

Field reconnaissance on August 25th, after August 24th, 2016 Central Italy Earthquake

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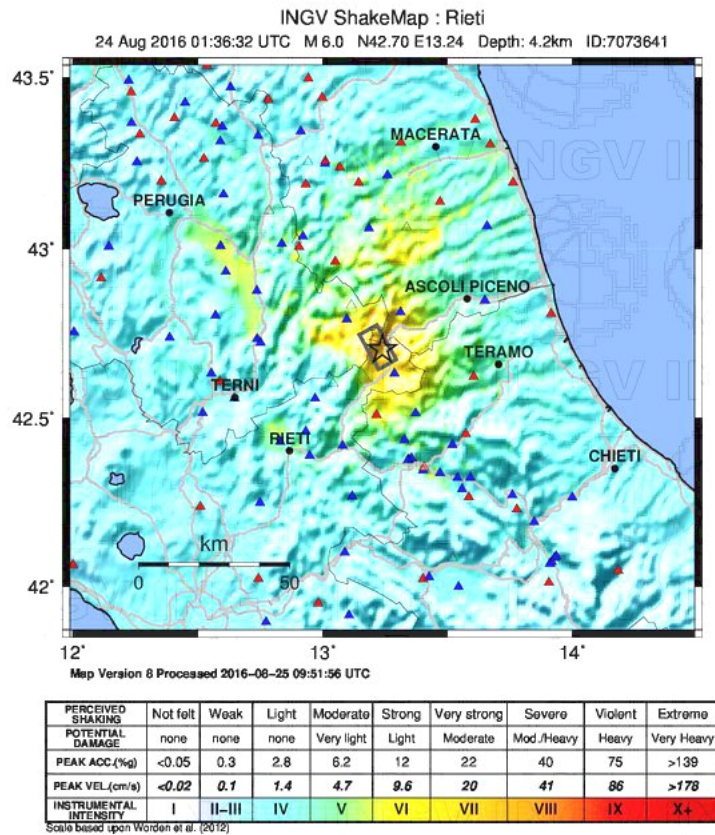


Outline

- ☐ Seismic sequence;
- ☐ Main shock;
- ☐ Emergency Response;
- ☐ Strategic Buildings;
- ☐ Residential Buildings;
- ☐ Historical Buildings;



Location



Courtesy of INGV



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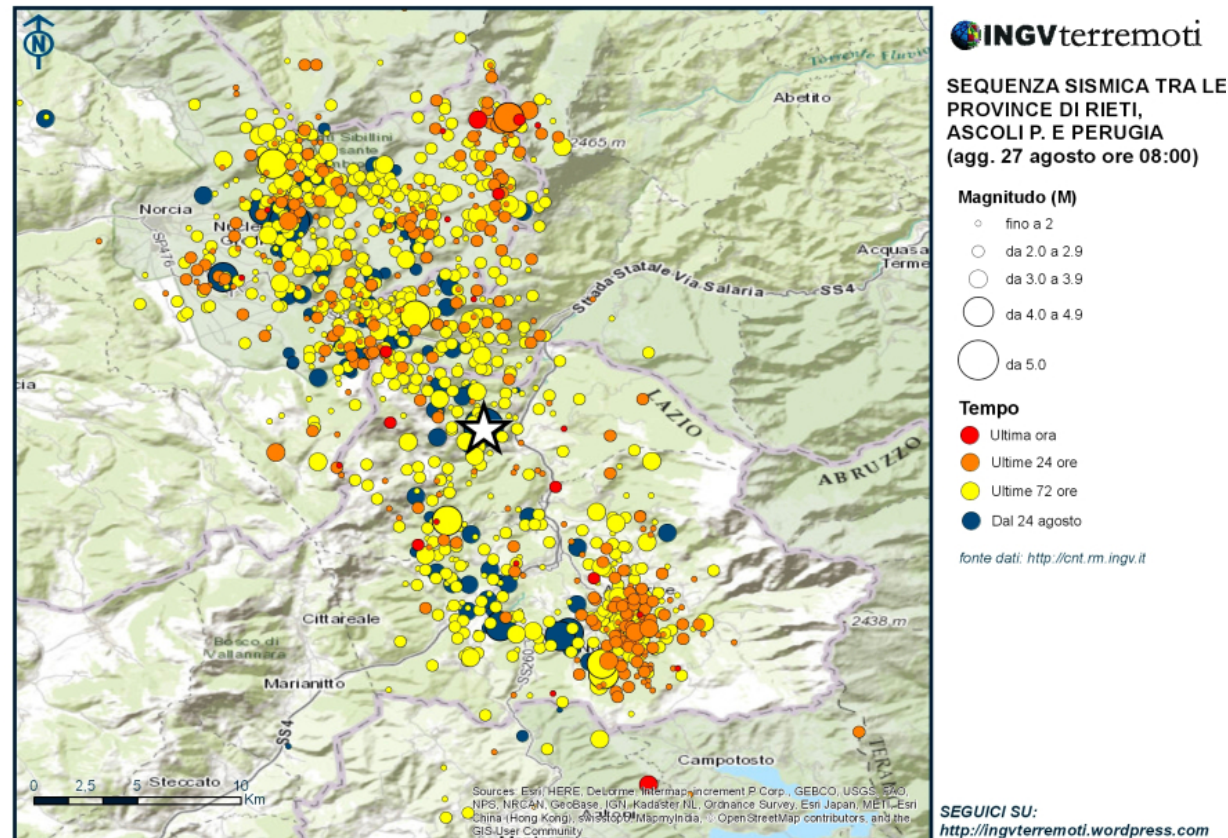


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Seismic sequence



Seismic sequence recorded in the Province of Rieti-Ascoli Piceno and Perugia. Last update on August 26, 2016 at 8.00 a.m. (INGV, 2016).



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Seismic sequence

Date	Local time (CEST)	Moment magnitude	Hypocenter depth	Epicenter Municipality	Latitude	Longitude
24 August 2016	03:36:32 ^[13]	6.2	10 km (6.2 mi)	Norcia	42.71	13.17
24 August 2016	03:56:02 ^[14]	4.6	10 km (6.2 mi)	Amatrice	42.61	13.28
24 August 2016	04:33:29 ^[15]	5.5	10 km (6.2 mi)	Norcia	42.79	13.15
24 August 2016	04:59:35 ^[16]	4.3	9 km (5.6 mi)	Norcia	42.80	13.14
24 August 2016	05:40:11 ^[17]	4.3	10.7 km (6.6 mi)	Amatrice	42.62	13.25
24 August 2016	06:06:53 ^[18]	4.4	10 km (6.2 mi)	Cascia	42.75	13.03
24 August 2016	13:50:31 ^[19]	4.9	10 km (6.2 mi)	Visso	42.87	13.11
24 August 2016	13:50:57 ^[20]	4.1	8 km (5.0 mi)	Arquata del Tronto	42.82	13.15
24 August 2016	19:46:09 ^[21]	4.6	10 km (6.2 mi)	Arquata del Tronto	42.72	13.19
25 August 2016	01:22:06 ^[22]	4.1	7.3 km (4.5 mi)	Maltignano	42.67	13.14
25 August 2016	05:17:16 ^[23]	4.7	10 km (6.2 mi)	Norcia	42.78	13.18
25 August 2016	05:36:07 ^[24]	4.3	10 km (6.2 mi)	Maltignano	42.65	13.16
26 August 2016	06:28:27 ^[25]	4.7	10 km (6.2 mi)	Amatrice	42.66	13.25
27 August 2016	04:50:59 ^[26]	4.2	12.2 km (7.6 mi)	Norcia	42.83	13.15
28 August 2016	15:07:34 ^[27]	4,3	11.7 km (7.3 mi)	Amatrice	42,66	13,24
28 August 2016	17:55:36 ^[28]	4,6	5.7 km (3.5 mi)	Norcia	42,78	13,15
28 August 2016	18:42:02 ^[29]	4,3	10 km (6.2 mi)	Visso	42,86	13,03



Seismic sequence

Date (GMT)	Time	Epicenter		Depth [km]	M _L
		Lat [°]	Long [°]		
160826	042825	42.600 N	13.290 E	10.90	4.8
160825	123605	42.596 N	13.290 E	10.00	4.3
160825	031716	42.753 N	13.208 E	9.50	4.5
160824	174609	42.663 N	13.222 E	10.00	4.4
160824	040650	42.769 N	13.125 E	7.60	4.3
160824	034011	42.617 N	13.245 E	10.60	4.2
160824	025935	42.799 N	13.143 E	9.00	4.1
160824	023329	42.794 N	13.154 E	8.70	5.4
160824	015600	42.614 N	13.275 E	4.80	4.4
160824	013632	42.706 N	13.223 E	4.20	6.0

Main event

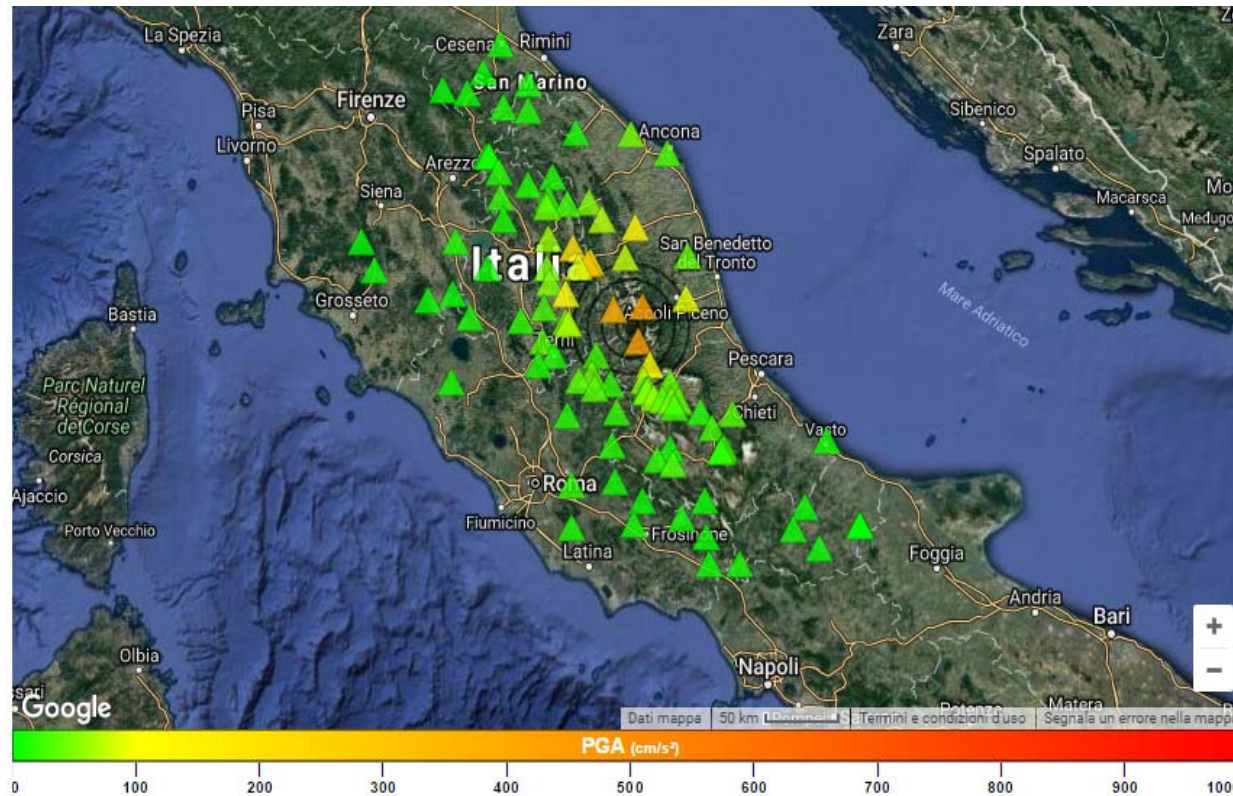
List of main events (M_L > 4.0).

The two main shocks are underlined in red.



Main event of August 24, 2016 (ML 6.0)

Epicenter: Lat: 42.706 N, Long: 13.223 E



Recording stations



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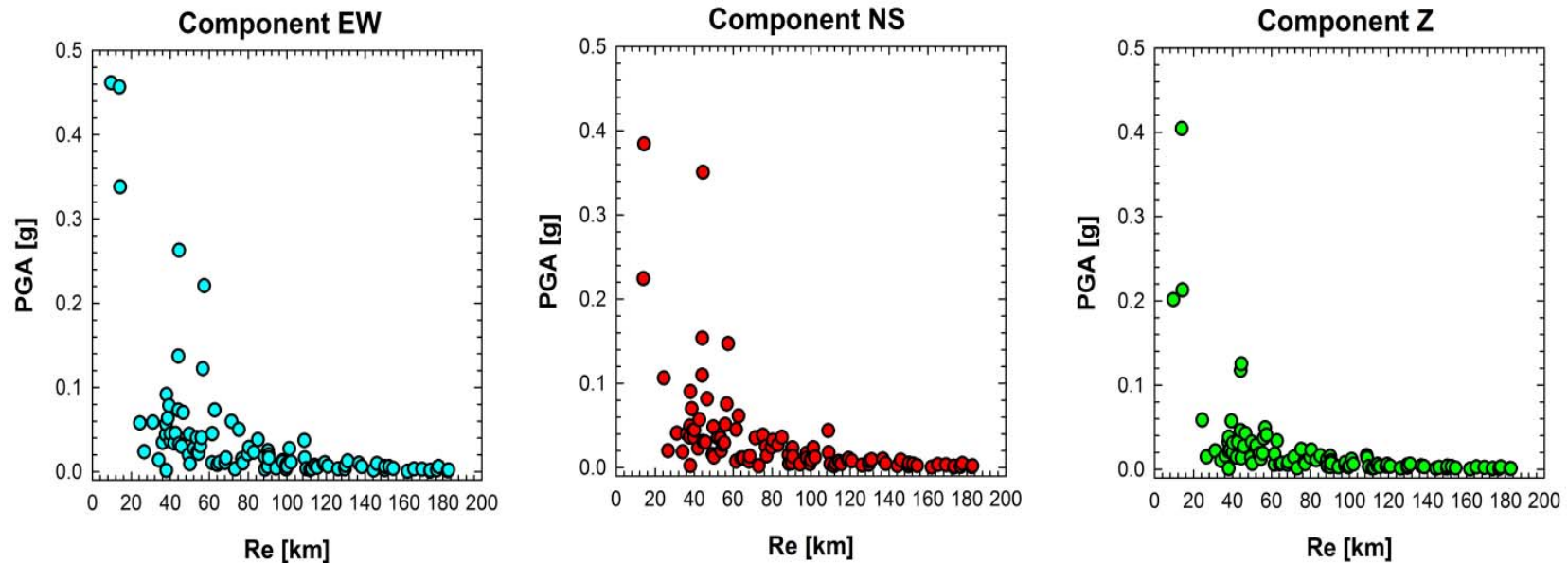


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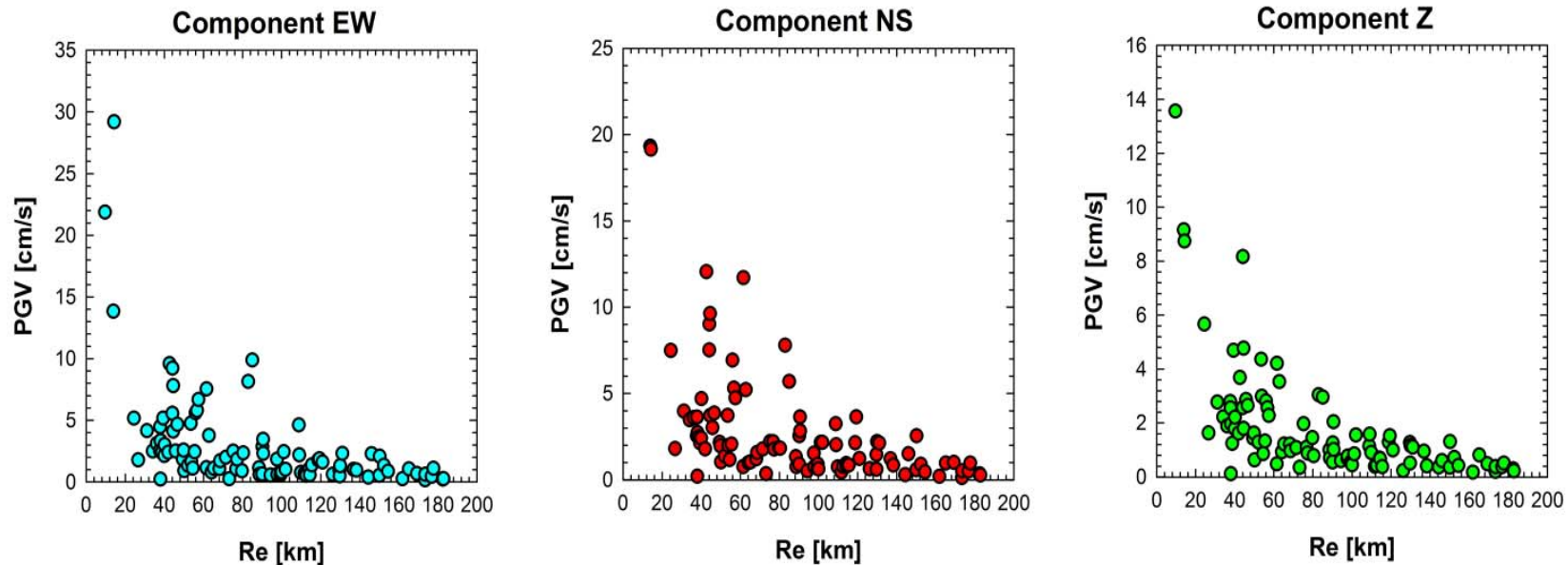
Main event of August 24, 2016 (ML 6.0)



**PGA vs. Epicenter distance
all records**



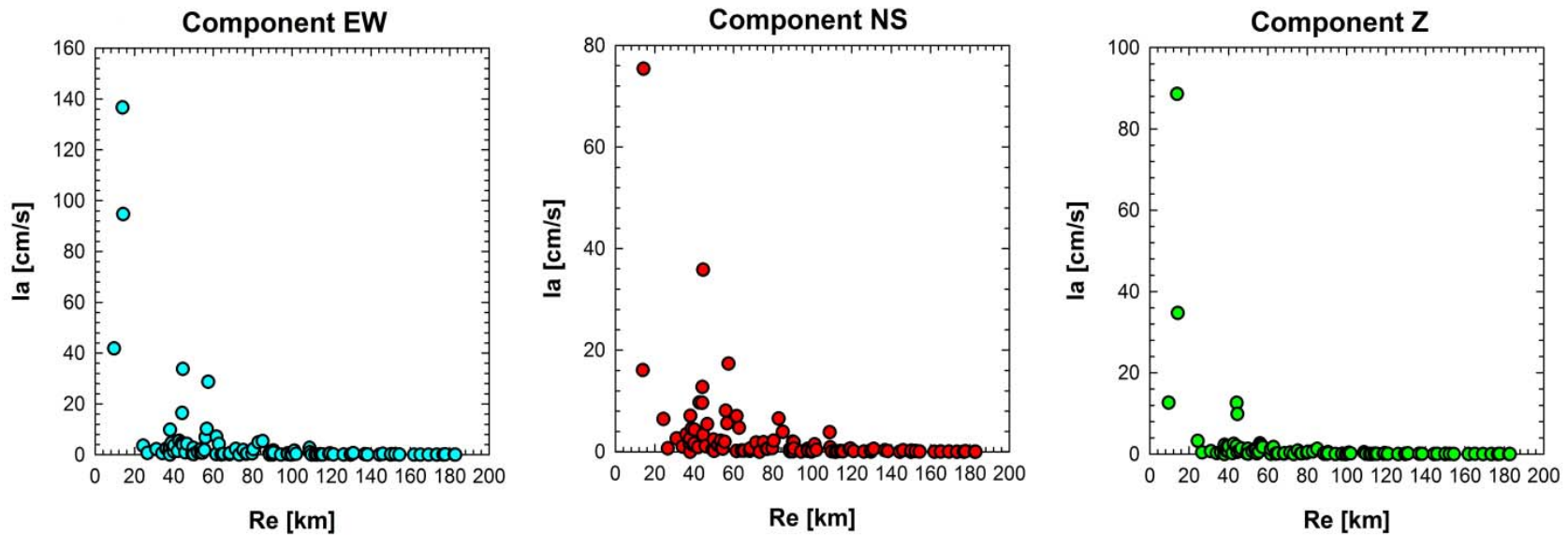
Main event of August 24, 2016 (ML 6.0)



**PGV vs. Epicenter distance
all records**



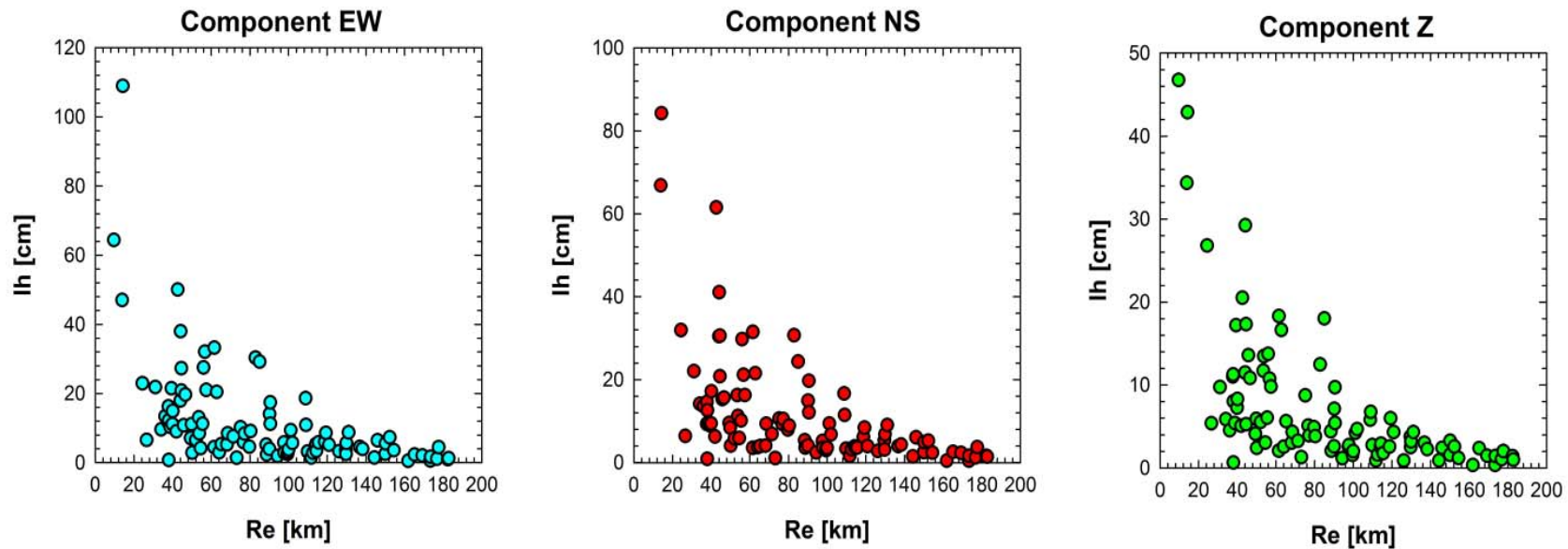
Main event of August 24, 2016 (ML 6.0)



**Arias intensity vs. Epicenter distance
all records**



Main event of August 24, 2016 (ML 6.0)



**Housner intensity vs. Epicenter distance
all records**



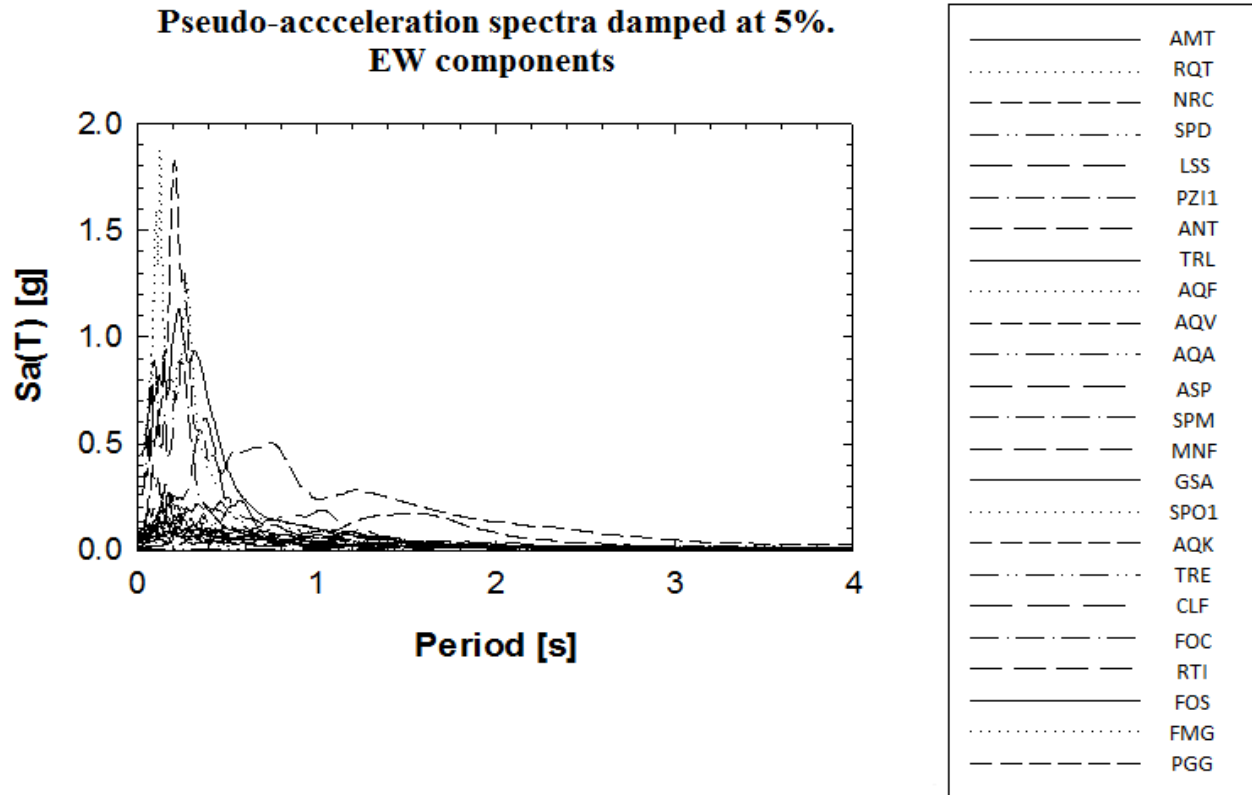
Main event of August 24, 2016 (ML 6.0)

PGA > 0.3 g and $I_a > 40$ cm/s are recorded only in the three following stations:

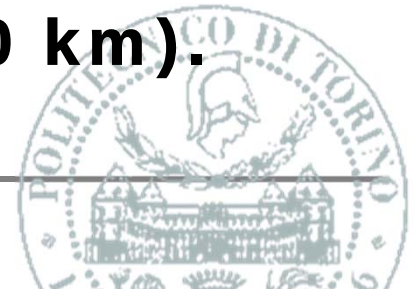
Station	Location	Re [km]
AMT	Amatrice	9.58
RQT	Arquata del Tronto	13.91
NRC	Norcia	14.25



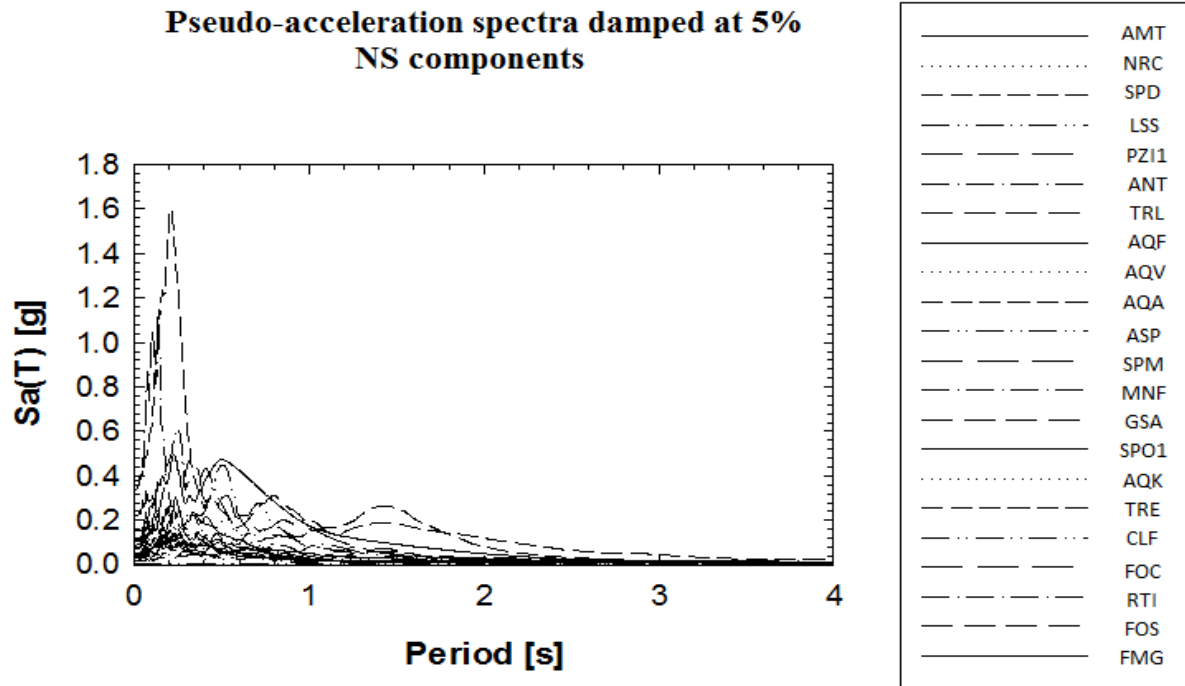
Main event of August 24, 2016 (ML 6.0)



Pseudo-acceleration spectra ($R_e < 50$ km).
EW components



Main event of August 24, 2016 (ML 6.0)



Pseudo-acceleration spectra ($R_e < 50$ km).
NS components

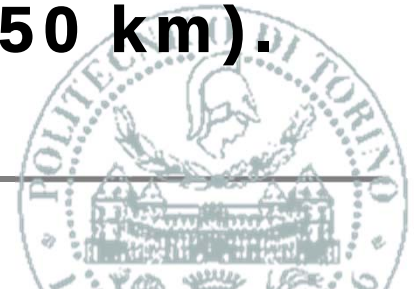


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Areal view - Amatrice



Coordinates	Lat	42.6292
	Long	17.3039
Topography category		T2
Soil category		B - C



Areal view- Arquata del Tronto



Coordinates	Lat	42.7672
	Long	13.2900
Topography category		T2
Soil category		B - C



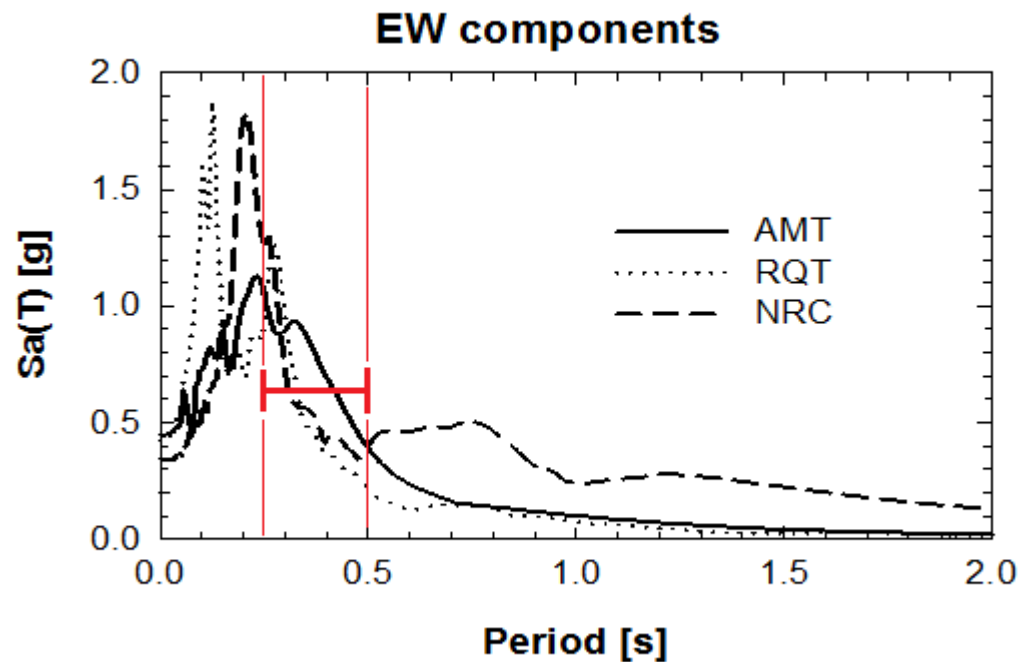
Areal view - Norcia



Coordinates	Lat	42.8017
	Long	13.1000
Topography category		T1
Soil category		B - C



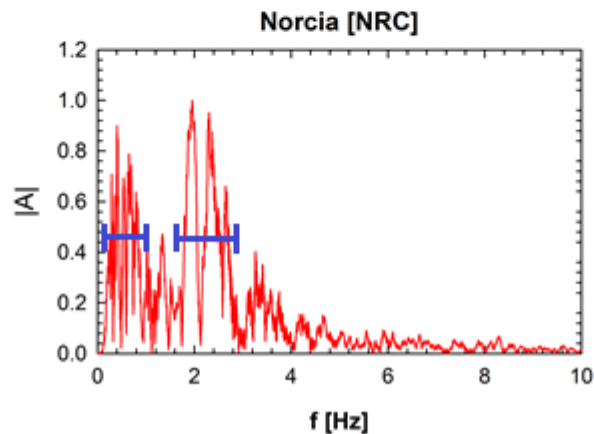
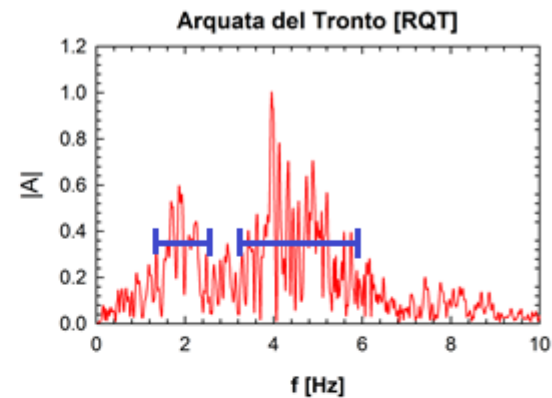
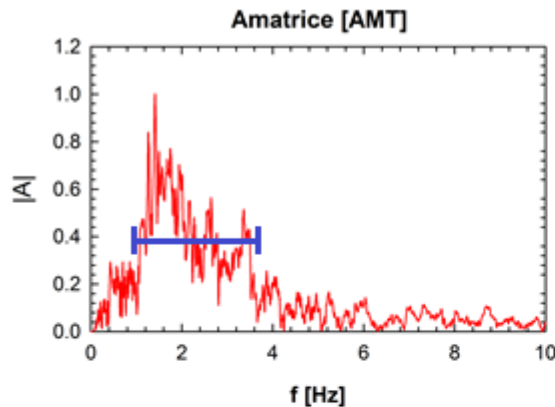
Main event of August 24, 2016 (ML 6.0)



Comparison between the pseudo-acceleration spectra for AMT, RQT and NRC stations



Main event of August 24, 2016 (ML 6.0)



Comparison between the FFT for AMT, RQT and NRC stations

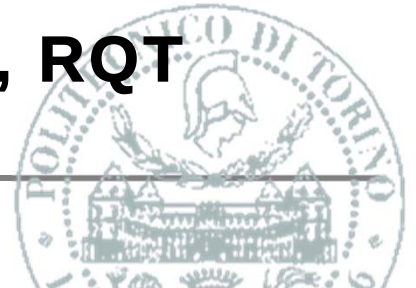


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Main event of August 24, 2016 (ML 6.0)



Example of seismic retrofit of buildings in Norcia. Norcia had minor damages with respect to the other towns because it was retrofitted after 1997 earthquake.



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Emergency Response



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Strategic buildings



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School

The earthquake has damaged about 15 schools. % of them are heavily damaged.

□ The elementary school Romolo Capranica in Amatrice is completely destroyed. They collapsed the childhood classes, the presidency, the secretariats.



Elementary school «R. Capranica», Amatrice

The school was seismically retrofitted in
2012.



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Elementary school «R. Capranica», Amatrice –before the earthquake



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Elementary school «R. Capranica», Amatrice –before the earthquake



Pre-event



Post-event



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Elementary school «R. Capranica», Amatrice –before the earthquake

In 2012, the building was seismically retrofitted. All columns were reinforced with carbon fibers bandages, the internal and external partition cladding were repaired, the heating system was installed in the floor, all windows were replaced, as well as the floor pavements and the plaster.





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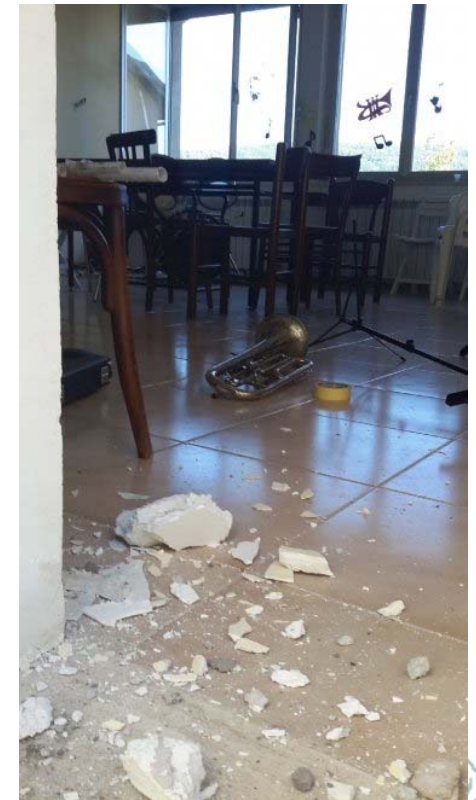
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School - Accumuli

❑ The elementary school in Accumuli shows major internal cracks and damages of the external walls.



School – Arquata del Tronto

□ The middle school Angelo Ruffini di Borgo (Arquata del Tronto) shows external and internal cracks on the ground floor.



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School - Acquasanta

- ❑ The school Berardo Tucci di Acquasanta has major internal horizontal cracks.



Schools

□ Presentano lesioni minori una scuola dell'infanzia ad Amandola (FM), un istituto a Macerata e altri tre nella sua provincia: Visso, Pievebovigliana e Pieve Torina.



Hospitals

The hospital Francesco Grifoni of Amatrice is not functional, so it was evacuated. They had been allocated 2 million Euros for its seismic retrofit.



Hospitals

External details



Internal details



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Hospitals

The hospital in amandola has been also evacuated for the damages and the cracks to the internal partition walls.



Carabinieri station, Amatrice



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Police station, Amatrice



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Police station, Amatrice



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Residential buildings



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Reinforced concrete structures, Amatrice



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Masonry structures, Amatrice



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Retrosi-Amatrice



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Historical buildings



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Sant'Agostino church, Amatrice



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