Site characterization of the DPC station IT.ZPP – ZOLA PREDOSA PIANA

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Subject: **Final report illustrating measurements, analysis and results at IT.ZPP station**	

Cite as: Working group INGV "Convenzione DPC-INGV 2017 Allegato B2, Obiettivo 1 - TASK B: Caratterizzazione siti accelerometrici", (2017). Site characterization of the DPC station IT.ZPP ZOLA PREDOSA PIANA. doi: 10.5281/zenodo.1145684

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1. Introduction

In this report, we present the geophysical measurements and the results obtained in the framework of the 2017 agreement between INGV and DPC, named *Allegato B2: Obiettivo 1 - TASK B: Caratterizzazione siti accelerometrici* for the characterization of sites of the Italian National Seismic Network (RSN-INGV) with accelerometers and of the Italian Accelerometric Network (RAN-DPC). Here the results for station IT-ZPP are presented.

Geophysical measurements are 2D microtremor arrays that provide results in terms of dispersion curves, inverted to obtain shear-wave velocity (V_S) profiles for the studied area, suitable for assigning the EC8 class.

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2. Geophisical investigation

Figure 1 shows the location of the stations used for the 2D array.

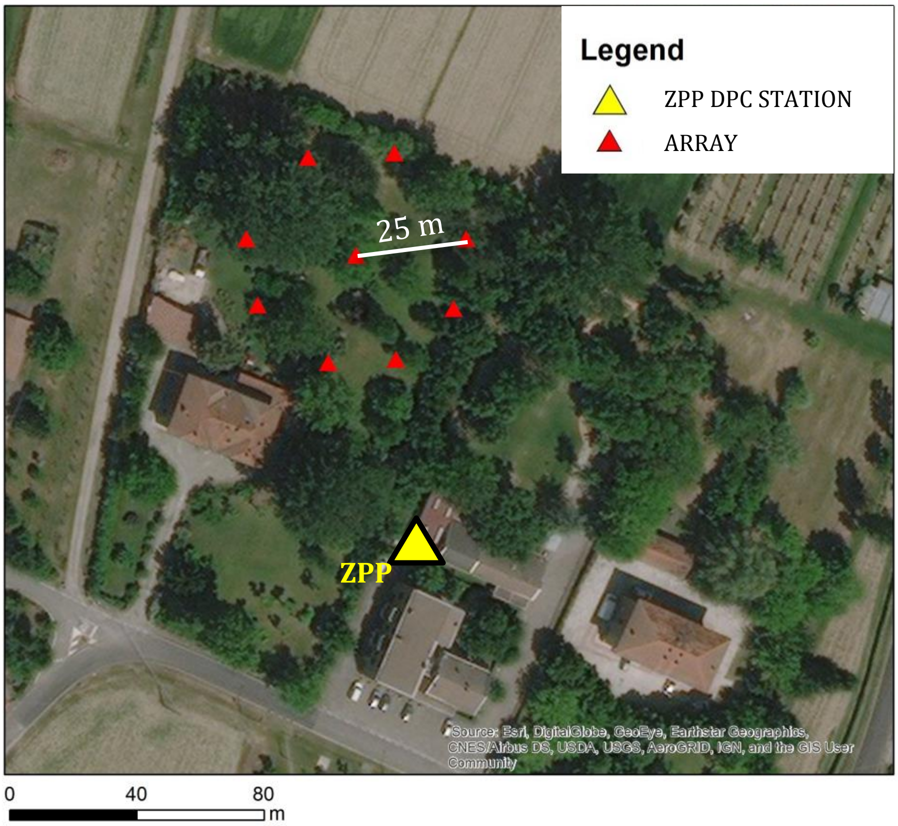

Figure 1: Plan view of the geophysical measurements performed at IT-ZPP site. The red points are the nine stations of the 2D array in passive configuration (all stations are equipped with Reftek R130 digitizer and Lennartz 3D-5sec velocimetric sensors). The yellow triangle indicates station IT-ZPP. The array is in a circular configuration with a ray of 25 m.

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2.1 ARRAY MEASUREMENTS RESULTS

A 2D array was performed using 9 single seismic stations equipped with Reftek 130 digitizers and Lennartz 3d-5s velocimetric sensors. The common noise recording lasted about 2 hours. A view of the 2D passive array survey is shown in Figure 2.

The seismic sensors were positioned in a circular geometry with ray of 25 m, as shown in Figure 2.

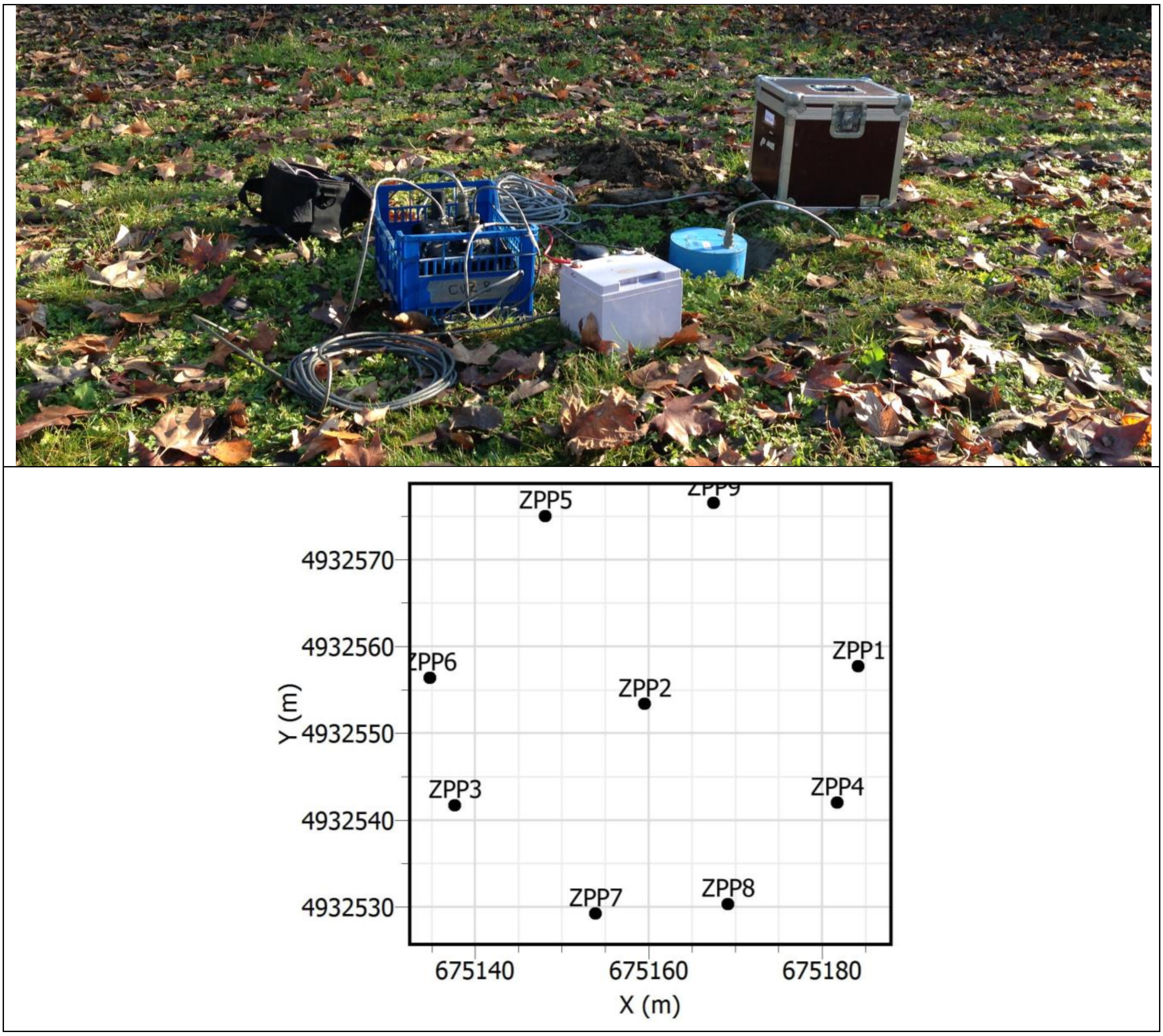

Figure 2: Top: installation of a station of the 2D array. Bottom: 2D Array geometry

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The geometry of the array allows the performance described in Figure 3.

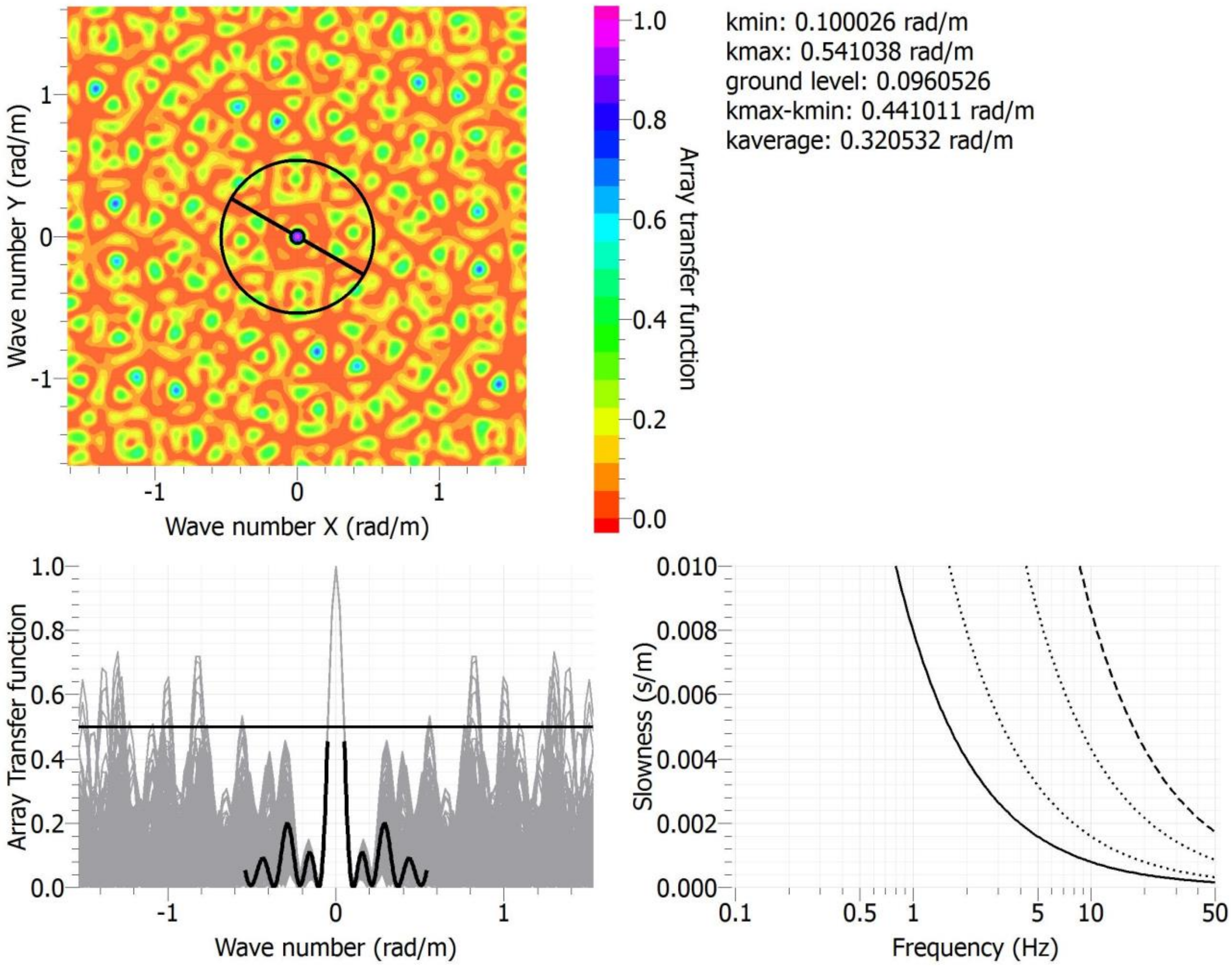

Figure 3: Theoretical Array Transfer function for the 2D array at IT-ZPP

In Figure 4, a representative H/V curve among the 9 stations of the array is reported, highlighting a broad peak from 0.35 to 0.9 Hz, where two main amplified frequencies can be recognized at 0.4 and 0.69 Hz. The analysis was performed with 120 s time windows and Konno & Ohmachi smoothing with the b coefficient set to 40. The rotated HV spectral ratios evidence consistently the same broad peak (0.35-0.9 Hz) showing no significant polarization effect.

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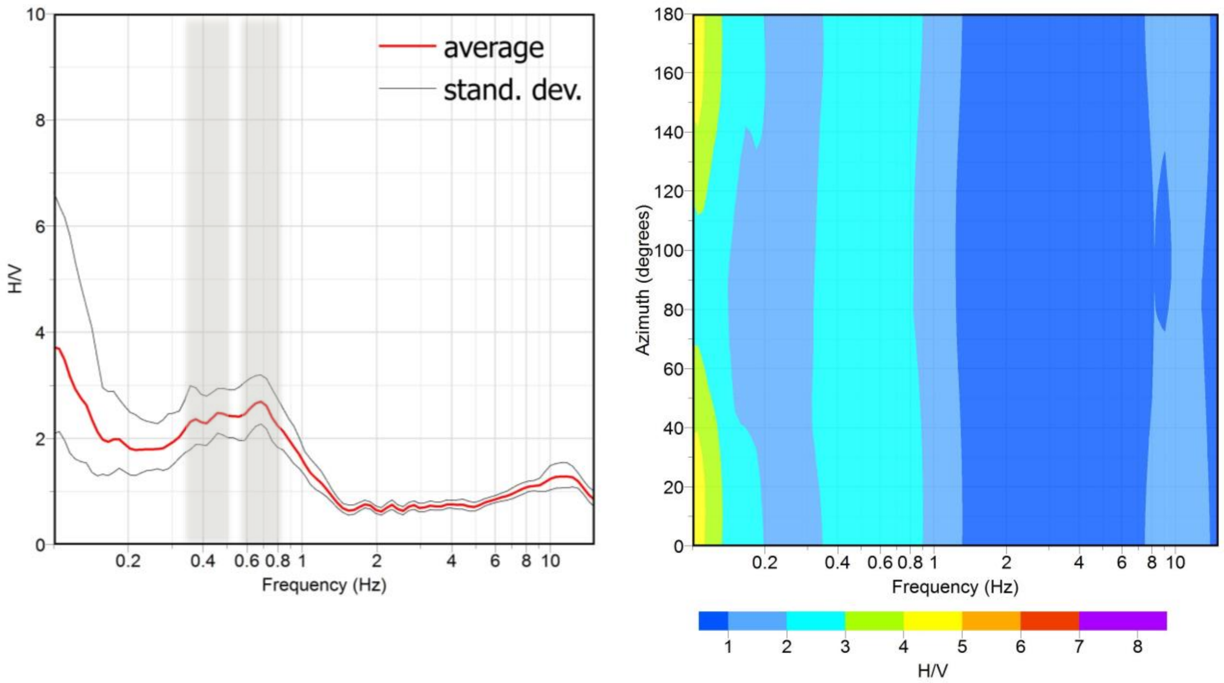

a) b)

Figure 4: a) representative H/V curve and b) rotated H/V of the 9 seismic stations of the array

Data from the 2D array have been analyzed in terms of FK analysis and MSPAC analysis. The two techniques were both considered for the definition of the Rayleigh wave dispersion curve, fundamental mode only (Figure 5). For the analysis, we used the GEOPSY code (http://www.geopsy.org).

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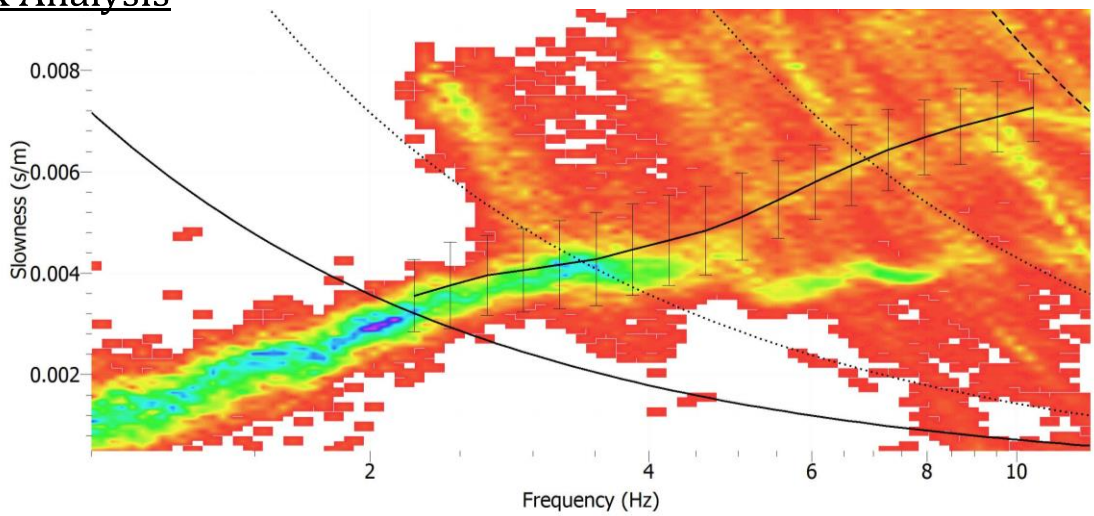
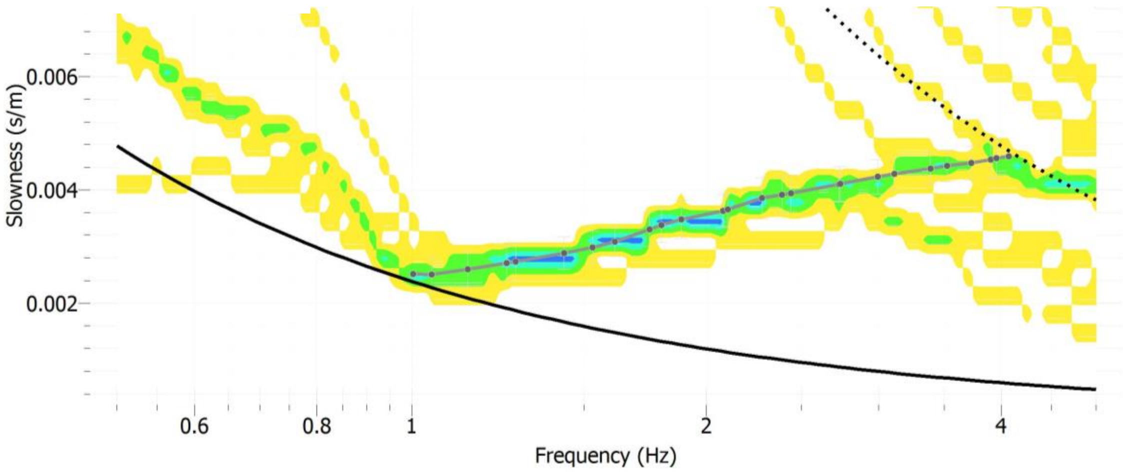
F-K Analysis



a)

MSPAC Analysis



b)

Figure 5: picked dispersion curve for the 2D array, with the FK method (a) and MSPAC method (b)

We interpret and assume that the dispersion curve obtained with the 2D array is relative to the fundamental mode of the Rayleigh dispersive waves. On the FK Analysis, the contribution of higher modes is evident between 5-10 Hz but it was not considered.

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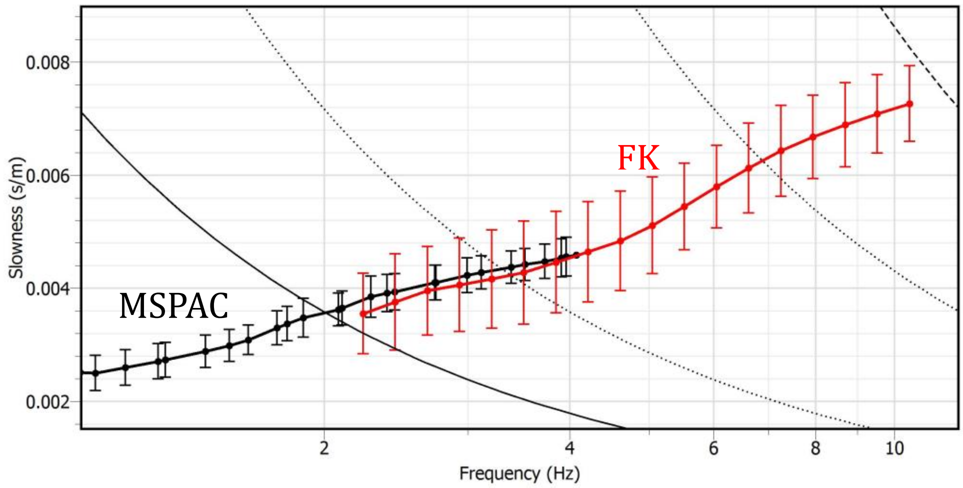
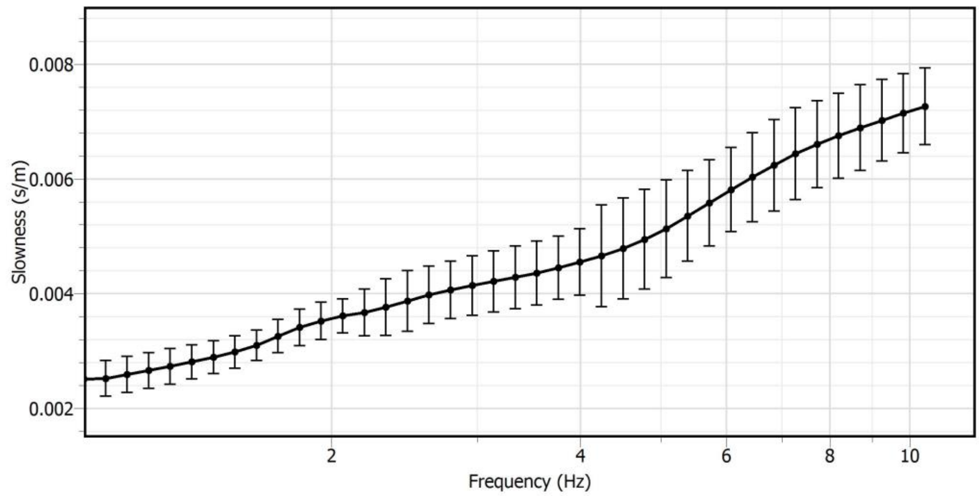
3. Vs Model

Comparing the two dispersion curves in Figure 5, coming from the 2D passive array, we observe a good match (Figure 6a). In particular, the MSPAC method can better define the lower frequencies, whereas the FK method can better define the higher frequencies, therefore the final dispersion curve considered for the inversion is a combination between the two (Figure 6b).



a)



b)

Figure 6: a) comparison between the dispersion curves obtained with different methodologies; b) dispersion curve considered for the inversion.

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To proceed with the inversion, we estimate the ellipticity curve from the H/V curve (Figure 4a), considering in particular the right flank of the H/V peaks, where the influence of the Rayleigh waves is higher. Moreover, a common practice to reduce the contribution of other waves in the H/V flanks is to reduce the amplitude for the square root of 2 (Figure 7).

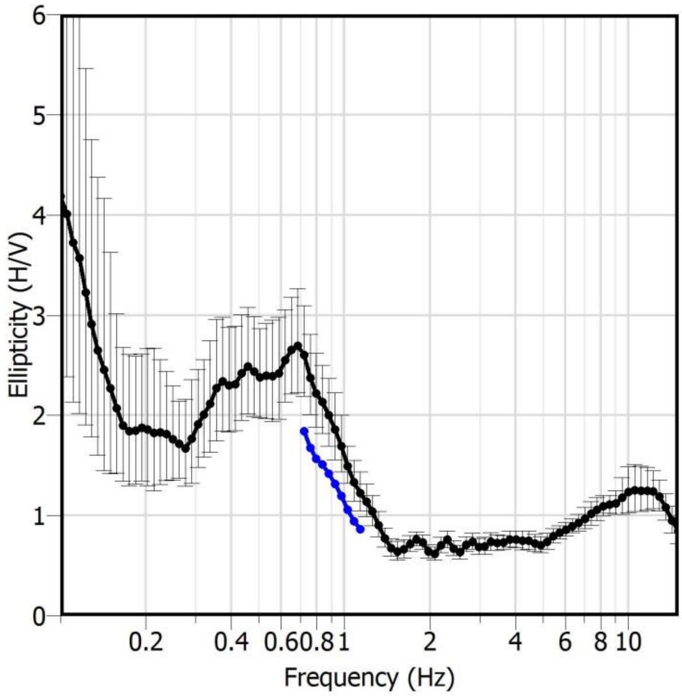

Figure 7: estimation of the ellipticity curve (blue) from the H/V curve (black).

Finally, we jointly invert the following targets:

1) Ellipticity curve as in Figure 7 (blue curves)
2) Rayleigh wave dispersion curve (fundamental mode) in Figure 6b

Figure 8 shows the comparison between the targets obtained experimentally and the ones expected for the Vs model proposed for this site.

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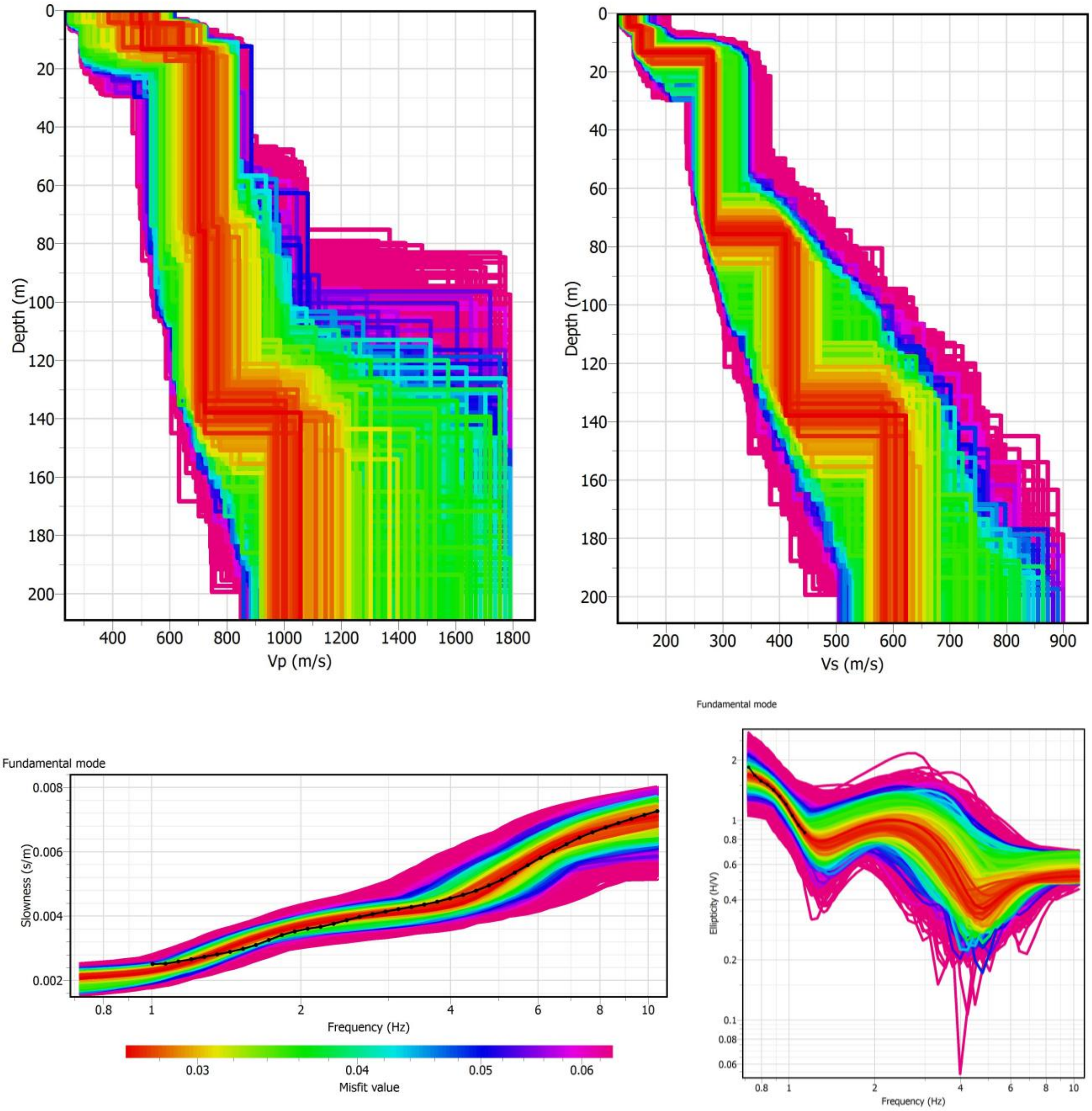

Figure 8: Inversion of the dispersion curve obtained with the 2D passive array, constrained with the H/V results.

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The best-fit Vp and Vs model are proposed in Figure 9 and Tab 1.

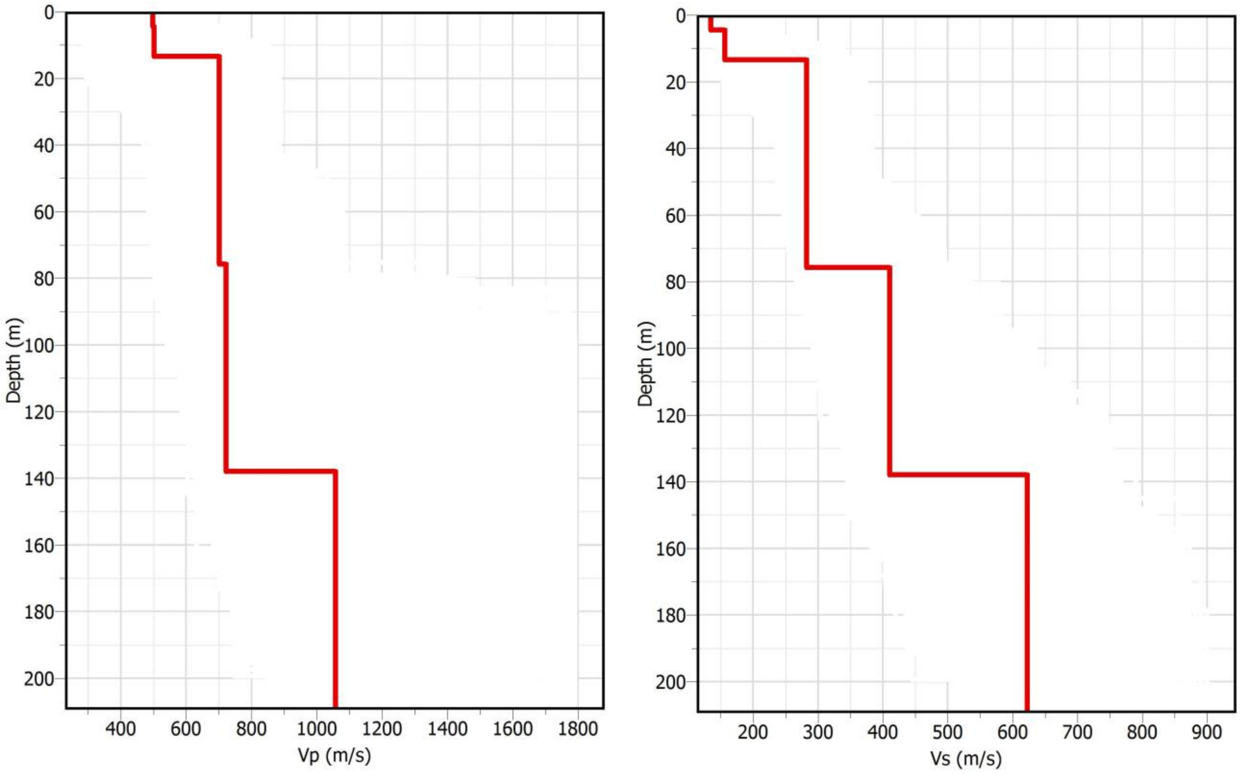

Figure 9: Best-fit model of Vp (left panel) and Vs (right panel) values

From (m)	*To (m)*	*Thickness (m)*	*Vs (m/s)*	*Vp (m/s)*
0	4	4	135	497
4	12	8	157	502
12	75	63	283	699
75	137	62	410	721
137			625	1054

Tab 1 Best-fit model

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4. Conclusions

The H/V analysis for this site shows a broad peak from 0.35 to 0.9 Hz, where two main amplified frequencies can be recognized at 0.4 and 0.69 Hz with no significant polarization effects. The right flank of the H/V peak was considered for the analysis, as shown in Fig. 7, whereas the results of the joint inversion of the dispersion and ellipticity curves are shown in Fig. 8. In this case, the seismic bedrock depth was not reached.

The V_{s30} retrieved from the joint inversion of the dispersion and ellipticity curves is 290 m/s (Tab 2), therefore IT-ZPP is classified as soil class C in terms of NTC 08 seismic classification.

V_{s30} (m/s)	***Soil class***
208	C

Tab 2: Soil Class

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