How Reliable Is our Existing "Seismic Hazard Analysis"?

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National Taiwan University | NCREE | Taiwan Typhoon & Flood Research Institute | Disaster Management Society of Taiwan | National Science and Technology Center for Disaster Reduction

US-Taiwan Workshop on the Advancement of Societal Responses to Mega-Disasters afflicting Mega-Cities

Monday 12 May 2008

14:28:01.42

magnitude of 8.0 Ms

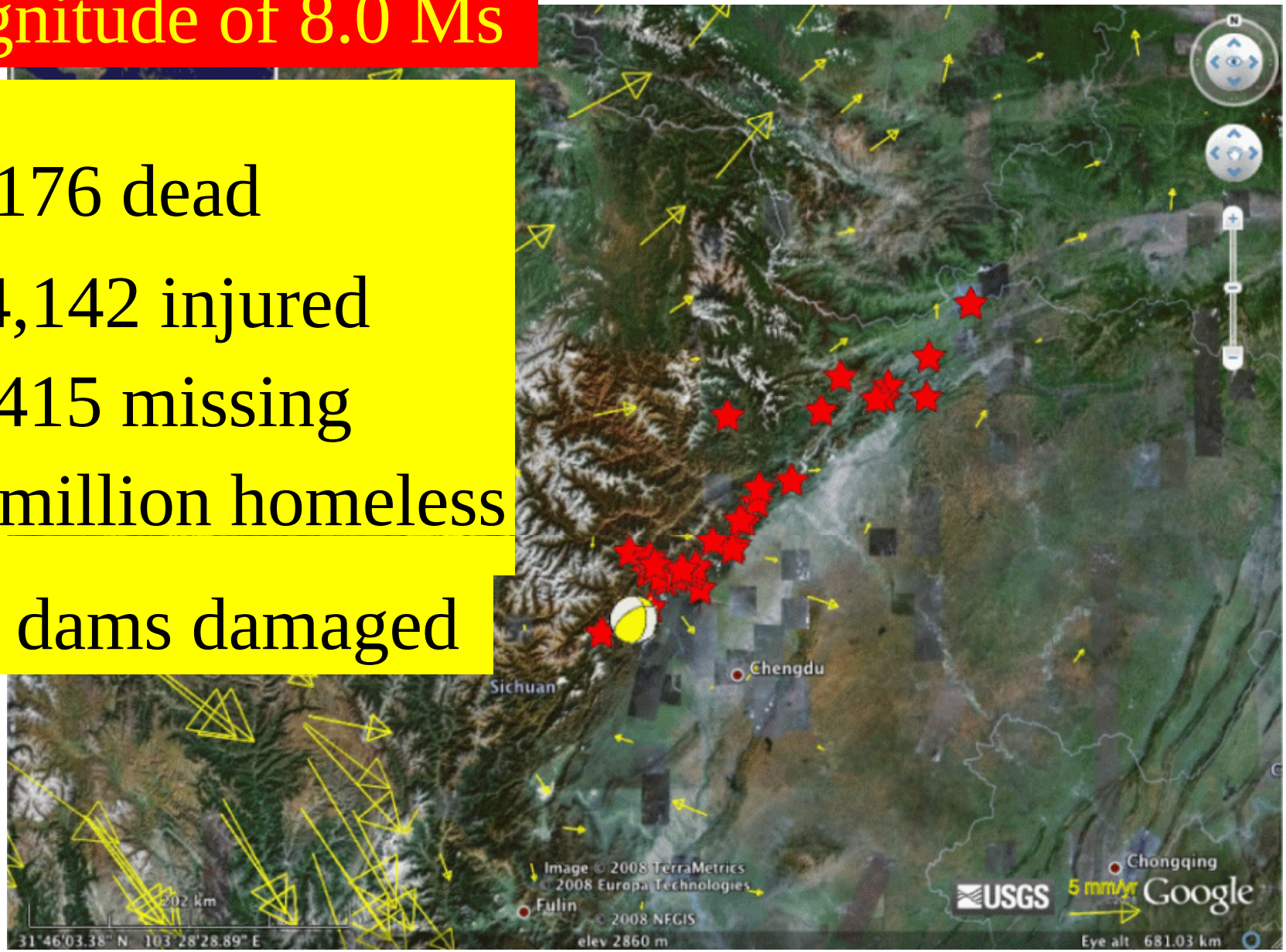
69,176 dead

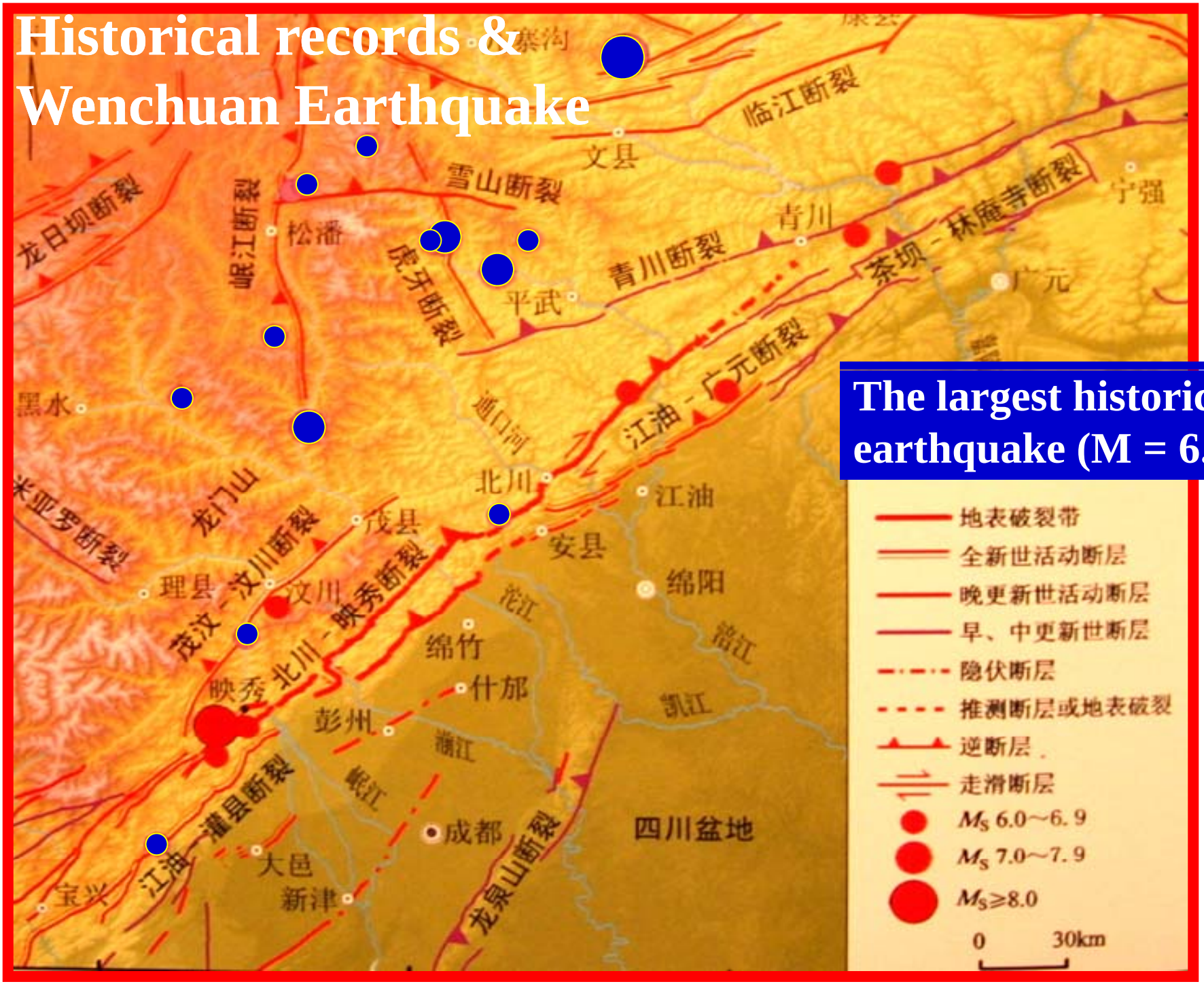
374,142 injured

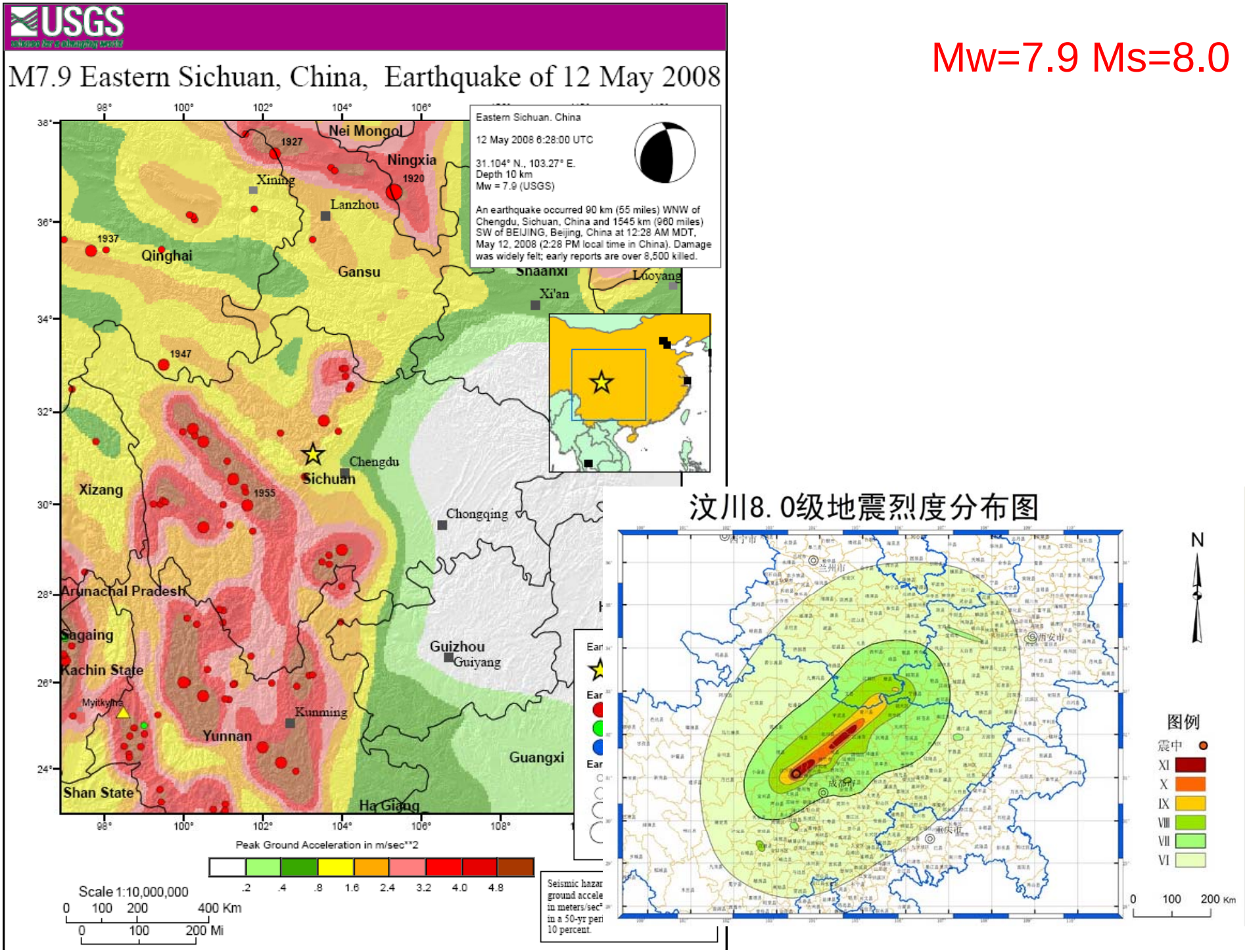
17,415 missing

4.8 million homeless

391 dams damaged



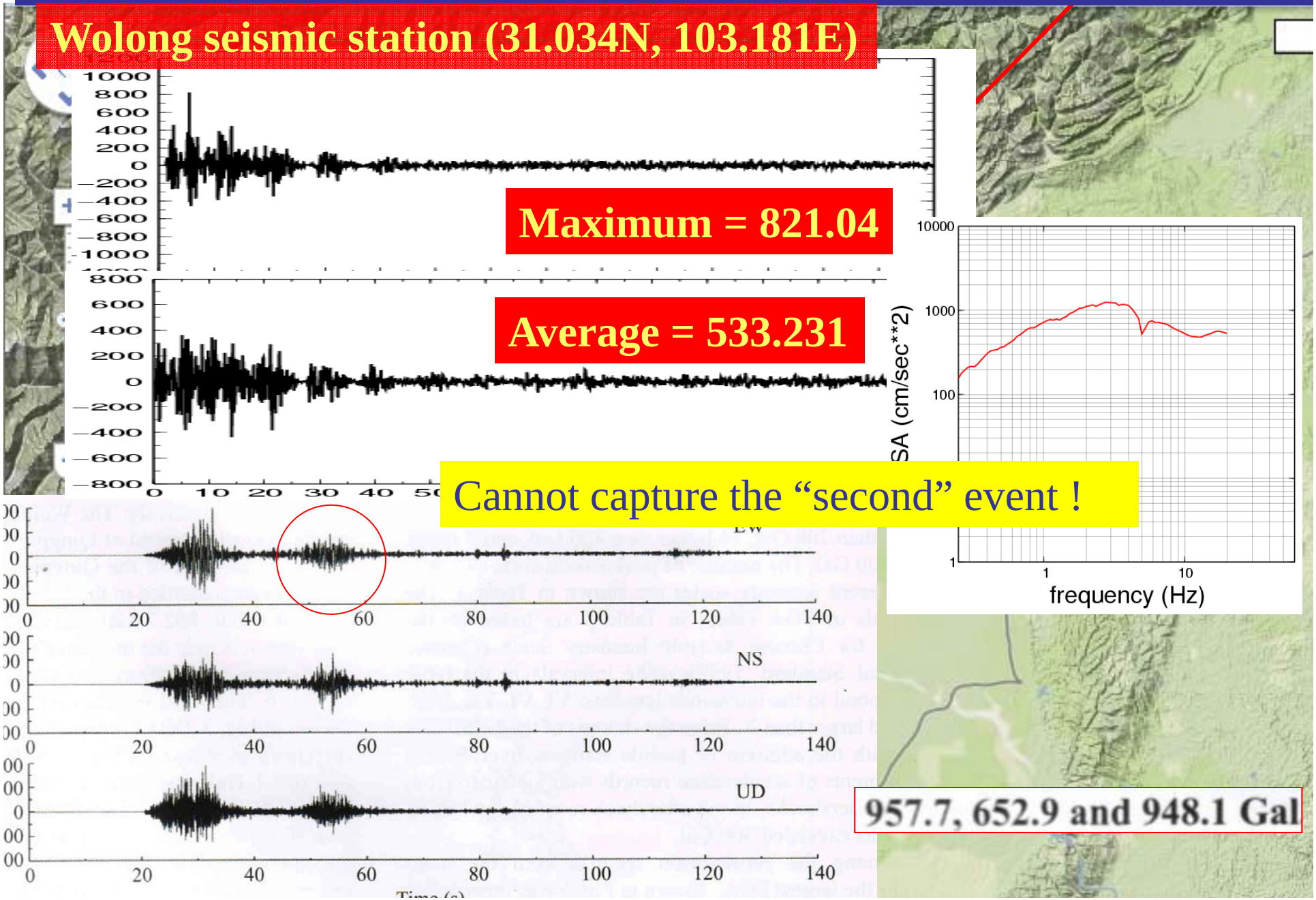

Historical records &
Wenchuan Earthquake
The largest historical earthquake (M = 6.5)
地表破裂带
全新世活动断层
晚更新世活动断层
早、中更新世断层
隐伏断层
推测断层或地表破裂
逆断层
走滑断层
M_S 6.0~6.9
M_S 7.0~7.9
M_S≥8.0
0
30km
寨沟
文县
临江断裂
雪山断裂
龙日坝断裂
岷江断裂
松潘
虎牙断裂
平武
青川断裂
青川
茶坝-林庵寺断裂
宁强
广元
黑水
米亚罗断裂
龙门山
北川
江油-广元断裂
江油
安县
茂县
理县
汶川
茂汶-汉川断裂
北川-映秀断裂
绵阳
涪江
绵竹
什邡
映秀
彭州
湔江
岷江
凯江
成都
四川盆地
大邑
新津
宝兴
江油-灌县断裂
龙泉山断裂


USGS
M7.9 Eastern Sichuan, China, Earthquake of 12 May 2008
Eastern Sichuan, China
12 May 2008 6:28:00 UTC
31.104° N., 103.27° E.
Depth 10 km
Mw = 7.9 (USGS)
An earthquake occurred 90 km (55 miles) WNW of Chengdu, Sichuan, China and 1545 km (960 miles) SW of BEIJING, Beijing, China at 12:28 AM MDT, May 12, 2008 (2:28 PM local time in China). Damage was widely felt; early reports are over 8,500 killed.
Nei Mongol
Ningxia
Xining
Lanzhou
Qinghai
Gansu
Shaanxi
Xi'an
Luoyang
Chengdu
Sichuan
Xizang
Chongqing
Arunachal Pradesh
Sagaing
Kachin State
Myitkyina
Kunming
Yunnan
Guizhou
Guiyang
Guangxi
Shan State
Ha Giang
1927
1920
1937
1947
1955
Peak Ground Acceleration in m/sec**2
.2 .4 .8 1.6 2.4 3.2 4.0 4.8
Scale 1:10,000,000
0 100 200 400 Km
0 100 200 Mi
汶川8.0级地震烈度分布图
N
图例
震中
XI
X
IX
VIII
VII
VI
0 100 200 Km

Mw=7.9 Ms=8.0

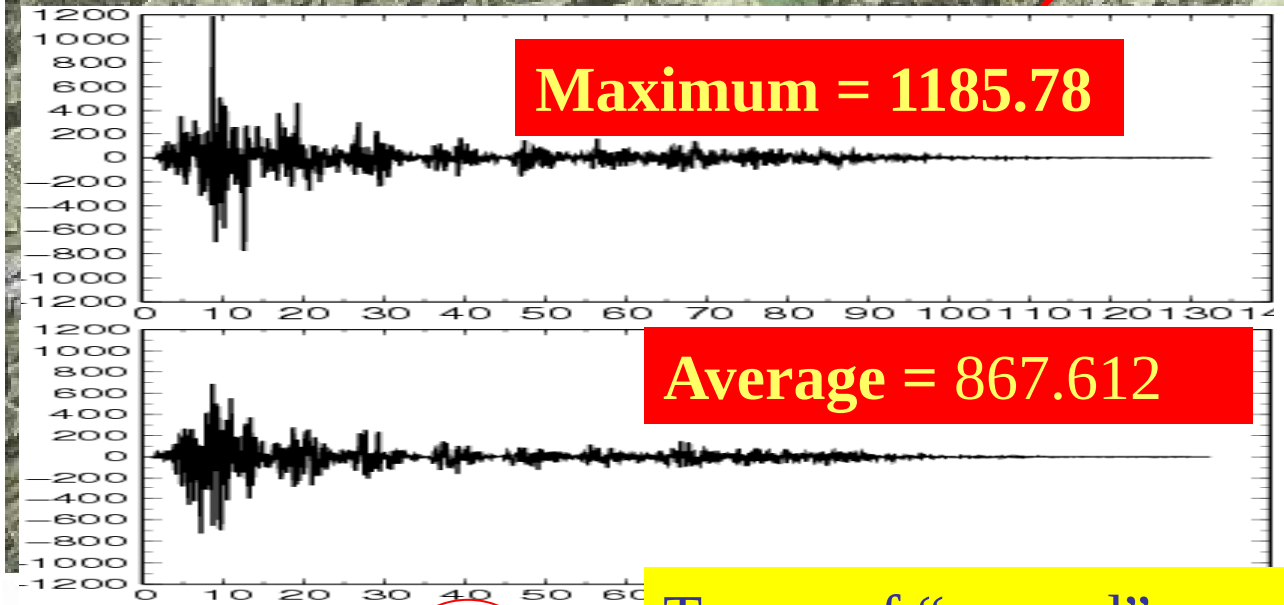
Stochastic simulations compares with observation

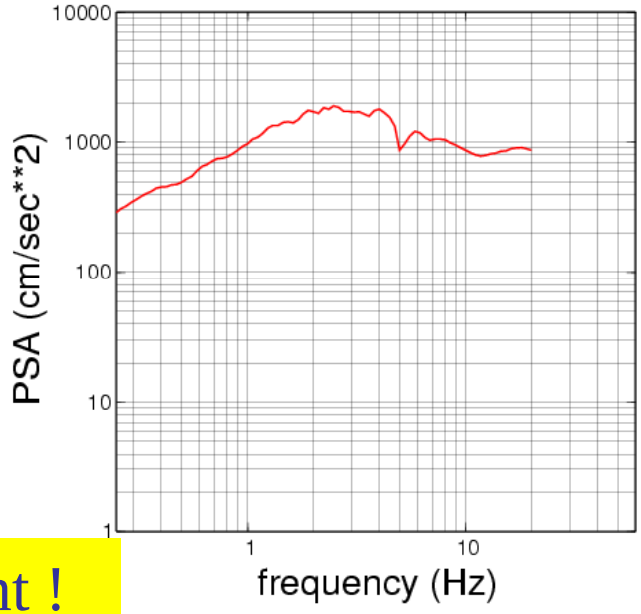
Wolong seismic station (31.034N, 103.181E)



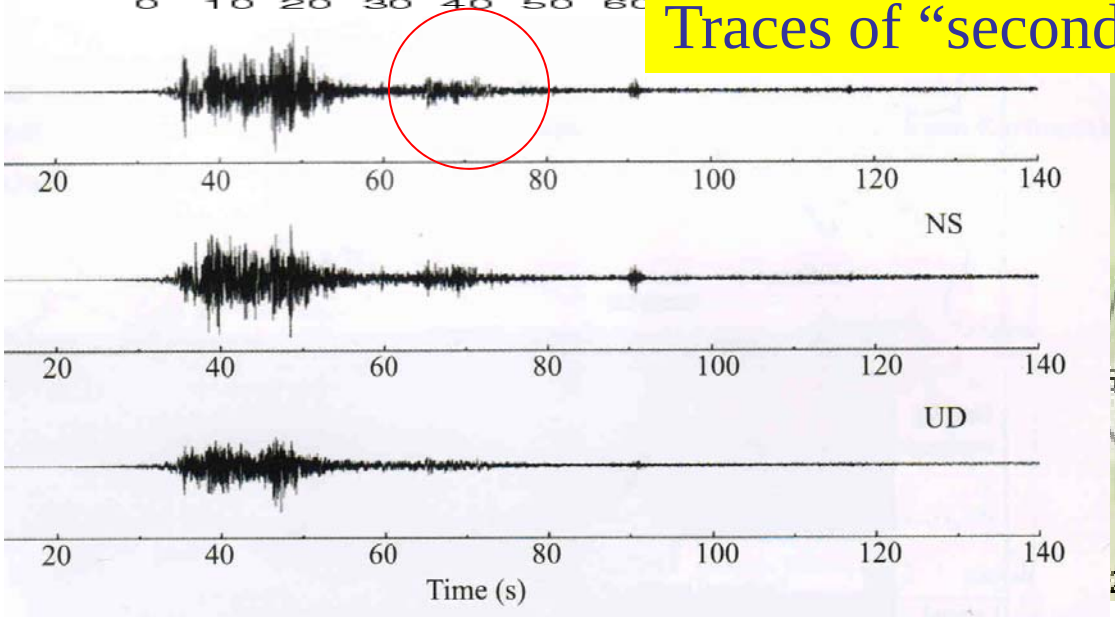
Stochastic simulations compares with observation

Qingping seismic station (31.520N, 104.090E)



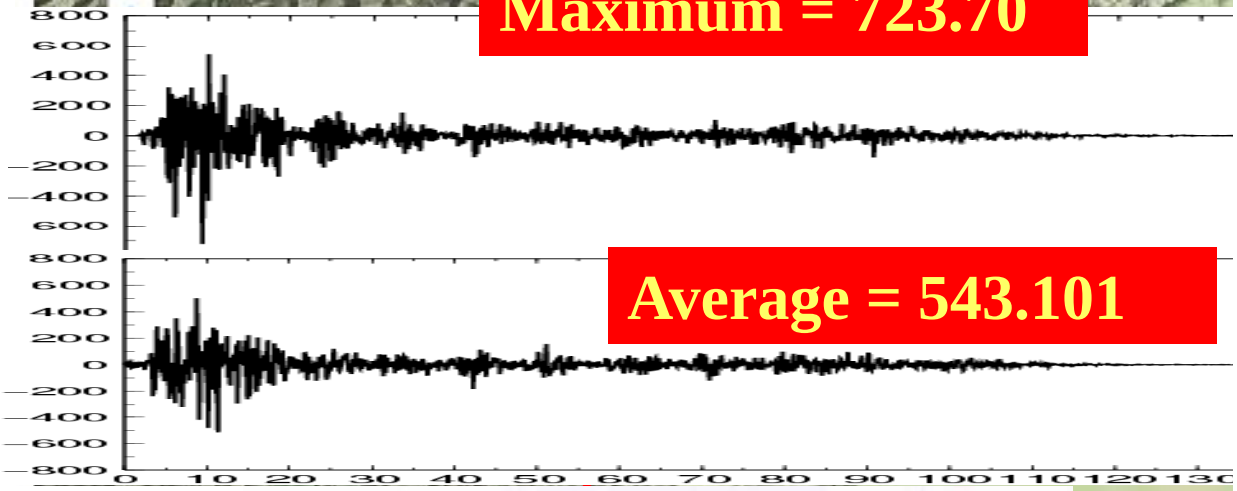


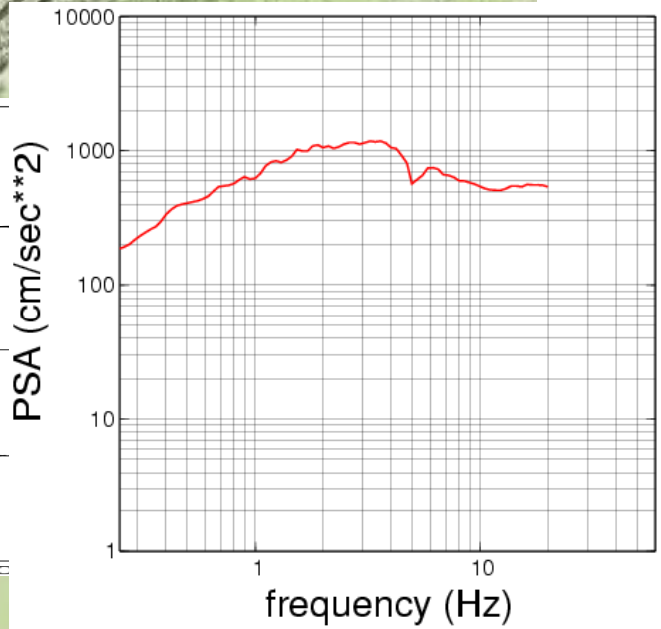
Traces of “second” event !

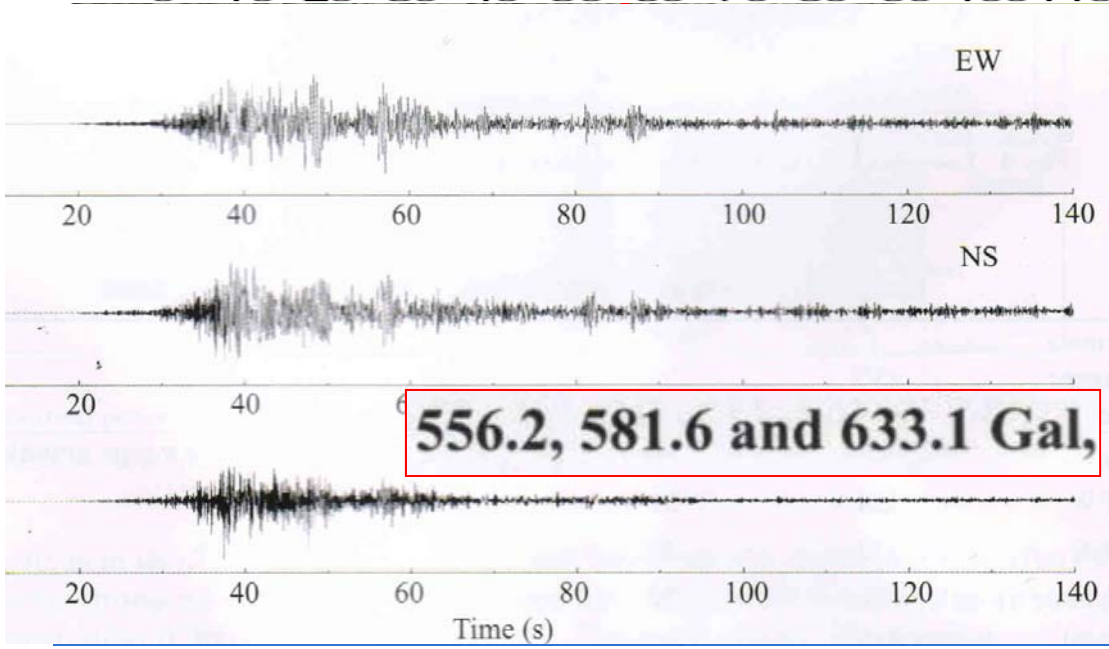


Stochastic simulations compares with observation

Bajiao seismic station (31.280N, 103.990E)

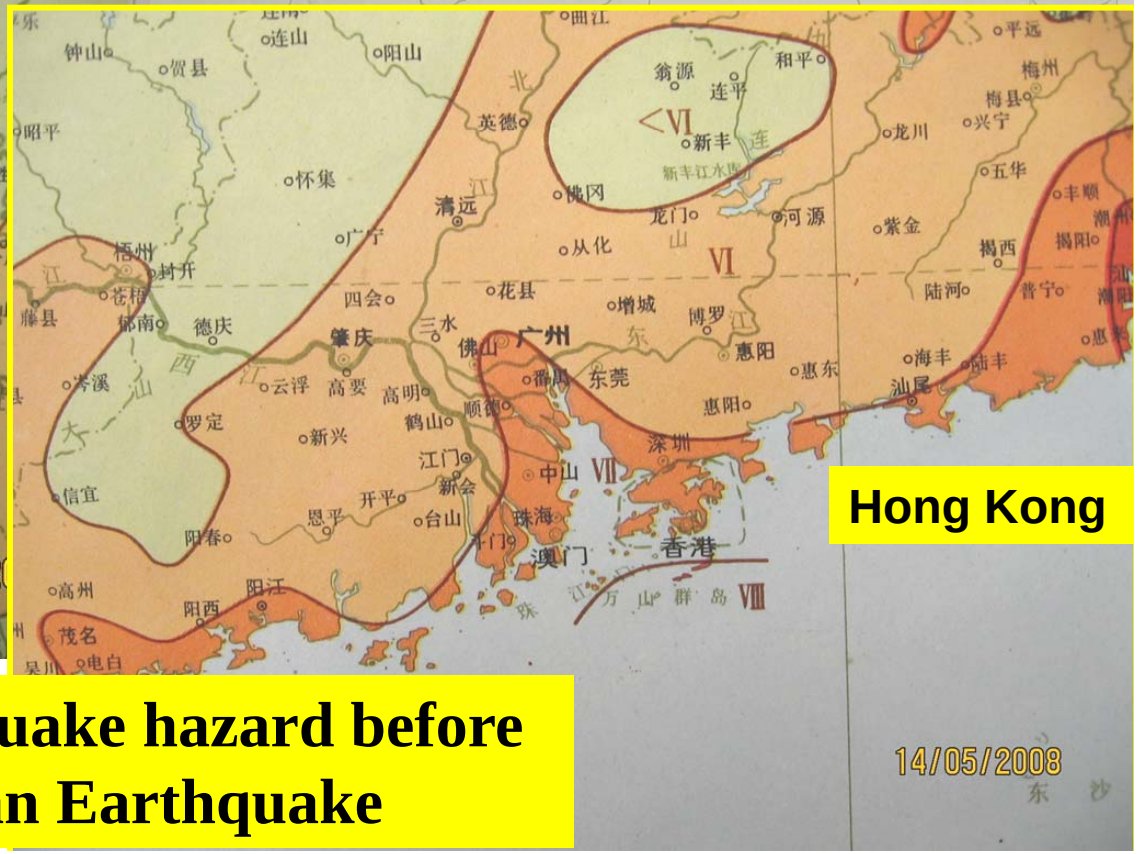






Seismic hazard map in intensity

Intensity VII for 475 return period

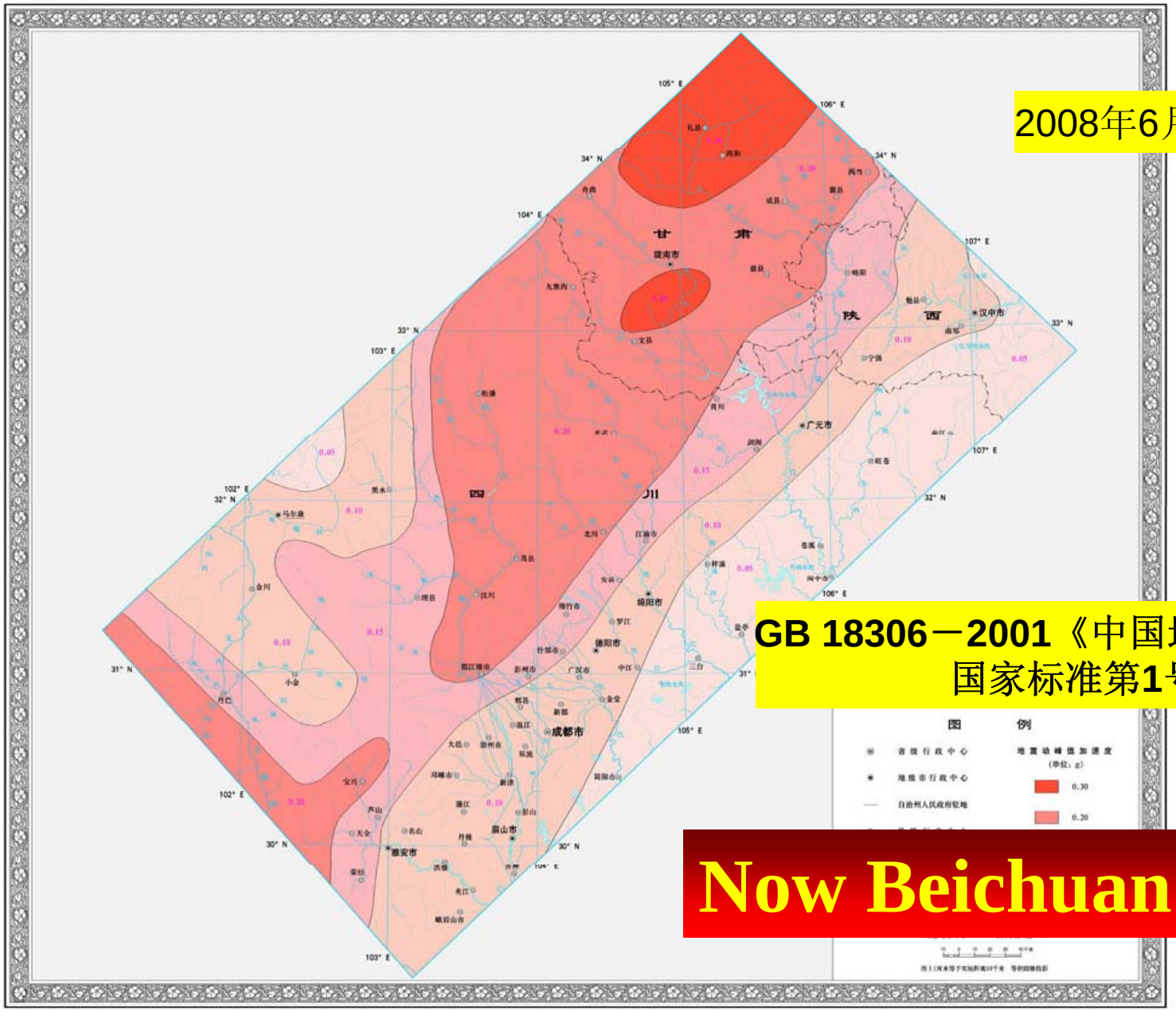


Same earthquake hazard before the Wenchuan Earthquake


青海玉树县
2010.4.14 07:49
青海省玉树藏族自治州玉树县
7.1级
Earthquake
地震
2001 PGA Hazard Map
万众一心 众志成城
汶川地震 抗震救灾

四川 甘肃 陕西部分地区
地震动峰值加速度区划图

GB 18306－2001图A2

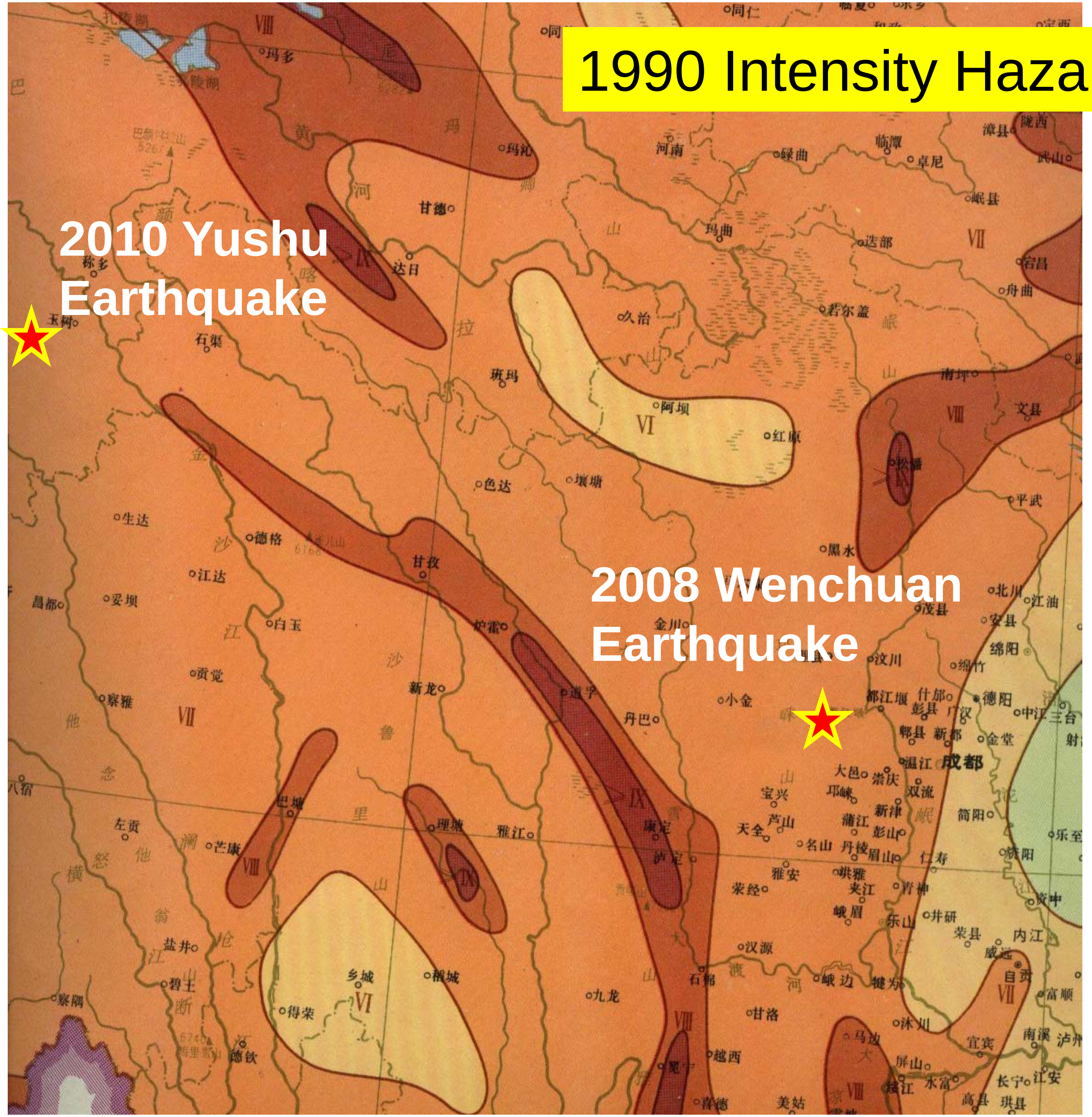


2008年6月11日批准

GB 18306－2001《中国地震动参数区划图》
国家标准第1号修改单

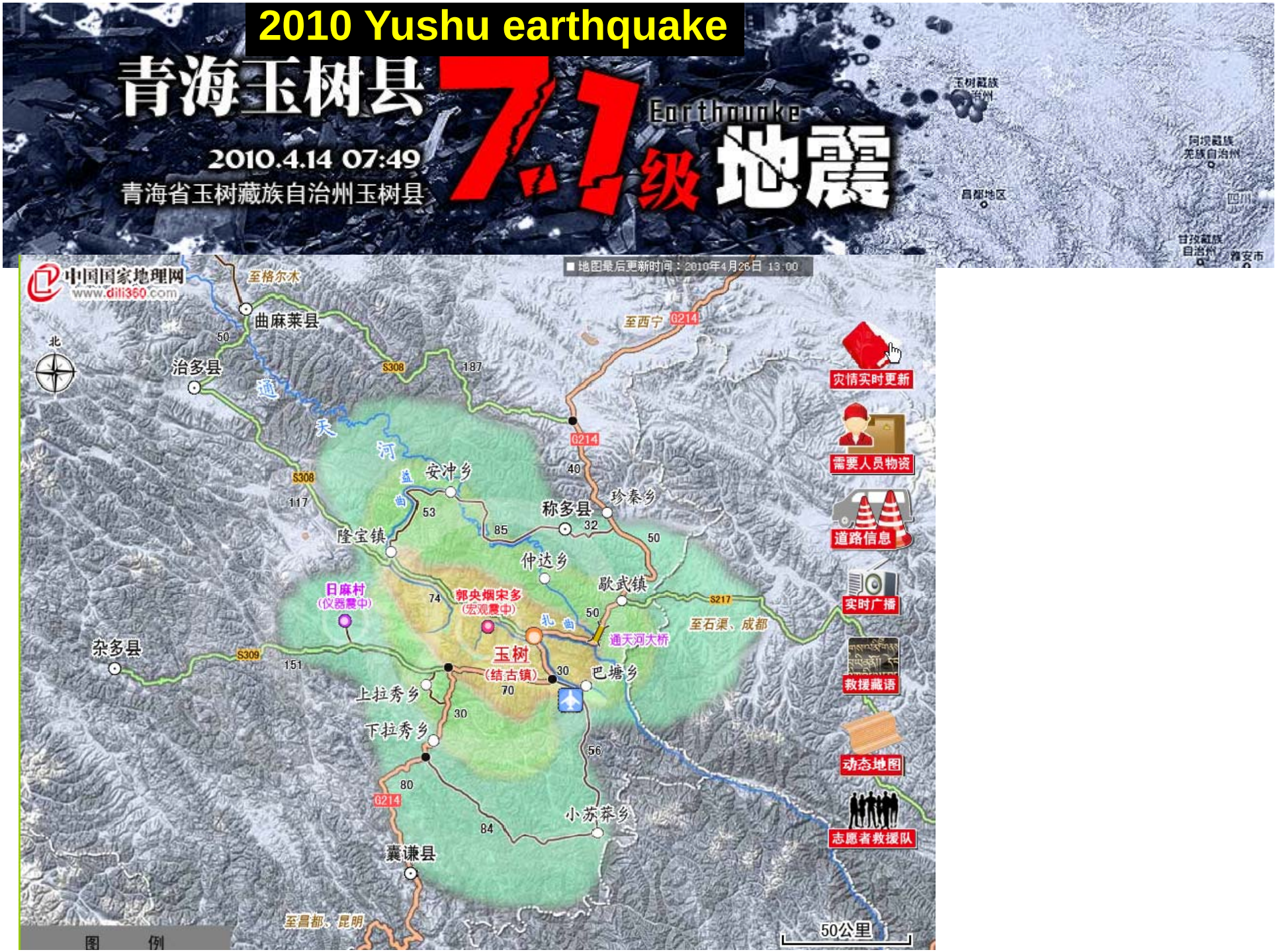
Now Beichuan is 0.2g!

1990 Intensity Hazard Map




青海玉树县
7.1
Earthquake
2010.4.14 07:49
青海省玉树藏族自治州玉树县
级地震
2010 Yushu earthquake
13 April 2010
Mw=6.9 Ms=7.1
亨直
果波
达地
团结村
红卫村
解放村
胜利村
民主村
玉树体育场
前进村
县二民中
州卫生学校
Death 2220 Missing 70 injury 12135
国家测绘局提供

2010 Yushu earthquake

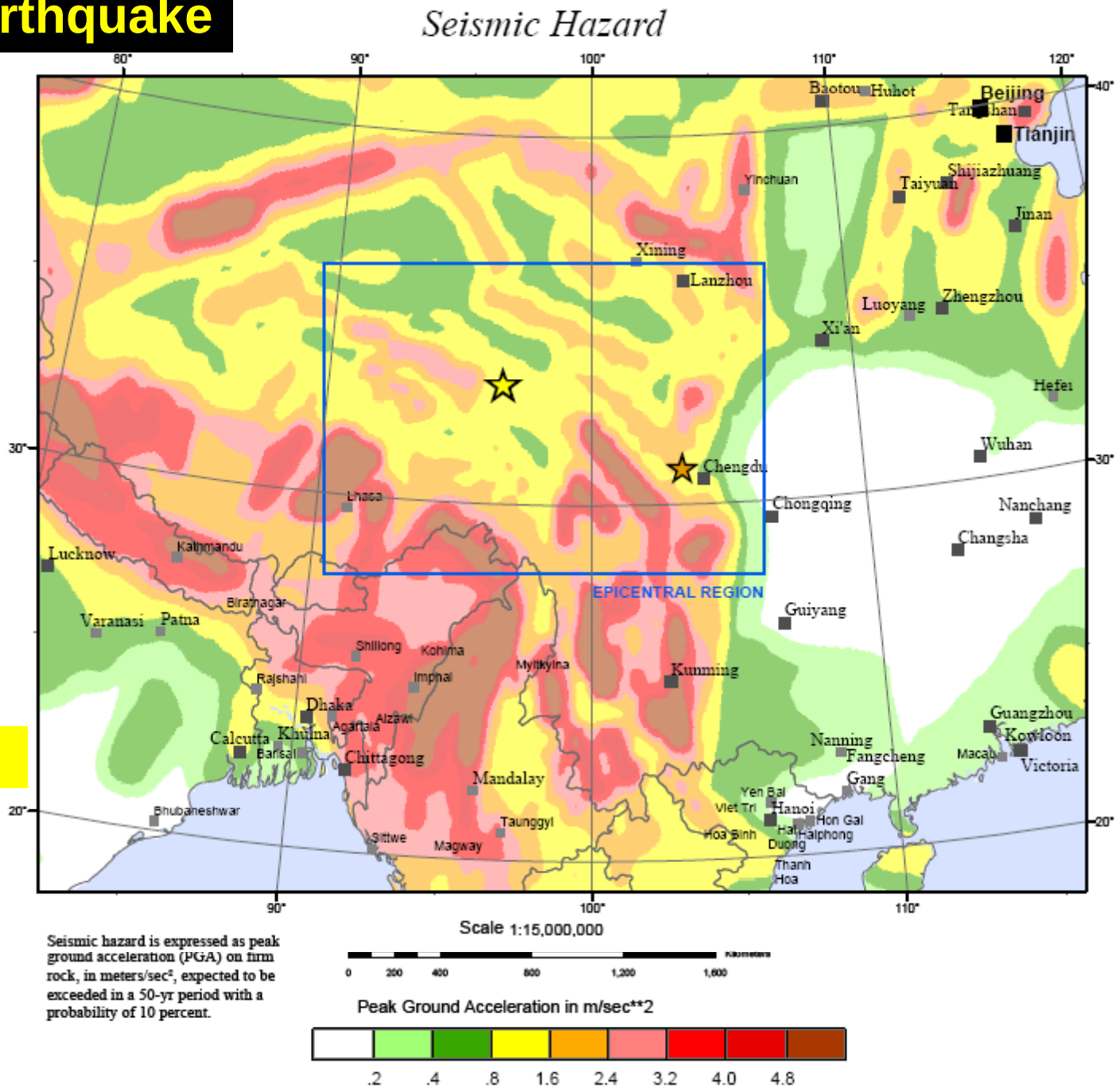


2010 Yushu earthquake

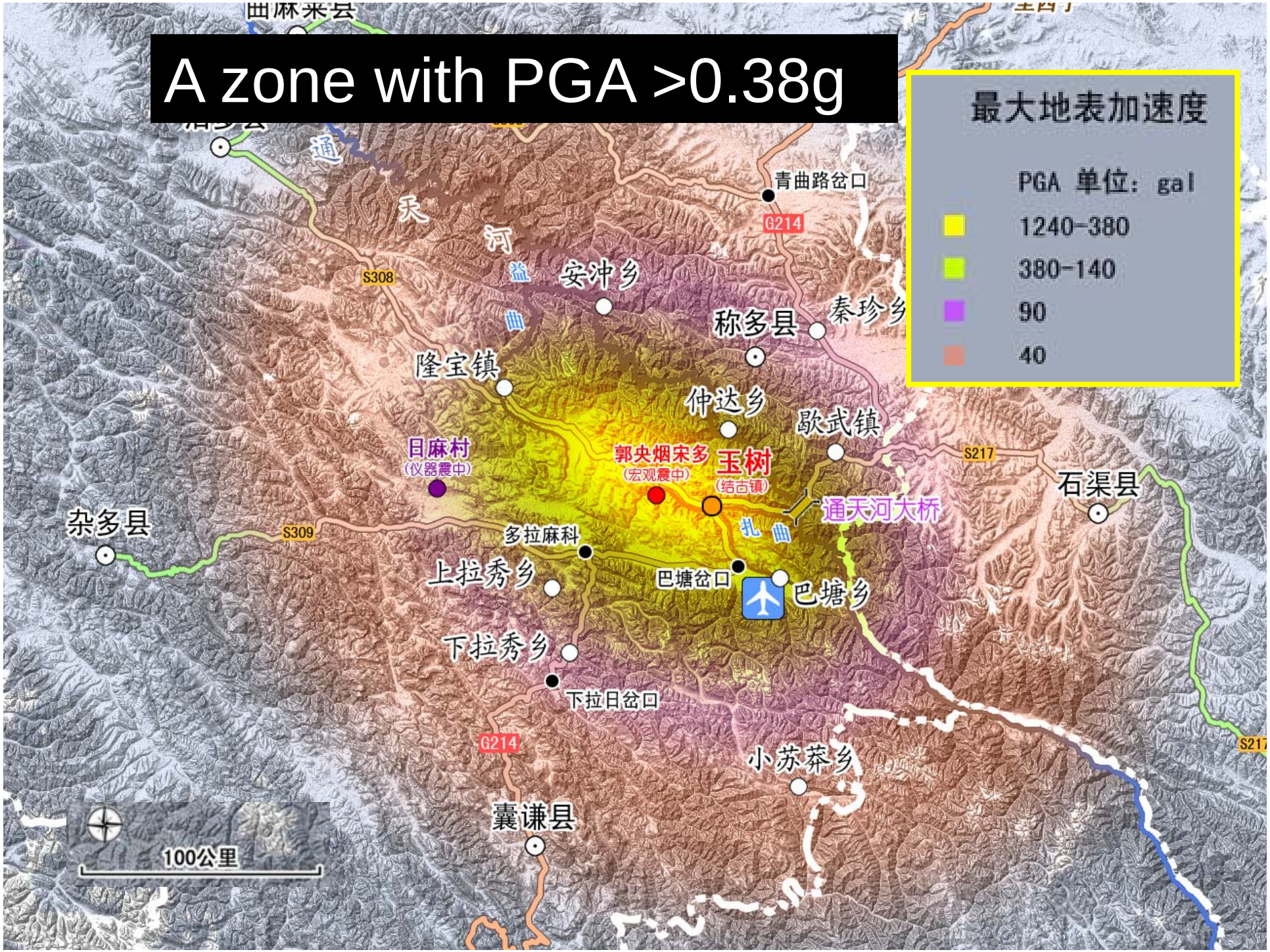
13 April 2010

8-15% g for 475 year return period

USGS hazard map

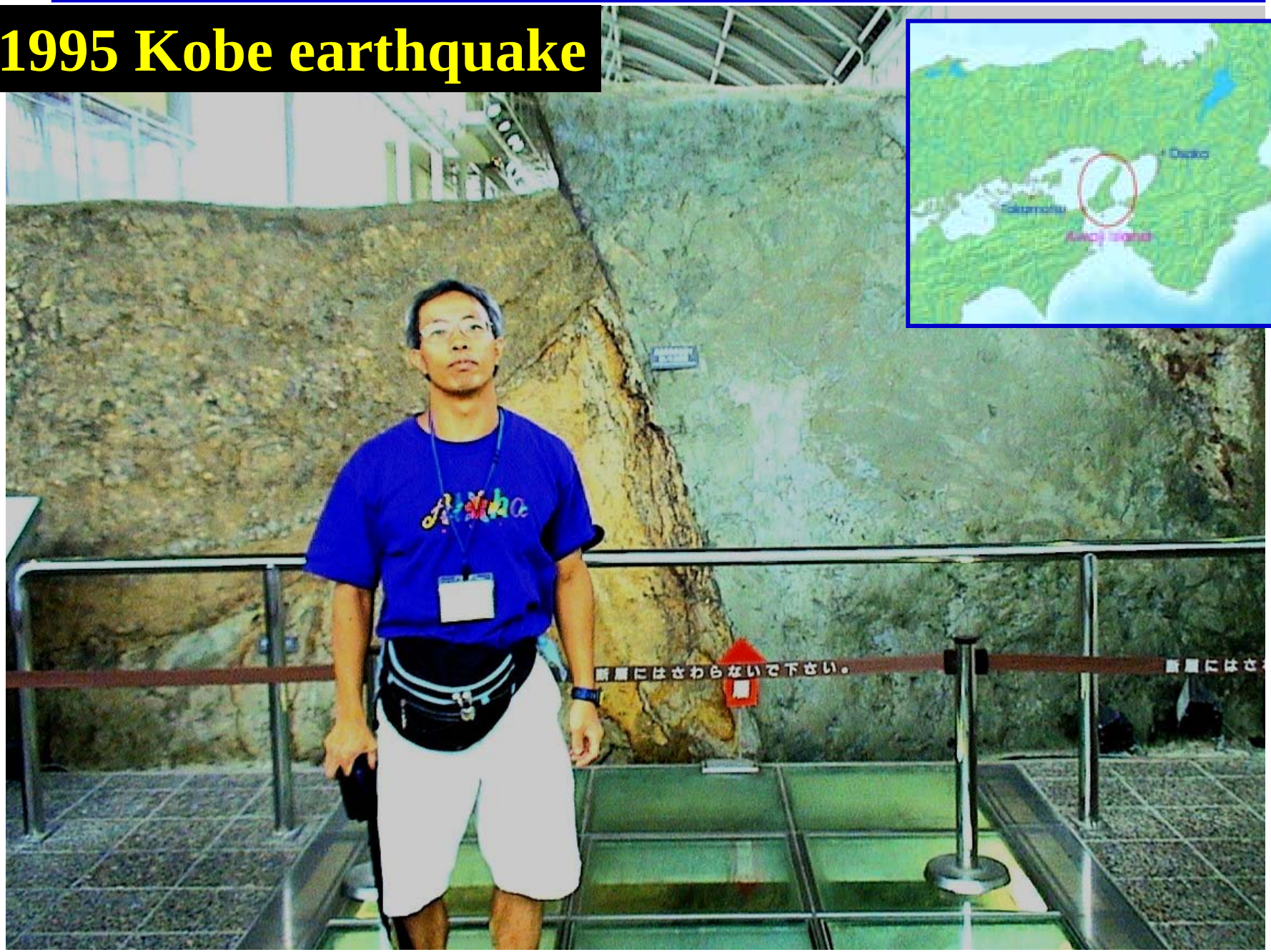



青海玉树县
2010.4.14 07:49
青海省玉树藏族自治州玉树县
7.1级
Earthquake
地震
2001 PGA Hazard Map
万众一心 众志成城
汶川地震 抗震救灾

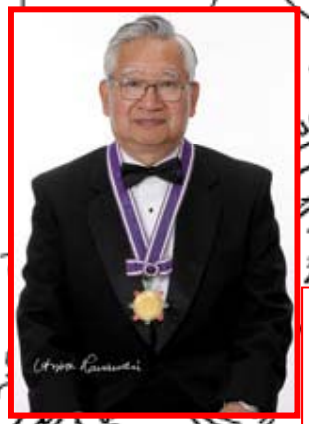

A zone with PGA >0.38g
最大地表加速度
PGA 单位: gal
1240-380
380-140
90
40
青曲路岔口
G214
S308
安冲乡
称多县
秦珍乡
隆宝镇
仲达乡
歇武镇
S217
日麻村
(仪器震中)
郭央烟宋多
(宏观震中)
玉树
(结古镇)
通天河大桥
石渠县
杂多县
S309
多拉麻科
上拉秀乡
巴塘岔口
巴塘乡
下拉秀乡
下拉日岔口
G214
小苏莽乡
囊谦县
100公里

Nojima Fault Preservation Museum (Awaji Island淡路島)

1995 Kobe earthquake



Kanamori



No major earthquake had ever occurred along the Nojima fault (which results in the 1995 Kobe earthquake)!

(*M*=7.1, 3769 dead). Historically, only 2 earthquakes (*M*>7 in 868, *M*≈6 in 1916) have occurred in the vicinity of the Kobe earthquake. (The 868 earthquake is generally believed to have occurred on the Yamasaki fault, about 50 km northwest of the Kobe earthquake, Figure 1). The source param-

Nojima fault was not explicitly discussed!

damaging earthquakes, the seismic hazard potential in the Kinki district that includes the Kobe area has been a matter of serious concern (e.g., Oike, 1992). For example, in 1994 The Committee of Earthquake Observation and Research in the Kansai Area (1994) reviewed the potential seismic hazard in the Kinki district, although the fault system on which the Kobe earthquake occurred was not explicitly discussed.

▲ Figure
four other
Fukui) in Ja
and Fukui e
Quaternary
modified. M

Major Problems

Our dynamic earth is constantly changing!!

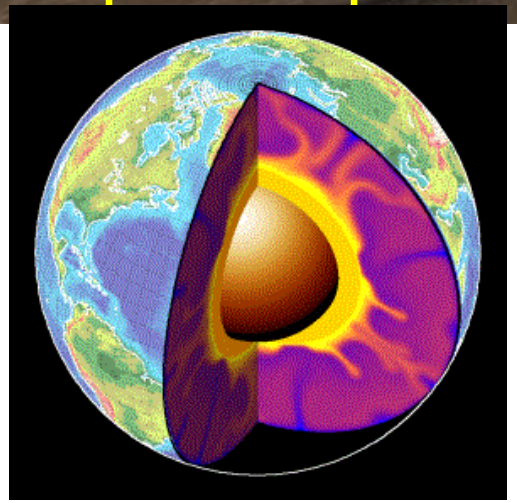
Is Cornell's approach accurate?

Are earthquakes independent events? Are they Poisson's Process?

Elastic rebound theory is no good most of the time!

We only based on past records! (Very limited data)

Can we based on the past to predict future?



Are we prepared?

Hong Kong Polytechnic University

Thank you