

***May 12, 2008 Sichuan, China  
Earthquake Reconnaissance***

Zhenming Wang  
Kentucky Geological Survey  
228 MMRB

University of Kentucky  
Lexington, KY 40506  
zmwang@uky.edu

July 2008



# *Acknowledgement*

- Mr. Furen Xie (Deputy Director, Institute of Crustal Dynamics, CEA)
- Dr. Lanmin Wang (Director, Lanzhou Institute of Seismology, CEA)
- Mr. Yi Du (Institute of Crustal Dynamics, CEA) – in Sichuan
- Dr. Zijian Wu (Lanzhou Institute of Seismology, CEA) – in Gansu



# Outline

- General Earthquake Information
- Some Observations
  - Chengdu
  - Dujiangyan
  - Xiaoyudong
  - Hanwang
  - Pintong
- Lesson Learned

# 2008.5.12 四川汶川8.0级地震4.0级以上余震分布图

**Magnitude: 8.0 (7.9 USGS)**

**Fault Rupture: ~300 km x 30 km**

**Surface Displacement: 5m (v), 4.8m (h)**

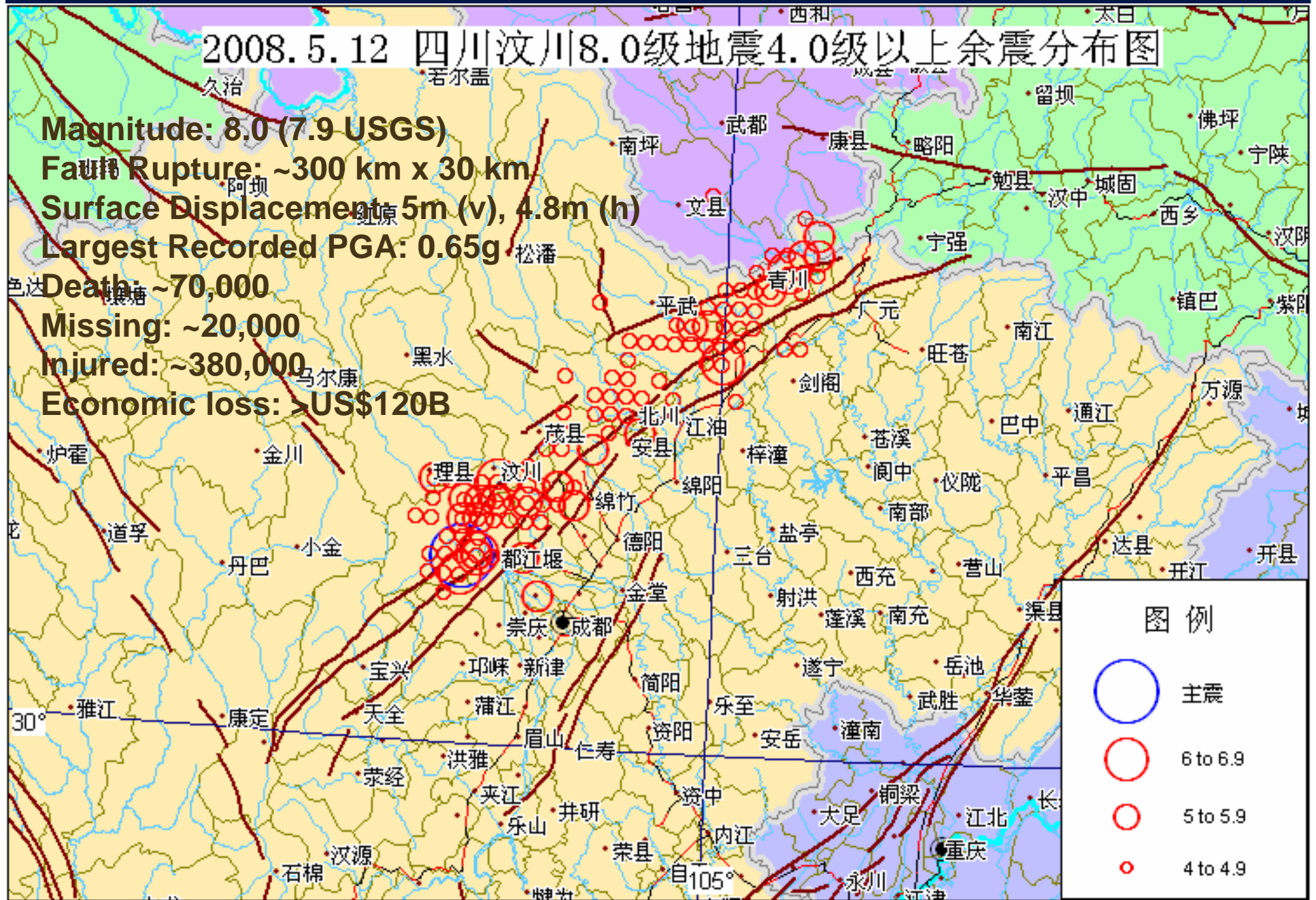
**Largest Recorded PGA: 0.65g**

**Death: ~70,000**

**Missing: ~20,000**

**Injured: ~380,000**

**Economic loss: >US\$120B**



- 图例
- 主震
  - 6 to 6.9
  - 5 to 5.9
  - 4 to 4.9

The map is from CEA website (<http://ww.cea.gov.cn:99/>)



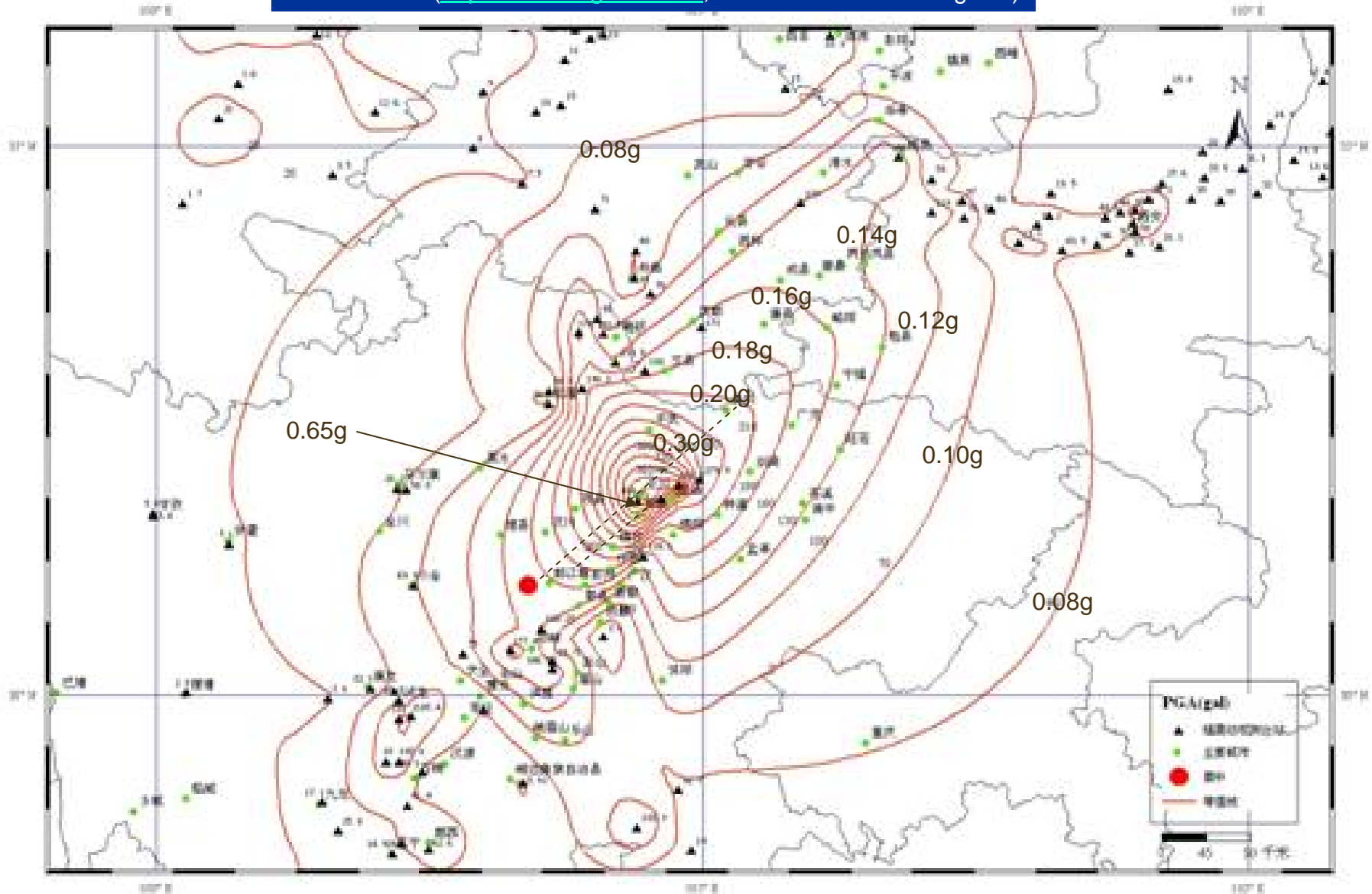
# The Felt Areas of the Wenchuan M8.0 Earthquake

2008年5月12日四川省汶川县发生8.0级地震，多个省市有震感



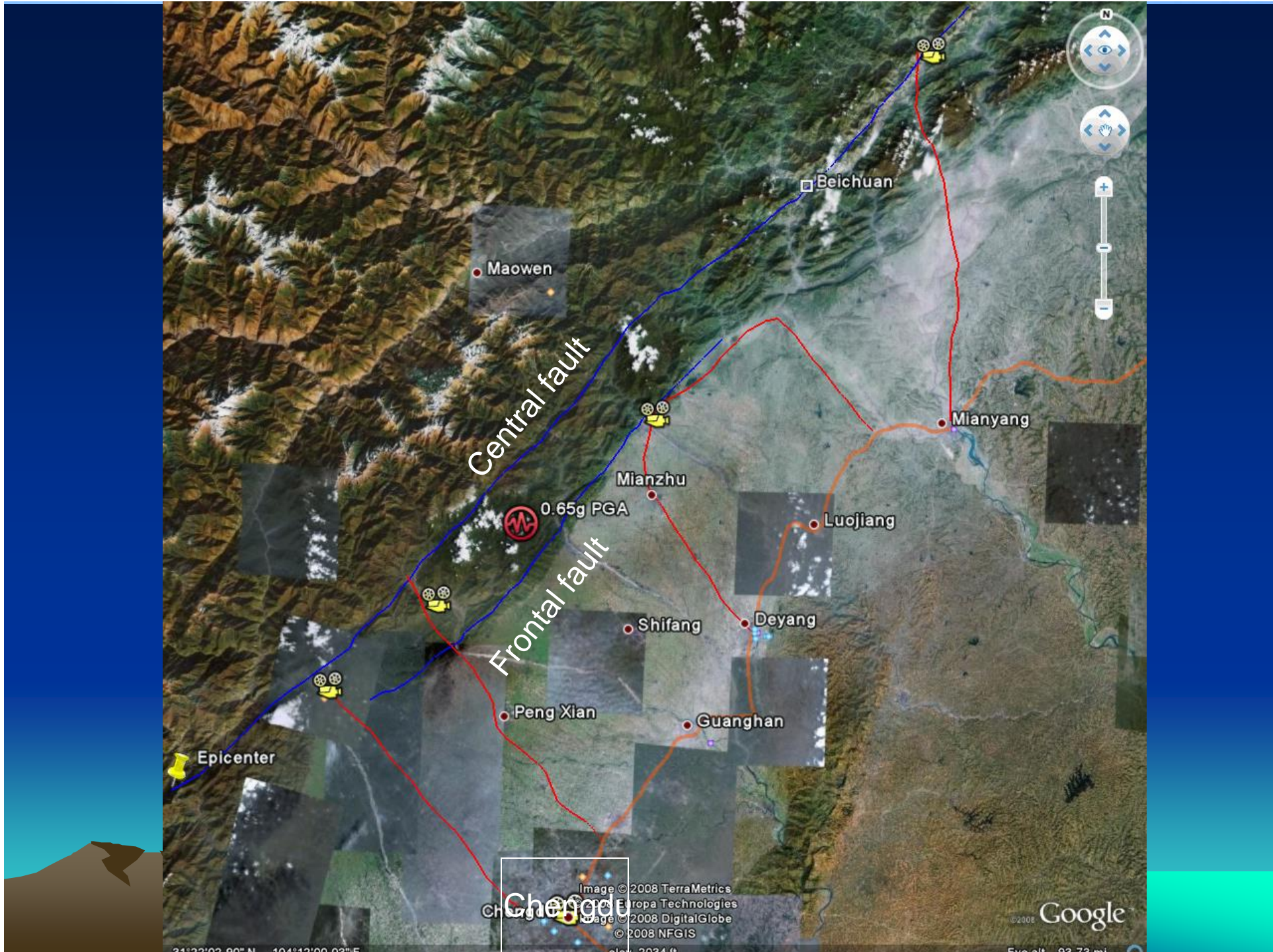
# Peak Ground Acceleration (E-W component) of Wenchuan M8.0 Earthquake

CEA website (<http://ww.cea.gov.cn:99/>, no contour value was given)



\* The contour values were estimated and may not be accurate.





Epicenter

Central fault

Frontal fault

Chengdu

Image © 2008 TerraMetrics  
Europa Technologies  
Image © 2008 DigitalGlobe  
© 2008 NFGIS  
2034 ft

0.65g PGA

Beichuan

Mianyang

Luojiang

Mianzhu

Deyang

Shifang

Peng Xian

Guanghan

Google

31°22'02.90" N 104°12'00.03" E

Eye alt: 93.73 mi





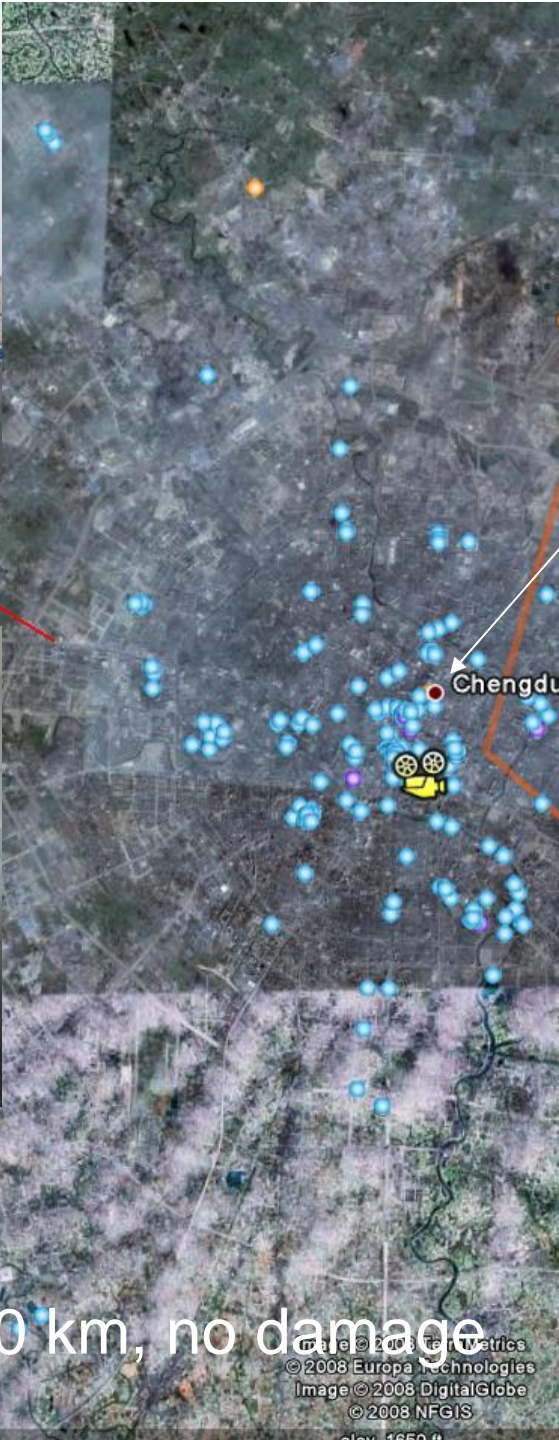
Apartment building



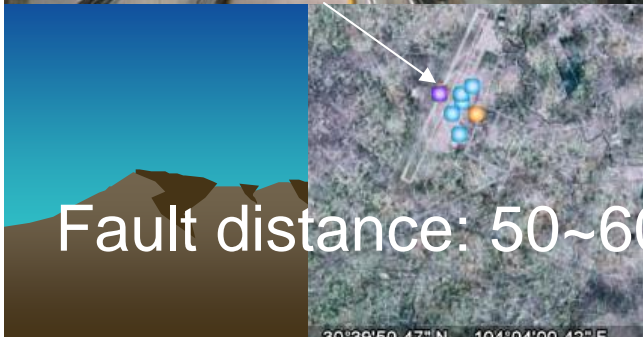
City Center



Chengdu Airport



Chengdu



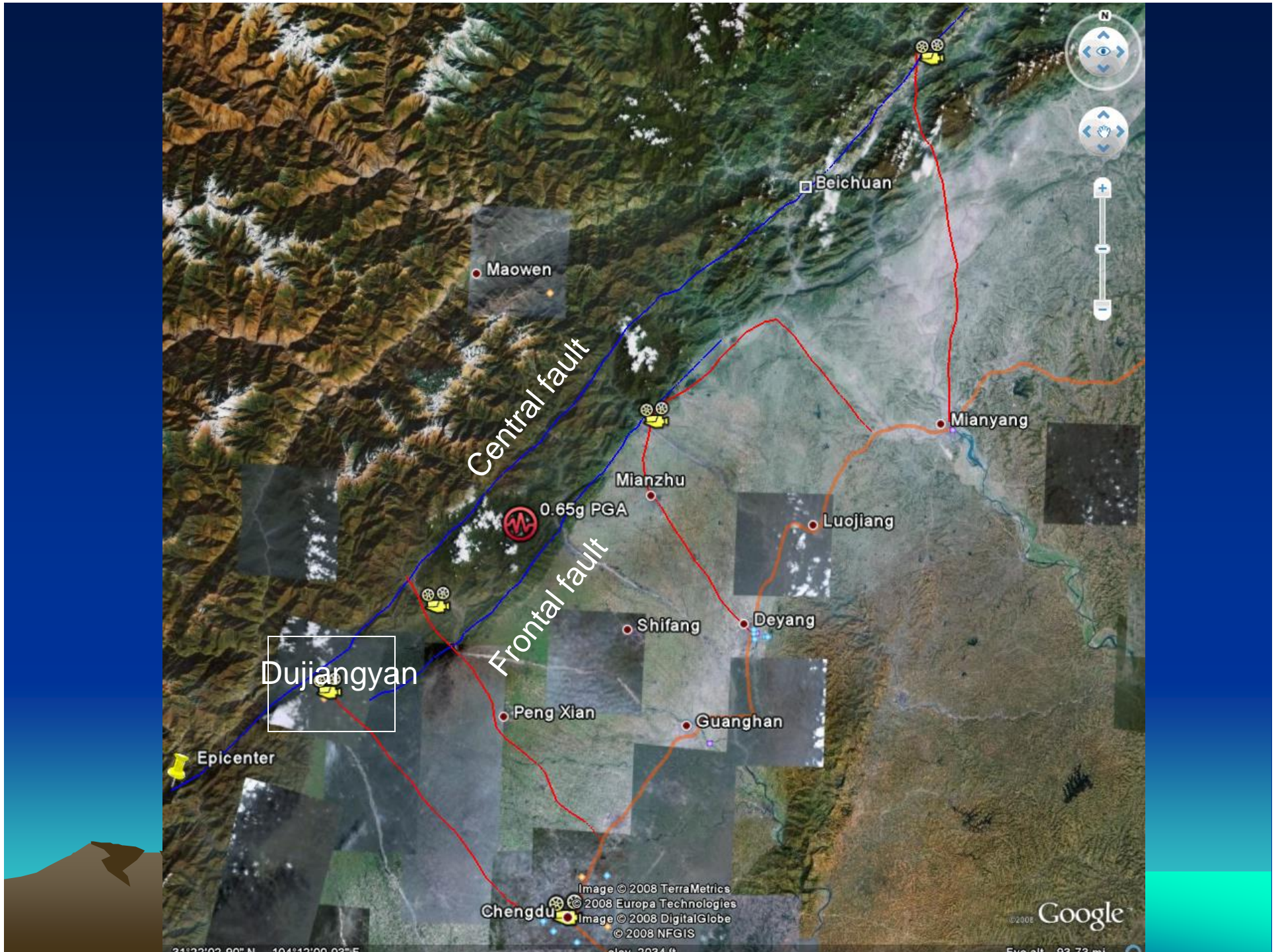
Fault distance: 50~60 km, no damage

© 2008 Europa Technologies  
Image © 2008 DigitalGlobe  
© 2008 NFGIS  
elevation: 1650 ft



Yulin Hotel





31°22'02.96" N, 104°12'00.03" E

elev: 2034 ft





Tourist City



Dujiangyan-Irrigation system, built 2,000 years ago



90% buildings damaged  
102 buildings collapsed

© 2008 Europa Technologies  
Image © 2008 TerraMetrics  
Image © 2008 DigitalGlobe

© 2008 Google  
Mar 31, 2006 Eye alt 10.92 mi



Collapsed building in Dujiangyan





Collapsed building in Dujiangyan





Damaged police station (new) in Dujiangyan



Damaged new hotel in Dujiangyan







Juyuan Middle School ( 300+ students were killed)



Zhipingpu Dam, built in 2005



Water level before earthquake





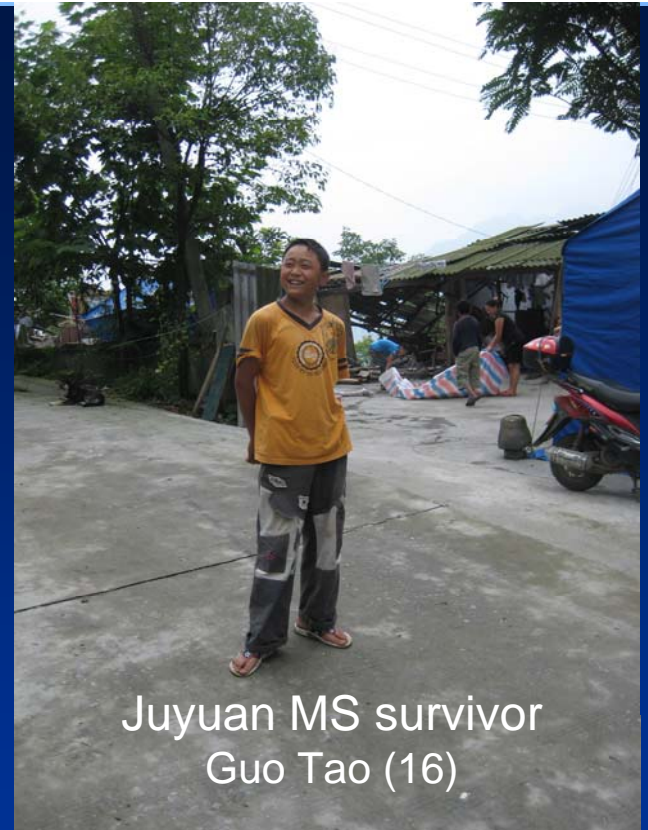
Damaged house







Luo Yu Zheng is crying for the losses of her son (Tao Liang killed at Juyuan MS) and house.



Juyuan MS survivor  
Guo Tao (16)



Results from the natural + manmade disasters



Juyuan MS victim  
Tao Liang (16)





Dangerous road



Damaged bridge

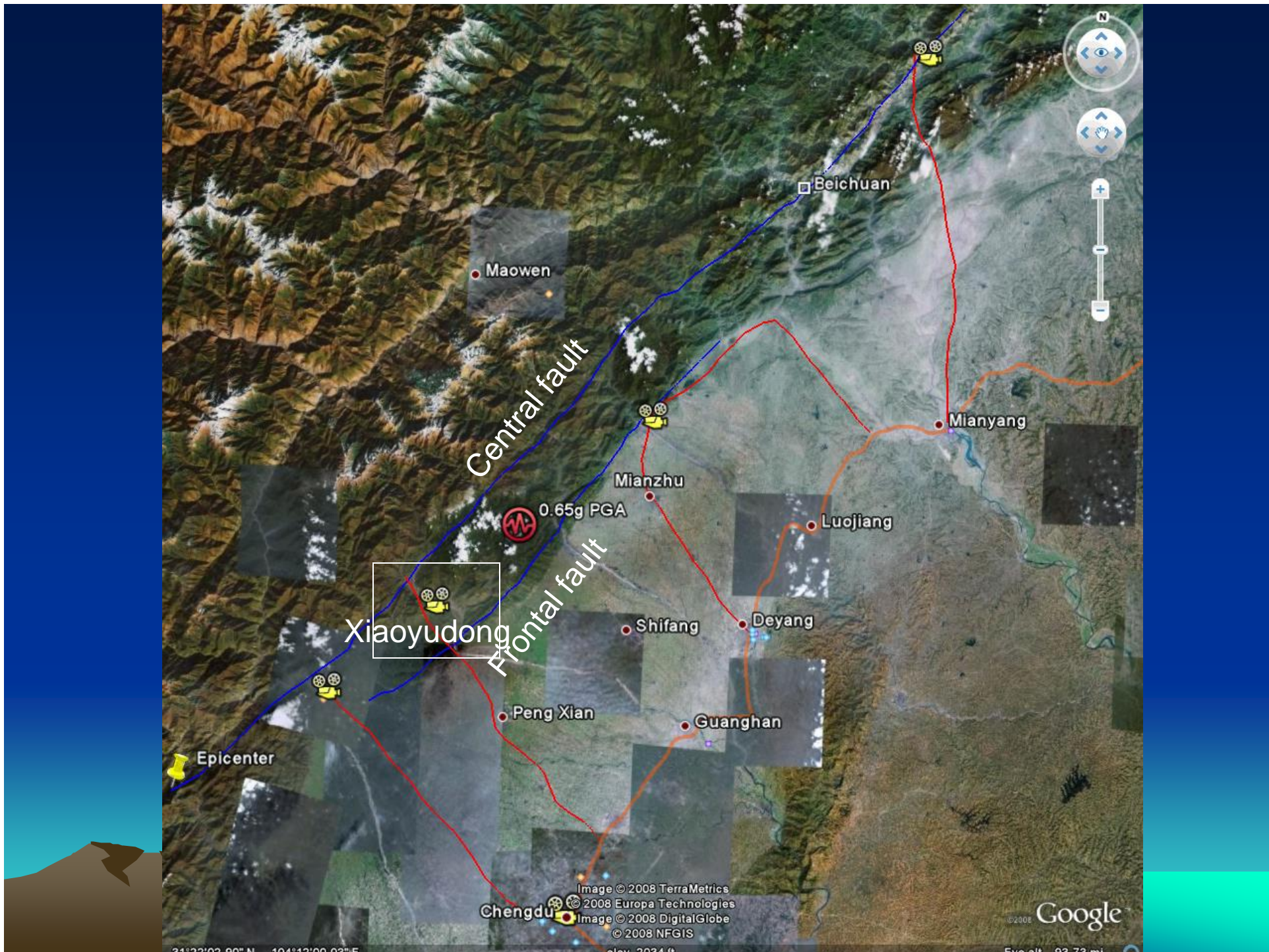
Lateral spreading











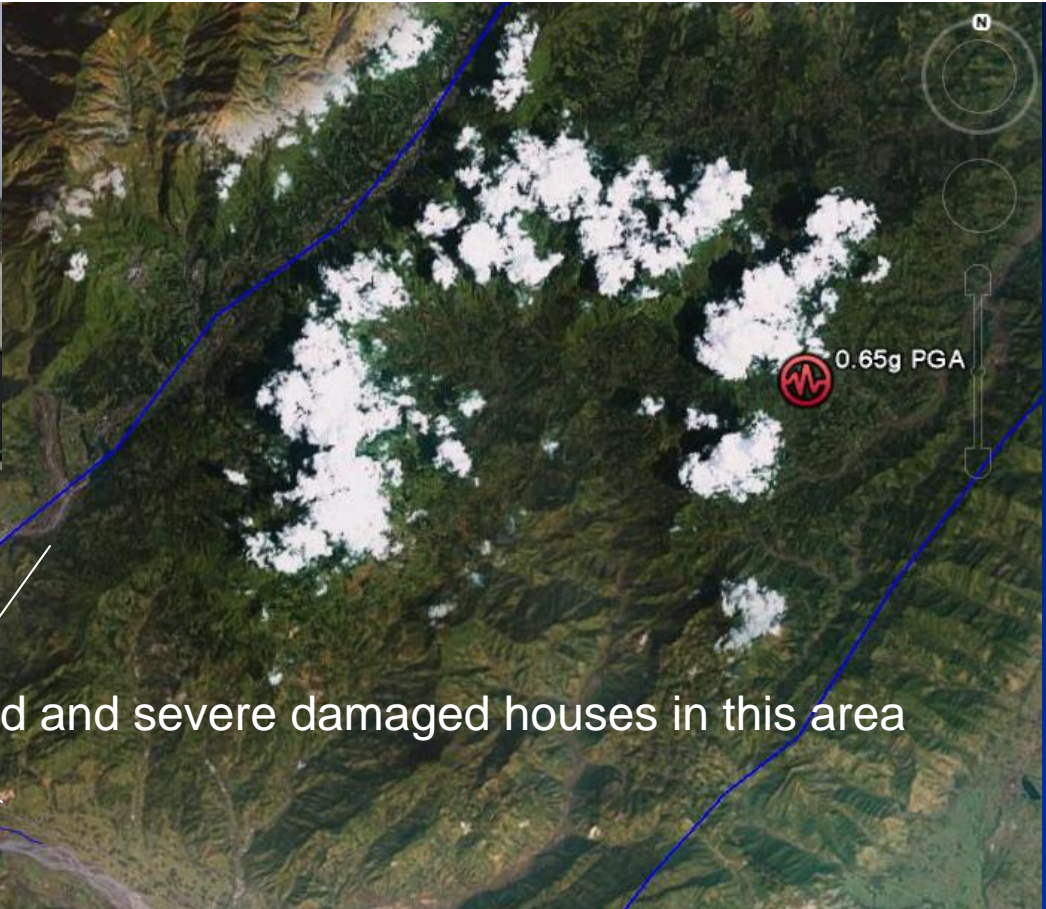
31°22'02.90" N 104°12'00.03" E

Image © 2008 TerraMetrics  
© 2008 Europa Technologies  
Image © 2008 DigitalGlobe  
© 2008 NFGIS

Google

Eye alt. 93.73 mi





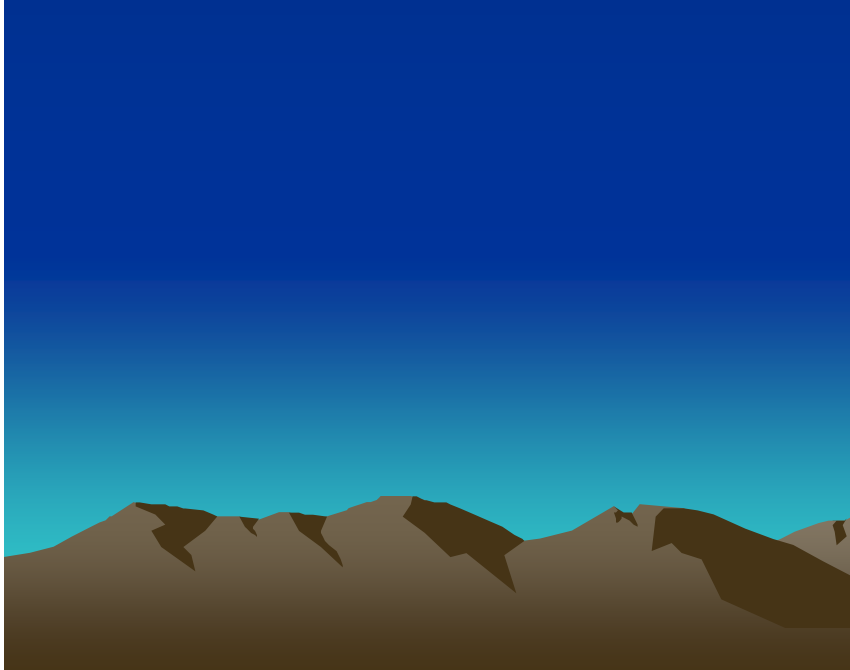
Collapsed and severe damaged houses in this area



© 2008 Europa Technologies  
Image © 2008 TerraMetrics  
Image © 2008 DigitalGlobe

31°11'52.26" N 103°50'54.88" E







House with some damage

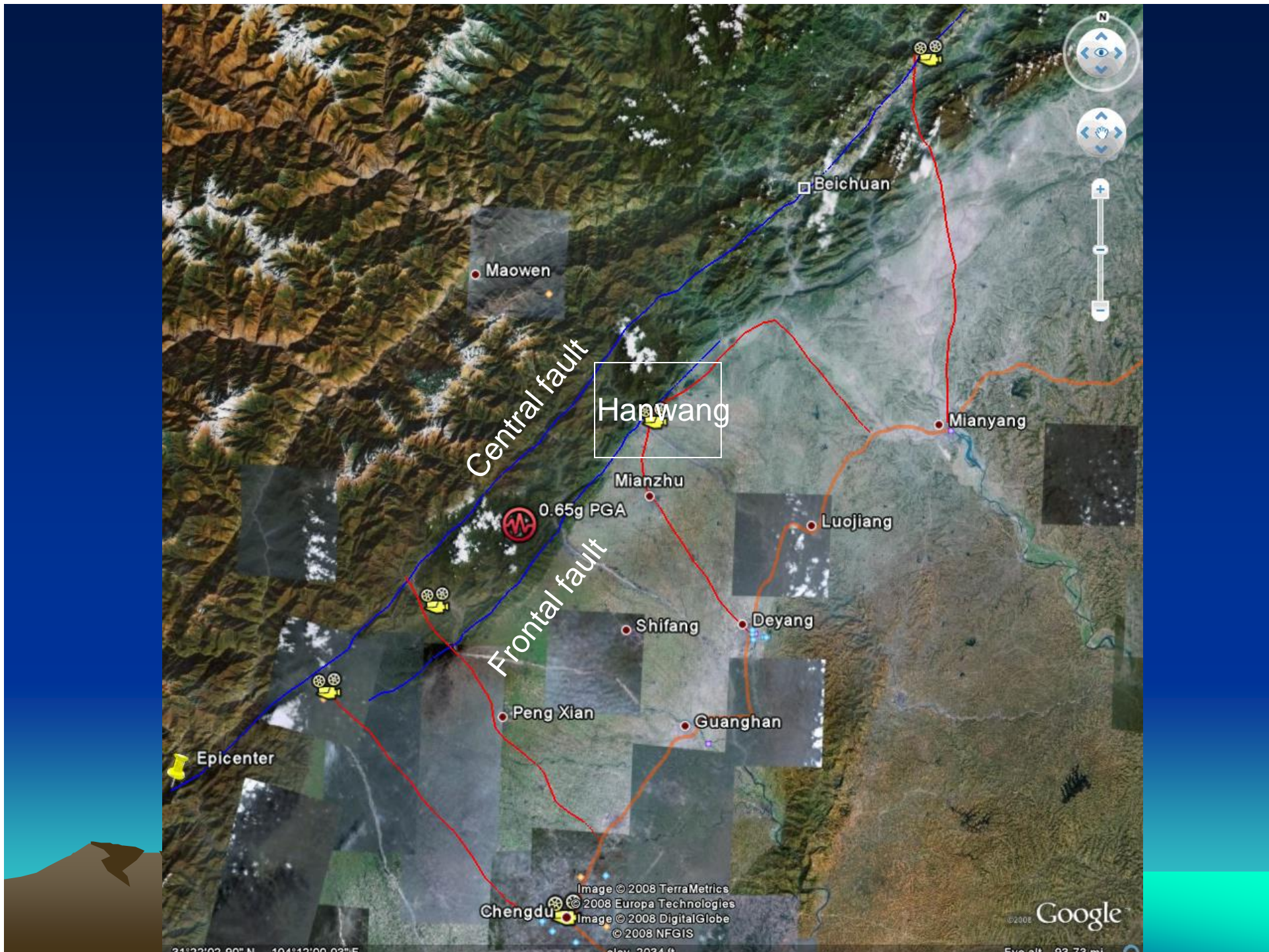


This may be the reason

Rupture







31°22'02.90" N 104°12'00.03" E

Image © 2008 TerraMetrics  
© 2008 Europa Technologies  
Image © 2008 DigitalGlobe  
© 2008 NFGIS

Google

Eye alt: 93.73 mi



Clock stopped at 2:28pm on May 12, 2008





Collapsed school buildings







Collapsed school buildings





Collapsed school buildings







Cut through levee



Water fall



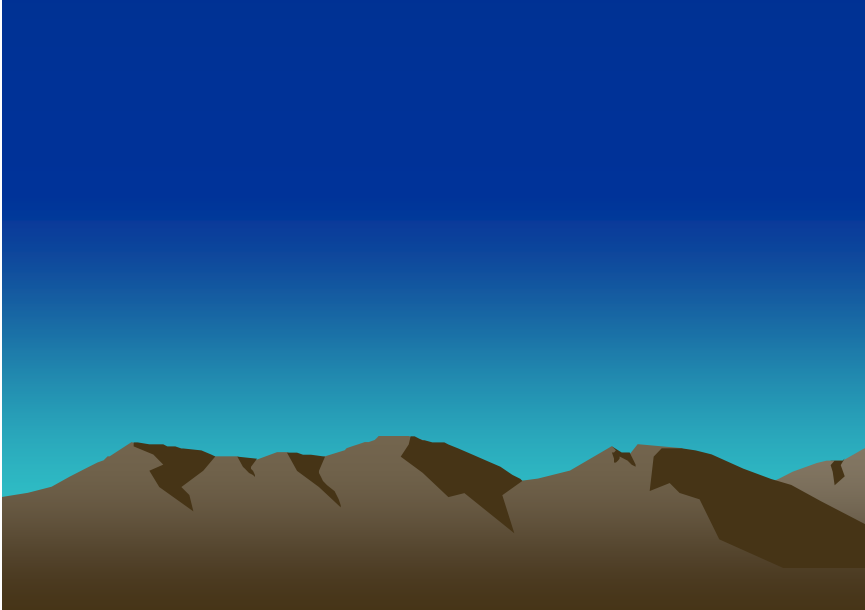
Uplift



Frontal fault rupture









Family lunch on top of ruptured fault

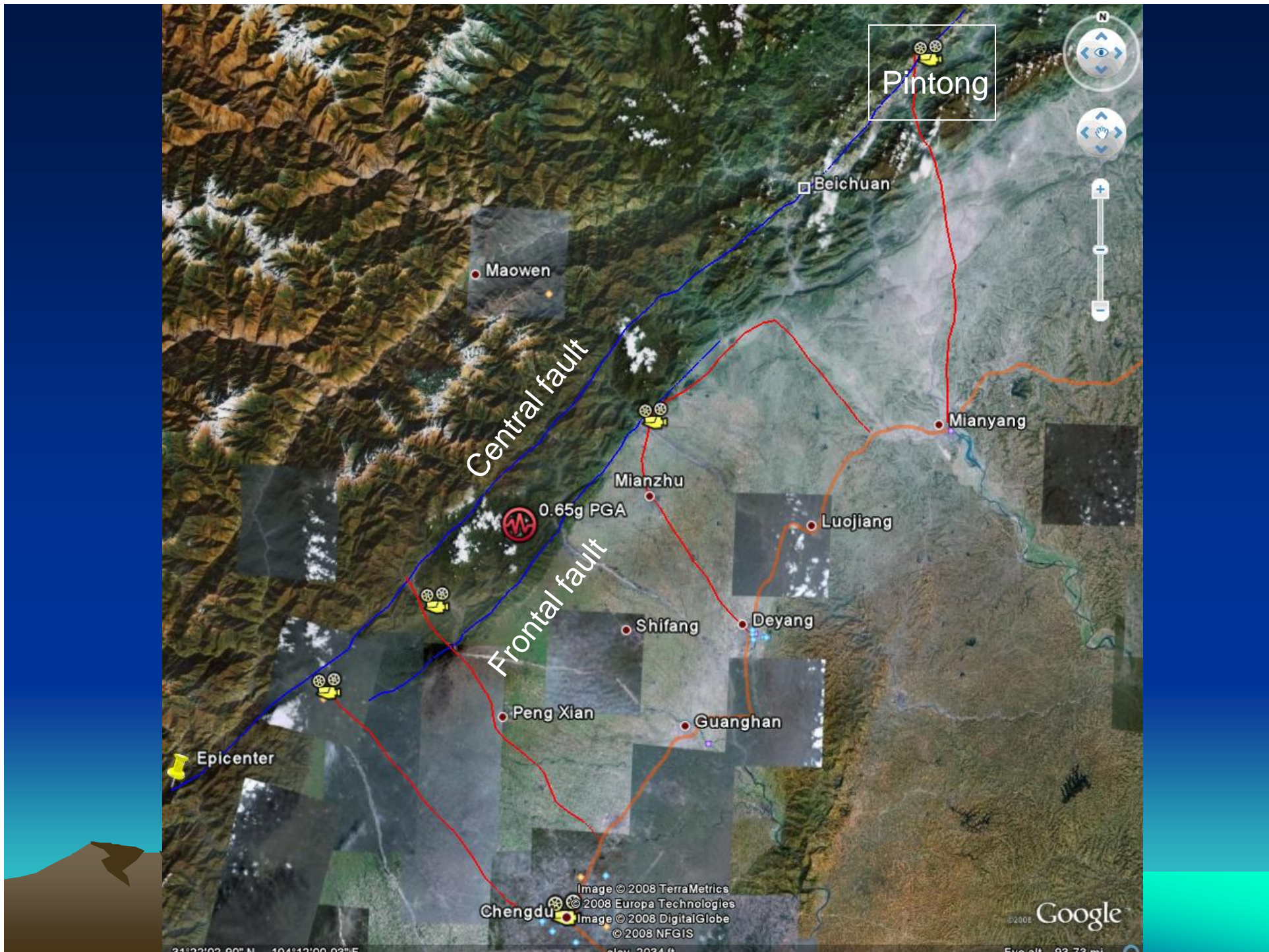


Fault rupture

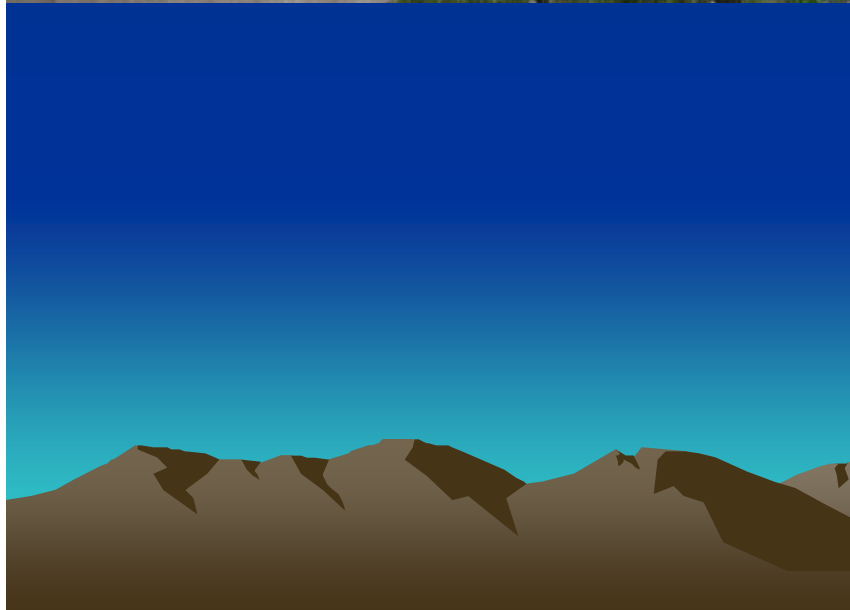


Minor damage





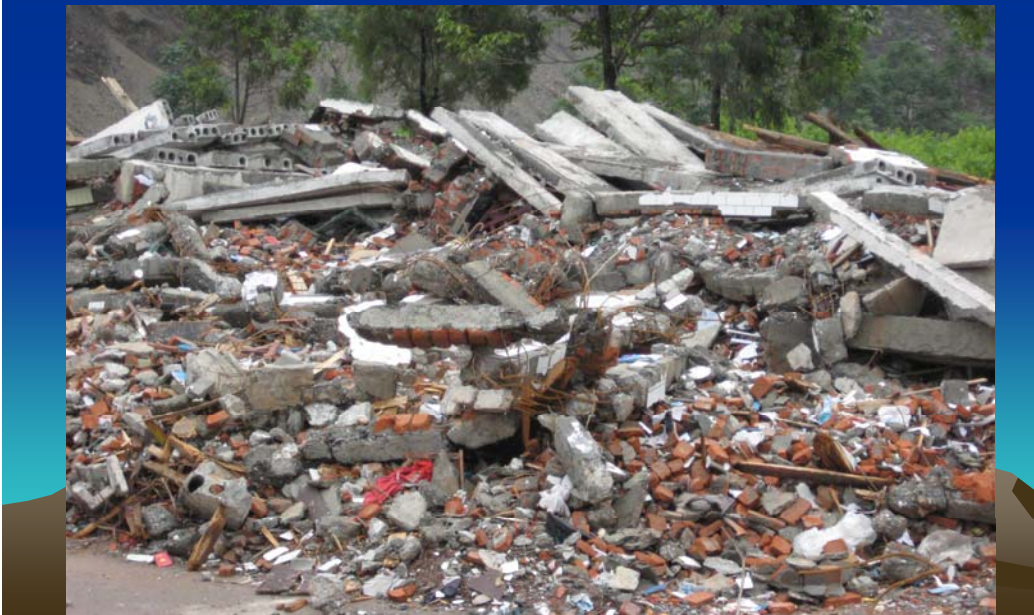






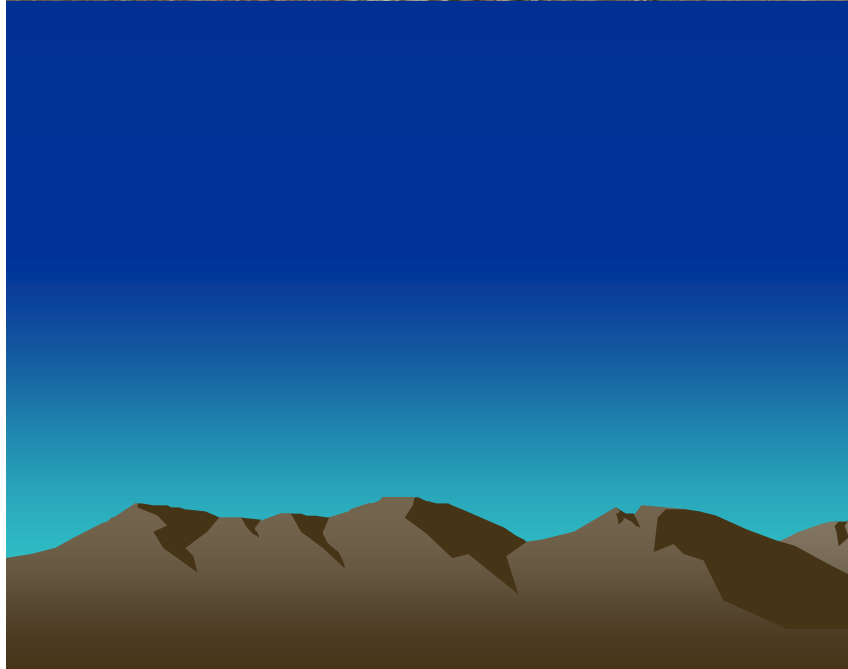


100+ students were killed



Collapsed school buildings









Massive landslide

less damage  
(foot wall)

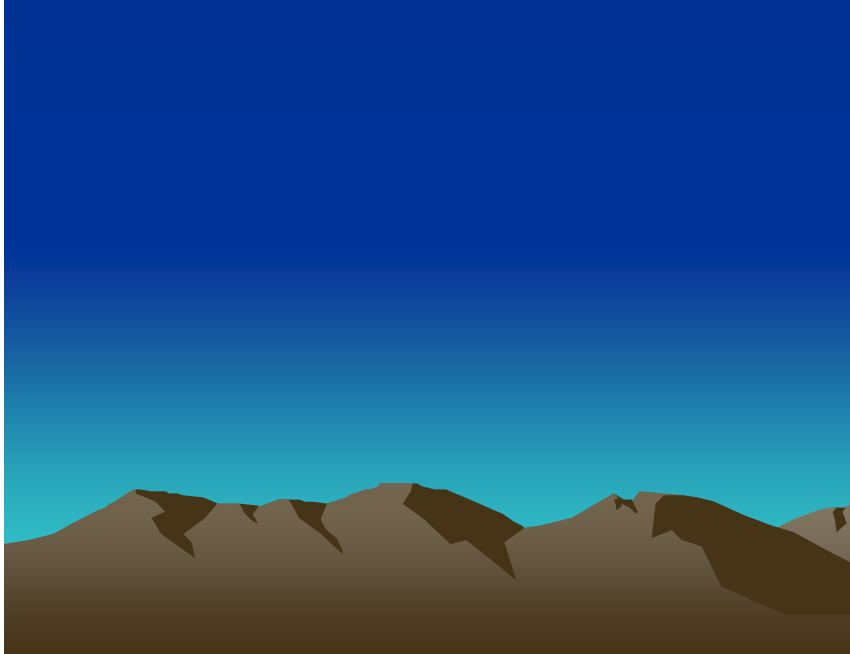
More damage  
(hanging wall)

Fault rupture





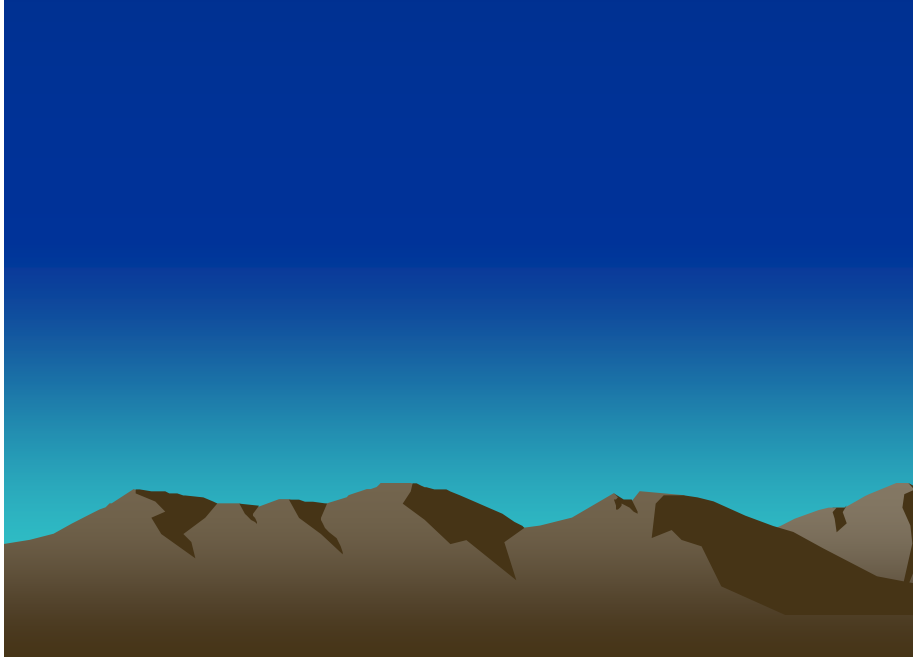
No damage to this house  
(about 50 m from the rupture)







Large landslide





60+ people were buried

Buried houses



Fault scarp

Fault rupture

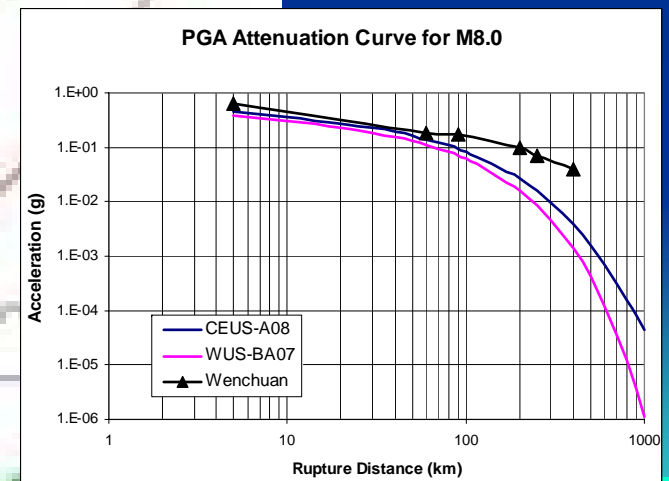
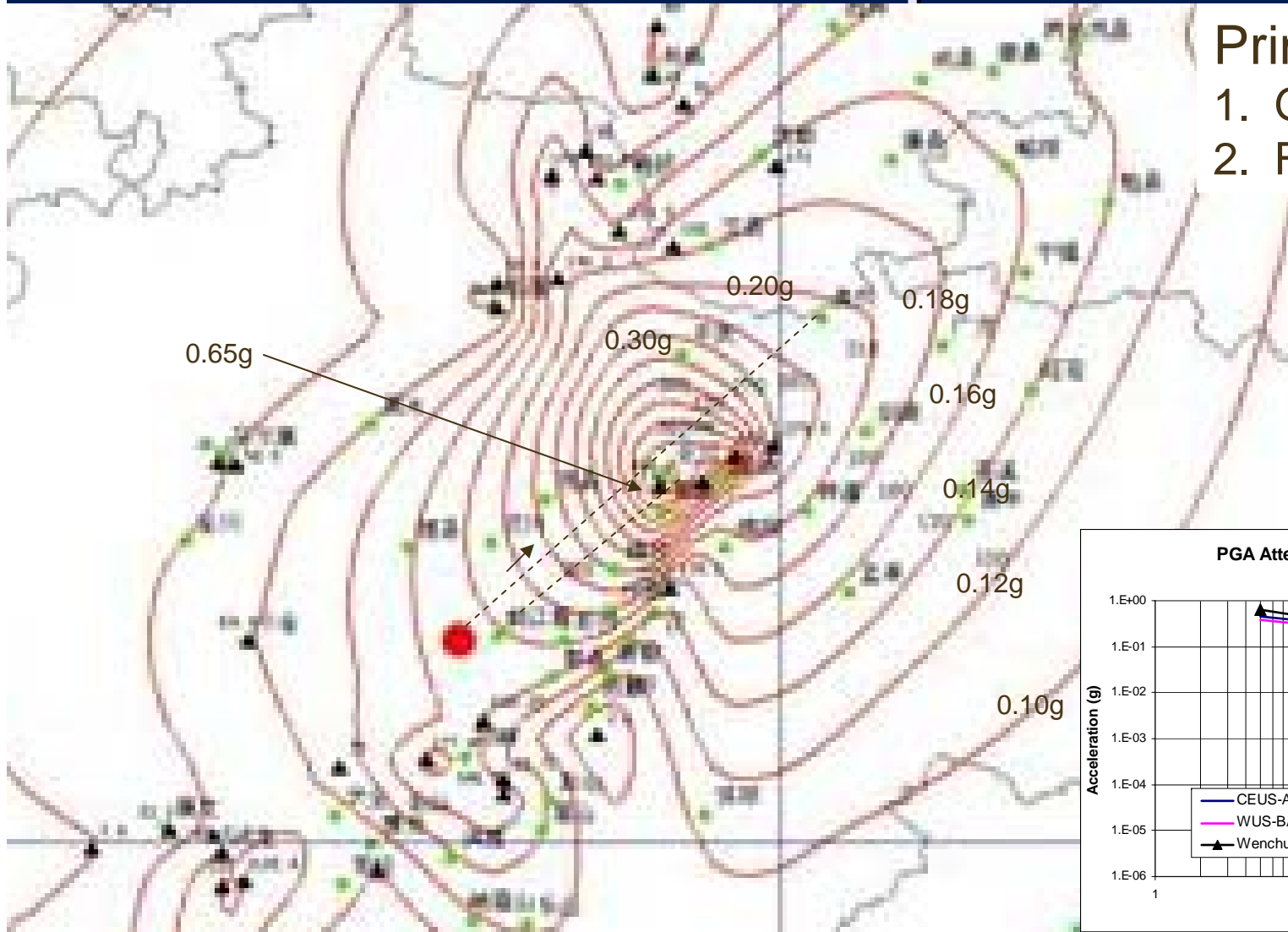




# Lesson 1 – Earthquake Science

## Primary Hazard

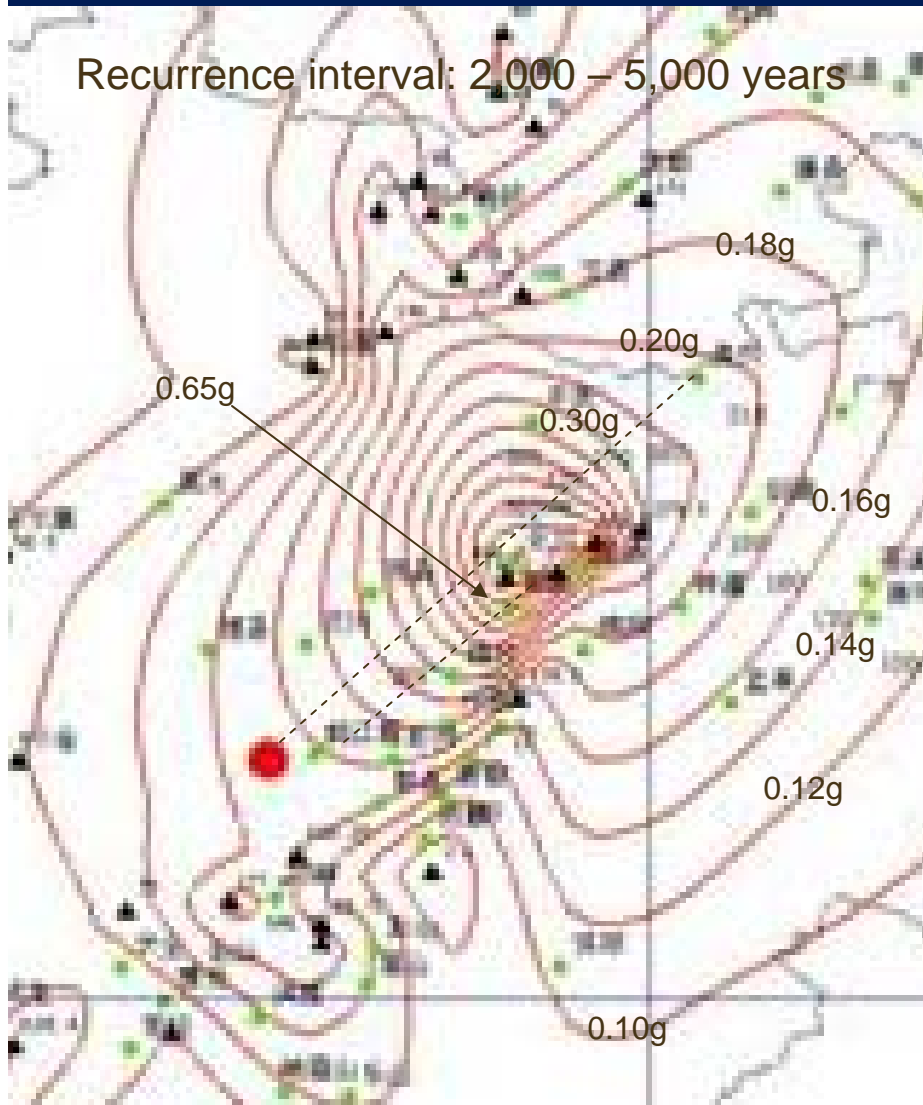
1. Ground Motion
2. Fault Rupture



Earthquake science is the base for seismic hazard assessment and mitigation

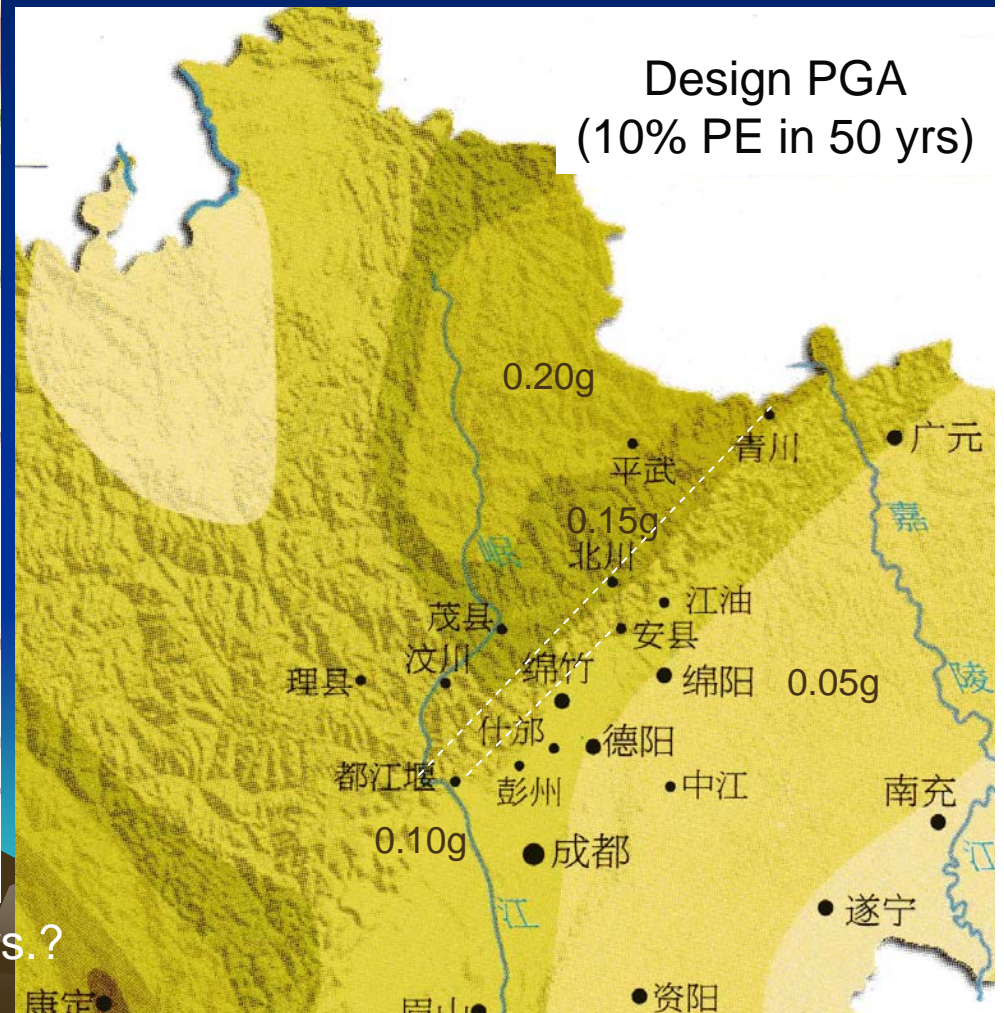


# Lesson 2 – Design Ground Motion



## Building damage

1. Under design
2. Quality of construction



How about PGA with 5 and 2% PE in 50 yrs.?



# Lesson 3 – Induced (secondary) hazards



## Secondary Hazard

1. Landslide/Rock fall
2. Ground Motion Amp.
3. Liquefaction (reported)





# Lesson 4 – Mitigation Works



Not necessary expensive  
Not design for 0.6g PGA or larger



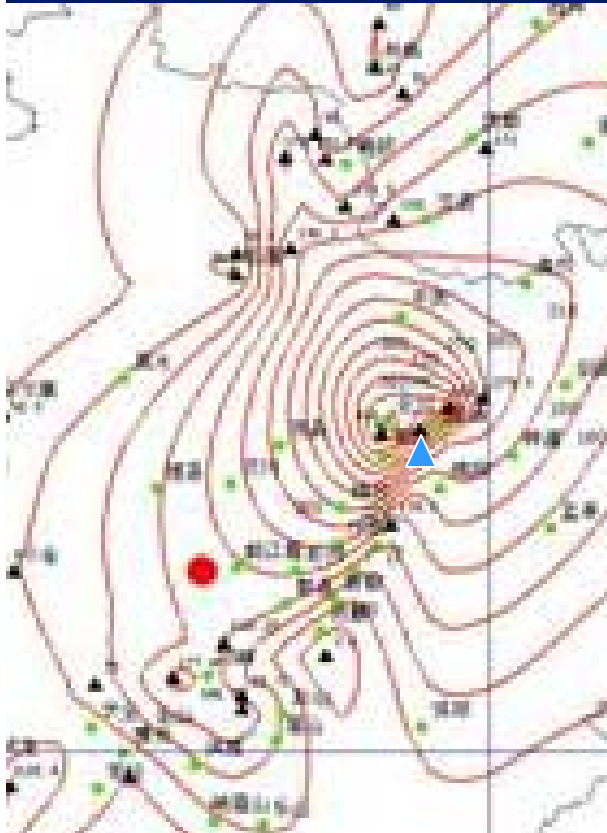
# “Best Story”

Shan Zhao Middle School

School Principal: 叶志平 (Ye Zhi Ping)

Built in 1980's (RMB170,000)

Retrofit (RMB400,000)



All evacuated in 2 minutes after EQ  
2,200 students with no single injury



Thank you!

