LN BORGIANO MASW

Analyzing Phase velocities

==o== SECTION#1
dataset: 215borgiano.DAT
minimum offset (m): 5
geophone spacing (m): 1.5
sampling (ms): 0.125
Dispersion curve: LN BORGIANO CHIESA.cdp
Number of individuals: 80
Number of generations: 81

Rayleigh-wave dispersion analysis

Analyzing Phase Velocities

Adopted search space (minimum Vs & thickness): 231 4.092 429
5.148 495 19.8 429
Adopted search space (maximum Vs & thickness): 490 8.68 910
10.92 1050 42 910
Adopted Poisson values: 0.39991 0.34998 0.35019 0.29998

Output folder: ..\IO\output_disp

==o== SECTION#2

Rayleigh wave analysis
Optimizing Vs & Thickness - generation: 1; average & best misfits: -78.4718
-12.6219
Optimizing Vs & Thickness - generation: 2; average & best misfits: -71.3936
-12.6219
Optimizing Vs & Thickness - generation: 3; average & best misfits: -69.4207
-11.4097
Optimizing Vs & Thickness - generation: 4; average & best misfits: -64.3783
-11.4097
Optimizing Vs & Thickness - generation: 5; average & best misfits: -60.0289
-11.4097
Optimizing Vs & Thickness - generation: 6; average & best misfits: -53.3731
-11.3177
Optimizing Vs & Thickness - generation: 7; average & best misfits: -48.0377
-11.3177
Optimizing Vs & Thickness - generation: 8; average & best misfits: -42.6191
-11.3177
Optimizing Vs & Thickness - generation: 9; average & best misfits: -37.6747
-10.6907
Optimizing Vs & Thickness - generation: 10; average & best misfits: -37.9999
-10.3881
Optimizing Vs & Thickness - generation: 11; average & best misfits: -35.0708
-9.58441
Optimizing Vs & Thickness - generation: 12; average & best misfits: -36.4093
-9.58441
Optimizing Vs & Thickness - generation: 13; average & best misfits: -35.1158
-9.58441
Optimizing Vs & Thickness - generation: 14; average & best misfits: -35.5518
-9.58441
Optimizing Vs & Thickness - generation: 15; average & best misfits: -36.4338
-9.58441
Optimizing Vs & Thickness - generation: 16; average & best misfits: -35.8063
-9.58441
Optimizing Vs & Thickness - generation: 17; average & best misfits: -36.0056
-9.58441
Optimizing Vs & Thickness - generation: 18; average & best misfits: -35.2609
-9.58441

Optimizing Vs & Thickness - generation: 19; average & best misfits: -37.6491
-9.58441
Optimizing Vs & Thickness - generation: 20; average & best misfits: -33.5804
-9.58441
Optimizing Vs & Thickness - generation: 21; average & best misfits: -29.4155
-9.58441
Optimizing Vs & Thickness - generation: 22; average & best misfits: -29.3347
-9.58441
Optimizing Vs & Thickness - generation: 23; average & best misfits: -29.8175
-9.58441
Optimizing Vs & Thickness - generation: 24; average & best misfits: -29.648
-9.27036
Optimizing Vs & Thickness - generation: 25; average & best misfits: -29.156
-8.53937
Optimizing Vs & Thickness - generation: 26; average & best misfits: -25.4299
-8.53937
Optimizing Vs & Thickness - generation: 27; average & best misfits: -26.3105
-8.51715
Optimizing Vs & Thickness - generation: 28; average & best misfits: -25.8712
-8.51715
Optimizing Vs & Thickness - generation: 29; average & best misfits: -22.6151
-8.03179
Optimizing Vs & Thickness - generation: 30; average & best misfits: -24.6178
-6.72928
Optimizing Vs & Thickness - generation: 31; average & best misfits: -22.518
-6.61984
Optimizing Vs & Thickness - generation: 32; average & best misfits: -23.425
-6.61984
Optimizing Vs & Thickness - generation: 33; average & best misfits: -27.6084
-6.61984
Optimizing Vs & Thickness - generation: 34; average & best misfits: -29.8886
-6.61984
Optimizing Vs & Thickness - generation: 35; average & best misfits: -24.3396
-6.61984
Optimizing Vs & Thickness - generation: 36; average & best misfits: -24.2678
-6.61984
Optimizing Vs & Thickness - generation: 37; average & best misfits: -22.7773
-6.61984
Optimizing Vs & Thickness - generation: 38; average & best misfits: -21.7344
-6.61984
Optimizing Vs & Thickness - generation: 39; average & best misfits: -21.1622
-6.61984
Optimizing Vs & Thickness - generation: 40; average & best misfits: -21.6898
-6.61984
Optimizing Vs & Thickness - generation: 41; average & best misfits: -20.5926
-6.61984
Optimizing Vs & Thickness - generation: 42; average & best misfits: -19.2196
-6.37549
Optimizing Vs & Thickness - generation: 43; average & best misfits: -17.4961
-6.37549
Optimizing Vs & Thickness - generation: 44; average & best misfits: -19.6994
-6.37549
Optimizing Vs & Thickness - generation: 45; average & best misfits: -17.8941
-6.37549
Optimizing Vs & Thickness - generation: 46; average & best misfits: -18.6514
-6.37549
Optimizing Vs & Thickness - generation: 47; average & best misfits: -16.7701
-6.37549
Optimizing Vs & Thickness - generation: 48; average & best misfits: -17.7866
-6.37549
Optimizing Vs & Thickness - generation: 49; average & best misfits: -16.466
-6.37549
Optimizing Vs & Thickness - generation: 50; average & best misfits: -18.5344
-6.37549
Optimizing Vs & Thickness - generation: 51; average & best misfits: -21.6501
-6.37549
Optimizing Vs & Thickness - generation: 52; average & best misfits: -20.2417
-6.37549

Optimizing Vs & Thickness - generation: 53; average & best misfits: -19.7383
-6.37549
Optimizing Vs & Thickness - generation: 54; average & best misfits: -18.1665
-6.37549
Optimizing Vs & Thickness - generation: 55; average & best misfits: -18.7801
-6.37549
Optimizing Vs & Thickness - generation: 56; average & best misfits: -18.0441
-6.37549
Optimizing Vs & Thickness - generation: 57; average & best misfits: -17.2091
-6.37549
Optimizing Vs & Thickness - generation: 58; average & best misfits: -17.3396
-6.37549
Optimizing Vs & Thickness - generation: 59; average & best misfits: -16.0098
-6.37549
Optimizing Vs & Thickness - generation: 60; average & best misfits: -15.4902
-6.37549
Optimizing Vs & Thickness - generation: 61; average & best misfits: -14.9448
-6.37549
Optimizing Vs & Thickness - generation: 62; average & best misfits: -15.2748
-6.37549
Optimizing Vs & Thickness - generation: 63; average & best misfits: -16.1982
-6.37549
Optimizing Vs & Thickness - generation: 64; average & best misfits: -15.5154
-6.32727
Optimizing Vs & Thickness - generation: 65; average & best misfits: -13.1689
-6.32727
Optimizing Vs & Thickness - generation: 66; average & best misfits: -12.6537
-6.32727
Optimizing Vs & Thickness - generation: 67; average & best misfits: -13.4297
-6.32727
Optimizing Vs & Thickness - generation: 68; average & best misfits: -13.8824
-6.32727
Optimizing Vs & Thickness - generation: 69; average & best misfits: -15.1072
-6.32727
Optimizing Vs & Thickness - generation: 70; average & best misfits: -14.6487
-6.32727
Optimizing Vs & Thickness - generation: 71; average & best misfits: -15.6203
-6.32727
Optimizing Vs & Thickness - generation: 72; average & best misfits: -17.2077
-6.32727
Optimizing Vs & Thickness - generation: 73; average & best misfits: -15.2244
-6.32727
Optimizing Vs & Thickness - generation: 74; average & best misfits: -14.8225
-6.32727
Optimizing Vs & Thickness - generation: 75; average & best misfits: -15.2514
-6.32727
Optimizing Vs & Thickness - generation: 76; average & best misfits: -16.365
-6.32727
Optimizing Vs & Thickness - generation: 77; average & best misfits: -18.2751
-6.32727
Optimizing Vs & Thickness - generation: 78; average & best misfits: -19.0099
-6.32727
Optimizing Vs & Thickness - generation: 79; average & best misfits: -18.672
-6.32727
Optimizing Vs & Thickness - generation: 80; average & best misfits: -15.8738
-6.32727
Optimizing Vs & Thickness - generation: 81; average & best misfits: -17.8085
-6.32727

Checking the new search space (for the finer search)

Now a finer search around the most promising search space area

Rayleigh wave analysis
Optimizing Vs & Thickness - generation: 1; average & best misfits: -76.87
-6.32727
Optimizing Vs & Thickness - generation: 2; average & best misfits: -67.8428
-6.32727

```
Optimizing Vs & Thickness - generation: 3; average & best misfits: -64.7929
-6.32727
Optimizing Vs & Thickness - generation: 4; average & best misfits: -58.6212
-6.32727
Optimizing Vs & Thickness - generation: 5; average & best misfits: -58.3585
-6.32727
Optimizing Vs & Thickness - generation: 6; average & best misfits: -53.6572
-6.32727
Optimizing Vs & Thickness - generation: 7; average & best misfits: -49.4767
-6.32727
Optimizing Vs & Thickness - generation: 8; average & best misfits: -48.3355
-6.32727
Optimizing Vs & Thickness - generation: 9; average & best misfits: -48.7102
-6.32727
Optimizing Vs & Thickness - generation: 10; average & best misfits: -46.3341
-6.32727
Optimizing Vs & Thickness - generation: 11; average & best misfits: -44.6424
-6.32727
Optimizing Vs & Thickness - generation: 12; average & best misfits: -42.0209
-6.32727
Optimizing Vs & Thickness - generation: 13; average & best misfits: -38.1686
-6.32727
Optimizing Vs & Thickness - generation: 14; average & best misfits: -42.0519
-6.28589
Optimizing Vs & Thickness - generation: 15; average & best misfits: -36.4485
-6.28589
Optimizing Vs & Thickness - generation: 16; average & best misfits: -38.5075
-6.28589
Optimizing Vs & Thickness - generation: 17; average & best misfits: -39.7357
-6.28589
Optimizing Vs & Thickness - generation: 18; average & best misfits: -28.7673
-6.28589
Optimizing Vs & Thickness - generation: 19; average & best misfits: -25.8101
-6.28589
Optimizing Vs & Thickness - generation: 20; average & best misfits: -25.9976
-6.28589
Optimizing Vs & Thickness - generation: 21; average & best misfits: -28.5871
-6.28589

Model after the Vs & Thickness optimization (fixed Poisson values):
Vs (m/s): 350  671  766  591
Thickness (m): 6.2      9.7       31

Poisson: 0.4      0.35      0.35       0.3
Number of models considered to calculate the average model: 121


######################################################################
RESULTS
######################################################################

Dataset: 215borgiano.DAT
Analyzed curve: LN BORGIANO CHIESA.cdp


==o== SECTION#3

Analyzing Phase Velocities

Analyzing Rayleigh-Wave Dispersion

================================================================================
MEAN MODEL

Vs (m/s):                  350  669  766  586
Standard deviations (m/s): 1   4   2  17

Thickness (m):            6.2         9.4        31.6
```

Standard deviations (m): 0.0 0.8 1.5

Approximate values for Vp, density, Poisson & Shear modulus
Vp (m/s): 857 1393 1595 1096
Density (gr/cm3): 2.02 2.13 2.17 2.08
Vp/Vs ratio: 2.45 2.08 2.08 1.87
Poisson: 0.40 0.35 0.35 0.30
Shear modulus (MPa): 247 955 1272 713

Fundamental mode
Mean model
frequency (Hz) VR(m/s)
4.82434 596.8571
7.54539 627.9352
10.0809 634.1052
12.5546 627.9838
19.3572 561.0282
22.573 497.208
29.623 384.5947
30.8599 375.4873

==o== SECTION#4

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BEST MODEL

Vs (m/s): 350 671 766 591
thickness (m): 6.2 9.70094 31.427

Approximate values for Vp, density, Poisson & Shear modulus
Vp (m/s): 857 1397 1595 1106
Density (gr/cm3): 2.02 2.14 2.17 2.08
Vp/Vs ratio: 2.45 2.08 2.08 1.87
Poisson: 0.40 0.35 0.35 0.30
Shear modulus (MPa): 247 961 1272 726

dispersion curve (frequency - Rayleigh phase velocity)

Fundamental mode
best model
F(Hz) VR(m/s)
4.82434 590.5773
7.54539 628.4888
10.0809 634.3028
12.5546 627.7797
19.3572 561.1004
22.573 497.7731
29.623 384.6636
30.8599 375.5273

==o== SECTION#5

Maximum penetration depth according to the "Steady State Rayleigh Method": 49 m

Inversion quality: very good

Vs5 (mean model): 350 350 m/s
Vs5 (best model): 350 350 m/s

Vs20 (mean model): 533 533 m/s
Vs20 (best model): 533 533 m/s

Vs30 (mean model): 593 593 m/s
Vs30 (best model): 593 593 m/s

==o== SECTION#6

For Italian Users:
Decreto 17 gennaio 2018 in aggiornamento alle Norme Tecniche per le Costruzioni e pubblicato sul Supplemento ordinario n° 8 alla Gazzetta Ufficiale del 20/02/2018:
A - Ammassi rocciosi affioranti o terreni molto rigidi caratterizzati da valori di velocità delle onde di taglio superiori a 800 m/s, eventualmente comprendenti in superficie terreni di caratteristiche meccaniche più scadenti con spessore massimo pari a 3 m.
B - Rocce tenere e depositi di terreni a grana grossa molto addensati o terreni a grana fina molto consistenti, caratterizzati da un miglioramento delle proprietà meccaniche con la profondità e da valori di velocità equivalente compresi tra 360 m/s e 800 m/s.
C - Depositi di terreni a grana grossa mediamente addensati o terreni a grana fina mediamente consistenti con profondità del substrato superiori a 30 m, caratterizzati da un miglioramento delle proprietà meccaniche con la profondità e da valori di velocità equivalente compresi tra 180 m/s e 360 m/s.
D - Depositi di terreni a grana grossa scarsamente addensati o di terreni a grana fina scarsamente consistenti, con profondità del substrato superiori a 30 m, caratterizzati da un miglioramento delle proprietà meccaniche con la profondità e da valori di velocità equivalente compresi tra 100 e 180 m/s.
E - Terreni con caratteristiche e valori di velocità equivalente riconducibili a quelle definite per le categorie C o D, con profondità del substrato non superiore a 30 m.

Per qualsiasi condizione di sottosuolo non classificabile nelle categorie precedenti, è necessario predisporre specifiche analisi di risposta locale per la definizione delle azioni sismiche.

Results saved in the folder "..\IO\output_disp".

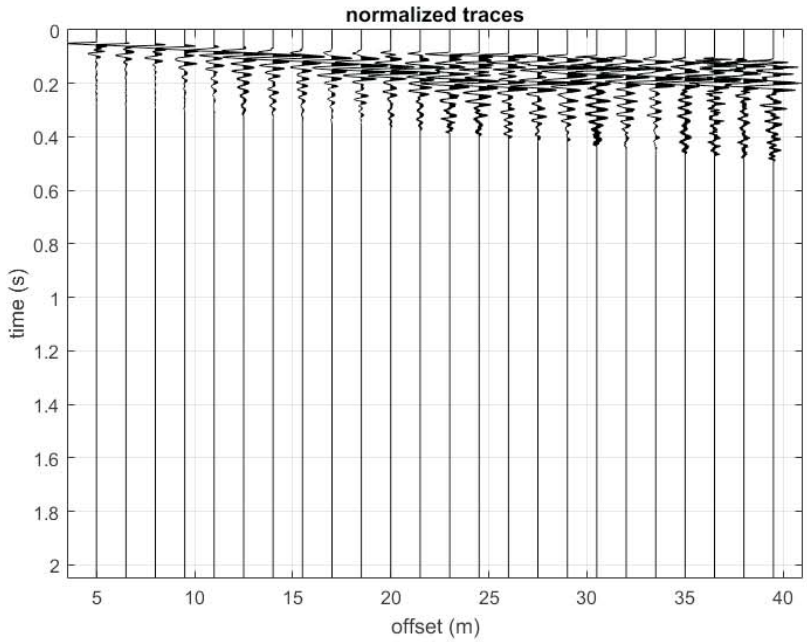
==========

winMASW - Surface Waves & Beyond

www.winmasw.com
Number of models used to define the mean model: 121
Vs5 for the best model: 350 350
Vs30 for the best model: 593 593

#1: uploading & processing (MASW analyses)

dataset: 215borgiano.DAT
sampling: 0.125 ms
minimum offset: 5 m
geophone spacing: 1.5 m



resampling: 0.5 | resample | accept

data selection: activate | select | 60 | cancel | save

filtering & spectra: filter | cancel | spectrum | spectrogram

refraction: refraction | 100 | upload | save | clear refraction

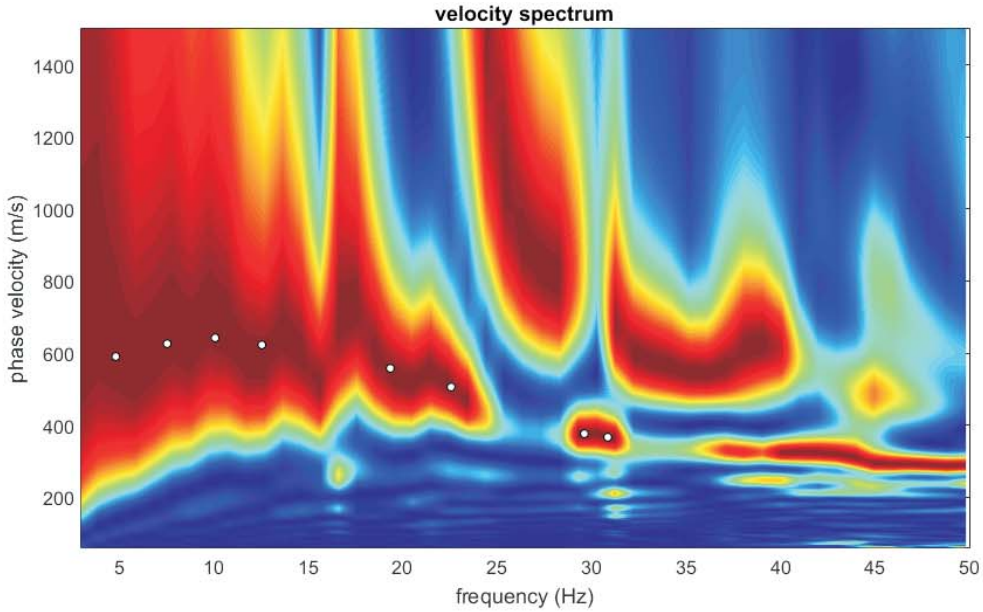
other tools & setting: 2.04787 | time length to visualize (s) | done | cut | flip traces | zero padding

#2: velocity spectrum, modelling & picking (MASW/ReMi/ESAC analyses)

MASW: compute velocity spectrum: phase velocity | f-k | group velocity

handling the spectra: save | upload | merge

explore spectrum | mode separation



modelling

Vs (m/s)	Poisson	thickness (m)
350	0.4	6.2
650	0.35	7.8
750	0.35	30
650	0.3	0
0	0.35	0
0	0.35	0
0	0.3	0
0	0.2	

? | about Poisson

general setting: Rayleigh | 1 | phase vel | 0 Reference depth | Refraction | H/V body waves | 0 H/V modes (SW ellipticity)

compute | upload mod. | save model | refresh | report

synthetics: ZVF | shows DC | synthetics

visualize curves: input curve | ?

picking: ? | show f-k | fundamental

to select the last point of the considered mode click the right button

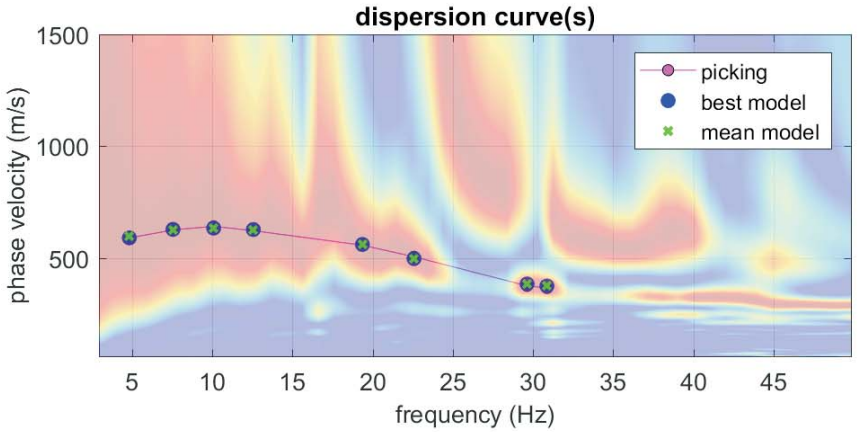
save picking | ?

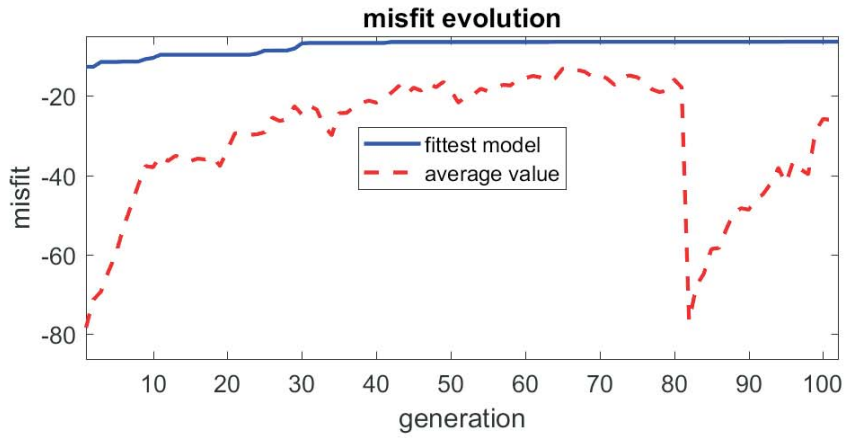
LN BORGIANO CHIESA.cdp

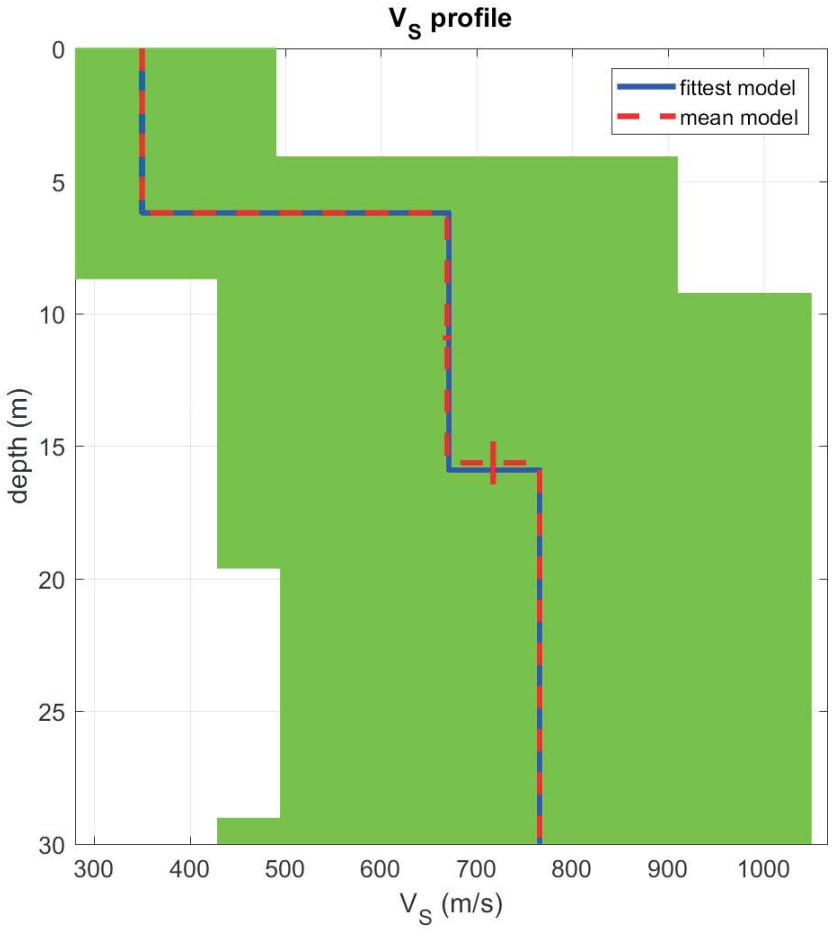
cancel picking

inversion: inversion | Joint DC-HV inv.

www.winmasw.com







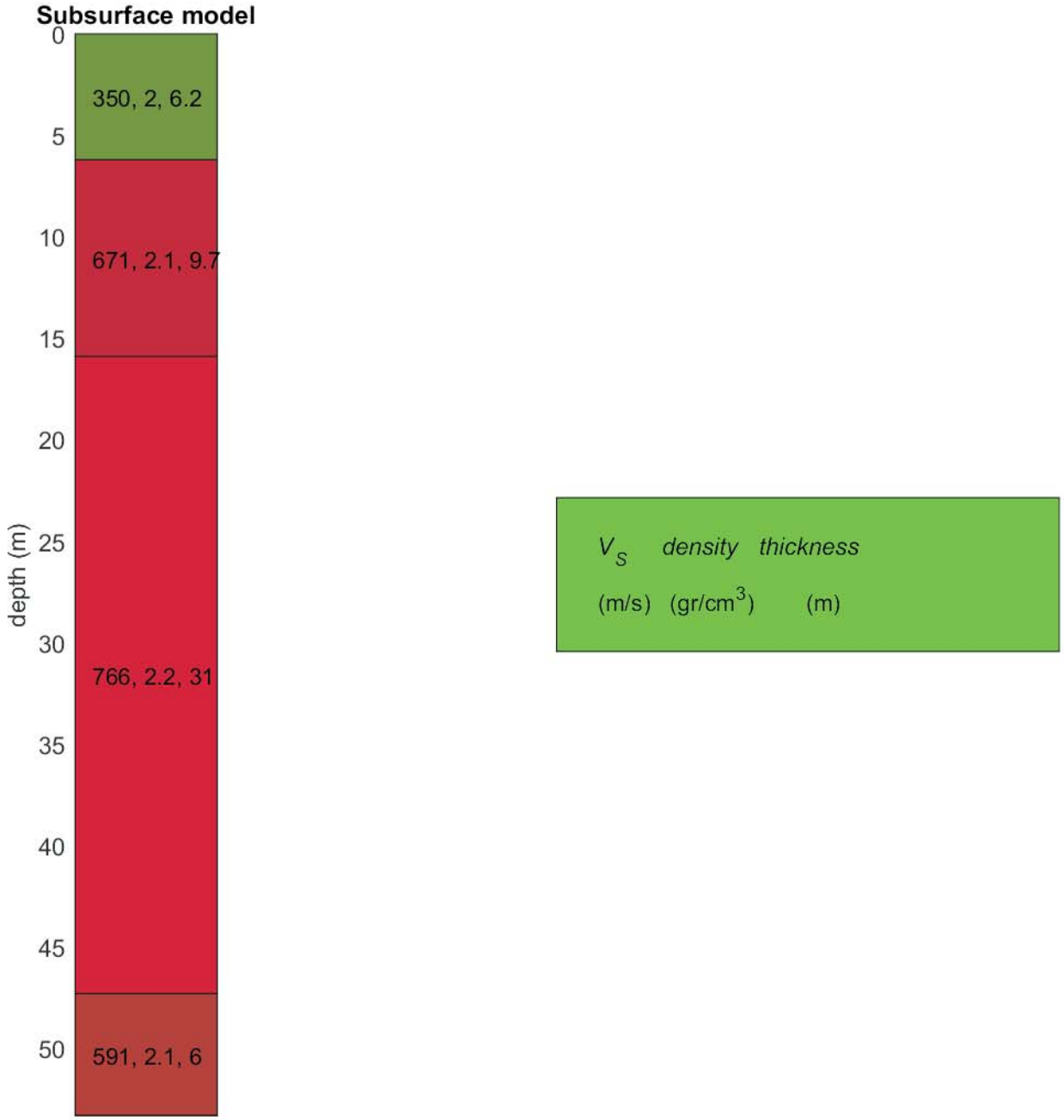
www.winmasw.com

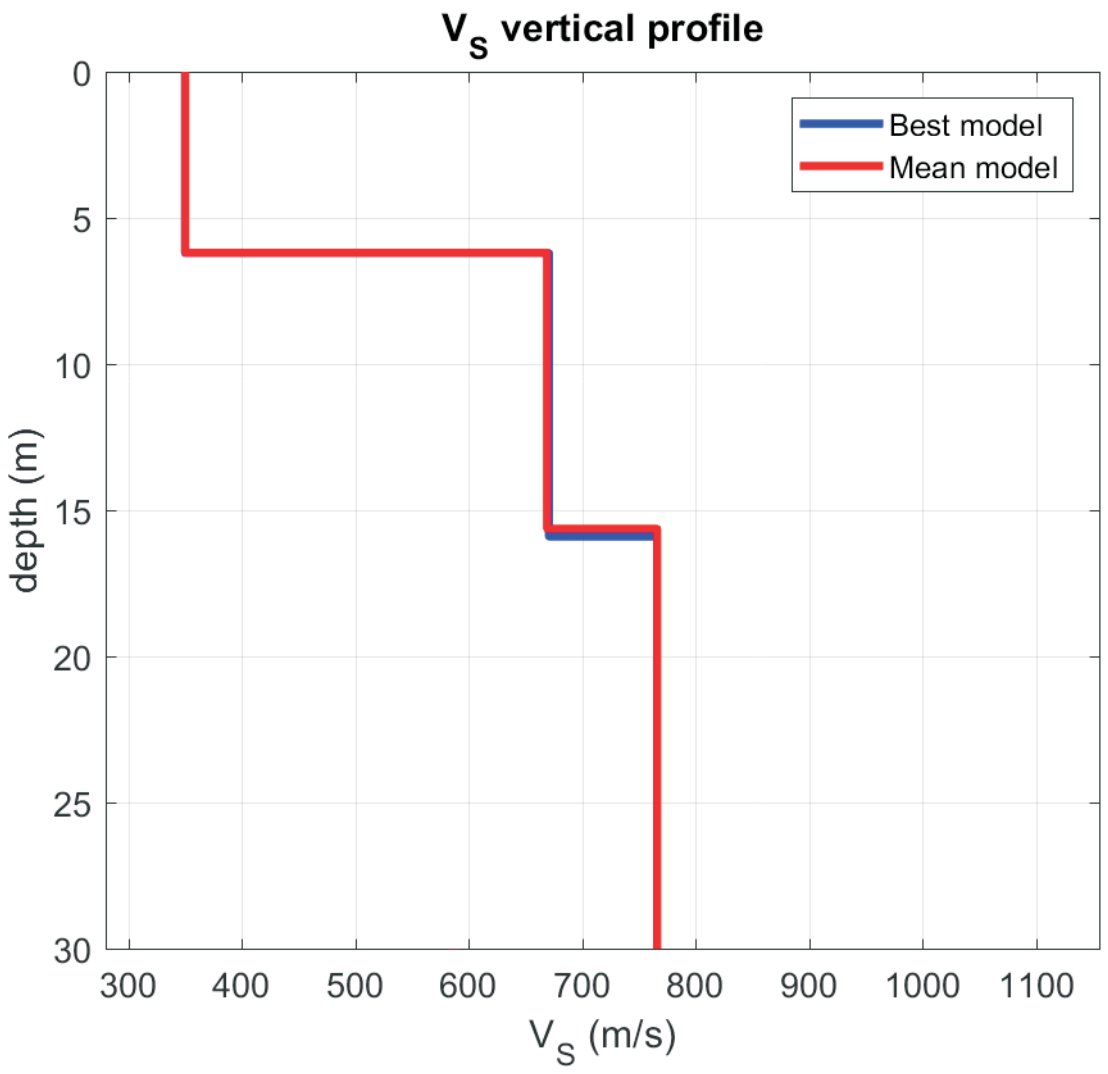
dataset: 215borgiano.DAT

dispersion curve: LN BORGIANO CHIESA.cdp

Vs30 & VsE (best model): 593 593 m/s

Vs30 & VsE (mean model): 593 593 m/s


Subsurface model
0
5
10
15
20
25
30
35
40
45
50
depth (m)
350, 2, 6.2
671, 2.1, 9.7
766, 2.2, 31
591, 2.1, 6
V_S density thickness
(m/s) (gr/cm^3) (m)


V_S vertical profile
Best model
Mean model
depth (m)
0
5
10
15
20
25
30
300
400
500
600
700
800
900
1000
1100
V_S (m/s)