

GEER Efforts in China after May 12, 2008 Sichuan Earthquake

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Geo-engineering Extreme Events Reconnaissance Association



Event Summary

Time: 14:28:01, May 12, 2008

Location: Wenchuan, Sichuan Province

Magnitude: 8.0 (Ms)

Depth: 14 km (depth)

Death: 89,000+

Injury: 370,000+

Loss: 700 billion RMB

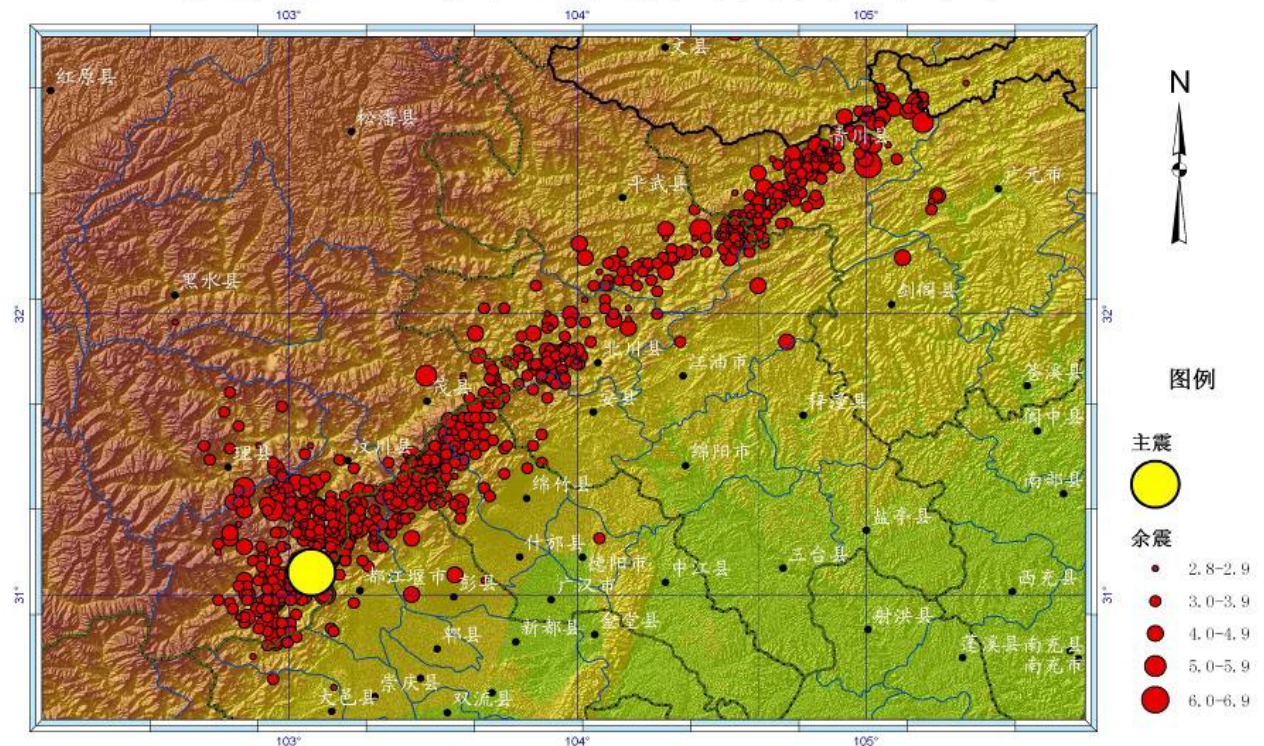
Aftershocks:

7 with $M_s > 6$

37 with $M_s > 5$

244 with $M_s > 4$

汶川8.0级地震余震分布图



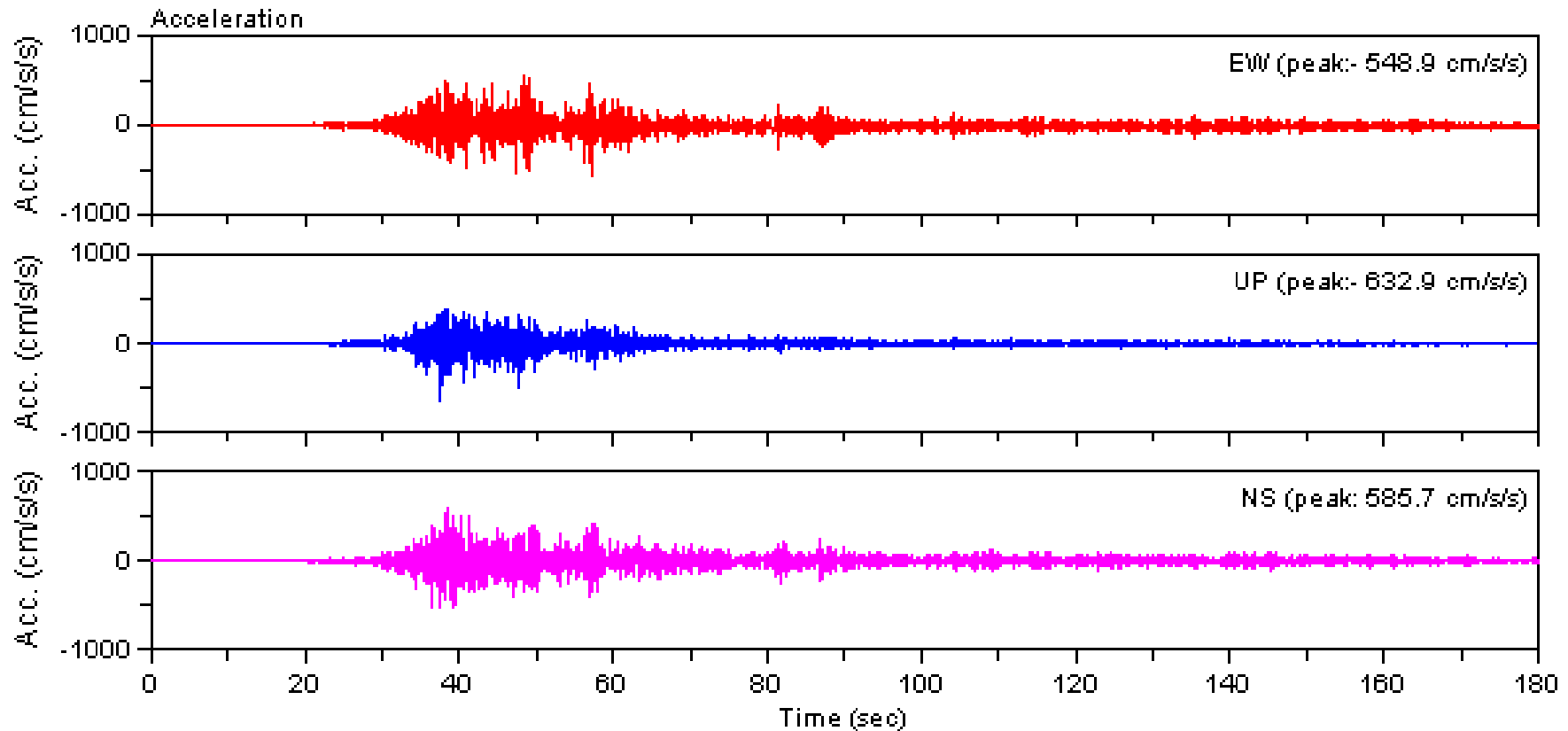
Courtesy of IEM/CEA

Strong Ground Motion

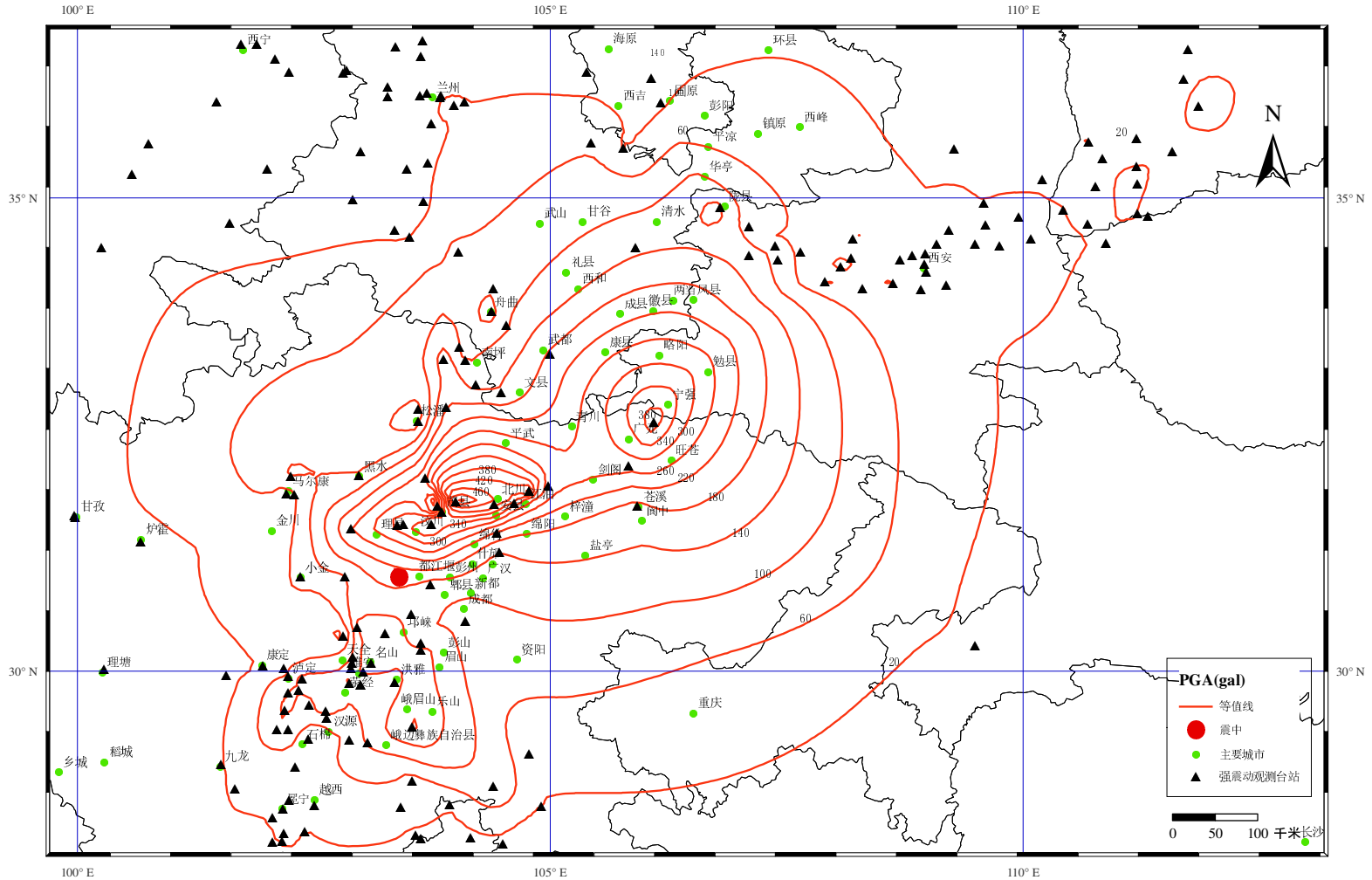
Ground Motion Data Synopsis

- National Strong Motion Observation Network System (NSMONS) established and put into formal operation March 2008
- NSMONS consists of 1,154 permanent free-field stations; 12 observation arrays; 200 mobile instruments; network management system.
- Over 1,400 components of acceleration records from 460 permanent stations and 3 arrays were recorded for main event
- Over 20,000 components of acceleration records from permanent stations and 59 mobile stations were recorded for strong aftershocks in 2.5 months after event
- 3 strong motion stations within 10 km of surface rupture; 5 within 20 km; 15 within 50 km

Example Ground Motion Record



Bajiao Station – Shifang City
Courtesy of IEM/CEA



编图说明：由于强震动台站破坏及交通、通讯等原因，震中区部分台站记录数据无法及时汇集至国家强震动台网中心。

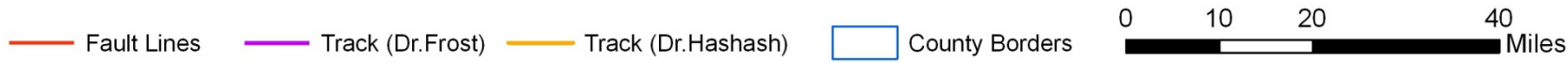
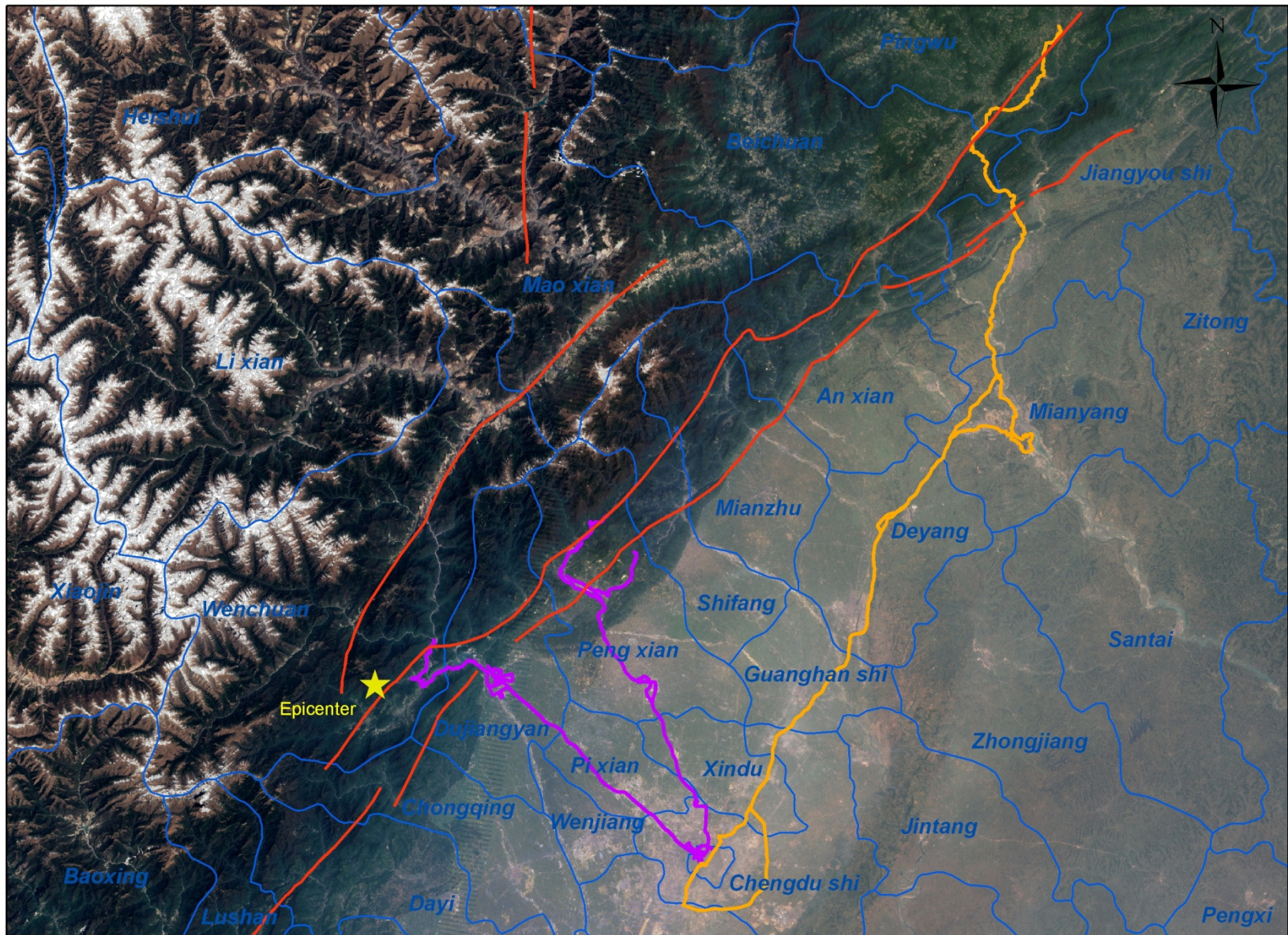
国家强震动台网中心

本图以主震触发的17个省市378个强震动台站记录数据为基础，按南北向绘制汶川地震主震峰值加速度（PGA）等值线图。

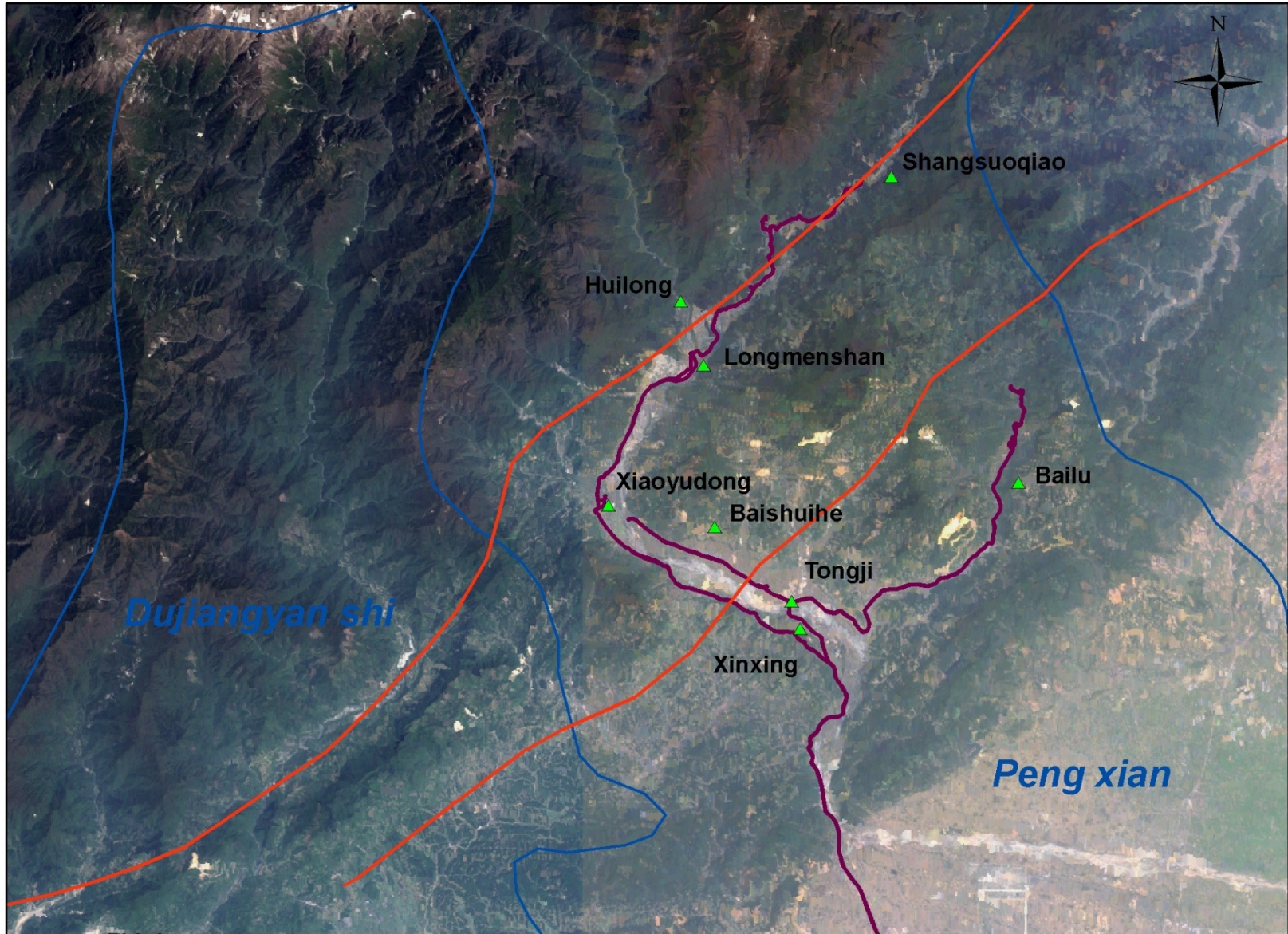
PGA (EW) Distribution

Courtesy of IEM/CEA

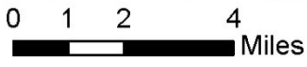
GEER Association Reconnaissance Efforts



Background Image: LANDSAT 7 Satellite Imagery
 Acquisition Date: April 19, 2007 Projection: UTM Zone 48N Datum: WGS 84



▲ Cities
 — Fault Lines
 — Track
 County Borders



Background Image: LANDSAT 7 Satellite Imagery
 Acquisition Date: April 19, 2007
 Projection: UTM Zone 48N
 Datum: WGS 84

Surface Rupture

Surface Rupture Synopsis

- Rupture occurred along multiple fault segments (Yingxiu-Beichuan and Pengguan faults)
- Yingxiu-Beichuan rupture produced both thrust and right lateral movements (similar magnitudes up to 5+ m)
- Smaller surface deformations along Pengguan fault
- Topographic variations produced locally complex surface deformations

Surface Fault Rupture



Surface Fault Rupture



Landslides

Landslide Synopsis

- Extensive post event field studies conducted by SKLGP-CUT show as of late July, 2008
- >9,600 geo-hazards (landslides, slope collapses, debris flows, unstable slopes)
- 26 landslides involved movement of > 10M m³ (range 18M to 10 M m³)
- 16 landslides yielded > 30 casualties (range 1600 to 35)

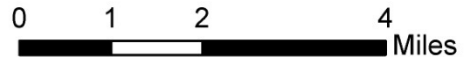
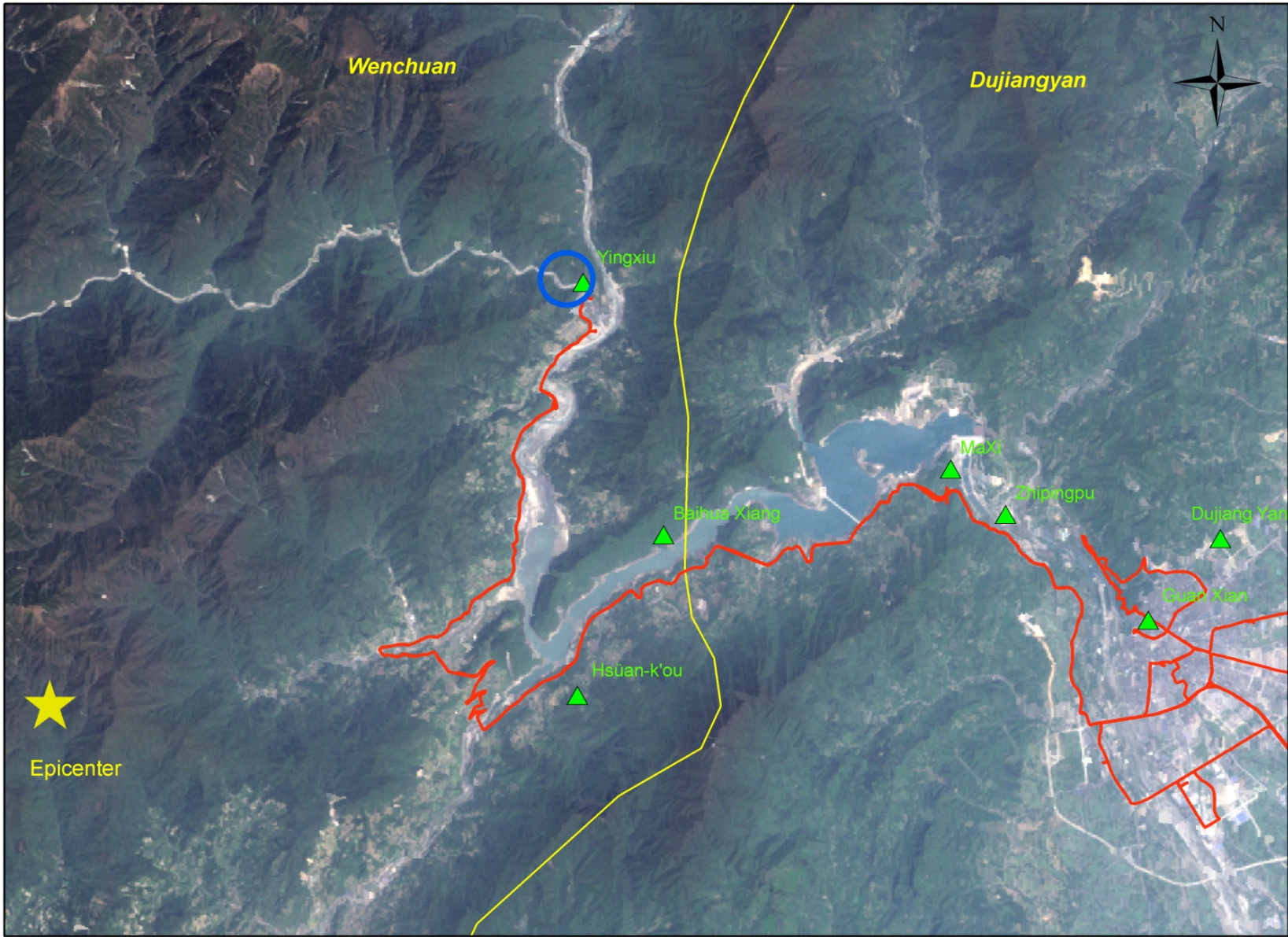
(courtesy Prof. Huang, SKLGP-CUT)

Landslides



Landslides





Background Image: LANDSAT 7 Satellite Imagery
Acquisition Date: April 19, 2007
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Image: Quickbird True Color Pan Sharpened Satellite Imagery
Acquisition Date: June 26, 2005
Spatial Resolution: 0.6 Meters

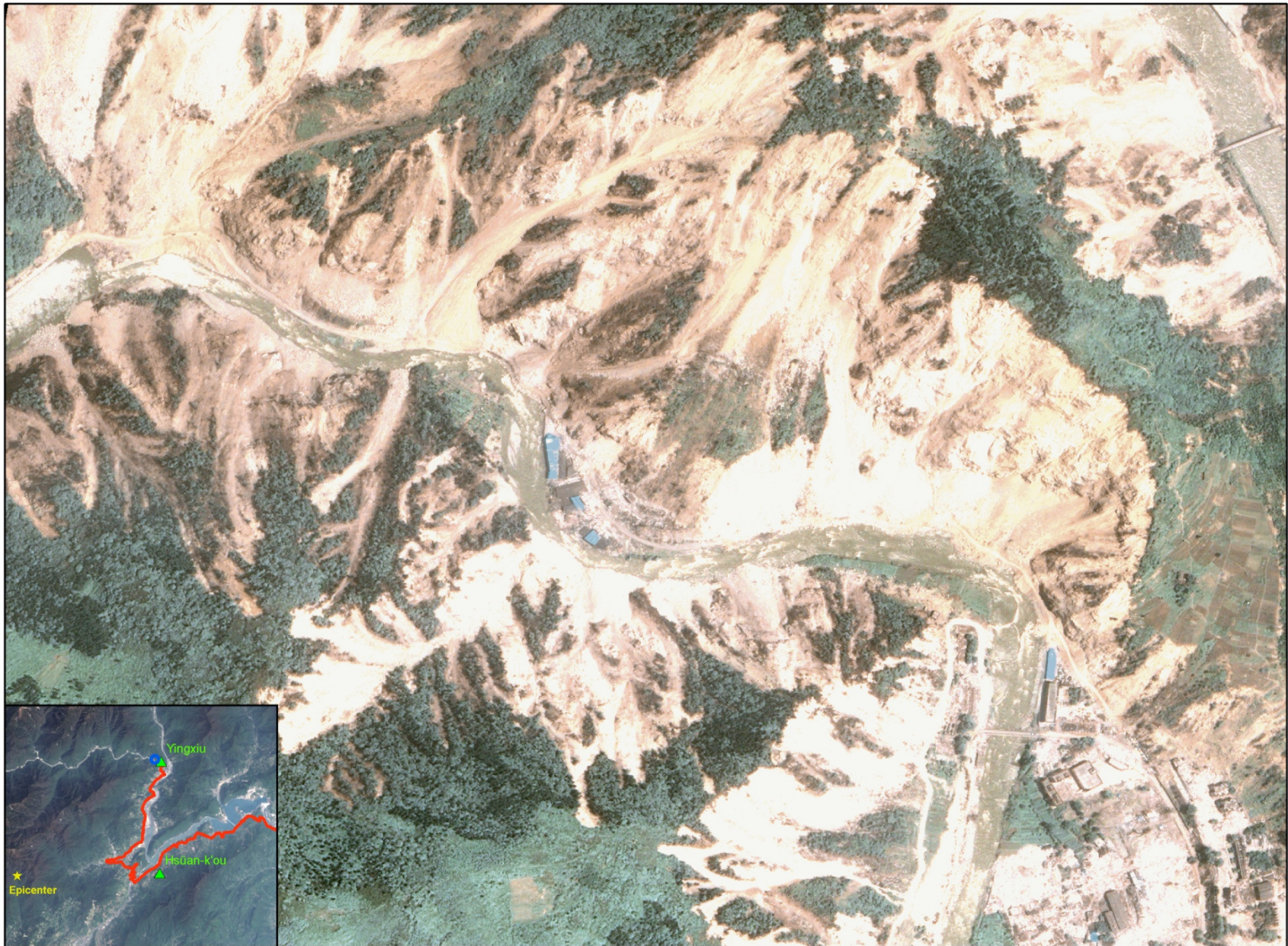


Image: Quickbird True Color Pan Sharpened Satellite Imagery
Acquisition Date: June 3, 2008
Spatial Resolution: 0.6 Meters

Landslide Secondary Effects

Liangaiping Landslide



Post Event Access Challenges



Rainfall Induced Mudflows



Non-technical Issues

Non-technical Issues

- GEER efforts were accomplished not with “standard” single trip approach
- Initial trip was multi-agency effort to gain access; NEHRP, USGS, EERI, GEER, IRIS (~ 1 month after event)
- Embedded/supported GEER members in other teams - UC, FHWA, TCLEE, NSF-China (~1.5 to 2 months after event)
- Second trip was joint EERI-GEER team (~2.5 months after event)
- Third trip was to WCEE (~5 months after event)

Non-technical Issues

- Not allowed to perform aerial reconnaissance
- Non-Chinese nationals not allowed to use GPS
- Use of technologies such as LiDAR not allowed
- Sensitivity to use of word “reconnaissance”
- Travelled in large groups (multiple vehicles in convoy) to sites pre-determined by hosts
- Limited stops to conduct reconnaissance
- Extensive use of “drive-by photography”
- Short days – 8 to 5 pm

Work-around solutions

- Chinese national in every group plus use of “photo-tracker” with time-synchronization rather than “way-point” collection.
- Worked to build relationship with hosts (and drivers) – able to push boundary a little.
- Interactions with other Chinese groups – e.g. SKLGP-CUT (MOU etc.) – not new but became a source of much more information for team than perhaps normal.