USGS
science for a changing world

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

Earthquake and Tsunami activities of the United States Geological Survey

Presentation to the
Ring of Fire Delegation

Dr. Michael L. Blanpied, *mblanpied@usgs.gov*
USGS Earthquake Hazard Program
August 28, 2010

This release can be found in the USGS Newsroom at: http://www.usgs.gov/newsroom/article.asp?ID=2439.

USGS
science for a changing world

So many earthquakes… too many earthquakes?

News Release

April 14, 2010	Dr. Michael Blanpied	703-648-6696	mblanpied@usgs.gov
	Clarice Nassif Ransom	703-648-4299	cransom@usgs.gov

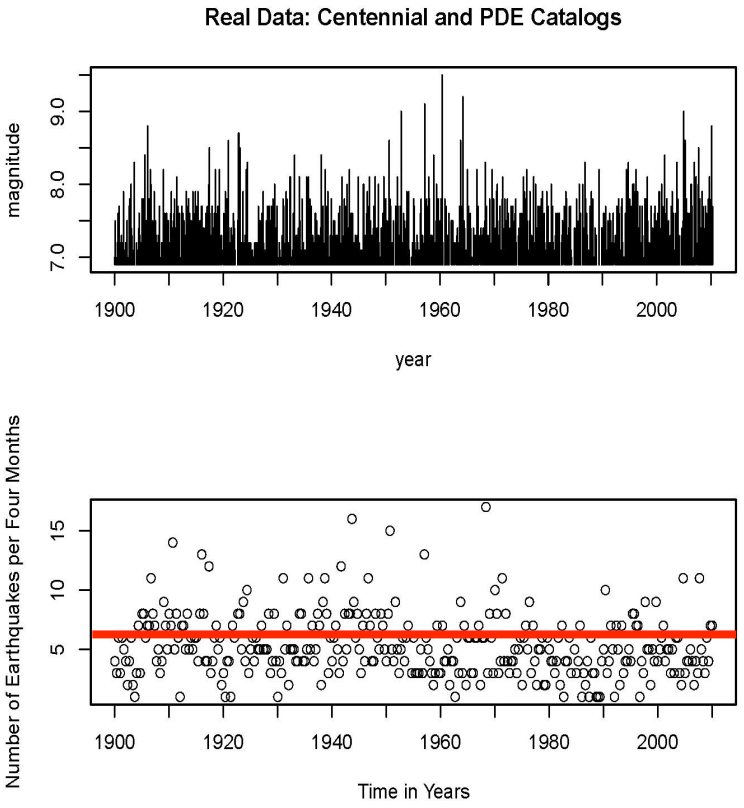
Is Recent Earthquake Activity Unusual? Scientists Say No.

SHARE

China's tragic magnitude 6.9 earthquake on April 13 and the recent devastating earthqua
many wondering if this earthquake activity is unusual.

Scientists say 2010 is not showing signs of unusually high earthquake activity. Since 1900
earthquakes — the size that seismologists define as major — have occurred worldwide e
1986 and 1989, while 1943 had 32, with considerable variability from year to year.

With six major earthquakes striking in the first four months of this year, 2010 is well withi
2009, to April 14, 2010, there have been 18 major earthquakes, a number also well with



USGS statutory roles and responsibilities

- **USGS has the delegated 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 weather (including hurricane) warnings; our geomagnetic observatories support solar storm forecasts.**
- **USGS geospatial information supports response operations for wildfire and many other hazards.**

USGS

The mandate of the National Earthquake Hazard Reduction Program

- Develop effective measures for earthquake loss reduction;
- Promote their adoption;
- Improve the understanding of earthquakes and their effects on communities, buildings, structures, and lifelines.

nehrp

FEMA

NIST National Institute of Standards and Technology

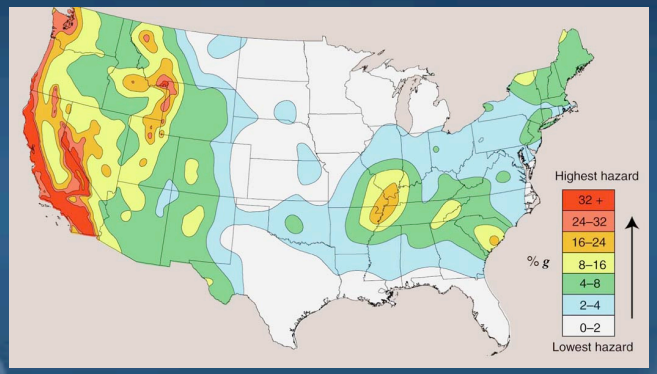
NSF

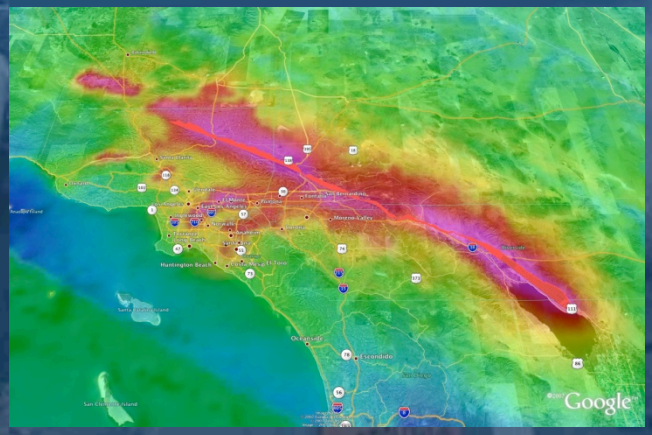
USGS science for a changing world

national earthquake hazards reduction program

The USGS role in NEHRP

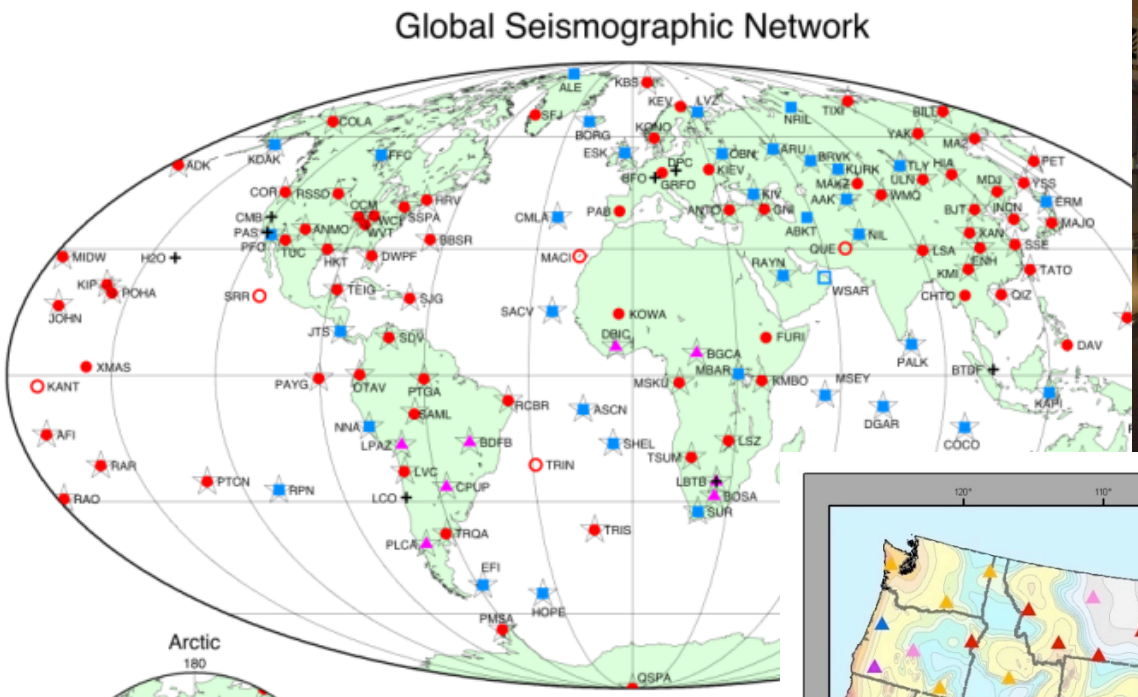
- Provide earthquake monitoring and notifications,
- Assess seismic hazards, and
- Conduct targeted research needed to reduce the risk from earthquake hazards nationwide.

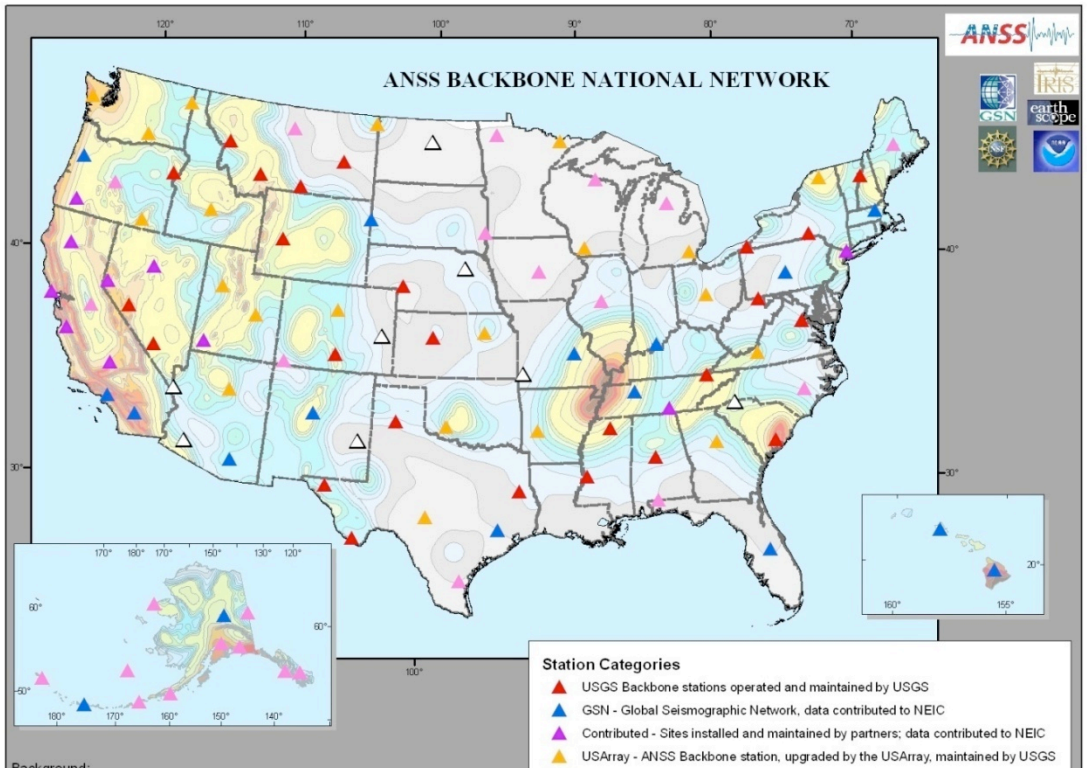




USGS nehrp

USGS provides rapid information on earthquakes worldwide

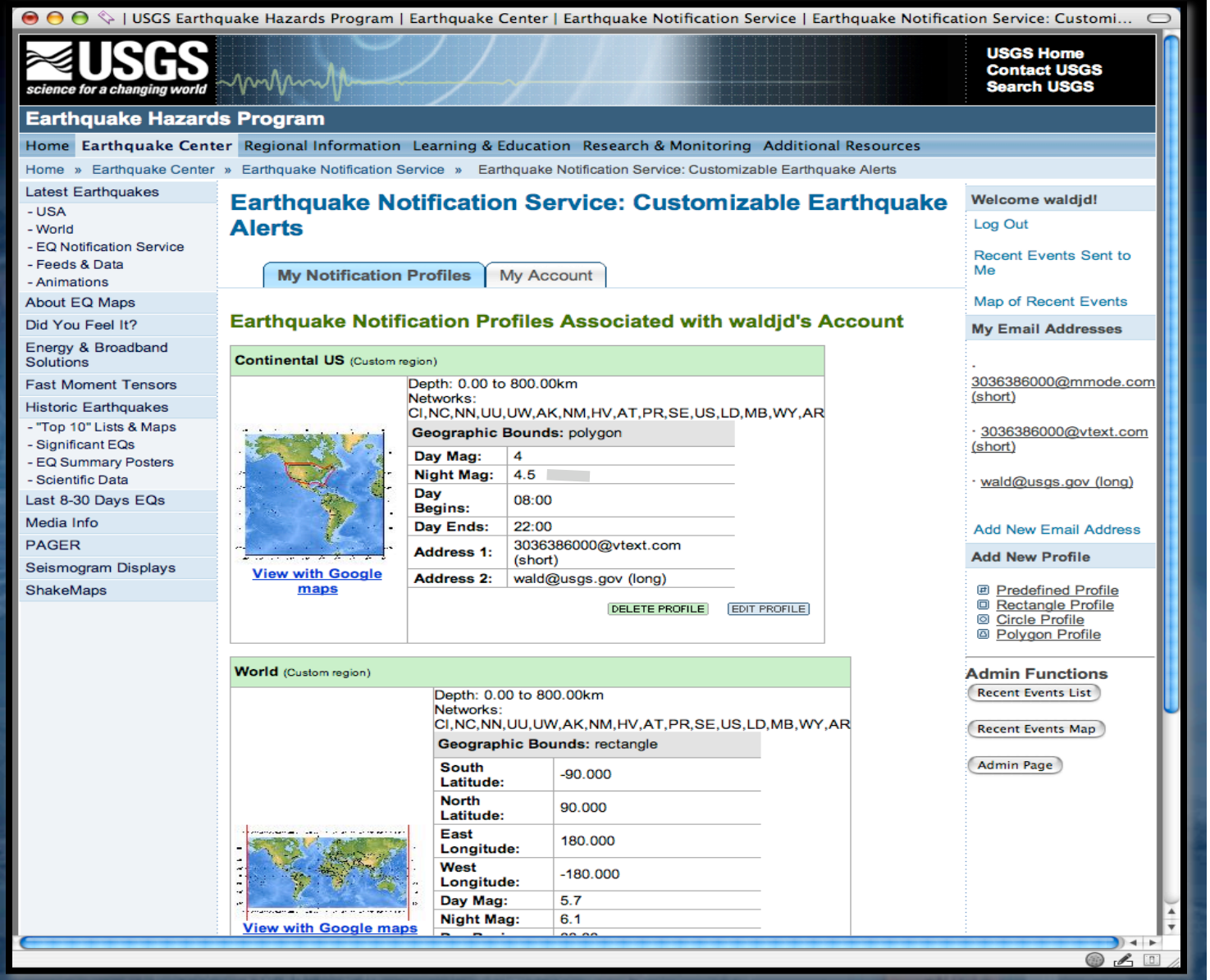




USGS Earthquake Notification System

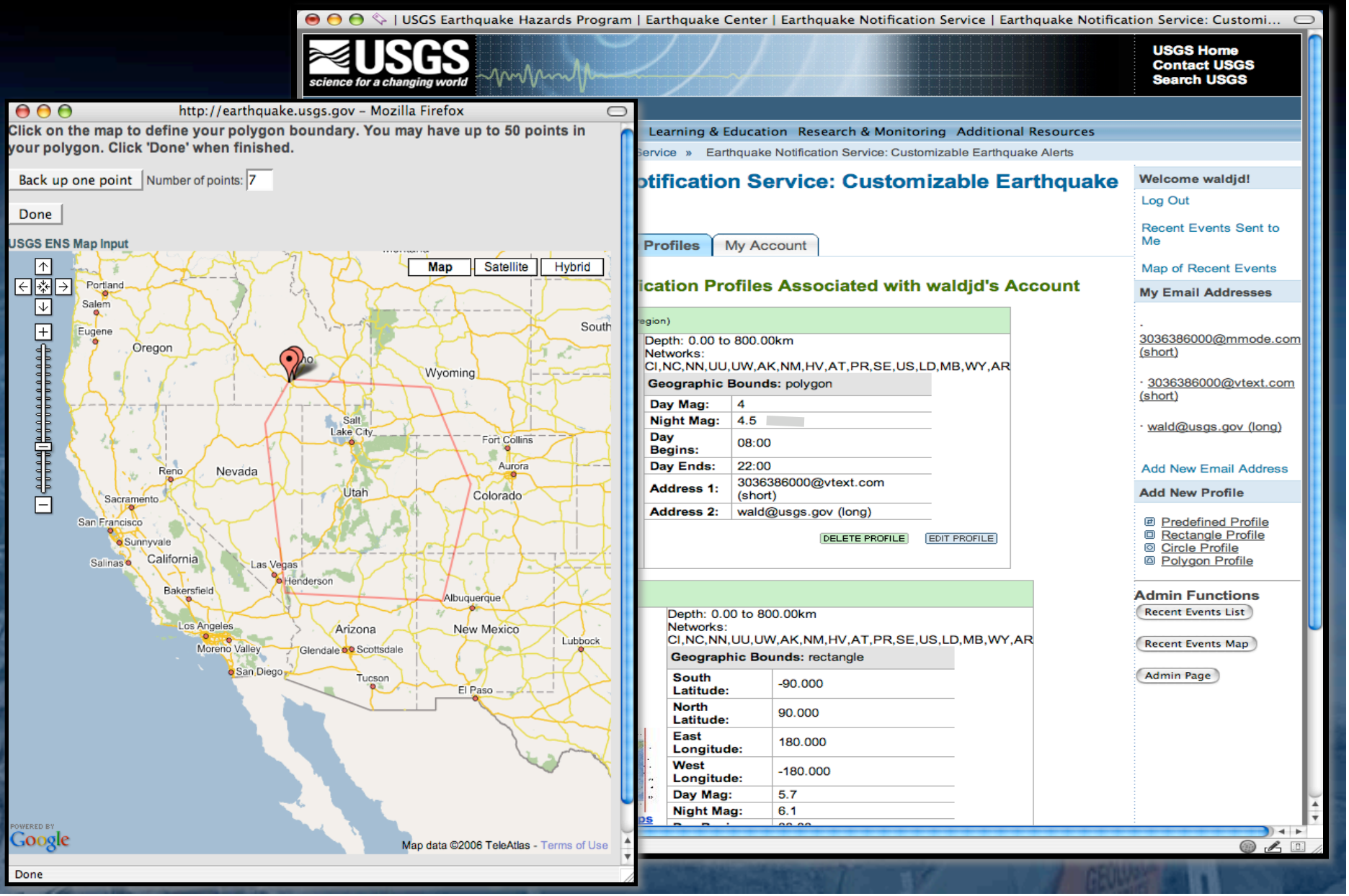
Over 175,000 users

ENS can be customized to suit your needs



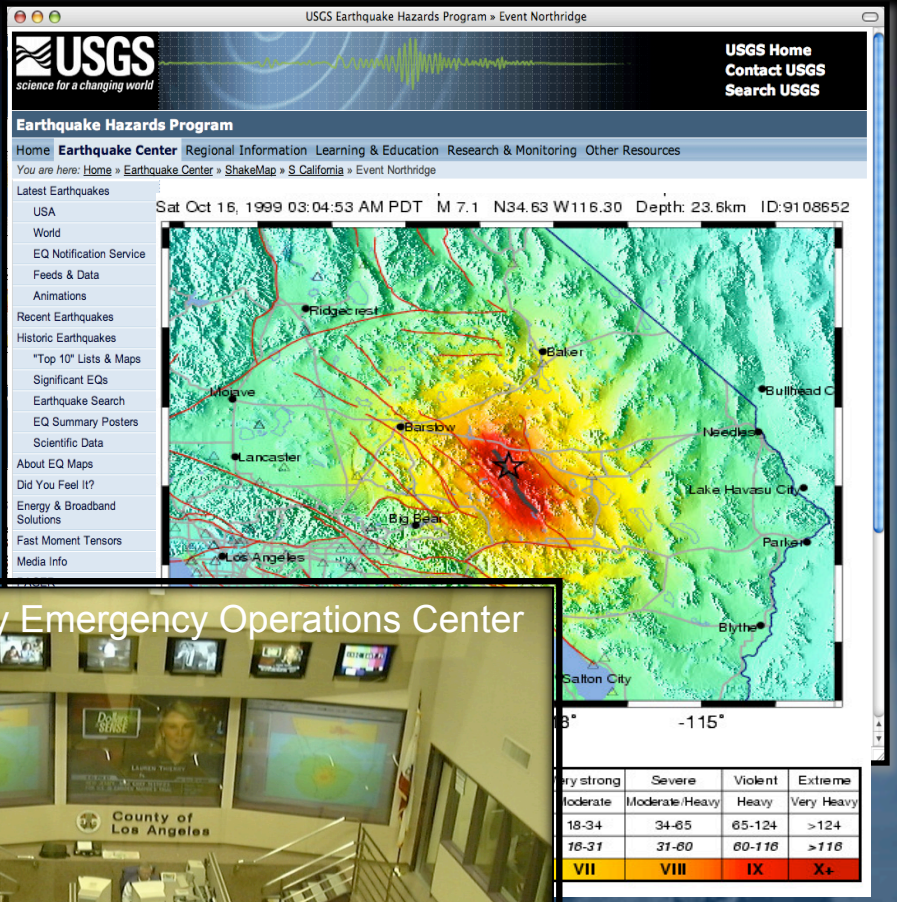
USGS

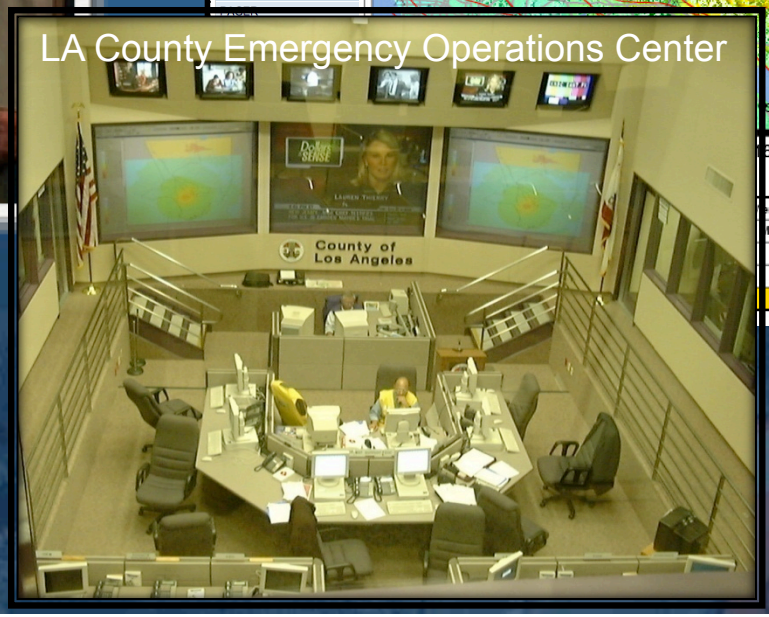
ENS can be customized to suit your needs



ShakeMap: A tool for rapid post-earthquake response, coordination, and situational awareness

California Governor Schwarzenegger pointing to ShakeMap at his press conference following the 2008 M5.4 Chino Hills earthquake that hit LA.



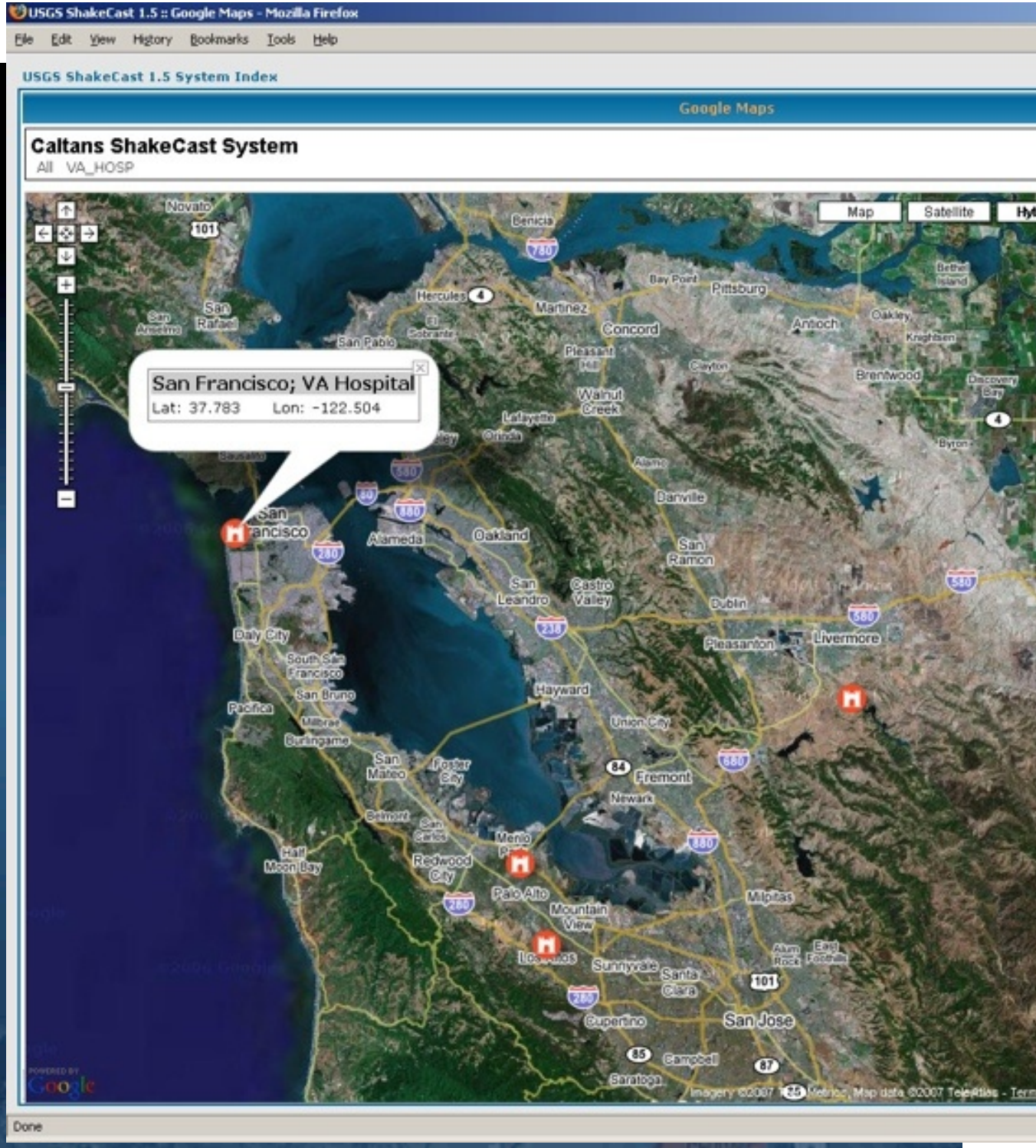


USGS nehrp

ShakeCast

Automated notifications to operators of critical facilities

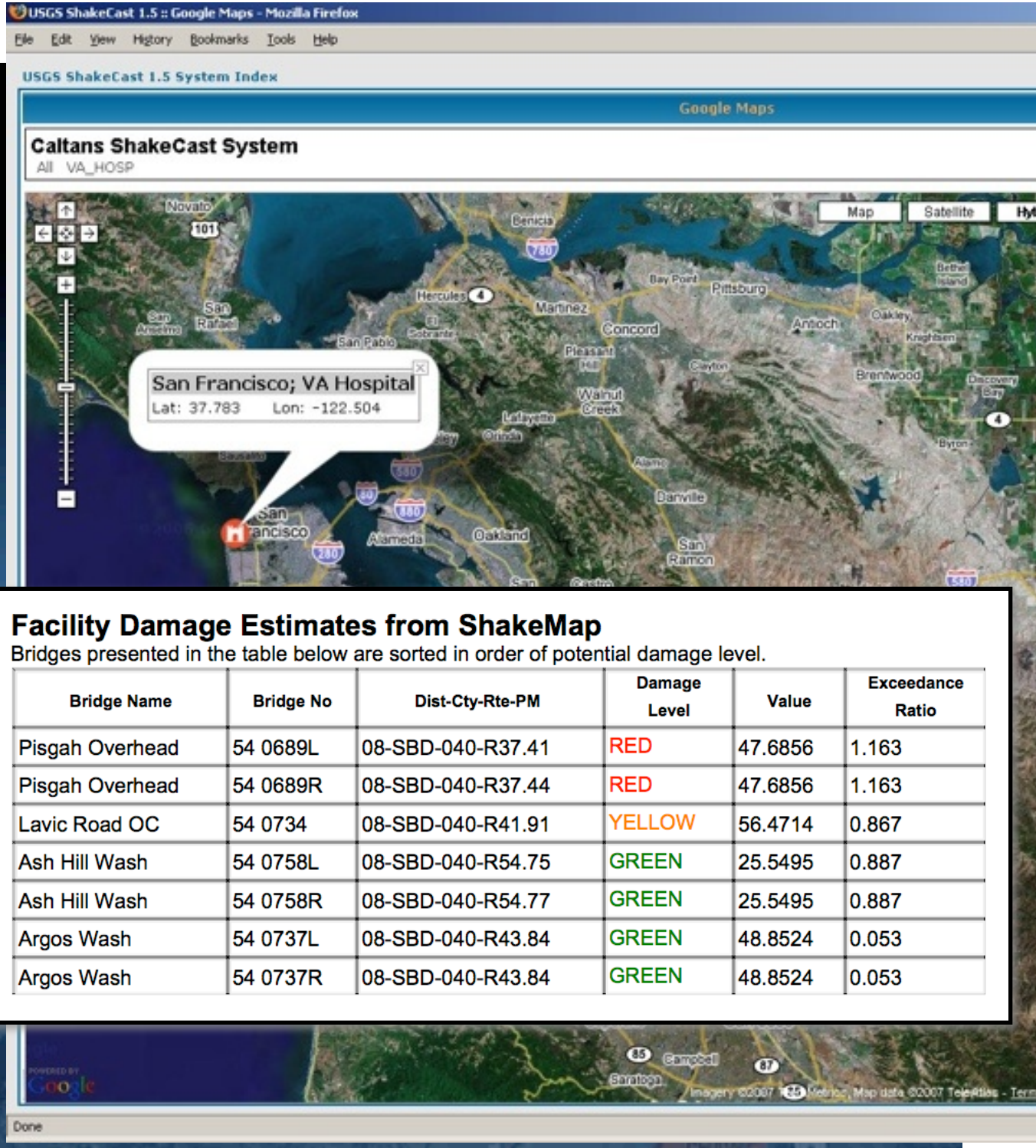
USGS nehrp



ShakeCast

Automated notifications to operators of critical facilities

USGS nehrp



Facility Damage Estimates from ShakeMap

Bridges presented in the table below are sorted in order of potential damage level.

Bridge Name	Bridge No	Dist-Cty-Rte-PM	Damage Level	Value	Exceedance Ratio
Pisgah Overhead	54 0689L	08-SBD-040-R37.41	RED	47.6856	1.163
Pisgah Overhead	54 0689R	08-SBD-040-R37.44	RED	47.6856	1.163
Lavic Road OC	54 0734	08-SBD-040-R41.91	YELLOW	56.4714	0.867
Ash Hill Wash	54 0758L	08-SBD-040-R54.75	GREEN	25.5495	0.887
Ash Hill Wash	54 0758R	08-SBD-040-R54.77	GREEN	25.5495	0.887
Argos Wash	54 0737L	08-SBD-040-R43.84	GREEN	48.8524	0.053
Argos Wash	54 0737R	08-SBD-040-R43.84	GREEN	48.8524	0.053

Situational awareness available in 20 minutes

Prompt Assessment of Global Earthquakes for Response

USGS
science for a changing world

GSN USAID FROM THE AMERICAN PEOPLE

M 6.9, SOUTHERN QINGHAI, CHINA

Origin Time: Tue 2010-04-13 23:49:37 UTC
Location: 33.27°N 96.63°E Depth: 10 km

PAGER
Version 2
Created: 37 minutes, 54 seconds after earthquake

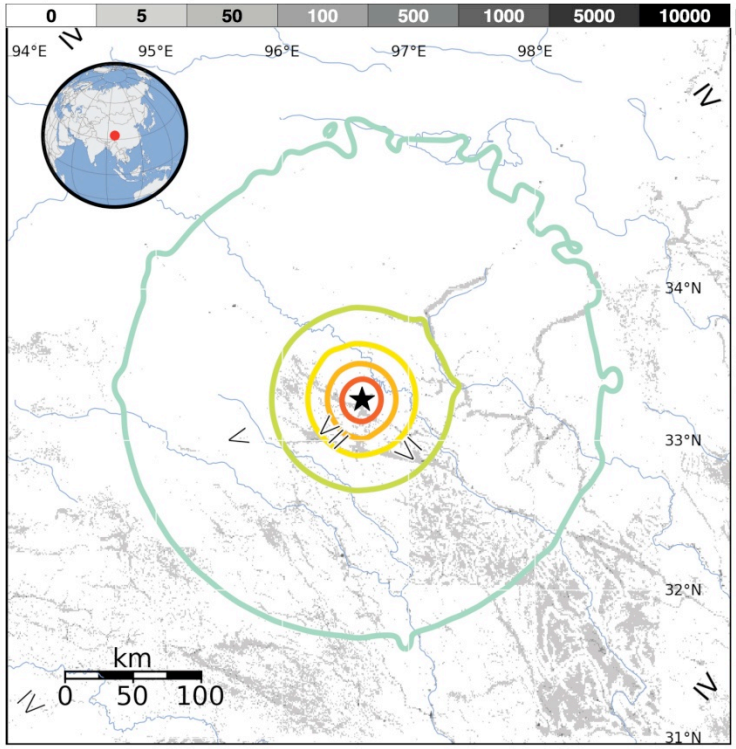
Estimated Population Exposed to Earthquake Shaking

ESTIMATED POPULATION EXPOSURE (k = x1000)		- -*	- -*	540k*	237k	48k	9k	5k	3k	0
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

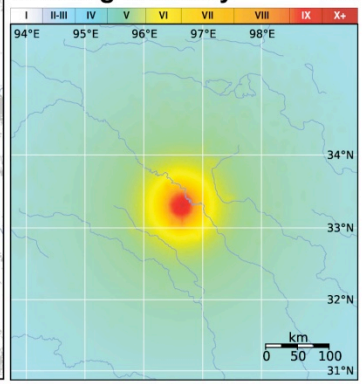
population per ~1 sq. km from Landscan



Selected City Exposure

MMI City	Population
bold cities appear on map	(k = x1000)

Shaking Intensity MMI



Overall, the population in this region resides in structures that are highly vulnerable to earthquake shaking, though some resistant structures exist. On June 15, 1982 (UTC), a magnitude 5.6 earthquake 338 km Southeast of this one struck China, with estimated population exposures of 1,000 at intensity VII and 2,000 at intensity VI, resulting in a reported 11 fatalities.

Situational awareness available in 20 minutes

Prompt Assessment of Global Earthquakes for Response

Beta-test product: LossPAGER

USGS science for a changing world

M 6.9, SOUTHERN QINGHAI, CHINA

Origin Time: Tue 2010-04-13 23:49:37 UTC
Location: 33.27°N 96.63°E Depth: 10 km

GSN USAID FROM THE AMERICAN PEOPLE

PAGER Version 2

Created: 37 minutes, 54 seconds after earthquake

Estimated Population Exposed to Earthquake Shaking

ESTIMATED POPULATION EXPOSURE (k = x1000)		- -*	- -*	540k*	237k	48k	9k	5k	3k	0
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.

USGS science for a changing world

Summary Alert **Orange**

GSN USAID FROM THE AMERICAN PEOPLE

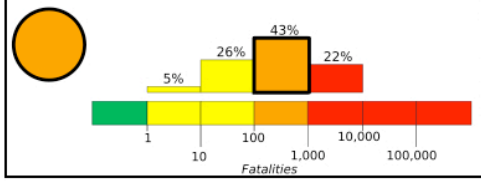
M 6.9, SOUTHERN QINGHAI, CHINA

Origin Time: Tue 2010-04-13 23:49:37 UTC (07:49:37 local)
Location: 33.27°N 96.63°E Depth: 10 km

PAGER Version 2

Created: 38 minutes, 39 seconds after earthquake

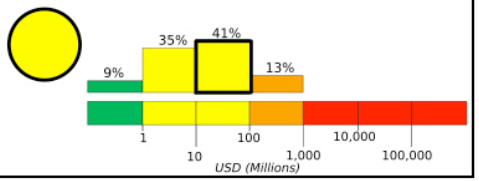
Estimated Fatalities



Orange alert level for fatalities. Significant casualties are likely and the disaster is potentially widespread. Past events with this alert level have required a regional or national level response.

Yellow alert level for economic losses. Some damage is possible. Estimated economic losses are less than 1% of GDP of China.

Estimated Economic Losses



Estimated Population Exposed to Earthquake Shaking

ION 0)	- -*	- -*	540k*	233k	50k	9k	6k	3k	0
ED Y	I	II-III	IV	V	VI	VII	VIII	IX	X+
G	Not felt	Weak	Light	Moderate	Strong	Very Strong	Severe	Violent	Extreme
POTENTIAL DAMAGE ant 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

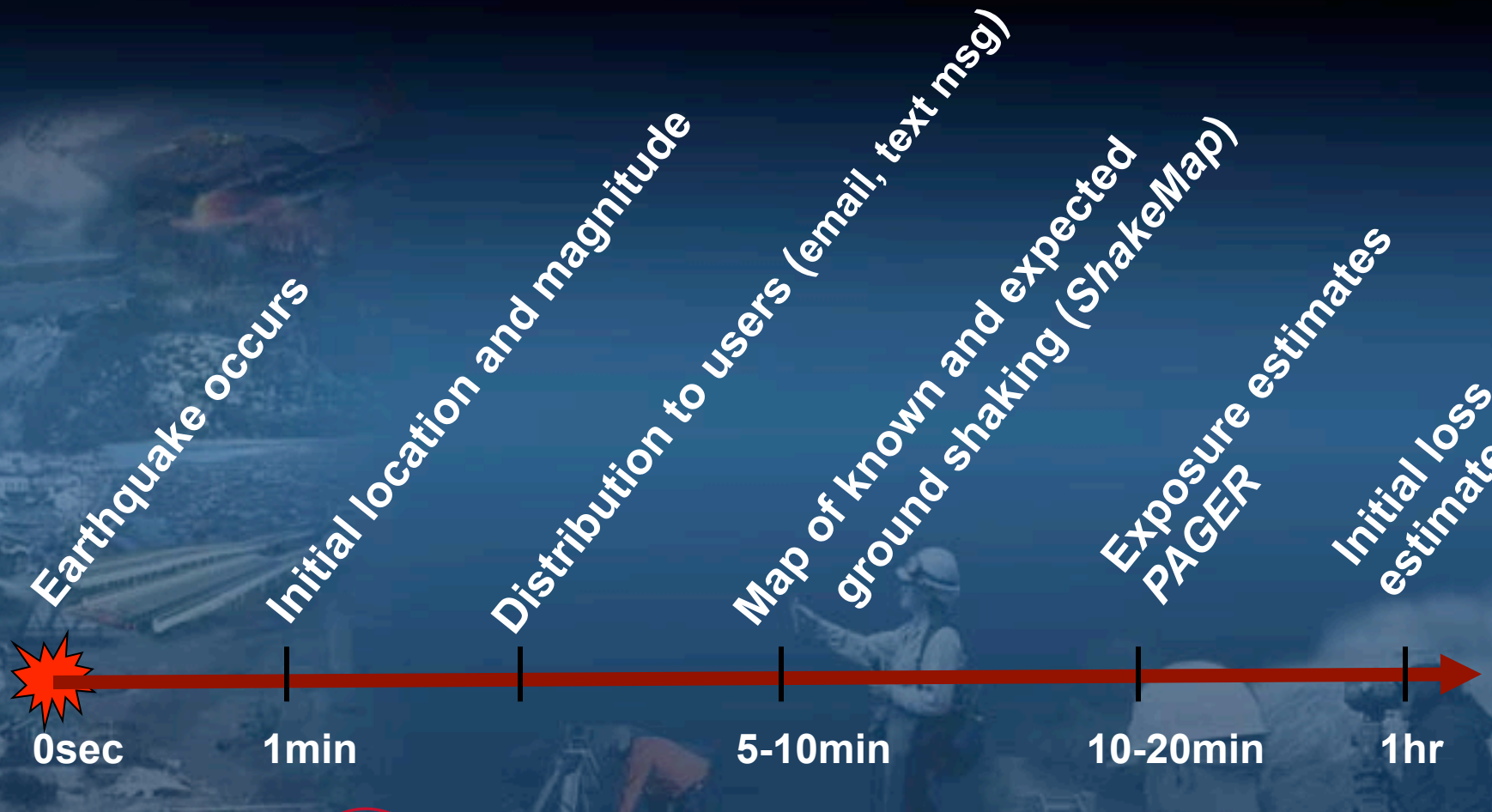
*Estimated exposure only includes population within the map area.

Population Exposure

population per ~1 sq. km from Landscan

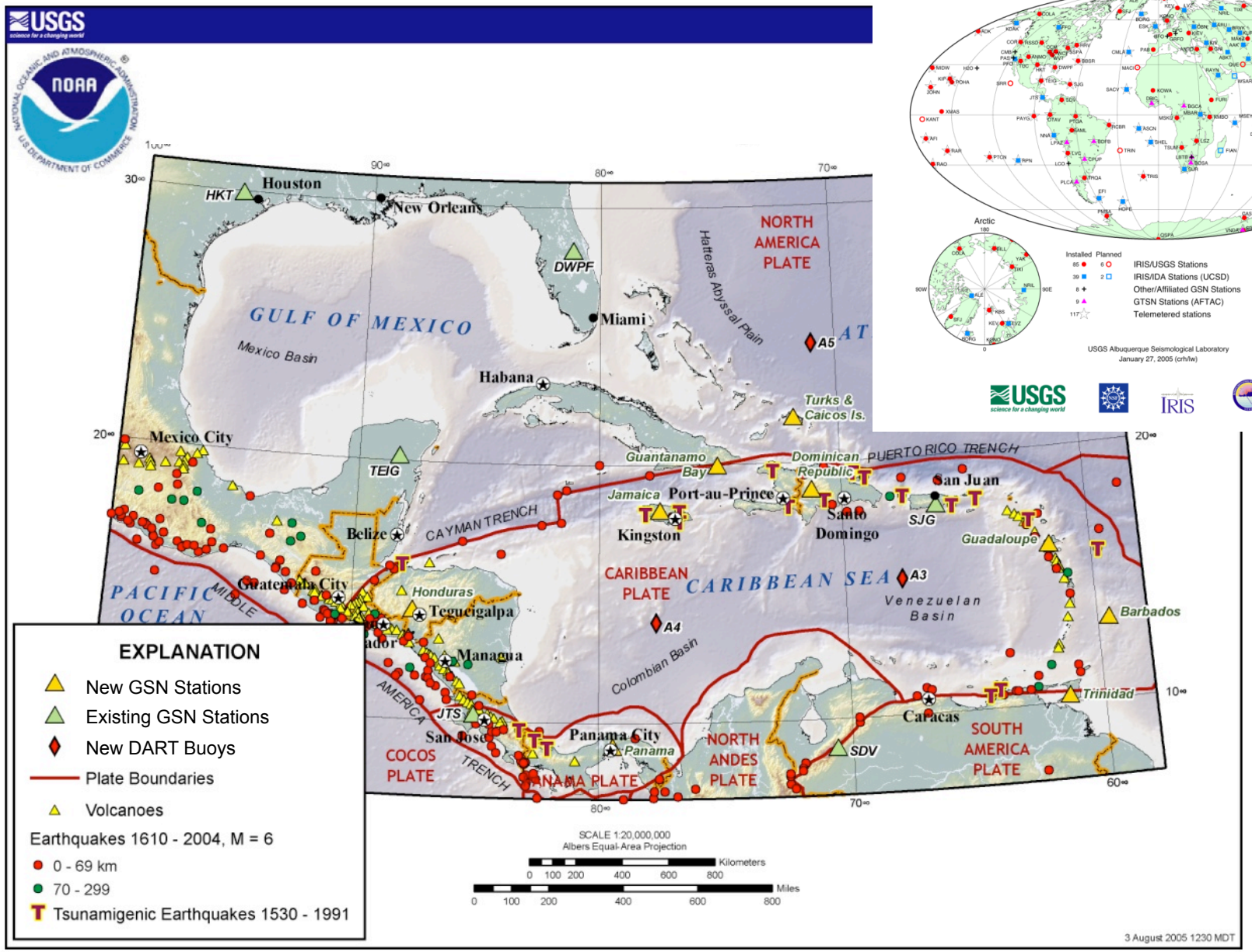
Structures:
Overall, the population in this region resides

An earthquake information timeline
(domestic earthquake)



USGS nehrp

NOAA-USGS Post-Sumatra tsunami warning initiative



Earthquake Disaster Assistance Team

- Cooperative program of the USGS and USAID's Office of Foreign Disaster Assistance (OFDA)
- Purposes:
  - Support OFDA's response activities to earthquake disasters in developing nations.
  - Make USGS experts or scientific services available to assist local geological agencies, when requested.
  - Conduct rapid assessment of earthquake, tsunami, and landslide hazards and impacts.
  - Provide advice and training to build capacity in monitoring, hazard asmt., microzonation, etc.
- Can also support mitigation and capacity-building projects.

USGS

Earthquake Disaster Assistance Team

Teams deployed following recent earthquakes:

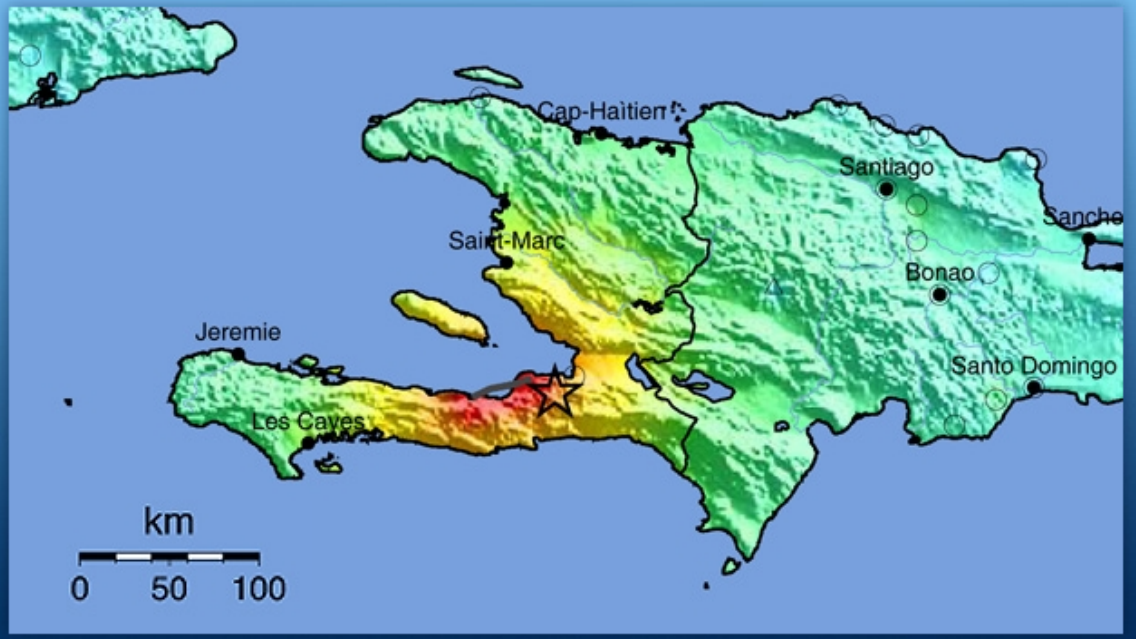
- Padang, Sumatra M7.6, September 2009
- Karonga, Malawi M6.0, December 2009
- Port au Prince, Haiti M7.0, January 2009

HELP for HAITI

The President speaks on the urgent situation after the earthquake in Haiti and the government's response. Read his remarks and learn how to contribute to the relief effort.

Learn More

1 2 3 4



Map courtesy of USGS

A NEW FOUNDATION

The President's Plan for Health Insurance Reform

Cut through the rhetoric on health insurance reform. Read the essentials of the President's plan, and watch a video with highlights of his speech to Congress.

Learn More

BACK | NEXT

SEARCH the SITE

Search WhiteHouse.gov Search

PHOTO of the DAY

THE BLOG

January 13, 2010 at 9:53 AM EST

FEATURED LEGISLATION

Ryan White HIV/AIDS Treatment

PAGER

Prompt
Assessment of
Global
Earthquakes
for
Response

Rapidly estimated that over 2 million people were exposed to violent shaking

USGS science for a changing world

M 7.0, HAITI REGION

Origin Time: Tue 2010-01-12 21:53:10 UTC
Location: 18.46°N 72.53°W Depth: 13 km

GSN USAID FROM THE AMERICAN PEOPLE

PAGER
Version 8
Created: 1 day, 20 hours after earthquake

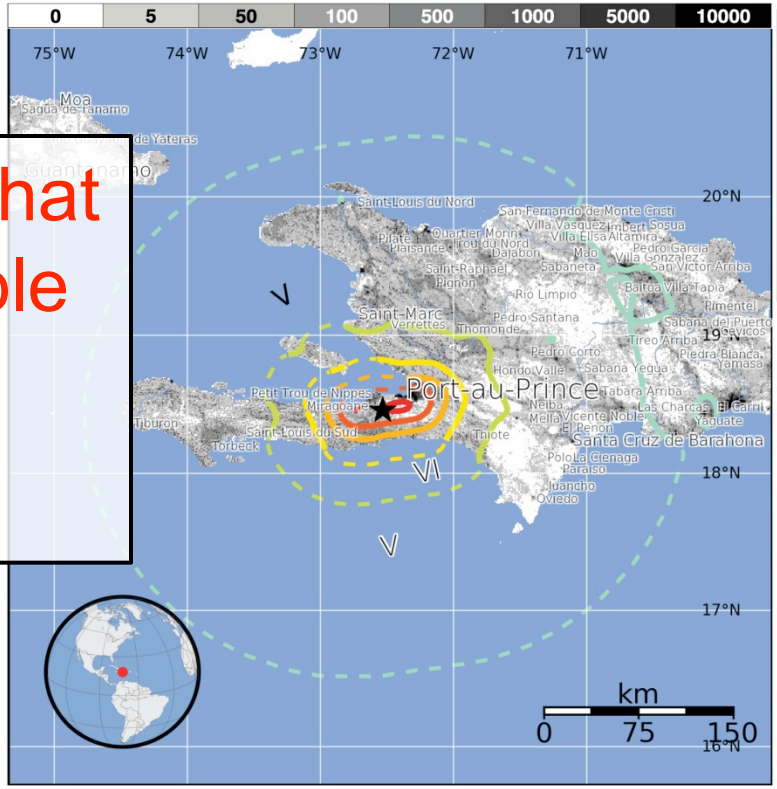
Estimated Population Exposed to Earthquake Shaking

ESTIMATED POPULATION EXPOSURE (k = x1000)		- -*	- -*	5,887k*	7,261k	1,049k	571k	314k	2,246k	332k
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



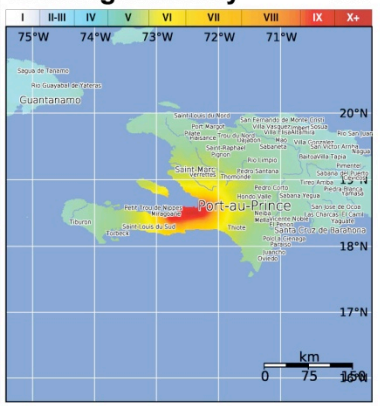
Selected City Exposure

MMI	City	Population
X	Grand Goave	5k
IX	**Port-au-Prince**	**1,235k**
IX	Carrefour	442k
IX	Petionville	108k
IX	Delmas 73	383k
IX	Croix des Bouquets	9k
VI	**Miragoane**	**6k**
V	**Verrettes**	**49k**
III	Santo Domingo	2,202k
III	**Guantanamo**	**273k**

bold cities appear on map (k = x1000)

Shaking Intensity

MMI



Overall, the population in this region resides in structures that are vulnerable to earthquake shaking, though some resistant structures exist. On June 24, 1984 (UTC), a magnitude 6.7 earthquake 329 km East of this one struck the Dominican Republic, with estimated population exposures of 320,000 at intensity VII and 2,964,000 at intensity VI, resulting in 5 reported fatalities. Recent earthquakes in this

Past
- Past 8–30 days
- Significant Earthquakes
- Earthquake Lists & Maps
- Search for an Earthquake

Present
- Real-time - CA/NV
- Real-time - USA
- Real-time - Worldwide
- About Earthquake Maps
- KML / RSS Feeds & Data
- Earthquake Notifications
- Seismogram Displays
- Earthquake Animations
- Did You Feel It?
- ShakeMaps
- PAGER
- EQ Summary Posters

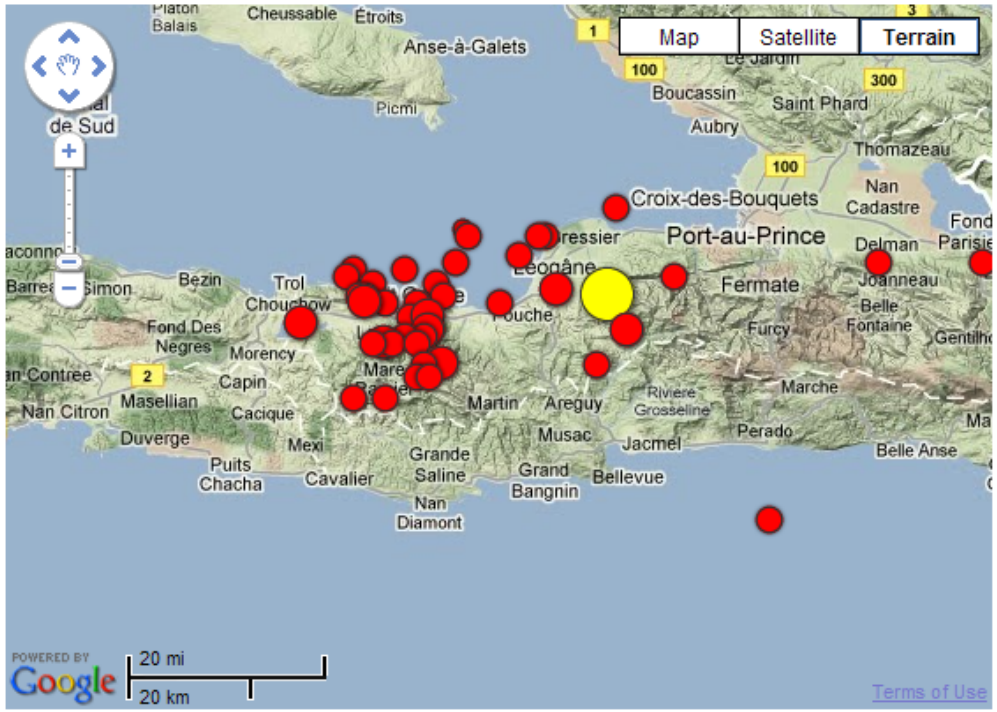
Future
- Earthquake Scenarios
- Prediction
- Probabilities

Location
- Info by State
- Info by Country/Region

Aftershock Mapping

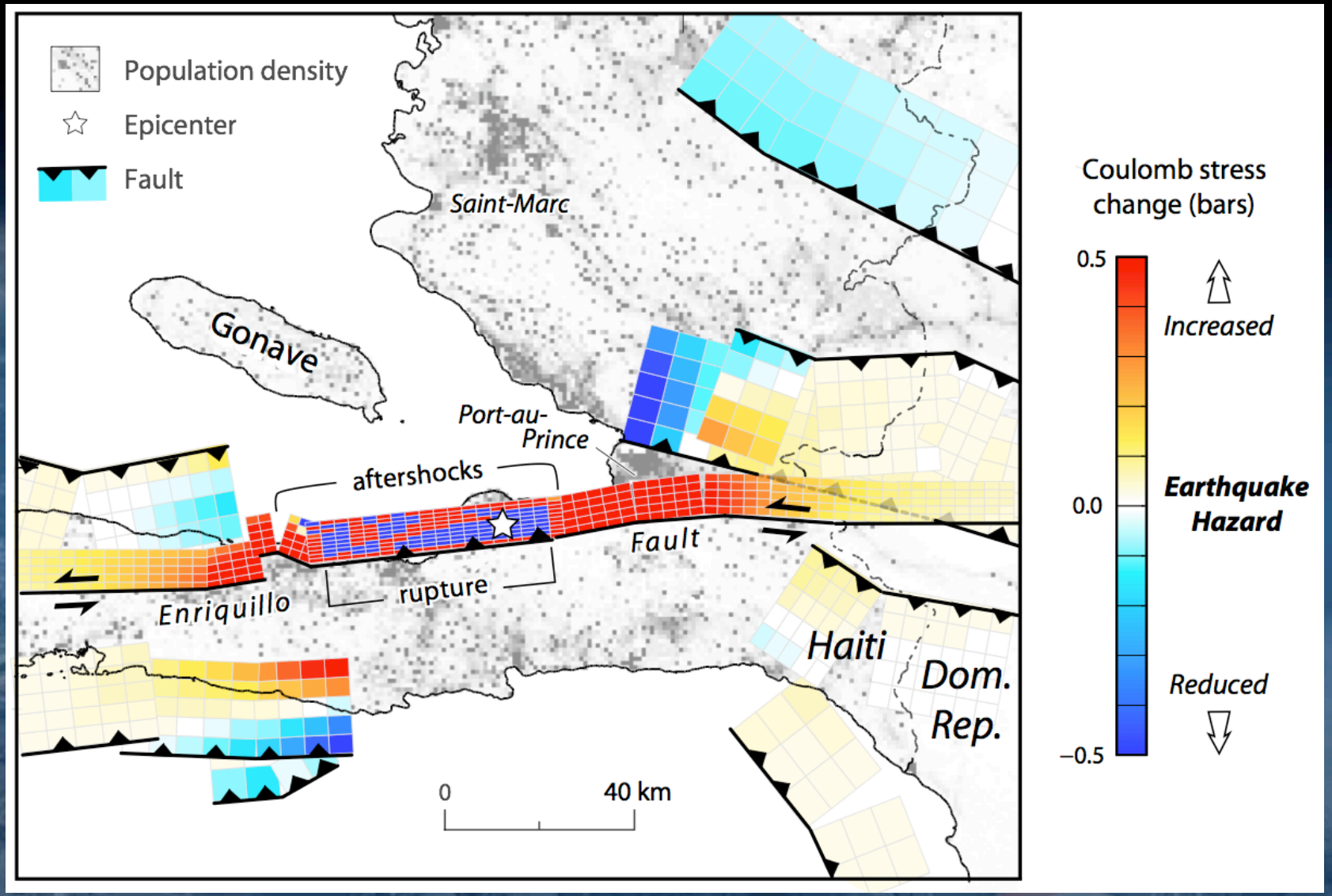
Aftershock Map - Mainshock and 42 Aftershocks

Last Updated: 04 March 2010, 00:08:59 UTC



Legend

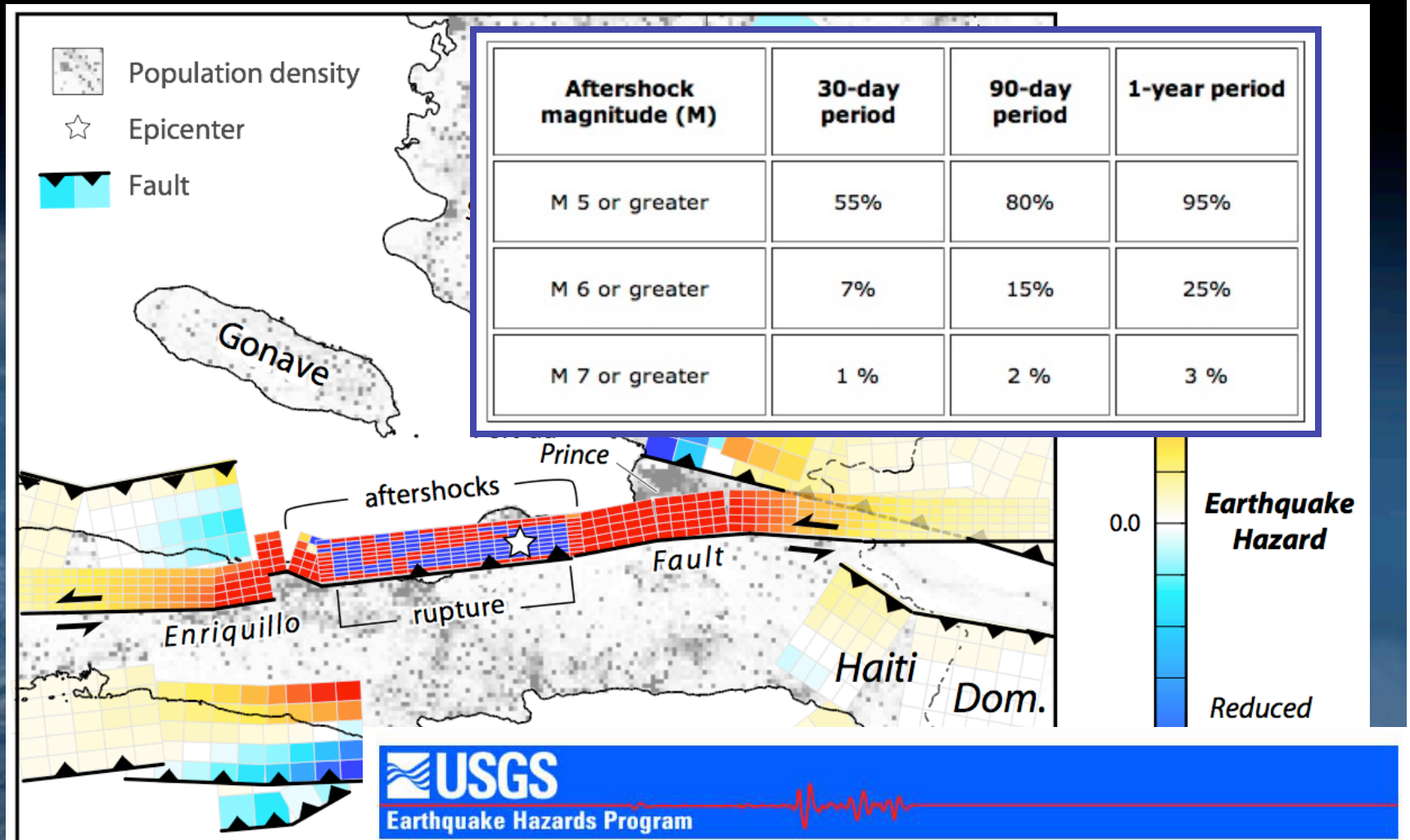
Stress increase on Enriquillo & adjoining faults



USGS

USGS Open-File Report 2010-101 by Lin, Stein, Sevilgen & Toda

Stress increase on Enriquillo & adjoining faults



Aftershock magnitude (M)	30-day period	90-day period	1-year period
M 5 or greater	55%	80%	95%
M 6 or greater	7%	15%	25%
M 7 or greater	1 %	2 %	3 %

USGS
Earthquake Hazards Program

Information summary distributed in English, French, Spanish and Creole

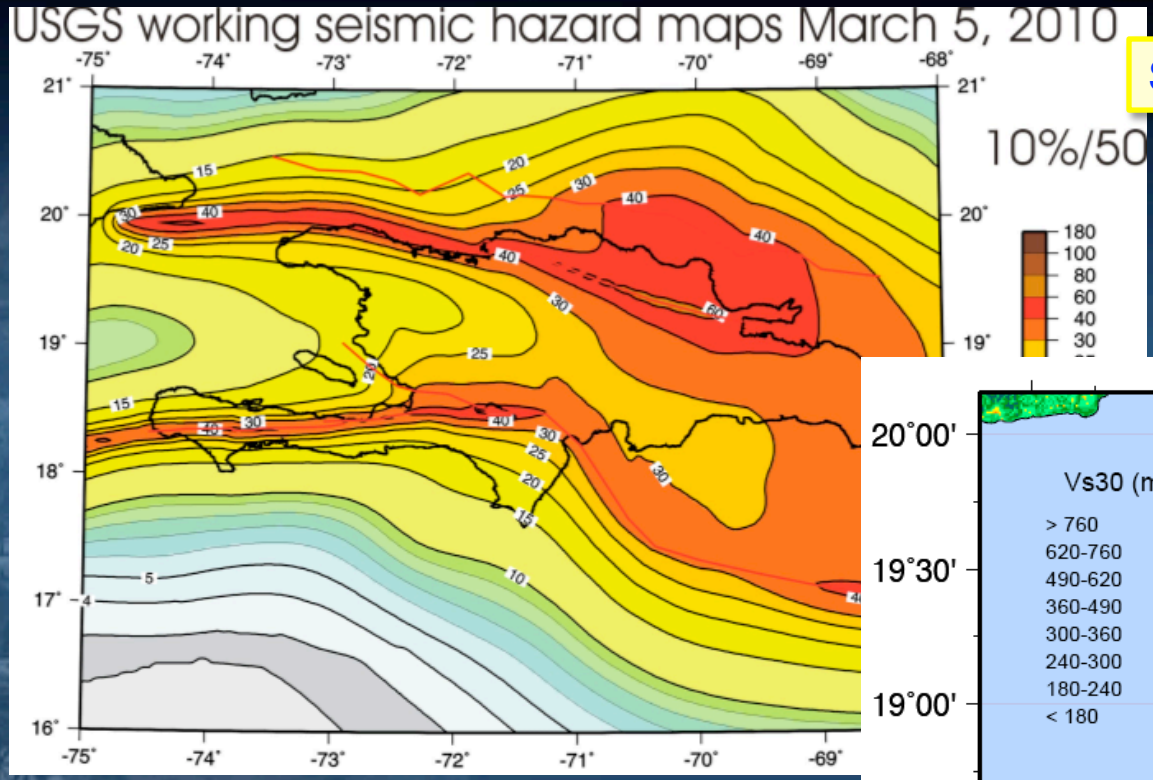
Risk tranblemanntè ak mezu sékirité nan Péyi Dayiti ak tout zòn Karayib-la

Komuniké Sant enspéksyon jéolojik Étazini

28 janvyé 2010

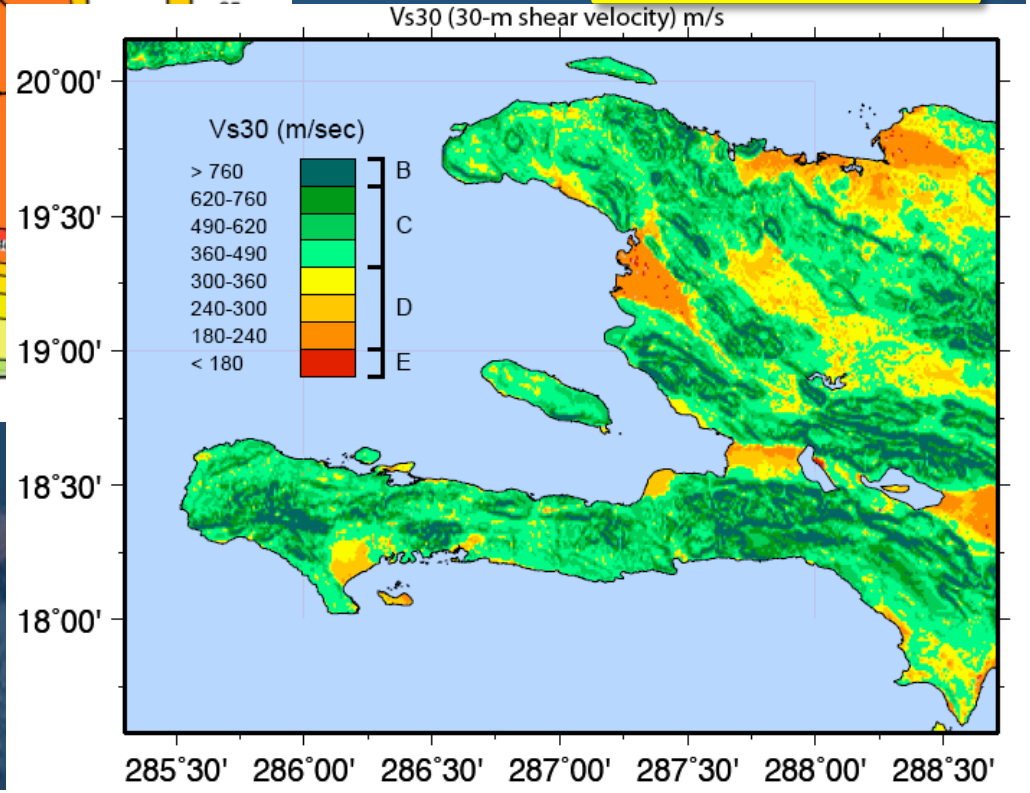
Échèl Richtè, sé yon mannyè pou mezuré puisans yon tranblemanntè.
Yon lòt mo pou di **puisans** yon tranblemanntè, sé **mayitud**.
Yon lòt mo pou di tranblemanntè, sé **séyis**, ou byen **kataklis** tou, ki pi jénéral.

USGS/USAID Earthquake Disaster Assistance Team: Improved seismic hazard analysis



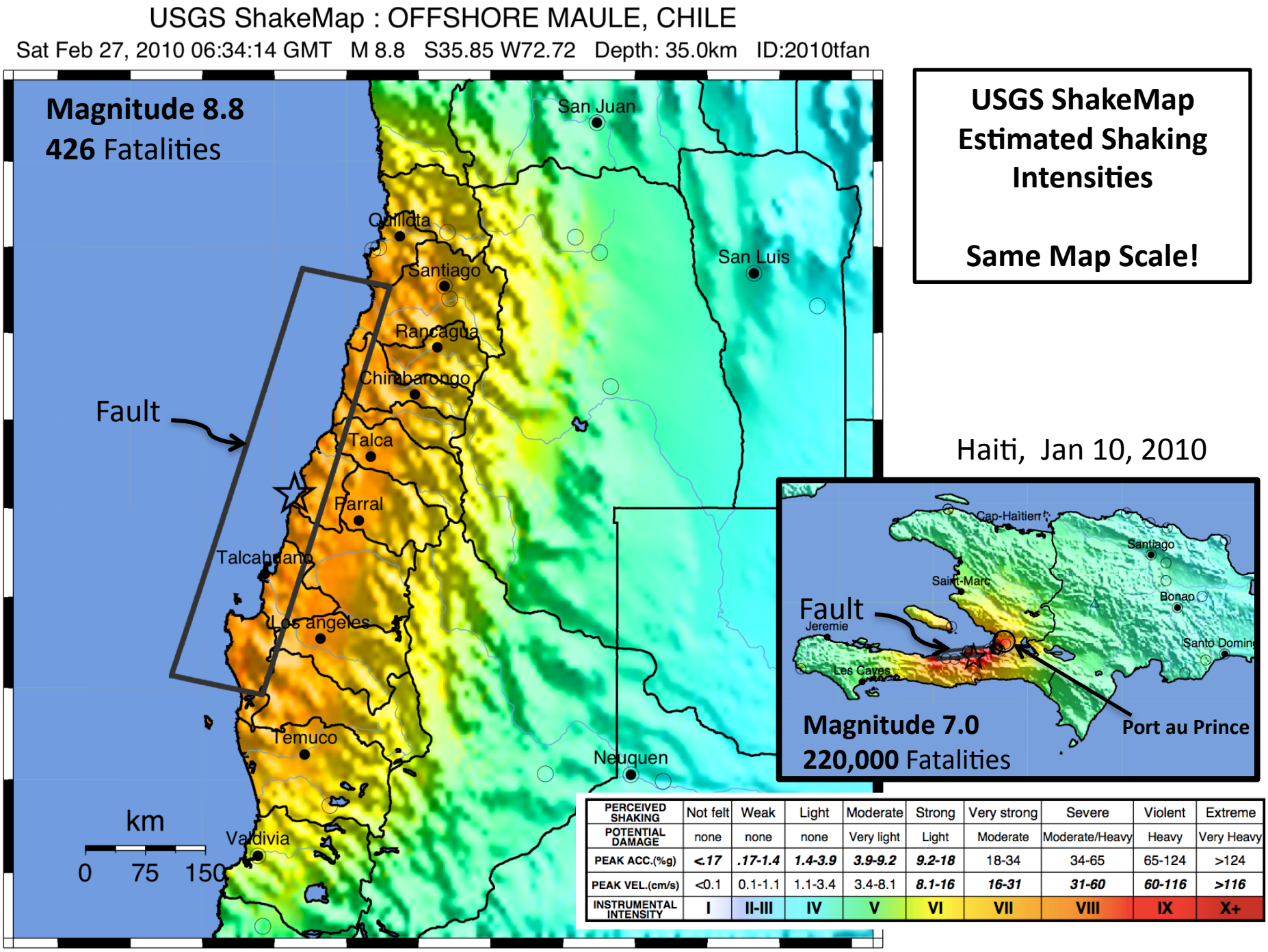
Shaking hazard

Shallow seismic wave speed

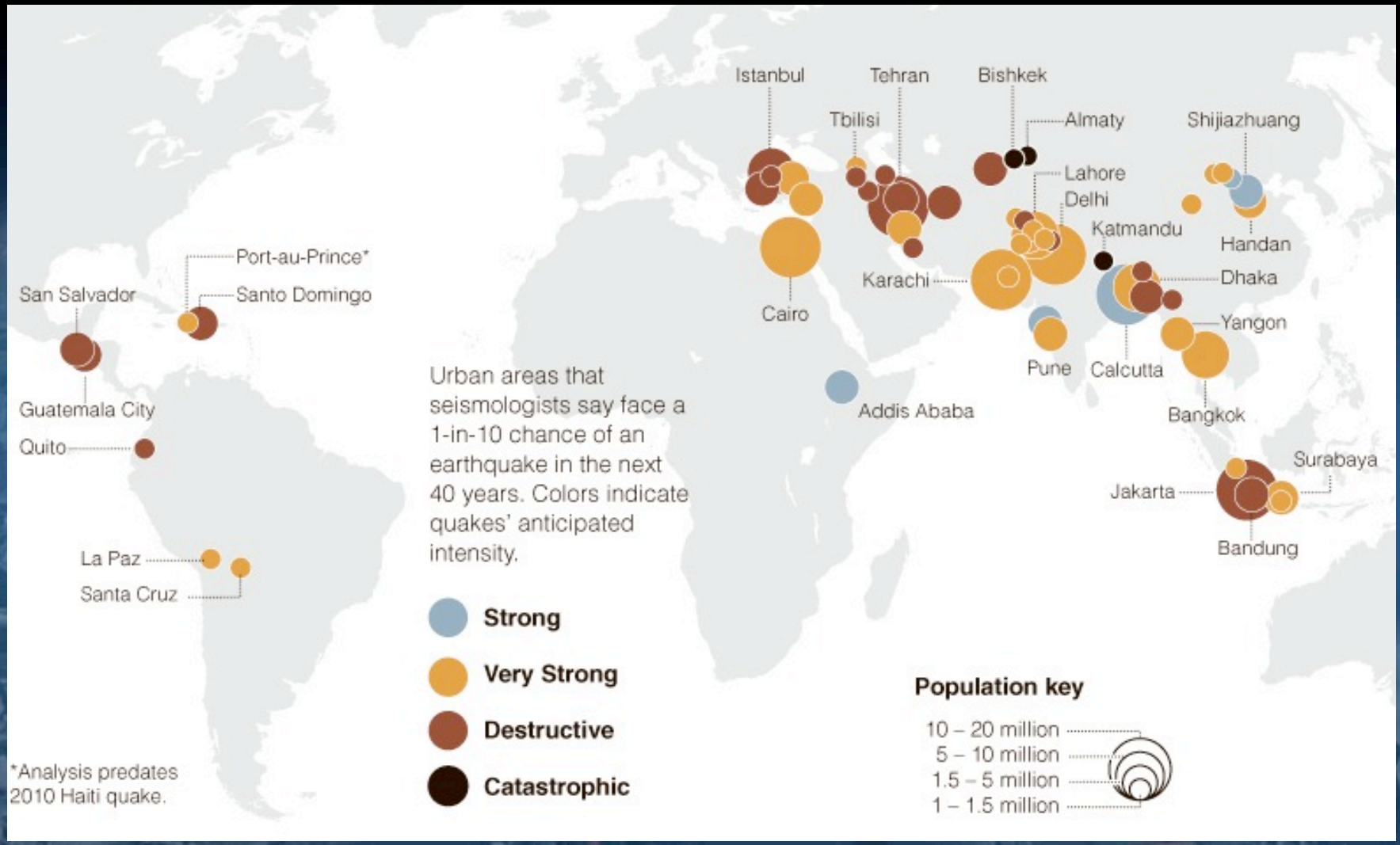


USAID FROM THE AMERICAN PEOPLE

USGS nehrp


USGS ShakeMap : OFFSHORE MAULE, CHILE
Sat Feb 27, 2010 06:34:14 GMT M 8.8 S35.85 W72.72 Depth: 35.0km ID:2010tfan
Magnitude 8.8
426 Fatalities
San Juan
Quillota
Santiago
San Luis
Rancagua
Chimbarongo
Fault
Talca
Parral
Talcahuano
Los angeles
Temuco
Neuquen
Valdivia
km
0 75 150
USGS ShakeMap
Estimated Shaking
Intensities
Same Map Scale!
Haiti, Jan 10, 2010
Cap-Haitien
Santiago
Saint-Marc
Bonao
Fault
Jeremie
Les Cayes
Port au Prince
Magnitude 7.0
220,000 Fatalities
PERCEIVED 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
PEAK ACC.(%g) | <.17 | .17-1.4 | 1.4-3.9 | 3.9-9.2 | 9.2-18 | 18-34 | 34-65 | 65-124 | >124
PEAK VEL.(cm/s) | <0.1 | 0.1-1.1 | 1.1-3.4 | 3.4-8.1 | 8.1-16 | 16-31 | 31-60 | 60-116 | >116
INSTRUMENTAL INTENSITY | I | II-III | IV | V | VI | VII | VIII | IX | X+

Cities at risk: There will be more bulls-eyes



USGS

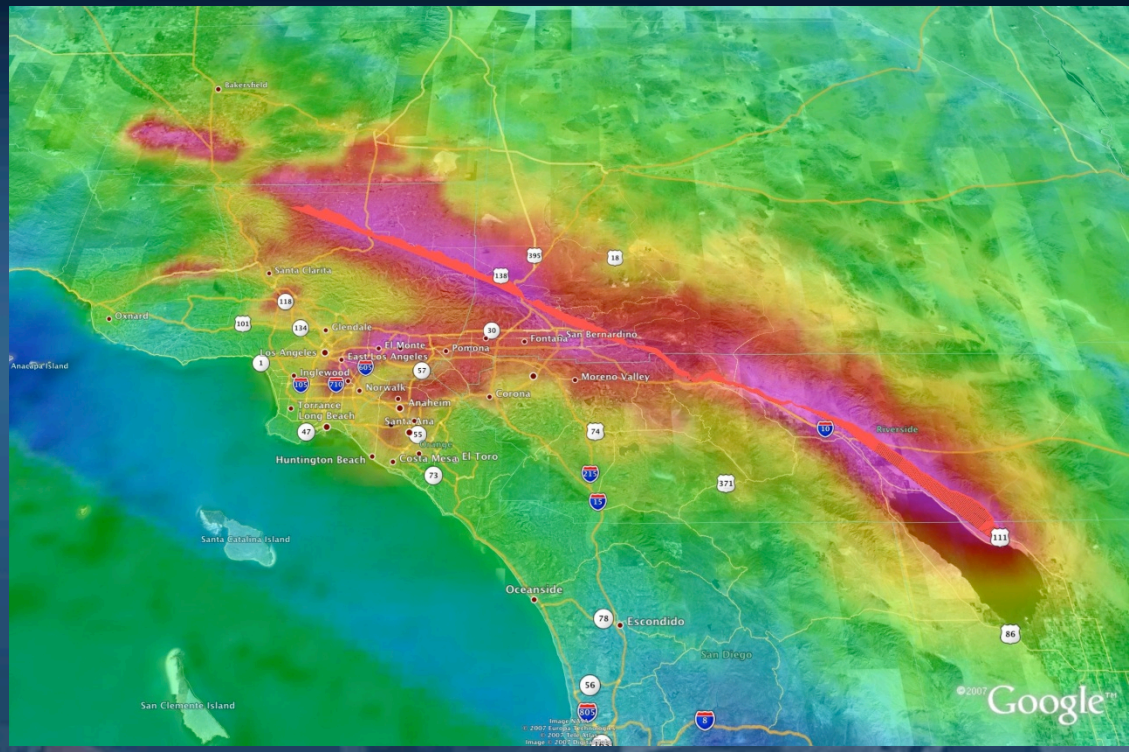
Graphic courtesy of *The New York Times*
Data from Columbia University Earth Institute

San Andreas ShakeOut Scenario

The Great Southern California ShakeOut

- Top request of emergency managers
- Rallying point for community

- San Andreas 'Big One' simulated magnitude-7.8 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



USGS

CGS CALIFORNIA GEOLOGICAL SURVEY

SCEC an NSF+USGS center

California-wide public preparedness drill

The Great California ShakeOut

October 15, 2009

OES CALIFORNIA
Governor's Office of Emergency Services

USGS

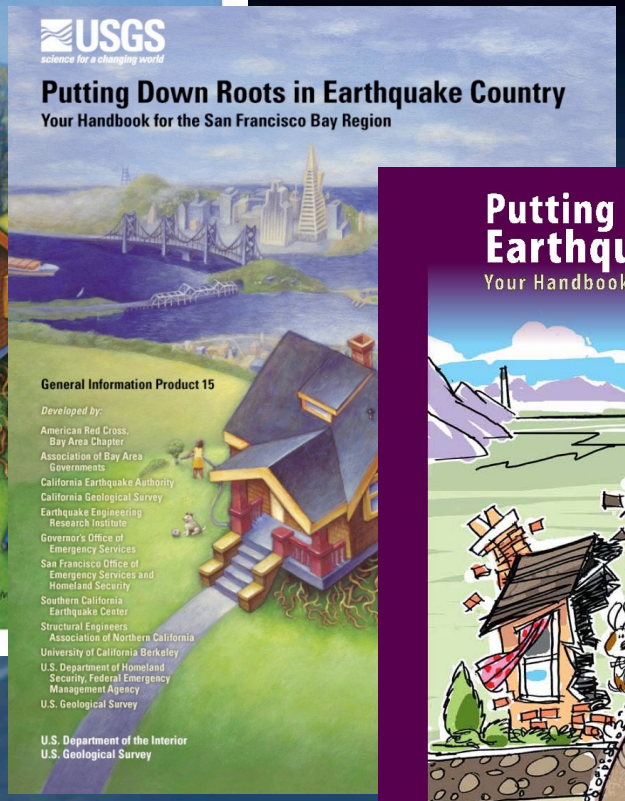
SCEC
an NSF+USGS center

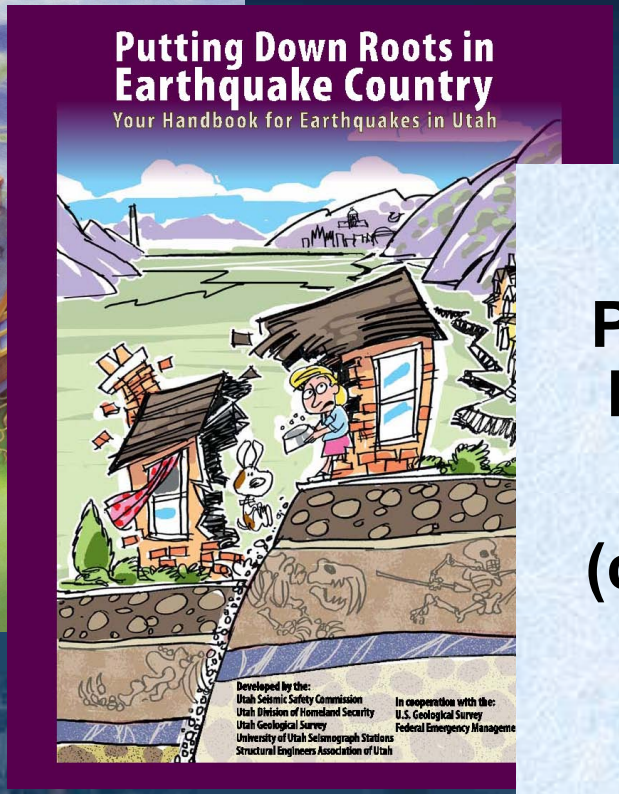
Earthquake Country **Alliance**
We're all in this together.

FEMA

ShakeOut

Putting Down Roots in Earthquake Country





FEMA

CEA CALIFORNIA EARTHQUAKE AUTHORITY

NSF

SCEC an NSF+USGS center

USGS science for a changing world

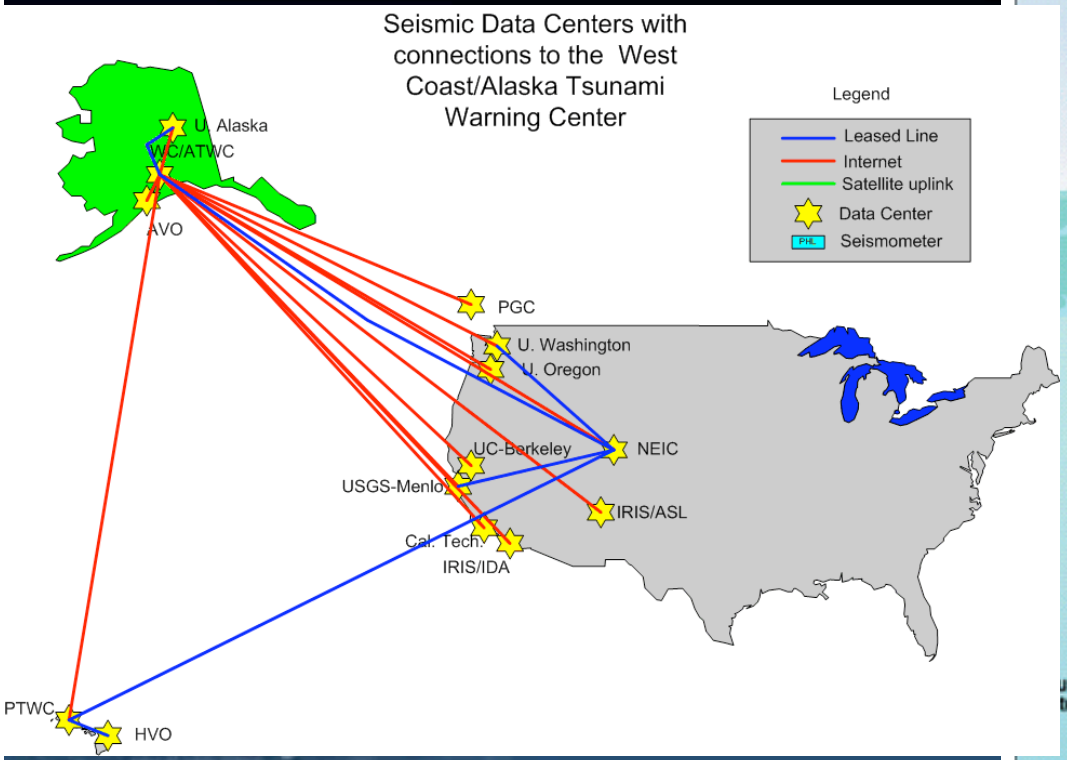
CGS

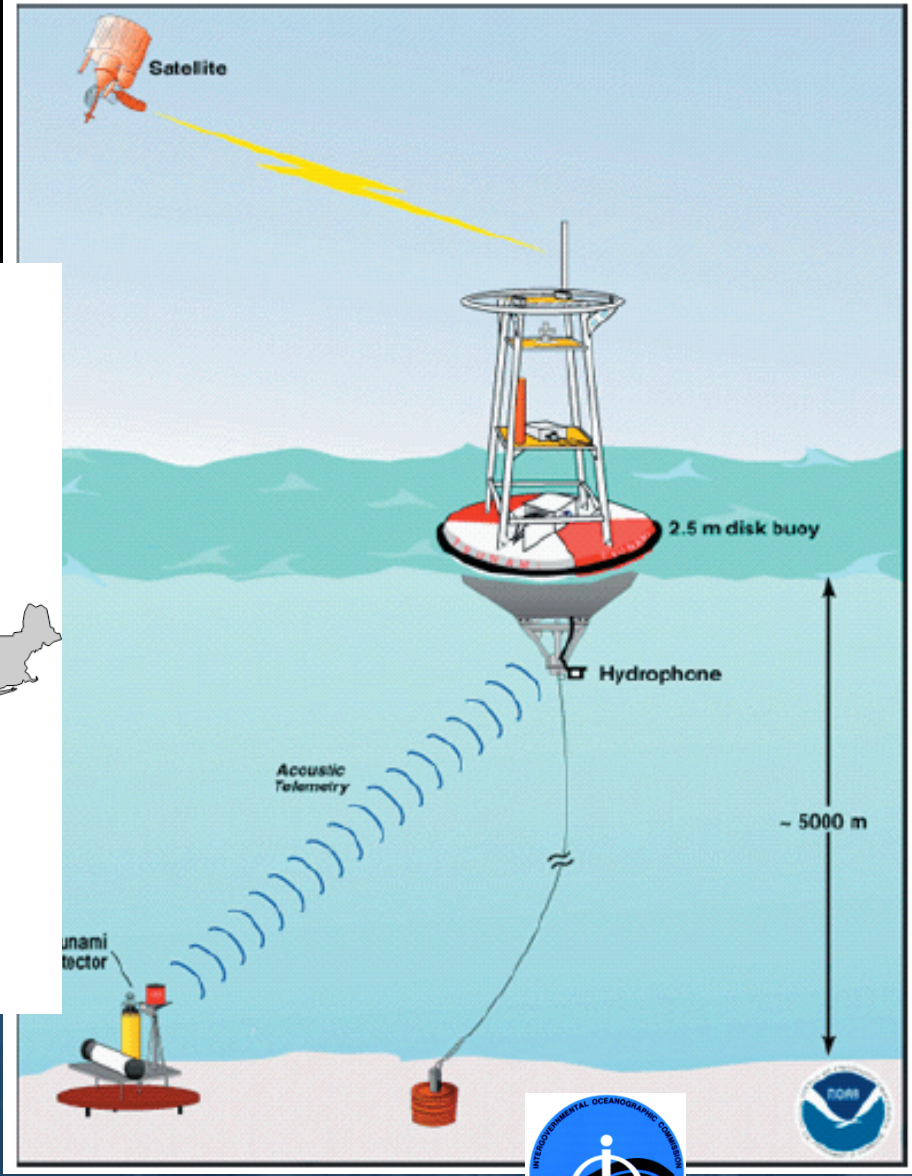
Utah Seismic Safety Commission
American Red Cross, Pacific Gas & Electric and many more…

Putting Down Roots for the Central US

(coming soon)

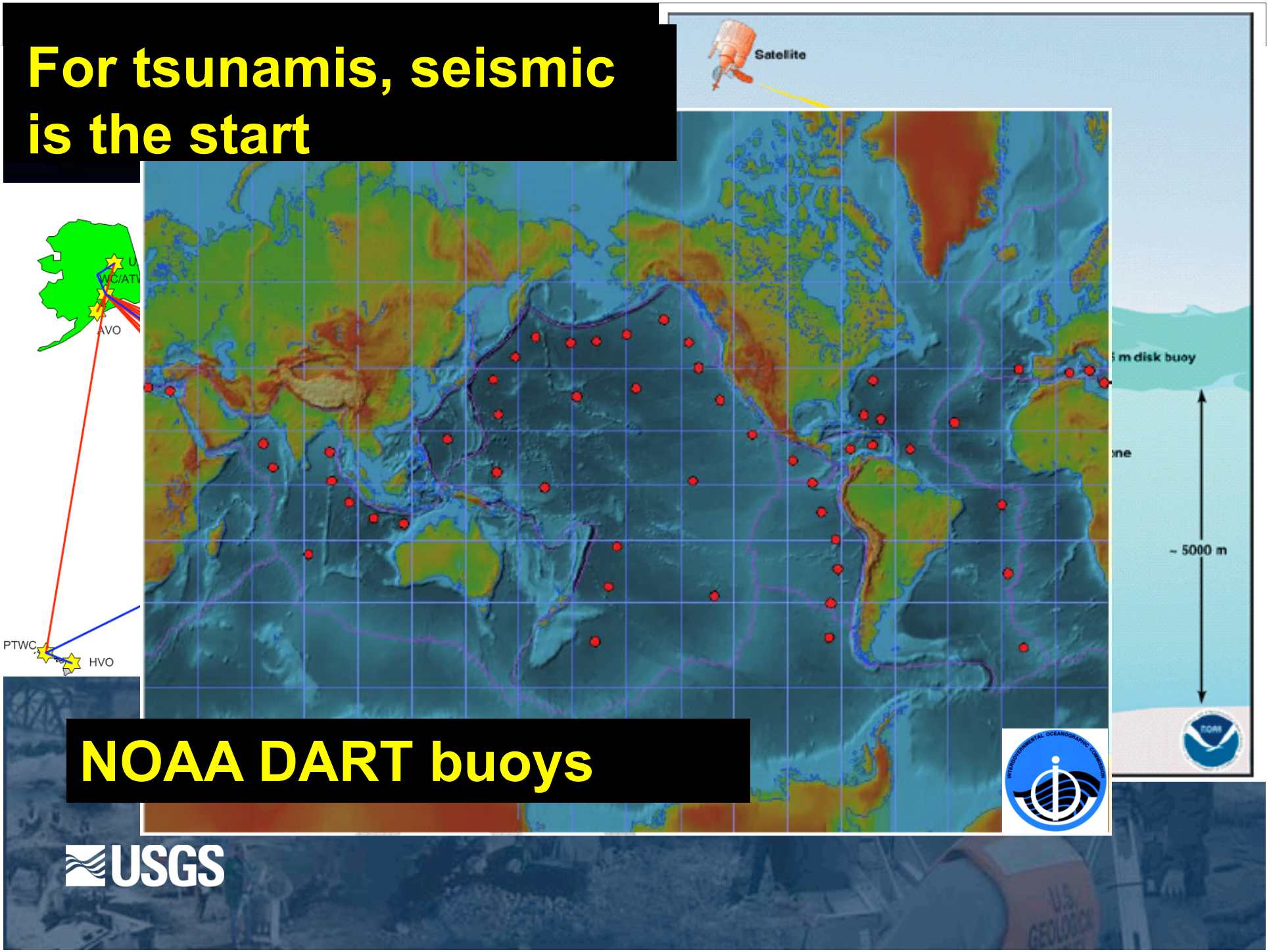
For tsunamis, seismic is the start





USGS

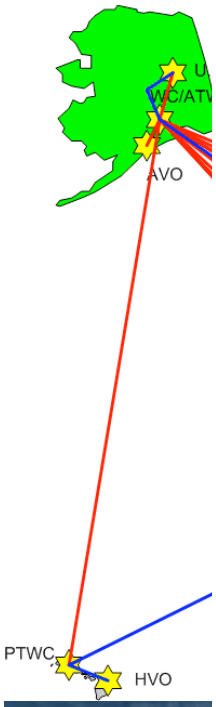
For tsunamis, seismic is the start

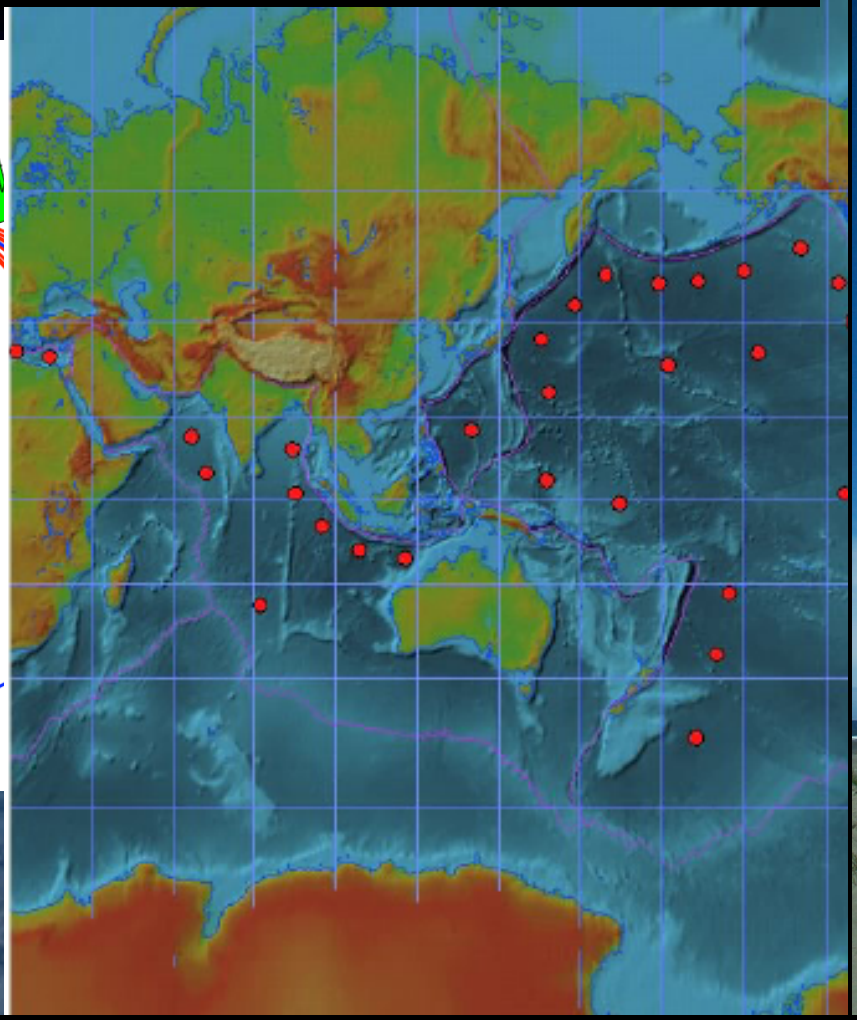


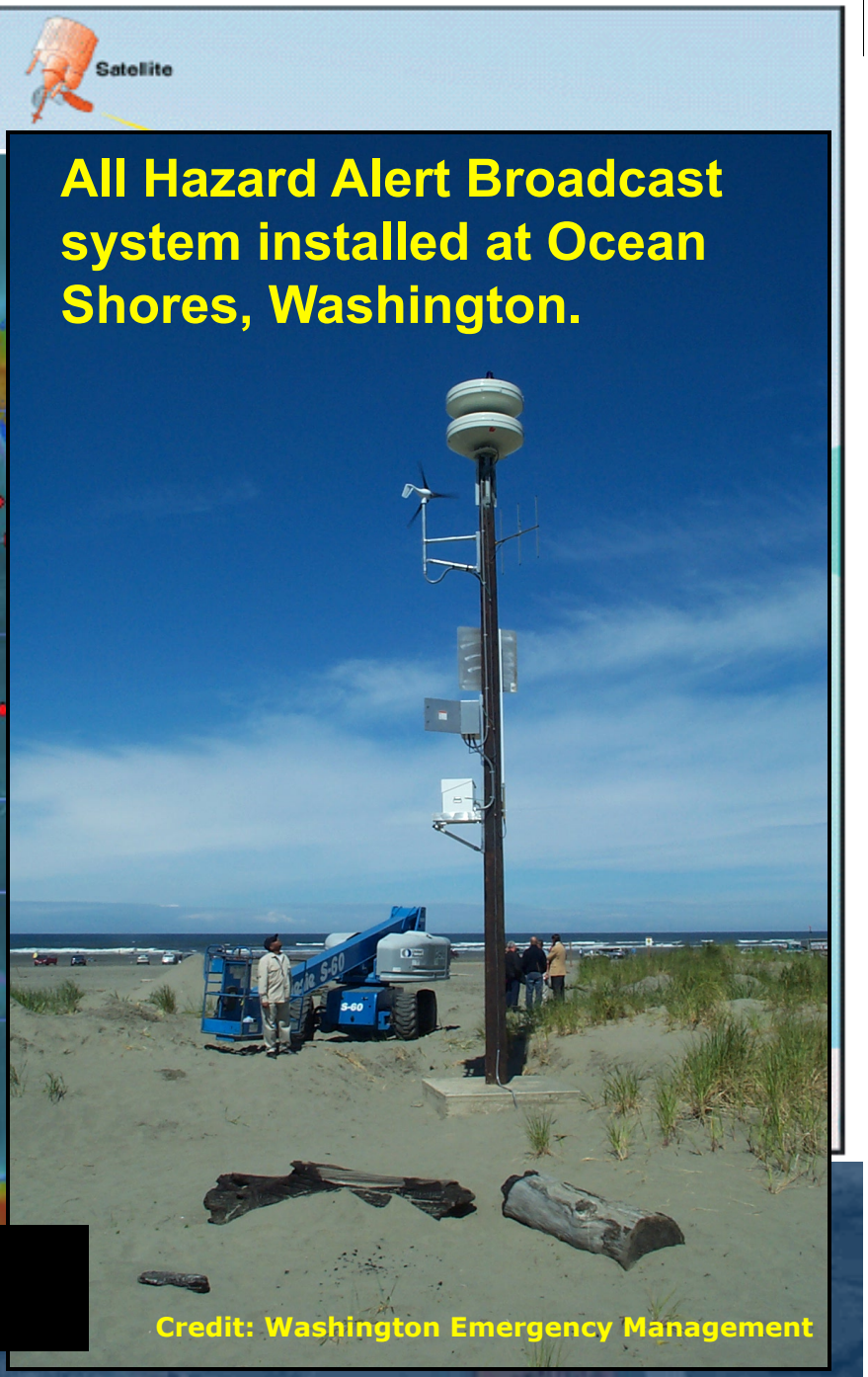
NOAA DART buoys

USGS

For tsunamis, seismic is the start





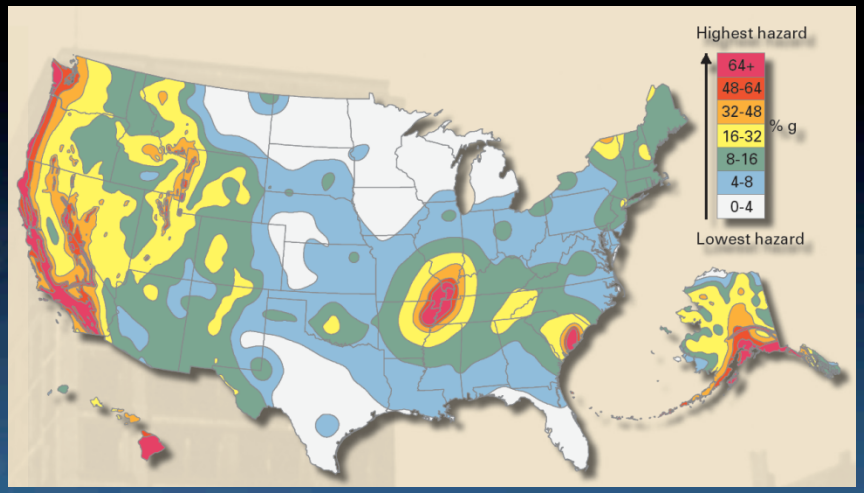


All Hazard Alert Broadcast system installed at Ocean Shores, Washington.

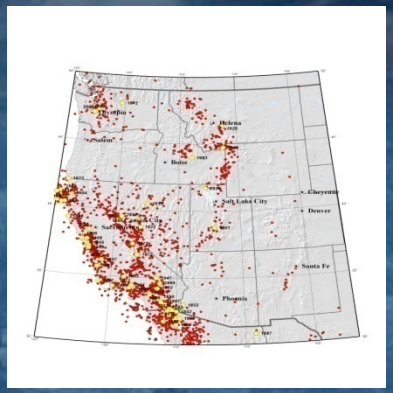
Credit: Washington Emergency Management

The beach is the finish

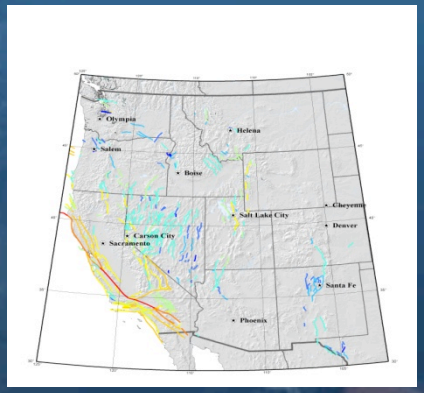
National seismic hazard assessment inputs



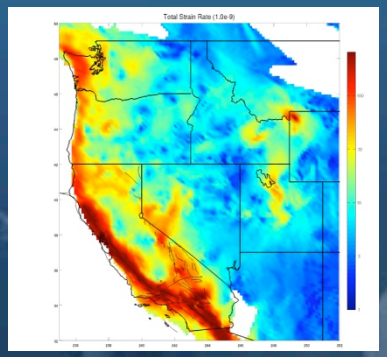
Seismicity



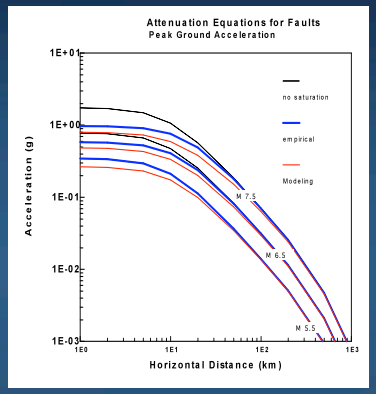
Quaternary Faults



Geodetics



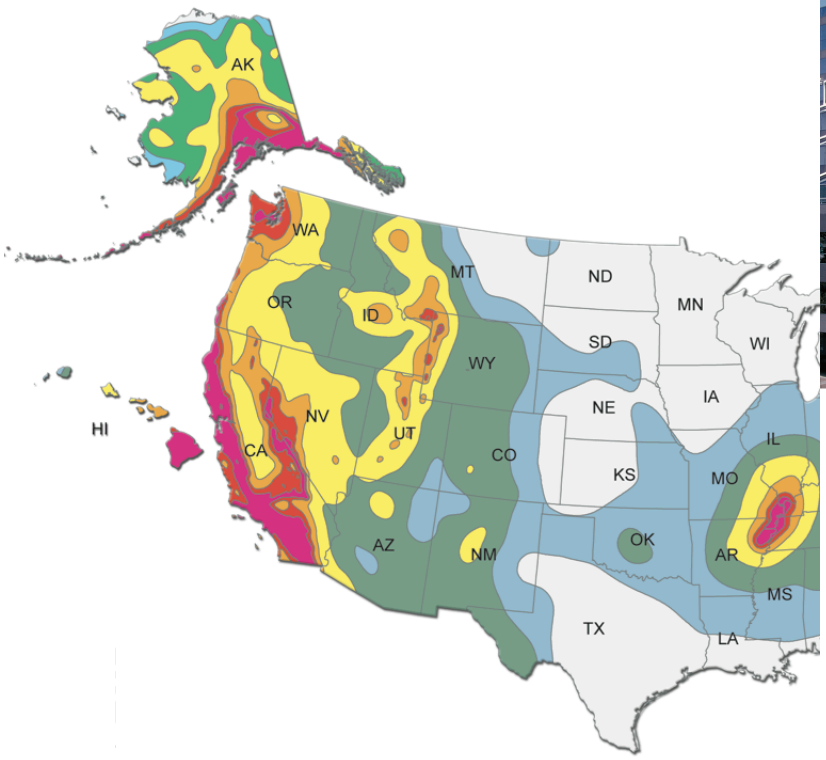
Attenuation Relations



USGS nehrp

Inputs are derived from regional geology, seismology, and crustal structure studies

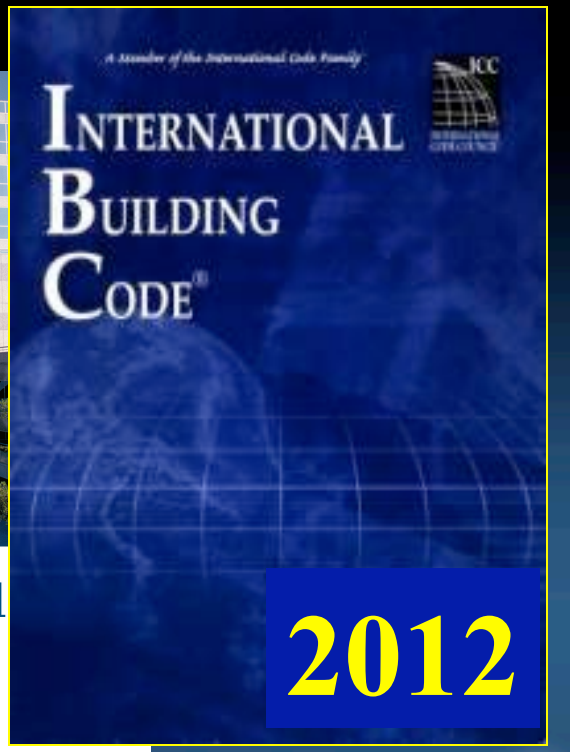
Translating USGS national hazard maps into model building codes



NEHRP Recommended Seismic Provisions
for New Buildings and Other Structures
FEMA P-750 / 2009 Edition

FEMA

nehrp



USGS nehrp

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


For more information on recent earthquakes,
earthquake hazards,
and USGS earthquake monitoring,
research and hazards assessments, see:
http://earthquake.usgs.gov
USGS
nehrp