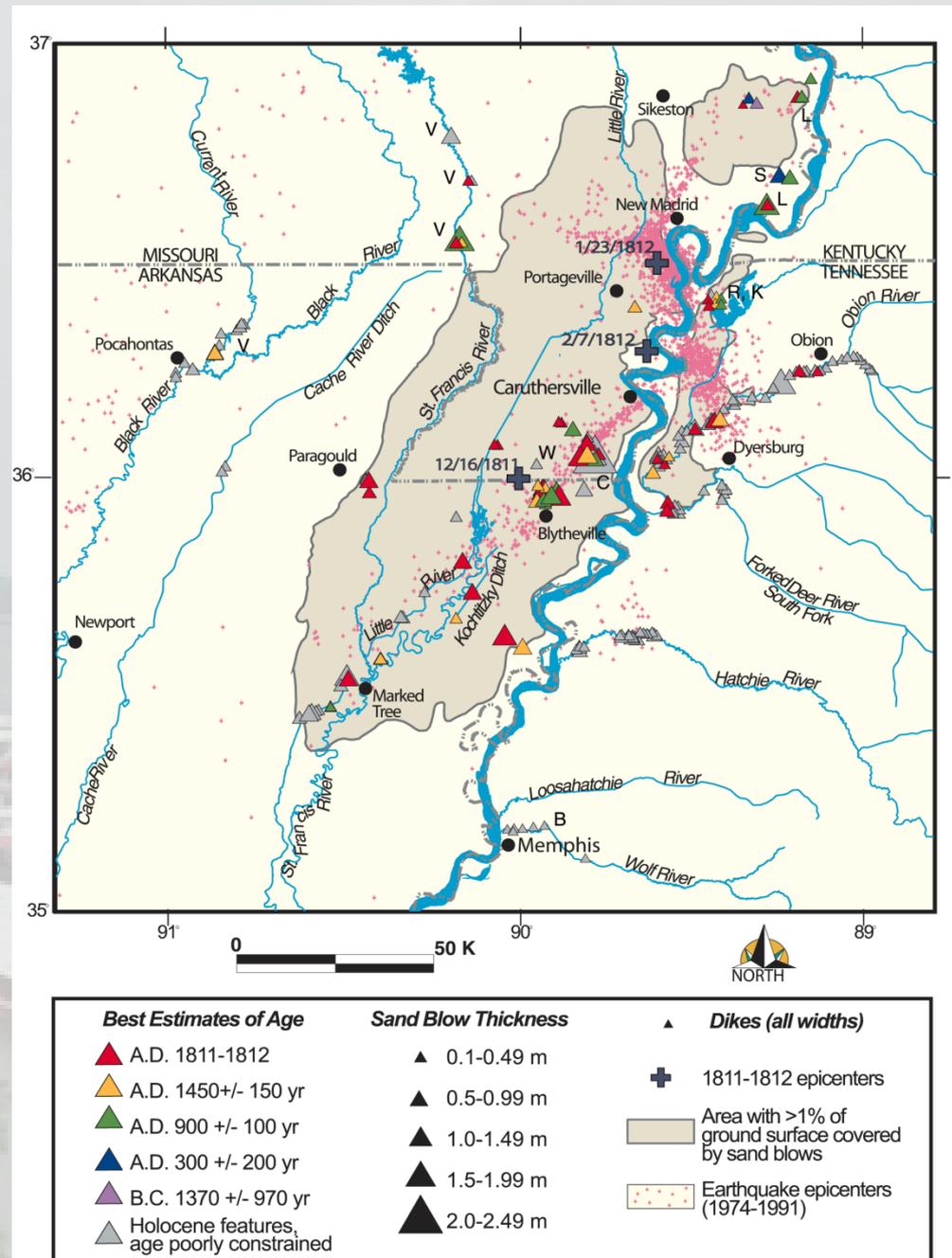
The prehistoric earthquakes were approximately the same size as the 1811-1812 earthquakes

Each may actually represent **sequence** of large earthquakes, as in 1811-1812

Dec 16, 1811

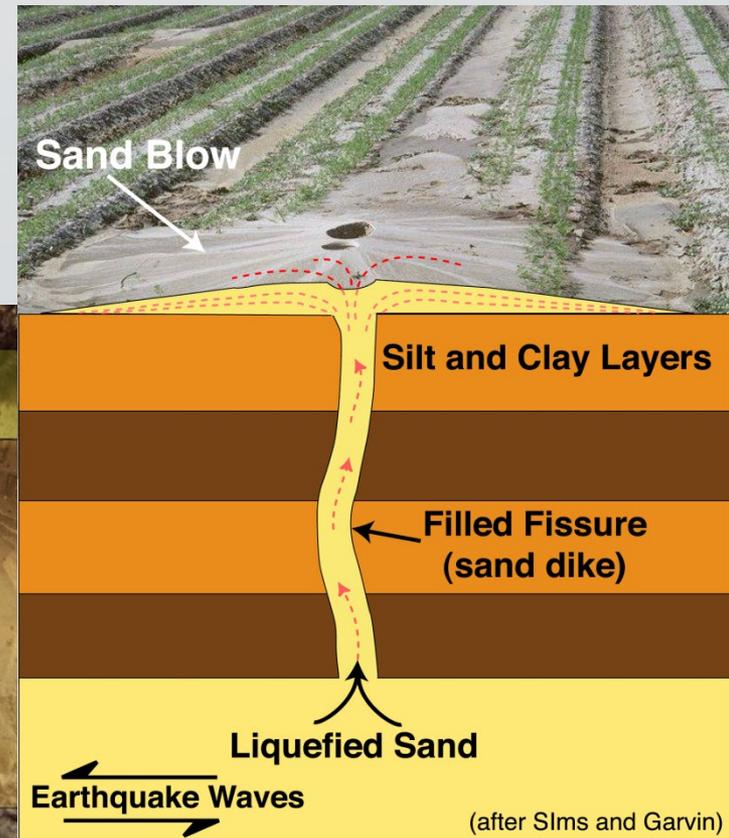
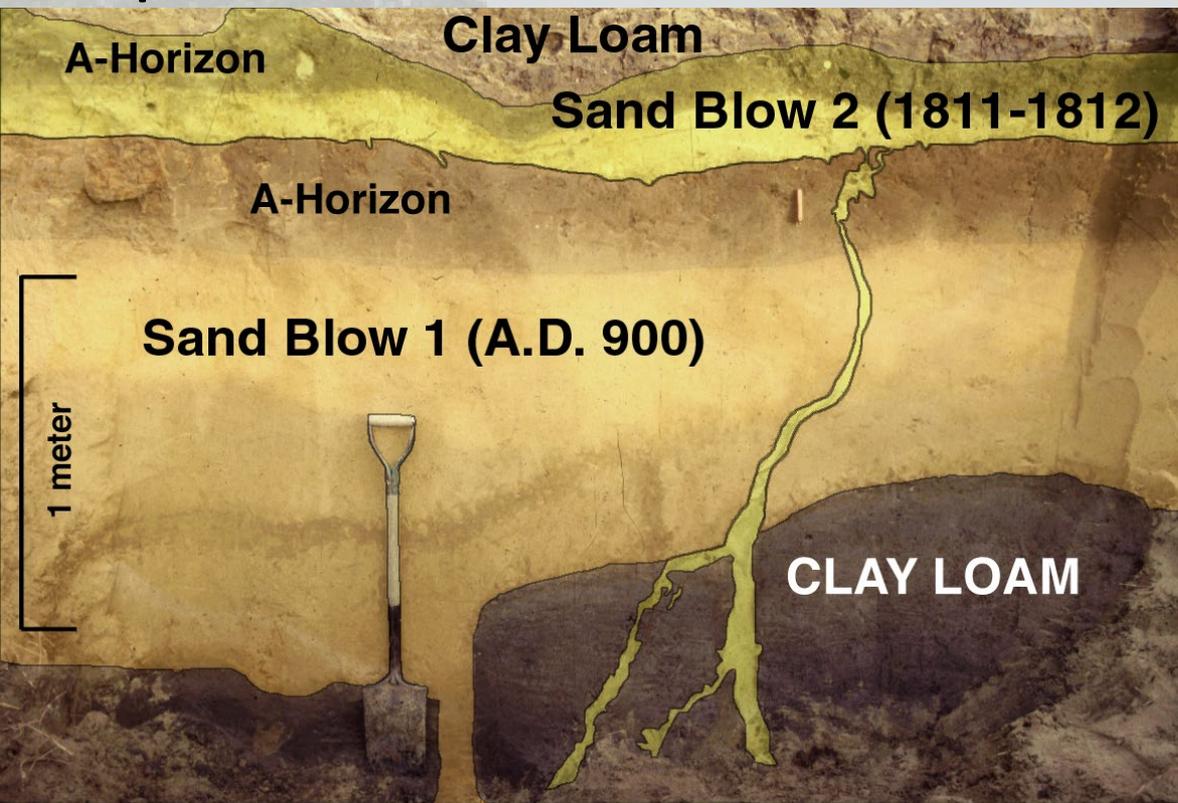
Jan 23, 1812

Feb 7, 1812



# How Do Researchers Determine Past Events When you Can't See the Fault?

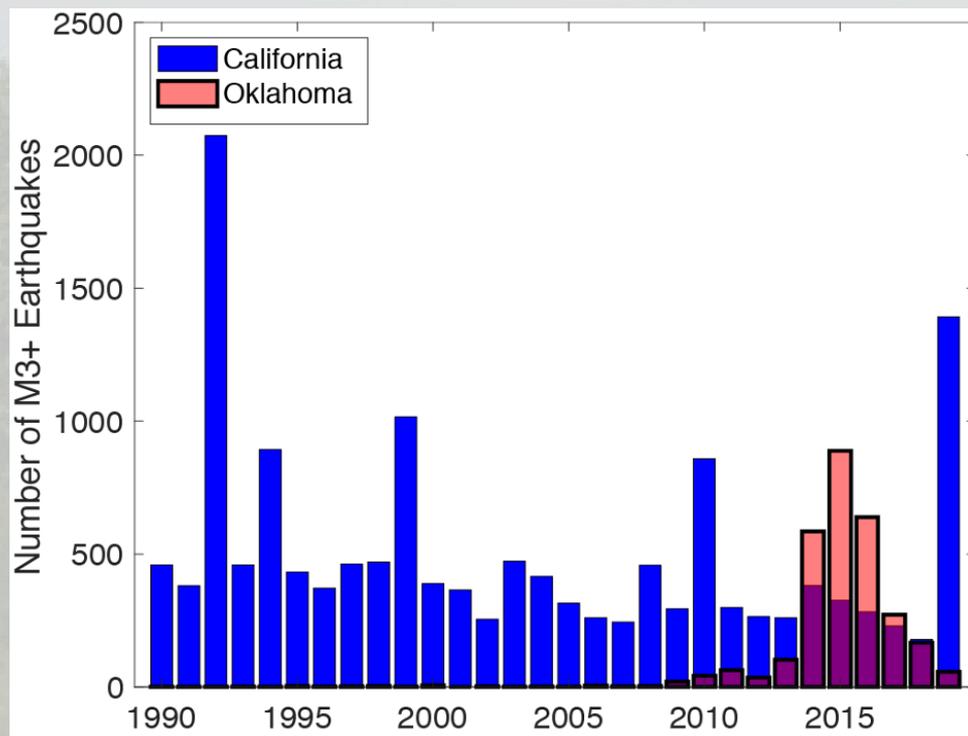
## Liquefaction



# Large area susceptible to liquefaction



# Induced Earthquakes



Sources/Usage: Public Domain

Bar graph showing the number of M3+ Earthquakes in Oklahoma vs California from 1990 to 2019.

- Can occur anywhere in the U.S. that geologic conditions support
- 1960's Rocky Mountain Arsenal Denver Colorado
- Jan 4, 2016 5.0 Cushing, OK 5.0 destroyed 14 homes and injured two
- Sept 3, 2016 Pawnee 5.8 Damage recorded 300 miles away in Kansas

# Secondary Hazards

- Landslides
- Liquefaction
- Disruption of ground water supplies
- Changes to river channels
- Hazardous Materials Release
- Localized flooding
- Fire
- Ground displacement – lateral spreading

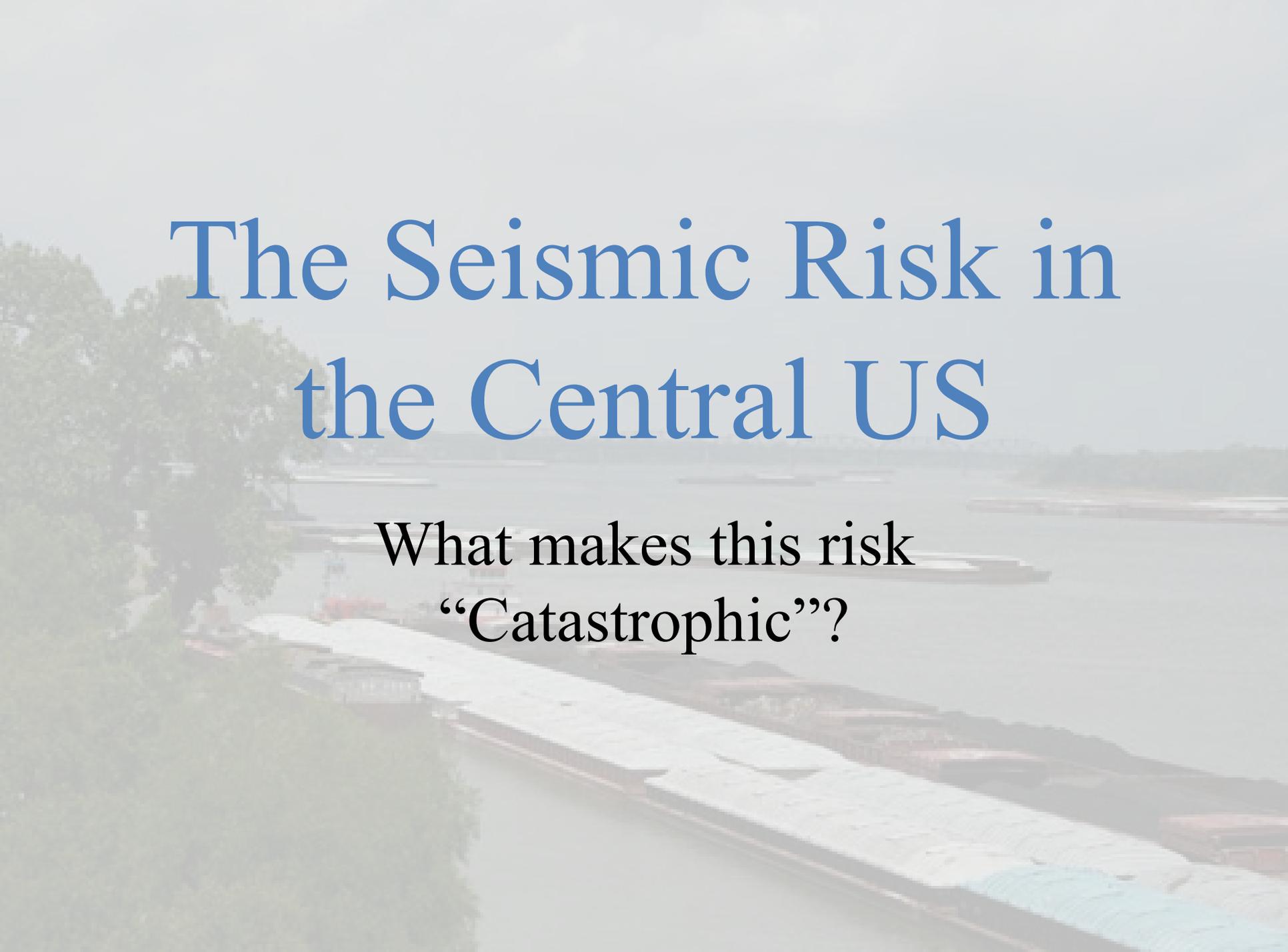
# What Makes the Central US Unique Geologically?

- Low reoccurrence interval but high impact
- Large area of unconsolidated soils
- Felt/impact area can be 20 times larger than similar events in the western U.S.
- 1811/12 type earthquakes occur in clusters
- Large area susceptible to liquefaction

# So what does all this mean in terms of earthquake probabilities?

- Magnitude  $\sim 7.5 - 8.0$   
(similar to 1811-1812)  
Approximately 7-10%  
Low probability, high consequence
- Magnitude 6.0 or greater  
(similar to 1843 Marked Tree, AR and 1895 Charleston , M0)  
Approximately 25-40%  
Higher probability, still significant impacts

**Broad agreement in earth science community that NMSZ continues to pose significant and ongoing hazard**



# The Seismic Risk in the Central US

What makes this risk  
“Catastrophic”?

# Problems on a Good Day – *What if...*



Lance Murphy – Commercial Appeal Photographer



J. Wilkinson CUSEC

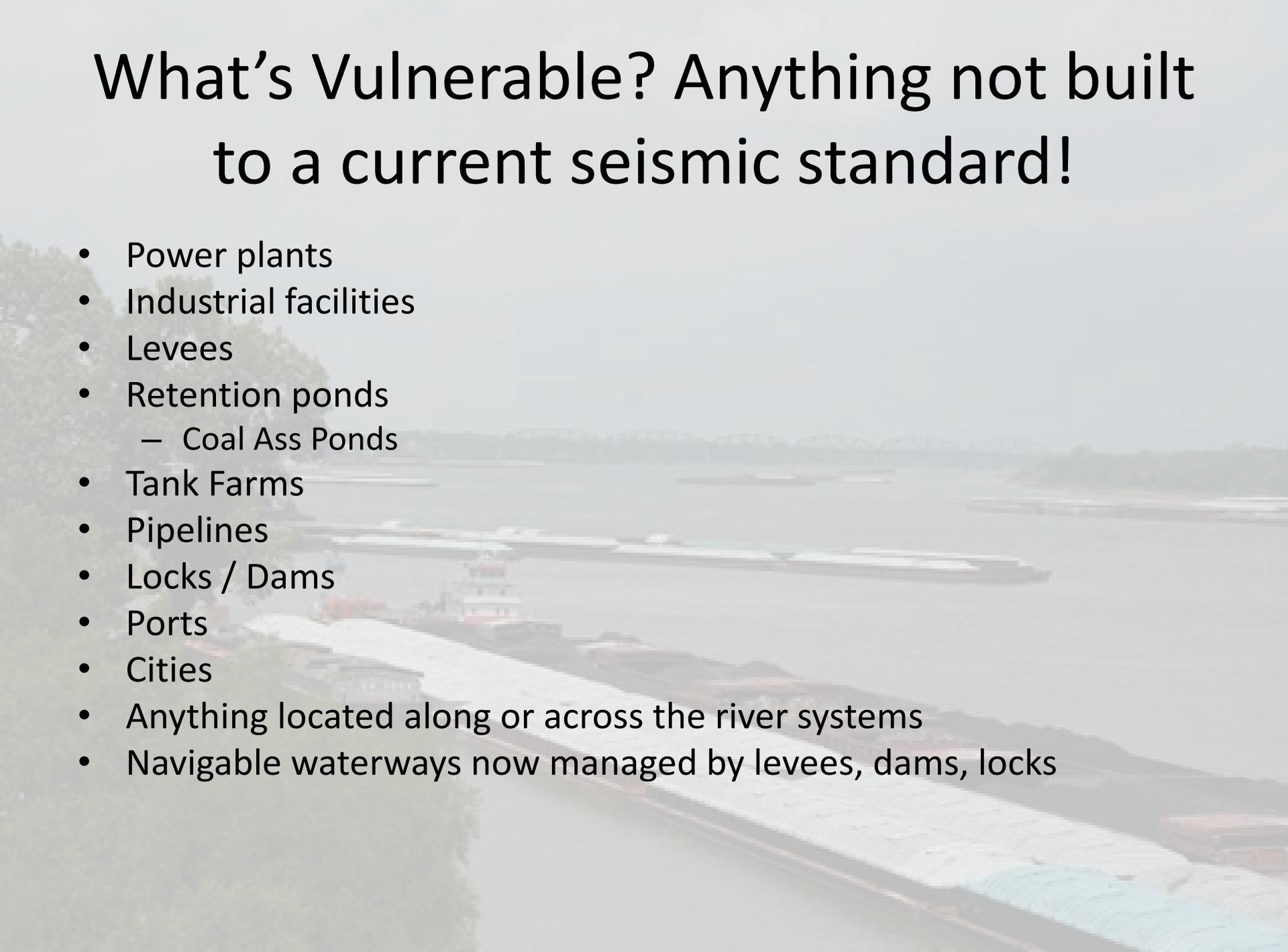


Wikipedia



J. Wilkinson CUSEC

# What's Vulnerable? Anything not built to a current seismic standard!

- Power plants
  - Industrial facilities
  - Levees
  - Retention ponds
    - Coal Ass Ponds
  - Tank Farms
  - Pipelines
  - Locks / Dams
  - Ports
  - Cities
  - Anything located along or across the river systems
  - Navigable waterways now managed by levees, dams, locks
- 

# River Systems of 1811 are vastly different from today



H. Bosse, draughtsman with the Corps of Engineers, 1883-1891. (*U. S. Army Corps of Engineers, St. Paul District*)

- Still a major transportation corridor
- Navigational and control systems are now critical elements
- Industrial / commercial / community developments increase associated risk



Friends of the Mississippi River (FMR)

# Damage to Ports



USGS/EERI Haiti EQ Damage report



FEMA photo



# Damage to Industrial Sites Along Major Rivers Will Result in Secondary Hazards



A number of factories were severely damaged in Sendai, northern Japan *Image: AP*



EPA Office of Water (4608T) | EPA 810-B-18-001 March 2018

Photo - Rick Loomis/ Los Angeles Times



Figure 9. Spilled oil inundated a refinery area in Sendai at the 1978 Miyagi Earthquake (Courtesy of Kahoku Simpo Publishing Co.)

# Rivers are going to be choked with debris



Man made debris - I-35 bridge



Photo credit: Mark Moran Noxen, Pennsylvania



North Shore Emergency Management

Up and Downstream of the Impact zone will become a parking lot



# Upstream from Impact Area

- Management of river traffic
  - Mooring of excess number of vessels unable to go downstream
  - Normal operation of vessels operating in area
  - Response vessels
- River Navigation
  - River's infrastructure is deteriorating.
  - Backlogged maintenance costs at more than \$1 billion. Should any lock or dam fail long-term, it could create havoc for U.S. commerce.
  - In 2013, the American Society of Civil Engineers gave America's inland waterway system a grade of D minus for poor condition and frequent delays.
  - The Mississippi and Ohio river systems, two most vulnerable to an earthquake, account for a disproportionate number of delays.

# Downstream from Impact Area

- Management of river traffic
  - Vessels that would have been going up stream
  - Vessels operating in area
  - Response vessels
- Contaminates in the river
  - Hazardous materials
  - Debris
  - Large volumes of soil/silt – i.e. sandbars, islands, landslides,
- River channel conditions may be altered
  - River channel could shift
  - River depth subject to change

# Response Challenges

- Differing priorities / mandates
- Damage over a large geographical area
  - Multiple jurisdictions requesting aid
  - Differing needs / level of response needed
- Disruption to the infrastructure
  - Slows response
  - Restricts access
- Hazardous conditions
- Adjudication of resources -Just not enough to go around
  - Tents
  - Generators
  - Food/Water
  - Repair specialist

# Long Term Recovery Issues

- Legal Issues
  - Debris from I-35 bridge collapse in Minneapolis remained 3 years after the incident
- Design/Code Modifications
  - Flood control
  - Land use
  - Building
- Volume of Repairs / Reconstruction Projects
  - Limited resources
  - Limited labor
  - Lose of River Channels
  - Prioritization challenges
    - Bridges, levees, drainage/irrigation canals, locks
- Recovery will take decades to achieve

# To Summarize - What if it happened here today?

## 7.7M New Madrid Earthquake

### 8 State Perspective

- 7+ Million People
- 85,000 Injured
- 3,500 Deaths
- 2M Seek Shelter
- 3600 Bridges Damaged
- 700K Buildings Damaged
- 32K Buildings Collapsed
- \$300B Event
- 2.6M Households without electricity
- 1.1M without Water
- 1,500 USAR Teams needed – 28 currently
- Widespread Bridge, Dam and Levee damage
- What about cascading events?

# The Stage is Set for a Catastrophic Event

- High percentage of structures built without seismic considerations
  - High percentage of URM's
  - Building codes have only recently addressed the seismic hazard
- Last significant earthquake 1895 - 6.8
- Central US Serves as the Crossroads Of America
- Low level of understanding / belief

# Sources of Local Earthquake Technical Assistance

- Central U.S. Earthquake Consortium
  - Jim Wilkinson – [jwilkinson@cusec.org](mailto:jwilkinson@cusec.org), [www.cusec.org](http://www.cusec.org)
- Center for Earthquake Research and Information, Univ. of Memphis, USGS  
Central Regional Office Memphis, TN
  - [www.ceri.memphis.edu](http://www.ceri.memphis.edu), [www.usgs.gov](http://www.usgs.gov)

An aerial photograph of a wide river, likely the Mississippi, showing a long line of barges being pushed or pulled by a tugboat. The barges have various colored covers, including white and blue. The river is surrounded by green trees on the left and distant land on the right. The sky is overcast and grey.

Questions?