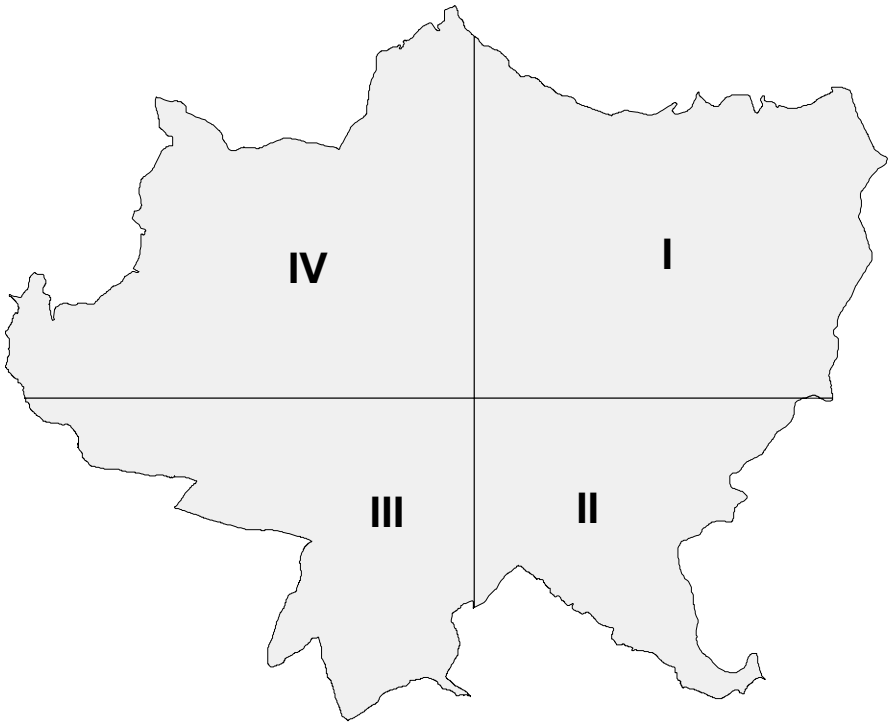
Piano Strutturale B09.3.2

Schede

indagini sismiche



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Comune di Siena

STUDIO DI MICROZONAZIONE SISMICA DI 1° LIVELLO

COMUNE DI SIENA

INDAGINI DI SISMICA PASSIVA MEDIANTE TECNICA A STAZIONE SINGOLA (HVSR)

RELAZIONE TECNICA

SETTEMBRE 2017

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Sommario

1 – PREMESSA

La presente relazione concerne la campagna di indagini di sismica passiva effettuate mediante tecnica a stazione singola (HVSR) per lo studio di Microzonazione sismica di 1° livello del Comune di Siena. Le acquisizioni di rumore sismico ambientale, eseguite nrl mese di agosto 2017 sono state n° 62, come indicato e concordato con il Servizio Sismico della Regione Toscana e il Comune di Siena. Esse sono state suddivise all'interno delle aree di indagine.

2 – IL RUMORE SISMICO AMBIENTALE **[DA D. ALBARELLO E S. CASTELLARO]**

Esistono due configurazioni sperimentali per lo studio del rumore sismico ai fini geognostici: la configurazione a stazione singola e la configurazione ad antenna sismica (array).

La prima è basata sull'analisi dell'ampiezza delle componenti spettrali del campo di vibrazioni ambientali misurato nelle tre direzioni dello spazio, mentre nella seconda vengono analizzati i rapporti di fase tra i treni d'onda che attraversano un'antenna sismica (array) ovvero una distribuzione di sensori disposti con geometrie variabili alla superficie del terreno.

Quello trattato nel presente lavoro riguarda la configurazione a stazione singola.

La prova comunemente nota con il termine H/V (prova di Nakamura) o HVSR acronimo per Horizontal to Vertical Spectral Ratio è una tecnica di indagine applicata la prima volta da Nogoshi e Igarshi (1970) e resa nota da Nakamura (1989).

Si tratta di una valutazione sperimentale dei rapporti di ampiezza spettrale fra le componenti orizzontali (H) e le componenti verticali (V) delle vibrazioni ambientali sulla superficie del terreno misurati in un punto con apposito sismometro a tre componenti.

L'esito di questa prova è una curva sperimentale che rappresenta il valore del rapporto fra le ampiezze spettrali medie delle vibrazioni ambientali in funzione della frequenza di vibrazione (Fig. 1). Le frequenze alla quali la curva H/V mostra dei

massimi sono legate alle frequenze di risonanza del terreno al di sotto del punto di misura.

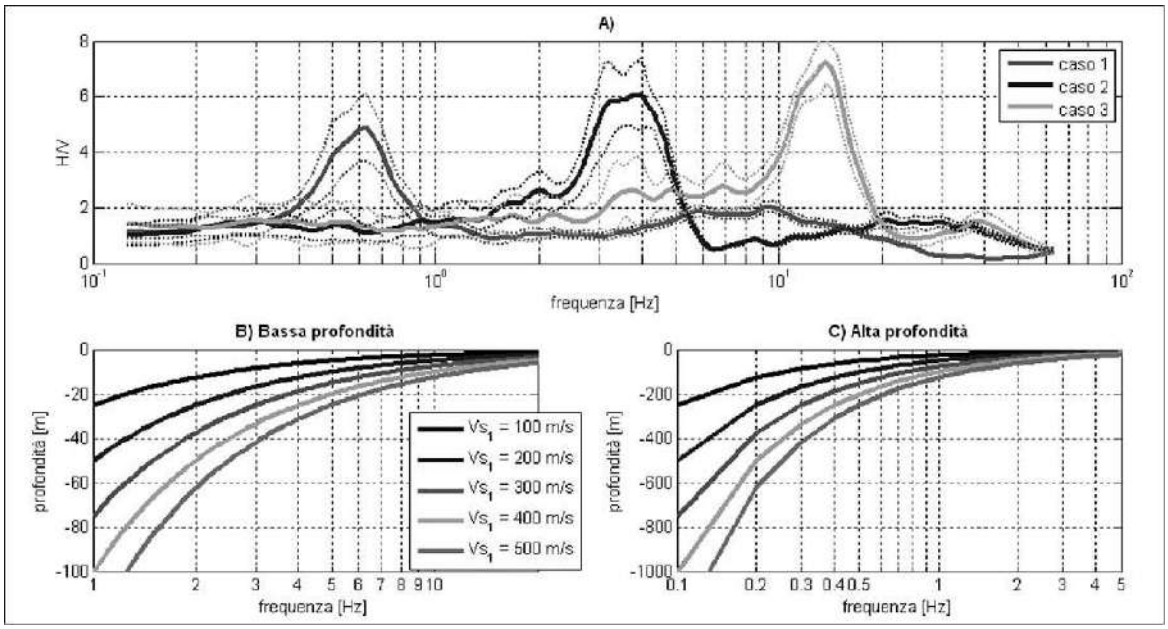

Figura1) Esempio di bedrock sismico a diverse profondità che genera risonanze a diverse frequenze. Caso 1: bedrock a 300 m di profondità. Caso 2: bedrock a 20 m di profondità. Caso 3: bedrock a 4 m di profondità; B) relazione V-f0-H alle medioalte frequenze; C) relazione V-f0-H alle medio-basse frequenze.

Quando la misura è effettuata su un basamento sismico affiorante (e quindi dove non sono attesi fenomeni di risonanza sismica) la curva non mostra massimi significativi e si assesta intorno ad ampiezza 1 (Fig. 2).

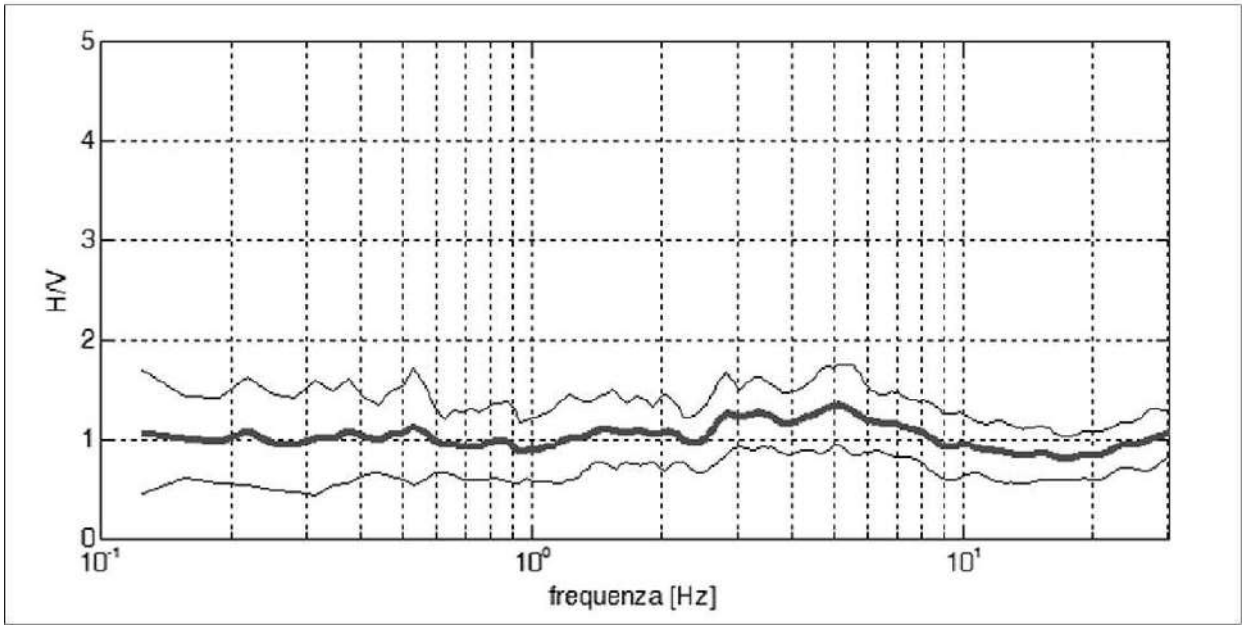

Figura 2 - Curva H/V di un sito su roccia non fratturata e morfologicamente piatta. Si noti l'assenza di
amplificazione per risonanza in tutto il dominio delle frequenze.

Pertanto, questa prova ha lo scopo di mettere in luce la presenza di fenomeni di risonanza sismica e consentire una stima delle frequenze alle quali il moto del terreno può risultare amplificato a causa di questi fenomeni. Contestualmente fornisce indicazioni di tipo qualitativo sull'entità delle risonanze attese. In generale, la stima della frequenza di risonanza f sarà tanto più precisa quanto maggiore è il contrasto di impedenza sismica responsabile del fenomeno, ovvero dove sono maggiori gli effetti potenzialmente pericolosi. Inoltre, se i risultati della prova sono invertiti mediante opportune procedure numeriche, soprattutto se in associazione ad altre indicazioni sperimentali (per esempio le curva di dispersione delle onde superficiali, prove Down Hole, sismica a rifrazione) possono fornire vincoli importanti al profilo di velocità delle onde di taglio nel sottosuolo.

In casi semplici (coperture soffici al disopra di un basamento sismico rigido), è possibile stabilire una relazione fra lo spessore dello strato soffice, la velocità media delle onde S all'interno di quest'ultimo (Vs) e la frequenza di risonanza fondamentale f dello strato, nella forma:

$$f = \frac{V_s}{4h}$$

Poiché la tecnica H/V indica la risonanza verticale locale nell'assunzione di una configurazione puramente 1D (sono ammesse solo variazioni verticali del profilo di velocità), essa è sensibile alle variazioni stratigrafiche laterali, permettendo di discriminare geometrie 1D da geometrie 2D, entro i limiti di visibilità imposti dalla legge fisica $\lambda f = V$ (lunghezza d'onda per frequenza = velocità).

Dal punto di vista fisico nel campo delle vibrazioni ambientali sono presenti sia onde di volume (P e S) che onde di superficie (Love e Rayleigh). Non è però possibile prevedere a priori per un dato sito l'entità del contributo relativo delle onde di volume e delle onde di superficie (nei diversi modi di propagazione) al campo d'onda delle

vibrazioni ambientali. I rapporti relativi delle diverse fasi cambiano in funzione delle frequenze, della situazione stratigrafica e della distribuzione delle sorgenti all'intorno della stazione di misura.

Tuttavia questa eterogeneità non influenza la stima della frequenza di risonanza fondamentale, ma solo l'ampiezza della curva H/V in corrispondenza di f, ampiezza che va quindi interpretata con cautela.

2.1 – CARATTERIZZAZIONE SISMICA CON MICROTREMORI - HVSR O NAKAMURA

Il metodo dei rapporti spettrali H/V (rapporto fra gli spettri di ampiezza delle componenti orizzontali rispetto a quelle verticali del moto del suolo) o metodo di Nakamura (Nakamura, 1989) è stato utilizzato in modo intensivo per stimare le frequenze di risonanza del sito in esame.

Esso è stato applicato in diversi campi d'indagine, quali la zonazione sismica in aree urbane (Lachet et al., 1996), lo studio dei bacini sedimentari (Al Yuncha & Luzon, 2000) e lo studio delle frequenze di risonanza delle strutture abitative (Mucciarelli & Monachesi, 1998; Mucciarelli et al., 2001; Nakamura et al., 2000).

L'ampio uso di tale metodologia ha evidenziato nelle diverse applicazioni numerosi punti di dibattito nell'ambito della comunità scientifica. L'aspetto comune che può essere dedotto dai lavori presenti in letteratura è che la tecnica di Nakamura è in grado di stimare la frequenza di risonanza del sito in esame ma non è affidabile per la stima assoluta dell'amplificazione del moto del suolo (Mucciarelli et al., 2001).

Inoltre i numerosi lavori riguardanti l'applicazione del metodo H/V offrono spiegazioni non univoche circa alcune importanti assunzioni del metodo, quali la composizione del campo d'onda analizzato, le condizioni di registrazione del rumore sismico e la procedura di "pre - processing" dei dati di rumore.

Per l'utilizzo di tale metodo si assume che gli strati soffici siano piani e paralleli e che la componente verticale del moto non subisca amplificazioni all'interfaccia substrato sismico – strato soffice.

2.2 STRUMENTAZIONE PER MICROTREMORI

I dati sono stati acquisiti tramite un tromografo a 4,5 Hz scegliendo 62 postazioni di misura all'interno delle aree da analizzare e misurando per ognuna di esse i microtremori per un tempo tra i 20 e i 45 minuti.
Dopo aver posizionato il tromografo in piano e allineato i suoi assi orizzontali con le direzioni nord - sud e est - ovest, abbiamo scelto come frequenza di campionamento 50 o 100 Hz.
La durata di ciascuna registrazione è stata di minimo 20 minuti e massimo di 45 in funzione delle caratteristiche locali della zona.

3 - ELABORAZIONE DATI E RISULTATI

Elaborazione dei dati microtremori – HVSR

I sismogrammi ottenuti sono stati opportunamente elaborati con il software WinMasw Academy 7.0 distribuito dalla ditta Eliosoft. In particolare, dopo una visione generale delle registrazioni, sono state scelte le finestre temporali sulle quali eseguire i rapporti H/V. E' stato scelto di usare finestre temporali variabili con t compreso tra 20 e 40 secondi dopo aver rimosso i possibili rumori antropici locali in modo da captare frequenze di risonanza minime dell'ordine di 0,5 - 1 Hz (se esistenti). Inoltre il software è stato settato in modo da evitare fenomeni di triggering sul dato di campagna e ottenere uno smoothing triangolare tra il 5 e il 20% dei risultati finali.

Negli allegati sono mostrate le curve H/V con il grafico della persistenza, della stazionarietà e dei criteri del progetto SESAME. Nella tabella seguente sono indicati i parametri derivati dalle misure H/V eseguite nelle aree oggetto d'intervento.

Tipo	Numero	fo	Ao	Classe
HVSR1	1	nn	nn	B2
HVSR2	2	0.8	2.4	B1
HVSR3	3	nn	nn	B2
HVSR4	4	nn	nn	A2
HVSR5	5	nn	nn	A2
HVSR6	6	nn	nn	A2
HVSR7	7	nn	nn	A2
HVSR8	8	7	7.1	B1
HVSR9	9	nn	nn	B2
HVSR10	10	nn	nn	A2
HVSR11	11	nn	nn	B2
HVSR12	12	nn	nn	B2
HVSR13	13	nn	nn	B2
HVSR14	14	nn	nn	B2
HVSR15	15	13.3	6.9	B1
HVSR16	16	nn	nn	A2
HVSR17	17	nn	nn	B2
HVSR18	18	15.6	2.4	A1
HVSR19	19	1.2	1.8	A1
HVSR20	20	6.5	8.9	A1
HVSR21	21	nn	nn	C
HVSR22	22	15.9	2.7	B1
HVSR23	23	nn	nn	A2
HVSR24	24	nn	nn	C
HVSR25	25	9.2	2.2	B1
HVSR26	26	nn	nn	A2
HVSR27	27	nn	nn	B2
HVSR28	28	25	3.5	B1
HVSR29	29	nn	nn	A2
HVSR30	30	nn	nn	B2
HVSR31	31	nn	nn	A2
HVSR32	32	nn	nn	A2
HVSR33	33	nn	nn	A2
HVSR34	34	nn	nn	B2
HVSR35	35	nn	nn	B2
HVSR36	36	nn	nn	C
HVSR37	37	10.7	4	B1
HVSR38	38	nn	nn	B2
HVSR39	39	nn	nn	A2

HVSR40	40	nn	nn	C
HVSR41	41	nn	nn	A2
HVSR42	42	nn	nn	A2
HVSR43	43	12	2.4	B1
HVSR44	44	nn	nn	B2
HVSR45	45	nn	nn	A2
HVSR46	46	nn	nn	B2
HVSR47	47	nn	nn	B2
HVSR48	48	nn	nn	A2
HVSR49	49	17.7	2.7	B1
HVSR50	50	nn	nn	B2
HVSR51	51	nn	nn	B2
HVSR52	52	nn	nn	B2
HVSR53	53	nn	nn	B2
HVSR54	54	13.3	1.5	B1
HVSR55	55	6.9	2.4	B1
HVSR56	56	6	3.9	A1
HVSR57	57	nn	nn	A2
HVSR58	58	nn	nn	A2
HVSR59	59	nn	nn	A2
HVSR60	60	nn	nn	A2
HVSR61	61	nn	nn	B2
HVSR62	62	nn	nn	C

4 – CAMPAGNA E SCHEDE DI ACQUISIZIONE

Dal punto di vista pratico, nelle prove di sismica passiva si tratta di misurare vibrazioni del terreno caratterizzate da ampiezze molto piccole. Questo implica che la prova vada effettuata con cura, soprattutto per quanto riguarda l'accoppiamento dello strumento di misura con il terreno e la riduzione delle possibili fonti di disturbo nelle immediate vicinanze dei sensori. Lo strumento di misura va dunque posto a diretto contatto col terreno e reso solidale con questo, possibilmente senza interfacce intermedie.

Quando questo non fosse possibile è necessario tener conto dei possibili effetti indotti dai terreni artificiali rigidi in questo tipo di misure. Bisogna inoltre evitare possibili movimenti dello strumento nel corso della misura (basculamenti, assestamenti del suolo,ecc.) e curare la messa in bolla dei sensori,controllando al termine della misura

che questa sia stata conservata. Infine, le eventuali parti mobili della strumentazione devono essere poste al riparo da spostamenti d'aria, va evitato il contatto con elementi mobili (fili d'erba, ecc.). Una lista di cautele per l'esecuzione di questo genere di misura è stata messa a punto nell'ambito del progetto SESAME.

Le misure effettuate nel presente lavoro seguono le linee guida presentate dal progetto SESAME.

Inoltre per ogni misura è stata riportata una foto dell'acquisizione e compilata una scheda, sempre seguendo il modello di quella riportata nelle linee guida SESAME.

5 – ANALISI DEI DATI E VALUTAZIONI DI QUALITA' DELLE MISURE

Le serie temporali registrate nelle tre componenti del moto vengono analizzate secondo procedure spettrali di vario tipo (FFT, wavelet, ecc.) fino alla produzione delle curve H/V, dove H è la media di due componenti spettrali orizzontali ortogonali. Si rimanda a SESAME (2004) e D'Amico et al. (2008) per due possibili protocolli di analisi. Tuttavia va rilevato che in presenza di un buon segnale e di fenomeni di risonanza significativi, i diversi protocolli producono gli stessi esiti.

Prima di qualsiasi interpretazione delle curve H/V sono indispensabili due accorgimenti:

1. la curva H/V deve essere statisticamente significativa, ossia essere caratterizzata da una deviazione in ampiezza e in frequenza ridotta. Quando questa caratteristica non sia presente sin dall'inizio, essa va ricercata tramite una pulizia del tracciato.
2. la curva H/V non va mai osservata da sola ma sempre congiuntamente agli spettri delle singole componenti da cui essa deriva. Questo permette di discernere agevolmente i picchi di natura stratigrafica da quelli generati da fonti di disturbo di natura antropica (motori elettrici, ecc.). In condizioni normali le componenti spettrali NS, EW e Z (verticale) hanno ampiezze simili. Alla frequenza di risonanza si genera spesso un picco H/V legato ad un minimo locale della componente spettrale verticale che determina una forma "a occhio" o

"a ogiva"come quella indicata dalla freccia in Fig. 3. Questa forma è indicativa di risonanze stratigrafiche.

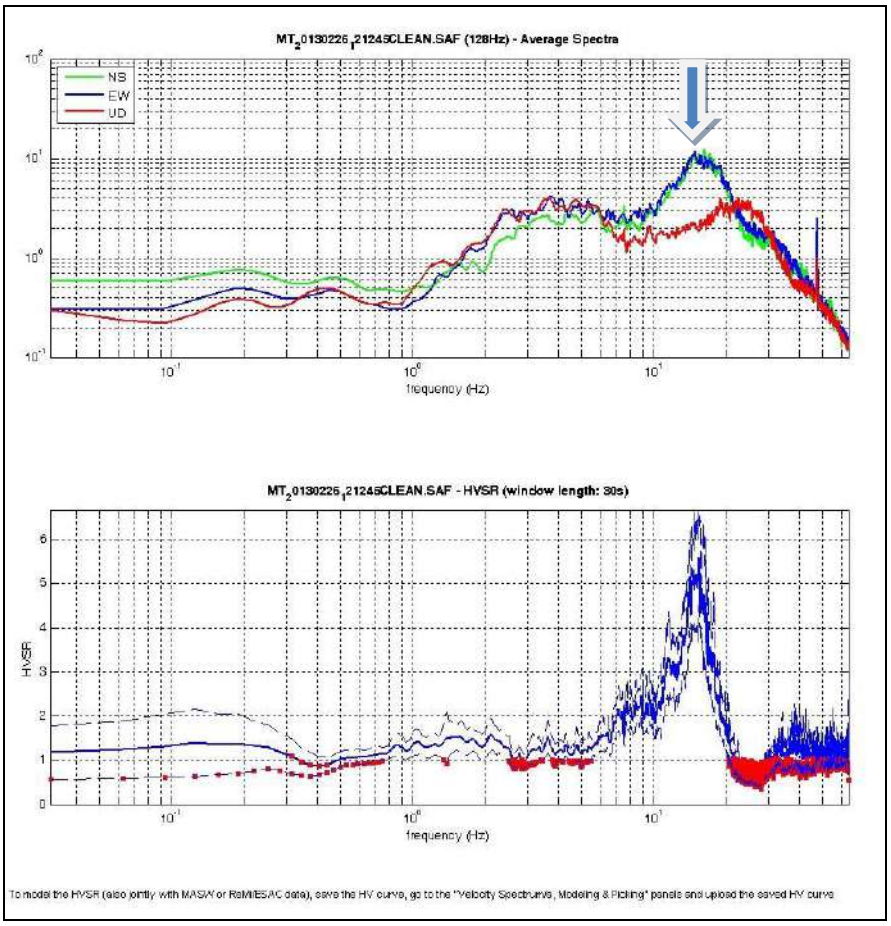

Figura 3 - Forma ad occhio o a "ogiva" tipica di una risonanza

Nel 2004 il progetto SESAME ha stabilito una serie di criteri per la valutazione della significatività dei picchi H/V. Si tratta essenzialmente di criteri di tipo statistico che hanno lo scopo di segnalare situazioni poco chiare per le quali sono necessarie ulteriori indagini (ripetizione della misura, variazione delle condizioni di accoppiamento con il terreno, ecc.).

La prima parte di questi criteri è dedicata alla valutazione dell'attendibilità statistica della curva H/V. In pratica, individuata la frequenza del picco di risonanza, i criteri aiutano a verificare se la registrazione è stata effettuata per un periodo abbastanza lungo e analizzata per un numero sufficiente di intervalli di tempo adeguati.

La seconda parte è dedicata alla valutazione della chiarezza del picco H/V. In pratica viene analizzata la morfologia del picco e si valuta semplicemente se il picco ha una

forma geometricamente ben definita. Questa parte dei test SESAME va interpretata con cognizione di causa perché solo un contatto netto tra litotipi diversi dal punto di vista meccanico genera picchi nitidi. Al contrario, le transizioni graduali (per es. roccia fratturata su roccia sana, passaggi da limo-argilloso a sabbia-limosa, ecc.) generano più spesso amplificazione in una banda larga di frequenze. In questo caso eventuali non superamenti dei criteri SESAME non significano che non ci siano risonanze importanti ma solo che non ci sono picchi singoli ben definiti.

Naturalmente, i criteri SESAME (2004) risultano non soddisfatti nei siti che non presentano amplificazione.

I criteri SESAME (2004) considerano significativi solo picchi con ampiezza H/V superiore a 2. Questo criterio ha carattere puramente empirico. Tuttavia va tenuto presente che massimi H/V di ampiezza inferiore a 2 indicano bassi contrasti di impedenza e, in questo caso, la frequenza corrispondente al massimo della curva H/V potrebbe fornire una indicazione meno precisa della frequenza di risonanza delle onde S. Questo non significa che il massimo osservato non sia fisicamente significativo, ma solo che l'interpretazione della curva va effettuata con maggiore cautela ed utilizzando procedure di inversione più raffinate.

Questi criteri hanno solo carattere statistico e non tengono conto di altre caratteristiche del campo di vibrazioni utili per individuare misure potenzialmente poco attendibili. Per ovviare a questi limiti, nell'ambito delle attività di microzonazione successive al terremoto di L'Aquila dell'aprile 2009, sono state definiti altri criteri di classificazione delle misure H/V che integrano le proposte nell'ambito del progetto SESAME (Albarello et al., 2010). Anche in questo caso, lo scopo è di fornire all'operatore impegnato nell'interpretazione dei risultati alcuni criteri di giudizio sulla qualità delle singole misure.

CRITERI SESAME

Criteri per una curva H/V affidabile [Tutti 3 dovrebbero risultare soddisfatti]	$f_0 > 10 / L_w$ $n_c(f_0) > 200$ $\sigma_A(f) < 2$ per $0.5f_0 < f < 2f_0$ se $f_0 > 0.5$Hz $\sigma_A(f) < 3$ per $0.5f_0 < f < 2f_0$ se $f_0 < 0.5$Hz
Criteri per un picco H/V chiaro [Almeno 5 su 6 dovrebbero essere soddisfatti]	Esiste f^- in $[f_0/4, f_0] \mid A_{H/V}(f^-) < A_0 / 2$ Esiste f^+ in $[f_0, 4f_0] \mid A_{H/V}(f^+) < A_0 / 2$ $A_0 > 2$ $f_{picco}[A_{H/V}(f) \pm \sigma_A(f)] = f_0 \pm 5\%$ $\sigma_f < \varepsilon(f_0)$ $\sigma_A(f_0) < \theta(f_0)$

L_w	lunghezza della finestra
n_w	numero di finestre usate nell'analisi
$n_c = L_w n_w f_0$	numero di cicli significativi
f	frequenza attuale
f_0	frequenza del picco H/V
σ_f	deviazione standard della frequenza del picco H/V
$\varepsilon(f_0)$	valore di soglia per la condizione di stabilità $\sigma_f < \varepsilon(f_0)$
A_0	ampiezza media della curva H/V alla frequenza f_0
$A_{H/V}(f)$	ampiezza media della curva H/V alla frequenza f
f^-	frequenza tra $f_0/4$ e f_0 alla quale $A_{H/V}(f^-) < A_0/2$
f^+	frequenza tra f_0 e $4f_0$ alla quale $A_{H/V}(f^+) < A_0/2$
$\sigma_A(f)$	deviazione standard di $A_{H/V}(f)$, $\sigma_A(f)$ è il fattore per il quale la curva $A_{H/V}(f)$ media deve essere moltiplicata o divisa
$\sigma_{logH/V}(f)$	deviazione standard della funzione log $A_{H/V}(f)$
$\theta(f_0)$	valore di soglia per la condizione di stabilità $\sigma_A(f) < \theta(f_0)$

Valori di soglia per σ_f e $\sigma_A(f_0)$					
Intervallo di freq. [Hz]	< 0.2	0.2 – 0.5	0.5 – 1.0	1.0 – 2.0	> 2.0
$\varepsilon(f_0)$ [Hz]	0.25 f_0	0.2 f_0	0.15 f_0	0.10 f_0	0.05 f_0
$\theta(f_0)$ per $\sigma_A(f_0)$	3.0	2.5	2.0	1.78	1.58
log $\theta(f_0)$ per $\sigma_{logH/V}(f_0)$	0.48	0.40	0.30	0.25	0.20

CLASSIFICAZIONE MISURE H/V [Albarello et alii, 2010]

Obiettivo della classificazione è fornire una indicazione immediata circa la qualità delle singole misure H/V, con lo scopo di aiutare gli operatori nella fase interpretativa e nel confronto con altri dati osservati. Questo tipo di classificazione trova il suo principale impiego nella redazione delle mappe delle indagini relative al livello 1 della microzonazione sismica. I criteri proposti sono più rigidi di quelli di SESAME in quanto includono elementi di giudizio non contemplati in precedenza, quali:

1. durata complessiva della registrazione che deve essere tale da produrre stime "robuste" del campo medio delle vibrazioni ambientali
2. stazionarietà temporale dei rapporti spettrali
3. isotropia del segnale in termini dei rapporti spettrali
4. assenza di rumore elettromagnetico
5. andamento complessivo della curva H/V

Si confrontano misure ottenute con spettri lisciati con una finestra triangolare al 5% della frequenza centrale. Valori maggiori dell'ampiezza della finestra di lisciamento possono essere utilizzati per migliorare la leggibilità della curva in fase di interpretazione.

Vengono proposte tre classi di qualità:

Classe A: H/V affidabile e interpretabile: può essere utilizzata anche da sola

1. la forma dell'H/V nell'intervallo di frequenze di interesse rimane stazionaria per almeno il 30% circa della durata della misura (*stazionarietà*)
2. le variazioni azimuthali di ampiezza non superano il 30% del massimo (*isotropia*)
3. non ci sono indizi di rumore elettromagnetico nella banda di frequenza di interesse (*assenza di disturbi*)
4. i massimi sono caratterizzati da una diminuzione localizzata di ampiezza dello spettro verticale (*plausibilità fisica*)
5. i criteri di SESAME per una curva H/V attendibile (primi 3 criteri) sono verificati (*robustezza statistica*)
6. la misura è durata almeno 15/20 minuti (*durata*)

ECCEZIONE: misure effettuate su roccia integra affiorante o in zone alluvionali fini con basamento sismico molto profondo (tipicamente > 1 km) possono non mostrare alcun picco statisticamente significativo della curva H/V nell'intervallo di frequenze di interesse ingegneristico, a causa dell'assenza di contrasti di impedenza sufficientemente marcati. In questi casi, in cui la curva H/V apparirà piatta e con *ampiezza circa pari a 1*, il criterio 5 risulterà non verificato anche se la misura è di fatto attendibile. In questo solo caso la misura può ricadere nella classe A ma si consiglia di ripetere la misura per confermare l'effettiva assenza di massimi significativi.

Classe B: curva H/V sospetta (da "interpretare"): va utilizzata con cautela e solo se coerente con altre misure ottenute nelle vicinanze

1. almeno una delle condizioni della classe A non è soddisfatta, a condizione che non si rientri nell'ECCEZIONE citata per la Classe A

Classe C: curva H/V scadente e di difficile interpretazione: non va utilizzata

1. misura di tipo B nella quale la curva H/V mostra una ampiezza crescente al diminuire

della frequenza (deriva), indice di un movimento dello strumento durante la misura
2. misura di tipo B nella quale si evidenza la presenza di rumore elettromagnetico nell'intervallo di frequenze di potenziale interesse

I criteri delineati sopra non riguardano l'interpretazione in chiave geologico-stratigrafica della curva, per la quale sono richiesti ulteriori criteri (per esempio i criteri SESAME per la "chiarezza" del picco).

Per le sole Classi A e B si possono pertanto definire due sottoclassi delle classi precedenti, ossia:

Tipo 1. Presenta almeno un picco "chiaro" secondo i criteri di SESAME: *possibile risonanza*

Tipo 2. Non presenta picchi "chiari" nell'intervallo di frequenze di interesse: *assenza di risonanza*

6 – CONCLUSIONI

Per il presente lavoro sono state distinte le misure nelle quali è presente almeno un picco della curva H/V statisticamente significativo nell'intervallo di frequenze di interesse (misure di Tipo 1 secondo la classificazione di Albarello et al. 2010) da quelle dove non ci sono picchi significativi (misure di Tipo 2). Le prime sono rappresentative di siti o unità litologiche caratterizzate da possibili fenomeni di risonanza.

SCHEDE DELLE INDAGINI

HVSR1

DATE 23.08.2017	HOUR 9:17	PLACE San Martino
OPERATOR ProGeo Engineering srl	GPS TYPE and #	
GAUSS-BOAGA LATITUDE 4801368	GAUSS-BOAGA LONGITUDE 1684986	ALTITUDE 332 m slm
STATION TYPE GPA	SENSOR TYPE 4,5 Hz	
STATION #	SENSOR #	DISK #
FILE NAME HVSR1		POINT #
GAIN	SAMPL. FREQ. 100 Hz	REC. DURATION 30 min (minutes / seconds)

WEATHER CONDITIONS

WIND (●) none ( ) weak (5m/s) ( ) medium ( ) strong Measurement (if any): _____

RAIN (●) none ( ) weak ( ) medium ( ) strong Measurement (if any): _____

Temperature (approx): 21 Remarks _____

GROUND TYPE

( ) earth (( ) hard ( ) soft) ( ) gravel ( ) sand ( ) rock (●) grass = ((●) short ( ) tall)

( ) asphalt ( ) cement ( ) concrete ( ) paved ( ) other _____

(●) dry soil ( ) wet soil Remarks _____

ARTIFICIAL GROUND-SENSOR COUPLING (●) no ( ) yes, type _____

BUILDING DENSITY ( ) none (●) scattered ( ) dense ( ) other, type _____

TRANSIENTS

	none	few	moderate	many	very dense	distance
cars		●				
trucks	●					
pedestrians		●				
other	●					

MONOCHROMATIC NOISE SOURCES (factories, works, pumps, rivers,..)

(●) no ( ) yes, type _____

NEARBY STRUCTURES (description, height, distance) (trees, polls, buildings, bridges, underground structures,...)

Trees, Buildings

OBSERVATIONS

FREQUENCY: Hz (if computed in the field)

Qualità della misura:

Durata: rispettata
Stazionarietà: rispettata
Isotropia: rispettata
Assenza di disturbi: rispettata
Plausibilità fisica: rispettata
Robustezza statistica: rispettata

MISURA TIPO B2

HVSR1

Peak frequency (Hz): 16.2 (±7.1)
Peak HVSR value: 1.3 (±0.6)

=== Criteria for a reliable H/V curve ==========
#1. [f0 > 10/Lw]: 16.235 > 0.5 (OK)
#2. [nc > 200]: 57795 > 200 (OK)
#3. [f0>0.5Hz; sigmaA(f) < 2 for 0.5f0 < f < 2f0] (OK)

=== Criteria for a clear H/V peak (at least 5 should be fulfilled) ==========
#1. [exists f- in the range [f0/4, f0] | AH/V(f-) < A0/2]: yes (considering standard deviations), at frequency 4.1Hz (OK)
#2. [exists f+ in the range [f0, 4f0] | AH/V(f+) < A0/2]: yes (considering standard deviations), at frequency Hz (OK)
#3. [A0 > 2]: 1.3 < 2 (NO)
#4. [fpeak[Ah/v(f) ą sigmaA(f)] = f0 ą 5%]: (NO)
#5. [sigmaf < epsilon(f0)]: 7.126 > 0.812 (NO)
#6. [sigmaA(f0) < theta(f0)]: 0.633 < 1.58 (OK)

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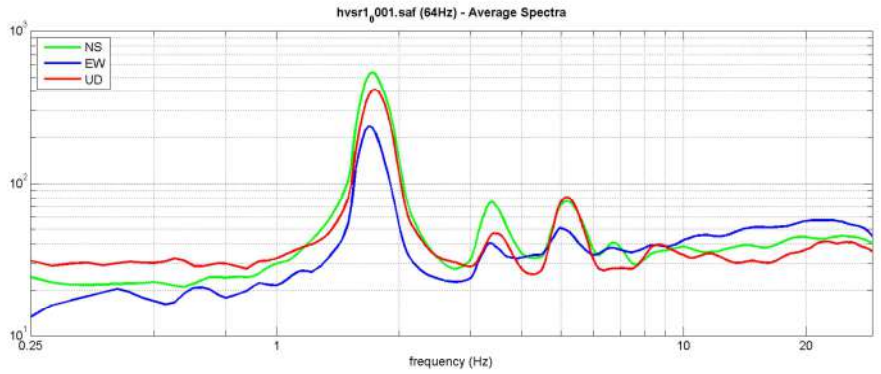
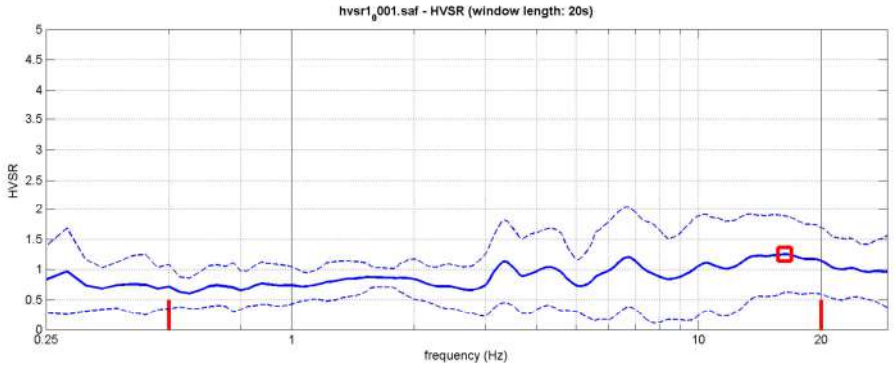
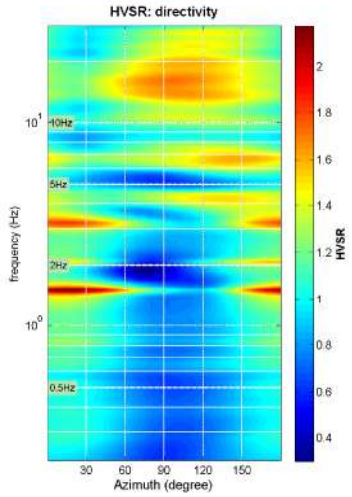
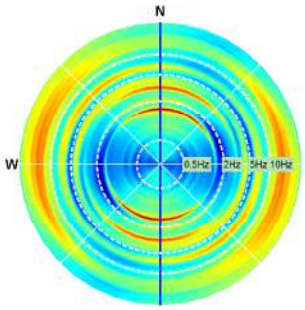
via Don Luigi Sturzo, 43/A - 52100 - Arezzo
tel. 0575 324114 - fax. 0575 406473 - email: info@progeo.arezzo.it

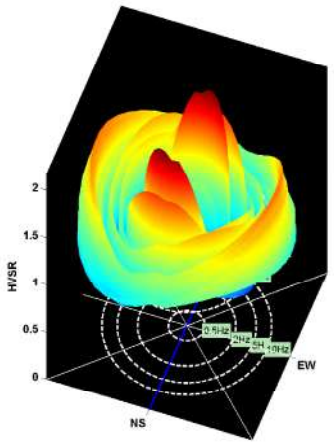


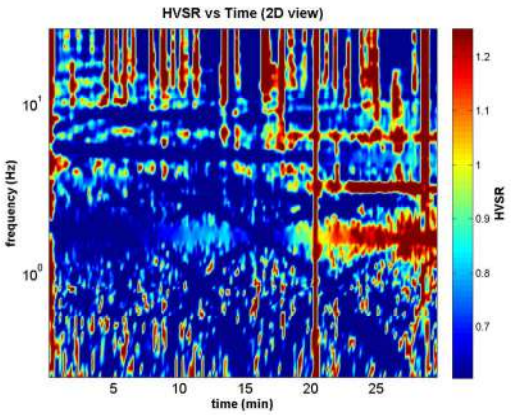


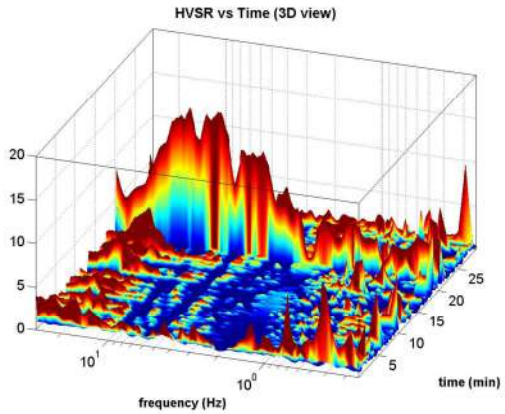
To model the HVSR (also jointly with MASW or ReMi/EGAC data), save the H/V curve, go to the "Velocity Spectrum/a, Modeling & Picking" panels and upload the saved H/V curve











HVSR2

DATE 27.07.2017	HOUR 9:36	PLACE Viale V. di Baviera
OPERATOR ProGeo Engineering srl	GPS TYPE and #	
GAUSS-BOAGA LATITUDE 4801110	GAUSS-BOAGA LONGITUDE 1686406	ALTITUDE 309,5 m slm
STATION TYPE GPA	SENSOR TYPE 4,5 Hz	
STATION #	SENSOR #	DISK #
FILE NAME HVSR2		POINT #
GAIN	SAMPL. FREQ. 100 Hz	REC. DURATION 30 min (minutes / seconds)

WEATHER CONDITIONS: WIND (●) none ( ) weak (5m/s) ( ) medium ( ) strong Measurement (if any): ____
RAIN (●) none ( ) weak ( ) medium ( ) strong Measurement (if any): ____
Temperature (approx): 22 Remarks ____

GROUND TYPE: ( ) earth (( ) hard ( ) soft) ( ) gravel ( ) sand ( ) rock (●) grass = ((●) short ( ) tall)
( ) asphalt ( ) cement ( ) concrete ( ) paved ( ) other ____
(●) dry soil ( ) wet soil Remarks ____

ARTIFICIAL GROUND-SENSOR COUPLING (●) no ( ) yes, type ____

BUILDING DENSITY ( ) none (●) scattered ( ) dense ( ) other, type ____

TRANSIENTS	none	few	moderate	many	very dense	distance
cars			●			
trucks	●					
pedestrians		●				
other	●					

MONOCHROMATIC NOISE SOURCES (factories, works, pumps, rivers,..)
(●) no ( ) yes, type ____

NEARBY STRUCTURES (description, height, distance) (trees, polls, buildings, bridges, underground structures,...)
Trees, Buildings

OBSERVATIONS

FREQUENCY: Hz (if computed in the field)

Qualità della misura:

Durata: rispettata
Stazionarietà: rispettata
Isotropia: rispettata
Assenza di disturbi: rispettata
Plausibilità fisica: rispettata
Robustezza statistica: rispettata

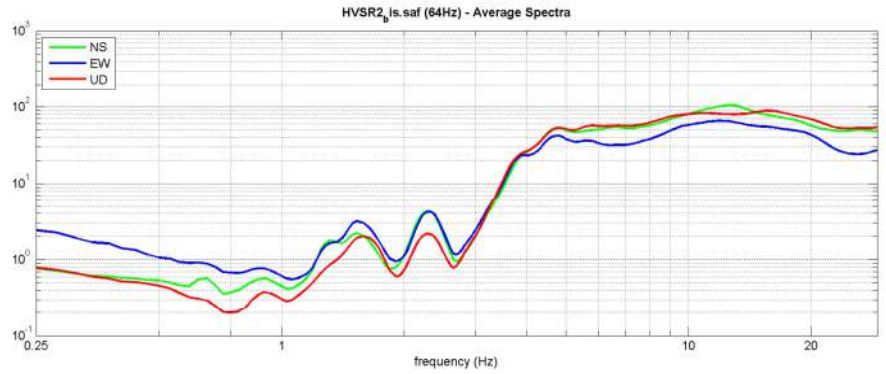
MISURA TIPO B1

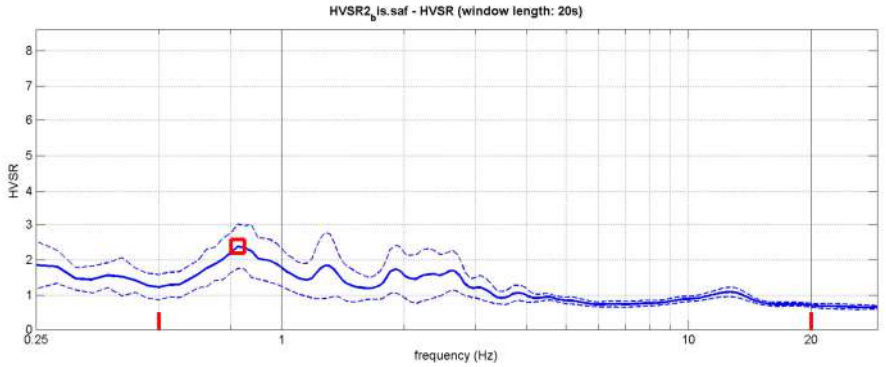
HVSR2

Peak frequency (Hz): 0.8 (±0.7)
Peak HVSR value: 2.4 (±0.6)

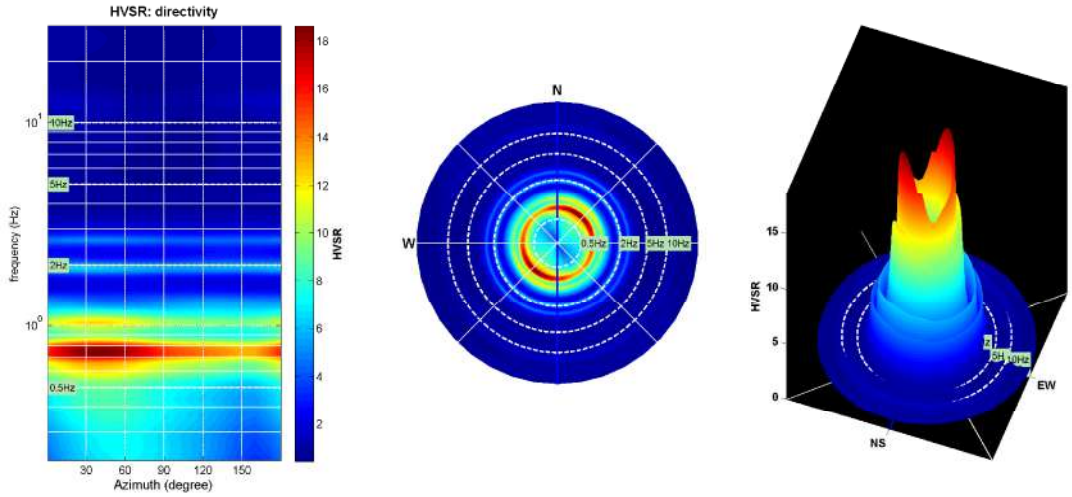
=== Criteria for a reliable H/V curve ==========
#1. [f0 > 10/Lw]: 0.782 > 0.5 (OK)
#2. [nc > 200]: 2111 > 200 (OK)
#3. [f0>0.5Hz; sigmaA(f) < 2 for 0.5f0 < f < 2f0] (OK)

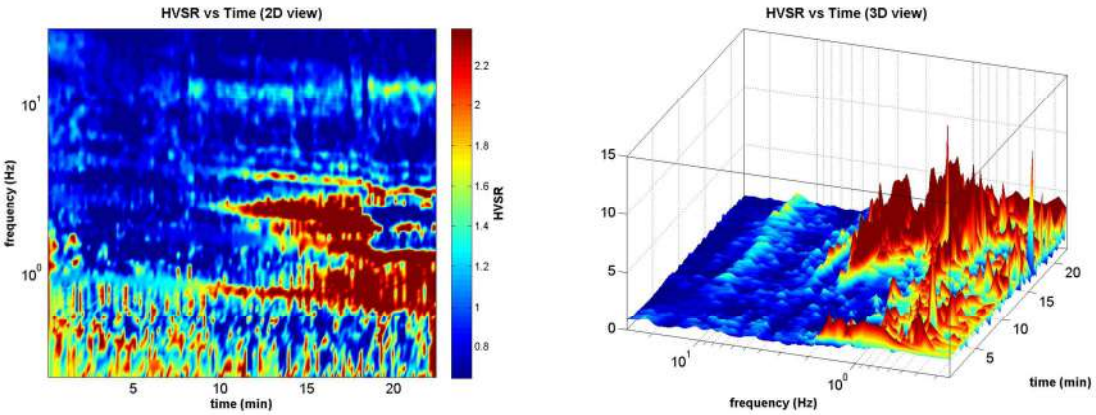
=== Criteria for a clear H/V peak (at least 5 should be fulfilled) ==========
#1. [exists f- in the range [f0/4, f0] | AH/V(f-) < A0/2]: yes (considering standard deviations), at frequency 0.5Hz (OK)
#2. [exists f+ in the range [f0, 4f0] | AH/V(f+) < A0/2]: yes, at frequency 1.7Hz (OK)
#3. [A0 > 2]: 2.4 > 2 (OK)
#4. [fpeak[Ah/v(f) ± sigmaA(f)] = f0 ± 5%]: (OK)
#5. [sigmaf < epsilon(f0)]: 0.688 > 0.117 (NO)
#6. [sigmaA(f0) < theta(f0)]: 0.628 < 2 (OK)





To model the HVSR (also jointly with MASW or ReMi/EGAC data), save the H/V curve, go to the "Velocity Spectrum/a, Modeling & Picking" panels and upload the saved H/V curve





HVSR3

DATE 27.07.2017	HOUR 10:04	PLACE Torre Fiorentina
OPERATOR ProGeo Engineering srl	GPS TYPE and #	
GAUSS-BOAGA LATITUDE 4800854	GAUSS-BOAGA LONGITUDE 1686855	ALTITUDE 343 m slm
STATION TYPE GPA	SENSOR TYPE 4,5 Hz	
STATION #	SENSOR #	DISK #
FILE NAME HVSR3		POINT #
GAIN	SAMPL. FREQ. 100 Hz	REC. DURATION 30 min (minutes / seconds)

WEATHER CONDITIONS
WIND ● none ☐ weak (5m/s) ☐ medium ☐ strong Measurement (if any): _____
RAIN ● none ☐ weak ☐ medium ☐ strong Measurement (if any): _____
Temperature (approx): 26 Remarks _____

GROUND TYPE
● earth (☐ hard ● soft) ☐ gravel ☐ sand ☐ rock ☐ grass = (☐ short ☐ tall)
☐ asphalt ☐ cement ☐ concrete ☐ paved ☐ other _____
● dry soil ☐ wet soil Remarks _____

ARTIFICIAL GROUND-SENSOR COUPLING ● no ☐ yes, type _____

BUILDING DENSITY ☐ none ● scattered ☐ dense ☐ other, type _____

TRANSIENTS

	none	few	moderate	many	very dense	distance
cars		●				
trucks	●					
pedestrians		●				
other	●					

MONOCHROMATIC NOISE SOURCES (factories, works, pumps, rivers,..)
● no ☐ yes, type _____

NEARBY STRUCTURES (description, height, distance) (trees, polls, buildings, bridges, underground structures,...)
Trees

OBSERVATIONS

FREQUENCY: Hz (if computed in the field)

Qualità della misura:

Durata: rispettata
Stazionarietà: rispettata
Isotropia: rispettata
Assenza di disturbi: non rispettata
Plausibilità fisica: rispettata
Robustezza statistica: rispettata

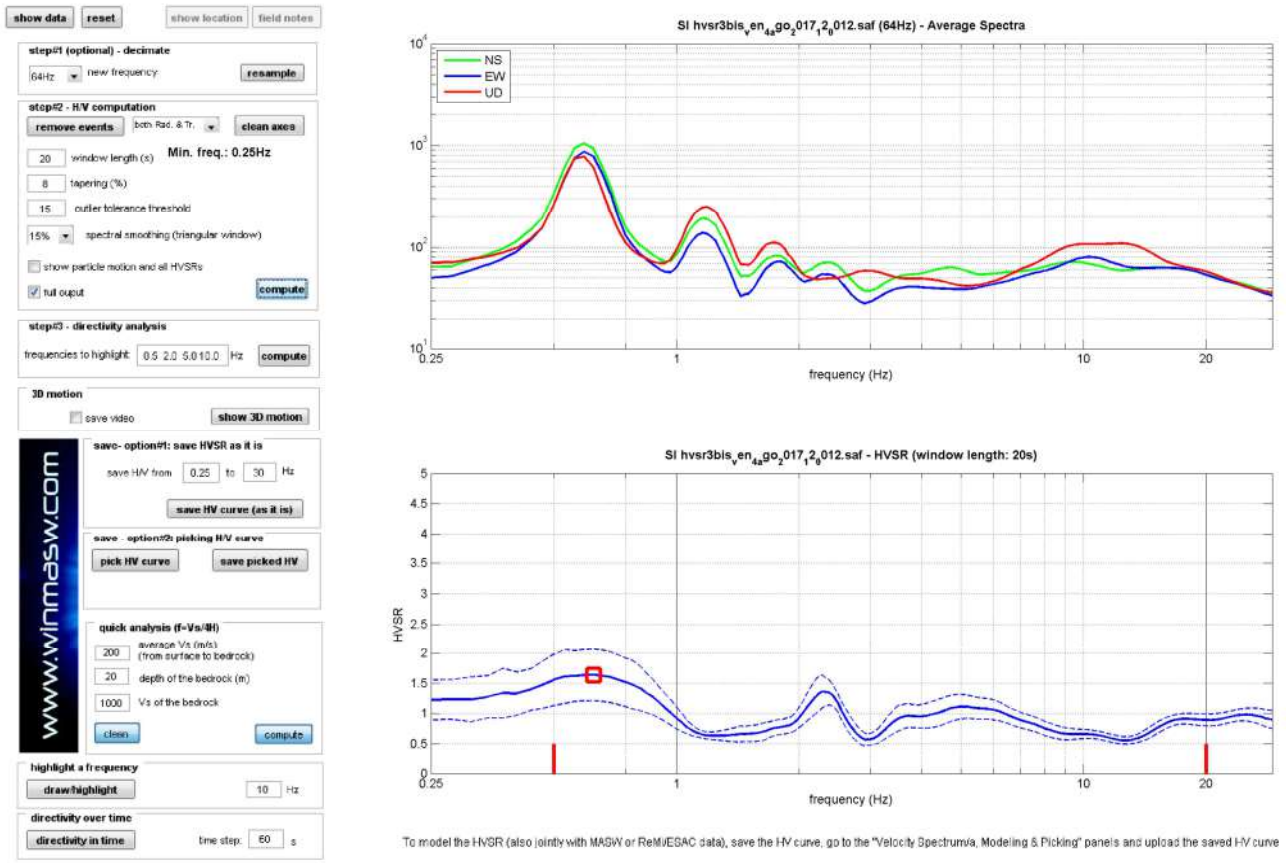
MISURA TIPO B2

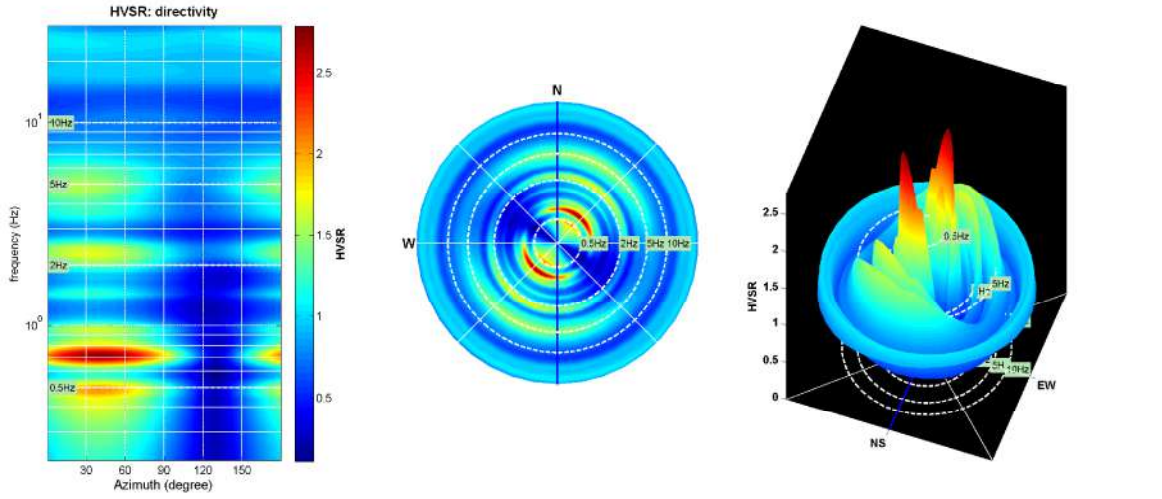
HVSR3

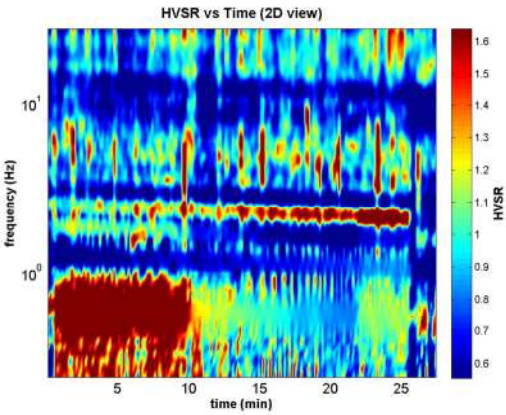
Peak frequency (Hz): 0.6 (±2.3)
Peak HVSR value: 1.6 (±0.4)

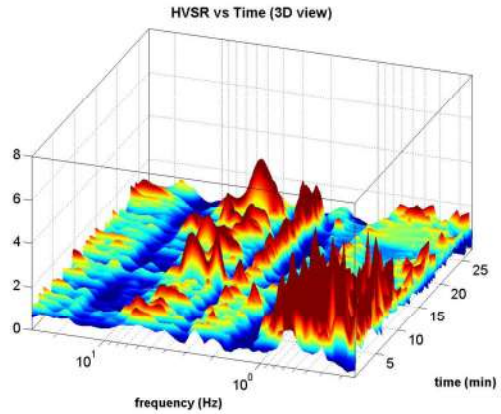
=== Criteria for a reliable H/V curve ==========
#1. [f0 > 10/Lw]: 0.626 > 0.5 (OK)
#2. [nc > 200]: 2065 > 200 (OK)
#3. [f0>0.5Hz; sigmaA(f) < 2 for 0.5f0 < f < 2f0] (OK)

=== Criteria for a clear H/V peak (at least 5 should be fulfilled) ==========
#1. [exists f- in the range [f0/4, f0] | AH/V(f-) < A0/2]: (NO)
#2. [exists f+ in the range [f0, 4f0] | AH/V(f+) < A0/2]: yes, at frequency 1.1Hz (OK)
#3. [A0 > 2]: 1.6 < 2 (NO)
#4. [fpeak[Ah/v(f) ą sigmaA(f)] = f0 ą 5%]: (OK)
#5. [sigmaf < epsilon(f0)]: 2.318 > 0.094 (NO)
#6. [sigmaA(f0) < theta(f0)]: 0.428 < 2 (OK)


show data
reset
show location
field notes
step#1 (optional) - decimate
64Hz
new frequency
resample
step#2 - H/V computation
remove events
both Rad. & Tr.
clean axes
20
window length (s)
Min. freq.: 0.25Hz
8
tapering (%)
15
outlier tolerance threshold
15%
spectral smoothing (triangular window)
show particle motion and all HVSRs
full output
compute
step#3 - directivity analysis
frequencies to highlight
0.5 2.0 5.0 10.0
Hz
compute
3D motion
save video
show 3D motion
www.winmasw.com
save- option#1: save HVSR as it is
save H/V from
0.25
to
30
Hz
save HV curve (as it is)
save - option#2: picking H/V curve
pick HV curve
save picked HV
quick analysis (f=Vs/4H)
200
average Vs (m/s)
(from surface to bedrock)
20
depth of the bedrock (m)
1000
Vs of the bedrock
clean
compute
highlight a frequency
draw/highlight
10
Hz
directivity over time
directivity in time
time step.
60
s
SI hvsr3bis_ven_4a_go_2017_2_0_012.saf (64Hz) - Average Spectra
NS
EW
UD
frequency (Hz)
SI hvsr3bis_ven_4a_go_2017_2_0_012.saf - HVSR (window length: 20s)
HVSR
frequency (Hz)
To model the HVSR (also jointly with MASW or ReMi/EGAC data), save the H/V curve, go to the "Velocity Spectrum/a, Modeling & Picking" panels and upload the saved H/V curve


HVSR: directivity
frequency (Hz)
10Hz
5Hz
2Hz
0.5Hz
HVSR
Azimuth (degree)
N
W
0.5Hz
2Hz
5Hz
10Hz
H/SR
EW
NS


HVSR vs Time (2D view)
frequency (Hz)
HVSR
time (min)


HVSR vs Time (3D view)
frequency (Hz)
time (min)

HVSR4

DATE 27.07.2017	HOUR 11:41	PLACE Via B. Tolomei
OPERATOR ProGeo Engineering srl	GPS TYPE and #	
GAUSS-BOAGA LATITUDE 4800388	GAUSS-BOAGA LONGITUDE 1686374	ALTITUDE 322 m slm
STATION TYPE GPA	SENSOR TYPE 4,5 Hz	
STATION #	SENSOR #	DISK #
FILE NAME HVSR4		POINT #
GAIN	SAMPL. FREQ. 100 Hz	REC. DURATION 30 min (minutes / seconds)

WEATHER CONDITIONS

WIND ☐ none ◉ weak (5m/s) ☐ medium ☐ strong Measurement (if any): _____

RAIN ◉ none ☐ weak ☐ medium ☐ strong Measurement (if any): _____

Temperature (approx): 28 Remarks _____

GROUND TYPE

◉ earth (☐ hard ◉ soft) ☐ gravel ☐ sand ☐ rock ☐ grass (☐ short ☐ tall)

☐ asphalt ☐ cement ☐ concrete ☐ paved ☐ other _____

◉ dry soil ☐ wet soil Remarks _____

ARTIFICIAL GROUND-SENSOR COUPLING ◉ no ☐ yes, type _____

BUILDING DENSITY ☐ none ☐ scattered ◉ dense ☐ other, type _____

TRANSIENTS

	none	few	moderate	many	very dense	distance
cars				◉		
trucks		◉				
pedestrians		◉				
other	◉					

MONOCHROMATIC NOISE SOURCES (factories, works, pumps, rivers,..)

◉ no ☐ yes, type _____

NEARBY STRUCTURES (description, height, distance) (trees, polls, buildings, bridges, underground structures,...)

Trees, Buildings

OBSERVATIONS

FREQUENCY: Hz (if computed in the field)

Qualità della misura:

Durata: rispettata
Stazionarietà: rispettata
Isotropia: rispettata
Assenza di disturbi: rispettata
Plausibilità fisica: rispettata
Robustezza statistica: rispettata

MISURA TIPO A2

HVSR4

Peak frequency (Hz): 20.0 (±6.3)
Peak HVSR value: 1.2 (±0.1)

=== Criteria for a reliable H/V curve ==========
#1. [f0 > 10/Lw]: 19.994 > 0.25 (OK)
#2. [nc > 200]: 68780 > 200 (OK)
#3. [f0>0.5Hz; sigmaA(f) < 2 for 0.5f0 < f < 2f0] (OK)

=== Criteria for a clear H/V peak (at least 5 should be fulfilled) ==========
#1. [exists f- in the range [f0/4, f0] | AH/V(f-) < A0/2]: yes, at frequency 9.5Hz (OK)
#2. [exists f+ in the range [f0, 4f0] | AH/V(f+) < A0/2]: (NO)
#3. [A0 > 2]: 1.2 < 2 (NO)
#4. [fpeak[Ah/v(f) ą sigmaA(f)] = f0 ą 5%]: (OK)
#5. [sigmaf < epsilon(f0)]: 6.331 > 1.000 (NO)
#6. [sigmaA(f0) < theta(f0)]: 0.094 < 1.58 (OK)

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show data | reset | show location | field notes

step#1 (optional) - decimate

64Hz | new frequency | resample

step#2 - H/V computation

remove events | both Rad. & Tr. | clean axes

40 window length (s) — Min. freq.: 0.125Hz

15 tapering (%)

15 outlier tolerance threshold

15% spectral smoothing (triangular window)

☐ show particle motion and all HVSRs

☑ full output | compute

step#3 - directivity analysis

frequencies to highlight: 0.5 2.0 5.0 10.0 Hz | compute

3D motion

☐ save video | show 3D motion

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save- option#1: save HVSR as it is

save H/V from 0.125 to 30 Hz

save HV curve (as it is)

save - option#2: picking H/V curve

pick HV curve | save picked HV

quick analysis (f=Vs/4H)

200 average Vs (m/s) (from surface to bedrock)

20 depth of the bedrock (m)

1000 Vs of the bedrock

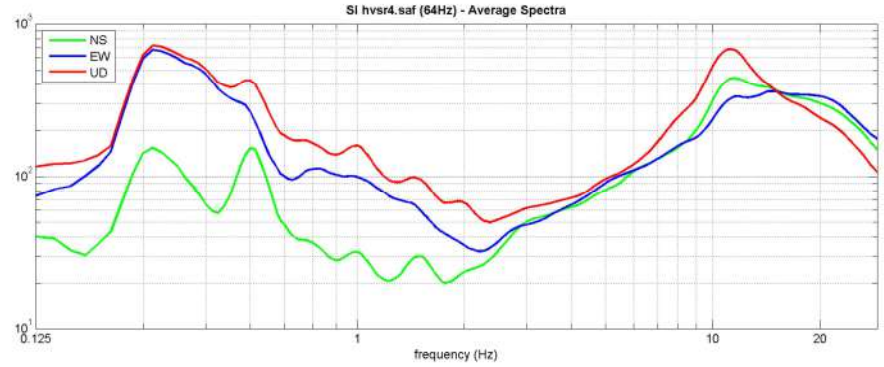
clean | compute

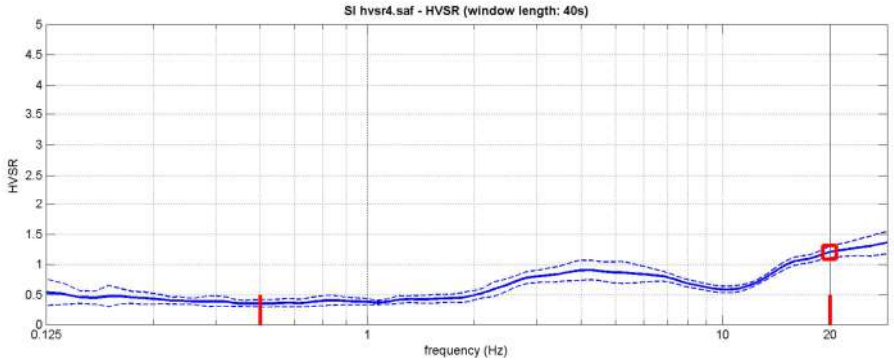
highlight a frequency

draw/highlight | 10 Hz

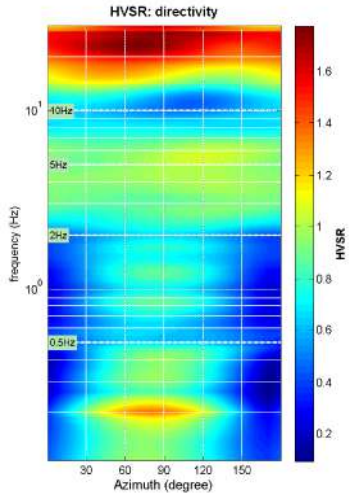
directivity over time

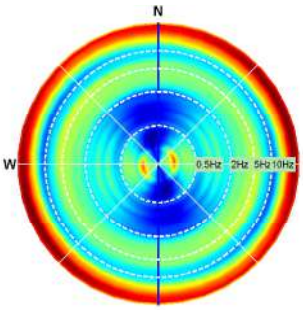
directivity in time | time step: 60 s

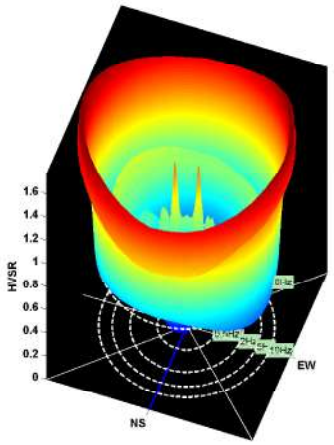


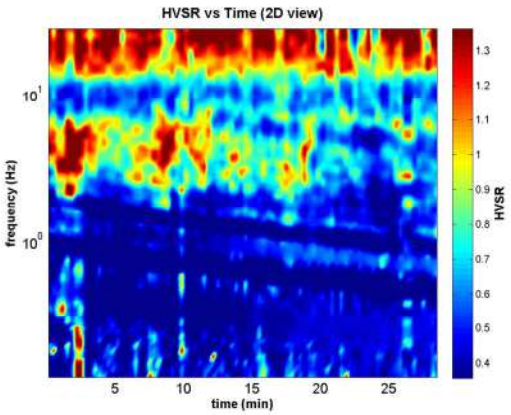


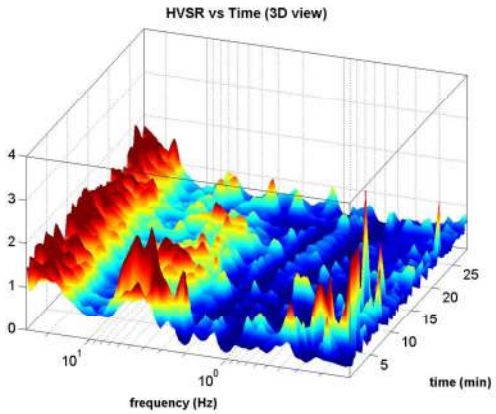
To model the HVSR (also jointly with MASW or ReMi/EGAC data), save the H/V curve, go to the "Velocity Spectrum/a, Modeling & Picking" panels and upload the saved H/V curve











HVSR5

DATE 08.08.2017	HOUR 10:20	PLACE Istituto F. Tozzi
OPERATOR ProGeo Engineering srl	GPS TYPE and #	
GAUSS-BOAGA LATITUDE 4800269	GAUSS-BOAGA LONGITUDE 1686718	ALTITUDE 318,5 m slm
STATION TYPE GPA	SENSOR TYPE 4,5 Hz	
STATION #	SENSOR #	DISK #
FILE NAME HVSR5		POINT #
GAIN	SAMPL. FREQ. 100 Hz	REC. DURATION 30 min (minutes / seconds)

WEATHER CONDITIONS
WIND ● none ☐ weak (5m/s) ☐ medium ☐ strong Measurement (if any): _____
RAIN ● none ☐ weak ☐ medium ☐ strong Measurement (if any): _____
Temperature (approx): 30 Remarks _____

GROUND TYPE
☐ earth (☐hard ☐soft) ☐ gravel ☐ sand ☐ rock ☐ grass (☐short ☐tall)
● asphalt ☐ cement ☐ concrete ☐ paved ☐ other _____
☐ dry soil ☐ wet soil Remarks _____

ARTIFICIAL GROUND-SENSOR COUPLING ● no ☐ yes, type _____

BUILDING DENSITY ☐ none ● scattered ☐ dense ☐ other, type _____

TRANSIENTS

	none	few	moderate	many	very dense	distance
cars	●					
trucks	●					
pedestrians	●					
other	●					

MONOCHROMATIC NOISE SOURCES (factories, works, pumps, rivers,..)
● no ☐ yes, type _____

NEARBY STRUCTURES (description, height, distance) (trees, polls, buildings, bridges, underground structures,...)
Trees

OBSERVATIONS

FREQUENCY: Hz (if computed in the field)

Qualità della misura:

Durata: rispettata
Stazionarietà: rispettata
Isotropia: rispettata
Assenza di disturbi: rispettata
Plausibilità fisica: rispettata
Robustezza statistica: rispettata

MISURA TIPO A2

HVSR5

Peak frequency (Hz): 1.4 (±5.0)
Peak HVSR value: 1.1 (±0.2)

=== Criteria for a reliable H/V curve ==========
#1. [f0 > 10/Lw]: 1.393 > 0.25 (OK)
#2. [nc > 200]: 7132 > 200 (OK)
#3. [f0>0.5Hz; sigmaA(f) < 2 for 0.5f0 < f < 2f0] (OK)

=== Criteria for a clear H/V peak (at least 5 should be fulfilled) ==========
#1. [exists f- in the range [f0/4, f0] | AH/V(f-) < A0/2]: (NO)
#2. [exists f+ in the range [f0, 4f0] | AH/V(f+) < A0/2]: (NO)
#3. [A0 > 2]: 1.1 < 2 (NO)
#4. [fpeak[Ah/v(f) ą sigmaA(f)] = f0 ą 5%]: (NO)
#5. [sigmaf < epsilon(f0)]: 5.013 > 0.139 (NO)
#6. [sigmaA(f0) < theta(f0)]: 0.175 < 1.78 (OK)

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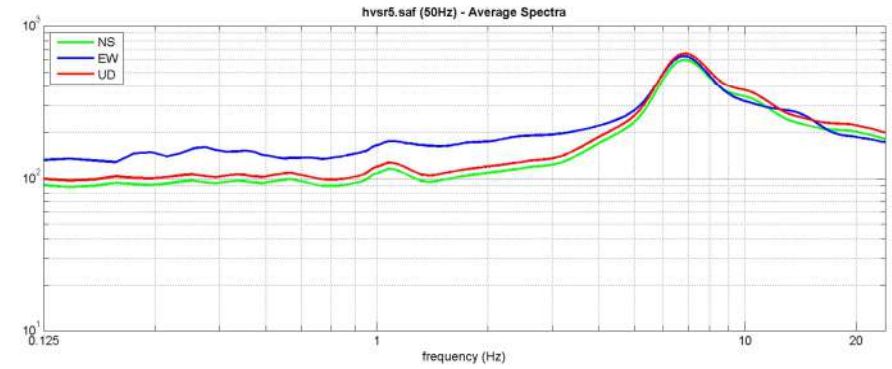
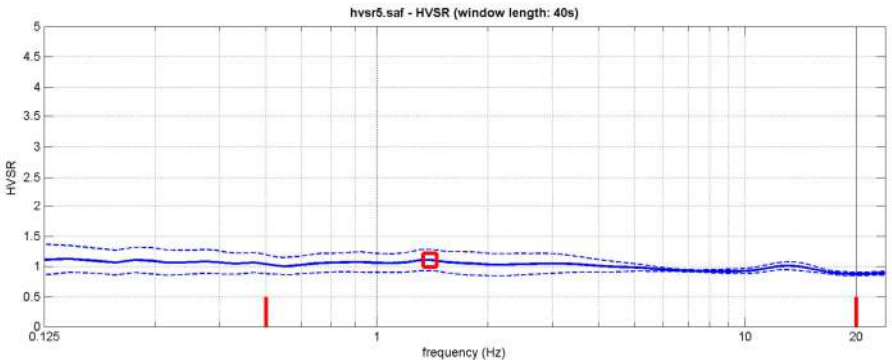
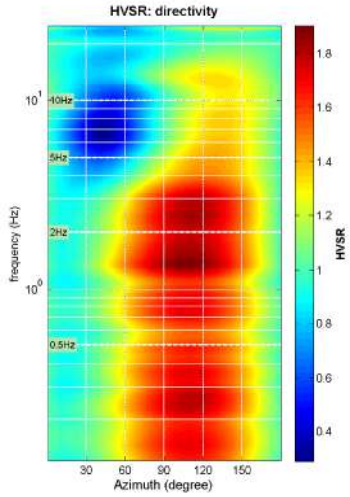
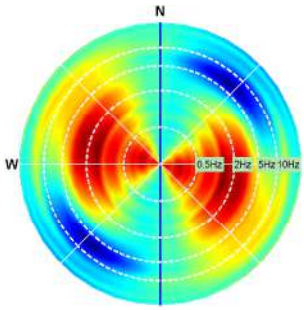
tel. 0575 324114 - fax. 0575 406473 - email: info@progeo.arezzo.it

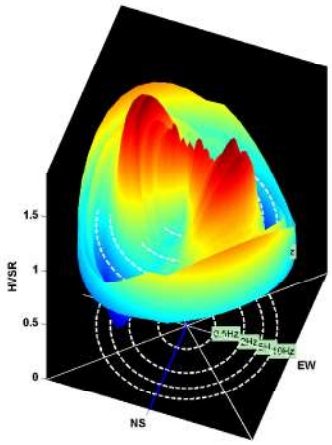


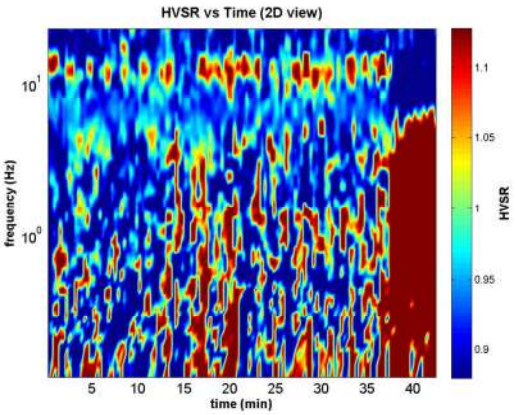


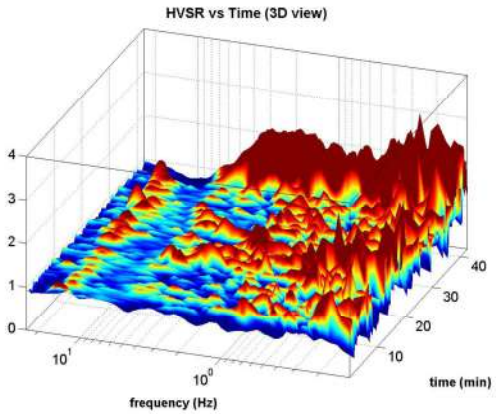
To model the HVSR (also jointly with MASW or ReMi/EGAC data), save the H/V curve, go to the "Velocity Spectrum/a, Modeling & Picking" panels and upload the saved H/V curve











HVSR6

DATE 14.07.2017	HOUR 9:08	PLACE Viale Sclavo
OPERATOR ProGeo Engineering srl	GPS TYPE and #	
GAUSS-BOAGA LATITUDE 4800584	GAUSS-BOAGA LONGITUDE 1687534	ALTITUDE 306 m slm
STATION TYPE PGA	SENSOR TYPE 4,5 Hz	
STATION #	SENSOR #	DISK #
FILE NAME HVSR6		POINT #
GAIN	SAMPL. FREQ. 100 Hz	REC. DURATION 30 min (minutes / seconds)

WEATHER CONDITIONS
WIND ☐ none ☑ weak (5m/s) ☐ medium ☐ strong Measurement (if any): _____
RAIN ☑ none ☐ weak ☐ medium ☐ strong Measurement (if any): _____
Temperature (approx): 26 Remarks _____

GROUND TYPE
☑ earth (☑ hard ☐ soft) ☐ gravel ☐ sand ☐ rock ☐ grass = (☐ short ☐ tall)
☐ asphalt ☐ cement ☐ concrete ☐ paved ☐ other _____
☑ dry soil ☐ wet soil Remarks _____

ARTIFICIAL GROUND-SENSOR COUPLING ☑ no ☐ yes, type _____

BUILDING DENSITY ☐ none ☑ scattered ☐ dense ☐ other, type _____

TRANSIENTS	none	few	moderate	many	very dense	distance
cars	●					
trucks	●					
pedestrians	●					
other	●					

MONOCHROMATIC NOISE SOURCES (factories, works, pumps, rivers,..)
☑ no ☐ yes, type _____

NEARBY STRUCTURES (description, height, distance) (trees, polls, buildings, bridges, underground structures,...)

OBSERVATIONS

FREQUENCY: Hz (if computed in the field)

Qualità della misura:

Durata: rispettata
Stazionarietà: rispettata
Isotropia: rispettata
Assenza di disturbi: rispettata
Plausibilità fisica: rispettata
Robustezza statistica: rispettata

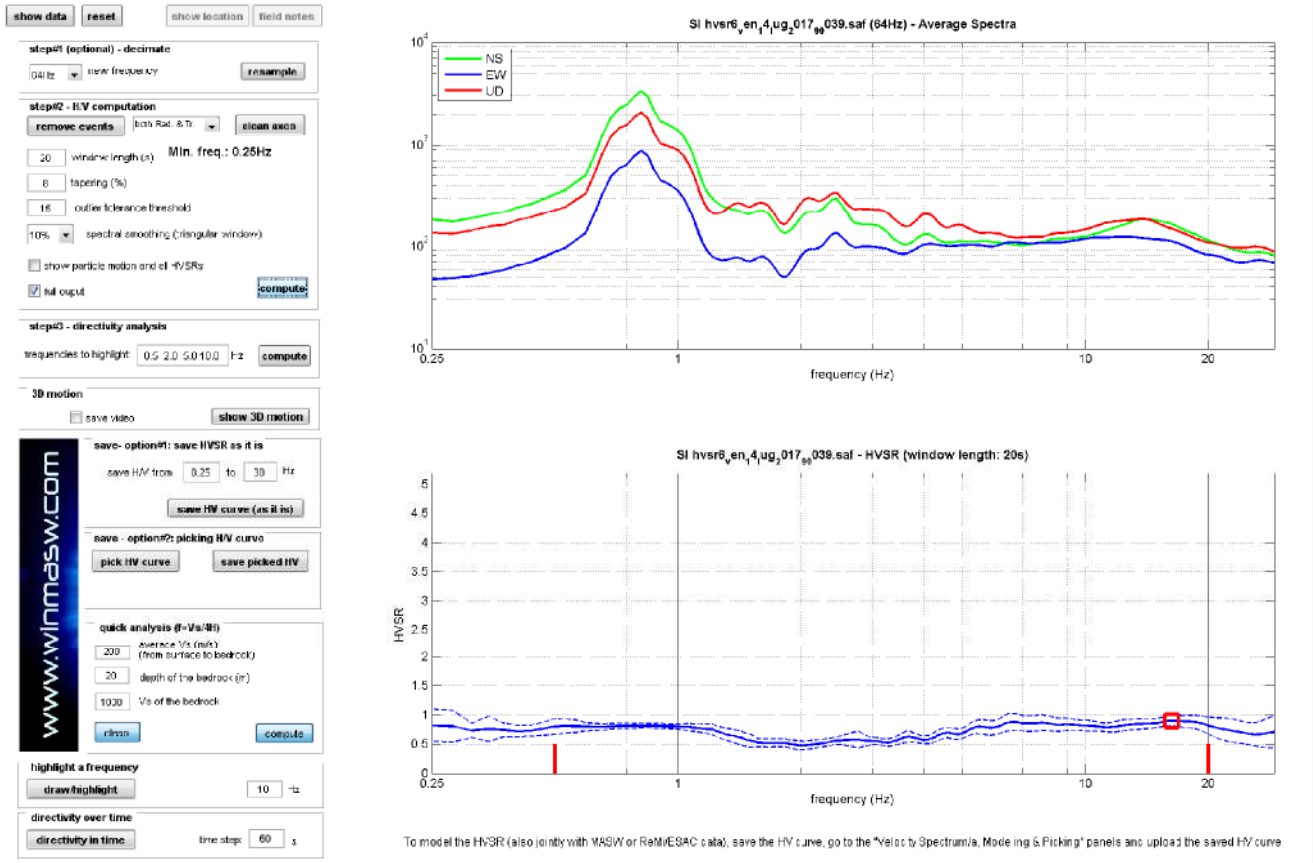
MISURA TIPO A2

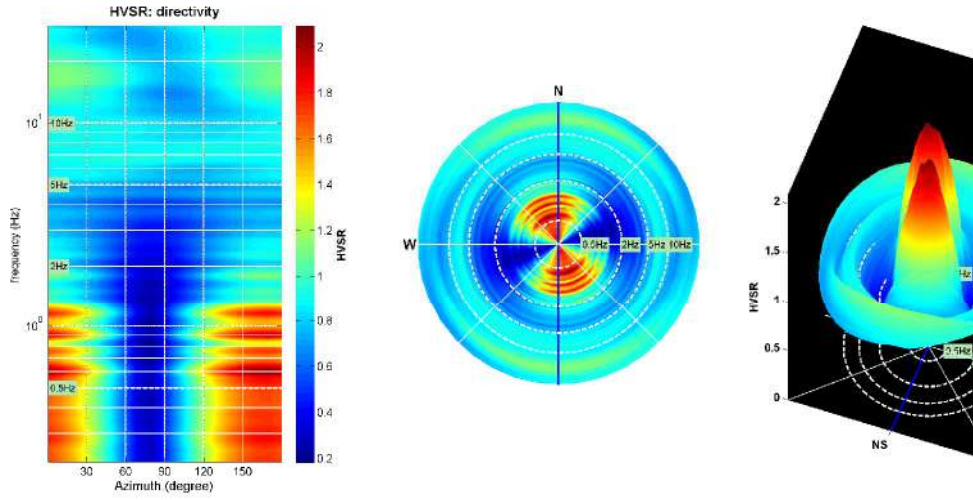
HVSR 6

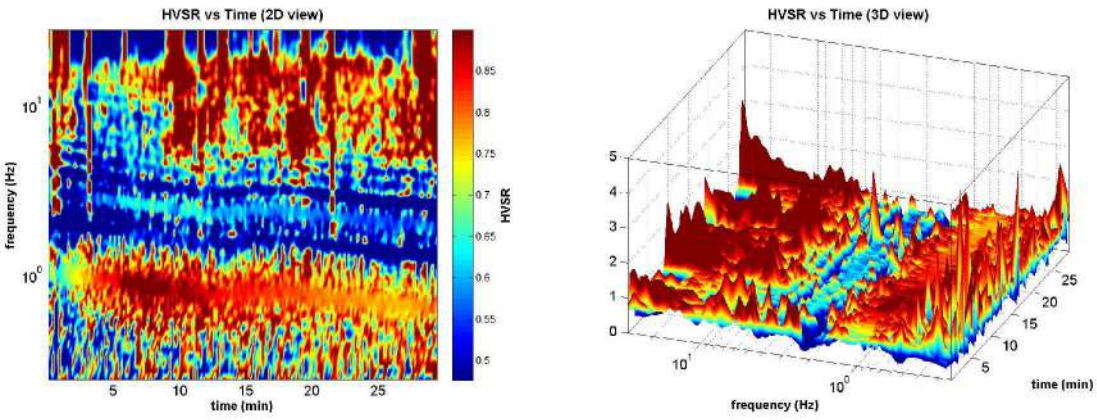
Peak frequency (Hz): 16.2 (±6.4)
Peak HVSR value: 0.9 (±0.1)

=== Criteria for a reliable H/V curve ==========
#1. [f0 > 10/Lw]: 16.235 > 0.5 (OK)
#2. [nc > 200]: 57470 > 200 (OK)
#3. [f0>0.5Hz; sigmaA(f) < 2 for 0.5f0 < f < 2f0] (OK)

=== Criteria for a clear H/V peak (at least 5 should be fulfilled) ==========
#1. [exists f- in the range [f0/4, f0] | AH/V(f-) < A0/2]: (NO)
#2. [exists f+ in the range [f0, 4f0] | AH/V(f+) < A0/2]: (NO)
#3. [A0 > 2]: 0.9 < 2 (NO)
#4. [fpeak[Ah/v(f) ą sigmaA(f)] = f0 ą 5%]: (NO)
#5. [sigmaf < epsilon(f0)]: 6.450 > 0.812 (NO)
#6. [sigmaA(f0) < theta(f0)]: 0.089 < 1.58 (OK)


show data
reset
show location
field notes
step#1 (optional) - decimate
04Hz
new frequency
resample
step#2 - H/V computation
remove events
both Rad. & Tr.
clean axes
20
window length (s)
Min. freq.: 0.25Hz
5
tapering (%)
15
outlier tolerance threshold
10%
spectral smoothing (triangular window)
show particle motion and all HVSRs
full output
compute
step#3 - directivity analysis
frequencies to highlight
0.5 2.0 5.0 10.0
Hz
compute
3D motion
save video
show 3D motion
www.winmasw.com
save- option#1: save HVSR as it is
save H/V from
0.25
to
20
Hz
save H/V curve (as it is)
save - option#2: picking H/V curve
pick H/V curve
save picked H/V
quick analysis (f=Vs/4H)
200
average Vs (m/s)
(from surface to bedrock)
20
depth of the bedrock (m)
1000
Vs of the bedrock
clean
compute
highlight a frequency
draw/highlight
10
Hz
directivity over time
directivity in time
time step:
60
s
S1 hvsr6_v_en_1_4_ug_2_017_99_039.saf (64Hz) - Average Spectra
NS
EW
UD
frequency (Hz)
S1 hvsr6_v_en_1_4_ug_2_017_99_039.saf - HVSR (window length: 20s)
HVSR
frequency (Hz)
To model the HVSR (also jointly with MASW or ReMi/ESAC data), save the HV curve, go to the "Velocity Spectrum/a, Modeling & Picking" panels and upload the saved HV curve


HVSR: directivity
frequency (Hz)
Azimuth (degree)
HVSR
N
W
EW
NS
0.5Hz
2Hz
5Hz
10Hz


HVSR vs Time (2D view)
frequency (Hz)
time (min)
HVSR
HVSR vs Time (3D view)
frequency (Hz)
time (min)

HVSR7

DATE 27.07.2017	HOUR 17:15	PLACE Via Emilia
OPERATOR ProGeo Engineering srl	GPS TYPE and #	
GAUSS-BOAGA LATITUDE 4801106	GAUSS-BOAGA LONGITUDE 1687610	ALTITUDE 391 m slm
STATION TYPE GPA	SENSOR TYPE 4,5 Hz	
STATION #	SENSOR #	DISK #
FILE NAME HVSR7		POINT #
GAIN	SAMPL. FREQ. 100 Hz	REC. DURATION 30 min (minutes / seconds)

WEATHER CONDITIONS

WIND ☐ none ● weak (5m/s) ☐ medium ☐ strong Measurement (if any): _____

RAIN ● none ☐ weak ☐ medium ☐ strong Measurement (if any): _____

Temperature (approx): 32 Remarks _____

GROUND TYPE

☐ earth (☐ hard ☐ soft) ● gravel ☐ sand ☐ rock ☐ grass (☐ short ☐ tall)

☐ asphalt ☐ cement ☐ concrete ☐ paved ☐ other _____

● dry soil ☐ wet soil Remarks _____

ARTIFICIAL GROUND-SENSOR COUPLING ● no ☐ yes, type _____

BUILDING DENSITY ☐ none ● scattered ☐ dense ☐ other, type _____

TRANSIENTS

	none	few	moderate	many	very dense	distance
cars		●				
trucks	●					
pedestrians	●					
other	●					

MONOCHROMATIC NOISE SOURCES (factories, works, pumps, rivers,..)

● no ☐ yes, type _____

NEARBY STRUCTURES (description, height, distance) (trees, polls, buildings, bridges, underground structures,...)

Trees

OBSERVATIONS

FREQUENCY: Hz (if computed in the field)

Qualità della misura:

Durata: rispettata
Stazionarietà: rispettata
Isotropia: rispettata
Assenza di disturbi: rispettata
Plausibilità fisica: rispettata
Robustezza statistica: rispettata

MISURA TIPO A2

HVSR7

Peak frequency (Hz): 1.0 (±4.4)
Peak HVSR value: 1.3 (±0.3)

=== Criteria for a reliable H/V curve ==========
#1. [f0 > 10/Lw]: 1.026 > 0.5 (OK)
#2. [nc > 200]: 3633 > 200 (OK)
#3. [f0>0.5Hz; sigmaA(f) < 2 for 0.5f0 < f < 2f0] (OK)

=== Criteria for a clear H/V peak (at least 5 should be fulfilled) ==========
#1. [exists f- in the range [f0/4, f0] | AH/V(f-) < A0/2]: yes (considering standard deviations), at frequency 0.5Hz (OK)
#2. [exists f+ in the range [f0, 4f0] | AH/V(f+) < A0/2]: yes, at frequency 1.8Hz (OK)
#3. [A0 > 2]: 1.3 < 2 (NO)
#4. [fpeak[Ah/v(f) ą sigmaA(f)] = f0 ą 5%]: (NO)
#5. [sigmaf < epsilon(f0)]: 4.370 > 0.103 (NO)
#6. [sigmaA(f0) < theta(f0)]: 0.286 < 1.78 (OK)

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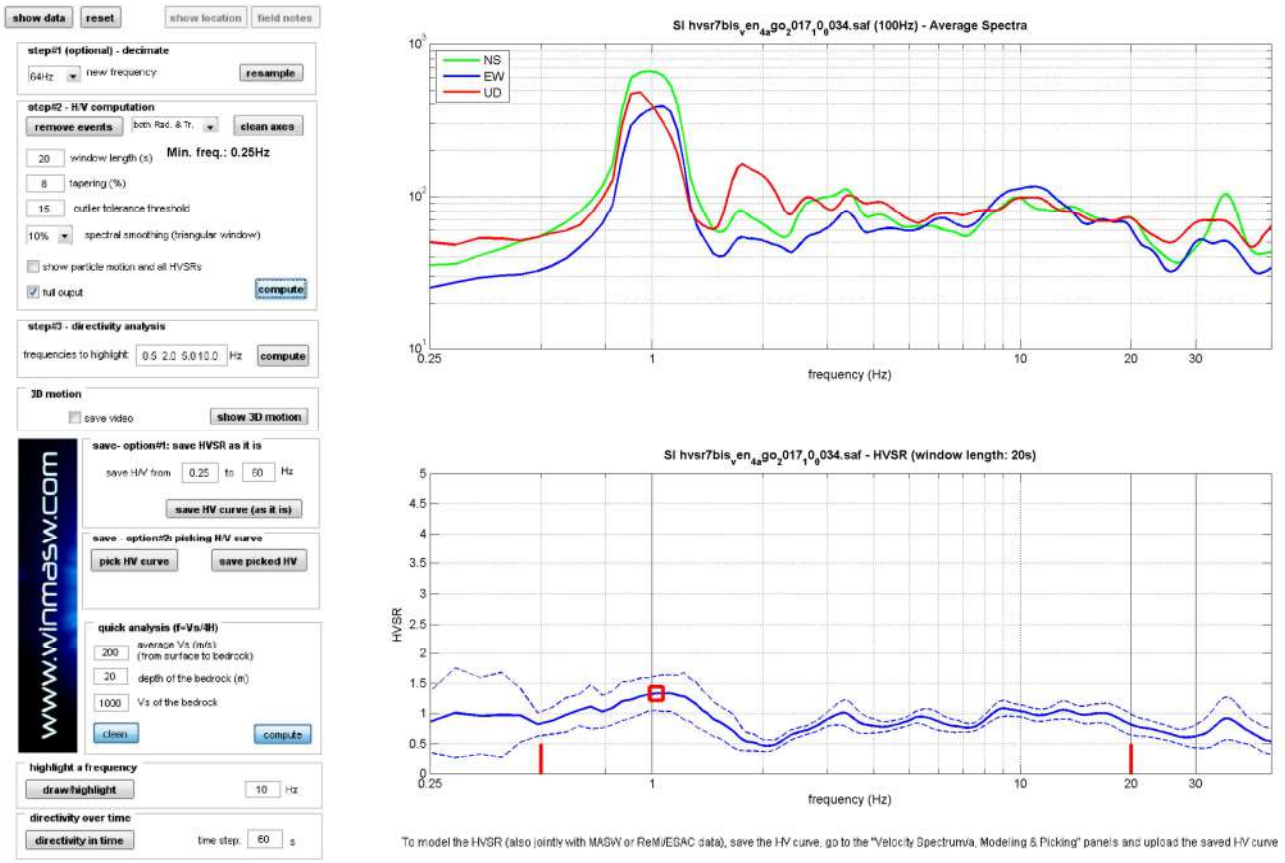
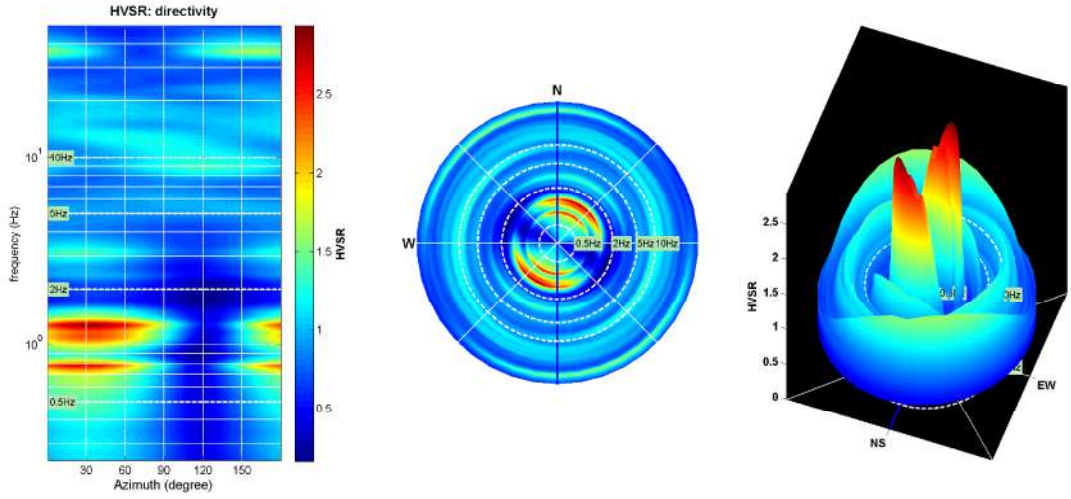
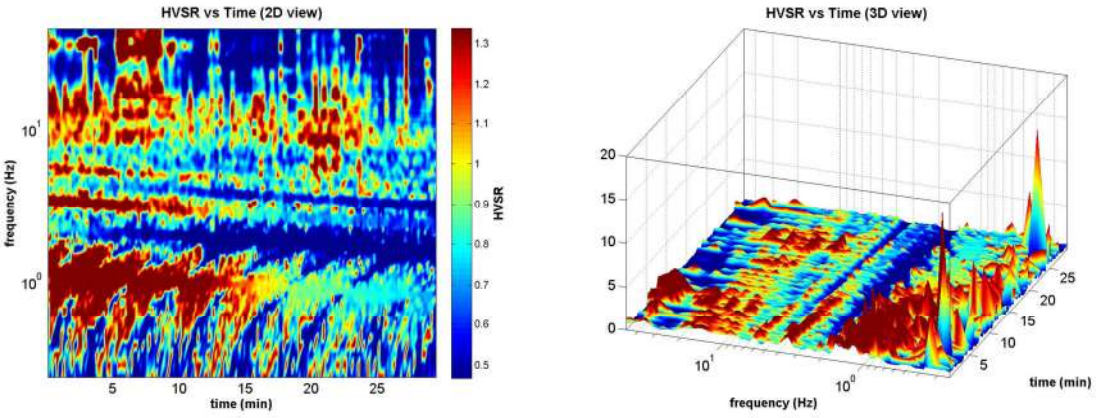

show data
reset
show location
field notes
step#1 (optional) - decimate
64Hz
new frequency
resample
step#2 - H/V computation
remove events
both Rad. & Tr.
clean axes
20
window length (s)
Min. freq.: 0.25Hz
8
tapering (%)
15
outlier tolerance threshold
10%
spectral smoothing (triangular window)
show particle motion and all HVSRs
full output
compute
step#3 - directivity analysis
frequencies to highlight
0.5 2.0 5.0 10.0
Hz
compute
3D motion
save video
show 3D motion
www.winmasw.com
save- option#1: save HVSR as it is
save H/V from
0.25
to
60
Hz
save HV curve (as it is)
save - option#2: picking H/V curve
pick HV curve
save picked HV
quick analysis (f=Vs/4H)
200
average Vs (m/s)
(from surface to bedrock)
20
depth of the bedrock (m)
1000
Vs of the bedrock
clean
compute
highlight a frequency
draw/highlight
10
Hz
directivity over time
directivity in time
time step:
60
s
SI hvsr7bis_ven_4a_go_2017_10_0034.saf (100Hz) - Average Spectra
NS
EW
UD
frequency (Hz)
SI hvsr7bis_ven_4a_go_2017_10_0034.saf - HVSR (window length: 20s)
HVSR
frequency (Hz)
To model the HVSR (also jointly with MASW or ReMi/ESAC data), save the H/V curve, go to the "Velocity Spectrum/a, Modeling & Picking" panels and upload the saved H/V curve


HVSR: directivity
frequency (Hz)
10Hz
5Hz
2Hz
0.5Hz
HVSR
Azimuth (degree)
N
W
0.5Hz
2Hz
5Hz
10Hz
H/SR
NS
EW


HVSR vs Time (2D view)
frequency (Hz)
HVSR
time (min)
HVSR vs Time (3D view)
frequency (Hz)
time (min)

HVSR8

DATE 27.07.2017	HOUR 16:38	PLACE Via Sicilia
OPERATOR ProGeo Engineering srl	GPS TYPE and #	
GAUSS-BOAGA LATITUDE 4801777	GAUSS-BOAGA LONGITUDE 1687371	ALTITUDE 388 m slm
STATION TYPE GPA	SENSOR TYPE 4,5 Hz	
STATION #	SENSOR #	DISK #
FILE NAME HVSR8		POINT #
GAIN	SAMPL. FREQ. 100 Hz	REC. DURATION 30 min (minutes / seconds)

WEATHER CONDITIONS

WIND ☐ none ☑ weak (5m/s) ☐ medium ☐ strong Measurement (if any): _____

RAIN ☑ none ☐ weak ☐ medium ☐ strong Measurement (if any): _____

Temperature (approx): 32 Remarks _____

GROUND TYPE

☐ earth (☐ hard ☐ soft) ☐ gravel ☐ sand ☐ rock ☑ grass (☐ short ☐ tall)

☐ asphalt ☐ cement ☐ concrete ☐ paved ☐ other _____

☑ dry soil ☐ wet soil Remarks _____

ARTIFICIAL GROUND-SENSOR COUPLING ☑ no ☐ yes, type _____

BUILDING DENSITY ☐ none ☑ scattered ☐ dense ☐ other, type _____

TRANSIENTS

	none	few	moderate	many	very dense	distance
cars		●				
trucks	●					
pedestrians	●					
other	●					

MONOCHROMATIC NOISE SOURCES (factories, works, pumps, rivers,..)

☑ no ☐ yes, type _____

NEARBY STRUCTURES (description, height, distance) (trees, polls, buildings, bridges, underground structures,...)

Trees

OBSERVATIONS

FREQUENCY: Hz (if computed in the field)

Qualità della misura:

Durata: rispettata
Stazionarietà: rispettata
Isotropia: rispettata
Assenza di disturbi: non rispettata
Plausibilità fisica: rispettata
Robustezza statistica: rispettata

MISURA TIPO B1

HVSR8

Peak frequency (Hz): 7.0 (±0.9)
Peak HVSR value: 7.1 (±0.7)

=== Criteria for a reliable H/V curve ==========
#1. [f0 > 10/Lw]: 6.976 > 0.5 (OK)
#2. [nc > 200]: 24554 > 200 (OK)
#3. [f0>0.5Hz; sigmaA(f) < 2 for 0.5f0 < f < 2f0] (OK)

=== Criteria for a clear H/V peak (at least 5 should be fulfilled) ==========
#1. [exists f- in the range [f0/4, f0] | AH/V(f-) < A0/2]: yes, at frequency 1.8Hz (OK)
#2. [exists f+ in the range [f0, 4f0] | AH/V(f+) < A0/2]: yes, at frequency 10.4Hz (OK)
#3. [A0 > 2]: 7.1 > 2 (OK)
#4. [fpeak[Ah/v(f) ± sigmaA(f)] = f0 ± 5%]: (OK)
#5. [sigmaf < epsilon(f0)]: 0.932 > 0.349 (NO)
#6. [sigmaA(f0) < theta(f0)]: 0.646 < 1.58 (OK)

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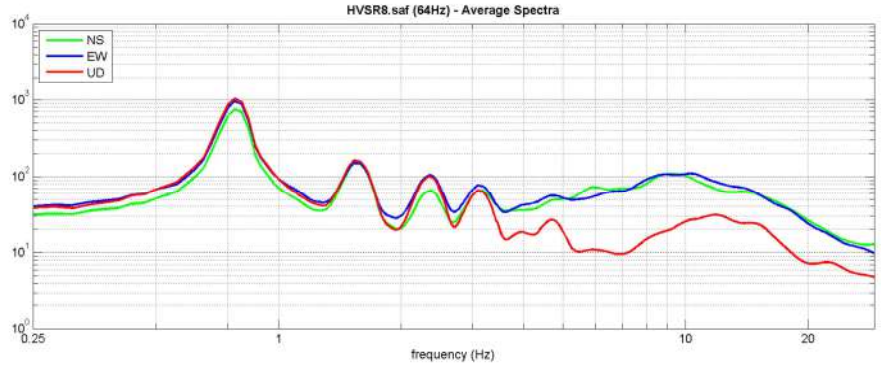
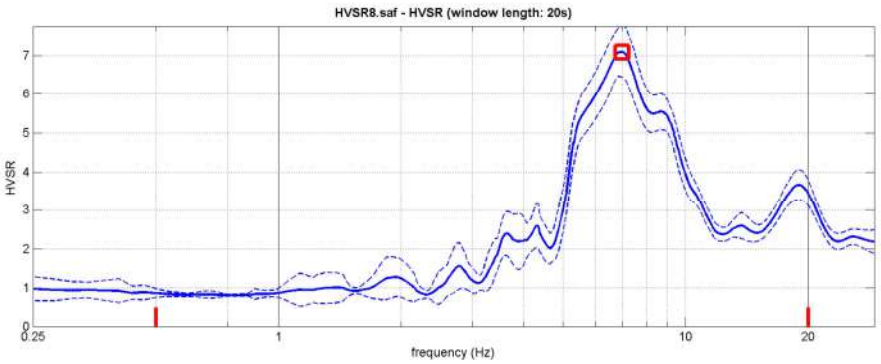
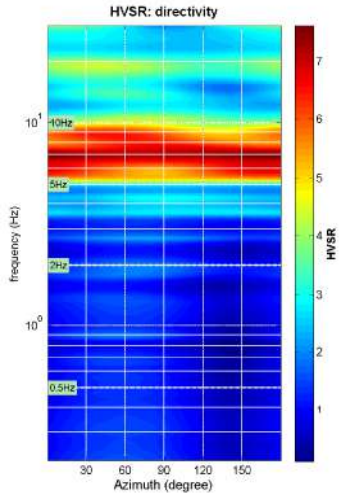
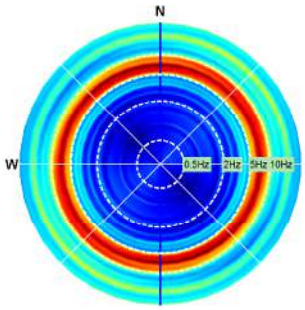
tel. 0575 324114 - fax. 0575 406473 - email: info@progeo.arezzo.it

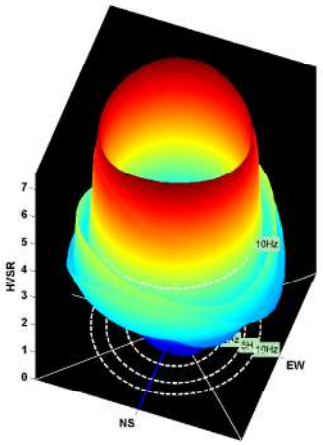


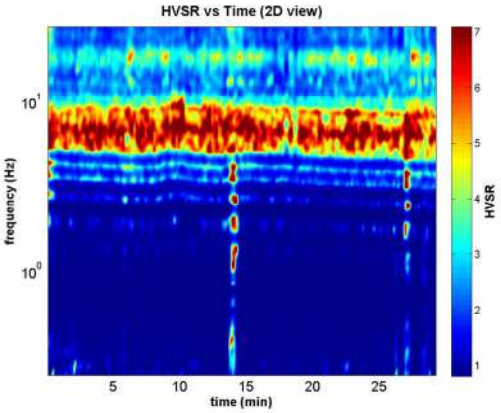


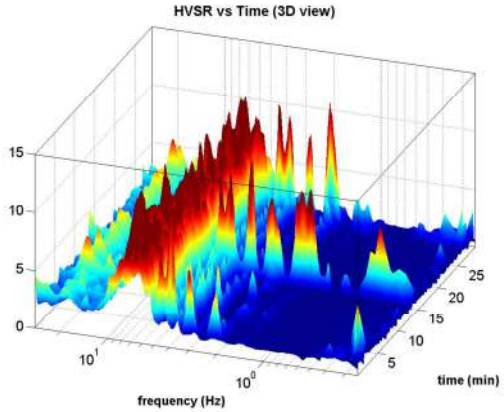
To model the HVSR (also jointly with MASW or ReMi/EGAC data), save the H/V curve, go to the "Velocity Spectrum/a, Modeling & Picking" panels and upload the saved H/V curve











HVSR9

DATE 11.08.2017	HOUR 17:55	PLACE Ficareto
OPERATOR ProGeo Engineering srl	GPS TYPE and #	
GAUSS-BOAGA LATITUDE 4802545	GAUSS-BOAGA LONGITUDE 1687965	ALTITUDE 341 m slm
STATION TYPE GPA	SENSOR TYPE 4,5 Hz	
STATION #	SENSOR #	DISK #
FILE NAME HVSR9		POINT #
GAIN	SAMPL. FREQ. 50 Hz	REC. DURATION 30 min (minutes / seconds)

WEATHER CONDITIONS: WIND ☐ none ☐ weak (5m/s) ☒ medium ☐ strong Measurement (if any): ____ ; RAIN ☒ none ☐ weak ☐ medium ☐ strong Measurement (if any): ____ ; Temperature (approx): 25 ; Remarks ____

GROUND TYPE: ☐ earth (☐ hard ☐ soft) ☐ gravel ☐ sand ☐ rock ☐ grass (☐ short ☐ tall) ; ☒ asphalt ☐ cement ☐ concrete ☐ paved ☐ other ____ ; ☐ dry soil ☐ wet soil Remarks ____

ARTIFICIAL GROUND-SENSOR COUPLING ☒ no ☐ yes, type ____

BUILDING DENSITY ☐ none ☒ scattered ☐ dense ☐ other, type ____

TRANSIENTS	none	few	moderate	many	very dense	distance
cars		●				
trucks	●					
pedestrians	●					
other ____	●					

MONOCHROMATIC NOISE SOURCES (factories, works, pumps, rivers,..) ☒ no ☐ yes, type ____

NEARBY STRUCTURES (description, height, distance) (trees, polls, buildings, bridges, underground structures,...)

Trees

OBSERVATIONS

FREQUENCY: Hz (if computed in the field)

Qualità della misura:

Durata: rispettata
Stazionarietà: rispettata
Isotropia: rispettata
Assenza di disturbi: non rispettata
Plausibilità fisica: rispettata
Robustezza statistica: rispettata

MISURA TIPO B2

HVSR9

Peak frequency (Hz): 5.0 (±3.9)
Peak HVSR value: 0.7 (±0.1)

=== Criteria for a reliable H/V curve ==========
#1. [f0 > 10/Lw]: 4.990 > 0.5 (OK)
#2. [nc > 200]: 17067 > 200 (OK)
#3. [f0>0.5Hz; sigmaA(f) < 2 for 0.5f0 < f < 2f0] (OK)

=== Criteria for a clear H/V peak (at least 5 should be fulfilled) ==========
#1. [exists f- in the range [f0/4, f0] | AH/V(f-) < A0/2]: yes, at frequency 1.3Hz (OK)
#2. [exists f+ in the range [f0, 4f0] | AH/V(f+) < A0/2]: yes, at frequency 18.0Hz (OK)
#3. [A0 > 2]: 0.7 < 2 (NO)
#4. [fpeak[Ah/v(f) ą sigmaA(f)] = f0 ą 5%]: (NO)
#5. [sigmaf < epsilon(f0)]: 3.931 > 0.250 (NO)
#6. [sigmaA(f0) < theta(f0)]: 0.078 < 1.58 (OK)

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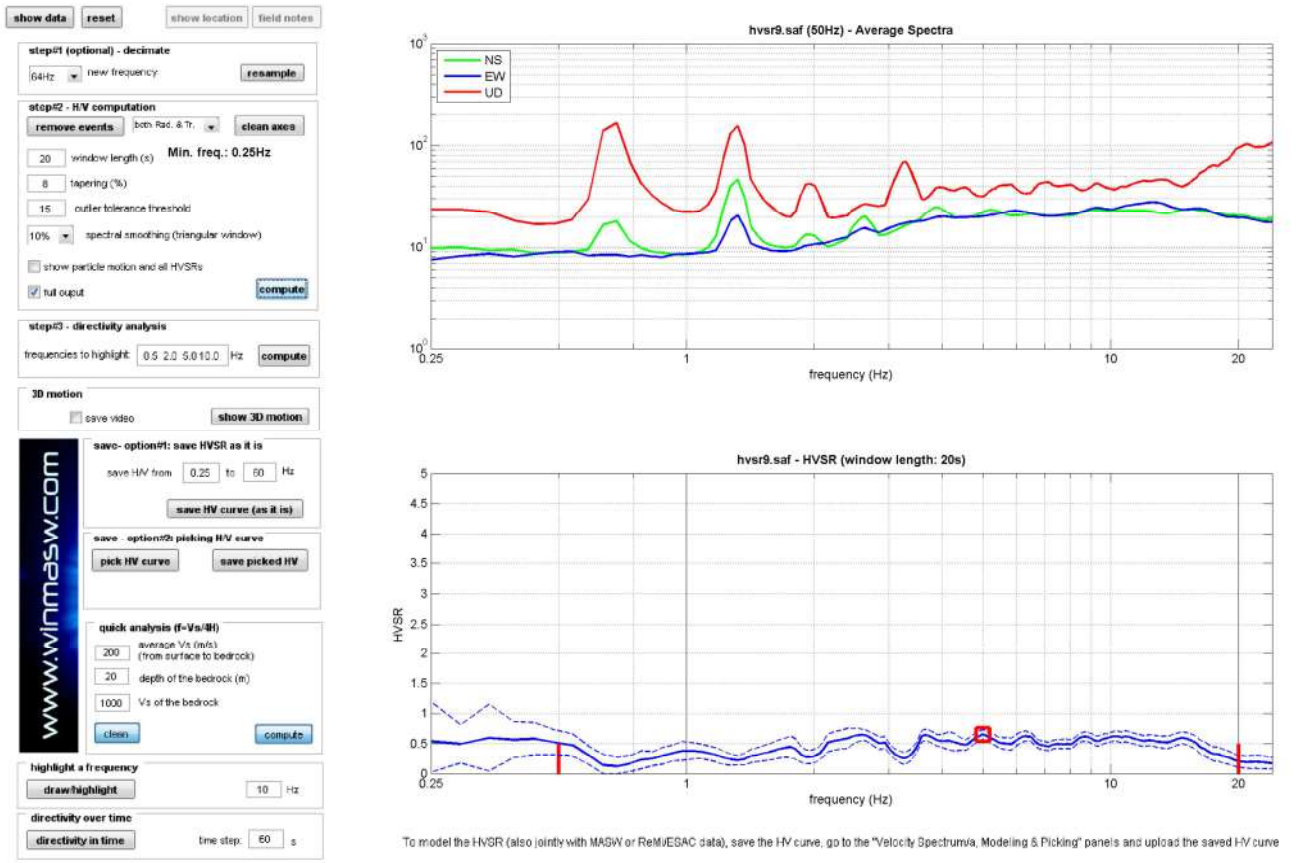
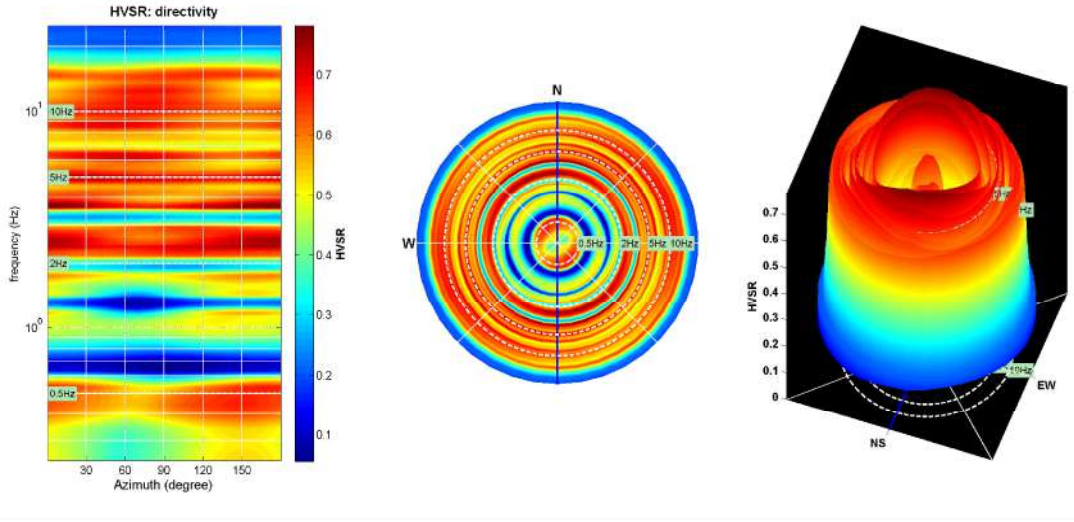
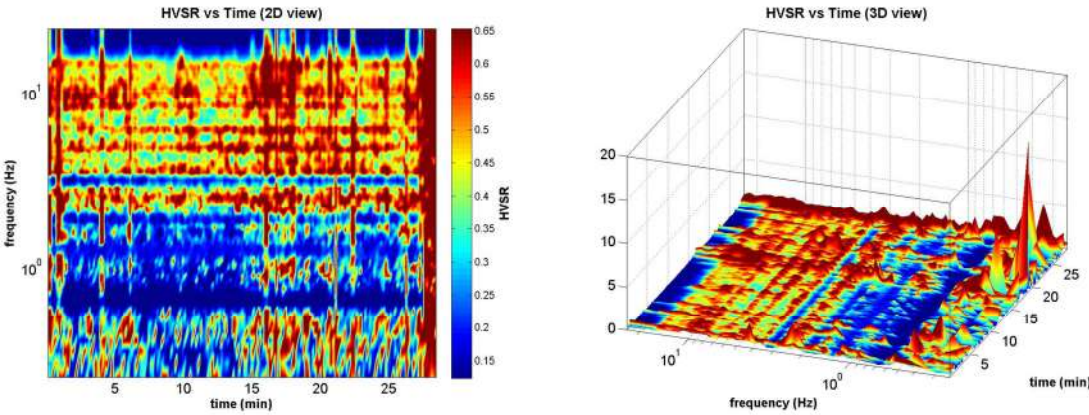

show data
reset
show location
field notes
step#1 (optional) - decimate
64Hz
new frequency
resample
step#2 - H/V computation
remove events
both Rad. & Tr.
clean axes
20
window length (s)
Min. freq.: 0.25Hz
8
tapering (%)
15
outlier tolerance threshold
10%
spectral smoothing (triangular window)
show particle motion and all HVSRs
full output
compute
step#3 - directivity analysis
frequencies to highlight
0.5 2.0 5.0 10.0
Hz
compute
3D motion
save video
show 3D motion
www.winmasw.com
save- option#1: save HVSR as it is
save H/V from
0.25
to
60
Hz
save HV curve (as it is)
save - option#2: picking H/V curve
pick HV curve
save picked HV
quick analysis (f=Vs/4H)
200
average Vs (m/s)
(from surface to bedrock)
20
depth of the bedrock (m)
1000
Vs of the bedrock
clean
compute
highlight a frequency
draw/highlight
10
Hz
directivity over time
directivity in time
time step.
60
s
hvsr9.saf (50Hz) - Average Spectra
NS
EW
UD
frequency (Hz)
hvsr9.saf - HVSR (window length: 20s)
HVSR
frequency (Hz)
To model the HVSR (also jointly with MASW or ReMi/EGAC data), save the H/V curve, go to the "Velocity Spectrum/a, Modeling & Picking" panels and upload the saved H/V curve


HVSR: directivity
10Hz
5Hz
2Hz
0.5Hz
frequency (Hz)
HVSR
Azimuth (degree)
N
W
0.5Hz
2Hz
5Hz
10Hz
H/SR
NS
EW


HVSR vs Time (2D view)
frequency (Hz)
HVSR
time (min)
HVSR vs Time (3D view)
frequency (Hz)
time (min)

HVSR10

DATE 11.08.2017	HOUR 16:15	PLACE San Miniato
OPERATOR ProGeo Engineering srl	GPS TYPE and #	
GAUSS-BOAGA LATITUDE 4802343	GAUSS-BOAGA LONGITUDE 1688542	ALTITUDE 304,5 m slm
STATION TYPE GPA	SENSOR TYPE 4,5 Hz	
STATION #	SENSOR #	DISK #
FILE NAME HVSR10		POINT #
GAIN	SAMPL. FREQ. 50 Hz	REC. DURATION 30 min (minutes / seconds)

WEATHER CONDITIONS: WIND ☐ none ☐ weak (5m/s) ☐ medium ● strong Measurement (if any): ____
RAIN ● none ☐ weak ☐ medium ☐ strong Measurement (if any): ____
Temperature (approx): 36 Remarks ____

GROUND TYPE: ● earth (● hard ☐ soft) ☐ gravel ☐ sand ☐ rock ☐ grass = (☐ short ☐ tall)
☐ asphalt ☐ cement ☐ concrete ☐ paved ☐ other ____
● dry soil ☐ wet soil Remarks ____

ARTIFICIAL GROUND-SENSOR COUPLING ● no ☐ yes, type ____

BUILDING DENSITY ☐ none ● scattered ☐ dense ☐ other, type ____

TRANSIENTS	none	few	moderate	many	very dense	distance
cars			●			
trucks	●					
pedestrians		●				
other	●					

MONOCHROMATIC NOISE SOURCES (factories, works, pumps, rivers,..)
● no ☐ yes, type ____

NEARBY STRUCTURES (description, height, distance) (trees, polls, buildings, bridges, underground structures,...)
Buildings, Trees

OBSERVATIONS

FREQUENCY: Hz (if computed in the field)

Qualità della misura:

Durata: rispettata
Stazionarietà: rispettata
Isotropia: rispettata
Assenza di disturbi: rispettata
Plausibilità fisica: rispettata
Robustezza statistica: rispettata

MISURA TIPO A2

HVSR10

Peak frequency (Hz): 1.4 (±3.4)
Peak HVSR value: 1.2 (±0.2)

=== Criteria for a reliable H/V curve ==========
#1. [f0 > 10/Lw]: 1.370 > 0.5 (OK)
#2. [nc > 200]: 7096 > 200 (OK)
#3. [f0>0.5Hz; sigmaA(f) < 2 for 0.5f0 < f < 2f0] (OK)

=== Criteria for a clear H/V peak (at least 5 should be fulfilled) ==========
#1. [exists f- in the range [f0/4, f0] | AH/V(f-) < A0/2]: (NO)
#2. [exists f+ in the range [f0, 4f0] | AH/V(f+) < A0/2]: (NO)
#3. [A0 > 2]: 1.2 < 2 (NO)
#4. [fpeak[Ah/v(f) ą sigmaA(f)] = f0 ą 5%]: (OK)
#5. [sigmaf < epsilon(f0)]: 3.402 > 0.137 (NO)
#6. [sigmaA(f0) < theta(f0)]: 0.219 < 1.78 (OK)

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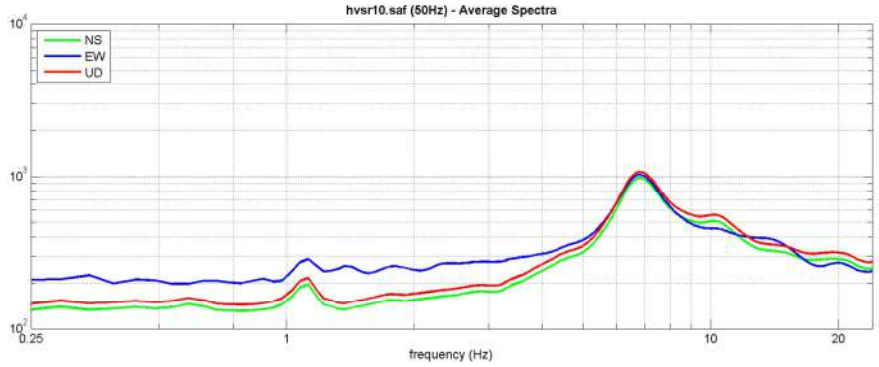
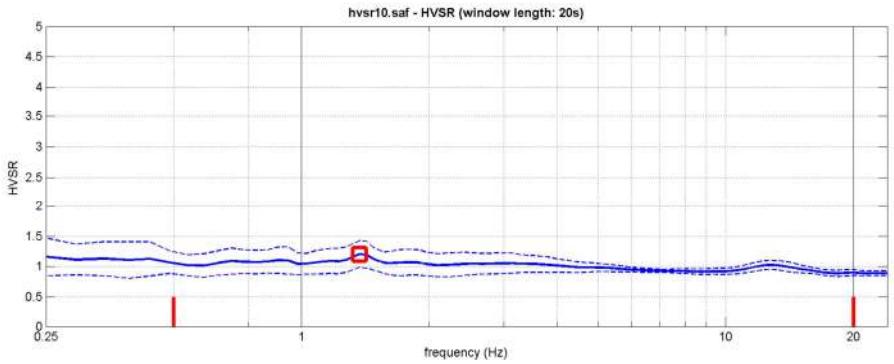
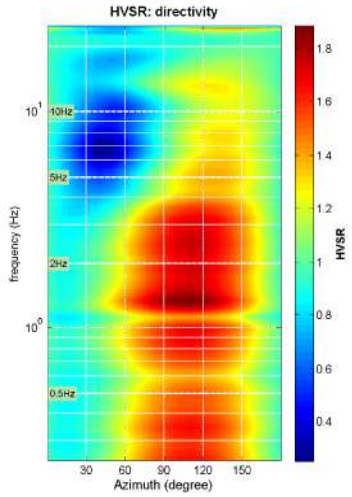
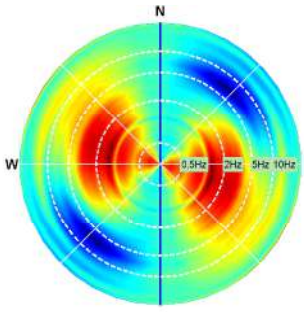
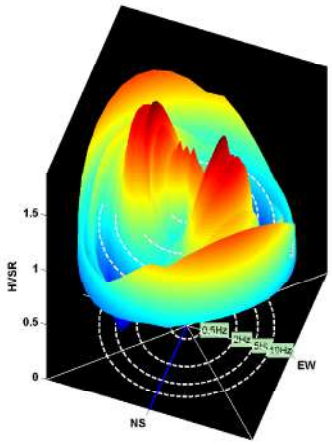


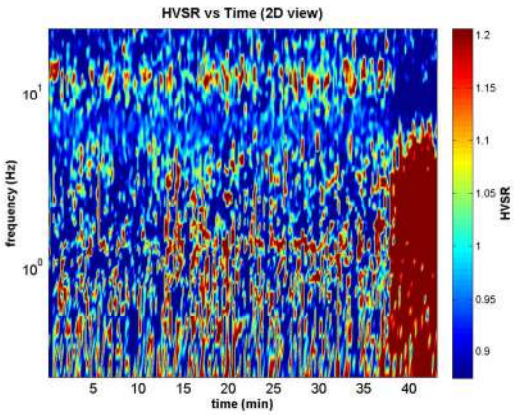


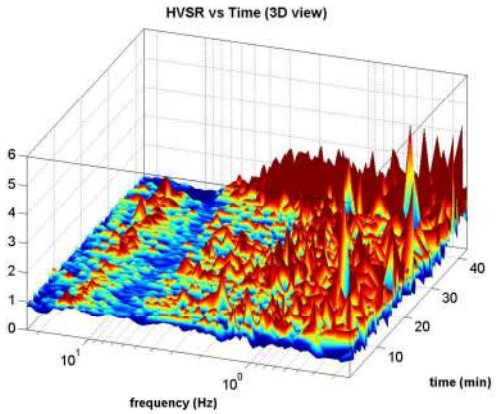
To model the HVSR (also jointly with MASW or ReMi/EGAC data), save the H/V curve, go to the "Velocity Spectrum/a, Modeling & Picking" panels and upload the saved H/V curve











HVSR11

DATE 27.07.2017	HOUR 14:12	PLACE Via di Colledoro
OPERATOR ProGeo Engineering srl	GPS TYPE and #	
GAUSS-BOAGA LATITUDE 4801067	GAUSS-BOAGA LONGITUDE 1689513	ALTITUDE 330 m slm
STATION TYPE GPA	SENSOR TYPE 4,5 Hz	
STATION #	SENSOR #	DISK #
FILE NAME HVSR11		POINT #
GAIN	SAMPL. FREQ. 100 Hz	REC. DURATION 30 min (minutes / seconds)

WEATHER CONDITIONS: WIND ☐ none ◉ weak (5m/s) ☐ medium ☐ strong Measurement (if any): ____ ; RAIN ◉ none ☐ weak ☐ medium ☐ strong Measurement (if any): ____ ; Temperature (approx): 32 Remarks ____

GROUND TYPE: ◉ earth (◉ hard ☐ soft) ☐ gravel ☐ sand ☐ rock ☐ grass = (☐ short ☐ tall) ; ☐ asphalt ☐ cement ☐ concrete ☐ paved ☐ other ____ ; ◉ dry soil ☐ wet soil Remarks ____

ARTIFICIAL GROUND-SENSOR COUPLING ◉ no ☐ yes, type ____

BUILDING DENSITY ☐ none ◉ scattered ☐ dense ☐ other, type ____

TRANSIENTS	none	few	moderate	many	very dense	distance
cars	◉					
trucks	◉					
pedestrians	◉					
other ____	◉					

MONOCHROMATIC NOISE SOURCES (factories, works, pumps, rivers,..) ◉ no ☐ yes, type ____

NEARBY STRUCTURES (description, height, distance) (trees, polls, buildings, bridges, underground structures,...)

OBSERVATIONS

FREQUENCY: Hz (if computed in the field)

Qualità della misura:

Durata: rispettata
Stazionarietà: rispettata
Isotropia: rispettata
Assenza di disturbi: non rispettata
Plausibilità fisica: rispettata
Robustezza statistica: rispettata

MISURA TIPO B2

HVSR11

Peak frequency (Hz): 1.4 (±2.3)
Peak HVSR value: 0.8 (±0.0)

=== Criteria for a reliable H/V curve ==========
#1. [f0 > 10/Lw]: 1.439 > 0.5 (OK)
#2. [nc > 200]: 5065 > 200 (OK)
#3. [f0>0.5Hz; sigmaA(f) < 2 for 0.5f0 < f < 2f0] (OK)

=== Criteria for a clear H/V peak (at least 5 should be fulfilled) ==========
#1. [exists f- in the range [f0/4, f0] | AH/V(f-) < A0/2]: (NO)
#2. [exists f+ in the range [f0, 4f0] | AH/V(f+) < A0/2]: (NO)
#3. [A0 > 2]: 0.8 < 2 (NO)
#4. [fpeak[Ah/v(f) ą sigmaA(f)] = f0 ą 5%]: (NO)
#5. [sigmaf < epsilon(f0)]: 2.297 > 0.144 (NO)
#6. [sigmaA(f0) < theta(f0)]: 0.046 < 1.78 (OK)

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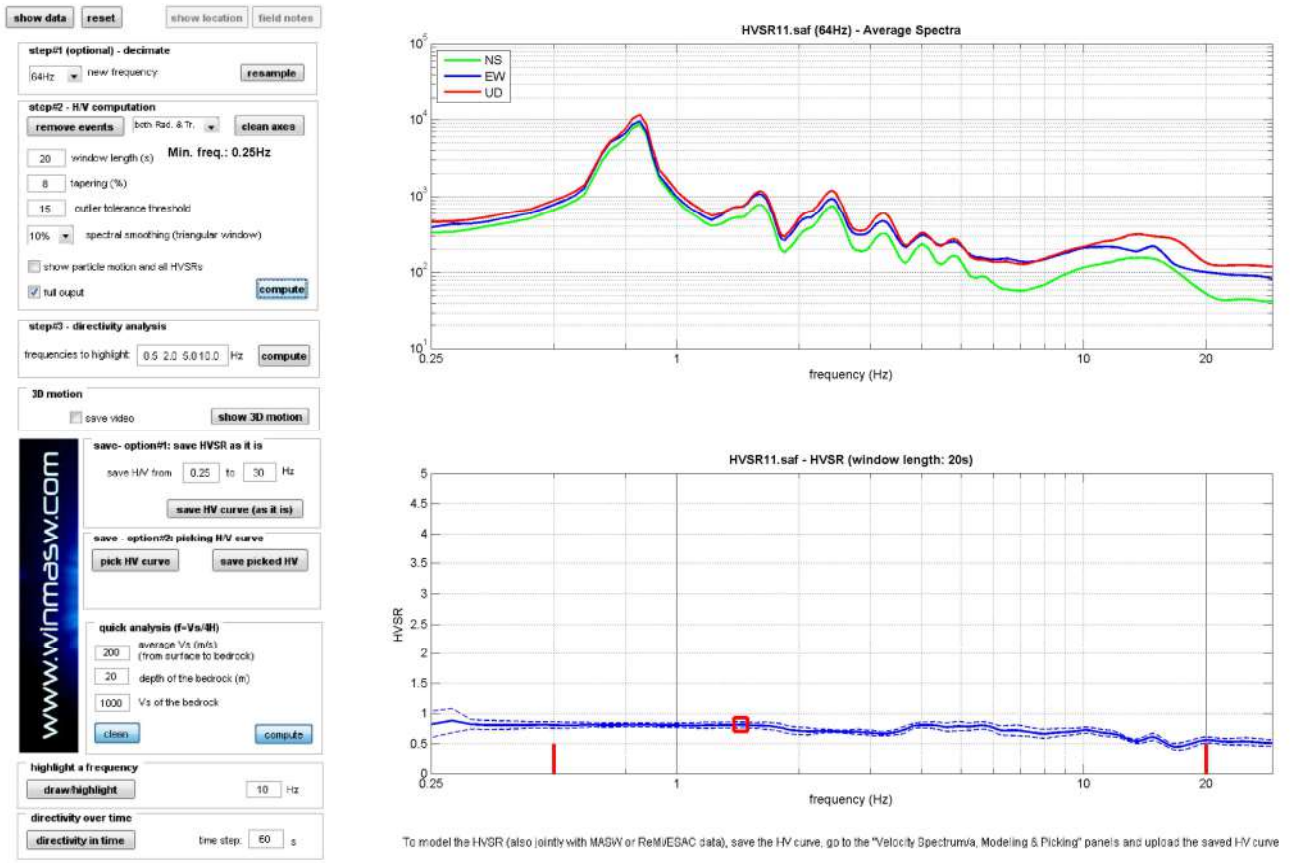
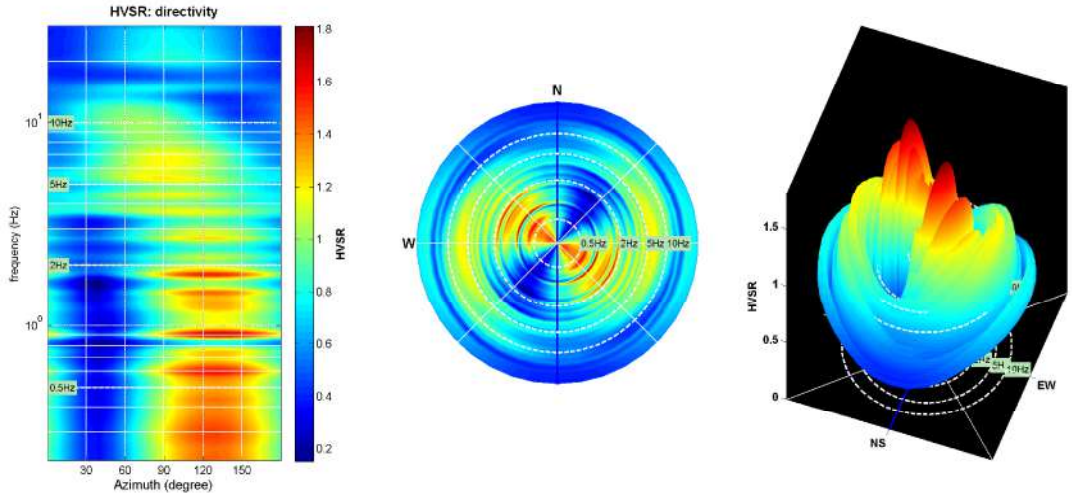
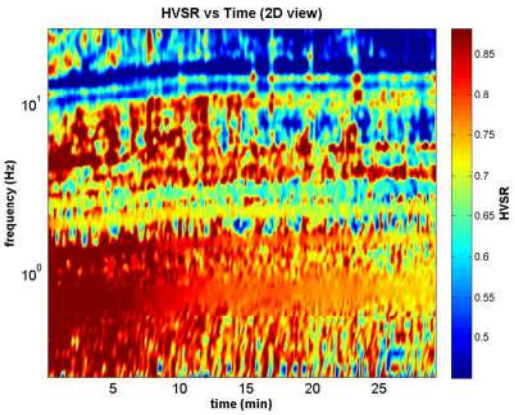
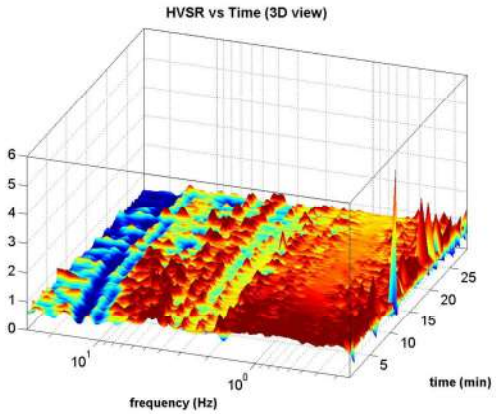

show data
reset
show location
field notes
step#1 (optional) - decimate
64Hz
new frequency
resample
step#2 - H/V computation
remove events
both Rad. & Tr.
clean axes
20
window length (s)
Min. freq.: 0.25Hz
8
tapering (%)
15
outlier tolerance threshold
10%
spectral smoothing (triangular window)
show particle motion and all HVSRs
full output
compute
step#3 - directivity analysis
frequencies to highlight
0.5 2.0 5.0 10.0
Hz
compute
3D motion
save video
show 3D motion
www.winmasw.com
save- option#1: save HVSR as it is
save H/V from
0.25
to
30
Hz
save HV curve (as it is)
save - option#2: picking H/V curve
pick HV curve
save picked HV
quick analysis (f=Vs/4H)
200
average Vs (m/s)
(from surface to bedrock)
20
depth of the bedrock (m)
1000
Vs of the bedrock
clean
compute
highlight a frequency
draw/highlight
10
Hz
directivity over time
directivity in time
time step.
60
s
HVSR11.saf (64Hz) - Average Spectra
NS
EW
UD
frequency (Hz)
HVSR11.saf - HVSR (window length: 20s)
HVSR
frequency (Hz)
To model the HVSR (also jointly with MASW or ReMi/EGAC data), save the H/V curve, go to the "Velocity Spectrum/a, Modeling & Picking" panels and upload the saved H/V curve


HVSR: directivity
10Hz
5Hz
2Hz
0.5Hz
frequency (Hz)
Azimuth (degree)
HVSR
N
W
0.5Hz
2Hz
5Hz
10Hz
H/SR
NS
EW


HVSR vs Time (2D view)
frequency (Hz)
time (min)
HVSR


HVSR vs Time (3D view)
frequency (Hz)
time (min)

HVSR12

DATE 08.08.2017	HOUR 17:17	PLACE Centro Spostivo S. Miniato
OPERATOR ProGeo Engineering srl	GPS TYPE and #	
GAUSS-BOAGA LATITUDE 4801949	GAUSS-BOAGA LONGITUDE 1688695	ALTITUDE 299,5 m slm
STATION TYPE GPA	SENSOR TYPE 4,5 Hz	
STATION #	SENSOR #	DISK #
FILE NAME HVSR12		POINT #
GAIN	SAMPL. FREQ. 100 Hz	REC. DURATION 30 min (minutes / seconds)

WEATHER CONDITIONS: WIND [ ] none [x] weak (5m/s) [ ] medium [ ] strong Measurement (if any): ____ ; RAIN [x] none [ ] weak [ ] medium [ ] strong Measurement (if any): ____ ; Temperature (approx): 36 ; Remarks ____

GROUND TYPE: [x] earth ([x] hard [ ] soft) [ ] gravel [ ] sand [ ] rock [ ] grass = ([ ] short [ ] tall) ; [ ] asphalt [ ] cement [ ] concrete [ ] paved [ ] other ____ ; [x] dry soil [ ] wet soil Remarks ____

ARTIFICIAL GROUND-SENSOR COUPLING [x] no [ ] yes, type ____

BUILDING DENSITY [ ] none [ ] scattered [x] dense [ ] other, type ____

TRANSIENTS

	none	few	moderate	many	very dense	distance
cars		x				
trucks	x					
pedestrians		x				
other	x					

MONOCHROMATIC NOISE SOURCES (factories, works, pumps, rivers,..) [x] no [ ] yes, type ____

NEARBY STRUCTURES (description, height, distance) (trees, polls, buildings, bridges, underground structures,...)

Buildings

OBSERVATIONS

FREQUENCY: Hz (if computed in the field)

Qualità della misura:

Durata: rispettata
Stazionarietà: rispettata
Isotropia: rispettata
Assenza di disturbi:non rispettata
Plausibilità fisica: rispettata
Robustezza statistica: rispettata

MISURA TIPO B2

HVSR12

Peak frequency (Hz): 7.4 (±3.3)
Peak HVSR value: 1.0 (±0.3)

=== Criteria for a reliable H/V curve ==========
#1. [f0 > 10/Lw]: 7.351 > 0.5 (OK)
#2. [nc > 200]: 25728 > 200 (OK)
#3. [f0>0.5Hz; sigmaA(f) < 2 for 0.5f0 < f < 2f0] (OK)

=== Criteria for a clear H/V peak (at least 5 should be fulfilled) ==========
#1. [exists f- in the range [f0/4, f0] | AH/V(f-) < A0/2]: yes, at frequency 1.9Hz (OK)
#2. [exists f+ in the range [f0, 4f0] | AH/V(f+) < A0/2]: yes (considering standard deviations), at frequency Hz (OK)
#3. [A0 > 2]: 1.0 < 2 (NO)
#4. [fpeak[Ah/v(f) ą sigmaA(f)] = f0 ą 5%]: (NO)
#5. [sigmaf < epsilon(f0)]: 3.264 > 0.368 (NO)
#6. [sigmaA(f0) < theta(f0)]: 0.262 < 1.58 (OK)

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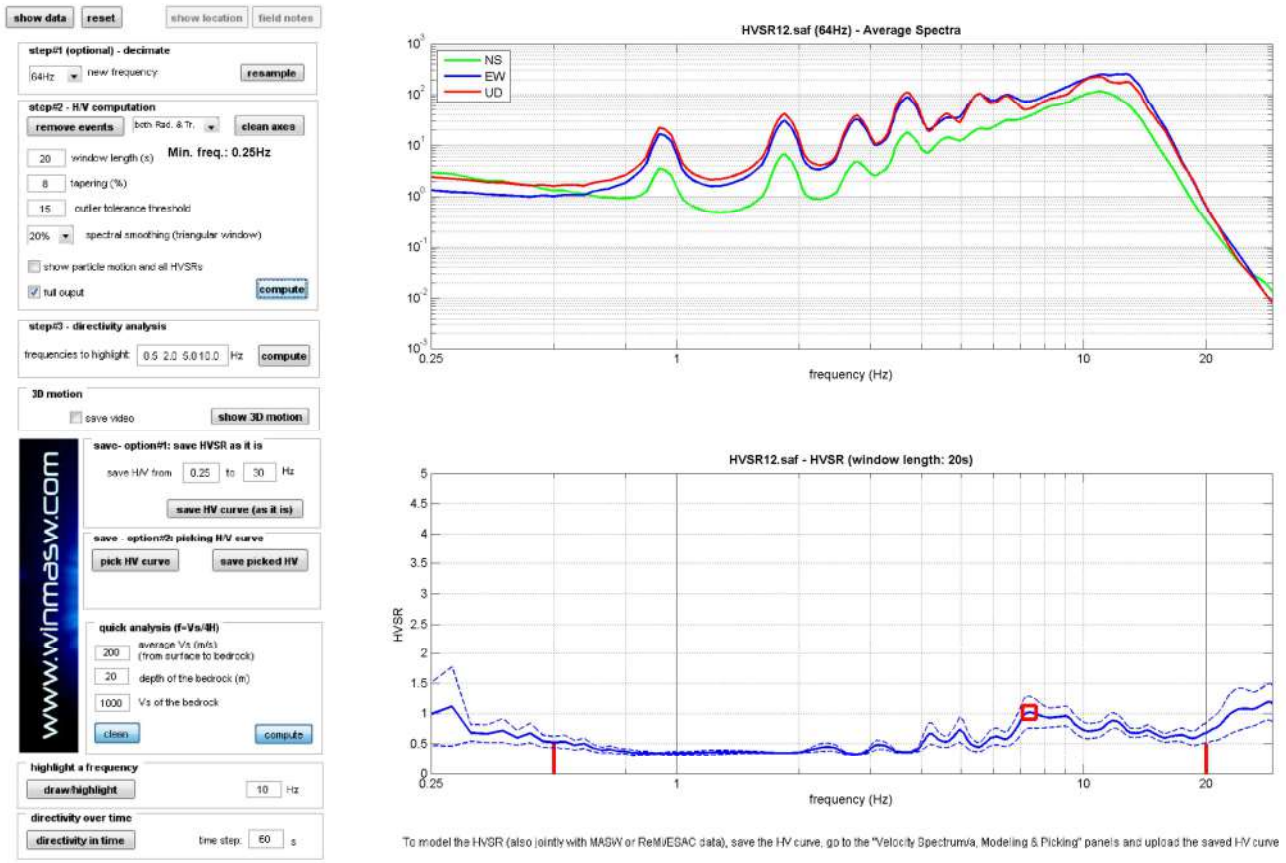
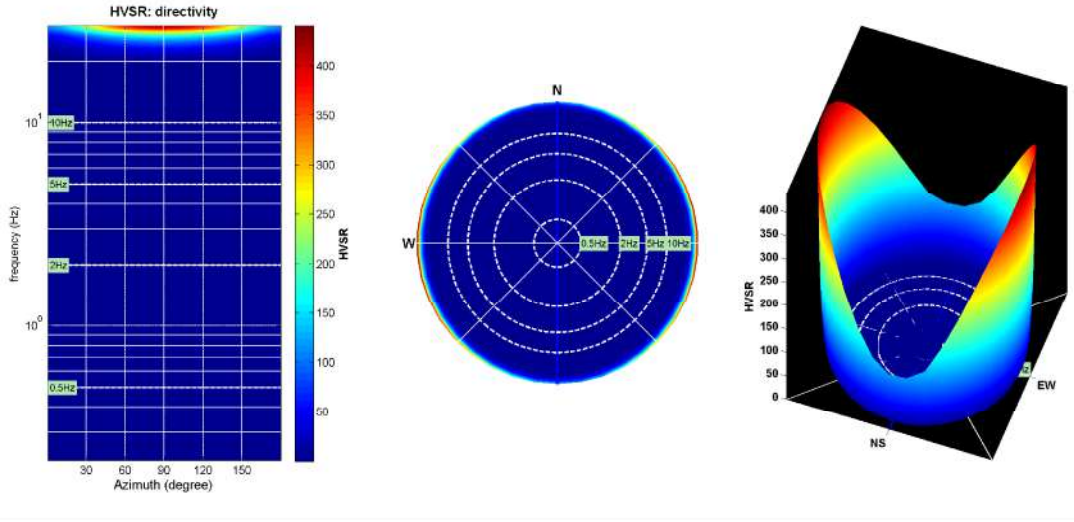
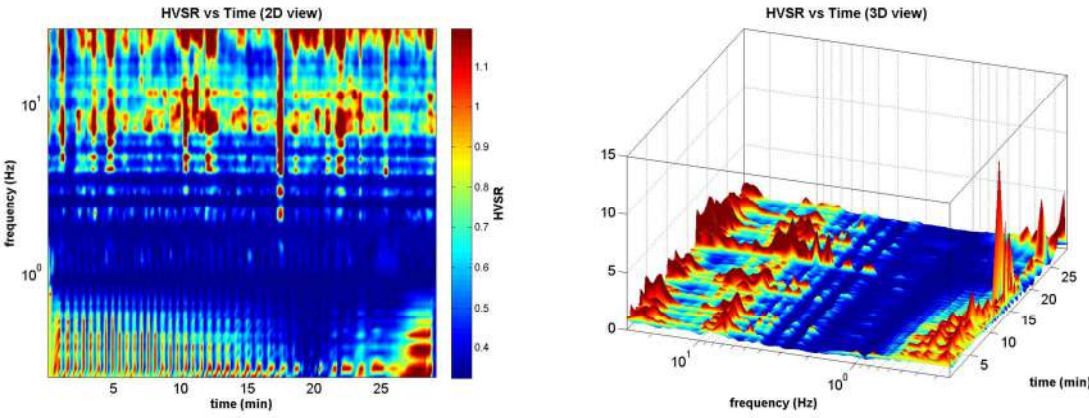

show data
reset
show location
field notes
step#1 (optional) - decimate
64Hz
new frequency
resample
step#2 - H/V computation
remove events
both Rad. & Tr.
clean axes
20
window length (s)
Min. freq.: 0.25Hz
8
tapering (%)
15
outlier tolerance threshold
20%
spectral smoothing (triangular window)
show particle motion and all HVSRs
full output
compute
step#3 - directivity analysis
frequencies to highlight
0.5 2.0 5.0 10.0
Hz
compute
3D motion
save video
show 3D motion
www.winmasw.com
save- option#1: save HVSR as it is
save H/V from
0.25
to
30
Hz
save HV curve (as it is)
save - option#2: picking H/V curve
pick HV curve
save picked HV
quick analysis (f=Vs/4H)
200
average Vs (m/s)
(from surface to bedrock)
20
depth of the bedrock (m)
1000
Vs of the bedrock
clean
compute
highlight a frequency
draw highlight
10
Hz
directivity over time
directivity in time
time step.
60
s
HVSR12.saf (64Hz) - Average Spectra
NS
EW
UD
frequency (Hz)
HVSR12.saf - HVSR (window length: 20s)
HVSR
frequency (Hz)
To model the HVSR (also jointly with MASW or ReMi/EGAC data), save the H/V curve, go to the "Velocity Spectrum/a, Modeling & Picking" panels and upload the saved H/V curve


HVSR: directivity
frequency (Hz)
10Hz
5Hz
2Hz
0.5Hz
HVSR
Azimuth (degree)
N
W
0.5Hz
2Hz
5Hz
10Hz
HVSR
NS
EW


HVSR vs Time (2D view)
frequency (Hz)
HVSR
time (min)
HVSR vs Time (3D view)
frequency (Hz)
time (min)

HVSR13

DATE 27.07.2017	HOUR 15:00	PLACE Via G. Verdi
OPERATOR ProGeo Engineering srl	GPS TYPE and #	
GAUSS-BOAGA LATITUDE 4800966	GAUSS-BOAGA LONGITUDE 1688640	ALTITUDE 324 m slm
STATION TYPE GPA	SENSOR TYPE 4,5 Hz	
STATION #	SENSOR #	DISK #
FILE NAME HVSR13		POINT #
GAIN	SAMPL. FREQ. 100 Hz	REC. DURATION 30 min (minutes / seconds)

WEATHER CONDITIONS

WIND ☐ none ◉ weak (5m/s) ☐ medium ☐ strong Measurement (if any): _____

RAIN ◉ none ☐ weak ☐ medium ☐ strong Measurement (if any): _____

Temperature (approx): 32 Remarks _____

GROUND TYPE

☐ earth (☐ hard ☐ soft) ☐ gravel ☐ sand ☐ rock ☐ grass (☐ short ☐ tall)

◉ asphalt ☐ cement ☐ concrete ☐ paved ☐ other _____

☐ dry soil ☐ wet soil Remarks _____

ARTIFICIAL GROUND-SENSOR COUPLING ◉ no ☐ yes, type _____

BUILDING DENSITY ☐ none ◉ scattered ☐ dense ☐ other, type _____

TRANSIENTS

	none	few	moderate	many	very dense	distance
cars			●			
trucks	●					
pedestrians		●				
other	●					

MONOCHROMATIC NOISE SOURCES (factories, works, pumps, rivers,..)

◉ no ☐ yes, type _____

NEARBY STRUCTURES (description, height, distance) (trees, polls, buildings, bridges, underground structures,...)

Buildings, Trees

OBSERVATIONS

FREQUENCY: Hz (if computed in the field)

Qualità della misura:

Durata: rispettata
Stazionarietà: rispettata
Isotropia: rispettata
Assenza di disturbi: non rispettata
Plausibilità fisica: rispettata
Robustezza statistica: rispettata

MISURA TIPO B2

HVSR13

Peak frequency (Hz): 9.4 (±4.4)
Peak HVSR value: 1.2 (±0.2)

=== Criteria for a reliable H/V curve ==========
#1. [f0 > 10/Lw]: 9.353 > 0.5 (OK)
#2. [nc > 200]: 32735 > 200 (OK)
#3. [f0>0.5Hz; sigmaA(f) < 2 for 0.5f0 < f < 2f0] (OK)

=== Criteria for a clear H/V peak (at least 5 should be fulfilled) ==========
#1. [exists f- in the range [f0/4, f0] | AH/V(f-) < A0/2]: yes (considering standard deviations), at frequency 2.4Hz (OK)
#2. [exists f+ in the range [f0, 4f0] | AH/V(f+) < A0/2]: yes (considering standard deviations), at frequency Hz (OK)
#3. [A0 > 2]: 1.2 < 2 (NO)
#4. [fpeak[Ah/v(f) ą sigmaA(f)] = f0 ą 5%]: (NO)
#5. [sigmaf < epsilon(f0)]: 4.402 > 0.468 (NO)
#6. [sigmaA(f0) < theta(f0)]: 0.151 < 1.58 (OK)

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show data | reset | show location | field notes

step#1 (optional) - decimate

64Hz | new frequency | resample

step#2 - H/V computation

remove events | both Rad. & Tr. | clean axes

20 window length (s) — Min. freq.: 0.25Hz

8 tapering (%)

15 outlier tolerance threshold

10% | spectral smoothing (triangular window)

☐ show particle motion and all HVSRs

☑ full output | compute

step#3 - directivity analysis

frequencies to highlight: 0.5 2.0 5.0 10.0 Hz | compute

3D motion

☐ save video | show 3D motion

www.winmasw.com

save- option#1: save HVSR as it is

save H/V from 0.25 to 30 Hz

save HV curve (as it is)

save - option#2: picking H/V curve

pick HV curve | save picked HV

quick analysis (f=Vs/4H)

200 average Vs (m/s) (from surface to bedrock)

20 depth of the bedrock (m)

1000 Vs of the bedrock

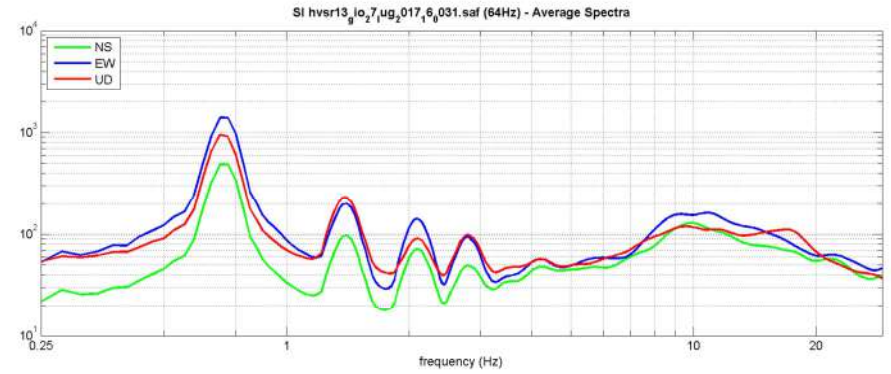
clean | compute

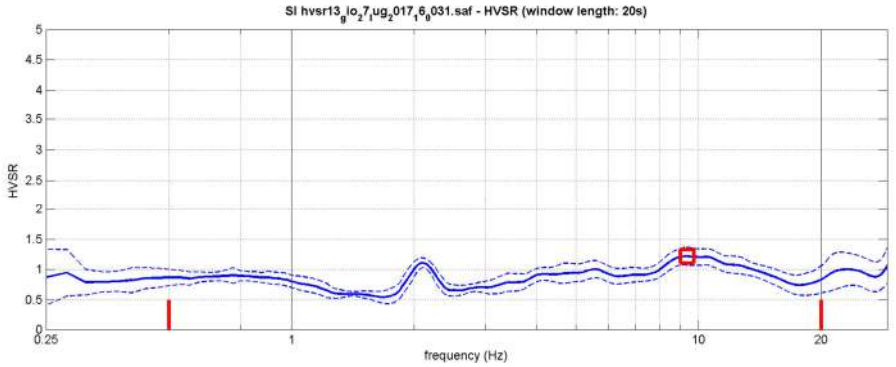
highlight a frequency

draw/highlight | 10 Hz

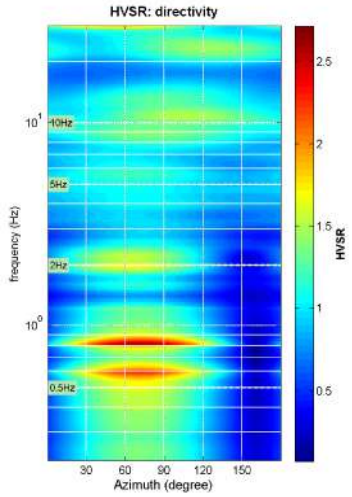
directivity over time

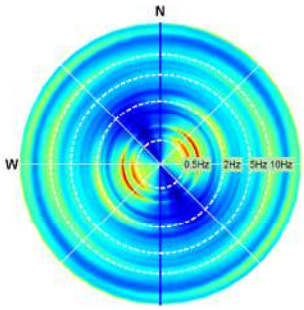
directivity in time | time step: 60 s

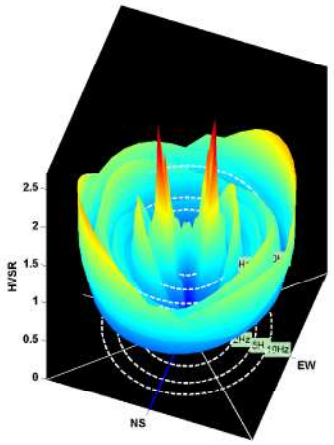


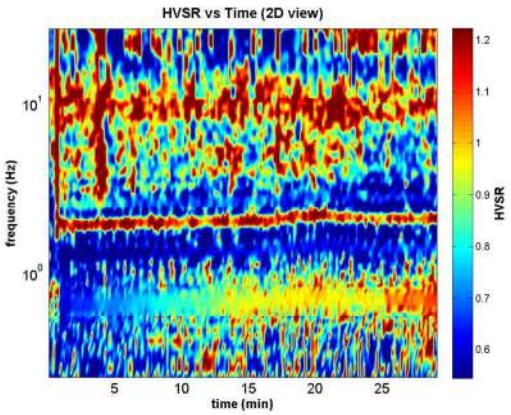


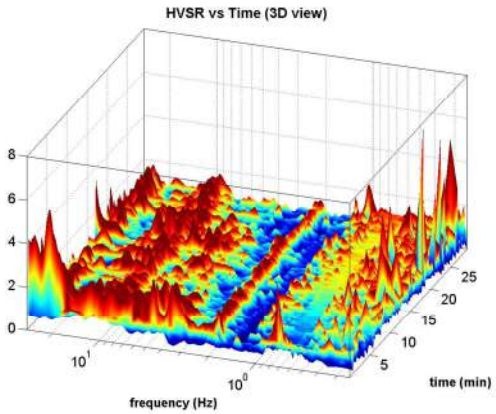
To model the HVSR (also jointly with MASW or ReMi/EGAC data), save the H/V curve, go to the "Velocity Spectrum/a, Modeling & Picking" panels and upload the saved H/V curve











HVSR14

DATE 27.07.2017	HOUR 15:27	PLACE Strada di Malizia
OPERATOR ProGeo Engineering srl	GPS TYPE and #	
GAUSS-BOAGA LATITUDE 4800625	GAUSS-BOAGA LONGITUDE 1688863	ALTITUDE 326 m slm
STATION TYPE GPA	SENSOR TYPE 4,5 Hz	
STATION #	SENSOR #	DISK #
FILE NAME HVSR14		POINT #
GAIN	SAMPL. FREQ. 100 Hz	REC. DURATION 30 min (minutes / seconds)

WEATHER CONDITIONS: WIND ☐ none ◉ weak (5m/s) ☐ medium ☐ strong Measurement (if any): ____ ; RAIN ◉ none ☐ weak ☐ medium ☐ strong Measurement (if any): ____ ; Temperature (approx): 31 Remarks ____

GROUND TYPE: ☐ earth (☐ hard ☐ soft) ☐ gravel ☐ sand ☐ rock ☐ grass (☐ short ☐ tall) ; ◉ asphalt ☐ cement ☐ concrete ☐ paved ☐ other ____ ; ☐ dry soil ☐ wet soil Remarks ____

ARTIFICIAL GROUND-SENSOR COUPLING ◉ no ☐ yes, type ____

BUILDING DENSITY ☐ none ◉ scattered ☐ dense ☐ other, type ____

TRANSIENTS	none	few	moderate	many	very dense	distance
cars		●				
trucks	●					
pedestrians		●				
other ____	●					

MONOCHROMATIC NOISE SOURCES (factories, works, pumps, rivers,..) ◉ no ☐ yes, type ____

NEARBY STRUCTURES (description, height, distance) (trees, polls, buildings, bridges, underground structures,...)

Buildings, Trees

OBSERVATIONS

FREQUENCY: Hz (if computed in the field)

Qualità della misura:

Durata: rispettata
Stazionarietà: rispettata
Isotropia: rispettata
Assenza di disturbi: non rispettata
Plausibilità fisica: rispettata
Robustezza statistica: rispettata

MISURA TIPO B2

HVSR14

Peak frequency (Hz): 5.3 (±3.9)
Peak HVSR value: 1.1 (±0.3)

=== Criteria for a reliable H/V curve ==========
#1. [f0 > 10/Lw]: 5.286 > 0.5 (OK)
#2. [nc > 200]: 18714 > 200 (OK)
#3. [f0>0.5Hz; sigmaA(f) < 2 for 0.5f0 < f < 2f0] (OK)

=== Criteria for a clear H/V peak (at least 5 should be fulfilled) ==========
#1. [exists f- in the range [f0/4, f0] | AH/V(f-) < A0/2]: yes, at frequency 1.3Hz (OK)
#2. [exists f+ in the range [f0, 4f0] | AH/V(f+) < A0/2]: yes (considering standard deviations), at frequency Hz (OK)
#3. [A0 > 2]: 1.1 < 2 (NO)
#4. [fpeak[Ah/v(f) ą sigmaA(f)] = f0 ą 5%]: (NO)
#5. [sigmaf < epsilon(f0)]: 3.899 > 0.264 (NO)
#6. [sigmaA(f0) < theta(f0)]: 0.280 < 1.58 (OK)

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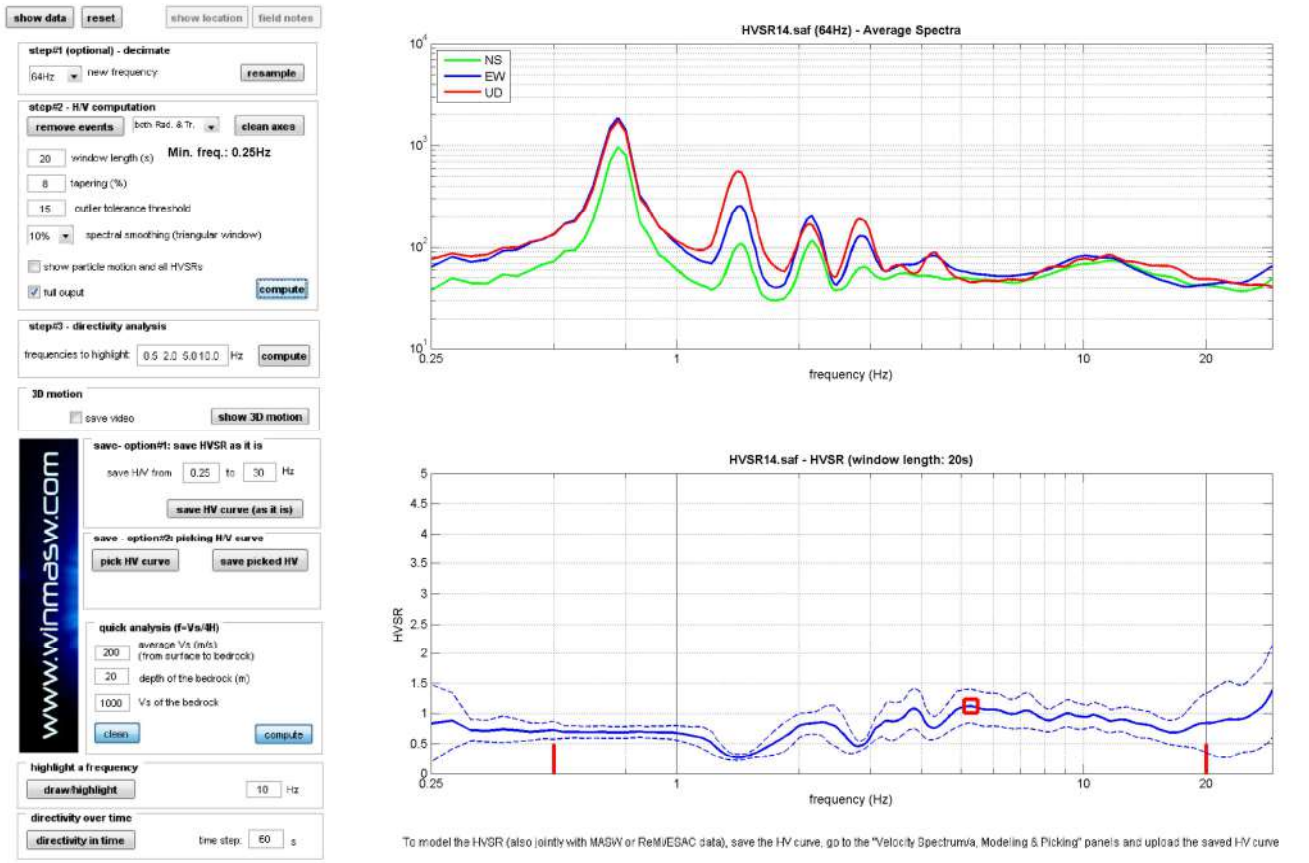
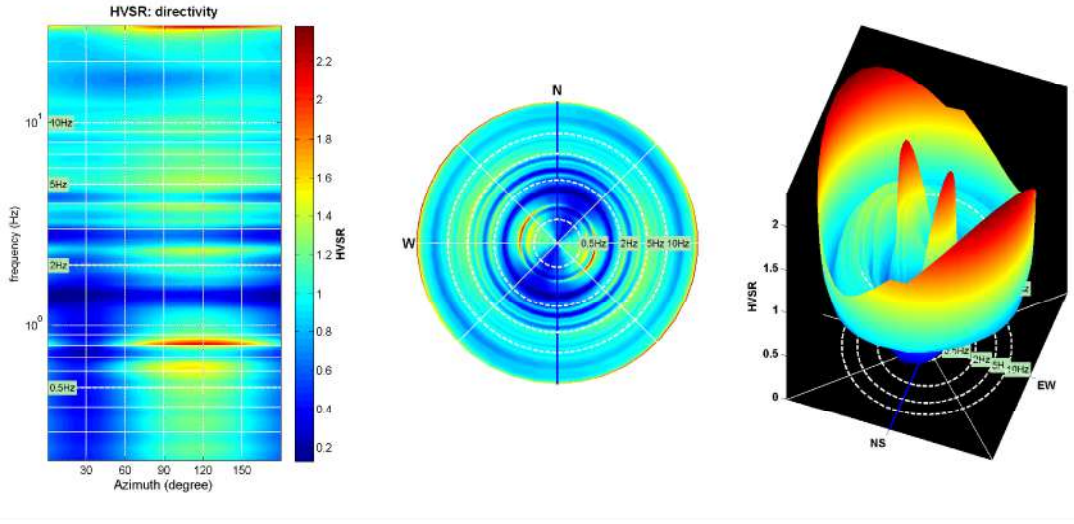
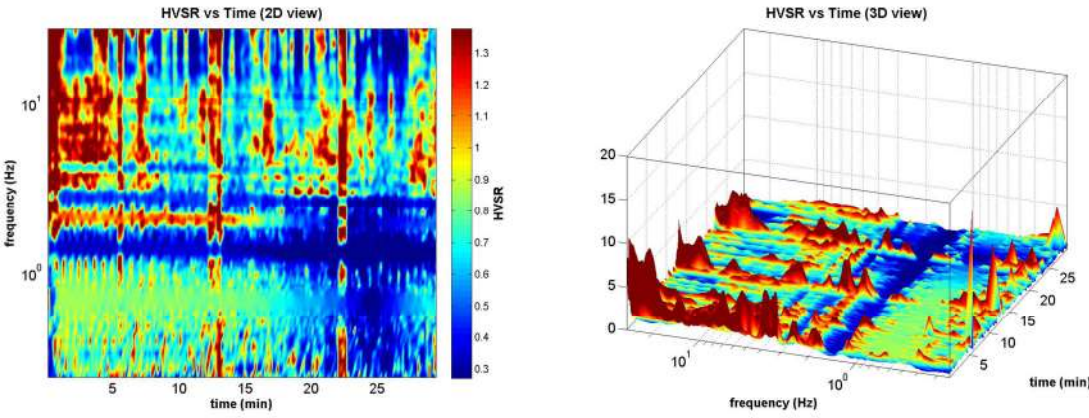

show data
reset
show location
field notes
step#1 (optional) - decimate
64Hz
new frequency
resample
step#2 - H/V computation
remove events
both Rad. & Tr.
clean axes
20
window length (s)
Min. freq.: 0.25Hz
8
tapering (%)
15
outlier tolerance threshold
10%
spectral smoothing (triangular window)
show particle motion and all HVSRs
full output
compute
step#3 - directivity analysis
frequencies to highlight
0.5 2.0 5.0 10.0
Hz
compute
3D motion
save video
show 3D motion
www.winmasw.com
save- option#1: save HVSR as it is
save H/V from
0.25
to
30
Hz
save HV curve (as it is)
save - option#2: picking H/V curve
pick HV curve
save picked HV
quick analysis (f=Vs/4H)
200
average Vs (m/s)
(from surface to bedrock)
20
depth of the bedrock (m)
1000
Vs of the bedrock
clean
compute
highlight a frequency
draw/highlight
10
Hz
directivity over time
directivity in time
time step.
60
s
HVSR14.saf (64Hz) - Average Spectra
NS
EW
UD
frequency (Hz)
HVSR14.saf - HVSR (window length: 20s)
HVSR
frequency (Hz)
To model the HVSR (also jointly with MASW or ReMi/EGAC data), save the H/V curve, go to the "Velocity Spectrum/a, Modeling & Picking" panels and upload the saved H/V curve


HVSR: directivity
frequency (Hz)
10Hz
5Hz
2Hz
0.5Hz
Azimuth (degree)
HVSR
N
W
0.5Hz
2Hz
5Hz
10Hz
H/SR
NS
EW


HVSR vs Time (2D view)
frequency (Hz)
time (min)
HVSR
HVSR vs Time (3D view)
frequency (Hz)
time (min)

HVSR15

DATE 27.07.2017	HOUR 14:49	PLACE Strada di Ventena
OPERATOR ProGeo Engineering srl	GPS TYPE and #	
GAUSS-BOAGA LATITUDE 4800612	GAUSS-BOAGA LONGITUDE 1689239	ALTITUDE 332,9 m slm
STATION TYPE GPA	SENSOR TYPE 4,5 Hz	
STATION #	SENSOR #	DISK #
FILE NAME HVSR15		POINT #
GAIN	SAMPL. FREQ. 100 Hz	REC. DURATION 30 min (minutes / seconds)

WEATHER CONDITIONS

WIND ☐ none ☑ weak (5m/s) ☐ medium ☐ strong Measurement (if any): _____

RAIN ☑ none ☐ weak ☐ medium ☐ strong Measurement (if any): _____

Temperature (approx): 31 Remarks _____

GROUND TYPE

☑ earth (☑ hard ☐ soft) ☐ gravel ☐ sand ☐ rock ☐ grass = (☐ short ☐ tall)

☐ asphalt ☐ cement ☐ concrete ☐ paved ☐ other _____

☑ dry soil ☐ wet soil Remarks _____

ARTIFICIAL GROUND-SENSOR COUPLING ☑ no ☐ yes, type _____

BUILDING DENSITY ☐ none ☑ scattered ☐ dense ☐ other, type _____

TRANSIENTS

	none	few	moderate	many	very dense	distance
cars	●					
trucks	●					
pedestrians	●					
other	●					

MONOCHROMATIC NOISE SOURCES (factories, works, pumps, rivers,..)

☑ no ☐ yes, type _____

NEARBY STRUCTURES (description, height, distance) (trees, polls, buildings, bridges, underground structures,...)

OBSERVATIONS

FREQUENCY: Hz (if computed in the field)

Qualità della misura:

Durata: rispettata
Stazionarietà: rispettata
Isotropia: rispettata
Assenza di disturbi: non rispettata
Plausibilità fisica: rispettata
Robustezza statistica: rispettata

MISURA TIPO B1

HVSR15

Peak frequency (Hz): 13.3 (±4.5)
Peak HVSR value: 6.9 (±5.0)

=== Criteria for a reliable H/V curve ==========
#1. [f0 > 10/Lw]: 13.343 > 0.25 (OK)
#2. [nc > 200]: 68850 > 200 (OK)
#3. [f0>0.5Hz; sigmaA(f) < 2 for 0.5f0 < f < 2f0] (OK)

=== Criteria for a clear H/V peak (at least 5 should be fulfilled) ==========
#1. [exists f- in the range [f0/4, f0] | AH/V(f-) < A0/2]: yes, at frequency 3.3Hz (OK)
#2. [exists f+ in the range [f0, 4f0] | AH/V(f+) < A0/2]: yes, at frequency 15.7Hz (OK)
#3. [A0 > 2]: 6.9 > 2 (OK)
#4. [fpeak[Ah/v(f) ą sigmaA(f)] = f0 ą 5%]: (NO)
#5. [sigmaf < epsilon(f0)]: 4.524 > 0.667 (NO)
#6. [sigmaA(f0) < theta(f0)]: 5.028 < 1.58 (NO)

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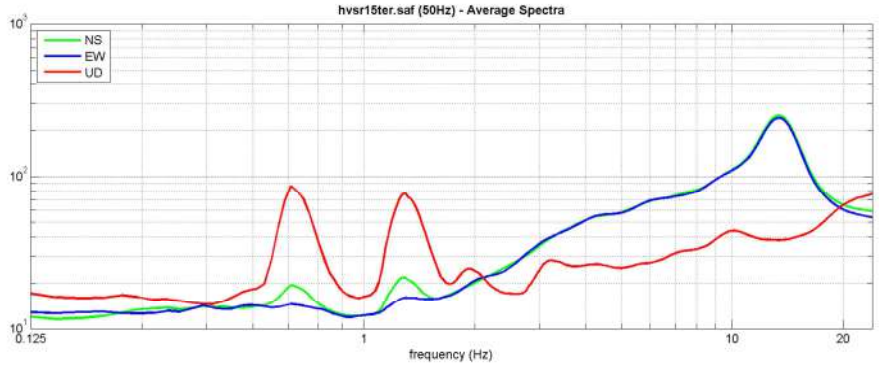
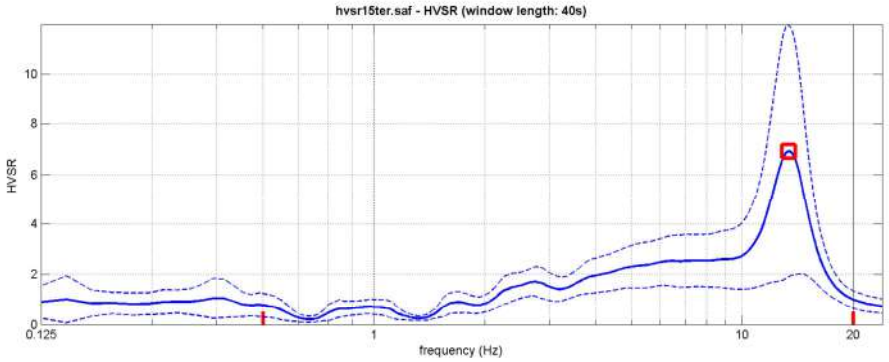
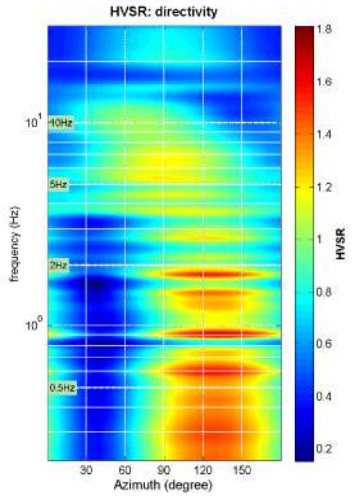
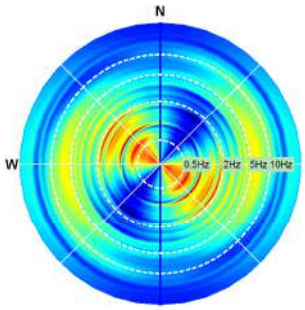
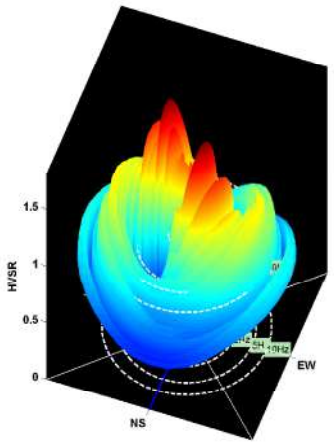


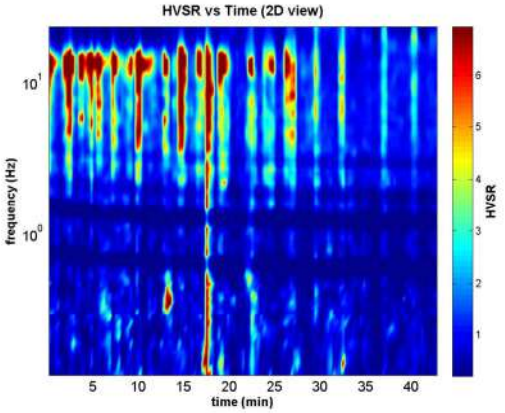


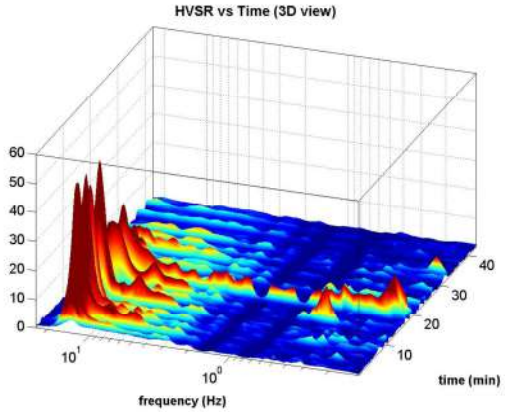
To model the HVSR (also jointly with MASW or ReMi/EGAC data), save the H/V curve, go to the "Velocity Spectrum/a, Modeling & Picking" panels and upload the saved H/V curve











HVSR16

DATE 27.07.2017	HOUR 13:32	PLACE Strada dell'Osservanza
OPERATOR ProGeo Engineering srl	GPS TYPE and #	
GAUSS-BOAGA LATITUDE 4800662	GAUSS-BOAGA LONGITUDE 1689809	ALTITUDE 330 m slm
STATION TYPE GPA	SENSOR TYPE 4,5 Hz	
STATION #	SENSOR #	DISK #
FILE NAME HVSR16		POINT #
GAIN	SAMPL. FREQ. 100 Hz	REC. DURATION 30 min (minutes / seconds)

WEATHER CONDITIONS: WIND ☐ none ◉ weak (5m/s) ☐ medium ☐ strong Measurement (if any): ____ ; RAIN ◉ none ☐ weak ☐ medium ☐ strong Measurement (if any): ____ ; Temperature (approx): 31 Remarks ____

GROUND TYPE: ☐ earth (☐ hard ☐ soft) ☐ gravel ☐ sand ☐ rock ◉ grass (☐ short ◉ tall) ☐ asphalt ☐ cement ☐ concrete ☐ paved ☐ other ____ ; ◉ dry soil ☐ wet soil Remarks ____

ARTIFICIAL GROUND-SENSOR COUPLING ◉ no ☐ yes, type ____

BUILDING DENSITY ☐ none ◉ scattered ☐ dense ☐ other, type ____

TRANSIENTS	none	few	moderate	many	very dense	distance
cars	●					
trucks	●					
pedestrians	●					
other ____	●					

MONOCHROMATIC NOISE SOURCES (factories, works, pumps, rivers,..) ◉ no ☐ yes, type ____

NEARBY STRUCTURES (description, height, distance) (trees, polls, buildings, bridges, underground structures,...)

OBSERVATIONS

FREQUENCY: Hz (if computed in the field)

Qualità della misura:

Durata: rispettata
Stazionarietà: rispettata
Isotropia: rispettata
Assenza di disturbi: rispettata
Plausibilità fisica: rispettata
Robustezza statistica: rispettata

MISURA TIPO A2

HVSR16

Peak frequency (Hz): 11.7 (±4.6)
Peak HVSR value: 1.7 (±0.3)

=== Criteria for a reliable H/V curve ==========
#1. [f0 > 10/Lw]: 11.699 > 0.5 (OK)
#2. [nc > 200]: 41414 > 200 (OK)
#3. [f0>0.5Hz; sigmaA(f) < 2 for 0.5f0 < f < 2f0] (OK)

=== Criteria for a clear H/V peak (at least 5 should be fulfilled) ==========
#1. [exists f- in the range [f0/4, f0] | AH/V(f-) < A0/2]: yes, at frequency 2.9Hz (OK)
#2. [exists f+ in the range [f0, 4f0] | AH/V(f+) < A0/2]: (NO)
#3. [A0 > 2]: 1.7 < 2 (NO)
#4. [fpeak[Ah/v(f) ą sigmaA(f)] = f0 ą 5%]: (OK)
#5. [sigmaf < epsilon(f0)]: 4.608 > 0.585 (NO)
#6. [sigmaA(f0) < theta(f0)]: 0.329 < 1.58 (OK)

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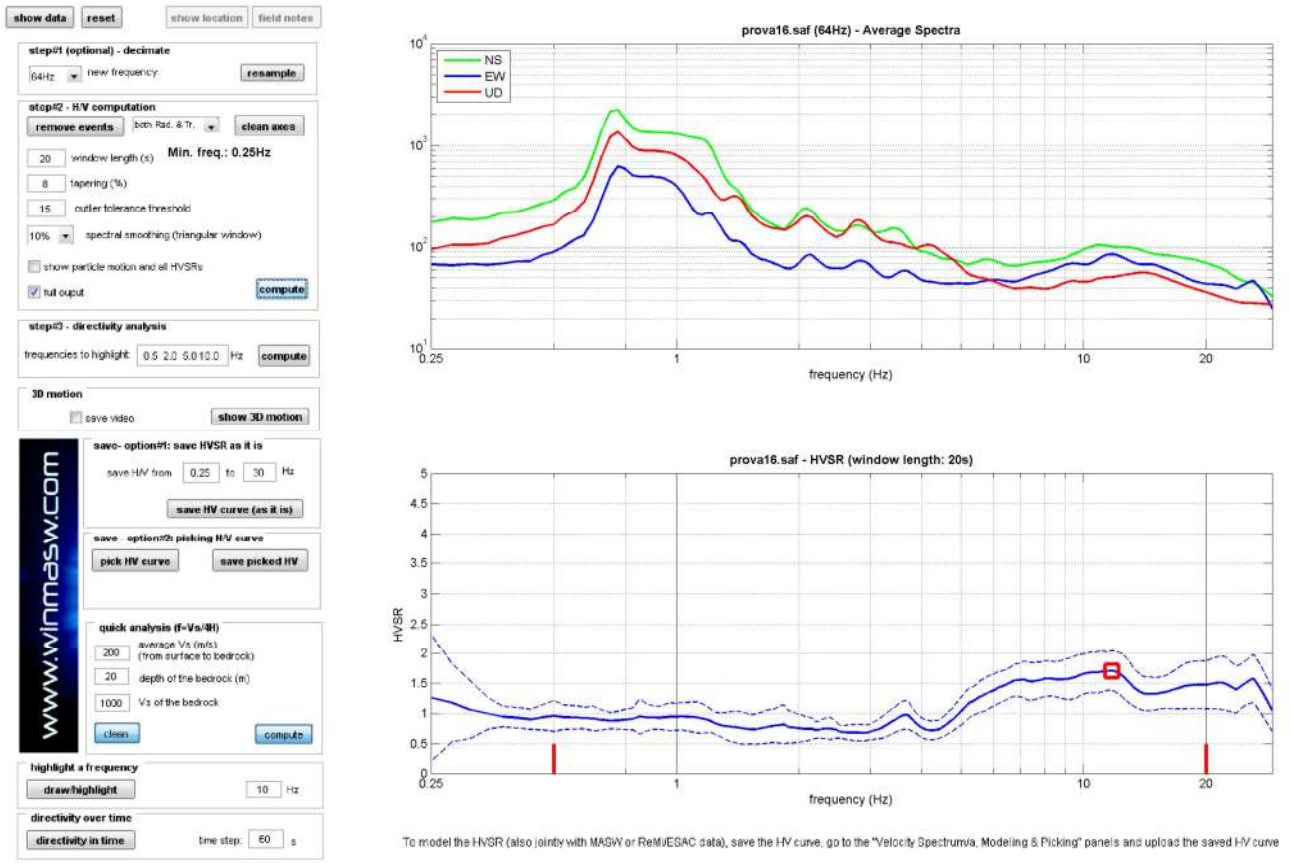
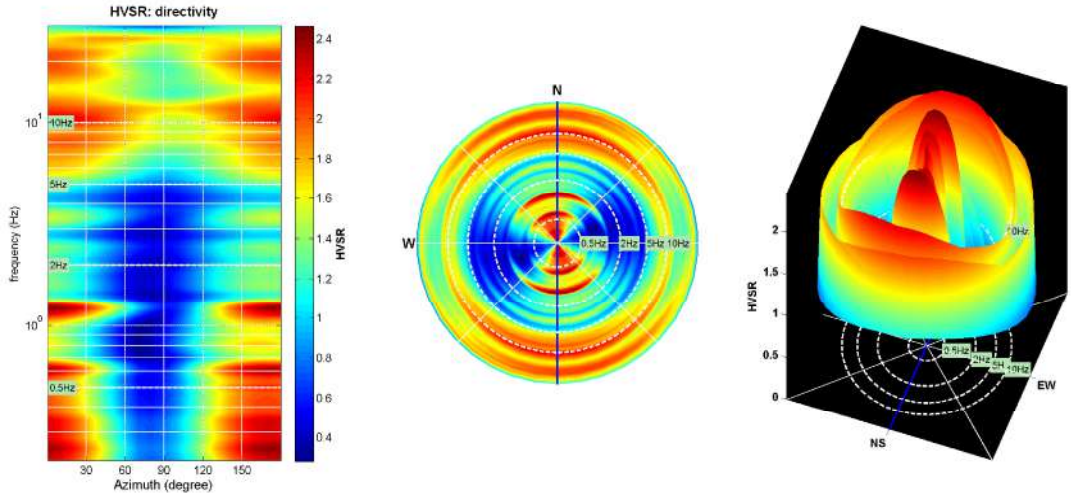
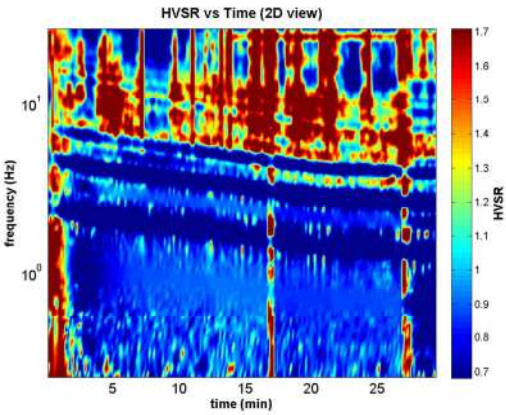
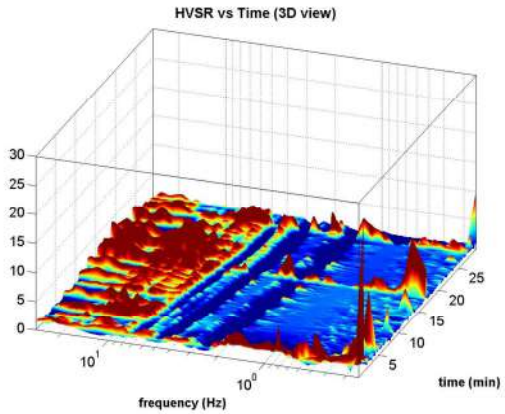

show data
reset
show location
field notes
step#1 (optional) - decimate
64Hz
new frequency
resample
step#2 - H/V computation
remove events
both Rad. & Tr.
clean axes
20
window length (s)
Min. freq.: 0.25Hz
8
tapering (%)
15
outlier tolerance threshold
10%
spectral smoothing (triangular window)
show particle motion and all HVSRs
full output
compute
step#3 - directivity analysis
frequencies to highlight
0.5 2.0 5.0 10.0
Hz
compute
3D motion
save video
show 3D motion
www.winmasw.com
save- option#1: save HVSR as it is
save H/V from
0.25
to
30
Hz
save HV curve (as it is)
save - option#2: picking H/V curve
pick HV curve
save picked HV
quick analysis (f=Vs/4H)
200
average Vs (m/s)
(from surface to bedrock)
20
depth of the bedrock (m)
1000
Vs of the bedrock
clean
compute
highlight a frequency
draw/highlight
10
Hz
directivity over time
directivity in time
time step.
60
s
prova16.saf (64Hz) - Average Spectra
NS
EW
UD
frequency (Hz)
prova16.saf - HVSR (window length: 20s)
HVSR
frequency (Hz)
To model the HVSR (also jointly with MASW or ReMi/EGAC data), save the H/V curve, go to the "Velocity Spectrum/a, Modeling & Picking" panels and upload the saved H/V curve


HVSR: directivity
10Hz
5Hz
2Hz
0.5Hz
frequency (Hz)
Azimuth (degree)
HVSR
N
W
0.5Hz
2Hz
5Hz
10Hz
H/SR
NS
EW


HVSR vs Time (2D view)
frequency (Hz)
time (min)
HVSR


HVSR vs Time (3D view)
frequency (Hz)
time (min)

HVSR17

DATE 14.07.2017	HOUR 12:55	PLACE Bottega Nuova
OPERATOR ProGeo Engineering srl	GPS TYPE and #	
GAUSS-BOAGA LATITUDE 4800330	GAUSS-BOAGA LONGITUDE 1690063	ALTITUDE 294 m slm
STATION TYPE GPA	SENSOR TYPE 4,5 Hz	
STATION #	SENSOR #	DISK #
FILE NAME HVSR17		POINT #
GAIN	SAMPL. FREQ. 100 Hz	REC. DURATION 30 min (minutes / seconds)

WEATHER CONDITIONS

WIND ☐ none ◉ weak (5m/s) ☐ medium ☐ strong Measurement (if any): _____

RAIN ◉ none ☐ weak ☐ medium ☐ strong Measurement (if any): _____

Temperature (approx): 30 Remarks _____

GROUND TYPE

☐ earth (☐ hard ☐ soft) ☐ gravel ☐ sand ☐ rock ☐ grass (☐ short ☐ tall)

◉ asphalt ☐ cement ☐ concrete ☐ paved ☐ other _____

☐ dry soil ☐ wet soil Remarks _____

ARTIFICIAL GROUND-SENSOR COUPLING ◉ no ☐ yes, type _____

BUILDING DENSITY ☐ none ◉ scattered ☐ dense ☐ other, type _____

TRANSIENTS

	none	few	moderate	many	very dense	distance
cars			◉			
trucks		◉				
pedestrians	◉					
other	◉					

MONOCHROMATIC NOISE SOURCES (factories, works, pumps, rivers,..)

◉ no ☐ yes, type _____

NEARBY STRUCTURES (description, height, distance) (trees, polls, buildings, bridges, underground structures,...)

Buildings

OBSERVATIONS

FREQUENCY: Hz (if computed in the field)

Qualità della misura:

Durata: rispettata
Stazionarietà: rispettata
Isotropia: rispettata
Assenza di disturbi: non rispettata
Plausibilità fisica: rispettata
Robustezza statistica: rispettata

MISURA TIPO B2

HVSR17

Peak frequency (Hz): 2.3 (±3.5)
Peak HVSR value: 1.1 (±0.2)

=== Criteria for a reliable H/V curve ==========
#1. [f0 > 10/Lw]: 2.252 > 0.5 (OK)
#2. [nc > 200]: 7612 > 200 (OK)
#3. [f0>0.5Hz; sigmaA(f) < 2 for 0.5f0 < f < 2f0] (OK)

=== Criteria for a clear H/V peak (at least 5 should be fulfilled) ==========
#1. [exists f- in the range [f0/4, f0] | AH/V(f-) < A0/2]: yes, at frequency 1.5Hz (OK)
#2. [exists f+ in the range [f0, 4f0] | AH/V(f+) < A0/2]: yes (considering standard deviations), at frequency Hz (OK)
#3. [A0 > 2]: 1.1 < 2 (NO)
#4. [fpeak[Ah/v(f) ą sigmaA(f)] = f0 ą 5%]: (OK)
#5. [sigmaf < epsilon(f0)]: 3.481 > 0.113 (NO)
#6. [sigmaA(f0) < theta(f0)]: 0.178 < 1.58 (OK)

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show data | reset | show location | field notes

step#1 (optional) - decimate

64Hz | new frequency | resample

step#2 - H/V computation

remove events | both Rad. & Tr. | clean axes

20 window length (s) — Min. freq.: 0.25Hz

8 tapering (%)

15 outlier tolerance threshold

10% spectral smoothing (triangular window)

☐ show particle motion and all HVSRs

☑ full output | compute

step#3 - directivity analysis

frequencies to highlight: 0.5 2.0 5.0 10.0 Hz | compute

3D motion

☐ save video | show 3D motion

www.winmasw.com

save- option#1: save HVSR as it is

save H/V from 0.25 to 30 Hz

save HV curve (as it is)

save - option#2: picking H/V curve

pick HV curve | save picked HV

quick analysis (f=Vs/4H)

200 average Vs (m/s) (from surface to bedrock)

20 depth of the bedrock (m)

1000 Vs of the bedrock

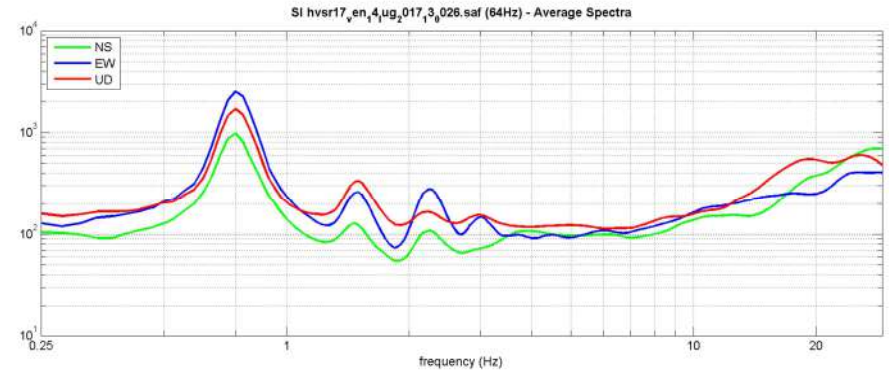
clean | compute

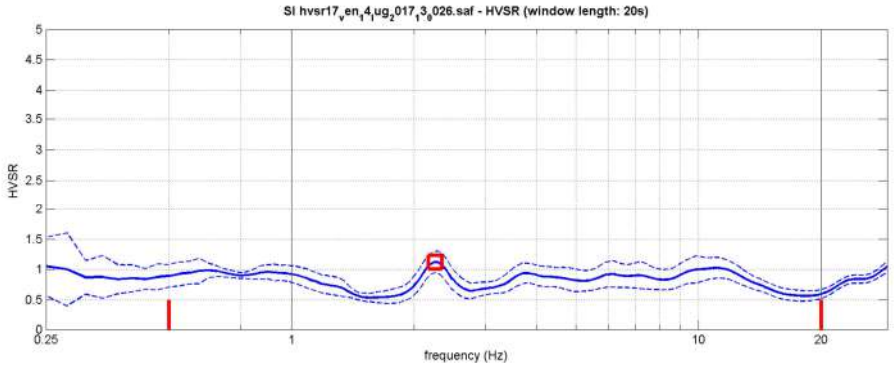
highlight a frequency

draw/highlight | 10 Hz

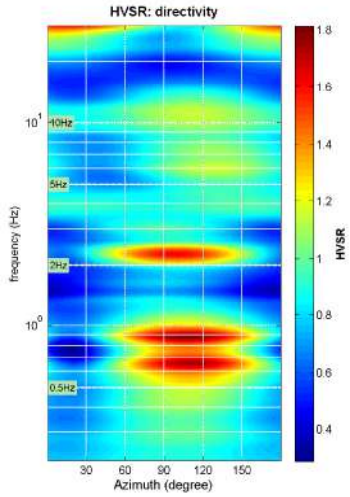
directivity over time

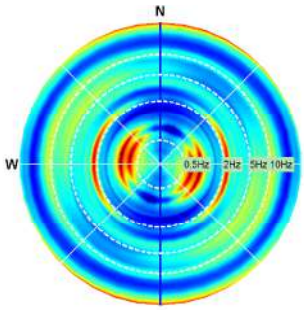
directivity in time | time step: 60 s

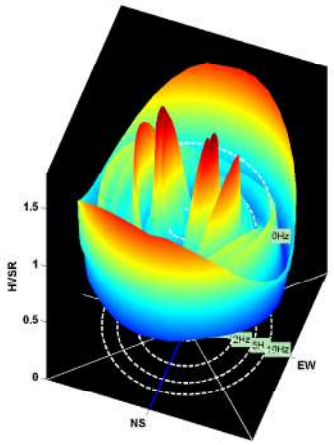


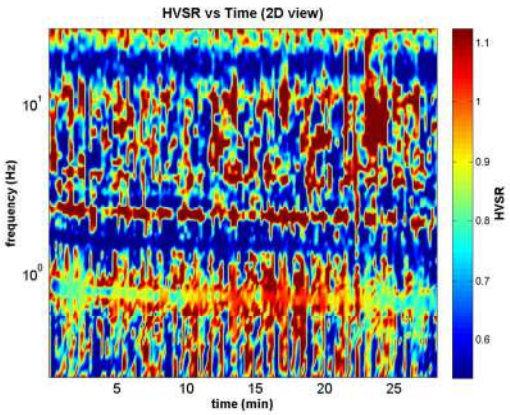


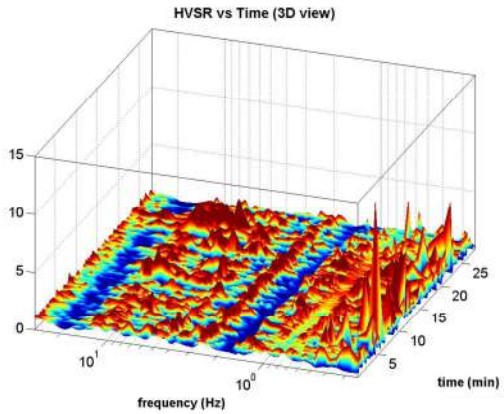
To model the HVSR (also jointly with MASW or ReMi/EGAC data), save the H/V curve, go to the "Velocity Spectrum/a, Modeling & Picking" panels and upload the saved H/V curve











HVSR18

DATE 15.08.2017	HOUR 16:45	PLACE Via A. Federighi
OPERATOR ProGeo Engineering srl	GPS TYPE and #	
GAUSS-BOAGA LATITUDE 4799417	GAUSS-BOAGA LONGITUDE 1689557	ALTITUDE 280 m slm
STATION TYPE GPA	SENSOR TYPE 4,5 Hz	
STATION #	SENSOR #	DISK #
FILE NAME HVSR18		POINT #
GAIN	SAMPL. FREQ. 50 Hz	REC. DURATION 30 min (minutes / seconds)

WEATHER CONDITIONS: WIND ☐ none ● weak (5m/s) ☐ medium ☐ strong Measurement (if any): ____ ; RAIN ● none ☐ weak ☐ medium ☐ strong Measurement (if any): ____ ; Temperature (approx): 36 ; Remarks ____

GROUND TYPE: ☐ earth (☐ hard ☐ soft) ☐ gravel ☐ sand ☐ rock ☐ grass (☐ short ☐ tall) ; ● asphalt ☐ cement ☐ concrete ☐ paved ☐ other ____ ; ☐ dry soil ☐ wet soil Remarks ____

ARTIFICIAL GROUND-SENSOR COUPLING ● no ☐ yes, type ____

BUILDING DENSITY ☐ none ☐ scattered ● dense ☐ other, type ____

TRANSIENTS	none	few	moderate	many	very dense	distance
cars		●				
trucks		●				
pedestrians		●				
other ____	●					

MONOCHROMATIC NOISE SOURCES (factories, works, pumps, rivers,..) ● no ☐ yes, type ____

NEARBY STRUCTURES (description, height, distance) (trees, polls, buildings, bridges, underground structures,...)

Trees

OBSERVATIONS

FREQUENCY: Hz (if computed in the field)

Qualità della misura:

Durata: rispettata
Stazionarietà: rispettata
Isotropia: rispettata
Assenza di disturbi: rispettata
Plausibilità fisica: rispettata
Robustezza statistica: rispettata

MISURA TIPO A1

HVSR18

Peak frequency (Hz): 15.6 ±6.0)
Peak HVSR value: 2.4 (±0.9)

=== Criteria for a reliable H/V curve ==========
#1. [f0 > 10/Lw]: 15.607 > 0.5 (OK)
#2. [nc > 200]: 14982 > 200 (OK)
#3. [f0>0.5Hz; sigmaA(f) < 2 for 0.5f0 < f < 2f0] (OK)

=== Criteria for a clear H/V peak (at least 5 should be fulfilled) ==========
#1. [exists f- in the range [f0/4, f0] | AH/V(f-) < A0/2]: yes, at frequency 6.4Hz (OK)
#2. [exists f+ in the range [f0, 4f0] | AH/V(f+) < A0/2]: yes (considering standard deviations), at frequency Hz (OK)
#3. [A0 > 2]: 2.4 > 2 (OK)
#4. [fpeak[Ah/v(f) ą sigmaA(f)] = f0 ą 5%]: (OK)
#5. [sigmaf < epsilon(f0)]: 6.008 > 0.780 (NO)
#6. [sigmaA(f0) < theta(f0)]: 0.926 < 1.58 (OK)

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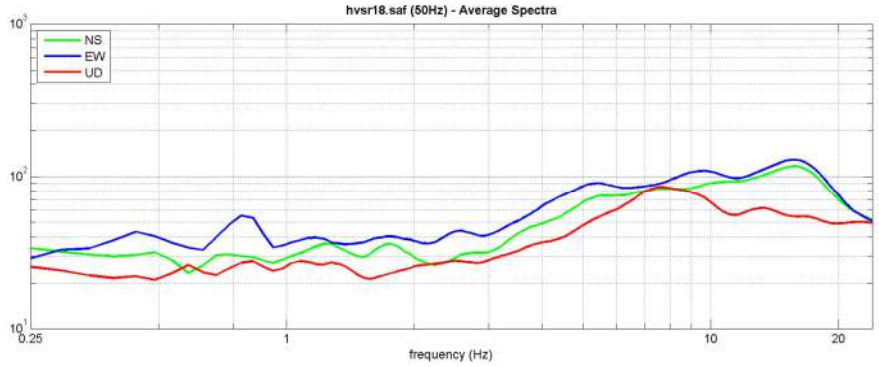
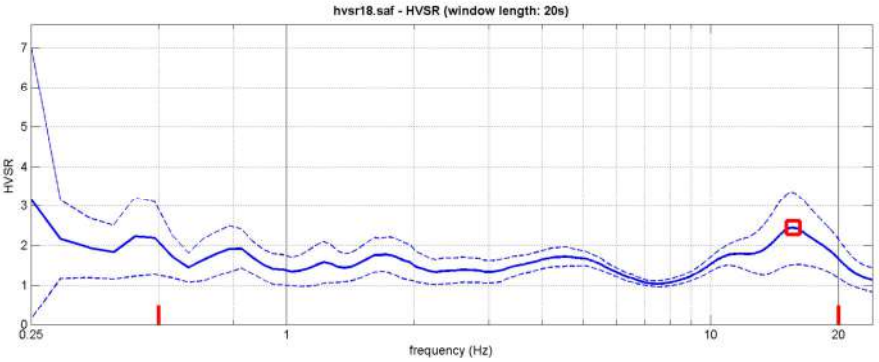
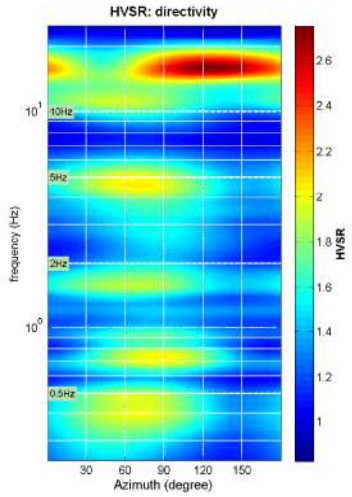
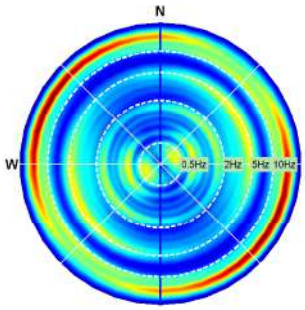
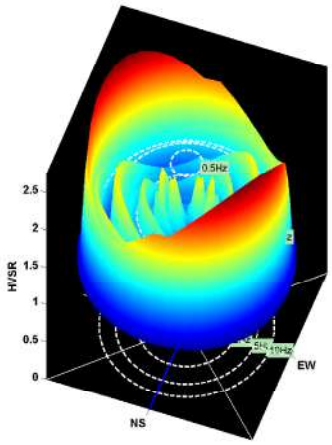


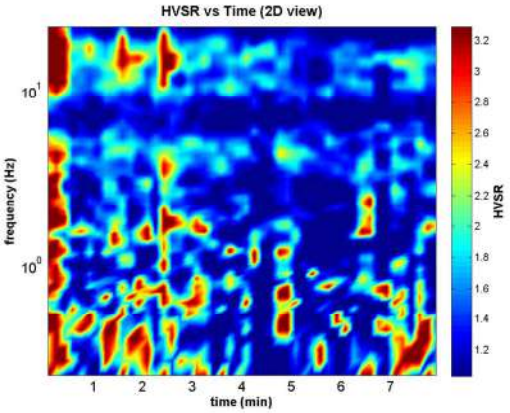


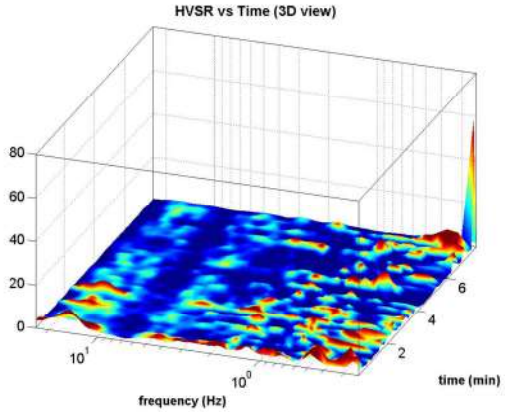
To model the HVSR (also jointly with MASW or ReMi/EGAC data), save the H/V curve, go to the "Velocity Spectrum/a, Modeling & Picking" panels and upload the saved H/V curve











HVSR19

DATE 16.08.2017	HOUR 16:32	PLACE Via Vivaldi
OPERATOR ProGeo Engineering srl	GPS TYPE and #	
GAUSS-BOAGA LATITUDE 4798876	GAUSS-BOAGA LONGITUDE 1690126	ALTITUDE 272 m slm
STATION TYPE GPA	SENSOR TYPE 4,5 Hz	
STATION #	SENSOR #	DISK #
FILE NAME HVSR19		POINT #
GAIN	SAMPL. FREQ. 50 Hz	REC. DURATION 24 min (minutes / seconds)

WEATHER CONDITIONS: WIND ● none ☐ weak (5m/s) ☐ medium ☐ strong Measurement (if any): ____ ; RAIN ● none ☐ weak ☐ medium ☐ strong Measurement (if any): ____ ; Temperature (approx): 37 Remarks ____

GROUND TYPE: ☐ earth (☐ hard ☐ soft) ☐ gravel ☐ sand ☐ rock ☐ grass (☐ short ☐ tall) ; ☐ asphalt ● cement ☐ concrete ☐ paved ☐ other ____ ; ● dry soil ☐ wet soil Remarks ____

ARTIFICIAL GROUND-SENSOR COUPLING ● no ☐ yes, type ____

BUILDING DENSITY ☐ none ☐ scattered ● dense ☐ other, type ____

TRANSIENTS	none	few	moderate	many	very dense	distance
cars		●				
trucks	●					
pedestrians		●				
other ____	●					

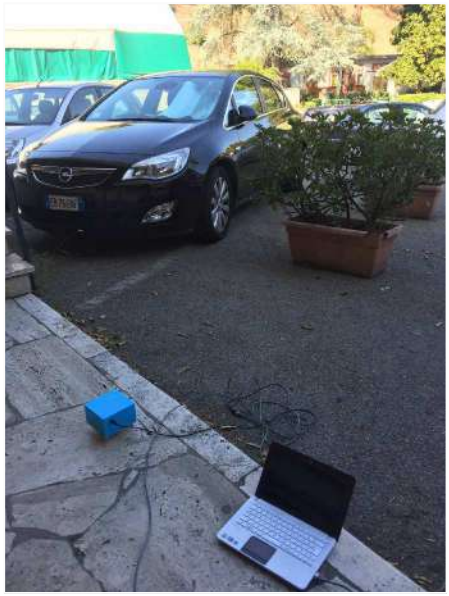
MONOCHROMATIC NOISE SOURCES (factories, works, pumps, rivers,..) ● no ☐ yes, type ____

NEARBY STRUCTURES (description, height, distance) (trees, polls, buildings, bridges, underground structures,...)

Trees, Buildings

OBSERVATIONS

FREQUENCY: Hz (if computed in the field)



Qualità della misura:

Durata: rispettata
Stazionarietà: rispettata
Isotropia: rispettata
Assenza di disturbi: rispettata
Plausibilità fisica: rispettata
Robustezza statistica: rispettata

MISURA TIPO A1

HVSR 19

Peak frequency (Hz): 1.2 (±1.7)
Peak HVSR value: 1.8 (±0.7)

=== Criteria for a reliable H/V curve ==========
#1. [f0 > 10/Lw]: 1.223 > 0.5 (OK)
#2. [nc > 200]: 3156 > 200 (OK)
#3. [f0>0.5Hz; sigmaA(f) < 2 for 0.5f0 < f < 2f0] (OK)

=== Criteria for a clear H/V peak (at least 5 should be fulfilled) ==========
#1. [exists f- in the range [f0/4, f0] | AH/V(f-) < A0/2]: yes (considering standard deviations), at frequency 0.5Hz (OK)
#2. [exists f+ in the range [f0, 4f0] | AH/V(f+) < A0/2]: yes, at frequency 1.9Hz (OK)
#3. [A0 > 2]: 1.8 < 2 (NO)
#4. [fpeak[Ah/v(f) ą sigmaA(f)] = f0 ą 5%]: (OK)
#5. [sigmaf < epsilon(f0)]: 1.725 > 0.122 (NO)
#6. [sigmaA(f0) < theta(f0)]: 0.706 < 1.78 (OK)

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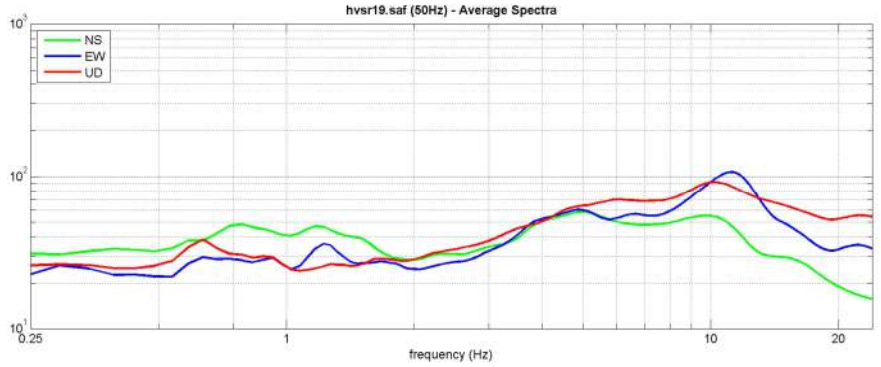
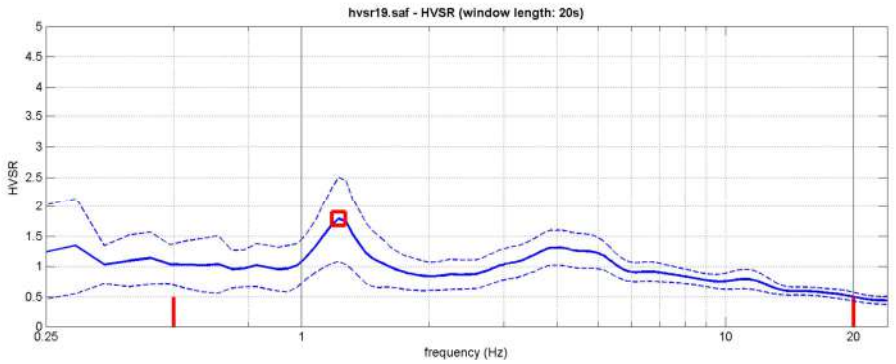
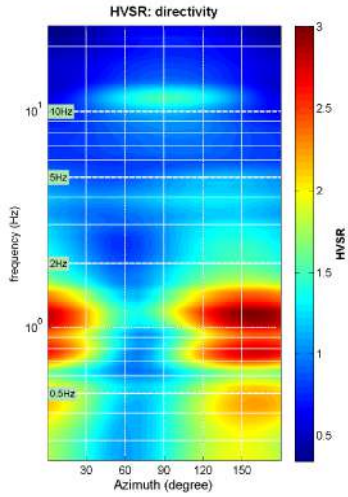
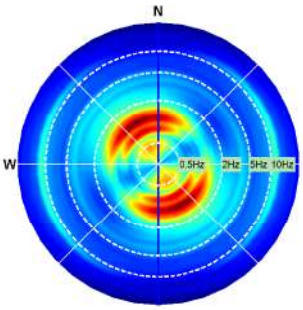
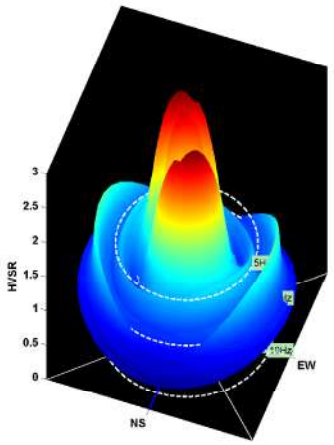


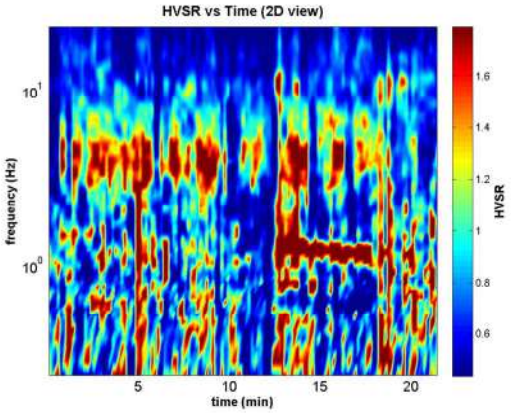


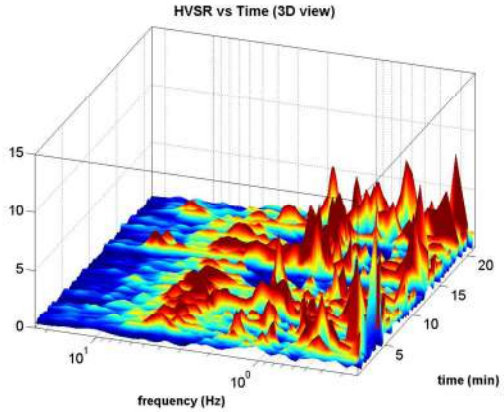
To model the HVSR (also jointly with MASW or ReMi/ESAC data), save the H/V curve, go to the "Velocity Spectrum/a, Modeling & Picking" panels and upload the saved H/V curve











HVSR20

DATE 15.08.2017	HOUR 17:30	PLACE San Francesco
OPERATOR ProGeo Engineering srl	GPS TYPE and #	
GAUSS-BOAGA LATITUDE 4799190	GAUSS-BOAGA LONGITUDE 1689289	ALTITUDE 322 m slm
STATION TYPE GPA	SENSOR TYPE 4,5 Hz	
STATION #	SENSOR #	DISK #
FILE NAME HVSR20		POINT #
GAIN	SAMPL. FREQ. 50 Hz	REC. DURATION 30 min (minutes / seconds)

WEATHER CONDITIONS

WIND ☐ none ☑ weak (5m/s) ☐ medium ☐ strong Measurement (if any): _____

RAIN ☑ none ☐ weak ☐ medium ☐ strong Measurement (if any): _____

Temperature (approx): 35 Remarks _____

GROUND TYPE

☑ earth (☐ hard ☐ soft) ☐ gravel ☐ sand ☐ rock ☐ grass (☐ short ☐ tall)

☐ asphalt ☐ cement ☐ concrete ☐ paved ☐ other _____

☑ dry soil ☐ wet soil Remarks _____

ARTIFICIAL GROUND-SENSOR COUPLING ☑ no ☐ yes, type _____

BUILDING DENSITY ☐ none ☐ scattered ☑ dense ☐ other, type _____

TRANSIENTS

	none	few	moderate	many	very dense	distance
cars		●				
trucks	●					
pedestrians				●		
other	●					

MONOCHROMATIC NOISE SOURCES (factories, works, pumps, rivers,..)

☑ no ☐ yes, type _____

NEARBY STRUCTURES (description, height, distance) (trees, polls, buildings, bridges, underground structures,...)

Trees

OBSERVATIONS

FREQUENCY: Hz (if computed in the field)

Qualità della misura:

Durata: rispettata
Stazionarietà: rispettata
Isotropia: rispettata
Assenza di disturbi: rispettata
Plausibilità fisica: rispettata
Robustezza statistica: rispettata

MISURA TIPO A1

HVSR 20

Peak frequency (Hz): 6.5 (±1.4)
Peak HVSR value: 8.9 (±1.4)

=== Criteria for a reliable H/V curve ==========
#1. [f0 > 10/Lw]: 6.507 > 0.5 (OK)
#2. [nc > 200]: 17048 > 200 (OK)
#3. [f0>0.5Hz; sigmaA(f) < 2 for 0.5f0 < f < 2f0] (OK)

=== Criteria for a clear H/V peak (at least 5 should be fulfilled) ==========
#1. [exists f- in the range [f0/4, f0] | AH/V(f-) < A0/2]: yes, at frequency 1.7Hz (OK)
#2. [exists f+ in the range [f0, 4f0] | AH/V(f+) < A0/2]: yes, at frequency 7.9Hz (OK)
#3. [A0 > 2]: 8.9 > 2 (OK)
#4. [fpeak[Ah/v(f) ± sigmaA(f)] = f0 ± 5%]: (OK)
#5. [sigmaf < epsilon(f0)]: 1.423 > 0.325 (NO)
#6. [sigmaA(f0) < theta(f0)]: 1.434 < 1.58 (OK)

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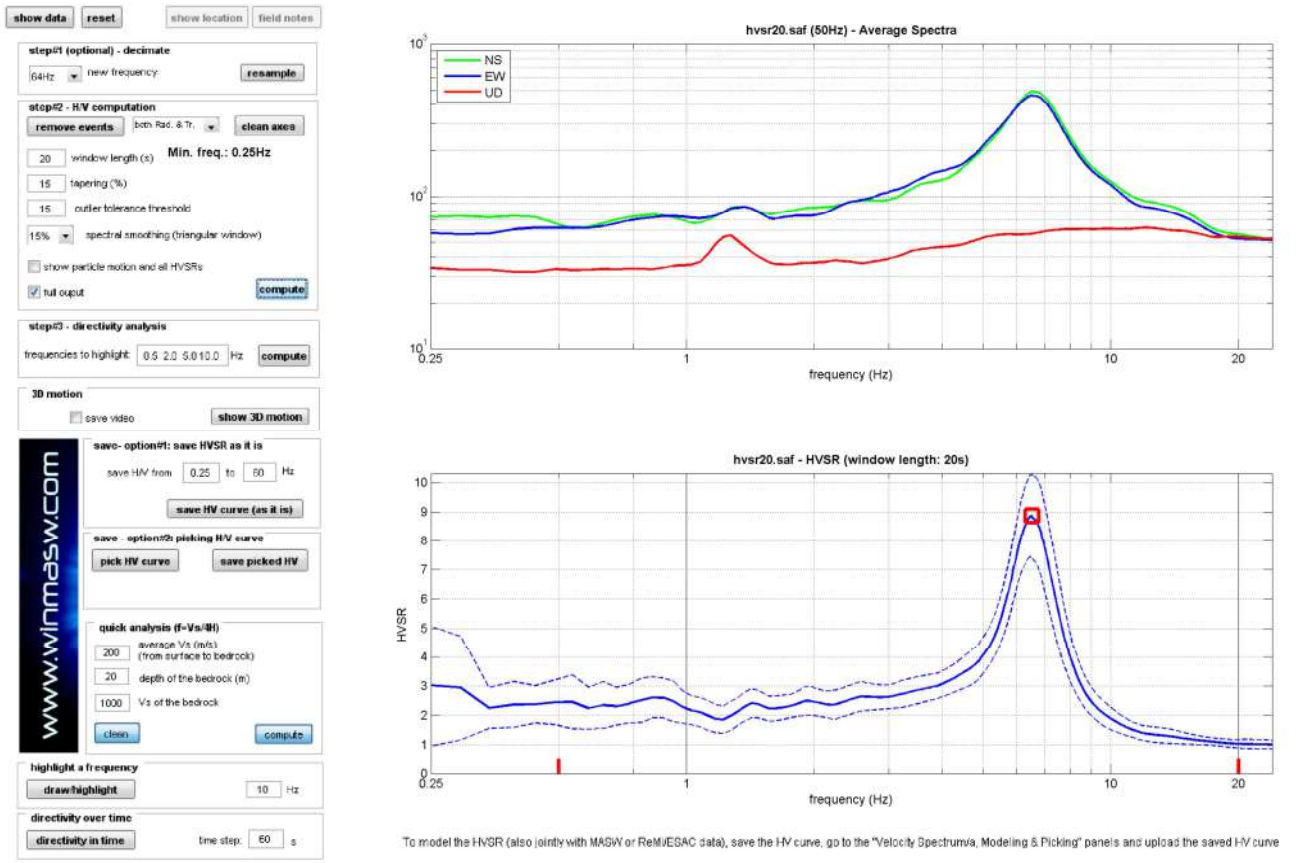
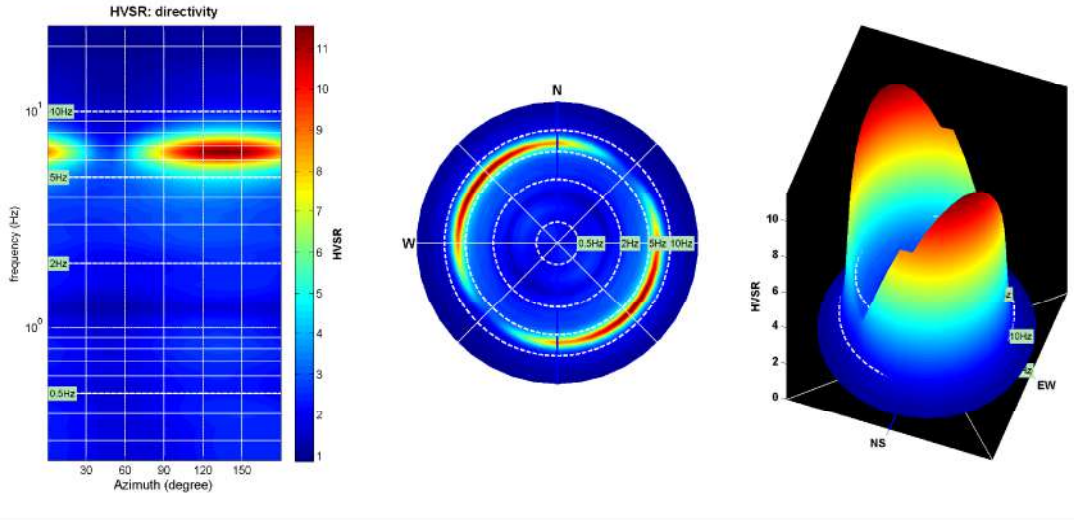
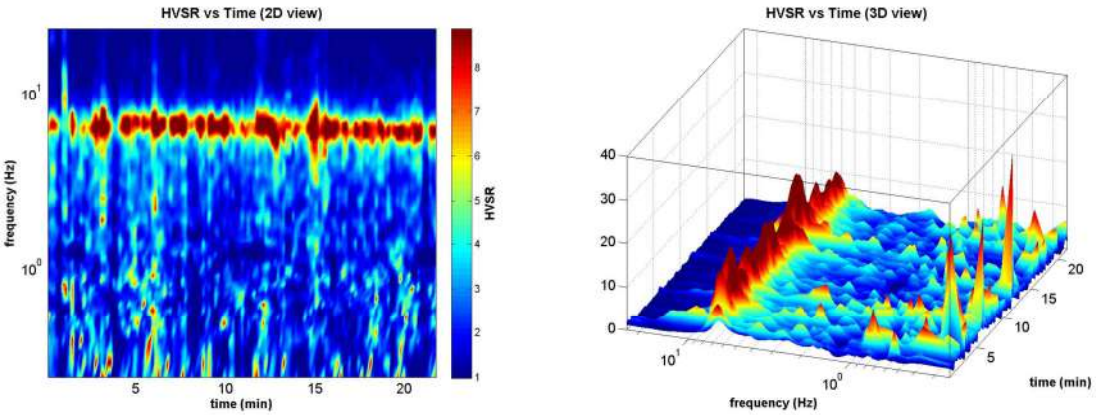

show data
reset
show location
field notes
step#1 (optional) - decimate
64Hz
new frequency
resample
step#2 - H/V computation
remove events
both Rad. & Tr.
clean axes
20
window length (s)
Min. freq.: 0.25Hz
15
tapering (%)
15
outlier tolerance threshold
15%
spectral smoothing (triangular window)
show particle motion and all HVSRs
full output
compute
step#3 - directivity analysis
frequencies to highlight
0.5 2.0 5.0 10.0
Hz
compute
3D motion
save video
show 3D motion
www.winmasw.com
save- option#1: save HVSR as it is
save H/V from
0.25
to
60
Hz
save HV curve (as it is)
save - option#2: picking H/V curve
pick HV curve
save picked HV
quick analysis (f=Vs/4H)
200
average Vs (m/s)
(from surface to bedrock)
20
depth of the bedrock (m)
1000
Vs of the bedrock
clean
compute
highlight a frequency
draw/highlight
10
Hz
directivity over time
directivity in time
time step.
60
s
hvsr20.saf (50Hz) - Average Spectra
NS
EW
UD
frequency (Hz)
hvsr20.saf - HVSR (window length: 20s)
HVSR
frequency (Hz)
To model the HVSR (also jointly with MASW or ReMi/EGAC data), save the H/V curve, go to the "Velocity Spectrum/a, Modeling & Picking" panels and upload the saved H/V curve


HVSR: directivity
10Hz
5Hz
2Hz
0.5Hz
frequency (Hz)
HVSR
Azimuth (degree)
N
W
0.5Hz
2Hz
5Hz
10Hz
H/SR
NS
EW


HVSR vs Time (2D view)
frequency (Hz)
time (min)
HVSR
HVSR vs Time (3D view)
frequency (Hz)
time (min)

HVSR21

DATE 13.07.2017	HOUR 18:23	PLACE Via Piccolomini
OPERATOR ProGeo Engineering srl	GPS TYPE and #	
GAUSS-BOAGA LATITUDE 4797657	GAUSS-BOAGA LONGITUDE 1689832	ALTITUDE 278 m slm
STATION TYPE GPA	SENSOR TYPE 4,5 Hz	
STATION #	SENSOR #	DISK #
FILE NAME HVSR21		POINT #
GAIN	SAMPL. FREQ. 100 Hz	REC. DURATION 30 min (minutes / seconds)

WEATHER CONDITIONS

WIND ☐ none ☒ weak (5m/s) ☐ medium ☐ strong Measurement (if any): _____

RAIN ☒ none ☐ weak ☐ medium ☐ strong Measurement (if any): _____

Temperature (approx): 36 Remarks _____

GROUND TYPE

☒ earth (☒ hard ☐ soft) ☐ gravel ☐ sand ☐ rock ☐ grass = (☐ short ☐ tall)

☐ asphalt ☐ cement ☐ concrete ☐ paved ☐ other _____

☒ dry soil ☐ wet soil Remarks _____

ARTIFICIAL GROUND-SENSOR COUPLING ☒ no ☐ yes, type _____

BUILDING DENSITY ☐ none ☒ scattered ☐ dense ☐ other, type _____

TRANSIENTS

	none	few	moderate	many	very dense	distance
cars	●					
trucks	●					
pedestrians	●					
other	●					

MONOCHROMATIC NOISE SOURCES (factories, works, pumps, rivers,..)
☒ no ☐ yes, type _____

NEARBY STRUCTURES (description, height, distance) (trees, polls, buildings, bridges, underground structures,...)

Trees

OBSERVATIONS

FREQUENCY: Hz (if computed in the field)

Qualità della misura:

Durata: rispettata
Stazionarietà: rispettata
Isotropia: rispettata
Assenza di disturbi: non rispettata
Plausibilità fisica: non rispettata
Robustezza statistica: rispettata

MISURA TIPO C

HVSR21

Peak frequency (Hz): 0.6 (±6.4)
Peak HVSR value: 2.3 (±0.2)

=== Criteria for a reliable H/V curve ==========
#1. [f0 > 10/Lw]: 0.563 > 0.5 (OK)
#2. [nc > 200]: 1959 > 200 (OK)
#3. [f0>0.5Hz; sigmaA(f) < 2 for 0.5f0 < f < 2f0] (OK)

=== Criteria for a clear H/V peak (at least 5 should be fulfilled) ==========
#1. [exists f- in the range [f0/4, f0] | AH/V(f-) < A0/2]: (NO)
#2. [exists f+ in the range [f0, 4f0] | AH/V(f+) < A0/2]: yes, at frequency 1.1Hz (OK)
#3. [A0 > 2]: 2.3 > 2 (OK)
#4. [fpeak[Ah/v(f) ą sigmaA(f)] = f0 ą 5%]: (NO)
#5. [sigmaf < epsilon(f0)]: 6.389 > 0.084 (NO)
#6. [sigmaA(f0) < theta(f0)]: 0.191 < 2 (OK)

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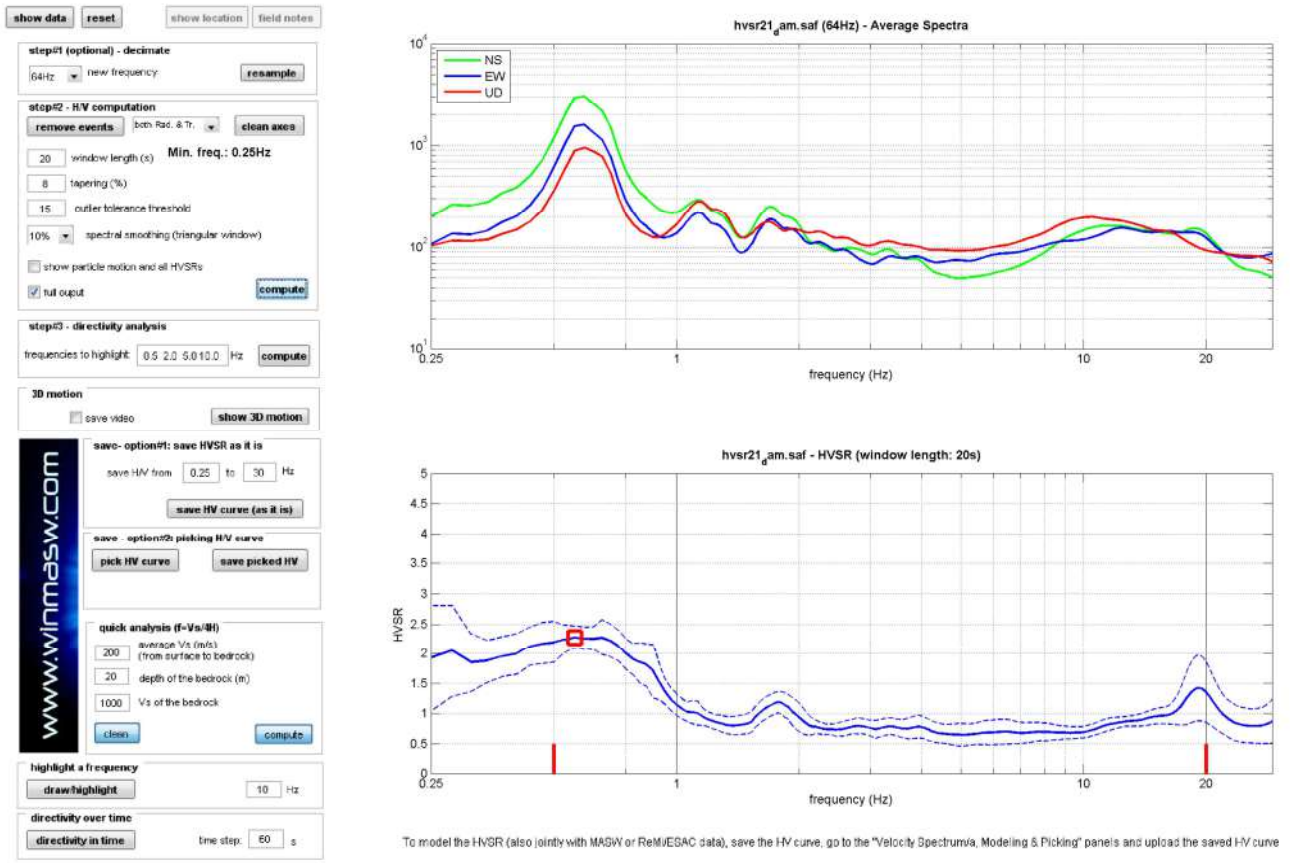
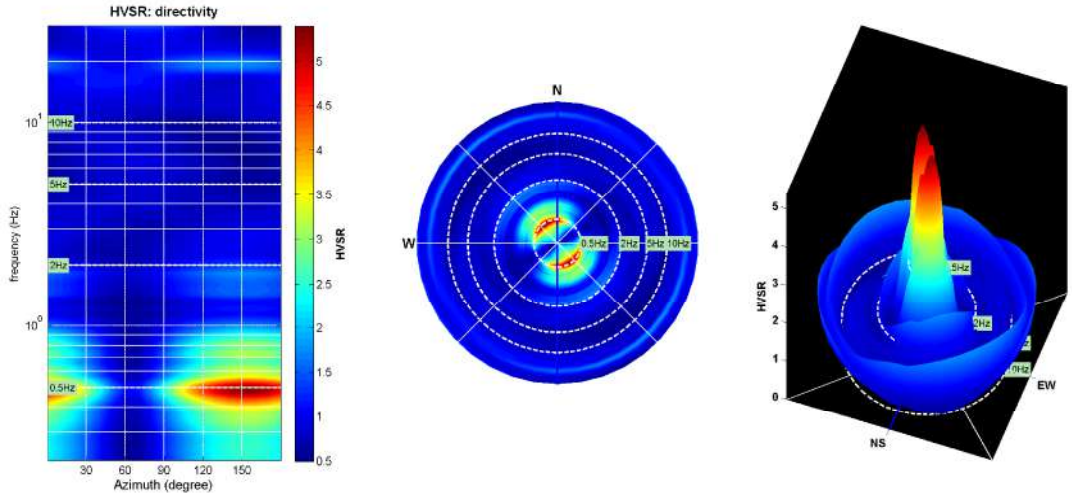
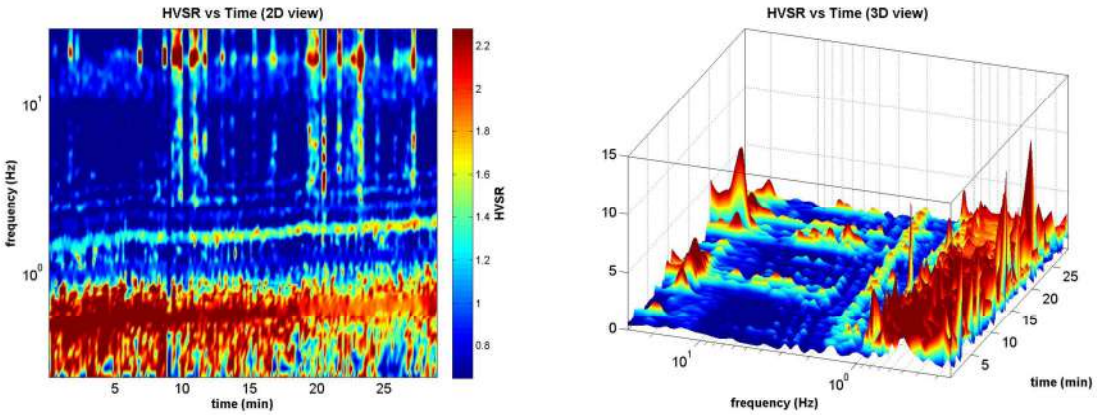

show data
reset
show location
field notes
step#1 (optional) - decimate
64Hz
new frequency
resample
step#2 - H/V computation
remove events
both Rad. & Tr.
clean axes
20
window length (s)
Min. freq.: 0.25Hz
8
tapering (%)
15
outlier tolerance threshold
10%
spectral smoothing (triangular window)
show particle motion and all HVSRs
full output
compute
step#3 - directivity analysis
frequencies to highlight
0.5 2.0 5.0 10.0
Hz
compute
3D motion
save video
show 3D motion
www.winmasw.com
save- option#1: save HVSR as it is
save H/V from
0.25
to
30
Hz
save HV curve (as it is)
save - option#2: picking H/V curve
pick HV curve
save picked HV
quick analysis (f=Vs/4H)
200
average Vs (m/s)
(from surface to bedrock)
20
depth of the bedrock (m)
1000
Vs of the bedrock
clean
compute
highlight a frequency
draw/highlight
10
Hz
directivity over time
directivity in time
time step:
60
s
hvsr21_am.saf (64Hz) - Average Spectra
NS
EW
UD
frequency (Hz)
hvsr21_am.saf - HVSR (window length: 20s)
HVSR
frequency (Hz)
To model the HVSR (also jointly with MASW or ReMi/EGAC data), save the H/V curve, go to the "Velocity Spectrum/a, Modeling & Picking" panels and upload the saved H/V curve


HVSR: directivity
frequency (Hz)
10Hz
5Hz
2Hz
0.5Hz
HVSR
Azimuth (degree)
N
W
0.5Hz
2Hz
5Hz
10Hz
HVSR
5Hz
2Hz
EW
NS


HVSR vs Time (2D view)
frequency (Hz)
HVSR
time (min)
HVSR vs Time (3D view)
frequency (Hz)
time (min)

HVSR22

DATE 16.08.2017	HOUR 14:23	PLACE I Tufi
OPERATOR ProGeo Engineering srl	GPS TYPE and #	
GAUSS-BOAGA LATITUDE 4797712	GAUSS-BOAGA LONGITUDE 1689157	ALTITUDE 301,4 m slm
STATION TYPE GPA	SENSOR TYPE 4,5 Hz	
STATION #	SENSOR #	DISK #
FILE NAME HVSR22		POINT #
GAIN	SAMPL. FREQ. 50 Hz	REC. DURATION 30 min (minutes / seconds)

WEATHER CONDITIONS: WIND (●) none ( ) weak (5m/s) ( ) medium ( ) strong Measurement (if any): ____
RAIN (●) none ( ) weak ( ) medium ( ) strong Measurement (if any): ____
Temperature (approx): 36 Remarks ____

GROUND TYPE: (●) earth ( ) hard ( ) soft ( ) gravel ( ) sand ( ) rock ( ) grass = ( ) short ( ) tall
( ) asphalt ( ) cement ( ) concrete ( ) paved ( ) other ____
(●) dry soil ( ) wet soil Remarks ____

ARTIFICIAL GROUND-SENSOR COUPLING (●) no ( ) yes, type ____

BUILDING DENSITY ( ) none (●) scattered ( ) dense ( ) other, type ____

TRANSIENTS

	none	few	moderate	many	very dense	distance
cars			●			
trucks	●					
pedestrians		●				
other	●					

MONOCHROMATIC NOISE SOURCES (factories, works, pumps, rivers,..)
(●) no ( ) yes, type ____

NEARBY STRUCTURES (description, height, distance) (trees, polls, buildings, bridges, underground structures,...)
Trees

OBSERVATIONS

FREQUENCY: Hz (if computed in the field)

Qualità della misura:

Durata: rispettata
Stazionarietà: rispettata
Isotropia: rispettata
Assenza di disturbi: non rispettata
Plausibilità fisica: rispettata
Robustezza statistica: rispettata

MISURA TIPO B1

HVSR 22

Peak frequency (Hz): 15.9 (±6.5)
Peak HVSR value: 2.7 (±0.9)

=== Criteria for a reliable H/V curve ==========
#1. [f0 > 10/Lw]: 15.949 > 0.5 (OK)
#2. [nc > 200]: 56141 > 200 (OK)
#3. [f0>0.5Hz; sigmaA(f) < 2 for 0.5f0 < f < 2f0] (OK)

=== Criteria for a clear H/V peak (at least 5 should be fulfilled) ==========
#1. [exists f- in the range [f0/4, f0] | AH/V(f-) < A0/2]: yes (considering standard deviations), at frequency 4.1Hz (OK)
#2. [exists f+ in the range [f0, 4f0] | AH/V(f+) < A0/2]: yes, at frequency 19.7Hz (OK)
#3. [A0 > 2]: 2.7 > 2 (OK)
#4. [fpeak[Ah/v(f) ą sigmaA(f)] = f0 ą 5%]: (OK)
#5. [sigmaf < epsilon(f0)]: 6.451 > 0.797 (NO)
#6. [sigmaA(f0) < theta(f0)]: 0.913 < 1.58 (OK)

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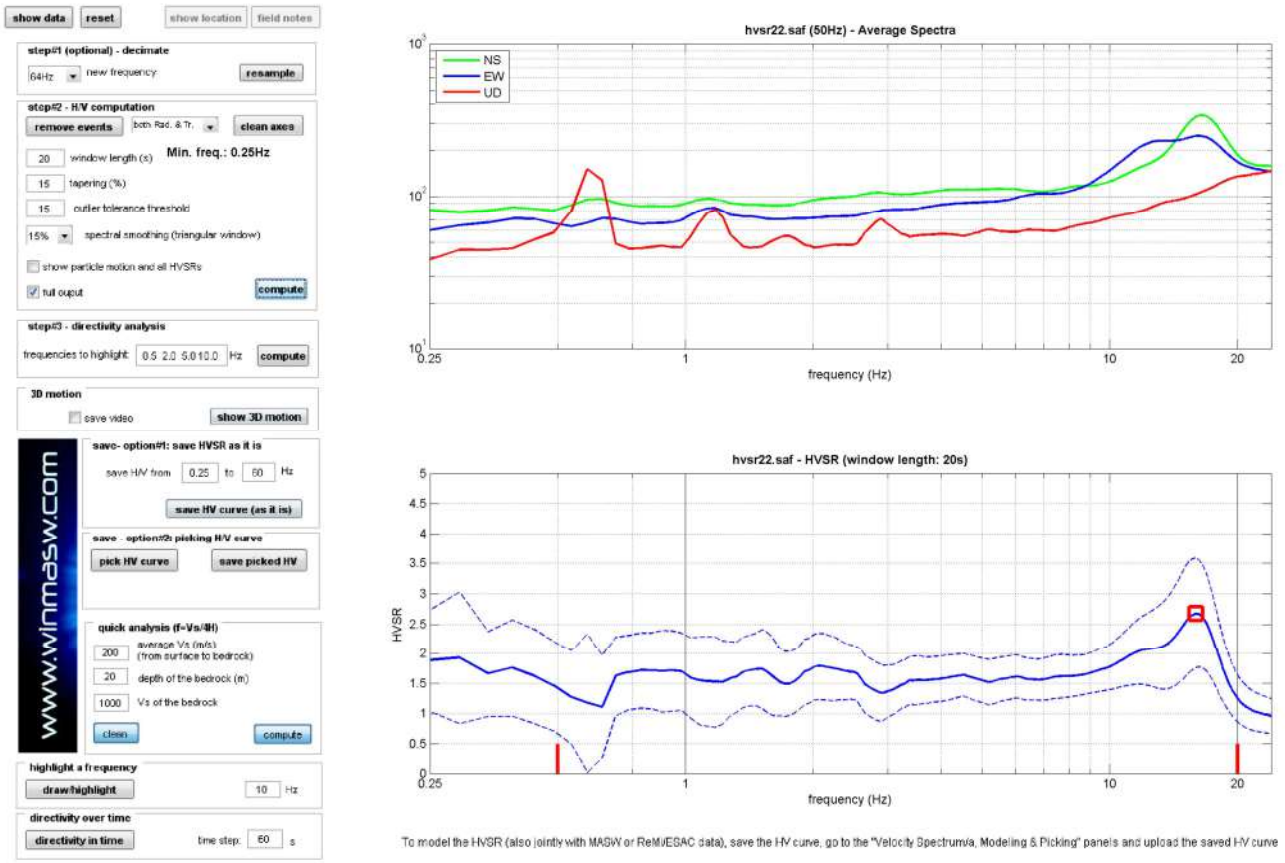
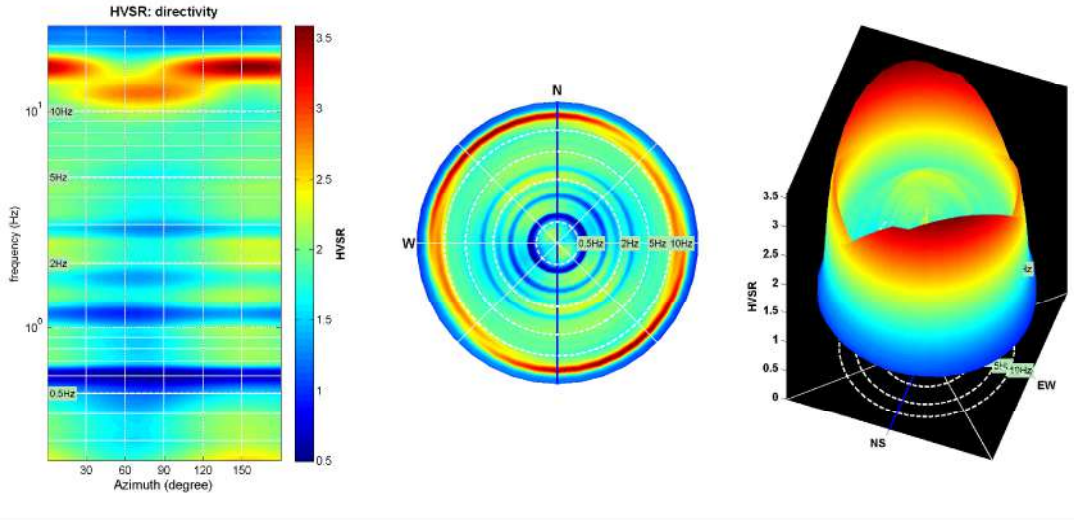
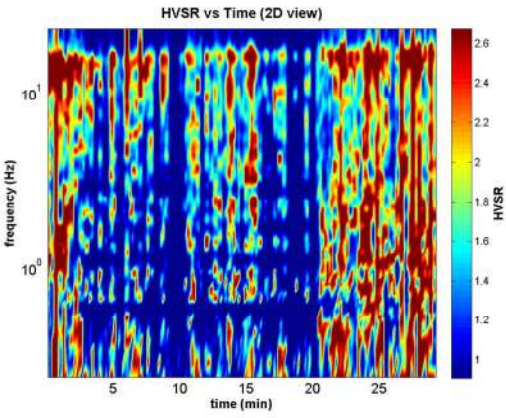
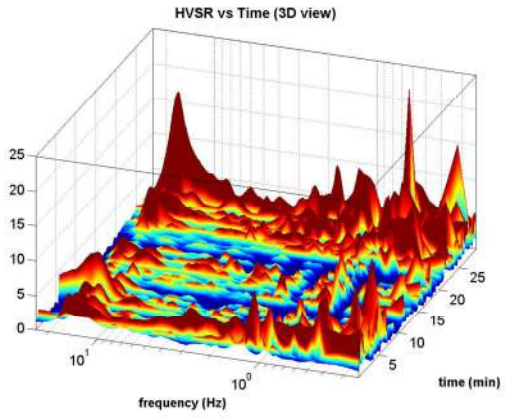

show data
reset
show location
field notes
step#1 (optional) - decimate
64Hz
new frequency
resample
step#2 - H/V computation
remove events
both Rad. & Tr.
clean axes
20
window length (s)
Min. freq.: 0.25Hz
15
tapering (%)
15
outlier tolerance threshold
15%
spectral smoothing (triangular window)
show particle motion and all HVSRs
full output
compute
step#3 - directivity analysis
frequencies to highlight
0.5 2.0 5.0 10.0
Hz
compute
3D motion
save video
show 3D motion
www.winmasw.com
save- option#1: save HVSR as it is
save H/V from
0.25
to
60
Hz
save HV curve (as it is)
save - option#2: picking H/V curve
pick HV curve
save picked HV
quick analysis (f=Vs/4H)
200
average Vs (m/s)
(from surface to bedrock)
20
depth of the bedrock (m)
1000
Vs of the bedrock
clean
compute
highlight a frequency
draw highlight
10
Hz
directivity over time
directivity in time
time step.
60
s
hvsr22.saf (50Hz) - Average Spectra
NS
EW
UD
frequency (Hz)
hvsr22.saf - HVSR (window length: 20s)
HVSR
frequency (Hz)
To model the HVSR (also jointly with MASW or ReMi/EGAC data), save the H/V curve, go to the "Velocity Spectrum/a, Modeling & Picking" panels and upload the saved H/V curve


HVSR: directivity
10Hz
5Hz
2Hz
0.5Hz
frequency (Hz)
HVSR
Azimuth (degree)
N
W
0.5Hz
2Hz
5Hz
10Hz
H/SR
EW
NS


HVSR vs Time (2D view)
frequency (Hz)
HVSR
time (min)


HVSR vs Time (3D view)
frequency (Hz)
time (min)

HVSR23

DATE 16.08.2017	HOUR 13:08	PLACE San Marco
OPERATOR ProGeo Engineering srl	GPS TYPE and #	
GAUSS-BOAGA LATITUDE 4798058	GAUSS-BOAGA LONGITUDE 1688551	ALTITUDE 223,7 m slm
STATION TYPE GPA	SENSOR TYPE 4,5 Hz	
STATION #	SENSOR #	DISK #
FILE NAME HVSR23		POINT #
GAIN	SAMPL. FREQ. 50 Hz	REC. DURATION 30 min (minutes / seconds)

WEATHER CONDITIONS: WIND ● none ☐ weak (5m/s) ☐ medium ☐ strong Measurement (if any): ____ ; RAIN ● none ☐ weak ☐ medium ☐ strong Measurement (if any): ____ ; Temperature (approx): 33 Remarks ____

GROUND TYPE: ☐ earth (☐ hard ☐ soft) ☐ gravel ☐ sand ☐ rock ☐ grass (☐ short ☐ tall) ; ☐ asphalt ● cement ☐ concrete ☐ paved ☐ other ____ ; ☐ dry soil ☐ wet soil Remarks ____

ARTIFICIAL GROUND-SENSOR COUPLING ● no ☐ yes, type ____

BUILDING DENSITY ☐ none ● scattered ☐ dense ☐ other, type ____

TRANSIENTS	none	few	moderate	many	very dense	distance
cars		●				
trucks	●					
pedestrians			●			
other	●					

MONOCHROMATIC NOISE SOURCES (factories, works, pumps, rivers,..) ● no ☐ yes, type ____

NEARBY STRUCTURES (description, height, distance) (trees, polls, buildings, bridges, underground structures,...)

Trees

OBSERVATIONS

FREQUENCY: Hz (if computed in the field)

Qualità della misura:

Durata: rispettata
Stazionarietà: rispettata
Isotropia: rispettata
Assenza di disturbi: rispettata
Plausibilità fisica: rispettata
Robustezza statistica: rispettata

MISURA TIPO A2

HVSR 23

Peak frequency (Hz): 17.6 (±5.6)
Peak HVSR value: 1.0 (±0.1)

=== Criteria for a reliable H/V curve ==========
#1. [f0 > 10/Lw]: 17.564 > 0.5 (OK)
#2. [nc > 200]: 62175 > 200 (OK)
#3. [f0>0.5Hz; sigmaA(f) < 2 for 0.5f0 < f < 2f0] (OK)

=== Criteria for a clear H/V peak (at least 5 should be fulfilled) ==========
#1. [exists f- in the range [f0/4, f0] | AH/V(f-) < A0/2]: (NO)
#2. [exists f+ in the range [f0, 4f0] | AH/V(f+) < A0/2]: (NO)
#3. [A0 > 2]: 1.0 < 2 (NO)
#4. [fpeak[Ah/v(f) ą sigmaA(f)] = f0 ą 5%]: (NO)
#5. [sigmaf < epsilon(f0)]: 5.602 > 0.878 (NO)
#6. [sigmaA(f0) < theta(f0)]: 0.147 < 1.58 (OK)

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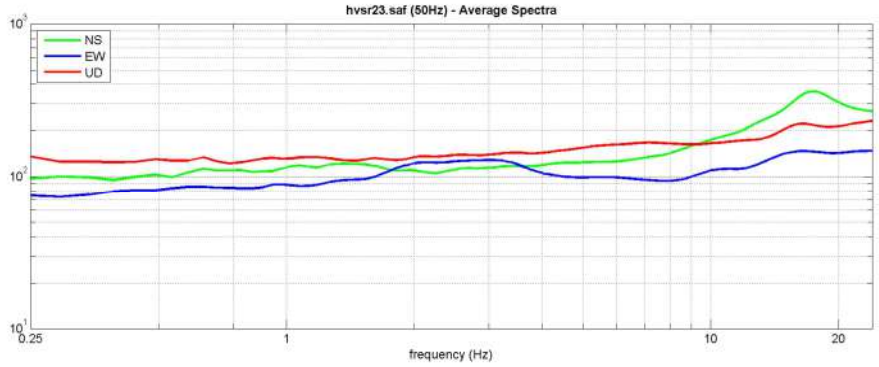
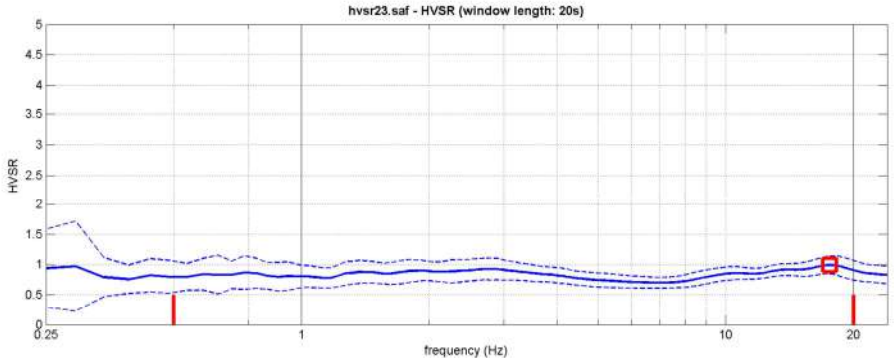
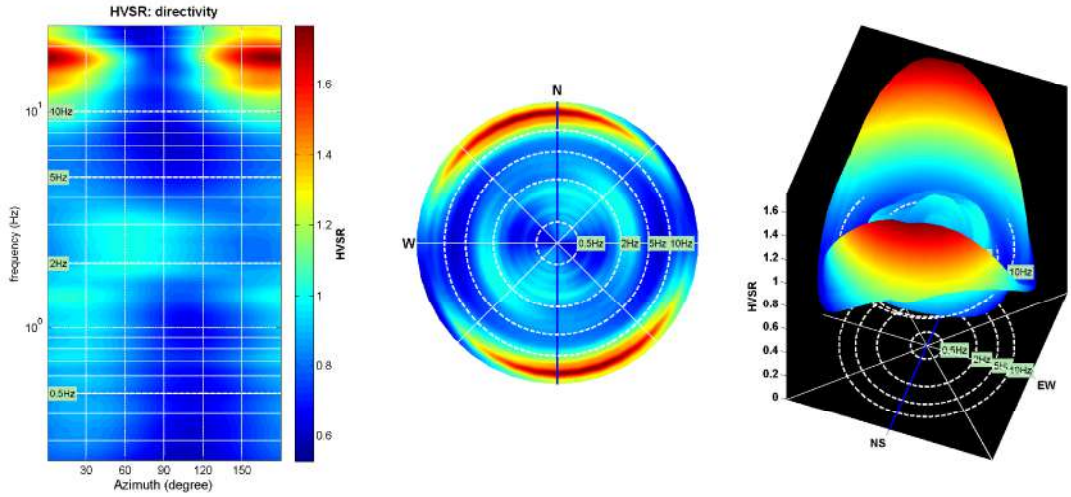
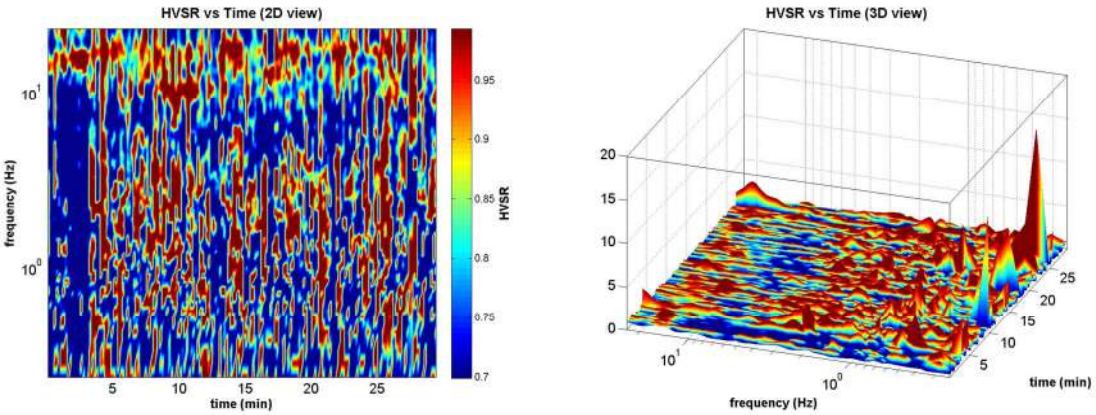




To model the HVSR (also jointly with MASW or ReMi/EGAC data), save the H/V curve, go to the "Velocity Spectrum/a, Modeling & Picking" panels and upload the saved H/V curve





HVSR24

DATE 11.08.2017	HOUR 20:13	PLACE Orto dei Pecci
OPERATOR ProGeo Engineering srl	GPS TYPE and #	
GAUSS-BOAGA LATITUDE 4798482	GAUSS-BOAGA LONGITUDE 1689370	ALTITUDE 272 m slm
STATION TYPE GPA	SENSOR TYPE 4,5 Hz	
STATION #	SENSOR #	DISK #
FILE NAME HVSR24		POINT #
GAIN	SAMPL. FREQ. 50 Hz	REC. DURATION 30 min (minutes / seconds)

WEATHER CONDITIONS

WIND ☐ none ● weak (5m/s) ☐ medium ☐ strong Measurement (if any): _____

RAIN ● none ☐ weak ☐ medium ☐ strong Measurement (if any): _____

Temperature (approx): 21 Remarks _____

GROUND TYPE

☐ earth (☐ hard ☐ soft) ☐ gravel ☐ sand ☐ rock ● grass = (● short ☐ tall)

☐ asphalt ☐ cement ☐ concrete ☐ paved ☐ other _____

☐ dry soil ☐ wet soil Remarks _____

ARTIFICIAL GROUND-SENSOR COUPLING ● no ☐ yes, type _____

BUILDING DENSITY ☐ none ● scattered ☐ dense ☐ other, type _____

TRANSIENTS

	none	few	moderate	many	very dense	distance
cars	●					
trucks	●					
pedestrians		●				
other	●					

MONOCHROMATIC NOISE SOURCES (factories, works, pumps, rivers,..)

● no ☐ yes, type _____

NEARBY STRUCTURES (description, height, distance) (trees, polls, buildings, bridges, underground structures,...)

Trees

OBSERVATIONS

FREQUENCY: Hz (if computed in the field)

Qualità della misura:

Durata: rispettata
Stazionarietà: rispettata
Isotropia: rispettata
Assenza di disturbi: rispettata
Plausibilità fisica: rispettata
Robustezza statistica: rispettata

MISURA TIPO C

HVSR24

Peak frequency (Hz): 1.6 (±3.2)
Peak HVSR value: 2.3 (±0.9)

=== Criteria for a reliable H/V curve ==========
#1. [f0 > 10/Lw]: 1.564 > 0.25 (OK)
#2. [nc > 200]: 5443 > 200 (OK)
#3. [f0>0.5Hz; sigmaA(f) < 2 for 0.5f0 < f < 2f0] (OK)

=== Criteria for a clear H/V peak (at least 5 should be fulfilled) ==========
#1. [exists f- in the range [f0/4, f0] | AH/V(f-) < A0/2]: yes (considering standard deviations), at frequency 0.8Hz (OK)
#2. [exists f+ in the range [f0, 4f0] | AH/V(f+) < A0/2]: (NO)
#3. [A0 > 2]: 2.3 > 2 (OK)
#4. [fpeak[Ah/v(f) ą sigmaA(f)] = f0 ą 5%]: (NO)
#5. [sigmaf < epsilon(f0)]: 3.206 > 0.156 (NO)
#6. [sigmaA(f0) < theta(f0)]: 0.944 < 1.78 (OK)

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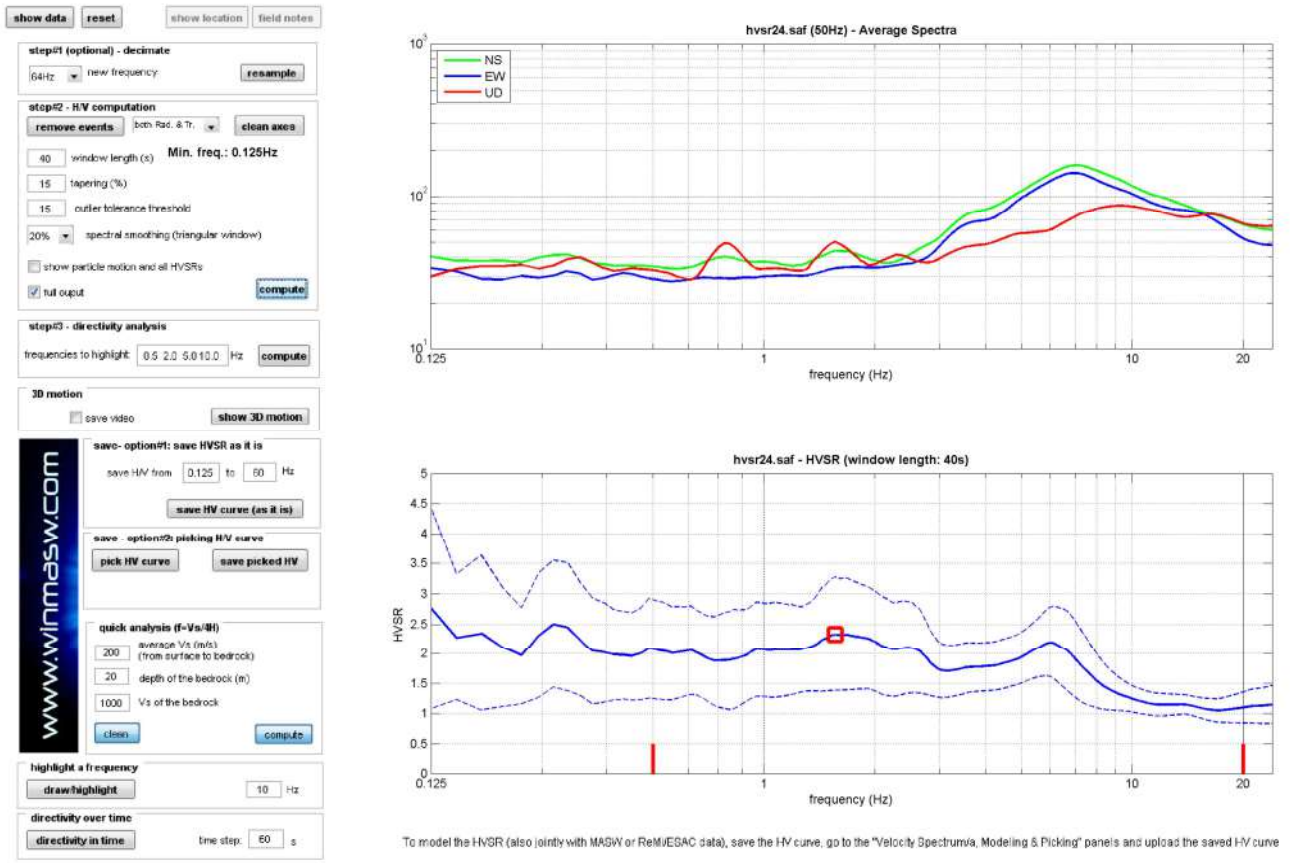
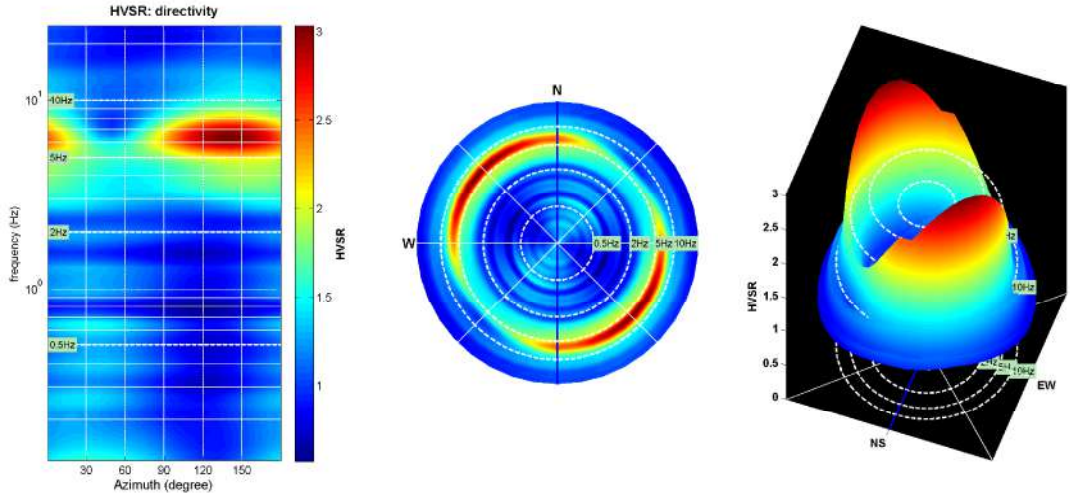
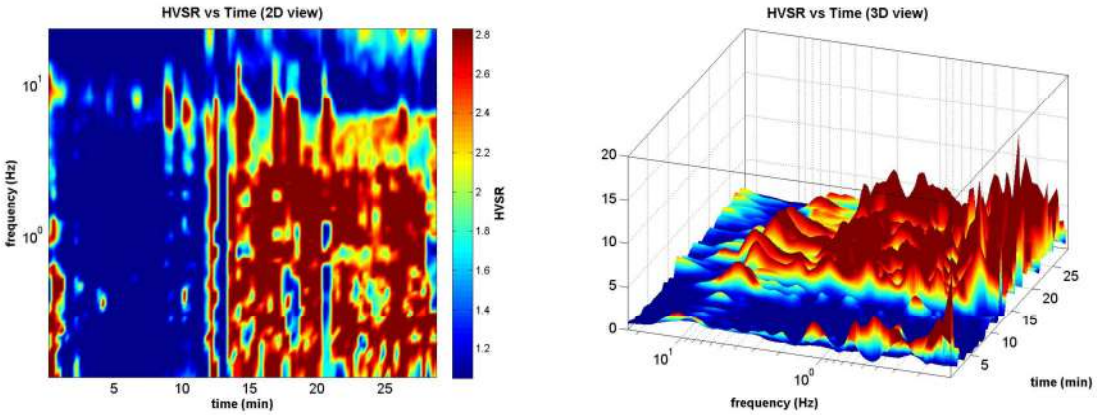

show data
reset
show location
field notes
step#1 (optional) - decimate
64Hz
new frequency
resample
step#2 - H/V computation
remove events
both Rad. & Tr.
clean axes
40
window length (s)
Min. freq.: 0.125Hz
15
tapering (%)
15
outlier tolerance threshold
20%
spectral smoothing (triangular window)
show particle motion and all HVSRs
full output
compute
step#3 - directivity analysis
frequencies to highlight
0.5 2.0 5.0 10.0
Hz
compute
3D motion
save video
show 3D motion
www.winmasw.com
save- option#1: save HVSR as it is
save H/V from
0.125
to
60
Hz
save HV curve (as it is)
save - option#2: picking H/V curve
pick HV curve
save picked HV
quick analysis (f=Vs/4H)
200
average Vs (m/s)
(from surface to bedrock)
20
depth of the bedrock (m)
1000
Vs of the bedrock
clean
compute
highlight a frequency
draw/highlight
10
Hz
directivity over time
directivity in time
time step.
60
s
hvsr24.saf (50Hz) - Average Spectra
NS
EW
UD
frequency (Hz)
hvsr24.saf - HVSR (window length: 40s)
HVSR
frequency (Hz)
To model the HVSR (also jointly with MASW or ReMi/ESAC data), save the H/V curve, go to the "Velocity Spectrum/a, Modeling & Picking" panels and upload the saved H/V curve


HVSR: directivity
10Hz
5Hz
2Hz
0.5Hz
frequency (Hz)
HVSR
Azimuth (degree)
N
W
0.5Hz
2Hz
5Hz
10Hz
H/SR
NS
EW


HVSR vs Time (2D view)
frequency (Hz)
HVSR
time (min)
HVSR vs Time (3D view)
frequency (Hz)
time (min)

HVSR25

DATE 14.07.2017	HOUR 10:25	PLACE Viale Vittorio Veneto
OPERATOR ProGeo Engineering srl	GPS TYPE and #	
GAUSS-BOAGA LATITUDE 4799120	GAUSS-BOAGA LONGITUDE 1688324	ALTITUDE 339.4 m slm
STATION TYPE GPA	SENSOR TYPE 4,5 Hz	
STATION #	SENSOR #	DISK #
FILE NAME HVSR25		POINT #
GAIN	SAMPL. FREQ. 100 Hz	REC. DURATION 30 min (minutes / seconds)

WEATHER CONDITIONS: WIND ☐ none ☑ weak (5m/s) ☐ medium ☐ strong Measurement (if any): ____ ; RAIN ☑ none ☐ weak ☐ medium ☐ strong Measurement (if any): ____ ; Temperature (approx): 29 Remarks ____

GROUND TYPE: ☑ earth (☑ hard ☐ soft) ☐ gravel ☐ sand ☐ rock ☐ grass (☐ short ☐ tall) ☐ asphalt ☐ cement ☐ concrete ☐ paved ☐ other ____ ; ☑ dry soil ☐ wet soil Remarks ____

ARTIFICIAL GROUND-SENSOR COUPLING ☑ no ☐ yes, type ____

BUILDING DENSITY ☐ none ☐ scattered ☑ dense ☐ other, type ____

TRANSIENTS	none	few	moderate	many	very dense	distance
cars				●		
trucks	●					
pedestrians				●		
other	●					

MONOCHROMATIC NOISE SOURCES (factories, works, pumps, rivers,..) ☑ no ☐ yes, type ____

NEARBY STRUCTURES (description, height, distance) (trees, polls, buildings, bridges, underground structures,...)

Trees, Buildings

OBSERVATIONS

FREQUENCY: Hz (if computed in the field)

Qualità della misura:

Durata: rispettata
Stazionarietà: rispettata
Isotropia: rispettata
Assenza di disturbi: non rispettata
Plausibilità fisica: rispettata
Robustezza statistica: rispettata

MISURA TIPO B1

HVSR25

Peak frequency (Hz): 9.2 (±2.6)
Peak HVSR value: 2.2 (±0.3)

=== Criteria for a reliable H/V curve ==========
#1. [f0 > 10/Lw]: 9.165 > 0.5 (OK)
#2. [nc > 200]: 30428 > 200 (OK)
#3. [f0>0.5Hz; sigmaA(f) < 2 for 0.5f0 < f < 2f0] (OK)

=== Criteria for a clear H/V peak (at least 5 should be fulfilled) ==========
#1. [exists f- in the range [f0/4, f0] | AH/V(f-) < A0/2]: yes (considering standard deviations), at frequency 2.8Hz (OK)
#2. [exists f+ in the range [f0, 4f0] | AH/V(f+) < A0/2]: yes (considering standard deviations), at frequency Hz (OK)
#3. [A0 > 2]: 2.2 > 2 (OK)
#4. [fpeak[Ah/v(f) ą sigmaA(f)] = f0 ą 5%]: (NO)
#5. [sigmaf < epsilon(f0)]: 2.607 > 0.458 (NO)
#6. [sigmaA(f0) < theta(f0)]: 0.348 < 1.58 (OK)

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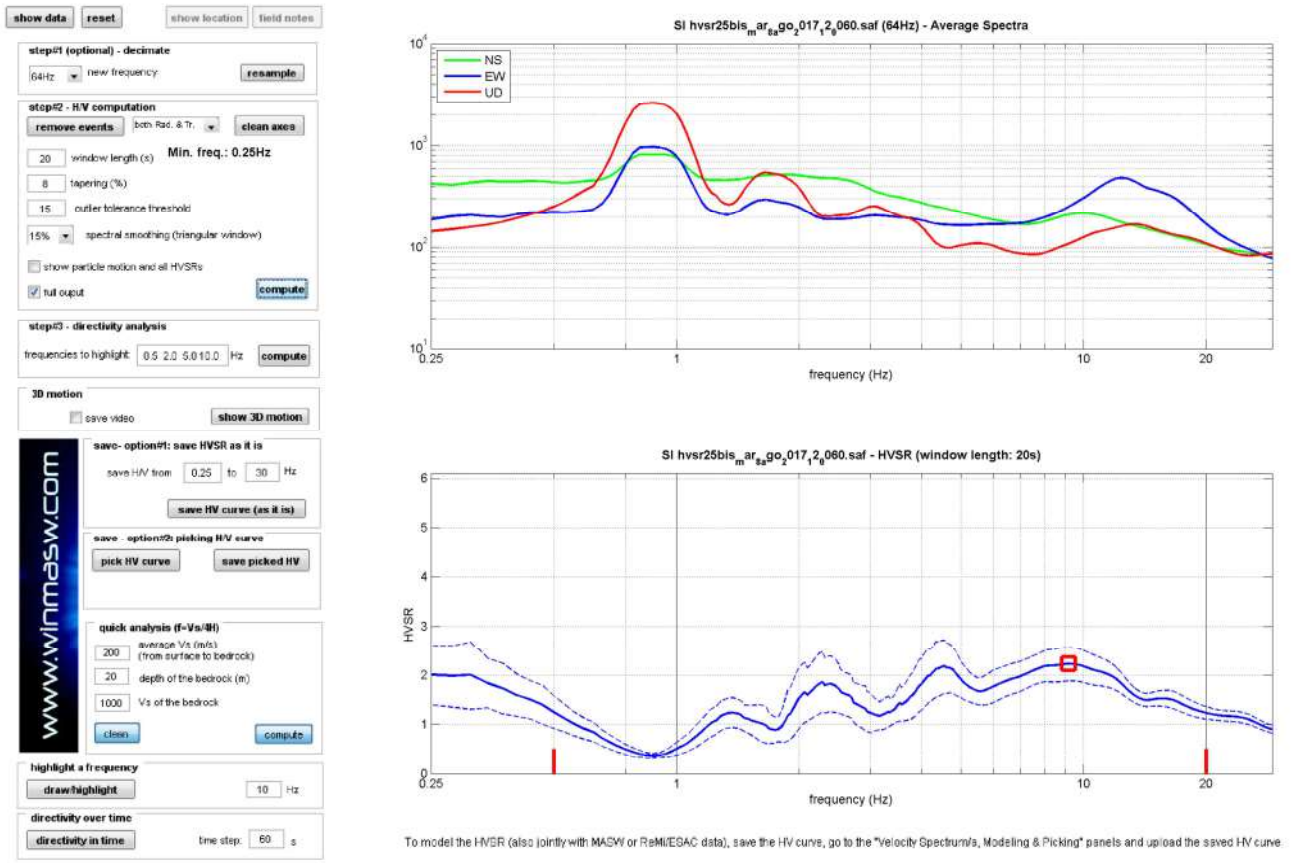
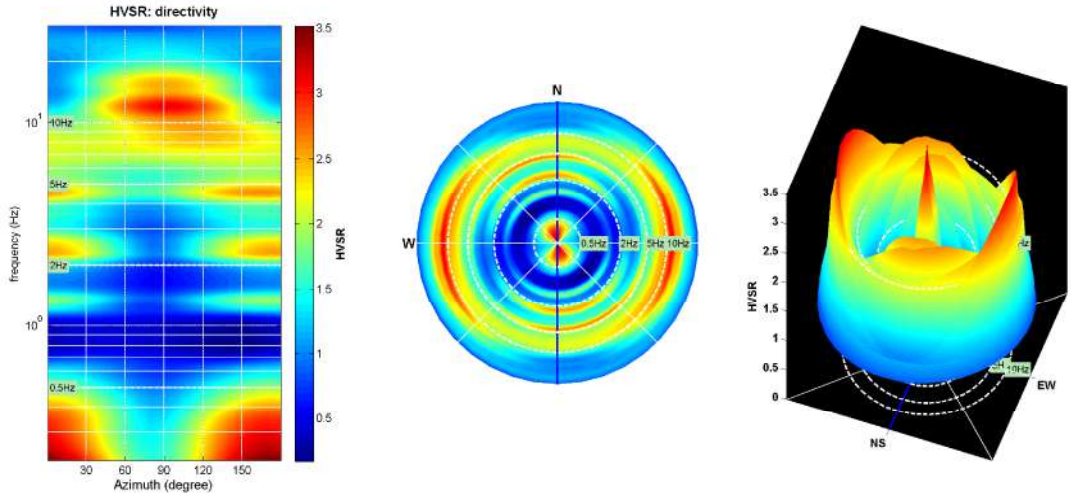
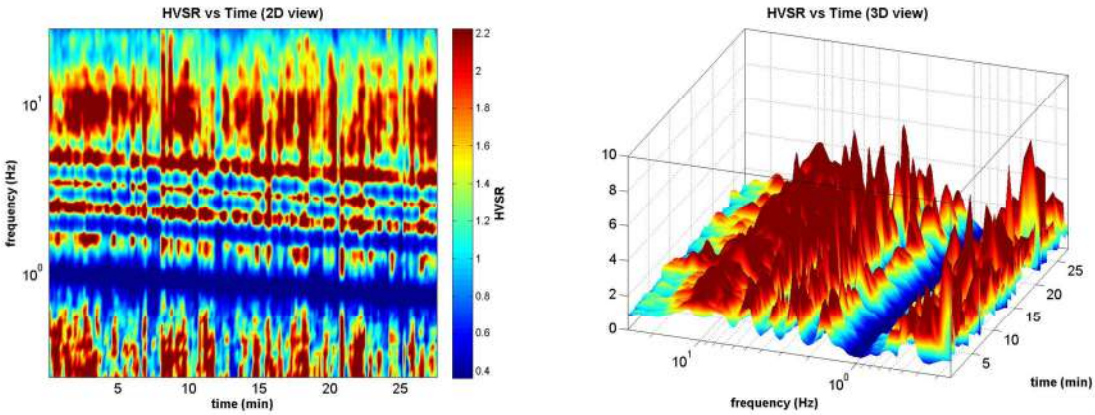

show data
reset
show location
field notes
step#1 (optional) - decimate
64Hz
new frequency
resample
step#2 - H/V computation
remove events
both Rad. & Tr.
clean axes
20
window length (s)
Min. freq.: 0.25Hz
8
tapering (%)
15
outlier tolerance threshold
15%
spectral smoothing (triangular window)
show particle motion and all HVSRs
full output
compute
step#3 - directivity analysis
frequencies to highlight
0.5 2.0 5.0 10.0
Hz
compute
3D motion
save video
show 3D motion
www.winmasw.com
save- option#1: save HVSR as it is
save H/V from
0.25
to
30
Hz
save HV curve (as it is)
save - option#2: picking H/V curve
pick HV curve
save picked HV
quick analysis (f=Vs/4H)
200
average Vs (m/s)
(from surface to bedrock)
20
depth of the bedrock (m)
1000
Vs of the bedrock
clean
compute
highlight a frequency
draw highlight
10
Hz
directivity over time
directivity in time
time step:
60
s
SI hvsr25bis_m_ar_8a_go_2_017_1_2_0_060.saf (64Hz) - Average Spectra
NS
EW
UD
frequency (Hz)
SI hvsr25bis_m_ar_8a_go_2_017_1_2_0_060.saf - HVSR (window length: 20s)
HVSR
frequency (Hz)
To model the HVSR (also jointly with MASW or ReMi/ESAC data), save the HV curve, go to the "Velocity Spectrum/a, Modeling & Picking" panels and upload the saved HV curve


HVSR: directivity
10Hz
5Hz
2Hz
0.5Hz
frequency (Hz)
HVSR
Azimuth (degree)
N
W
0.5Hz
2Hz
5Hz
10Hz
H/SR
EW
NS


HVSR vs Time (2D view)
frequency (Hz)
HVSR
time (min)
HVSR vs Time (3D view)
frequency (Hz)
time (min)

HVSR26

DATE 08.08.2017	HOUR 16:30	PLACE Via Lorenzo Maitani
OPERATOR ProGeo Engineering srl	GPS TYPE and #	
GAUSS-BOAGA LATITUDE 4799702	GAUSS-BOAGA LONGITUDE 1689369	ALTITUDE 305 m slm
STATION TYPE GPA	SENSOR TYPE 4,5 Hz	
STATION #	SENSOR #	DISK #
FILE NAME HVSR26		POINT #
GAIN	SAMPL. FREQ. 100 Hz	REC. DURATION 30 min (minutes / seconds)

WEATHER CONDITIONS: WIND ☐ none ◉ weak (5m/s) ☐ medium ☐ strong Measurement (if any): ____ ; RAIN ◉ none ☐ weak ☐ medium ☐ strong Measurement (if any): ____ ; Temperature (approx): 38 Remarks ____

GROUND TYPE: ◉ earth (◉ hard ☐ soft) ☐ gravel ☐ sand ☐ rock ☐ grass = (☐ short ☐ tall) ☐ asphalt ☐ cement ☐ concrete ☐ paved ☐ other ____ ; ◉ dry soil ☐ wet soil Remarks ____

ARTIFICIAL GROUND-SENSOR COUPLING ◉ no ☐ yes, type ____

BUILDING DENSITY ☐ none ☐ scattered ◉ dense ☐ other, type ____

TRANSIENTS	none	few	moderate	many	very dense	distance
cars			◉			
trucks	◉					
pedestrians		◉				
other	◉					

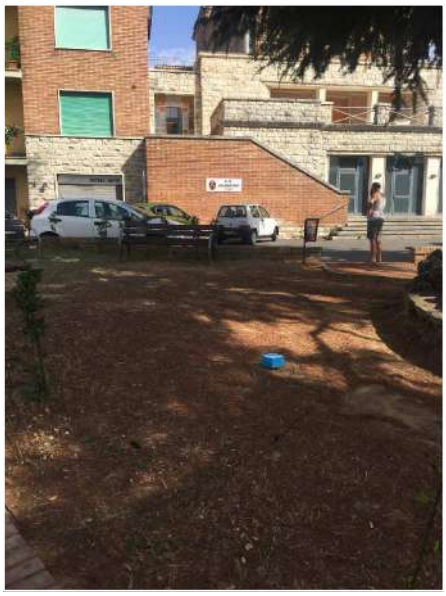
MONOCHROMATIC NOISE SOURCES (factories, works, pumps, rivers...) ◉ no ☐ yes, type ____

NEARBY STRUCTURES (description, height, distance) (trees, polls, buildings, bridges, underground structures,...)

Trees, Buildings

OBSERVATIONS

FREQUENCY: Hz (if computed in the field)



Qualità della misura:

Durata: rispettata
Stazionarietà: rispettata
Isotropia: rispettata
Assenza di disturbi: rispettata
Plausibilità fisica: rispettata
Robustezza statistica: rispettata

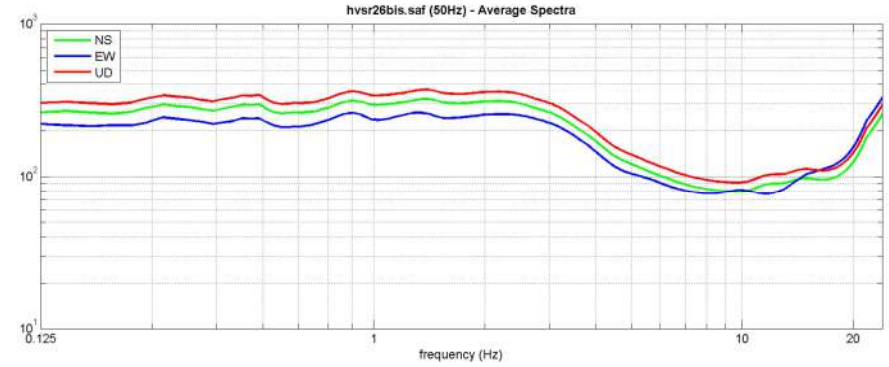
MISURA TIPO A2

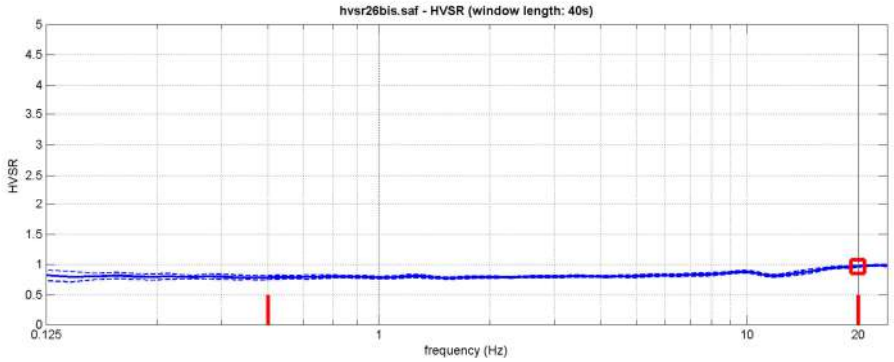
HVSR26

Peak frequency (Hz): 20.0 (±6.3)
Peak HVSR value: 1.0 (±0.0)

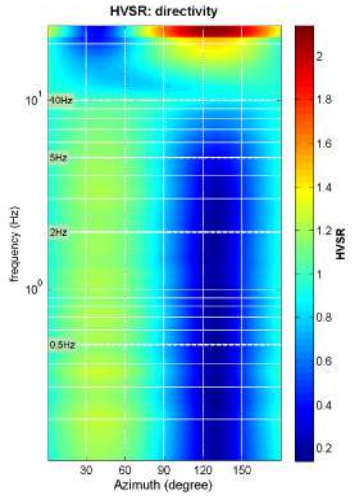
=== Criteria for a reliable H/V curve ==========
#1. [f0 > 10/Lw]: 19.990 > 0.25 (OK)
#2. [nc > 200]: 68766 > 200 (OK)
#3. [f0>0.5Hz; sigmaA(f) < 2 for 0.5f0 < f < 2f0] (OK)

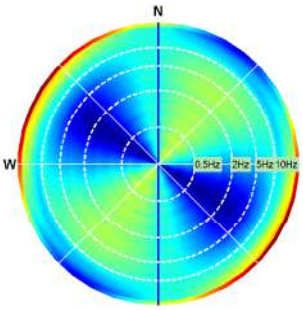
=== Criteria for a clear H/V peak (at least 5 should be fulfilled) ==========
#1. [exists f- in the range [f0/4, f0] | AH/V(f-) < A0/2]: (NO)
#2. [exists f+ in the range [f0, 4f0] | AH/V(f+) < A0/2]: (NO)
#3. [A0 > 2]: 1.0 < 2 (NO)
#4. [fpeak[Ah/v(f) ą sigmaA(f)] = f0 ą 5%]: (OK)
#5. [sigmaf < epsilon(f0)]: 6.340 > 1.000 (NO)
#6. [sigmaA(f0) < theta(f0)]: 0.016 < 1.58 (OK)

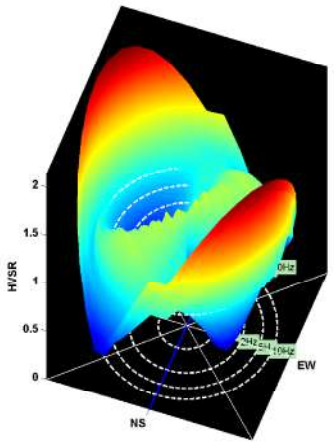


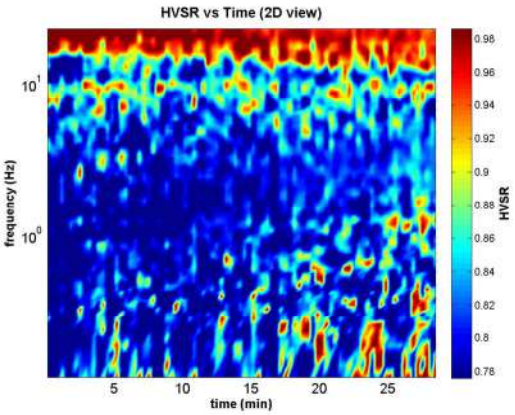


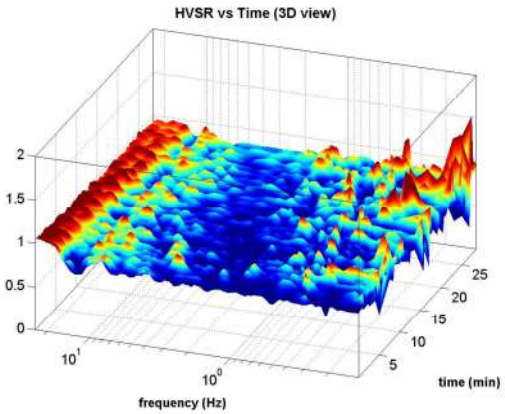
To model the HVSR (also jointly with MASW or ReMi/EGAC data), save the H/V curve, go to the "Velocity Spectrum/a, Modeling & Picking" panels and upload the saved H/V curve











HVSR27

DATE 14.07.2017	HOUR 10:08	PLACE La Lizza
OPERATOR ProGeo Engineering srl	GPS TYPE and #	
GAUSS-BOAGA LATITUDE 4799391	GAUSS-BOAGA LONGITUDE 1688662	ALTITUDE 340,9 m slm
STATION TYPE GPA	SENSOR TYPE 4,5 Hz	
STATION #	SENSOR #	DISK #
FILE NAME HVSR27		POINT #
GAIN	SAMPL. FREQ. 100 Hz	REC. DURATION 30 min (minutes / seconds)

WEATHER CONDITIONS: WIND (●) none ( ) weak (5m/s) ( ) medium ( ) strong Measurement (if any): ____ ; RAIN (●) none ( ) weak ( ) medium ( ) strong Measurement (if any): ____ ; Temperature (approx): 30 ; Remarks ____

GROUND TYPE: ( ) earth (□hard □soft) (●) gravel ( ) sand ( ) rock ( ) grass (□short □tall) ; ( ) asphalt ( ) cement ( ) concrete ( ) paved ( ) other ____ ; (●) dry soil ( ) wet soil Remarks ____

ARTIFICIAL GROUND-SENSOR COUPLING (●) no ( ) yes, type ____

BUILDING DENSITY ( ) none ( ) scattered (●) dense ( ) other, type ____

TRANSIENTS	none	few	moderate	many	very dense	distance
cars			●			
trucks		●				
pedestrians			●			
other ____	●					

MONOCHROMATIC NOISE SOURCES (factories, works, pumps, rivers,..): (●) no ( ) yes, type ____

NEARBY STRUCTURES (description, height, distance) (trees, polls, buildings, bridges, underground structures,...): Trees, Buildings

OBSERVATIONS

FREQUENCY: Hz (if computed in the field)

Qualità della misura:

Durata: rispettata
Stazionarietà: rispettata
Isotropia: rispettata
Assenza di disturbi: non rispettata
Plausibilità fisica: rispettata
Robustezza statistica: rispettata

MISURA TIPO B2

HVSR27

Peak frequency (Hz): 2.4 (±2.7)
Peak HVSR value: 1.3 (±0.2)

=== Criteria for a reliable H/V curve ==========
#1. [f0 > 10/Lw]: 2.377 > 0.5 (OK)
#2. [nc > 200]: 8368 > 200 (OK)
#3. [f0>0.5Hz; sigmaA(f) < 2 for 0.5f0 < f < 2f0] (OK)

=== Criteria for a clear H/V peak (at least 5 should be fulfilled) ==========
#1. [exists f- in the range [f0/4, f0] | AH/V(f-) < A0/2]: yes, at frequency 1.5Hz (OK)
#2. [exists f+ in the range [f0, 4f0] | AH/V(f+) < A0/2]: yes (considering standard deviations), at frequency Hz (OK)
#3. [A0 > 2]: 1.3 < 2 (NO)
#4. [fpeak[Ah/v(f) ą sigmaA(f)] = f0 ą 5%]: (NO)
#5. [sigmaf < epsilon(f0)]: 2.655 > 0.119 (NO)
#6. [sigmaA(f0) < theta(f0)]: 0.145 < 1.58 (OK)

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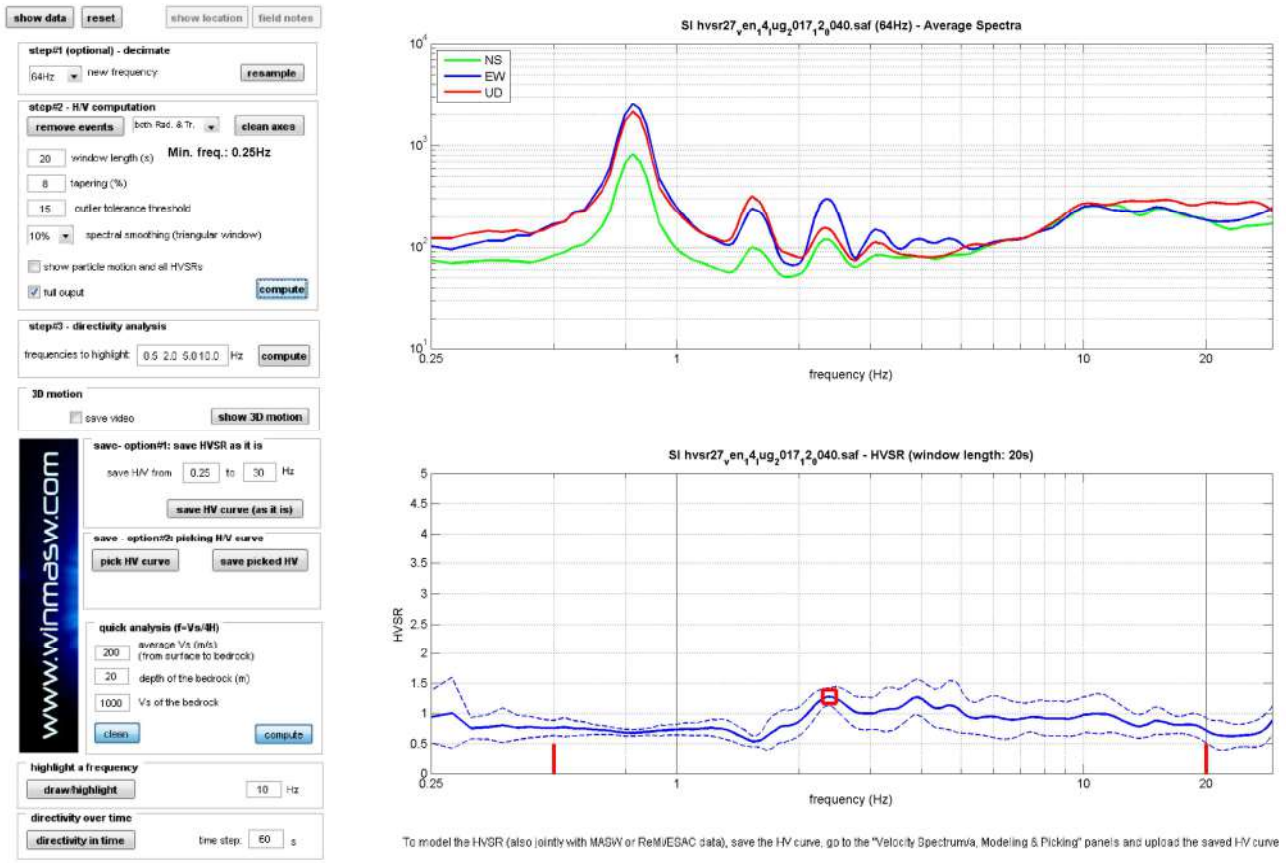
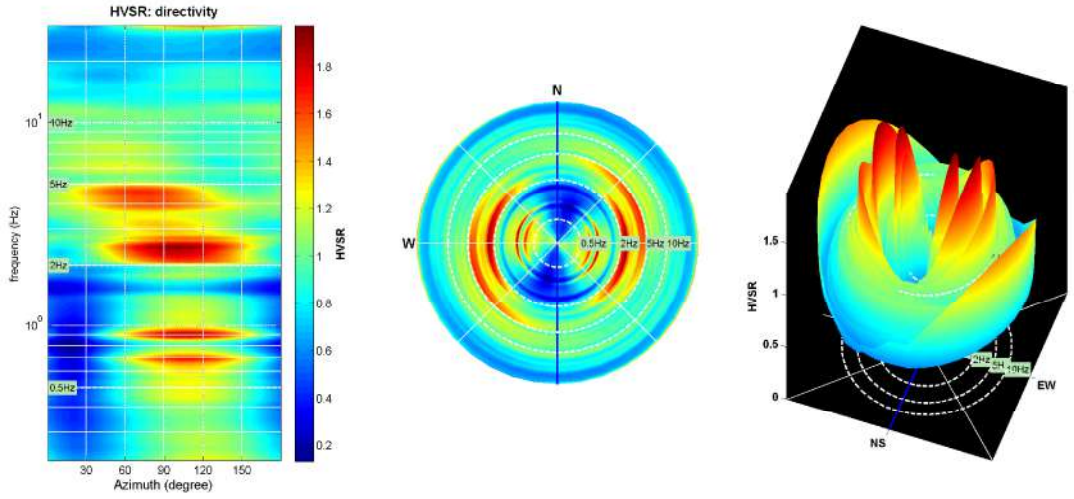
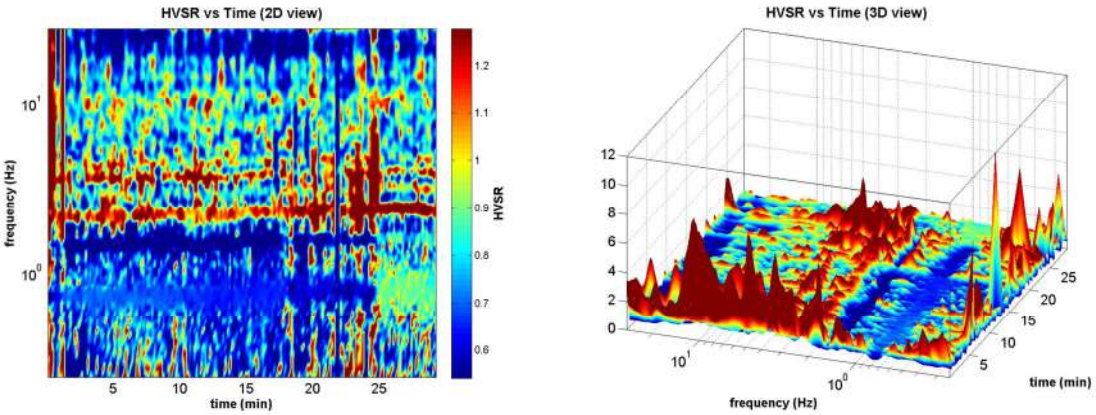

show data
reset
show location
field notes
step#1 (optional) - decimate
64Hz
new frequency
resample
step#2 - H/V computation
remove events
both Rad. & Tr.
clean axes
20
window length (s)
Min. freq.: 0.25Hz
8
tapering (%)
15
outlier tolerance threshold
10%
spectral smoothing (triangular window)
show particle motion and all HVSRs
full output
compute
step#3 - directivity analysis
frequencies to highlight
0.5 2.0 5.0 10.0
Hz
compute
3D motion
save video
show 3D motion
www.winmasw.com
save- option#1: save HVSR as it is
save H/V from
0.25
to
30
Hz
save HV curve (as it is)
save - option#2: picking H/V curve
pick HV curve
save picked HV
quick analysis (f=Vs/4H)
200
average Vs (m/s)
(from surface to bedrock)
20
depth of the bedrock (m)
1000
Vs of the bedrock
clean
compute
highlight a frequency
draw/highlight
10
Hz
directivity over time
directivity in time
time step:
60
s
SI hvsr27_ven_14_ug_2017_12_040.saf (64Hz) - Average Spectra
NS
EW
UD
frequency (Hz)
SI hvsr27_ven_14_ug_2017_12_040.saf - HVSR (window length: 20s)
HVSR
frequency (Hz)
To model the HVSR (also jointly with MASW or ReMi/EGAC data), save the H/V curve, go to the "Velocity Spectrum/a, Modeling & Picking" panels and upload the saved H/V curve


HVSR: directivity
10Hz
5Hz
2Hz
0.5Hz
frequency (Hz)
HVSR
Azimuth (degree)
N
W
0.5Hz
2Hz
5Hz
10Hz
H/SR
NS
EW


HVSR vs Time (2D view)
frequency (Hz)
HVSR
time (min)
HVSR vs Time (3D view)
frequency (Hz)
time (min)

HVSR28

DATE 14.07.2017	HOUR 10:37	PLACE Piazza Giovanni Amendola
OPERATOR ProGeo Engineering srl	GPS TYPE and #	
GAUSS-BOAGA LATITUDE 4799779	GAUSS-BOAGA LONGITUDE 1688308	ALTITUDE 341 m slm
STATION TYPE GPA	SENSOR TYPE 4,5 Hz	
STATION #	SENSOR #	DISK #
FILE NAME HVSR28		POINT #
GAIN	SAMPL. FREQ. 100 Hz	REC. DURATION 30 min (minutes / seconds)

WEATHER CONDITIONS: WIND (●none ☐weak (5m/s) ☐medium ☐strong) Measurement (if any): _____ ; RAIN (●none ☐weak ☐medium ☐strong) Measurement (if any): _____ ; Temperature (approx): 28 ; Remarks _____

GROUND TYPE: (●earth (●hard ☐soft) ☐gravel ☐sand ☐rock ☐grass (☐short ☐tall)) ☐asphalt ☐cement ☐concrete ☐paved ☐other _____ ; (●dry soil ☐wet soil) Remarks _____

ARTIFICIAL GROUND-SENSOR COUPLING (●no ☐yes, type _____)

BUILDING DENSITY ☐none ☐scattered ●dense ☐other, type _____

TRANSIENTS	none	few	moderate	many	very dense	distance
cars		●				
trucks	●					
pedestrians				●		
other	●					

MONOCHROMATIC NOISE SOURCES (factories, works, pumps, rivers,..): (●no ☐yes, type _____)

NEARBY STRUCTURES (description, height, distance) (trees, polls, buildings, bridges, underground structures,...): Trees, Buildings

OBSERVATIONS

FREQUENCY: Hz (if computed in the field)

Qualità della misura:

Durata: rispettata
Stazionarietà: rispettata
Isotropia: rispettata
Assenza di disturbi:non rispettata
Plausibilità fisica: rispettata
Robustezza statistica: rispettata

MISURA TIPO B1

HVSR28

Peak frequency (Hz): 20.0 (±4.9)
Peak HVSR value: 2.6 (±0.3)

=== Criteria for a reliable H/V curve ==========
#1. [f0 > 10/Lw]: 19.988 > 0.5 (OK)
#2. [nc > 200]: 70359 > 200 (OK)
#3. [f0>0.5Hz; sigmaA(f) < 2 for 0.5f0 < f < 2f0] (OK)

=== Criteria for a clear H/V peak (at least 5 should be fulfilled) ==========
#1. [exists f- in the range [f0/4, f0] | AH/V(f-) < A0/2]: yes (considering standard deviations), at frequency 5.0Hz (OK)
#2. [exists f+ in the range [f0, 4f0] | AH/V(f+) < A0/2]: (NO)
#3. [A0 > 2]: 2.6 > 2 (OK)
#4. [fpeak[Ah/v(f) ą sigmaA(f)] = f0 ą 5%]: (OK)
#5. [sigmaf < epsilon(f0)]: 4.874 > 0.999 (NO)
#6. [sigmaA(f0) < theta(f0)]: 0.281 < 1.58 (OK)

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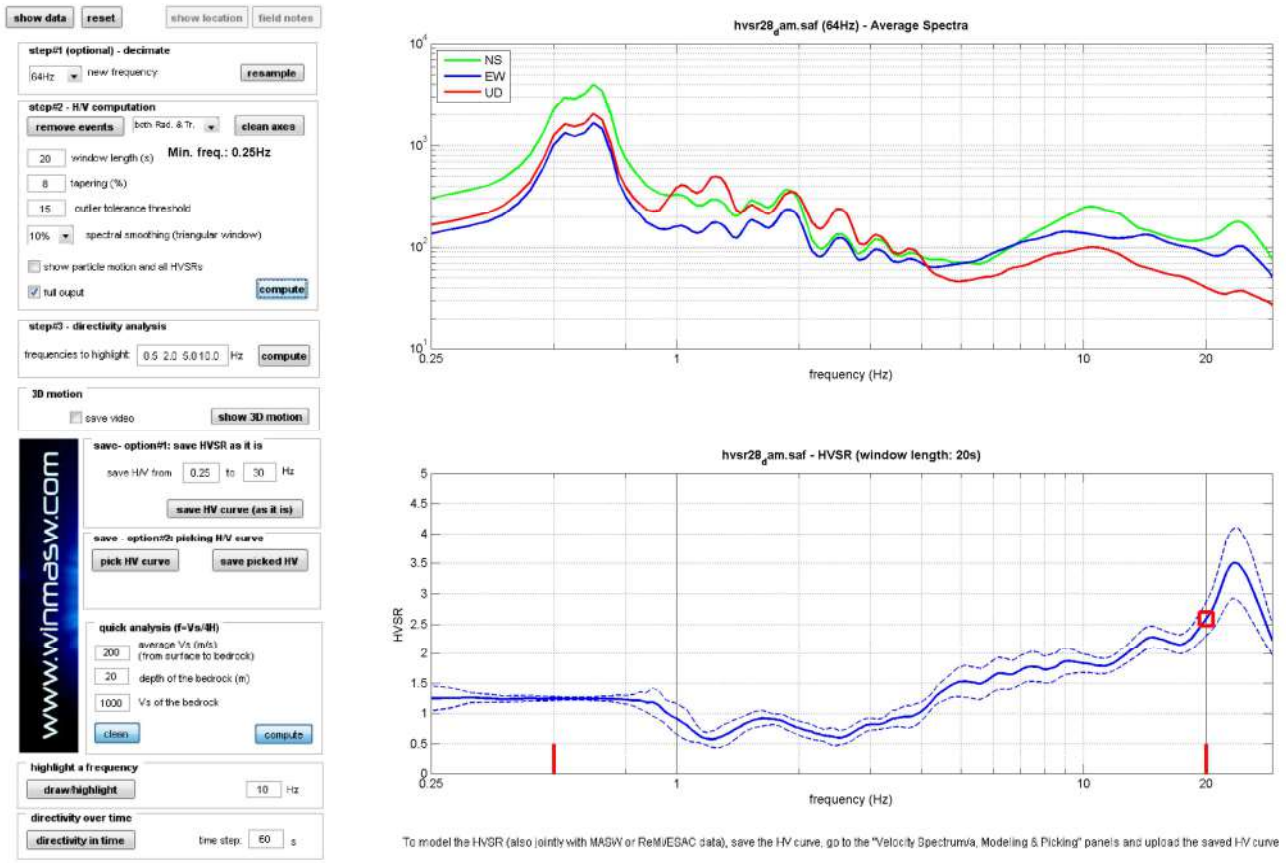
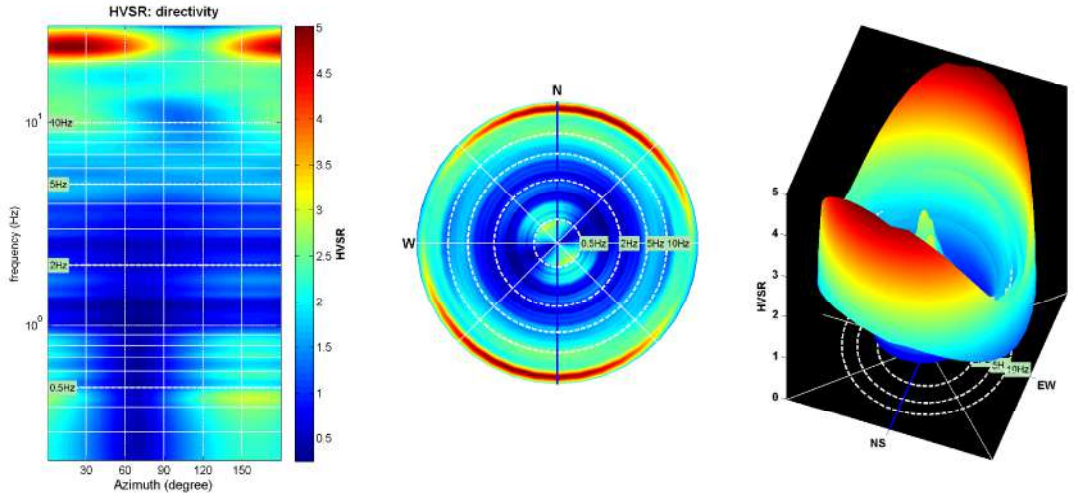
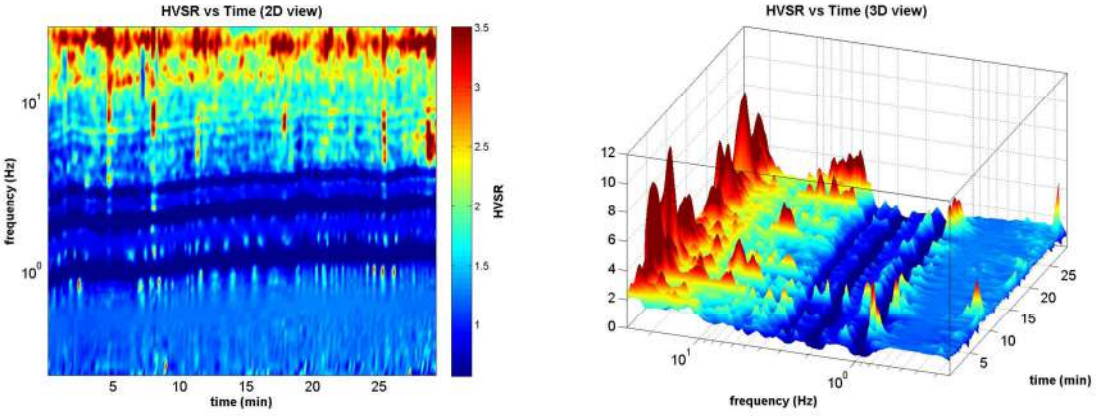
via Don Luigi Sturzo, 43/A - 52100 - Arezzo
tel. 0575 324114 - fax. 0575 406473 - email: info@progeo.arezzo.it


show data
reset
show location
field notes
step#1 (optional) - decimate
64Hz
new frequency
resample
step#2 - H/V computation
remove events
both Rad. & Tr.
clean axes
20
window length (s)
Min. freq.: 0.25Hz
8
tapering (%)
15
outlier tolerance threshold
10%
spectral smoothing (triangular window)
show particle motion and all HVSRs
full output
compute
step#3 - directivity analysis
frequencies to highlight
0.5 2.0 5.0 10.0
Hz
compute
3D motion
save video
show 3D motion
www.winmasw.com
save- option#1: save HVSR as it is
save H/V from
0.25
to
30
Hz
save HV curve (as it is)
save - option#2: picking H/V curve
pick HV curve
save picked HV
quick analysis (f=Vs/4H)
200
average Vs (m/s)
(from surface to bedrock)
20
depth of the bedrock (m)
1000
Vs of the bedrock
clean
compute
highlight a frequency
draw/highlight
10
Hz
directivity over time
directivity in time
time step.
60
s
hvsr28_am.saf (64Hz) - Average Spectra
NS
EW
UD
frequency (Hz)
hvsr28_am.saf - HVSR (window length: 20s)
HVSR
frequency (Hz)
To model the HVSR (also jointly with MASW or ReMi/EGAC data), save the H/V curve, go to the "Velocity Spectrum/a, Modeling & Picking" panels and upload the saved H/V curve


HVSR: directivity
10Hz
5Hz
2Hz
0.5Hz
frequency (Hz)
Azimuth (degree)
HVSR
N
W
0.5Hz
2Hz
5Hz
10Hz
HVSR
EW
NS


HVSR vs Time (2D view)
frequency (Hz)
time (min)
HVSR
HVSR vs Time (3D view)
frequency (Hz)
time (min)

HVSR29

DATE 14.07.2017	HOUR 10:00	PLACE Viale Avignone
OPERATOR ProGeo Engineering srl	GPS TYPE and #	
GAUSS-BOAGA LATITUDE 4799971	GAUSS-BOAGA LONGITUDE 1687992	ALTITUDE 320 m slm
STATION TYPE GPA	SENSOR TYPE 4,5 Hz	
STATION #	SENSOR #	DISK #
FILE NAME HVSR29		POINT #
GAIN	SAMPL. FREQ. 100 Hz	REC. DURATION 30 min (minutes / seconds)

WEATHER CONDITIONS: WIND ☐ none ◉ weak (5m/s) ☐ medium ☐ strong Measurement (if any): ____ ; RAIN ◉ none ☐ weak ☐ medium ☐ strong Measurement (if any): ____ ; Temperature (approx): 27 Remarks ____

GROUND TYPE: ◉ earth (◉ hard ☐ soft) ☐ gravel ☐ sand ☐ rock ☐ grass (☐ short ☐ tall) ☐ asphalt ☐ cement ☐ concrete ☐ paved ☐ other ____ ; ◉ dry soil ☐ wet soil Remarks ____

ARTIFICIAL GROUND-SENSOR COUPLING ◉ no ☐ yes, type ____

BUILDING DENSITY ☐ none ◉ scattered ☐ dense ☐ other, type ____

TRANSIENTS

	none	few	moderate	many	very dense	distance
cars			◉			
trucks		◉				
pedestrians	◉					
other	◉					

MONOCHROMATIC NOISE SOURCES (factories, works, pumps, rivers,..) ◉ no ☐ yes, type ____

NEARBY STRUCTURES (description, height, distance) (trees, polls, buildings, bridges, underground structures,...)

Trees

OBSERVATIONS

FREQUENCY: Hz (if computed in the field)

Qualità della misura:

Durata: rispettata
Stazionarietà: rispettata
Isotropia: rispettata
Assenza di disturbi: rispettata
Plausibilità fisica: rispettata
Robustezza statistica: rispettata

MISURA TIPO A2

HVSR29

Peak frequency (Hz): 4.7 (±2.9)
Peak HVSR value: 1.4 (±0.2)

=== Criteria for a reliable H/V curve ==========
#1. [f0 > 10/Lw]: 4.692 > 0.5 (OK)
#2. [nc > 200]: 16610 > 200 (OK)
#3. [f0>0.5Hz; sigmaA(f) < 2 for 0.5f0 < f < 2f0] (OK)

=== Criteria for a clear H/V peak (at least 5 should be fulfilled) ==========
#1. [exists f- in the range [f0/4, f0] | AH/V(f-) < A0/2]: yes, at frequency 1.2Hz (OK)
#2. [exists f+ in the range [f0, 4f0] | AH/V(f+) < A0/2]: (NO)
#3. [A0 > 2]: 1.4 < 2 (NO)
#4. [fpeak[Ah/v(f) ą sigmaA(f)] = f0 ą 5%]: (OK)
#5. [sigmaf < epsilon(f0)]: 2.880 > 0.235 (NO)
#6. [sigmaA(f0) < theta(f0)]: 0.165 < 1.58 (OK)

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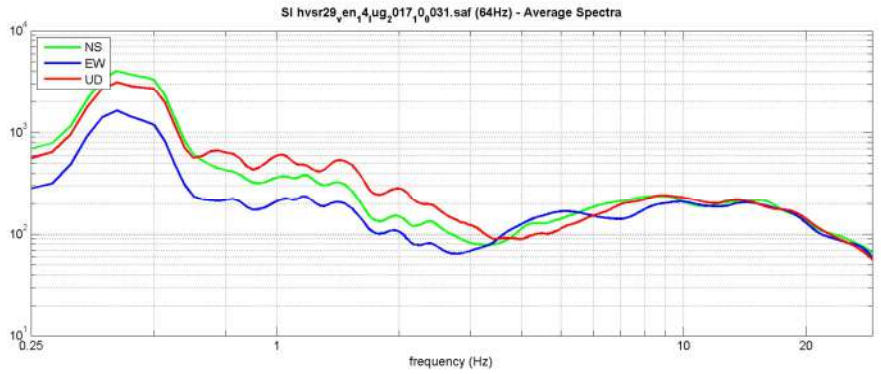
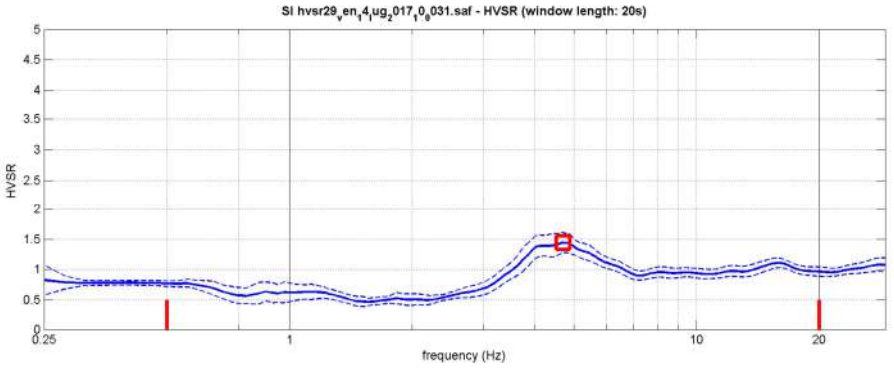
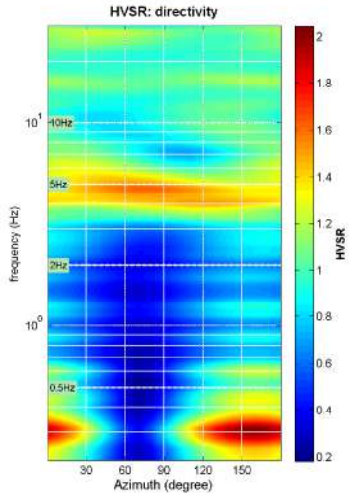
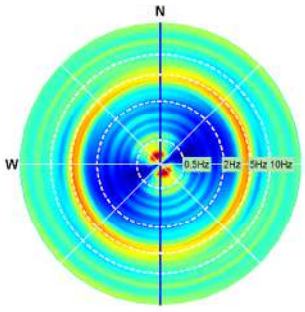
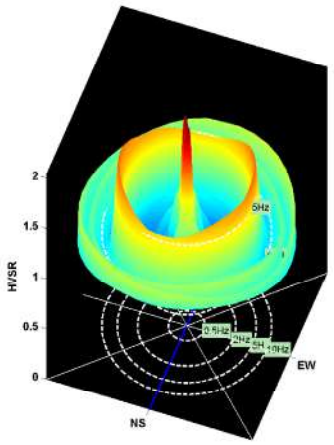


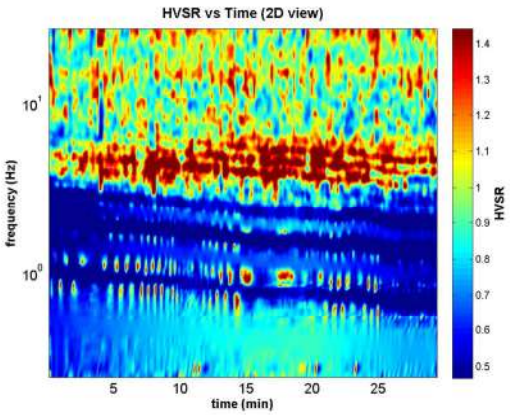


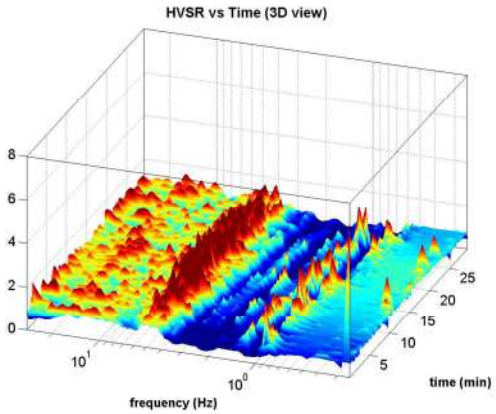
To model the HVSR (also jointly with MASW or ReMi/ESAC data), save the H/V curve, go to the "Velocity Spectrum/a, Modeling & Picking" panels and upload the saved H/V curve











HVSR30

DATE 16.08.2017	HOUR 11:48	PLACE Giardini di Pescaia
OPERATOR ProGeo Engineering srl		GPS TYPE and #
GAUSS-BOAGA LATITUDE 4799479	GAUSS-BOAGA LONGITUDE 1687864	ALTITUDE 283 m slm
STATION TYPE GPA	SENSOR TYPE 4,5 Hz	
STATION #	SENSOR #	DISK #
FILE NAME HVSR30		POINT #
GAIN	SAMPL. FREQ. 50 Hz	REC. DURATION 30 min (minutes / seconds)

WEATHER CONDITIONS: WIND ☐ none ● weak (5m/s) ☐ medium ☐ strong Measurement (if any): ____ ; RAIN ● none ☐ weak ☐ medium ☐ strong Measurement (if any): ____ ; Temperature (approx): 31 Remarks ____

GROUND TYPE: ● earth (☐hard ☐soft) ☐gravel ☐sand ☐rock ☐grass (☐short ☐tall) ☐asphalt ☐cement ☐concrete ☐paved ☐other ____ ; ● dry soil ☐ wet soil Remarks ____

ARTIFICIAL GROUND-SENSOR COUPLING ● no ☐ yes, type ____

BUILDING DENSITY ● none ☐ scattered ☐ dense ☐ other, type ____

TRANSIENTS

	none	few	moderate	many	very dense	distance
cars		●				
trucks		●				
pedestrians		●				
other ____	●					

MONOCHROMATIC NOISE SOURCES (factories, works, pumps, rivers,..) ● no ☐ yes, type ____

NEARBY STRUCTURES (description, height, distance) (trees, polls, buildings, bridges, underground structures,...)

Trees

OBSERVATIONS

FREQUENCY: Hz (if computed in the field)

Qualità della misura:

Durata: rispettata
Stazionarietà: rispettata
Isotropia: rispettata
Assenza di disturbi: non rispettata
Plausibilità fisica: rispettata
Robustezza statistica: rispettata

MISURA TIPO B2

HVSR 30

Peak frequency (Hz): 9.9 (±3.9)
Peak HVSR value: 1.6 (±0.2)

=== Criteria for a reliable H/V curve ==========
#1. [f0 > 10/Lw]: 9.897 > 0.25 (OK)
#2. [nc > 200]: 33651 > 200 (OK)
#3. [f0>0.5Hz; sigmaA(f) < 2 for 0.5f0 < f < 2f0] (OK)

=== Criteria for a clear H/V peak (at least 5 should be fulfilled) ==========
#1. [exists f- in the range [f0/4, f0] | AH/V(f-) < A0/2]: yes, at frequency 2.8Hz (OK)
#2. [exists f+ in the range [f0, 4f0] | AH/V(f+) < A0/2]: yes, at frequency 13.8Hz (OK)
#3. [A0 > 2]: 1.6 < 2 (NO)
#4. [fpeak[Ah/v(f) ą sigmaA(f)] = f0 ą 5%]: (OK)
#5. [sigmaf < epsilon(f0)]: 3.945 > 0.495 (NO)
#6. [sigmaA(f0) < theta(f0)]: 0.190 < 1.58 (OK)

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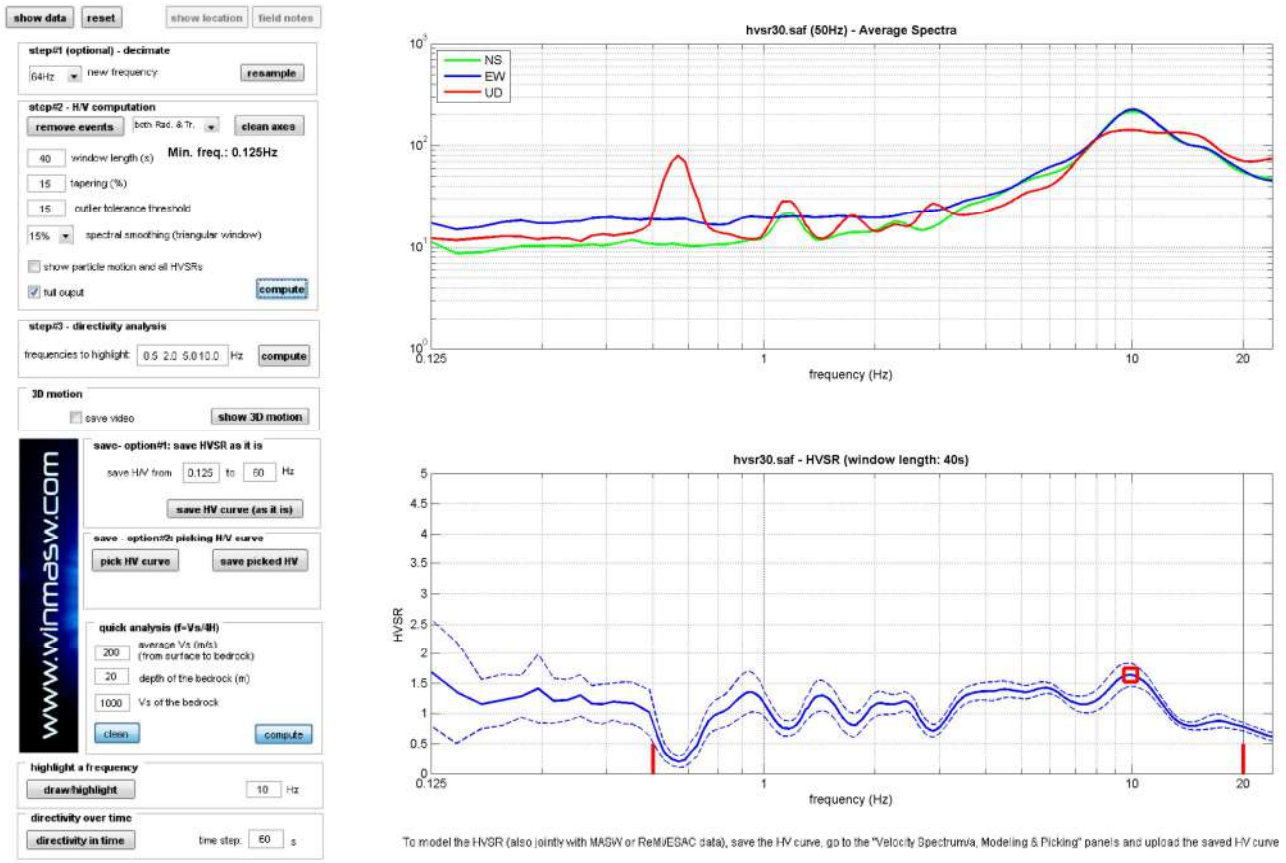
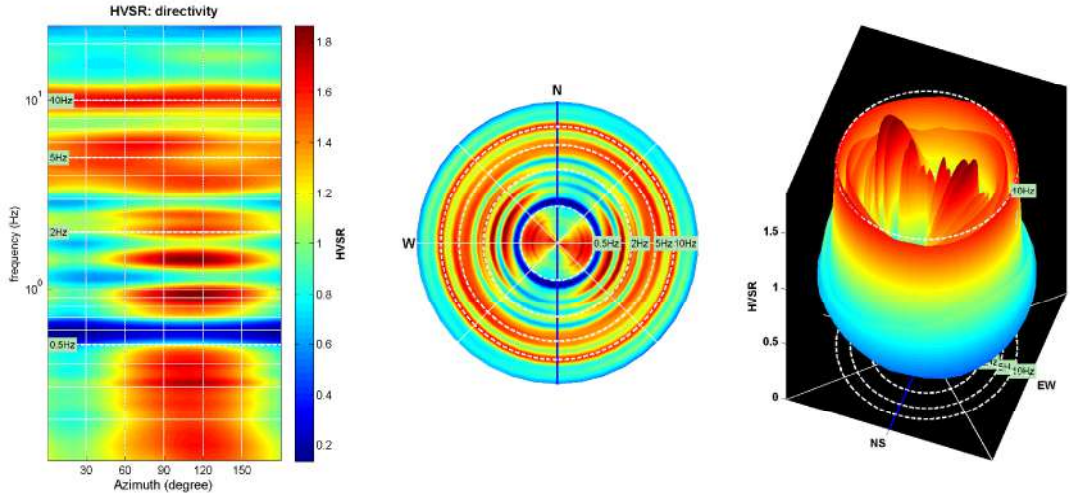
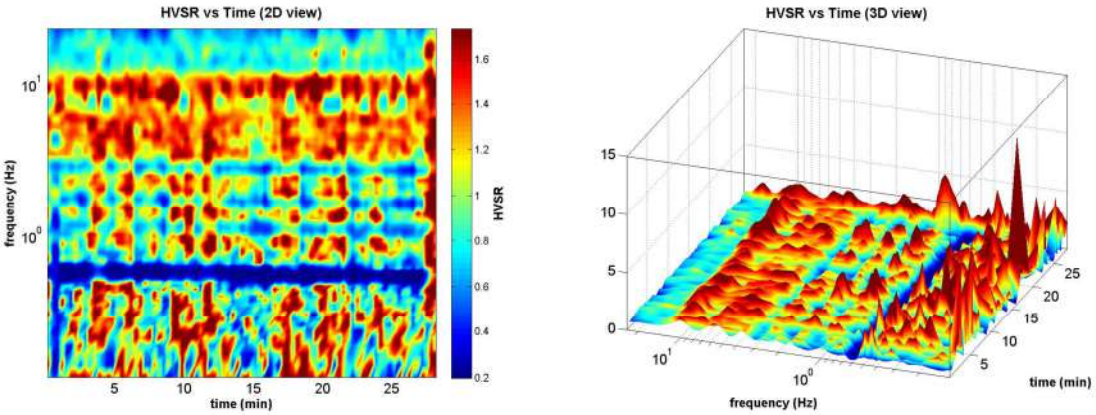

show data
reset
show location
field notes
step#1 (optional) - decimate
64Hz
new frequency
resample
step#2 - H/V computation
remove events
both Rad. & Tr.
clean axes
40
window length (s)
Min. freq.: 0.125Hz
15
tapering (%)
15
outlier tolerance threshold
15%
spectral smoothing (triangular window)
show particle motion and all HVSRs
full output
compute
step#3 - directivity analysis
frequencies to highlight
0.5 2.0 5.0 10.0
Hz
compute
3D motion
save video
show 3D motion
www.winmasw.com
save- option#1: save HVSR as it is
save H/V from
0.125
to
60
Hz
save HV curve (as it is)
save - option#2: picking H/V curve
pick HV curve
save picked HV
quick analysis (f=Vs/4H)
200
average Vs (m/s)
(from surface to bedrock)
20
depth of the bedrock (m)
1000
Vs of the bedrock
clean
compute
highlight a frequency
draw/highlight
10
Hz
directivity over time
directivity in time
time step:
60
s
hvsr30.saf (50Hz) - Average Spectra
NS
EW
UD
frequency (Hz)
hvsr30.saf - HVSR (window length: 40s)
HVSR
frequency (Hz)
To model the HVSR (also jointly with MASW or ReMi/EGAC data), save the H/V curve, go to the "Velocity Spectrum/a, Modeling & Picking" panels and upload the saved H/V curve


HVSR: directivity
10Hz
5Hz
2Hz
0.5Hz
frequency (Hz)
HVSR
Azimuth (degree)
N
W
0.5Hz
2Hz
5Hz
10Hz
HVSR
NS
EW


HVSR vs Time (2D view)
frequency (Hz)
time (min)
HVSR
HVSR vs Time (3D view)
frequency (Hz)
time (min)

HVSR31

DATE 16.08.2017	HOUR 10:20	PLACE Via Custoza
OPERATOR ProGeo Engineering srl		GPS TYPE and #
GAUSS-BOAGA LATITUDE 4799987	GAUSS-BOAGA LONGITUDE 1687524	ALTITUDE 328 m slm
STATION TYPE GPA	SENSOR TYPE 4,5 Hz	
STATION #	SENSOR #	DISK #
FILE NAME HVSR31		POINT #
GAIN	SAMPL. FREQ. 50 Hz	REC. DURATION 30 min (minutes / seconds)

WEATHER CONDITIONS: WIND (●) none ( ) weak (5m/s) ( ) medium ( ) strong Measurement (if any): ____
RAIN (●) none ( ) weak ( ) medium ( ) strong Measurement (if any): ____
Temperature (approx): 31 Remarks ____

GROUND TYPE: ( ) earth (□hard □soft) ( ) gravel ( ) sand ( ) rock ( ) grass (□short □tall)
(●) asphalt ( ) cement ( ) concrete ( ) paved ( ) other ____
( ) dry soil ( ) wet soil Remarks ____

ARTIFICIAL GROUND-SENSOR COUPLING (●) no ( ) yes, type ____

BUILDING DENSITY ( ) none ( ) scattered (●) dense ( ) other, type ____

TRANSIENTS	none	few	moderate	many	very dense	distance
cars	●					
trucks	●					
pedestrians	●					
other	●					

MONOCHROMATIC NOISE SOURCES (factories, works, pumps, rivers,..)
(●) no ( ) yes, type ____

NEARBY STRUCTURES (description, height, distance) (trees, polls, buildings, bridges, underground structures,...)
Trees

OBSERVATIONS

FREQUENCY: Hz (if computed in the field)

Qualità della misura:

Durata: rispettata
Stazionarietà: rispettata
Isotropia: rispettata
Assenza di disturbi: rispettata
Plausibilità fisica: rispettata
Robustezza statistica: rispettata

MISURA TIPO A2

HVSR 31

Peak frequency (Hz): 1.7 (±4.4)
Peak HVSR value: 1.0 (±0.1)

=== Criteria for a reliable H/V curve ==========
#1. [f0 > 10/Lw]: 1.735 > 0.25 (OK)
#2. [nc > 200]: 6108 > 200 (OK)
#3. [f0>0.5Hz; sigmaA(f) < 2 for 0.5f0 < f < 2f0] (OK)

=== Criteria for a clear H/V peak (at least 5 should be fulfilled) ==========
#1. [exists f- in the range [f0/4, f0] | AH/V(f-) < A0/2]: (NO)
#2. [exists f+ in the range [f0, 4f0] | AH/V(f+) < A0/2]: (NO)
#3. [A0 > 2]: 1.0 < 2 (NO)
#4. [fpeak[Ah/v(f) ą sigmaA(f)] = f0 ą 5%]: (OK)
#5. [sigmaf < epsilon(f0)]: 4.360 > 0.174 (NO)
#6. [sigmaA(f0) < theta(f0)]: 0.142 < 1.78 (OK)

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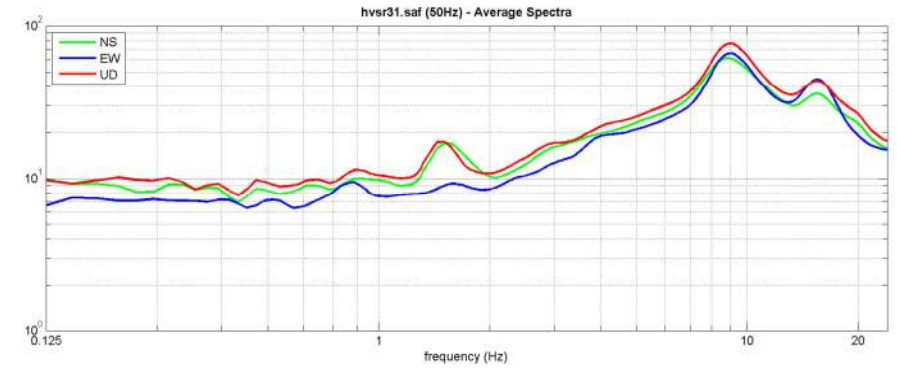
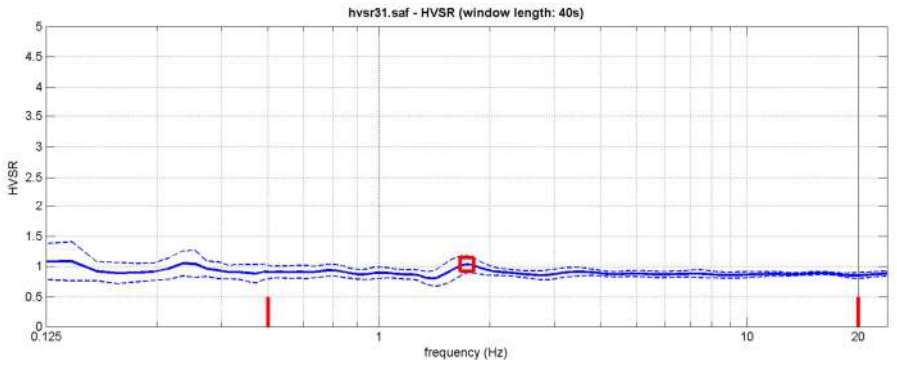
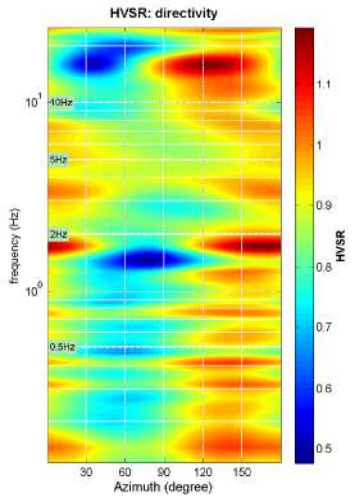
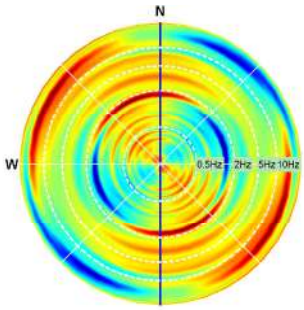
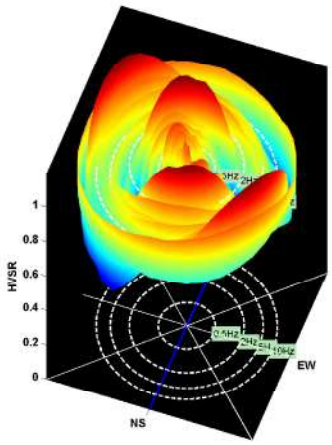


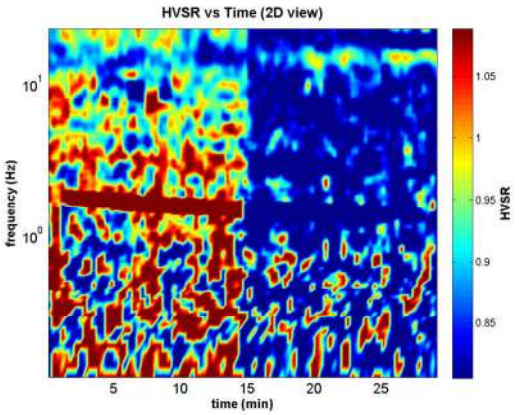


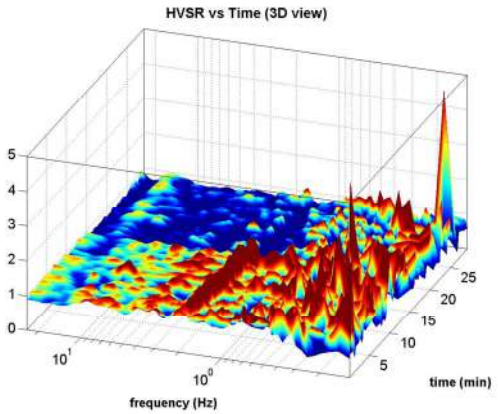
To model the HVSR (also jointly with MASW or ReMi/ESAC data), save the H/V curve, go to the "Velocity Spectrum/a, Modeling & Picking" panels and upload the saved H/V curve











HVSR32

DATE 23.08.2017	HOUR 12:16	PLACE Agostoli
OPERATOR ProGeo Engineering srl	GPS TYPE and #	
GAUSS-BOAGA LATITUDE 4797836	GAUSS-BOAGA LONGITUDE 1686510	ALTITUDE 332,5 m slm
STATION TYPE GPA	SENSOR TYPE 4,5 Hz	
STATION #	SENSOR #	DISK #
FILE NAME HVSR32		POINT #
GAIN	SAMPL. FREQ. 100 Hz	REC. DURATION 30 min (minutes / seconds)

WEATHER CONDITIONS: WIND (●) none ( ) weak (5m/s) ( ) medium ( ) strong Measurement (if any): ____
RAIN (●) none ( ) weak ( ) medium ( ) strong Measurement (if any): ____
Temperature (approx): 24 Remarks ____

GROUND TYPE: (●) earth ( ) hard ( ) soft ( ) gravel ( ) sand ( ) rock ( ) grass = ( ) short ( ) tall
( ) asphalt ( ) cement ( ) concrete ( ) paved ( ) other ____
(●) dry soil ( ) wet soil Remarks ____

ARTIFICIAL GROUND-SENSOR COUPLING (●) no ( ) yes, type ____

BUILDING DENSITY ( ) none (●) scattered ( ) dense ( ) other, type ____

TRANSIENTS

	none	few	moderate	many	very dense	distance
cars		●				
trucks	●					
pedestrians	●					
other ____	●					

MONOCHROMATIC NOISE SOURCES (factories, works, pumps, rivers,..)
(●) no ( ) yes, type ____

NEARBY STRUCTURES (description, height, distance) (trees, polls, buildings, bridges, underground structures,...)
Trees, Buildings

OBSERVATIONS

FREQUENCY: Hz (if computed in the field)

Qualità della misura:

Durata: rispettata
Stazionarietà: rispettata
Isotropia: rispettata
Assenza di disturbi: rispettata
Plausibilità fisica: rispettata
Robustezza statistica: rispettata

MISURA TIPO A2

HVSR 32

Peak frequency (Hz): 20.0 ±7.2)
Peak HVSR value: 1.1 (±0.2)

=== Criteria for a reliable H/V curve ==========
#1. [f0 > 10/Lw]: 19.994 > 0.25 (OK)
#2. [nc > 200]: 70379 > 200 (OK)
#3. [f0>0.5Hz; sigmaA(f) < 2 for 0.5f0 < f < 2f0] (OK)

=== Criteria for a clear H/V peak (at least 5 should be fulfilled) ==========
#1. [exists f- in the range [f0/4, f0] | AH/V(f-) < A0/2]: yes (considering standard deviations), at frequency 5.0Hz (OK)
#2. [exists f+ in the range [f0, 4f0] | AH/V(f+) < A0/2]: (NO)
#3. [A0 > 2]: 1.1 < 2 (NO)
#4. [fpeak[Ah/v(f) ą sigmaA(f)] = f0 ą 5%]: (OK)
#5. [sigmaf < epsilon(f0)]: 7.158 > 1.000 (NO)
#6. [sigmaA(f0) < theta(f0)]: 0.190 < 1.58 (OK)

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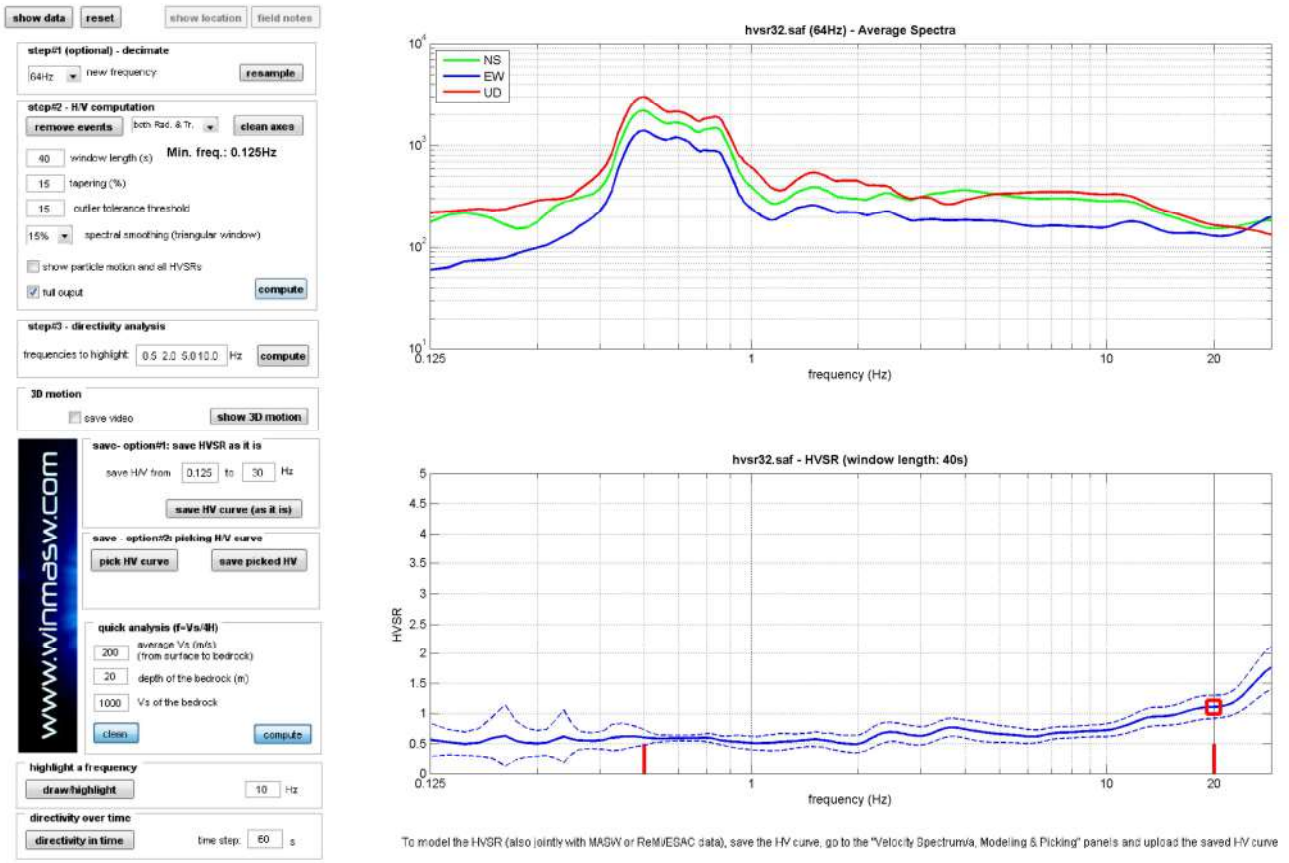
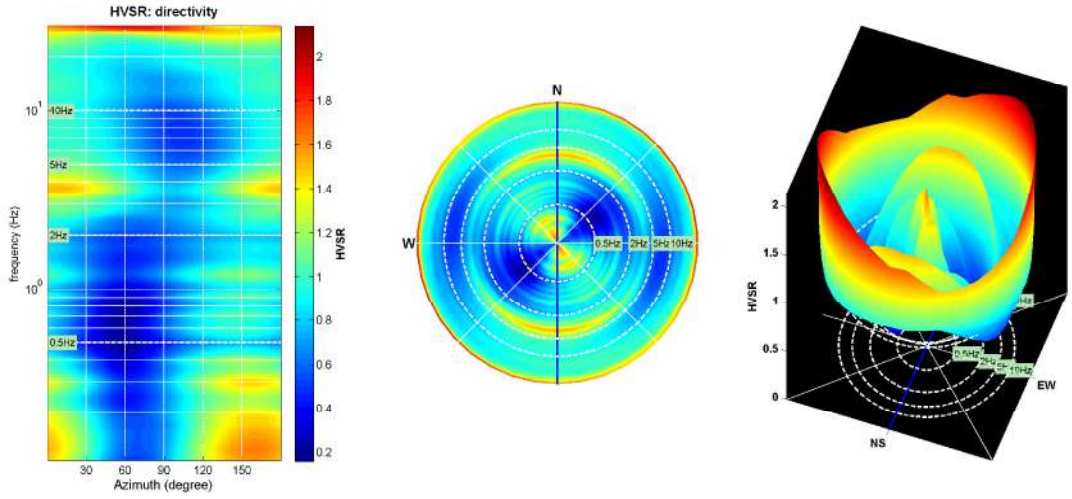
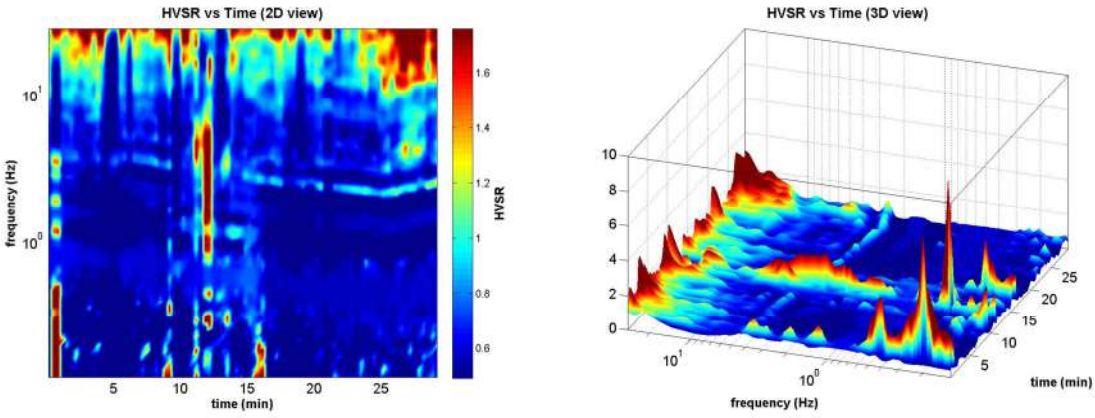

show data
reset
show location
field notes
step#1 (optional) - decimate
64Hz
new frequency
resample
step#2 - H/V computation
remove events
both Rad. & Tr.
clean axes
40
window length (s)
Min. freq.: 0.125Hz
15
tapering (%)
15
outlier tolerance threshold
15%
spectral smoothing (triangular window)
show particle motion and all HVSRs
full output
compute
step#3 - directivity analysis
frequencies to highlight
0.5 2.0 5.0 10.0
Hz
compute
3D motion
save video
show 3D motion
www.winmasw.com
save- option#1: save HVSR as it is
save H/V from
0.125
to
30
Hz
save HV curve (as it is)
save - option#2: picking H/V curve
pick HV curve
save picked HV
quick analysis (f=Vs/4H)
200
average Vs (m/s)
(from surface to bedrock)
20
depth of the bedrock (m)
1000
Vs of the bedrock
clean
compute
highlight a frequency
draw/highlight
10
Hz
directivity over time
directivity in time
time step.
60
s
hvsr32.saf (64Hz) - Average Spectra
NS
EW
UD
frequency (Hz)
hvsr32.saf - HVSR (window length: 40s)
HVSR
frequency (Hz)
To model the HVSR (also jointly with MASW or ReMi/EGAC data), save the H/V curve, go to the "Velocity Spectrum/a, Modeling & Picking" panels and upload the saved H/V curve


HVSR: directivity
10Hz
5Hz
2Hz
0.5Hz
frequency (Hz)
HVSR
Azimuth (degree)
N
W
0.5Hz
2Hz
5Hz
10Hz
H/SR
NS
EW


HVSR vs Time (2D view)
frequency (Hz)
HVSR
time (min)
HVSR vs Time (3D view)
frequency (Hz)
time (min)

HVSR33

DATE 23.08.2017	HOUR 13:55	PLACE Agazzara
OPERATOR ProGeo Engineering srl	GPS TYPE and #	
GAUSS-BOAGA LATITUDE 4795805	GAUSS-BOAGA LONGITUDE 1686199	ALTITUDE 267 m slm
STATION TYPE GPA	SENSOR TYPE 4,5 Hz	
STATION #	SENSOR #	DISK #
FILE NAME HVSR33		POINT #
GAIN	SAMPL. FREQ. 100 Hz	REC. DURATION 30 min (minutes / seconds)

WEATHER CONDITIONS

WIND ● none ☐ weak (5m/s) ☐ medium ☐ strong Measurement (if any): _____

RAIN ● none ☐ weak ☐ medium ☐ strong Measurement (if any): _____

Temperature (approx): 25 Remarks _____

GROUND TYPE

● earth (● hard ☐ soft) ☐ gravel ☐ sand ☐ rock ☐ grass (☐ short ☐ tall)

☐ asphalt ☐ cement ☐ concrete ☐ paved ☐ other _____

● dry soil ☐ wet soil Remarks _____

ARTIFICIAL GROUND-SENSOR COUPLING ● no ☐ yes, type _____

BUILDING DENSITY ● none ☐ scattered ☐ dense ☐ other, type _____

TRANSIENTS

	none	few	moderate	many	very dense	distance
cars		●				
trucks	●					
pedestrians	●					
other		●				

MONOCHROMATIC NOISE SOURCES (factories, works, pumps, rivers,..)

● no ☐ yes, type _____

NEARBY STRUCTURES (description, height, distance) (trees, polls, buildings, bridges, underground structures,...)

Trees

OBSERVATIONS

FREQUENCY: Hz (if computed in the field)

Qualità della misura:

Durata: rispettata
Stazionarietà: rispettata
Isotropia: rispettata
Assenza di disturbi: rispettata
Plausibilità fisica: rispettata
Robustezza statistica: rispettata

MISURA TIPO A2

HVSR 33

Peak frequency (Hz): 17.1 (±7.2)
Peak HVSR value: 1.1 (±0.1)

=== Criteria for a reliable H/V curve ==========
#1. [f0 > 10/Lw]: 17.079 > 0.5 (OK)
#2. [nc > 200]: 60119 > 200 (OK)
#3. [f0>0.5Hz; sigmaA(f) < 2 for 0.5f0 < f < 2f0] (OK)

=== Criteria for a clear H/V peak (at least 5 should be fulfilled) ==========
#1. [exists f- in the range [f0/4, f0] | AH/V(f-) < A0/2]: yes, at frequency 4.3Hz (OK)
#2. [exists f+ in the range [f0, 4f0] | AH/V(f+) < A0/2]: (NO)
#3. [A0 > 2]: 1.1 < 2 (NO)
#4. [fpeak[Ah/v(f) ą sigmaA(f)] = f0 ą 5%]: (OK)
#5. [sigmaf < epsilon(f0)]: 7.217 > 0.854 (NO)
#6. [sigmaA(f0) < theta(f0)]: 0.098 < 1.58 (OK)

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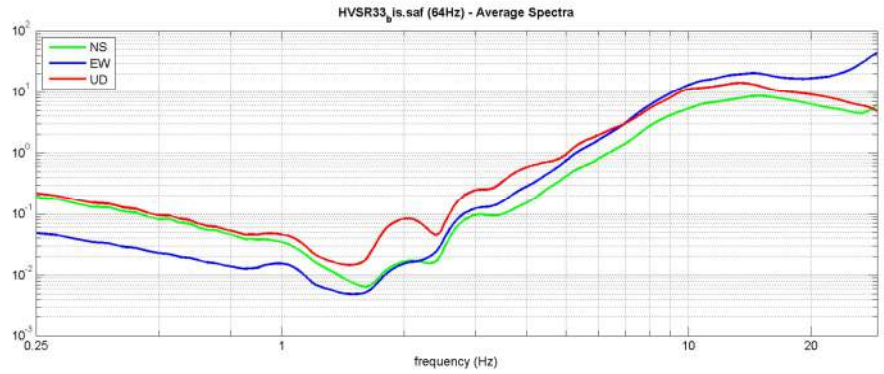
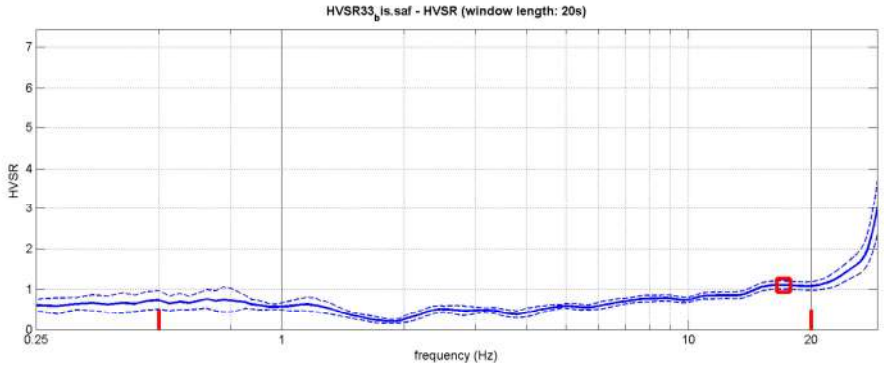
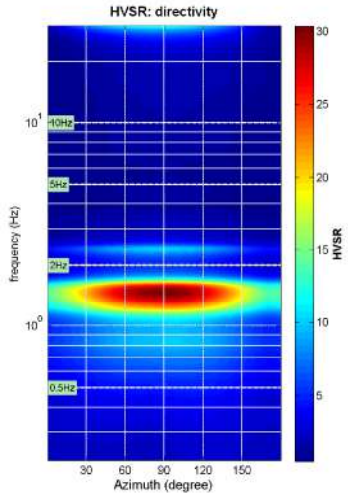
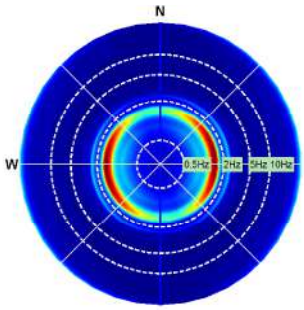
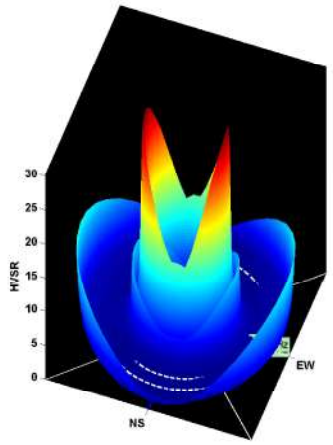


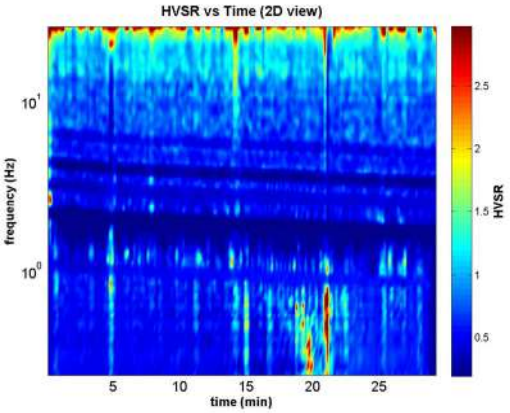


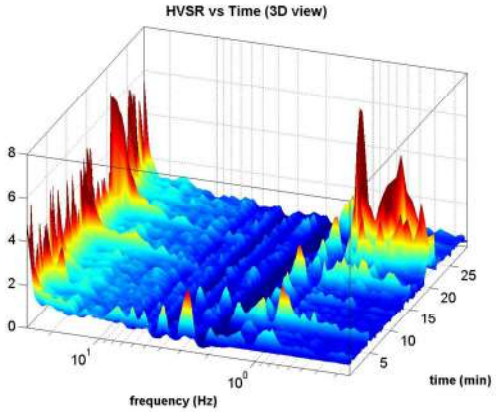
To model the HVSR (also jointly with MASW or ReMi/EGAC data), save the H/V curve, go to the "Velocity Spectrum/a, Modeling & Picking" panels and upload the saved H/V curve











HVSR34

DATE 23.08.2017	HOUR 13:04	PLACE Costafabbri
OPERATOR ProGeo Engineering srl	GPS TYPE and #	
GAUSS-BOAGA LATITUDE 4796813	GAUSS-BOAGA LONGITUDE 1687810	ALTITUDE 289 m slm
STATION TYPE GPA	SENSOR TYPE 4,5 Hz	
STATION #	SENSOR #	DISK #
FILE NAME HVSR34		POINT #
GAIN	SAMPL. FREQ. 100 Hz	REC. DURATION 30 min (minutes / seconds)

WEATHER CONDITIONS
WIND (●) none ( ) weak (5m/s) ( ) medium ( ) strong Measurement (if any): _____
RAIN (●) none ( ) weak ( ) medium ( ) strong Measurement (if any): _____
Temperature (approx): 24 Remarks _____

GROUND TYPE
( ) earth (□hard □soft) ( ) gravel ( ) sand ( ) rock ( ) grass (□short □tall)
(●) asphalt ( ) cement ( ) concrete ( ) paved ( ) other _____
(●) dry soil ( ) wet soil Remarks _____

ARTIFICIAL GROUND-SENSOR COUPLING (●) no ( ) yes, type _____

BUILDING DENSITY ( ) none (●) scattered ( ) dense ( ) other, type _____

TRANSIENTS

	none	few	moderate	many	very dense	distance
cars			●			
trucks	●					
pedestrians		●				
other	●					

MONOCHROMATIC NOISE SOURCES (factories, works, pumps, rivers,..)
(●) no ( ) yes, type _____

NEARBY STRUCTURES (trees, polls, buildings, bridges, underground structures,...)
(description, height, distance)
Trees, Buildings

OBSERVATIONS

FREQUENCY: Hz
(if computed in the field)

Qualità della misura:

Durata: rispettata
Stazionarietà: rispettata
Isotropia: rispettata
Assenza di disturbi: non rispettata
Plausibilità fisica: rispettata
Robustezza statistica: rispettata

MISURA TIPO B2

HVSR 34

Peak frequency (Hz): 4.0 (±3.8)
Peak HVSR value: 0.6 (±0.1)

=== Criteria for a reliable H/V curve ==========
#1. [f0 > 10/Lw]: 4.049 > 0.25 (OK)
#2. [nc > 200]: 8260 > 200 (OK)
#3. [f0>0.5Hz; sigmaA(f) < 2 for 0.5f0 < f < 2f0] (OK)

=== Criteria for a clear H/V peak (at least 5 should be fulfilled) ==========
#1. [exists f- in the range [f0/4, f0] | AH/V(f-) < A0/2]: (NO)
#2. [exists f+ in the range [f0, 4f0] | AH/V(f+) < A0/2]: (NO)
#3. [A0 > 2]: 0.6 < 2 (NO)
#4. [fpeak[Ah/v(f) ą sigmaA(f)] = f0 ą 5%]: (OK)
#5. [sigmaf < epsilon(f0)]: 3.817 > 0.202 (NO)
#6. [sigmaA(f0) < theta(f0)]: 0.073 < 1.58 (OK)

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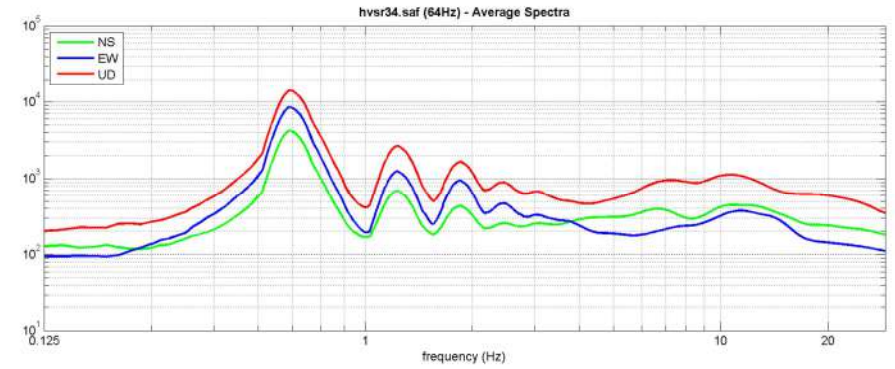
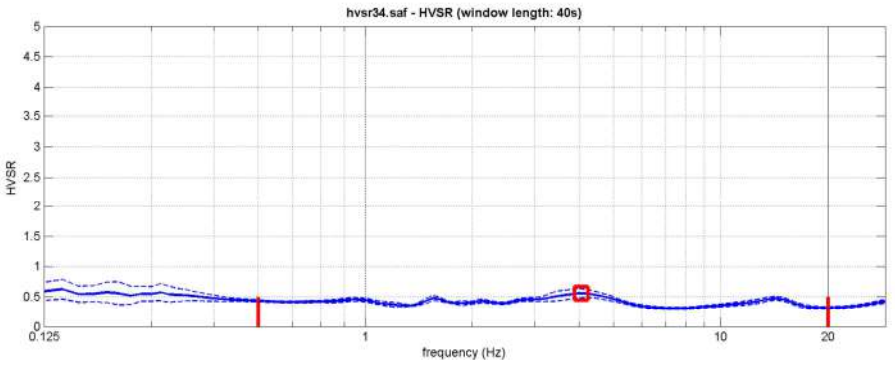
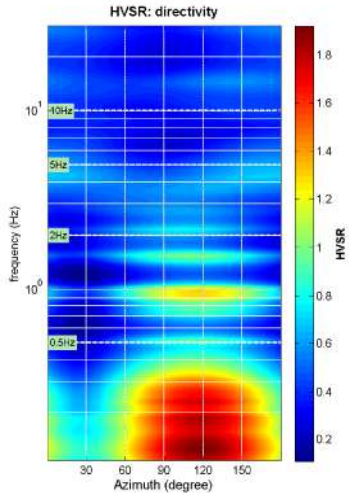
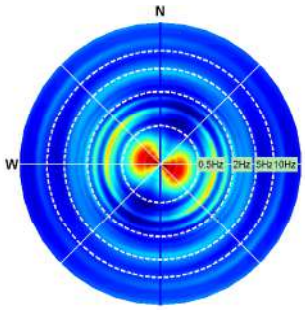
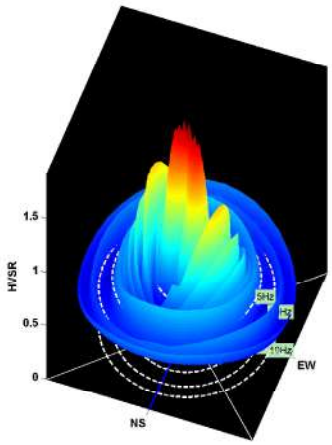


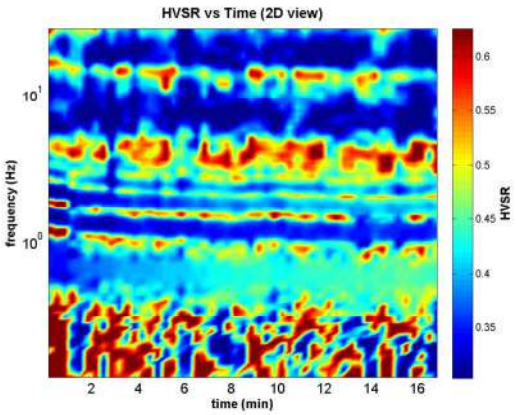


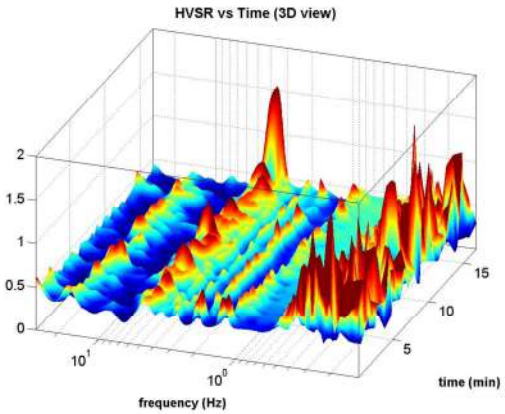
To model the HVSR (also jointly with MASW or ReMi/ESAC data), save the H/V curve, go to the "Velocity Spectrum/a, Modeling & Picking" panels and upload the saved H/V curve











HVSR35

DATE 23.08.2017	HOUR 11:32	PLACE Le Coste
OPERATOR ProGeo Engineering srl	GPS TYPE and #	
GAUSS-BOAGA LATITUDE 4799413	GAUSS-BOAGA LONGITUDE 1685816	ALTITUDE 302 m slm
STATION TYPE GPA	SENSOR TYPE 4,5 Hz	
STATION #	SENSOR #	DISK #
FILE NAME HVSR35		POINT #
GAIN	SAMPL. FREQ. 100 Hz	REC. DURATION 30 min (minutes / seconds)

WEATHER CONDITIONS

WIND ● none ☐ weak (5m/s) ☐ medium ☐ strong Measurement (if any): _____

RAIN ● none ☐ weak ☐ medium ☐ strong Measurement (if any): _____

Temperature (approx): 22 Remarks _____

GROUND TYPE

☐ earth (☐ hard ☐ soft) ● gravel ☐ sand ☐ rock ☐ grass = (☐ short ☐ tall)

☐ asphalt ☐ cement ☐ concrete ☐ paved ☐ other _____

● dry soil ☐ wet soil Remarks _____

ARTIFICIAL GROUND-SENSOR COUPLING ● no ☐ yes, type _____

BUILDING DENSITY ☐ none ● scattered ☐ dense ☐ other, type _____

TRANSIENTS

	none	few	moderate	many	very dense	distance
cars	●					
trucks	●					
pedestrians	●					
other						

MONOCHROMATIC NOISE SOURCES (factories, works, pumps, rivers,..)

● no ☐ yes, type _____

NEARBY STRUCTURES (description, height, distance) (trees, polls, buildings, bridges, underground structures,...)

OBSERVATIONS

FREQUENCY: Hz (if computed in the field)

Qualità della misura:

Durata: rispettata
Stazionarietà: rispettata
Isotropia: rispettata
Assenza di disturbi: non rispettata
Plausibilità fisica: rispettata
Robustezza statistica: rispettata

MISURA TIPO B2

HVSR 35

Peak frequency (Hz): 8.0 (±6.6)
Peak HVSR value: 1.7 (±0.2)

=== Criteria for a reliable H/V curve ==========
#1. [f0 > 10/Lw]: 7.953 > 0.66667 (OK)
#2. [nc > 200]: 25768 > 200 (OK)
#3. [f0>0.5Hz; sigmaA(f) < 2 for 0.5f0 < f < 2f0] (OK)

=== Criteria for a clear H/V peak (at least 5 should be fulfilled) ==========
#1. [exists f- in the range [f0/4, f0] | AH/V(f-) < A0/2]: (NO)
#2. [exists f+ in the range [f0, 4f0] | AH/V(f+) < A0/2]: (NO)
#3. [A0 > 2]: 1.7 < 2 (NO)
#4. [fpeak[Ah/v(f) ą sigmaA(f)] = f0 ą 5%]: (NO)
#5. [sigmaf < epsilon(f0)]: 6.573 > 0.398 (NO)
#6. [sigmaA(f0) < theta(f0)]: 0.233 < 1.58 (OK)

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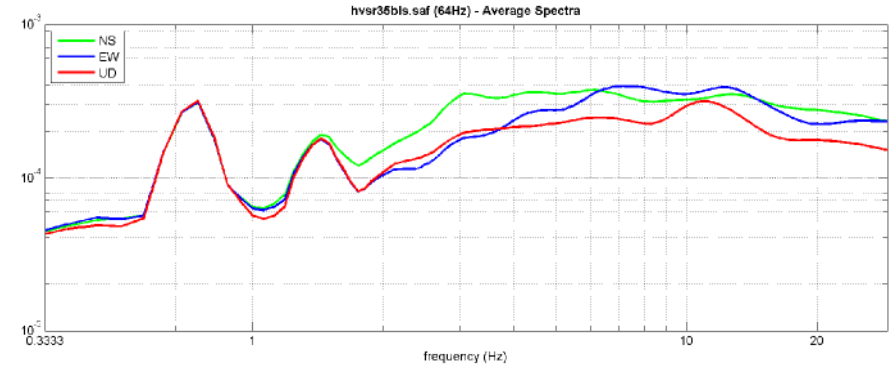
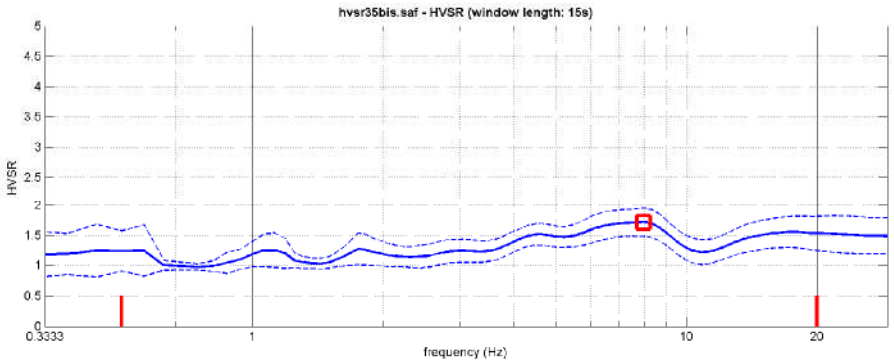
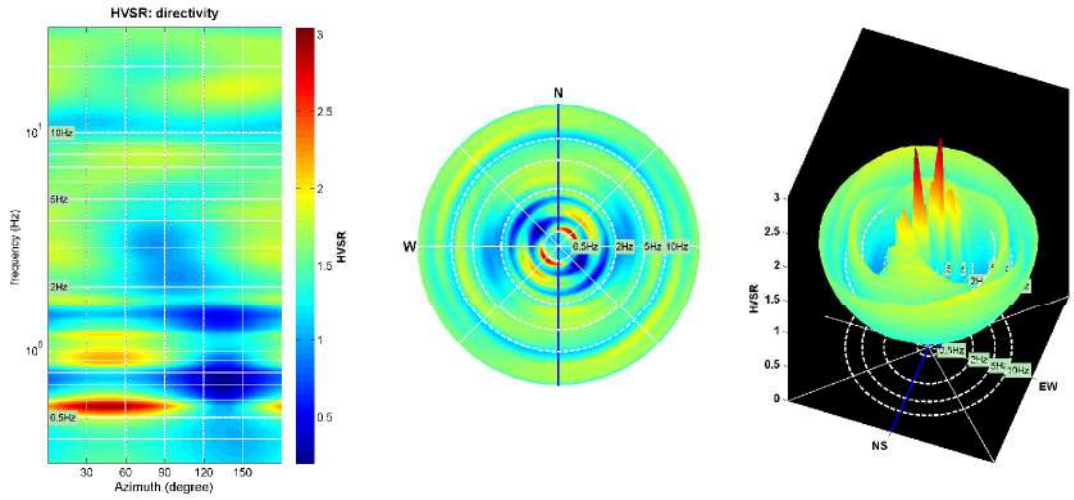
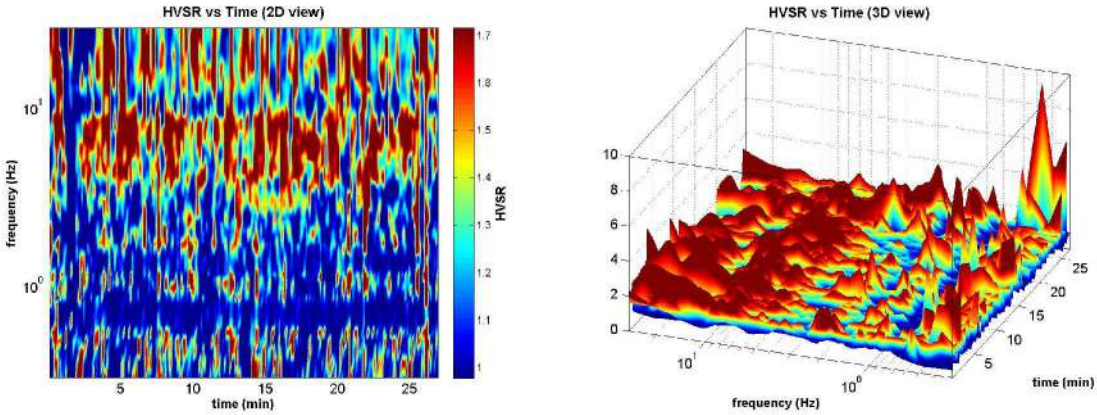




To model the HVSR (also jointly with MASW or ReMi/ESAC data), save the HV curve, go to the "Velocity Spectrum/a, Modeling & Picking" panels and upload the saved HV curve





HVSR36

DATE 23.08.2017	HOUR 16:25	PLACE S. Andrea a Montecchio
OPERATOR ProGeo Engineering srl	GPS TYPE and #	
GAUSS-BOAGA LATITUDE 4794775	GAUSS-BOAGA LONGITUDE 1686967	ALTITUDE 256,4 m slm
STATION TYPE GPA	SENSOR TYPE 4,5 Hz	
STATION #	SENSOR #	DISK #
FILE NAME HVSR36		POINT #
GAIN	SAMPL. FREQ. 100 Hz	REC. DURATION 30 min (minutes / seconds)

WEATHER CONDITIONS: WIND ● none ☐ weak (5m/s) ☐ medium ☐ strong Measurement (if any): ____ ; RAIN ● none ☐ weak ☐ medium ☐ strong Measurement (if any): ____ ; Temperature (approx): 29 Remarks ____

GROUND TYPE: ☐ earth (☐ hard ☐ soft) ● gravel ☐ sand ☐ rock ☐ grass = (☐ short ☐ tall) ; ☐ asphalt ☐ cement ☐ concrete ☐ paved ☐ other ____ ; ● dry soil ☐ wet soil Remarks ____

ARTIFICIAL GROUND-SENSOR COUPLING ● no ☐ yes, type ____

BUILDING DENSITY ☐ none ☐ scattered ● dense ☐ other, type ____

TRANSIENTS	none	few	moderate	many	very dense	distance
cars			●			
trucks		●				
pedestrians	●					
other	●					

MONOCHROMATIC NOISE SOURCES (factories, works, pumps, rivers,..): ● no ☐ yes, type ____

NEARBY STRUCTURES (description, height, distance) (trees, polls, buildings, bridges, underground structures,...): Trees, Buildings

OBSERVATIONS

FREQUENCY: Hz (if computed in the field)

Qualità della misura:

Durata: rispettata
Stazionarietà: rispettata
Isotropia: rispettata
Assenza di disturbi: non rispettata
Plausibilità fisica: non rispettata
Robustezza statistica: rispettata

MISURA TIPO C

HVSR 36

Peak frequency (Hz): 1.0 (±0.9)
Peak HVSR value: 1.6 (±0.2)

=== Criteria for a reliable H/V curve ==========
#1. [f0 > 10/Lw]: 1.032 > 0.25 (OK)
#2. [nc > 200]: 3632 > 200 (OK)
#3. [f0>0.5Hz; sigmaA(f) < 2 for 0.5f0 < f < 2f0] (OK)

=== Criteria for a clear H/V peak (at least 5 should be fulfilled) ==========
#1. [exists f- in the range [f0/4, f0] | AH/V(f-) < A0/2]: yes, at frequency 0.5Hz (OK)
#2. [exists f+ in the range [f0, 4f0] | AH/V(f+) < A0/2]: yes, at frequency 1.3Hz (OK)
#3. [A0 > 2]: 1.6 < 2 (NO)
#4. [fpeak[Ah/v(f) ± sigmaA(f)] = f0 ± 5%]: (OK)
#5. [sigmaf < epsilon(f0)]: 0.931 > 0.103 (NO)
#6. [sigmaA(f0) < theta(f0)]: 0.235 < 1.78 (OK)

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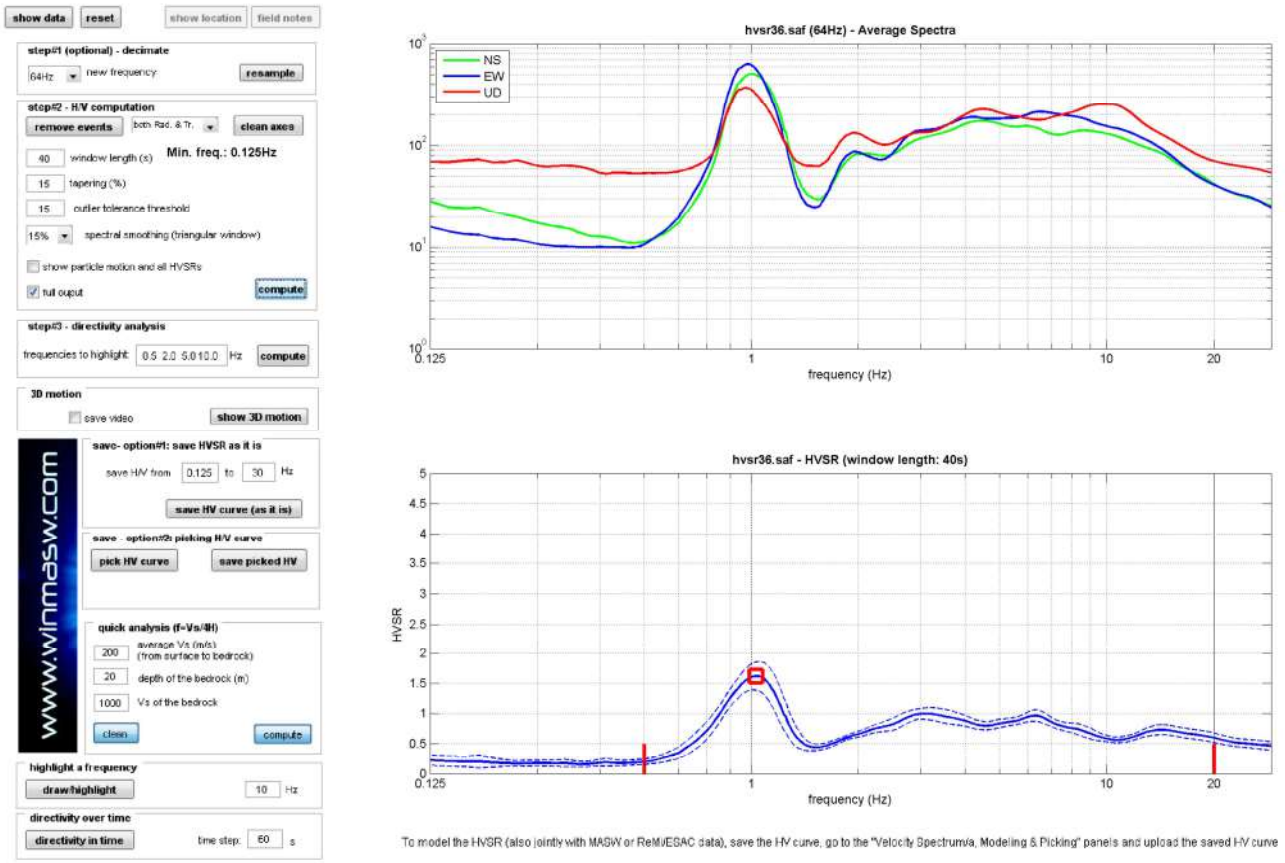
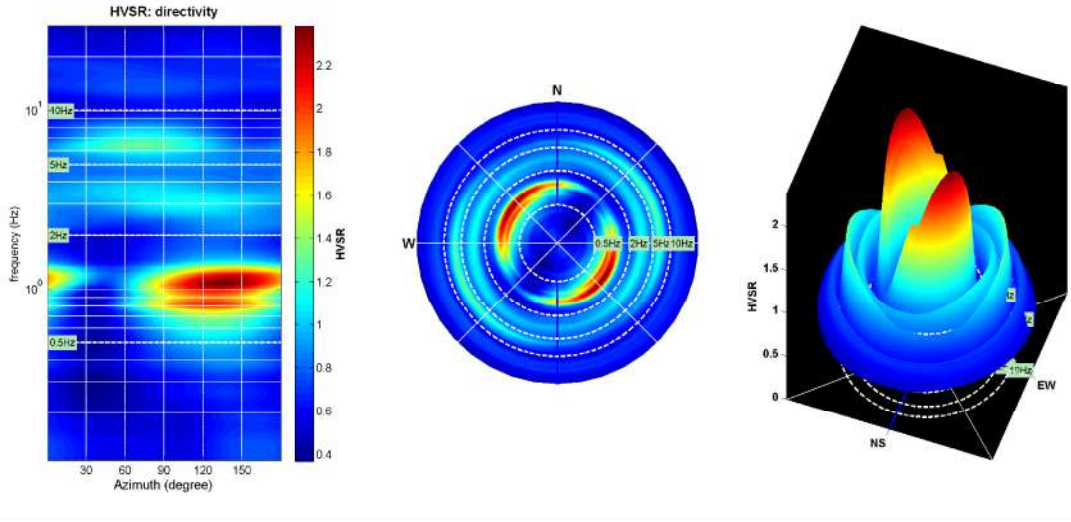
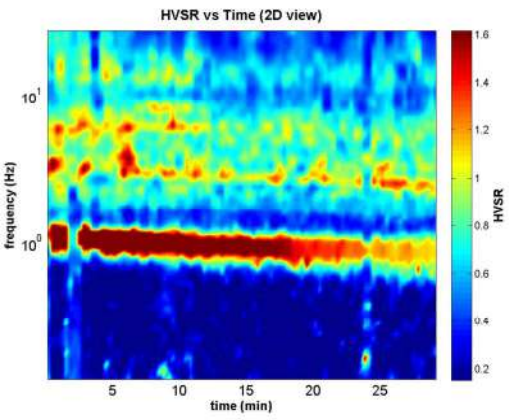
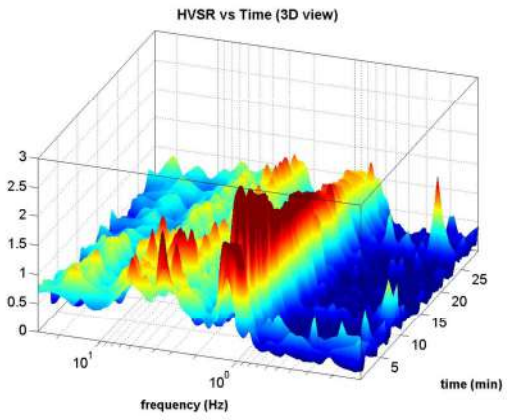

show data
reset
show location
field notes
step#1 (optional) - decimate
64Hz
new frequency
resample
step#2 - H/V computation
remove events
both Rad. & Tr.
clean axes
40
window length (s)
Min. freq.: 0.125Hz
15
tapering (%)
15
outlier tolerance threshold
15%
spectral smoothing (triangular window)
show particle motion and all HVSRs
full output
compute
step#3 - directivity analysis
frequencies to highlight
0.5 2.0 5.0 10.0
Hz
compute
3D motion
save video
show 3D motion
www.winmasw.com
save- option#1: save HVSR as it is
save H/V from
0.125
to
30
Hz
save HV curve (as it is)
save - option#2: picking H/V curve
pick HV curve
save picked HV
quick analysis (f=Vs/4H)
200
average Vs (m/s)
(from surface to bedrock)
20
depth of the bedrock (m)
1000
Vs of the bedrock
clean
compute
highlight a frequency
draw/highlight
10
Hz
directivity over time
directivity in time
time step.
60
s
hvsr36.saf (64Hz) - Average Spectra
NS
EW
UD
frequency (Hz)
hvsr36.saf - HVSR (window length: 40s)
HVSR
frequency (Hz)
To model the HVSR (also jointly with MASW or ReMi/EGAC data), save the H/V curve, go to the "Velocity Spectrum/a, Modeling & Picking" panels and upload the saved H/V curve


HVSR: directivity
10Hz
5Hz
2Hz
0.5Hz
frequency (Hz)
HVSR
Azimuth (degree)
N
W
0.5Hz
2Hz
5Hz
10Hz
H/SR
NS
EW


HVSR vs Time (2D view)
frequency (Hz)
HVSR
time (min)


HVSR vs Time (3D view)
frequency (Hz)
time (min)

HVSR37

DATE 12.07.2017	HOUR 18:09	PLACE Abbadia
OPERATOR ProGeo Engineering srl	GPS TYPE and #	
GAUSS-BOAGA LATITUDE 4796500	GAUSS-BOAGA LONGITUDE 1693012	ALTITUDE 237,7 m slm
STATION TYPE GPA	SENSOR TYPE 4,5 Hz	
STATION #	SENSOR #	DISK #
FILE NAME HVSR37		POINT #
GAIN	SAMPL. FREQ. 100 Hz	REC. DURATION 30 min (minutes / seconds)

WEATHER CONDITIONS: WIND ☐ none ● weak (5m/s) ☐ medium ☐ strong Measurement (if any): ____ ; RAIN ● none ☐ weak ☐ medium ☐ strong Measurement (if any): ____ ; Temperature (approx): 33 Remarks ____

GROUND TYPE: ☐ earth (☐ hard ☐ soft) ☐ gravel ☐ sand ☐ rock ☐ grass (☐ short ☐ tall) ; ● asphalt ☐ cement ☐ concrete ☐ paved ☐ other ____ ; ● dry soil ☐ wet soil Remarks ____

ARTIFICIAL GROUND-SENSOR COUPLING ● no ☐ yes, type ____

BUILDING DENSITY ☐ none ● scattered ☐ dense ☐ other, type ____

TRANSIENTS	none	few	moderate	many	very dense	distance
cars		●				
trucks	●					
pedestrians		●				
other	●					

MONOCHROMATIC NOISE SOURCES (factories, works, pumps, rivers,..): ● no ☐ yes, type ____

NEARBY STRUCTURES (description, height, distance) (trees, polls, buildings, bridges, underground structures,...): Buildings

OBSERVATIONS

FREQUENCY: Hz (if computed in the field)

Qualità della misura:

Durata: rispettata
Stazionarietà: rispettata
Isotropia: rispettata
Assenza di disturbi: non rispettata
Plausibilità fisica: rispettata
Robustezza statistica: rispettata

MISURA TIPO B1

HVSR37

Peak frequency (Hz): 10.7 (±2.1)
Peak HVSR value: 4.0 (±0.6)

=== Criteria for a reliable H/V curve ==========
#1. [f0 > 10/Lw]: 10.729 > 0.5 (OK)
#2. [nc > 200]: 38196 > 200 (OK)
#3. [f0>0.5Hz; sigmaA(f) < 2 for 0.5f0 < f < 2f0] (OK)

=== Criteria for a clear H/V peak (at least 5 should be fulfilled) ==========
#1. [exists f- in the range [f0/4, f0] | AH/V(f-) < A0/2]: yes, at frequency 2.7Hz (OK)
#2. [exists f+ in the range [f0, 4f0] | AH/V(f+) < A0/2]: yes, at frequency 17.3Hz (OK)
#3. [A0 > 2]: 4.0 > 2 (OK)
#4. [fpeak[Ah/v(f) ą sigmaA(f)] = f0 ą 5%]: (NO)
#5. [sigmaf < epsilon(f0)]: 2.068 > 0.536 (NO)
#6. [sigmaA(f0) < theta(f0)]: 0.589 < 1.58 (OK)

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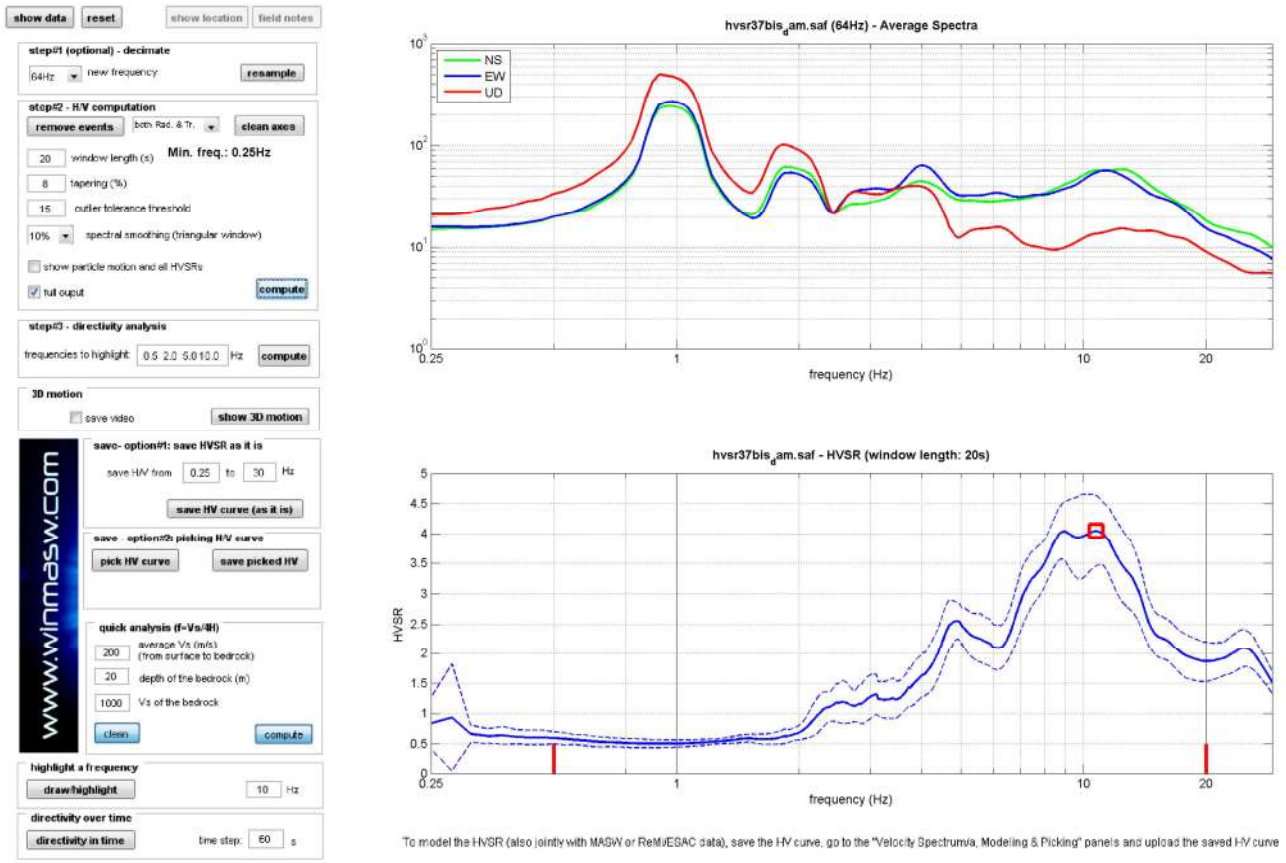
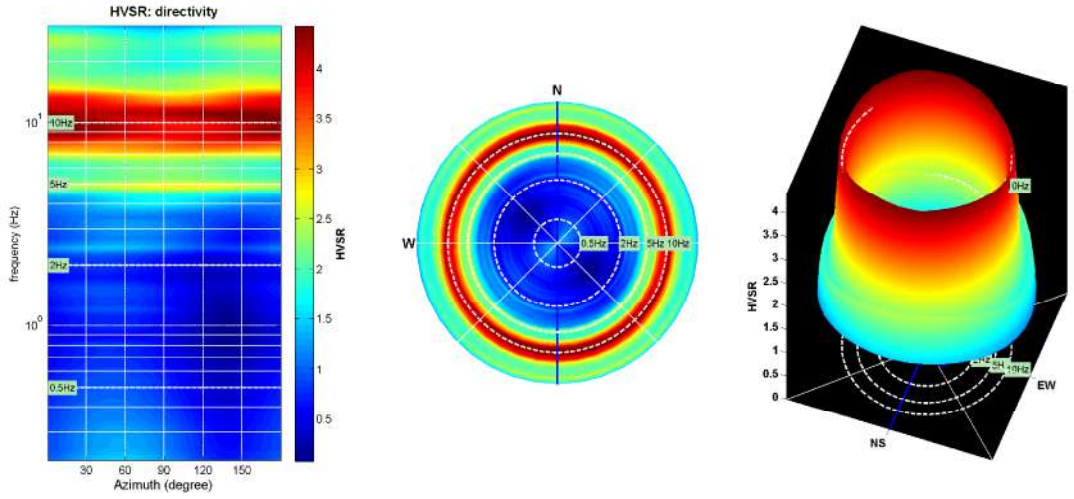
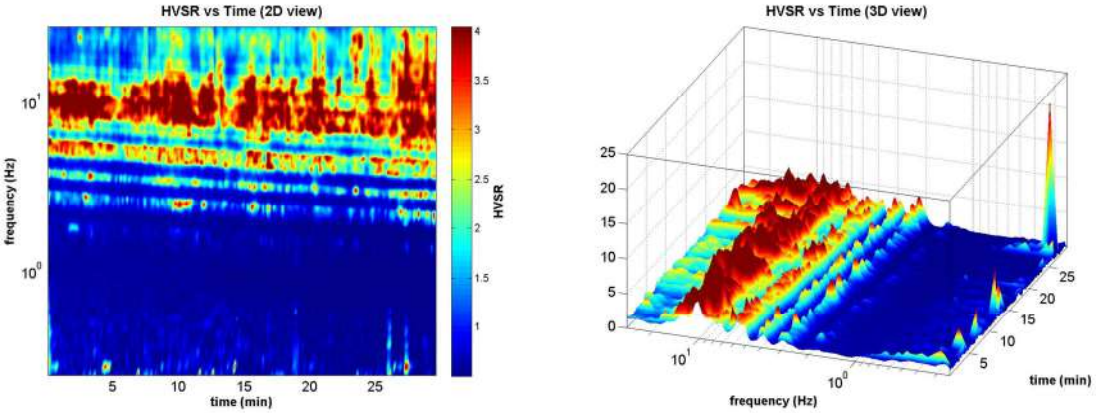

show data
reset
show location
field notes
step#1 (optional) - decimate
64Hz
new frequency
resample
step#2 - H/V computation
remove events
both Rad. & Tr.
clean axes
20
window length (s)
Min. freq.: 0.25Hz
8
tapering (%)
15
outlier tolerance threshold
10%
spectral smoothing (triangular window)
show particle motion and all HVSRs
full output
compute
step#3 - directivity analysis
frequencies to highlight
0.5 2.0 5.0 10.0
Hz
compute
3D motion
save video
show 3D motion
www.winmasw.com
save- option#1: save HVSR as it is
save H/V from
0.25
to
30
Hz
save HV curve (as it is)
save - option#2: picking H/V curve
pick HV curve
save picked HV
quick analysis (f=Vs/4H)
200
average Vs (m/s)
(from surface to bedrock)
20
depth of the bedrock (m)
1000
Vs of the bedrock
clean
compute
highlight a frequency
draw/highlight
10
Hz
directivity over time
directivity in time
time step.
60
s
hvsr37bls_am.saf (64Hz) - Average Spectra
NS
EW
UD
frequency (Hz)
hvsr37bls_am.saf - HVSR (window length: 20s)
HVSR
frequency (Hz)
To model the HVSR (also jointly with MASW or ReMi/EGAC data), save the H/V curve, go to the "Velocity Spectrum/a, Modeling & Picking" panels and upload the saved H/V curve


HVSR: directivity
10Hz
5Hz
2Hz
0.5Hz
frequency (Hz)
HVSR
Azimuth (degree)
N
W
0.5Hz
2Hz
5Hz
10Hz
0Hz
H/SR
EW
NS


HVSR vs Time (2D view)
frequency (Hz)
HVSR
time (min)
HVSR vs Time (3D view)
frequency (Hz)
time (min)

HVSR38

DATE 12.07.2017	HOUR 17:26	PLACE Taverne d'Arbia
OPERATOR ProGeo Engineering srl	GPS TYPE and #	
GAUSS-BOAGA LATITUDE 4796057	GAUSS-BOAGA LONGITUDE 1693879	ALTITUDE 179,9 m slm
STATION TYPE GPA	SENSOR TYPE 4,5 Hz	
STATION #	SENSOR #	DISK #
FILE NAME HVSR38		POINT #
GAIN	SAMPL. FREQ. 100 Hz	REC. DURATION 30 min (minutes / seconds)

WEATHER CONDITIONS

WIND ☐ none ☑ weak (5m/s) ☐ medium ☐ strong Measurement (if any): _____

RAIN ☑ none ☐ weak ☐ medium ☐ strong Measurement (if any): _____

Temperature (approx): 34 Remarks _____

GROUND TYPE

☐ earth (☐ hard ☐ soft) ☐ gravel ☐ sand ☐ rock ☐ grass = (☐ short ☐ tall)

☐ asphalt ☐ cement ☑ concrete ☐ paved ☐ other _____

☑ dry soil ☐ wet soil Remarks _____

ARTIFICIAL GROUND-SENSOR COUPLING ☑ no ☐ yes, type _____

BUILDING DENSITY ☐ none ☑ scattered ☐ dense ☐ other, type _____

TRANSIENTS

	none	few	moderate	many	very dense	distance
cars		●				
trucks		●				
pedestrians	●					
other	●					

MONOCHROMATIC NOISE SOURCES (factories, works, pumps, rivers,..)

☑ no ☐ yes, type _____

NEARBY STRUCTURES (description, height, distance) (trees, polls, buildings, bridges, underground structures,...)

Buildings

OBSERVATIONS

FREQUENCY: Hz (if computed in the field)

Qualità della misura:

Durata: rispettata
Stazionarietà: rispettata
Isotropia: rispettata
Assenza di disturbi: non rispettata
Plausibilità fisica: rispettata
Robustezza statistica: rispettata

MISURA TIPO B2

HVSR38

Peak frequency (Hz): 4.3 (±2.5)
Peak HVSR value: 1.0 (±0.1)

=== Criteria for a reliable H/V curve ==========
#1. [f0 > 10/Lw]: 4.348 > 0.5 (OK)
#2. [nc > 200]: 14957 > 200 (OK)
#3. [f0>0.5Hz; sigmaA(f) < 2 for 0.5f0 < f < 2f0] (OK)

=== Criteria for a clear H/V peak (at least 5 should be fulfilled) ==========
#1. [exists f- in the range [f0/4, f0] | AH/V(f-) < A0/2]: yes, at frequency 1.2Hz (OK)
#2. [exists f+ in the range [f0, 4f0] | AH/V(f+) < A0/2]: yes, at frequency 10.2Hz (OK)
#3. [A0 > 2]: 1.0 < 2 (NO)
#4. [fpeak[Ah/v(f) ą sigmaA(f)] = f0 ą 5%]: (OK)
#5. [sigmaf < epsilon(f0)]: 2.518 > 0.217 (NO)
#6. [sigmaA(f0) < theta(f0)]: 0.130 < 1.58 (OK)

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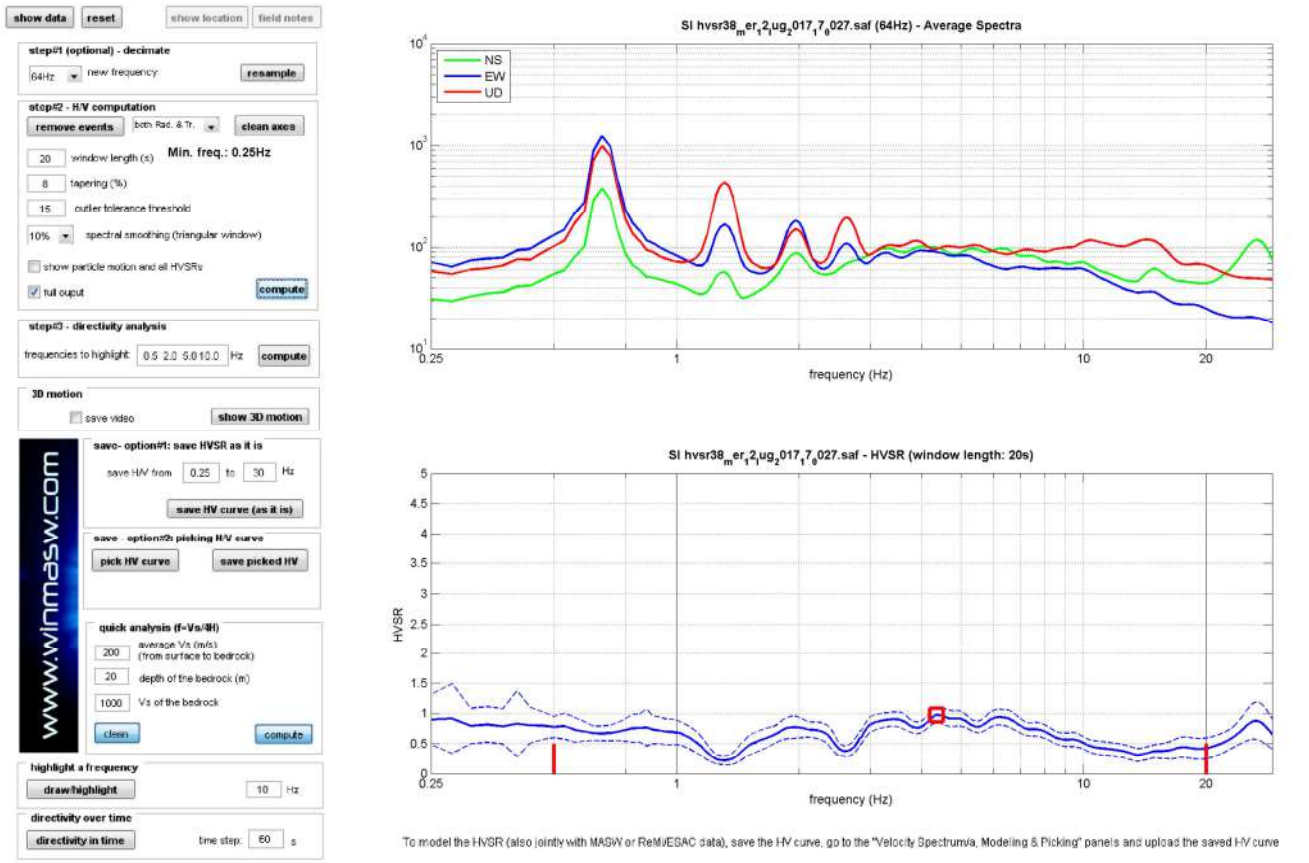
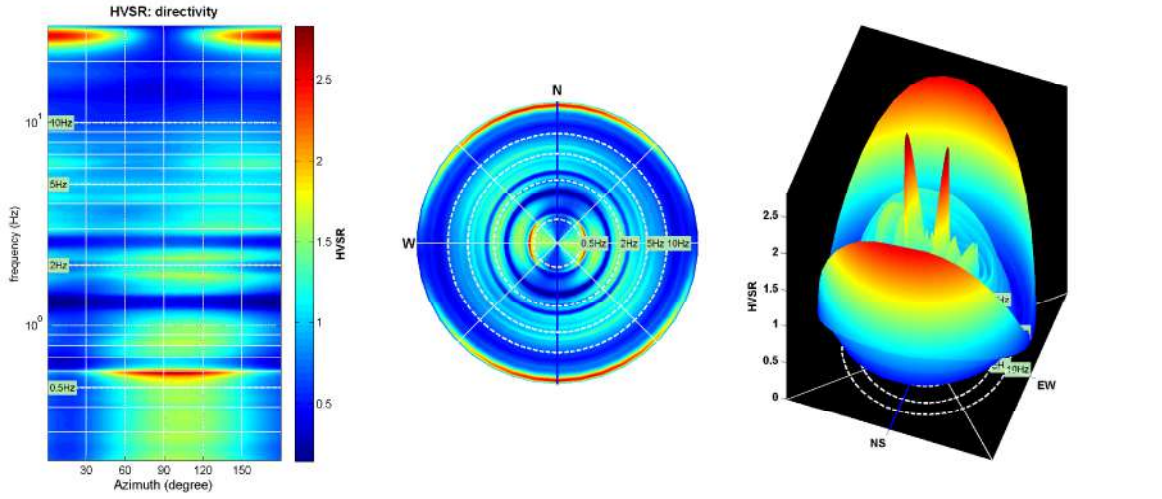
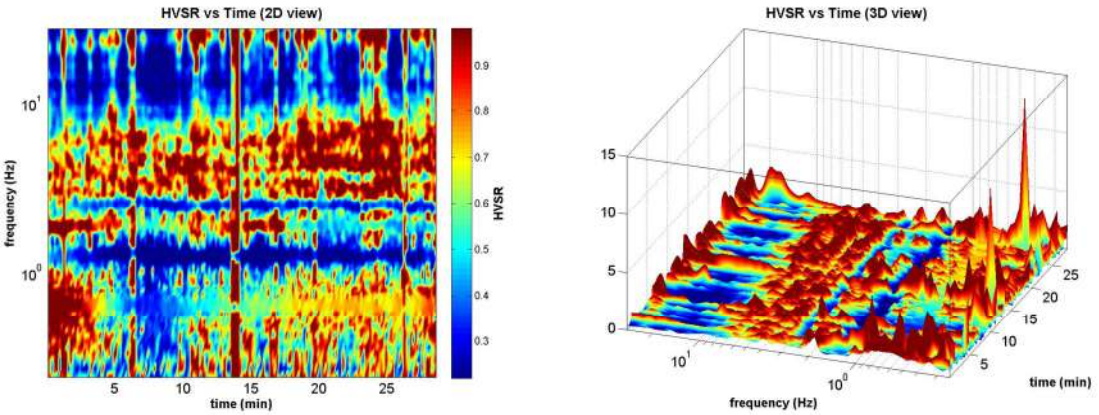

show data
reset
show location
field notes
step#1 (optional) - decimate
64Hz
new frequency
resample
step#2 - H/V computation
remove events
both Rad. & Tr.
clean axes
20
window length (s)
Min. freq.: 0.25Hz
8
tapering (%)
15
outlier tolerance threshold
10%
spectral smoothing (triangular window)
show particle motion and all HVSRs
full output
compute
step#3 - directivity analysis
frequencies to highlight
0.5 2.0 5.0 10.0
Hz
compute
3D motion
save video
show 3D motion
www.winmasw.com
save- option#1: save HVSR as it is
save H/V from
0.25
to
30
Hz
save HV curve (as it is)
save - option#2: picking H/V curve
pick HV curve
save picked HV
quick analysis (f=Vs/4H)
200
average Vs (m/s)
(from surface to bedrock)
20
depth of the bedrock (m)
1000
Vs of the bedrock
clean
compute
highlight a frequency
draw highlight
10
Hz
directivity over time
directivity in time
time step.
60
s
SI hvsr38_m_er_1_2_ug_2_017_1_7_0_027.saf (64Hz) - Average Spectra
NS
EW
UD
frequency (Hz)
SI hvsr38_m_er_1_2_ug_2_017_1_7_0_027.saf - HVSR (window length: 20s)
HVSR
frequency (Hz)
To model the HVSR (also jointly with MASW or ReMi/EGAC data), save the H/V curve, go to the "Velocity Spectrum/a, Modeling & Picking" panels and upload the saved H/V curve


HVSR: directivity
frequency (Hz)
10Hz
5Hz
2Hz
0.5Hz
HVSR
Azimuth (degree)
N
W
0.5Hz
2Hz
5Hz
10Hz
H/SR
NS
EW


HVSR vs Time (2D view)
frequency (Hz)
HVSR
time (min)
HVSR vs Time (3D view)
frequency (Hz)
time (min)

HVSR39

DATE 15.08.2017	HOUR 12:52	PLACE Strada di Peruzza
OPERATOR ProGeo Engineering srl		GPS TYPE and #
GAUSS-BOAGA LATITUDE 4797853	GAUSS-BOAGA LONGITUDE 1690908	ALTITUDE 269 m slm
STATION TYPE GPA	SENSOR TYPE 4,5 Hz	
STATION #	SENSOR #	DISK #
FILE NAME HVSR39		POINT #
GAIN	SAMPL. FREQ. 50 Hz	REC. DURATION 30 min (minutes / seconds)

WEATHER CONDITIONS: WIND (●) none ( ) weak (5m/s) ( ) medium ( ) strong Measurement (if any): ____ ; RAIN (●) none ( ) weak ( ) medium ( ) strong Measurement (if any): ____ ; Temperature (approx): 32 Remarks ____

GROUND TYPE: (●) earth ( ) hard ( ) soft ( ) gravel ( ) sand ( ) rock ( ) grass = ( ) short ( ) tall ( ) asphalt ( ) cement ( ) concrete ( ) paved ( ) other ____ (●) dry soil ( ) wet soil Remarks ____

ARTIFICIAL GROUND-SENSOR COUPLING (●) no ( ) yes, type ____

BUILDING DENSITY ( ) none (●) scattered ( ) dense ( ) other, type ____

TRANSIENTS	none	few	moderate	many	very dense	distance
cars		●				
trucks	●					
pedestrians	●					
other	●					

MONOCHROMATIC NOISE SOURCES (factories, works, pumps, rivers,..) (●) no ( ) yes, type ____

NEARBY STRUCTURES (description, height, distance) (trees, polls, buildings, bridges, underground structures,...)

Trees

OBSERVATIONS

FREQUENCY: Hz (if computed in the field)

Qualità della misura:

Durata: rispettata
Stazionarietà: rispettata
Isotropia: rispettata
Assenza di disturbi: rispettata
Plausibilità fisica: rispettata
Robustezza statistica: rispettata

MISURA TIPO A2

HVSR39

Peak frequency (Hz): 0.8 (±7.0)
Peak HVSR value: 1.2 (±0.2)

=== Criteria for a reliable H/V curve ==========
#1. [f0 > 10/Lw]: 0.806 > 0.25 (OK)
#2. [nc > 200]: 1613 > 200 (OK)
#3. [f0>0.5Hz; sigmaA(f) < 2 for 0.5f0 < f < 2f0] (OK)

=== Criteria for a clear H/V peak (at least 5 should be fulfilled) ==========
#1. [exists f- in the range [f0/4, f0] | AH/V(f-) < A0/2]: yes (considering standard deviations), at frequency 0.6Hz (OK)
#2. [exists f+ in the range [f0, 4f0] | AH/V(f+) < A0/2]: yes, at frequency 2.7Hz (OK)
#3. [A0 > 2]: 1.2 < 2 (NO)
#4. [fpeak[Ah/v(f) ą sigmaA(f)] = f0 ą 5%]: (NO)
#5. [sigmaf < epsilon(f0)]: 7.040 > 0.121 (NO)
#6. [sigmaA(f0) < theta(f0)]: 0.210 < 2 (OK)

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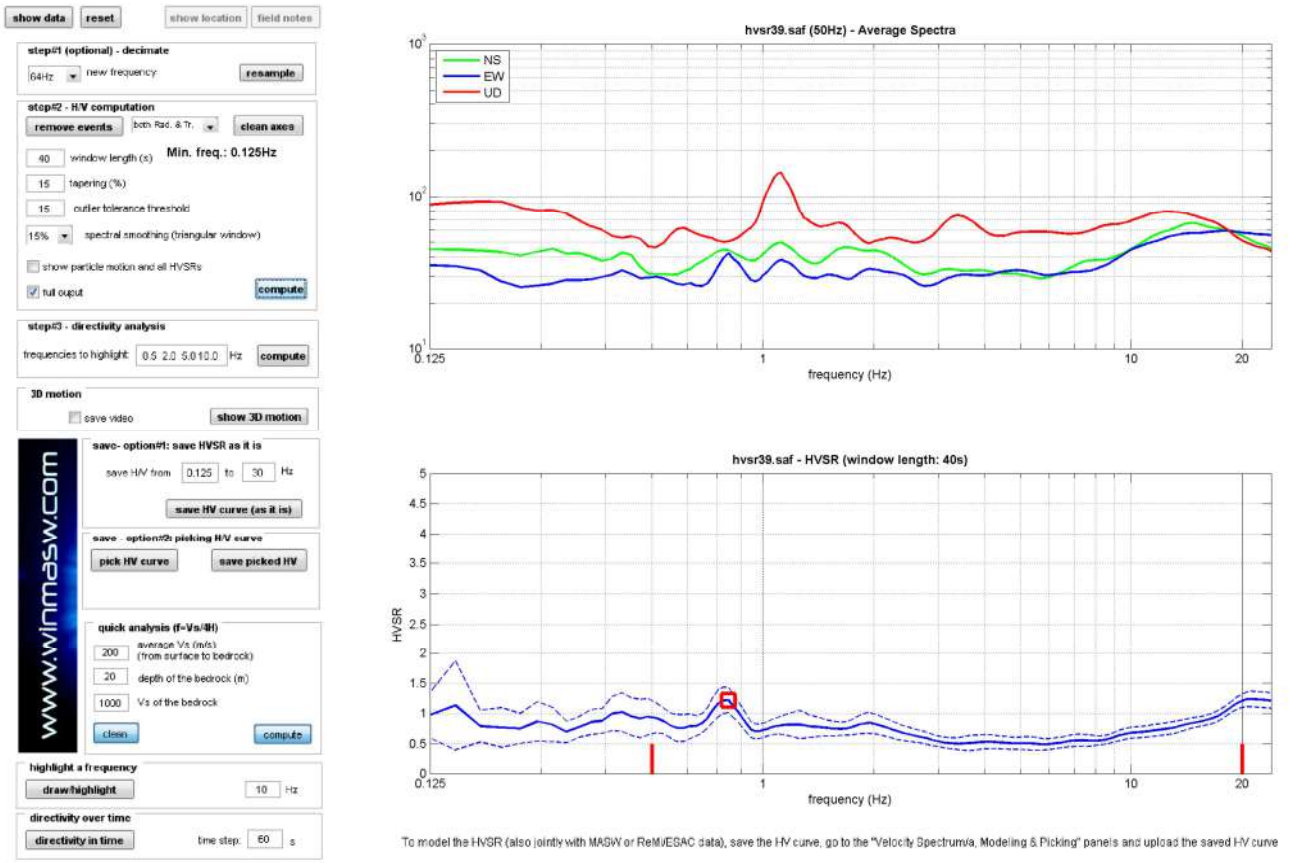
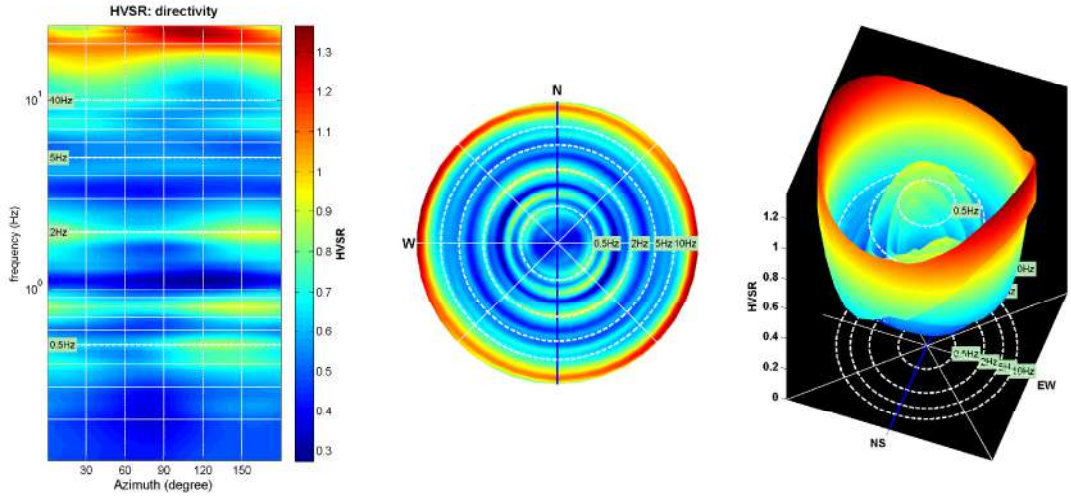
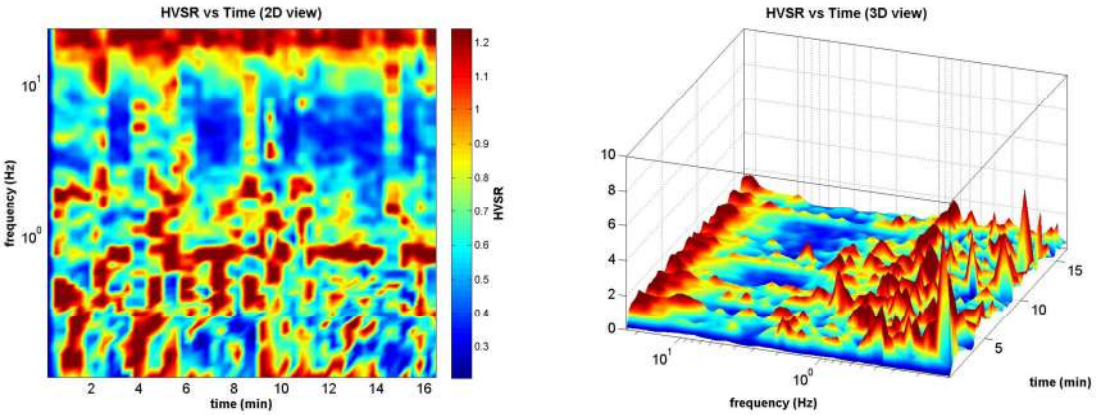

show data
reset
show location
field notes
step#1 (optional) - decimate
64Hz
new frequency
resample
step#2 - H/V computation
remove events
both Rad. & Tr.
clean axes
40
window length (s)
Min. freq.: 0.125Hz
15
tapering (%)
15
outlier tolerance threshold
15%
spectral smoothing (triangular window)
show particle motion and all HVSRs
full ouput
compute
step#3 - directivity analysis
frequencies to highlight
0.5 2.0 5.0 10.0
Hz
compute
3D motion
save video
show 3D motion
www.winmasw.com
save- option#1: save HVSR as it is
save H/V from
0.125
to
30
Hz
save HV curve (as it is)
save - option#2: picking H/V curve
pick HV curve
save picked HV
quick analysis (f=Vs/4H)
200
average Vs (m/s)
(from surface to bedrock)
20
depth of the bedrock (m)
1000
Vs of the bedrock
clean
compute
highlight a frequency
draw/highlight
10
Hz
directivity over time
directivity in time
time step.
60
s
hvsr39.saf (50Hz) - Average Spectra
NS
EW
UD
frequency (Hz)
hvsr39.saf - HVSR (window length: 40s)
HVSR
frequency (Hz)
To model the HVSR (also jointly with MASW or ReMi/EGAC data), save the H/V curve, go to the "Velocity Spectrum/a, Modeling & Picking" panels and upload the saved H/V curve


HVSR: directivity
frequency (Hz)
10Hz
5Hz
2Hz
0.5Hz
HVSR
Azimuth (degree)
N
W
0.5Hz
2Hz
5Hz
10Hz
H/SR
NS
EW


HVSR vs Time (2D view)
frequency (Hz)
HVSR
time (min)
HVSR vs Time (3D view)
frequency (Hz)
time (min)

HVSR40

DATE 15.08.2017	HOUR 11:30	PLACE Strada di Busseto
OPERATOR ProGeo Engineering srl	GPS TYPE and #	
GAUSS-BOAGA LATITUDE 4799130	GAUSS-BOAGA LONGITUDE 1690697	ALTITUDE 246,5 m slm
STATION TYPE GPA	SENSOR TYPE 4,5 Hz	
STATION #	SENSOR #	DISK #
FILE NAME HVSR40		POINT #
GAIN	SAMPL. FREQ. 50 Hz	REC. DURATION 30 min (minutes / seconds)

WEATHER CONDITIONS: WIND [●] none [ ] weak (5m/s) [ ] medium [ ] strong Measurement (if any): ____
RAIN [●] none [ ] weak [ ] medium [ ] strong Measurement (if any): ____
Temperature (approx): 28 Remarks ____

GROUND TYPE: [ ] earth ([ ] hard [ ] soft) [ ] gravel [ ] sand [ ] rock [ ] grass = ([ ] short [ ] tall)
[●] asphalt [ ] cement [ ] concrete [ ] paved [ ] other ____
[ ] dry soil [ ] wet soil Remarks ____

ARTIFICIAL GROUND-SENSOR COUPLING [●] no [ ] yes, type ____

BUILDING DENSITY [ ] none [●] scattered [ ] dense [ ] other, type ____

TRANSIENTS	none	few	moderate	many	very dense	distance
cars			●			
trucks	●					
pedestrians	●					
other ____	●					

MONOCHROMATIC NOISE SOURCES (factories, works, pumps, rivers,..)
[●] no [ ] yes, type ____

NEARBY STRUCTURES (description, height, distance) (trees, polls, buildings, bridges, underground structures,...)
Trees

OBSERVATIONS

FREQUENCY: Hz (if computed in the field)

Qualità della misura:

Durata: rispettata
Stazionarietà: rispettata
Isotropia: rispettata
Assenza di disturbi: rispettata
Plausibilità fisica: rispettata
Robustezza statistica: rispettata

MISURA TIPO C

HVSR40

Peak frequency (Hz): 12.7 (±5.0)
Peak HVSR value: 2.4 (±1.1)

=== Criteria for a reliable H/V curve ==========
#1. [f0 > 10/Lw]: 12.683 > 0.25 (OK)
#2. [nc > 200]: 43630 > 200 (OK)
#3. [f0>0.5Hz; sigmaA(f) < 2 for 0.5f0 < f < 2f0] (OK)

=== Criteria for a clear H/V peak (at least 5 should be fulfilled) ==========
#1. [exists f- in the range [f0/4, f0] | AH/V(f-) < A0/2]: yes (considering standard deviations), at frequency 3.2Hz (OK)
#2. [exists f+ in the range [f0, 4f0] | AH/V(f+) < A0/2]: yes (considering standard deviations), at frequency Hz (OK)
#3. [A0 > 2]: 2.4 > 2 (OK)
#4. [fpeak[Ah/v(f) ą sigmaA(f)] = f0 ą 5%]: (OK)
#5. [sigmaf < epsilon(f0)]: 4.965 > 0.634 (NO)
#6. [sigmaA(f0) < theta(f0)]: 1.105 < 1.58 (OK)

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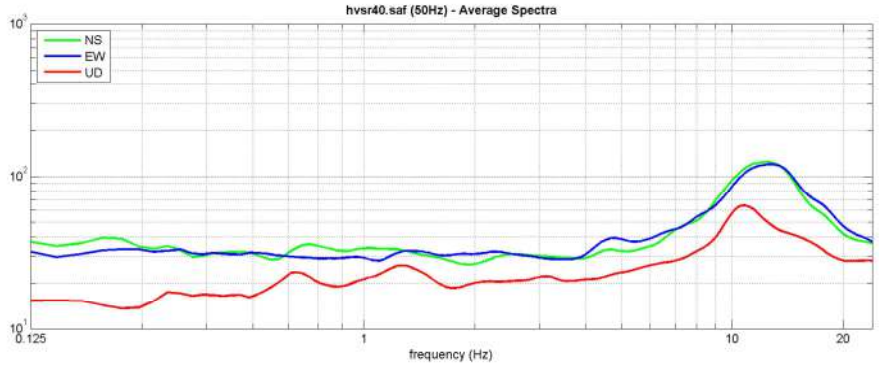
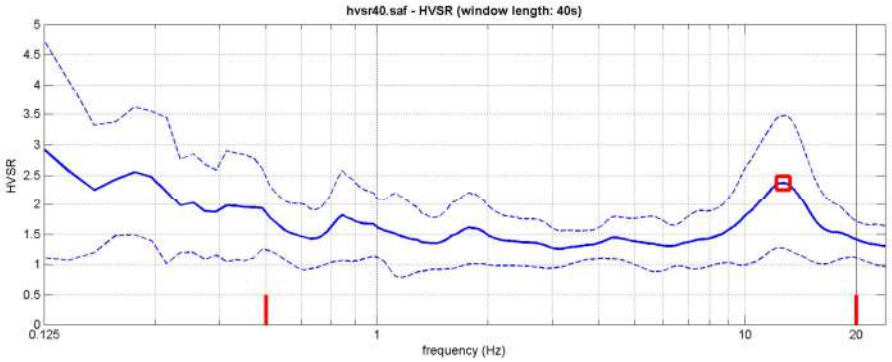
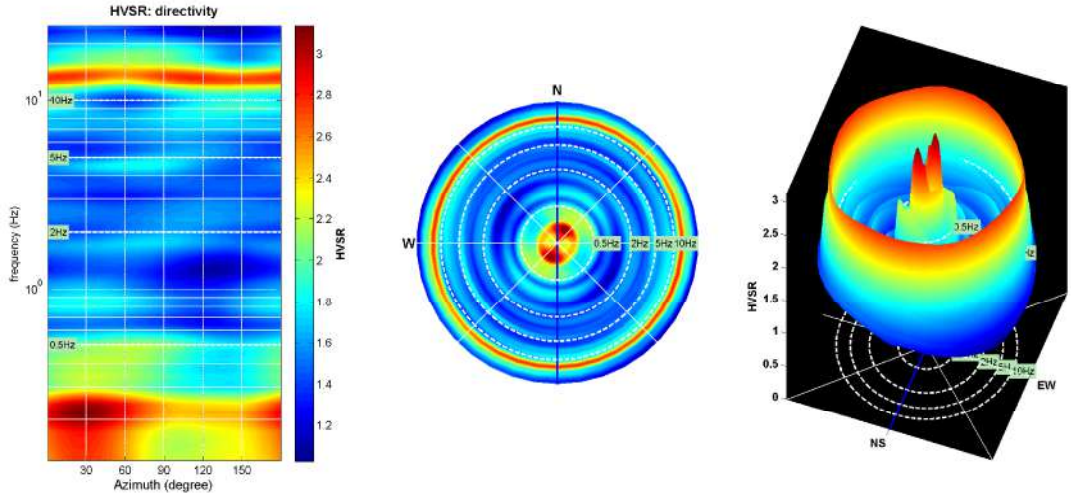
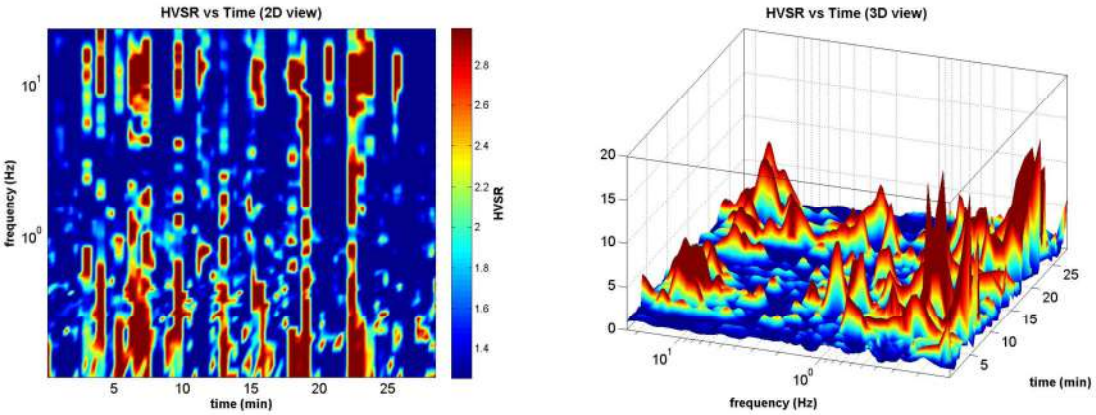




To model the HVSR (also jointly with MASW or ReMi/EGAC data), save the H/V curve, go to the "Velocity Spectrum/a, Modeling & Picking" panels and upload the saved H/V curve





HVSR41

DATE 12.07.2017 | HOUR 18:56 | PLACE Bucciano

OPERATOR ProGeo Engineering srl | GPS TYPE and #

GAUSS-BOAGA LATITUDE 4796731 | GAUSS-BOAGA LONGITUDE 1692106 | ALTITUDE 236,8 m slm

STATION TYPE: GPA | SENSOR TYPE: 4,5 Hz

STATION # | SENSOR # | DISK #

FILE NAME HVSR41 | POINT #

GAIN | SAMPL. FREQ. 100 Hz | REC. DURATION 30 min (minutes / seconds)

WEATHER CONDITIONS
WIND ☐ none ◉ weak (5m/s) ☐ medium ☐ strong Measurement (if any): _____
RAIN ◉ none ☐ weak ☐ medium ☐ strong Measurement (if any): _____
Temperature (approx): 33 Remarks _____

GROUND TYPE
☐ earth (☐ hard ☐ soft) ☐ gravel ◉ sand ☐ rock ☐ grass (☐ short ☐ tall)
☐ asphalt ☐ cement ☐ concrete ☐ paved ☐ other _____
◉ dry soil ☐ wet soil Remarks _____

ARTIFICIAL GROUND-SENSOR COUPLING ◉ no ☐ yes, type _____

BUILDING DENSITY ☐ none ◉ scattered ☐ dense ☐ other, type _____

TRANSIENTS

	none	few	moderate	many	very dense	distance
cars		◉				
trucks	◉					
pedestrians		◉				
other	◉					

MONOCHROMATIC NOISE SOURCES (factories, works, pumps, rivers,..)
◉ no ☐ yes, type _____

NEARBY STRUCTURES (trees, polls, buildings, bridges, underground structures,... ; description, height, distance)
Buildings, Trees

OBSERVATIONS

FREQUENCY: Hz (if computed in the field)

Qualità della misura:

Durata: rispettata
Stazionarietà: rispettata
Isotropia: rispettata
Assenza di disturbi: rispettata
Plausibilità fisica: rispettata
Robustezza statistica: rispettata

MISURA TIPO A2

HVSR41

Peak frequency (Hz): 4.3 (±3.2)
Peak HVSR value: 1.5 (±0.2)

=== Criteria for a reliable H/V curve ==========
#1. [f0 > 10/Lw]: 4.348 > 0.5 (OK)
#2. [nc > 200]: 15305 > 200 (OK)
#3. [f0>0.5Hz; sigmaA(f) < 2 for 0.5f0 < f < 2f0] (OK)

=== Criteria for a clear H/V peak (at least 5 should be fulfilled) ==========
#1. [exists f- in the range [f0/4, f0] | AH/V(f-) < A0/2]: yes (considering standard deviations), at frequency 1.1Hz (OK)
#2. [exists f+ in the range [f0, 4f0] | AH/V(f+) < A0/2]: yes, at frequency 7.5Hz (OK)
#3. [A0 > 2]: 1.5 < 2 (NO)
#4. [fpeak[Ah/v(f) ą sigmaA(f)] = f0 ą 5%]: (OK)
#5. [sigmaf < epsilon(f0)]: 3.163 > 0.217 (NO)
#6. [sigmaA(f0) < theta(f0)]: 0.237 < 1.58 (OK)

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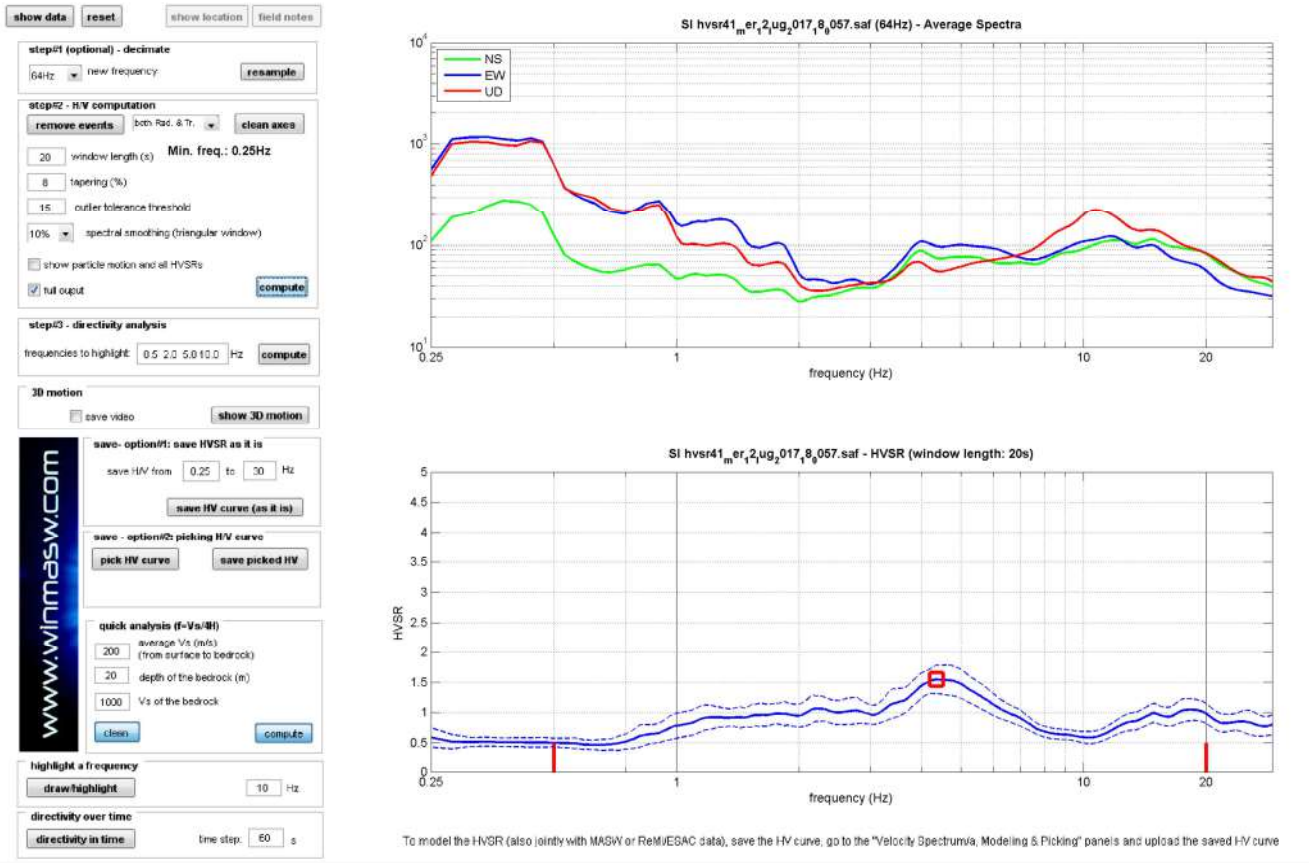
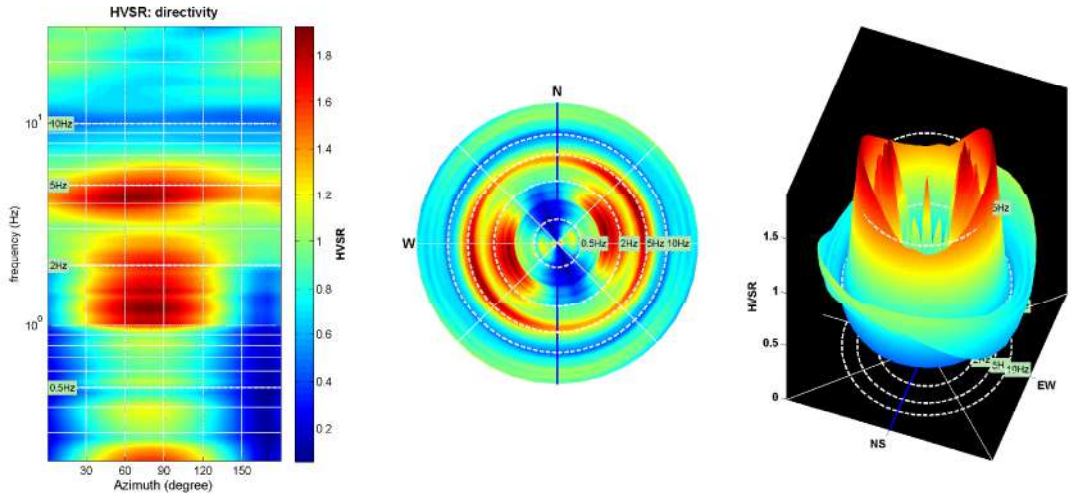
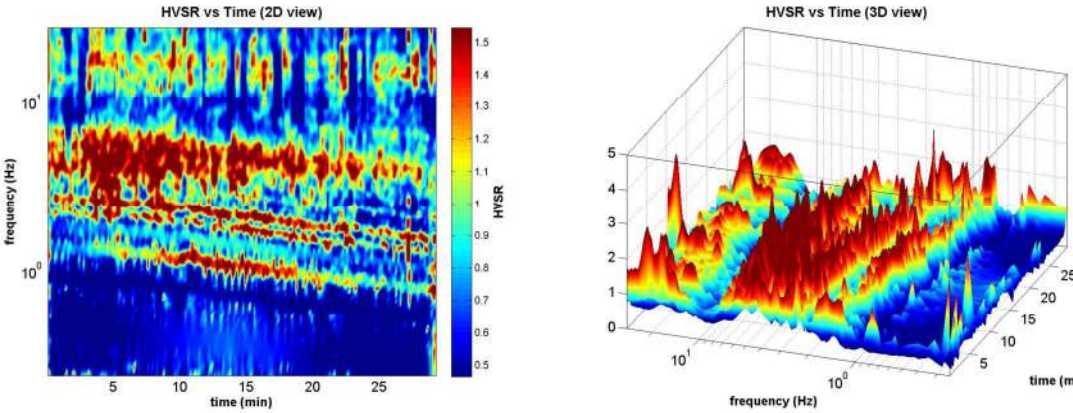

show data
reset
show location
field notes
step#1 (optional) - decimate
64Hz
new frequency
resample
step#2 - H/V computation
remove events
both Rad. & Tr.
clean axes
20
window length (s)
Min. freq.: 0.25Hz
8
tapering (%)
15
outlier tolerance threshold
10%
spectral smoothing (triangular window)
show particle motion and all HVSRs
full output
compute
step#3 - directivity analysis
frequencies to highlight
0.5 2.0 5.0 10.0
Hz
compute
3D motion
save video
show 3D motion
www.winmasw.com
save- option#1: save HVSR as it is
save H/V from
0.25
to
20
Hz
save HV curve (as it is)
save - option#2: picking H/V curve
pick HV curve
save picked HV
quick analysis (f=Vs/4H)
200
average Vs (m/s)
(from surface to bedrock)
20
depth of the bedrock (m)
1000
Vs of the bedrock
clean
compute
highlight a frequency
draw/highlight
10
Hz
directivity over time
directivity in time
time step:
60
s
SI hvsr41_m_er_1_2_l_ug_2_017_1_8_0_057.saf (64Hz) - Average Spectra
NS
EW
UD
frequency (Hz)
SI hvsr41_m_er_1_2_l_ug_2_017_1_8_0_057.saf - HVSR (window length: 20s)
HVSR
frequency (Hz)
To model the HVSR (also jointly with MASW or ReMi/ESAC data), save the H/V curve, go to the "Velocity Spectrum/a, Modeling & Picking" panels and upload the saved H/V curve


HVSR: directivity
frequency (Hz)
10Hz
5Hz
2Hz
0.5Hz
HVSR
Azimuth (degree)
N
W
0.5Hz
2Hz
5Hz
10Hz
H/SR
EW
NS


HVSR vs Time (2D view)
frequency (Hz)
HVSR
time (min)
HVSR vs Time (3D view)
frequency (Hz)
time (min)

HVSR42

DATE 13.07.2017	HOUR 15:35	PLACE Viale Narciso Mengozzi
OPERATOR ProGeo Engineering srl	GPS TYPE and #	
GAUSS-BOAGA LATITUDE 4793082	GAUSS-BOAGA LONGITUDE 1692717	ALTITUDE 176,7 m slm
STATION TYPE GPA	SENSOR TYPE 4,5 Hz	
STATION #	SENSOR #	DISK #
FILE NAME HVSR42		POINT #
GAIN	SAMPL. FREQ. 100 Hz	REC. DURATION 30 min (minutes / seconds)

WEATHER CONDITIONS: WIND (●) none ( ) weak (5m/s) ( ) medium ( ) strong Measurement (if any): ____
RAIN (●) none ( ) weak ( ) medium ( ) strong Measurement (if any): ____
Temperature (approx): 36 Remarks ____

GROUND TYPE: ( ) earth (( ) hard ( ) soft) ( ) gravel ( ) sand ( ) rock (●) grass = ((●) short ( ) tall)
( ) asphalt ( ) cement ( ) concrete ( ) paved ( ) other ____
(●) dry soil ( ) wet soil Remarks ____

ARTIFICIAL GROUND-SENSOR COUPLING (●) no ( ) yes, type ____

BUILDING DENSITY ( ) none (●) scattered ( ) dense ( ) other, type ____

TRANSIENTS

	none	few	moderate	many	very dense	distance
cars		●				
trucks		●				
pedestrians	●					
other	●					

MONOCHROMATIC NOISE SOURCES (factories, works, pumps, rivers,..)
(●) no ( ) yes, type ____

NEARBY STRUCTURES (description, height, distance) (trees, polls, buildings, bridges, underground structures,...)
Buildings

OBSERVATIONS

FREQUENCY: Hz (if computed in the field)

Qualità della misura:

Durata: rispettata
Stazionarietà: rispettata
Isotropia: rispettata
Assenza di disturbi: rispettata
Plausibilità fisica: rispettata
Robustezza statistica: rispettata

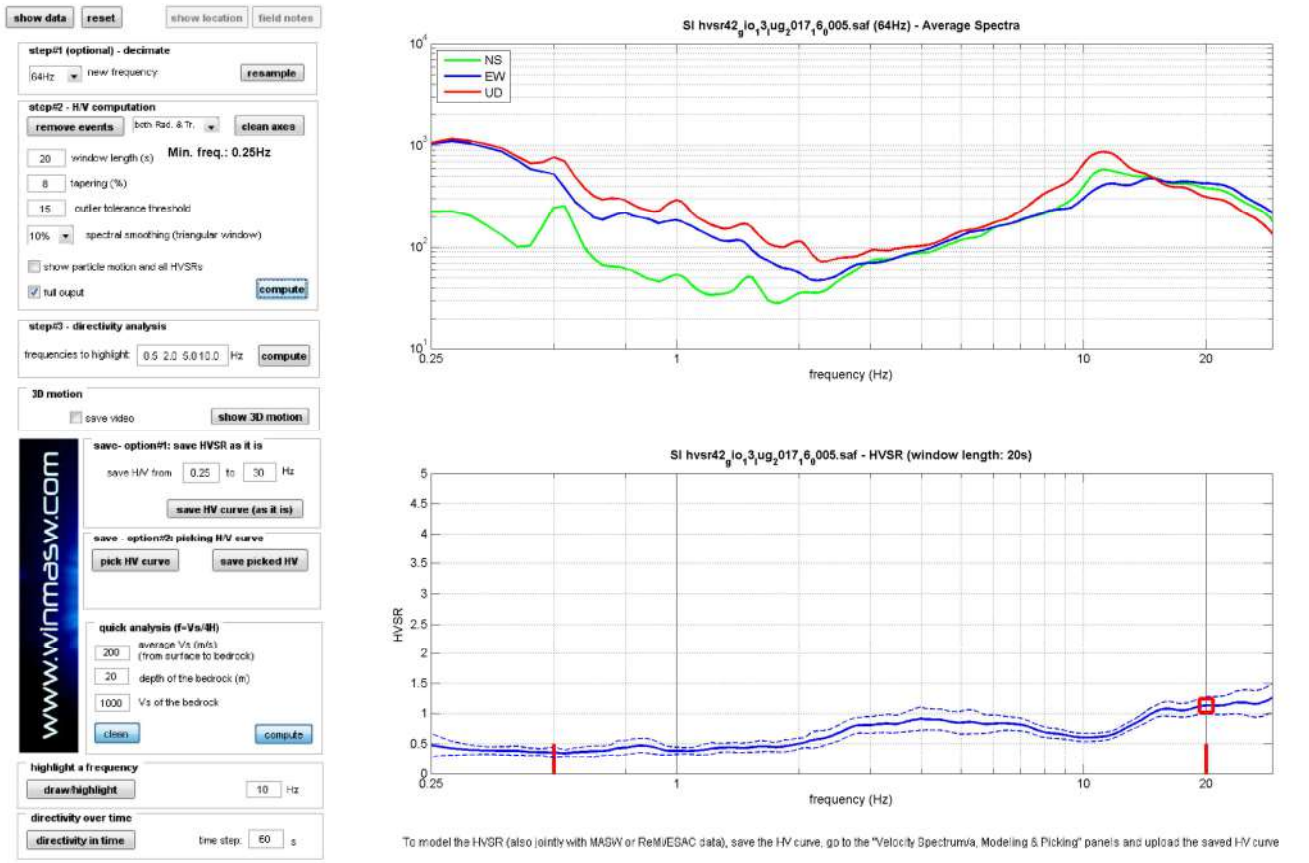
MISURA TIPO A2

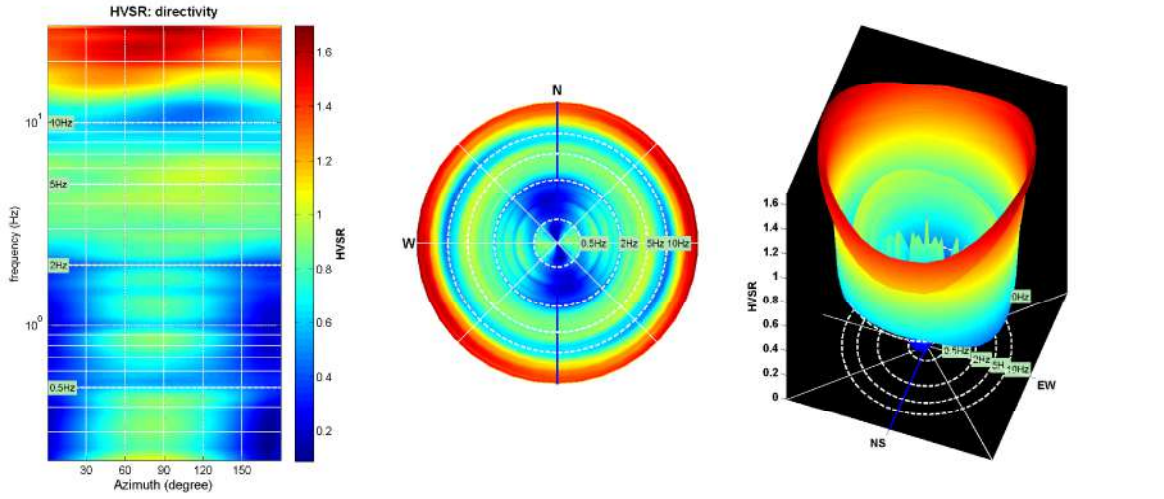
HVSR42

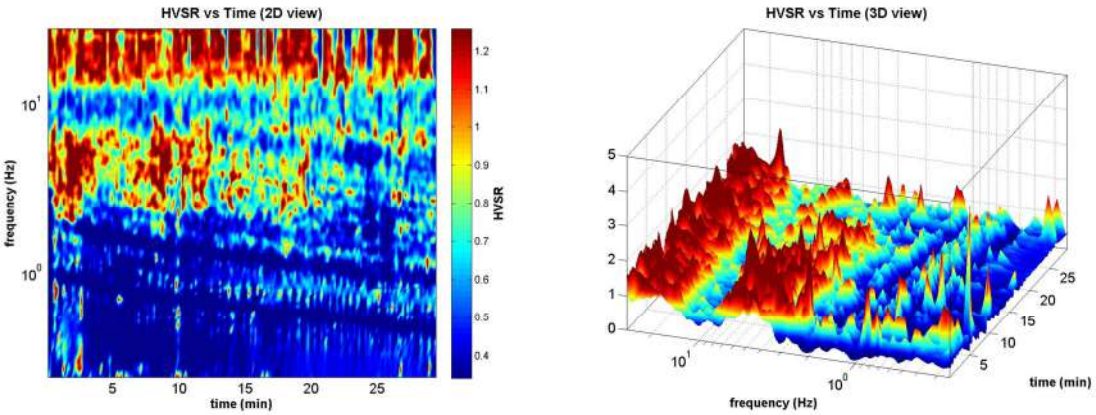
Peak frequency (Hz): 20.0 (±7.2)
Peak HVSR value: 1.1 (±0.1)

=== Criteria for a reliable H/V curve ==========
#1. [f0 > 10/Lw]: 19.988 > 0.5 (OK)
#2. [nc > 200]: 70758 > 200 (OK)
#3. [f0>0.5Hz; sigmaA(f) < 2 for 0.5f0 < f < 2f0] (OK)

=== Criteria for a clear H/V peak (at least 5 should be fulfilled) ==========
#1. [exists f- in the range [f0/4, f0] | AH/V(f-) < A0/2]: yes (considering standard deviations), at frequency 9.2Hz (OK)
#2. [exists f+ in the range [f0, 4f0] | AH/V(f+) < A0/2]: (NO)
#3. [A0 > 2]: 1.1 < 2 (NO)
#4. [fpeak[Ah/v(f) ą sigmaA(f)] = f0 ą 5%]: (OK)
#5. [sigmaf < epsilon(f0)]: 7.186 > 0.999 (NO)
#6. [sigmaA(f0) < theta(f0)]: 0.141 < 1.58 (OK)


show data
reset
show location
field notes
step#1 (optional) - decimate
64Hz
new frequency
resample
step#2 - H/V computation
remove events
both Rad. & Tr.
clean axes
20
window length (s)
Min. freq.: 0.25Hz
8
tapering (%)
15
outlier tolerance threshold
10%
spectral smoothing (triangular window)
show particle motion and all HVSRs
full output
compute
step#3 - directivity analysis
frequencies to highlight
0.5 2.0 5.0 10.0
Hz
compute
3D motion
save video
show 3D motion
www.winmasw.com
save- option#1: save HVSR as it is
save H/V from
0.25
to
30
Hz
save HV curve (as it is)
save - option#2: picking H/V curve
pick HV curve
save picked HV
quick analysis (f=Vs/4H)
200
average Vs (m/s)
(from surface to bedrock)
20
depth of the bedrock (m)
1000
Vs of the bedrock
clean
compute
highlight a frequency
draw highlight
10
Hz
directivity over time
directivity in time
time step.
60
s
SI hvsr42_g_lo_1_3_ug_2_017_1_6_0_005.saf (64Hz) - Average Spectra
NS
EW
UD
frequency (Hz)
SI hvsr42_g_lo_1_3_ug_2_017_1_6_0_005.saf - HVSR (window length: 20s)
HVSR
frequency (Hz)
To model the HVSR (also jointly with MASW or ReMi/EGAC data), save the H/V curve, go to the "Velocity Spectrum/a, Modeling & Picking" panels and upload the saved H/V curve


HVSR: directivity
10Hz
5Hz
2Hz
0.5Hz
frequency (Hz)
Azimuth (degree)
HVSR
N
W
0.5Hz
2Hz
5Hz
10Hz
H/V SR
NS
EW


HVSR vs Time (2D view)
frequency (Hz)
time (min)
HVSR
HVSR vs Time (3D view)
frequency (Hz)
time (min)

HVSR43

DATE 13.07.2017	HOUR 16:13	PLACE Isola d'Arbia
OPERATOR ProGeo Engineering srl	GPS TYPE and #	
GAUSS-BOAGA LATITUDE 4792343	GAUSS-BOAGA LONGITUDE 1693101	ALTITUDE 173,1 m slm
STATION TYPE GPA	SENSOR TYPE 4,5 Hz	
STATION #	SENSOR #	DISK #
FILE NAME HVSR43		POINT #
GAIN	SAMPL. FREQ. 100 Hz	REC. DURATION 30 min (minutes / seconds)

WEATHER CONDITIONS: WIND (●) none ( ) weak (5m/s) ( ) medium ( ) strong Measurement (if any): ____
RAIN (●) none ( ) weak ( ) medium ( ) strong Measurement (if any): ____
Temperature (approx): 37 Remarks ____

GROUND TYPE: ( ) earth (( ) hard ( ) soft) ( ) gravel ( ) sand ( ) rock (●) grass = ((●) short ( ) tall)
( ) asphalt ( ) cement ( ) concrete ( ) paved ( ) other ____
(●) dry soil ( ) wet soil Remarks ____

ARTIFICIAL GROUND-SENSOR COUPLING (●) no ( ) yes, type ____

BUILDING DENSITY ( ) none (●) scattered ( ) dense ( ) other, type ____

TRANSIENTS

	none	few	moderate	many	very dense	distance
cars		●				
trucks	●					
pedestrians		●				
other	●					

MONOCHROMATIC NOISE SOURCES (factories, works, pumps, rivers,..)
( ) no (●) yes, type Ferrovia

NEARBY STRUCTURES (description, height, distance) (trees, polls, buildings, bridges, underground structures,...)
Buildings

OBSERVATIONS

FREQUENCY: Hz (if computed in the field)

Qualità della misura:

Durata: rispettata
Stazionarietà: rispettata
Isotropia: rispettata
Assenza di disturbi: non rispettata
Plausibilità fisica: rispettata
Robustezza statistica: rispettata

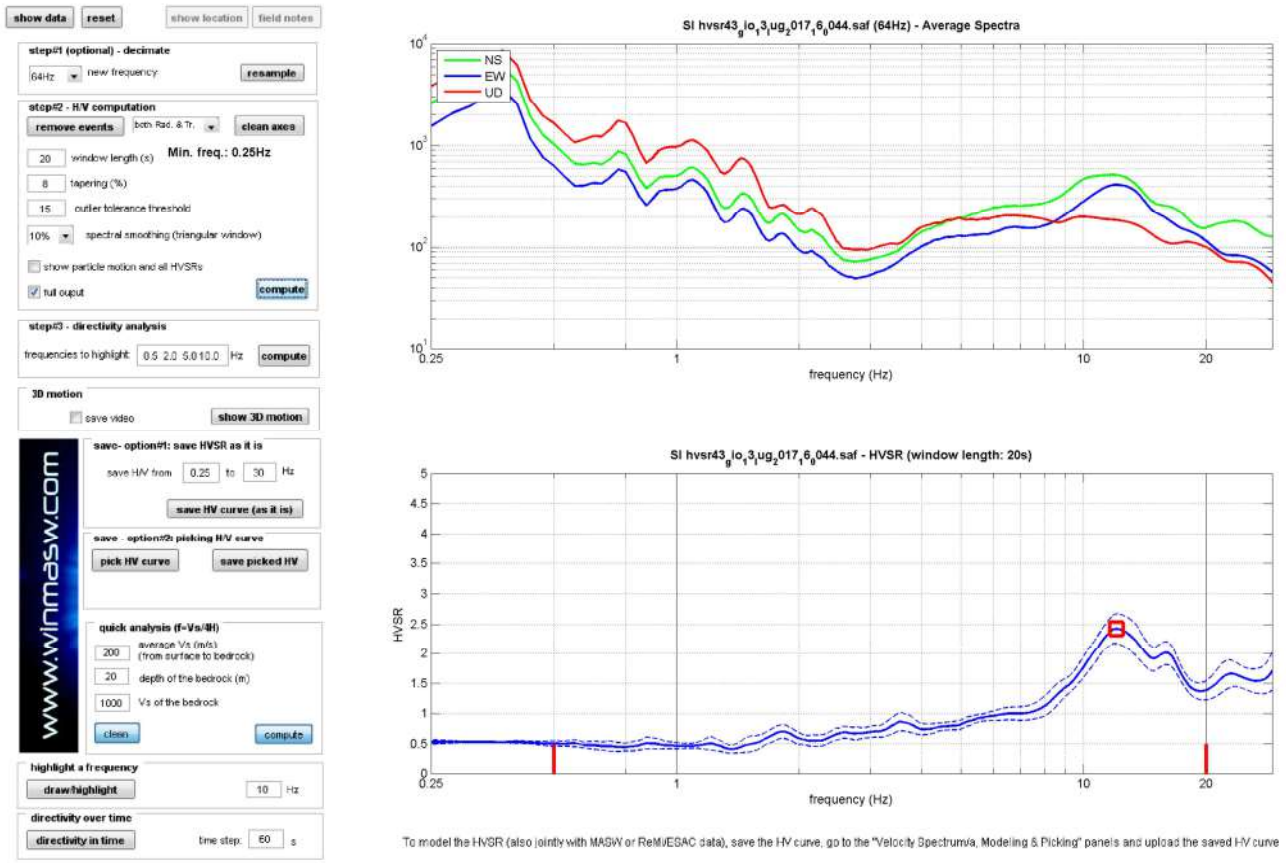
MISURA TIPO B1

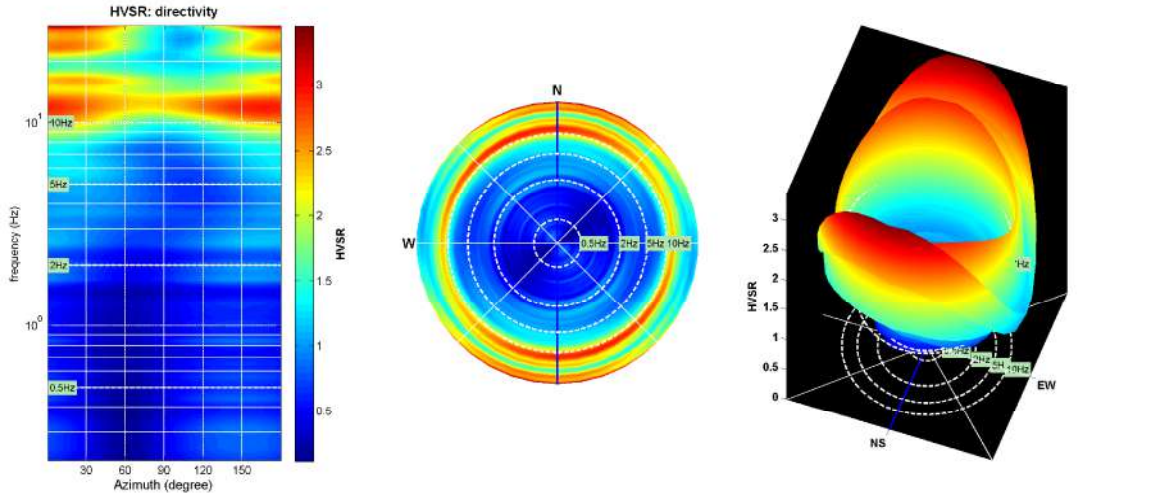
HVSR43

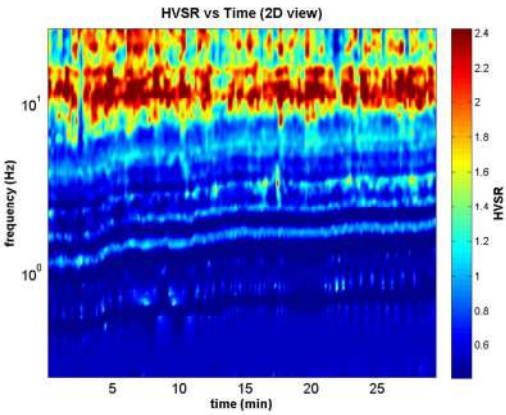
Peak frequency (Hz): 12.0 (±2.0)
Peak HVSR value: 2.4 (±0.2)

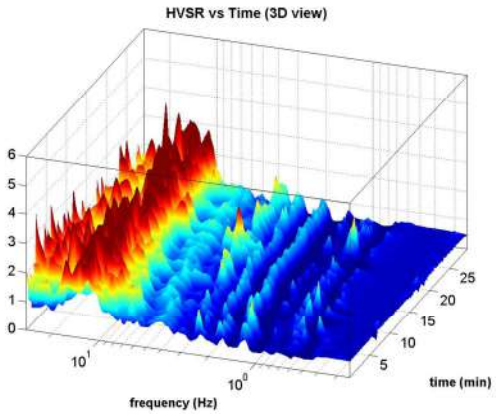
=== Criteria for a reliable H/V curve ==========
#1. [f0 > 10/Lw]: 12.043 > 0.5 (OK)
#2. [nc > 200]: 42632 > 200 (OK)
#3. [f0>0.5Hz; sigmaA(f) < 2 for 0.5f0 < f < 2f0] (OK)

=== Criteria for a clear H/V peak (at least 5 should be fulfilled) ==========
#1. [exists f- in the range [f0/4, f0] | AH/V(f-) < A0/2]: yes, at frequency 3.0Hz (OK)
#2. [exists f+ in the range [f0, 4f0] | AH/V(f+) < A0/2]: (NO)
#3. [A0 > 2]: 2.4 > 2 (OK)
#4. [fpeak[Ah/v(f) ą sigmaA(f)] = f0 ą 5%]: (OK)
#5. [sigmaf < epsilon(f0)]: 1.952 > 0.602 (NO)
#6. [sigmaA(f0) < theta(f0)]: 0.247 < 1.58 (OK)


show data
reset
show location
field notes
step#1 (optional) - decimate
64Hz
new frequency
resample
step#2 - H/V computation
remove events
both Rad. & Tr.
clean axes
20
window length (s)
Min. freq.: 0.25Hz
8
tapering (%)
15
outlier tolerance threshold
10%
spectral smoothing (triangular window)
show particle motion and all HVSRs
full output
compute
step#3 - directivity analysis
frequencies to highlight
0.5 2.0 5.0 10.0
Hz
compute
3D motion
save video
show 3D motion
www.winmasw.com
save- option#1: save HVSR as it is
save H/V from
0.25
to
30
Hz
save HV curve (as it is)
save - option#2: picking H/V curve
pick HV curve
save picked HV
quick analysis (f=Vs/4H)
200
average Vs (m/s)
(from surface to bedrock)
20
depth of the bedrock (m)
1000
Vs of the bedrock
clean
compute
highlight a frequency
draw/highlight
10
Hz
directivity over time
directivity in time
time step.
60
s
SI hvsr43_g_o_1_3_u_g_2_017_1_6_0_044.saf (64Hz) - Average Spectra
NS
EW
UD
frequency (Hz)
SI hvsr43_g_o_1_3_u_g_2_017_1_6_0_044.saf - HVSR (window length: 20s)
HVSR
frequency (Hz)
To model the HVSR (also jointly with MASW or ReMi/EGAC data), save the H/V curve, go to the "Velocity Spectrum/a, Modeling & Picking" panels and upload the saved H/V curve


HVSR: directivity
frequency (Hz)
10Hz
5Hz
2Hz
0.5Hz
Azimuth (degree)
HVSR
N
W
0.5Hz
2Hz
5Hz
10Hz
HVSR
NS
EW


HVSR vs Time (2D view)
frequency (Hz)
time (min)
HVSR


HVSR vs Time (3D view)
frequency (Hz)
time (min)

HVSR44

DATE 12.07.2017	HOUR 16:48	PLACE Taverne d'Arbia
OPERATOR ProGeo Engineering srl	GPS TYPE and #	
GAUSS-BOAGA LATITUDE 4796184	GAUSS-BOAGA LONGITUDE 1694321	ALTITUDE 181,4 m slm
STATION TYPE GPA	SENSOR TYPE 4,5 Hz	
STATION #	SENSOR #	DISK #
FILE NAME HVSR44		POINT #
GAIN	SAMPL. FREQ. 100 Hz	REC. DURATION 30 min (minutes / seconds)

WEATHER CONDITIONS: WIND ☐ none ● weak (5m/s) ☐ medium ☐ strong Measurement (if any): ____ ; RAIN ● none ☐ weak ☐ medium ☐ strong Measurement (if any): ____ ; Temperature (approx): 34 Remarks ____

GROUND TYPE: ☐ earth (☐ hard ☐ soft) ☐ gravel ☐ sand ☐ rock ● grass = (● short ☐ tall) ; ☐ asphalt ☐ cement ☐ concrete ☐ paved ☐ other ____ ; ☐ dry soil ☐ wet soil Remarks ____

ARTIFICIAL GROUND-SENSOR COUPLING ● no ☐ yes, type ____

BUILDING DENSITY ☐ none ● scattered ☐ dense ☐ other, type ____

TRANSIENTS	none	few	moderate	many	very dense	distance
cars		●				
trucks	●					
pedestrians	●					
other ____	●					

MONOCHROMATIC NOISE SOURCES (factories, works, pumps, rivers,..): ● no ☐ yes, type ____

NEARBY STRUCTURES (description, height, distance) (trees, polls, buildings, bridges, underground structures,...): Buildings, Trees

OBSERVATIONS

FREQUENCY: Hz (if computed in the field)

Qualità della misura:

Durata: rispettata
Stazionarietà: rispettata
Isotropia: rispettata
Assenza di disturbi: rispettata
Plausibilità fisica: rispettata
Robustezza statistica: rispettata

MISURA TIPO B2

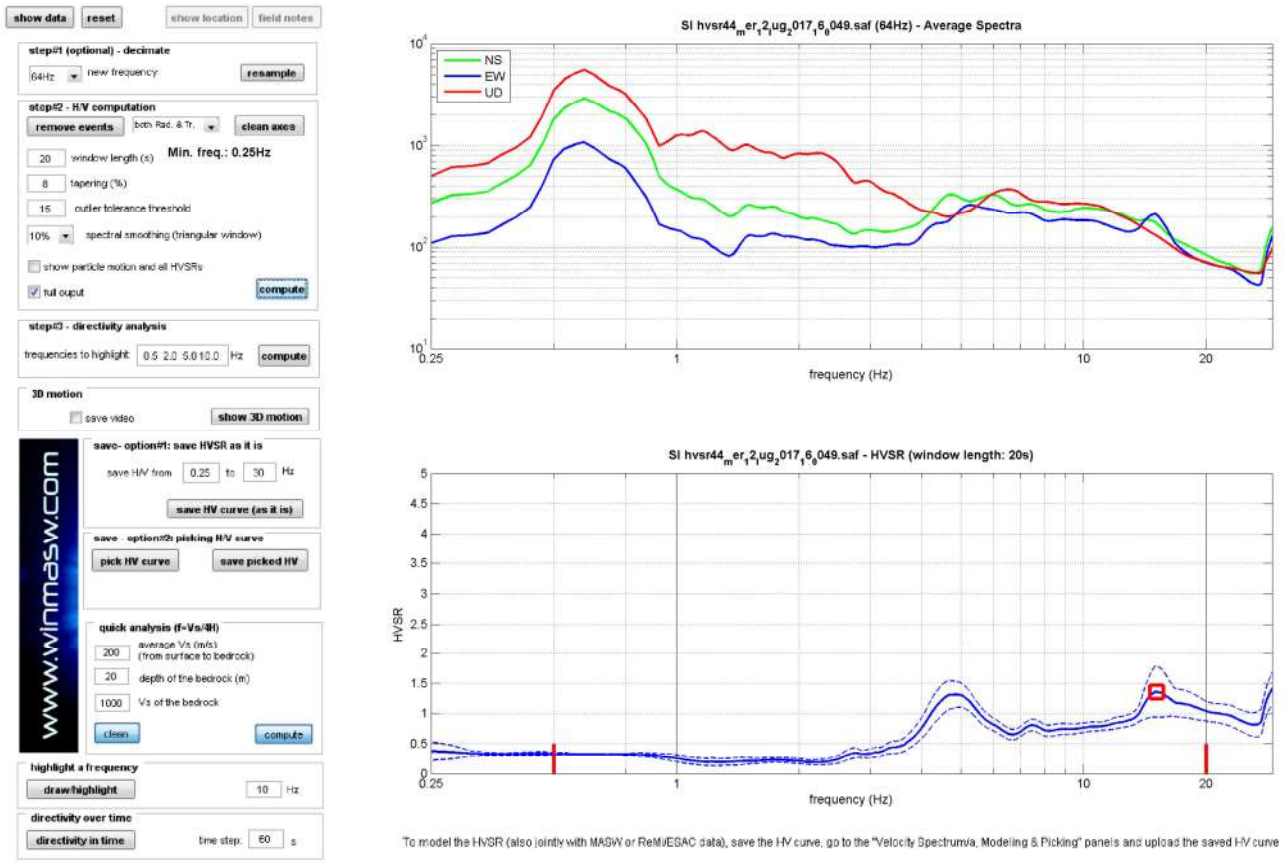
HVSR44

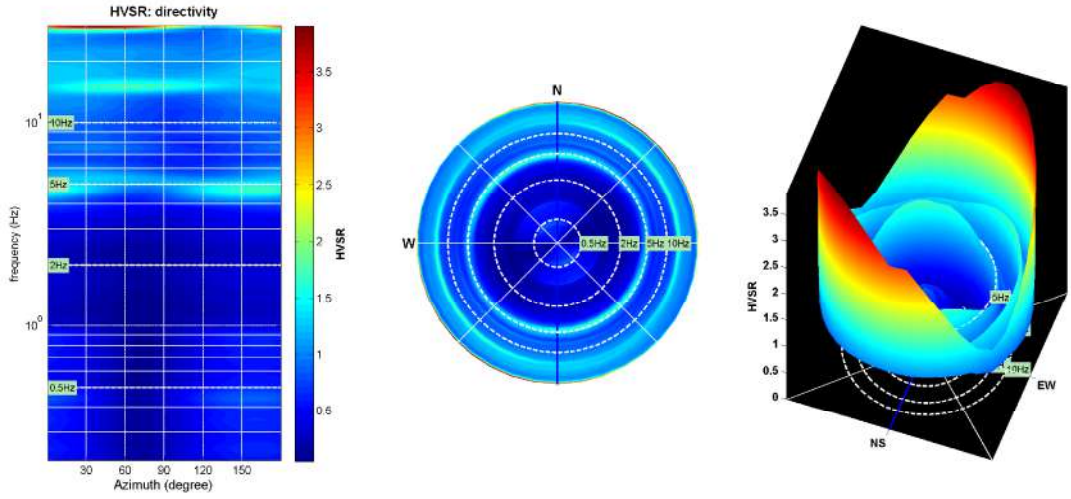
Peak frequency (Hz): 15.1 (±5.8)
Peak HVSR value: 1.4 (±0.4)

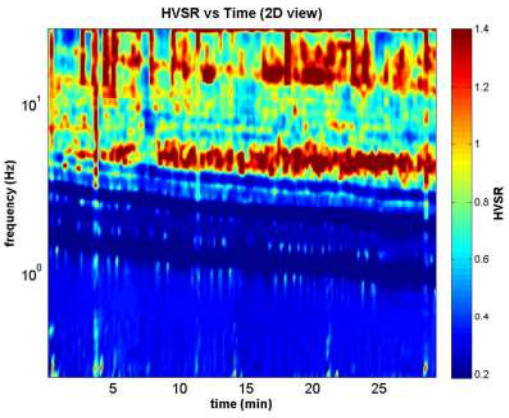
=== Criteria for a reliable H/V curve ==========
#1. [f0 > 10/Lw]: 15.109 > 0.5 (OK)
#2. [nc > 200]: 53182 > 200 (OK)
#3. [f0>0.5Hz; sigmaA(f) < 2 for 0.5f0 < f < 2f0] (OK)

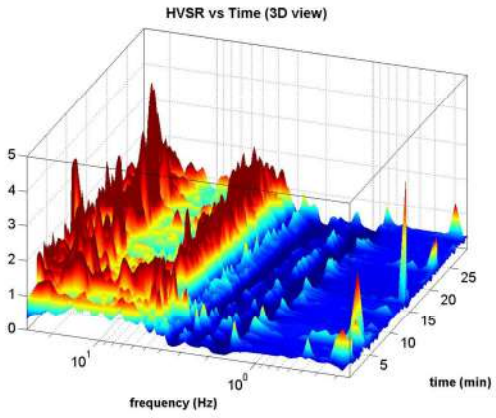
=== Criteria for a clear H/V peak (at least 5 should be fulfilled) ==========
#1. [exists f- in the range [f0/4, f0] | AH/V(f-) < A0/2]: yes, at frequency 3.8Hz (OK)
#2. [exists f+ in the range [f0, 4f0] | AH/V(f+) < A0/2]: (NO)
#3. [A0 > 2]: 1.4 < 2 (NO)
#4. [fpeak[Ah/v(f) ą sigmaA(f)] = f0 ą 5%]: (NO)
#5. [sigmaf < epsilon(f0)]: 5.790 > 0.755 (NO)
#6. [sigmaA(f0) < theta(f0)]: 0.420 < 1.58 (OK)

ProGeo Engineering S.r.l.
via Don Luigi Sturzo, 43/A - 52100 - Arezzo
tel. 0575 324114 - fax. 0575 406473 - email: info@progeo.arezzo.it


show data
reset
show location
field notes
step#1 (optional) - decimate
64Hz
new frequency
resample
step#2 - H/V computation
remove events
both Rad. & Tr.
clean axes
20
window length (s)
Min. freq.: 0.25Hz
8
tapering (%)
15
outlier tolerance threshold
10%
spectral smoothing (triangular window)
show particle motion and all HVSRs
full output
compute
step#3 - directivity analysis
frequencies to highlight
0.5 2.0 5.0 10.0
Hz
compute
3D motion
save video
show 3D motion
www.winmasw.com
save- option#1: save HVSR as it is
save H/V from
0.25
to
30
Hz
save HV curve (as it is)
save - option#2: picking H/V curve
pick HV curve
save picked HV
quick analysis (f=Vs/4H)
200
average Vs (m/s)
(from surface to bedrock)
20
depth of the bedrock (m)
1000
Vs of the bedrock
clean
compute
highlight a frequency
draw highlight
10
Hz
directivity over time
directivity in time
time step:
60
s
SI hvsr44_m_er_1_1_2_ug_2_017_1_6_0_049.saf (64Hz) - Average Spectra
NS
EW
UD
frequency (Hz)
SI hvsr44_m_er_1_1_2_ug_2_017_1_6_0_049.saf - HVSR (window length: 20s)
HVSR
frequency (Hz)
To model the HVSR (also jointly with MASW or ReMi/ESAC data), save the H/V curve, go to the "Velocity Spectrum/a, Modeling & Picking" panels and upload the saved H/V curve


HVSR: directivity
10Hz
5Hz
2Hz
0.5Hz
frequency (Hz)
HVSR
Azimuth (degree)
N
W
0.5Hz
2Hz
5Hz
10Hz
H/SR
NS
EW


HVSR vs Time (2D view)
frequency (Hz)
HVSR
time (min)


HVSR vs Time (3D view)
frequency (Hz)
time (min)

HVSR45

DATE 23.08.2017	HOUR 14:50	PLACE Ferratore
OPERATOR ProGeo Engineering srl	GPS TYPE and #	
GAUSS-BOAGA LATITUDE 4796175	GAUSS-BOAGA LONGITUDE 1684600	ALTITUDE 226 m slm
STATION TYPE GPA	SENSOR TYPE 4,5 Hz	
STATION #	SENSOR #	DISK #
FILE NAME HVSR45		POINT #
GAIN	SAMPL. FREQ. 100 Hz	REC. DURATION 30 min (minutes / seconds)

WEATHER CONDITIONS: WIND (●) none ( ) weak (5m/s) ( ) medium ( ) strong Measurement (if any): ____
RAIN (●) none ( ) weak ( ) medium ( ) strong Measurement (if any): ____
Temperature (approx): 29 Remarks ____

GROUND TYPE: (●) earth (●) hard ( ) soft ( ) gravel ( ) sand ( ) rock ( ) grass = ( ) short ( ) tall
( ) asphalt ( ) cement ( ) concrete ( ) paved ( ) other ____
(●) dry soil ( ) wet soil Remarks ____

ARTIFICIAL GROUND-SENSOR COUPLING (●) no ( ) yes, type ____

BUILDING DENSITY (●) none ( ) scattered ( ) dense ( ) other, type ____

TRANSIENTS

	none	few	moderate	many	very dense	distance
cars				●		
trucks		●				
pedestrians	●					
other	●					

MONOCHROMATIC NOISE SOURCES (factories, works, pumps, rivers,..)
(●) no ( ) yes, type ____

NEARBY STRUCTURES (trees, polls, buildings, bridges, underground structures,... ; description, height, distance)
Trees, Buildings

OBSERVATIONS

FREQUENCY: Hz (if computed in the field)

Qualità della misura:

Durata: rispettata
Stazionarietà: rispettata
Isotropia: rispettata
Assenza di disturbi: rispettata
Plausibilità fisica: rispettata
Robustezza statistica: rispettata

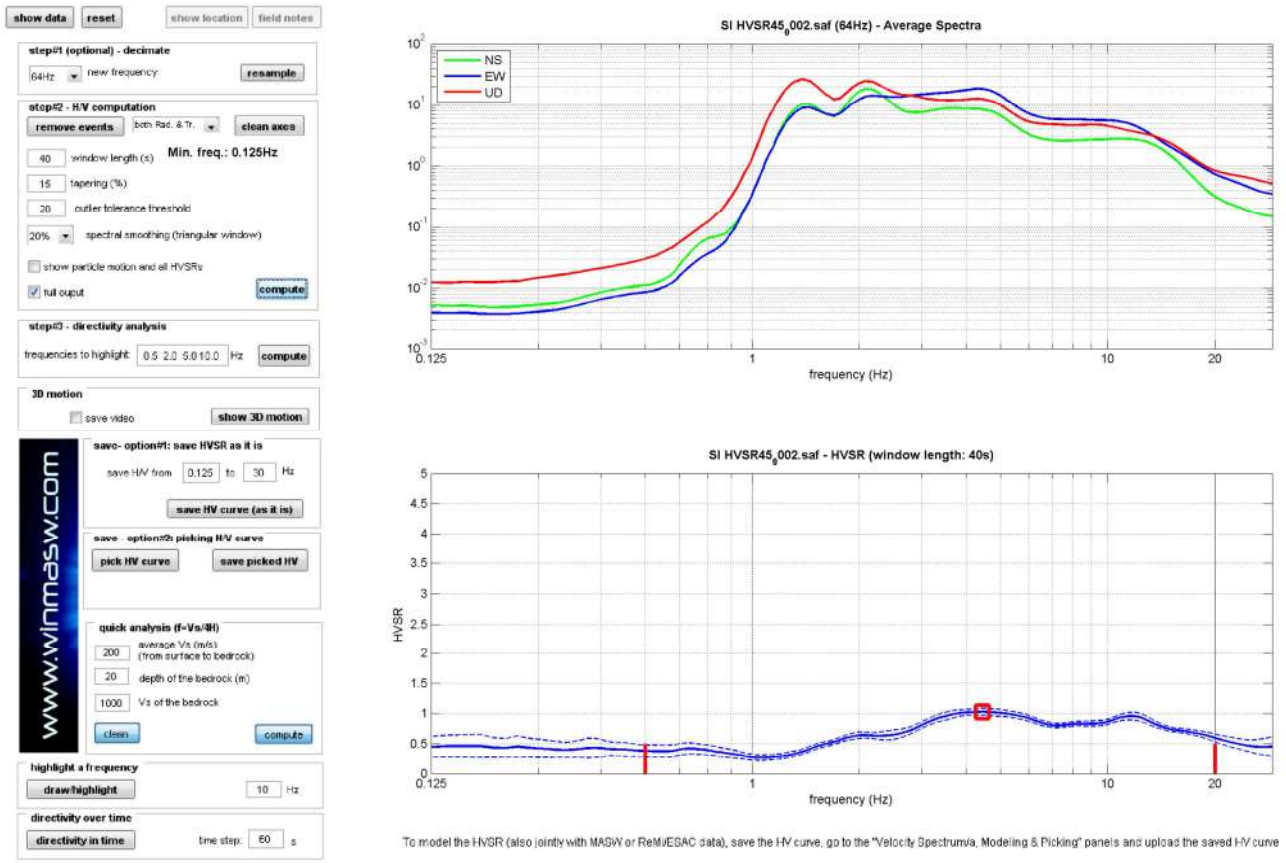
MISURA TIPO A2

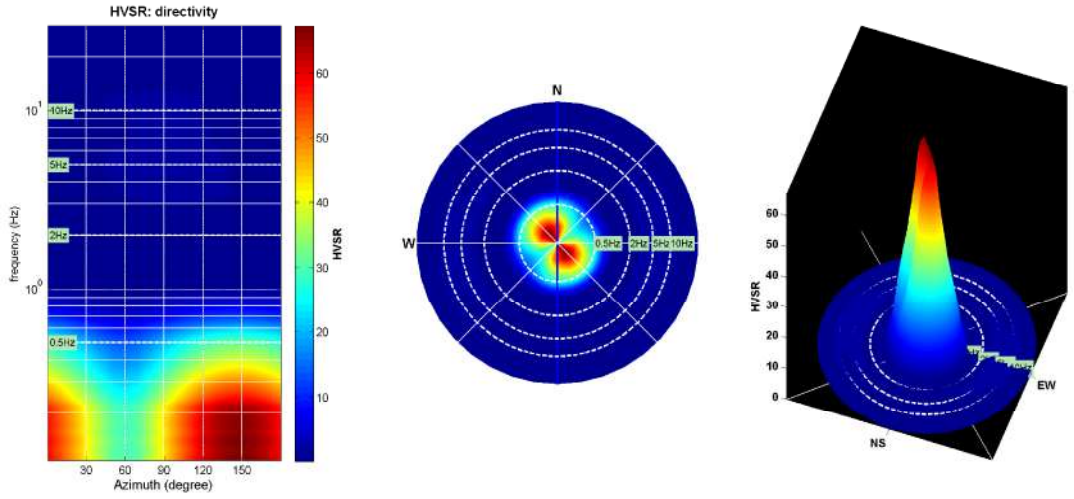
HVSR 45

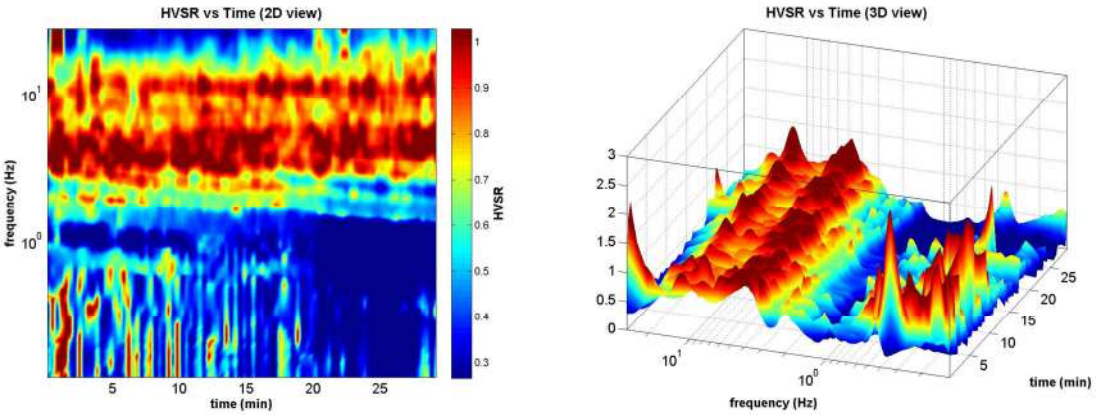
Peak frequency (Hz): 4.4 (±3.1)
Peak HVSR value: 1.0 (±0.1)

=== Criteria for a reliable H/V curve ==========
#1. [f0 > 10/Lw]: 4.440 > 0.25 (OK)
#2. [nc > 200]: 15628 > 200 (OK)
#3. [f0>0.5Hz; sigmaA(f) < 2 for 0.5f0 < f < 2f0] (OK)

=== Criteria for a clear H/V peak (at least 5 should be fulfilled) ==========
#1. [exists f- in the range [f0/4, f0] | AH/V(f-) < A0/2]: yes, at frequency 1.1Hz (OK)
#2. [exists f+ in the range [f0, 4f0] | AH/V(f+) < A0/2]: (NO)
#3. [A0 > 2]: 1.0 < 2 (NO)
#4. [fpeak[Ah/v(f) ą sigmaA(f)] = f0 ą 5%]: (OK)
#5. [sigmaf < epsilon(f0)]: 3.062 > 0.222 (NO)
#6. [sigmaA(f0) < theta(f0)]: 0.058 < 1.58 (OK)


show data
reset
show location
field notes
step#1 (optional) - decimate
64Hz
new frequency
resample
step#2 - H/V computation
remove events
both Rad. & Tr.
clean axes
40
window length (s)
Min. freq.: 0.125Hz
15
tapering (%)
20
outlier tolerance threshold
20%
spectral smoothing (triangular window)
show particle motion and all HVSRs
full ouput
compute
step#3 - directivity analysis
frequencies to highlight
0.5 2.0 5.0 10.0
Hz
compute
3D motion
save video
show 3D motion
www.winmasw.com
save- option#1: save HVSR as it is
save H/V from
0.125
to
30
Hz
save HV curve (as it is)
save - option#2: picking H/V curve
pick HV curve
save picked HV
quick analysis (f=Vs/4H)
200
average Vs (m/s)
(from surface to bedrock)
20
depth of the bedrock (m)
1000
Vs of the bedrock
clean
compute
highlight a frequency
draw highlight
10
Hz
directivity over time
directivity in time
time step.
60
s
SI HVSR45_002.saf (64Hz) - Average Spectra
NS
EW
UD
frequency (Hz)
SI HVSR45_002.saf - HVSR (window length: 40s)
HVSR
frequency (Hz)
To model the HVSR (also jointly with MASW or ReMi/EGAC data), save the H/V curve, go to the "Velocity Spectrum/a, Modeling & Picking" panels and upload the saved H/V curve


HVSR: directivity
10Hz
5Hz
2Hz
0.5Hz
frequency (Hz)
HVSR
Azimuth (degree)
N
W
0.5Hz
2Hz
5Hz
10Hz
H/SR
NS
EW


HVSR vs Time (2D view)
frequency (Hz)
HVSR
time (min)
HVSR vs Time (3D view)
frequency (Hz)
time (min)

HVSR46

DATE 23.08.2017	HOUR 17:10	PLACE Montecchino
OPERATOR ProGeo Engineering srl	GPS TYPE and #	
GAUSS-BOAGA LATITUDE 4794606	GAUSS-BOAGA LONGITUDE 1686550	ALTITUDE 245 m slm
STATION TYPE GPA	SENSOR TYPE 4,5 Hz	
STATION #	SENSOR #	DISK #
FILE NAME HVSR46		POINT #
GAIN	SAMPL. FREQ. 100 Hz	REC. DURATION 30 min (minutes / seconds)

WEATHER CONDITIONS: WIND (●) none ( ) weak (5m/s) ( ) medium ( ) strong Measurement (if any): ____
RAIN (●) none ( ) weak ( ) medium ( ) strong Measurement (if any): ____
Temperature (approx): 28 Remarks ____

GROUND TYPE: (●) earth (●) hard ( ) soft ( ) gravel ( ) sand ( ) rock ( ) grass = ( ) short ( ) tall
( ) asphalt ( ) cement ( ) concrete ( ) paved ( ) other ____
(●) dry soil ( ) wet soil Remarks ____

ARTIFICIAL GROUND-SENSOR COUPLING (●) no ( ) yes, type ____

BUILDING DENSITY ( ) none (●) scattered ( ) dense ( ) other, type ____

TRANSIENTS

	none	few	moderate	many	very dense	distance
cars		●				
trucks	●					
pedestrians	●					
other	●					

MONOCHROMATIC NOISE SOURCES (factories, works, pumps, rivers,..)
(●) no ( ) yes, type ____

NEARBY STRUCTURES (description, height, distance) (trees, polls, buildings, bridges, underground structures,...)
Trees, Buildings

OBSERVATIONS

FREQUENCY: Hz (if computed in the field)

Qualità della misura:

Durata: rispettata
Stazionarietà: rispettata
Isotropia: rispettata
Assenza di disturbi: non rispettata
Plausibilità fisica: rispettata
Robustezza statistica: rispettata

MISURA TIPO B2

HVSR 46

Peak frequency (Hz): 20.0 (±1.8)
Peak HVSR value: 2.3 (±0.2)

=== Criteria for a reliable H/V curve ==========
#1. [f0 > 10/Lw]: 19.994 > 0.25 (OK)
#2. [nc > 200]: 67980 > 200 (OK)
#3. [f0>0.5Hz; sigmaA(f) < 2 for 0.5f0 < f < 2f0] (OK)

=== Criteria for a clear H/V peak (at least 5 should be fulfilled) ==========
#1. [exists f- in the range [f0/4, f0] | AH/V(f-) < A0/2]: yes, at frequency 5.0Hz (OK)
#2. [exists f+ in the range [f0, 4f0] | AH/V(f+) < A0/2]: (NO)
#3. [A0 > 2]: 2.3 > 2 (OK)
#4. [fpeak[Ah/v(f) ą sigmaA(f)] = f0 ą 5%]: (OK)
#5. [sigmaf < epsilon(f0)]: 1.797 > 1.000 (NO)
#6. [sigmaA(f0) < theta(f0)]: 0.242 < 1.58 (OK)

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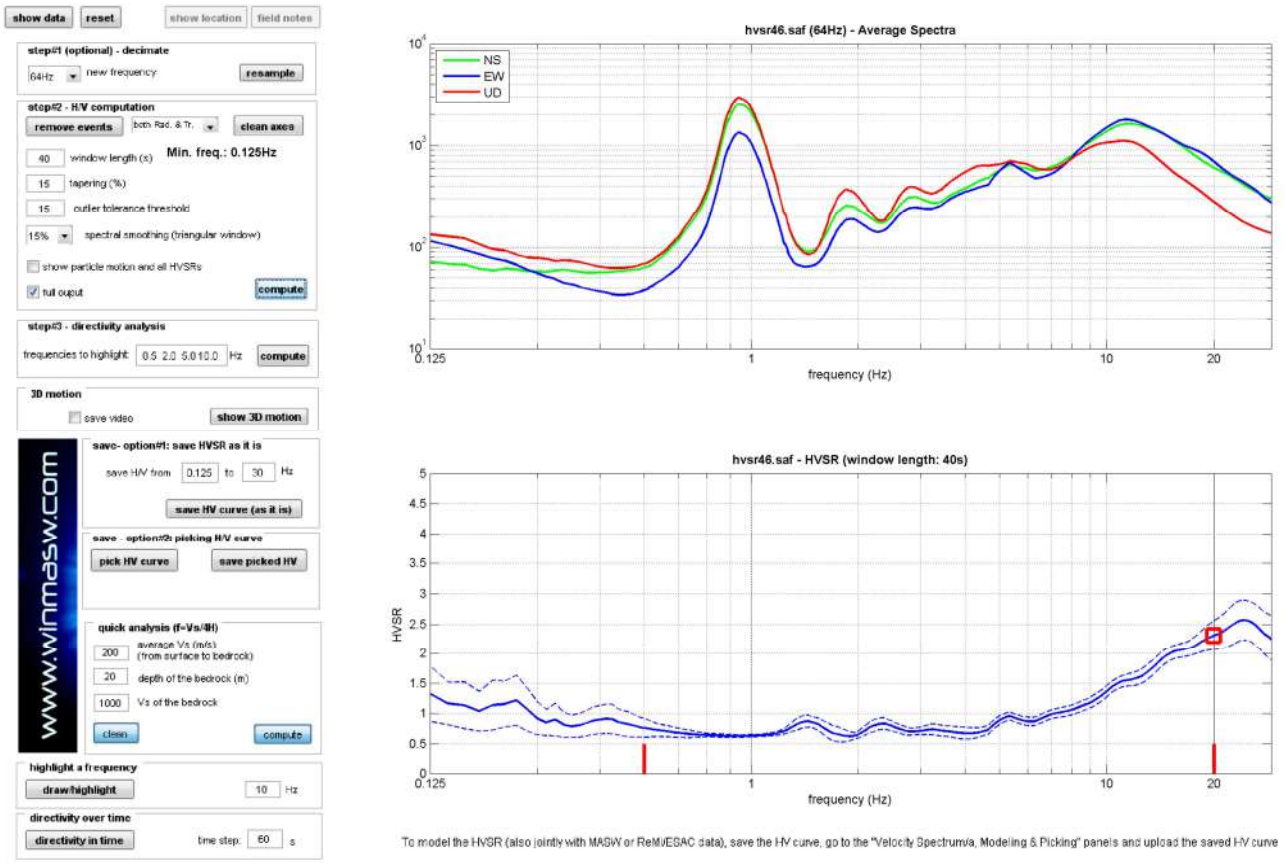
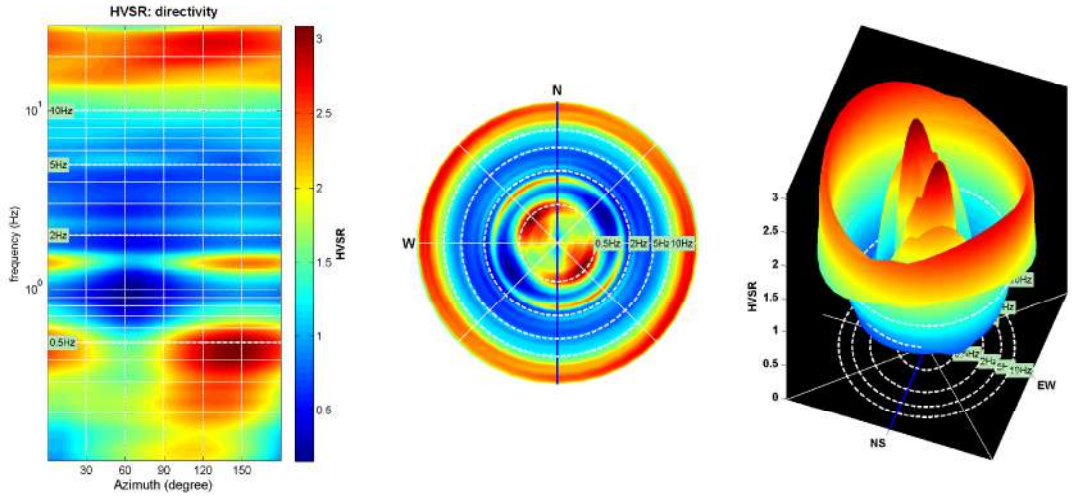
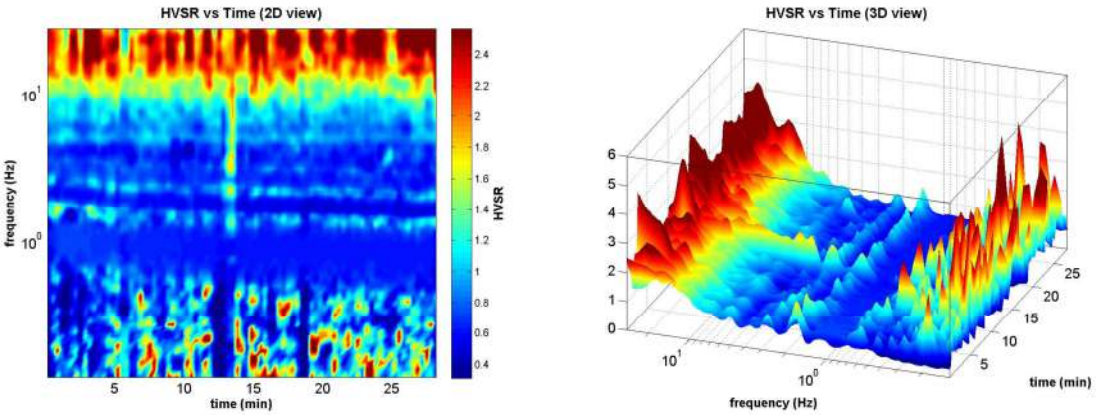
tel. 0575 324114 - fax. 0575 406473 - email: info@progeo.arezzo.it


show data
reset
show location
field notes
step#1 (optional) - decimate
64Hz
new frequency
resample
step#2 - H/V computation
remove events
both Rad. & Tr.
clean axes
40
window length (s)
Min. freq.: 0.125Hz
15
tapering (%)
15
outlier tolerance threshold
15%
spectral smoothing (triangular window)
show particle motion and all HVSRs
full output
compute
step#3 - directivity analysis
frequencies to highlight
0.5 2.0 5.0 10.0
Hz
compute
3D motion
save video
show 3D motion
www.winmasw.com
save- option#1: save HVSR as it is
save H/V from
0.125
to
30
Hz
save HV curve (as it is)
save - option#2: picking H/V curve
pick HV curve
save picked HV
quick analysis (f=Vs/4H)
200
average Vs (m/s)
(from surface to bedrock)
20
depth of the bedrock (m)
1000
Vs of the bedrock
clean
compute
highlight a frequency
draw/highlight
10
Hz
directivity over time
directivity in time
time step.
60
s
hvsr46.saf (64Hz) - Average Spectra
NS
EW
UD
frequency (Hz)
hvsr46.saf - HVSR (window length: 40s)
HVSR
frequency (Hz)
To model the HVSR (also jointly with MASW or ReMi/EGAC data), save the H/V curve, go to the "Velocity Spectrum/a, Modeling & Picking" panels and upload the saved H/V curve


HVSR: directivity
10Hz
5Hz
2Hz
0.5Hz
frequency (Hz)
HVSR
Azimuth (degree)
N
W
0.5Hz
2Hz
5Hz
10Hz
HVSR
NS
EW


HVSR vs Time (2D view)
frequency (Hz)
HVSR
time (min)
HVSR vs Time (3D view)
frequency (Hz)
time (min)

HVSR47

DATE 15.08.2017	HOUR 12:08	PLACE Via delle Arti
OPERATOR ProGeo Engineering srl		GPS TYPE and #
GAUSS-BOAGA LATITUDE 4797976	GAUSS-BOAGA LONGITUDE 1691410	ALTITUDE 214,5 m slm
STATION TYPE GPA	SENSOR TYPE 4,5 Hz	
STATION #	SENSOR #	DISK #
FILE NAME HVSR47		POINT #
GAIN	SAMPL. FREQ. 50 Hz	REC. DURATION 30 min (minutes / seconds)

WEATHER CONDITIONS: WIND ● none ☐ weak (5m/s) ☐ medium ☐ strong Measurement (if any): ____ ; RAIN ● none ☐ weak ☐ medium ☐ strong Measurement (if any): ____ ; Temperature (approx): 29 Remarks ____

GROUND TYPE: ☐ earth (☐ hard ☐ soft) ☐ gravel ☐ sand ☐ rock ☐ grass (☐ short ☐ tall) ; ● asphalt ☐ cement ☐ concrete ☐ paved ☐ other ____ ; ☐ dry soil ☐ wet soil Remarks ____

ARTIFICIAL GROUND-SENSOR COUPLING ● no ☐ yes, type ____

BUILDING DENSITY ☐ none ● scattered ☐ dense ☐ other, type ____

TRANSIENTS

	none	few	moderate	many	very dense	distance
cars			●			
trucks		●				
pedestrians	●					
other	●					

MONOCHROMATIC NOISE SOURCES (factories, works, pumps, rivers,..) ● no ☐ yes, type ____

NEARBY STRUCTURES (description, height, distance) (trees, polls, buildings, bridges, underground structures,...)

Trees, Buildings

OBSERVATIONS

FREQUENCY: Hz (if computed in the field)

Qualità della misura:

Durata: rispettata
Stazionarietà: rispettata
Isotropia: rispettata
Assenza di disturbi: non rispettata
Plausibilità fisica: rispettata
Robustezza statistica: rispettata

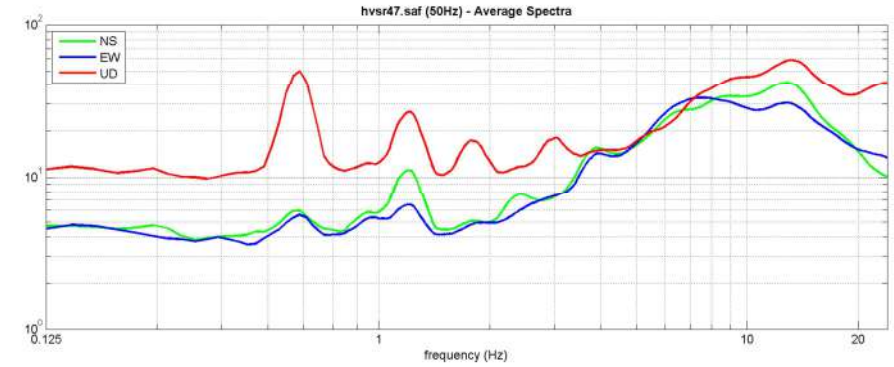
MISURA TIPO B2

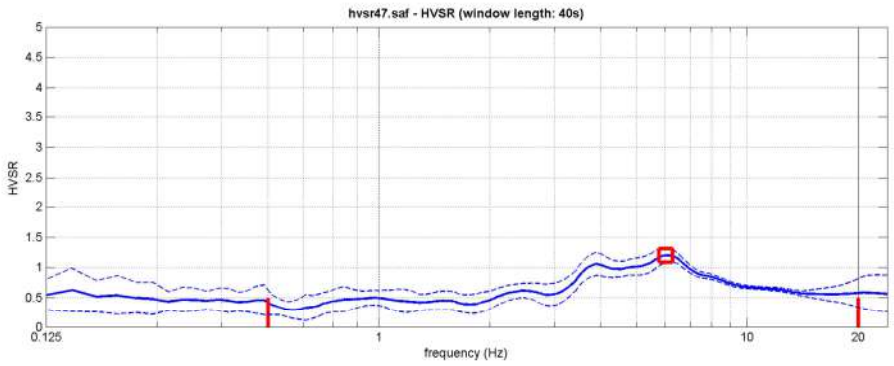
HVSR47

Peak frequency (Hz): 6.0 (±2.1)
Peak HVSR value: 1.2 (±0.1)

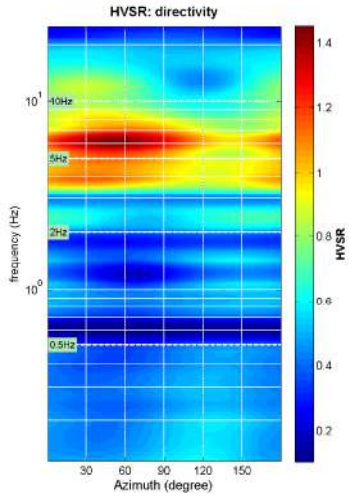
=== Criteria for a reliable H/V curve ==========
#1. [f0 > 10/Lw]: 6.012 > 0.25 (OK)
#2. [nc > 200]: 20921 > 200 (OK)
#3. [f0>0.5Hz; sigmaA(f) < 2 for 0.5f0 < f < 2f0] (OK)

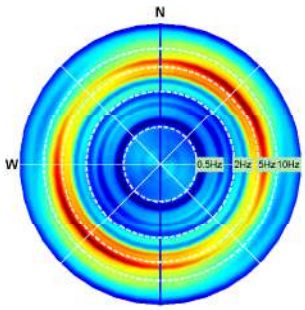
=== Criteria for a clear H/V peak (at least 5 should be fulfilled) ==========
#1. [exists f- in the range [f0/4, f0] | AH/V(f-) < A0/2]: yes, at frequency 1.5Hz (OK)
#2. [exists f+ in the range [f0, 4f0] | AH/V(f+) < A0/2]: yes, at frequency 13.2Hz (OK)
#3. [A0 > 2]: 1.2 < 2 (NO)
#4. [fpeak[Ah/v(f) ą sigmaA(f)] = f0 ą 5%]: (OK)
#5. [sigmaf < epsilon(f0)]: 2.068 > 0.301 (NO)
#6. [sigmaA(f0) < theta(f0)]: 0.126 < 1.58 (OK)

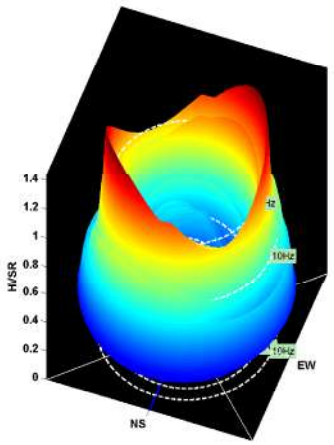


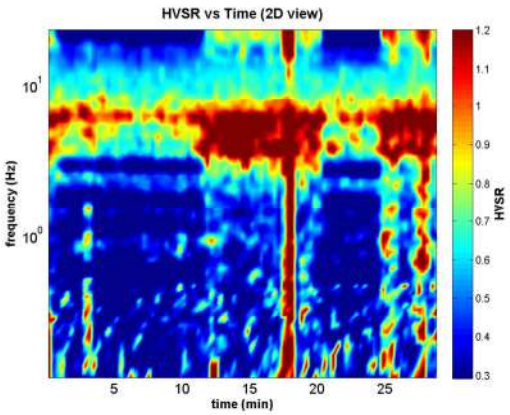


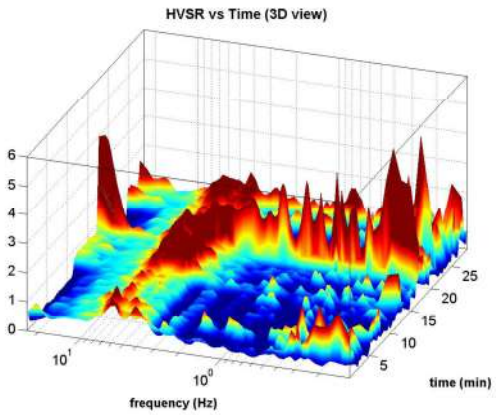
To model the HVSR (also jointly with MASW or ReMi/ESAC data), save the H/V curve, go to the "Velocity Spectrum/a, Modeling & Picking" panels and upload the saved H/V curve











HVSR48

DATE 16.08.2017	HOUR 15:03	PLACE Cerchiaia
OPERATOR ProGeo Engineering srl	GPS TYPE and #	
GAUSS-BOAGA LATITUDE 4796141	GAUSS-BOAGA LONGITUDE 1689792	ALTITUDE 211,4 m slm
STATION TYPE GPA	SENSOR TYPE 4,5 Hz	
STATION #	SENSOR #	DISK #
FILE NAME HVSR48		POINT #
GAIN	SAMPL. FREQ. 50 Hz	REC. DURATION 30 min (minutes / seconds)

WEATHER CONDITIONS
WIND ● none ☐ weak (5m/s) ☐ medium ☐ strong Measurement (if any): _____
RAIN ● none ☐ weak ☐ medium ☐ strong Measurement (if any): _____
Temperature (approx): 36 Remarks _____

GROUND TYPE
☐ earth (☐ hard ☐ soft) ☐ gravel ☐ sand ☐ rock ☐ grass (☐ short ☐ tall)
● asphalt ☐ cement ☐ concrete ☐ paved ☐ other _____
☐ dry soil ☐ wet soil Remarks _____

ARTIFICIAL GROUND-SENSOR COUPLING ● no ☐ yes, type _____

BUILDING DENSITY ☐ none ● scattered ☐ dense ☐ other, type _____

TRANSIENTS	none	few	moderate	many	very dense	distance
cars		●				
trucks		●				
pedestrians	●					
other	●					

MONOCHROMATIC NOISE SOURCES (factories, works, pumps, rivers,..)
● no ☐ yes, type _____

NEARBY STRUCTURES (description, height, distance) (trees, polls, buildings, bridges, underground structures,...)
Trees

OBSERVATIONS

FREQUENCY: Hz (if computed in the field)

Qualità della misura:

Durata: rispettata
Stazionarietà: rispettata
Isotropia: rispettata
Assenza di disturbi: rispettata
Plausibilità fisica: rispettata
Robustezza statistica: rispettata

MISURA TIPO A2

HVSR 48

Peak frequency (Hz): 0.5 (±1.2)
Peak HVSR value: 1.1 (±0.2)

=== Criteria for a reliable H/V curve ==========
#1. [f0 > 10/Lw]: 0.489 > 0.25 (OK)
#2. [nc > 200]: 1662 > 200 (OK)
#3. [f0<0.5Hz; sigmaA(f) < 3 for 0.5f0 < f < 2f0] (OK)

=== Criteria for a clear H/V peak (at least 5 should be fulfilled) ==========
#1. [exists f- in the range [f0/4, f0] | AH/V(f-) < A0/2]: (NO)
#2. [exists f+ in the range [f0, 4f0] | AH/V(f+) < A0/2]: (NO)
#3. [A0 > 2]: 1.1 < 2 (NO)
#4. [fpeak[Ah/v(f) ą sigmaA(f)] = f0 ą 5%]: (NO)
#5. [sigmaf < epsilon(f0)]: 1.248 > 0.098 (NO)
#6. [sigmaA(f0) < theta(f0)]: 0.235 < 2.5 (OK)

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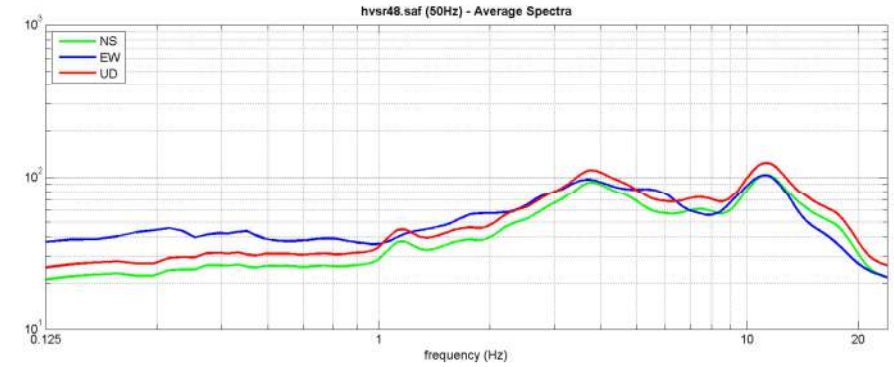
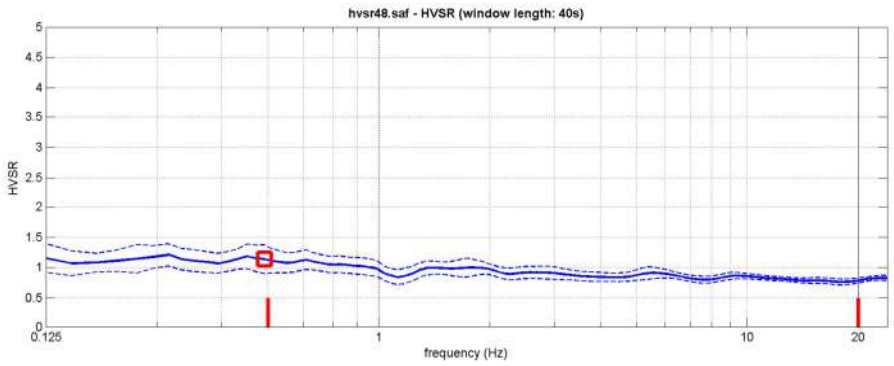
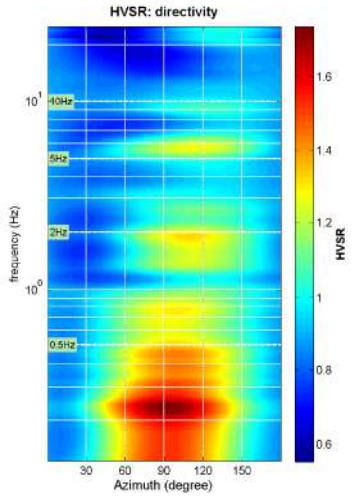
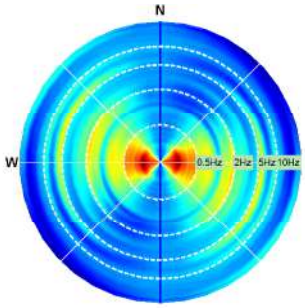
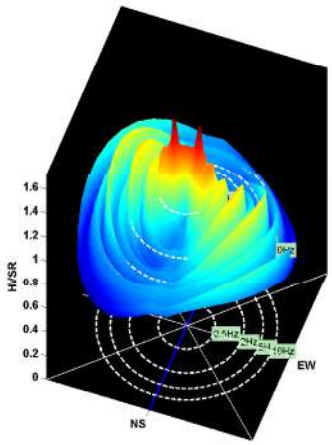


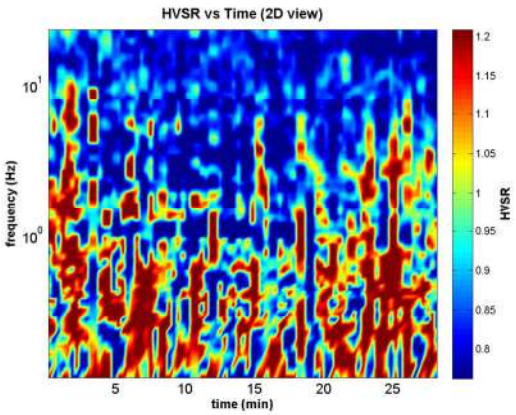


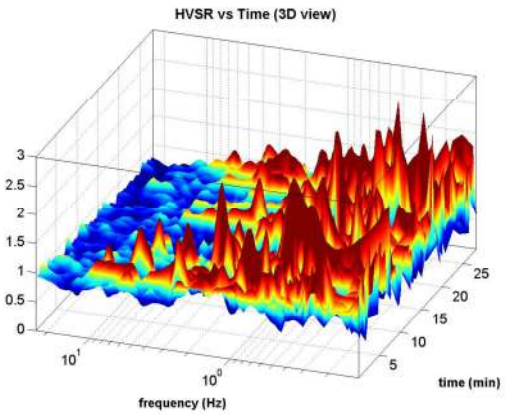
To model the HVSR (also jointly with MASW or ReMi/ESAC data), save the H/V curve, go to the "Velocity Spectrum/a, Modeling & Picking" panels and upload the saved H/V curve











HVSR49

DATE 13.07.2017	HOUR 17:37	PLACE Strada della Tana
OPERATOR ProGeo Engineering srl	GPS TYPE and #	
GAUSS-BOAGA LATITUDE 4795409	GAUSS-BOAGA LONGITUDE 1690037	ALTITUDE 243 m slm
STATION TYPE GPA	SENSOR TYPE 4,5 Hz	
STATION #	SENSOR #	DISK #
FILE NAME HVSR49		POINT #
GAIN	SAMPL. FREQ. 100 Hz	REC. DURATION 30 min (minutes / seconds)

WEATHER CONDITIONS: WIND ☐ none ☒ weak (5m/s) ☐ medium ☐ strong Measurement (if any): ____ ; RAIN ☒ none ☐ weak ☐ medium ☐ strong Measurement (if any): ____ ; Temperature (approx): 37 Remarks ____

GROUND TYPE: ☒ earth (☒ hard ☐ soft) ☐ gravel ☐ sand ☐ rock ☐ grass (☐ short ☐ tall) ☐ asphalt ☐ cement ☐ concrete ☐ paved ☐ other ____ ; ☒ dry soil ☐ wet soil Remarks ____

ARTIFICIAL GROUND-SENSOR COUPLING ☒ no ☐ yes, type ____

BUILDING DENSITY ☒ none ☐ scattered ☐ dense ☐ other, type ____

TRANSIENTS

	none	few	moderate	many	very dense	distance
cars	●					
trucks	●					
pedestrians	●					
other	●					

MONOCHROMATIC NOISE SOURCES (factories, works, pumps, rivers,..) ☒ no ☐ yes, type ____

NEARBY STRUCTURES (description, height, distance) (trees, polls, buildings, bridges, underground structures,...)

OBSERVATIONS

FREQUENCY: Hz (if computed in the field)

Qualità della misura:

Durata: rispettata
Stazionarietà: rispettata
Isotropia: rispettata
Assenza di disturbi: rispettata
Plausibilità fisica: non rispettata
Robustezza statistica: rispettata

MISURA TIPO B1

HVSR49

Peak frequency (Hz): 17.1 (±7.2)
Peak HVSR value: 2.7 (±0.6)

=== Criteria for a reliable H/V curve ==========
#1. [f0 > 10/Lw]: 17.082 > 0.25 (OK)
#2. [nc > 200]: 56029 > 200 (OK)
#3. [f0>0.5Hz; sigmaA(f) < 2 for 0.5f0 < f < 2f0] (OK)

=== Criteria for a clear H/V peak (at least 5 should be fulfilled) ==========
#1. [exists f- in the range [f0/4, f0] | AH/V(f-) < A0/2]: yes, at frequency 4.7Hz (OK)
#2. [exists f+ in the range [f0, 4f0] | AH/V(f+) < A0/2]: (NO)
#3. [A0 > 2]: 2.7 > 2 (OK)
#4. [fpeak[Ah/v(f) ą sigmaA(f)] = f0 ą 5%]: (OK)
#5. [sigmaf < epsilon(f0)]: 7.178 > 0.854 (NO)
#6. [sigmaA(f0) < theta(f0)]: 0.613 < 1.58 (OK)

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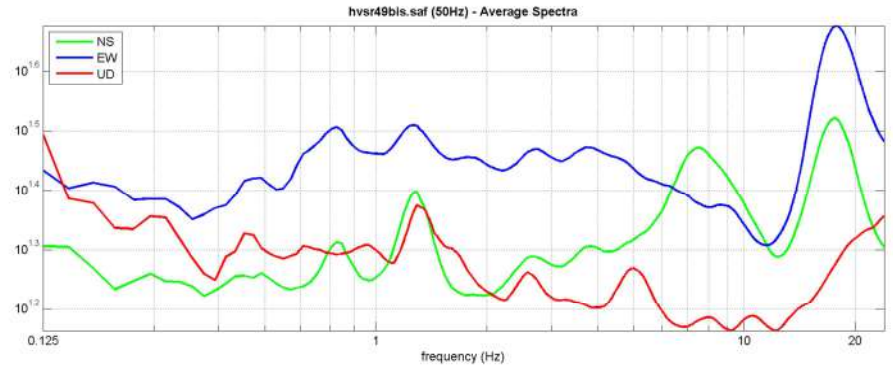
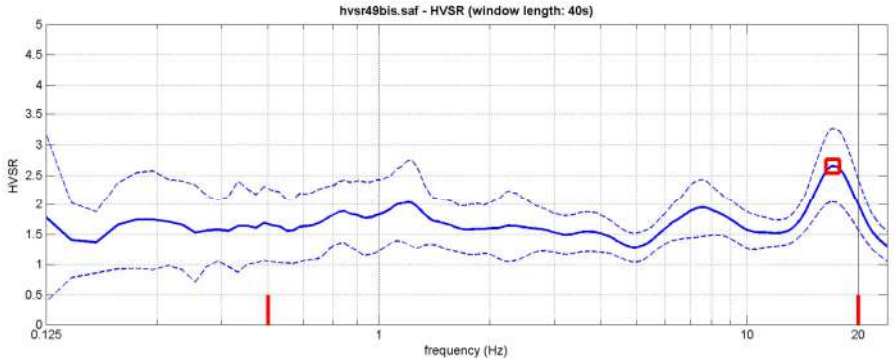
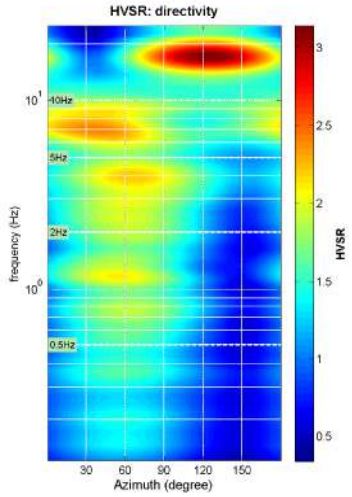
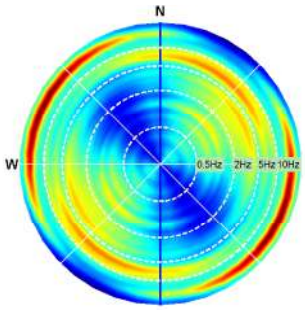
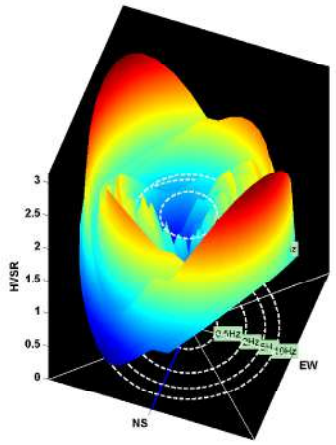


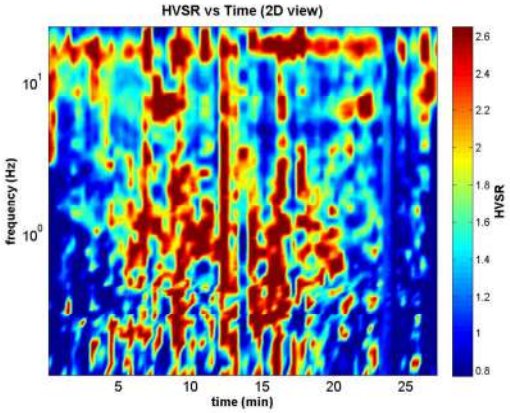


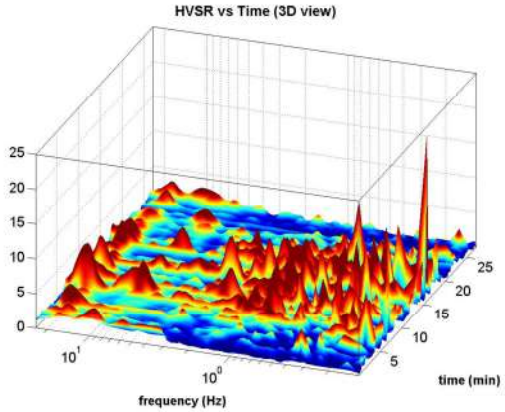
To model the HVSR (also jointly with MASW or ReMi/EGAC data), save the H/V curve, go to the "Velocity Spectrum/a, Modeling & Picking" panels and upload the saved H/V curve











HVSR50

DATE 23.08.2017	HOUR 18:47	PLACE San Rocco
OPERATOR ProGeo Engineering srl	GPS TYPE and #	
GAUSS-BOAGA LATITUDE 4792170	GAUSS-BOAGA LONGITUDE 1685754	ALTITUDE 247 m slm
STATION TYPE GPA	SENSOR TYPE 4,5 Hz	
STATION #	SENSOR #	DISK #
FILE NAME HVSR50		POINT #
GAIN	SAMPL. FREQ. 100 Hz	REC. DURATION 30 min (minutes / seconds)

WEATHER CONDITIONS

WIND ● none ☐ weak (5m/s) ☐ medium ☐ strong Measurement (if any): _____

RAIN ● none ☐ weak ☐ medium ☐ strong Measurement (if any): _____

Temperature (approx): 25 Remarks _____

GROUND TYPE

☐ earth (☐ hard ☐ soft) ☐ gravel ☐ sand ☐ rock ☐ grass = (☐ short ☐ tall)

● asphalt ☐ cement ☐ concrete ☐ paved ☐ other _____

● dry soil ☐ wet soil Remarks _____

ARTIFICIAL GROUND-SENSOR COUPLING ● no ☐ yes, type _____

BUILDING DENSITY ☐ none ☐ scattered ● dense ☐ other, type _____

TRANSIENTS

	none	few	moderate	many	very dense	distance
cars		●				
trucks	●					
pedestrians	●					
other	●					

MONOCHROMATIC NOISE SOURCES (factories, works, pumps, rivers,..)

● no ☐ yes, type _____

NEARBY STRUCTURES (description, height, distance) (trees, polls, buildings, bridges, underground structures,...)

Trees, Buildings

OBSERVATIONS

FREQUENCY: Hz (if computed in the field)

Qualità della misura:

Durata: rispettata
Stazionarietà: rispettata
Isotropia: rispettata
Assenza di disturbi: non rispettata
Plausibilità fisica: rispettata
Robustezza statistica: rispettata

MISURA TIPO B2

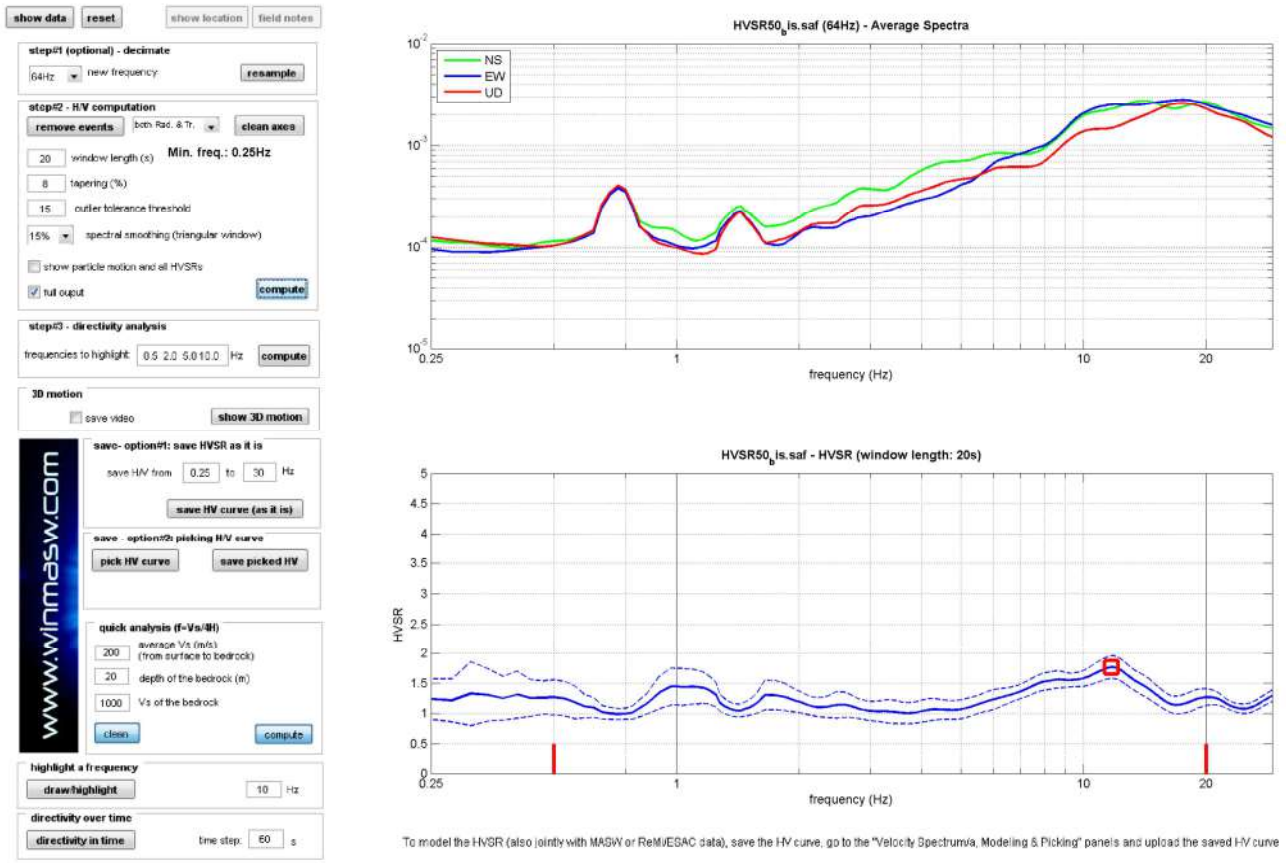
HVSR 50

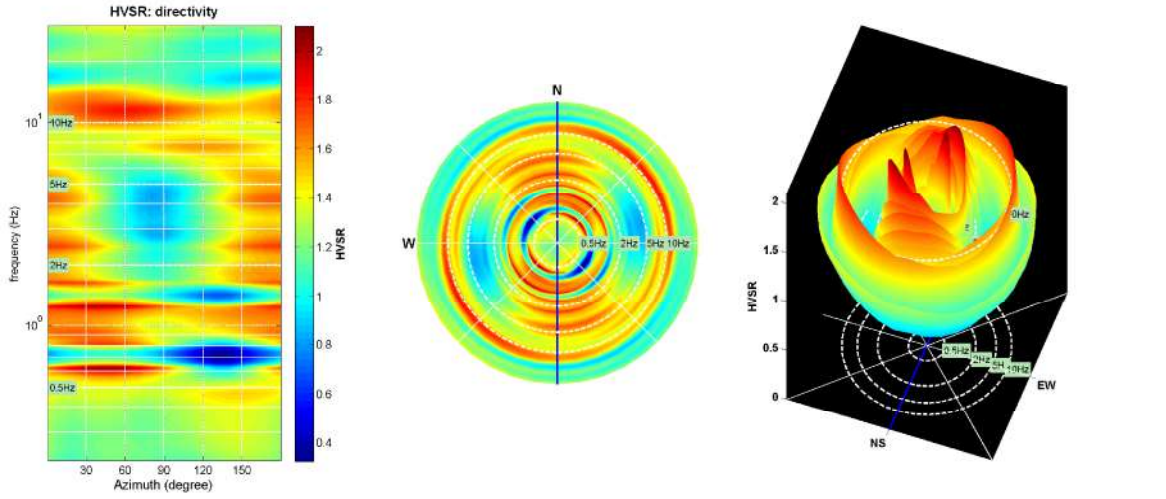
Peak frequency (Hz): 11.7 (±4.9)
Peak HVSR value: 1.8 (±0.2)

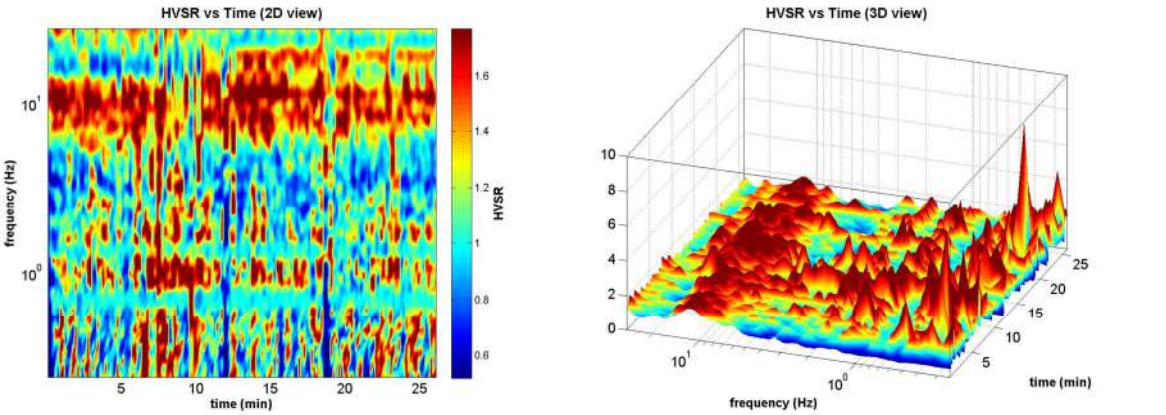
=== Criteria for a reliable H/V curve ==========
#1. [f0 > 10/Lw]: 11.668 > 0.5 (OK)
#2. [nc > 200]: 36636 > 200 (OK)
#3. [f0>0.5Hz; sigmaA(f) < 2 for 0.5f0 < f < 2f0] (OK)

=== Criteria for a clear H/V peak (at least 5 should be fulfilled) ==========
#1. [exists f- in the range [f0/4, f0] | AH/V(f-) < A0/2]: yes (considering standard deviations), at frequency 3.0Hz (OK)
#2. [exists f+ in the range [f0, 4f0] | AH/V(f+) < A0/2]: (NO)
#3. [A0 > 2]: 1.8 < 2 (NO)
#4. [fpeak[Ah/v(f) ą sigmaA(f)] = f0 ą 5%]: (OK)
#5. [sigmaf < epsilon(f0)]: 4.933 > 0.583 (NO)
#6. [sigmaA(f0) < theta(f0)]: 0.188 < 1.58 (OK)

ProGeo Engineering S.r.l.
via Don Luigi Sturzo, 43/A - 52100 - Arezzo
tel. 0575 324114 - fax. 0575 406473 - email: info@progeo.arezzo.it


show data
reset
show location
field notes
step#1 (optional) - decimate
64Hz
new frequency
resample
step#2 - H/V computation
remove events
both Rad. & Tr.
clean axes
20
window length (s)
Min. freq.: 0.25Hz
8
tapering (%)
15
outlier tolerance threshold
15%
spectral smoothing (triangular window)
show particle motion and all HVSRs
full output
compute
step#3 - directivity analysis
frequencies to highlight
0.5 2.0 5.0 10.0
Hz
compute
3D motion
save video
show 3D motion
www.winmasw.com
save- option#1: save HVSR as it is
save H/V from
0.25
to
30
Hz
save HV curve (as it is)
save - option#2: picking H/V curve
pick HV curve
save picked HV
quick analysis (f=Vs/4H)
200
average Vs (m/s)
(from surface to bedrock)
20
depth of the bedrock (m)
1000
Vs of the bedrock
clean
compute
highlight a frequency
draw/highlight
10
Hz
directivity over time
directivity in time
time step.
60
s
HVSR50_b_is.saf (64Hz) - Average Spectra
NS
EW
UD
frequency (Hz)
HVSR50_b_is.saf - HVSR (window length: 20s)
HVSR
frequency (Hz)
To model the HVSR (also jointly with MASW or ReMi/EGAC data), save the H/V curve, go to the "Velocity Spectrum/a, Modeling & Picking" panels and upload the saved H/V curve


HVSR: directivity
10Hz
5Hz
2Hz
0.5Hz
frequency (Hz)
Azimuth (degree)
HVSR
N
W
0.5Hz
2Hz
5Hz
10Hz
H/SR
0Hz
EW
NS


HVSR vs Time (2D view)
frequency (Hz)
time (min)
HVSR
HVSR vs Time (3D view)
frequency (Hz)
time (min)

HVSR51

DATE 23.08.2017	HOUR 17:55	PLACE Poggiarello
OPERATOR ProGeo Engineering srl	GPS TYPE and #	
GAUSS-BOAGA LATITUDE 4793408	GAUSS-BOAGA LONGITUDE 1686825	ALTITUDE 250 m slm
STATION TYPE GPA	SENSOR TYPE 4,5 Hz	
STATION #	SENSOR #	DISK #
FILE NAME HVSR51		POINT #
GAIN	SAMPL. FREQ. 100 Hz	REC. DURATION 30 min (minutes / seconds)

WEATHER CONDITIONS: WIND (●) none ( ) weak (5m/s) ( ) medium ( ) strong Measurement (if any): ____ ; RAIN (●) none ( ) weak ( ) medium ( ) strong Measurement (if any): ____ ; Temperature (approx): 26 ; Remarks ____

GROUND TYPE: (●) earth (●) hard ( ) soft ( ) gravel ( ) sand ( ) rock ( ) grass = ( ) short ( ) tall ; ( ) asphalt ( ) cement ( ) concrete ( ) paved ( ) other ____ ; (●) dry soil ( ) wet soil Remarks ____

ARTIFICIAL GROUND-SENSOR COUPLING (●) no ( ) yes, type ____

BUILDING DENSITY ( ) none (●) scattered ( ) dense ( ) other, type ____

TRANSIENTS	none	few	moderate	many	very dense	distance
cars		●				
trucks	●					
pedestrians	●					
other	●					

MONOCHROMATIC NOISE SOURCES (factories, works, pumps, rivers,..): (●) no ( ) yes, type ____

NEARBY STRUCTURES (description, height, distance) (trees, polls, buildings, bridges, underground structures,...): Trees, Buildings

OBSERVATIONS

FREQUENCY: Hz (if computed in the field)

Qualità della misura:

Durata: rispettata
Stazionarietà: rispettata
Isotropia: rispettata
Assenza di disturbi: non rispettata
Plausibilità fisica: rispettata
Robustezza statistica: rispettata

MISURA TIPO B2

HVSR 51

Peak frequency (Hz): 17.5 (±6.4)
Peak HVSR value: 1.5 (±0.2)

=== Criteria for a reliable H/V curve ==========
#1. [f0 > 10/Lw]: 17.486 > 0.5 (OK)
#2. [nc > 200]: 53157 > 200 (OK)
#3. [f0>0.5Hz; sigmaA(f) < 2 for 0.5f0 < f < 2f0] (OK)

=== Criteria for a clear H/V peak (at least 5 should be fulfilled) ==========
#1. [exists f- in the range [f0/4, f0] | AH/V(f-) < A0/2]: (NO)
#2. [exists f+ in the range [f0, 4f0] | AH/V(f+) < A0/2]: (NO)
#3. [A0 > 2]: 1.5 < 2 (NO)
#4. [fpeak[Ah/v(f) ą sigmaA(f)] = f0 ą 5%]: (NO)
#5. [sigmaf < epsilon(f0)]: 6.433 > 0.874 (NO)
#6. [sigmaA(f0) < theta(f0)]: 0.171 < 1.58 (OK)

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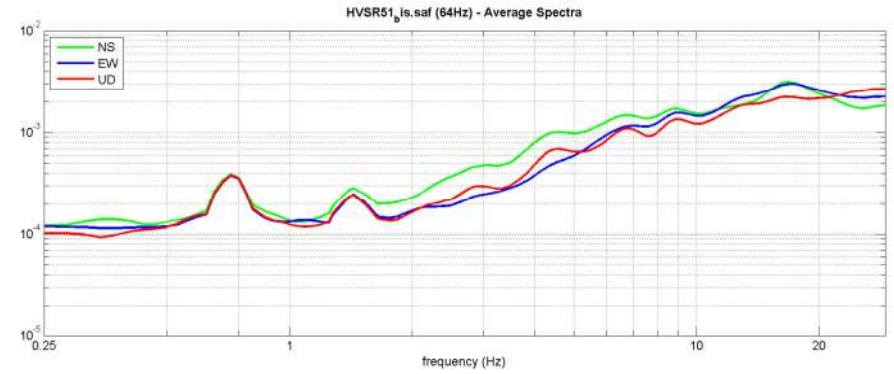
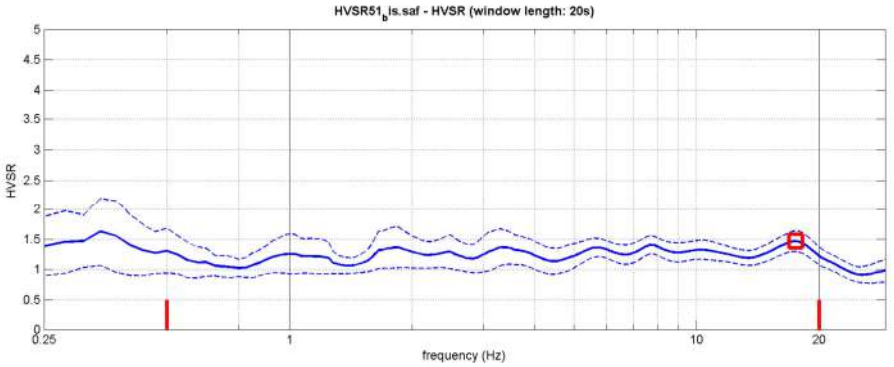
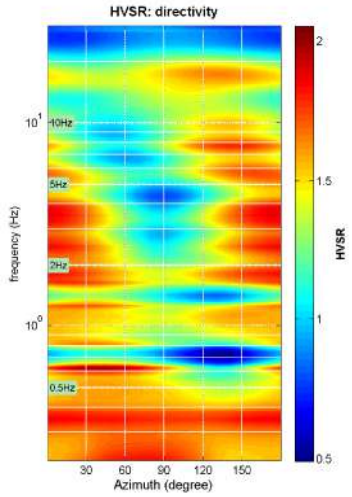
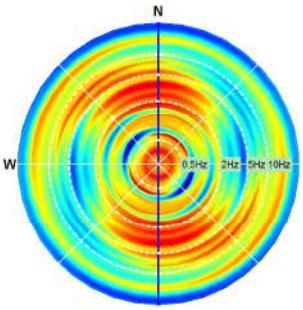
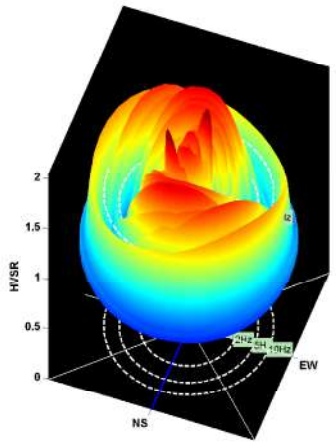


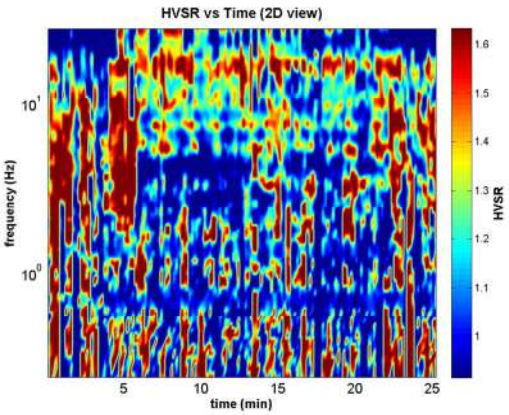


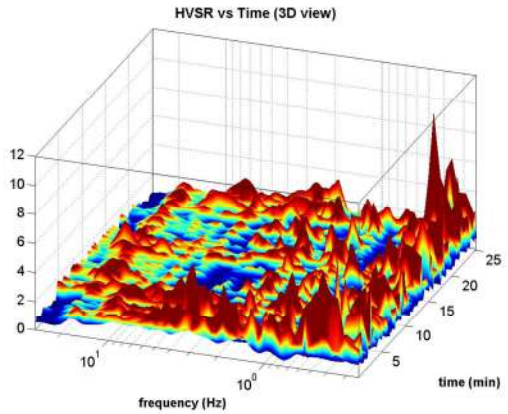
To model the HVSR (also jointly with MASW or ReMi/EGAC data), save the H/V curve, go to the "Velocity Spectrum/a, Modeling & Picking" panels and upload the saved H/V curve











HVSR52

DATE 23.08.2017	HOUR 10:00	PLACE Str. di Pian del Lago
OPERATOR ProGeo Engineering srl	GPS TYPE and #	
GAUSS-BOAGA LATITUDE 4801678	GAUSS-BOAGA LONGITUDE 1684381	ALTITUDE 318 m slm
STATION TYPE GPA	SENSOR TYPE 4,5 Hz	
STATION #	SENSOR #	DISK #
FILE NAME HVSR52		POINT #
GAIN	SAMPL. FREQ. 100 Hz	REC. DURATION 30 min (minutes / seconds)

WEATHER CONDITIONS: WIND ■ none ☐ weak (5m/s) ☐ medium ☐ strong Measurement (if any): ____
RAIN ■ none ☐ weak ☐ medium ☐ strong Measurement (if any): ____
Temperature (approx): 21 Remarks ____

GROUND TYPE: ☐ earth (☐ hard ☐ soft) ☐ gravel ☐ sand ☐ rock ☐ grass = (☐ short ☐ tall)
■ asphalt ☐ cement ☐ concrete ☐ paved ☐ other ____
☐ dry soil ■ wet soil Remarks ____

ARTIFICIAL GROUND-SENSOR COUPLING ■ no ☐ yes, type ____

BUILDING DENSITY ☐ none ■ scattered ☐ dense ☐ other, type ____

TRANSIENTS	none	few	moderate	many	very dense	distance
cars			●			
trucks	●					
pedestrians	●					
other	●					

MONOCHROMATIC NOISE SOURCES (factories, works, pumps, rivers,..)
■ no ☐ yes, type ____

NEARBY STRUCTURES (description, height, distance) (trees, polls, buildings, bridges, underground structures,...)
Trees, Buildings

OBSERVATIONS

FREQUENCY: Hz (if computed in the field)

Qualità della misura:

Durata: rispettata
Stazionarietà: rispettata
Isotropia: rispettata
Assenza di disturbi: non rispettata
Plausibilità fisica: rispettata
Robustezza statistica: rispettata

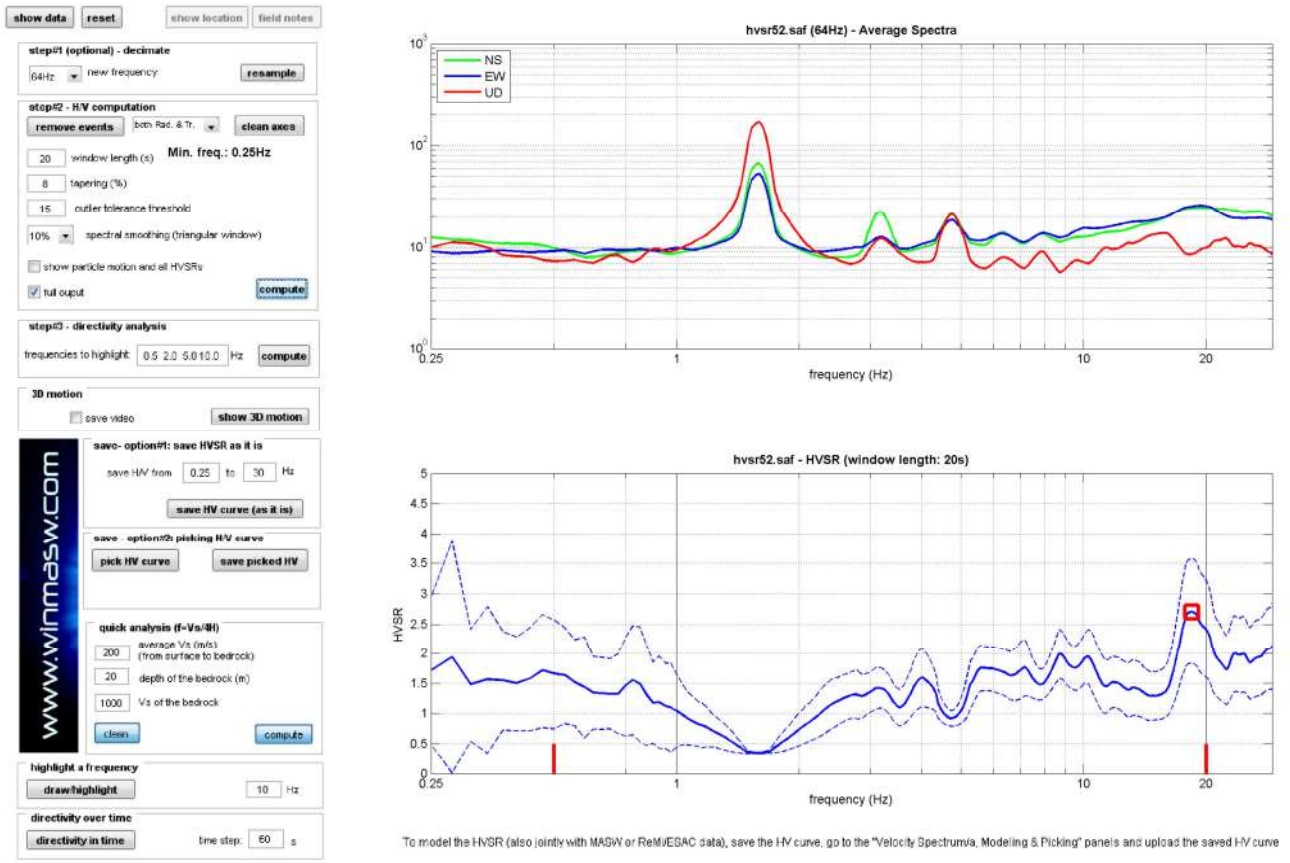
MISURA TIPO B2

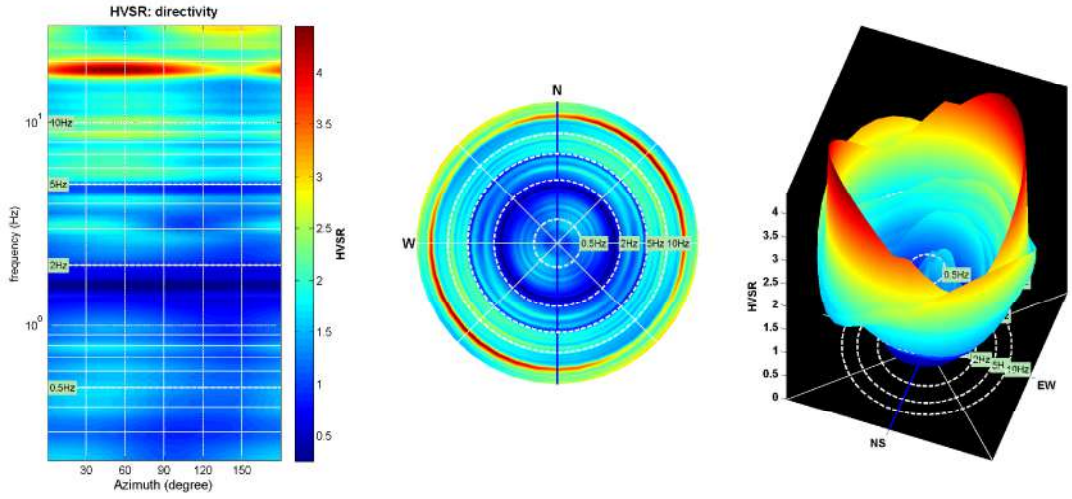
HVSR52

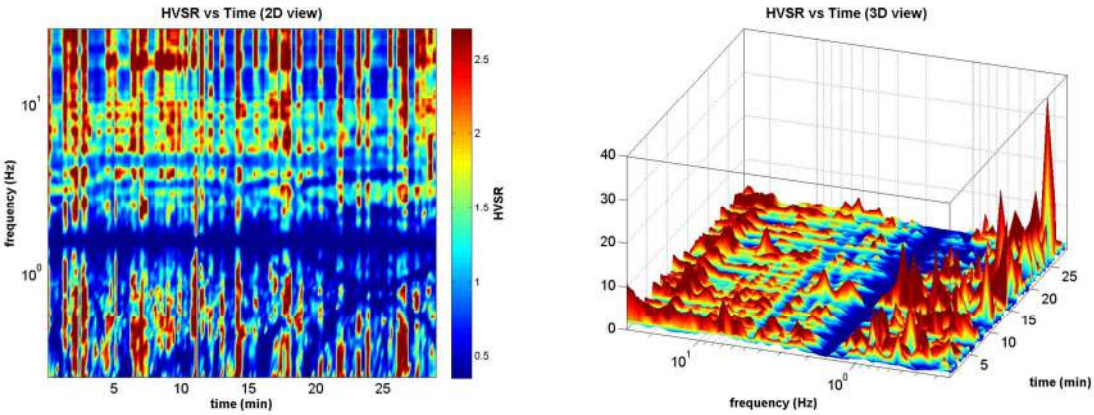
Peak frequency (Hz): 18.4 (±7.3)
Peak HVSR value: 2.7 (±0.9)

=== Criteria for a reliable H/V curve ==========
#1. [f0 > 10/Lw]: 18.362 > 0.5 (OK)
#2. [nc > 200]: 63899 > 200 (OK)
#3. [f0>0.5Hz; sigmaA(f) < 2 for 0.5f0 < f < 2f0] (OK)

=== Criteria for a clear H/V peak (at least 5 should be fulfilled) ==========
#1. [exists f- in the range [f0/4, f0] | AH/V(f-) < A0/2]: yes, at frequency 4.6Hz (OK)
#2. [exists f+ in the range [f0, 4f0] | AH/V(f+) < A0/2]: (NO)
#3. [A0 > 2]: 2.7 > 2 (OK)
#4. [fpeak[Ah/v(f) ą sigmaA(f)] = f0 ą 5%]: (OK)
#5. [sigmaf < epsilon(f0)]: 7.288 > 0.918 (NO)
#6. [sigmaA(f0) < theta(f0)]: 0.871 < 1.58 (OK)


show data
reset
show location
field notes
step#1 (optional) - decimate
64Hz
new frequency
resample
step#2 - H/V computation
remove events
both Rad. & Tr.
clean axes
20
window length (s)
Min. freq.: 0.25Hz
8
tapering (%)
15
outlier tolerance threshold
10%
spectral smoothing (triangular window)
show particle motion and all HVSRs
full output
compute
step#3 - directivity analysis
frequencies to highlight
0.5 2.0 5.0 10.0
Hz
compute
3D motion
save video
show 3D motion
www.winmasw.com
save- option#1: save HVSR as it is
save H/V from
0.25
to
30
Hz
save HV curve (as it is)
save - option#2: picking H/V curve
pick HV curve
save picked HV
quick analysis (f=Vs/4H)
200
average Vs (m/s)
(from surface to bedrock)
20
depth of the bedrock (m)
1000
Vs of the bedrock
clean
compute
highlight a frequency
draw/highlight
10
Hz
directivity over time
directivity in time
time step.
60
s
hvsr52.saf (64Hz) - Average Spectra
NS
EW
UD
frequency (Hz)
hvsr52.saf - HVSR (window length: 20s)
HVSR
frequency (Hz)
To model the HVSR (also jointly with MASW or ReMi/ESAC data), save the H/V curve, go to the "Velocity Spectrum/a, Modeling & Picking" panels and upload the saved H/V curve


HVSR: directivity
10Hz
5Hz
2Hz
0.5Hz
frequency (Hz)
HVSR
Azimuth (degree)
N
W
0.5Hz
2Hz
5Hz
10Hz
H/SR
EW
NS


HVSR vs Time (2D view)
frequency (Hz)
HVSR
time (min)
HVSR vs Time (3D view)
frequency (Hz)
time (min)

HVSR53

DATE 23.08.2017	HOUR 10:45	PLACE Fullino Nero
OPERATOR ProGeo Engineering srl		GPS TYPE and #
GAUSS-BOAGA LATITUDE 4800984	GAUSS-BOAGA LONGITUDE 1684962	ALTITUDE 328 m slm
STATION TYPE GPA	SENSOR TYPE 4,5 Hz	
STATION #	SENSOR #	DISK #
FILE NAME HVSR53		POINT #
GAIN	SAMPL. FREQ. 100 Hz	REC. DURATION 30 min (minutes / seconds)

WEATHER CONDITIONS: WIND [x] none [ ] weak (5m/s) [ ] medium [ ] strong Measurement (if any): ____
RAIN [x] none [ ] weak [ ] medium [ ] strong Measurement (if any): ____
Temperature (approx): 22 Remarks ____

GROUND TYPE: [x] earth ([ ] hard [ ] soft) [ ] gravel [ ] sand [ ] rock [ ] grass = ([ ] short [ ] tall)
[ ] asphalt [ ] cement [ ] concrete [ ] paved [ ] other ____
[x] dry soil [ ] wet soil Remarks ____

ARTIFICIAL GROUND-SENSOR COUPLING [x] no [ ] yes, type ____

BUILDING DENSITY [ ] none [x] scattered [ ] dense [ ] other, type ____

TRANSIENTS	none	few	moderate	many	very dense	distance
cars			●			
trucks		●				
pedestrians	●					
other	●					

MONOCHROMATIC NOISE SOURCES (factories, works, pumps, rivers,..)
[x] no [ ] yes, type ____

NEARBY STRUCTURES (description, height, distance) (trees, polls, buildings, bridges, underground structures,...)
Trees, Buildings

OBSERVATIONS

FREQUENCY: Hz (if computed in the field)

Qualità della misura:

Durata: rispettata
Stazionarietà: rispettata
Isotropia: rispettata
Assenza di disturbi: non rispettata
Plausibilità fisica: rispettata
Robustezza statistica: rispettata

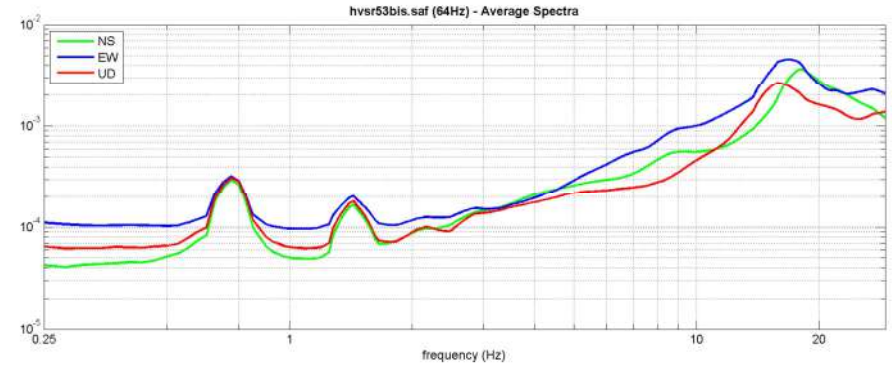
MISURA TIPO B2

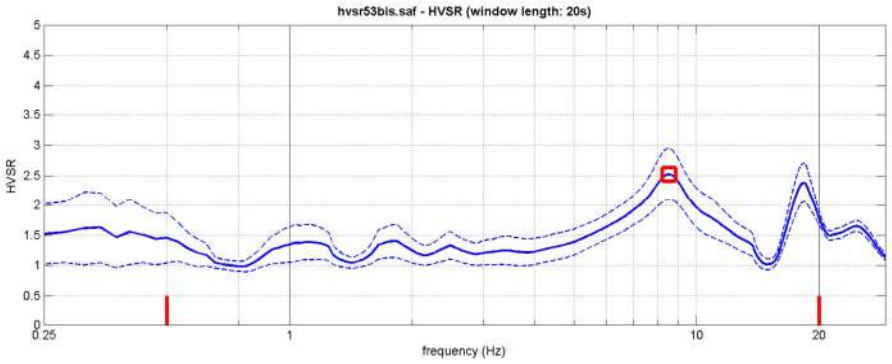
HVSR53

Peak frequency (Hz): 8.5 (±6.1)
Peak HVSR value: 2.5 (±0.4)

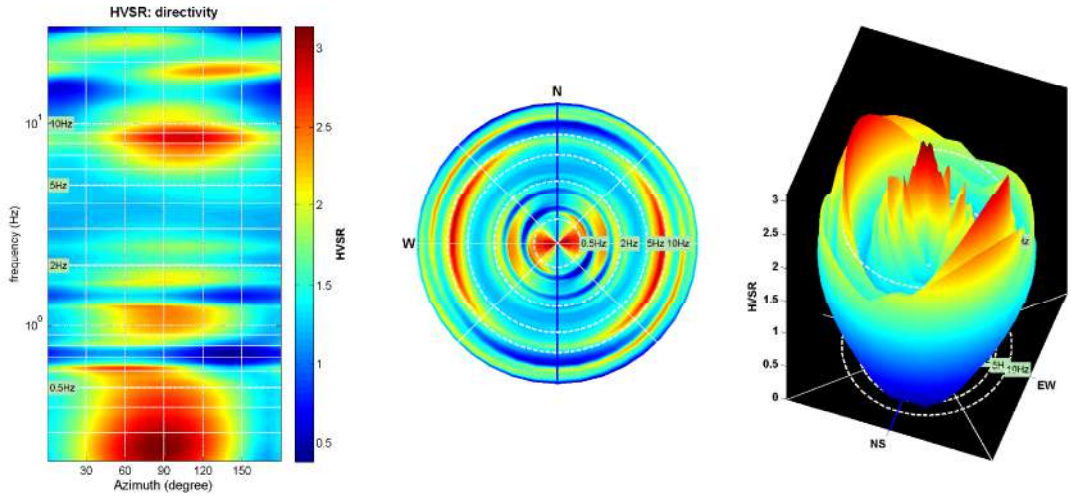
=== Criteria for a reliable H/V curve ==========
#1. [f0 > 10/Lw]: 8.540 > 0.5 (OK)
#2. [nc > 200]: 26131 > 200 (OK)
#3. [f0>0.5Hz; sigmaA(f) < 2 for 0.5f0 < f < 2f0] (OK)

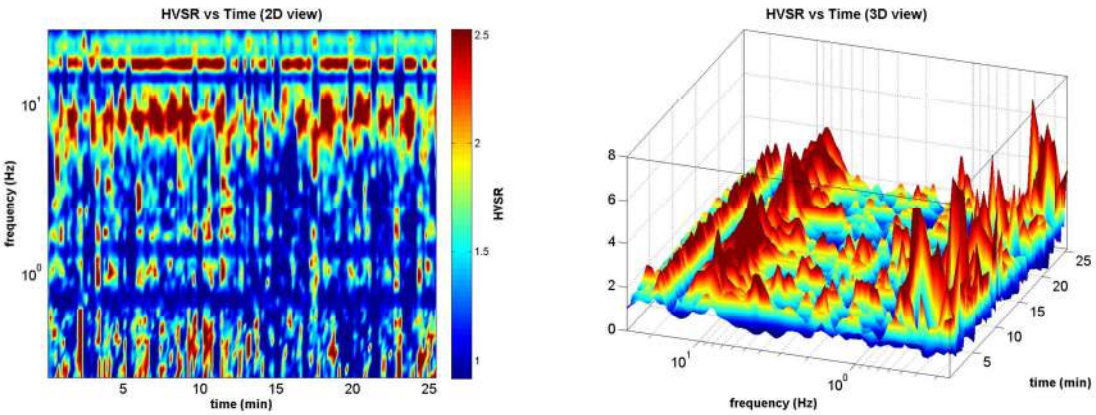
=== Criteria for a clear H/V peak (at least 5 should be fulfilled) ==========
#1. [exists f- in the range [f0/4, f0] | AH/V(f-) < A0/2]: yes, at frequency 2.2Hz (OK)
#2. [exists f+ in the range [f0, 4f0] | AH/V(f+) < A0/2]: yes, at frequency 13.9Hz (OK)
#3. [A0 > 2]: 2.5 > 2 (OK)
#4. [fpeak[Ah/v(f) ą sigmaA(f)] = f0 ą 5%]: (OK)
#5. [sigmaf < epsilon(f0)]: 6.139 > 0.427 (NO)
#6. [sigmaA(f0) < theta(f0)]: 0.426 < 1.58 (OK)





To model the HVSR (also jointly with MASW or ReMi/ESAC data), save the H/V curve, go to the "Velocity Spectrum/a, Modeling & Picking" panels and upload the saved H/V curve





HVSR54

DATE 27.07.2017	HOUR 9:00	PLACE Acquacalda
OPERATOR ProGeo Engineering srl	GPS TYPE and #	
GAUSS-BOAGA LATITUDE 4800684	GAUSS-BOAGA LONGITUDE 1686038	ALTITUDE 298,5 m slm
STATION TYPE GPA	SENSOR TYPE 4,5 Hz	
STATION #	SENSOR #	DISK #
FILE NAME HVSR54		POINT #
GAIN	SAMPL. FREQ. 100 Hz	REC. DURATION 30 min (minutes / seconds)

WEATHER CONDITIONS: WIND ● none ☐ weak (5m/s) ☐ medium ☐ strong Measurement (if any): ____ ; RAIN ● none ☐ weak ☐ medium ☐ strong Measurement (if any): ____ ; Temperature (approx): 21 Remarks ____

GROUND TYPE: ☐ earth (☐ hard ☐ soft) ☐ gravel ☐ sand ☐ rock ● grass = (● short ☐ tall) ; ☐ asphalt ☐ cement ☐ concrete ☐ paved ☐ other ____ ; ☐ dry soil ● wet soil Remarks ____

ARTIFICIAL GROUND-SENSOR COUPLING ● no ☐ yes, type ____

BUILDING DENSITY ☐ none ● scattered ☐ dense ☐ other, type ____

TRANSIENTS

	none	few	moderate	many	very dense	distance
cars		●				
trucks	●					
pedestrians		●				
other ____	●					

MONOCHROMATIC NOISE SOURCES (factories, works, pumps, rivers,..) ● no ☐ yes, type ____

NEARBY STRUCTURES (description, height, distance) (trees, polls, buildings, bridges, underground structures,...)

Trees

OBSERVATIONS

FREQUENCY: Hz (if computed in the field)

Qualità della misura:

Durata: rispettata
Stazionarietà: rispettata
Isotropia: rispettata
Assenza di disturbi: non rispettata
Plausibilità fisica: rispettata
Robustezza statistica: rispettata

MISURA TIPO B1

HVSR54

Peak frequency (Hz): 13.1 (±3.2)
Peak HVSR value: 1.5 (±0.5)

=== Criteria for a reliable H/V curve ==========
#1. [f0 > 10/Lw]: 13.107 > 0.5 (OK)
#2. [nc > 200]: 46397 > 200 (OK)
#3. [f0>0.5Hz; sigmaA(f) < 2 for 0.5f0 < f < 2f0] (OK)

=== Criteria for a clear H/V peak (at least 5 should be fulfilled) ==========
#1. [exists f- in the range [f0/4, f0] | AH/V(f-) < A0/2]: yes, at frequency 3.3Hz (OK)
#2. [exists f+ in the range [f0, 4f0] | AH/V(f+) < A0/2]: yes, at frequency 18.9Hz (OK)
#3. [A0 > 2]: 1.5 < 2 (NO)
#4. [fpeak[Ah/v(f) ą sigmaA(f)] = f0 ą 5%]: (NO)
#5. [sigmaf < epsilon(f0)]: 3.209 > 0.655 (NO)
#6. [sigmaA(f0) < theta(f0)]: 0.469 < 1.58 (OK)

show data | reset | show location | field notes

step#1 (optional) - decimate

64Hz | new frequency | resample

step#2 - H/V computation

remove events | both Rad. & Tr. | clean axes

20 window length (s) — Min. freq.: 0.25Hz

8 tapering (%)

15 outlier tolerance threshold

10% | spectral smoothing (triangular window)

☐ show particle motion and all HVSRs

☑ full output | compute

step#3 - directivity analysis

frequencies to highlight: 0.5 2.0 5.0 10.0 Hz | compute

3D motion

☐ save video | show 3D motion

www.winmasw.com

save- option#1: save HVSR as it is

save H/V from 0.25 to 30 Hz

save HV curve (as it is)

save - option#2: picking H/V curve

pick HV curve | save picked HV

quick analysis (f=Vs/4H)

200 average Vs (m/s) (from surface to bedrock)

20 depth of the bedrock (m)

1000 Vs of the bedrock

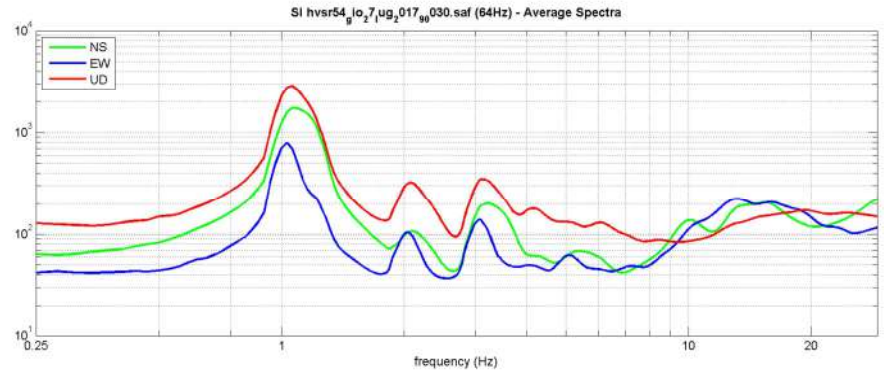
clean | compute

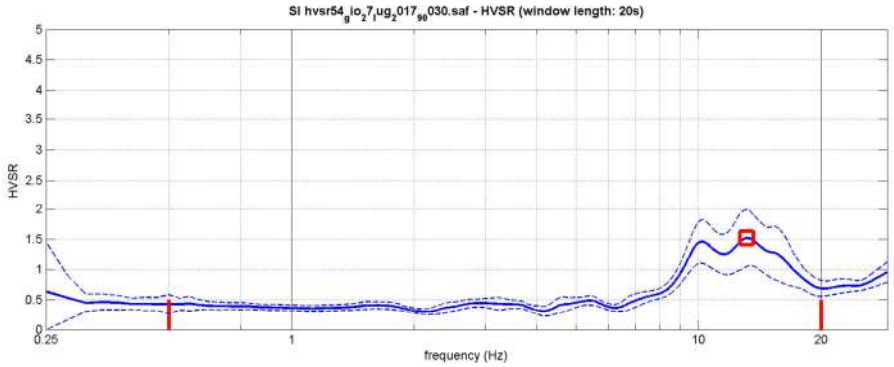
highlight a frequency

draw/highlight | 10 Hz

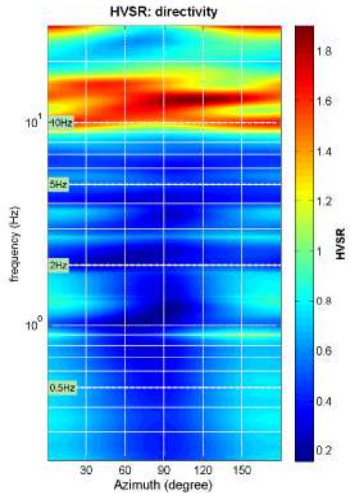
directivity over time

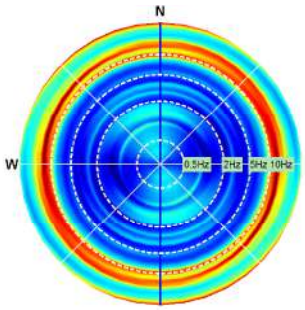
directivity in time | time step: 60 s

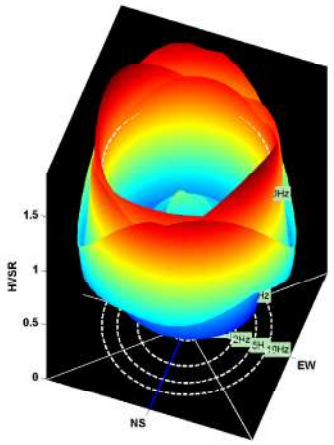


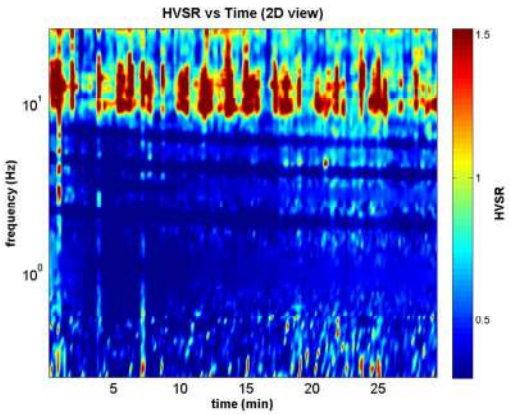


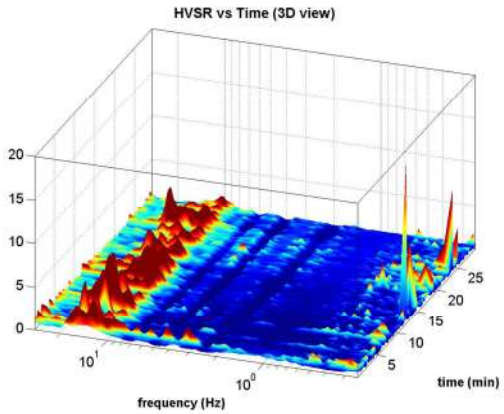
To model the HVSR (also jointly with MASW or ReMi/EGAC data), save the H/V curve, go to the "Velocity Spectrum/a, Modeling & Picking" panels and upload the saved H/V curve











HVSR55

DATE 08.08.2017	HOUR 11:00	PLACE Via P. Strozzi
OPERATOR ProGeo Engineering srl		GPS TYPE and #
GAUSS-BOAGA LATITUDE 4800440	GAUSS-BOAGA LONGITUDE 1687155	ALTITUDE 360,8 m slm
STATION TYPE GPA	SENSOR TYPE 4,5 Hz	
STATION #	SENSOR #	DISK #
FILE NAME HVSR55		POINT #
GAIN	SAMPL. FREQ. 100 Hz	REC. DURATION 30 min (minutes / seconds)

WEATHER CONDITIONS

WIND ● none ☐ weak (5m/s) ☐ medium ☐ strong Measurement (if any): _____

RAIN ● none ☐ weak ☐ medium ☐ strong Measurement (if any): _____

Temperature (approx): 31 Remarks _____

GROUND TYPE

☐ earth (☐ hard ☐ soft) ☐ gravel ☐ sand ☐ rock ☐ grass = (☐ short ☐ tall)

● asphalt ☐ cement ☐ concrete ☐ paved ☐ other _____

☐ dry soil ☐ wet soil Remarks _____

ARTIFICIAL GROUND-SENSOR COUPLING ● no ☐ yes, type _____

BUILDING DENSITY ☐ none ☐ scattered ● dense ☐ other, type _____

TRANSIENTS

	none	few	moderate	many	very dense	distance
cars		●				
trucks	●					
pedestrians		●				
other	●					

MONOCHROMATIC NOISE SOURCES (factories, works, pumps, rivers,..)

● no ☐ yes, type _____

NEARBY STRUCTURES (description, height, distance) (trees, polls, buildings, bridges, underground structures,...)

Trees, Buildings

OBSERVATIONS

FREQUENCY: Hz (if computed in the field)

Qualità della misura:

Durata: rispettata
Stazionarietà: rispettata
Isotropia: rispettata
Assenza di disturbi: non rispettata
Plausibilità fisica: rispettata
Robustezza statistica: rispettata

MISURA TIPO B1

HVSR55

Peak frequency (Hz): 6.9 (±1.5)
Peak HVSR value: 2.4 (±0.7)

=== Criteria for a reliable H/V curve ==========
#1. [f0 > 10/Lw]: 6.850 > 0.5 (OK)
#2. [nc > 200]: 23977 > 200 (OK)
#3. [f0>0.5Hz; sigmaA(f) < 2 for 0.5f0 < f < 2f0] (OK)

=== Criteria for a clear H/V peak (at least 5 should be fulfilled) ==========
#1. [exists f- in the range [f0/4, f0] | AH/V(f-) < A0/2]: yes, at frequency 1.8Hz (OK)
#2. [exists f+ in the range [f0, 4f0] | AH/V(f+) < A0/2]: yes, at frequency 9.2Hz (OK)
#3. [A0 > 2]: 2.4 > 2 (OK)
#4. [fpeak[Ah/v(f) ą sigmaA(f)] = f0 ą 5%]: (OK)
#5. [sigmaf < epsilon(f0)]: 1.493 > 0.343 (NO)
#6. [sigmaA(f0) < theta(f0)]: 0.687 < 1.58 (OK)

show data | reset | show location | field notes

step#1 (optional) - decimate

64Hz | new frequency | resample

step#2 - H/V computation

remove events | both Rad. & Tr. | clean axes

20 window length (s) — Min. freq.: 0.25Hz

8 tapering (%)

15 outlier tolerance threshold

10% spectral smoothing (triangular window)

☐ show particle motion and all HVSRs

☑ full output | compute

step#3 - directivity analysis

frequencies to highlight: 0.5 2.0 5.0 10.0 Hz | compute

3D motion

☐ save video | show 3D motion

www.winmasw.com

save- option#1: save HVSR as it is

save H/V from 0.25 to 30 Hz

save HV curve (as it is)

save - option#2: picking H/V curve

pick HV curve | save picked HV

quick analysis (f=Vs/4H)

200 average Vs (m/s) (from surface to bedrock)

20 depth of the bedrock (m)

1000 Vs of the bedrock

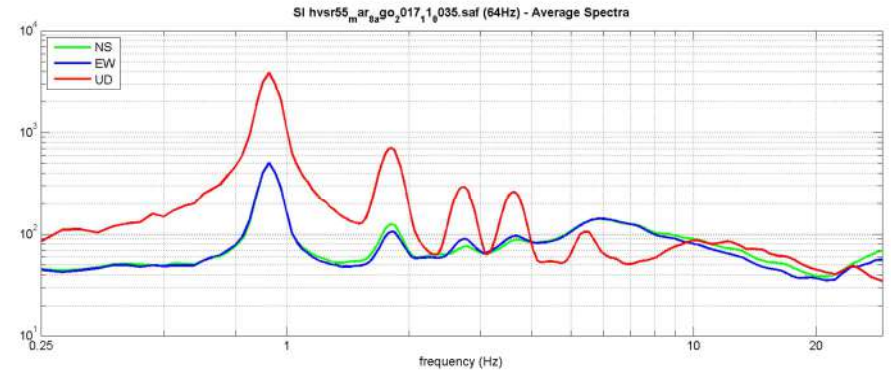
clean | compute

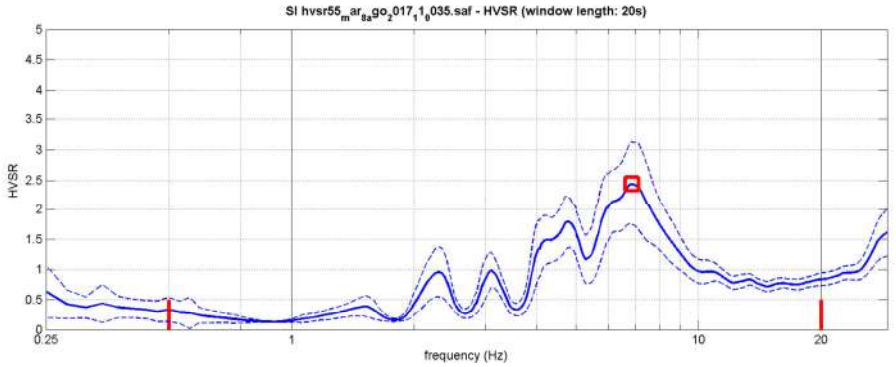
highlight a frequency

draw/highlight | 10 Hz

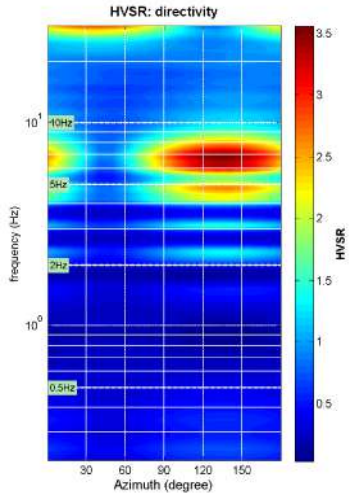
directivity over time

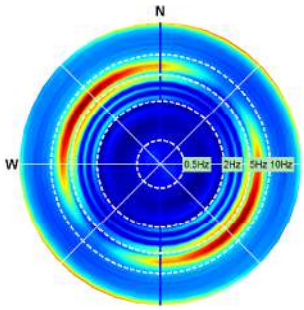
directivity in time | time step: 60 s

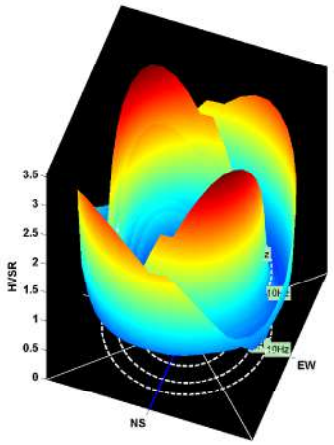


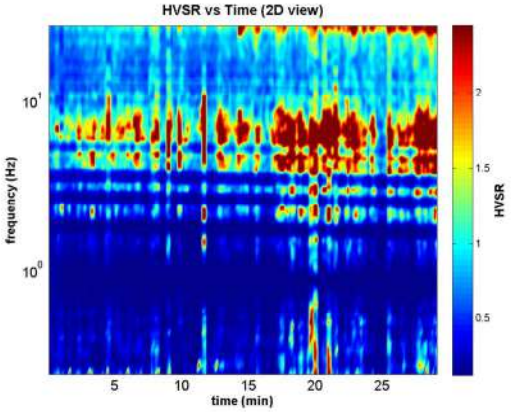


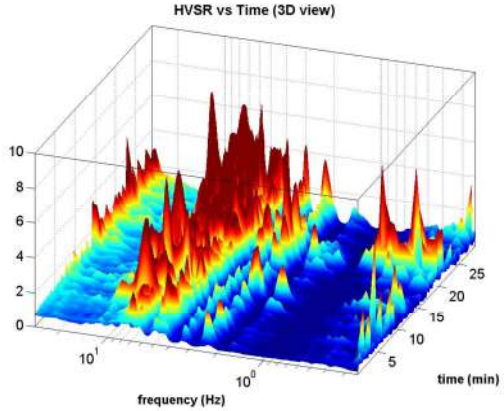
To model the HVSR (also jointly with MASW or ReMi/EGAC data), save the H/V curve, go to the "Velocity Spectrum/a, Modeling & Picking" panels and upload the saved H/V curve











HVSR56

DATE 16.08.2017	HOUR 11:05	PLACE Via Michelangelo
OPERATOR ProGeo Engineering srl	GPS TYPE and #	
GAUSS-BOAGA LATITUDE 4798768	GAUSS-BOAGA LONGITUDE 1687487	ALTITUDE 304 m slm
STATION TYPE GPA	SENSOR TYPE 4,5 Hz	
STATION #	SENSOR #	DISK #
FILE NAME HVSR56		POINT #
GAIN	SAMPL. FREQ. 50 Hz	REC. DURATION 30 min (minutes / seconds)

WEATHER CONDITIONS: WIND ● none ☐ weak (5m/s) ☐ medium ☐ strong Measurement (if any): ____
RAIN ● none ☐ weak ☐ medium ☐ strong Measurement (if any): ____
Temperature (approx): 30 Remarks ____

GROUND TYPE: ☐ earth (☐ hard ☐ soft) ☐ gravel ☐ sand ☐ rock ☐ grass (☐ short ☐ tall)
☐ asphalt ● cement ☐ concrete ☐ paved ☐ other ____
☐ dry soil ☐ wet soil Remarks ____

ARTIFICIAL GROUND-SENSOR COUPLING ● no ☐ yes, type ____

BUILDING DENSITY ☐ none ● scattered ☐ dense ☐ other, type ____

TRANSIENTS	none	few	moderate	many	very dense	distance
cars	●					
trucks	●					
pedestrians	●					
other ____	●					

MONOCHROMATIC NOISE SOURCES (factories, works, pumps, rivers,..)
● no ☐ yes, type ____

NEARBY STRUCTURES (description, height, distance) (trees, polls, buildings, bridges, underground structures,...)
Trees

OBSERVATIONS

FREQUENCY: Hz (if computed in the field)

Qualità della misura:

Durata: rispettata
Stazionarietà: rispettata
Isotropia: rispettata
Assenza di disturbi: rispettata
Plausibilità fisica: rispettata
Robustezza statistica: rispettata

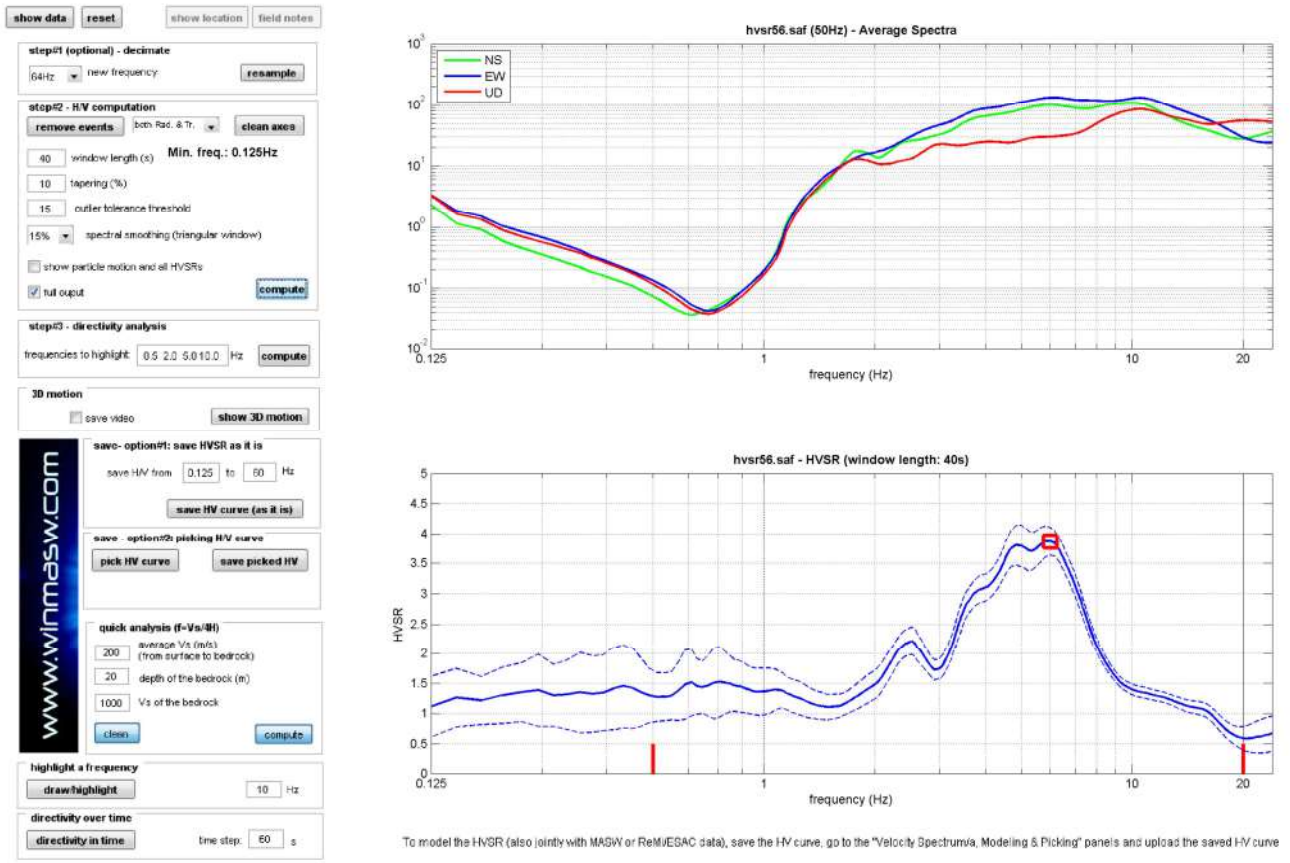
MISURA TIPO A1

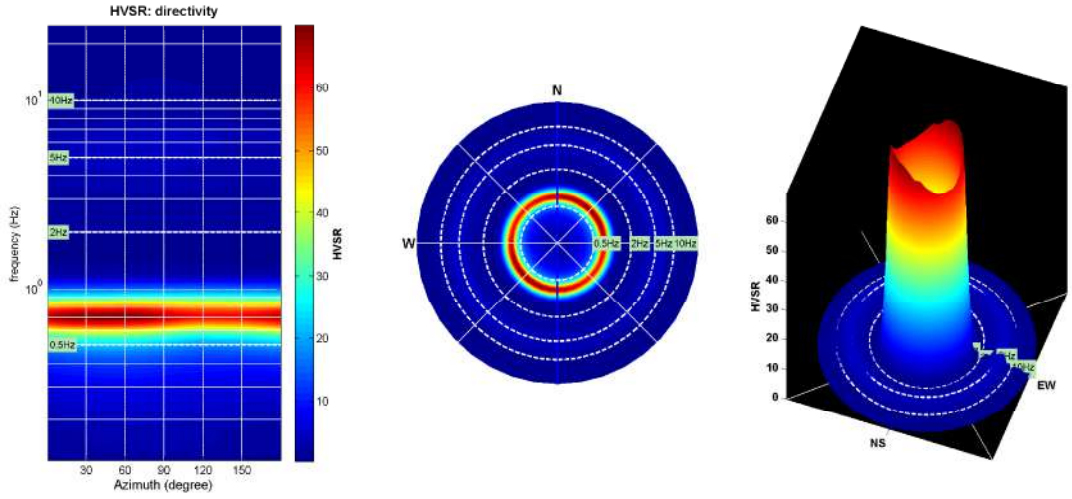
HVSR 56

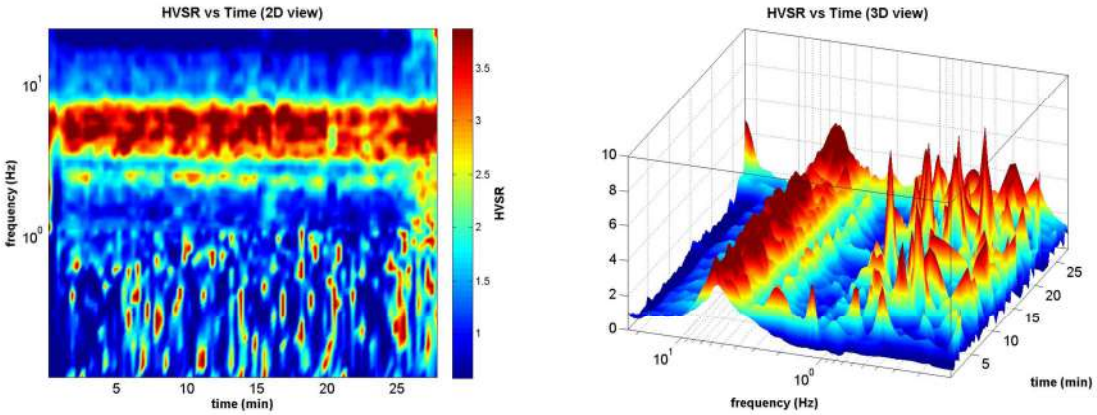
Peak frequency (Hz): 6.0 (±1.5)
Peak HVSR value: 3.9 (±0.2)

=== Criteria for a reliable H/V curve ==========
#1. [f0 > 10/Lw]: 5.987 > 0.25 (OK)
#2. [nc > 200]: 20117 > 200 (OK)
#3. [f0>0.5Hz; sigmaA(f) < 2 for 0.5f0 < f < 2f0] (OK)

=== Criteria for a clear H/V peak (at least 5 should be fulfilled) ==========
#1. [exists f- in the range [f0/4, f0] | AH/V(f-) < A0/2]: yes, at frequency 1.5Hz (OK)
#2. [exists f+ in the range [f0, 4f0] | AH/V(f+) < A0/2]: yes, at frequency 8.4Hz (OK)
#3. [A0 > 2]: 3.9 > 2 (OK)
#4. [fpeak[Ah/v(f) ą sigmaA(f)] = f0 ą 5%]: (NO)
#5. [sigmaf < epsilon(f0)]: 1.535 > 0.299 (NO)
#6. [sigmaA(f0) < theta(f0)]: 0.238 < 1.58 (OK)


show data
reset
show location
field notes
step#1 (optional) - decimate
64Hz
new frequency
resample
step#2 - H/V computation
remove events
both Rad. & Tr.
clean axes
40
window length (s)
Min. freq.: 0.125Hz
10
tapering (%)
15
outlier tolerance threshold
15%
spectral smoothing (triangular window)
show particle motion and all HVSRs
full ouput
compute
step#3 - directivity analysis
frequencies to highlight
0.5 2.0 5.0 10.0
Hz
compute
3D motion
save video
show 3D motion
www.winmasw.com
save- option#1: save HVSR as it is
save H/V from
0.125
to
60
Hz
save HV curve (as it is)
save - option#2: picking H/V curve
pick HV curve
save picked HV
quick analysis (f=Vs/4H)
200
average Vs (m/s)
(from surface to bedrock)
20
depth of the bedrock (m)
1000
Vs of the bedrock
clean
compute
highlight a frequency
draw/highlight
10
Hz
directivity over time
directivity in time
time step.
60
s
hvsr56.saf (50Hz) - Average Spectra
NS
EW
UD
frequency (Hz)
hvsr56.saf - HVSR (window length: 40s)
HVSR
frequency (Hz)
To model the HVSR (also jointly with MASW or ReMi/EGAC data), save the H/V curve, go to the "Velocity Spectrum/a, Modeling & Picking" panels and upload the saved H/V curve


HVSR: directivity
10Hz
5Hz
2Hz
0.5Hz
frequency (Hz)
HVSR
Azimuth (degree)
N
W
0.5Hz
2Hz
5Hz
10Hz
H/SR
NS
EW


HVSR vs Time (2D view)
frequency (Hz)
HVSR
time (min)
HVSR vs Time (3D view)
frequency (Hz)
time (min)

HVSR57

DATE 11.08.2017	HOUR 17:15	PLACE Strada del Castagno
OPERATOR ProGeo Engineering srl	GPS TYPE and #	
GAUSS-BOAGA LATITUDE 4803116	GAUSS-BOAGA LONGITUDE 1687992	ALTITUDE 344 m slm
STATION TYPE GPA	SENSOR TYPE 4,5 Hz	
STATION #	SENSOR #	DISK #
FILE NAME HVSR57		POINT #
GAIN	SAMPL. FREQ. 50 Hz	REC. DURATION 30 min (minutes / seconds)

WEATHER CONDITIONS: WIND ☐ none ☐ weak (5m/s) ☐ medium ☒ strong Measurement (if any): ____
RAIN ☒ none ☐ weak ☐ medium ☐ strong Measurement (if any): ____
Temperature (approx): 26 Remarks ____

GROUND TYPE: ☒ earth (☒ hard ☐ soft) ☐ gravel ☐ sand ☐ rock ☐ grass (☐ short ☐ tall)
☐ asphalt ☐ cement ☐ concrete ☐ paved ☐ other ____
☒ dry soil ☐ wet soil Remarks ____

ARTIFICIAL GROUND-SENSOR COUPLING ☒ no ☐ yes, type ____

BUILDING DENSITY ☒ none ☐ scattered ☐ dense ☐ other, type ____

TRANSIENTS	none	few	moderate	many	very dense	distance
cars	●					
trucks	●					
pedestrians	●					
other	●					

MONOCHROMATIC NOISE SOURCES (factories, works, pumps, rivers,..)
☒ no ☐ yes, type ____

NEARBY STRUCTURES (description, height, distance) (trees, polls, buildings, bridges, underground structures,...)
Trees

OBSERVATIONS

FREQUENCY: Hz (if computed in the field)

Qualità della misura:

Durata: rispettata
Stazionarietà: rispettata
Isotropia: rispettata
Assenza di disturbi: rispettata
Plausibilità fisica: rispettata
Robustezza statistica: rispettata

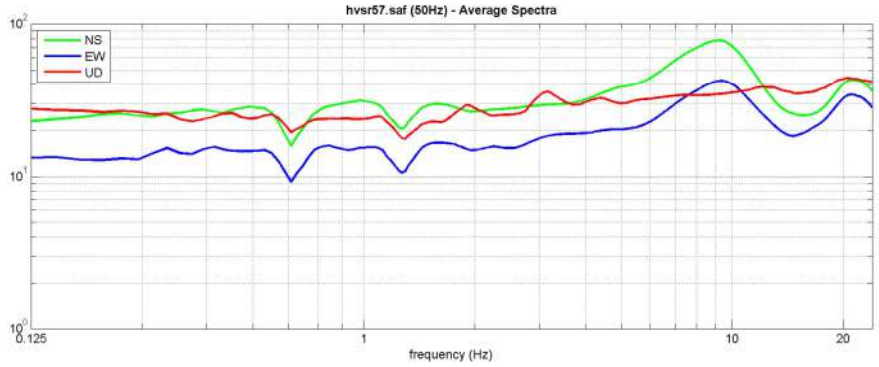
MISURA TIPO A2

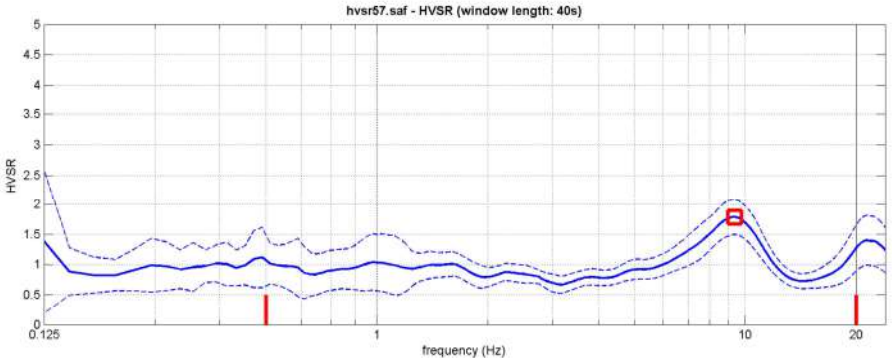
HVSR57

Peak frequency (Hz): 9.4 (±6.1)
Peak HVSR value: 1.8 (±0.3)

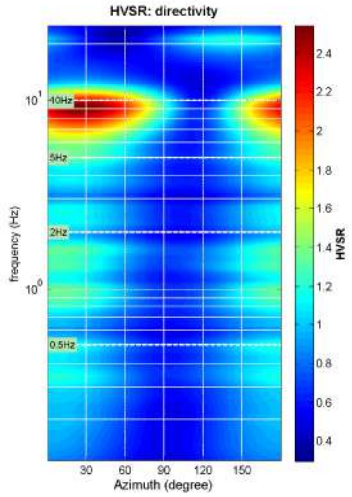
=== Criteria for a reliable H/V curve ==========
#1. [f0 > 10/Lw]: 9.360 > 0.25 (OK)
#2. [nc > 200]: 32572 > 200 (OK)
#3. [f0>0.5Hz; sigmaA(f) < 2 for 0.5f0 < f < 2f0] (OK)

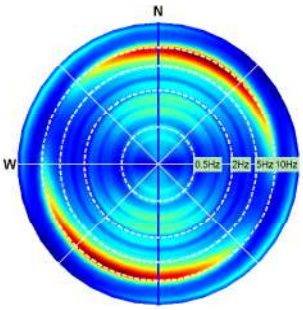
=== Criteria for a clear H/V peak (at least 5 should be fulfilled) ==========
#1. [exists f- in the range [f0/4, f0] | AH/V(f-) < A0/2]: yes, at frequency 2.4Hz (OK)
#2. [exists f+ in the range [f0, 4f0] | AH/V(f+) < A0/2]: yes, at frequency 12.5Hz (OK)
#3. [A0 > 2]: 1.8 < 2 (NO)
#4. [fpeak[Ah/v(f) ą sigmaA(f)] = f0 ą 5%]: (OK)
#5. [sigmaf < epsilon(f0)]: 6.066 > 0.468 (NO)
#6. [sigmaA(f0) < theta(f0)]: 0.290 < 1.58 (OK)

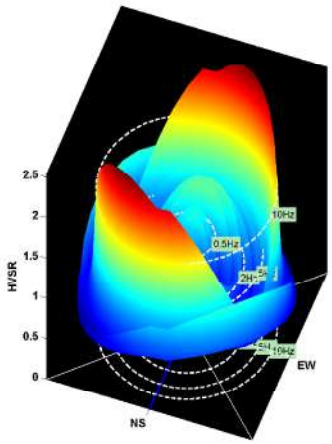


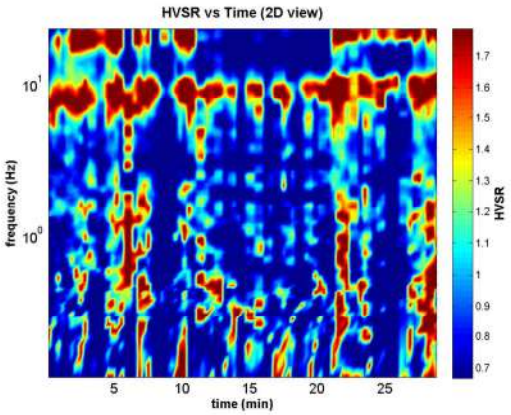


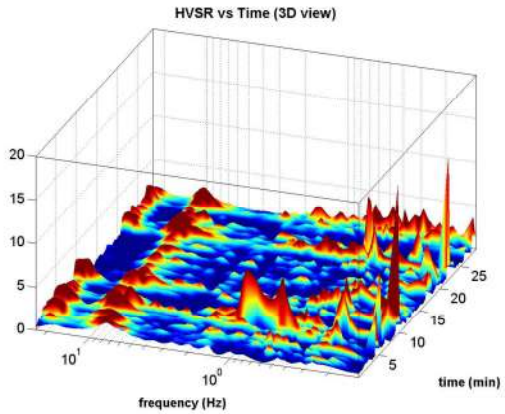
To model the HVSR (also jointly with MASW or ReMi/EGAC data), save the H/V curve, go to the "Velocity Spectrum/a, Modeling & Picking" panels and upload the saved H/V curve











HVSR58

DATE 23.08.2017	HOUR 15:35	PLACE Volte Basse
OPERATOR ProGeo Engineering srl	GPS TYPE and #	
GAUSS-BOAGA LATITUDE 4795624	GAUSS-BOAGA LONGITUDE 1684124	ALTITUDE 217 m slm
STATION TYPE GPA	SENSOR TYPE 4,5 Hz	
STATION #	SENSOR #	DISK #
FILE NAME HVSR58		POINT #
GAIN	SAMPL. FREQ. 100 Hz	REC. DURATION 30 min (minutes / seconds)

WEATHER CONDITIONS

WIND ● none ☐ weak (5m/s) ☐ medium ☐ strong Measurement (if any): _____

RAIN ● none ☐ weak ☐ medium ☐ strong Measurement (if any): _____

Temperature (approx): 30 Remarks _____

GROUND TYPE

● earth (● hard ☐ soft) ☐ gravel ☐ sand ☐ rock ☐ grass = (☐ short ☐ tall)

☐ asphalt ☐ cement ☐ concrete ☐ paved ☐ other _____

● dry soil ☐ wet soil Remarks _____

ARTIFICIAL GROUND-SENSOR COUPLING ● no ☐ yes, type _____

BUILDING DENSITY ● none ☐ scattered ☐ dense ☐ other, type _____

TRANSIENTS

	none	few	moderate	many	very dense	distance
cars			●			
trucks		●				
pedestrians	●					
other	●					

MONOCHROMATIC NOISE SOURCES (factories, works, pumps, rivers,..)

● no ☐ yes, type _____

NEARBY STRUCTURES (description, height, distance) (trees, polls, buildings, bridges, underground structures,...)

Trees, Buildings

OBSERVATIONS

FREQUENCY: Hz (if computed in the field)

Qualità della misura:

Durata: rispettata
Stazionarietà: rispettata
Isotropia: rispettata
Assenza di disturbi: rispettata
Plausibilità fisica: rispettata
Robustezza statistica: rispettata

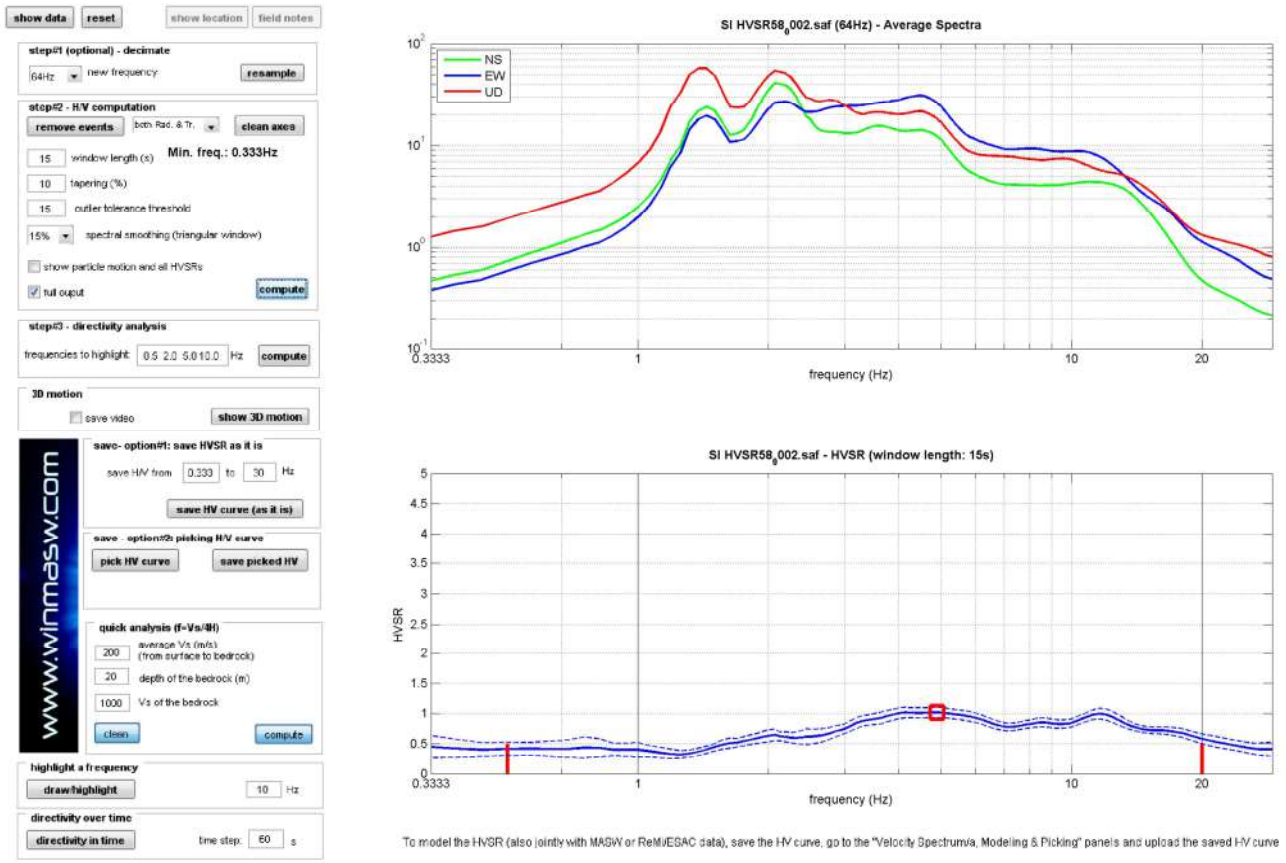
MISURA TIPO A2

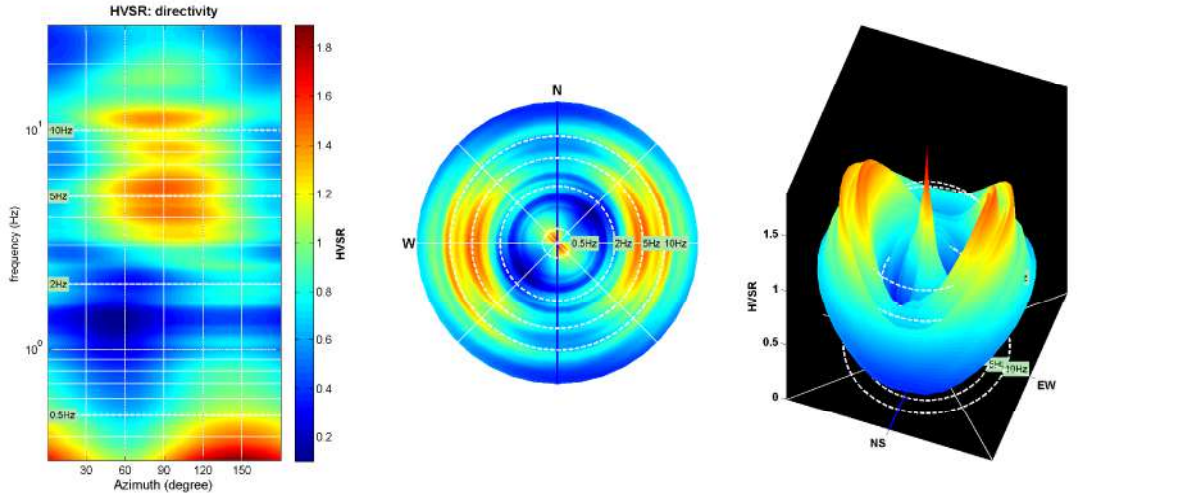
HVSR 58

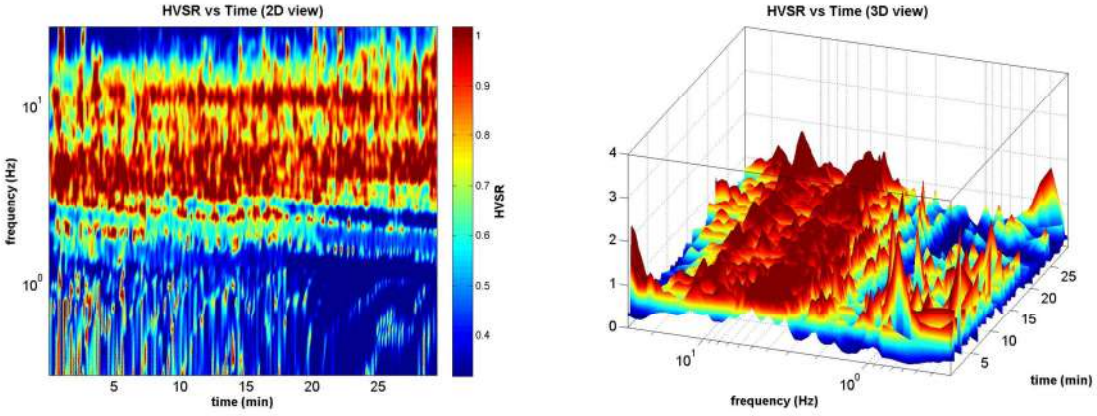
Peak frequency (Hz): 4.9 (±3.5)
Peak HVSR value: 1(±0.1)

=== Criteria for a reliable H/V curve ==========
#1. [f0 > 10/Lw]: 4.885 > 0.66667 (OK)
#2. [nc > 200]: 17291 > 200 (OK)
#3. [f0>0.5Hz; sigmaA(f) < 2 for 0.5f0 < f < 2f0] (OK)

=== Criteria for a clear H/V peak (at least 5 should be fulfilled) ==========
#1. [exists f- in the range [f0/4, f0] | AH/V(f-) < A0/2]: yes, at frequency 1.3Hz (OK)
#2. [exists f+ in the range [f0, 4f0] | AH/V(f+) < A0/2]: (NO)
#3. [A0 > 2]: 1.0 < 2 (NO)
#4. [fpeak[Ah/v(f) ą sigmaA(f)] = f0 ą 5%]: (OK)
#5. [sigmaf < epsilon(f0)]: 3.517 > 0.244 (NO)
#6. [sigmaA(f0) < theta(f0)]: 0.087 < 1.58 (OK)


show data
reset
show location
field notes
step#1 (optional) - decimate
64Hz
new frequency
resample
step#2 - H/V computation
remove events
both Rad. & Tr.
clean axes
15
window length (s)
Min. freq.: 0.333Hz
10
tapering (%)
15
outlier tolerance threshold
15%
spectral smoothing (triangular window)
show particle motion and all HVSRs
full output
compute
step#3 - directivity analysis
frequencies to highlight
0.5 2.0 5.0 10.0
Hz
compute
3D motion
save video
show 3D motion
www.winmasw.com
save- option#1: save HVSR as it is
save H/V from
0.333
to
30
Hz
save HV curve (as it is)
save - option#2: picking H/V curve
pick HV curve
save picked HV
quick analysis (f=Vs/4H)
200
average Vs (m/s)
(from surface to bedrock)
20
depth of the bedrock (m)
1000
Vs of the bedrock
clean
compute
highlight a frequency
draw/highlight
10
Hz
directivity over time
directivity in time
time step.
60
s
SI HVSR58_002.saf (64Hz) - Average Spectra
NS
EW
UD
frequency (Hz)
SI HVSR58_002.saf - HVSR (window length: 15s)
HVSR
frequency (Hz)
To model the HVSR (also jointly with MASW or ReMi/EGAC data), save the H/V curve, go to the "Velocity Spectrum/a, Modeling & Picking" panels and upload the saved H/V curve


HVSR: directivity
10Hz
5Hz
2Hz
0.5Hz
frequency (Hz)
Azimuth (degree)
HVSR
N
W
0.5Hz
2Hz
5Hz
10Hz
H/SR
NS
EW


HVSR vs Time (2D view)
frequency (Hz)
time (min)
HVSR
HVSR vs Time (3D view)
frequency (Hz)
time (min)

HVSR59

DATE 27.07.2017	HOUR 10:11	PLACE Via delle Province
OPERATOR ProGeo Engineering srl	GPS TYPE and #	
GAUSS-BOAGA LATITUDE 4801433	GAUSS-BOAGA LONGITUDE 1686808	ALTITUDE 332 m slm
STATION TYPE GPA	SENSOR TYPE 4,5 Hz	
STATION #	SENSOR #	DISK #
FILE NAME HVSR59		POINT #
GAIN	SAMPL. FREQ. 50 Hz	REC. DURATION 30 min (minutes / seconds)

WEATHER CONDITIONS: WIND [●] none [ ] weak (5m/s) [ ] medium [ ] strong Measurement (if any): ____
RAIN [●] none [ ] weak [ ] medium [ ] strong Measurement (if any): ____
Temperature (approx): 24 Remarks ____

GROUND TYPE: [ ] earth ([ ] hard [ ] soft) [ ] gravel [ ] sand [ ] rock [●] grass = ([ ] short [●] tall)
[ ] asphalt [ ] cement [ ] concrete [ ] paved [ ] other ____
[●] dry soil [ ] wet soil Remarks ____

ARTIFICIAL GROUND-SENSOR COUPLING [●] no [ ] yes, type ____

BUILDING DENSITY [ ] none [●] scattered [ ] dense [ ] other, type ____

TRANSIENTS	none	few	moderate	many	very dense	distance
cars				●		
trucks		●				
pedestrians	●					
other	●					

MONOCHROMATIC NOISE SOURCES (factories, works, pumps, rivers,..)
[●] no [ ] yes, type ____

NEARBY STRUCTURES (description, height, distance) (trees, polls, buildings, bridges, underground structures,...)
Trees, Buildings

OBSERVATIONS

FREQUENCY: Hz (if computed in the field)

Qualità della misura:

Durata: rispettata
Stazionarietà: rispettata
Isotropia: rispettata
Assenza di disturbi: rispettata
Plausibilità fisica: rispettata
Robustezza statistica: rispettata

MISURA TIPO A2

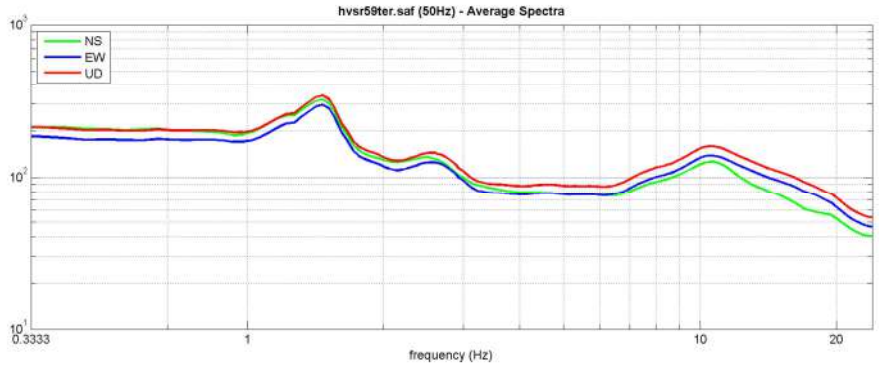
HVSR59

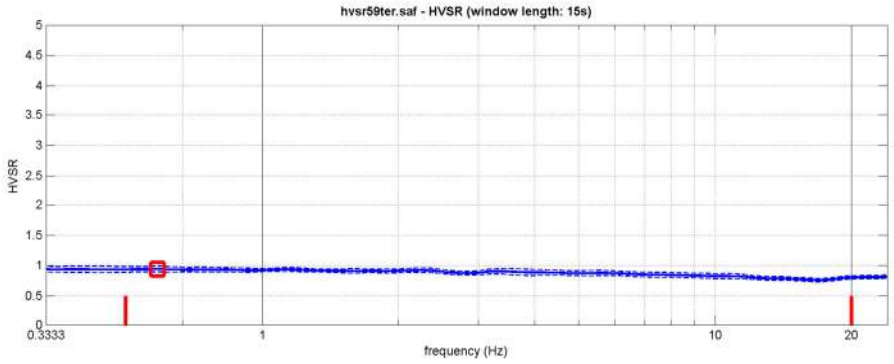
Peak frequency (Hz): 0.6 (±2.2)
Peak HVSR value: 0.9 (±0.0)

=== Criteria for a reliable H/V curve ==========
#1. [f0 > 10/Lw]: 0.587 < 0.66667 (NO)
#2. [nc > 200]: 3153 > 200 (OK)
#3. [f0>0.5Hz; sigmaA(f) < 2 for 0.5f0 < f < 2f0] (OK)

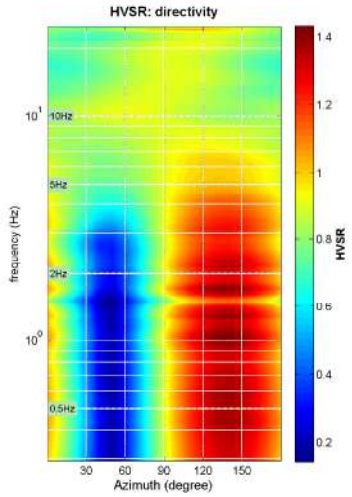
=== Criteria for a clear H/V peak (at least 5 should be fulfilled) ==========
#1. [exists f- in the range [f0/4, f0] | AH/V(f-) < A0/2]: (NO)
#2. [exists f+ in the range [f0, 4f0] | AH/V(f+) < A0/2]: (NO)
#3. [A0 > 2]: 0.9 < 2 (NO)
#4. [fpeak[Ah/v(f) ą sigmaA(f)] = f0 ą 5%]: (NO)
#5. [sigmaf < epsilon(f0)]: 2.159 > 0.088 (NO)
#6. [sigmaA(f0) < theta(f0)]: 0.046 < 2 (OK)

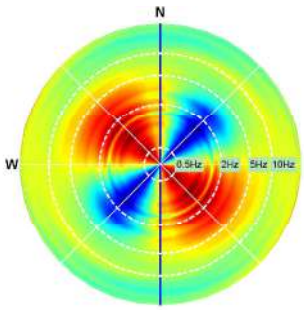
ProGeo Engineering S.r.l.
via Don Luigi Sturzo, 43/A - 52100 - Arezzo
tel. 0575 324114 - fax. 0575 406473 - email: info@progeo.arezzo.it

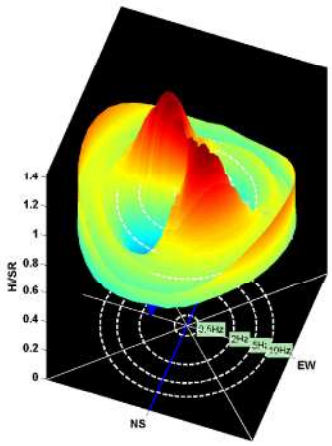


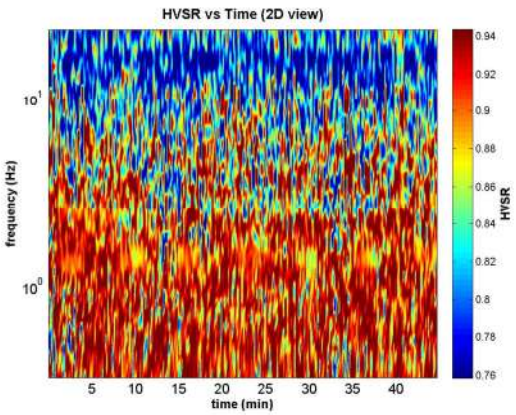


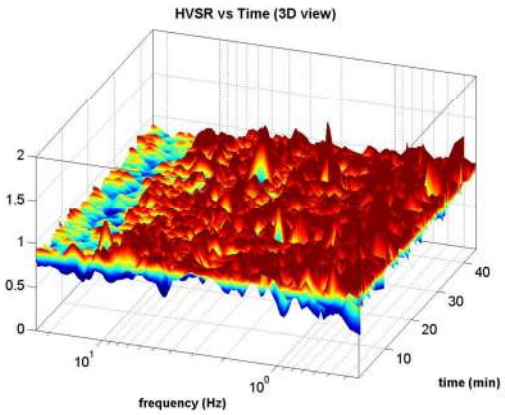
To model the HVSR (also jointly with MASW or ReMi/ESAC data), save the H/V curve, go to the "Velocity Spectrum/a, Modeling & Picking" panels and upload the saved H/V curve











HVSR60

DATE 08.08.2017	HOUR 11:43	PLACE Strada di Marciano
OPERATOR ProGeo Engineering srl	GPS TYPE and #	
GAUSS-BOAGA LATITUDE 4799648	GAUSS-BOAGA LONGITUDE 1686763	ALTITUDE 351,6 m slm
STATION TYPE GPA	SENSOR TYPE 4,5 Hz	
STATION #	SENSOR #	DISK #
FILE NAME HVSR60		POINT #
GAIN	SAMPL. FREQ. 50 Hz	REC. DURATION 30 min (minutes / seconds)

WEATHER CONDITIONS: WIND ☐ none ● weak (5m/s) ☐ medium ☐ strong Measurement (if any): ____ ; RAIN ● none ☐ weak ☐ medium ☐ strong Measurement (if any): ____ ; Temperature (approx): 33 Remarks ____

GROUND TYPE: ☐ earth (☐ hard ☐ soft) ☐ gravel ☐ sand ☐ rock ☐ grass (☐ short ☐ tall) ; ● asphalt ☐ cement ☐ concrete ☐ paved ☐ other ____ ; ☐ dry soil ☐ wet soil Remarks ____

ARTIFICIAL GROUND-SENSOR COUPLING ● no ☐ yes, type ____

BUILDING DENSITY ☐ none ☐ scattered ● dense ☐ other, type ____

TRANSIENTS	none	few	moderate	many	very dense	distance
cars	●					
trucks	●					
pedestrians	●					
other ____	●					

MONOCHROMATIC NOISE SOURCES (factories, works, pumps, rivers,..) ● no ☐ yes, type ____

NEARBY STRUCTURES (description, height, distance) (trees, polls, buildings, bridges, underground structures,...)

OBSERVATIONS

FREQUENCY: Hz (if computed in the field)

Qualità della misura:

Durata: rispettata
Stazionarietà: rispettata
Isotropia: rispettata
Assenza di disturbi: rispettata
Plausibilità fisica: rispettata
Robustezza statistica: rispettata

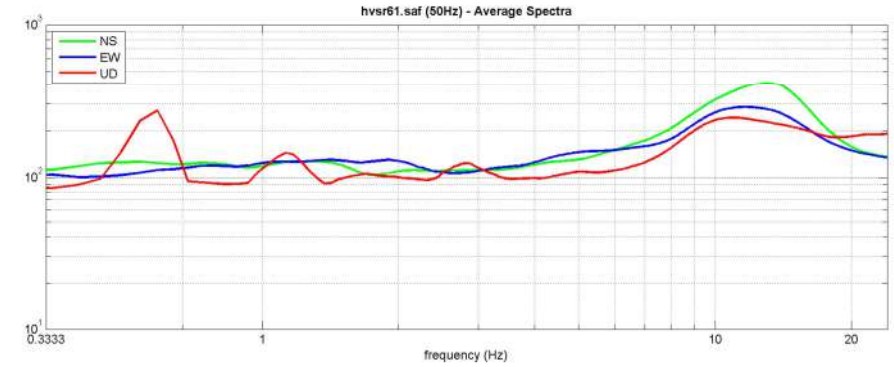
MISURA TIPO A2

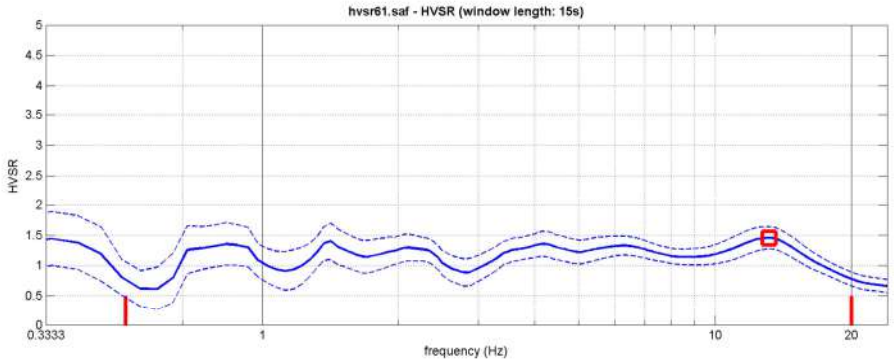
HVSR60

Peak frequency (Hz): 13.2 (±4.6)
Peak HVSR value: 1.5 (±0.2)

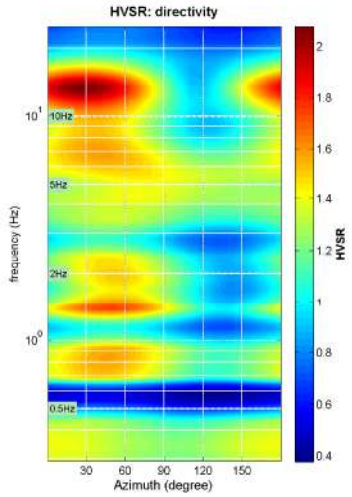
=== Criteria for a reliable H/V curve ==========
#1. [f0 > 10/Lw]: 13.160 > 0.66667 (OK)
#2. [nc > 200]: 45798 > 200 (OK)
#3. [f0>0.5Hz; sigmaA(f) < 2 for 0.5f0 < f < 2f0] (OK)

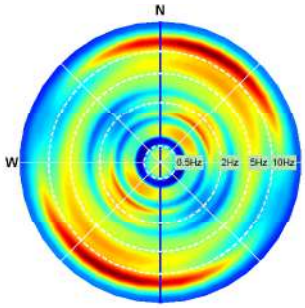
=== Criteria for a clear H/V peak (at least 5 should be fulfilled) ==========
#1. [exists f- in the range [f0/4, f0] | AH/V(f-) < A0/2]: (NO)
#2. [exists f+ in the range [f0, 4f0] | AH/V(f+) < A0/2]: yes (considering standard deviations), at frequency Hz (OK)
#3. [A0 > 2]: 1.5 < 2 (NO)
#4. [fpeak[Ah/v(f) ą sigmaA(f)] = f0 ą 5%]: (NO)
#5. [sigmaf < epsilon(f0)]: 4.593 > 0.658 (NO)
#6. [sigmaA(f0) < theta(f0)]: 0.184 < 1.58 (OK)

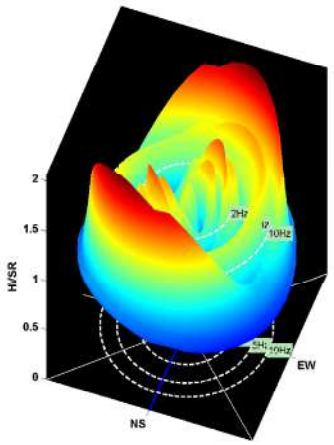


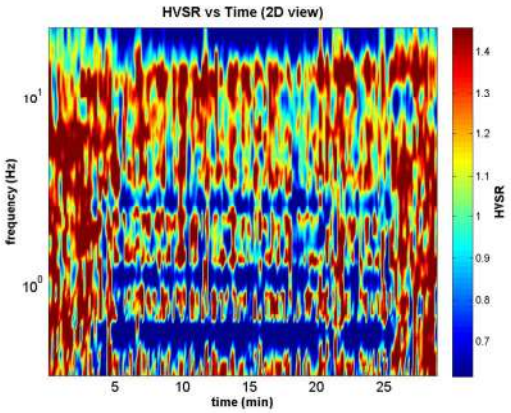


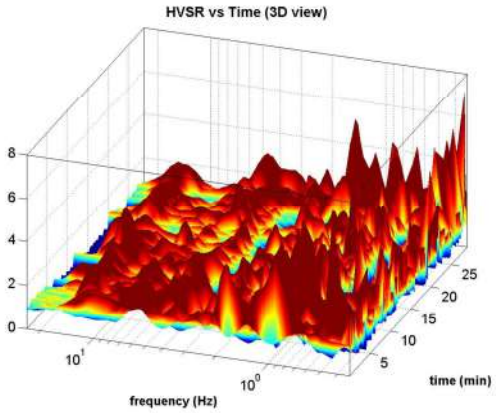
To model the HVSR (also jointly with MASW or ReMi/ESAC data), save the H/V curve, go to the "Velocity Spectrum/a, Modeling & Picking" panels and upload the saved H/V curve











HVSR61

DATE 16.08.2017	HOUR 12:27	PLACE Parcheggi di Pescaia
OPERATOR ProGeo Engineering srl		GPS TYPE and #
GAUSS-BOAGA LATITUDE 4798343	GAUSS-BOAGA LONGITUDE 1687945	ALTITUDE 250 m slm
STATION TYPE GPA	SENSOR TYPE 4,5 Hz	
STATION #	SENSOR #	DISK #
FILE NAME HVSR61		POINT #
GAIN	SAMPL. FREQ. 50 Hz	REC. DURATION 30 min (minutes / seconds)

WEATHER CONDITIONS: WIND (●) none ( ) weak (5m/s) ( ) medium ( ) strong Measurement (if any): ____
RAIN (●) none ( ) weak ( ) medium ( ) strong Measurement (if any): ____
Temperature (approx): 32 Remarks ____

GROUND TYPE: (●) earth ( ) hard ( ) soft ( ) gravel ( ) sand ( ) rock ( ) grass = ( ) short ( ) tall
( ) asphalt ( ) cement ( ) concrete ( ) paved ( ) other ____
(●) dry soil ( ) wet soil Remarks ____

ARTIFICIAL GROUND-SENSOR COUPLING (●) no ( ) yes, type ____

BUILDING DENSITY ( ) none (●) scattered ( ) dense ( ) other, type ____

TRANSIENTS

	none	few	moderate	many	very dense	distance
cars			●			
trucks			●			
pedestrians		●				
other	●					

MONOCHROMATIC NOISE SOURCES (factories, works, pumps, rivers,..)
(●) no ( ) yes, type ____

NEARBY STRUCTURES (trees, polls, buildings, bridges, underground structures,...)
(description, height, distance)
Trees

OBSERVATIONS

FREQUENCY: Hz (if computed in the field)

Qualità della misura:

Durata: rispettata
Stazionarietà: rispettata
Isotropia: rispettata
Assenza di disturbi: non rispettata
Plausibilità fisica: rispettata
Robustezza statistica: rispettata

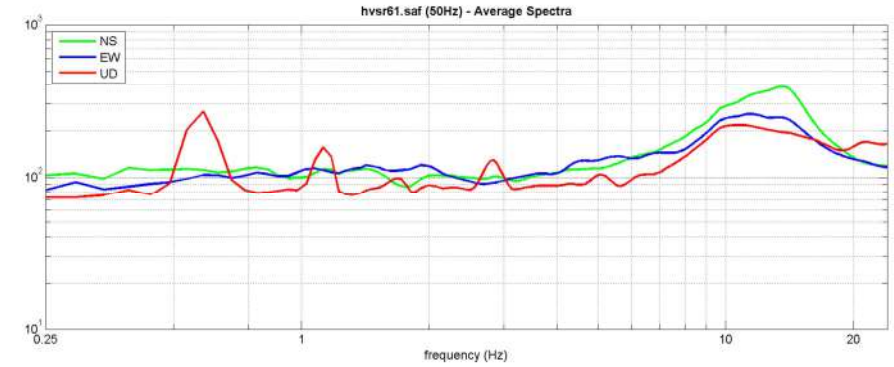
MISURA TIPO B2

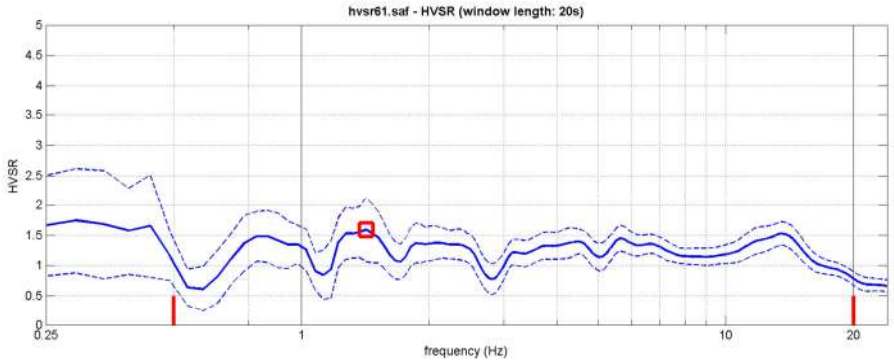
HVSR 61

Peak frequency (Hz): 1.4 (±3.1)
Peak HVSR value: 1.6 (±0.5)

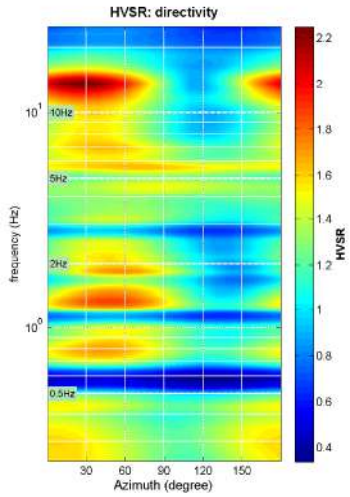
=== Criteria for a reliable H/V curve ==========
#1. [f0 > 10/Lw]: 1.419 > 0.5 (OK)
#2. [nc > 200]: 4937 > 200 (OK)
#3. [f0>0.5Hz; sigmaA(f) < 2 for 0.5f0 < f < 2f0] (OK)

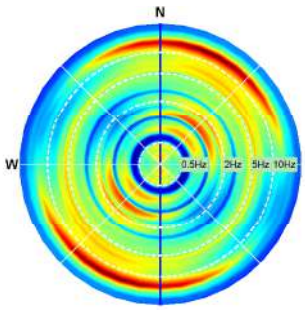
=== Criteria for a clear H/V peak (at least 5 should be fulfilled) ==========
#1. [exists f- in the range [f0/4, f0] | AH/V(f-) < A0/2]: yes, at frequency 0.6Hz (OK)
#2. [exists f+ in the range [f0, 4f0] | AH/V(f+) < A0/2]: yes, at frequency 2.8Hz (OK)
#3. [A0 > 2]: 1.6 < 2 (NO)
#4. [fpeak[Ah/v(f) ą sigmaA(f)] = f0 ą 5%]: (NO)
#5. [sigmaf < epsilon(f0)]: 3.113 > 0.142 (NO)
#6. [sigmaA(f0) < theta(f0)]: 0.528 < 1.78 (OK)

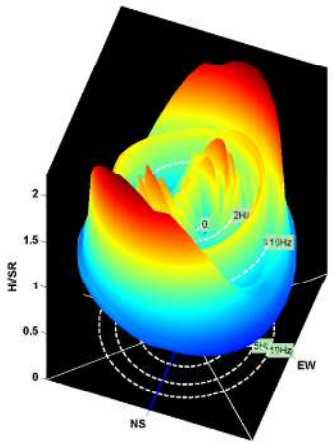


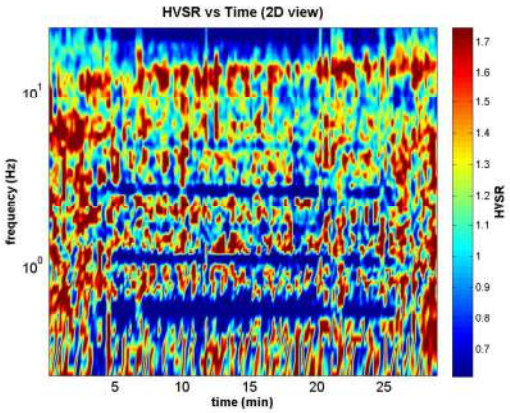


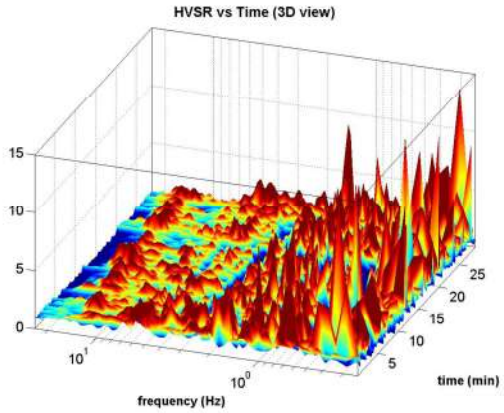
To model the HVSR (also jointly with MASW or ReMi/ESAC data), save the H/V curve, go to the "Velocity Spectrum/a, Modeling & Picking" panels and upload the saved H/V curve











HVSR62

DATE 13.07.2017	HOUR 16:58	PLACE Strada di Istieto
OPERATOR ProGeo Engineering srl	GPS TYPE and #	
GAUSS-BOAGA LATITUDE 4796404	GAUSS-BOAGA LONGITUDE 1691294	ALTITUDE 228,3 m slm
STATION TYPE GPA	SENSOR TYPE 4,5 Hz	
STATION #	SENSOR #	DISK #
FILE NAME HVSR62		POINT #
GAIN	SAMPL. FREQ. 100 Hz	REC. DURATION 30 min (minutes / seconds)

WEATHER CONDITIONS: WIND [●] none [ ] weak (5m/s) [ ] medium [ ] strong Measurement (if any): ____
RAIN [●] none [ ] weak [ ] medium [ ] strong Measurement (if any): ____
Temperature (approx): 37 Remarks ____

GROUND TYPE: [●] earth ([●] hard [ ] soft) [ ] gravel [ ] sand [ ] rock [ ] grass = ([ ] short [ ] tall)
[ ] asphalt [ ] cement [ ] concrete [ ] paved [ ] other ____
[●] dry soil [ ] wet soil Remarks ____

ARTIFICIAL GROUND-SENSOR COUPLING [●] no [ ] yes, type ____

BUILDING DENSITY [ ] none [●] scattered [ ] dense [ ] other, type ____

TRANSIENTS	none	few	moderate	many	very dense	distance
cars		●				
trucks	●					
pedestrians	●					
other ____	●					

MONOCHROMATIC NOISE SOURCES (factories, works, pumps, rivers,..)
[●] no [ ] yes, type ____

NEARBY STRUCTURES (description, height, distance) (trees, polls, buildings, bridges, underground structures,...)
Buildings

OBSERVATIONS

FREQUENCY: Hz (if computed in the field)

Qualità della misura:

Durata: rispettata
Stazionarietà: rispettata
Isotropia: rispettata
Assenza di disturbi: non rispettata
Plausibilità fisica: rispettata
Robustezza statistica: rispettata

MISURA TIPO C

HVSR62

Peak frequency (Hz): 0.5 (±3.1)
Peak HVSR value: 1.7 (±0.5)

=== Criteria for a reliable H/V curve ==========
#1. [f0 > 10/Lw]: 0.500 > 0.5 (OK)
#2. [nc > 200]: 1732 > 200 (OK)
#3. [f0>0.5Hz; sigmaA(f) < 2 for 0.5f0 < f < 2f0] (OK)

=== Criteria for a clear H/V peak (at least 5 should be fulfilled) ==========
#1. [exists f- in the range [f0/4, f0] | AH/V(f-) < A0/2]: (NO)
#2. [exists f+ in the range [f0, 4f0] | AH/V(f+) < A0/2]: yes, at frequency 1.3Hz (OK)
#3. [A0 > 2]: 1.7 < 2 (NO)
#4. [fpeak[Ah/v(f) ą sigmaA(f)] = f0 ą 5%]: (OK)
#5. [sigmaf < epsilon(f0)]: 3.101 > 0.075 (NO)
#6. [sigmaA(f0) < theta(f0)]: 0.438 < 2 (OK)

show data | reset | show location | field notes

step#1 (optional) - decimate

64Hz | new frequency | resample

step#2 - H/V computation

remove events | both Rad. & Tr. | clean axes

20 window length (s) — Min. freq.: 0.25Hz

8 tapering (%)

15 outlier tolerance threshold

10% spectral smoothing (triangular window)

☐ show particle motion and all HVSRs

☑ full output | compute

step#3 - directivity analysis

frequencies to highlight: 0.5 2.0 5.0 10.0 Hz | compute

3D motion

☐ save video | show 3D motion

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save- option#1: save HVSR as it is

save H/V from 0.25 to 20 Hz

save HV curve (as it is)

save - option#2: picking H/V curve

pick HV curve | save picked HV

quick analysis (f=Vs/4H)

200 average Vs (m/s) (from surface to bedrock)

20 depth of the bedrock (m)

1000 Vs of the bedrock

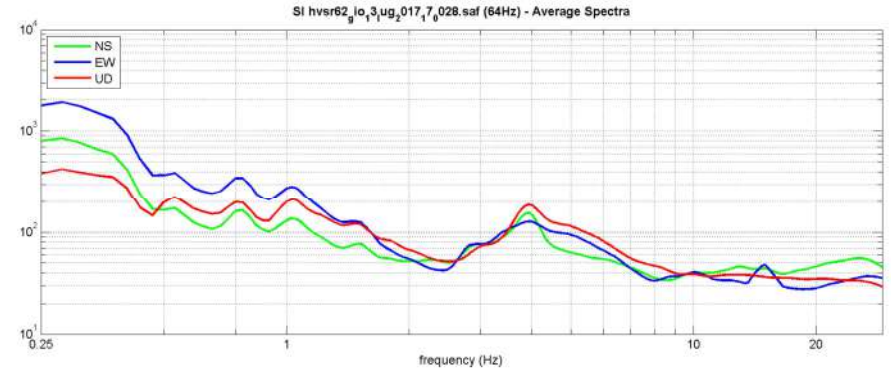
clean | compute

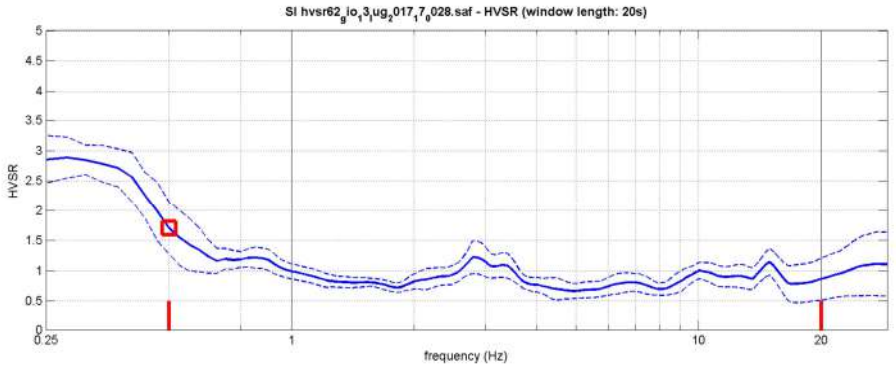
highlight a frequency

draw/highlight | 10 Hz

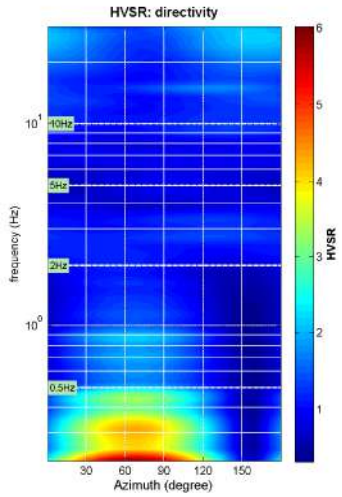
directivity over time

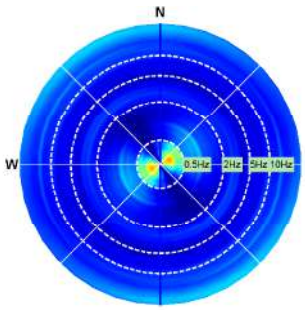
directivity in time | time step: 60 s

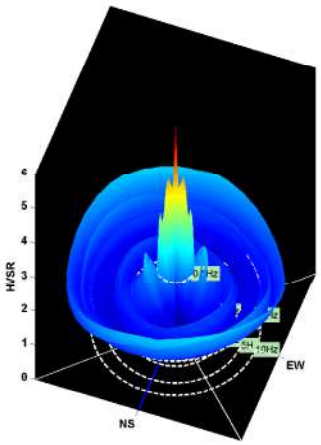


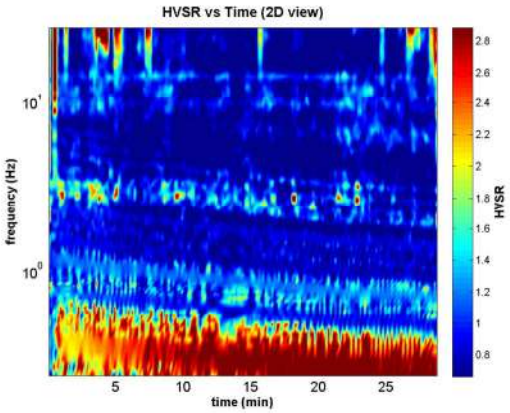


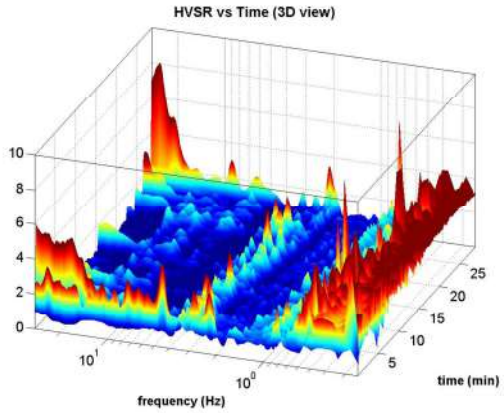
To model the HVSR (also jointly with MASW or ReMi/ESAC data), save the H/V curve, go to the "Velocity Spectrum/a, Modeling & Picking" panels and upload the saved H/V curve











HVSR63

DATE 07.11.2017	HOUR 16:00	PLACE Volte Basse
OPERATOR ProGeo Engineering srl	GPS TYPE and #	
GAUSS-BOAGA LATITUDE	GAUSS-BOAGA LONGITUDE	ALTITUDE
STATION TYPE GPA	SENSOR TYPE 4,5 Hz	
STATION #	SENSOR #	DISK #
FILE NAME HVSR63		POINT #
GAIN	SAMPL. FREQ. 300 Hz	REC. DURATION 30 min (minutes / seconds)

WEATHER CONDITIONS
WIND (●) none ( ) weak (5m/s) ( ) medium ( ) strong Measurement (if any): _____
RAIN ( ) none (●) weak ( ) medium ( ) strong Measurement (if any): _____
Temperature (approx): 10 Remarks _____

GROUND TYPE
(●) earth ( ) hard (●) soft ( ) gravel ( ) sand ( ) rock ( ) grass = ( ) short ( ) tall
( ) asphalt ( ) cement ( ) concrete ( ) paved ( ) other _____
( ) dry soil ( ) wet soil Remarks _____

ARTIFICIAL GROUND-SENSOR COUPLING (●) no ( ) yes, type _____

BUILDING DENSITY ( ) none (●) scattered ( ) dense ( ) other, type _____

TRANSIENTS

	none	few	moderate	many	very dense	distance
cars		●				
trucks	●					
pedestrians	●					
other	●					

MONOCHROMATIC NOISE SOURCES (factories, works, pumps, rivers,..)
(●) no ( ) yes, type _____

NEARBY STRUCTURES (description, height, distance) (trees, polls, buildings, bridges, underground structures,...)

OBSERVATIONS

FREQUENCY: Hz (if computed in the field)

Qualità della misura:

Durata: rispettata
Stazionarietà: rispettata
Isotropia: rispettata
Assenza di disturbi: rispettata
Plausibilità fisica: rispettata
Robustezza statistica: rispettata

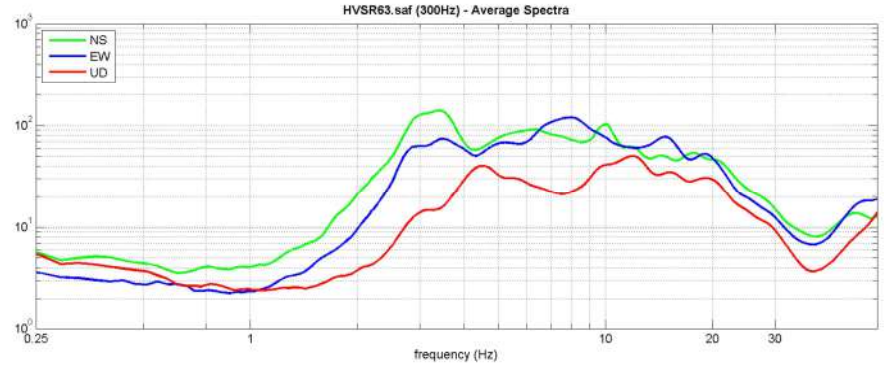
MISURA TIPO A1

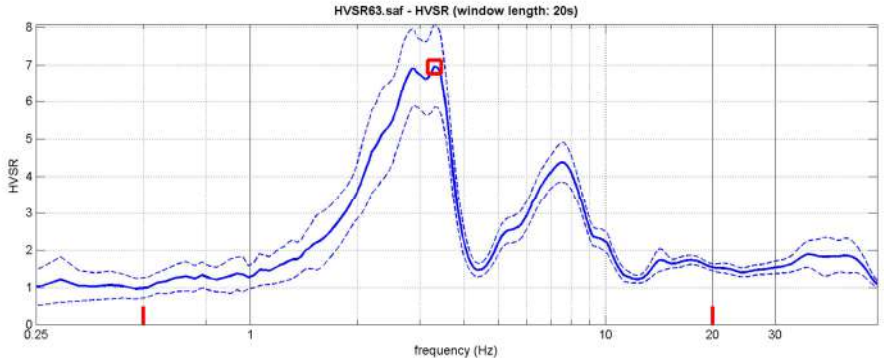
HVSR63

Peak frequency (Hz): 3.3 (±1.5)
Peak HVSR value: 7.0 (±1.1)

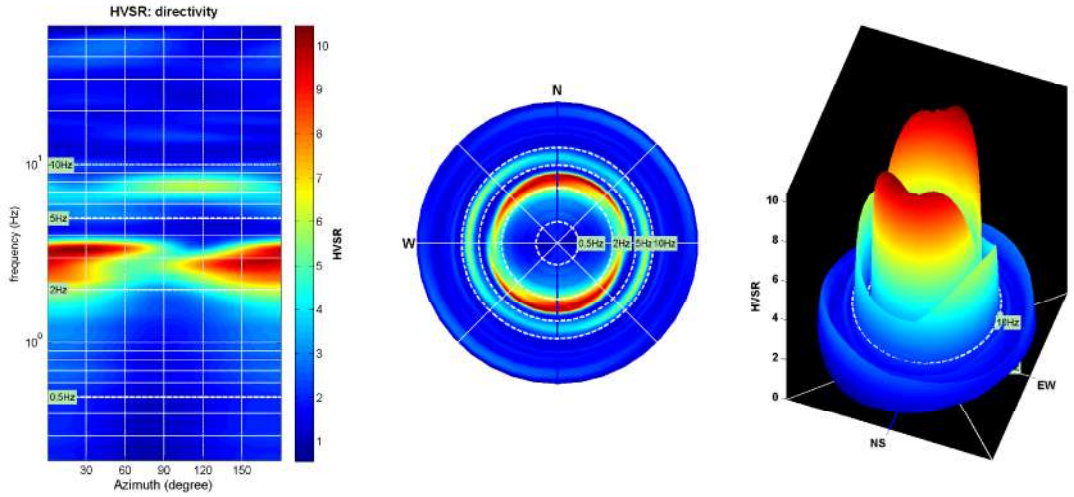
=== Criteria for a reliable H/V curve ==========
#1. [f0 > 10/Lw]: 3.297 > 0.5 (OK)
#2. [nc > 200]: 6330 > 200 (OK)
#3. [f0>0.5Hz; sigmaA(f) < 2 for 0.5f0 < f < 2f0] (OK)

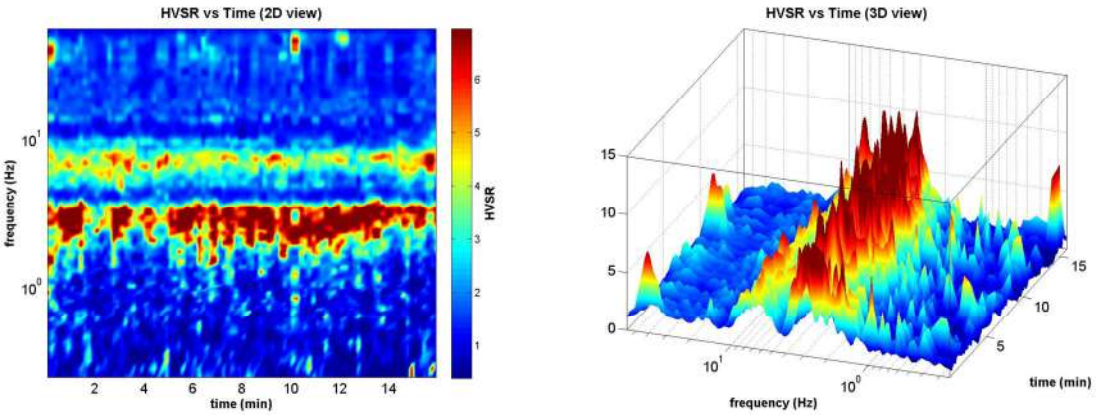
=== Criteria for a clear H/V peak (at least 5 should be fulfilled) ==========
#1. [exists f- in the range [f0/4, f0] | AH/V(f-) < A0/2]: yes, at frequency 0.9Hz (OK)
#2. [exists f+ in the range [f0, 4f0] | AH/V(f+) < A0/2]: yes, at frequency 3.8Hz (OK)
#3. [A0 > 2]: 7.0 > 2 (OK)
#4. [fpeak[Ah/v(f) ± sigmaA(f)] = f0 ± 5%]: (NO)
#5. [sigmaf < epsilon(f0)]: 1.450 > 0.165 (NO)
#6. [sigmaA(f0) < theta(f0)]: 1.124 < 1.58 (OK)





To model the HVSR (also jointly with MASW or ReMi/EGAC data), save the H/V curve, go to the "Velocity Spectrum/a, Modeling & Picking" panels and upload the saved H/V curve





HVSR64

DATE 07.11.2017	HOUR 16:30	PLACE Petriccio
OPERATOR ProGeo Engineering srl	GPS TYPE and #	
GAUSS-BOAGA LATITUDE	GAUSS-BOAGA LONGITUDE	ALTITUDE
STATION TYPE GPA	SENSOR TYPE 4,5 Hz	
STATION #	SENSOR #	DISK #
FILE NAME HVSR63		POINT #
GAIN	SAMPL. FREQ. 300 Hz	REC. DURATION 30 min (minutes / seconds)

WEATHER CONDITIONS
WIND ■ none ☐ weak (5m/s) ☐ medium ☐ strong Measurement (if any): _____
RAIN ■ none ☐ weak ☐ medium ☐ strong Measurement (if any): _____
Temperature (approx): 8 Remarks _____

GROUND TYPE
■ earth (☐ hard ■ soft) ☐ gravel ☐ sand ☐ rock ☐ grass (☐ short ☐ tall)
☐ asphalt ☐ cement ☐ concrete ☐ paved ☐ other _____
☐ dry soil ☐ wet soil Remarks _____

ARTIFICIAL GROUND-SENSOR COUPLING ■ no ☐ yes, type _____

BUILDING DENSITY ☐ none ■ scattered ☐ dense ☐ other, type _____

TRANSIENTS

	none	few	moderate	many	very dense	distance
cars			●			
trucks	●					
pedestrians		●				
other	●					

MONOCHROMATIC NOISE SOURCES (factories, works, pumps, rivers,..)
■ no ☐ yes, type _____

NEARBY STRUCTURES (description, height, distance) (trees, polls, buildings, bridges, underground structures,...)

OBSERVATIONS

FREQUENCY: Hz (if computed in the field)

Qualità della misura:

Durata: rispettata
Stazionarietà: rispettata
Isotropia: rispettata
Assenza di disturbi: rispettata
Plausibilità fisica: rispettata
Robustezza statistica: rispettata

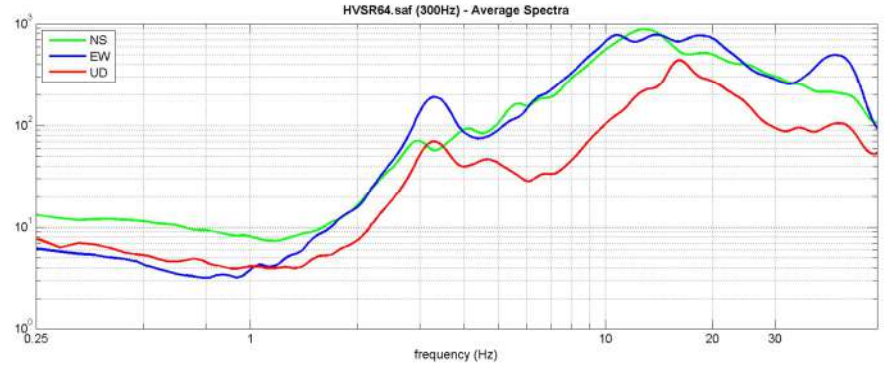
MISURA TIPO A1

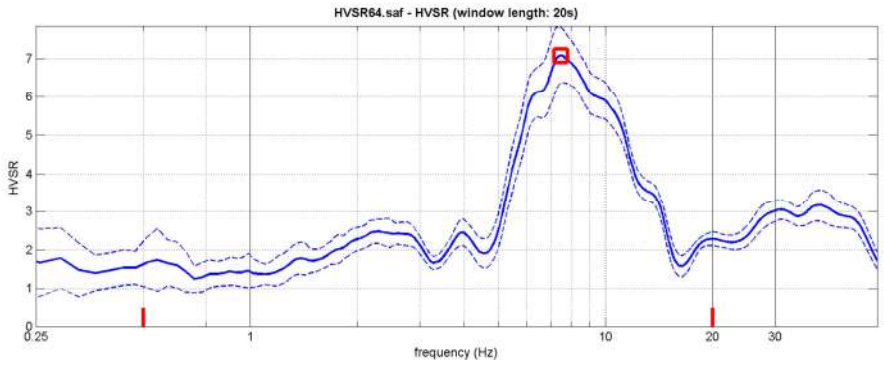
HVSR64

Peak frequency (Hz): 7.5 (1.8)
Peak HVSR value: 7.1 (0.7)

=== Criteria for a reliable H/V curve ==========
#1. [f0 > 10/Lw]: 7.473 > 0.5 (OK)
#2. [nc > 200]: 15692 > 200 (OK)
#3. [f0>0.5Hz; sigmaA(f) < 2 for 0.5f0 < f < 2f0] (OK)

=== Criteria for a clear H/V peak (at least 5 should be fulfilled) ==========
#1. [exists f- in the range [f0/4, f0] | AH/V(f-) < A0/2]: yes, at frequency 1.9Hz (OK)
#2. [exists f+ in the range [f0, 4f0] | AH/V(f+) < A0/2]: yes, at frequency 13.2Hz (OK)
#3. [A0 > 2]: 7.1 > 2 (OK)
#4. [fpeak[Ah/v(f) ą sigmaA(f)] = f0 ą 5%]: (OK)
#5. [sigmaf < epsilon(f0)]: 1.831 > 0.374 (NO)
#6. [sigmaA(f0) < theta(f0)]: 0.725 < 1.58 (OK)





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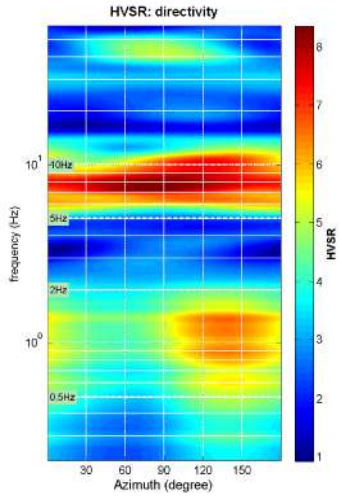
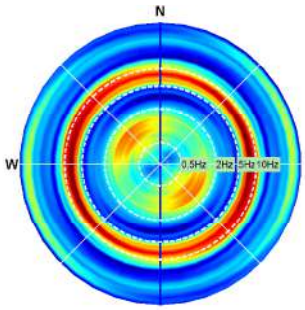
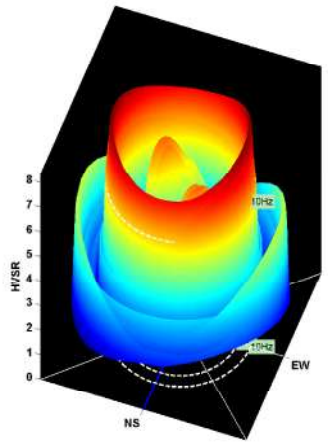
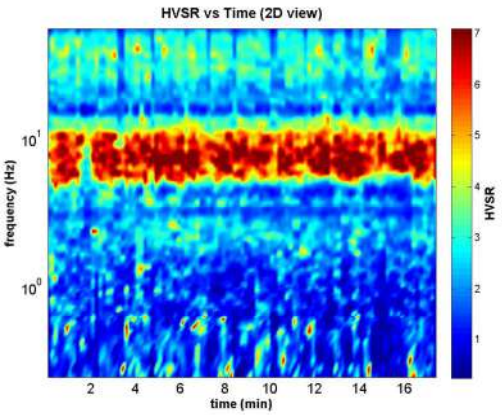
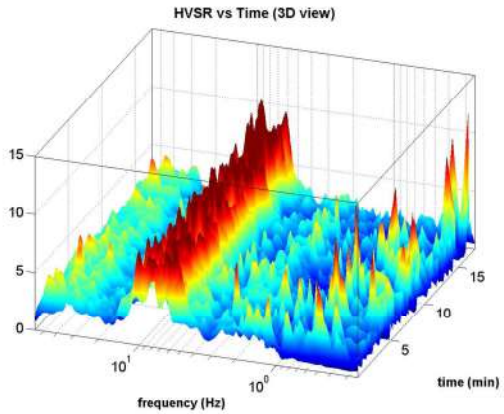










INDAGINI GEOFISICHE INTEGRATE PER LO STUDIO DI MICROZONAZIONE SISMICA DI PRIMO LIVELLO NEI CENTRI ABITATI ED ANALISI DELLE CONDIZIONI LIMITE PER L'EMERGENZA (CLE)

§ 1) INTRODUZIONE

1.1) Premessa

Il presente documento riferisce sulle prove geofisiche, di tipo sismico attivo e passivo, per lo studio MOPS condotto in corrispondenza delle aree definite in fase preliminare tra Servizio Urbanistica del Comune di Siena, Servizio di Prevenzione Sismica della Regione Toscana e studio ProGeo Engineering corrispondenti ad una integrazione adeguata delle aree dei centri abitati.

Lo studio di microzonazione sismica (MS) di livello 1 rappresenta un livello propedeutico a successivi studi di MS (livello 2 e 3) e consiste in una raccolta organica e ragionata dei dati di natura geologica, geofisica e geotecnica preesistenti e/o acquisite al fine di suddividere il territorio comunale in microzone qualitativamente omogenee dal punto di vista del comportamento sismico. Tale approfondimento è finalizzato alla realizzazione della Carta delle Microzone Omogenee in Prospettiva Sismica (MOPS), oltre agli elaborati propedeutici come la Carta delle Frequenze di Sito, la Carta delle Indagini e la Carta Geologico – Tecnica, eseguite con la finalità di guidare le scelte pianificatorie, nell'ottica di perseguire ed assicurare la riduzione del rischio sismico, evidenziando le criticità e identificando le aree per le quali sono richiesti studi di approfondimento.

1.2) Contesto

Le indagini geofisiche integrate, sono state eseguite all'interno del territorio del Comune di Siena come concordato con lo Studio Progeo.

Si rimanda alla Carta delle Indagini per l'inquadramento delle prove sismiche eseguite nel territorio comunale.

1.3) Scopo delle indagini

La caratterizzazione sismica - dinamica del terreno, è stata eseguita attraverso prove geofisiche integrate e complementari fra loro, di cui:

• *Sismica a rifrazione con onde P ed onde SH, con restituzione secondo tecniche di analisi a rifrazione classica e tomografica, delle velocità Vp e Vs nel sottosuolo;*

• *Prove MASW (Multistation Analysis of Surface Waves), per la determinazione di profili di velocità Vs nel sottosuolo, che hanno permesso di ottenere la classificazione del sottosuolo ai sensi della vigente normativa NCT 2008 "Norme Tecniche per le Costruzione DM 14/01/2008";*

• *Prove ESAC (Extended Spatial AutoCorrelation) per determinazione di profili di velocità Vs nel sottosuolo e per eseguire l'analisi congiunta con le prospezioni MASW;*

1.4) Scelta delle zone oggetto delle indagini

Le indagini sono state effettuate nel comprensorio del Comune di Siena e in particolare sono state suddivise come segue:

- *Sismica a rifrazione con onde P ed onde SH:*

SR_1 centro storico, Loc. La Lizza;

SR_2 abitato di Siena, Loc. Petriccio;

SR_3 abitato di Taverne d'Arbia;

SR_4 Loc. Volte Basse.

- *MASW + ESAC:*

MASW- ESAC 1 periferia di Siena, Loc. Cerchiaia;

MASW- ESAC 2 centro storico, Loc. La Lizza;

MASW- ESAC 3 periferia di Siena, Loc. San Miniato.

1.5) Descrizione dei contenuti della relazione

La presente relazione illustrerà la metodologia di acquisizione, la strumentazione utilizzata, le tecniche e le modalità di inversione/interpretazione, oltre ad evidenziare i risultati ottenuti con la campagna di prospezione geofisica sismica integrata, a supporto della caratterizzazione sismica del sottosuolo relativamente alle diverse aree di indagine.

Dopo un quadro descrittivo delle tecniche di indagine, riportate nel Capitolo 2 ("Caratterizzazione sismica"), si riportano le modalità di interpretazione e analisi dei dati acquisiti ed i risultati, di cui al Capitolo 3 ("Elaborazione dati e risultati").

Il documento è poi completato con un allegato contenente: - ALLEGATI GRAFICI, in cui sono riportati in dettaglio i dati acquisiti, la loro elaborazione ed i risultati ottenuti.

§ 2) CARATTERIZZAZIONE SISMICA

Ai fini di una completa caratterizzazione sismica delle aree oggetto di indagine, i dati sono stati acquisiti secondo modalità che hanno permesso l'inversione ed interpretazione sequenziale e correlata, secondo diverse tecniche di cui:

1. Sismica a rifrazione e tomografia sismica con restituzione di sismostrati secondo metodi classici di elaborazione a rifrazione, Plus-Minus, Wavefront e CMP "Intercept Time Refraction", e profilo tomografico 2D delle onde di compressione P;

2. Sismica a rifrazione e tomografia sismica con restituzione di sismostrati secondo metodi classici di elaborazione a rifrazione, Plus-Minus, Wavefront e CMP "Intercept Time Refraction", e profilo tomografico 2D delle onde di taglio SH;

3. Tecnica MASW (Multichannel Analysis of Surface Waves) che è una derivazione delle tecniche SASW (Spectral Analysis of Surface Waves) che si basano sull'elaborazione delle proprietà spettrali delle onde di superficie per la costruzione di un modello monodimensionale verticale di velocità di propagazione delle onde di taglio Vs;

4. Tecnica ESAC (Extended Spatial AutoCorrelation method) è una generalizzazione del metodo ReMi finalizzata alla determinazione delle velocità di propagazione delle onde superficiali presenti nel campo delle vibrazioni ambientali alle varie frequenze;

2.1) Sismica a rifrazione

Le onde elastiche provocate da una vibrazione si trasmettono nel suolo con velocità differenti per ogni litotipo, per cui nella prospezione sismica a rifrazione, si sfrutta la diversa velocità di propagazione delle onde longitudinali (onde P o "di compressione e dilatazione") o trasversali (onde SH o “di taglio”) per determinare spessori e andamento dei livelli presenti. La tecnica di indagine consiste nel generare un'onda sismica di compressione o di taglio nel terreno attraverso una determinata sorgente di energia (colpo di mazza o di maglio, esplosivo etc.) e nel misurare il tempo impiegato da detta onda a compiere il percorso nel sottosuolo dal punto di energizzazione fino ai sensori di rilevazione (geofoni) secondo le leggi di rifrazione dell'ottica (Legge di Snell), nel rifrangerosi sulle superfici di separazione tra due strati sovrapposti di densità (o meglio di modulo elastico) crescente.

La rifrazione si basa sull’analisi, secondo diversi modelli dei primi arrivi rispetto a geofoni posti a distanze diverse dalla sorgente energizzante, per ricostruire una serie di curve tempo-distanza (dromocrone).

Attraverso metodi analitici si ricavano quindi le velocità delle onde elastiche longitudinali (Vp) o trasversali (Vs) dei mezzi attraversati ed il loro spessore. La velocità di propagazione delle onde elastiche nel suolo è compresa tra larghi limiti. Per lo stesso tipo di materiale, può variare in funzione di numerosi parametri quali il grado di alterazione, di fessurazione e/o di fratturazione per i materiali litoidi, ed in funzione dello stato di consistenza/addensamento, grado di saturazione, per i materiali granulari e fini.

Sensibili differenze si possono avere, anche con riferimento all’assetto morfologico rispetto alle velocità rilevate lungo i piani di strato e quelle rilevate perpendicolarmente a questi. Inoltre la velocità delle onde P compressionali, rispetto alle SH trasversali, è fortemente influenzata dalla presenza di eventuale acquifero e/o dal grado di saturazione.

Questo comporta che anche litotipi differenti possano avere uguali velocità delle onde sismiche compressionali (ad esempio roccia fortemente fratturata e materiale detritico saturo con velocità Vp dell'ordine di 1400÷1700 m/sec), per cui non necessariamente l'interpretazione sismostratigrafica corrisponderà con la reale situazione geologico - stratigrafica.

2.2) Tomografia sismica in onde P e SH

La tomografia sismica, per raggi diretti, è una tecnica d'indagine che permette l'individuazione di anomalie nella velocità di propagazione delle onde sismiche con un potere risolutivo nettamente superiore ad altri metodi, offrendo la possibilità della ricostruzione, con elevato grado di qualità, di anomalie stratigrafiche anche particolarmente complesse non risolvibili con differenti tecniche d'indagine. Per la realizzazione di immagini tomografiche è necessario utilizzare un maggior numero di sorgenti di energizzazione e di punti di ricezione delle onde sismiche, che permettano una distribuzione dei raggi sismici omogenea e con una densità che viene predefinita in funzione del "target" da raggiungere.

Le tecniche operative possono essere molto diverse, si può infatti operare:

• a livello del piano di campagna disponendo i ricevitori (geofoni) ed i trasmettitori (punti di scoppio) su linee parallele;

• utilizzando due fori, residui di sondaggi geognostici, (tomografia cross-hole), dove, previo opportuno condizionamento, si alloggiano i ricevitori ed i trasmettitori;

• utilizzando un solo foro (sondaggio sismico tomografico), in cui sono alloggiati i ricevitori, eseguendo una serie di tiri a distanze crescenti dall'imboccatura del foro stesso.

Per il trattamento dei dati per la ricostruzione tomografica dell'immagine si utilizza una suddivisione dell'area di studio in celle elementari, calcolando per ciascuna di queste un valore di velocità congruente con il tempo di tragitto medio relativo ai percorsi dei raggi sismici che le attraversano; la presentazione delle elaborazioni eseguite dà come risultato una mappa della distribuzione delle velocità sismiche in una sezione piana contenente le sorgenti ed i geofoni.

Le classiche prospezioni sismiche si basano sul concetto che le onde acustiche si propagano nei diversi mezzi con velocità differenti.

Generando tali onde in un punto (detto di scoppio) e osservando i loro tempi di arrivo in altri punti predeterminati (detti di registrazione), è possibile ricostruire la distribuzione di velocità e con questa definire dal punto di vista elastico le aree oggetto di studio e individuare anomalie o corpi anomali. L'applicazione della tecnica tomografica alle misure sismiche permette poi di ricostruire l'andamento di tale caratteristica fisica all'interno di una porzione di spazio non accessibile direttamente e di ottenere come risultati, immagini che visualizzano le non omogeneità incontrate nel mezzo. Il risultato finale sarà la rappresentazione delle velocità (in m/s) per piani, secondo una scala cromatica prefissata, che in genere va dal magenta (basse velocità) al blu (alte velocità). Quanto più il mezzo attraversato è rigido e incomprimibile, tanto maggiore sarà la sua velocità caratteristica.

Valori bassi della velocità mettono in evidenza la variazione negativa delle caratteristiche elastiche e meccaniche, indicando la presenza di un possibile deterioramento della struttura interna.

2.2.1 Strumentazione per sismica a rifrazione e tecnica tomografica

Le misure sono state effettuate con strumento combinato PASI MOD.16SG24-N corredato da 24 geofoni a 10 Hz ad asse verticale per le acquisizioni in onde P e 24 geofoni a 10 Hz ad asse orizzontale per le acquisizioni in onde SH.

I geofoni verticali e orizzontali sono stati posizionati in corrispondenza della medesima progressiva metrica. I profili sismici sono stati eseguiti a mezzo di energizzazione artificiale del terreno, battendo una mazza da 11 Kg su una piastra in alluminio tramite un argano artigianale. Sono state scelte nove posizioni di battuta, due esterne sinistre, cinque centrali e due esterne destre così come previsto dalle linee guida VEL della Regione Toscana.

2.3) Tecnica MASW

Il principio ispiratore della tecnica MASW è il carattere dispersivo delle onde di Rayleigh e di Love quando queste si propagano in un mezzo stratificato. La dispersione consiste nella variazione della velocità di fase a diverse frequenze, con l'aumento della lunghezza d'onda (abbassamento di frequenza) la profondità coinvolta dalla propagazione dell'onda è via via maggiore.

È quindi possibile, impiegando onde di un certo intervallo di frequenza, caratterizzare le proprietà acustiche dei terreni sino ad una certa profondità. Nella maggior parte delle indagini sismiche per le quali si utilizzano le onde compressive, più di due terzi dell'energia sismica totale generata viene trasmessa nella forma di onde di Rayleigh, la componente principale delle onde superficiali.

Ipotizzando una variazione di velocità dei terreni in senso verticale, ciascuna componente di frequenza dell'onda superficiale ha una diversa velocità di propagazione (chiamata velocità di fase) che, a sua volta, corrisponde ad una diversa lunghezza d'onda per ciascuna frequenza che si propaga.

Questa proprietà si chiama dispersione.

Sebbene le onde superficiali siano considerate rumore per le indagini sismiche che utilizzano le onde di corpo (riflessione e rifrazione), la loro proprietà dispersiva può essere utilizzata per studiare le proprietà elastiche dei terreni superficiali.

La costruzione di un profilo verticale di velocità delle onde di taglio (Vs), ottenuto dall'analisi delle onde piane della modalità fondamentale delle onde di Rayleigh è una delle pratiche più comuni per utilizzare le proprietà dispersive delle onde superficiali.

Questo tipo di analisi fornisce i parametri fondamentali comunemente utilizzati per valutare la rigidezza superficiale, una proprietà critica per molti studi geotecnici.

L'intero processo comprende tre passi successivi:

- L'acquisizione delle onde superficiali (ground roll);

- la costruzione di una curva di dispersione (il grafico della velocità di fase rispetto alla frequenza);

- l'inversione della curva di dispersione per ottenere il profilo verticale delle Vs.

Per ottenere un profilo Vs bisogna produrre un treno d'onde superficiali a banda larga e registrarlo minimizzando il rumore.

Una molteplicità di tecniche diverse sono state utilizzate nel tempo per ricavare l'inversione dello spettro di velocità così prodotto, ciascuna con i suoi vantaggi e svantaggi, in quanto l'inversione di tale spettro viene realizzata iterativamente, utilizzandolo come riferimento sia per la modellazione diretta che per la procedura ai minimi quadrati.

I valori preliminari per il rapporto di Poisson e per la densità sono necessari per ottenere il profilo verticale Vs e vengono solitamente stimati utilizzando misure prese in loco o valutando le tipologie dei materiali.

Le onde superficiali riverberate (back scattered) possono essere prevalenti in un sismogramma multicanale, se in prossimità delle misure sono presenti discontinuità orizzontali quali fondazioni e muri di contenimento.

Le ampiezze relative di ciascuna tipologia di rumore generalmente cambiano con la frequenza e la distanza dalla sorgente.

Ciascun rumore, inoltre, ha diverse velocità e proprietà di attenuazione che possono essere identificate sulla registrazione multicanale grazie all'utilizzo di modelli di coerenza e in base ai tempi di arrivo e all'ampiezza di ciascuno.

La scomposizione di un campo di onde registrate in un formato a frequenza variabile consente l'identificazione della maggior parte del rumore, analizzando la fase e la frequenza in funzione della distanza dalla sorgente. La scomposizione può essere quindi utilizzata in associazione con la registrazione multicanale per minimizzare il rumore durante l'acquisizione.

La scelta dei parametri di elaborazione così come del miglior intervallo di frequenza per il calcolo della velocità di fase, può essere fatto con maggior accuratezza utilizzando dei sismogrammi multicanale.

Una volta scomposto il sismogramma, un'opportuna misura di coerenza applicata nel tempo e nel dominio della frequenza può essere utilizzata per calcolare la velocità di fase rispetto alla frequenza.

La velocità di fase e la frequenza sono le due variabili (x; y), il cui legame costituisce lo spettro di velocità.

E' anche possibile determinare l'accuratezza del calcolo analizzando la pendenza lineare di ciascuna componente di frequenza delle onde superficiali in un singolo sismogramma. In questo caso la prova MASW permette la miglior registrazione e separazione ad ampia banda ed elevati rapporti S/N. Un buon rapporto S/N assicura accuratezza nel calcolo dello spettro di velocità, mentre l'ampiezza di banda migliora la risoluzione e la possibile profondità di indagine del profilo Vs. Le onde di superficie sono facilmente generate da una sorgente sismica quale, ad esempio, una mazza battente.

In particolare l'analisi MASW è stata realizzata con il seguente tipo di acquisizione:

· acquisizione ZVF ossia con energizzazione verticale e acquisizione con geofoni verticali per l'analisi MASW della componente verticale delle onde di Rayleigh;

2.3.1 Strumentazione per sismica MASW

Le misure MASW sono state effettuate con strumento combinato PASI MOD.16SG24-N corredato da 12 geofoni a 4,5 Hz. I profili sismici sono stati eseguiti energizzando artificialmente il terreno e registrando le vibrazioni prodotte mediante captatori, denominati geofoni, collegati ad un ricevitore (sismografo) attraverso un cavo multipolare. I 12 geofoni, con frequenza minima di soglia di 4,5 Hz, sono stati posizionati ad una distanza definita l'uno dall'altro così da coprire una distanza orizzontale predeterminata. L'energizzazione è avvenuta battendo una mazza da 11 Kg su una piastra in alluminio; al momento della battuta vengono generate artificialmente onde sismiche nel terreno ed ha inizio la registrazione (trigger) con campionamento costante e predeterminato del segnale da parte dei geofoni.

Per ogni scoppio abbiamo utilizzato la metodologia dello stacking che consiste nel ripetere più volte le misurazioni al fine di amplificare l'ampiezza del segnale sismico ed ottenere quindi sismogrammi di più facile lettura.

Eseguita la prima acquisizione è stato allontanato il punto di scoppio pari alla metà della distanza tra il primo scoppio e il primo geofono e ripetute le operazioni di registrazione.

Questa operazione permette di avere sismogrammi a 24 tracce con soli 12 geofoni.

2.4) Metodo ESAC

Si tratta di una procedura sperimentale per la determinazione del profilo di velocità delle onde S nel sottosuolo a partire da misure di vibrazioni ambientali condotte con geofoni verticali posizionati con una geometria conosciuta (antenna sismica o seismic array).

In particolare, la procedura è finalizzata alla determinazione delle velocità di propagazione delle onde superficiali presenti nel campo delle vibrazioni ambientali alle varie frequenze di vibrazione ("spettro di velocità").

Questa informazione verrà poi utilizzata all'interno di una procedura di inversione per dedurre il profilo di velocità delle onde S nel sottosuolo nell'ipotesi che questo sia costituito da una pila di strati orizzontali sovrapposti ed omogenei al loro interno.

Il metodo ESAC (Extended Spectral AutoCorrelation method) è frutto di una idea sviluppata inizialmente da Aki (1957). Secondo Aki, il campo d'onda delle vibrazioni ambientali può essere rappresentato come la combinazione lineare di onde piane di diverse frequenze e con fase ed ampiezza casuale che si muovono sul piano orizzontale e che provengono da direzioni differenti. Aki dimostrò che, sebbene ogni serie temporale dedotta dalla registrazione di questo campo d'onde in un punto abbia un carattere stocastico, due registrazioni effettuate in punti diversi mostrino delle "somiglianze" (in senso statistico) e che da queste sia possibile dedurre informazioni sulle velocità di fase delle diverse onde misurate nelle due posizioni.

Queste somiglianze sono rivelate dall'andamento di una funzione di correlazione.

Dato che la stima della correlazione fra le due serie di registrazioni è effettuata senza tenere conto di alcuno sfasamento temporale, la funzione è detta di autocorrelazione.

Aki dimostrò che sotto condizioni molto generali (in particolare che le onde siano tutte fra loro indipendenti e che le direzioni di provenienza siano distribuite con probabilità uniforme attorno ai due geofoni) la funzione di autocorrelazione relativa alla componente verticale delle vibrazioni misurate in due posizioni ha la forma di una funzione di Bessel di ordine 0 e dipende solo dalla loro distanza relativa. Per una data frequenza vengono calcolate le diverse funzioni di autocorrelazione per tutte le distanze relative alle diverse coppie di sensori.

La velocità di fase viene determinata in modo da riprodurre al meglio l'andamento osservato della funzione di correlazione in funzione della distanza Δr.

2.4.1 Strumentazione per sismica ESAC

I dati sono stati acquisiti con strumento combinato PASI MOD.16SG24-N corredato da 12 geofoni verticali a 4,5 Hz disposti ad L o comunque combinazioni molto simili, con lunghezza di acquisizione poco superiore ai venticinque minuti. Le distanze tra i vari geofoni sono state scelte variabili per avere la massima correlazione tra le varie coppie di geofoni e per essere sicuri di avere la massima penetrazione possibile se in presenza di una coltre alterata di copertura.

§ 3) ELABORAZIONE DATI E RISULTATI

3.1) Elaborazione dei dati sismici con metodo a rifrazione

Le tracce acquisite sono state opportunamente filtrate utilizzando il programma Pickwin 3.14 della OYO Corporation: in particolare è stato eseguito un filtraggio passa basso (250 Hz) per eliminare le componenti in alta frequenza; quindi sono state inserite le coordinate di ogni geofono rispetto all'origine di riferimento. Visualizzate le tracce dei 24 geofoni abbiamo effettuato, con l'ausilio del software sopra menzionato, il picking dei primi arrivi delle onde P ed SH per ciascuno dei 9 scoppi.

I dati relativi ai tempi dei primi arrivi delle onde P ed SH a ciascun geofono e le relative distanze dei geofoni dai punti di scoppio sono poi stati utilizzati per tracciare le traveltime su grafici distanza/tempo.

Lanciato il programma Plotrefa_ee 2.73 della OYO Corporation, abbiamo inserito i dati topografici del profilo investigato e dopo la scelta del tipo di interpretazione da utilizzare (metodo G.R.M. – Time Term) sono state scelte le porzioni di traveltime a eguale velocità.

Infine il software visualizza l'ipotetica sezione invertita in base alle scelte sopra effettuate.

3.2) Elaborazione dei dati sismici con tecnica tomografica

Le tracce acquisite sono state opportunamente filtrate utilizzando il programma Pickwin 3.14 della OYO Corporation: in particolare è stato eseguito un filtraggio passa basso (250 Hz) per eliminare le componenti in alta frequenza; quindi sono state inserite le coordinate di ogni geofono rispetto all'origine di riferimento.

Visualizzate le tracce dei 24 geofoni abbiamo effettuato, con l'ausilio del software sopra menzionato, il picking dei primi arrivi delle onde P ed SH per ciascuno dei 9 scoppi.

I dati relativi ai tempi dei primi arrivi delle onde P ed SH a ciascun geofono e le relative distanze dei geofoni dai punti di scoppio sono poi stati utilizzati per tracciare le traveltime su grafici distanza/tempo.

Lanciato il programma Plotrefa_ee 2.73 della OYO Corporation, abbiamo inserito i dati topografici del profilo investigato dopodiché è stata avviata la procedura tomografica in automatico, scegliendo le condizioni al contorno più attinenti possibili al contesto geologico e stratigrafico dell'area.

Dopo l'inversione è stata nostra cura controllare il fitting tra le dromocrone sperimentali e quelle calcolate.

3.3) Elaborazione dei dati sismici MASW

Le tracce acquisite sono state elaborate attraverso il software di calcolo winMASW Academy 7.0 (Eliosoft Geophysical Software). E' stata quindi caricata la registrazione e verificato lo spettro di velocità.

Abbiamo quindi generato curve di dispersione artificiali e il Full Velocity Spetrum da un modello sismostratigrafico immesso manualmente e progressivamente migliorato per far coincidere le curve di dispersione e l'FVS, per i vari modi con lo spettro di velocità risultato dall'analisi.

E' stato eseguito poi il ripasso grafico dei massimi dello spettro di velocità (picking) così da ottenere dei binomi velocità – frequenza anche attraverso l'ausilio della curva di dispersione effettiva scaturita dall'inversione ESAC.

La fase successiva ha interessato l'inversione analitica di questi dati considerando come modello di partenza quello calcolato precedentemente in maniera manuale.

E' stato altresì verificato che il modello sismostratigrafico fosse compatibile con l'analisi HVSR effettuata in corrispondenza o in prossimità delle stese sismiche (MASW e ESAC), producendo così un'inversione "robusta". Il metodo d'inversione della curva di dispersione è basato su una tecnica di approssimazione particolarmente sofisticata (algoritmi genetici), che comunque non richiede necessariamente modelli di partenza.

Lanciata l'inversione il programma ha ricercato il modello medio e il modello migliore, tra i vari possibili nello spazio di ricerca che abbiamo precedentemente fissato.

La scelta dello spazio di ricerca è stata effettuata in modo oculato tenendo conto delle caratteristiche geologiche e sismiche dell'area.

3.4) Elaborazione dei dati tecnica ESAC

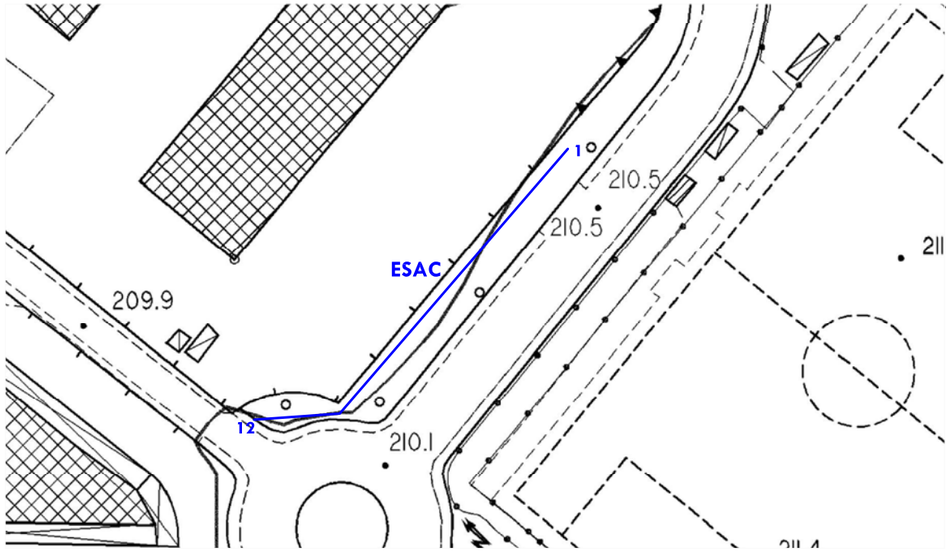
I sismogrammi ottenuti sono stati opportunamente elaborati con il software WinMasw Academy distribuito dalla ditta Eliosoft.

In particolare, dopo una visione generale delle registrazioni, è stato scelto l'intervallo di frequenze sul quale eseguire l'elaborazione. E' stata poi generata la curva di dispersione effettiva utilizzata nell'inversione MASW per ottenere la massima penetrazione possibile degli strati.

ALLEGATO 1

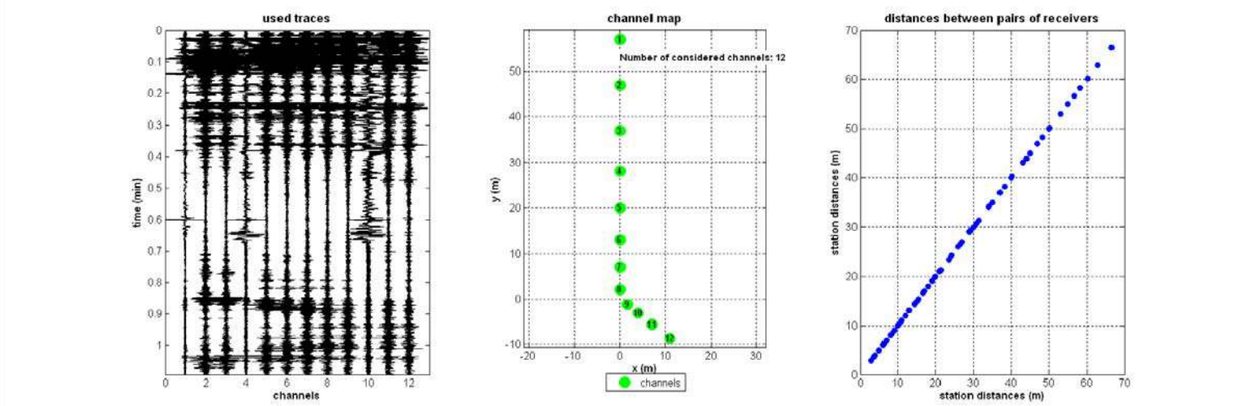
REPORT DELLE MIRURE MASW ED ESAC

CERCHIAIA

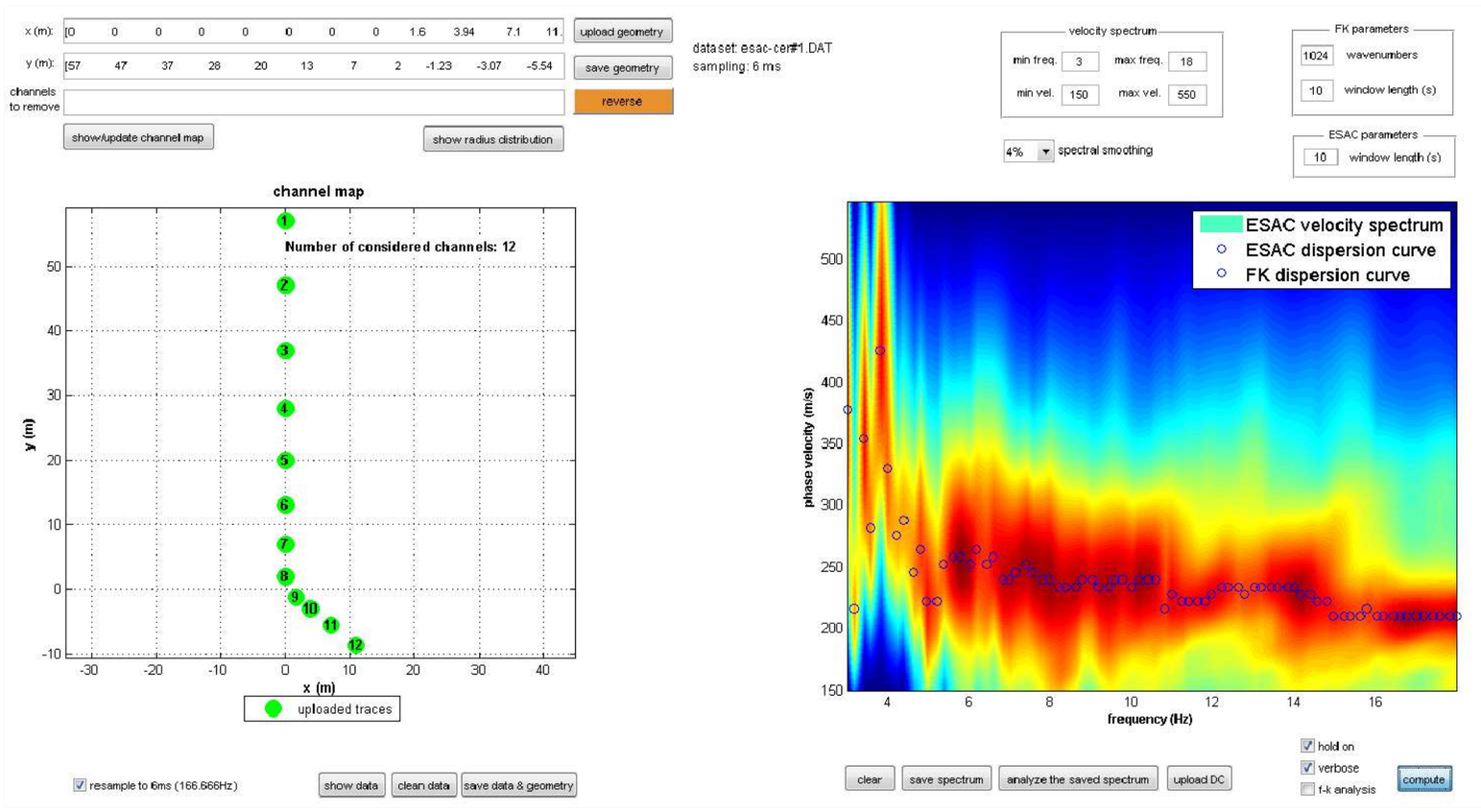


1 ESAC 12 Stendimento di sismica passiva ESAC

ACQUISIZIONE ESAC



SPETTRO DI VELOCITA' ESAC E CURVA DI DISPERSIONE EFFETTIVA



Stendimento ESAC

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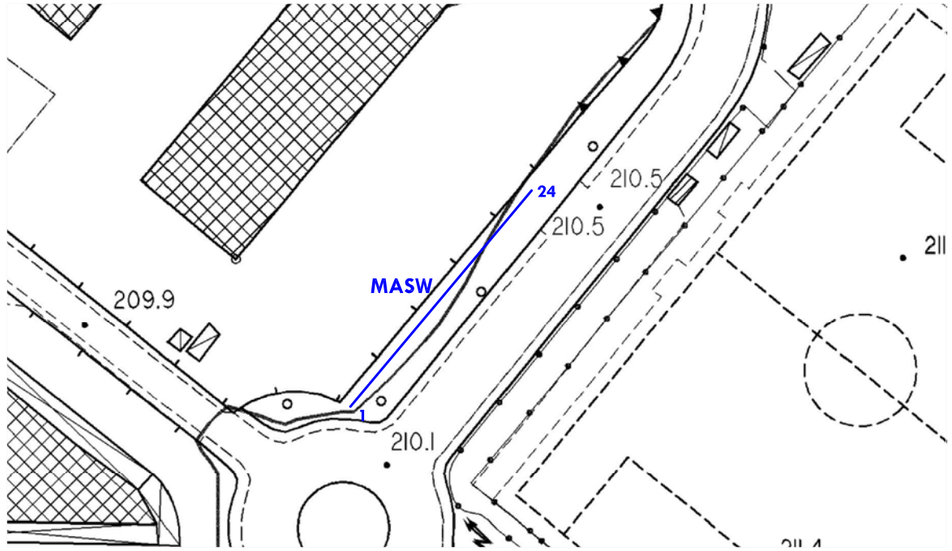
RISULTANZE DELL'ANALISI SISMICA CONGIUNTA MASW 1 - ESAC 1

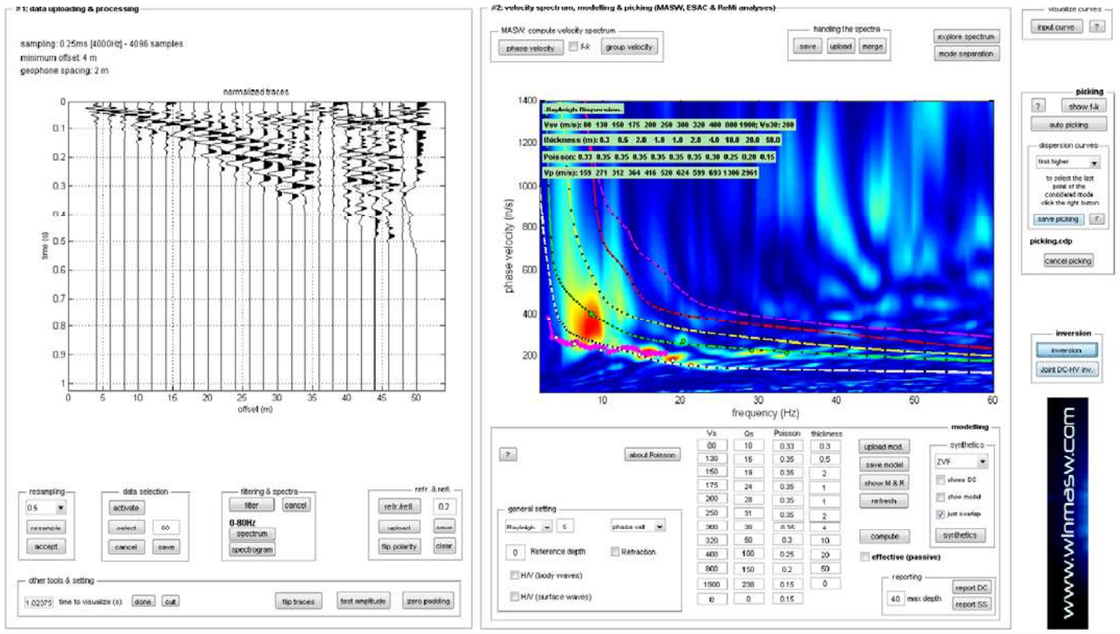
CERCHIAIA



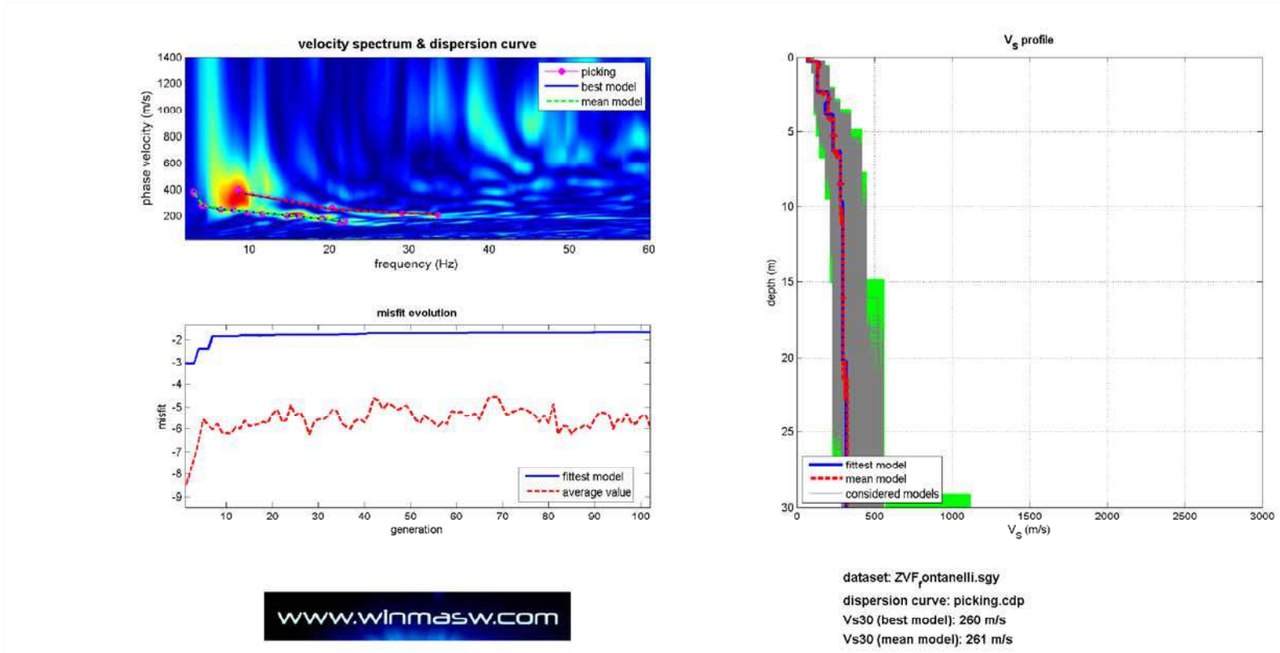
1 MASW 24 Stendimento di sismica attiva MASW

Stendimento MASW

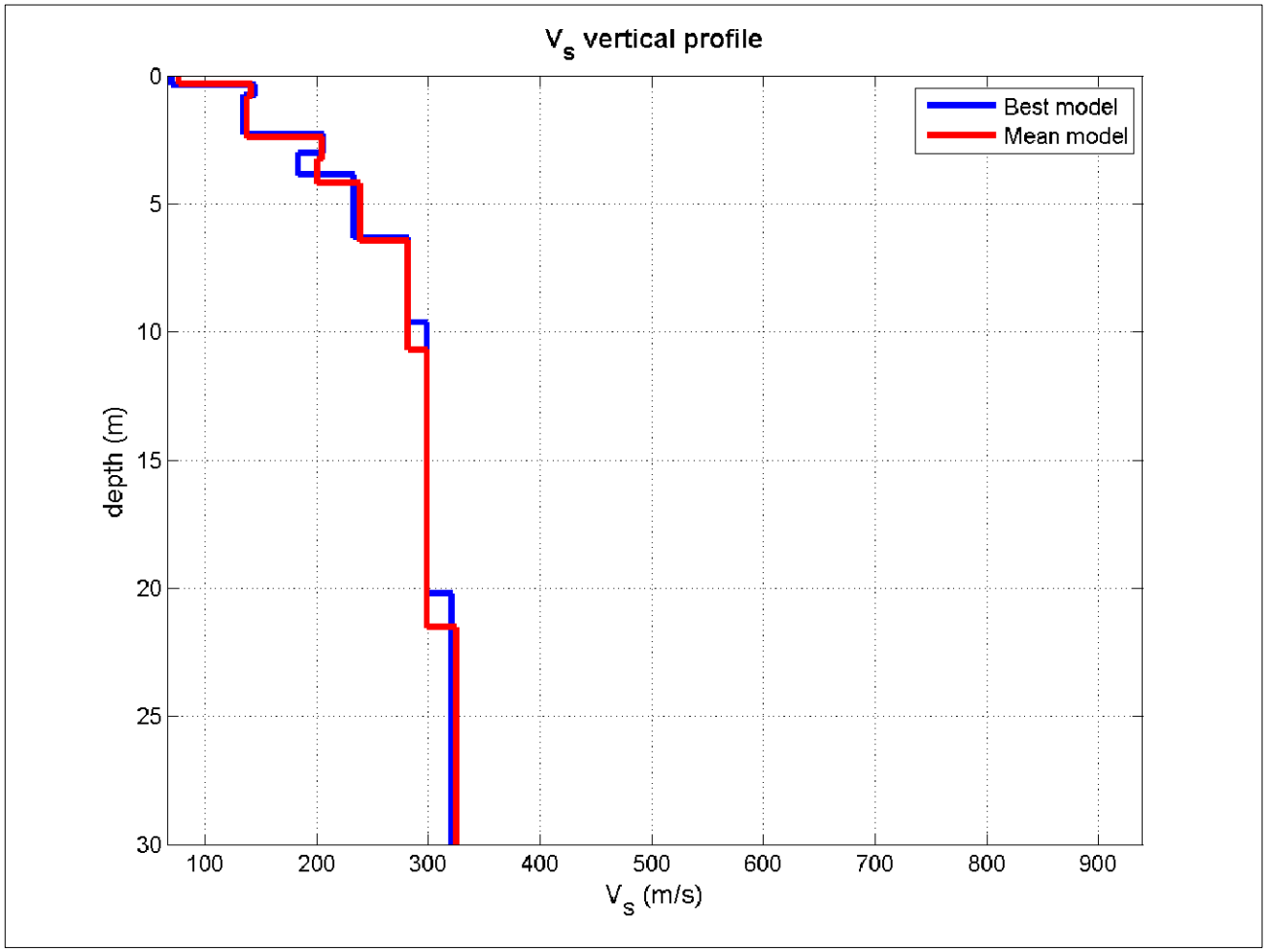
SPETTRO DI VELOCITA' MASW + CURVA DI DISPERSIONE EFFETTIVA ESAC



INVERSIONE CONGIUNTA MASW - ESAC E PROFILO DI VELOCITA'



PROFILO DI VELOCITA' MASW 1 - ESAC 1



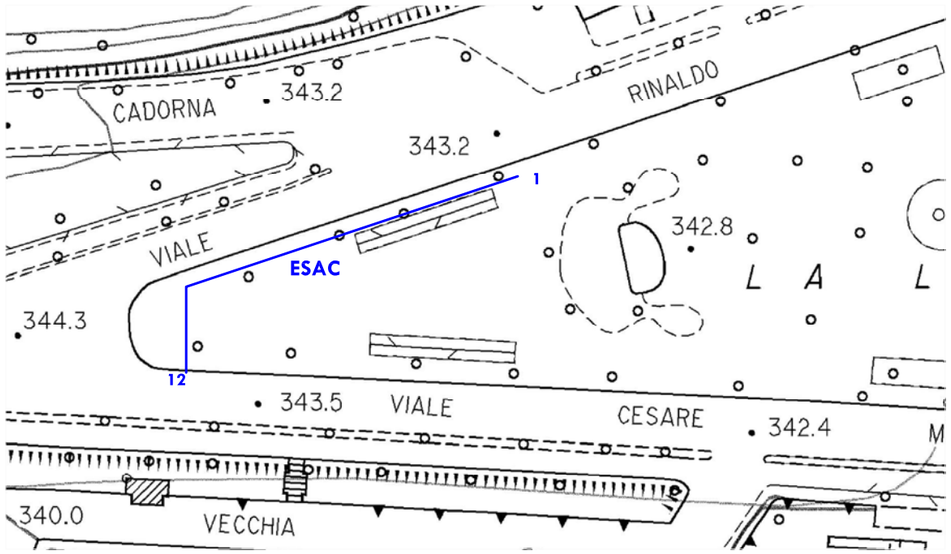
Mean model
Vs (m/s): 76, 141, 137, 205, 200, 239, 282, 299, 325
Thickness (m): 0.3, 0.5, 1.6, 0.9, 1.0, 2.2, 4.2, 10.8, 23.3

Density (gr/cm3) (approximate values): 1.57 1.78 1.76 1.84 1.86 1.85 1.93 1.89 1.91
Seismic/Dynamic Shear modulus (MPa) (approximate values): 9 35 33 77 74 106 153 169 202

Approximate values for Vp and Poisson)
Vp (m/s): 136 315 299 411 442 430 588 509 561
Poisson: 0.27 0.37 0.37 0.33 0.37 0.28 0.35 0.24 0.25

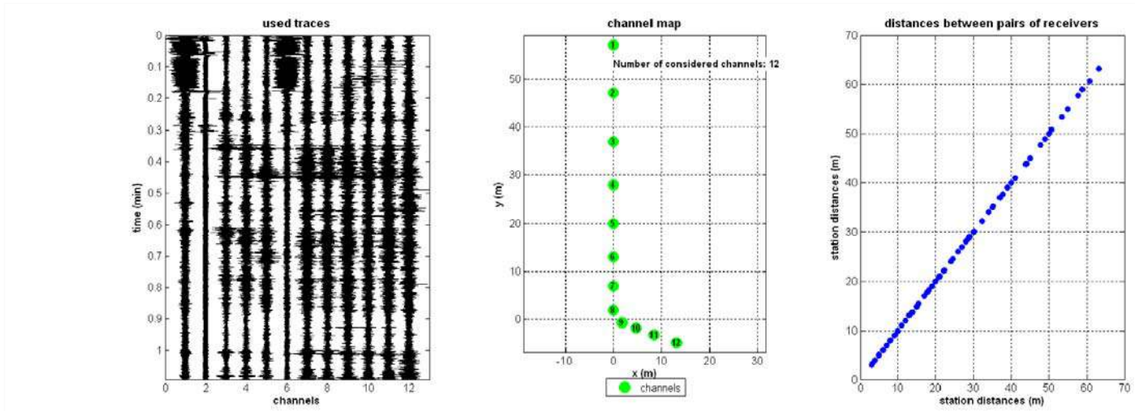
Vs30 (m/s): 261

LA LIZZA



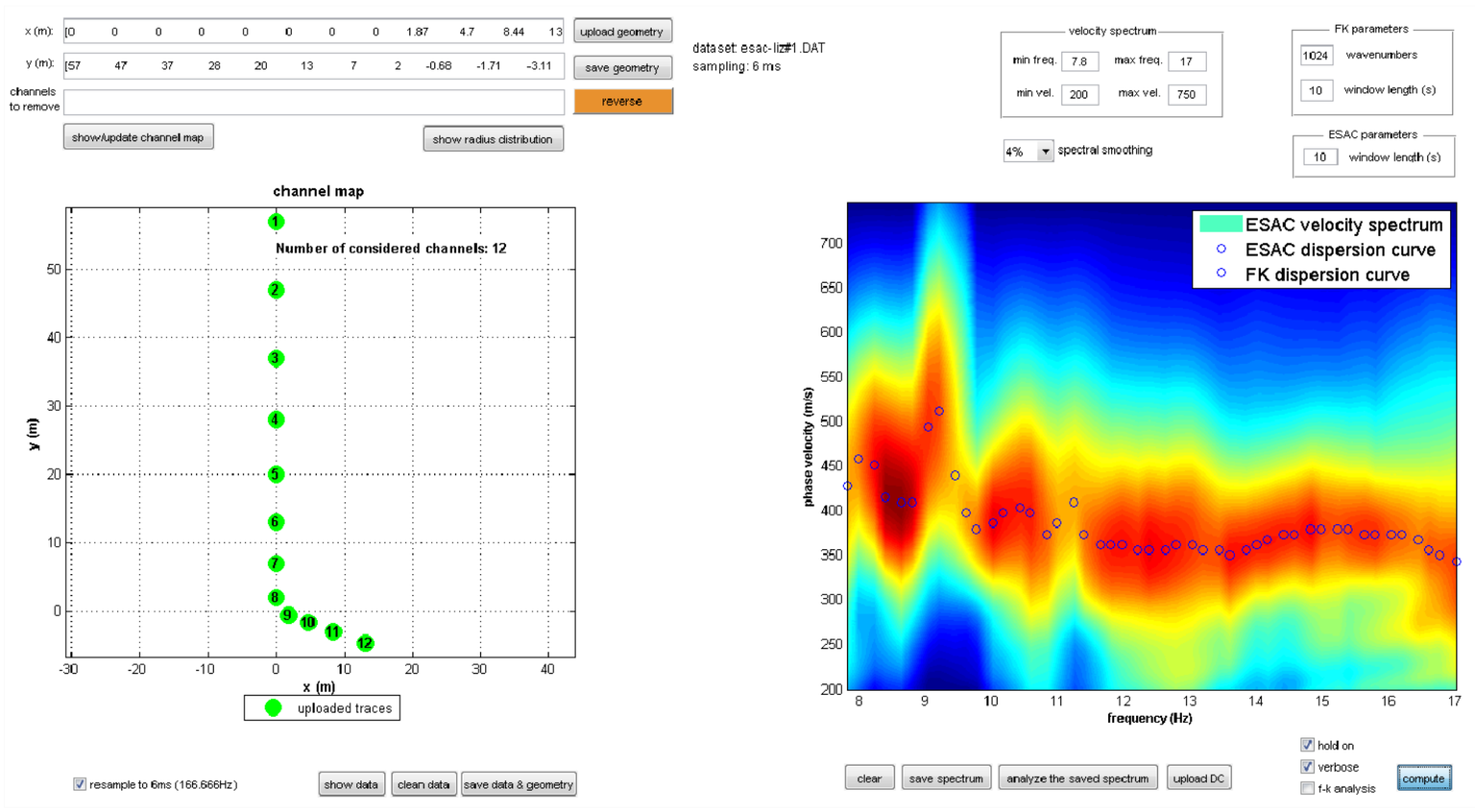
1 **ESAC** 12 Stendimento di sismica passiva ESAC

ACQUISIZIONE ESAC



Stendimento ESAC

SPETTRO DI VELOCITA' ESAC E CURVA DI DISPERSIONE EFFETTIVA



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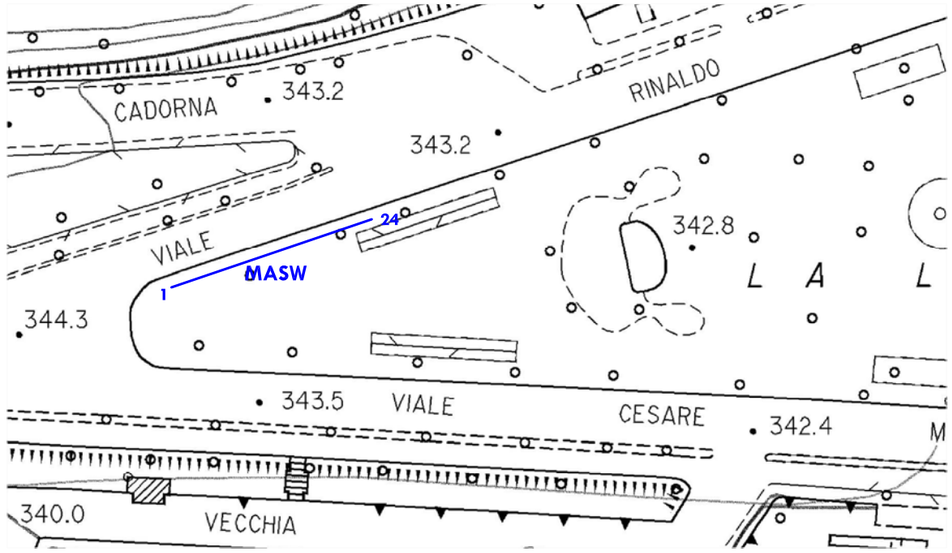
RISULTANZE DELL'ANALISI SISMICA CONGIUNTA MASW 2 - ESAC 2

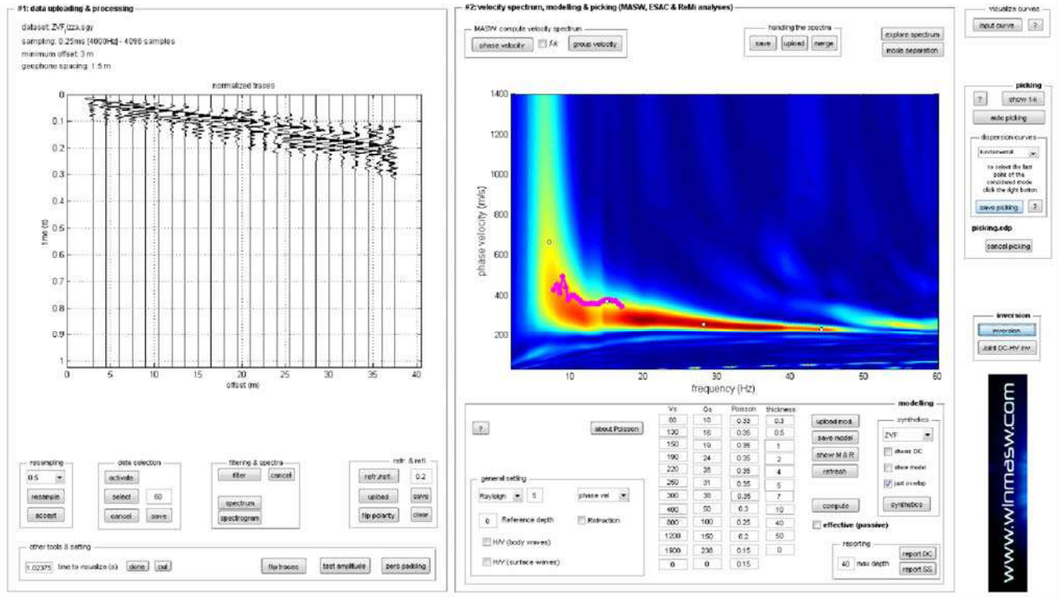
LA LIZZA



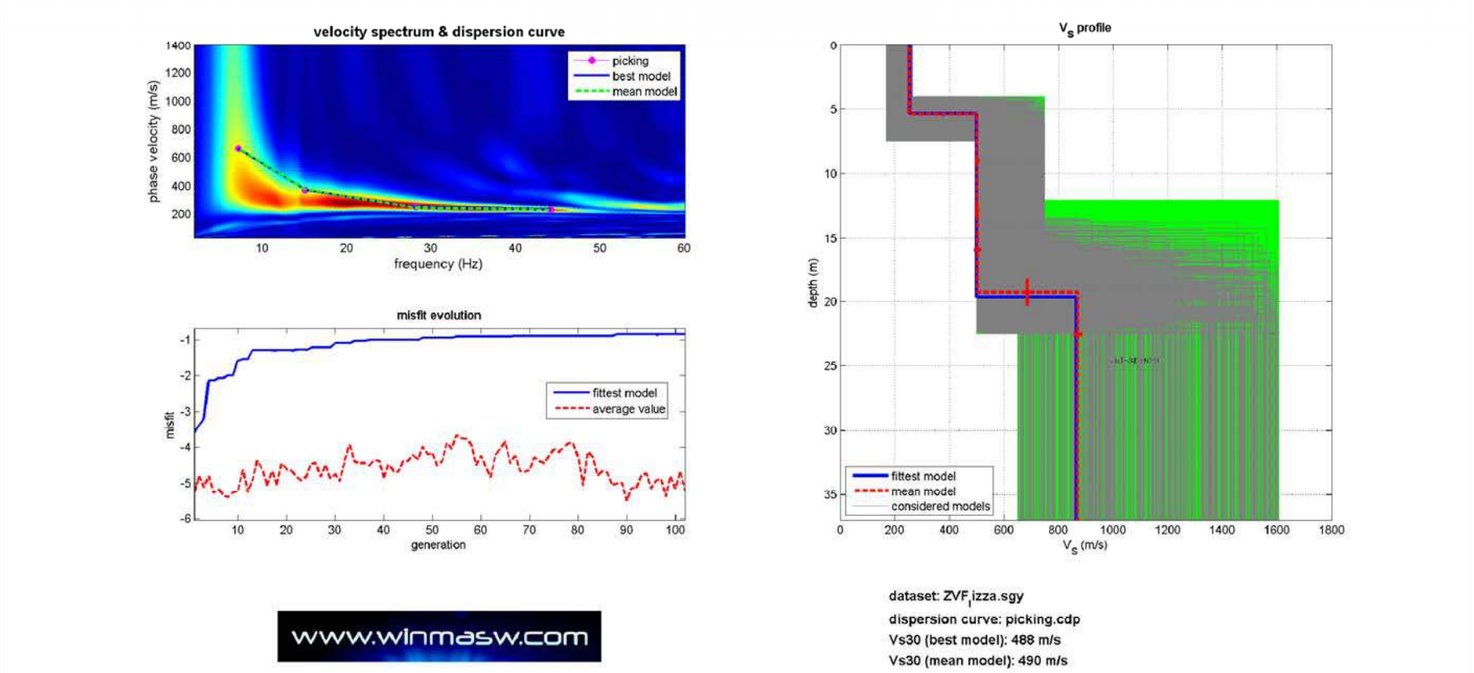
1 MASW 24 Stendimento di sismica attiva MASW

Stendimento MASW

SPETTRO DI VELOCITA' MASW + CURVA DI DISPERSIONE EFFETTIVA ESAC



INVERSIONE CONGIUNTA MASW - ESAC E PROFILO DI VELOCITA'



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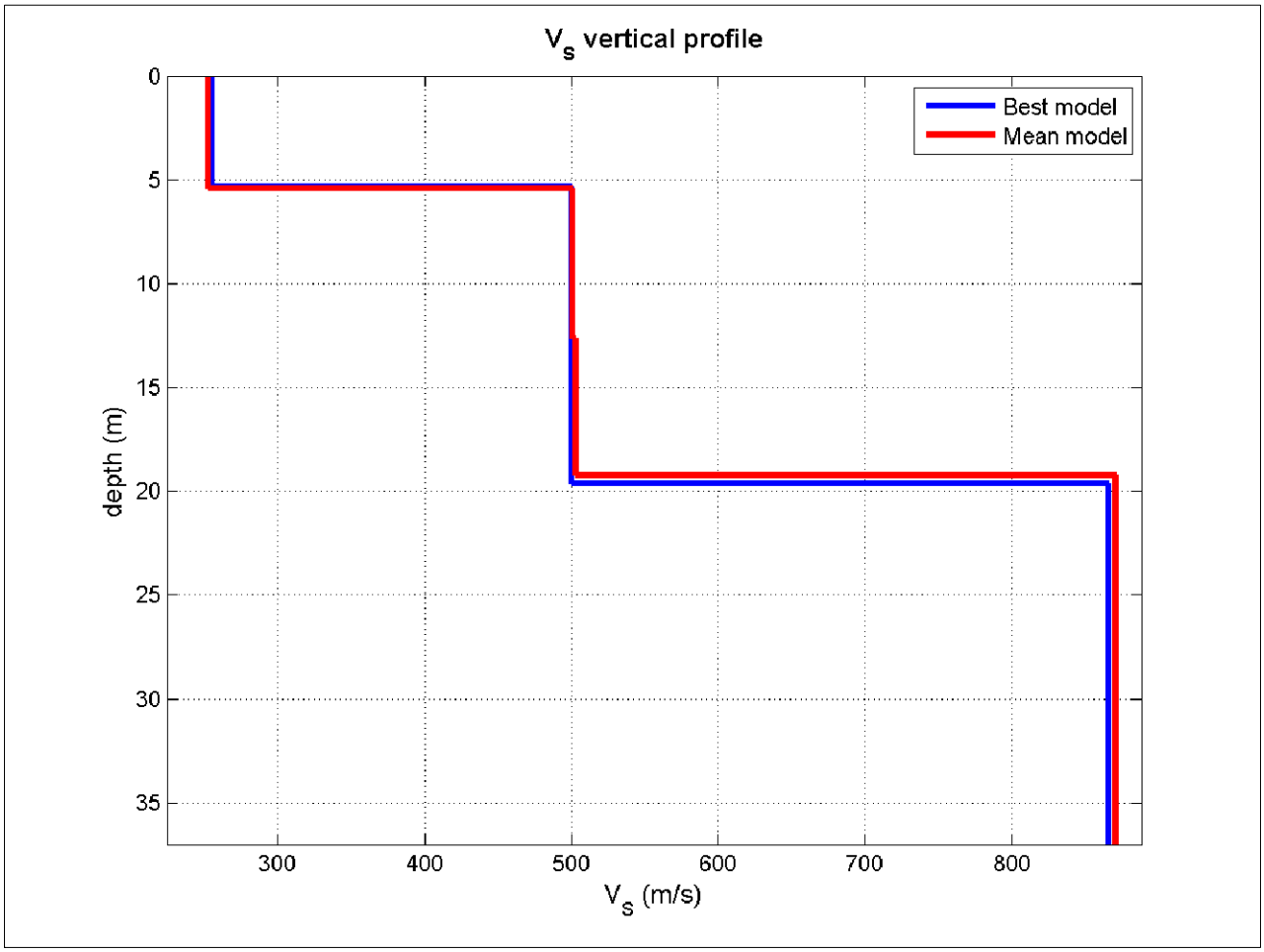
RISULTANZE DELL'ANALISI SISMICA CONGIUNTA MASW 2 - ESAC 2

PROFILO DI VELOCITA' MASW 2 - ESAC 2



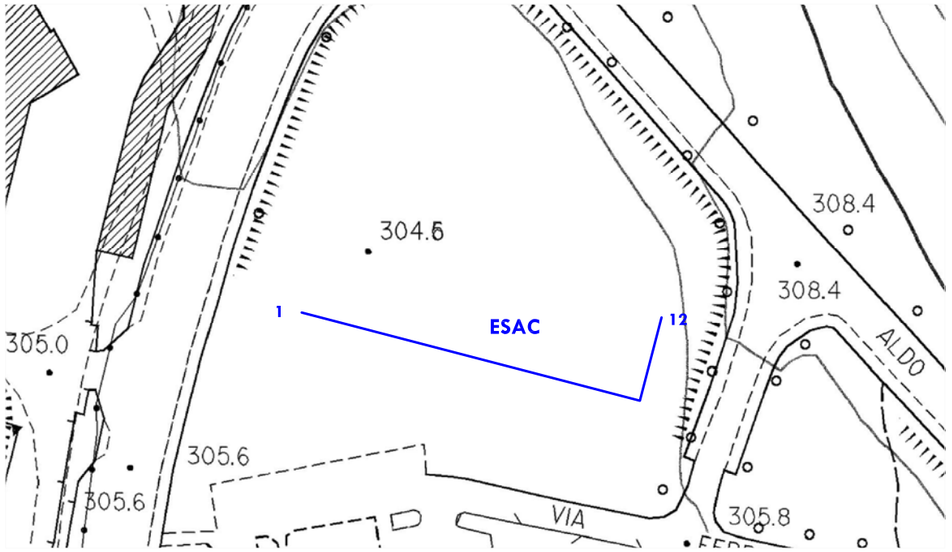
Mean model
Vs (m/s): 253, 501, 503, 871
Thickness (m): 5.4, 7.2, 6.6, 20.8

Density (gr/cm3) (approximate values): 1.85 2.04 2.06 2.20
Seismic/Dynamic Shear modulus (MPa) (approximate values): 119 512 520 1668

Approximate values for Vp and Poisson
Vp (m/s): 437 939 1012 1816
Poisson: 0.25 0.30 0.34 0.35

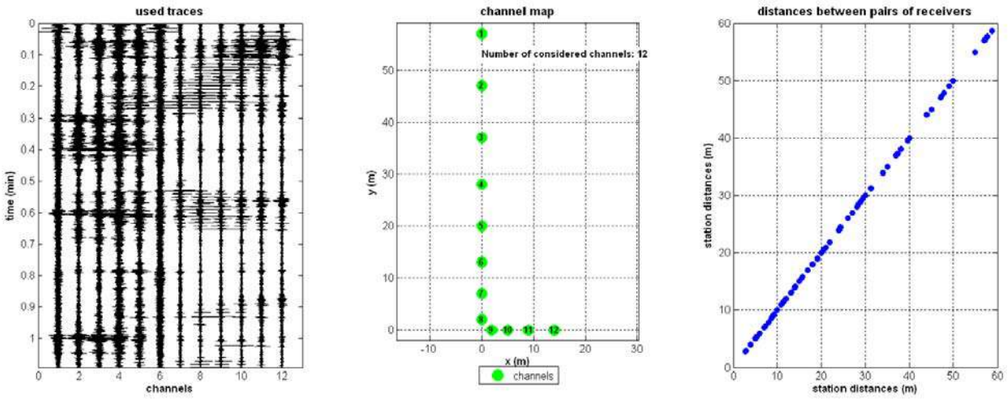
Vs30 (m/s): 490

SAN MINIATO



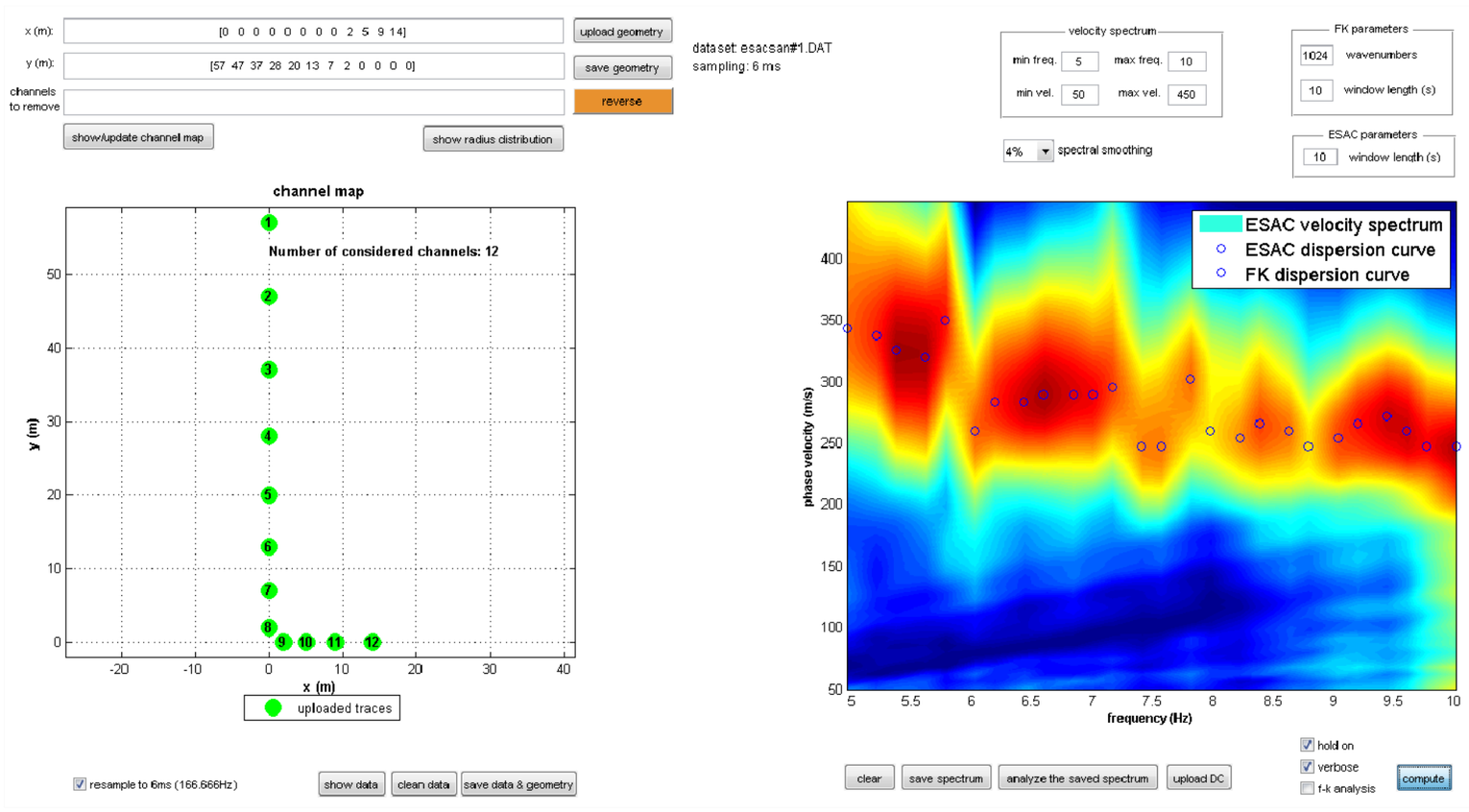
1 ESAC 12 Stendimento di sismica passiva ESAC

ACQUISIZIONE ESAC



Stendimento ESAC

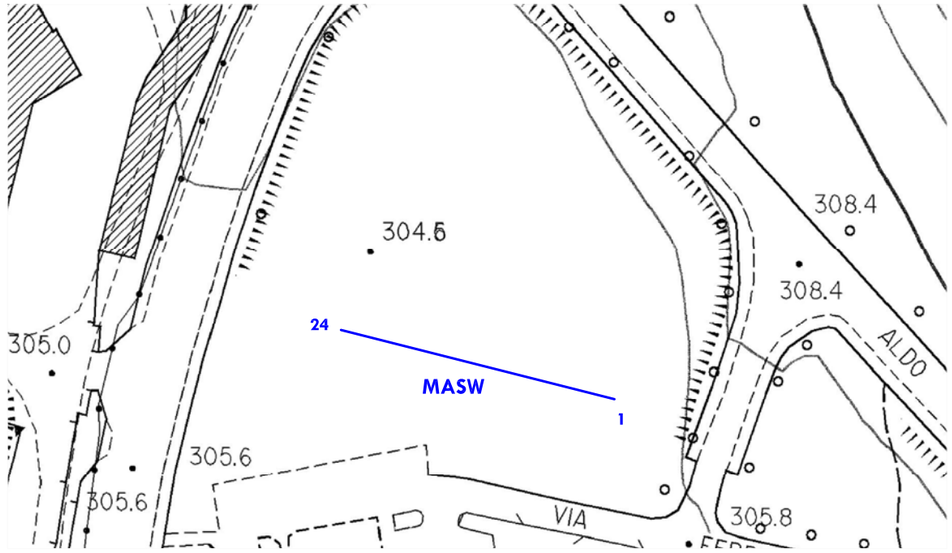
SPETTRO DI VELOCITA' ESAC E CURVA DI DISPERSIONE EFFETTIVA



GEOLOGICA TOSCANA
Prospezioni Geofisiche s.n.c.

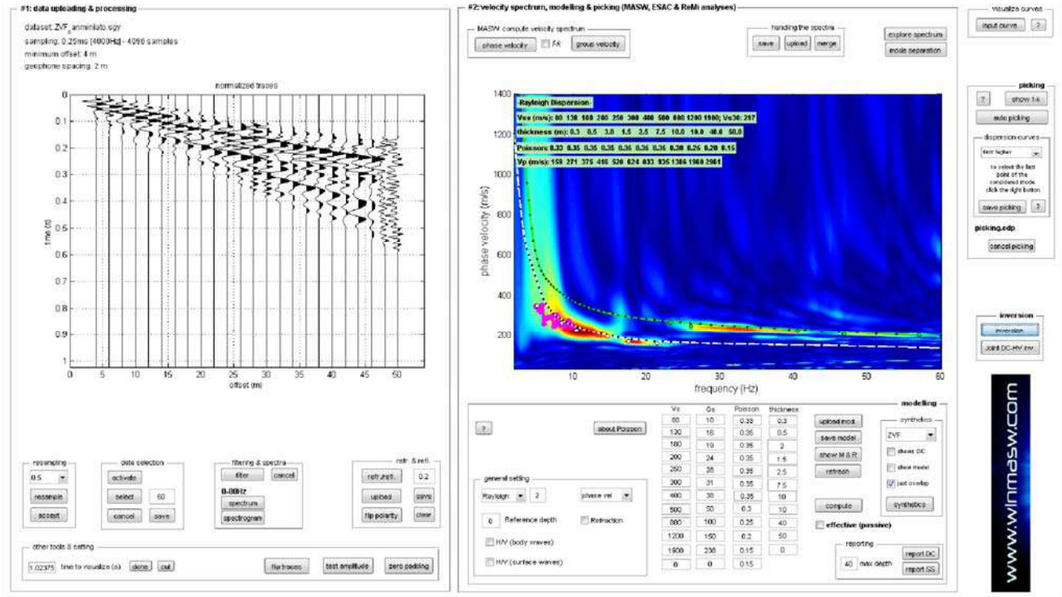
RISULTANZE DELL'ANALISI SISMICA CONGIUNTA MASW 3 - ESAC 3

SAN MINIATO

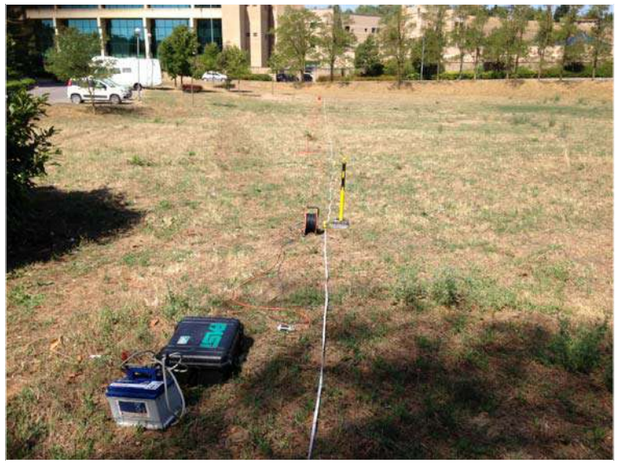


1 MASW 24 Stendimento di sismica attiva MASW

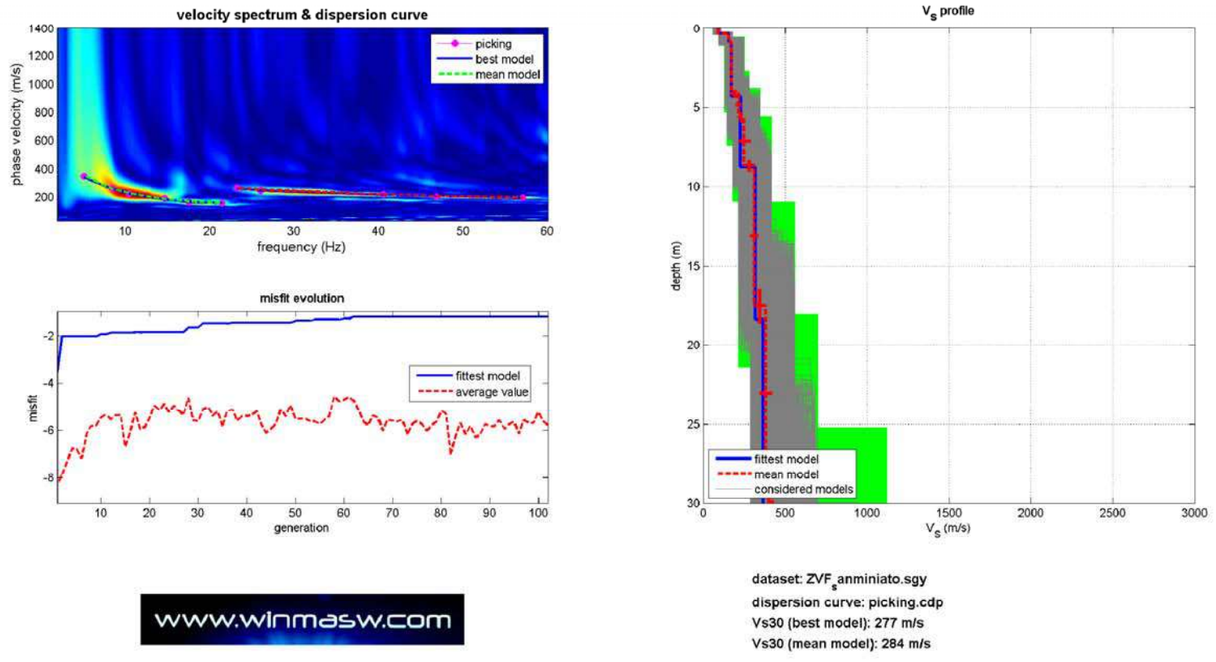
SPETTRO DI VELOCITA' MASW + CURVA DI DISPERSIONE EFFETTIVA ESAC



Stendimento MASW



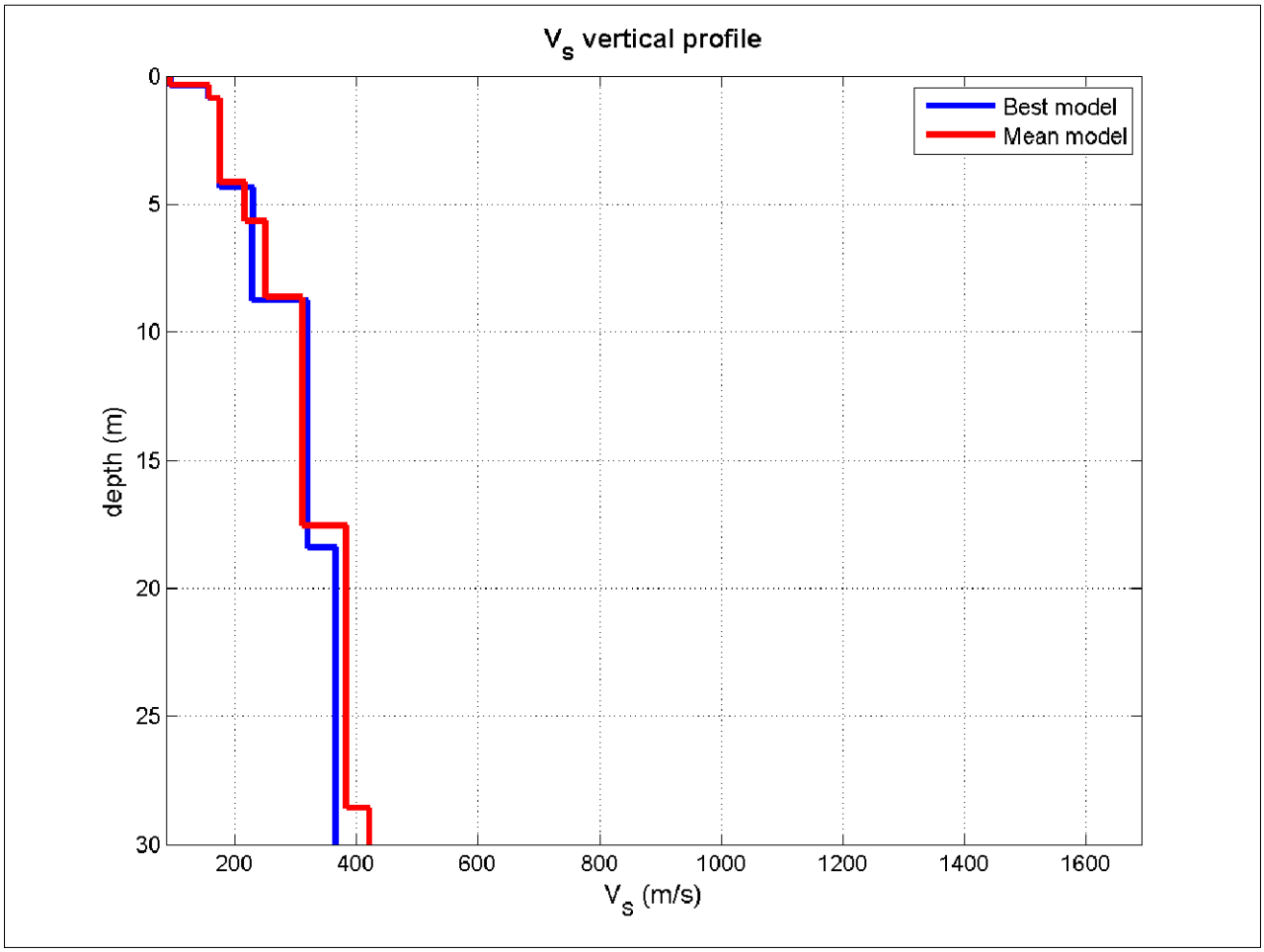
INVERSIONE CONGIUNTA MASW - ESAC E PROFILO DI VELOCITA'



GEOLOGICA TOSCANA
Prospezioni Geofisiche s.n.c.

RISULTANZE DELL'ANALISI SISMICA CONGIUNTA MASW 3 - ESAC 3

PROFILO DI VELOCITA' MASW 3 - ESAC 3



Mean model
Vs (m/s): 92, 157, 175, 216, 251, 312, 383, 422
Thickness (m): 0.4, 0.5, 3.3, 1.5, 3.0, 8.9, 11.0, 17.0

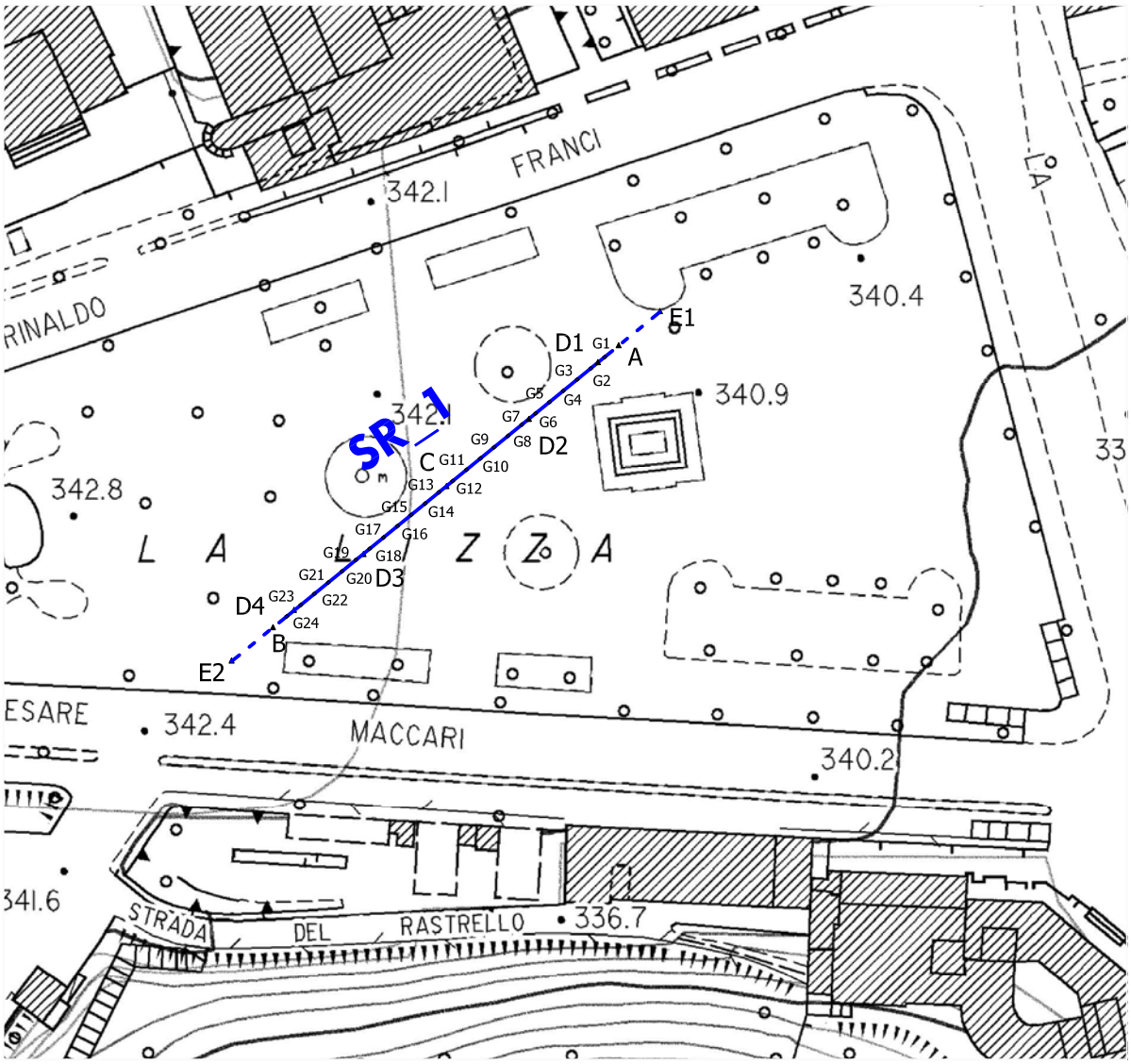
Density (gr/cm3) (approximate values): 1.63 1.75 1.77 1.86 1.91 1.94 2.07 1.98
Seismic/Dynamic Shear modulus (MPa) (approximate values): 14 43 54 87 120 188 304 353

Approximate values for Vp and Poisson
Vp (m/s): 172 288 313 440 546 614 1084 739
Poisson: 0.30 0.29 0.27 0.34 0.37 0.33 0.43 0.26

Vs30 (m/s): 284

ALLEGATO 2

REPORT DEGLI STENDIMENTI DI SISMICA A RIFRAZIONE



Scala 1:1.000

PROSPEZIONE SISMICA A RIFRAZIONE (SR_1) CON ONDE P E SH

▫ G1	POSIZIONE GEOFONO
E ▲	TIRI ESTERNI
A e B ▲	TIRI ESTREMI
C ▲	TIRO CENTRALE
D1-D2 ▲	TIRI INTERMEDI SINISTRI
D3-D4 ▲	TIRI INTERMEDI DESTRI

SR_1 — LINEA SISMICA SR_1

N
W E
S

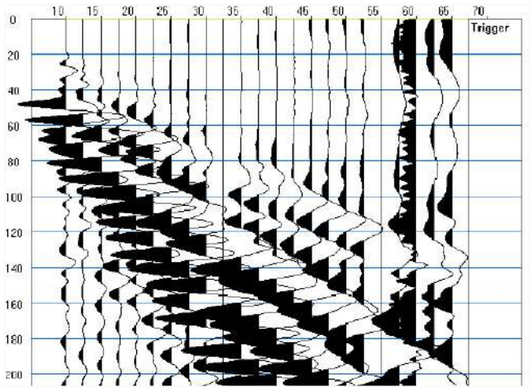
Linea sismica a rifrazione SR_1																								
Geofoni	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Distanza Progressiva (m)	10	12.5	15	17.5	20	22.5	25	27.5	30	32.5	35	37.5	40	42.5	45	47.5	50	52.5	55	57.5	60	62.5	65	67.5
Distanza Parziale (m)	0	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
Quota (m slm)	342.1	342.12	342.13	342.15	342.16	342.18	342.19	342.21	342.22	342.24	342.25	342.27	342.28	342.3	342.31	342.33	342.34	342.36	342.37	342.39	342.4	342.42	342.43	342.45

Linea sismica SR_1		
	Coordinate Gauss Boaga	
	Geofono N.1 (G1)	Geofono N.24 (G24)
X (m)	1688668	1688624
Y (m)	4799400	4799364

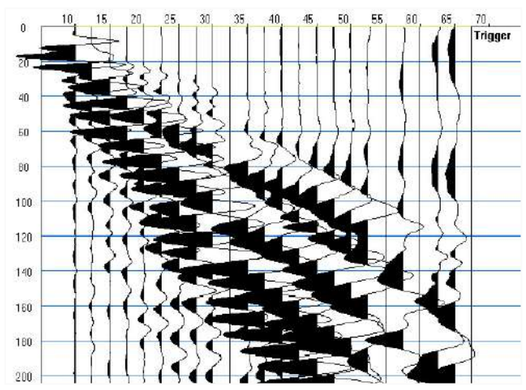
	Punti di energizzazione linea sismica SR_1								
	E1 Esterno Sx	A Estremo Sx	D1 Intermedio Sx	D2 Intermedio Sx	C Centrale	D3 Intermedio Dx	D4 Intermedio Dx	B Estremo Dx	E2 Esterno Dx
Onde P	lizza p1	lizza p2	lizza p3	lizza p4	lizza p5	lizza p6	lizza p7	lizza p8	lizza p9
Onde SH	sh1	sh2	sh3	sh4	sh5	sh6	sh7	sh8	sh9
Posiz. dal geof. N.1 (m)	0	7.5	11.25	23.75	38.75	53.75	66.25	70	77.5
Quota (m slm)	342,05	342,1	342,11	342,185	342,275	342,365	342,44	342,45	342,46

LINEA SISMICA SR_1
REGISTRAZIONI DI CAMPAGNA DELLE ONDE P

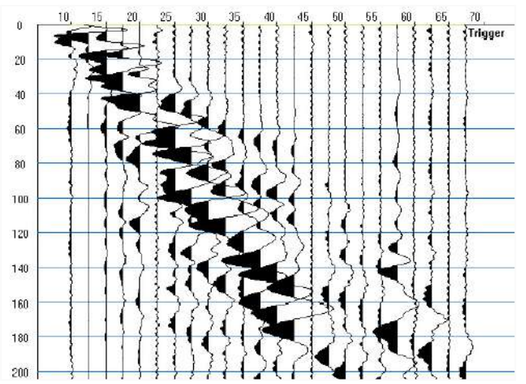
TIRO ESTERNO SINISTRO E1



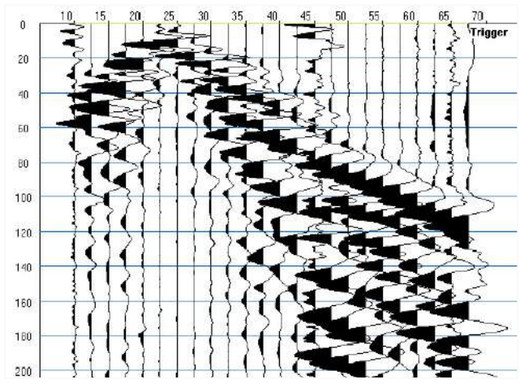
TIRO ESTREMO SINISTRO A



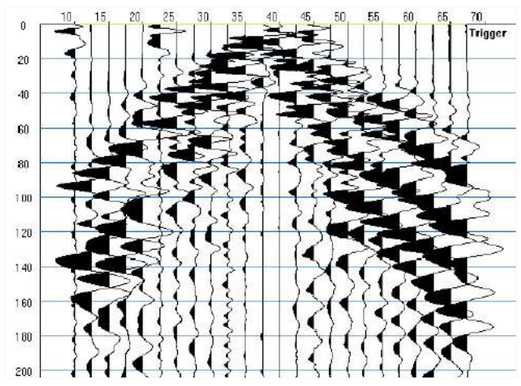
TIRO INTERMEDIO D1



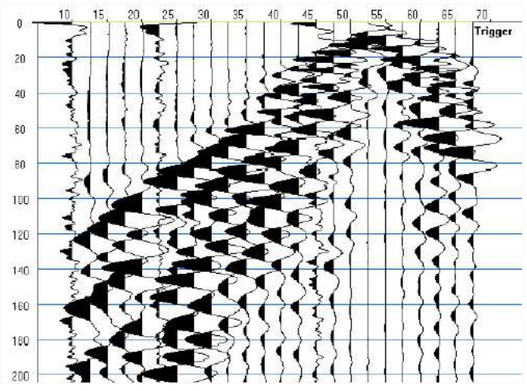
TIRO INTERMEDIO D2



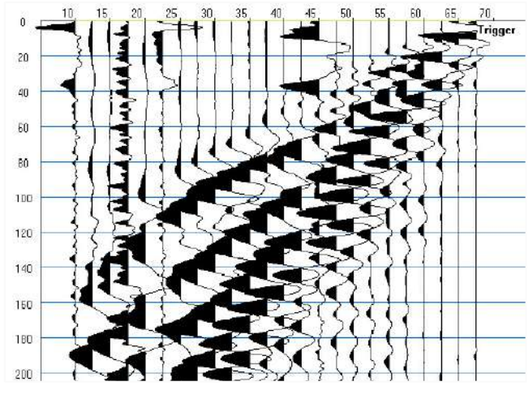
TIRO CENTRALE C



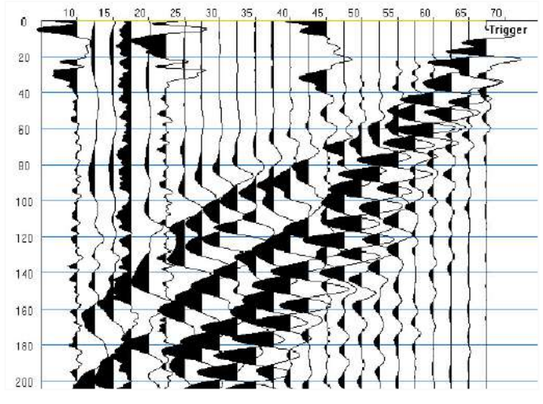
TIRO INTERMEDIO D3



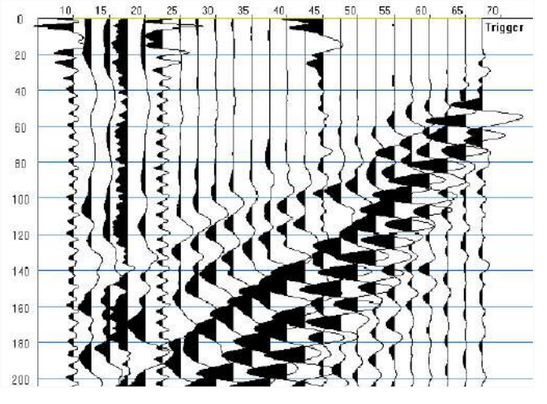
TIRO INTERMEDIO D4



TIRO ESTREMO DESTRO B

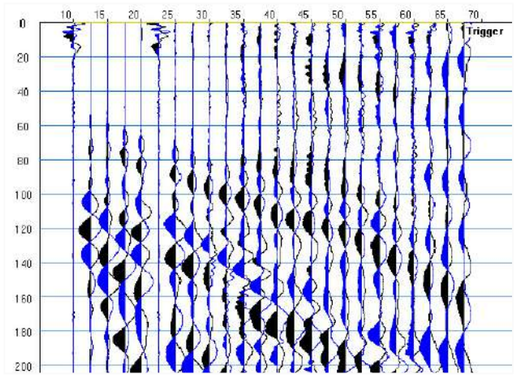


TIRO ESTERNO DESTRO E2

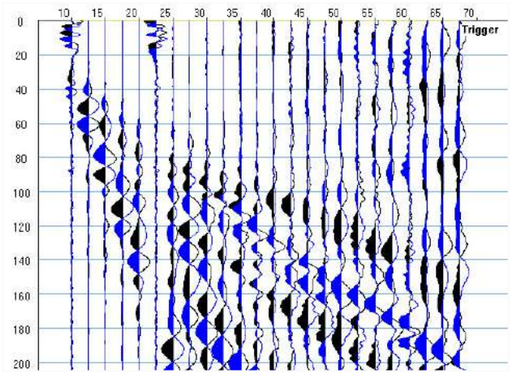


LINEA SISMICA SR_1
REGISTRAZIONI DI CAMPAGNA DELLE ONDE SH

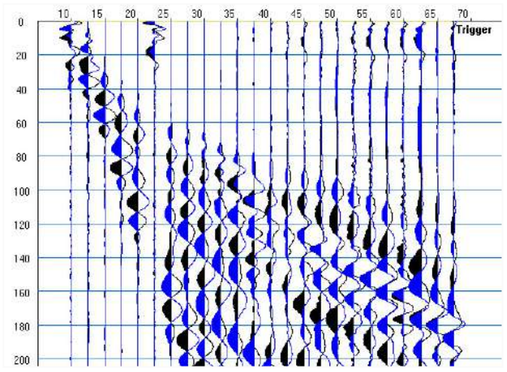
TIRO ESTERNO SINISTRO E1



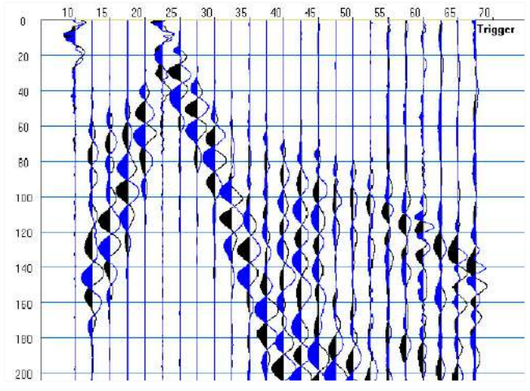
TIRO ESTREMO SINISTRO A



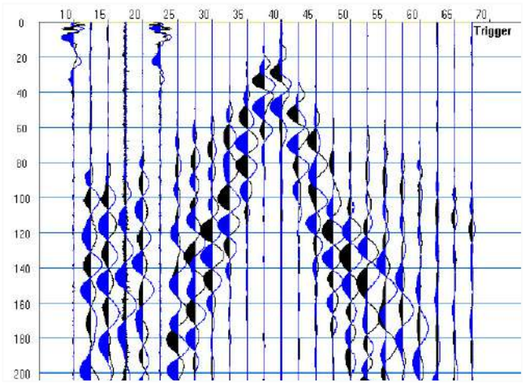
TIRO INTERMEDIO D1



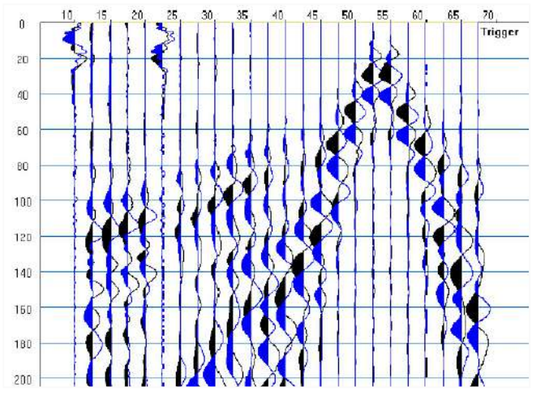
TIRO INTERMEDIO D2



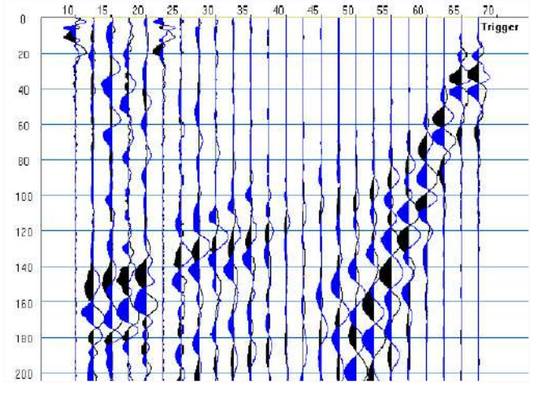
TIRO CENTRALE C



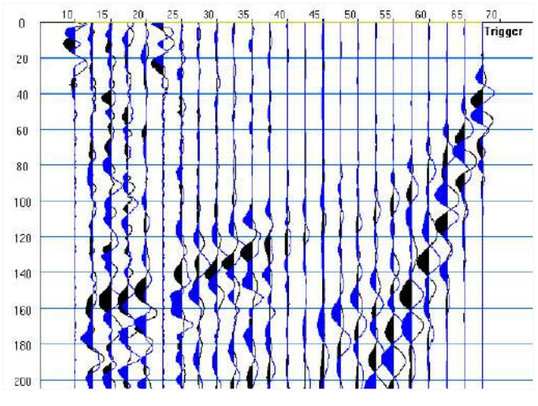
TIRO INTERMEDIO D3



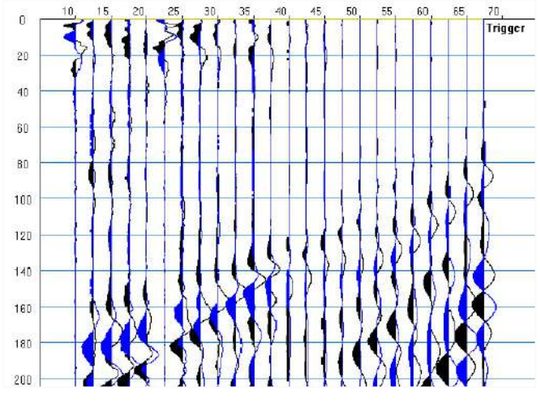
TIRO INTERMEDIO D4



TIRO ESTREMO DESTRO B



TIRO ESTERNO DESTRO E2



LINEA SISMICA SR_1
TEMPI DI PROPAGAZIONE DELLE ONDE P

SP	Elev	X-loc	Y-Loc	Depth
1	0.00	0.00	0.00	0.00
2	0.00	7.50	0.00	0.00
3	342.11	11.25	0.00	0.00
4	342.18	23.75	0.00	0.00
5	342.27	38.75	0.00	0.00
6	342.36	53.75	0.00	0.00
7	342.44	66.25	0.00	0.00
8	0.00	70.00	0.00	0.00
9	0.00	77.50	0.00	0.00

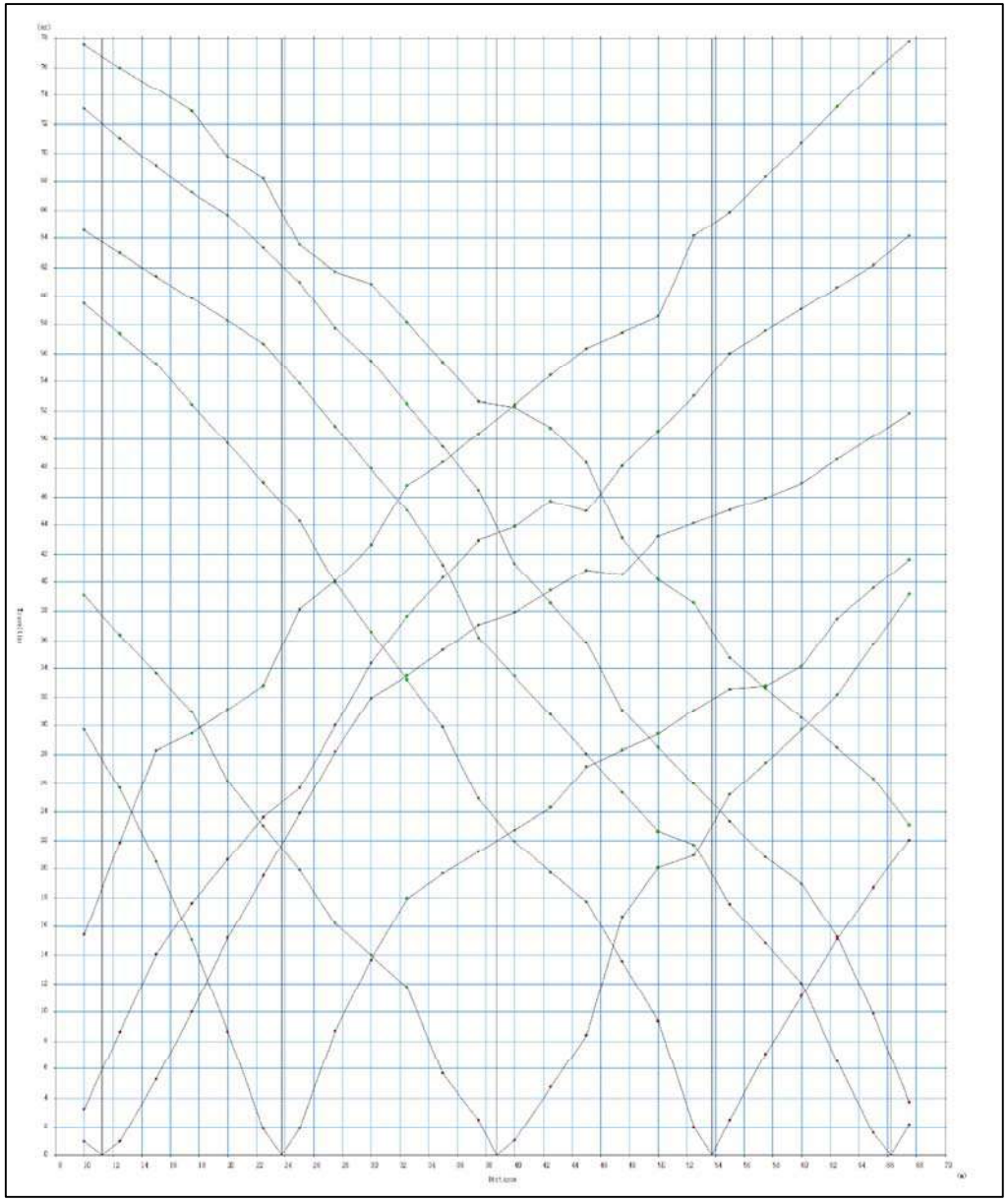
Geo	Elev	X-loc	Y-Loc	SP 1	SP 2	SP 3	SP 4	SP 5	SP 6	SP 7	SP 8	SP 9
1	342.10	10.00	0.00	0.00 1	0.00 1	2.17 1	25.31 1	38.94 1	51.73 1	56.87 1	0.00 1	0.00 1
2	342.11	12.50	0.00	0.00 1	0.00 1	2.17 1	21.94 1	37.00 1	50.63 1	55.77 1	0.00 1	0.00 1
3	342.13	15.00	0.00	0.00 1	0.00 1	6.63 1	18.31 1	34.39 1	50.06 1	55.21 1	0.00 1	0.00 1
4	342.14	17.50	0.00	0.00 1	0.00 1	11.23 1	13.95 1	31.26 1	49.59 1	54.84 1	0.00 1	0.00 1
5	342.16	20.00	0.00	0.00 1	0.00 1	16.21 1	8.94 1	27.41 1	45.90 1	53.33 1	0.00 1	0.00 1
6	342.17	22.50	0.00	0.00 1	0.00 1	21.16 1	3.39 1	23.62 1	42.19 1	49.62 1	0.00 1	0.00 1
7	342.19	25.00	0.00	0.00 1	0.00 1	25.37 1	3.39 1	20.60 1	39.66 1	47.10 1	0.00 1	0.00 1
8	342.20	27.50	0.00	0.00 1	0.00 1	28.57 1	8.92 1	18.10 1	37.22 1	45.19 1	0.00 1	0.00 1
9	342.22	30.00	0.00	0.00 1	0.00 1	31.56 1	13.94 1	15.61 1	34.75 1	43.07 1	0.00 1	0.00 1
10	342.23	32.50	0.00	0.00 1	0.00 1	33.91 1	17.16 1	11.41 1	31.85 1	40.31 1	0.00 1	0.00 1
11	342.25	35.00	0.00	0.00 1	0.00 1	35.85 1	19.10 1	6.91 1	28.62 1	37.74 1	0.00 1	0.00 1
12	342.27	37.50	0.00	0.00 1	0.00 1	37.37 1	21.02 1	2.57 1	25.12 1	35.47 1	0.00 1	0.00 1
13	342.28	40.00	0.00	0.00 1	0.00 1	38.67 1	23.30 1	2.57 1	21.89 1	33.33 1	0.00 1	0.00 1
14	342.30	42.50	0.00	0.00 1	0.00 1	40.54 1	26.04 1	6.30 1	19.11 1	30.74 1	0.00 1	0.00 1
15	342.31	45.00	0.00	0.00 1	0.00 1	42.65 1	29.31 1	9.99 1	16.13 1	28.18 1	0.00 1	0.00 1
16	342.33	47.50	0.00	0.00 1	0.00 1	45.37 1	32.72 1	14.24 1	12.73 1	25.90 1	0.00 1	0.00 1
17	342.34	50.00	0.00	0.00 1	0.00 1	48.31 1	35.88 1	18.45 1	8.20 1	23.68 1	0.00 1	0.00 1
18	342.36	52.50	0.00	0.00 1	0.00 1	50.89 1	39.11 1	21.91 1	2.84 1	20.91 1	0.00 1	0.00 1
19	342.37	55.00	0.00	0.00 1	0.00 1	50.74 1	41.09 1	25.23 1	2.84 1	17.66 1	0.00 1	0.00 1
20	342.39	57.50	0.00	0.00 1	0.00 1	51.16 1	41.61 1	27.02 1	7.23 1	14.49 1	0.00 1	0.00 1
21	342.40	60.00	0.00	0.00 1	0.00 1	52.17 1	42.71 1	28.62 1	10.87 1	11.02 1	0.00 1	0.00 1
22	342.42	62.50	0.00	0.00 1	0.00 1	53.68 1	44.46 1	30.74 1	14.46 1	7.17 1	0.00 1	0.00 1
23	342.43	65.00	0.00	0.00 1	0.00 1	55.35 1	46.80 1	33.29 1	17.80 1	2.47 1	0.00 1	0.00 1
24	342.45	67.50	0.00	0.00 1	0.00 1	56.68 1	49.12 1	35.62 1	21.05 1	2.47 1	0.00 1	0.00 1

LINEA SISMICA SR_1
TEMPI DI PROPAGAZIONE DELLE ONDE SH

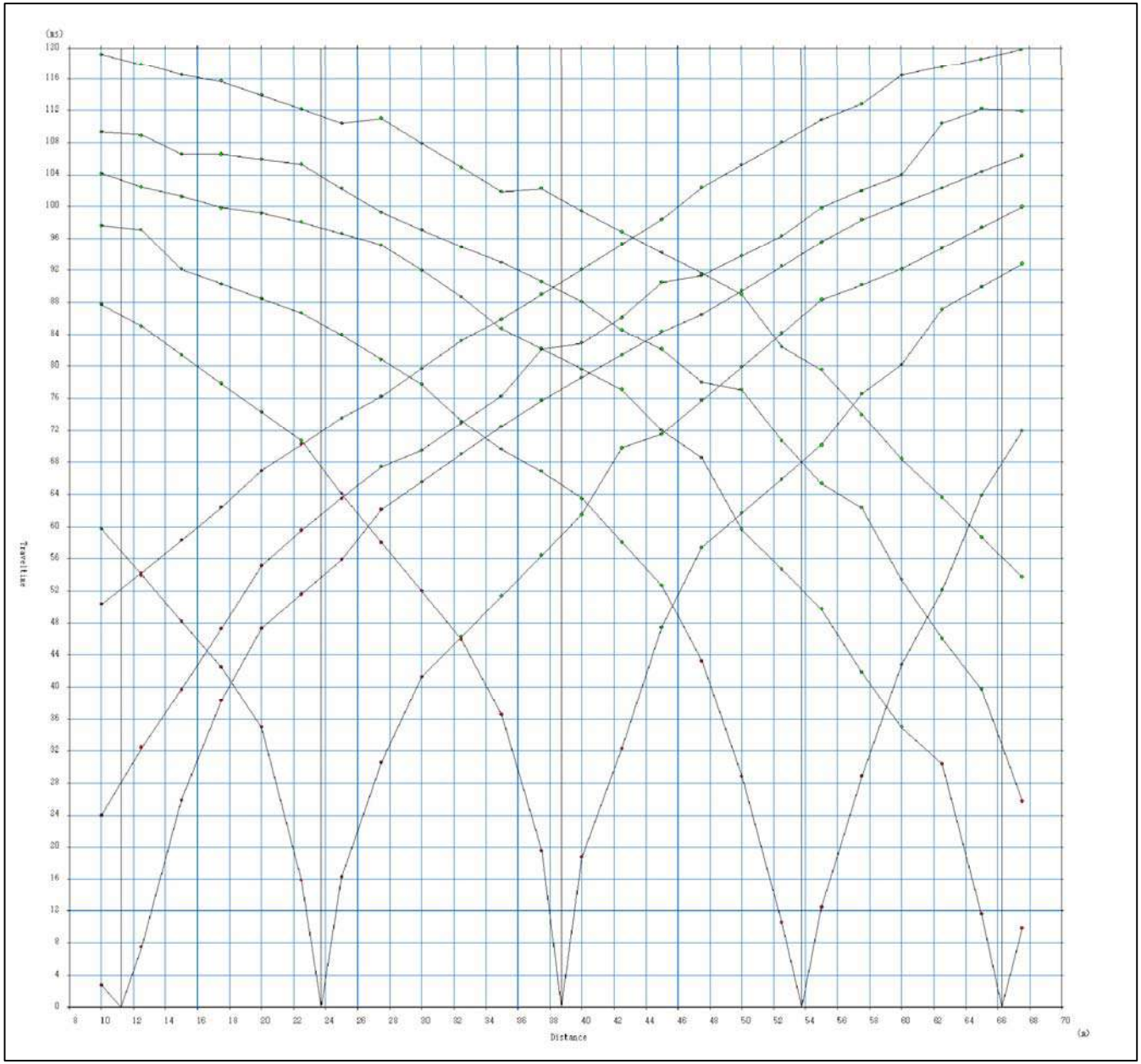
SP	Elev	X-loc	Y-Loc	Depth
1	0.00	0.00	0.00	0.00
2	0.00	7.50	0.00	0.00
3	342.11	11.25	0.00	0.00
4	342.18	23.75	0.00	0.00
5	342.27	38.75	0.00	0.00
6	342.36	53.75	0.00	0.00
7	342.44	66.25	0.00	0.00
8	0.00	70.00	0.00	0.00
9	0.00	77.50	0.00	0.00

Geo	Elev	X-loc	Y-Loc	SP 1	SP 2	SP 3	SP 4	SP 5	SP 6	SP 7	SP 8	SP 9
1	342.10	10.00	0.00	0.00 1	0.00 1	7.73 1	58.16 1	82.43 1	96.74 1	108.22	10.00 1	0.00 1
2	342.11	12.50	0.00	0.00 1	0.00 1	7.73 1	53.56 1	79.94 1	94.34 1	105.82	10.00 1	0.00 1
3	342.13	15.00	0.00	0.00 1	0.00 1	24.76 1	48.87 1	77.81 1	92.48 1	103.97	10.00 1	0.00 1
4	342.14	17.50	0.00	0.00 1	0.00 1	38.55 1	42.15 1	75.35 1	90.95 1	102.45	10.00 1	0.00 1
5	342.16	20.00	0.00	0.00 1	0.00 1	47.48 1	32.72 1	71.80 1	89.51 1	101.03	10.00 1	0.00 1
6	342.17	22.50	0.00	0.00 1	0.00 1	53.38 1	12.15 1	67.18 1	87.37 1	98.96 1	0.00 1	0.00 1
7	342.19	25.00	0.00	0.00 1	0.00 1	57.59 1	12.15 1	62.15 1	83.95 1	96.02 1	0.00 1	0.00 1
8	342.20	27.50	0.00	0.00 1	0.00 1	61.92 1	31.11 1	57.28 1	80.43 1	93.20 1	0.00 1	0.00 1
9	342.22	30.00	0.00	0.00 1	0.00 1	65.85 1	41.79 1	51.49 1	77.21 1	90.60 1	0.00 1	0.00 1
10	342.23	32.50	0.00	0.00 1	0.00 1	69.65 1	48.79 1	43.58 1	74.27 1	88.20 1	0.00 1	0.00 1
11	342.25	35.00	0.00	0.00 1	0.00 1	73.71 1	55.01 1	31.87 1	71.36 1	86.38 1	0.00 1	0.00 1
12	342.27	37.50	0.00	0.00 1	0.00 1	78.51 1	61.34 1	11.78 1	69.01 1	85.35 1	0.00 1	0.00 1
13	342.28	40.00	0.00	0.00 1	0.00 1	81.65 1	67.17 1	11.78 1	64.17 1	83.36 1	0.00 1	0.00 1
14	342.30	42.50	0.00	0.00 1	0.00 1	83.52 1	71.78 1	31.06 1	57.91 1	78.93 1	0.00 1	0.00 1
15	342.31	45.00	0.00	0.00 1	0.00 1	85.49 1	74.44 1	45.64 1	51.60 1	74.61 1	0.00 1	0.00 1
16	342.33	47.50	0.00	0.00 1	0.00 1	87.72 1	77.30 1	54.18 1	42.13 1	70.51 1	0.00 1	0.00 1
17	342.34	50.00	0.00	0.00 1	0.00 1	90.39 1	80.59 1	59.61 1	28.03 1	65.86 1	0.00 1	0.00 1
18	342.36	52.50	0.00	0.00 1	0.00 1	93.47 1	84.11 1	64.70 1	10.72 1	61.63 1	0.00 1	0.00 1
19	342.37	55.00	0.00	0.00 1	0.00 1	96.64 1	87.41 1	69.93 1	10.72 1	55.11 1	0.00 1	0.00 1
20	342.39	57.50	0.00	0.00 1	0.00 1	99.32 1	90.09 1	74.32 1	28.18 1	46.69 1	0.00 1	0.00 1
21	342.40	60.00	0.00	0.00 1	0.00 1	101.14	192.01 1	78.13 1	41.56 1	39.84 1	0.00 1	0.00 1
22	342.42	62.50	0.00	0.00 1	0.00 1	103.41	194.36 1	81.50 1	49.82 1	30.19 1	0.00 1	0.00 1
23	342.43	65.00	0.00	0.00 1	0.00 1	105.82	196.77 1	84.08 1	56.86 1	11.15 1	0.00 1	0.00 1
24	342.45	67.50	0.00	0.00 1	0.00 1	108.15	199.09 1	86.44 1	62.30 1	11.15 1	0.00 1	0.00 1

LINEA SISMICA SR_1
DROMOCRONE DELLE ONDE P



LINEA SISMICA SR_1
DROMOCRONE DELLE ONDE SH



LINEA SISMICA SR_1
VELOCITA' SISMICHE DEI RIFRATTORI INDIVIDUATI

Onde P

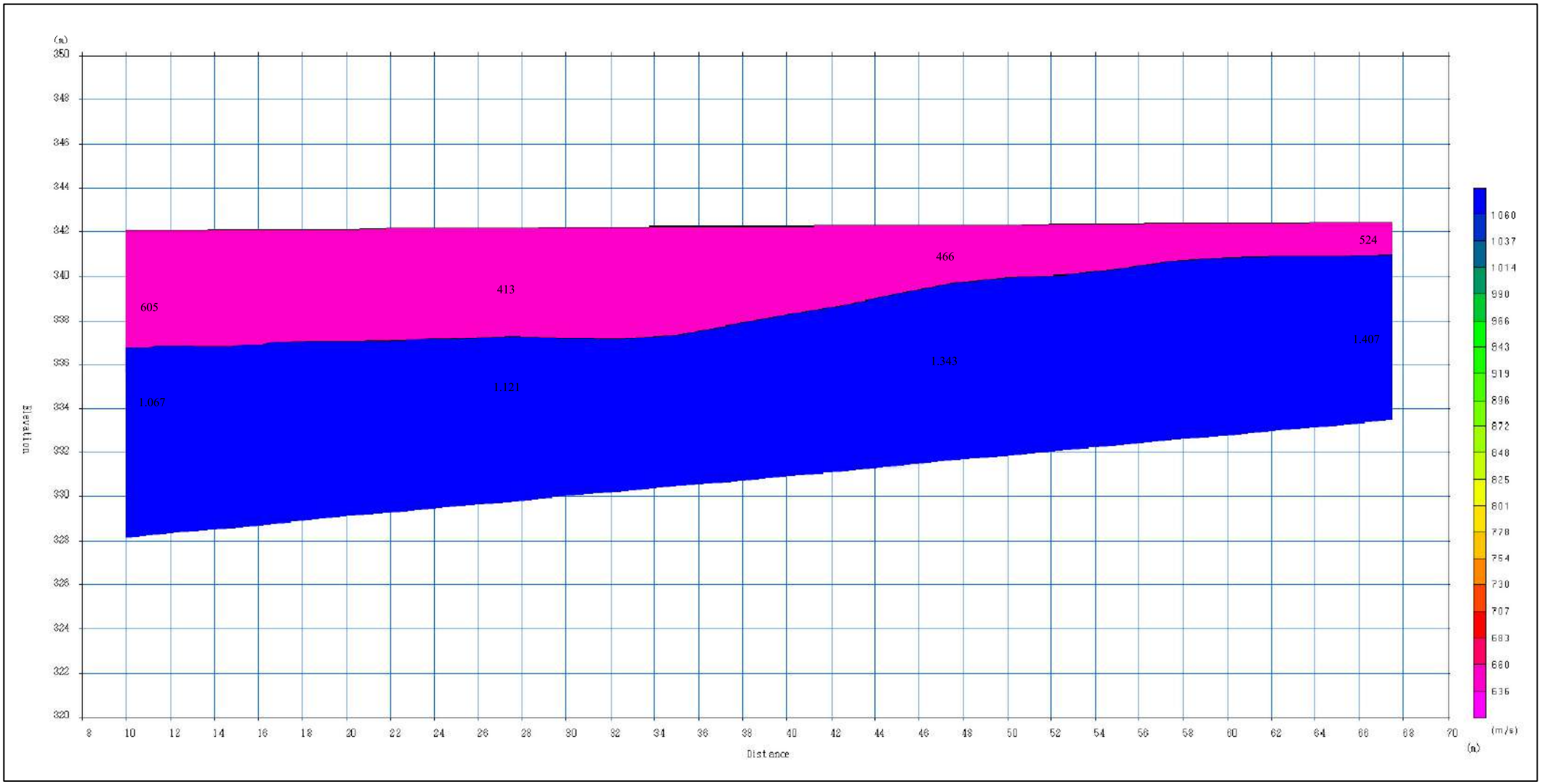
		Strato 1	Strato 2
Geofono	x (m)	Vs (m/sec)	Vs (m/sec)
1	10	637.10	1072.77
2	12.5	572.17	1061.03
3	15	485.62	1041.24
4	17.5	433.54	1028.43
5	20	434.88	1030.60
6	22.5	453.31	1047.07
7	25	436.34	1072.67
8	27.5	411.25	1099.36
9	30	414.76	1117.22
10	32.5	461.30	1125.19
11	35	549.50	1135.42
12	37.5	623.75	1150.34
13	40	633.46	1163.97
14	42.5	580.73	1178.14
15	45	510.49	1188.59
16	47.5	468.30	1221.03
17	50	463.09	1299.84
18	52.5	501.05	1385.46
19	55	573.50	1446.54
20	57.5	612.60	1466.76
21	60	592.64	1445.53
22	62.5	556.69	1418.66
23	65	532.14	1408.13
24	67.5	516.58	1406.55

Onde SH

		Strato 1	Strato 2
Geofono	x (m)	Vs (m/sec)	Vs (m/sec)
1	10	222.52	628.87
2	12.5	216.31	627.33
3	15	207.49	623.19
4	17.5	199.27	618.37
5	20	195.76	612.83
6	22.5	197.93	607.18
7	25	200.27	601.85
8	27.5	201.89	649.76
9	30	203.36	642.90
10	32.5	199.46	638.28
11	35	187.02	633.74
12	37.5	175.77	627.31
13	40	176.46	665.00
14	42.5	183.26	659.09
15	45	188.36	654.43
16	47.5	192.00	688.47
17	50	192.87	689.47
18	52.5	191.57	691.78
19	55	194.31	694.08
20	57.5	202.46	700.19
21	60	209.88	709.17
22	62.5	214.79	715.26
23	65	218.31	716.59
24	67.5	220.73	716.02

LINEA SISMICA SR_1
SEZIONE SISMOSTRATIGRAFICA: ONDE P

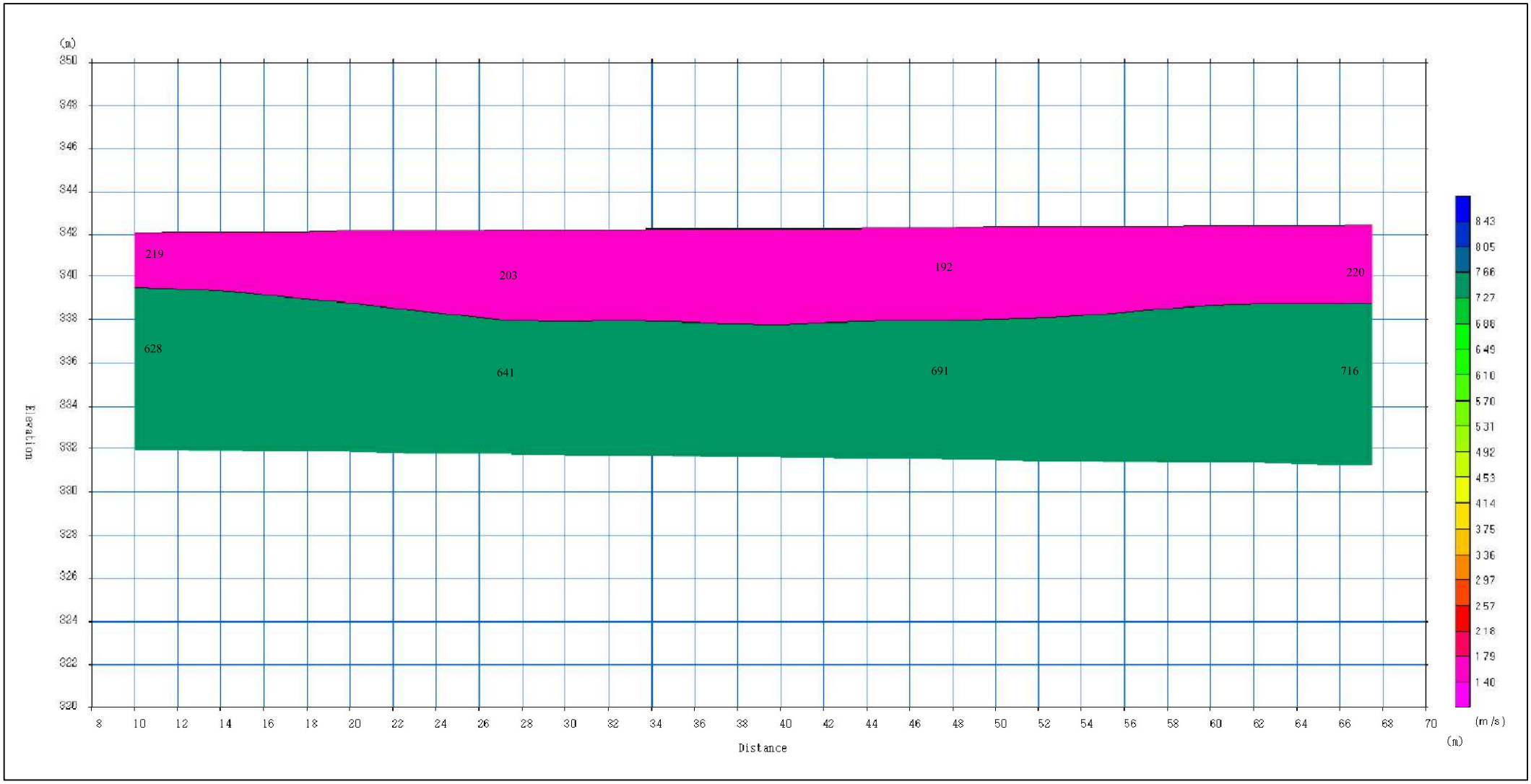
Geologica Toscana - PROSPEZIONI GEOFISICHE s.n.c.



321 VELOCITA' SISMICA DELLO STRATO IN m/sec

Scala 1:250

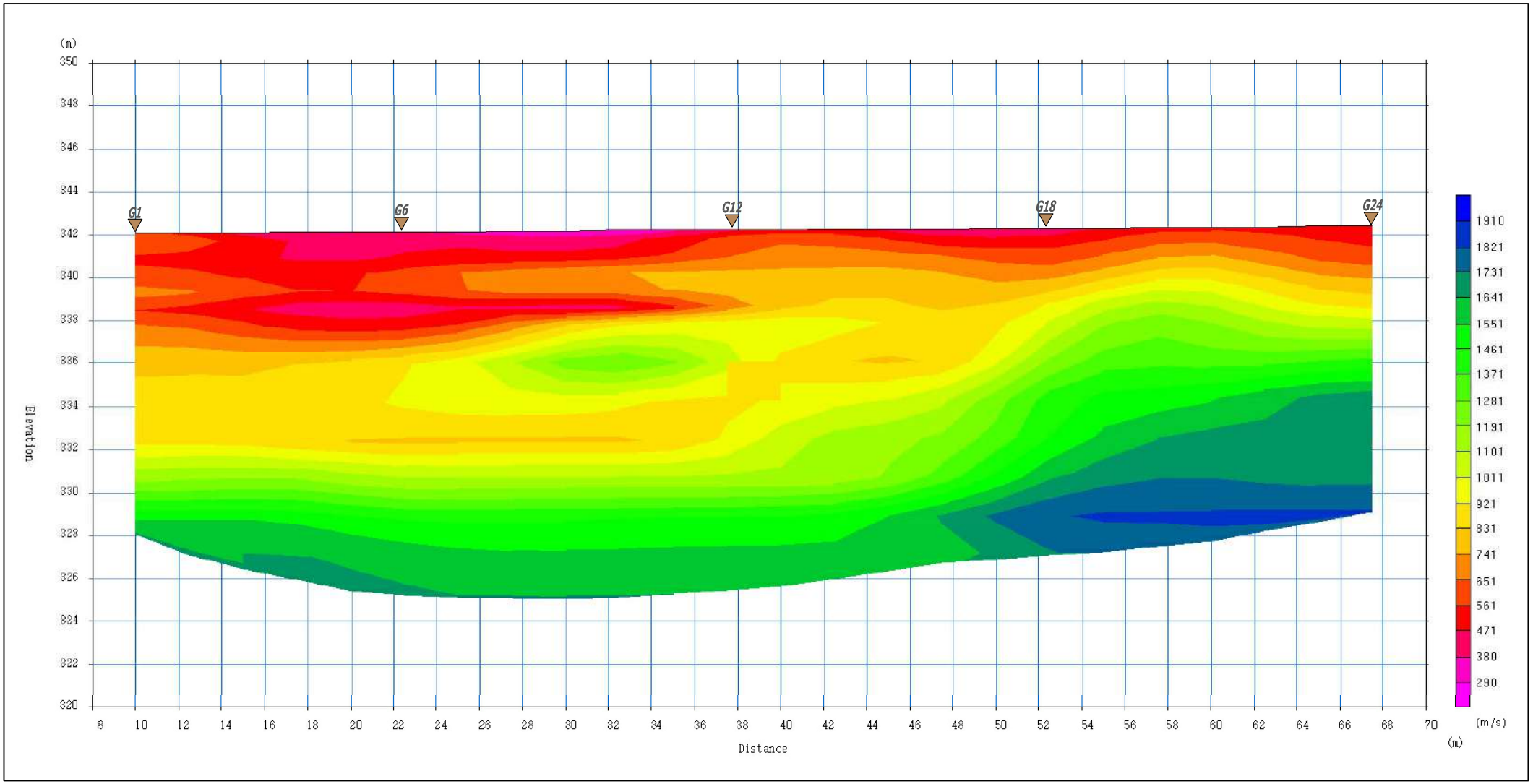
LINEA SISMICA SR_1
SEZIONE SISMOSTRATIGRAFICA: ONDE SH



Scala 1:250

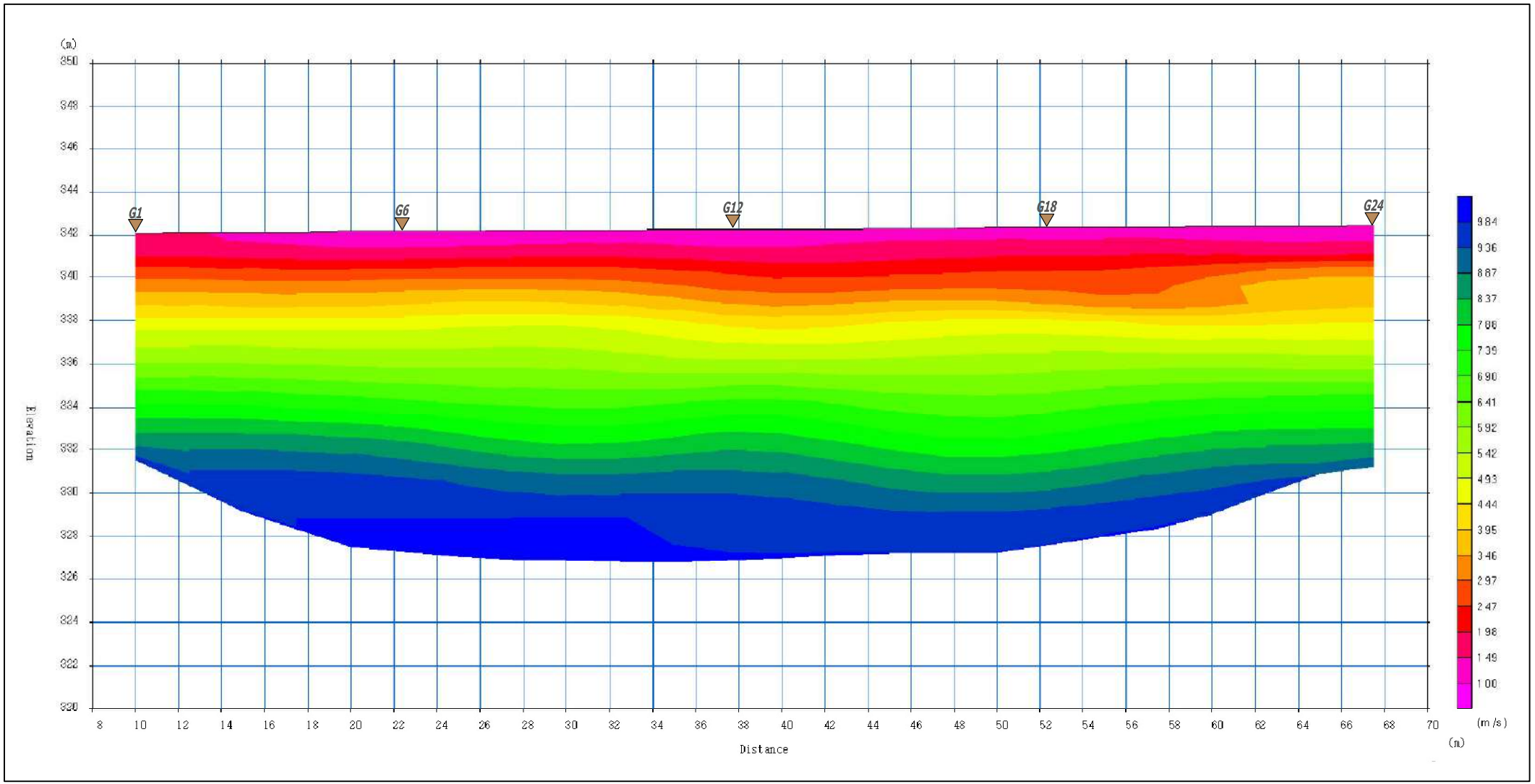
321 VELOCITA' SISMICA DELLO STRATO IN m/sec

LINEA SISMICA SR_1
SEZIONE TOMOGRAFICA ONDE P

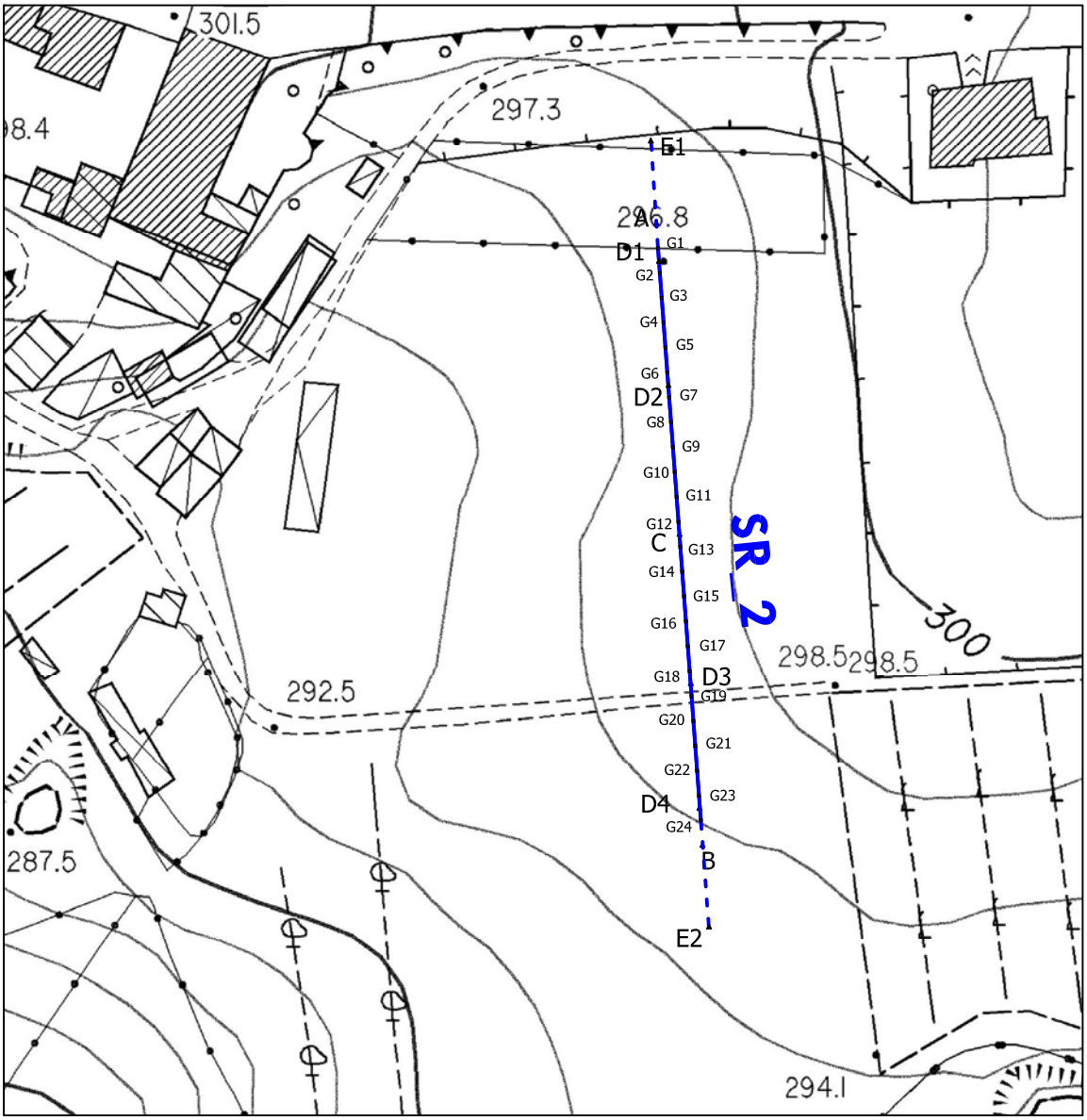


Scala 1:250

LINEA SISMICA SR_1
SEZIONE TOMOGRAFICA ONDE SH



Scala 1:250



Scala 1:1.000

PROSPEZIONE SISMICA A RIFRAZIONE (SR_2) CON ONDE P E SH

▫ G1	POSIZIONE GEOFONO
E ▲	TIRI ESTERNI
A e B ▲	TIRI ESTREMI
C ▲	TIRO CENTRALE
D1-D2 ▲	TIRI INTERMEDI SINISTRI
D3-D4 ▲	TIRI INTERMEDI DESTRI

SR_2 — LINEA SISMICA SR_2

N
W E
S

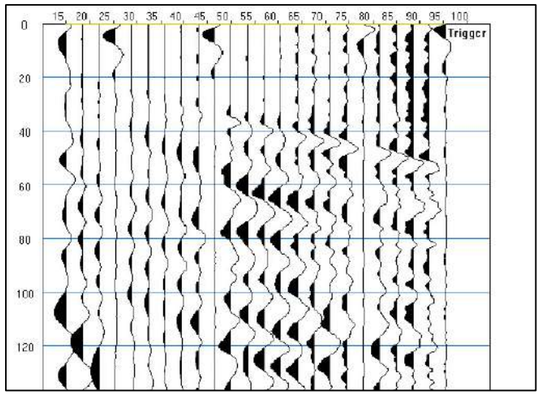
Linea sismica a rifrazione SR_2																								
Geofoni	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Distanza Progressiva (m)	15	18.5	22	25.5	29	32.5	36	39.5	43	46.5	50	53.5	57	60.5	64	67.5	71	74.5	78	81.5	85	88.5	92	95.5
Distanza Parziale (m)	0	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5
Quota (m slm)	297.5	297.45	297.4	297.4	297.35	297.35	297.4	297.45	297.5	297.55	297.6	297.65	297.7	297.75	297.75	297.8	297.8	297.75	297.75	297.8	297.7	297.65	297.65	297.6

	Linea sismica SR_2	
	Coordinate Gauss Boaga	
	Geofono N.1 (G1)	Geofono N.24 (G24)
X (m)	1686141	1686148
Y (m)	4800027	4799946

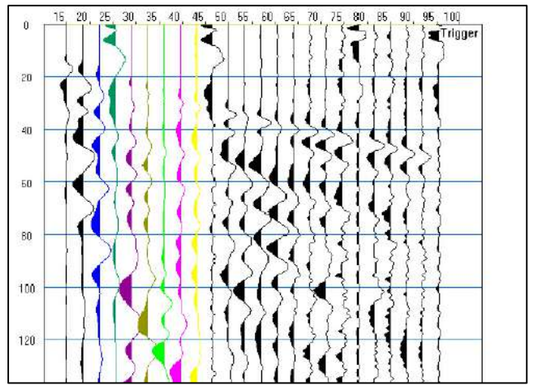
	Punti di energizzazione linea sismica SR_2								
	E1 Esterno Sx	A Estremo Sx	D1 Intermedio Sx	D2 Intermedio Sx	C Centrale	D3 Intermedio Dx	D4 Intermedio Dx	B Estremo Dx	E2 Esterno Dx
Onde P	petp1	petp2	petp3	petp4	petp5	petp6	petp7	petp8	petp9
Onde SH	sh1	sh2	sh3	sh4	sh5	sh6	sh7	sh8	sh9
Posiz. dal geof. N.1 (m)	0	11.5	16.75	34.25	55.25	76.25	93.75	99	110.5
Quota (m slm)	297.7	297.55	297.47	297.37	297.64	297.75	297.63	297.55	297.1

LINEA SISMICA SR_2
REGISTRAZIONI DI CAMPAGNA DELLE ONDE P

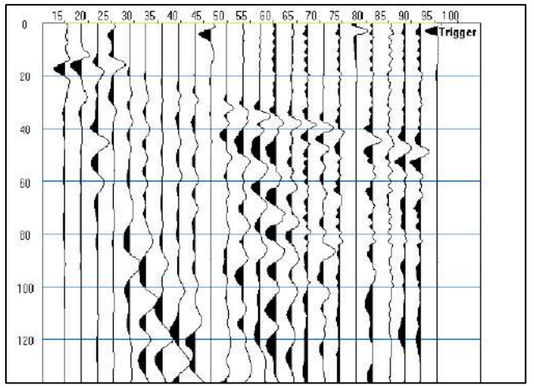
TIRO ESTERNO SINISTRO E1



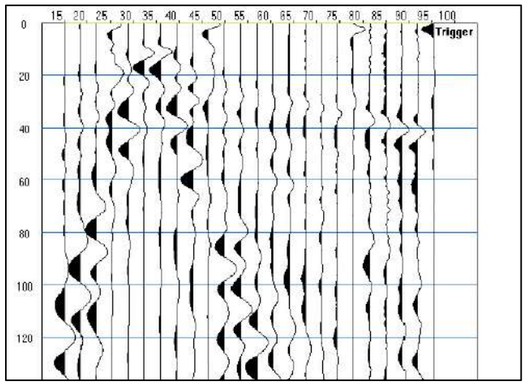
TIRO ESTREMO SINISTRO A



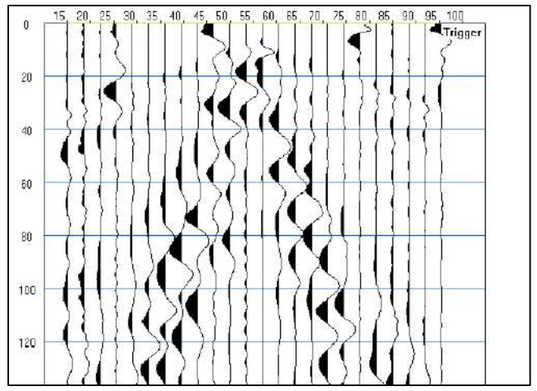
TIRO INTERMEDIO D1



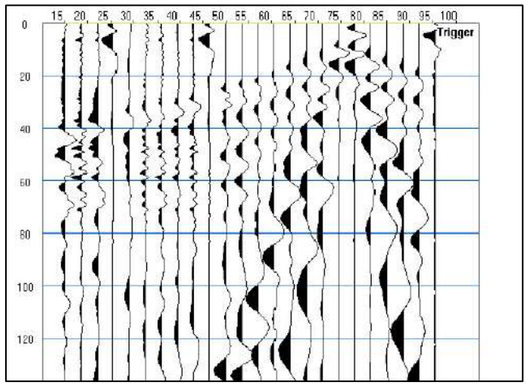
TIRO INTERMEDIO D2



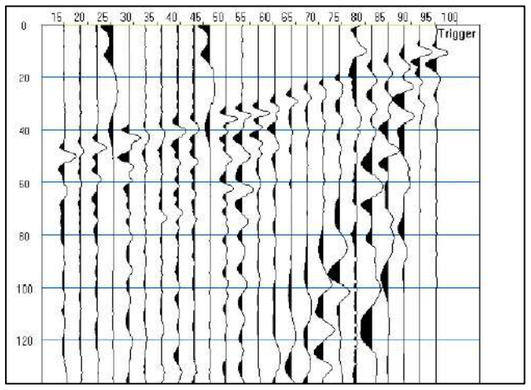
TIRO CENTRALE C



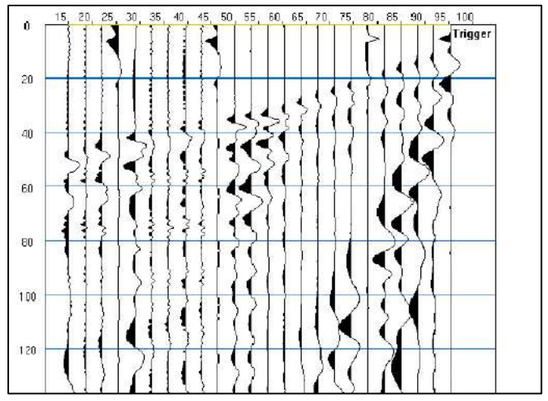
TIRO INTERMEDIO D3



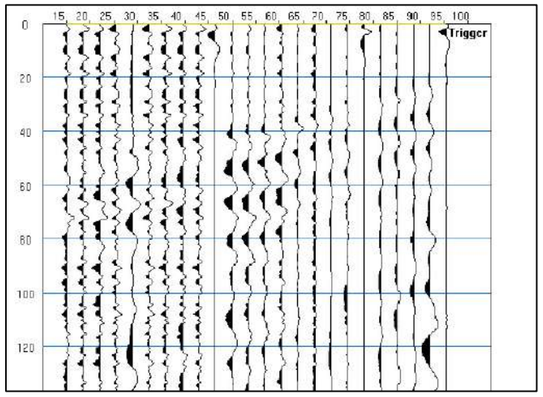
TIRO INTERMEDIO D4



TIRO ESTREMO DESTRO B

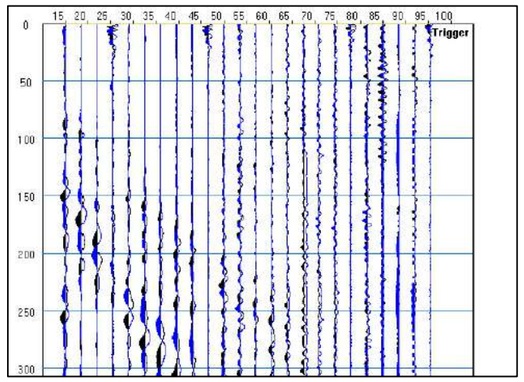


TIRO ESTERNO DESTRO E2

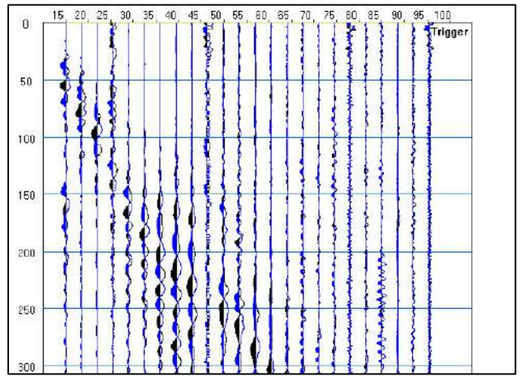


LINEA SISMICA SR_2
REGISTRAZIONI DI CAMPAGNA DELLE ONDE SH

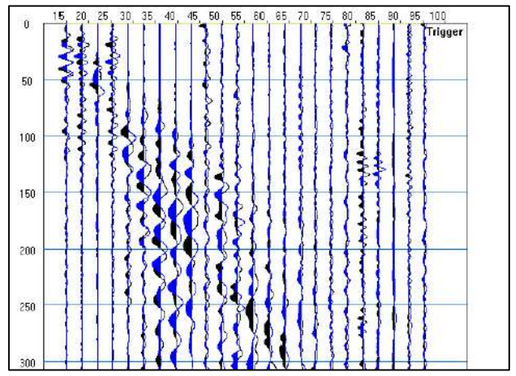
TIRO ESTERNO SINISTRO E1



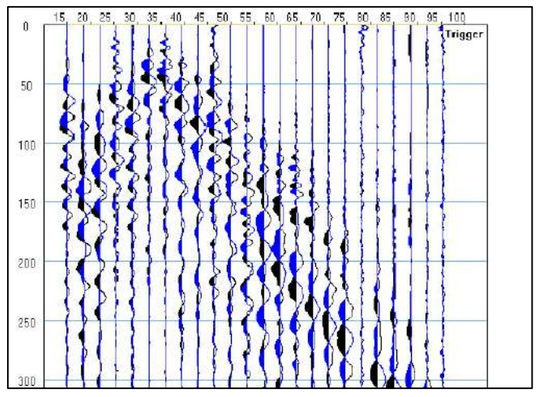
TIRO ESTREMO SINISTRO A



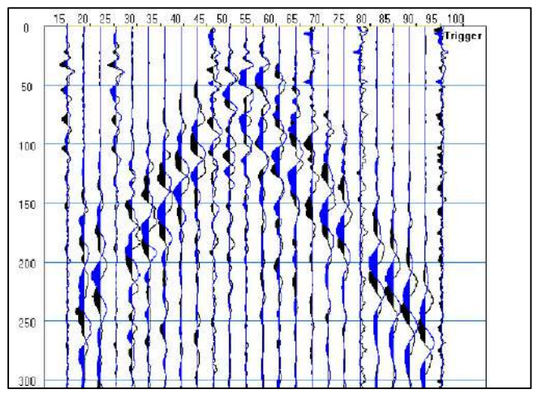
TIRO INTERMEDIO D1



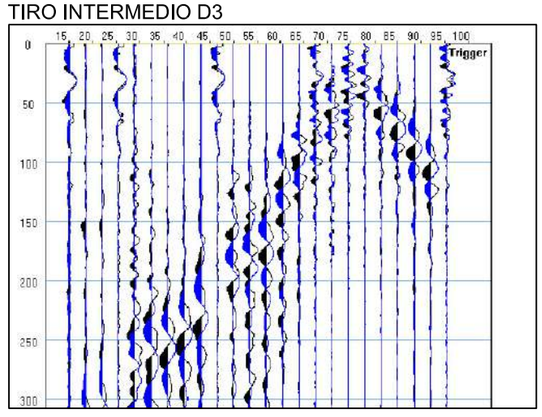
TIRO INTERMEDIO D2



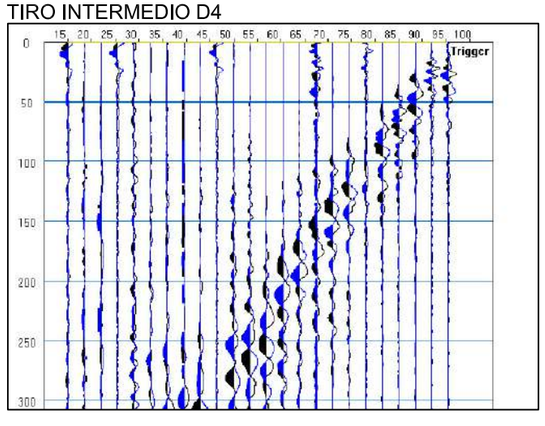
TIRO CENTRALE C



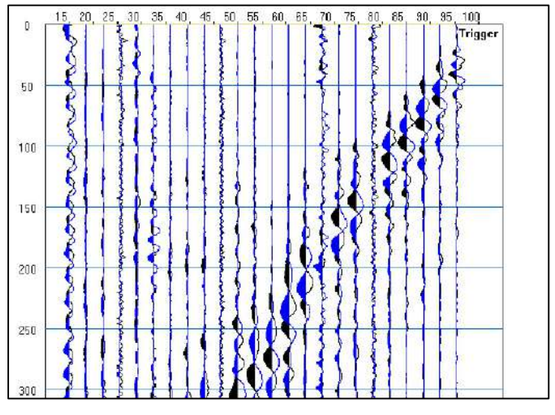
TIRO INTERMEDIO D3



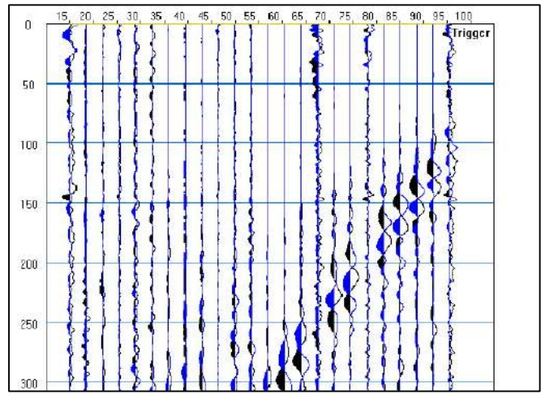
TIRO INTERMEDIO D4



TIRO ESTREMO DESTRO B



TIRO ESTERNO DESTRO E2



LINEA SISMICA SR_2
TEMPI DI PROPAGAZIONE DELLE ONDE P

SP	Elev	X-loc	Y-Loc	Depth
1	0.00	0.00	0.00	0.00
2	0.00	11.50	0.00	0.00
3	297.48	16.75	0.00	0.00
4	297.35	34.25	0.00	0.00
5	297.63	55.25	0.00	0.00
6	297.77	76.25	0.00	0.00
7	297.63	93.75	0.00	0.00
8	0.00	99.00	0.00	0.00
9	0.00	110.50	0.00	0.00

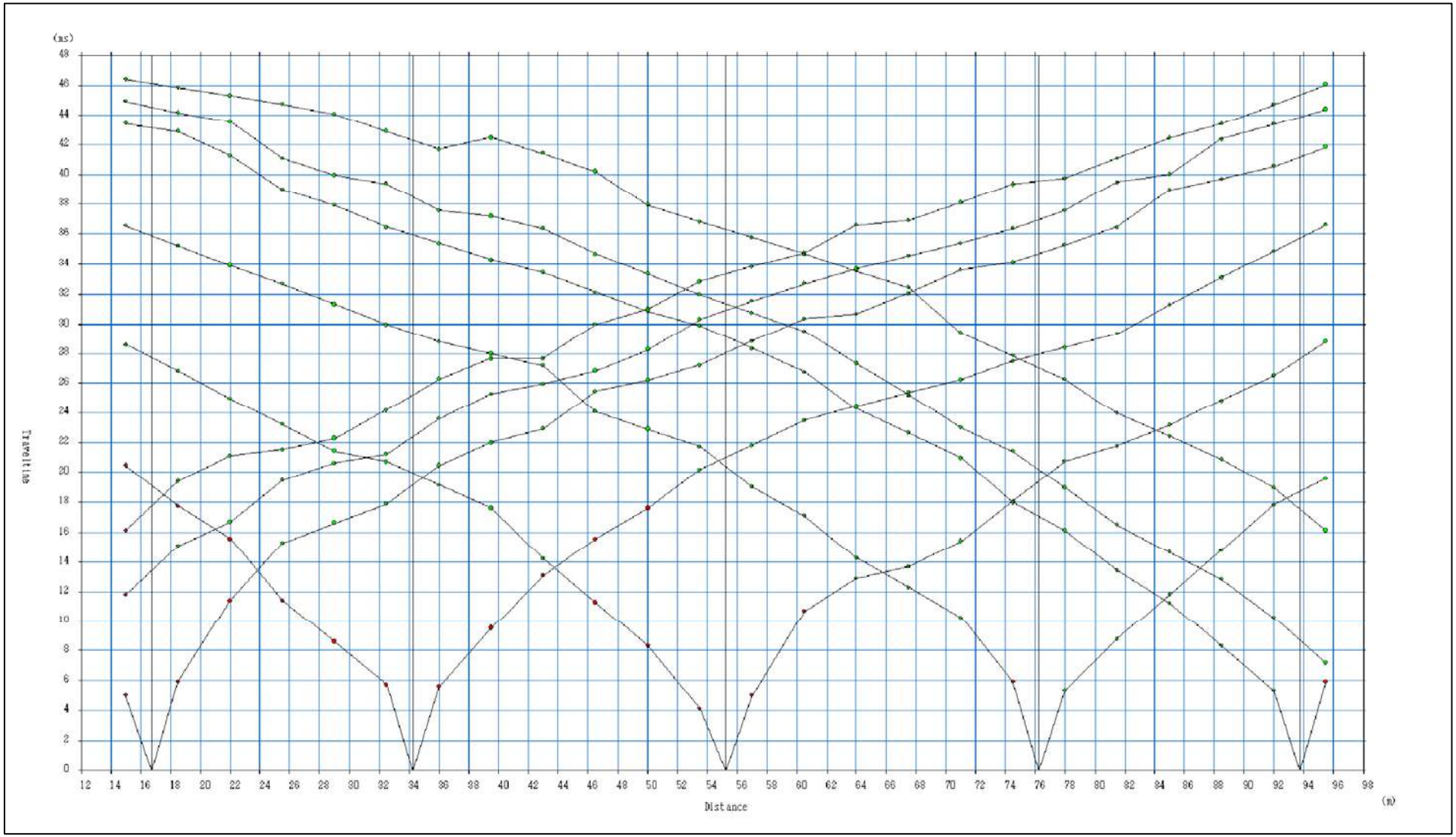
Geo	Elev	X-loc	Y-Loc	SP 1	SP 2	SP 3	SP 4	SP 5	SP 6	SP 7	SP 8	SP 9
1	297.50	15.00	0.00	0.00 1	0.00 1	5.91 1	19.93 1	28.54 1	36.24 1	42.93 1	0.00 1	0.00 1
2	297.45	18.50	0.00	0.00 1	0.00 1	5.91 1	18.05 1	27.15 1	34.93 1	41.72 1	0.00 1	0.00 1
3	297.40	22.00	0.00	0.00 1	0.00 1	11.36 1	15.33 1	25.63 1	33.49 1	40.36 1	0.00 1	0.00 1
4	297.40	25.50	0.00	0.00 1	0.00 1	14.20 1	12.47 1	23.99 1	31.92 1	38.88 1	0.00 1	0.00 1
5	297.35	29.00	0.00	0.00 1	0.00 1	16.14 1	9.61 1	22.49 1	30.47 1	37.45 1	0.00 1	0.00 1
6	297.35	32.50	0.00	0.00 1	0.00 1	18.23 1	5.64 1	21.18 1	29.33 1	36.31 1	0.00 1	0.00 1
7	297.35	36.00	0.00	0.00 1	0.00 1	19.97 1	5.64 1	19.47 1	28.27 1	35.25 1	0.00 1	0.00 1
8	297.40	39.50	0.00	0.00 1	0.00 1	21.79 1	9.90 1	17.25 1	27.29 1	34.27 1	0.00 1	0.00 1
9	297.45	43.00	0.00	0.00 1	0.00 1	23.32 1	12.88 1	14.93 1	26.04 1	33.09 1	0.00 1	0.00 1
10	297.50	46.50	0.00	0.00 1	0.00 1	24.62 1	15.20 1	12.62 1	24.17 1	31.70 1	0.00 1	0.00 1
11	297.55	50.00	0.00	0.00 1	0.00 1	25.84 1	17.31 1	9.60 1	22.35 1	30.32 1	0.00 1	0.00 1
12	297.60	53.50	0.00	0.00 1	0.00 1	27.10 1	19.42 1	5.33 1	20.55 1	28.98 1	0.00 1	0.00 1
13	297.65	57.00	0.00	0.00 1	0.00 1	28.53 1	21.22 1	5.33 1	18.65 1	27.43 1	0.00 1	0.00 1
14	297.70	60.50	0.00	0.00 1	0.00 1	30.12 1	22.91 1	10.26 1	16.70 1	25.82 1	0.00 1	0.00 1
15	297.75	64.00	0.00	0.00 1	0.00 1	31.35 1	24.20 1	12.76 1	14.54 1	23.98 1	0.00 1	0.00 1
16	297.75	67.50	0.00	0.00 1	0.00 1	32.46 1	25.43 1	14.50 1	12.35 1	22.18 1	0.00 1	0.00 1
17	297.80	71.00	0.00	0.00 1	0.00 1	33.75 1	26.89 1	16.47 1	9.76 1	20.49 1	0.00 1	0.00 1
18	297.80	74.50	0.00	0.00 1	0.00 1	35.00 1	28.15 1	18.54 1	5.27 1	18.73 1	0.00 1	0.00 1
19	297.75	78.00	0.00	0.00 1	0.00 1	36.07 1	29.22 1	20.47 1	5.27 1	16.44 1	0.00 1	0.00 1
20	297.80	81.50	0.00	0.00 1	0.00 1	37.28 1	30.43 1	21.94 1	9.36 1	14.06 1	0.00 1	0.00 1
21	297.70	85.00	0.00	0.00 1	0.00 1	38.59 1	31.74 1	23.42 1	11.77 1	11.62 1	0.00 1	0.00 1
22	297.65	88.50	0.00	0.00 1	0.00 1	40.15 1	33.30 1	25.17 1	14.19 1	9.28 1	0.00 1	0.00 1
23	297.65	92.00	0.00	0.00 1	0.00 1	41.69 1	35.00 1	27.19 1	16.58 1	5.55 1	0.00 1	0.00 1
24	297.60	95.50	0.00	0.00 1	0.00 1	42.85 1	36.30 1	28.90 1	18.88 1	5.55 1	0.00 1	0.00 1

LINEA SISMICA SR_2
TEMPI DI PROPAGAZIONE DELLE ONDE SH

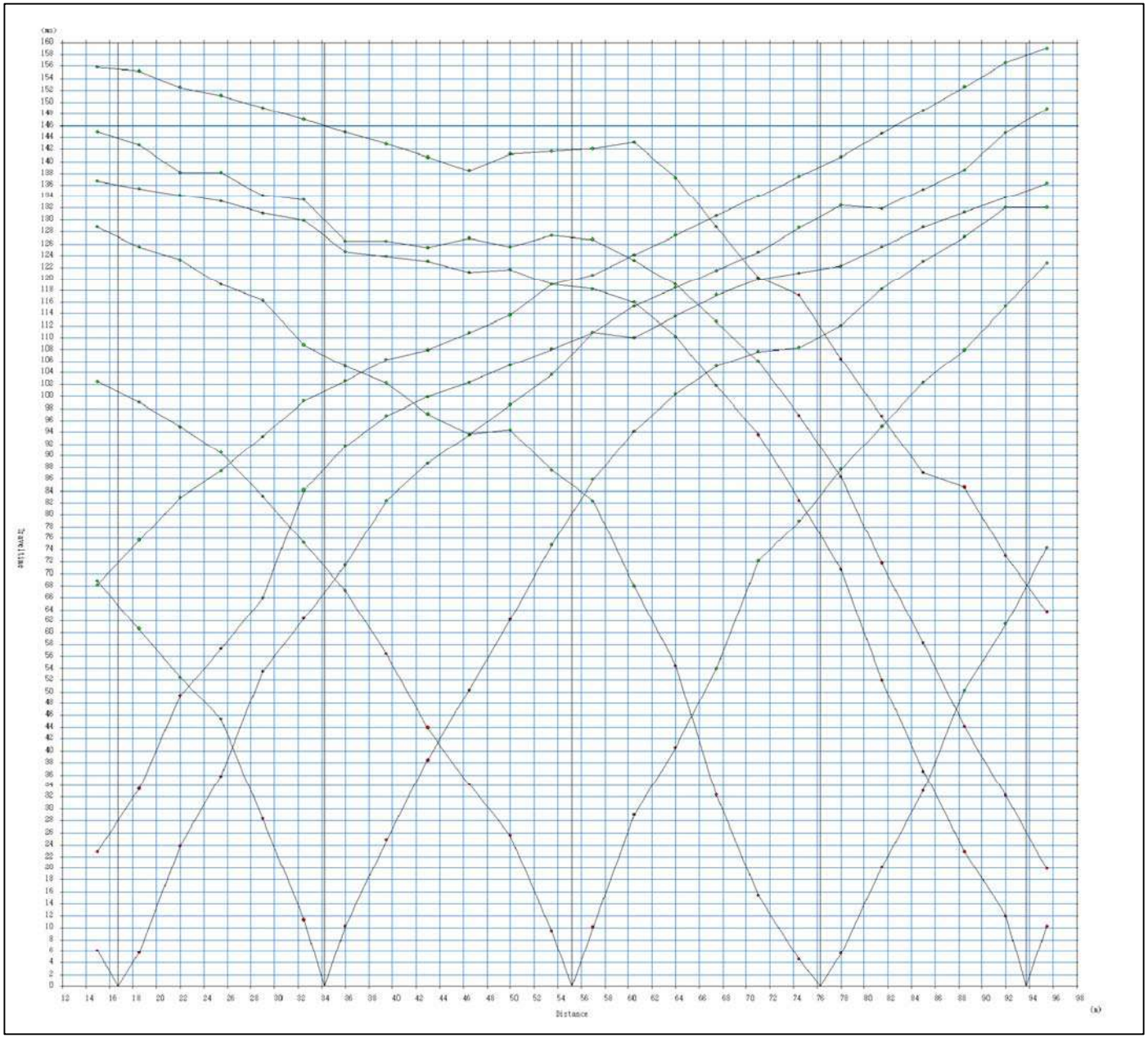
SP	Elev	X-loc	Y-Loc	Depth
1	0.00	0.00	0.00	0.00
2	0.00	11.50	0.00	0.00
3	297.48	16.75	0.00	0.00
4	297.35	34.25	0.00	0.00
5	297.63	55.25	0.00	0.00
6	297.77	76.25	0.00	0.00
7	297.63	93.75	0.00	0.00
8	0.00	99.00	0.00	0.00
9	0.00	110.50	0.00	0.00

Geo	Elev	X-loc	Y-Loc	SP 1	SP 2	SP 3	SP 4	SP 5	SP 6	SP 7	SP 8	SP 9
1	297.50	15.00	0.00	0.00 1	0.00 1	7.61 1	69.76 1	104.57	1126.08	1145.15	10.00 1	0.00 1
2	297.45	18.50	0.00	0.00 1	0.00 1	7.61 1	61.47 1	101.95	1123.46	1142.52	10.00 1	0.00 1
3	297.40	22.00	0.00	0.00 1	0.00 1	22.67 1	52.15 1	98.50 1	121.04	1140.11	10.00 1	0.00 1
4	297.40	25.50	0.00	0.00 1	0.00 1	36.94 1	42.27 1	93.28 1	118.64	1137.71	10.00 1	0.00 1
5	297.35	29.00	0.00	0.00 1	0.00 1	51.73 1	27.61 1	87.87 1	115.86	1134.95	10.00 1	0.00 1
6	297.35	32.50	0.00	0.00 1	0.00 1	61.93 1	10.21 1	81.67 1	112.49	1131.60	10.00 1	0.00 1
7	297.35	36.00	0.00	0.00 1	0.00 1	69.94 1	10.21 1	72.26 1	108.84	1127.99	10.00 1	0.00 1
8	297.40	39.50	0.00	0.00 1	0.00 1	77.34 1	25.51 1	58.94 1	105.57	1124.78	10.00 1	0.00 1
9	297.45	43.00	0.00	0.00 1	0.00 1	84.15 1	37.98 1	46.93 1	102.22	1121.92	10.00 1	0.00 1
10	297.50	46.50	0.00	0.00 1	0.00 1	89.30 1	49.82 1	35.72 1	97.97 1	119.52	10.00 1	0.00 1
11	297.55	50.00	0.00	0.00 1	0.00 1	94.33 1	61.47 1	24.65 1	94.48 1	117.69	10.00 1	0.00 1
12	297.60	53.50	0.00	0.00 1	0.00 1	100.11	172.72 1	10.96 1	88.58 1	116.01	10.00 1	0.00 1
13	297.65	57.00	0.00	0.00 1	0.00 1	106.29	182.83 1	10.96 1	81.21 1	113.72	10.00 1	0.00 1
14	297.70	60.50	0.00	0.00 1	0.00 1	111.66	192.49 1	26.83 1	66.74 1	110.52	10.00 1	0.00 1
15	297.75	64.00	0.00	0.00 1	0.00 1	115.70	1100.27	140.99 1	51.14 1	105.83	10.00 1	0.00 1
16	297.75	67.50	0.00	0.00 1	0.00 1	118.44	1104.79	154.91 1	35.09 1	98.55 1	0.00 1	0.00 1
17	297.80	71.00	0.00	0.00 1	0.00 1	120.53	1106.87	168.52 1	19.81 1	88.75 1	0.00 1	0.00 1
18	297.80	74.50	0.00	0.00 1	0.00 1	122.96	1109.30	181.24 1	6.49 1	76.88 1	0.00 1	0.00 1
19	297.75	78.00	0.00	0.00 1	0.00 1	126.10	1112.44	188.39 1	6.49 1	64.32 1	0.00 1	0.00 1
20	297.80	81.50	0.00	0.00 1	0.00 1	130.36	1116.70	195.97 1	20.37 1	51.55 1	0.00 1	0.00 1
21	297.70	85.00	0.00	0.00 1	0.00 1	134.77	1121.11	1102.23	134.71 1	38.15 1	0.00 1	0.00 1
22	297.65	88.50	0.00	0.00 1	0.00 1	138.63	1125.04	1108.54	148.81 1	24.56 1	0.00 1	0.00 1
23	297.65	92.00	0.00	0.00 1	0.00 1	142.09	1128.50	1113.66	163.19 1	9.16 1	0.00 1	0.00 1
24	297.60	95.50	0.00	0.00 1	0.00 1	145.20	1131.61	1116.97	177.47 1	9.16 1	0.00 1	0.00 1

LINEA SISMICA SR_2
DROMOCRONE DELLE ONDE P



LINEA SISMICA SR_2
DROMOCRONE DELLE ONDE SH



LINEA SISMICA SR_2
VELOCITA' SISMICHE DEI RIFRATTORI INDIVIDUATI

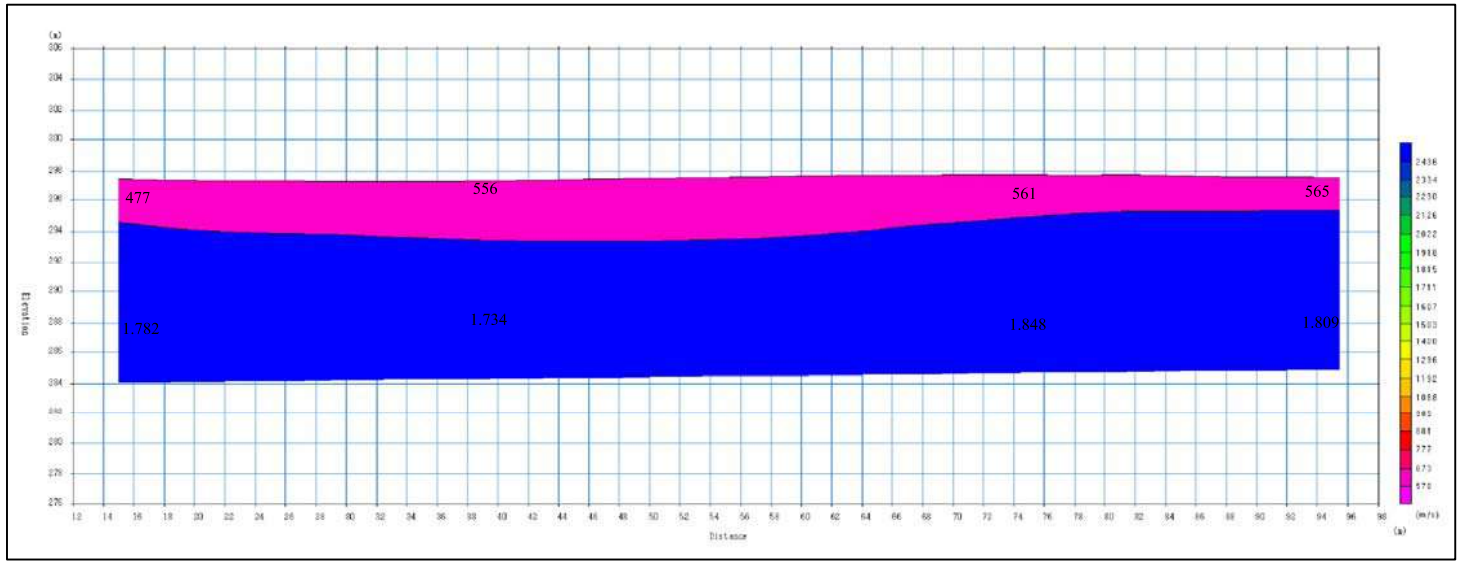
Onde P

		Strato 1	Strato 2
Geofono	x (m)	Vs (m/sec)	Vs (m/sec)
1	15	475.10	1774.84
2	18.5	479.89	1788.66
3	22	500.39	1821.53
4	25.5	539.52	1855.08
5	29	568.77	1861.17
6	32.5	569.51	1836.83
7	36	556.43	1798.30
8	39.5	549.40	1756.36
9	43	562.35	1731.29
10	46.5	586.75	1736.71
11	50	597.95	1744.76
12	53.5	575.84	1743.30
13	57	536.38	1759.65
14	60.5	527.08	1793.74
15	64	548.83	1823.18
16	67.5	561.91	1838.97
17	71	559.27	1845.56
18	74.5	570.13	1849.47
19	78	599.15	1846.13
20	81.5	613.73	1834.84
21	85	603.44	1822.52
22	88.5	583.51	1813.79
23	92	569.09	1809.75
24	95.5	561.50	1807.71

Onde SH

		Strato 1	Strato 2
Geofono	x (m)	Vs (m/sec)	Vs (m/sec)
1	15	279.90	853.59
2	18.5	274.83	846.68
3	22	267.69	835.33
4	25.5	259.32	824.31
5	29	255.33	815.18
6	32.5	259.02	808.89
7	36	265.09	850.63
8	39.5	270.40	847.21
9	43	270.81	838.70
10	46.5	263.45	826.45
11	50	253.32	815.33
12	53.5	241.26	807.25
13	57	229.50	803.18
14	60.5	223.99	803.32
15	64	225.51	805.86
16	67.5	235.80	807.55
17	71	252.84	806.61
18	74.5	266.33	804.78
19	78	336.10	854.26
20	81.5	330.07	860.29
21	85	323.84	868.49
22	88.5	319.96	874.73
23	92	319.18	877.47
24	95.5	319.62	878.47

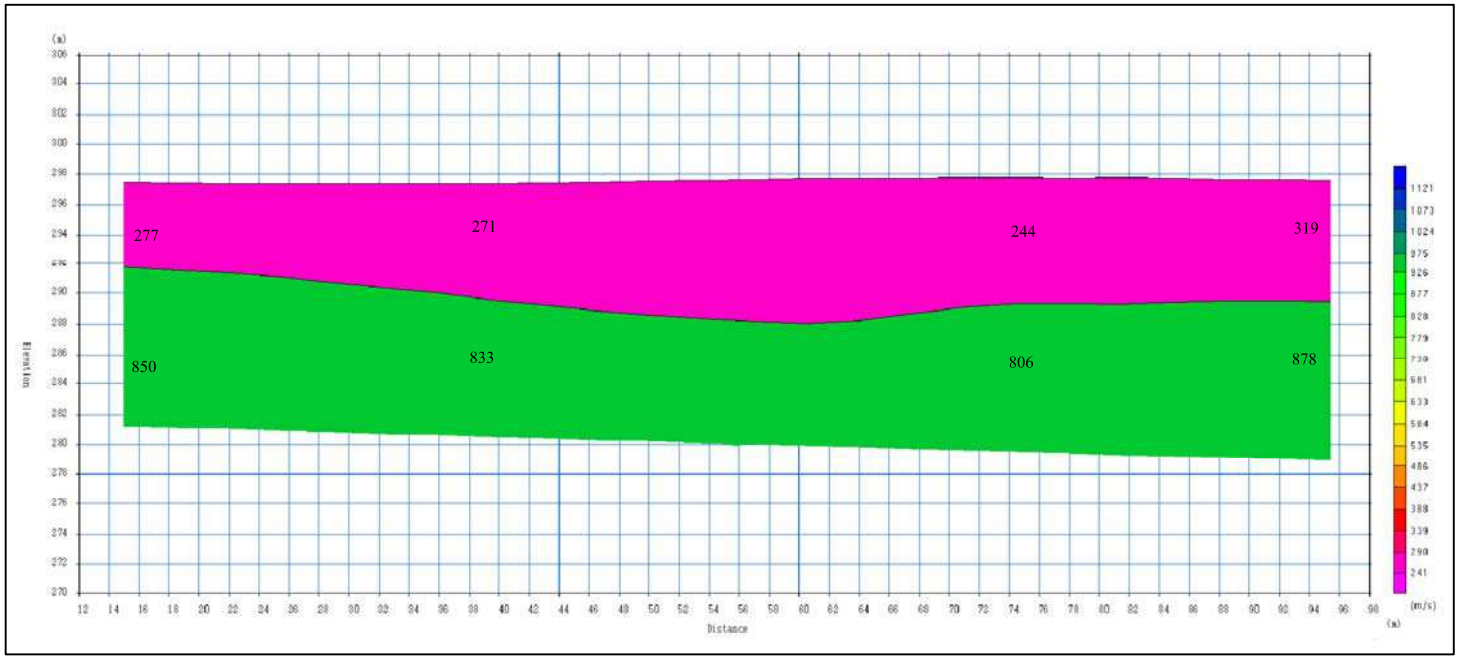
LINEA SISMICA SR_2
SEZIONE SISMOSTRATIGRAFICA: ONDE P



Scala 1:500

321 VELOCITA' SISMICA DELLO STRATO IN m/sec

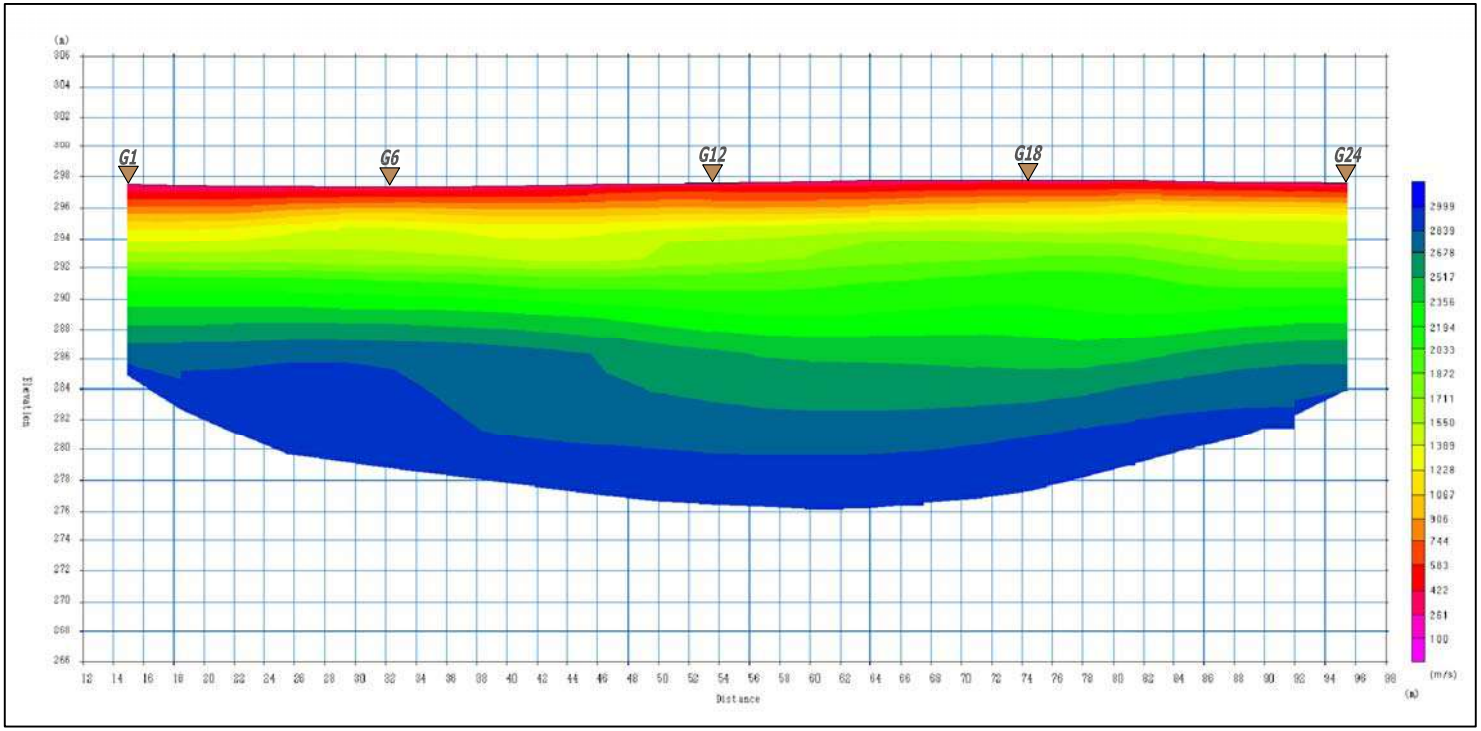
LINEA SISMICA SR_2
SEZIONE SISMOSTRATIGRAFICA: ONDE SH



Scala 1:500

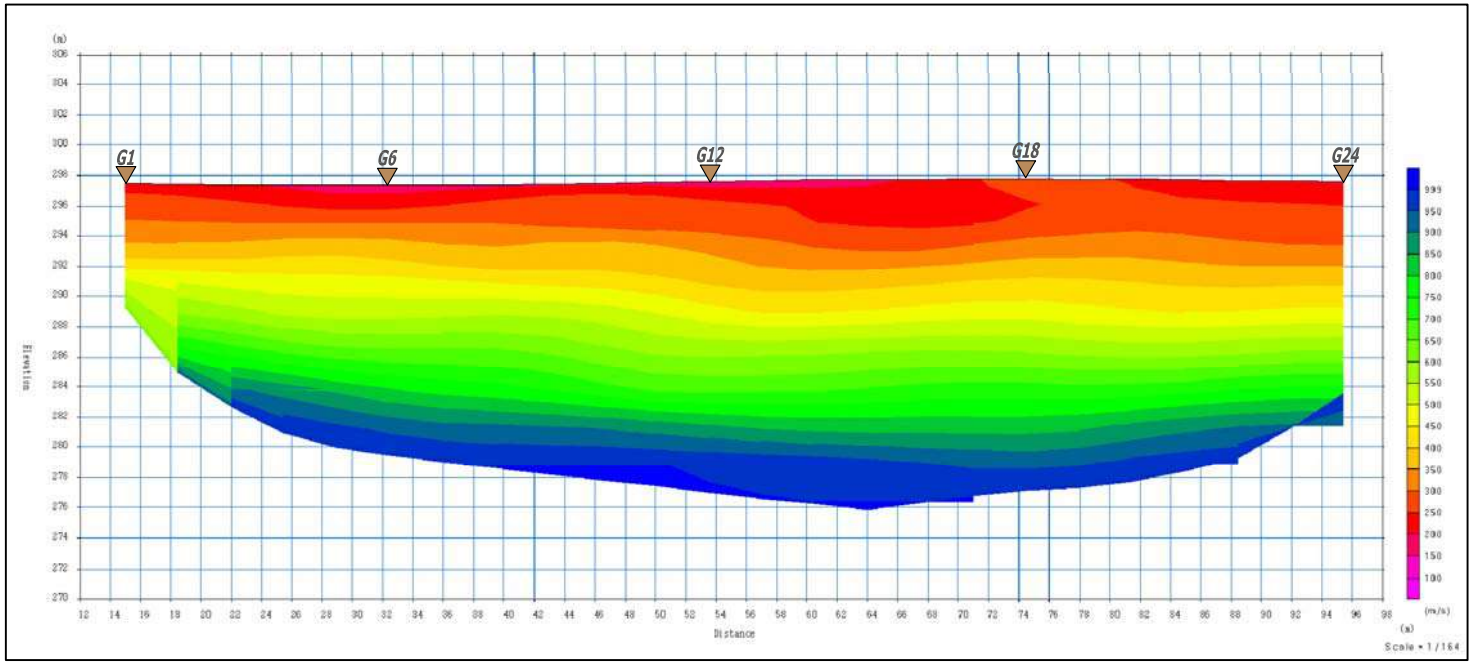
321 VELOCITA' SISMICA DELLO STRATO IN m/sec

LINEA SISMICA SR_2
SEZIONE TOMOGRAFICA ONDE P

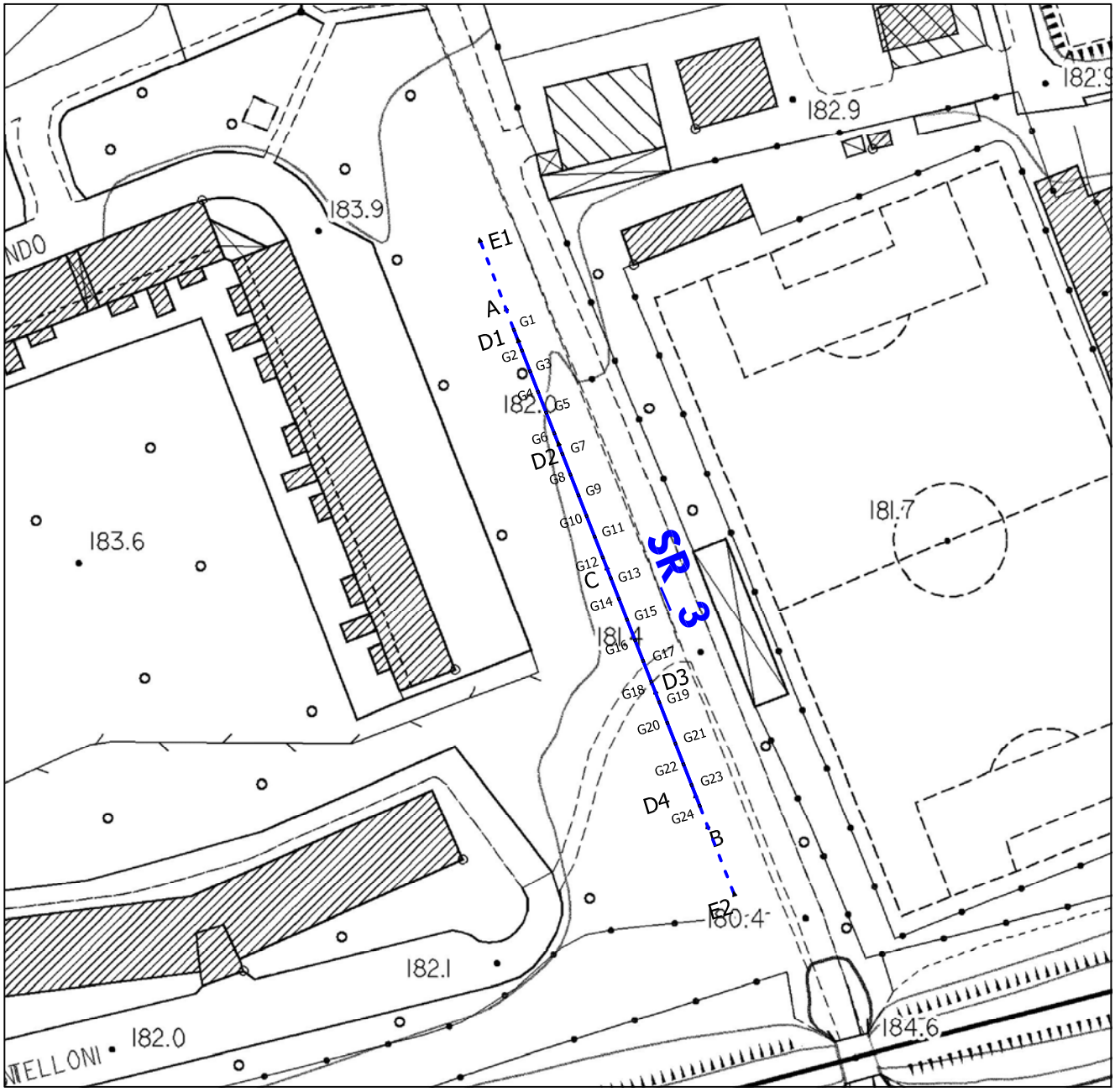


Scala 1:500

LINEA SISMICA SR_2
SEZIONE TOMOGRAFICA ONDE SH



Scala 1:500



Scala 1:1.000

PROSPEZIONE SISMICA A RIFRAZIONE (SR_3) CON ONDE P E SH

▫ G1	POSIZIONE GEOFONO
E ▲	TIRI ESTERNI
A e B ▲	TIRI ESTREMI
C ▲	TIRO CENTRALE
D1-D2 ▲	TIRI INTERMEDI SINISTRI
D3-D4 ▲	TIRI INTERMEDI DESTRI

SR_3 — LINEA SISMICA SR_3

N
W E
S

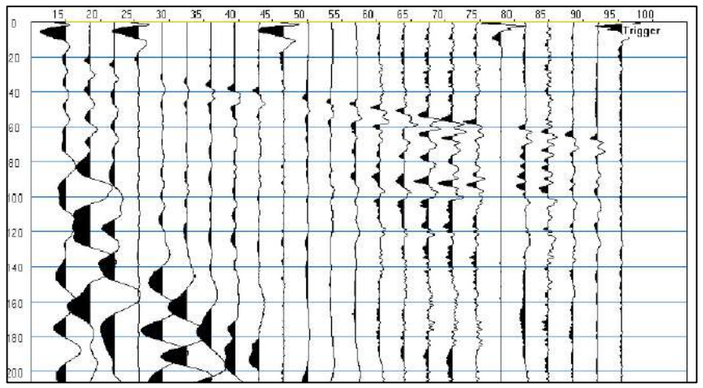
Linea sismica a rifrazione SR_3																								
Geofoni	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Distanza Progressiva (m)	15	18.5	22	25.5	29	32.5	36	39.5	43	46.5	50	53.5	57	60.5	64	67.5	71	74.5	78	81.5	85	88.5	92	95.5
Distanza Parziale (m)	0	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5
Quota (m slm)	182.4	182.3	182.2	182.1	182	181.95	181.9	181.85	181.8	181.75	181.7	181.65	181.6	181.55	181.5	181.45	181.4	181.38	181.35	181.32	181.3	181.26	181.23	181.2

Linea sismica SR_3		
	Coordinate Gauss Boaga	
	Geofono N.1 (G1)	Geofono N.24 (G24)
X (m)	1694302	1694327
Y (m)	4796244	4796167

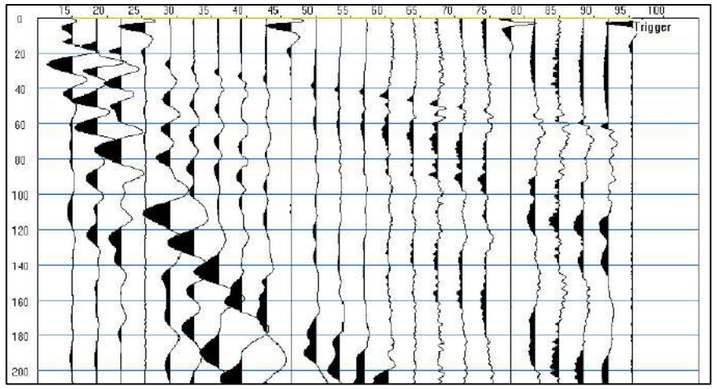
Punti di energizzazione linea sismica SR_3									
	E1 Esterno Sx	A Estremo Sx	D1 Intermedio Sx	D2 Intermedio Sx	C Centrale	D3 Intermedio Dx	D4 Intermedio Dx	B Estremo Dx	E2 Esterno Dx
Onde P	arb1p1	arb1p2	arb1p3	arb1p4	arb1p5	arb1p6	arb1p7	arb1p8	arb1p9
Onde SH	s1	s2	s3	s4	s5	s6	s7	s8	s9
Posiz. dal geof. N.1 (m)	0	11.5	16.75	34.25	55.25	76.25	93.75	99	110.5
Quota (m slm)	183	182.5	182.35	181.93	181.63	181.37	181.21	181.19	180.7

LINEA SISMICA SR_3
REGISTRAZIONI DI CAMPAGNA DELLE ONDE P

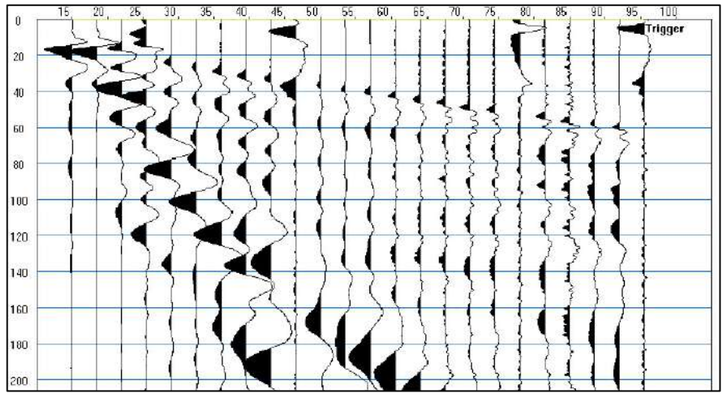
TIRO ESTERNO SINISTRO E1



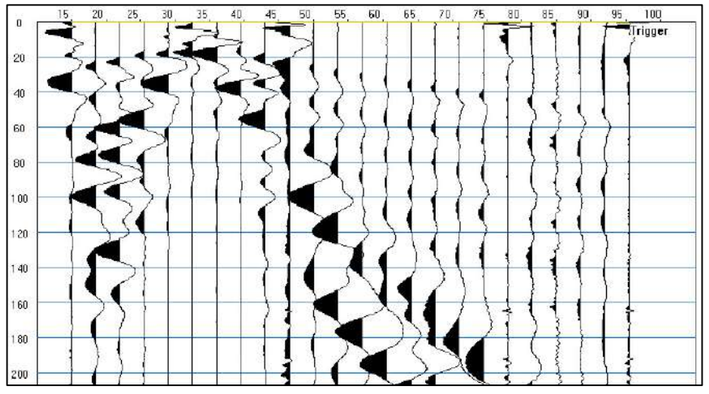
TIRO ESTREMO SINISTRO A



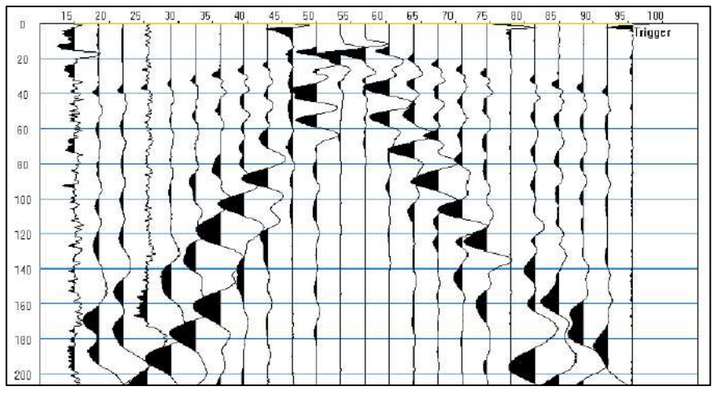
TIRO INTERMEDIO D1



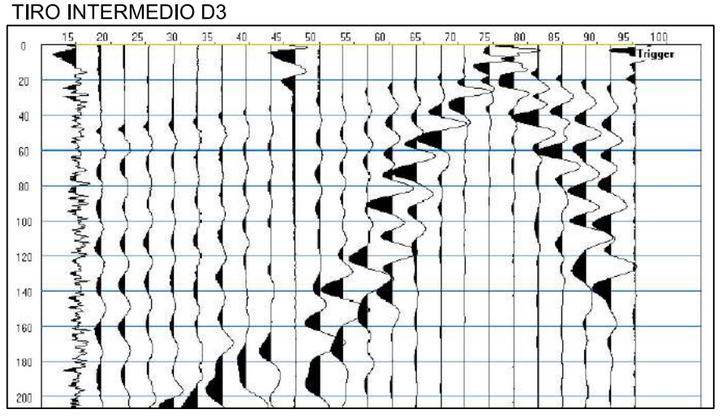
TIRO INTERMEDIO D2



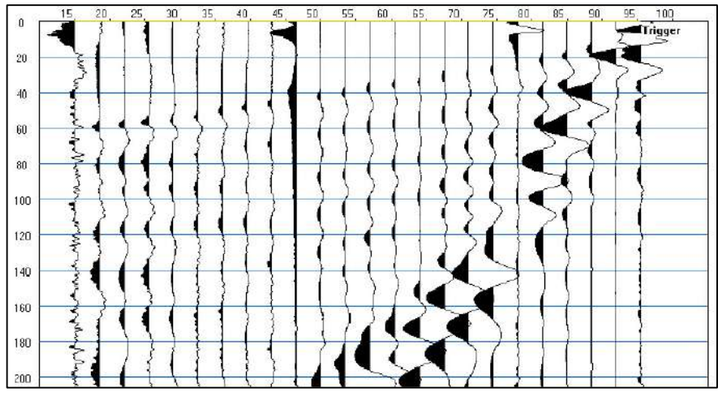
TIRO CENTRALE C



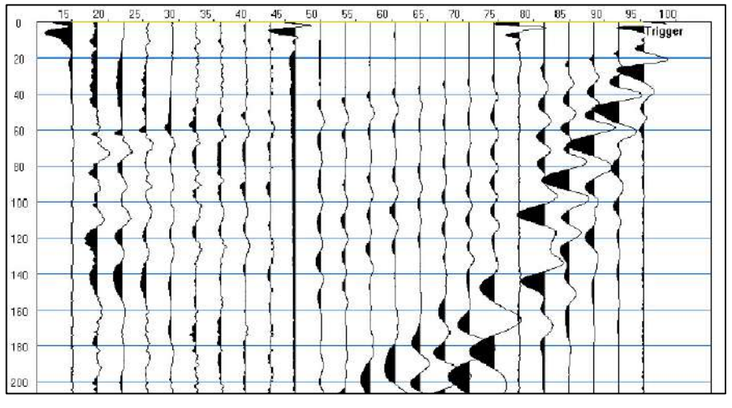
TIRO INTERMEDIO D3



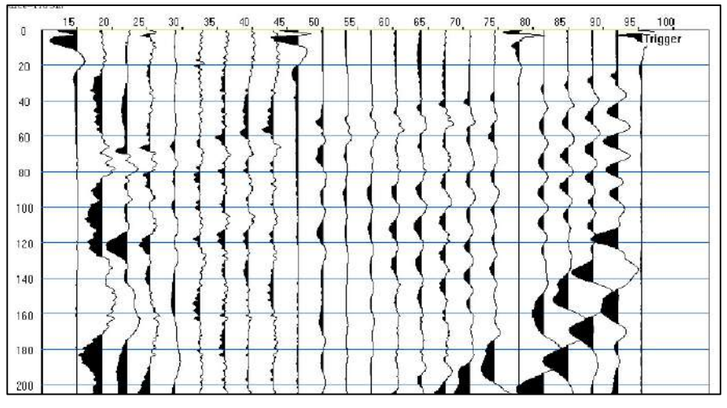
TIRO INTERMEDIO D4



TIRO ESTREMO DESTRO B

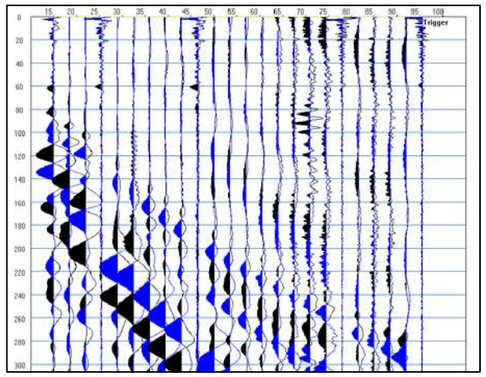


TIRO ESTERNO DESTRO E2

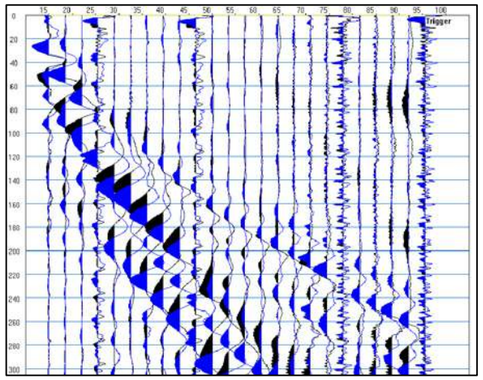


LINEA SISMICA SR_3
REGISTRAZIONI DI CAMPAGNA DELLE ONDE SH

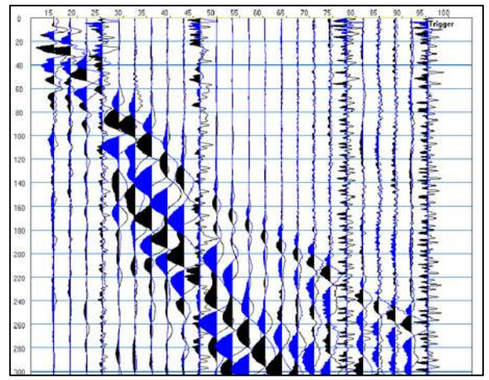
TIRO ESTERNO SINISTRO E1



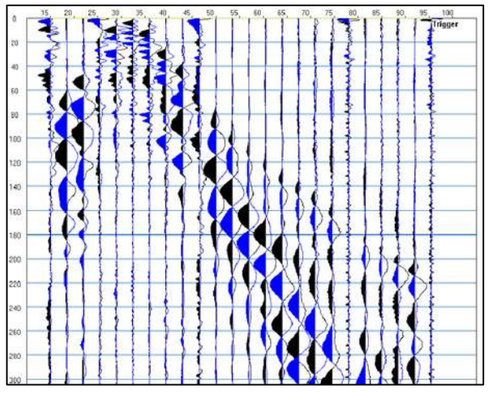
TIRO ESTREMO SINISTRO A



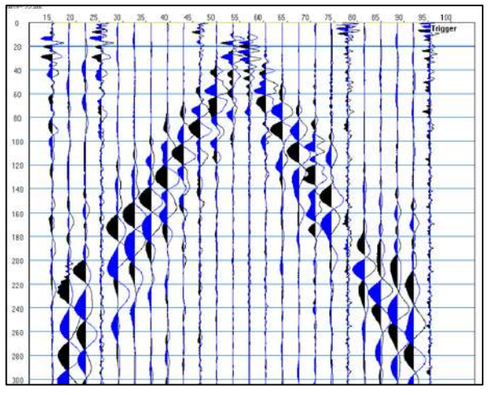
TIRO INTERMEDIO D1



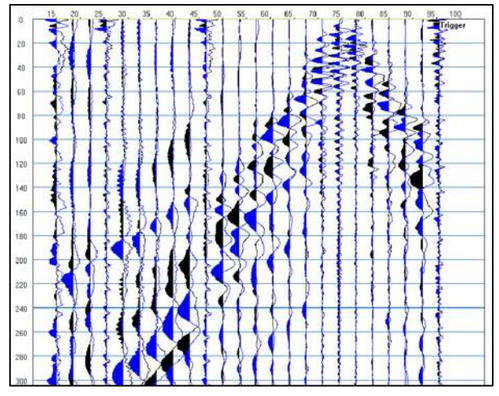
TIRO INTERMEDIO D2



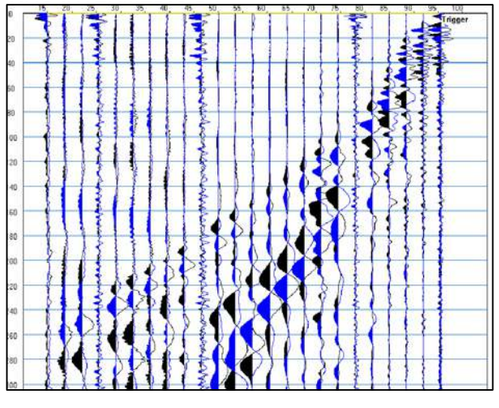
TIRO CENTRALE C



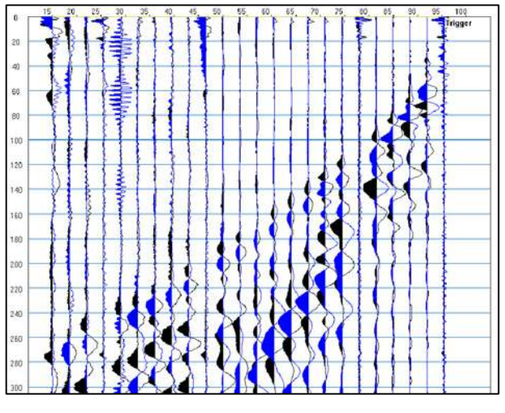
TIRO INTERMEDIO D3



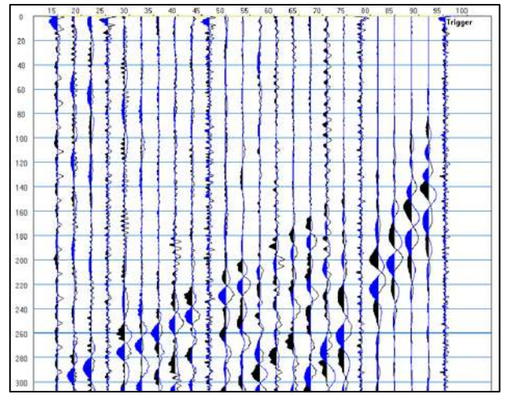
TIRO INTERMEDIO D4



TIRO ESTREMO DESTRO B



TIRO ESTERNO DESTRO E2



LINEA SISMICA SR_3
TEMPI DI PROPAGAZIONE DELLE ONDE P

SP	Elev	X-loc	Y-Loc	Depth
1	0.00	0.00	0.00	0.00
2	0.00	11.50	0.00	0.00
3	182.35	16.75	0.00	0.00
4	181.92	34.25	0.00	0.00
5	181.63	55.25	0.00	0.00
6	181.37	76.25	0.00	0.00
7	181.21	93.75	0.00	0.00
8	0.00	99.00	0.00	0.00
9	0.00	110.50	0.00	0.00

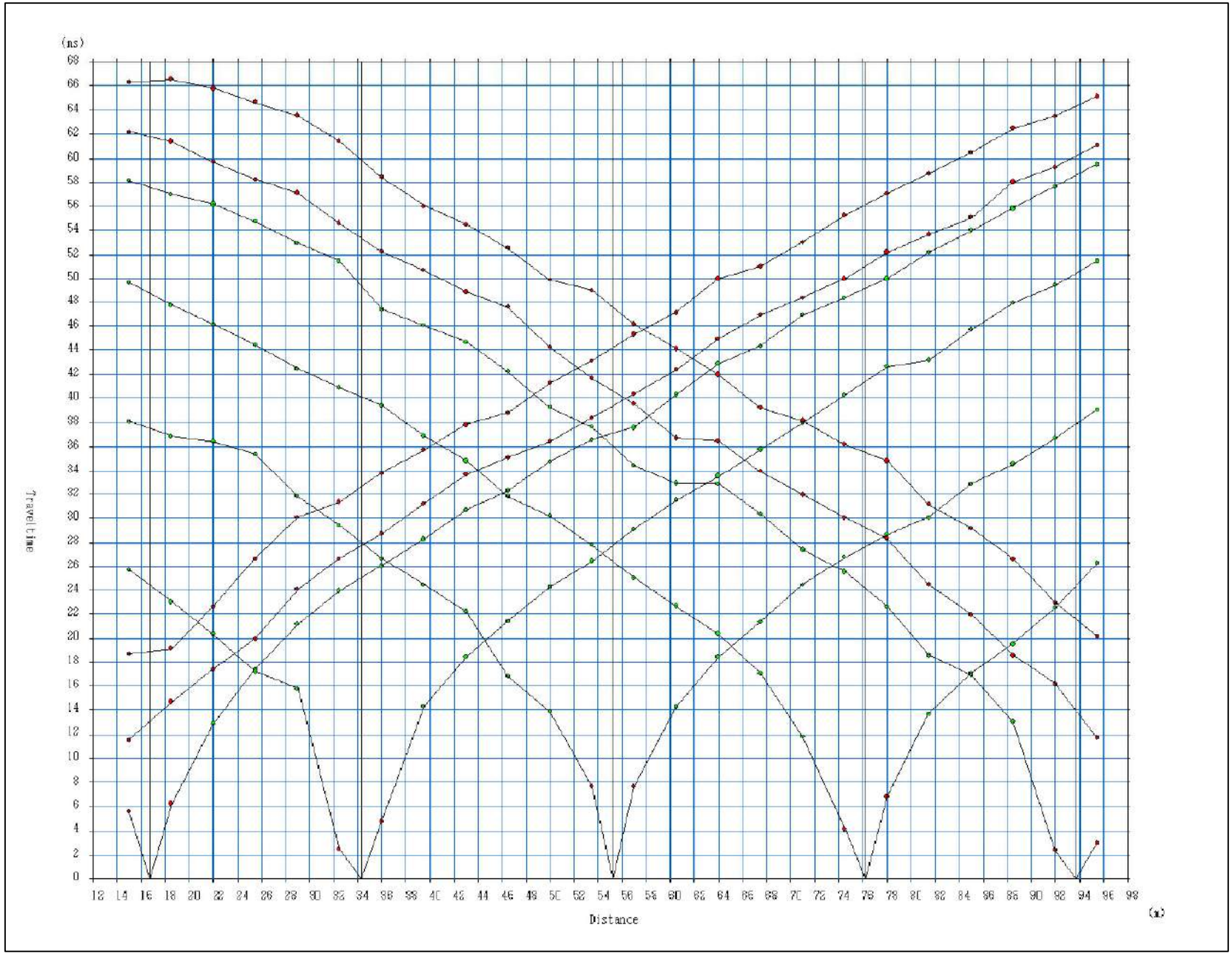
Geo	Elev	X-loc	Y-Loc	SP 1	SP 2	SP 3	SP 4	SP 5	SP 6	SP 7	SP 8	SP 9
1	182.40	15.00	0.00	0.00 1	0.00 1	7.31 1	25.97 1	39.03 1	49.71 1	58.50 1	0.00 1	0.00 1
2	182.30	18.50	0.00	0.00 1	0.00 1	7.31 1	23.20 1	36.97 1	47.83 1	57.17 1	0.00 1	0.00 1
3	182.20	22.00	0.00	0.00 1	0.00 1	13.83 1	20.67 1	35.16 1	46.21 1	55.93 1	0.00 1	0.00 1
4	182.10	25.50	0.00	0.00 1	0.00 1	17.60 1	18.23 1	33.44 1	44.71 1	54.64 1	0.00 1	0.00 1
5	182.00	29.00	0.00	0.00 1	0.00 1	20.47 1	15.03 1	31.35 1	43.02 1	52.94 1	0.00 1	0.00 1
6	181.95	32.50	0.00	0.00 1	0.00 1	23.28 1	6.96 1	29.01 1	41.21 1	51.13 1	0.00 1	0.00 1
7	181.90	36.00	0.00	0.00 1	0.00 1	26.02 1	6.96 1	26.50 1	38.96 1	49.05 1	0.00 1	0.00 1
8	181.85	39.50	0.00	0.00 1	0.00 1	28.38 1	14.56 1	24.03 1	36.72 1	46.87 1	0.00 1	0.00 1
9	181.80	43.00	0.00	0.00 1	0.00 1	30.57 1	18.38 1	21.12 1	34.54 1	44.80 1	0.00 1	0.00 1
10	181.75	46.50	0.00	0.00 1	0.00 1	32.61 1	21.33 1	17.88 1	32.18 1	42.58 1	0.00 1	0.00 1
11	181.70	50.00	0.00	0.00 1	0.00 1	34.70 1	24.22 1	14.06 1	29.97 1	40.42 1	0.00 1	0.00 1
12	181.65	53.50	0.00	0.00 1	0.00 1	36.86 1	26.71 1	7.98 1	27.86 1	38.31 1	0.00 1	0.00 1
13	181.60	57.00	0.00	0.00 1	0.00 1	39.04 1	28.91 1	7.98 1	25.81 1	36.26 1	0.00 1	0.00 1
14	181.55	60.50	0.00	0.00 1	0.00 1	40.93 1	31.08 1	14.15 1	23.29 1	34.24 1	0.00 1	0.00 1
15	181.50	64.00	0.00	0.00 1	0.00 1	42.74 1	33.28 1	17.97 1	20.39 1	32.27 1	0.00 1	0.00 1
16	181.45	67.50	0.00	0.00 1	0.00 1	44.50 1	35.37 1	20.94 1	17.33 1	30.11 1	0.00 1	0.00 1
17	181.40	71.00	0.00	0.00 1	0.00 1	46.12 1	37.27 1	23.62 1	13.45 1	27.61 1	0.00 1	0.00 1
18	181.38	74.50	0.00	0.00 1	0.00 1	47.84 1	39.18 1	25.80 1	6.92 1	25.18 1	0.00 1	0.00 1
19	181.35	78.00	0.00	0.00 1	0.00 1	49.72 1	41.14 1	27.90 1	6.92 1	22.46 1	0.00 1	0.00 1
20	181.32	81.50	0.00	0.00 1	0.00 1	51.70 1	43.19 1	30.07 1	13.51 1	19.73 1	0.00 1	0.00 1
21	181.30	85.00	0.00	0.00 1	0.00 1	53.68 1	45.16 1	32.15 1	17.04 1	16.90 1	0.00 1	0.00 1
22	181.26	88.50	0.00	0.00 1	0.00 1	55.51 1	47.00 1	34.08 1	19.67 1	13.07 1	0.00 1	0.00 1
23	181.23	92.00	0.00	0.00 1	0.00 1	57.10 1	49.02 1	36.13 1	22.33 1	5.20 1	0.00 1	0.00 1
24	181.20	95.50	0.00	0.00 1	0.00 1	58.67 1	51.39 1	38.53 1	25.24 1	5.20 1	0.00 1	0.00 1

LINEA SISMICA SR_3
TEMPI DI PROPAGAZIONE DELLE ONDE SH

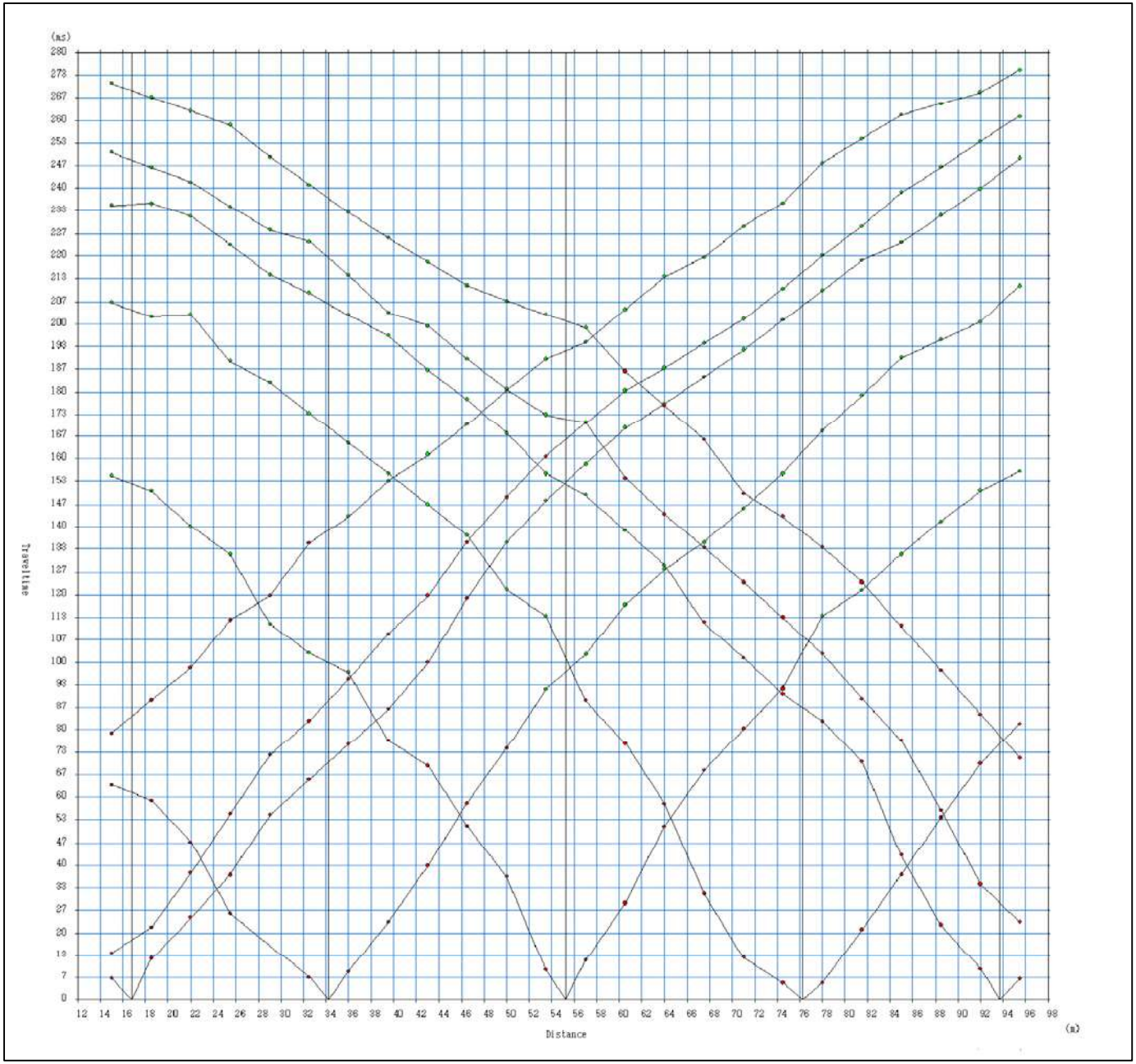
SP	Elev	X-loc	Y-Loc	Depth
1	0.00	0.00	0.00	0.00
2	0.00	11.50	0.00	0.00
3	182.35	16.75	0.00	0.00
4	181.92	34.25	0.00	0.00
5	181.63	55.25	0.00	0.00
6	181.37	76.25	0.00	0.00
7	181.21	93.75	0.00	0.00
8	0.00	99.00	0.00	0.00
9	0.00	110.50	0.00	0.00

Geo	Elev	X-loc	Y-Loc	SP 1	SP 2	SP 3	SP 4	SP 5	SP 6	SP 7	SP 8	SP 9
1	182.40	15.00	0.00	0.00 1	0.00 1	8.81 1	72.39 1	157.64	1209.62	1238.64	10.00 1	0.00 1
2	182.30	18.50	0.00	0.00 1	0.00 1	8.81 1	60.58 1	147.83	1205.73	1234.75	10.00 1	0.00 1
3	182.20	22.00	0.00	0.00 1	0.00 1	24.31 1	46.21 1	137.34	1200.88	1230.92	10.00 1	0.00 1
4	182.10	25.50	0.00	0.00 1	0.00 1	37.70 1	33.01 1	125.97	1189.87	1224.72	10.00 1	0.00 1
5	182.00	29.00	0.00	0.00 1	0.00 1	50.02 1	21.01 1	114.51	1179.12	1217.45	10.00 1	0.00 1
6	181.95	32.50	0.00	0.00 1	0.00 1	61.83 1	8.25 1	103.63	1169.60	1211.86	10.00 1	0.00 1
7	181.90	36.00	0.00	0.00 1	0.00 1	73.40 1	8.25 1	92.79 1	160.51	1204.44	10.00 1	0.00 1
8	181.85	39.50	0.00	0.00 1	0.00 1	86.51 1	23.38 1	81.35 1	151.85	1195.79	10.00 1	0.00 1
9	181.80	43.00	0.00	0.00 1	0.00 1	100.89	139.21 1	68.58 1	143.07	1187.20	10.00 1	0.00 1
10	181.75	46.50	0.00	0.00 1	0.00 1	116.22	156.64 1	51.83 1	133.24	1178.27	10.00 1	0.00 1
11	181.70	50.00	0.00	0.00 1	0.00 1	131.61	175.46 1	33.36 1	122.22	1169.17	10.00 1	0.00 1
12	181.65	53.50	0.00	0.00 1	0.00 1	145.90	191.12 1	11.75 1	108.12	1160.01	10.00 1	0.00 1
13	181.60	57.00	0.00	0.00 1	0.00 1	159.52	1105.03	111.75 1	90.86 1	152.03	10.00 1	0.00 1
14	181.55	60.50	0.00	0.00 1	0.00 1	168.85	1117.33	131.45 1	72.07 1	142.41	10.00 1	0.00 1
15	181.50	64.00	0.00	0.00 1	0.00 1	178.39	1126.88	149.36 1	53.71 1	127.43	10.00 1	0.00 1
16	181.45	67.50	0.00	0.00 1	0.00 1	188.51	1136.99	166.15 1	35.67 1	112.88	10.00 1	0.00 1
17	181.40	71.00	0.00	0.00 1	0.00 1	199.26	1147.75	180.82 1	20.25 1	99.36 1	0.00 1	0.00 1
18	181.38	74.50	0.00	0.00 1	0.00 1	205.21	1159.28	194.13 1	6.71 1	86.79 1	0.00 1	0.00 1
19	181.35	78.00	0.00	0.00 1	0.00 1	210.74	1170.13	1107.38	16.71 1	74.21 1	0.00 1	0.00 1
20	181.32	81.50	0.00	0.00 1	0.00 1	216.78	1179.15	1121.07	121.54 1	59.38 1	0.00 1	0.00 1
21	181.30	85.00	0.00	0.00 1	0.00 1	222.88	1188.18	1134.37	138.16 1	42.75 1	0.00 1	0.00 1
22	181.26	88.50	0.00	0.00 1	0.00 1	228.83	1196.29	1143.62	155.36 1	25.55 1	0.00 1	0.00 1
23	181.23	92.00	0.00	0.00 1	0.00 1	234.44	1204.48	1151.81	172.41 1	8.51 1	0.00 1	0.00 1
24	181.20	95.50	0.00	0.00 1	0.00 1	239.96	1212.21	1160.68	186.62 1	8.51 1	0.00 1	0.00 1

LINEA SISMICA SR_3
DROMOCRONE DELLE ONDE P



LINEA SISMICA SR_3
DROMOCRONE DELLE ONDE SH



LINEA SISMICA SR_3
VELOCITA' SISMICHE DEI RIFRATTORI INDIVIDUATI

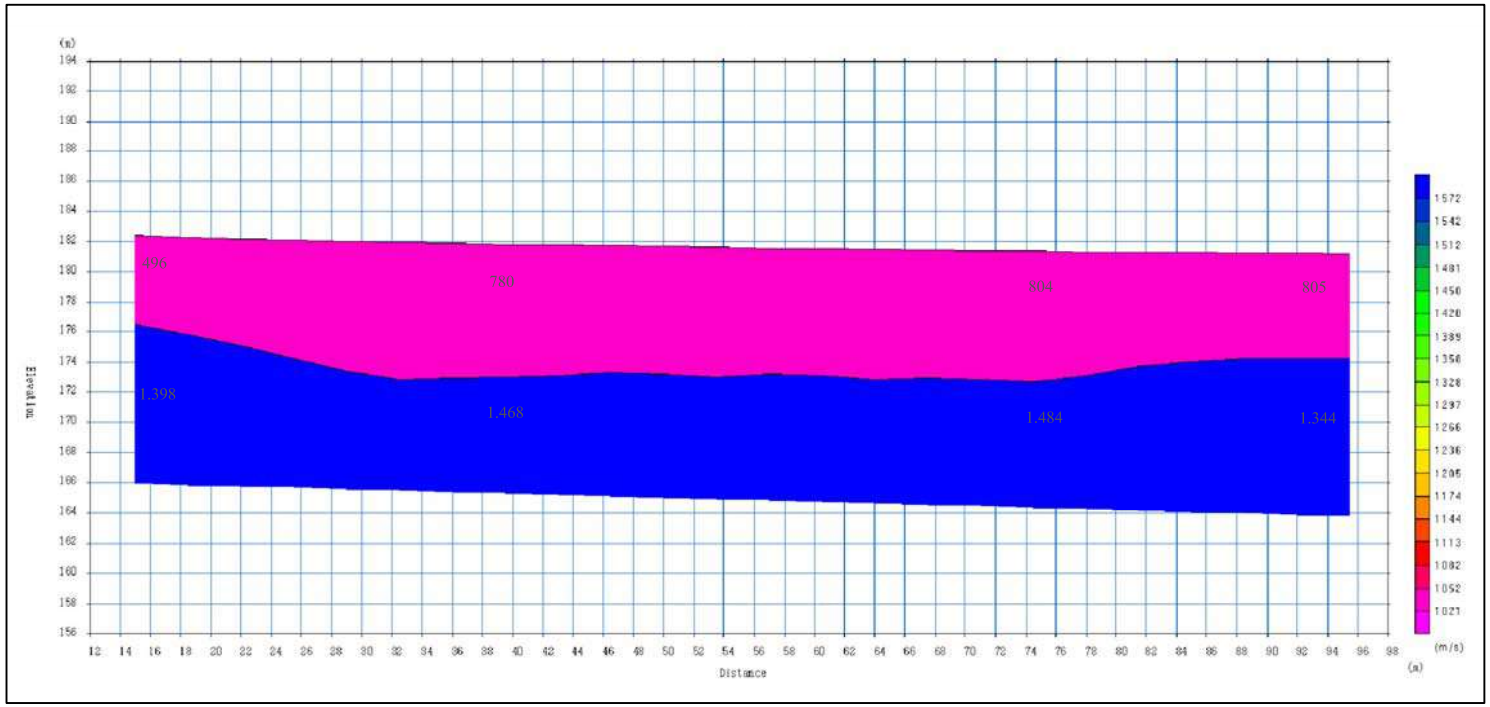
Onde P

		Strato 1	Strato 2
Geofono	x (m)	Vs (m/sec)	Vs (m/sec)
1	15	799.68	1400.23
2	18.5	791.71	1396.70
3	22	773.64	1393.81
4	25.5	755.61	1398.73
5	29	749.45	1410.40
6	32.5	756.71	1419.15
7	36	766.77	1425.42
8	39.5	773.96	1436.41
9	43	786.76	1454.15
10	46.5	804.33	1481.15
11	50	812.88	1514.07
12	53.5	813.02	1537.87
13	57	810.93	1545.92
14	60.5	803.70	1540.49
15	64	795.62	1519.60
16	67.5	798.98	1498.17
17	71	808.55	1488.58
18	74.5	807.99	1480.11
19	78	800.83	1464.90
20	81.5	795.91	1439.17
21	85	795.33	1404.04
22	88.5	800.02	1369.05
23	92	804.10	1348.62
24	95.5	805.42	1339.97

Onde SH

		Strato 1	Strato 2
Geofono	x (m)	Vs (m/sec)	Vs (m/sec)
1	15	250.02	434.21
2	18.5	251.44	433.13
3	22	256.66	430.87
4	25.5	263.42	429.23
5	29	262.95	431.86
6	32.5	250.81	440.89
7	36	232.04	453.16
8	39.5	213.04	463.22
9	43	197.14	469.04
10	46.5	186.48	472.94
11	50	183.72	477.05
12	53.5	188.68	481.77
13	57	194.50	486.18
14	60.5	198.57	487.20
15	64	206.16	483.53
16	67.5	217.69	476.17
17	71	226.98	465.16
18	74.5	229.14	451.79
19	78	223.57	439.97
20	81.5	215.08	431.41
21	85	210.30	423.37
22	88.5	210.67	414.48
23	92	212.39	409.10
24	95.5	213.41	407.16

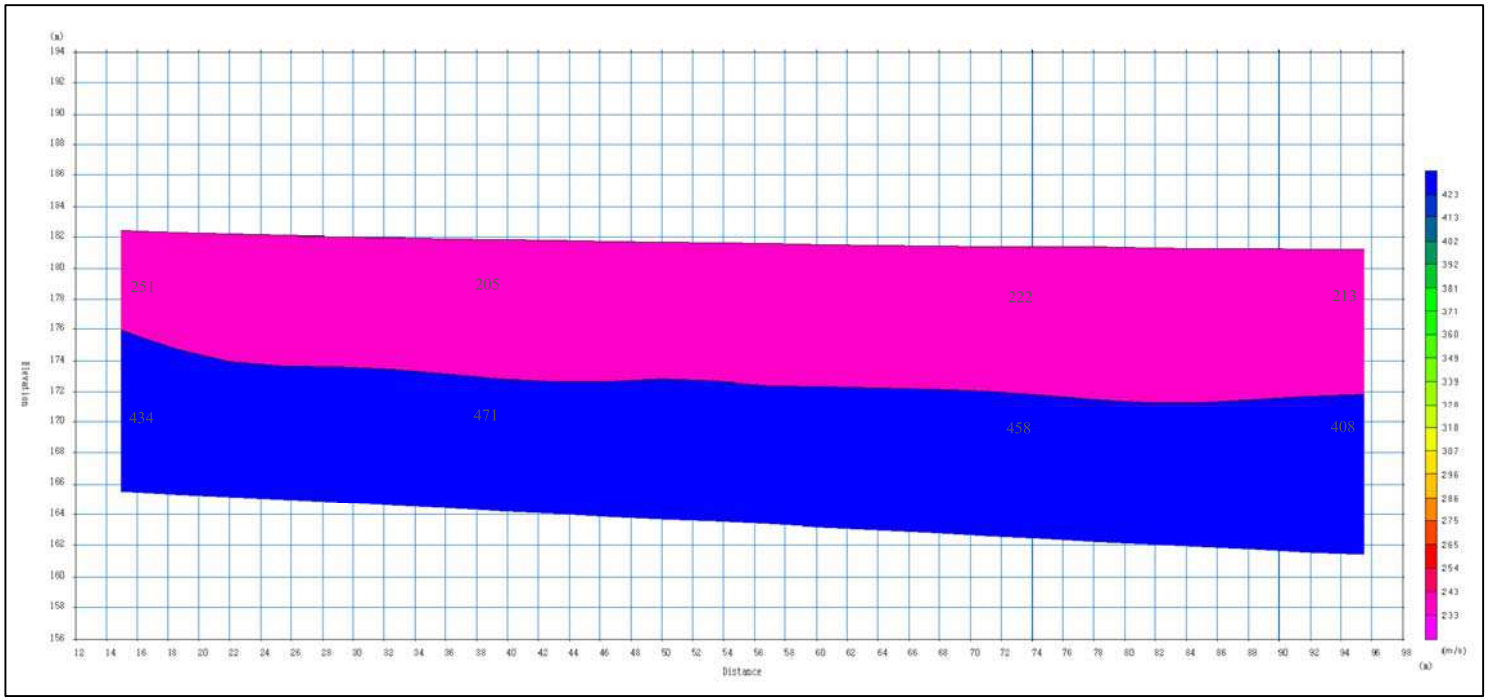
LINEA SISMICA SR_3
SEZIONE SISMOSTRATIGRAFICA: ONDE P



Scala 1:500

321 VELOCITA' SISMICA DELLO STRATO IN m/sec

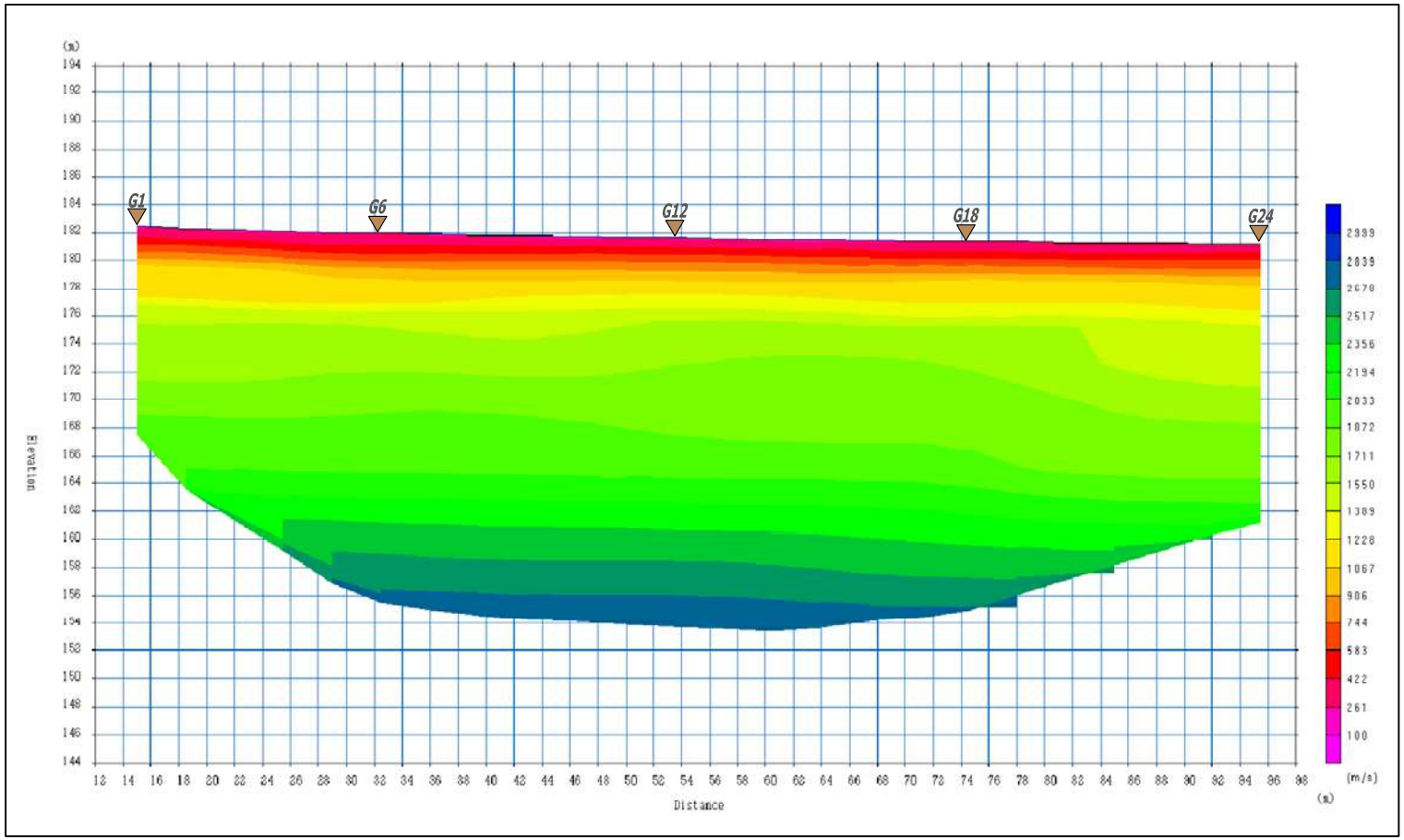
LINEA SISMICA SR_3
SEZIONE SISMOSTRATIGRAFICA: ONDE SH



Scala 1:500

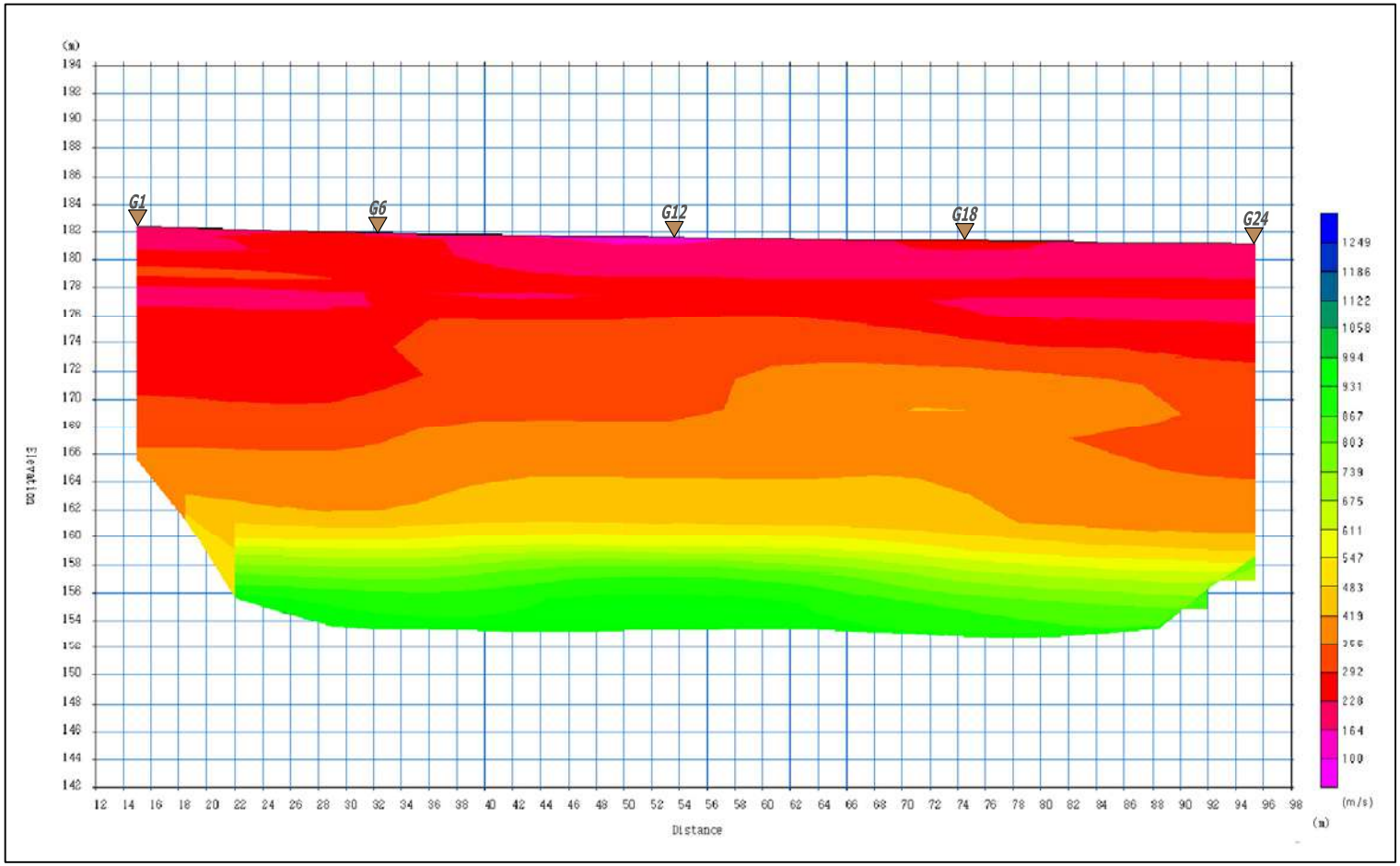
321 VELOCITA' SISMICA DELLO STRATO IN m/sec

LINEA SISMICA SR_3
SEZIONE TOMOGRAFICA ONDE P



Scala 1:500

LINEA SISMICA SR_3
SEZIONE TOMOGRAFICA ONDE SH



Scala 1:500

Scala 1:1.000

PROSPEZIONE SISMICA A RIFRAZIONE (SR_4) CON ONDE P E SH

▫ G1	POSIZIONE GEOFONO
E ▲	TIRI ESTERNI
A e B ▲	TIRI ESTREMI
C ▲	TIRO CENTRALE
D1-D2 ▲	TIRI INTERMEDI SINISTRI
D3-D4 ▲	TIRI INTERMEDI DESTRI

SR_4 LINEA SISMICA SR_4

N
W E
S

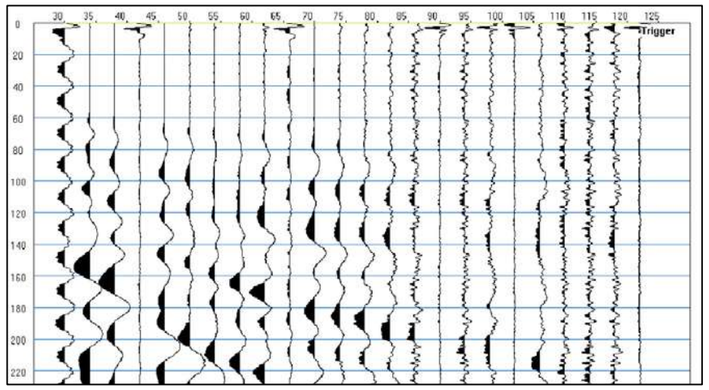
Linea sismica a rifrazione SR_4																								
Geofoni	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Distanza Progressiva (m)	30	34	38	42	46	50	54	58	62	66	70	74	78	82	86	90	94	98	102	106	110	114	118	122
Distanza Parziale (m)	0	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
Quota (m slm)	211.5	211.5	211.5	211.5	211.5	211.5	211.5	211.5	211.5	211.5	211.5	211.5	211.5	211.5	211.5	211.5	211.5	211.5	211.5	211.5	211.5	211.5	211.5	211.5

	Linea sismica SR_4	
	Coordinate Gauss Boaga	
	Geofono N.1 (G1)	Geofono N.24 (G24)
X (m)	1683979	1684068
Y (m)	4795612	4795693

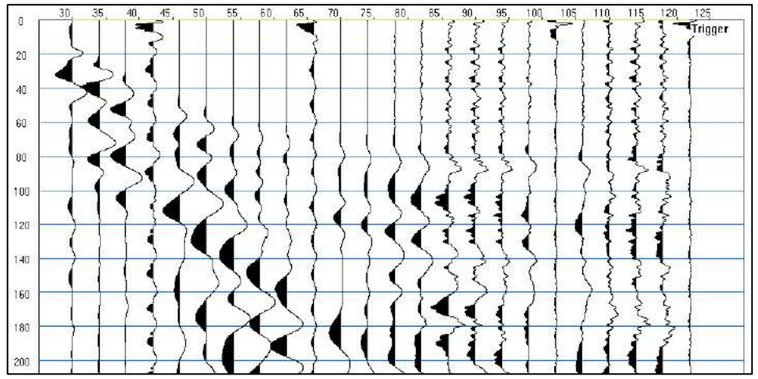
	Punti di energizzazione linea sismica SR_4								
	E1 Esterno Sx	A Estremo Sx	D1 Intermedio Sx	D2 Intermedio Sx	C Centrale	D3 Intermedio Dx	D4 Intermedio Dx	B Estremo Dx	E2 Esterno Dx
Onde P	vols1p1	vols1p2	vols1p3	vols1p4	vols1p5	vols1p6	vols1p7	vols1p8	vols1p9
Onde SH	s1	s2	s3	s4	s5	s6	s7	s8	s9
Posiz. dal geof. N.1 (m)	0	26	32	52	76	100	120	126	152
Quota (m slm)	211.5	211.5	211.5	211.5	211.5	211.5	211.5	211.5	211.5

LINEA SISMICA SR_4
REGISTRAZIONI DI CAMPAGNA DELLE ONDE P

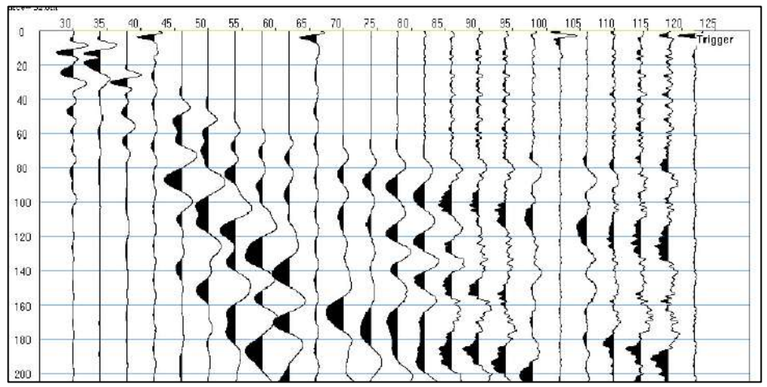
TIRO ESTERNO SINISTRO E1



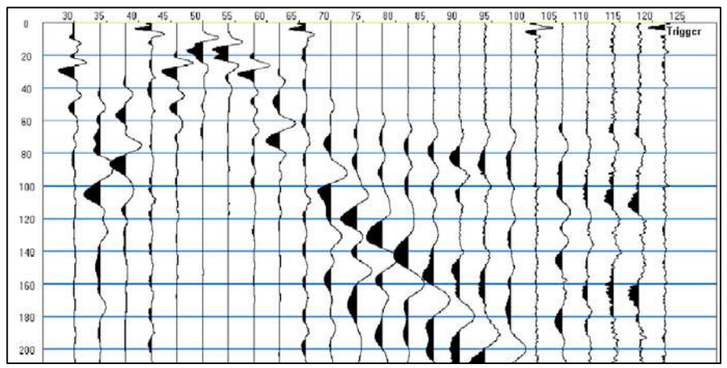
TIRO ESTREMO SINISTRO A



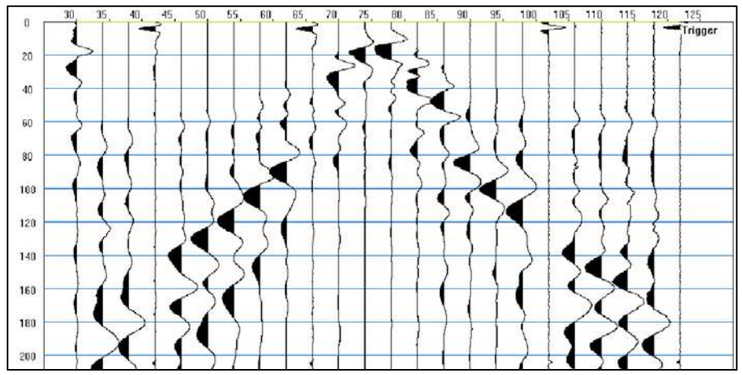
TIRO INTERMEDIO D1



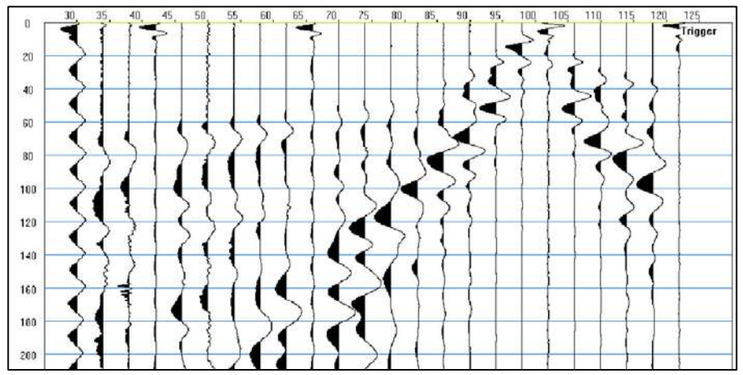
TIRO INTERMEDIO D2



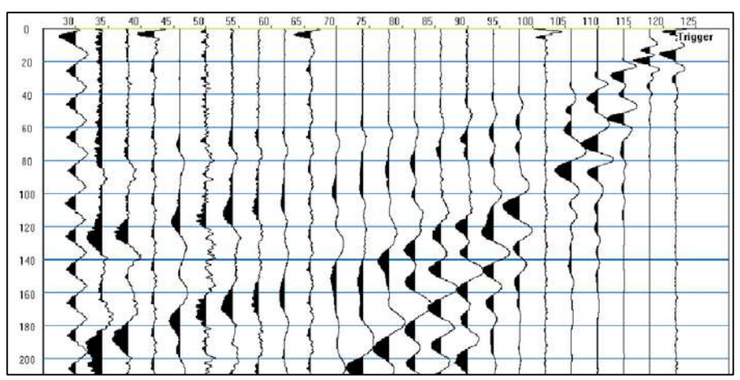
TIRO CENTRALE C



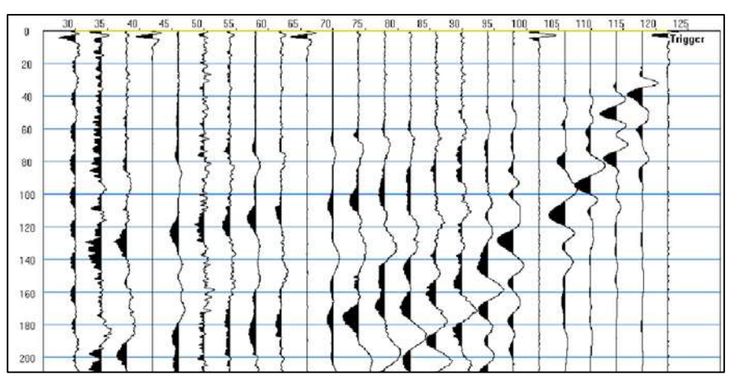
TIRO INTERMEDIO D3



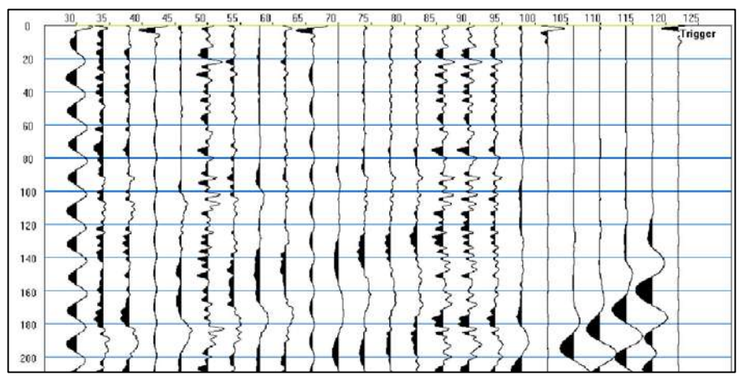
TIRO INTERMEDIO D4



TIRO ESTREMO DESTRO B

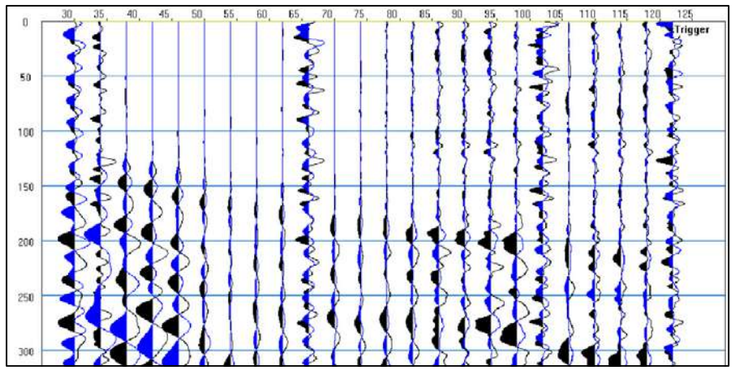


TIRO ESTERNO DESTRO E2

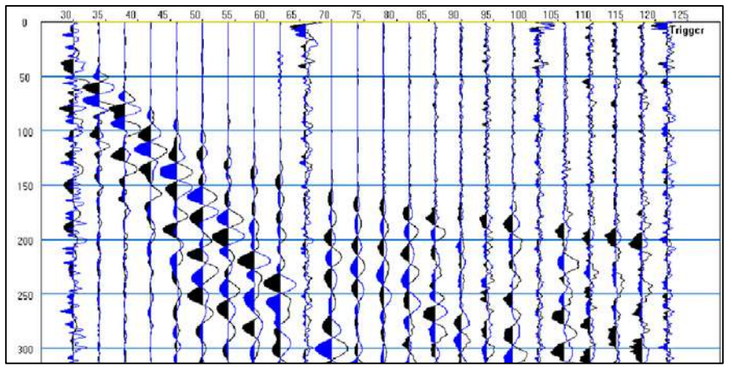


LINEA SISMICA SR_4
REGISTRAZIONI DI CAMPAGNA DELLE ONDE SH

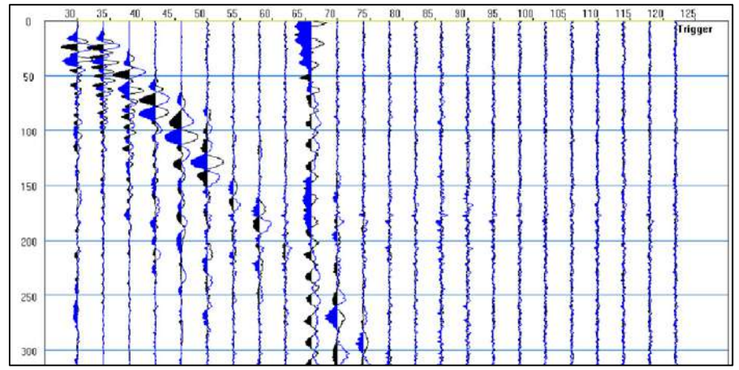
TIRO ESTERNO SINISTRO E1



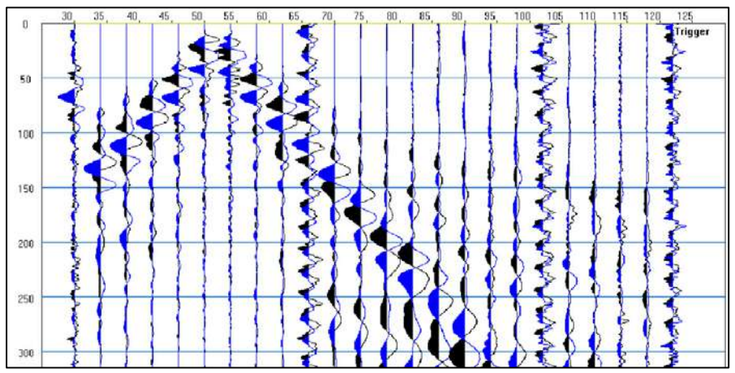
TIRO ESTREMO SINISTRO A



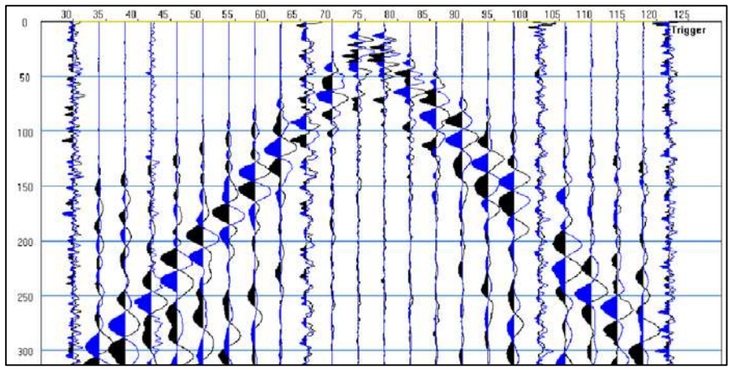
TIRO INTERMEDIO D1



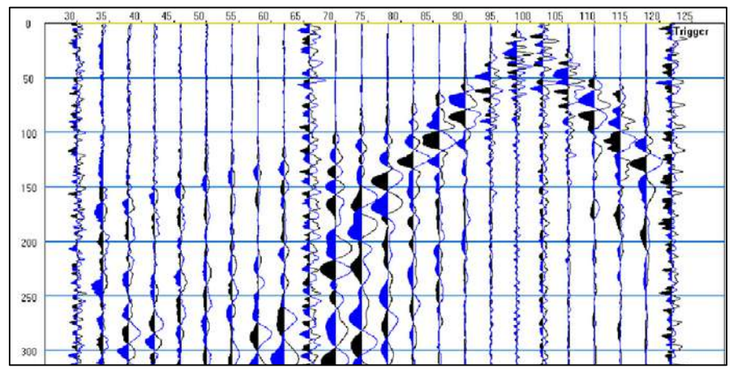
TIRO INTERMEDIO D2



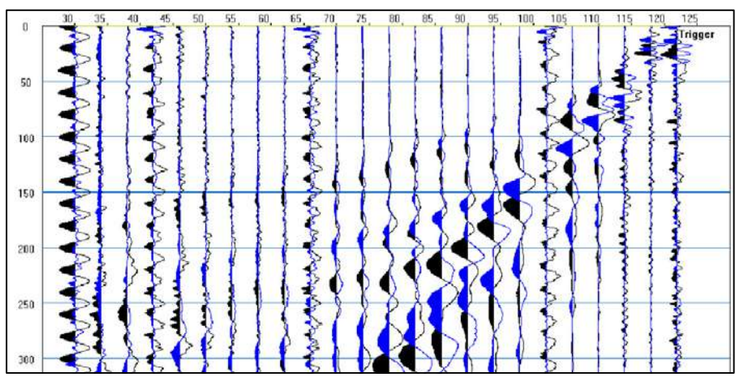
TIRO CENTRALE C



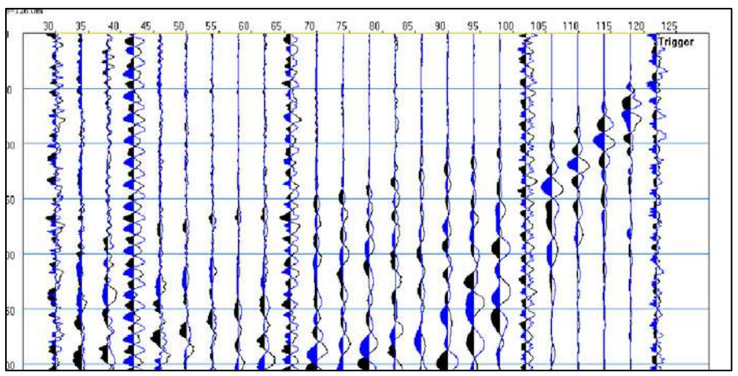
TIRO INTERMEDIO D3



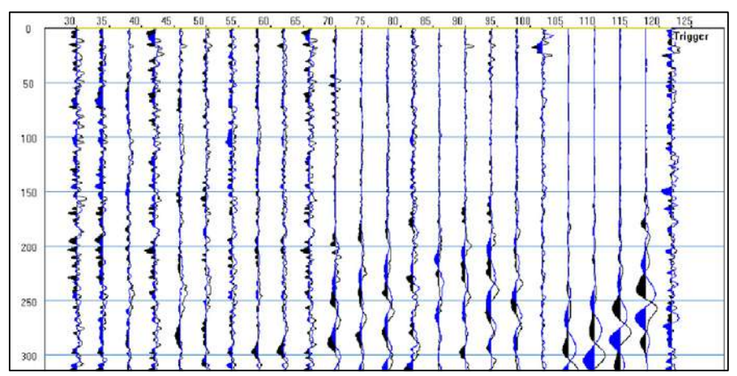
TIRO INTERMEDIO D4



TIRO ESTREMO DESTRO B



TIRO ESTERNO DESTRO E2



LINEA SISMICA SR_4
TEMPI DI PROPAGAZIONE DELLE ONDE P

SP	Elev	X-loc	Y-Loc	Depth
1	0.00	0.00	0.00	0.00
2	0.00	26.00	0.00	0.00
3	211.50	32.00	0.00	0.00
4	211.50	52.00	0.00	0.00
5	211.50	76.00	0.00	0.00
6	211.50	100.00	0.00	0.00
7	211.50	120.00	0.00	0.00
8	0.00	126.00	0.00	0.00
9	0.00	152.00	0.00	0.00

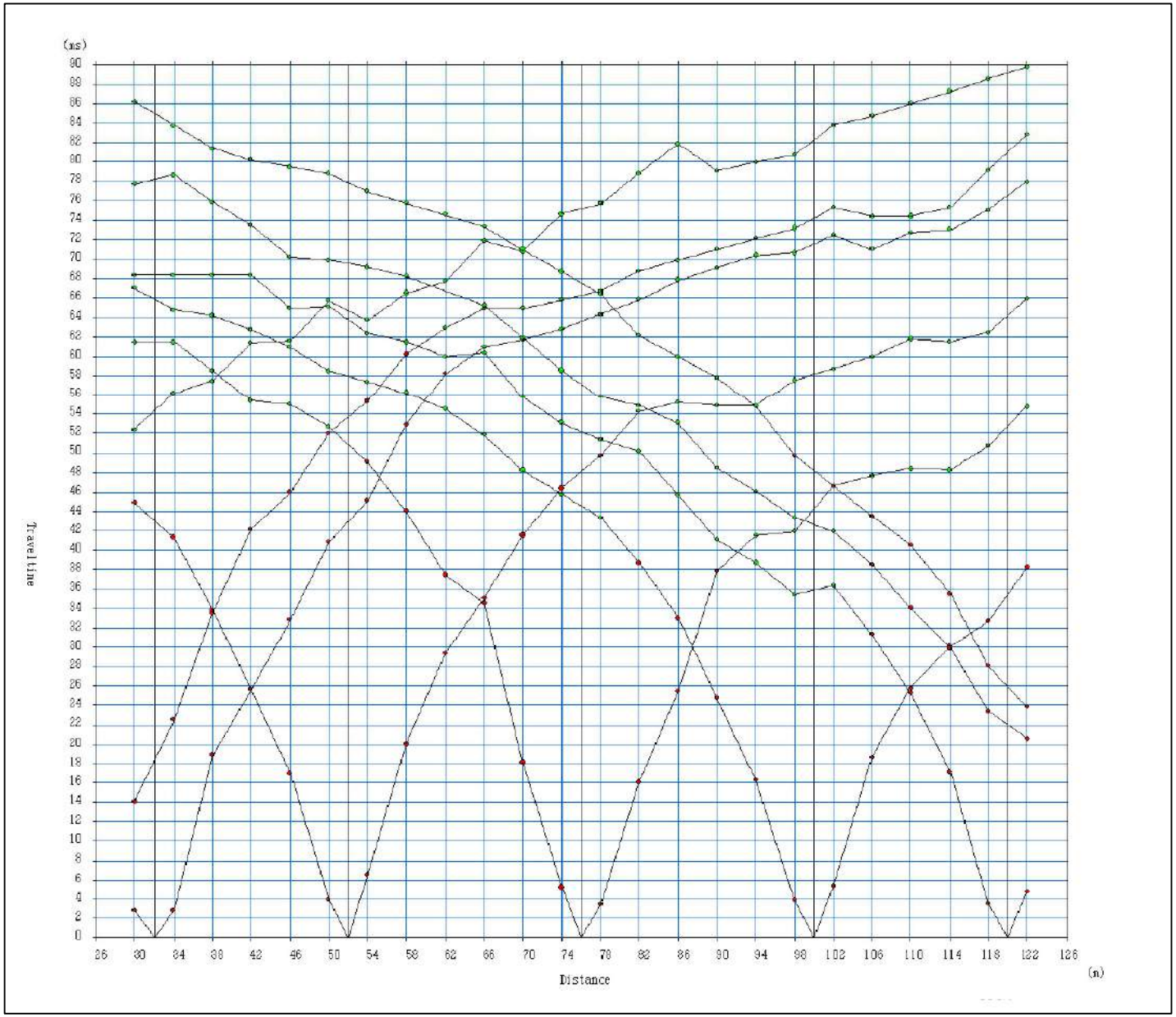
Geo	Elev	X-loc	Y-Loc	SP 1	SP 2	SP 3	SP 4	SP 5	SP 6	SP 7	SP 8	SP 9
1	211.50	30.00	0.00	0.00 1	0.00 1	6.72 1	45.23 1	63.32 1	68.57 1	73.18 1	0.00 1	0.00 1
2	211.50	34.00	0.00	0.00 1	0.00 1	6.72 1	38.80 1	61.21 1	66.92 1	71.65 1	0.00 1	0.00 1
3	211.50	38.00	0.00	0.00 1	0.00 1	19.13 1	32.54 1	58.73 1	65.38 1	70.35 1	0.00 1	0.00 1
4	211.50	42.00	0.00	0.00 1	0.00 1	26.53 1	26.25 1	56.16 1	63.10 1	68.99 1	0.00 1	0.00 1
5	211.50	46.00	0.00	0.00 1	0.00 1	32.89 1	19.93 1	53.61 1	61.00 1	66.89 1	0.00 1	0.00 1
6	211.50	50.00	0.00	0.00 1	0.00 1	38.95 1	8.34 1	50.62 1	59.04 1	64.94 1	0.00 1	0.00 1
7	211.50	54.00	0.00	0.00 1	0.00 1	45.11 1	8.34 1	46.91 1	57.51 1	63.42 1	0.00 1	0.00 1
8	211.50	58.00	0.00	0.00 1	0.00 1	50.91 1	20.93 1	42.76 1	56.53 1	62.48 1	0.00 1	0.00 1
9	211.50	62.00	0.00	0.00 1	0.00 1	56.15 1	28.72 1	37.19 1	55.03 1	61.50 1	0.00 1	0.00 1
10	211.50	66.00	0.00	0.00 1	0.00 1	59.31 1	35.63 1	30.50 1	52.28 1	59.75 1	0.00 1	0.00 1
11	211.50	70.00	0.00	0.00 1	0.00 1	60.83 1	41.78 1	19.74 1	49.06 1	57.01 1	0.00 1	0.00 1
12	211.50	74.00	0.00	0.00 1	0.00 1	61.88 1	47.00 1	8.13 1	45.95 1	53.93 1	0.00 1	0.00 1
13	211.50	78.00	0.00	0.00 1	0.00 1	63.14 1	50.54 1	8.13 1	42.17 1	51.48 1	0.00 1	0.00 1
14	211.50	82.00	0.00	0.00 1	0.00 1	64.34 1	53.20 1	18.58 1	38.22 1	49.19 1	0.00 1	0.00 1
15	211.50	86.00	0.00	0.00 1	0.00 1	65.48 1	55.09 1	27.71 1	32.11 1	46.72 1	0.00 1	0.00 1
16	211.50	90.00	0.00	0.00 1	0.00 1	66.26 1	56.04 1	35.10 1	25.25 1	43.50 1	0.00 1	0.00 1
17	211.50	94.00	0.00	0.00 1	0.00 1	66.68 1	56.62 1	39.94 1	18.70 1	39.59 1	0.00 1	0.00 1
18	211.50	98.00	0.00	0.00 1	0.00 1	67.56 1	57.70 1	42.82 1	7.81 1	36.36 1	0.00 1	0.00 1
19	211.50	102.00	0.00	0.00 1	0.00 1	68.62 1	59.04 1	45.64 1	7.81 1	33.60 1	0.00 1	0.00 1
20	211.50	106.00	0.00	0.00 1	0.00 1	69.72 1	60.56 1	47.56 1	18.99 1	30.10 1	0.00 1	0.00 1
21	211.50	110.00	0.00	0.00 1	0.00 1	70.53 1	61.71 1	49.15 1	25.32 1	24.42 1	0.00 1	0.00 1
22	211.50	114.00	0.00	0.00 1	0.00 1	71.04 1	62.44 1	50.34 1	30.65 1	17.19 1	0.00 1	0.00 1
23	211.50	118.00	0.00	0.00 1	0.00 1	72.02 1	63.53 1	51.83 1	33.56 1	6.55 1	0.00 1	0.00 1
24	211.50	122.00	0.00	0.00 1	0.00 1	73.47 1	65.07 1	53.80 1	36.40 1	6.55 1	0.00 1	0.00 1

LINEA SISMICA SR_4
TEMPI DI PROPAGAZIONE DELLE ONDE SH

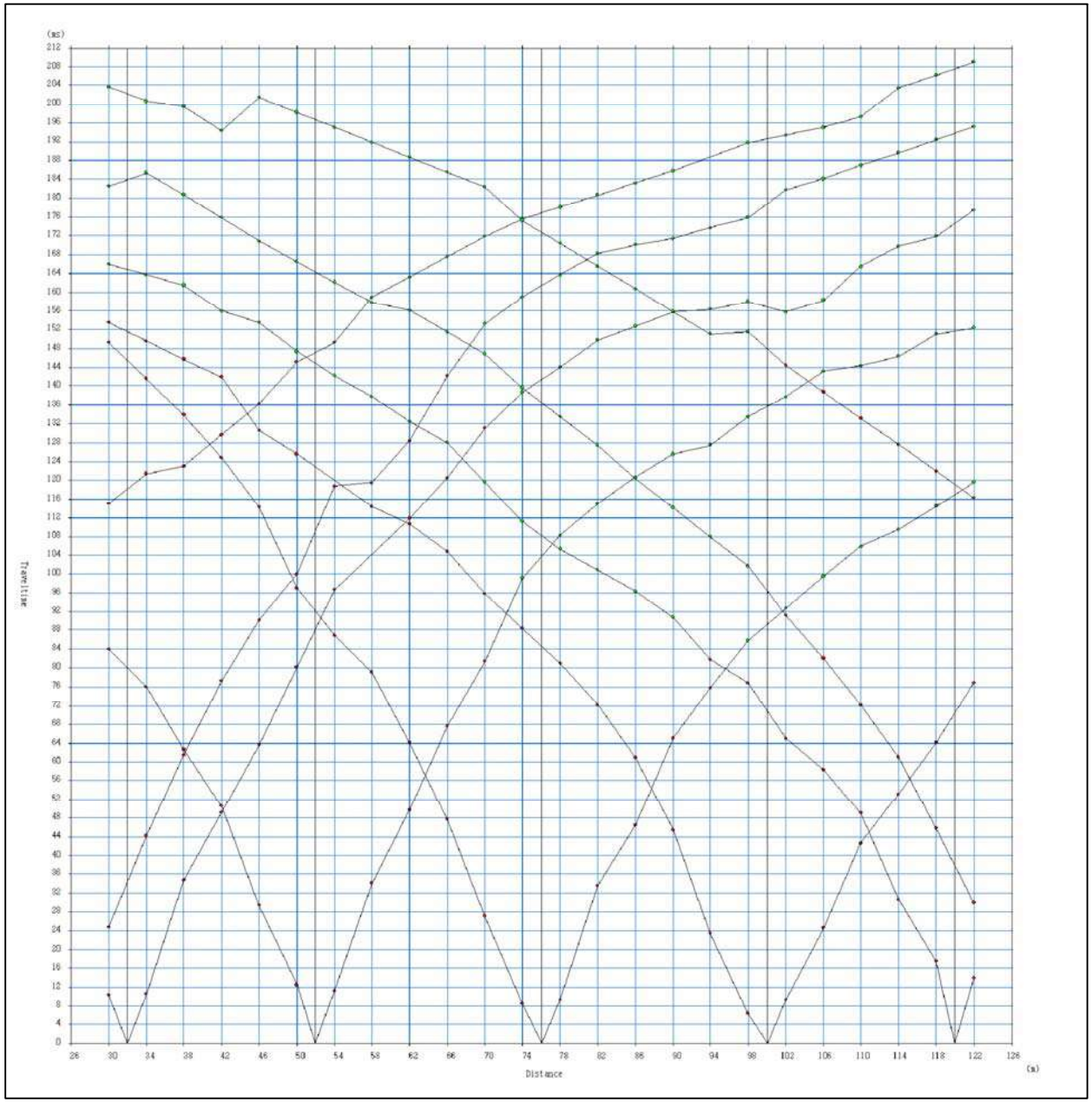
SP	Elev	X-loc	Y-Loc	Depth
1	0.00	0.00	0.00	0.00
2	0.00	26.00	0.00	0.00
3	211.50	32.00	0.00	0.00
4	211.50	52.00	0.00	0.00
5	211.50	76.00	0.00	0.00
6	211.50	100.00	0.00	0.00
7	211.50	120.00	0.00	0.00
8	0.00	126.00	0.00	0.00
9	0.00	152.00	0.00	0.00

Geo	Elev	X-loc	Y-Loc	SP 1	SP 2	SP 3	SP 4	SP 5	SP 6	SP 7	SP 8	SP 9
1	211.50	30.00	0.00	0.00 1	0.00 1	12.48 1	90.41 1	144.60	1156.68	1171.88	10.00 1	0.00 1
2	211.50	34.00	0.00	0.00 1	0.00 1	12.48 1	77.61 1	137.69	1152.76	1168.07	10.00 1	0.00 1
3	211.50	38.00	0.00	0.00 1	0.00 1	33.28 1	64.08 1	129.66	1147.55	1163.62	10.00 1	0.00 1
4	211.50	42.00	0.00	0.00 1	0.00 1	50.53 1	49.37 1	120.85	1142.21	1158.57	10.00 1	0.00 1
5	211.50	46.00	0.00	0.00 1	0.00 1	64.23 1	31.99 1	111.63	1137.72	1154.23	10.00 1	0.00 1
6	211.50	50.00	0.00	0.00 1	0.00 1	77.77 1	12.57 1	102.67	1133.89	1150.68	10.00 1	0.00 1
7	211.50	54.00	0.00	0.00 1	0.00 1	90.52 1	12.57 1	92.15 1	128.45	1148.31	10.00 1	0.00 1
8	211.50	58.00	0.00	0.00 1	0.00 1	103.07	132.65 1	79.22 1	120.19	1141.77	10.00 1	0.00 1
9	211.50	62.00	0.00	0.00 1	0.00 1	112.68	149.65 1	64.14 1	112.68	1134.40	10.00 1	0.00 1
10	211.50	66.00	0.00	0.00 1	0.00 1	122.08	165.45 1	47.35 1	105.95	1127.94	10.00 1	0.00 1
11	211.50	70.00	0.00	0.00 1	0.00 1	131.42	179.77 1	30.09 1	99.27 1	121.77	10.00 1	0.00 1
12	211.50	74.00	0.00	0.00 1	0.00 1	138.65	192.48 1	11.04 1	91.16 1	116.29	10.00 1	0.00 1
13	211.50	78.00	0.00	0.00 1	0.00 1	143.64	1103.00	111.04 1	82.26 1	111.04	10.00 1	0.00 1
14	211.50	82.00	0.00	0.00 1	0.00 1	146.81	1112.44	130.78 1	72.29 1	105.48	10.00 1	0.00 1
15	211.50	86.00	0.00	0.00 1	0.00 1	149.20	1118.51	148.15 1	60.51 1	99.05 1	0.00 1	0.00 1
16	211.50	90.00	0.00	0.00 1	0.00 1	150.82	1123.58	163.67 1	43.47 1	91.73 1	0.00 1	0.00 1
17	211.50	94.00	0.00	0.00 1	0.00 1	152.01	1126.96	175.89 1	26.59 1	83.49 1	0.00 1	0.00 1
18	211.50	98.00	0.00	0.00 1	0.00 1	154.05	1130.51	183.36 1	9.38 1	74.93 1	0.00 1	0.00 1
19	211.50	102.00	0.00	0.00 1	0.00 1	156.64	1134.57	189.85 1	9.38 1	65.88 1	0.00 1	0.00 1
20	211.50	106.00	0.00	0.00 1	0.00 1	159.81	1138.48	196.86 1	26.41 1	57.33 1	0.00 1	0.00 1
21	211.50	110.00	0.00	0.00 1	0.00 1	163.02	1142.25	1103.09	142.48 1	47.11 1	0.00 1	0.00 1
22	211.50	114.00	0.00	0.00 1	0.00 1	165.92	1145.15	1107.78	157.13 1	31.67 1	0.00 1	0.00 1
23	211.50	118.00	0.00	0.00 1	0.00 1	168.90	1148.15	1111.58	165.92 1	13.60 1	0.00 1	0.00 1
24	211.50	122.00	0.00	0.00 1	0.00 1	172.40	1151.66	1116.00	174.61 1	13.60 1	0.00 1	0.00 1

LINEA SISMICA SR_4
DROMOCRONE DELLE ONDE P



LINEA SISMICA SR_4
DROMOCRONE DELLE ONDE SH



LINEA SISMICA SR_4
VELOCITA' SISMICHE DEI RIFRATTORI INDIVIDUATI

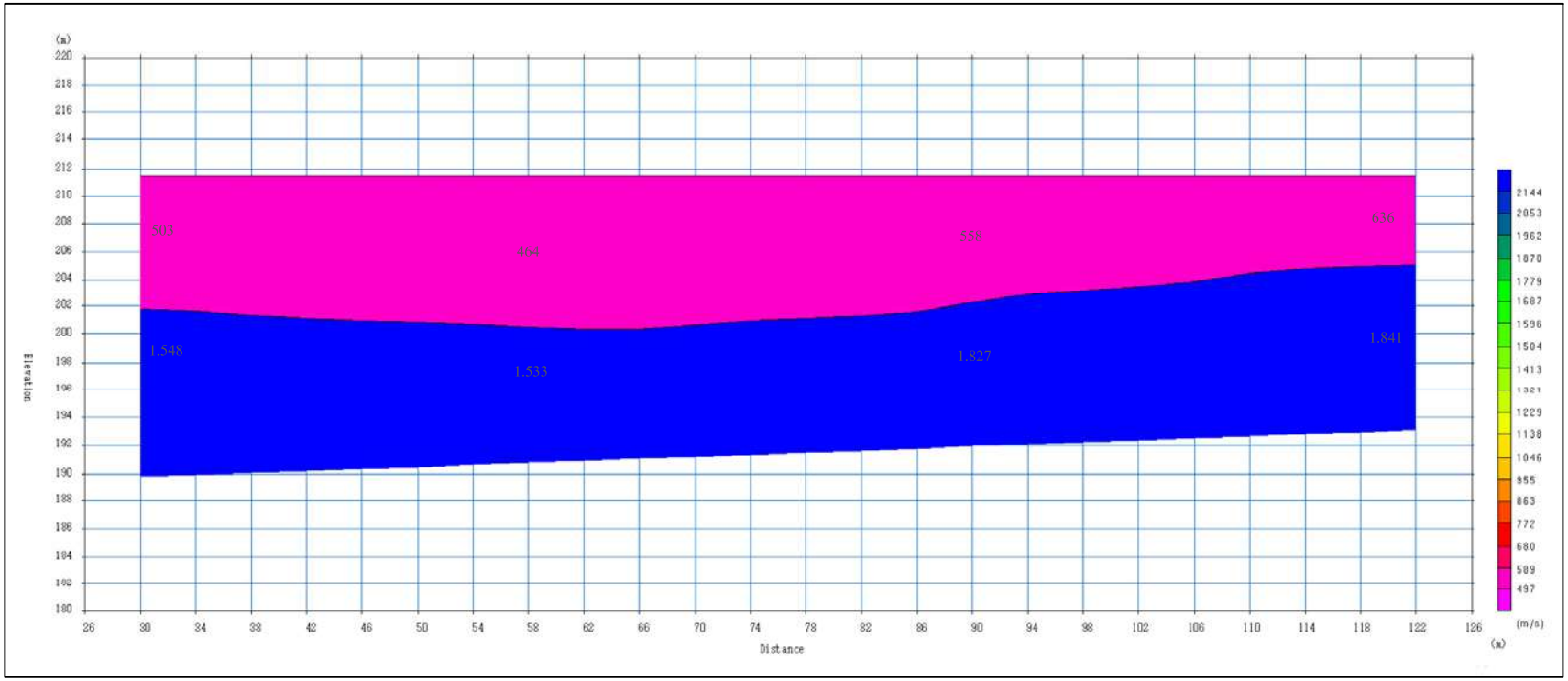
Onde P

		Strato 1	Strato 2
Geofono	x (m)	Vs (m/sec)	Vs (m/sec)
1	30	499.77	1553.86
2	34	507.18	1542.10
3	38	518.53	1522.93
4	42	524.82	1502.35
5	46	523.99	1496.22
6	50	514.04	1503.50
7	54	491.73	1511.02
8	58	469.50	1521.15
9	62	457.66	1531.30
10	66	455.54	1534.93
11	70	467.10	1544.21
12	74	483.67	1575.19
13	78	490.68	1622.80
14	82	494.58	1668.48
15	86	511.80	1710.86
16	90	543.68	1759.11
17	94	571.41	1808.90
18	98	576.60	1845.34
19	102	568.27	1863.82
20	106	571.86	1874.72
21	110	591.79	1875.58
22	114	616.55	1860.40
23	118	632.54	1845.03
24	122	639.86	1836.43

Onde SH

		Strato 1	Strato 2
Geofono	x (m)	Vs (m/sec)	Vs (m/sec)
1	30	255.42	727.89
2	34	259.65	725.25
3	38	265.45	720.06
4	42	268.80	713.74
5	46	265.79	712.55
6	50	256.35	717.67
7	54	251.35	721.22
8	58	254.36	719.68
9	62	256.53	718.78
10	66	257.79	721.88
11	70	259.69	729.02
12	74	258.89	744.42
13	78	260.02	770.74
14	82	245.81	759.53
15	86	249.93	798.30
16	90	257.79	803.43
17	94	271.65	821.81
18	98	280.45	826.98
19	102	276.93	831.84
20	106	270.38	837.52
21	110	269.71	835.77
22	114	271.63	828.76
23	118	272.83	825.47
24	122	273.78	825.47

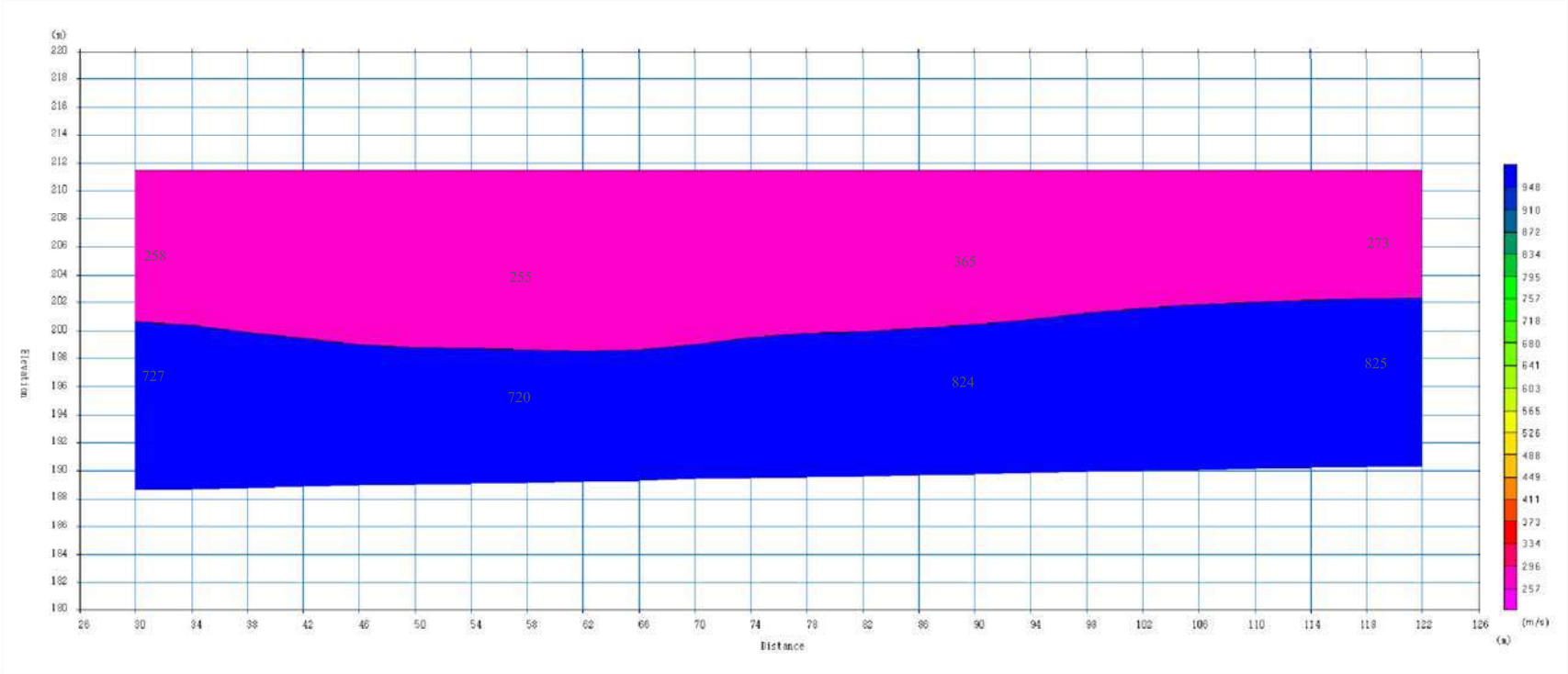
LINEA SISMICA SR_4
SEZIONE SISMOSTRATIGRAFICA: ONDE P



Scala 1:500

321 VELOCITA' SISMICA DELLO STRATO IN m/sec

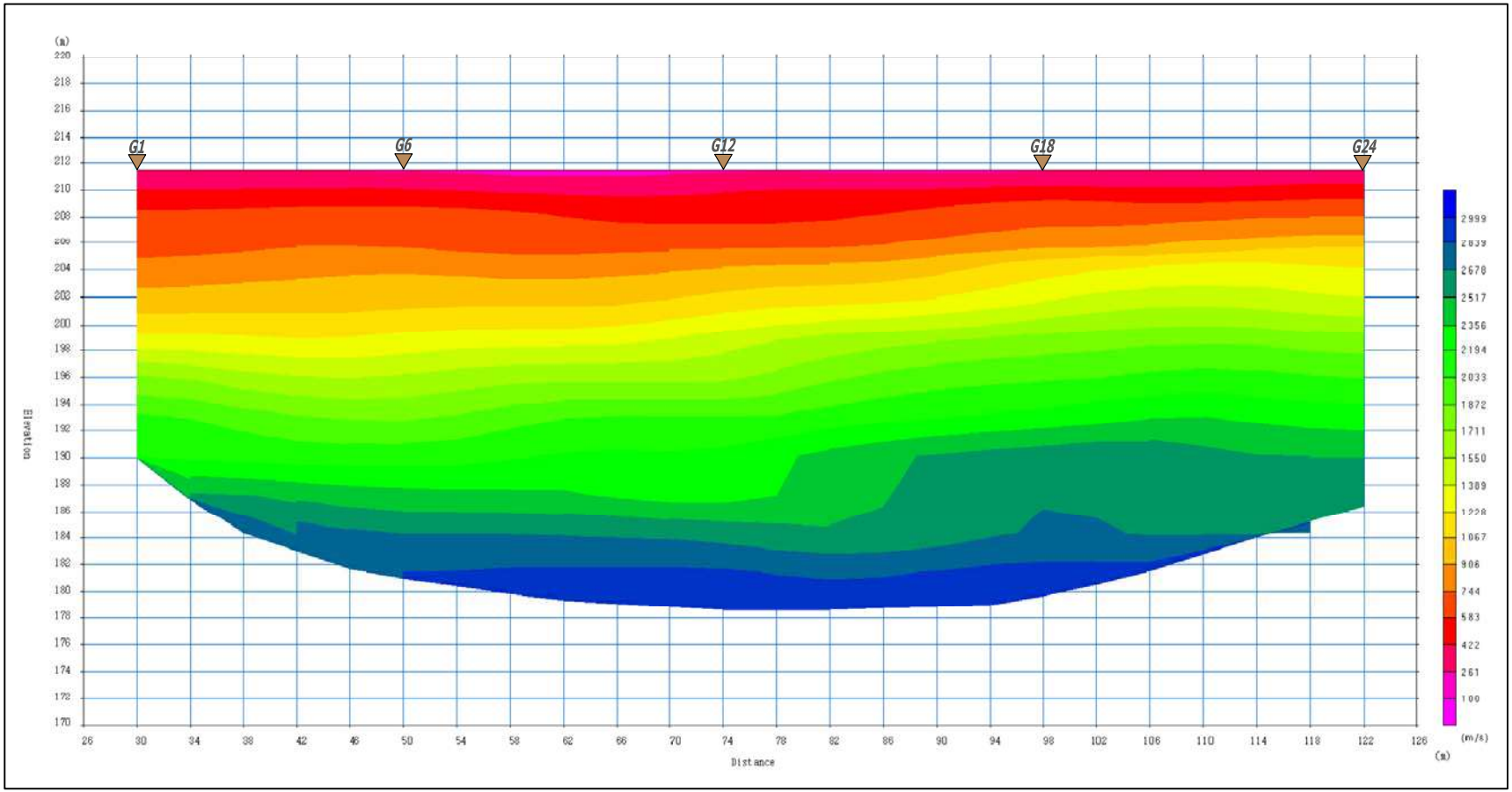
LINEA SISMICA SR_4
SEZIONE SISMOSTRATIGRAFICA: ONDE SH



Scala 1:500

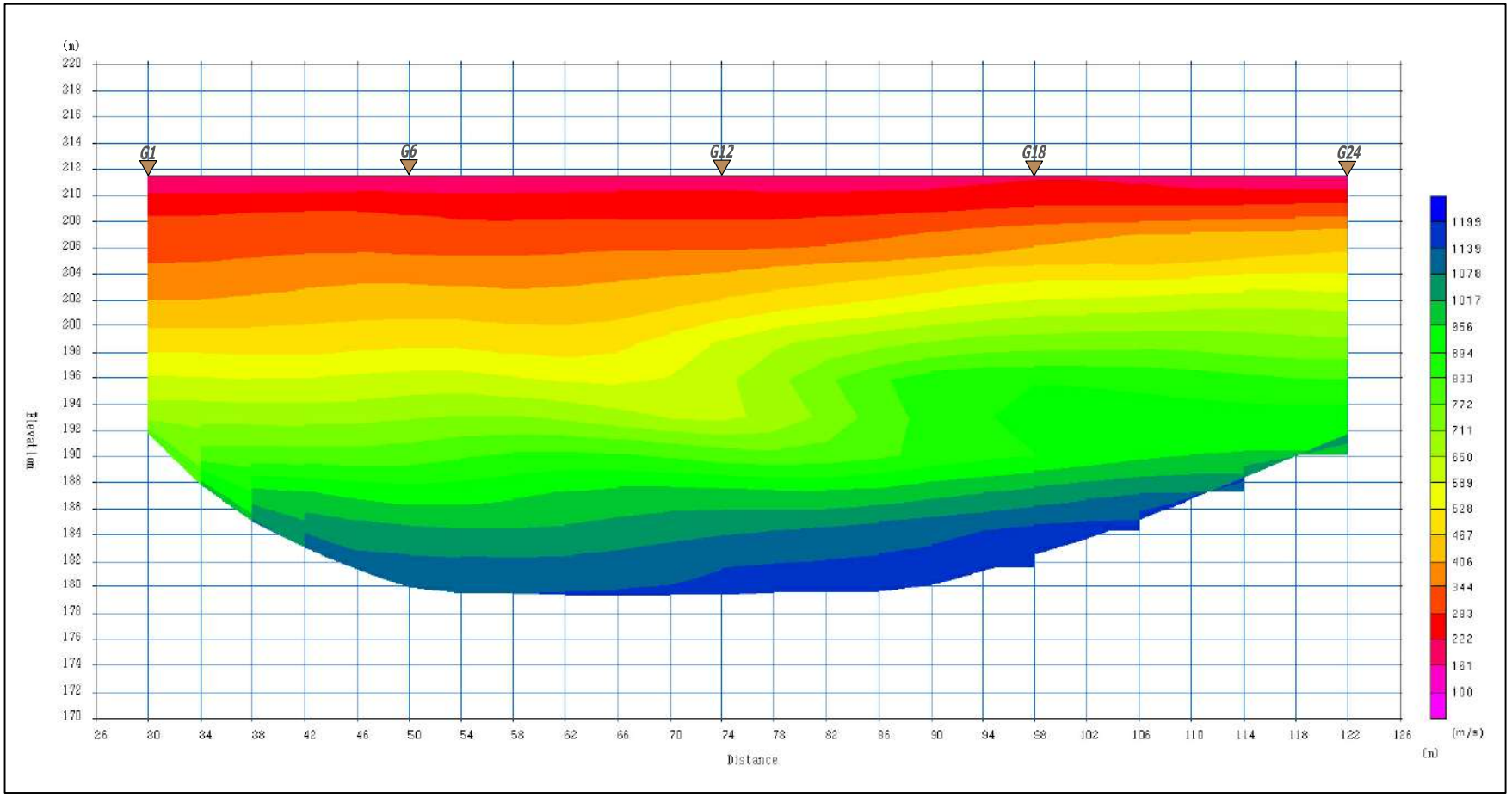
321 VELOCITA' SISMICA DELLO STRATO IN m/sec

LINEA SISMICA SR_4
SEZIONE TOMOGRAFICA ONDE P



Scala 1:500

LINEA SISMICA SR_4
SEZIONE TOMOGRAFICA ONDE SH



Scala 1:500