Site Effects Assessment Using Ambient Excitations

SESAME

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Final report on

Measurement Guidelines

LGIT Grenoble, CETE Nice

WP02

H/V technique : experimental conditions

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Summary

In the following we report the final results for WP02-Measurement Guidelines. This work was conducted under the framework of the **SESAME Project** (Site Effects Assessment Using Ambient Excitations, EC-RGD, Project No. EVG1-CT-2000-00026 SESAME), Task A (H/V technique), Work Package 02 (WP02 – Measurement Guidelines).

A - Introduction

WP02 Partnership

LGIT	Laboratoire de Géophysique Interne et Tectonophysique	Grenoble, France
UIB.ISI	Insitutt for Geovitenskap, Universitetet I Bergen	Bergen, Norway
ETH	Swiss Federal Institute of Technology	Zürich, Switzerland
ICTE	Insituto de Ciências da Terra e do Espago, Universidade de Lisboa	Lisbon, Portugal
INGV	Instituto Nazionale di Geofisica e Vulcanologia	Roma, Italy
CETEMED	Centre d'Etudes Techniques de l'Equipement Méditerranée	Nice, France

This part of WP02 started in July 2001, with the first proposal of directions for use and a list of parameters to test. A series of meetings and informal gatherings were held in Postdam, Nice, Rome and Grenoble, to discuss the status of data collection and processing. Each team collected and processed its own data using its own software. Team progress reports were used to redirect the objectives.

WP02 goals

This work package is dedicated to the evaluation of the influence of experimental parameters in stability and reproducibility of H/V estimation from ambient vibrations:

Reminder (extract of the SESAME technical report):

Task A: On the technical side, series of investigations will be carried out to clearly identify the key elements in each of the two techniques considered (H/V: task A…), and to clearly assess the conditions under which they have to be performed to provide reproducible, reliable, meaningful results: experimental conditions for the measurements, and processing techniques as well.

WP 02 [H/V technique, experimental conditions] is dedicated to investigations on the required experimental conditions (instrumental characteristics, data acquisition environment) for warranting the stability and reproducibility of measurements,

To achieve this goal, the influence of various types of parameters had to be tested on the results of H/V curves both in frequency and amplitude.
The parameters to be checked (see Annex 1) were decided by the participants.

Final report

Data processing

For the sake of uniformity, data sets from all teams were re-processed using a program written by Guillier and Chatelain. The SESAME software could not be used because (1) it is not made for comparisons between two data sets and (2) at the time it was not running on a Macintosh platform. The program is based on the same routines as the SESAME software for H/V computing.

Results presentation

The results are presented by the means of four graphs: (1) the H/V results of the reference, (2) the H/V results of the tested parameter, (3) a comparison between these two results and (4) the standard deviations of graphs 1 and 2 together on the same graph. Evaluations of the influence of the tested parameter on the results are mainly derived from these graphs.

B - Data Acquisition

Experimental parameters
The experimental tested parameters are classified in nine families, termed P1 to P9 (see annex 1). Two types of parameters can be distinguished:

- parameters relative only to the characteristics of the site itself and to the instrumentation. Ideally, the noise source and external conditions should not vary during the experiment. This is the case for the series of parameters P1, P2, P3, P4, P5, and P6;
- parameters relative to the variation of external conditions at the same place (weather, time, noise sources …): P7, P8 and P9.

Site types
The sites were classified following their fundamental frequency (f_0):

- $f_0 \leq 1$ Hz : low frequency site ;
- 1 Hz < $f_0 \leq 5$ Hz : medium frequency site ;
- $f_0 > 5$ Hz : high frequency site ;
- flat curve without identifiable peak: no peak site.

As far as possible the parameters have to be tested at all of the four types of sites.

Recording conditions
For the first series of parameters it is recommended to perform the experiment with a reference recording (i.e. as it would have been performed during say a microzonation experiment), and a test recording (i.e. with a change in the recording conditions with respect to the reference recording). Only one change in the recording conditions should be tested at a time. It is also recommended to perform the two recordings at the same time, or at least immediately one after another, the two recordings being separated by a time lag roughly corresponding to the recording duration.

The recordings of the reference and tested parameter of the second series are performed at the same place, but obviously not at the same time.

We categorized the mode of recording based on the time lag between the two recordings:

- synchronous: the two recordings are performed exactly at the same time. There is no time lag between the beginning of the recordings;
- simultaneous: the two recordings performed at the same time, but there is a time lag of few seconds between the beginning of the recordings;
- sequential: the two recordings are performed at different times. The time lag between the recordings can vary from several minutes (for parameters of the first series) to several days, weeks or months (for parameters of the second series).

As far as possible the first series of tests should be performed at the same place on each of the four types of site. Several changes in the recording conditions can occur.

As far as possible, the reference recordings used for different tests should be performed with the same recording parameters (gain, sampling rate, length of recording).

Equipment
The tests were performed with the use of the following stations:
- Bergen: Geosig GBV316
- Grenoble: CityShark, CitySharkII
- Lisbon: CityShark, Mars Lite

- Nice: Hathor3, Mars 88, Mars Lite
- Roma: Reftek, Mars Lite
- Zurich: Mars 88

and the following sensors:
- Bergen: 4.5 Hz built-in sensor (from Netherlands)
- Grenoble: 5-second Lennartz, 4.5-Hz Mark Products L-28, 20-second Lennartz, 1-Hz Lennartz LE-3D Lite
- Lisbon: 5-second Lennartz, 1-Hz Lennartz LE-3D Lite
- Nice: 5-second Lennartz, 2-Hz Mark Products L22, 1-Hz Mark Products L4-3D
- Roma: 5-second Lennartz, Guralp CMG40
- Zurich: 5-second Lennartz

C - Data Processing

For each tested parameter, H/V data are computed for a reference and the tested parameter data. The results are average H/V amplitudes and their corresponding standard deviations. Then, a Student-t test is performed to analyze the degree of similarity between the two curves. Finally, the average frequency and standard deviation from individual windows of the two frequency peaks are computed.

Initial data format

- Bergen : SEISAN
- Grenoble : CityShark
- Lisbon : CityShark, Mars Lite
- Nice : Hathor, Mars Lite, Mars 88
- Roma : Reftek, Mars 88
- Zurich : Mars 88

For processing, all data files were transformed into Sesame ASCII Format (SAF) by each concerned team, except data in CityShark format. SAF parameters were defined by WP02 participants (see description in 2002 WP03-Nice-Minutes).

Windowing parameters

- STA : 2 seconds
- LTA : 30 seconds
- STA/LTA min. : 0.3
- STA/LTA max. : 2
- Window length: a minimum window length of 25 seconds is entered and the program is looking for stable windows of this length up to the next power of 2 of the number of samples. The window length can therefore vary from 25 seconds to 32.76 (for data acquisition sample rates of 62.5, 125, 250 Hz) or 40.96 seconds (for data acquisition sample rates of 50, 100, 200 Hz). Window overlapping is not used.

When the parameter to test is composed of perturbations in the signal (e.g. transient), in order for the program to keep the windows where the perturbations occur, the data have been processed with the following changes in the windowing parameters : STA/LTA min. = 0.01 and STA/LTA max. = 10. These changes were applied to the processing of : P1-3, P9-1, P9-2, P9-3, P9-4, P9-6 and P9-7.

Input file

The processing program reads an input file in which are given (1) the data file names to be processed, (2) information about the tested parameter, and (3) some information about data acquisition.

The file is organized in the following way:

- line 1 : code of parameter tested, data acquisition team, and test number
- line 2 : reference data file name
- line 3 : station used for the reference recording
- line 4 : sensor used for the reference recording
- line 5 : tested parameter data file name
- line 6 : station used for the tested parameter recording
- line 7 : sensor used for the tested parameter recording
- line 8 : type of recording (synchronous, simultaneous, sequential)
- line 9 : description of the tested parameter

- line 10 (optional) : more information's about the tested parameter (has to be a blank line if not used).

Example :
line 1 : P8-2-Roma-test27
line 2 : rov5_19980310_2340.saf
line 3 : Reftek 72A07
line 4 : Guralp CMG 40T
line 5 : rov5_19980314_1912.saf
line 6 : Reftek 72A07
line 7 : Guralp CMG 40T
line 8 : sequential
line 9 : H/V stability over time-site low frequency peak
line 10 : On natural soil. Ref : T0 ; Test : T0 + 90 hours

This information has no effect on H/V computation, except for the data file names that have to be processed.

H/V computation
H/V computation is performed through the following steps :

1. Offset removal : the mean of the entire signal recorded is deducted from each sample value.
2. Stable signal windows are selected and processed one by one :
   - a cosine tapering with a length of 5% is applied on both side of the window signal of the vertical (V), North-South(NS) and East-West(EW) components.
   - a FFT is applied to the signal of the three components to obtain the three spectral amplitudes.
   - a Konno and Ohmachi smoothing, with a bandwidth of 40 and arithmetical average, is applied to the three spectral amplitudes.
   - H/V is computed by merging the horizontal (NS and EW) components with a quadratic mean $H = \frac{\sqrt{NS^2 + EW^2}}{2}$.

   Thus, in each of the $n_{windows}$ windows the distribution of $\log_{10}(H/V)$ is obtained as a function of the frequency.

3. The geometric mean of H/V is calculated :
   - H/V is averaged over all window results : $H/V_{average} = \frac{\sum \log_{10}(H/V)}{n_{windows}}$
   - H/V standard deviation is calculated : $\sigma_{H/V} = \sqrt{\frac{\sum \log_{10}^2(H/V) - n_{windows} \times \log_{10}^2(H/V_{average})}{(n_{windows} - 1)}}$
4. $H/V_{average}$ and $\sigma_{H/V}$ are set back to a linear scale by calculating $\overline{H/V} = 10^{H/V_{average}}$ and $\sigma_{\overline{H/V}} = 10^{\sigma_{H/V}}$

Note : no sensor nor station correction is applied to the rough signal.

D - Similarity between Reference and Tested Parameter

In order to evaluate the effect of a given change in the recording parameters we have to compare the H/V results of the reference and the tested parameter. This comparison has to be made in an objective way, i.e. with the use of a statistical method.

Student-t test

The Student-t test is one of the most commonly used techniques for testing an hypothesis on the basis of a difference between sample means. It determines a probability that two populations are the same with respect to the variable tested. The basis of the t-test would be known as 'Gosset's t distribution' if it were not for contractual obligations that prevented W.S. Gosset from taking credit for its development. Gosset used measurements of the heights and left middle finger lengths of criminals in a local prison to work out the t-distribution empirically. The mathematical theory followed. Gosset published his distribution in 1908 under the pseudonym 'Student'.

The t-test can be performed knowing just the means, standard deviation, and number of data points. Note that the raw data must be used for the t-test. The two sample t-test yields a statistic t, in which

$$t = \frac{|\overline{x}_1 - \overline{x}_2|}{\sqrt{A \times B}} \qquad (1)$$

where

$$A = \frac{(n_1 + n_2)}{n_1 n_2} \qquad (2)$$

$$B = \frac{(n_1 - 1)\sigma_1^2 + (n_2 - 1)\sigma_2^2}{n_1 + n_2 - 2} \qquad (3)$$

$\overline{x}$ is the sample mean, and σ is the sample standard deviation. Note that the numerator of the formula is the difference between the means and the denominator is a measurement of experimental error in the two groups combined. Thus the higher the value of t, the greater the confidence that there is a difference.

Probability tables have been prepared based on the t-distribution originally worked out by W.S. Gossett. To use the table, one has to find the critical value (t_0) that corresponds to the number of degrees of freedom $(n_1 + n_2 - 2)$. If |t| exceeds t_0, the means are significantly different with a (1- 2p) probability, where p is the probability level listed in the table.

As the Student-t test is very sensitive, it has been decided to use the probability level p = 0.001 to find the t_0 to be compared to t.

The Student-t test has been applied to compare both the H/V amplitudes and peak frequencies of the reference and tested parameter (see also section F and appendix 3).

H/V amplitudes t-test

The H/V amplitude t-test has been computed using the output of H/V amplitude averages of the reference and tested parameter and their corresponding standard deviations. The parameters of formulas (1) to (3) were determined for each frequency as follows :

$\overline{x_1}$: H/V amplitude of the reference
$\overline{x_2}$: H/V amplitude of the tested parameter

σ_1 : standard deviation of $\overline{x_1}$
σ_2 : standard deviation of $\overline{x_2}$

n_1 : number of signal windows used to compute $\overline{x_1}$
n_2 : number of signal windows used to compute $\overline{x_2}$

As the outputs of the H/V computation are $\overline{\mathrm{H/V}} = 10^{\mathrm{H/V}_{\mathrm{average}}}$ and $\sigma_{\overline{H/V}} = 10^{\sigma_{\mathrm{H/V}}}$, we have to use $\overline{x} = \log_{10}(\overline{\mathrm{H/V}})$ and $\sigma = \log_{10}(\sigma_{\overline{H/V}})$.

In order to have a better graphic visualization of the test, instead of plotting t and t_0, we plotted $\mathrm{Diff}_{\mathrm{H/V}} = \overline{x_1} - \overline{x_2}$ and t = $t_0\sqrt{A \times B}$. In this case, if $|\mathrm{Diff}_{\mathrm{H/V}}|$ exceeds t, the H/V amplitudes are significantly different at the probability level (1-2p).

Frequency peak t-test

The parameters of formulas (1) to (3) were determined as follows :

$\overline{x_1}$: average frequency peak of the reference
$\overline{x_2}$: average frequency peak of the tested parameter

σ_1 : standard deviation of $\overline{x_1}$
σ_2 : standard deviation of $\overline{x_2}$

n_1 : number of $\overline{H/V}$ windows used to compute $\overline{x_1}$
n_2 : number of $\overline{H/V}$ windows used to compute $\overline{x_2}$

The peak frequencies (f_0) of the reference and the tested parameter are obtained from the H/V results of each window used to compute $\overline{\mathrm{H/V}}$. In each individual H/V window the frequency peak is searched in the interval $[f_0/R_f, f_0 \times R_f]$, from which the average frequency peak $(\bar{f}_0)$ is obtained. We have decided to set :

$$R_f = 1.5 - 0.25\frac{(f_0 - f_{min})}{(f_{max} - f_{min})}$$

For WP02 it has been decided to use $f_{min} = 0.2\mathrm{Hz}$ and $f_{max} = 20\mathrm{Hz}$. Therefore we have :
$1.25 \le R_f \le 1.50$

Windows without peak in the interval (i.e. where no point was both preceded and followed by at least one point with a lower amplitude) were rejected.

The standard deviation was calculated as $\sigma(\bar{f}_0) = \sqrt{\frac{\sum(f_i - \bar{f}_0)^2}{(n-1)}}$, where n is the number of windows kept to calculate $\bar{f}_0$.

For a homogenous use of the Student-t test, instead of plotting t and t_0, we plotted $\mathrm{Diff}_f = (\overline{x_1} - \overline{x_2})$ and t = $t_0\sqrt{A \times B}$ as for the H/V curves. In this case, if $|\mathrm{Diff}_f|$ exceeds t, the peak frequencies are significantly different at the probability level (1-2p).

E - Output Data Organization

For each tested parameter, data are stored in a folder containing the following files :

Program input files :

- signal of recorded ambient noise of the reference and the tested parameter (2 files);
- one input file (1 file, named input_file), described in section C.

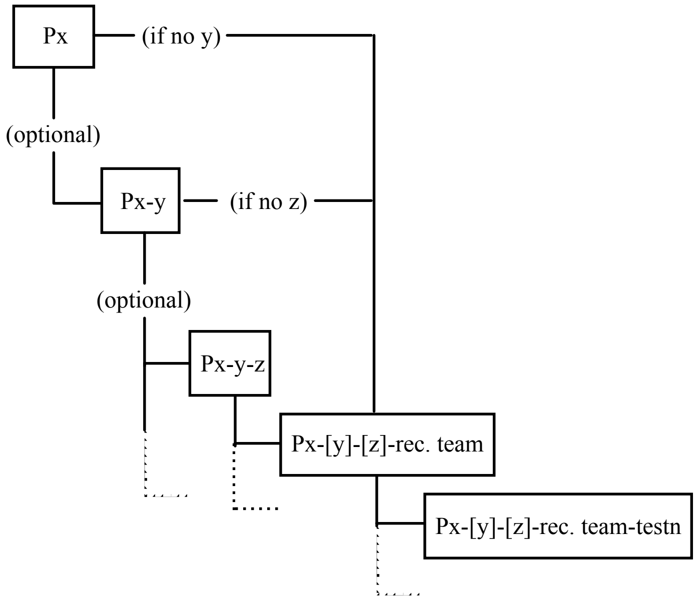
Program output files :

- $\overline{\mathrm{H/V}}$ results for the reference and the tested parameter (2 files). Names start with *HV*, followed by the name of the processed ambient noise data file. Each file comprises 10 columns in which are stored, in the following order : frequency, $\overline{\mathrm{H/V}}_{\mathrm{N-E}}$ computed by averaging the two horizontal components, $\overline{\mathrm{H/V}}_{\mathrm{N-E}}/\sigma$, $\overline{\mathrm{H/V}}_{\mathrm{N-E}}\times\sigma$, $\overline{\mathrm{H/V}}_{\mathrm{N}}$ computed using the North-South component, $\overline{\mathrm{H/V}}_{\mathrm{N}}/\sigma$, $\overline{\mathrm{H/V}}_{\mathrm{N}}\times\sigma$, $\overline{\mathrm{H/V}}_{\mathrm{E}}$ computed using the East-West component, $\overline{\mathrm{H/V}}_{\mathrm{E}}/\sigma$, $\overline{\mathrm{H/V}}_{\mathrm{E}}\times\sigma$;
- H/V for each frequency in each selected window for both the reference and the tested parameter (as many files as the number of windows). File names start with *win-*, followed by the name of the input data file and end with *–nnn*, where *nnn* is the window number. Files comprises 3 columns in which are stored, in the following order : frequency, $\mathrm{H/V}_{\mathrm{N-E}}$ computed by averaging the two horizontal components, $\mathrm{H/V}_{\mathrm{N-E}}/\sigma$, $\mathrm{H/V}_{\mathrm{N-E}}\times\sigma$;
- H/V amplitudes student parameters. The file is named *stud_temp*. It comprises 4 columns in which are stored, in the following order : frequency, $\mathrm{Diff}_{\mathrm{H/V}}$, t, and –t ;
- the technical card (1 file, in pdf format), which name includes the tested parameter number, the name of the team that performed the test, and the test number, followed by *.pdf*. The technical card is described in section F as well as in annexes 2, 3 and 4 ;
- a *Result* file were information about data processing is given. An example of the *Result* file is shown in appendix 5 ;
- if photos have been taken there are in a folder called *photo*.

Example (files in folder P1-1-1-Grenoble):

Test 1 station 1
Test 1 station 3
input_file
HVTest 1 station 1
HVTest 1 station 3
win-Test 1 station 1-001
win-Test 1 station 1-002
(…)
win-Test 1 station 1-019
win-Test 1 station 1-020
win-Test 1 station 3-001
win-Test 1 station 3-002
(…)
win-Test 1 station 3-019
win-Test 1 station 3-020
stud_temp
P1-1-1-Grenoble-test1.pdf
Result

The folder is located at the end of the following hierarchical tree :



Even when there is only one experiment on the tested parameter the name of the folder (Px-[y]-[z]-rec. team-testn) includes the test number, i.e. test1.

Besides the code number of the tested parameter, the name of each folder from Px to Px-y-z includes a description of the tested parameter.

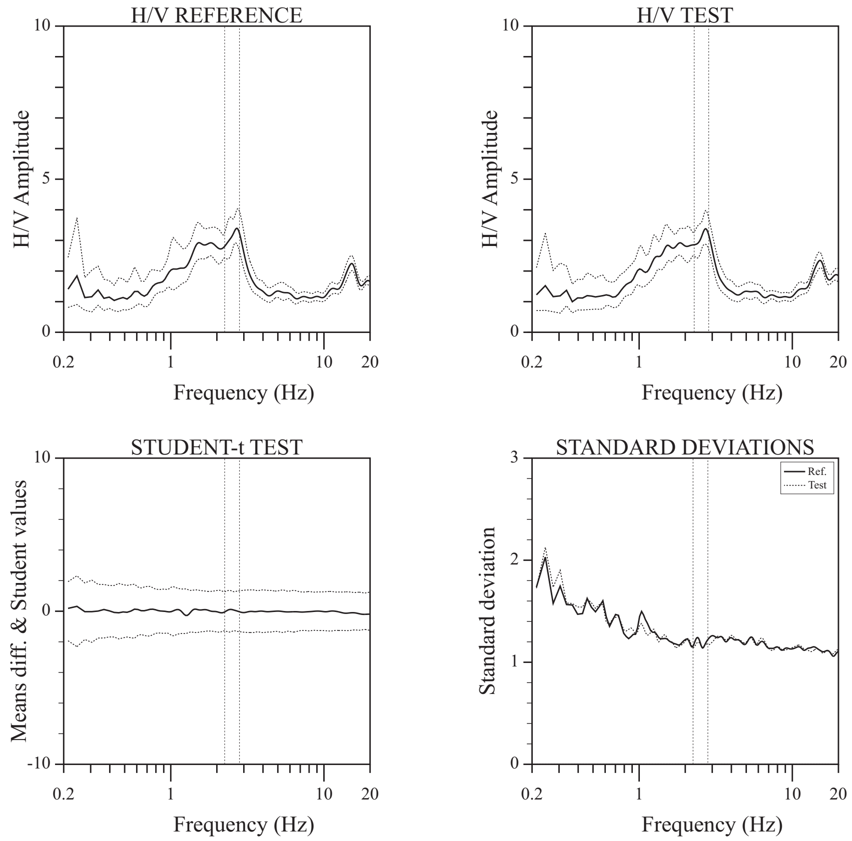
Examples:

P1-Recording-instrument parameters
P1-1-Influence of recorder
P1-1-1-one sensor with several recorders

F - Technical Card

After the processing, the above mentioned program produces a technical card (Figure 1), which includes :

1. four graphs : H/V graphs of the reference and the tested parameter, the Student-t test graph and the two standard deviations grouped on a graph ;
2. two tables describing the peak frequency results, some acquisition parameters and some processing parameters, as well as a short conclusion on the influence of the tested parameter on the H/V results. The acquisition parameters come from the input file mentioned above. The acquisition parameters come from the ambient noise data files.



	File name	f0 ($\overline{H/V}$) (Hz)	Nb win	Sample rate (Hz)	Recording duration (s)	Frequency stastistics from individual windows			
						$\overline{f0}$ (Hz)	Sigma (Hz)	Nb win	Student-t test
Ref.	01221442.saf	2.72	21	250	720	2.53	0.28	21	|diff| = 0.04 t = 0.31 Similar peak frequencies
Test	001c7dd60 096dc0.saf	2.75	20	250	720	2.57	0.28	20	
	Conclusion	NO INFLUENCE							

	Recorder	Sensor	Rec. type : simultaneous	Medium frequency site
Ref.	Mars Lite	5-second Lennartz LE3D	**P1-1-2-Grenoble Nice-test5** Influence of recorder Same type sensors with recorders of different type	
Test	Mars 88	5-second Lennartz LE3D		

Figure 1 : Example of technical card

Explanations on the content of the technical card are in annexes 2 (graphs), 3 (upper table) and 4 (lower table).

G - Results

The aim of WP02 is to evaluate the influence of various parameters on the H/V results. The results are classified into three main categories : (1) the parameters that do not influence the results, (2) those that influence the results and (3) those that may influence the results. The later are separated into two groups : (3) those which influence the results only beyond some limits that can easily controlled and set up, and (4) those on which there is no possible control. Finally some tested parameters produce rather mitigated results and it would be necessary to conduct further testing. These parameters are not grouped in a particular category, the information is given in the conclusion of the concerned test.

The results are also summarized in two tables showing :
- a list of the tests according to the type of sites on which they were performed (Table 1) ;
- a synthesis of results and conclusions for each tested parameter (Table 2).

In order to avoid artificial discrepancy in the results, those that were obtained with a small number of windows (< 6) and for which the standard deviation was high are not used in parameter conclusion settings. Therefore, they are not taken into account in the tables, but are, however, kept and presented in the final data set.

For each tested parameter, we give :
- its reference number, as in annex 1 ;
- the number of tests performed ;
- a short description of the tests ;
- the reference of the figure in which an example is shown ;
- the conclusion about the impact of the parameter on H/V results.

1. PARAMETERS THAT *DO NOT INFLUENCE* H/V RESULTS

P1 Recording/instrument parameters

These experimental field tests complement the laboratory instrumental tests from Bergen, completed in 2002 (Deliverable D01.02)

P1-1 Recorder. Two types of experiments were conducted to test the influence of recorders.

P1-1-1. 10 tests. The signal from one sensor is recorded by several recorders of the same type. Figure 2.

P1-1-2. 12 tests. The signal from several sensors of the same type is recorded by recorders of different types. Stations tested : Hathor3, Mars Lite, Mars 88, CityShark, CitySharkII. Figure 3.

Conclusion : the type of recorder has no influence on the results, although comparison between Mars Lite and CityShark does not give the exact same results (6-7% outside the peak zone).

P1-3 Time for stabilization of the sensor. 8 tests. Figure 4.

Conclusion : shaking of the sensor has no influence. Only a CMG40 has been tested. It is interesting to notice that the shaking has no more influence after only 2 minutes. However, this type of sensor if not commonly used for H/V recordings. It is not worth testing its influence of time stabilization of the most commonly used sensors (e.g. 5-second Lennartz LE-3D, 1-Hz Lennartz LE-3D, 4.5-Hz Mark Products L28, 2-Hz Mark Products L22) as experience shows that they are stabilizing very rapidly (few tens of seconds) after the shaking produced when setting up the sensor.

P1-5 Sampling rate. 8 tests. Sample rates tested : 50, 100, 125, 200, 250 Hz. It was not possible to make comparison between all of the tested sample rates because the frequency step of the Fourier transform varies according to the sample rate. Figure 5.

Conclusion : sampling rate has no influence on the results.

P1-6 Sensor cable length. 9 tests. Lengths tested from 10 meters up to 100 meters. Figure 6.

Conclusion : cable length has no influence on the results, at least up to 100 meters, no matter how the cable is installed (rolled or stretched).

P1-7 Azimuth of the sensor. 4 tests. Figure 7.

Conclusion : the orientation of the sensor has no influence. However, all tests were performed over a homogeneous alluvium basin. Tests next to geologic discontinuities or 2D structures have still to be performed.

P2 In situ soil-sensor coupling

P2-3 Concrete. 11 tests. The peaks are the same and curves are quite similar. Figure 8.

Conclusion : recording on concrete is not a problem.

P2-6-1 Compacted snow. 2 tests. Tests were performed during no sunny days. Figure 9.

Conclusion : recording on compacted snow is not a problem, at least up to a thickness of 30 cm, and when the sun is not shinning.

P3 Modified soil-sensor coupling

P3-1-6 Artificial interface between in-situ ground and sensor : stratified wooden plate. 1 test. Figure 10.

Conclusion : recording on a stratified wooden plate do not influence the results. However only one test has been performed. It may be welcome to test the plate before use.

P3-1-7 Artificial interface between in-situ ground and sensor : agglomerated wooden plate. 3 tests. Figure 11.

Conclusion : recording on an agglomerated wooden plate do not influence the results.

P3-1-8 Artificial interface between in-situ ground and sensor : PVC plate. 2 tests. Figure 12.

Conclusion : recording on a PVC plate do not influence the results.

P3-1-11 Artificial interface between in-situ ground and sensor : metal plate with legs. 10 tests. Tests were performed on soil, concrete, grass and asphalt. There is only a slight influence on the frequency value of the fundamental peak : small influences are sometimes observed resulting in a double peak or higher amplitudes in the lower frequencies. Figure 13.

Conclusion : a metal plate does not influence significantly the results. However such plate should only be used when absolutely necessary.

P3-1-12 Artificial interface between in-situ ground and sensor : trihedron. 12 tests. Tests were performed on soil, concrete, grass and asphalt. Figure 14.

Conclusion : a trihedron has no influence on the results. Nevertheless, it is recommended to use it only when it is really necessary.

P3-1-13 Artificial interface between in-situ ground and sensor : ceramic plate. 1 test. Figure 15.

Conclusion : recording on a ceramic plate do not influence the results. However only one test has been performed. It may be welcome to test the plate before use.

P3-2 Sensor anchoring. 18 tests. Results are thoroughly not influenced by setting up the sensor in a hole whether filled or not. Some tests show some slight differences of the H/V amplitude over 10 Hz. Figure 16.

Conclusion : recording in a hole (filled or not) does not influence the results. However, some care about the first soil layer should be taken as to not entirely remove it when digging the hole. It is usually not needed to dig a hole to set up the seismometer anyway. However, data already collected with the seismometer in a hole (filled or not) can be used together with data collected on soil.

P3-4 Feet of sensor not blocked. 3 tests. Figure 17.

Conclusion : recording with or without the feet of the sensor blocked do not influence the results.

P3-6 Sand. 5 tests. Tests were made both on a pile of sand and on sand in a plastic container. Figure 18.

Conclusion : recording on sand either on a pile or in a plastic container do not influence the results.

P6 Weather

P6-4 Temperature. 9 tests. Tests were conducted only to compare morning and afternoon temperatures. Figure 19.

Conclusion : no influence in the 17.2° - 22.7° range. However, a slight squeeze of the peak amplitude can be observed for higher temperatures.

P8 Site response (for H/V stability with time)

P8-1 H/V variation with time on no-peak sites. 2 tests. Test intervals vary from 3 to 5 years. Figure 20.

Conclusion : there is no variation with time. However, given the fact that there are only 2 tests, it is hazardous to give a definitive conclusion.

P8-2 H/V variation with time on low frequency sites. 60 tests. From hours to 1 year. Figure 21.

Conclusion : there is no variation with time. The differences that appear for some tests are not related to time as later tests do not show differences ; they might be due to variations of weather or human activity. More test should be performed with notice of other possible variable parameters.

P8-3 H/V variation with time on medium frequency sites. 50 tests. From hours to 1 year. Figure 22.

Conclusion : there is no variation with time. The differences that appear for some tests are not related to time as later tests do not show differences ; they might be due to variations of weather or human activity. More tests should be performed with notice of other possible variable parameters.

P9 Noise sources

P9-5 High voltage cable. 27 tests. Tests were conducted at various distances from a high voltage line both perpendicularly to the line and underneath it. Figure 23.

Conclusion : the high voltage line does not perturb the results. The small difference in amplitude observed in the 6-7 Hz range may be due to variations in the surficial layer. The differences observed beneath the line are related to variations of the type of soil, not to the line.

P9-7 Music in car participating to the experiment. 2 tests. Figure 24.

Conclusion : A slight influence is noticed in the lower frequencies. People in charge of the recordings may listen to the music, not too loud though, but definitively avoid dancing on it next to the sensor as shown by test P9-1.

2. PARAMETERS THAT *DO INFLUENCE* H/V RESULTS

P2 In situ soil-sensor coupling

P2-2 Pile of gravel. 3 tests. Mitigated results. Figure 25.

Conclusion : avoid recording on a pile of gravel.

P2-9 Synthetic cover : tartan. 1 test. Figure 26.

Conclusion : recording on synthetic cover, such as tartan, influence the results and should be avoided.

P2-10 Karstic filling. 2 tests. The results on the calcareous rock and the filling are completely different. Figure 27.

Conclusion : recording on karstic filling greatly influence the results and should be avoided.

P3 Modified soil-sensor coupling

P3-1-1 Artificial interface between in-situ ground and sensor : styrofoam. 14 tests. Peak amplitudes are considerably amplified in the lower frequency range (< 1 Hz), and artificial secondary well marked peaks appear around 10 Hz. Figure 28.

Conclusion : styrofoam should definitively not be used to help setting the sensor.

P3-1-2 Artificial interface between in-situ ground and sensor : cardboard plate. 2 tests. Peak amplitudes are amplified in the lower frequency range (< 1 Hz), and artificial secondary well marked peaks appear around 10 Hz. Figure 29.

Conclusion : cardboard plate should definitively not be used to help setting the sensor.

P3-1-3 Artificial interface between in-situ ground and sensor : foam. 2 tests. Figure 30.

Conclusion : foam should definitively not be used to help setting the sensor.

P3-1-4 Artificial interface between in-situ ground and sensor : empty plastic container. 3 tests. Peak amplitudes are amplified in the lower frequency range (< 1 Hz), and artificial secondary well marked peaks appear above 10 Hz. Figure 31.

Conclusion : empty plastic container should definitively not be used to help setting the sensor.

P3-1-9 Artificial interface between in-situ ground and sensor : cement plate. 4 tests. While there is no influence on the frequency value of the fundamental peak , variable results were obtained on the rest of the curve, sometimes creating artificial peaks especially in the higher frequencies. Figure 32.

Conclusion : a cement plate can be used as far as it has been tested before use.

P3-3 Ballast on sensor. 4 tests. For a light ballast, while the frequency value of the peak is not changed, its H/V amplitude is quite higher and some light secondary peaks can show up. A heavy ballast completely changes the curve. Figure 33.

Conclusion : it is not recommended to set ballast on the sensor.

P5 Underground structures

P5-1 Large underground structures. 12 tests. Tests were conducted above a large cave and next to a subway tube. Figure 34.

Conclusion : it is not recommended to record on top of a large cave. Results obtained next to the subway tube show contradictory results, which might be explained by the influence of another parameter as no change is observed at the largest distance from subway. More tests are necessary.

P5-2 Small underground structure. 4 tests. Figure 35.

Conclusion : mitigated results. It is recommended anyway to avoid recording, for example, on top of a sewer lid.

P6 Influence of weather

P6-1 Wind. 5 tests. Figure 36.

Conclusion : avoid recording when strong wind is blowing. Tests for other parameters (grass, trees or H/V stability over time) also clearly show that wind can modify the results in great proportion. Tests on grass also show that even slight wind can influence the results.

P6-2 Rain. 5 tests. Figure 37.

Conclusion : the value of the frequency of the peak is not changed. The H/V amplitude is squeezed under heavy rain and secondary peak can appear in the higher frequencies. Light rain does not have a noticeable influence. It is recommended to avoid recording under the rain.

3. PARAMETERS THAT *MAY INFLUENCE* H/V RESULTS *WITH* POSSIBLE CONTROL

P1 Recording/instrument parameters

P1-2 Sensor. 17 tests. Figure 38. The following series of tests has been conducted :

- 5-second Lennartz LE-3D *vs* 1-Hz Lennartz LE-3D
- 5-second Lennartz LE-3D *vs* 4.5-Hz Mark Products L28
- 5-second Lennartz LE-3D *vs* 20-seconds Lennartz LE-3D
- 5-second Lennartz 4.5-Hz *vs* Mark Products L28
- 5-second Lennartz LE-3D *vs* 2-Hz Mark Products L22

Conclusion : similar curves are found except when using a 2-Hz Mark Products L22, with which even the peak frequency is found to be different, and marked amplitudes differences show up below about 1 Hz. More investigations are necessary for the L22 as all the tests were conducted with a single sensor. It is very interesting to note that results obtained with a 4.5-Hz Mark Products L28 give the same peak frequency even on low frequency sites.

P1-4 Gain. 24 tests. Gain does not influence the results as long as the signal saturation level is small. When the gain is so high that the saturation level becomes to important, the frequency peak value is not changed, but the H/V curve is somewhat squeezed. Figure 39.

Conclusion : avoid signal saturation due to too high values of gain. It should be noted that gain 1 does give very good results. It is therefore highly recommended to be rather conservative to set up the gain.

P1-8 Sensor horizontality. 2 tests. The only tested sensor is the 5-second Lennartz LE-3D .The sensor can be tilted, up to a point where peak frequency can still be found, but the H/V curve is drastically squeezed. Figure 40.

Conclusion : avoid important tilting of the sensor (> 4°, in the 5-second Lennartz LE-3D case).

P2 In situ soil-sensor coupling

P2-1 Grass. 37 tests. Results can be very different even on the same site. A peak or bulb can be observed at places in the lower frequency range. These phenomena can be reproduced artificially by setting the sensor on top of two layers of grass. It may also have been produced when recording over a tube with fluid running. Finally the main observation is that recording on grass can give quite different results when wind is blowing, even lightly. Figure 41.

Conclusion : It is highly recommended, in general, to remove grass to set the sensor up, especially when grass is tall, or at least to make sure that the sensor feet are set on the ground and not on the grass itself. In any case, recording on grass should be avoided when wind is blowing, or the sensor should be installed in a hole.

P2-4 Asphalt. 36 tests. The peaks can be a little squeezed, while amplitudes over 7-8 Hz can be a little higher. No test has been performed on high frequency sites. Figure 42.

Conclusion : recording on asphalt does not seem to be a real problem, except for slightly higher H/V values over 7-8 Hz. Tests should be performed on high frequency sites in order to check the influence of the higher amplitude values observed on other types of sites in the higher frequencies.

P2-5 Ice. 3 tests. Figure 43.

Conclusion : recording on ice is not recommended. The feet of the sensor produce local ice melting that destabilizes the sensor and causes important perturbations in the signal. We observe much higher amplitude levels in the lower frequencies. It is only once the sensor stabilized that results are no longer disturbed. Recording using an artificial interface should be tested.

P2-6-2 Not compacted snow. 14 tests. There is a notable difference when records are performed under the shade or exposed to the sun. More recordings under the sun should be performed with the sensor sitting on an artificial interface. Figure 44.

Conclusion : recording on snow under the shade is not a problem. Records obtained under the sun while showing the fundamental peak frequency are highly perturbed in the low frequency range where amplitudes are much higher than the amplitude peak frequency. Recordings under the sun are highly not recommended. However, recordings under the sun with the sensor sitting on a plate might give better results as the bad results are the consequence of the sensor feet melting the snow and sinking by step that highly perturb the signal.

P2-7 Ploughed soil. 4 tests. Figure 45.

Conclusion : recording on ploughed soil while giving some good results on thin ploughed layer, but should be avoided when the ploughed layer is thick. Peaks with very high amplitudes can show up, the H/V curve can be pushed towards higher amplitudes, or the fundamental peak frequency can be shifted.

P2-8 Mud. 2 tests. Different results are obtained depending on the mud thickness and presence of water. For recording performed in the thicker layer in presence of water , the peak frequency does not change, however amplitudes are much higher and an artificial peak appears in the higher frequencies. For the thin layer no change is observed over the H/V curve. Figure 46.

Conclusion : It is better to avoid recording in mud, especially when water is present. However, further tests are needed to better control the effect of mud on the results.

P3 Modified soil-sensor coupling

P3-1-5 Artificial interface between in-situ ground and sensor : wooden plate. 5 tests. Very variable results were obtained, from no influence to highly influencing depending on the kind of wood used. Figure 47.

Conclusion : a wooden plate may be used as far as it has been extensively tested before use.

P3-1-10 Artificial interface between in-situ ground and sensor : metal plate. 10 tests. While there is no influence on the frequency value of the fundamental peak, very variable results were obtained on the rest of the curve, sometimes creating artificial peaks, depending on the thickness of the plate and the kind of metal. Figure 48.

Conclusion : a metal plate can be used as far as it has been extensively tested before use.

P3-5 Feet of sensor removed. 6 tests. Tests performed directly on the ground, or in sand or gravel. The results are influenced on the ground, for which a squeeze of the H/V amplitude is observed all along the curve, and in gravel. Figure 49.

Conclusion : avoid recording without the feet of the sensor on the ground or on gravel whether in a container or not. Recording without feet on sand, whether in a container or not, does not influence the results.

P3-7 Gravel. 4 tests. Tests were made both on a pile of gravel and on gravel in a plastic container. Figure 50.

Conclusion : while the peak frequencies are not influenced, the H/V amplitudes are somewhat higher, and therefore recording on gravel either on a pile or in a plastic container is not recommended.

P9 Influence of noise sources

P9-1 Steps. 11 tests. Tests were performed with people walking around the sensor at various distances. It is not sure that it is representative of people passing by during a recording. Some tests could not be used due the weak number of windows (1-2). Figure 51.

Conclusion : It is not recommended to have too many people walking very close to the sensor. Passing-by people do not seem to raise too much problem. More tests should be conducted in a different way (people passing-by).

P9-2-1 Cars moving. 39 tests. 36 recordings were made at various distances from two highways one with quite heavy traffic, the second with lighter traffic, 3 recordings were made with a car turning around the sensor from 1 to 20 meters. Figure 52.

Conclusion : Avoid recording close to a highway with heavy high speed traffic. No influence from about 40 meters from highway. For light traffic no influence is noticed from about 15-20 meters from highway. Note that when processing data with the default parameters (i.e. with the anti-trigger on) the influence of traffic the results do not show much change. Cars moving around the sensor have a strong influence up to 20 meters.

P9-2-2 Cars turned on, not moving. 4 tests. Figure 53.

Conclusion : Amplitudes in the lower frequencies can be higher. It is not recommended to record close to a turned on vehicle.

P9-3 Trains. 2 tests. Not enough data for interpretation. More tests are needed. Figure 54.

P9-4-1 Machinery. 5 tests. One of the tests (working engine) could not be used because of the too small number of windows. Figure 55.

Conclusion : Avoid recording close to working machinery. If possible try to wait until it stops.

P9-4-2 Boat. 7 tests. Not used because of the too small number of windows. Figure 56.

4. PARAMETERS THAT *MAY INFLUENCE* H/V RESULTS *WITHOUT* POSSIBLE CONTROL

P4 Influence of nearby structures

P4-1 Large nearby structures. 13 tests. Tests made at various distances from a building before and after its construction. Figure 57.

Conclusion : tests close to the building indicate strong changes especially in the 5-10 Hz range. The recording conditions have to be investigated more deeply. The number of tests is not sufficient.

P4-2 Small nearby structures. 12 tests. Tests made at various distances from small structures. Figure 58.

Conclusion : close to the structure up to about 10 m the influence is highly noticeable especially under windy condition. More investigations should be conducted.

P9 Noise sources

P9-6 Sea. 6 tests. Test at various distances from the sea both when it was agitated and not. Figure 59.

Conclusion : the results are difficult to interpret. Due to the long distance from the sea, the observed differences may (or not) be related to differences in the soil.

H - Conclusion

The WP02 results are based on 596 recordings that were used to test 60 parameters. No-peak and high frequency sites are less documented (20 and 43 recordings respectively) than low and medium frequency sites (291 and 242 recordings respectively). However, when tested jointly they showed the same kind of results.

One of the main result of WP02 is that no matter how strongly a tested parameter influences H/V amplitudes curves the value of the frequency peak is usually **not affected**, with the noticeable exception of the wind.

H/V measurements in cities imply both reliability of the results and rapidity of data collection. It is therefore important to understand which recording parameters (1) influence data quality and reliability, and (2) can help speeding up the recording process.

H/V measurements in cities are conducted within the following context :

-it is quite rare to be able to get data on the soil *per se*. Most data will be obtained on streets (i.e. asphalt, or pavement) , sidewalks (i.e. asphalt, cement or concrete), and to a lesser extent in parks (i.e. on grass or soil) ;

-measurements are performed in an environment dominated by buildings of various dimensions ;

-recordings are not performed at the same time and under the same weather conditions.

Therefore the estimation of the possible influence of asphalt, grass, cement and concrete interfaces, that of nearby buildings, that of weather conditions and stability of the results over time are crucial issues for data quality and reliability. It is also crucial to make sure that the results are not equipment dependent. Most of these points are shown to be not influencing the H/V results, as long as the wind is not involved. However, some parameters need to be tested more thoroughly in order to get a more precise answer.

Rapidity of data acquisition, besides the duration of recording, is mainly dependent on the sensor setting and station parameterization. It is sometimes useful to use an artificial interface to help installing the sensor. WP02 results show that basically any equipment that has been tested can be used, that station parameterization does not matter significantly and that the sensor can be installed without too much precision as long as logical conditions are kept in mind (e.g. no signal saturation …). It is not recommended to use interface to set up the sensor, unless really necessary (e.g. to make it easier to level the sensor), in which case it is recommended to use of either container filled with sand or a trihedron.

Finally, concerning the recording team it has been clearly shown that it is not good to forget to turn the engine car off and that while it is not a problem to listen to the music while waiting for the data to be recorded, as long as it is not too loud, it is recommended not to dance around the sensor, even though the music is great.

Thanks to the results of WP02 it should now be quite easy to produce a booklet that will be written in order to help people concerned by the use of H/V-ambient noise for such tasks as, for example, microzonation. It will be useful two main reasons : (1) avoid experiments with wrong recording parameters and (2) somewhat standardizing data acquisition for this type of experiment, thus making it easier to compare results from different experiments.

Annex 1 : List of Parameters to be Tested

P1 Recording/instrument parameters

P1-1 Recorder. Recording the same noise by different recorders (same sensor)

P1-2 Sensor Recording the same noise by different sensors (same recorder)

P1-3 Time for stabilization of the sensor

P1-4 Numerical gain / analogical gain: perform several records at the same place using various gains.

P1-5 Sampling rate: perform several records at the same place using various sampling rate.

P1-6 Sensor cable length: perform several records at the same place using various lengths of cable connecting the sensor to the recorder.

P1-7 Azimuth of the sensor : perform several records at the same place rotating the sensor.

P1-8 Sensor horizontality perform several records at the same place progressively tilting the sensor.

P2 In situ soil-sensor coupling

P2-1 Grass / soil /soft ground : perform records with a grass slab or soft soil volume over natural ground (soft soil, rock, concrete, asphalt). Different surfaces, thickness and nature of soft soil should be tested.

P2-2 Gravel : perform records with some gravel over natural ground (soft soil, rock, concrete, asphalt). Different surface, thickness and nature of gravel should be tested.

P2-3 Concrete : perform records with concrete block over natural ground (soft soil, rock, concrete, asphalt). Different surface, thickness an nature of block should be tested.

P2-4 Asphalt: perform records at the same place successively on the ground without the asphalt then over the asphalt.

P2-5 Ice

P2-6 Snow : perform records on compacted and not compacted snow, under the sun and under the shade. Various thicknesses should be tested.

P2-7 Ploughed soil : perform records on various thicknesses of ploughed soils.

P2-8 Mud : perform records in mud with various water contents and various thicknesses.

P2-9 Synthetic cover : tartan

P2-10 Karstic filling : perform records on calcareous rock and dirt filling.

P3 Modified soil-sensor coupling

P3-1 Artificial interface between in-situ ground and sensor : perform records over an iron plate, rigid plastic, stereo foam, paper, box filled of sand …. Many different artificial interfaces can be set between the *in situ* ground and the sensor. Simultaneous records will be performed with/without interface for several types of *in situ* ground (soft soil, rock, concrete, asphalt…).

P3-2 Sensor anchoring : perform records with buried sensors at different depth ranging from 10 cm to 1 m and another one not buried.

P3-3 Ballast on sensor : perform records with a ballast on the sensor. Simultaneous records will be performed with and without a ballast for several types of *in situ* ground (soft soil, rock, concrete, asphalt…) and several sizes of ballast.

P3-4 Feet of sensor not blocked : perform records with sensors with feet not blocked and another one with blocked feet.

P3-5 Feet of sensor removed : perform records with sensors with feet removed and another one with blocked feet.

P3-6 Sand : perform records with sensors on ground and on a pile of sand.

P3-7 Gravel : perform records with sensors on ground and on a pile of gravel.

P 4 Nearby structures

Measurements should be made over homogeneous sites with regular noise source as much as possible :

- before/after building of the structure
- at different distance from the structure

P4-1 Large nearby artificial structures (building, foundation, bridge) : Interpretation of the results obtained inside building is not the aim of SESAME. However, in order to check the influence of a building in measurement obtained next to it, ambient noise recorded inside this structure has to be processed.

P4-2 Small nearby artificial structures (trees, monument, pile)

P5 Underground structures

Same test as P4 but with underground structures

P5-1 Large underground structures (parking, tube…)

P5-2 Small underground structure (ex: pipeline, basement, pavement, parking) : if possible, check the influence of different depth and different size of structures, different types of pipeline (gas, water …) with and without fluid circulation.

P6 Weather

Perform several records with variation of intensity of a given weather parameter. If the parameter intensity cannot be quantitatively measured, a simple classification is used : no, weak, strong , severe. One sensor should be left exposed to the weather condition, and another isolated from the parameter tested.

P6-1 Wind

P6-2 Rain

P6-3 Snow

P6-4 Temperature

P7 Water table

P7-1 Level of water table : this test should be performed next to a piezometer (or observation well or water-level gauge).

P7-2 Pore pressure

P8 Site response (for H/V stability with time)

Different site responses should be considered for the study of stability of H/V with time. Numerous records should be performed regularly, at the same location. Any changes (of weather, for example) should be noted. For each kind of site response (P8-1, P8-2, P8-3), tests should be performed in a quiet area as well as in an urban or industrial area.

P8-1 No peak site

P8-2 Low frequency site

P8-3 Medium frequency site

P8-4 High frequency site

P9 Noise sources (for H/V stability with time)

There are sources of noise, related to human activity or natural objects, that are not random. Among them, some are more or less regular to quasi stationary (e.g. engines, electric generators, river, sea). Other sources are related to transient noise, shorter in time than the preceding ones and more energetic (e.g. steps, cars, trains).

Records should be performed at the same place with and without the regular source and at different distances from the source. The site conditions and other noise should not change. Windows with transient should be gathered and their results compared with the windows without transient.

P9-1 Steps : people walking

P9-2 Cars : test should include cars moving and just turned on

P9-3 Trains

P9-4 Machinery : generator, vibrator, boat

P9-5 High voltage cable : in the air and underground. High intensity electromagnetic field.

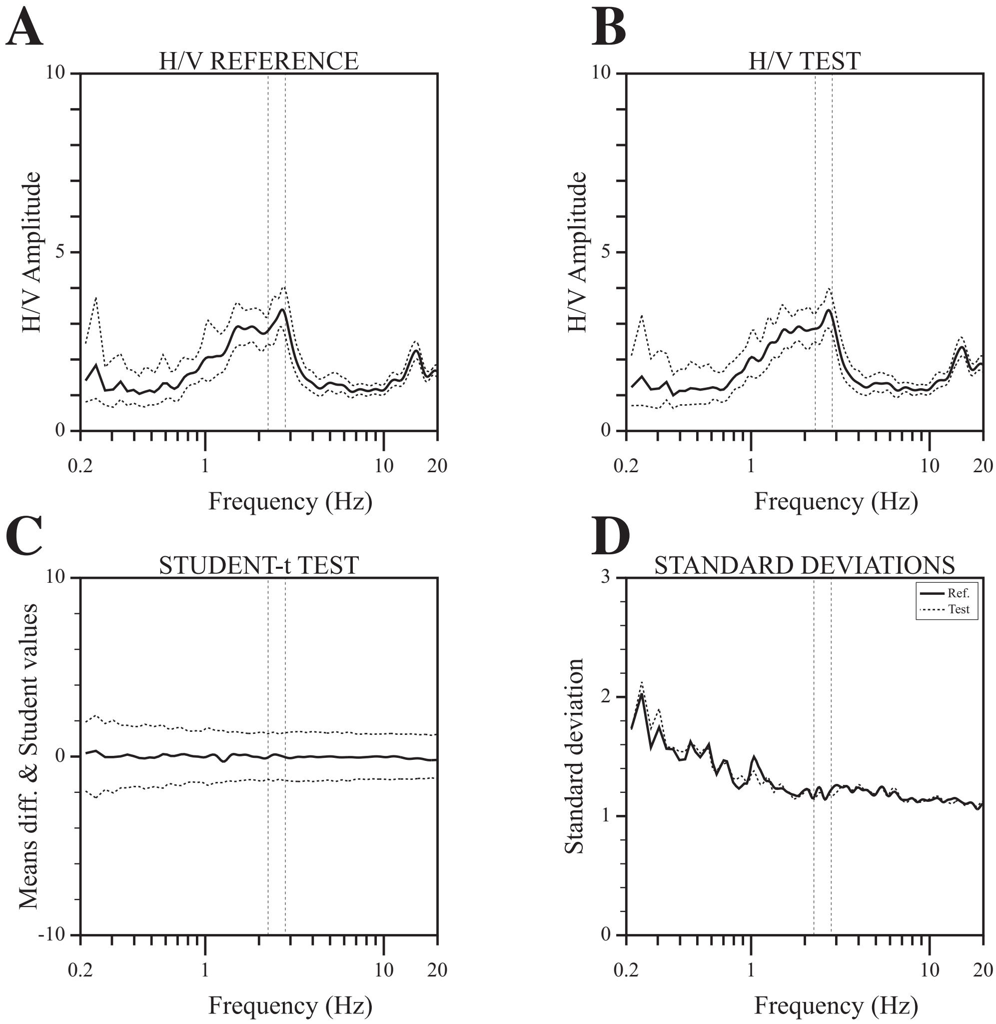
P9-6 Sea : when it is calm and agitated.

P9-7 Music in car participating to the experiment

Annex 2 : Technical Card - Graphs

The results shown in the technical include four graphs showing :
- the H/V results of the reference (Graph A) ;
- the H/V results of the tested parameter (Graph B) ;
- a graph showing the Student-t values obtained from the results of graphs A and B (Graph C) ;
- a graph showing the standard deviations of graphs A and B (Graph D).

Example



Explanation

Graphs A and B : $\overline{H/V}$ is shown by the black line. The two dashed lines on both sides of the black line are $\overline{H/V}/\sigma_{H/V}$ and $\overline{H/V}\times\sigma_{H/V}$.

Graph C : $Diff_{H/V}$ is shown by the black line. The two dashed lines on both sides of the black line are the Student-t values t and –t.

Graph D : $\sigma_{H/V}$ of the reference is shown by the black line, and $\sigma_{H/V}$ of the tested parameter by a dashed line.

All four graphs : the *vertical* dashed lines in all four graphs are the interval $[\bar{f}_0-\sigma(\bar{f}_0),\bar{f}_0+\sigma(\bar{f}_0)]$ from the results shown in table1 of the technical card (see Annex 3). In graphs A, B, and C the interval is the one obtained for the reference, and in graph C it is the one obtained for the tested parameter.

Annex 3 : Technical Card – Table 1

Table 1 of the technical card summarizes the frequency peak results of the reference and of the tested parameter, together with some information about ambient noise signal acquisition for both data sets (Sample rate and recording duration).

Example

		1	2	3	4	5	6	7	8	9
		File name	f0 ($\overline{H/V}$) (Hz)	Nb win	Sample rate (Hz)	Recording duration (s)	Frequency stastistics from individual windows			
							$\overline{f0}$ (Hz)	Sigma (Hz)	Nb win	Student-t test
1	Ref.	01221442.saf	2.72	21	250	720	2.53	0.28	21	|diff| = 0.04 t = 0.31 Similar peak frequencies
2	Test	001c7dd60 096dc0.saf	2.75	20	250	720	2.57	0.28	20	
3		Conclusion	NO INFLUENCE							

Line 1 : H/V results and information about data acquisition of the *reference*.
Line 2 : H/V results and information about data acquisition of the *tested parameter*.

Explanation

H/V results and processing parameters :

Column 2 : H/V average peak frequencies ($f_0(H/V)$, in Hertz) from graphs A and B.
Column 3 : number of stable signal windows used in the H/V processing.

Data acquisition parameters :

Column 1 : original file names of ambient noise signal.
Column 4 : ambient noise signal acquisition sample rate (in Hertz).
Column 5 : ambient noise signal recording duration (in seconds).

Results obtained from individual windows :

Column 6 : average peak frequencies ($\bar{f}_0$, in Hertz).
Column 7 : standard deviation of the average frequency peak (□($\bar{f}_0$), in Hertz)
Column 8 : numbers of individual windows used to calculate the average frequency $\bar{f}_0$. This number can be different from the one in column 3.

Student-t test for individual windows(Column 9) :

|diff| : absolute value of the difference of the average peak frequencies ($\bar{f}_0$) of the reference and of the tested parameter.
t : value of $t_0\sqrt{A \times B}$ obtained with the standard deviations of column7, and the number of windows of column 8.

Conclusion of the Student-t analysis on the frequencies obtained from individual windows :
if |diff| $\leq$ t : the peak frequencies of the reference and the tested parameter are similar. The text is "Similar peak frequencies" ;

if |diff| > t : the peak frequencies of the reference and the tested parameter are different. The text is "NOT similar peak frequencies"

General conclusion for the tested parameter (Line 3) :

If the conclusion of the Student-t test for individual windows (in column 9) is "NOT similar peak frequencies", the general conclusion is "NOT RECOMMENDED", i.e. the tested parameter greatly influences the H/V results.

If the conclusion of the Student-t test for individual windows (in column 9) is "Similar peak frequencies", the general conclusion varies according to the percentage of "bad" points, which verify $Diff_{H/V}$ > t (from graph 3) inside and outside the interval $\left[\bar{f}_0 - \sigma(\bar{f}_0), \bar{f}_0 + \sigma(\bar{f}_0)\right]$, termed "the peak zone". The total number of points as well as the number of "bad" points inside and outside the peak zone are obtained as $\sum\left[\log_{10}(f + \Delta f/2) - \log_{10}(f - \Delta f/2)\right]$, where Δf is the frequency step from the Fourier transform.

Priority is given to the behavior inside the peak zone, as follows :

Percentage of $Diff_{H/V}$ **> t**		**Conclusion**
inside (pe)	**outside** (po)	
pe = 0	po ≤ 5	NO INFLUENCE
0 ≤ pe ≤ 5	Any value	Combination of commentaries as described below
5 < pe ≤ 15	Any value	CAUTION (pe % inside the peak zone)
pe ≥ 15	Any value	NOT RECOMMENDED (pe % inside the peak zone)

If 0 ≤ pe ≤ 5% *inside* the peak zone, the behavior of H/V outside the peak zone is taken into account and the conclusion is a combination of a commentary for inside the peak zone and another for outside the peak zone :

Percentage (pe) **of** $Diff_{H/V}$ > t ***inside* peak zone**	**Conclusion**
pe = 0	No influence inside
0 < pe ≤ 5	Slight influence inside (pe %)

Percentage (po) **of** $Diff_{H/V} > t$ ***outside* peak zone**	**Conclusion**
po ≤ 5	no influence outside
5 < po ≤ 10	negligible influence outside (po %)
10 < po ≤ 20	slight influence outside (po %)
20 < po ≤ 40	caution outside (po %)
po > 40	discard outside (po %)

Annex 4 : Technical Card – Table 2

Table 2 of the technical card summarizes data acquisition conditions and gives information about the tested parameter.

Example

		1	2	A	B	
		Recorder	Sensor	Rec. type : simultaneous	Medium frequency site	**A**
1	Ref.	Mars Lite	5-second Lennartz LE3D	**P1-1-2-Grenoble Nice-test5**		**B**
				Influence of recorder		**C**
2	Test	Mars 88	5-second Lennartz LE3D	Same type sensors with recorders of different type		**D**

The table is divided into two parts :

- Part 1 :
  - line 1 : equipment used for the reference.
  - line 2 : equipment used for the parameter tested.
- Part 2 :
  - line A : type of recording and site.
  - lines B, C and D : information about the test.

Explanation

Equipment :

- column 1: type of sensor.
- column 2 : type of station.

Recording type (column A) :

Three types of recording are differentiated :

- synchronous: the records of the reference and of the tested parameter start exactly at the same time.
- simultaneous : the two records are done at the same time, but there are few seconds of delay between the beginning of the records.
- sequential : the two records are done one after another.

Title (lines B, C, and D) :

- line B :
  the reference of the test (as in annex 1) ; P1-1-2 in the example
  the data acquisition team ; Grenoble Nice in the example.
  experiment number for this test ; test5 in the example
- line C : the type of tested parameter
- line D (optional) : more information about the tested parameter.

Annex 5 : Example of Result File

```
*******************************************************
 *******************************************************
  PARAMETRES DU TRAITEMENT
 *******************************************************
 *******************************************************

 ********************* LISSAGE *******************************
 Lissage a la Konno & Ohmachi - bexp = 40.000
 Moyenne arithmétique (linlog = 0)

 ***************** SIGNAL NORMAL ************************************
 Fenêtre .................. : 25.
 STA ...................... : 1.00
 LTA ...................... : 30.
 Seuil mini ............... : 0.30
 Seuil maxi ............... : 2.00

 ***************** SIGNAL FILTRE ************************************
 Filtre sur signal ......... : non

 ***************** FENETRAGE ************************************
 Fenêtres calculées par le programme

 ***************** TYPE DE CAPTEUR **********************************
 Capteur : Capteur non répertorié

 ***************** TRANSFORMATION EN DATA 1 BIT *********************
 Transf. en données 1 bit : non

 ***************** FICHIERS CREES ***********************************
 Rapports spectraux ................. : oui
 Amplitudes spectrales moyennes ..... : non
 Amplitudes spectrales fenêtres ..... : non
 Déplacement, vitesse, accélération . : non
 Signal ............................ : non

*******************************************************
 *******************************************************
  TRAITEMENT DES DONNEES
 *******************************************************
 *******************************************************

**************************************************************

Fichier bruit : rov5_19980310_2340.saf

 Station n° 0

 Gain : 1.000

 Fréquence d'échantillonnage : 125 Hz
 Nombre d'échantillons : 75000
 Échantillons écrétés : 0.00 %
 Longueur des fenêtres comprise entre 25.00 et 32.76 secondes

 Nombre de fenêtres :   16


  Fenêtre  Début   Fin  Longueur
   1   15.44   48.20   32.76
   2   66.22   98.15   31.93
 (…)
   15  511.54  544.30   32.76
   16  544.31  577.07   32.76

 Moyenne des signaux (counts) : 285.87


 MOYENNES PAR COMPOSANTE

  Fenêtre  Moy. Z Moy. N-S Moy. E-W
     counts counts counts
   1  480.46 386.27 777.28
   2  211.82 238.27 306.80
(…)
   15  151.88 254.40 276.09
   16  185.61 251.58 267.47

 Moyenne :  230.82 263.62 315.38
 *******************************************************
 *******************************************************
```

Table 1 : Number of Tests per Type of Site

	No peak	Low freq.	Medium freq.	High freq.	Total
P1-1-1		7	3		10
P1-1-2			12		12
P1-2		6	8	3	17
P1-3		2	6		8
P1-4		13	11		24
P1-5		6	2		8
P1-6		7	2		9
P1-7		4			4
P1-8		2			2
P2-1		32	5		37
P2-2	1		2		3
P2-3		1	10		11
P2-4		28	8		36
P2-5				3	3
P2-6-1		2			2
P2-6-2	1	8		5	14
P2-7		1		3	4
P2-8		2			2
P2-9		1			1
P2-10				2	2
P3-1-1		10	4		14
P3-1-2		1	1		2
P3-1-3		1	1		2
P3-1-4		2	1		3
P3-1-5	1	1	3		5
P3-1-6			1		1
P3-1-7		1	2		3
P3-1-8		1	1		2
P3-1-9		3	1		4
P3-1-10		3	7		10
P3-1-11	4	1	3	2	10
P3-1-12	1	2	8	1	12
P3-1-13			1		1
P3-2	2	11	3	2	18
P3-3		3	1		4
P3-4		3			3
P3-5	1	5			6
P3-6		3	2		5
P3-7		1	2	1	4
P4-1	2	2	8	1	13
P4-2	5	6		1	12
P5-1			12		12
P5-2			2	2	4
P6-1		4	1		5
P6-2		1	4		5
P6-3					0
P6-4			9		9
P7			1		1

P8-1	2				2
P8-2		60			60
P8-3			50		50
P8-4				2	2
P9-1		1	4	6	11
P9-2-1			36	3	39
P9-2-2		4			4
P9-3		1	1		2
P9-4-1		1		4	5
P9-4-2		7			7
P9-5		27			27
P9-6		3	3		6
P9-7				2	2
TOTAL	20	291	242	43	596

____

Table 2 : Summary of Results and Conclusions

	P1-1-1	P1-1-2	P1-2	P1-3	P1-4	P1-5	P1-6	P1-7	P1-8
Peaks similar	10	12	14	8	24	8	9	4	2
Peaks not similar			3						
NO INFLUENCE	10	8	8	8	15	8	9	4	1
No/Negligible		4							
No/Slight			1		1				
No/Caution			1						
No/Discard			1		2				
NOT RECOM.			6		6				1
CONCLUSION	OK	OK	May Infl.	OK	May Infl.	OK	OK	OK	May Infl.
	P2-1	P2-2	P2-3	P2-4	P2-5	P2-6-1			
Peaks similar	34	3	11	34	3	2			
Peaks not similar	3			2					
NO INFLUENCE	4		1	9		2			
SLIGHT INFLUENCE		1							
CAUTION									
No/Negligible	9	1	5	3	1				
No/Slight	5		4	9					
No/Caution	1	1	1	8	2				
No/Discard	6			4					
NOT RECOM.	12			5					
CONCLUSION	May Infl.	N.R.	OK	May Infl.	May Infl.	OK			
	P2-6-2	P2-7	P2-8	P2-9	P2-10				
Peaks similar	10	4	2	1					
Peaks not similar	4				2				
NO INFLUENCE	1	4	1						
SLIGHT INFLUENCE	1								
CAUTION									
No/Negligible	3								
No/Slight	2								
No/Caution	2								
No/Discard				1					
NOT RECOM.	5		1		2				
CONCLUSION	May Infl.	May Infl	May Infl.	N.R.	N.R.				
	P3-1-1	P3-1-2	P3-1-3	P3-1-4	P3-1-5	P3-1-6	P3-1-7		
Peaks similar	11	1	2	3	5	1	3		
Peaks not similar	3	1							
NO INFLUENCE					1				
NEGL. INFLUENCE					1				
CAUTION									
No/Negligible					1				
No/Slight				1	1	1	3		
No/Caution		1		1	1				
No/Discard	3		1						
NOT RECOM.	11	1	1	1					
CONCLUSION	N.R.	N.R.	N.R.	N.R.	May Infl.	OK	OK		

	P3-1-8	P3-1-9	P3-1-10	P3-1-11	P3-1-12	P3-1-13			
Peaks similar	2	4	10	10	12	1			
Peaks not similar									
NO INFLUENCE			6	3	6				
NEGL. INFLUENCE				1					
SLIGHT INFLUENCE				1					
CAUTION				1					
No/Negligible				1	5				
No/Slight	2	2	1	2	1	1			
No/Caution		1	3	1					
No/Discard		1							
NOT RECOM.									
CONCLUSION	OK	N.R.	May Infl.	OK	OK	OK			
	P3-2	P3-3	P3-4	P3-5	P3-6	P3-7			
Peaks similar	18	4	3	6	5	4			
Peaks not similar									
NO INFLUENCE	9	1	2	2	5	1			
NEGL. INFLUENCE									
SLIGHT INFLUENCE	2								
CAUTION									
No/Negligible	4		1	2		2			
No/Slight	3	1		1		1			
No/Caution		1							
No/Discard				1					
NOT RECOM.		1							
CONCLUSION	OK	N.R.	OK	May Infl.	OK	May Infl			
	P4-1	P4-2							
Peaks similar	12	11							
Peaks not similar	1	1							
NO INFLUENCE	2								
NEGL. INFLUENCE									
SLIGHT INFLUENCE		2							
CAUTION		2							
No/Negligible	4								
No/Slight	1	3							
No/Caution	1	2							
No/Discard									
NOT RECOM.	5	3							
CONCLUSION	May Infl.	May Infl.							
	P5-1	P5-2							
Peaks similar	7	4							
Peaks not similar	5								
NO INFLUENCE	1								
NEGL. INFLUENCE									
SLIGHT INFLUENCE	2								
CAUTION									
No/Negligible		1							
No/Slight		1							
No/Caution	1	1							
No/Discard									
NOT RECOM.	8	1							
CONCLUSION	N.R.	N.R.							

	P6-1	P6-2	P6-3	P6-4		P7			
Peaks similar	4	4		8		1			
Peaks not similar	1	1		1					
NO INFLUENCE	1			6					
NEGL. INFLUENCE									
SLIGHT INFLUENCE									
CAUTION									
No/Negligible				1		1			
No/Slight	1	1							
No/Caution	2								
No/Discard									
NOT RECOM.	1	4		2					
CONCLUSION	N.R.	N.R.		OK		N.E.D.			
	P8-1	P8-2	P8-3	P8-4					
Peaks similar	2	47	40	1					
Peaks not similar		13	10	1					
NO INFLUENCE	1	12	17						
NEGL. INFLUENCE									
SLIGHT INFLUENCE									
CAUTION	1								
No/Negligible		8	7						
No/Slight		15	8						
No/Caution		6							
No/Discard		4	1						
NOT RECOM.		15	17	2					
CONCLUSION	N.E.D.	OK	OK	N.E.D.					
	P9-1	P9-2-1	P9-2-2	P9-3	P9-4-1	P9-4-2	P9-5	P9-6	P9-7
Peaks similar	9	Irrelevant	4	1	2	5	27	6	2
Peaks not similar	2			1	3	2			
NO INFLUENCE	5		3	1	2	5	4	1	2
NEGL. INFLUENCE			1				11		
CAUTION							5		
No/Negligible	1							1	
No/Slight								1	
No/Caution							7	1	
No/Discard								1	
NOT RECOM.	5			1	3	2		1	
CONCLUSION	May Infl.	May Infl	May Infl.	N.E.D.	May Infl.	N.E.D.	OK	N.E.D.	OK

May Infl. : May influence H/V results
N.E.D. : Not enough usable data to reach a convincing conclusion
N.R. : Not recommended, do influence H/V results
OK : do not influence H/V results

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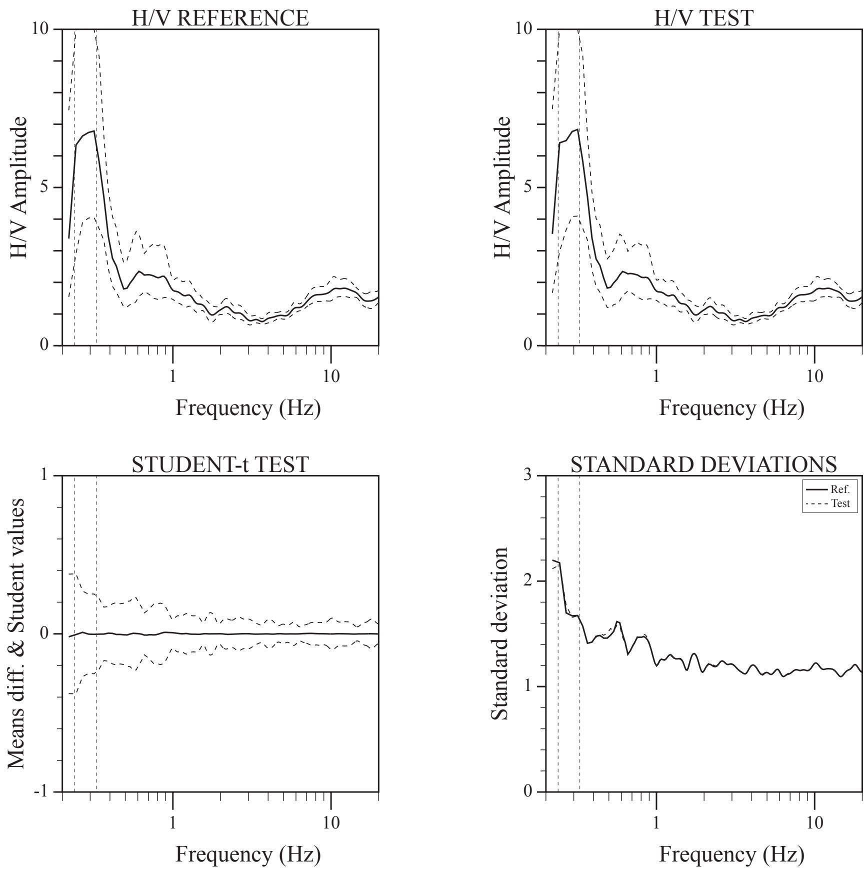
This project (Project No. EVG1-CT-2000-00026 SESAME) is supported by the European Commission – Research General Directorate. We thank all the technical staff from the participating institutions, who have helped in the preparations and the data collection. We also thank G. Collombat and J.-P. Glot for their collaboration on helping to find and understand the statistical test (Student-t test).

The deliverable (report, figures, data, results and appendices) are available on a DVD.

Project Acronym: SESAME
Project Title: Site Effects Assessment Using Ambient Excitations
Supported by: The European Commission – Research General Directorate
Project No: EVG1-CT-2000-00026 SESAME
Report Title: Final report on Measurement Guidelines (WP02). LGIT, CETE
Deliverable No: D08.02



	File name	f0 (H/V) (Hz)	Nb win	Sample rate (Hz)	Recording duration (s)	Frequency stastistics from individual windows			
						f0 (Hz)	Sigma (Hz)	Nb win	Student-t test
Ref.	Test 2 station 3	0.32	20	200	900	0.28	0.04	20	|diff| = 0.00 t = 0.05 Similar peak frequencies
Test	Test 2 station 4	0.32	20	200	900	0.28	0.04	20	
	Conclusion	NO INFLUENCE							

	Recorder	Sensor	Rec. type : simultaneous	Low frequency site
Ref.	CityShark	5-second Lennartz LE3D	**P1-1-1-Grenoble-test4** Influence of recorder One sensor with several recorders	
Test	CityShark	5-second Lennartz LE3D		

Figure 2 : Parameters that **do not** influence H/V results. Influence of recorder. One sensor with several recorders.

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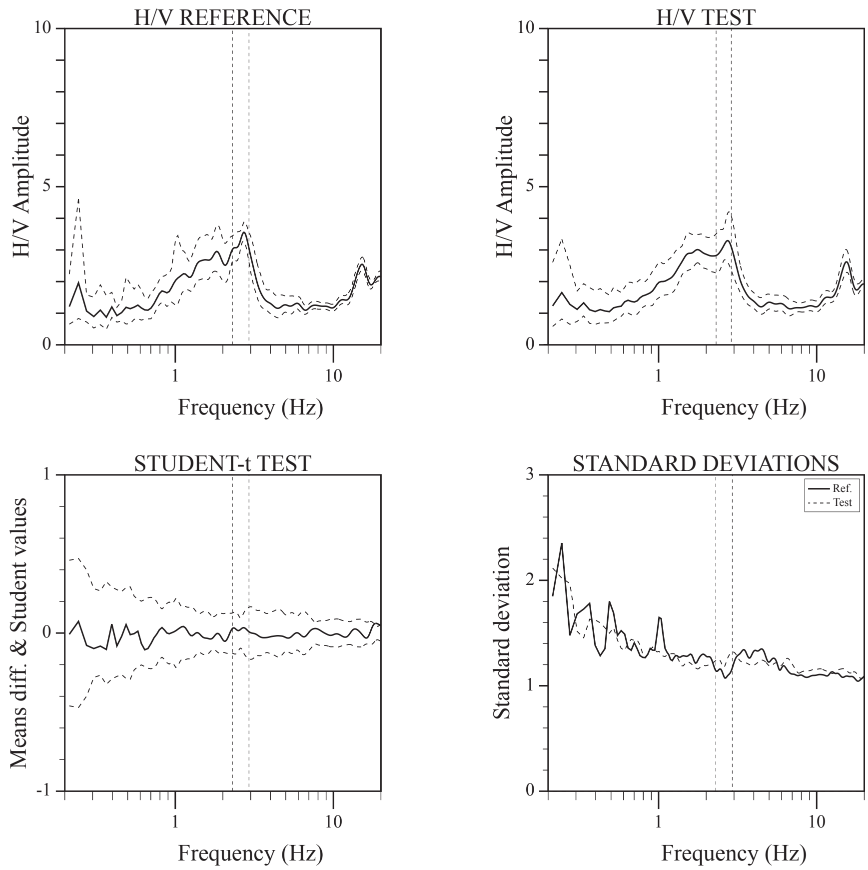

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<tr><th></th><th></th><th></th><th></th><th></th><th></th><th>$\overline{f0}$ (Hz)</th><th>Sigma (Hz)</th><th>Nb win</th><th>Student-t test</th></tr>
<tr><td>Ref.</td><td>03012201.saf</td><td>2.72</td><td>8</td><td>250</td><td>283</td><td>2.61</td><td>0.31</td><td>8</td><td rowspan="2">|diff| = 0.02
t = 0.43
Similar
peak frequencies</td></tr>
<tr><td>Test</td><td>Capt_3_ 01221543.001</td><td>2.75</td><td>26</td><td>250</td><td>900</td><td>2.60</td><td>0.29</td><td>26</td></tr>
<tr><td></td><td>Conclusion</td><td colspan="8">NO INFLUENCE</td></tr>
</table>

	Recorder	Sensor	Rec. type : simultaneous	Medium frequency site
Ref.	Hathor 3	5-second Lennartz LE3D	**P1-1-2-Grenoble Nice-test4** Influence of recorder Same type sensors with recorders of different type	
Test	CitySharkII	5-second Lennartz LE3D		

Figure 3 : Parameters that **do not** influence H/V results. Influence of recorder. Same type sensors with recorders of different type.

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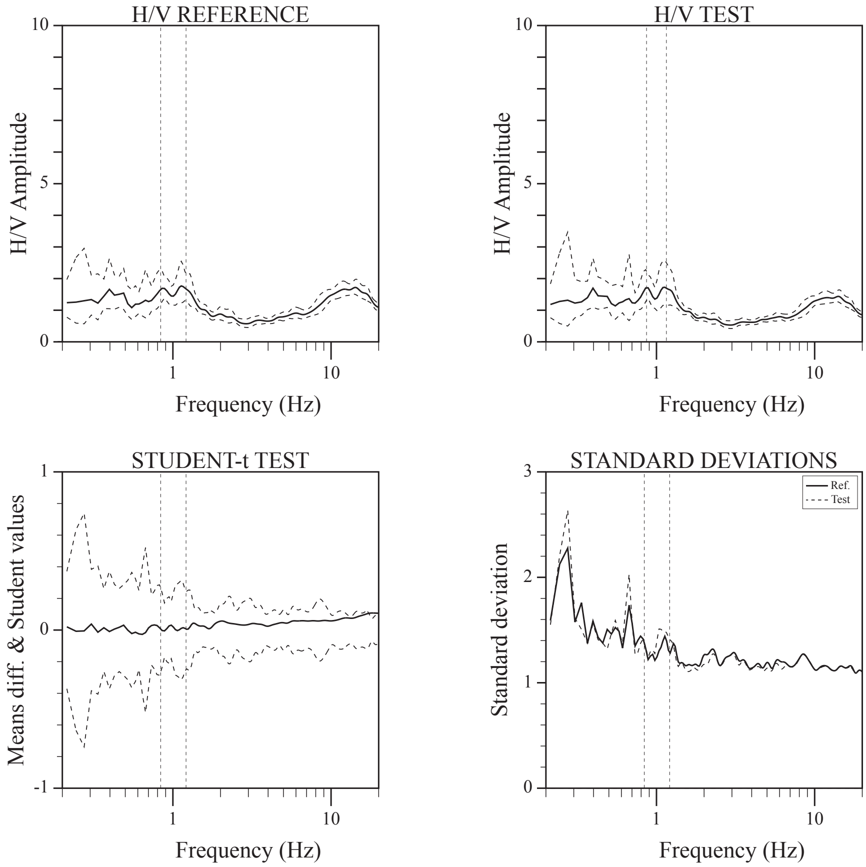

	File name	f0 (H/V) (Hz)	Nb win	Sample rate (Hz)	Recording duration (s)	Frequency stastistics from individual windows: f0 (Hz)	Sigma (Hz)	Nb win	Student-t test
Ref.	ID42_2002 0510_1507.saf	1.13	9	125	300	1.02	0.19	9	|diff| = 0.01 t = 0.32 Similar peak frequencies
Test	ID45_2002 0510_1507.saf	1.13	9	125	300	1.01	0.15	9	
	Conclusion	NO INFLUENCE							

	Recorder	Sensor
Ref.	Lennartz M88	Guralp cmg 40T
Test	Lennartz M88	Guralp cmg 40T

Rec. type : synchronous — Medium frequency site

P1-3-Roma-test3
Influence of time stabilization for the sensor
Ref : not shaked ; Test : 120-420 sec. after shaking

Figure 4 : Parameters that **do not** influence H/V results. Influence of time stabilization for the sensor.

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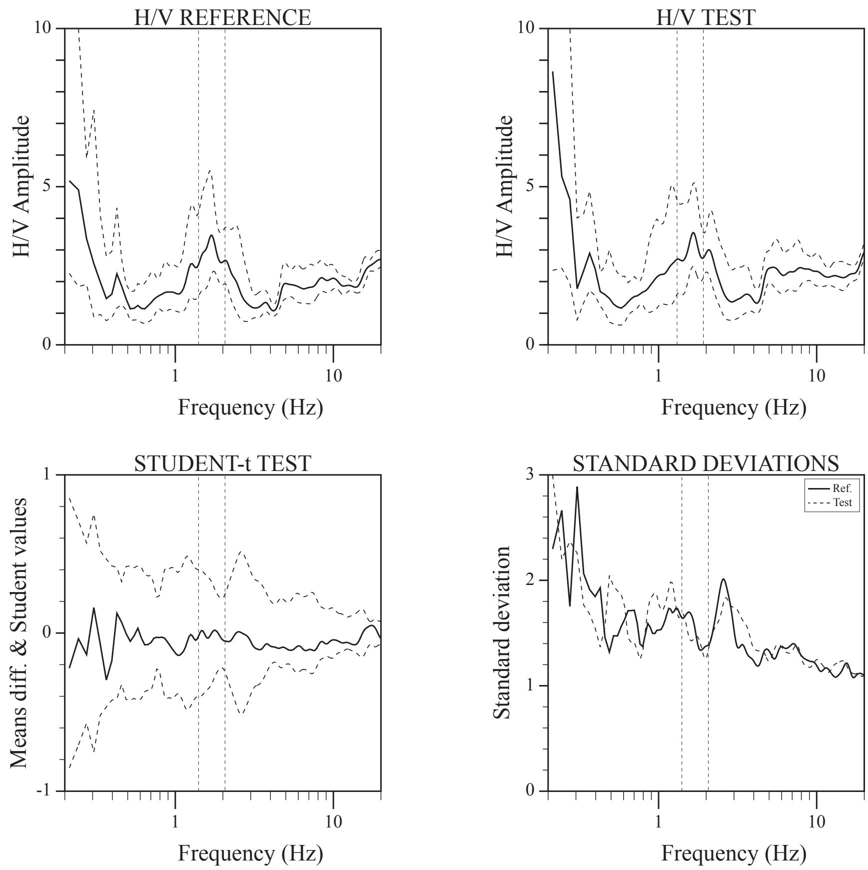

	File name	f0 (H/V) (Hz)	Nb win	Sample rate (Hz)	Recording duration (s)	Frequency stastistics from individual windows			
						f0 (Hz)	Sigma (Hz)	Nb win	Student-t test
Ref.	06281045.saf	1.71	10	125	684	1.73	0.33	10	|diff| = 0.12 t = 0.58 Similar peak frequencies
Test	06281034.saf	1.65	9	250	632	1.61	0.30	9	
	Conclusion	NO INFLUENCE							

	Recorder	Sensor	Rec. type : sequential	Medium frequency site
Ref.	Marslite	5-second Lennartz LE3D	**P1-5-Nice-test2** Influence of sampling rate	
Test	Marslite	5-second Lennartz LE3D		

Figure 5 : Parameters that **do not** influence H/V results. Influence of sampling rate.

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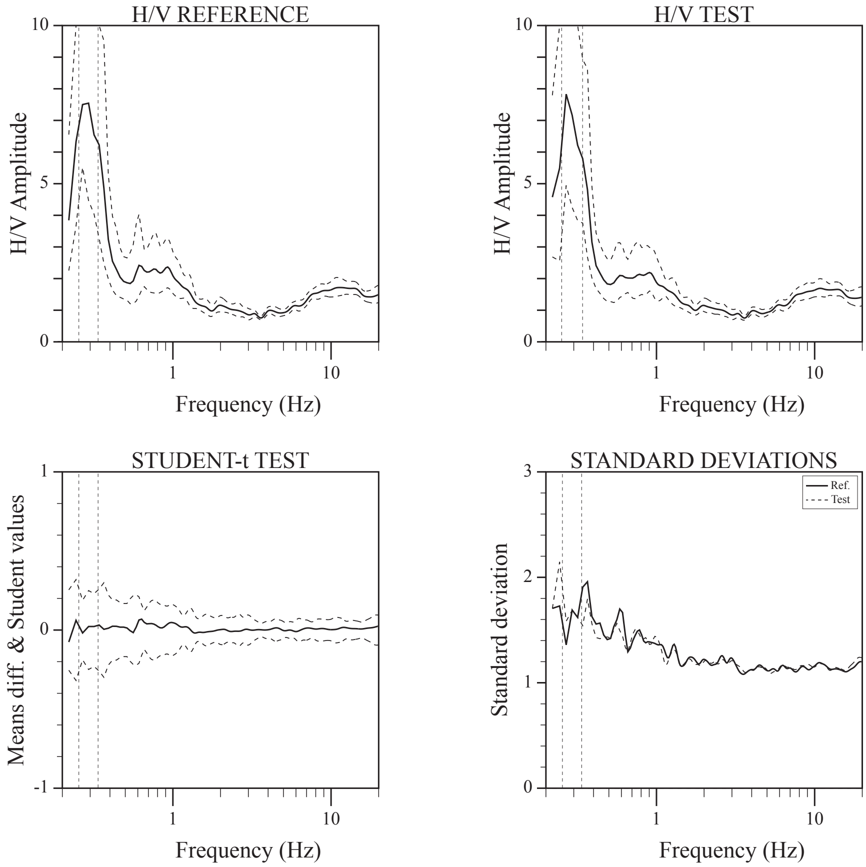

	File name	f0 (H/V) (Hz)	Nb win	Sample rate (Hz)	Recording duration (s)	Frequency stastistics from individual windows: f0 (Hz)	Sigma (Hz)	Nb win	Student-t test
Ref.	Reference 4	0.29	20	200	900	0.30	0.04	20	|diff| = 0.00 t = 0.05 Similar peak frequencies
Test	4 - 100 m stretched	0.27	22	200	900	0.30	0.04	22	
	Conclusion	NO INFLUENCE							

	Recorder	Sensor	Rec. type : simultaneous	Low frequency site
Ref.	CityShark	5-second Lennartz LE3D	**P1-6-Grenoble-test6** Influence of sensor cable length Ref : 10 m random ; Test : 100 m stretched	
Test	CityShark	5-second Lennartz LE3D		

Figure 6 : Parameters that **do not** influence H/V results. Influence of sensor cable length.

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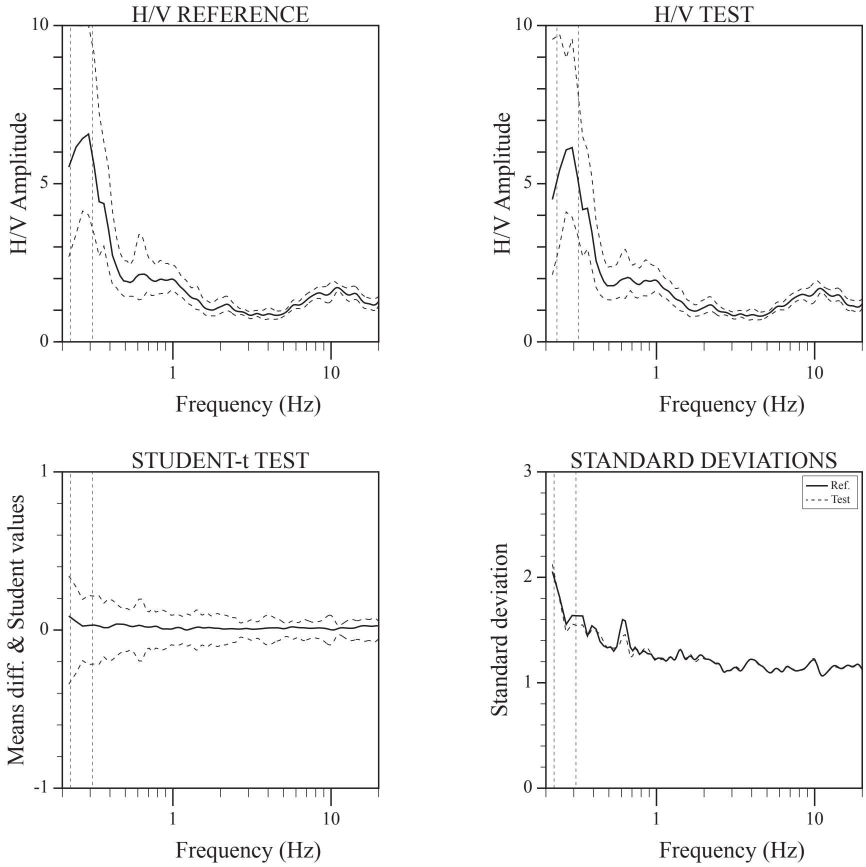

	File name	f0 ($\overline{H/V}$) (Hz)	Nb win	Sample rate (Hz)	Recording duration (s)	Frequency stastistics from individual windows			
						$\overline{f0}$ (Hz)	Sigma (Hz)	Nb win	Student-t test
Ref.	Reference 1	0.29	22	200	900	0.27	0.04	22	|diff| = 0.01 t = 0.05 Similar peak frequencies
Test	1 - 30 degrees	0.29	22	200	900	0.28	0.04	22	
	Conclusion	NO INFLUENCE							

	Recorder	Sensor	Rec. type : simultaneous	Low frequency site
Ref.	CityShark	5-second Lennartz LE3D	**P1-7-Grenoble-test1** Influence of sensor azimuth Ref : N-S ; Test : 30°E rotation	
Test	CityShark	5-second Lennartz LE3D		

Figure 7 : Parameters that **do not** influence H/V results. Influence of sensor azimuth.

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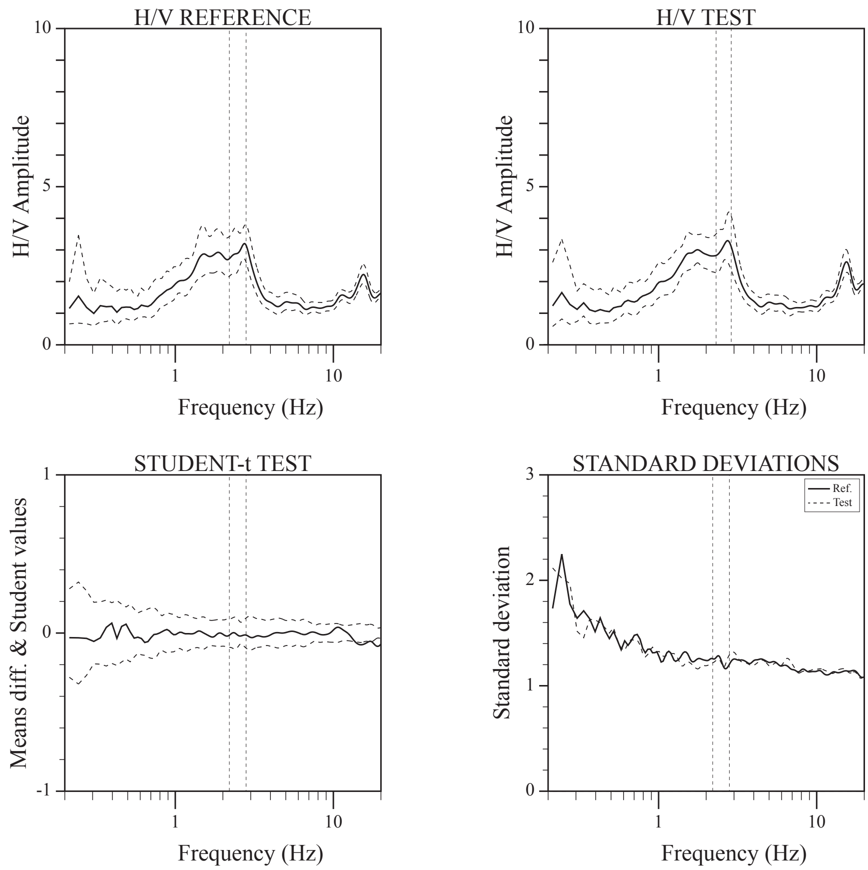

	File name	f0 (H/V) (Hz)	Nb win	Sample rate (Hz)	Recording duration (s)	Frequency stastistics from individual windows: f0 (Hz)	Sigma (Hz)	Nb win	Student-t test
Ref.	Ref1	2.75	26	250	900	2.50	0.30	26	|diff| = 0.09 t = 0.29 Similar peak frequencies
Test	1-Plaque beton	2.75	26	250	900	2.60	0.28	26	
	Conclusion	No influence inside the peak zone, negligible influence outside (8%)							

	Recorder	Sensor	Rec. type : synchronous	Medium frequency site
Ref.	CitySharkII	5-second Lennartz LE3D	**P2-3-Grenoble Nice-test1** Influence of concrete Ref : natural soil ; Test : on concrete slab	
Test	CitySharkII	5-second Lennartz LE3D		

Figure 8 : Parameters that **do not** influence H/V results. Influence of concrete.

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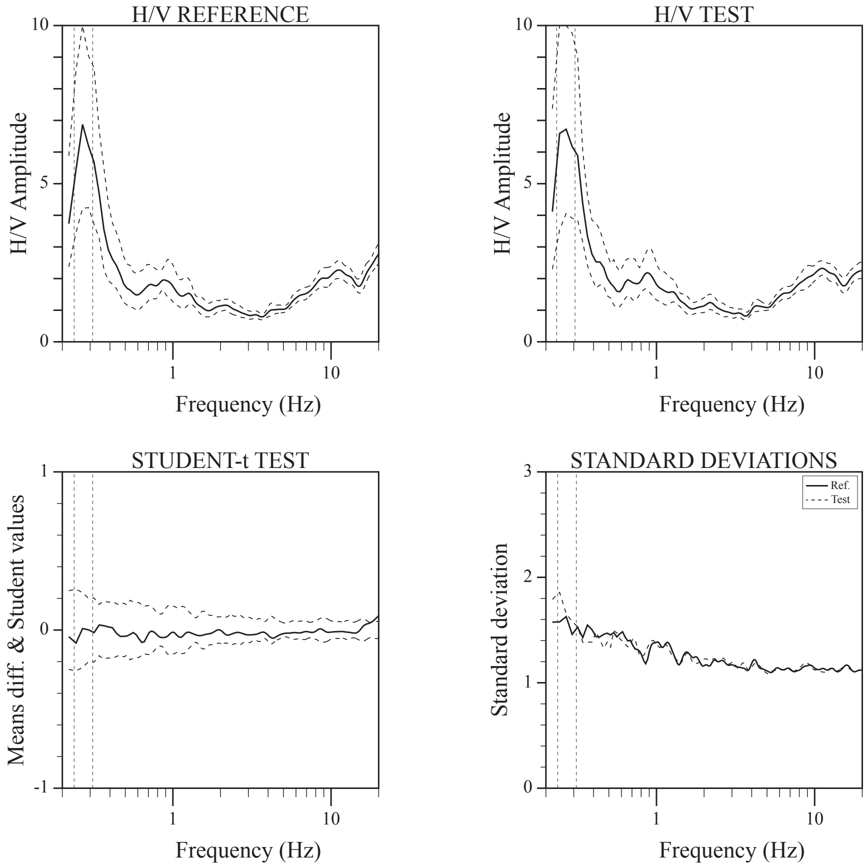

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<tr><th>$\overline{f0}$ (Hz)</th><th>Sigma (Hz)</th><th>Nb win</th><th>Student-t test</th></tr>
<tr><td>Ref.</td><td>Ref 1</td><td>0.27</td><td>21</td><td>200</td><td>900</td><td>0.27</td><td>0.04</td><td>21</td><td rowspan="2">|diff| = 0.00
t = 0.04
Similar
peak frequencies</td></tr>
<tr><td>Test</td><td>1-5cm compacted</td><td>0.27</td><td>21</td><td>200</td><td>900</td><td>0.27</td><td>0.04</td><td>21</td></tr>
<tr><td></td><td>Conclusion</td><td colspan="8">NO INFLUENCE</td></tr>
</table>

	Recorder	Sensor	Rec. type : simultaneous	Low frequency site
Ref.	CityShark	5-second Lennartz LE3D	**P2-6-1-Grenoble-test1** Influence of snow - compacted Ref : natural soil ; Test : 1-5 cm compacted snow	
Test	CityShark	5-second Lennartz LE3D		

Figure 9 : Parameters that **do not** influence H/V results. Influence of snow - compacted.

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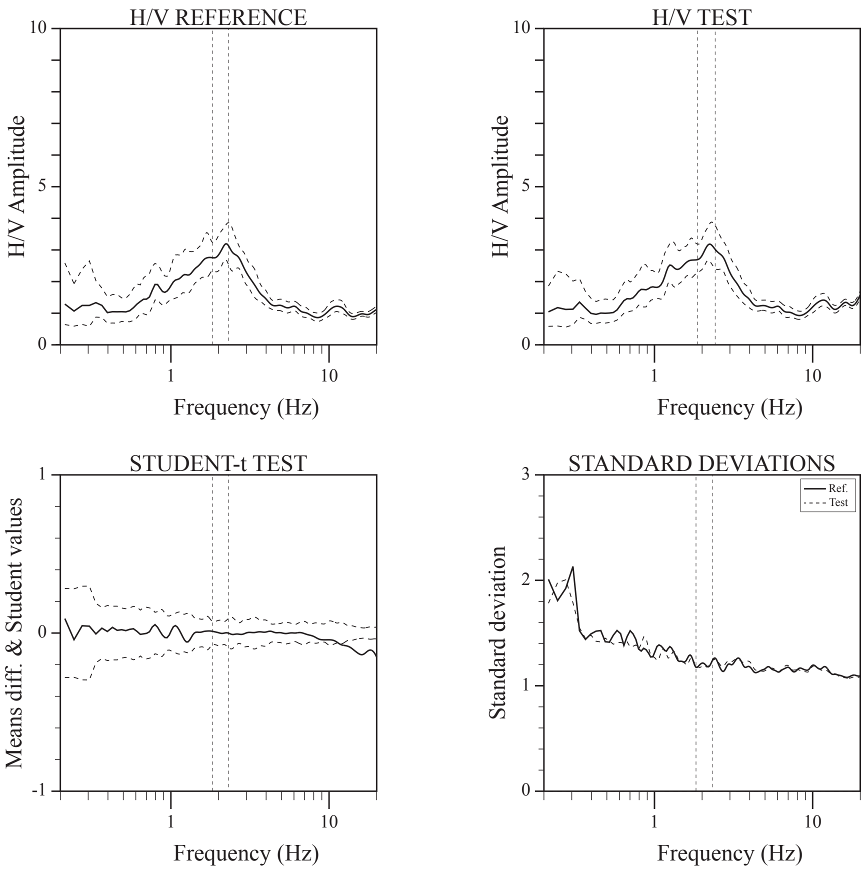

	File name	f0 (H/V) (Hz)	Nb win	Sample rate (Hz)	Recording duration (s)	Frequency stastistics from individual windows			
						f0 (Hz)	Sigma (Hz)	Nb win	Student-t test
Ref.	Ref Nice	2.23	25	250	900	2.07	0.24	25	|diff| = 0.07 t = 0.26 Similar peak frequencies
Test	Nice-contr eplaque	2.23	24	250	900	2.14	0.28	24	
	Conclusion	No influence inside the peak zone, slight influence outside (13%)							

	Recorder	Sensor
Ref.	CitySharkII	5-second Lennartz LE3D
Test	CitySharkII	5-second Lennartz LE3D

Rec. type : synchronous | Medium frequency site

P3-1-6-Grenoble Nice-test1
Artificial interface between in-situ ground and sensor
Ref : on natural soil ; Test : on a stratified wooden plate

Figure 10 : Parameters that **do not** influence H/V results. Influence of artificial interface between in-situ ground and sensor. Stratified wooden plate.

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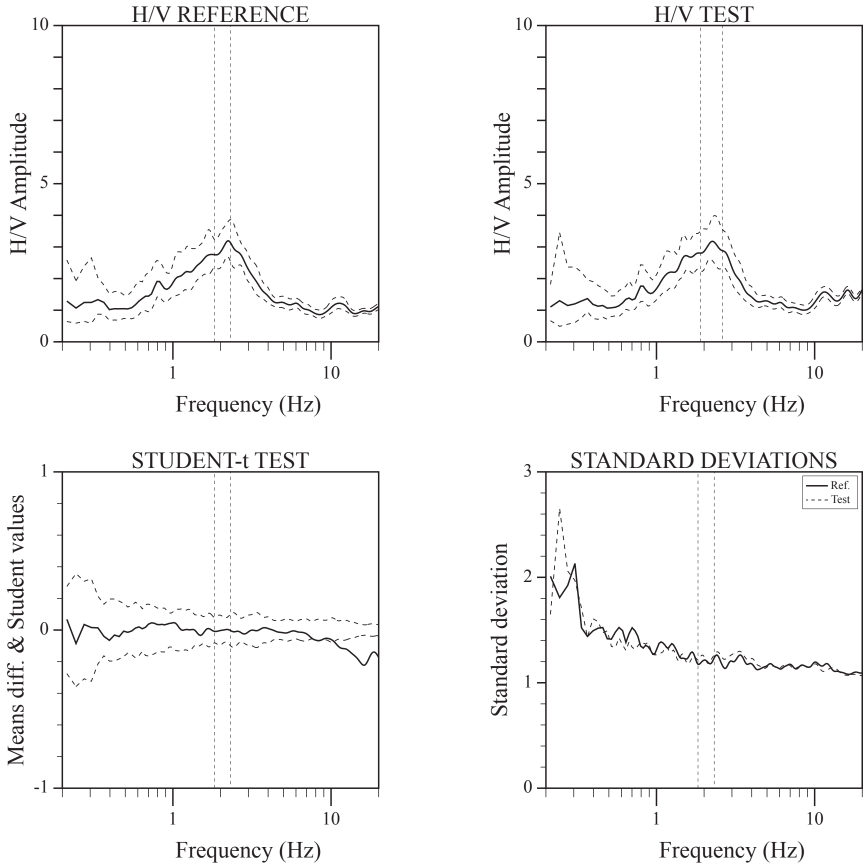

	File name	f0 (H/V) (Hz)	Nb win	Sample rate (Hz)	Recording duration (s)	Frequency stastistics from individual windows			
						f0 (Hz)	Sigma (Hz)	Nb win	Student-t test
Ref.	Ref Nice	2.23	25	250	900	2.07	0.24	25	|diff| = 0.18 t = 0.31 Similar peak frequencies
Test	Nice-agglo	2.26	22	250	900	2.25	0.35	22	
	Conclusion	No influence inside the peak zone, slight influence outside (15%)							

	Recorder	Sensor	Rec. type : synchronous	Medium frequency site
Ref.	CitySharkII	5-second Lennartz LE3D	**P3-1-7-Grenoble Nice-test1** Artificial interface between in-situ ground and sensor Ref : natural soil ; Test : agglomerated wooden plate	
Test	CitySharkII	5-second Lennartz LE3D		

Figure 11 : Parameters that **do not** influence H/V results. Influence of artificial interface between in-situ ground and sensor. Agglomerated wooden plate.

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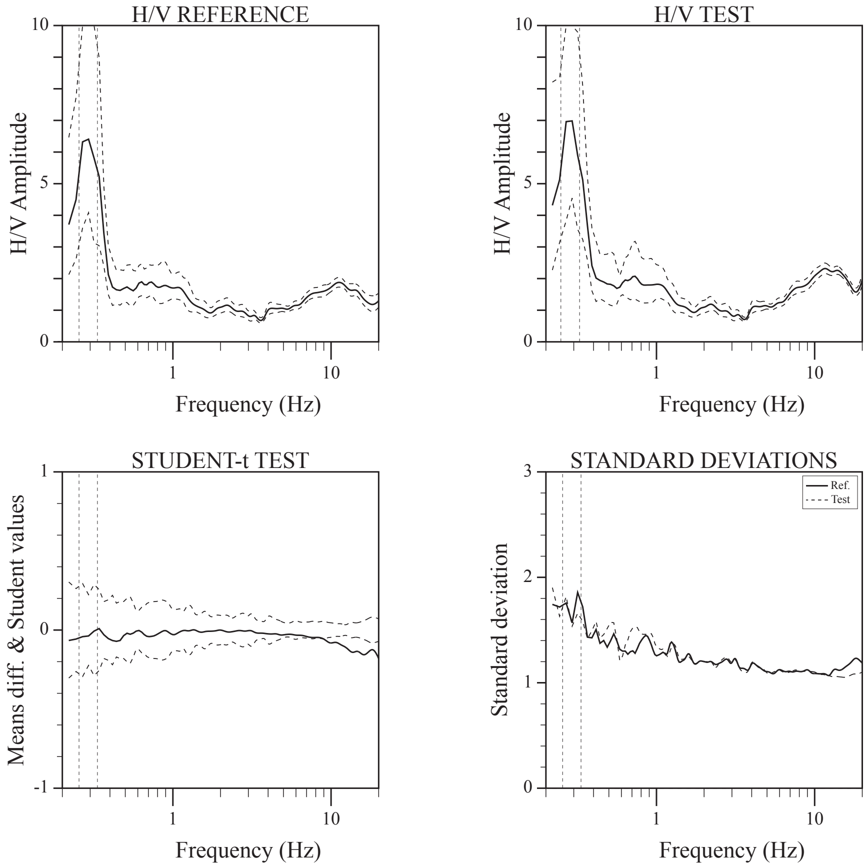

	File name	f0 (H/V) (Hz)	Nb win	Sample rate (Hz)	Recording duration (s)	Frequency stastistics from individual windows			
						f0 (Hz)	Sigma (Hz)	Nb win	Student-t test
Ref.	Reference 4	0.29	20	200	900	0.29	0.04	20	|diff| = 0.01 t = 0.05 Similar peak frequencies
Test	4-PVC plate	0.29	18	200	900	0.29	0.04	18	
	Conclusion	No influence inside the peak zone, slight influence outside (19%)							

	Recorder	Sensor	Rec. type : simultaneous	Low frequency site
Ref.	CityShark	5-second Lennartz LE3D	**P3-1-8-Grenoble-test1** Artificial interface between in-situ ground and sensor Ref : on natural soil ; Test : on a PVC plate	
Test	CityShark	5-second Lennartz LE3D		

Figure 12 : Parameters that **do not** influence H/V results. Influence of artificial interface between in-situ ground and sensor. PVC plate.

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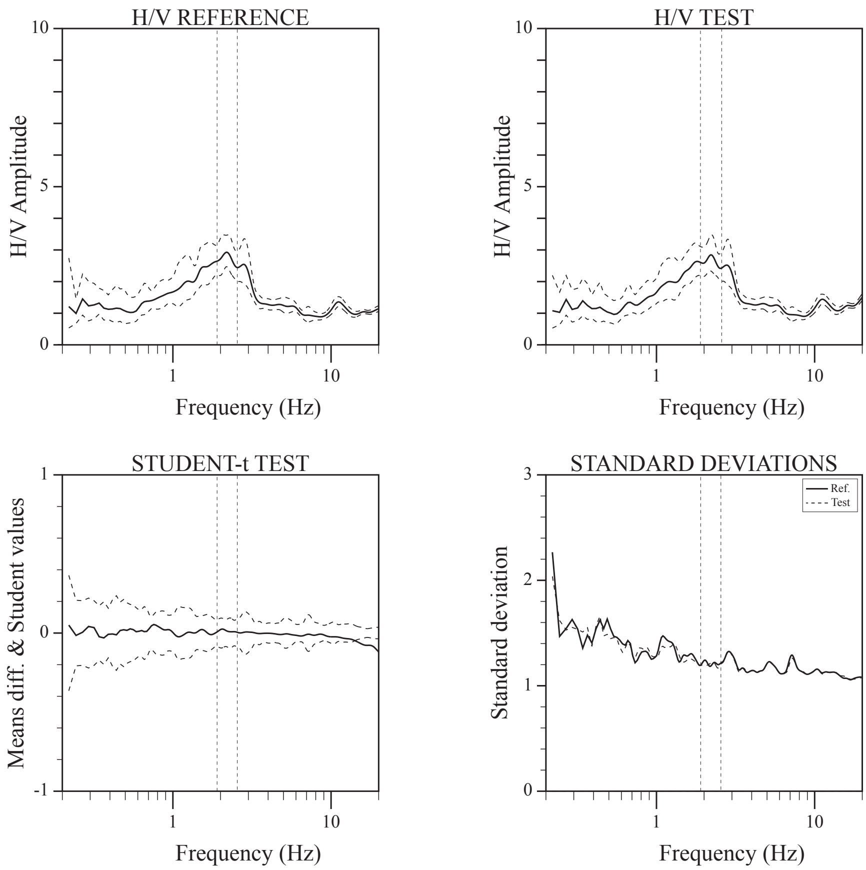

	File name	f0 (H/V) (Hz)	Nb win	Sample rate (Hz)	Recording duration (s)	Frequency stastistics from individual windows			
						f0 (Hz)	Sigma (Hz)	Nb win	Student-t test
Ref.	Ref Nice4	2.20	21	200	900	2.23	0.33	21	|diff| = 0.01 t = 0.37 Similar peak frequencies
Test	Nice4-plaque fer	2.22	21	200	900	2.24	0.34	21	
	Conclusion	No influence inside the peak zone, negligible influence outside (8%)							

	Recorder	Sensor	Rec. type : synchronous	Medium frequency site
Ref.	CitySharkII	5-second Lennartz LE3D	**P3-1-11-b-Grenoble Nice-test2** Artificial interface between in-situ ground and sensor Ref : natural soil ; Test : iron plate with legs	
Test	CitySharkII	5-second Lennartz LE3D		

Figure 13 : Parameters that **do not** influence H/V results. Influence of artificial interface between in-situ ground and sensor. Iron plate with legs.

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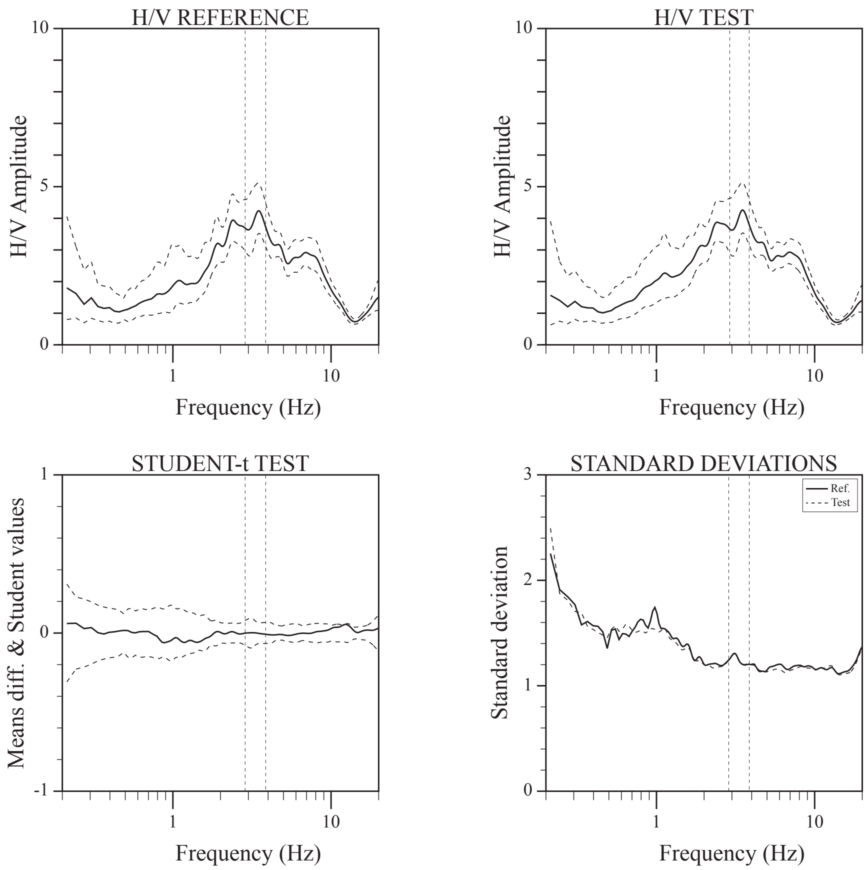

	File name	f0 (H/V) (Hz)	Nb win	Sample rate (Hz)	Recording duration (s)	Frequency stastistics from individual windows			
						f0 (Hz)	Sigma (Hz)	Nb win	Student-t test
Ref.	P3-1.R3-3.saf	3.48	35	125	1440	3.36	0.50	35	|diff| = 0.02 t = 0.40
Test	P3-1.R3-2.saf	3.51	37	125	1440	3.38	0.48	37	Similar peak frequencies
	Conclusion	NO INFLUENCE							

	Recorder	Sensor
Ref.	Mars 88	5-second Lennartz LE3D
Test	Mars 88	5-second Lennartz LE3D

Rec. type : synchronous | Medium frequency site

P3-1-12-Zurich-test3
Artificial interface between in-situ ground and sensor
Ref : asphalt ; Test : asphalt + trihedron

Figure 14 : Parameters that **do not** influence H/V results. Influence of artificial interface between in-situ ground and sensor. Trihedron.

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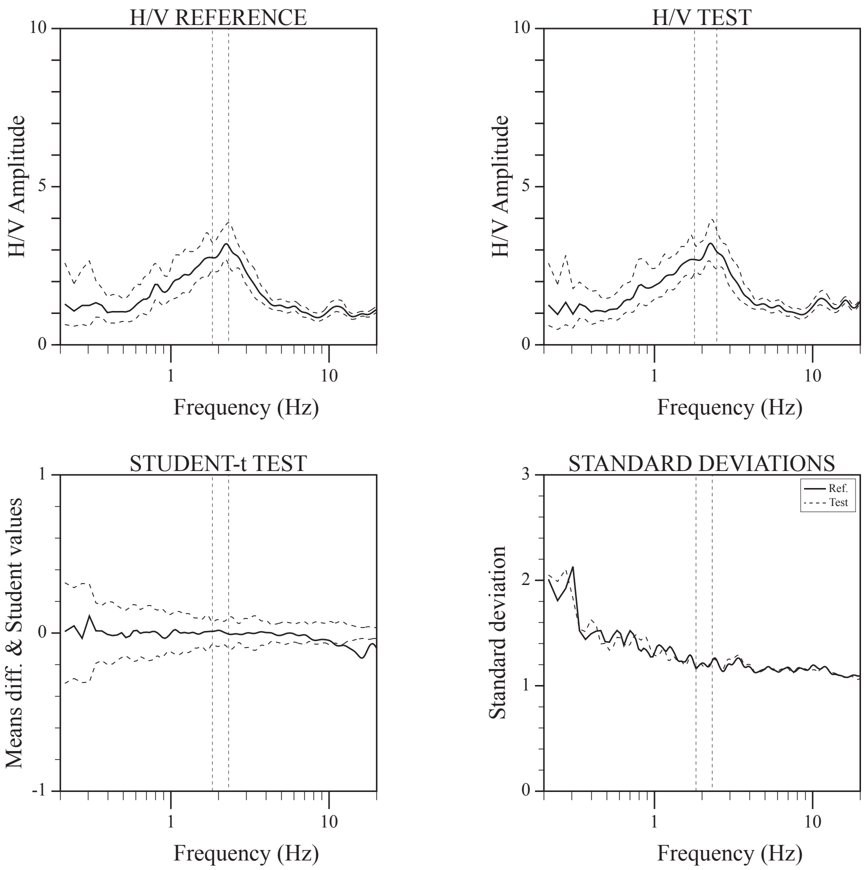

	File name	f0 (H/V) (Hz)	Nb win	Sample rate (Hz)	Recording duration (s)	Frequency stastistics from individual windows			
						f0 (Hz)	Sigma (Hz)	Nb win	Student-t test
Ref.	Ref Nice3	2.23	25	250	900	2.07	0.24	25	|diff| = 0.06 t = 0.30 Similar peak frequencies
Test	Nice-faience3	2.26	22	250	900	2.13	0.34	22	
	Conclusion	No influence inside the peak zone, slight influence outside (14%)							

	Recorder	Sensor	Rec. type : synchronous	Medium frequency site
Ref.	CitySharkII	5-second Lennartz LE3D	**P3-1-13-Grenoble Nice-test1** Artificial interface between in-situ ground and sensor Ref : natural soil ; Test : natural soil + ceramic plate	
Test	CitySharkII	5-second Lennartz LE3D		

Figure 15 : Parameters that **do not** influence H/V results. Influence of artificial interface between in-situ ground and sensor. Ceramic plate.

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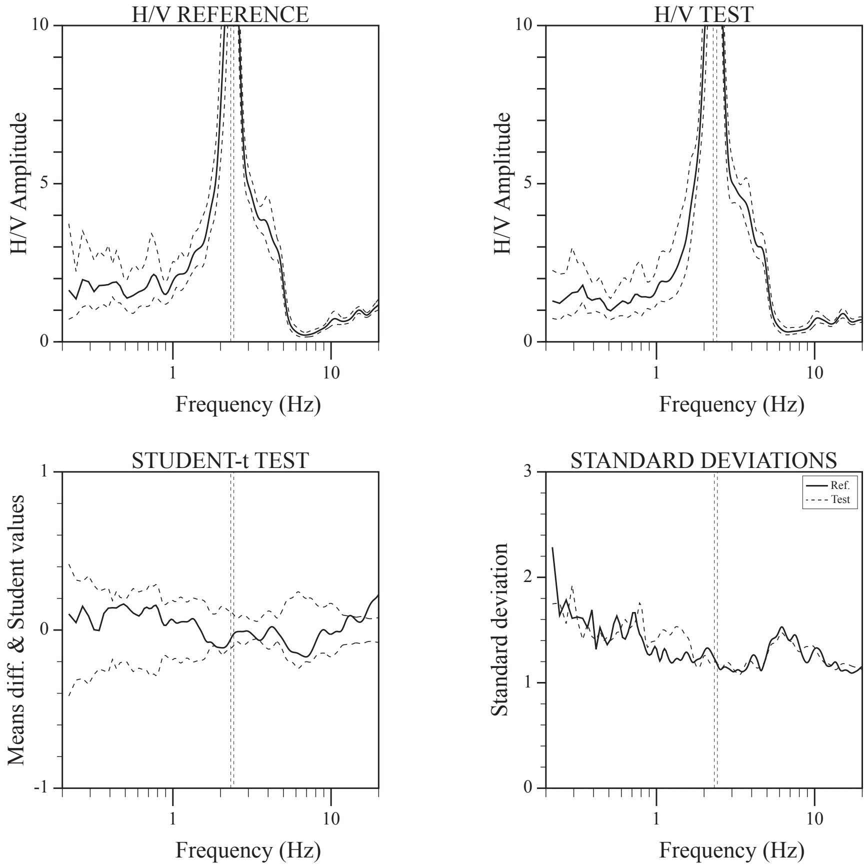

	File name	f0 (H/V) (Hz)	Nb win	Sample rate (Hz)	Recording duration (s)	Frequency stastistics from individual windows			
						f0 (Hz)	Sigma (Hz)	Nb win	Student-t test
Ref.	Not filled hole	2.39	14	200	900	2.38	0.05	14	|diff| = 0.03 t = 0.08 Similar peak frequencies
Test	Filled hole	2.34	15	200	900	2.34	0.06	15	
	Conclusion	No influence inside the peak zone, negligible influence outside (7%)							

	Recorder	Sensor	Rec. type : synchronous	Medium frequency site
Ref.	CitySharkII	5-second Lennartz LE3D	**P3-2-Grenoble-test12** Influence of sensor anchoring Ref : 30-cm unfilled hole ; Test : 30-cm filled hole	
Test	CitySharkII	5-second Lennartz LE3D		

Figure 16 : Parameters that **do not** influence H/V results. Influence of sensor anchoring.

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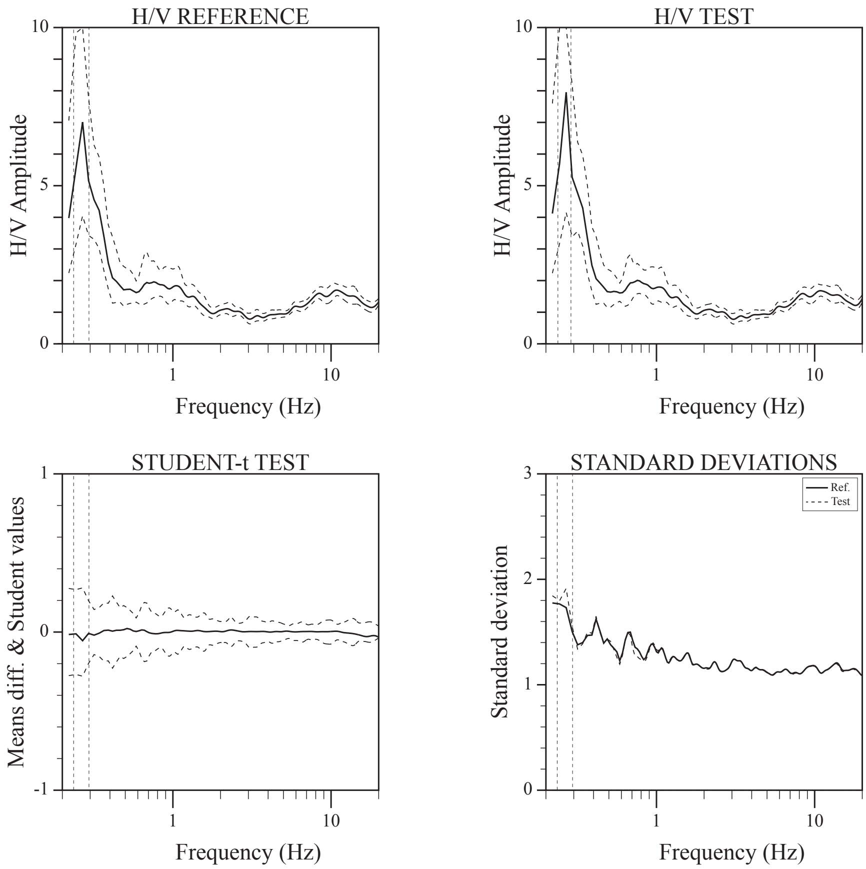

	File name	f0 (H/V) (Hz)	Nb win	Sample rate (Hz)	Recording duration (s)	Frequency stastistics from individual windows			
						f0 (Hz)	Sigma (Hz)	Nb win	Student-t test
Ref.	Reference	0.27	22	200	900	0.27	0.03	22	|diff| = 0.00 t = 0.03 Similar peak frequencies
Test	Pdev-CEpas serr	0.27	22	200	900	0.26	0.02	22	
	Conclusion	NO INFLUENCE							

	Recorder	Sensor	Rec. type : simultaneous	Low frequency site
Ref.	CityShark	5-second Lennartz LE3D	**P3-4-Grenoble-test1** Feet of sensor not blocked Ref : tightened counter-nuts ; Test : untightened counter-nuts	
Test	CityShark	5-second Lennartz LE3D		

Figure 17 : Parameters that **do not** influence H/V results. Influence of sensor feet blocking.

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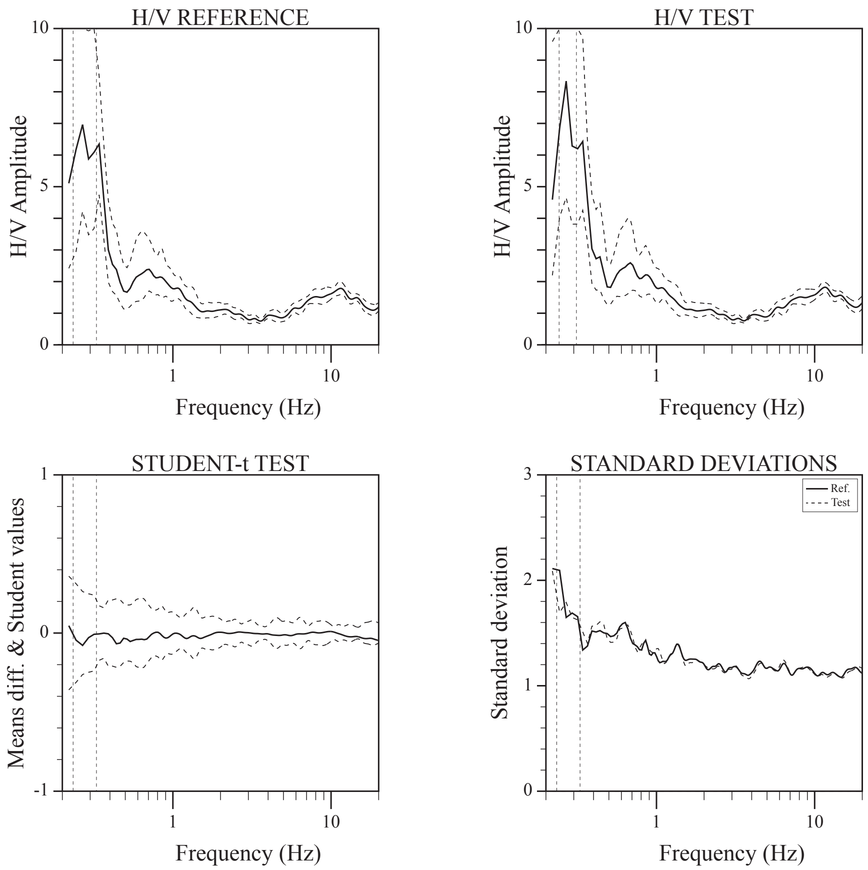

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<tr><th>f0 (Hz)</th><th>Sigma (Hz)</th><th>Nb win</th><th>Student-t test</th></tr>
<tr><td>Ref.</td><td>Ref 1</td><td>0.27</td><td>21</td><td>200</td><td>900</td><td>0.28</td><td>0.05</td><td>21</td><td rowspan="2">|diff| = 0.00
t = 0.05
Similar
peak frequencies</td></tr>
<tr><td>Test</td><td>1-Sand</td><td>0.27</td><td>20</td><td>200</td><td>900</td><td>0.28</td><td>0.03</td><td>20</td></tr>
<tr><td></td><td>Conclusion</td><td colspan="8">NO INFLUENCE</td></tr>
</table>

<table>
<tr><th></th><th>Recorder</th><th>Sensor</th><th>Rec. type : simultaneous</th><th>Low frequency site</th></tr>
<tr><td>Ref.</td><td>CityShark</td><td>5-second Lennartz LE3D</td><td colspan="2" rowspan="2">P3-6-Grenoble-test4
Influence of a pile of sand
Ref : natural soil ; Test : pile of sand</td></tr>
<tr><td>Test</td><td>CityShark</td><td>5-second Lennartz LE3D</td></tr>
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Figure 18 : Parameters that **do not** influence H/V results. Influence of a pile of sand.

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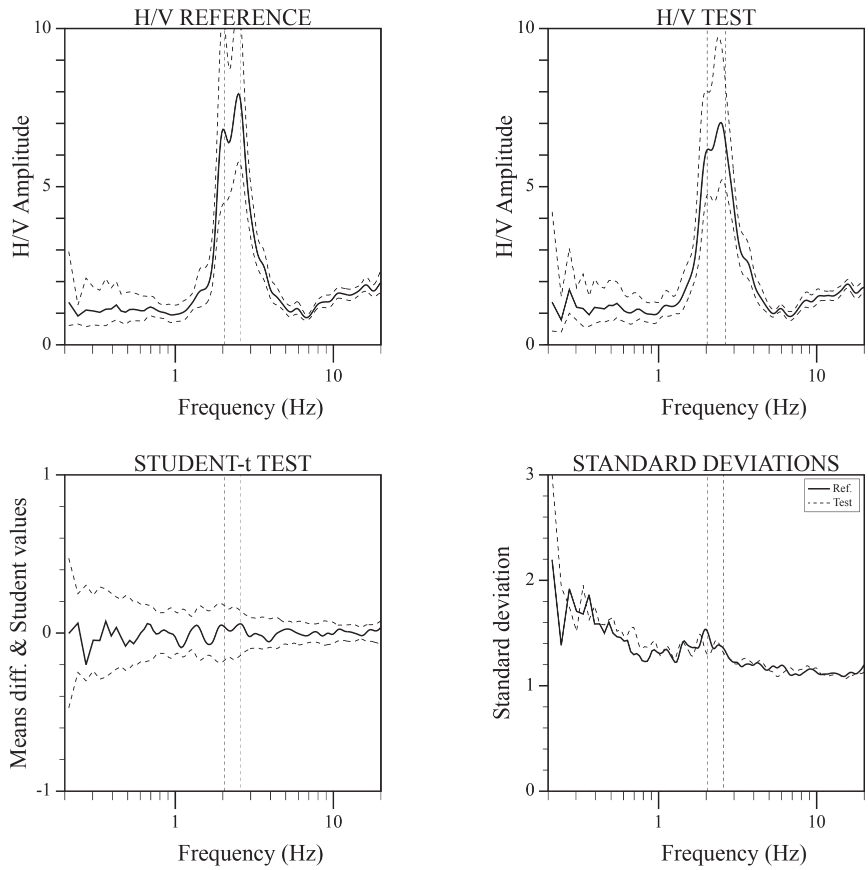

	File name	f0 (H/V) (Hz)	Nb win	Sample rate (Hz)	Recording duration (s)	Frequency stastistics from individual windows: f0 (Hz)	Sigma (Hz)	Nb win	Student-t test
Ref.	PIPs08_2002 0710_0706.saf	2.51	22	62	831	2.31	0.26	22	|diff| = 0.03 t = 0.33 Similar peak frequencies
Test	PIPs09_2002 0710_0801.saf	2.48	18	62	637	2.34	0.31	18	
	Conclusion	NO INFLUENCE							

	Recorder	Sensor	Rec. type : sequential	Medium frequency site
Ref.	CityShark	1-Hz Lennartz LE3D Lite	**P6-4-Lisbon-test1** Influence of temperature Ref : 17.2° ; Test : 20.0°	
Test	CityShark	1-Hz Lennartz LE3D Lite		

Figure 19 : Parameters that **do not** influence H/V results. Influence of temperature.

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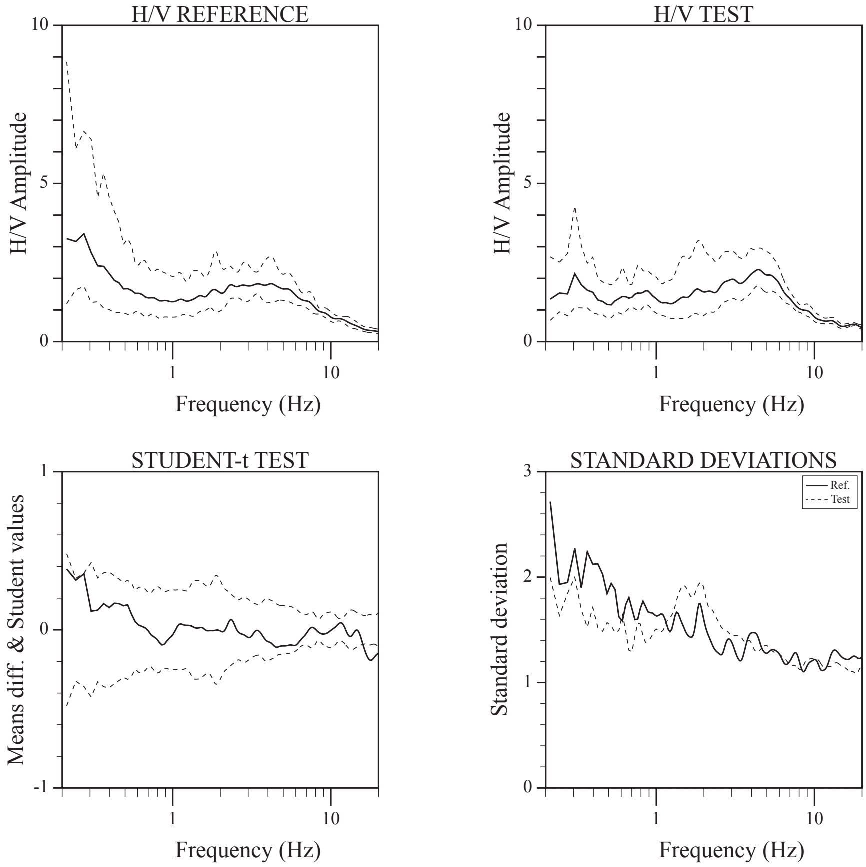

	File name	f0 (H/V) (Hz)	Nb win	Sample rate (Hz)	Recording duration (s)	Frequency stastistics from individual windows			
						f0 (Hz)	Sigma (Hz)	Nb win	
Ref.	gemgep306.saf		16	125	784				
Test	09251052.saf		16	125	944				
	Conclusion	NO INFLUENCE							

	Recorder	Sensor	Rec. type : sequential	No peak site
Ref.	Mars Lite	5-second Lennartz LE3D	**P8-1-Nice-test2** H/V stability over time Natural soil Ref : 20/04/99; Test : 25/09/02	
Test	Mars Lite	5-second Lennartz LE3D		

Figure 20 : Parameters that **do not** influence H/V results. Influence of time in H/V stability for no peak site.

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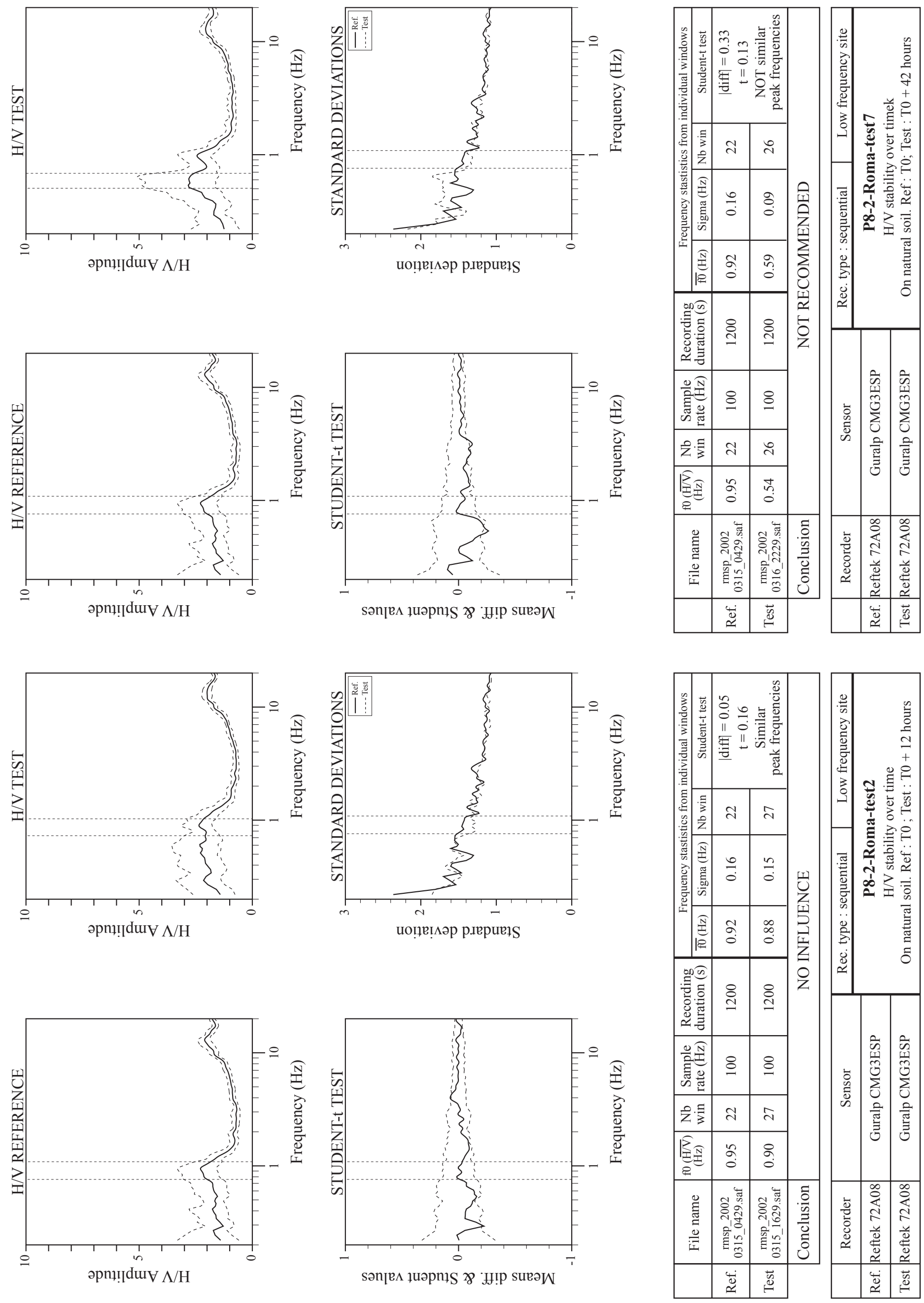

Figure 21 : Parameters that **do not** influence H/V results. Influence of time in H/V stability for low frequency site.

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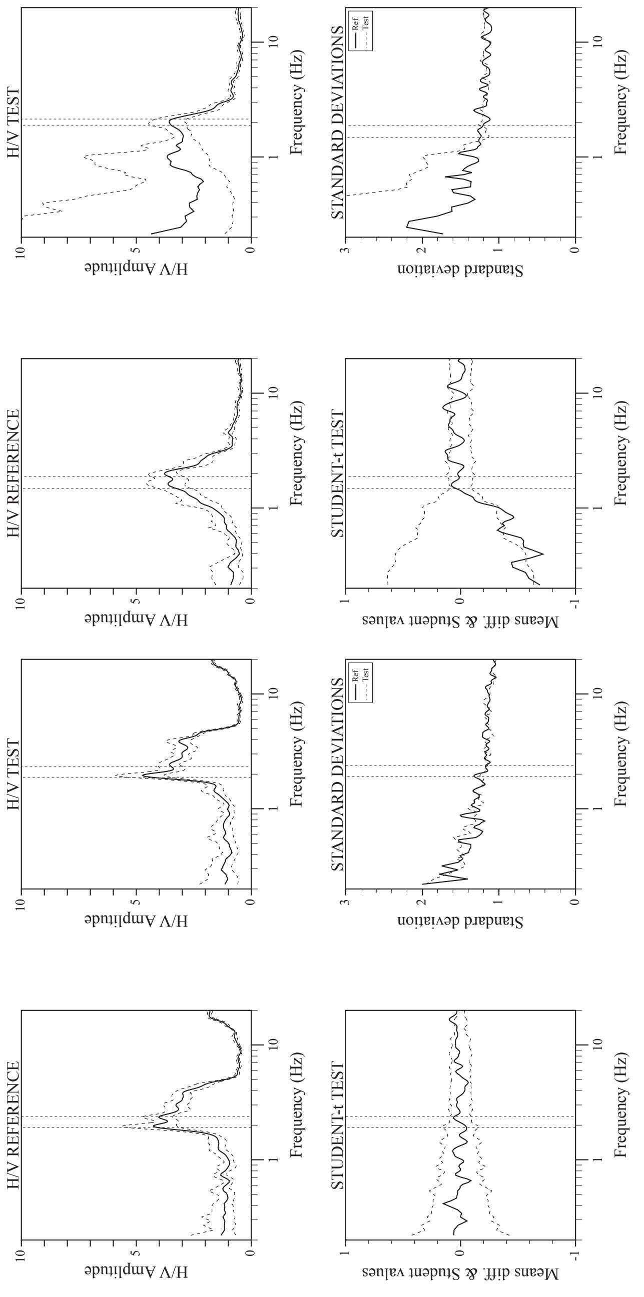

	File name	f0 (H/V) (Hz)	Nb win	Sample rate (Hz)	Recording duration (s)	Frequency stastistics from individual windows			
						f0 (Hz)	Sigma (Hz)	Nb win	Student-t test
Ref.	IGIDL1_2002 0327_0758.saf	1.95	13	50	604	2.15	0.23	13	|diff| = 0.05 t = 0.34 Similar peak frequencies
Test	IGIDL1_2002 0327_1958.saf	1.95	14	50	604	2.10	0.24	14	
Conclusion	No influence inside the peak zone, negligible influence outside (6%)								

	Recorder	Sensor	Rec. type : sequential	Medium frequency site
Ref.	Reftek	Guralp CMG 40T (GS)	**P8-3-Lisbon-test12** H/V stability over time Inside lab. Ref : T0 ; Test : T0 + 12 hours	
Test	Reftek	Guralp CMG 40T (GS)		

	File name	f0 (H/V) (Hz)	Nb win	Sample rate (Hz)	Recording duration (s)	Frequency stastistics from individual windows			
						f0 (Hz)	Sigma (Hz)	Nb win	Student-t test
Ref.	177lyc.saf	2.01	12	125	432	1.68	0.21	12	|diff| = 0.32 t = 0.21 NOT similar peak frequencies
Test	10041431.saf	2.04	23	125	932	2.00	0.14	23	
Conclusion	NOT RECOMMENDED								

	Recorder	Sensor	Rec. type : sequential	Medium frequency site
Ref.	Mars 88	1 Hz seismometer ?	**P8-3-Nice-test5** H/V stability over time-site medium frequency peak Inside house. Ref : 28/12/91 ; Test : 04/10/02	
Test	Mars Lite	5-second Lennartz LE3D		

Figure 22 : Parameters that **do not** influence H/V results. Influence of time in H/V stability for medium frequency site.

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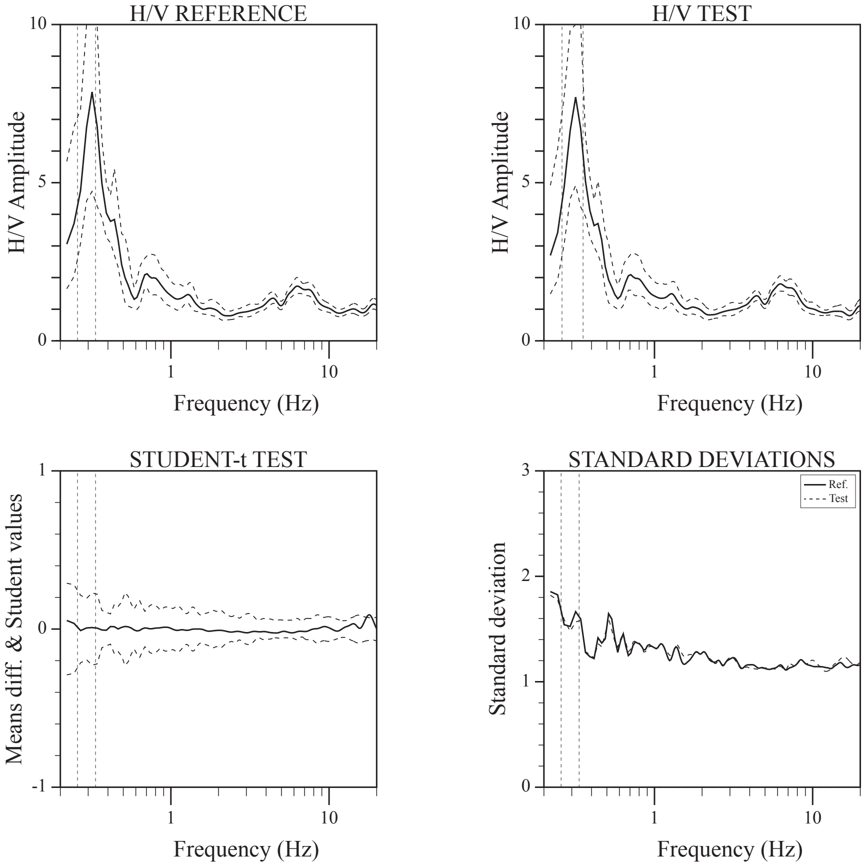

	File name	f0 (H/V) (Hz)	Nb win	Sample rate (Hz)	Recording duration (s)	Frequency stastistics from individual windows			
						f0 (Hz)	Sigma (Hz)	Nb win	Student-t test
Ref.	5m ref	0.32	21	200	900	0.30	0.04	21	|diff| = 0.01 t = 0.05 Similar peak frequencies
Test	5m amont	0.32	21	200	900	0.31	0.05	21	
	Conclusion	NO INFLUENCE							

	Recorder	Sensor	Rec. type : simultaneous	Low frequency site
Ref.	CityShark	5-second Lennartz LE3D	**P9-5-Grenoble-test1** Influence of power line Perp. to the power line. Ref: below PL ; test : 5 m to the North	
Test	CityShark	5-second Lennartz LE3D		

Figure 23 : Parameters that **do not** influence H/V results. Influence of power lines.

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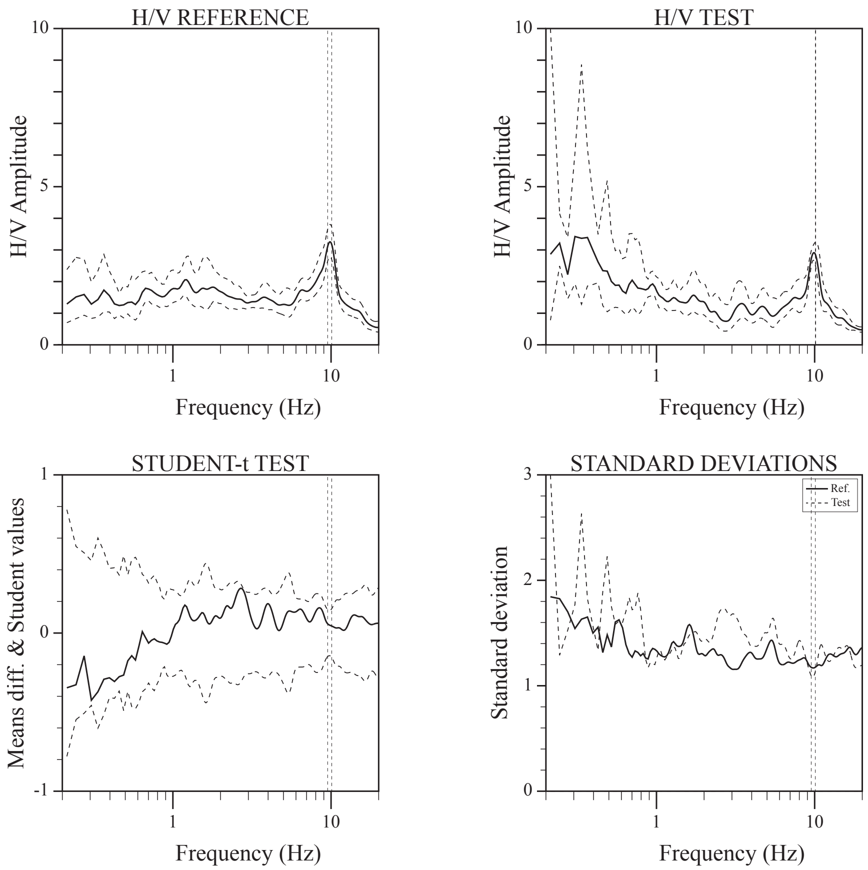

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<tr><th></th><th></th><th></th><th></th><th></th><th></th><th>f0 (Hz)</th><th>Sigma (Hz)</th><th>Nb win</th><th>Student-t test</th></tr>
<tr><td>Ref.</td><td>ref_0917 _1539.saf</td><td>9.86</td><td>14</td><td>125</td><td>480</td><td>9.81</td><td>0.29</td><td>14</td><td rowspan="2">|diff| = 0.32
t = 0.60
Similar peak frequencies</td></tr>
<tr><td>Test</td><td>0917_1644.saf</td><td>10.31</td><td>4</td><td>125</td><td>160</td><td>10.13</td><td>0.00</td><td>4</td></tr>
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	Recorder	Sensor	Rec. type : sequential	High frequency site
Ref.	Mars Lite	5-second Lennartz LE3D	**P9-7-Nice-test2** Influence of music in car participating to experiment	
Test	Mars Lite	5-second Lennartz LE3D	On asphalt. Ref : calm record ; test : rap music radio	

Figure 24 : Parameters that **do not** influence H/V results Influence of music in car participating to experiment.

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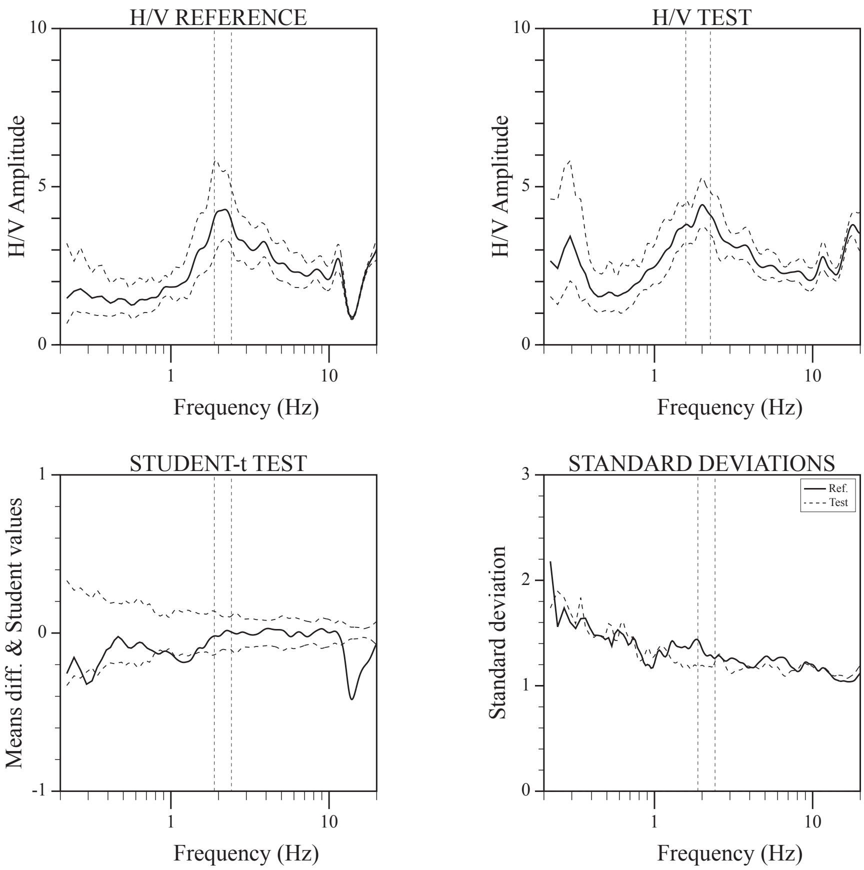

	File name	f0 (H/V) (Hz)	Nb win	Sample rate (Hz)	Recording duration (s)	Frequency stastistics from individual windows			
						f0 (Hz)	Sigma (Hz)	Nb win	Student-t test
Ref.	02032711.saf	2.20	20	100	903	2.15	0.27	20	|diff| = 0.23 t = 0.35 Similar peak frequencies
Test	02032710.saf	2.00	20	100	903	1.92	0.34	20	
	Conclusion	No influence inside the peak zone, caution outside (27%)							

	Recorder	Sensor	Rec. type : simultaneous	Medium frequency site
Ref.	Mars Lite	5-second Lennartz LE3D	**P2-2-Nice-test1** Influence of gravel Ref : on natural soil ; Test : on gravel	
Test	Mars Lite	5-second Lennartz LE3D		

Figure 25 : Parameters that **do** influence H/V results. Influence of gravel.

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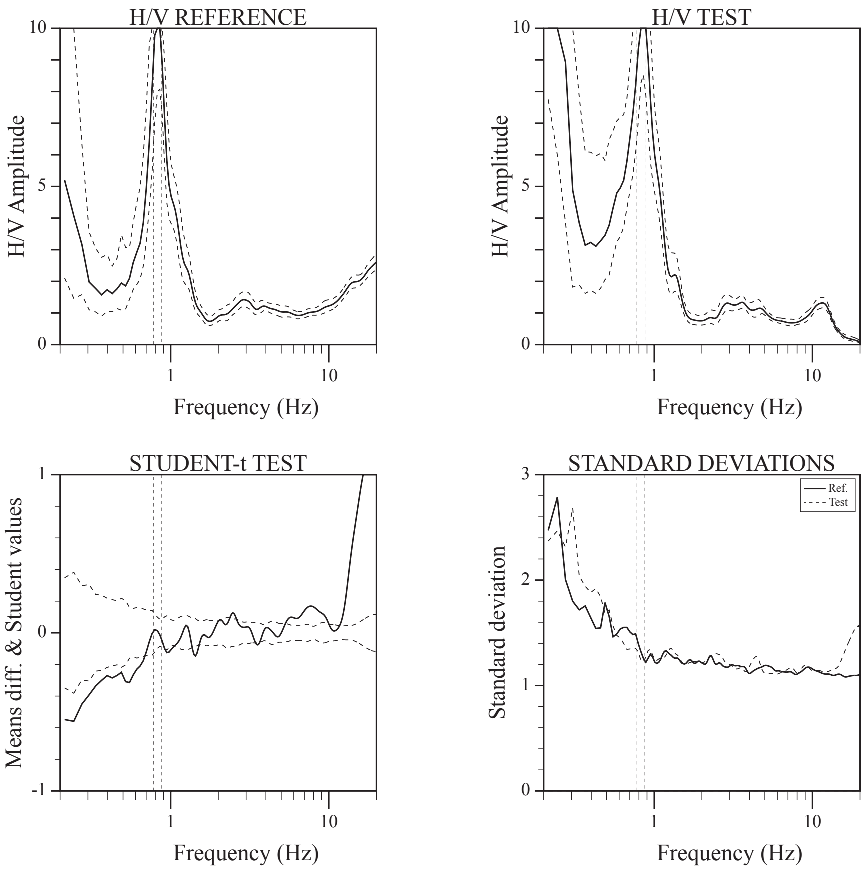

	File name	f0 (H/V) (Hz)	Nb win	Sample rate (Hz)	Recording duration (s)	Frequency stastistics from individual windows			
						f0 (Hz)	Sigma (Hz)	Nb win	Student-t test
Ref.	02130846.saf	0.82	36	125	1348	0.82	0.05	36	|diff| = 0.00 t = 0.05 Similar peak frequencies
Test	02131211.saf	0.85	26	125	1018	0.83	0.06	26	
	Conclusion	No influence inside the peak zone, discard outside (64%)							

	Recorder	Sensor	Rec. type : sequential	Low frequency site
Ref.	Mars Lite	5-second Lennartz LE3D	**P2-9-Nice-test1** Influence of synthetic cover Ref : on grass ; Test : on synthetic cover	
Test	Mars Lite	5-second Lennartz LE3D		

Figure 26 : Parameters that **do** influence H/V results. Influence of synthetic cover, tartan.

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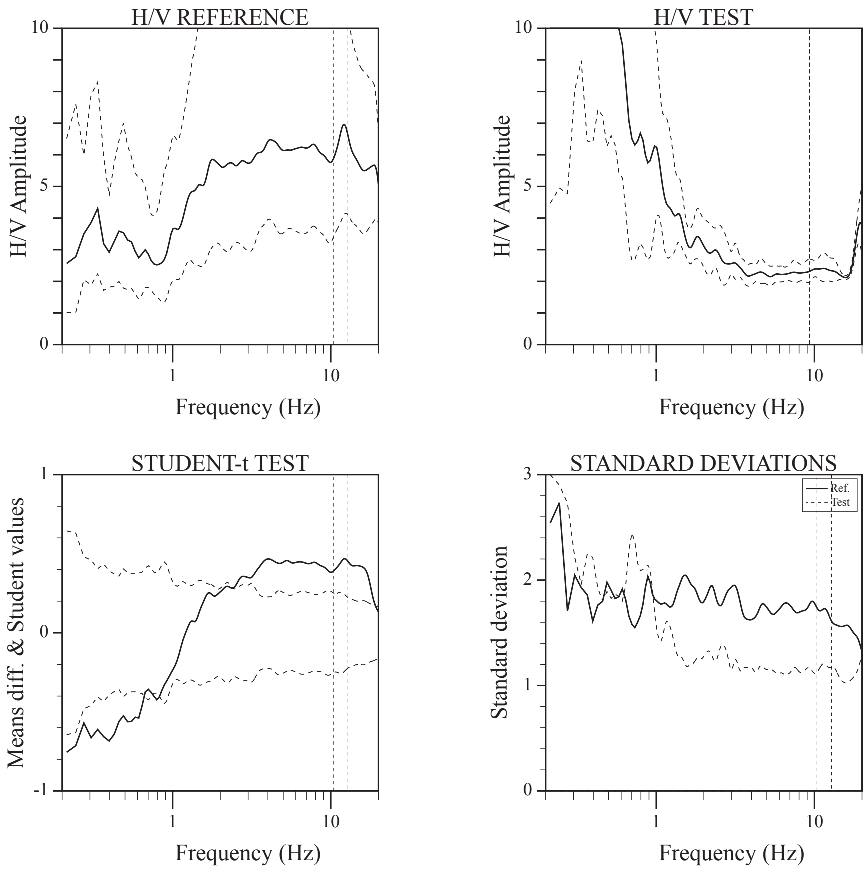

	File name	f0 (H/V) (Hz)	Nb win	Sample rate (Hz)	Recording duration (s)	Frequency stastistics from individual windows			
						f0 (Hz)	Sigma (Hz)	Nb win	Student-t test
Ref.	10021001.saf	12.12	15	125	960	11.60	1.23	15	|diff| = 2.29 t = 1.26 NOT similar peak frequencies
Test	10021039.saf	0.31	13	125	935	9.31	0.00	13	
	Conclusion	NOT RECOMMENDED							

	Recorder	Sensor	Rec. type : sequential	High frequency site
Ref.	Mars Lite	5-second Lennartz LE3D	**P2-10-Nice-test1** Influence of a karstic filling Ref : on calcareous rock ; Test : on vegetal soil	
Test	Mars Lite	5-second Lennartz LE3D		

Figure 27 : Parameters that **do** influence H/V results. Influence of a karstic filling.

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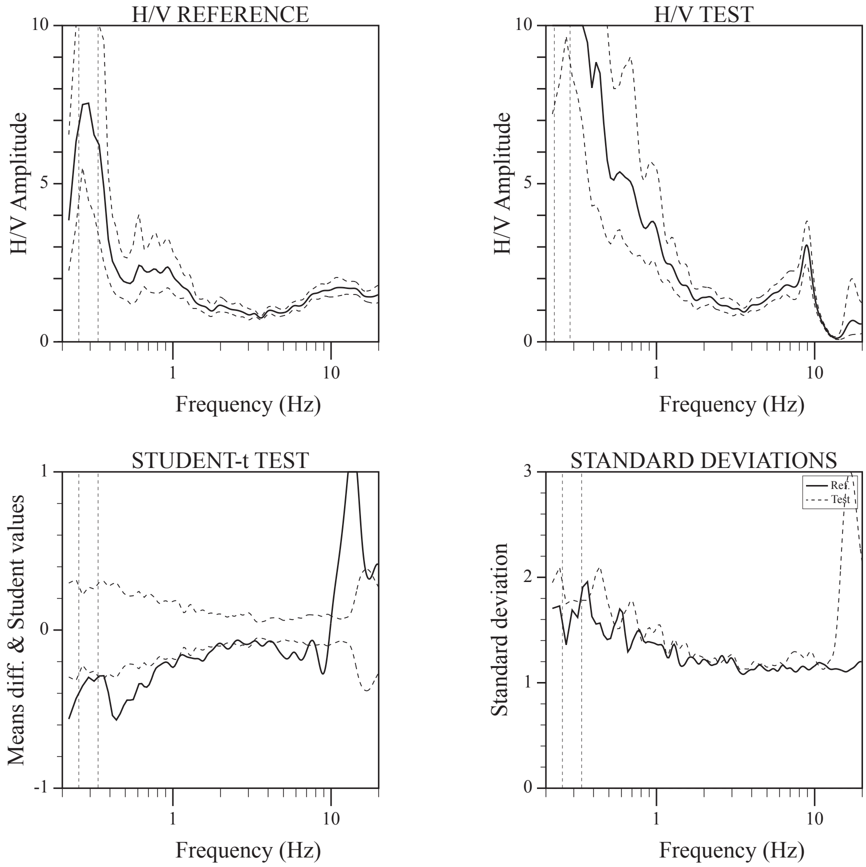

	File name	f0 (H/V) (Hz)	Nb win	Sample rate (Hz)	Recording duration (s)	Frequency stastistics from individual windows: f0 (Hz)	Sigma (Hz)	Nb win	Student-t test
Ref.	Reference 1	0.29	20	200	900	0.30	0.04	20	|diff| = 0.04 t = 0.04 NOT similar peak frequencies
Test	1-Polystyren1	0.24	20	200	900	0.26	0.03	20	
	Conclusion	NOT RECOMMENDED							

	Recorder	Sensor	Rec. type : simultaneous	Low frequency site
Ref.	CityShark	5-second Lennartz LE3D	**P3-1-1-Grenoble-test1** Artificial interface between in-situ ground and sensor Ref : natural soil ; Test : styrofoam	
Test	CityShark	5-second Lennartz LE3D		

Figure 28 : Parameters that **do** influence H/V results. Influence of artificial interface between in-situ ground and sensor. Styrofoam.

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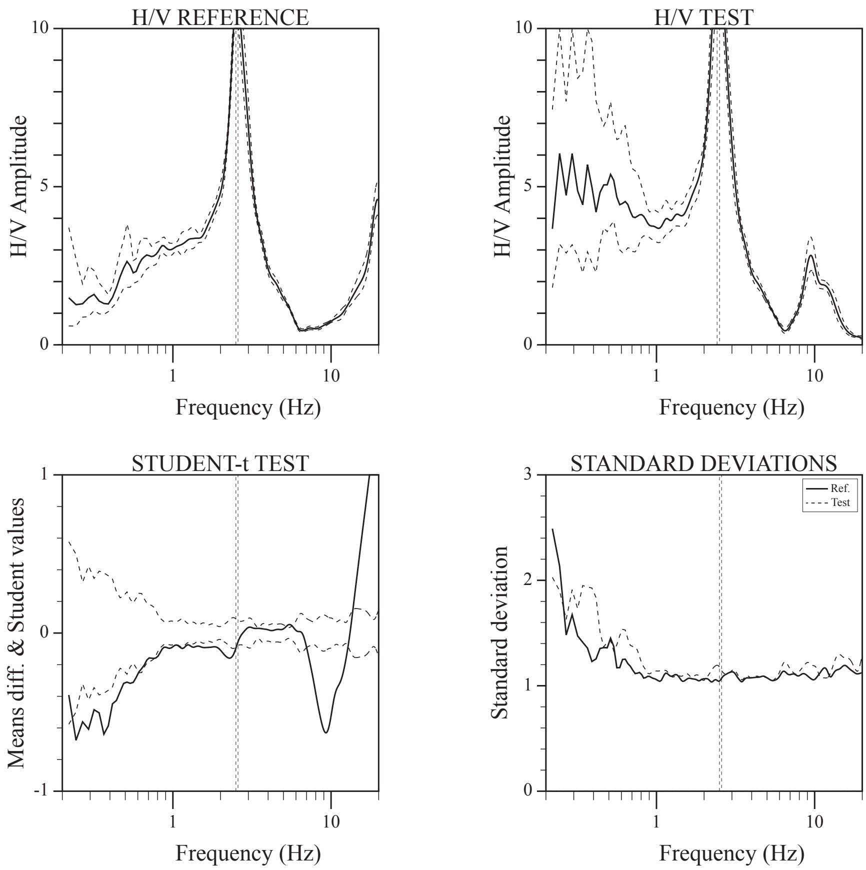

	File name	f0 (H/V) (Hz)	Nb win	Sample rate (Hz)	Recording duration (s)	Frequency stastistics from individual windows			
						f0 (Hz)	Sigma (Hz)	Nb win	Student-t test
Ref.	Ref3	2.54	10	200	900	2.54	0.04	10	|diff| = 0.08 t = 0.07 NOT similar peak frequencies
Test	3-Cardboard	2.47	12	200	900	2.46	0.05	12	
	Conclusion	NOT RECOMMENDED							

	Recorder	Sensor	Rec. type : simultaneous	Medium frequency site
Ref.	CityShark	5-second Lennartz LE3D	**P3-1-2-Grenoble-test2** Artificial interface between in-situ ground and sensor Ref : on natural soil ; Test : on cardboard plate	
Test	CityShark	5-second Lennartz LE3D		

Figure 29 : Parameters that **do** influence H/V results. Influence of artificial interface between in-situ ground and sensor. Cardboard plate.

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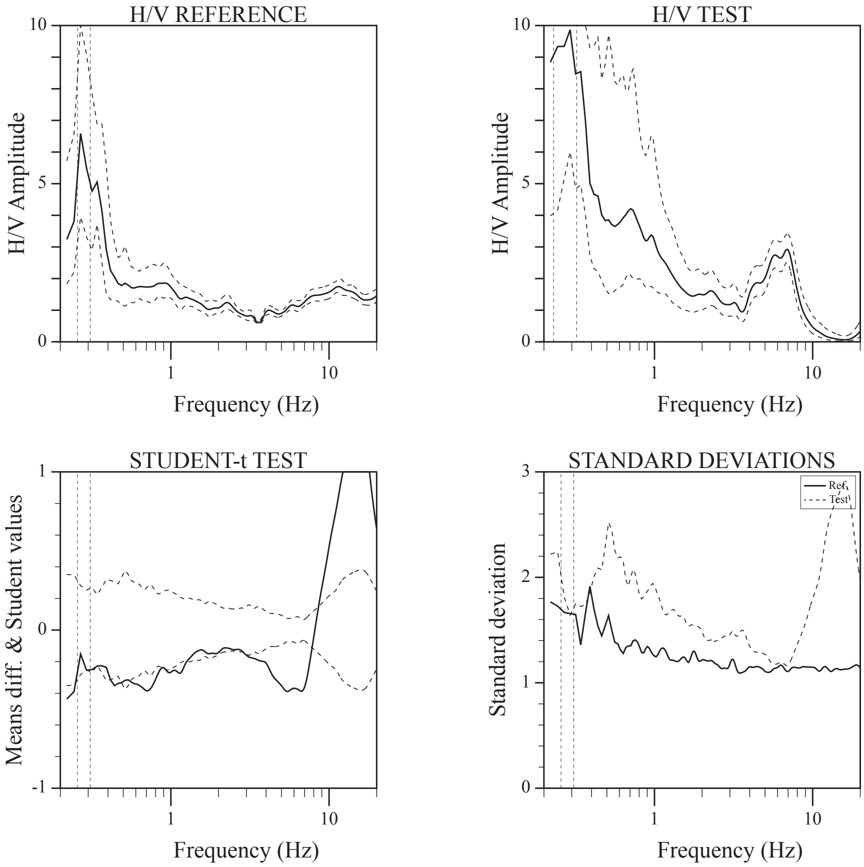

	File name	f0 (H/V) (Hz)	Nb win	Sample rate (Hz)	Recording duration (s)	Frequency stastistics from individual windows			
						f0 (Hz)	Sigma (Hz)	Nb win	Student-t test
Ref.	Reference 5	0.27	19	200	900	0.28	0.03	19	|diff| = 0.01 t = 0.04 Similar peak frequencies
Test	5-Foam	0.29	19	200	900	0.28	0.05	19	
	Conclusion	NOT RECOMMENDED (67% inside peak zone)							

	Recorder	Sensor	Rec. type : simultaneous	Low frequency site
Ref.	CityShark	5-second Lennartz LE3D	**P3-1-3-Grenoble-test1** Artificial interface between in-situ ground and sensor Ref : on natural soil ; Test : on foam	
Test	CityShark	5-second Lennartz LE3D		

Figure 30 : Parameters that **do** influence H/V results. Influence of artificial interface between in-situ ground and sensor. Foam.

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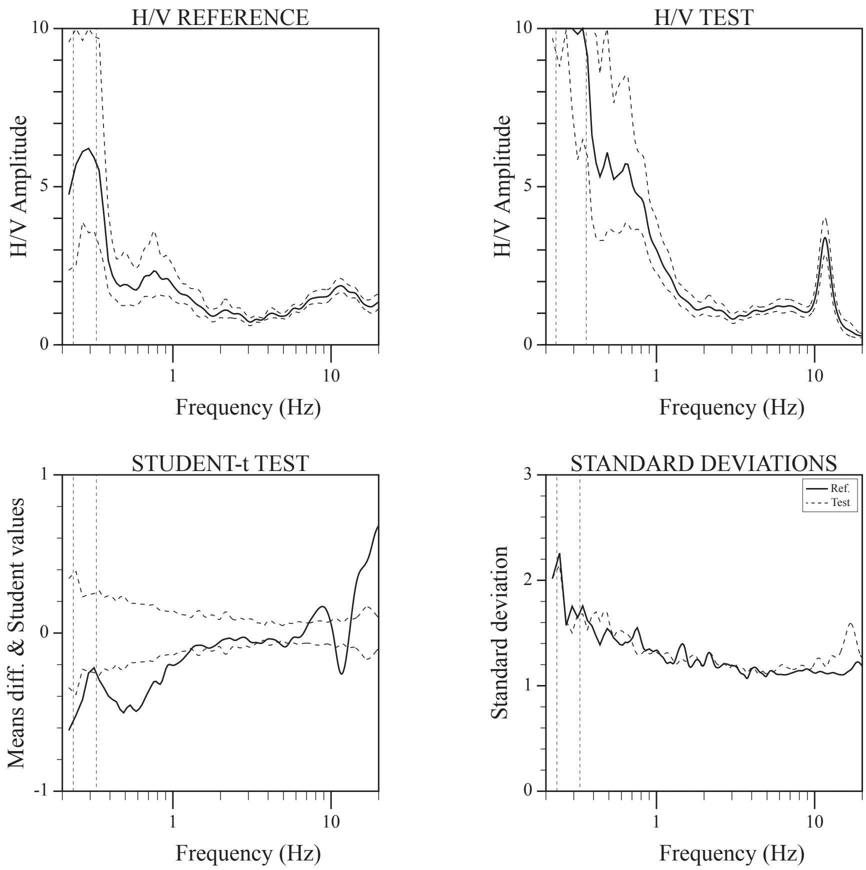

	File name	f0 (H/V) (Hz)	Nb win	Sample rate (Hz)	Recording duration (s)	Frequency stastistics from individual windows			
						f0 (Hz)	Sigma (Hz)	Nb win	Student-t test
Ref.	Reference 10	0.29	21	200	900	0.28	0.05	21	|diff| = 0.01 t = 0.06 Similar peak frequencies
Test	10-Plastic container	0.34	19	200	900	0.30	0.06	19	
	Conclusion	NOT RECOMMENDED (69% inside peak zone)							

	Recorder	Sensor	Rec. type : simultaneous	Low frequency site
Ref.	CityShark	5-second Lennartz LE3D	**P3-1-4-Grenoble-test1** Artificial interface between in-situ ground and sensor Ref : natural soil ; Test : empty plastic container	
Test	CityShark	5-second Lennartz LE3D		

Figure 31 : Parameters that **do** influence H/V results. Influence of artificial interface between in-situ ground and sensor. Empty plastic container.

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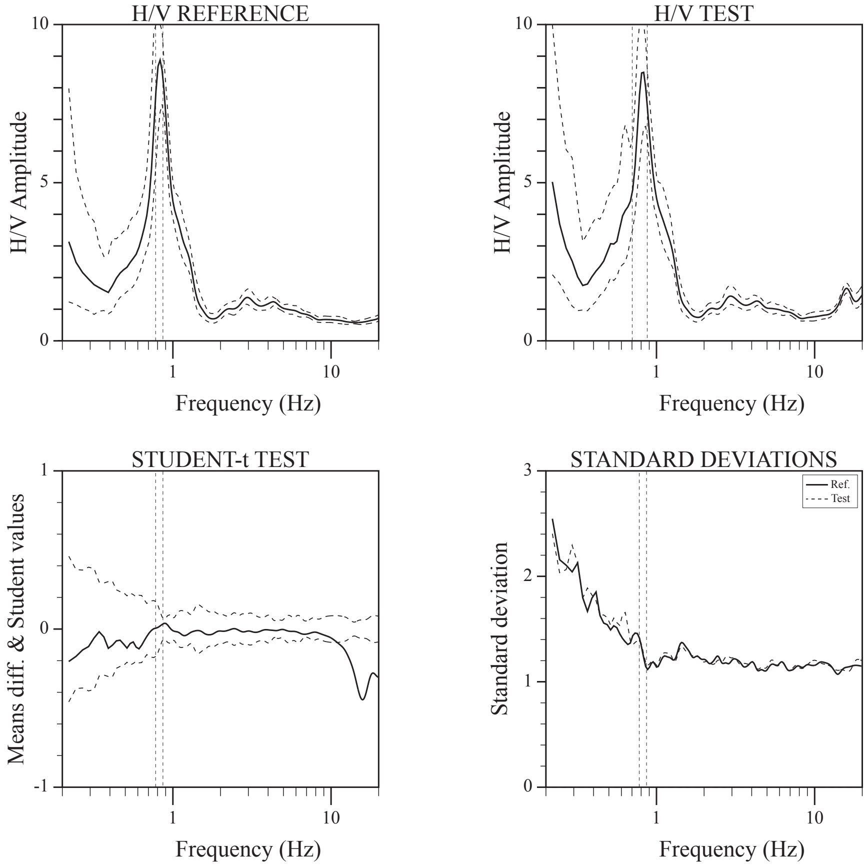

	File name	f0 (H/V) (Hz)	Nb win	Sample rate (Hz)	Recording duration (s)	Frequency stastistics from individual windows			
						f0 (Hz)	Sigma (Hz)	Nb win	Student-t test
Ref.	02032901.saf	0.83	20	100	903	0.82	0.04	20	|diff| = 0.03 t = 0.08 Similar peak frequencies
Test	02032907.saf	0.83	18	100	903	0.79	0.09	18	
	Conclusion	No influence inside the peak zone, slight influence outside (13%)							

	Recorder	Sensor	Rec. type : simultaneous	Low frequency site
Ref.	Hathor 3	5-second Lennartz LE3D	**P3-1-9-Nice-test1** Artificial interface between in-situ ground and sensor Ref : on natural soil ; Test : on a cement plate	
Test	Hathor 3	5-second Lennartz LE3D		

Figure 32 : Parameters that **do** influence H/V results. Influence of artificial interface between in-situ ground and sensor. Cement plate.

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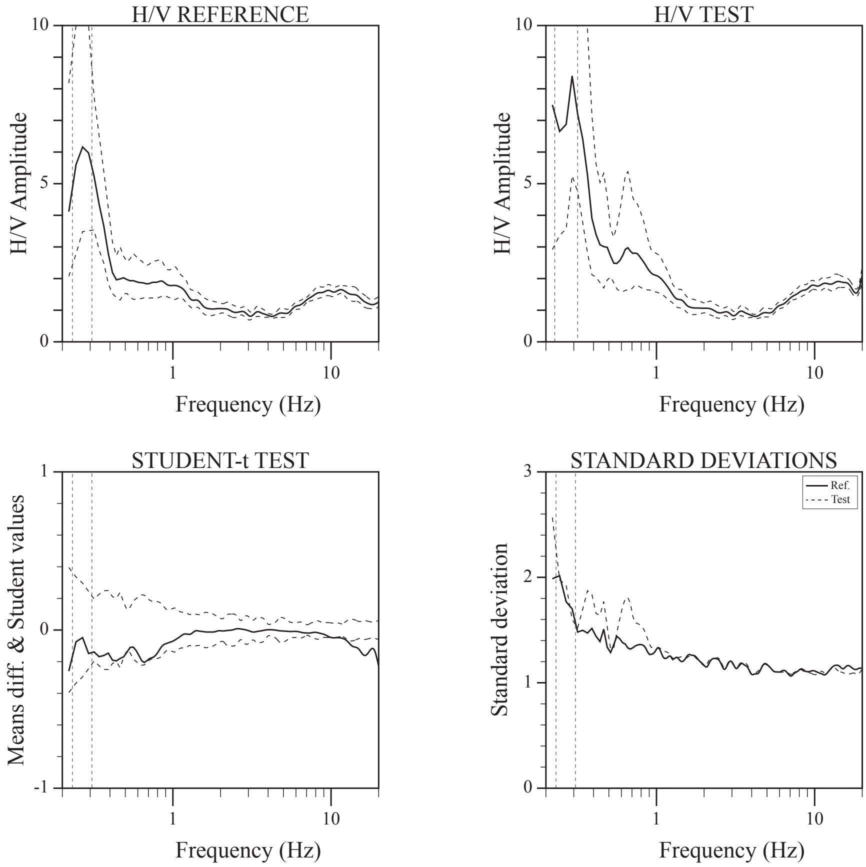

	File name	f0 (H/V) (Hz)	Nb win	Sample rate (Hz)	Recording duration (s)	Frequency stastistics from individual windows			
						f0 (Hz)	Sigma (Hz)	Nb win	Student-t test
Ref.	Reference 1	0.27	22	200	900	0.27	0.04	22	|diff| = 0.00 t = 0.05 Similar peak frequencies
Test	1-5.4 Kg	0.29	19	200	900	0.27	0.04	19	
	Conclusion	No influence inside the peak zone, slight influence outside (18%)							

	Recorder	Sensor	Rec. type : simultaneous	Low frequency site
Ref.	CityShark	5-second Lennartz LE3D	**P3-3-Grenoble-test1** Influence of ballast on sensor Ref : natural soil ; Test : natural soil + a 5.4 kg ballast	
Test	CityShark	5-second Lennartz LE3D		

Figure 33 : Parameters that **do** influence H/V results. Influence ballast on sensor.

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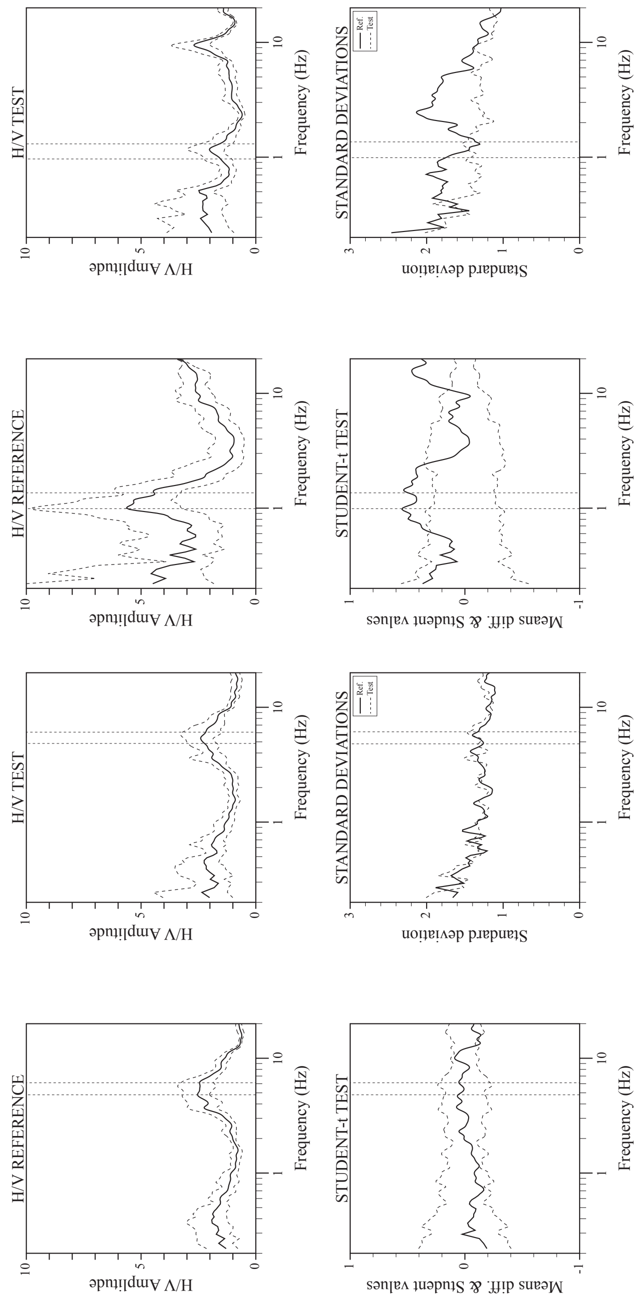

	File name	f0 ($\overline{H/V}$) (Hz)	Nb win	Sample rate (Hz)	Recording duration (s)	Frequency stastistics from individual windows			
						$\overline{f0}$ (Hz)	Sigma (Hz)	Nb win	Student-t test
Ref.	EUL006_2002 0523_1455.saf	4.83	14	100	600	5.46	0.66	14	|diff| = 0.00 t = 1.00 Similar peak frequencies
Test	EUL001_2002 0523_1339.saf	5.37	10	100	600	5.46	0.62	10	
	Conclusion	NO INFLUENCE							

	Recorder	Sensor	Rec. type : sequential	Medium frequency site
Ref.	CityShark	1-Hz Lennartz LE3D Lite	**P5-1-Lisbon-test1** Influence of large underground structures Subway. Ref : 60 m away ; Test : 0 m away	
Test	CityShark	1-Hz Lennartz LE3D Lite		

	File name	f0 ($\overline{H/V}$) (Hz)	Nb win	Sample rate (Hz)	Recording duration (s)	Frequency stastistics from individual windows			
						$\overline{f0}$ (Hz)	Sigma (Hz)	Nb win	Student-t test
Ref.	point03.64	1.03	9	100	600	1.17	0.18	9	|diff| = 0.04 t = 0.29 Similar peak frequencies
Test	point10.64	1.17	14	100	600	1.14	0.17	14	
	Conclusion	NOT RECOMMENDED (100% inside peak zone)							

	Recorder	Sensor	Rec. type : sequential	Medium frequency site
Ref.	CityShark	5-second Lennartz LE3D	**P5-1-Grenoble-test1** Influence of large underground structures : 20x50x3m cavity Ref : 30 m East away of cavity center ; Test : at cavity center	
Test	CityShark	5-second Lennartz LE3D		

Figure 34 : Parameters that **do** influence H/V results. Influence of large underground structures.

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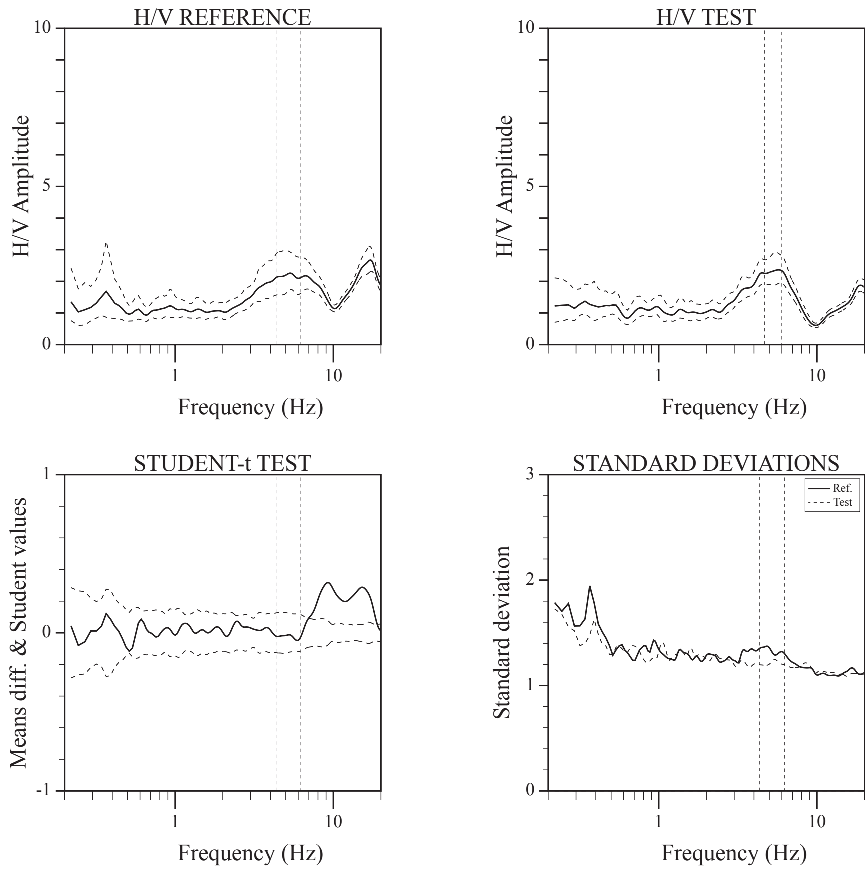

	File name	f0 ($\overline{H/V}$) (Hz)	Nb win	Sample rate (Hz)	Recording duration (s)	Frequency stastistics from individual windows: $\overline{f0}$ (Hz)	Sigma (Hz)	Nb win	Student-t test
Ref.	Ref 2	5.35	19	100	900	5.29	0.94	19	|diff| = 0.04 t = 0.95 Similar peak frequencies
Test	2-Bouche egout	5.74	19	100	900	5.32	0.67	19	
	Conclusion	No influence inside the peak zone, caution outside (24%)							

	Recorder	Sensor	Rec. type : sequential	High frequency site
Ref.	CityShark	5-second Lennartz LE3D	**P5-2-Grenoble-test3** Influence of small underground structures Ref : natural soil ; Test : top of a sewer drain	
Test	CityShark	5-second Lennartz LE3D		

Figure 35 : Parameters that **do** influence H/V results. Influence of small underground structures.
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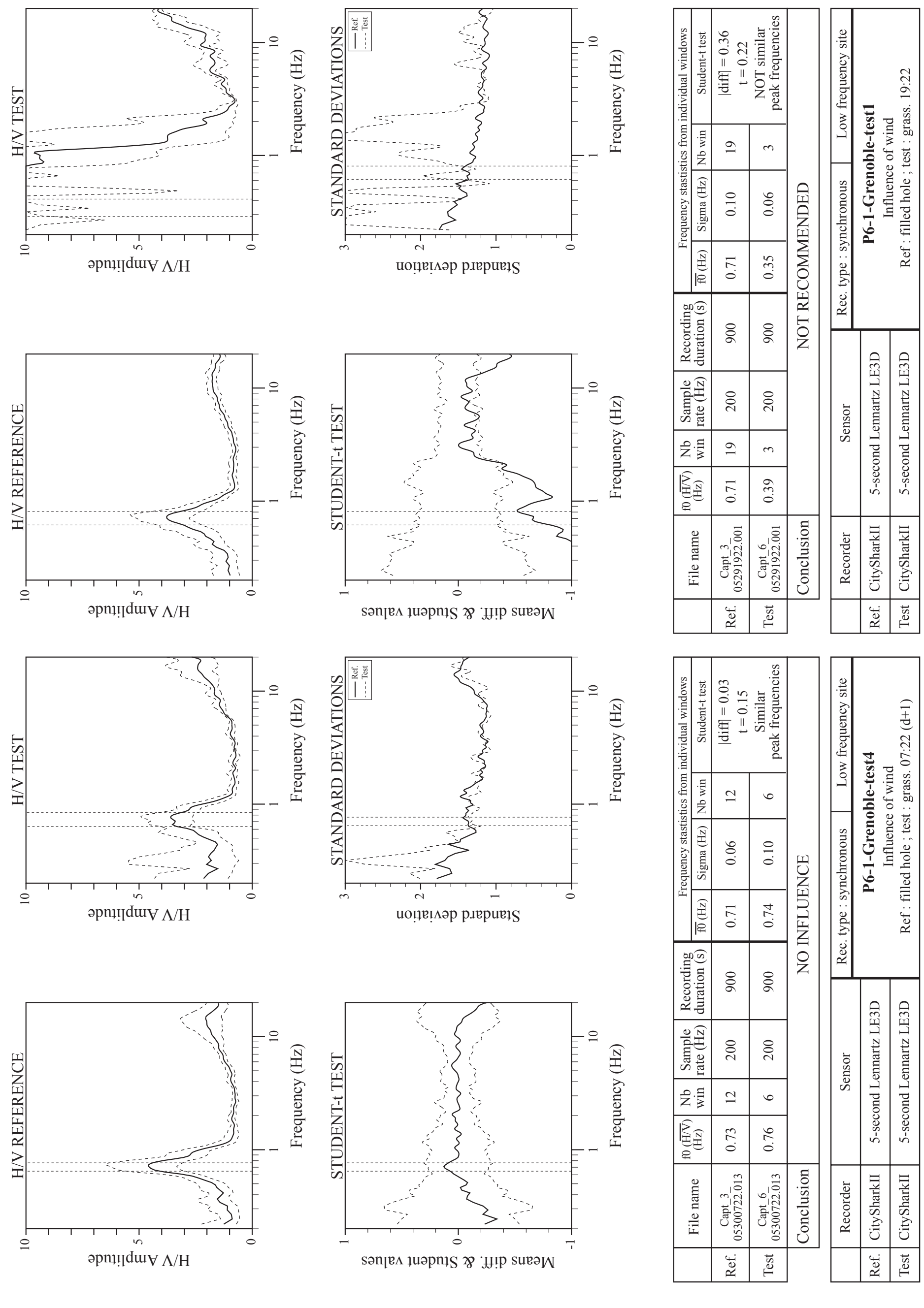

Figure 36 : Parameters that **do** influence H/V results. Influence of wind.

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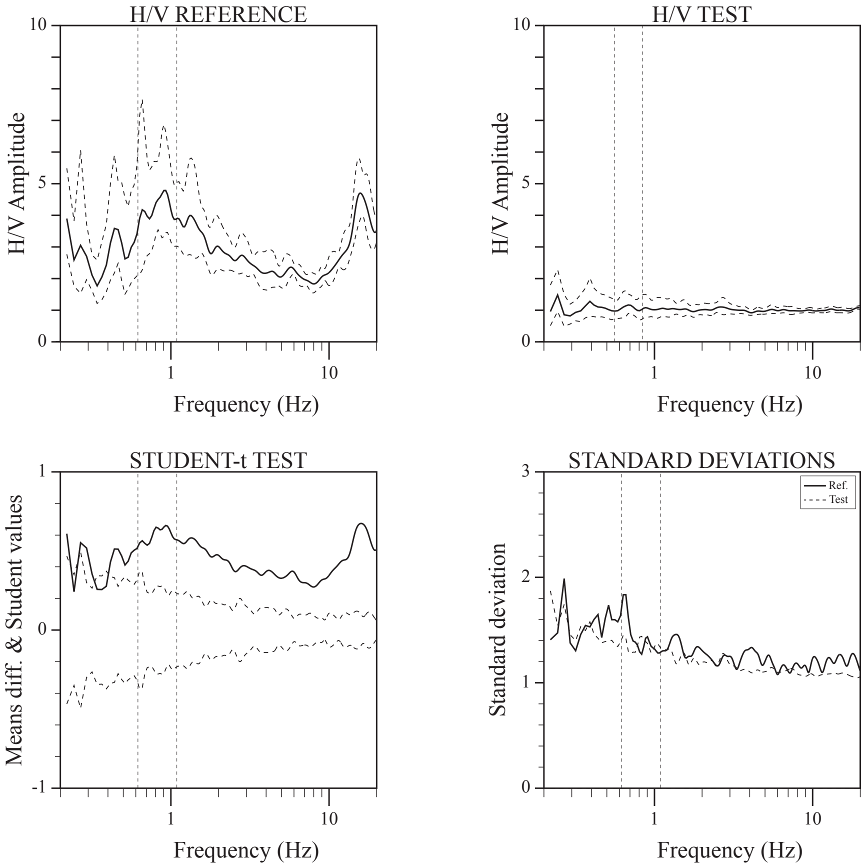

	File name	f0 (H/V) (Hz)	Nb win	Sample rate (Hz)	Recording duration (s)	Frequency stastistics from individual windows			
						f0 (Hz)	Sigma (Hz)	Nb win	Student-t test
Ref.	2003-01-17-1227-27S.SESAM_003	0.93	6	100	576	0.85	0.24	6	|diff| = 0.16 t = 0.33 Similar peak frequencies
Test	2003-01-17-1240-00S.N11___003	0.68	14	100	576	0.70	0.14	14	
	Conclusion	NOT RECOMMENDED (100% inside peak zone)							

	Recorder	Sensor	Rec. type : simultaneous	Low frequency site
Ref.	GBV-316#06	internal 4.5 Hz	**P6-2-Bergen-test1** Influence of rain Ref : sensor inside original waterproof casing ; Test : under rain	
Test	GBV-316#11	internal 4.5 Hz		

Figure 37 : Parameters that **do** influence H/V results. Influence of rain.

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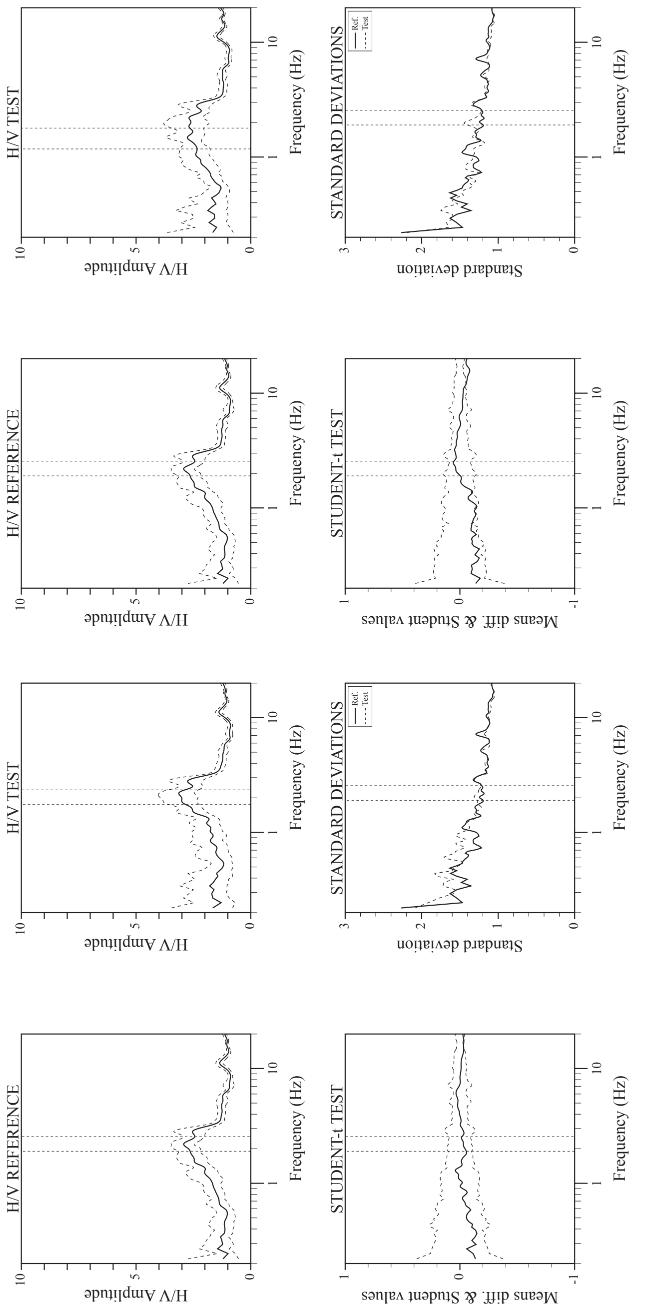

	File name	f0 (H/V) (Hz)	Nb win	Sample rate (Hz)	Recording duration (s)	f0 mean (Hz)	Sigma (Hz)	Nb win	Student-t test
Ref.	11_LEN_5sec	2.20	21	200	900	2.23	0.33	21	|diff| = 0.18 t = 0.35 Similar peak frequencies
Test	11_MP_4_5Hz	2.20	20	200	900	2.05	0.30	20	
Conclusion	NO INFLUENCE								

	Recorder	Sensor	Rec. type : synchronous / Medium frequency site
Ref.	CitySharkII	5-second Lennartz LE3D	**P1-2-Grenoble Nice-test4** Influence of sensor
Test	CitySharkII	4.5-Hz Mark Product L28	

	File name	f0 (H/V) (Hz)	Nb win	Sample rate (Hz)	Recording duration (s)	f0 mean (Hz)	Sigma (Hz)	Nb win	Student-t test
Ref.	11_LEN_5sec	2.20	21	200	900	2.23	0.33	21	|diff| = 0.75 t = 0.35 NOT similar peak frequencies
Test	11_MP_L22	1.46	20	200	900	1.48	0.31	20	
Conclusion	NOT RECOMMENDED								

	Recorder	Sensor	Rec. type : synchronous / Medium frequency site
Ref.	CitySharkII	5-second Lennartz LE3D	**P1-2-Grenoble Nice-test6** Influence of sensor
Test	CitySharkII	2-Hz Mark Products L22	

Figure 38 : Parameters that **may** influence H/V results **with possible control**. Influence of sensor.

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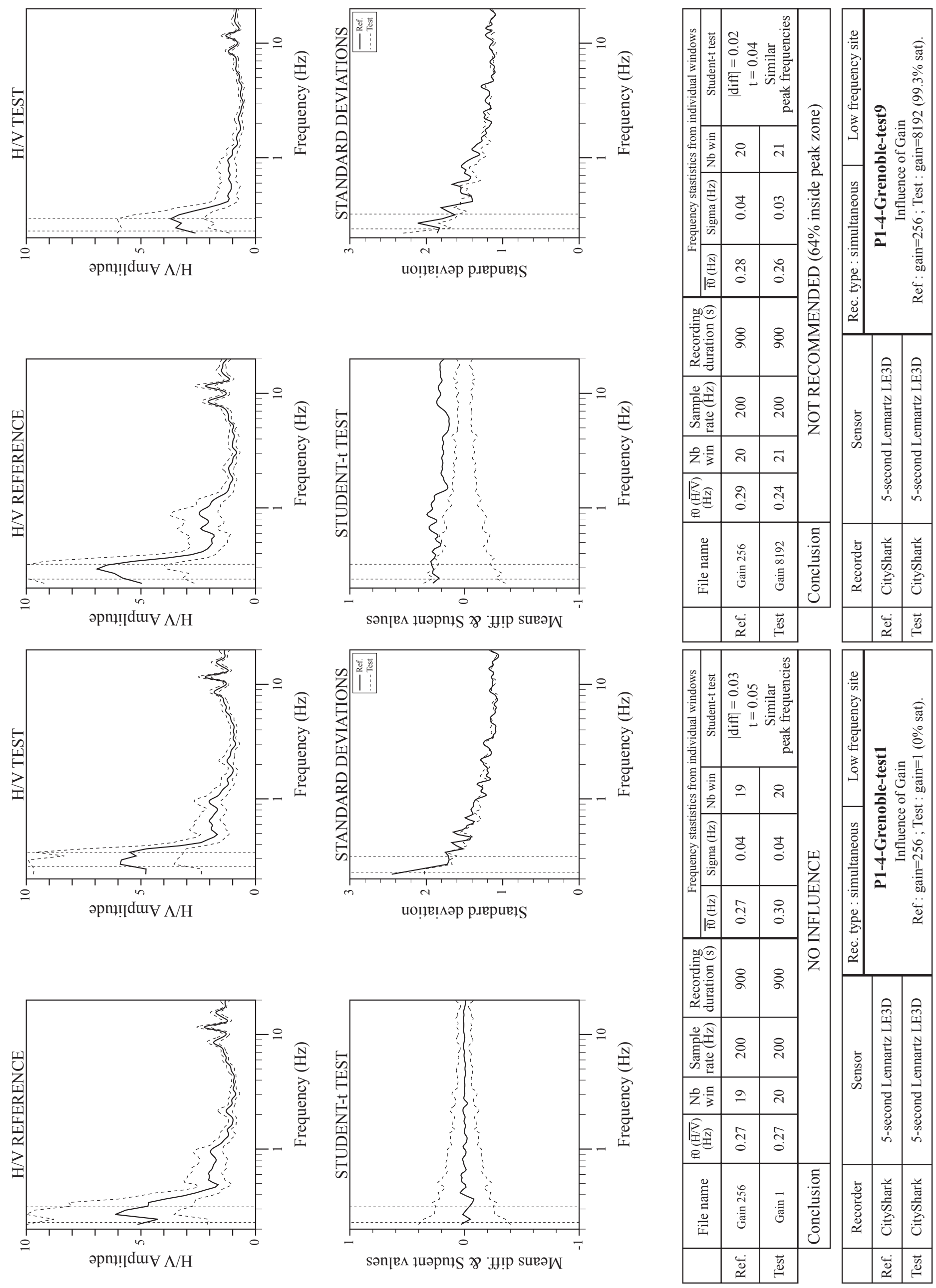

Figure 39 : Parameters that **may** influence H/V results **with possible control**. Influence of gain.

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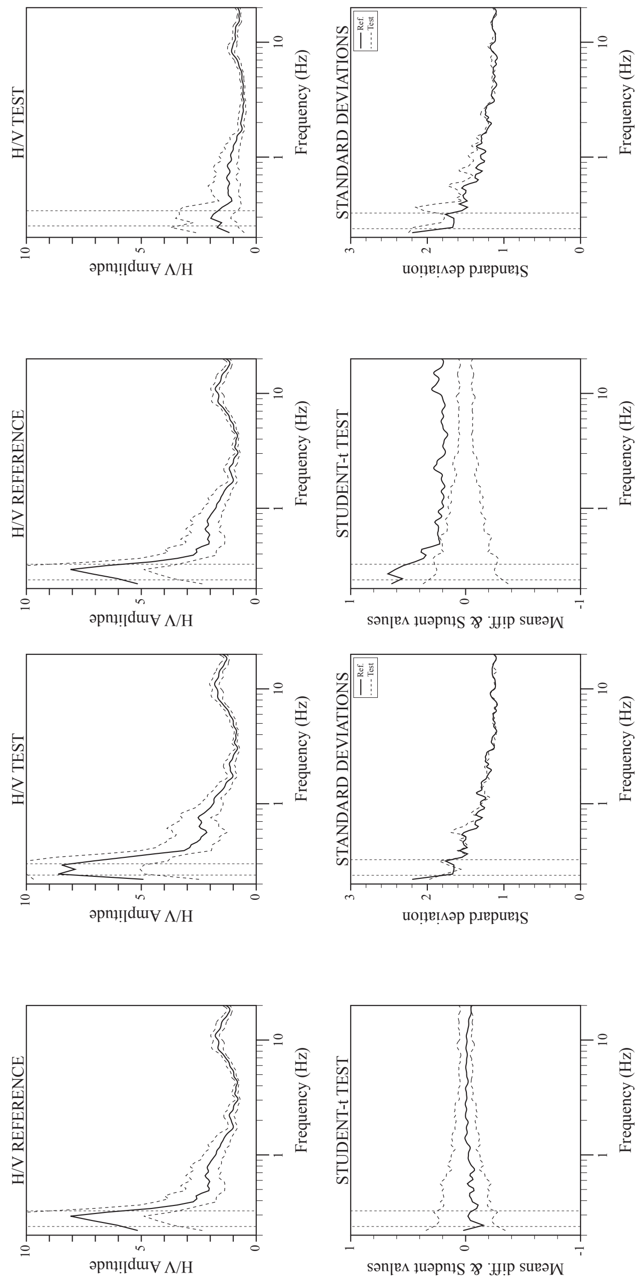

	File name	f0 ($\overline{H/V}$) (Hz)	Nb win	Sample rate (Hz)	Recording duration (s)	Frequency statistics from individual windows			
						$\overline{f0}$ (Hz)	Sigma (Hz)	Nb win	Student-t test
Ref.	Reference	0.29	22	200	900	0.28	0.04	22	|diff| = 0.01 t = 0.04 Similar peak frequencies
Test	Tilt 4	0.24	21	200	900	0.27	0.03	21	
	Conclusion	NO INFLUENCE							

	Recorder	Sensor	Rec. type : simultaneous	Low frequency site
Ref.	CityShark	5-second Lennartz LE3D	**P1-8-Grenoble-test1** Influence of sensor horizontality Ref : 0° tilt ; Test : 4° tilt	
Test	CityShark	5-second Lennartz LE3D		

	File name	f0 ($\overline{H/V}$) (Hz)	Nb win	Sample rate (Hz)	Recording duration (s)	Frequency statistics from individual windows			
						$\overline{f0}$ (Hz)	Sigma (Hz)	Nb win	Student-t test
Ref.	Reference	0.29	22	200	900	0.28	0.04	22	|diff| = 0.01 t = 0.05 Similar peak frequencies
Test	Tilt 8	0.29	22	200	900	0.30	0.04	22	
	Conclusion	NOT RECOMMENDED (100% inside peak zone)							

	Recorder	Sensor	Rec. type : simultaneous	Low frequency site
Ref.	CityShark	5-second Lennartz LE3D	**P1-8-Grenoble-test2** Influence of sensor horizontality Ref : 0° tilt ; Test : 8° tilt	
Test	CityShark	5-second Lennartz LE3D		

Figure 40 : Parameters that **may** influence H/V results **with possible control**. Influence of sensor horizontality.

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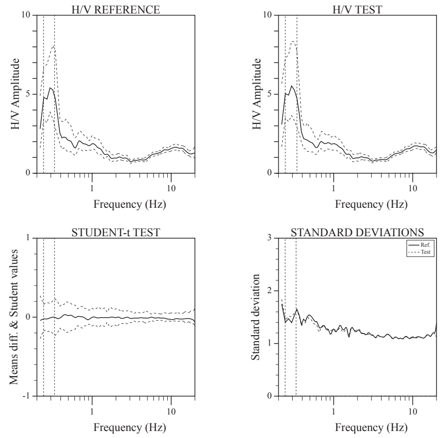
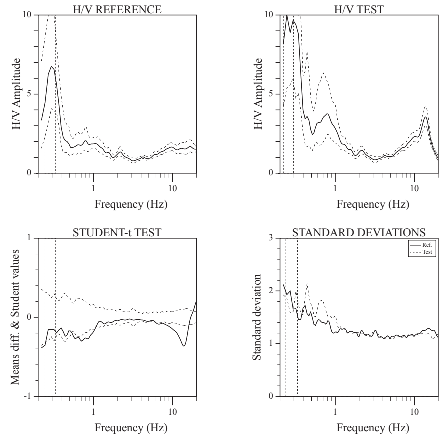


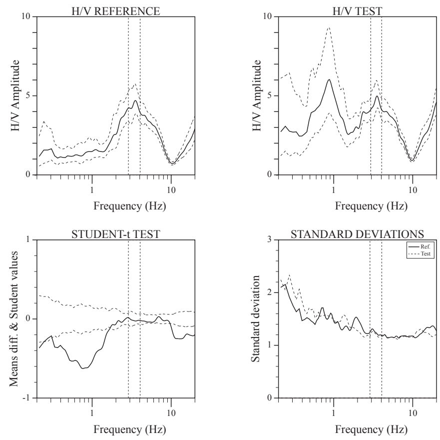
	File name	f0 ($\overline{H/V}$) (Hz)	Nb win	Sample rate (Hz)	Recording duration (s)	Frequency stastistics from individual windows: $\overline{f0}$ (Hz)	Sigma (Hz)	Nb win	Student-t test
Ref.	Grass removed	0.29	22	200	900	0.29	0.05	22	|diff| = 0.00 t = 0.05 Similar peak frequencies
Test	Ref on grass	0.29	22	200	900	0.29	0.05	22	
	Conclusion	NO INFLUENCE							

	Recorder	Sensor	Rec. type : simultaneous	Low frequency site
Ref.	CityShark	5-second Lennartz LE3D	**P2-1-Grenoble-test1** Influence of grass Ref : grass removed ; Test : on grass	
Test	CityShark	5-second Lennartz LE3D		



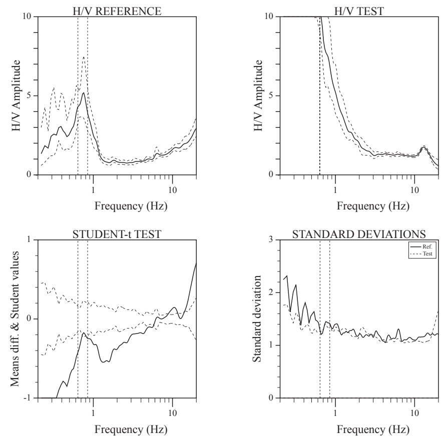
	File name	f0 ($\overline{H/V}$) (Hz)	Nb win	Sample rate (Hz)	Recording duration (s)	Frequency stastistics from individual windows: $\overline{f0}$ (Hz)	Sigma (Hz)	Nb win	Student-t test
Ref.	Grass removed-1	0.29	21	200	900	0.28	0.05	21	|diff| = 0.03 t = 0.05 Similar peak frequencies
Test	Grass*2-3-r1	0.24	18	200	900	0.26	0.04	18	
	Conclusion	No influence inside the peak zone, discard outside (46%)							

	Recorder	Sensor	Rec. type : synchonous	Low frequency site
Ref.	CitySharkII	5-second Lennartz LE3D	**P2-1-Grenoble-test5** Influence of grass Ref : grass removed ; Test : double layer of grass	
Test	CitySharkII	5-second Lennartz LE3D		



	File name	f0 ($\overline{H/V}$) (Hz)	Nb win	Sample rate (Hz)	Recording duration (s)	Frequency stastistics from individual windows: $\overline{f0}$ (Hz)	Sigma (Hz)	Nb win	Student-t test
Ref.	P3-1.R1-1.saf	3.51	34	125	1440	3.47	0.59	34	|diff| = 0.02 t = 0.50 Similar peak frequencies
Test	P3-1.R1-3.saf	3.54	30	125	1440	3.49	0.55	30	
	Conclusion	No influence inside the peak zone, discard outside (62%)							

	Recorder	Sensor	Rec. type : synchronous	Medium frequency site
Ref.	Mars 88	5-second Lennartz LE3D	**P2-1-Zurich-test1** Influence of grass Ref : 30-cm hole ; Test : on grass	
Test	Mars 88	5-second Lennartz LE3D		



	File name	f0 ($\overline{H/V}$) (Hz)	Nb win	Sample rate (Hz)	Recording duration (s)	Frequency stastistics from individual windows: $\overline{f0}$ (Hz)	Sigma (Hz)	Nb win	Student-t test
Ref.	1- Grass removed	0.76	11	200	900	0.74	0.10	11	|diff| = 0.11 t = 0.12 Similar peak frequencies
Test	1- Tall grass	0.27	14	200	900	0.63	0.00	11	
	Conclusion	NOT RECOMMENDED (67% inside peak zone)							

	Recorder	Sensor	Rec. type : synchonous	Low frequency site
Ref.	CitySharkII	5-second Lennartz LE3D	**P2-1-Grenoble-test29** Influence of grass Ref : grass removed ; Test : tall grass	
Test	CitySharkII	5-second Lennartz LE3D		

Figure 41 : Parameters that **may** influence H/V results **with possible control**. Influence of grass.

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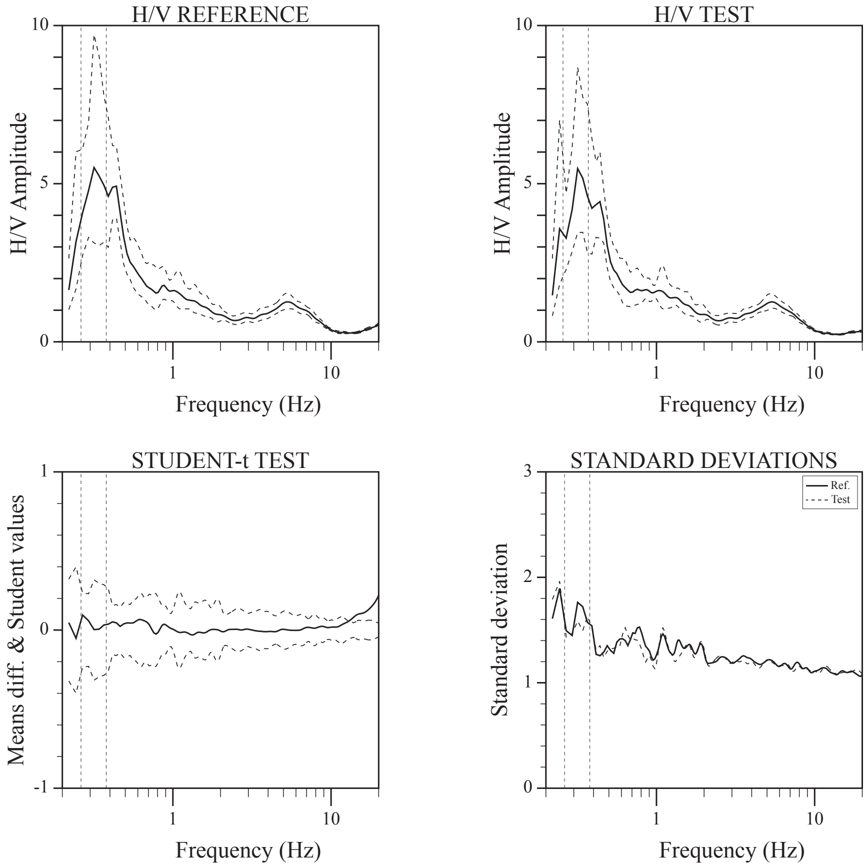

	File name	f0 (H/V) (Hz)	Nb win	Sample rate (Hz)	Recording duration (s)	Frequency stastistics from individual windows			
						f0 (Hz)	Sigma (Hz)	Nb win	Student-t test
Ref.	Ground 2	0.32	15	200	900	0.32	0.06	15	|diff| = 0.01 t = 0.08 Similar peak frequencies
Test	Asphalt 2	0.32	13	200	900	0.31	0.06	13	
	Conclusion	No influence inside the peak zone, slight influence outside (10%)							

	Recorder	Sensor	Rec. type : simultaneous	Low frequency site
Ref.	CityShark	5-second Lennartz LE3D	**P2-4-Grenoble-test2** Influence of asphalt Ref : natural soil ; Test : asphalt	
Test	CityShark	5-second Lennartz LE3D		

Figure 42 : Parameters that **may** influence H/V results **with possible control**. Influence of asphalt.

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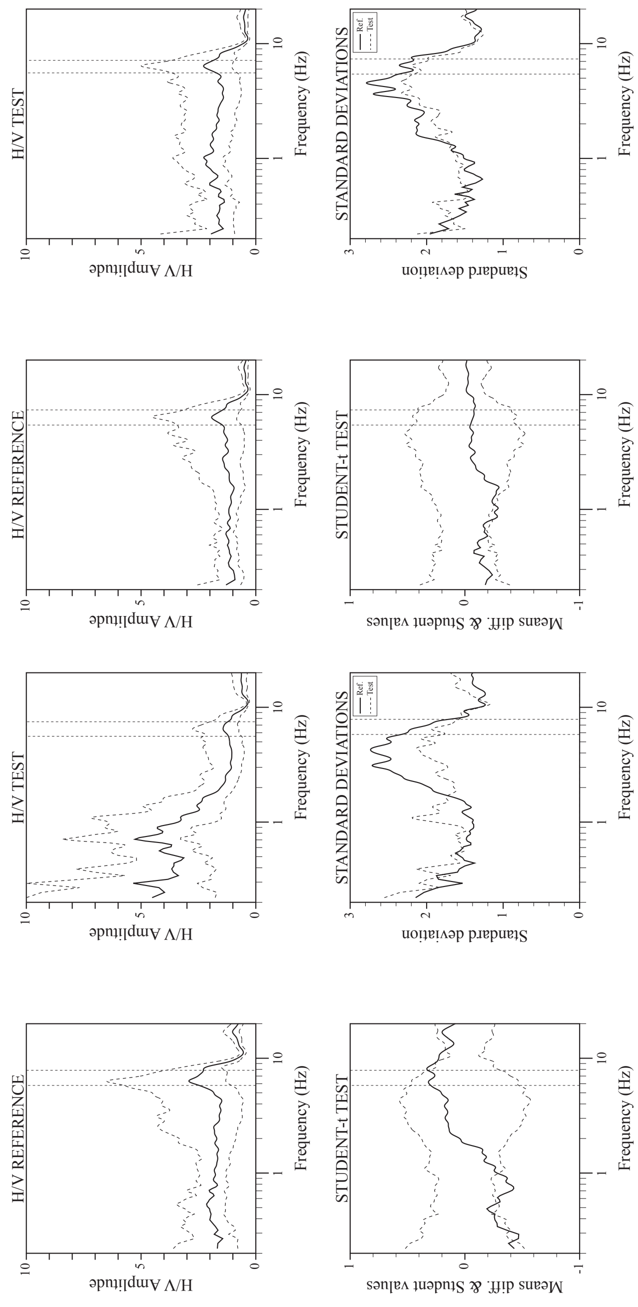

	File name	f0 (H/V) (Hz)	Nb win	Sample rate (Hz)	Recording duration (s)	Frequency statistics from individual windows: f0 (Hz)	Sigma (Hz)	Nb win	Student-t test
Ref.	1-neige 5cm&tar	6.35	17	200	900	6.83	1.03	17	|diff| = 0.30, t = 1.43, Similar peak frequencies
Test	1-sol gele	6.50	11	200	900	6.53	0.94	11	
Conclusion	No influence inside the peak zone, caution outside (28%)								

	Recorder	Sensor	Rec. type : synchronous / High frequency site
Ref.	CitySharkII	5-second Lennartz LE3D	**P2-5-Grenoble-test2** Influence of ice
Test	CitySharkII	5-second Lennartz LE3D	Ref : 5-cm not compacted snow ; Test : frozen nat. soil

	File name	f0 (H/V) (Hz)	Nb win	Sample rate (Hz)	Recording duration (s)	Frequency statistics from individual windows: f0 (Hz)	Sigma (Hz)	Nb win	Student-t test
Ref.	2-neige 5cm&tar	6.32	18	200	900	6.39	0.96	18	|diff| = 0.04, t = 1.13, Similar peak frequencies
Test	2-sol gele	6.37	15	200	900	6.35	0.79	15	
Conclusion	No influence inside the peak zone, negligible influence outside (7%)								

	Recorder	Sensor	Rec. type : sequential / High frequency site
Ref.	CitySharkII	5-second Lennartz LE3D	**P2-5-Grenoble-test3** Influence of ice
Test	CitySharkII	5-second Lennartz LE3D	Ref : frozen nat. soil ; Test : frozen nat. soil

Figure 43 : Parameters that **may** influence H/V results **with possible control**. Influence of ice.

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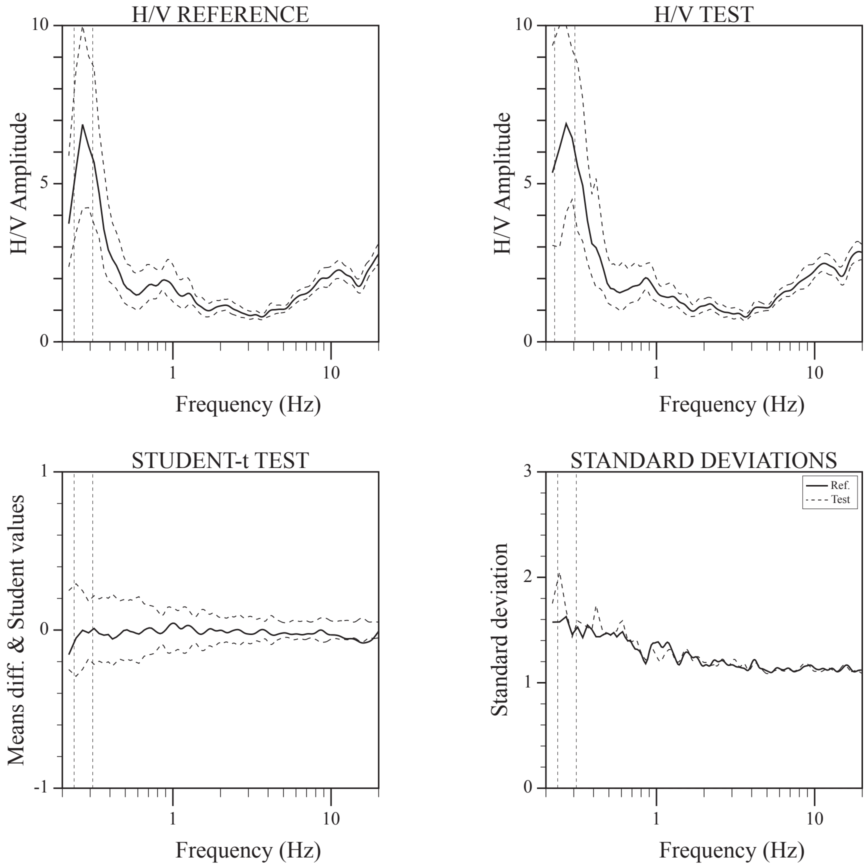

	File name	f0 (H/V) (Hz)	Nb win	Sample rate (Hz)	Recording duration (s)	Frequency stastistics from individual windows: f0 (Hz)	Sigma (Hz)	Nb win	Student-t test
Ref.	Ref 1	0.27	21	200	900	0.27	0.04	21	|diff| = 0.01 t = 0.04 Similar peak frequencies
Test	1-10cm not compacted	0.27	19	200	900	0.27	0.04	19	
	Conclusion	No influence inside the peak zone, negligible influence outside (8%)							

	Recorder	Sensor
Ref.	CityShark	5-second Lennartz LE3D
Test	CityShark	5-second Lennartz LE3D

Rec. type : simultaneous — Low frequency site

P2-6-2-Grenoble-test1
Influence of snow - not compacted
Ref : natural soil ; Test : 10-cm not compacted snow

Figure 44 : Parameters that **may** influence H/V results **with possible control**. Influence of snow – not compacted.

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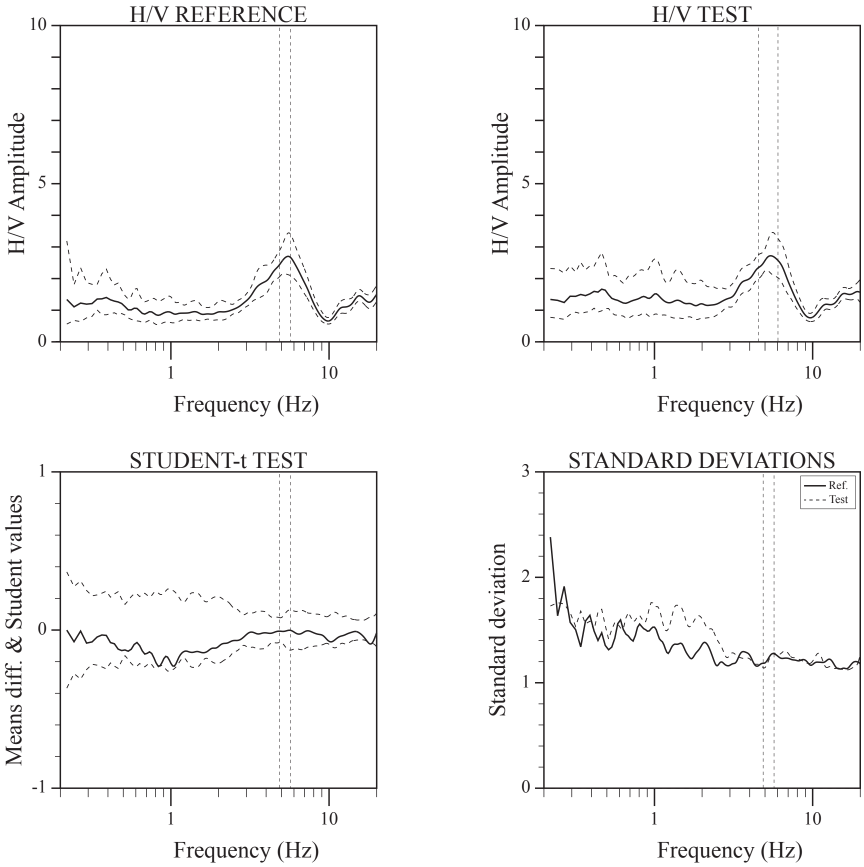

	File name	f0 (H/V) (Hz)	Nb win	Sample rate (Hz)	Recording duration (s)	Frequency stastistics from individual windows			
						f0 (Hz)	Sigma (Hz)	Nb win	Student-t test
Ref.	Ref2	5.52	17	200	900	5.28	0.42	17	|diff| = 0.00 t = 0.74 Similar peak frequencies
Test	2-Scarifie	5.42	20	200	900	5.29	0.75	20	
	Conclusion	NO INFLUENCE							

	Recorder	Sensor	Rec. type : simultaneous	High frequency site
Ref.	CityShark	5-second Lennartz LE3D	**P2-7-Grenoble-test3** Influence of ploughed soil Ref : on natural soil ; Test : on superficially ploughed soil	
Test	CityShark	5-second Lennartz LE3D		

Figure 45 : Parameters that **may** influence H/V results **with possible control**. Influence of ploughed soil.

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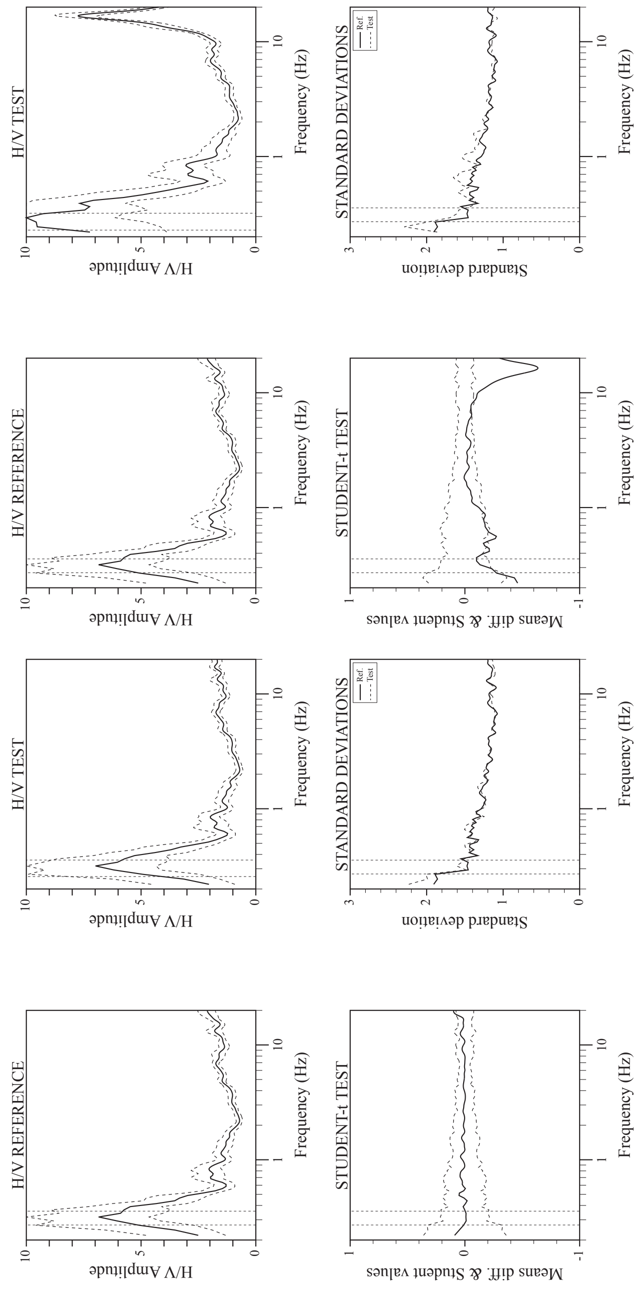

	File name	f0 (H/V) (Hz)	Nb win	Sample rate (Hz)	Recording duration (s)	Frequency stastistics from individual windows: f0 (Hz)	Sigma (Hz)	Nb win	Student-t test
Ref.	Ref1	0.32	19	200	900	0.31	0.04	19	|diff| = 0.01 t = 0.05 Similar peak frequencies
Test	1-Mud	0.32	21	200	900	0.31	0.05	21	
	Conclusion	NO INFLUENCE							

	Recorder	Sensor	Rec. type : simultaneous	Low frequency site
Ref.	CityShark	5-second Lennartz LE3D	**P2-8-Grenoble-test1** Influence of mud Ref : natural soil ; Test : mud	
Test	CityShark	5-second Lennartz LE3D		

	File name	f0 (H/V) (Hz)	Nb win	Sample rate (Hz)	Recording duration (s)	Frequency stastistics from individual windows: f0 (Hz)	Sigma (Hz)	Nb win	Student-t test
Ref.	Ref1	0.32	19	200	900	0.31	0.04	19	|diff| = 0.04 t = 0.05 Similar peak frequencies
Test	1-Field2	0.29	20	200	900	0.27	0.05	20	
	Conclusion	NOT RECOMMENDED (36% inside peak zone)							

	Recorder	Sensor	Rec. type : simultaneous	Low frequency site
Ref.	CityShark	5-second Lennartz LE3D	**P2-8-Grenoble-test2** Influence of mud Ref : natural soil ; Test : thick mud with water	
Test	CityShark	5-second Lennartz LE3D		

Figure 46 : Parameters that **may** influence H/V results **with possible control**. Influence of mud.

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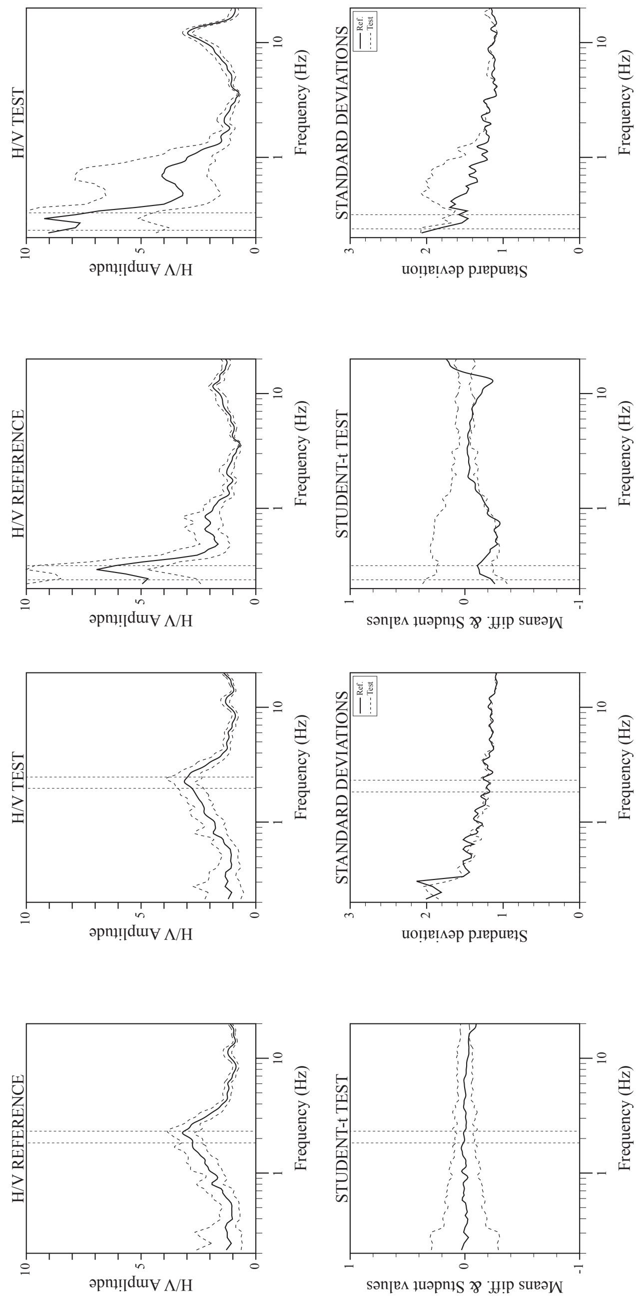

	File name	f0 (H/V) (Hz)	Nb win	Sample rate (Hz)	Recording duration (s)	$\overline{f0}$ (Hz)	Sigma (Hz)	Nb win	Student-t test
						Frequency stastistics from individual windows			
Ref.	Ref Nice	2.23	25	250	900	2.07	0.24	25	|diff| = 0.14 t = 0.25 Similar peak frequencies
Test	Nice-wood	2.26	23	250	900	2.22	0.25	23	
Conclusion	No influence inside the peak zone, negligible influence outside (5%)								

	Recorder	Sensor	Rec. type : synchronous / Medium frequency site
Ref.	CitySharkII	5-second Lennartz LE3D	**P3-1-5-Grenoble Nice-test1** Artificial interface between in-situ ground and sensor Ref : on natural soil ; Test : on a wooden plate
Test	CitySharkII	5-second Lennartz LE3D	

	File name	f0 (H/V) (Hz)	Nb win	Sample rate (Hz)	Recording duration (s)	$\overline{f0}$ (Hz)	Sigma (Hz)	Nb win	Student-t test
						Frequency stastistics from individual windows			
Ref.	Reference 3	0.29	19	200	900	0.28	0.04	19	|diff| = 0.00 t = 0.05 Similar peak frequencies
Test	3-Wooden plate	0.29	19	200	900	0.28	0.05	19	
Conclusion	No influence inside the peak zone, caution outside (31%)								

	Recorder	Sensor	Rec. type : simultaneous / Low frequency site
Ref.	CityShark	5-second Lennartz LE3D	**P3-1-5-Grenoble-test1** Artificial interface between in-situ ground and sensor Ref : on natural soil ; Test : on a wooden plate
Test	CityShark	5-second Lennartz LE3D	

Figure 47 : Parameters that **may** influence H/V results **with possible control**. Influence of artificial interface between in-situ ground and sensor. Wooden plate.

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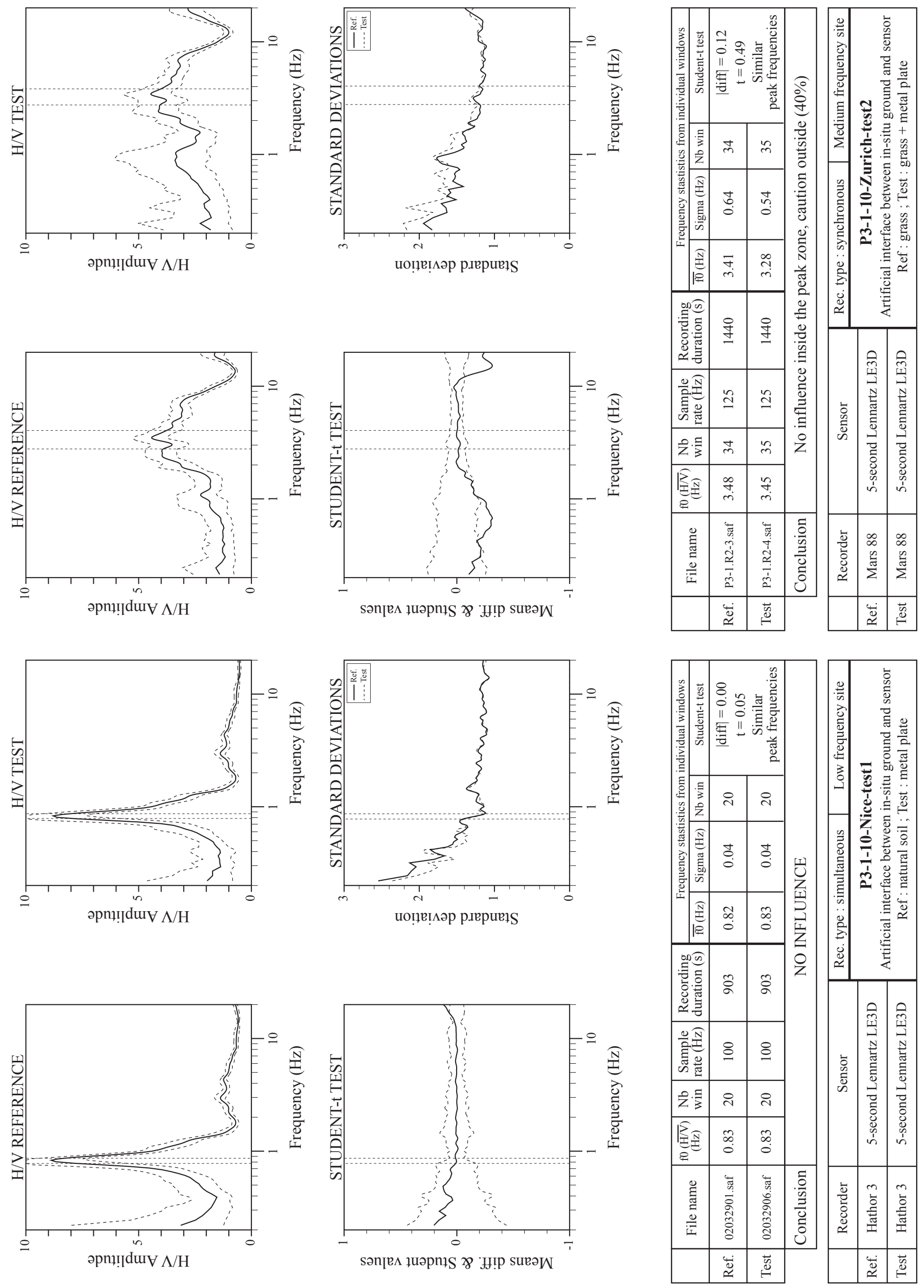

Figure 48 : Parameters that **may** influence H/V results **with possible control**. Influence of artificial interface between in-situ ground and sensor. Metal plate.

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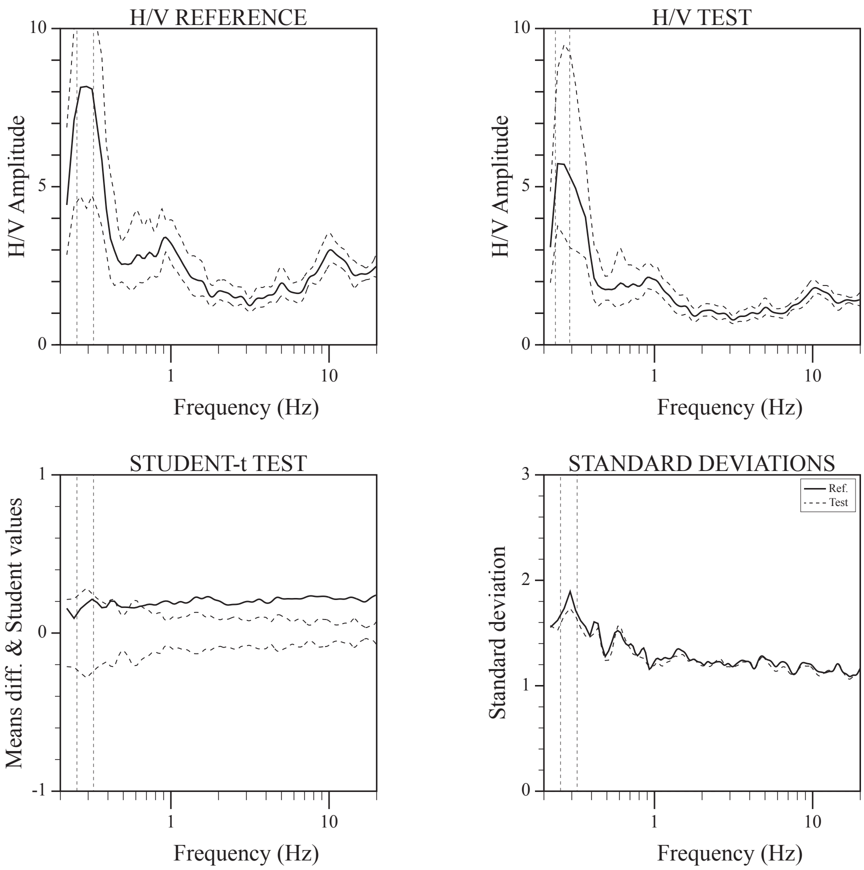

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<tr><th rowspan="2"></th><th rowspan="2">File name</th><th rowspan="2">f0 ($\overline{H/V}$) (Hz)</th><th rowspan="2">Nb win</th><th rowspan="2">Sample rate (Hz)</th><th rowspan="2">Recording duration (s)</th><th colspan="4">Frequency stastistics from individual windows</th></tr>
<tr><th>$\overline{f0}$ (Hz)</th><th>Sigma (Hz)</th><th>Nb win</th><th>Student-t test</th></tr>
<tr><td>Ref.</td><td>Ref 1</td><td>0.29</td><td>21</td><td>200</td><td>900</td><td>0.29</td><td>0.03</td><td>21</td><td rowspan="2">|diff| = 0.03
t = 0.03
Similar
peak frequencies</td></tr>
<tr><td>Test</td><td>1-w-o feet PC</td><td>0.24</td><td>21</td><td>200</td><td>900</td><td>0.26</td><td>0.03</td><td>21</td></tr>
<tr><td></td><td>Conclusion</td><td colspan="8">No influence inside the peak zone, discard outside (84%)</td></tr>
</table>

<table>
<tr><th></th><th>Recorder</th><th>Sensor</th><th>Rec. type : simultaneous</th><th>Low frequency site</th></tr>
<tr><td>Ref.</td><td>CityShark</td><td>5-second Lennartz LE3D</td><td colspan="2" rowspan="2">P3-5-Grenoble-test1
Sensor without feet
Ref : natural soil with feet; Test : natural soil without feet</td></tr>
<tr><td>Test</td><td>CityShark</td><td>5-second Lennartz LE3D</td></tr>
</table>

Figure 49 : Parameters that **may** influence H/V results **with possible control**. Influence of plugging or not the feet of the sensor.

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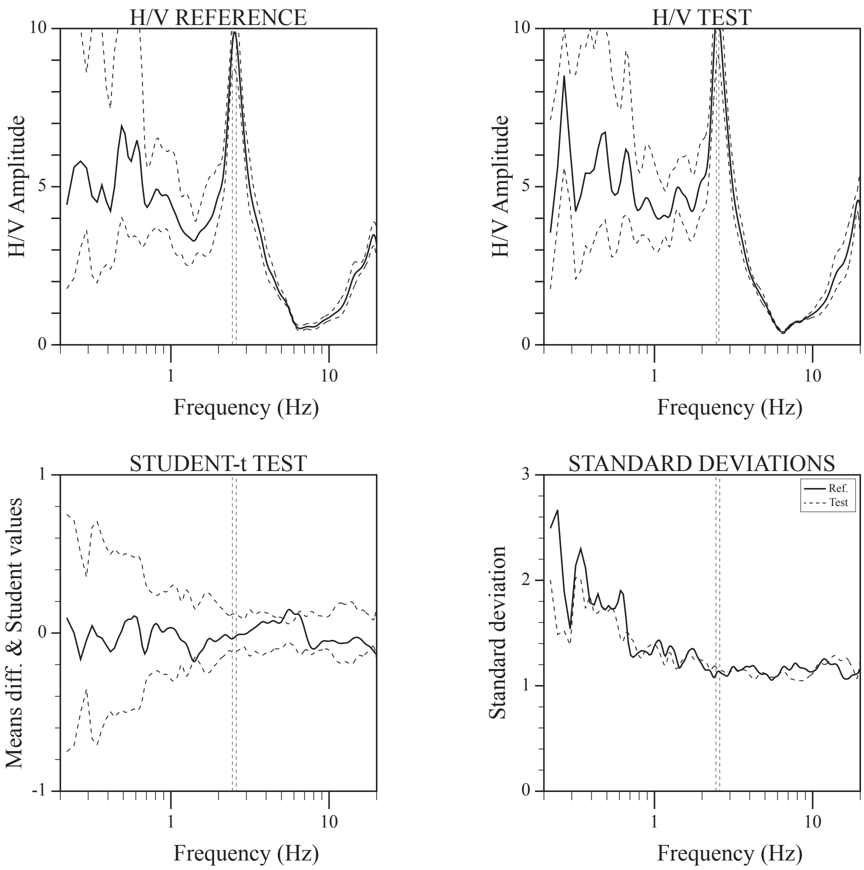

	File name	f0 (H/V) (Hz)	Nb win	Sample rate (Hz)	Recording duration (s)	Frequency stastistics from individual windows			
						f0 (Hz)	Sigma (Hz)	Nb win	Student-t test
Ref.	Ref7	2.54	9	200	900	2.52	0.07	9	|diff| = 0.01 t = 0.13 Similar peak frequencies
Test	7-Gravel	2.49	7	200	900	2.51	0.05	7	
	Conclusion	No influence inside the peak zone, negligible influence outside (7%)							

	Recorder	Sensor	Rec. type : simultaneous	Medium frequency site
Ref.	CityShark	5-second Lennartz LE3D	**P3-7-Grenoble-test1** Influence of gravel Ref : natural soil ; Test : gravel pile	
Test	CityShark	5-second Lennartz LE3D		

Figure 50 : Parameters that **may** influence H/V results **with possible control**. Influence of gravel.

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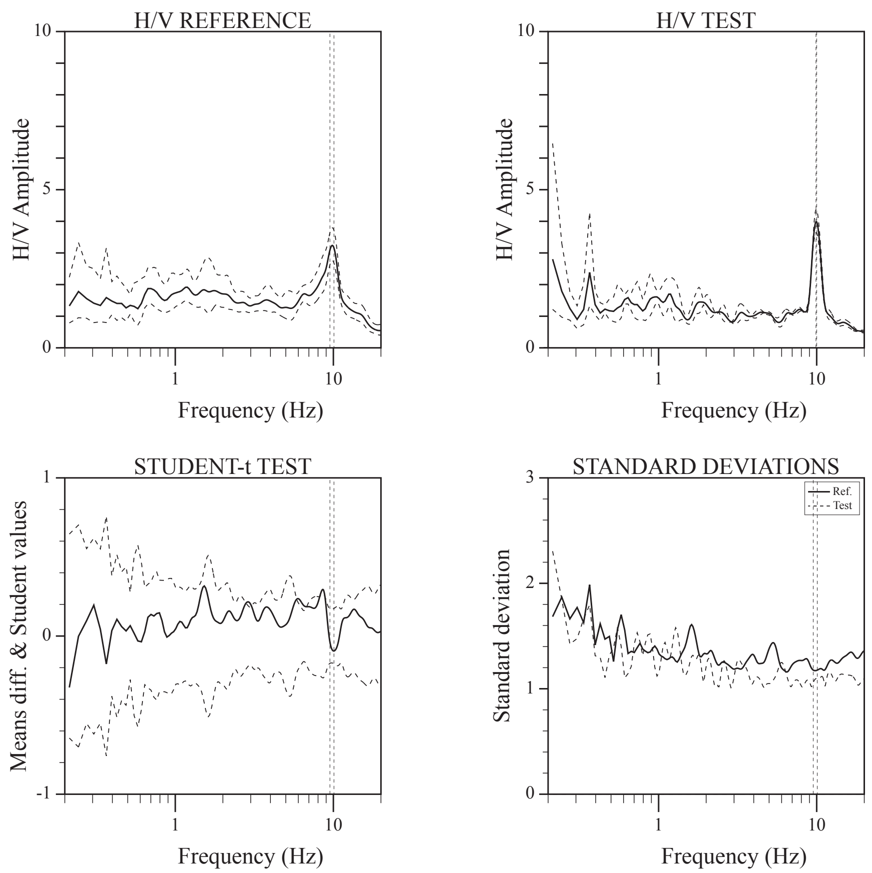

	File name	f0 (H/V) (Hz)	Nb win	Sample rate (Hz)	Recording duration (s)	Frequency stastistics from individual windows			
						f0 (Hz)	Sigma (Hz)	Nb win	Student-t test
Ref.	ref_0917 _1539.saf	9.86	14	125	480	9.80	0.29	14	|diff| = 0.15 t = 0.69 Similar peak frequencies
Test	port_0917 _1605.saf	9.95	3	125	110	9.95	0.05	3	
	Conclusion	No influence inside the peak zone, negligible influence outside (7%)							

	Recorder	Sensor	Rec. type : sequential	High frequency site
Ref.	Mars Lite	5-second Lennartz LE3D	**P9-1-Nice-test6** Influence of steps - people walking On asphalt. Ref : no steps ; test : steps 2 to 25 m from sensor	
Test	Mars Lite	5-second Lennartz LE3D		

Figure 51 : Parameters that **may** influence H/V results **with possible control**. Influence of step – people walking.

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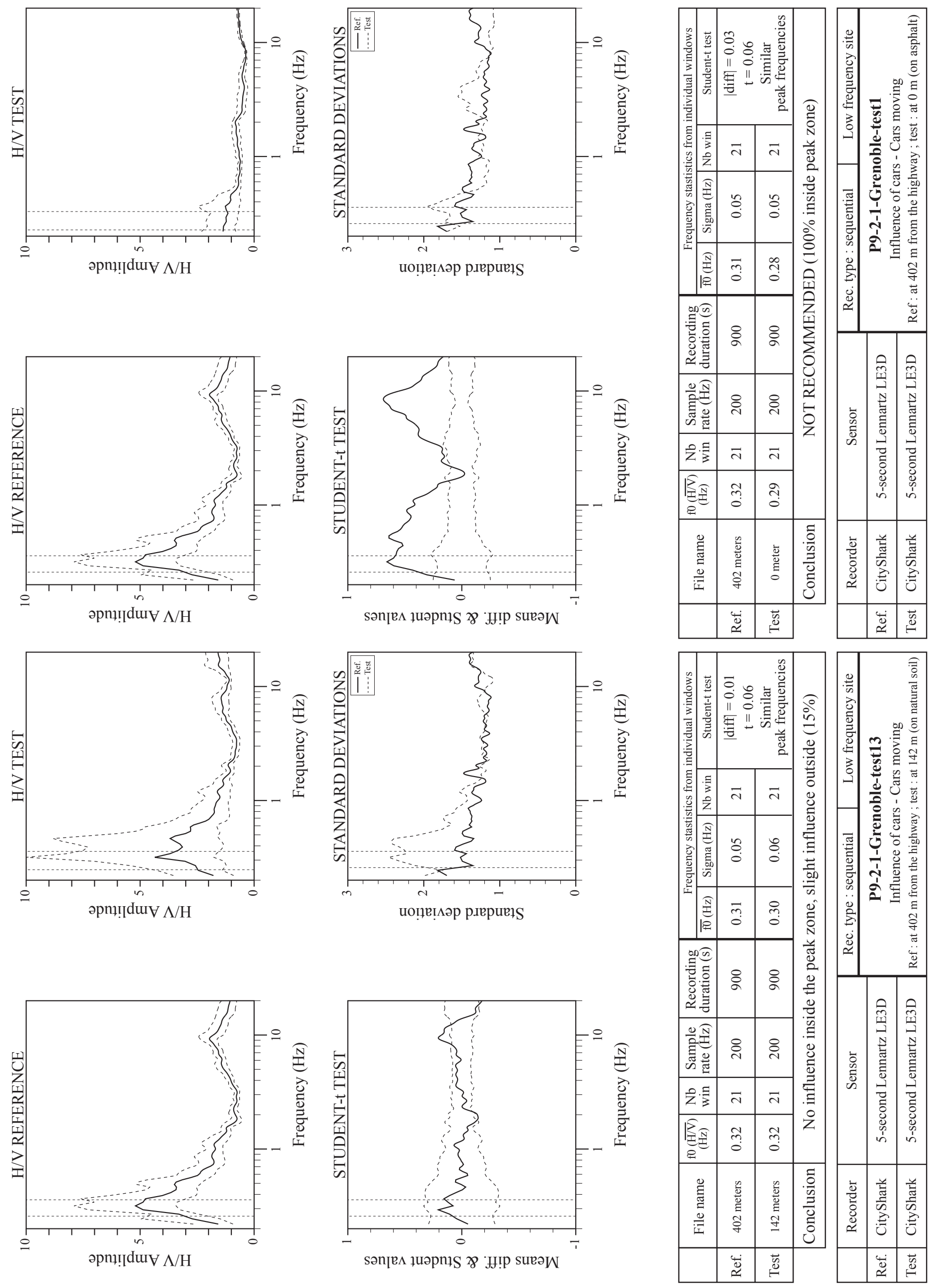

Figure 52 : Parameters that **may** influence H/V results **with possible control**. Influence of cars – Cars moving.

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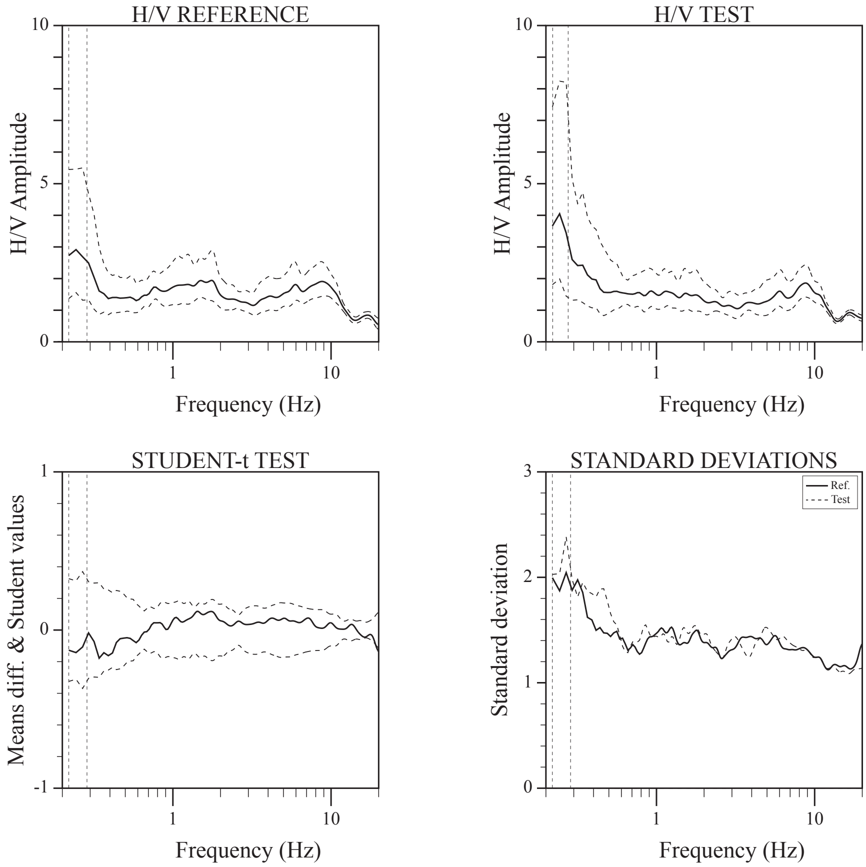

	File name	f0 (H/V) (Hz)	Nb win	Sample rate (Hz)	Recording duration (s)	Frequency stastistics from individual windows			
						f0 (Hz)	Sigma (Hz)	Nb win	Student-t test
Ref.	02061217.saf	0.24	22	100	903	0.25	0.03	22	|diff| = 0.00 t = 0.03 Similar peak frequencies
Test	02061221.saf	0.24	22	100	903	0.25	0.03	22	
	Conclusion	NO INFLUENCE							

	Recorder	Sensor	Rec. type : sequential	Low frequency site
Ref.	Hathor 3	5-second Lennartz LE3D	**P9-2-2-Nice-test4** Influence of cars - Cars not moving but turned on Ref : car off ; test : car on at 1.2m	
Test	Hathor 3	5-second Lennartz LE3D		

Figure 53 : Parameters that **may** influence H/V results **with possible control**. Influence of cars – Cars not moving but turned on.

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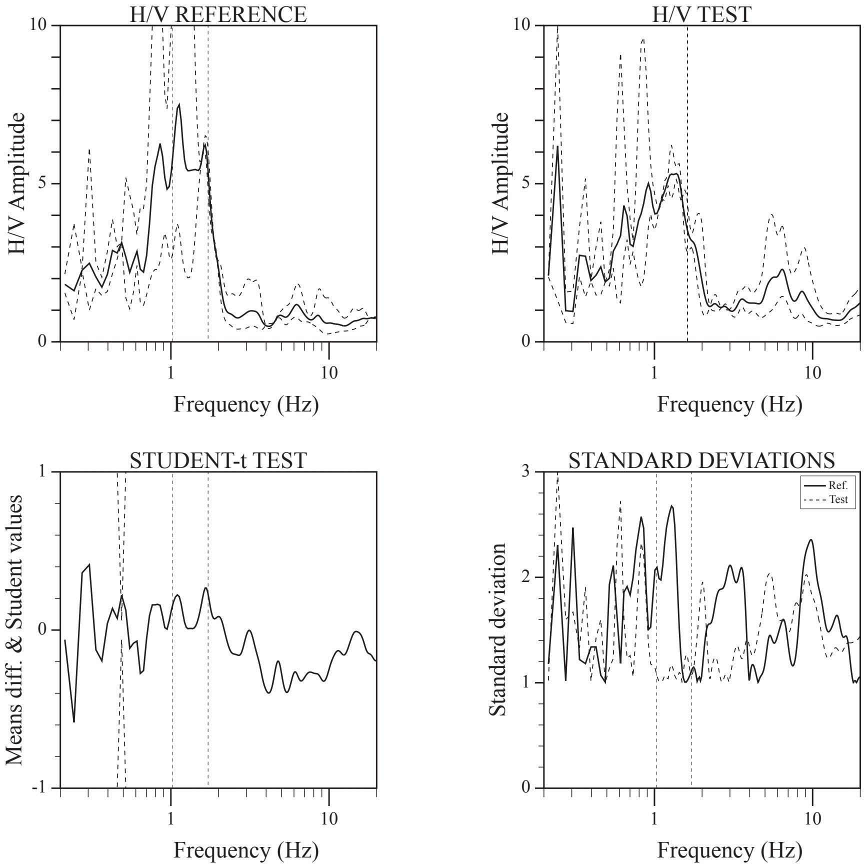

	File name	f0 (H/V) (Hz)	Nb win	Sample rate (Hz)	Recording duration (s)	Frequency stastistics from individual windows			
						f0 (Hz)	Sigma (Hz)	Nb win	Student-t test
Ref.	12.P9_2_2. T1_R1.saf	1.13	2	125	88	1.37	0.35	2	|diff| = 0.24 t = 7.71
Test	12.P9_2_2. T1_R3.saf	0.24	2	125	88	1.62	0.00	2	Similar peak frequencies
	Conclusion	NO INFLUENCE							

	Recorder	Sensor	Rec. type : sequential	Medium frequency site
Ref.	Mars Lite	5-second Lennartz LE3D	**P9-3-Nice-test1** Influence of trains	
Test	Mars Lite	5-second Lennartz LE3D	On ground. Ref : no traind ; test : train 10 m away	

Figure 54 : Parameters that **may** influence H/V results **with possible control**. Influence of trains.

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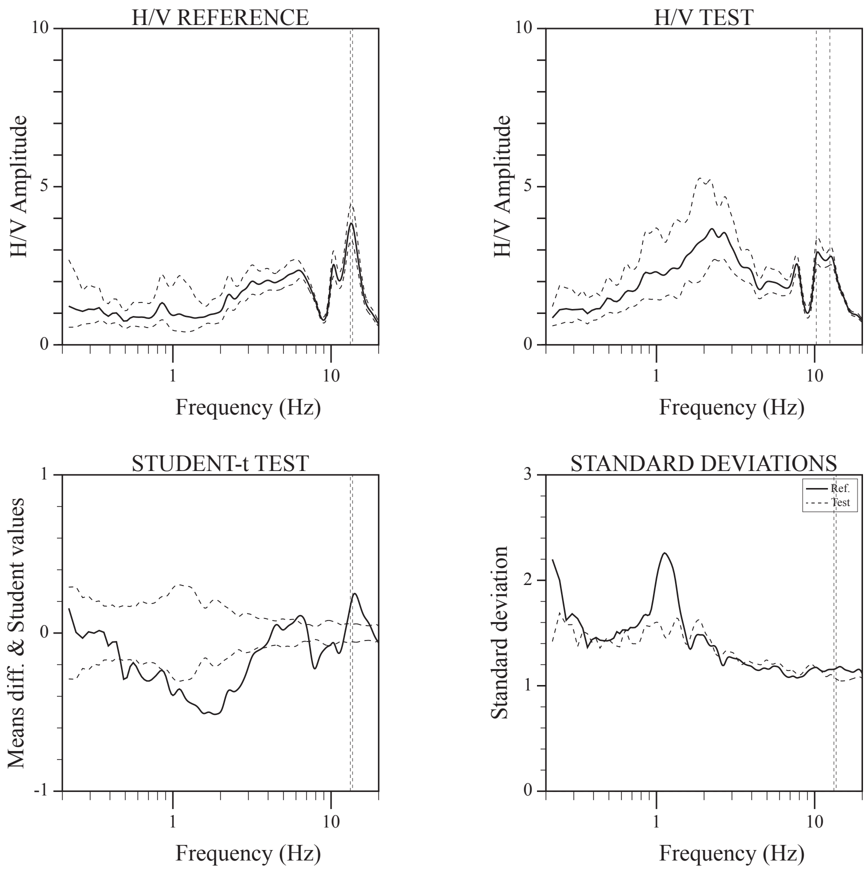

	File name	f0 (H/V) (Hz)	Nb win	Sample rate (Hz)	Recording duration (s)	Frequency stastistics from individual windows			
						f0 (Hz)	Sigma (Hz)	Nb win	Student-t test
Ref.	0m without pumps	13.45	21	200	900	13.46	0.22	21	|diff| = 2.09 t = 0.89 NOT similar peak frequencies
Test	0m with pumps	12.65	21	200	900	11.36	1.12	21	
	Conclusion	NOT RECOMMENDED							

	Recorder	Sensor	Rec. type : simultaneous	High frequency site
Ref.	CityShark	5-second Lennartz LE3D	**P9-4-1-Grenoble-test1** Influence of machinery : water pumps Next to the pumps. Ref : pumps off ; test : pumps on	
Test	CityShark	5-second Lennartz LE3D		

Figure 55 : Parameters that **may** influence H/V results **with possible control**. Influence of machinery : water pumps.

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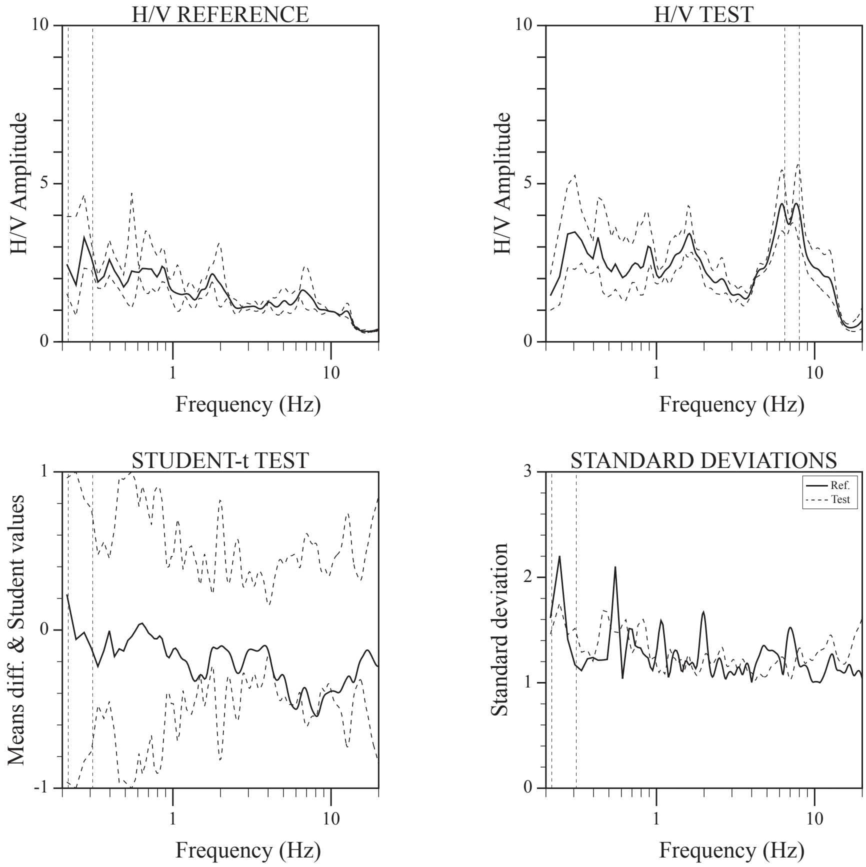

	File name	f0 (H/V) (Hz)	Nb win	Sample rate (Hz)	Recording duration (s)	Frequency stastistics from individual windows			
						f0 (Hz)	Sigma (Hz)	Nb win	Student-t test
Ref.	batt_0917 _1739.saf	0.27	3	125	130	0.26	0.05	3	|diff| = 6.98 t = 3.11 NOT similar peak frequencies
Test	batt_0917 _1811.saf	7.63	4	125	150	7.24	0.76	4	
	Conclusion	NOT RECOMMENDED							

	Recorder	Sensor	Rec. type : sequential	Low frequency site
Ref.	Mars Lite	5-second Lennartz LE3D	**P9-4-2-Nice-test5** Influence of boat On asphalt. Ref : calm period ; test : ship approach (still far)	
Test	Mars Lite	5-second Lennartz LE3D		

Figure 56 : Parameters that **may** influence H/V results **with possible control**. Influence of boat.

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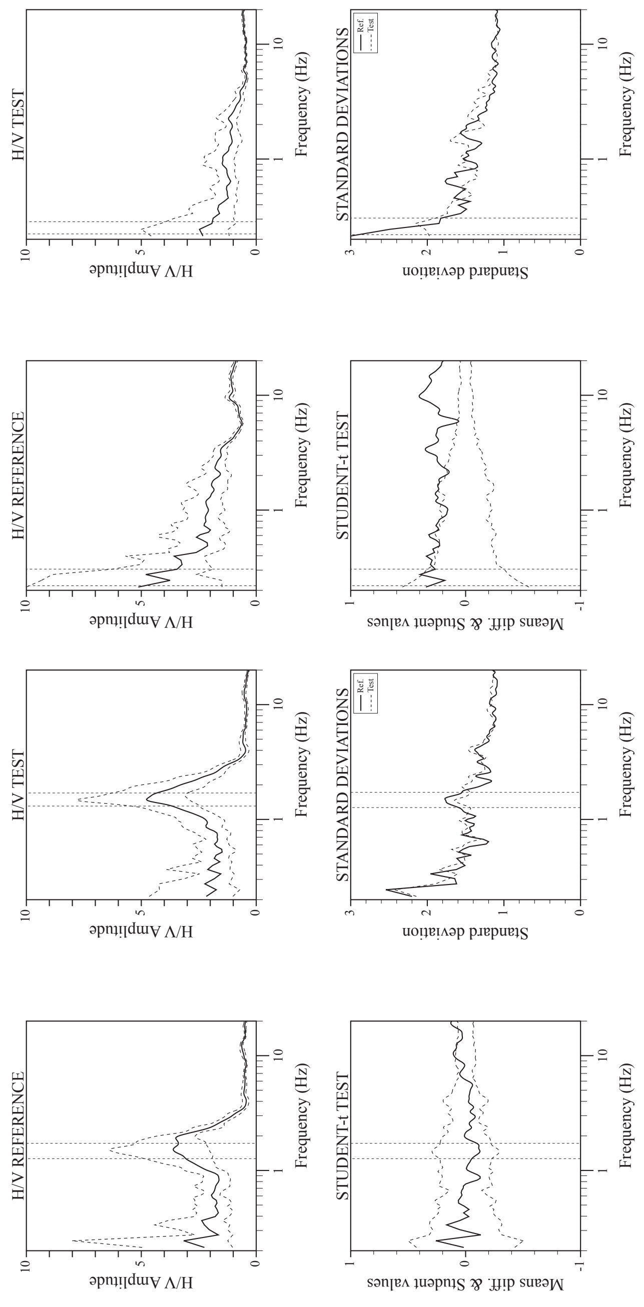

	File name	$f0\ (\overline{H/V})$ (Hz)	Nb win	Sample rate (Hz)	Recording duration (s)	Frequency stastistics from individual windows: $\overline{f0}$ (Hz)	Sigma (Hz)	Nb win	Student-t test
Ref.	0317100900 .saf	1.53	15	125	540	1.50	0.23	15	|diff| = 0.01 t = 0.27 Similar peak frequencies
Test	09200838.saf	1.50	18	125	668	1.50	0.20	18	
Conclusion	No influence inside the peak zone, negligible influence outside (10%)								

	Recorder	Sensor	Rec. type : sequential	Medium frequency site
Ref.	Mars Lite	5-second Lennartz LE3D	**P4-1-Nice-test5** Influence of large nearby structures 700 m from building. Ref : before construction ; Test : after	
Test	Mars Lite	5-second Lennartz LE3D		

	File name	$f0\ (\overline{H/V})$ (Hz)	Nb win	Sample rate (Hz)	Recording duration (s)	Frequency stastistics from individual windows: $\overline{f0}$ (Hz)	Sigma (Hz)	Nb win	Student-t test
Ref.	0501130636 .saf	0.27	18	125	676	0.26	0.04	18	|diff| = 0.01 t = 0.05 Similar peak frequencies
Test	09191459.saf	0.24	16	125	676	0.25	0.03	16	
Conclusion	NOT RECOMMENDED (33% inside peak zone)								

	Recorder	Sensor	Rec. type : sequential	Low frequency site
Ref.	Mars Lite	5-second Lennartz LE3D	**P4-1-Nice-test6** Influence of large nearby structures 20 m West from building. Ref : before construction ; Test : after	
Test	Mars Lite	5-second Lennartz LE3D		

Figure 57 : Parameters that **may** influence H/V results **without control**. Influence of large nearby structures.

Project Acronym: SESAME
Project Title: Site Effects Assessment Using Ambient Excitations
Supported by: The European Commission – Research General Directorate
Project No: EVG1-CT-2000-00026 SESAME
Report Title: Final report on Measurement Guidelines (WP02). LGIT, CETE
Deliverable No: D08.02

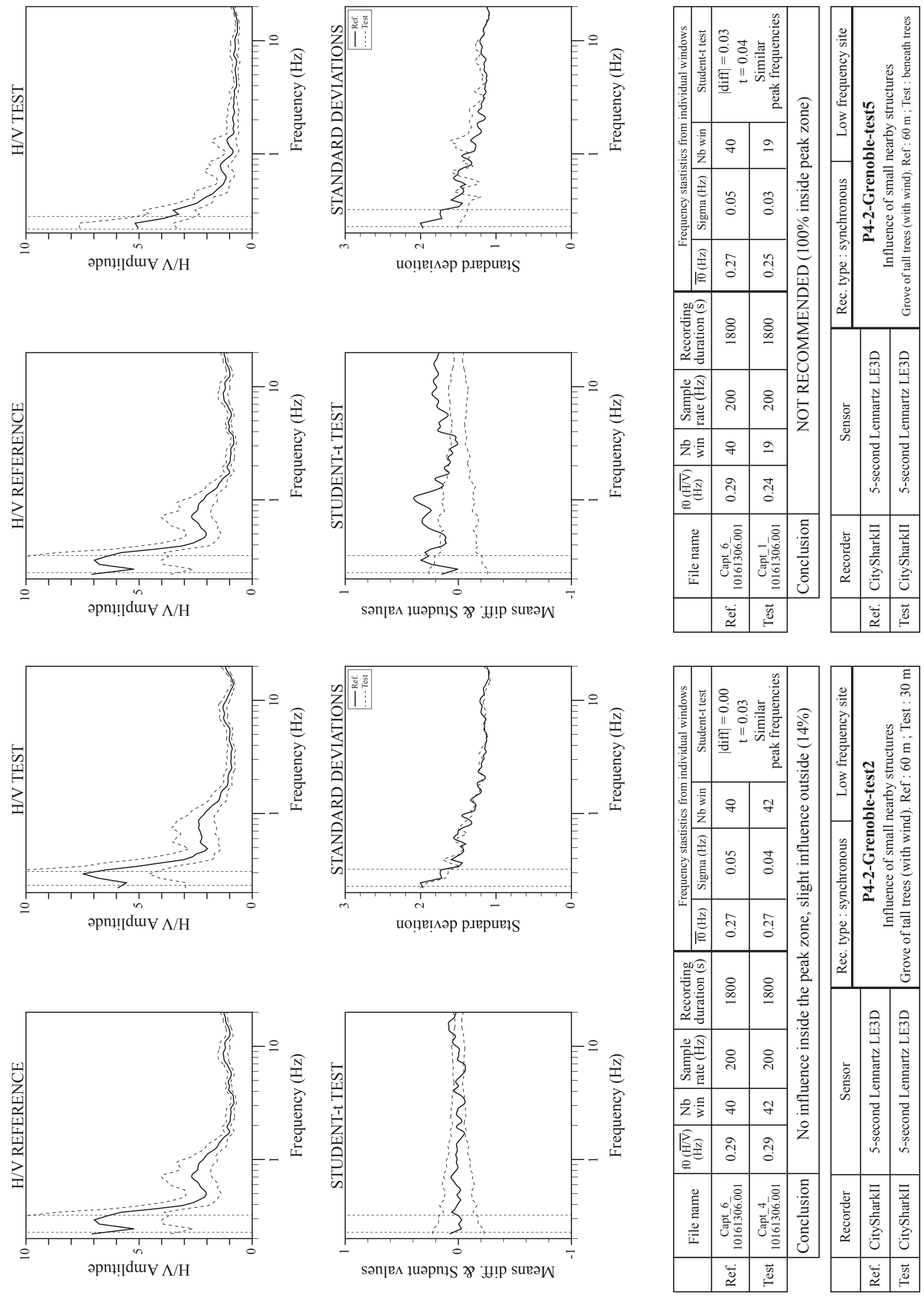

Figure 58 : Parameters that **may** influence H/V results **without control**. Influence of small nearby structures.

Project Acronym: SESAME
Project Title: Site Effects Assessment Using Ambient Excitations
Supported by: The European Commission – Research General Directorate
Project No: EVG1-CT-2000-00026 SESAME
Report Title: Final report on Measurement Guidelines (WP02). LGIT, CETE
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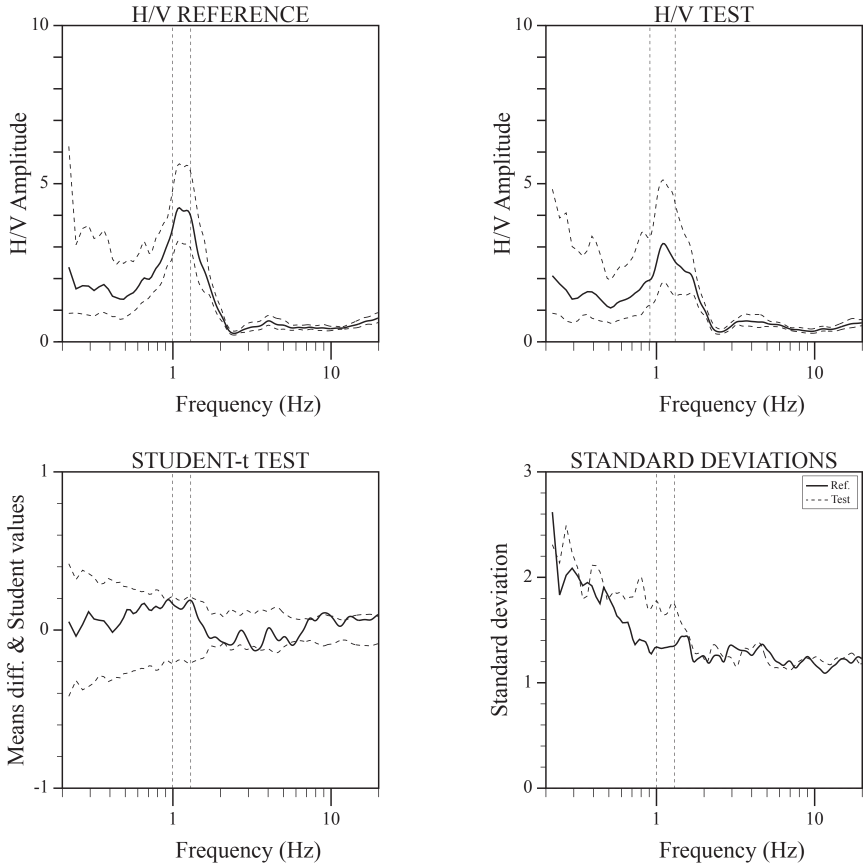

	File name	f0 (H/V) (Hz)	Nb win	Sample rate (Hz)	Recording duration (s)	Frequency stastistics from individual windows			
						f0 (Hz)	Sigma (Hz)	Nb win	Student-t test
Ref.	02052803.saf	1.10	22	100	903	1.15	0.15	22	|diff| = 0.04 t = 0.19 Similar peak frequencies
Test	02052303.saf	1.10	22	100	903	1.11	0.20	22	
	Conclusion	No influence inside the peak zone, slight influence outside (12%)							

	Recorder	Sensor	Rec. type : sequential	Medium frequency site
Ref.	Hathor 3	5-second Lennartz LE3D	**P9-6-Nice-test3** Influence of the sea Sea at 1430 m. Ref : calm sea ; test : agitated sea	
Test	Hathor 3	5-second Lennartz LE3D		

Figure 59 : Parameters that **may** influence H/V results **without control**. Influence of the sea.