

# The USGS Earthquake Hazards Program within NEHRP

## NEHRP Advisory Committee for Earthquake Hazard Reduction

William Leith  
U.S. Geological Survey  
10 May 2007



# outline

- USGS Role with NEHRP, Stafford Act Responsibilities, Mission Areas
- Seismic Monitoring, ANSS, Earthquake Information Products, Users
- Earthquake Hazard Assessment, input to building codes and Loss Estimation
- Research (internal and external), Partnerships, Leveraging
- Budget history, status and initiatives
- Global Seismographic Network --a partnership with NSF
- USGS Strategic Science Directions (new document)
- Multi-Hazards Initiative
- Broader Efforts: SDR, GEOSS, International Projects

# outline

## By NEHRP Program Activity:

-Develop Effective Measures...

-Improve Understanding...

-Develop, Operate and Maintain...

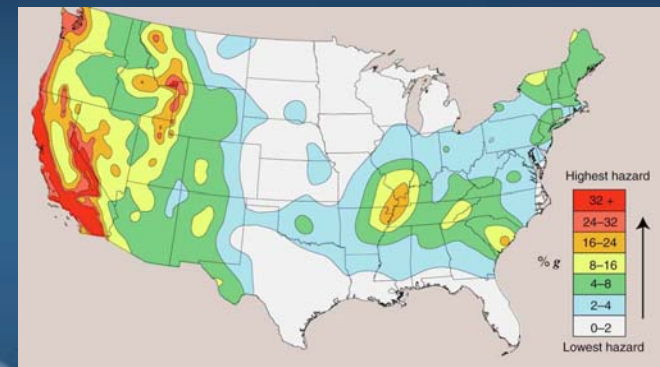
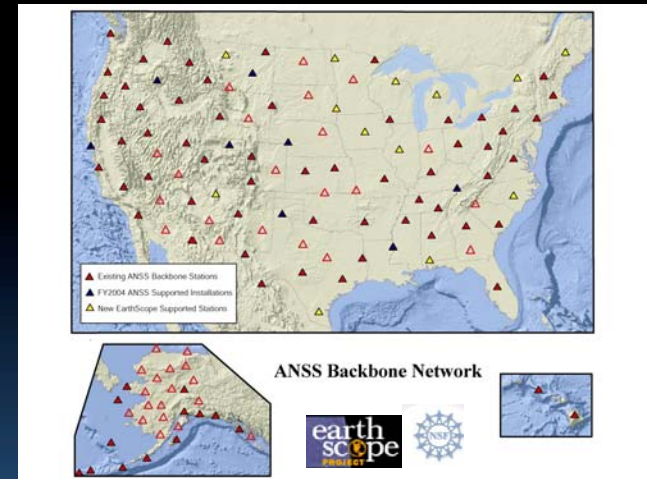
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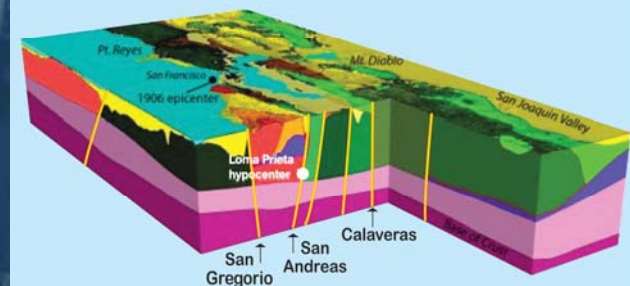
# The USGS role in NEHRP

- Provide earthquake monitoring and notifications,
- Assess seismic hazards, and
- Conduct research needed to reduce the risk from earthquake hazards nationwide.

Making the handoff from research to implementation takes partnerships at all levels of government and the private sector



## 3D Geologic "fault and block" model



Bob Jachens, Russ Graymer, Bob Simpson, and Carl Wentworth

# NEHRP priority areas of emphasis

- Developing advanced risk mitigation technologies and practices.
- Facilitating improved earthquake mitigation at state and local levels.
- Full implementation of ANSS.
- Further development of techniques for evaluating and rehabilitating existing buildings.
- Further development of Performance-Based Seismic Design (PBSD)
- Conducting future earthquake scenarios for key urban areas.
- Development of a Post-Earthquake Information Management System.
- Increasing consideration of socio-economic issues in both mitigation and response.





# Stafford Act Responsibilities

## Earthquake Hazards



## Volcano Hazards

- USGS has the lead federal responsibility to provide notification and warnings for **earthquakes**, **volcanoes**, and **landslides**.
- USGS seismic networks support NOAA in carrying out its responsibility for **tsunami** warnings.



## Landslide Hazards

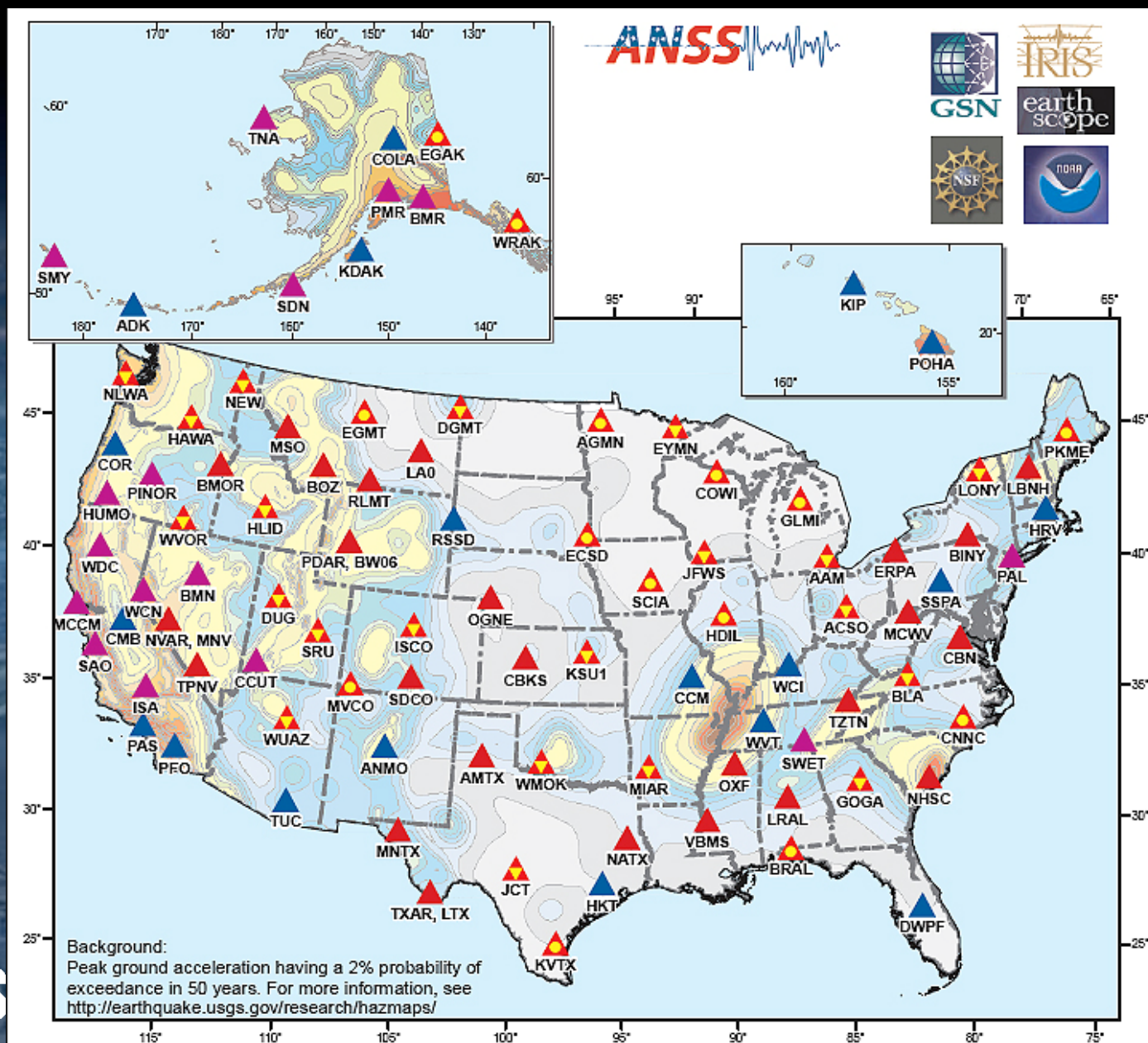
# The Advanced National Seismic System

- An integrated national monitoring system
  - A focus on the areas of highest risk
    - 26 urban areas slated for dense instrumentation
  - A commitment to rapid delivery of earthquake information to critical users and the public
  - A strategy to gather critically needed data on earthquake effects on structures
  - A system built through close partnerships with States and local jurisdictions
- 6000 strong motion sensors in 26 at-risk areas
  - 50% of these instruments in buildings and structures
  - 1000 new or upgraded regional stations
  - 100-station Backbone National Network



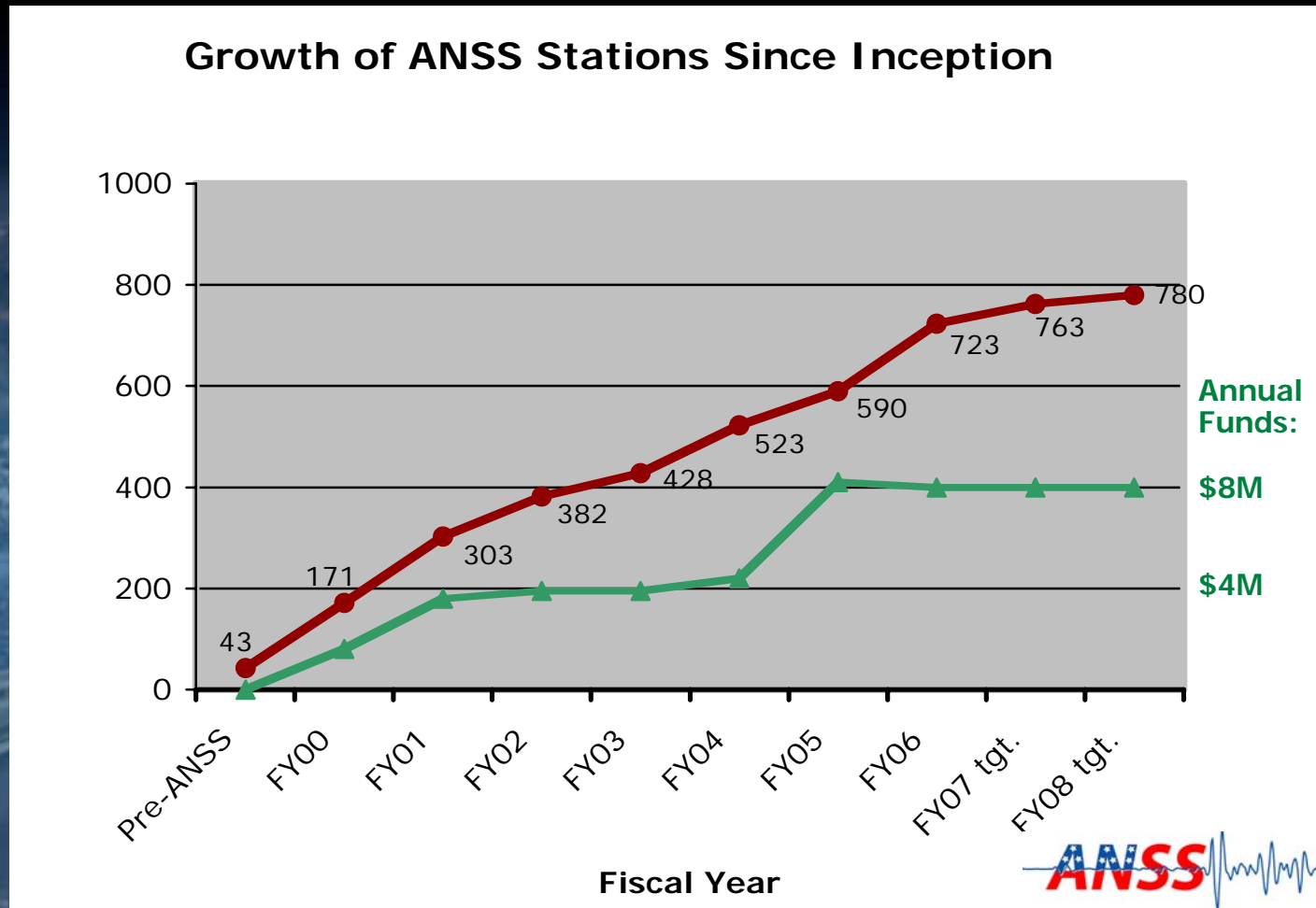


# The ANSS Backbone National Seismic Network





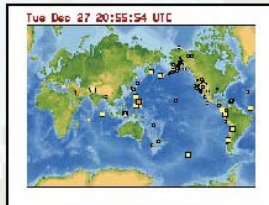
# Progress Implementing ANSS



ANSS Total Costs: Capitalization \$178M, Operations \$50M/yr



# ANSS Earthquake Informa



## Latest Earthquakes

Maps and information for U.S. and worldwide earthquakes within minutes after they occur.  
<http://earthquake.usgs.gov/eqcenter/>



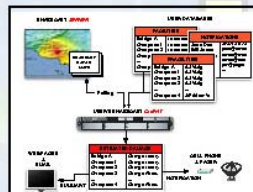
## ShakeMaps

Distribution of shaking from an earthquake anywhere in the world within minutes.  
<http://earthquake.usgs.gov/shakemap/>



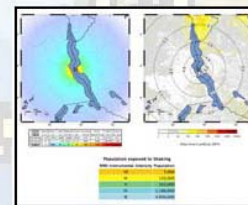
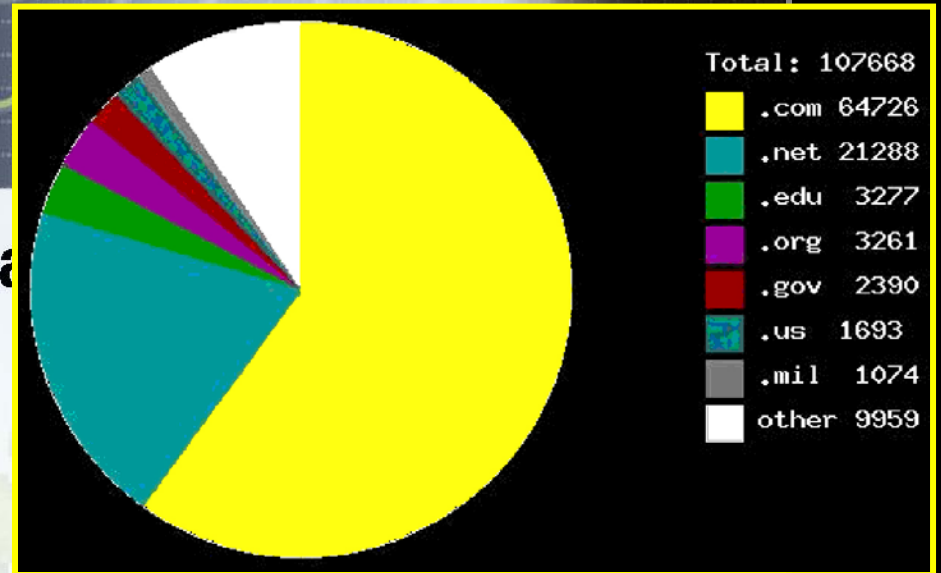
## Realtime Feeds & Data

Real-time earthquake data in a variety of formats including RSS, CAP, CSV, and KML.  
[http://earthquake.usgs.gov/eqcenter/feeds\\_data.php](http://earthquake.usgs.gov/eqcenter/feeds_data.php)



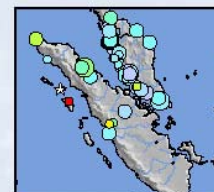
## ShakeCast

Automated ShakeMap delivery, damage assessment, and notification for critical lifeline operators.  
<http://earthquake.usgs.gov/resources/software/shakecast/>



## PAGER

Estimates of population exposure to significant earthquake shaking anywhere in the world within minutes.  
<http://earthquake.usgs.gov/pager/>



## Did You Feel It?

Citizen science webpage where shaking intensity maps are created by the people who felt the earthquake.  
<http://earthquake.usgs.gov/dyfi/>



## CISEN Display

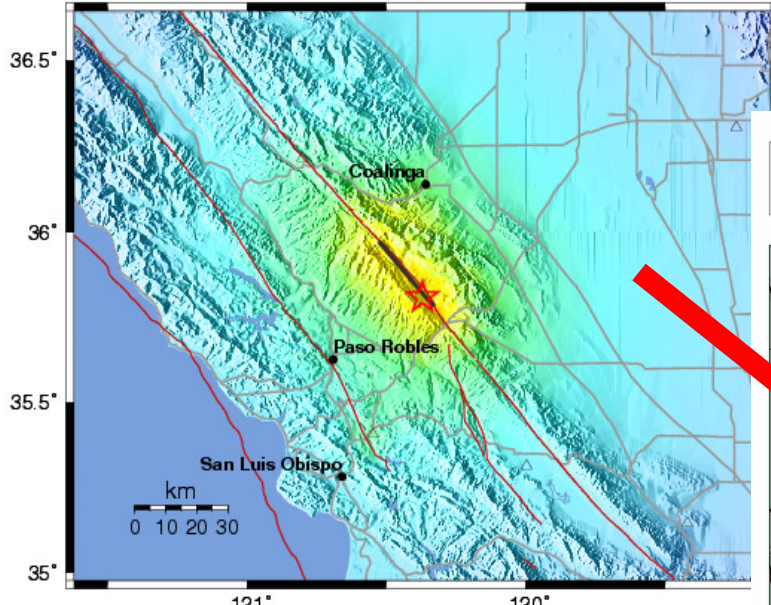
Downloadable software to visualize and receive notifications for seismicity anywhere in the world on your computer.  
<http://www.cisn.org/software/cisndisplay.html>



# ShakeMap supports targeted response and rapid loss estimation

## ShakeMap for the M6.0 Parkfield earthquake Sep. 28, 2004

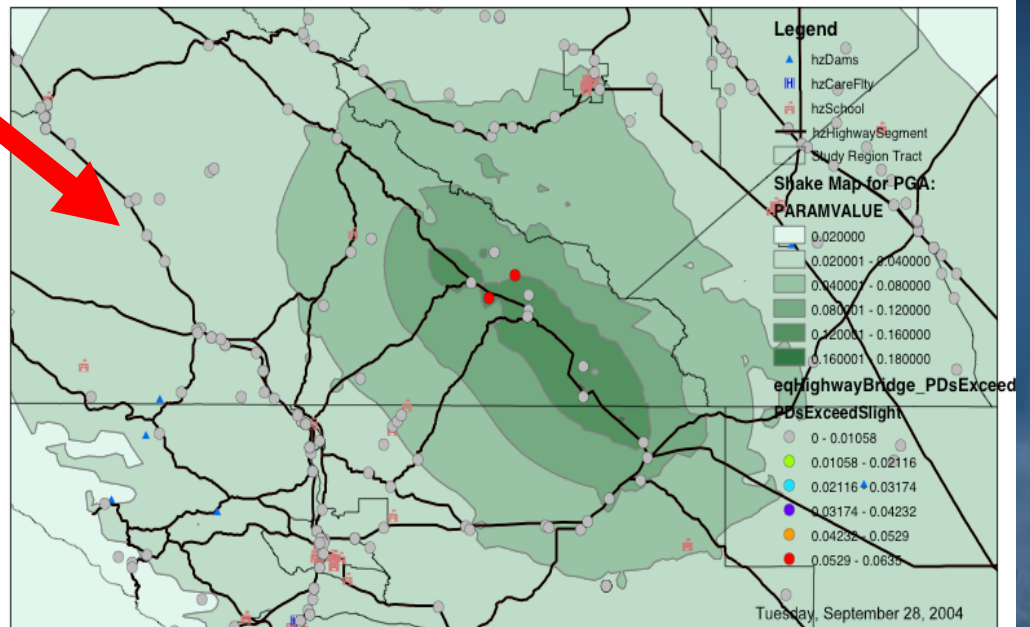
CISN Rapid Instrumental Intensity Map Epicenter: 11 km SSE of Parkfield, CA  
 Tue Sep 28, 2004 10:15:24 AM PDT M 6.0 N35.81 W120.37 Depth: 7.9km ID:51147892



Processed: Tue Sep 28, 2004 12:18:03 PM PDT, -- NOT REVIEWED BY HUMAN

PERCEIVED SHAKING	Not felt	Weak	Light	Moderate	Strong	Very strong	Severe	Violent	Ext
POTENTIAL DAMAGE	none	none	none	Very light	Light	Moderate	Moderate/Heavy	Heavy	Very
PEAK ACC.(%g)	<.17	.17-1.4	1.4-3.9	3.9-9.2	9.2-18	18-34	34-65	65-124	>
PEAK VEL.(cm/s)	<0.1	0.1-1.1	1.1-3.4	3.4-8.1	8.1-18	18-31	31-60	60-118	>
INSTRUMENTAL INTENSITY	I	II-III	IV	V	VI	VII	VIII	IX	X

Study Region : Parkfield Region  
 Hazard Scenario : ShakeMap Mw 6.0 Parkfield



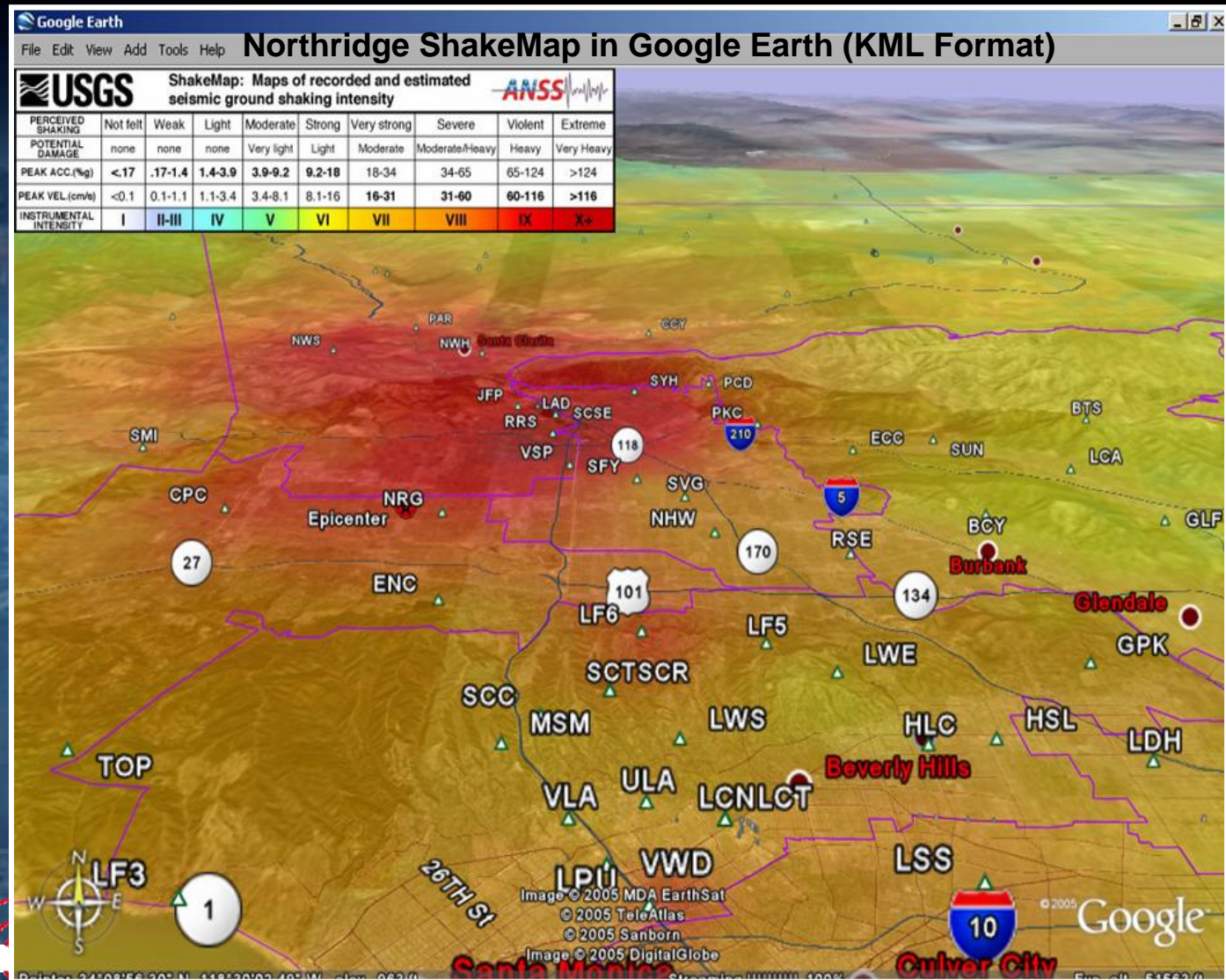
(c) 1997-2003 FEMA.



FEMA-generated loss estimation results based on ShakeMap data

# ShakeMap and Recent Earthquakes now available to users as Google Earth overlays and symbol sets

In progress:  
ANSS event  
catalog and  
stations

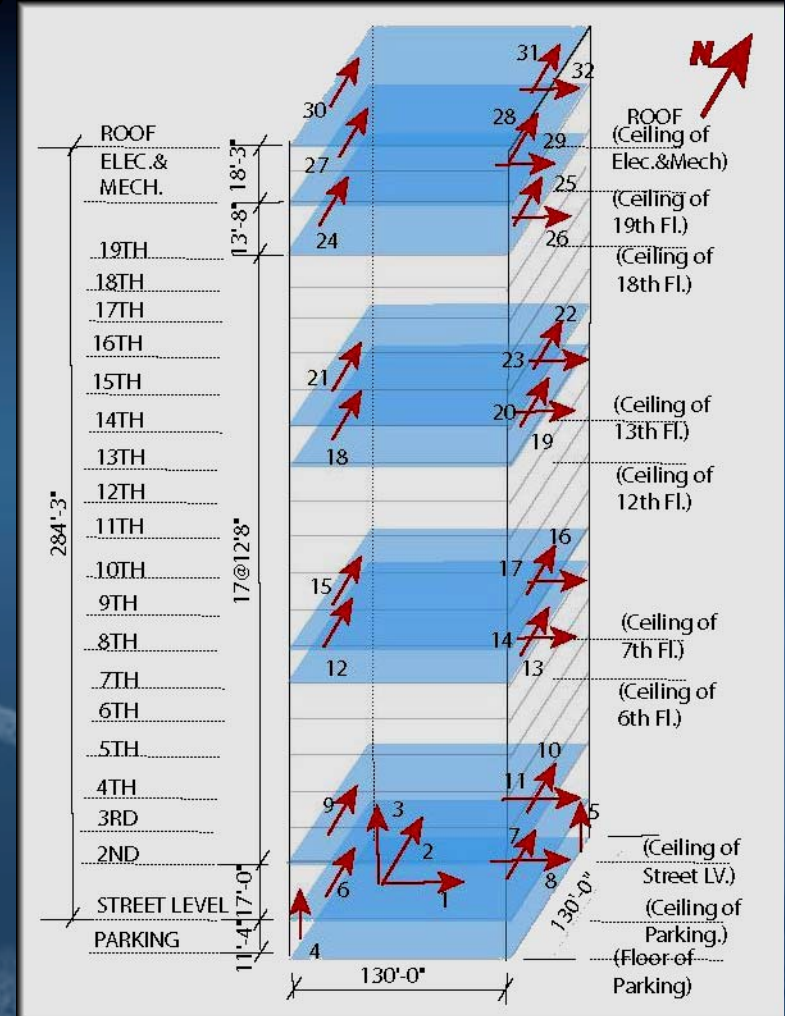




# Instrumentation of Structures, to provide data for engineers and designers so that safer structures are built

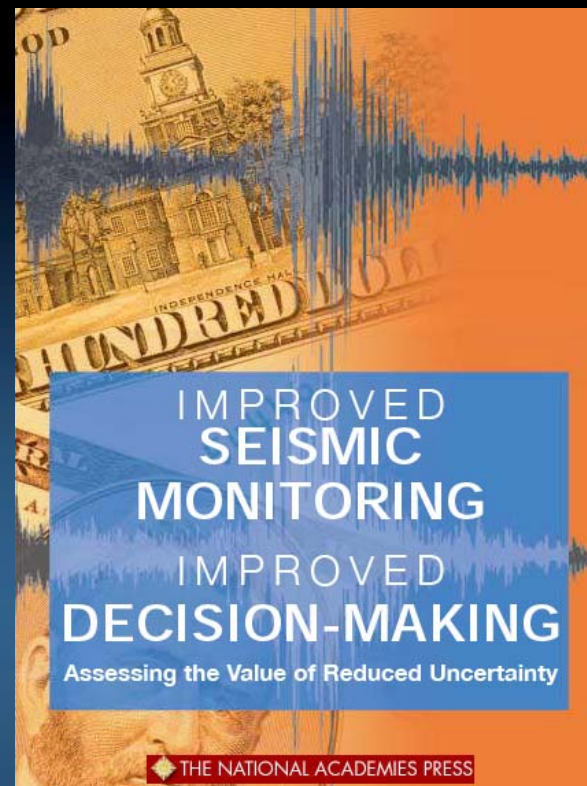
Northridge ShakeMap in Google Earth (KML Form)

- ANSS has completed instrumentation of six structures, with another ten to be completed in 2007
- Focus is on densely-instrumented structures to complement the CSMIP program
- ANSS Plan is nominally for ~9000 channels of data in buildings, bridges and geostructures
- ANSS boasts the most densely instrumented building in the U.S.



# Economic Cost/Benefit Study by the National Research Council

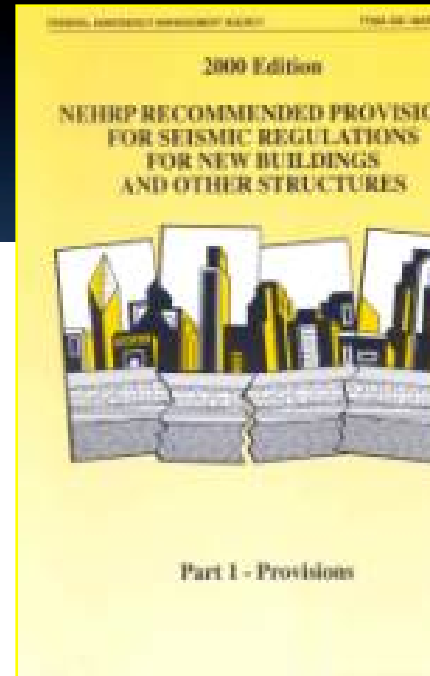
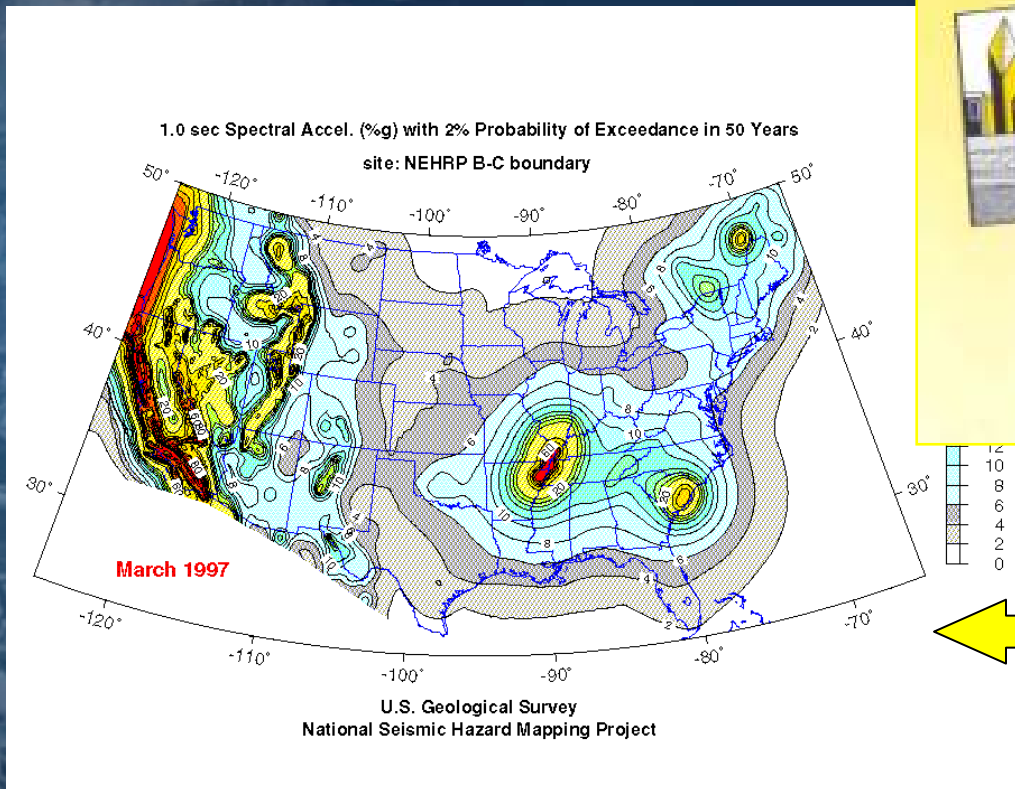
- *What are the benefit areas?*
- Emergency Response and Recovery
- Tsunami Warning
- Loss Estimation Modeling
- Improved Building Codes and Land Use Regulations
- Performance-Based Engineering
- Insurance and Reinsurance
- Public Confidence and Understanding



The report's bottom line: Benefits of improved seismic monitoring far exceed the costs, with costs for improved monitoring estimated in the tens of millions, but potential dollar benefits in the hundreds of millions.



# USGS national hazard mapping results in dramatic change in building codes... and now in 2007: The Next Generation



Seismic element of  
2000 NEHRP  
Provisions and 2003  
Int'l Building Code  
based on the 1996  
USGS national  
seismic hazard map

# Liquefaction Susceptibility - Highest zone

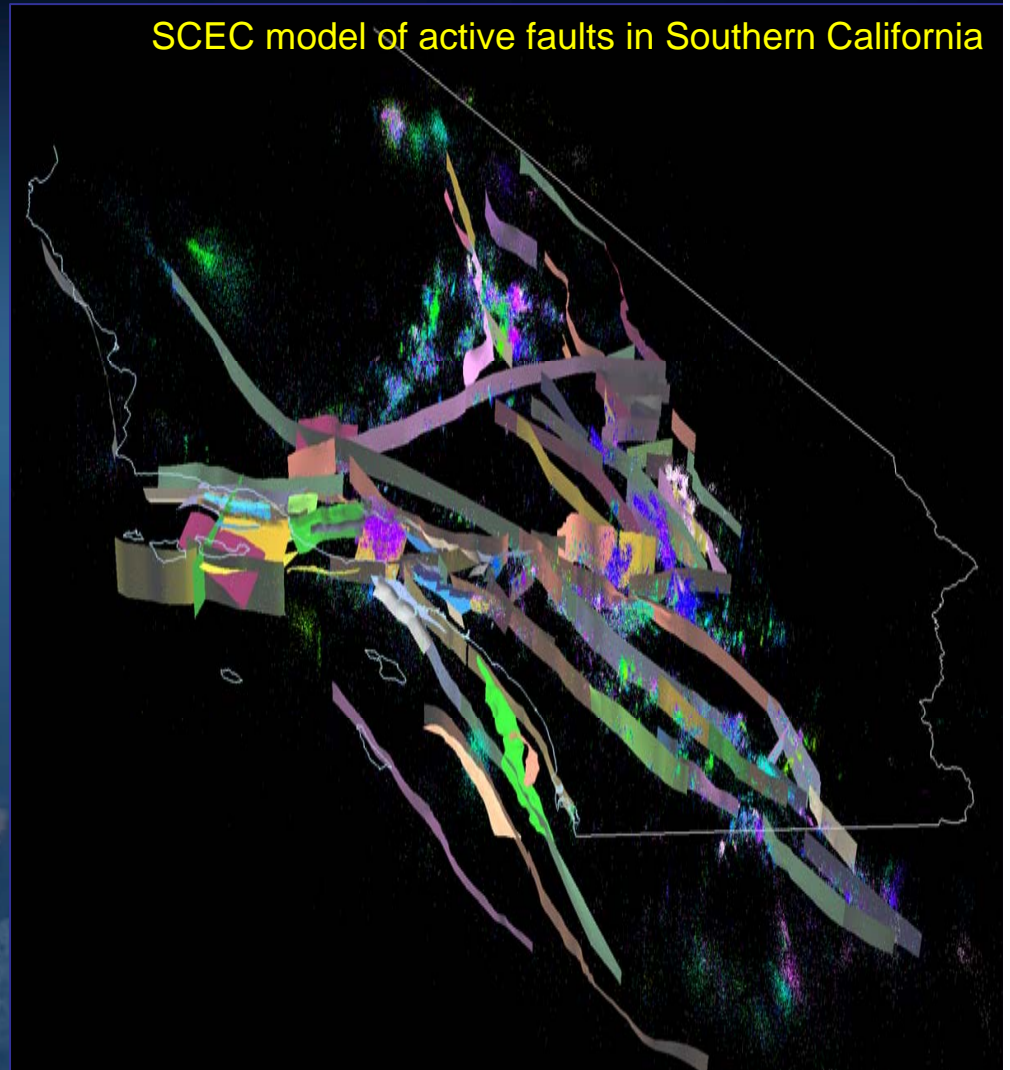




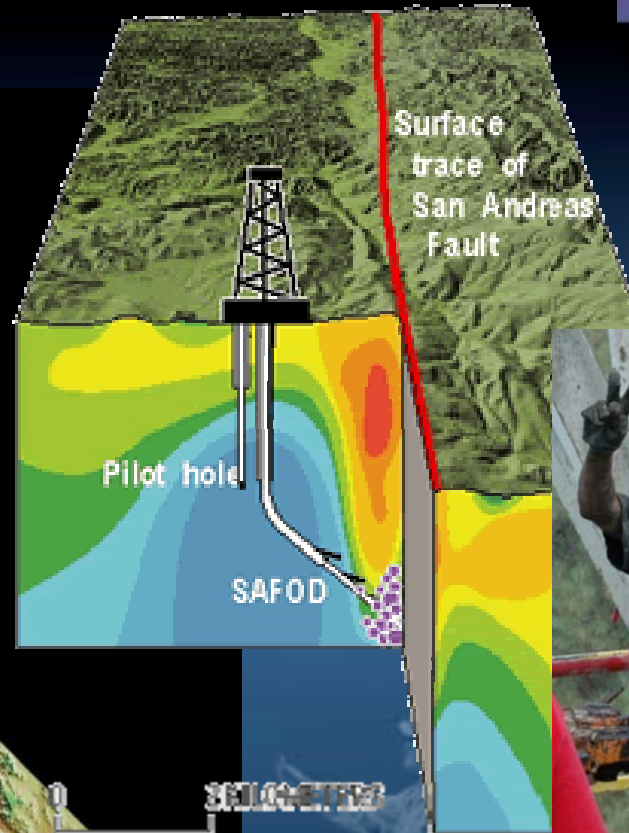
# External grants and cooperative agreements are a key component of the Earthquake Hazards Program

- Approximately 25% of core program funds (just over \$12M in FY06)
- Gives flexibility and adds breadth of expertise to program
- Leverages support from other state and federal agencies, universities and the private sector

SCEC model of active faults in Southern California



# Parkfield and SAFOD



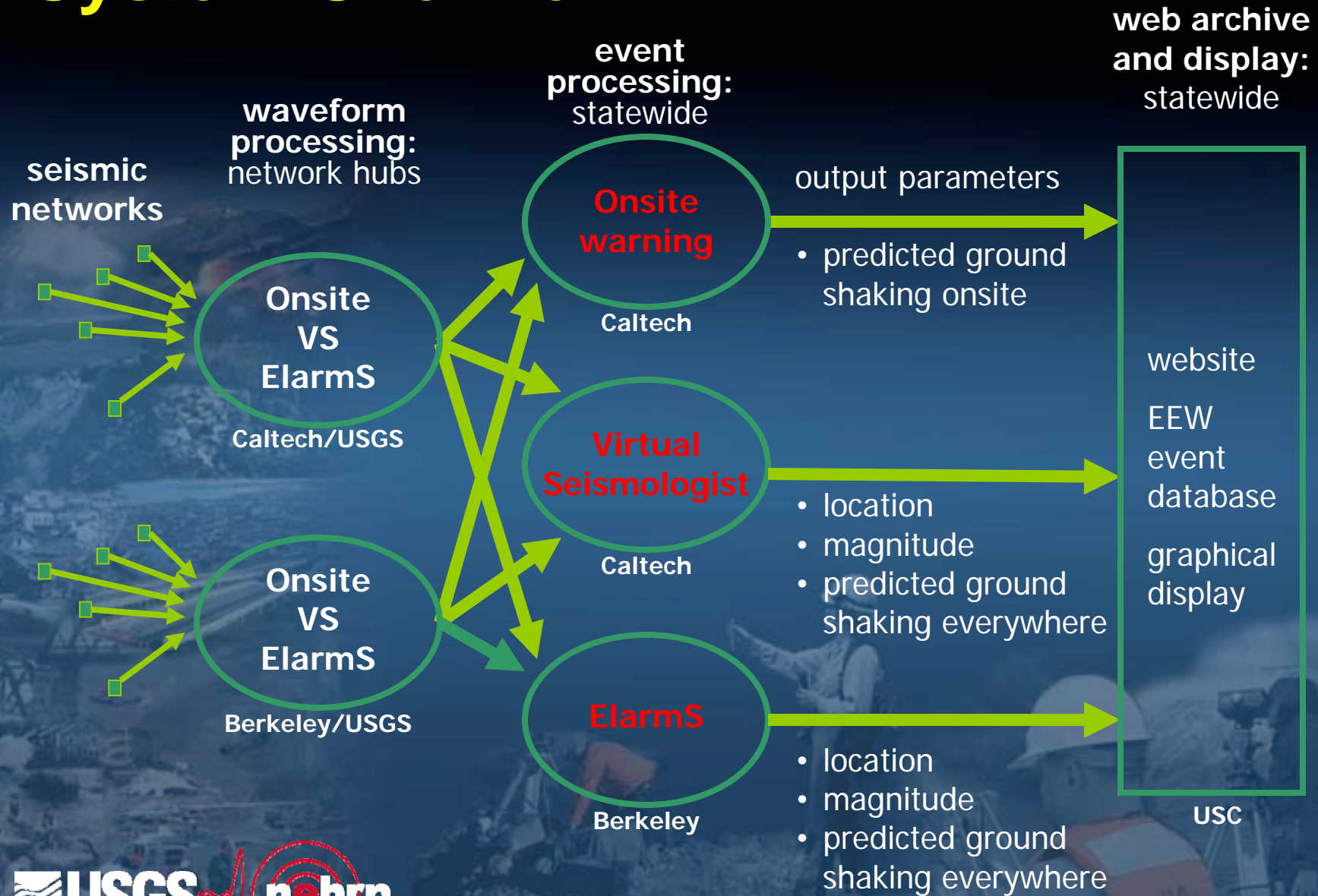


# FY06 External grants and cooperative agreements

- “NEHRP” Grants allow independence of investigators
  - 94 one-year grants and 5 two-year grants for a total of \$4.6M
- Cooperative Agreements are used when USGS will have substantive involvement during investigations or network operations
  - 16 regional seismic networks funded with a combination of base program and ANSS funds (\$5.9M)
  - 7 geodetic monitoring operations (\$0.5M)
  - 15 unsolicited proposals (\$1.8M) including
    - Southern California Earthquake Center (\$1.1M; jointly funded with NSF)
    - CalTech, UC Berkeley, & USC for testing of earthquake early warning algorithms

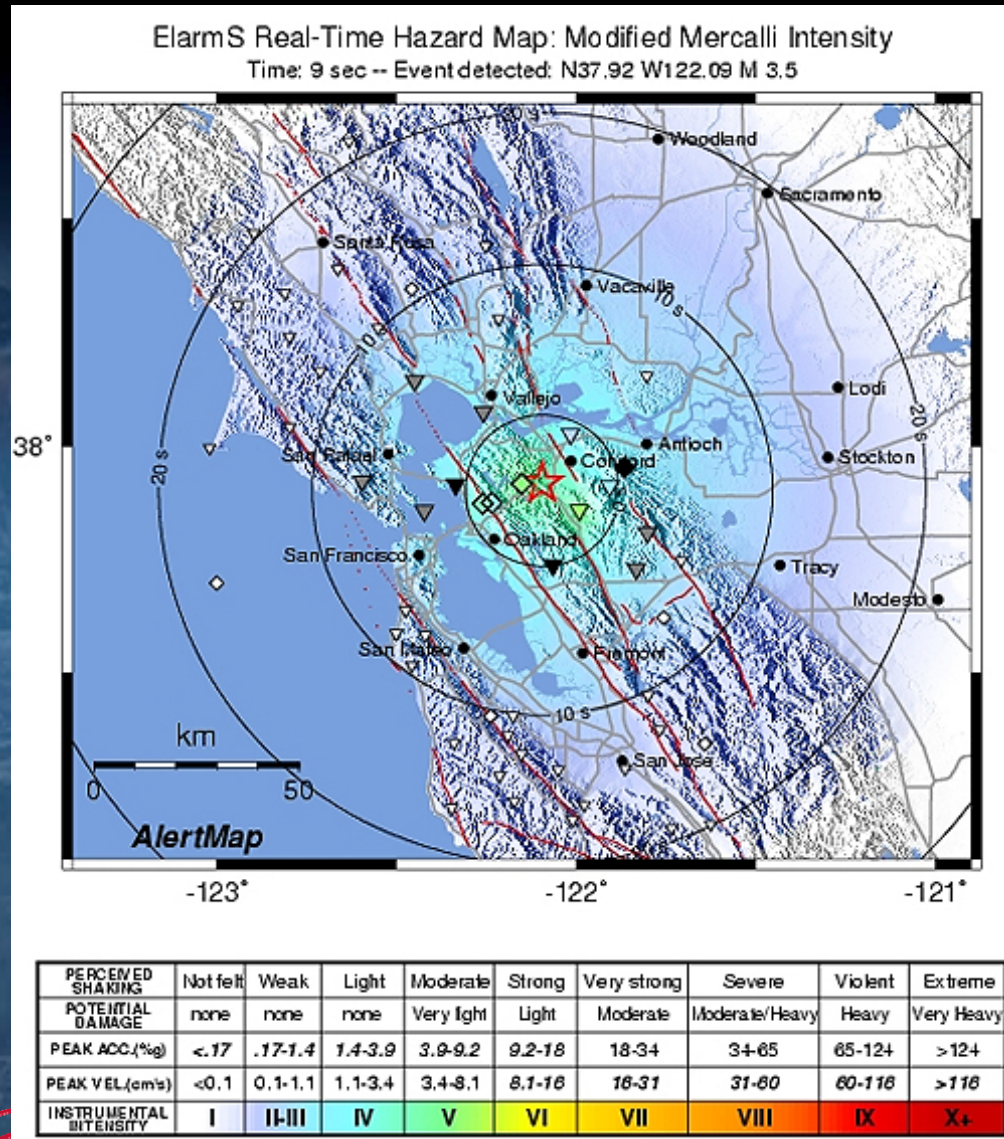
## Earthquake Early Warning

# System Overview

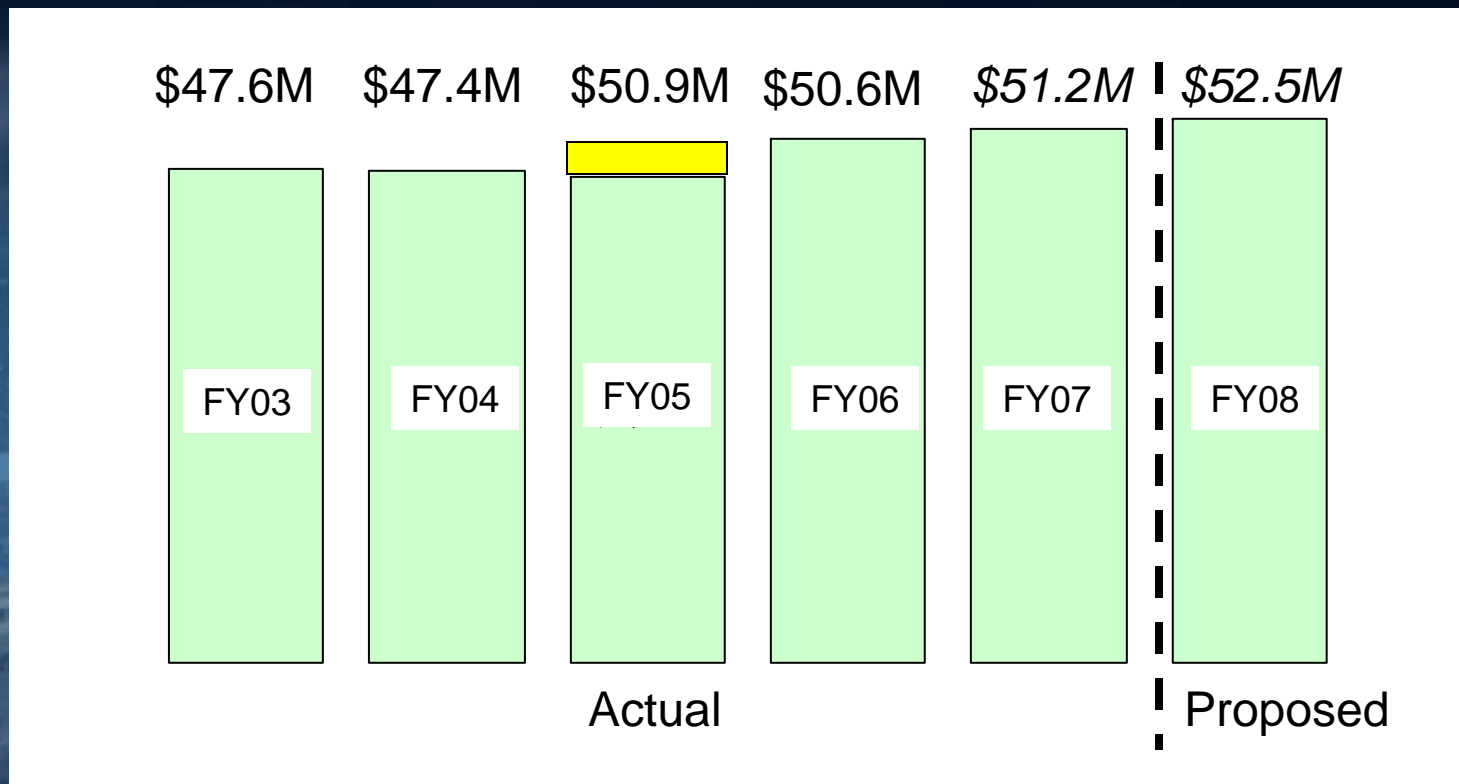




# Sample Alarms output for M4.4 Bay Area Earthquake



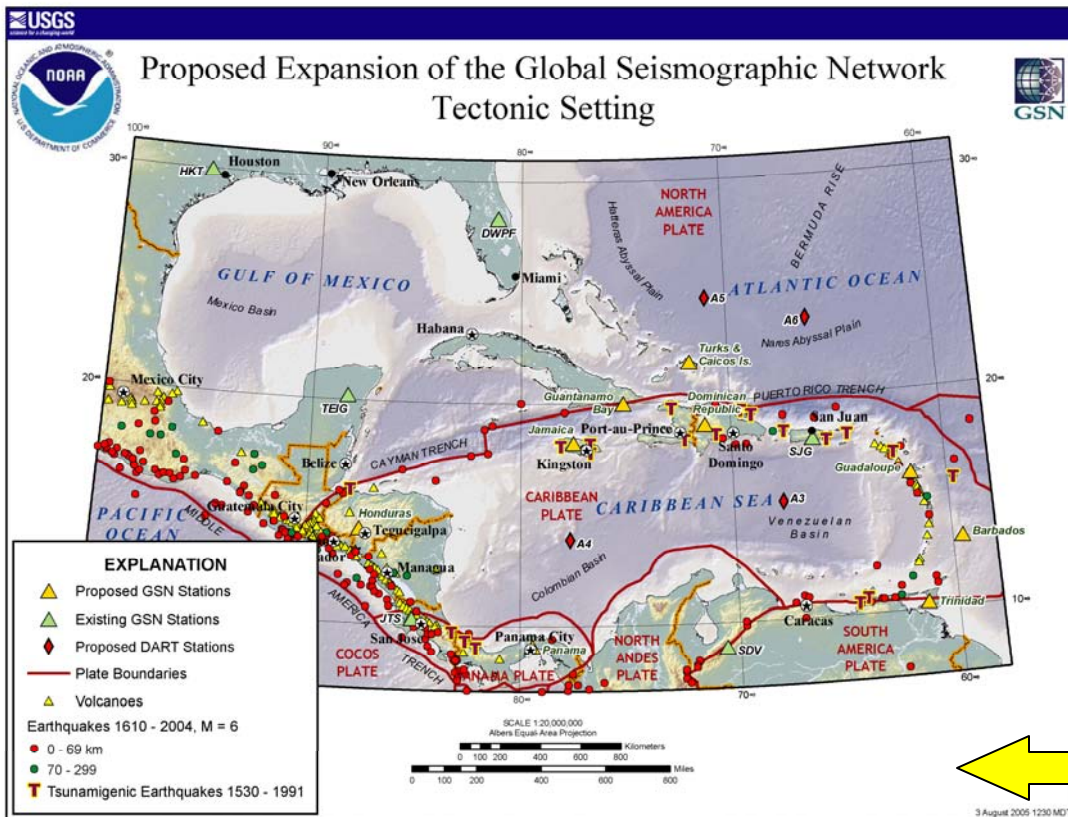
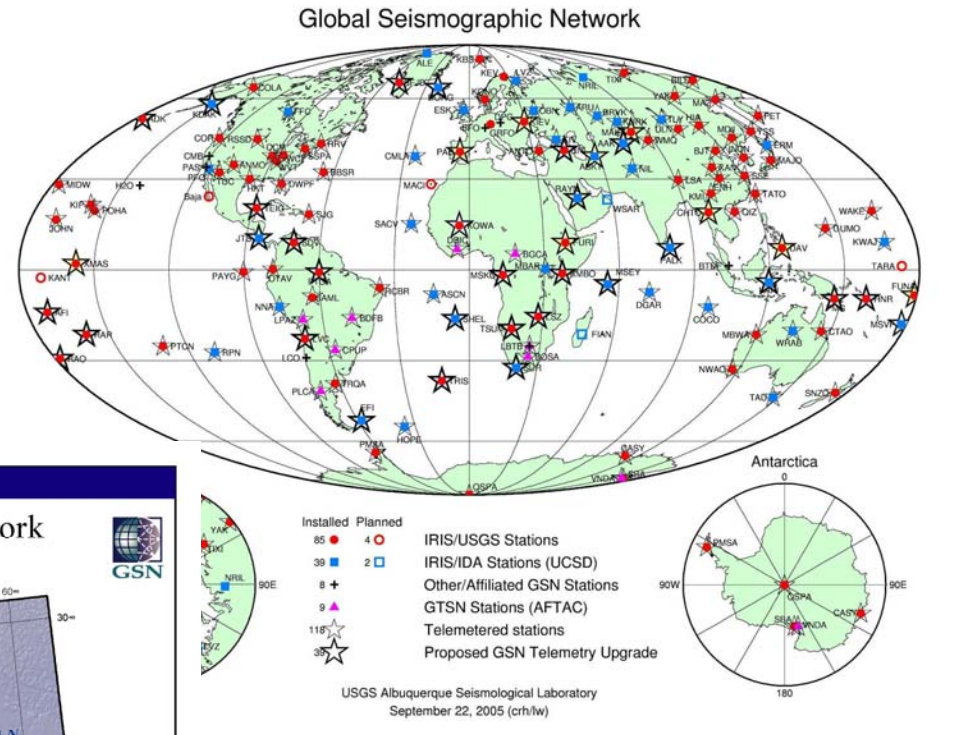
# Recent Earthquake Hazards Program funding history and FY08 request





# Global Seismographic Network

**FY 2005 enacted: \$3.4 million**  
**FY 2005 supplemental: +\$4.1M**  
**FY 2006 enacted: \$3.9M**  
**FY 2007 operations: \$3.9M**  
**FY 2008 request: \$4.0M**



- 32 stations upgraded
  - Bandwidth expanded at 21 stations
  - Telemetry added to 8 stations
- 9 new stations**

# Global Disaster Response Role: Kuril Islands quake, M8.3

USGS Earthquake Hazards Program - Magnitude 8.3 - KURIL ISLANDS - Microsoft Internet Explorer

Address: <http://earthquake.usgs.gov/eqcenter/eqcenterpwn/Quakes/usvcam.php#details>

**USGS**  
science for a changing world

**Earthquake Hazards Program**

Home | **Earthquake Center** | Regional Information | About Earthquakes | Research & Monitoring | Other Resources

You are here: Home > Earthquake Center > Latest Earthquakes - World > Magnitude 8.3 - KURIL ISLANDS

**Latest Earthquakes**

**Magnitude 8.3 - KURIL ISLANDS**  
2006 November 15 11:14:16 UTC

Version en Español

Details Summary Maps Scientific & Technical

**Earthquake Details**

Magnitude	8.3 (Great)
Date-Time	Wednesday = Coordinated Wednesday = local time at
Location	46.577°N, 153.550°E
Depth	26.7 km (16.6 mi)
Region	KURIL ISLANDS
Distances	440 km (275 mi) 505 km (315 mi) 1650 km (1030 mi) 7185 km (4465 mi)
Location Uncertainty	horizontal +/- vertical +/-
Parameters	Nst=232, Nph=1, M-type=moment tensor
Source	USGS NEIC (Worldwide)
Event ID	usvcam

This event has been reviewed by a seismologist.

[Did you feel it?](#)  
Report shaking and damage at your location. You can also report shaking and damage at your location.

**Preliminary Earthquake Report**

NOAA's National Weather Service  
**Pacific Tsunami Warning Center**

Site Map News Organization Search [NWS Search] Go

Local forecast by "City, St or Zip Code"  
City, St, Zip Go

NOAA > NWS > PTWC Home Page > Bulletins

**PTWC Bulletins**

**PACIFIC OCEAN**

- Latest
- Previous

**HAWAII ISLANDS**

- Latest
- Previous

**INDIAN OCEAN**

- Latest
- Previous

**PUERTO RICO/VIRGIN IS.**

- Latest
- Previous

**Bulletins**

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- Indian Ocean
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- Regional HQ
- Central Pacific
- Hurricane Center
- WFO, Honolulu
- WFO, Guam
- WSO, Pago Pago
- International
- Tsunami
- Information
- Center
- Contact Us
- ptwc@ptwc.noaa.gov
- webmaster@ptwc.noaa.gov

Search the Pacific Tsunami Warning Center Website!  
PTWC search Go

**Epicenter - 15 NOV 2006 11:14Z 153.5E 46.7N Mag: 8.1**

elevation (m)  
10000  
9000  
8000  
7000  
6000  
5000  
4000  
3000  
2000  
1000  
0  
-1000  
-2000  
-3000  
-4000  
-5000  
-6000  
-7000  
-8000  
-9000  
-10000

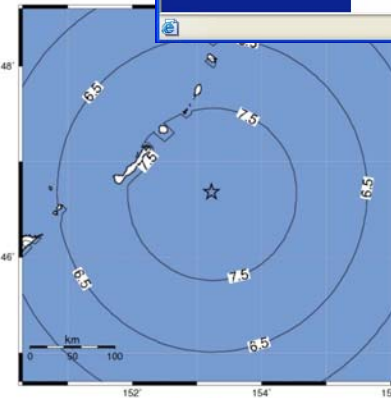
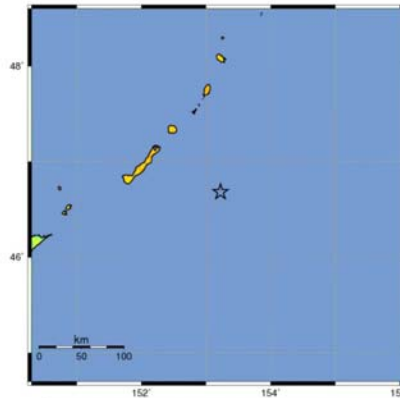


## Prompt Assessment of Global Earthquakes for M8.3 KURIL ISLANDS

PAGER V2(Wed Nov 15, 2006, 03:08:47 PM GMT)

N46.68 E153.22 27.7km Wed Nov 15, 2006 11:14:16

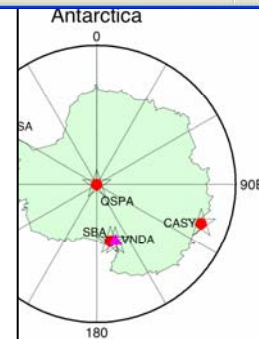
### Shaking Intensity



Intensity	Peak Acc (g)	Peak Vel (cm/s)	Peak Disp (cm)	Intensity	Peak Acc (g)	Peak Vel (cm/s)	Peak Disp (cm)
I	0.05	0.5	1	VI	0.5	5	10
II	0.1	1	2	VII	1	10	20
III	0.2	2	4	VIII	2	20	40
IV	0.4	4	8	IX	4	40	80
V	0.8	8	16	X	8	80	160
VI	1.6	16	32	XI	16	160	320
VII	3.2	32	64	XII	32	320	640
VIII	6.4	64	128				
IX	12.8	128	256				
X	25.6	256	512				
XI	51.2	512	1024				
XII	102.4	1024	2048				

(Data from LandScan 2003)

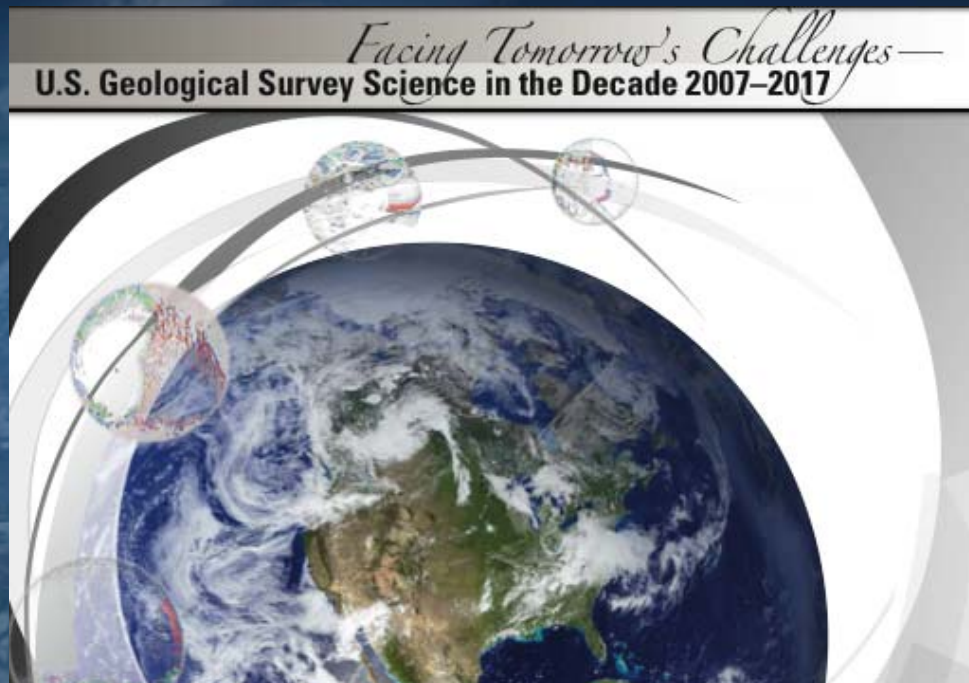
Population exposed to shaking  
No population exposure





# Bureau Strategic Science Direction

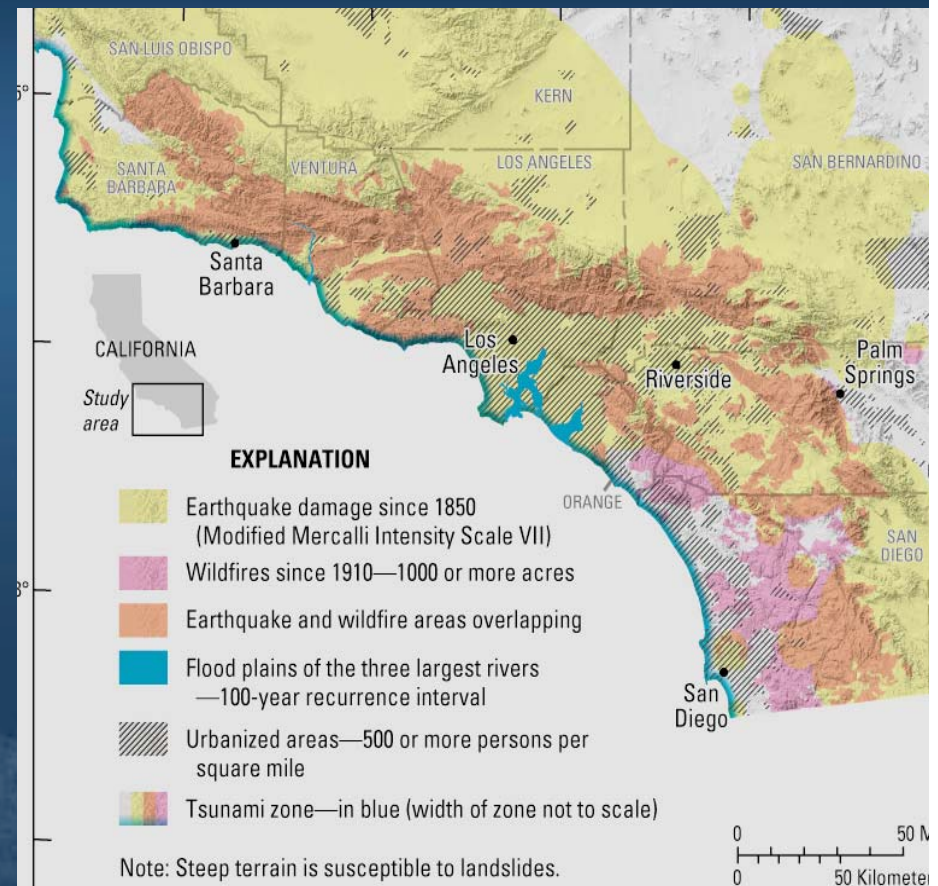
- New USGS Bureau Science Strategy identifies five areas for USGS to focus hazards efforts in the next decade:



- Robust monitoring infrastructure
  - calls out ANSS, NVEWS, stream gauges, Marsh Surface Elevation Table Network, and LiDAR
- Technology for network communications
- Characterizing and assessing hazards
  - expand urban hazard mapping and incorporate vulnerability to deliver risk assessment
- Improved forecasting capability based on understanding physical processes
- Partnerships

# USGS Hazards Initiative in FY07: Multi-Hazard Demonstration Project

- Focused on reducing losses in Southern California: a region subject to multiple hazards
- Integrate information from multiple hazards to improve usefulness
- Work closely with dozens of partner organizations to leverage resources and optimize performance

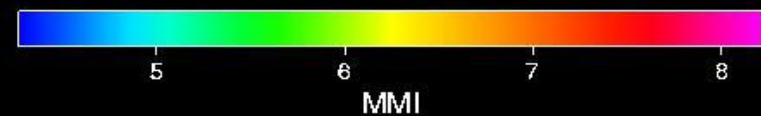
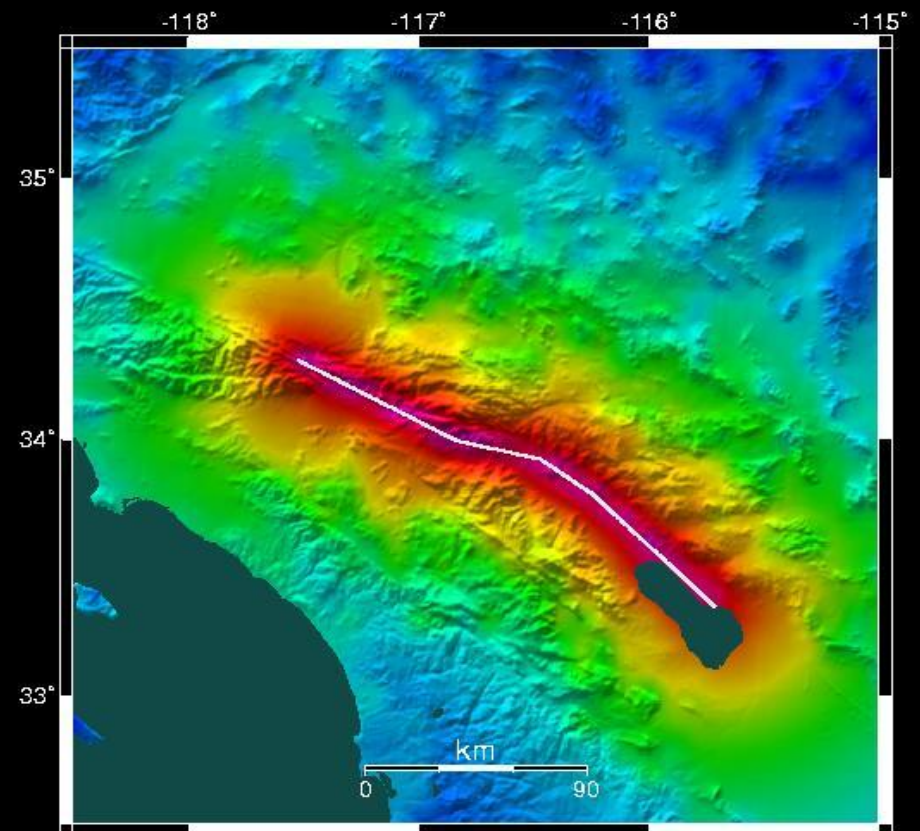




# Multi-hazard scenario

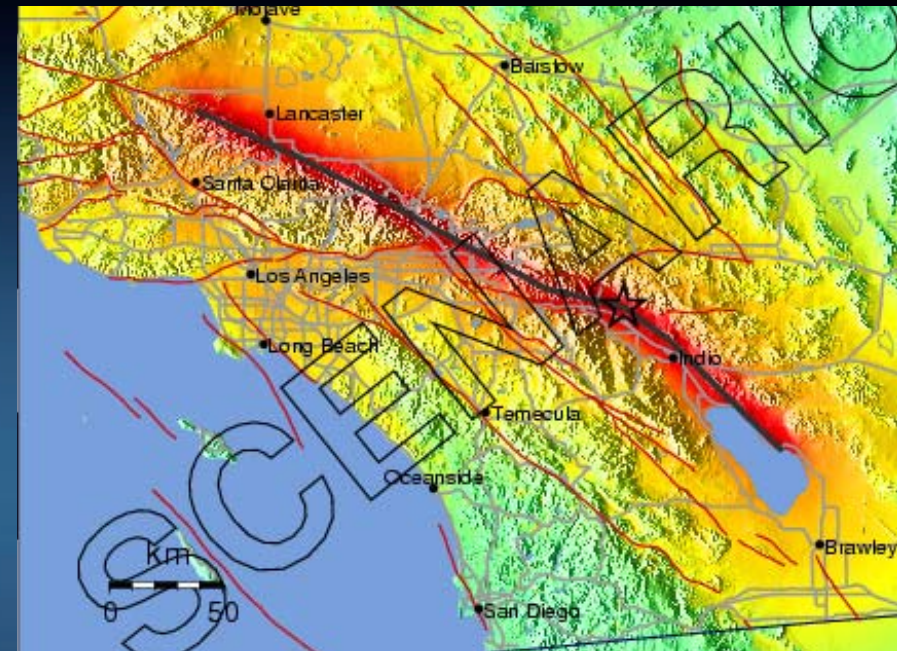
- “Rupture-to-recovery” scenario (including economic analysis) for a San Andreas earthquake that triggers secondary fires, landslides and dam failure

Southernmost San  
Andreas Fault,  
Magnitude 7.7  
Shaking Intensity



# The Great Southern California ShakeOut

- USGS and partners will create complete “rupture-to-recovery scenario” for most likely earthquake
- Use scenario to run region-wide exercise in 2008
- Agreement with CA Office of Homeland Security to make this the 2008 “Golden Guardian Exercise”





# Partnerships: Earthquake Country Alliance and “Dare to Prepare” campaign

VIERNES 27 DE ABRIL DE 2007

**PREPÁRATE HOY Y PROTEGE A TUS SERES QUERIDOS!**

**MITOS Y REALIDADES SOBRE LOS TERREMOTOS**



Estimate cómo prepararte para un terremoto y CÓMO OBTENER TU COPIA GRATIS del cuadernillo informativo "Echando raíces en tierra de terremotos" al final de esta sección.



SRE LOS ANGELES 34 SCS/EC CEA CALIFORNIA EARTHQUAKE AUTHORITY Earthquake Country Alliance Hoy SUPLEMENTO PUBLICITARIO

**Shift happens.**  
*secure your space...*



Let's talk about our faults.  
[www.daretoprepare.org](http://www.daretoprepare.org)

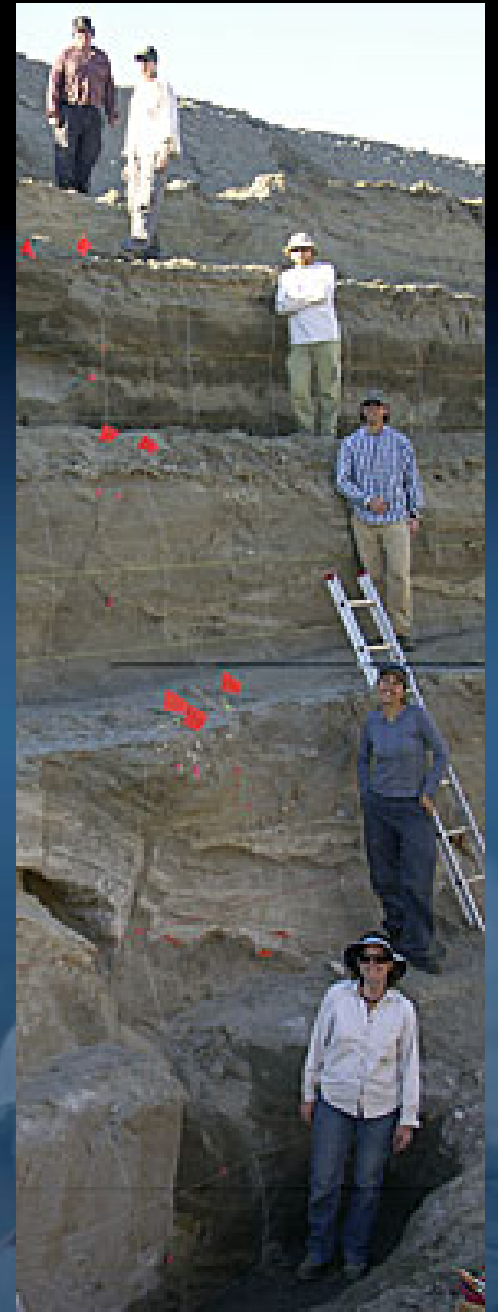
**DARE to prepare**  
2007 Earthquake Readiness Campaign



**Earthquake Country Alliance**  
*We're all in this together.*

# SoSAFE

- Digging into the fault because the past is the key to understanding the future
- Targeted research to fill critical gaps in our understanding of the southern San Andreas Fault
- Carried out with academic partners through Southern California Earthquake Center

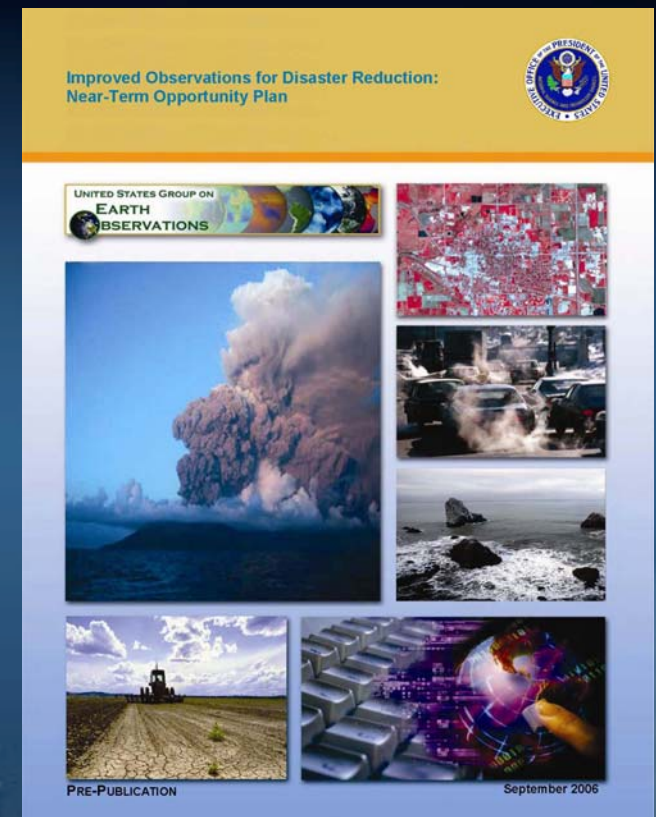




# Improved Observations for Disaster Reduction: Joint USGEO/SDR Near-Term Opportunity Plan

Building on the tremendous progress that has been made in warning capabilities for meteorological hazards due to investments in network modernization and improved system integration, the IEOS *Strategic Plan* identified a Near-Term Opportunity to make similar progress in the geologic hazards, including earthquakes, volcanic eruptions, tsunamis and coastal inundation hazards, landslides and subsidence.

<http://usgeo.gov/>



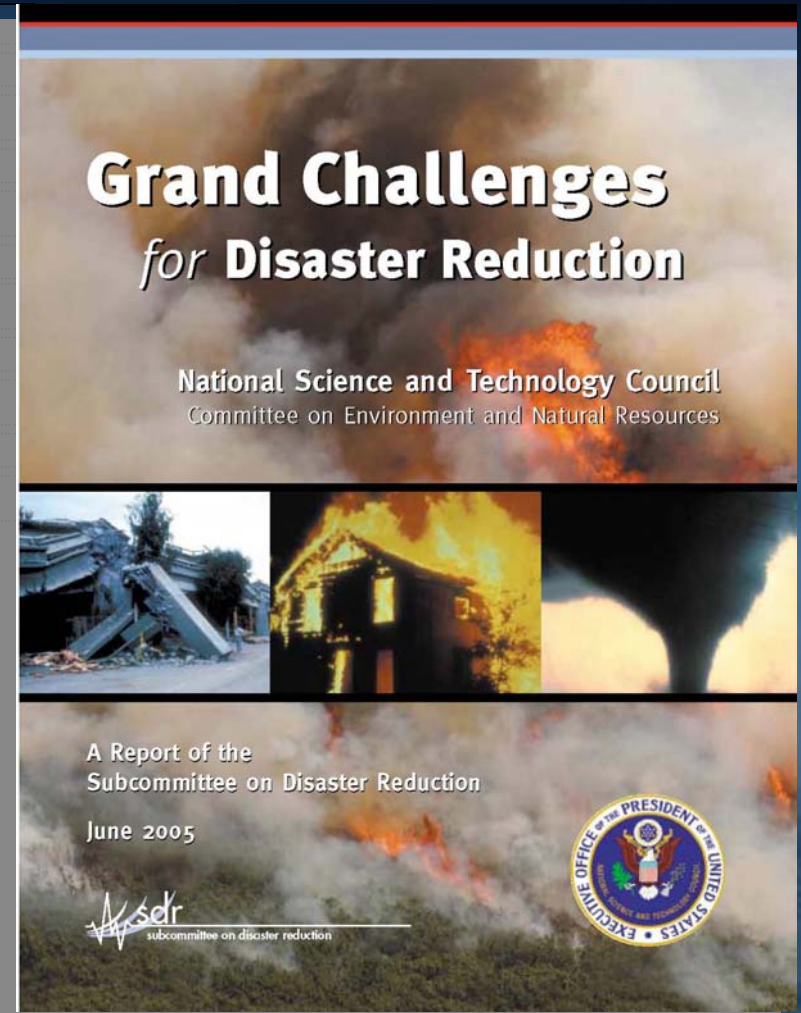
USGS



# Implementing the Grand Challenges

The implementation strategy for the Grand Challenges will be outlined in a series of four-page documents describing the science and technology agenda for all major types of hazards as well as critical cross-cutting topics, including:

- Coastal Inundation
- Drought
- Earthquake
- Environmental/Public Health Hazards
- Fire
- Flood
- Hurricane
- Landslide
- Space Weather
- Technological Hazards
- Tornado
- Tsunami
- Volcano
- Wildfire
- Winter Storms





# Summary for USGS Within NEHRP

- **Monitoring, Hazard Assessment, Research, and Outreach**
- **Products are USED**
- **Program is strongly PARTNERED**
- **Commitment to external RESEARCH**
- **Budget is FLAT**
- **New initiatives in Multi-Hazard risk reduction**
- **Pursuing several opportunities for leveraging with other NEHRP agencies**

