USGS
science for a changing world

Earthquakes ★ Floods ★ Hurricanes ★ Landslides ★ Tsunamis ★ Volcanoes ★ Wildfires

USGS in nehrp

National Earthquake Conference

April 23, 2008

U.S. Department of the Interior
U.S. Geological Survey

USGS Stafford Act roles and responsibilities

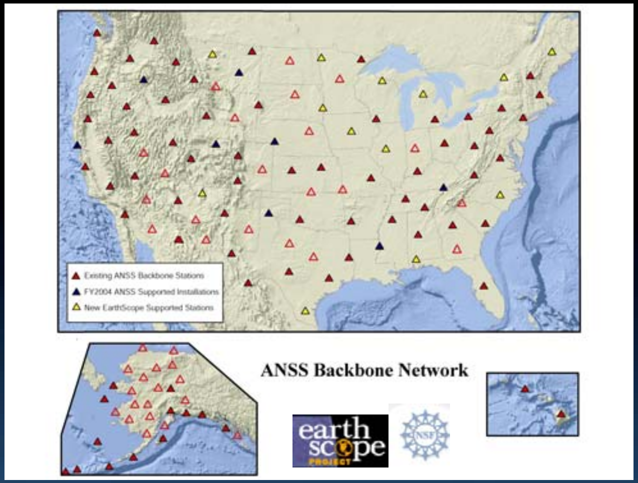
- USGS has the lead federal responsibility to provide notification and warnings for **earthquakes**, **volcanoes**, and **landslides**.
- In addition, USGS seismic networks support NOAA in carrying out its **tsunami** warning responsibility; USGS streamgages and storm surge monitors support NOAA’s **flood** and **severe storm** (including **hurricane**) warnings; and our geomagnetic observatories support **space weather** forecasts.
- USGS geospatial information supports response operations for **wildfire** and other hazards.

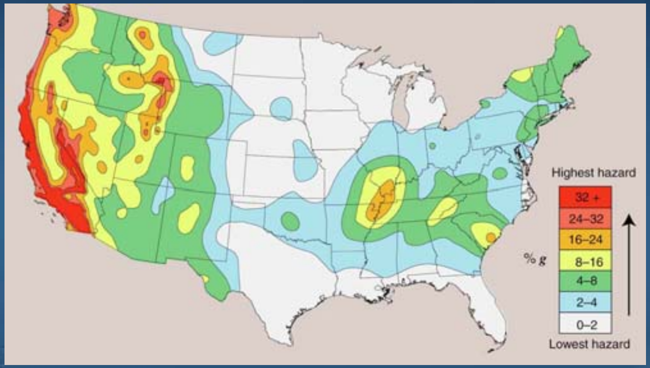
USGS

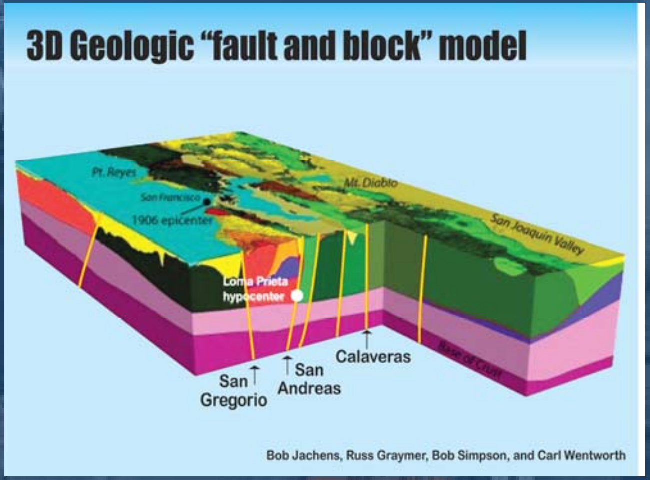
The USGS role in NEHRP

Statute: The United States Geological Survey shall conduct research and other activities necessary to characterize and identify earthquake hazards, assess earthquake risks, monitor seismic activity, and improve earthquake predictions.

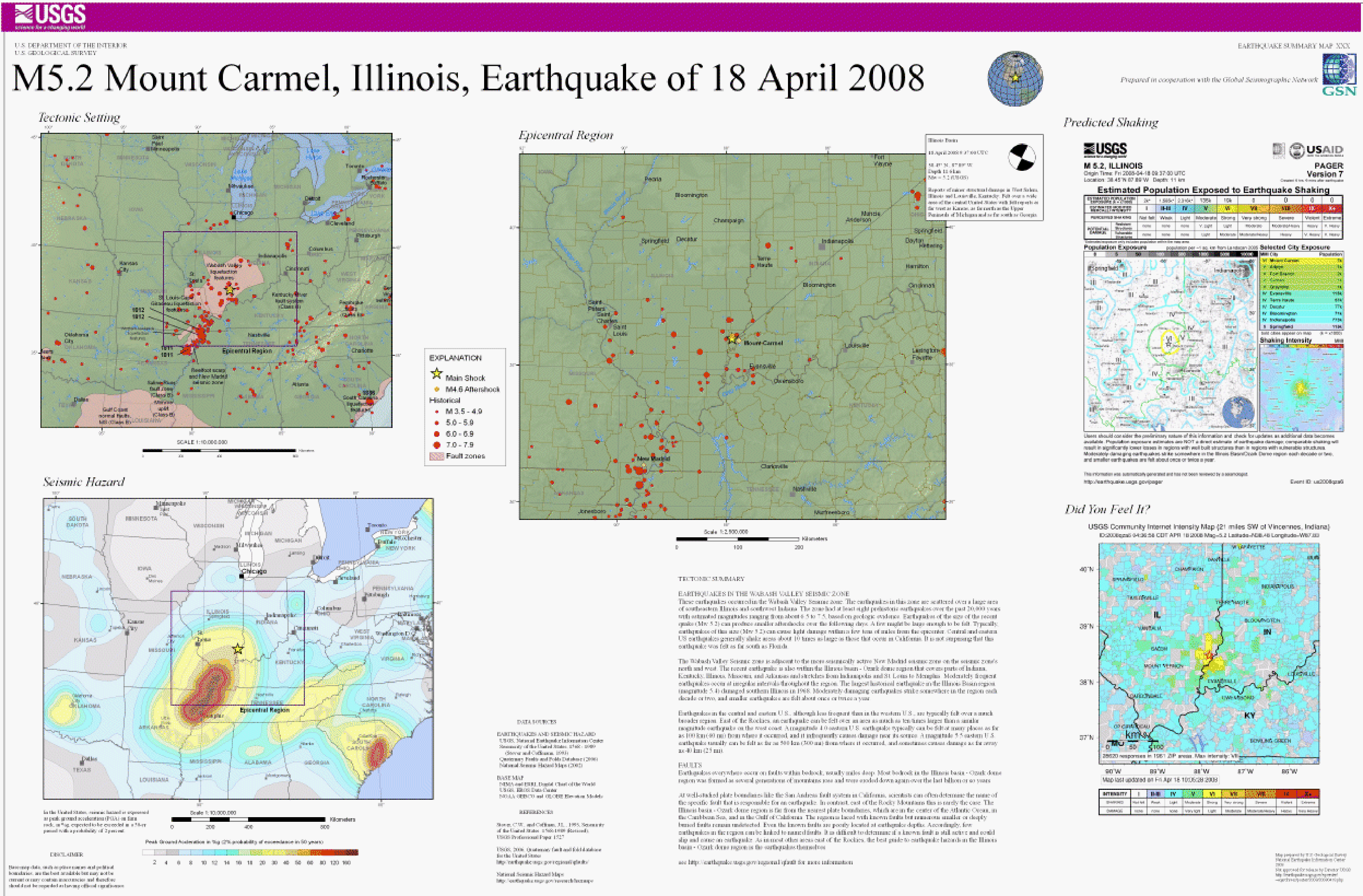
- Provide earthquake monitoring and notifications,
- Assess seismic hazards, and
- Conduct research needed to reduce the risk from earthquake hazards nationwide.







Provide earthquake monitoring and notifications

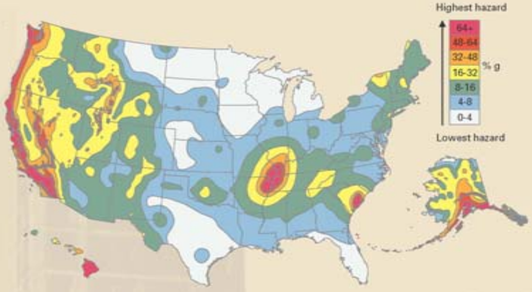


Assess seismic hazards

USGS science for a changing world — nehrp

2008 United States National Seismic Hazard Maps

The U.S. Geological Survey's National Seismic Hazard maps are the basis for seismic design provisions of building codes, insurance rate structures, earthquake loss studies, retrofit priorities, and land-use planning. Incorporating these hazard maps into designs of buildings, bridges, highways, and critical infrastructure allows these structures to withstand earthquake shaking without collapse. Properly engineered designs not only save lives, but also reduce disruption to critical activities following a damaging event. By estimating the likely shaking for a given area, the maps also help engineers avoid costs from over-design for unlikely levels of ground motion.



*Colors on this map show the levels of horizontal shaking that have a 1-in-10 chance of being exceeded in a 50-year period. Shaking is expressed as a percentage of **g** (**g** is the acceleration of a falling object due to gravity).*

The Update Process

The U.S. Geological Survey recently updated the National Seismic Hazard Maps by incorporating new seismic, geologic, and geodetic information on earthquake rates and associated ground shaking. These 2008 maps supersede versions released in 1996 and 2002. Updating the maps involved interactions with hundreds of scientists and engineers at regional and topical workshops. USGS also solicited advice from working groups, expert panels, State geological surveys, Federal agencies, and hazard experts from industry and academia. The Pacific Earthquake Engineering Research Center developed new crustal ground-motion models; the Working Group on California Earthquake Probabilities revised the California earthquake rate model; the Western States Seismic Policy Council submitted recommendations for the Intermountain West; and three expert panels were assembled to provide advice on best available science.

Changes to the Maps

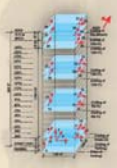
The most significant changes to the 2008 maps fall into two categories, as follows:

1. Changes to earthquake source and occurrence rate models.
   - In California, the source model was updated to account for new scientific information on faults. For example, models for the southern San Andreas Fault System were modified to incorporate new geologic data. The source model was also modified to better match the historical rate of magnitude 6.5 to 7 earthquakes.
   - The Cascadia Subduction Zone lying offshore of northern California, Oregon, and Washington was modeled using a distribution of large earthquakes between magnitude 8 and 9. Additional weight was given to the possibility for a catastrophic magnitude 9 earthquake that ruptures, on average, every 500 years from northern California to Washington, compared to a model that allows for smaller ruptures.

USGS Earthquake Hazard Assessment Products and Tools

U.S. National Probabilistic Ground-Motion Maps.

This Web site contains maps and associated input/output data and documentation for probabilistic hazard maps for the 48 Conterminous States, Alaska, Hawaii, and Puerto Rico. *http://earthquake.usgs.gov/hazmaps/products_data/*



Hazard Mapping and Analysis Tools.

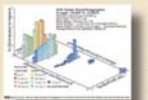
USGS offers a number of on-line Web tools that allow an individual to assess which sources pose the greatest hazard in a particular region, look up hazard values using latitude/longitude or Zip code, make customized USGS probabilistic hazard maps for an area of interest, map probability of a given magnitude within a certain distance from a site, and access computer software for seismic hazard analysis. *http://earthquake.usgs.gov/hazmaps/interactive/*

Seismic Design Values for Buildings.

This Web site allows users to determine design ground motion at a site for various building codes, using latitude/longitude or Zip code. In addition, one can display and download a hazard curve or uniform hazard spectrum for a site. *http://earthquake.usgs.gov/hazmaps/design/*

Urban Probabilistic Ground-Motion Maps.

These maps show more detailed probabilistic seismic hazard maps for urban areas that take into account near-surface geologic conditions, sedimentary basin structure, and directivity effects. *http://earthquake.usgs.gov/hazmaps/products_data/*



Deterministic or Scenario Ground-Motion Maps.

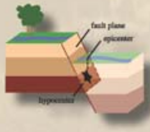
Maps predict the median level of ground shaking from a particular "scenario" event. They do not take into account the likelihood of that scenario occurring, but they are helpful when assessing the potential impact of a particular event. [Need URL]

Time-Dependent Earthquake Probability Maps.

These maps forecast the likelihood of an earthquake rupture occurring during an interval of time in the future. Time-dependent maps are considered research tools and are not currently applied in building codes.

U.S. Quaternary Fault and Fold Database.

This Web site contains information on faults and associated folds in the United States that are believed to be sources of M>6 earthquakes during the Quaternary (the past 1,600,000 years). Maps of these geologic structures are linked to detailed descriptions and references. *http://earthquake.usgs.gov/qfaults/*



Earthquake Hazards 101.

USGS provides a wealth of explanatory materials for the layperson, including information on concepts behind earthquake maps, the use of probability, what the maps mean, how they are made, and answers to frequently asked questions. http://earthquake.usgs.gov/research/hazmaps/haz101/index.php

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For more information, see the Web site for the U.S. Geological Survey Earth Hazards Program at

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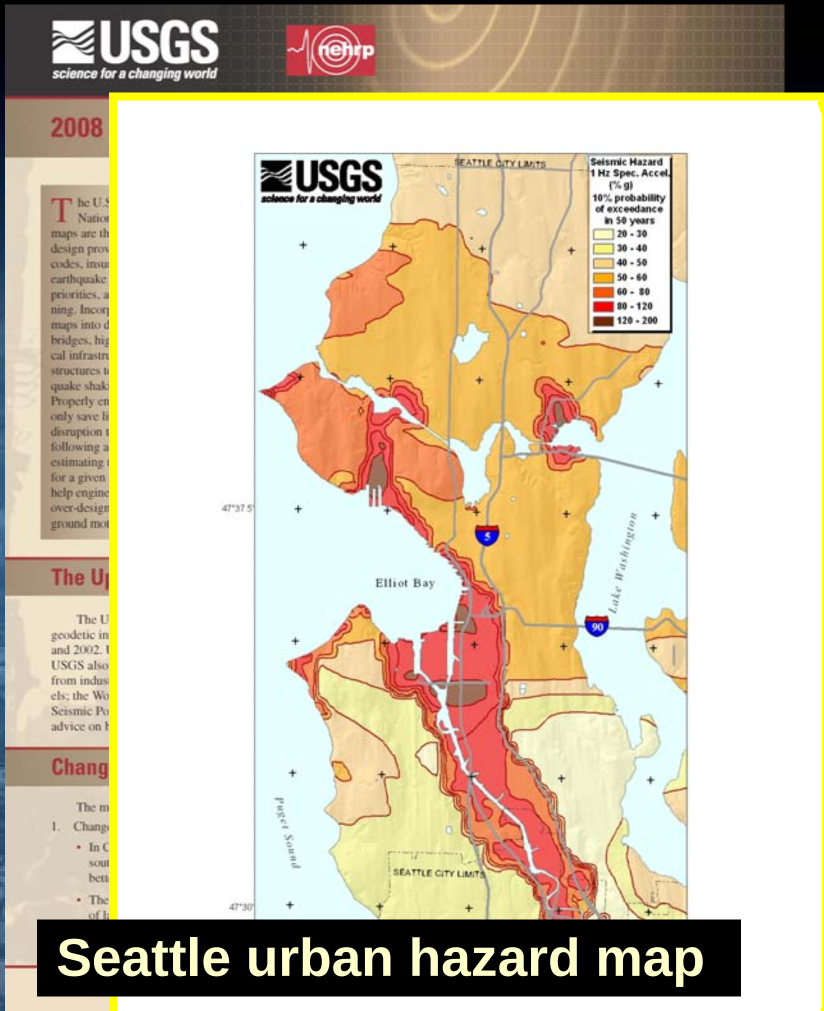
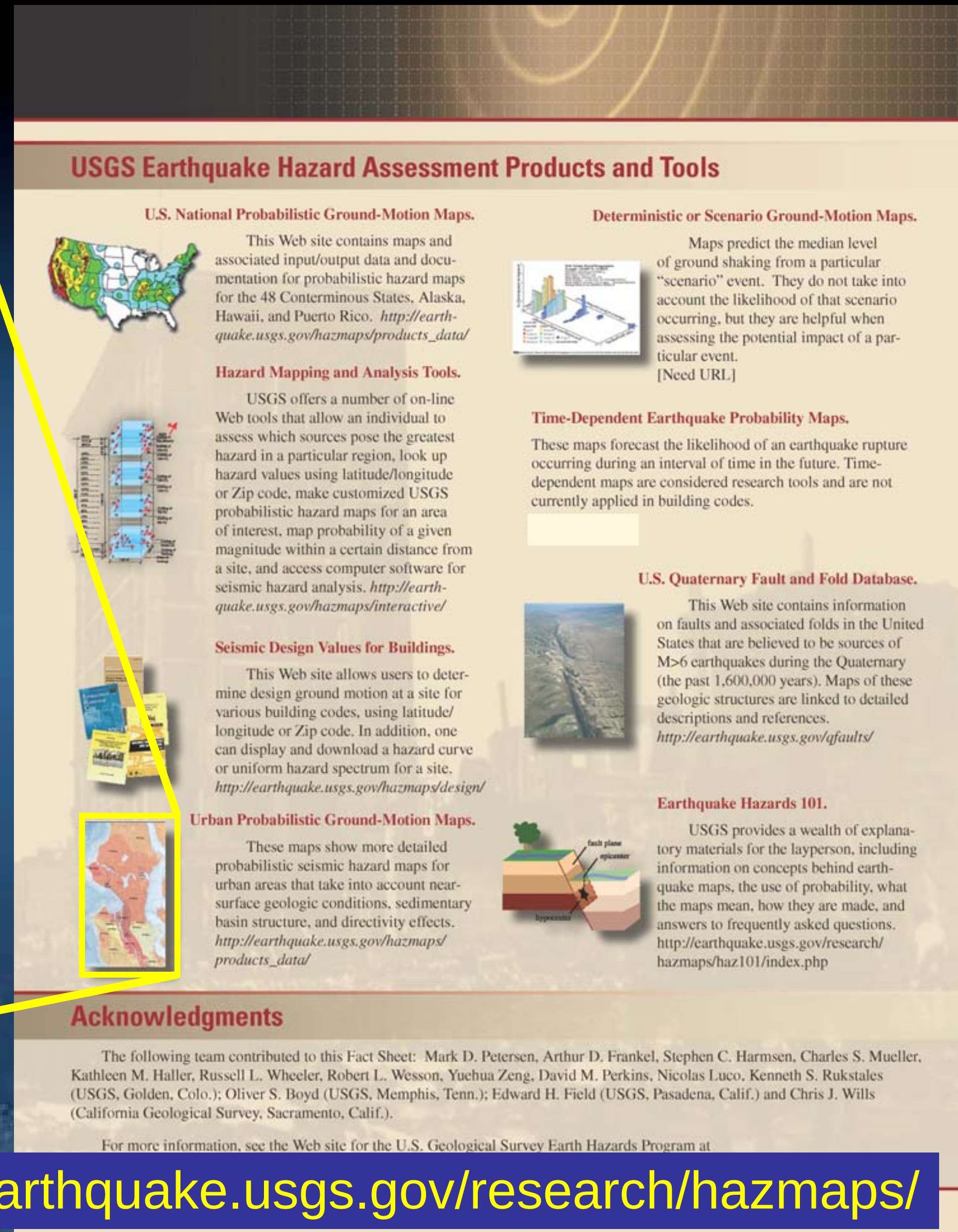


Seattle urban hazard map



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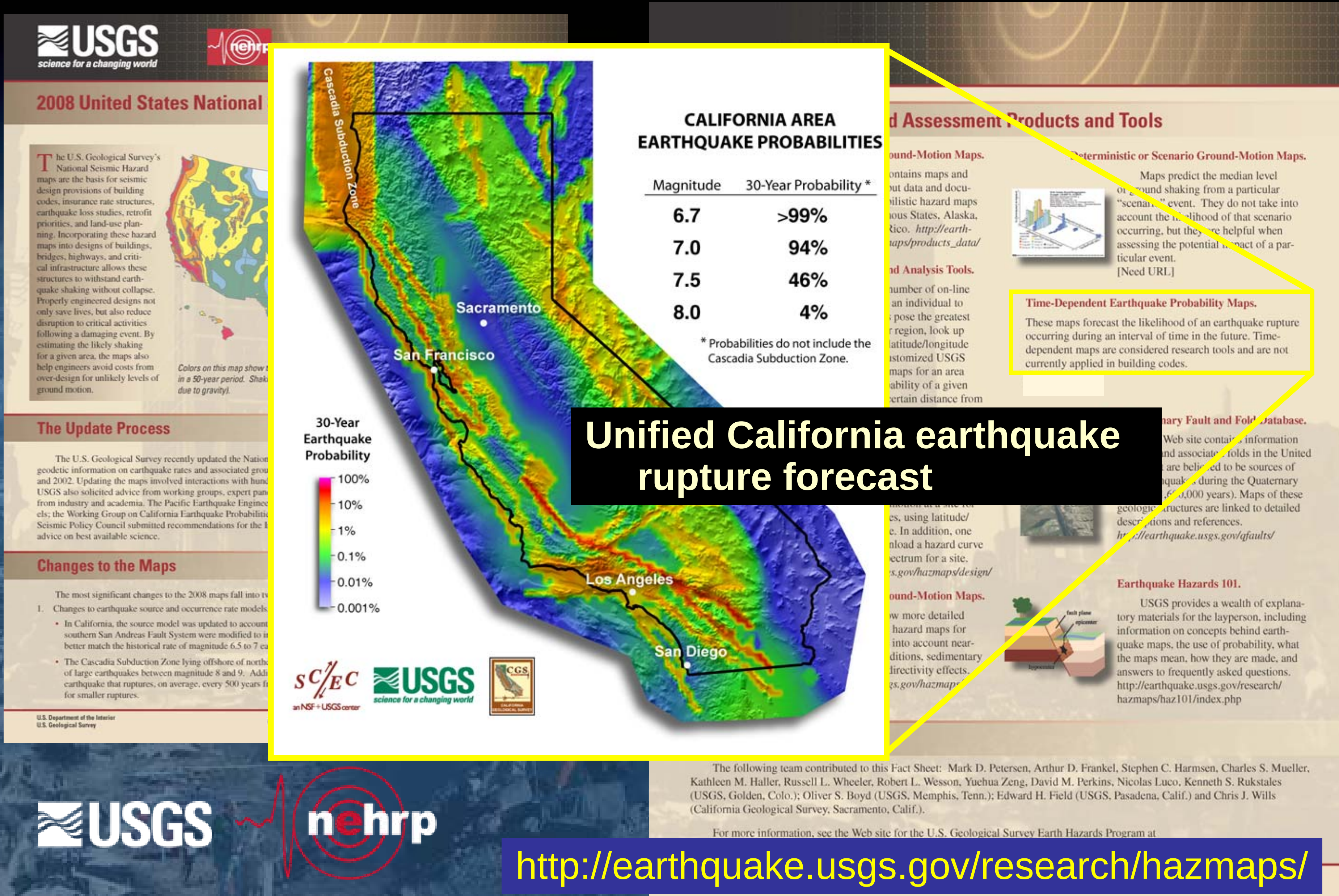

Unified California earthquake rupture forecast

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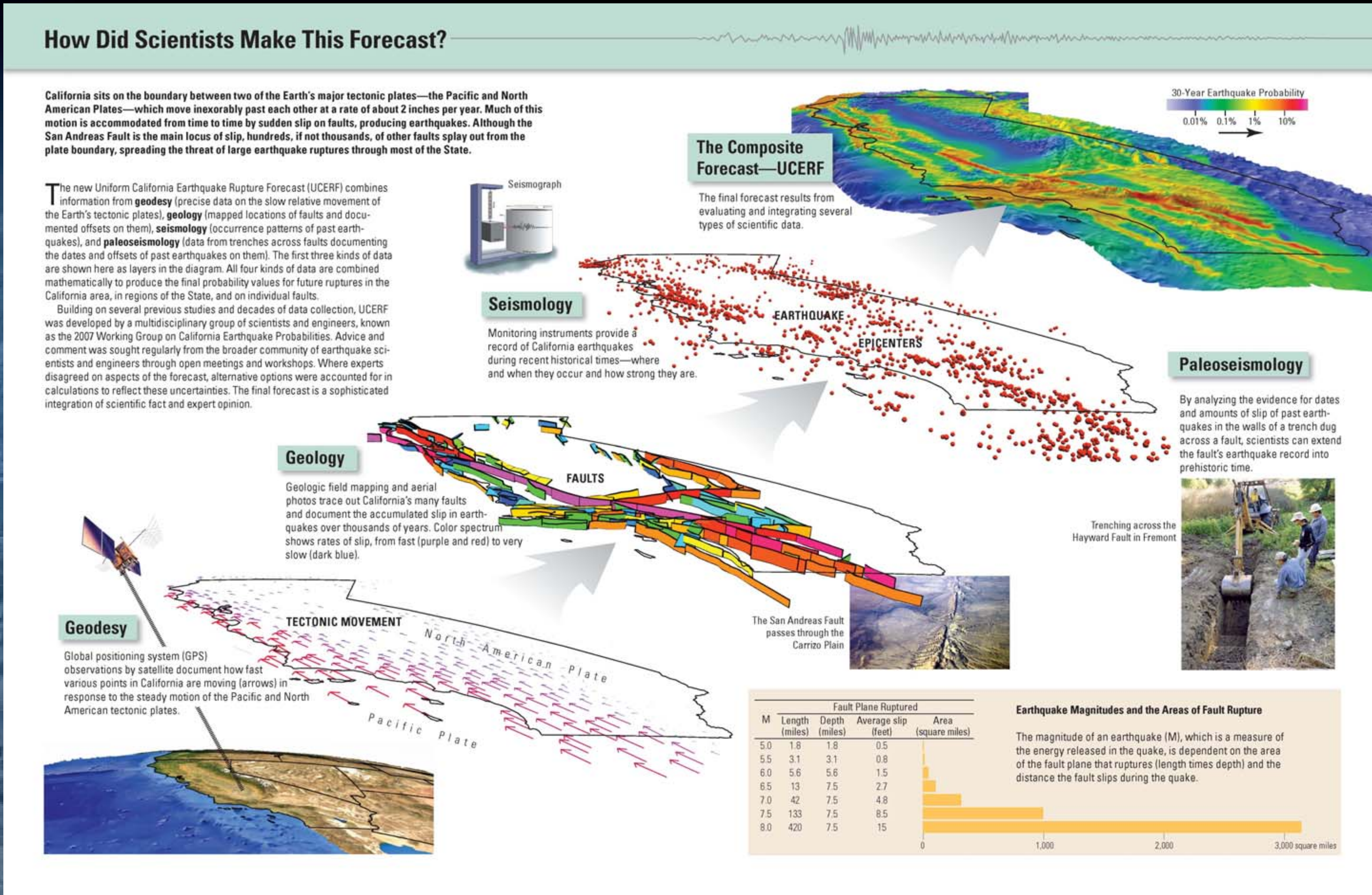
http://earthquake.usgs.gov/research/hazmaps/

Conduct research needed to reduce the risk from earthquake hazards



How Did Scientists Make This Forecast?

California sits on the boundary between two of the Earth's major tectonic plates—the Pacific and North American Plates—which move inexorably past each other at a rate of about 2 inches per year. Much of this motion is accommodated from time to time by sudden slip on faults, producing earthquakes. Although the San Andreas Fault is the main locus of slip, hundreds, if not thousands, of other faults splay out from the plate boundary, spreading the threat of large earthquake ruptures through most of the State.

The new Uniform California Earthquake Rupture Forecast (UCERF) combines information from **geodesy** (precise data on the slow relative movement of the Earth's tectonic plates), **geology** (mapped locations of faults and documented offsets on them), **seismology** (occurrence patterns of past earthquakes), and **paleoseismology** (data from trenches across faults documenting the dates and offsets of past earthquakes on them). The first three kinds of data are shown here as layers in the diagram. All four kinds of data are combined mathematically to produce the final probability values for future ruptures in the California area, in regions of the State, and on individual faults.

Building on several previous studies and decades of data collection, UCERF was developed by a multidisciplinary group of scientists and engineers, known as the 2007 Working Group on California Earthquake Probabilities. Advice and comment was sought regularly from the broader community of earthquake scientists and engineers through open meetings and workshops. Where experts disagreed on aspects of the forecast, alternative options were accounted for in calculations to reflect these uncertainties. The final forecast is a sophisticated integration of scientific fact and expert opinion.

The Composite Forecast—UCERF

The final forecast results from evaluating and integrating several types of scientific data.

Seismology

Monitoring instruments provide a record of California earthquakes during recent historical times—where and when they occur and how strong they are.

Paleoseismology

By analyzing the evidence for dates and amounts of slip of past earthquakes in the walls of a trench dug across a fault, scientists can extend the fault's earthquake record into prehistoric time.

Trenching across the Hayward Fault in Fremont

Geology

Geologic field mapping and aerial photos trace out California's many faults and document the accumulated slip in earthquakes over thousands of years. Color spectrum shows rates of slip, from fast (purple and red) to very slow (dark blue).

The San Andreas Fault passes through the Carrizo Plain

Geodesy

Global positioning system (GPS) observations by satellite document how fast various points in California are moving (arrows) in response to the steady motion of the Pacific and North American tectonic plates.

M	Fault Plane Ruptured: Length (miles)	Depth (miles)	Average slip (feet)	Area (square miles)
5.0	1.8	1.8	0.5	
5.5	3.1	3.1	0.8	
6.0	5.6	5.6	1.5	
6.5	13	7.5	2.7	
7.0	42	7.5	4.8	
7.5	133	7.5	8.5	
8.0	420	7.5	15	

0 1,000 2,000 3,000 square miles

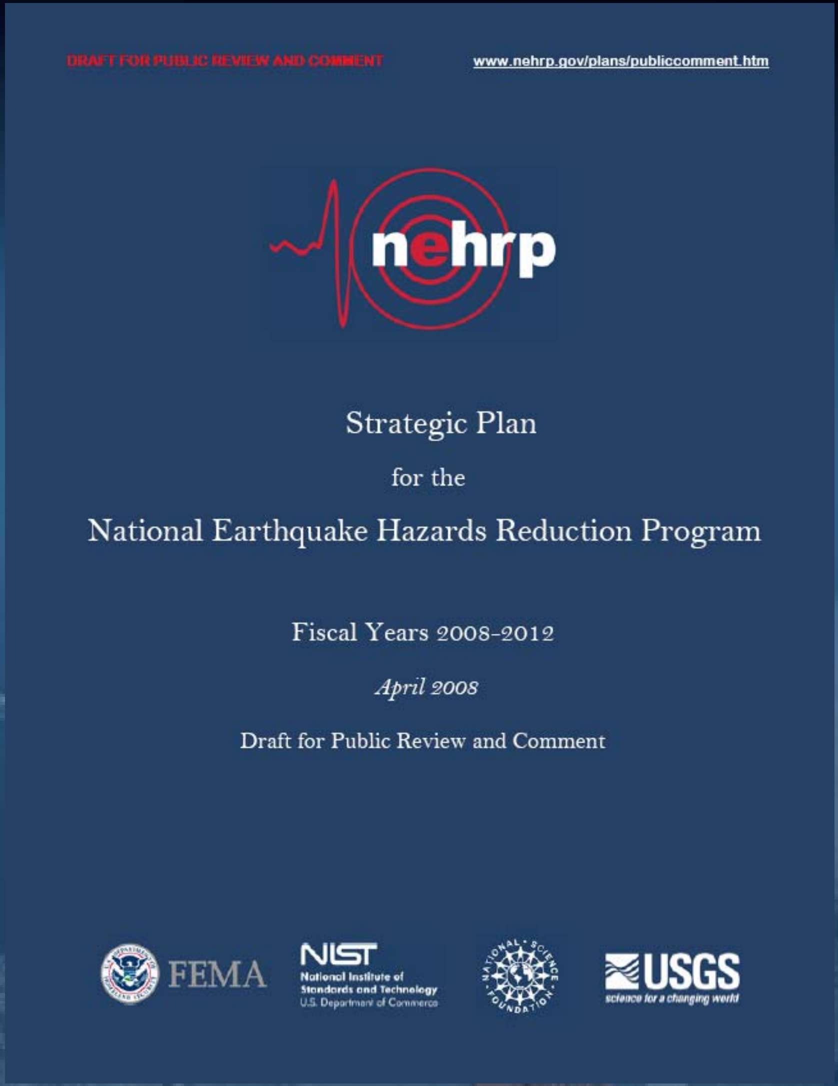
Earthquake Magnitudes and the Areas of Fault Rupture

The magnitude of an earthquake (M), which is a measure of the energy released in the quake, is dependent on the area of the fault plane that ruptures (length times depth) and the distance the fault slips during the quake.

NEHRP Draft Plan: Addressing the strategic priorities

In 2008, we are using multi-hazards initiative funds to make progress on two of the strategic priority areas:

- Fully implement Advanced National Seismic System (ANSS)
- Develop & conduct earthquake scenarios for effective earthquake risk mitigation


DRAFT FOR PUBLIC REVIEW AND COMMENT www.nehrp.gov/plans/publiccomment.htm

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Strategic Plan

for the

National Earthquake Hazards Reduction Program

Fiscal Years 2008-2012

April 2008

Draft for Public Review and Comment

FEMA NIST National Institute of Standards and Technology U.S. Department of Commerce USGS science for a changing world

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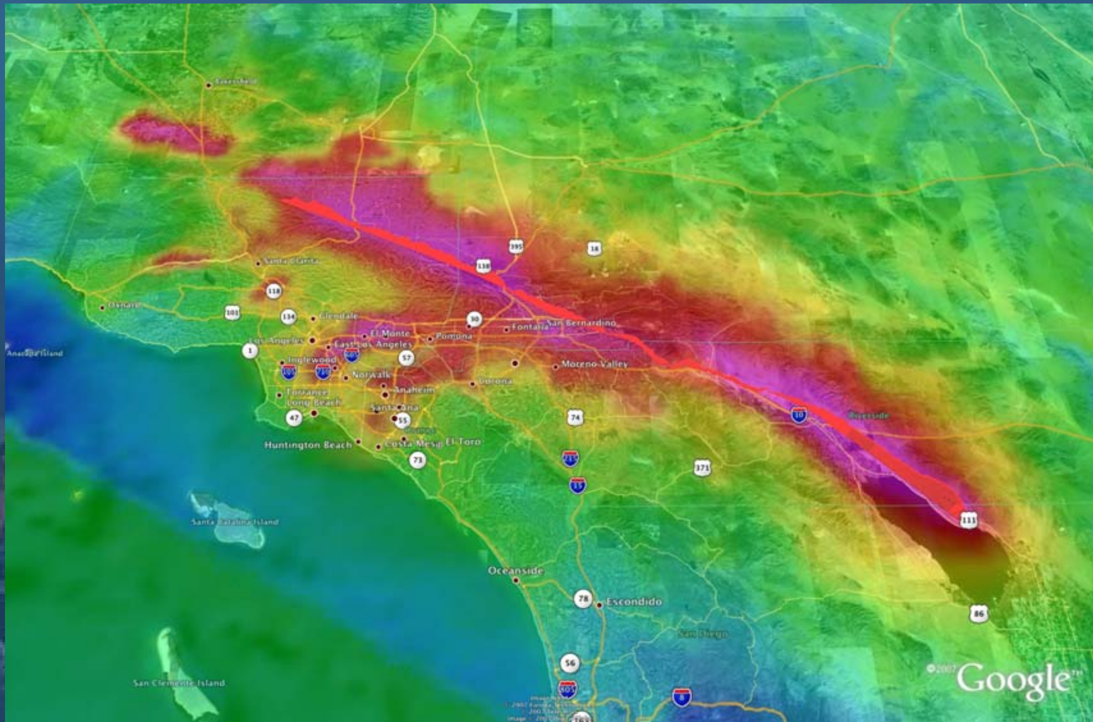
The Great Southern California ShakeOut

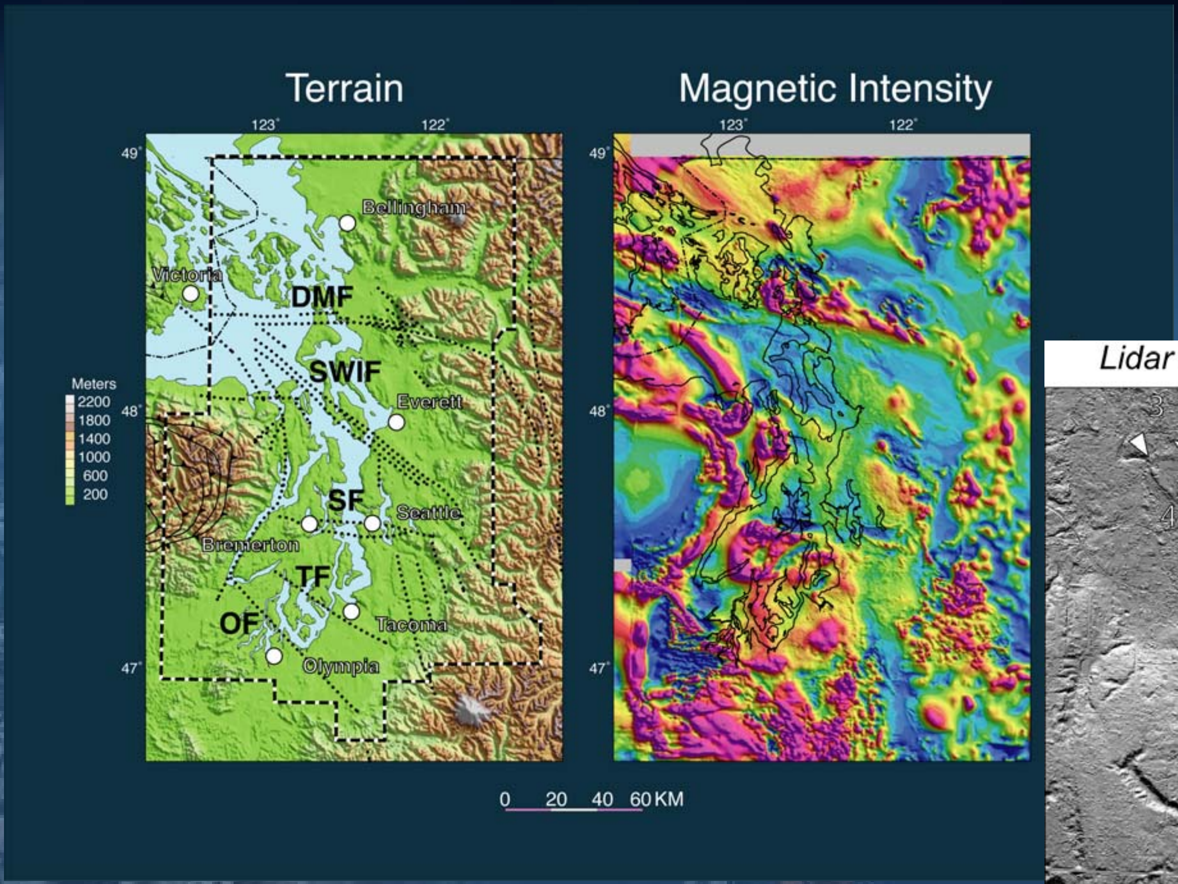
- USGS and partners will create complete “rupture-to-recovery scenario” for most likely earthquake
- Use scenario to run region-wide exercise in 2008
- Agreement with Office of Homeland Security to make this the 2008 “Golden Guardian Exercise”

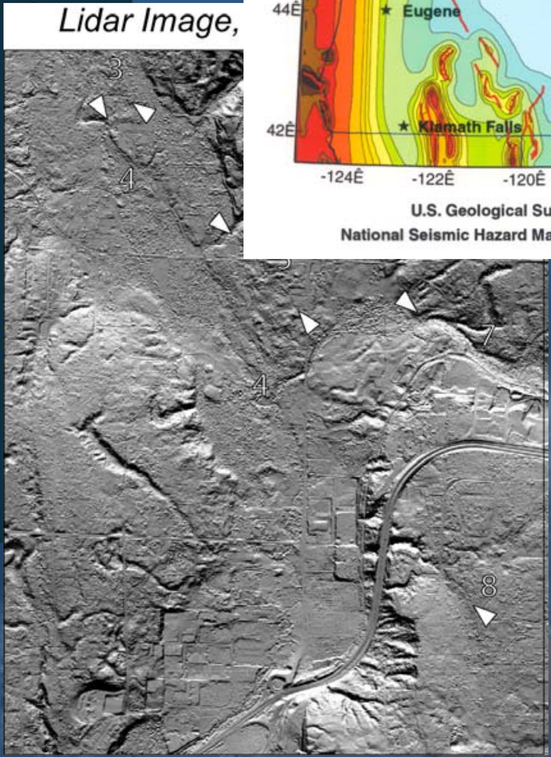
DARE
to prepare
2007 Earthquake Readiness Campaign

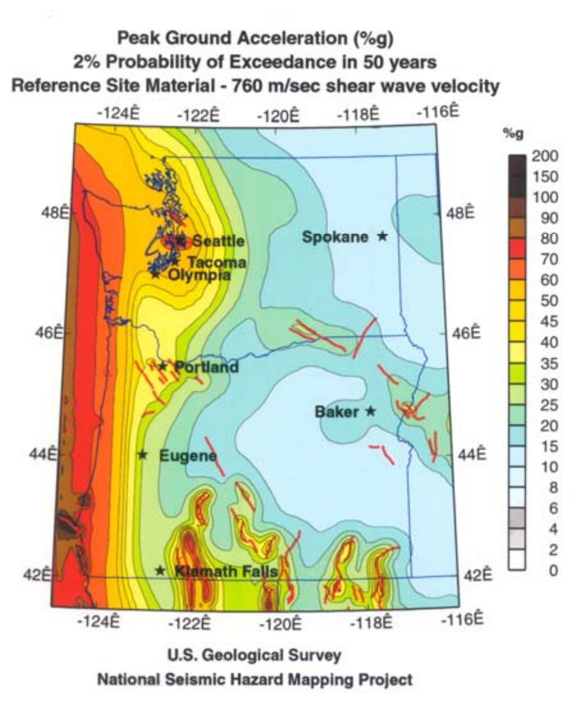
USGS



Taking the multi-hazard initiative on the road: Pacific Northwest







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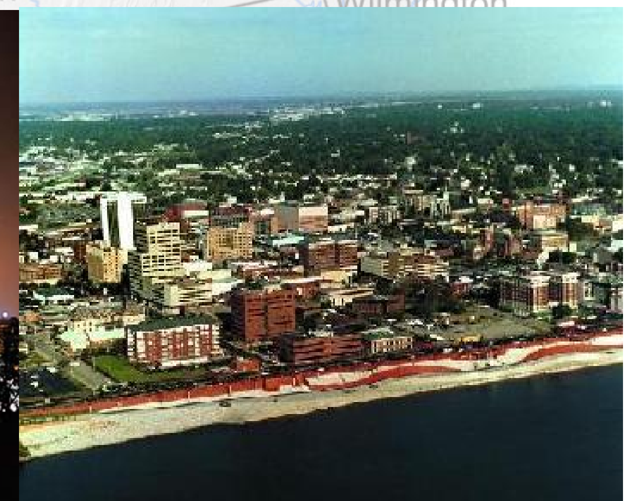
Urban hazard mapping in the Central U.S. involves many local and state partners

St. Louis

Memphis



Evansville

Missouri Dept
Of Natural Resources

Scientific Earthquake Studies Advisory Committee 2007 report recommendations

1. Full funding of the ANSS at authorized levels.
2. Endorsement of multi-hazards demonstration project and encourage expansion to include other high-risk areas.
3. USGS should develop comprehensive monitoring, analysis and research program to study the significance of episodic tremor and slip events.
4. Need for hiring in order to maintain ability of USGS to fulfill its NEHRP responsibilities.

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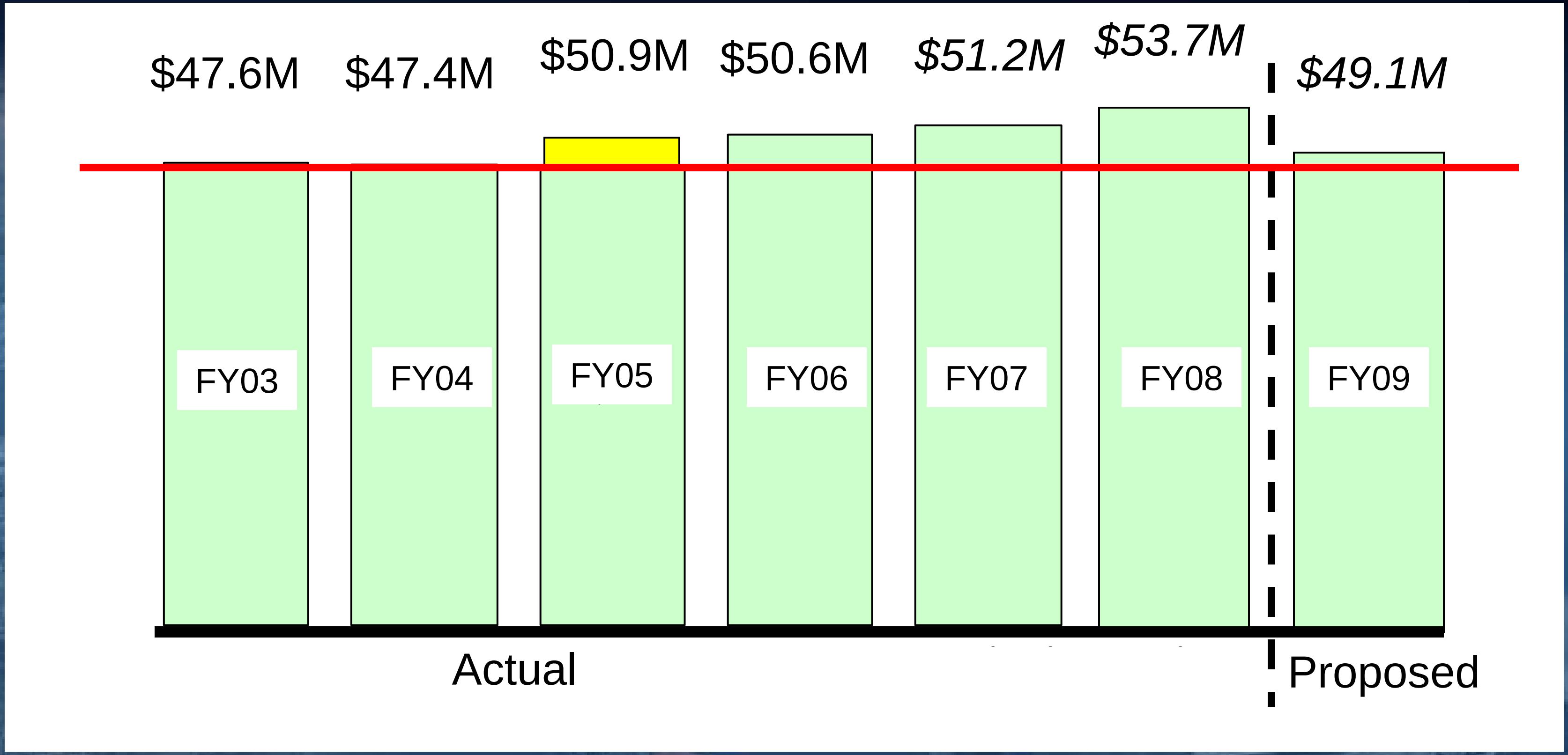
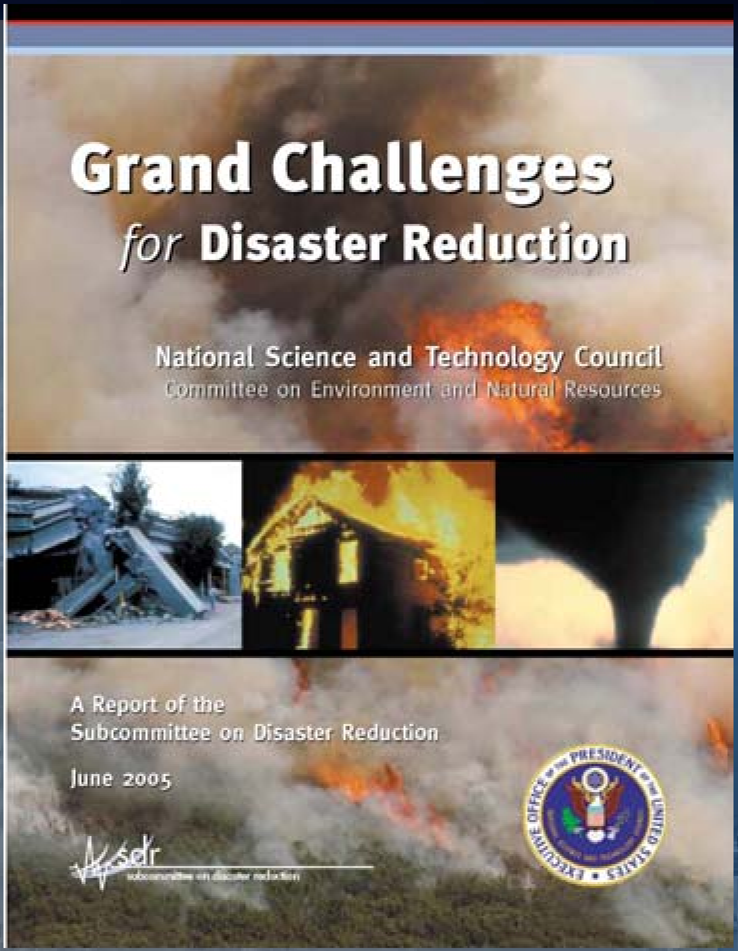
Recent Earthquake Hazards Program funding history and FY09 request



Tsunami Supplemental
(became part of base in FY06)

Grand Challenges for Disaster Reduction

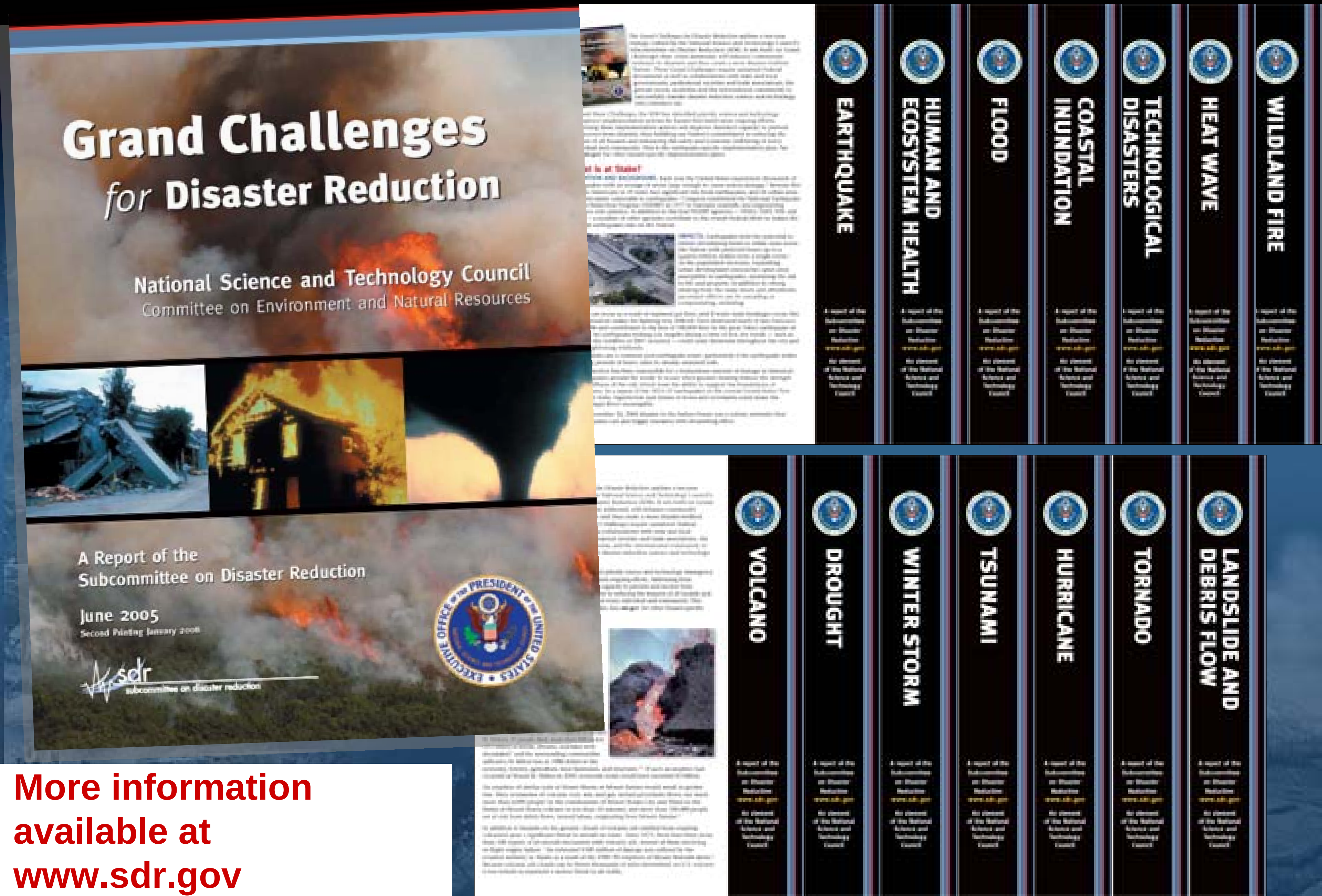
National Science & Technology Council
Subcommittee on Disaster Reduction



1. Provide hazard and disaster information where and when it is needed.
2. Understand the natural processes that produce hazards.
3. Develop hazard mitigation strategies and technologies.
4. Recognize and reduce vulnerability of interdependent critical infrastructure.
5. Assess disaster resilience using standard methods.
6. Promote risk-wise behavior.

USGS

Implementation plans



More information available at www.sdr.gov