

# May 12<sup>th</sup> Sichuan earthquake: A global challenge

David Applegate

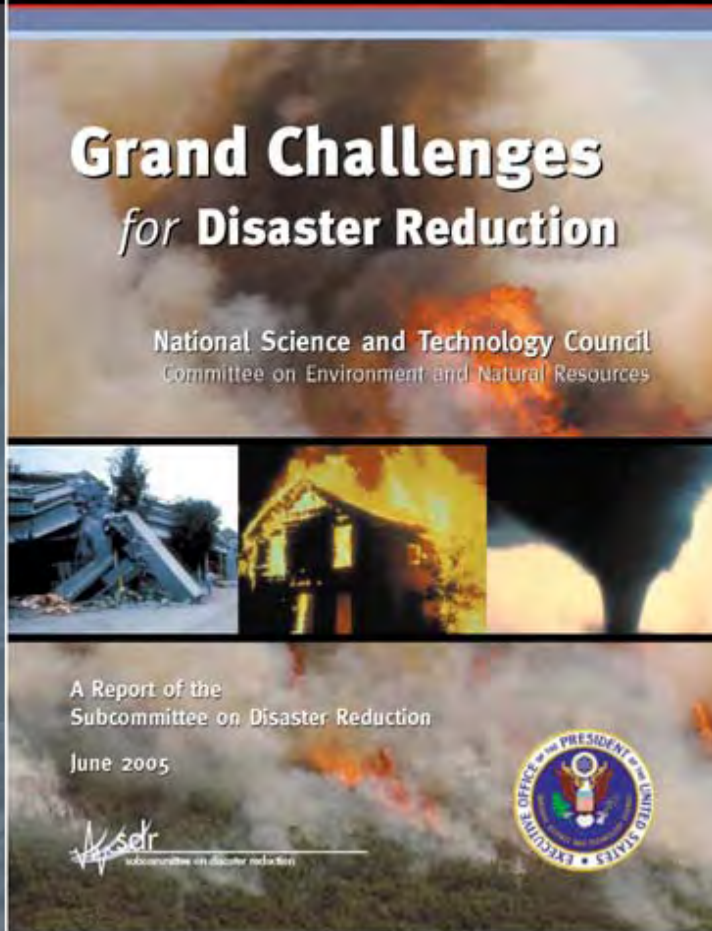
Sr. Science Advisor for Earthquake & Geologic Hazards

June 5, 2008



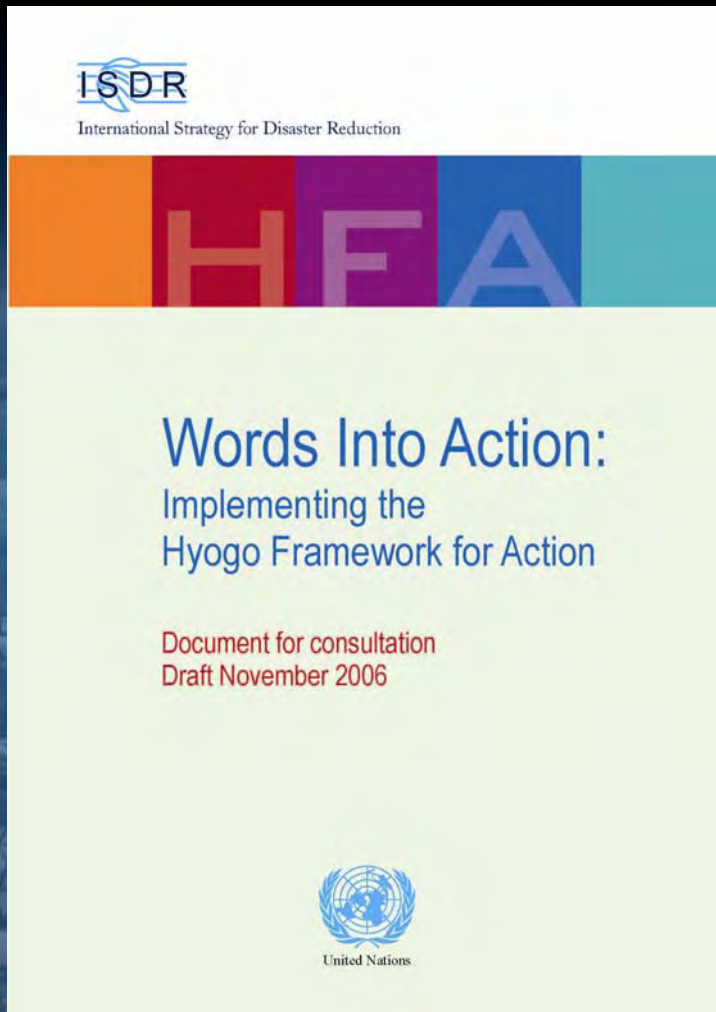
Images: Xinhua, AP

# Grand Challenges for Disaster Reduction



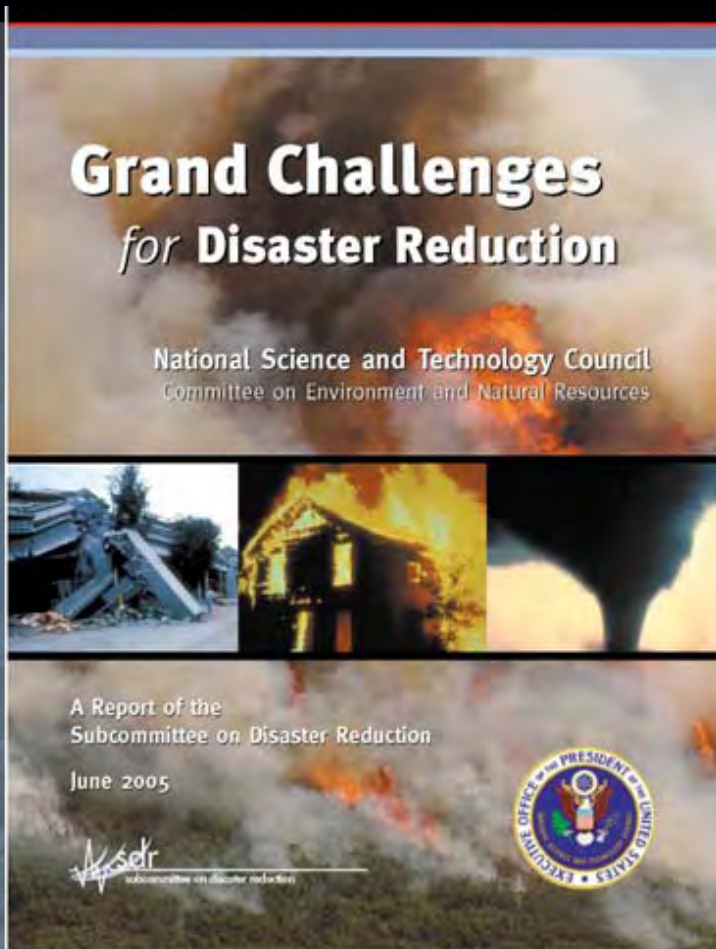
1. Provide hazard and disaster information where and when it is needed.
2. Understand the natural processes that produce hazards.
3. Develop hazard mitigation strategies and technologies.
4. Recognize and reduce vulnerability of interdependent critical infrastructure.
5. Assess disaster resilience using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

# The Hyogo Framework for Action



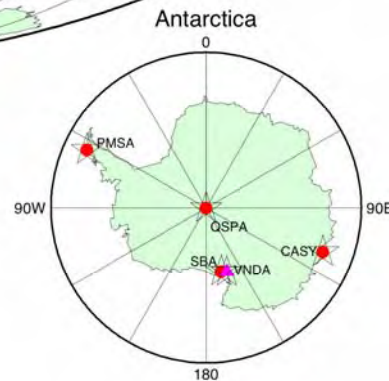
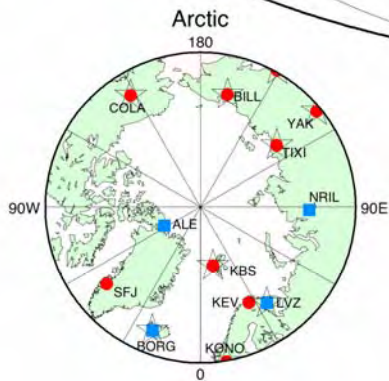
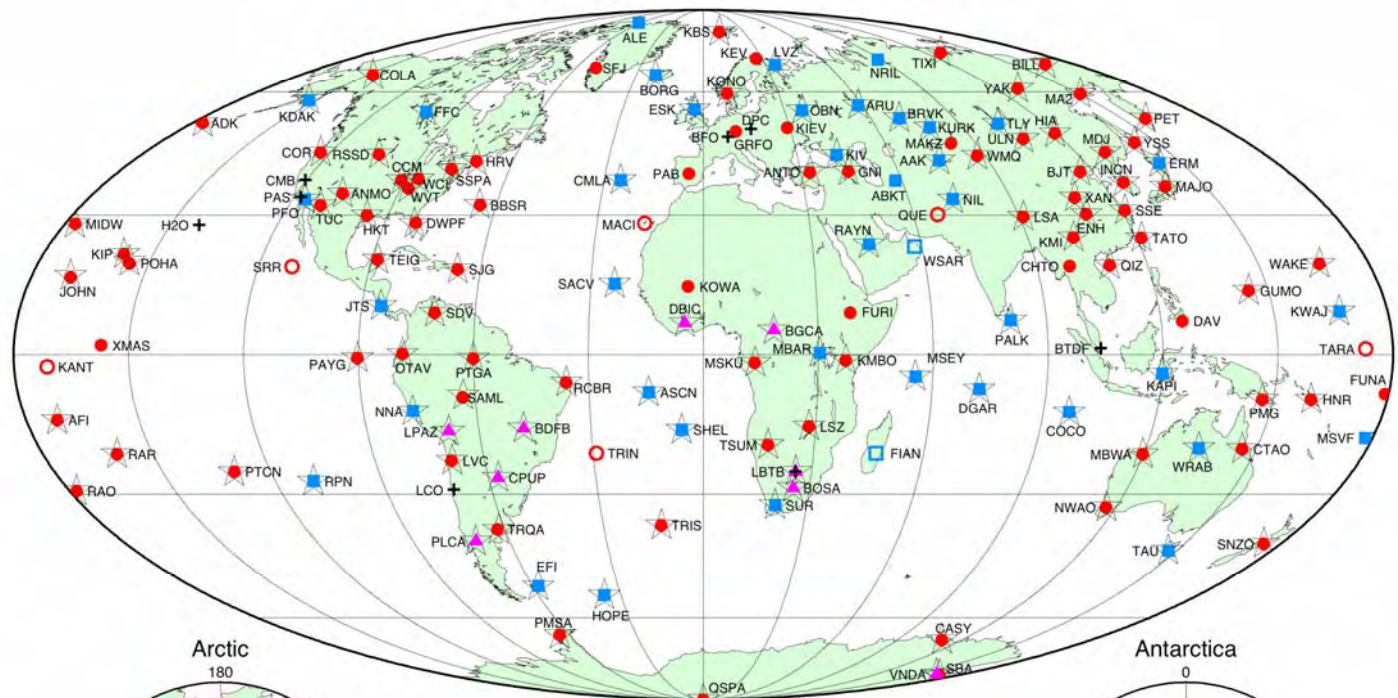
1. Ensure that disaster risk reduction is a national and local priority;
2. Identify, assess and monitor disaster risks and enhance early warning;
3. Use knowledge, innovation and education to build a culture of safety and resilience at all levels;
4. Reduce the underlying risk factors; and
5. Strengthen disaster preparedness for effective response at all levels.

# 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.
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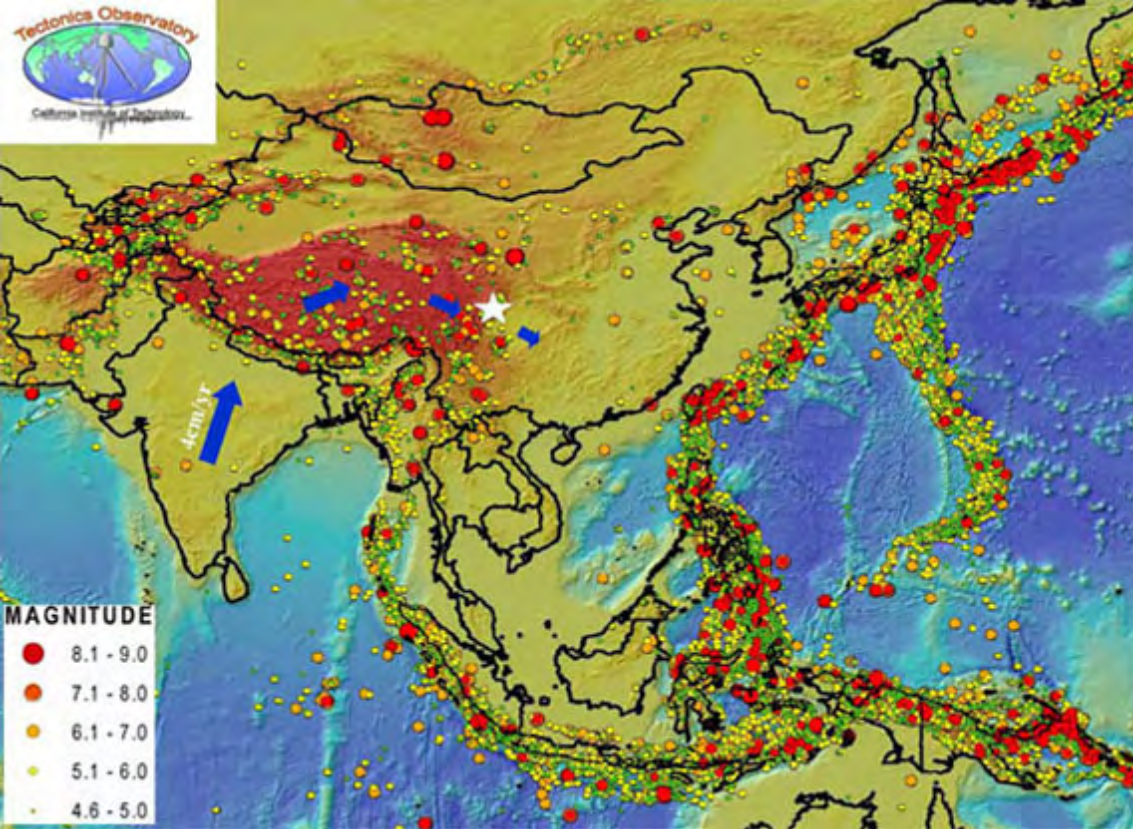
# Global Seismographic Network



- |           |         |                               |
|-----------|---------|-------------------------------|
| Installed | Planned |                               |
| 85 ●      | 6 ○     | IRIS/USGS Stations            |
| 39 ■      | 2 □     | IRIS/IDA Stations (UCSD)      |
| 8 +       |         | Other/Affiliated GSN Stations |
| 9 ▲       |         | GTSN Stations (AFTAC)         |
| 117 ☆     |         | Telemetered stations          |

USGS Albuquerque Seismological Laboratory  
January 27, 2005 (crh/lw)





ANSS

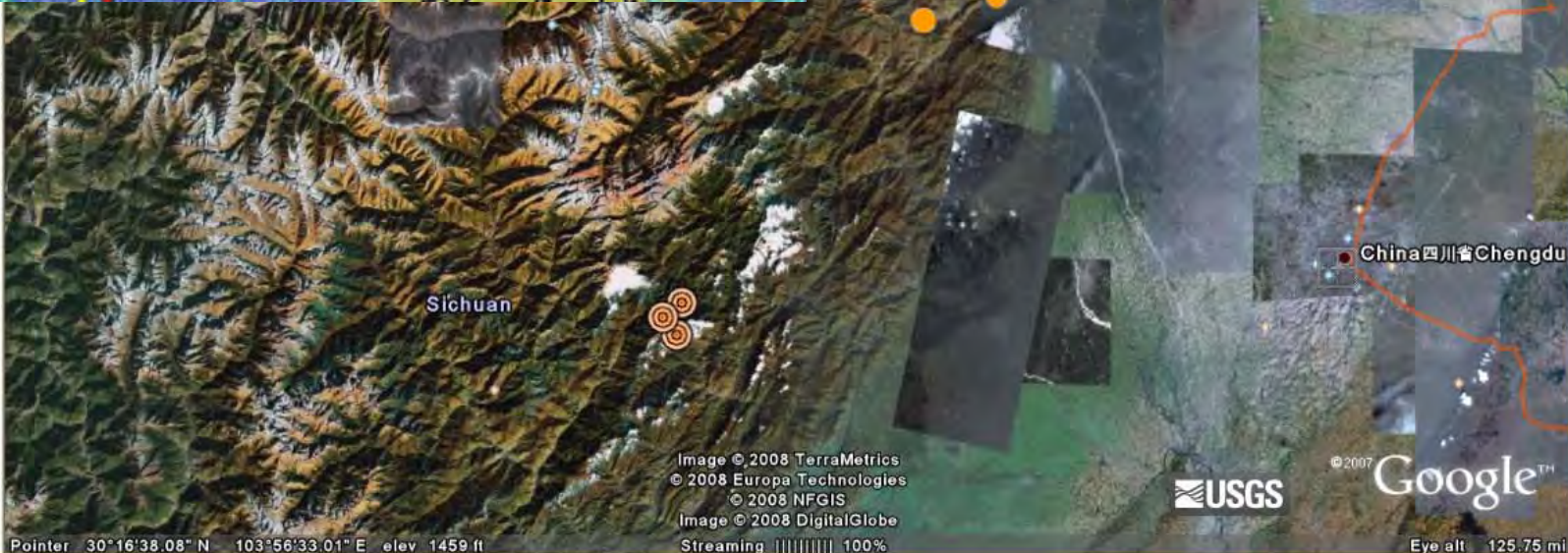
8:00 UTC  
 8:00 PM at epicenter

son AZ

Layers

View: Core

- Primary Database
- Geographic Web
- roads
- 3D Buildings
- Borders and Labels
- Traffic
- Weather
- Gallery
- Global Awareness
- Places of Interest
- More
- Terrain



Search

Fly To Find Businesses Directions

Fly to e.g., Tokyo, Japan

wenchuan, china

China四川省Chengdu

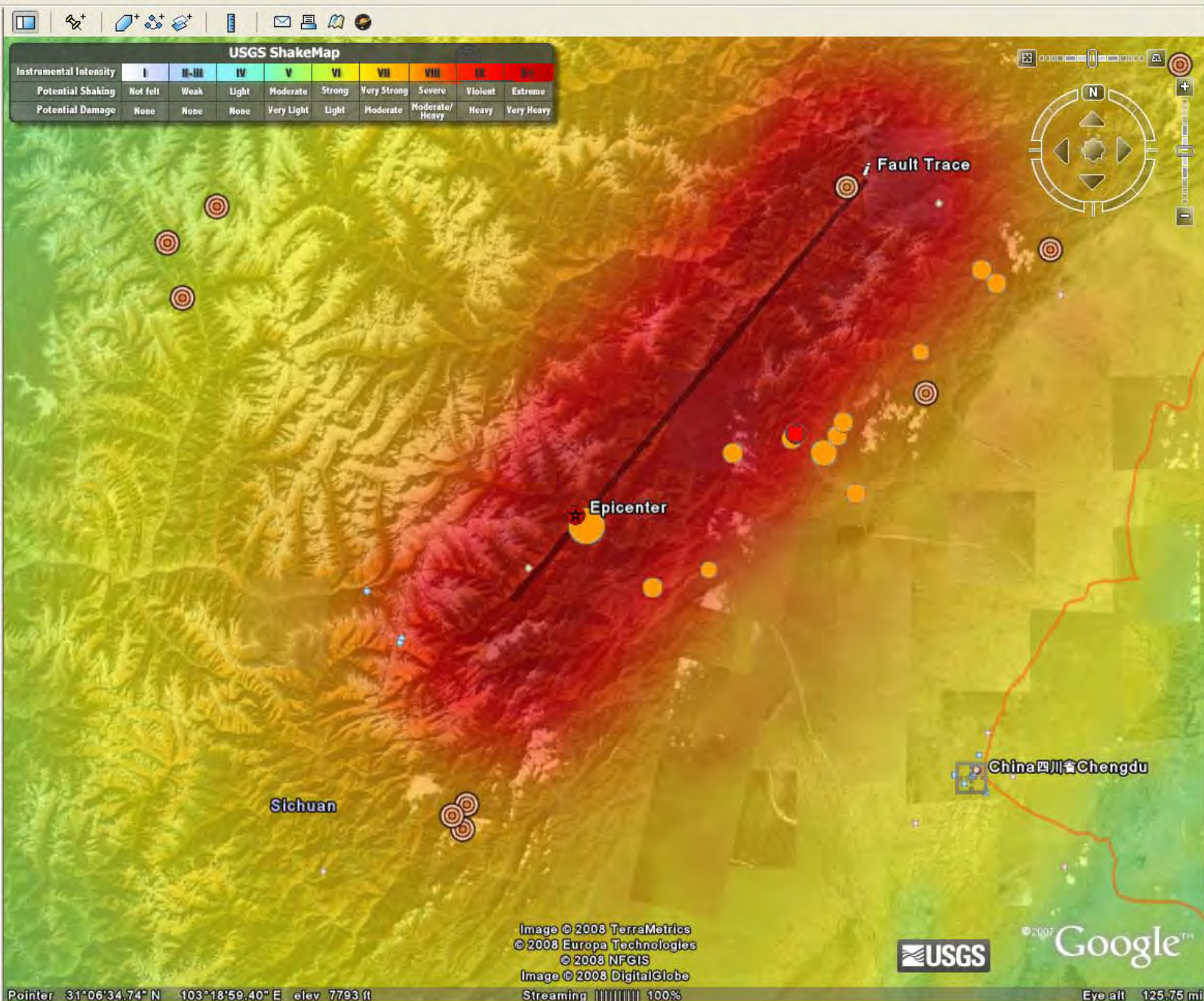
Places Add Content

- Magnitude 2 (298 quak)
- Magnitude 1 (673 quak)
- Plate Boundaries
- USGS Logo
- Legend
- ShakeMap: 2008mmaw
- Timberline house rented for Dec. 29-31, 2007
- Seismic Stations
- Westward Look Resort, Tucson AZ
- Northridge.kml
- Sightseeing
- Temporary Places
- ShakeMap: 2008ryan

Layers

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# PAGER

## Prompt Assessment of Global Earthquakes for Response

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



### M 7.9, EASTERN SICHUAN, CHINA

Origin Time: Mon 2008-05-12 06:28:01 UTC

Location: 31.02°N 103.37°E Depth: 19 km



USAID  
FROM THE AMERICAN PEOPLE

### PAGER Version 8

Created: 1 days, 8 hrs after earthquake

### Estimated Population Exposed to Earthquake Shaking

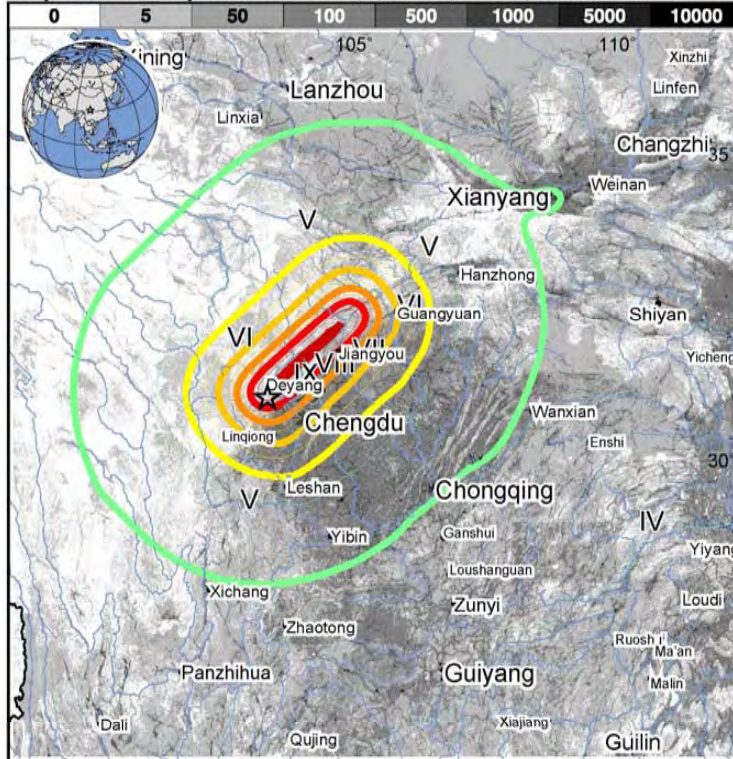
ESTIMATED POPULATION EXPOSURE (k = x1000)	--*	--*	188,523k*	89,143k	15,400k	12,673k	3,897k	707k	610k
ESTIMATED MODIFIED MERCALLI INTENSITY	I	II-III	IV	V	VI	VII	VIII	IX	X+
PERCEIVED SHAKING	Not felt	Weak	Light	Moderate	Strong	Very strong	Severe	Violent	Extreme
POTENTIAL DAMAGE	Resistant Structures	none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

\*Estimated exposure only includes population within the map area.

#### Population Exposure

population per ~1 sq. km from Landsat 2005

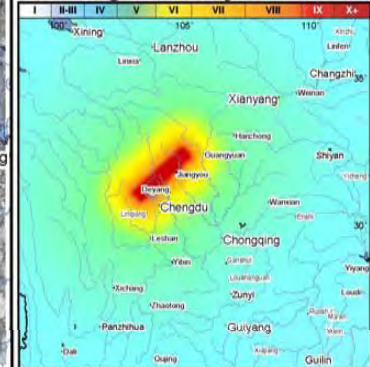
#### Selected City Exposure



MMI City	Population
VIII Jianguyou	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 Shiyang	3,460k

bold cities appear on map (k = x1000)

#### Shaking Intensity



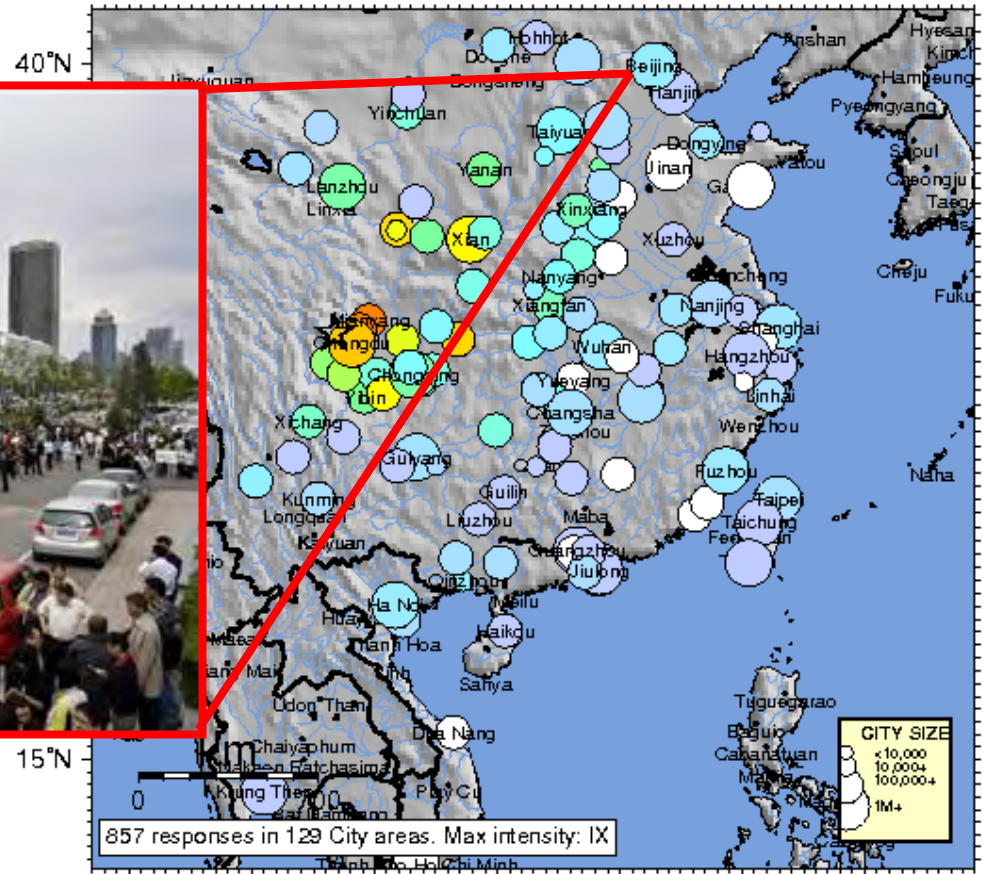
Overall, structures in this region are vulnerable to earthquake shaking, though some resistant structures exist. A magnitude 6.4 earthquake struck the Sichuan, China region on August 23, 1976 (UTC), with estimated population exposures of 1,500 at intensity IX or greater and 5,700 at intensity VIII, resulting 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.

# Global felt intensity reports:

## Did you feel it?



USGS Community Internet Intensity Map (52 miles WNW of Chengdu, China)  
 ID:2008ryan 06:28:01 GMT MAY 12 2008 Mag=7.9 Latitude=N31.02 Longitude=E103.37

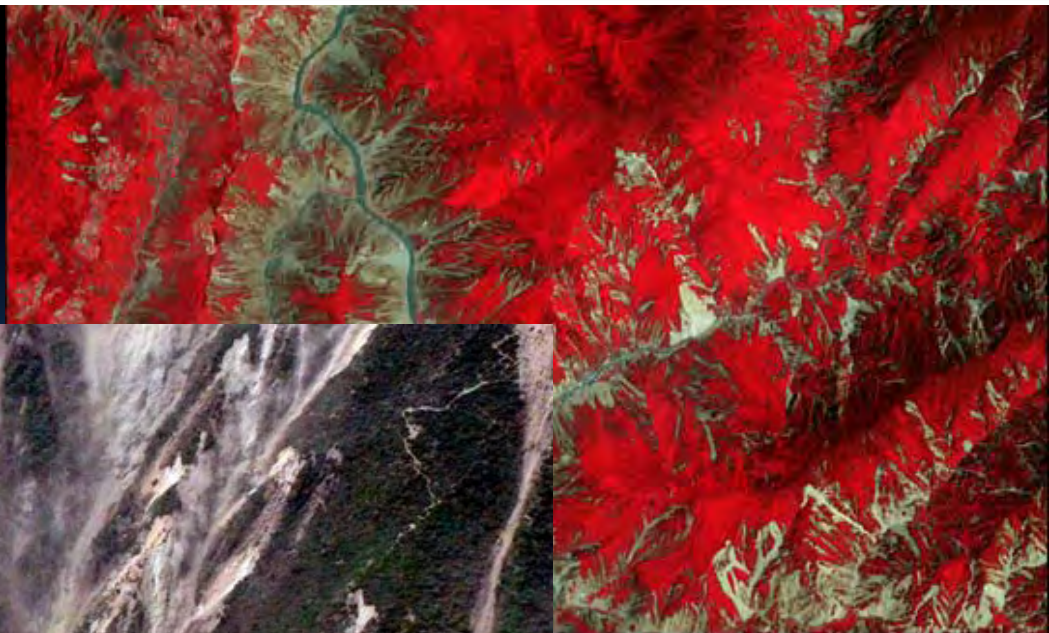


95°E 100°E 105°E 110°E 115°E 120°E 125°E  
 Map last updated on Sun Jun 1 14:15:01 2008

INTENSITY	I	II-III	IV	V	VI	VII	VIII	IX	X+
SHAKING	Not felt	Weak	Light	Moderate	Strong	Very strong	Severe	Violent	Extreme
DAMAGE	none	none	none	Very light	Light	Moderate	Moderate/Heavy	Heavy	Very Heavy



# The earthquake triggered landslides



# International charter: Space & major disasters

北川县唐家山堰塞湖和滑坡监测图 Barrier Lake and Landslide Monitoring Map in Beichuan County

Charter 204号订单 - 产品编号 07  
Charter Call 204 - Product No. 07



2008年5月12日, 四川省发生8.0级强烈地震, 震中位于汶川县, 此次地震给四川、甘肃、陕西等地造成巨大的人员和财产损失。

根据5月14日福卫二号和5月17日Radarsat-1数据对堰塞湖监测结果的对比, 可见堰塞湖水面面积增加了0.4平方公里。

The 2008 Wenchuan earthquake at a magnitude 8.0 Ms, occurred at 14:28:01.42 CST (06:28:01.42 UTC) on 12 May 2008 in Sichuan province of China, which has caused lots of landslides and barrier lake come into being. The barrier lake change map was based on Formosat-2 image (on 14th May) and Radarsat-2 image (on 17th May) in Beichuan County.

- Barrier lake area based on Radarsat-1 (17 May)
- Barrier lake area based on Formosat-2 (14 May)
- Flooded village area

灾害类型: 地震  
Disaster Type: Earthquake  
时间: 2008年5月12日  
Date: 12 May 2008

灾害影像 Disaster Image:  
Radarsat-1 分辨率10m, 获取时间2008年5月17日  
Radarsat-1 10m acquired on 17 May 2008 © CSA  
Formosat-2 分辨率8m, 获取时间2008年5月14日  
Formosat-2 8m acquired on 14 May 2008

灾害分析 Earthquake Analysis:  
NDRCC, 2008年5月19日21时 UTC13:00 19 May 2008©NDRCC  
制图 Map Production:  
NDRCC, 2008年5月19日23时 UTC16:00 19 May 2008©NDRCC

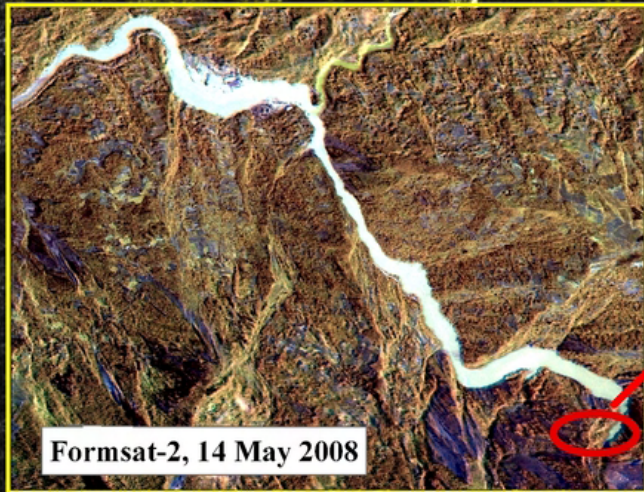
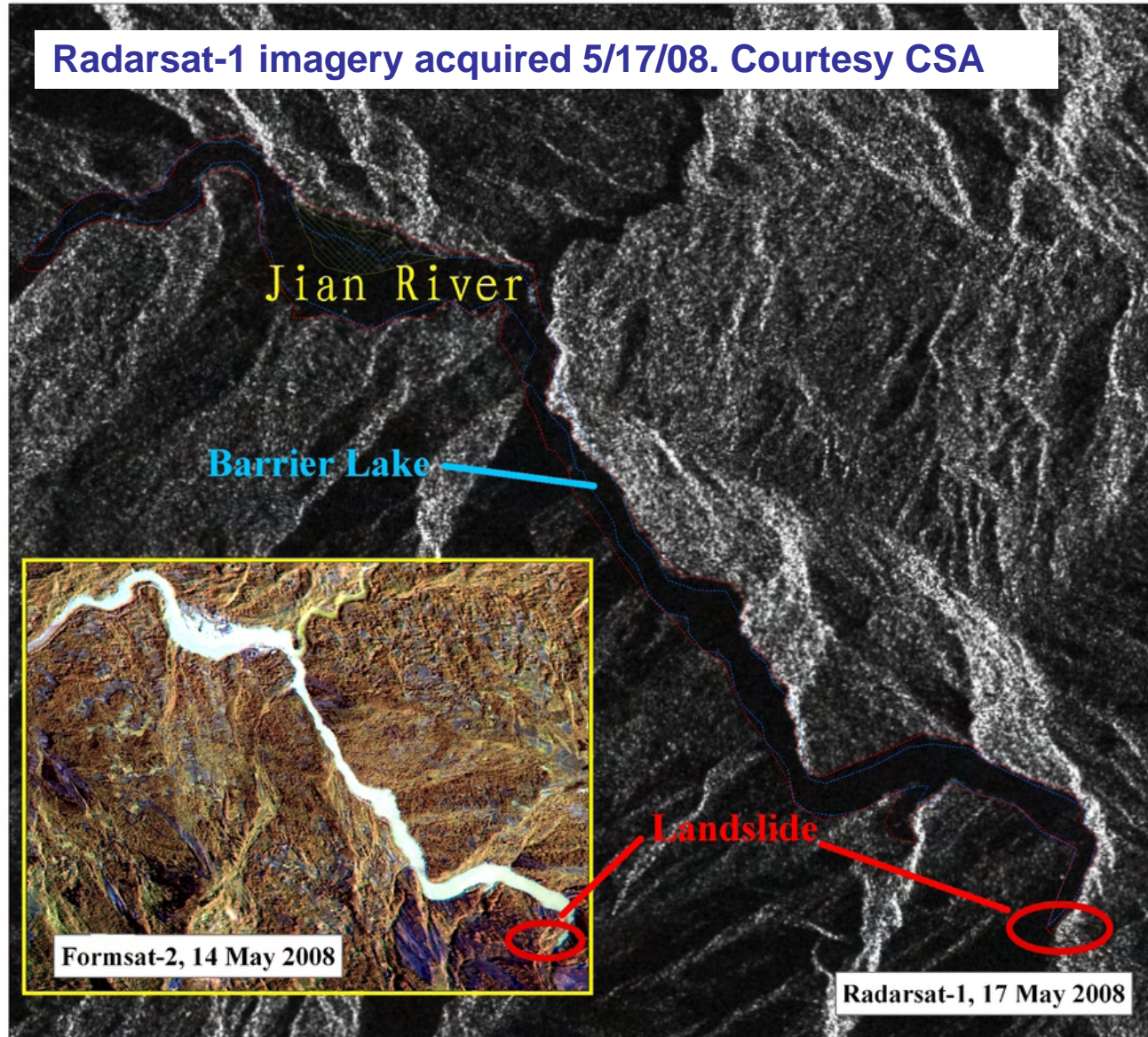
投影 Projection: UTM  
椭球体 Spheroid: WGS84  
地球模型 Datum: WGS84  
0 125 250 500 Meters

国家减灾委员会  
National Committee for Disaster Reduction, P.R.C.  
国家减灾中心  
National Disaster Reduction Center of China

联系方式 Contact Information:  
remotesensing@ndrcc.gov.cn  
电话 Hotline: (86-10) 6353 1082  
http://www.jianzai.gov.cn/rs/  
http://www.ndrcc.gov.cn



Radarsat-1 imagery acquired 5/17/08. Courtesy CSA

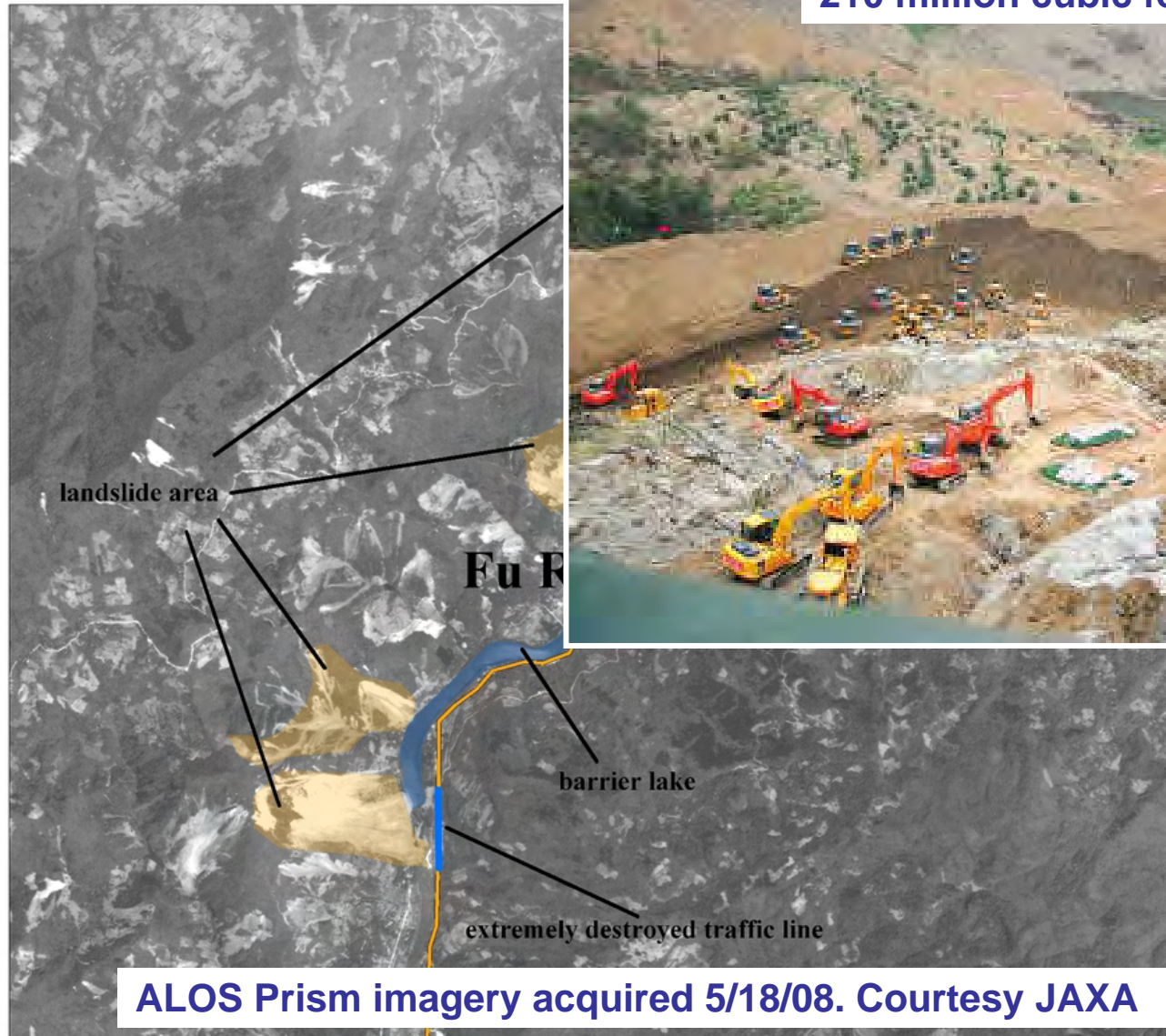


Radarsat-1, 17 May 2008

# International charter: Space & major disasters

平武县平通镇滑坡和堰塞湖监测图

Monitoring Map on Landslide, Barrier Lake and Dest



210 million cubic feet of water backed up



灾害影像 Disaster Image:  
ALOS PRISM 分辨率 2.5m 获取时间 2008年5月18日  
ALOS PRISM 2.5m acquired on 18 May 2008 © JAXA

灾害分析 Earthquake Analysis:  
NDRCC. 2008年5月20日12时 UTC12:00 20 May 2008©NDRCC  
制图 Map Production:  
NDRCC. 2008年5月20日12时 UTC15:00 20 May 2008©NDRCC

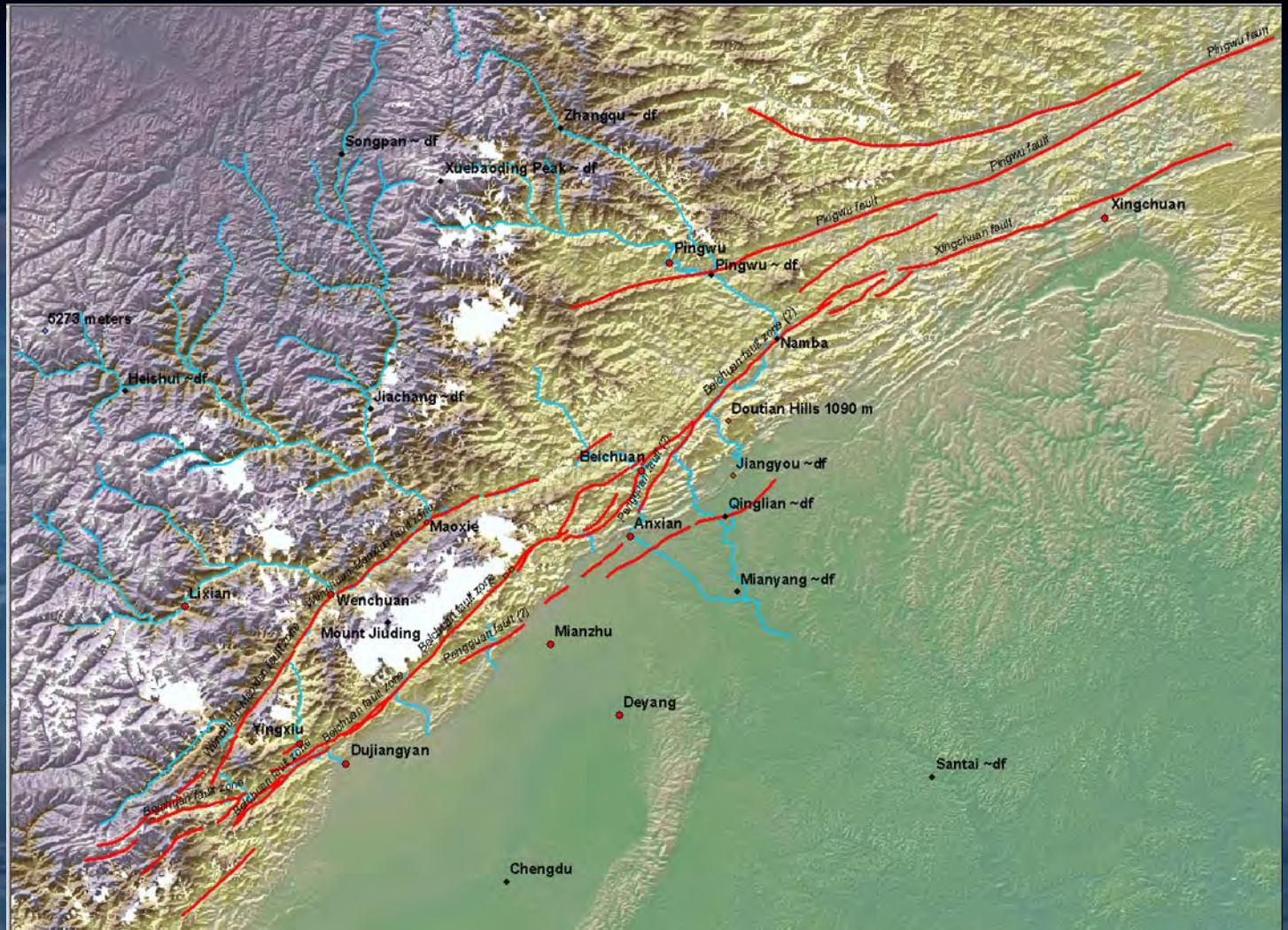
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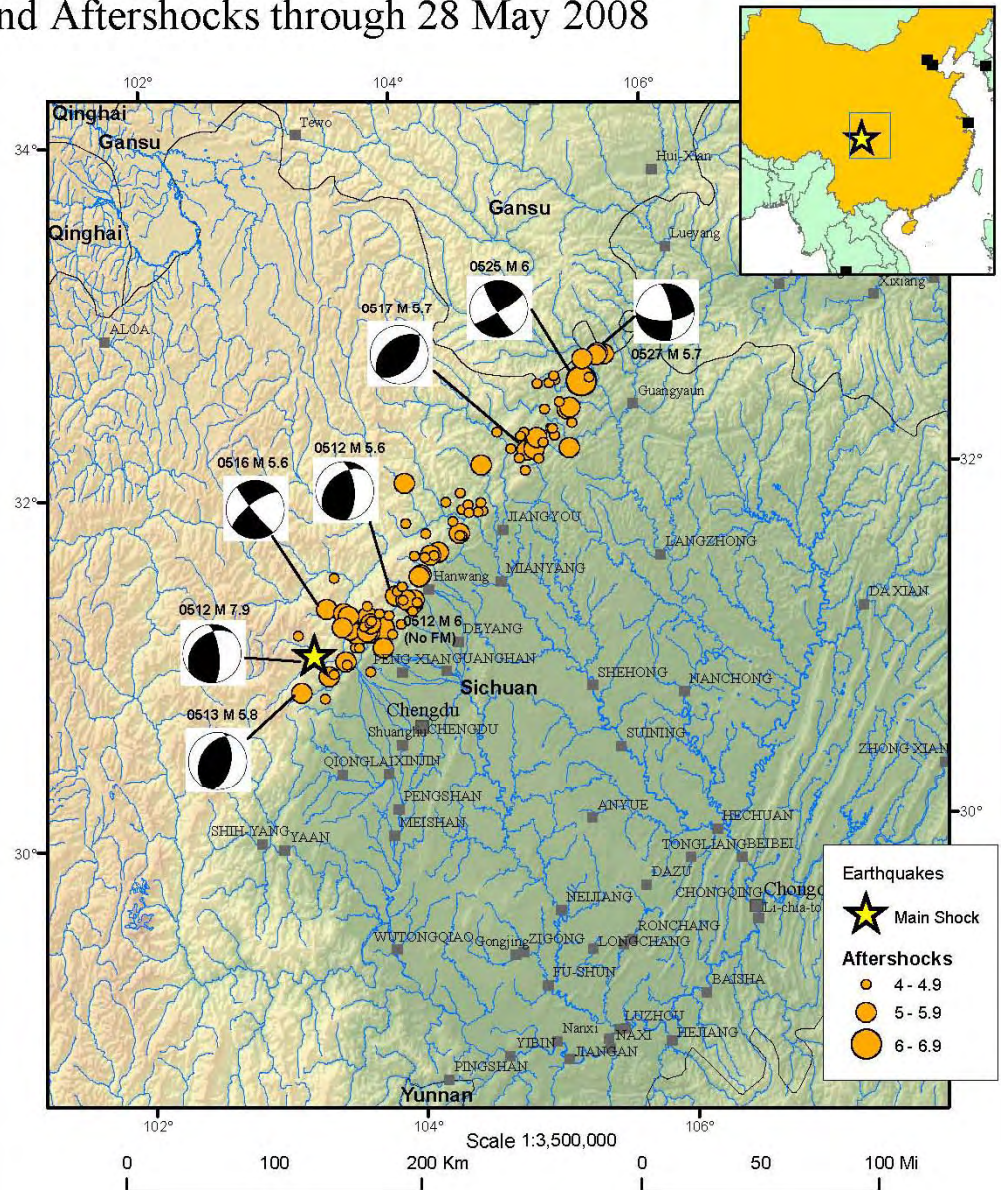
# Imagery analysis of the fault trace provided to China through State Department



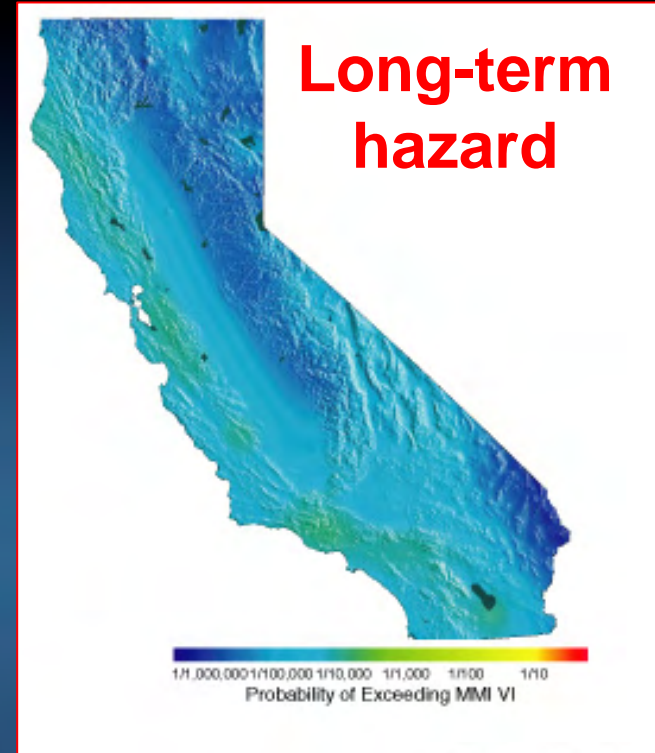
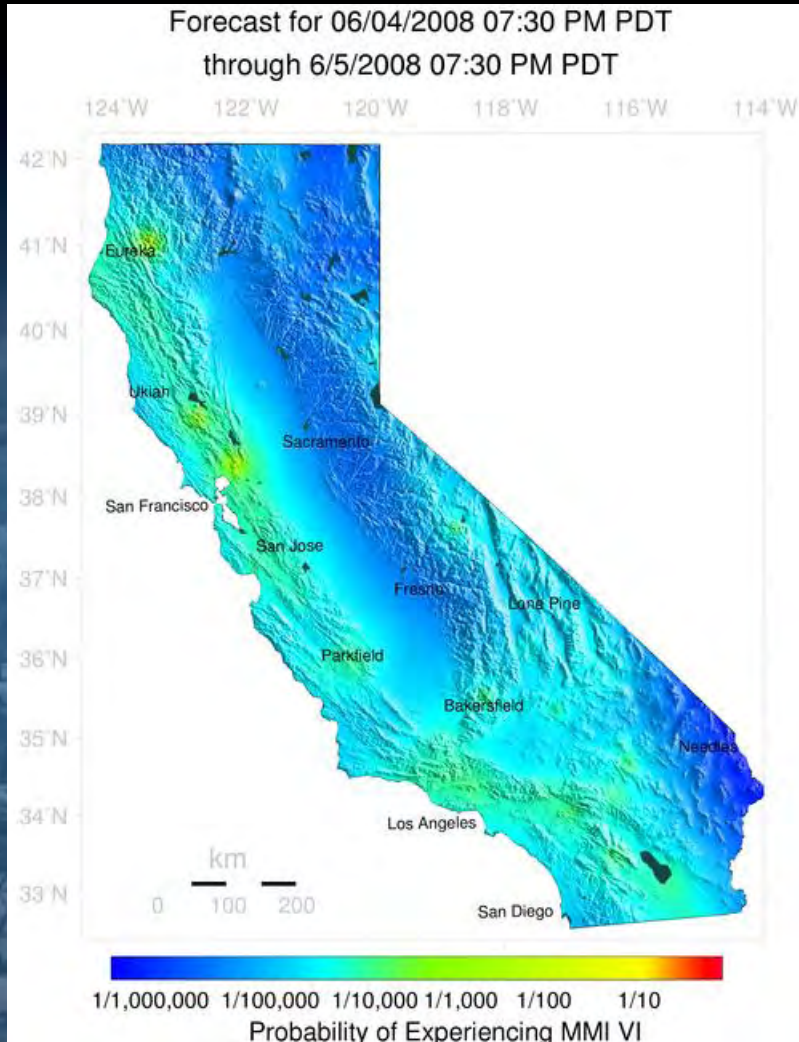
# Chinese also have sought aftershock probabilities

Fear of aftershocks beyond the immediate area of quake damage drives tent shortage. This makes the task of gathering the three million plus tents needed to temporarily house the earthquake homeless in the most affected areas.

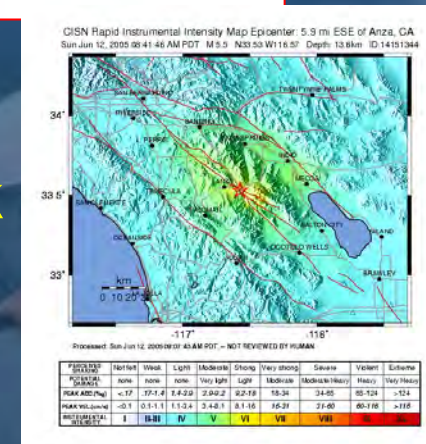
M7.9 Eastern Sichuan, China, Earthquake of 12 May 2008 and Aftershocks through 28 May 2008



# 24-hour aftershock forecast map

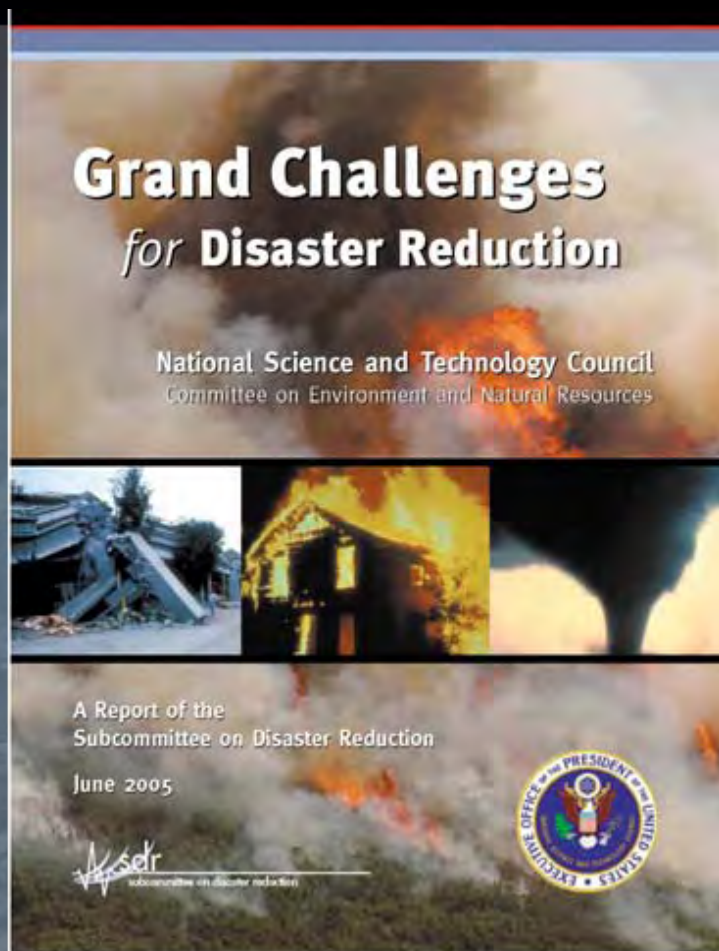


**+**  
**Aftershock hazard**





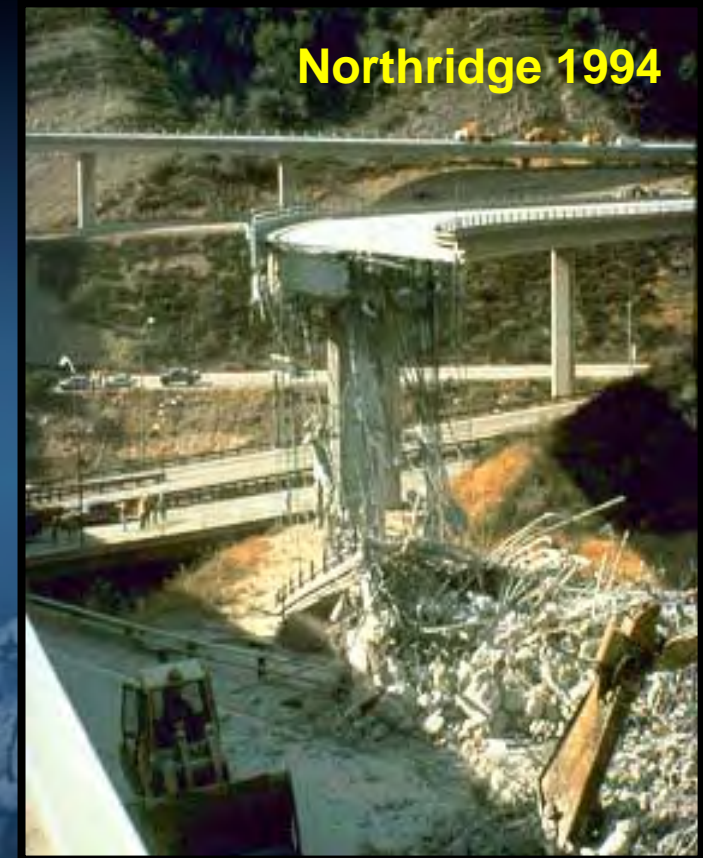
# Grand Challenges for Disaster Reduction



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5. **Assess disaster resilience using standard methods.**
6. Promote risk-wise behavior.

# 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.



FEMA

NIST

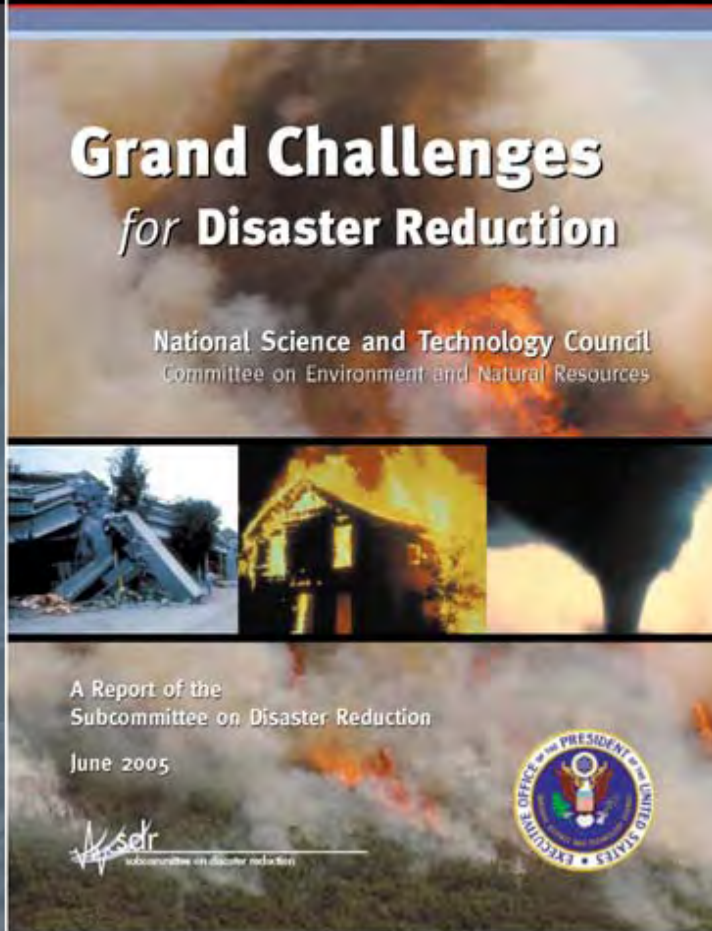
National Institute of  
Standards and Technology



USGS  
science for a changing world

national **earthquake** hazards reduction program

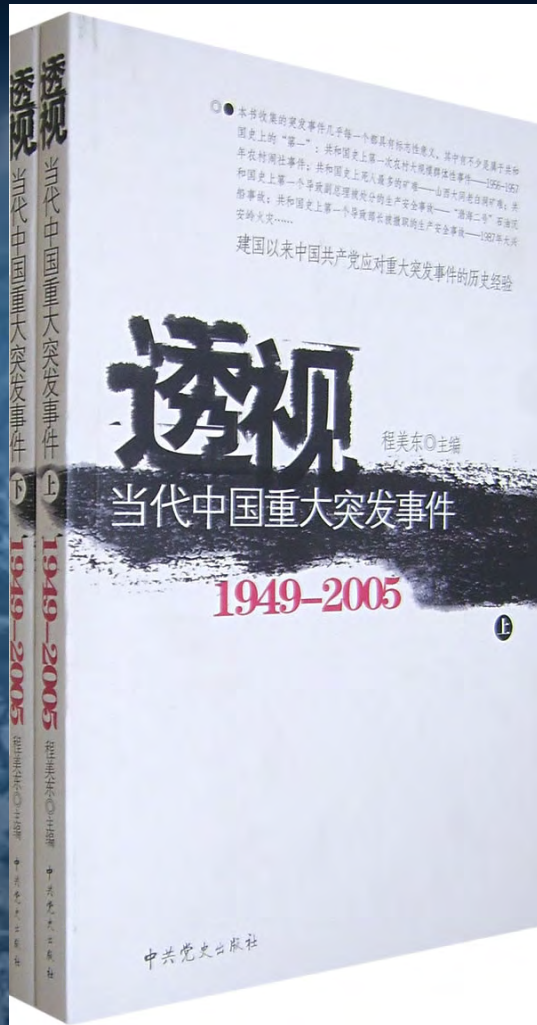
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# China's Emergency Response in Perspective: 1949 – 2005

Chinese Communist Party History Publishing House, 2007



- Emphasizes that the Chinese Party and government can mobilize public opinion and resources faster and more effectively than can many other countries, now increasingly augmented by spontaneous contributions from private citizens.
- Lessons learned over the past several years include the need for more openness about crisis situations, and decision-making.

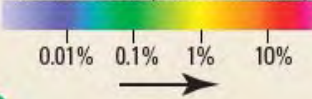
Source: State Department

# 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).

30-Year Earthquake Probability



Boundary used in this study between northern and southern California

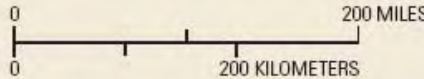
### Regional 30-year earthquake probabilities

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



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

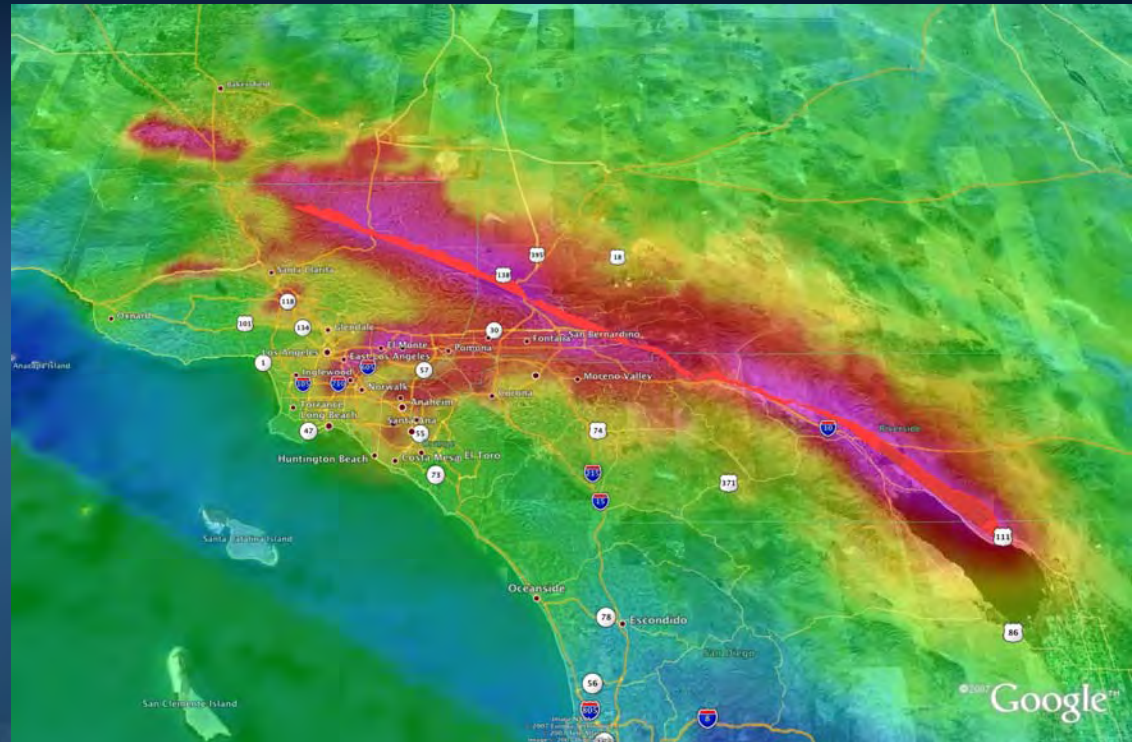


# San Andreas ShakeOut Scenario



- Top request of partners
- 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



# Partners (only a partial list)

Office of Emergency Services, City of Los Angeles, SCEC, EERI, PEER, FEMA, California Geological Survey, California Seismic Safety Commission, Counties of Los Angeles, San Bernardino, Riverside, Imperial, Ventura and Orange, Office of Homeland Security, Los Angeles Chamber of Commerce, Los Angeles County and City Fire Departments, Caltech, Art Center College of Design, UCLA School of Public Health, ABS Consulting, NBC Universal, Los Angeles Unified School District, Southern California Association of Governments, Metropolitan Transportation Authority, California Department of Transportation, MetroLink, Metropolitan Water District, Southern California Edison, California Utilities Emergency Association, Homeland Security Advisory Council, American Red Cross, City of Palm Springs, City of Torrance, Coachella Valley Chamber of Commerce, ESRI, CERT



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

# 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





# Putting Down Roots in Earthquake Country

- Earthquake preparedness handbook developed by Southern California Earthquake Center
- Available in English and Spanish; also Asian-language version
- Millions of copies distributed through newspapers, American Red Cross, home improvement stores
- City of Oakland has plans to develop braille and audiotape versions

