USGS
science for a changing world

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

Meeting the Grand Challenges for Disaster Reduction

David Applegate
Chair, NSTC Subcommittee on Disaster Reduction
September 19, 2008

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subcommittee on disaster reduction

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

U.S. National Science & Technology Council Subcommittee on Disaster Reduction

- The U.S. Subcommittee on Disaster Reduction (SDR) is an element of the President's National Science & Technology Council charged with:
  - Establishing clear national goals for Federal science and technology investments in disaster reduction.
  - Promoting interagency cooperation for natural and technological hazards and disaster planning.
  - Facilitating interagency approaches to identifying and assessing risk, and to disaster reduction.
  - Advising the Administration about relevant resources and the work of SDR member agencies.

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subcommittee on disaster reduction

National Science & Technology Council
Subcommittee on Disaster Reduction

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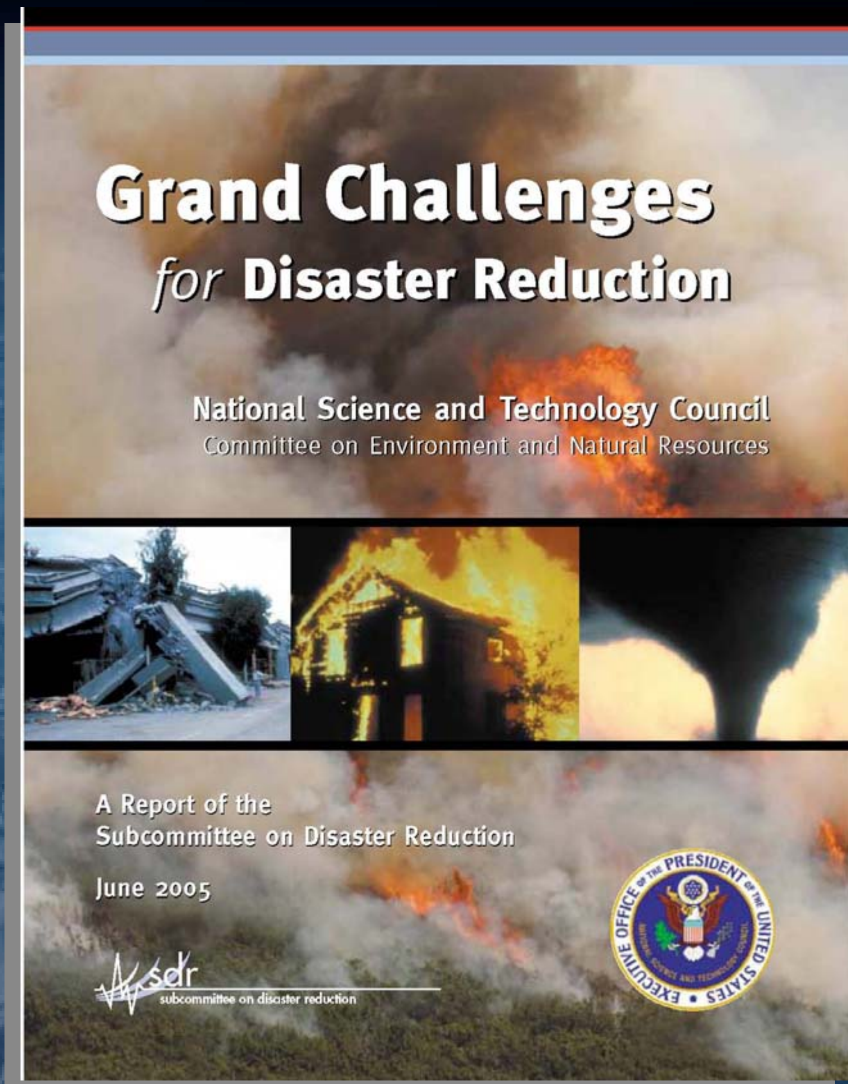
- U.S. Department of Agriculture
- U.S. Forest Service
- U.S. Geological Survey
- U.S. Public Health Commissioned Corps

Framing the Grand Challenges for Disaster Reduction

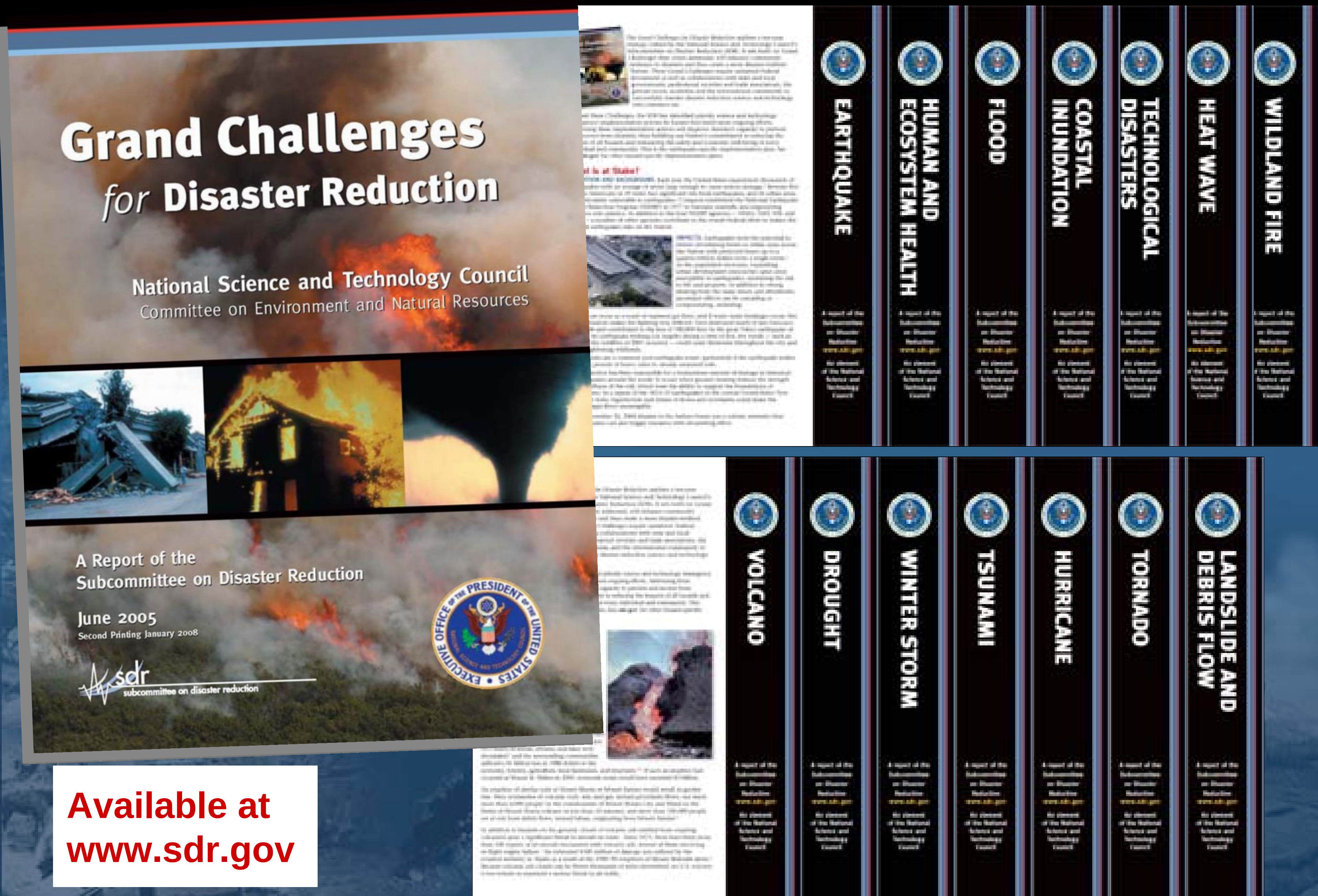
- Objective: To enhance disaster resilience by composing a ten-year agenda for science and technology activities that will produce a dramatic reduction in the loss of life and property from natural and technological disasters.

Grand Challenges for 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.

Implementation plans released March 2008



Available at www.sdr.gov

Implementing the Grand Challenges

Grand Challenges for Disaster Reduction: Priority Interagency Landslide and Debris Flow Implementation Actions

GRAND CHALLENGE #1: Provide hazard and disaster information where and when it is needed.

- ■ Increase the use of Interferometric Synthetic Aperture Radar as well as airborne and ground-based side-looking LiDAR for more accurate landslide hazard assessments, susceptibility mapping, and to determine the volumes of susceptible material and possible runout distances;
- ➤ Inventory sensors needed to predict and monitor landslides. Determine and fill critical gaps.

Priority interagency actions identified

GRAND CHALLENGE #2: Understand the natural processes that produce hazards.

- ➤ Research landslide initiation processes to better understand the interaction between soil type, texture, terrain grade, weather, fire, and other hazards;
- ➤ Develop better rainfall threshold models for landslides in areas routinely threatened by hurricanes and winter rainy seasons;
- ➤ Better integrate models that evaluate post-wildfire debris flow and landslide potential with near real-time rainfall estimates that blend *in situ*, radar, and satellite observations.

Key: ■ Short Term Action (1-2 years) ➤ Medium Term Action (2-5 years) ◆ Long Term Effort (5+ years)

GRAND CHALLENGE #3: Develop hazard mitigation strategies and technologies.

- ➤ Develop improved structural mitigation techniques for landslide hazards;
- ➤ Evaluate effectiveness of alternative treatments for post-fire rehabilitation and restoration of severely burned slopes on reducing landslides and debris flows hazards.

GRAND CHALLENGE #4: Reduce the vulnerability of infrastructure.

- ◆ Inventory and assess the vulnerability of the Nation's most critical infrastructure to landslide hazards;
- ◆ Utilize research and data from past events to provide the technical basis for codes and standards and local zoning decisions that will locate hospitals, schools, power plants, and other essential facilities away from the risk area, or retrofit to provide adequate protection from the assessed landslide risk.

GRAND CHALLENGE #5: Assess disaster resilience.

- ■ Incorporate the use of risk analysis techniques to guide loss reduction efforts at the state and local levels;
- ➤ Update the national landslide susceptibility map and state landslide susceptibility maps;
- ➤ Produce landslide hazard maps for communities at risk throughout the U.S.;
- ➤ Complete risk assessments for at-risk communities;
- ➤ Provide information necessary to develop effective land use plans and policies for at-risk communities;
- ➤ Develop comprehensive pre-event recovery plans.

GRAND CHALLENGE #6: Promote risk-wise behavior.

- ■ Develop a guidebook with best practices for mitigating landslide hazards and train local decision makers to use it efficiently and effectively;
- ■ Test a pilot warning system for debris flows following fires in Southern California and expand the system to other parts of California;
- ■ Develop a warning system that utilizes an emergency communication network, forecasting ability, and geologic expertise;
- ■ Continue to build better links between the fire fighting community, landslide researchers, forest managers, and communities most at risk near forested areas;
- ➤ Identify and develop effective methods to educate individuals and decision makers about landslide threats so they can make more informed decisions when purchasing land and structures;
- ◆ Test and expand the warning system for debris flows to other susceptible regions.

Key: ■ Short Term Action (1-2 years) ➤ Medium Term Action (2-5 years) ◆ Long Term Effort (5+ years)

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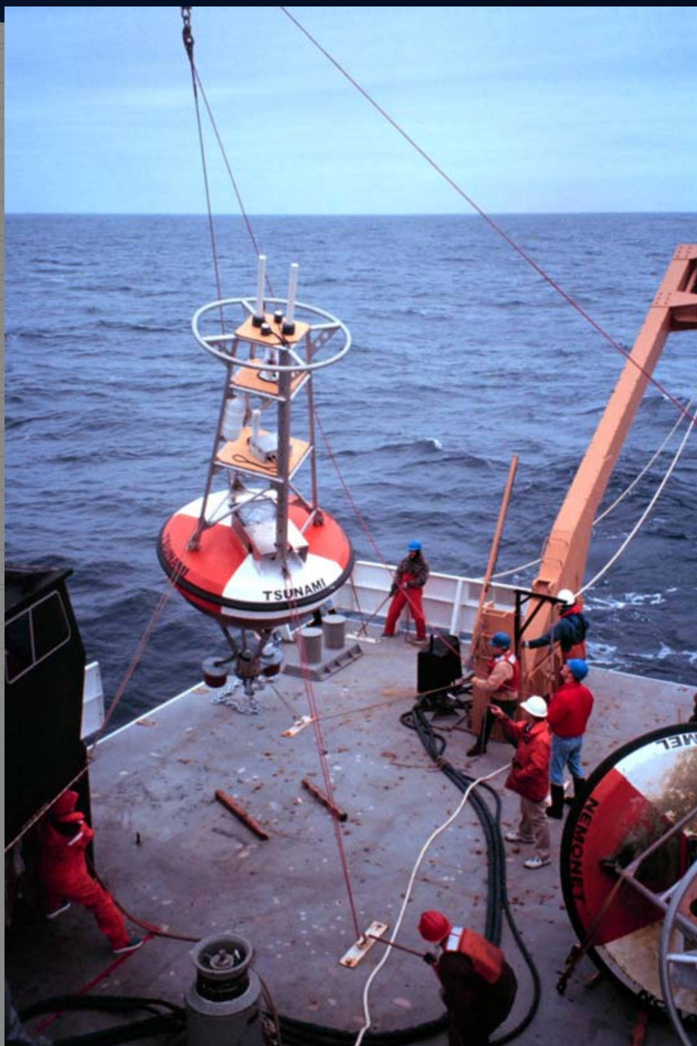
Grand Challenge 1. Provide hazard and disaster information where and when it is needed.

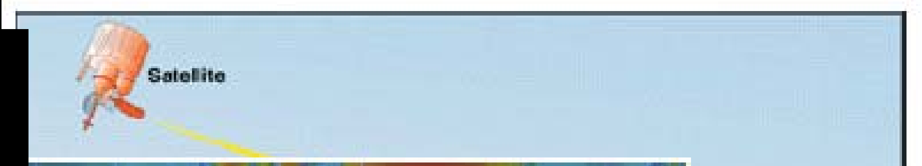


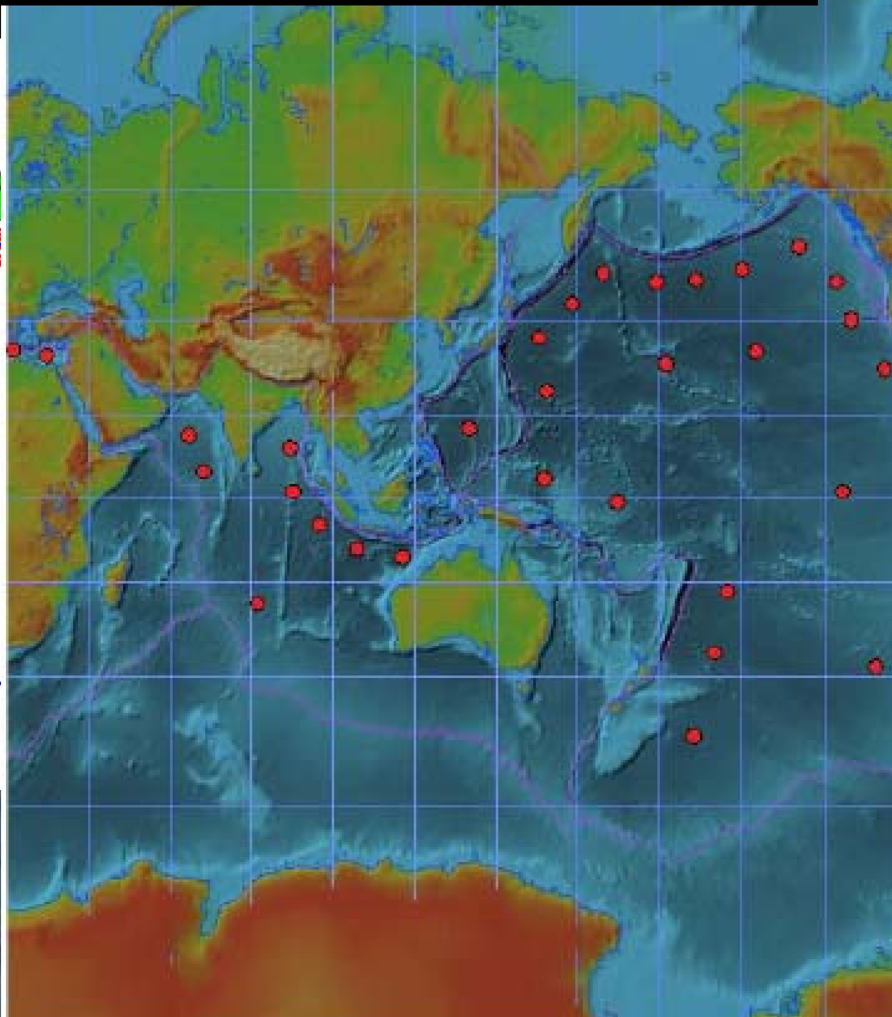
"To identify and anticipate the hazards that threaten communities, a mechanism for real-time data collection and interpretation must be readily available to and usable by scientists, emergency managers, first responders, citizens, and policy makers.

Developing and improving observation tools is essential to provide pertinent, comprehensive, and timely information for planning and response."

Warn the right people in the right place at the right time.

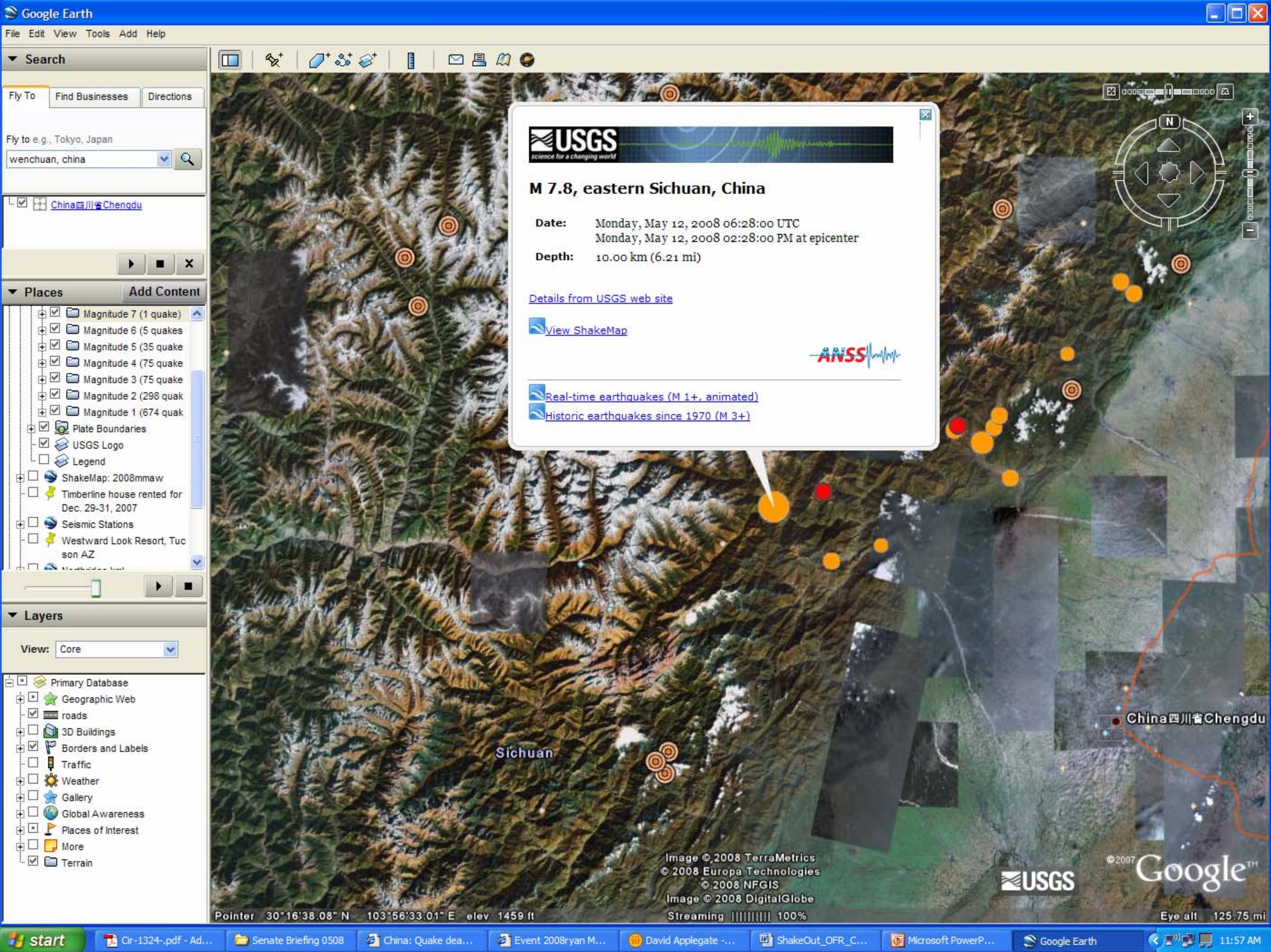
For tsunamis, seismic is the start





All Hazard Alert Broadcast system installed at Ocean Shores, Washington.

The beach is the finish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ShakeMap: 2008mmaw
Timberline house rented for Dec. 29-31, 2007
Seismic Stations
Westward Look Resort, Tucson AZ
Layers
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Borders and Labels
Traffic
Weather
Gallery
Global Awareness
Places of Interest
More
Terrain
USGS
science for a changing world
M 7.8, eastern Sichuan, China
Date: Monday, May 12, 2008 06:28:00 UTC
Monday, May 12, 2008 02:28:00 PM at epicenter
Depth: 10.00 km (6.21 mi)
Details from USGS web site
View ShakeMap
ANSS
Real-time earthquakes (M 1+, animated)
Historic earthquakes since 1970 (M 3+)
Sichuan
China四川省Chengdu
Image © 2008 TerraMetrics
© 2008 Europa Technologies
© 2008 NFGIS
Image © 2008 DigitalGlobe
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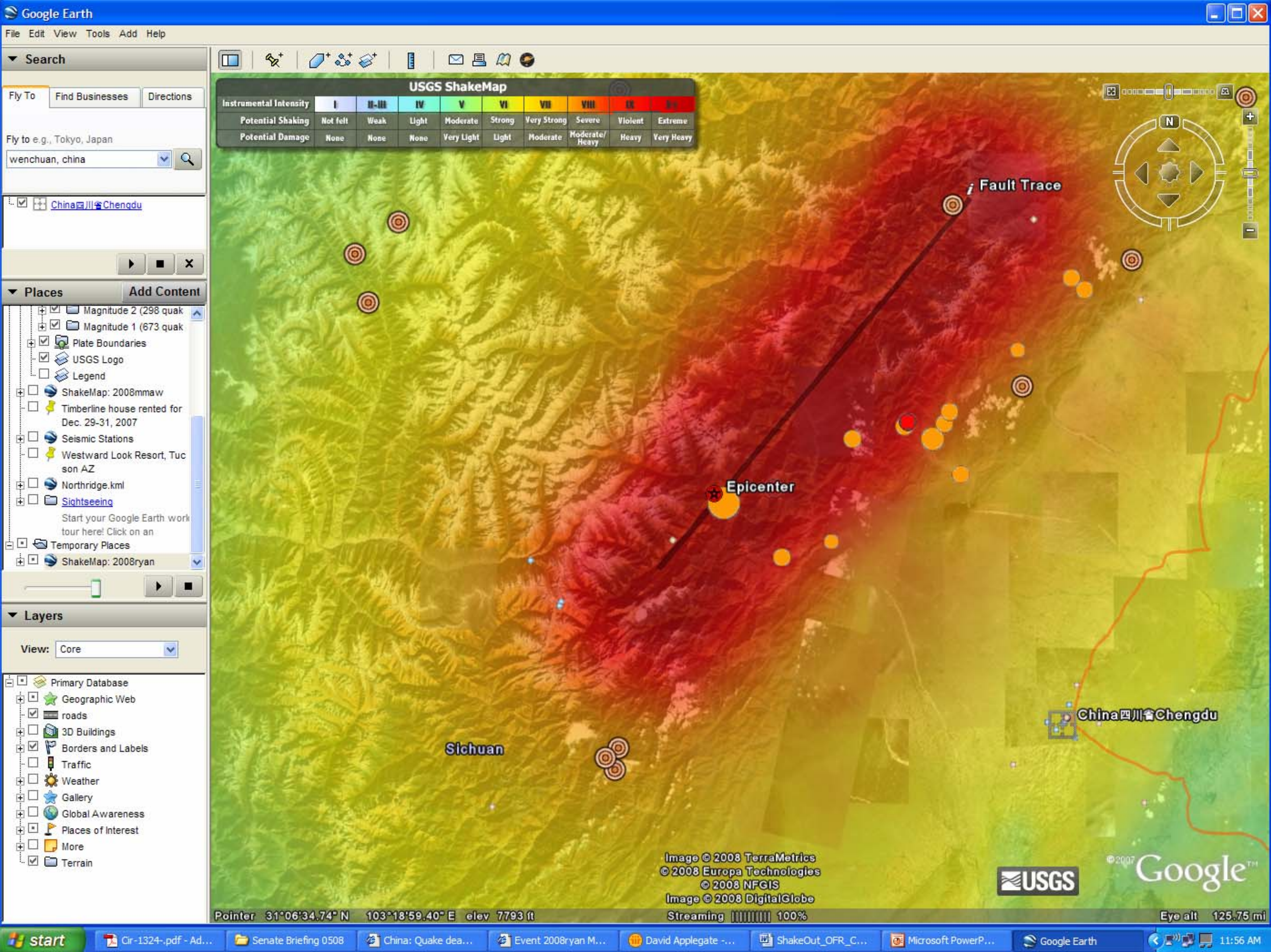
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Primary Database
Geographic Web
roads
3D Buildings
Borders and Labels
Traffic
Weather
Gallery
Global Awareness
Places of Interest
More
Terrain
USGS ShakeMap
Instrumental Intensity | I | II-III | IV | V | VI | VII | VIII | IX | X+
Potential Shaking | Not felt | Weak | Light | Moderate | Strong | Very Strong | Severe | Violent | Extreme
Potential Damage | None | None | None | Very Light | Light | Moderate | Moderate/Heavy | Heavy | Very Heavy
Fault Trace
Epicenter
Sichuan
China四川省Chengdu
Image © 2008 TerraMetrics
© 2008 Europa Technologies
© 2008 NFGIS
Image © 2008 DigitalGlobe
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David Applegate -...
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Google Earth
11:56 AM

PAGER

Prompt **A**ssessment of **G**lobal **E**arthquakes for **R**esponse

http://earthquake.usgs.gov/pager/

USGS nehrp

USGS science for a changing world — GSN — USAID FROM THE AMERICAN PEOPLE

M 7.9, EASTERN SICHUAN, CHINA

PAGER Version 8

Origin Time: Mon 2008-05-12 06:28:01 UTC
Location: 31.02°N 103.37°E Depth: 19 km

Created: 1 days, 8 hrs after earthquake

Estimated Population Exposed to Earthquake Shaking

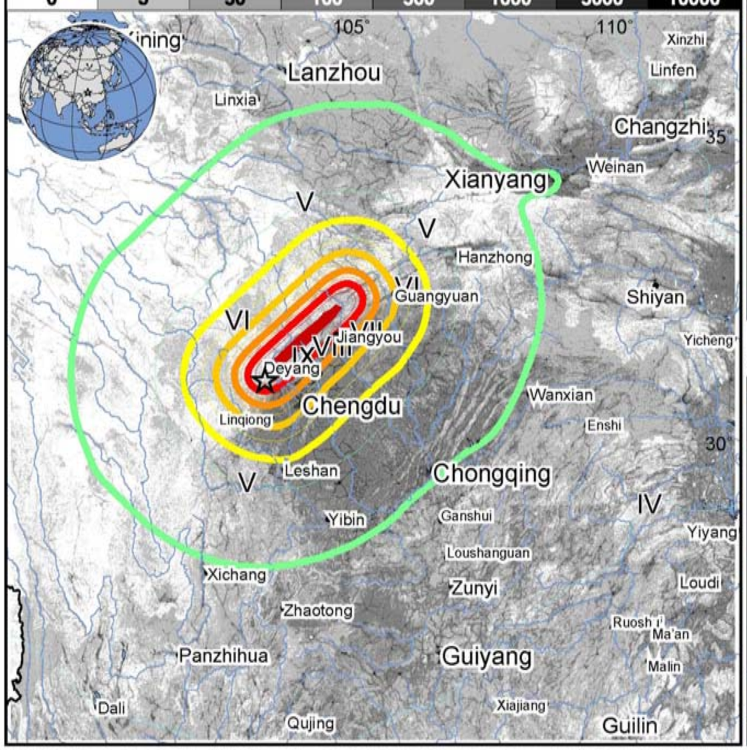
ESTIMATED POPULATION EXPOSURE (k = x1000)		- -*	- -*	188,523k*	89,143k	15,400k	12,673k	3,897k	707k	610k
ESTIMATED MODIFIED MERCALLI INTENSITY		I	II-III	IV	V	VI	VII	VIII	IX	X+
PERCEIVED SHAKING		Not felt	Weak	Light	Moderate	Strong	Very strong	Severe	Violent	Extreme
POTENTIAL DAMAGE	Resistant Structures	none	none	none	V. Light	Light	Moderate	Moderate/Heavy	Heavy	V. Heavy
	Vulnerable Structures	none	none	none	Light	Moderate	Moderate/Heavy	Heavy	V. Heavy	V. Heavy

*Estimated exposure only includes population within the map area.

Population Exposure

population per ~1 sq. km from Landscan 2005

0	5	50	100	500	1000	5000	10000



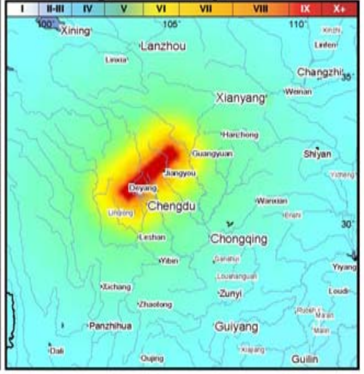
Selected City Exposure

MMI	City	Population
VIII	**Jiangyou**	127k
VIII	Tianpeng	60k
VII	**Deyang**	152k
VII	**Linqiong**	55k
VII	**Chengdu**	3,950k
VII	Mianyang	264k
VII	**Guangyuan**	213k
V	Nanchong	7,150k
V	**Chongqing**	3,967k
V	**Lanzhou**	3,200k
IV	Shiyan	3,460k

bold cities appear on map (k = x1000)

Shaking Intensity

MMI



Overall, structures in this region are vulnerable to earthquake shaking, though some resistant structures exist. A magnitude 6.4 earthquake struck the Sichuan, China region on August 23, 1976 (UTC), with estimated population exposures of 1,500 at intensity IX or greater and 5,700 at intensity VIII, resulting in 41 deaths. Additionally, a magnitude 7.3 struck this region in 1933 killing 6,800 people. Recent earthquakes in this area have also triggered landslide hazards that have contributed to losses. Users should consider the preliminary nature of this information and check for updates as additional data becomes available.

Grand Challenge 2. Understand the natural processes that produce hazards.

"Continuous and useful information about the hazard must be available to everyone affected."

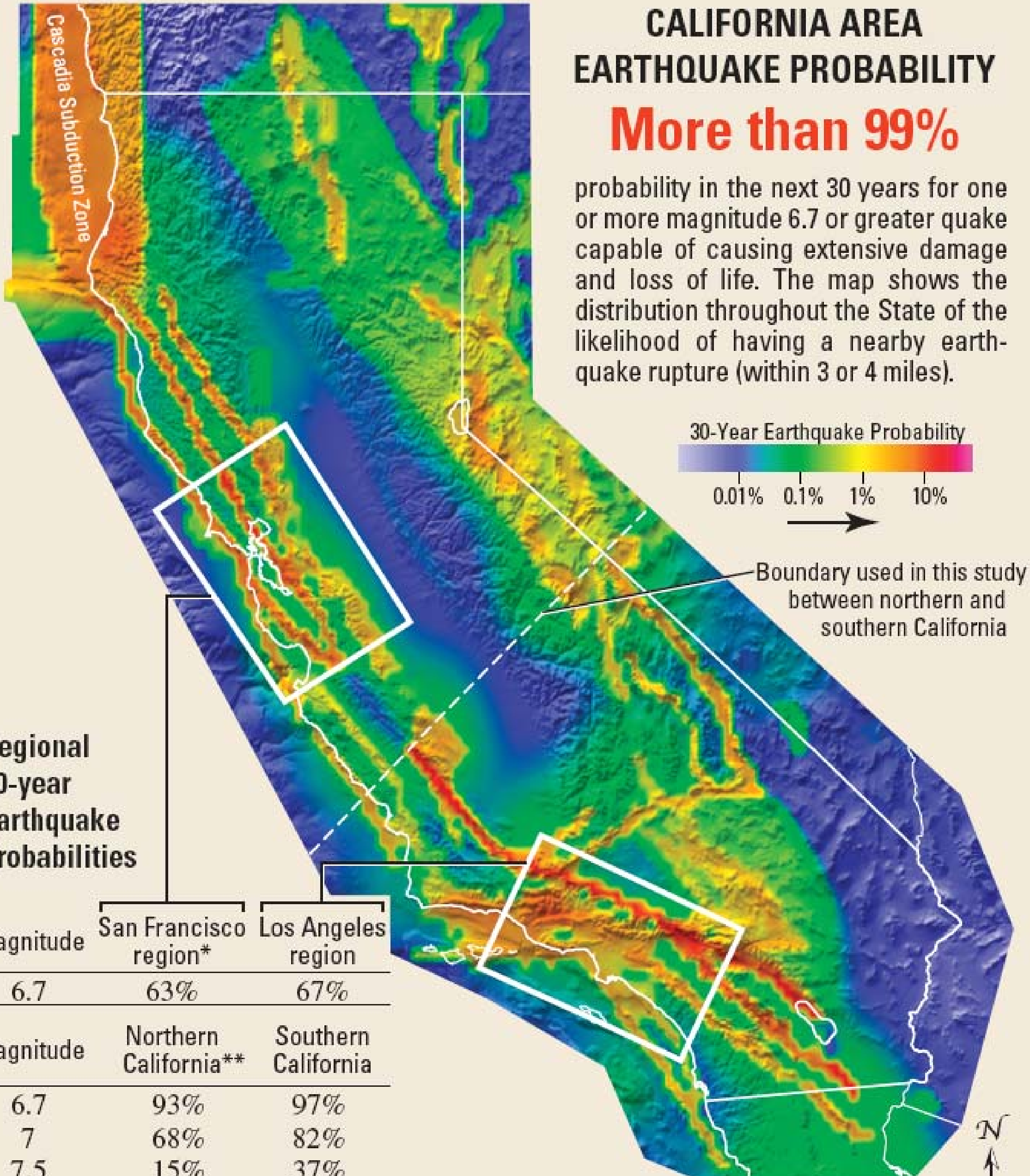
"To improve forecasting and predictions, scientists and engineers must continue to pursue basic research on the natural processes that produce hazards and understand how and when natural processes become hazardous.

New data must be collected and incorporated into advanced and validated models that support an improved understanding of underlying natural system processes and enhance assessment of the impacts."

CALIFORNIA AREA EARTHQUAKE PROBABILITY

More than 99%

probability in the next 30 years for one or more magnitude 6.7 or greater quake capable of causing extensive damage and loss of life. The map shows the distribution throughout the State of the likelihood of having a nearby earthquake rupture (within 3 or 4 miles).



Regional 30-year earthquake probabilities

Magnitude	San Francisco region*	Los Angeles region
6.7	63%	67%

Magnitude	Northern California**	Southern California
6.7	93%	97%
7	68%	82%
7.5	15%	37%
8	2%	3%

*Probabilities from UCERF for the San Francisco region are nearly identical to the previous results from WGCEP 2003.
**These probabilities do not include the Cascadia Subduction Zone

A new model for earthquake probabilities in California

Funded in part by the California Earthquake Authority

CEA CALIFORNIA EARTHQUAKE AUTHORITY

Released April 14th
http://pubs.usgs.gov/fs/2008/3027/

Grand Challenge 3. Develop hazard mitigation strategies and technologies.

"To prevent or reduce damage from natural hazards, scientists must invent – and communities must implement – affordable and effective hazard mitigation strategies, including land-use planning and zoning laws that recognize the risks of natural hazards.

In addition, technologies such as disaster-resilient design and materials and smart structures that respond to changing conditions must be used for development in hazardous areas."

"By designing and building structures and infrastructures that are inherently hazard resilient, communities can greatly reduce their vulnerability."

Grand Challenge 4. Recognize and reduce vulnerability of interdependent critical infrastructure.

"Protecting critical infrastructure systems, or lifelines, is essential to developing disaster-resilient communities.

To be successful, scientists and communities must identify and address the interdependencies of these lifelines at a systems level (e.g., communications, electricity, financial, gas, sewage, transportation, and water)."

"Protecting critical infrastructure provides a solid foundation from which the community can respond to hazards rapidly and effectively."

The Trans-Alaska Pipeline and the 2002 Denali earthquake: An infrastructure success story

The Trans-Alaska Pipeline survived the 2002 mag-7.9 Denali earthquake because of stringent earthquake design specifications based on geologic studies done by the USGS & others when the pipeline was constructed.

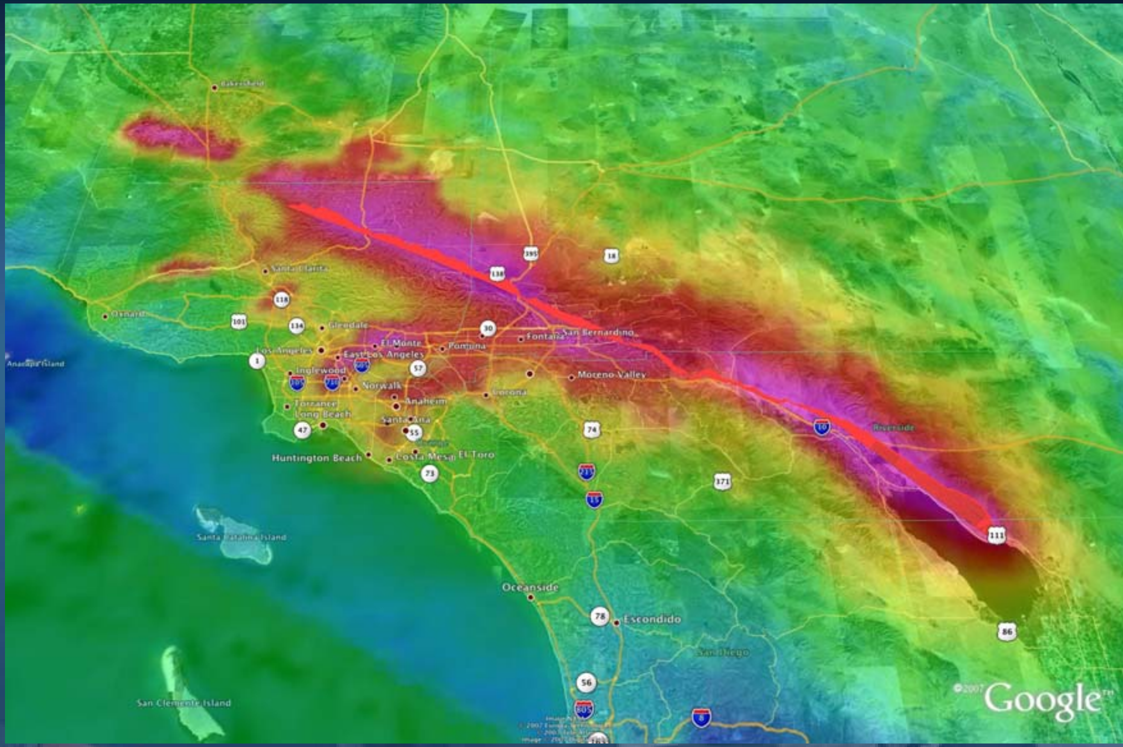
USGS

San Andreas ShakeOut Scenario

The Great Southern California ShakeOut

- Top request of emergency managers
- Rallying point for community

- San Andreas 'Big One' simulated earthquake; multi-hazard scenario
- Initiation near Bombay Beach, rupturing to the northwest
- Disruption of critical lifeline infrastructure (freeway, internet, power and gas lines) along surface rupture
- Strong shaking throughout region, including urban areas



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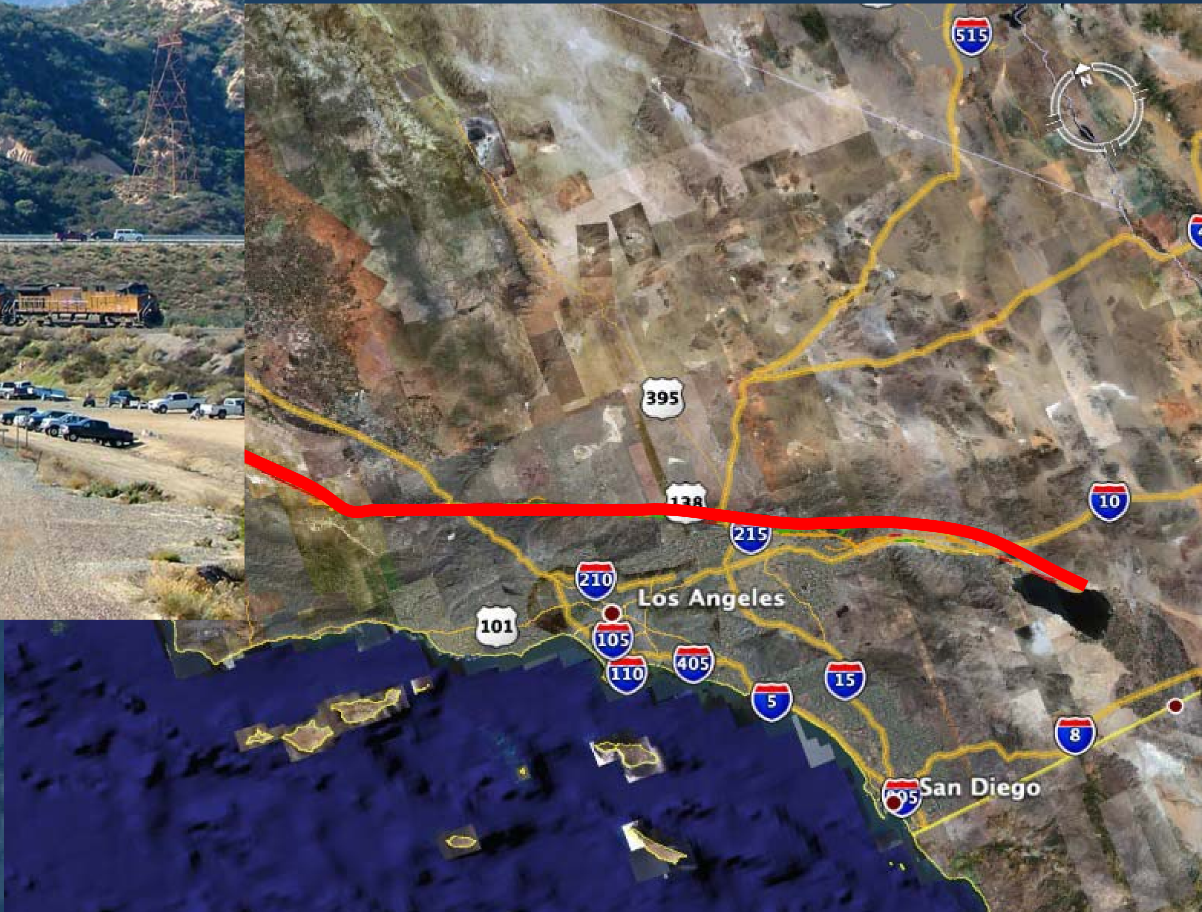
CALIFORNIA GEOLOGICAL SURVEY

SCEC an NSF+USGS center

All railroads and freeways into Los Angeles cross the San Andreas fault



Grand Challenge 5. Assess disaster resilience using standard methods

"Federal agencies must work with universities, local governments, and the private sector to identify effective standards and metrics for assessing disaster resilience.

With consistent factors and regularly updated metrics, communities will be able to maintain report cards that accurately assess the community's level of disaster resilience."

"Learn from each hazard event…to support ongoing hazard research and future mitigation plans."

Grand Challenge 6: Promote risk-wise behavior

"Develop and apply principles of economics and human behavior to enhance communications, trust, and understanding within the community to promote 'risk-wise' behavior.

To be effective, hazard information (e.g., forecasts and warnings) must be communicated to a population that understands and trusts messages. The at-risk population must then respond appropriately to the information."

"This is an ongoing challenge that can only be met by effectively leveraging the findings from social science research."

The Great Southern California ShakeOut

- November 13, 2008
- Golden Guardian DHS exercise
- Public drills
  - Schools earthquake drills
  - Business emergency drills
  - Faith-based communities
- City of Los Angeles Earthquake Safety conference
- Art Center Earthquake Spectacle

DARE to prepare
2007 Earthquake Readiness Campaign

USGS
GOLDEN GUARDIAN 2008
OES CALIFORNIA Governor's Office of Emergency Services
SCEC an NSF+USGS center
FEMA

In a more disaster-resilient world…

- Relevant hazards are recognized and understood.
- Communities at risk know when a hazard event is imminent.
- Property losses and lives at risk in future natural hazard events are minimized.
- Disaster-resilient communities experience minimum disruption to life and economy after a hazard event has passed.

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More Information

http://www.sdr.gov

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