# Gemona valley (Italy)

## Situation of the valley

Gemona is a city located in the north-eastern part of Italy. It is mainly built on an alluvial fan.
The area were Gemona is located is a seismologically active area characterized by a compressional tectonic regime, approximately along the NS direction, related to the convergence of the Eurasian and Adriatic microplate. In the past several events of medium-high intensity occurred in the area. The most recent destructive events was the Friuli earthquake in May and September 1976. The area of Gemona built on alluvial fan sediments was almost completely destroyed.

Figure 1: Alluvial fan: the top-bottom axis is in the EW direction.

## State of art of the instrumentation and measurements in the valley at the beginning of the project

Three accelerometric stations, run by the Friuli Venezia Giulia Accelerometric Network (RAF), have been set in Gemona for site effects estimation purposes since 1993. These three stations are GEPF, the reference station on bedrock, GESC, located on alluvial fan sediments and GETM (operating from 1993 to 2000 and then replaced by GEDE station), positioned in the sedimentary basin. Using weak motion recordings of these stations, we are able to derive the horizontal to vertical spectral ratio and also to apply the reference site technique.

The information about the subsoil structure comes from geotechnical exploration. From 1977 to 1981 some boreholes were drilled to evaluate the stability of the soil; some of these reach the bedrock. Starting with these geotechnical information Giorgetti and Stefanini made a map of top of bedrock depths in the sedimetary basin. For the Gemona alluvial fan we did not find any similar localization of subsoil.

## Instrumentation and measurements realised in the valleys during the project

During the Sismovalp project we planned and carried out different type of measurements and analysis: the seismic characterization for the first 30 meters of soil, the gravimetric characterization of the Gemona alluvial fan and seismic noise measurements.

For seismic characterization for the first 30 meters of soil we carried out measurements on 3 selected lines transversal to the fan axis (Figure 2). One of these passes through the accelerometric station GESC. The

intergeophone distance was 10 meters. We used 1Hz and 4.5Hz geophones. The data were analysed with FTAN method and a hedgehog inversion was performed to calculate Vs profiles.

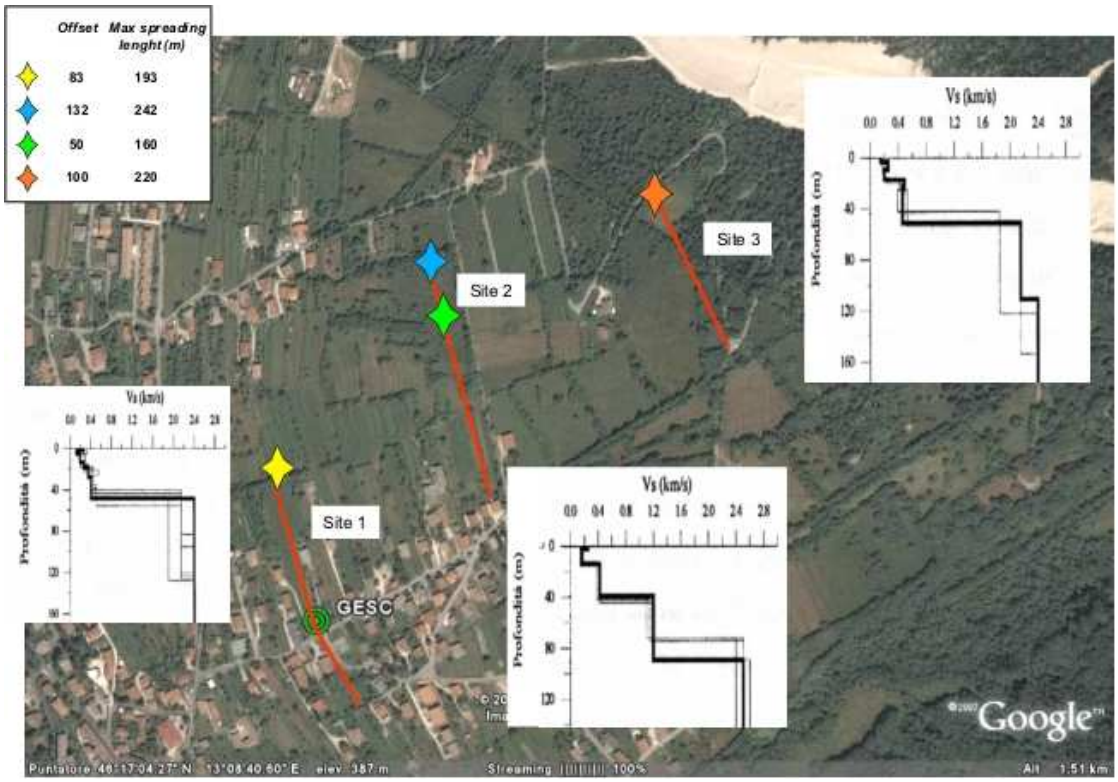



Figure 2: Seismic profiles location with the final results of data inversion.

Gravimetric measurements were carried out on 5 profiles: 3 transversal and 2 coaxial to the fan axis. Micro-gravimetric data were able to discriminate sediments-bedrock contrast densities in order to evaluate the bedrock mean depth through data inversion.
In evidence on the map (Figure 3) the location of boreholes that reach bedrock (stars), RAF stations (white circles) and connecting points on profiles (**X**).

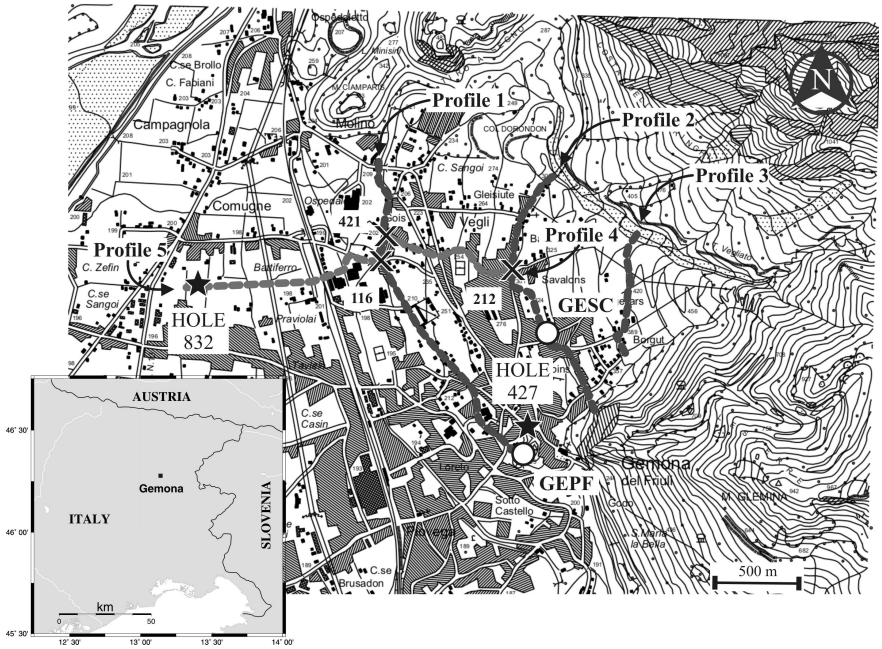



Figure 3: Plan of the 5 gravimetrical profiles on technical map

Gravimetric data were acquired in standard way, the final data set include 163 sites. Field operations were performed using a gravimeter LaCoste&Romberg mod. D-018, with ZLS feedback. Standard corrections were

applied to gravimetrical field data and the Bouguer anomaly was calculated. The calculated local field was attributed to variations of bedrock topography. The selected model is the simplest one: the bedrock density was fixed at 2.6 $kgm^{-3}$, equivalent to massive carbonate rock that form bedrock in surveyed area; the sedimentary layer is a single, homogeneous layer with no intrusions, with density 1.8 $kgm^{-3}$. The constraints that we consider doing modelling were: the 2 boreholes that reach subsoil, the geological outcrops at the ends of the north-south profiles, the points where profiles intersect each other.

## Results of the work done in the valley

The complete model is shown above (Figure 4). It reports the average sedimentary thickness along the 5 profiles and the location of the two seismological stations, GESC and GEPF.

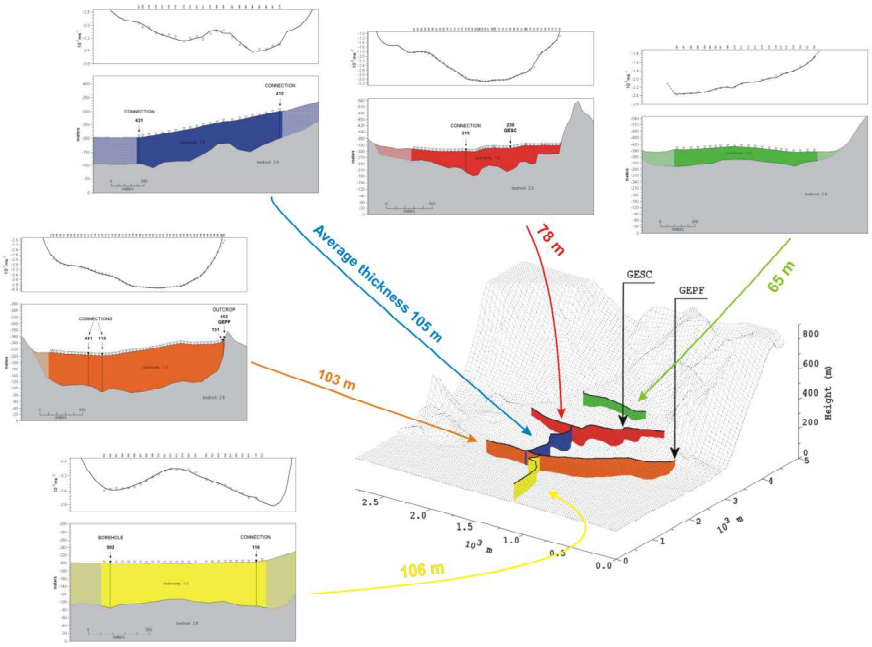



Figure 4: Gemona complete valley model

Using these 2D models, preliminary finite difference modelling were performed along an interpolated E-W profile (GAA) that passes through GESC station and user the Bovec '98 event as source. In Figure 5: on the left the preliminary SH waves along an E-W profile from 2D wave propagation modeling, on the right the frequency amplification analysis for the same profile.

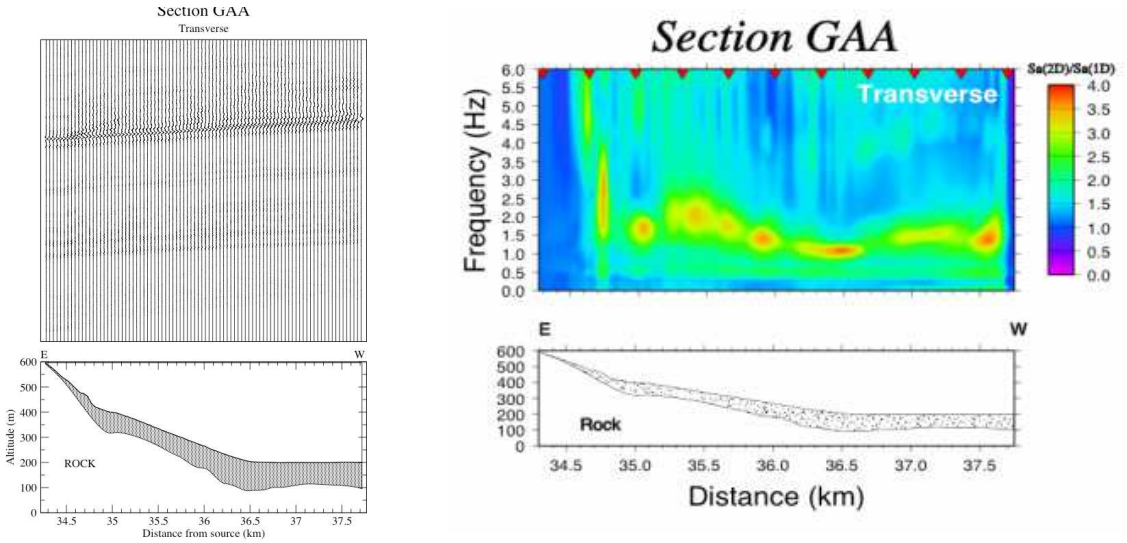



Figure 5: on the left the preliminary SH waves along an E-W profile from 2D wave propagation modeling, on the right the frequency amplification analysis for the same profile.

The seismic noise measurements were carried out along the same profile traced for gravimetrical measurements (Figure 6). The sampling step is bigger.

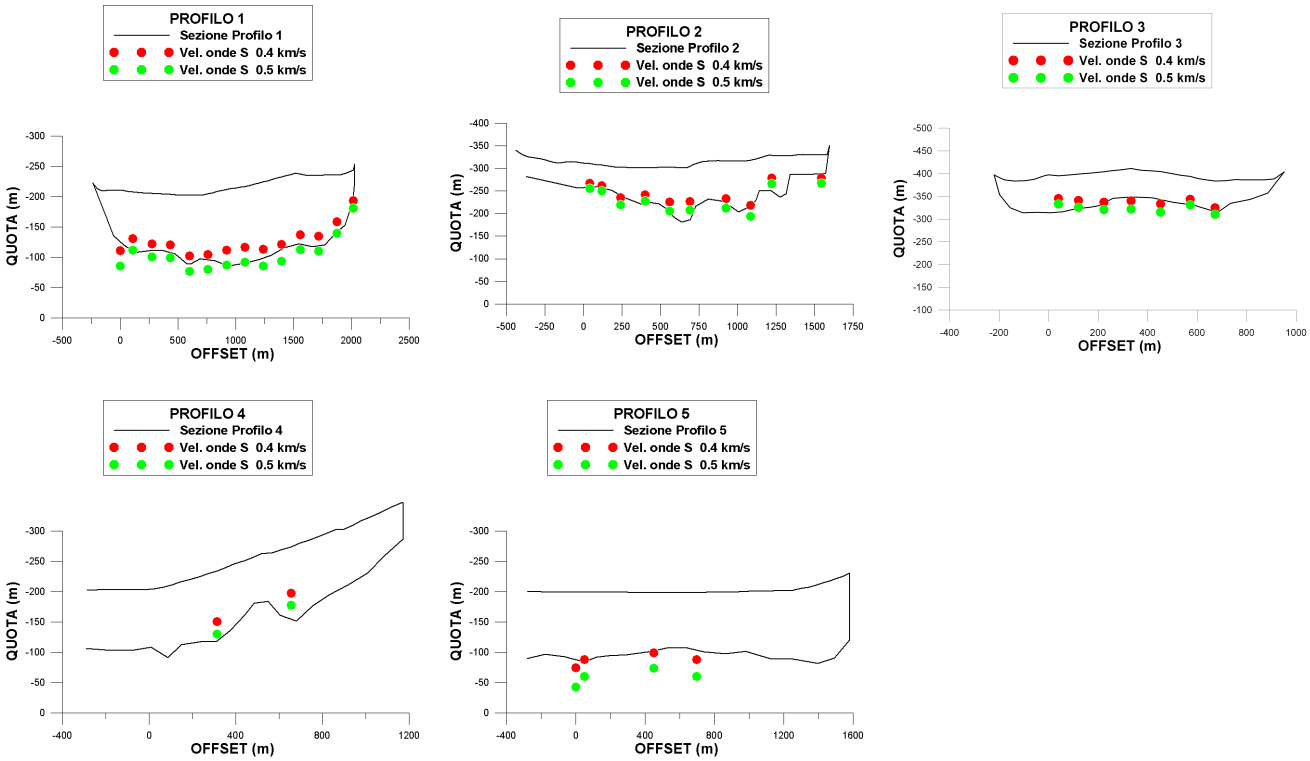
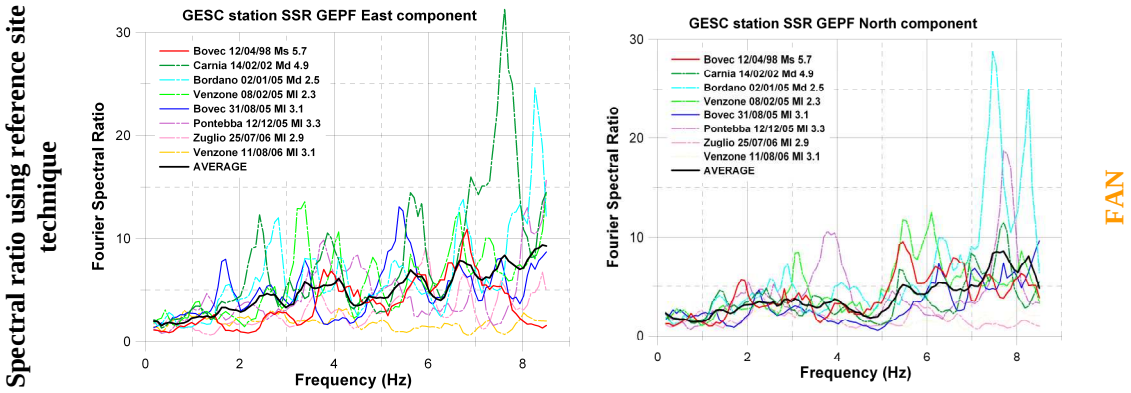



Figure 6

To perform noise measurements we acquired three Guralp CMG40, after field measurements two of these were installed in GESC and GEPF stations to update the RAF instrumentations. GESC station was not only updated in his instrumentations but also relocated, not far from the original place, on a newly constructed concrete plinth.

The recorded events were included in the database and showed different resonant frequencies at the two sites, the station on the fan and the one on the sedimentary basin, when excited by the same event, and also different resonance frequencies at the same site when excited by different events.



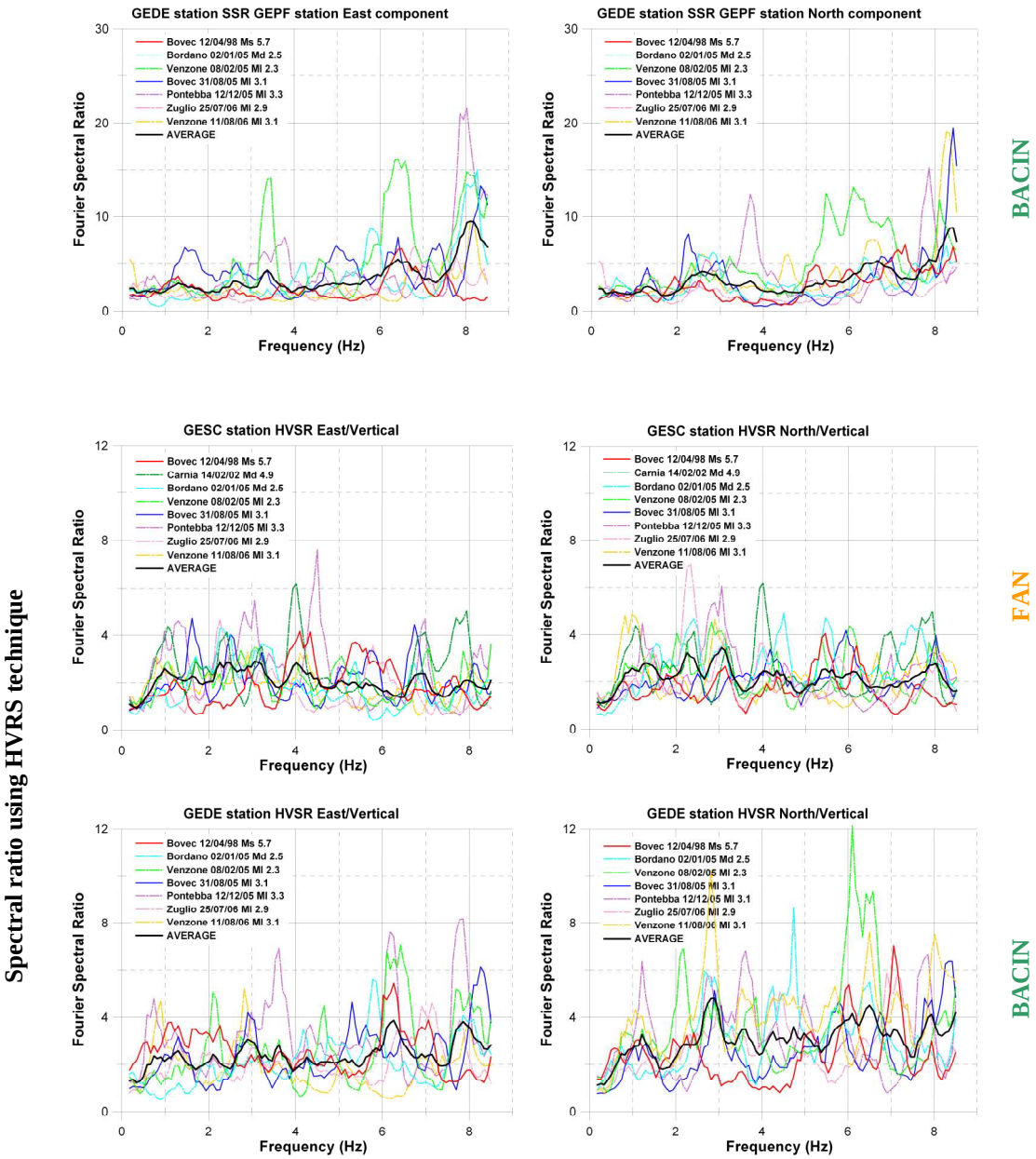



Figure 7

## References presenting the results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