April 6 2009 L'Aquila (Abruzzo) Earthquake in Central Italy

Jonathan P. Stewart

GEER Team Leader

GEER Workshop. May 19 2009

Outline

- Team organization and management
- Source characteristics
- Ground motions
- Geotechnical aspects
  - Site effects
  - Landslides
  - Levees/embankments
  - Lake Sinizzio
- Technology applications

Team Organization and Management

- GEER-funded:
  - Stewart
  - D. Scott Kieffer, U. Graz
  - R.E. Kayen, USGS
  - G. Biscontin, T. A&M

Team Organization and Management

- GEER-funded
- Italians:
  - **G. DiCapua**, INGV
  - G. Scasserra, U. Rome
  - **F. Silvestri**, U. Naples
  - G. Lanzo, U. Rome
  - P. Tommasi, CNR-IGAG, Rome
  - A. Simonelli, U. Sannio

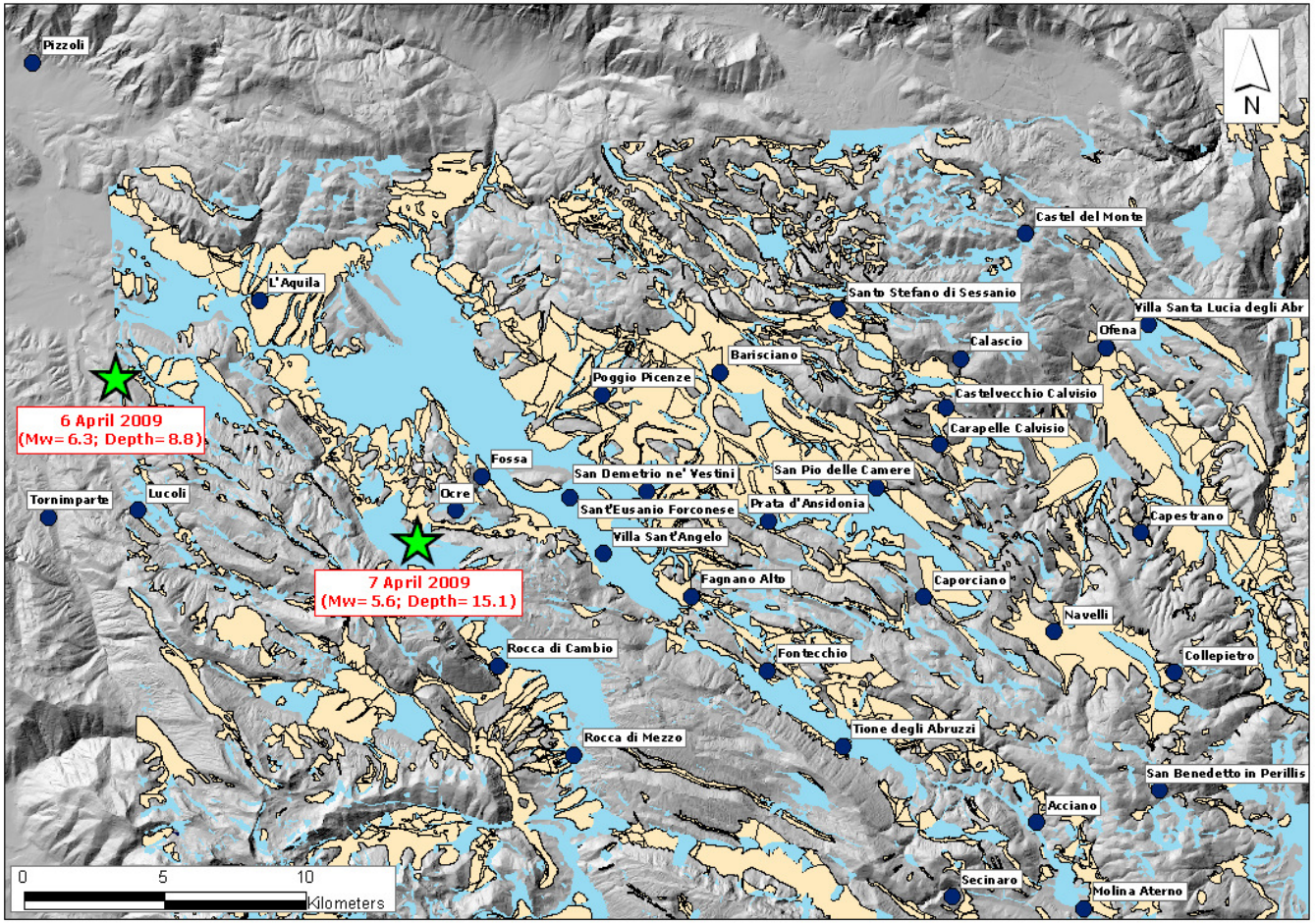
Team Organization and Management

- GEER-funded
- Italians
- Non-Italian volunteers:
  - E. Button, ETH Zurich
  - G. Mylonakis, U. Patras
  - G. Athanasopoulos, U. Patras

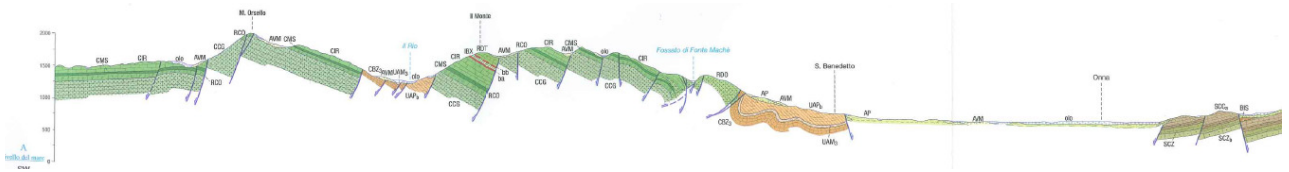
Team Organization and Management

- GEER-funded
- Italians
- Non-Italian volunteers
- Discussion points:
  - Italians' disposition
  - Local inclusiveness
  - FTP site/Clearinghouse
  - Training (mission, GEER vs. local)
  - Deployment issues
    - Always an Italian
    - Experience counts

Local Geology

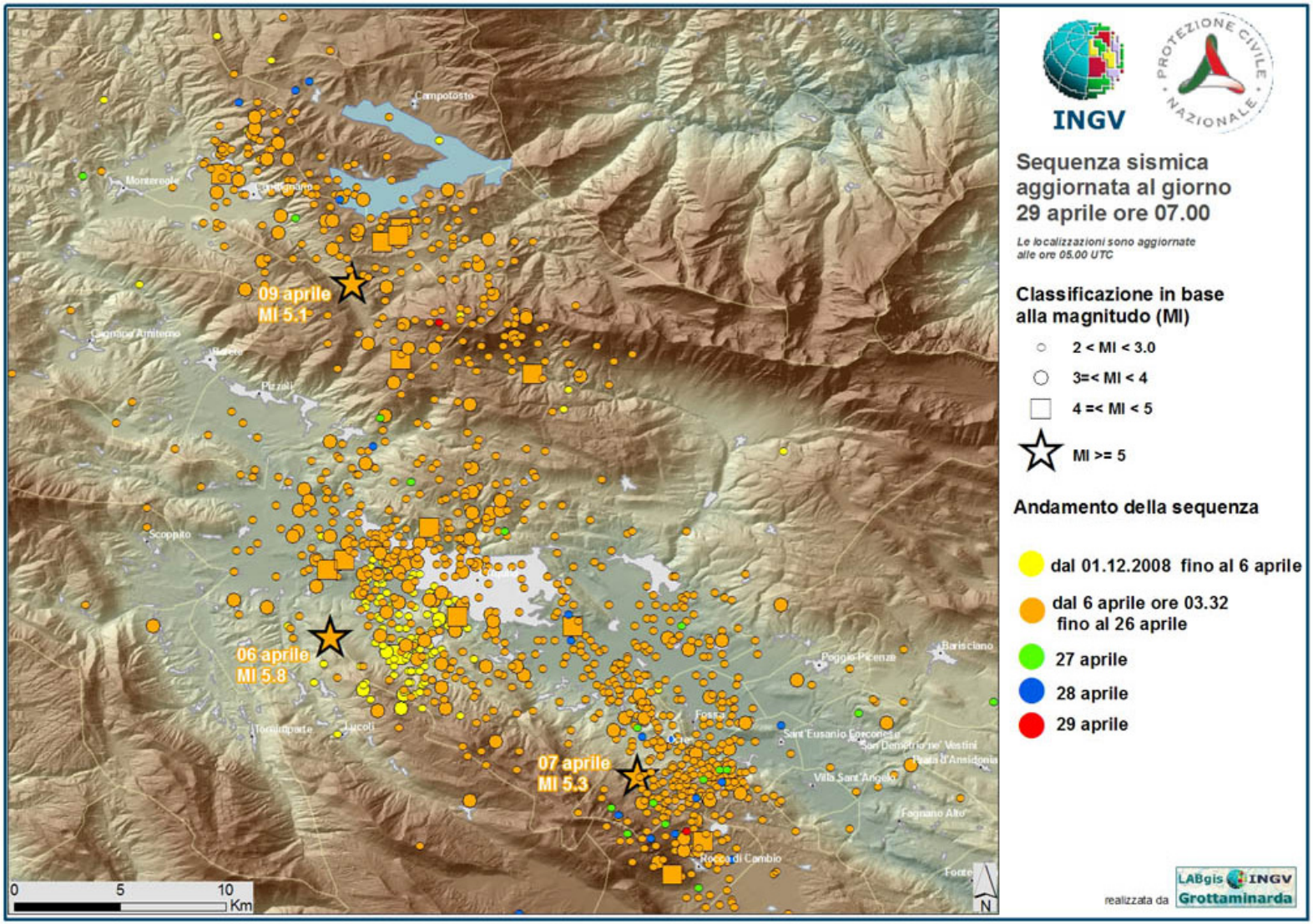


SW



NE

Source Characteristics



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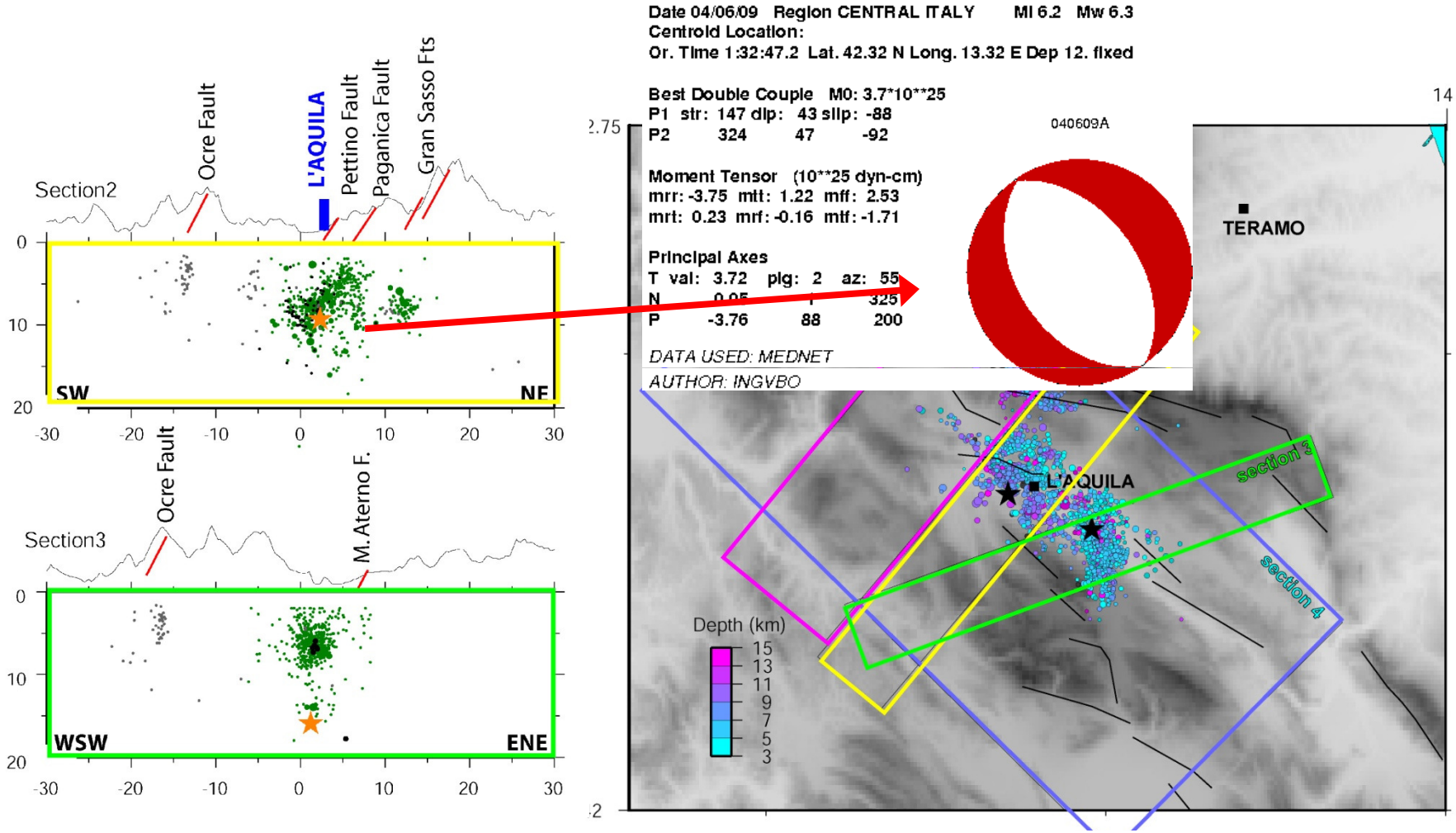

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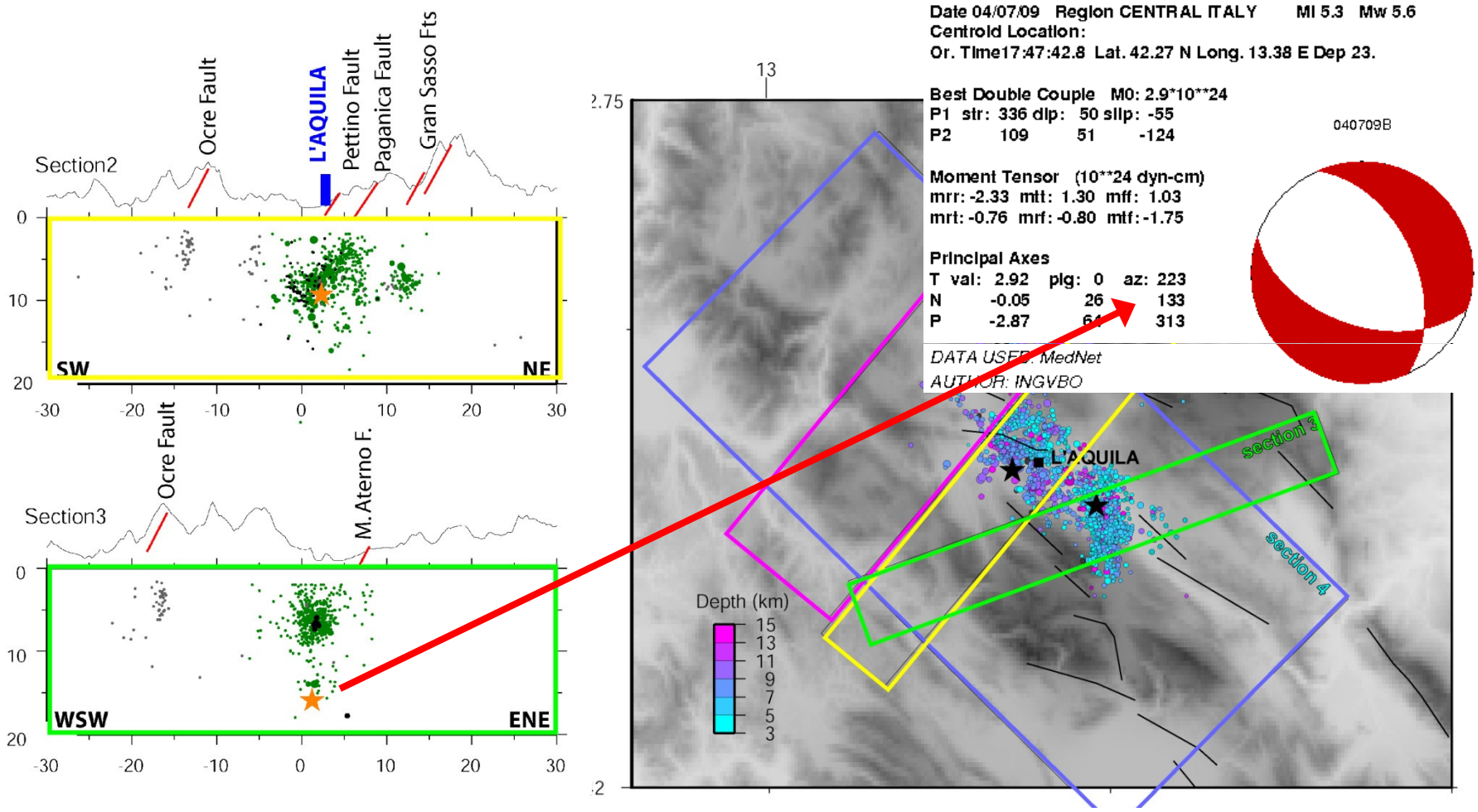

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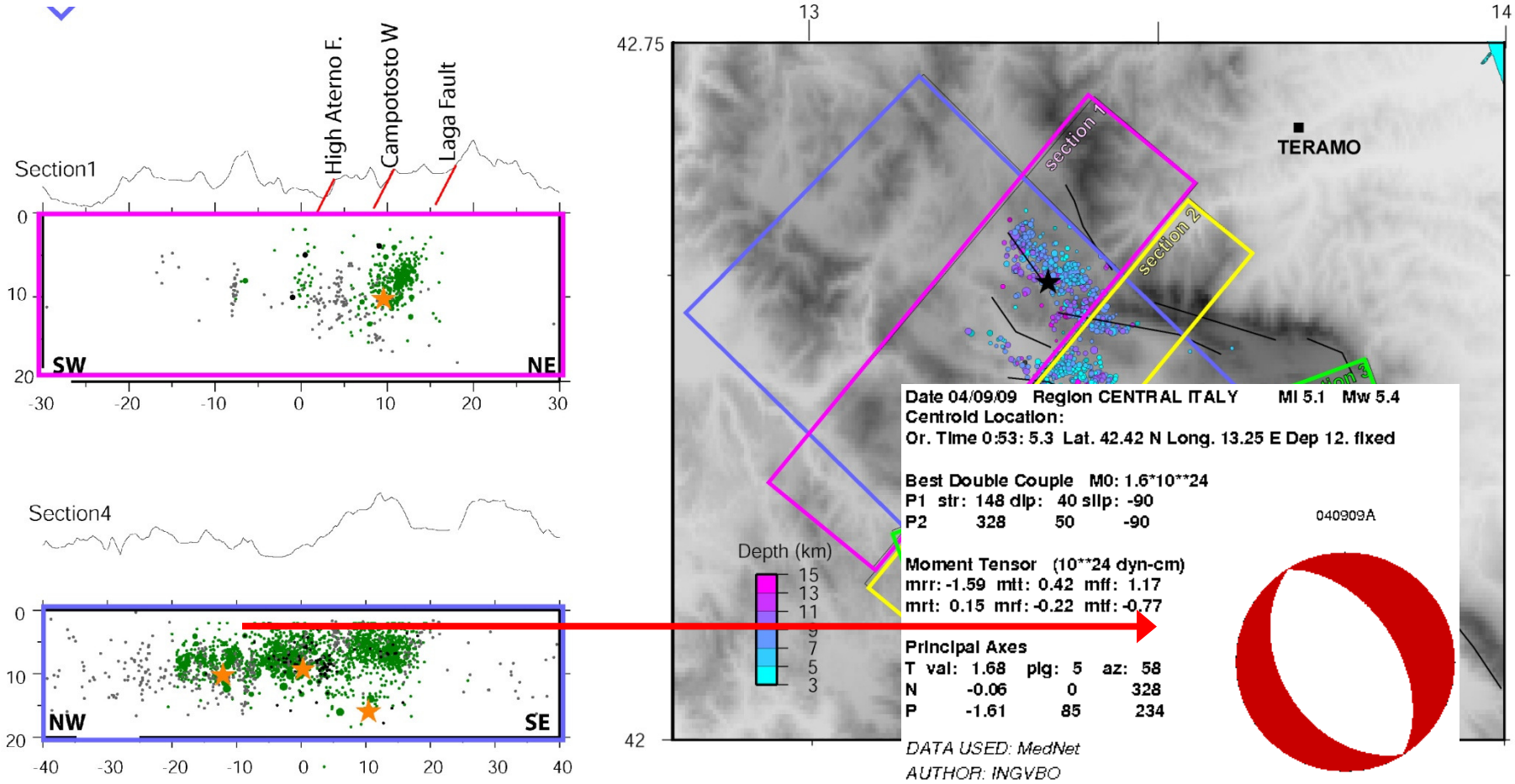
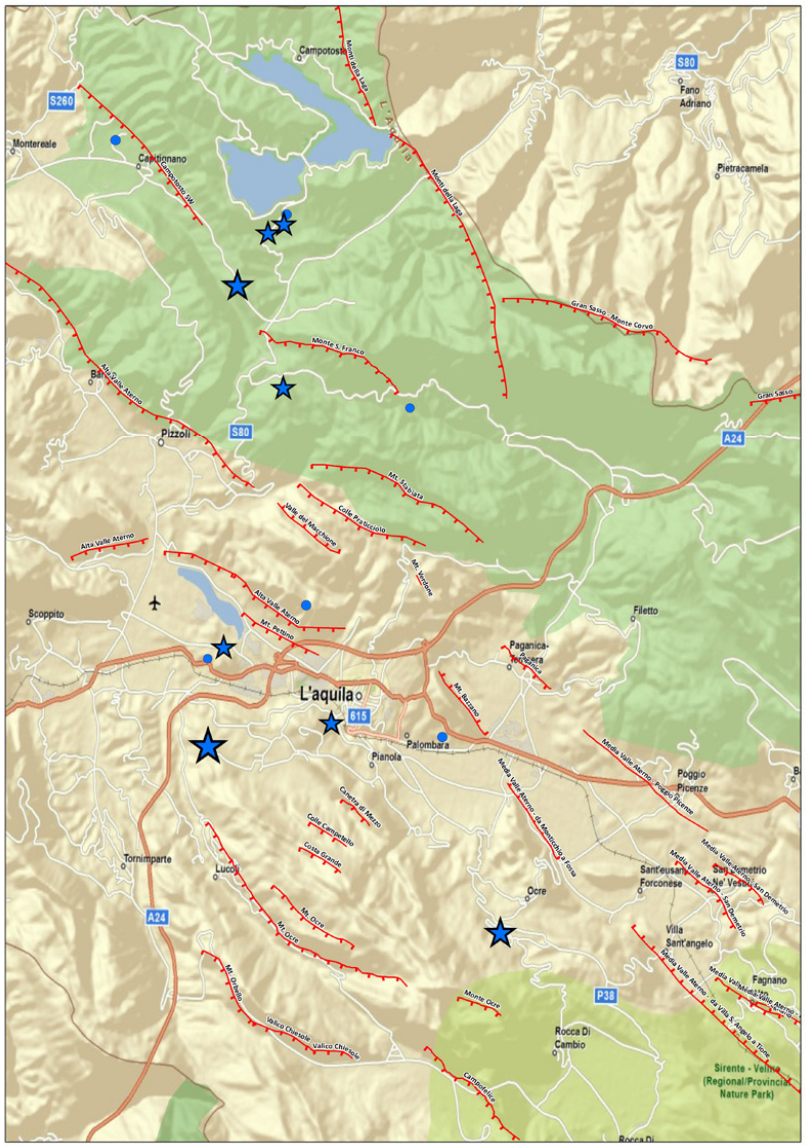


Surface Rupture

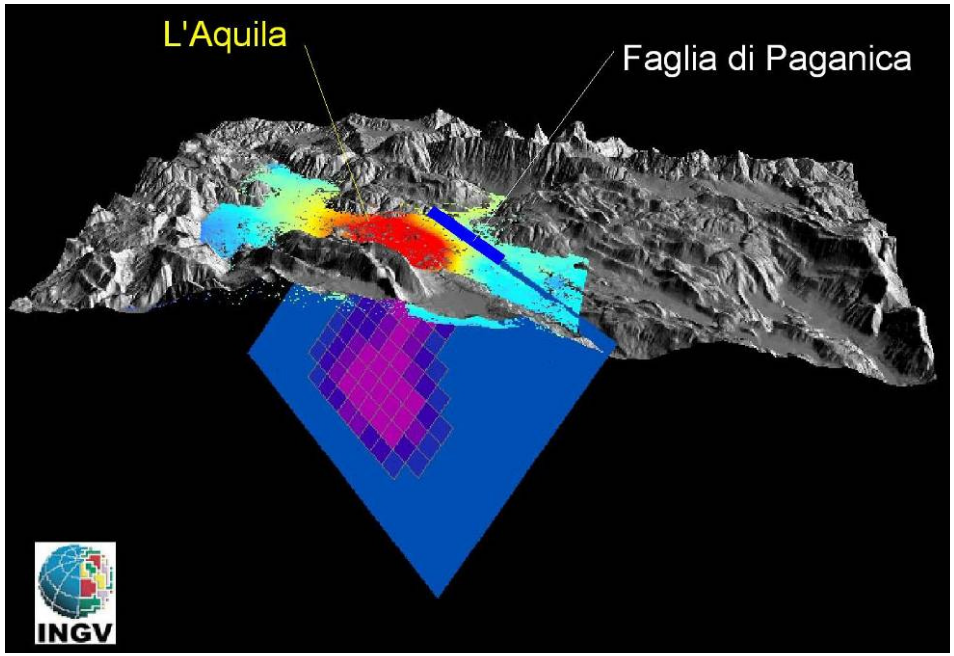
- Some deformation reported:
  - Paganica
  - Poggio
  - Aterno
- Consensus: No SR from primary fault
- Controversial: Co-seismic origin of displacements near mapped faults

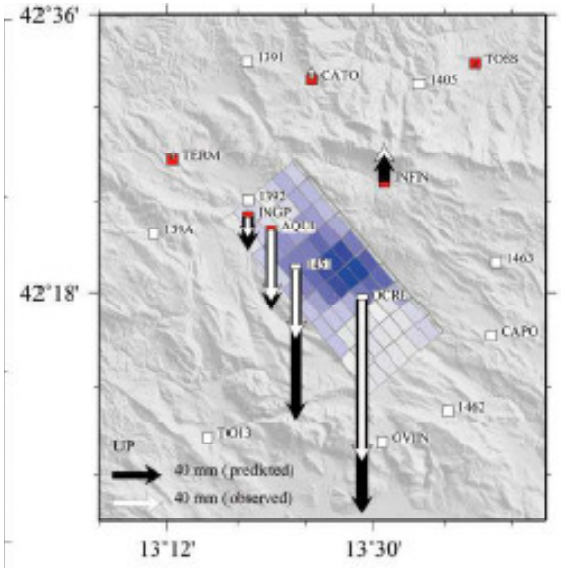


Surface Rupture

Source Characteristics

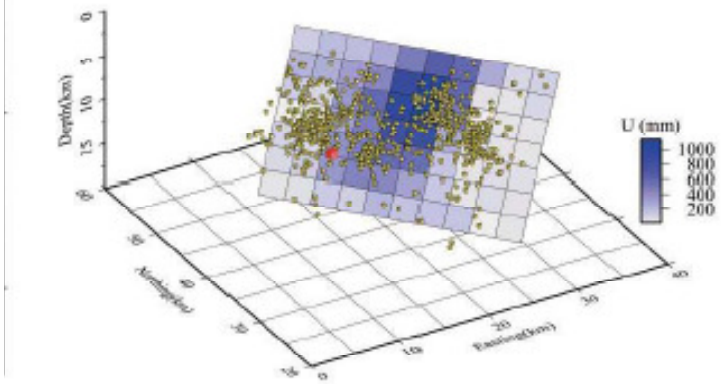
InSAR





Slip max = 1.1. m
Mw = 6.33
Mo = 3.5x10**18Nm

GPS



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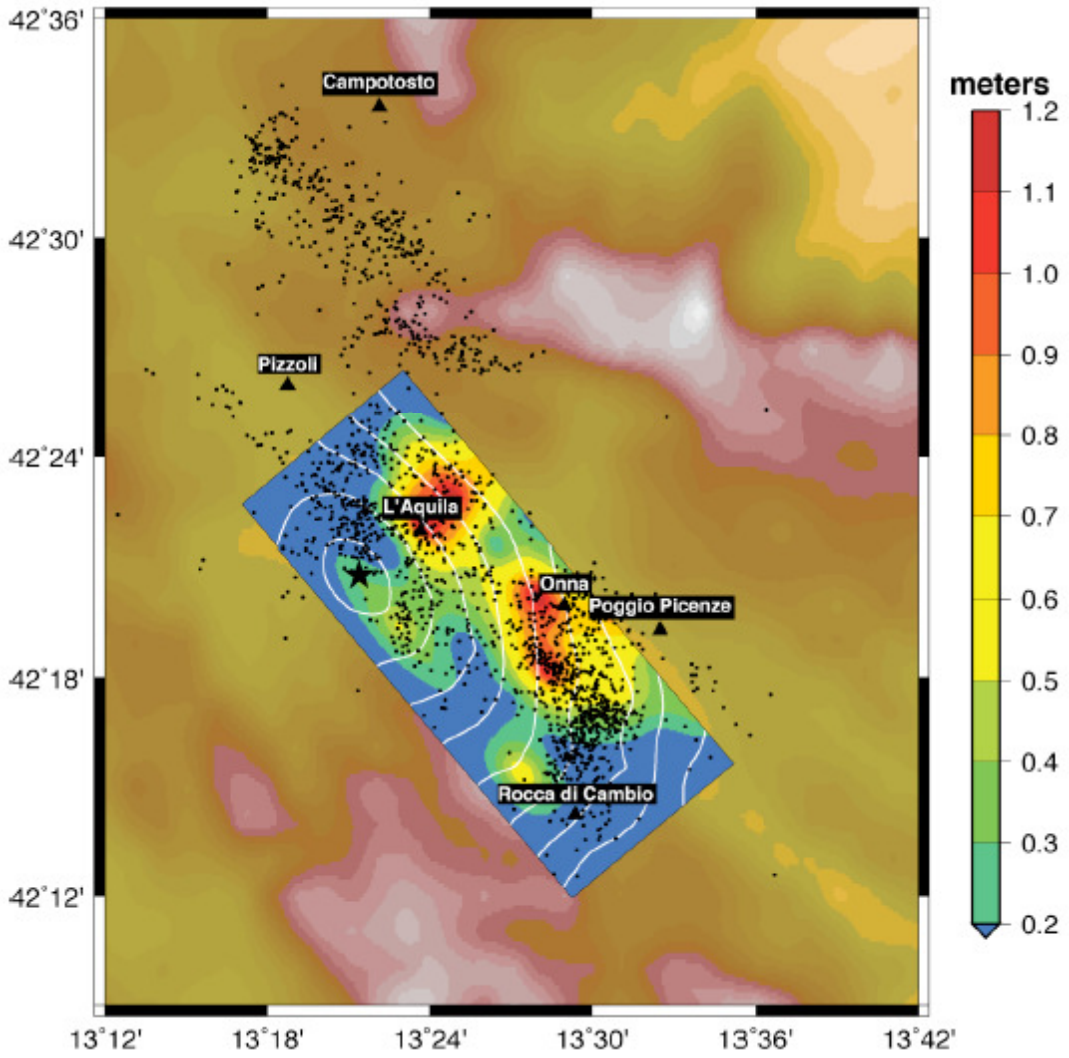
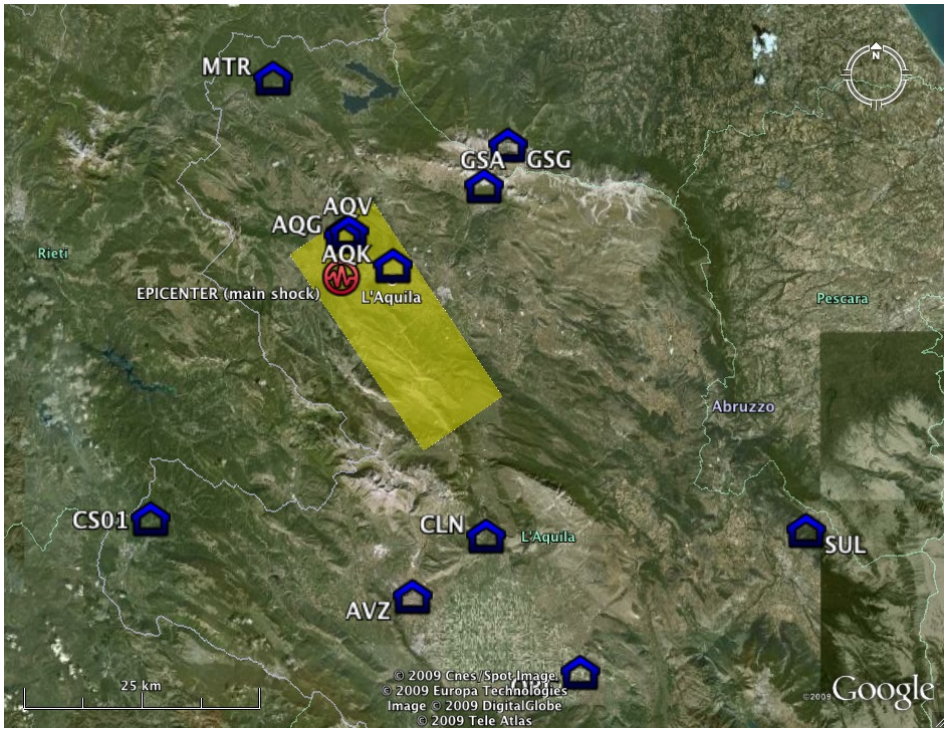


Ground Motions



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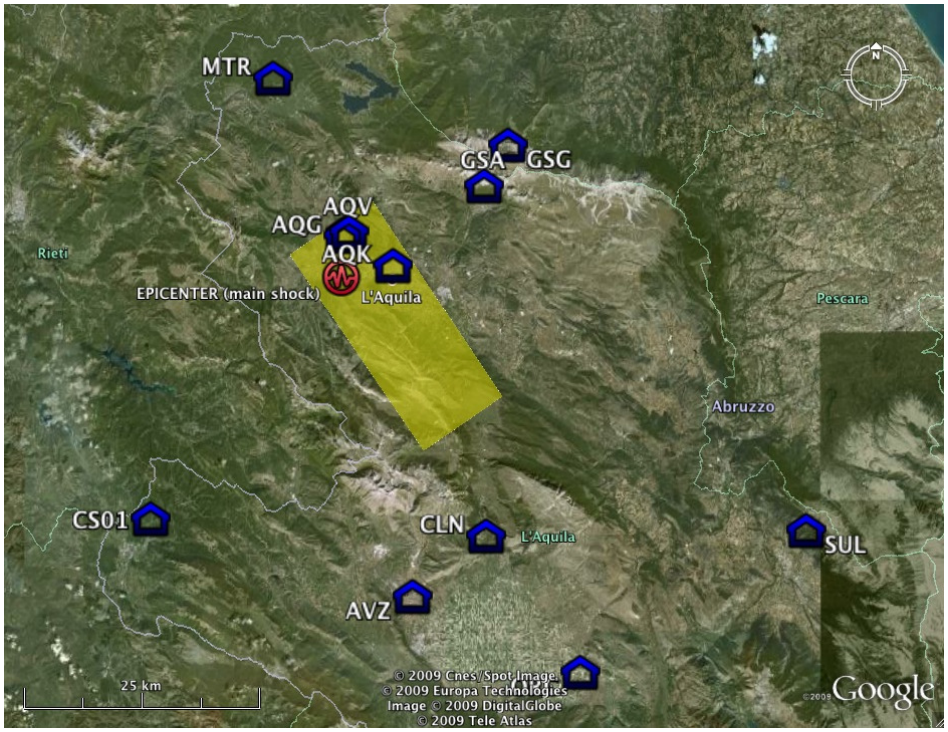
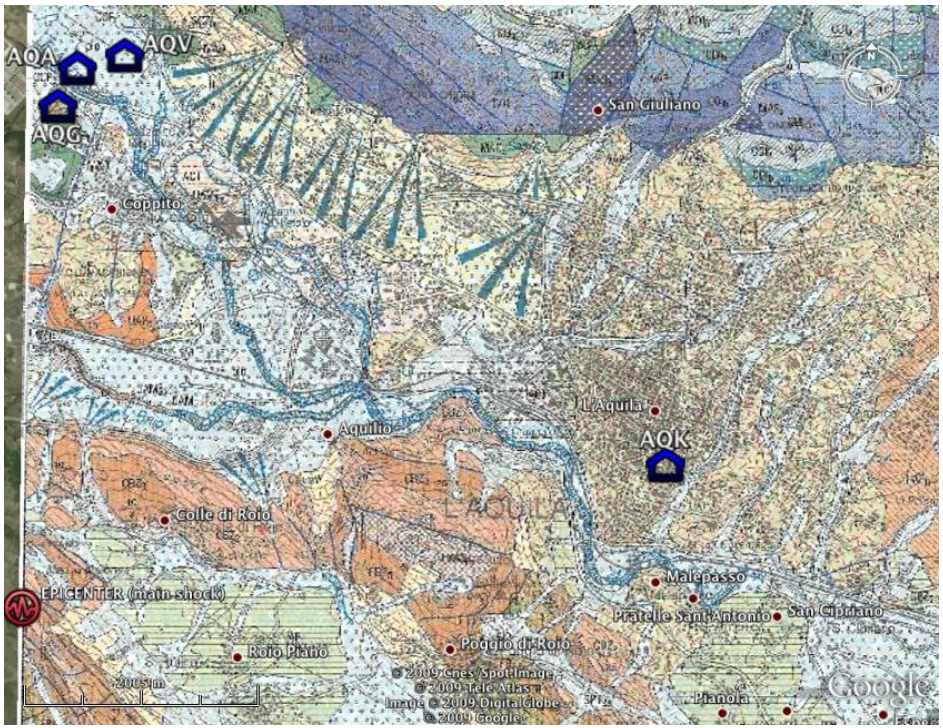
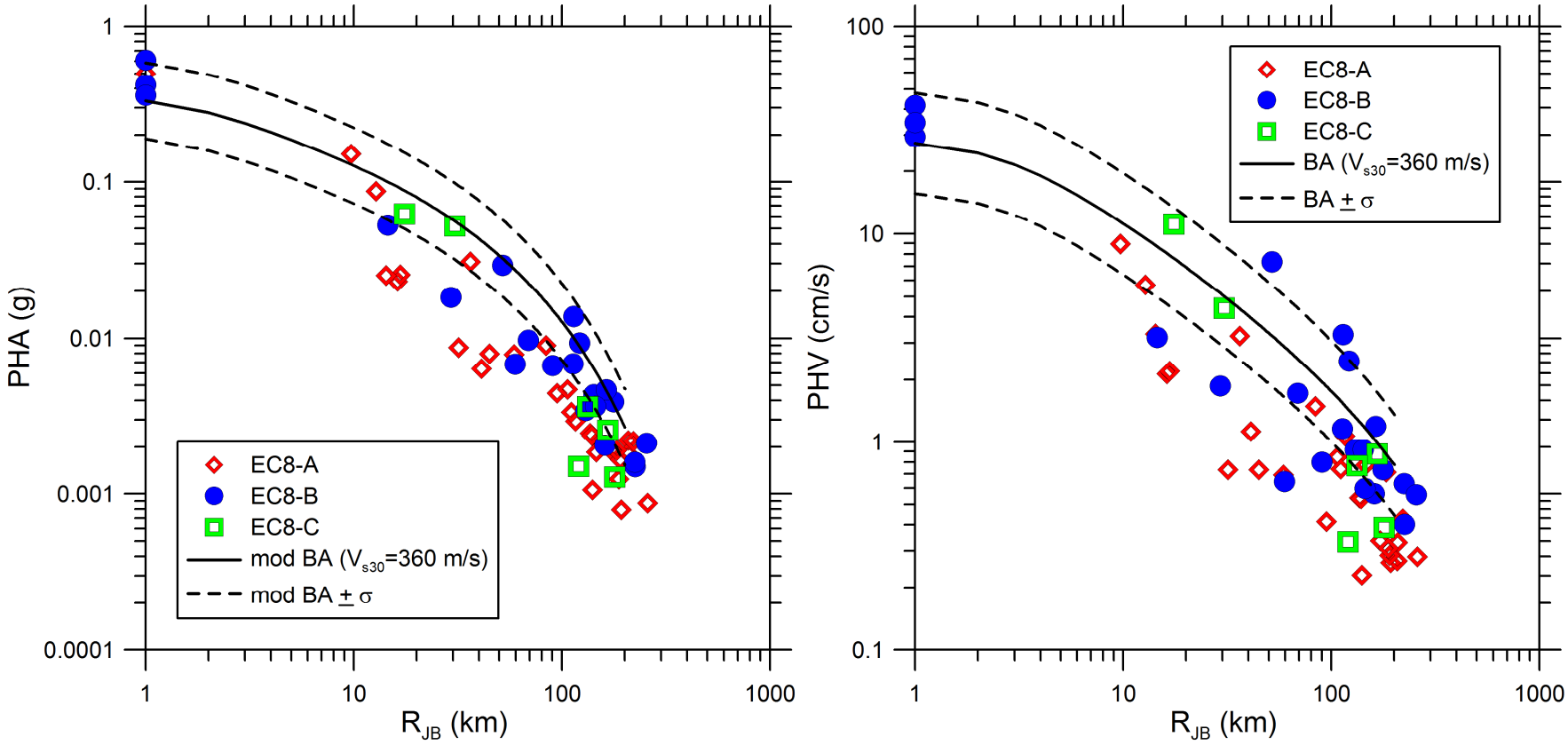




Ground Motions

- 56 digital recordings
- Permanent displacement evident in L'Aquila – AQ* recordings on hanging wall.
- Analogue recordings?
- Preliminary site classifications in report
- Few sites with velocity profiles

Ground Motions



Geotechnical Aspects

- Damage Patterns

Damage Level	Description	Marker Color
D0	No damage	
D1	Cracking of non-structural elements, such as dry walls, brick or stucco external cladding	
D2	Major damage to the non-structural elements, such as collapse of a whole masonry infill wall; minor damage to load bearing elements	
D3	Significant damage to load-bearing elements, but no collapse	
D4	Partial structural collapse (individual floor or portion of building)	
D5	Full collapse	

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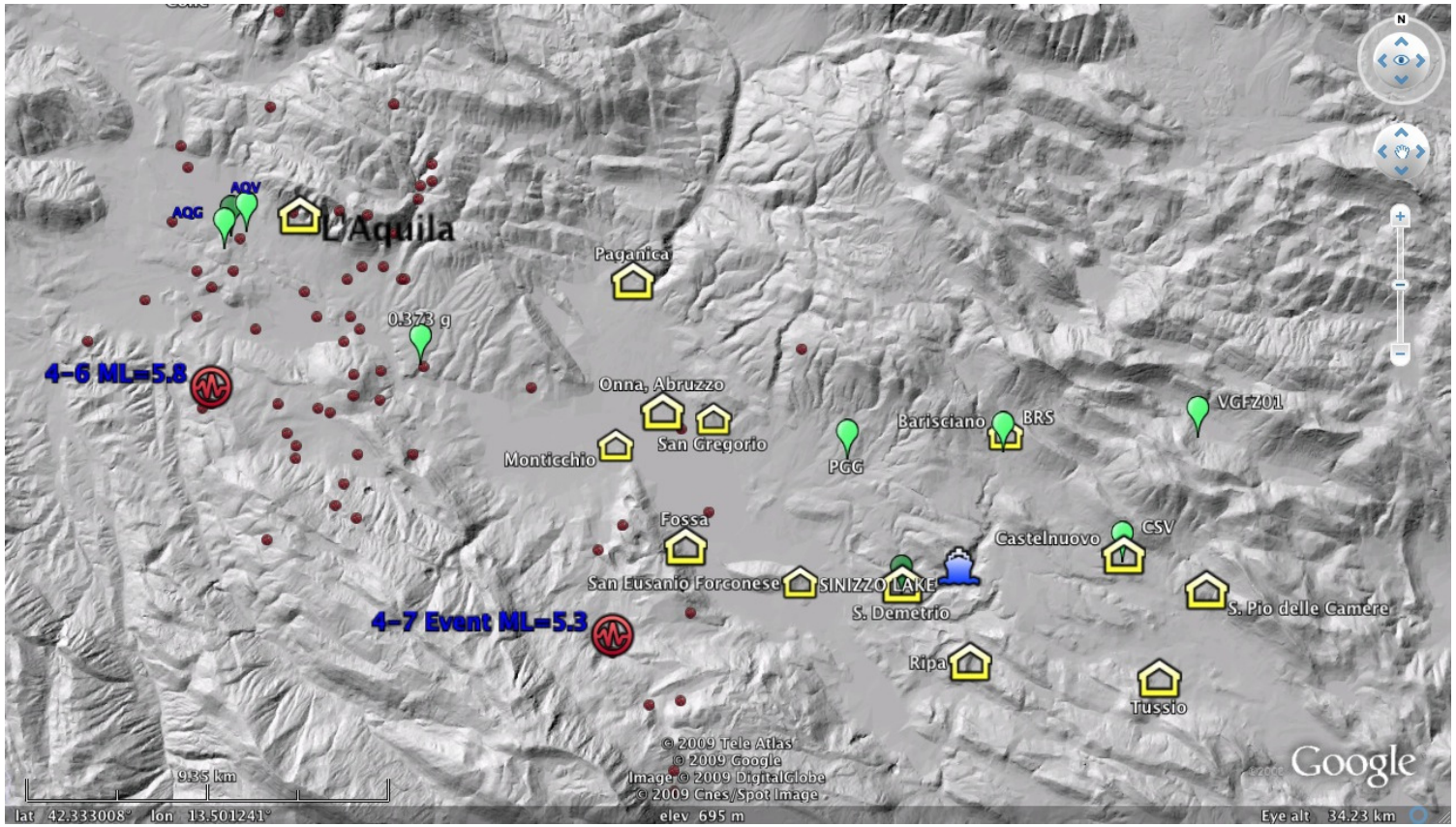

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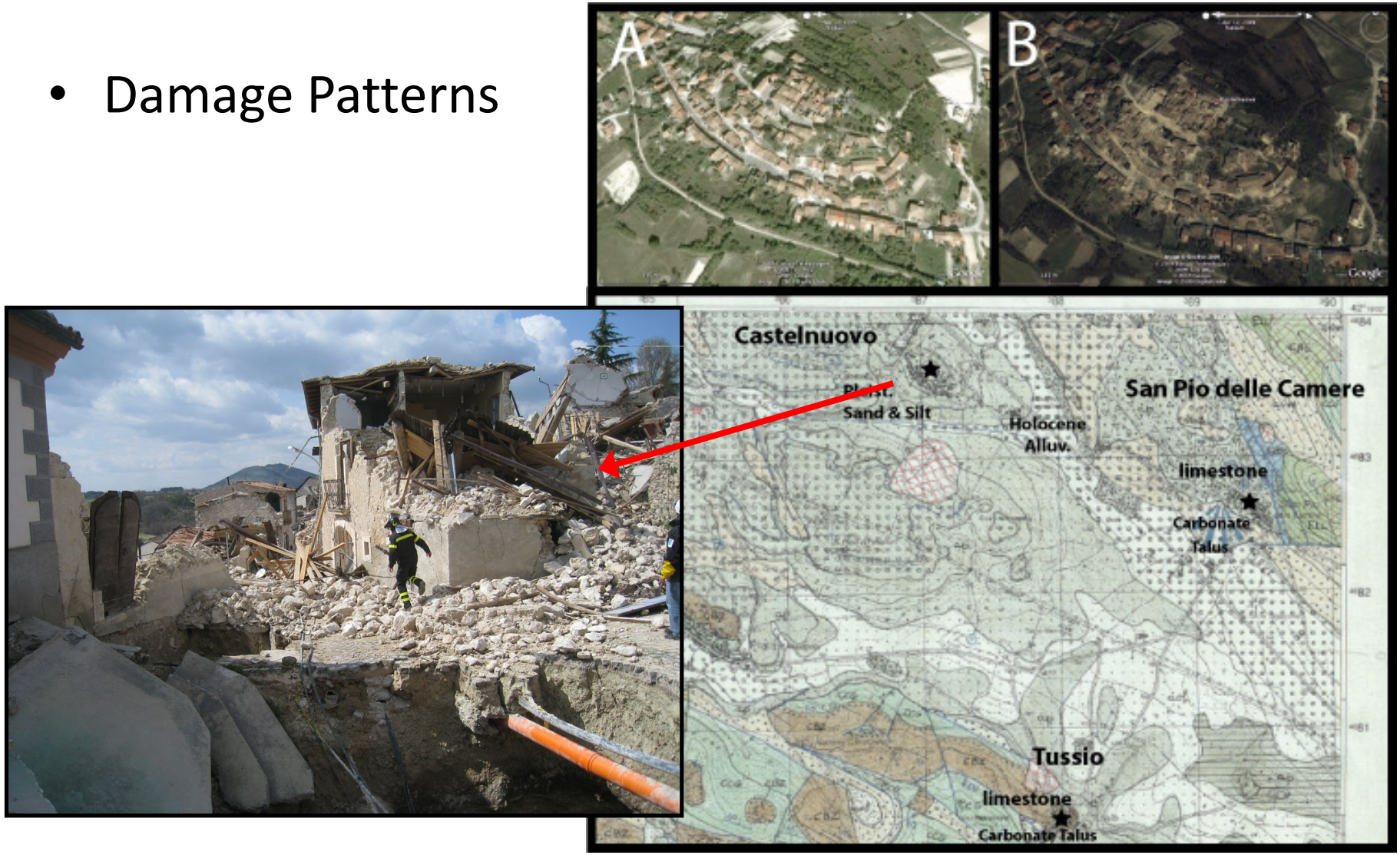

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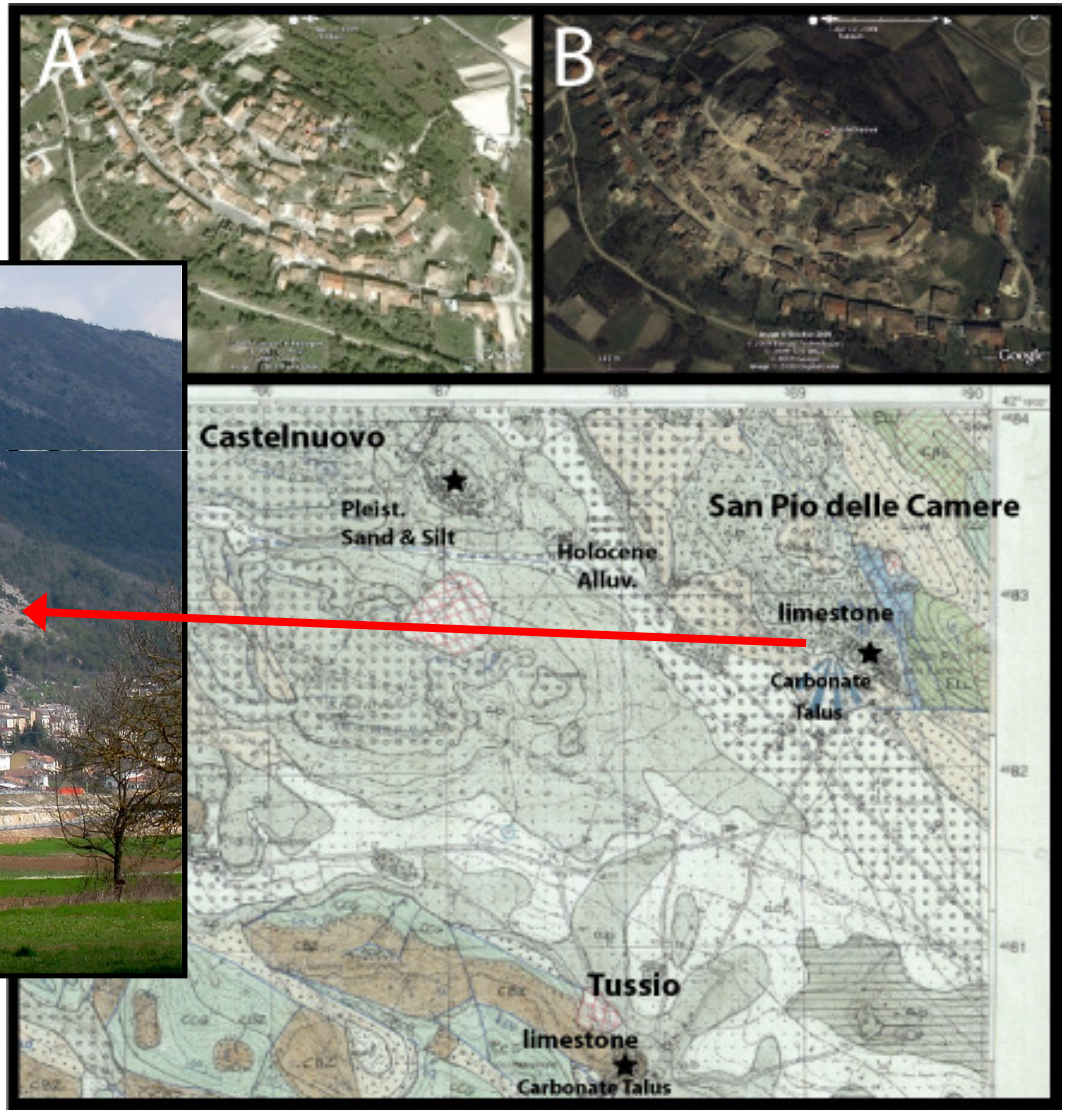

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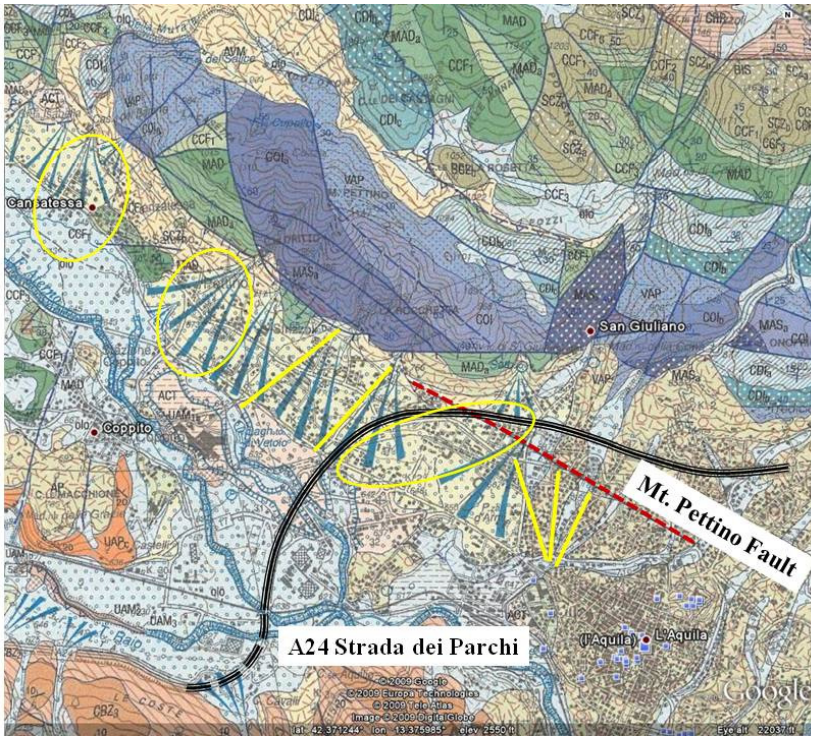

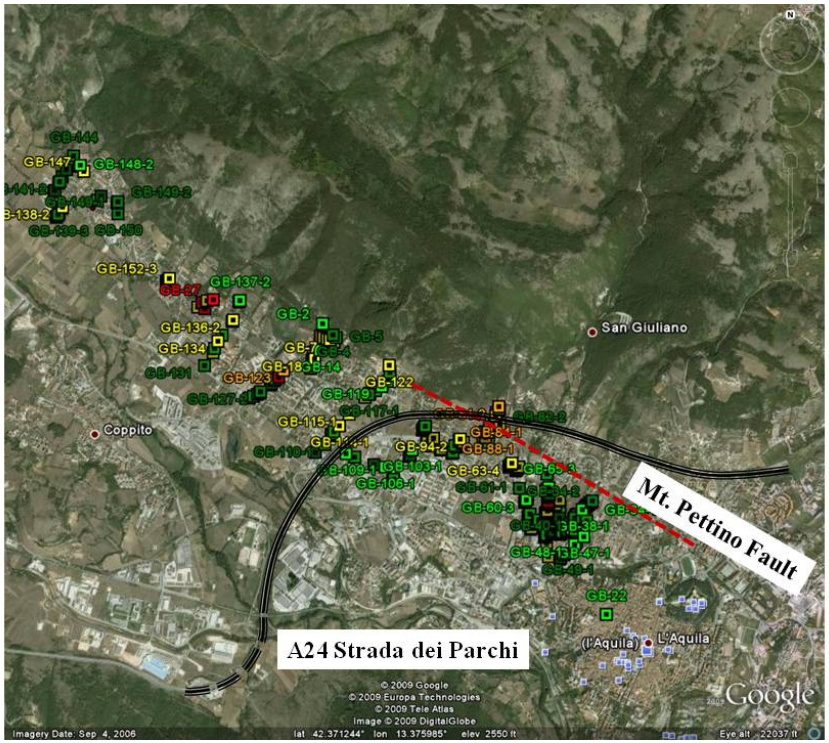

Geotechnical Aspects

- Damage Patterns
- Landslides/Rockfalls

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- Damage Patterns
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- Lake Sinizzio

Technology Applications

- Common GPS
- “Layering” capability in Google Earth (GE)
- GE on laptops in field
- Lidar