CONTRIBUTIONS FROM PROJECT S4 TO THE INVESTIGATIONS ON THE L'AQUILA EARTHQUAKE

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Fig.1 http://esse4.mi.ingv.it
A section is devoted to release reports on the research activities and data collection about L'Aquila seismic sequence

ABSTRACT

The occurrence of the L'Aquila earthquake, has promoted within Project S4 several activities, stimulating some reflections on the way the Project itself should move on to comply with the requirements coming from DPC and from the national and international scientific and technical community as well.
All the RUs were involved and details on the performed investigations and results can be found in the RU-Posters Section
RU1: INGV-MI, RU2: INGV-RM, RU3: POLI-MI, RU4: Poli-TO; RU5: Uni-BAS, UR6: Uni-RM1, UR7: Uni-SI, UR8: GFZ

1 As a first major contribution, strictly related to the main objective of the Project, a great deal of efforts was spent to publish in ITACA, within a short amount of time from the earthquake occurrence, the strong motion data from the mainshock and the 12 largest events (M > 4) of the sequence. About 900 waveforms were included, both in the uncorrected and corrected version, recorded by more than 65 digital stations. After publication of records, the ITACA web site performed well when facing a dramatic increase of the number of accesses and downloads, around 150-200 visits/day, mainly from Italy but also from worldwide.

Figure 1 – A) ITACA homepage http://itaca.mi.ingv.it; B) Event page for the 6 April 2009 Aquila earthquake

STATISTICS

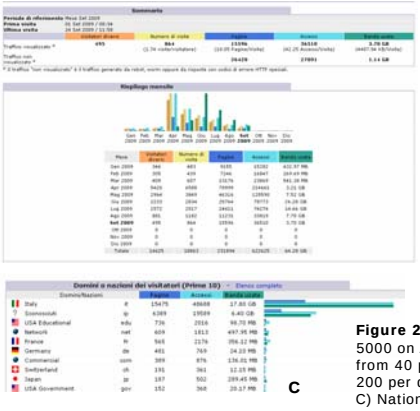
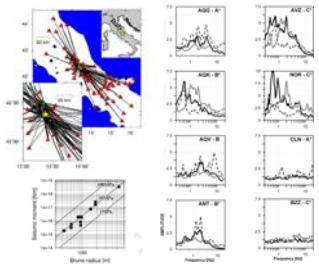


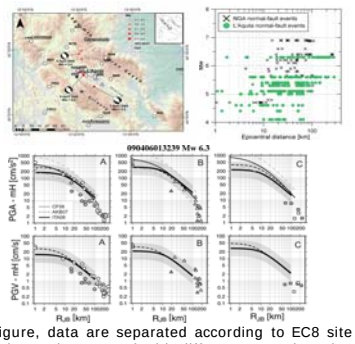
Figure 2 – A) Accesses per month: more than 5000 on April B) Accesses per day; they pass from 40 per day before the L'Aquila to about 200 per day after the event
C) National users on June, 2009.

2 RU1 and RU3 contributed to analyse the characteristics of different strong-motion parameters as function of distance, azimuth and site conditions. Furthermore RU1 analyzed the strong-motion data set with the aim of evaluating source, path and site spectral parameters.

Stress drop, attenuation curves and response site estimates through generalized inversion technique (*Bindi et al.; 2009*)



Characterization of the strong motion data recorded during the 2009 L'Aquila seismic sequence (*Ameri et al.; 2009; Pacor et al.; 2009; Paolucci; 2009*)



In the Figure, data are separated according to EC8 site classification and compared with different ground motion prediction equations. Empty and gray filled symbols correspond to observations over the azimuthal range 0° - 180° and 180° - 360°, computed respect to the North, respectively.

3 RU2 and RU6 carried out a geological survey at the accelerometric stations recording the Abruzzo main event. On the base of litological map and other available geophysical and geological information, a site classification of these stations was proposed, based on the EC8 classes

Deliverable D4: http://esse4.mi.ingv.it/images/stories/deliverable_d4.pdf

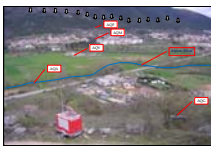


Figure 3 – RAN accelerometric stations in the Aterno River valley (in the north-west of L'Aquila). White arrows mark the Pettino Fault. The Aterno River flows from left to right.

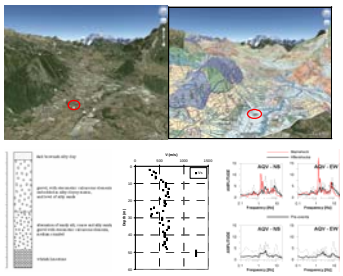
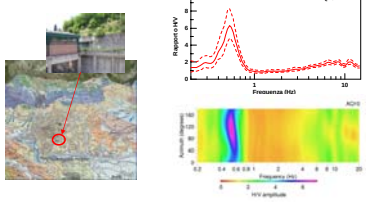


Figure 4 – AQV accelerometric station, in the Aterno River valley: available data. Top: site location (left) and Geological Map at 1:50,000 scale (right).
Bottom: borehole stratigraphy (left), Vs profile from down-hole (center), HVSR results (right) using records of the seismic sequences before (up) and after (down) the April 6 L'Aquila mainshock.

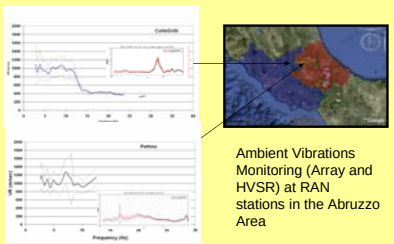
4 RU4, RU7 and RU8 applied active and passive surface wave methods for site characterization at accelerometric stations located in epicentral area, such as the AQP and AQA permanent stations, and Bazzano and Onna sites, where recording stations were installed after the mainshock. Insight on the response site at AQK station, located close to L'Aquila downtown, have been provided by the monitoring activity carried out by RU2 in the framework of microzonation study of L'Aquila town

AQK STATION – RU2



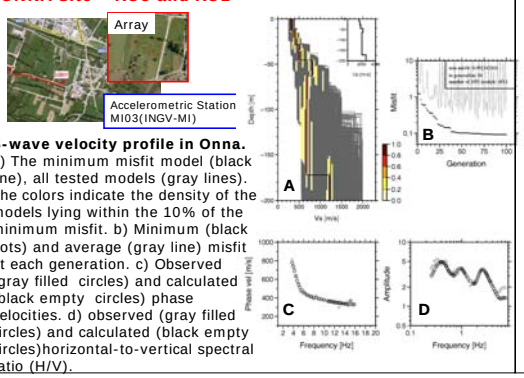
Noise Measurements at a site near AQK site

AQG and AQP Sites – RU7



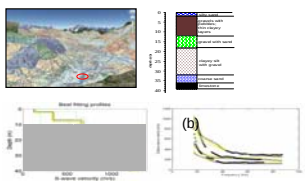
Ambient Vibrations Monitoring (Array and HVSR) at RAN stations in the Abruzzo Area

ONNA Site – RU8 and RU1



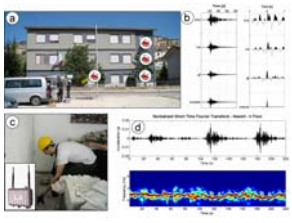
S-wave velocity profile in Onna.
a) The minimum misfit model (black line), all tested models (gray lines). The colors indicate the density of the models lying within the 10% of the minimum misfit. b) Minimum (black dots) and average (gray line) misfit at each generation. c) Observed (gray filled circles) and calculated (black empty circles) phase velocities. d) observed (gray filled circles) and calculated (black empty circles)horizontal-to-vertical spectral ratio (H/V).

AQA Station – RU4 and RU2



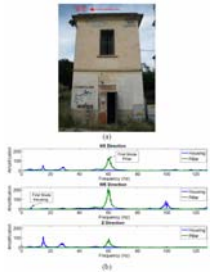
Preliminary results AQA RAN Station:
(a) shear wave velocity profiles from multimodal montecarlo inversion (the shadowed area represents less reliable results due to the limited extension of the area available for testing);
(b) comparison between experimental dispersion curves and numerical dispersion curves for the best fitting profiles;

5 RU5 together with RU8 installed several strong motion arrays to monitor the seismic response of buildings during the seismic sequence. Furthermore, RU5 performed noise measurements at ENEL cabins where accelerometric station were installed to be compared with strong motion data in order to evaluate the interaction with hosting structures.



Real-time monitoring of Navelli's municipality center (L'Aquila, Italy). (**a and b**) Three wireless accelerometric stations have been installed at the different floors, with one station deployed outside of it, (**c and d**) The deconvolution of accelerometric recordings within the building with a reference one allows the monitoring of the transfer function of the structure. The continuous spectral analysis of data (d) allows a nearly real-time monitoring of the building's modal property variations and of the level of damage during the occurrence of aftershocks.

Transfer functions evaluated to the **San Demetrio housing** (with characterization of the pillar).
The housing belongs to the typology of masonry housing. The transfer functions were evaluated dividing the spectra evaluated by top recordings (housing and pillar) and the spectra evaluated from signal recorded at the bottom and used as a reference. The estimated frequencies are: 6.7 Hz and 60 Hz respectively for the housing and for the pillar.



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