Session SM6.3/ERE5.11/TS3.14

The activities of the EMERSITO INGV emergency task force following the Mw 5.5 Costa Marchigiana-Pesarese earthquake (2022)

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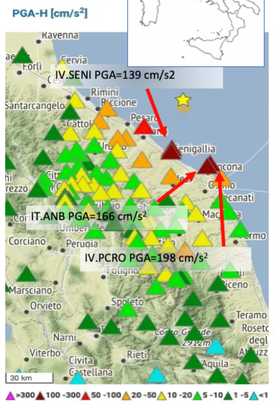
1. ABSTRACT

EMERSITO is the INGV emergency task force (http://emersitoweb.rm.ingv.it/) with skills and experience in seismic response studies and in seismic microzonation activities, and contributes to emergency interventions following significant seismic events (M>5.0 or lower if a noticeable level of damage is observed). After the Mw 5.5 (M_L 5.7) event of November 9, 2022 *06:07:24* UTC (Italian time *07:07:24*) localized in the Costa Marchigiana Pesarese area, EMERSITO acted immediately to collect multidisciplinary available information regarding the epicentral area and adjacent areas. EMERSITO decided to focus the scientific intervention in the municipal area of Ancona which is the main city of the Marche region. This choice was driven by: a) the values of peak ground accelerations observed during the main shock in the city compared with other cities at the same or lower epicentral distance; b) the observed damage and evacuations, fortunately minor, as reported by the technicians of Regione Marche and the Fire Brigade; c) the scientific interest in the evaluation of the local seismic response in the urban area that is characterized by strong lithological heterogeneities; d) the presence of an INGV office in Ancona which supported the activities of all the INGV emergency groups, including the EMERSITO working group. The EMERSITO intervention concerned the installation of a temporary network (registered as 6N; the code was released by FDSN, the *Federation of Digital Seismograph Networks*) of 11 seismic stations equipped with both velocimetric and accelerometric sensors. A part of these stations (6) has been set up in real-time mode, while the remaining stations (5), have a local acquisition system, requiring periodic maintenance interventions for checking and downloading the data.
At the end of the experiment, all continuous data will be transferred to the European Integrated Data Archive (EIDA) repository, with a Digital Object Identifier (DOI) and made public after a pre-established restriction period to allow both preliminary data analysis and a general publication about the intervention of the EMERSITO group.
Site selection for network 6N was planned on the basis of the geological map, damage survey and other information. It was preceded by field inspections in collaboration with the technicians of the Municipality of Ancona and Regione Marche and was supported by colleagues from the INGV headquarter in Ancona. Given the observed variability in the seismic response of the permanent stations, particular attention was paid to the identification of one or more reliable reference sites. The operativity of the network is between 13 November and 24 February.
In this work we present the seismic dataset composed of ambient vibrations and aftershock recordings acquired from the 6N network during the experiment. Preliminary data analysis suggests a variability of the site responses depending on the outcropping lithologies. The instrumental data acquired by EMERSITO task force, together with the microzonation study available for the municipality of Ancona, can increase the knowledge on site effects of the city after the Mw 5.5 event of November 9, 2022.

2. MAIN GOALS

- Investigate site effects in Italian regions hit by seismic events with Magnitude ≥ 5 by installing temporary seismic network in interesting areas.
- Support of post- and non-emergency activities for microzonation studies in urban areas with higher level of damage.
- EMERSITO task force was operative immediately after the Mw 5.5 earthquake, since November 9th 2022.



- collecting available previous studies for the epicentral area (geological maps, microzonation studies, puntual geophysical and geological investigations) in the perspective of possible site effects studies

- retrieving information about the level of damage of the epicentral area

Selection of areas suitable for site effect studies

3. 6N EMERSITO SEISMIC NETWORK

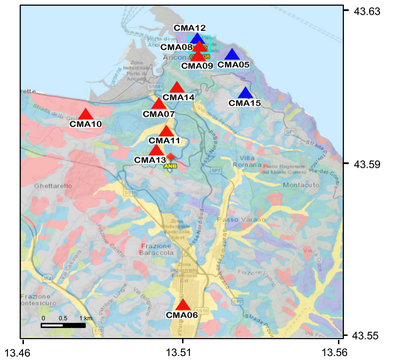


Figure 3.a Location map of 6N network with details of the geological setting of the Ancona area.

Figure 3.b Group activities and installations details: 11 stations equipped with Reftek130 + Lennartz 3D-5s velocimeter and Episensor accelerometer. Real time transmission to INGV data center.

4. DATA ANALYSIS & RESULTS

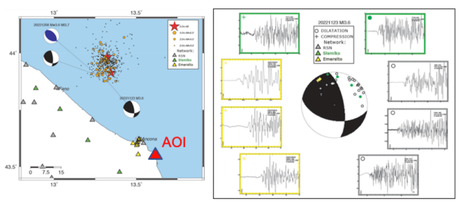


Figure 4.a. Contribution of 6N network data for focal mechanisms definition for bigger events

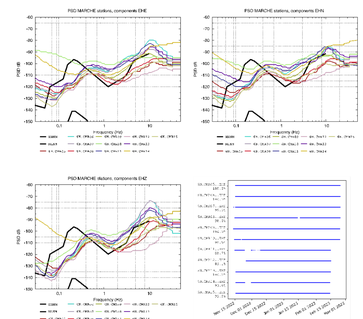


Figure 4.b. Data quality check during the entire recording period.

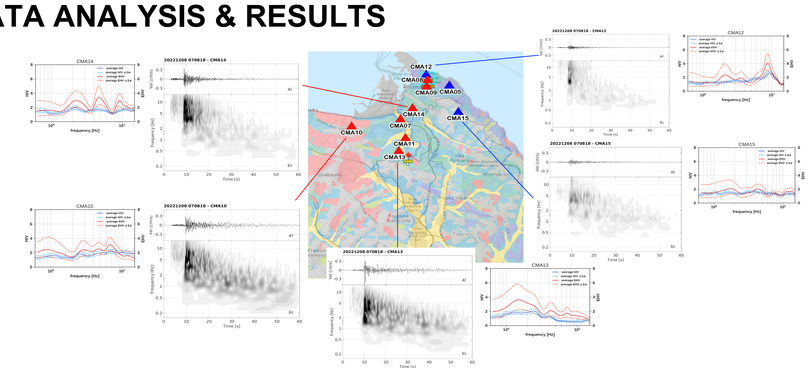


Figure 4.c. S-transform (Stockwell et al. 1996) calculated for the M 3.9 event (08-12-2022) recorded by the 6N EMERSITO network is reported (grey plots) for some representative sites with different geological condition (see Fig.g). At stations on sedimentary deposits, the energy release is prolonged in time and amplified in site and source-dependent frequency ranges. The spectral ratios analysis of earthquakes (SSR in red, HVSR in blue) is useful to compute experimental transfer functions of the sites

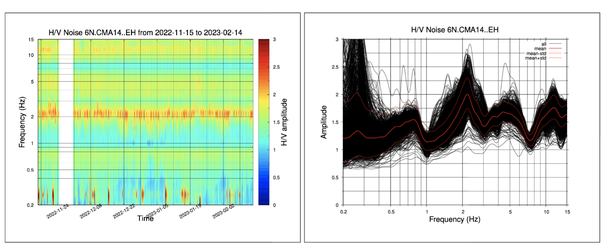


Figure 4.d. Ambient noise spectral ratios analysis are performed with HVNEA software (Vassallo et al. 2022) for the entire acquisition period of the network for checking influence of weather conditions (temperature, pressure, wind, water table…) or anthropic noise on characteristics of spectral ratios curves.

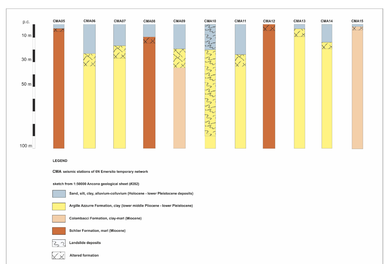


Figure 4.e. 1D geological models representation of each site considering all the collected technical information coming from Municipal, Regional offices and private companies

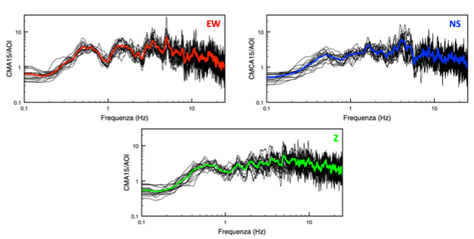


Figure 4.f. Evaluation of reference site for standard spectral ratios (SSR) analysis (Borcherdt 1970). Spectral ratio between CMA15 station with more flat HVSR curve (Fig.4.d) and velocimeter AOI station, belonging to the INGV network (mapped in Fig.4.a), located in a hard rock site (Fig.3.a).

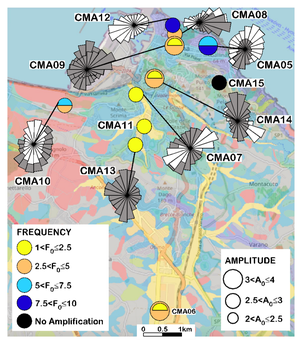


Figure 4.g. Map of resonance frequencies of the area with rose diagrams showing results of polarization analysis performed on earthquake (grey bars) and ambient noise data (white bars).

5. FUTURE ACTIVITIES

- Check effects on HV of building vibrational modes (complexities of urban setting)
- Check differences between HV-Noise and HV-Earthquakes (2D/3D effects?)
- Complex geological setting of the study area: identification of stratigraphic / morphologic effects

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