Piano Strutturale R3 all

INDAGINI SISMICHE

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Comune di Colle di Val d'Elsa

GEOLOGICA TOSCANA s.n.c.

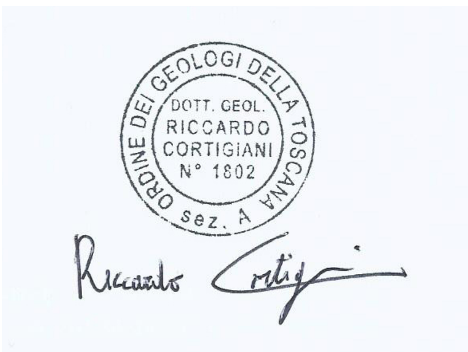
di Damiano Guarguaglini & C.

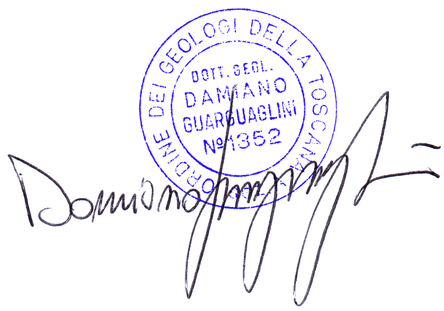
RELAZIONE TECNICA

SULLE INDAGINI SISMICHE A RIFRAZIONE (ONDE OP E SH), MASW, ESAC E HVSR

PER LO STUDIO DI MICROZONAZIONE SISMICA DI PRIMO LIVELLO

DEL COMUNE DI COLLE DI VAL D'ELSA (SI)





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§ 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 Colle di Val d'Elsa, 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 Colle di Val d'Elsa 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 2018 "Aggiornamento delle 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;*

• *Prospezioni geofisiche con acquisizione ed analisi dei microtremori (HVSR), e con processo di inversione e interpretazione secondo la metodologia di analisi del rapporto spettrale H/V o di Nakamura, per determinare l'eventuale comportamento amplificativo del terreno.*

1.4) Scelta delle zone oggetto delle indagini

Le indagini sono state effettuate nel comprensorio del Comune di Colle di Val d'Elsa e in particolare sono state suddivise come segue:

- *Sismica a rifrazione con onde P ed onde SH:*

SR_1 in Loc. Quartaia;

SR_2 in Loc. Zona Industriale Belvedere;

- *MASW + ESAC:*

MASW- ESAC 1 in Loc. Campiglia;

MASW- ESAC 2 in Loc. Le Grazie;

MASW- ESAC 3 in Loc. Gracciano;

MASW- ESAC 4 in Loc. La Badia.

- *HVSR:*

ubicati in maniera omogenea e ragionata sui centri abitati del Comune (vedi carta delle indagini)

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 taglio SH;

2. 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;

3. 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;

4. Acquisizione ed analisi dei microtremori, con processo di inversione e interpretazione secondo la metodologia di analisi del rapporto spettrale H/V o di Nakamura, per la classificazione del sottosuolo ai sensi dalla vigente normativa, NTC 2008, e determinare l’eventuale comportamento amplificativo del terreno.

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.

2.5) 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.

2.5.1 Strumentazione per microtremori

I dati sono stati acquisiti tramite un tromografo a 4,5 Hz scegliendo 35 postazioni di misura all'interno delle aree da analizzare e misurando per ognuna di esse i microtremori per un tempo minimo di 20 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 300 Hz.

§ 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.

3.5) 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	f_0	A_0	Classe
HVSR1	1	2.2	4.8	A1
HVSR2	2	2.9	2.0	A1
HVSR3	3	1.5	2.1	B1
HVSR4	4	1.1	3.7	A1
HVSR5	5	1.3	3.2	A1
HVSR6	6	9.2	4.1	A1
HVSR7	7	3.1	2.3	B1
HVSR8	8	0.5	2.0	A1
HVSR9	9	0.5	2.8	A1
HVSR10	10	1.3	2.3	A1
HVSR11	11	3.8	2.9	A1
HVSR12	12	3.5	2.8	A1
HVSR13	13	3.1	2.3	A1
HVSR14	14	3.8	3.8	A1
HVSR15	15	nn	nn	A2
HVSR16	16	nn	nn	A2
HVSR17	17	2.1	6.9	A1
HVSR18	18	nn	nn	A2
HVSR19	19	nn	nn	A2
HVSR20	20	nn	nn	A2
HVSR21	21	3.2	3.3	A1
HVSR22	22	nn	nn	A2
HVSR23	23	4.3	4.0	A1
HVSR24	24	11.6	2.5	A1
HVSR25	25	nn	nn	A2
HVSR26	26	nn	nn	A2
HVSR27	27	nn	nn	A2
HVSR28	28	3.2	2.8	B1
HVSR29	29	nn	nn	A2
HVSR30	30	4.8	2.6	A1
HVSR31	31	4.3	2.3	A1
HVSR32	32	1.2	5.1	B1
HVSR33	33	1.5	2.1	A1
HVSR34	34	nn	nn	A2
HVSR35	35	1.7	2.9	A1

ALLEGATO 1

REPORT DELLE MIRURE HVSR

Viale Marconi, 106 – 53036 Poggibonsi (SI) Tel. 0577 935891 Fax 0577 989279 - Cod. Fisc. e P.I. 01228880520
e- mail: info@geologicatoscana.eu - www.geologicatoscana.eu

HVSR1

DATE 14.09.2018	HOUR 18.43		PLACE Zona Industriale Belvedere Colle di Val d'Elsa		
OPERATOR Geologica Toscana S.n.c.		GPS TYPE and #			
WGS84 - UTM33N LATITUDE 4808108	WGS84 - UTM33N LONGITUDE 1675401		ALTITUDE 233 m slm		
STATION TYPE GPA Engeenering	SENSOR TYPE 3D - 4,5 Hz				
STATION #	SENSOR #		DISK #		
FILE NAME HVSR1.saf			POINT #		
GAIN	SAMPL. FREQ. 300 Hz		REC. DURATION 20 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): 25 — 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 [x] scattered [ ] dense [ ] other, type ____

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

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

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

HVSR1

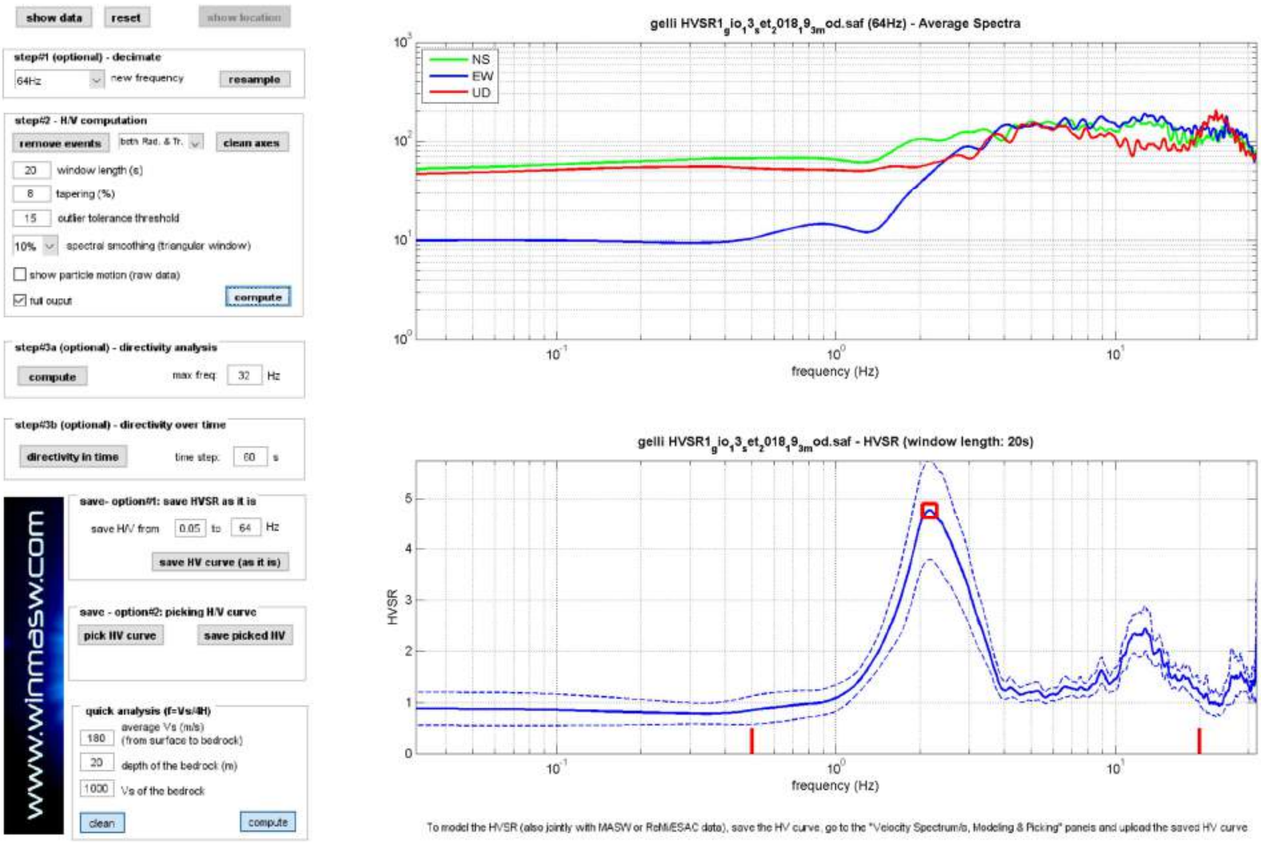
Peak frequency (Hz): 2.2 (±3.9)
Peak HVSR value: 4.8 (±1.0)

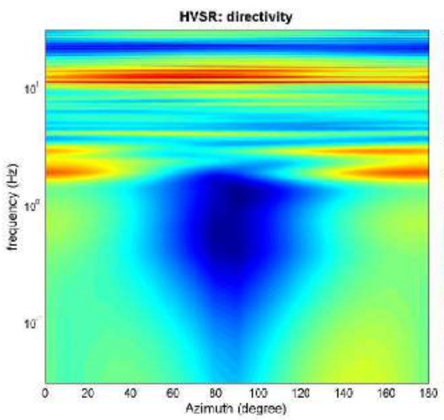
=== Criteria for a reliable H/V curve ====================================

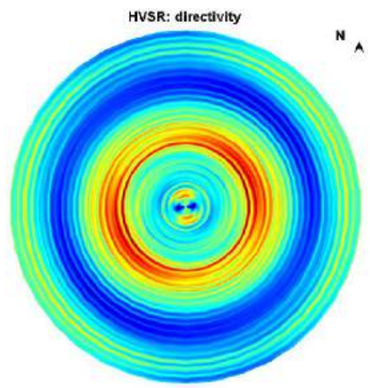
#1. [f0 > 10/Lw]: 2.158 > 0.5 (OK)
#2. [nc > 200]: 2202 > 200 (OK)
#3. [f0>0.5Hz; sigmaA(f) < 2 for 0.5f0 < f < 2f0] (OK)

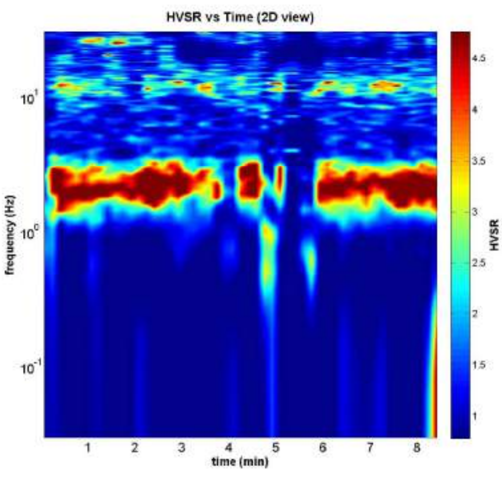
=== Criteria for a clear H/V peak (at least 5 should be fulfilled) ===========

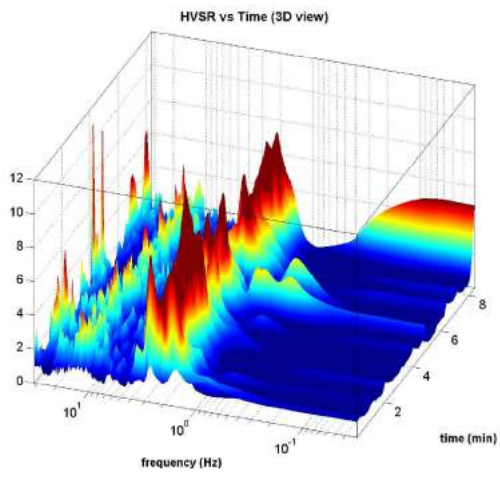
#1. [exists f- in the range [f0/4, f0] | AH/V(f-) < A0/2]: yes, at frequency 0.6Hz (OK)
#2. [exists f+ in the range [f0, 4f0] | AH/V(f+) < A0/2]: yes, at frequency 3.4Hz (OK)
#3. [A0 > 2]: 4.8 > 2 (OK)
#4. [fpeak[Ah/v(f) ± sigmaA(f)] = f0 ± 5%]: (OK)
#5. [sigmaf < epsilon(f0)]: 3.870 > 0.108 (NO)
#6. [sigmaA(f0) < theta(f0)]: 0.974 < 1.58 (OK)


show data
reset
show location
step#1 (optional) - decimate
64Hz
new frequency
resample
step#2 - H/V computation
remove events
both Rad. & Tr.
clean axes
20 window length (s)
8 tapering (%)
15 outlier tolerance threshold
10% spectral smoothing (triangular window)
show particle motion (raw data)
full ouput
compute
step#3a (optional) - directivity analysis
compute
max freq: 32 Hz
step#3b (optional) - directivity over time
directivity in time
time step: 60 s
www.winmasw.com
save- option#1: save HVSR as it is
save H/V from 0.05 to 64 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)
180 average Vs (m/s) (from surface to bedrock)
20 depth of the bedrock (m)
1000 Vs of the bedrock
clean
compute
gelli HVSR1_g io_1 3_s et_2 018_1 9_3m od.saf (64Hz) - Average Spectra
NS
EW
UD
frequency (Hz)
gelli HVSR1_g io_1 3_s et_2 018_1 9_3m od.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/s, Modeling & Picking" panels and upload the saved HV curve


HVSR: directivity
frequency (Hz)
Azimuth (degree)
HVSR


HVSR: directivity
N


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


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

HVSR2

DATE 03.10.2018	HOUR 11.28	PLACE Scarna Colle di Val d'Elsa
OPERATOR Geologica Toscana S.n.c.	GPS TYPE and #	
WGS84 - UTM33N LATITUDE 4806933	WGS84 - UTM33N LONGITUDE 1675092	ALTITUDE 222 m slm
STATION TYPE GPA Engeenering	SENSOR TYPE 3D - 4,5 Hz	
STATION #	SENSOR #	DISK #
FILE NAME HVSR2.saf		POINT #
GAIN	SAMPL. FREQ. 300 Hz	REC. DURATION 20 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): 15 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 A1

HVSR2

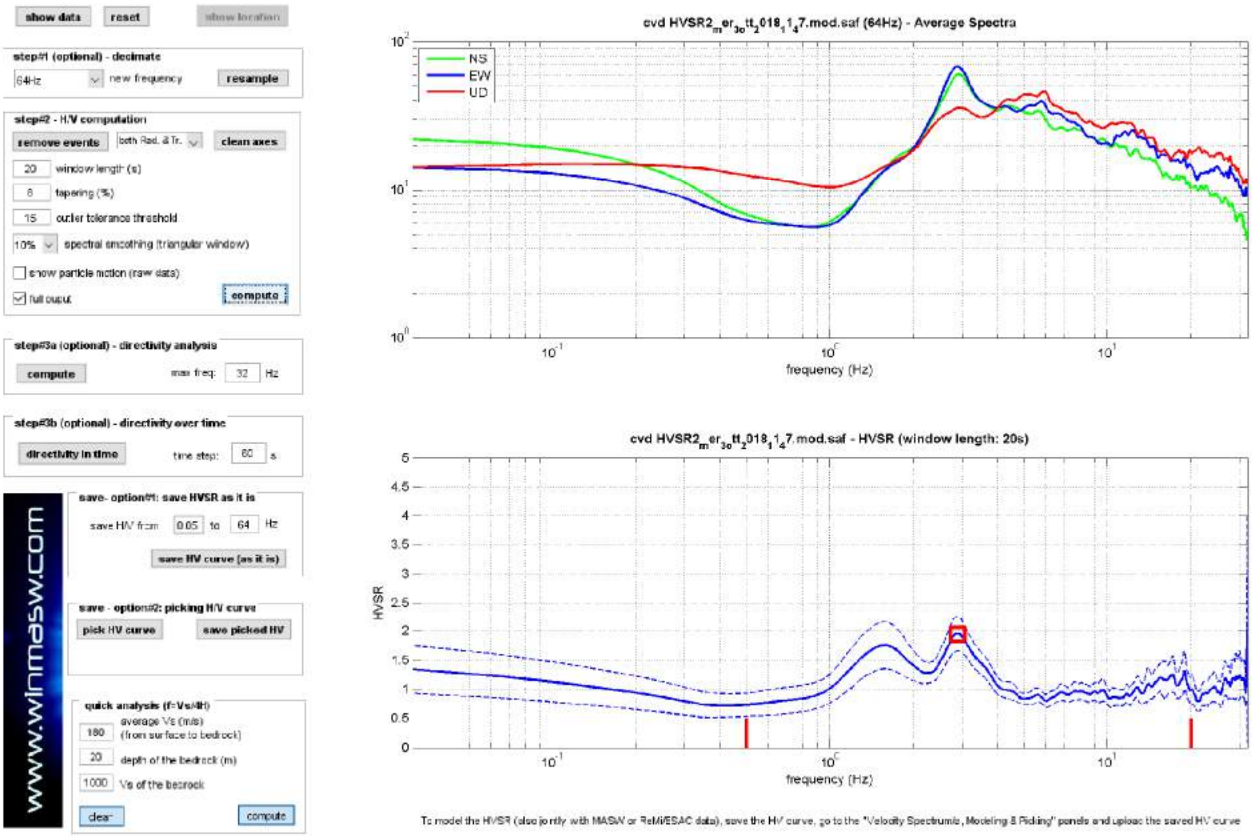
Peak frequency (Hz): 2.9 (±5.5)
Peak HVSR value: 2.0 (±0.3)

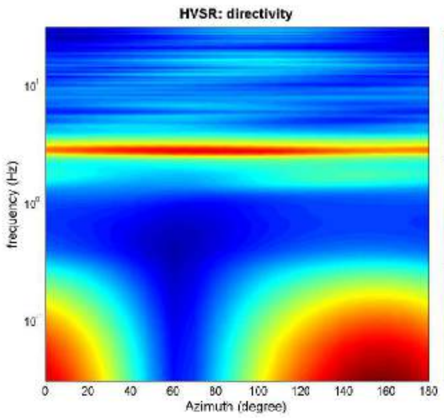
=== Criteria for a reliable H/V curve ===================================

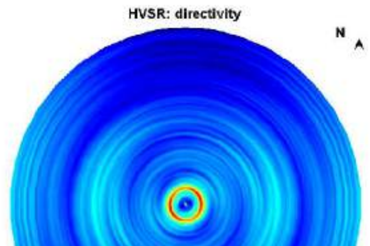
#1. [f0 > 10/Lw]: 2.878 > 0.5 (OK)
#2. [nc > 200]: 6734 > 200 (OK)
#3. [f0>0.5Hz; sigmaA(f) < 2 for 0.5f0 < f < 2f0] (OK)

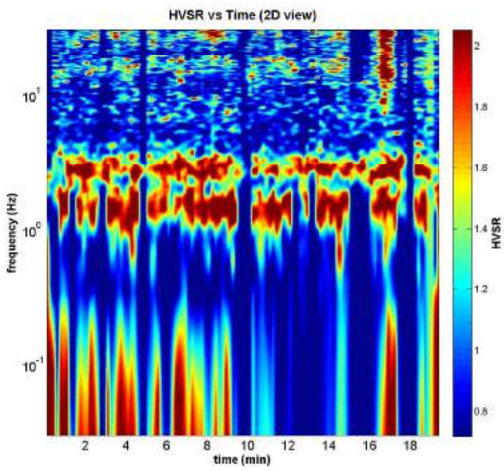
=== Criteria for a clear H/V peak (at least 5 should be fulfilled) ===========

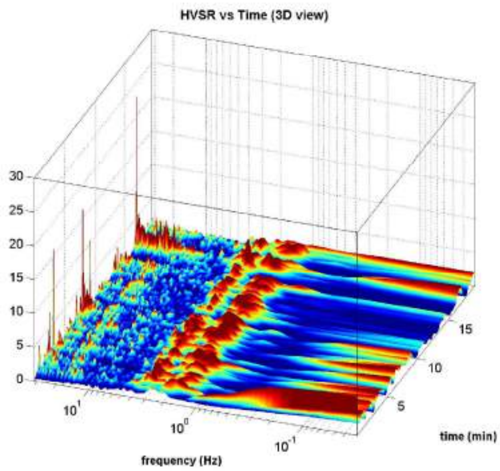
#1. [exists f- in the range [f0/4, f0] | AH/V(f-) < A0/2]: yes, at frequency 0.8Hz (OK)
#2. [exists f+ in the range [f0, 4f0] | AH/V(f+) < A0/2]: yes, at frequency 4.5Hz (OK)
#3. [A0 > 2]: 2.0 < 2 (NO)
#4. [fpeak[Ah/v(f) ± sigmaA(f)] = f0 ± 5%]: (OK)
#5. [sigmaf < epsilon(f0)]: 5.463 > 0.144 (NO)
#6. [sigmaA(f0) < theta(f0)]: 0.298 < 1.58 (OK)


show data
reset
show location
step#1 (optional) - decimate
64Hz
new frequency
resample
step#2 - H/V computation
remove events
both Rad. & Tr.
clean axes
20 window length (s)
8 tapering (%)
15 outlier tolerance threshold
10% spectral smoothing (triangular window)
show particle motion (raw data)
full ouput
compute
step#3a (optional) - directivity analysis
compute
max freq: 32 Hz
step#3b (optional) - directivity over time
directivity in time
time step: 60 s
www.winmasw.com
save- option#1: save HVSR as it is
save H/V from 0.05 to 64 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)
180 average Vs (m/s) (from surface to bedrock)
20 depth of the bedrock (m)
1000 Vs of the bedrock
clear
compute
cvd HVSR2_m er_3o tt_2 018_1 1_4 7.mod.saf (64Hz) - Average Spectra
NS
EW
UD
frequency (Hz)
cvd HVSR2_m er_3o tt_2 018_1 1_4 7.mod.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, Modeling & Picking" panels and upload the saved HV curve


HVSR: directivity
frequency (Hz)
Azimuth (degree)
HVSR


HVSR: directivity
N


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


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

HVSR3

DATE 21.09.2018	HOUR 15.45	PLACE Ponelle - Colle di Val d'Elsa
OPERATOR Geologica Toscana S.n.c.	GPS TYPE and #	
WGS84 - UTM33N LATITUDE 4807409	WGS84 - UTM33N LONGITUDE 1673871	ALTITUDE 195 m slm
STATION TYPE GPA Engeenering	SENSOR TYPE 3D - 4,5 Hz	
STATION #	SENSOR #	DISK #
FILE NAME HVSR3.saf		POINT #
GAIN	SAMPL. FREQ. 300 Hz	REC. DURATION 20 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): 33 Remarks ______

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

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

BUILDING DENSITY [x] none [ ] 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

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

HVSR3

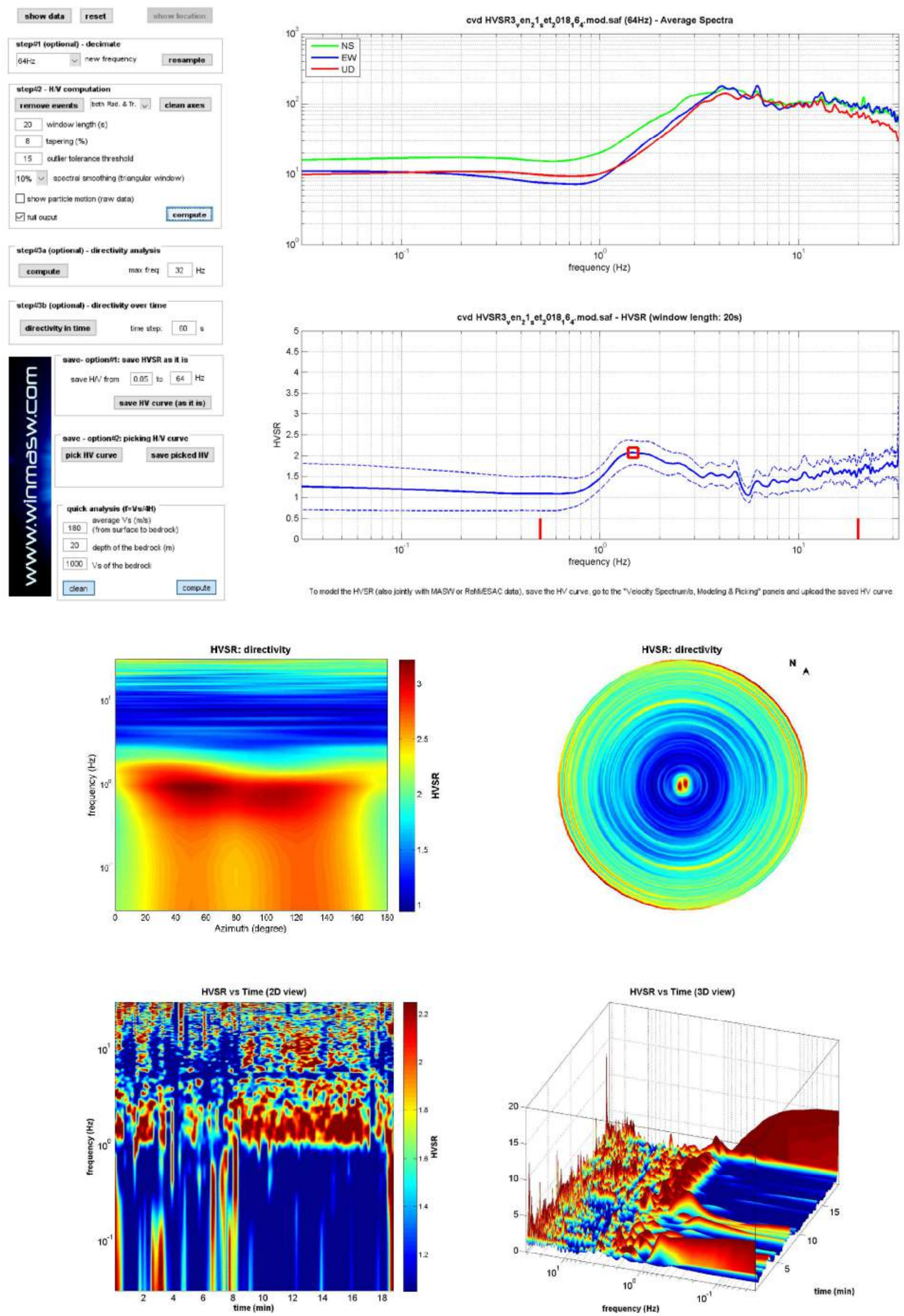
Peak frequency (Hz): 1.5 (±6.3)
Peak HVSR value: 2.1 (±0.3)

=== Criteria for a reliable H/V curve ====================================

#1. [f0 > 10/Lw]: 1.470 > 0.5 (OK)
#2. [nc > 200]: 3323 > 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 (considering standard deviations), at frequency Hz (OK)
#3. [A0 > 2]: 2.1 > 2 (OK)
#4. [fpeak[Ah/v(f) ± sigmaA(f)] = f0 ± 5%]: (NO)
#5. [sigmaf < epsilon(f0)]: 6.295 > 0.147 (NO)
#6. [sigmaA(f0) < theta(f0)]: 0.292 < 1.78 (OK)


show data
reset
show location
step#1 (optional) - decimate
64Hz
new frequency
resample
step#2 - H/V computation
remove events
both Rad. & Tr.
clean axes
20 window length (s)
8 tapering (%)
15 outlier tolerance threshold
10% spectral smoothing (triangular window)
show particle motion (raw data)
full ouput
compute
step#3a (optional) - directivity analysis
compute
max freq: 32 Hz
step#3b (optional) - directivity over time
directivity in time
time step: 60 s
www.winmasw.com
save- option#1: save HVSR as it is
save H/V from 0.05 to 64 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)
180 average Vs (m/s) (from surface to bedrock)
20 depth of the bedrock (m)
1000 Vs of the bedrock
clean
compute
cvd HVSR3_v en_2 1_s et_2 018_1 6_4.mod.saf (64Hz) - Average Spectra
NS
EW
UD
frequency (Hz)
cvd HVSR3_v en_2 1_s et_2 018_1 6_4.mod.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/s, Modeling & Picking" panels and upload the saved HV curve
HVSR: directivity
frequency (Hz)
Azimuth (degree)
HVSR
HVSR: directivity
N
HVSR vs Time (2D view)
frequency (Hz)
time (min)
HVSR
HVSR vs Time (3D view)
frequency (Hz)
time (min)

HVSR4

DATE 02.10.2018	HOUR 10.25	PLACE Le Grazie Colle di Val d'Elsa
OPERATOR Geologica Toscana S.n.c.	GPS TYPE and #	
WGS84 - UTM33N LATITUDE 4809581	WGS84 - UTM33N LONGITUDE 1669884	ALTITUDE 241 m slm
STATION TYPE GPA Engeenering	SENSOR TYPE 3D - 4,5 Hz	
STATION #	SENSOR #	DISK #
FILE NAME HVSR4.saf		POINT #
GAIN	SAMPL. FREQ. 300 Hz	REC. DURATION 20 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): 19 — 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 A1

HVSR4

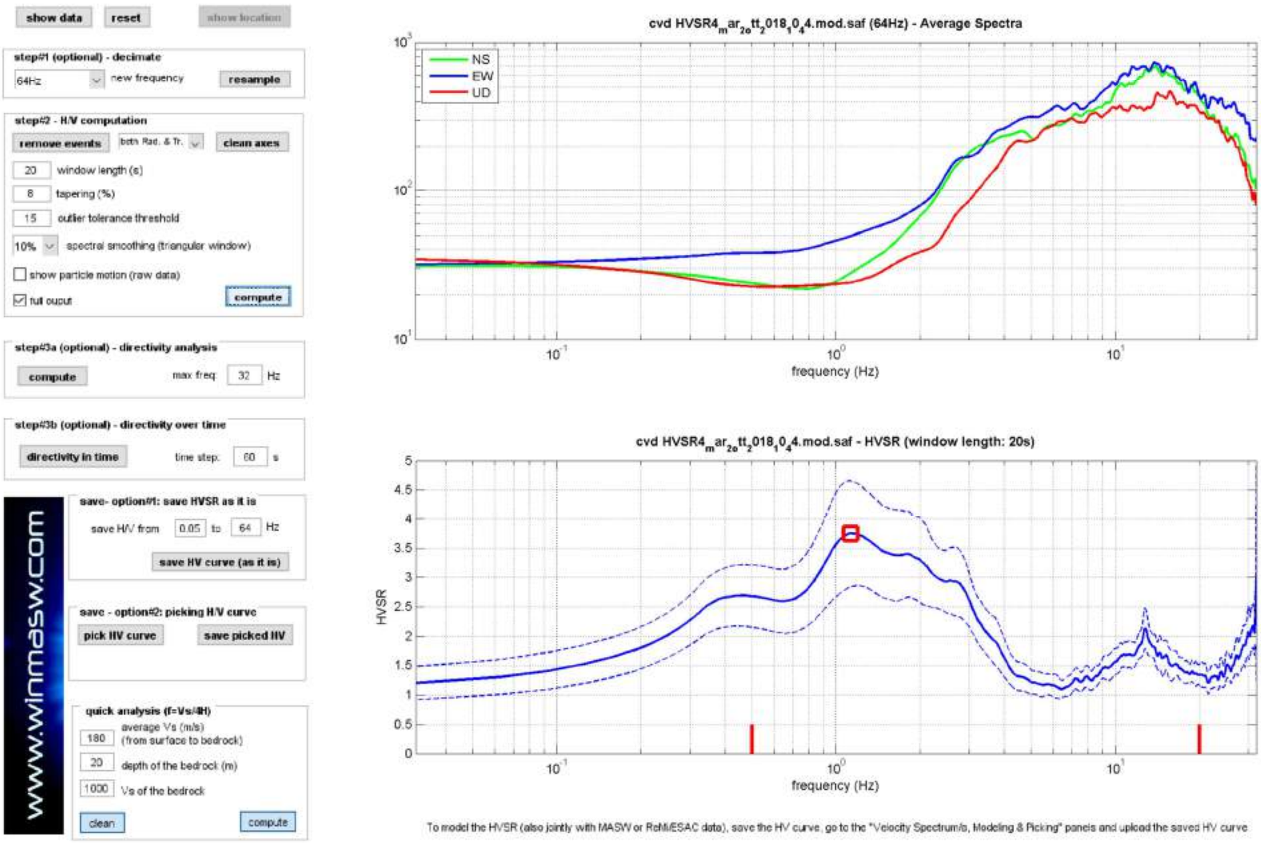
Peak frequency (Hz): 1.1 (±3.6)
Peak HVSR value: 3.7 (±0.9)

=== Criteria for a reliable H/V curve ====================================

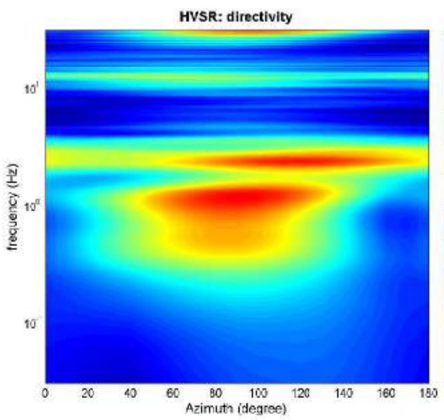
#1. [f0 > 10/Lw]: 1.126 > 0.5 (OK)
#2. [nc > 200]: 2658 > 200 (OK)
#3. [f0>0.5Hz; sigmaA(f) < 2 for 0.5f0 < f < 2f0] (OK)

=== Criteria for a clear H/V peak (at least 5 should be fulfilled) ===========

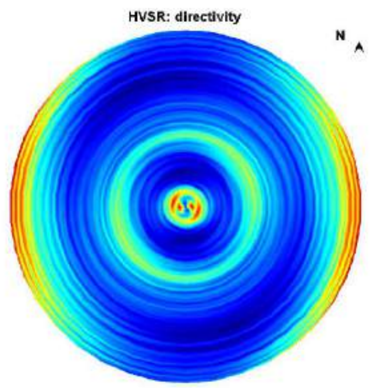
#1. [exists f- in the range [f0/4, f0] | AH/V(f-) < A0/2]: (NO)
#2. [exists f+ in the range [f0, 4f0] | AH/V(f+) < A0/2]: yes, at frequency 3.8Hz (OK)
#3. [A0 > 2]: 3.7 > 2 (OK)
#4. [fpeak[Ah/v(f) ± sigmaA(f)] = f0 ± 5%]: (NO)
#5. [sigmaf < epsilon(f0)]: 3.565 > 0.113 (NO)
#6. [sigmaA(f0) < theta(f0)]: 0.911 < 1.78 (OK)



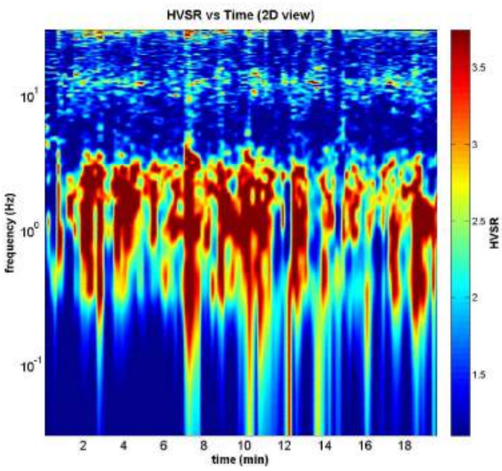
show data
reset
show location
step#1 (optional) - decimate
64Hz
new frequency
resample
step#2 - H/V computation
remove events
both Rad. & Tr.
clean axes
20 window length (s)
8 tapering (%)
15 outlier tolerance threshold
10% spectral smoothing (triangular window)
show particle motion (raw data)
full ouput
compute
step#3a (optional) - directivity analysis
compute
max freq: 32 Hz
step#3b (optional) - directivity over time
directivity in time
time step: 60 s
www.winmasw.com
save- option#1: save HVSR as it is
save H/V from 0.05 to 64 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)
180 average Vs (m/s) (from surface to bedrock)
20 depth of the bedrock (m)
1000 Vs of the bedrock
clean
compute
cvd HVSR4_m ar_2o tt_2 018_1 0_4.mod.saf (64Hz) - Average Spectra
NS
EW
UD
frequency (Hz)
cvd HVSR4_m ar_2o tt_2 018_1 0_4.mod.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/s, Modeling & Picking" panels and upload the saved HV curve



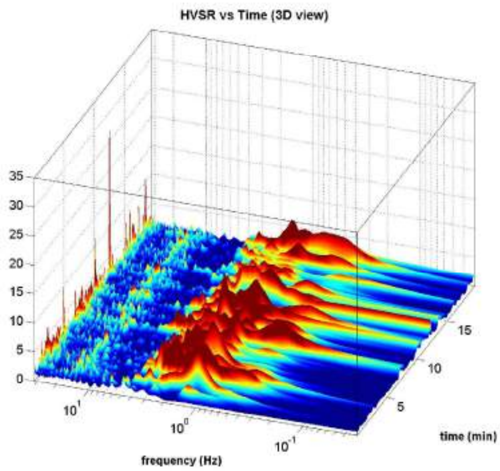
HVSR: directivity
frequency (Hz)
Azimuth (degree)
HVSR



HVSR: directivity
N



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



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

HVSR5

DATE 02.10.2018	HOUR 11.45	PLACE Campiglia Colle di Val d'Elsa
OPERATOR Geologica Toscana S.n.c.	GPS TYPE and #	
WGS84 - UTM33N LATITUDE 4809114	WGS84 - UTM33N LONGITUDE 1668281	ALTITUDE 246m slm
STATION TYPE GPA Engeenering	SENSOR TYPE 3D - 4,5 Hz	
STATION #	SENSOR #	DISK #
FILE NAME HVSR5.saf		POINT #
GAIN	SAMPL. FREQ. 300 Hz	REC. DURATION 20 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): 18 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 A1

HVSR5

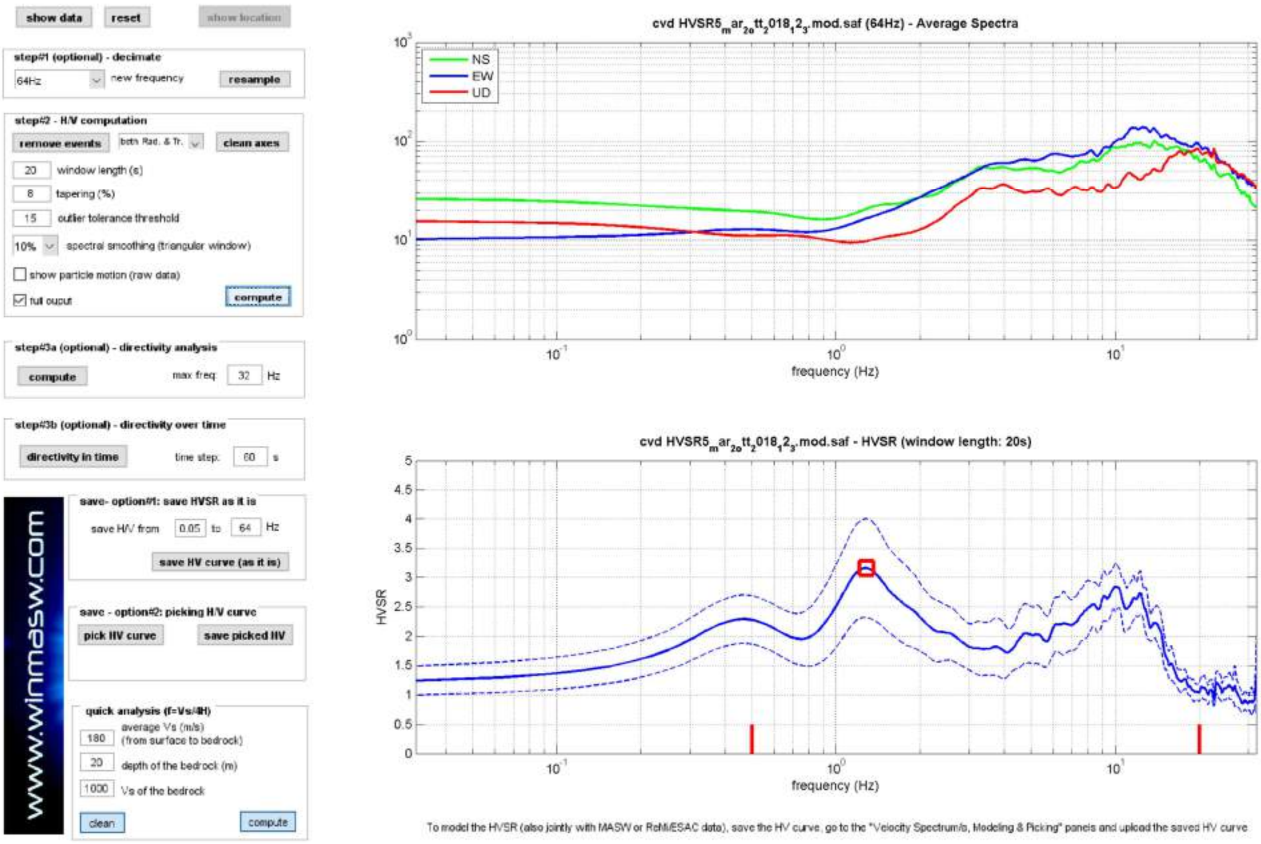
Peak frequency (Hz): 1.3 (±4.4)
Peak HVSR value: 3.2 (±0.8)

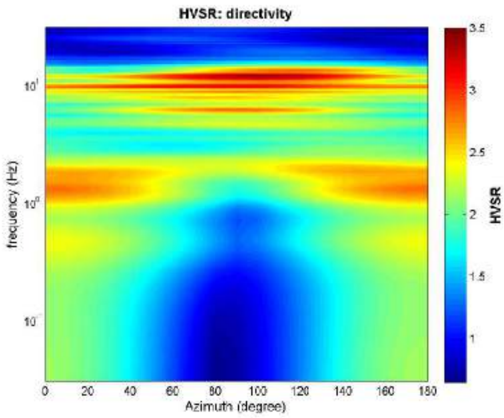
=== Criteria for a reliable H/V curve =================================

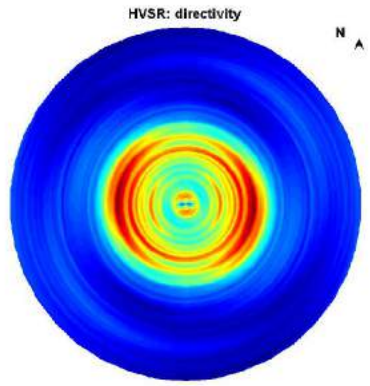
#1. [f0 > 10/Lw]: 1.283 > 0.5 (OK)
#2. [nc > 200]: 3027 > 200 (OK)
#3. [f0>0.5Hz; sigmaA(f) < 2 for 0.5f0 < f < 2f0] (OK)

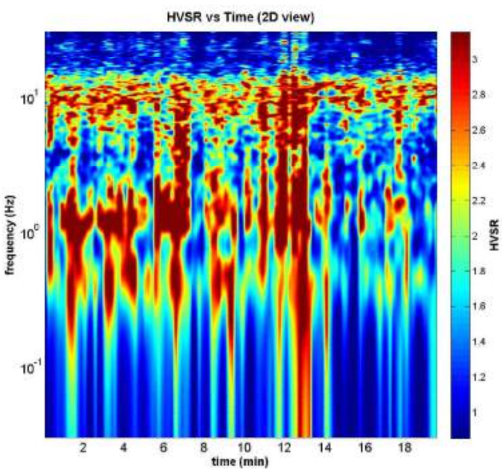
=== Criteria for a clear H/V peak (at least 5 should be fulfilled) ===========

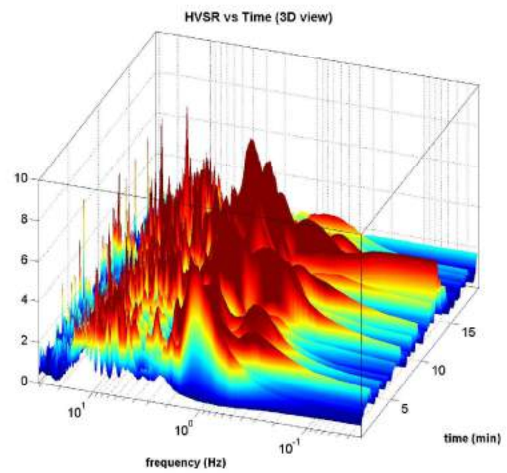
#1. [exists f- in the range [f0/4, f0] | AH/V(f-) < A0/2]: yes (considering standard deviations), at frequency 0.7Hz (OK)
#2. [exists f+ in the range [f0, 4f0] | AH/V(f+) < A0/2]: yes (considering standard deviations), at frequency Hz (OK)
#3. [A0 > 2]: 3.2 > 2 (OK)
#4. [fpeak[Ah/v(f) ± sigmaA(f)] = f0 ± 5%]: (NO)
#5. [sigmaf < epsilon(f0)]: 4.407 > 0.128 (NO)
#6. [sigmaA(f0) < theta(f0)]: 0.840 < 1.78 (OK)


show data
reset
show location
step#1 (optional) - decimate
64Hz
new frequency
resample
step#2 - H/V computation
remove events
both Rad. & Tr.
clean axes
20 window length (s)
8 tapering (%)
15 outlier tolerance threshold
10% spectral smoothing (triangular window)
show particle motion (raw data)
full ouput
compute
step#3a (optional) - directivity analysis
compute
max freq: 32 Hz
step#3b (optional) - directivity over time
directivity in time
time step: 60 s
www.winmasw.com
save- option#1: save HVSR as it is
save H/V from 0.05 to 64 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)
180 average Vs (m/s) (from surface to bedrock)
20 depth of the bedrock (m)
1000 Vs of the bedrock
clean
compute
cvd HVSR5_m ar_2o tt_2 018_1 2_3 .mod.saf (64Hz) - Average Spectra
NS
EW
UD
frequency (Hz)
cvd HVSR5_m ar_2o tt_2 018_1 2_3 .mod.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/s, Modeling & Picking" panels and upload the saved HV curve


HVSR: directivity
frequency (Hz)
Azimuth (degree)
HVSR


HVSR: directivity
N


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


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

HVSR6

DATE 22.11.2018	HOUR	PLACE Quartaia Colle di Val d'Elsa
OPERATOR Geologica Toscana S.n.c.	GPS TYPE and #	
WGS84 - UTM33N LATITUDE 4805922	WGS84 - UTM33N LONGITUDE 1668993	ALTITUDE 252 m slm
STATION TYPE GPA Engeenering	SENSOR TYPE 3D - 4,5 Hz	
STATION #	SENSOR #	DISK #
FILE NAME HVSR6.saf		POINT #
GAIN	SAMPL. FREQ. 300 Hz	REC. DURATION 20 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,...)

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

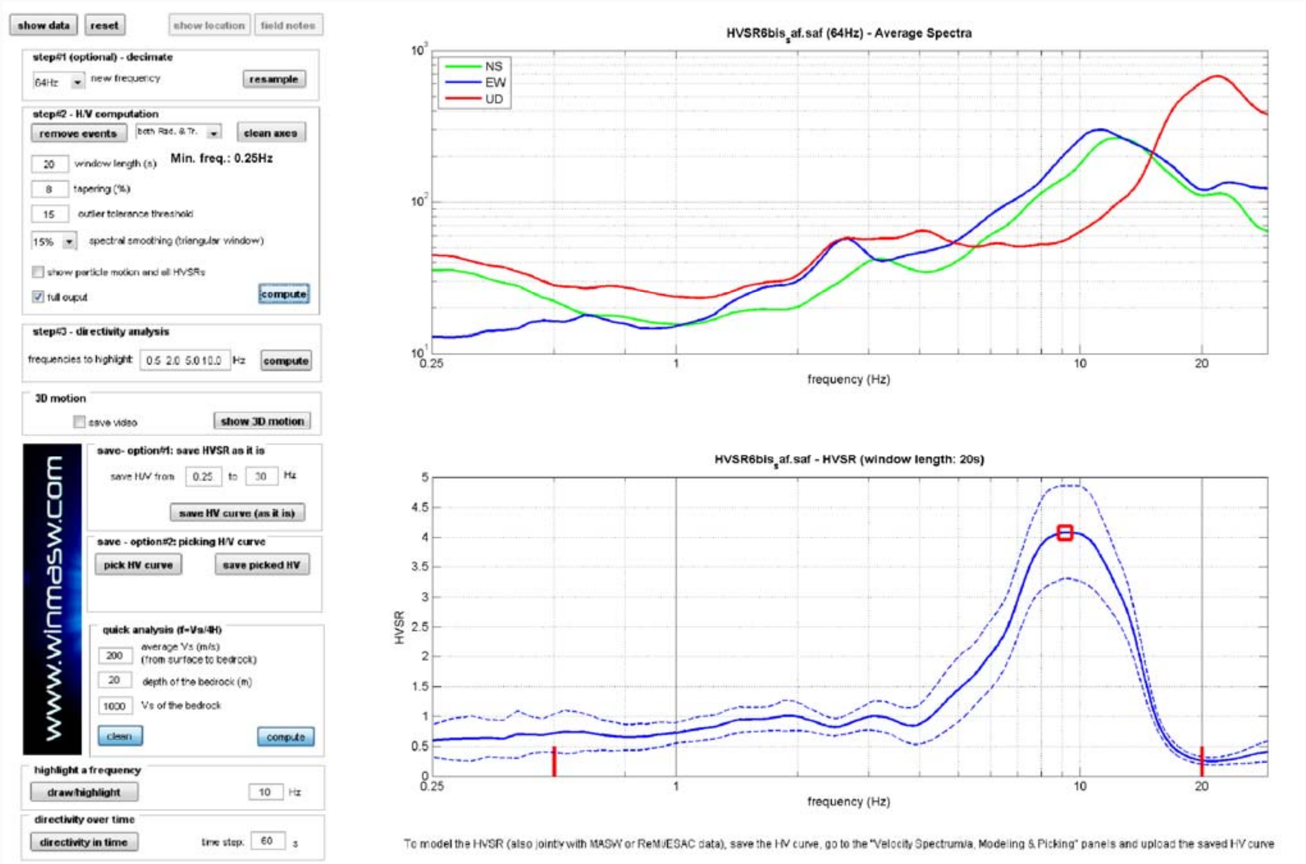
MISURA TIPO A1

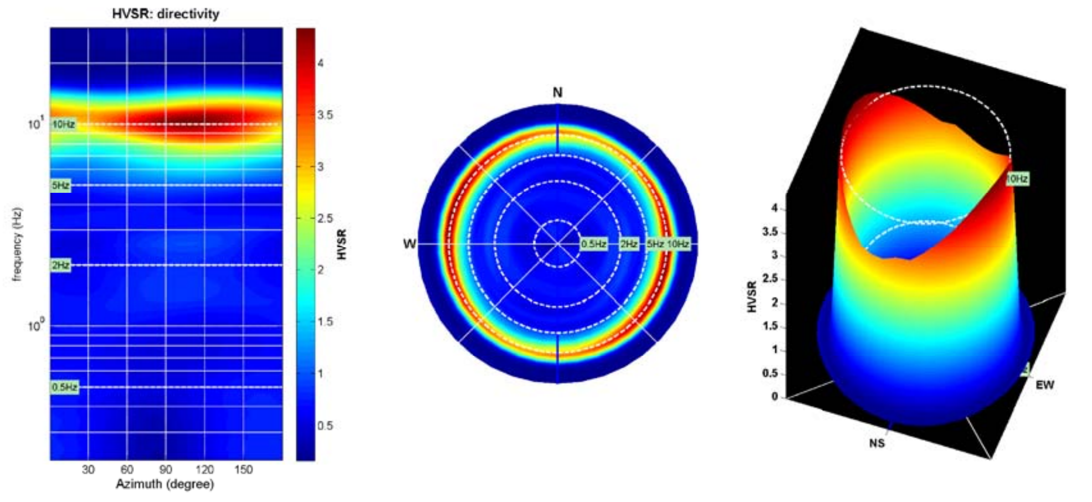
HVSR6

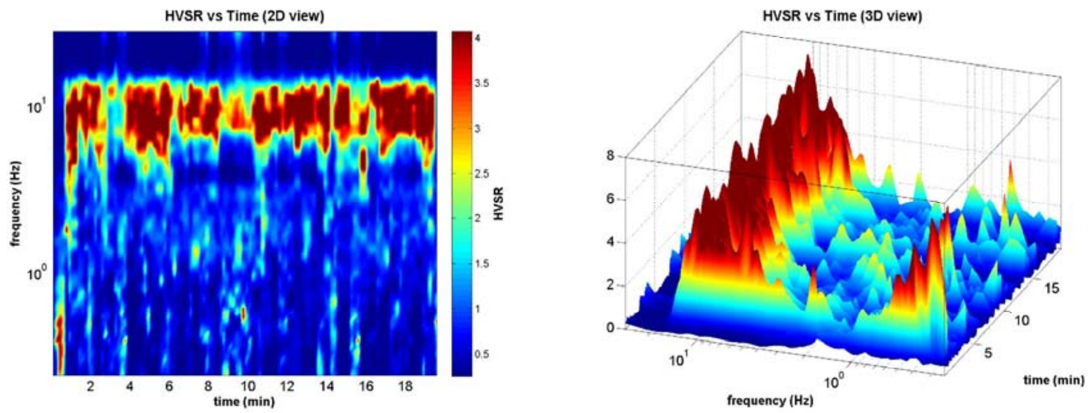
Peak frequency (Hz): 9.2 (±2.6)
Peak HVSR value: 4.1 (±0.8)

=== Criteria for a reliable H/V curve ====================================
#1. [f0 > 10/Lw]: 9.165 > 0.5 (OK)
#2. [nc > 200]: 21630 > 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 2.3Hz (OK)
#2. [exists f+ in the range [f0, 4f0] | AH/V(f+) < A0/2]: yes, at frequency 14.0Hz (OK)
#3. [A0 > 2]: 4.1 > 2 (OK)
#4. [fpeak[Ah/v(f) ą sigmaA(f)] = f0 ą 5%]: (OK)
#5. [sigmaf < epsilon(f0)]: 2.618 > 0.458 (NO)
#6. [sigmaA(f0) < theta(f0)]: 0.775 < 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
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
0.25
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
HVSR6bis_s af.saf (64Hz) - Average Spectra
NS
EW
UD
frequency (Hz)
HVSR6bis_s af.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)
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)

HVSR7

DATE 21.11.2018	HOUR	PLACE Fonterna Colle di Val d'Elsa	
OPERATOR Geologica Toscana S.n.c.		GPS TYPE and #	
WGS84 - UTM33N LATITUDE 4807034	WGS84 - UTM33N LONGITUDE 1669188	ALTITUDE 240 m slm	
STATION TYPE GPA Engeenering	SENSOR TYPE 3D - 4,5 Hz		
STATION #	SENSOR #	DISK #	
FILE NAME HVSR7.saf		POINT #	
GAIN	SAMPL. FREQ. 300 Hz	REC. DURATION 20 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): 10 — Remarks ______

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

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

BUILDING DENSITY [x] none [ ] 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, ...)

OBSERVATIONS

FREQUENCY: Hz (if computed in the field)

Qualità della misura:

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

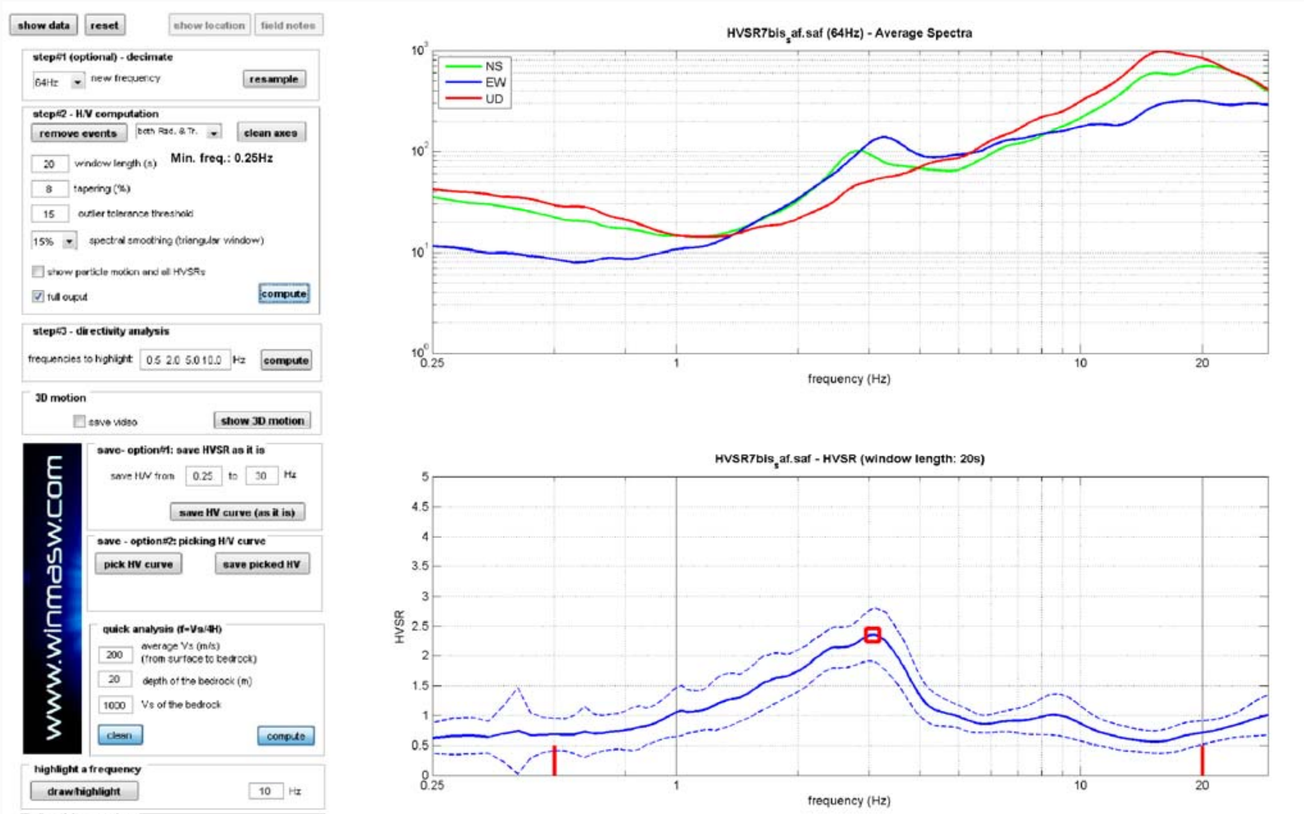
MISURA TIPO B1

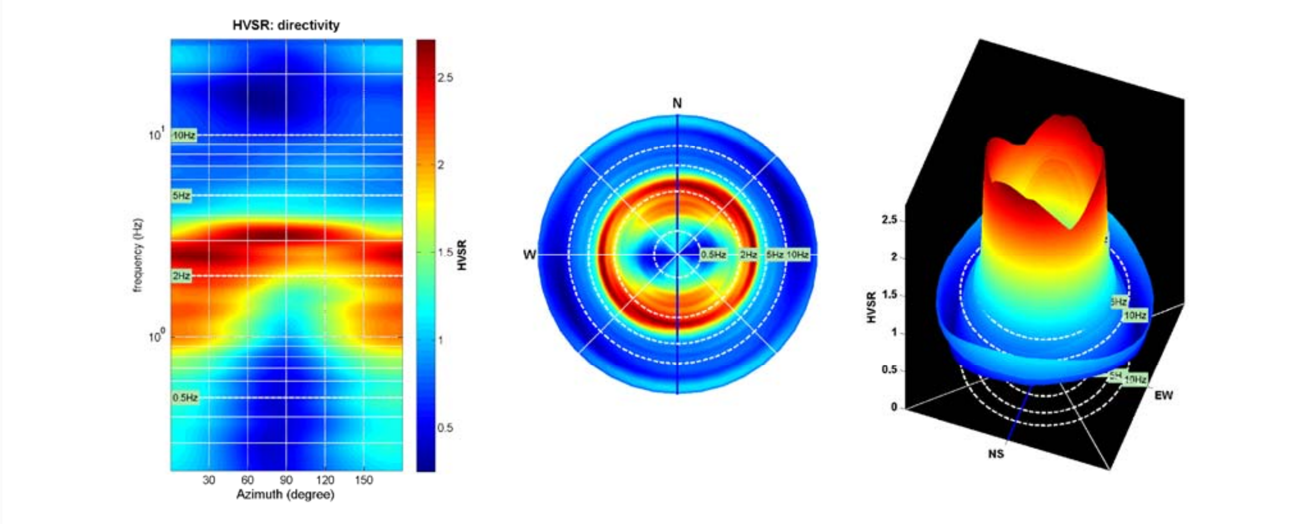
HVSR7

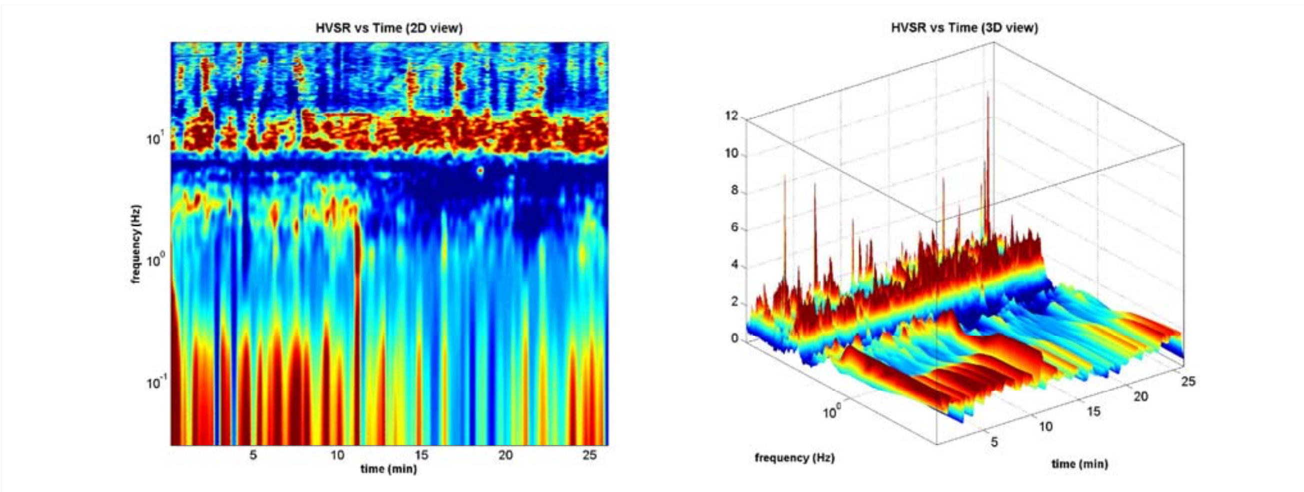
Peak frequency (Hz): 3.1 (±0.9)
Peak HVSR value: 2.3 (±0.5)

=== Criteria for a reliable H/V curve ====================================
#1. [f0 > 10/Lw]: 3.065 > 0.5 (OK)
#2. [nc > 200]: 6928 > 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 0.8Hz (OK)
#2. [exists f+ in the range [f0, 4f0] | AH/V(f+) < A0/2]: yes, at frequency 4.2Hz (OK)
#3. [A0 > 2]: 2.3 > 2 (OK)
#4. [fpeak[Ah/v(f) ± sigmaA(f)] = f0 ± 5%]: (OK)
#5. [sigmaf < epsilon(f0)]: 0.937 > 0.153 (NO)
#6. [sigmaA(f0) < theta(f0)]: 0.446 < 1.58 (OK)


show data
reset
show location
field notes
step#1 (optional) - decimate
new frequency
resample
step#2 - H/V computation
remove events
clean axes
window length (s)
Min. freq.: 0.25Hz
tapering (%)
outlier tolerance threshold
spectral smoothing (triangular window)
show particle motion and all HVSRs
full ouput
compute
step#3 - directivity analysis
frequencies to highlight
compute
3D motion
save video
show 3D motion
www.winmasw.com
save- option#1: save HVSR as it is
save H/V from
save HV curve (as it is)
save - option#2: picking H/V curve
pick HV curve
save picked HV
quick analysis (f=Vs/4H)
average Vs (m/s)
(from surface to bedrock)
depth of the bedrock (m)
Vs of the bedrock
clean
compute
highlight a frequency
draw/highlight
HVSR7bis_s_af.saf (64Hz) - Average Spectra
NS
EW
UD
frequency (Hz)
HVSR7bis_s_af.saf - HVSR (window length: 20s)
HVSR
frequency (Hz)


HVSR: directivity
frequency (Hz)
Azimuth (degree)
HVSR
N
W
EW
NS


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

HVSR8

DATE 21.11.2018	HOUR	PLACE Via di Boscona Colle di Val d'Elsa
OPERATOR Geologica Toscana S.n.c.	GPS TYPE and #	
WGS84 - UTM33N LATITUDE 4808561	WGS84 - UTM33N LONGITUDE 1669579	ALTITUDE 232 m slm
STATION TYPE GPA Engeenering	SENSOR TYPE 3D - 4,5 Hz	
STATION #	SENSOR #	DISK #
FILE NAME HVSR8.saf		POINT #
GAIN	SAMPL. FREQ. 300 Hz	REC. DURATION 20 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

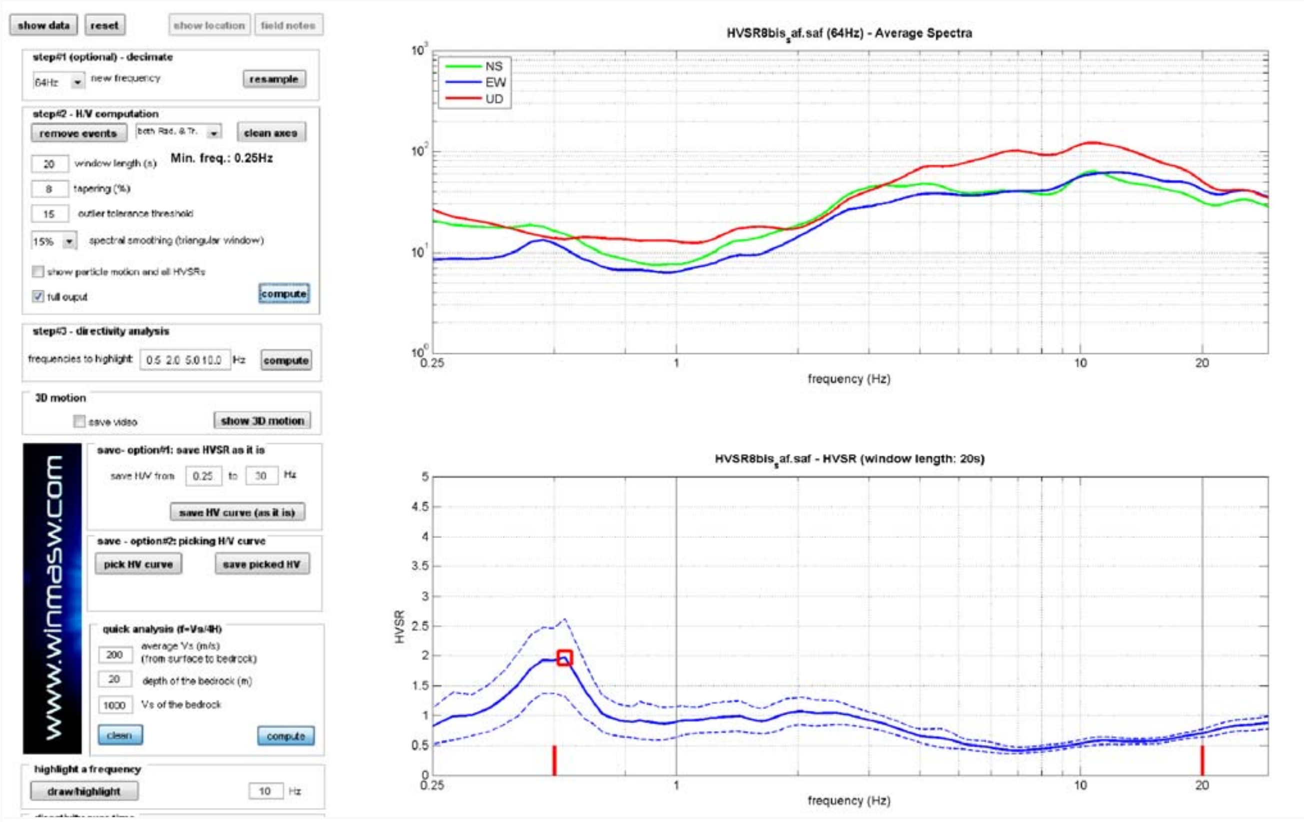
MISURA TIPO A1

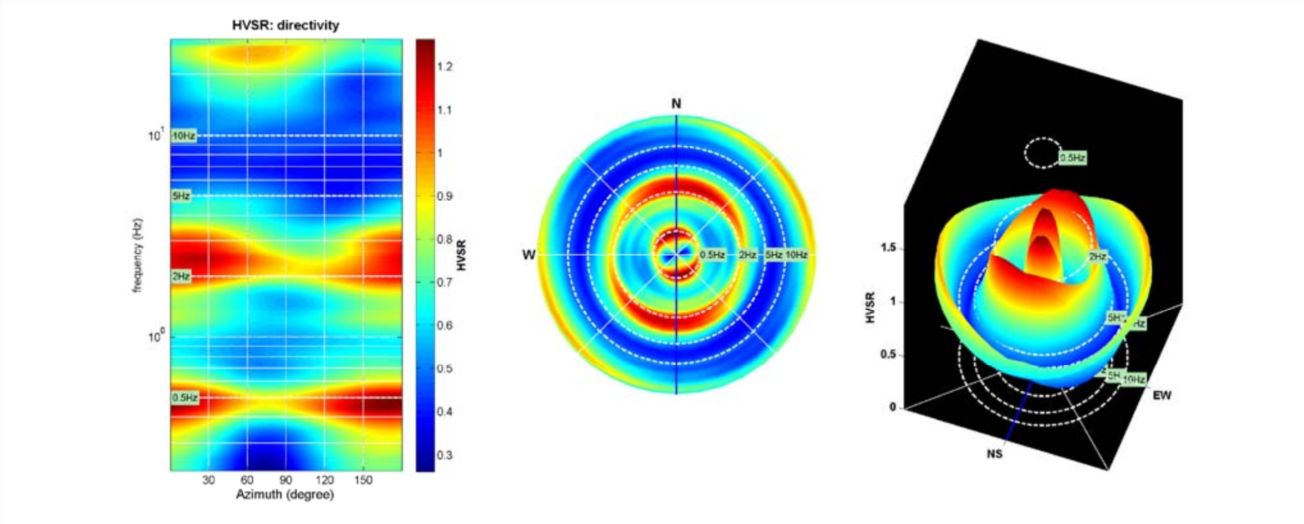
HVSR8

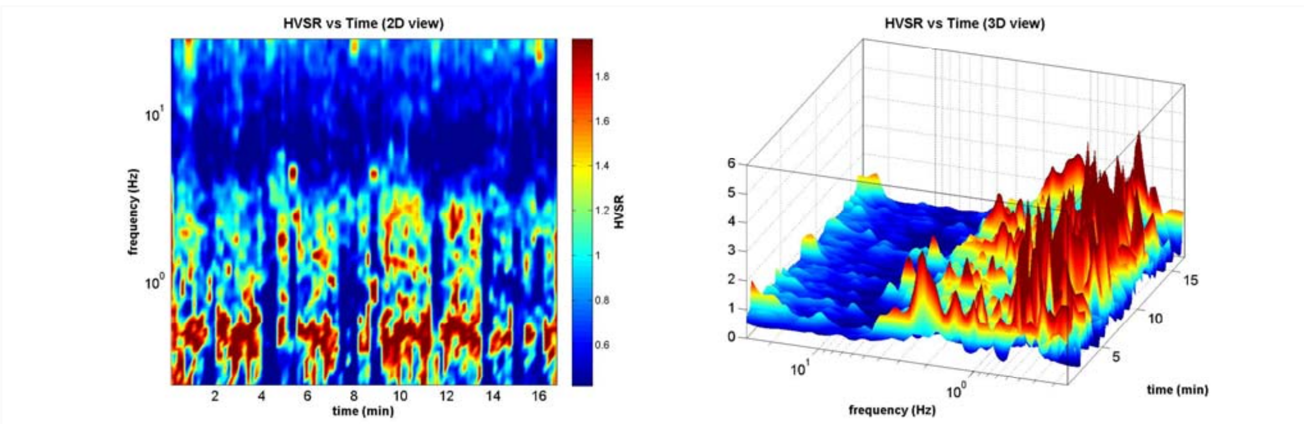
Peak frequency (Hz): 0.5 (±2.5)
Peak HVSR value: 2.0 (±0.6)

=== Criteria for a reliable H/V curve ====================================
#1. [f0 > 10/Lw]: 0.532 > 0.5 (OK)
#2. [nc > 200]: 1074 > 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 0.7Hz (OK)
#3. [A0 > 2]: 2.0 < 2 (NO)
#4. [fpeak[Ah/v(f) ą sigmaA(f)] = f0 ą 5%]: (NO)
#5. [sigmaf < epsilon(f0)]: 2.521 > 0.080 (NO)
#6. [sigmaA(f0) < theta(f0)]: 0.655 < 2 (OK)


show data
reset
show location
field notes
step#1 (optional) - decimate
new frequency
resample
step#2 - H/V computation
remove events
clean axes
window length (s)
Min. freq.: 0.25Hz
tapering (%)
outlier tolerance threshold
spectral smoothing (triangular window)
show particle motion and all HVSRs
full ouput
compute
step#3 - directivity analysis
frequencies to highlight
compute
3D motion
save video
show 3D motion
www.winmasw.com
save- option#1: save HVSR as it is
save H/V from
save HV curve (as it is)
save - option#2: picking H/V curve
pick HV curve
save picked HV
quick analysis (f=Vs/4H)
average Vs (m/s)
(from surface to bedrock)
depth of the bedrock (m)
Vs of the bedrock
clean
compute
highlight a frequency
draw/highlight
HVSR8bis_s af.saf (64Hz) - Average Spectra
NS
EW
UD
frequency (Hz)
HVSR8bis_s af.saf - HVSR (window length: 20s)
HVSR
frequency (Hz)


HVSR: directivity
frequency (Hz)
Azimuth (degree)
HVSR
N
W
EW
NS


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

HVSR9

DATE 21.11.2018	HOUR	PLACE Boscona Colle di Val d'Elsa
OPERATOR Geologica Toscana S.n.c.	GPS TYPE and #	
WGS84 - UTM33N LATITUDE 4808457	WGS84 - UTM33N LONGITUDE 1670004	ALTITUDE 233 m slm
STATION TYPE GPA Engeenering	SENSOR TYPE 3D - 4,5 Hz	
STATION #	SENSOR #	DISK #
FILE NAME HVSR9.saf		POINT #
GAIN	SAMPL. FREQ. 300 Hz	REC. DURATION 20 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

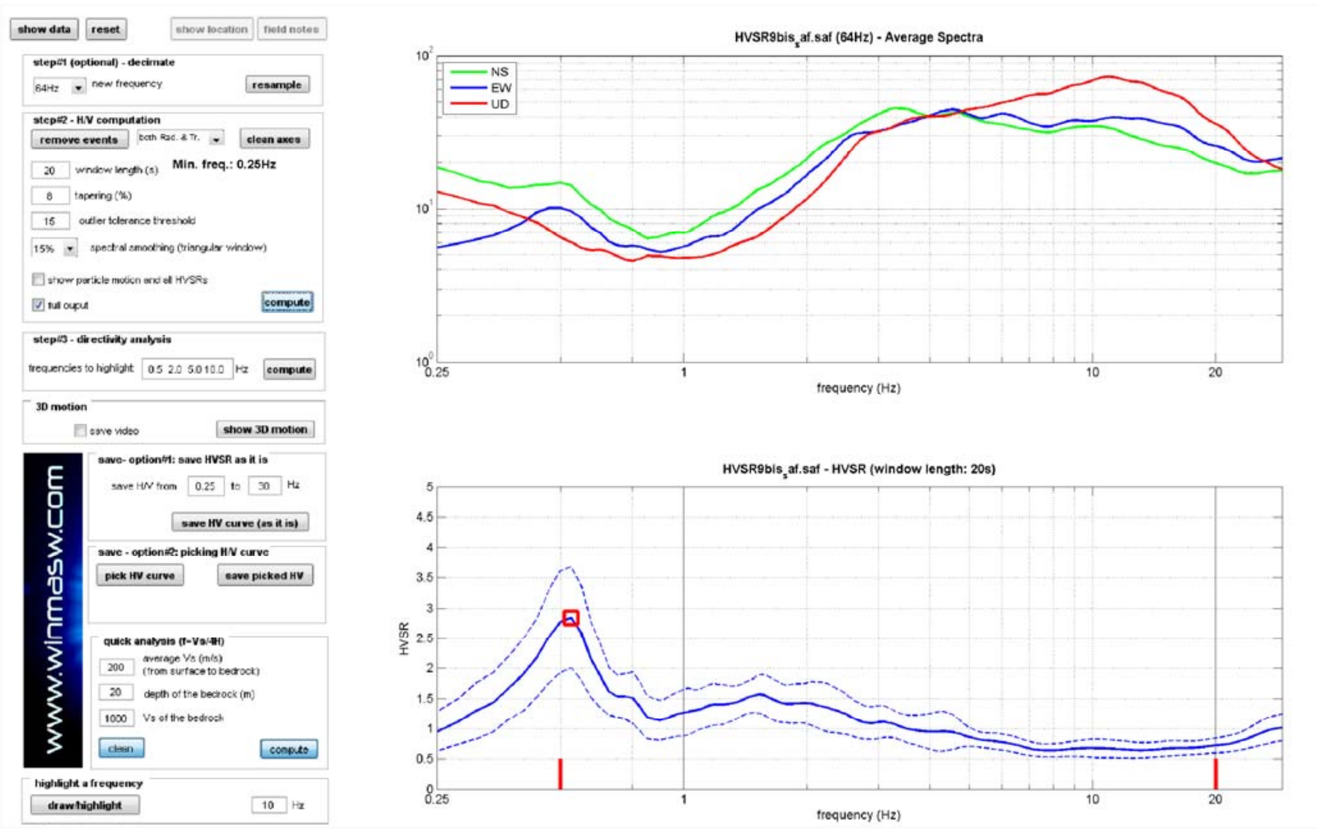
MISURA TIPO A1

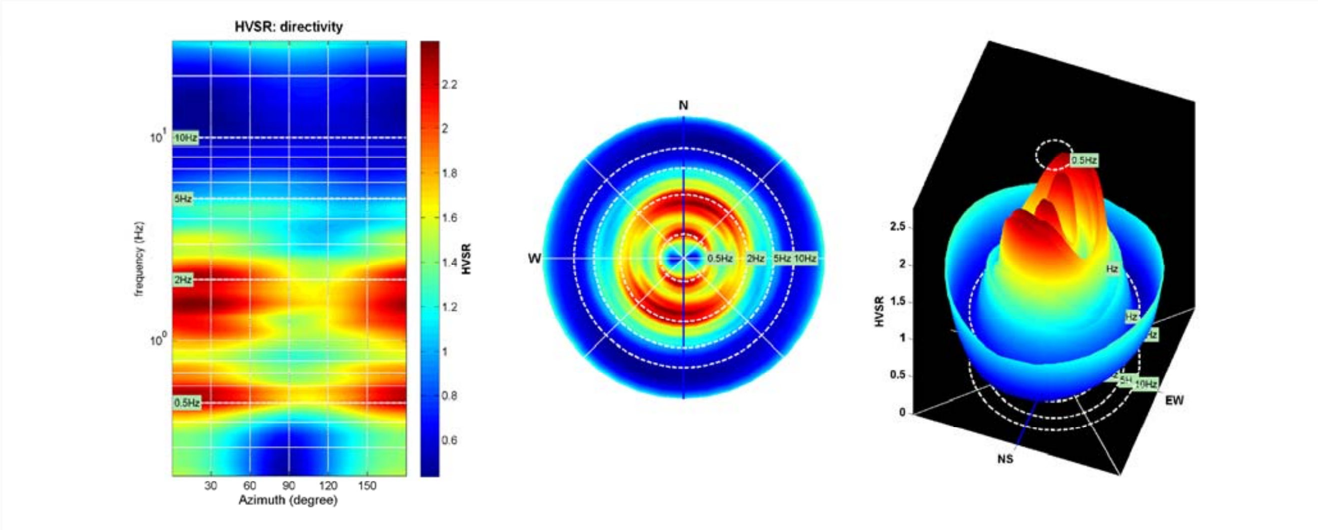
HVSR9

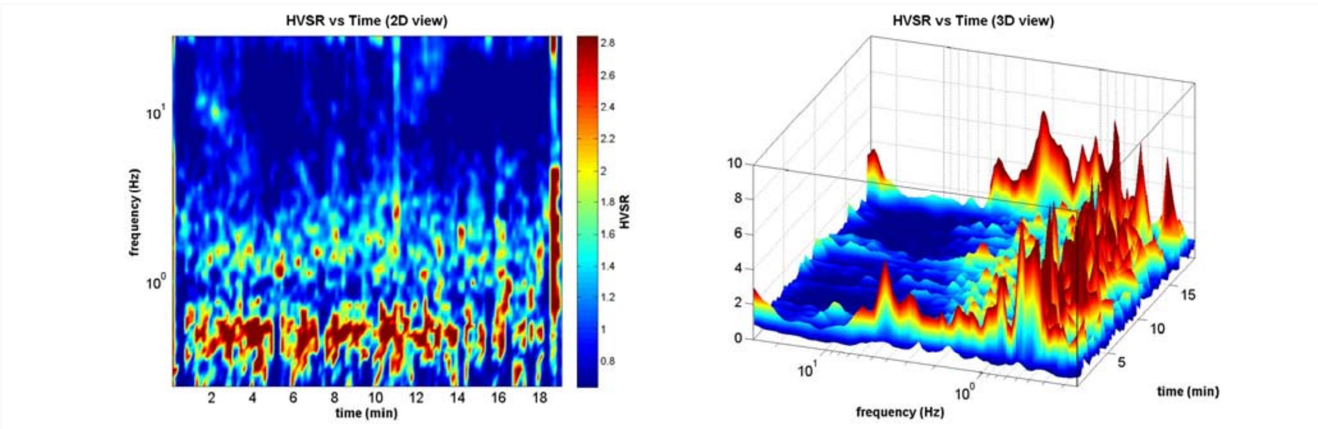
Peak frequency (Hz): 0.5 (±0.6)
Peak HVSR value: 2.8 (±0.8)

=== Criteria for a reliable H/V curve ====================================
#1. [f0 > 10/Lw]: 0.532 > 0.5 (OK)
#2. [nc > 200]: 1223 > 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 0.8Hz (OK)
#3. [A0 > 2]: 2.8 > 2 (OK)
#4. [fpeak[Ah/v(f) ± sigmaA(f)] = f0 ± 5%]: (OK)
#5. [sigmaf < epsilon(f0)]: 0.558 > 0.080 (NO)
#6. [sigmaA(f0) < theta(f0)]: 0.836 < 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 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
0.25
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
HVSR9bis_saf.saf (64Hz) - Average Spectra
NS
EW
UD
frequency (Hz)
HVSR9bis_saf.saf - HVSR (window length: 20s)
HVSR
frequency (Hz)


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


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

HVSR10

DATE 02.10.2018	HOUR 16.20	PLACE Agrestone Colle di Val d'Elsa
OPERATOR Geologica Toscana S.n.c.	GPS TYPE and #	
WGS84 - UTM33N LATITUDE 4808307	WGS84 - UTM33N LONGITUDE 1672122	ALTITUDE 208 m slm
STATION TYPE GPA Engeenering	SENSOR TYPE 3D - 4,5 Hz	
STATION #	SENSOR #	DISK #
FILE NAME HVSR10.saf		POINT #
GAIN	SAMPL. FREQ. 300 Hz	REC. DURATION 20 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): 18 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

HVSR10

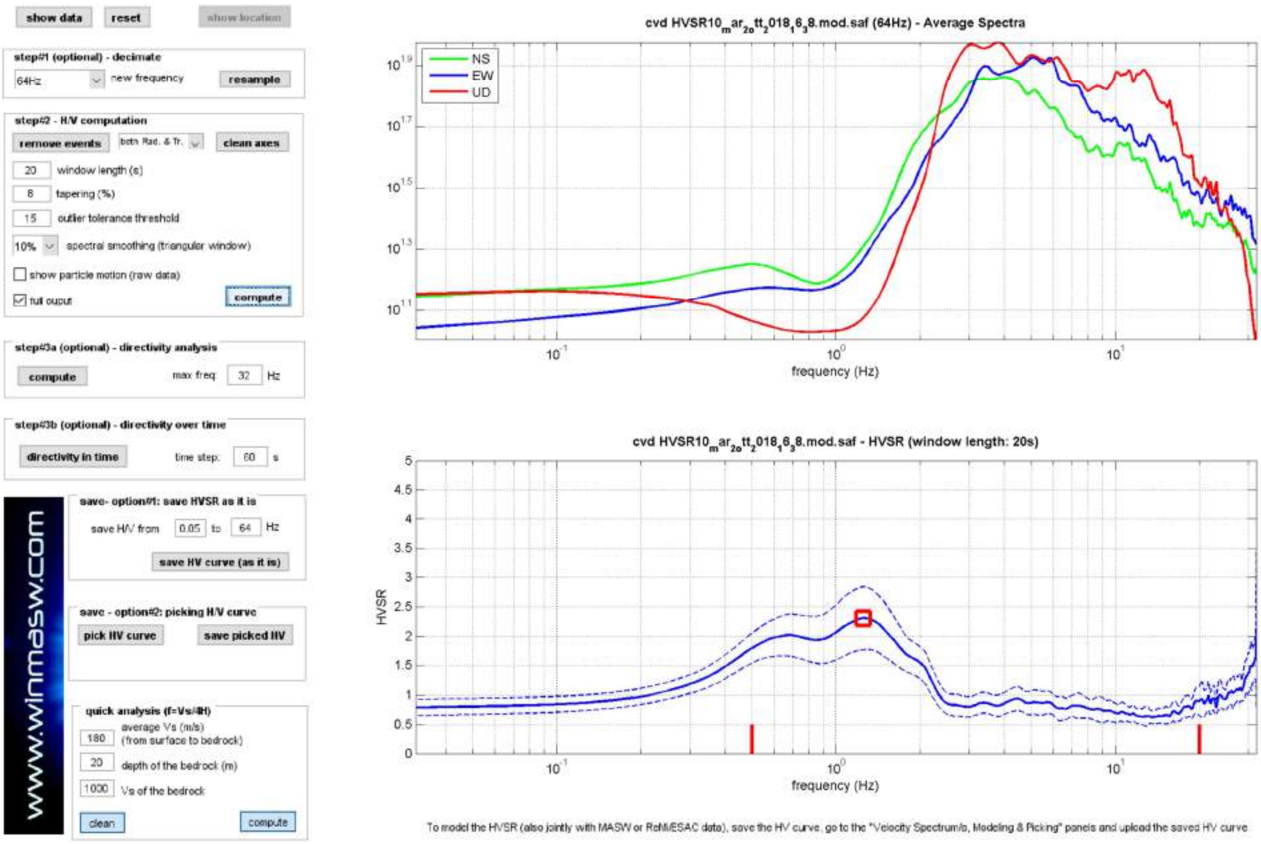
Peak frequency (Hz): 1.3 (±2.0)
Peak HVSR value: 2.3 (±0.5)

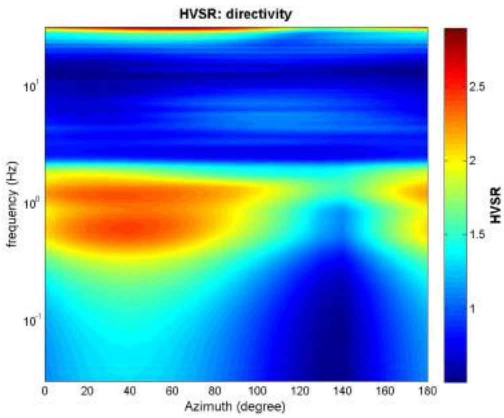
=== Criteria for a reliable H/V curve ====================================

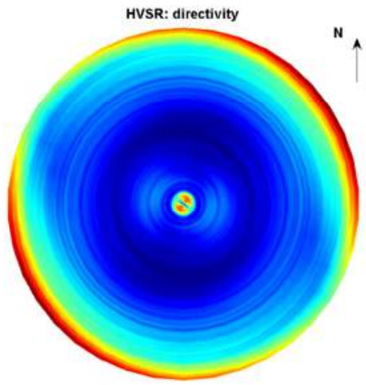
#1. [f0 > 10/Lw]: 1.251 > 0.5 (OK)
#2. [nc > 200]: 2953 > 200 (OK)
#3. [f0>0.5Hz; sigmaA(f) < 2 for 0.5f0 < f < 2f0] (OK)

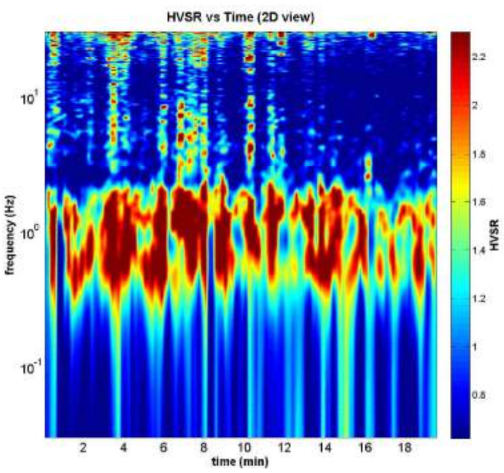
=== Criteria for a clear H/V peak (at least 5 should be fulfilled) ===========

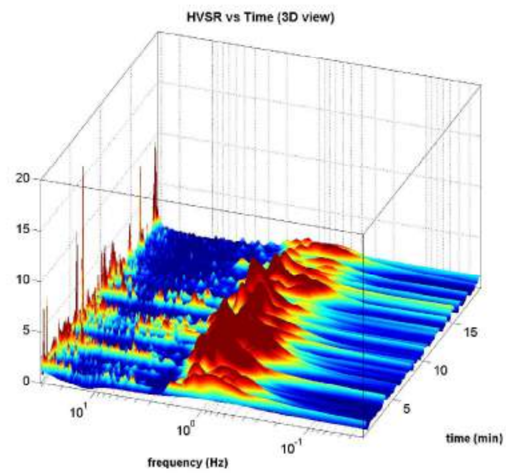
#1. [exists f- in the range [f0/4, f0] | AH/V(f-) < A0/2]: (NO)
#2. [exists f+ in the range [f0, 4f0] | AH/V(f+) < A0/2]: yes, at frequency 2.3Hz (OK)
#3. [A0 > 2]: 2.3 > 2 (OK)
#4. [fpeak[Ah/v(f) ± sigmaA(f)] = f0 ± 5%]: (OK)
#5. [sigmaf < epsilon(f0)]: 1.966 > 0.125 (NO)
#6. [sigmaA(f0) < theta(f0)]: 0.538 < 1.78 (OK)


show data
reset
show location
step#1 (optional) - decimate
64Hz
new frequency
resample
step#2 - H/V computation
remove events
both Rad. & Tr.
clean axes
20
window length (s)
8
tapering (%)
15
outlier tolerance threshold
10%
spectral smoothing (triangular window)
show particle motion (raw data)
full ouput
compute
step#3a (optional) - directivity analysis
compute
max freq
32
Hz
step#3b (optional) - directivity over time
directivity in time
time step:
60
s
www.winmasw.com
save- option#1: save HVSR as it is
save H/V from
0.05
to
64
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)
180
average Vs (m/s) (from surface to bedrock)
20
depth of the bedrock (m)
1000
Vs of the bedrock
clean
compute
cvd HVSR10_m ar_2o tt_2 018_1 6_3 8.mod.saf (64Hz) - Average Spectra
NS
EW
UD
frequency (Hz)
cvd HVSR10_m ar_2o tt_2 018_1 6_3 8.mod.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


HVSR: directivity
N


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


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

HVSR11

DATE 02.10.2018	HOUR 16.52	PLACE S. Andrea Colle di Val d'Elsa
OPERATOR Geologica Toscana S.n.c.	GPS TYPE and #	
WGS84 - UTM33N LATITUDE 4809095	WGS84 - UTM33N LONGITUDE 1670783	ALTITUDE 229 m slm
STATION TYPE GPA Engeenering	SENSOR TYPE 3D - 4,5 Hz	
STATION #	SENSOR #	DISK #
FILE NAME HVSR11.saf		POINT #
GAIN	SAMPL. FREQ. 300 Hz	REC. DURATION 20 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): 18 — 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

HVSR11

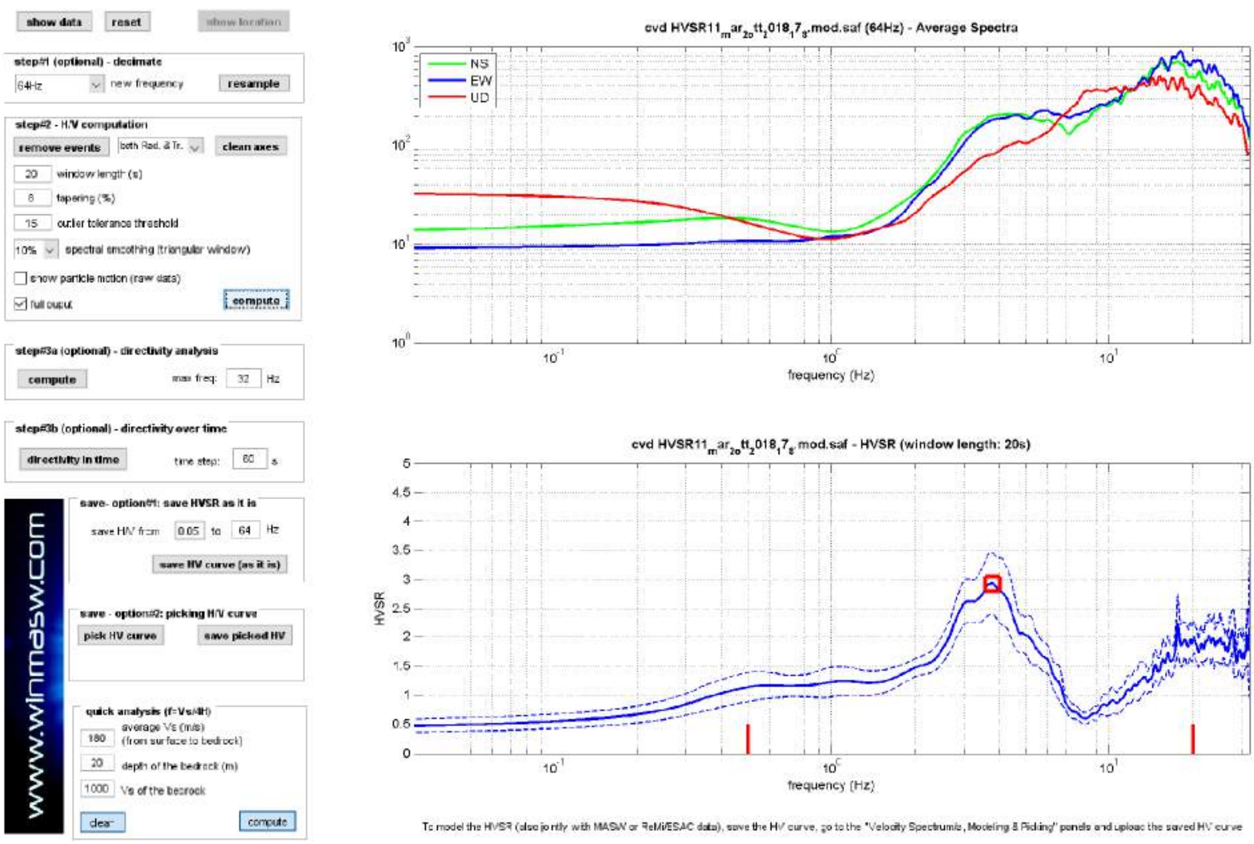
Peak frequency (Hz): 3.8 (±6.1)
Peak HVSR value: 2.9 (±0.5)

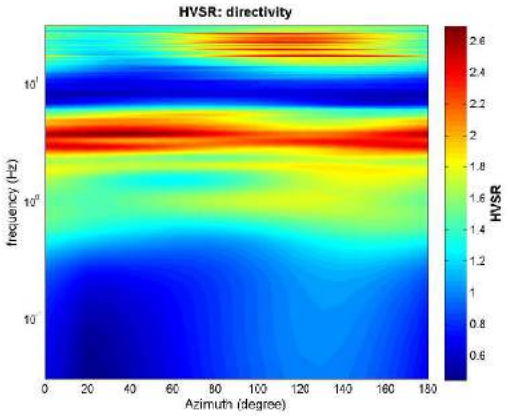
=== Criteria for a reliable H/V curve ====================================

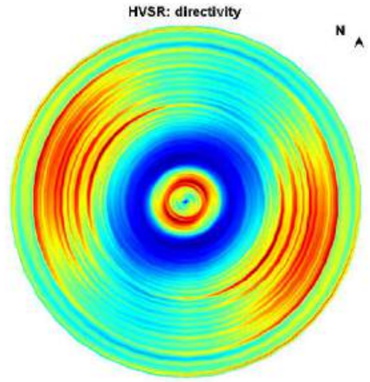
#1. [f0 > 10/Lw]: 3.785 > 0.5 (OK)
#2. [nc > 200]: 4542 > 200 (OK)
#3. [f0>0.5Hz; sigmaA(f) < 2 for 0.5f0 < f < 2f0] (OK)

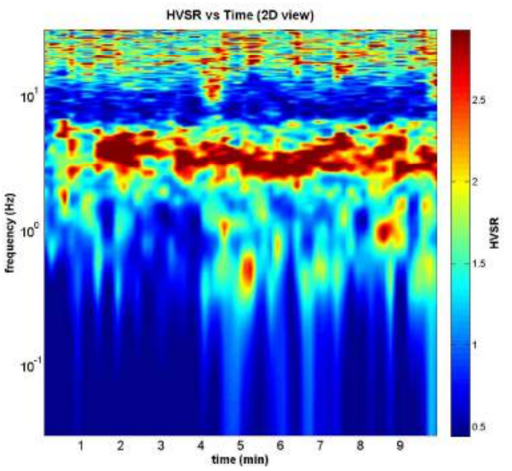
=== Criteria for a clear H/V peak (at least 5 should be fulfilled) ===========

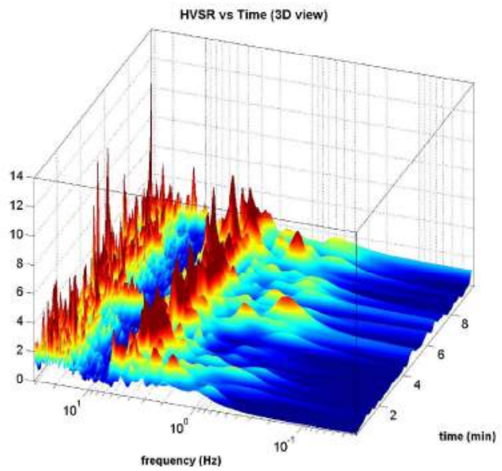
#1. [exists f- in the range [f0/4, f0] | AH/V(f-) < A0/2]: yes, at frequency 1.0Hz (OK)
#2. [exists f+ in the range [f0, 4f0] | AH/V(f+) < A0/2]: yes, at frequency 6.2Hz (OK)
#3. [A0 > 2]: 2.9 > 2 (OK)
#4. [fpeak[Ah/v(f) ± sigmaA(f)] = f0 ± 5%]: (OK)
#5. [sigmaf < epsilon(f0)]: 6.077 > 0.189 (NO)
#6. [sigmaA(f0) < theta(f0)]: 0.528 < 1.58 (OK)


show data
reset
show location
step#1 (optional) - decimate
64Hz
new frequency
resample
step#2 - H/V computation
remove events
both Rad. & Tr.
clean axes
20 window length (s)
5 tapering (%)
15 outlier tolerance threshold
10% spectral smoothing (triangular window)
show particle motion (raw data)
full ouput
compute
step#3a (optional) - directivity analysis
compute
max freq: 32 Hz
step#3b (optional) - directivity over time
directivity in time
time step: 60 s
www.winmasw.com
save- option#1: save HVSR as it is
save H/V from 0.05 to 64 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)
180 average Vs (m/s) (from surface to bedrock)
20 depth of the bedrock (m)
1000 Vs of the bedrock
clear
compute
cvd HVSR11_m ar_20 tt_2 018_1 7_8 mod.saf (64Hz) - Average Spectra
NS
EW
UD
frequency (Hz)
cvd HVSR11_m ar_20 tt_2 018_1 7_8 mod.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 Spectrums, Modeling & Picking" panels and upload the saved HV curve


HVSR: directivity
frequency (Hz)
Azimuth (degree)
HVSR


HVSR: directivity
N


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


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

HVSR12

DATE 24.09.2018	HOUR 15.41	PLACE Via Solferino Colle di Val d'Elsa
OPERATOR Geologica Toscana S.n.c.	GPS TYPE and #	
WGS84 - UTM33N LATITUDE 4809511	WGS84 - UTM33N LONGITUDE 1672025	ALTITUDE 149 m slm
STATION TYPE GPA Engeenering	SENSOR TYPE 3D - 4,5 Hz	
STATION #	SENSOR #	DISK #
FILE NAME HVSR12.saf		POINT #
GAIN	SAMPL. FREQ. 300 Hz	REC. DURATION 20 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): 30 — Remarks

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

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

BUILDING DENSITY [ ] none [ ] scattered [x] 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,...)

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 A1

HVSR12

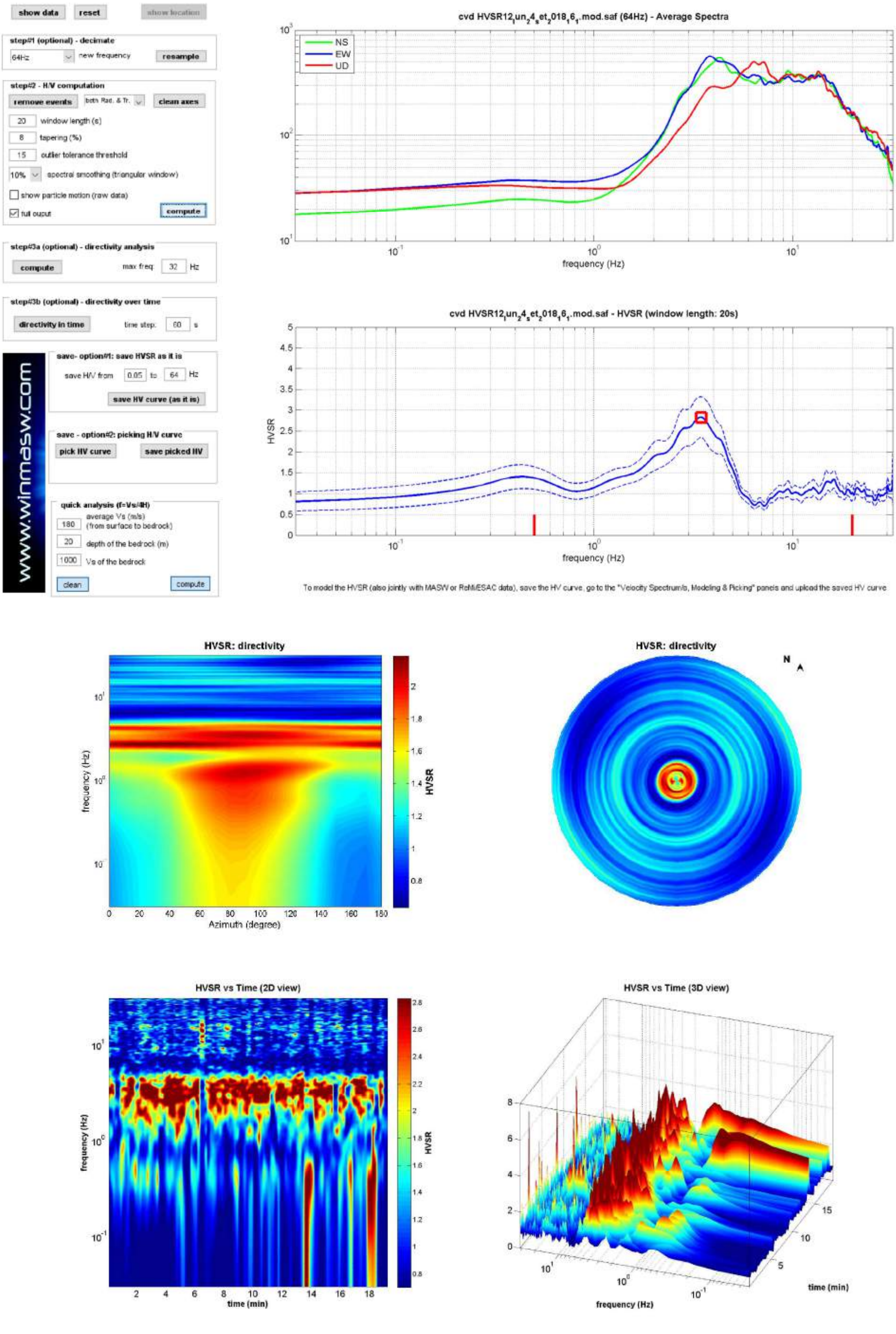
Peak frequency (Hz): 3.5 (±2.9)
Peak HVSR value: 2.8 (±0.5)

=== Criteria for a reliable H/V curve ====================================

#1. [f0 > 10/Lw]: 3.472 > 0.5 (OK)
#2. [nc > 200]: 8055 > 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 5.2Hz (OK)
#3. [A0 > 2]: 2.8 > 2 (OK)
#4. [fpeak[Ah/v(f) ± sigmaA(f)] = f0 ± 5%]: (OK)
#5. [sigmaf < epsilon(f0)]: 2.926 > 0.174 (NO)
#6. [sigmaA(f0) < theta(f0)]: 0.488 < 1.58 (OK)


show data
reset
show location
step#1 (optional) - decimate
64Hz
new frequency
resample
step#2 - H/V computation
remove events
both Rad. & Tr.
clean axes
20
window length (s)
8
tapering (%)
15
outlier tolerance threshold
10%
spectral smoothing (triangular window)
show particle motion (raw data)
full ouput
compute
step#3a (optional) - directivity analysis
compute
max freq:
32
Hz
step#3b (optional) - directivity over time
directivity in time
time step:
60
s
www.winmasw.com
save- option#1: save HVSR as it is
save H/V from
0.05
to
64
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)
180
average Vs (m/s) (from surface to bedrock)
20
depth of the bedrock (m)
1000
Vs of the bedrock
clean
compute
Average Spectra
NS
EW
UD
frequency (Hz)
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
HVSR: directivity
N
HVSR vs Time (2D view)
frequency (Hz)
time (min)
HVSR
HVSR vs Time (3D view)
frequency (Hz)
time (min)

HVSR13

DATE 21.11.2018	HOUR	PLACE Borgatello Colle di Val d'Elsa
OPERATOR Geologica Toscana S.n.c.	GPS TYPE and #	
WGS84 - UTM33N LATITUDE 4810167	WGS84 - UTM33N LONGITUDE 1669391	ALTITUDE 248 m slm
STATION TYPE GPA Engeenering	SENSOR TYPE 3D - 4,5 Hz	
STATION #	SENSOR #	DISK #
FILE NAME HVSR13.saf		POINT #
GAIN	SAMPL. FREQ. 300 Hz	REC. DURATION 20 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, ...)
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

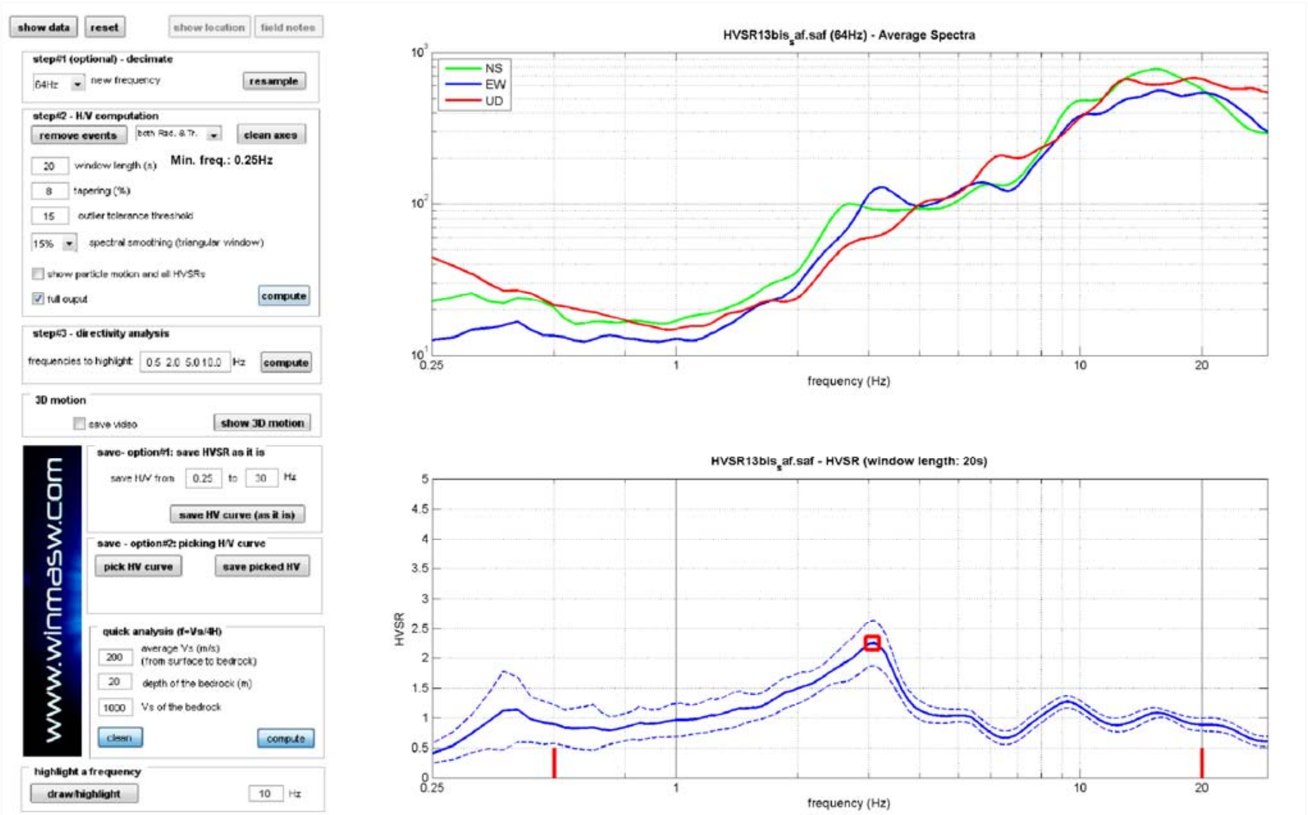
MISURA TIPO A1

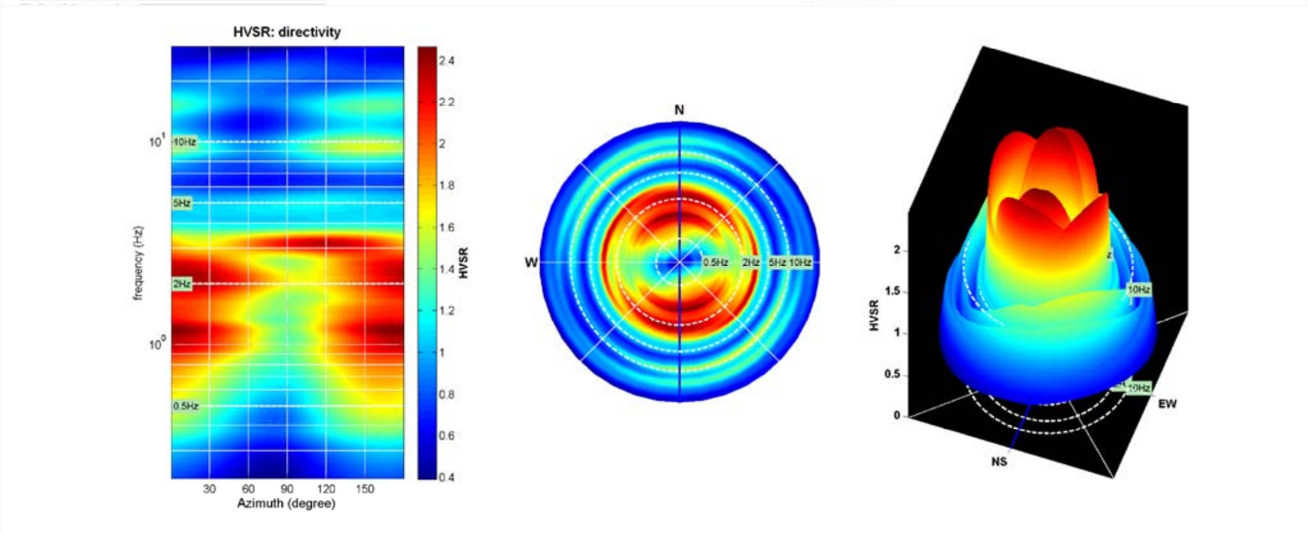
HVSR13

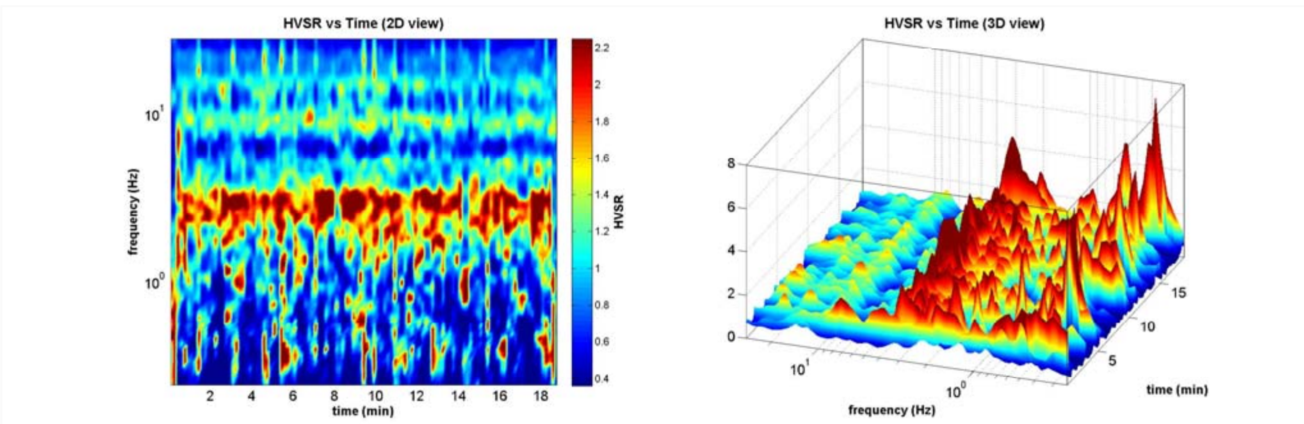
Peak frequency (Hz): 3.1 (±1.2)
Peak HVSR value: 2.3 (±0.4)

=== Criteria for a reliable H/V curve ====================================
#1. [f0 > 10/Lw]: 3.065 > 0.5 (OK)
#2. [nc > 200]: 6928 > 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 0.8Hz (OK)
#2. [exists f+ in the range [f0, 4f0] | AH/V(f+) < A0/2]: yes, at frequency 4.1Hz (OK)
#3. [A0 > 2]: 2.3 > 2 (OK)
#4. [fpeak[Ah/v(f) ą sigmaA(f)] = f0 ą 5%]: (OK)
#5. [sigmaf < epsilon(f0)]: 1.219 > 0.153 (NO)
#6. [sigmaA(f0) < theta(f0)]: 0.379 < 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
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
0.25
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
HVSR13bis_s af.saf (64Hz) - Average Spectra
NS
EW
UD
frequency (Hz)
HVSR13bis_s af.saf - HVSR (window length: 20s)
HVSR
frequency (Hz)


HVSR: directivity
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)

HVSR14

DATE 24.09.2018	HOUR 15.12	PLACE Depuratore Colle di Val d'Elsa	
OPERATOR Geologica Toscana S.n.c.		GPS TYPE and #	
WGS84 - UTM33N LATITUDE 4810756	WGS84 - UTM33N LONGITUDE 1672668	ALTITUDE 123 m slm	
STATION TYPE GPA Engeenering	SENSOR TYPE 3D - 4,5 Hz		
STATION #	SENSOR #	DISK #	
FILE NAME HVSR14.saf		POINT #	
GAIN	SAMPL. FREQ. 300 Hz	REC. DURATION 20 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 A1

HVSR14

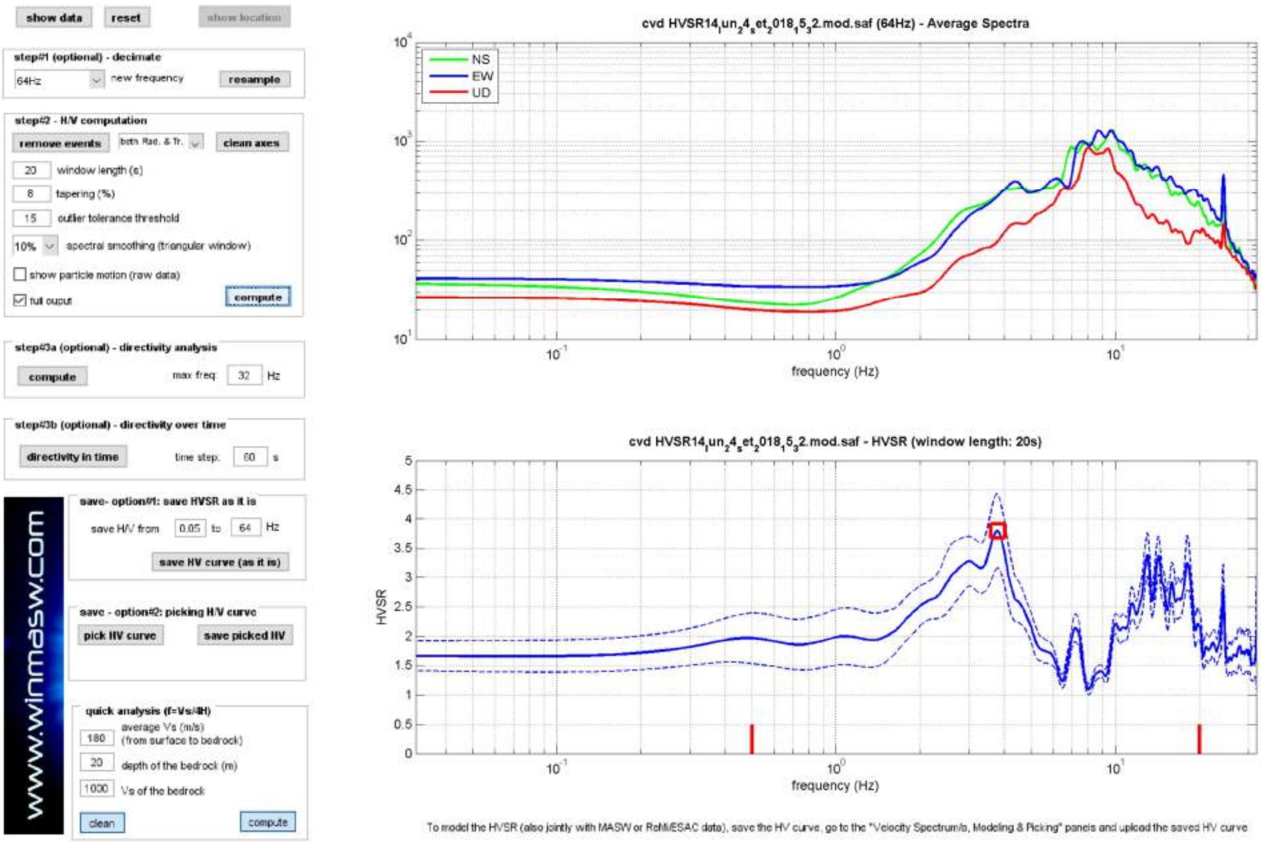
Peak frequency (Hz): 3.8 (±5.8)
Peak HVSR value: 3.8 (±0.6)

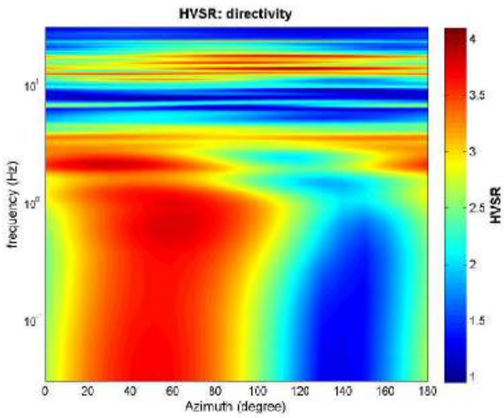
=== Criteria for a reliable H/V curve ====================================

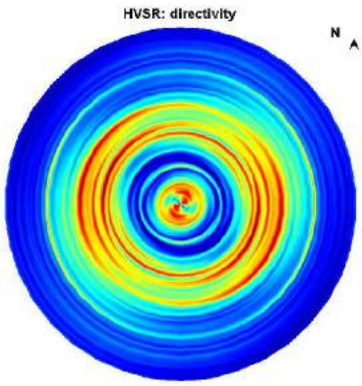
#1. [f0 > 10/Lw]: 3.785 > 0.5 (OK)
#2. [nc > 200]: 8630 > 200 (OK)
#3. [f0>0.5Hz; sigmaA(f) < 2 for 0.5f0 < f < 2f0] (OK)

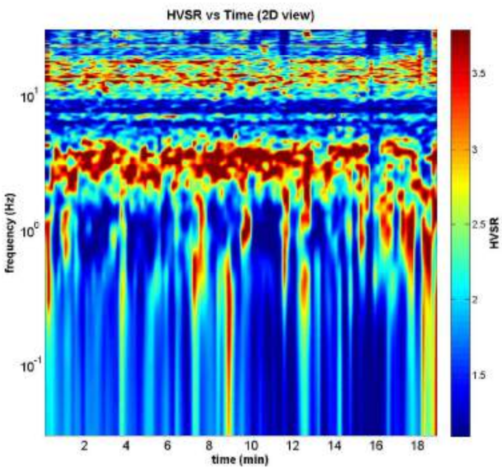
=== Criteria for a clear H/V peak (at least 5 should be fulfilled) ===========

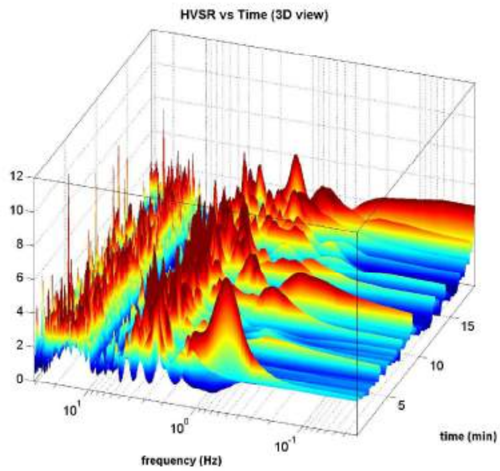
#1. [exists f- in the range [f0/4, f0] | AH/V(f-) < A0/2]: yes (considering standard deviations), at frequency 1.0Hz (OK)
#2. [exists f+ in the range [f0, 4f0] | AH/V(f+) < A0/2]: yes, at frequency 5.3Hz (OK)
#3. [A0 > 2]: 3.8 > 2 (OK)
#4. [fpeak[Ah/v(f) ± sigmaA(f)] = f0 ± 5%]: (OK)
#5. [sigmaf < epsilon(f0)]: 5.796 > 0.189 (NO)
#6. [sigmaA(f0) < theta(f0)]: 0.636 < 1.58 (OK)


show data
reset
show location
step#1 (optional) - decimate
64Hz
new frequency
resample
step#2 - H/V computation
remove events
both Rad. & Tr.
clean axes
20 window length (s)
8 tapering (%)
15 outlier tolerance threshold
10% spectral smoothing (triangular window)
show particle motion (raw data)
full ouput
compute
step#3a (optional) - directivity analysis
compute
max freq: 32 Hz
step#3b (optional) - directivity over time
directivity in time
time step: 60 s
www.winmasw.com
save- option#1: save HVSR as it is
save H/V from 0.05 to 64 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)
180 average Vs (m/s) (from surface to bedrock)
20 depth of the bedrock (m)
1000 Vs of the bedrock
clean
compute
cvd HVSR14un24set2018532.mod.saf (64Hz) - Average Spectra
NS
EW
UD
frequency (Hz)
cvd HVSR14un24set2018532.mod.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


HVSR: directivity
N


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


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

HVSR15

DATE 21.09.2018	HOUR 18.10	PLACE Ponte dell'Armi Colle di Val d'Elsa
OPERATOR Geologica Toscana S.n.c.	GPS TYPE and #	
WGS84 - UTM33N LATITUDE 4811365	WGS84 - UTM33N LONGITUDE 1673458	ALTITUDE 117 m slm
STATION TYPE GPA Engeenering	SENSOR TYPE 3D - 4,5 Hz	
STATION #	SENSOR #	DISK #
FILE NAME HVSR15.saf		POINT #
GAIN	SAMPL. FREQ. 300 Hz	REC. DURATION 20 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, ...)

OBSERVATIONS

FREQUENCY: Hz (if computed in the field)

Qualità della misura:

MISURA TIPO A2

HVSR15

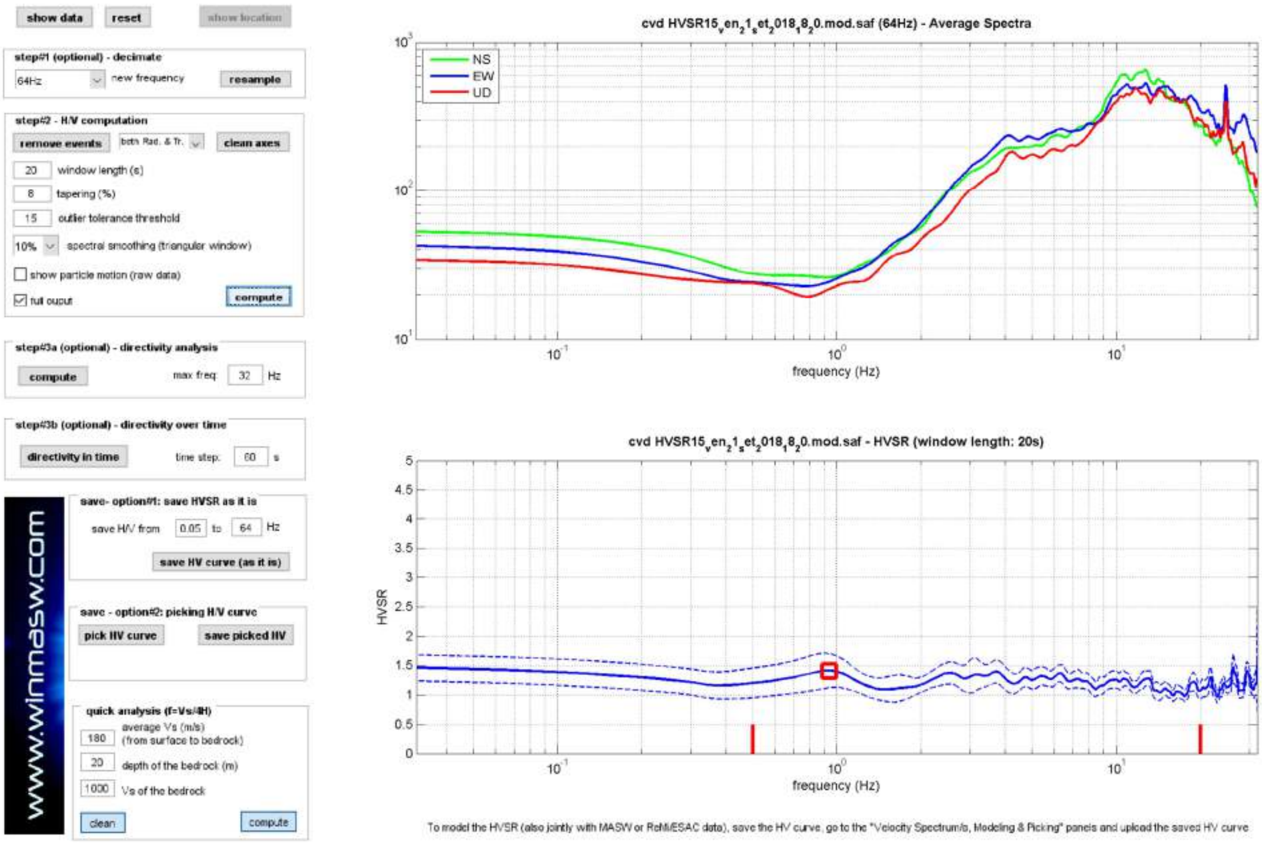
Peak frequency (Hz): 0.9 (±4.9)
Peak HVSR value: 1.4 (±0.3)

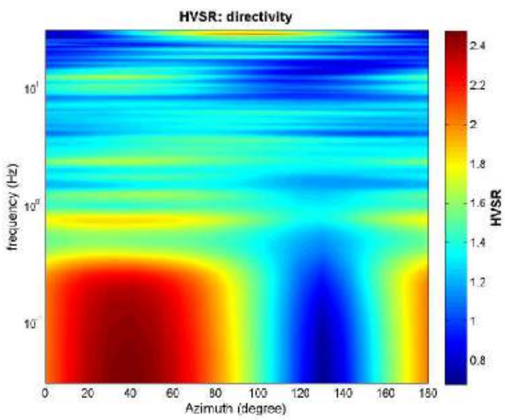
=== Criteria for a reliable H/V curve ===================================

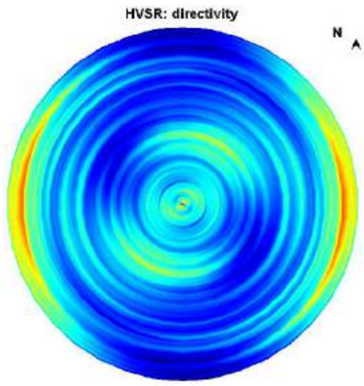
#1. [f0 > 10/Lw]: 0.938 > 0.5 (OK)
#2. [nc > 200]: 2177 > 200 (OK)
#3. [f0>0.5Hz; sigmaA(f) < 2 for 0.5f0 < f < 2f0] (OK)

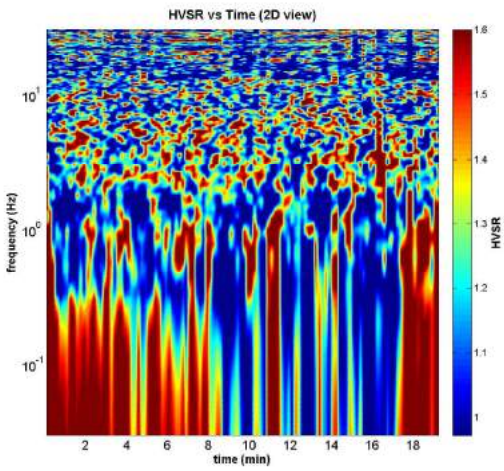
=== Criteria for a clear H/V peak (at least 5 should be fulfilled) ============

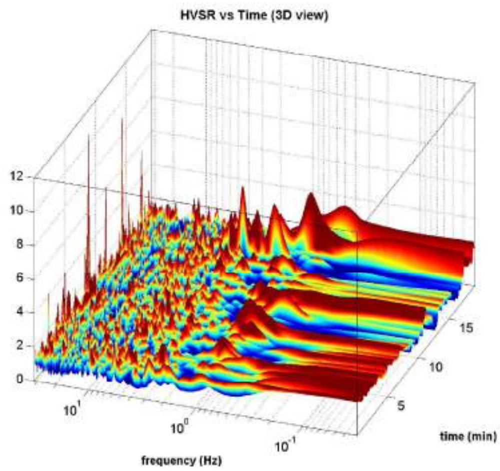
#1. [exists f- in the range [f0/4, f0] | AH/V(f-) < A0/2]: (NO)
#2. [exists f+ in the range [f0, 4f0] | AH/V(f+) < A0/2]: (NO)
#3. [A0 > 2]: 1.4 < 2 (NO)
#4. [fpeak[Ah/v(f) ± sigmaA(f)] = f0 ± 5%]: (NO)
#5. [sigmaf < epsilon(f0)]: 4.902 > 0.141 (NO)
#6. [sigmaA(f0) < theta(f0)]: 0.290 < 2 (OK)


show data
reset
show location
step#1 (optional) - decimate
64Hz
new frequency
resample
step#2 - H/V computation
remove events
both Rad. & Tr.
clean axes
20 window length (s)
8 tapering (%)
15 outlier tolerance threshold
10% spectral smoothing (triangular window)
show particle motion (raw data)
full ouput
compute
step#3a (optional) - directivity analysis
compute
max freq: 32 Hz
step#3b (optional) - directivity over time
directivity in time
time step: 60 s
www.winmasw.com
save- option#1: save HVSR as it is
save H/V from 0.05 to 64 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)
180 average Vs (m/s) (from surface to bedrock)
20 depth of the bedrock (m)
1000 Vs of the bedrock
clean
compute
cvd HVSR15_v en_2 1_s et_2 018_1 8_2 0.mod.saf (64Hz) - Average Spectra
NS
EW
UD
frequency (Hz)
cvd HVSR15_v en_2 1_s et_2 018_1 8_2 0.mod.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/s, Modeling & Picking" panels and upload the saved HV curve


HVSR: directivity
frequency (Hz)
Azimuth (degree)
HVSR


HVSR: directivity
N


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


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

HVSR16

DATE 21.09.2018	HOUR 16.15	PLACE Selvamaggio Colle di Val d'Elsa
OPERATOR Geologica Toscana S.n.c.	GPS TYPE and #	
WGS84 - UTM33N LATITUDE 4808904	WGS84 - UTM33N LONGITUDE 1673803	ALTITUDE 214 m slm
STATION TYPE GPA Engeenering	SENSOR TYPE 3D - 4,5 Hz	
STATION #	SENSOR #	DISK #
FILE NAME HVSR16.saf		POINT #
GAIN	SAMPL. FREQ. 300 Hz	REC. DURATION 20 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:

MISURA TIPO A2

HVSR16

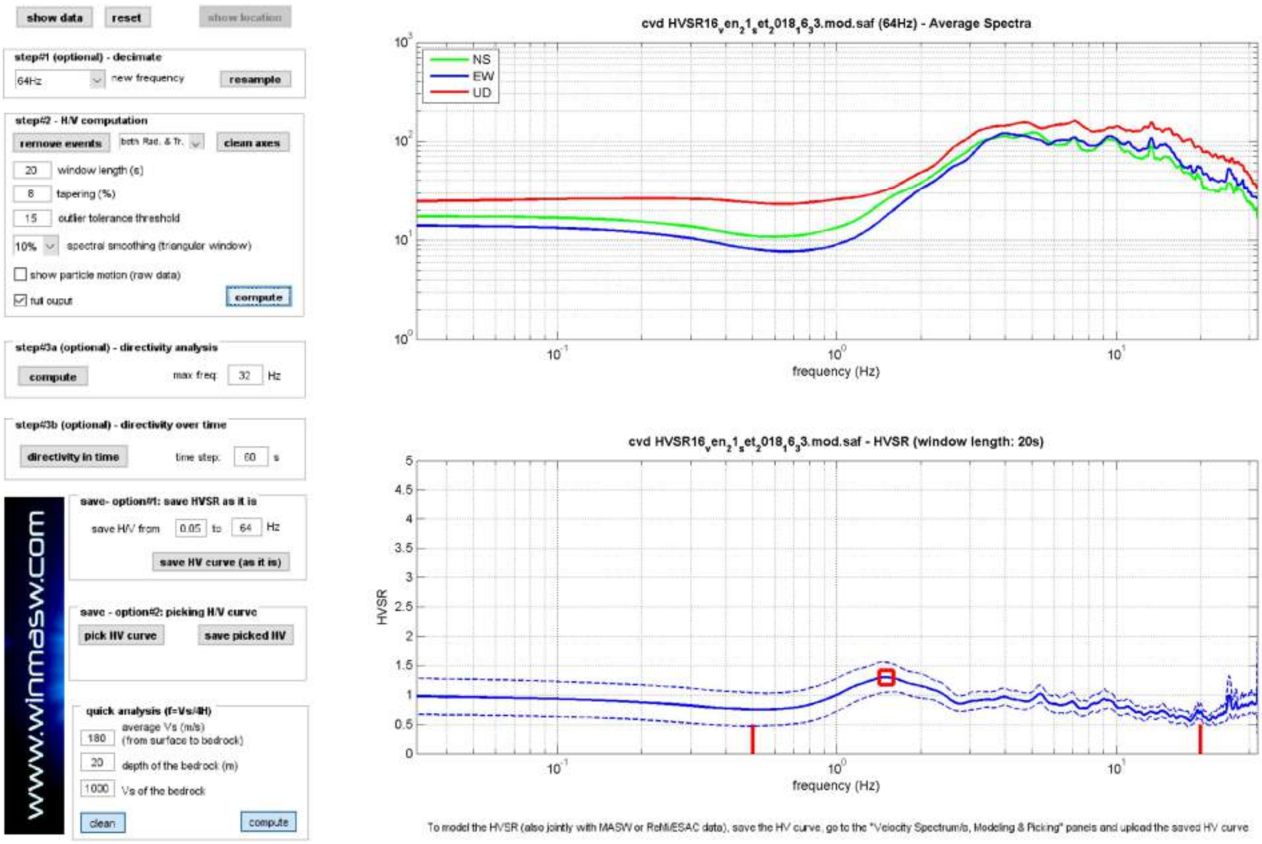
Peak frequency (Hz): 1.5 (±4.5)
Peak HVSR value: 1.3 (±0.3)

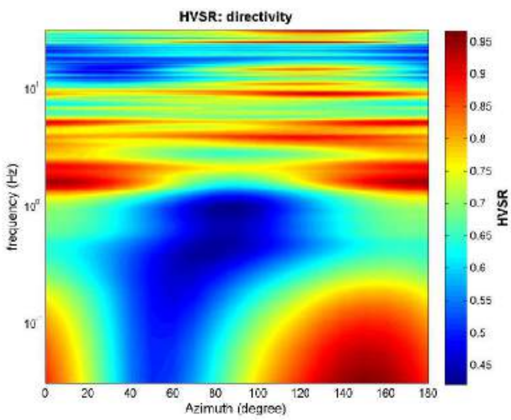
=== Criteria for a reliable H/V curve ====================================

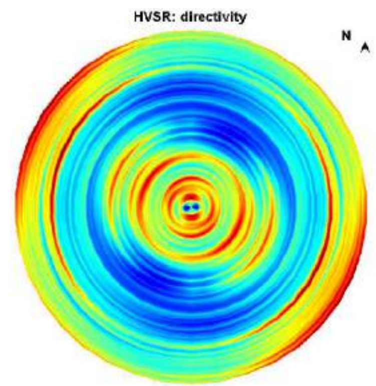
#1. [f0 > 10/Lw]: 1.501 > 0.5 (OK)
#2. [nc > 200]: 3543 > 200 (OK)
#3. [f0>0.5Hz; sigmaA(f) < 2 for 0.5f0 < f < 2f0] (OK)

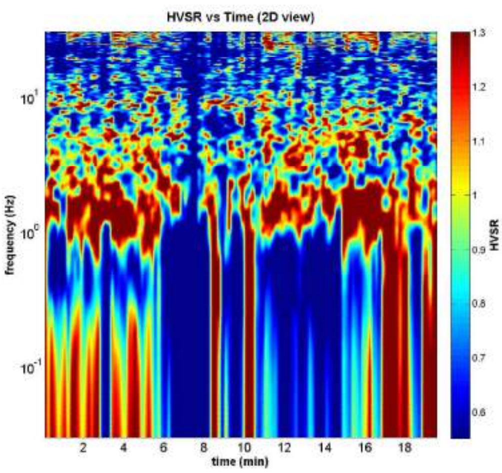
=== Criteria for a clear H/V peak (at least 5 should be fulfilled) ===========

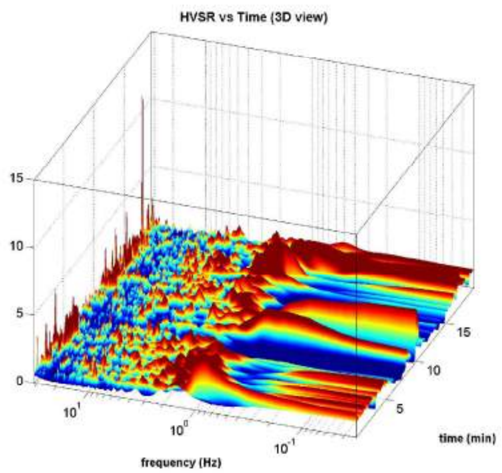
#1. [exists f- in the range [f0/4, f0] | AH/V(f-) < A0/2]: yes (considering standard deviations), at frequency 0.5Hz (OK)
#2. [exists f+ in the range [f0, 4f0] | AH/V(f+) < A0/2]: (NO)
#3. [A0 > 2]: 1.3 < 2 (NO)
#4. [fpeak[Ah/v(f) ± sigmaA(f)] = f0 ± 5%]: (NO)
#5. [sigmaf < epsilon(f0)]: 4.481 > 0.150 (NO)
#6. [sigmaA(f0) < theta(f0)]: 0.257 < 1.78 (OK)


show data
reset
show location
step#1 (optional) - decimate
64Hz
new frequency
resample
step#2 - H/V computation
remove events
both Rad. & Tr.
clean axes
20
window length (s)
8
tapering (%)
15
outlier tolerance threshold
10%
spectral smoothing (triangular window)
show particle motion (raw data)
full ouput
compute
step#3a (optional) - directivity analysis
compute
max freq:
32
Hz
step#3b (optional) - directivity over time
directivity in time
time step:
60
s
www.winmasw.com
save- option#1: save HVSR as it is
save H/V from
0.05
to
64
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)
180
average Vs (m/s) (from surface to bedrock)
20
depth of the bedrock (m)
1000
Vs of the bedrock
clean
compute
cvd HVSR16_ven21set2018163.mod.saf (64Hz) - Average Spectra
NS
EW
UD
frequency (Hz)
cvd HVSR16_ven21set2018163.mod.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/s, Modeling & Picking" panels and upload the saved HV curve


HVSR: directivity
frequency (Hz)
Azimuth (degree)
HVSR


HVSR: directivity
N


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


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

HVSR17

DATE 21.09.2018	HOUR 15.18	PLACE Pod. Querciola Colle di Val d'Elsa
OPERATOR Geologica Toscana S.n.c.	GPS TYPE and #	
WGS84 - UTM33N LATITUDE 4807683	WGS84 - UTM33N LONGITUDE 1674766	ALTITUDE 245 m slm
STATION TYPE GPA Engeenering	SENSOR TYPE 3D - 4,5 Hz	
STATION #	SENSOR #	DISK #
FILE NAME HVSR17.saf		POINT #
GAIN	SAMPL. FREQ. 300 Hz	REC. DURATION 20 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

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

HVSR17

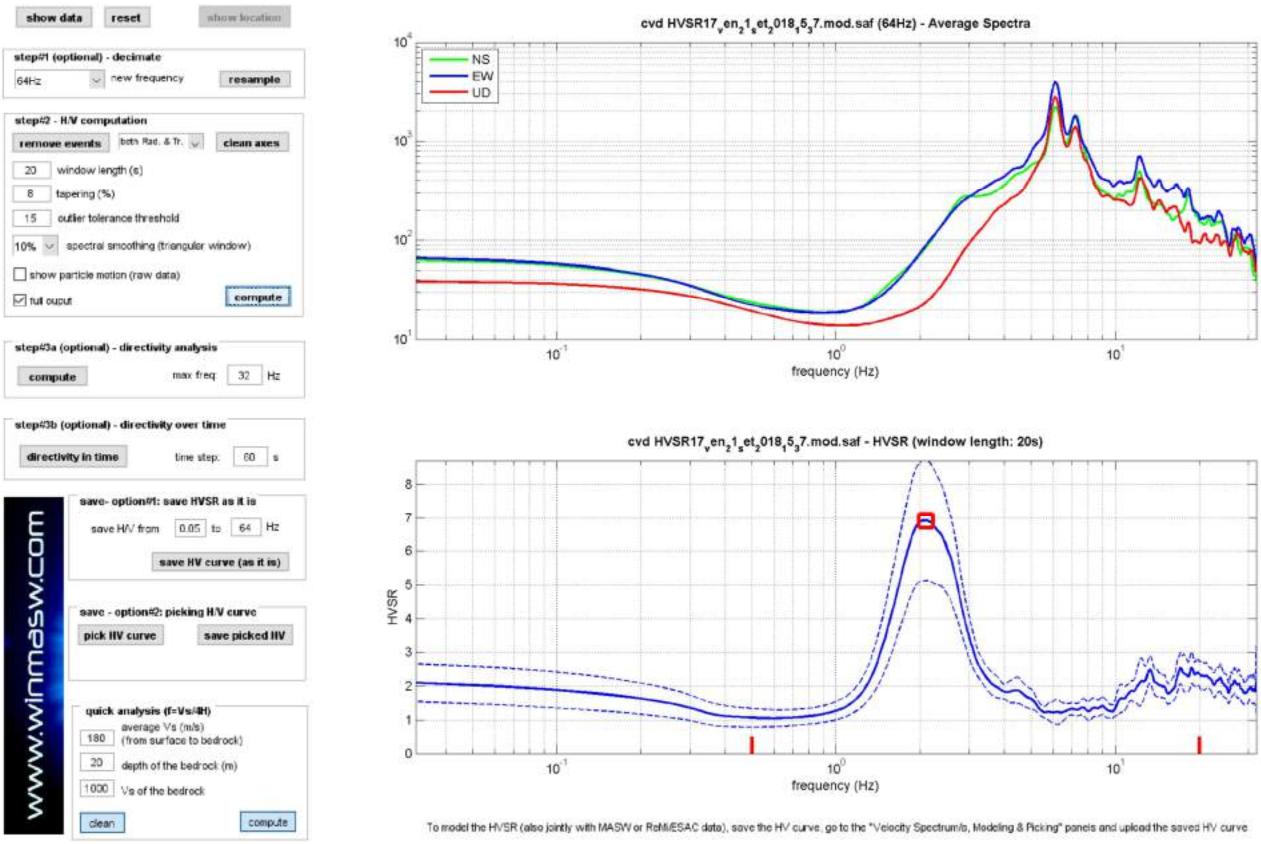
Peak frequency (Hz): 2.1 (±4.1)
Peak HVSR value: 6.9 (±1.8)

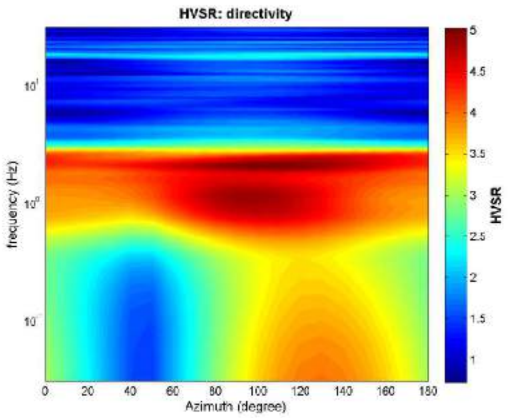
=== Criteria for a reliable H/V curve ==================================

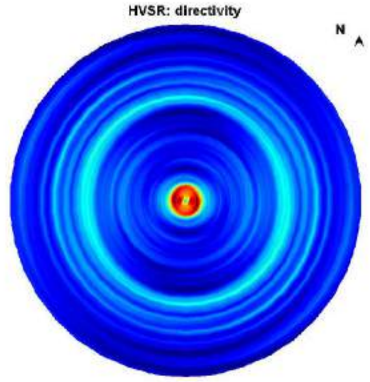
#1. [f0 > 10/Lw]: 2.096 > 0.5 (OK)
#2. [nc > 200]: 4946 > 200 (OK)
#3. [f0>0.5Hz; sigmaA(f) < 2 for 0.5f0 < f < 2f0] (OK)

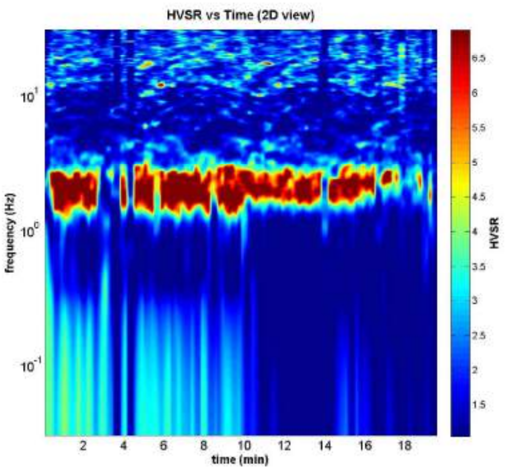
=== Criteria for a clear H/V peak (at least 5 should be fulfilled) ===========

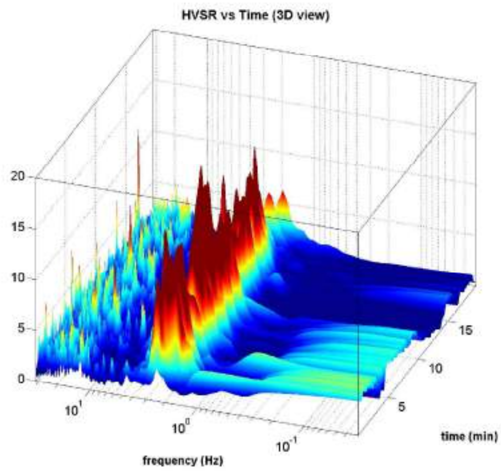
#1. [exists f- in the range [f0/4, f0] | AH/V(f-) < A0/2]: yes, at frequency 0.6Hz (OK)
#2. [exists f+ in the range [f0, 4f0] | AH/V(f+) < A0/2]: yes, at frequency 3.0Hz (OK)
#3. [A0 > 2]: 6.9 > 2 (OK)
#4. [fpeak[Ah/v(f) ± sigmaA(f)] = f0 ± 5%]: (OK)
#5. [sigmaf < epsilon(f0)]: 4.090 > 0.105 (NO)
#6. [sigmaA(f0) < theta(f0)]: 1.787 < 1.58 (NO)


show data
reset
show location
step#1 (optional) - decimate
new frequency
resample
step#2 - H/V computation
remove events
clean axes
window length (s)
tapering (%)
outlier tolerance threshold
spectral smoothing (triangular window)
show particle motion (raw data)
full ouput
compute
step#3a (optional) - directivity analysis
max freq
step#3b (optional) - directivity over time
directivity in time
time step
save- option#1: save HVSR as it is
save H/V from 0.05 to 64 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)
average Vs (m/s) (from surface to bedrock)
depth of the bedrock (m)
Vs of the bedrock
clean
www.winmasw.com
Average Spectra
NS
EW
UD
frequency (Hz)
HVSR (window length: 20s)
HVSR
To model the HVSR (also jointly with MASW or ReMi/ESAC data), save the HV curve, go to the "Velocity Spectrum/s, Modeling & Picking" panels and upload the saved HV curve


HVSR: directivity
frequency (Hz)
Azimuth (degree)
HVSR


HVSR: directivity
N


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


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

HVSR18

DATE 03.10.2018	HOUR 12.21	PLACE Gracciano Colle di Val d'Elsa
OPERATOR Geologica Toscana S.n.c.	GPS TYPE and #	
WGS84 - UTM33N LATITUDE 4806879	WGS84 - UTM33N LONGITUDE 1672692	ALTITUDE 183 m slm
STATION TYPE GPA Engeenering	SENSOR TYPE 3D - 4,5 Hz	
STATION #	SENSOR #	DISK #
FILE NAME HVSR18.saf		POINT #
GAIN	SAMPL. FREQ. 300 Hz	REC. DURATION 20 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): 16 Remarks ____

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

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

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

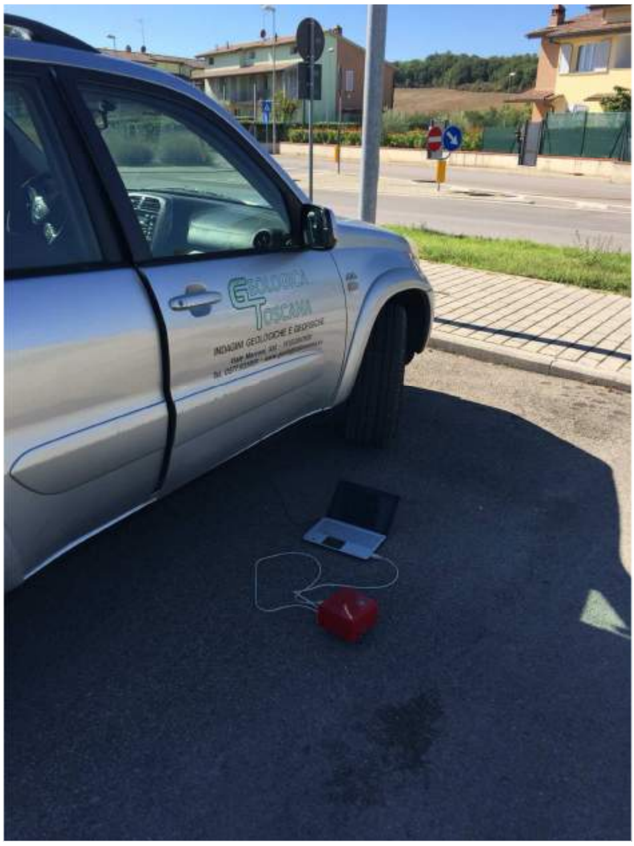
TRANSIENTS	none	few	moderate	many	very dense	distance
cars			●			
trucks		●				
pedestrians		●				
other	●					

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

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

OBSERVATIONS

FREQUENCY: Hz (if computed in the field)



Qualità della misura:

MISURA TIPO A2

HVSR18

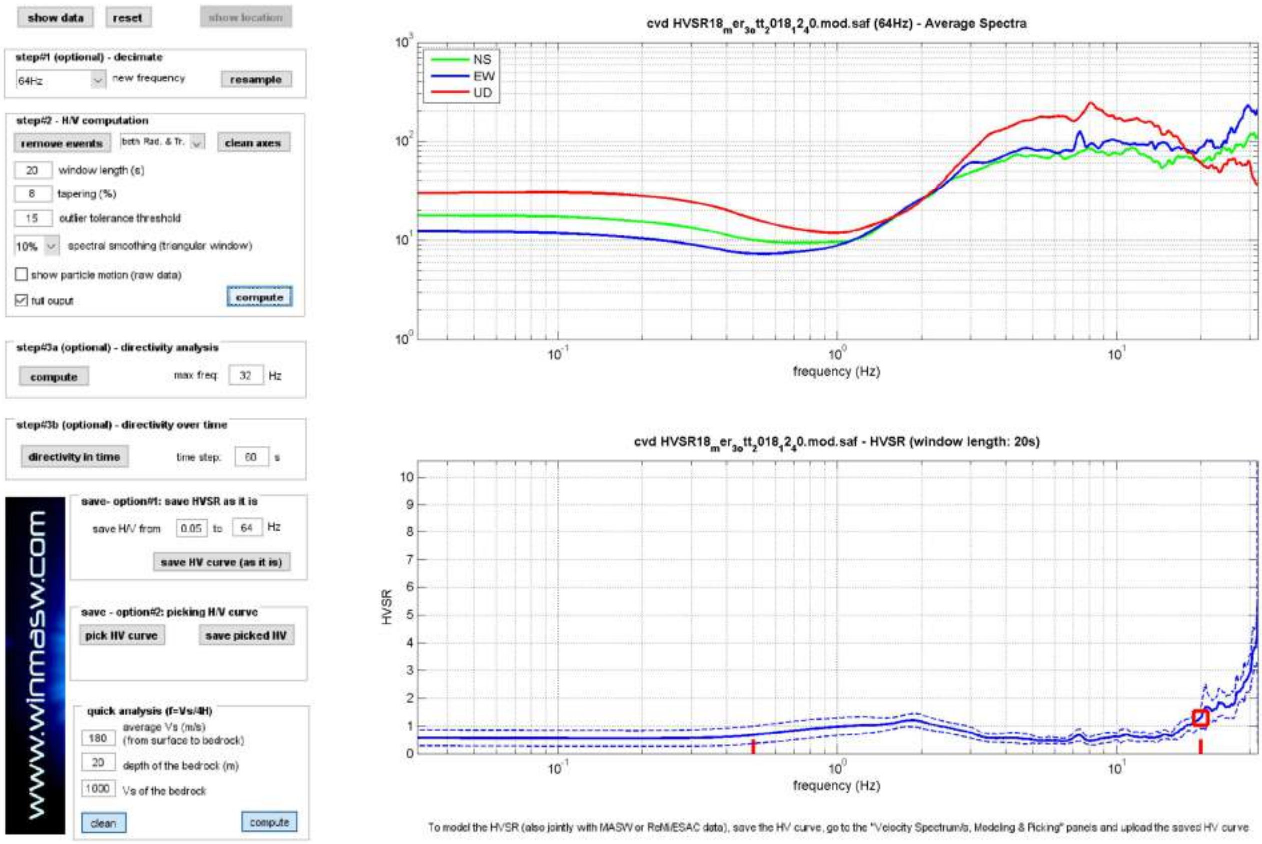
Peak frequency (Hz): 20.0 (±8.6)
Peak HVSR value: 1.3 (±0.4)

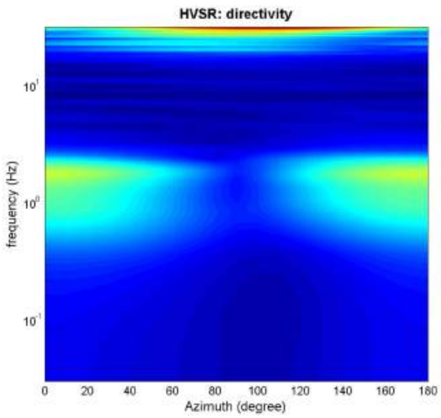
=== Criteria for a reliable H/V curve ====================================

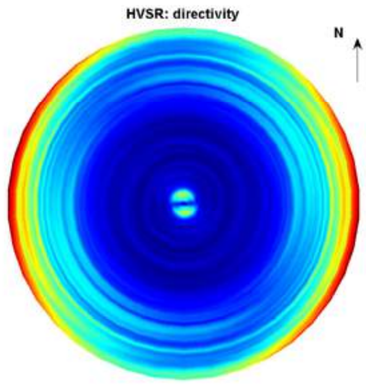
#1. [f0 > 10/Lw]: 19.988 > 0.5 (OK)
#2. [nc > 200]: 46773 > 200 (OK)
#3. [f0>0.5Hz; sigmaA(f) < 2 for 0.5f0 < f < 2f0] (OK)

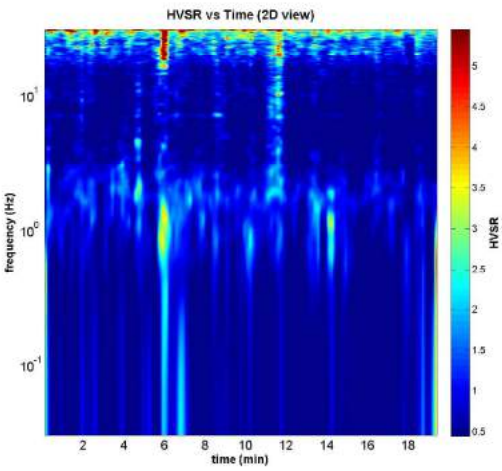
=== Criteria for a clear H/V peak (at least 5 should be fulfilled) ===========

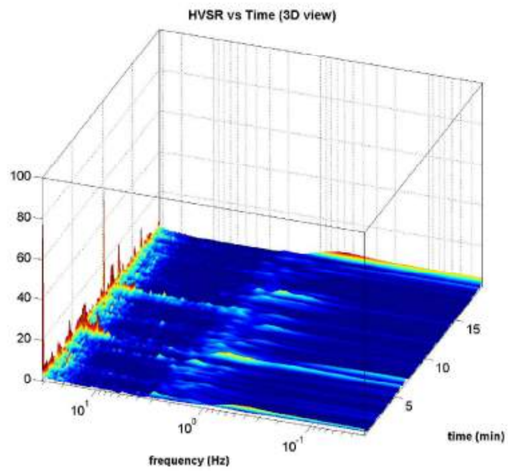
#1. [exists f- in the range [f0/4, f0] | AH/V(f-) < A0/2]: yes, at frequency 5.0Hz (OK)
#2. [exists f+ in the range [f0, 4f0] | AH/V(f+) < A0/2]: (NO)
#3. [A0 > 2]: 1.3 < 2 (NO)
#4. [fpeak[Ah/v(f) ± sigmaA(f)] = f0 ± 5%]: (NO)
#5. [sigmaf < epsilon(f0)]: 8.581 > 0.999 (NO)
#6. [sigmaA(f0) < theta(f0)]: 0.375 < 1.58 (OK)


show data
reset
show location
step#1 (optional) - decimate
64Hz
new frequency
resample
step#2 - H/V computation
remove events
both Rad. & Tr.
clean axes
20
window length (s)
8
tapering (%)
15
outlier tolerance threshold
10%
spectral smoothing (triangular window)
show particle motion (raw data)
full ouput
compute
step#3a (optional) - directivity analysis
compute
max freq
32
Hz
step#3b (optional) - directivity over time
directivity in time
time step:
60
s
www.winmasw.com
save- option#1: save HVSR as it is
save H/V from
0.05
to
64
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)
180
average Vs (m/s) (from surface to bedrock)
20
depth of the bedrock (m)
1000
Vs of the bedrock
clean
compute
cvd HVSR18_m er_3o tt_2 018_1 2_4 0.mod.saf (64Hz) - Average Spectra
NS
EW
UD
frequency (Hz)
cvd HVSR18_m er_3o tt_2 018_1 2_4 0.mod.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/s, Modeling & Picking" panels and upload the saved HV curve


HVSR: directivity
frequency (Hz)
Azimuth (degree)
HVSR


HVSR: directivity
N


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


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

HVSR19

DATE 06.09.2018	HOUR 11.28	PLACE Mensanello - Colle di Val d'Elsa
OPERATOR Geologica Toscana S.n.c.	GPS TYPE and #	
WGS84 - UTM33N LATITUDE 4805312	WGS84 - UTM33N LONGITUDE 1671597	ALTITUDE 245 m slm
STATION TYPE GPA Engeenering	SENSOR TYPE 3D - 4,5 Hz	
STATION #	SENSOR #	DISK #
FILE NAME HVSR19.saf		POINT #
GAIN	SAMPL. FREQ. 300 Hz	REC. DURATION 20 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): 25 Remarks ____

GROUND TYPE
- [ ] earth ([ ] hard [ ] soft) [ ] gravel [ ] sand [ ] rock [ ] grass = ([ ] short [ ] tall)
- [ ] asphalt [ ] cement [ ] concrete [x] paved [ ] other ____
- [ ] 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, ...)

Buildings

OBSERVATIONS

FREQUENCY: Hz (if computed in the field)

Qualità della misura:

MISURA TIPO A2

HVSR19

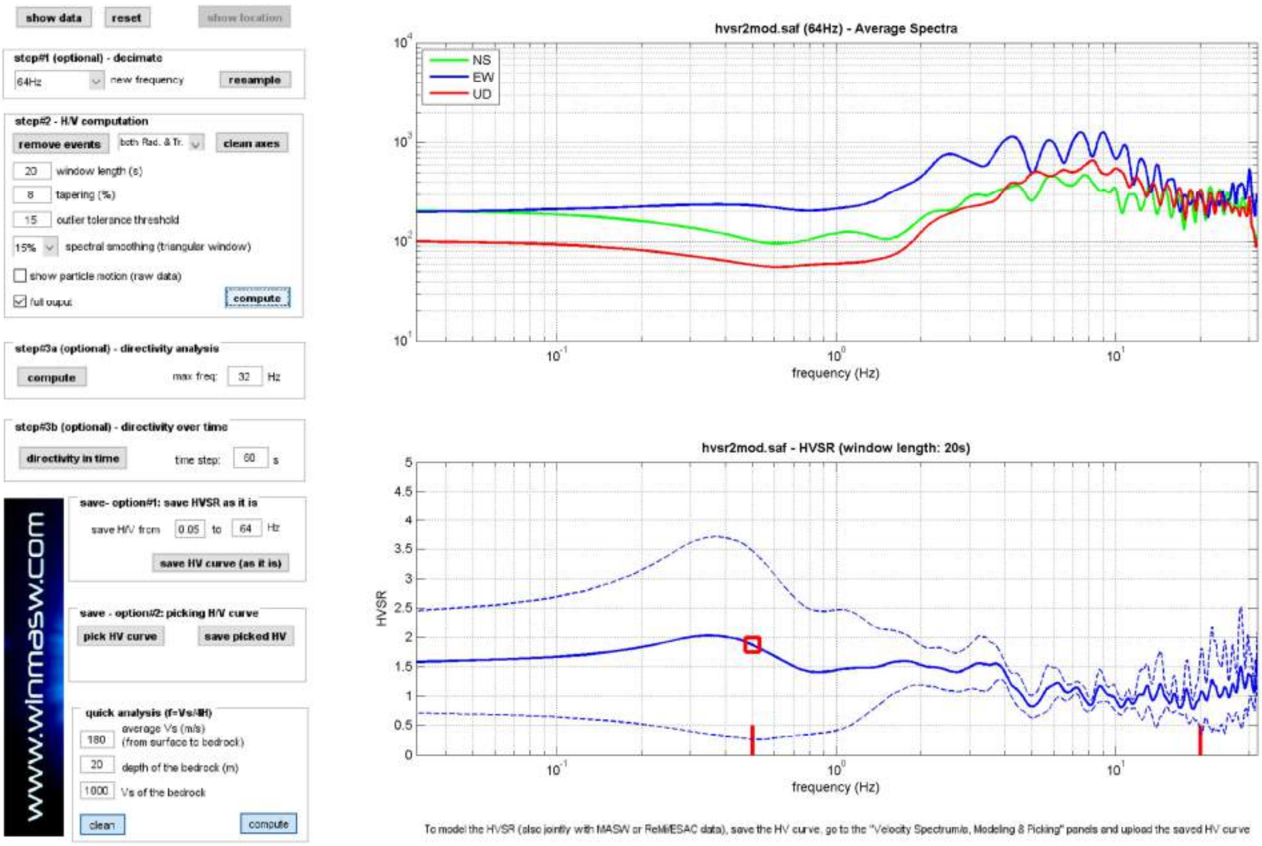
Peak frequency (Hz): 0.5 (±4.9)
Peak HVSR value: 1.9 (±1.5)

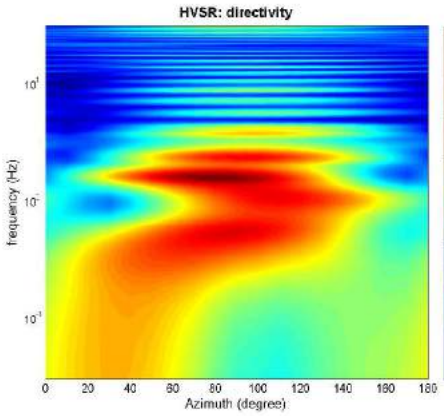
=== Criteria for a reliable H/V curve ====================================

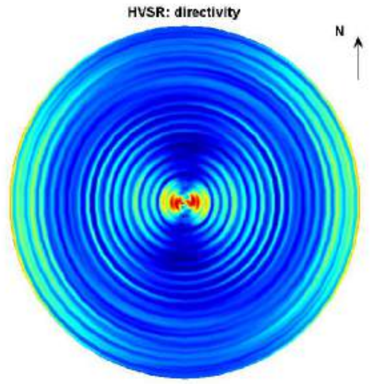
#1. [f0 > 10/Lw]: 0.500 > 0.5 (OK)
#2. [nc > 200]: 150 < 200 (NO)
#3. [f0>0.5Hz; sigmaA(f) < 2 for 0.5f0 < f < 2f0] (OK)

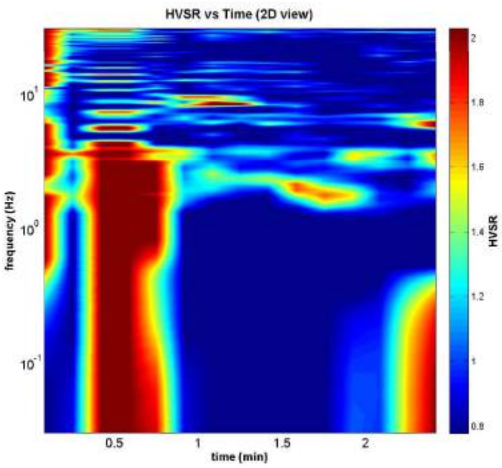
=== Criteria for a clear H/V peak (at least 5 should be fulfilled) ===========

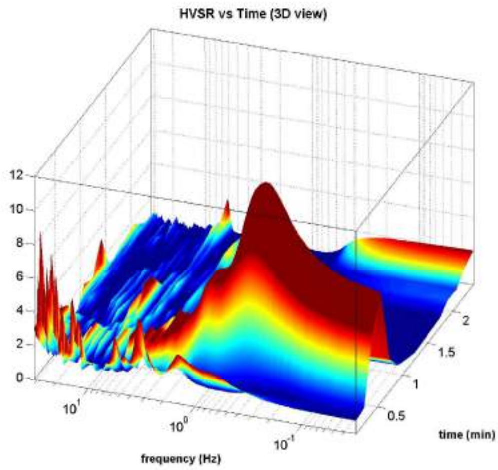
#1. [exists f- in the range [f0/4, f0] | AH/V(f-) < A0/2]: yes (considering standard deviations), at frequency 0.5Hz (OK)
#2. [exists f+ in the range [f0, 4f0] | AH/V(f+) < A0/2]: yes (considering standard deviations), at frequency Hz (OK)
#3. [A0 > 2]: 1.9 < 2 (NO)
#4. [fpeak[Ah/v(f) ± sigmaA(f)] = f0 ± 5%]: (NO)
#5. [sigmaf < epsilon(f0)]: 4.857 > 0.075 (NO)
#6. [sigmaA(f0) < theta(f0)]: 1.602 < 2 (OK)


show data
reset
show location
step#1 (optional) - decimate
64Hz
new frequency
resample
step#2 - H/V computation
remove events
both Rad. & Tr.
clean axes
20 window length (s)
8 tapering (%)
15 outlier tolerance threshold
15% spectral smoothing (triangular window)
show particle motion (raw data)
full ouput
compute
step#3a (optional) - directivity analysis
compute
max freq: 32 Hz
step#3b (optional) - directivity over time
directivity in time
time step: 60 s
www.winmasw.com
save- option#1: save HVSR as it is
save H/V from 0.05 to 64 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)
180 average Vs (m/s) (from surface to bedrock)
20 depth of the bedrock (m)
1000 Vs of the bedrock
clean
compute
hvsr2mod.saf (64Hz) - Average Spectra
NS
EW
UD
frequency (Hz)
hvsr2mod.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


HVSR: directivity
N


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


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

HVSR20

DATE 03.10.2018	HOUR 15.53	PLACE Onci Colle di Val d'Elsa
OPERATOR Geologica Toscana S.n.c.	GPS TYPE and #	
WGS84 - UTM33N LATITUDE 4806912	WGS84 - UTM33N LONGITUDE 1672050	ALTITUDE 177 m slm
STATION TYPE GPA Engeenering	SENSOR TYPE 3D - 4,5 Hz	
STATION #	SENSOR #	DISK #
FILE NAME HVSR20.saf		POINT #
GAIN	SAMPL. FREQ. 300 Hz	REC. DURATION 20 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): 23 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:

MISURA TIPO A2

HVSR20

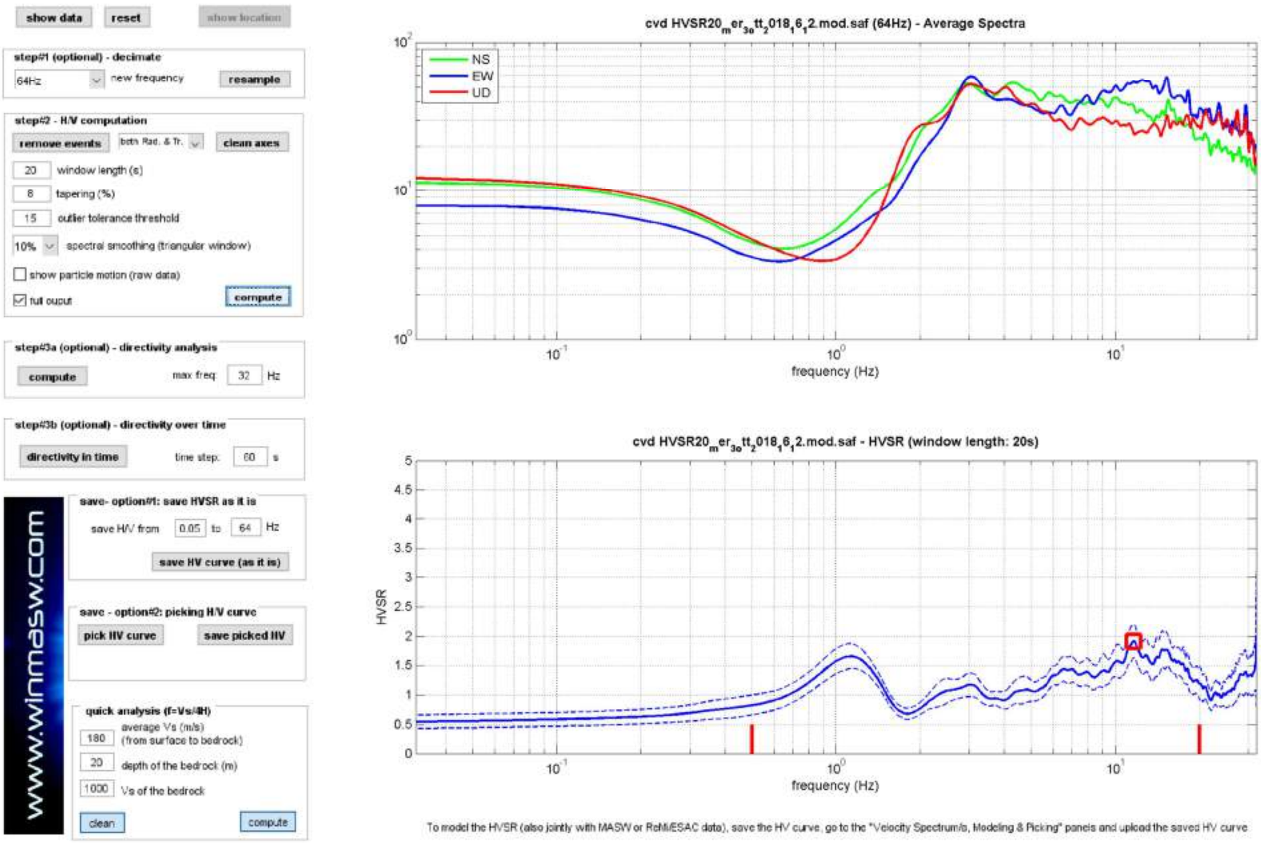
Peak frequency (Hz): 11.6 (±4.4)
Peak HVSR value: 1.9 (±0.3)

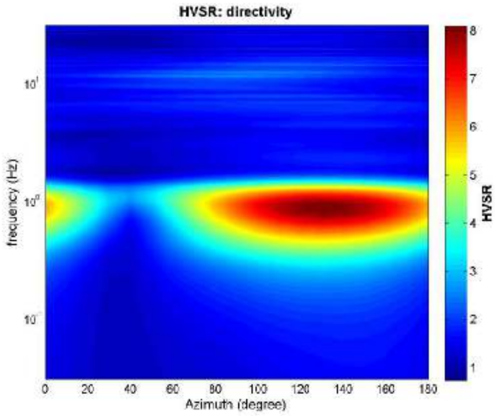
=== Criteria for a reliable H/V curve ====================================

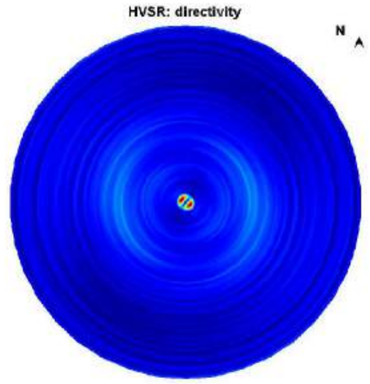
#1. [f0 > 10/Lw]: 11.636 > 0.5 (OK)
#2. [nc > 200]: 27229 > 200 (OK)
#3. [f0>0.5Hz; sigmaA(f) < 2 for 0.5f0 < f < 2f0] (OK)

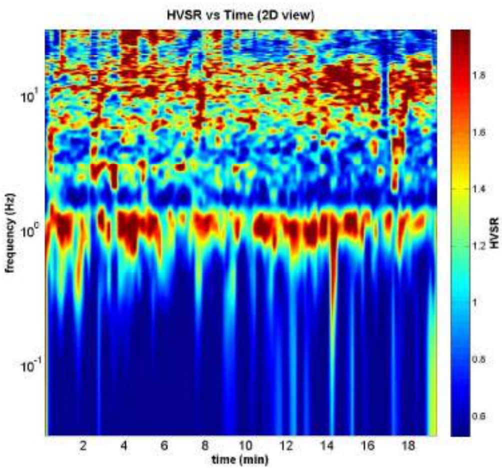
=== Criteria for a clear H/V peak (at least 5 should be fulfilled) ===========

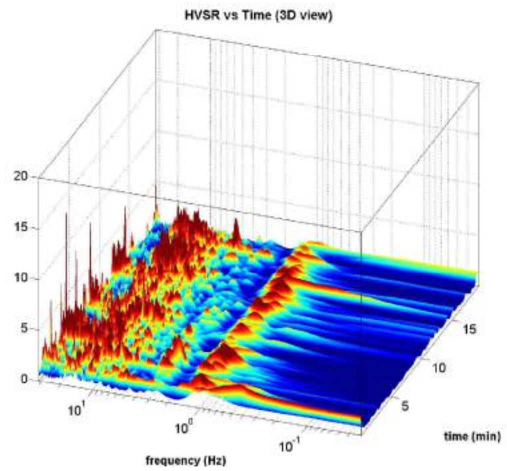
#1. [exists f- in the range [f0/4, f0] | AH/V(f-) < A0/2]: yes, at frequency 3.5Hz (OK)
#2. [exists f+ in the range [f0, 4f0] | AH/V(f+) < A0/2]: yes (considering standard deviations), at frequency Hz (OK)
#3. [A0 > 2]: 1.9 < 2 (NO)
#4. [fpeak[Ah/v(f) ± sigmaA(f)] = f0 ± 5%]: (OK)
#5. [sigmaf < epsilon(f0)]: 4.446 > 0.582 (NO)
#6. [sigmaA(f0) < theta(f0)]: 0.281 < 1.58 (OK)


show data
reset
show location
step#1 (optional) - decimate
64Hz
new frequency
resample
step#2 - H/V computation
remove events
both Rad. & Tr.
clean axes
20 window length (s)
8 tapering (%)
15 outlier tolerance threshold
10% spectral smoothing (triangular window)
show particle motion (raw data)
full ouput
compute
step#3a (optional) - directivity analysis
compute
max freq: 32 Hz
step#3b (optional) - directivity over time
directivity in time
time step: 60 s
www.winmasw.com
save- option#1: save HVSR as it is
save H/V from 0.05 to 64 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)
180 average Vs (m/s) (from surface to bedrock)
20 depth of the bedrock (m)
1000 Vs of the bedrock
clean
compute
cvd HVSR20mer30tt2018612.mod.saf (64Hz) - Average Spectra
NS
EW
UD
frequency (Hz)
cvd HVSR20mer30tt2018612.mod.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/s, Modeling & Picking" panels and upload the saved HV curve


HVSR: directivity
frequency (Hz)
Azimuth (degree)
HVSR


HVSR: directivity
N


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


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

HVSR21

DATE 21.11.2018	HOUR	PLACE Fabbrica Colle di Val d'Elsa
OPERATOR Geologica Toscana S.n.c.	GPS TYPE and #	
WGS84 - UTM33N LATITUDE 4806105	WGS84 - UTM33N LONGITUDE 1669959	ALTITUDE 251 m slm
STATION TYPE GPA Engeenering	SENSOR TYPE 3D - 4,5 Hz	
STATION #	SENSOR #	DISK #
FILE NAME HVSR21.saf		POINT #
GAIN	SAMPL. FREQ. 300 Hz	REC. DURATION 20 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): 10 Remarks ______

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

ARTIFICIAL GROUND-SENSOR COUPLING [ ] no [x] 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

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

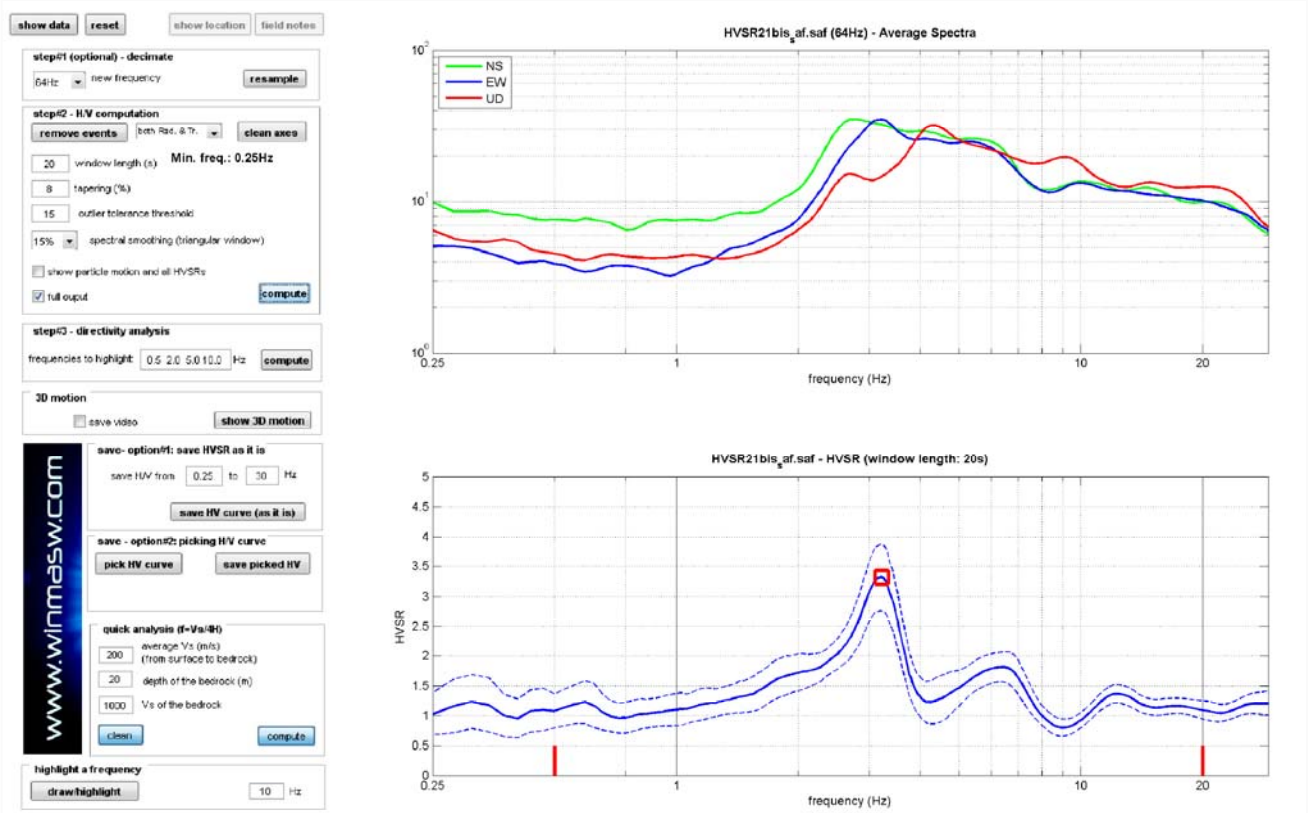
MISURA TIPO A1

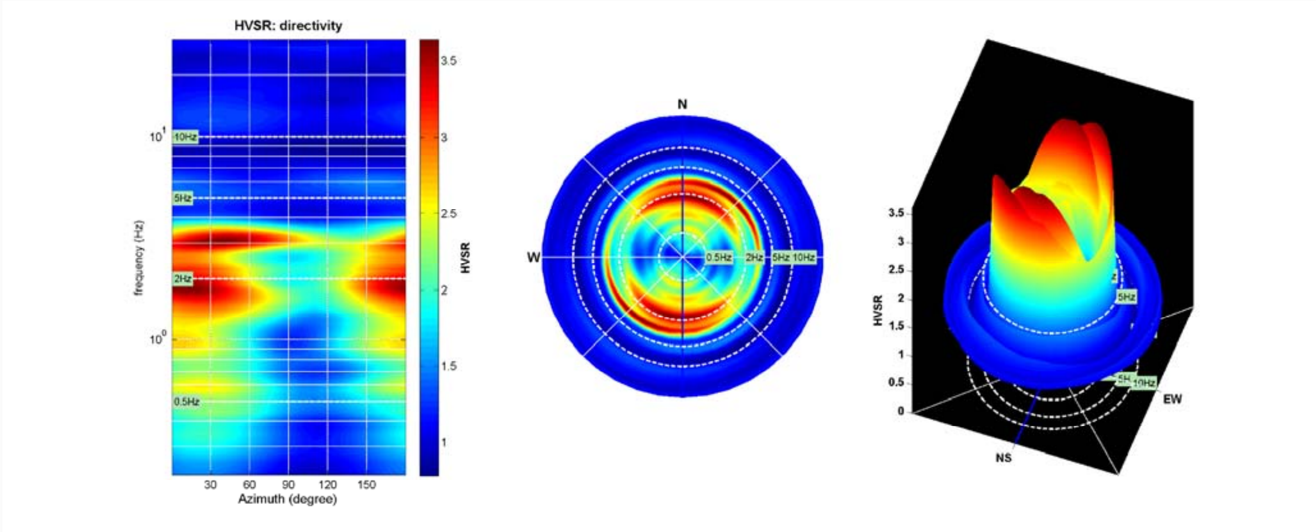
HVSR21

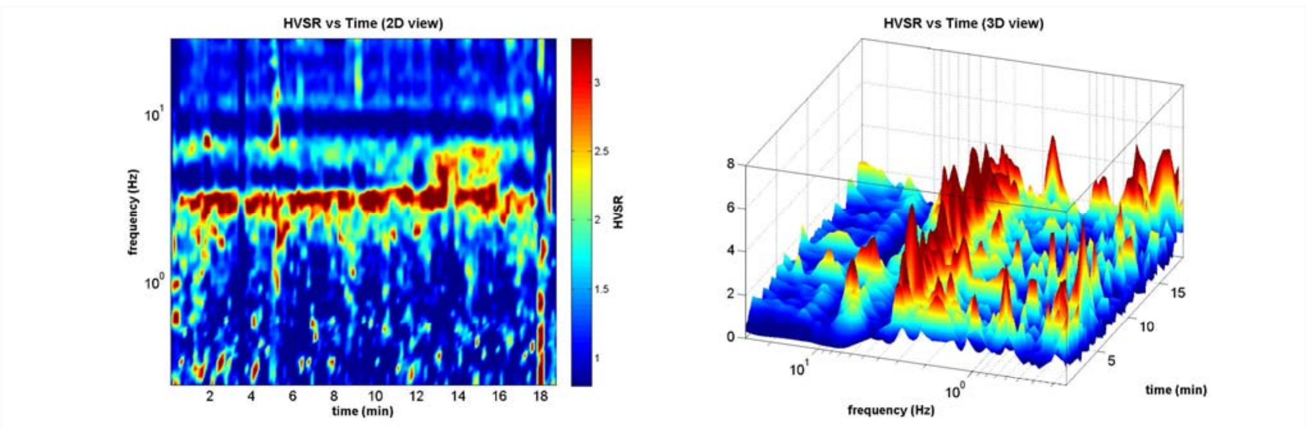
Peak frequency (Hz): 3.2 (±1.5)
Peak HVSR value: 3.3 (±0.6)

=== Criteria for a reliable H/V curve ====================================
#1. [f0 > 10/Lw]: 3.222 > 0.5 (OK)
#2. [nc > 200]: 7281 > 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 0.8Hz (OK)
#2. [exists f+ in the range [f0, 4f0] | AH/V(f+) < A0/2]: yes, at frequency 3.8Hz (OK)
#3. [A0 > 2]: 3.3 > 2 (OK)
#4. [fpeak[Ah/v(f) ą sigmaA(f)] = f0 ą 5%]: (OK)
#5. [sigmaf < epsilon(f0)]: 1.528 > 0.161 (NO)
#6. [sigmaA(f0) < theta(f0)]: 0.556 < 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
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 ouput
compute
step#3 - directivity analysis
frequencies to highlight
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
NS
EW
UD
frequency (Hz)
HVSR
frequency (Hz)


HVSR: directivity
frequency (Hz)
Azimuth (degree)
HVSR
N
W
EW
NS
HVSR


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

HVSR22

DATE 03.10.2018	HOUR 16.19	PLACE Campinovi Colle di Val d'Elsa
OPERATOR Geologica Toscana S.n.c.	GPS TYPE and #	
WGS84 - UTM33N LATITUDE 4806405	WGS84 - UTM33N LONGITUDE 1671343	ALTITUDE 201 m slm
STATION TYPE GPA Engeenering	SENSOR TYPE 3D - 4,5 Hz	
STATION #	SENSOR #	DISK #
FILE NAME HVSR22.saf		POINT #
GAIN	SAMPL. FREQ. 300 Hz	REC. DURATION 20 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): 20 Remarks

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

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

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

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

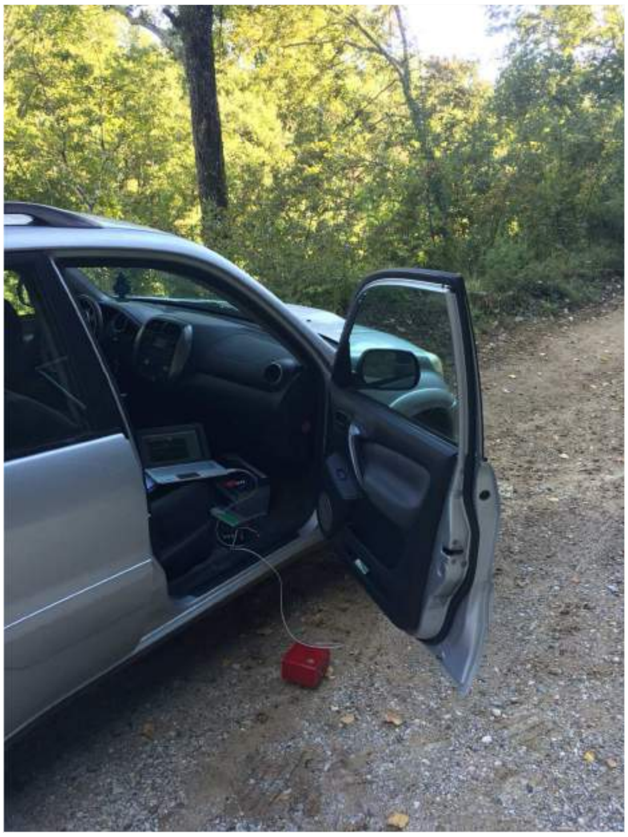
MONOCHROMATIC NOISE SOURCES (factories, works, pumps, rivers...) [x] no [ ] yes, type

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

Trees

OBSERVATIONS

FREQUENCY: Hz (if computed in the field)



Qualità della misura:

MISURA TIPO A2

HVSR22

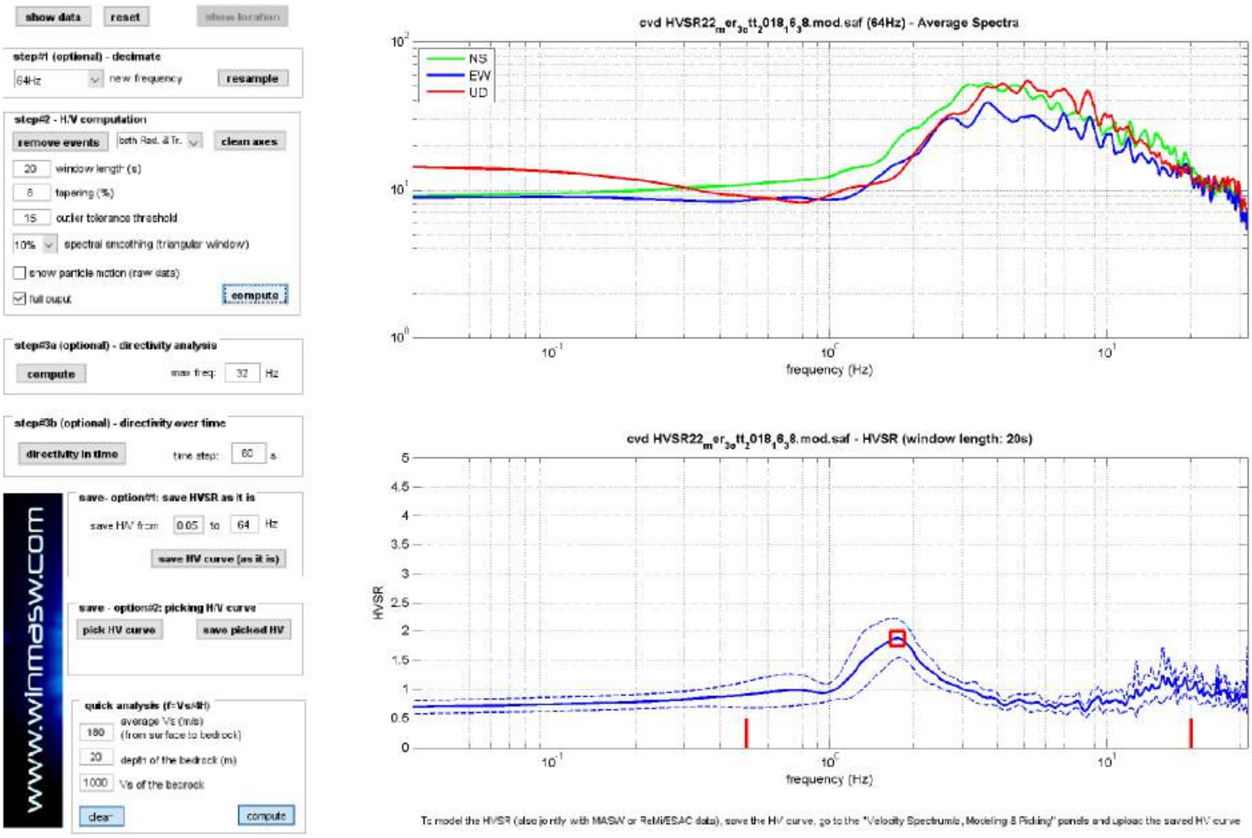
Peak frequency (Hz): 1.8 (±7.6)
Peak HVSR value: 1.9 (±0.3)

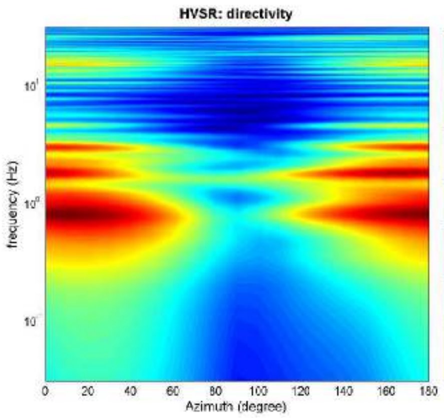
=== Criteria for a reliable H/V curve ====================================

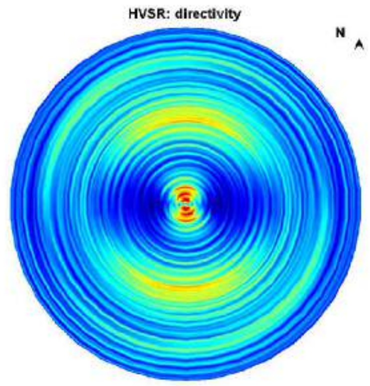
#1. [f0 > 10/Lw]: 1.752 > 0.5 (OK)
#2. [nc > 200]: 631 > 200 (OK)
#3. [f0>0.5Hz; sigmaA(f) < 2 for 0.5f0 < f < 2f0] (OK)

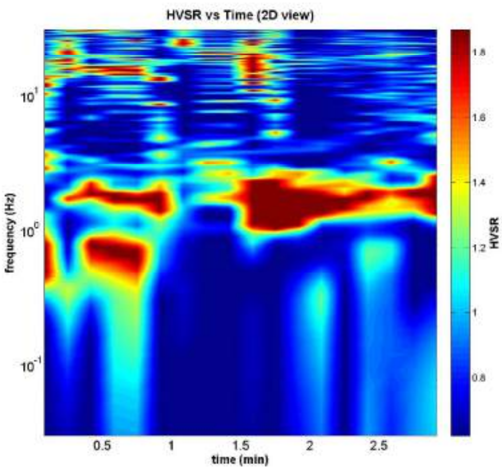
=== Criteria for a clear H/V peak (at least 5 should be fulfilled) ===========

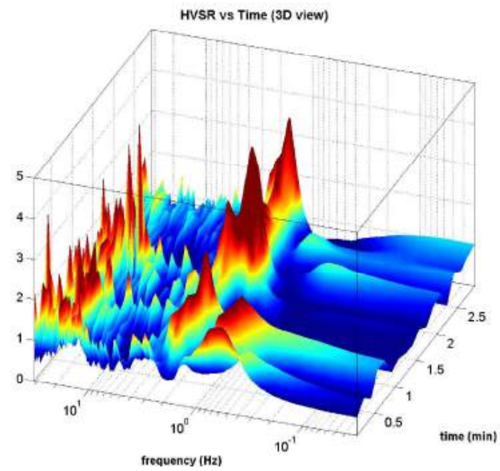
#1. [exists f- in the range [f0/4, f0] | AH/V(f-) < A0/2]: yes, at frequency 0.5Hz (OK)
#2. [exists f+ in the range [f0, 4f0] | AH/V(f+) < A0/2]: yes, at frequency 3.4Hz (OK)
#3. [A0 > 2]: 1.9 < 2 (NO)
#4. [fpeak[Ah/v(f) ± sigmaA(f)] = f0 ± 5%]: (OK)
#5. [sigmaf < epsilon(f0)]: 7.567 > 0.175 (NO)
#6. [sigmaA(f0) < theta(f0)]: 0.330 < 1.78 (OK)


show data
reset
show location
step#1 (optional) - decimate
new frequency
resample
step#2 - H/V computation
remove events
clean axes
window length (s)
tapering (%)
outlier tolerance threshold
spectral smoothing (triangular window)
show particle motion (raw data)
full ouput
compute
step#3a (optional) - directivity analysis
max freq:
step#3b (optional) - directivity over time
directivity in time
time step:
save- option#1: save HVSR as it is
save H/V from
save HV curve (as it is)
save - option#2: picking H/V curve
pick HV curve
save picked HV
quick analysis (f=Vs/4H)
average Vs (m/s) (from surface to bedrock)
depth of the bedrock (m)
Vs of the bedrock
clear
www.winmasw.com
Average Spectra
NS
EW
UD
frequency (Hz)
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 Spectrums, Modeling & Picking" panels and upload the saved HV curve


HVSR: directivity
frequency (Hz)
Azimuth (degree)
HVSR


HVSR: directivity
N


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


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

HVSR23

DATE 14.09.2018	HOUR 17.44	PLACE Pian dell'Olmino Colle di Val d'Elsa
OPERATOR Geologica Toscana S.n.c.	GPS TYPE and #	
WGS84 - UTM33N LATITUDE 4805729	WGS84 - UTM33N LONGITUDE 1672775	ALTITUDE 181 m slm
STATION TYPE GPA Engeenering	SENSOR TYPE 3D - 4,5 Hz	
STATION #	SENSOR #	DISK #
FILE NAME HVSR23.saf		POINT #
GAIN	SAMPL. FREQ. 300 Hz	REC. DURATION 20 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): 26 Remarks ____

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

ARTIFICIAL GROUND-SENSOR COUPLING [ ] no [x] 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...) [ ] no [x] yes, type Factories

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

HVSR23

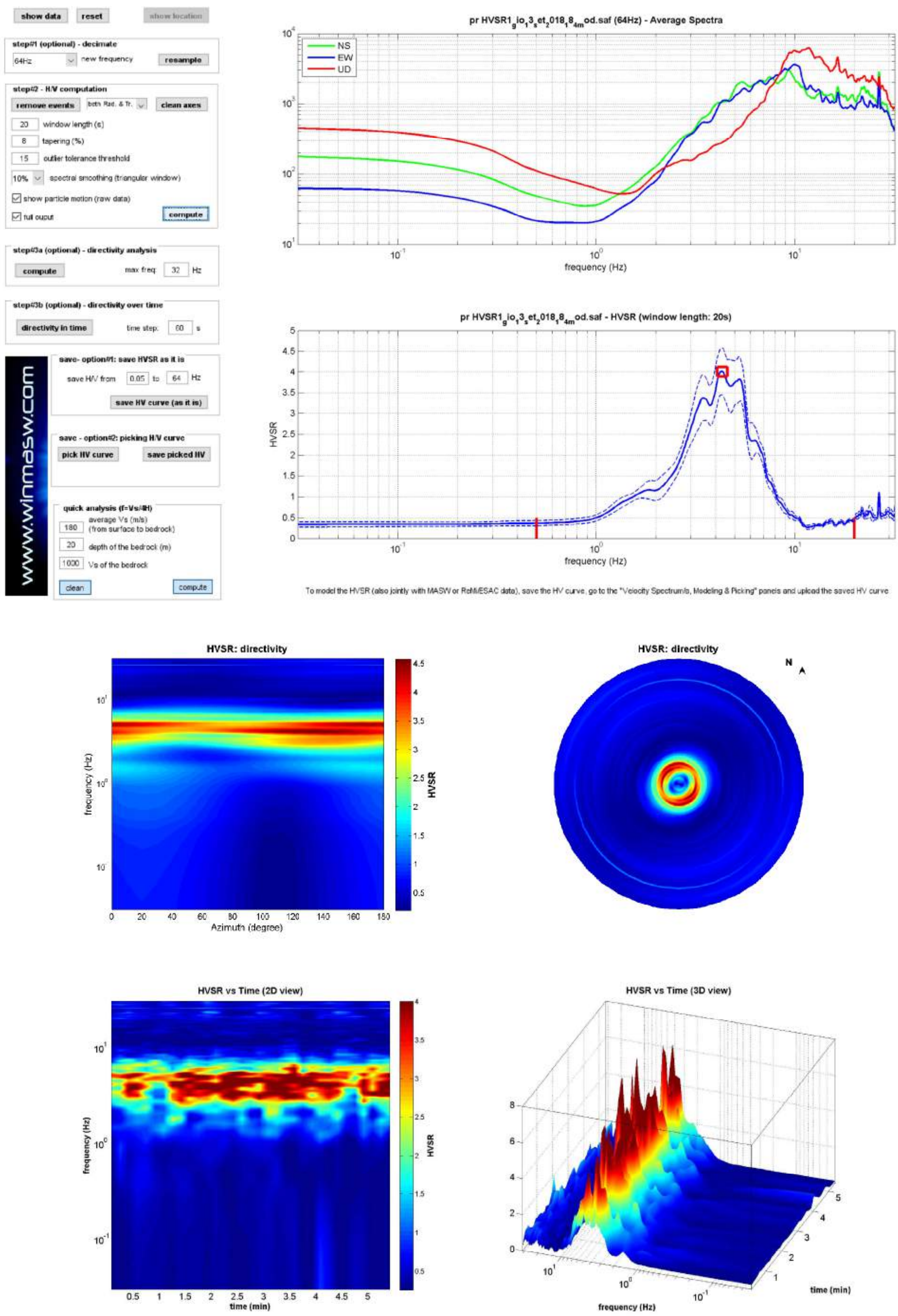
Peak frequency (Hz): 4.3 (±0.6)
Peak HVSR value: 4.0 (±0.6)

=== Criteria for a reliable H/V curve ===================================

#1. [f0 > 10/Lw]: 4.317 > 0.5 (OK)
#2. [nc > 200]: 2849 > 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]: yes, at frequency 6.9Hz (OK)
#3. [A0 > 2]: 4.0 > 2 (OK)
#4. [fpeak[Ah/v(f) ± sigmaA(f)] = f0 ± 5%]: (OK)
#5. [sigmaf < epsilon(f0)]: 0.559 > 0.216 (NO)
#6. [sigmaA(f0) < theta(f0)]: 0.568 < 1.58 (OK)


show data
reset
show location
step#1 (optional) - decimate
64Hz
new frequency
resample
step#2 - H/V computation
remove events
both Rad. & Tr.
clean axes
20 window length (s)
8 tapering (%)
15 outlier tolerance threshold
10% spectral smoothing (triangular window)
show particle motion (raw data)
full ouput
compute
step#3a (optional) - directivity analysis
compute
max freq: 32 Hz
step#3b (optional) - directivity over time
directivity in time
time step: 60 s
www.winmasw.com
save- option#1: save HVSR as it is
save H/V from 0.05 to 64 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)
180 average Vs (m/s) (from surface to bedrock)
20 depth of the bedrock (m)
1000 Vs of the bedrock
clean
compute
pr HVSR1gio13set2018184mod.saf (64Hz) - Average Spectra
NS
EW
UD
frequency (Hz)
pr HVSR1gio13set2018184mod.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
HVSR: directivity
N
HVSR vs Time (2D view)
frequency (Hz)
time (min)
HVSR
HVSR vs Time (3D view)
frequency (Hz)
time (min)

HVSR24

DATE 03.10.2018 | HOUR 12.44 | PLACE Le Caldane Colle di Val d'Elsa

OPERATOR Geologica Toscana S.n.c. | GPS TYPE and #

WGS84 - UTM33N LATITUDE 4806257 | WGS84 - UTM33N LONGITUDE 1672779 | ALTITUDE 183 m slm

STATION TYPE GPA Engeenering | SENSOR TYPE 3D - 4,5 Hz

STATION # | SENSOR # | DISK #

FILE NAME HVSR24.saf | POINT #

GAIN | SAMPL. FREQ. 300 Hz | REC. DURATION 20 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): 16 Remarks

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

ARTIFICIAL GROUND-SENSOR COUPLING [ ] no [x] 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,...)

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

HVSR24

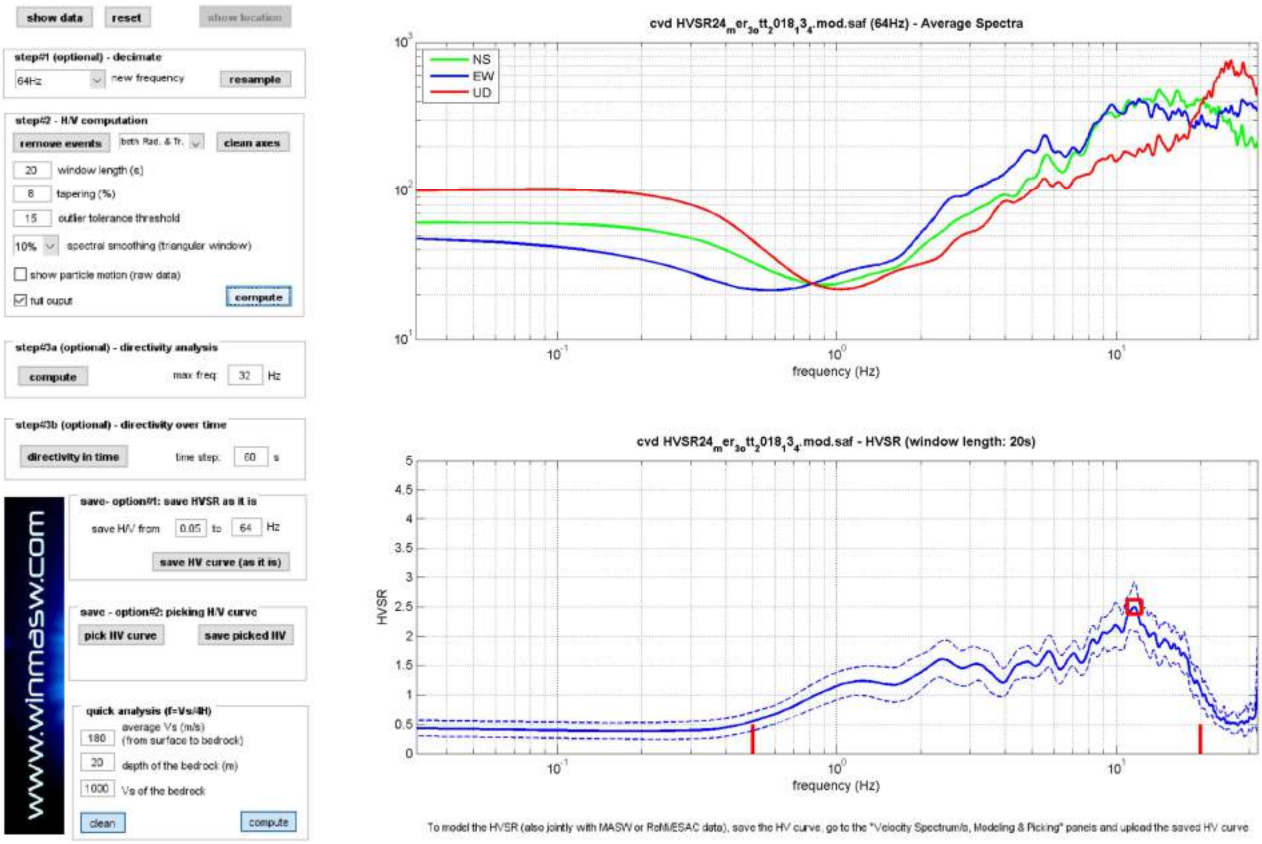
Peak frequency (Hz): 11.6 (±3.5)
Peak HVSR value: 2.5 (±0.4)

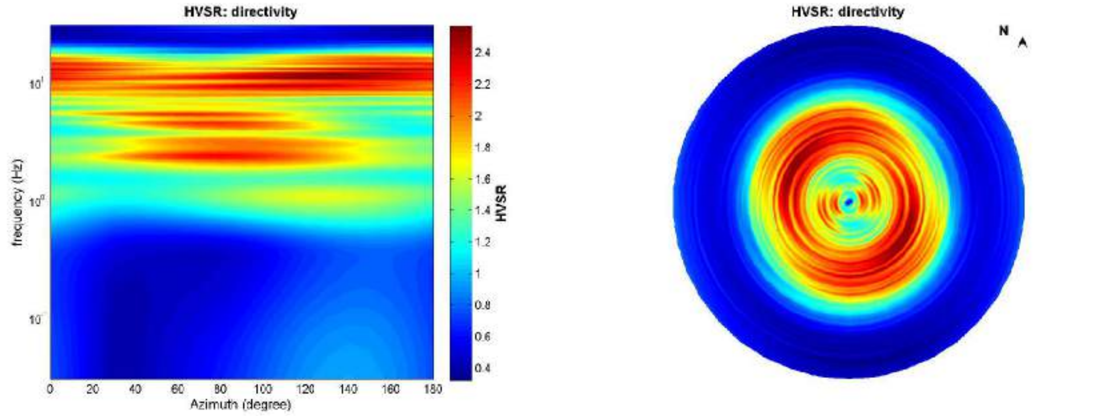
=== Criteria for a reliable H/V curve ===============================

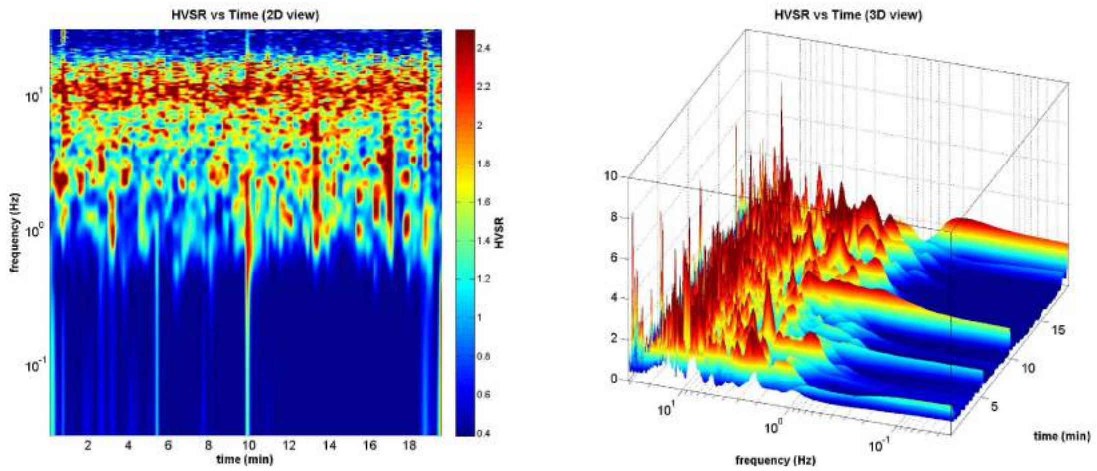
#1. [f0 > 10/Lw]: 11.605 > 0.5 (OK)
#2. [nc > 200]: 27388 > 200 (OK)
#3. [f0>0.5Hz; sigmaA(f) < 2 for 0.5f0 < f < 2f0] (OK)

=== 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]: yes, at frequency 18.9Hz (OK)
#3. [A0 > 2]: 2.5 > 2 (OK)
#4. [fpeak[Ah/v(f) ± sigmaA(f)] = f0 ± 5%]: (OK)
#5. [sigmaf < epsilon(f0)]: 3.457 > 0.580 (NO)
#6. [sigmaA(f0) < theta(f0)]: 0.420 < 1.58 (OK)


show data
reset
show location
step#1 (optional) - decimate
64Hz
new frequency
resample
step#2 - H/V computation
remove events
both Rad. & Tr.
clean axes
20 window length (s)
8 tapering (%)
15 outlier tolerance threshold
10% spectral smoothing (triangular window)
show particle motion (raw data)
full ouput
compute
step#3a (optional) - directivity analysis
compute
max freq: 32 Hz
step#3b (optional) - directivity over time
directivity in time
time step: 60 s
www.winmasw.com
save- option#1: save HVSR as it is
save H/V from 0.05 to 64 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)
180 average Vs (m/s) (from surface to bedrock)
20 depth of the bedrock (m)
1000 Vs of the bedrock
clean
compute
cvd HVSR24_m er_3o tt_2 018_1 3_4.mod.saf (64Hz) - Average Spectra
NS
EW
UD
frequency (Hz)
cvd HVSR24_m er_3o tt_2 018_1 3_4.mod.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
HVSR: directivity
N


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

HVSR25

DATE 03.10.2018	HOUR 15.28	PLACE Gracciano Colle di Val d'Elsa		
OPERATOR Geologica Toscana S.n.c.		GPS TYPE and #		
WGS84 - UTM33N LATITUDE 4807559	WGS84 - UTM33N LONGITUDE 1672633	ALTITUDE 173 m slm		
STATION TYPE GPA Engeenering	SENSOR TYPE 3D - 4,5 Hz			
STATION #	SENSOR #	DISK #		
FILE NAME HVSR25.saf		POINT #		
GAIN	SAMPL. FREQ. 300 Hz	REC. DURATION 20 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): 23 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:

MISURA TIPO A2

HVSR25

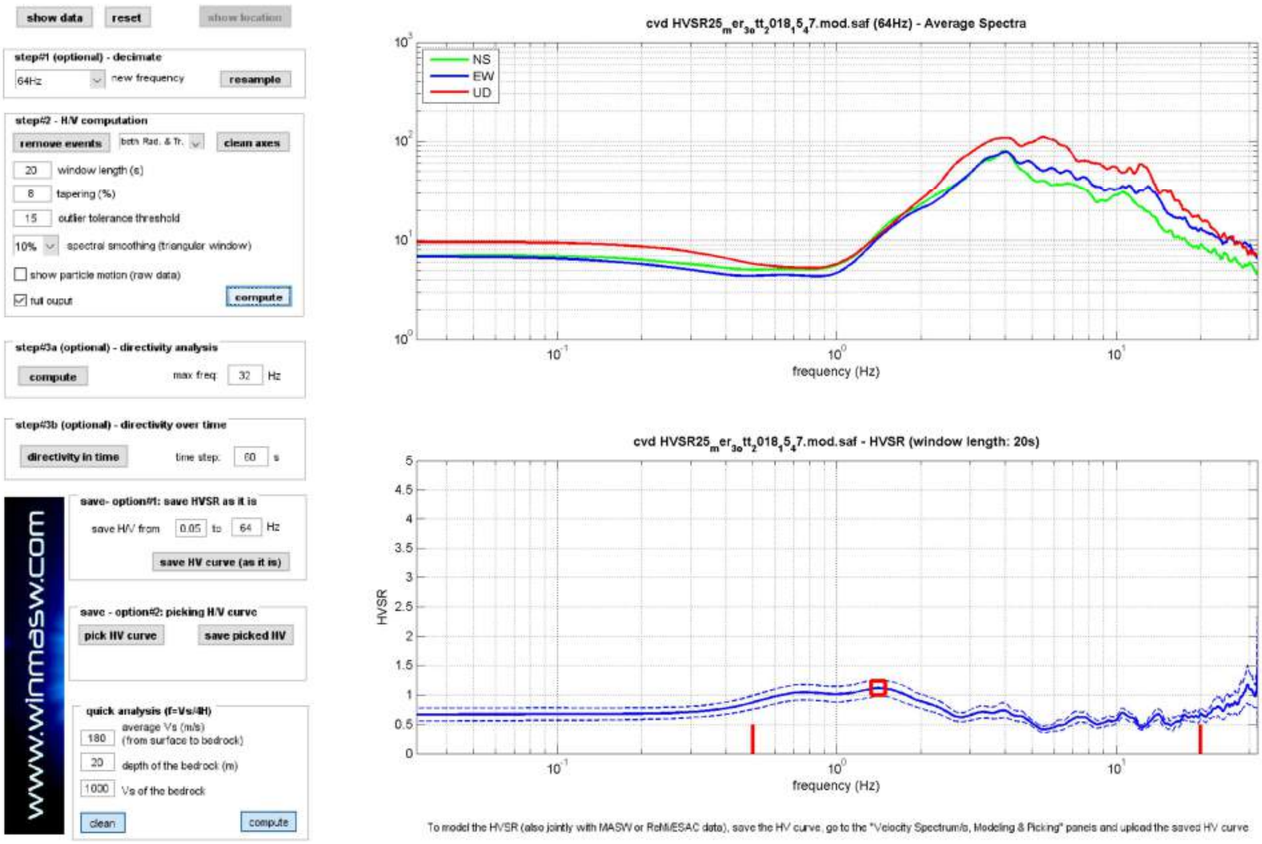
Peak frequency (Hz): 1.4 (±4.1)
Peak HVSR value: 1.1 (±0.1)

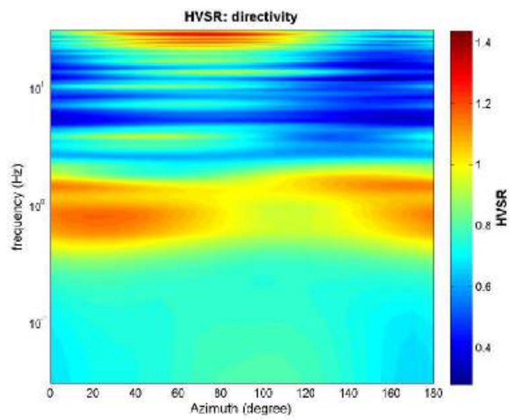
=== Criteria for a reliable H/V curve ====================================

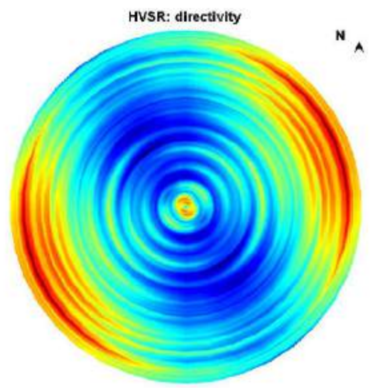
#1. [f0 > 10/Lw]: 1.408 > 0.5 (OK)
#2. [nc > 200]: 3266 > 200 (OK)
#3. [f0>0.5Hz; sigmaA(f) < 2 for 0.5f0 < f < 2f0] (OK)

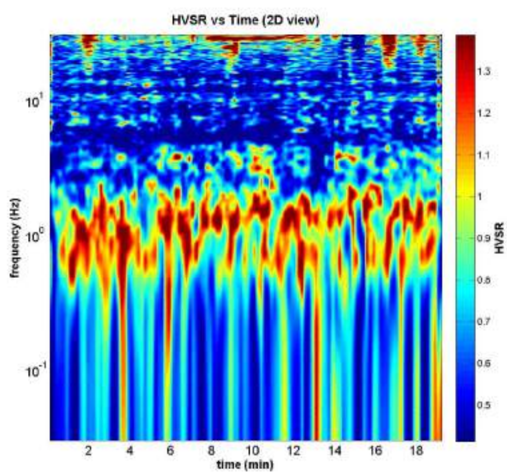
=== Criteria for a clear H/V peak (at least 5 should be fulfilled) ===========

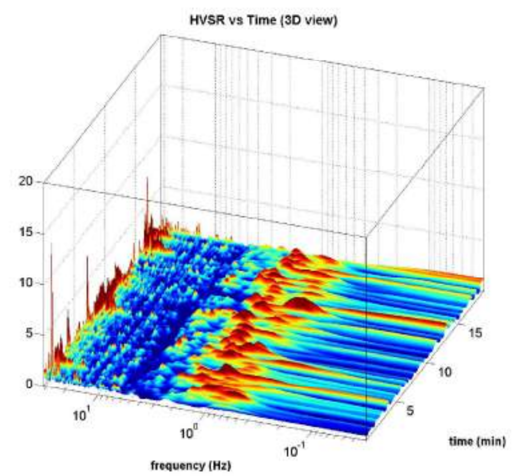
#1. [exists f- in the range [f0/4, f0] | AH/V(f-) < A0/2]: (NO)
#2. [exists f+ in the range [f0, 4f0] | AH/V(f+) < A0/2]: yes, at frequency 4.9Hz (OK)
#3. [A0 > 2]: 1.1 < 2 (NO)
#4. [fpeak[Ah/v(f) ± sigmaA(f)] = f0 ± 5%]: (OK)
#5. [sigmaf < epsilon(f0)]: 4.081 > 0.141 (NO)
#6. [sigmaA(f0) < theta(f0)]: 0.137 < 1.78 (OK)


show data
reset
show location
step#1 (optional) - decimate
64Hz
new frequency
resample
step#2 - H/V computation
remove events
both Rad. & Tr.
clean axes
20 window length (s)
8 tapering (%)
15 outlier tolerance threshold
10% spectral smoothing (triangular window)
show particle motion (raw data)
full ouput
compute
step#3a (optional) - directivity analysis
compute
max freq: 32 Hz
step#3b (optional) - directivity over time
directivity in time
time step: 60 s
www.winmasw.com
save- option#1: save HVSR as it is
save H/V from 0.05 to 64 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)
180 average Vs (m/s) (from surface to bedrock)
20 depth of the bedrock (m)
1000 Vs of the bedrock
clean
compute
cvd HVSR25_m er_3o tt_2 018_1 5_4 7.mod.saf (64Hz) - Average Spectra
NS
EW
UD
frequency (Hz)
cvd HVSR25_m er_3o tt_2 018_1 5_4 7.mod.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/s, Modeling & Picking" panels and upload the saved HV curve


HVSR: directivity
frequency (Hz)
Azimuth (degree)
HVSR


HVSR: directivity
N


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


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

HVSR26

DATE 03.10.2018	HOUR 11.56	PLACE Gracciano Colle di Val d'Elsa	
OPERATOR Geologica Toscana S.n.c.		GPS TYPE and #	
WGS84 - UTM33N LATITUDE 4807659	WGS84 - UTM33N LONGITUDE 1672935	ALTITUDE 175 m slm	
STATION TYPE GPA Engeenering	SENSOR TYPE 3D - 4,5 Hz		
STATION #	SENSOR #	DISK #	
FILE NAME HVSR26.saf		POINT #	
GAIN	SAMPL. FREQ. 300 Hz	REC. DURATION 20 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): 15 — Remarks

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

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

BUILDING DENSITY: [ ] none [ ] scattered [x] 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, ...): Buildings

OBSERVATIONS

FREQUENCY: Hz (if computed in the field)

Qualità della misura:

MISURA TIPO A2

HVSR26

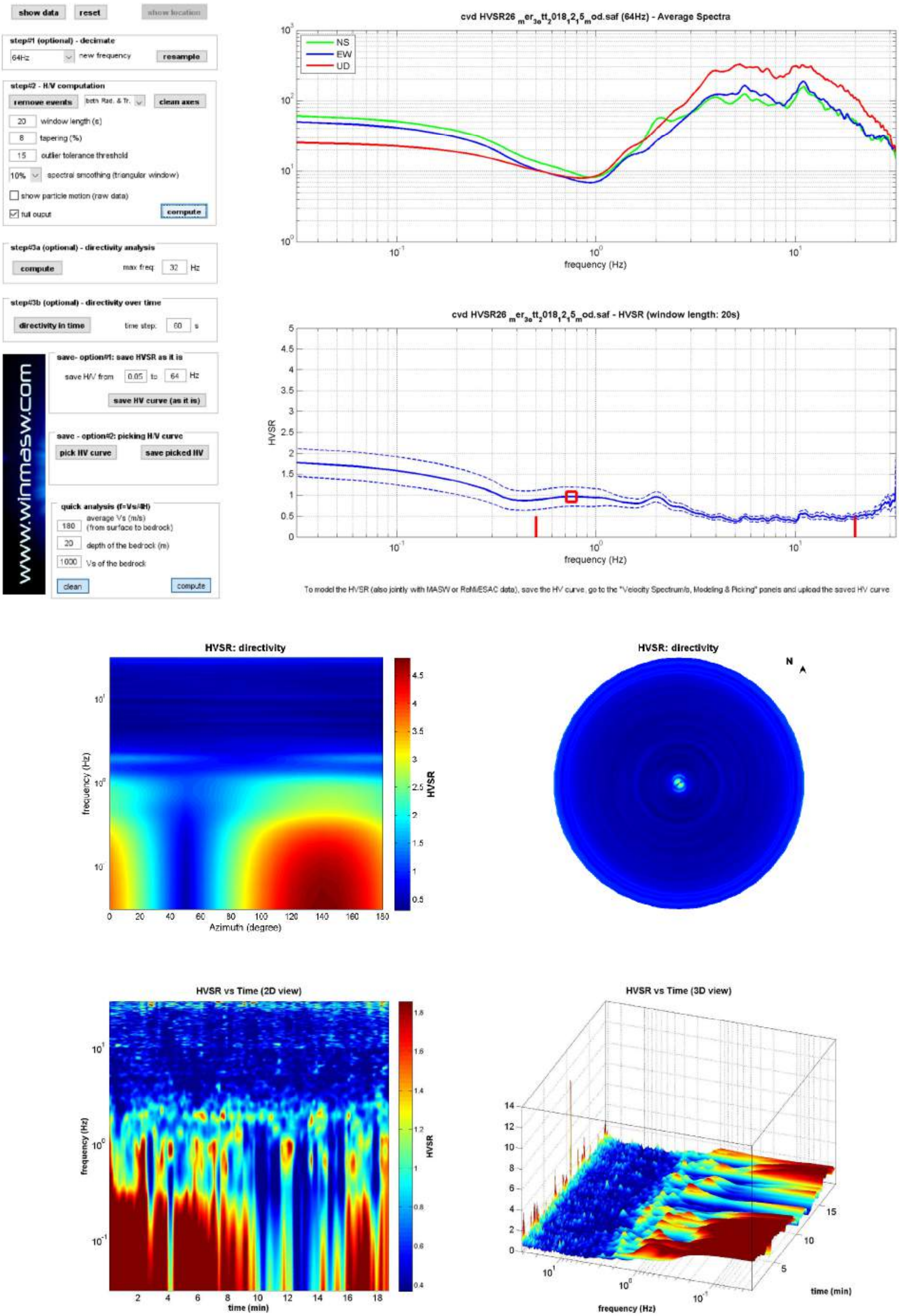
Peak frequency (Hz): 0.8 (±3.9)
Peak HVSR value: 1.0 (±0.2)

=== Criteria for a reliable H/V curve ===================================

#1. [f0 > 10/Lw]: 0.751 > 0.5 (OK)
#2. [nc > 200]: 1697 > 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) ± sigmaA(f)] = f0 ± 5%]: (NO)
#5. [sigmaf < epsilon(f0)]: 3.906 > 0.113 (NO)
#6. [sigmaA(f0) < theta(f0)]: 0.229 < 2 (OK)



HVSR27

DATE 03.10.2018	HOUR 15.00	PLACE Agresto Bruciato Colle di Val d'Elsa
OPERATOR Geologica Toscana S.n.c.	GPS TYPE and #	
WGS84 - UTM33N LATITUDE 4808000	WGS84 - UTM33N LONGITUDE 1672780	ALTITUDE 170 m slm
STATION TYPE GPA Engeenering	SENSOR TYPE 3D - 4,5 Hz	
STATION #	SENSOR #	DISK #
FILE NAME HVSR27.saf		POINT #
GAIN	SAMPL. FREQ. 300 Hz	REC. DURATION 20 min (minutes / seconds)

WEATHER CONDITIONS: WIND none; RAIN none; Temperature (approx): 22; Remarks

GROUND TYPE: asphalt; dry soil; Remarks

ARTIFICIAL GROUND-SENSOR COUPLING: yes, type

BUILDING DENSITY: scattered

TRANSIENTS: cars – few; trucks – none; pedestrians – none; other – none

MONOCHROMATIC NOISE SOURCES (factories, works, pumps, rivers...): no

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

OBSERVATIONS

FREQUENCY: Hz (if computed in the field)

Qualità della misura:

MISURA TIPO A2

HVSR27

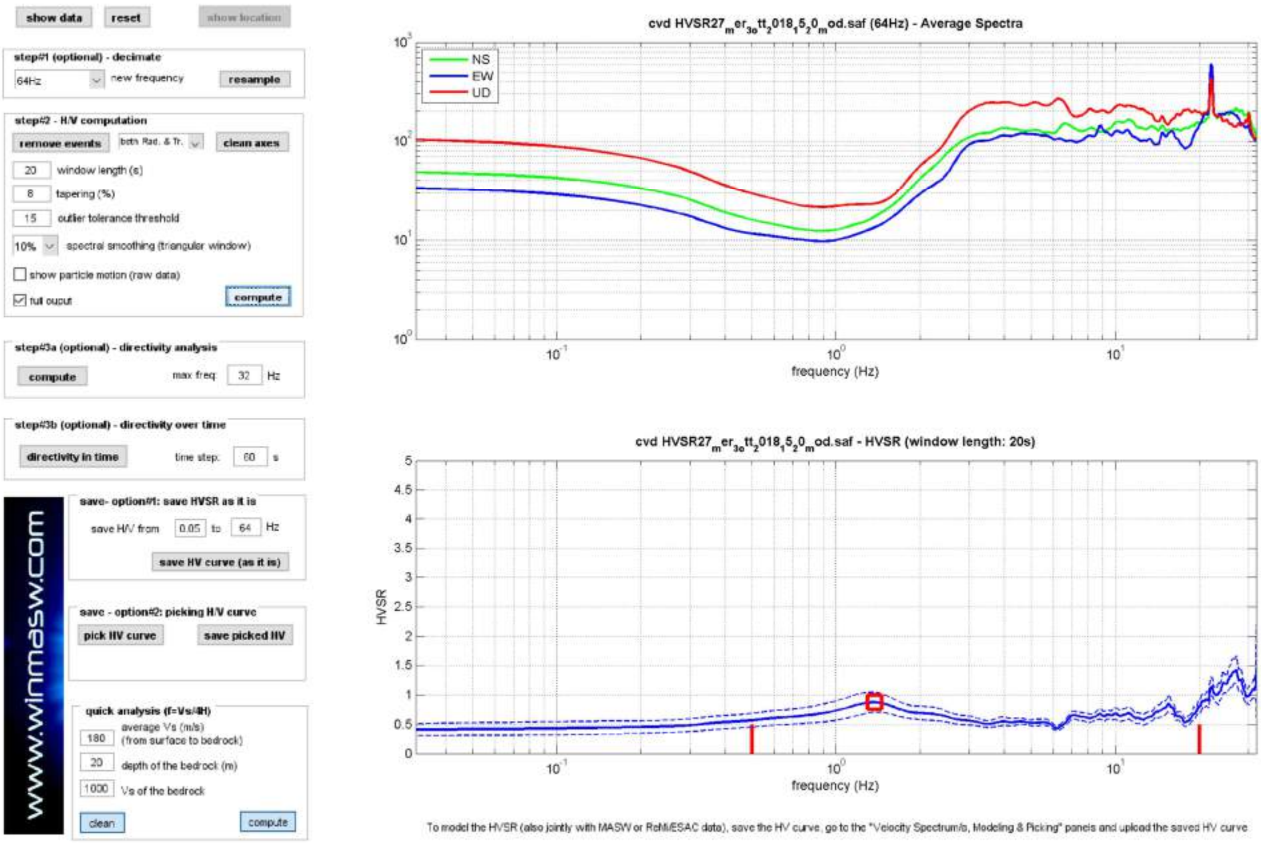
Peak frequency (Hz): 1.4 (±7.3)
Peak HVSR value: 0.9 (±0.2)

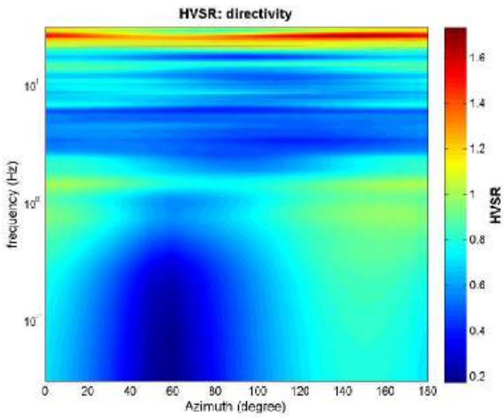
=== Criteria for a reliable H/V curve ====================================

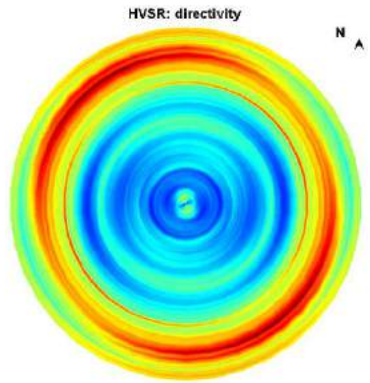
#1. [f0 > 10/Lw]: 1.376 > 0.5 (OK)
#2. [nc > 200]: 3221 > 200 (OK)
#3. [f0>0.5Hz; sigmaA(f) < 2 for 0.5f0 < f < 2f0] (OK)

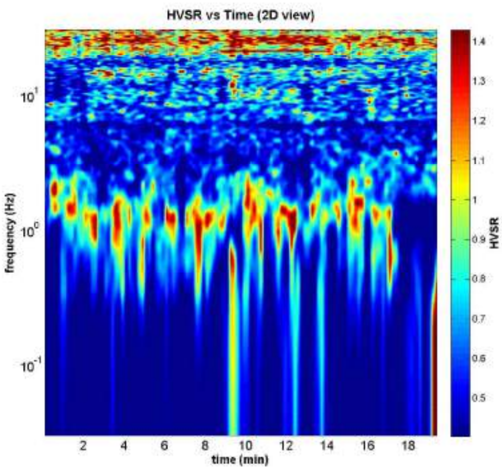
=== Criteria for a clear H/V peak (at least 5 should be fulfilled) ===========

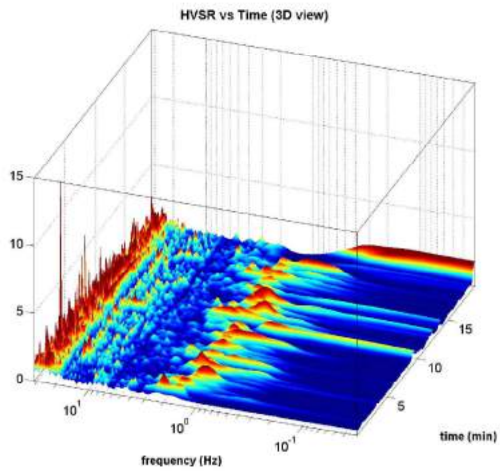
#1. [exists f- in the range [f0/4, f0] | AH/V(f-) < A0/2]: (NO)
#2. [exists f+ in the range [f0, 4f0] | AH/V(f+) < A0/2]: (NO)
#3. [A0 > 2]: 0.9 < 2 (NO)
#4. [fpeak[Ah/v(f) ± sigmaA(f)] = f0 ± 5%]: (NO)
#5. [sigmaf < epsilon(f0)]: 7.253 > 0.138 (NO)
#6. [sigmaA(f0) < theta(f0)]: 0.169 < 1.78 (OK)


show data
reset
show location
step#1 (optional) - decimate
64Hz
new frequency
resample
step#2 - H/V computation
remove events
both Rad. & Tr.
clean axes
20
window length (s)
8
tapering (%)
15
outlier tolerance threshold
10%
spectral smoothing (triangular window)
show particle motion (raw data)
full ouput
compute
step#3a (optional) - directivity analysis
compute
max freq:
32
Hz
step#3b (optional) - directivity over time
directivity in time
time step:
60
s
www.winmasw.com
save- option#1: save HVSR as it is
save H/V from
0.05
to
64
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)
180
average Vs (m/s) (from surface to bedrock)
20
depth of the bedrock (m)
1000
Vs of the bedrock
clean
compute
Average Spectra
NS
EW
UD
frequency (Hz)
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/s, Modeling & Picking" panels and upload the saved HV curve


HVSR: directivity
frequency (Hz)
Azimuth (degree)
HVSR


HVSR: directivity
N


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


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

HVSR28

DATE 21.11.2018	HOUR	PLACE Coneo Colle di Val d'Elsa
OPERATOR Geologica Toscana S.n.c.	GPS TYPE and #	
WGS84 - UTM33N LATITUDE 4807417	WGS84 - UTM33N LONGITUDE 1668446	ALTITUDE 231 m slm
STATION TYPE GPA Engeenering	SENSOR TYPE 3D - 4,5 Hz	
STATION #	SENSOR #	DISK #
FILE NAME HVSR28.saf		POINT #
GAIN	SAMPL. FREQ 300 Hz	REC. DURATION 20 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, ...)

Buildings

OBSERVATIONS

FREQUENCY: Hz (if computed in the field)

Qualità della misura:

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

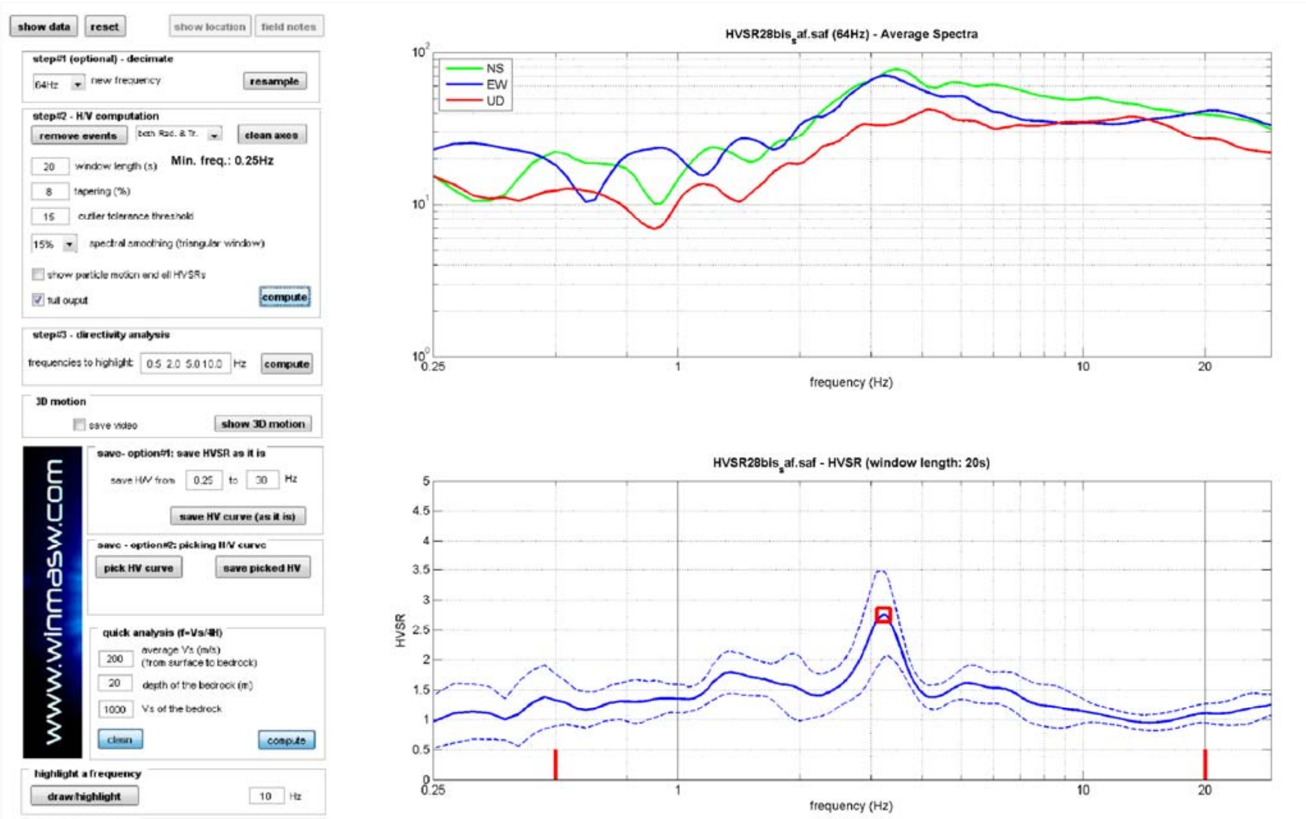
MISURA TIPO B1

HVSR28

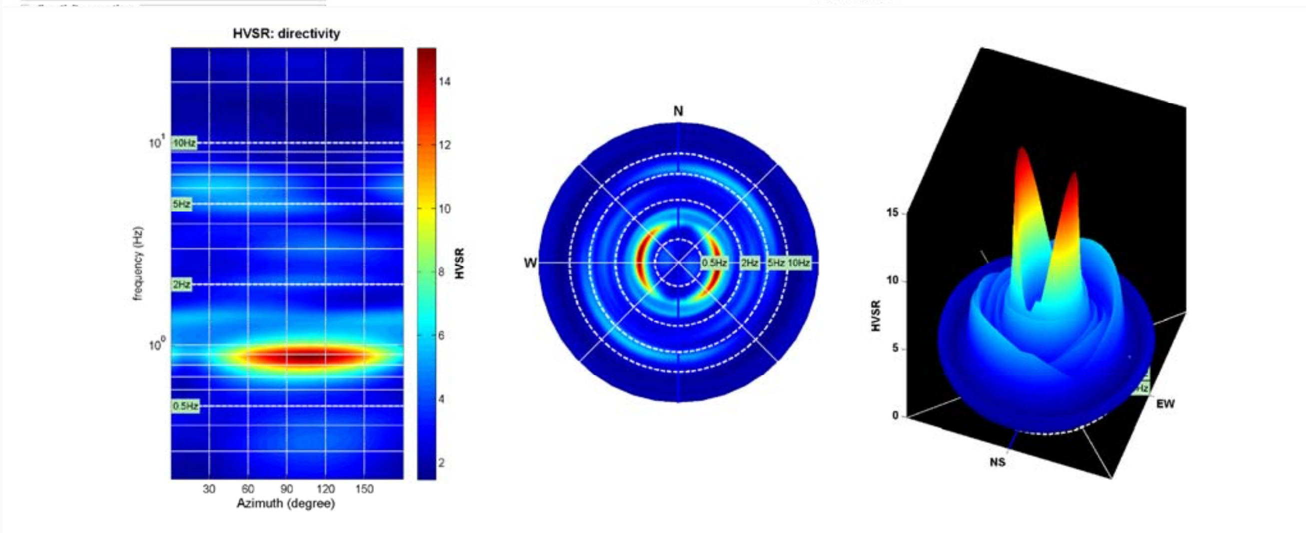
Peak frequency (Hz): 3.2 (±1.5)
Peak HVSR value: 2.8 (±0.7)

=== Criteria for a reliable H/V curve ====================================
#1. [f0 > 10/Lw]: 3.222 > 0.5 (OK)
#2. [nc > 200]: 7410 > 200 (OK)
#3. [f0>0.5Hz; sigmaA(f) < 2 for 0.5f0 < f < 2f0] (OK)

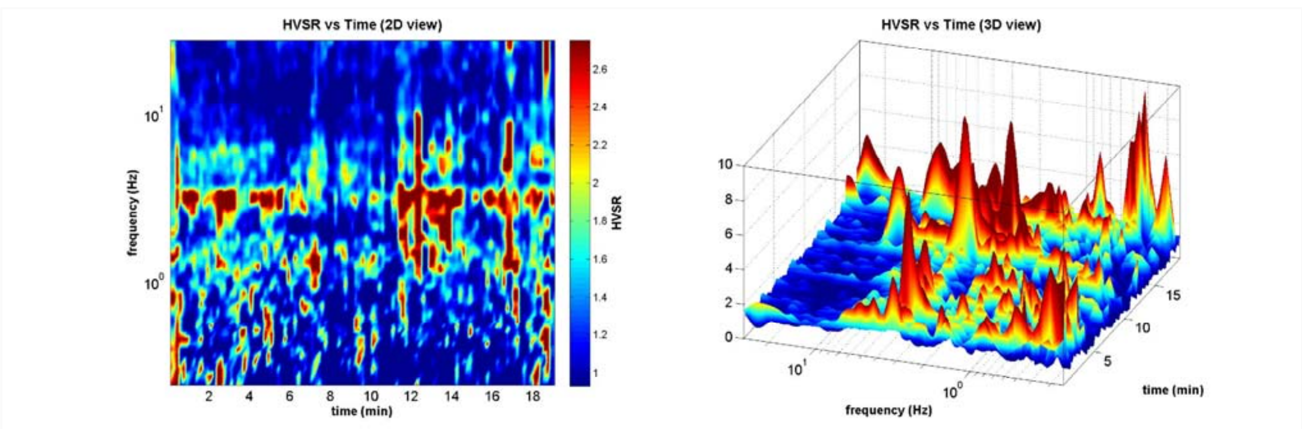
=== Criteria for a clear H/V peak (at least 5 should be fulfilled) ===========
#1. [exists f- in the range [f0/4, f0] | AH/V(f-) < A0/2]: yes, at frequency 0.8Hz (OK)
#2. [exists f+ in the range [f0, 4f0] | AH/V(f+) < A0/2]: yes, at frequency 4.2Hz (OK)
#3. [A0 > 2]: 2.8 > 2 (OK)
#4. [fpeak[Ah/v(f) ą sigmaA(f)] = f0 ą 5%]: (OK)
#5. [sigmaf < epsilon(f0)]: 1.479 > 0.161 (NO)
#6. [sigmaA(f0) < theta(f0)]: 0.721 < 1.58 (OK)



HVSR28bis_saf.saf (64Hz) - Average Spectra
NS
EW
UD
frequency (Hz)
HVSR28bis_saf.saf - HVSR (window length: 20s)
HVSR
Min. freq.: 0.25Hz
www.winmasw.com



HVSR: directivity
frequency (Hz)
Azimuth (degree)
HVSR
N
W
NS
EW



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

HVSR29

DATE 21.09.2018	HOUR 16.40	PLACE Galognano di Sopra Colle di Val d'Elsa
OPERATOR Geologica Toscana S.n.c.	GPS TYPE and #	
WGS84 - UTM33N LATITUDE 4810337	WGS84 - UTM33N LONGITUDE 1674647	ALTITUDE 231 m slm
STATION TYPE GPA Engeenering	SENSOR TYPE 3D - 4,5 Hz	
STATION #	SENSOR #	DISK #
FILE NAME HVSR29.saf		POINT #
GAIN	SAMPL. FREQ. 300 Hz	REC. DURATION 20 min minutes seconds

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

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

ARTIFICIAL GROUND-SENSOR COUPLING: no; yes, type (checked)

BUILDING DENSITY: none (checked); scattered; dense; other, type

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

MONOCHROMATIC NOISE SOURCES (factories, works, pumps, rivers...): no (checked); yes, type

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

OBSERVATIONS

FREQUENCY: Hz (if computed in the field)

Qualità della misura:

MISURA TIPO A2

HVSR29

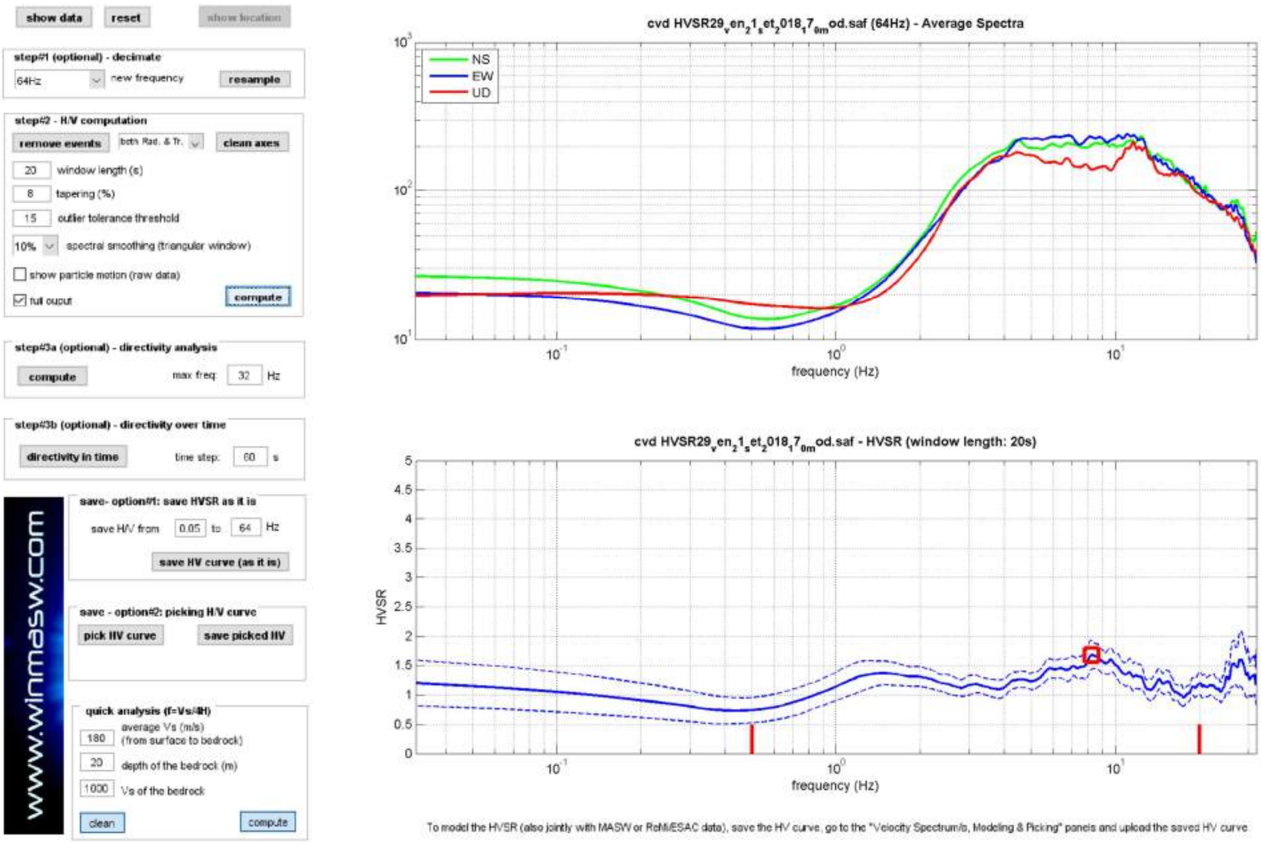
Peak frequency (Hz): 8.2 (±4.0)
Peak HVSR value: 1.7 (±0.2)

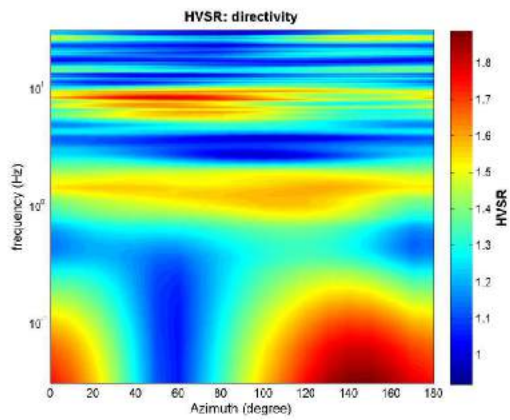
=== Criteria for a reliable H/V curve ====================================

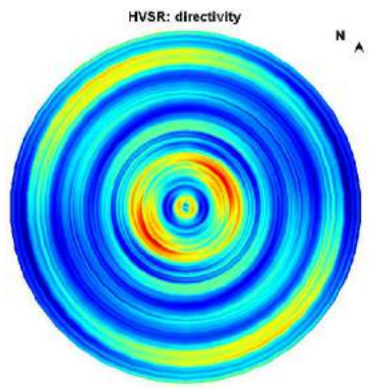
#1. [f0 > 10/Lw]: 8.227 > 0.5 (OK)
#2. [nc > 200]: 19415 > 200 (OK)
#3. [f0>0.5Hz; sigmaA(f) < 2 for 0.5f0 < f < 2f0] (OK)

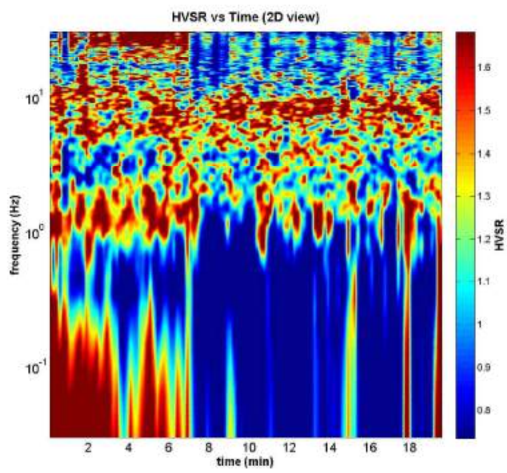
=== Criteria for a clear H/V peak (at least 5 should be fulfilled) ===========

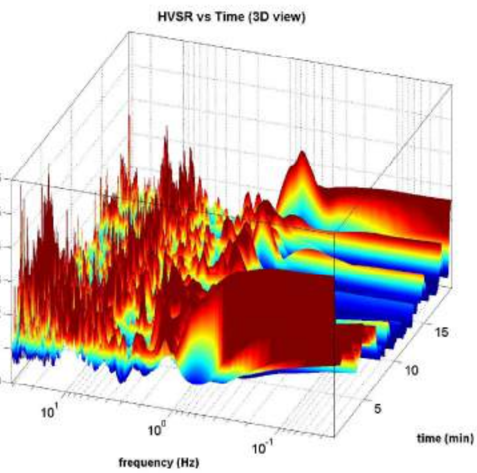
#1. [exists f- in the range [f0/4, f0] | AH/V(f-) < A0/2]: (NO)
#2. [exists f+ in the range [f0, 4f0] | AH/V(f+) < A0/2]: yes (considering standard deviations), at frequency Hz (OK)
#3. [A0 > 2]: 1.7 < 2 (NO)
#4. [fpeak[Ah/v(f) ± sigmaA(f)] = f0 ± 5%]: (OK)
#5. [sigmaf < epsilon(f0)]: 3.999 > 0.411 (NO)
#6. [sigmaA(f0) < theta(f0)]: 0.245 < 1.58 (OK)


show data
reset
show location
step#1 (optional) - decimate
64Hz
new frequency
resample
step#2 - H/V computation
remove events
both Rad. & Tr.
clean axes
20 window length (s)
8 tapering (%)
15 outlier tolerance threshold
10% spectral smoothing (triangular window)
show particle motion (raw data)
full ouput
compute
step#3a (optional) - directivity analysis
compute
max freq: 32 Hz
step#3b (optional) - directivity over time
directivity in time
time step: 60 s
www.winmasw.com
save- option#1: save HVSR as it is
save H/V from 0.05 to 64 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)
180 average Vs (m/s) (from surface to bedrock)
20 depth of the bedrock (m)
1000 Vs of the bedrock
clean
compute
cvd HVSR29_ven_21_set_2018_17_0m od.saf (64Hz) - Average Spectra
NS
EW
UD
frequency (Hz)
cvd HVSR29_ven_21_set_2018_17_0m od.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/s, Modeling & Picking" panels and upload the saved HV curve


HVSR: directivity
frequency (Hz)
Azimuth (degree)
HVSR


HVSR: directivity
N


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


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

HVSR30

DATE 24.09.2018	HOUR 16.40	PLACE Via di Speretolo Colle di Val d'Elsa
OPERATOR Geologica Toscana S.n.c.	GPS TYPE and #	
WGS84 - UTM33N LATITUDE 4810151	WGS84 - UTM33N LONGITUDE 1671232	ALTITUDE 215 m slm
STATION TYPE GPA Engeenering	SENSOR TYPE 3D - 4,5 Hz	
STATION #	SENSOR #	DISK #
FILE NAME HVSR30.saf		POINT #
GAIN	SAMPL. FREQ. 300 Hz	REC. DURATION 20 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): 30 Remarks ____

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

ARTIFICIAL GROUND-SENSOR COUPLING [ ] no [x] 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: rispettata
Plausibilità fisica: rispettata
Robustezza statistica: rispettata

MISURA TIPO A1

HVSR30

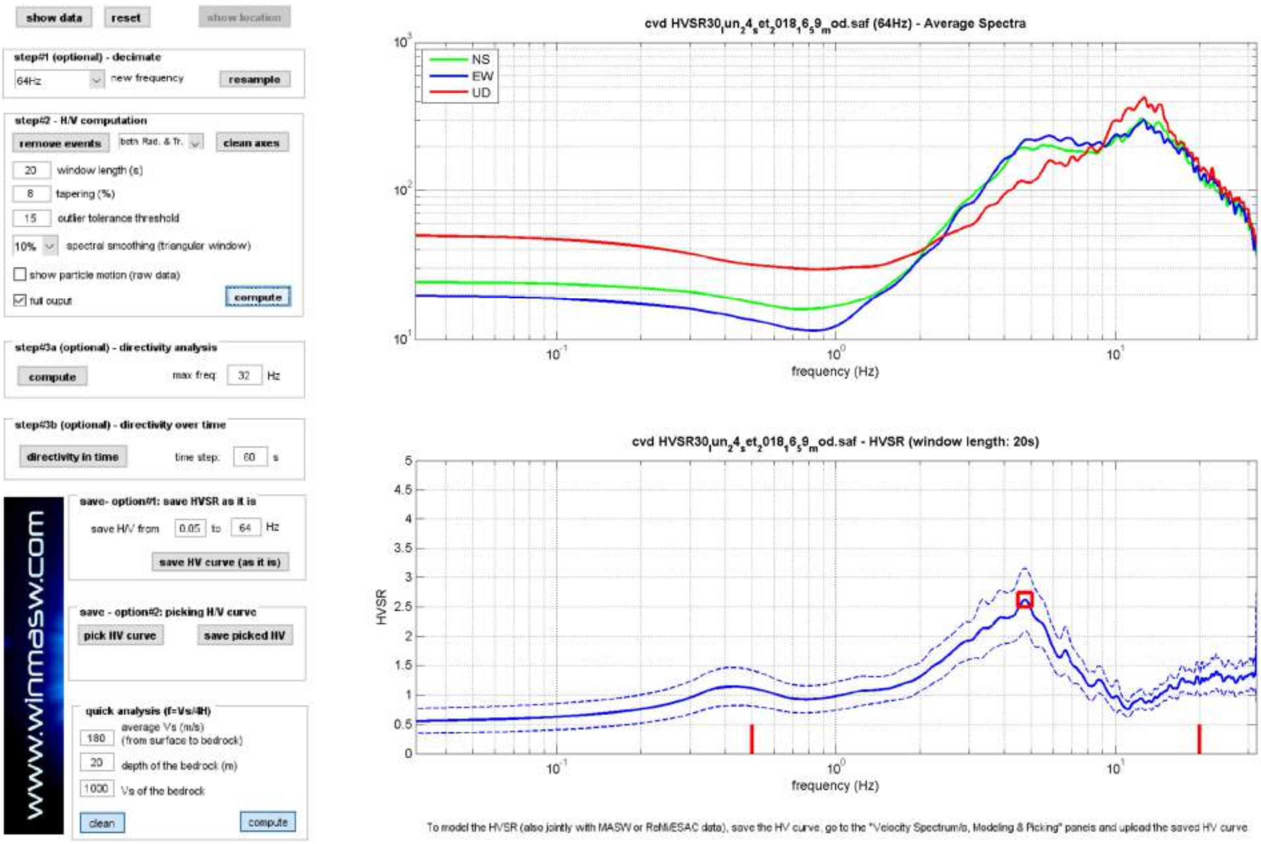
Peak frequency (Hz): 4.8 (±3.4)
Peak HVSR value: 2.6 (±0.5)

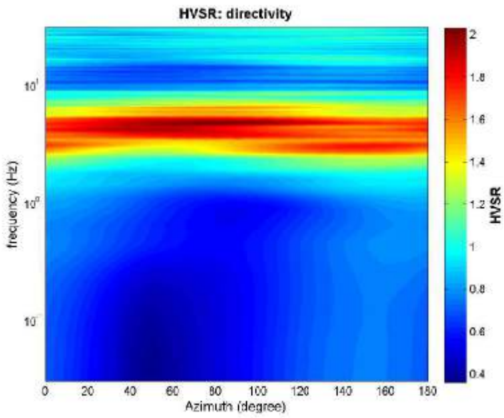
=== Criteria for a reliable H/V curve ====================================

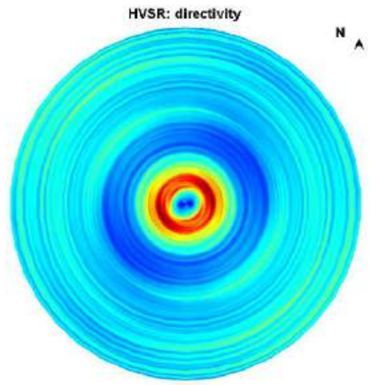
#1. [f0 > 10/Lw]: 4.755 > 0.5 (OK)
#2. [nc > 200]: 11126 > 200 (OK)
#3. [f0>0.5Hz; sigmaA(f) < 2 for 0.5f0 < f < 2f0] (OK)

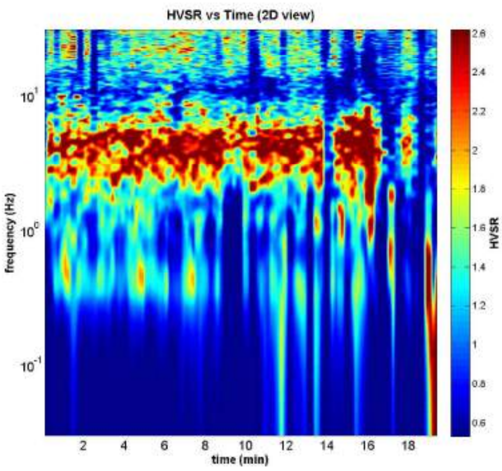
=== Criteria for a clear H/V peak (at least 5 should be fulfilled) ===========

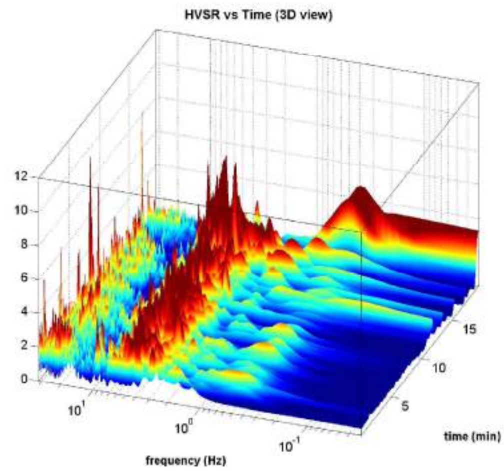
#1. [exists f- in the range [f0/4, f0] | AH/V(f-) < A0/2]: yes, at frequency 1.2Hz (OK)
#2. [exists f+ in the range [f0, 4f0] | AH/V(f+) < A0/2]: yes, at frequency 7.7Hz (OK)
#3. [A0 > 2]: 2.6 > 2 (OK)
#4. [fpeak[Ah/v(f) ± sigmaA(f)] = f0 ± 5%]: (OK)
#5. [sigmaf < epsilon(f0)]: 3.443 > 0.238 (NO)
#6. [sigmaA(f0) < theta(f0)]: 0.530 < 1.58 (OK)


show data
reset
show location
step#1 (optional) - decimate
64Hz
new frequency
resample
step#2 - H/V computation
remove events
both Rad. & Tr.
clean axes
20
window length (s)
8
tapering (%)
15
outlier tolerance threshold
10%
spectral smoothing (triangular window)
show particle motion (raw data)
full ouput
compute
step#3a (optional) - directivity analysis
compute
max freq:
32
Hz
step#3b (optional) - directivity over time
directivity in time
time step:
60
s
www.winmasw.com
save- option#1: save HVSR as it is
save H/V from
0.05
to
64
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)
180
average Vs (m/s) (from surface to bedrock)
20
depth of the bedrock (m)
1000
Vs of the bedrock
clean
compute
cvd HVSR30 un 4 et 018 6 9 od.saf (64Hz) - Average Spectra
NS
EW
UD
frequency (Hz)
cvd HVSR30 un 4 et 018 6 9 od.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/s, Modeling & Picking" panels and upload the saved HV curve


HVSR: directivity
frequency (Hz)
Azimuth (degree)
HVSR


HVSR: directivity
N


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


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

HVSR31

DATE 24.09.2018	HOUR 16.08	PLACE Parcheggio S. Agostino Colle di Val d'Elsa
OPERATOR Geologica Toscana S.n.c.	GPS TYPE and #	
WGS84 - UTM33N LATITUDE 4809813	WGS84 - UTM33N LONGITUDE 1671814	ALTITUDE 148 m slm
STATION TYPE GPA Engeenering	SENSOR TYPE 3D - 4,5 Hz	
STATION #	SENSOR #	DISK #
FILE NAME HVSR31.saf		POINT #
GAIN	SAMPL. FREQ. 300 Hz	REC. DURATION 20 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): 30 Remarks ______

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

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

BUILDING DENSITY [ ] none [ ] scattered [x] 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,...)
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 A1

HVSR31

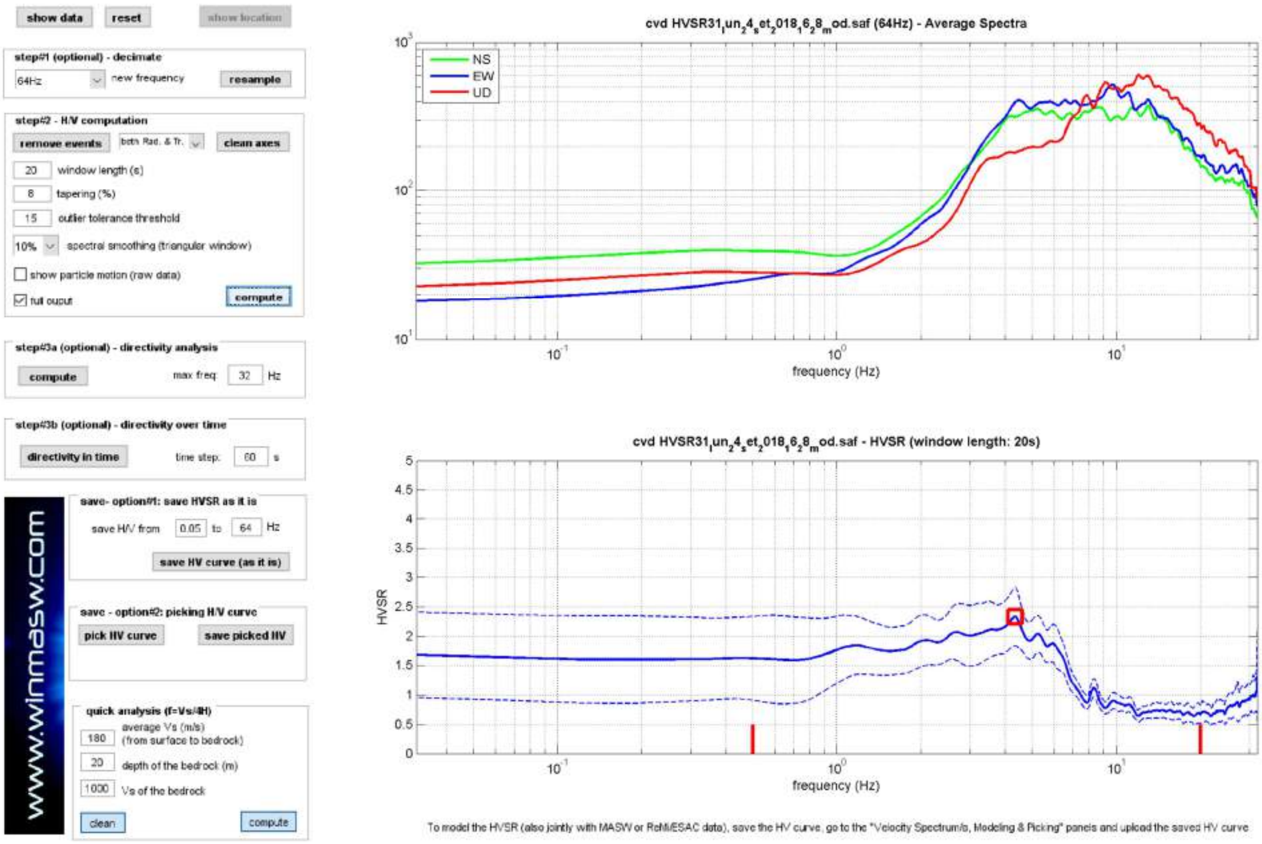
Peak frequency (Hz): 4.3 (±2.6)
Peak HVSR value: 2.3 (±0.5)

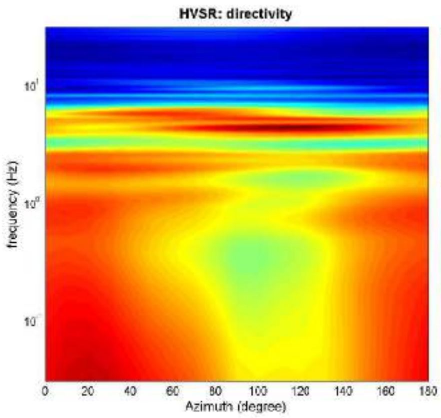
=== Criteria for a reliable H/V curve ====================================

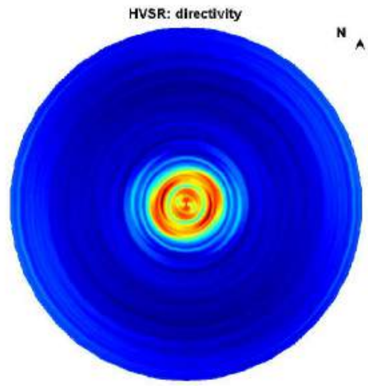
#1. [f0 > 10/Lw]: 4.348 > 0.5 (OK)
#2. [nc > 200]: 9826 > 200 (OK)
#3. [f0>0.5Hz; sigmaA(f) < 2 for 0.5f0 < f < 2f0] (OK)

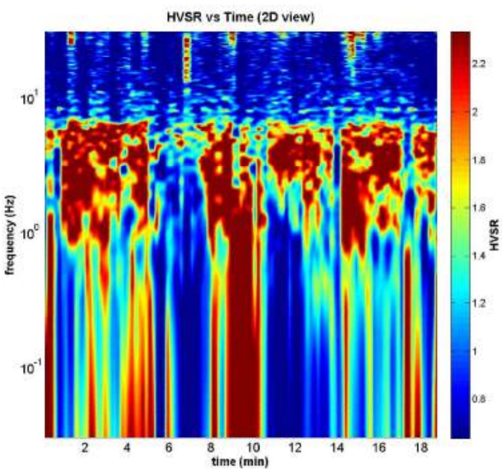
=== Criteria for a clear H/V peak (at least 5 should be fulfilled) ===========

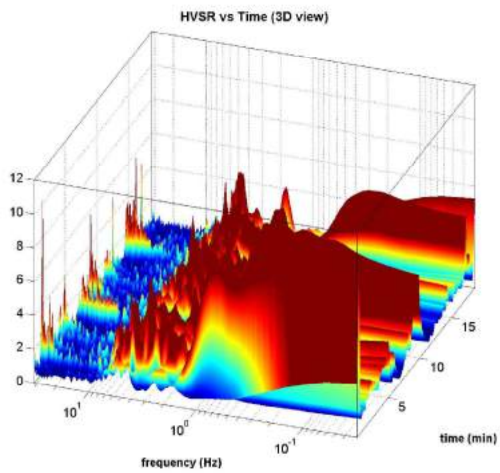
#1. [exists f- in the range [f0/4, f0] | AH/V(f-) < A0/2]: (NO)
#2. [exists f+ in the range [f0, 4f0] | AH/V(f+) < A0/2]: yes, at frequency 7.1Hz (OK)
#3. [A0 > 2]: 2.3 > 2 (OK)
#4. [fpeak[Ah/v(f) ± sigmaA(f)] = f0 ± 5%]: (OK)
#5. [sigmaf < epsilon(f0)]: 2.599 > 0.217 (NO)
#6. [sigmaA(f0) < theta(f0)]: 0.501 < 1.58 (OK)


show data
reset
show location
step#1 (optional) - decimate
64Hz
new frequency
resample
step#2 - H/V computation
remove events
both Rad. & Tr.
clean axes
20 window length (s)
8 tapering (%)
15 outlier tolerance threshold
10% spectral smoothing (triangular window)
show particle motion (raw data)
full ouput
compute
step#3a (optional) - directivity analysis
compute
max freq: 32 Hz
step#3b (optional) - directivity over time
directivity in time
time step: 60 s
www.winmasw.com
save- option#1: save HVSR as it is
save H/V from 0.05 to 64 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)
180 average Vs (m/s) (from surface to bedrock)
20 depth of the bedrock (m)
1000 Vs of the bedrock
clean
compute
cvd HVSR31un4et018628od.saf (64Hz) - Average Spectra
NS
EW
UD
frequency (Hz)
cvd HVSR31un4et018628od.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/s, Modeling & Picking" panels and upload the saved HV curve


HVSR: directivity
frequency (Hz)
Azimuth (degree)
HVSR


HVSR: directivity
N


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


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

HVSR32

DATE 02.10.2018	HOUR 11.16	PLACE Montecchio Colle di Val d'Elsa
OPERATOR Geologica Toscana S.n.c.	GPS TYPE and #	
WGS84 - UTM33N LATITUDE 4810637	WGS84 - UTM33N LONGITUDE 1668655	ALTITUDE 252 m slm
STATION TYPE GPA Engeenering	SENSOR TYPE 3D - 4,5 Hz	
STATION #	SENSOR #	DISK #
FILE NAME HVSR32.saf		POINT #
GAIN	SAMPL. FREQ. 300 Hz	REC. DURATION 20 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): 18 — Remarks ______

GROUND TYPE
- [x] earth ([x] hard [ ] soft) [ ] gravel [ ] sand [ ] rock [ ] grass ([ ] short [ ] tall)
- [ ] asphalt [ ] cement [ ] concrete [ ] paved [ ] other ______
- [ ] dry soil [x] wet soil — Remarks ______

ARTIFICIAL GROUND-SENSOR COUPLING [ ] no [x] 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

OBSERVATIONS

FREQUENCY: Hz (if computed in the field)

Qualità della misura:

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

MISURA TIPO B1

HVSR32

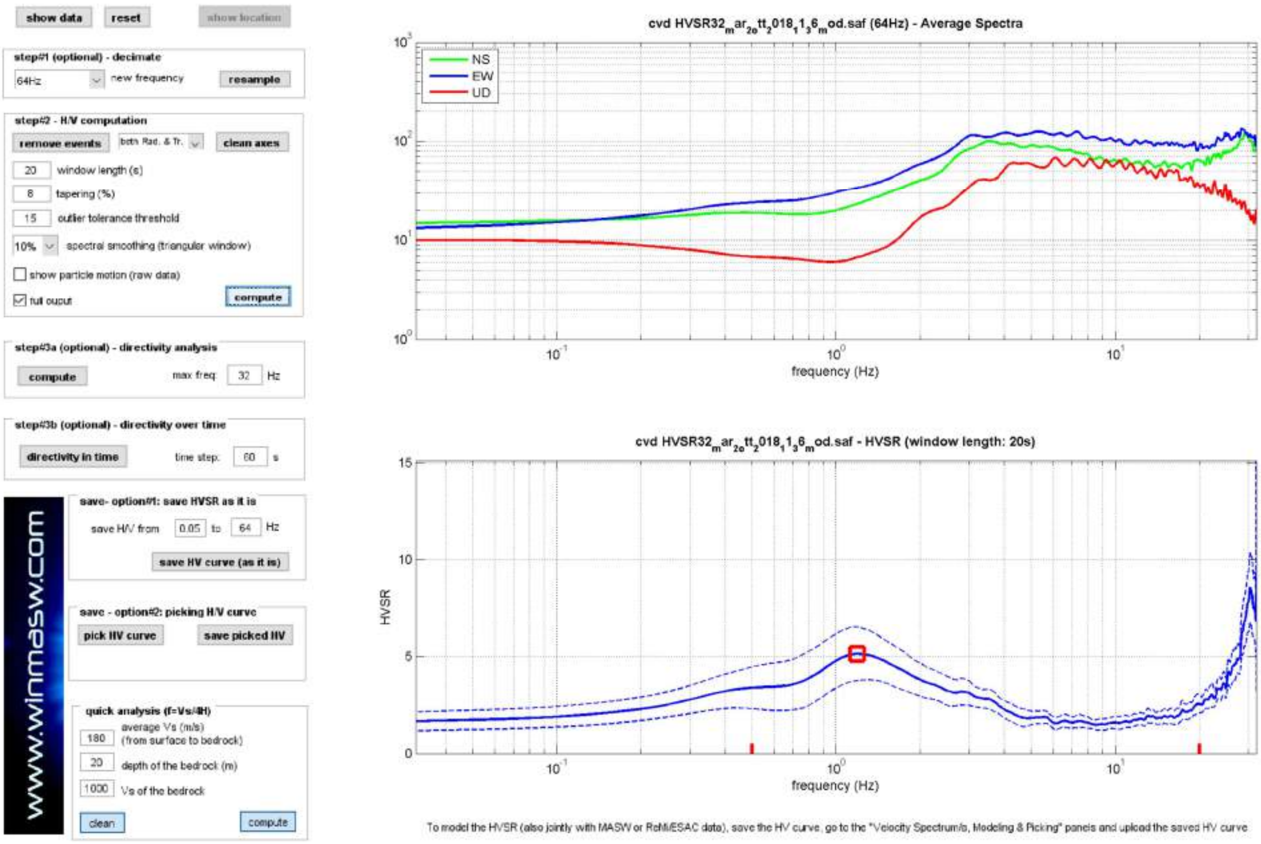
Peak frequency (Hz): 1.2 (±3.8)
Peak HVSR value: 5.1 (±1.4)

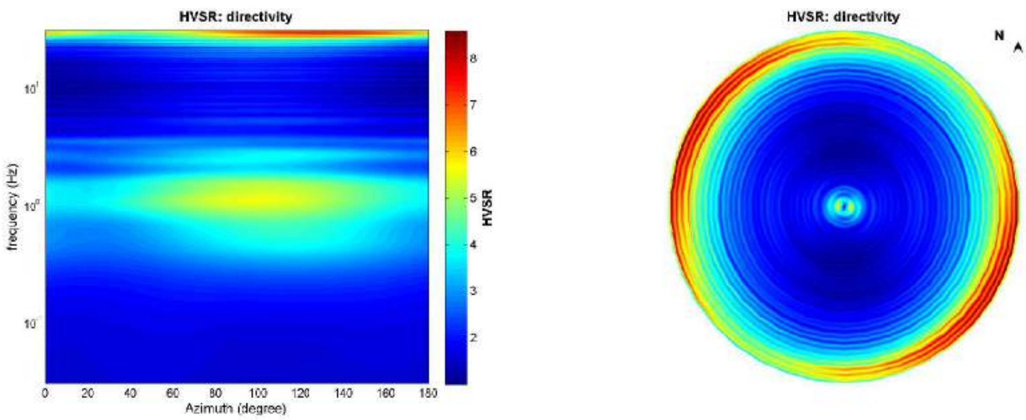
=== Criteria for a reliable H/V curve ====================================

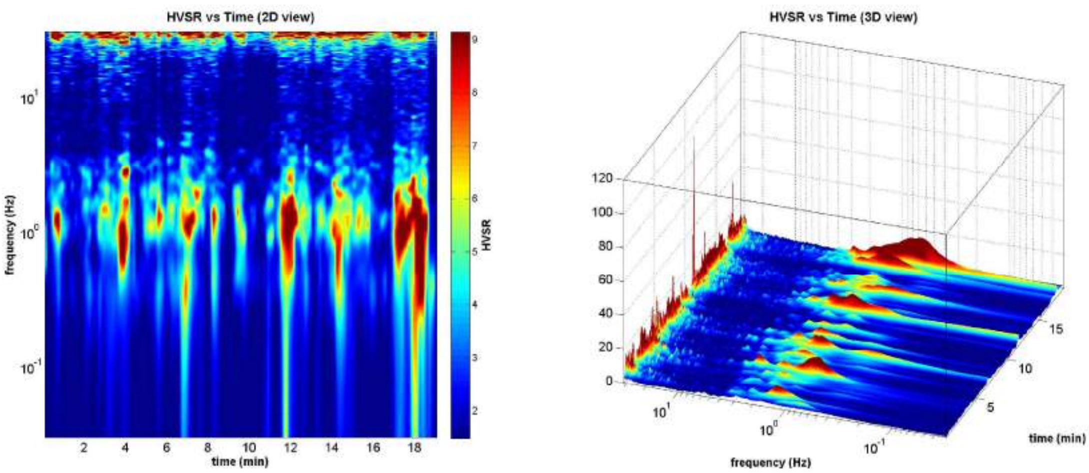
#1. [f0 > 10/Lw]: 1.189 > 0.5 (OK)
#2. [nc > 200]: 2734 > 200 (OK)
#3. [f0>0.5Hz; sigmaA(f) < 2 for 0.5f0 < f < 2f0] (OK)

=== 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 3.8Hz (OK)
#3. [A0 > 2]: 5.1 > 2 (OK)
#4. [fpeak[Ah/v(f) ± sigmaA(f)] = f0 ± 5%]: (NO)
#5. [sigmaf < epsilon(f0)]: 3.846 > 0.119 (NO)
#6. [sigmaA(f0) < theta(f0)]: 1.378 < 1.78 (OK)


show data
reset
show location
step#1 (optional) - decimate
64Hz
new frequency
resample
step#2 - H/V computation
remove events
both Rad. & Tr.
clean axes
20 window length (s)
8 tapering (%)
15 outlier tolerance threshold
10% spectral smoothing (triangular window)
show particle motion (raw data)
full ouput
compute
step#3a (optional) - directivity analysis
compute
max freq: 32 Hz
step#3b (optional) - directivity over time
directivity in time
time step: 60 s
www.winmasw.com
save- option#1: save HVSR as it is
save H/V from 0.05 to 64 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)
180 average Vs (m/s) (from surface to bedrock)
20 depth of the bedrock (m)
1000 Vs of the bedrock
clean
compute
frequency (Hz)
NS
EW
UD
HVSR
frequency (Hz)
To model the HVSR (also jointly with MASW or ReMi/ESAC data), save the HV curve, go to the "Velocity Spectrum/s, Modeling & Picking" panels and upload the saved HV curve


HVSR: directivity
frequency (Hz)
Azimuth (degree)
HVSR
HVSR: directivity
N


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

HVSR33

DATE 21.09.2018	HOUR 17.10	PLACE Belvedere Colle di Val d'Elsa
OPERATOR Geologica Toscana S.n.c.	GPS TYPE and #	
WGS84 - UTM33N LATITUDE 4808740	WGS84 - UTM33N LONGITUDE 1674626	ALTITUDE 233 m slm
STATION TYPE GPA Engeenering	SENSOR TYPE 3D - 4,5 Hz	
STATION #	SENSOR #	DISK #
FILE NAME HVSR33.saf		POINT #
GAIN	SAMPL. FREQ. 300 Hz	REC. DURATION 20 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): 29 — Remarks ______

GROUND TYPE
- [ ] earth ([ ] hard [ ] soft) [ ] gravel [ ] sand [ ] rock [x] grass ([x] short [ ] tall)
- [ ] asphalt [ ] cement [ ] concrete [ ] paved [ ] other ______
- [x] dry soil [ ] wet soil — Remarks ______

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

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

TRANSIENTS

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

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

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 A1

HVSR33

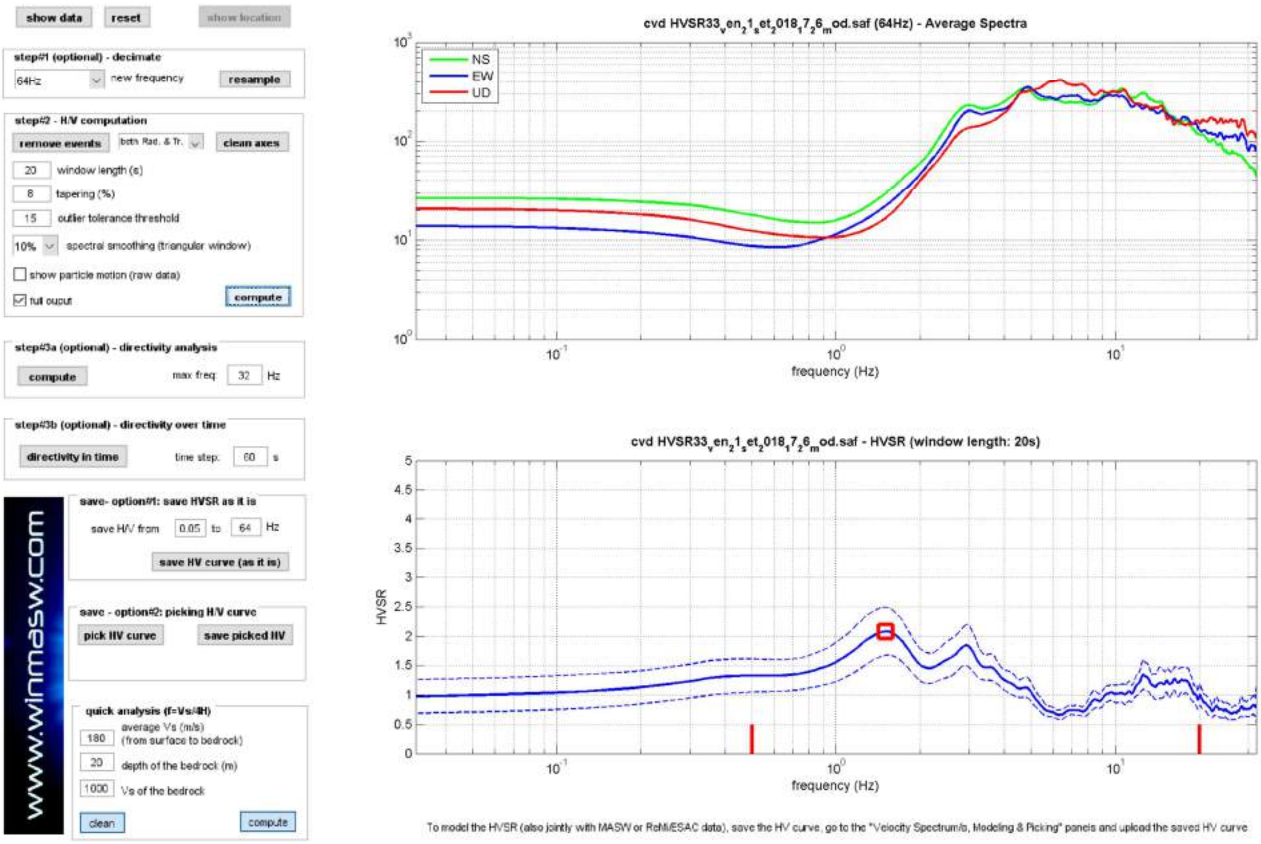
Peak frequency (Hz): 1.5 (±4.6)
Peak HVSR value: 2.1 (±0.4)

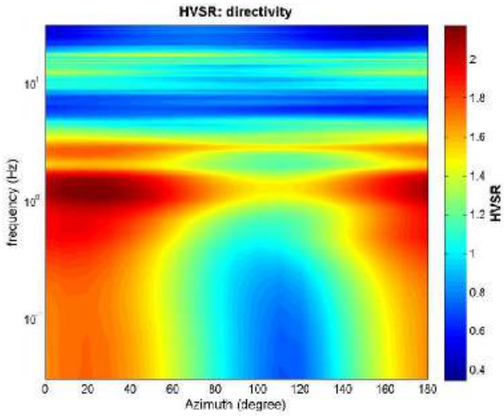
=== Criteria for a reliable H/V curve ====================================

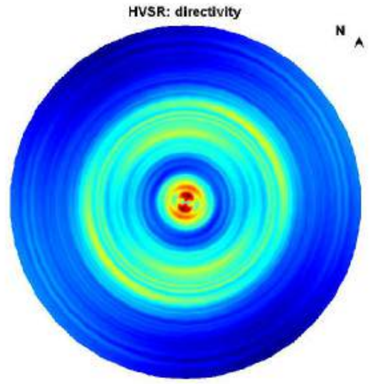
#1. [f0 > 10/Lw]: 1.501 > 0.5 (OK)
#2. [nc > 200]: 3543 > 200 (OK)
#3. [f0>0.5Hz; sigmaA(f) < 2 for 0.5f0 < f < 2f0] (OK)

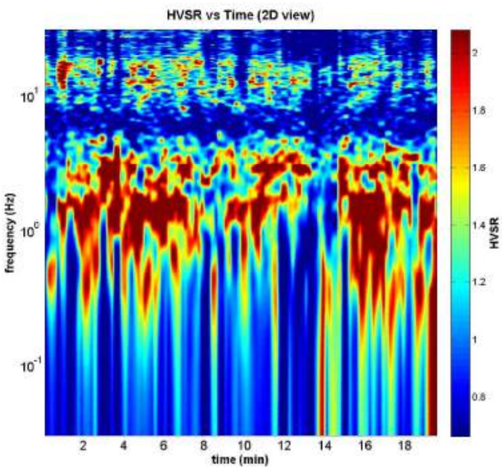
=== Criteria for a clear H/V peak (at least 5 should be fulfilled) ===========

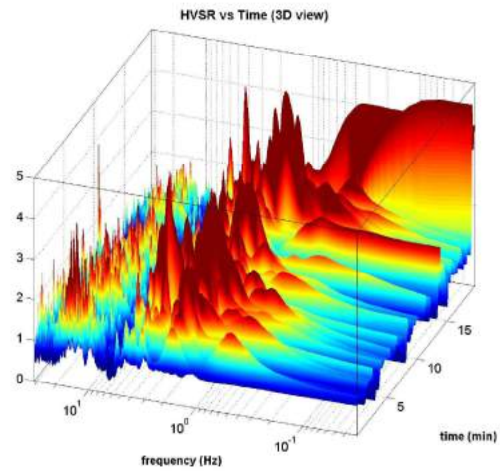
#1. [exists f- in the range [f0/4, f0] | AH/V(f-) < A0/2]: (NO)
#2. [exists f+ in the range [f0, 4f0] | AH/V(f+) < A0/2]: yes, at frequency 5.0Hz (OK)
#3. [A0 > 2]: 2.1 > 2 (OK)
#4. [fpeak[Ah/v(f) ± sigmaA(f)] = f0 ± 5%]: (OK)
#5. [sigmaf < epsilon(f0)]: 4.595 > 0.150 (NO)
#6. [sigmaA(f0) < theta(f0)]: 0.410 < 1.78 (OK)


show data
reset
show location
step#1 (optional) - decimate
64Hz
new frequency
resample
step#2 - H/V computation
remove events
both Rad. & Tr.
clean axes
20 window length (s)
8 tapering (%)
15 outlier tolerance threshold
10% spectral smoothing (triangular window)
show particle motion (raw data)
full ouput
compute
step#3a (optional) - directivity analysis
compute
max freq: 32 Hz
step#3b (optional) - directivity over time
directivity in time
time step: 60 s
www.winmasw.com
save- option#1: save HVSR as it is
save H/V from 0.05 to 64 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)
180 average Vs (m/s) (from surface to bedrock)
20 depth of the bedrock (m)
1000 Vs of the bedrock
clean
compute
cvd HVSR33_ven_21_set_2018_17_26_mod.saf (64Hz) - Average Spectra
NS
EW
UD
frequency (Hz)
cvd HVSR33_ven_21_set_2018_17_26_mod.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/s, Modeling & Picking" panels and upload the saved HV curve


HVSR: directivity
frequency (Hz)
Azimuth (degree)
HVSR


HVSR: directivity
N


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


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

HVSR34

DATE 21.09.2018 | HOUR 17.40 | PLACE Stadio Gino Manni Colle di Val d'Elsa

OPERATOR Geologica Toscana S.n.c. | GPS TYPE and #

WGS84 - UTM33N LATITUDE 4809966 | WGS84 - UTM33N LONGITUDE 1673173 | ALTITUDE 172 m slm

STATION TYPE GPA Engeenering | SENSOR TYPE 3D - 4,5 Hz

STATION # | SENSOR # | DISK #

FILE NAME HVSR34.saf | POINT #

GAIN | SAMPL. FREQ. 300 Hz | REC. DURATION 20 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): 28 Remarks ______

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

ARTIFICIAL GROUND-SENSOR COUPLING [ ] no [x] 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, ...)

Buildings

OBSERVATIONS

FREQUENCY: Hz (if computed in the field)

Qualità della misura:

MISURA TIPO A2

HVSR34

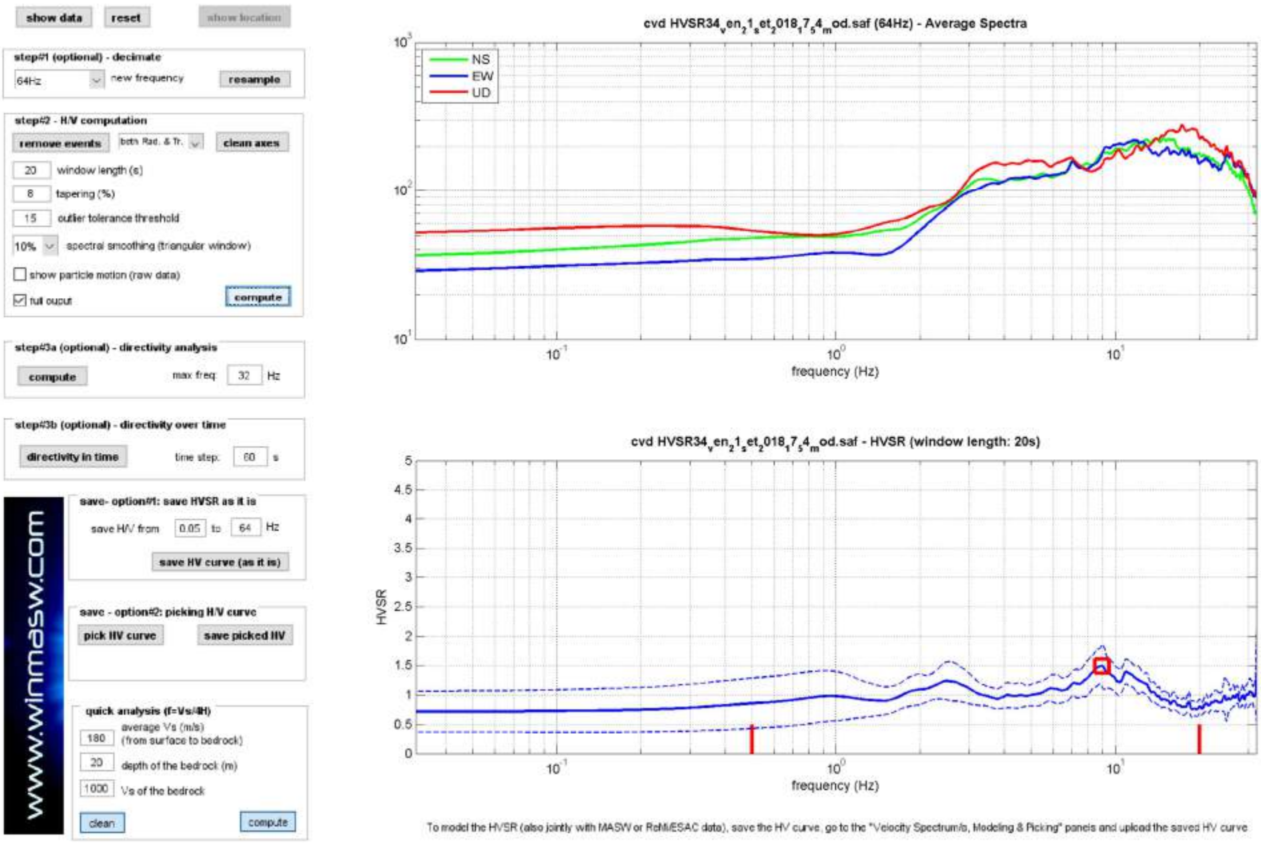
Peak frequency (Hz): 8.9 (±4.4)
Peak HVSR value: 1.5 (±0.4)

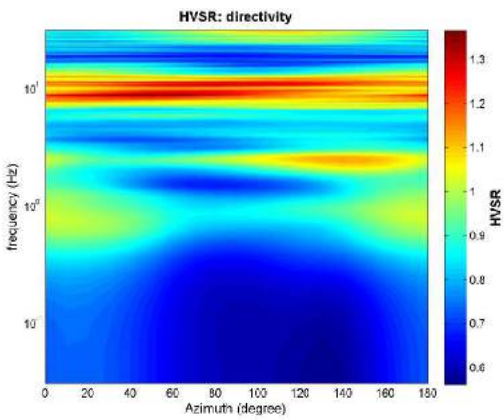
=== Criteria for a reliable H/V curve ====================================

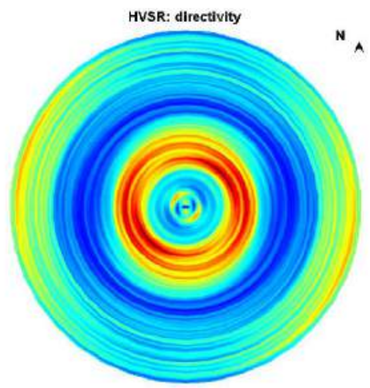
#1. [f0 > 10/Lw]: 8.946 > 0.5 (OK)
#2. [nc > 200]: 20755 > 200 (OK)
#3. [f0>0.5Hz; sigmaA(f) < 2 for 0.5f0 < f < 2f0] (OK)

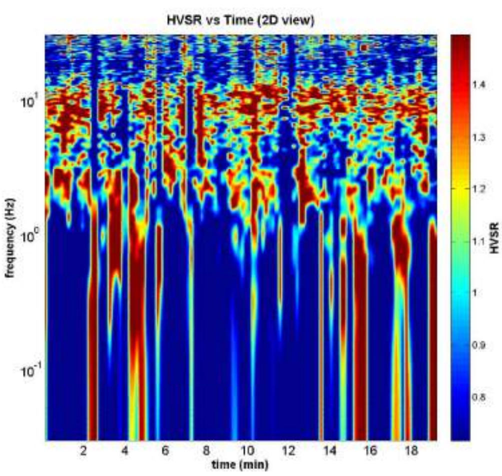
=== Criteria for a clear H/V peak (at least 5 should be fulfilled) ===========

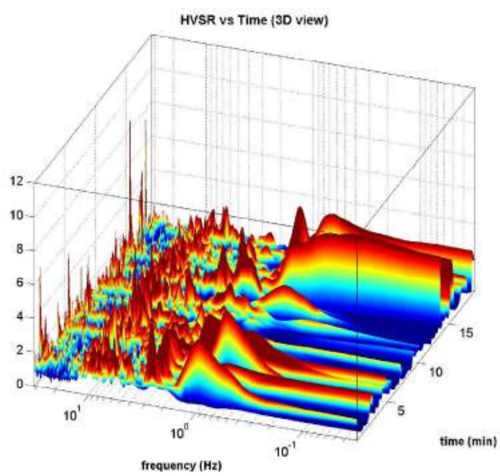
#1. [exists f- in the range [f0/4, f0] | AH/V(f-) < A0/2]: (NO)
#2. [exists f+ in the range [f0, 4f0] | AH/V(f+) < A0/2]: yes (considering standard deviations), at frequency Hz (OK)
#3. [A0 > 2]: 1.5 < 2 (NO)
#4. [fpeak[Ah/v(f) ± sigmaA(f)] = f0 ± 5%]: (NO)
#5. [sigmaf < epsilon(f0)]: 4.397 > 0.447 (NO)
#6. [sigmaA(f0) < theta(f0)]: 0.352 < 1.58 (OK)


show data
reset
show location
step#1 (optional) - decimate
64Hz
new frequency
resample
step#2 - H/V computation
remove events
both Rad. & Tr.
clean axes
20 window length (s)
8 tapering (%)
15 outlier tolerance threshold
10% spectral smoothing (triangular window)
show particle motion (raw data)
full ouput
compute
step#3a (optional) - directivity analysis
compute
max freq: 32 Hz
step#3b (optional) - directivity over time
directivity in time
time step: 60 s
www.winmasw.com
save- option#1: save HVSR as it is
save H/V from 0.05 to 64 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)
180 average Vs (m/s) (from surface to bedrock)
20 depth of the bedrock (m)
1000 Vs of the bedrock
clean
compute
NS
EW
UD
frequency (Hz)
HVSR
frequency (Hz)
To model the HVSR (also jointly with MASW or ReMi/ESAC data), save the HV curve, go to the "Velocity Spectrum/s, Modeling & Picking" panels and upload the saved HV curve


HVSR: directivity
frequency (Hz)
Azimuth (degree)
HVSR


HVSR: directivity
N


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


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

HVSR35

DATE 02.10.2018	HOUR 17.20	PLACE Paretaio Colle di Val d'Elsa
OPERATOR Geologica Toscana S.n.c.	GPS TYPE and #	
WGS84 - UTM33N LATITUDE 4807441	WGS84 - UTM33N LONGITUDE 1670483	ALTITUDE 233 m slm
STATION TYPE GPA Engeenering	SENSOR TYPE 3D - 4,5 Hz	
STATION #	SENSOR #	DISK #
FILE NAME HVSR35.saf		POINT #
GAIN	SAMPL. FREQ. 300 Hz	REC. DURATION 20 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): 17 — Remarks

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

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

BUILDING DENSITY: [x] none [ ] 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

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

HVSR35

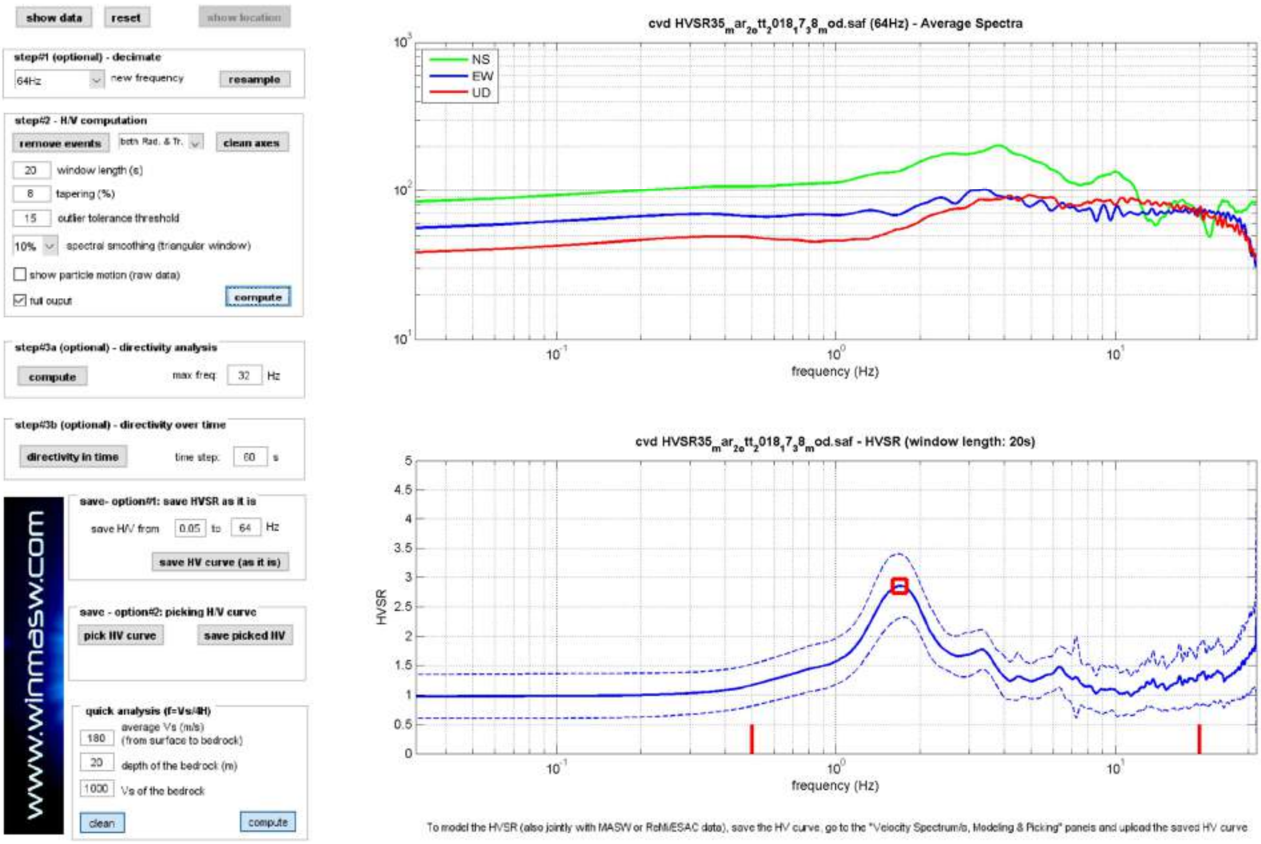
Peak frequency (Hz): 1.7 (±5.2)
Peak HVSR value: 2.9 (±0.5)

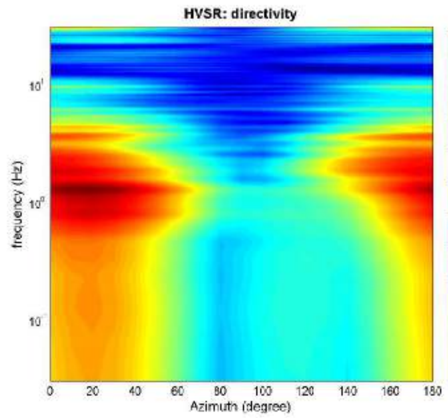
=== Criteria for a reliable H/V curve ===================================

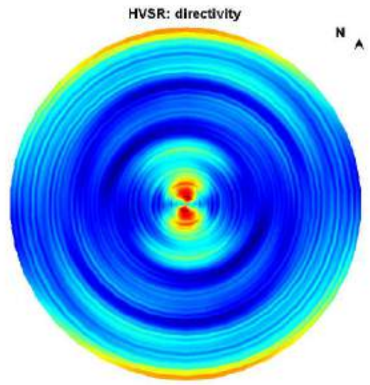
#1. [f0 > 10/Lw]: 1.689 > 0.5 (OK)
#2. [nc > 200]: 3953 > 200 (OK)
#3. [f0>0.5Hz; sigmaA(f) < 2 for 0.5f0 < f < 2f0] (OK)

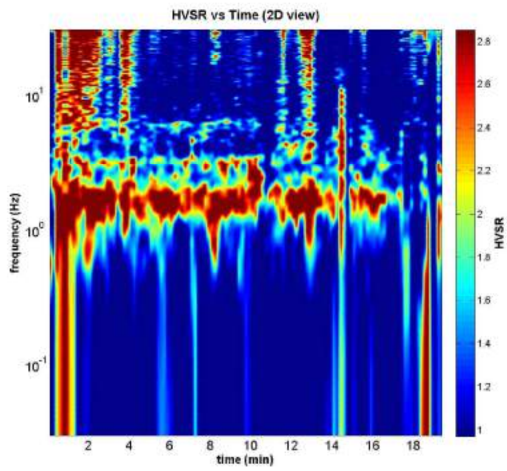
=== Criteria for a clear H/V peak (at least 5 should be fulfilled) ============

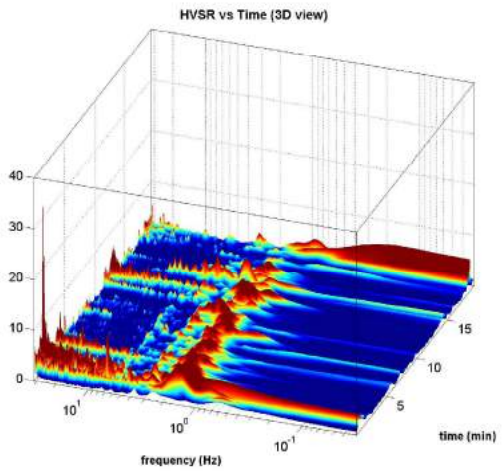
#1. [exists f- in the range [f0/4, f0] | AH/V(f-) < A0/2]: yes, at frequency 0.5Hz (OK)
#2. [exists f+ in the range [f0, 4f0] | AH/V(f+) < A0/2]: yes, at frequency 3.8Hz (OK)
#3. [A0 > 2]: 2.9 > 2 (OK)
#4. [fpeak[Ah/v(f) ± sigmaA(f)] = f0 ± 5%]: (OK)
#5. [sigmaf < epsilon(f0)]: 5.210 > 0.169 (NO)
#6. [sigmaA(f0) < theta(f0)]: 0.547 < 1.78 (OK)


show data
reset
show location
step#1 (optional) - decimate
64Hz
new frequency
resample
step#2 - H/V computation
remove events
both Rad. & Tr.
clean axes
20 window length (s)
8 tapering (%)
15 outlier tolerance threshold
10% spectral smoothing (triangular window)
show particle motion (raw data)
full ouput
compute
step#3a (optional) - directivity analysis
compute
max freq: 32 Hz
step#3b (optional) - directivity over time
directivity in time
time step: 60 s
www.winmasw.com
save- option#1: save HVSR as it is
save H/V from 0.05 to 64 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)
180 average Vs (m/s) (from surface to bedrock)
20 depth of the bedrock (m)
1000 Vs of the bedrock
clean
compute
cvd HVSR35_mar_2ott_2018_17_38_mod.saf (64Hz) - Average Spectra
NS
EW
UD
frequency (Hz)
cvd HVSR35_mar_2ott_2018_17_38_mod.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/s, Modeling & Picking" panels and upload the saved HV curve


HVSR: directivity
frequency (Hz)
Azimuth (degree)
HVSR


HVSR: directivity
N

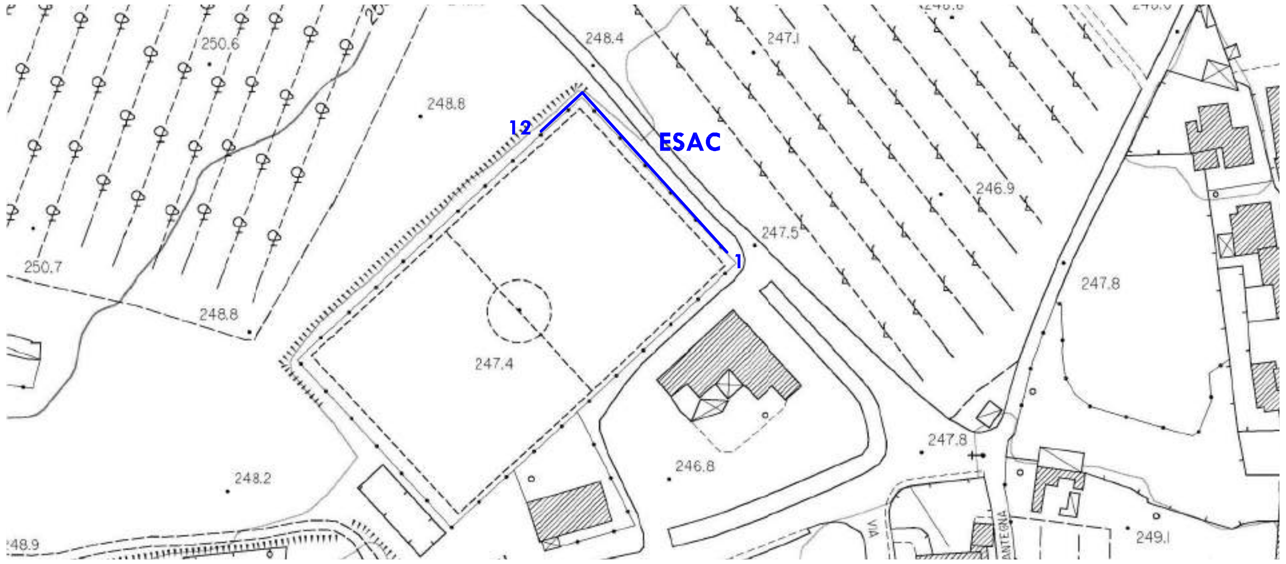

HVSR vs Time (2D view)
frequency (Hz)
time (min)
HVSR


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

ALLEGATO 2

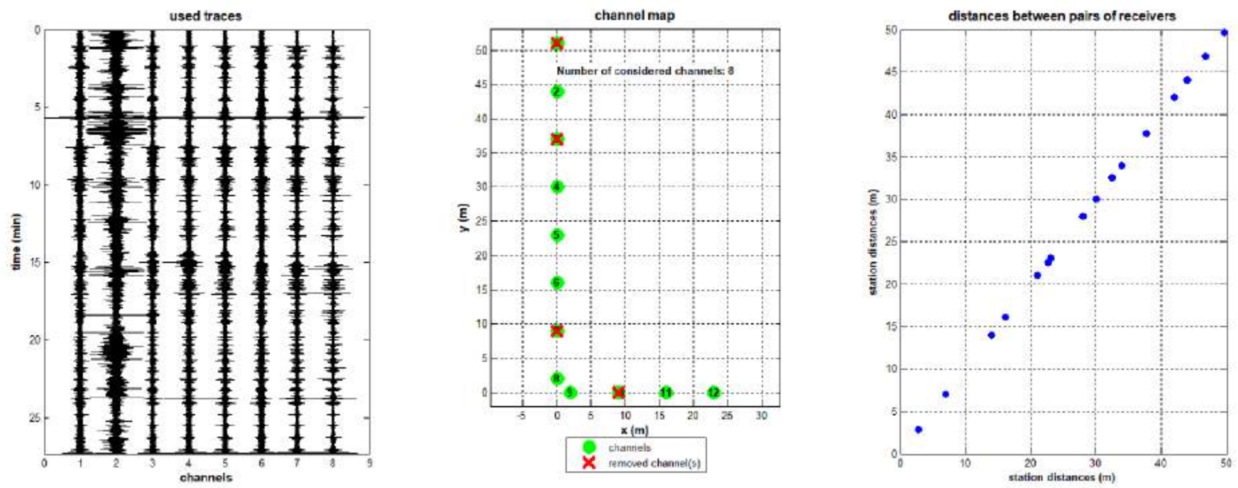
REPORT DELLE MIRURE MASW ED ESAC

CAMPIGLIA



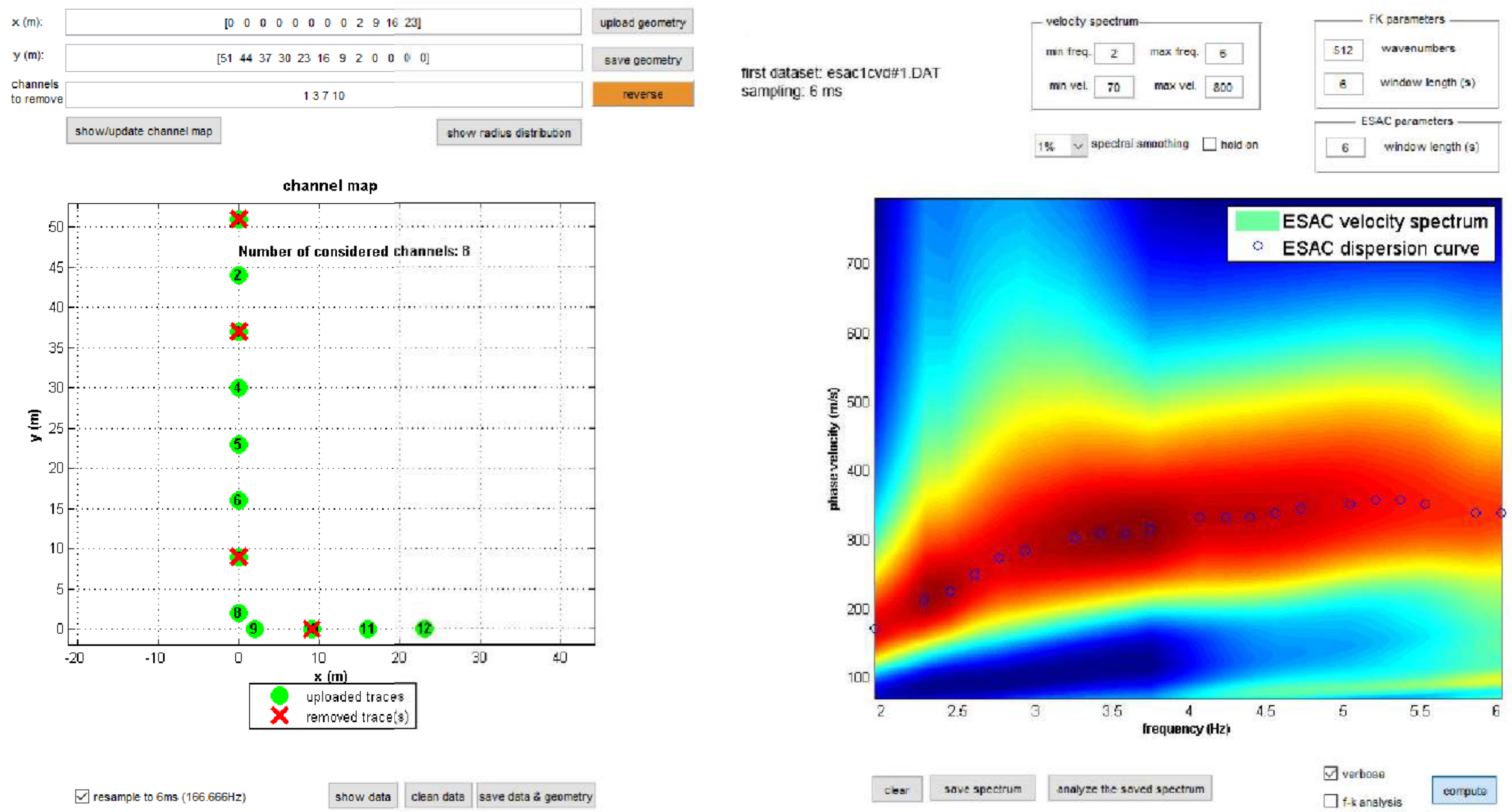
1 ESAC 12 Stendimento di sismica passiva ESAC

ACQUISIZIONE ESAC



Stendimento ESAC

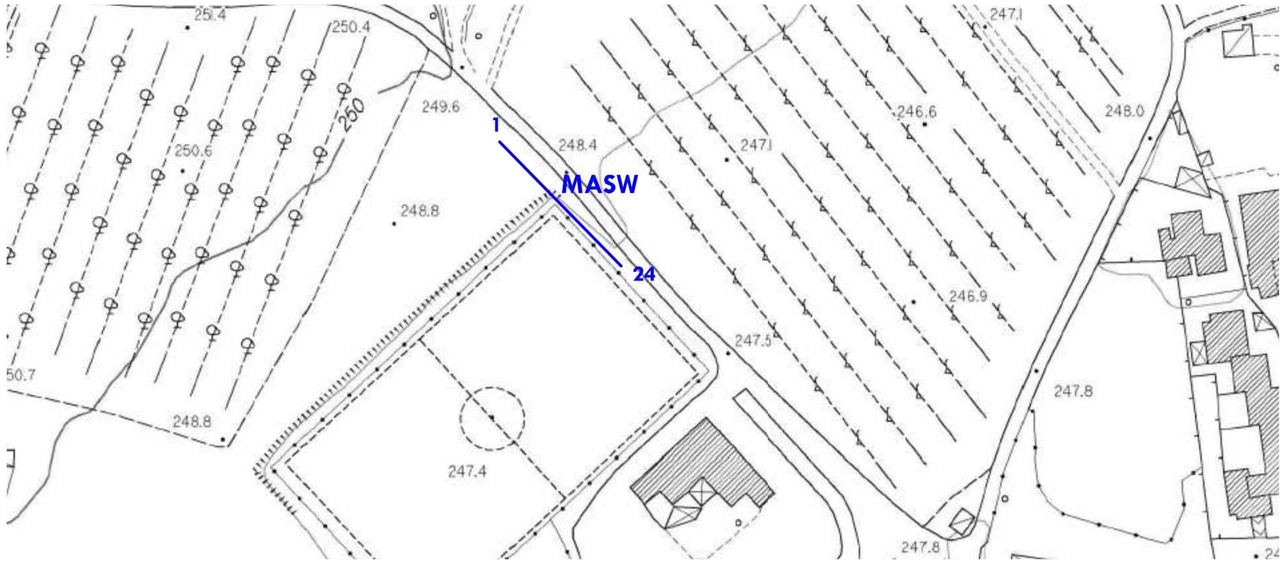
SPETTRO DI VELOCITA' ESAC E CURVA DI DISPERSIONE EFFETTIVA



GEOLOGICA TOSCANA s.n.c.

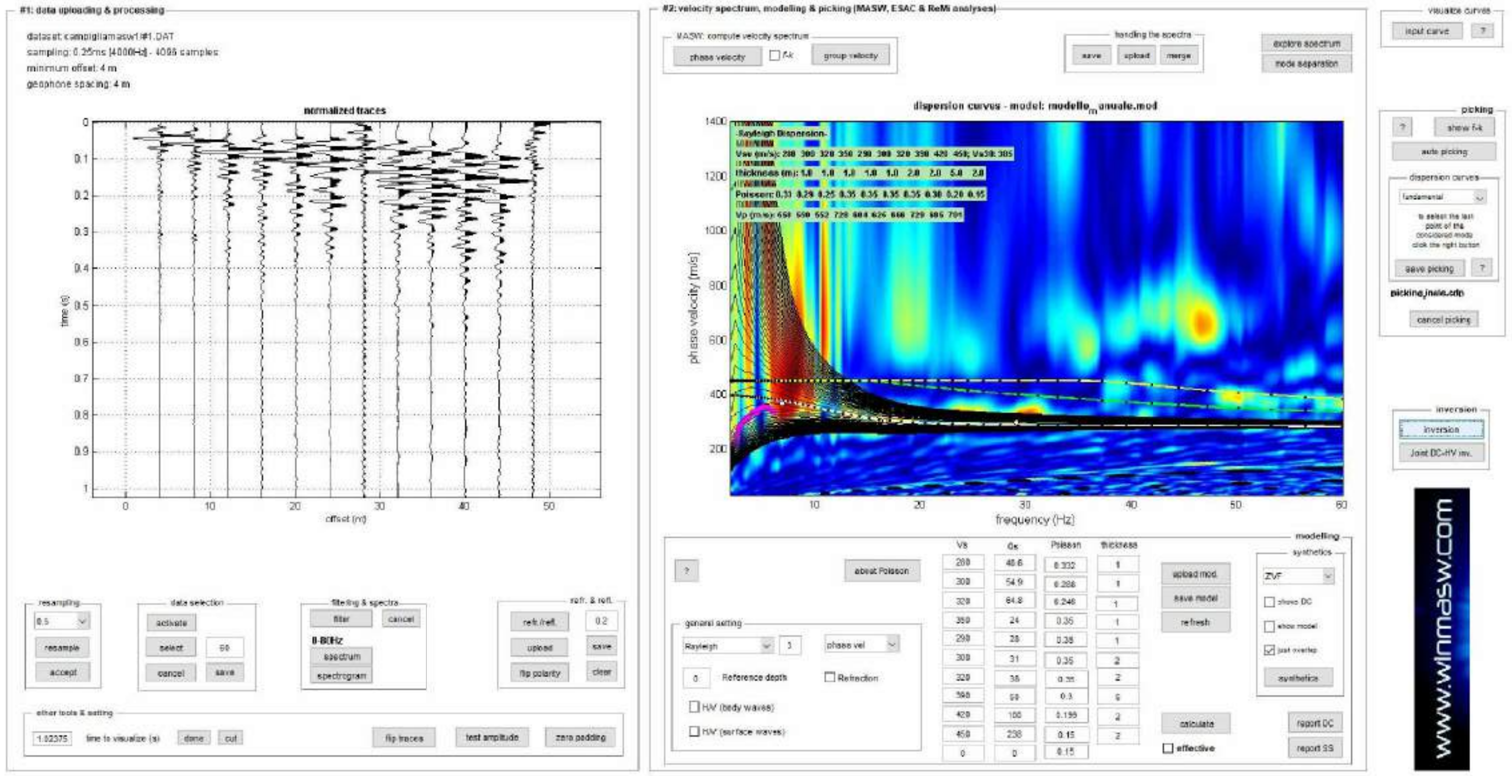
RISULTANZE DELL'ANALISI SISMICA CONGIUNTA MASW 1 - ESAC 1

CAMPIGLIA



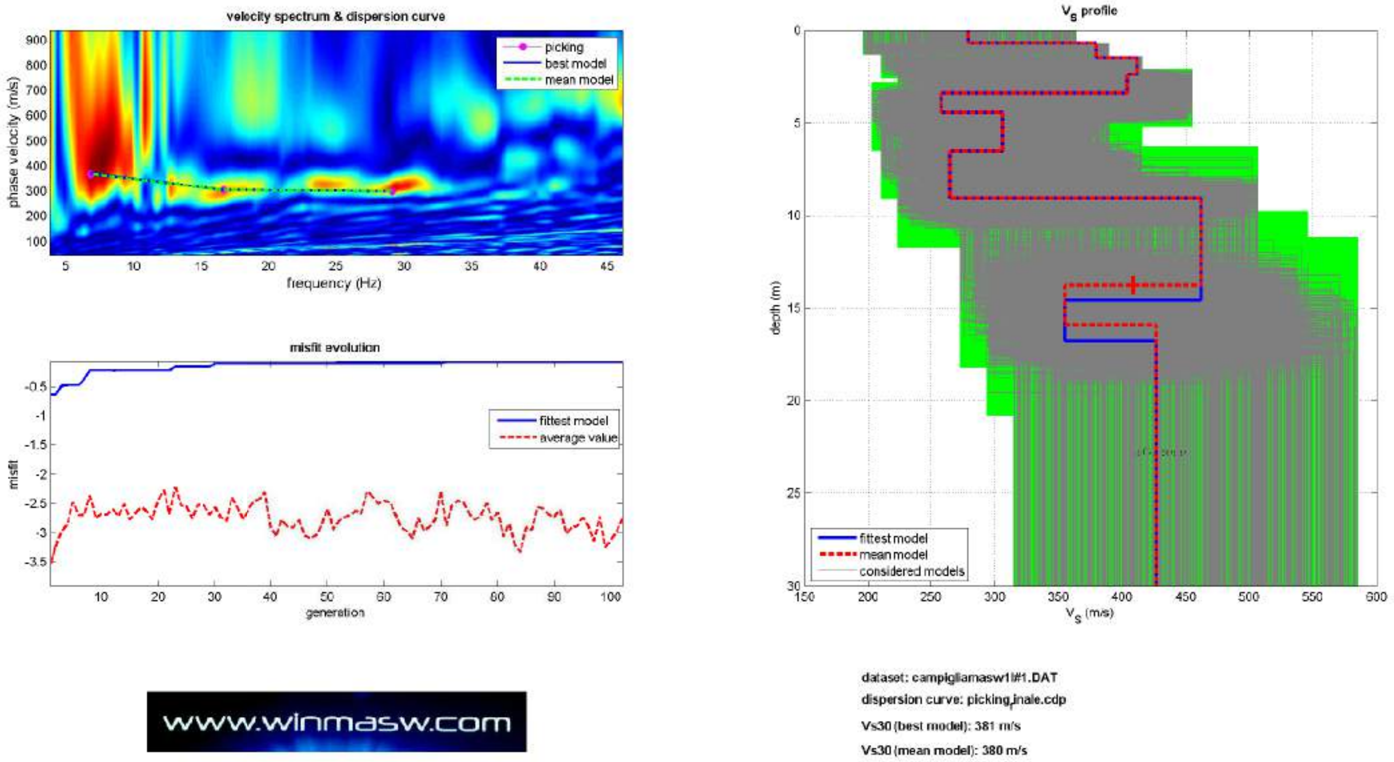
1 MASW 24 Stendimento di sismica attiva MASW

SPETTRO DI VELOCITA' MASW + CURVA DI DISPERSIONE EFFETTIVA ESAC



Stendimento MASW

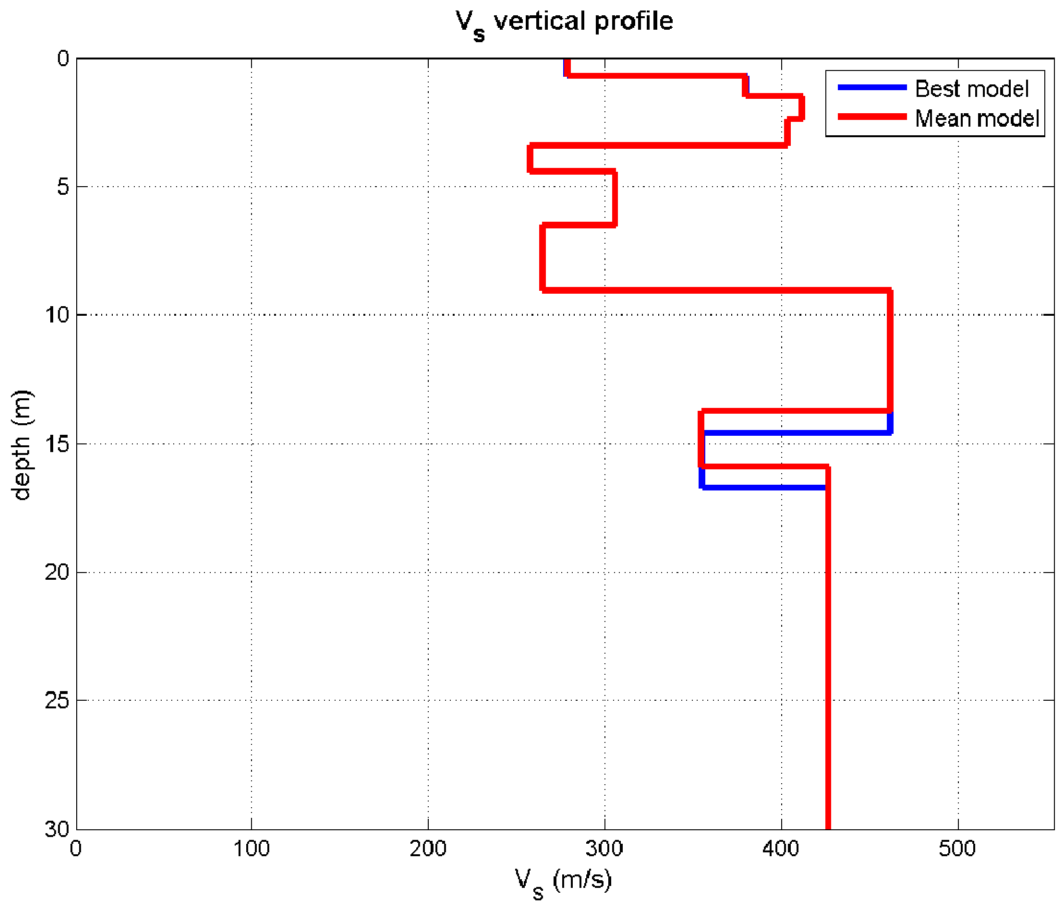
INVERSIONE CONGIUNTA MASW – ESAC E PROFILO DI VELOCITA'



GEOLOGICA TOSCANA s.n.c.

RISULTANZE DELL'ANALISI SISMICA CONGIUNTA MASW 1 - ESAC 1

PROFILO DI VELOCITA' MASW 1 – ESAC 1



Vs (m/s):279, 380, 412, 404, 258, 306, 265, 462, 355, 427
Thickness (m):0.7, 0.8, 0.9, 1.0, 1.0, 2.1, 2.5, 4.7, 2.1

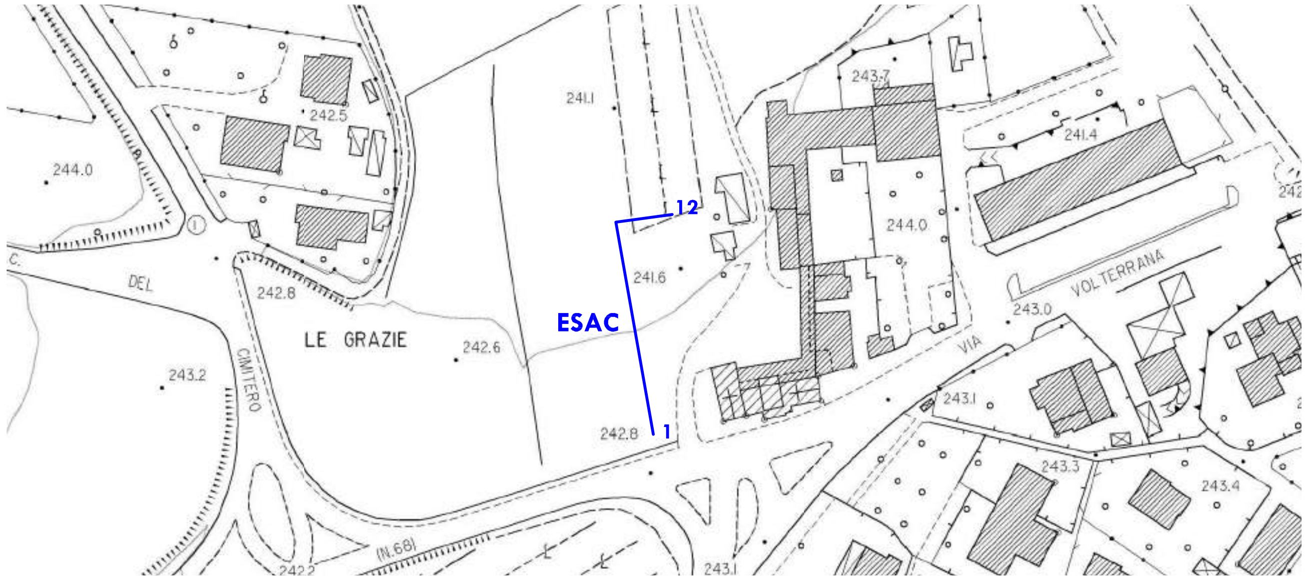
Density (gr/cm3) (approximate values):1.911.961.972.001.861.961.952.011.911.96
Seismic/Dynamic Shear modulus (MPa) (approximate values):1482843343271241841374292413 58

Approximate values for Vp and Poisson
Vp (m/s):541690706803451685656835563683
Poisson:0.320.280.240.330.260.380.400.280.170.18

Vs30 (m/s): 380

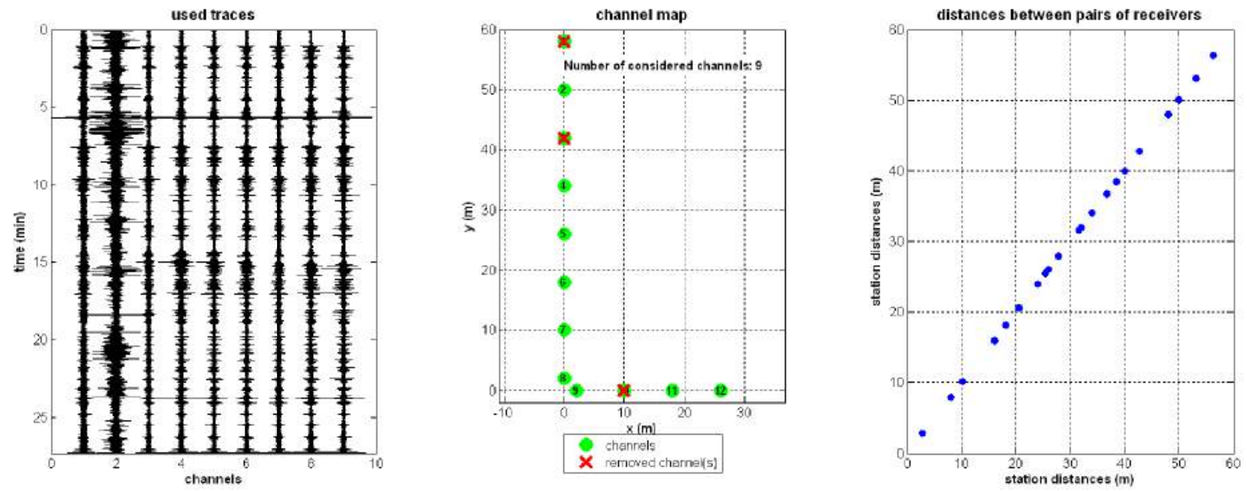
GEOLOGICA TOSCANA s.n.c.

LE GRAZIE



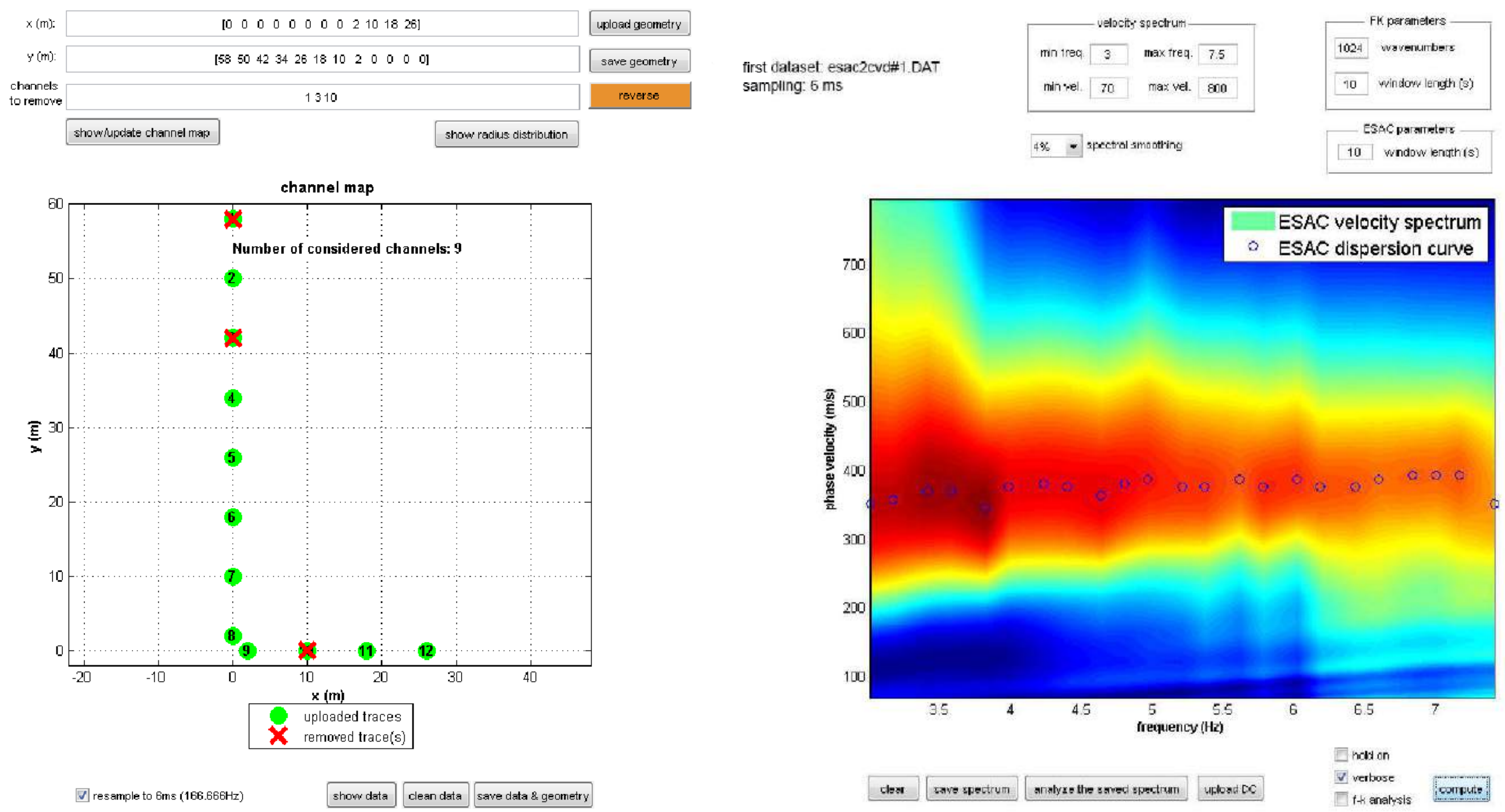
1 ESAC 12 Stendimento di sismica passiva ESAC

ACQUISIZIONE ESAC



Stendimento ESAC

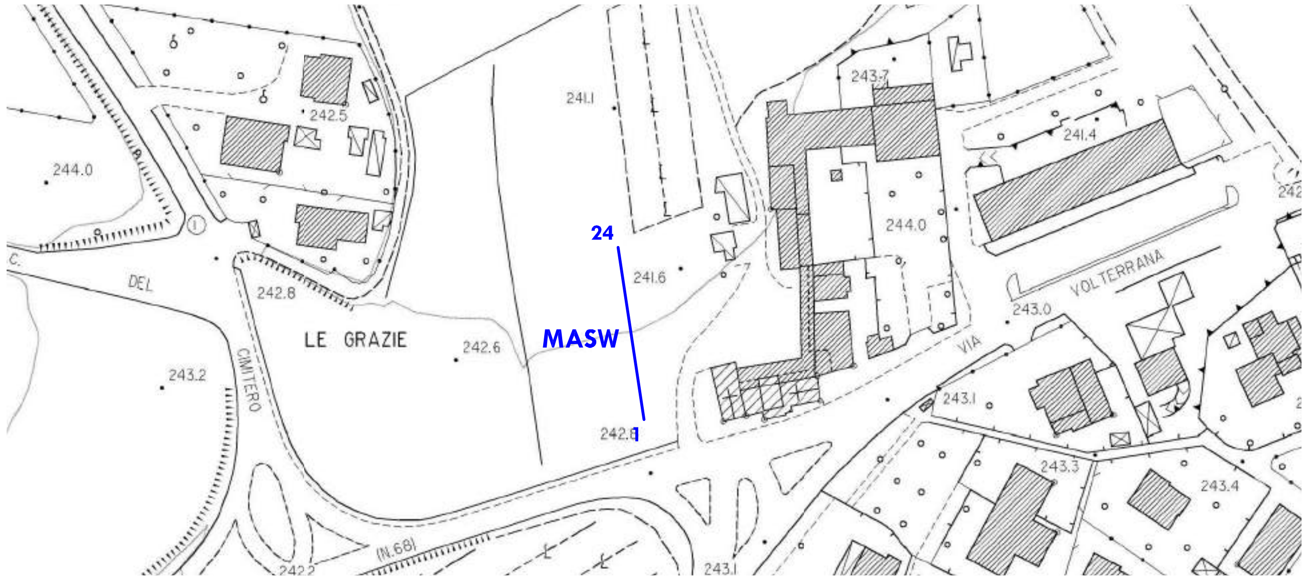
SPETTRO DI VELOCITA' ESAC E CURVA DI DISPERSIONE EFFETTIVA



GEOLOGICA TOSCANA s.n.c.

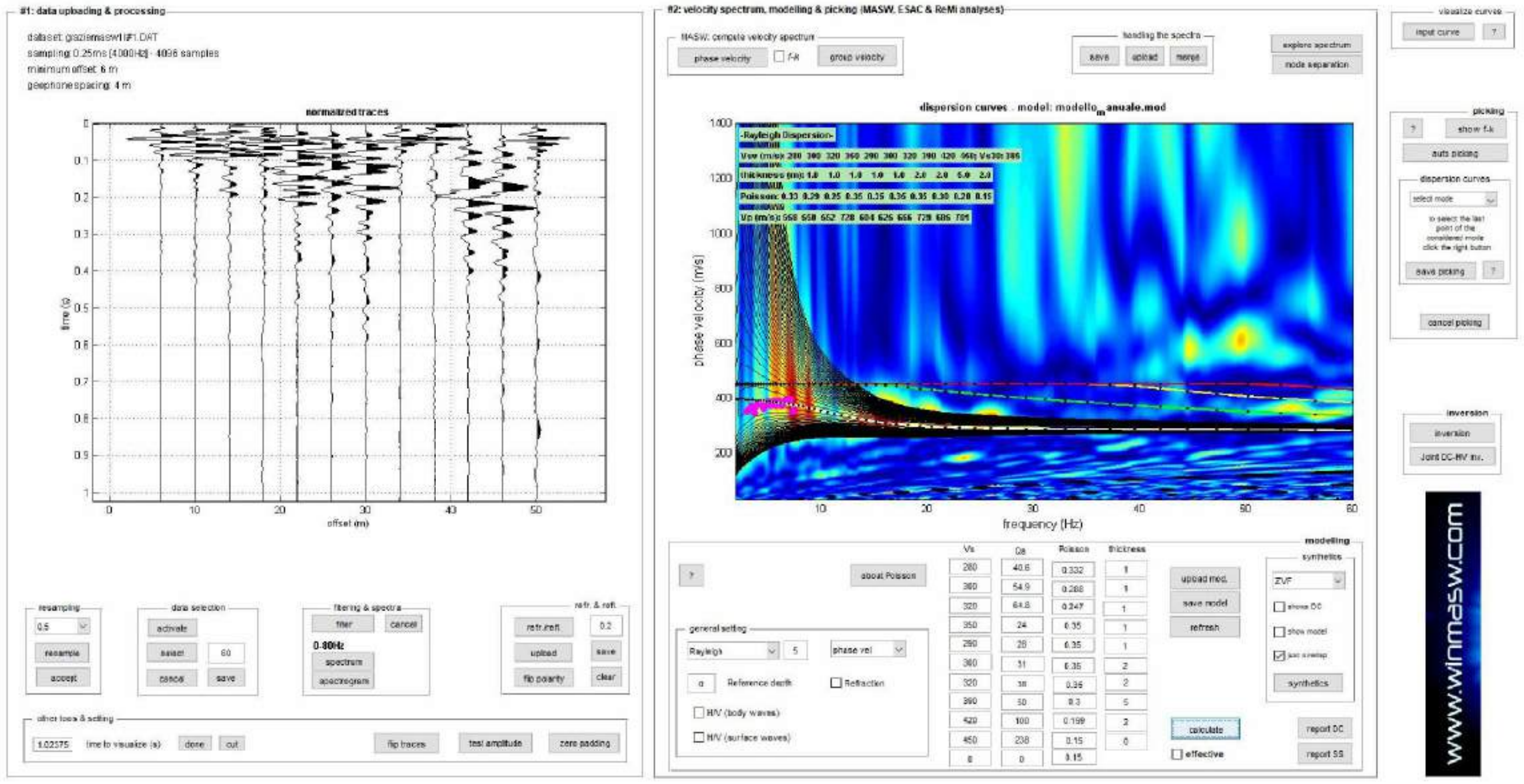
RISULTANZE DELL'ANALISI SISMICA CONGIUNTA MASW 2 - ESAC 2

LE GRAZIE



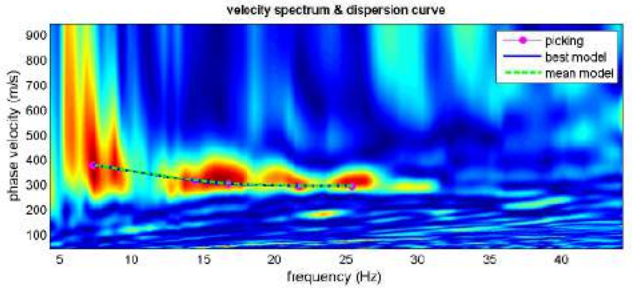
1 MASW 24 Stendimento di sismica attiva MASW

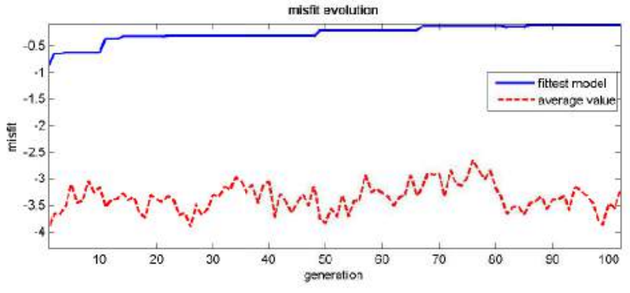
SPETTRO DI VELOCITA' MASW + CURVA DI DISPERSIONE EFFETTIVA ESAC

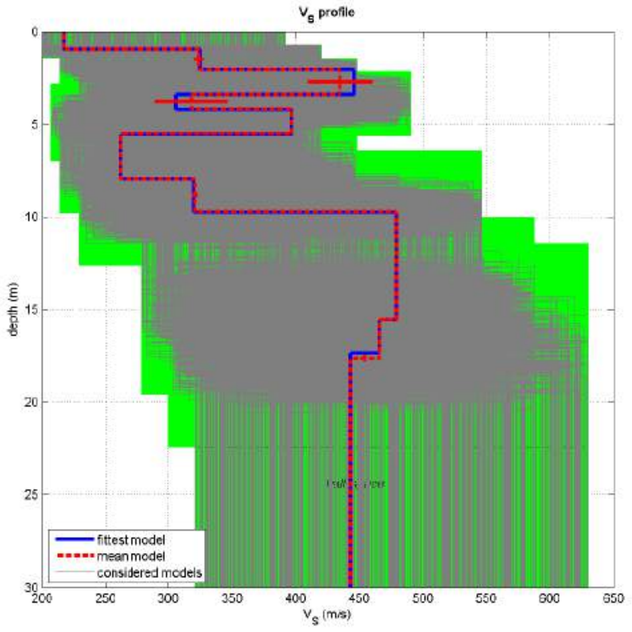


Stendimento MASW

INVERSIONE CONGIUNTA MASW – ESAC E PROFILO DI VELOCITA'







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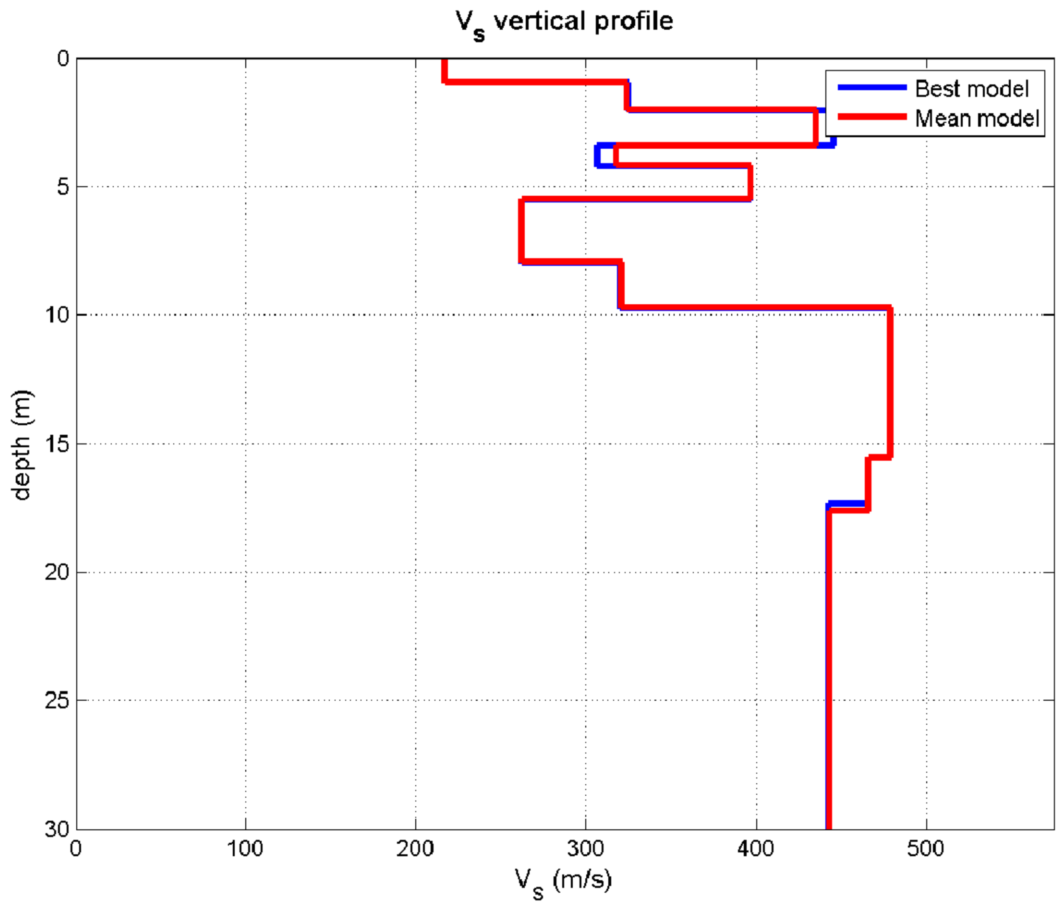
dataset: grazlemasw1#1.DAT
dispersion curve: picking.cdp
Vs30 (best model): 394 m/s
Vs30 (mean model): 394 m/s

GEOLOGICA TOSCANA s.n.c.

RISULTANZE DELL'ANALISI SISMICA CONGIUNTA MASW 2 - ESAC 2

PROFILO DI VELOCITA' MASW 2 – ESAC 2



Vs (m/s):217, 324, 435, 318, 397, 262, 321, 479, 466, 443
Thickness (m):1.0, 1.1, 1.4, 0.8, 1.3, 2.4, 1.8, 5.8, 2.1

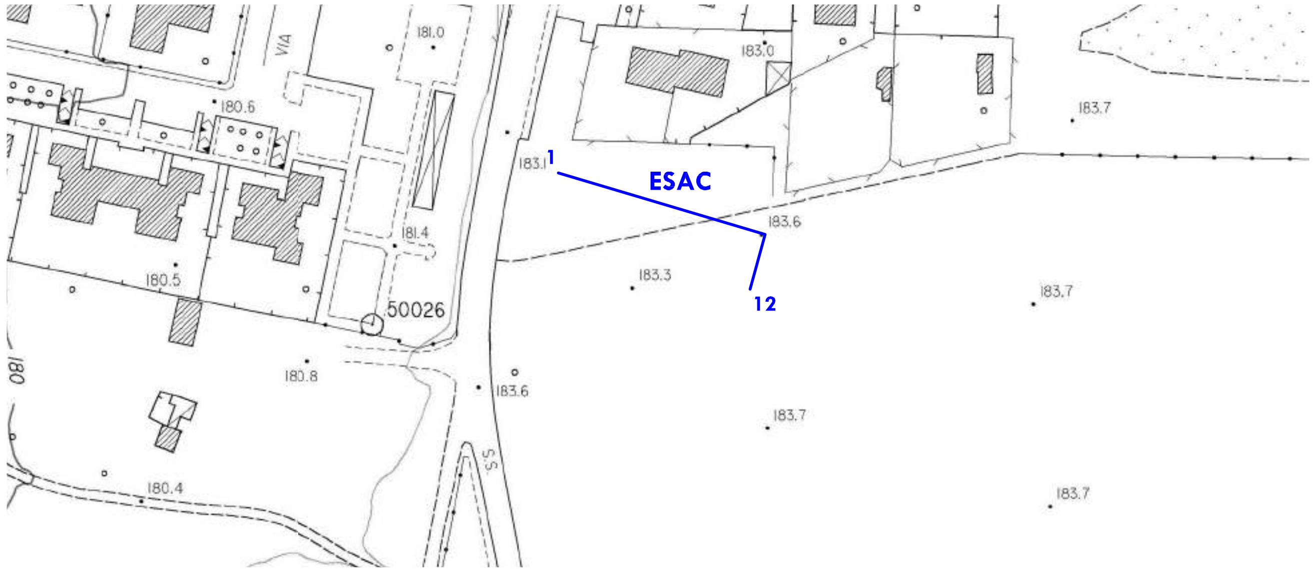
Density (gr/cm3) (approximate values):1.851.902.001.951.971.881.962.031.981.96
Seismic/Dynamic Shear modulus (MPa) (approximate values):87200378197310129202465430385

Approximate values for Vp and Poisson
Vp (m/s):428535785653702488669894743685
Poisson:0.330.210.280.340.260.300.350.300.180.14

Vs30 (m/s): 394

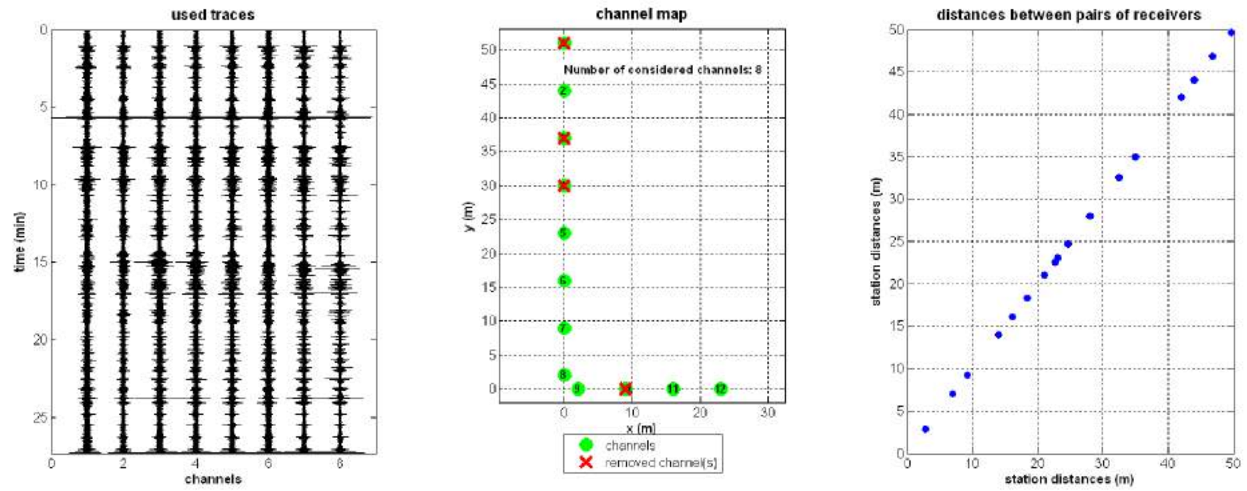
GEOLOGICA TOSCANA s.n.c.

GRACCIANO



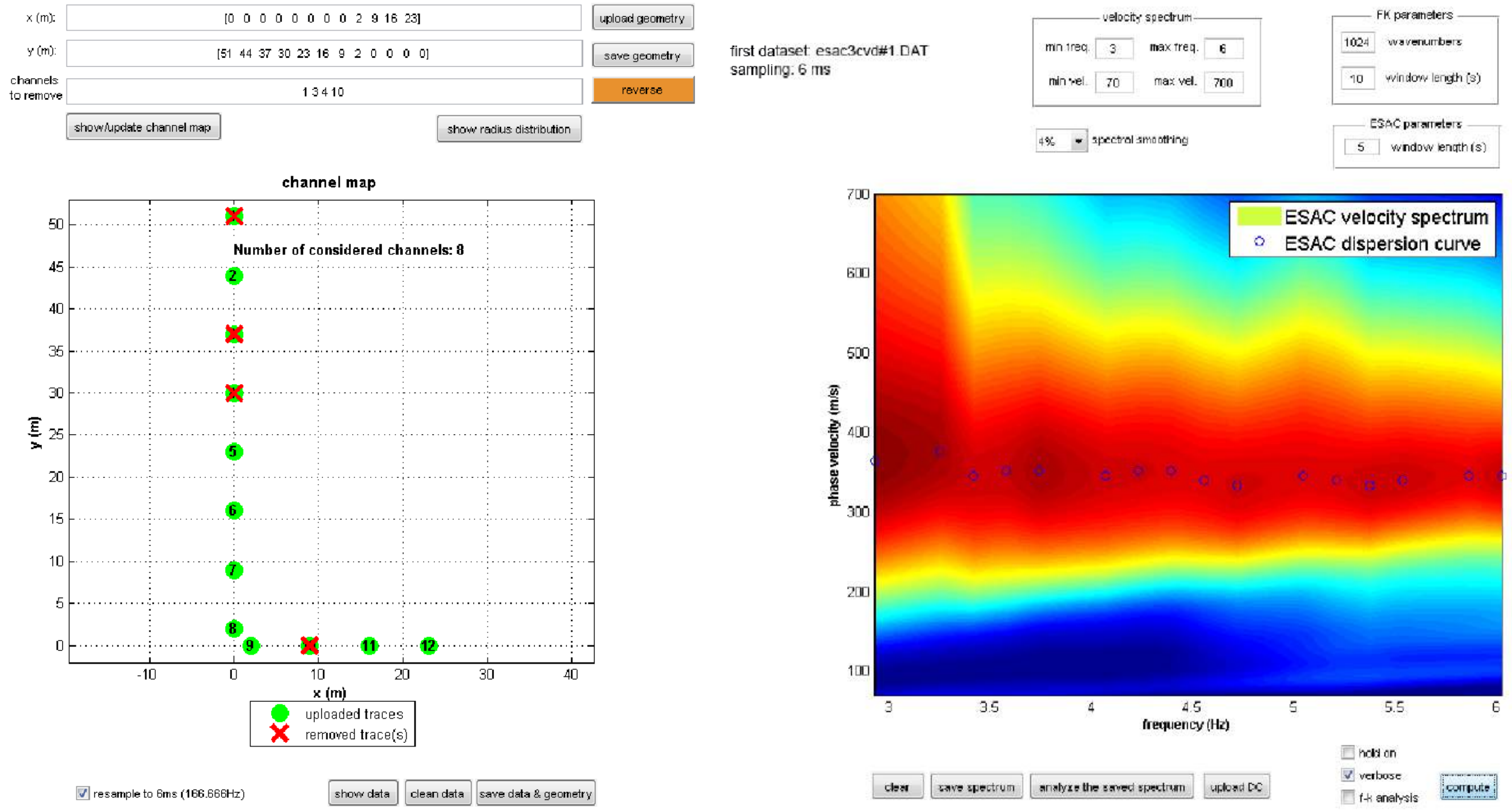
1 ESAC 12 Stendimento di sismica passiva ESAC

ACQUISIZIONE ESAC



Stendimento ESAC

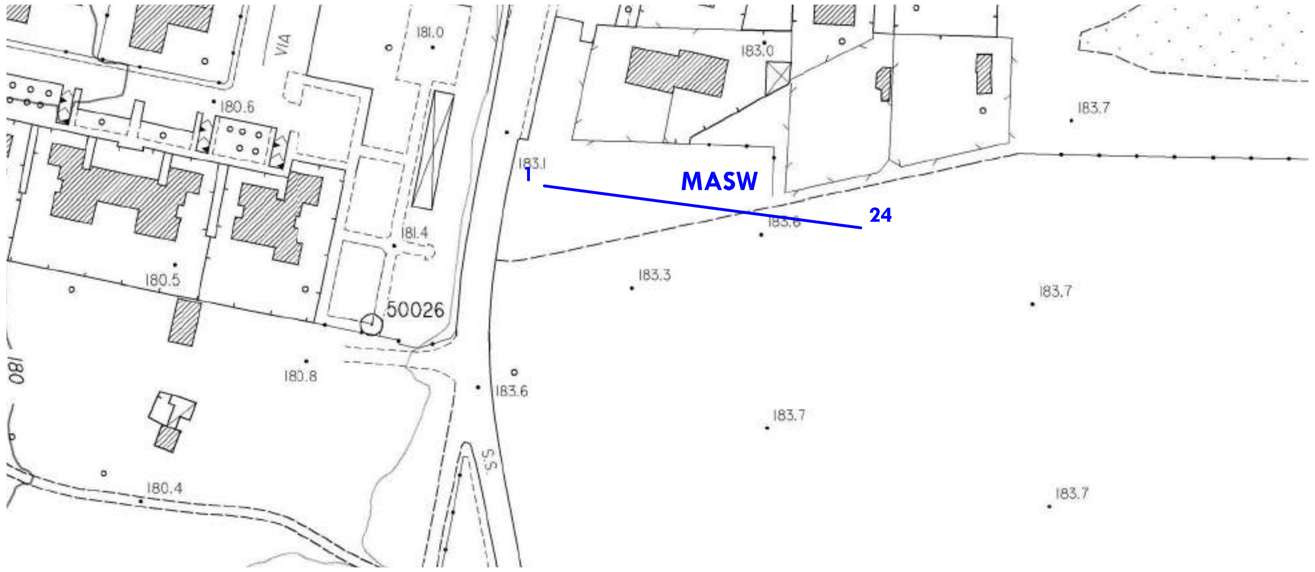
SPETTRO DI VELOCITA' ESAC E CURVA DI DISPERSIONE EFFETTIVA



GEOLOGICA TOSCANA s.n.c.

RISULTANZE DELL'ANALISI SISMICA CONGIUNTA MASW 3 - ESAC 3

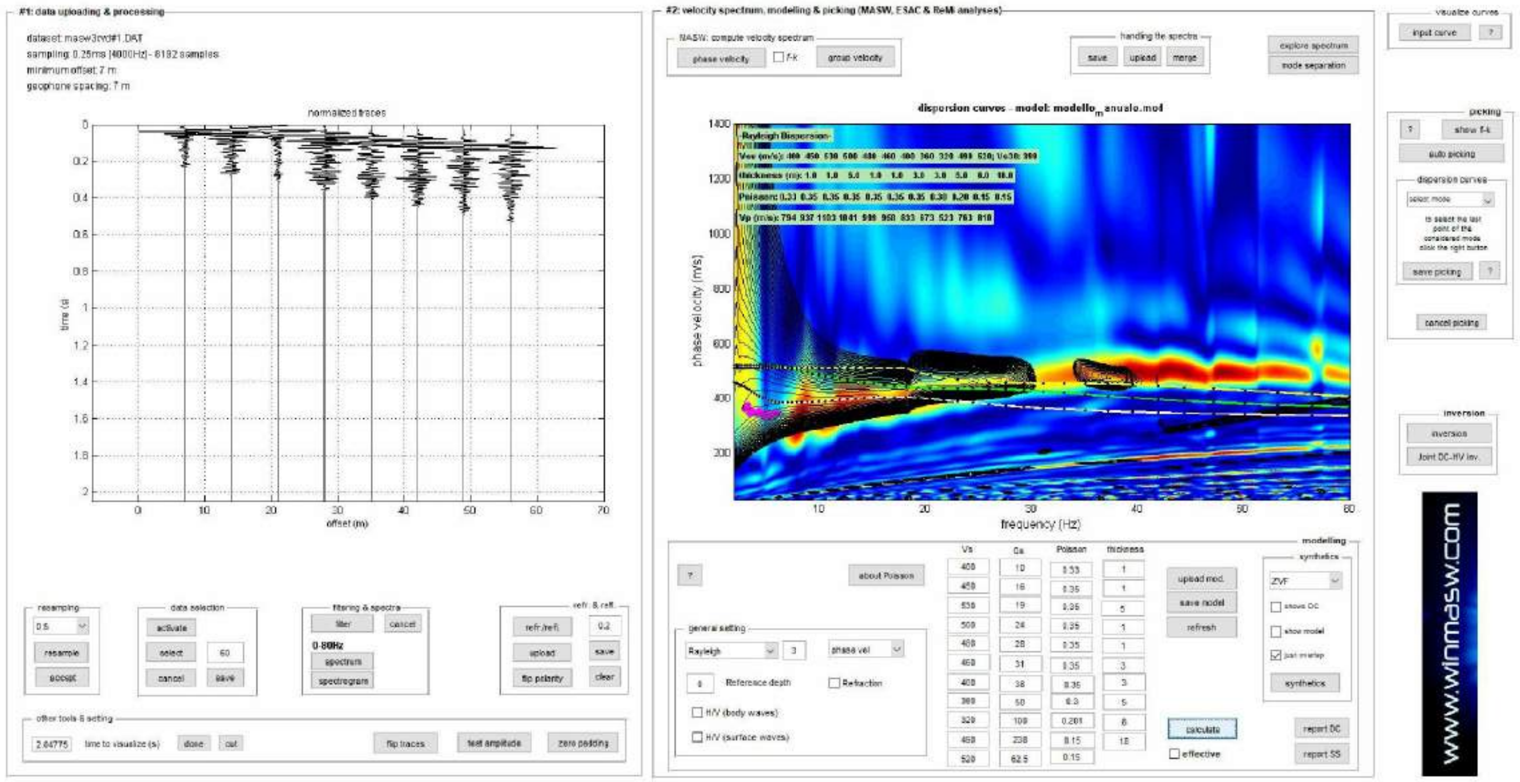
GRACCIANO



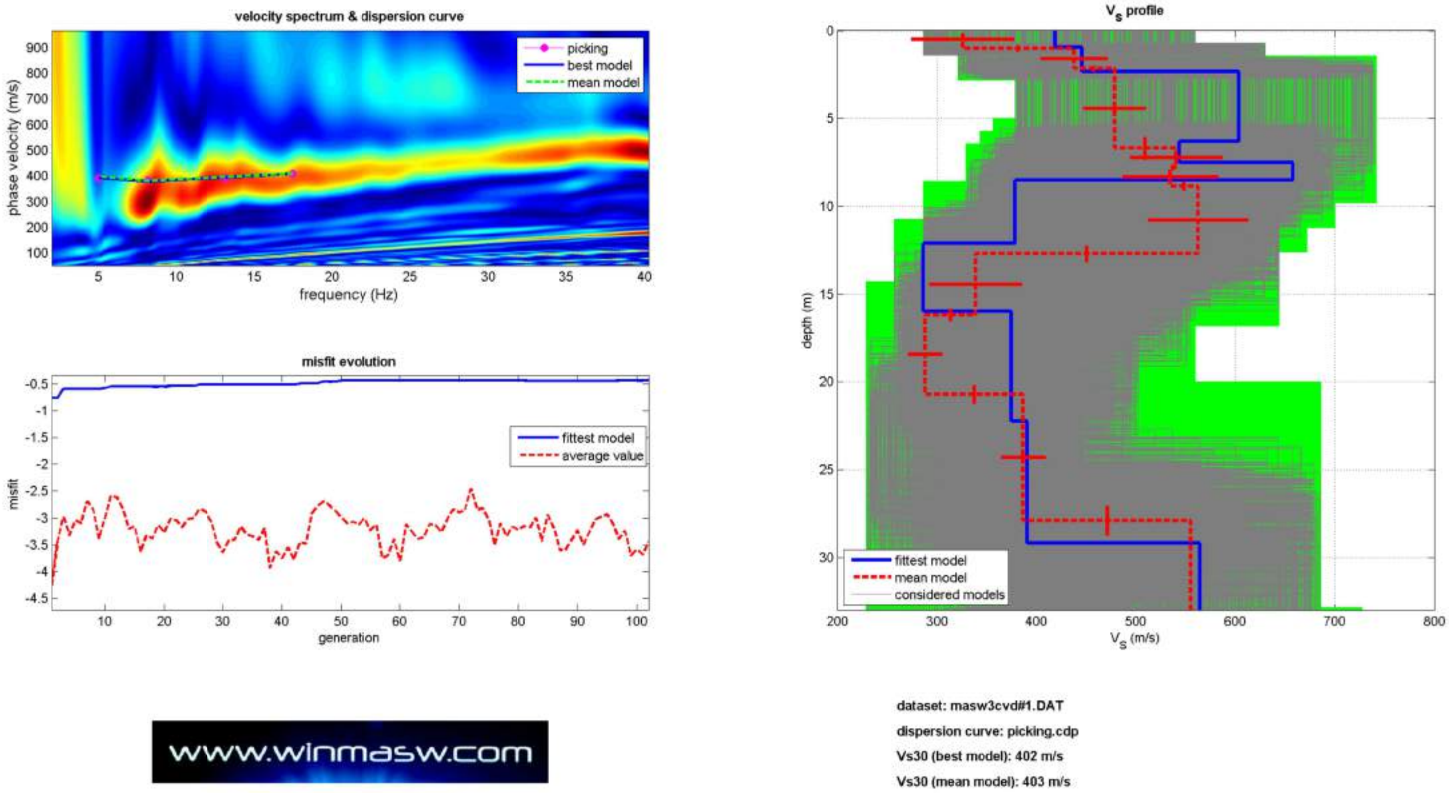
1 MASW 24 Stendimento di sismica attiva MASW

Stendimento MASW

SPETTRO DI VELOCITA' MASW + CURVA DI DISPERSIONE EFFETTIVA ESAC



INVERSIONE CONGIUNTA MASW – ESAC E PROFILO DI VELOCITA'

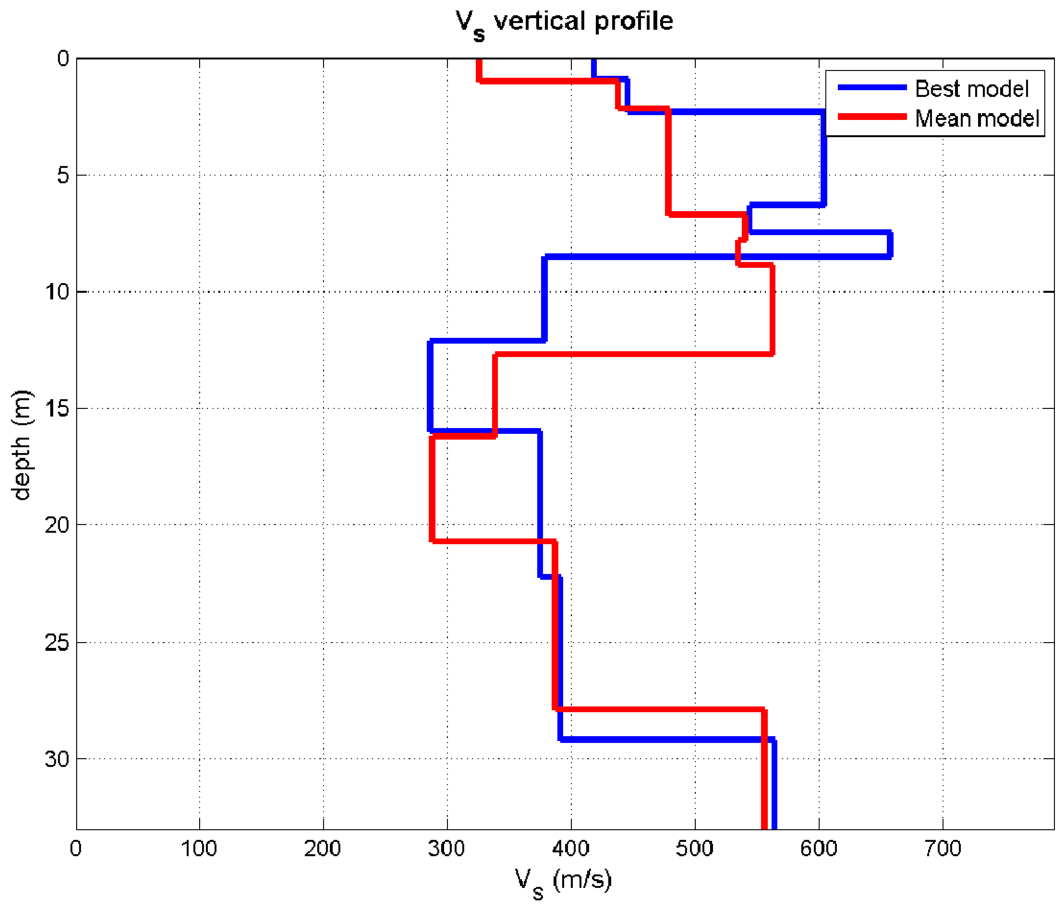


dataset: masw3cvd#1.DAT
dispersion curve: picking.cdp
Vs30 (best model): 402 m/s
Vs30 (mean model): 403 m/s

GEOLOGICA TOSCANA s.n.c.

RISULTANZE DELL'ANALISI SISMICA CONGIUNTA MASW 3 - ESAC 3

PROFILO DI VELOCITA' MASW 3 – ESAC 3



Vs (m/s):326, 438, 479, 541, 535, 563, 339, 288, 387, 556, 451
Thickness (m):1.0, 1.2, 4.5, 1.1, 1.1, 3.8, 3.5, 4.5, 7.2, 16.7

Density (gr/cm3) (approximate values):1.942.022.022.062.082.121.971.921.952.021.97
Seismic/Dynamic Shear modulus (MPa) (approximate values):2063874656045956732271592926244401

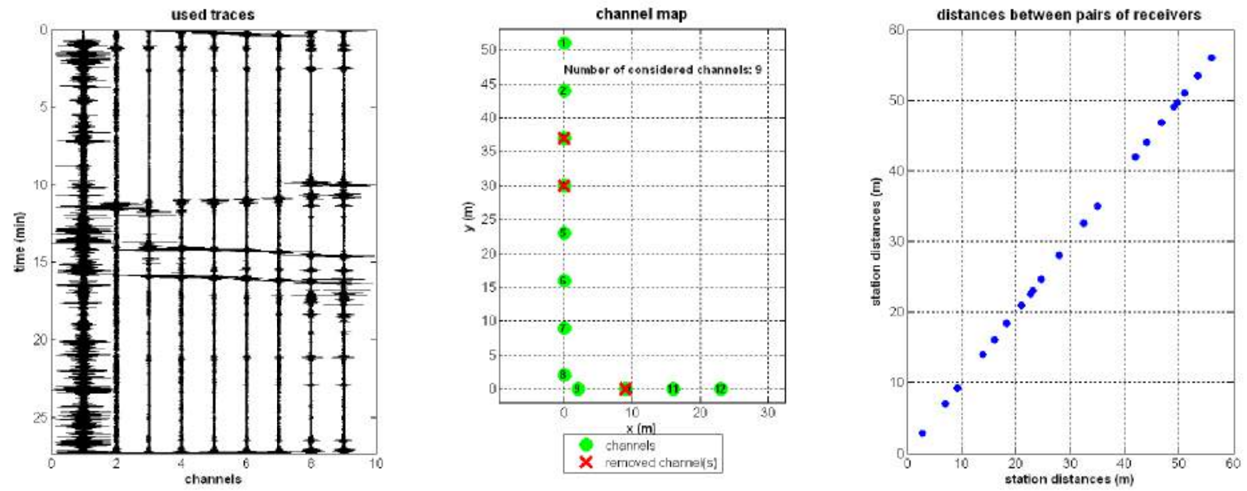
Approximate values for Vp and Poisson
Vp (m/s):626855887104511031331717574649864705
Poisson:0.310.320.290.320.350.390.360.330.220.150.15

Vs30 (m/s): 403

LA BADIA

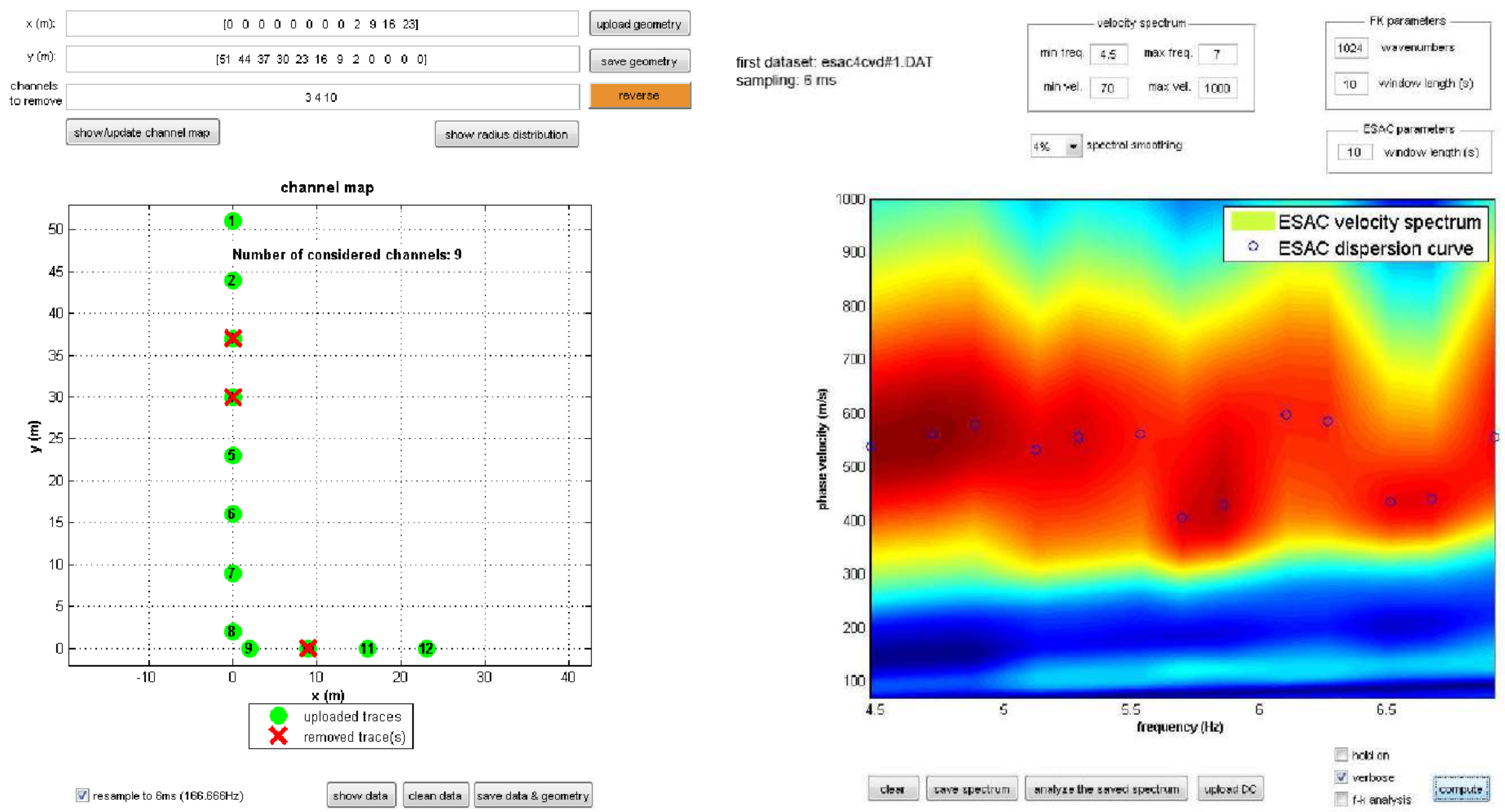
1 ESAC 12 Stendimento di sismica passiva ESAC

ACQUISIZIONE ESAC



Stendimento ESAC

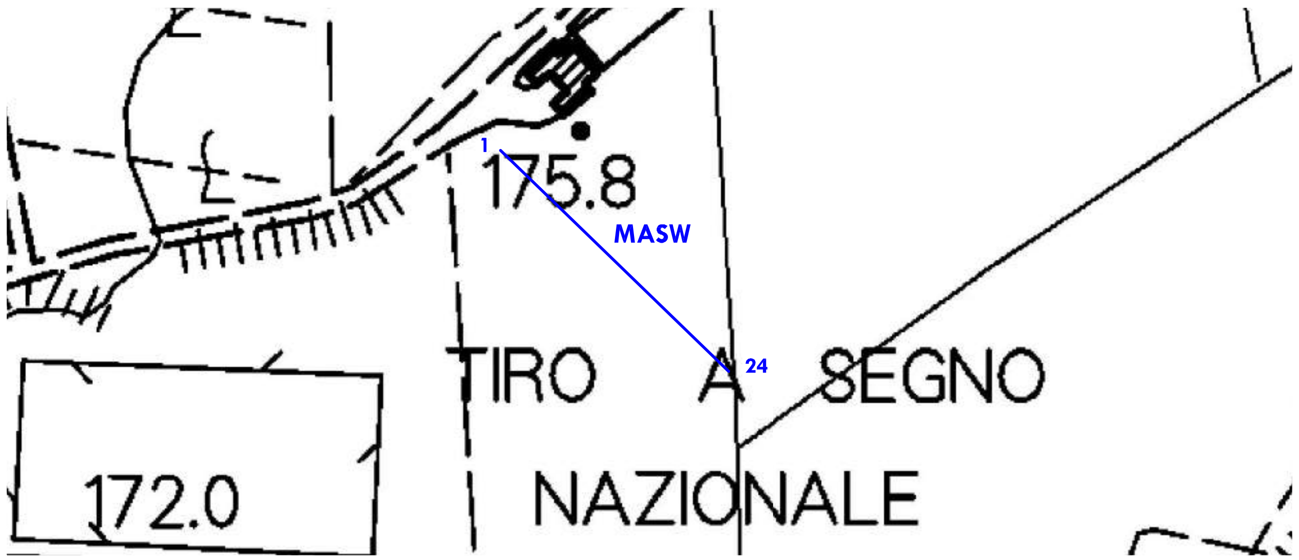
SPETTRO DI VELOCITA' ESAC E CURVA DI DISPERSIONE EFFETTIVA



GEOLOGICA TOSCANA s.n.c.

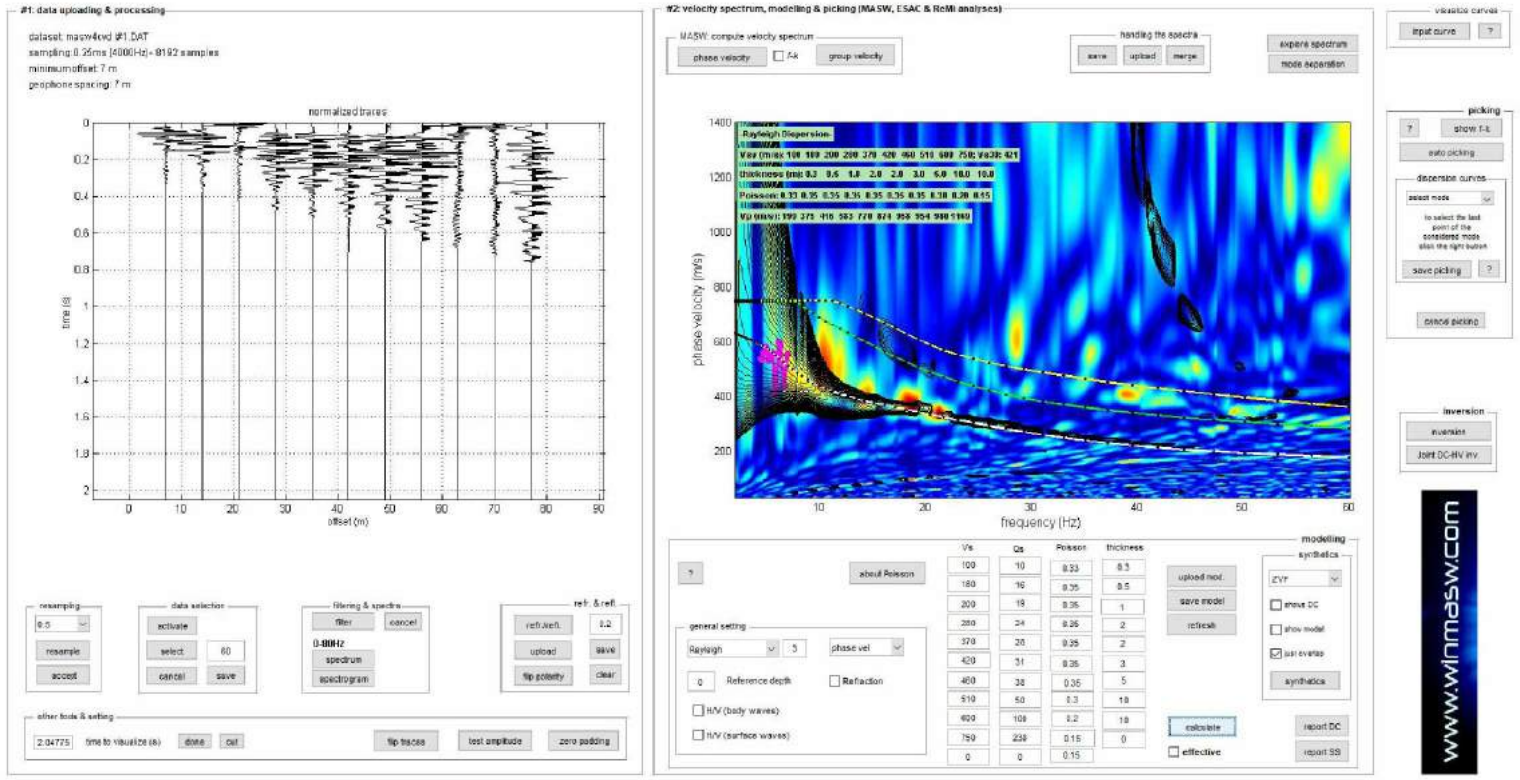
RISULTANZE DELL'ANALISI SISMICA CONGIUNTA MASW 4 - ESAC 4

LA BADIA



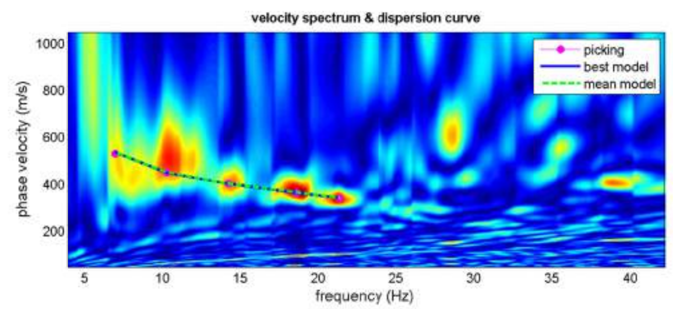
1 MASW 24 Stendimento di sismica attiva MASW

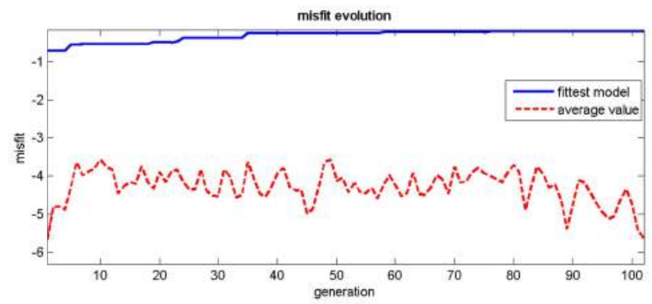
SPETTRO DI VELOCITA' MASW + CURVA DI DISPERSIONE EFFETTIVA ESAC

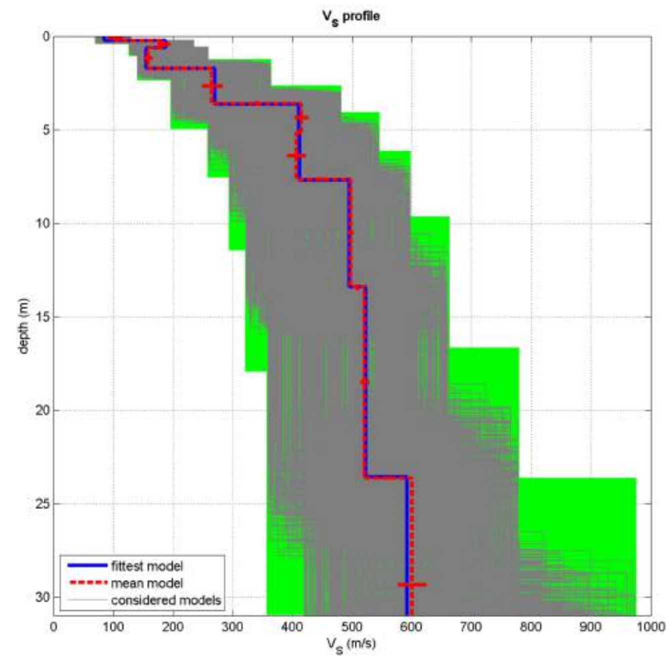


Stendimento MASW

INVERSIONE CONGIUNTA MASW – ESAC E PROFILO DI VELOCITA'







dataset: masw4cvd I#1.DAT
dispersion curve: picking.cdp
Vs30 (best model): 424 m/s
Vs30 (mean model): 428 m/s

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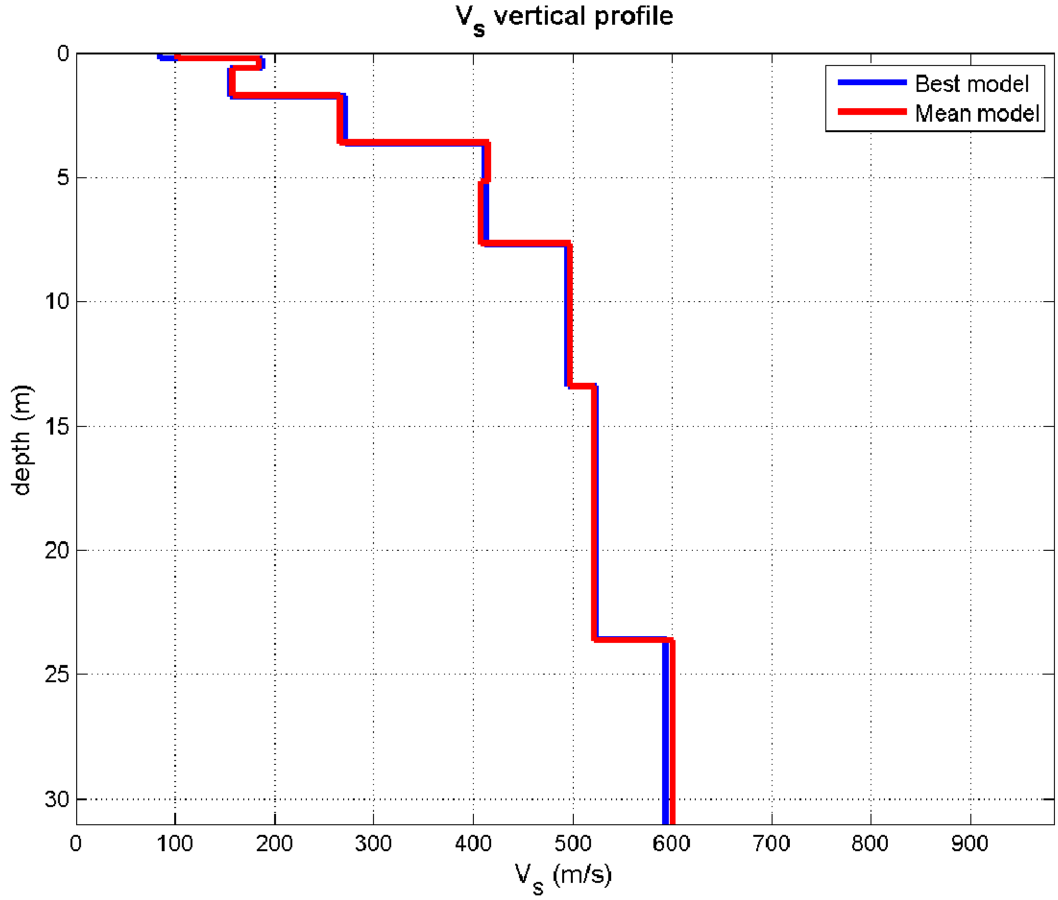
GEOLOGICA TOSCANA s.n.c.

RISULTANZE DELL'ANALISI SISMICA CONGIUNTA MASW 4 - ESAC 4

PROFILO DI VELOCITA' MASW 4 – ESAC 4



Vs (m/s):103, 184, 158, 266, 415, 407, 497, 522, 601, 808
Thickness (m):0.2, 0.4, 1.1, 1.9, 1.5, 2.5, 5.8, 10.2, 11.5

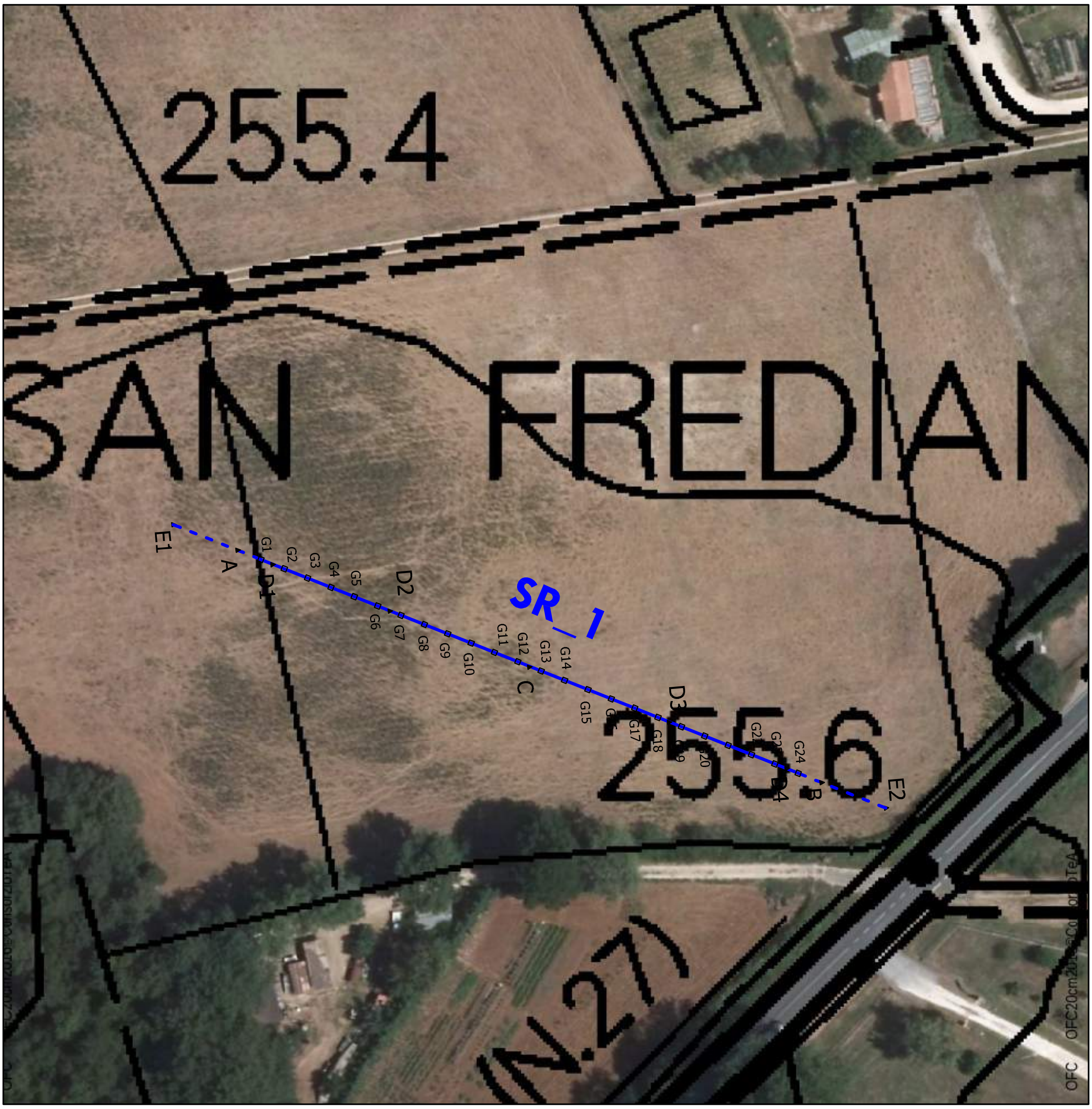
Density (gr/cm3) (approximate values):1.641.871.781.931.971.992.112.052.052.12
Seismic/Dynamic Shear modulus (MPa) (approximate values):17634413734033052255874O1382

Approximate values for Vp and Poisson
Vp (m/s):18146432260972178312839739751295
Poisson:0.260.410.340.380.250.310.410.300.190.18

Vs30 (m/s): 428

ALLEGATO 3

REPORT DEGLI STENDIMENTI DI SISMICA A RIFRAZIONE

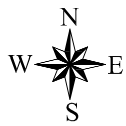


PROSPEZIONE SISMICA A RIFRAZIONE (SR_1) CON ONDE P E SH

Scala 1:1.000

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



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)	15	19	23	27	31	35	39	43	47	51	55	59	63	67	71	75	79	83	87	91	95	99	103	107
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)	255.4	255.35	255.3	255.25	255.2	255.15	255.1	255.05	255	255.05	254.95	255	254.95	254.9	254.8	254.7	254.8	254.9	255	255.1	255.2	255.3	255.4	255.5

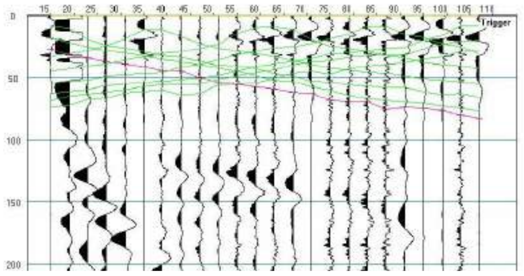
	Linea sismica SR_1	
	Coordinate Gauss Boaga	
	Geofono N.1 (G1)	Geofono N.24 (G24)
X (m)	1668774	1668859
Y (m)	4805733	4805696

Punti di energizzazione linea sismica SR_1

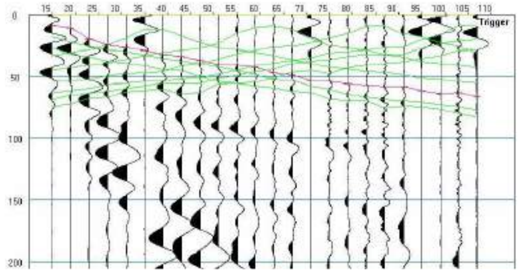
	E1 Esterno Sx	A Estremo Sx	D1 Intermedio Sx	D2 Intermedio Sx	C Centrale	D3 Intermedio Dx	D4 Intermedio Dx	B Estremo Dx	E2 Esterno Dx
Onde P	quar p1	quar p2	quar p3	quar p4	quar p5	quar p6	quar p7	quar p8	quar p9
Onde SH	s1	s2	s3	s4	s5	s6	s7	s8	s9
Posiz. dal geof. N.1 (m)	0	11	17	37	61	85	105	111	122
Quota (m slm)	255.5	255.4	255.37	255.12	254.97	254.95	255.45	255.55	255.75

LINEA SISMICA SR_1
REGISTRAZIONI DI CAMPAGNA DELLE ONDE P

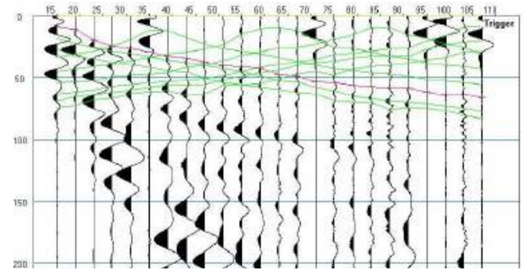
TIRO ESTERNO SINISTRO E1



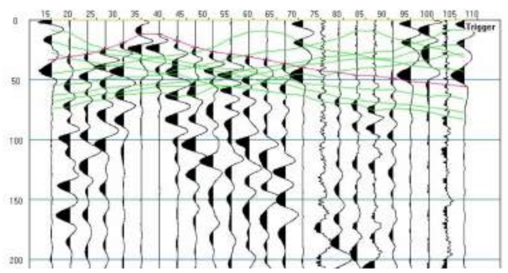
TIRO ESTREMO SINISTRO A



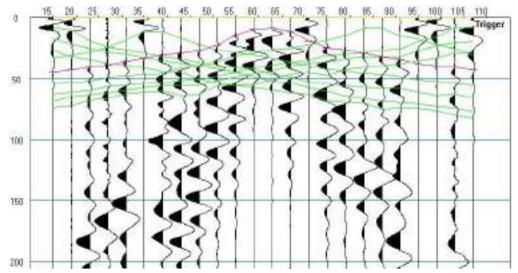
TIRO INTERMEDIO D1



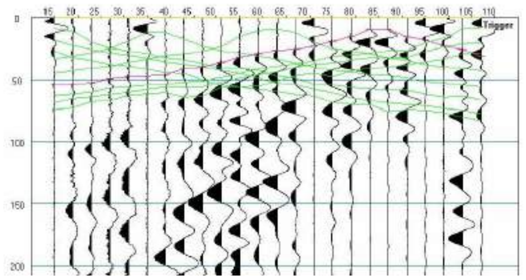
TIRO INTERMEDIO D2



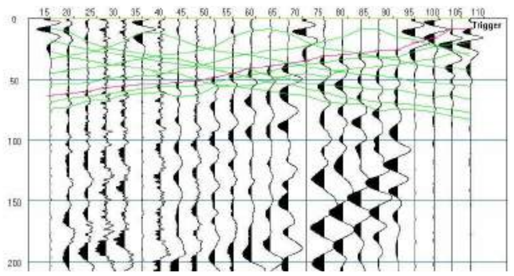
TIRO CENTRALE C



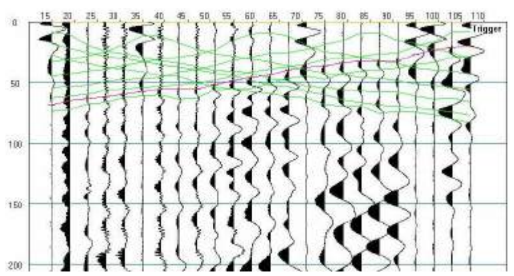
TIRO INTERMEDIO D3



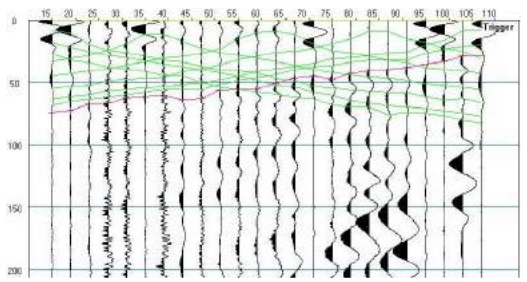
TIRO INTERMEDIO D4



TIRO ESTREMO DESTRO B

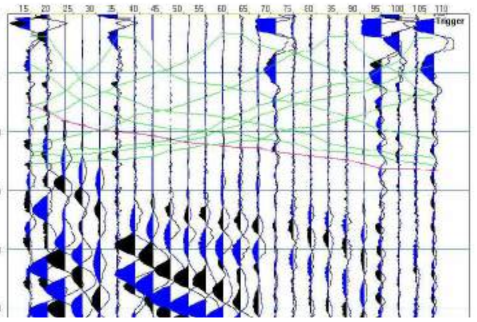


TIRO ESTERNO DESTRO E2

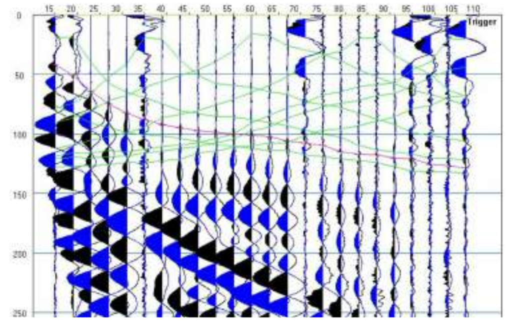


LINEA SISMICA SR_1
REGISTRAZIONI DI CAMPAGNA DELLE ONDE SH

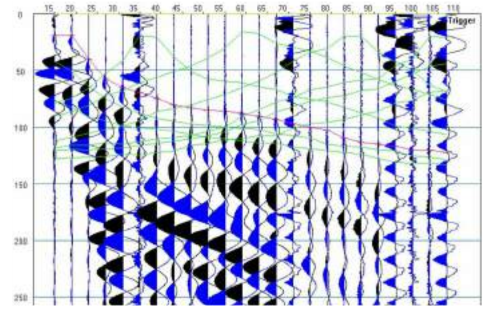
TIRO ESTERNO SINISTRO E1



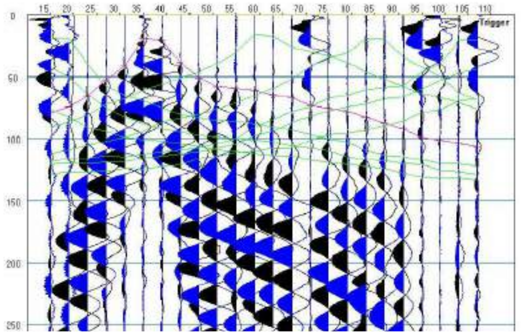
TIRO ESTREMO SINISTRO A



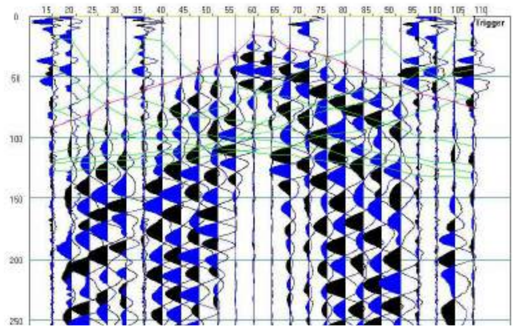
TIRO INTERMEDIO D1



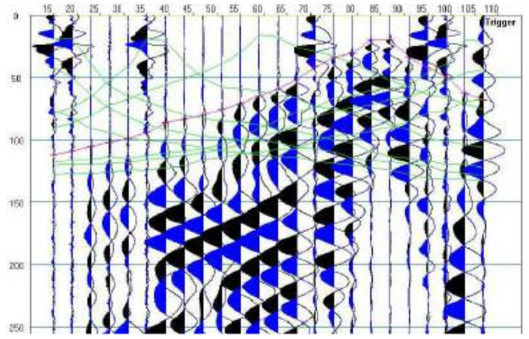
TIRO INTERMEDIO D2



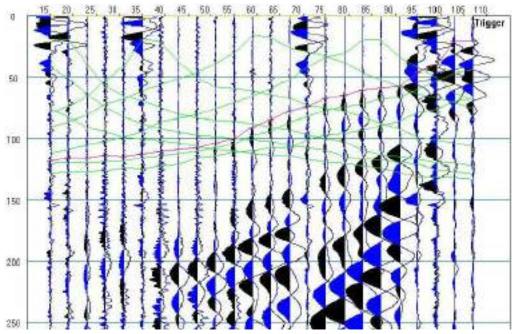
TIRO CENTRALE C



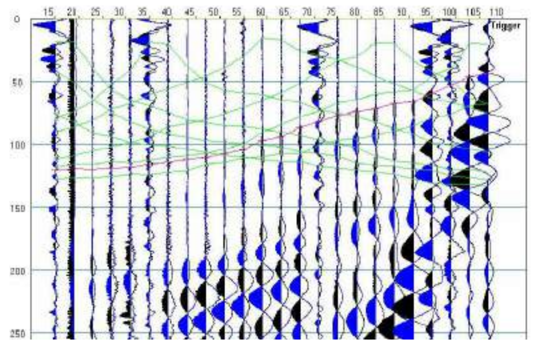
TIRO INTERMEDIO D3



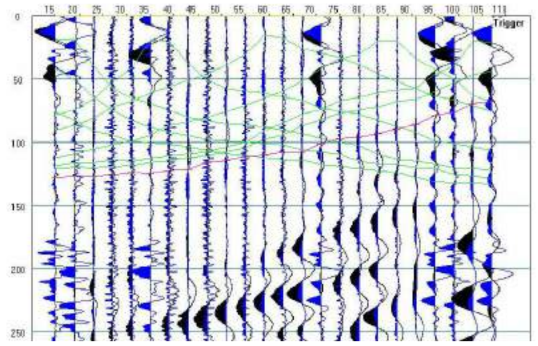
TIRO INTERMEDIO D4



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	11.00	0.00	0.00	
3	255.38		17.00	0.00	0.00
4	255.13		37.00	0.00	0.00
5	254.97		61.00	0.00	0.00
6	254.95		85.00	0.00	0.00
7	255.45		105.000.00		0.00
8	0.00	111.000.00		0.00	
9	0.00	122.000.00		0.00	

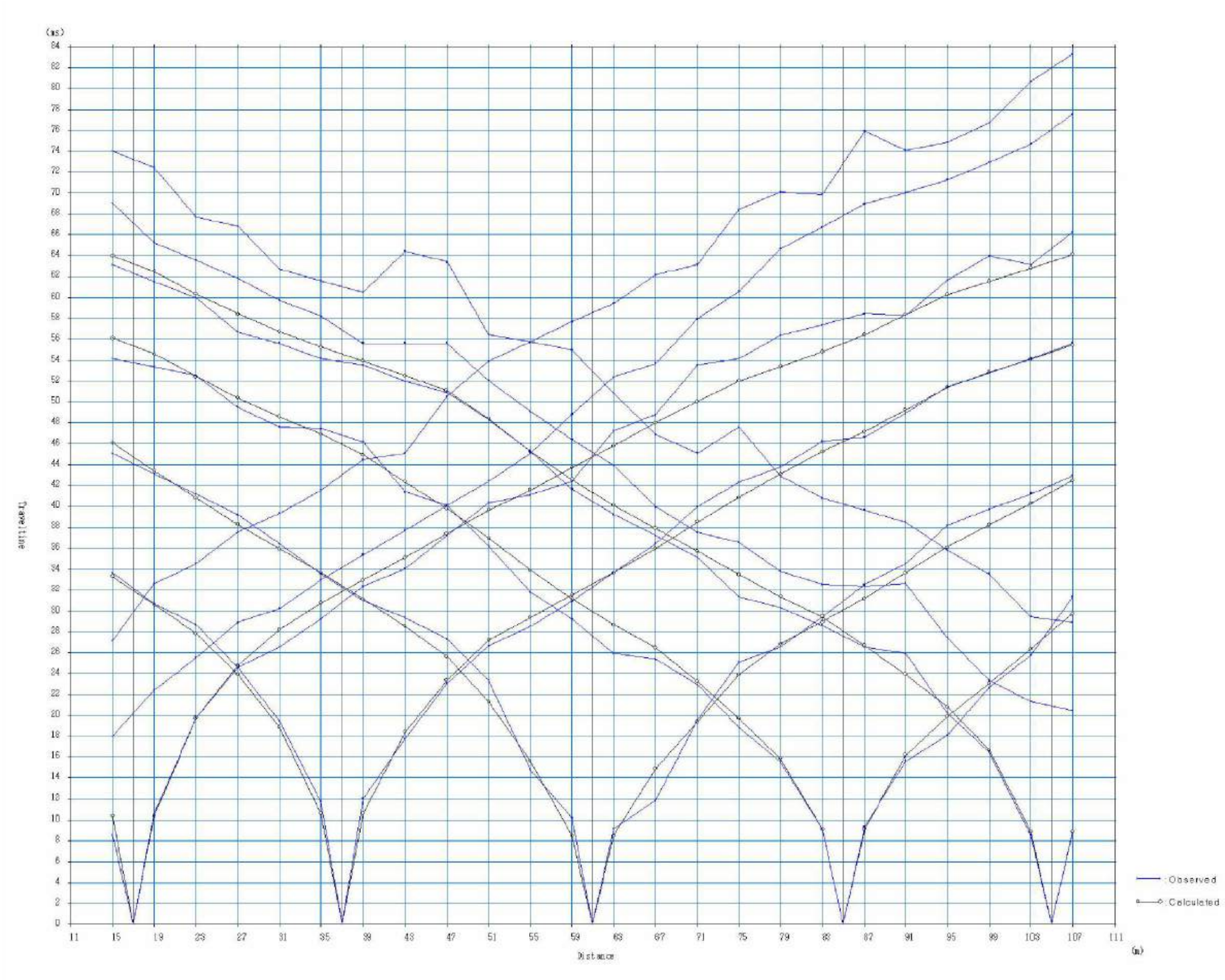
Geo	Elev	X-loc	Y-Loc	SP 1	SP 2	SP 3	SP 4	SP 5	SP 6	SP 7	SP 8	SP 9						
1	255.40		15.00	0.00	0.00 1	0.00 1	10.33 1		33.31 1		46.10 1		56.15 1		63.99 1		0.00 1	0.00 1
2	255.35		19.00	0.00	0.00 1	0.00 1	10.33 1		30.61 1		43.40 1		54.61 1		62.49 1		0.00 1	0.00 1
3	255.30		23.00	0.00	0.00 1	0.00 1	19.77 1		27.86 1		40.83 1		52.44 1		60.39 1		0.00 1	0.00 1
4	255.25		27.00	0.00	0.00 1	0.00 1	24.75 1		23.95 1		38.31 1		50.39 1		58.43 1		0.00 1	0.00 1
5	255.20		31.00	0.00	0.00 1	0.00 1	28.22 1		18.86 1		35.94 1		48.57 1		56.75 1		0.00 1	0.00 1
6	255.15		35.00	0.00	0.00 1	0.00 1	30.77 1		10.57 1		33.64 1		46.95 1		55.30 1		0.00 1	0.00 1
7	255.10		39.00	0.00	0.00 1	0.00 1	32.96 1		10.57 1		31.17 1		44.92 1		53.91 1		0.00 1	0.00 1
8	255.05		43.00	0.00	0.00 1	0.00 1	35.11 1		18.45 1		28.55 1		42.38 1		52.50 1		0.00 1	0.00 1
9	255.00		47.00	0.00	0.00 1	0.00 1	37.43 1		23.41 1		25.66 1		39.81 1		51.13 1		0.00 1	0.00 1
10	255.05		51.00	0.00	0.00 1	0.00 1	39.69 1		27.25 1		21.32 1		36.99 1		48.42 1		0.00 1	0.00 1
11	254.95		55.00	0.00	0.00 1	0.00 1	41.59 1		29.38 1		15.66 1		33.87 1		45.30 1		0.00 1	0.00 1
12	255.00		59.00	0.00	0.00 1	0.00 1	43.73 1		31.52 1		8.48 1		31.18 1		42.60 1		0.00 1	0.00 1
13	254.95		63.00	0.00	0.00 1	0.00 1	45.79 1		33.63 1		8.48 1		28.70 1		40.13 1		0.00 1	0.00 1
14	254.90		67.00	0.00	0.00 1	0.00 1	48.00 1		36.00 1		14.93 1		26.49 1		37.91 1		0.00 1	0.00 1
15	254.80		71.00	0.00	0.00 1	0.00 1	50.06 1		38.53 1		19.38 1		23.27 1		35.74 1		0.00 1	0.00 1
16	254.70		75.00	0.00	0.00 1	0.00 1	52.04 1		40.89 1		23.95 1		19.74 1		33.48 1		0.00 1	0.00 1
17	254.80		79.00	0.00	0.00 1	0.00 1	53.43 1		43.12 1		26.87 1		15.90 1		31.41 1		0.00 1	0.00 1
18	254.90		83.00	0.00	0.00 1	0.00 1	54.82 1		45.25 1		28.99 1		9.15 1		29.48 1		0.00 1	0.00 1
19	255.00		87.00	0.00	0.00 1	0.00 1	56.44 1		47.18 1		31.21 1		9.15 1		26.73 1		0.00 1	0.00 1
20	255.10		91.00	0.00	0.00 1	0.00 1	58.37 1		49.26 1		33.65 1		16.22 1		23.96 1		0.00 1	0.00 1
21	255.20		95.00	0.00	0.00 1	0.00 1	60.30 1		51.42 1		36.09 1		19.91 1		20.83 1		0.00 1	0.00 1
22	255.30		99.00	0.00	0.00 1	0.00 1	61.56 1		52.86 1		38.26 1		23.08 1		16.73 1		0.00 1	0.00 1
23	255.40		103.000.00		0.00 1	0.00 1	62.80 1		54.10 1		40.30 1		26.38 1		8.93 1		0.00 1	0.00 1
24	255.50		107.000.00		0.00 1	0.00 1	64.14 1		55.44 1		42.52 1		29.75 1		8.93 1		0.00 1	0.00 1

LINEA SISMICA SR_1
TEMPI DI PROPAGAZIONE DELLE ONDE SH

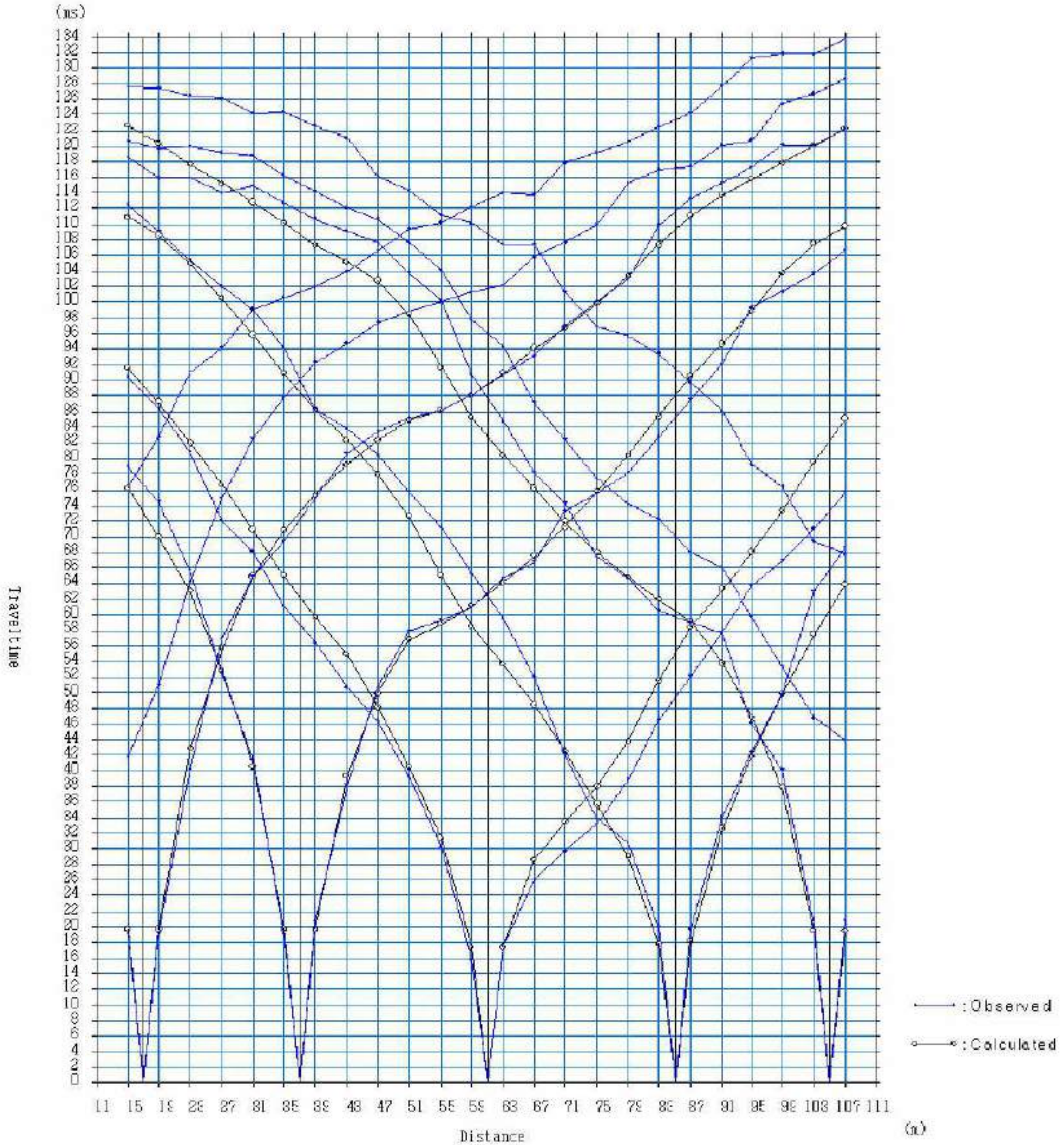
SP	Elev	X-loc	Y-Loc	Depth	
1	0.00	0.00	0.00	0.00	
2	0.00	11.00	0.00	0.00	
3	255.38		17.00	0.00	0.00
4	255.13		37.00	0.00	0.00
5	254.97		61.00	0.00	0.00
6	254.95		85.00	0.00	0.00
7	255.45		105.000.00		0.00
8	0.00	111.000.00		0.00	
9	0.00	122.000.00		0.00	

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	255.40		15.00	0.00	0.00 1	0.00 1	19.73	176.30	191.57	1111.04	1122.70	10.00 1	0.00 1
2	255.35		19.00	0.00	0.00 1	0.00 1	19.73	169.96	187.28	1108.65	1120.31	10.00 1	0.00 1
3	255.30		23.00	0.00	0.00 1	0.00 1	42.81	163.07	182.08	1104.99	1117.78	10.00 1	0.00 1
4	255.25		27.00	0.00	0.00 1	0.00 1	55.74	152.78	176.69	1100.52	1115.23	10.00 1	0.00 1
5	255.20		31.00	0.00	0.00 1	0.00 1	64.97	140.57	170.86	195.89	1112.88	10.00 1	0.00 1
6	255.15		35.00	0.00	0.00 1	0.00 1	70.85	119.77	165.04	190.94	1110.15	10.00 1	0.00 1
7	255.10		39.00	0.00	0.00 1	0.00 1	75.32	119.77	159.73	186.31	1107.35	10.00 1	0.00 1
8	255.05		43.00	0.00	0.00 1	0.00 1	79.33	139.38	154.99	182.39	1105.16	10.00 1	0.00 1
9	255.00		47.00	0.00	0.00 1	0.00 1	82.38	149.93	148.20	178.07	1102.85	10.00 1	0.00 1
10	255.05		51.00	0.00	0.00 1	0.00 1	84.90	156.91	140.47	172.55	198.54	10.00 1	0.00 1
11	254.95		55.00	0.00	0.00 1	0.00 1	86.24	158.80	131.36	165.09	191.78	10.00 1	0.00 1
12	255.00		59.00	0.00	0.00 1	0.00 1	88.14	161.12	117.48	158.63	185.31	10.00 1	0.00 1
13	254.95		63.00	0.00	0.00 1	0.00 1	90.96	164.13	117.48	153.73	180.48	10.00 1	0.00 1
14	254.90		67.00	0.00	0.00 1	0.00 1	94.20	167.53	128.63	148.53	176.25	10.00 1	0.00 1
15	254.80		71.00	0.00	0.00 1	0.00 1	96.83	171.25	133.47	142.55	171.91	10.00 1	0.00 1
16	254.70		75.00	0.00	0.00 1	0.00 1	99.89	175.79	138.06	135.77	168.04	10.00 1	0.00 1
17	254.80		79.00	0.00	0.00 1	0.00 1	103.45	180.48	143.86	129.10	164.82	10.00 1	0.00 1
18	254.90		83.00	0.00	0.00 1	0.00 1	107.43	185.43	151.61	117.87	162.03	10.00 1	0.00 1
19	255.00		87.00	0.00	0.00 1	0.00 1	111.15	190.62	158.44	118.12	159.19	10.00 1	0.00 1
20	255.10		91.00	0.00	0.00 1	0.00 1	113.82	194.74	163.34	132.60	153.88	10.00 1	0.00 1
21	255.20		95.00	0.00	0.00 1	0.00 1	115.90	198.88	168.07	141.89	146.93	10.00 1	0.00 1
22	255.30		99.00	0.00	0.00 1	0.00 1	117.86	1103.78	173.39	149.87	137.92 1	0.00 1	0.00 1
23	255.40		103.000.00		0.00 1	0.00 1	120.05	1107.60	179.67	157.46	119.47 1	0.00 1	0.00 1
24	255.50		107.000.00		0.00 1	0.00 1	122.27	1109.82	185.15	163.85	119.47 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

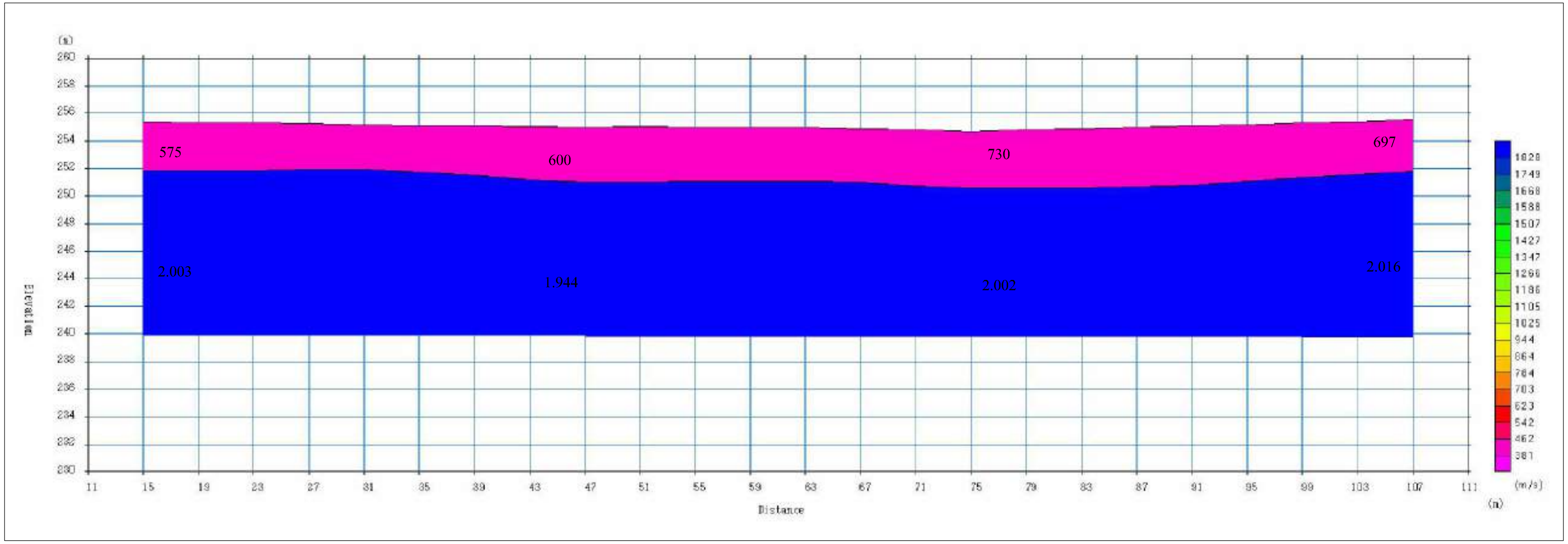
Onde P

		Strato 1	Strato 2
Geofono	x (m)	Vs (m/sec)	Vs (m/sec)
1	15	572.28	2002.36
2	19	578.07	2003.65
3	23	587.20	2004.01
4	27	598.04	2006.01
5	31	603.46	2008.64
6	35	605.57	2007.61
7	39	609.03	1999.12
8	43	603.24	1977.38
9	47	597.53	1951.35
10	51	615.79	1936.35
11	55	649.30	1932.45
12	59	679.98	1933.53
13	63	693.25	1938.63
14	67	684.31	1950.82
15	71	689.12	1972.81
16	75	717.42	1995.21
17	79	742.92	2002.69
18	83	758.84	2001.18
19	87	752.64	2003.11
20	91	725.26	2006.64
21	95	702.42	2011.05
22	99	695.08	2015.47
23	103	696.77	2016.14
24	107	696.77	2016.14

Onde SH

		Strato 1	Strato 2
Geofono	x (m)	Vs (m/sec)	Vs (m/sec)
1	15	239.03	830.06
2	19	241.03	835.21
3	23	246.68	848.01
4	27	254.84	863.19
5	31	262.30	871.63
6	35	270.92	875.06
7	39	280.62	880.00
8	43	289.47	884.66
9	47	303.49	885.52
10	51	331.12	888.92
11	55	378.69	903.13
12	59	433.52	923.35
13	63	463.80	936.98
14	67	466.13	938.30
15	71	456.27	931.75
16	75	429.46	917.88
17	79	386.02	902.14
18	83	351.36	896.28
19	87	336.29	897.27
20	91	327.78	904.47
21	95	316.21	920.65
22	99	298.64	936.16
23	103	285.76	942.79
24	107	280.63	944.48

LINEA SISMICA SR_1
SEZIONE SISMOSTRATIGRAFICA: ONDE P

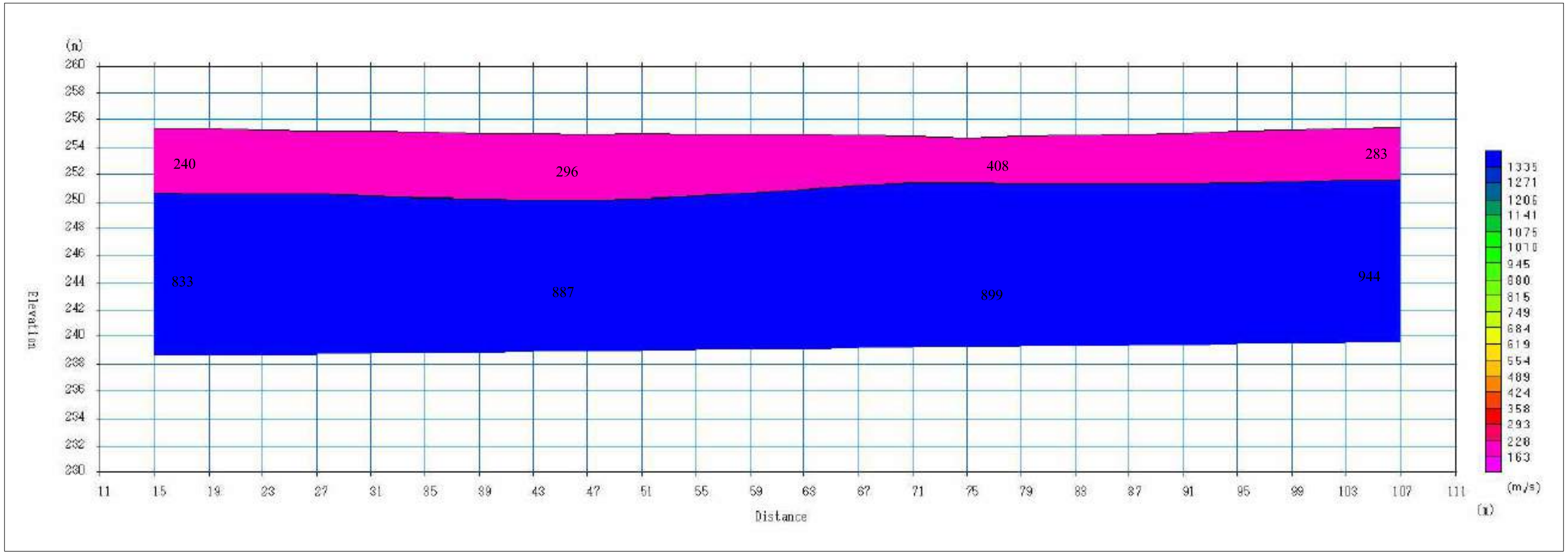


Scala 1:500

321 VELOCITA' SISMICA DELLO STRATO IN m/sec

GEOLOGICA TOSCANA s.n.c.

LINEA SISMICA SR_1
SEZIONE SISMOSTRATIGRAFICA: ONDE SH

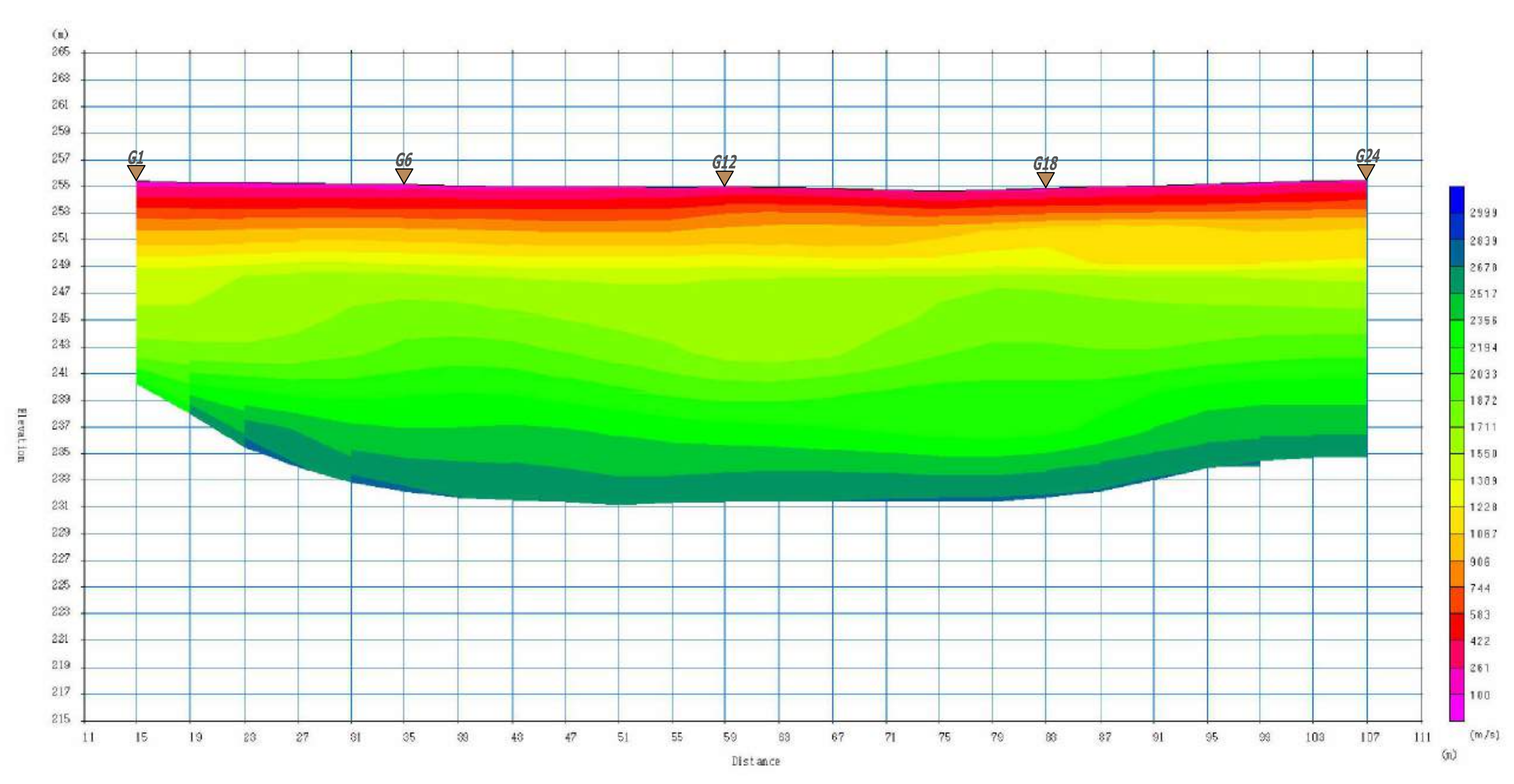


Scala 1:500

321 VELOCITA' SISMICA DELLO STRATO IN m/sec

GEOLOGICA TOSCANA s.n.c.

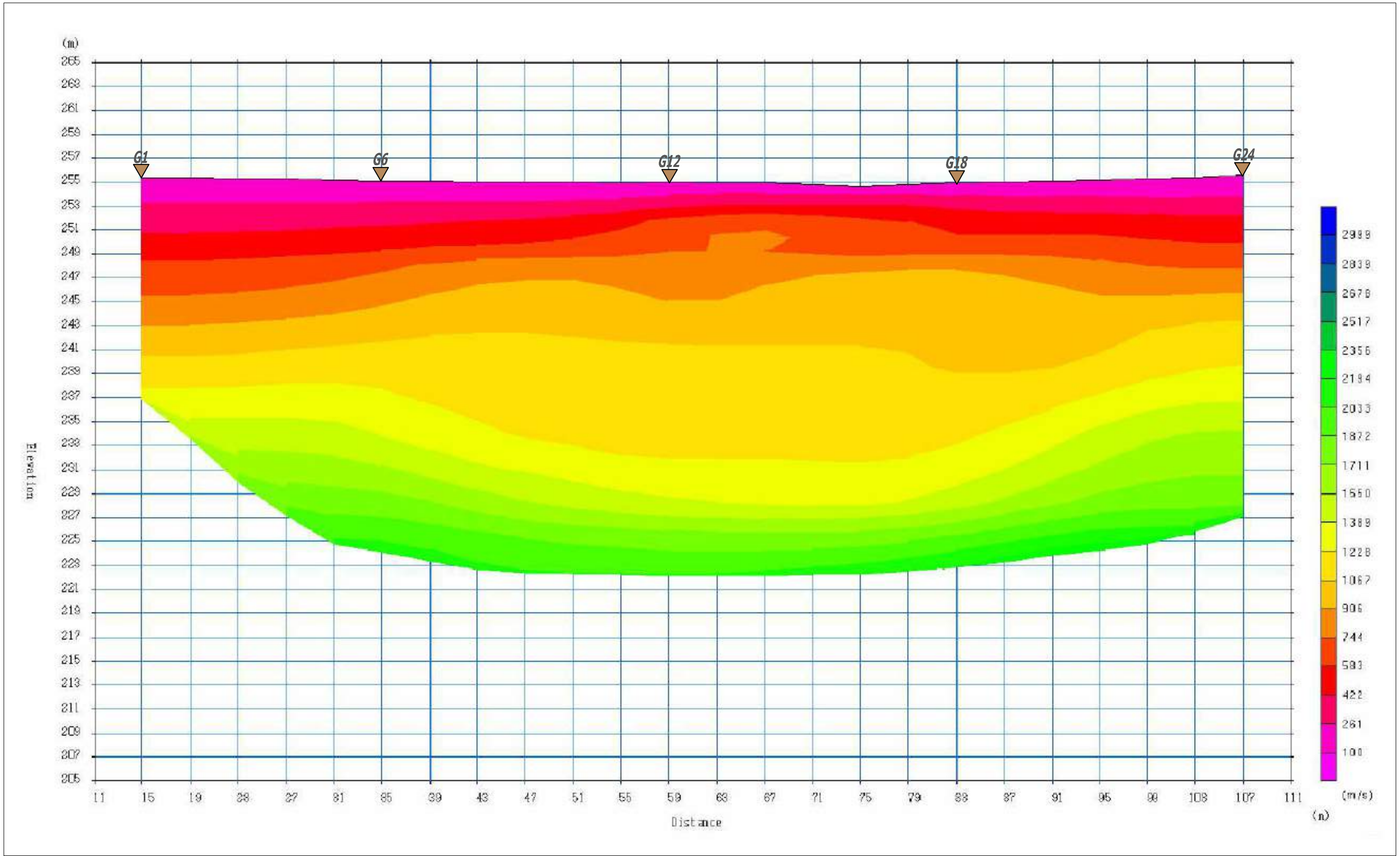
LINEA SISMICA SR_1
SEZIONE TOMOGRAFICA ONDE P



Scala 1:500

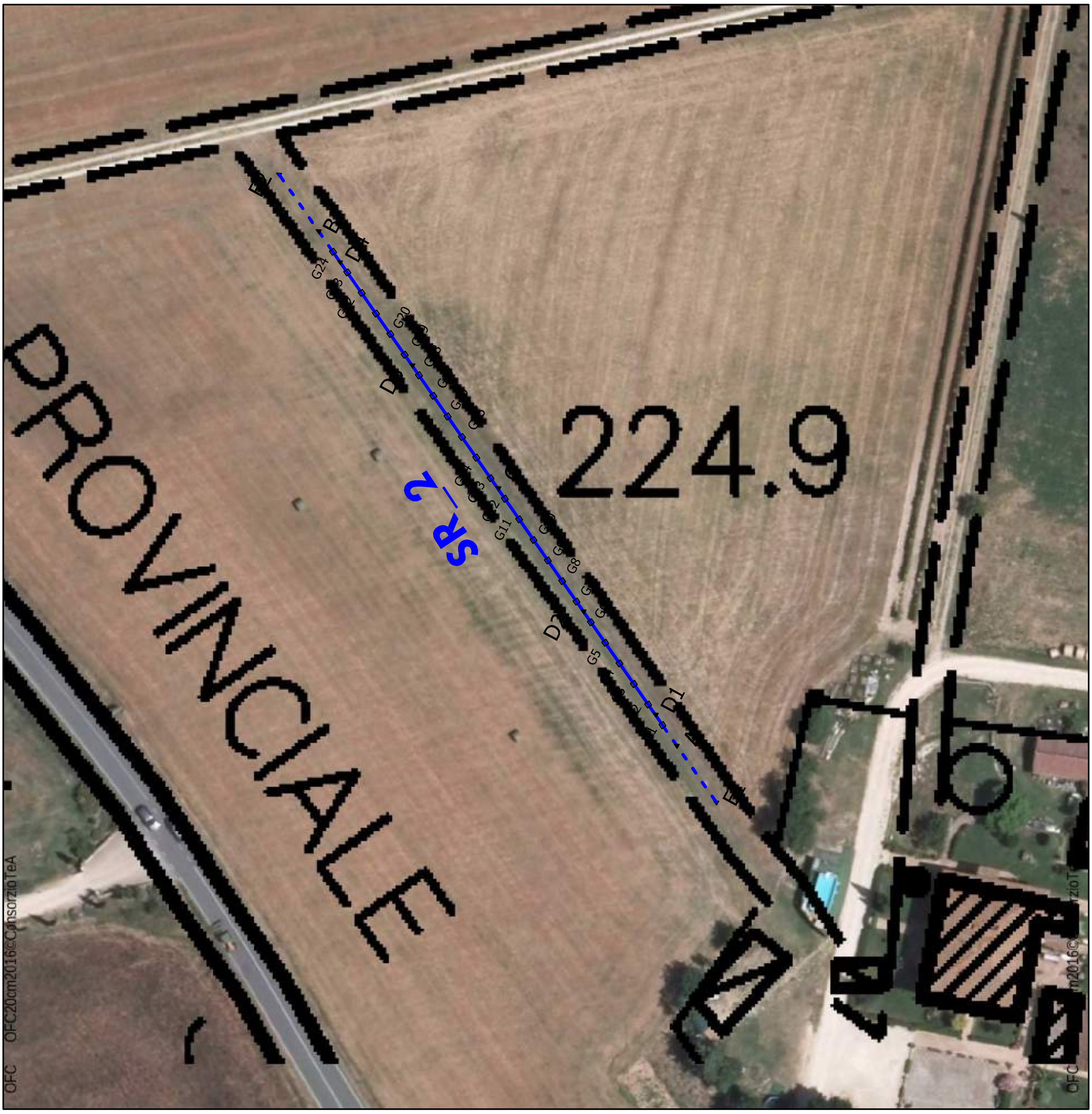
GEOLOGICA TOSCANA s.n.c.

LINEA SISMICA SR_1
SEZIONE TOMOGRAFICA ONDE SH



Scala 1:500

GEOLOGICA TOSCANA s.n.c.



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

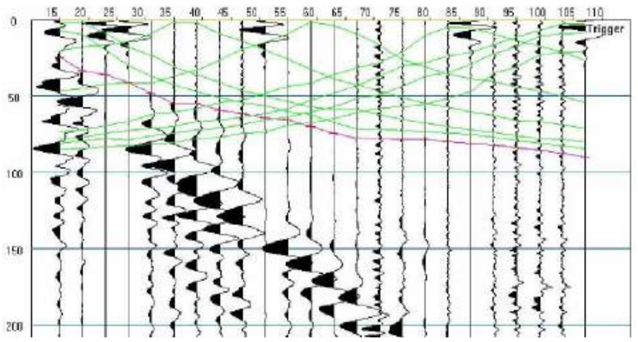
Linea sismica a rifrazione SR_2																								
Geofoni	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Distanza Progressiva (m)	15	19	23	27	31	35	39	43	47	51	55	59	63	67	71	75	79	83	87	91	95	99	103	107
Distanza Parziale (m)	0	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
Quota (m slm)	224.9	224.9	224.9	224.9	224.9	224.9	224.9	224.9	224.9	224.9	224.9	224.9	224.9	224.9	224.9	224.9	224.9	224.9	224.9	224.9	224.9	224.9	224.9	224.9

	Linea sismica SR_2	
	Coordinate Gauss Boaga	
	Geofono N.1 (G1)	Geofono N.24 (G24)
X (m)	1675769	1675716
Y (m)	4808072	4808148

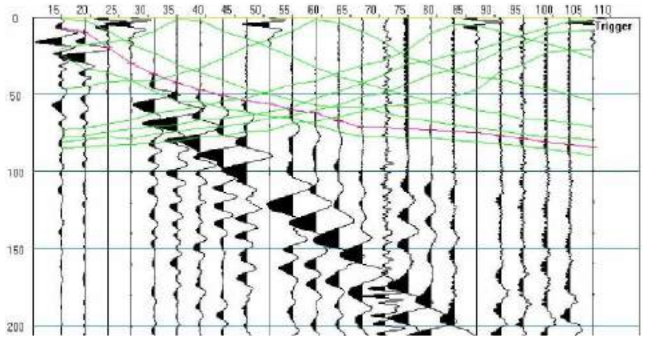
	Punti di energizzazione linea sismica SR_2								
	E1 Esterno Sx	A Estremo Sx	D1 Intermedio Sx	D2 Intermedio Sx	C Centrale	D3 Intermedio Dx	D4 Intermedio Dx	B Estremo Dx	E2 Esterno Dx
Onde P	bel p1	bel p2	bel p3	bel p4	bel p5	bel p6	bel p7	bel p8	bel p9
Onde SH	s1	s2	s3	s4	s5	s6	s7	s8	s9
Posiz. dal geof. N.1 (m)	0	11	17	37	61	85	105	111	122
Quota (m slm)	224.9	224.9	224.9	224.9	224.9	224.9	224.9	224.9	224.9

LINEA SISMICA SR_2
REGISTRAZIONI DI CAMPAGNA DELLE ONDE P

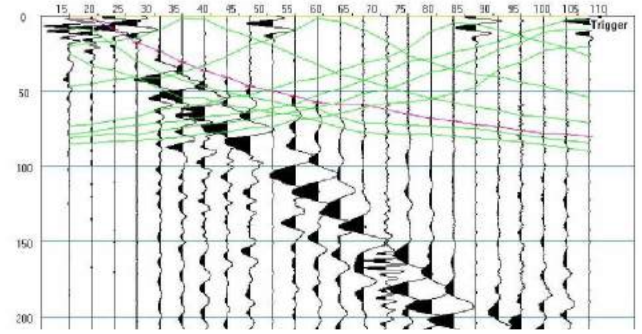
TIRO ESTERNO SINISTRO E1



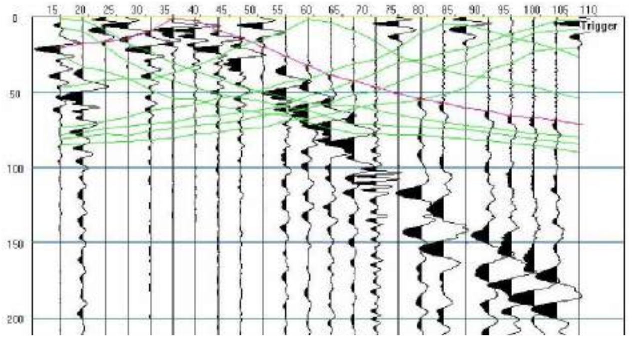
TIRO ESTREMO SINISTRO A



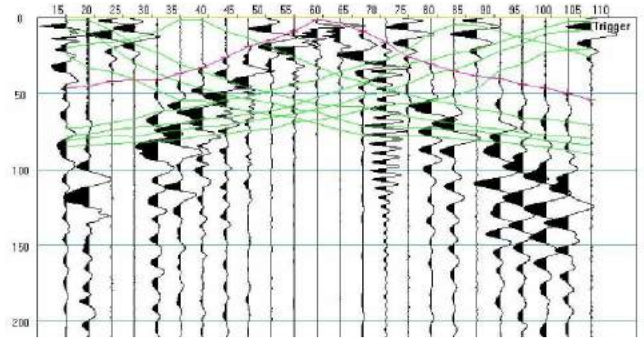
TIRO INTERMEDIO D1



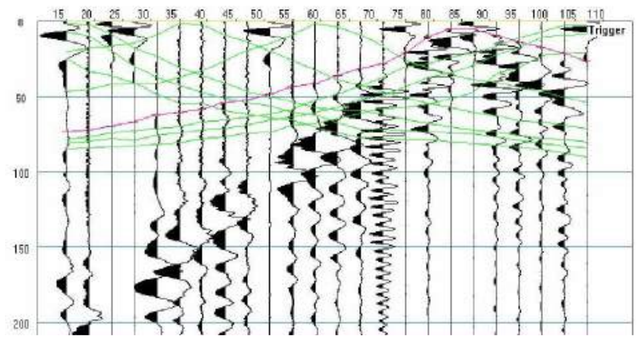
TIRO INTERMEDIO D2



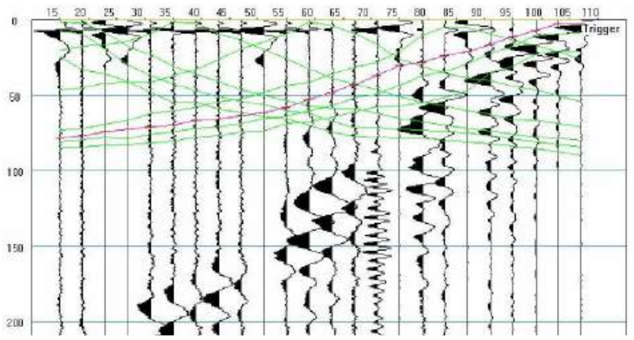
TIRO CENTRALE C



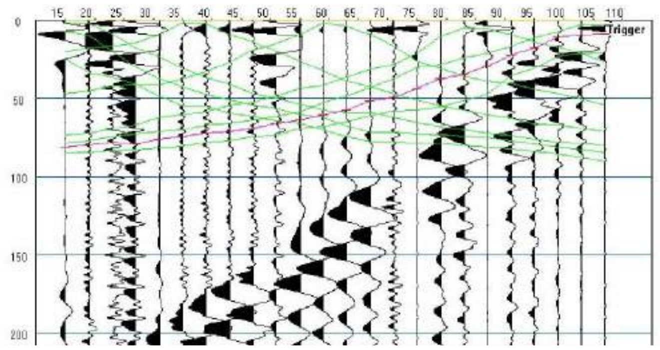
TIRO INTERMEDIO D3



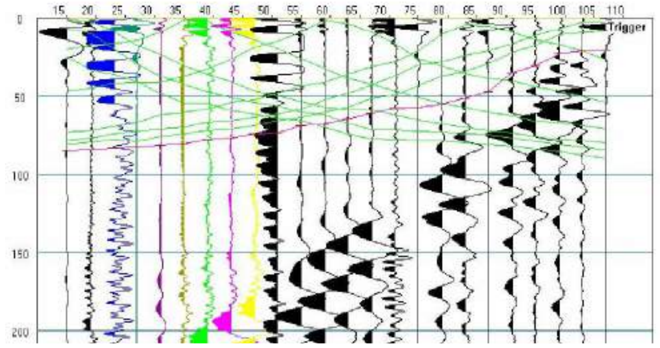
TIRO INTERMEDIO D4



TIRO ESTREMO DESTRO B

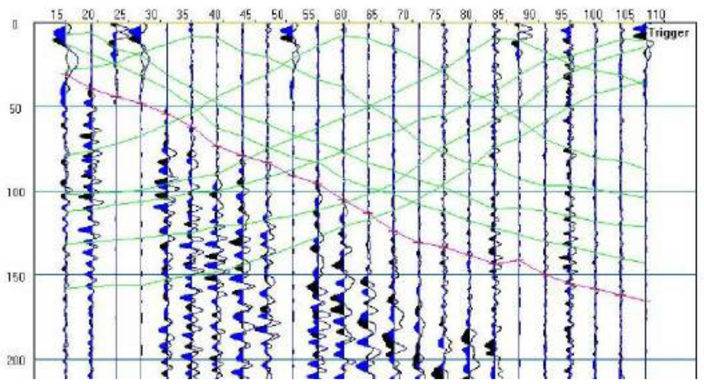


TIRO ESTERNO DESTRO E2

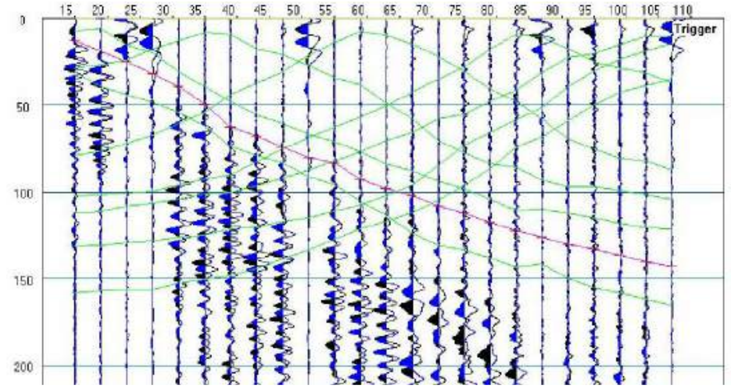


LINEA SISMICA SR_2
REGISTRAZIONI DI CAMPAGNA DELLE ONDE SH

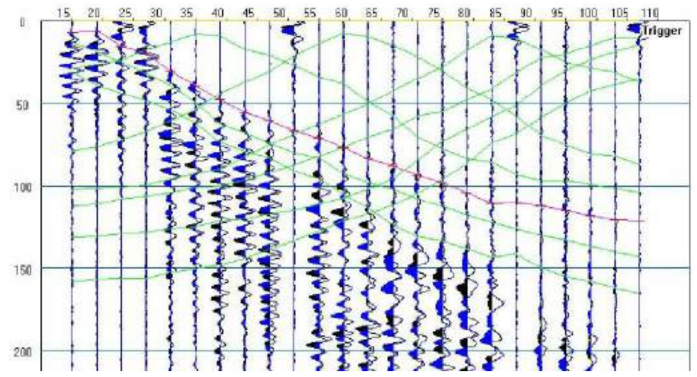
TIRO ESTERNO SINISTRO E1



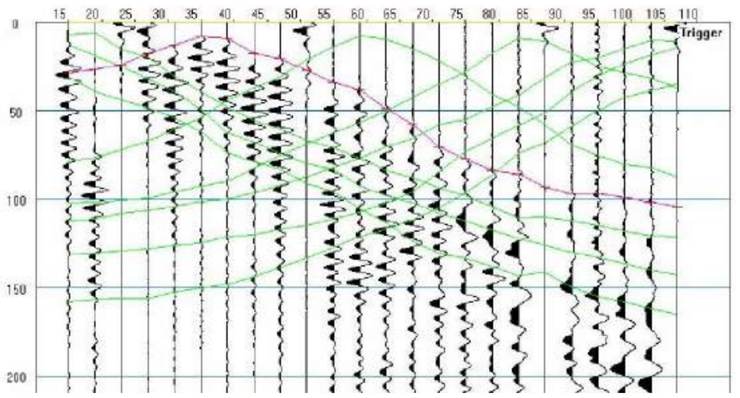
TIRO ESTREMO SINISTRO A



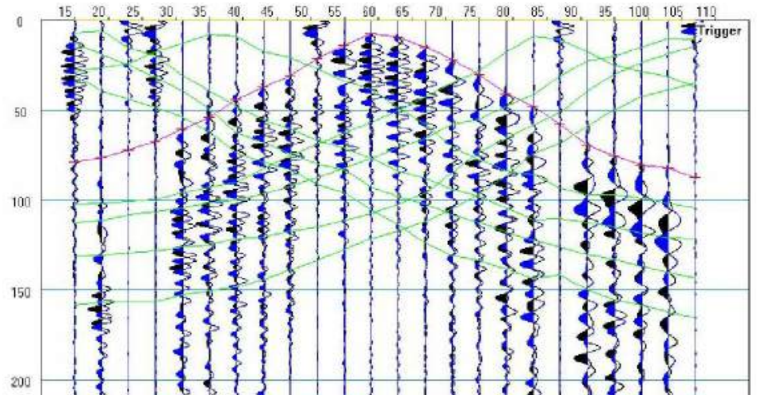
TIRO INTERMEDIO D1



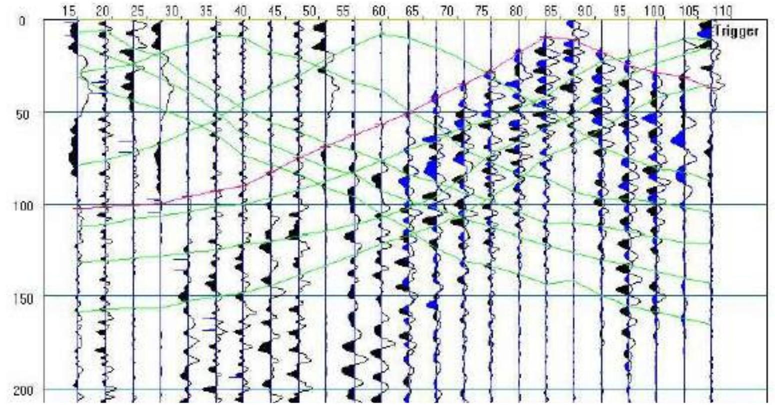
TIRO INTERMEDIO D2



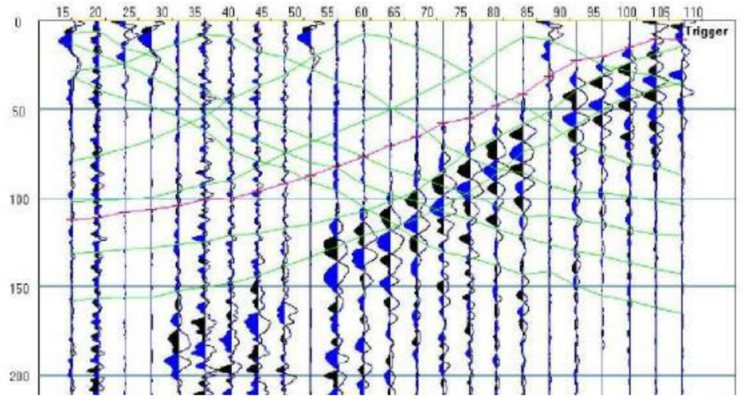
TIRO CENTRALE C



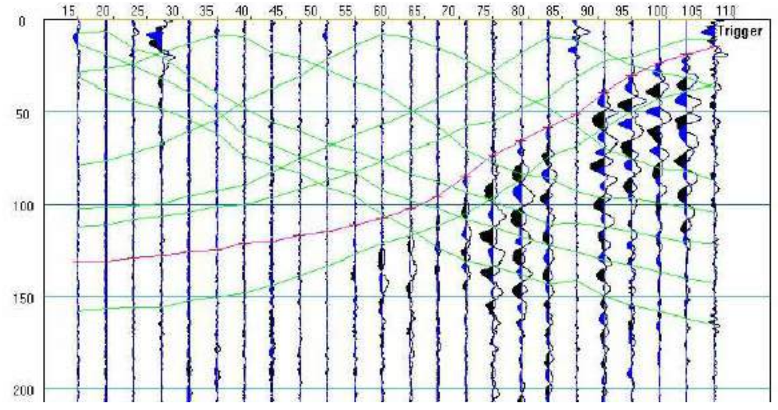
TIRO INTERMEDIO D3



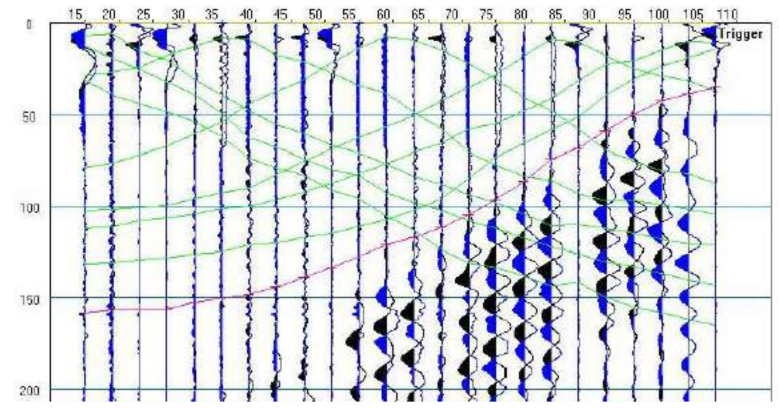
TIRO INTERMEDIO D4



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	11.00	0.00	0.00
3	224.90	17.00	0.00	0.00
4	224.90	37.00	0.00	0.00
5	224.90	61.00	0.00	0.00
6	224.90	85.00	0.00	0.00
7	224.90	105.00	0.00	0.00
8	0.00	111.00	0.00	0.00
9	0.00	122.00	0.00	0.00

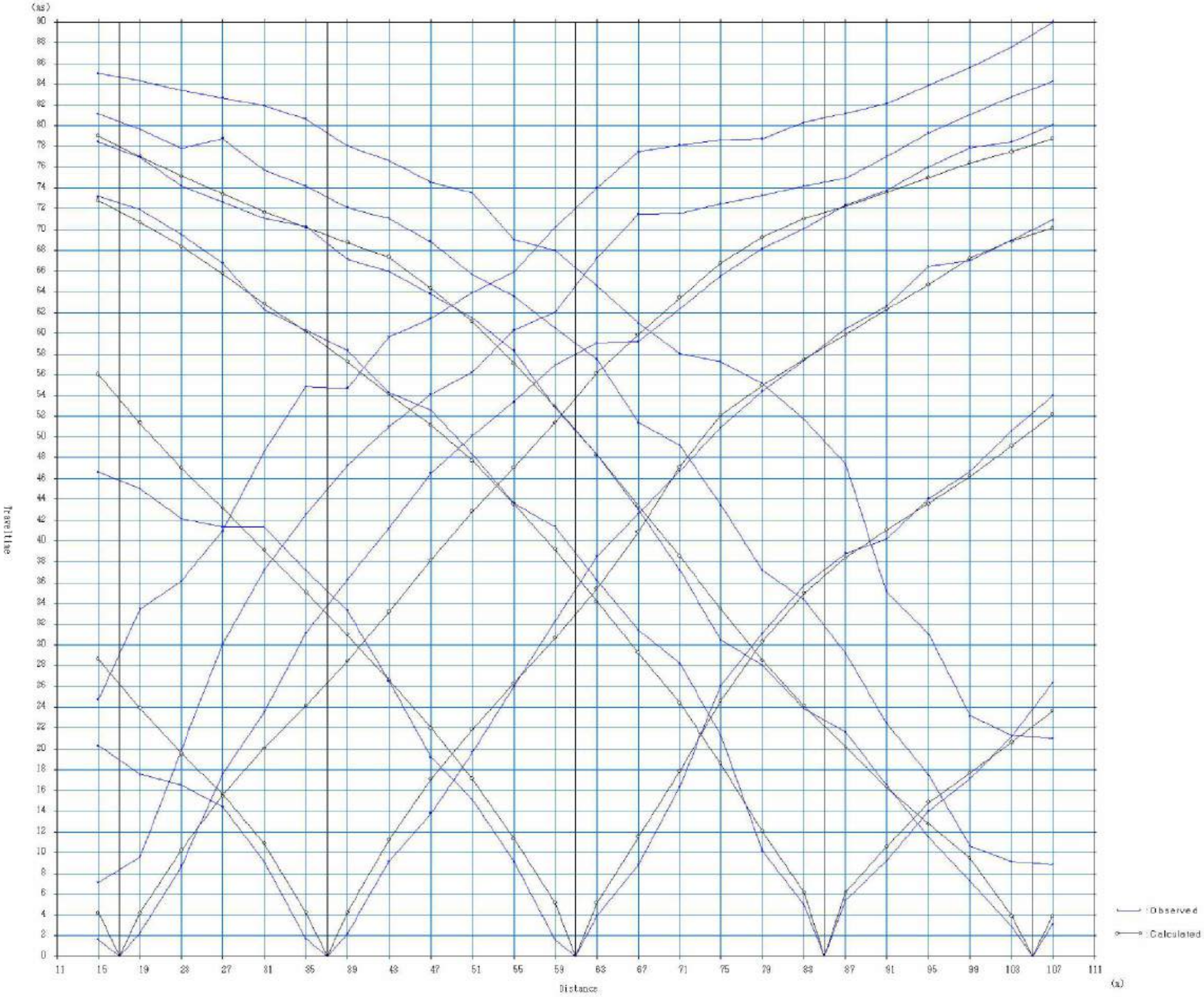
Geo	Elev	X-loc	Y-Loc	SP 1	SP 2	SP 3	SP 4	SP 5	SP 6	SP 7	SP 8	SP 9
1	224.90	15.00	0.00	0.00 1	0.00 1	4.20 1	28.63 1	56.08 1	72.84 1	79.04 1	0.00 1	0.00 1
2	224.90	19.00	0.00	0.00 1	0.00 1	4.20 1	23.91 1	51.37 1	70.68 1	77.06 1	0.00 1	0.00 1
3	224.90	23.00	0.00	0.00 1	0.00 1	10.23 1	19.56 1	47.03 1	68.40 1	75.18 1	0.00 1	0.00 1
4	224.90	27.00	0.00	0.00 1	0.00 1	15.49 1	15.67 1	43.16 1	65.76 1	73.41 1	0.00 1	0.00 1
5	224.90	31.00	0.00	0.00 1	0.00 1	20.06 1	10.87 1	39.09 1	62.88 1	71.69 1	0.00 1	0.00 1
6	224.90	35.00	0.00	0.00 1	0.00 1	24.15 1	4.25 1	35.07 1	60.16 1	70.20 1	0.00 1	0.00 1
7	224.90	39.00	0.00	0.00 1	0.00 1	28.46 1	4.25 1	31.00 1	57.29 1	68.77 1	0.00 1	0.00 1
8	224.90	43.00	0.00	0.00 1	0.00 1	33.18 1	11.23 1	26.61 1	54.19 1	67.36 1	0.00 1	0.00 1
9	224.90	47.00	0.00	0.00 1	0.00 1	38.14 1	17.08 1	21.98 1	51.18 1	64.36 1	0.00 1	0.00 1
10	224.90	51.00	0.00	0.00 1	0.00 1	42.88 1	21.86 1	17.11 1	47.77 1	61.14 1	0.00 1	0.00 1
11	224.90	55.00	0.00	0.00 1	0.00 1	47.13 1	26.35 1	11.37 1	43.62 1	57.14 1	0.00 1	0.00 1
12	224.90	59.00	0.00	0.00 1	0.00 1	51.43 1	30.68 1	5.15 1	39.22 1	52.98 1	0.00 1	0.00 1
13	224.90	63.00	0.00	0.00 1	0.00 1	56.16 1	35.41 1	5.15 1	34.14 1	48.27 1	0.00 1	0.00 1
14	224.90	67.00	0.00	0.00 1	0.00 1	59.88 1	40.91 1	11.55 1	29.25 1	43.38 1	0.00 1	0.00 1
15	224.90	71.00	0.00	0.00 1	0.00 1	63.44 1	47.15 1	17.86 1	24.42 1	38.55 1	0.00 1	0.00 1
16	224.90	75.00	0.00	0.00 1	0.00 1	66.76 1	52.13 1	24.61 1	18.60 1	33.50 1	0.00 1	0.00 1
17	224.90	79.00	0.00	0.00 1	0.00 1	69.30 1	55.04 1	30.31 1	12.10 1	28.52 1	0.00 1	0.00 1
18	224.90	83.00	0.00	0.00 1	0.00 1	71.06 1	57.51 1	34.98 1	6.19 1	24.13 1	0.00 1	0.00 1
19	224.90	87.00	0.00	0.00 1	0.00 1	72.30 1	59.88 1	38.37 1	6.19 1	20.18 1	0.00 1	0.00 1
20	224.90	91.00	0.00	0.00 1	0.00 1	73.57 1	62.32 1	41.10 1	10.58 1	16.32 1	0.00 1	0.00 1
21	224.90	95.00	0.00	0.00 1	0.00 1	75.01 1	64.71 1	43.63 1	14.84 1	12.76 1	0.00 1	0.00 1
22	224.90	99.00	0.00	0.00 1	0.00 1	76.44 1	67.26 1	46.27 1	17.71 1	9.46 1	0.00 1	0.00 1
23	224.90	103.00	0.00	0.00 1	0.00 1	77.50 1	68.88 1	49.18 1	20.64 1	3.87 1	0.00 1	0.00 1
24	224.90	107.00	0.00	0.00 1	0.00 1	78.78 1	70.16 1	52.23 1	23.69 1	3.87 1	0.00 1	0.00 1

LINEA SISMICA SR_2
TEMPI DI PROPAGAZIONE DELLE ONDE SH

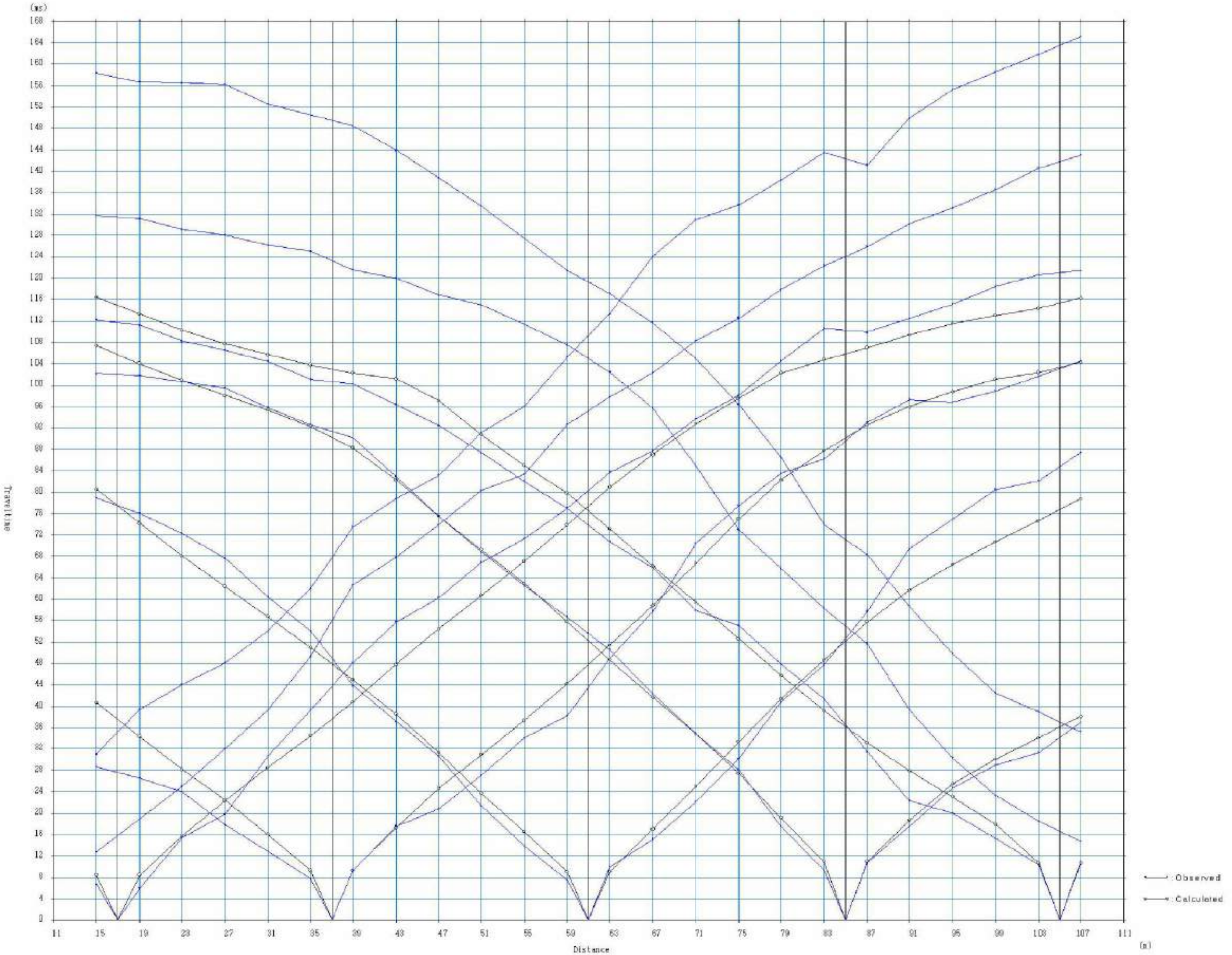
SP	Elev	X-loc	Y-Loc	Depth
1	0.00	0.00	0.00	0.00
2	0.00	11.00	0.00	0.00
3	224.90	17.00	0.00	0.00
4	224.90	37.00	0.00	0.00
5	224.90	61.00	0.00	0.00
6	224.90	85.00	0.00	0.00
7	224.90	105.00	0.00	0.00
8	0.00	111.00	0.00	0.00
9	0.00	122.00	0.00	0.00

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	224.90	15.00	0.00	0.00 1	0.00 1	8.43 1	40.71 1	80.58 1	107.40	1116.45	10.00 1	0.00 1
2	224.90	19.00	0.00	0.00 1	0.00 1	8.43 1	34.35 1	74.23 1	104.11	1113.35	10.00 1	0.00 1
3	224.90	23.00	0.00	0.00 1	0.00 1	15.79 1	28.22 1	68.10 1	100.94	1110.27	10.00 1	0.00 1
4	224.90	27.00	0.00	0.00 1	0.00 1	22.31 1	22.50 1	62.43 1	98.05 1	107.74	10.00 1	0.00 1
5	224.90	31.00	0.00	0.00 1	0.00 1	28.55 1	16.05 1	56.82 1	95.43 1	105.71	10.00 1	0.00 1
6	224.90	35.00	0.00	0.00 1	0.00 1	34.55 1	9.31 1	50.98 1	92.29 1	103.81	10.00 1	0.00 1
7	224.90	39.00	0.00	0.00 1	0.00 1	40.85 1	9.31 1	44.94 1	88.28 1	102.27	10.00 1	0.00 1
8	224.90	43.00	0.00	0.00 1	0.00 1	47.85 1	17.28 1	38.58 1	82.27 1	101.27	10.00 1	0.00 1
9	224.90	47.00	0.00	0.00 1	0.00 1	54.45 1	24.70 1	31.39 1	75.59 1	97.12 1	0.00 1	0.00 1
10	224.90	51.00	0.00	0.00 1	0.00 1	60.75 1	31.00 1	23.70 1	69.26 1	90.79 1	0.00 1	0.00 1
11	224.90	55.00	0.00	0.00 1	0.00 1	67.14 1	37.38 1	16.53 1	62.92 1	85.07 1	0.00 1	0.00 1
12	224.90	59.00	0.00	0.00 1	0.00 1	73.93 1	44.18 1	9.08 1	55.82 1	79.84 1	0.00 1	0.00 1
13	224.90	63.00	0.00	0.00 1	0.00 1	80.98 1	51.42 1	9.08 1	48.75 1	73.17 1	0.00 1	0.00 1
14	224.90	67.00	0.00	0.00 1	0.00 1	87.12 1	58.86 1	17.05 1	41.71 1	66.18 1	0.00 1	0.00 1
15	224.90	71.00	0.00	0.00 1	0.00 1	92.73 1	66.69 1	24.98 1	34.85 1	59.43 1	0.00 1	0.00 1
16	224.90	75.00	0.00	0.00 1	0.00 1	97.56 1	74.93 1	33.40 1	27.37 1	52.68 1	0.00 1	0.00 1
17	224.90	79.00	0.00	0.00 1	0.00 1	102.26	182.26 1	41.42 1	19.14 1	45.77 1	0.00 1	0.00 1
18	224.90	83.00	0.00	0.00 1	0.00 1	104.80	187.84 1	48.70 1	10.97 1	39.17 1	0.00 1	0.00 1
19	224.90	87.00	0.00	0.00 1	0.00 1	106.98	192.63 1	55.86 1	10.95 1	33.19 1	0.00 1	0.00 1
20	224.90	91.00	0.00	0.00 1	0.00 1	109.37	195.97 1	61.75 1	18.71 1	27.94 1	0.00 1	0.00 1
21	224.90	95.00	0.00	0.00 1	0.00 1	111.51	198.83 1	66.52 1	25.50 1	23.08 1	0.00 1	0.00 1
22	224.90	99.00	0.00	0.00 1	0.00 1	113.08	1101.15	170.74 1	30.07 1	17.98 1	0.00 1	0.00 1
23	224.90	103.00	0.00	0.00 1	0.00 1	114.36	1102.43	174.71 1	34.05 1	10.70 1	0.00 1	0.00 1
24	224.90	107.00	0.00	0.00 1	0.00 1	116.27	1104.34	178.76 1	38.10 1	10.70 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

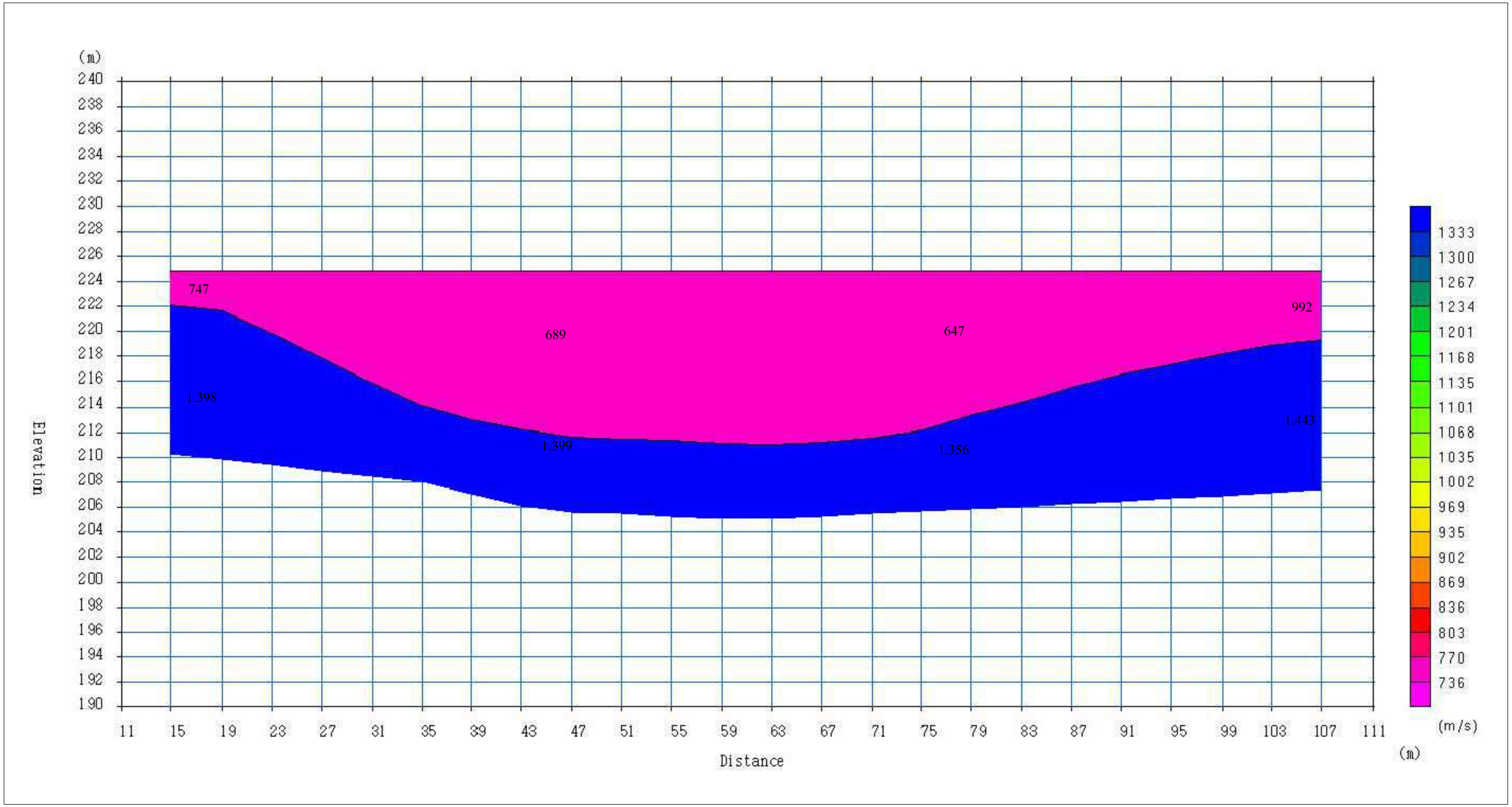
Onde P

		Strato 1	Strato 2
Geofono	x (m)	Vs (m/sec)	Vs (m/sec)
1	15	751.57	1398.39
2	19	743.34	1397.01
3	23	740.65	1401.77
4	27	749.63	1412.26
5	31	764.87	1420.91
6	35	759.81	1421.83
7	39	723.54	1415.54
8	43	693.84	1408.77
9	47	684.61	1403.01
10	51	684.57	1395.42
11	55	687.05	1384.08
12	59	671.90	1369.66
13	63	630.66	1353.50
14	67	591.02	1340.03
15	71	581.87	1334.49
16	75	612.45	1335.73
17	79	680.97	1345.64
18	83	771.87	1365.54
19	87	860.47	1388.03
20	91	929.26	1409.03
21	95	976.13	1428.31
22	99	996.41	1440.42
23	103	995.10	1443.43
24	107	988.92	1443.06

Onde SH

		Strato 1	Strato 2
Geofono	x (m)	Vs (m/sec)	Vs (m/sec)
1	15	398.69	713.21
2	19	420.44	703.84
3	23	437.45	703.68
4	27	432.79	715.67
5	31	423.35	719.68
6	35	401.55	710.41
7	39	369.36	693.98
8	43	362.52	672.11
9	47	381.39	652.72
10	51	398.49	645.80
11	55	397.69	645.94
12	59	383.96	642.54
13	63	372.44	629.93
14	67	361.61	610.74
15	71	344.25	599.75
16	75	332.51	603.27
17	79	337.33	617.42
18	83	346.78	639.46
19	87	351.48	664.62
20	91	352.69	692.05
21	95	352.45	727.78
22	99	354.85	758.70
23	103	357.94	767.51
24	107	359.32	765.11

LINEA SISMICA SR_2
SEZIONE SISMOSTRATIGRAFICA: ONDE P

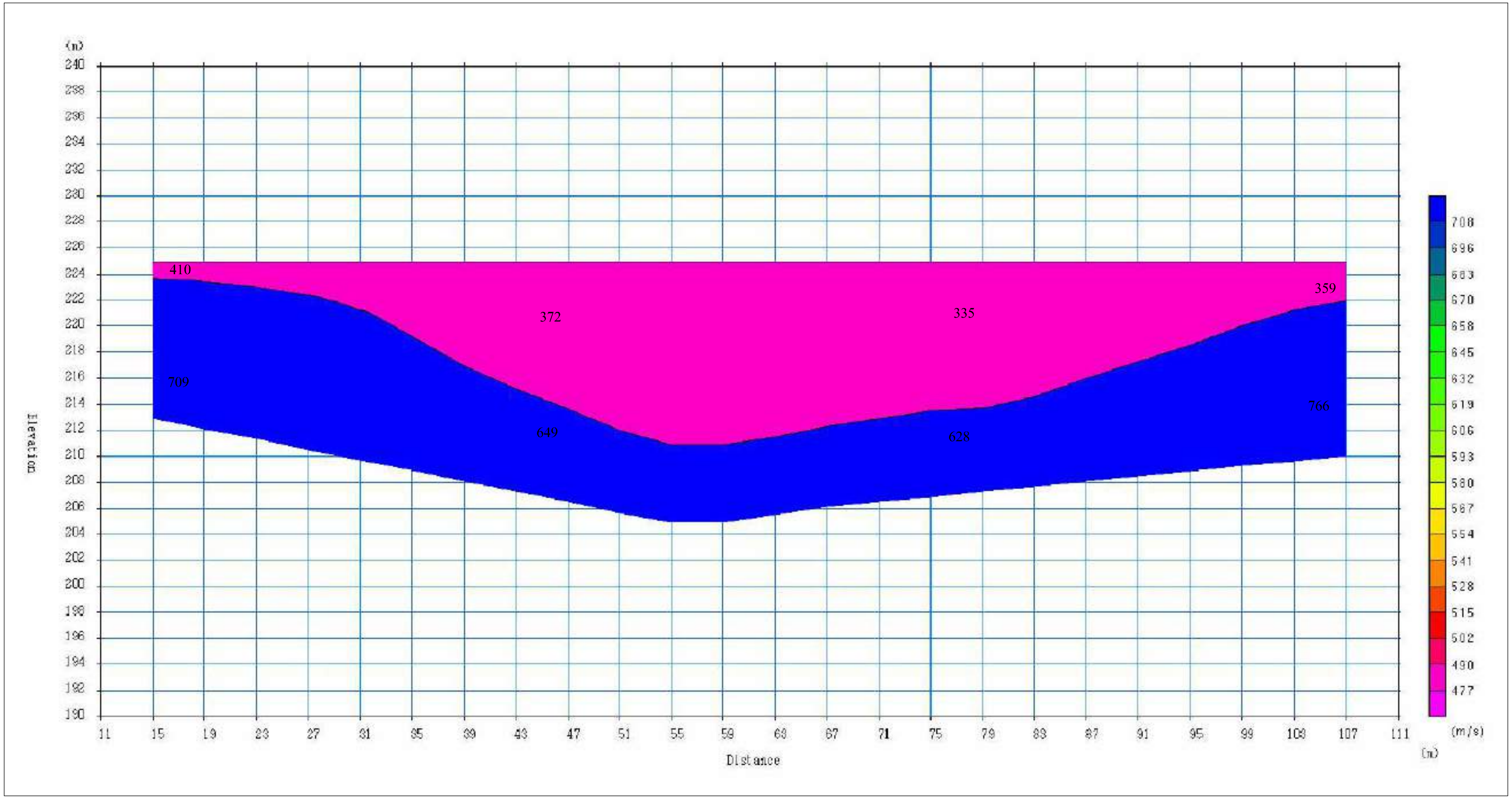


Scala 1:500

321 VELOCITA' SISMICA DELLO STRATO IN m/sec

GEOLOGICA TOSCANA s.n.c.

LINEA SISMICA SR_2
SEZIONE SISMOSTRATIGRAFICA: ONDE SH

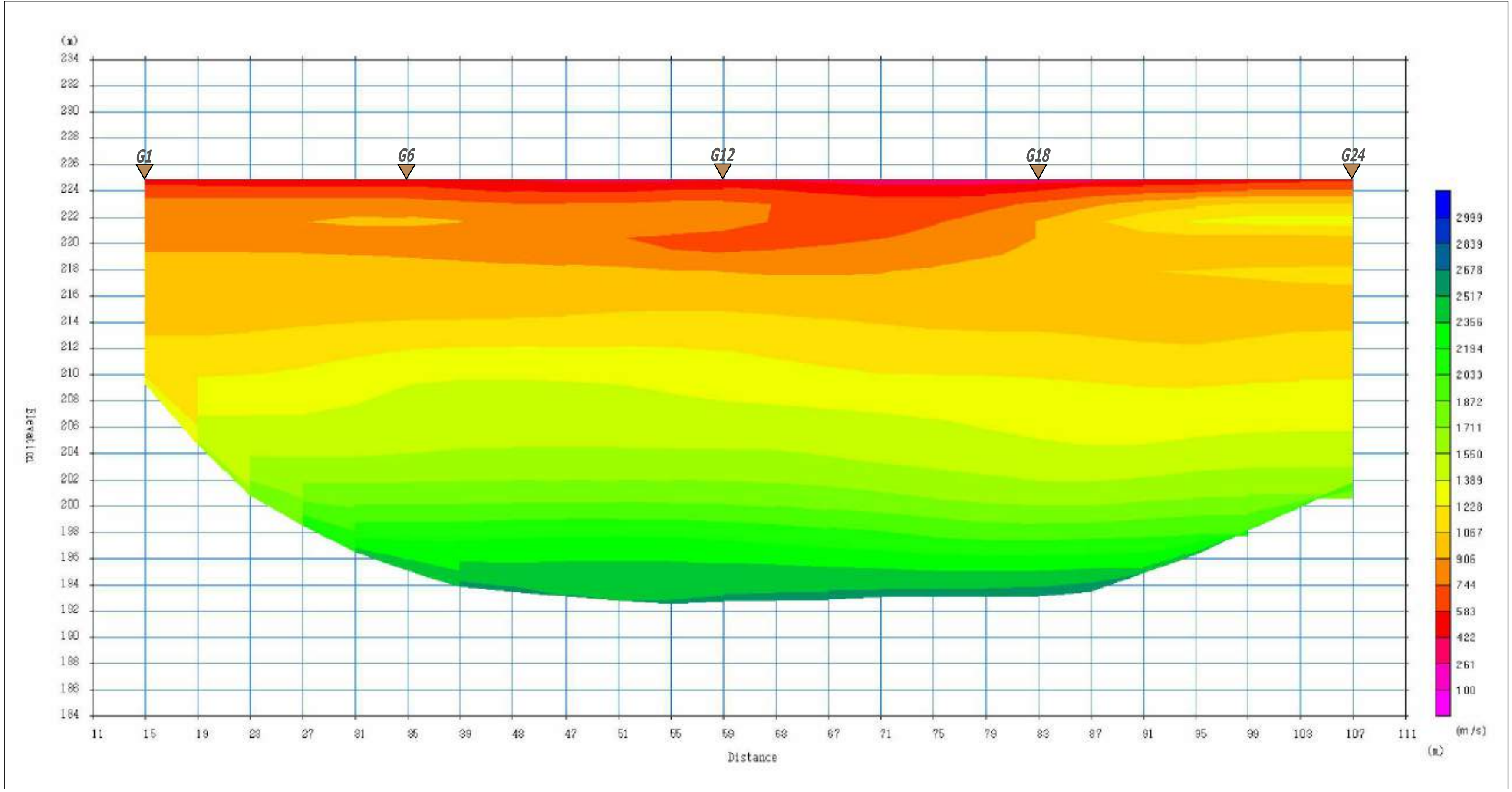


Scala 1:500

321 VELOCITA' SISMICA DELLO STRATO IN m/sec

GEOLOGICA TOSCANA s.n.c.

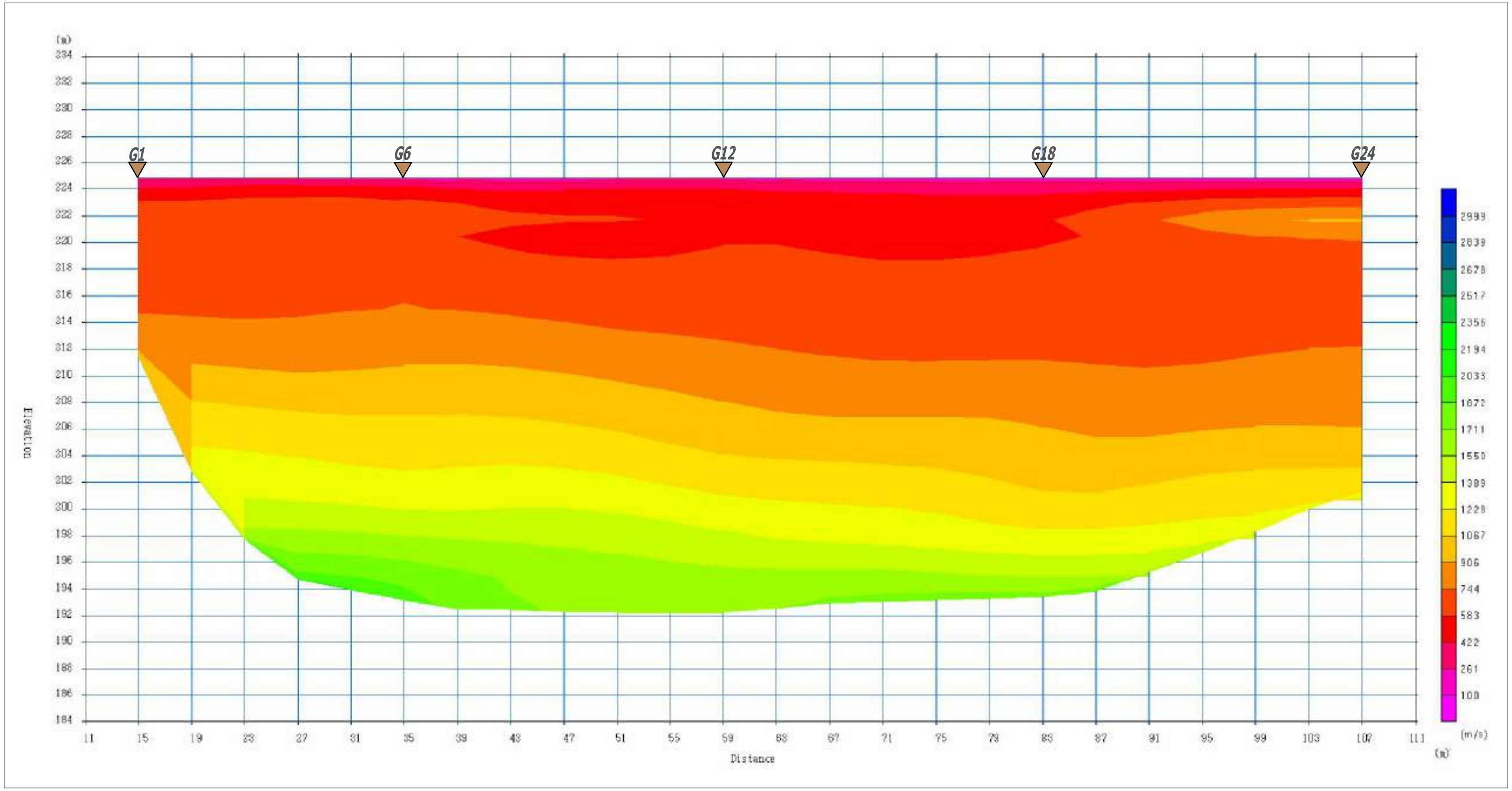
LINEA SISMICA SR_2
SEZIONE TOMOGRAFICA ONDE P



Scala 1:500

GEOLOGICA TOSCANA s.n.c.

LINEA SISMICA SR_2
SEZIONE TOMOGRAFICA ONDE SH



Scala 1:500

GEOLOGICA TOSCANA s.n.c.