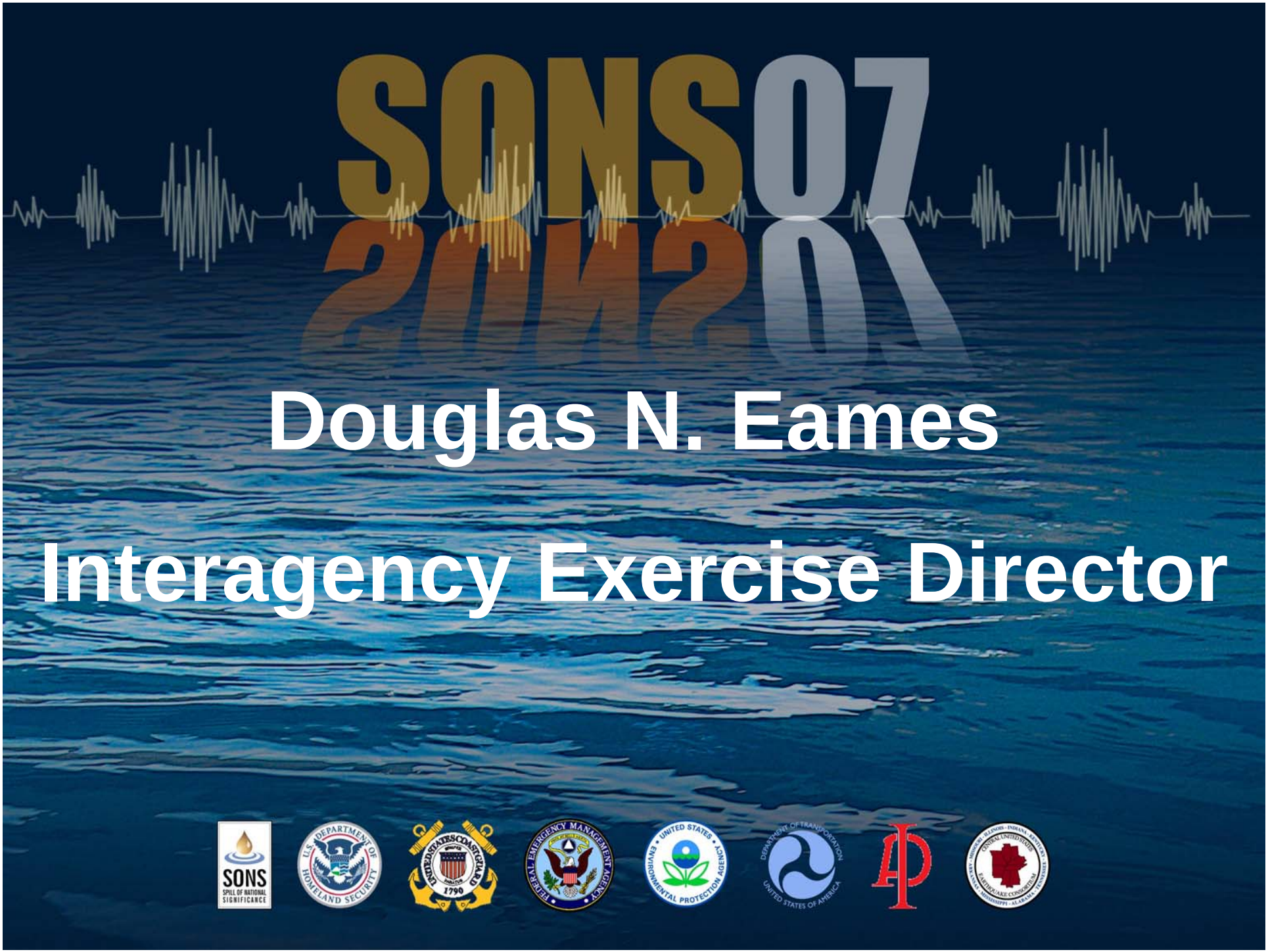


# What happened 200 years ago

**In 1811-1812 three earthquakes, magnitude 7.5-8.0, struck the Mississippi Valley; Thousands of aftershocks followed**

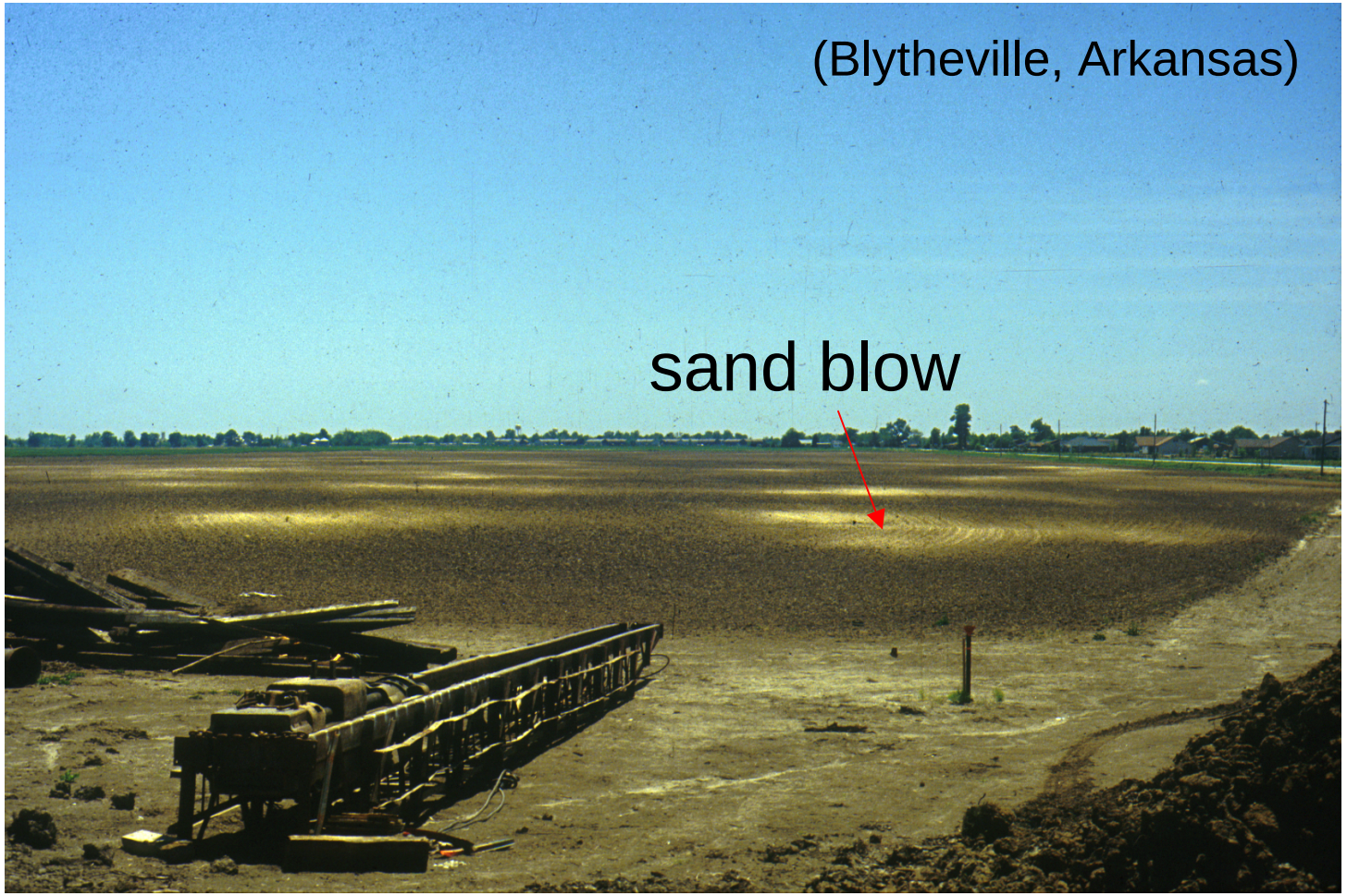
# Riverbanks caved

Riverbanks Falling In—Missouri River
Courtesy of the State Historical Society of Missouri,
Columbia, Mo.

# Vast tracts of land sank and were uplifted

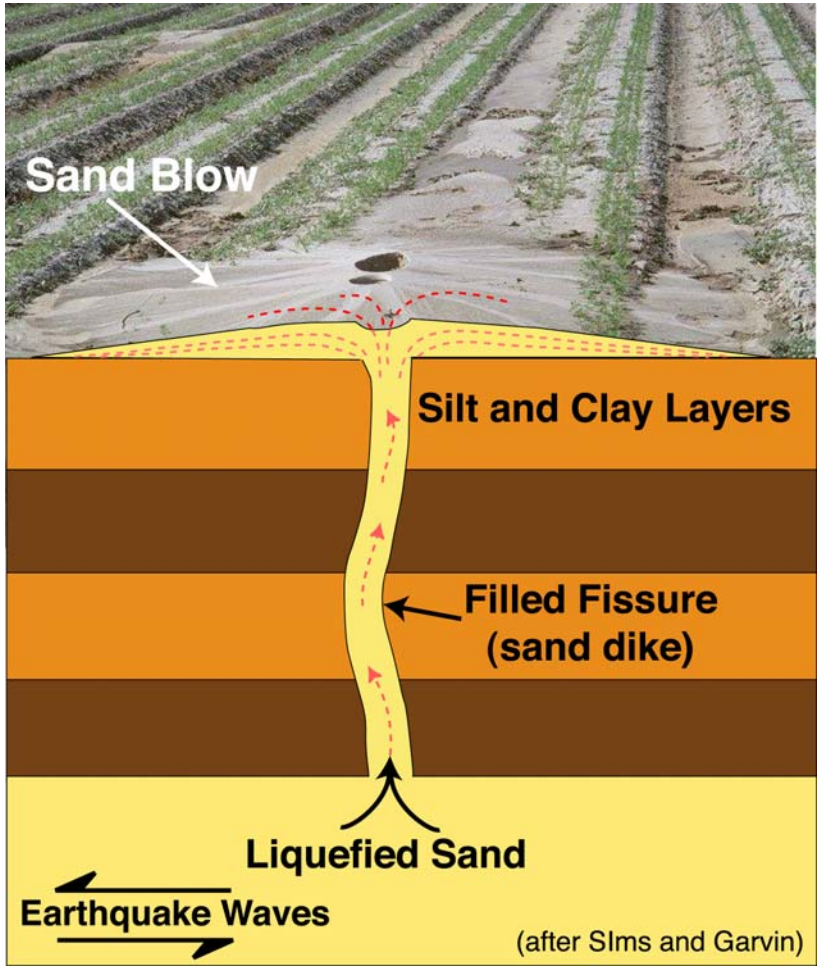
# Landslides occurred all along the bluffs

# What remains today…



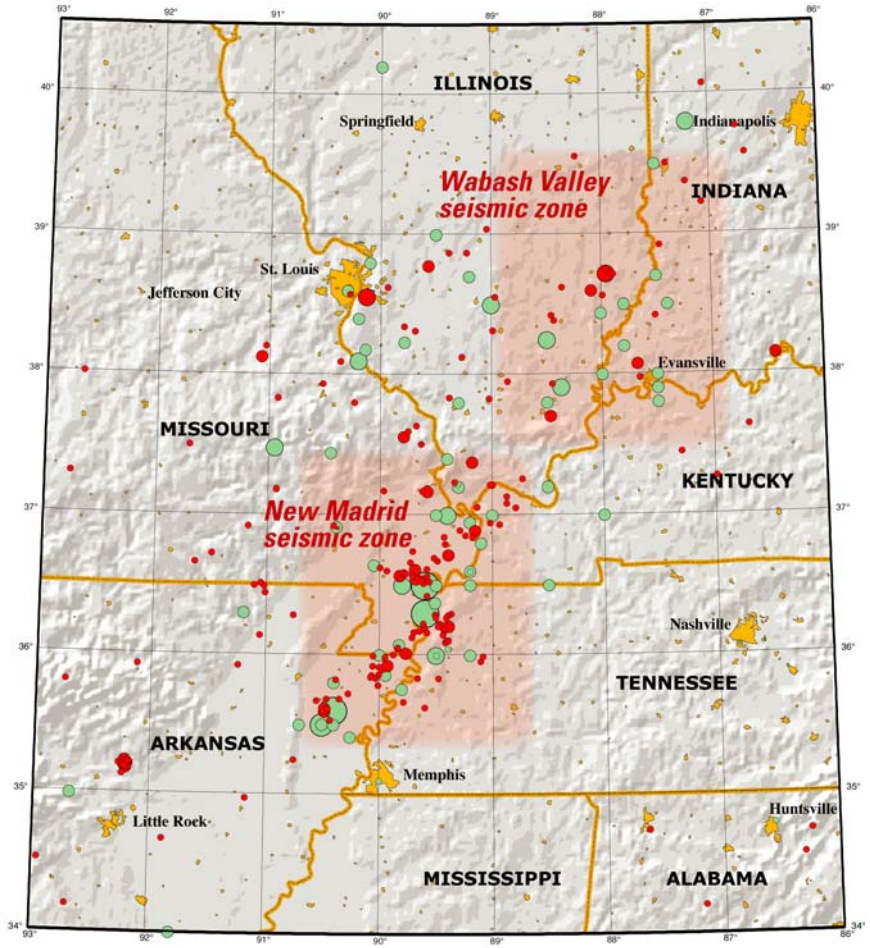
# Liquefaction and Sand Blow Formation

**During strong ground shaking, water pressure in wet, loose sand increases until the sand loses its strength and acts like a liquid, finally erupting to the ground surface through fissures, forming sand blows.**



# What's the situation today?

**Earthquakes continue up and down the Mississippi Valley as well as along the Wabash Valley and south Central Illinois**



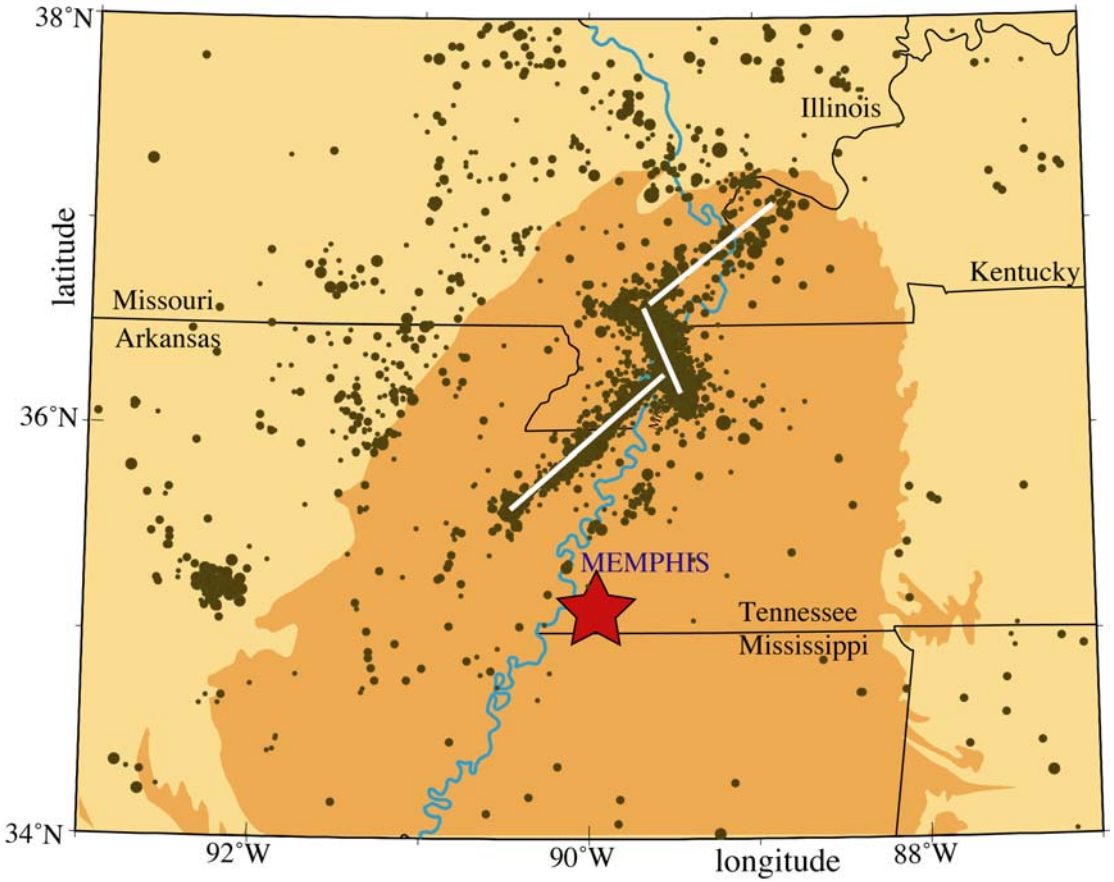
# What do we expect in the future?

- About a 10% chance of an earthquake similar in size to the 1811-1812 earthquakes (about magnitude 7.7)
- Likely to be a sequence
- May trigger other more distant earthquakes

# How do we estimate the likelihood of future earthquakes?

- We study the record of of buried sand blows
- Prehistoric earthquakes in 900 and 1450 A.D.

# Where will future earthquakes occur?




- Safe to assume the same faults will rupture as in 1811-1812

# Shaking: Modified Mercalli Intensity Scale

VI. Felt by all, many frightened. Some heavy furniture moved; a few instances of fallen plaster. Damage slight.

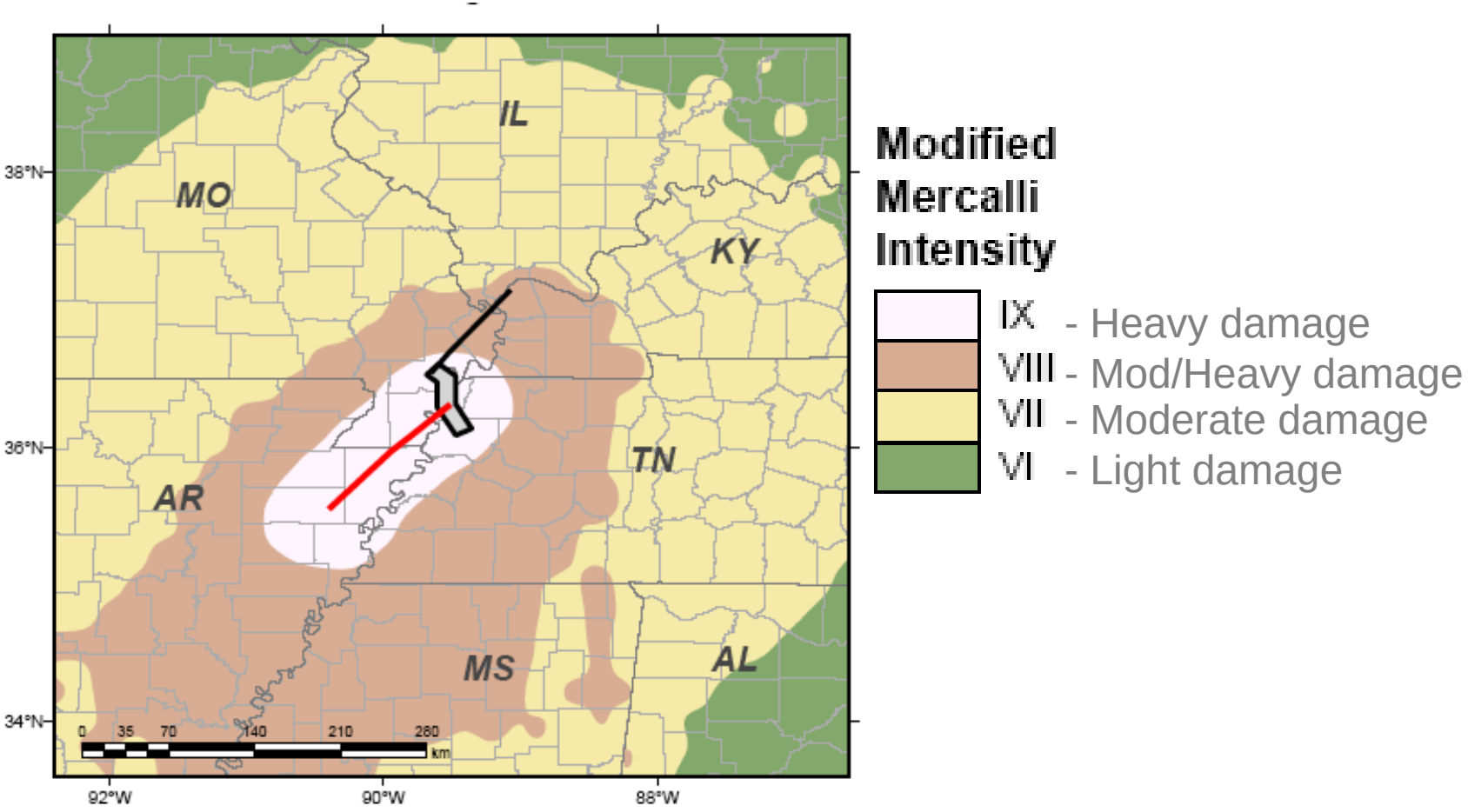
VII. Damage negligible in buildings of good design and construction; slight to moderate in well-built ordinary structures; considerable damage in poorly built or badly designed structures; some chimneys broken.

VIII. 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.

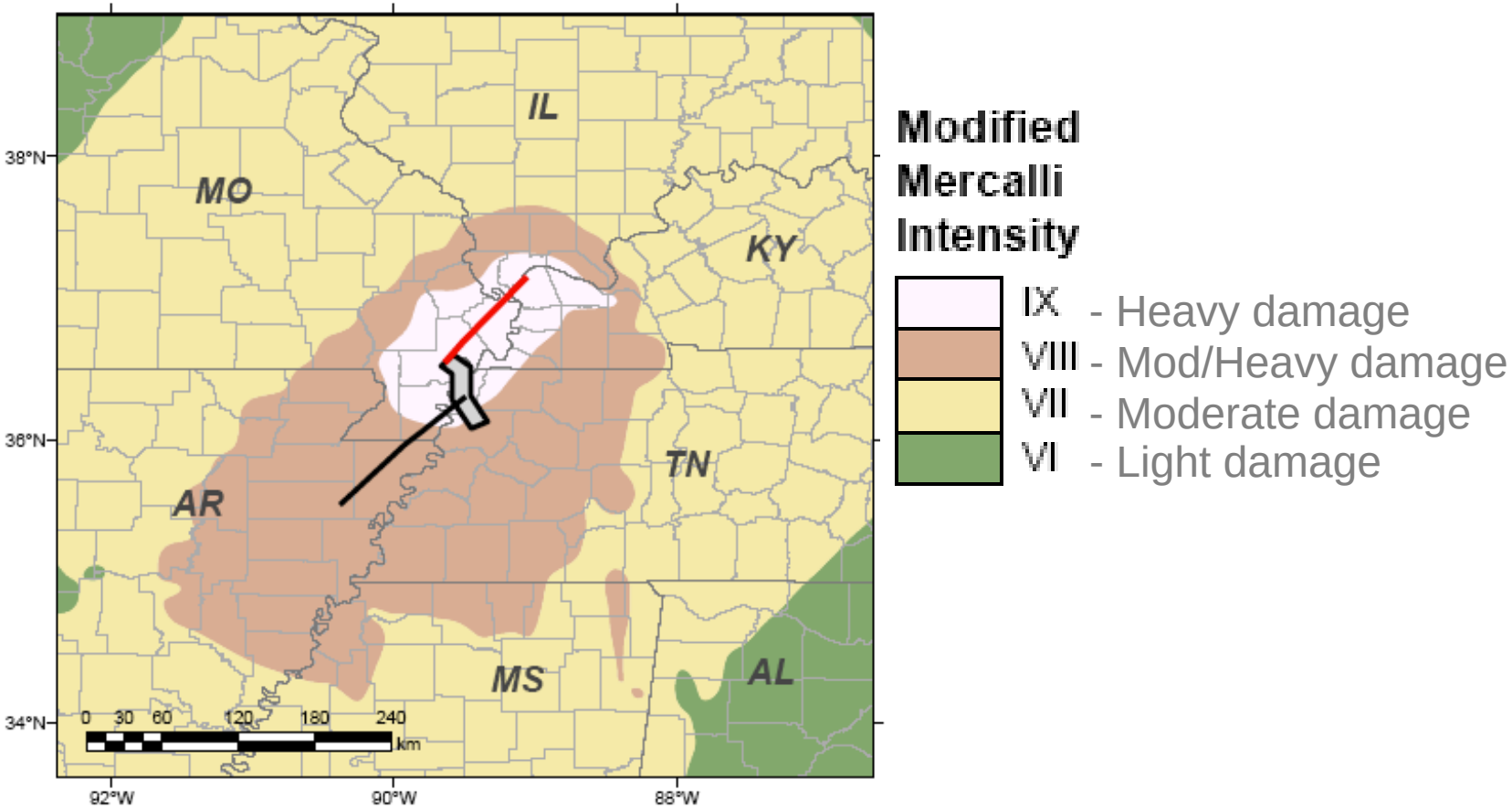
IX. Damage considerable in specially designed structures; well-designed frame structures thrown out of plumb. Damage great in substantial buildings, with partial collapse. Buildings shifted off foundations.

X. Some well-built wooden structures destroyed; most masonry and frame structures destroyed with foundations. Rails bent.

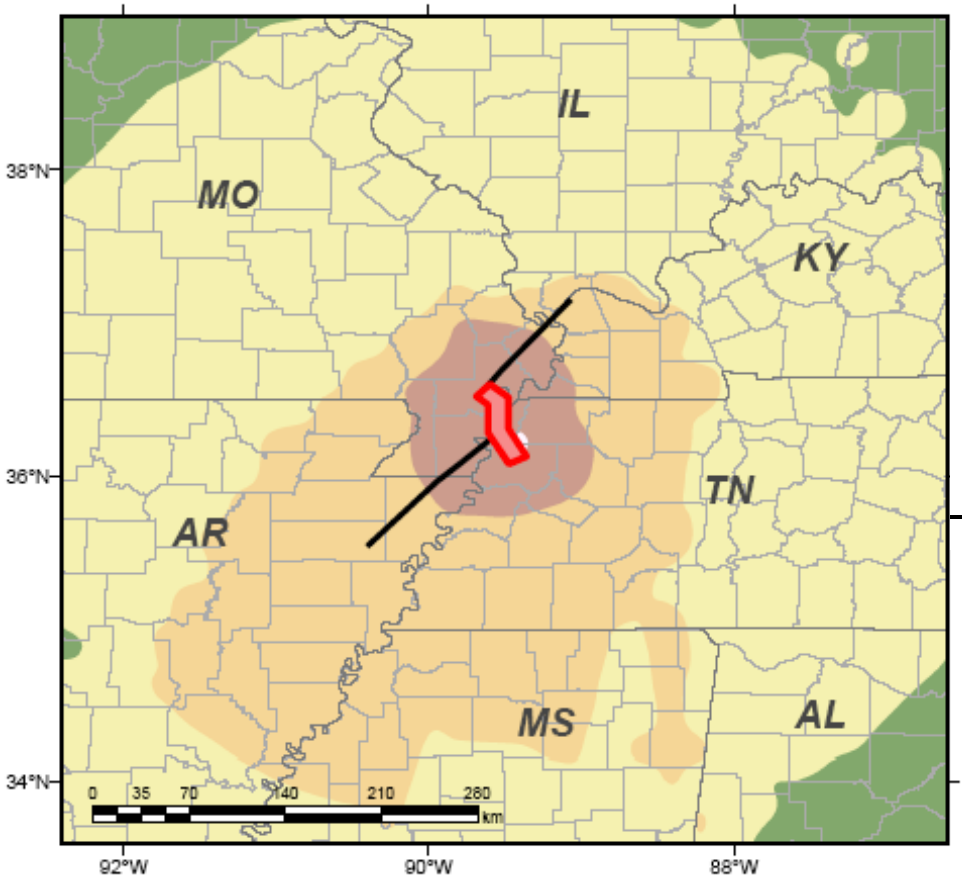
# Scenario Intensity Map: M 7.7 Southwest Segment New Madrid Seismic Zone



# Scenario Intensity Map: M 7.7 Northeast Segment New Madrid Seismic Zone



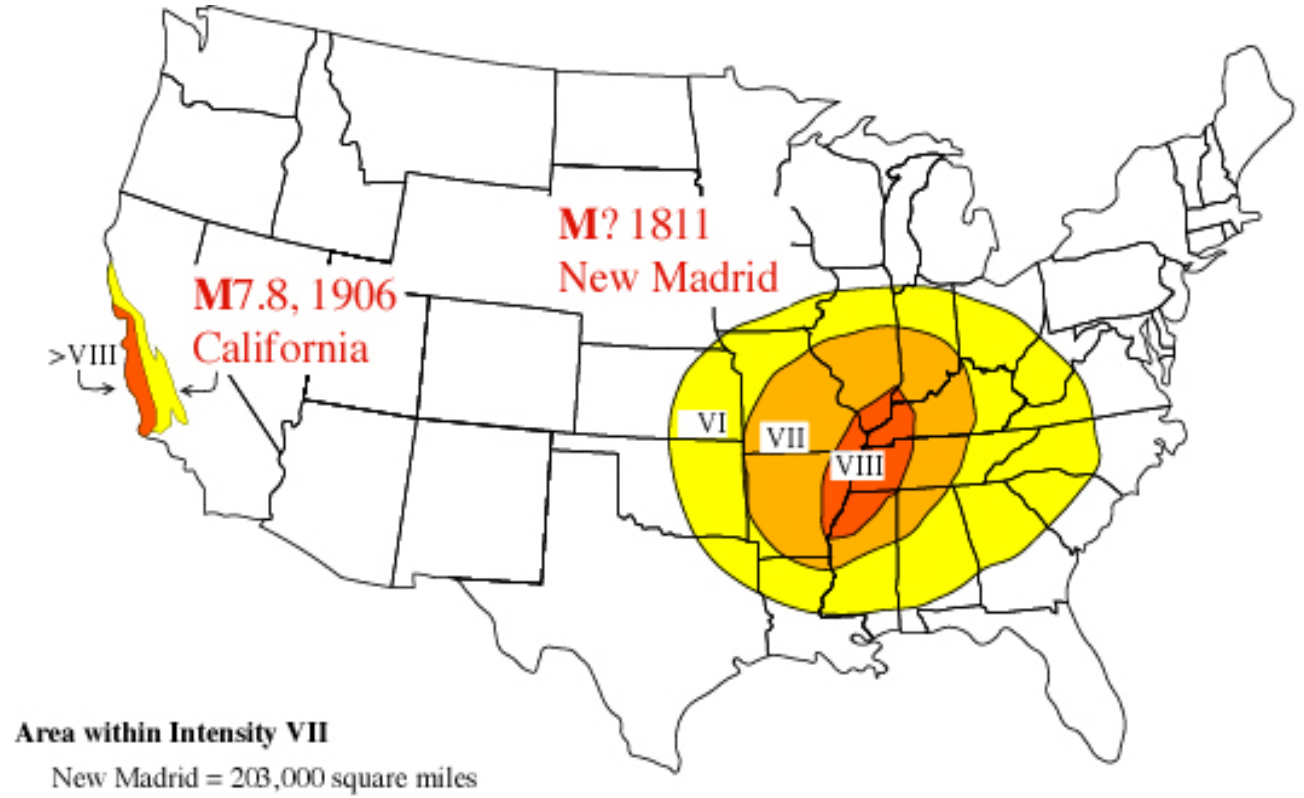
# Scenario Intensity Map: M 7.7 Central Segment New Madrid Seismic Zone




**Modified Mercalli Intensity**

- X - Very heavy damage
- IX - Heavy damage
- VIII - Mod/Heavy damage
- VII - Moderate damage
- VI - Light damage

# In the central & eastern U.S., earthquakes affect much larger areas than in the west

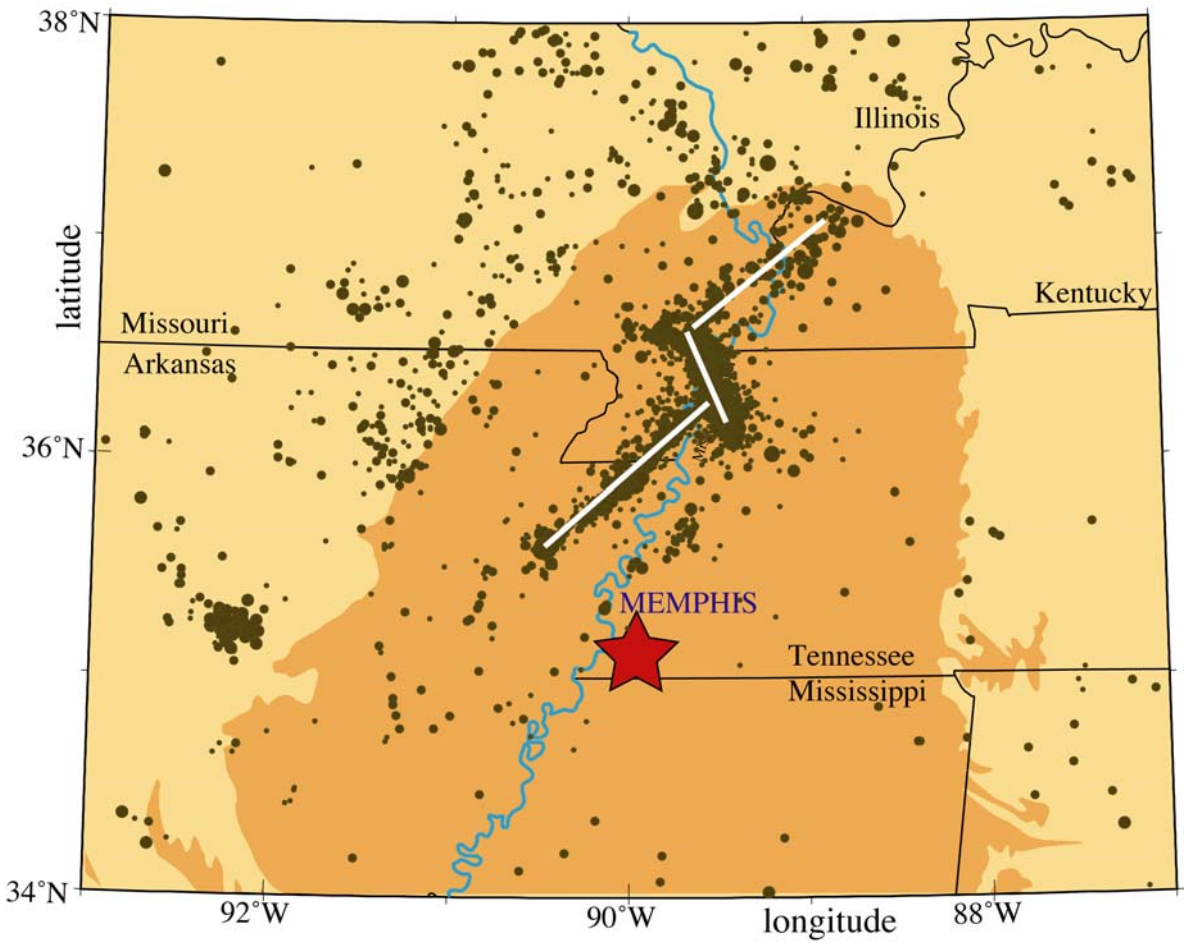



**Area within Intensity VII**

New Madrid = 203,000 square miles

San Francisco = only 12,000 square miles!

# Double Whammy: The Mississippi Valley sediments can also significantly increase the shaking



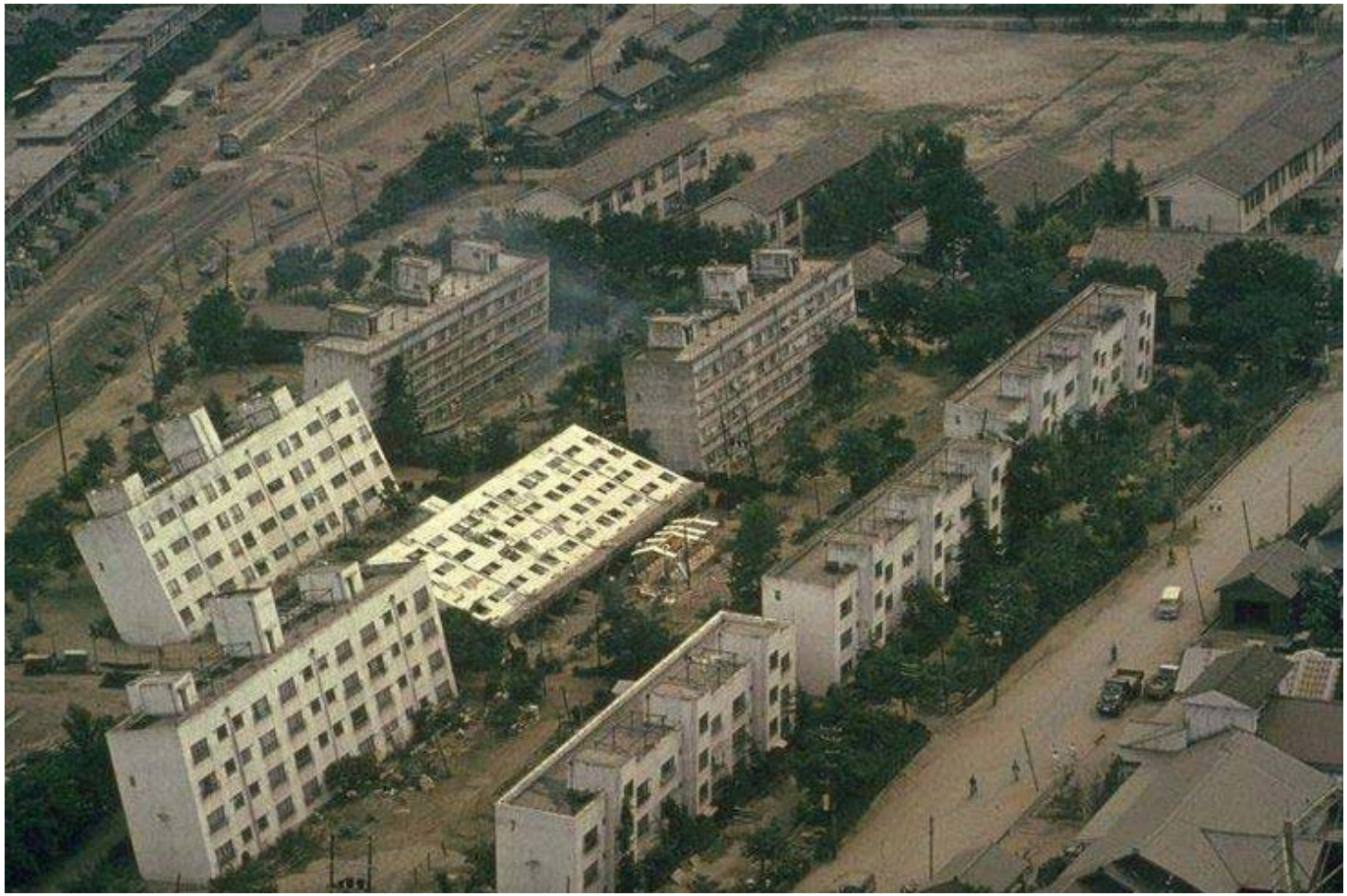
# Damage from Shaking

- Most buildings in the region were built before the advent of codes that took earthquake shaking into account
- Same for much of the infrastructure

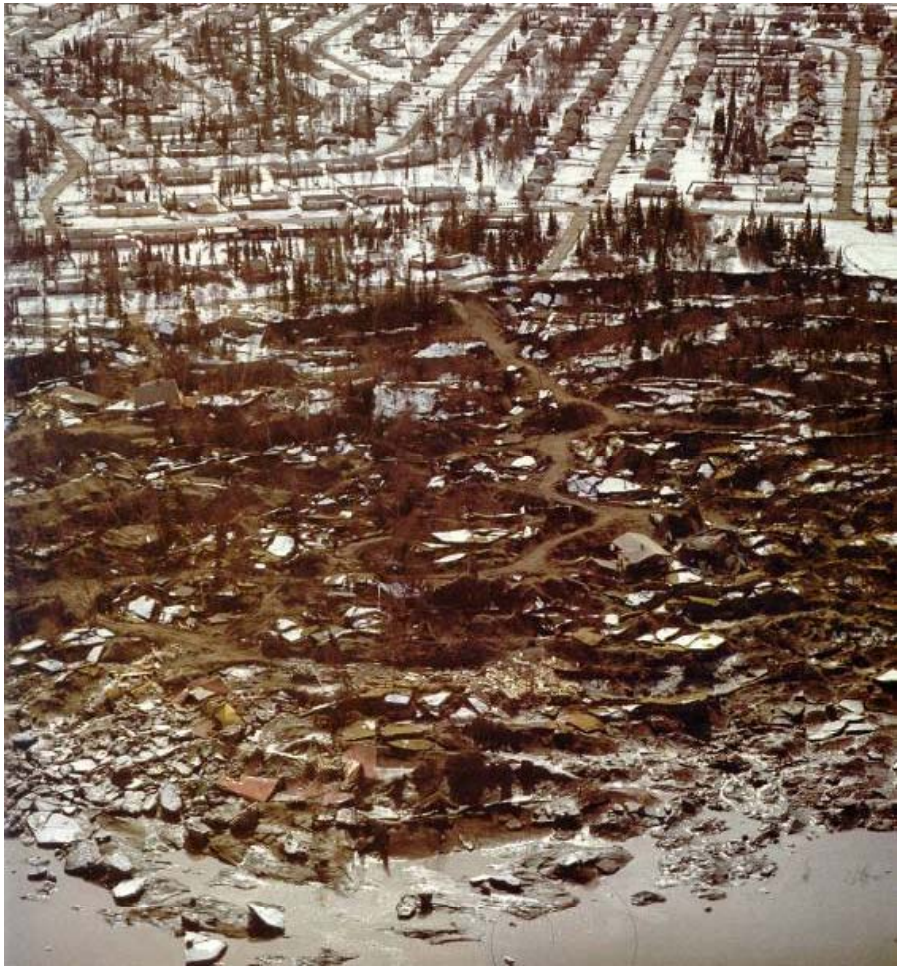
# Liquefaction

- There is no place in the world that has experience such intense liquefaction over such a broad region as the New Madrid seismic zone
- In 1811-1812, fields over tens of thousands of square miles covered in sand, mud, and water

# Liquefaction: Loss of bearing strength

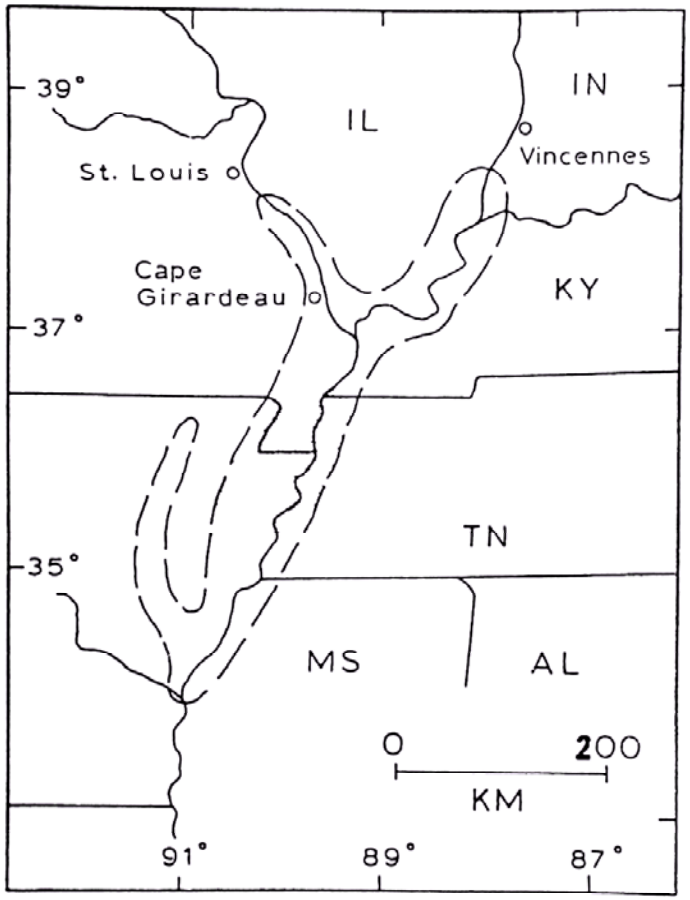


# Liquefaction: Lateral spread landslides



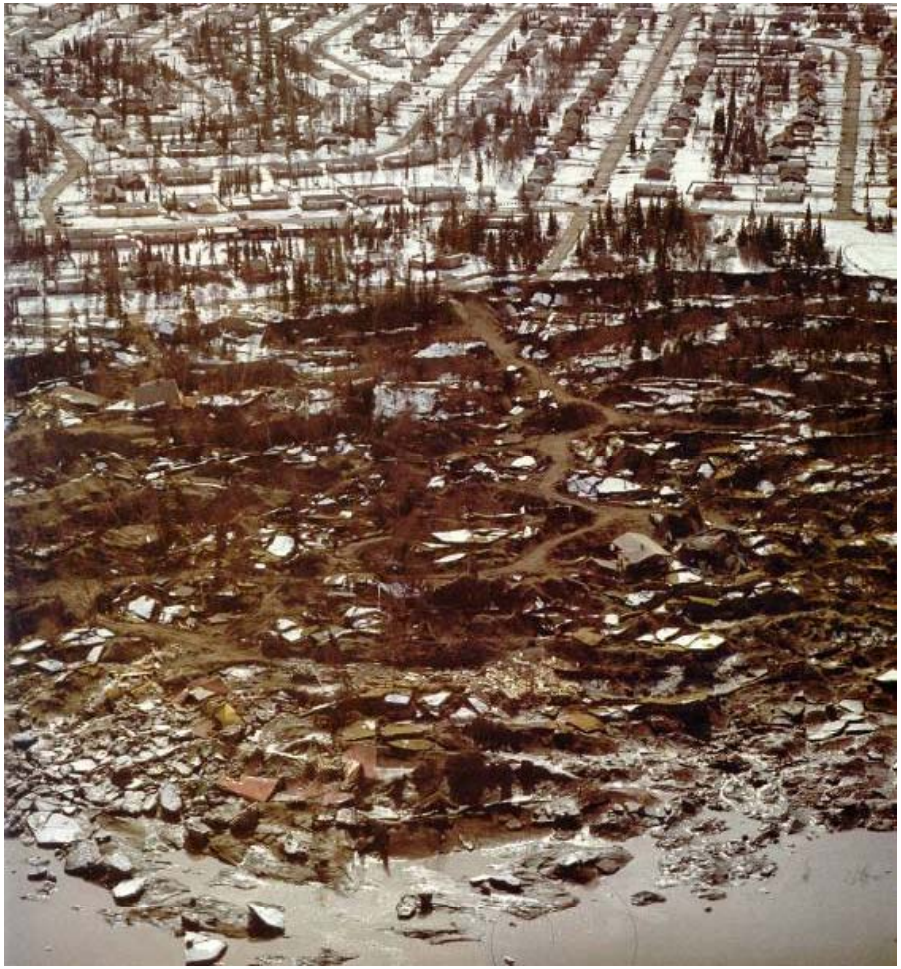
- With the slightest slope, soil over liquefied sand will move downhill
- Responsible for much of the failure of the bluffs, loss of islands, etc. in 1811-1812

# Liquefaction and Landslides



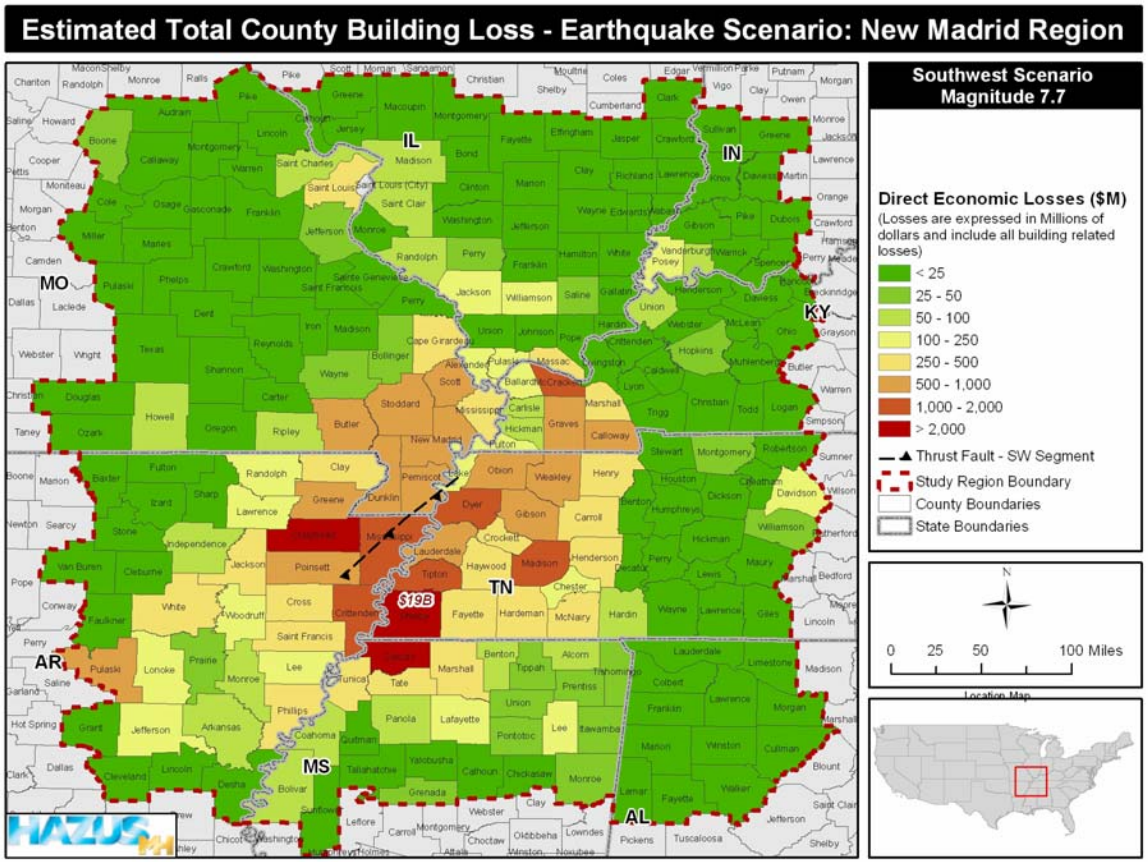

Area of major ground failures (liquefaction and landslides) in 1811-1812 (Myron Fuller, USGS, 1912)

# Liquefaction and Landslides: Likely consequences



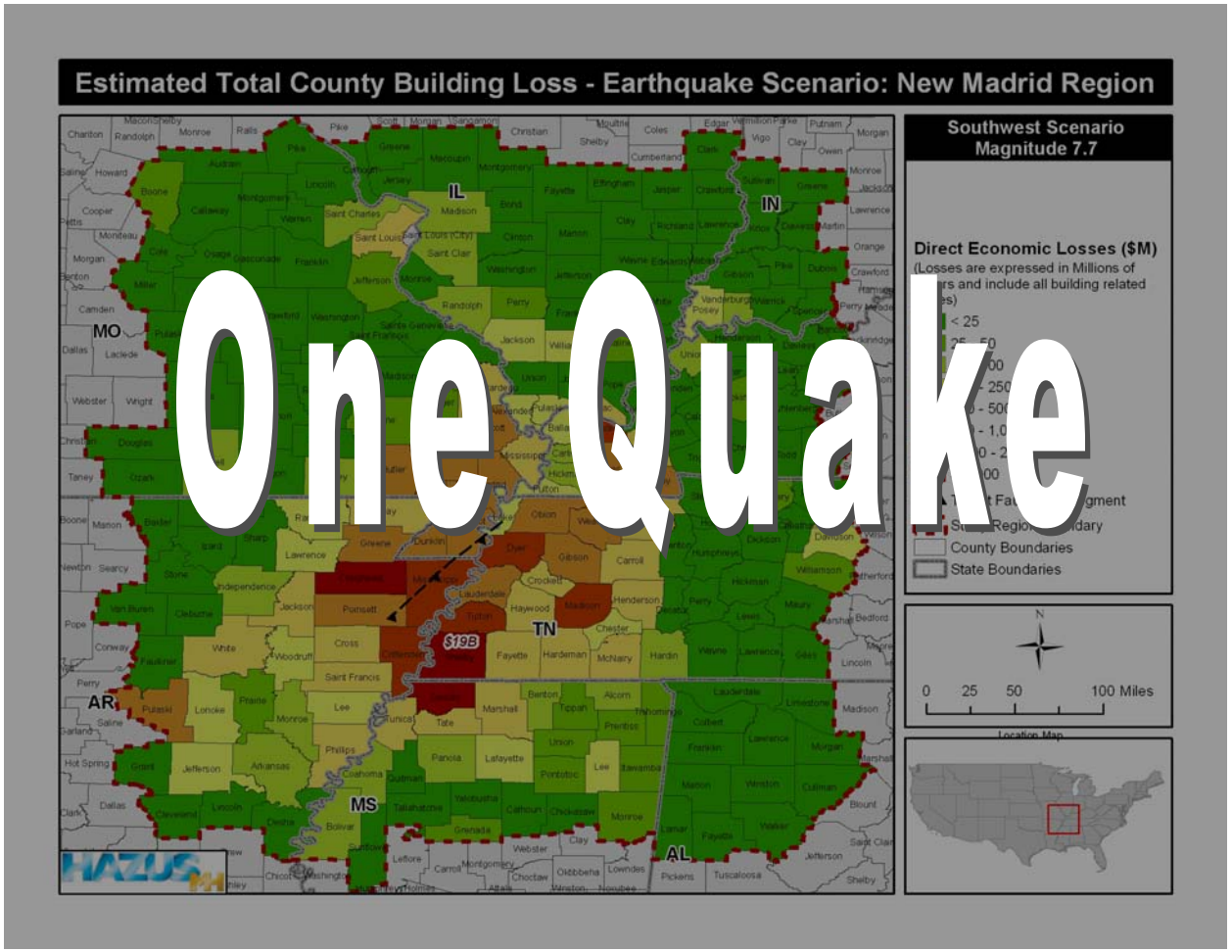
- A magnitude 7.7 earthquake today will likely cause:
  - Failure of bluffs
  - Failure of earthen levees
  - Local loss of navigation
  - Failure of bridge supports and approaches over a very large region
  - Roadways impassible in low-lying areas
  - Rupture of pipelines and cables crossing the Mississippi and other rivers
  - Buried tanks may float to the surface, breaking connections

# Estimates of Losses




- Magnitude 7.7, southwest arm

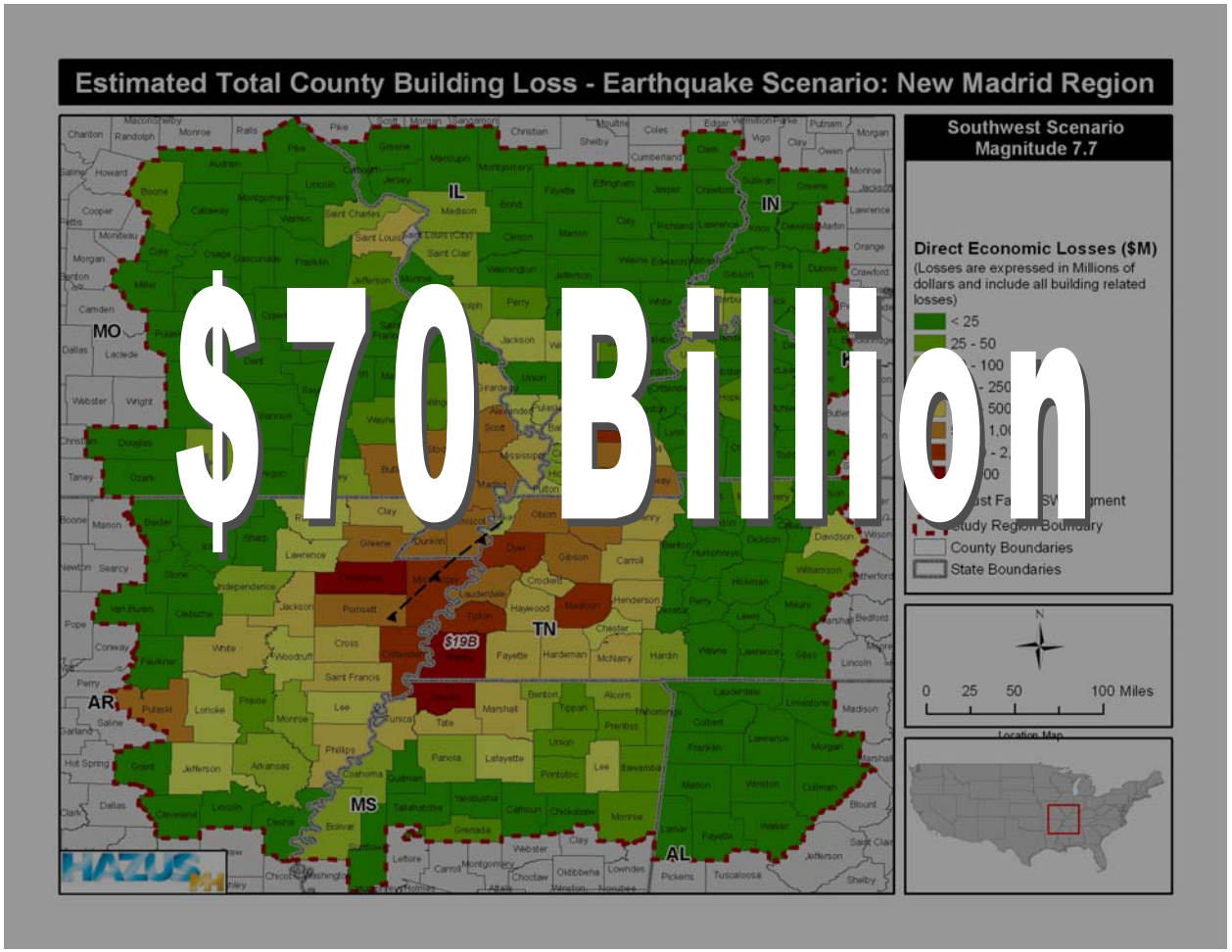
# Estimates of Losses




One Quake

- Magnitude 7.7, southwest arm

# Estimates of Losses




- Magnitude 7.7, southwest arm

# SONS 07
# Exercise Vision

It is our vision to conduct a national-level exercise that provides an environment for an unprecedented level of cooperation throughout all levels of government, industry and non-governmental organizations in response to a major natural disaster. The impacts to critical infrastructure, public health, public safety and security, and the environment (oil spill and hazardous material releases) will offer broad opportunities to practice plans and procedures. This robust participation, will create sustainable integrated solutions and foster relationships that are essential to maintaining public health and safety, national security, economic stability, and public confidence.

# SONS 07
# Historical Development

- Spill of National Significance Program
  - EPA and USCG Requirement
  - First Exercise in Fresh Water
  - First Exercise Initiated by a Natural Disaster
- FEMA Catastrophic Planning Initiative
  - FEMA Headquarters Planning Initiative
  - CUSEC: Regional and State Level Planning
- Combined Exercise Opportunities
  - Opportunity to Capitalize on Recent Natural Disaster Lessons Learned

# A PARTNERSHIP

From the beginning, the SONS 2007 exercise has been a joint effort and partnership

The Partnership is led by the EPA, USCG, FEMA CUSEC and API

The planning organization is a multi-agency collaborative effort at national and regional levels

# SONS 07 Participants

| | |
|---|---|
| Region 4 States | Alabama. Kentucky, Mississippi, Tennessee |
| Region 5 States | Illinois, Indiana, Michigan, Wisconsin, Ohio |
| Regions 6/7 States | Arkansas, Louisiana, Iowa, Missouri |
| Federal Departments Participating | DHS, EPA, DoD, DHHS, DOI, DOC, DOL, DoT, VA |
| Other Major Participants | CUSEC, WHO, NGB, NORTHCOM: (ARNORTH) |

# SONS 07
# Exercise Design

- **Two-Stage Exercise**
  - **Two Consecutive Weeks**
    - Execute June 2007
  - **Week 1**
    - Full Scale Exercises
    - Initial Responders
  - **Week 2**
    - Roundtable Discussions
      - Vertical and Horizontal Plan Alignment
  - **30 Days after Full Scale Exercise**
    - Senior Official's Exercise/Seminar

# SONS 07
# Exercise Design (cont'd)

- **Week 1**
  - **Full Scale Exercise Week 1 (1-5 Days of FSE)**
    - First Responders
    - Damage Assessment
    - Continuity of Government
    - Federal Response Development and Deployment
  - **Multiple Levels of Participation**
    - TTX
    - CPX
    - FSE
  - **Federal Government Organizing for Initial Response**
    - Establish requirements for JFOs
    - First Response

# SONS 07
# Exercise Design (cont'd)

- **Week 2 (2-3 Days of Discussions)**
  - Table Top Exercise and Roundtable Discussions
    - Focus on ESF/JFO Functionality and Support to the States
      - Vertical and Horizontal Discussions from the ESF Perspective
  - Discussions Groups Could be Led by ESF Lead Agency Representative with a Facilitator
  - Additional Discussion Groups
    - Continuity of Government
    - Industry Focus
    - Politics
    - Economics
    - Media
- **Senior Officials Exercise/Seminar (Washington D.C.)**

# SONS 07
# Exercise Focus

- **Focus on Validating Plans**
  - Can we do what our Plans say we will do?
  - Do the Plans exist?
  - No Pass/Fail
  - Training and Performance Assessment will occur

- **Do we have Vertical and Horizontal Alignment Between our family of Plans?**
    - Local Jurisdictions to State
    - State to Regional
    - Regional to National
    - Bottom to Top, Top to Bottom, and Cross-Functional

# SONS 07
# Exercise Scope

- Multiple Levels of Governmental and Industry Participation
  - Local Jurisdictions
  - States
  - Regional
  - National
- Private Industry
  - Oil/hazmat
  - Power
  - Communications
- There May Be as Many as 13 JFOs
  - What will the Federal Response look like?
  - What will be the Initial Response?

# SONS 07
# Planning Conferences

- Initial Planning Conference
  - February 21-23, 2006
  - Memphis, TN
- Middle Planning Conference
  - October 2006
  - St. Louis, MO
- Final Planning Conference
  - March 2007
  - Memphis, TN