GFZ Helmholtz Centre Potsdam

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Project S4 (DPC-INGV 2007 - 2009): Italian strong motion database

Overview of the GFZ Task Force activities in the Aterno valley (Central Italy)

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Abstract

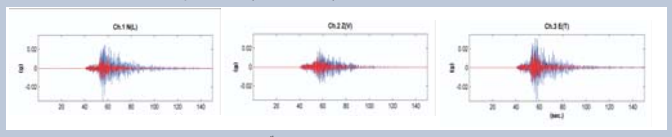
On April 6, 2009, a Mw 6.3 normal faulting event struck the Abruzzo region close to the city of L´Aquila, central Italy, causing many casualties and serious damage. Soon after the main shock, a dense network of 7 velocimetric and 11 accelerometric stations was installed in the epicentral area to the south-east of the city of L´Aquila by the German Task Force for earthquakes in support of the italian collegues with the aim of studying possible site effects and the response of the buildings. Additionally, we performed 2D array measurements nearby the village of Onna. These measurements were carried out using 17 seismic stations. The aperture of the array was of the order of a few hundred meters.
We present an overview of the activities with special focus on site effect investigation and building monitoring. To this regard, we selected several events including also the strong aftershock occurring on April 9 (Mw 5.4). In general, significant site effects are found for some settlements in the middle portion of the Aterno valley, located both on recent soft alluvial soil and on mid-Pleistocene silts. The high ground-motion amplifications partially explain the observed macroseismic intensity values (IX on MCS scale). Nearby villages, only a few kilometers apart, show lower amplification effects in agreement with the observed level of damage (VI to VII MCS). For the building of the municipality in Navelli, monitored in cooperation with the University of Basilicata, clear variation of resonance frequency was observed during the strongest aftershocks.

Example of site effects in Navelli (L'Aquila, Italy)

The city center of Navelli is located about 40 km from the epicentral area of the Mw 6.3 Central Italy Earthquake of the 6th April 2009.

The historical center was built on rock site, while the new settlments lies on soft sediments. Since the 8th April 2009, the GFZ-Postdam installed, in cooperation with the University of Basilicata, Kinemetrics Altus K2 accelerometric stations in the area. In particular, one stations has been installed in the historical center (a), while one has been installed in the ground floor of the Navelli's City Hall (b), which is located in the new settlement area.

Mw 5.4 aftershock of 9 April 2009 (00:53 UTC)

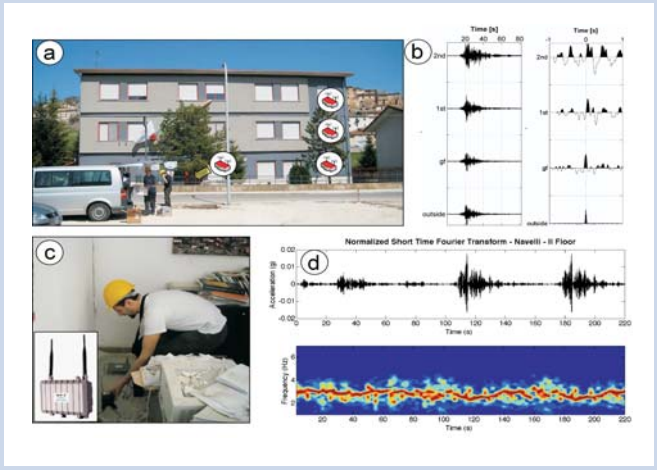


The recordings of the Mw 5.4 of the 09th April 2009 shows the higher ground motion amplitude and lengthening recorded in the Navelli's City Hall (blue), with respect to the one observed at the historical city center on rock site (red).

Station Coordinates GFZ L´Aquila

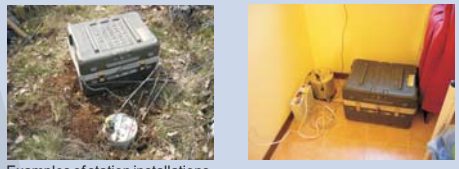
Accelerometer AGFZ			
AGFZ01	Navelli Piazza Piccioli	42,236576	13,726637
AGFZ02	Navelli municipio	42,238426	13,727509
AGFZ03	Civita Retenga	42,246550	13,706133
AGFZ04	Castelnuovo castello	42,29452	13,629620
AGFZ05	Castelnuovo strada	42,294333	13,628965
AGFZ06	Goriano Sicoli	42,080067	13,773117
AGFZ07	San Gregorio	42,327133	13,498450
AGFZ08	Civita Retenga Parrocchia	42,244600	13,705167
AGFZ09	Tendopoli ANPAS	42,3505	13,986
AGFZ10	Scuola Pizzoli	42,43296	13,31227
AGFZ11	Castelvecchio Calvisio	42,31012	13,68884
Velocimeter VGFZ			
VGFZ01	S Pio	42,284133	13,653317
VGFZ02	Barisciano	42,325167	13,587717
VGFZ03	Poggio Picenze	42,321270	13,542630
VGFZ04	S. Demetro nei Vestini	42,288750	13,552840
VGFZ05	Civita di Bagno	42,306000	13,448250
VGFZ06	Paganica	42,345933	13,471317
VGFZ07	S. Gregorio Agriturismo	42,326383	13,502183

Real-time monitoring of Navelli's municipality center (L'Aquila, Italy)

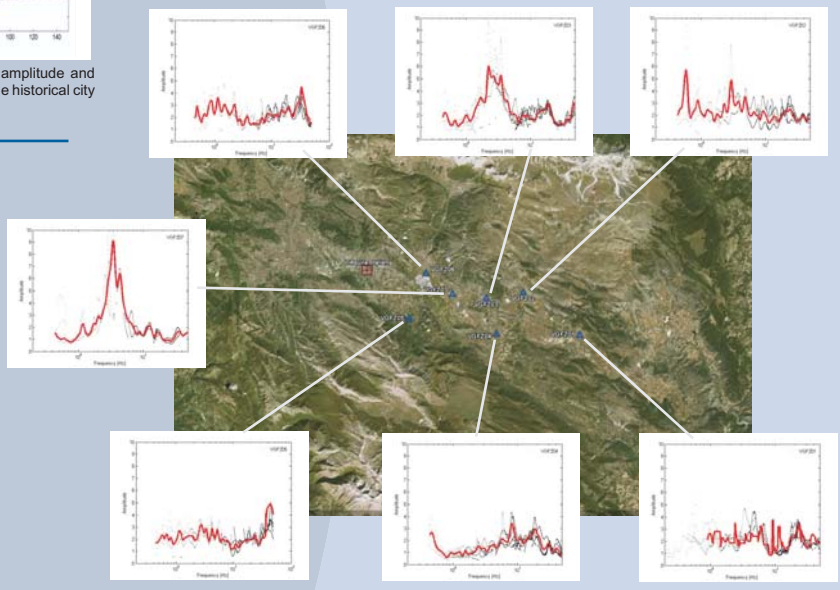


(**a and b**) Since the 8th April 2009, three wireless accelerometric stations have been installed at the different floors of the Navelli municipality building, with one station deployed outside of it, all recording the sequence of aftershocks following the Mw 6.3 Central Italy Earthquake April 6, 2009. (**c and d**) During the last few weeks, the structure has experienced an increasing amount of damage, with access to within the structure no longer considered possible. Nevertheless, the wireless accelerometers are still operating, hence the earthquake data can still be safely downloaded from outside the building. The deconvolution (b) of accelerometric recordings within the building with a reference one (in this case the station located outside) 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. Note the clear decrease between 100 and 140 seconds, as well as 170 and 210 seconds, of the fundamental resonance frequency of the building during the largest amplitude arrivals of the strongest aftershock recordings.

Site effect estimation by a temporary network



Examples of station installations



Map of station position. Horizontal-to-vertical spectral ratios of selected events calculated for S-waves with a signal-to-noise ratio larger than 3 are shown. The thick red line shows the median. Some stations (e.g. VGFZ03 and VGFZ07), located in the middle of the valley on thick sediments, show clear amplification peaks. Additionally, higher harmonics, which may overlap with the resonance frequency of neighboring buildings and might often not be visible when only considering noise spectra, can clearly be identified. The analysis of only few events is here preliminarily reported. In future the larger amount of available data will allow a more detailed analysis .

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Ralf Bauz and Regina Milkereit participated to the measurements and helped with data analysis.