

# Overview of the USGS Earthquake Hazards and Global Seismographic Network Programs

Bill Leith

Senior Science Advisor

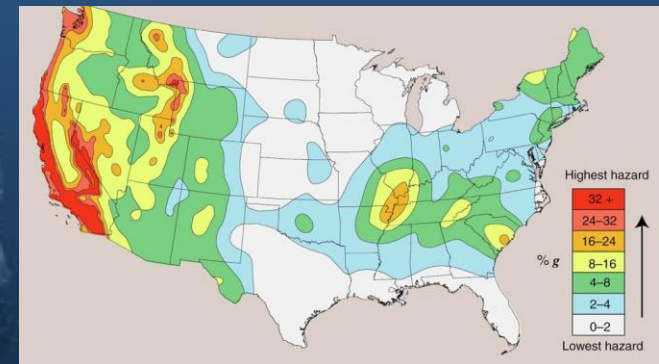
April 9, 2015

# Outline

- program overview
- FY14 accomplishments
- FY15 budget
- FY16 proposed budget
- unmet needs

# The USGS role in the National Earthquake Hazard Reduction Program

- Provide earthquake monitoring and notifications
- Assess seismic hazards
- Conduct targeted research needed to reduce the risk from earthquake hazards nationwide, and
- Build public awareness



FEMA

NIST  
National Institute of  
Standards and Technology



USGS  
science for a changing world

national **earthquake** hazards reduction program



# Primary EHP-funded Science Centers and Regional Offices

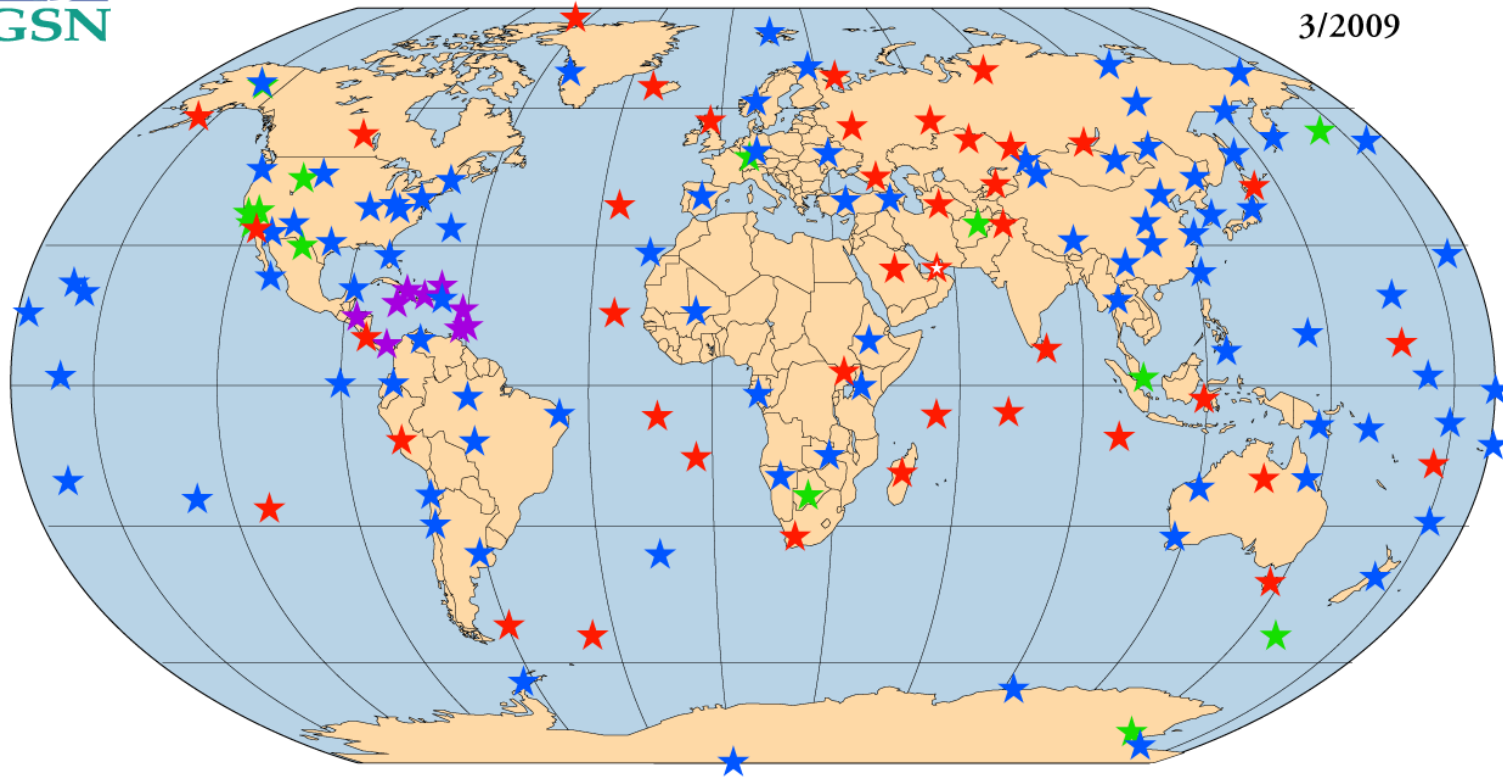
- Menlo Park, CA – *Earthquake Science Center*
  - Seattle, WA – Regional Office at Univ. Washington
  - Pasadena, CA – Regional Office at CalTech
- Golden, CO – *Geologic Hazards Science Center and the National Earthquake Information Center*
  - Albuquerque, NM – Regional Office for ANSS Backbone and GSN activities
- Alaska: Alaska and Volcano Science Centers

# Global Seismographic Network

a shared program of  
the USGS and NSF



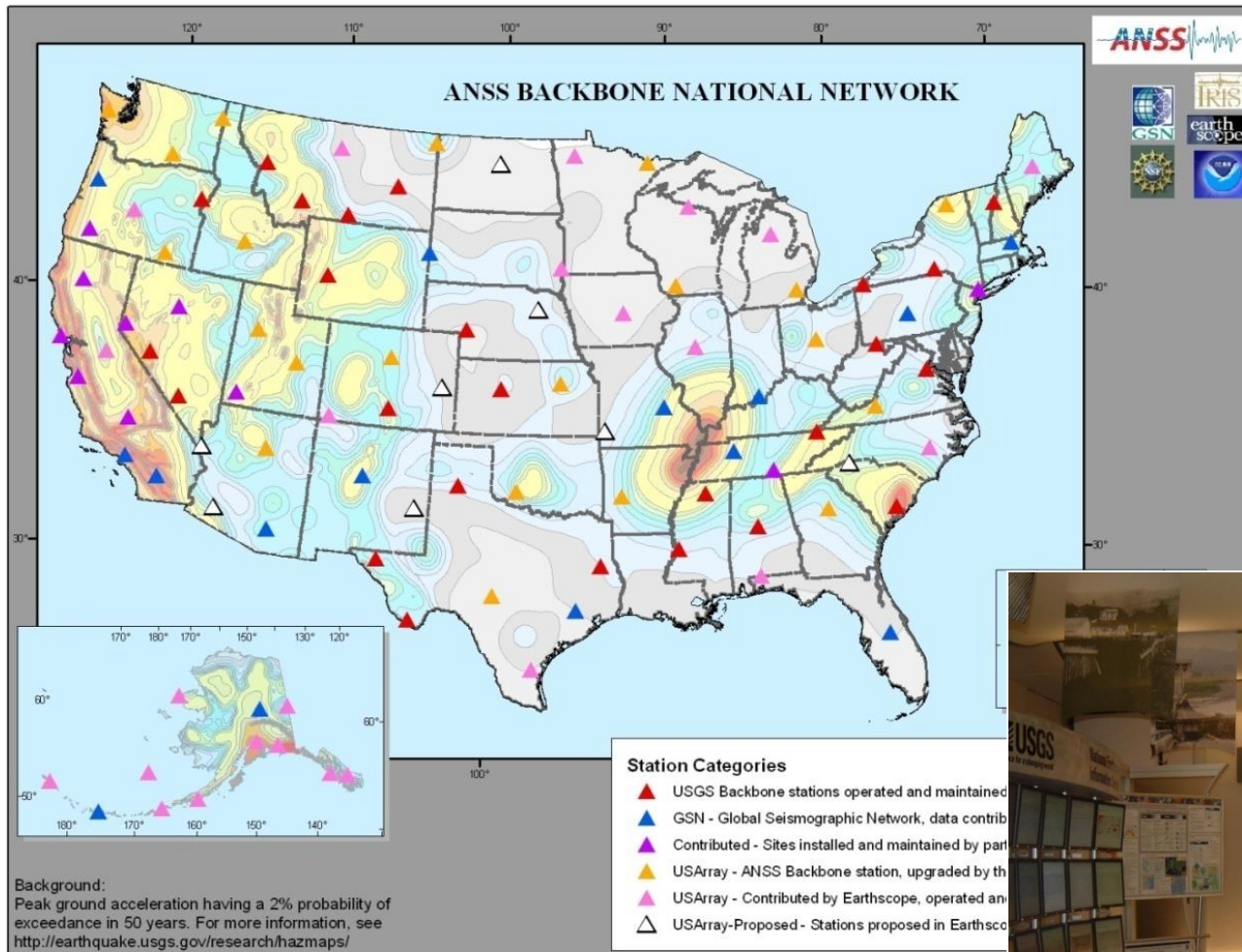
3/2009



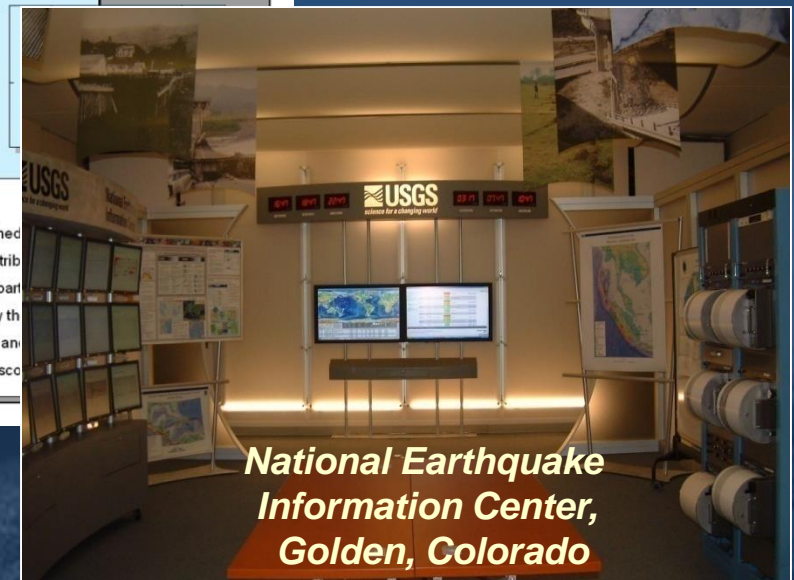
- ★ IRIS / IDA Stations
- ★ IRIS / USGS Stations
- ★ USGS Caribbean Network
- ★ GSN Affiliate Stations

The 150-station GSN is the workhorse of global seismology, supporting earthquake alerting, tsunami warning, nuclear treaty monitoring, and research on the structure and dynamics of the Earth.

# USGS Advanced National Seismic System



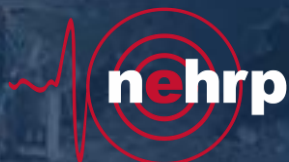
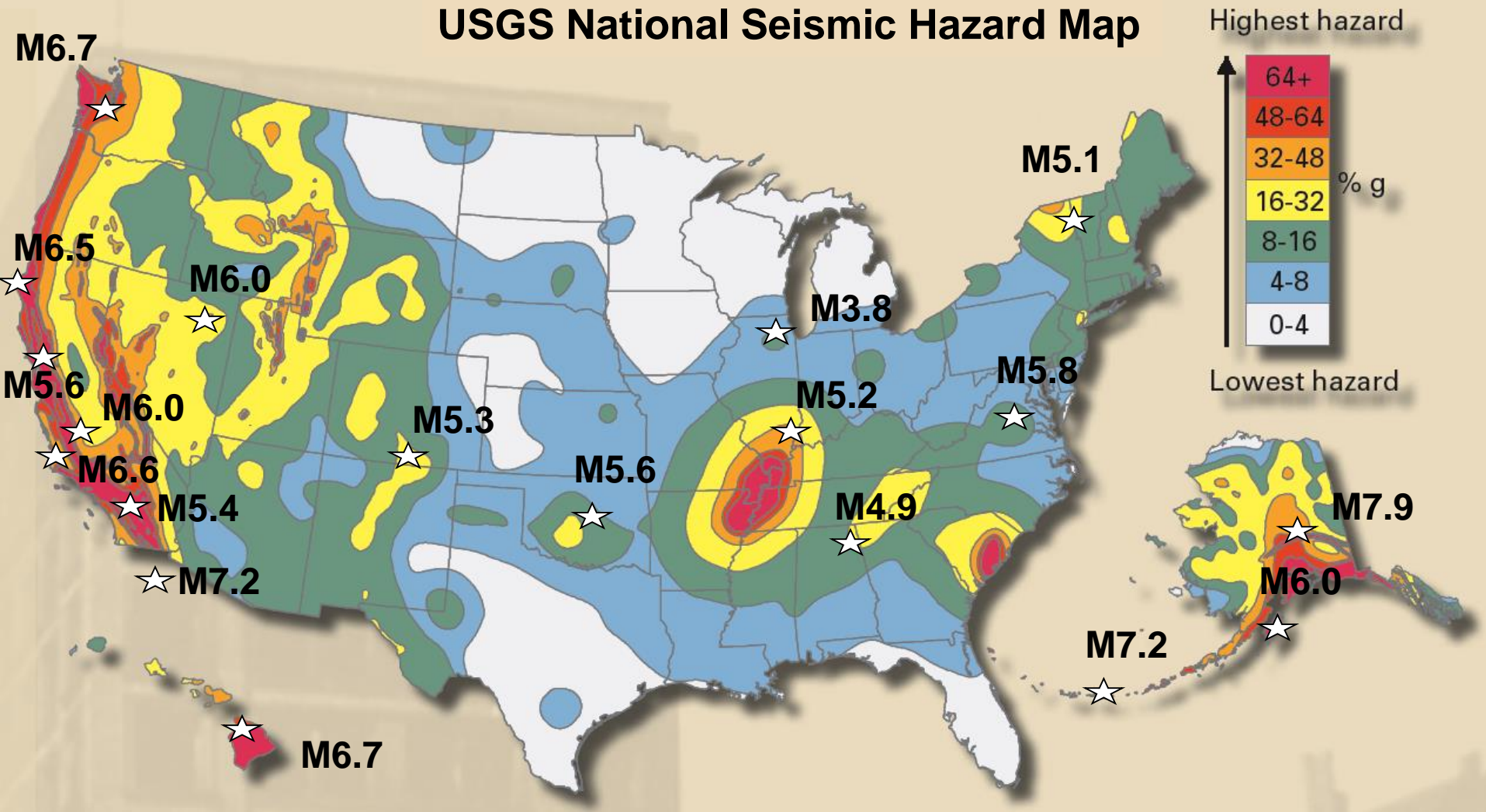
National, regional, strong motion and portable networks support the generation of USGS situational awareness products (PAGER, ShakeCast), catalogs and waveform databases





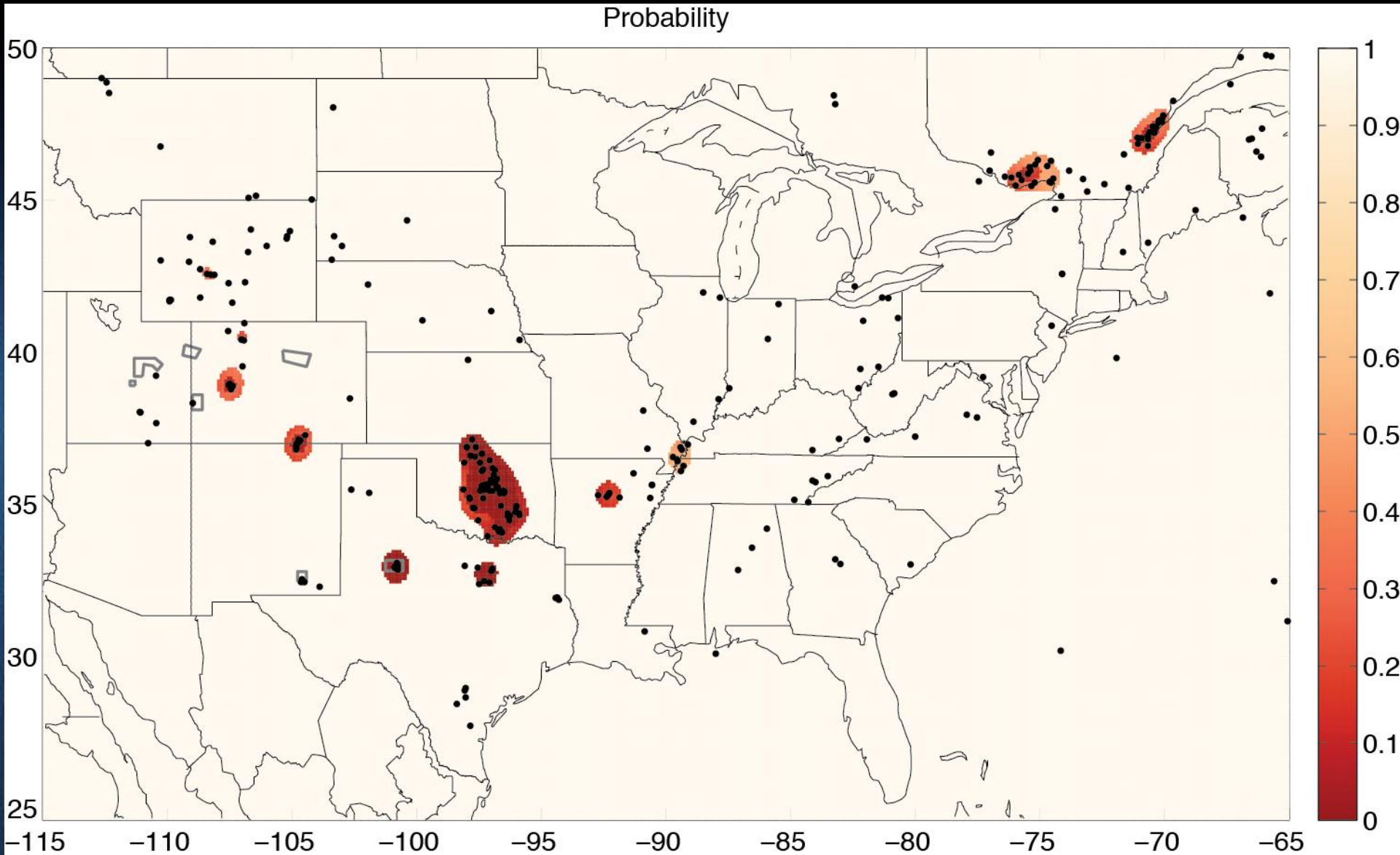
# Earthquakes are a national hazard

## USGS National Seismic Hazard Map



★ Notable earthquakes in past decade

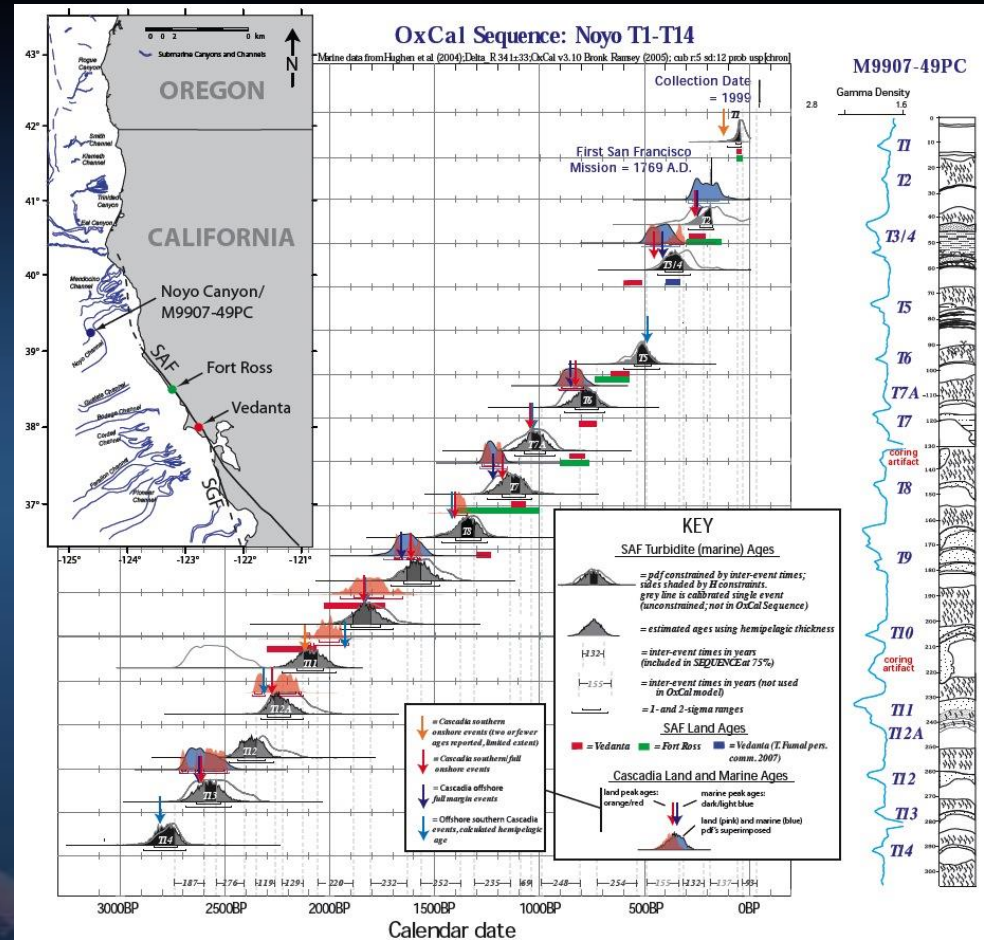
# Excess earthquakes, 2009-2013





# External grants and cooperative agreements a key component of the Earthquake Hazards Program

- Approximately 25% of core program funds
- Gives flexibility and adds breadth of expertise to program
- Leverages support from other state and federal agencies, and universities
- FY15 funding - \$16.5M:
  - \$7.0M for seismic and geodetic networks
  - \$7.8M research grants
  - \$1.3M SCEC
  - EEW funding TBD

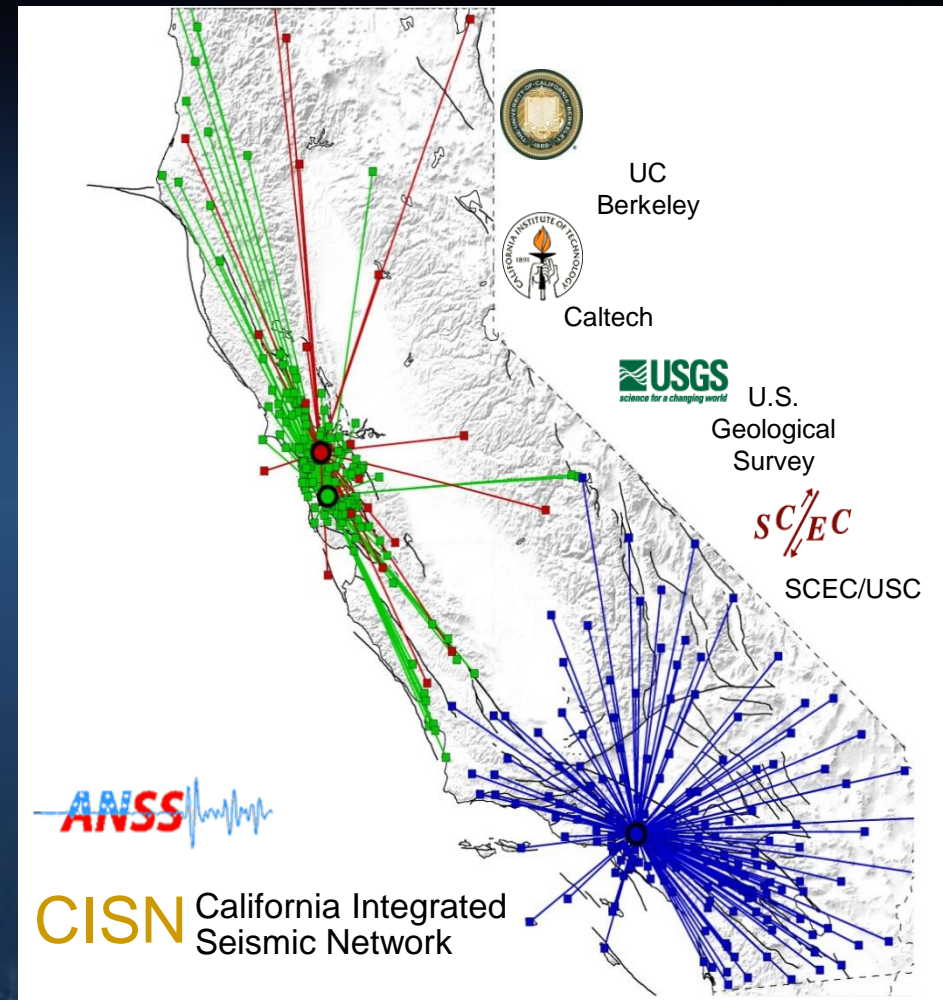


USGS-funded research by Goldfinger et al. uses turbidites to determine precise ages for earthquakes on the Cascadia Subduction Zone



# Earthquake Early Warning getting ahead of strong ground shaking

- USGS/CISN Phase I (2007-2009) cooperative agreement supported algorithm testing
- Phase II (2010-2012) supports prototype development and identifies test users
- ARRA funding used to reduce datalogger delays
- EEW requirements:
  - rapid earthquake detection
  - early magnitude estimation
  - ground shaking prediction
  - robust monitoring networks
  - well-defined user community



# Congress Advocates for Earthquake Early Warning

Congress of the United States  
Washington, DC 20515

March 23, 2015

The Honorable Ken Calvert  
Chairman  
Subcommittee on the Interior, Environment, and  
Related Agencies Appropriations  
B-308 Rayburn House Office Building  
Washington, DC 20515

The Honorable Betty McCollum  
Ranking Member  
Subcommittee on the Interior, Environment, and  
Related Agencies Appropriations  
1016 Longworth House Office Building  
Washington, DC 20515

Dear Chairman Calvert and Ranking Member McCollum:

As you craft the Fiscal Year 2016 Interior and Environment Appropriations bill, we respectfully request that you provide the U.S. Geological Survey (USGS) Earthquake Hazards program with \$70.552 million, of which \$16.1 million is to be provided to transition the earthquake early warning demonstration project into an operational capability on the West Coast. This is a \$12.6 million increase over the FY2016 requested level in the President's budget.

President Barack Obama  
The White House  
1600 Pennsylvania Avenue, NW  
Washington, DC 20500

Dear President Obama:

As you prepare your Fiscal Year 2016 Budget for the U.S. Geological Survey (USGS), we strongly urge you to request increased funding for USGS's earthquake-related programs, including an additional \$16.1 million for the development and operation of a West Coast Earthquake Early Warning (EEW) System.

Letter signed by Feinstein, Schiff and 35 other Senators and Representatives

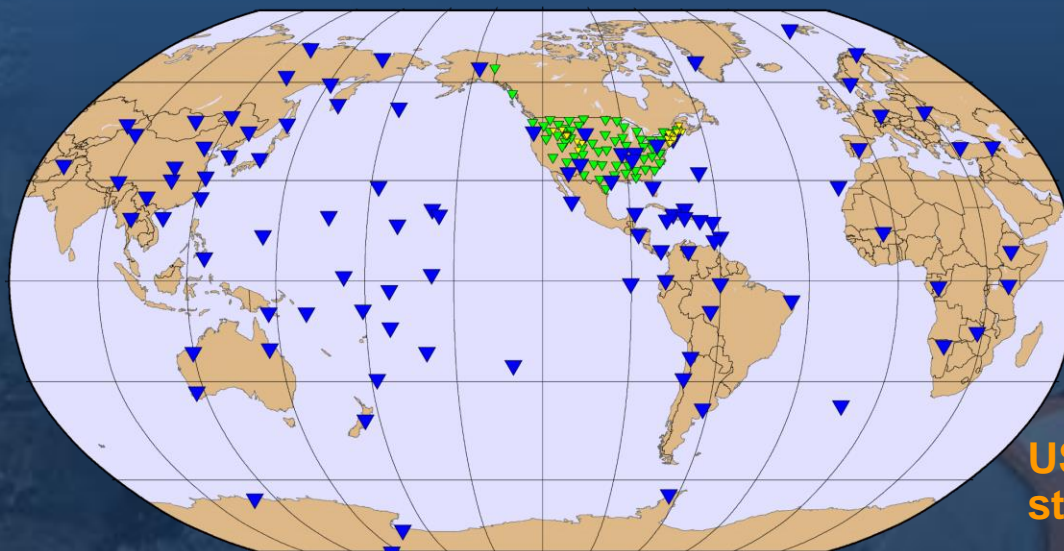
Letter signed by Schiff, DeFazio  
and 34 other Representatives





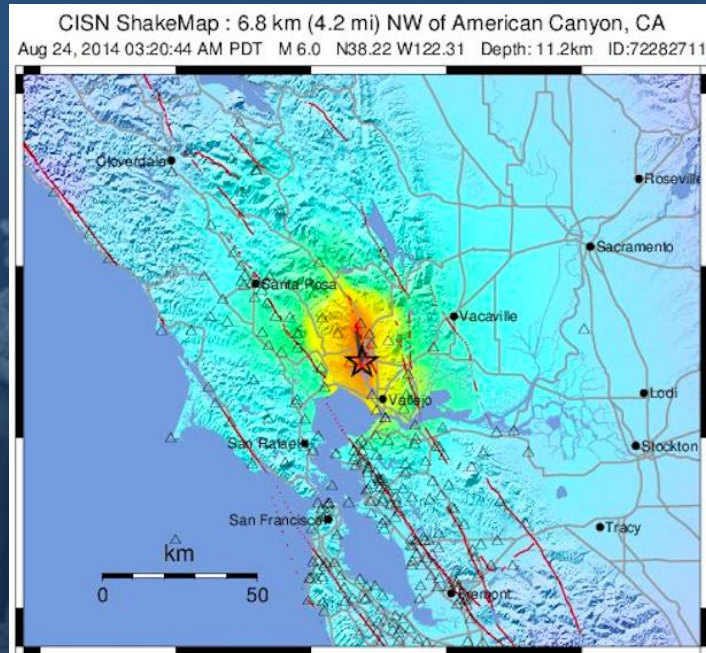
# Global Seismographic Network – 2014 Accomplishments

- Procurement progress for **new borehole sensors**. Solicitation posted, vendor recommended, and award in-progress. Vendor will provide prototype for testing 9 months after award. USGS also performed study of noise versus depth of deployment for borehole sensors in anticipation of deployment. However, additional funds are needed for installation. [DOE FUNDED]
- Furthered development of software to **automatically assess GSN data quality**, to quickly identify, diagnose and fix station performance and metadata problems. This has resulted in unprecedented data quality for the USGS-operated stations.
- **Metrozet M2166** evaluated to replace the venerable STS-1 vault seismometer.



# Earthquake Hazards – 2014 accomplishments

- **Napa earthquake response:** The USGS responded to the magnitude 6.0 South Napa earthquake with the rapid release of earthquake information products including ShakeMap, ShakeCast and PAGER. USGS joined the California Geological Survey in a suite of field investigations to document the earthquake and its impacts on infrastructure.
- Seismic and geodetic networks, InSaR and LiDaR captured details of the earthquake rupture and ground motion, including significant afterslip.
- FEMA funded USGS to document afterslip; USGS funded new paleoseismic fieldwork





Stone Bridge School, Los Carneros Avenue, Napa, CA X



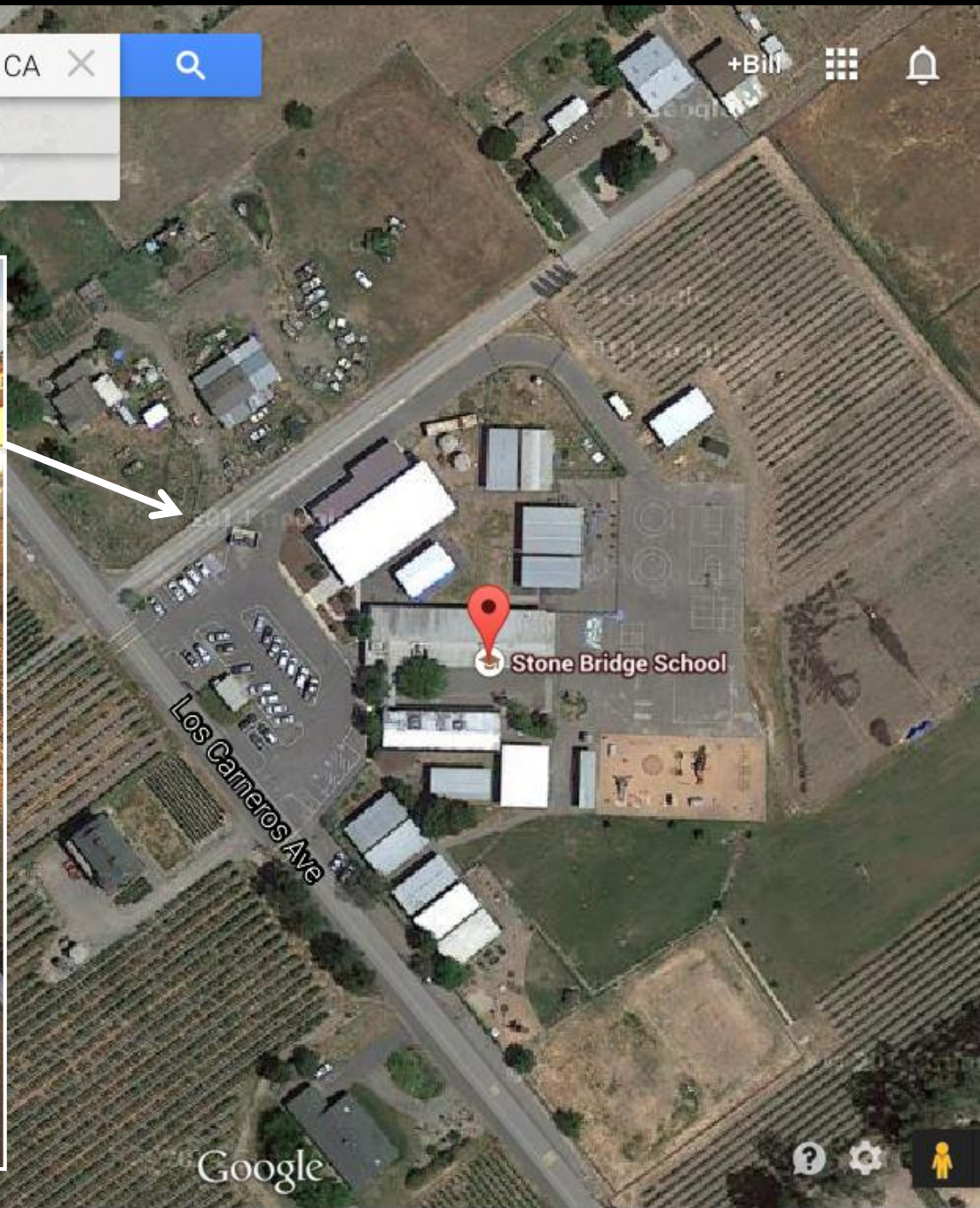
Stone Bridge School

(707) 252-5522

2 reviews



26" gas pipeline at 350 psi



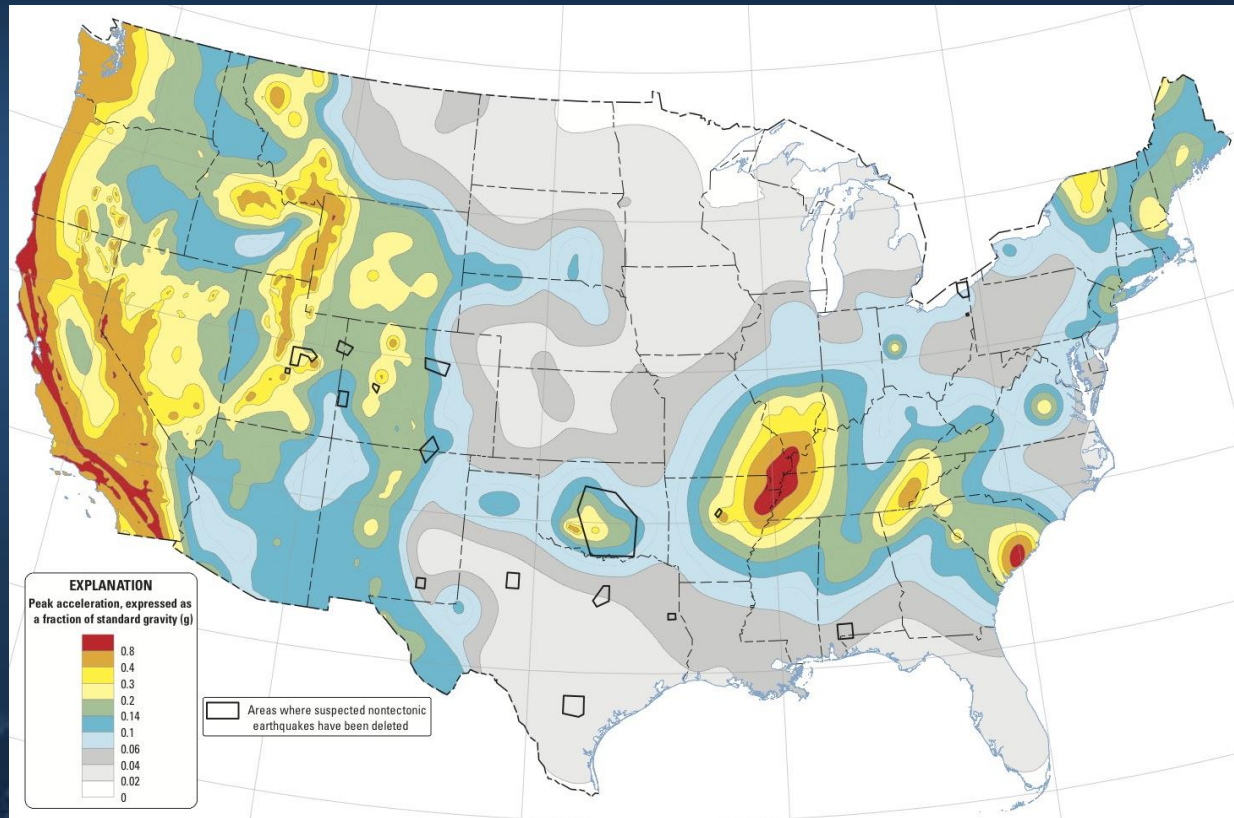
Google





# Earthquake Hazards – 2014 accomplishments

- **National Seismic Hazard Maps:** The USGS completed and released a major update to the National Seismic Hazard Maps. These maps, which forecast the levels of earthquake shaking expected throughout the conterminous USA over long time periods, are the basis for seismic provisions in building codes in use in most US states and communities.
- The maps were updated for the first time since 2008, using the latest data on faults, deformation and ground shaking.
- A new “Uniform California Earthquake Rupture Forecast”, completed by USGS, SCEC and partners last year, informs the Calif. Portion (UCERF3)



# Earthquake Hazards – 2014 accomplishments

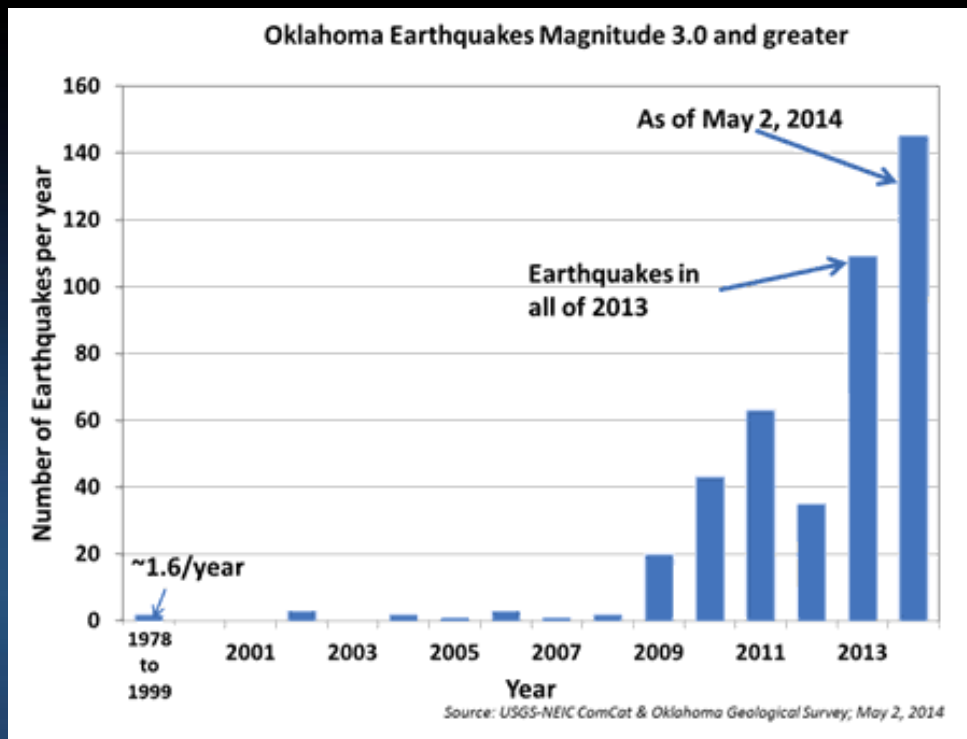
- **Alaska earthquake anniversary:** 2014 marks fifty years since the magnitude 9.2 Great Alaska earthquake rocked that state, causing extensive damage to Anchorage and spawning tsunamis. The USGS marked the anniversary with projects to raise education and preparedness, in partnership with federal, state and local organizations.
- The USGS supported FEMA in developing the **Alaska Shield** response preparedness exercise, which was based on a repeat of the 1964 earthquake, and participated in the exercise, providing twice-daily briefings to multi-agency partners on the earthquake's impacts and aftershocks.





# Earthquake Hazards – 2014 accomplishments

- **Induced Seismicity:** USGS researchers continued studies of potentially induced earthquakes in several states, demonstrated that Oklahoma's seismically active regions continue to expand, and tied this to an expansion in the number of wastewater disposal wells in northern Oklahoma.



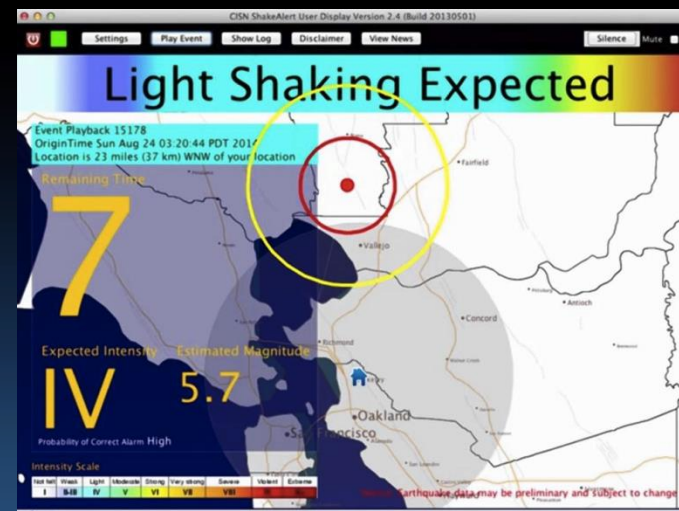
- In a public-private partnership, USGS also installed a seismic network at the high-volume CO2 injection site at Decatur, IL, and developed plans with DOE & industry partners for monitoring and modeling seismicity around the injection site of the FutureGen 2.0 test site (now cancelled).



# Earthquake Hazards – 2014 accomplishments

**Earthquake Early Warning System:** *ShakeAlert* demonstration system performed successfully for the M6.0 South Napa earthquake, providing 5 sec. of warning at Berkeley. In So. California, 125 seismic stations installed or upgraded with \$5.7M from the DHS-funded UASI project.

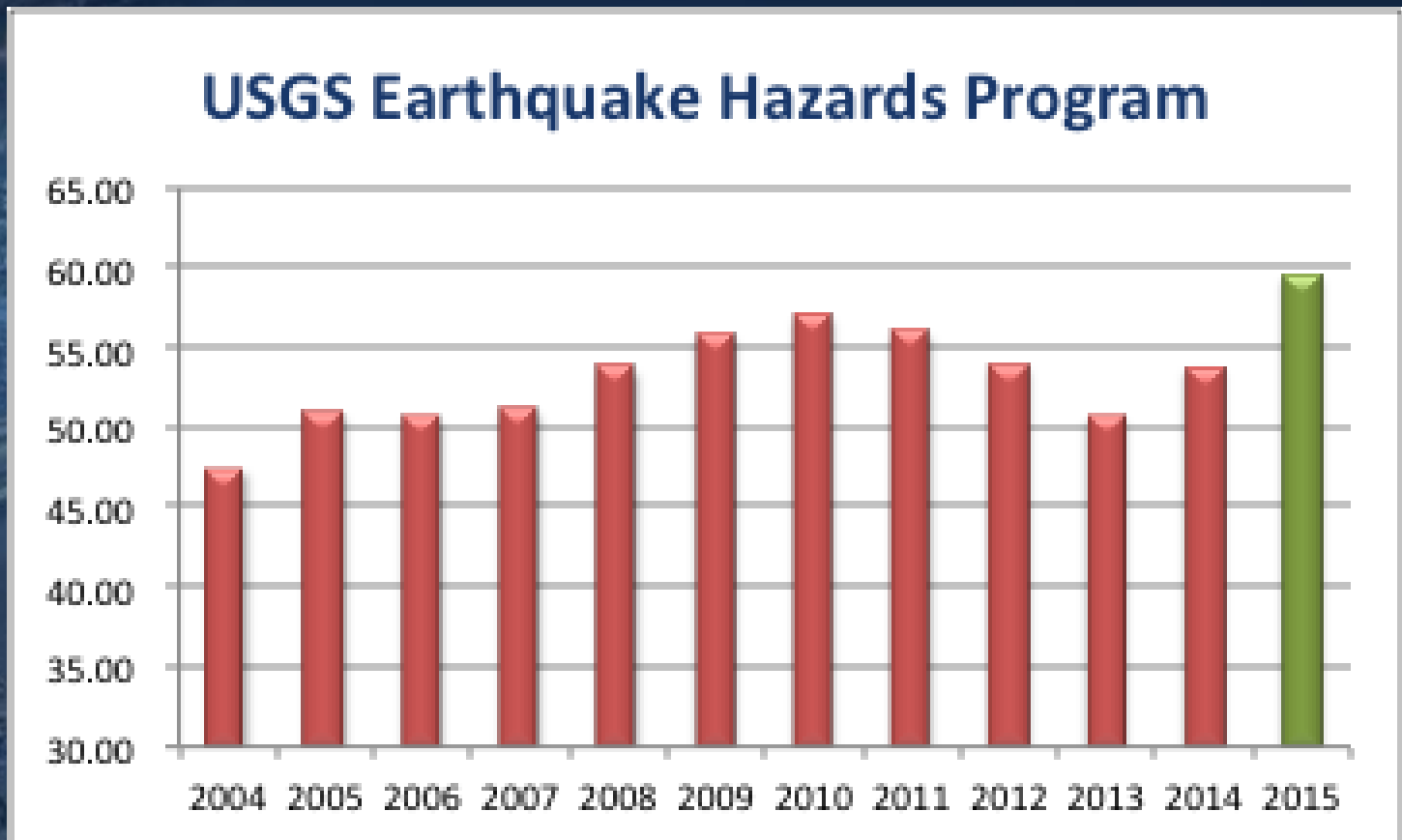
**Improved monitoring, the Central and Eastern US Network (CEUSN):** All CEUSN stations have been installed and are operated by IRIS. Equipment will continue to be bought and stations formally converted in FY15. NSF has been funding the majority of costs and USGS provided \$200K towards operations in FY14. USGS has continued need for full funding to take over the CEUSN .



# FY15 Budget

A second year of improving budget:

- ✓ +\$5.0M for earthquake early warning
- ✓ +\$0.7M for induced seismicity



# USGS Natural Hazards changes in the FY 2015 “CROmnibus” relative to request

- Congress provided an unrequested \$5M above FY14 levels toward development of earthquake early warning prototype for the West Coast
- A requested \$700K increase for induced seismicity studies was provided but without a requested offsetting cut to the Earthquake Hazards Program
- Provided an unrequested \$2M increase above FY14 for repairing and upgrading monitoring at highest threat volcanoes.

## FY15 CROmnibus by the numbers

USGS overall: \$1045M (+\$13M over FY14)

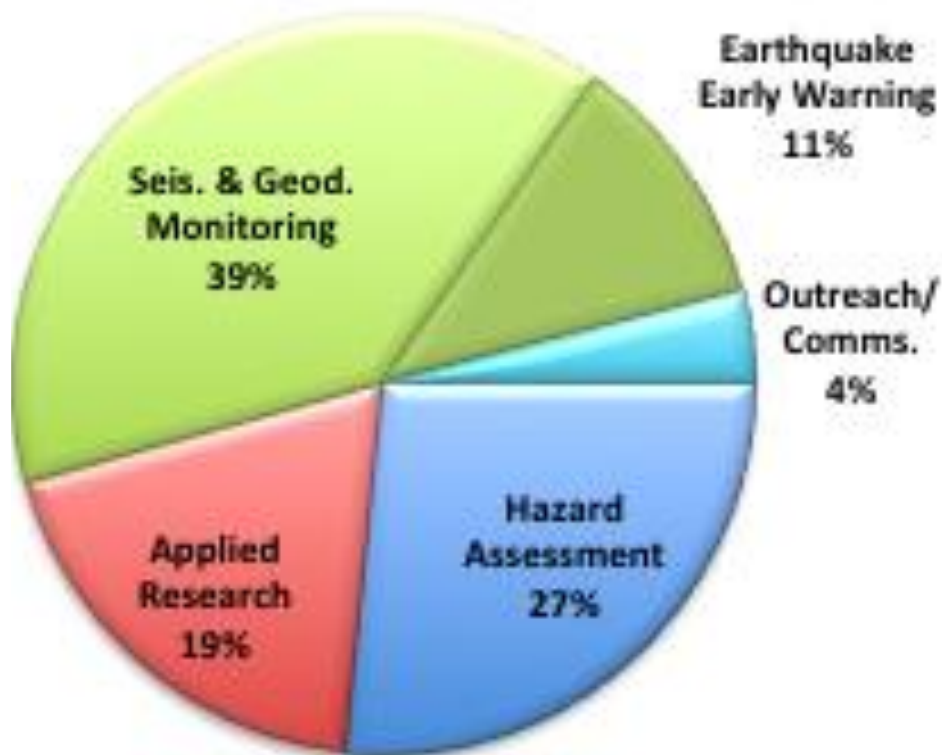
NHMA overall: \$135M (+6.7M over FY14)



# EHP FY15 Budget by Program Element

**Total  
budget is  
\$59M**

**External  
funding  
will be  
\$16.5M for  
grants and  
coops**



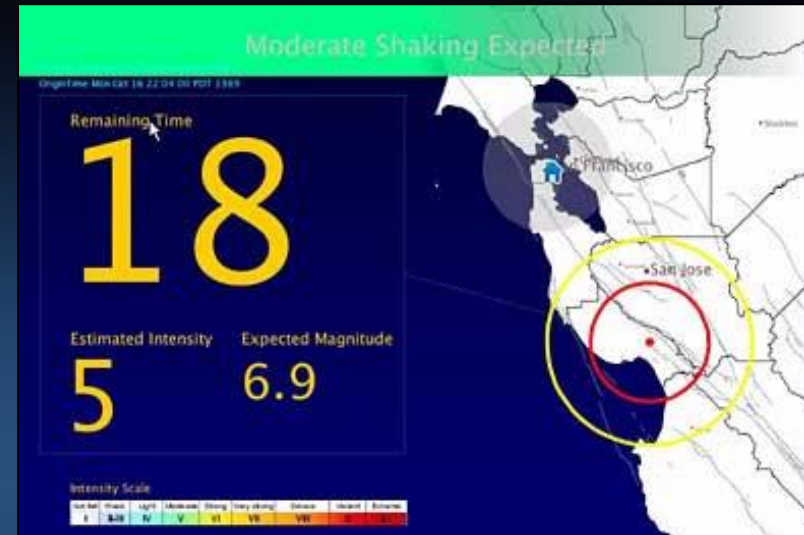
# FY 2016 initiative: “Natural Hazards Science for Disaster Response” (+\$6.6M over FY15)

- Expanding use of **flood** inundation mapping and rapid deployable streamgages (+\$0.5M)
- Rapid response to **volcano** unrest and eruption (at FY15 level)
- **Earthquake early warning** (-\$1.5M below FY15 level)
  - but \$700k cut proposed to the base program
- **Global Seismographic Network** sensor deployment (+\$4.9M)
- Building **landslide and sinkhole** response capacity (+\$0.7M)
- Improved **geomagnetic monitoring** to support space weather situational awareness (+\$1.7M)
- Rapid **wildfire** science response (+\$0.5M)
- **Disaster scenarios** and strategic science crisis response (+\$0.3M)

# Improving Disaster Response: Earthquake Early Warning

*(\$-1.5M relative to FY15; total funding requested \$5M)*

- Congress has proposed +\$5M for further EEW development in FY15
- This FY16 proposal leverages public and private sector investments to deliver EEW capability
- If funded, USGS could implement limited public warning system in southern California by 2018
- Requires expanding and modernizing existing networks, implementing and integrating response capabilities, partnering with end users on products, and support structure for rapid emergency response



**ShakeAlert Prototype – user display**





# Lingering effects of sequestration on the USGS hazards mission

Because Congress did not restore sequestration cuts in 2014 and the Administration did not request the restoration of cuts in 2015, there are lingering effects of the 2013 budget cuts:

- Funding for earthquake and volcano monitoring networks was reduced and modernization efforts are on-hold.
  - Cuts to networks include seismic, geodetic & geochemical
- Funding for targeted research grants to universities was reduced by about \$1 million
- Slow erosion of science staffing has reduced progress in many sub-disciplines
  - approximately one rehire for every two retirements

# Objectives not met in the FY16 budget proposal

## Earthquake Hazards:

- Restoration of sequestration cuts (*retaining stable staffing*)
- Ensuring the long-term operation of the Central and Eastern U.S. Seismic Network. (\$1.25M/yr needed)
- Implementing an Earthquake Early Warning System for the U.S. West Coast (\$16.1M/yr needed)

## Global Seismographic Network

- Replacement of the STS-1 sensors, no longer made
- Increased operating funds to reduce maintenance backlog (resulting in poorly performing stations)