# Comune di Livorno

# Campagna geognostica ai fini dell'adeguamento sismico delle strutture scolastiche comunali e per la predisposizione della 4° fase 3° stralcio della microzonazione sismica del Comune di Livorno (LI)

## Relazione tecnica e report delle indagini


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|---|---|---|
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# REPORT DELLA CAMPAGNA GEOGNOSTICA AI FINI DELL'ADEGUAMENTO SISMICO DELLE STRUTTURE SCOLASTICHE COMUNALI E PER LA PREDISPOSIZIONE DELLA 4° FASE 3° STRALCIO DELLA MICROZONAZIONE SISMICA DEL COMUNE DI LIVORNO

## § 1) INTRODUZIONE

### 1.1) Premessa

Il presente documento riferisce sulle prove geofisiche, di tipo sismico passivo, condotte per la *campagna geognostica ai fini dell'adeguamento sismico delle strutture scolastiche comunali e per la predisposizione della 4° fase 3° stralcio della microzonazione sismica* del Comune di Livorno (LI).

Ai sensi dell'aggiornamento della classificazione sismica della Toscana 2012 *Attuazione – Ord. PCM 3.519 – D.G.R. n° 431 del 19/06/2006* –, il Comune di Livorno è censito tra le aree a sismicità 3.

In funzione di ciò ed in ottica preventiva, l'Amministrazione ha commissionato nel corso dell'anno 2015 un programma di indagini geofisiche e geognostiche volte alla realizzazione della microzonazione sismica comunale, con l'obiettivo di ridurre la maglia di conoscenza dell'abitato di Livorno, iniziando le indagini da 20 plessi scolastici dislocati nell'area urbana livornese.

A inizio 2016 si è manifestata la necessità di implementare con ulteriori 29 misure di rumore sismico ambientale (HVSR) le indagini concluse nel dicembre precedente, estendendole alle frazioni di Ardenza, Antignano, Montenero, Castellaccio, Quercianella e Valle Benedetta.

Nonostante l'elevato numero di indagini eseguite, si è reso necessario l'esecuzione di ulteriori 16 punti di misura di rumore sismico ambientale (HVSR) da distribuire su tutto il territorio comunale.

**Il presente studio descrive la terza campagna geofisica realizzata a cavallo dei mesi di di maggio e giugno 2017 tramite una serie di 16 misure di rumore sismico ambientale (HVSR).**

## 1.2) Contesto

Le indagini geofisiche sono state eseguite all'interno del territorio del Comune di Livorno (vedi carta delle indagini).

## 1.3) Tipologia di indagini

La caratterizzazione sismica - dinamica del terreno, è stata eseguita attraverso prove geofisiche non invasive, in particolare:

- *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 in 16 distinte aree del Comune di Livorno (LI); nella tabella seguente si evidenziano con precisione le località in cui sono state effettuate le indagini stesse:

| **Indagine e numero progressivo rispetto a quelle realizzate nei precedenti stralci** | **Ubicazione** |
|---|---|
| HVSR 50 | ***LIVORNO* – *Piazza Dante*** |
| HVSR 51 | ***SALVIANO* – *Via Guadalajara*** |
| HVSR 52 | ***LIMONCINO* - *Via di Limoncino*** |
| HVSR 53 | ***Via della Valle Benedetta*** |
| HVSR 54 | ***PADULA* - *Via della Padula*** |

| | |
|---|---|
| HVSR 55 | ***PIAN DI ROTA* - *Via delle Sorgenti*** |
| HVSR 56 | ***ZONA INDUSTRIALE* - *Via della Ferrovia*** |
| HVSR 57 | ***SALVIANO* - *Via di Levante*** |
| HVSR 58 | ***ARDENZA* - *Via Grotta delle Fate*** |
| HVSR 59 | ***ARDENZA* - *Viale Italia*** |
| HVSR 60 | ***ANTIGNANO* - *Viale di Antignano*** |
| HVSR 61 | ***ANTIGNANO* - *Via Caduti nei Lager Nazisti*** |
| HVSR 62 | ***ANTIGNANO* - *Viale Amerigo Vespucci*** |
| HVSR 63 | ***ISOLA DI GORGONA*** |
| HVSR 64 | ***ISOLA DI GORGONA*** |
| HVSR 65 | ***ISOLA DI GORGONA*** |

### 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 frazioni comunali indagate.

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*”).

## § 2) CARATTERIZZAZIONE SISMICA

Ai fini di una preliminare caratterizzazione sismica del territorio comunale, abbiamo acquisito una discreta mole di dati sfruttando l’ottimo rapporto qualità/prezzo offerto dalle stazioni singole di monitoraggio sismico, nello specifico:

1. **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) 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.

### 2.1.1 Strumentazione per microtremori

I dati sono stati acquisiti tramite un geofono tridimensionale a 4,5 Hz scegliendo 16 postazioni di misura, corrispondenti ad altrettante aree concordate in precedenza con il Dott. Geol. Alessio Tanda della Protezione Civile comunale e misurando per ognuna di esse i microtremori per un tempo di circa 30 minuti.

Dopo aver posizionato il geofono tridimensionale in piano e allineato i suoi assi orizzontali con le direzioni nord - sud e est - ovest, abbiamo scelto una frequenza di campionamento di 250 Hz.

La durata di ciascuna registrazione è stata di circa 30 minuti acquisendo così circa 450.000 campioni.

## § 3) ELABORAZIONE DATI E RISULTATI

Come detto in precedenza le indagini hanno riguardato 16 distinti siti dislocati nell'area urbana di Livorno e nelle principali frazioni comunali.

Lo scopo primario di queste indagini è quello di coprire in modo omogeneo tutto il territorio comunale, dalle aree urbanizzate a quelle rurali.

Di seguito proponiamo un report di dettaglio con ubicazione e grafici delle indagini svolte.

Le interpretazioni delle prove geofisiche sono contenute nell'*All. 1* in appendice alla presente relazione.

**3.1) Interpretazione misure HVSR**

La *prova* ***HVSR50*** (vedi carta delle indagini) non ha dato un picco di risonanza chiaro, in quanto molto probabilmente non esiste un contrasto di impedenza acustica sensibile per le profondità investigate.

**La qualità della misura è risultata essere A2.**

La *prova* ***HVSR51*** (vedi carta delle indagini) non ha dato un picco di risonanza chiaro, in quanto molto probabilmente non esiste un contrasto di impedenza acustica sensibile per le profondità investigate.

**La qualità della misura è risultata essere A2.**

La *prova* ***HVSR52*** (vedi carta delle indagini) non ha dato un picco di risonanza chiaro, in quanto molto probabilmente non esiste un contrasto di impedenza acustica sensibile per le profondità investigate.

**La qualità della misura è risultata essere A2.**

La *prova* ***HVSR53*** (vedi carta delle indagini) non ha dato un picco di risonanza chiaro, in quanto molto probabilmente non esiste un contrasto di impedenza acustica sensibile per le profondità investigate.

**La qualità della misura è risultata essere A2.**

La *prova* ***HVSR54*** (vedi carta delle indagini) ha dato un picco di risonanza per la frequenza di 2.8 Hz con un valore H/V di 2.3.

Tale frequenza di risonanza indica un leggero contrasto di impedenza acustica tra depositi superficiali e il "substrato sismico".

Si ipotizza che i depositi superficiali abbiano uno spessore compreso tra gli 25 ed i 30 m.

**La qualità della misura è risultata essere B1.**

La *prova* ***HVSR55*** (vedi carta delle indagini) ha dato un picco di risonanza per la frequenza di 13.1 Hz con un valore H/V di 8.6.

Tale frequenza di risonanza indica un contrasto di impedenza dovuto molto probabilmente alla presenza della “panchina”.

Si ipotizza che la “panchina” possa trovarsi intorno ai 5/6 m.

**La qualità della misura è risultata essere B1.**

La *prova* ***HVSR56*** (vedi carta delle indagini) non ha dato un picco di risonanza chiaro, in quanto molto probabilmente non esiste un contrasto di impedenza acustica sensibile per le profondità investigate.

**La qualità della misura è risultata essere A2.**

La *prova* ***HVSR57*** (vedi carta delle indagini) non ha dato un picco di risonanza chiaro, in quanto molto probabilmente non esiste un contrasto di impedenza acustica sensibile per le profondità investigate.

**La qualità della misura è risultata essere B2.**

La *prova* ***HVSR58*** (vedi carta delle indagini) non ha dato un picco di risonanza chiaro, in quanto molto probabilmente non esiste un contrasto di impedenza acustica sensibile per le profondità investigate.

**La qualità della misura è risultata essere B2.**

La *prova* ***HVSR59*** (vedi carta delle indagini) non ha dato un picco di risonanza chiaro, in quanto molto probabilmente non esiste un contrasto di impedenza acustica sensibile per le profondità investigate.

**La qualità della misura è risultata essere A2.**

La *prova* ***HVSR60*** (vedi carta delle indagini) non ha dato un picco di risonanza chiaro, in quanto molto probabilmente non esiste un contrasto di impedenza acustica sensibile per le profondità investigate.

**La qualità della misura è risultata essere B2.**

La *prova* ***HVSR61*** (vedi carta delle indagini) non ha dato un picco di risonanza chiaro, in quanto molto probabilmente non esiste un contrasto di impedenza acustica sensibile per le profondità investigate.

**La qualità della misura è risultata essere B2.**

La *prova* ***HVSR62*** (vedi carta delle indagini) non ha dato un picco di risonanza chiaro, in quanto molto probabilmente non esiste un contrasto di impedenza acustica sensibile per le profondità investigate.

**La qualità della misura è risultata essere B2.**

La *prova* ***HVSR63*** (vedi carta delle indagini) non ha dato un picco di risonanza chiaro, in quanto molto probabilmente non esiste un contrasto di impedenza acustica sensibile per le profondità investigate.

**La qualità della misura è risultata essere B2.**

La *prova* ***HVSR64*** (vedi carta delle indagini) non ha dato un picco di risonanza chiaro, in quanto molto probabilmente non esiste un contrasto di impedenza acustica sensibile per le profondità investigate.

**La qualità della misura è risultata essere B2.**

La *prova* ***HVSR65*** (vedi carta delle indagini) non ha dato un picco di risonanza chiaro, in quanto molto probabilmente non esiste un contrasto di impedenza acustica sensibile per le profondità investigate.

**La qualità della misura è risultata essere B2.**

# A L L E G A T O   1

**Interpretazione grafica e numerica di 16 misure HVSR**

# HVSR50

| | | |
|---|---|---|
| DATE 26.05.2017 | HOUR 10.46 | PLACE Piazza Dante |
| OPERATOR Geologica Toscana - Prospezioni Geofisiche S.n.c. | GPS TYPE and # | |
| GAUSS-BOAGA LATITUDE | GAUSS-BOAGA LONGITUDE | ALTITUDE |
| STATION TYPE PGA | SENSOR TYPE Triassiale 4,5 Hz | |
| STATION # | SENSOR # | DISK # |
| FILE NAME HVSR1.saf | | POINT # |
| GAIN | SAMPL. FREQ. 250 Hz | REC. DURATION 30 min minutes seconds |

WEATHER CONDITIONS
- WIND ☐ none ☒ weak (5m/s) ☐ medium ☐ strong Measurement (if any):
- RAIN ☒ none ☐ weak ☐ medium ☐ strong Measurement (if any):
- Temperature (approx): 23 °C 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 Infissione

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, station

OBSERVATIONS

FREQUENCY: Hz (if computed in the field)

**Qualità della misura:**

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

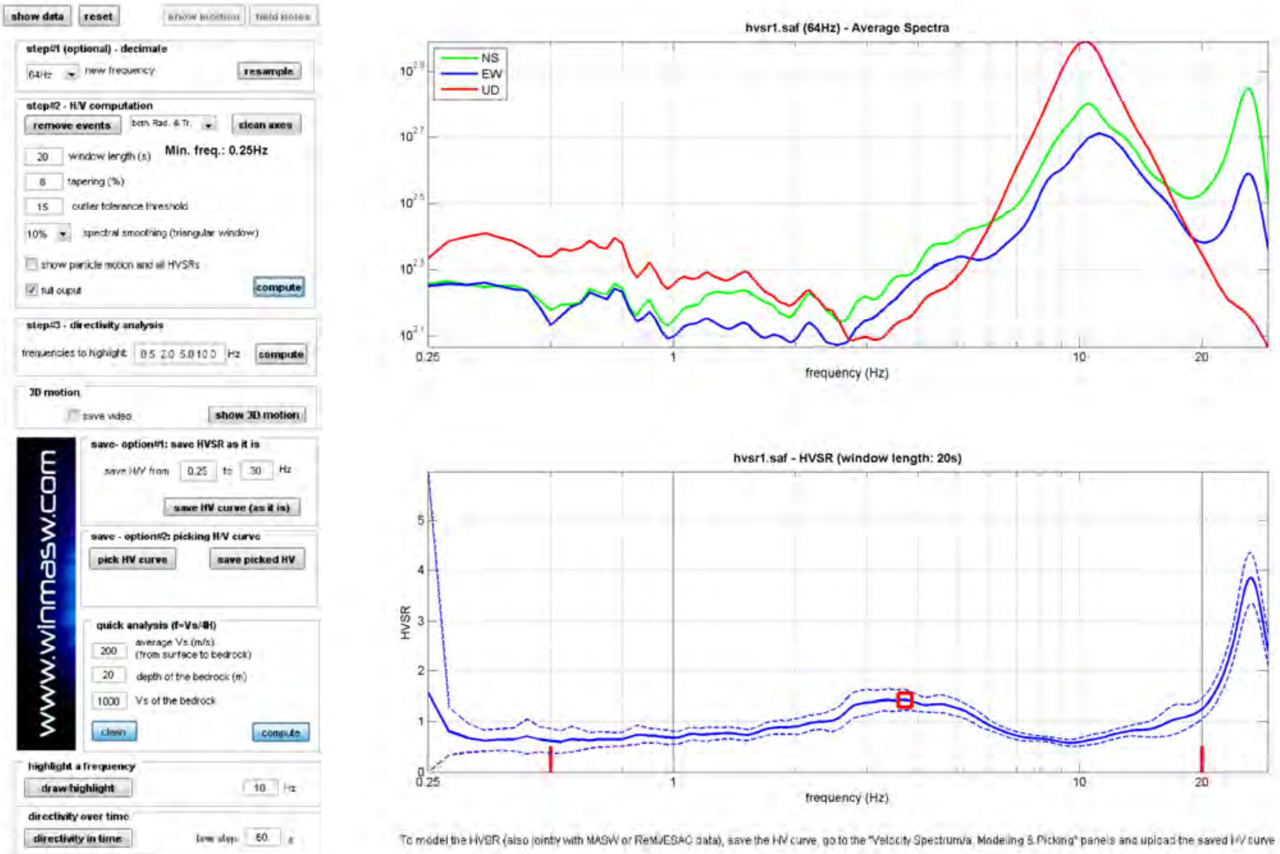
## MISURA TIPO A2

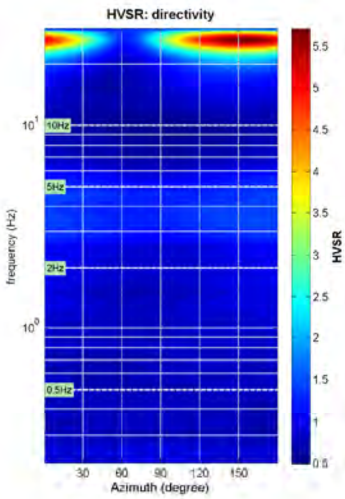
**HVSR50**

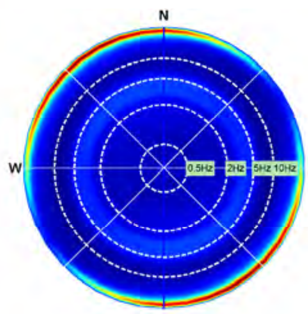
Peak frequency (Hz): 3.7 (±3.7)
Peak HVSR value: 1.4 (±0.2)

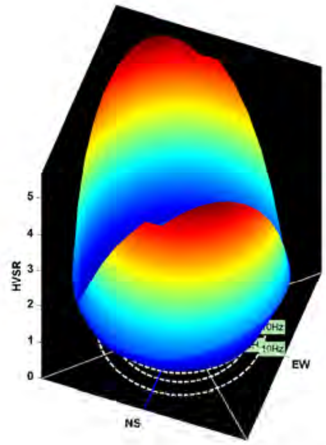
=== Criteria for a reliable H/V curve ====================================
#1. [f0 > 10/Lw]: 3.722 > 0.5 (OK)
#2. [nc > 200]: 13177 > 200 (OK)
#3. [f0>0.5Hz; sigmaA(f) < 2 for 0.5f0 < f < 2f0] (OK)

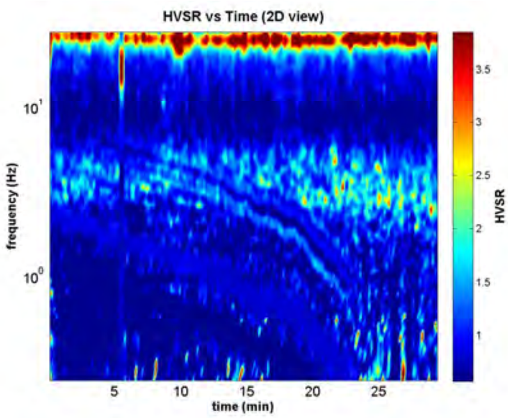
=== Criteria for a clear H/V peak (at least 5 should be fulfilled) ============
#1. [exists f- in the range [f0/4, f0] | AH/V(f-) < A0/2]: yes, at frequency 1.0Hz (OK)
#2. [exists f+ in the range [f0, 4f0] | AH/V(f+) < A0/2]: yes, at frequency 7.1Hz (OK)
#3. [A0 > 2]: 1.4 < 2 (NO)
#4. [fpeak[Ah/v(f) ą sigmaA(f)] = f0 ą 5%]: (NO)
#5. [sigmaf < epsilon(f0)]: 3.741 > 0.186 (NO)
#6. [sigmaA(f0) < theta(f0)]: 0.205 < 1.58 (OK)

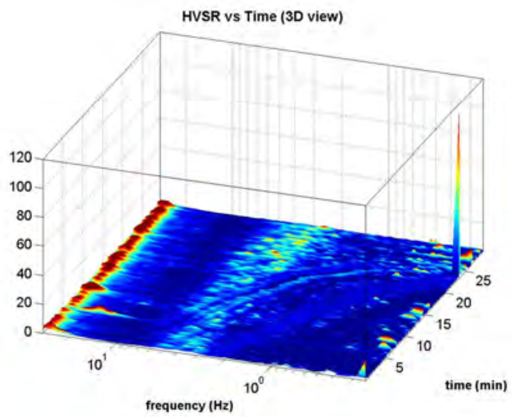

show data
reset
step#1 (optional) - decimate
new frequency
resample
step#2 - H/V computation
remove events
clean axes
window length (s)
Min. freq.: 0.25Hz
tapering (%)
outlier tolerance threshold
spectral smoothing (triangular window)
show particle motion and all HVSRs
full ouput
compute
step#3 - directivity analysis
frequencies to highlight
3D motion
save video
show 3D motion
www.winmasw.com
save- option#1: save HVSR as it is
save H/V 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
highlight a frequency
draw highlight
directivity over time
directivity in time
hvsr1.saf (64Hz) - Average Spectra
NS
EW
UD
frequency (Hz)
hvsr1.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 H/V curve


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


N
W


HVSR
EW
NS


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


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

# HVSR52

| | | |
|---|---|---|
| DATE 26.05.2017 | HOUR 12.32 | PLACE Via di Limoncino |
| OPERATOR Geologica Toscana - Prospezioni Geofisiche S.n.c. | GPS TYPE and # | |
| GAUSS-BOAGA LATITUDE | GAUSS-BOAGA LONGITUDE | ALTITUDE |
| STATION TYPE PGA | SENSOR TYPE Triassiale 4,5 Hz | |
| STATION # | SENSOR # | DISK # |
| FILE NAME HVSR3.saf | | POINT # |
| GAIN | SAMPL. FREQ. 250 Hz | REC. DURATION 30 min (minutes / seconds) |

WEATHER CONDITIONS
- WIND: ● none ☐ weak (5m/s) ☐ medium ☐ strong Measurement (if any): ______
- RAIN: ● none ☐ weak ☐ medium ☐ strong Measurement (if any): ______
- Temperature (approx): 29 °C 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 Infissione

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

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

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

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

OBSERVATIONS

FREQUENCY: Hz (if computed in the field)

**Qualità della misura:**

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

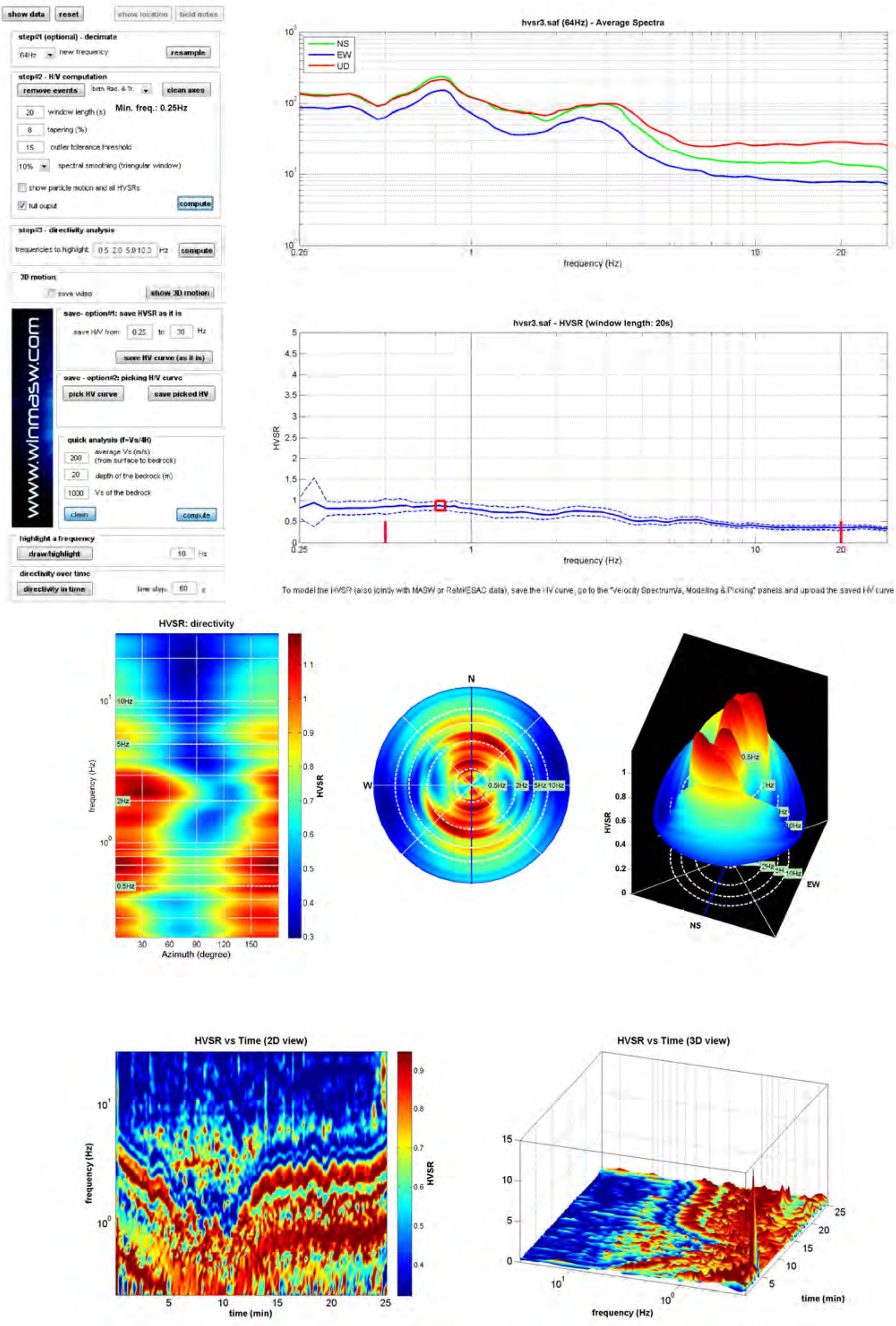
## MISURA TIPO A2

**HVSR52**

Peak frequency (Hz): 0.8 (±0.7)
Peak HVSR value: 0.9 (±0.1)

=== Criteria for a reliable H/V curve ====================================
#1. [f0 > 10/Lw]: 0.782 > 0.5 (OK)
#2. [nc > 200]: 2362 > 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)]: 0.700 > 0.117 (NO)
#6. [sigmaA(f0) < theta(f0)]: 0.102 < 2 (OK)


hvsr3.saf (64Hz) - Average Spectra
NS
EW
UD
frequency (Hz)
hvsr3.saf - 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/a, Modeling & Picking" panels and upload the saved HV curve
HVSR: directivity
frequency (Hz)
Azimuth (degree)
HVSR vs Time (2D view)
time (min)
HVSR vs Time (3D view)
www.winmasw.com

# HVSR53

| | | |
|---|---|---|
| DATE 26.05.2017 | HOUR 13.13 | PLACE Via della Valle Benedetta |
| OPERATOR Geologica Toscana - Prospezioni Geofisiche S.n.c. | GPS TYPE and # | |
| GAUSS-BOAGA LATITUDE | GAUSS-BOAGA LONGITUDE | ALTITUDE |
| STATION TYPE PGA | SENSOR TYPE Triassiale 4,5 Hz | |
| STATION # | SENSOR # | DISK # |
| FILE NAME HVSR4.saf | | POINT # |
| GAIN | SAMPL. FREQ. 250 Hz | REC. DURATION 30 min minutes seconds |

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

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

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

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

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

OBSERVATIONS

FREQUENCY: Hz (if computed in the field)

**Qualità della misura:**

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

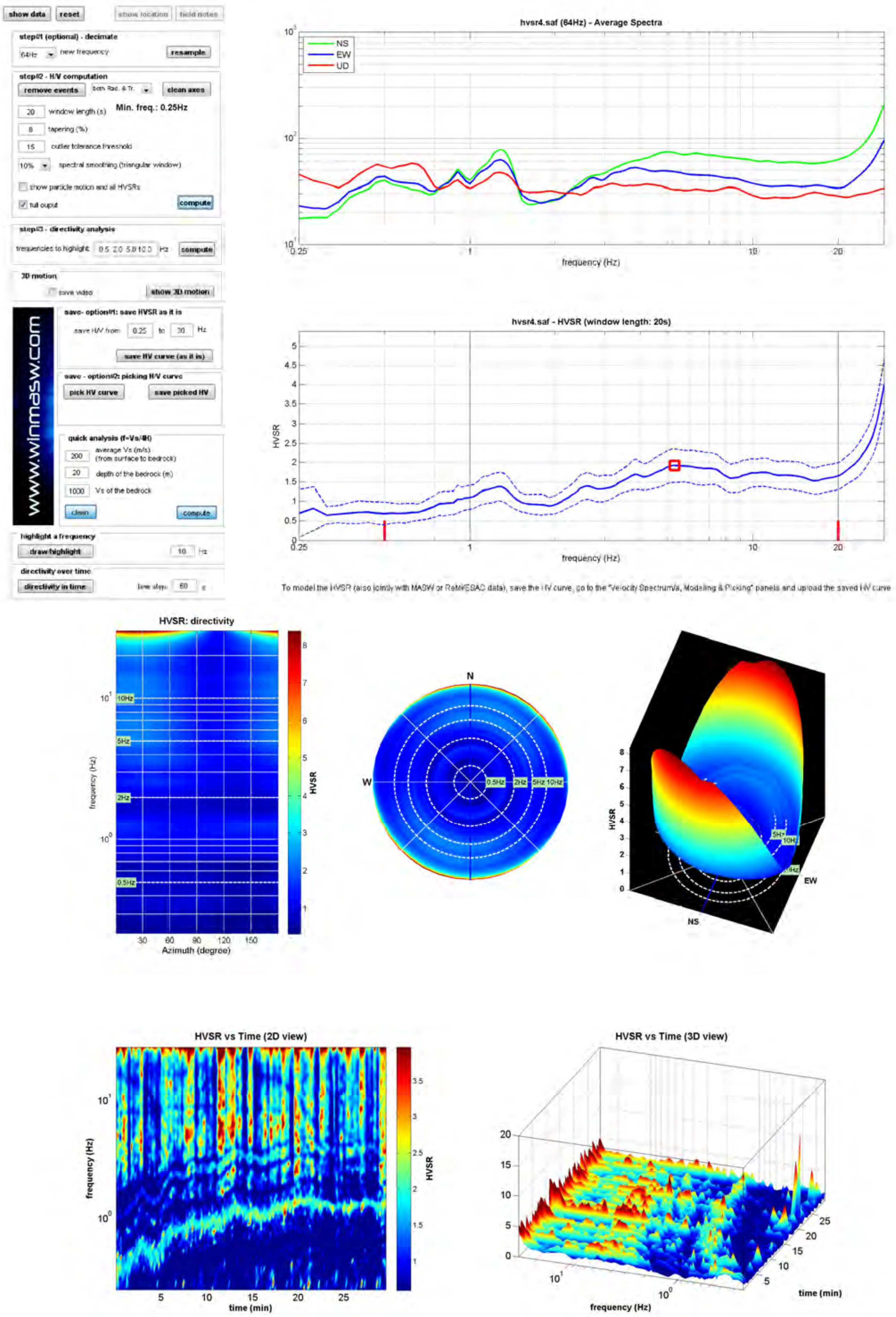
**MISURA TIPO A2**

## HVSR53

Peak frequency (Hz): 5.3 (±3.7)
Peak HVSR value: 1.9 (±0.4)

=== Criteria for a reliable H/V curve ====================================
#1. [f0 > 10/Lw]: 5.286 > 0.5 (OK)
#2. [nc > 200]: 18820 > 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 1.6Hz (OK)
#2. [exists f+ in the range [f0, 4f0] | AH/V(f+) < A0/2]: (NO)
#3. [A0 > 2]: 1.9 < 2 (NO)
#4. [fpeak[Ah/v(f) ą sigmaA(f)] = f0 ą 5%]: (NO)
#5. [sigmaf < epsilon(f0)]: 3.693 > 0.264 (NO)
#6. [sigmaA(f0) < theta(f0)]: 0.440 < 1.58 (OK)


show data
reset
step#1 (optional) - decimate
resample
step#2 - H/V computation
remove events
clean axes
Min. freq.: 0.25Hz
compute
step#3 - directivity analysis
3D motion
show 3D motion
www.winmasw.com
save - option#1: save HVSR as it is
save HV curve (as it is)
save - option#2: picking H/V curve
pick HV curve
save picked HV
quick analysis (f=Vs/4H)
highlight a frequency
draw highlight
directivity over time
directivity in time
hvsr4.saf (64Hz) - Average Spectra
NS
EW
UD
frequency (Hz)
hvsr4.saf - HVSR (window length: 20s)
HVSR
frequency (Hz)
To model the HVSR (also jointly with MASW or ReMi/ESAC data), save the H/V curve, go to the "Velocity Spectrum/a, Modeling & Picking" panels and upload the saved HV curve
HVSR: directivity
frequency (Hz)
Azimuth (degree)
HVSR
N
W
HVSR
EW
NS
HVSR vs Time (2D view)
frequency (Hz)
time (min)
HVSR
HVSR vs Time (3D view)
frequency (Hz)
time (min)

# HVSR54

| | | |
|---|---|---|
| DATE 26.05.2017 | HOUR 14.06 | PLACE Via della Padula |
| OPERATOR Geologica Toscana - Prospezioni Geofisiche S.n.c. | GPS TYPE and # | |
| GAUSS-BOAGA LATITUDE | GAUSS-BOAGA LONGITUDE | ALTITUDE |
| STATION TYPE PGA | SENSOR TYPE Triassiale 4,5 Hz | |
| STATION # | SENSOR # | DISK # |
| FILE NAME HVSR5.saf | | POINT # |
| GAIN | SAMPL. FREQ. 250 Hz | REC. DURATION 30 min minutes seconds |

WEATHER CONDITIONS
- WIND: ☒ none ☐ weak (5m/s) ☐ medium ☐ strong Measurement (if any): ______
- RAIN: ☒ none ☐ weak ☐ medium ☐ strong Measurement (if any): ______
- Temperature (approx): 28 °C 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 Infissione

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

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

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

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

Trees, buildings

OBSERVATIONS

FREQUENCY: Hz (if computed in the field)

**Qualità della misura:**

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

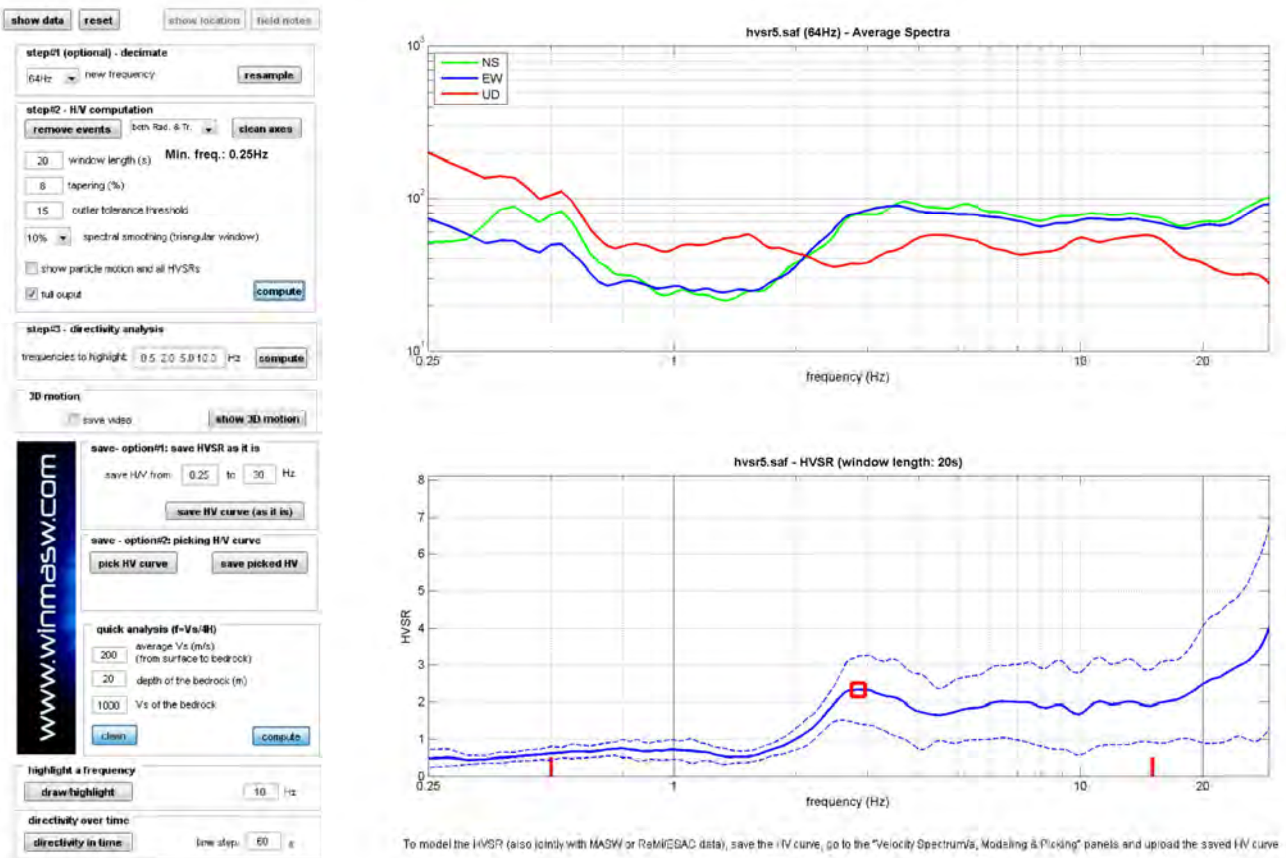
**MISURA TIPO B1**

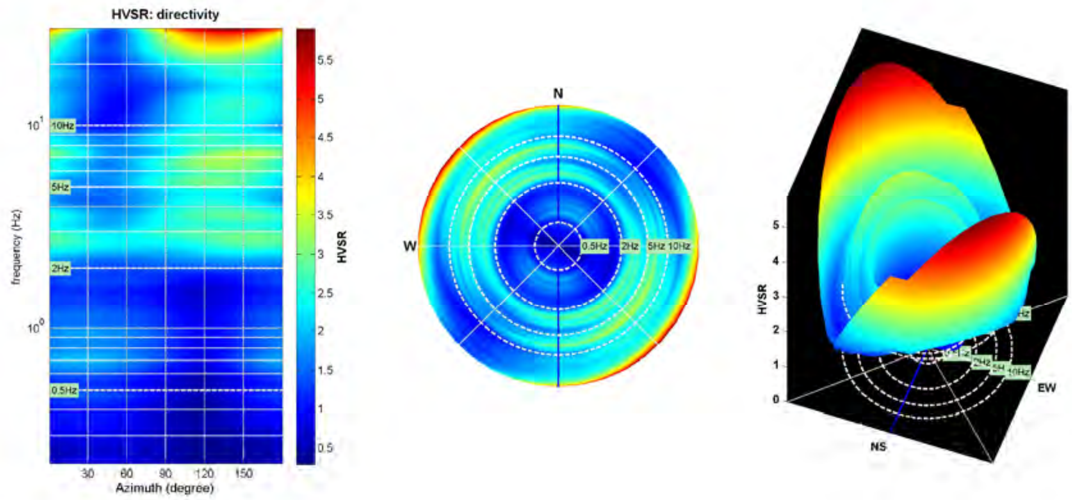
## HVSR54

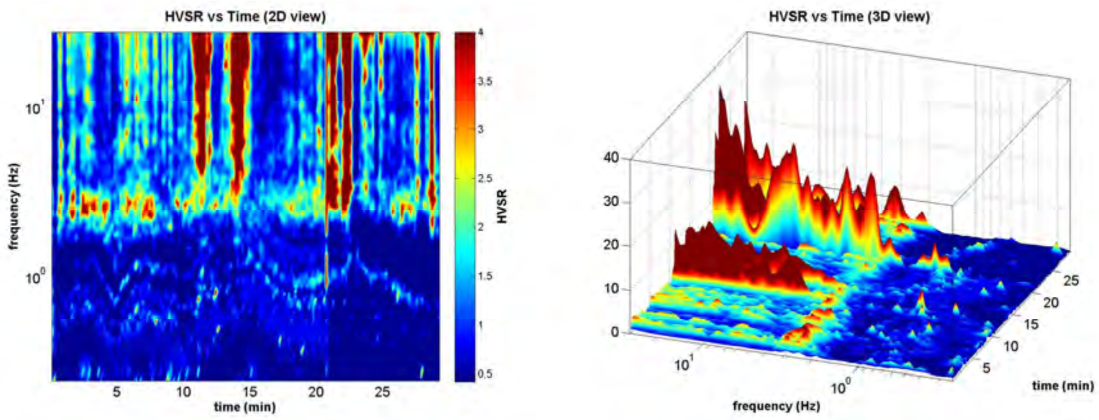
Peak frequency (Hz): 2.8 (±3.7)
Peak HVSR value: 2.3 (±0.9)

=== Criteria for a reliable H/V curve ====================================
#1. [f0 > 10/Lw]: 2.847 > 0.5 (OK)
#2. [nc > 200]: 10020 > 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 (considering standard deviations), at frequency Hz (OK)
#3. [A0 > 2]: 2.3 > 2 (OK)
#4. [fpeak[Ah/v(f) ą sigmaA(f)] = f0 ą 5%]: (NO)
#5. [sigmaf < epsilon(f0)]: 3.700 > 0.142 (NO)
#6. [sigmaA(f0) < theta(f0)]: 0.908 < 1.58 (OK)


show data
reset
show location
field notes
step#1 (optional) - decimate
64Hz
new frequency
resample
step#2 - H/V computation
remove events
both Rad. & Tr.
clean axes
20
window length (s)
Min. freq.: 0.25Hz
8
tapering (%)
15
outlier tolerance threshold
10%
spectral smoothing (triangular window)
show particle motion and all HVSRs
full 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)
average Vs (m/s)
(from surface to bedrock)
200
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
hvsr5.saf (64Hz) - Average Spectra
NS
EW
UD
frequency (Hz)
hvsr5.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)

# HVSR55

| | | |
|---|---|---|
| DATE 26.05.2017 | HOUR 14.56 | PLACE Via delle Sorgenti |
| OPERATOR Geologica Toscana - Prospezioni Geofisiche S.n.c. | GPS TYPE and # | |
| GAUSS-BOAGA LATITUDE | GAUSS-BOAGA LONGITUDE | ALTITUDE |
| STATION TYPE PGA | SENSOR TYPE Triassiale 4,5 Hz | |
| STATION # | SENSOR # | DISK # |
| FILE NAME HVSR6.saf | | POINT # |
| GAIN | SAMPL. FREQ. 250 Hz | REC. DURATION 30 min minutes seconds |

WEATHER CONDITIONS
WIND ☐ none ● weak (5m/s) ☐ medium ☐ strong Measurement (if any):
RAIN ● none ☐ weak ☐ medium ☐ strong Measurement (if any):
Temperature (approx): 28 °C 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 Infissione

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, ...)
Elettrodotto

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

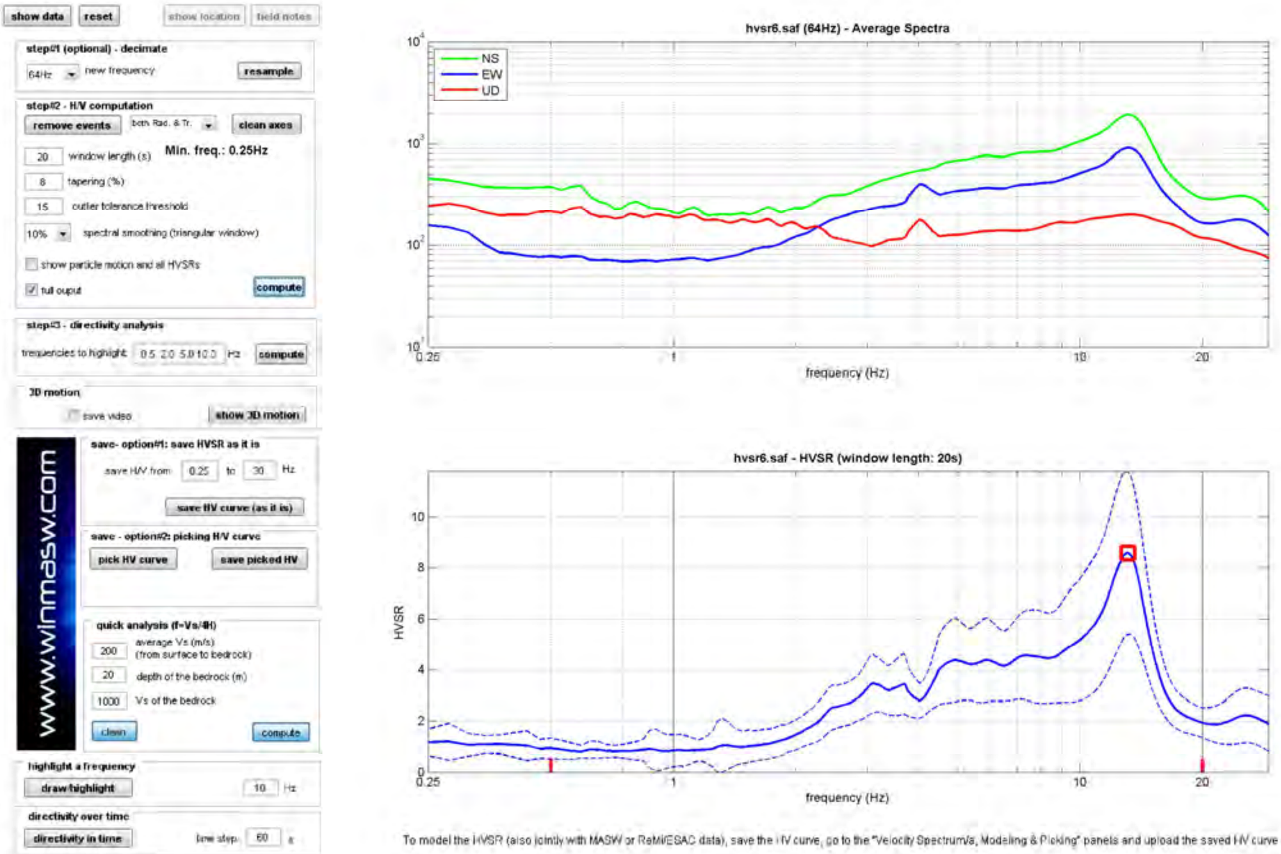
**MISURA TIPO A1**

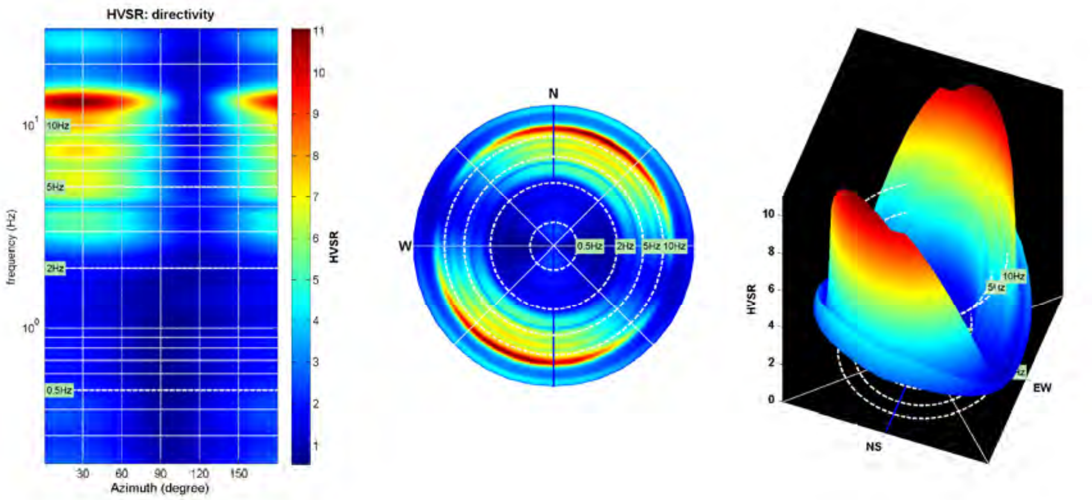
## HVSR55

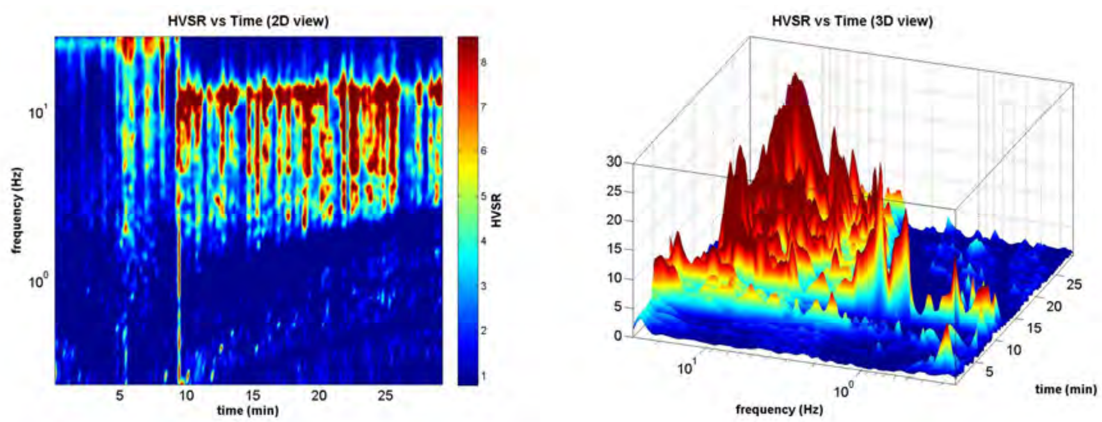
Peak frequency (Hz): 13.1 (±4.8)
Peak HVSR value: 8.6 (±3.2)

=== Criteria for a reliable H/V curve ====================================
#1. [f0 > 10/Lw]: 13.107 > 0.5 (OK)
#2. [nc > 200]: 46135 > 200 (OK)
#3. [f0>0.5Hz; sigmaA(f) < 2 for 0.5f0 < f < 2f0] (OK)

=== Criteria for a clear H/V peak (at least 5 should be fulfilled) ===========
#1. [exists f- in the range [f0/4, f0] | AH/V(f-) < A0/2]: yes, at frequency 3.3Hz (OK)
#2. [exists f+ in the range [f0, 4f0] | AH/V(f+) < A0/2]: yes, at frequency 15.4Hz (OK)
#3. [A0 > 2]: 8.6 > 2 (OK)
#4. [fpeak[Ah/v(f) ą sigmaA(f)] = f0 ą 5%]: (OK)
#5. [sigmaf < epsilon(f0)]: 4.815 > 0.655 (NO)
#6. [sigmaA(f0) < theta(f0)]: 3.176 < 1.58 (NO)


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
3D motion
save video
show 3D motion
www.winmasw.com
save- option#1: save HVSR as it is
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
highlight a frequency
draw highlight
directivity over time
directivity in time
hvsr6.saf (64Hz) - Average Spectra
NS
EW
UD
frequency (Hz)
hvsr6.saf - 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/a, Modeling & Picking" panels and upload the saved HV curve


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


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

# HVSR56

| | | |
|---|---|---|
| DATE 30.05.2017 | HOUR 9.40 | PLACE Via della Ferrovia |
| OPERATOR Geologica Toscana - Prospezioni Geofisiche S.n.c. | GPS TYPE and # | |
| GAUSS-BOAGA LATITUDE | GAUSS-BOAGA LONGITUDE | ALTITUDE |
| STATION TYPE PGA | SENSOR TYPE Triassiale 4,5 Hz | |
| STATION # | SENSOR # | DISK # |
| FILE NAME HVSR7.saf | | POINT # |
| GAIN | SAMPL. FREQ. 250 Hz | REC. DURATION 30 min minutes seconds |

WEATHER CONDITIONS
WIND ☐ none ● weak (5m/s) ☐ medium ☐ strong Measurement (if any): ______
RAIN ● none ☐ weak ☐ medium ☐ strong Measurement (if any): ______
Temperature (approx): 22 °C 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 Factories

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

OBSERVATIONS

FREQUENCY: Hz
(if computed in the field)

**Qualità della misura:**

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

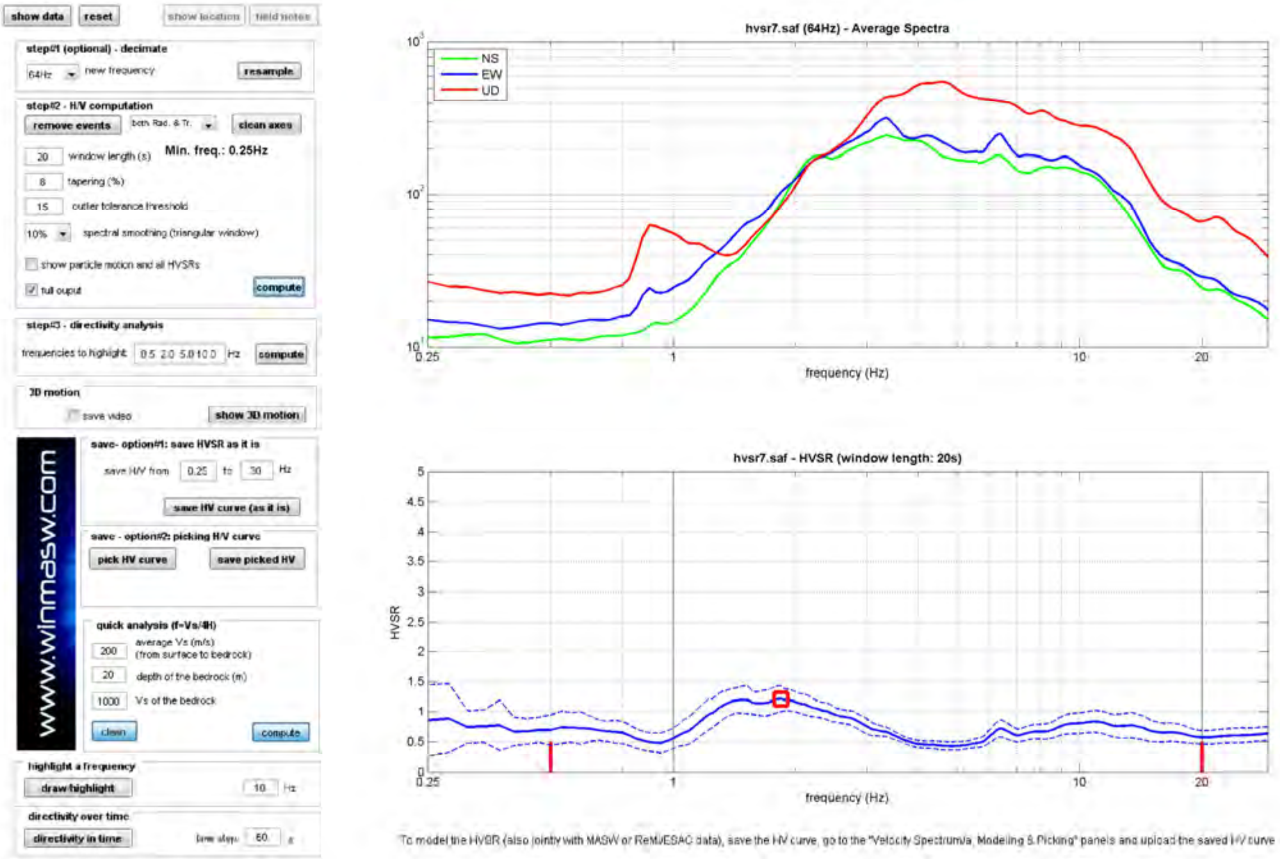
**MISURA TIPO A2**

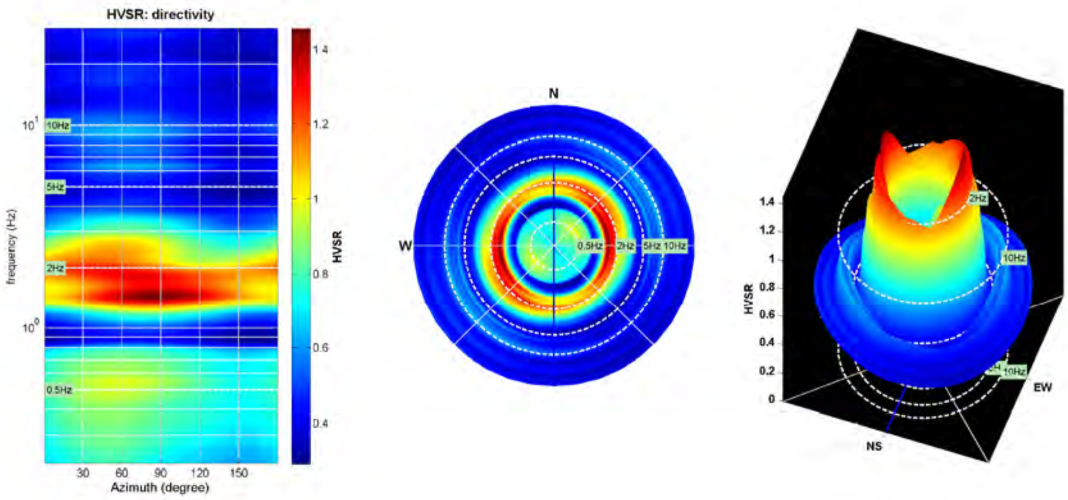
**HVSR56**

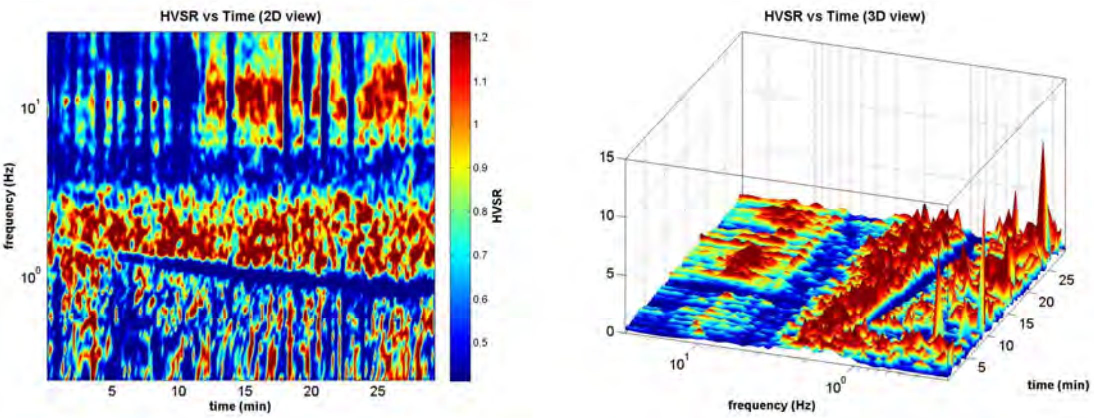
Peak frequency (Hz): 1.8 (±2.0)
Peak HVSR value: 1.2 (±0.2)

=== Criteria for a reliable H/V curve ====================================
#1. [f0 > 10/Lw]: 1.846 > 0.5 (OK)
#2. [nc > 200]: 6496 > 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 3.5Hz (OK)
#3. [A0 > 2]: 1.2 < 2 (NO)
#4. [fpeak[Ah/v(f) ą sigmaA(f)] = f0 ą 5%]: (OK)
#5. [sigmaf < epsilon(f0)]: 2.023 > 0.185 (NO)
#6. [sigmaA(f0) < theta(f0)]: 0.211 < 1.78 (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 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
directivity over time
directivity in time
hvsr7.saf (64Hz) - Average Spectra
NS
EW
UD
frequency (Hz)
hvsr7.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 H/V curve


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


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

# HVSR57

| | | |
|---|---|---|
| DATE 30.05.2017 | HOUR 10.30 | PLACE Via di Levante |
| OPERATOR Geologica Toscana - Prospezioni Geofisiche S.n.c. | GPS TYPE and # | |
| GAUSS-BOAGA LATITUDE | GAUSS-BOAGA LONGITUDE | ALTITUDE |
| STATION TYPE PGA | SENSOR TYPE Triassiale 4,5 Hz | |
| STATION # | SENSOR # | DISK # |
| FILE NAME HVSR8.saf | | POINT # |
| GAIN | SAMPL. FREQ. 250 Hz | REC. DURATION 30 min minutes seconds |

WEATHER CONDITIONS
- WIND: ☐ none ☐ weak (5m/s) ◉ medium ☐ strong Measurement (if any): ______
- RAIN: ◉ none ☐ weak ☐ medium ☐ strong Measurement (if any): ______
- Temperature (approx): 23 °C 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 Factories

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

Highway

OBSERVATIONS

FREQUENCY: Hz (if computed in the field)

**Qualità della misura:**

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

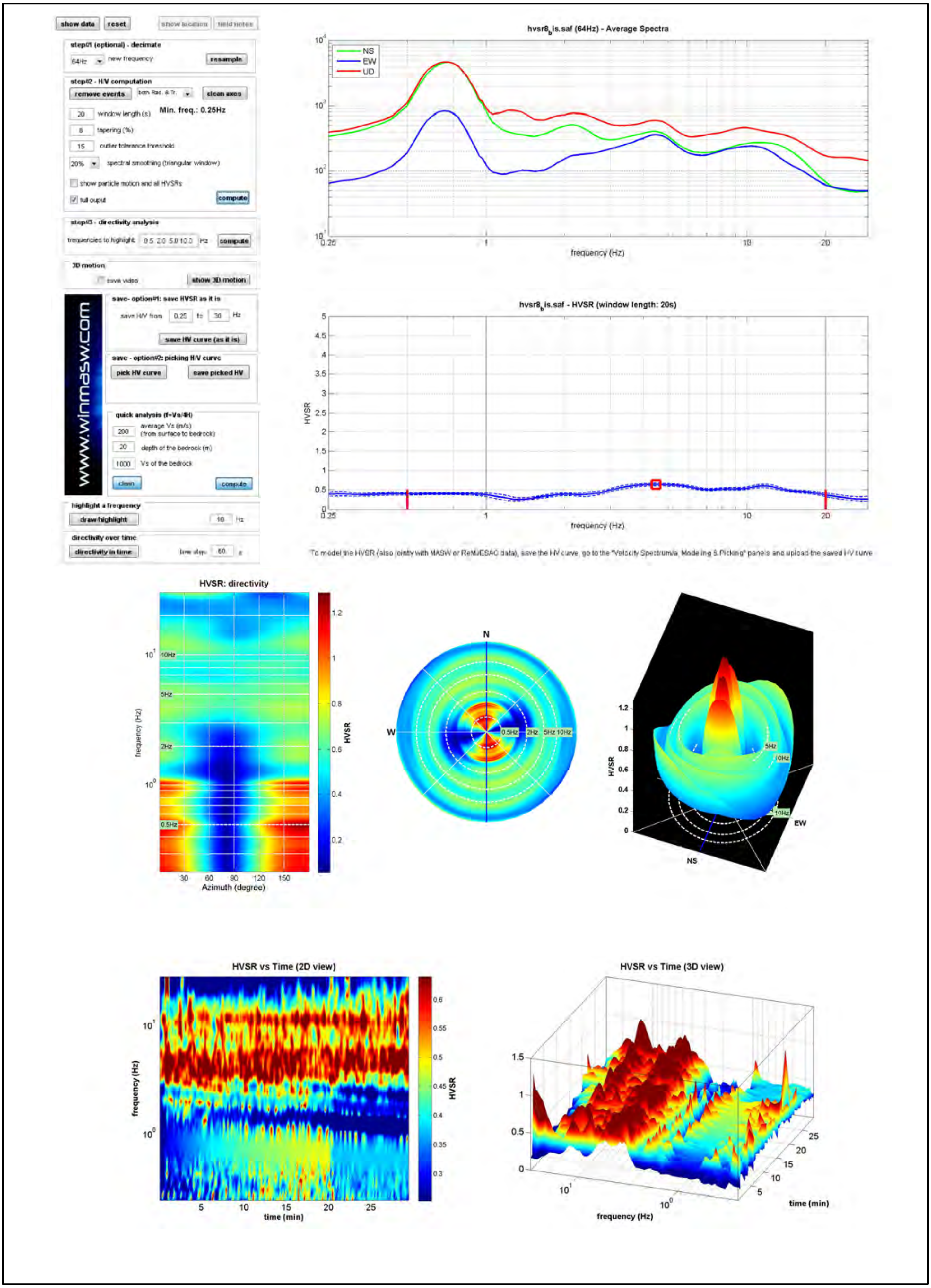
## MISURA TIPO B2

**HVSR57**

Peak frequency (Hz): 4.5 (±3.3)
Peak HVSR value: 0.6 (±0.0)

=== Criteria for a reliable H/V curve ====================================
#1. [f0 > 10/Lw]: 4.473 > 0.5 (OK)
#2. [nc > 200]: 15835 > 200 (OK)
#3. [f0>0.5Hz; sigmaA(f) < 2 for 0.5f0 < f < 2f0] (OK)

=== Criteria for a clear H/V peak (at least 5 should be fulfilled) ===========
#1. [exists f- in the range [f0/4, f0] | AH/V(f-) < A0/2]: yes, at frequency 1.2Hz (OK)
#2. [exists f+ in the range [f0, 4f0] | AH/V(f+) < A0/2]: (NO)
#3. [A0 > 2]: 0.6 < 2 (NO)
#4. [fpeak[Ah/v(f) ą sigmaA(f)] = f0 ą 5%]: (OK)
#5. [sigmaf < epsilon(f0)]: 3.279 > 0.224 (NO)
#6. [sigmaA(f0) < theta(f0)]: 0.040 < 1.58 (OK)


show data
reset
step#1 (optional) - decimate
resample
step#2 - H/V computation
remove events
clean axes
Min. freq.: 0.25Hz
window length (s)
tapering (%)
outlier tolerance threshold
spectral smoothing (triangular window)
show particle motion and all HVSRs
full ouput
compute
step#3 - directivity analysis
frequencies to highlight
3D motion
show 3D motion
www.winmasw.com
save- option#1: save HVSR as it is
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
highlight a frequency
draw highlight
directivity over time
directivity in time
hvsr8_b is.saf (64Hz) - Average Spectra
NS
EW
UD
frequency (Hz)
hvsr8_b is.saf - HVSR (window length: 20s)
HVSR
frequency (Hz)
To model the HVSR (also jointly with MASW or ReMi/ESAC data), save the HV curve, go to the "Velocity Spectrum/a, Modeling & Picking" panels and upload the saved HV curve
HVSR: directivity
frequency (Hz)
Azimuth (degree)
HVSR
N
W
HVSR
NS
EW
HVSR vs Time (2D view)
frequency (Hz)
time (min)
HVSR
HVSR vs Time (3D view)
frequency (Hz)
time (min)

# HVSR58

| | | |
|---|---|---|
| DATE 30.05.2017 | HOUR 11.13 | PLACE Via Grotta delle fate |
| OPERATOR Geologica Toscana - Prospezioni Geofisiche S.n.c. | GPS TYPE and # | |
| GAUSS-BOAGA LATITUDE | GAUSS-BOAGA LONGITUDE | ALTITUDE |
| STATION TYPE PGA | SENSOR TYPE Triassiale 4,5 Hz | |
| STATION # | SENSOR # | DISK # |
| FILE NAME HVSR9.saf | | POINT # |
| GAIN | SAMPL. FREQ. 250 Hz | REC. DURATION 30 min minutes seconds |

WEATHER CONDITIONS
- WIND: ☐ none ☐ weak (5m/s) ☒ medium ☐ strong Measurement (if any): ______
- RAIN: ☒ none ☐ weak ☐ medium ☐ strong Measurement (if any): ______
- Temperature (approx): 23 °C 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 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: non rispettata
Plausibilità fisica: rispettata
Robustezza statistica: rispettata

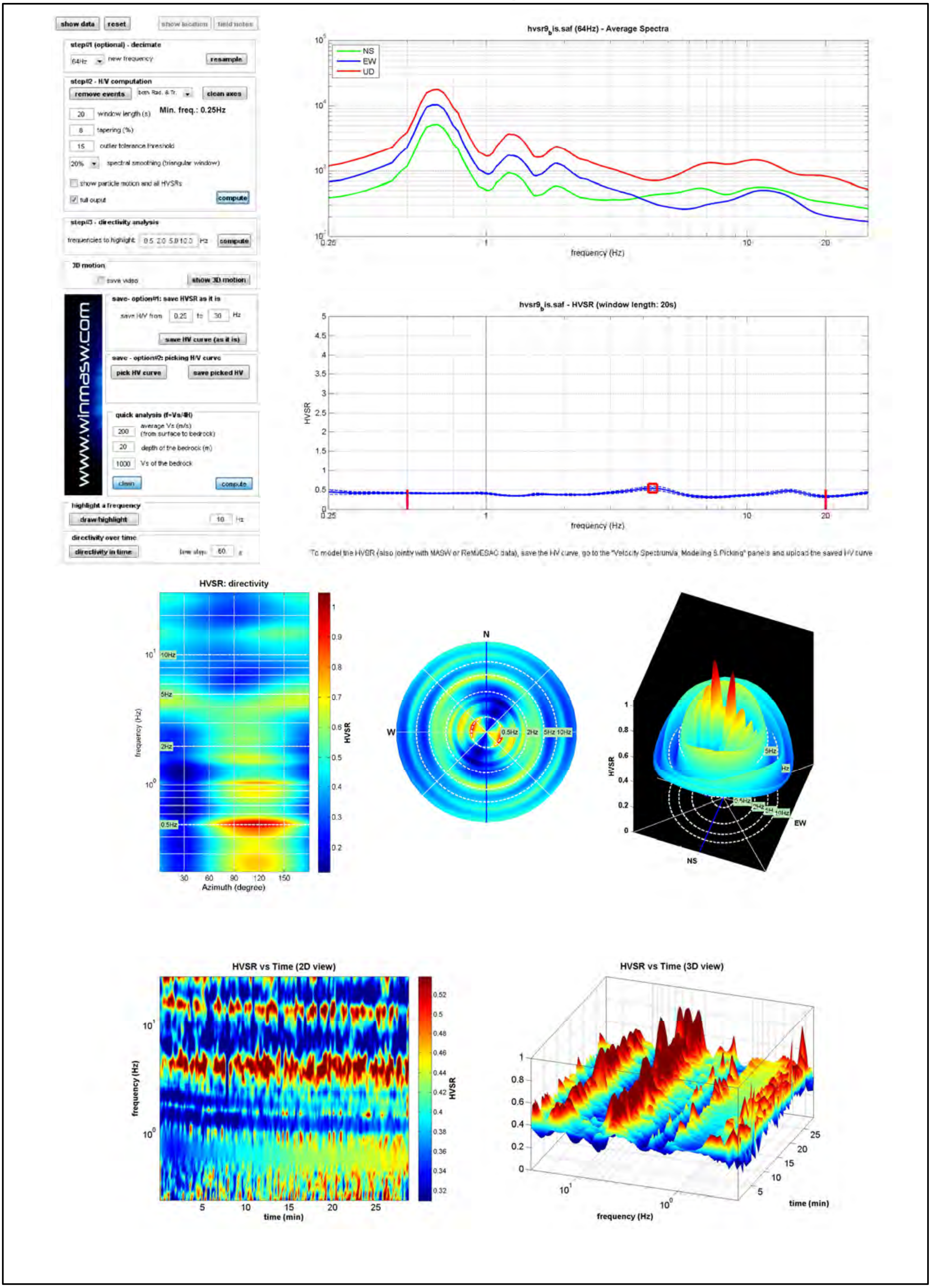
## MISURA TIPO B2

## HVSR58

Peak frequency (Hz): 4.3 (±4.0)
Peak HVSR value: 0.5 (±0.1)

=== Criteria for a reliable H/V curve ====================================
#1. [f0 > 10/Lw]: 4.348 > 0.5 (OK)
#2. [nc > 200]: 15044 > 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]: 0.5 < 2 (NO)
#4. [fpeak[Ah/v(f) ą sigmaA(f)] = f0 ą 5%]: (OK)
#5. [sigmaf < epsilon(f0)]: 4.030 > 0.217 (NO)
#6. [sigmaA(f0) < theta(f0)]: 0.051 < 1.58 (OK)



hvsr9_b is.saf (64Hz) - Average Spectra
NS
EW
UD
frequency (Hz)
hvsr9_b is.saf - 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/a, Modeling & Picking" panels and upload the saved HV curve
www.winmasw.com
HVSR: directivity
frequency (Hz)
Azimuth (degree)
HVSR vs Time (2D view)
time (min)
HVSR vs Time (3D view)
frequency (Hz)

# HVSR59

| | | |
|---|---|---|
| DATE 30.05.2017 | HOUR 11.55 | PLACE Viale Italia |
| OPERATOR Geologica Toscana - Prospezioni Geofisiche S.n.c. | GPS TYPE and # | |
| GAUSS-BOAGA LATITUDE | GAUSS-BOAGA LONGITUDE | ALTITUDE |
| STATION TYPE PGA | SENSOR TYPE Triassiale 4,5 Hz | |
| STATION # | SENSOR # | DISK # |
| FILE NAME HVSR10.saf | | POINT # |
| GAIN | SAMPL. FREQ. 250 Hz | REC. DURATION 30 min minutes seconds |

WEATHER CONDITIONS
- WIND ☐ none ☐ weak (5m/s) ☒ medium ☐ strong Measurement (if any): ______
- RAIN ☒ none ☐ weak ☐ medium ☐ strong Measurement (if any): ______
- Temperature (approx): 27 °C 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 Factories

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

Trees

OBSERVATIONS

FREQUENCY: Hz (if computed in the field)

**Qualità della misura:**

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

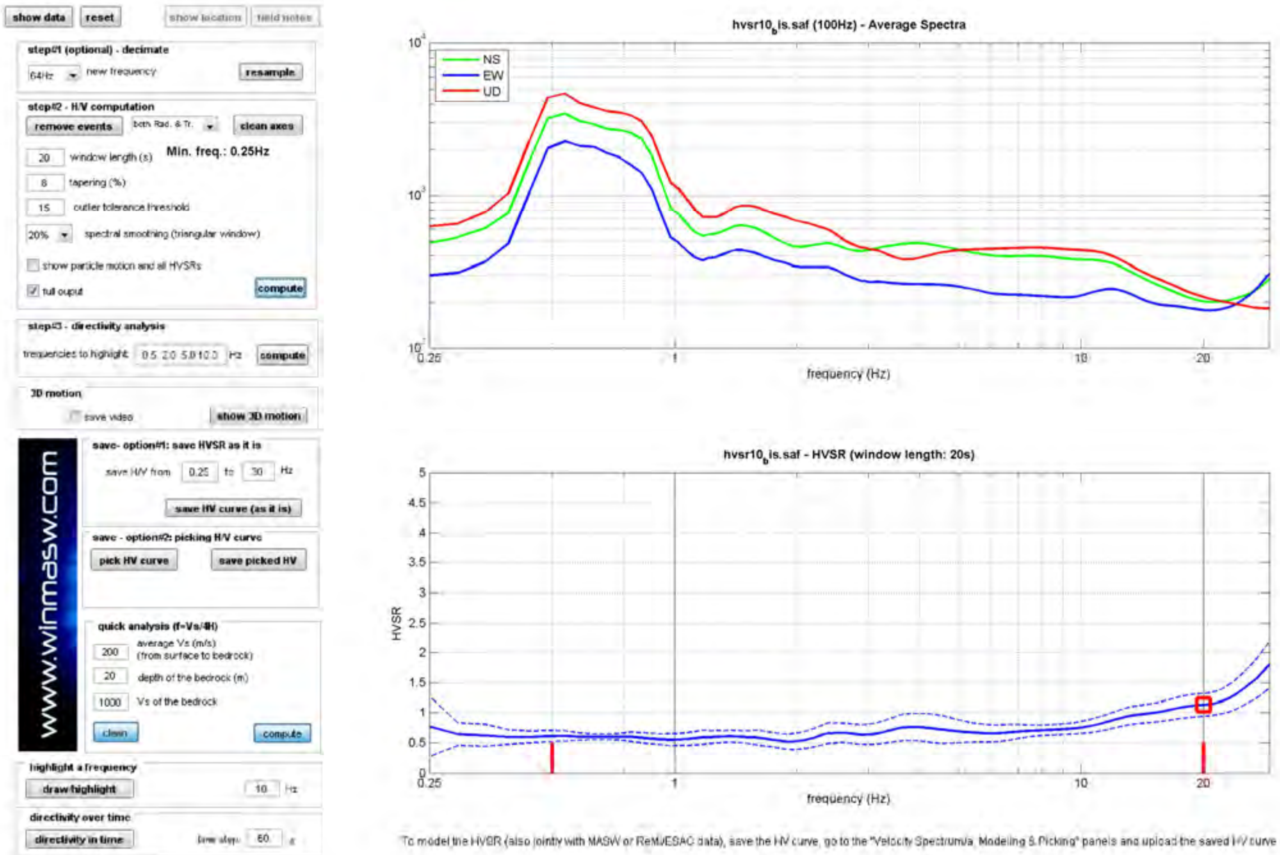
## MISURA TIPO A2

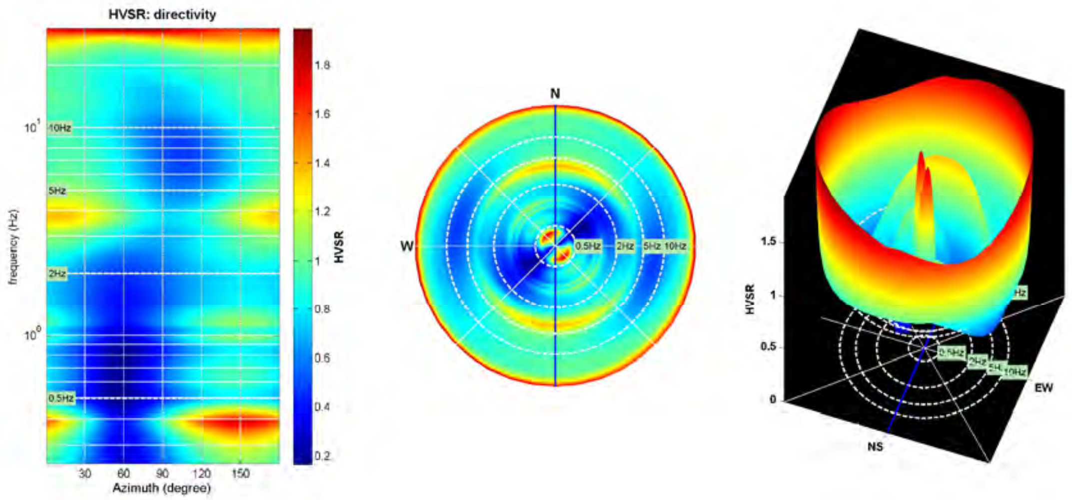
**HVSR59**

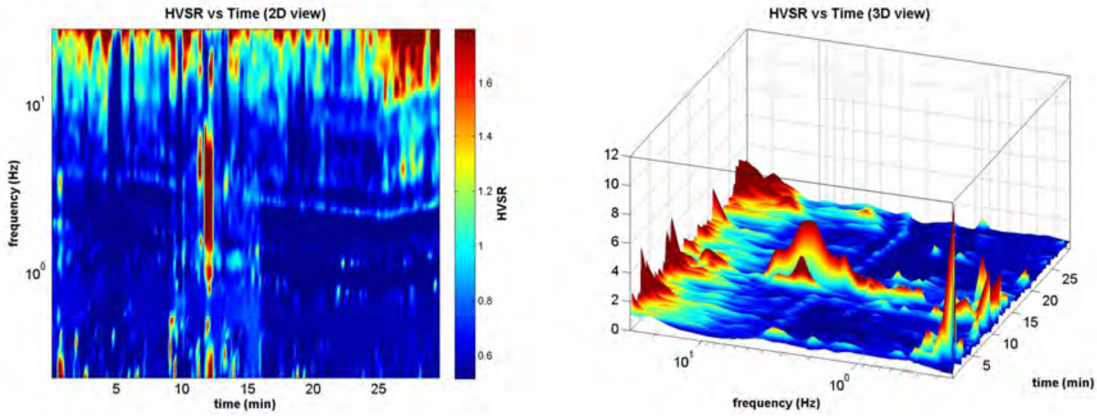
Peak frequency (Hz): 20.0 (±7.0)
Peak HVSR value: 1.1 (±0.2)

=== Criteria for a reliable H/V curve ====================================
#1. [f0 > 10/Lw]: 19.990 > 0.5 (OK)
#2. [nc > 200]: 71165 > 200 (OK)
#3. [f0>0.5Hz; sigmaA(f) < 2 for 0.5f0 < f < 2f0] (OK)

=== Criteria for a clear H/V peak (at least 5 should be fulfilled) ===========
#1. [exists f- in the range [f0/4, f0] | AH/V(f-) < A0/2]: yes (considering standard deviations), at frequency 5.0Hz (OK)
#2. [exists f+ in the range [f0, 4f0] | AH/V(f+) < A0/2]: (NO)
#3. [A0 > 2]: 1.1 < 2 (NO)
#4. [fpeak[Ah/v(f) ą sigmaA(f)] = f0 ą 5%]: (OK)
#5. [sigmaf < epsilon(f0)]: 7.034 > 1.000 (NO)
#6. [sigmaA(f0) < theta(f0)]: 0.190 < 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
20%
spectral smoothing (triangular window)
show particle motion and all HVSRs
full ouput
compute
step#3 - directivity analysis
frequencies to highlight
0.5 2.0 5.0 10.0
Hz
compute
3D motion
save video
show 3D motion
www.winmasw.com
save- option#1: save HVSR as it is
save H/V from
0.25
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
hvsr10_b is.saf (100Hz) - Average Spectra
NS
EW
UD
frequency (Hz)
hvsr10_b is.saf - HVSR (window length: 20s)
HVSR
frequency (Hz)
To model the HVSR (also jointly with MASW or ReMi/ESAC data), save the HV curve, go to the "Velocity Spectrum/a, Modeling & Picking" panels and upload the saved HV curve


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


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

# HVSR60

| | | |
|---|---|---|
| DATE 30.05.2017 | HOUR 13.05 | PLACE Viale di Antignano |
| OPERATOR Geologica Toscana - Prospezioni Geofisiche S.n.c. | GPS TYPE and # | |
| GAUSS-BOAGA LATITUDE | GAUSS-BOAGA LONGITUDE | ALTITUDE |
| STATION TYPE PGA | SENSOR TYPE Triassiale 4,5 Hz | |
| STATION # | SENSOR # | DISK # |
| FILE NAME HVSR11.saf | | POINT # |
| GAIN | SAMPL. FREQ. 250 Hz | REC. DURATION 30 min minutes seconds |

WEATHER CONDITIONS
WIND ☐ none ☒ weak (5m/s) ☐ medium ☐ strong Measurement (if any):
RAIN ☒ none ☐ weak ☐ medium ☐ strong Measurement (if any):
Temperature (approx): 28 °C Remarks

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

ARTIFICIAL GROUND-SENSOR COUPLING ☐ no ☒ yes, type

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

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

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

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

OBSERVATIONS

FREQUENCY: Hz
(if computed in the field)

**Qualità della misura:**

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

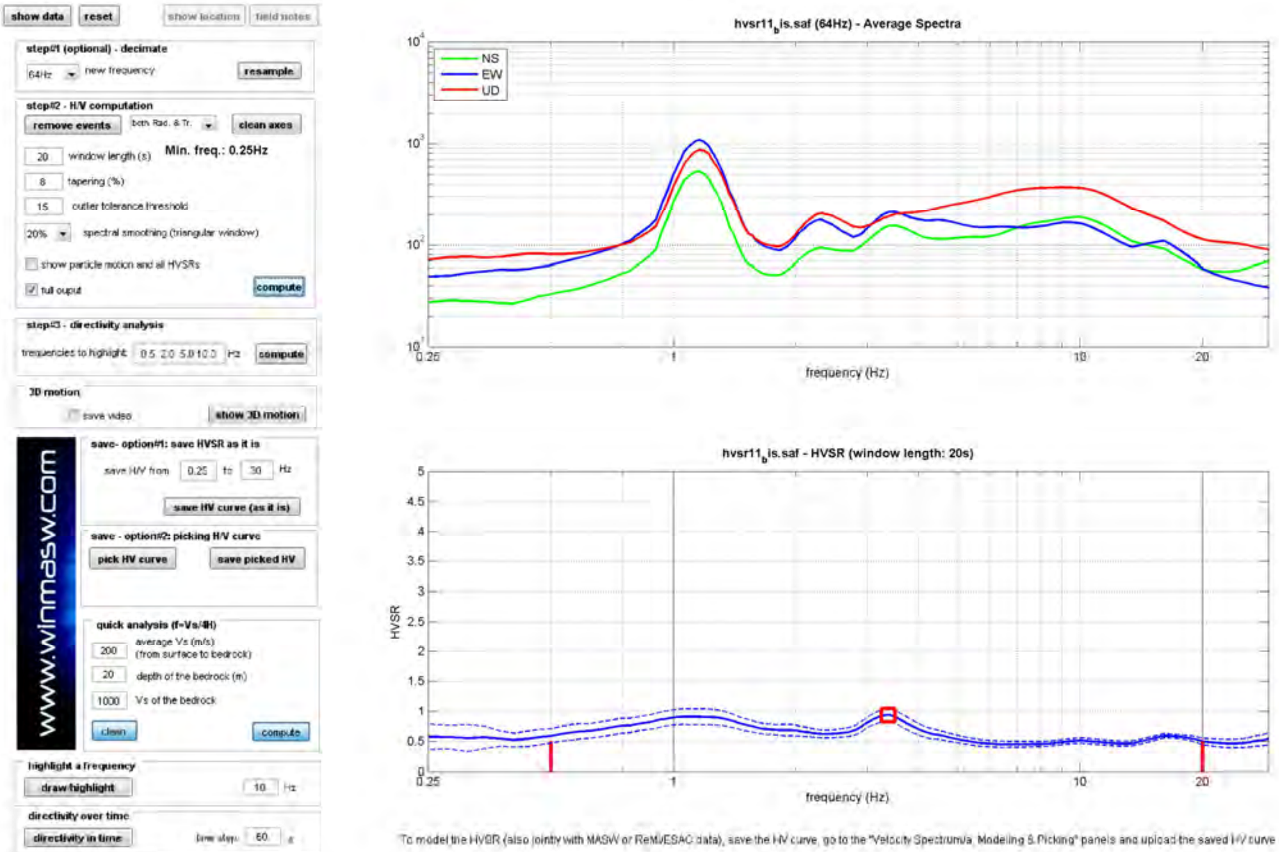
## MISURA TIPO B2

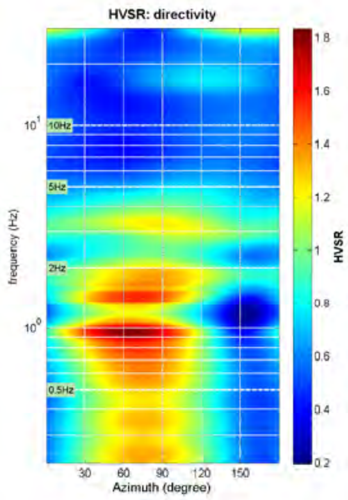
**HVSR60**

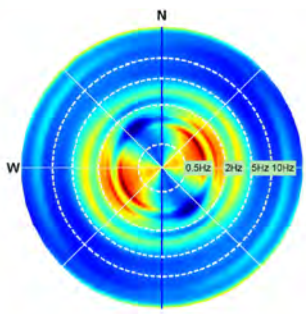
Peak frequency (Hz): 3.4 (±1.2)
Peak HVSR value: 0.9 (±0.1)

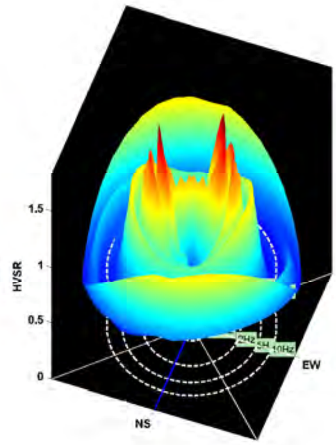
=== Criteria for a reliable H/V curve ====================================
#1. [f0 > 10/Lw]: 3.378 > 0.5 (OK)
#2. [nc > 200]: 11892 > 200 (OK)
#3. [f0>0.5Hz; sigmaA(f) < 2 for 0.5f0 < f < 2f0] (OK)

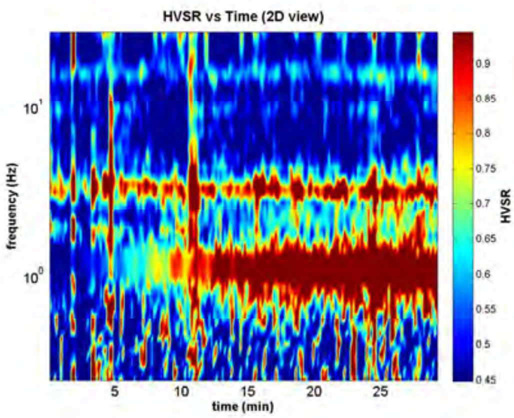
=== Criteria for a clear H/V peak (at least 5 should be fulfilled) ===========
#1. [exists f- in the range [f0/4, f0] | AH/V(f-) < A0/2]: (NO)
#2. [exists f+ in the range [f0, 4f0] | AH/V(f+) < A0/2]: yes, at frequency 5.7Hz (OK)
#3. [A0 > 2]: 0.9 < 2 (NO)
#4. [fpeak[Ah/v(f) ą sigmaA(f)] = f0 ą 5%]: (OK)
#5. [sigmaf < epsilon(f0)]: 1.187 > 0.169 (NO)
#6. [sigmaA(f0) < theta(f0)]: 0.104 < 1.58 (OK)

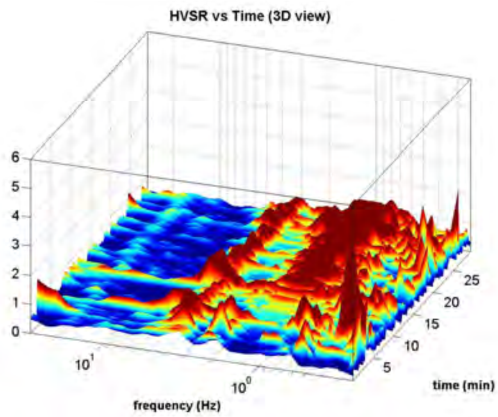

show data
reset
step#1 (optional) - decimate
resample
step#2 - H/V computation
remove events
clean axes
Min. freq.: 0.25Hz
window length (s)
tapering (%)
outlier tolerance threshold
spectral smoothing (triangular window)
show particle motion and all HVSRs
full ouput
compute
step#3 - directivity analysis
frequencies to highlight
3D motion
save video
show 3D motion
www.winmasw.com
save- option#1: save HVSR as it is
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
highlight a frequency
draw highlight
directivity over time
directivity in time
hvsr11_b is.saf (64Hz) - Average Spectra
NS
EW
UD
frequency (Hz)
hvsr11_b is.saf - HVSR (window length: 20s)
HVSR
frequency (Hz)
To model the HVSR (also jointly with MASW or ReMi/ESAC data), save the HV curve, go to the "Velocity Spectrum/a, Modeling & Picking" panels and upload the saved HV curve


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


N
W
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)

# HVSR61

| | | |
|---|---|---|
| DATE 30.05.2017 | HOUR 13.40 | PLACE Via Caduti dei lager nazisiti |
| OPERATOR Geologica Toscana - Prospezioni Geofisiche S.n.c. | GPS TYPE and # | |
| GAUSS-BOAGA LATITUDE | GAUSS-BOAGA LONGITUDE | ALTITUDE |
| STATION TYPE PGA | SENSOR TYPE Triassiale 4,5 Hz | |
| STATION # | SENSOR # | DISK # |
| FILE NAME HVSR12.saf | | POINT # |
| GAIN | SAMPL. FREQ. 250 Hz | REC. DURATION 30 min (minutes / seconds) |

WEATHER CONDITIONS
- WIND: ☐ none ☒ weak (5m/s) ☐ medium ☐ strong Measurement (if any):
- RAIN: ☒ none ☐ weak ☐ medium ☐ strong Measurement (if any):
- Temperature (approx): 28 °C Remarks

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

ARTIFICIAL GROUND-SENSOR COUPLING ☐ no ☒ yes, type

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

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

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

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

Buildings, trees

OBSERVATIONS

FREQUENCY: Hz (if computed in the field)

**Qualità della misura:**

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

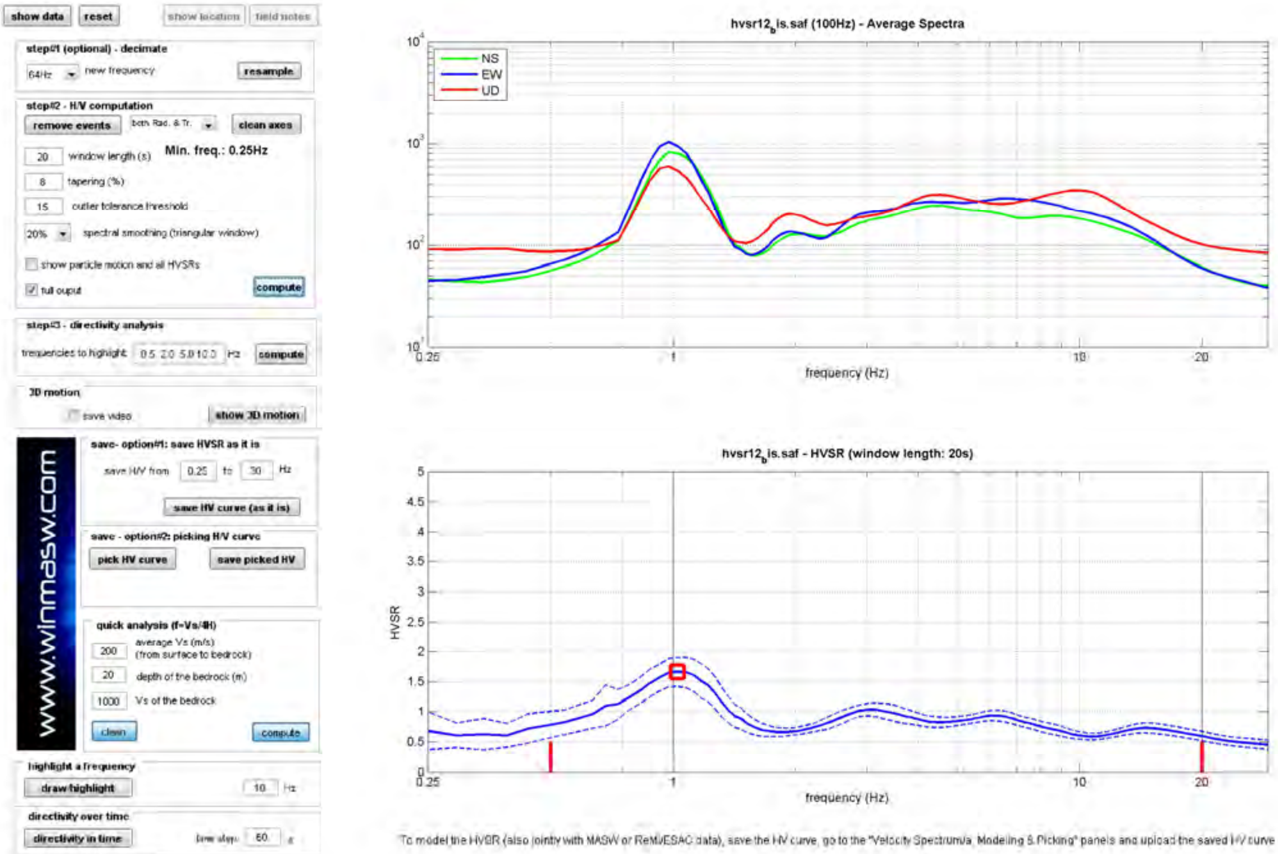
**MISURA TIPO B2**

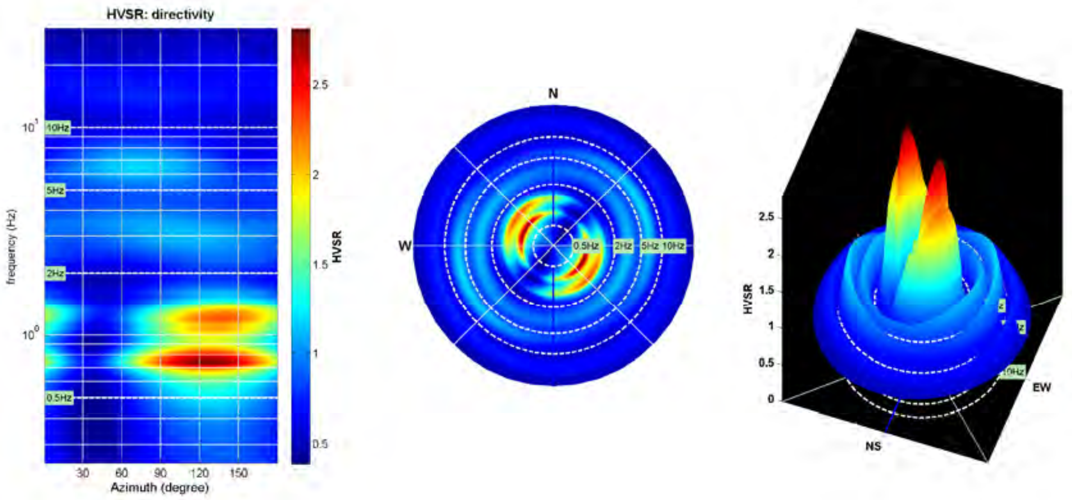
## HVSR61

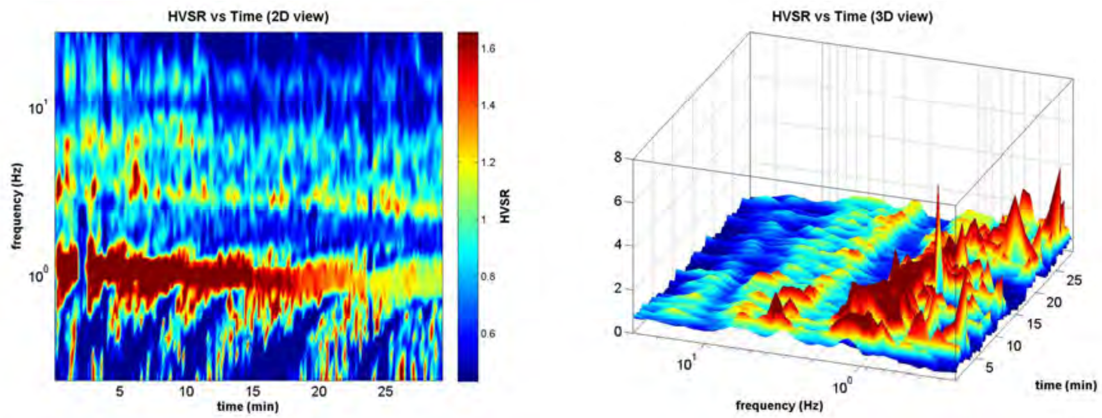
Peak frequency (Hz): 1.0 (±0.8)
Peak HVSR value: 1.7 (±0.3)

=== Criteria for a reliable H/V curve ====================================
#1. [f0 > 10/Lw]: 1.026 > 0.5 (OK)
#2. [nc > 200]: 3613 > 200 (OK)
#3. [f0>0.5Hz; sigmaA(f) < 2 for 0.5f0 < f < 2f0] (OK)

=== Criteria for a clear H/V peak (at least 5 should be fulfilled) ===========
#1. [exists f- in the range [f0/4, f0] | AH/V(f-) < A0/2]: yes, at frequency 0.5Hz (OK)
#2. [exists f+ in the range [f0, 4f0] | AH/V(f+) < A0/2]: yes, at frequency 1.6Hz (OK)
#3. [A0 > 2]: 1.7 < 2 (NO)
#4. [fpeak[Ah/v(f) ± sigmaA(f)] = f0 ± 5%]: (OK)
#5. [sigmaf < epsilon(f0)]: 0.842 > 0.103 (NO)
#6. [sigmaA(f0) < theta(f0)]: 0.242 < 1.78 (OK)


show data
reset
step#1 (optional) - decimate
step#2 - H/V computation
Min. freq.: 0.25Hz
step#3 - directivity analysis
3D motion
save- option#1: save HVSR as it is
save - option#2: picking H/V curve
quick analysis (f=Vs/4H)
highlight a frequency
directivity over time
www.winmasw.com
hvsr12_b is.saf (100Hz) - Average Spectra
NS
EW
UD
frequency (Hz)
hvsr12_b is.saf - HVSR (window length: 20s)
HVSR
frequency (Hz)
To model the HVSR (also jointly with MASW or ReMi/ESAC data), save the HV curve, go to the "Velocity Spectrum/a, Modeling & Picking" panels and upload the saved HV curve


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


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

# HVSR62

| | | |
|---|---|---|
| DATE 30.05.2017 | HOUR 14.25 | PLACE Viale Amerigo Vespucci |
| OPERATOR Geologica Toscana - Prospezioni Geofisiche S.n.c. | GPS TYPE and # | |
| GAUSS-BOAGA LATITUDE | GAUSS-BOAGA LONGITUDE | ALTITUDE |
| STATION TYPE PGA | SENSOR TYPE Triassiale 4,5 Hz | |
| STATION # | SENSOR # | DISK # |
| FILE NAME HVSR13.saf | | POINT # |
| GAIN | SAMPL. FREQ. 250 Hz | REC. DURATION 30 min minutes seconds |

WEATHER CONDITIONS
- WIND ☐ none ☒ weak (5m/s) ☐ medium ☐ strong Measurement (if any):
- RAIN ☒ none ☐ weak ☐ medium ☐ strong Measurement (if any):
- Temperature (approx): 30 °C 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 Factories

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

Highway

OBSERVATIONS

FREQUENCY: Hz (if computed in the field)

**Qualità della misura:**

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

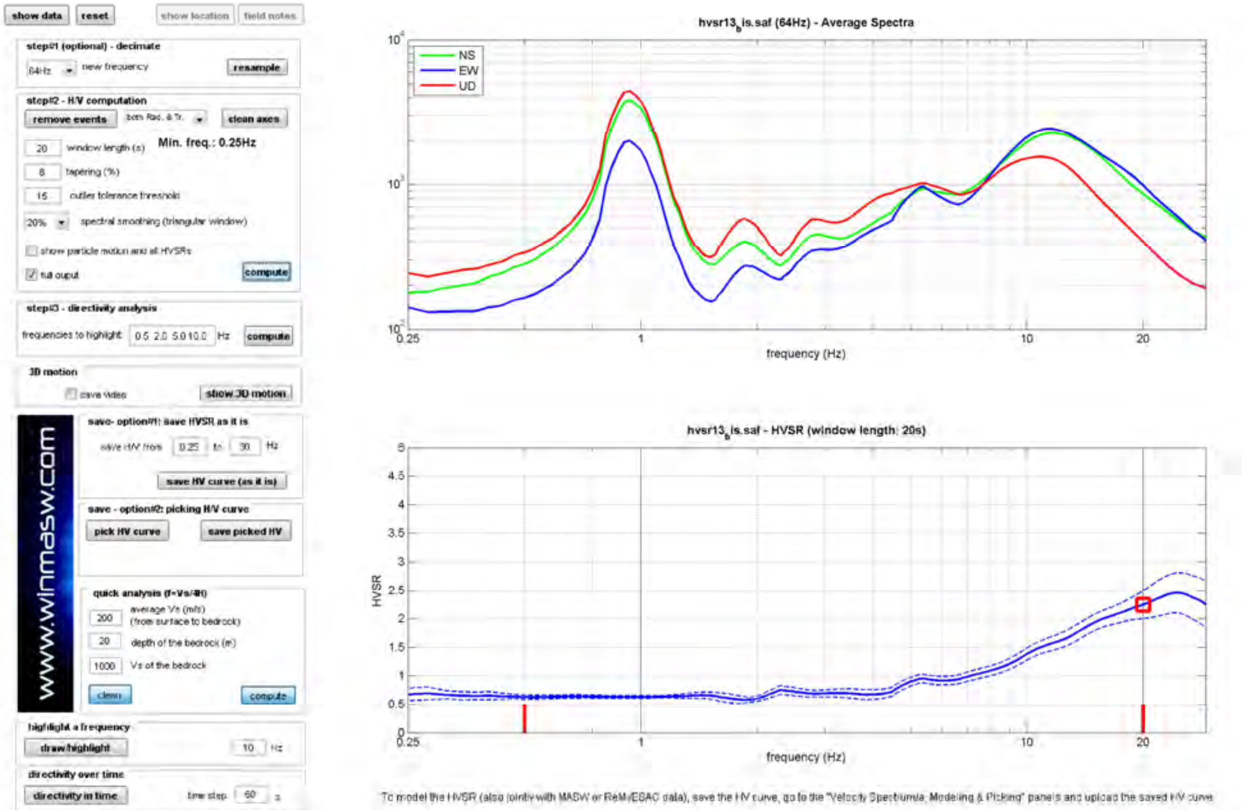
## MISURA TIPO B2

**HVSR62**

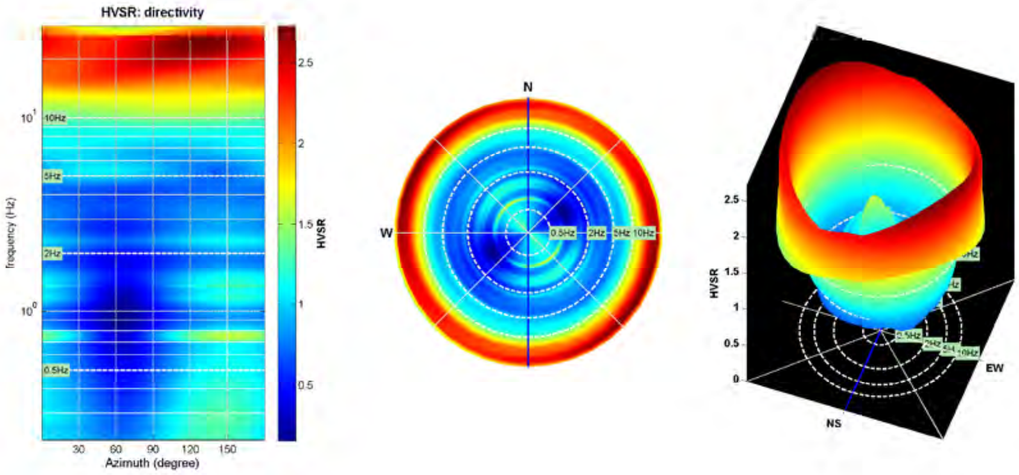
Peak frequency (Hz): 20.0 (±2.1)
Peak HVSR value: 2.2 (±0.2)

=== Criteria for a reliable H/V curve ====================================
#1. [f0 > 10/Lw]: 19.988 > 0.5 (OK)
#2. [nc > 200]: 71158 > 200 (OK)
#3. [f0>0.5Hz; sigmaA(f) < 2 for 0.5f0 < f < 2f0] (OK)

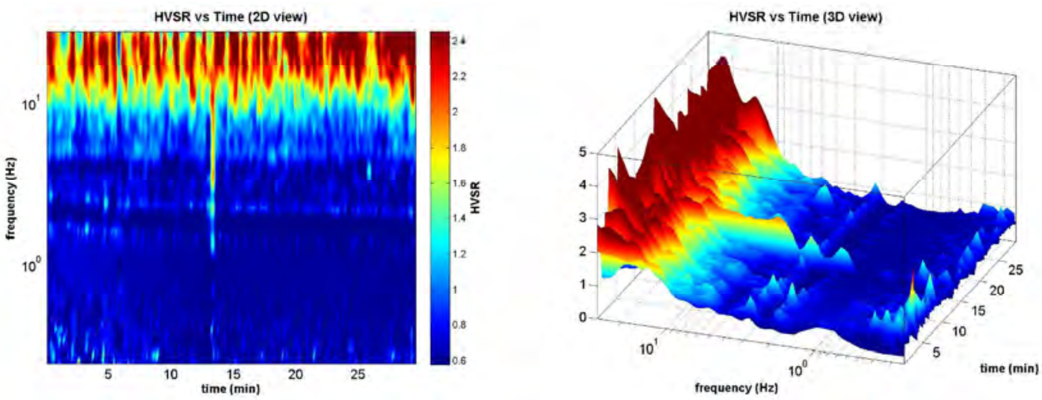
=== Criteria for a clear H/V peak (at least 5 should be fulfilled) ===========
#1. [exists f- in the range [f0/4, f0] | AH/V(f-) < A0/2]: yes, at frequency 5.0Hz (OK)
#2. [exists f+ in the range [f0, 4f0] | AH/V(f+) < A0/2]: (NO)
#3. [A0 > 2]: 2.2 > 2 (OK)
#4. [fpeak[Ah/v(f) ± sigmaA(f)] = f0 ± 5%]: (OK)
#5. [sigmaf < epsilon(f0)]: 2.099 > 0.999 (NO)
#6. [sigmaA(f0) < theta(f0)]: 0.244 < 1.58 (OK)



hvsr13_b_is.saf (64Hz) - Average Spectra
NS
EW
UD
frequency (Hz)
hvsr13_b_is.saf - HVSR (window length: 20s)
HVSR
frequency (Hz)
www.winmasw.com
Min. freq.: 0.25Hz

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

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

# HVSR63

| | | |
|---|---|---|
| DATE 13.06.2017 | HOUR 10.10 | PLACE Gorgona |
| OPERATOR Geologica Toscana - Prospezioni Geofisiche S.n.c. | GPS TYPE and # | |
| GAUSS-BOAGA LATITUDE | GAUSS-BOAGA LONGITUDE | ALTITUDE |
| STATION TYPE PGA | SENSOR TYPE Triassiale 4,5 Hz | |
| STATION # | SENSOR # | DISK # |
| FILE NAME HVSR14.saf | | POINT # |
| GAIN | SAMPL. FREQ. 100 Hz | REC. DURATION 30 min (minutes / seconds) |

WEATHER CONDITIONS
- WIND: [x] none [ ] weak (5m/s) [ ] medium [ ] strong Measurement (if any): ______
- RAIN: [x] none [ ] weak [ ] medium [ ] strong Measurement (if any): ______
- Temperature (approx): 22 °C Remarks ______

GROUND TYPE
- [ ] earth ([ ] hard [ ] soft) [ ] gravel [ ] sand [x] 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...) [ ] no [x] yes, type Factories

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

Industrial area

OBSERVATIONS

FREQUENCY: Hz (if computed in the field)

**Qualità della misura:**

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

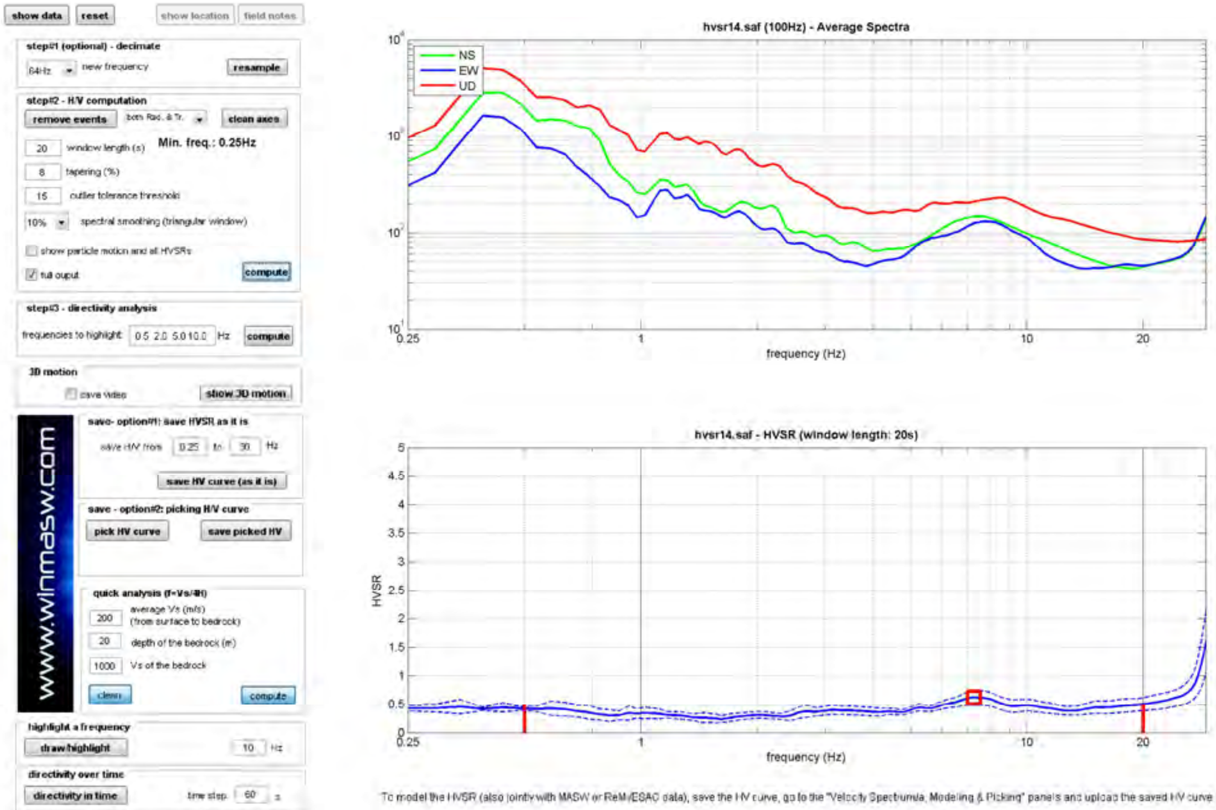
## MISURA TIPO B2

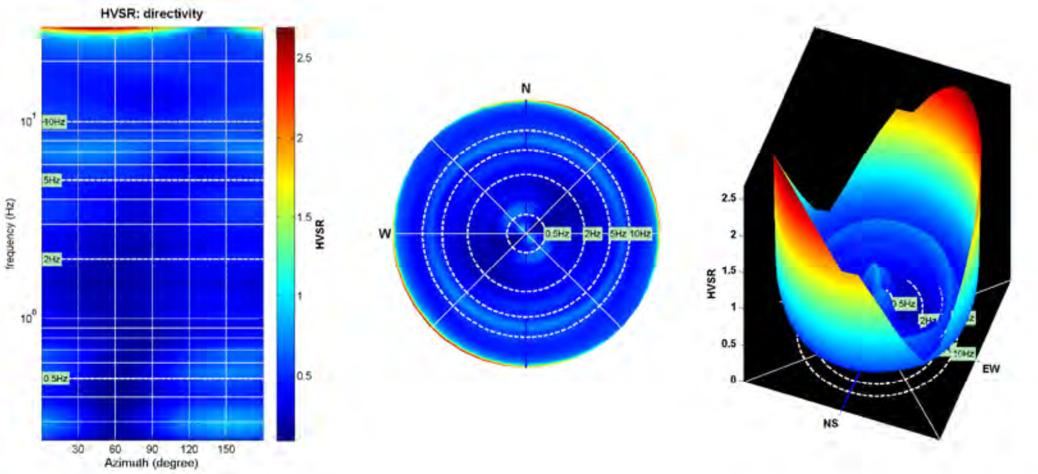
**HVSR63**

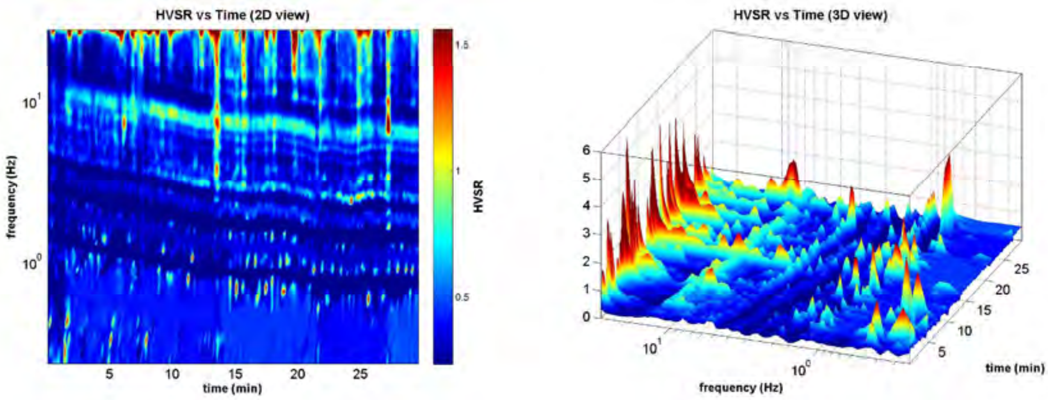
Peak frequency (Hz): 7.3 (±4.9)
Peak HVSR value: 0.6 (±0.1)

=== Criteria for a reliable H/V curve ====================================
#1. [f0 > 10/Lw]: 7.283 > 0.5 (OK)
#2. [nc > 200]: 25926 > 200 (OK)
#3. [f0>0.5Hz; sigmaA(f) < 2 for 0.5f0 < f < 2f0] (OK)

=== Criteria for a clear H/V peak (at least 5 should be fulfilled) ===========
#1. [exists f- in the range [f0/4, f0] | AH/V(f-) < A0/2]: yes, at frequency 1.9Hz (OK)
#2. [exists f+ in the range [f0, 4f0] | AH/V(f+) < A0/2]: yes (considering standard deviations), at frequency Hz (OK)
#3. [A0 > 2]: 0.6 < 2 (NO)
#4. [fpeak[Ah/v(f) ± sigmaA(f)] = f0 ± 5%]: (OK)
#5. [sigmaf < epsilon(f0)]: 4.874 > 0.364 (NO)
#6. [sigmaA(f0) < theta(f0)]: 0.123 < 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
directivity over time
directivity in time
time step
hvsr14.saf (100Hz) - Average Spectra
NS
EW
UD
frequency (Hz)
hvsr14.saf - HVSR (window length: 20s)
HVSR
frequency (Hz)
To model the HVSR (also jointly with MASW or ReMi/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
N
W
0.5Hz
2Hz
5Hz
10Hz
NS
EW


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

# HVSR64

| | | |
|---|---|---|
| DATE 13.06.2017 | HOUR 11.02 | PLACE Gorgona |
| OPERATOR Geologica Toscana - Prospezioni Geofisiche S.n.c. | GPS TYPE and # | |
| GAUSS-BOAGA LATITUDE | GAUSS-BOAGA LONGITUDE | ALTITUDE |
| STATION TYPE PGA | SENSOR TYPE Triassiale 4,5 Hz | |
| STATION # | SENSOR # | DISK # |
| FILE NAME HVSR15.saf | | POINT # |
| GAIN | SAMPL. FREQ. 100 Hz | REC. DURATION 30 min minutes seconds |

WEATHER CONDITIONS
- WIND ☒ none ☐ weak (5m/s) ☐ medium ☐ strong Measurement (if any):
- RAIN ☒ none ☐ weak ☐ medium ☐ strong Measurement (if any):
- Temperature (approx): 27 °C 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 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: non rispettata
Plausibilità fisica: rispettata
Robustezza statistica: rispettata

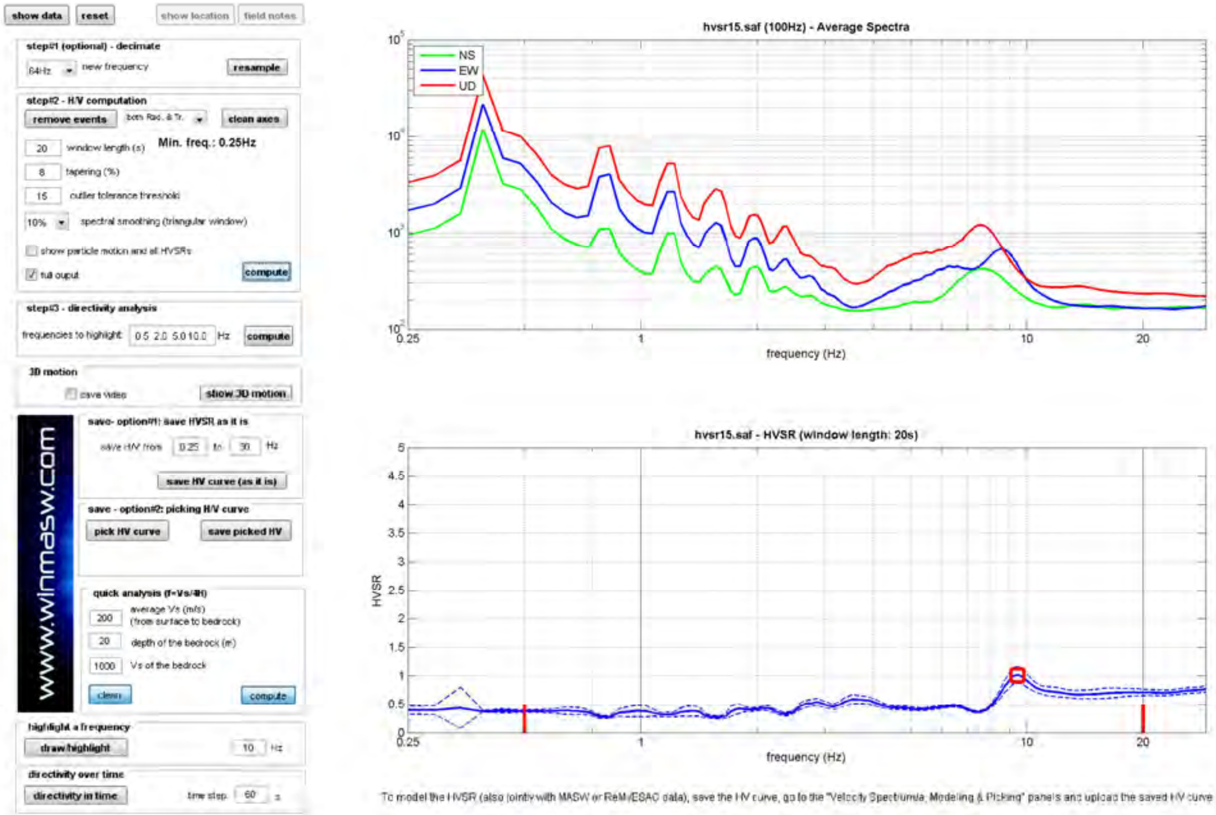
## MISURA TIPO B2

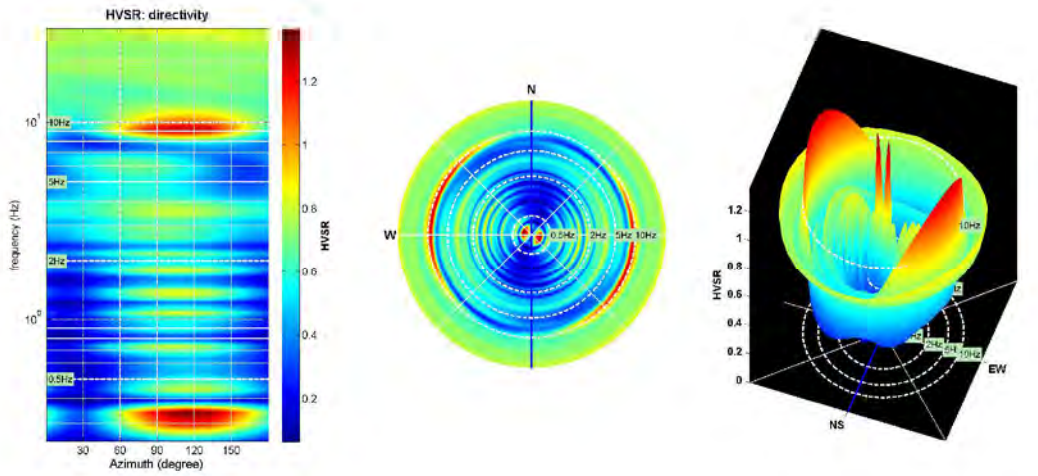
**HVSR64**

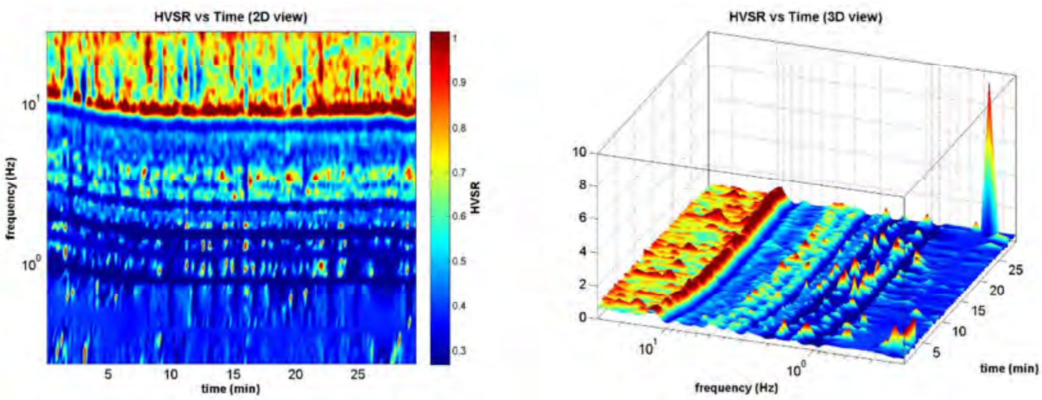
Peak frequency (Hz): 9.4 (±3.2)
Peak HVSR value: 1.0 (±0.1)

=== Criteria for a reliable H/V curve ====================================
#1. [f0 > 10/Lw]: 9.433 > 0.5 (OK)
#2. [nc > 200]: 33582 > 200 (OK)
#3. [f0>0.5Hz; sigmaA(f) < 2 for 0.5f0 < f < 2f0] (OK)

=== Criteria for a clear H/V peak (at least 5 should be fulfilled) ===========
#1. [exists f- in the range [f0/4, f0] | AH/V(f-) < A0/2]: yes, at frequency 2.4Hz (OK)
#2. [exists f+ in the range [f0, 4f0] | AH/V(f+) < A0/2]: (NO)
#3. [A0 > 2]: 1.0 < 2 (NO)
#4. [fpeak[Ah/v(f) ± sigmaA(f)] = f0 ± 5%]: (OK)
#5. [sigmaf < epsilon(f0)]: 3.207 > 0.472 (NO)
#6. [sigmaA(f0) < theta(f0)]: 0.145 < 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
Min. freq.: 0.25Hz
window length (s)
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
directivity over time
directivity in time
time step
hvsr15.saf (100Hz) - Average Spectra
NS
EW
UD
frequency (Hz)
hvsr15.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
N
W
HVSR
EW
NS


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

# HVSR65

| | | |
|---|---|---|
| DATE 13.06.2017 | HOUR 14.36 | PLACE Gorgona |
| OPERATOR Geologica Toscana - Prospezioni Geofisiche S.n.c. | GPS TYPE and # | |
| GAUSS-BOAGA LATITUDE | GAUSS-BOAGA LONGITUDE | ALTITUDE |
| STATION TYPE PGA | SENSOR TYPE Triassiale 4,5 Hz | |
| STATION # | SENSOR # | DISK # |
| FILE NAME HVSR16.saf | | POINT # |
| GAIN | SAMPL. FREQ. 250 Hz | REC. DURATION 30 min minutes seconds |

WEATHER CONDITIONS
- WIND: ☐ none ☒ weak (5m/s) ☐ medium ☐ strong Measurement (if any):
- RAIN: ☒ none ☐ weak ☐ medium ☐ strong Measurement (if any):
- Temperature (approx): 28 °C Remarks

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

ARTIFICIAL GROUND-SENSOR COUPLING ☐ no ☒ yes, type

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

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

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

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

OBSERVATIONS

FREQUENCY: Hz (if computed in the field)

**Qualità della misura:**

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

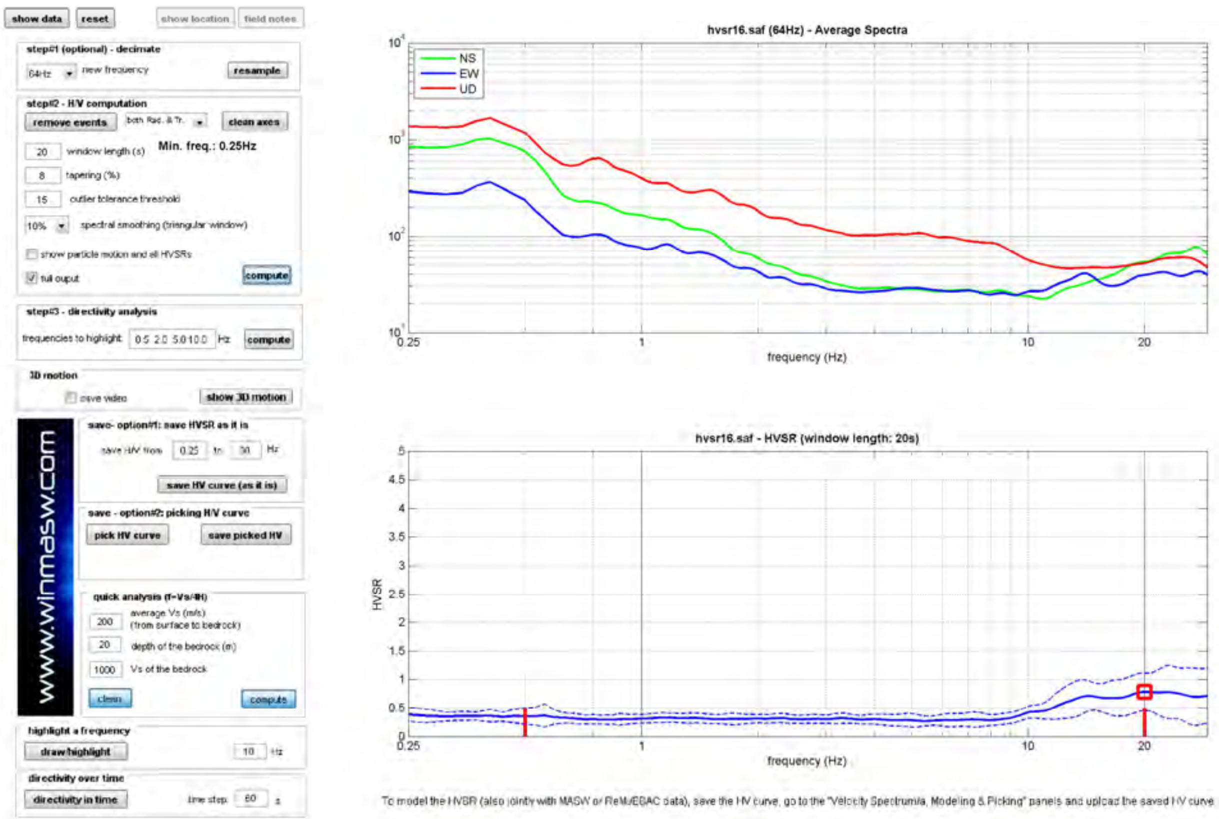
**MISURA TIPO B2**

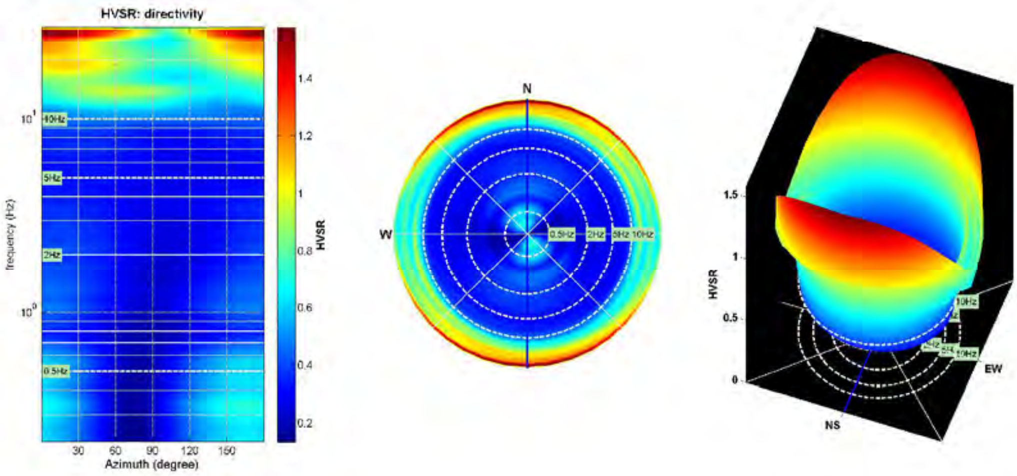
## HVSR65

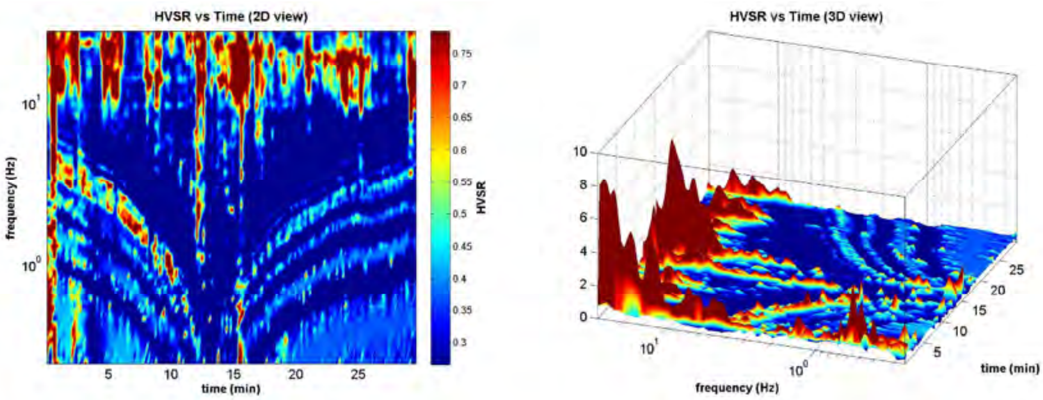
Peak frequency (Hz): 20.0 (±7.6)
Peak HVSR value: 0.8 (±0.3)

=== Criteria for a reliable H/V curve ====================================
#1. [f0 > 10/Lw]: 19.988 > 0.5 (OK)
#2. [nc > 200]: 71158 > 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]: 0.8 < 2 (NO)
#4. [fpeak[Ah/v(f) ± sigmaA(f)] = f0 ± 5%]: (NO)
#5. [sigmaf < epsilon(f0)]: 7.592 > 0.999 (NO)
#6. [sigmaA(f0) < theta(f0)]: 0.330 < 1.58 (OK)

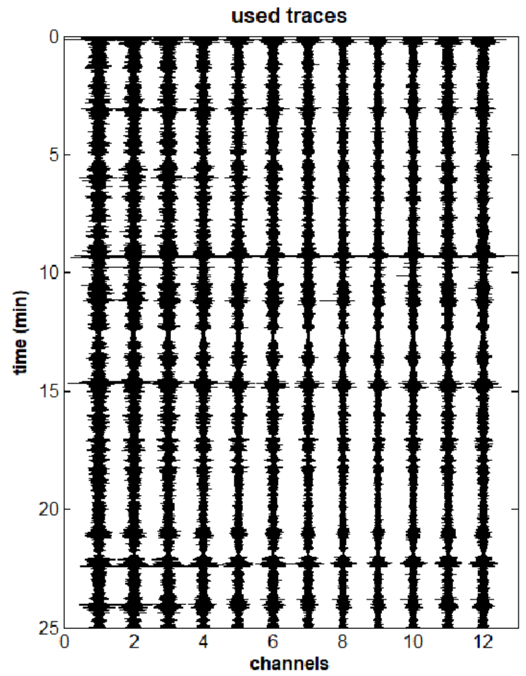

show data
reset
show location
field notes
step#1 (optional) - decimate
new frequency
resample
step#2 - H/V computation
remove events
clean axes
Min. freq.: 0.25Hz
window length (s)
tapering (%)
outlier tolerance threshold
spectral smoothing (triangular window)
show particle motion and all HVSRs
full 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 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
directivity over time
directivity in time
time step
hvsr16.saf (64Hz) - Average Spectra
NS
EW
UD
frequency (Hz)
hvsr16.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

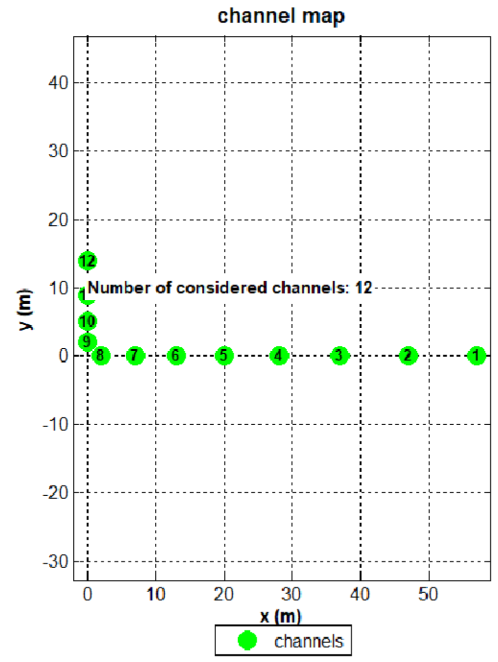

HVSR: directivity
frequency (Hz)
Azimuth (degree)
HVSR
N
W
HVSR
EW
NS

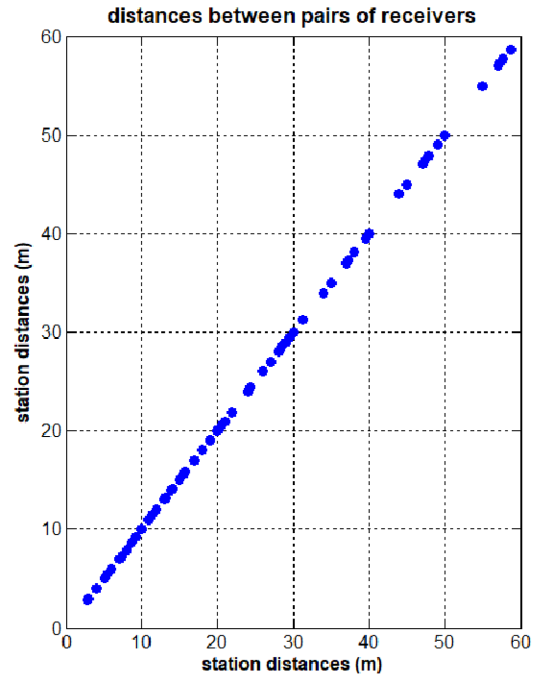

HVSR vs Time (2D view)
frequency (Hz)
time (min)
HVSR
HVSR vs Time (3D view)
frequency (Hz)
time (min)

MS3_MASW1-ESAC1

## ACQUISIZIONE ESAC

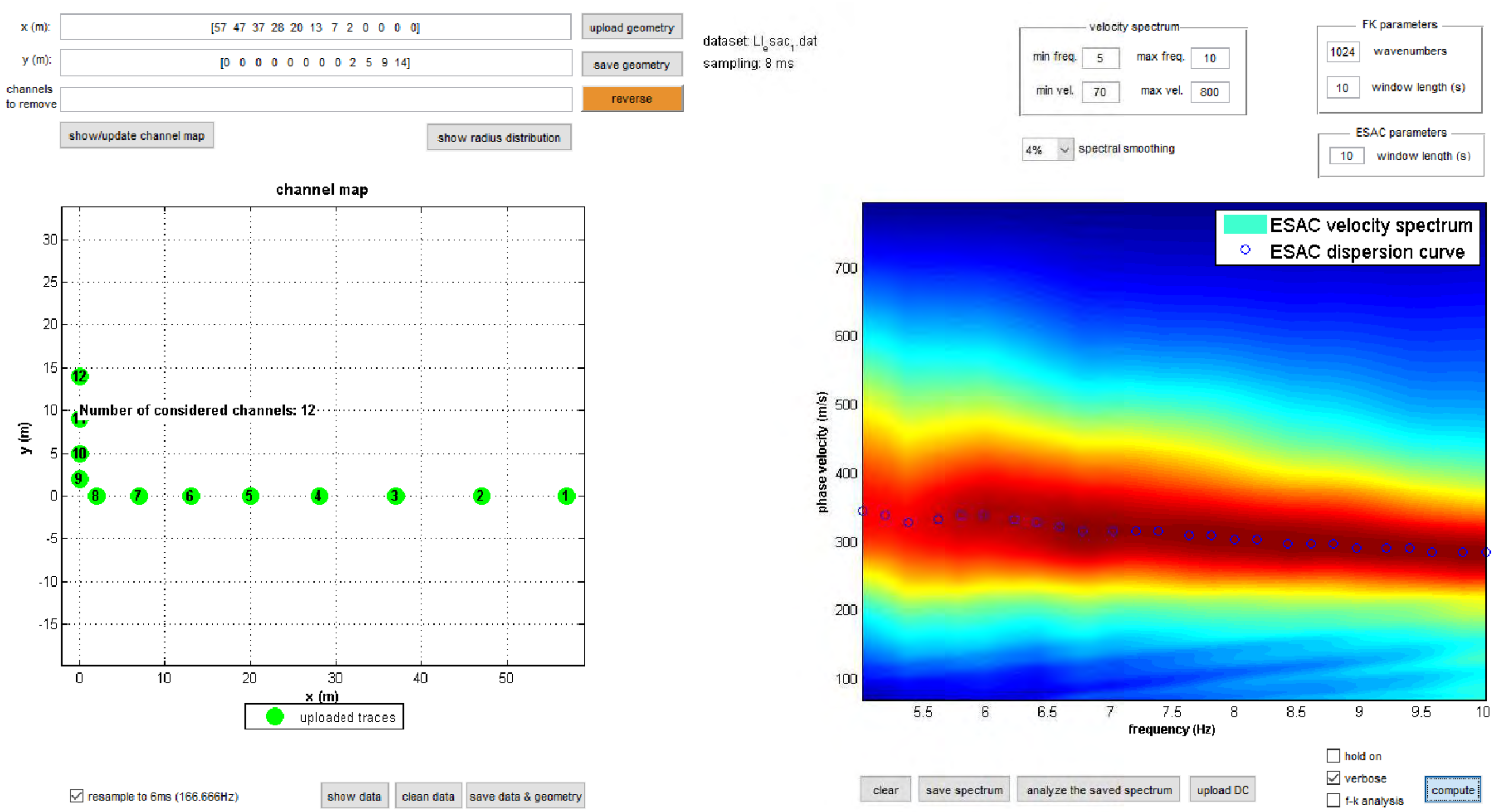



## SPETTRO DI VELOCITA' ESAC E CURVA DI DISPERSIONE EFFETTIVA

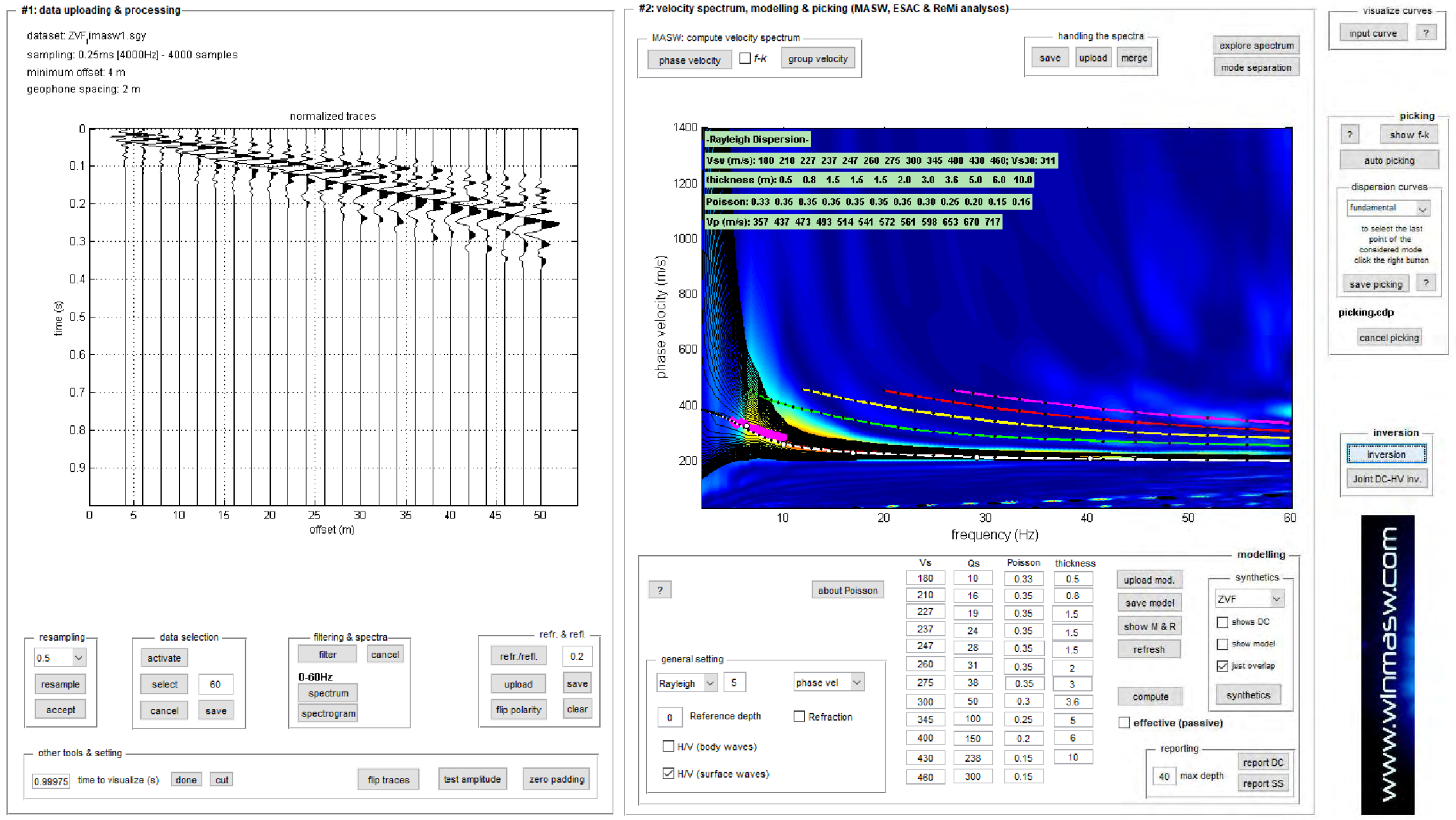
Stendimento ESAC1




GEOLOGICA TOSCANA s.n.c.

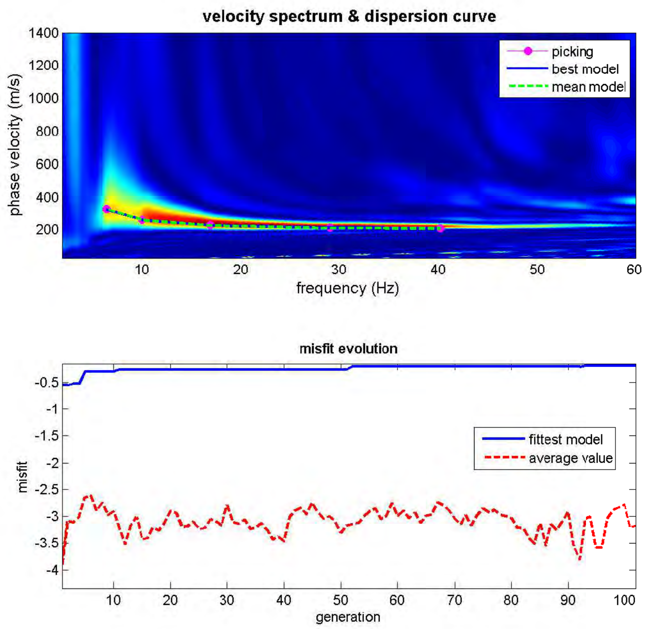
**RISULTANZE DELL'ANALISI SISMICA CONGIUNTA MASW 1 - ESAC 1**

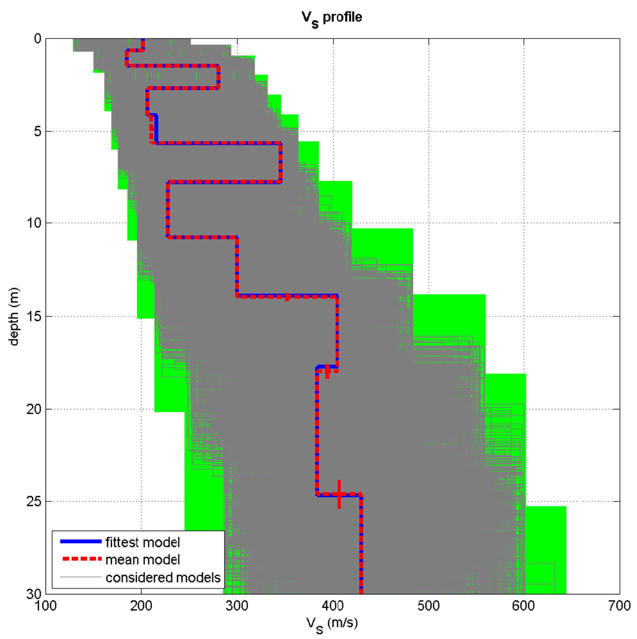
## SPETTRO DI VELOCITA' MASW + CURVA DI DISPERSIONE EFFETTIVA ESAC




## Stendimento MASW 1

## INVERSIONE CONGIUNTA MASW – ESAC E PROFILO DI VELOCITA'




dataset: ZVFimasw1.sgy
dispersion curve: picking.cdp
Vs30 (best model): 314 m/s
Vs30 (mean model): 313 m/s

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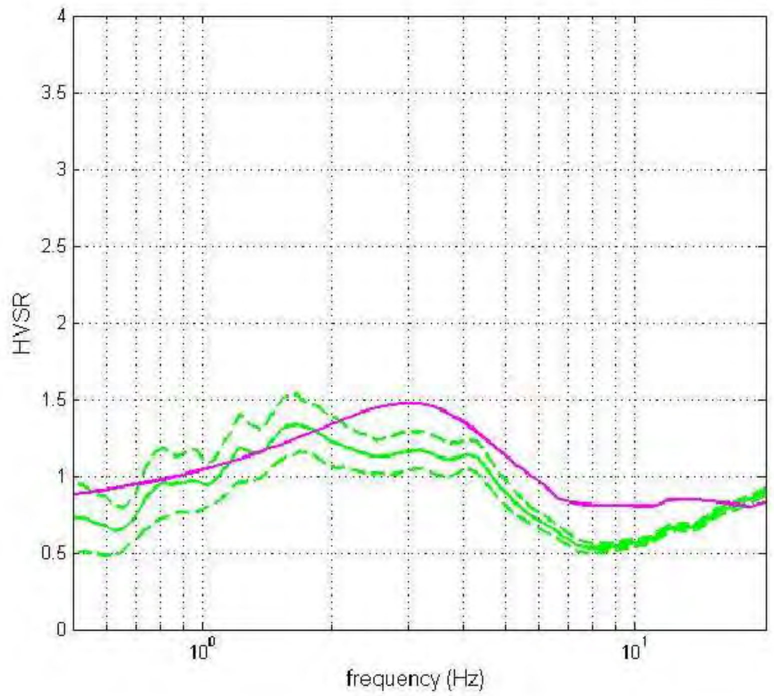
## INTERPRETAZIONE CONGIUNTA MASW 1 – HVSR1

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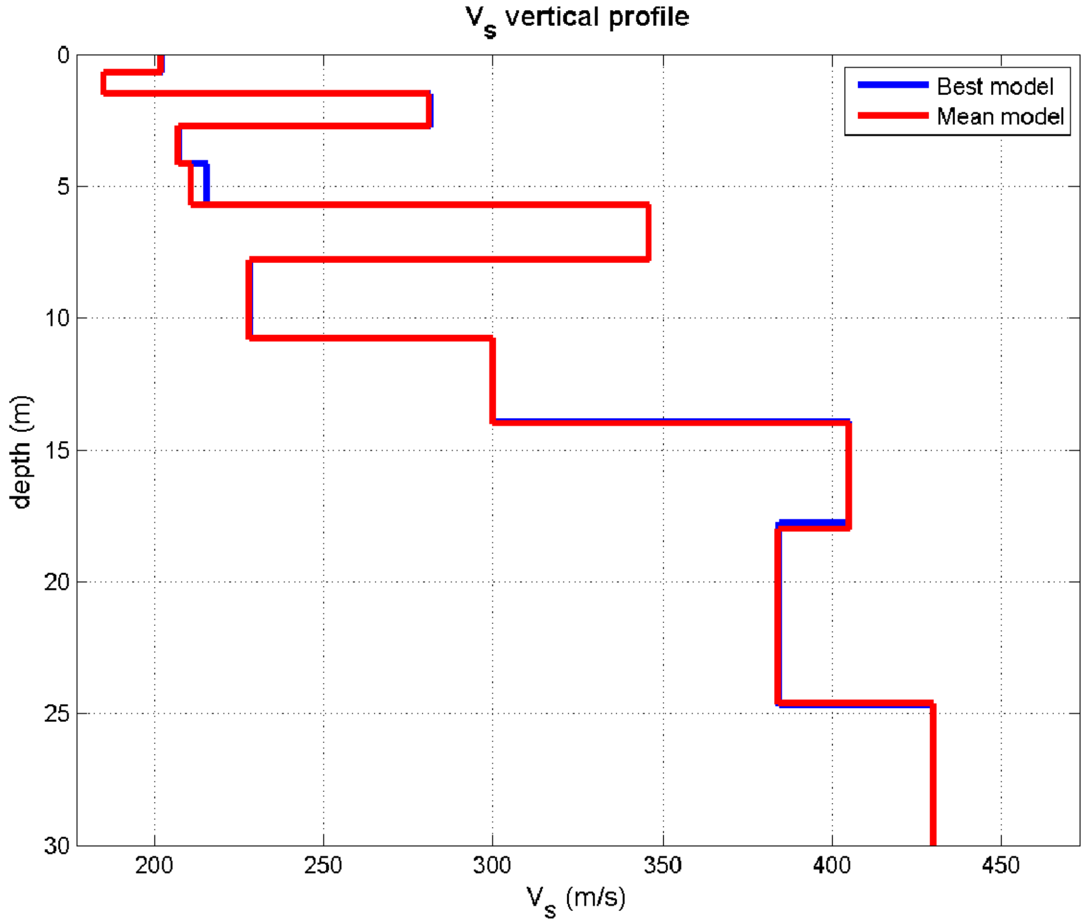
**RISULTANZE DELL'ANALISI SISMICA CONGIUNTA MASW 1 - ESAC 1**

PROFILO DI VELOCITA' MASW 1 – ESAC 1




Vs (m/s):202, 185, 281, 207, 211, 346, 228, 300, 405, 384, 430, 491
Standard deviations (m/s):0, 0, 0, 0, 2, 0, 0, 0, 0, 0, 0, 0

Thickness (m):0.7, 0.8, 1.3, 1.4, 1.5, 2.1, 3.0, 3.2, 4.0, 6.6, 12.4
Standard deviations (m/s):0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.2, 0.4, 0.8, 0.0

Density (gr/cm3) (approximate values):1.80, 1.84, 1.91, 1.88, 1.87, 2.21, 1.91, 1.93, 1.96, 1.94, 1.96, 1.99
Seismic/Dynamic Shear modulus (MPa) (approximate values):74, 63, 151, 80, 83, 265, 99, 173, 321, 285, 363, 479

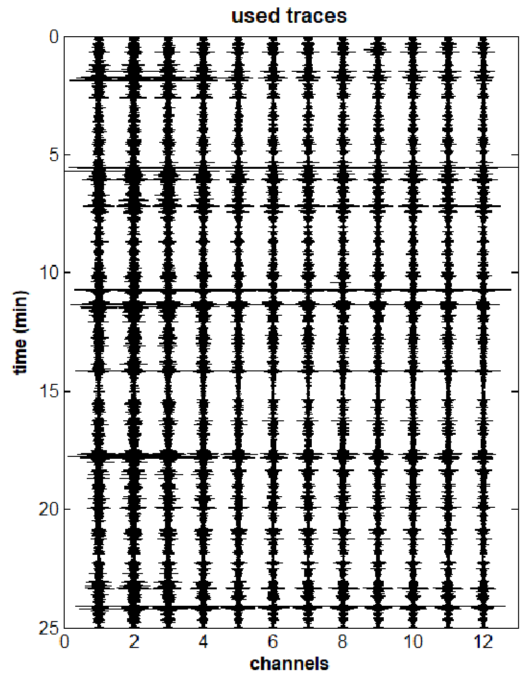
Approximate values for Vp and Poisson (please, see manual)
Vp (m/s):356, 415, 550, 481, 458, 1912, 557, 589, 667, 612, 688, 764
Poisson:0.26, 0.38, 0.32, 0.39, 0.37, 0.48, 0.40, 0.32, 0.21, 0.18, 0.18, 0.15

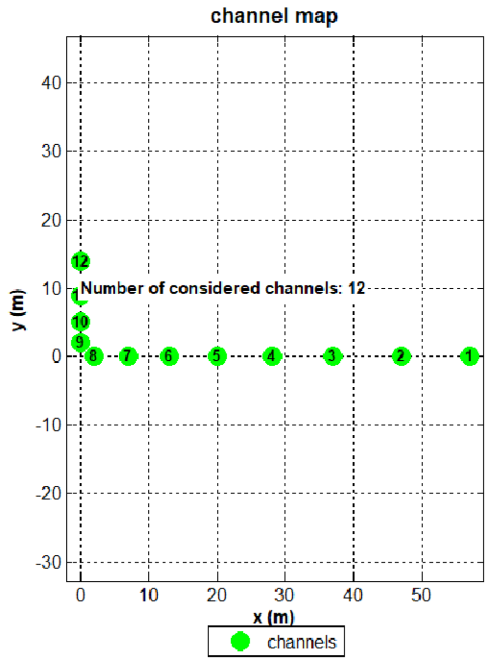
Vs30 (m/s): 313

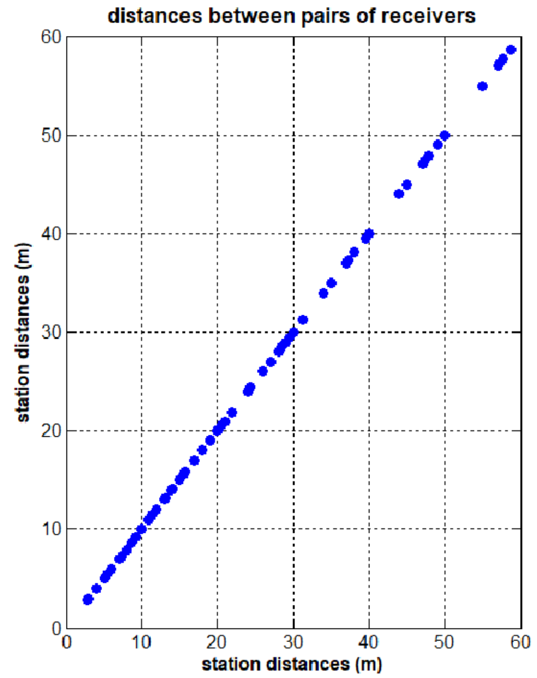
GEOLOGICA TOSCANA s.n.c.

ACQUISIZIONE ESAC

**MS3_MASW2-ESAC2**

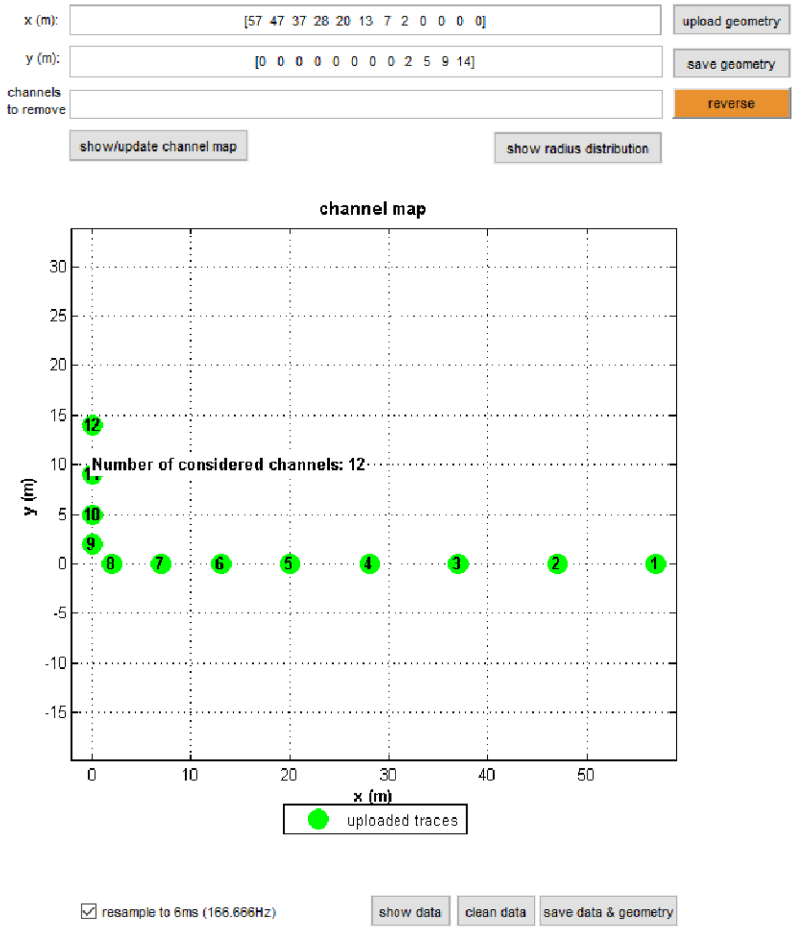


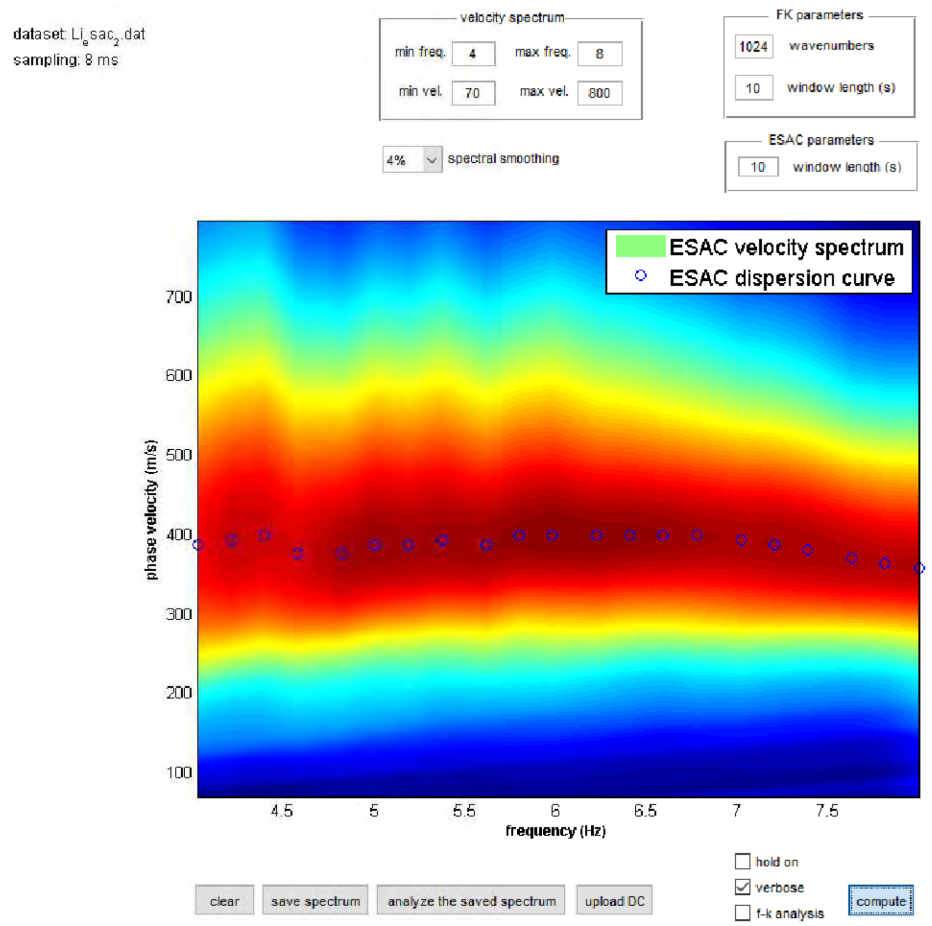




SPETTRO DI VELOCITA' ESAC E CURVA DI DISPERSIONE EFFETTIVA

Stendimento ESAC2

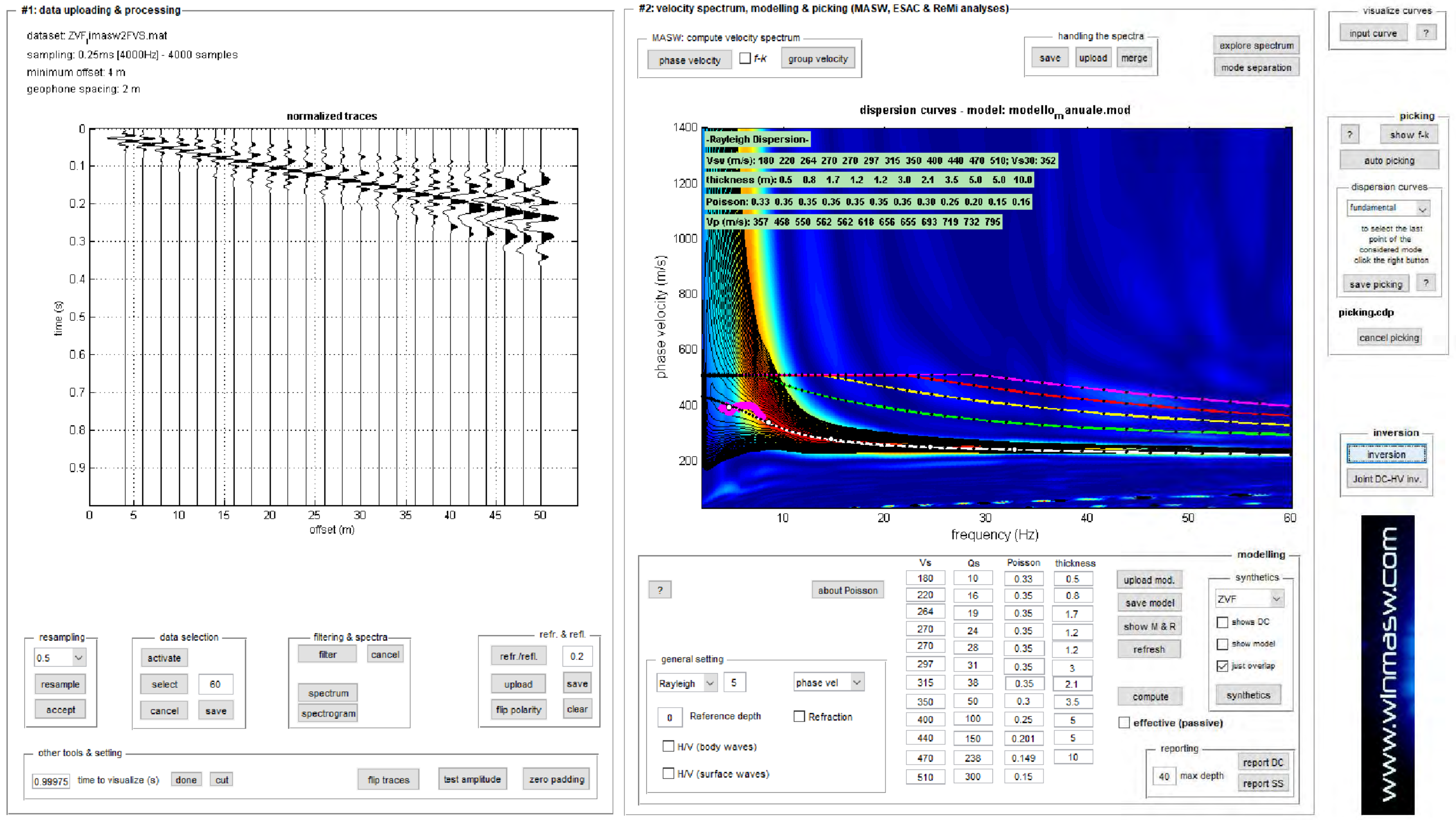



**GEOLOGICA TOSCANA s.n.c.**

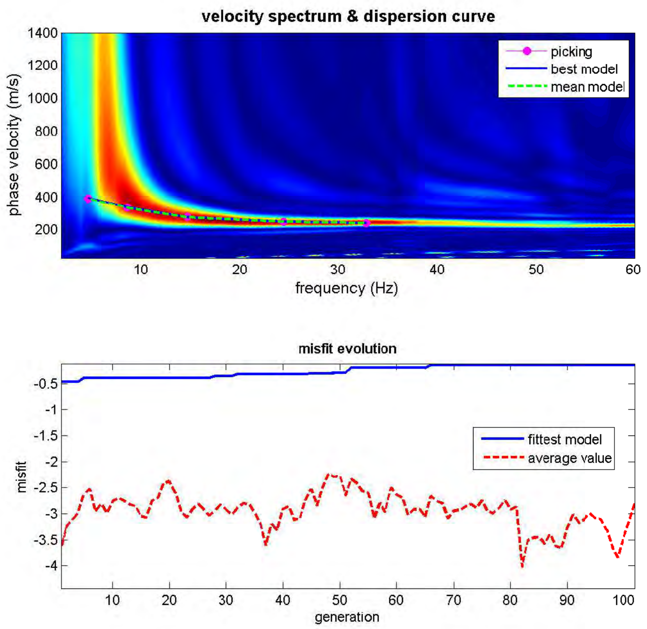
**RISULTANZE DELL'ANALISI SISMICA CONGIUNTA MASW 2 - ESAC 2**

## SPETTRO DI VELOCITA' MASW + CURVA DI DISPERSIONE EFFETTIVA ESAC

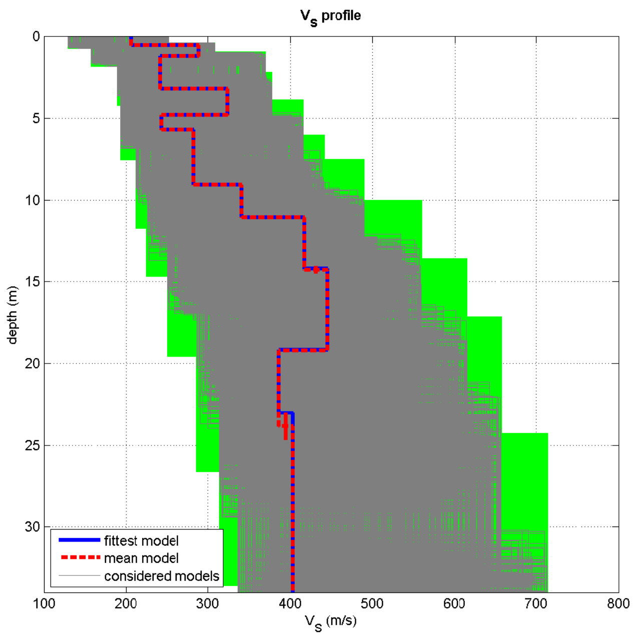



## Stendimento MASW 2

## INVERSIONE CONGIUNTA MASW – ESAC E PROFILO DI VELOCITA'



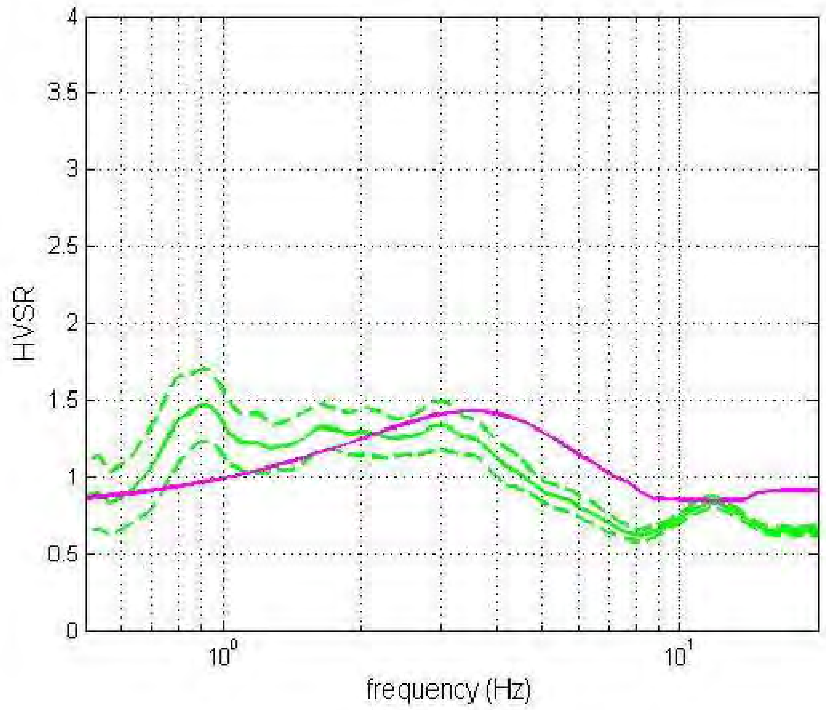

www.winmasw.com




dataset: ZVF_imasw2FVS.mat
dispersion curve: picking.cdp
Vs30 (best model): 351 m/s
Vs30 (mean model): 350 m/s

half-space

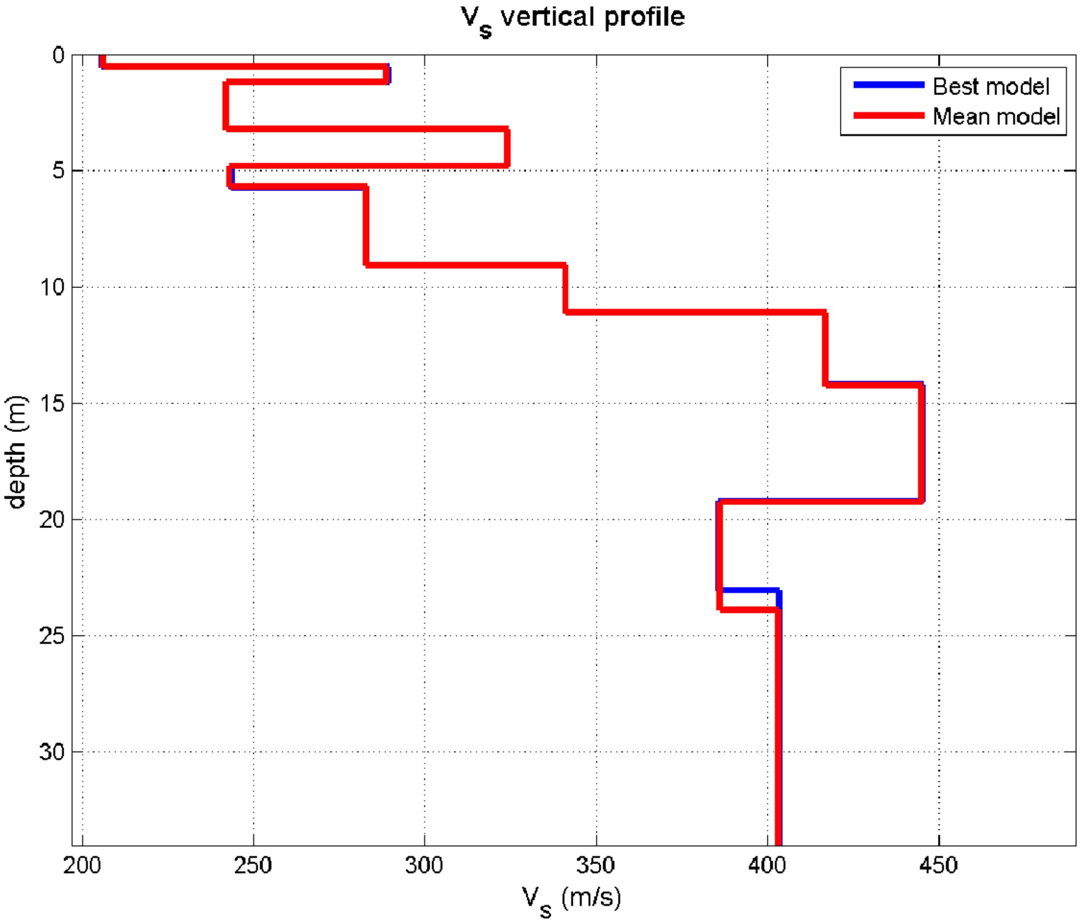
## INTERPRETAZIONE CONGIUNTA MASW 2 – HVSR2




GEOLOGICA TOSCANA s.n.c.

**RISULTANZE DELL'ANALISI SISMICA CONGIUNTA MASW 2 - ESAC 2**

PROFILO DI VELOCITA' MASW 2 – ESAC 2




Vs (m/s):206, 289, 242, 324, 243, 283, 341, 417, 445, 386, 403, 566
Thickness (m):0.5, 0.7, 2.0, 1.6, 0.9, 3.4, 2.0, 3.2, 5.0, 4.6, 11.5
Standard deviations (m/s):0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.2, 0.0, 0.8, 0.0

Density (gr/cm3) (approximate values):1.81, 1.88, 1.88, 1.95, 1.98, 1.88, 2.00, 1.97, 1.98, 1.95, 1.94, 2.03
Seismic/Dynamic Shear modulus (MPa) (approximate values):77, 157, 110, 204, 117, 151, 233, 342, 393, 291, 315, 649

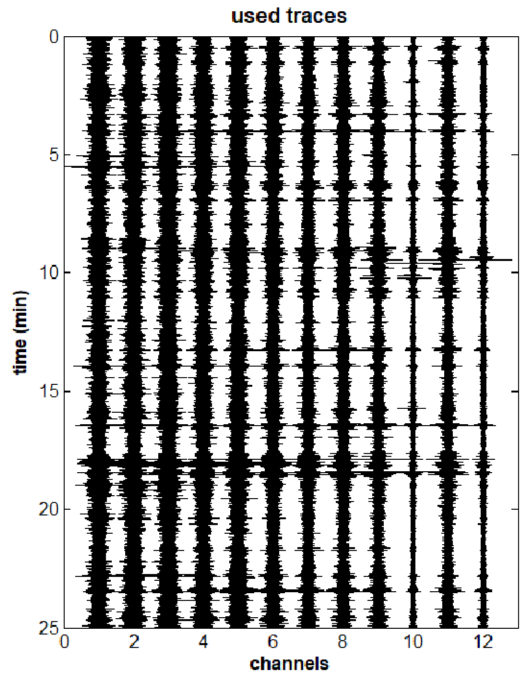
Approximate values for Vp and Poisson (please, see manual)
Vp (m/s):363, 487, 486, 641, 728, 491, 810, 701, 749, 652, 629, 888
Poisson:0.26, 0.23, 0.34, 0.33, 0.44, 0.25, 0.39, 0.23, 0.23, 0.23, 0.15, 0.16

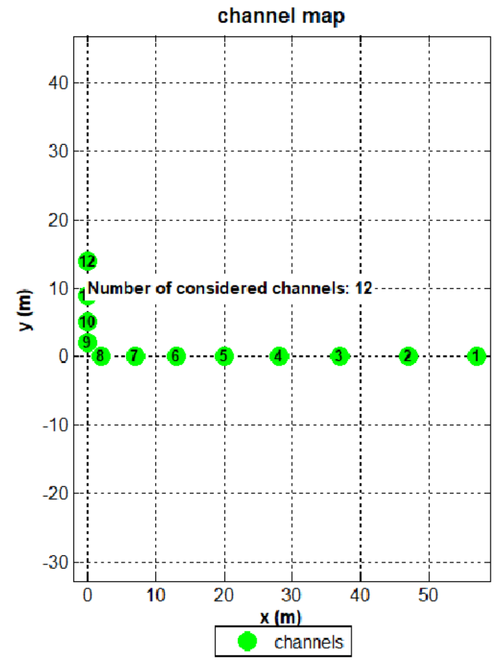
Vs30 (m/s): 350

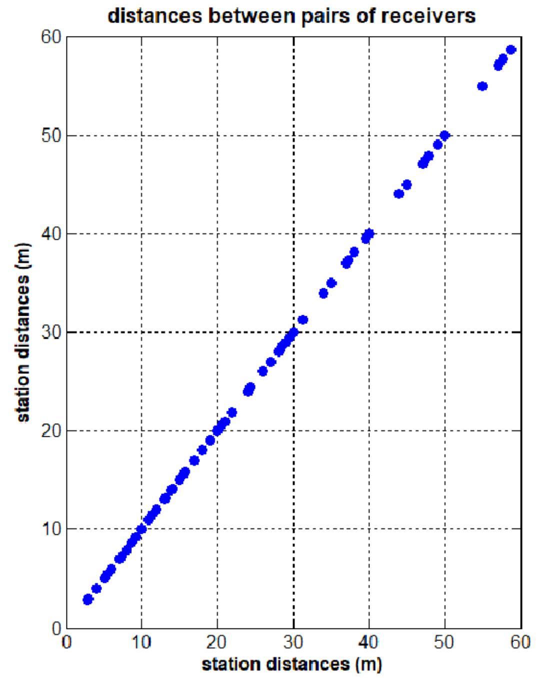
GEOLOGICA TOSCANA s.n.c.

ACQUISIZIONE ESAC

**MS3_MASW3-ESAC3**

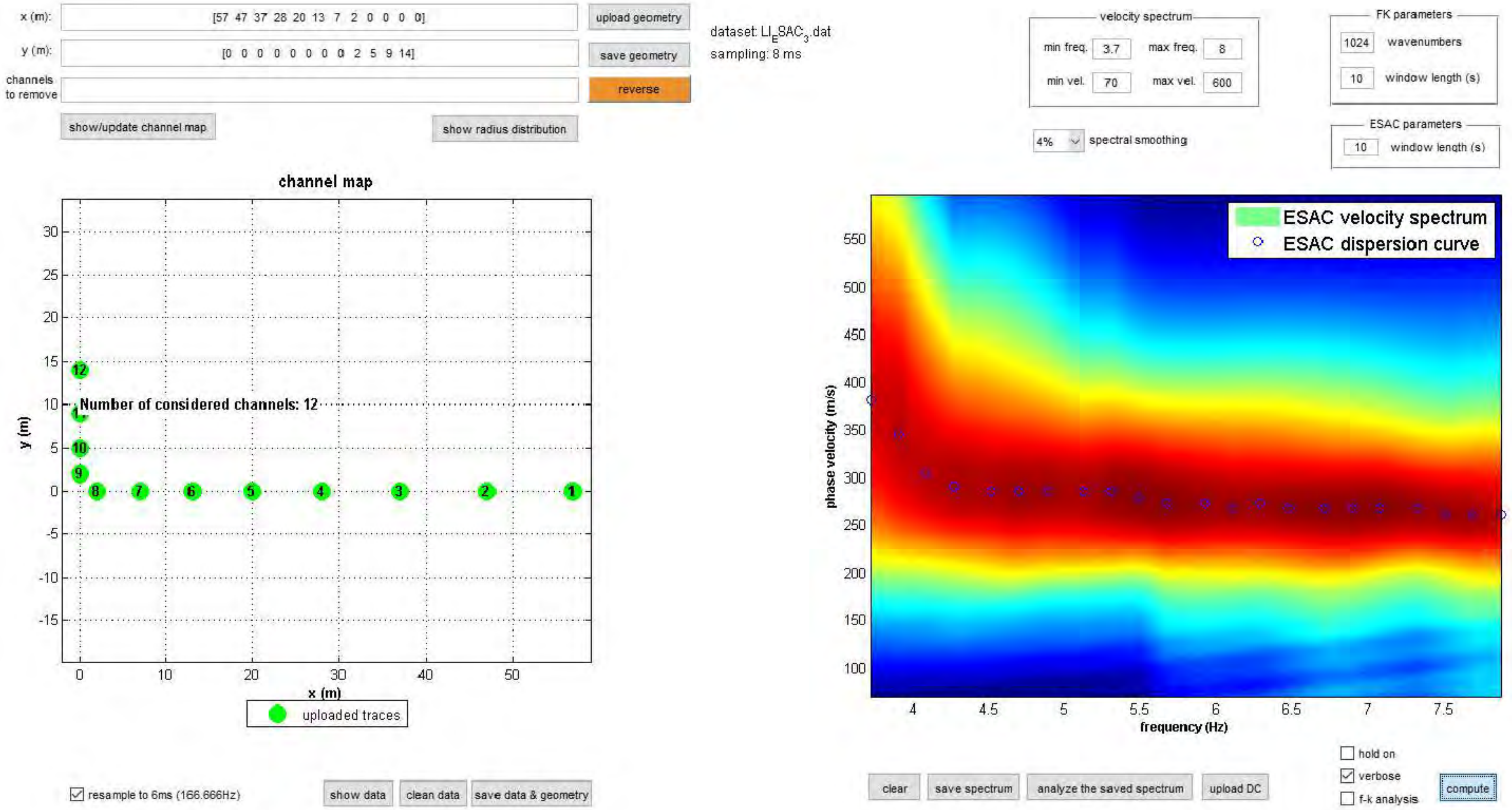



SPETTRO DI VELOCITA' ESAC E CURVA DI DISPERSIONE EFFETTIVA

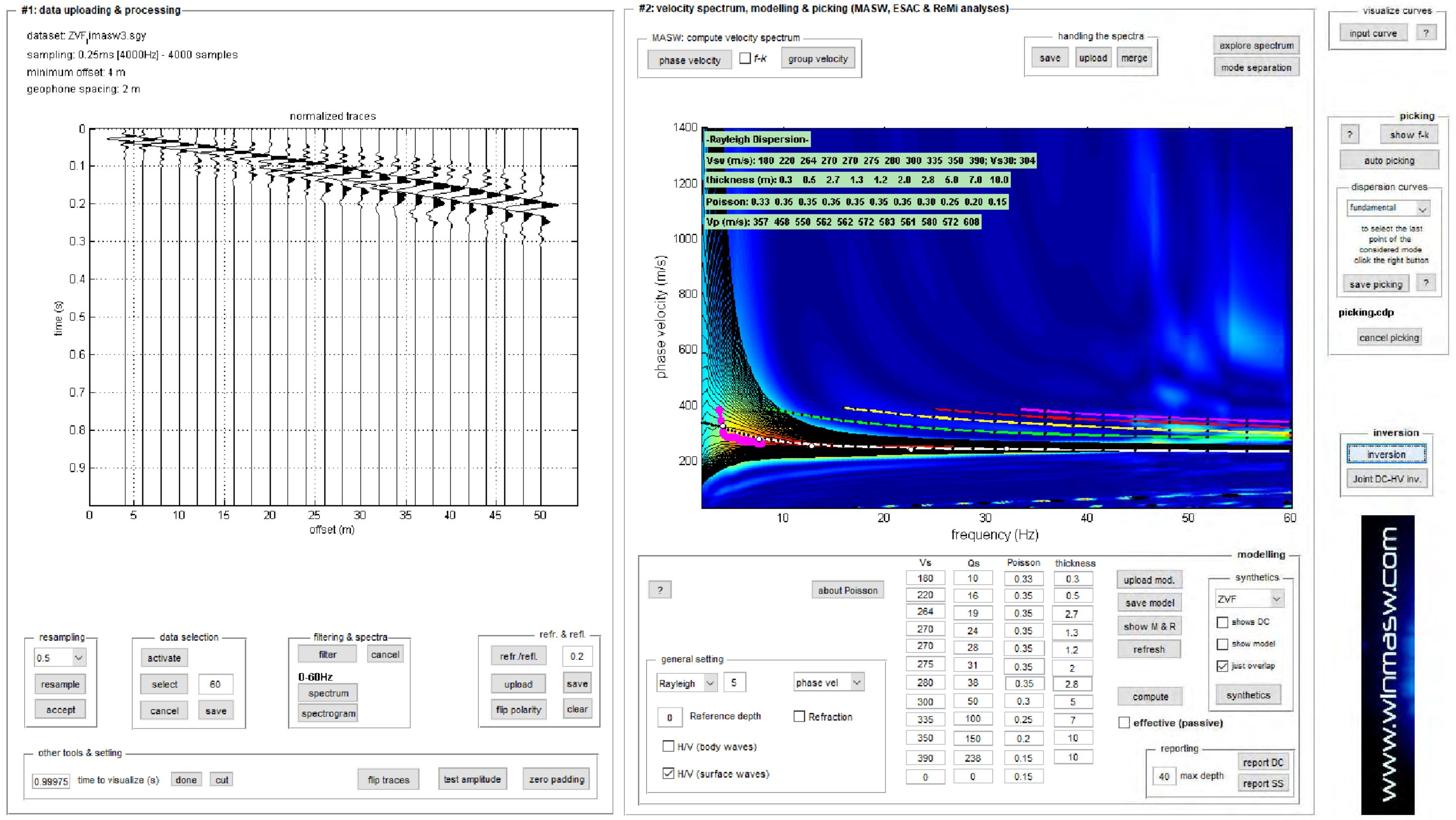
Stendimento ESAC3




GEOLOGICA TOSCANA s.n.c.

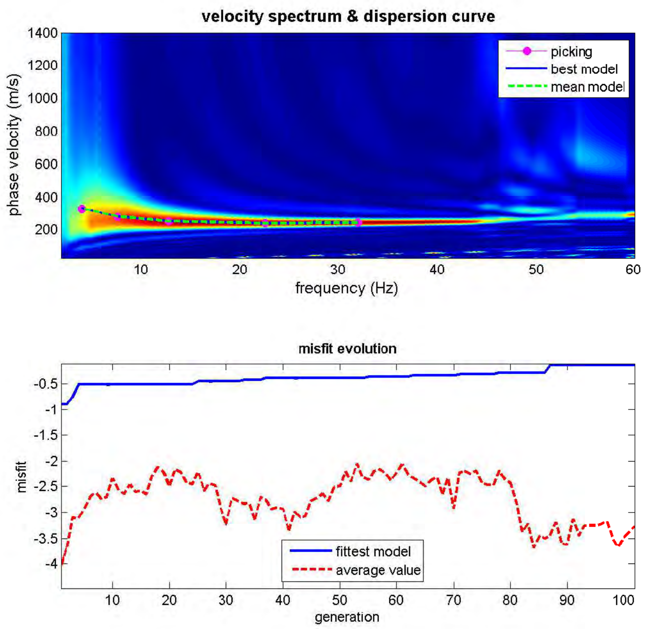
**RISULTANZE DELL'ANALISI SISMICA CONGIUNTA MASW 3 - ESAC 3**

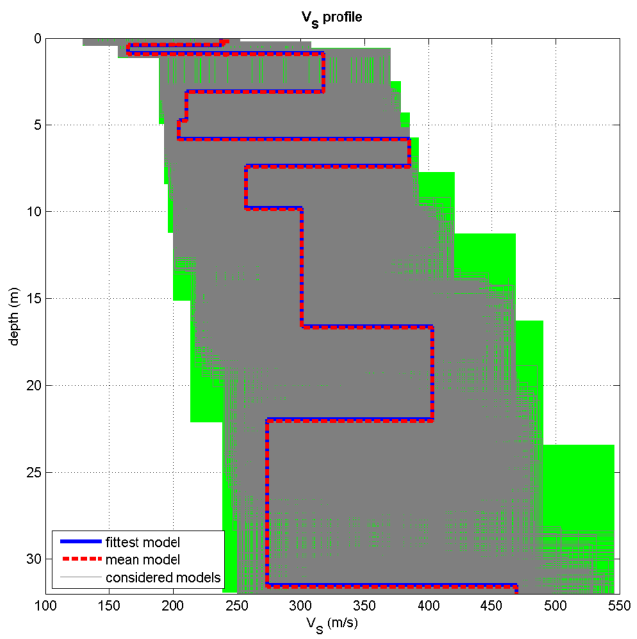
## SPETTRO DI VELOCITA' MASW + CURVA DI DISPERSIONE EFFETTIVA ESAC




## Stendimento MASW 3

## INVERSIONE CONGIUNTA MASW - ESAC E PROFILO DI VELOCITA'




dataset: ZVFimasw3.sgy
dispersion curve: picking.cdp
Vs30 (best model): 291 m/s
Vs30 (mean model): 290 m/s

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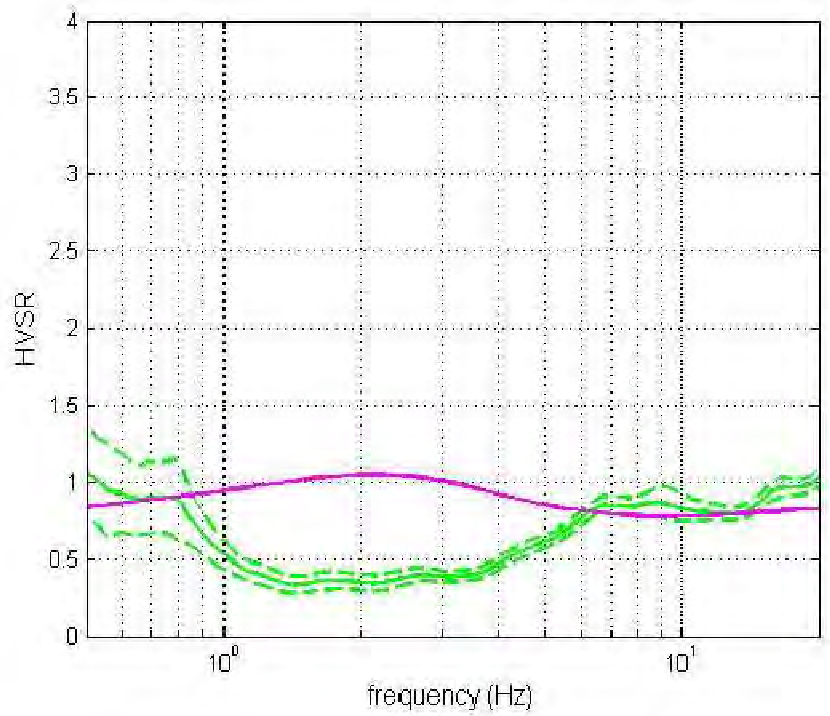
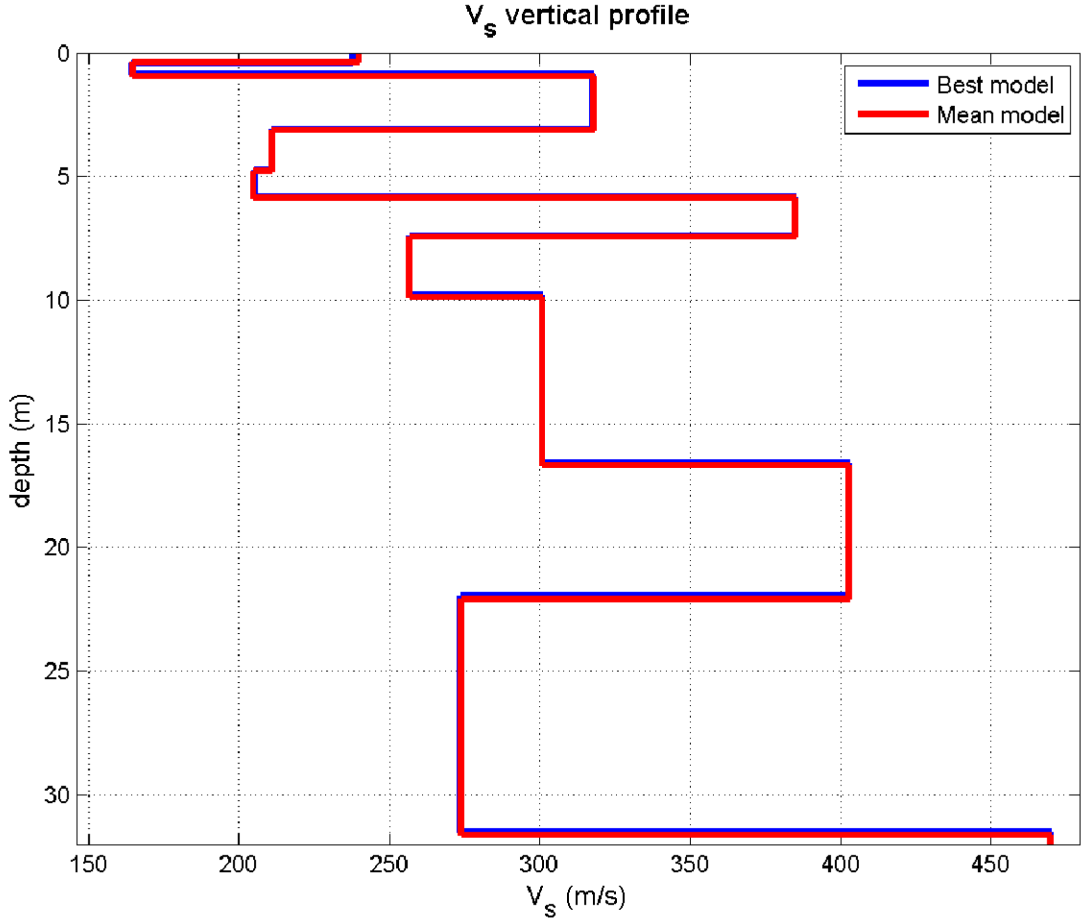
## INTERPRETAZIONE CONGIUNTA MASW 3 - HVSR3




GEOLOGICA TOSCANA s.n.c.

**RISULTANZE DELL'ANALISI SISMICA CONGIUNTA MASW 3 - ESAC 3**

PROFILO DI VELOCITA' MASW 3 – ESAC 3




Vs (m/s):240, 165, 318, 211, 205, 385, 257, 301, 403, 274, 470
Standard deviations (m/s):4, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0

Thickness (m):0.4, 0.5, 2.2, 1.6, 1.1, 1.6, 2.4, 6.8, 5.4, 9.5
Standard deviations (m/s):0.1, 0.1, 0.0, 0.0, 0.0, 0.0, 0.1, 0.0, 0.0, 0.0

Density (gr/cm3) (approximate values):1.91, 1.97, 2.03, 1.89, 1.83, 2.00, 1.89, 1.93, 1.94, 1.88, 1.98
Seismic/Dynamic Shear modulus (MPa) (approximate values):110, 54, 206, 84, 77, 297, 125, 175, 315, 141, 437

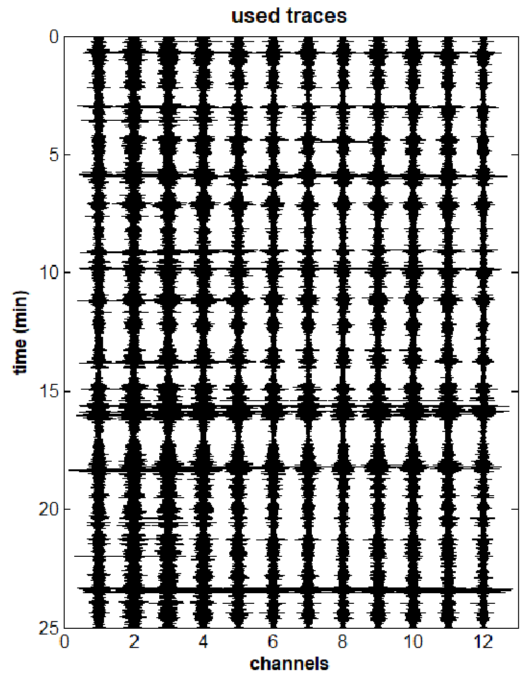
Approximate values for Vp and Poisson (please, see manual)
Vp (m/s):549, 709, 923, 517, 401, 814, 518, 607, 628, 487, 733
Poisson:0.38, 0.47, 0.43, 0.40, 0.32, 0.36, 0.34, 0.34, 0.15, 0.27, 0.15

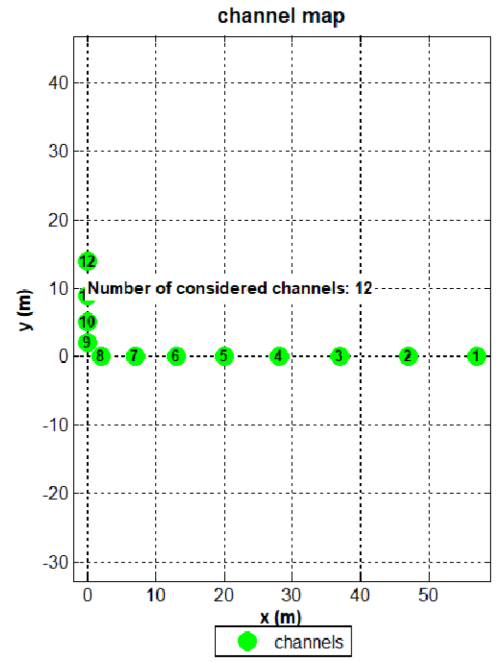
Vs30 (m/s): 290

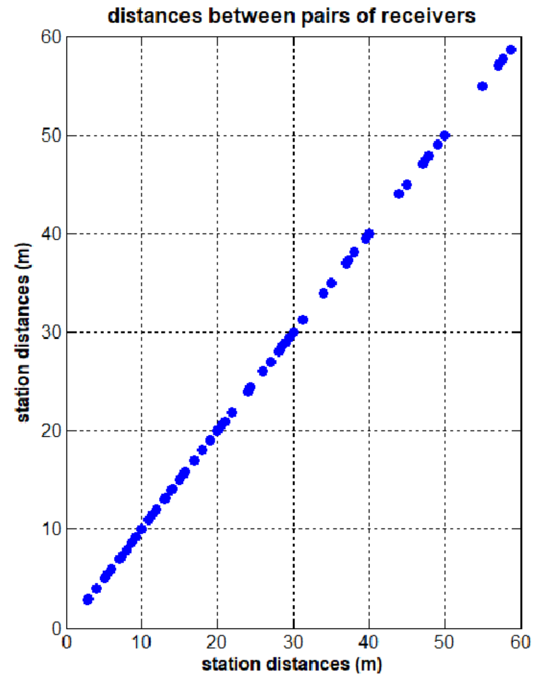
GEOLOGICA TOSCANA s.n.c.

ACQUISIZIONE ESAC

**MS3_MASW4-ESAC4**

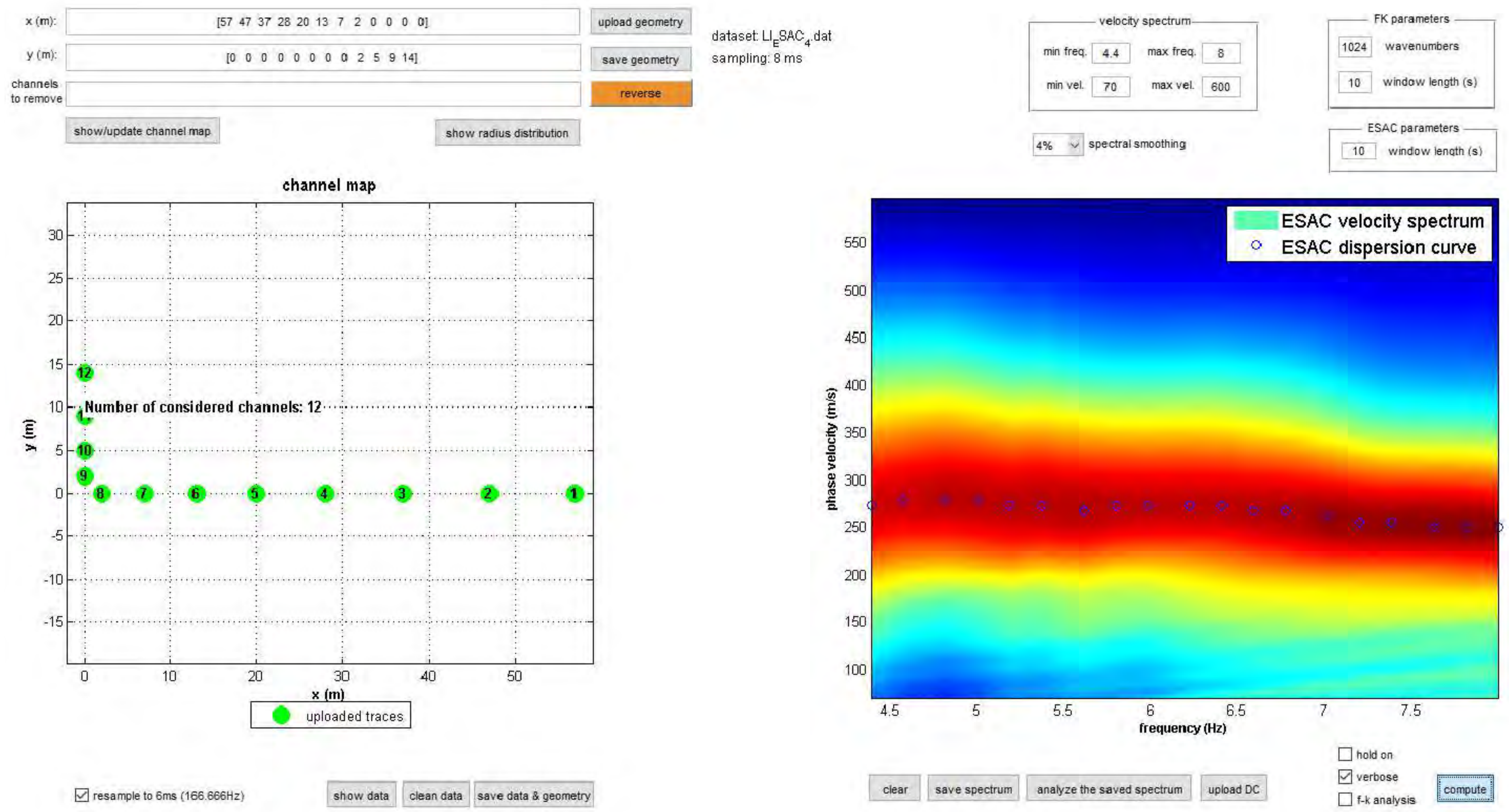



SPETTRO DI VELOCITA' ESAC E CURVA DI DISPERSIONE EFFETTIVA

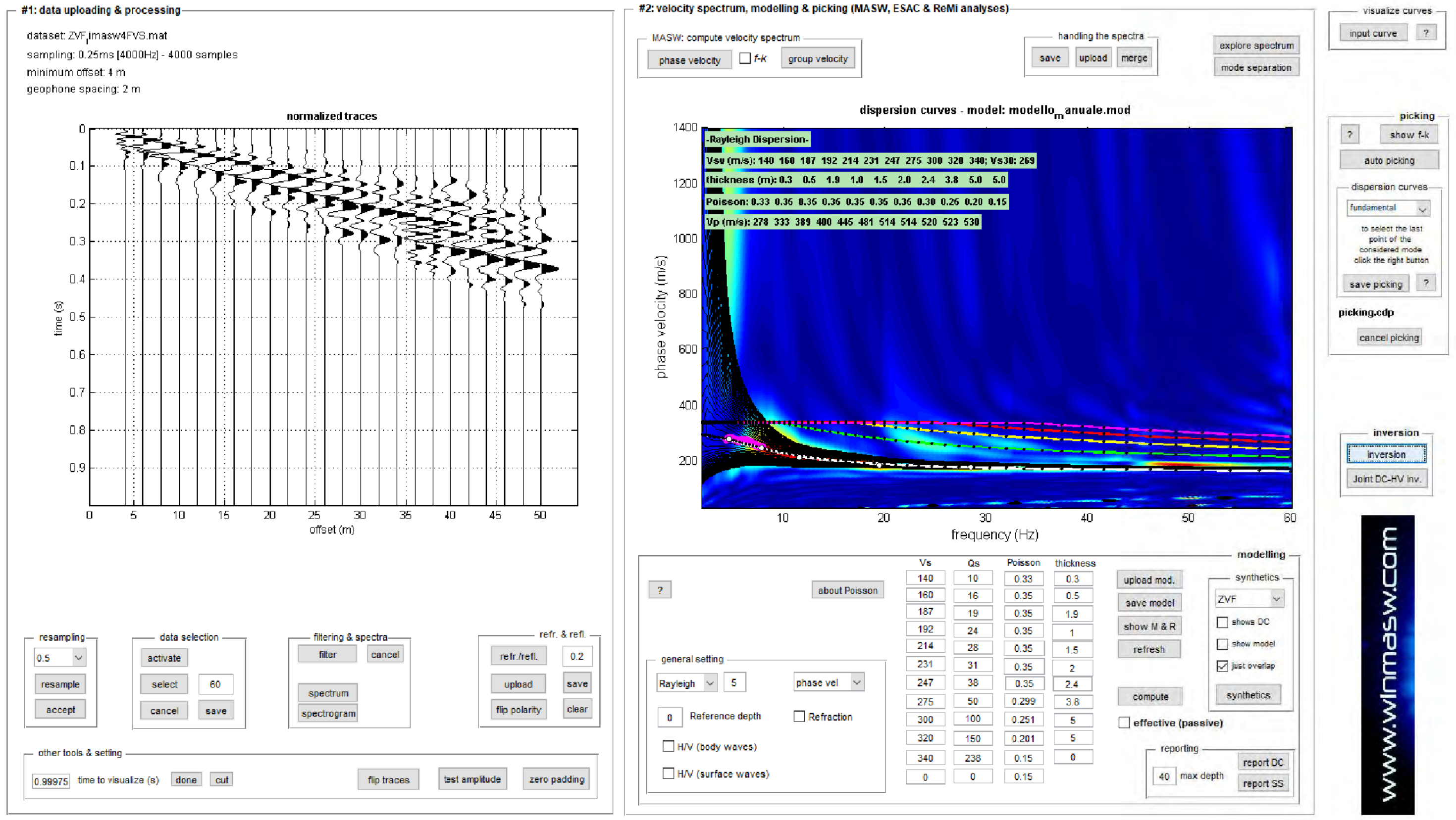
Stendimento ESAC4



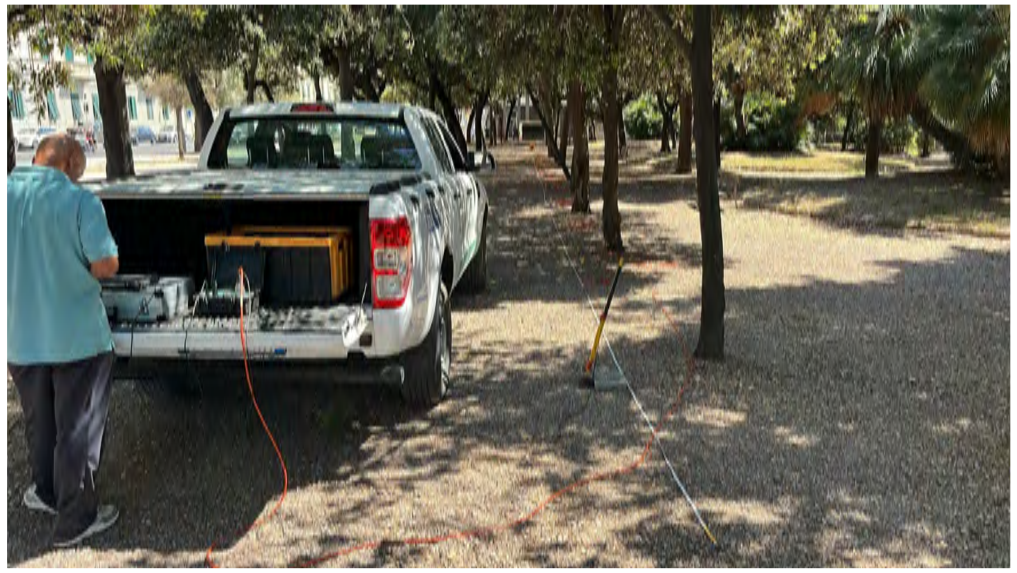

GEOLOGICA TOSCANA s.n.c.

**RISULTANZE DELL'ANALISI SISMICA CONGIUNTA MASW 4 - ESAC 4**

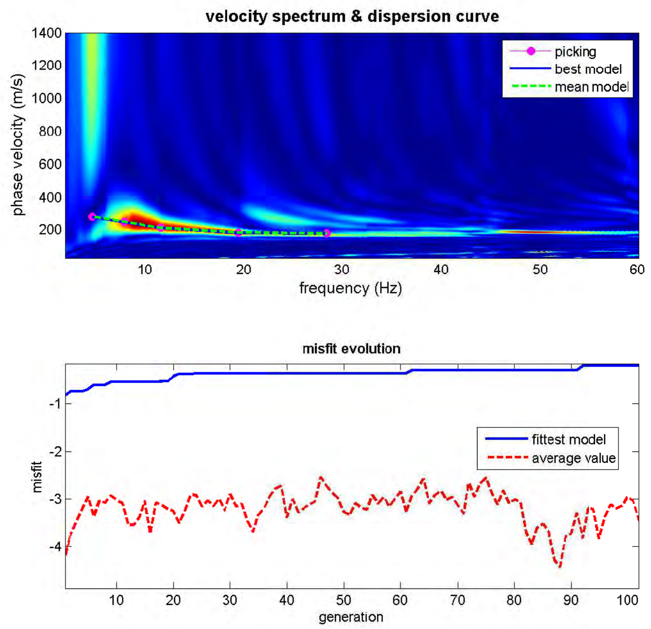
## SPETTRO DI VELOCITA' MASW + CURVA DI DISPERSIONE EFFETTIVA ESAC

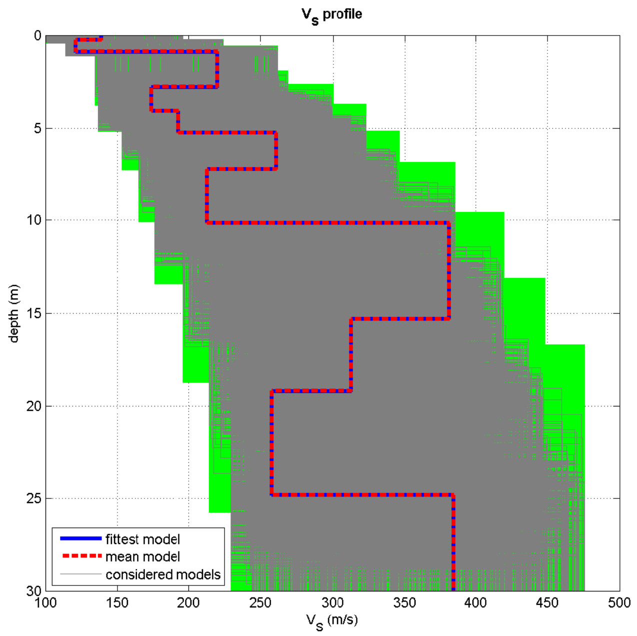



## Stendimento MASW 4



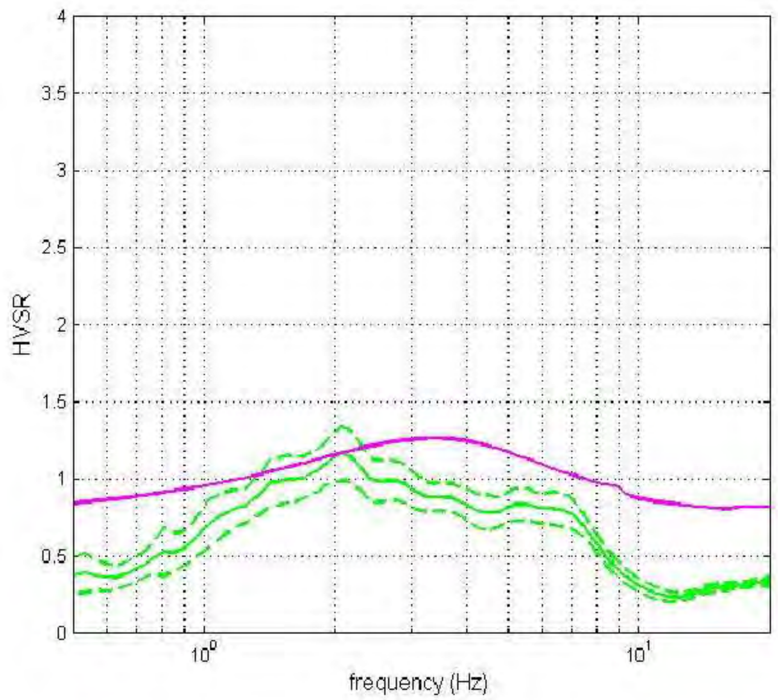
## INVERSIONE CONGIUNTA MASW – ESAC E PROFILO DI VELOCITA'




dataset: ZVF_imasw4FVS.mat
dispersion curve: picking.cdp
Vs30 (best model): 268 m/s
Vs30 (mean model): 269 m/s

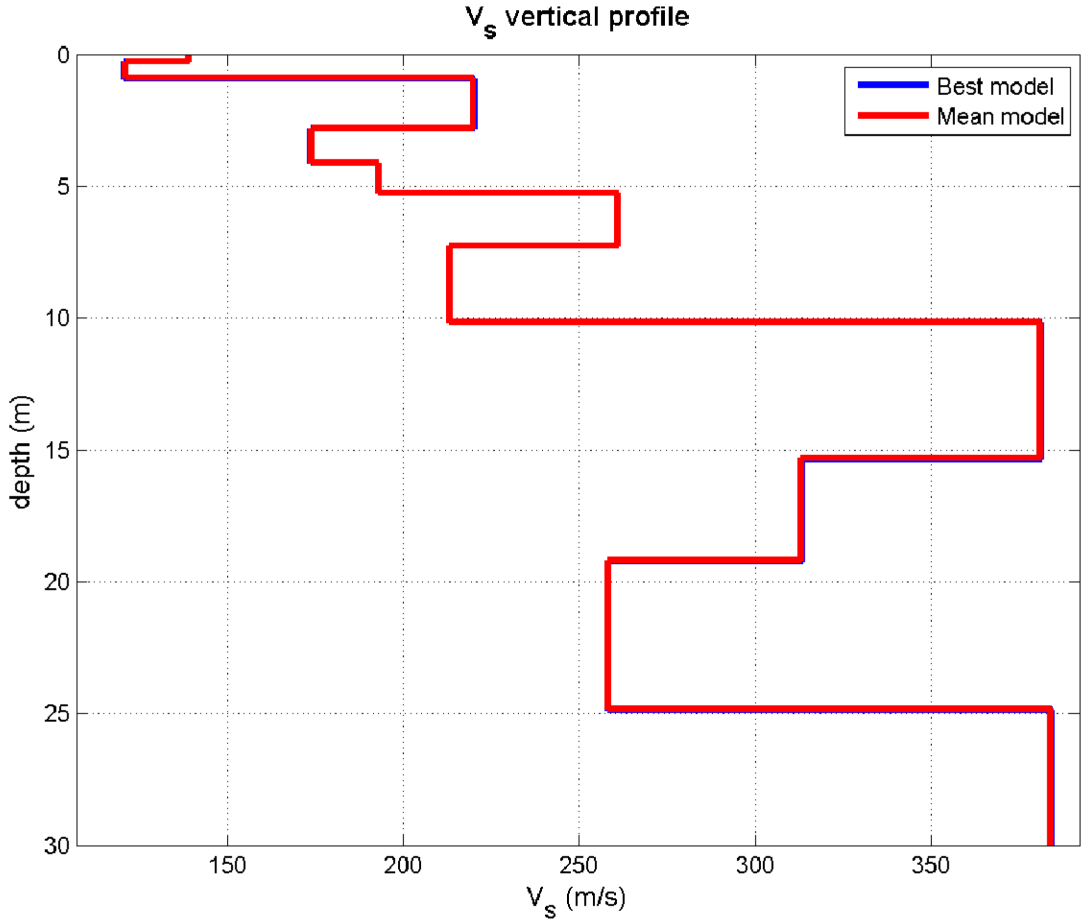
## INTERPRETAZIONE CONGIUNTA MASW 4 – HVSR4




GEOLOGICA TOSCANA s.n.c.

**RISULTANZE DELL'ANALISI SISMICA CONGIUNTA MASW 4 - ESAC 4**

PROFILO DI VELOCITA' MASW 4 – ESAC 4




Vs (m/s):139, 121, 220, 174, 193, 261, 213, 381, 313, 258, 384
Thickness (m):0.3, 0.6, 1.9, 1.3, 1.2, 2.0, 2.9, 5.2, 3.9, 5.6
Standard deviations (m/s):0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0

Density (gr/cm3) (approximate values):1.71, 1.74, 1.87, 1.79, 1,.88, 1.88, 1.82, 1.96, 1.94, 1.85, 1.94
Seismic/Dynamic Shear modulus (MPa) (approximate values):33, 25, 91, 54, 70, 128, 83, 284, 190, 123, 286

Approximate values for Vp and Poisson (please, see manual)
Vp (m/s):241, 272, 470, 333, 478, 483, 378, 672 614, 438 623
Poisson:0.25, 0.38, 0.36, 0.31, 0.40, 0.29, 0.27, 0.26, 0.32, 0.23, 0.19

Vs30 (m/s): 269

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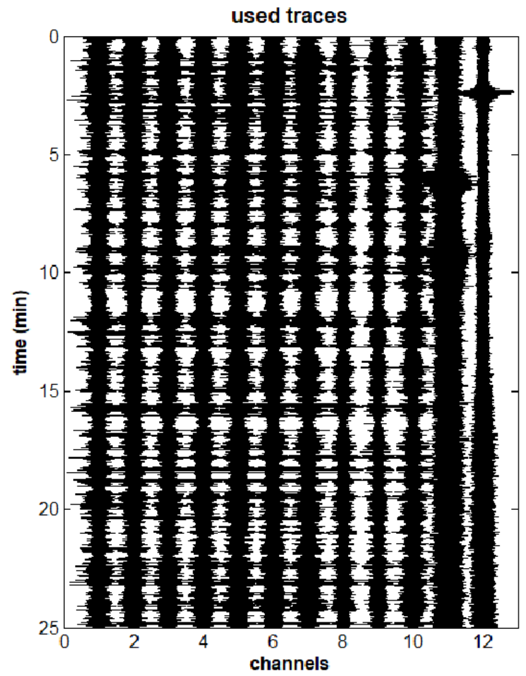
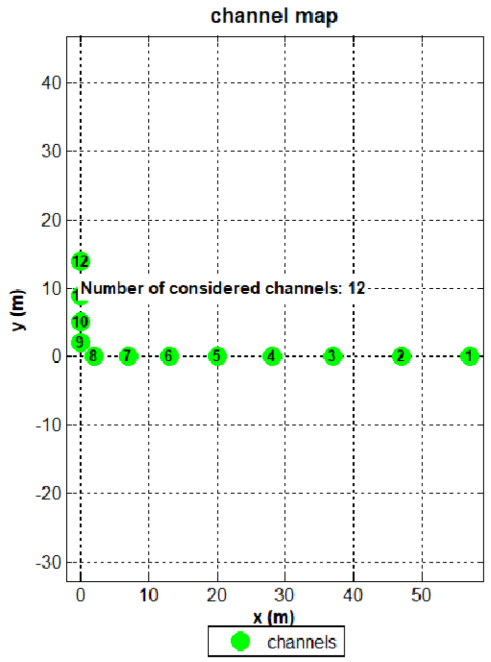
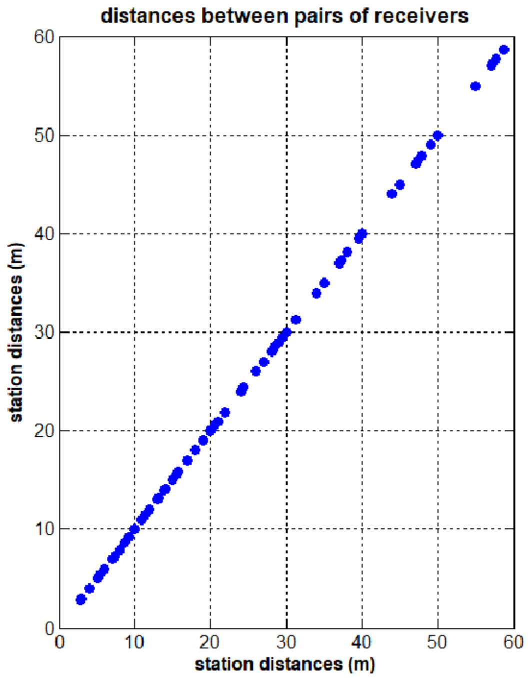
ACQUISIZIONE ESAC

**MS3_MASW5-ESAC5**

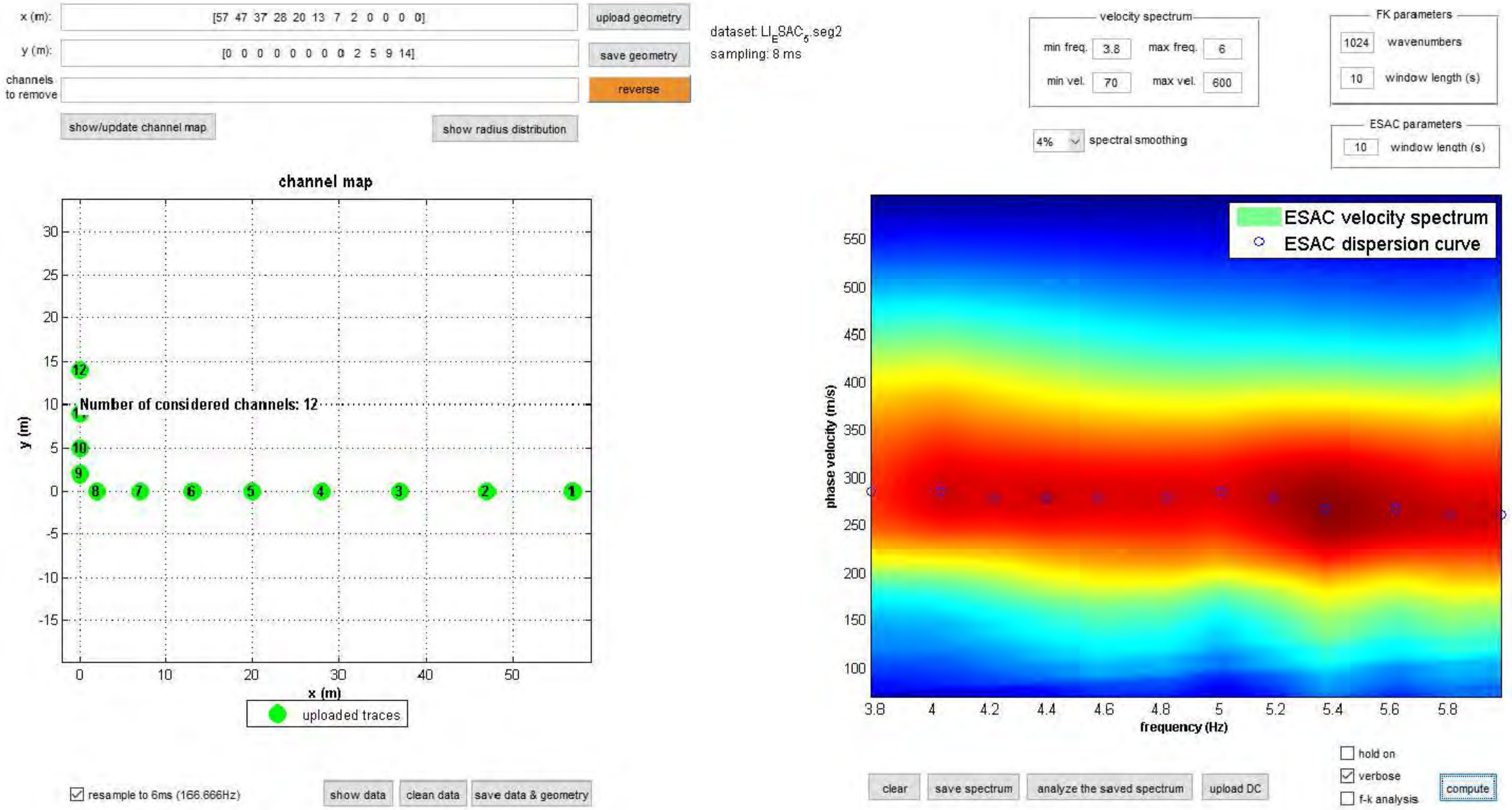



SPETTRO DI VELOCITA' ESAC E CURVA DI DISPERSIONE EFFETTIVA

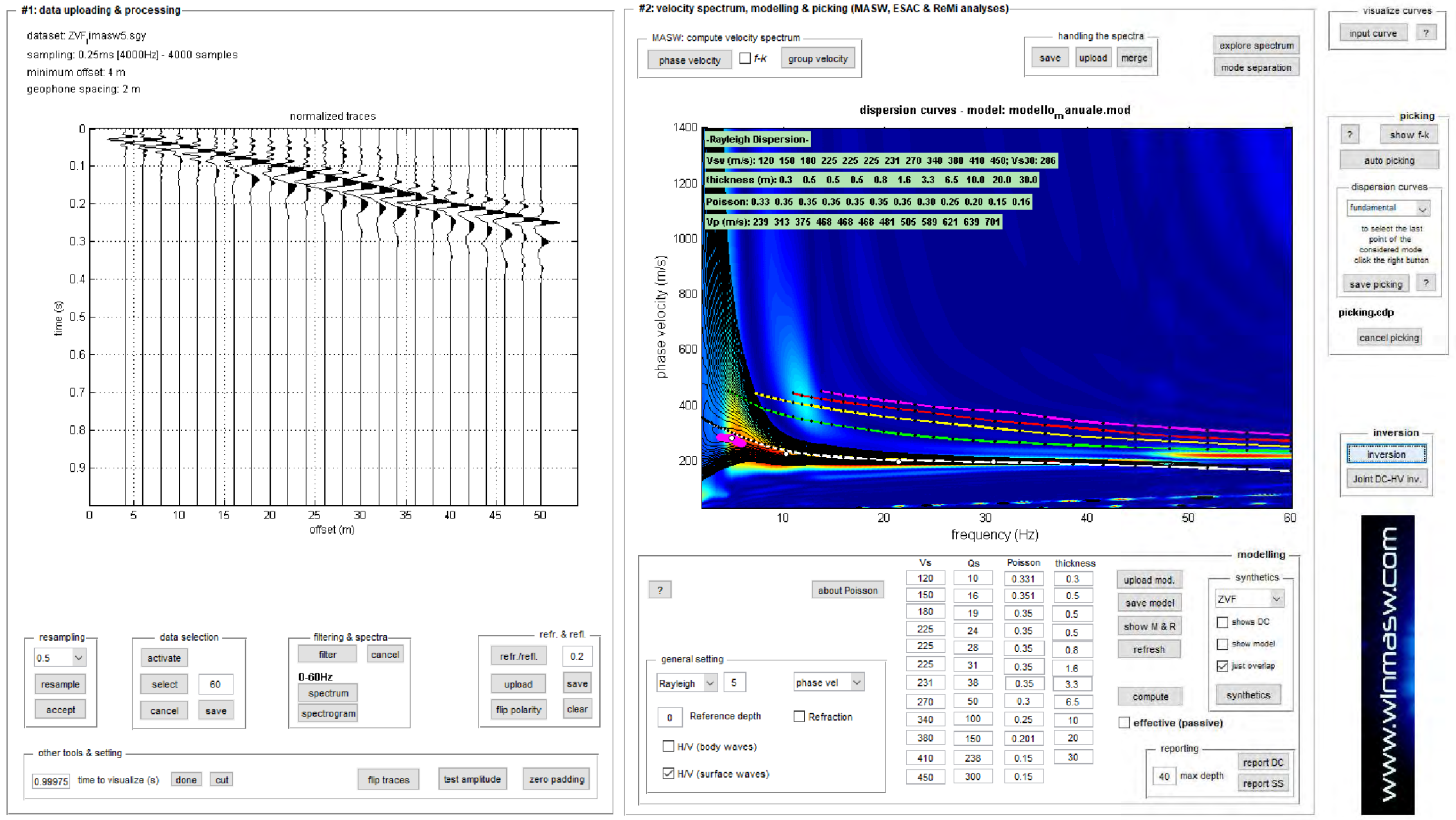
Stendimento ESAC5




GEOLOGICA TOSCANA s.n.c.

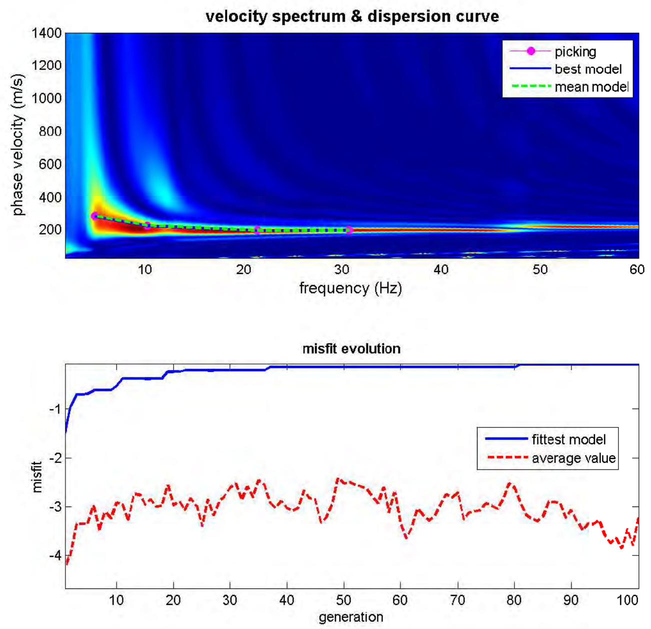
**RISULTANZE DELL'ANALISI SISMICA CONGIUNTA MASW 5 - ESAC 5**

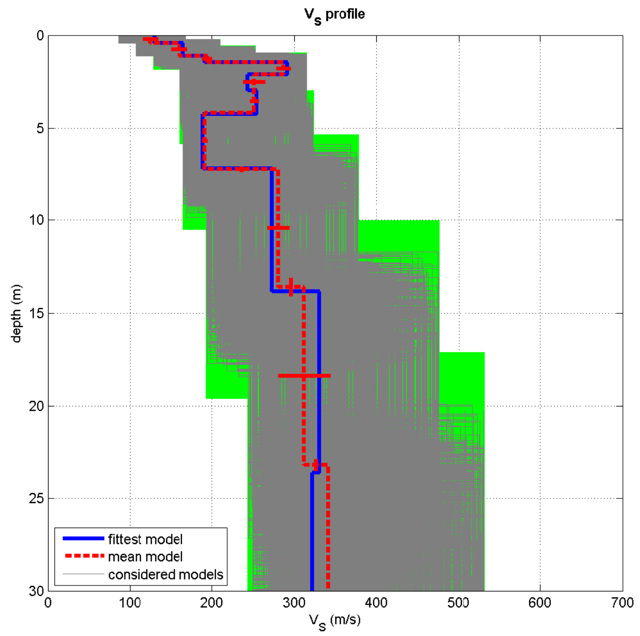
## SPETTRO DI VELOCITA' MASW + CURVA DI DISPERSIONE EFFETTIVA ESAC




Stendimento MASW 5

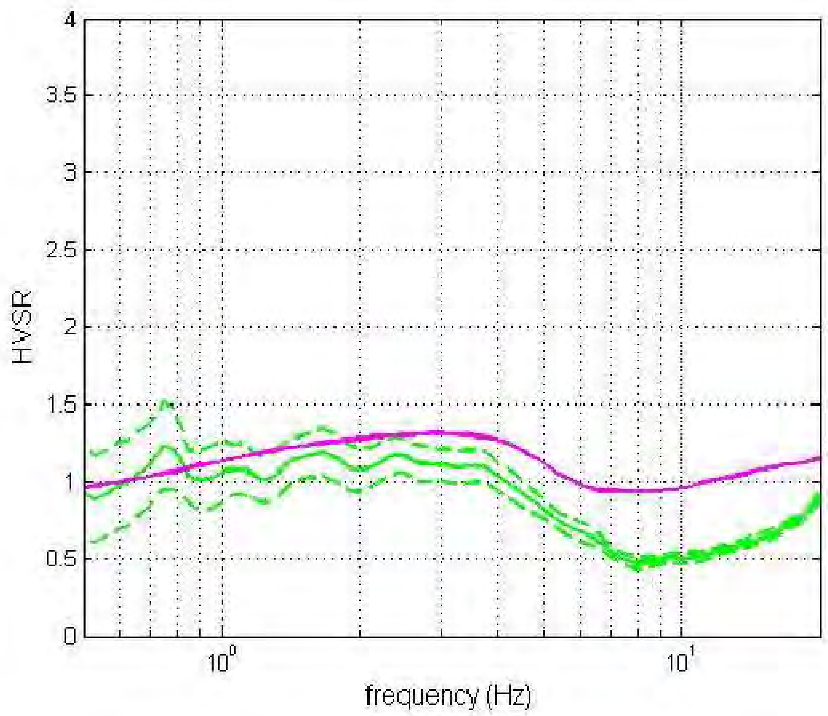
## INVERSIONE CONGIUNTA MASW – ESAC E PROFILO DI VELOCITA'




dataset: ZVFimasw5.sgy
dispersion curve: picking.cdp
Vs30 (best model): 274 m/s
Vs30 (mean model): 274 m/s

## INTERPRETAZIONE CONGIUNTA MASW 5 – HVSR5

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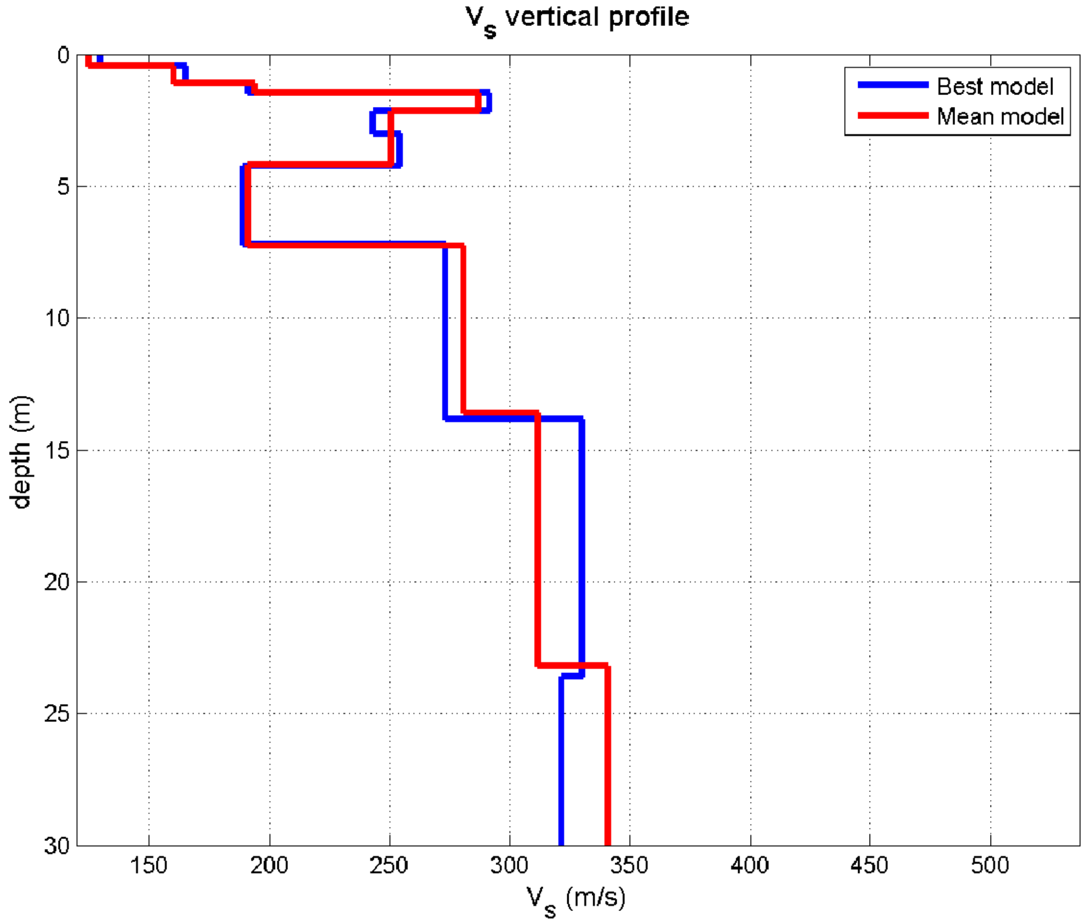
**RISULTANZE DELL'ANALISI SISMICA CONGIUNTA MASW 5 - ESAC 5**

PROFILO DI VELOCITA' MASW 5 – ESAC 5




Vs (m/s):125, 160, 194, 287, 251, 251, 191, 281, 312, 341, 475, 490
Standard deviations (m/s):9, 10, 6, 9, 14, 5, 3, 13, 31, 34, 24, 47

Thickness (m):0.4, 0.7, 0.4, 0.7, 0.8, 1.3, 3.0, 6.4, 9.6, 19.0, 26.1
Standard deviations (m/s):0.0, 0.0, 0.0, 0.0, 0.1, 0.0, 0.1, 0.5, 0.3, 0.0, 1.5

Density (gr/cm3) (approximate values):1.68, 1.75, 1.81, 1.88, 1.91, 1.91, 1.88, 1.90, 1.88, 1.94, 1.98, 1.99
Seismic/Dynamic Shear modulus (MPa) (approximate values):26, 45, 68, 155, 120, 120, 68, 150, 183, 225, 447, 478

Approximate values for Vp and Poisson (please, see manual)
Vp (m/s): 215, 280, 365, 488, 548, 548, 478, 534, 497, 613, 738, 765
Poisson: 0.24, 0.26, 0.30, 0.24, 0.37, 0.37, 0.40, 0.31, 0.17, 0.28, 0.15, 0.15

Vs30 (m/s): 274

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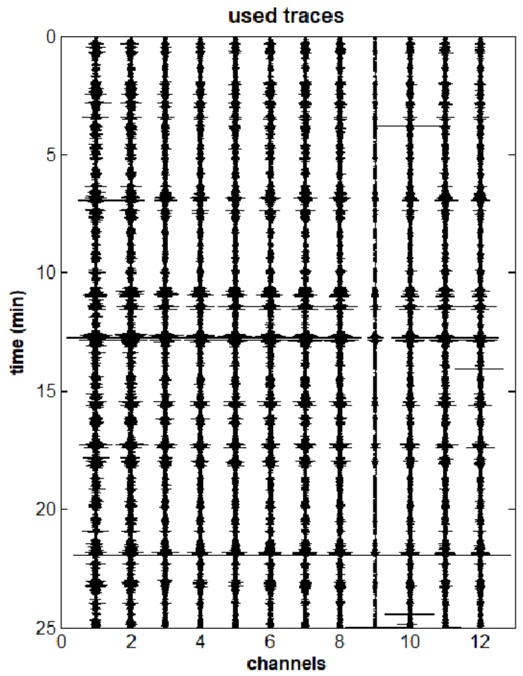
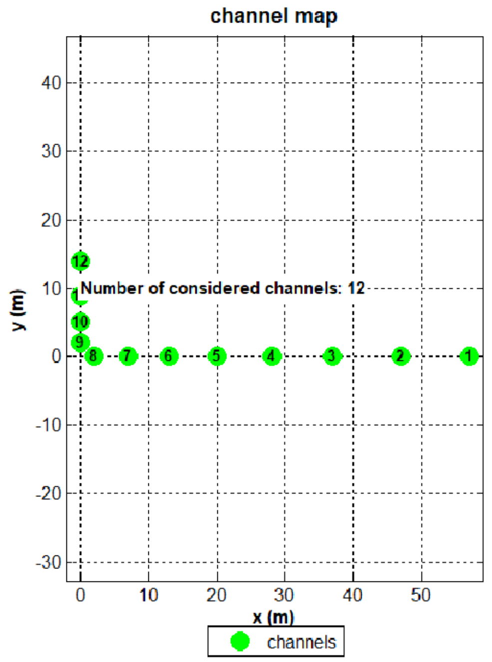
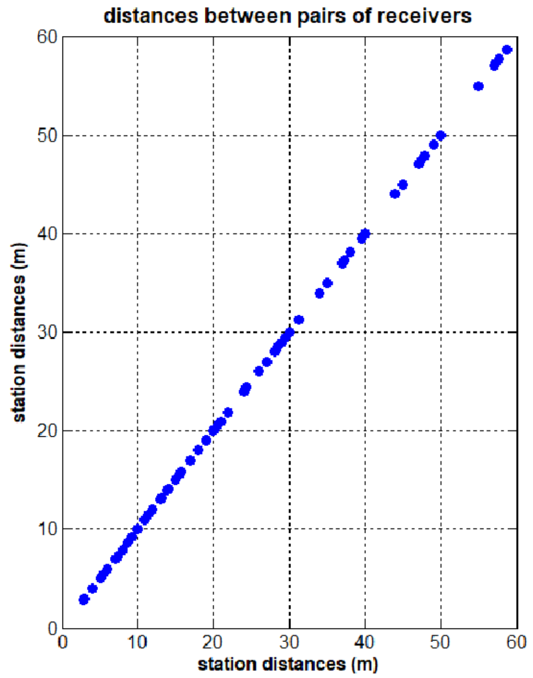
ACQUISIZIONE ESAC

**MS3_MASW6-ESAC6**

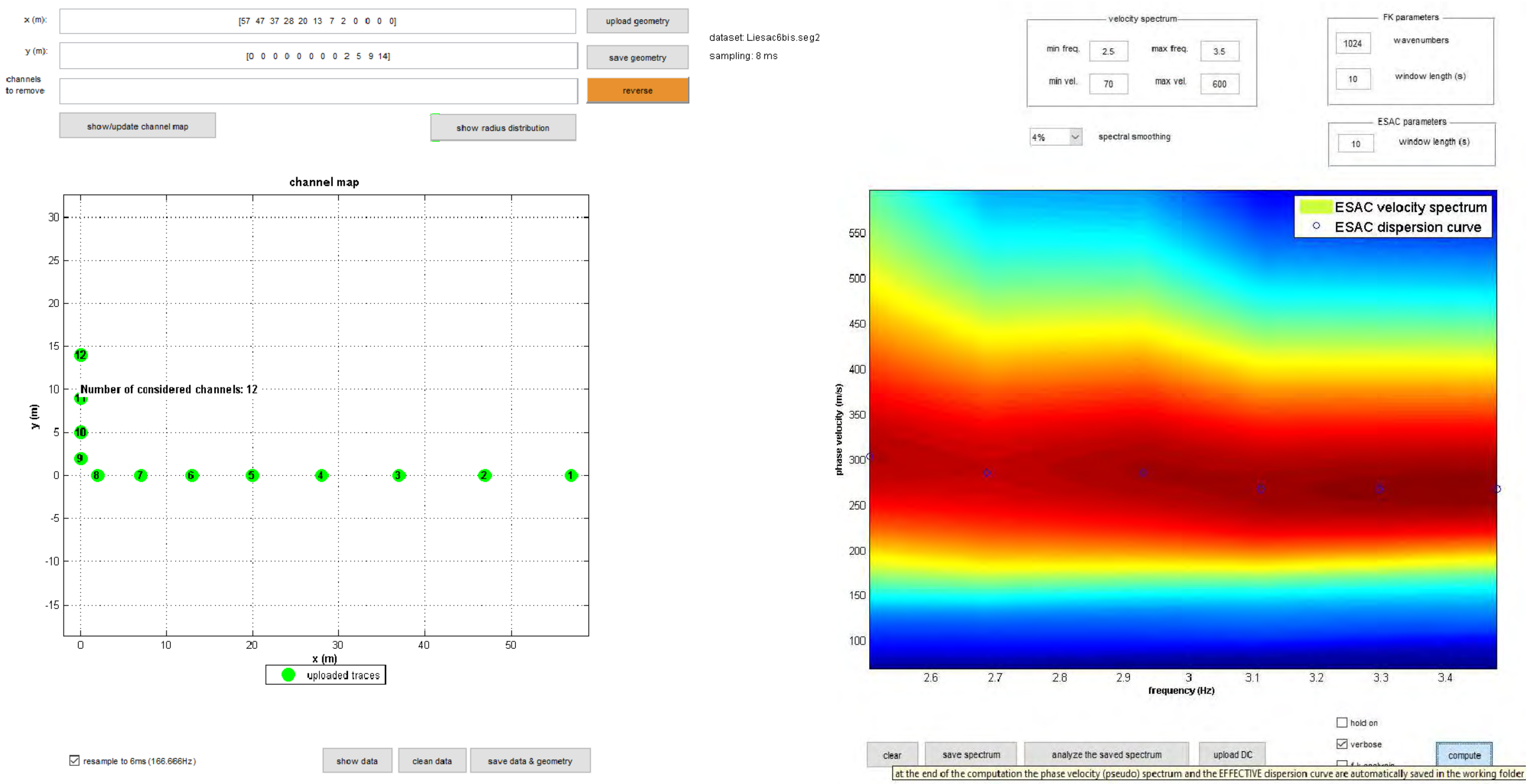



SPETTRO DI VELOCITA' ESAC E CURVA DI DISPERSIONE EFFETTIVA

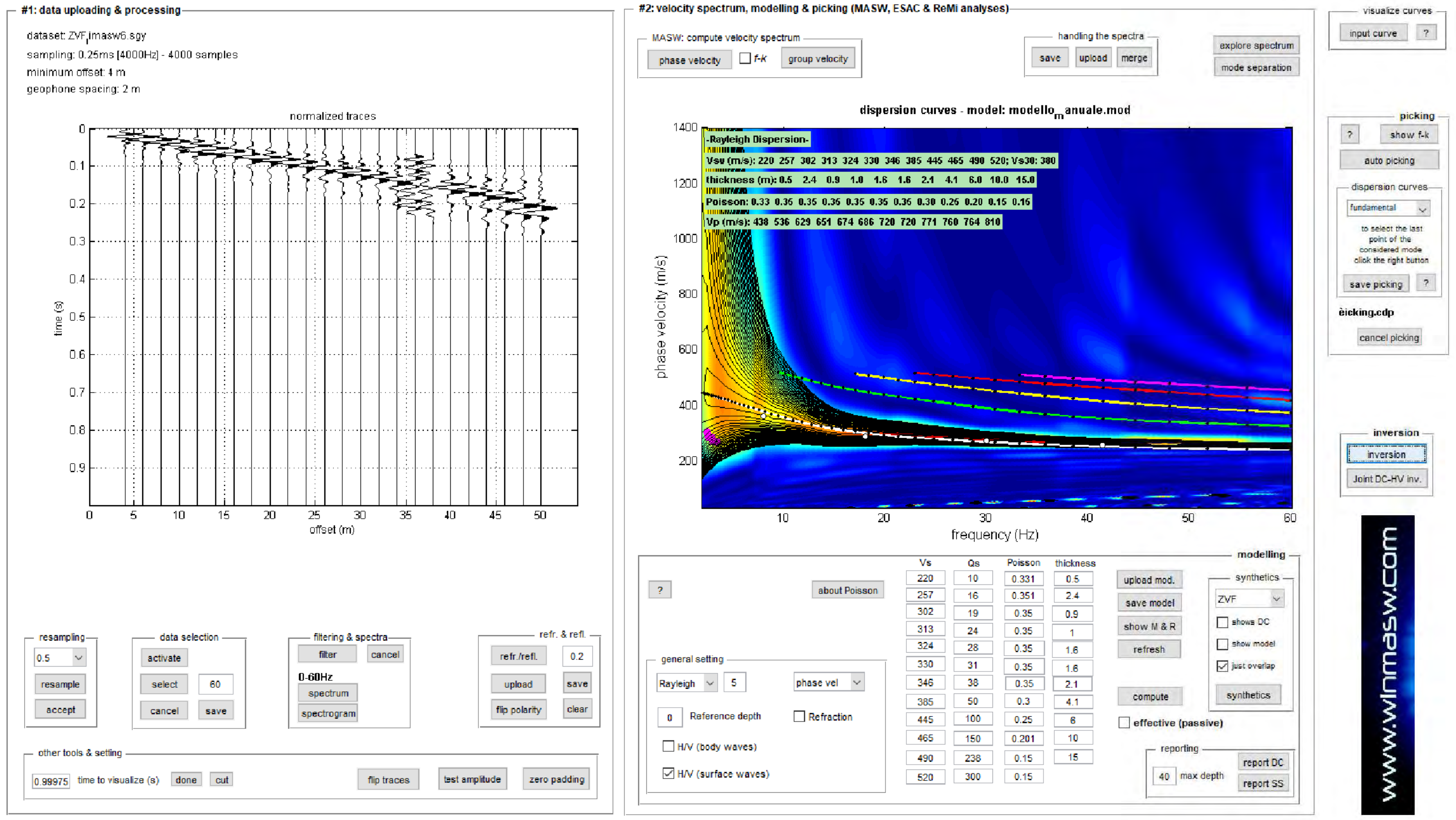
Stendimento ESAC6




**GEOLOGICA TOSCANA s.n.c.**

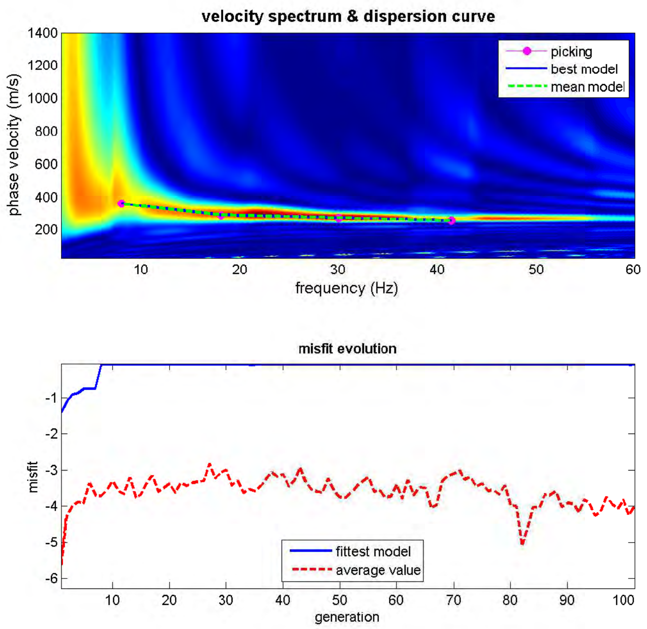
**RISULTANZE DELL'ANALISI SISMICA CONGIUNTA MASW 6 - ESAC 6**

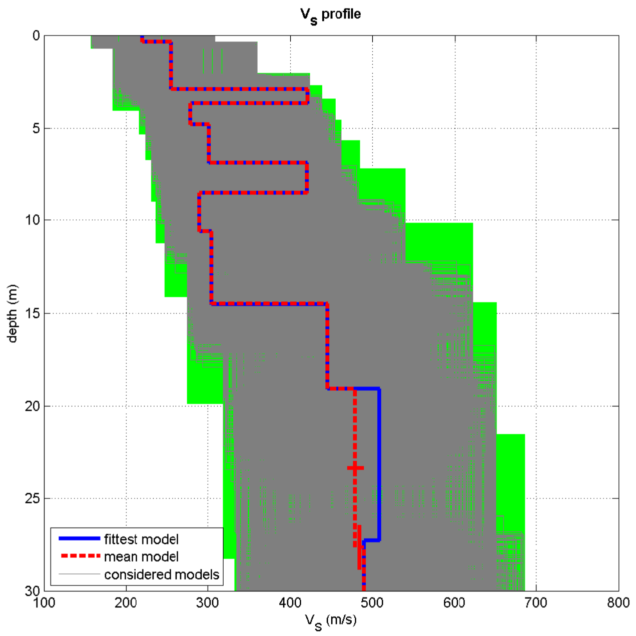
## SPETTRO DI VELOCITA' MASW + CURVA DI DISPERSIONE EFFETTIVA ESAC




## Stendimento MASW 6

## INVERSIONE CONGIUNTA MASW – ESAC E PROFILO DI VELOCITA'

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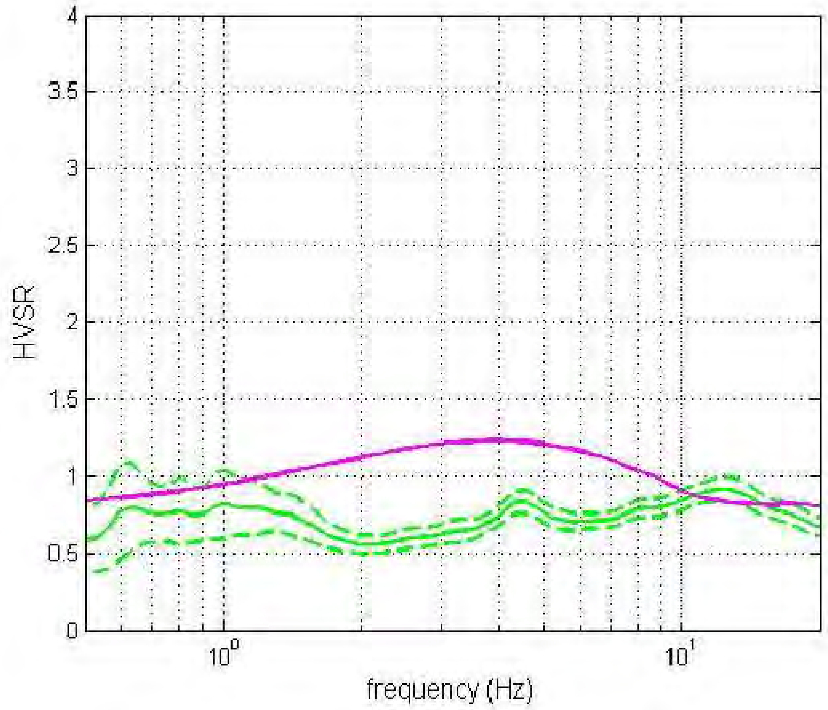
dataset: ZVFimasw6.sgy
dispersion curve: èicking.cdp
Vs30 (best model): 373 m/s
Vs30 (mean model): 369 m/s

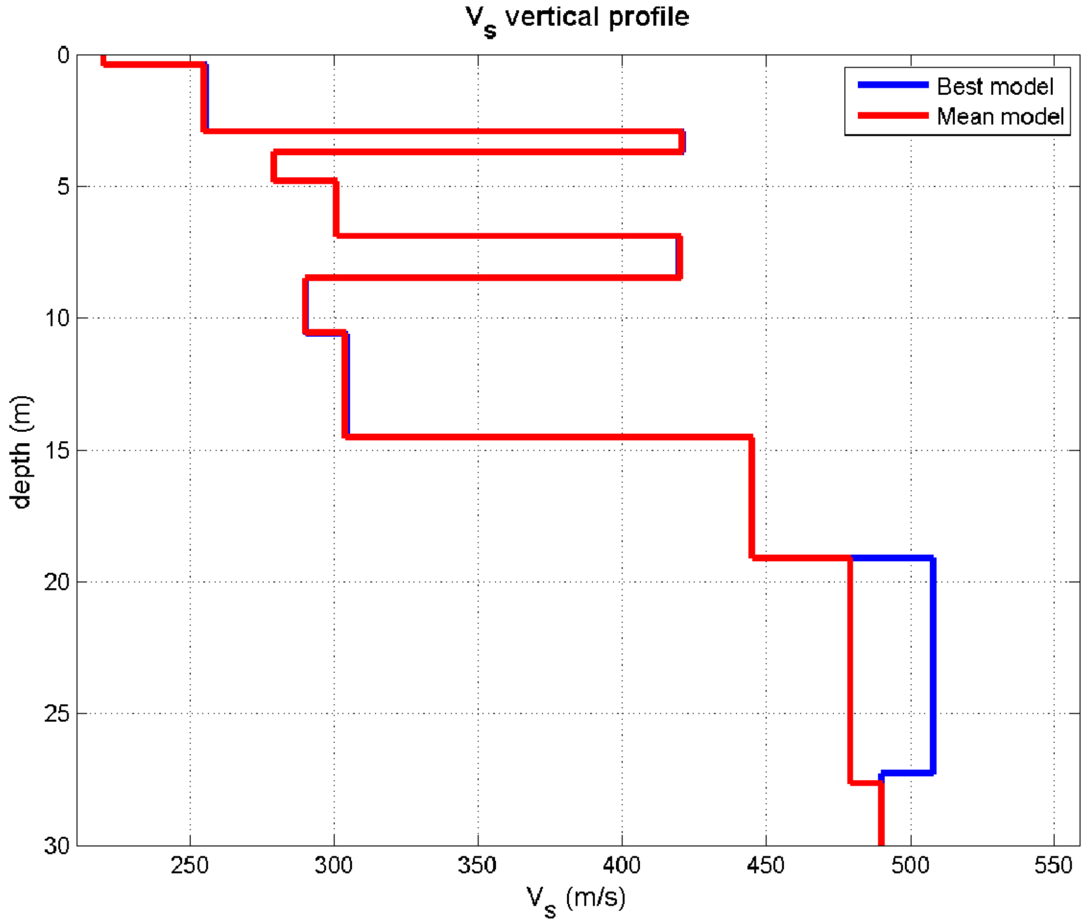
## INTERPRETAZIONE CONGIUNTA MASW 6 – HVSR6




GEOLOGICA TOSCANA s.n.c.

**RISULTANZE DELL'ANALISI SISMICA CONGIUNTA MASW 6 - ESAC 6**

PROFILO DI VELOCITA' MASW 6 – ESAC 6




Vs (m/s):220, 255, 421, 279, 301, 420, 290, 304, 445, 479, 490, 629
Standard deviations (m/s):0, 0, 0, 0, 0, 0, 0, 0, 0, 10, 0, 0

Thickness (m):0.4, 2.6, 0.7, 1.1, 2.1, 1.6, 2.1, 3.9, 4.6, 8.6, 16.1
Standard deviations (m/s):0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.1, 0.0, 0.0, 1.2, 1.5

Density (gr/cm3) (approximate values):1.82, 1.91, 2.11, 1.92, 2.16, 2.05, 2.05, 1.93, 2.01, 2.01, 1.99, 2.05
Seismic/Dynamic Shear modulus (MPa) (approximate values):88, 124, 374, 150, 196, 362, 172, 178, 398, 460, 477, 813

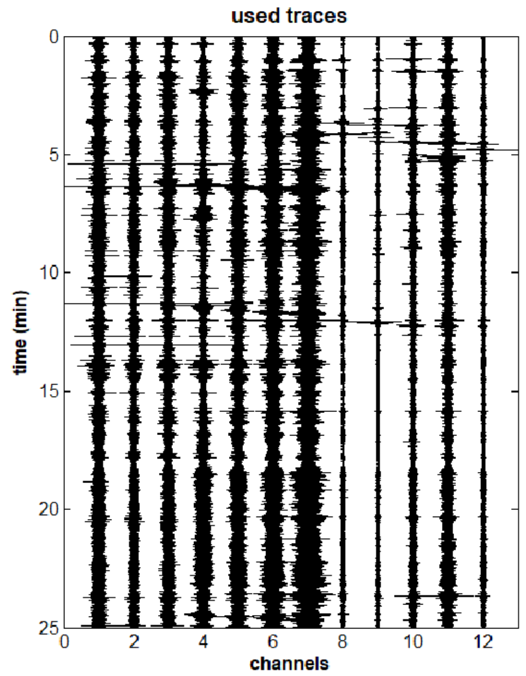
Approximate values for Vp and Poisson (please, see manual)
Vp (m/s):383, 543, 1256, 580, 1575, 1002, 985, 591, 839, 819, 764, 1003
Poisson:0.25, 0.36, 0.44, 0.35, 0.48, 0.39, 0.45, 0.32, 0.30, 0.24, 0.15, 0.18

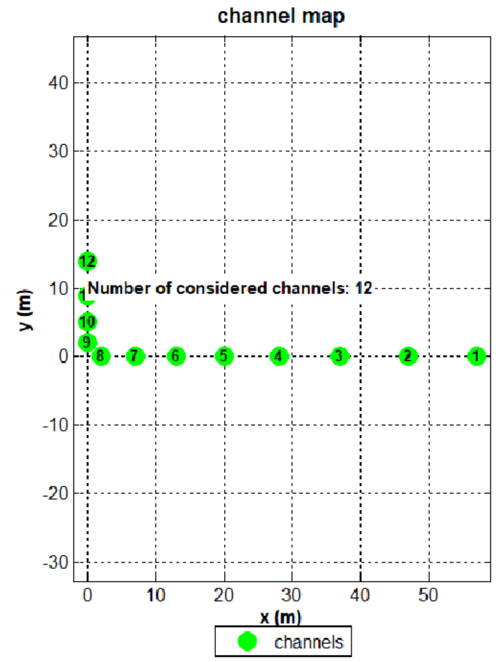
Vs30 (m/s): 369

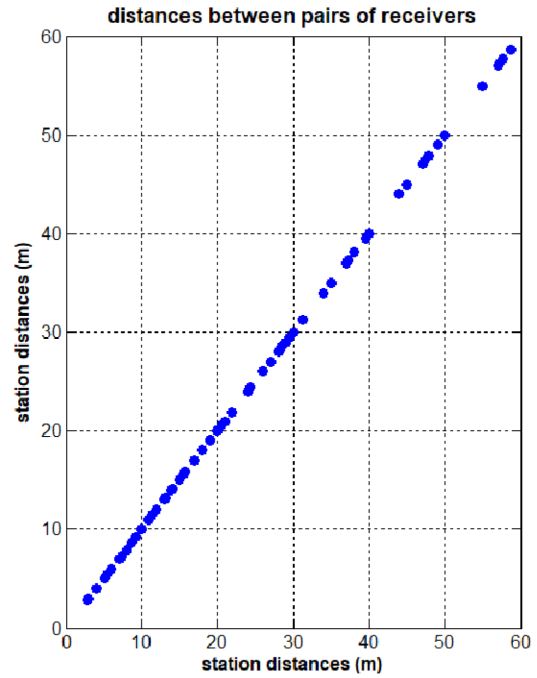
GEOLOGICA TOSCANA s.n.c.

MS3_MASW7-ESAC7

## ACQUISIZIONE ESAC

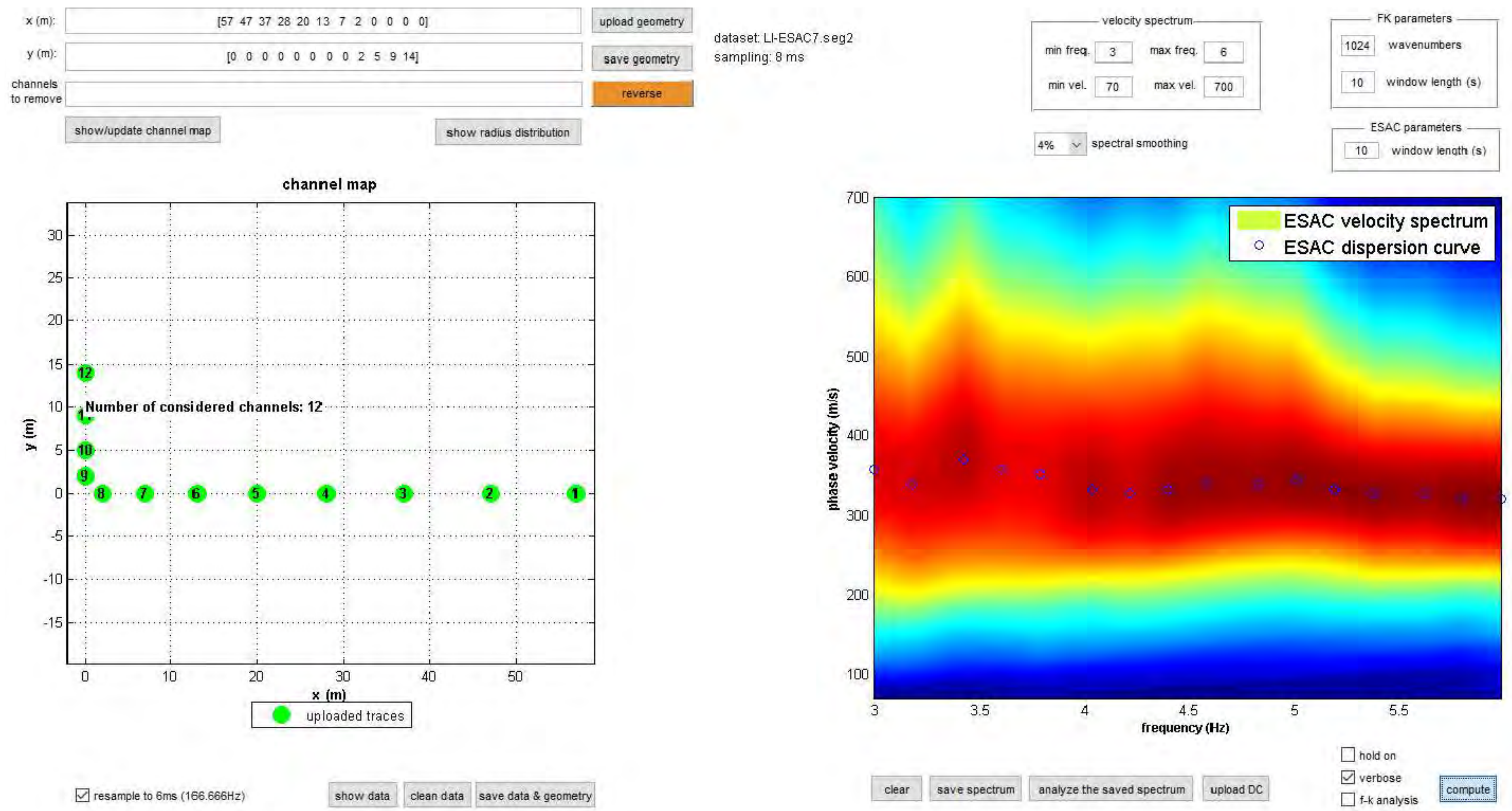



## SPETTRO DI VELOCITA' ESAC E CURVA DI DISPERSIONE EFFETTIVA

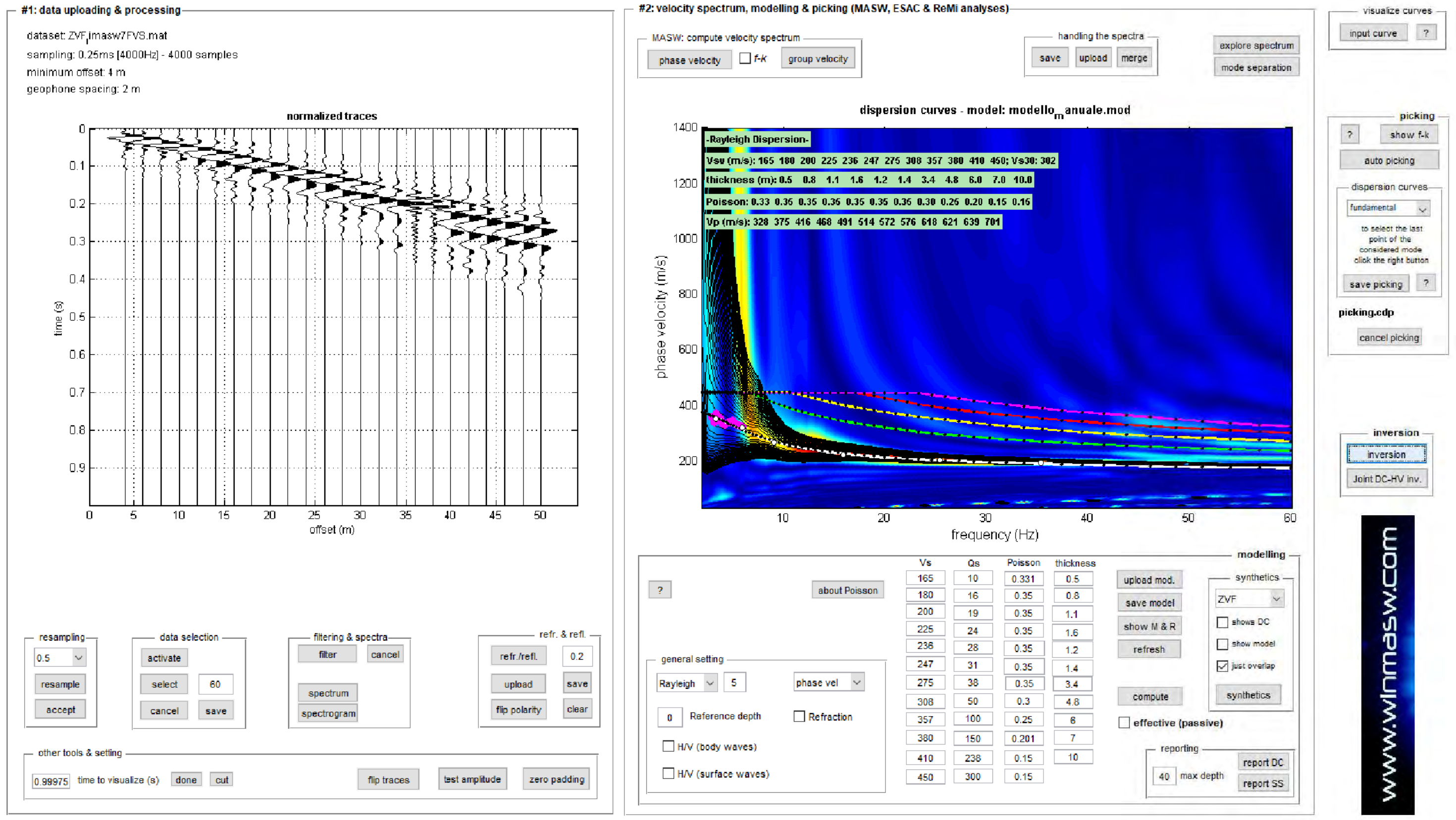
Stendimento ESAC7




**GEOLOGICA TOSCANA s.n.c.**

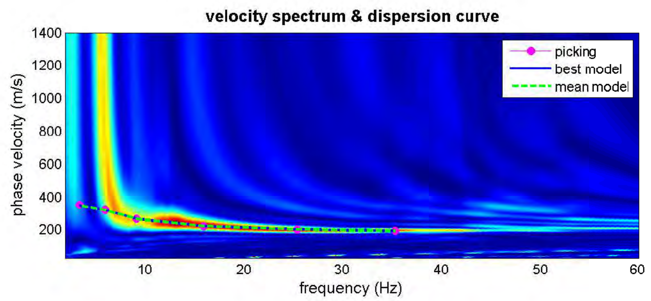
**RISULTANZE DELL'ANALISI SISMICA CONGIUNTA MASW 7 - ESAC 7**

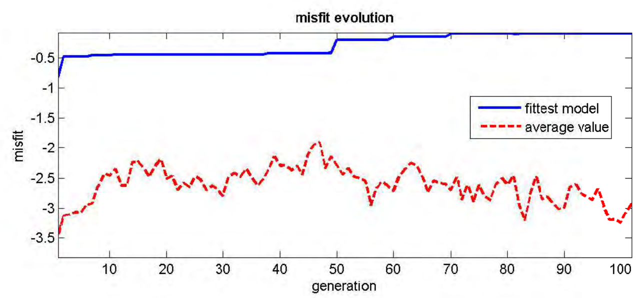
## SPETTRO DI VELOCITA' MASW + CURVA DI DISPERSIONE EFFETTIVA ESAC




Stendimento MASW 7

## INVERSIONE CONGIUNTA MASW – ESAC E PROFILO DI VELOCITA'

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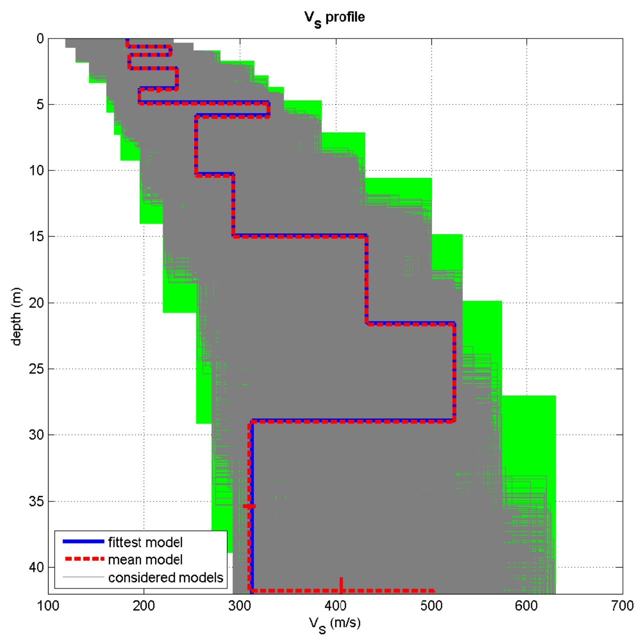
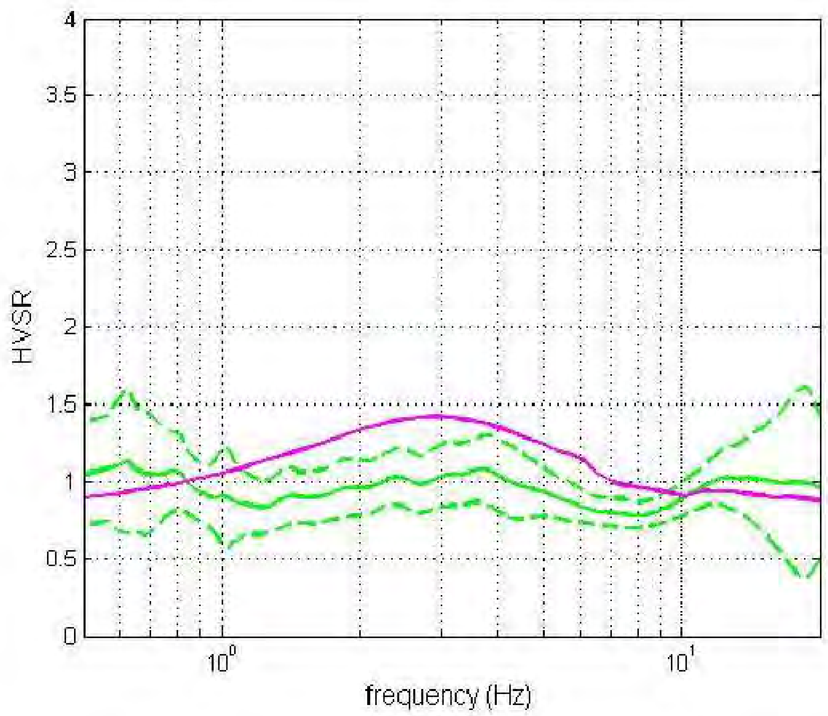



dataset: ZVF_imasw7FVS.mat
dispersion curve: picking.cdp
Vs30 (best model): 324 m/s
Vs30 (mean model): 324 m/s

*half-space*

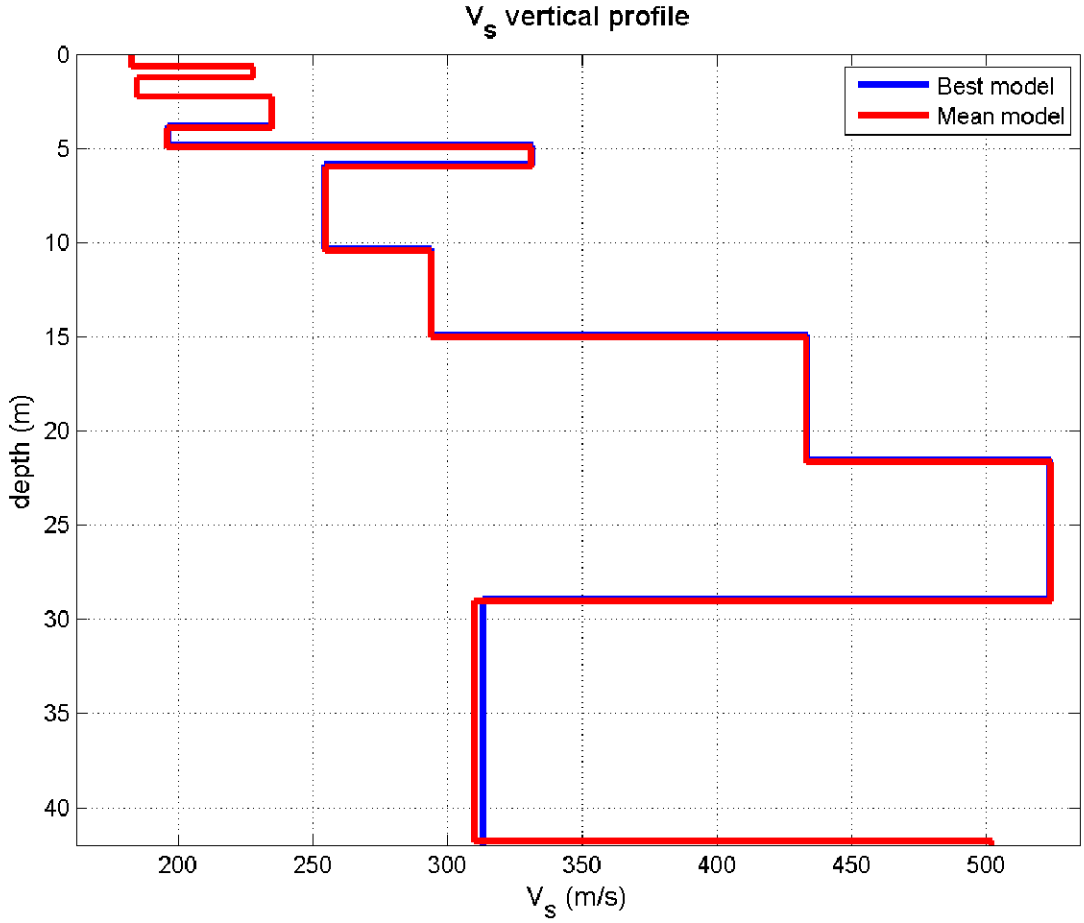
## INTERPRETAZIONE CONGIUNTA MASW 7 – HVSR7




**GEOLOGICA TOSCANA s.n.c.**

**RISULTANZE DELL'ANALISI SISMICA CONGIUNTA MASW 7 - ESAC 7**

PROFILO DI VELOCITA' MASW 7 – ESAC 7




Vs (m/s):183, 228, 185, 235, 196, 331, 255, 294, 433, 524, 310, 502
Standard deviations (m/s):0, 0, 0, 0, 0, 0, 0, 0, 1, 0, 6, 0

Thickness (m):0.7, 0.6, 1.0, 1.7, 1.0, 1.0, 4.5, 4.6, 6.6, 7.4, 12.8
Standard deviations (m/s):0.0, 0.0, 0.0, 0.2, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 1.0

Density (gr/cm3) (approximate values):1.80, 1.82, 1.83, 1.85, 1.85, 1.91, 1.88, 1.90, 2.00, 2.01, 1.88, 1.99
Seismic/Dynamic Shear modulus (MPa) (approximate values):60, 95, 63, 102, 71, 209, 122, 164, 374, 552, 181, 503

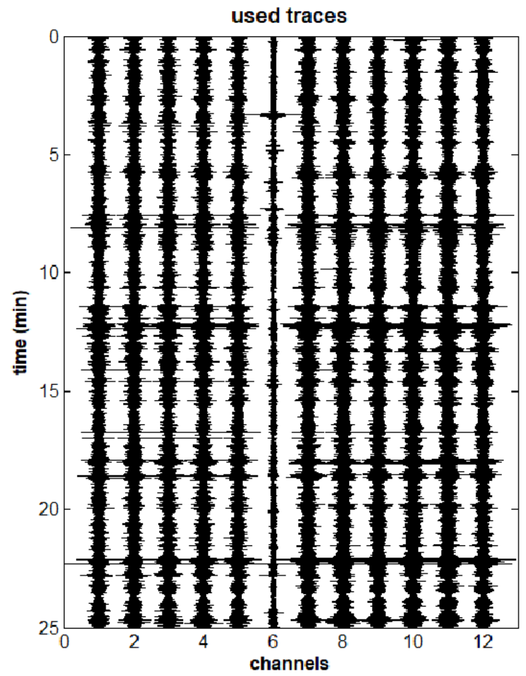
Approximate values for Vp and Poisson (please, see manual)
Vp (m/s):356, 383, 398, 423, 423, 557, 489, 533, 786, 834, 490, 783
Poisson:0.32, 0.23, 0.36, 0.28, 0.36, 0.23, 0.31, 0.28, 0.28, 0.17, 0.17, 0.15

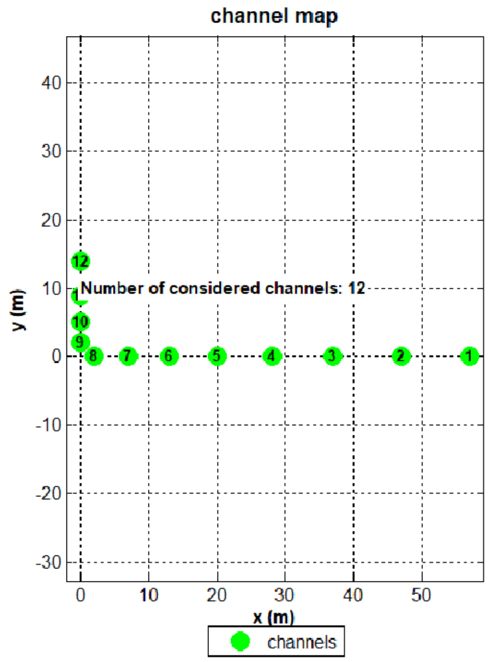
Vs30 (m/s): 324

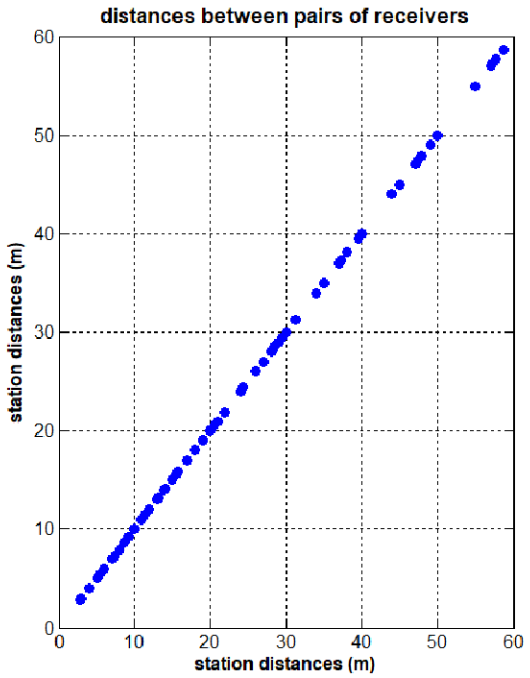
GEOLOGICA TOSCANA s.n.c.

**MS3_MASW8-ESAC8**

ACQUISIZIONE ESAC

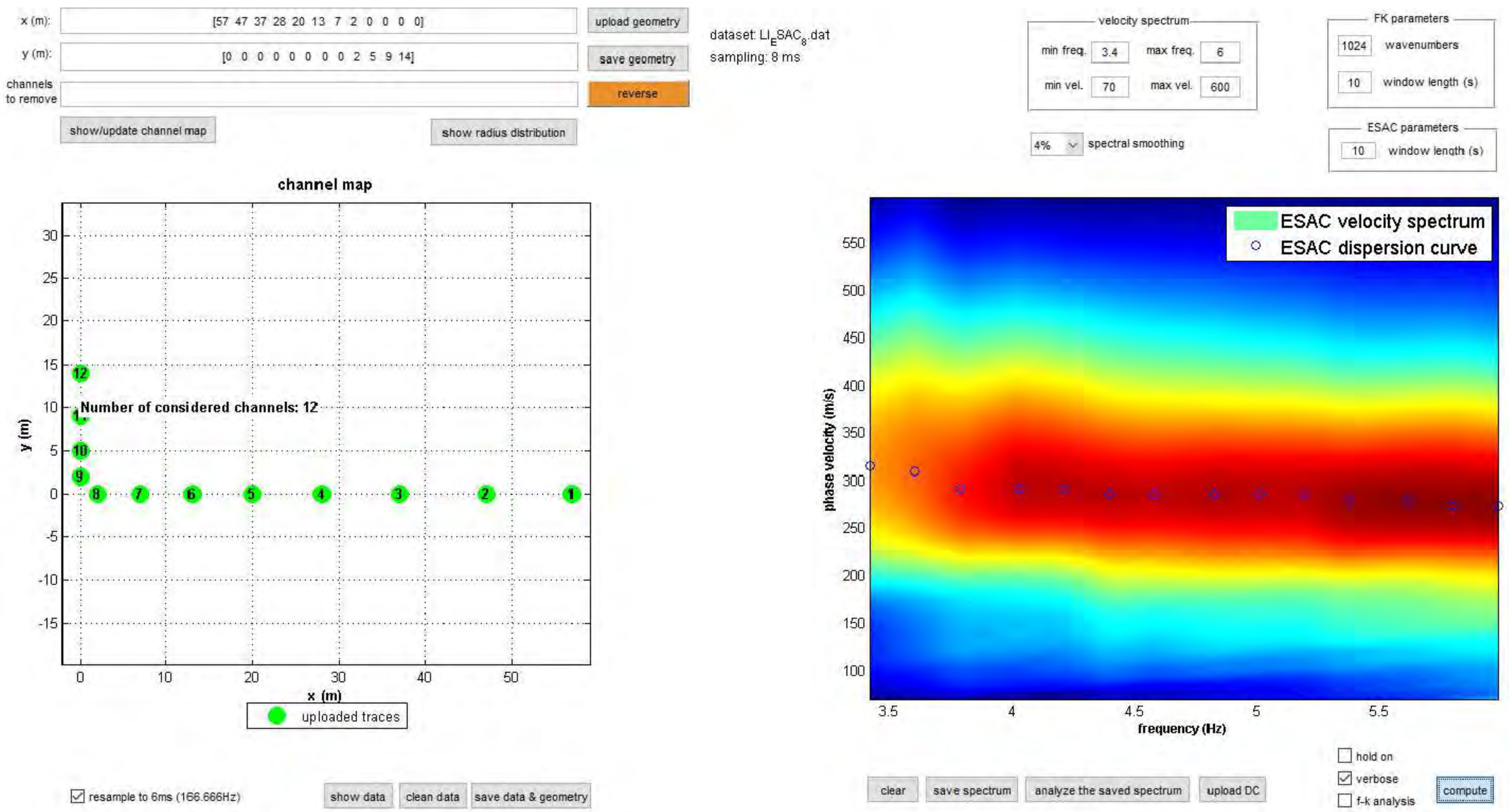



SPETTRO DI VELOCITA' ESAC E CURVA DI DISPERSIONE EFFETTIVA

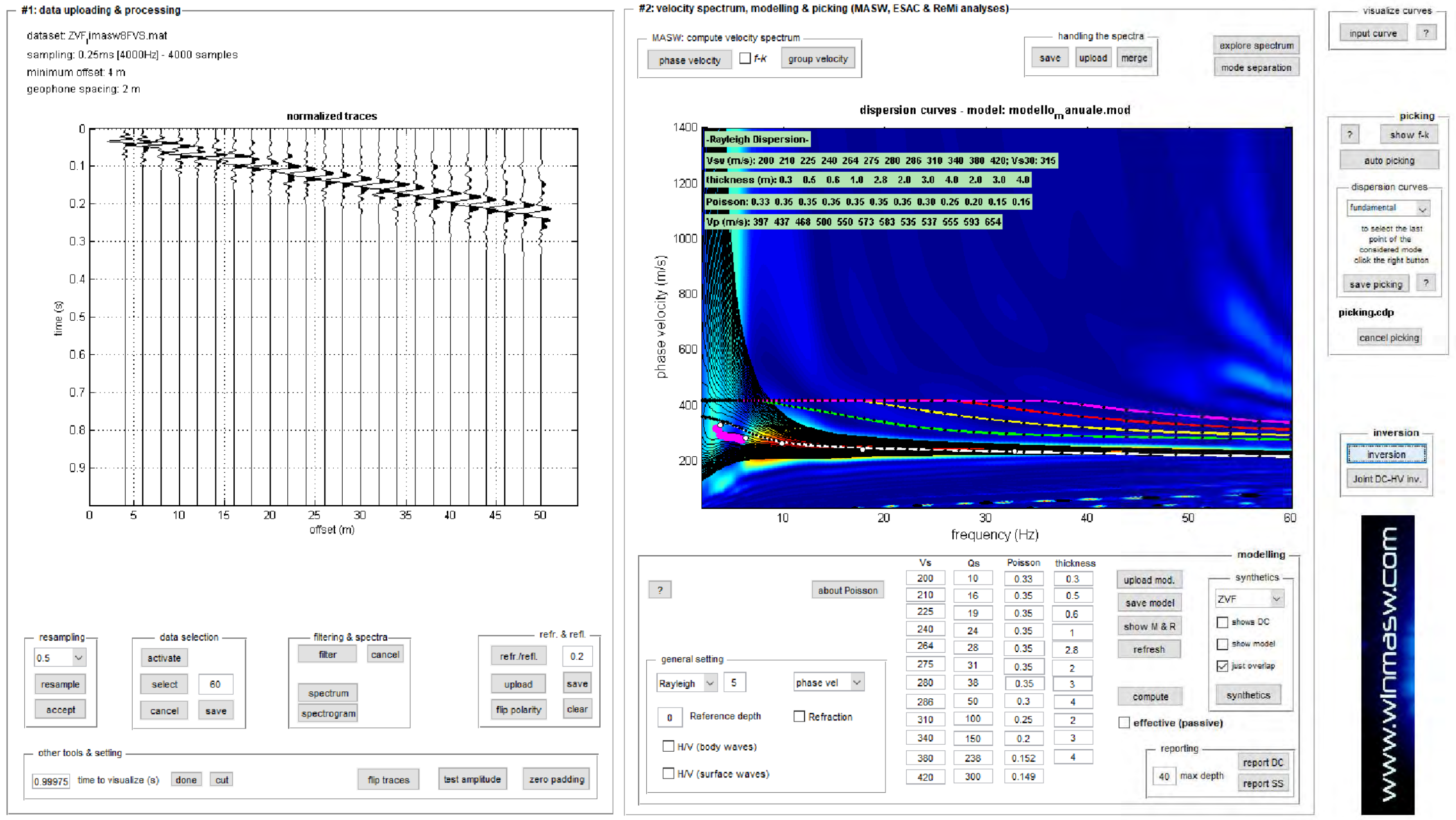
Stendimento ESAC8




GEOLOGICA TOSCANA s.n.c.

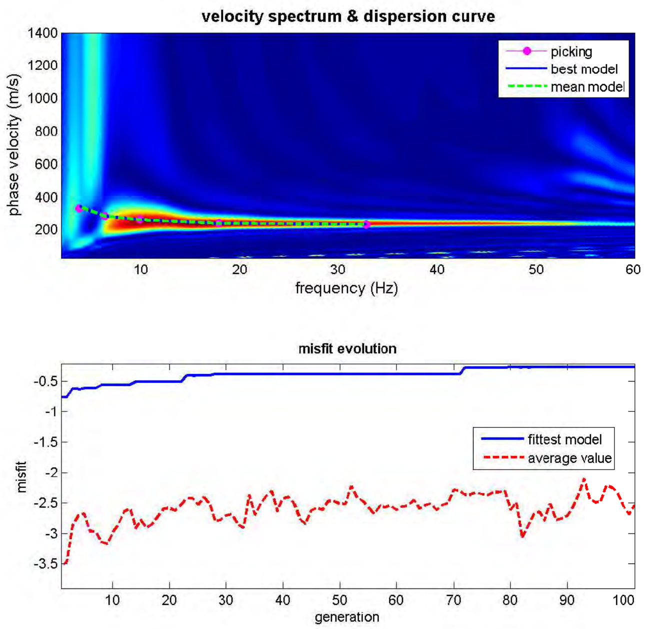
**RISULTANZE DELL'ANALISI SISMICA CONGIUNTA MASW 8 - ESAC 8**

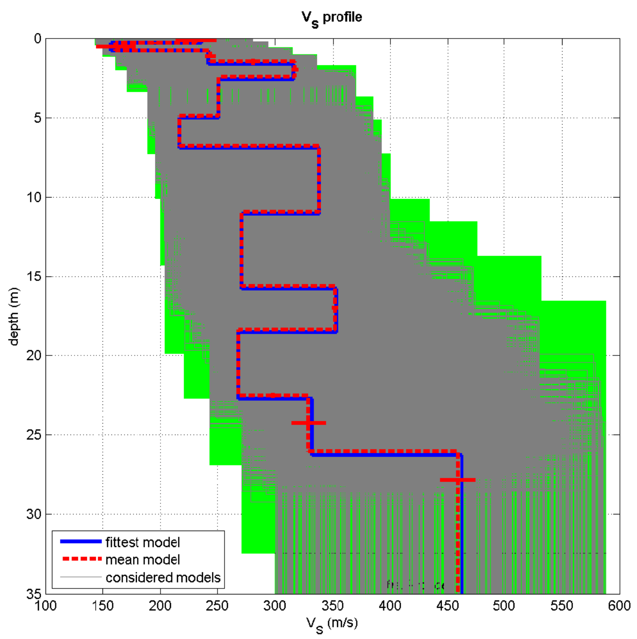
## SPETTRO DI VELOCITA' MASW + CURVA DI DISPERSIONE EFFETTIVA ESAC




## Stendimento MASW 8

## INVERSIONE CONGIUNTA MASW – ESAC E PROFILO DI VELOCITA'




dataset: ZVF_imasw8FVS.mat
dispersion curve: picking.cdp
Vs30 (best model): 297 m/s
Vs30 (mean model): 297 m/s

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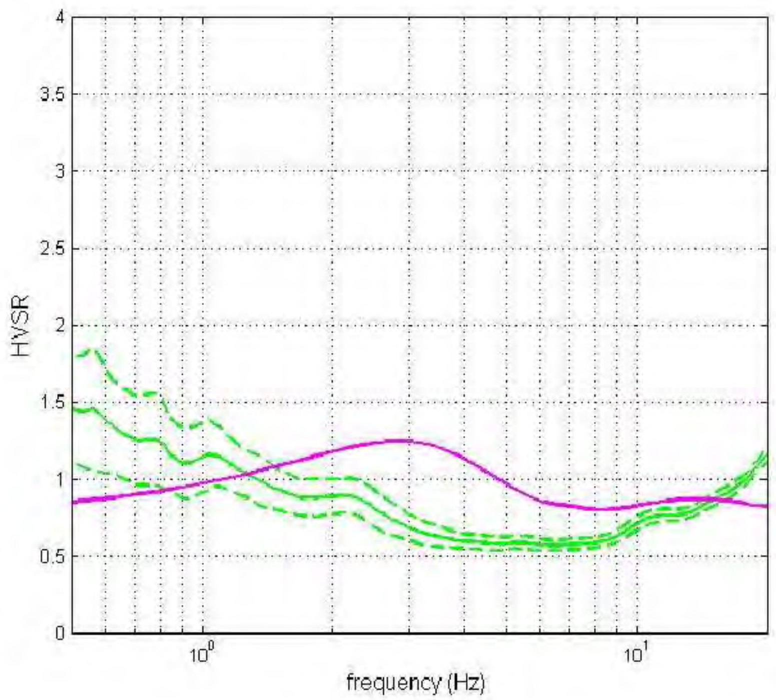
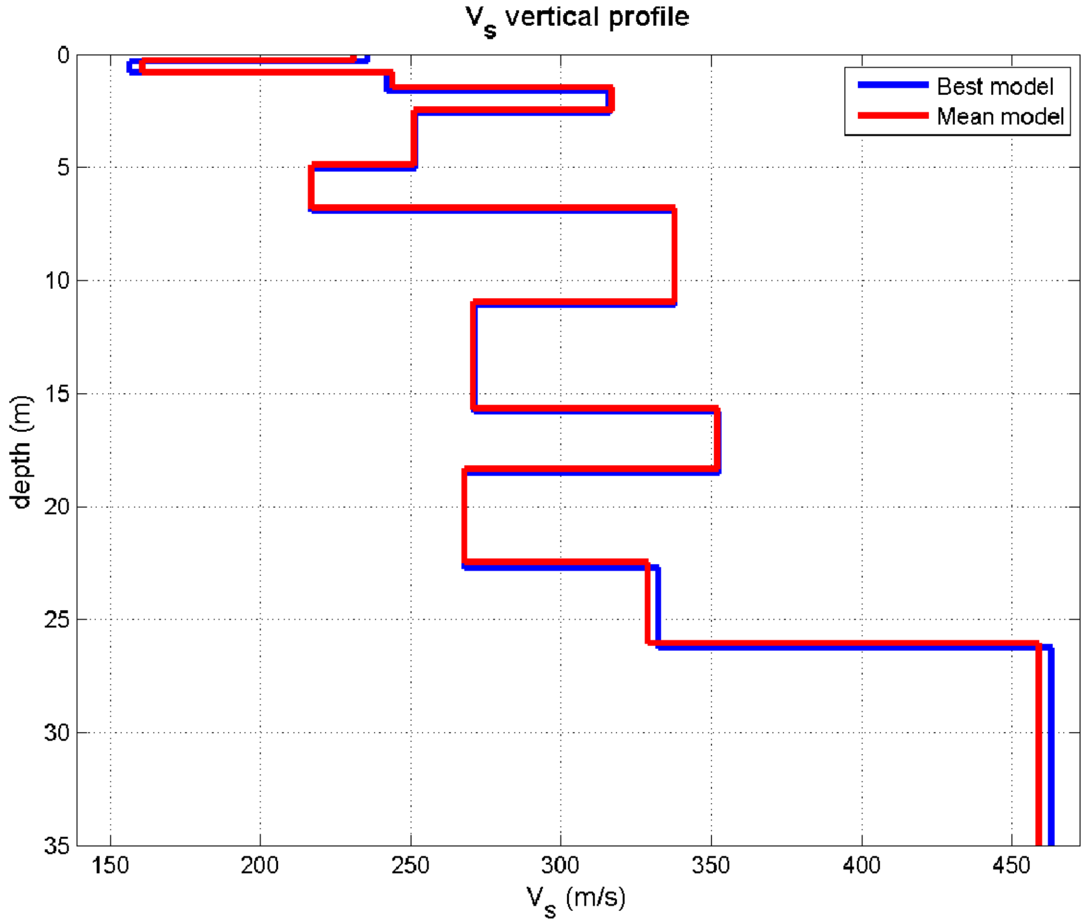
## INTERPRETAZIONE CONGIUNTA MASW 8 – HVSR8




GEOLOGICA TOSCANA s.n.c.

**RISULTANZE DELL'ANALISI SISMICA CONGIUNTA MASW 8 - ESAC 8**

PROFILO DI VELOCITA' MASW 8 – ESAC 8




Vs (m/s):231, 161, 244, 317, 251, 217, 338, 271, 352, 268, 329, 459
Standard deviations (m/s):18, 17, 4, 3, 0, 0, 0, 0, 3, 0, 15, 16
Thickness (m):0.3, 0.5, 0.7, 1.0, 2.4, 1.9, 4.1, 4.7, 2.7, 4.2, 3.5
Standard deviations (m/s):0.0, 0.0, 0.2, 0.0, 0.1, 0.0, 0.1, 0.1, 0.1, 0.1, 0.0

Density (gr/cm3) (approximate values):1.94, 1.78, 1.86, 1.94, 1.87, 1.86, 1.92, 1.90, 1.94, 1.84, 1.90, 1.97
Seismic/Dynamic Shear modulus (MPa) (approximate values):104, 46, 111, 195, 118, 88, 220, 139, 240, 132, 205, 416

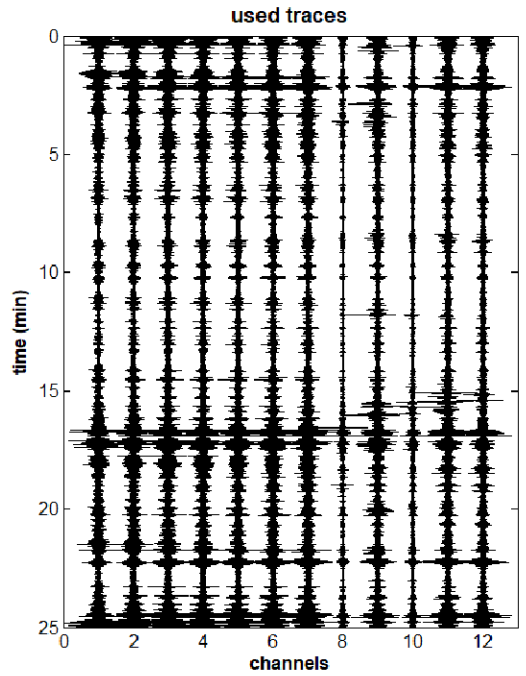
Approximate values for Vp and Poisson (please, see manual)
Vp (m/s):634, 319, 443, 634, 465, 449, 583, 522, 624, 418, 522, 714
Poisson:0.42, 0.33, 0.28, 0.33, 0.29, 0.35, 0.25, 0.32, 0.27, 0.15, 0.17, 0.15

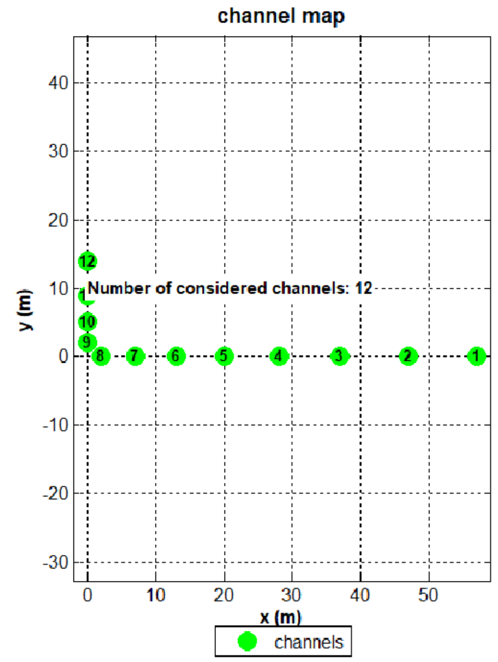
Vs30 (m/s): 297

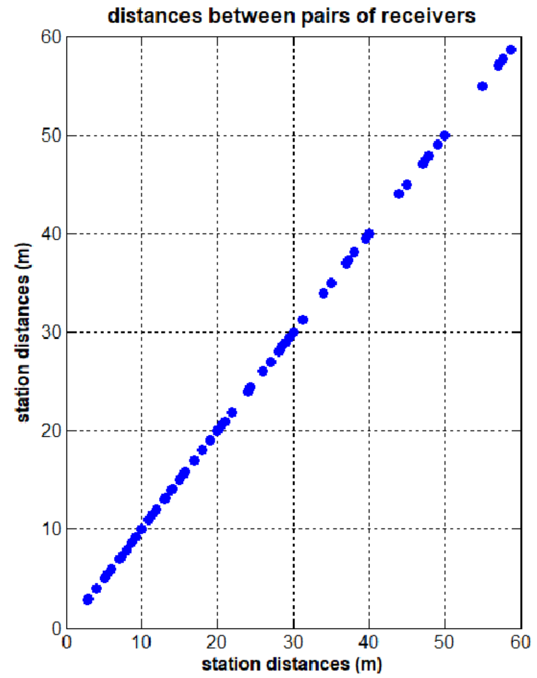
GEOLOGICA TOSCANA s.n.c.

ACQUISIZIONE ESAC

MS3_MASW9-ESAC9

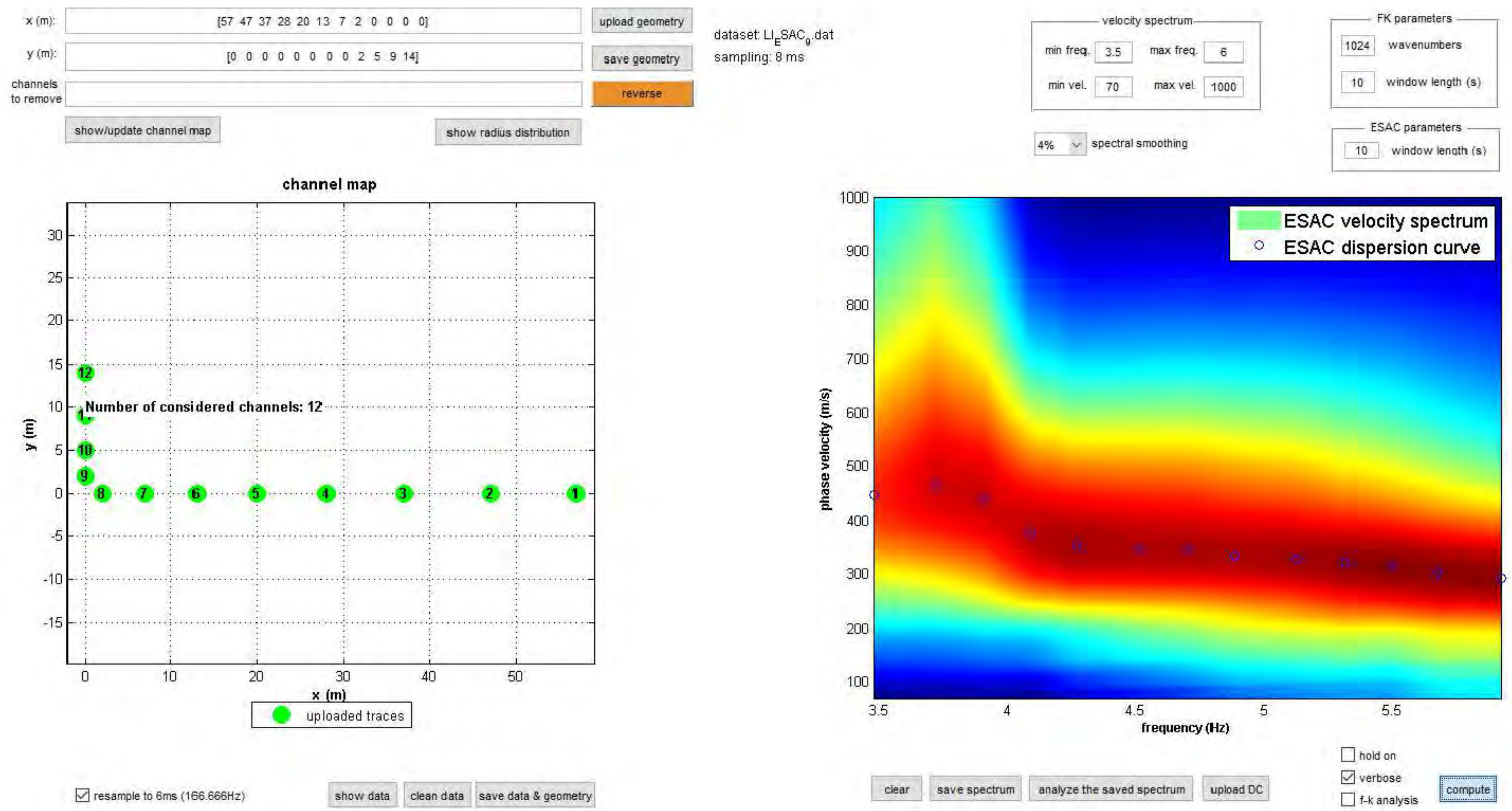



SPETTRO DI VELOCITA' ESAC E CURVA DI DISPERSIONE EFFETTIVA

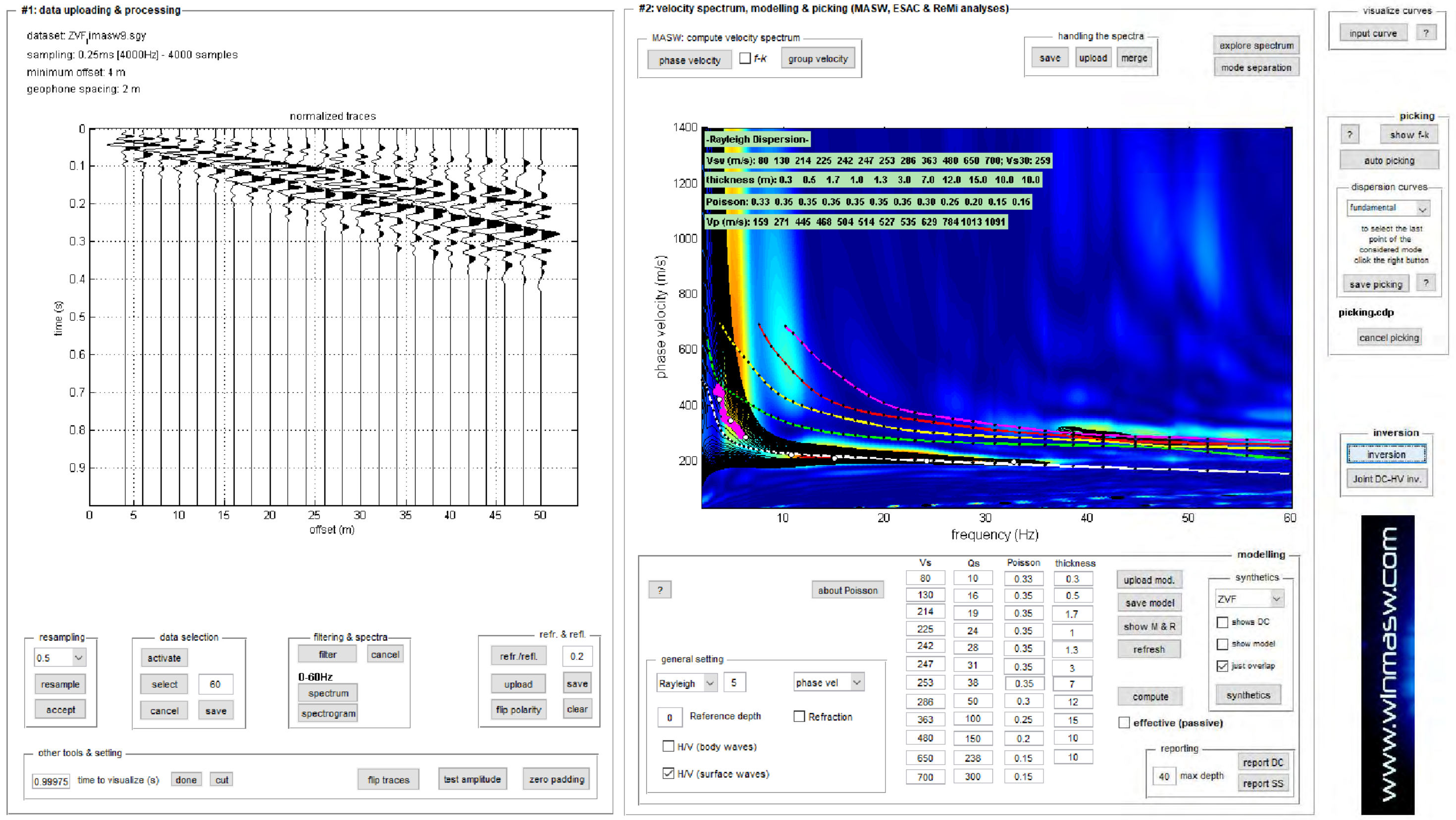
Stendimento ESAC9




GEOLOGICA TOSCANA s.n.c.

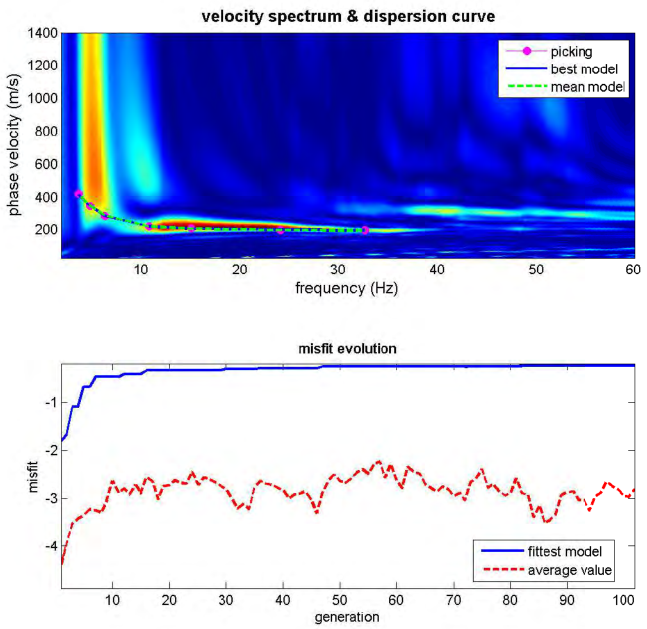
RISULTANZE DELL'ANALISI SISMICA CONGIUNTA MASW 9 - ESAC 9

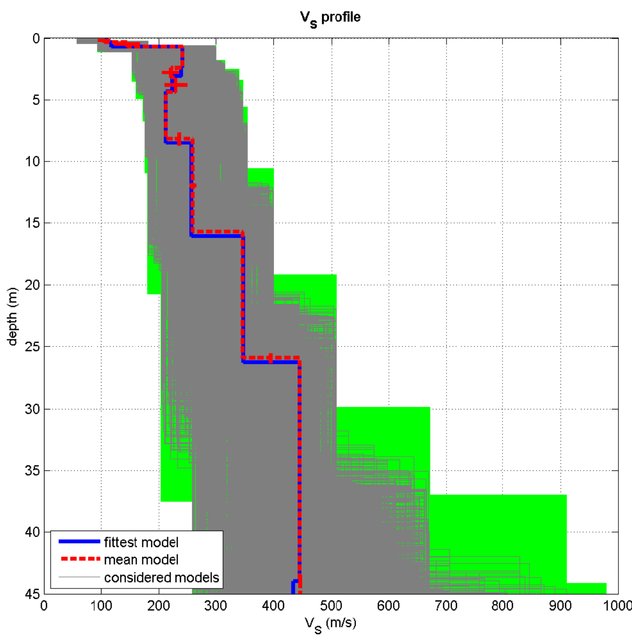
## SPETTRO DI VELOCITA' MASW + CURVA DI DISPERSIONE EFFETTIVA ESAC




## Stendimento MASW 9

## INVERSIONE CONGIUNTA MASW – ESAC E PROFILO DI VELOCITA'




dataset: ZVF_imasw9.sgy
dispersion curve: picking.cdp
Vs30 (best model): 277 m/s
Vs30 (mean model): 281 m/s

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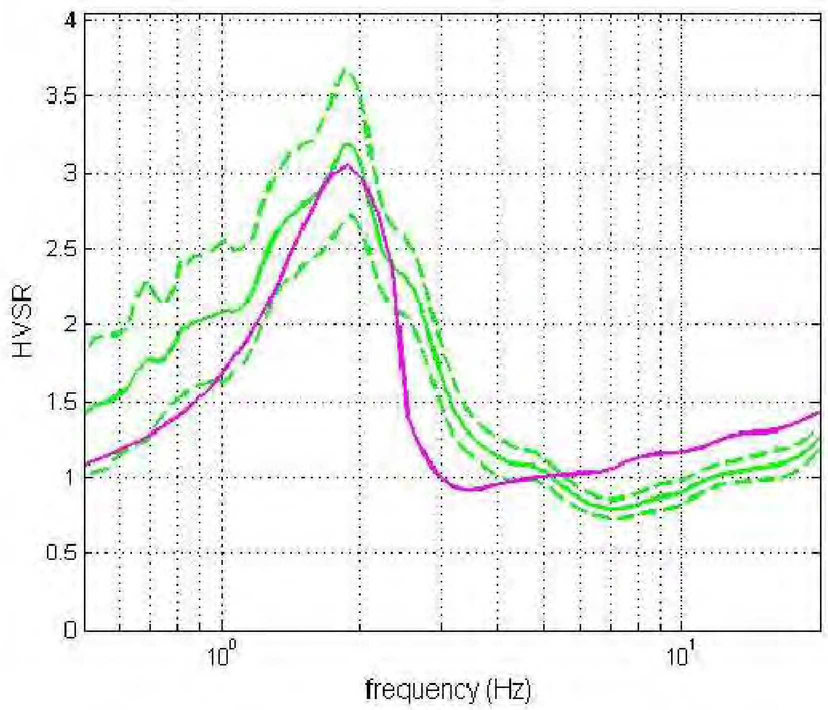
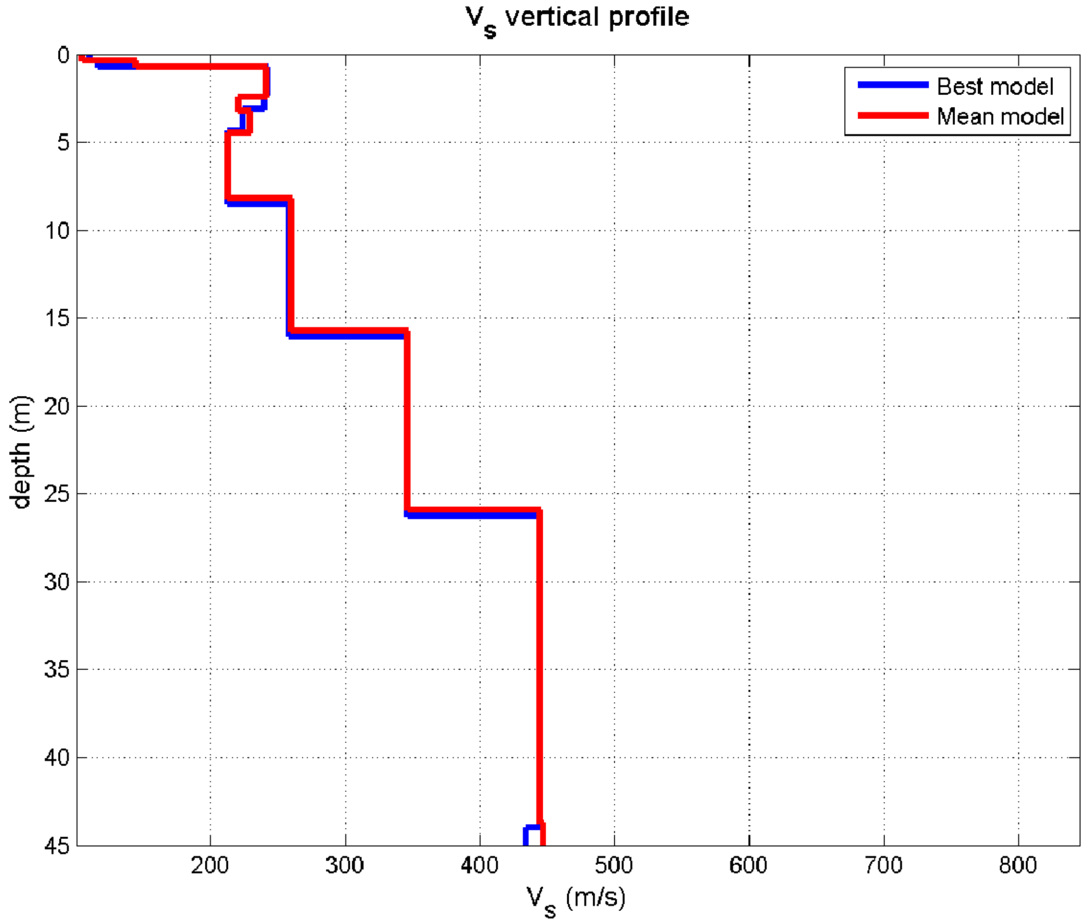
## INTERPRETAZIONE CONGIUNTA MASW 9 – HVSR9




**GEOLOGICA TOSCANA s.n.c.**

**RISULTANZE DELL'ANALISI SISMICA CONGIUNTA MASW 9 - ESAC 9**

PROFILO DI VELOCITA' MASW 9 – ESAC 9




Vs (m/s):105, 145, 242, 221, 230, 213, 260, 346, 445, 447, 757, 717
Standard deviations (m/s):11, 22, 0, 15, 19, 2, 5, 2, 0, 28, 33, 71

Thickness (m):0.3, 0.4, 1.7, 0.8, 1.2, 3.7, 7.6, 10.2, 17.8, 8.6, 11.6
Standard deviations (m/s):0.0, 0.0, 0.2, 0.1, 0.1, 0.5, 0.0, 0.4, 0.3, 1.4, 0.5

Density (gr/cm3) (approximate values):1.66, 1.72, 1.89, 1.83, 1.88, 1.98, 1.91, 2.00, 2.00, 1.97 2.09, 2.08
Seismic/Dynamic Shear modulus (MPa) (approximate values):18, 36, 110, 89, 99, 90, 129, 239, 396, 393, 1200, 1070

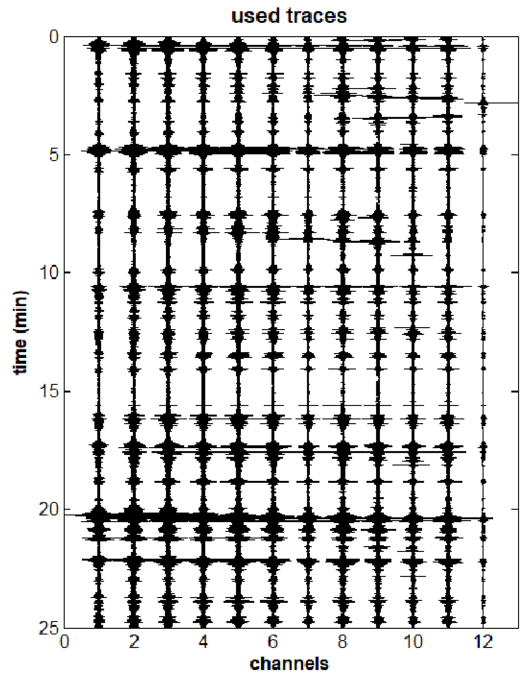
Approximate values for Vp and Poisson (please, see manual)
Vp (m/s): 194, 253, 499, 397, 481, 737, 555, 798, 792, 701, 1184, 1120
Poisson: 0.29, 0.26, 0.35, 0.28, 0.35, 0.45, 0.36, 0.38, 0.27, 0.16, 0.15, 0.15

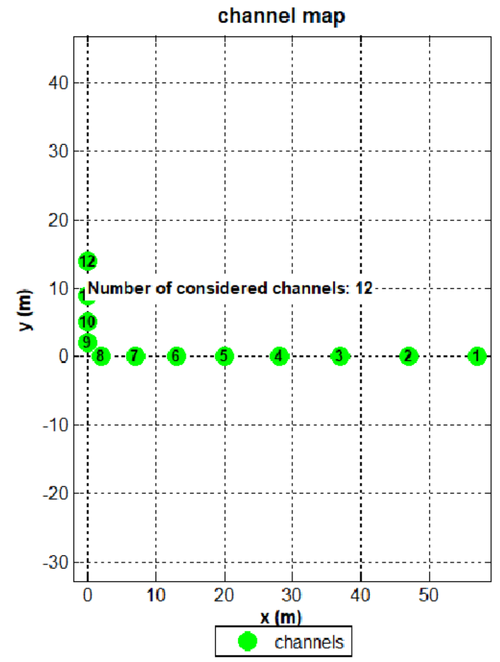
Vs30 (m/s): 281

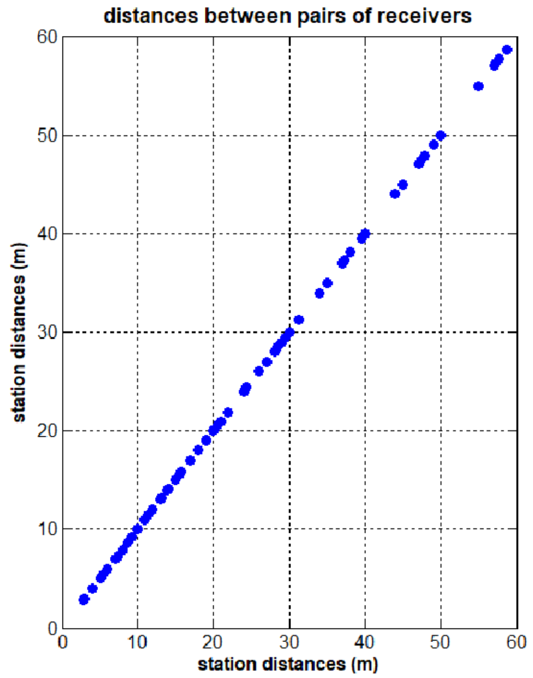
GEOLOGICA TOSCANA s.n.c.

ACQUISIZIONE ESAC

**MS3_MASW10-ESAC10**

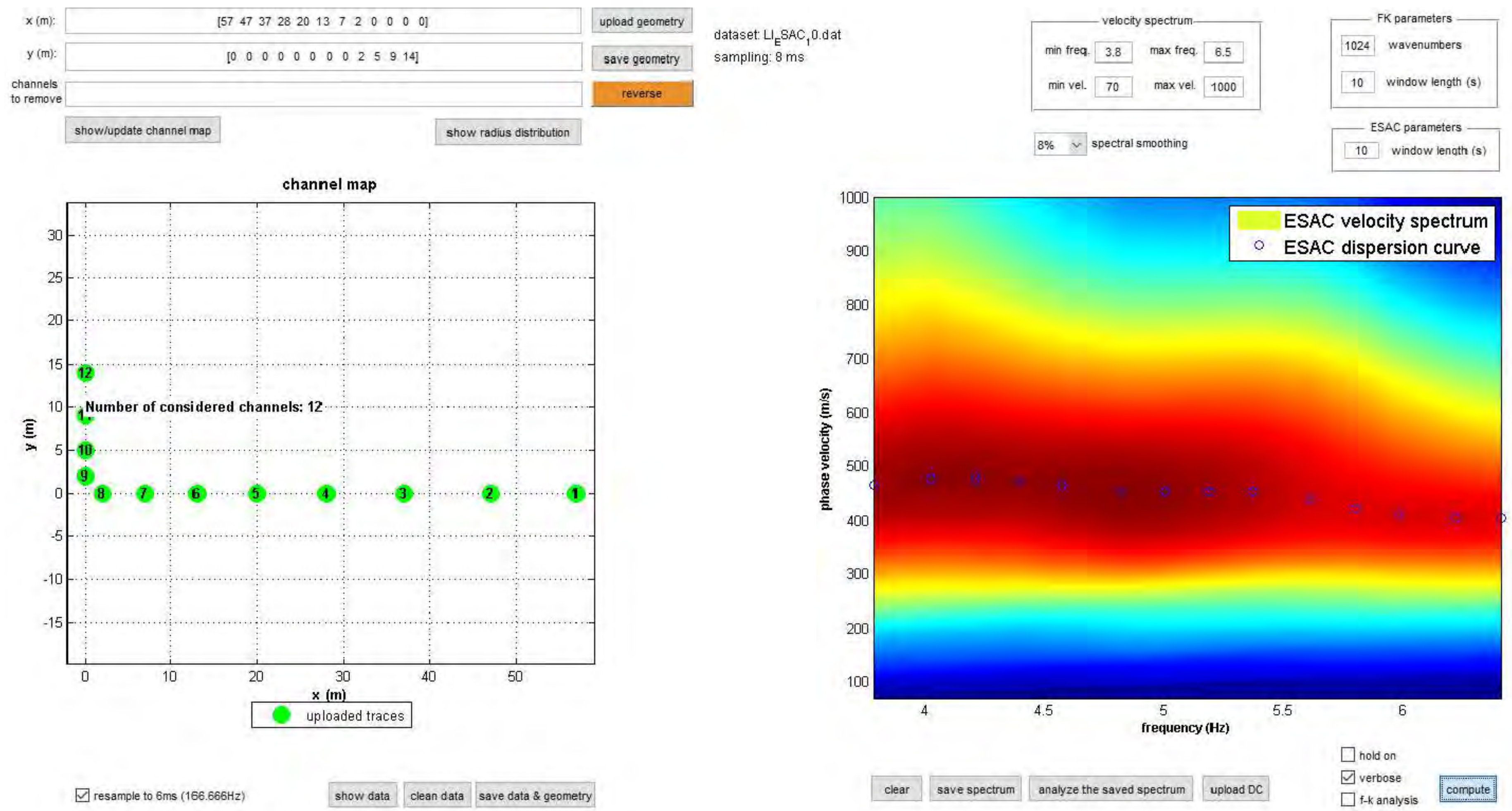



SPETTRO DI VELOCITA' ESAC E CURVA DI DISPERSIONE EFFETTIVA

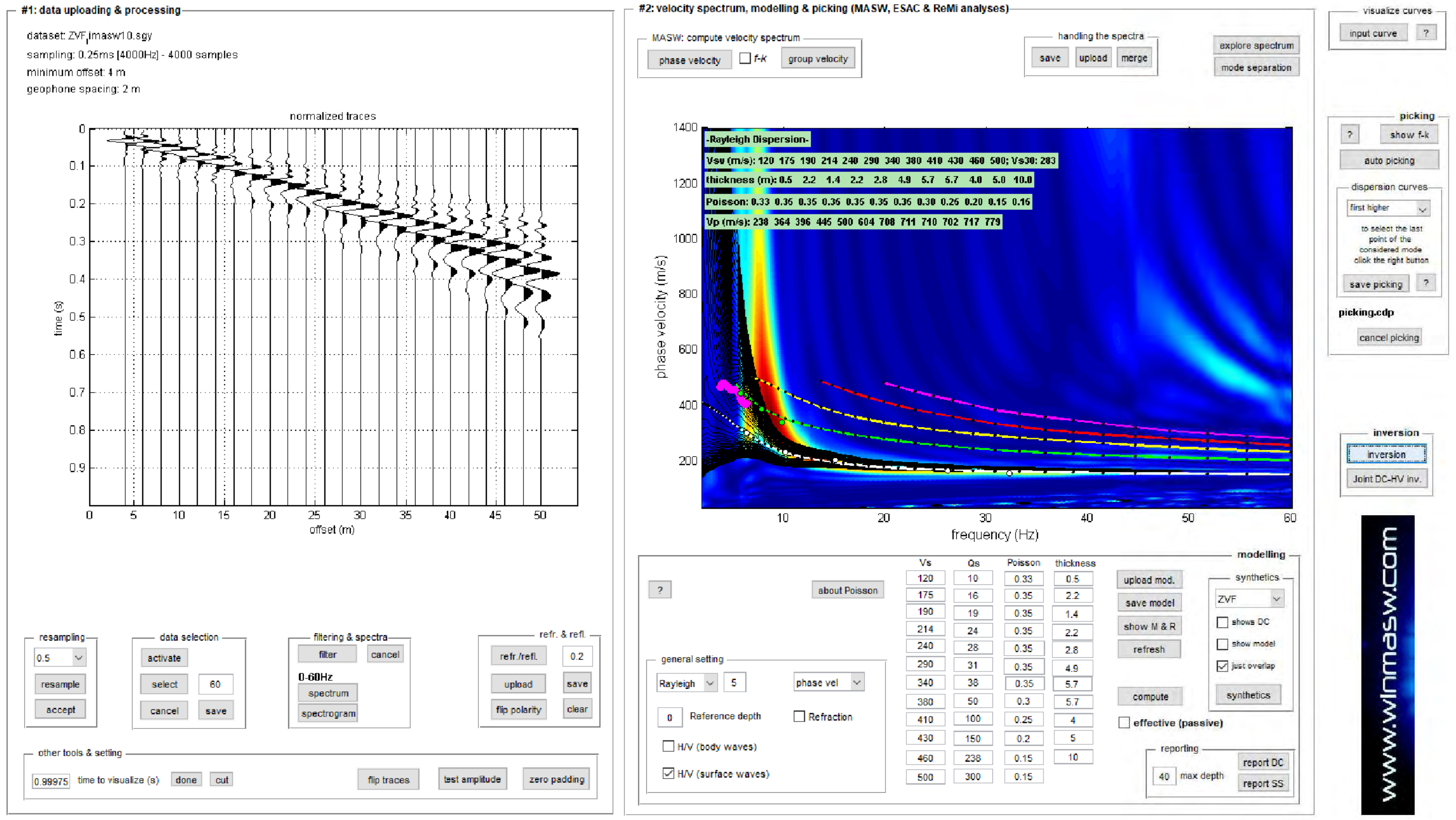
Stendimento ESAC10




GEOLOGICA TOSCANA s.n.c.

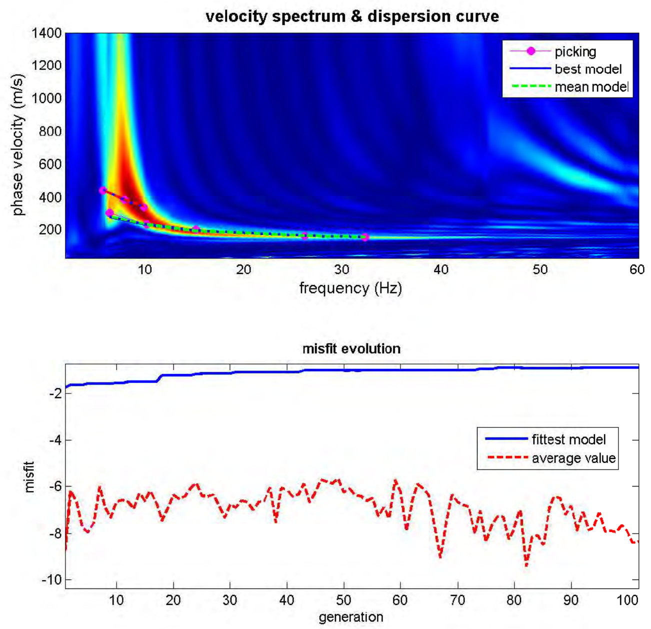
**RISULTANZE DELL'ANALISI SISMICA CONGIUNTA MASW 10 - ESAC 10**

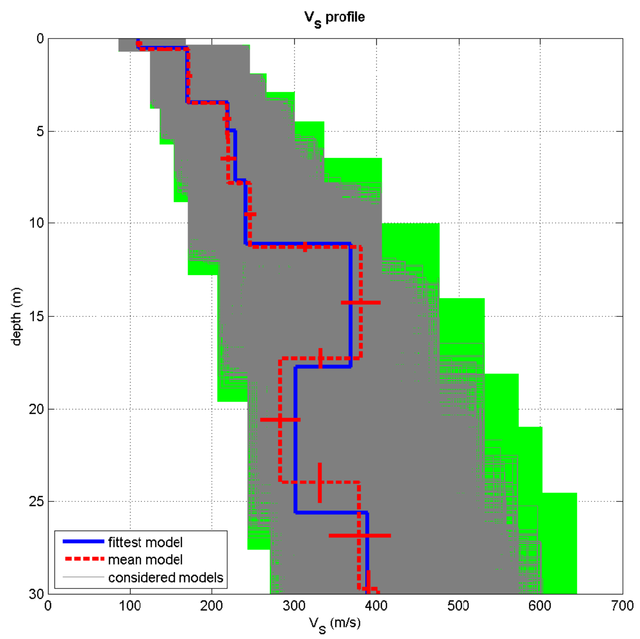
## SPETTRO DI VELOCITA' MASW + CURVA DI DISPERSIONE EFFETTIVA ESAC




## Stendimento MASW 10

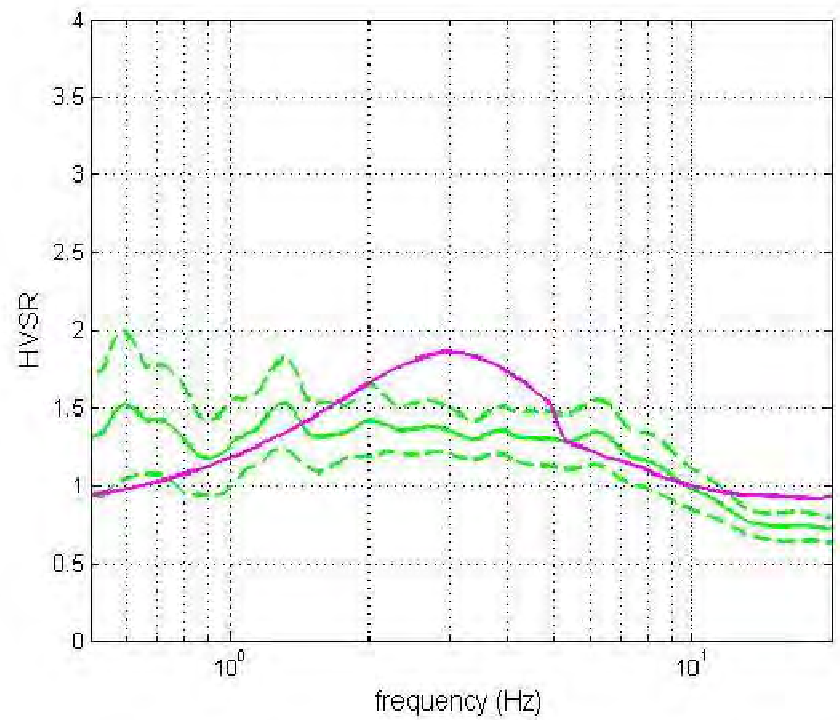
## INVERSIONE CONGIUNTA MASW – ESAC E PROFILO DI VELOCITA'




dataset: ZVF_imasw10.sgy
dispersion curve: picking.cdp
Vs30 (best model): 272 m/s
Vs30 (mean model): 270 m/s

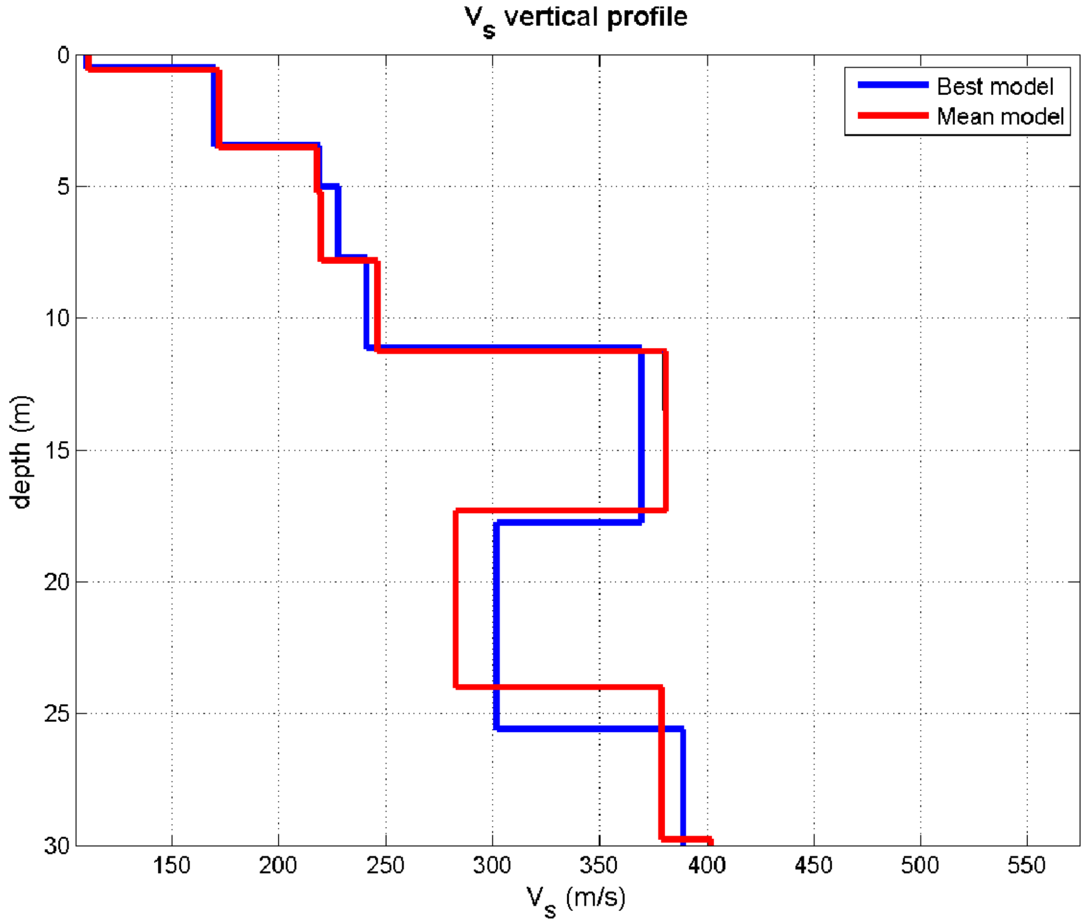
## INTERPRETAZIONE CONGIUNTA MASW 10 – HVSR10




GEOLOGICA TOSCANA s.n.c.

**RISULTANZE DELL'ANALISI SISMICA CONGIUNTA MASW 10 - ESAC 10**

PROFILO DI VELOCITA' MASW 10 – ESAC 10




Vs (m/s):111, 172, 218, 220, 246, 381, 283, 379, 402, 411, 534, 405
Standard deviations (m/s):4, 4, 5, 9, 7, 23, 24, 37, 100, 65, 50, 43

Thickness (m):0.6, 2.9, 1.7, 2.6, 3.5, 6.0, 6.7, 5.8, 3.8, 5.1, 9.0
Standard deviations (m/s):0.1, 0.0, 0.2, 0.1, 0.3, 0.5, 1.1, 1.0, 0.7, 1.1, 1.5

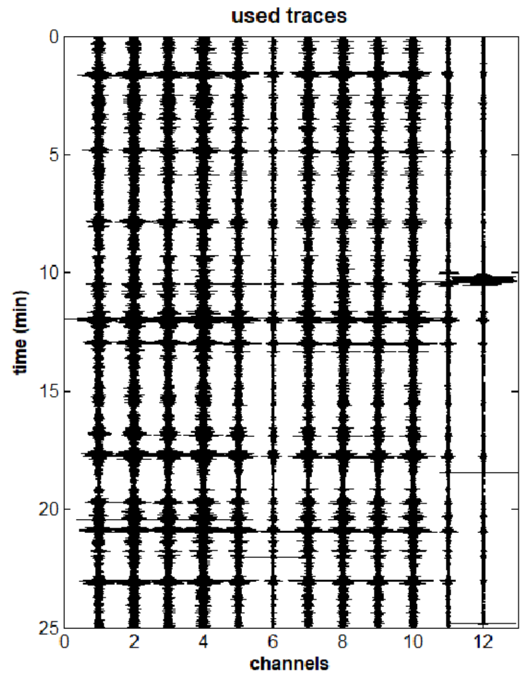
Density (gr/cm3) (approximate values):1.67, 1.91, 1.85, 1.86, 1.92, 1.96, 1.92, 1.96, 1.98, 1.95 2.01, 1.94
Seismic/Dynamic Shear modulus (MPa) (approximate values):21, 57, 88, 90, 116, 284, 154, 281, 319, 330, 575, 319

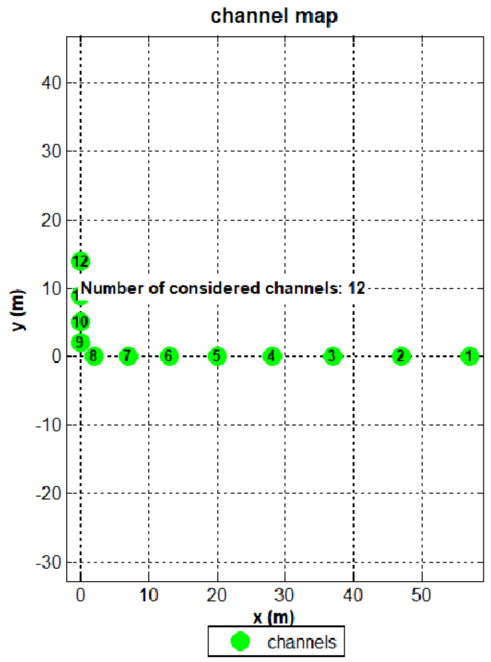
Approximate values for Vp and Poisson (please, see manual)
Vp (m/s):201, 563, 423, 445, 580, 674, 584, 677, 725 664, 852, 636
Poisson:0.28, 0.45, 0.32, 0.34, 0.39, 0.27, 0.35, 0.27, 0.28, 0.19, 0.18, 0.16

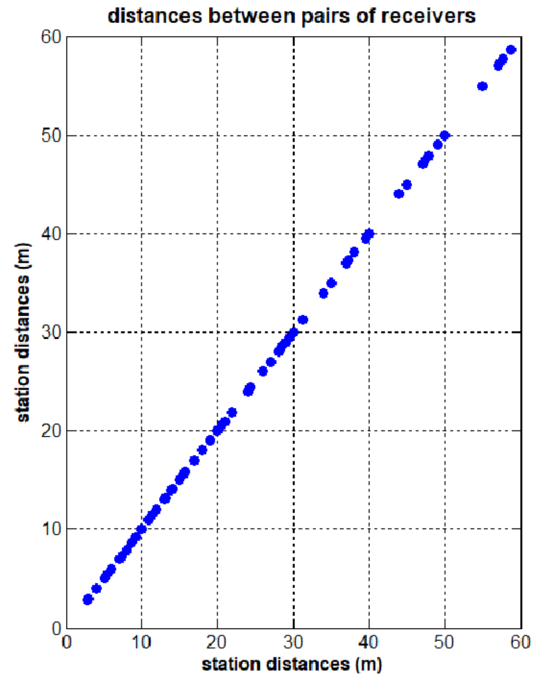
Vs30 (m/s): 270

GEOLOGICA TOSCANA s.n.c.

## ACQUISIZIONE ESAC

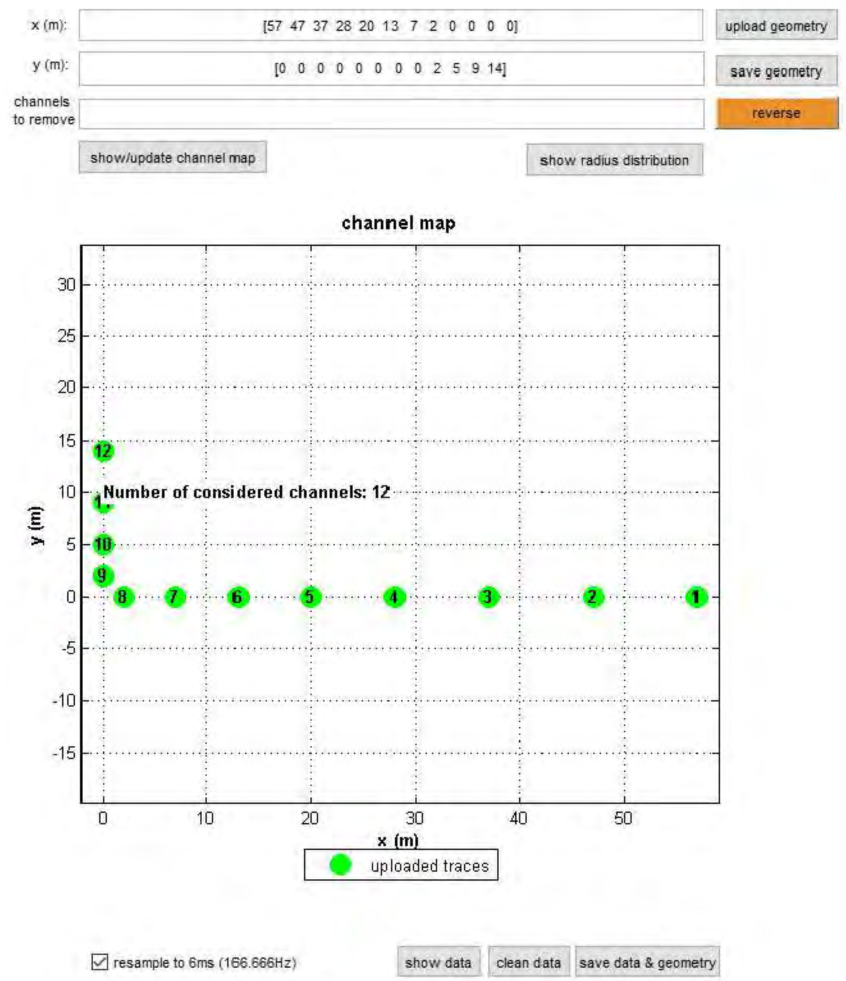


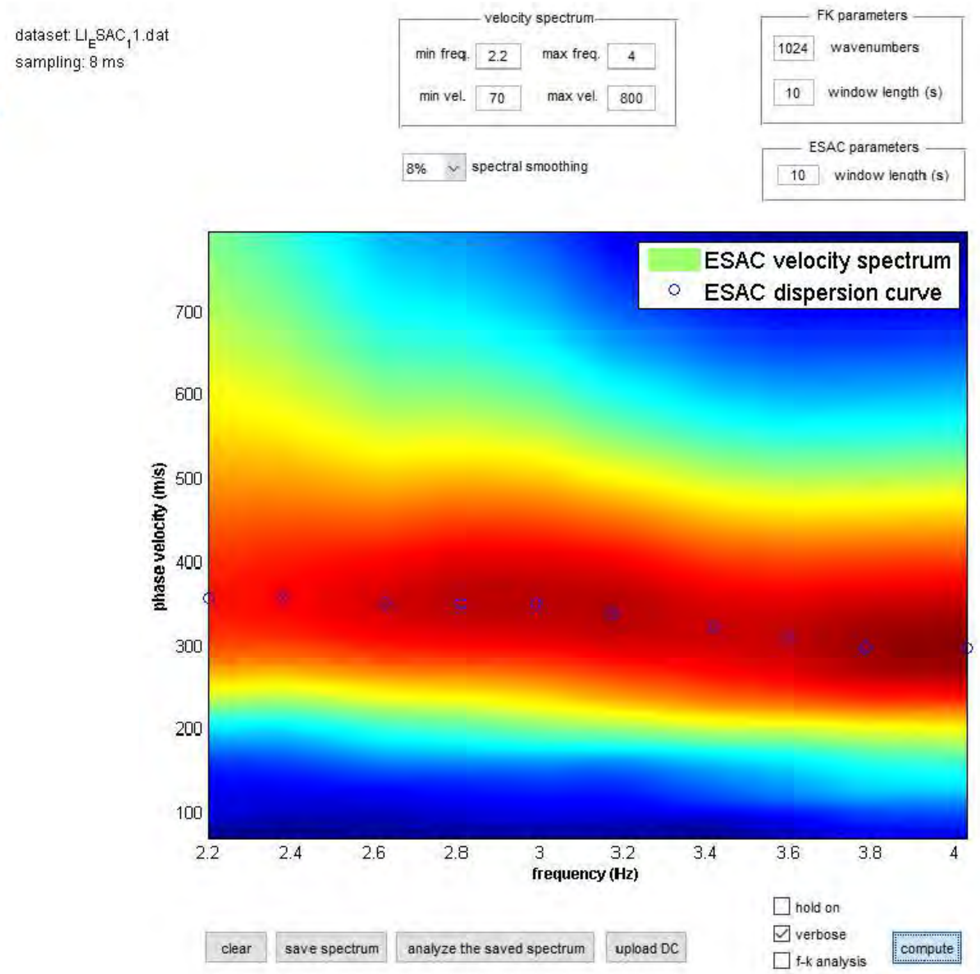




## SPETTRO DI VELOCITA' ESAC E CURVA DI DISPERSIONE EFFETTIVA

## Stendimento ESAC11

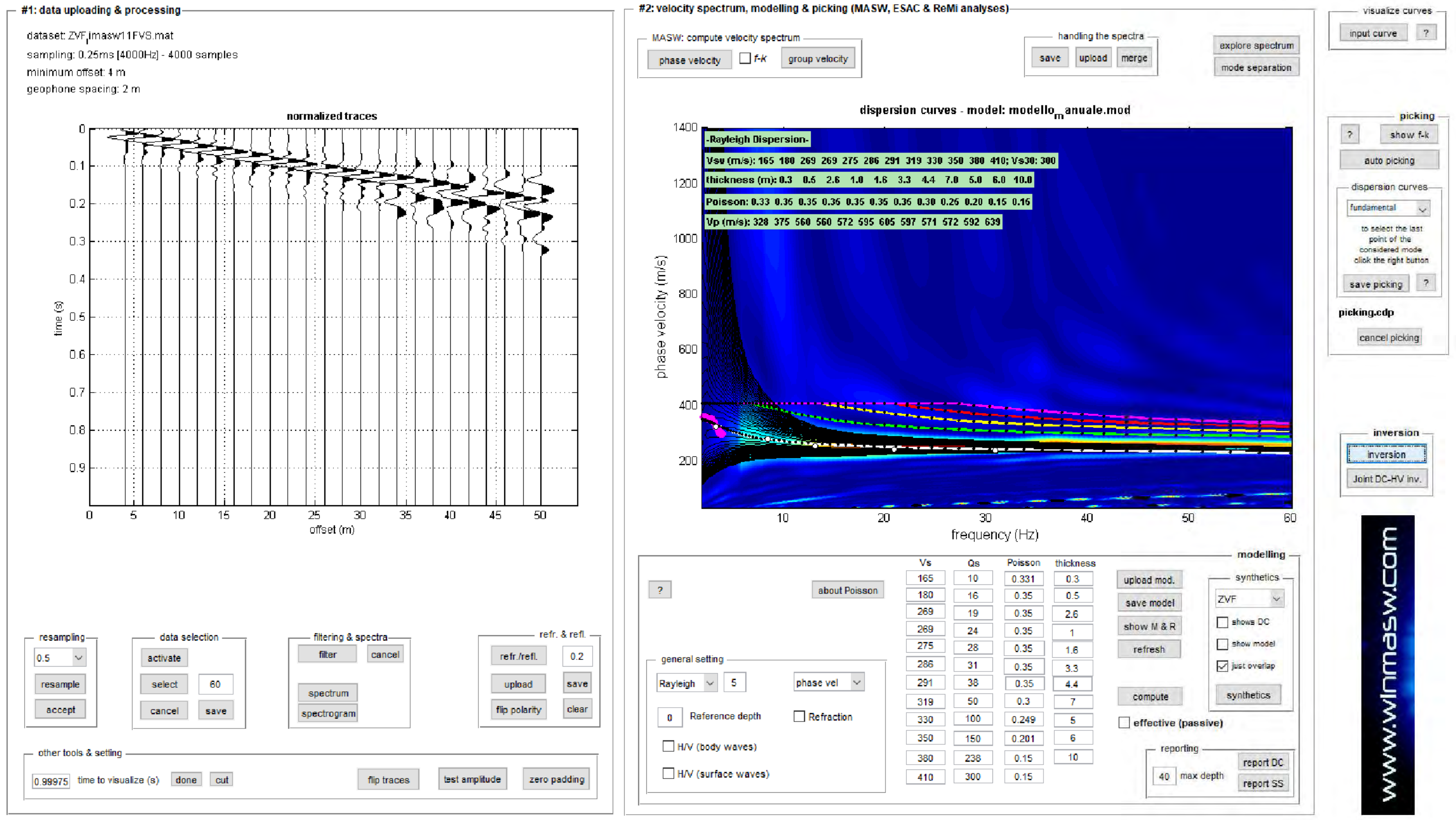



**GEOLOGICA TOSCANA s.n.c.**

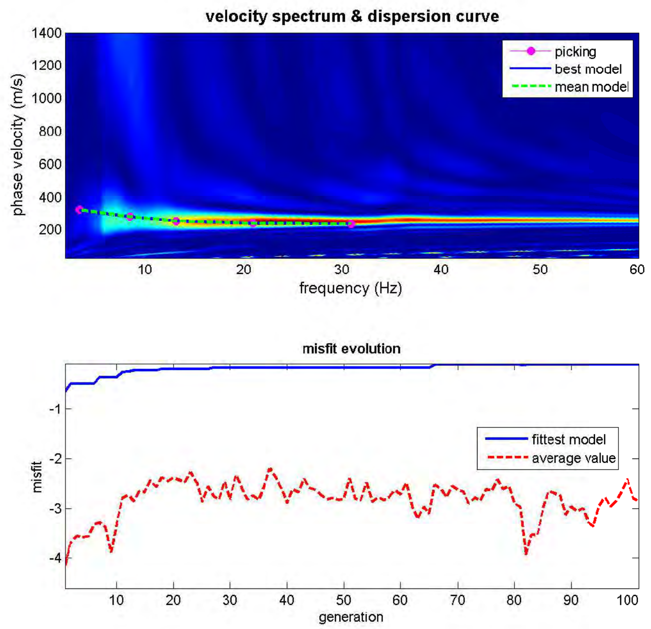
**RISULTANZE DELL'ANALISI SISMICA CONGIUNTA MASW 11 - ESAC 11**

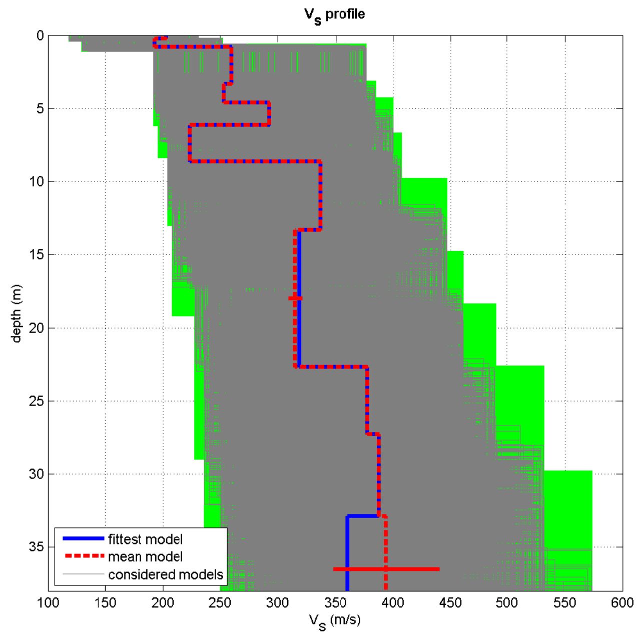
## SPETTRO DI VELOCITA' MASW + CURVA DI DISPERSIONE EFFETTIVA ESAC




## Stendimento MASW 11

## INVERSIONE CONGIUNTA MASW - ESAC E PROFILO DI VELOCITA'

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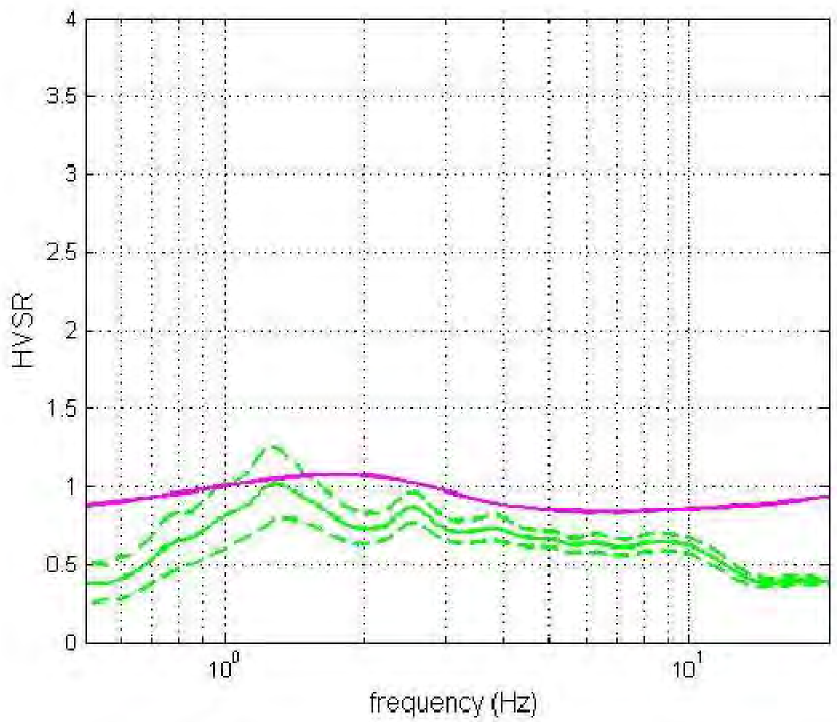
dataset: ZVF_imasw11FVS.mat
dispersion curve: picking.cdp
Vs30 (best model): 307 m/s
Vs30 (mean model): 306 m/s

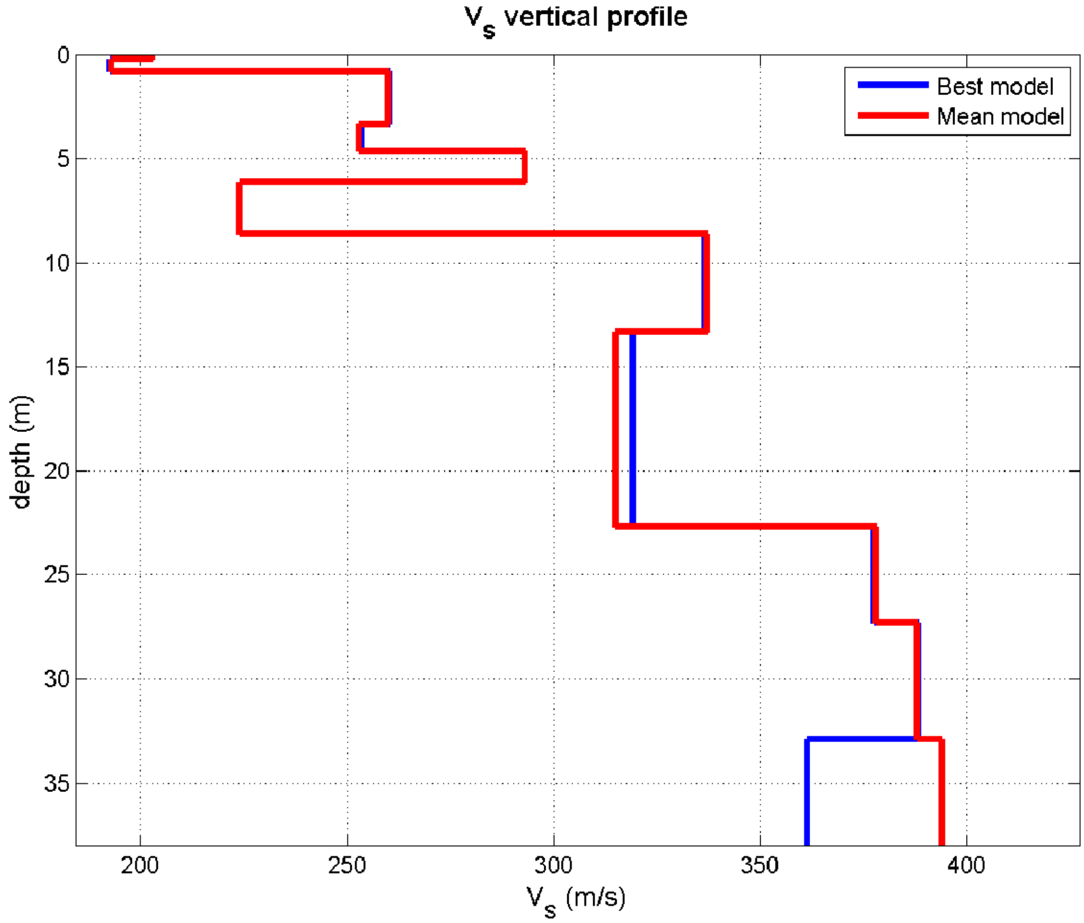
## INTERPRETAZIONE CONGIUNTA MASW 11 - HVSR11




GEOLOGICA TOSCANA s.n.c.

## RISULTANZE DELL'ANALISI SISMICA CONGIUNTA MASW 11 - ESAC 11

PROFILO DI VELOCITA' MASW 11 – ESAC 11




Vs (m/s):203, 193, 260, 253, 293, 224, 337, 315, 378, 388, 394, 362
Standard deviations (m/s):0, 0, 0, 0, 0, 0, 0, 6, 0, 0, 46, 0
Thickness (m):0.2, 0.6, 2.6, 1.3, 1.5, 2.5, 4.7, 9.4, 4.6, 5.6, 7.3
Standard deviations (m/s):0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0

Density (gr/cm3) (approximate values):1.87, 1.85, 1.92, 1.96, 1.90, 1.87, 1.93, 1.94, 1.94, 1.96 1.93, 1.93
Seismic/Dynamic Shear modulus (MPa) (approximate values):77, 69, 130, 125, 163, 94, 219, 193, 278, 294, 300, 253

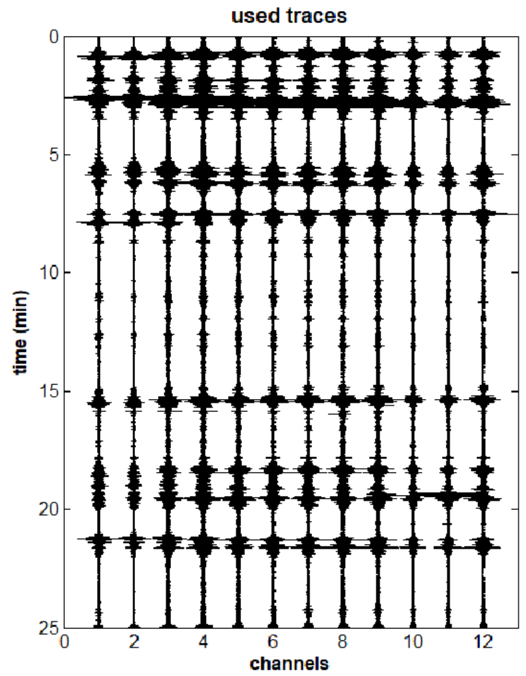
Approximate values for Vp and Poisson (please, see manual)
Vp (m/s):467, 434, 572, 665 521, 463, 606, 626, 631, 665, 609, 594
Poisson:0.38, 0.38, 0.37, 0.42, 0.27, 0.35, 0.28, 0.33, 0.22, 0.24, 0.14, 0.20

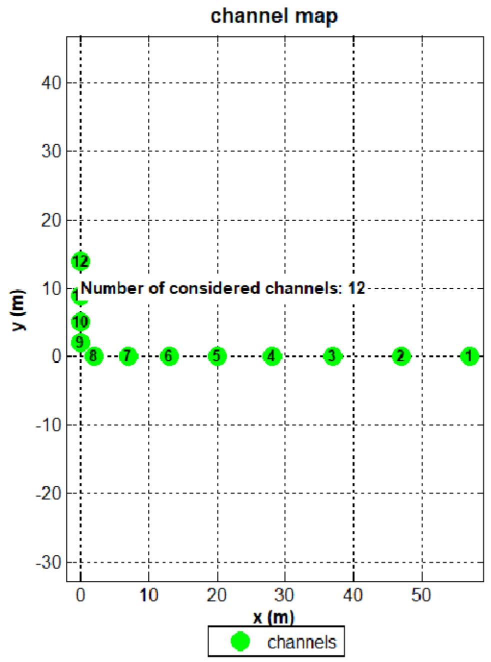
Vs30 (m/s): 306

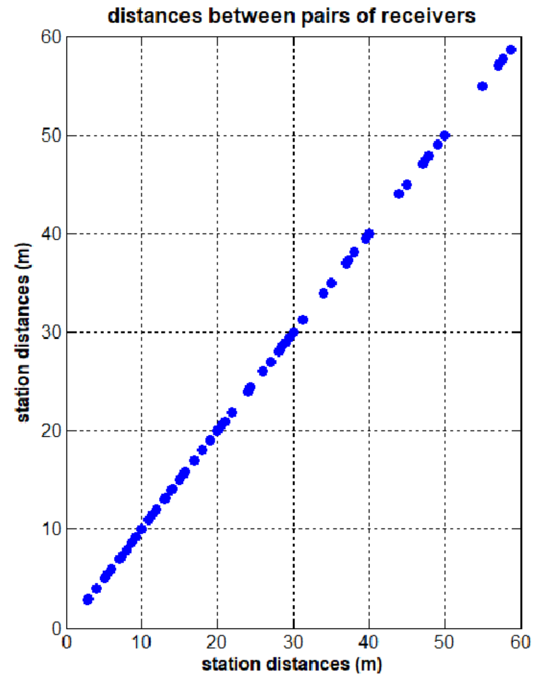
GEOLOGICA TOSCANA s.n.c.

ACQUISIZIONE ESAC

MS3_MASW12-ESAC12

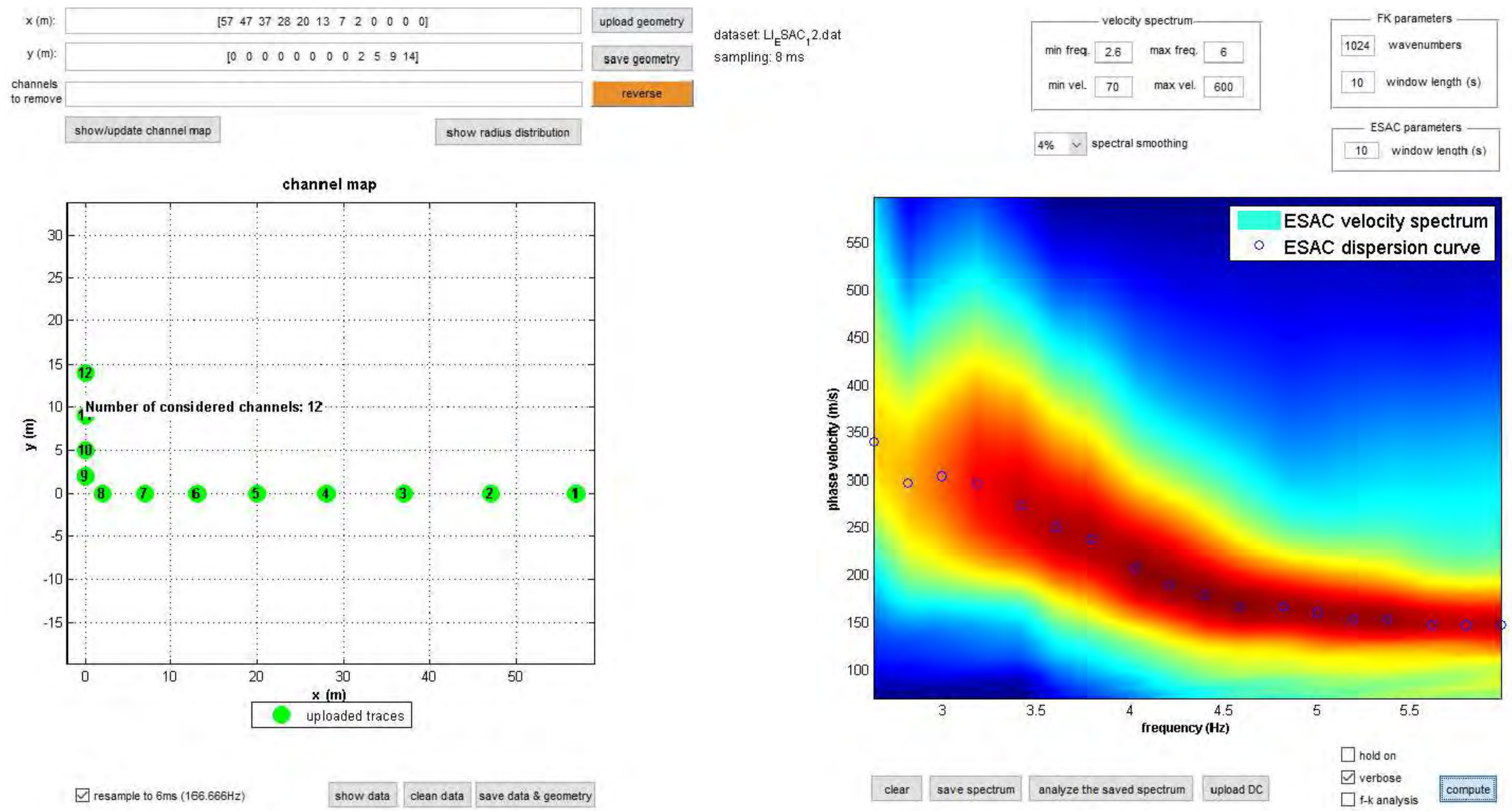



SPETTRO DI VELOCITA' ESAC E CURVA DI DISPERSIONE EFFETTIVA

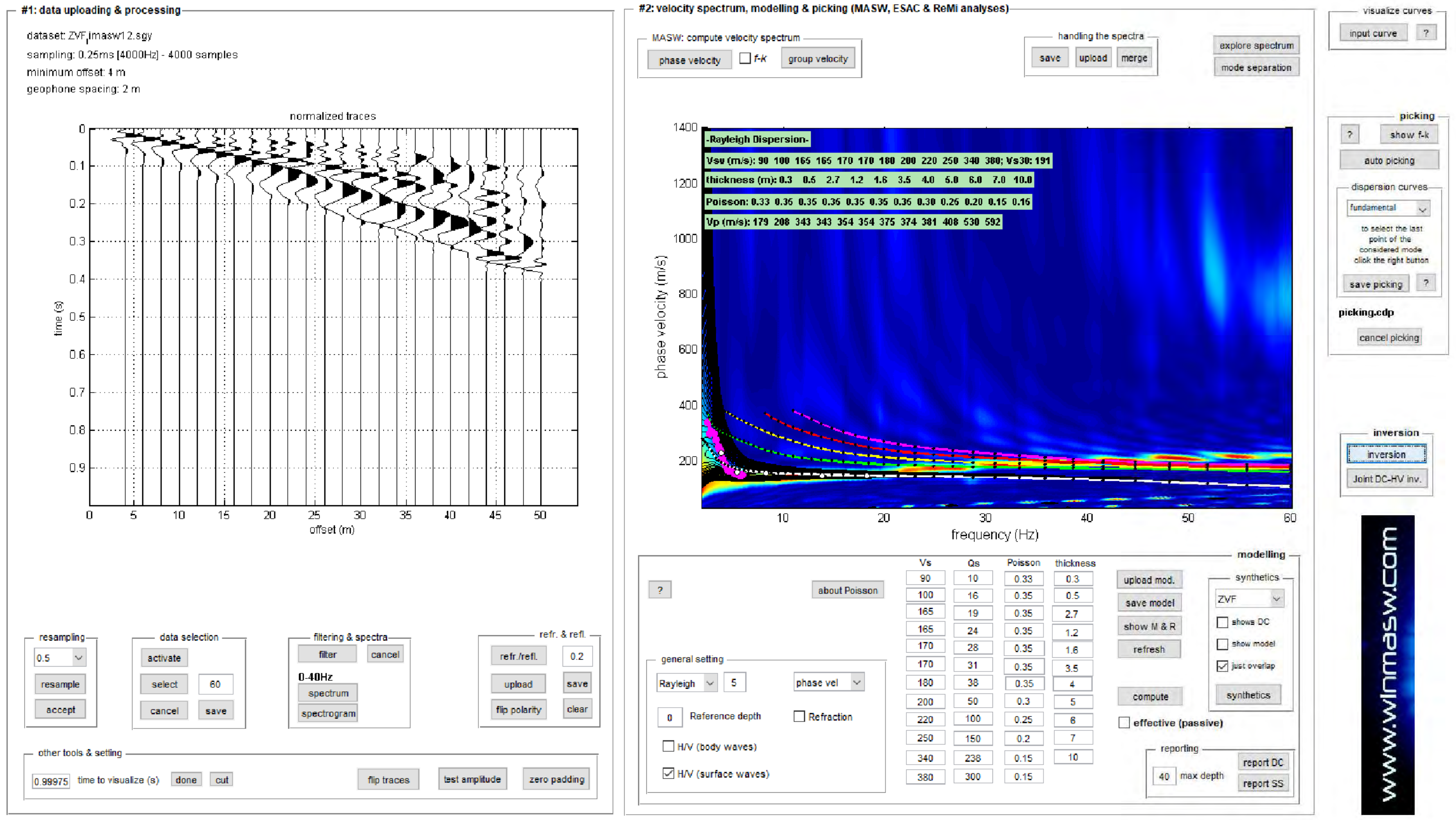
Stendimento ESAC12




GEOLOGICA TOSCANA s.n.c.

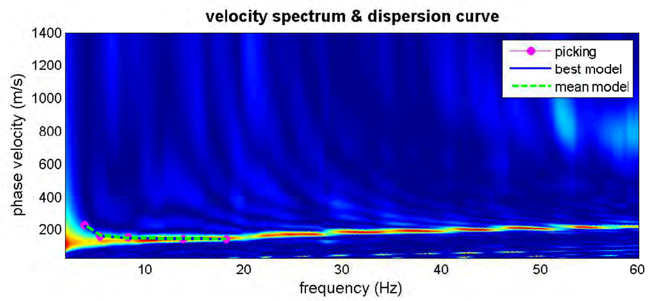
**RISULTANZE DELL'ANALISI SISMICA CONGIUNTA MASW 12 - ESAC 12**

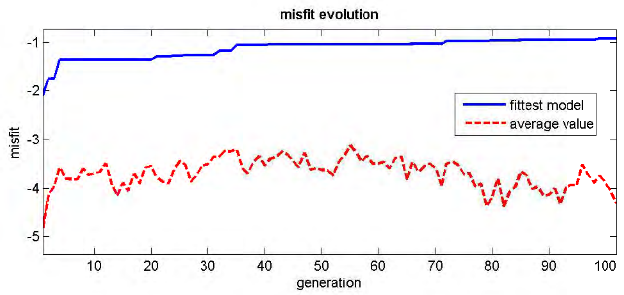
## SPETTRO DI VELOCITA' MASW + CURVA DI DISPERSIONE EFFETTIVA ESAC

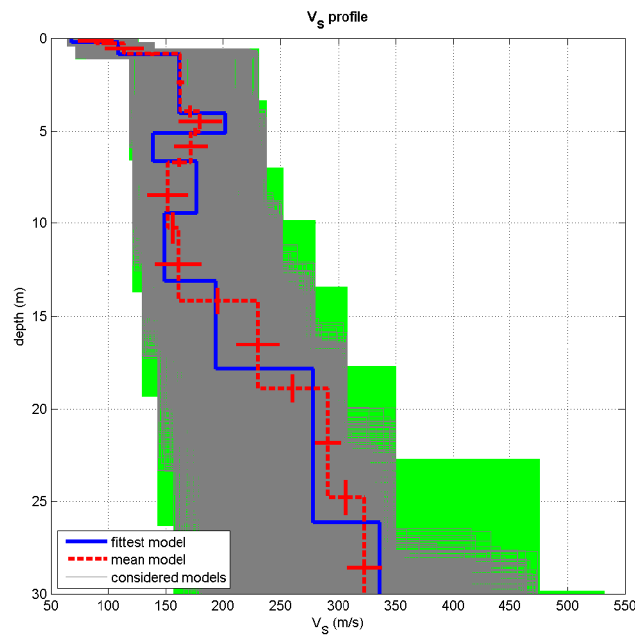



## Stendimento MASW 12

## INVERSIONE CONGIUNTA MASW – ESAC E PROFILO DI VELOCITA'



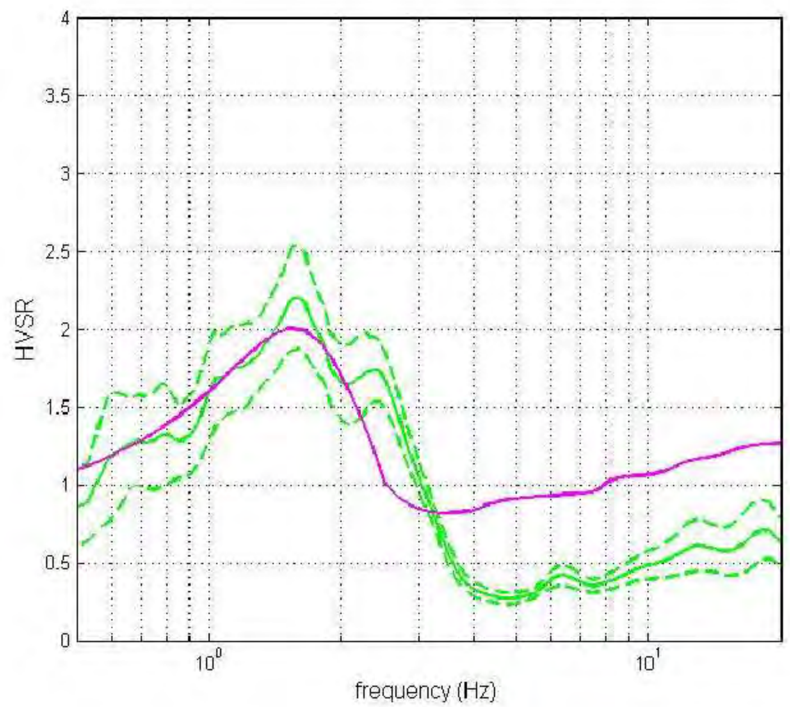




dataset: ZVF$_i$masw12.sgy
dispersion curve: picking.cdp
Vs30 (best model): 198 m/s
Vs30 (mean model): 203 m/s

www.winmasw.com

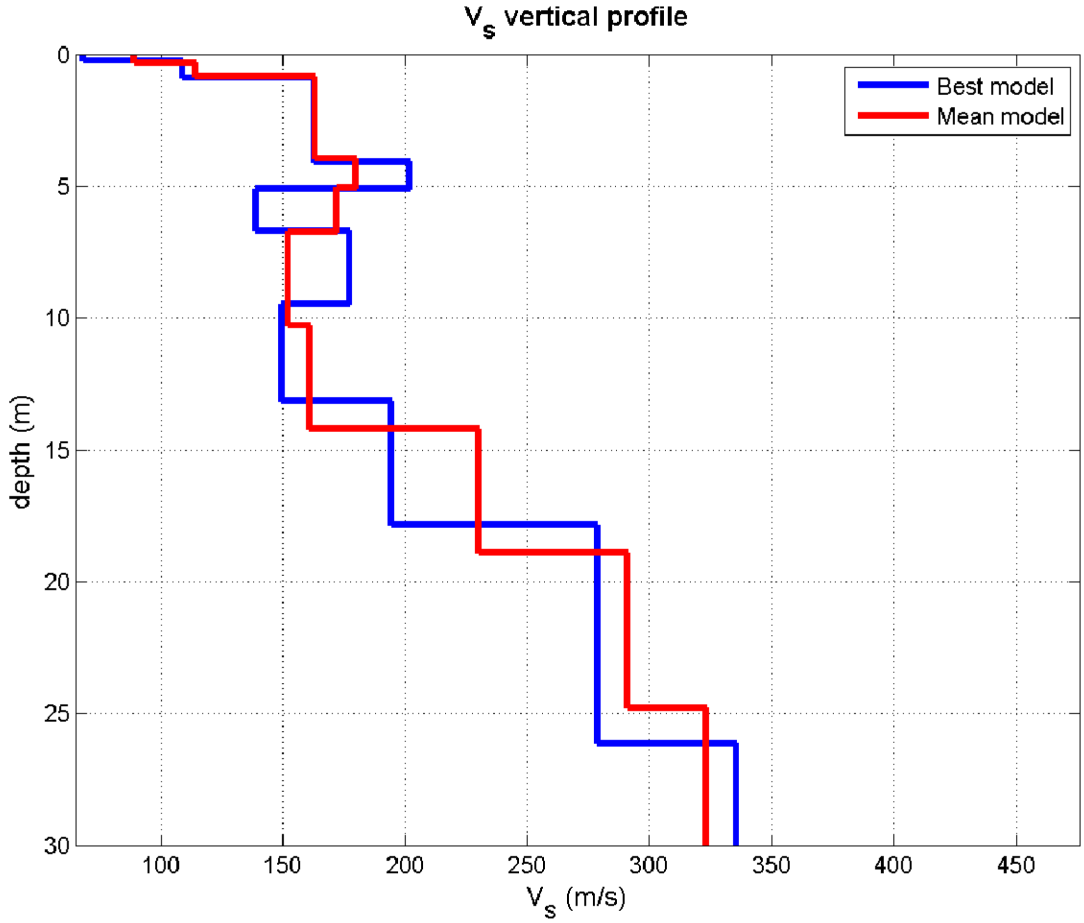
## INTERPRETAZIONE CONGIUNTA MASW 12 – HVSR12




GEOLOGICA TOSCANA s.n.c.

**RISULTANZE DELL'ANALISI SISMICA CONGIUNTA MASW 12 - ESAC 12**

PROFILO DI VELOCITA' MASW 12 – ESAC 12




Vs (m/s):89, 114, 163, 180, 172, 152, 161, 230, 291, 323, 413, 348
Standard deviations (m/s):16, 17, 3, 19, 15, 18, 20, 19, 11, 15, 37, 59

Thickness (m):0.3, 0.6, 3.1, 1.1, 1.7, 3.5, 3.9, 4.7, 5.9, 7.6, 10.1
Standard deviations (m/s):0.1, 0.1, 0.3, 0.2, 0.2, 0.8, 0.7, 0.7, 1.0, 1.2, 1.9

Density (gr/cm3) (approximate values):1.64, 1.67, 1.79, 1.79, 1.81, 1.78, 1.79, 1.88, 1.90, 1.90, 1.95, 1.91
Seismic/Dynamic Shear modulus (MPa) (approximate values):13, 22, 48, 58, 54, 41, 46, 99, 161, 198, 333, 231

Approximate values for Vp and Poisson (please, see manual)
Vp (m/s):181, 205, 339, 335, 372, 324, 331, 481, 527, 520 659, 544
Poisson:0.34, 0.28, 0.35, 0.30, 0.36, 0.36, 0.35, 0.35, 0.28, 0.19, 0.18, 0.15

Vs30 (m/s): 203

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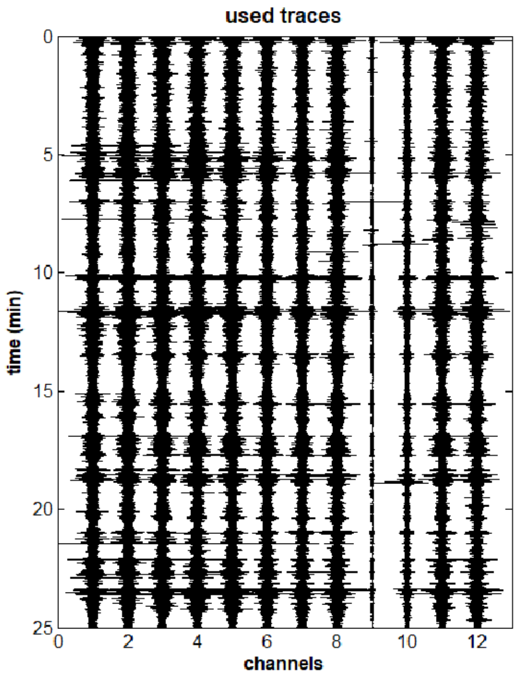
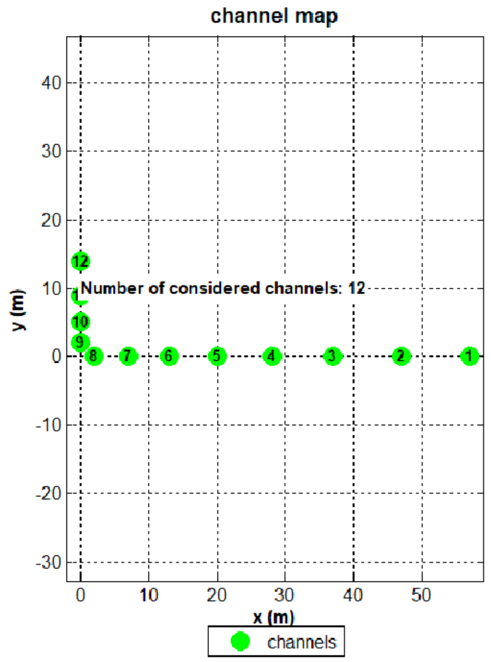
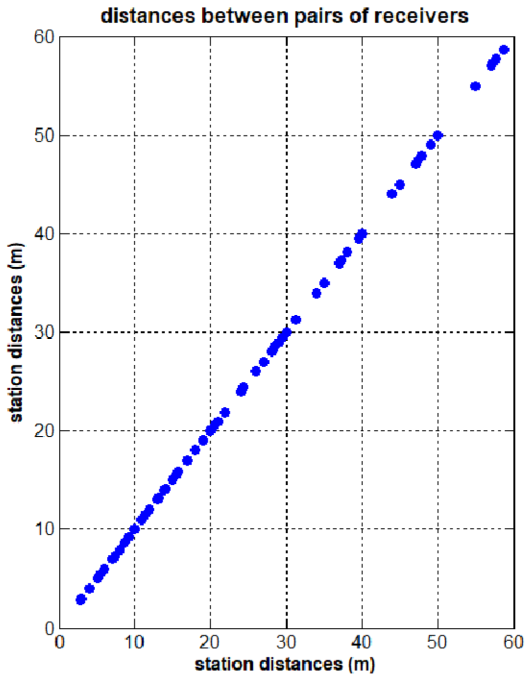
ACQUISIZIONE ESAC

**MS3_MASW13-ESAC13**

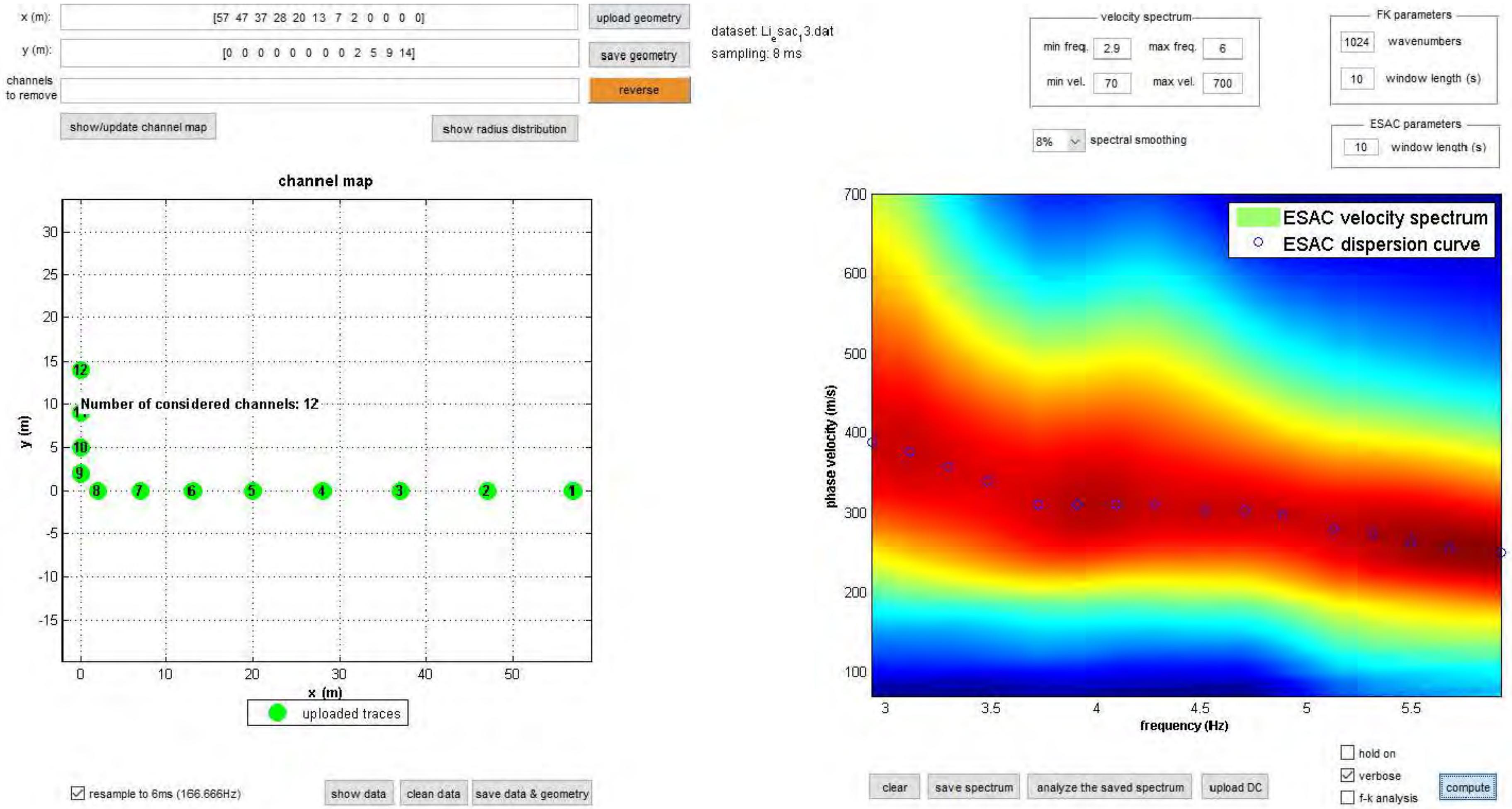



SPETTRO DI VELOCITA' ESAC E CURVA DI DISPERSIONE EFFETTIVA

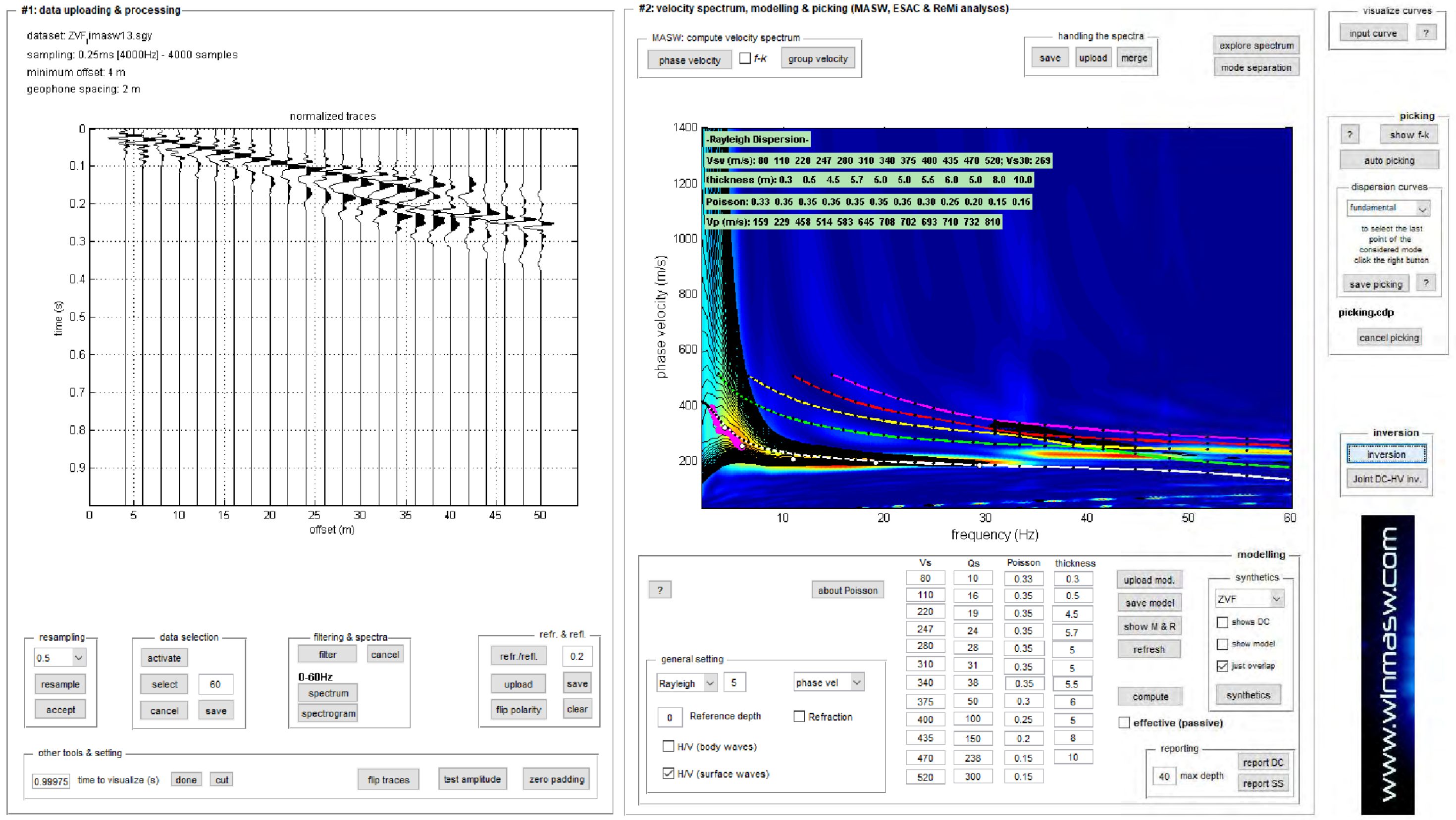
Stendimento ESAC13




GEOLOGICA TOSCANA s.n.c.

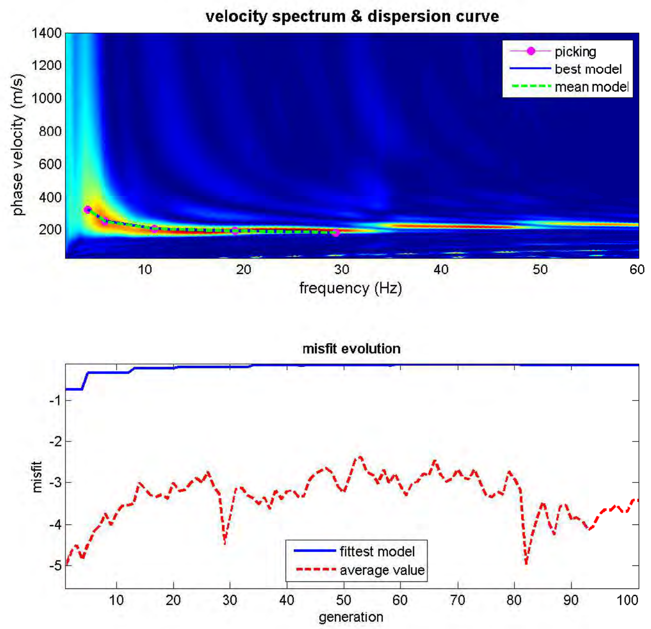
**RISULTANZE DELL'ANALISI SISMICA CONGIUNTA MASW 13 - ESAC 13**

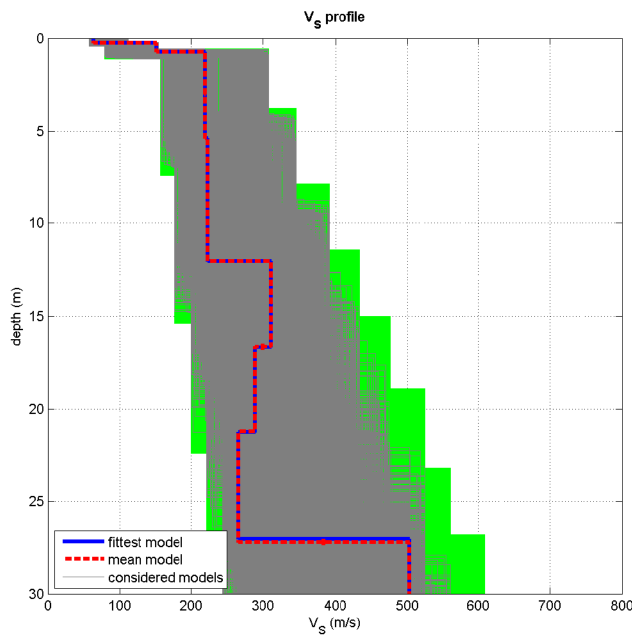
## SPETTRO DI VELOCITA' MASW + CURVA DI DISPERSIONE EFFETTIVA ESAC




## Stendimento MASW 13

## INVERSIONE CONGIUNTA MASW - ESAC E PROFILO DI VELOCITA'




dataset: ZVFjmasw13.sgy
dispersion curve: picking.cdp
Vs30 (best model): 257 m/s
Vs30 (mean model): 256 m/s

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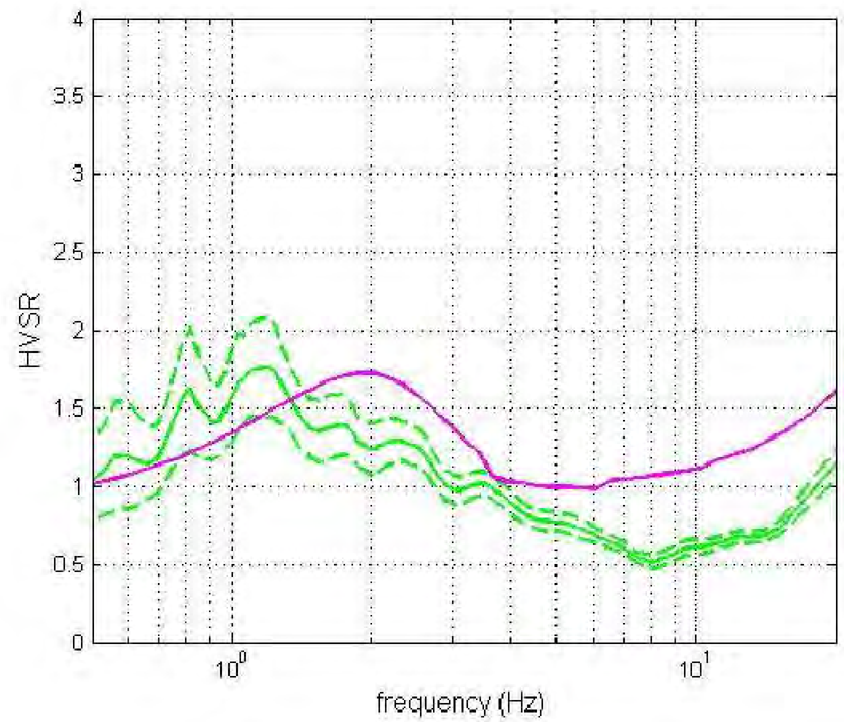
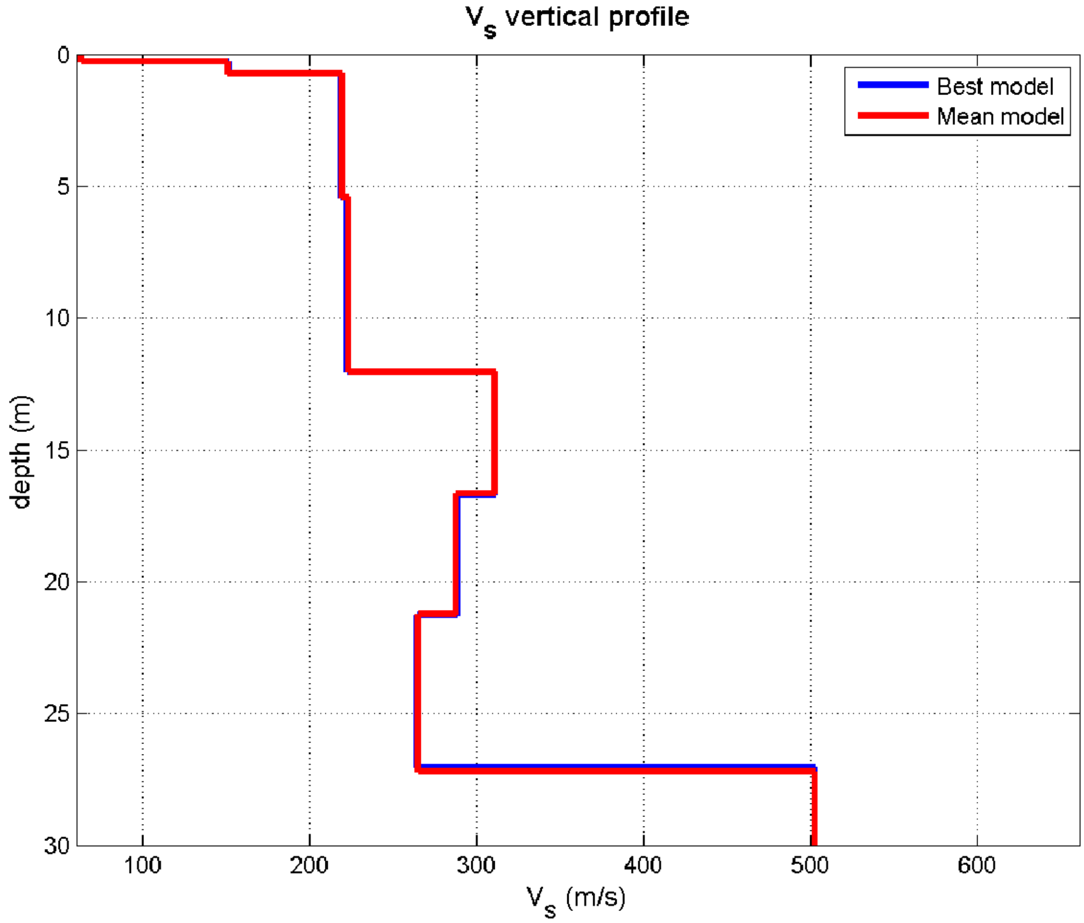
## INTERPRETAZIONE CONGIUNTA MASW 13 - HVSR13




GEOLOGICA TOSCANA s.n.c.

**RISULTANZE DELL'ANALISI SISMICA CONGIUNTA MASW 13 - ESAC 13**

PROFILO DI VELOCITA' MASW 13 – ESAC 13




Vs (m/s):63, 151, 219, 223, 311, 288, 265, 503, 489, 601, 368, 631
Standard deviations (m/s):0, 0, 0, 0, 0, 0, 0, 0, 0, 1, 0, 23

Thickness (m):0.3, 0.5, 4.7, 6.6, 4.6, 4.6, 6.0, 6.6, 4.3, 9.2, 9.0
Standard deviations (m/s):0.0, 0.0, 0.0, 0.0, 0.2, 0.0, 0.1, 0.4, 0.5, 0.9, 0.5

Density (gr/cm3) (approximate values):1.57, 1.73, 1.83, 1.85, 1.99, 1.89, 1.92, 2.05, 1.99, 2.04, 1.92, 2.05
Seismic/Dynamic Shear modulus (MPa) (approximate values):6, 40, 88, 92, 192, 156, 135, 520, 476, 737, 260, 818

Approximate values for Vp and Poisson (please, see manual)
Vp (m/s):131, 264, 404, 433, 756, 500, 567, 1004, 767, 942, 571, 997
Poisson:0.35, 0.26, 0.29, 0.32, 0.40, 0.25, 0.36, 0.33, 0.16, 0.16, 0.14, 0.17

Vs30 (m/s): 256

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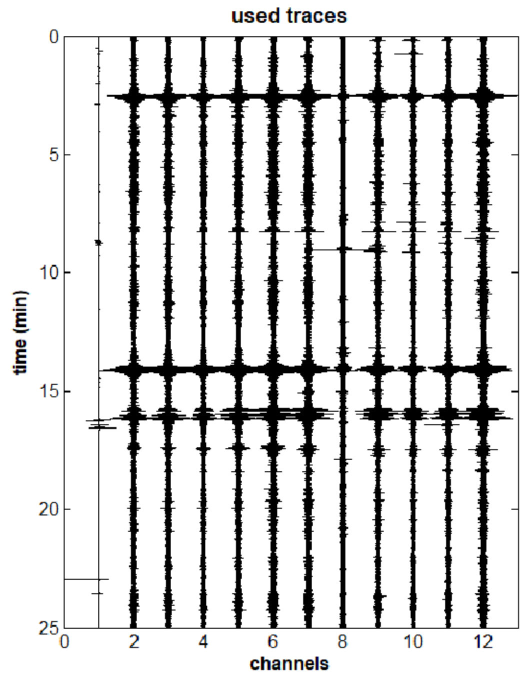
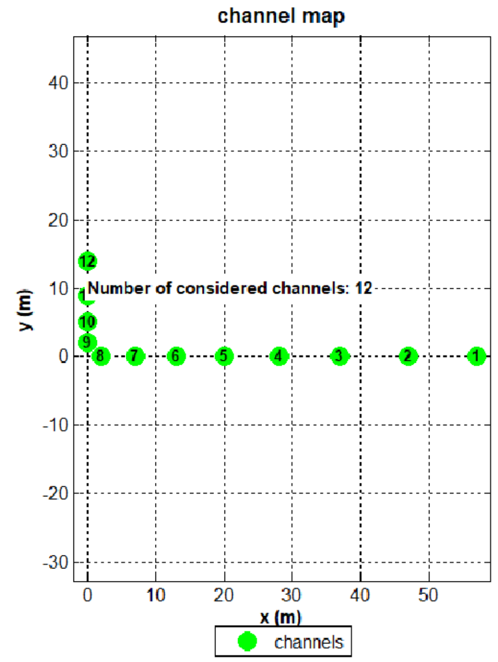
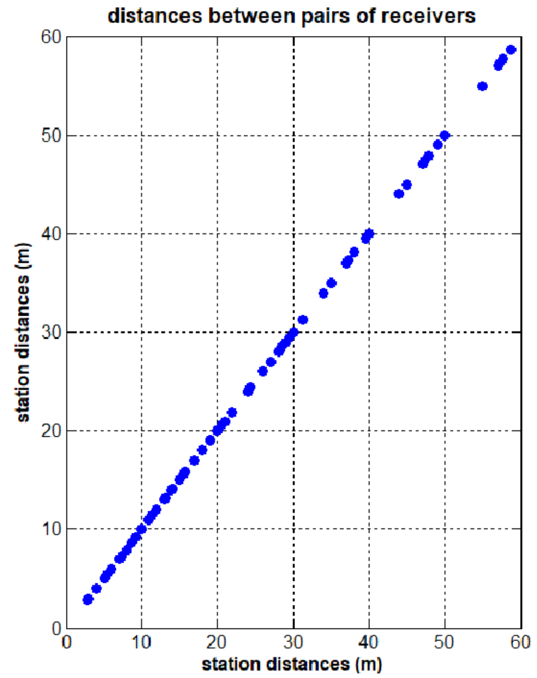
ACQUISIZIONE ESAC

**MS3_MASW14-ESAC14**

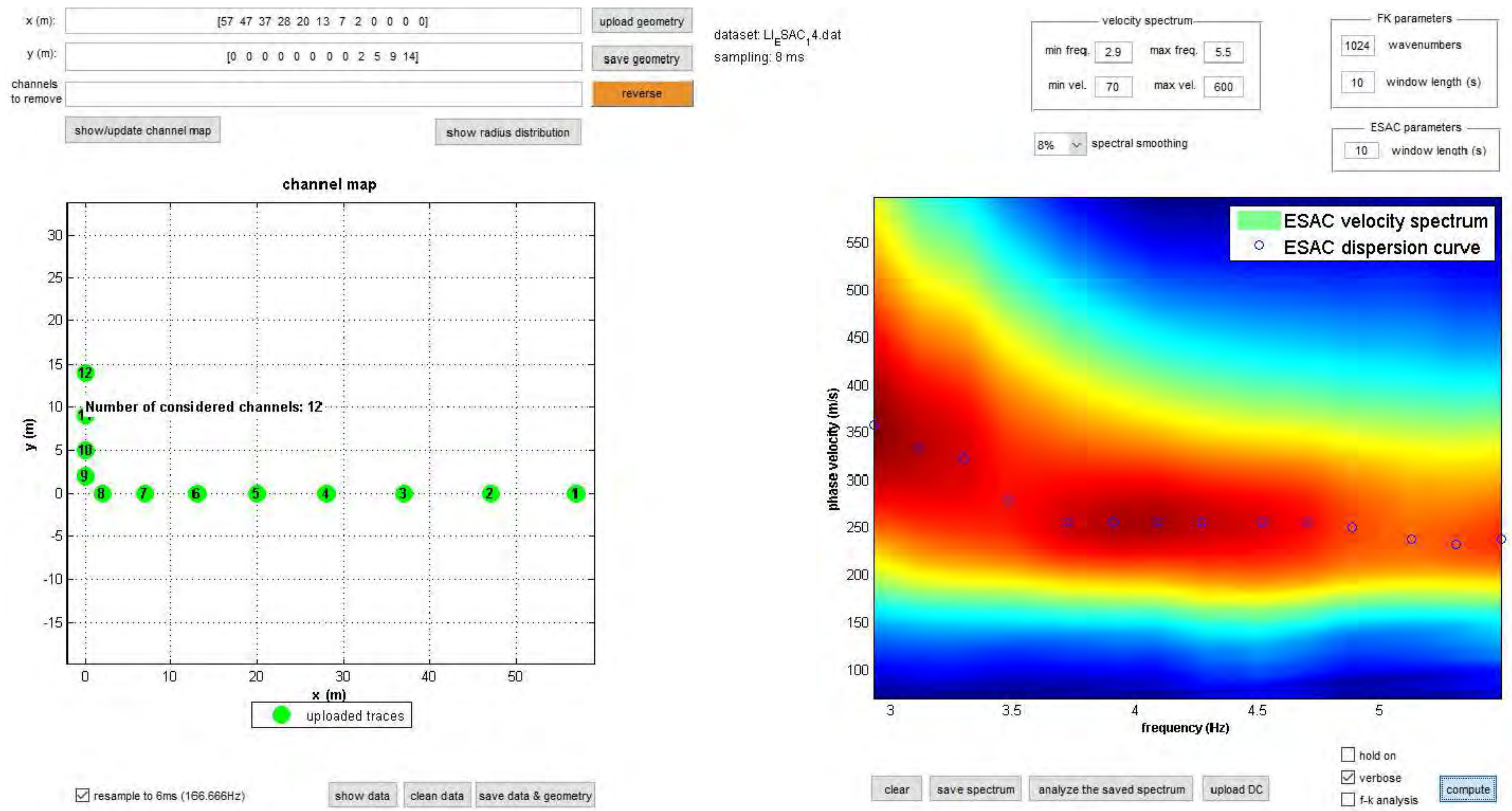



SPETTRO DI VELOCITA' ESAC E CURVA DI DISPERSIONE EFFETTIVA

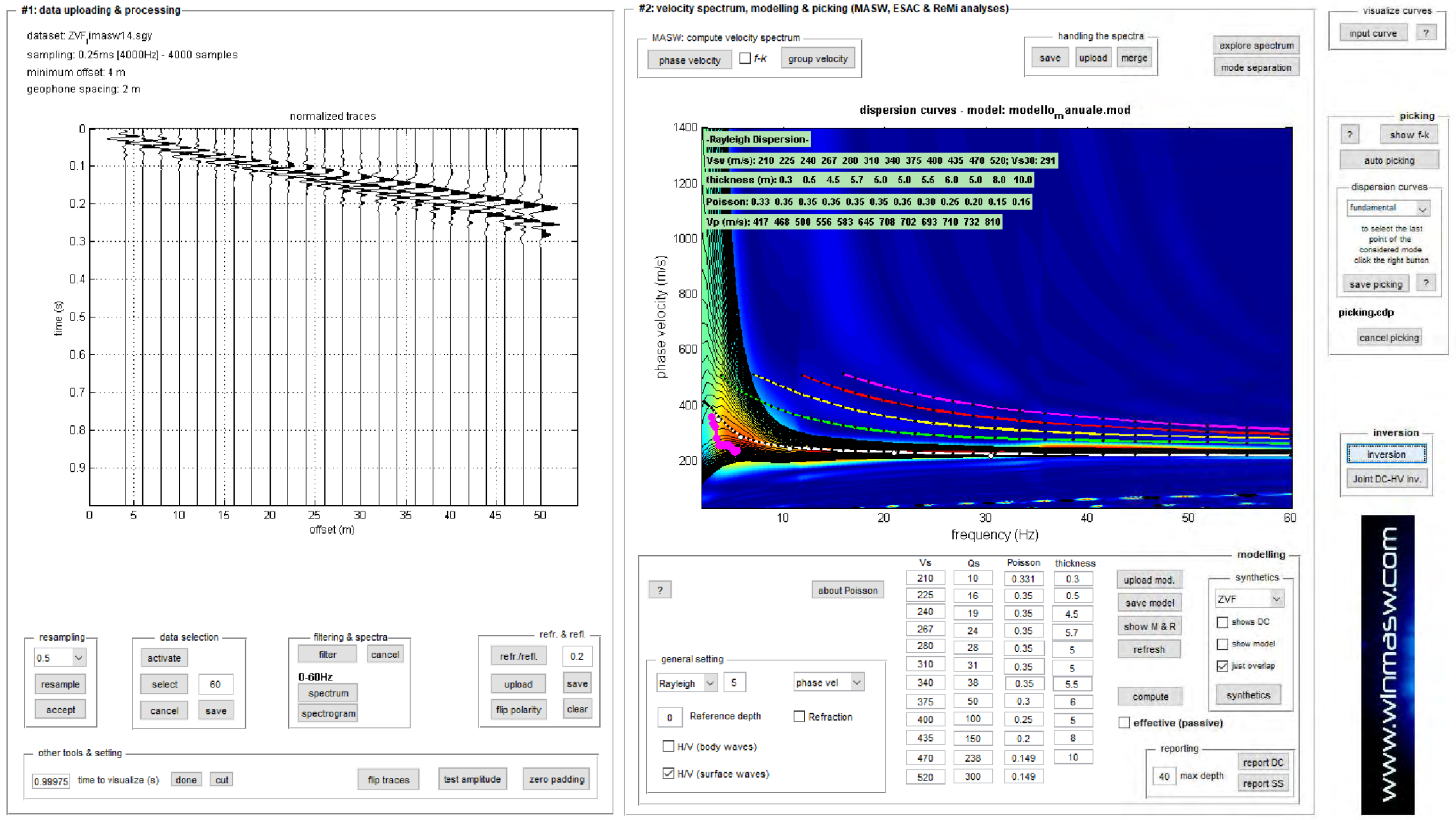
Stendimento ESAC14




GEOLOGICA TOSCANA s.n.c.

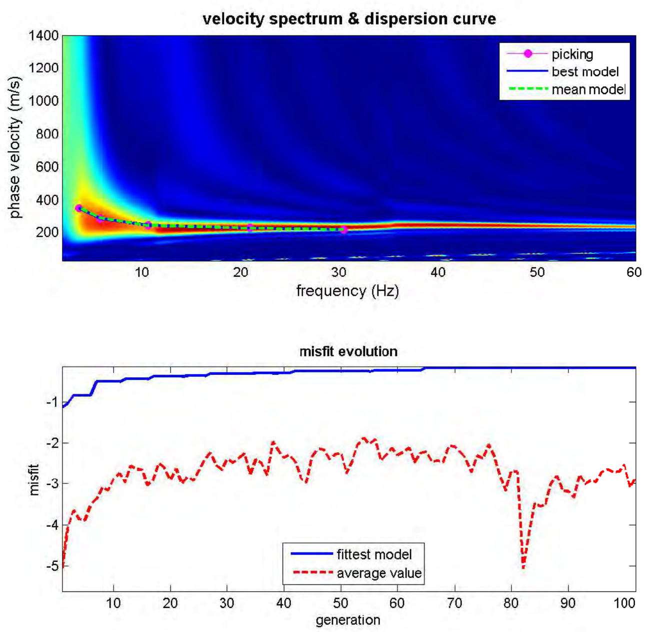
**RISULTANZE DELL'ANALISI SISMICA CONGIUNTA MASW 14 - ESAC 14**

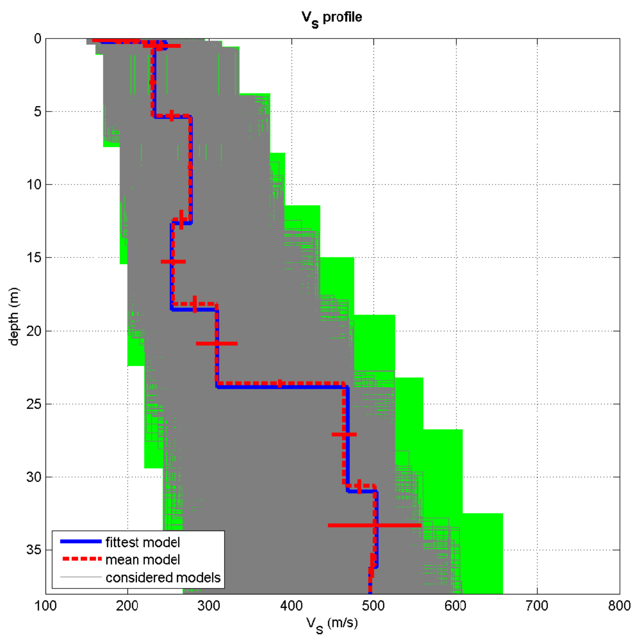
## SPETTRO DI VELOCITA' MASW + CURVA DI DISPERSIONE EFFETTIVA ESAC




## Stendimento MASW 14

## INVERSIONE CONGIUNTA MASW – ESAC E PROFILO DI VELOCITA'

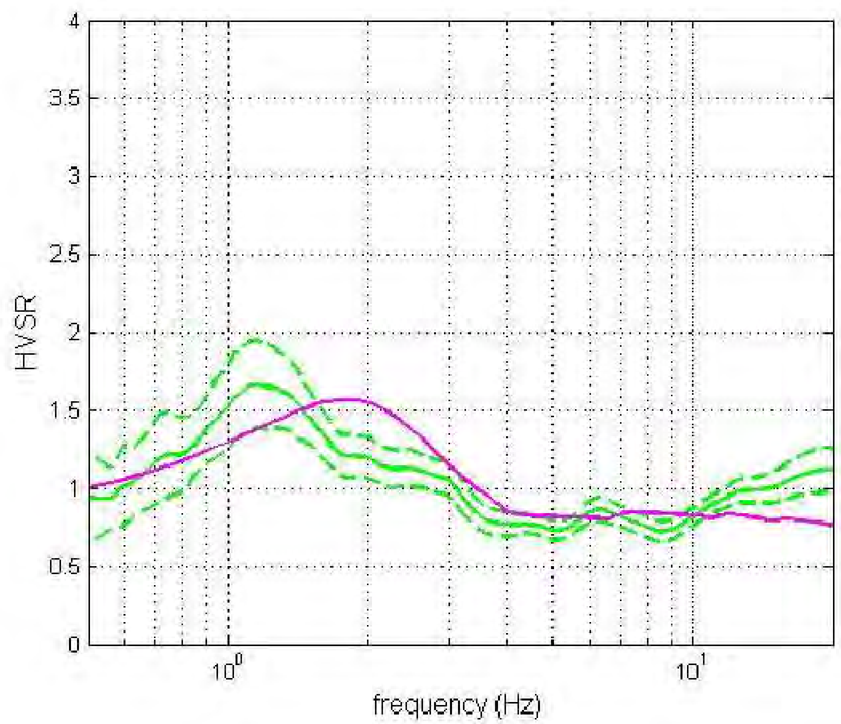



dataset: ZVFimasw14.sgy
dispersion curve: picking.cdp
Vs30 (best model): 291 m/s
Vs30 (mean model): 292 m/s

www.winmasw.com

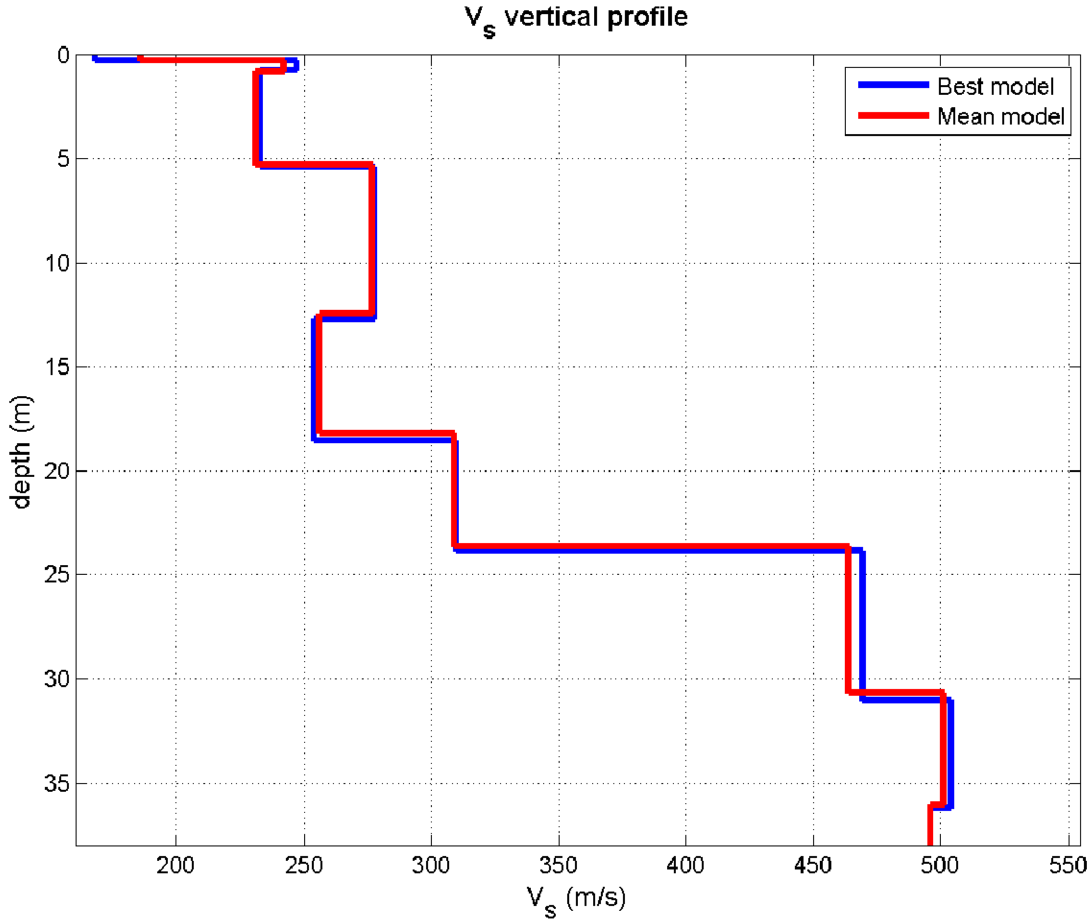
## INTERPRETAZIONE CONGIUNTA MASW 14 – HVSR14




GEOLOGICA TOSCANA s.n.c.

**RISULTANZE DELL'ANALISI SISMICA CONGIUNTA MASW 14 - ESAC 14**

PROFILO DI VELOCITA' MASW 14 – ESAC 14




Vs (m/s):186, 242, 231, 277, 256, 309, 464, 501, 496, 374, 418, 446
Standard deviations (m/s):29, 23, 4, 2, 15, 24, 15, 57, 28, 15, 64, 35

Thickness (m):0.3, 0.5, 4.5, 7.1, 5.8, 5.4, 7.0, 5.4, 5.9, 8.8, 12.2
Standard deviations (m/s):0.0, 0.0, 0.4, 0.6, 0.6, 0.3, 0.5, 0.8, 0.9, 0.7, 1.4

Density (gr/cm3) (approximate values):1.93, 1.94, 1.84, 1.92, 1.92, 1.90, 2.03, 2.03, 2.00, 1.94, 1.95, 1.97
Seismic/Dynamic Shear modulus (MPa) (approximate values):67, 113, 98, 147, 126, 182, 437, 509, 491, 271, 341, 393

Approximate values for Vp and Poisson (please, see manual)
Vp (m/s):605, 617, 420, 580, 564, 536, 909, 894 793 627, 651, 720
Poisson:0.45, 0.41, 0.28, 0.35 0.37, 0.25, 0.32, 0.27, 0.18, 0.22, 0.15, 0.19

Vs30 (m/s): 292

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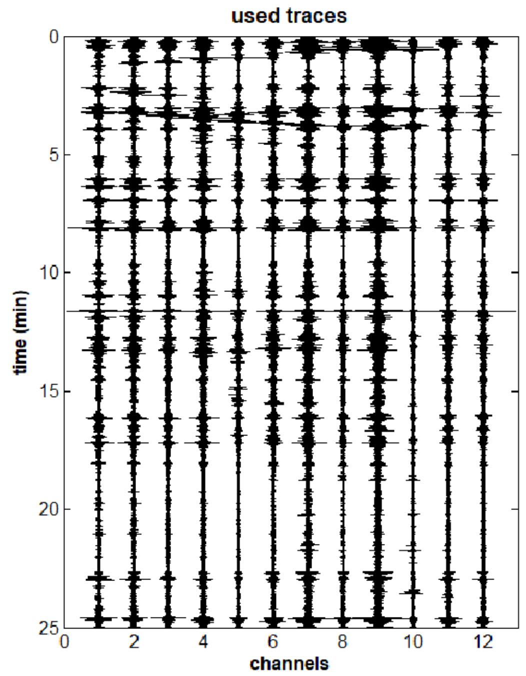
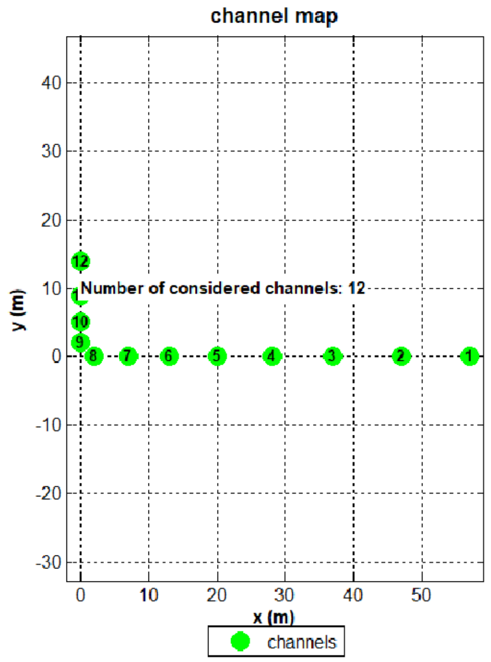
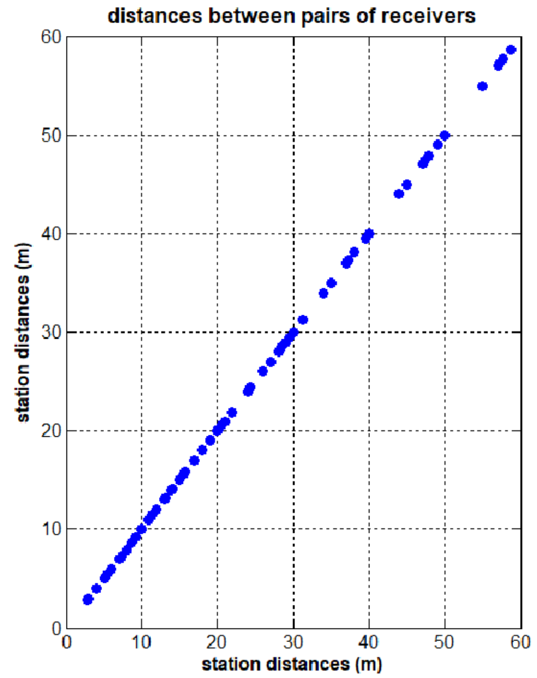
MS3_MASW15-ESAC15

## ACQUISIZIONE ESAC

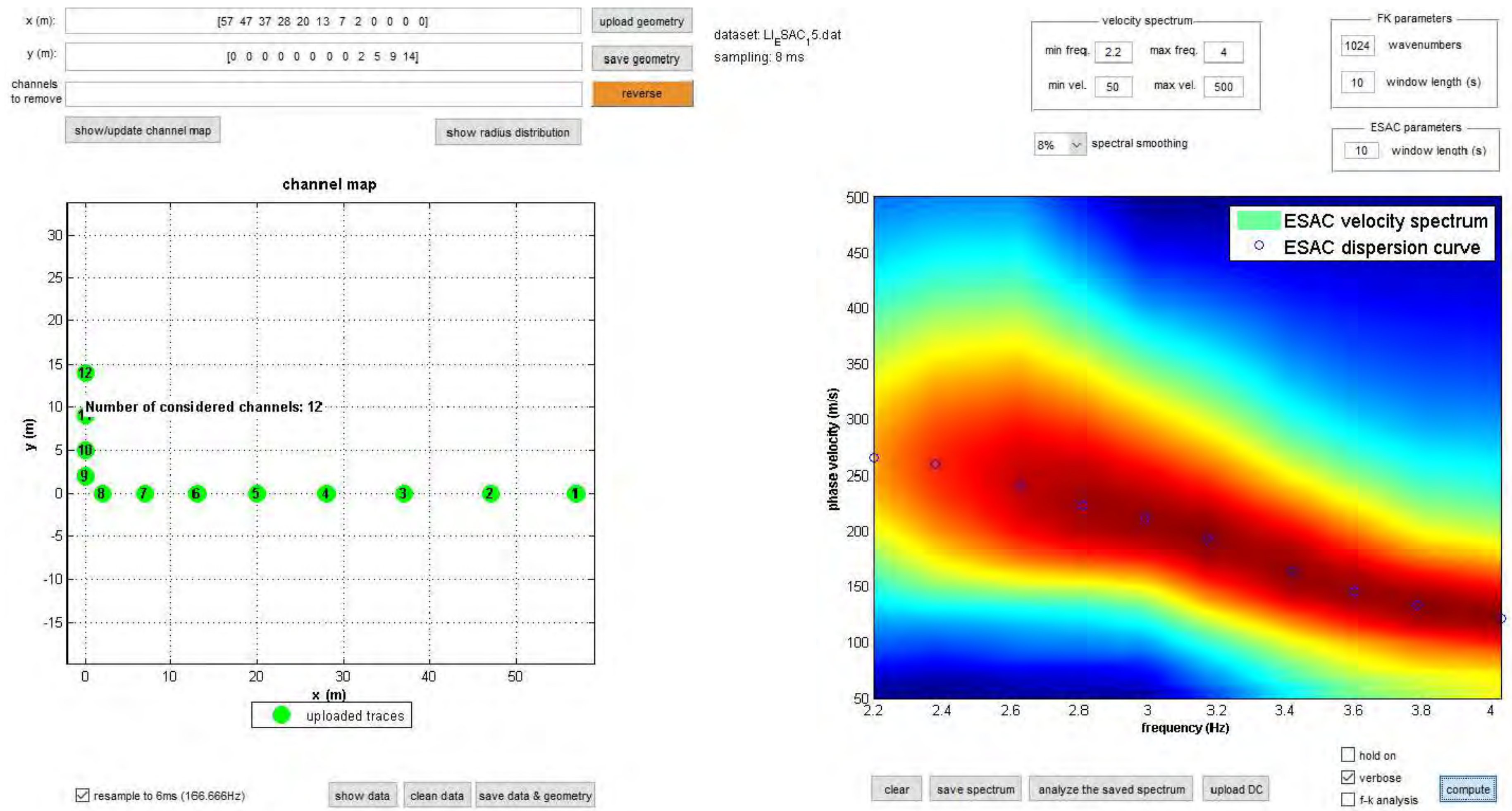



## SPETTRO DI VELOCITA' ESAC E CURVA DI DISPERSIONE EFFETTIVA

Stendimento ESAC15

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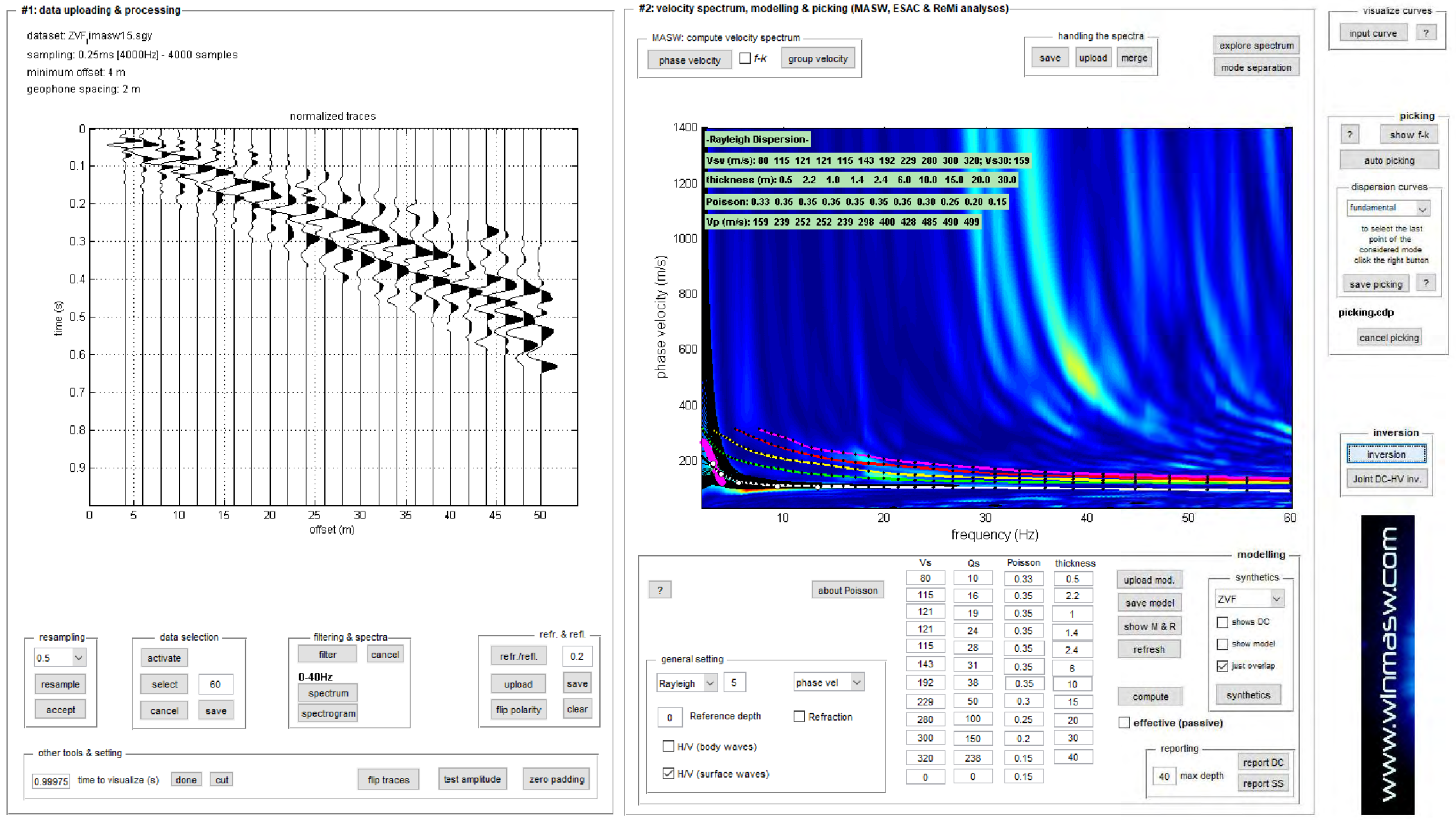
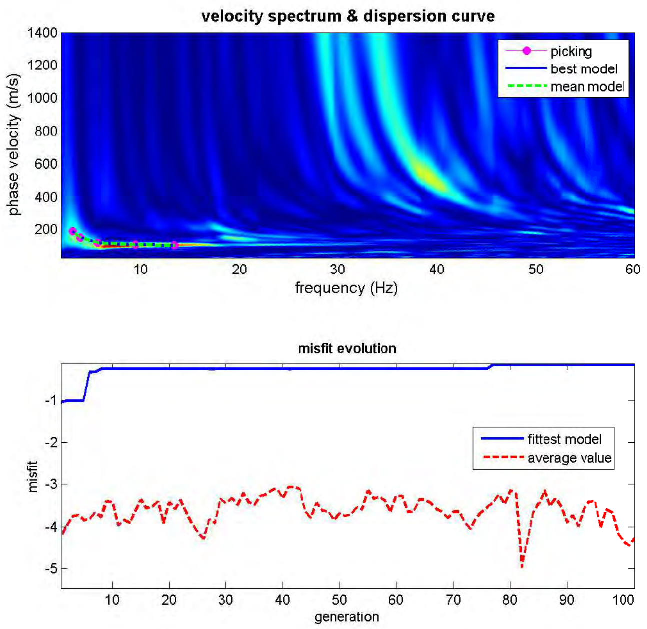
**RISULTANZE DELL'ANALISI SISMICA CONGIUNTA MASW 15 - ESAC 15**

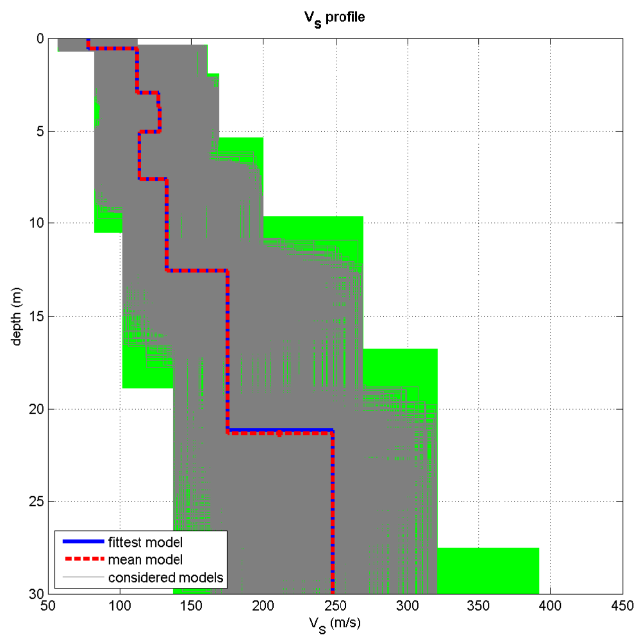
SPETTRO DI VELOCITA' MASW + CURVA DI DISPERSIONE EFFETTIVA ESAC




Stendimento MASW 15

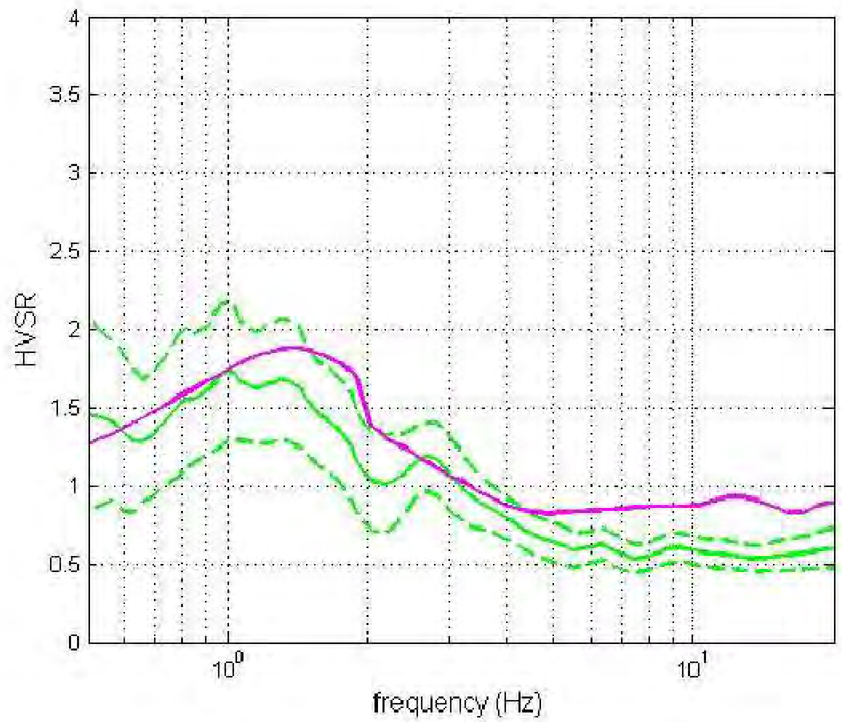
INVERSIONE CONGIUNTA MASW – ESAC E PROFILO DI VELOCITA'




dataset: ZVFimasw15.sgy
dispersion curve: picking.cdp
Vs30 (best model): 158 m/s
Vs30 (mean model): 158 m/s

INTERPRETAZIONE CONGIUNTA MASW 15 – HVSR15

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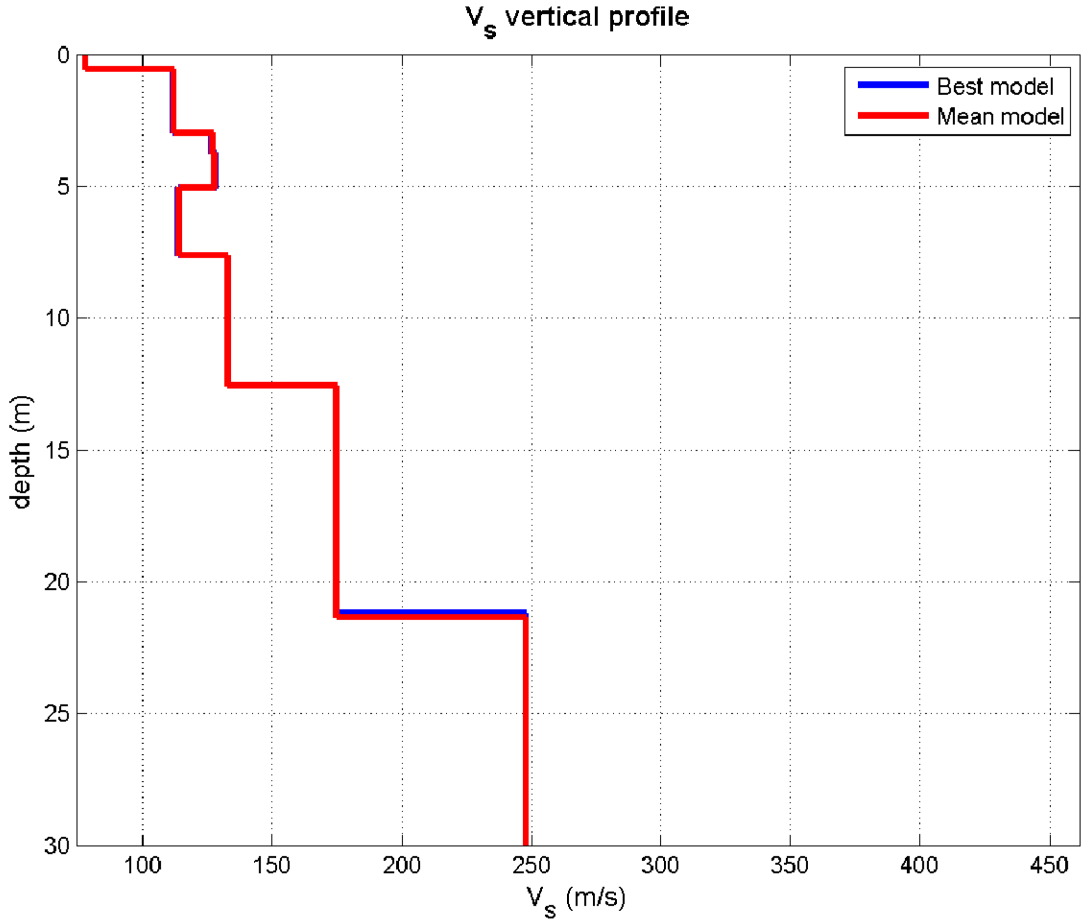
RISULTANZE DELL'ANALISI SISMICA CONGIUNTA MASW 15 - ESAC 15

PROFILO DI VELOCITA' MASW 15 – ESAC 15




Vs (m/s):78, 112, 127, 128, 114, 133, 175, 248, 281, 420, 433
Thickness (m):0.6, 2.4, 0.8, 1.3, 2.6, 5.0, 8.8, 16.0, 18.3, 38.5
Standard deviations (m/s):0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.2, 0.0, 0.0, 0.0

Density (gr/cm3) (approximate values):1.60, 1.66, 1.84, 1.70, 1.74, 1.75, 1.99, 1.89, 1.86, 1.98, 1.96
Seismic/Dynamic Shear modulus (MPa) (approximate values):10, 21, 30, 28, 23, 31, 61, 116, 147, 349, 368

Approximate values for Vp and Poisson (please, see manual)
Vp (m/s):153 194, 408, 235, 272, 281, 775, 506, 457, 725, 679
Poisson:0.32, 0.25, 0.45, 0.29, 0.39, 0.36, 0.47, 0.34 0.20, 0.25, 0.16

Vs30 (m/s): 158

GEOLOGICA TOSCANA s.n.c.

# HVSR1

| | | |
|---|---|---|
| DATE 20.07.2022 | HOUR 10:05 | PLACE Viale Italia - Livorno |
| OPERATOR Geologica Toscana snc | GPS TYPE and # | |
| WGS84 UTM 33N - EPSG: 32633 LATITUDE 4828792 | WGS84 UTM 33N - EPSG: 32633 LONGITUDE 121470 | ALTITUDE 3 m slm |
| STATION TYPE GPA Engeenering | SENSOR TYPE 3D - 4,5 Hz | |
| STATION # | SENSOR # | DISK # |
| FILE NAME Li HVSR1.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): 36 Remarks ______

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

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

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

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

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

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

Buildings, Trees

OBSERVATIONS

FREQUENCY: Hz (if computed in the field)

**Qualità della misura:**

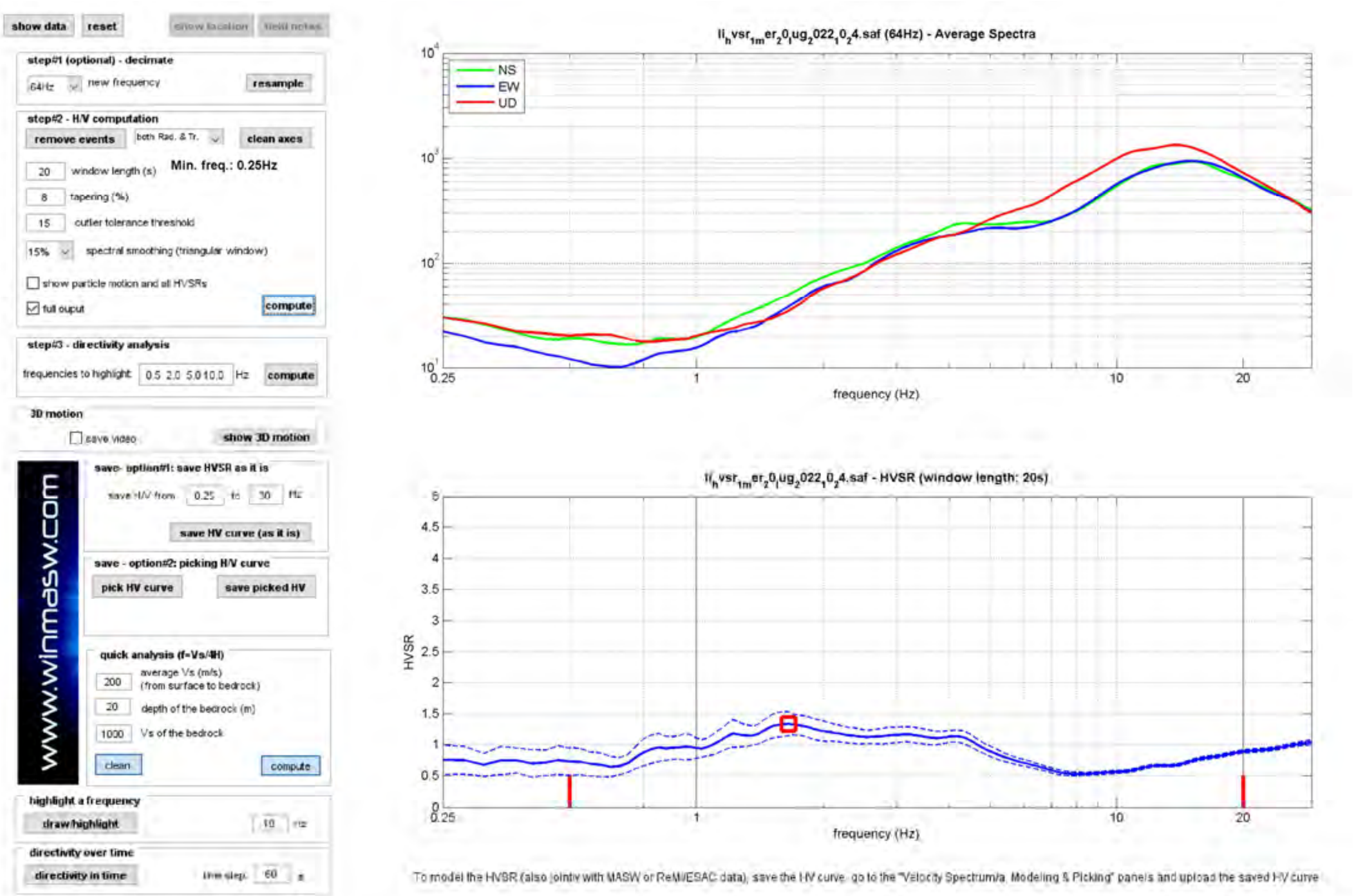
## MISURA TIPO A2

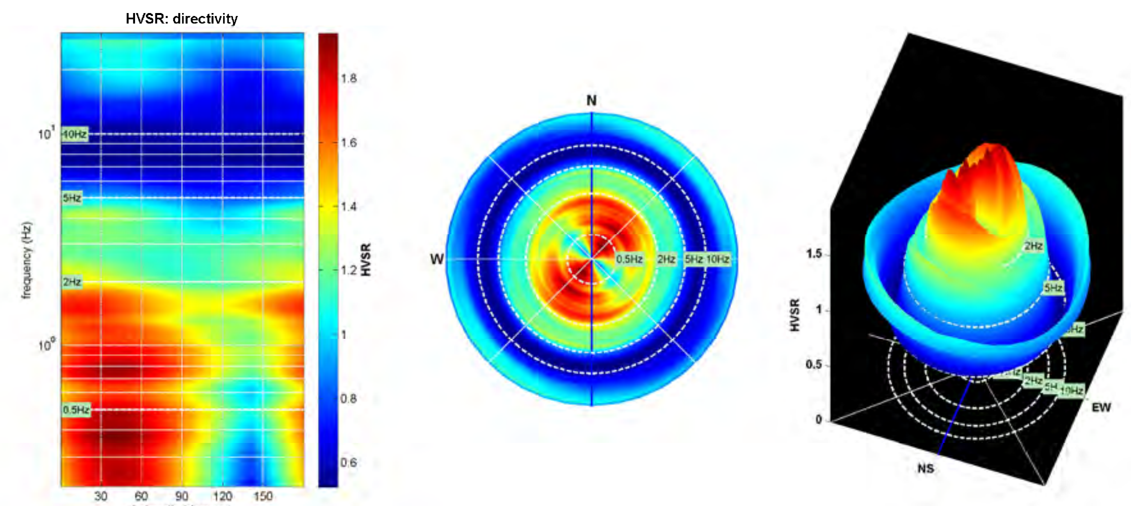
**HVSR1**

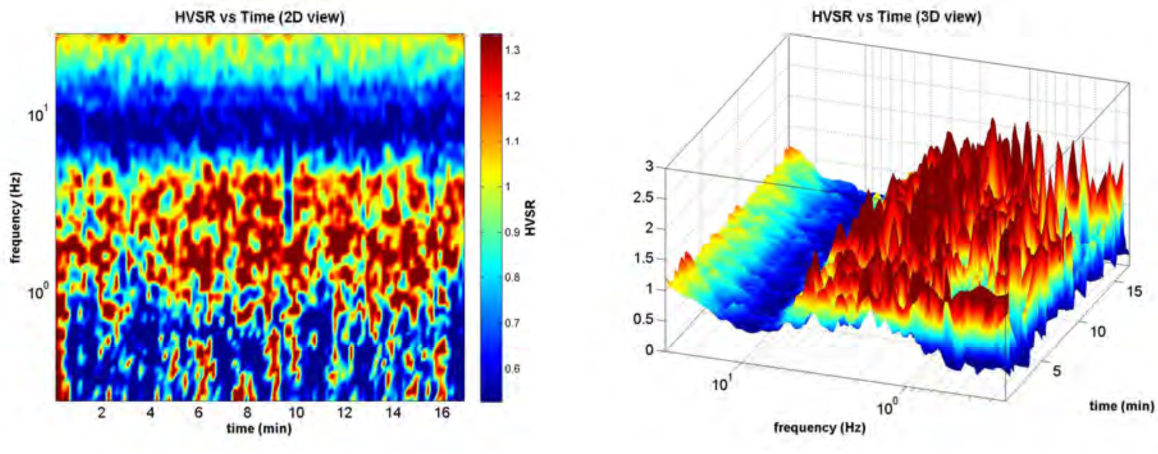
Peak frequency (Hz): 1.7 (±0.9)
Peak HVSR value: 1.3 (±0.2)

=== Criteria for a reliable H/V curve ====================================
#1. [f0 > 10/Lw]: 1.658 > 0.5 (OK)
#2. [nc > 200]: 3382 > 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 0.7Hz (OK)
#2. [exists f+ in the range [f0, 4f0] | AH/V(f+) < A0/2]: yes, at frequency 6.4Hz (OK)
#3. [A0 > 2]: 1.3 < 2 (NO)
#4. [fpeak[Ah/v(f) ± sigmaA(f)] = f0 ± 5%]: (OK)
#5. [sigmaf < epsilon(f0)]: 0.873 > 0.166 (NO)
#6. [sigmaA(f0) < theta(f0)]: 0.193 < 1.78 (OK)


show data
reset
step#1 (optional) - decimate
new frequency
resample
step#2 - H/V computation
remove events
clean axes
Min. freq.: 0.25Hz
window length (s)
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 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
directivity over time
directivity in time
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
N
W
NS
EW


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

# HVSR2

| | | |
|---|---|---|
| DATE 20.07.2022 | HOUR 9:03 | PLACE Via Ardensa - Livorno |
| OPERATOR Geologica Toscana snc | GPS TYPE and # | |
| WGS84 UTM 33N - EPSG: 32633 LATITUDE 4829347 | WGS84 UTM 33N - EPSG: 32633 LONGITUDE 122026 | ALTITUDE 11 m slm |
| STATION TYPE GPA Engeenering | SENSOR TYPE 3D - 4,5 Hz | |
| STATION # | SENSOR # | DISK # |
| FILE NAME Li 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): 32 Remarks ____

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

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

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

TRANSIENTS

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

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

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

Buildings, Trees

OBSERVATIONS

FREQUENCY: Hz (if computed in the field)

**Qualità della misura:**

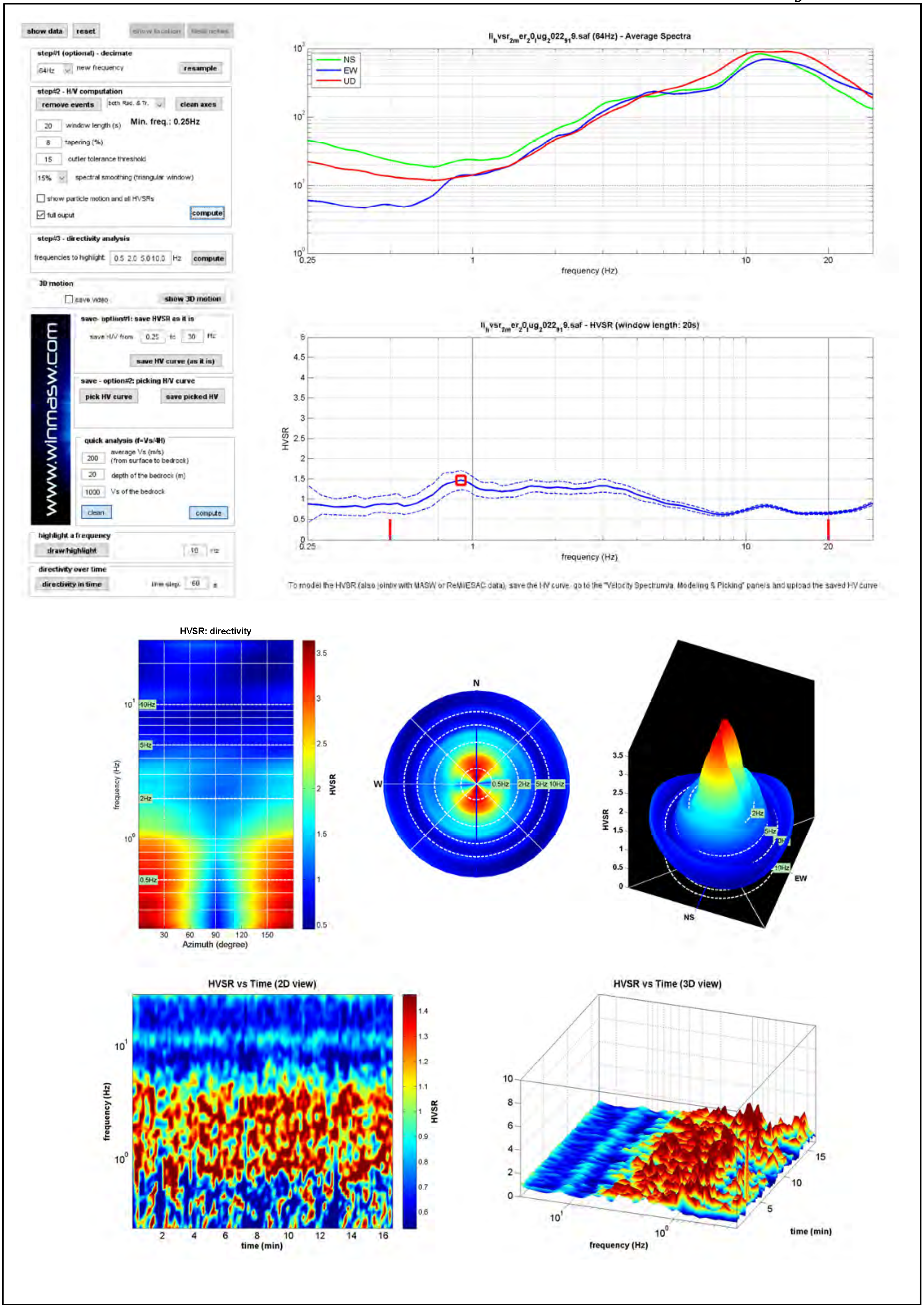
**MISURA TIPO A2**

## HVSR2

Peak frequency (Hz): 0.9 (±0.8)
Peak HVSR value: 1.5 (±0.2)

=== Criteria for a reliable H/V curve ===================================
#1. [f0 > 10/Lw]: 0.907 > 0.5 (OK)
#2. [nc > 200]: 1814 > 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]: 1.5 < 2 (NO)
#4. [fpeak[Ah/v(f) ± sigmaA(f)] = f0 ± 5%]: (OK)
#5. [sigmaf < epsilon(f0)]: 0.761 > 0.136 (NO)
#6. [sigmaA(f0) < theta(f0)]: 0.239 < 2 (OK)


show data
reset
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
Hz
3D motion
save video
show 3D motion
www.winmasw.com
save - option#1: save HVSR as it is
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
highlight a frequency
draw/highlight
directivity over time
directivity in time
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/a, Modeling & Picking" panels and upload the saved HV curve
HVSR: directivity
frequency (Hz)
Azimuth (degree)
N
W
EW
NS
HVSR vs Time (2D view)
time (min)
HVSR vs Time (3D view)
frequency (Hz)
time (min)

# HVSR3

| | | |
|---|---|---|
| DATE 20.07.2022 | HOUR 12:50 | PLACE Via Pietri - Livorno |
| OPERATOR Geologica Toscana snc | GPS TYPE and # | |
| WGS84 UTM 33N - EPSG: 32633 LATITUDE 4830973 | WGS84 UTM 33N - EPSG: 32633 LONGITUDE 120767 | ALTITUDE 6 m slm |
| STATION TYPE GPA Engeenering | SENSOR TYPE 3D - 4,5 Hz | |
| STATION # | SENSOR # | DISK # |
| FILE NAME Li HVSR3.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): 36 Remarks ______

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

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

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

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

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

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

OBSERVATIONS

FREQUENCY: Hz (if computed in the field)

**Qualità della misura:**

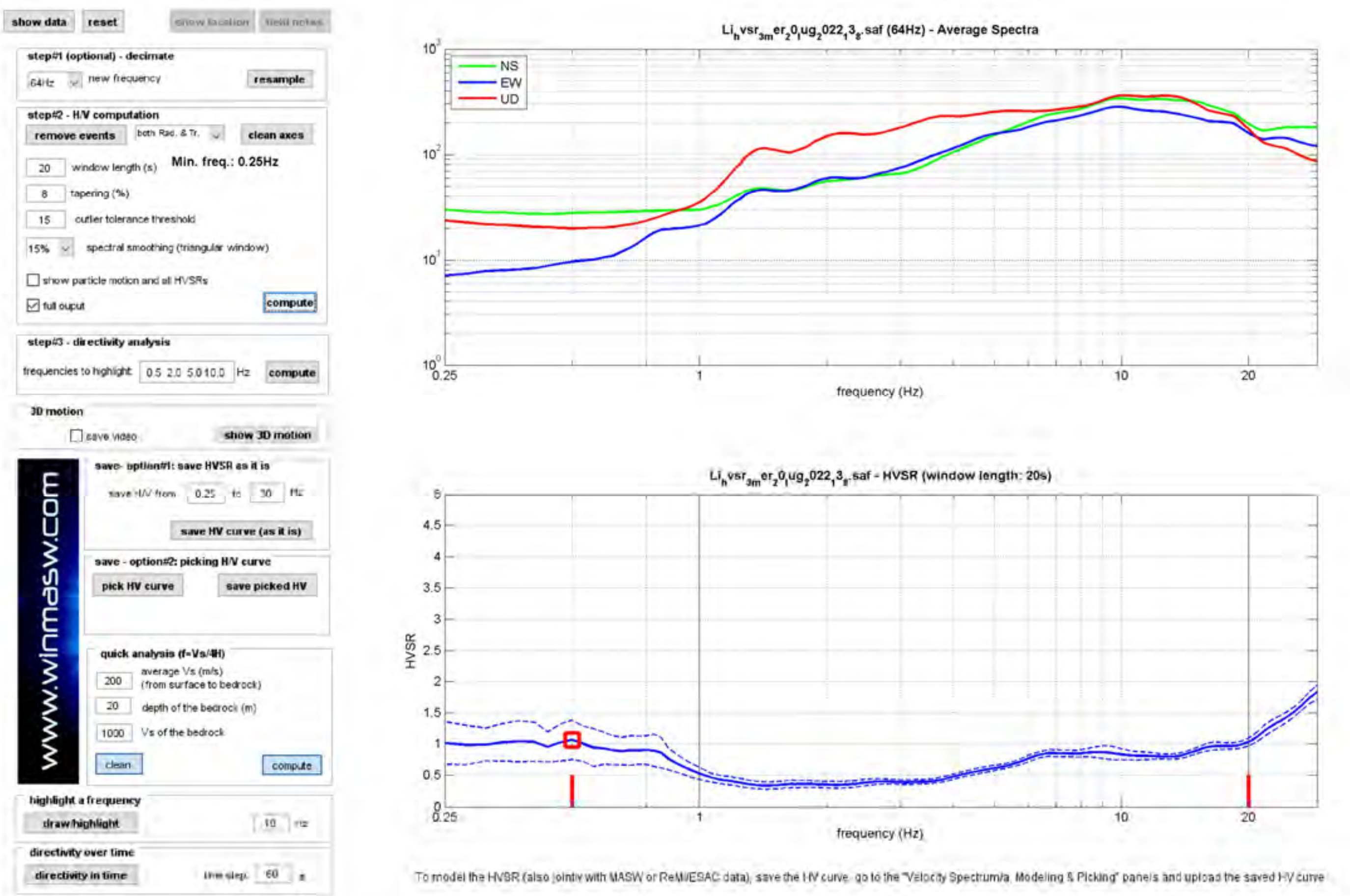
**MISURA TIPO A2**

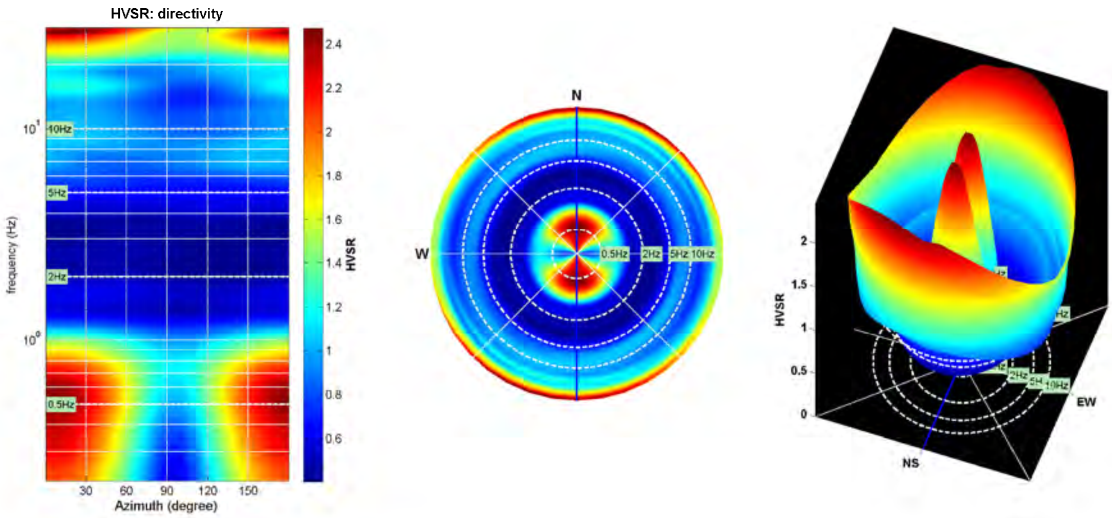
## HVSR3

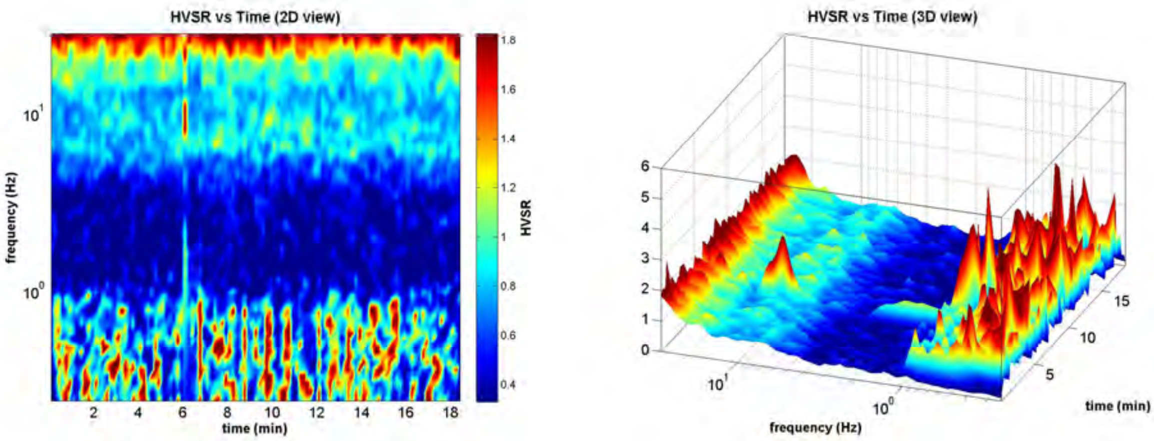
Peak frequency (Hz): 0.5 (±8.2)
Peak HVSR value: 1.1 (±0.3)

=== Criteria for a reliable H/V curve ====================================
#1. [f0 > 10/Lw]: 0.500 > 0.5 (OK)
#2. [nc > 200]: 1111 > 200 (OK)
#3. [f0>0.5Hz; sigmaA(f) < 2 for 0.5f0 < f < 2f0] (OK)

=== Criteria for a clear H/V peak (at least 5 should be fulfilled) ===========
#1. [exists f- in the range [f0/4, f0] | AH/V(f-) < A0/2]: (NO)
#2. [exists f+ in the range [f0, 4f0] | AH/V(f+) < A0/2]: yes, at frequency 1.0Hz (OK)
#3. [A0 > 2]: 1.1 < 2 (NO)
#4. [fpeak[Ah/v(f) ± sigmaA(f)] = f0 ± 5%]: (NO)
#5. [sigmaf < epsilon(f0)]: 8.232 > 0.075 (NO)
#6. [sigmaA(f0) < theta(f0)]: 0.317 < 2 (OK)


show data
reset
step#1 (optional) - decimate
new frequency
resample
step#2 - H/V computation
remove events
clean axes
Min. freq.: 0.25Hz
window length (s)
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 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
directivity over time
directivity in time
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
N
W
0.5Hz
2Hz
5Hz
10Hz
HVSR
NS
EW


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

# HVSR4

| | | |
|---|---|---|
| DATE 20.07.2022 | HOUR 14:40 | PLACE Via Italia - Livorno |
| OPERATOR Geologica Toscana snc | GPS TYPE and # | |
| WGS84 UTM 33N - EPSG: 32633<br>LATITUDE 4831549 | WGS84 UTM 33N - EPSG: 32633<br>LONGITUDE 120377 | ALTITUDE 2 m slm |
| STATION TYPE<br>GPA Engeenering | SENSOR TYPE<br>3D - 4,5 Hz | |
| STATION # | SENSOR # | DISK # |
| FILE NAME Li 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): 38 — Remarks ______

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

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

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

TRANSIENTS

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

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

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

Trees, Buildings

OBSERVATIONS

FREQUENCY: Hz (if computed in the field)

**Qualità della misura:**

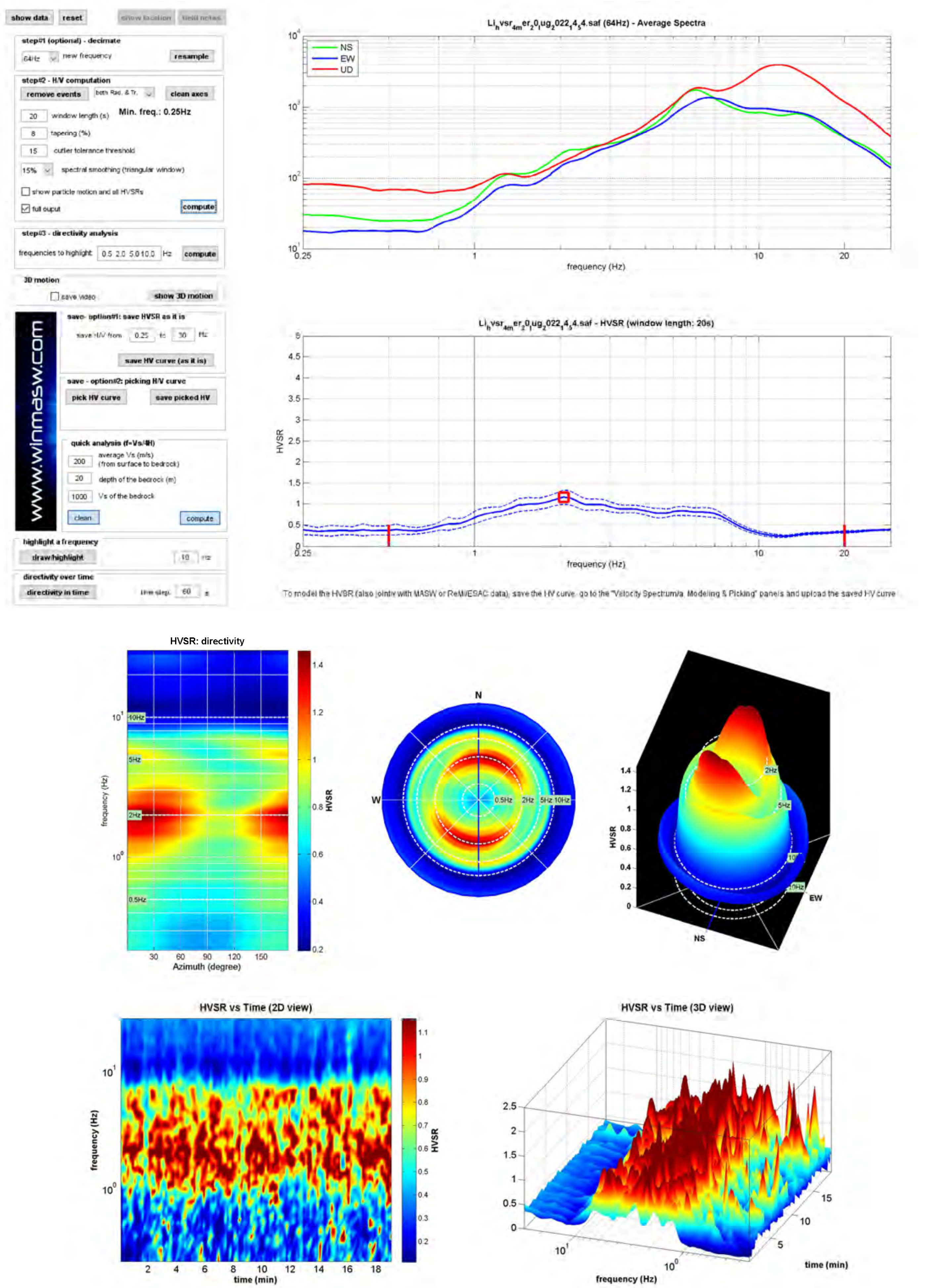
## MISURA TIPO A2

**HVSR4**

Peak frequency (Hz): 2.1 (±1.1)
Peak HVSR value: 1.2 (±0.2)

=== Criteria for a reliable H/V curve ====================================
#1. [f0 > 10/Lw]: 2.065 > 0.5 (OK)
#2. [nc > 200]: 4748 > 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 8.0Hz (OK)
#3. [A0 > 2]: 1.2 < 2 (NO)
#4. [fpeak[Ah/v(f) ± sigmaA(f)] = f0 ± 5%]: (OK)
#5. [sigmaf < epsilon(f0)]: 1.147 > 0.103 (NO)
#6. [sigmaA(f0) < theta(f0)]: 0.175 < 1.58 (OK)


show data
reset
step#1 (optional) - decimate
resample
step#2 - H/V computation
remove events
clean axes
Min. freq.: 0.25Hz
window length (s)
tapering (%)
outlier tolerance threshold
spectral smoothing (triangular window)
show particle motion and all HVSRs
full ouput
compute
step#3 - directivity analysis
frequencies to highlight
3D motion
save video
show 3D motion
www.winmasw.com
save - option#1: save HVSR as it is
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
directivity over time
directivity in time
Average Spectra
NS
EW
UD
frequency (Hz)
HVSR (window length: 20s)
HVSR
frequency (Hz)
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)

# HVSR5

| | | |
|---|---|---|
| DATE 20.07.2022 | HOUR 17:00 | PLACE Piazza della Vittoria - Livorno |
| OPERATOR Geologica Toscana snc | GPS TYPE and # | |
| WGS84 UTM 33N - EPSG: 32633<br>LATITUDE 4832000 | WGS84 UTM 33N - EPSG: 32633<br>LONGITUDE 121575 | ALTITUDE 8 m slm |
| STATION TYPE<br>GPA Engeenering | SENSOR TYPE<br>3D - 4,5 Hz | |
| STATION # | SENSOR # | DISK # |
| FILE NAME Li 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): 38 Remarks ______

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

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

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

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

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

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

Trees

OBSERVATIONS

FREQUENCY: Hz (if computed in the field)

**Qualità della misura:**

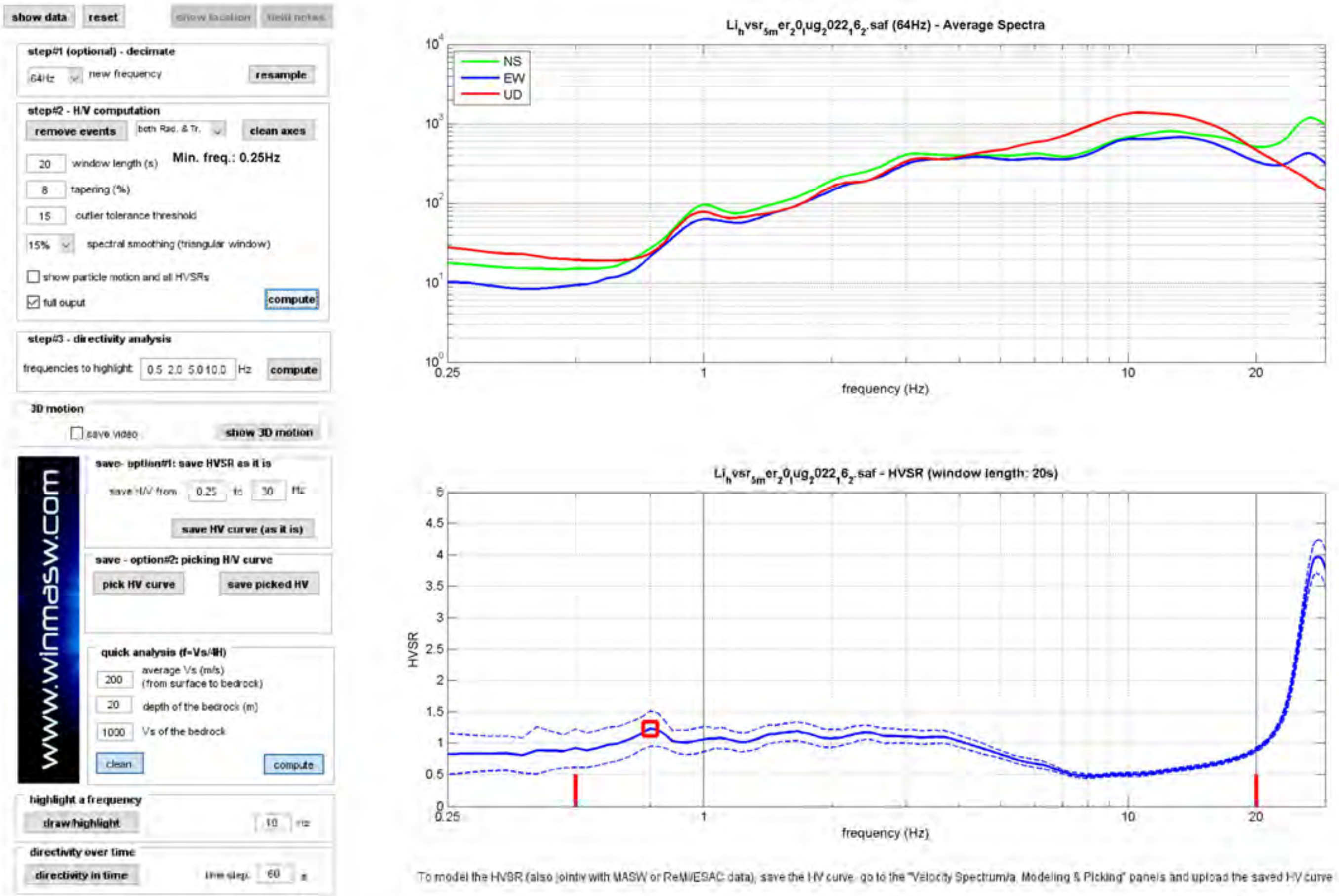
**MISURA TIPO A2**

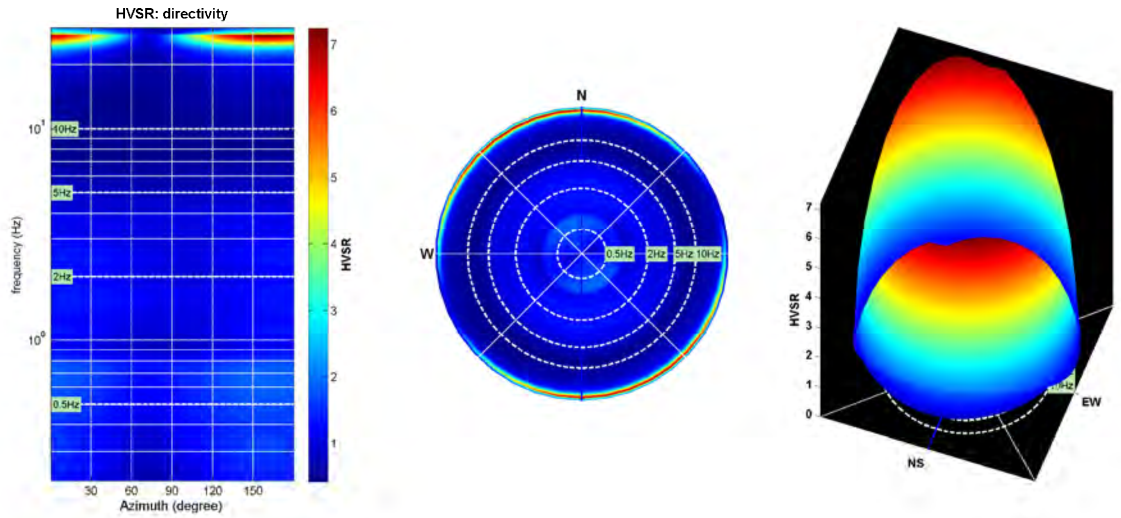
**HVSR5**

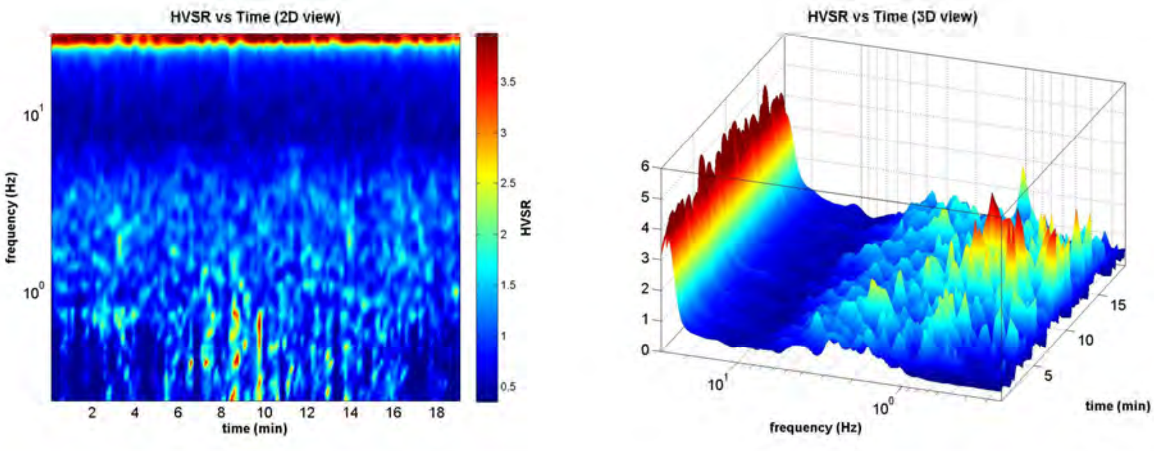
Peak frequency (Hz): 0.8 (±0.8)
Peak HVSR value: 1.2 (±0.3)

=== Criteria for a reliable H/V curve ====================================
#1. [f0 > 10/Lw]: 0.751 > 0.5 (OK)
#2. [nc > 200]: 1727 > 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]: 1.2 < 2 (NO)
#4. [fpeak[Ah/v(f) ± sigmaA(f)] = f0 ± 5%]: (NO)
#5. [sigmaf < epsilon(f0)]: 0.785 > 0.113 (NO)
#6. [sigmaA(f0) < theta(f0)]: 0.282 < 2 (OK)


show data
reset
step#1 (optional) - decimate
new frequency
resample
step#2 - H/V computation
remove events
clean axes
Min. freq.: 0.25Hz
window length (s)
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
save- option#1: save HVSR as it is
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
directivity over time
directivity in time
www.winmasw.com
Average Spectra
NS
EW
UD
frequency (Hz)
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)

# HVSR6

| | | |
|---|---|---|
| DATE 21.07.2022 | HOUR 13:50 | PLACE Piazza XX Settembre - Livorno |
| OPERATOR Geologica Toscana snc | GPS TYPE and # | |
| WGS84 UTM 33N - EPSG: 32633<br>LATITUDE 4832638 | WGS84 UTM 33N - EPSG: 32633<br>LONGITUDE 121599 | ALTITUDE 8 m slm |
| STATION TYPE<br>GPA Engeenering | SENSOR TYPE<br>3D - 4,5 Hz | |
| STATION # | SENSOR # | DISK # |
| FILE NAME Li 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): 38 Remarks ______

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

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

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

TRANSIENTS

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

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

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

Trees, Buildings

OBSERVATIONS

FREQUENCY: Hz (if computed in the field)

**Qualità della misura:**

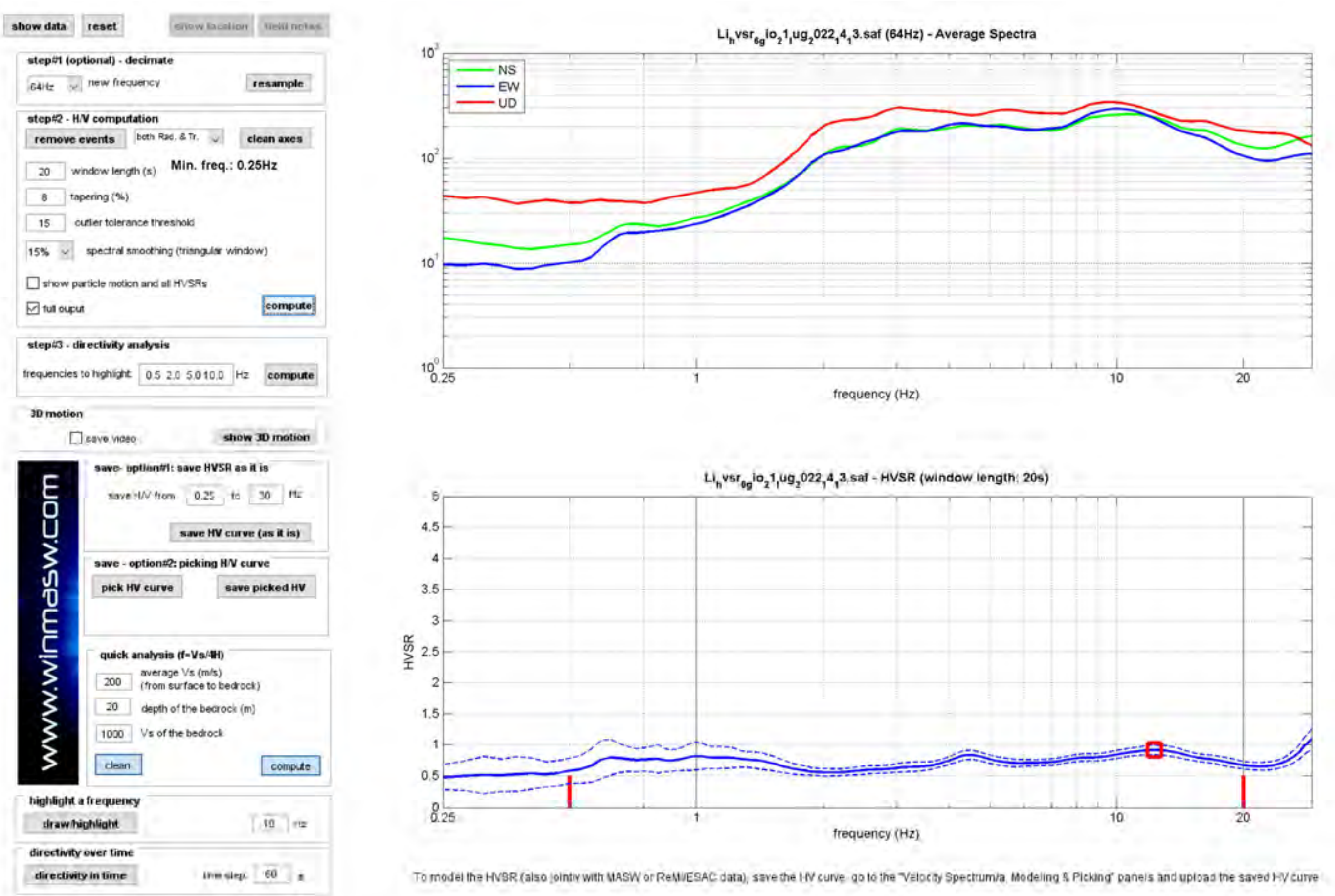
## MISURA TIPO A2

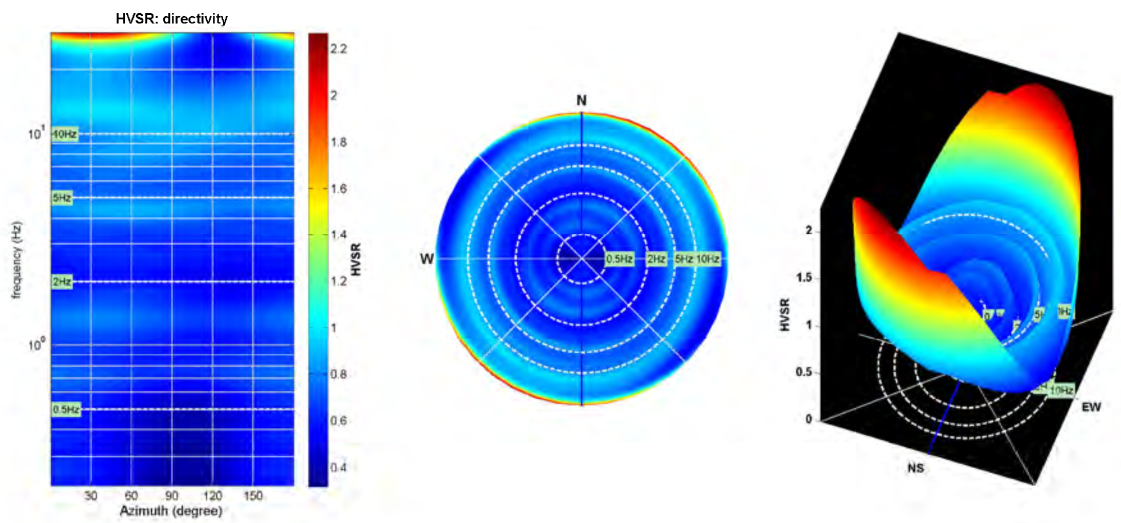
## HVSR6

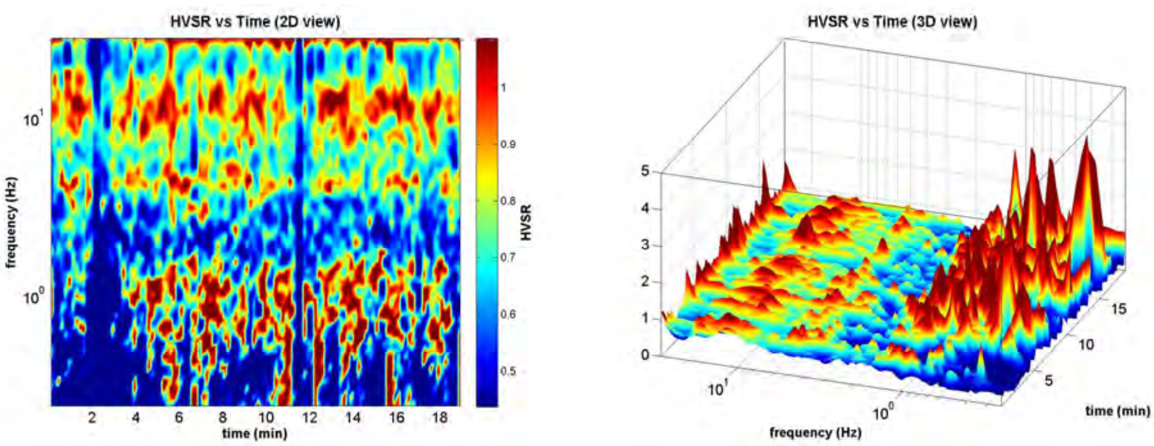
Peak frequency (Hz): 12.3 (±4.5)
Peak HVSR value: 0.9 (±0.1)

=== Criteria for a reliable H/V curve ====================================
#1. [f0 > 10/Lw]: 12.293 > 0.5 (OK)
#2. [nc > 200]: 28029 > 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)]: 4.531 > 0.615 (NO)
#6. [sigmaA(f0) < theta(f0)]: 0.080 < 1.58 (OK)


show data
reset
step#1 (optional) - decimate
new frequency
resample
step#2 - H/V computation
remove events
clean axes
Min. freq.: 0.25Hz
window length (s)
tapering (%)
outlier tolerance threshold
spectral smoothing (triangular window)
show particle motion and all HVSRs
full ouput
compute
step#3 - directivity analysis
frequencies to highlight
Hz
3D motion
save video
show 3D motion
www.winmasw.com
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
highlight a frequency
draw/highlight
directivity over time
directivity in time
Average Spectra
NS
EW
UD
frequency (Hz)
HVSR (window length: 20s)
HVSR
frequency (Hz)


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 20.07.2022 | HOUR 16:05 | PLACE Via San Carlo - Livorno |
| OPERATOR Geologica Toscana snc | GPS TYPE and # | |
| WGS84 UTM 33N - EPSG: 32633<br>LATITUDE 4831988 | WGS84 UTM 33N - EPSG: 32633<br>LONGITUDE 121096 | ALTITUDE 6 m slm |
| STATION TYPE<br>GPA Engeenering | SENSOR TYPE<br>3D - 4,5 Hz | |
| STATION # | SENSOR # | DISK # |
| FILE NAME Li HVSR7.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): 38 Remarks ______

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

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

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

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

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

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

Trees

OBSERVATIONS

FREQUENCY: Hz
(if computed in the field)

**Qualità della misura:**

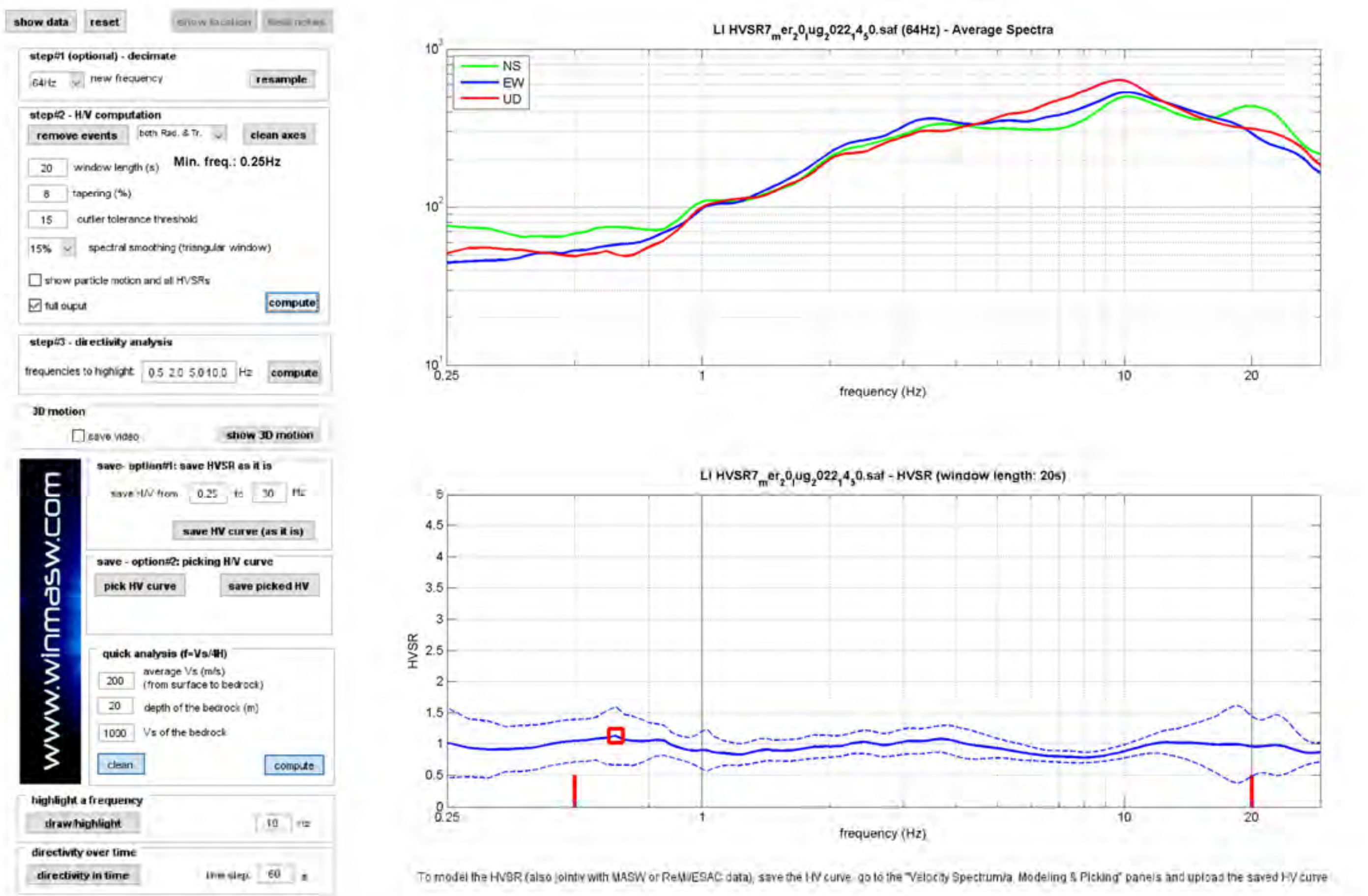
## MISURA TIPO A2

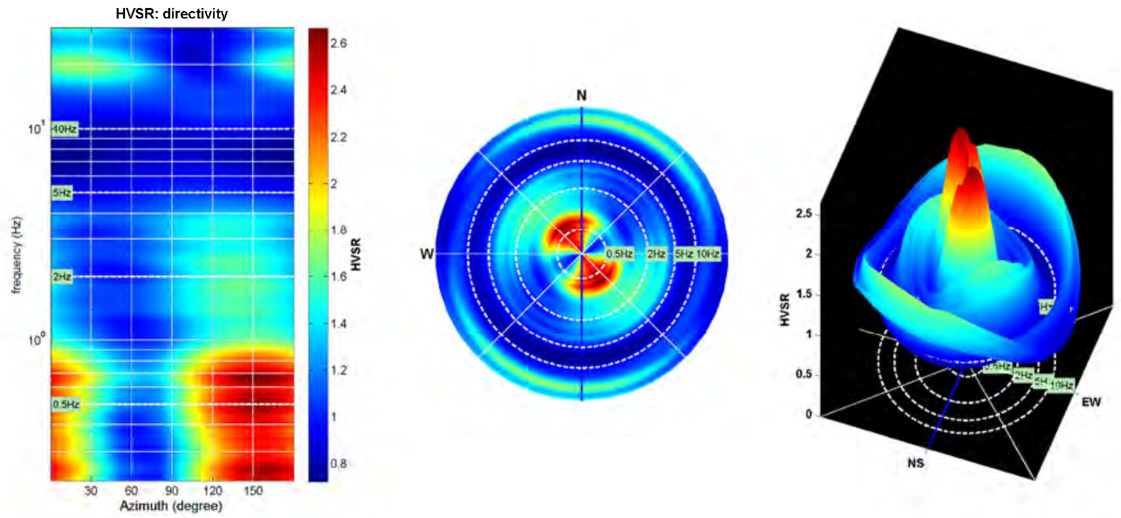
**HVSR7**

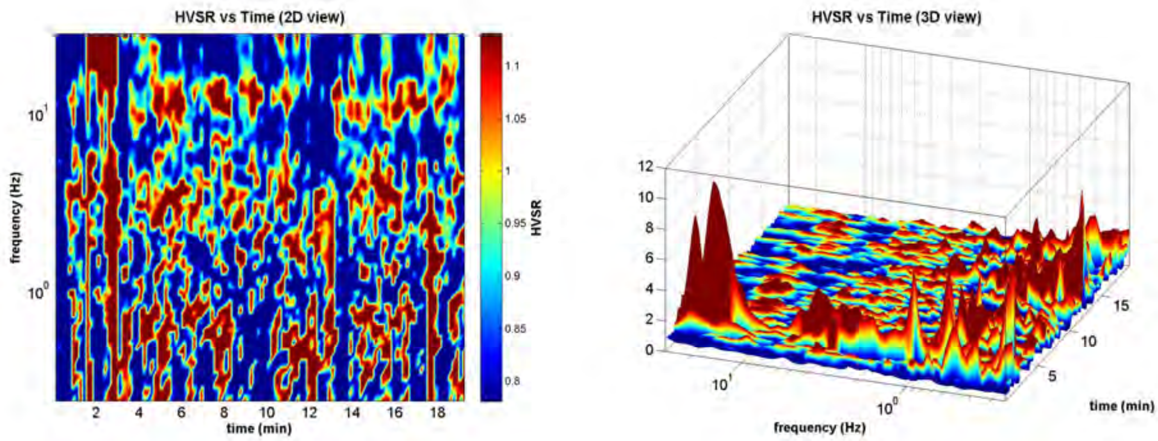
Peak frequency (Hz): 0.6 (±5.4)
Peak HVSR value: 1.1 (±0.4)

=== Criteria for a reliable H/V curve ====================================
#1. [f0 > 10/Lw]: 0.626 > 0.5 (OK)
#2. [nc > 200]: 1451 > 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]: 1.1 < 2 (NO)
#4. [fpeak[Ah/v(f) ± sigmaA(f)] = f0 ± 5%]: (NO)
#5. [sigmaf < epsilon(f0)]: 5.355 > 0.094 (NO)
#6. [sigmaA(f0) < theta(f0)]: 0.470 < 2 (OK)


show data
reset
step#1 (optional) - decimate
resample
step#2 - H/V computation
remove events
clean axes
Min. freq.: 0.25Hz
window length (s)
tapering (%)
outlier tolerance threshold
spectral smoothing (triangular window)
show particle motion and all HVSRs
full ouput
compute
step#3 - directivity analysis
frequencies to highlight
3D motion
save video
show 3D motion
save- option#1: save HVSR as it is
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
directivity over time
directivity in time
www.winmasw.com
NS
EW
UD
frequency (Hz)
HVSR
To model the HVSR (also jointly with MASW or ReMi/ESAC data), save the HV curve, go to the "Velocity Spectrum/a, Modeling & Picking" panels and upload the saved HV curve


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


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

# HVSR8

| | | |
|---|---|---|
| DATE 20.07.2022 | HOUR 11:40 | PLACE Viale Boccaccio - Livorno |
| OPERATOR Geologica Toscana snc | GPS TYPE and # | |
| WGS84 UTM 33N - EPSG: 32633 LATITUDE 4830638 | WGS84 UTM 33N - EPSG: 32633 LONGITUDE 121871 | ALTITUDE 12 m slm |
| STATION TYPE GPA Engeenering | SENSOR TYPE 3D - 4,5 Hz | |
| STATION # | SENSOR # | DISK # |
| FILE NAME Li 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): 36 — Remarks ______

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

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

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

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

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

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

Trees, Buildings

OBSERVATIONS

FREQUENCY: Hz (if computed in the field)

**Qualità della misura:**

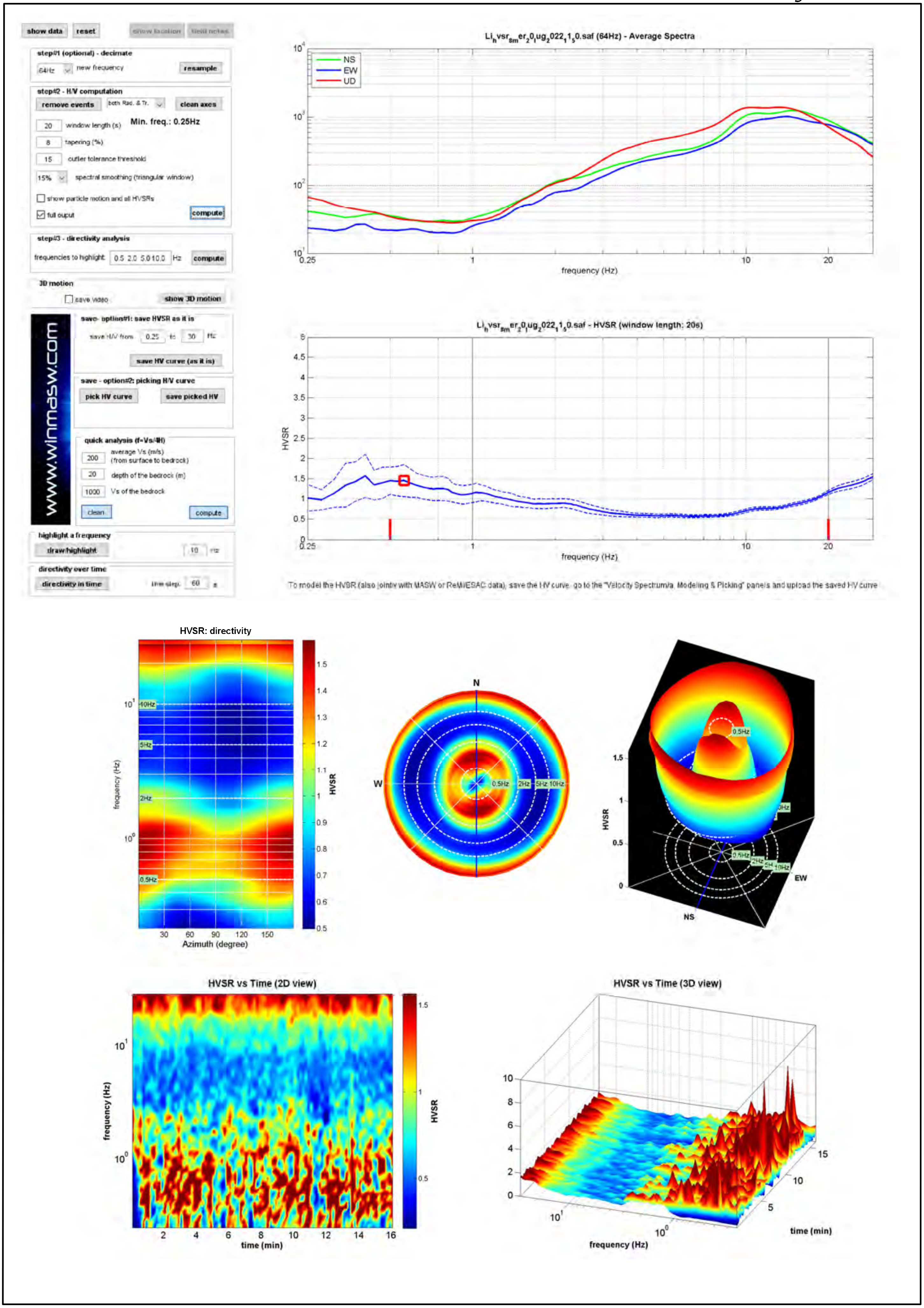
## MISURA TIPO A2

**HVSR8**

Peak frequency (Hz): 0.6 (±3.3)
Peak HVSR value: 1.5 (±0.3)

=== Criteria for a reliable H/V curve ====================================
#1. [f0 > 10/Lw]: 0.563 > 0.5 (OK)
#2. [nc > 200]: 1092 > 200 (OK)
#3. [f0>0.5Hz; sigmaA(f) < 2 for 0.5f0 < f < 2f0] (OK)

=== Criteria for a clear H/V peak (at least 5 should be fulfilled) ============
#1. [exists f- in the range [f0/4, f0] | AH/V(f-) < A0/2]: (NO)
#2. [exists f+ in the range [f0, 4f0] | AH/V(f+) < A0/2]: (NO)
#3. [A0 > 2]: 1.5 < 2 (NO)
#4. [fpeak[Ah/v(f) ± sigmaA(f)] = f0 ± 5%]: (NO)
#5. [sigmaf < epsilon(f0)]: 3.303 > 0.084 (NO)
#6. [sigmaA(f0) < theta(f0)]: 0.397 < 2 (OK)


show data
reset
step#1 (optional) - decimate
new frequency
resample
step#2 - H/V computation
remove events
clean axes
Min. freq.: 0.25Hz
window length (s)
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
save- option#1: save HVSR as it is
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
directivity over time
directivity in time
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 Spectrum/a, Modeling & Picking" panels and upload the saved HV curve
HVSR: directivity
frequency (Hz)
Azimuth (degree)
HVSR
N
W
HVSR
EW
NS
HVSR vs Time (2D view)
frequency (Hz)
time (min)
HVSR
HVSR vs Time (3D view)
frequency (Hz)
time (min)

# HVSR9

| | | |
|---|---|---|
| DATE 20.07.2022 | HOUR 7:45 | PLACE Via Inghilterra - Livorno |
| OPERATOR Geologica Toscana snc | GPS TYPE and # | |
| WGS84 UTM 33N - EPSG: 32633 LATITUDE 4829902 | WGS84 UTM 33N - EPSG: 32633 LONGITUDE 123316 | ALTITUDE 24 m slm |
| STATION TYPE GPA Engeenering | SENSOR TYPE 3D - 4,5 Hz | |
| STATION # | SENSOR # | DISK # |
| FILE NAME Li 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): 30 Remarks ______

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

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

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

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

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

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

Trees, Buildings

OBSERVATIONS

FREQUENCY: Hz (if computed in the field)

**Qualità della misura:**

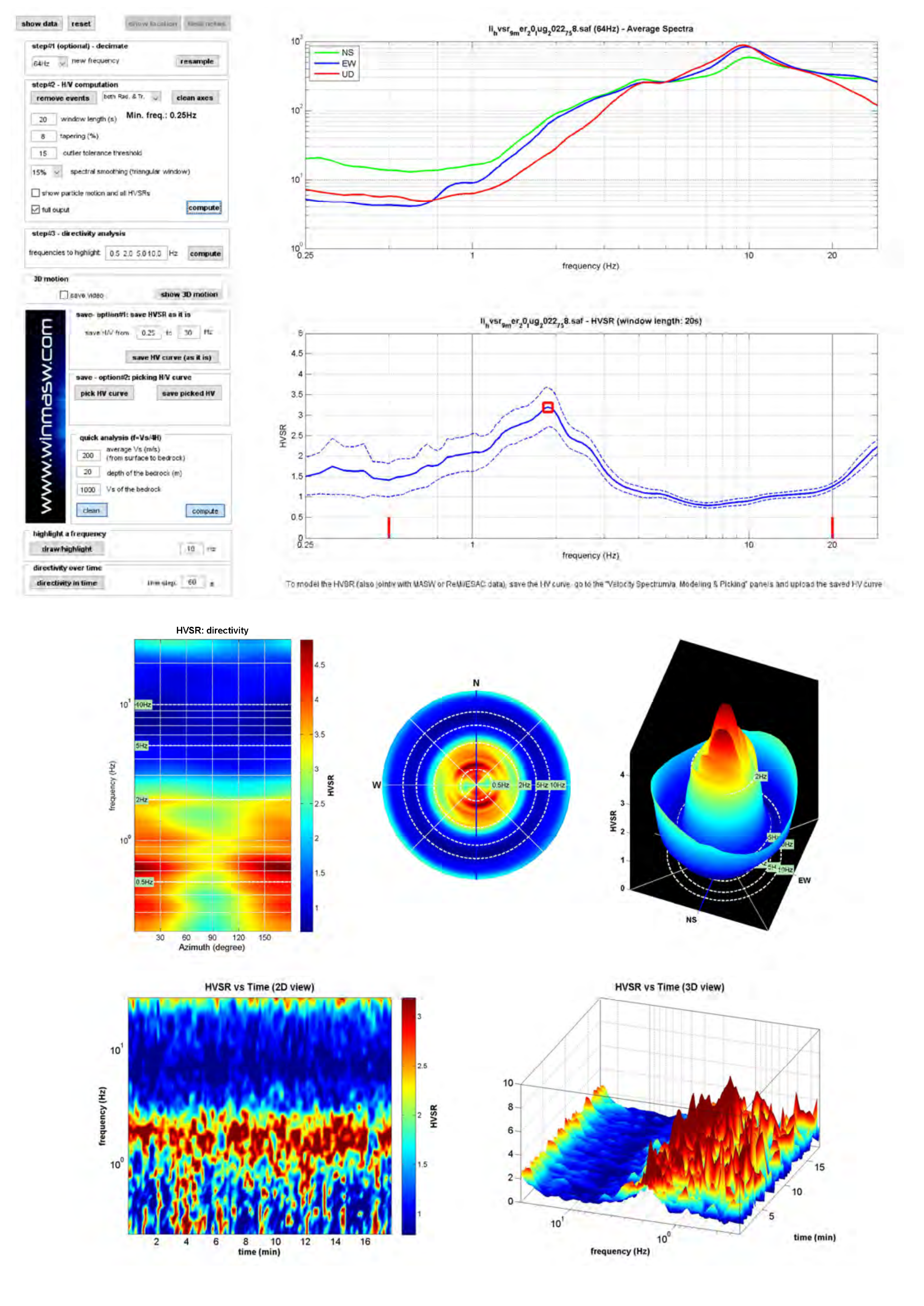
**MISURA TIPO A1**

## HVSR9

Peak frequency (Hz): 1.9 (±0.5)
Peak HVSR value: 3.2 (±0.5)

=== Criteria for a reliable H/V curve ====================================
#1. [f0 > 10/Lw]: 1.877 > 0.5 (OK)
#2. [nc > 200]: 4016 > 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 3.1Hz (OK)
#3. [A0 > 2]: 3.2 > 2 (OK)
#4. [fpeak[Ah/v(f) ± sigmaA(f)] = f0 ± 5%]: (OK)
#5. [sigmaf < epsilon(f0)]: 0.488 > 0.188 (NO)
#6. [sigmaA(f0) < theta(f0)]: 0.480 < 1.78 (OK)


show data
reset
step#1 (optional) - decimate
new frequency
resample
step#2 - H/V computation
remove events
clean axes
Min. freq.: 0.25Hz
window length (s)
tapering (%)
outlier tolerance threshold
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 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
directivity over time
directivity in time
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
N
W
NS
EW
HVSR vs Time (2D view)
frequency (Hz)
time (min)
HVSR
HVSR vs Time (3D view)
frequency (Hz)
time (min)

# HVSR10

| | | |
|---|---|---|
| DATE 21.07.2022 | HOUR 15:38 | PLACE Via del Limone - Livorno |
| OPERATOR Geologica Toscana snc | GPS TYPE and # | |
| WGS84 UTM 33N - EPSG: 32633 LATITUDE 4832888 | WGS84 UTM 33N - EPSG: 32633 LONGITUDE 124343 | ALTITUDE 18 m slm |
| STATION TYPE GPA Engeenering | SENSOR TYPE 3D - 4,5 Hz | |
| STATION # | SENSOR # | DISK # |
| FILE NAME Li 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): 38 Remarks ______

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

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

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

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

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

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

OBSERVATIONS

FREQUENCY: Hz
(if computed in the field)


**Qualità della misura:**

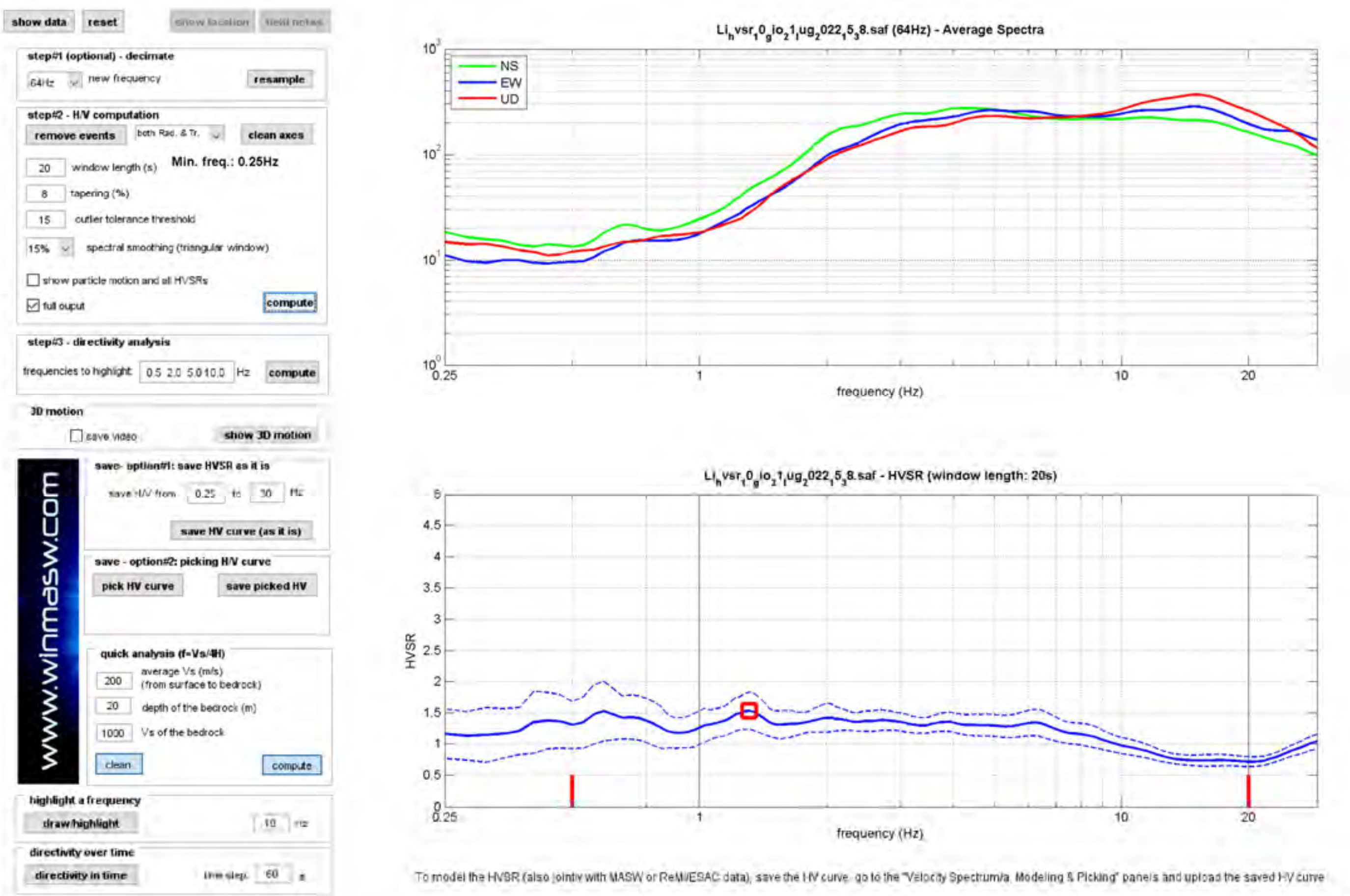
## MISURA TIPO A2

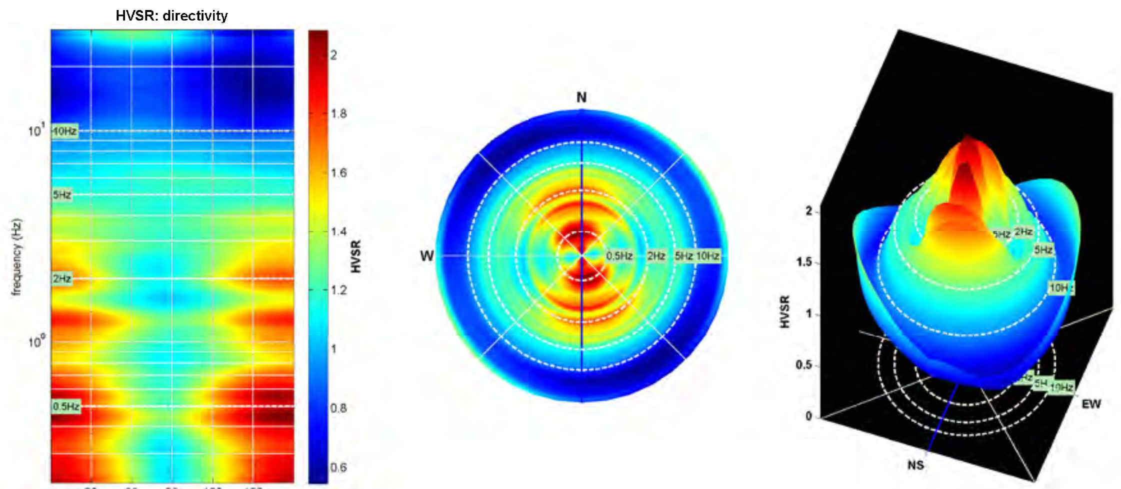
**HVSR10**

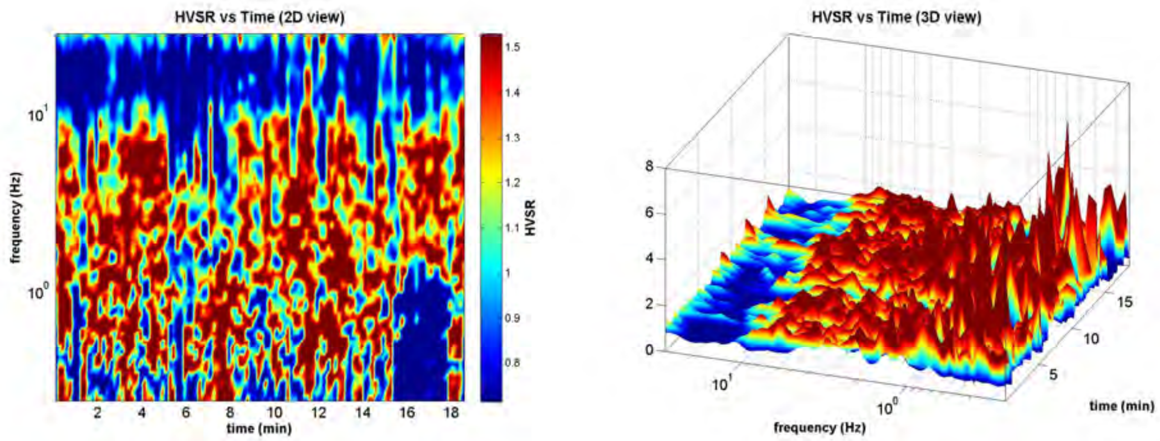
Peak frequency (Hz): 1.3 (±1.6)
Peak HVSR value: 1.5 (±0.3)

=== Criteria for a reliable H/V curve ===================================
#1. [f0 > 10/Lw]: 1.314 > 0.5 (OK)
#2. [nc > 200]: 2943 > 200 (OK)
#3. [f0>0.5Hz; sigmaA(f) < 2 for 0.5f0 < f < 2f0] (OK)

=== Criteria for a clear H/V peak (at least 5 should be fulfilled) ============
#1. [exists f- in the range [f0/4, f0] | AH/V(f-) < A0/2]: (NO)
#2. [exists f+ in the range [f0, 4f0] | AH/V(f+) < A0/2]: (NO)
#3. [A0 > 2]: 1.5 < 2 (NO)
#4. [fpeak[Ah/v(f) ± sigmaA(f)] = f0 ± 5%]: (NO)
#5. [sigmaf < epsilon(f0)]: 1.600 > 0.131 (NO)
#6. [sigmaA(f0) < theta(f0)]: 0.301 < 1.78 (OK)


show data
reset
step#1 (optional) - decimate
new frequency
resample
step#2 - H/V computation
remove events
clean axes
Min. freq.: 0.25Hz
window length (s)
tapering (%)
outlier tolerance threshold
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 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
directivity over time
directivity in time
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
N
W
NS
EW


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

# HVSR11

| | | |
|---|---|---|
| DATE 21.07.2022 | HOUR 9:30 | PLACE Via dell'Artigianato - Livorno |
| OPERATOR Geologica Toscana snc | GPS TYPE and # | |
| WGS84 UTM 33N - EPSG: 32633<br>LATITUDE 4832812 | WGS84 UTM 33N - EPSG: 32633<br>LONGITUDE 123604 | ALTITUDE 10 m slm |
| STATION TYPE<br>GPA Engeenering | SENSOR TYPE<br>3D - 4,5 Hz | |
| STATION # | SENSOR # | DISK # |
| FILE NAME Li 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): 38 Remarks ______

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

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

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

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

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

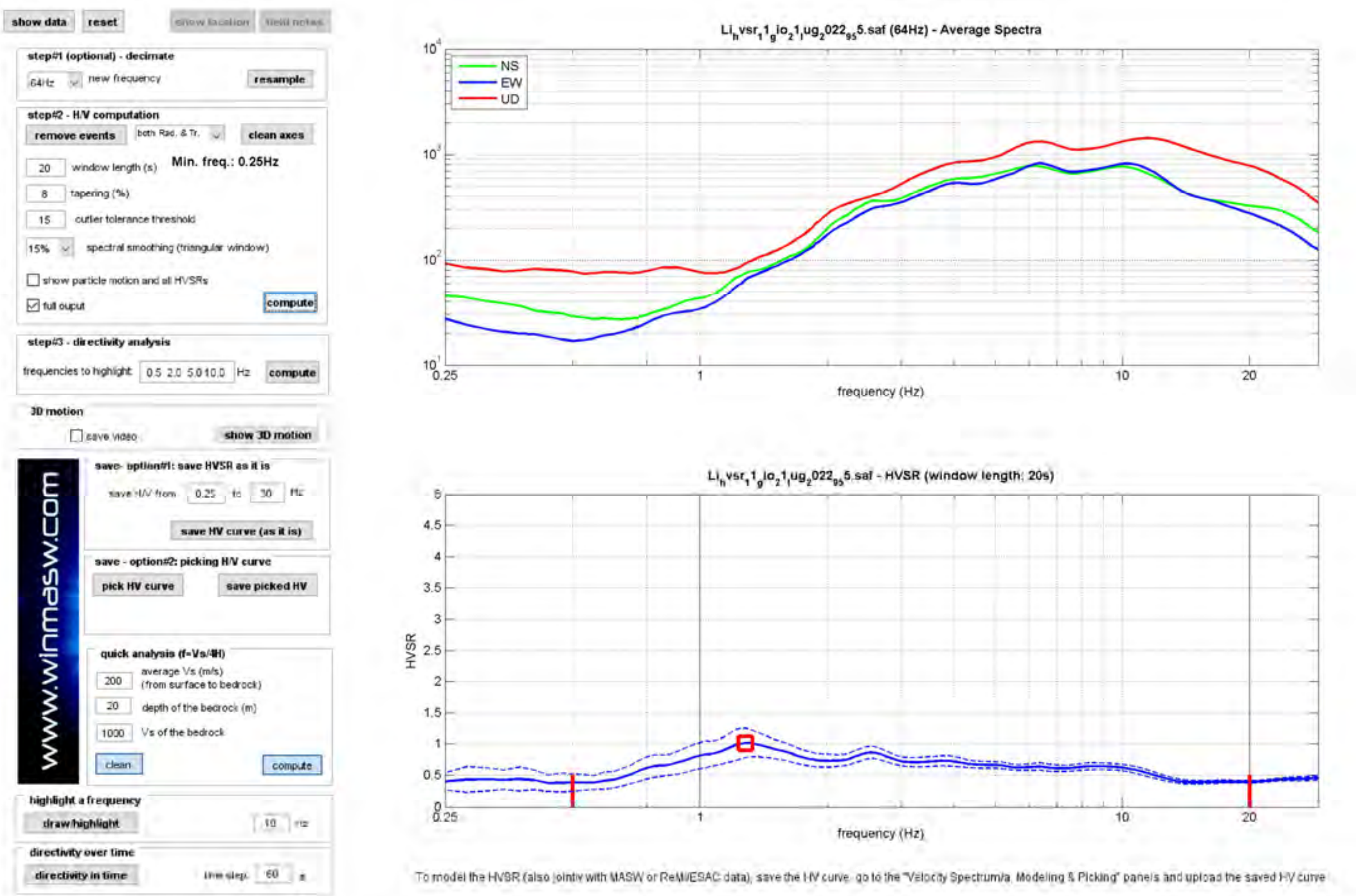
## MISURA TIPO A2

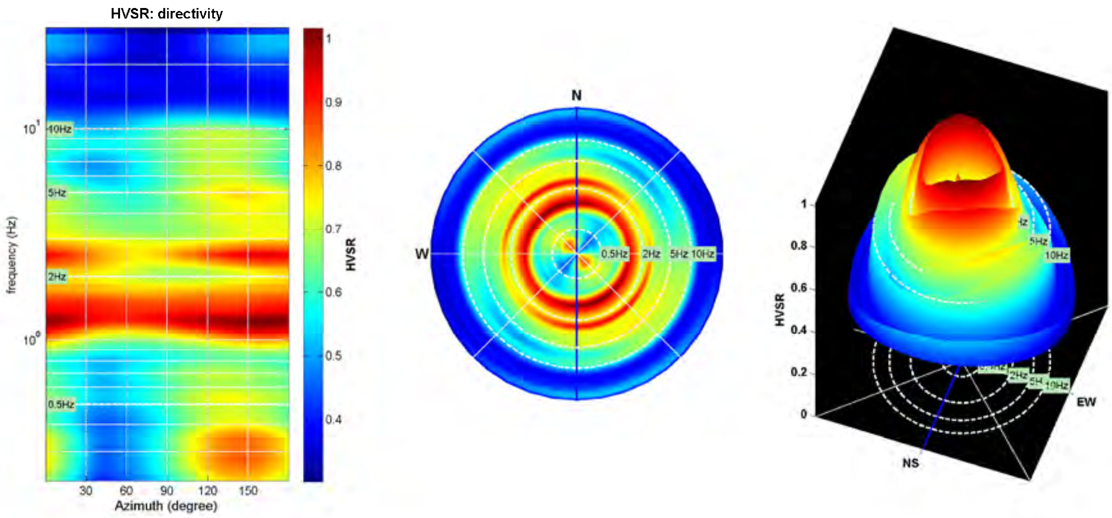
**HVSR11**

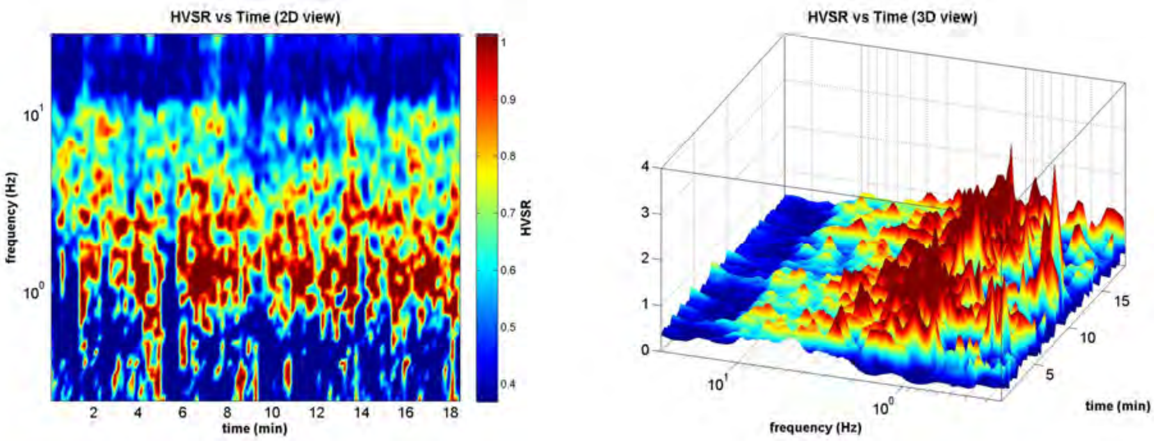
Peak frequency (Hz): 1.3 (±1.4)
Peak HVSR value: 1.0 (±0.2)

=== Criteria for a reliable H/V curve ====================================
#1. [f0 > 10/Lw]: 1.283 > 0.5 (OK)
#2. [nc > 200]: 2847 > 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]: (NO)
#3. [A0 > 2]: 1.0 < 2 (NO)
#4. [fpeak[Ah/v(f) ± sigmaA(f)] = f0 ± 5%]: (OK)
#5. [sigmaf < epsilon(f0)]: 1.351 > 0.128 (NO)
#6. [sigmaA(f0) < theta(f0)]: 0.235 < 1.78 (OK)


Li$_h$vsr$_1$1$_g$io$_2$1$_1$ug$_2$022$_{95}$5.saf (64Hz) - Average Spectra
Li$_h$vsr$_1$1$_g$io$_2$1$_1$ug$_2$022$_{95}$5.saf - HVSR (window length: 20s)
frequency (Hz)
HVSR
Min. freq.: 0.25Hz
www.winmasw.com
To model the HVSR (also jointly with MASW or ReMi/ESAC data), save the HV curve, go to the "Velocity Spectrum/a, Modeling & Picking" panels and upload the saved HV curve


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


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

# HVSR12

| | | |
|---|---|---|
| DATE 21.07.2022 | HOUR 8:20 | PLACE Via F. Enriques - Livorno |
| OPERATOR Geologica Toscana snc | GPS TYPE and # | |
| WGS84 UTM 33N - EPSG: 32633 LATITUDE 4835915 | WGS84 UTM 33N - EPSG: 32633 LONGITUDE 122843 | ALTITUDE 1 m slm |
| STATION TYPE GPA Engeenering | SENSOR TYPE 3D - 4,5 Hz | |
| STATION # | SENSOR # | DISK # |
| FILE NAME Li HVSR12.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 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:**

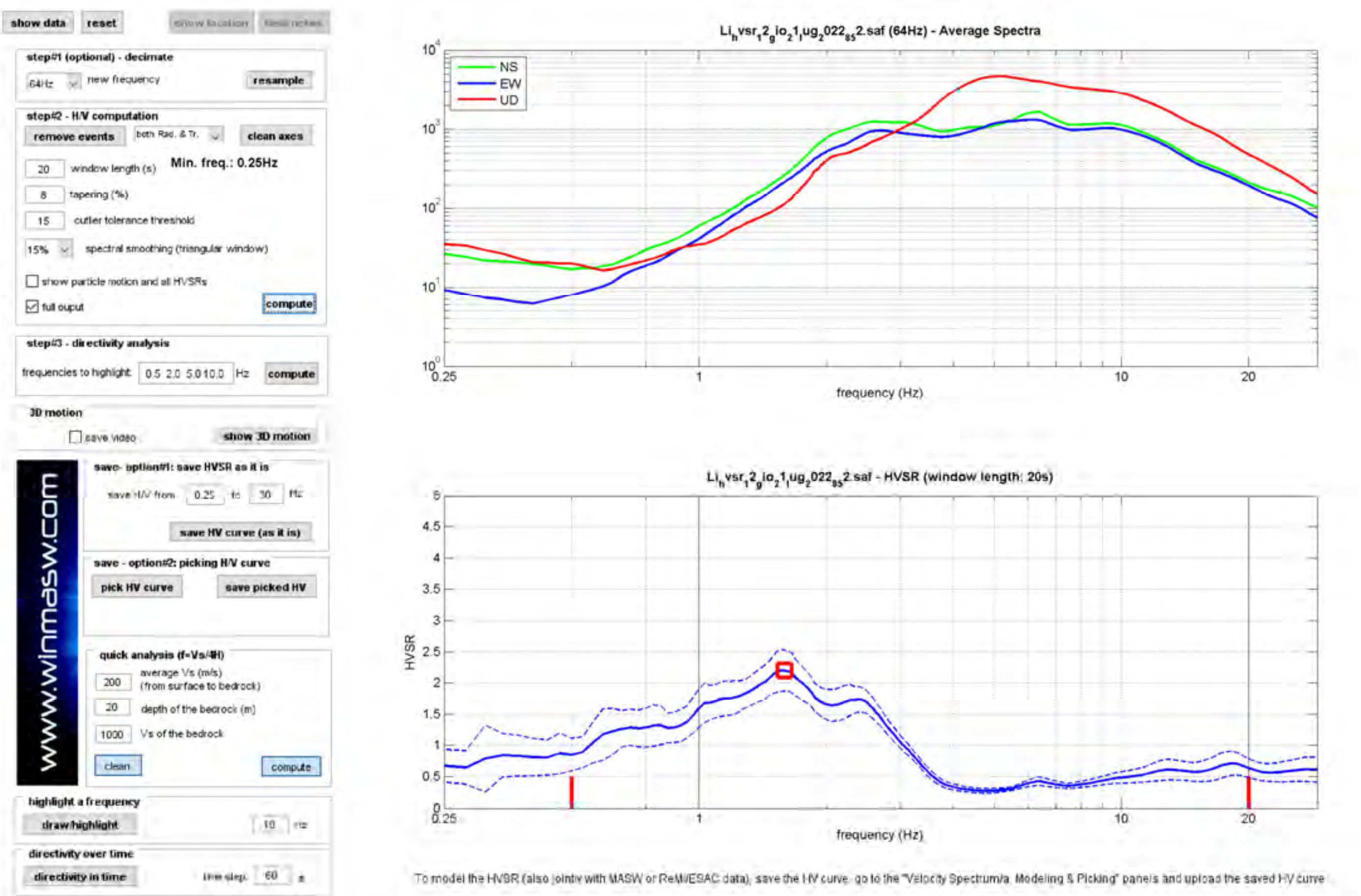
## MISURA TIPO A1

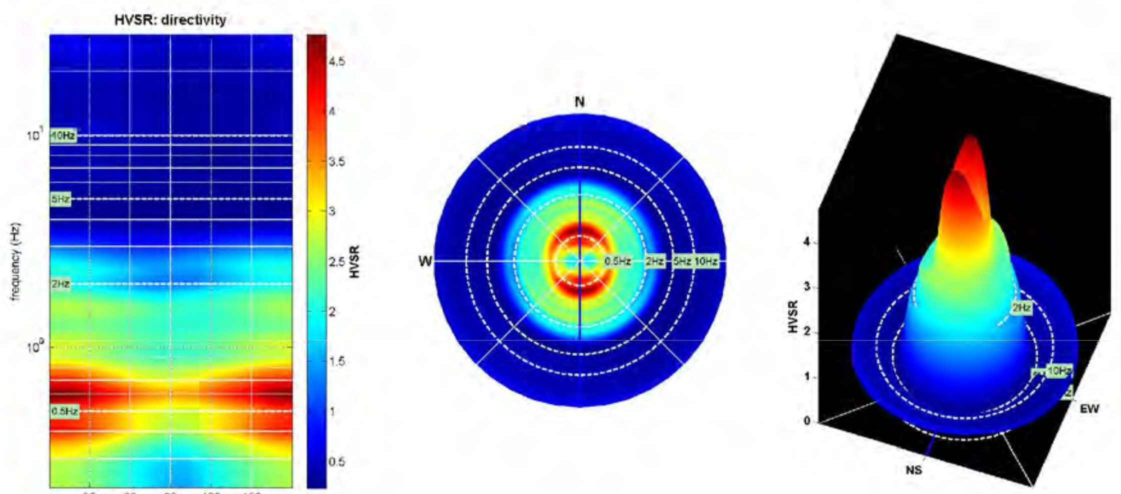
**HVSR12**

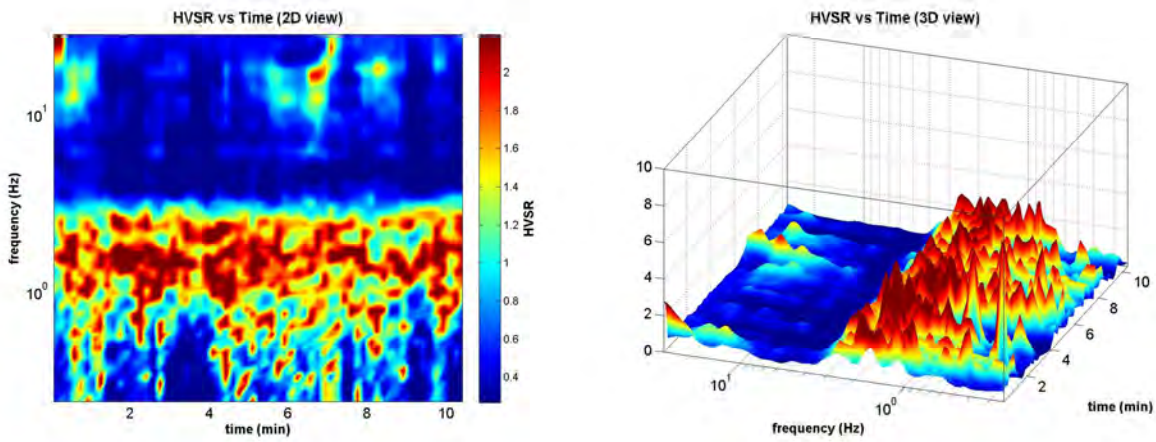
Peak frequency (Hz): 1.6 (±0.4)
Peak HVSR value: 2.2 (±0.3)

=== Criteria for a reliable H/V curve ====================================
#1. [f0 > 10/Lw]: 1.595 > 0.5 (OK)
#2. [nc > 200]: 2010 > 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 3.0Hz (OK)
#3. [A0 > 2]: 2.2 > 2 (OK)
#4. [fpeak[Ah/v(f) ± sigmaA(f)] = f0 ± 5%]: (OK)
#5. [sigmaf < epsilon(f0)]: 0.426 > 0.160 (NO)
#6. [sigmaA(f0) < theta(f0)]: 0.329 < 1.78 (OK)


show data
reset
step#1 (optional) - decimate
new frequency
resample
step#2 - H/V computation
remove events
clean axes
Min. freq.: 0.25Hz
window length (s)
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 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
directivity over time
directivity in time
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
N
W
NS
EW


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

# HVSR13

| | | |
|---|---|---|
| DATE 21.07.2022 | HOUR 12:29 | PLACE Villa Glori - Livorno |
| OPERATOR Geologica Toscana snc | GPS TYPE and # | |
| WGS84 UTM 33N - EPSG: 32633<br>LATITUDE 4833617 | WGS84 UTM 33N - EPSG: 32633<br>LONGITUDE 122236 | ALTITUDE 10 m slm |
| STATION TYPE<br>GPA Engeenering | SENSOR TYPE<br>3D - 4,5 Hz | |
| STATION # | SENSOR # | DISK # |
| FILE NAME Li 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): 37 — Remarks ______

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

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

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

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

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

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

Trees

OBSERVATIONS

FREQUENCY: Hz (if computed in the field)

**Qualità della misura:**

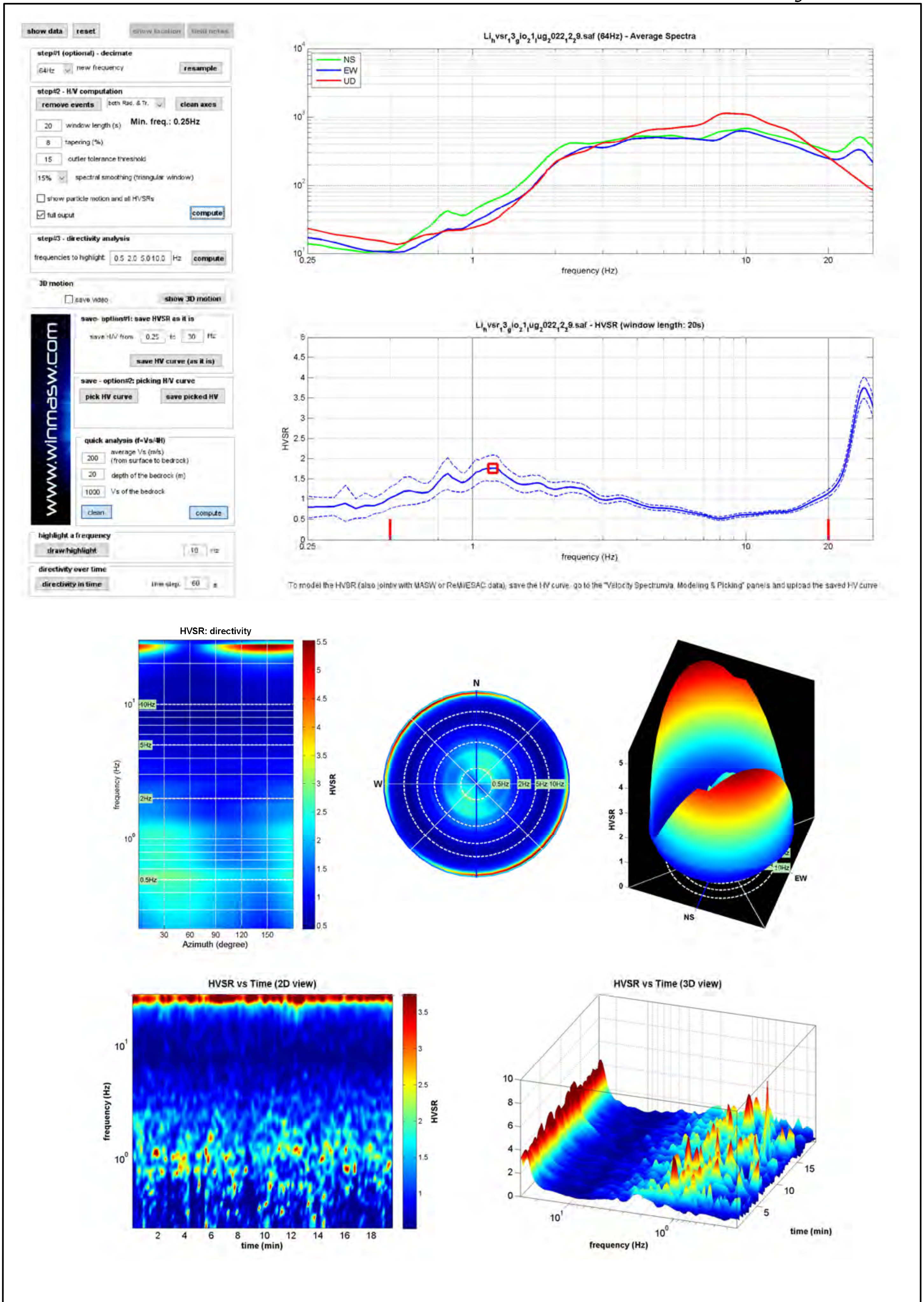
## MISURA TIPO A2

**HVSR13**

Peak frequency (Hz): 1.2 (±1.8)
Peak HVSR value: 1.8 (±0.3)

=== Criteria for a reliable H/V curve ====================================
#1. [f0 > 10/Lw]: 1.189 > 0.5 (OK)
#2. [nc > 200]: 2805 > 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 4.1Hz (OK)
#3. [A0 > 2]: 1.8 < 2 (NO)
#4. [fpeak[Ah/v(f) ± sigmaA(f)] = f0 ± 5%]: (NO)
#5. [sigmaf < epsilon(f0)]: 1.776 > 0.119 (NO)
#6. [sigmaA(f0) < theta(f0)]: 0.323 < 1.78 (OK)


show data
reset
step#1 (optional) - decimate
new frequency
resample
step#2 - H/V computation
remove events
clean axes
Min. freq.: 0.25Hz
window length (s)
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 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
directivity over time
directivity in time
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
N
W
NS
EW
HVSR vs Time (2D view)
frequency (Hz)
time (min)
HVSR
HVSR vs Time (3D view)
frequency (Hz)
time (min)

# HVSR14

| | | |
|---|---|---|
| DATE 21.07.2022 | HOUR 11:00 | PLACE Campo Orlando - Livorno |
| OPERATOR Geologica Toscana snc | GPS TYPE and # | |
| WGS84 UTM 33N - EPSG: 32633 LATITUDE 4834491 | WGS84 UTM 33N - EPSG: 32633 LONGITUDE 122929 | ALTITUDE 9 m slm |
| STATION TYPE GPA Engeenering | SENSOR TYPE 3D - 4,5 Hz | |
| STATION # | SENSOR # | DISK # |
| FILE NAME Li 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): 36 Remarks

GROUND TYPE: ☐ earth (☐ hard ☐ soft) ☐ gravel ☐ sand ☐ rock ☒ grass = (☒ short ☐ tall) ☐ asphalt ☐ cement ☐ concrete ☐ paved ☐ other

☒ dry soil ☐ wet soil Remarks

ARTIFICIAL GROUND-SENSOR COUPLING ☒ no ☐ yes, type

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

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

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

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

Trees, Buildings

OBSERVATIONS

FREQUENCY: Hz
(if computed in the field)

**Qualità della misura:**

**MISURA TIPO A2**

**HVSR14**

Peak frequency (Hz): 1.2 (±0.4)
Peak HVSR value: 1.7 (±0.3)

=== Criteria for a reliable H/V curve ====================================
#1. [f0 > 10/Lw]: 1.157 > 0.5 (OK)
#2. [nc > 200]: 2685 > 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 3.5Hz (OK)
#3. [A0 > 2]: 1.7 < 2 (NO)
#4. [fpeak[Ah/v(f) ± sigmaA(f)] = f0 ± 5%]: (OK)
#5. [sigmaf < epsilon(f0)]: 0.403 > 0.116 (NO)
#6. [sigmaA(f0) < theta(f0)]: 0.280 < 1.78 (OK)

# HVSR15

| | | |
|---|---|---|
| DATE 21.07.2022 | HOUR 7:30 | PLACE Pian di Rota - Livorno |
| OPERATOR Geologica Toscana snc | GPS TYPE and # | |
| WGS84 UTM 33N - EPSG: 32633<br>LATITUDE 4834998 | WGS84 UTM 33N - EPSG: 32633<br>LONGITUDE 123898 | ALTITUDE 11 m slm |
| STATION TYPE<br>GPA Engeenering | SENSOR TYPE<br>3D - 4,5 Hz | |
| STATION # | SENSOR # | DISK # |
| FILE NAME Li 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 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:**

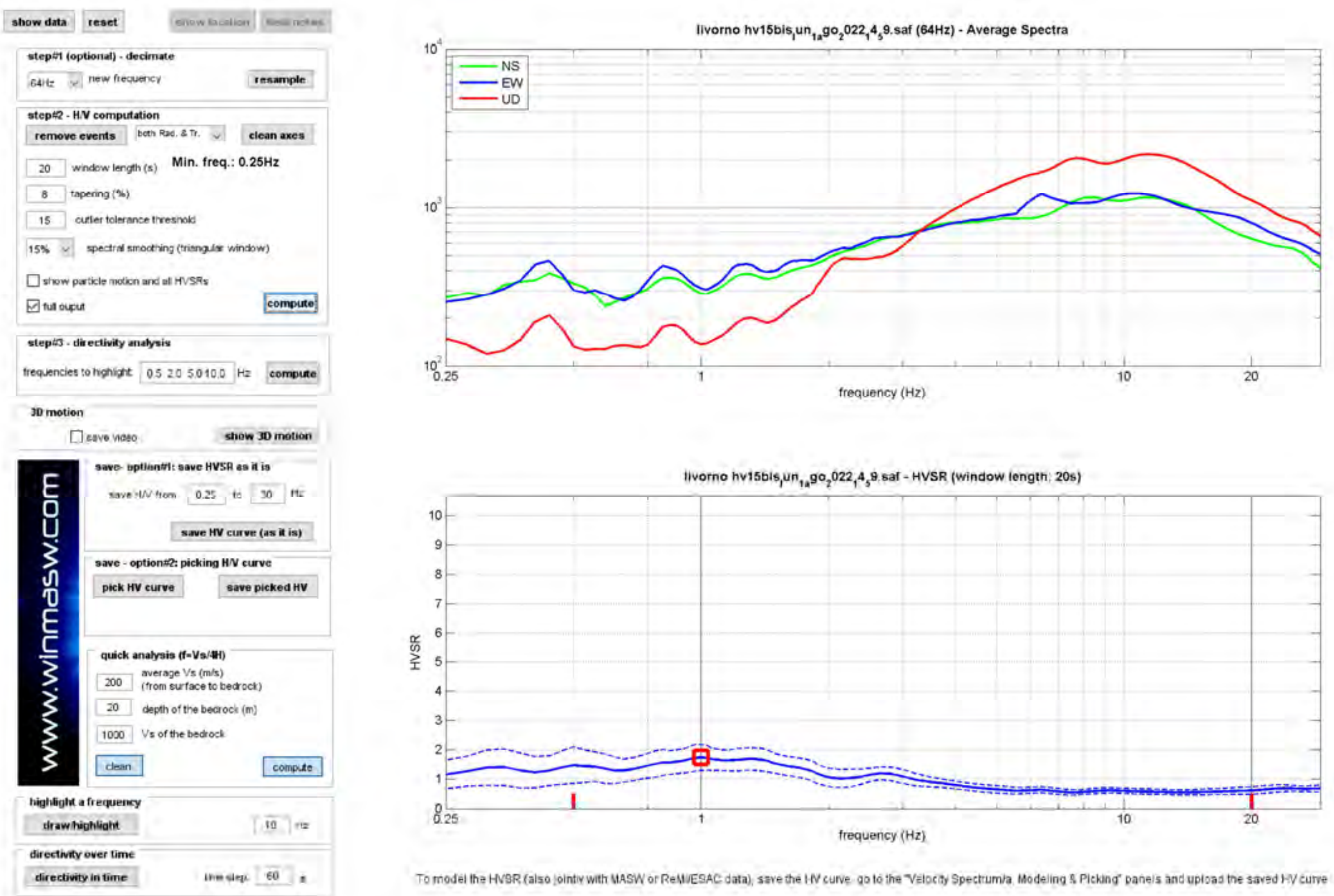
## MISURA TIPO A2

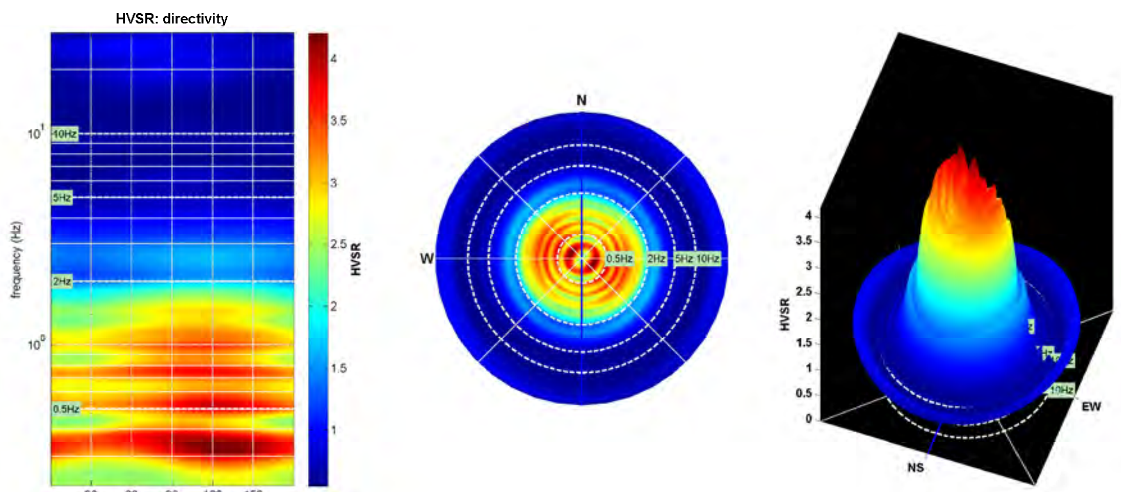
**HVSR15**

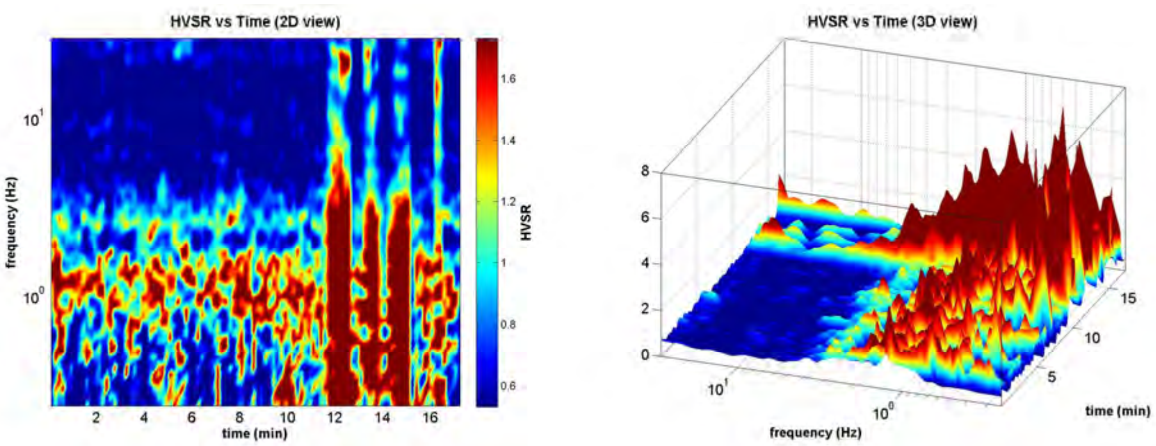
Peak frequency (Hz): 1.0 (±0.4)
Peak HVSR value: 1.7 (±0.4)

=== Criteria for a reliable H/V curve ====================================
#1. [f0 > 10/Lw]: 1.001 > 0.5 (OK)
#2. [nc > 200]: 2082 > 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 3.7Hz (OK)
#3. [A0 > 2]: 1.7 < 2 (NO)
#4. [fpeak[Ah/v(f) ± sigmaA(f)] = f0 ± 5%]: (NO)
#5. [sigmaf < epsilon(f0)]: 0.419 > 0.100 (NO)
#6. [sigmaA(f0) < theta(f0)]: 0.443 < 1.78 (OK)


show data
reset
step#1 (optional) - decimate
new frequency
resample
step#2 - H/V computation
remove events
clean axes
Min. freq.: 0.25Hz
window length (s)
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 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
directivity over time
directivity in time
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/a, Modeling & Picking" panels and upload the saved HV curve


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


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

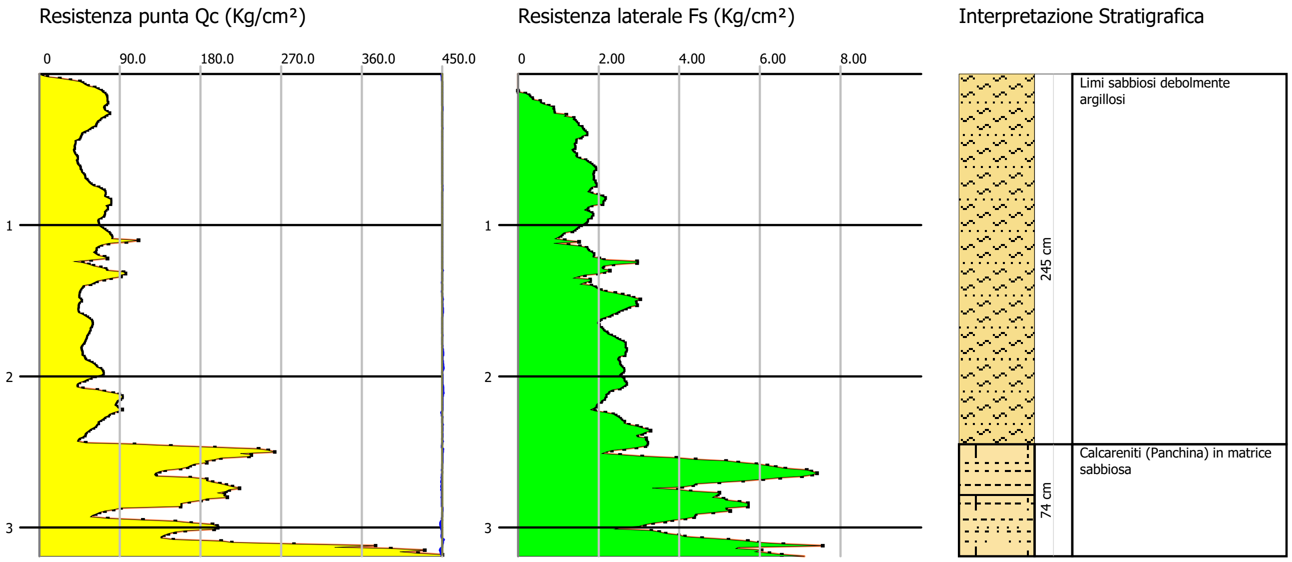
*Geologica Toscana snc*
*Viale Marconi 106 - 53036 - Poggibonsi (SI)*
*tel. 0577935891 - email: info@geologicatoscana.eu*
*Sito web: www.geologicatoscana.eu*

# MS3_CPTU1

Probe CPTU - Piezocone Nr.1
Strumento utilizzato PAGANI 200 kN (CPTU)

Committente: Comune di Livorno
Cantiere: Microzonazione sismica di III° livello
Località: Livorno

Data: 18/07/2022




Scala profondità 1:50 - Qc: 1 cm=84.44 Kg/cm² - Fs: 1 cm=1.88 Kg/cm² - U: 1 cm=8.444 Kg/cm²

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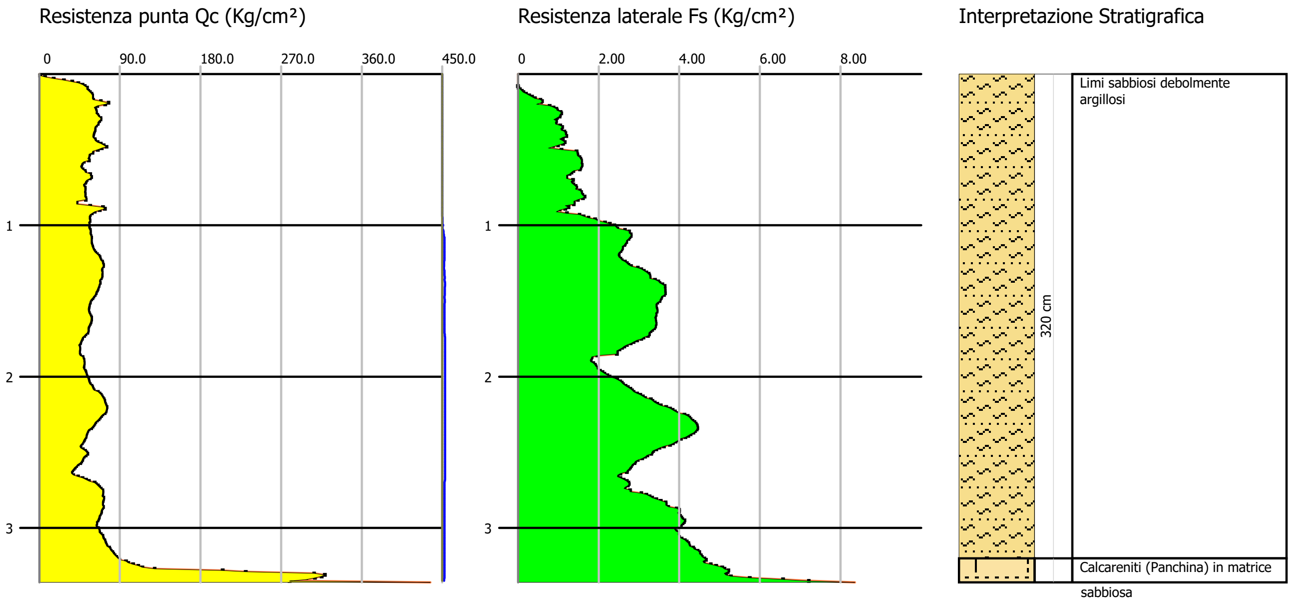
# MS3_CPTU2

Probe CPTU - Piezocone Nr.2
Strumento utilizzato PAGANI 200 kN (CPTU)

Committente: Comune di Livorno
Cantiere: Microzonazione sismica di III° livello
Località: Livorno

Data: 18/07/2022




Scala profondità 1:50 - Qc: 1 cm=84.44 Kg/cm² - Fs: 1 cm=1.88 Kg/cm² - U: 1 cm=8.444 Kg/cm²

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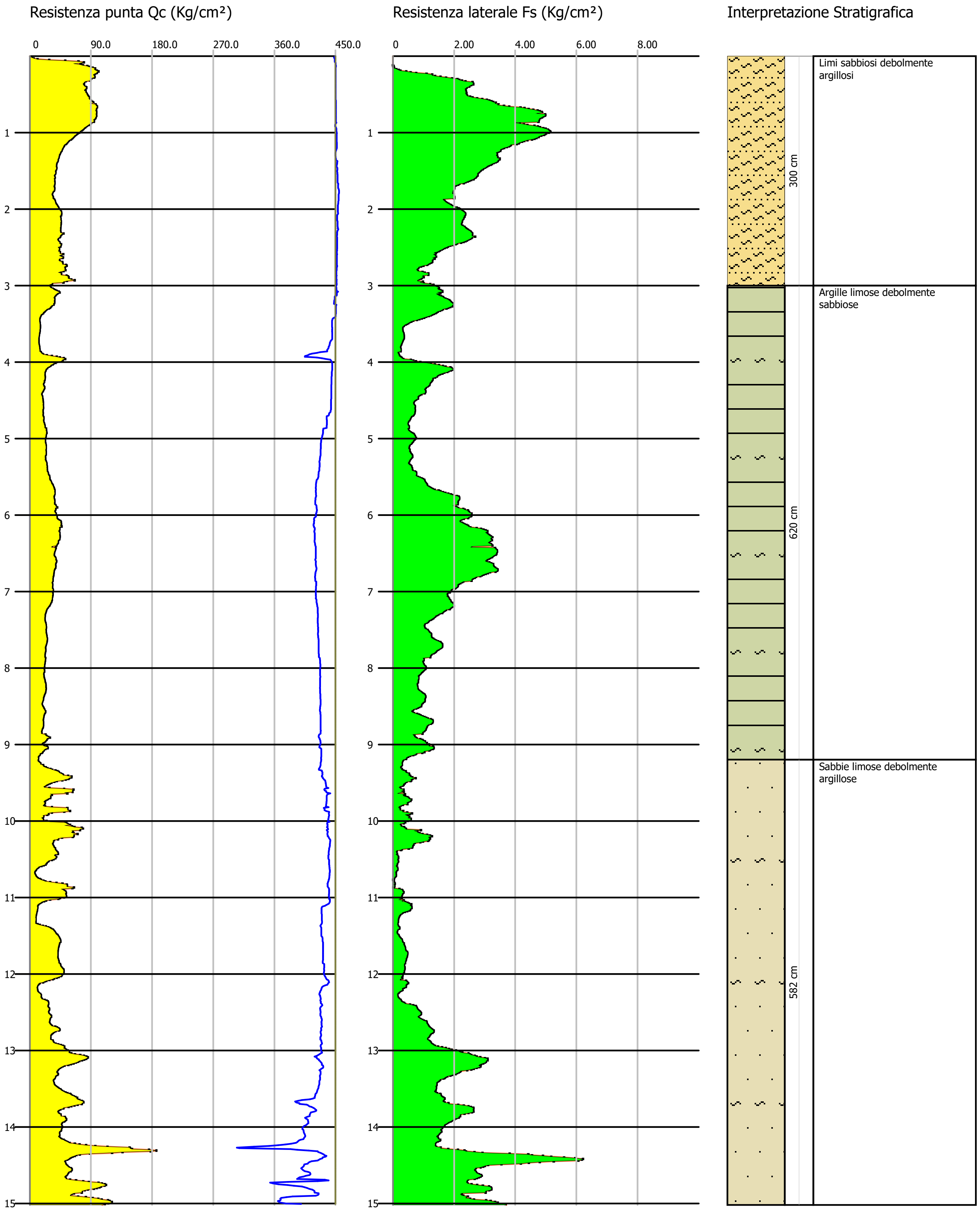
tel. 0577935891 - email: info@geologicatoscana.eu
Sito web: www.geologicatoscana.eu

Probe CPTU - Piezocone Nr.3
Strumento utilizzato PAGANI 200 kN (CPTU)

**MS3_CPTU3**

Committente: Comune di Livorno
Cantiere: Microzonazione sismica di III° livello
Località: Livorno

Data: 18/07/2022




Scala profondità 1:75 - Qc: 1 cm=84.44 Kg/cm² - Fs: 1 cm=1.88 Kg/cm² - U: 1 cm=8.444 Kg/cm²

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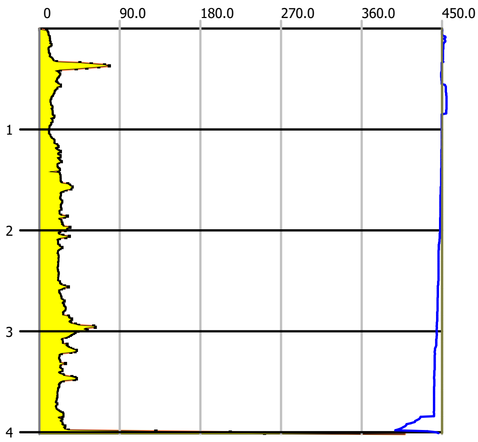
*tel. 0577935891 - email: info@geologicatoscana.eu*
*Sito web: www.geologicatoscana.eu*

Probe CPTU - Piezocone Nr.4
Strumento utilizzato PAGANI 200 kN (CPTU)

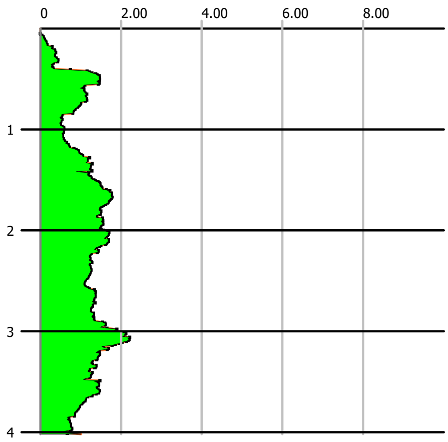
**MS3_CPTU4**

| | | |
|---|---|---|
| Committente: | Comune di Livorno | Data: 18/07/2022 |
| Cantiere: | Microzonazione sismica di III° livello | |
| Località: | Livorno | |

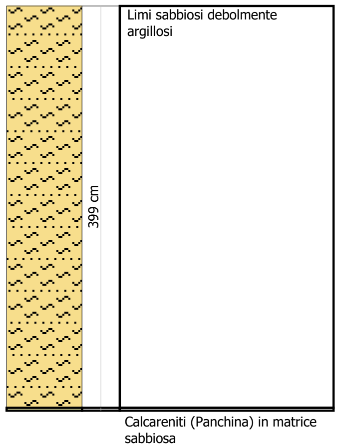
Resistenza punta Qc (Kg/cm²)




Resistenza laterale Fs (Kg/cm²)




Interpretazione Stratigrafica




Scala profondità 1:75 - Qc: 1 cm=84.44 Kg/cm² - Fs: 1 cm=1.88 Kg/cm² - U: 1 cm=8.444 Kg/cm²

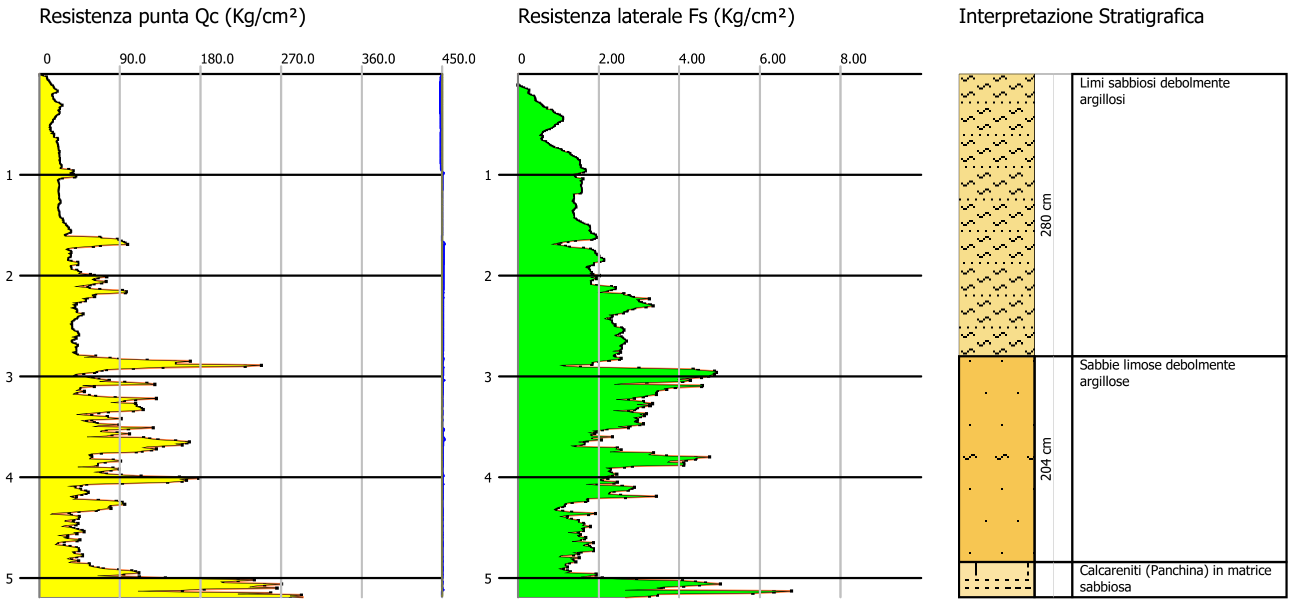
*Geologica Toscana snc*
*Viale Marconi 106 - 53036 - Poggibonsi (SI)*
*tel. 0577935891 - email: info@geologicatoscana.eu*
*Sito web: www.geologicatoscana.eu*

Probe CPTU - Piezocone Nr.5
Strumento utilizzato PAGANI 200 kN (CPTU)

**MS3_CPTU5**

Committente: Comune di Livorno
Cantiere: Microzonazione sismica di III° livello
Località: Livorno

Data: 25/07/2022




Scala profondità 1:75 - Qc: 1 cm=84.44 Kg/cm² - Fs: 1 cm=1.88 Kg/cm² - U: 1 cm=8.444 Kg/cm²

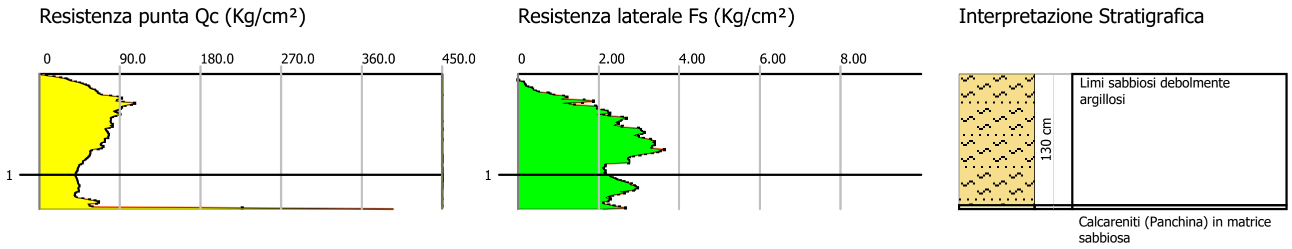
***Geologica Toscana snc***
***Viale Marconi 106 - 53036 - Poggibonsi (SI)***
***tel. 0577935891 - email: info@geologicatoscana.eu***
***Sito web: www.geologicatoscana.eu***

Probe CPTU - Piezocone Nr.6
Strumento utilizzato PAGANI 200 kN (CPTU)

**MS3_CPTU6**

Committente: Comune di Livorno
Cantiere: Microzonazione sismica di III° livello
Località: Livorno

Data: 25/07/2022




Scala profondità 1:75 - Qc: 1 cm=84.44 Kg/cm² - Fs: 1 cm=1.88 Kg/cm² - U: 1 cm=8.444 Kg/cm²

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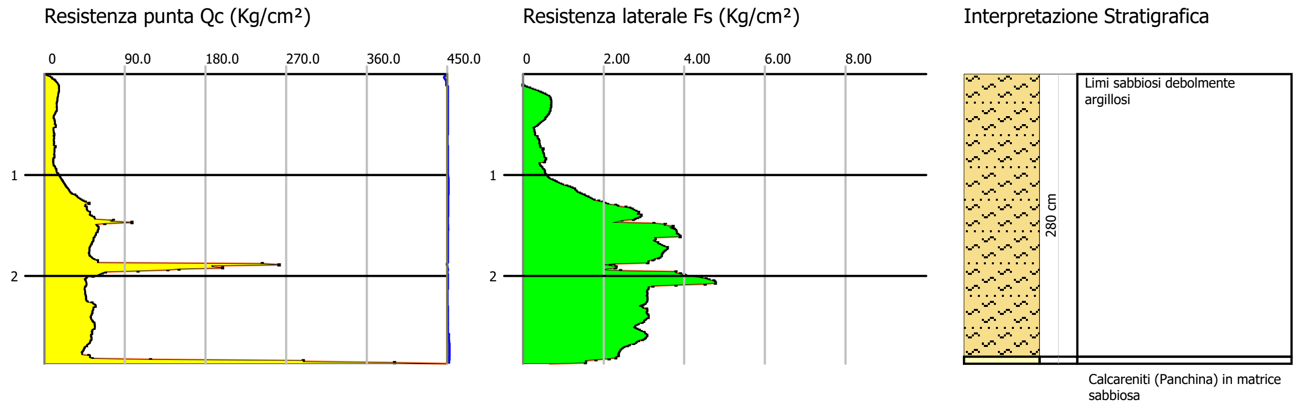
*Sito web: www.geologicatoscana.eu*

Probe CPTU - Piezocone Nr.7
Strumento utilizzato PAGANI 200 kN (CPTU)

**MS3_CPTU7**

Committente: Comune di Livorno
Cantiere: Microzonazione sismica di III° livello
Località: Livorno

Data: 18/07/2022




Scala profondità 1:75 - Qc: 1 cm=84.44 Kg/cm² - Fs: 1 cm=1.88 Kg/cm² - U: 1 cm=8.444 Kg/cm²

**Geologica Toscana snc**
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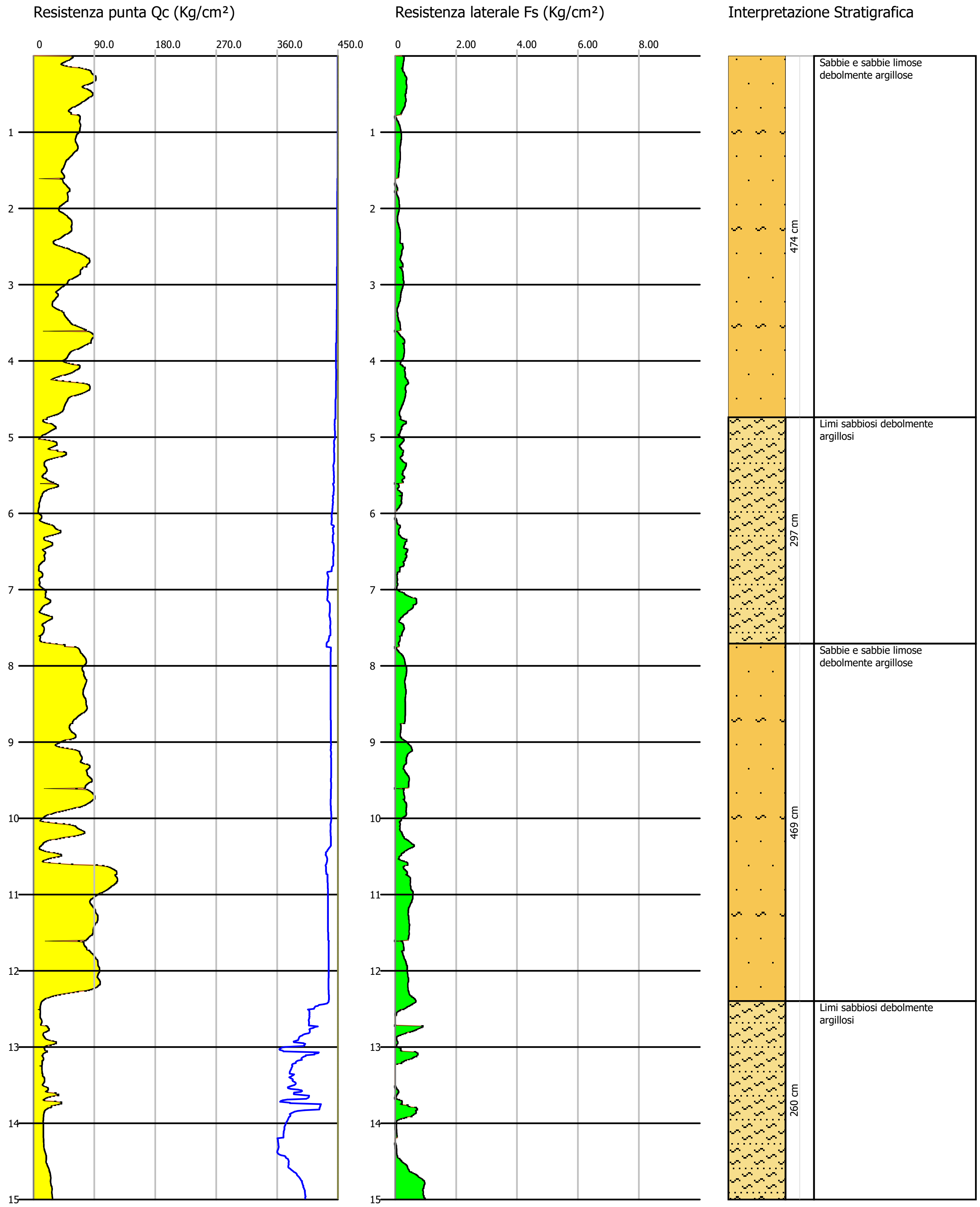
Probe CPTU - Piezocone Nr.8
Strumento utilizzato PAGANI 200 kN (CPTU)

## MS3_CPTU8

| | | |
|---|---|---|
| Committente: | Comune di Livorno | Data: 25/07/2022 |
| Cantiere: | Microzonazione sismica di III° livello | |
| Località: | Livorno | |




Scala profondità 1:75 - Qc: 1 cm=84.44 Kg/cm² - Fs: 1 cm=1.88 Kg/cm² - U: 1 cm=8.444 Kg/cm²

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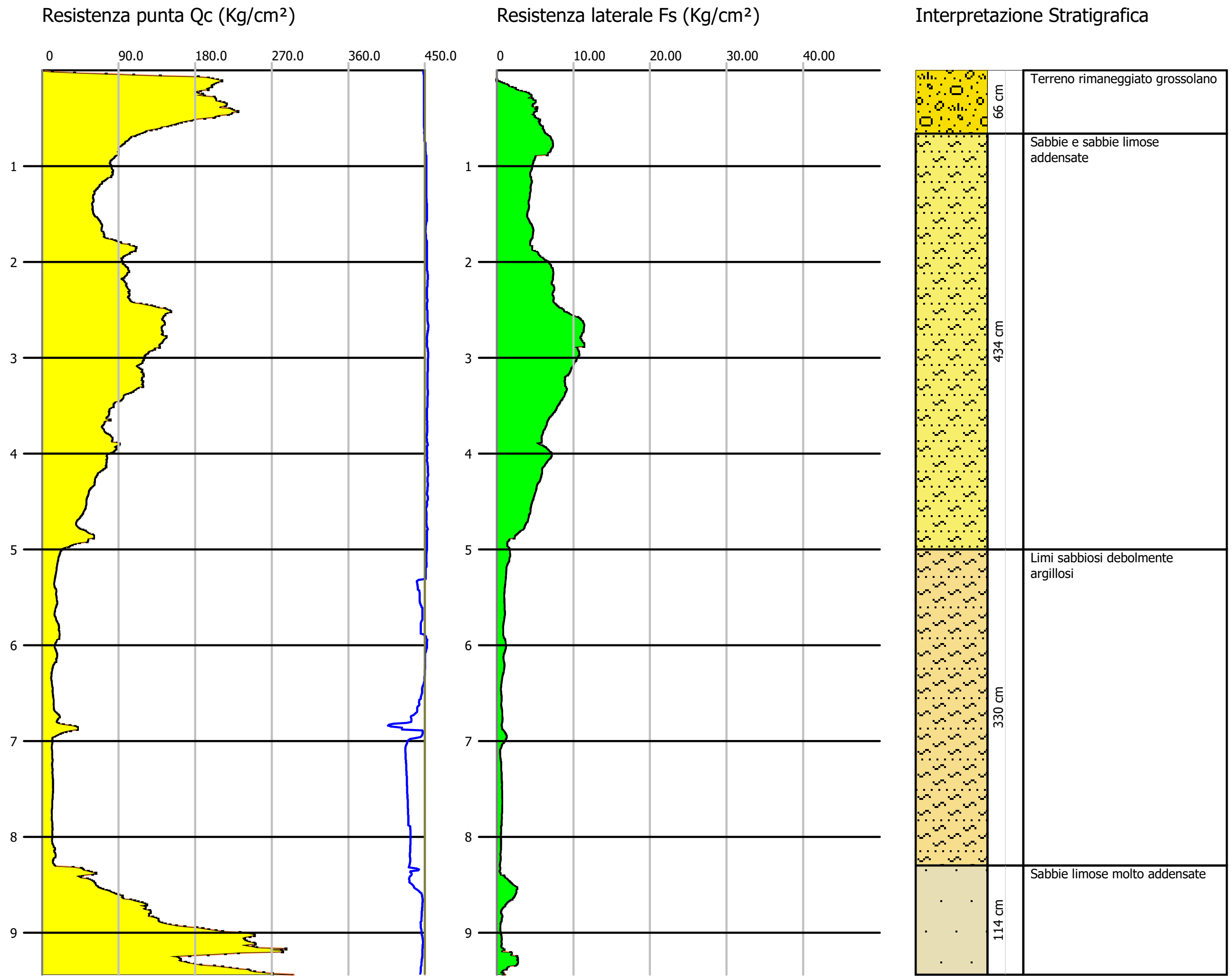
Probe CPTU - Piezocone Nr.9
Strumento utilizzato PAGANI 200 kN (CPTU)

**MS3_CPTU9**

Committente: Comune di Livorno
Cantiere: Microzonazione sismica di III° livello
Località: Livorno

Data: 25/07/2022




*Prova interrotta per disancoraggio

Scala profondità 1:75 - Qc: 1 cm=84.44 Kg/cm² - Fs: 1 cm=9.38 Kg/cm² - U: 1 cm=8.444 Kg/cm²

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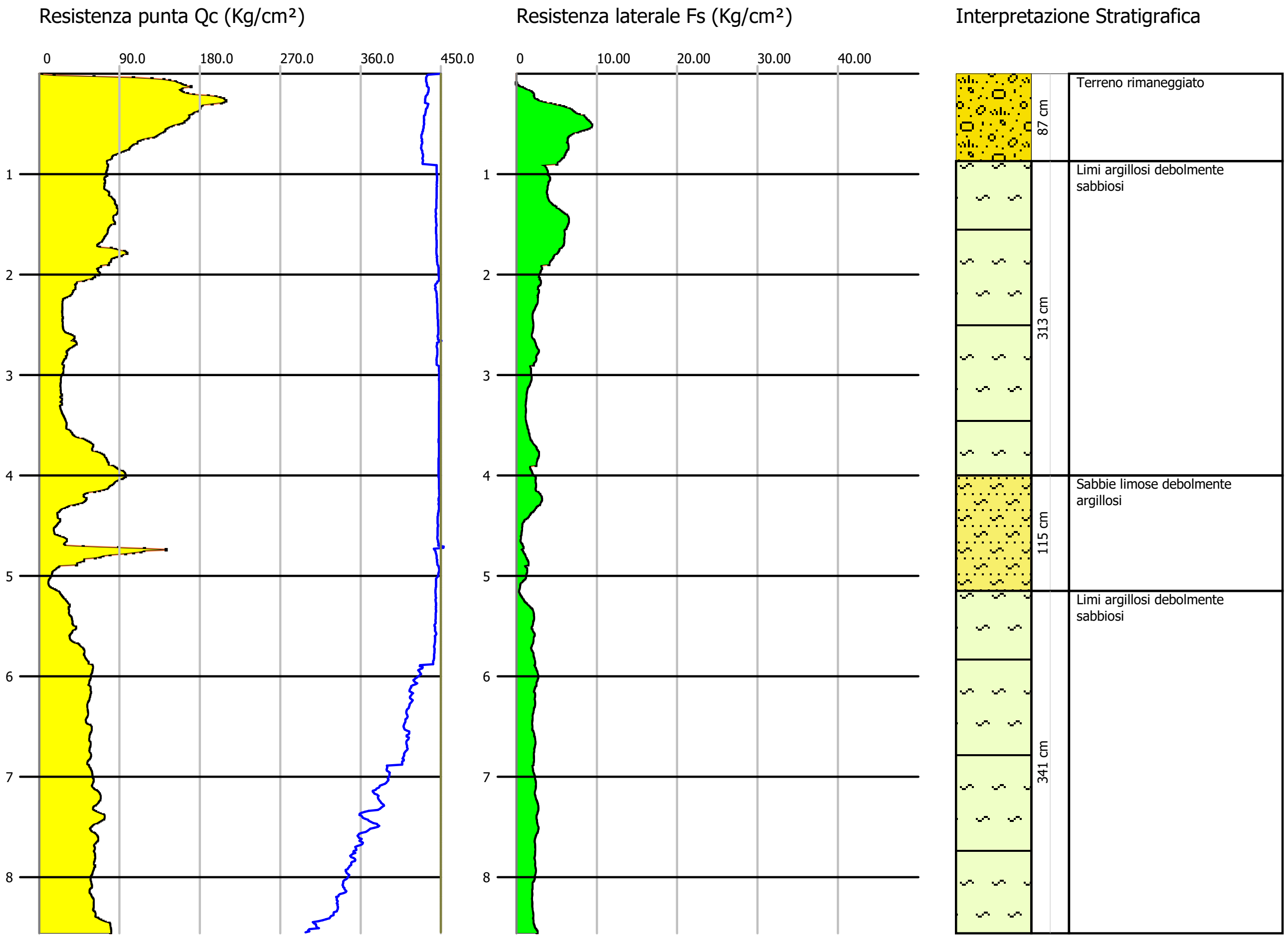
Probe CPTU - Piezocone Nr.10
Strumento utilizzato PAGANI 200 kN (CPTU)

# MS3_CPTU10

Committente: Comune di Livorno
Cantiere: Microzonazione sismica di III° livello
Località: Livorno

Data: 01/08/2022




*Prova interrotta per limite massimo di U

Scala profondità 1:75 - Qc: 1 cm=84.44 Kg/cm² - Fs: 1 cm=9.38 Kg/cm² - U: 1 cm=8.444 Kg/cm²

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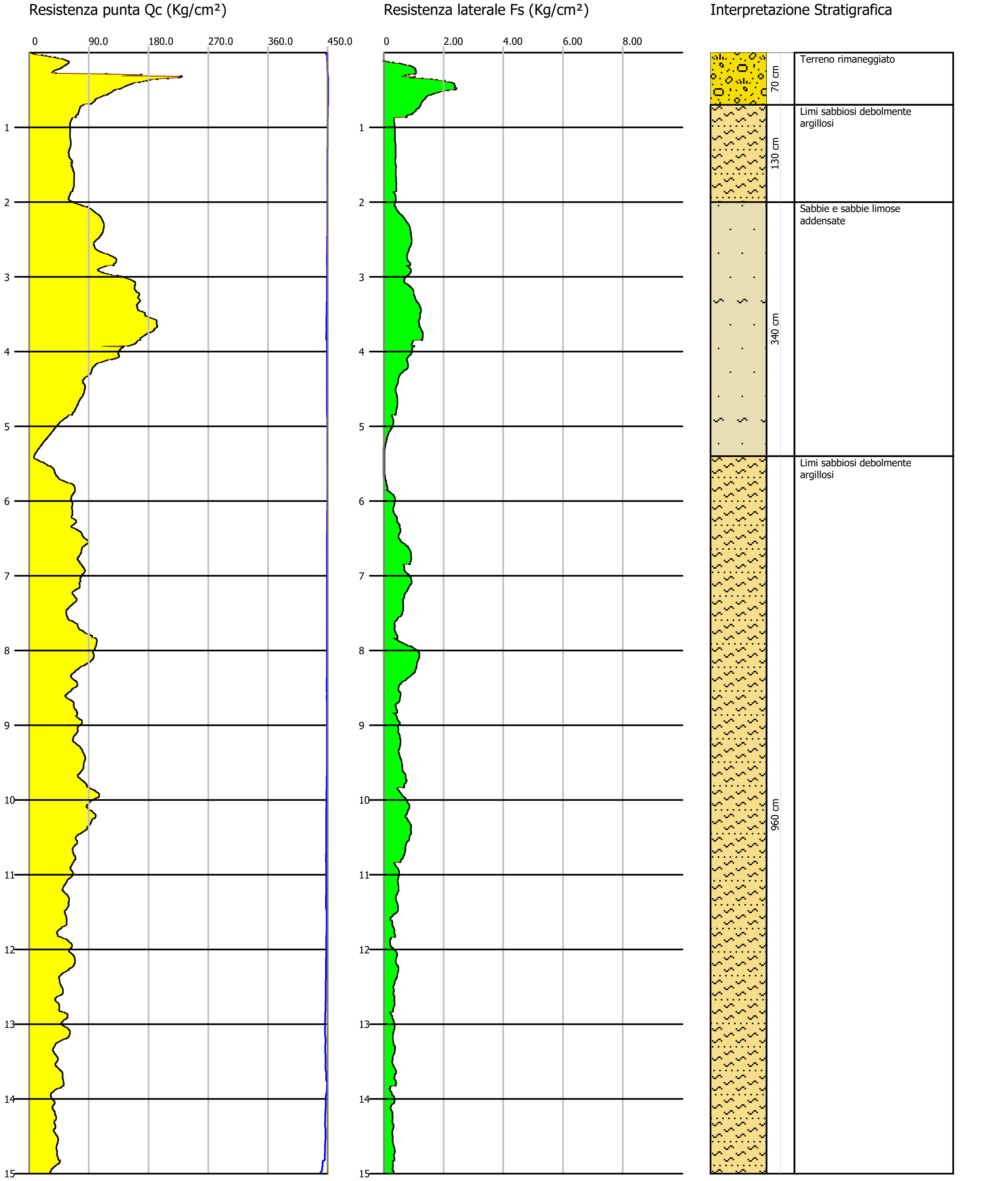
Probe CPTU - Piezocone Nr.11
Strumento utilizzato PAGANI 200 kN (CPTU)

**MS3_CPTU11**

Committente: Comune di Livorno
Cantiere: Microzonazione sismica di III° livello
Località: Livorno

Data: 01/08/2022




Scala profondità 1:75 - Qc: 1 cm=84.44 Kg/cm² - Fs: 1 cm=1.88 Kg/cm² - U: 1 cm=8.444 Kg/cm²

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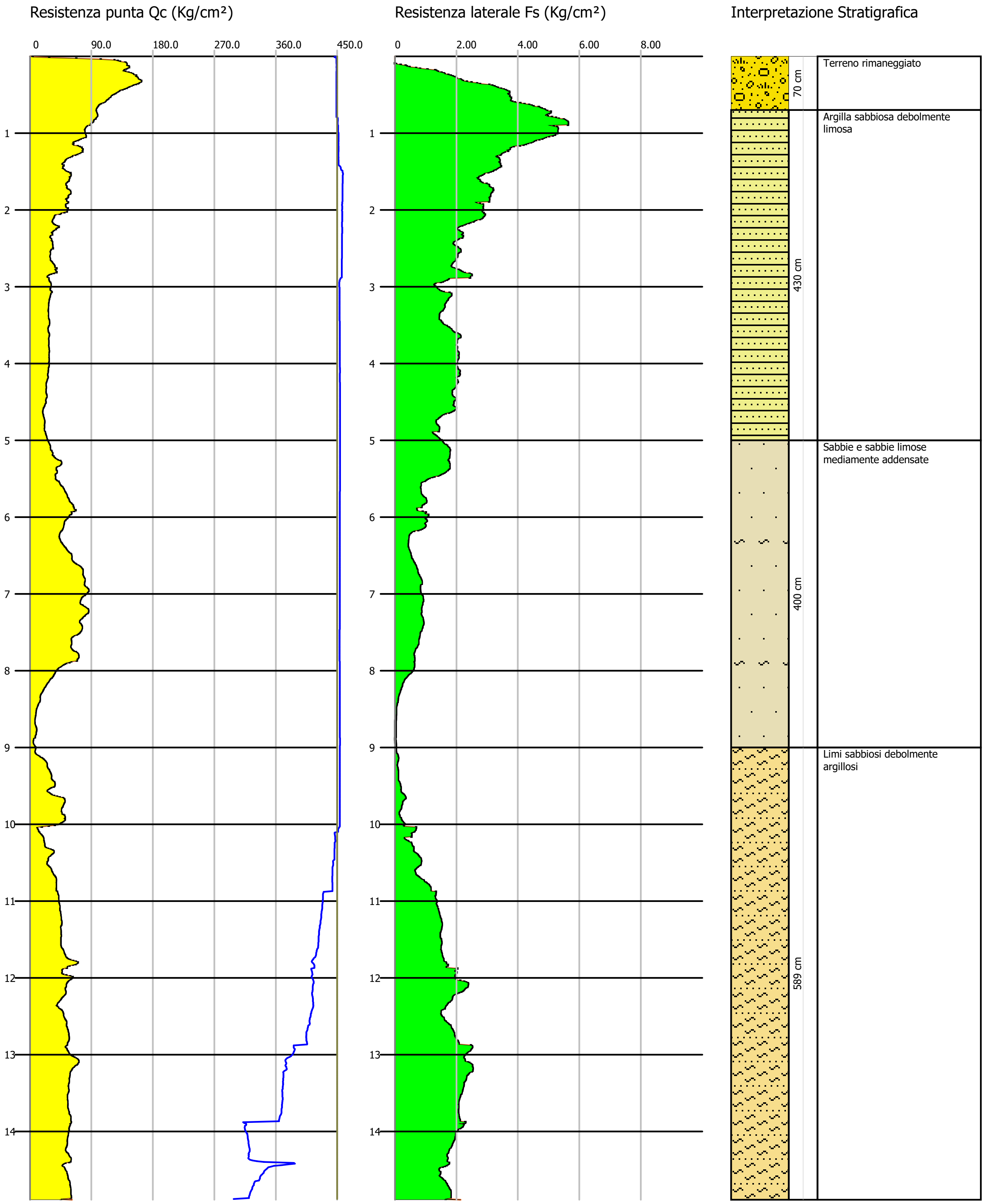
Probe CPTU - Piezocone Nr.12
Strumento utilizzato PAGANI 200 kN (CPTU)

## MS3_CPTU12

Committente: Comune di Livorno
Cantiere: Microzonazione sismica di III° livello
Località: Livorno

Data: 01/08/2022




*Prova interrotta per limite massimo di U

Scala profondità 1:75 - Qc: 1 cm=84.44 Kg/cm² - Fs: 1 cm=1.88 Kg/cm² - U: 1 cm=8.444 Kg/cm²

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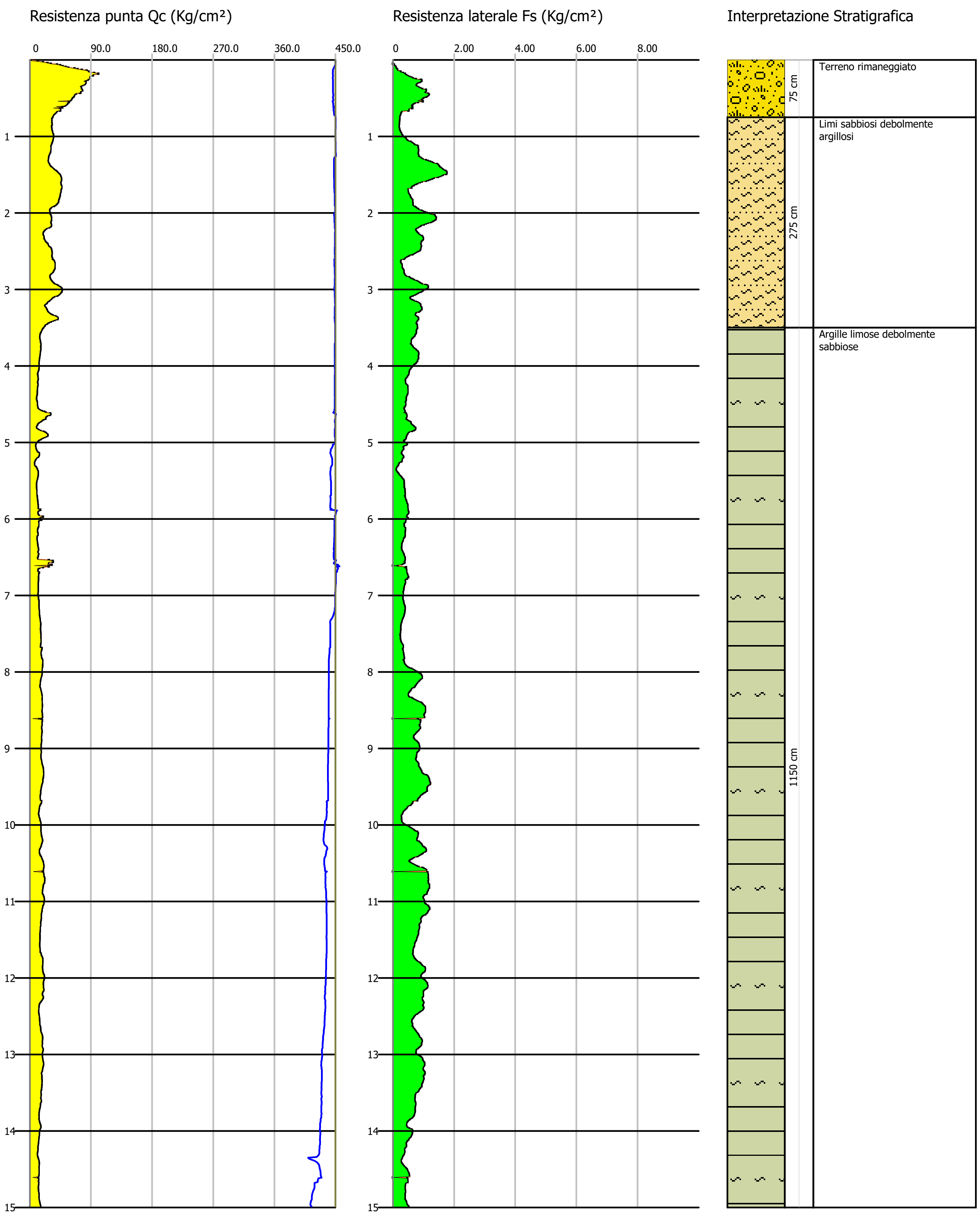
Probe CPTU - Piezocone Nr.13
Strumento utilizzato PAGANI 200 kN (CPTU)

# MS3_CPTU13

Committente: Comune di Livorno
Cantiere: Microzonazione sismica di III° livello
Località: Livorno

Data: 25/07/2022




Scala profondità 1:75 - Qc: 1 cm=84.44 Kg/cm² - Fs: 1 cm=1.88 Kg/cm² - U: 1 cm=8.444 Kg/cm²

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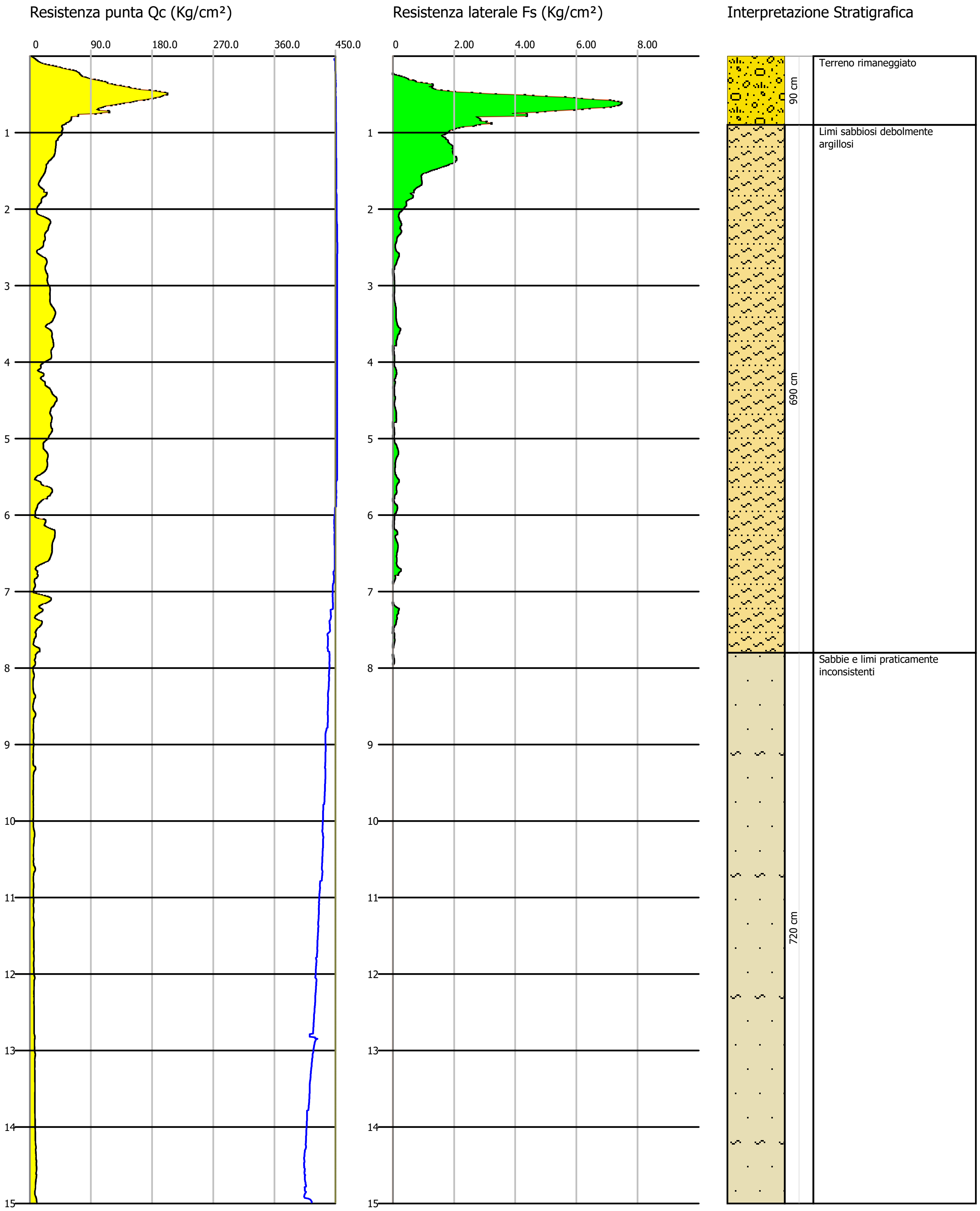
Probe CPTU - Piezocone Nr.14
Strumento utilizzato PAGANI 200 kN (CPTU)

# MS3_CPTU14

Committente: Comune di Livorno
Cantiere: Microzonazione sismica di III° livello
Località: Livorno

Data: 01/08/2022




Scala profondità 1:75 - Qc: 1 cm=84.44 Kg/cm² - Fs: 1 cm=1.88 Kg/cm² - U: 1 cm=8.444 Kg/cm²

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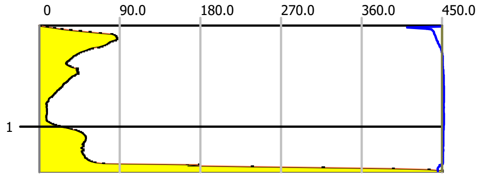
# MS3_CPTU15

Probe CPTU - Piezocone Nr.15
Strumento utilizzato PAGANI 200 kN (CPTU)

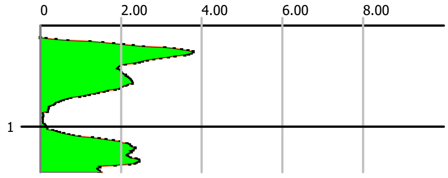
Committente: Comune di Livorno
Cantiere: Microzonazione sismica di III° livello
Località: Livorno

Data: 01/08/2022

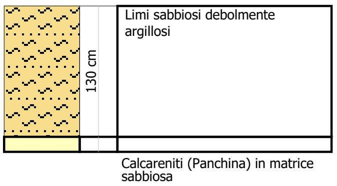
Resistenza punta Qc (Kg/cm²)




Resistenza laterale Fs (Kg/cm²)




Interpretazione Stratigrafica




Scala profondità 1:75 - Qc: 1 cm=84.44 Kg/cm² - Fs: 1 cm=1.88 Kg/cm² - U: 1 cm=8.444 Kg/cm²

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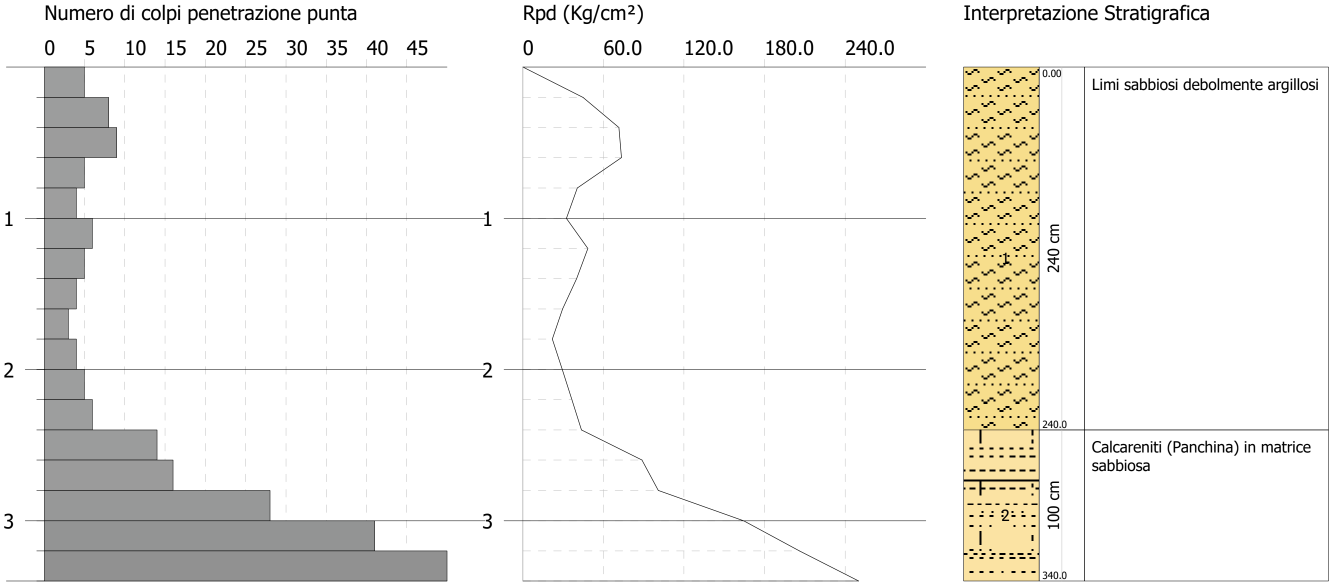
**PROVA PENETROMETRICA DINAMICA Nr.1**
**Strumento utilizzato... DPSH TG 63-100 PAGANI**

**MS3_DPSH1**

Committente: Comune di Livorno
Descrizione: Microzonazione sismica di III° livello
Località: Livorno

Data: 18/07/2022

Scala 1:50



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**PROVA PENETROMETRICA DINAMICA Nr.2**
**Strumento utilizzato... DPSH TG 63-100 PAGANI**

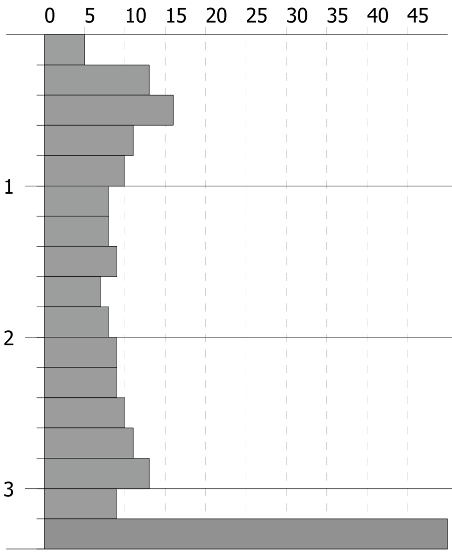
# MS3_DPSH2

Committente: Comune di Livorno
Descrizione: Microzonazione sismica di III° livello
Località: Livorno

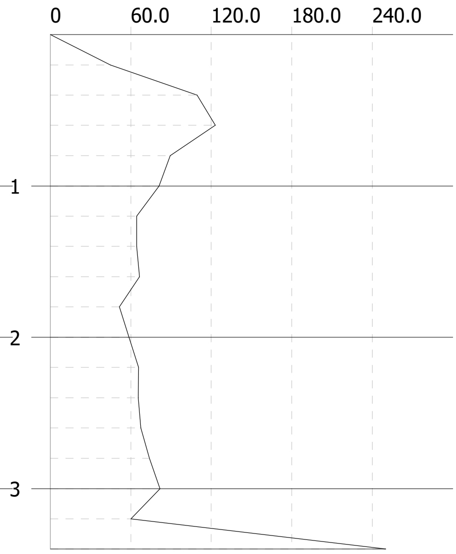
Data: 18/07/2022

Scala 1:50

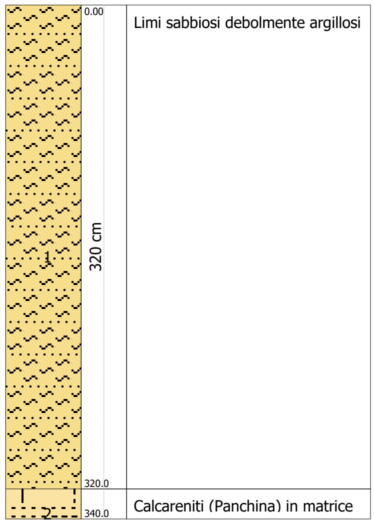
Numero di colpi penetrazione punta




Rpd (Kg/cm²)




Interpretazione Stratigrafica



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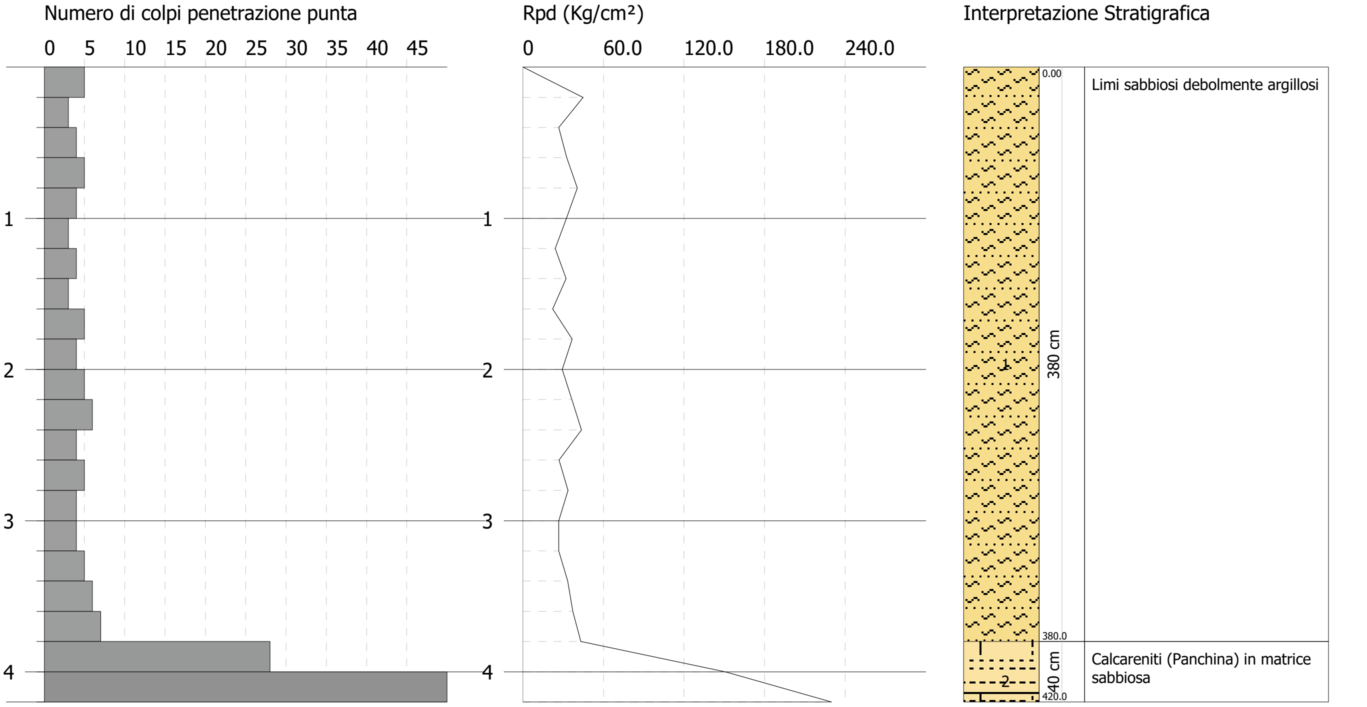
**PROVA PENETROMETRICA DINAMICA Nr.4**
**Strumento utilizzato... DPSH TG 63-100 PAGANI**

# MS3_DPSH4

Committente: Comune di Livorno
Descrizione: Microzonazione sismica di III° livello
Località: Livorno

Data: 18/07/2022

Scala 1:50



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**PROVA PENETROMETRICA DINAMICA Nr.6**
**Strumento utilizzato... DPSH TG 63-100 PAGANI**

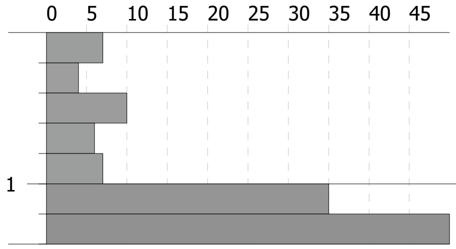
**MS3_DPSH6**

Committente: Comune di Livorno
Descrizione: Microzonazione sismica di III° livello
Località: Livorno

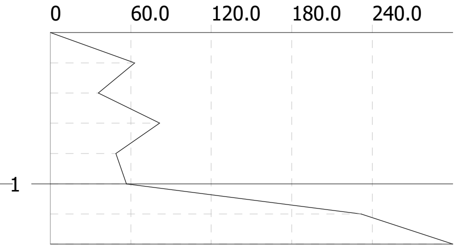
Data: 25/07/2022

Scala 1:50

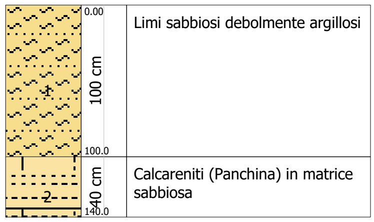
Numero di colpi penetrazione punta




Rpd (Kg/cm²)




Interpretazione Stratigrafica



***Geologica Toscana snc***
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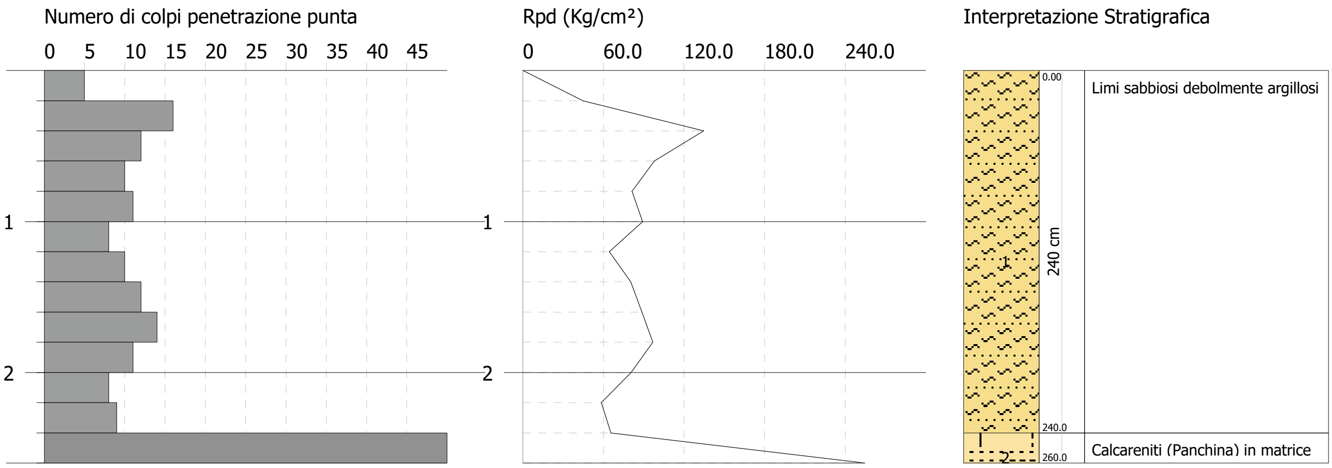
**PROVA PENETROMETRICA DINAMICA Nr.7**
**Strumento utilizzato... DPSH TG 63-100 PAGANI**

# MS3_DPSH7

Committente: Comune di Livorno
Descrizione: Microzonazione sismica di III° livello
Località: Livorno

Data: 18/07/2022

Scala 1:50



***Geologica Toscana snc***
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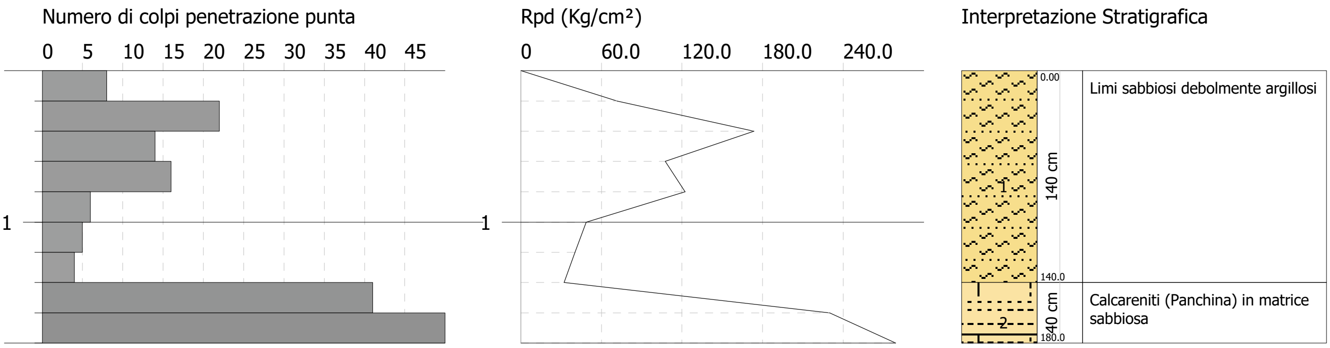
**PROVA PENETROMETRICA DINAMICA Nr.15**
**Strumento utilizzato... DPSH TG 63-200 PAGANI**

**MS3_DPSH15**

Committente: Comune di Livorno
Descrizione: Microzonazione sismica di III° livello
Località: Livorno

Data: 01/08/2022

Scala 1:50



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