REGIONE TOSCANA

VALDERA
UNIONE DEI COMUNI

STUDI ED INDAGINI DI MICROZONAZIONE SISMICA DI LIVELLO 1 NEI COMUNI DI PALAIA - CAPANNOLI - PONTEDERA

RAPPORTO SULLE INDAGINI

C2 - ESAC - MASW MONOGRAFIE E REPORTS

RTP incaricata:

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Arch. Maria Rosaria De Vita

Settembre 2018

UNIONE DI COMUNI DELLA VALDERA

INDAGINE ESAC/MASW - COMUNE DI PALAIA

LOC. FORCOLI - POSTAZIONE n. 1

documentazione fotografica

ubicazione scala 1:1.000

geometria ESAC

geof	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
x	55	50	45	40	35	30	25	20	15	10	5	0	0	0	0	0	0	0	0	0	0	0	0	0
y	0	0	0	0	0	0	0	0	0	0	0	0	3	6	9	12	15	18	21	24	27	30	33	36

geometria MASW

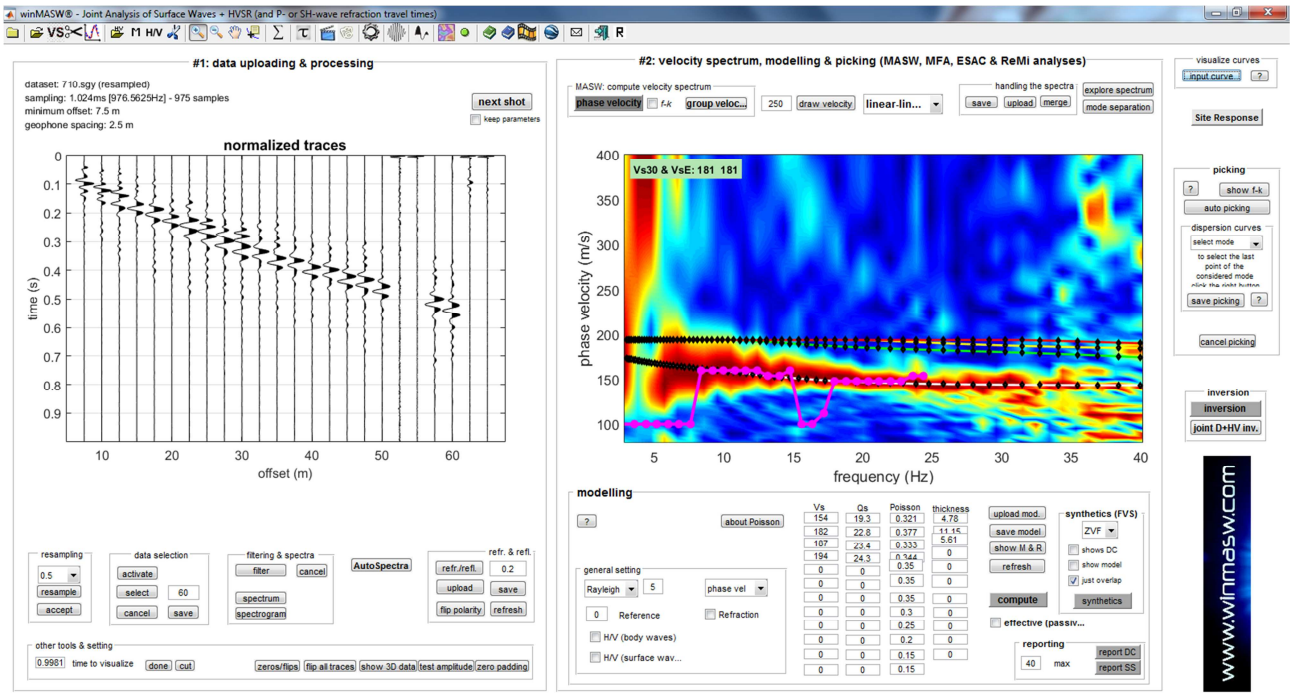
distanza geofonica 12 ch 5 m

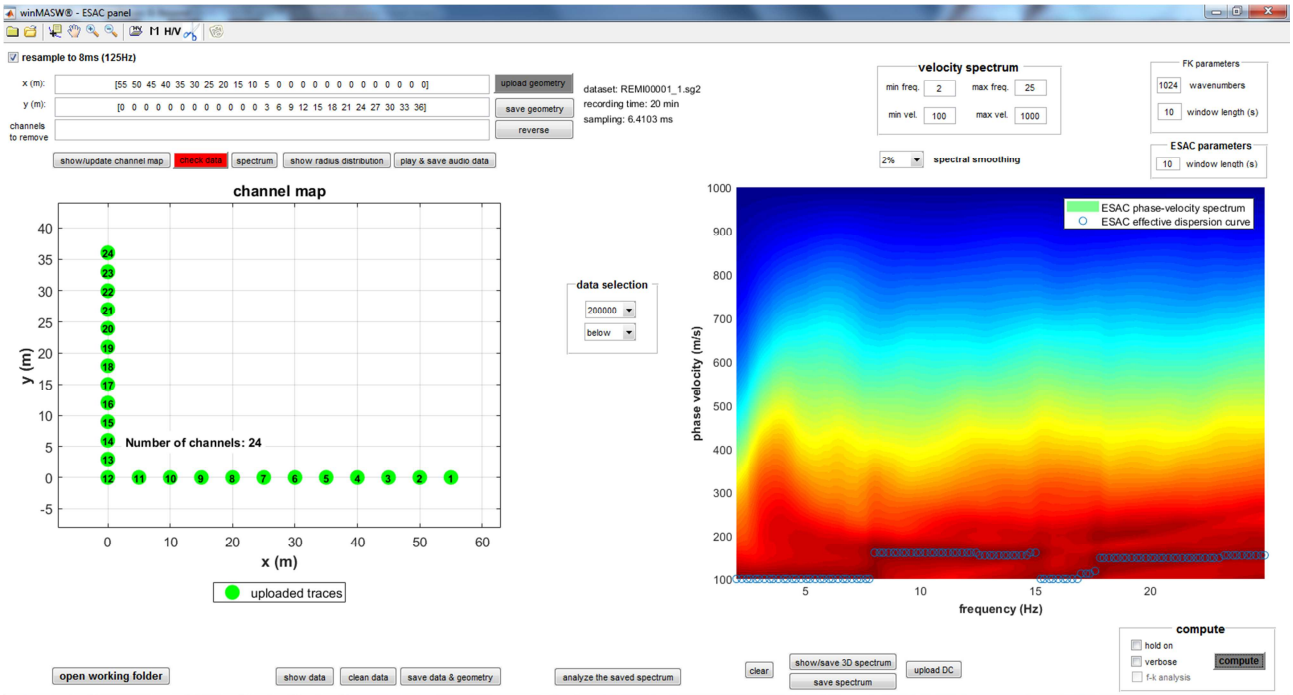
lunghezza linea 57.5 m

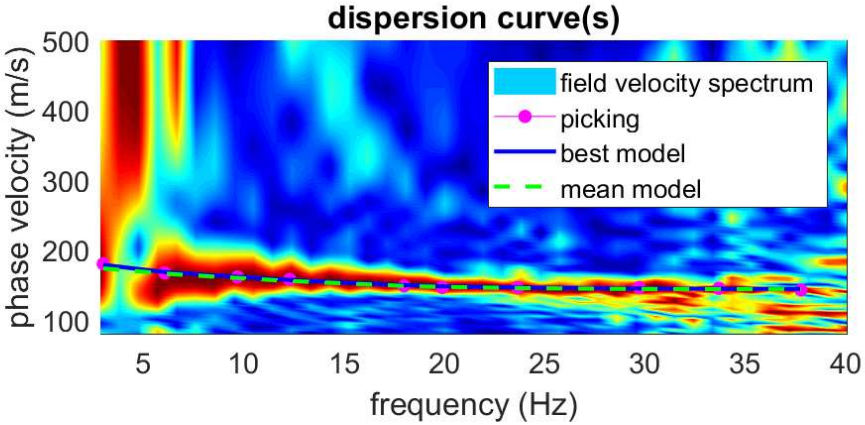
coordinate stazione 43°60’ 33.71” N 10°70’ 25.98” E

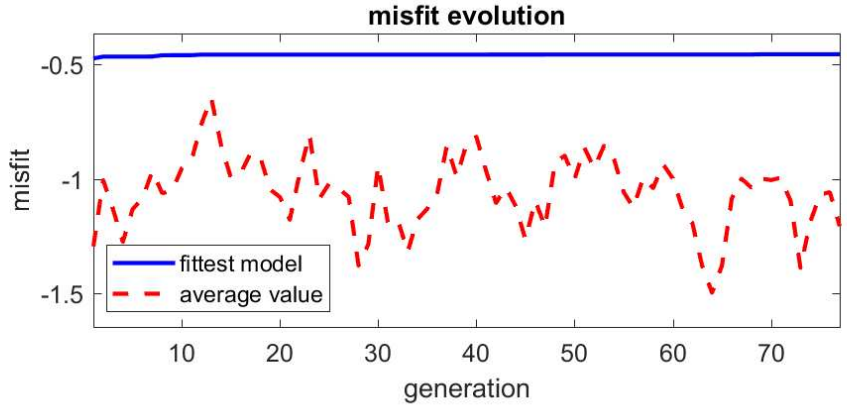
UNIONE VALDERA - Indagini sismiche MASW/ESAC

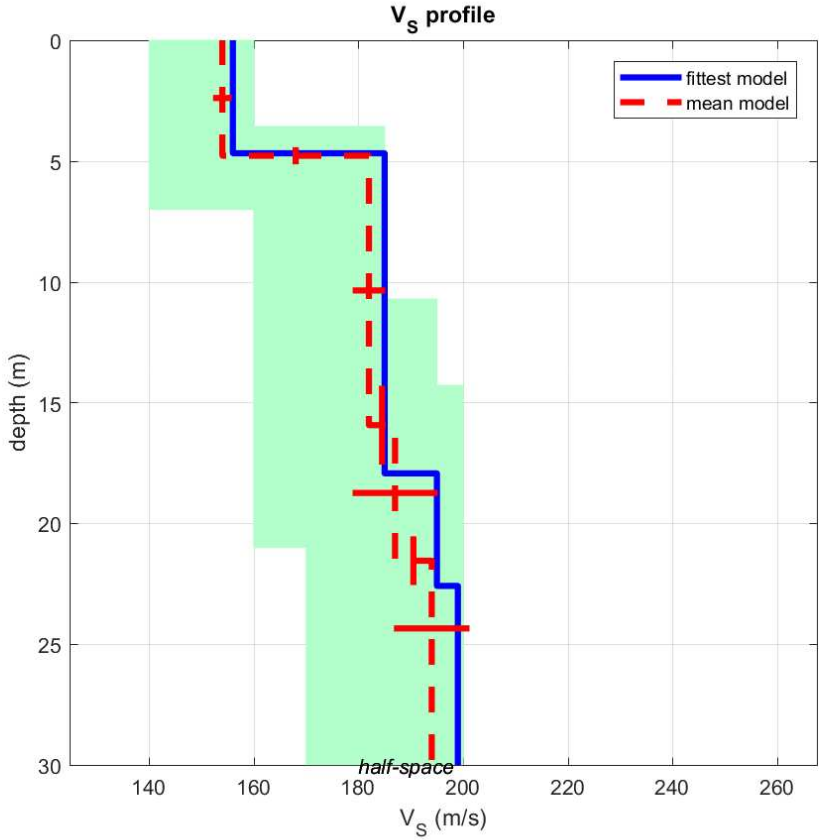
PROVA n. 1











www.winmasw.com

dataset: 710.sgy
dispersion curve: 710.cdp
Vs30 & VsE (best model): 184 184 m/s
Vs30 & VsE (mean model): 181 181 m/s

Mean model

Vs (m/s): 154, 182, 187, 194

Standard deviations (m/s): 2, 3, 8, 7

Thickness (m): 4.8, 11.2, 5.6

========== SECTION#1
dataset: 710.sgy
sampling (ms): 0.256
minimum offset (m): 7.5
geophone spacing (m): 2.5
offsets (m): 7.5 10 12.5 15 17.5
20 22.5 25 27.5 30 32.5 35
37.5 40 42.5 45 47.5 50
52.5 55 57.5 60 62.5 65
Dispersion curve: 710.cdp
Number of individuals: 32
Number of generations: 61

Rayleigh-wave dispersion analysis

Analyzing phase velocities

Adopted search space (minimum Vs): 140 160 170 170
Adopted search space (maximum Vs): 160 185 195 200

Adopted search space (minimum Poisson): 0.16521 0.17516 0.17524
0.17484
Adopted search space (maximum Poisson): 0.49564 0.499 0.499
0.499

Adopted search space (minimum Qs): 7.5 12 14.25 18
Adopted search space (maximum Qs): 15 24 28.5 36

Adopted search space (minimum reference frequency): 1
Adopted search space (maximum reference frequency): 37.795

Adopted search space (minimum thickness): 3.5714 7.1429 3.5714
Adopted search space (maximum thickness): 7 14 7

Output folder:
C:\Users\Benedetta\Desktop\valdERA-esac\valdera-esac-1\output_disp

========== SECTION#2
Rayleigh-wave analysis
Optimizing Vs & Thickness - generation: 1; average & best misfits: -1.2962
-0.47303
Optimizing Vs & Thickness - generation: 2; average & best misfits: -1.0059
-0.46514
Optimizing Vs & Thickness - generation: 3; average & best misfits: -1.133
-0.46514
Optimizing Vs & Thickness - generation: 4; average & best misfits: -1.2762
-0.46514
Optimizing Vs & Thickness - generation: 5; average & best misfits: -1.1321
-0.46509
Optimizing Vs & Thickness - generation: 6; average & best misfits: -1.0865
-0.46509
Optimizing Vs & Thickness - generation: 7; average & best misfits: -0.96631
-0.4648
Optimizing Vs & Thickness - generation: 8; average & best misfits: -1.0626
-0.45934
Optimizing Vs & Thickness - generation: 9; average & best misfits: -1.0535
-0.45885
Optimizing Vs & Thickness - generation: 10; average & best misfits: -0.95416
-0.45885
Optimizing Vs & Thickness - generation: 11; average & best misfits: -0.91774
-0.45885
Optimizing Vs & Thickness - generation: 12; average & best misfits: -0.76014
-0.45633
Optimizing Vs & Thickness - generation: 13; average & best misfits: -0.64571

-0.45633
Optimizing Vs & Thickness - generation: 14; average & best misfits: -0.85179
-0.45633
Optimizing Vs & Thickness - generation: 15; average & best misfits: -0.99522
-0.45633
Optimizing Vs & Thickness - generation: 16; average & best misfits: -0.97559
-0.45633
Optimizing Vs & Thickness - generation: 17; average & best misfits: -0.88811
-0.45633
Optimizing Vs & Thickness - generation: 18; average & best misfits: -0.90636
-0.45633
Optimizing Vs & Thickness - generation: 19; average & best misfits: -1.0463
-0.45633
Optimizing Vs & Thickness - generation: 20; average & best misfits: -1.08
-0.45633
Optimizing Vs & Thickness - generation: 21; average & best misfits: -1.1793
-0.45633
Optimizing Vs & Thickness - generation: 22; average & best misfits: -0.97734
-0.45633
Optimizing Vs & Thickness - generation: 23; average & best misfits: -0.80637
-0.45633
Optimizing Vs & Thickness - generation: 24; average & best misfits: -1.0878
-0.45633
Optimizing Vs & Thickness - generation: 25; average & best misfits: -1.0213
-0.45633
Optimizing Vs & Thickness - generation: 26; average & best misfits: -1.0429
-0.45633
Optimizing Vs & Thickness - generation: 27; average & best misfits: -1.0793
-0.45633
Optimizing Vs & Thickness - generation: 28; average & best misfits: -1.38
-0.45633
Optimizing Vs & Thickness - generation: 29; average & best misfits: -1.2861
-0.45633
Optimizing Vs & Thickness - generation: 30; average & best misfits: -0.94223
-0.45633
Optimizing Vs & Thickness - generation: 31; average & best misfits: -1.1937
-0.45633
Optimizing Vs & Thickness - generation: 32; average & best misfits: -1.1794
-0.45633
Optimizing Vs & Thickness - generation: 33; average & best misfits: -1.3197
-0.45633
Optimizing Vs & Thickness - generation: 34; average & best misfits: -1.1766
-0.45633
Optimizing Vs & Thickness - generation: 35; average & best misfits: -1.1316
-0.45633
Optimizing Vs & Thickness - generation: 36; average & best misfits: -1.0671
-0.45633
Optimizing Vs & Thickness - generation: 37; average & best misfits: -0.85374
-0.45633
Optimizing Vs & Thickness - generation: 38; average & best misfits: -0.99152
-0.45633
Optimizing Vs & Thickness - generation: 39; average & best misfits: -0.84702
-0.45633
Optimizing Vs & Thickness - generation: 40; average & best misfits: -0.81612
-0.45633
Optimizing Vs & Thickness - generation: 41; average & best misfits: -0.96623
-0.45633
Optimizing Vs & Thickness - generation: 42; average & best misfits: -1.106
-0.4561
Optimizing Vs & Thickness - generation: 43; average & best misfits: -1.0378
-0.4561
Optimizing Vs & Thickness - generation: 44; average & best misfits: -1.1189
-0.4561
Optimizing Vs & Thickness - generation: 45; average & best misfits: -1.2663
-0.4561
Optimizing Vs & Thickness - generation: 46; average & best misfits: -1.0962
-0.4561
Optimizing Vs & Thickness - generation: 47; average & best misfits: -1.2106

-0.4561
Optimizing Vs & Thickness - generation: 48; average & best misfits: -0.92943
-0.45585
Optimizing Vs & Thickness - generation: 49; average & best misfits: -0.89874
-0.45585
Optimizing Vs & Thickness - generation: 50; average & best misfits: -1.0016
-0.45585
Optimizing Vs & Thickness - generation: 51; average & best misfits: -0.86433
-0.45585
Optimizing Vs & Thickness - generation: 52; average & best misfits: -0.95307
-0.45585
Optimizing Vs & Thickness - generation: 53; average & best misfits: -0.85518
-0.45585
Optimizing Vs & Thickness - generation: 54; average & best misfits: -0.91066
-0.45585
Optimizing Vs & Thickness - generation: 55; average & best misfits: -1.058
-0.45585
Optimizing Vs & Thickness - generation: 56; average & best misfits: -1.1265
-0.45585
Optimizing Vs & Thickness - generation: 57; average & best misfits: -0.99406
-0.45585
Optimizing Vs & Thickness - generation: 58; average & best misfits: -1.0407
-0.45585
Optimizing Vs & Thickness - generation: 59; average & best misfits: -0.93556
-0.45585
Optimizing Vs & Thickness - generation: 60; average & best misfits: -0.9978
-0.45585
Optimizing Vs & Thickness - generation: 61; average & best misfits: -1.1317
-0.45583

Adopted search space (minimum Vs): 140 160 170 170
Adopted search space (maximum Vs): 160 185 195 200

Adopted search space (minimum Qs): 7.5 12 14.25 18
Adopted search space (maximum Qs): 15 24 28.5 36

Adopted search space (minimum reference frequency): 1
Adopted search space (maximum reference frequency): 37.795

Adopted search space (minimum Poisson): 0.16521 0.17516 0.17524
0.17484
Adopted search space (maximum Poisson): 0.49564 0.497 0.497
0.497

Adopted search space (minimum thickness): 3.5714 7.1429 3.5714
Adopted search space (maximum thickness): 7 14 7

Now a finer search around the most promising search space area

Rayleigh-wave analysis
Optimizing Vs & Thickness - generation: 1; average & best misfits: -1.1943
-0.45583
Optimizing Vs & Thickness - generation: 2; average & best misfits: -1.3822
-0.45583
Optimizing Vs & Thickness - generation: 3; average & best misfits: -1.4985
-0.45583
Optimizing Vs & Thickness - generation: 4; average & best misfits: -1.381
-0.45583
Optimizing Vs & Thickness - generation: 5; average & best misfits: -1.0876
-0.45583
Optimizing Vs & Thickness - generation: 6; average & best misfits: -0.99937
-0.45583
Optimizing Vs & Thickness - generation: 7; average & best misfits: -1.0385
-0.45583
Optimizing Vs & Thickness - generation: 8; average & best misfits: -0.99853
-0.45496
Optimizing Vs & Thickness - generation: 9; average & best misfits: -1.0053

-0.45496
Optimizing Vs & Thickness - generation: 10; average & best misfits: -0.99567
-0.45496
Optimizing Vs & Thickness - generation: 11; average & best misfits: -1.0974
-0.45496
Optimizing Vs & Thickness - generation: 12; average & best misfits: -1.3898
-0.45496
Optimizing Vs & Thickness - generation: 13; average & best misfits: -1.189
-0.45496
Optimizing Vs & Thickness - generation: 14; average & best misfits: -1.0681
-0.45496
Optimizing Vs & Thickness - generation: 15; average & best misfits: -1.0587
-0.45496
Optimizing Vs & Thickness - generation: 16; average & best misfits: -1.2079
-0.45496

Model after the Vs & Thickness optimization (fixed Poisson values):
Vs (m/s): 156 185 195 199
Thickness (m): 4.7 13 4.7

Number of models considered to calculate the average model: 794

##
RESULTS
##

Dataset: 710.sgy
Analyzed curve/spectrum: 710.cdp

========== SECTION#3

Analyzing Phase Velocities

Analyzing Rayleigh-Wave Dispersion

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

Vs (m/s): 154 182 187 194
Standard deviations (m/s): 2 3 8 7

Thickness (m): 4.8 11.2 5.6
Standard deviations (m): 0.4 1.6 1.0

Approximate values for Vp, density, Poisson & Shear modulus
Vp (m/s): 300 409 374 398
Density (gr/cm3): 1.76 1.84 1.82 1.83
Vp/Vs ratio: 1.95 2.25 2.00 2.05
Poisson: 0.32 0.38 0.33 0.34
Shear modulus (MPa): 42 61 64 69
Estimated static shear modulus (MPa): 0 0 0 0

Fundamental mode
Mean model
 f(Hz) VR(m/s)
3.00665 173.4406
6.06434 165.969
9.69895 159.7971
12.2951 155.4565
18.0066 148.3485
19.9105 146.9836
23.6605 145.286
29.7181 144.0561
33.6989 143.7122

 37.795   143.5273

========== SECTION#4

BEST MODEL

Vs (m/s): 156 185 195 199
thickness (m): 4.67695   13.2539   4.65811

Approximate values for Vp, density, Poisson & Shear modulus
Vp (m/s):   279 442 371 694
Density (gr/cm3):   1.75   1.86   1.81   1.97
Vp/Vs ratio: 1.79   2.39   1.90   3.49
Poisson: 0.27   0.39   0.31   0.46
Shear modulus (MPa): 42   64   69   78
Estimated static shear modulus (MPa): 0   0   0   0

dispersion curve (frequency - velocity)

Fundamental mode)
best model
 F(Hz)   VR(m/s)
3.00665   178.5345
6.06434   168.2355
9.69895   161.4183
12.2951   156.9174
18.0066   149.4062
19.9105   147.941
23.6605   146.1111
29.7181   144.783
33.6989   144.4126
 37.795   144.2146

========== SECTION#5

Maximum penetration depth according to the "Steady State Rayleigh Method": 30 m

Inversion quality: very good

Vs30 & VsE (mean model): 181 181 m/s
Vs30 & VsE (best model): 184 184 m/s

========== 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
"C:\Users\Benedetta\Desktop\valdERA-esac\valdera-esac-1\output_disp".

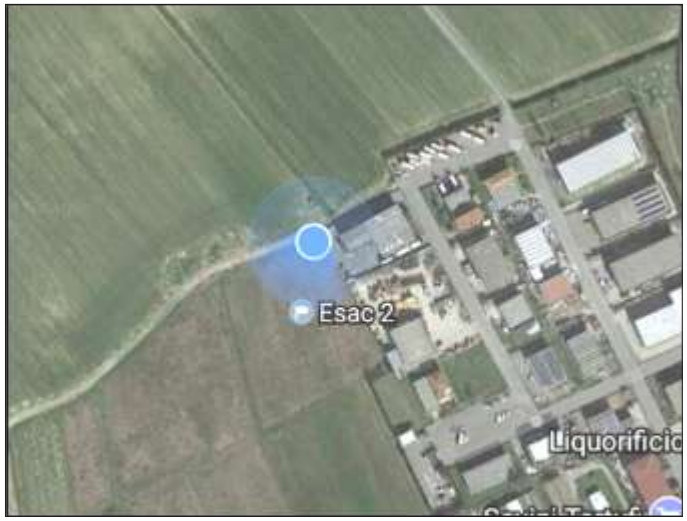
==========
winMASW - Surface Waves & Beyond
www.winmasw.com

Number of models used to define the mean model: 794
Vs30 for the best model: 184 184
Analyzing phase velocities

UNIONE DI COMUNI DELLA VALDERA

INDAGINE ESAC/MASW - COMUNE DI PALAIA

LOC. MONTANELLI - POSTAZIONE n. 2



documentazione fotografica

ubicazione scala 1:1.000

geometria ESAC

geof	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
x	55	50	45	40	35	30	25	20	15	10	5	0	0	0	0	0	0	0	0	0	0	0	0	0
y	0	0	0	0	0	0	0	0	0	0	0	0	3	6	9	12	15	18	21	24	27	30	33	36

geometria MASW

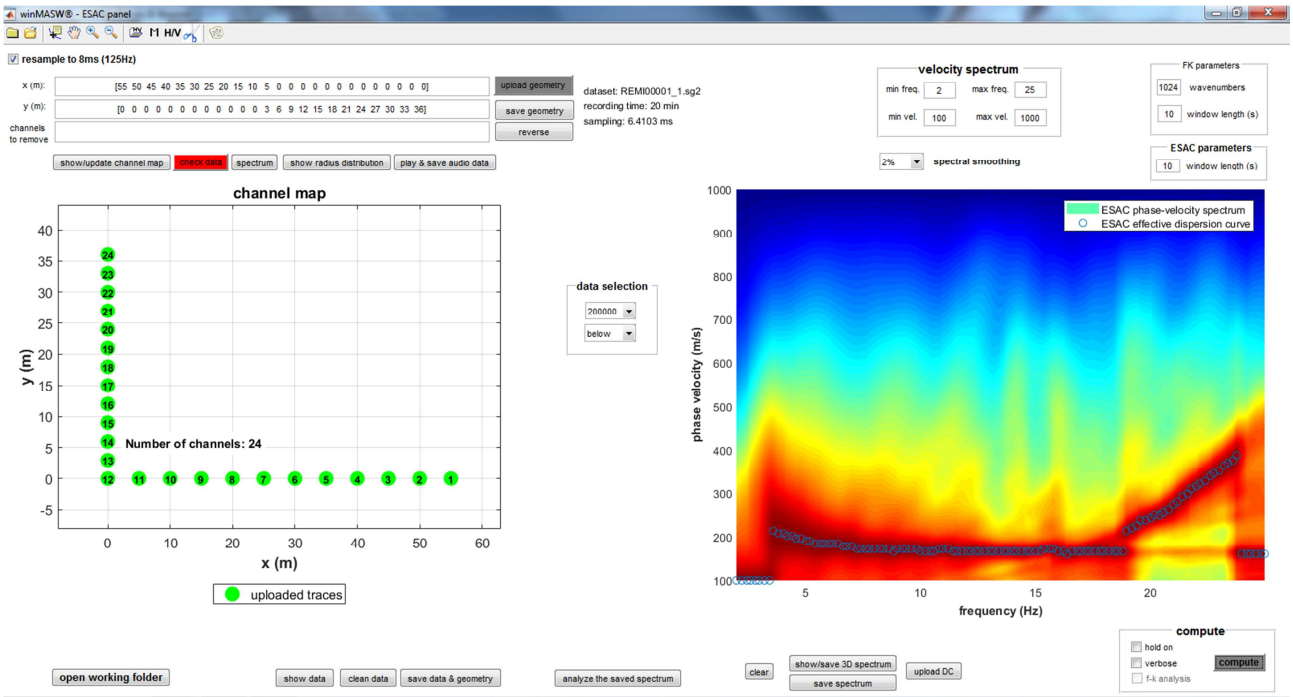
distanza geofonica 12 ch 5 m

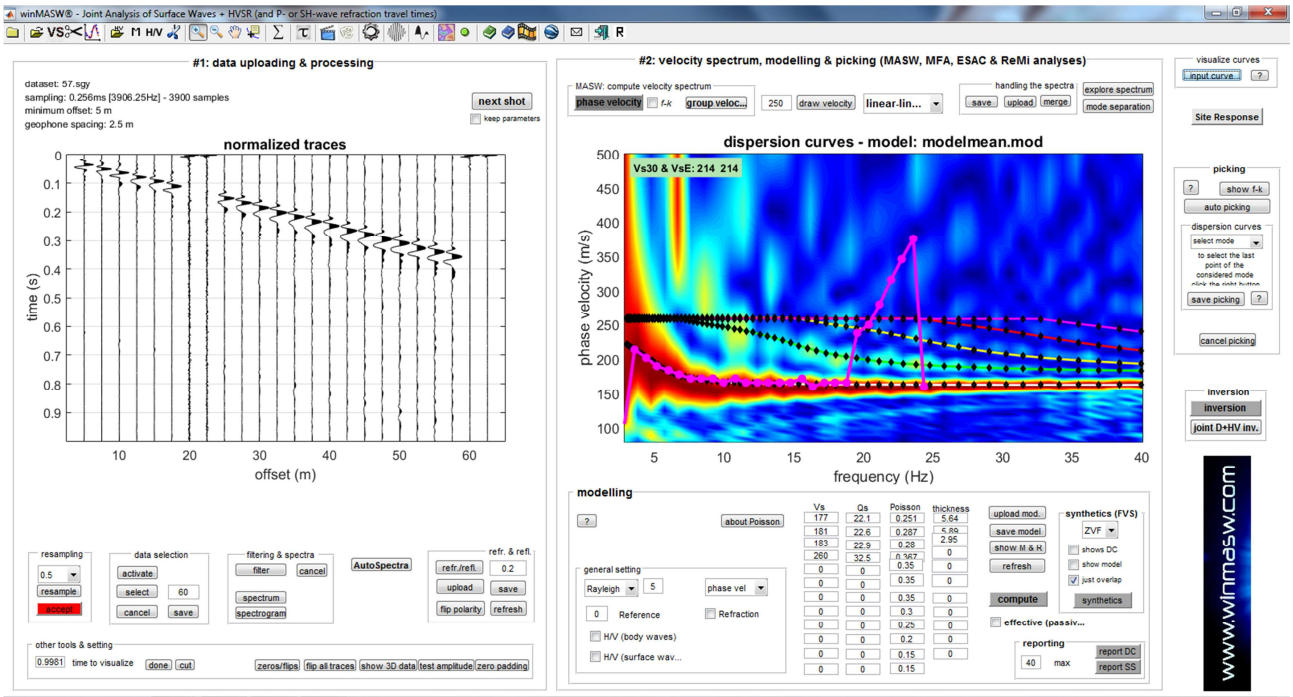
lunghezza linea 57.5 m

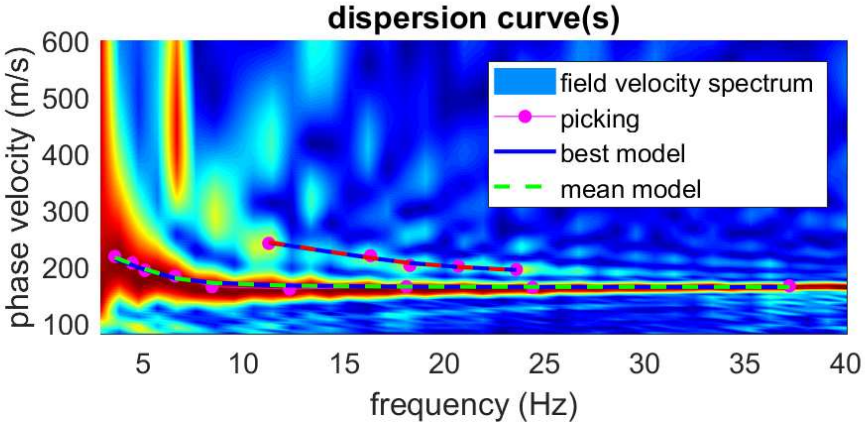
coordinate stazione 43°59’ 27.60” N 10°71’ 50.45” E

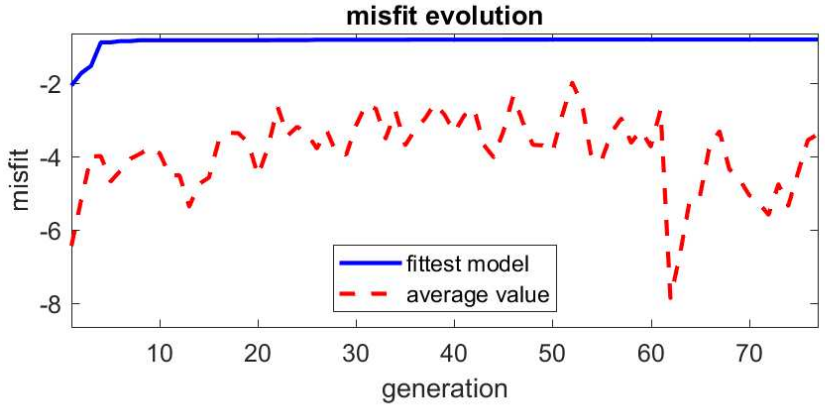
UNIONE VALDERA - Indagini sismiche MASW/ESAC

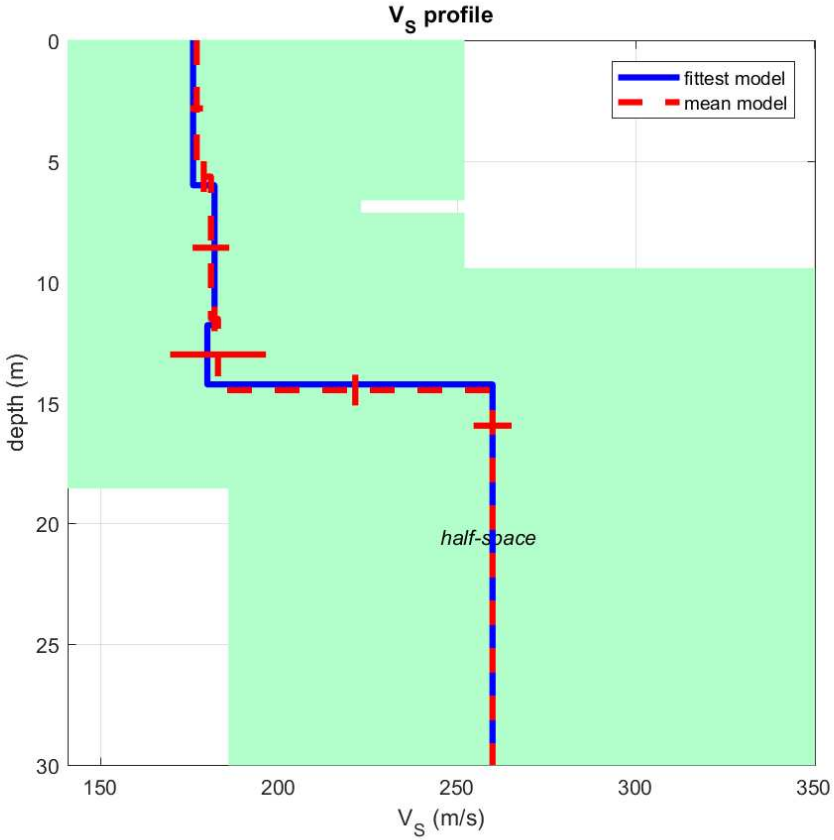
PROVA n. 2











www.winmasw.com

dataset: 57.sgy
dispersion curve: 57bis.cdp
Vs30 & VsE (best model): 214 214 m/s
Vs30 & VsE (mean model): 214 214 m/s

Mean model

Vs (m/s): 177, 181, 183, 260

Standard deviations (m/s): 2, 5, 13, 5

Thickness (m): 5.6, 5.9, 2.9

========== SECTION#1
dataset: 57.sgy
sampling (ms): 0.256
minimum offset (m): 5
geophone spacing (m): 2.5
offsets (m): 5 7.5 10 12.5 15 17.5
20 22.5 25 27.5 30 32.5
35 37.5 40 42.5 45 47.5
50 52.5 55 57.5 60 62.5
Dispersion curve: 57bis.cdp
Number of individuals: 32
Number of generations: 61

Rayleigh-wave dispersion analysis

Analyzing phase velocities

Adopted search space (minimum Vs): 129 114 129 186
Adopted search space (maximum Vs): 252 223 252 364

Adopted search space (minimum Poisson): 0.10938 0.1505 0.15723
0.21706
Adopted search space (maximum Poisson): 0.32813 0.45151 0.4717
0.499

Adopted search space (minimum Qs): 16.875 14.91 16.875 21.4725
Adopted search space (maximum Qs): 33.75 29.82 33.75 42.945

Adopted search space (minimum reference frequency): 1
Adopted search space (maximum reference frequency): 37.2181

Adopted search space (minimum thickness): 3.3714 3.7929 2.2929
Adopted search space (maximum thickness): 6.608 7.434 4.494

Output folder:
C:\Users\Benedetta\Desktop\valdERA-esac\valdera-esac-2\output_disp

========== SECTION#2
Rayleigh-wave analysis
Optimizing Vs & Thickness - generation: 1; average & best misfits: -6.4383
-2.0711
Optimizing Vs & Thickness - generation: 2; average & best misfits: -5.1766
-1.7349
Optimizing Vs & Thickness - generation: 3; average & best misfits: -4.0014
-1.5394
Optimizing Vs & Thickness - generation: 4; average & best misfits: -3.9919
-0.89753
Optimizing Vs & Thickness - generation: 5; average & best misfits: -4.6807
-0.89753
Optimizing Vs & Thickness - generation: 6; average & best misfits: -4.3875
-0.86289
Optimizing Vs & Thickness - generation: 7; average & best misfits: -4.0656
-0.86289
Optimizing Vs & Thickness - generation: 8; average & best misfits: -3.9289
-0.83957
Optimizing Vs & Thickness - generation: 9; average & best misfits: -3.7619
-0.83957
Optimizing Vs & Thickness - generation: 10; average & best misfits: -3.9203
-0.83957
Optimizing Vs & Thickness - generation: 11; average & best misfits: -4.5177
-0.83957
Optimizing Vs & Thickness - generation: 12; average & best misfits: -4.5123
-0.83957
Optimizing Vs & Thickness - generation: 13; average & best misfits: -5.3623

-0.83957
Optimizing Vs & Thickness - generation: 14; average & best misfits: -4.7507
-0.83957
Optimizing Vs & Thickness - generation: 15; average & best misfits: -4.5786
-0.83957
Optimizing Vs & Thickness - generation: 16; average & best misfits: -3.5755
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Optimizing Vs & Thickness - generation: 17; average & best misfits: -3.3596
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Optimizing Vs & Thickness - generation: 18; average & best misfits: -3.366
-0.83957
Optimizing Vs & Thickness - generation: 19; average & best misfits: -3.6191
-0.83957
Optimizing Vs & Thickness - generation: 20; average & best misfits: -4.5218
-0.83815
Optimizing Vs & Thickness - generation: 21; average & best misfits: -3.7748
-0.83815
Optimizing Vs & Thickness - generation: 22; average & best misfits: -2.6529
-0.83527
Optimizing Vs & Thickness - generation: 23; average & best misfits: -3.437
-0.83527
Optimizing Vs & Thickness - generation: 24; average & best misfits: -3.1919
-0.83527
Optimizing Vs & Thickness - generation: 25; average & best misfits: -3.3857
-0.83527
Optimizing Vs & Thickness - generation: 26; average & best misfits: -3.781
-0.82599
Optimizing Vs & Thickness - generation: 27; average & best misfits: -3.2946
-0.82599
Optimizing Vs & Thickness - generation: 28; average & best misfits: -3.9198
-0.82599
Optimizing Vs & Thickness - generation: 29; average & best misfits: -3.9488
-0.82599
Optimizing Vs & Thickness - generation: 30; average & best misfits: -3.1491
-0.82599
Optimizing Vs & Thickness - generation: 31; average & best misfits: -2.5895
-0.82588
Optimizing Vs & Thickness - generation: 32; average & best misfits: -2.7026
-0.82588
Optimizing Vs & Thickness - generation: 33; average & best misfits: -3.512
-0.82588
Optimizing Vs & Thickness - generation: 34; average & best misfits: -2.7718
-0.82588
Optimizing Vs & Thickness - generation: 35; average & best misfits: -3.6939
-0.82588
Optimizing Vs & Thickness - generation: 36; average & best misfits: -3.2716
-0.82296
Optimizing Vs & Thickness - generation: 37; average & best misfits: -2.9753
-0.82296
Optimizing Vs & Thickness - generation: 38; average & best misfits: -2.5653
-0.82296
Optimizing Vs & Thickness - generation: 39; average & best misfits: -2.8656
-0.82296
Optimizing Vs & Thickness - generation: 40; average & best misfits: -3.342
-0.82296
Optimizing Vs & Thickness - generation: 41; average & best misfits: -2.8884
-0.82296
Optimizing Vs & Thickness - generation: 42; average & best misfits: -2.6927
-0.82296
Optimizing Vs & Thickness - generation: 43; average & best misfits: -3.6887
-0.82296
Optimizing Vs & Thickness - generation: 44; average & best misfits: -4.0233
-0.82296
Optimizing Vs & Thickness - generation: 45; average & best misfits: -3.3071
-0.82191
Optimizing Vs & Thickness - generation: 46; average & best misfits: -2.3567
-0.82191
Optimizing Vs & Thickness - generation: 47; average & best misfits: -3.0899

-0.82191
Optimizing Vs & Thickness - generation: 48; average & best misfits: -3.6847
-0.82191
Optimizing Vs & Thickness - generation: 49; average & best misfits: -3.7013
-0.82191
Optimizing Vs & Thickness - generation: 50; average & best misfits: -3.8755
-0.82038
Optimizing Vs & Thickness - generation: 51; average & best misfits: -2.8602
-0.82038
Optimizing Vs & Thickness - generation: 52; average & best misfits: -1.9962
-0.82038
Optimizing Vs & Thickness - generation: 53; average & best misfits: -2.5792
-0.82038
Optimizing Vs & Thickness - generation: 54; average & best misfits: -4.0806
-0.82038
Optimizing Vs & Thickness - generation: 55; average & best misfits: -4.0992
-0.82038
Optimizing Vs & Thickness - generation: 56; average & best misfits: -3.3501
-0.82038
Optimizing Vs & Thickness - generation: 57; average & best misfits: -2.9664
-0.82038
Optimizing Vs & Thickness - generation: 58; average & best misfits: -3.6282
-0.82038
Optimizing Vs & Thickness - generation: 59; average & best misfits: -3.2894
-0.82038
Optimizing Vs & Thickness - generation: 60; average & best misfits: -3.7298
-0.82038
Optimizing Vs & Thickness - generation: 61; average & best misfits: -2.7336
-0.82038

Adopted search space (minimum Vs): 129 114 129 186
Adopted search space (maximum Vs): 252 223 252 364

Adopted search space (minimum Qs): 16.875 14.91 16.875 21.4725
Adopted search space (maximum Qs): 33.75 29.82 33.75 42.945

Adopted search space (minimum reference frequency): 1
Adopted search space (maximum reference frequency): 37.2181

Adopted search space (minimum Poisson): 0.15 0.1505 0.15723 0.21706
Adopted search space (maximum Poisson): 0.32813 0.45151 0.4717
0.497

Adopted search space (minimum thickness): 3.3714 3.7929 2.2929
Adopted search space (maximum thickness): 6.608 7.434 4.494

Now a finer search around the most promising search space area

Rayleigh-wave analysis
Optimizing Vs & Thickness - generation: 1; average & best misfits: -7.8541
-0.82038
Optimizing Vs & Thickness - generation: 2; average & best misfits: -6.6326
-0.82038
Optimizing Vs & Thickness - generation: 3; average & best misfits: -5.1479
-0.82038
Optimizing Vs & Thickness - generation: 4; average & best misfits: -5.0869
-0.82038
Optimizing Vs & Thickness - generation: 5; average & best misfits: -3.7041
-0.82038
Optimizing Vs & Thickness - generation: 6; average & best misfits: -3.3164
-0.82038
Optimizing Vs & Thickness - generation: 7; average & best misfits: -4.3462
-0.82038
Optimizing Vs & Thickness - generation: 8; average & best misfits: -4.6116
-0.82038
Optimizing Vs & Thickness - generation: 9; average & best misfits: -5.0419
-0.82038

Optimizing Vs & Thickness - generation: 10; average & best misfits: -5.2705
-0.82038
Optimizing Vs & Thickness - generation: 11; average & best misfits: -5.588
-0.82038
Optimizing Vs & Thickness - generation: 12; average & best misfits: -4.7571
-0.82038
Optimizing Vs & Thickness - generation: 13; average & best misfits: -5.3428
-0.82038
Optimizing Vs & Thickness - generation: 14; average & best misfits: -4.4417
-0.82038
Optimizing Vs & Thickness - generation: 15; average & best misfits: -3.5574
-0.82038
Optimizing Vs & Thickness - generation: 16; average & best misfits: -3.398
-0.82038

Model after the Vs & Thickness optimization (fixed Poisson values):
Vs (m/s): 176 182 180 260
Thickness (m): 6   5.8   2.5

Number of models considered to calculate the average model: 331

##
RESULTS
##

Dataset: 57.sgy
Analyzed curve/spectrum: 57bis.cdp

========== SECTION#3

Analyzing Phase Velocities

Analyzing Rayleigh-Wave Dispersion

==
MEAN MODEL

Vs (m/s):   177 181 183 260
Standard deviations (m/s): 2   5 13   5

Thickness (m):   5.6   5.9   2.9
Standard deviations (m): 0.6   0.5   0.6

Approximate values for Vp, density, Poisson & Shear modulus
Vp (m/s):   307 331 331 567
Density (gr/cm3):   1.77   1.79   1.79   1.92
Vp/Vs ratio: 1.73   1.83   1.81   2.18
Poisson: 0.25   0.29   0.28   0.37
Shear modulus (MPa): 55   59   60   130
Estimated static shear modulus (MPa): 0   0   0   0

Fundamental mode
Mean model
 f(Hz)   VR(m/s)
3.58357   215.0575
4.44896   203.508
5.08357   194.2991
6.58357   178.4287
8.42972   170.0089
12.2951   165.0564
 18.122   163.507
24.4105   163.0248
37.2181   162.7909

First higher mode
Mean model
11.2566 242.1937
16.3335 214.2355
18.2951 205.2677
20.7182 197.9935
23.6028 192.7216

========== SECTION#4

BEST MODEL

Vs (m/s): 176 182 180 260
thickness (m): 6.0017 5.7945 2.4518

Approximate values for Vp, density, Poisson & Shear modulus
Vp (m/s): 318 310 311 496
Density (gr/cm3): 1.78 1.77 1.77 1.88
Vp/Vs ratio: 1.81 1.70 1.73 1.91
Poisson: 0.28 0.24 0.25 0.31
Shear modulus (MPa): 55 59 57 127
Estimated static shear modulus (MPa): 0 0 0 0

dispersion curve (frequency - velocity)

Fundamental mode)
best model
F(Hz) VR(m/s)
3.58357 212.438
4.44896 201.5909
5.08357 193.1495
6.58357 178.4485
8.42972 170.2951
12.2951 165.2085
18.122 163.4733
24.4105 162.9255
37.2181 162.677

First higher mode)
best model
11.2566 241.3947
16.3335 214.1625
18.2951 205.3388
20.7182 198.1328
23.6028 192.8909

========== SECTION#5

Maximum penetration depth according to the "Steady State Rayleigh Method": 30 m

Inversion quality: very good

Vs30 & VsE (mean model): 214 214 m/s
Vs30 & VsE (best model): 214 214 m/s

========== 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
"C:\Users\Benedetta\Desktop\valdERA-esac\valdera-esac-2\output_disp".

==========
winMASW - Surface Waves & Beyond
www.winmasw.com

Number of models used to define the mean model: 331
Vs30 for the best model: 214 214
Analyzing phase velocities

UNIONE DI COMUNI DELLA VALDERA

INDAGINE ESAC/MASW - COMUNE DI PONTEDERA

LOC. LA ROTTA - POSTAZIONE n. 3

documentazione fotografica

ubicazione scala 1:1.000

geometria ESAC

geof	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
x	55	50	45	40	35	30	25	20	15	10	5	0	0	0	0	0	0	0	0	0	0	0	0	0
y	0	0	0	0	0	0	0	0	0	0	0	0	3	6	9	12	15	18	21	24	27	30	33	36

geometria MASW

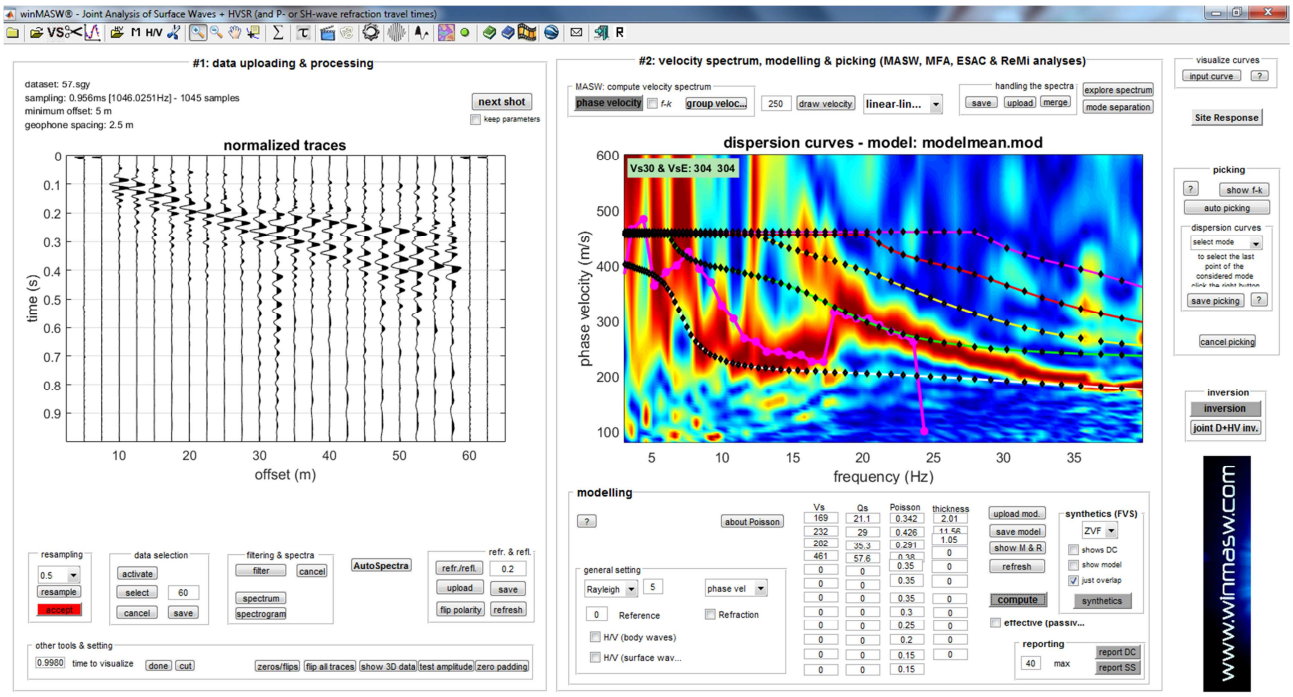
distanza geofonica 12 ch 5 m

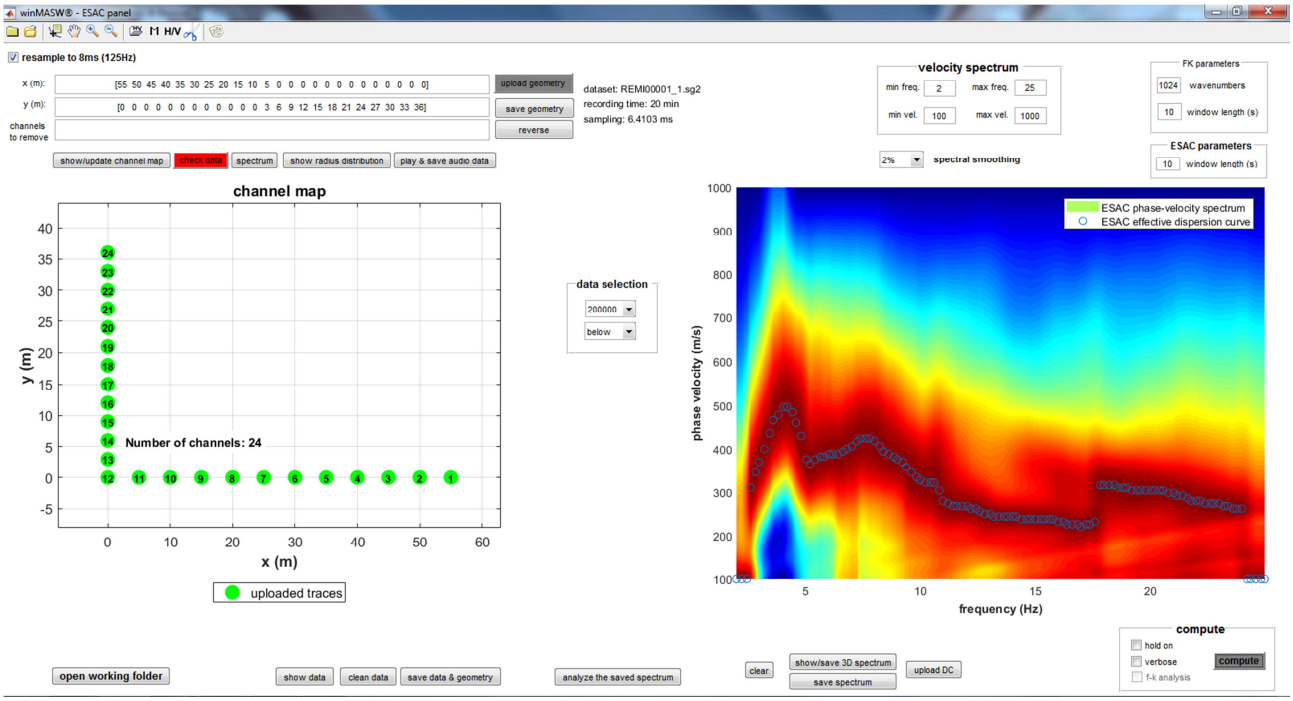
lunghezza linea 57.5 m

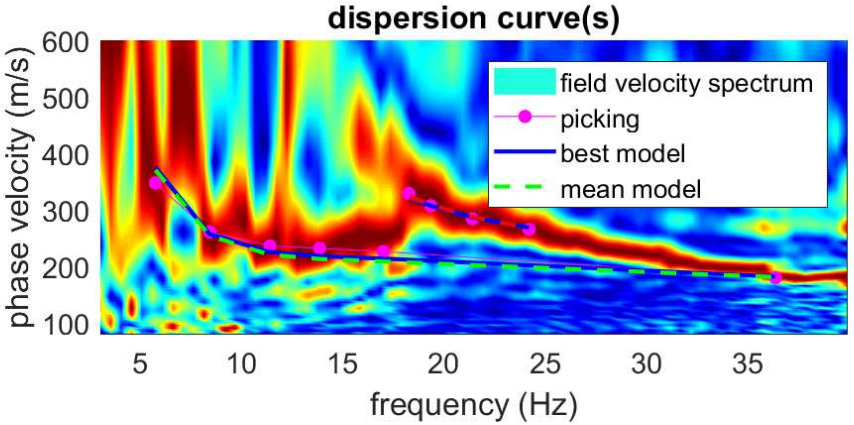
coordinate stazione 43°66’ 15.46” N 10°69’ 13.69” E

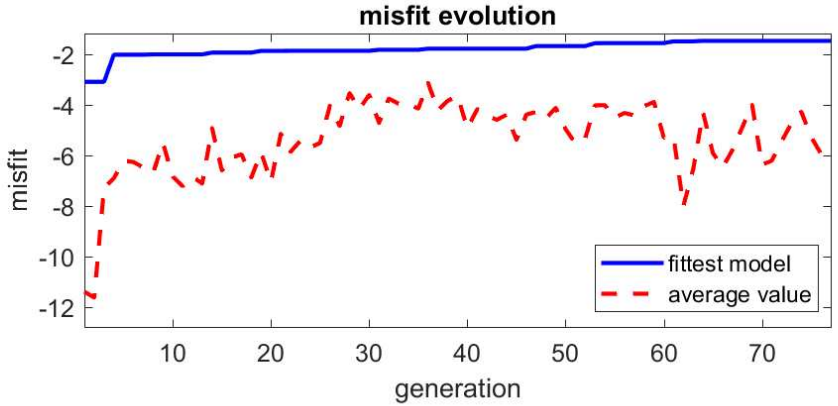
UNIONE VALDERA - Indagini sismiche MASW/ESAC

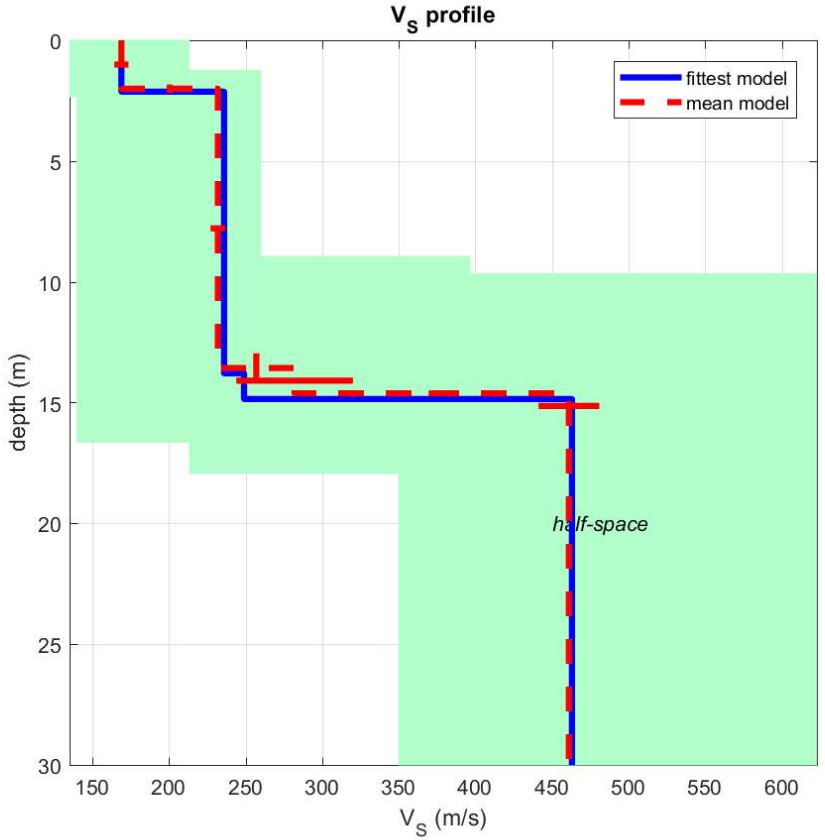
PROVA n. 3











www.winmasw.com

dataset: 57.sgy
dispersion curve: 57boh.cdp
Vs30 & VsE (best model): 303 303 m/s
Vs30 & VsE (mean model): 304 304 m/s

Mean model

Vs (m/s): 169, 232, 282, 461

Standard deviations (m/s): 5, 5, 38, 20

Thickness (m): 2.0, 11.6, 1.0

========== SECTION#1
dataset: 57.sgy
sampling (ms): 0.956
minimum offset (m): 5
geophone spacing (m): 2.5
offsets (m): 5 7.5 10 12.5 15 17.5
20 22.5 25 27.5 30 32.5
35 37.5 40 42.5 45 47.5
50 52.5 55 57.5 60 62.5
Dispersion curve: 57boh.cdp
Number of individuals: 32
Number of generations: 61

Rayleigh-wave dispersion analysis

Analyzing phase velocities

Adopted search space (minimum Vs): 114.8 140 213.5
350
Adopted search space (maximum Vs): 213.2 260 396.5
650

Adopted search space (minimum Poisson): 0.22209 0.24795 0.22468
0.24664
Adopted search space (maximum Poisson): 0.41244 0.46047 0.41727
0.45804

Adopted search space (minimum Qs): 14.35 22.575 26.6875 35.2625
Adopted search space (maximum Qs): 26.65 41.925 49.5625 65.4875

Adopted search space (minimum reference frequency): 1
Adopted search space (maximum reference frequency): 36.368

Adopted search space (minimum thickness): 1.26 7.7 0.7
Adopted search space (maximum thickness): 2.34 14.3 1.3

Output folder:
C:\Users\Benedetta\Desktop\valdERA-esac\valdera-esac-3\output_disp

========== SECTION#2
Rayleigh-wave analysis
Optimizing Vs & Thickness - generation: 1; average & best misfits: -11.3816
-3.07674
Optimizing Vs & Thickness - generation: 2; average & best misfits: -11.6182
-3.07674
Optimizing Vs & Thickness - generation: 3; average & best misfits: -7.2751
-3.0767
Optimizing Vs & Thickness - generation: 4; average & best misfits: -6.8903
-2.002
Optimizing Vs & Thickness - generation: 5; average & best misfits: -6.2017
-2.002
Optimizing Vs & Thickness - generation: 6; average & best misfits: -6.2499
-2.002
Optimizing Vs & Thickness - generation: 7; average & best misfits: -6.4708
-2.002
Optimizing Vs & Thickness - generation: 8; average & best misfits: -6.6741
-1.9891
Optimizing Vs & Thickness - generation: 9; average & best misfits: -5.4995
-1.9891
Optimizing Vs & Thickness - generation: 10; average & best misfits: -6.8294
-1.9891
Optimizing Vs & Thickness - generation: 11; average & best misfits: -7.2089
-1.9891
Optimizing Vs & Thickness - generation: 12; average & best misfits: -6.8225

-1.9891
Optimizing Vs & Thickness - generation: 13; average & best misfits: -7.1061
-1.9891
Optimizing Vs & Thickness - generation: 14; average & best misfits: -4.9044
-1.9189
Optimizing Vs & Thickness - generation: 15; average & best misfits: -6.5871
-1.9189
Optimizing Vs & Thickness - generation: 16; average & best misfits: -6.0761
-1.9189
Optimizing Vs & Thickness - generation: 17; average & best misfits: -5.9435
-1.9189
Optimizing Vs & Thickness - generation: 18; average & best misfits: -6.859
-1.9189
Optimizing Vs & Thickness - generation: 19; average & best misfits: -5.87
-1.8512
Optimizing Vs & Thickness - generation: 20; average & best misfits: -7.0336
-1.8512
Optimizing Vs & Thickness - generation: 21; average & best misfits: -5.1332
-1.8512
Optimizing Vs & Thickness - generation: 22; average & best misfits: -5.8455
-1.8485
Optimizing Vs & Thickness - generation: 23; average & best misfits: -5.4039
-1.8476
Optimizing Vs & Thickness - generation: 24; average & best misfits: -5.6785
-1.8476
Optimizing Vs & Thickness - generation: 25; average & best misfits: -5.4934
-1.8476
Optimizing Vs & Thickness - generation: 26; average & best misfits: -4.0232
-1.8476
Optimizing Vs & Thickness - generation: 27; average & best misfits: -4.8216
-1.8476
Optimizing Vs & Thickness - generation: 28; average & best misfits: -3.5218
-1.8476
Optimizing Vs & Thickness - generation: 29; average & best misfits: -4.1541
-1.8476
Optimizing Vs & Thickness - generation: 30; average & best misfits: -3.5907
-1.8476
Optimizing Vs & Thickness - generation: 31; average & best misfits: -4.7022
-1.8087
Optimizing Vs & Thickness - generation: 32; average & best misfits: -3.7395
-1.8087
Optimizing Vs & Thickness - generation: 33; average & best misfits: -3.9441
-1.8087
Optimizing Vs & Thickness - generation: 34; average & best misfits: -3.9627
-1.8087
Optimizing Vs & Thickness - generation: 35; average & best misfits: -4.1349
-1.8087
Optimizing Vs & Thickness - generation: 36; average & best misfits: -3.1176
-1.7627
Optimizing Vs & Thickness - generation: 37; average & best misfits: -4.1987
-1.7627
Optimizing Vs & Thickness - generation: 38; average & best misfits: -3.8256
-1.7627
Optimizing Vs & Thickness - generation: 39; average & best misfits: -3.6339
-1.7627
Optimizing Vs & Thickness - generation: 40; average & best misfits: -4.9169
-1.7627
Optimizing Vs & Thickness - generation: 41; average & best misfits: -4.1615
-1.7627
Optimizing Vs & Thickness - generation: 42; average & best misfits: -4.4177
-1.7627
Optimizing Vs & Thickness - generation: 43; average & best misfits: -4.5804
-1.7627
Optimizing Vs & Thickness - generation: 44; average & best misfits: -4.3781
-1.7627
Optimizing Vs & Thickness - generation: 45; average & best misfits: -5.3718
-1.7627
Optimizing Vs & Thickness - generation: 46; average & best misfits: -4.3708

-1.7627
Optimizing Vs & Thickness - generation: 47; average & best misfits: -4.2695
-1.6597
Optimizing Vs & Thickness - generation: 48; average & best misfits: -4.5239
-1.6597
Optimizing Vs & Thickness - generation: 49; average & best misfits: -4.1061
-1.6597
Optimizing Vs & Thickness - generation: 50; average & best misfits: -4.9478
-1.6597
Optimizing Vs & Thickness - generation: 51; average & best misfits: -5.511
-1.6597
Optimizing Vs & Thickness - generation: 52; average & best misfits: -5.314
-1.6597
Optimizing Vs & Thickness - generation: 53; average & best misfits: -4.0052
-1.5469
Optimizing Vs & Thickness - generation: 54; average & best misfits: -3.9992
-1.5435
Optimizing Vs & Thickness - generation: 55; average & best misfits: -4.4992
-1.5435
Optimizing Vs & Thickness - generation: 56; average & best misfits: -4.3083
-1.5435
Optimizing Vs & Thickness - generation: 57; average & best misfits: -4.4064
-1.5435
Optimizing Vs & Thickness - generation: 58; average & best misfits: -4.0344
-1.5435
Optimizing Vs & Thickness - generation: 59; average & best misfits: -3.8733
-1.5435
Optimizing Vs & Thickness - generation: 60; average & best misfits: -5.2807
-1.5435
Optimizing Vs & Thickness - generation: 61; average & best misfits: -5.2587
-1.4735

Adopted search space (minimum Vs): 114.8 140 213.5
350
Adopted search space (maximum Vs): 213.2 260 396.5
650

Adopted search space (minimum Qs): 14.35 22.575 26.6875 35.2625
Adopted search space (maximum Qs): 26.65 41.925 49.5625 65.4875

Adopted search space (minimum reference frequency): 1
Adopted search space (maximum reference frequency): 36.368

Adopted search space (minimum Poisson): 0.22209 0.24795 0.22468
0.24664
Adopted search space (maximum Poisson): 0.41244 0.46047 0.41727
0.45804

Adopted search space (minimum thickness): 1.26 7.7 0.7
Adopted search space (maximum thickness): 2.34 14.3 1.3

Now a finer search around the most promising search space area

Rayleigh-wave analysis
Optimizing Vs & Thickness - generation: 1; average & best misfits: -7.9863
-1.4735
Optimizing Vs & Thickness - generation: 2; average & best misfits: -6.5381
-1.4735
Optimizing Vs & Thickness - generation: 3; average & best misfits: -4.2984
-1.4537
Optimizing Vs & Thickness - generation: 4; average & best misfits: -5.894
-1.4537
Optimizing Vs & Thickness - generation: 5; average & best misfits: -6.461
-1.4537
Optimizing Vs & Thickness - generation: 6; average & best misfits: -5.7659
-1.4537
Optimizing Vs & Thickness - generation: 7; average & best misfits: -4.8692

-1.4537
Optimizing Vs & Thickness - generation: 8; average & best misfits: -3.991
-1.4537
Optimizing Vs & Thickness - generation: 9; average & best misfits: -6.3596
-1.4537
Optimizing Vs & Thickness - generation: 10; average & best misfits: -6.1984
-1.4537
Optimizing Vs & Thickness - generation: 11; average & best misfits: -5.4317
-1.4537
Optimizing Vs & Thickness - generation: 12; average & best misfits: -4.7142
-1.4537
Optimizing Vs & Thickness - generation: 13; average & best misfits: -4.2588
-1.4537
Optimizing Vs & Thickness - generation: 14; average & best misfits: -5.2492
-1.4537
Optimizing Vs & Thickness - generation: 15; average & best misfits: -5.9161
-1.4537
Optimizing Vs & Thickness - generation: 16; average & best misfits: -5.8874
-1.4537

Model after the Vs & Thickness optimization (fixed Poisson values):
Vs (m/s): 169 236 249 463
Thickness (m): 2.1 12 1.1

Number of models considered to calculate the average model: 275

##
RESULTS
##

Dataset: 57.sgy
Analyzed curve/spectrum: 57boh.cdp

========== SECTION#3

Analyzing Phase Velocities

Analyzing Rayleigh-Wave Dispersion

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

Vs (m/s): 169 232 282 461
Standard deviations (m/s): 5 5 38 20

Thickness (m): 2.0 11.6 1.0
Standard deviations (m): 0.2 0.6 0.1

Approximate values for Vp, density, Poisson & Shear modulus
Vp (m/s): 345 645 519 1049
Density (gr/cm3): 1.80 1.95 1.90 2.07
Vp/Vs ratio: 2.04 2.78 1.84 2.28
Poisson: 0.34 0.43 0.29 0.38
Shear modulus (MPa): 51 105 151 439
Estimated static shear modulus (MPa): 0 0 0 0

Fundamental mode
Mean model
 f(Hz) VR(m/s)
5.77836 370.3301
8.46065 253.593
11.4283 219.7722
13.8823 212.351
17.0212 207.8467

36.368	180.4066

First higher mode
Mean model

18.2767	322.4131
19.3611	308.7035
21.4156	286.846
24.212	267.3698

========== SECTION#4

BEST MODEL

Vs (m/s): 169 236 249 463
thickness (m): 2.12917 11.6579 1.06336

Approximate values for Vp, density, Poisson & Shear modulus
Vp (m/s): 386 863 418 1221
Density (gr/cm3): 1.82 2.02 1.84 2.10
Vp/Vs ratio: 2.28 3.66 1.68 2.64
Poisson: 0.38 0.46 0.22 0.42
Shear modulus (MPa): 52 112 114 451
Estimated static shear modulus (MPa): 0 0 0 0

dispersion curve (frequency - velocity)

Fundamental mode)
best model

F(Hz)	VR(m/s)
5.77836	374.5009
8.46065	256.3697
11.4283	224.6803
13.8823	217.5389
17.0212	213.07
36.368	181.3392

First higher mode)
best model

18.2767	320.3813
19.3611	306.7074
21.4156	286.0778
24.212	268.1043

========== SECTION#5

Maximum penetration depth according to the "Steady State Rayleigh Method": 30 m

Inversion quality: very good

Vs30 & VsE (mean model): 304 304 m/s
Vs30 & VsE (best model): 303 303 m/s

========== 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
"C:\Users\Benedetta\Desktop\valdERA-esac\valdera-esac-3\output_disp".

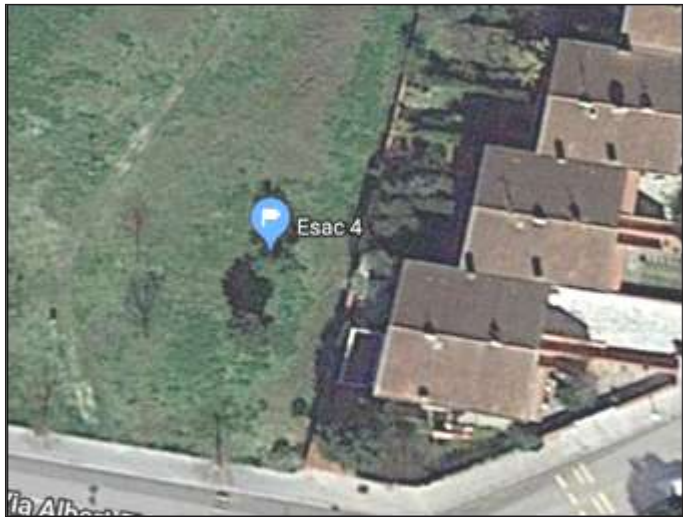
==========
winMASW - Surface Waves & Beyond
www.winmasw.com

Number of models used to define the mean model: 275
Vs30 for the best model: 303 303
Analyzing phase velocities

UNIONE DI COMUNI DELLA VALDERA

INDAGINE ESAC/MASW - COMUNE DI PONTEDERA

LOC. IL ROMITO - POSTAZIONE n.4



documentazione fotografica

ubicazione scala 1:1.000

geometria ESAC

geof	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
x	55	50	45	40	35	30	25	20	15	10	5	0	0	0	0	0	0	0	0	0	0	0	0	0
y	0	0	0	0	0	0	0	0	0	0	0	0	3	6	9	12	15	18	21	24	27	30	33	36

geometria MASW

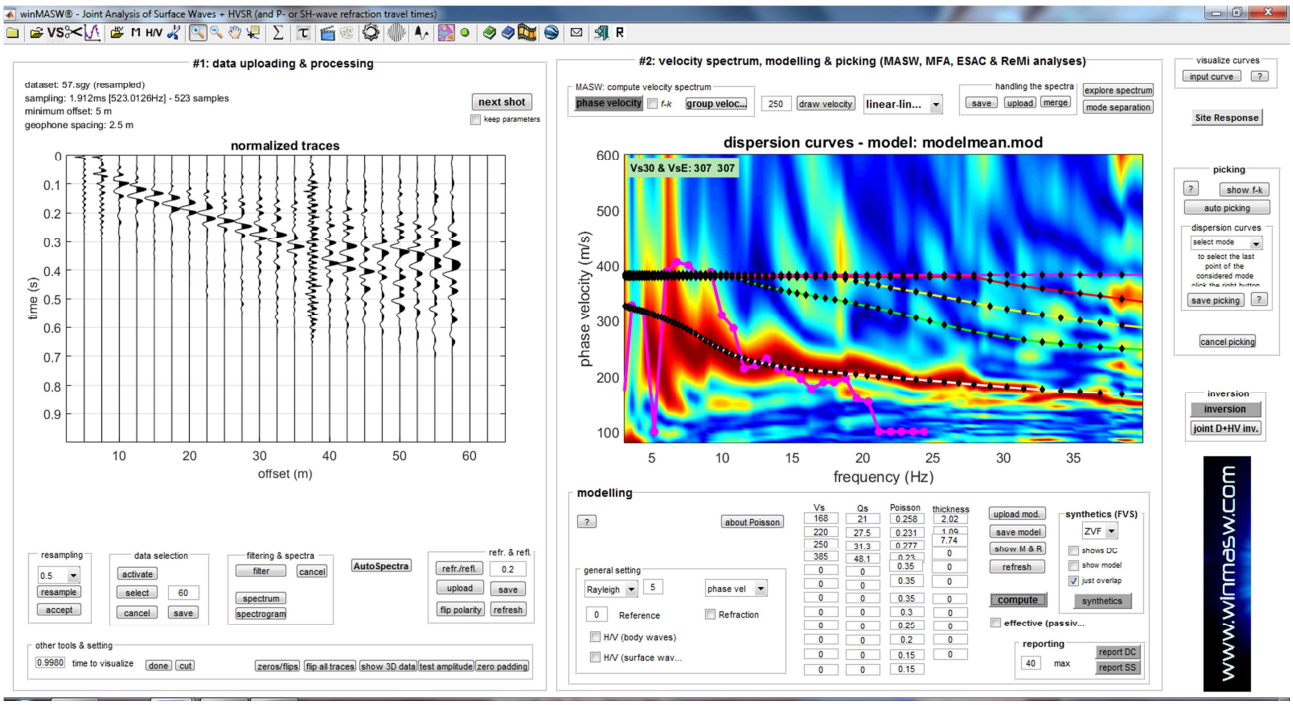
distanza geofonica 12 ch 5 m

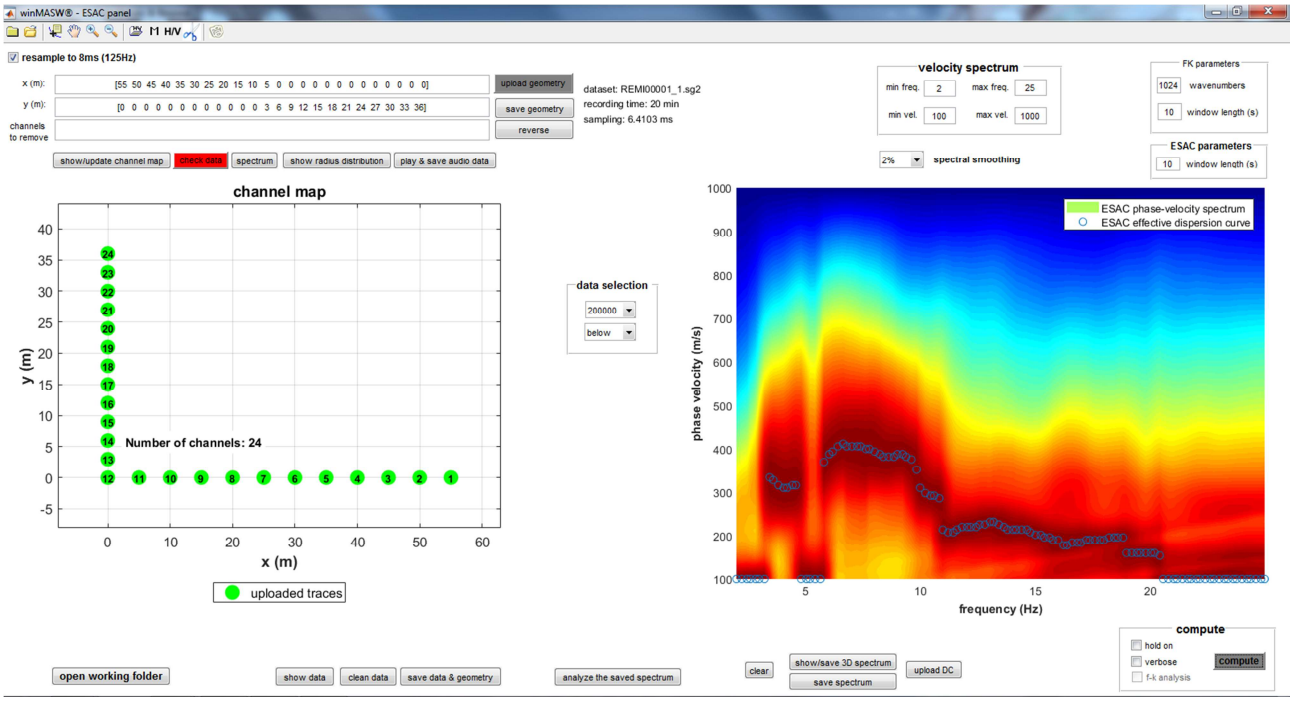
lunghezza linea 57.5 m

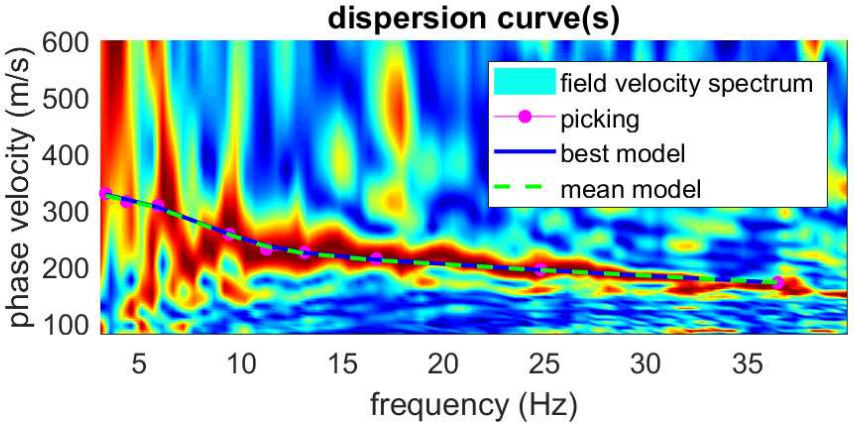
coordinate stazione 43°64’ 96.31” N 10°64’ 65.03” E

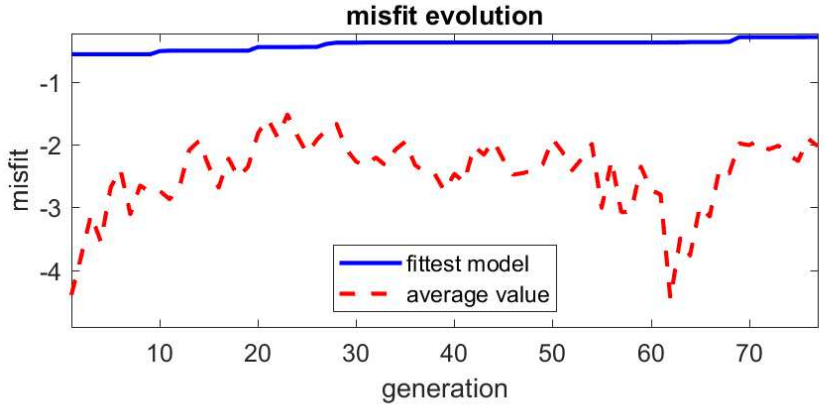
UNIONE VALDERA - Indagini sismiche MASW/ESAC

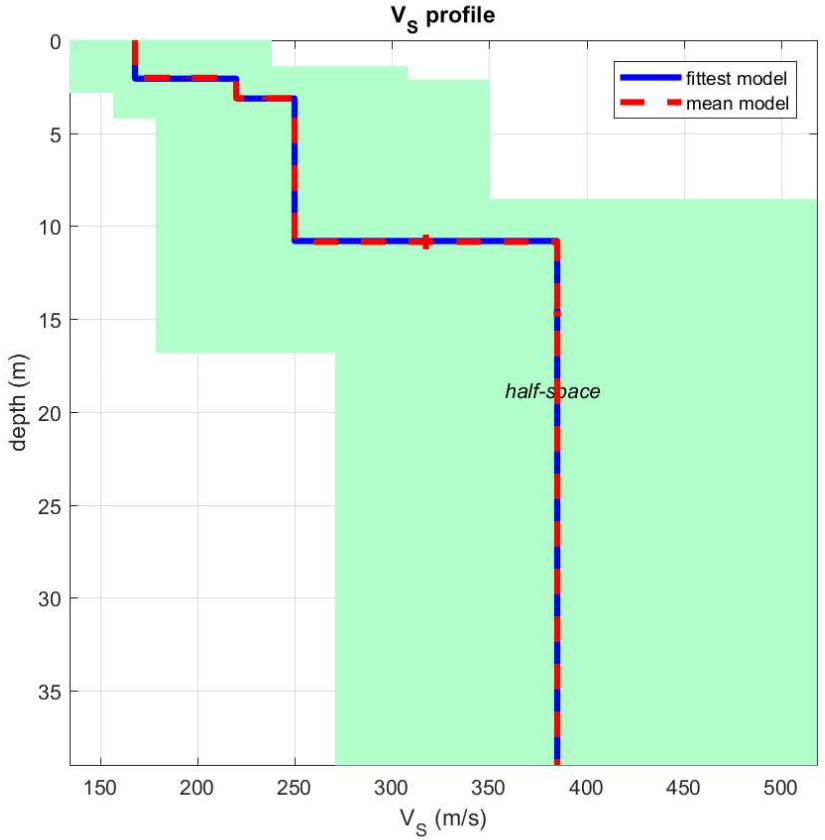
PROVA n. 4











www.winmasw.com

dataset: 57.sgy
dispersion curve: 57ter.cdp
Vs30 & VsE (best model): 307 307 m/s
Vs30 & VsE (mean model): 307 307 m/s

Mean model

Vs (m/s): 168, 220, 250, 385

Standard deviations (m/s): 1, 0, 1, 2

Thickness (m): 2.0, 1.1, 7.7

========== SECTION#1
dataset: 57.sgy
sampling (ms): 1.912
minimum offset (m): 5
geophone spacing (m): 2.5
offsets (m): 5 7.5 10 12.5 15 17.5
20 22.5 25 27.5 30 32.5
35 37.5 40 42.5 45 47.5
50 52.5 55 57.5 60 62.5
Dispersion curve: 57ter.cdp
Number of individuals: 32
Number of generations: 61

Rayleigh-wave dispersion analysis

Analyzing phase velocities

Adopted search space (minimum Vs): 121 157 179 271
Adopted search space (maximum Vs): 238 308 350 532

Adopted search space (minimum Poisson): 0.13058 0.12295 0.16104
0.13092
Adopted search space (maximum Poisson): 0.39174 0.36886 0.48312
0.39276

Adopted search space (minimum Qs): 15.75 20.4375 23.7225 24
Adopted search space (maximum Qs): 31.5 40.875 47.445 48

Adopted search space (minimum reference frequency): 1
Adopted search space (maximum reference frequency): 36.5178

Adopted search space (minimum thickness): 1.4286 0.71429 6.4286
Adopted search space (maximum thickness): 2.8 1.4 12.6

Output folder:
C:\Users\Benedetta\Desktop\valdERA-esac\valdera-esac-4\output_disp

========== SECTION#2
Rayleigh-wave analysis
Optimizing Vs & Thickness - generation: 1; average & best misfits: -4.3995
-0.55822
Optimizing Vs & Thickness - generation: 2; average & best misfits: -3.7771
-0.55822
Optimizing Vs & Thickness - generation: 3; average & best misfits: -3.1155
-0.55822
Optimizing Vs & Thickness - generation: 4; average & best misfits: -3.5487
-0.55822
Optimizing Vs & Thickness - generation: 5; average & best misfits: -2.6826
-0.55822
Optimizing Vs & Thickness - generation: 6; average & best misfits: -2.3966
-0.55822
Optimizing Vs & Thickness - generation: 7; average & best misfits: -3.1083
-0.55822
Optimizing Vs & Thickness - generation: 8; average & best misfits: -2.6523
-0.55822
Optimizing Vs & Thickness - generation: 9; average & best misfits: -2.7511
-0.55822
Optimizing Vs & Thickness - generation: 10; average & best misfits: -2.7368
-0.50793
Optimizing Vs & Thickness - generation: 11; average & best misfits: -2.8697
-0.50145
Optimizing Vs & Thickness - generation: 12; average & best misfits: -2.6802
-0.50145
Optimizing Vs & Thickness - generation: 13; average & best misfits: -2.0857

-0.50145
Optimizing Vs & Thickness - generation: 14; average & best misfits: -1.9408
-0.50145
Optimizing Vs & Thickness - generation: 15; average & best misfits: -2.3479
-0.50145
Optimizing Vs & Thickness - generation: 16; average & best misfits: -2.6841
-0.50145
Optimizing Vs & Thickness - generation: 17; average & best misfits: -2.2197
-0.50145
Optimizing Vs & Thickness - generation: 18; average & best misfits: -2.5213
-0.50145
Optimizing Vs & Thickness - generation: 19; average & best misfits: -2.3475
-0.50145
Optimizing Vs & Thickness - generation: 20; average & best misfits: -1.8182
-0.44355
Optimizing Vs & Thickness - generation: 21; average & best misfits: -1.5857
-0.44355
Optimizing Vs & Thickness - generation: 22; average & best misfits: -1.8845
-0.44355
Optimizing Vs & Thickness - generation: 23; average & best misfits: -1.5169
-0.44355
Optimizing Vs & Thickness - generation: 24; average & best misfits: -1.8546
-0.44355
Optimizing Vs & Thickness - generation: 25; average & best misfits: -2.1424
-0.44147
Optimizing Vs & Thickness - generation: 26; average & best misfits: -1.9221
-0.44147
Optimizing Vs & Thickness - generation: 27; average & best misfits: -1.7538
-0.39264
Optimizing Vs & Thickness - generation: 28; average & best misfits: -1.6682
-0.37328
Optimizing Vs & Thickness - generation: 29; average & best misfits: -2.075
-0.37328
Optimizing Vs & Thickness - generation: 30; average & best misfits: -2.272
-0.37328
Optimizing Vs & Thickness - generation: 31; average & best misfits: -2.3313
-0.37105
Optimizing Vs & Thickness - generation: 32; average & best misfits: -2.2034
-0.37105
Optimizing Vs & Thickness - generation: 33; average & best misfits: -2.3312
-0.37105
Optimizing Vs & Thickness - generation: 34; average & best misfits: -2.0779
-0.37105
Optimizing Vs & Thickness - generation: 35; average & best misfits: -1.9522
-0.37105
Optimizing Vs & Thickness - generation: 36; average & best misfits: -2.3252
-0.37105
Optimizing Vs & Thickness - generation: 37; average & best misfits: -2.4309
-0.37105
Optimizing Vs & Thickness - generation: 38; average & best misfits: -2.4659
-0.37105
Optimizing Vs & Thickness - generation: 39; average & best misfits: -2.7404
-0.37105
Optimizing Vs & Thickness - generation: 40; average & best misfits: -2.4646
-0.37105
Optimizing Vs & Thickness - generation: 41; average & best misfits: -2.6034
-0.37105
Optimizing Vs & Thickness - generation: 42; average & best misfits: -2.024
-0.37105
Optimizing Vs & Thickness - generation: 43; average & best misfits: -2.1581
-0.37105
Optimizing Vs & Thickness - generation: 44; average & best misfits: -1.9399
-0.37105
Optimizing Vs & Thickness - generation: 45; average & best misfits: -2.2447
-0.37105
Optimizing Vs & Thickness - generation: 46; average & best misfits: -2.4783
-0.37105
Optimizing Vs & Thickness - generation: 47; average & best misfits: -2.4527

-0.37105
Optimizing Vs & Thickness - generation: 48; average & best misfits: -2.405
-0.37105
Optimizing Vs & Thickness - generation: 49; average & best misfits: -2.3156
-0.37105
Optimizing Vs & Thickness - generation: 50; average & best misfits: -1.9068
-0.37105
Optimizing Vs & Thickness - generation: 51; average & best misfits: -2.1162
-0.37105
Optimizing Vs & Thickness - generation: 52; average & best misfits: -2.4072
-0.37105
Optimizing Vs & Thickness - generation: 53; average & best misfits: -2.2193
-0.37105
Optimizing Vs & Thickness - generation: 54; average & best misfits: -1.9889
-0.37105
Optimizing Vs & Thickness - generation: 55; average & best misfits: -3.0084
-0.37105
Optimizing Vs & Thickness - generation: 56; average & best misfits: -2.249
-0.37105
Optimizing Vs & Thickness - generation: 57; average & best misfits: -3.0777
-0.37105
Optimizing Vs & Thickness - generation: 58; average & best misfits: -3.0671
-0.37105
Optimizing Vs & Thickness - generation: 59; average & best misfits: -2.3494
-0.37105
Optimizing Vs & Thickness - generation: 60; average & best misfits: -2.7218
-0.37105
Optimizing Vs & Thickness - generation: 61; average & best misfits: -2.7945
-0.37105

Adopted search space (minimum Vs): 121 157 179 271
Adopted search space (maximum Vs): 238 308 350 532

Adopted search space (minimum Qs): 15.75 20.4375 23.7225 24
Adopted search space (maximum Qs): 31.5 40.875 47.445 48

Adopted search space (minimum reference frequency): 1
Adopted search space (maximum reference frequency): 36.5178

Adopted search space (minimum Poisson): 0.15 0.15 0.16104 0.15
Adopted search space (maximum Poisson): 0.39174 0.36886 0.48312
0.39276

Adopted search space (minimum thickness): 1.4286 0.71429 6.4286
Adopted search space (maximum thickness): 2.8 1.4 12.6

Now a finer search around the most promising search space area

Rayleigh-wave analysis
Optimizing Vs & Thickness - generation: 1; average & best misfits: -4.4604
-0.36924
Optimizing Vs & Thickness - generation: 2; average & best misfits: -3.4934
-0.36924
Optimizing Vs & Thickness - generation: 3; average & best misfits: -3.7678
-0.36454
Optimizing Vs & Thickness - generation: 4; average & best misfits: -2.979
-0.36454
Optimizing Vs & Thickness - generation: 5; average & best misfits: -3.1456
-0.36454
Optimizing Vs & Thickness - generation: 6; average & best misfits: -2.3812
-0.36454
Optimizing Vs & Thickness - generation: 7; average & best misfits: -2.4553
-0.35885
Optimizing Vs & Thickness - generation: 8; average & best misfits: -1.9793
-0.28574
Optimizing Vs & Thickness - generation: 9; average & best misfits: -2.0064
-0.28574

Optimizing Vs & Thickness - generation: 10; average & best misfits: -1.9386
-0.28574
Optimizing Vs & Thickness - generation: 11; average & best misfits: -2.077
-0.28574
Optimizing Vs & Thickness - generation: 12; average & best misfits: -2.016
-0.28512
Optimizing Vs & Thickness - generation: 13; average & best misfits: -2.1588
-0.28512
Optimizing Vs & Thickness - generation: 14; average & best misfits: -2.2601
-0.28474
Optimizing Vs & Thickness - generation: 15; average & best misfits: -1.9032
-0.28394
Optimizing Vs & Thickness - generation: 16; average & best misfits: -2.022
-0.28394

Model after the Vs & Thickness optimization (fixed Poisson values):
Vs (m/s): 168 220 250 385
Thickness (m): 2.1   1.1   7.7

Number of models considered to calculate the average model: 52

##
RESULTS
##

Dataset: 57.sgy
Analyzed curve/spectrum: 57ter.cdp

== SECTION#3

Analyzing Phase Velocities

Analyzing Rayleigh-Wave Dispersion

==
MEAN MODEL

Vs (m/s):   168 220 250 385
Standard deviations (m/s): 1 0 1 2

Thickness (m):   2.0   1.1   7.7
Standard deviations (m): 0.0   0.1   0.4

Approximate values for Vp, density, Poisson & Shear modulus
Vp (m/s):   294 372 450 650
Density (gr/cm3):   1.76   1.81   1.86   1.95
Vp/Vs ratio: 1.75   1.69   1.80   1.69
Poisson: 0.26   0.23   0.28   0.23
Shear modulus (MPa): 50   88   116   289
Estimated static shear modulus (MPa): 0   0   0   0

Fundamental mode
Mean model
 f(Hz)   VR(m/s)
3.32759   324.525
4.35586   316.649
5.89826   303.2082
9.44008   255.2487
11.2681   234.6564
13.1533   222.302
16.6951   210.2462
 24.807   192.685
36.5178   170.7937

========== SECTION#4

BEST MODEL

Vs (m/s): 168 220 250 385
thickness (m): 2.0649 1.0678 7.6698

Approximate values for Vp, density, Poisson & Shear modulus
Vp (m/s): 294 414 440 673
Density (gr/cm3): 1.76 1.84 1.86 1.96
Vp/Vs ratio: 1.75 1.88 1.76 1.75
Poisson: 0.26 0.30 0.26 0.26
Shear modulus (MPa): 50 89 116 290
Estimated static shear modulus (MPa): 0 0 0 0

dispersion curve (frequency - velocity)

Fundamental mode)
best model

F(Hz)	VR(m/s)
3.32759	326.2261
4.35586	318.0504
5.89826	304.1993
9.44008	256.2807
11.2681	235.8275
13.1533	223.4374
16.6951	211.2066
24.807	192.946
36.5178	170.295

========== SECTION#5

Maximum penetration depth according to the "Steady State Rayleigh Method": 39 m

Inversion quality: very good

Vs30 & VsE (mean model): 307 307 m/s
Vs30 & VsE (best model): 307 307 m/s

========== 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
"C:\Users\Benedetta\Desktop\valdERA-esac\valdera-esac-4\output_disp".

==========
winMASW - Surface Waves & Beyond
www.winmasw.com

Number of models used to define the mean model: 52
Vs30 for the best model: 307 307
Analyzing phase velocities

UNIONE DI COMUNI DELLA VALDERA

INDAGINE ESAC/MASW - COMUNE DI PONTEDERA

LOC. SANTA LUCIA - POSTAZIONE n.5

documentazione fotografica

ubicazione scala 1:1.000

geometria ESAC

geof	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
x	55	50	45	40	35	30	25	20	15	10	5	0	0	0	0	0	0	0	0	0	0	0	0	0
y	0	0	0	0	0	0	0	0	0	0	0	0	3	6	9	12	15	18	21	24	27	30	33	36

geometria MASW

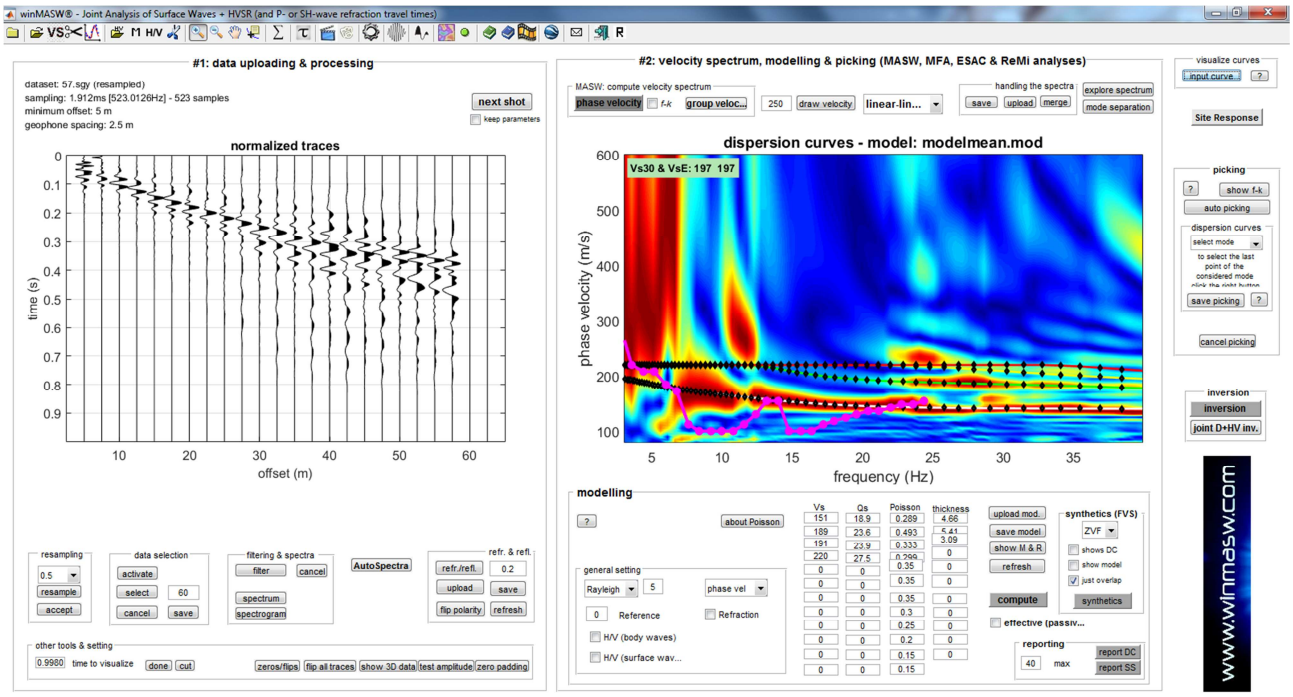
distanza geofonica 12 ch 5 m

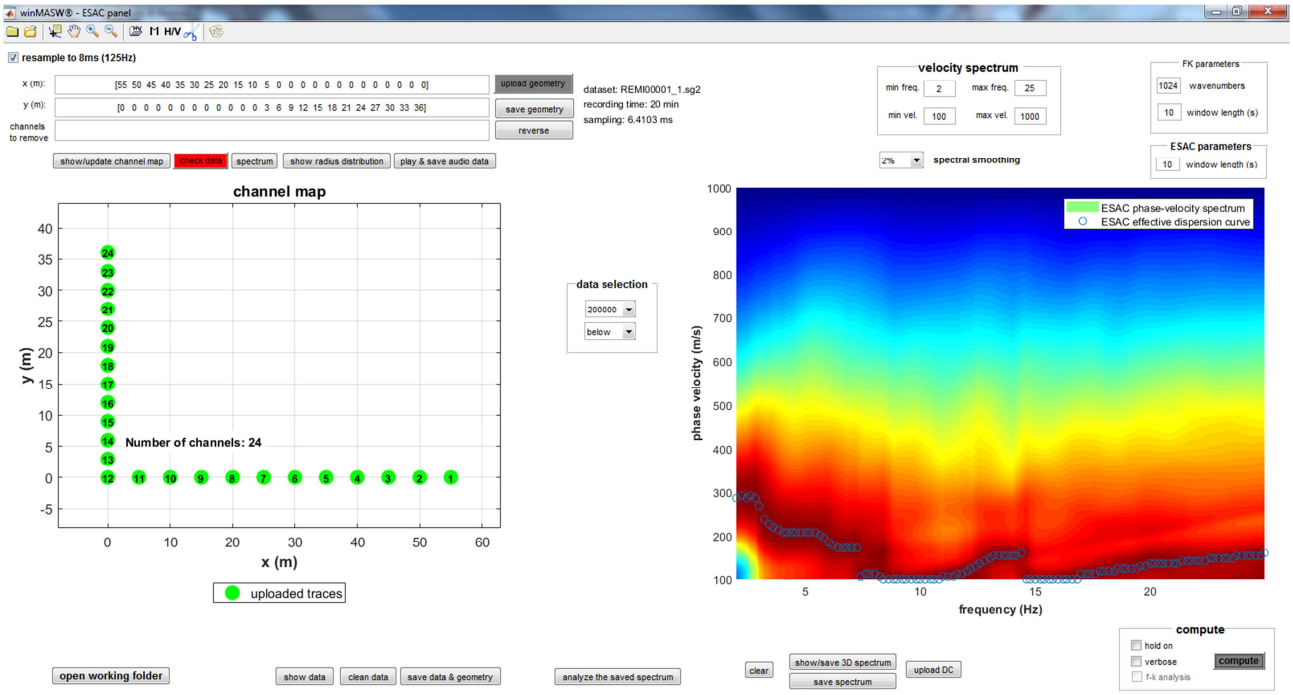
lunghezza linea 57.5 m

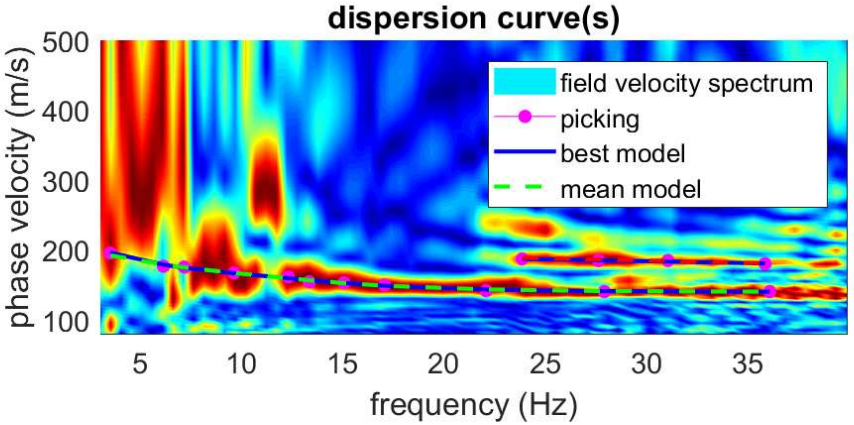
coordinate stazione 43°64’ 72.66” N 10°61’ 88.72” E

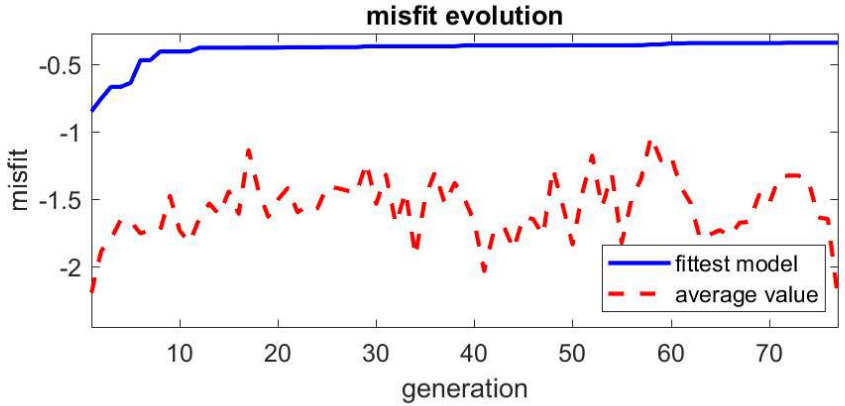
UNIONE VALDERA - Indagini sismiche MASW/ESAC

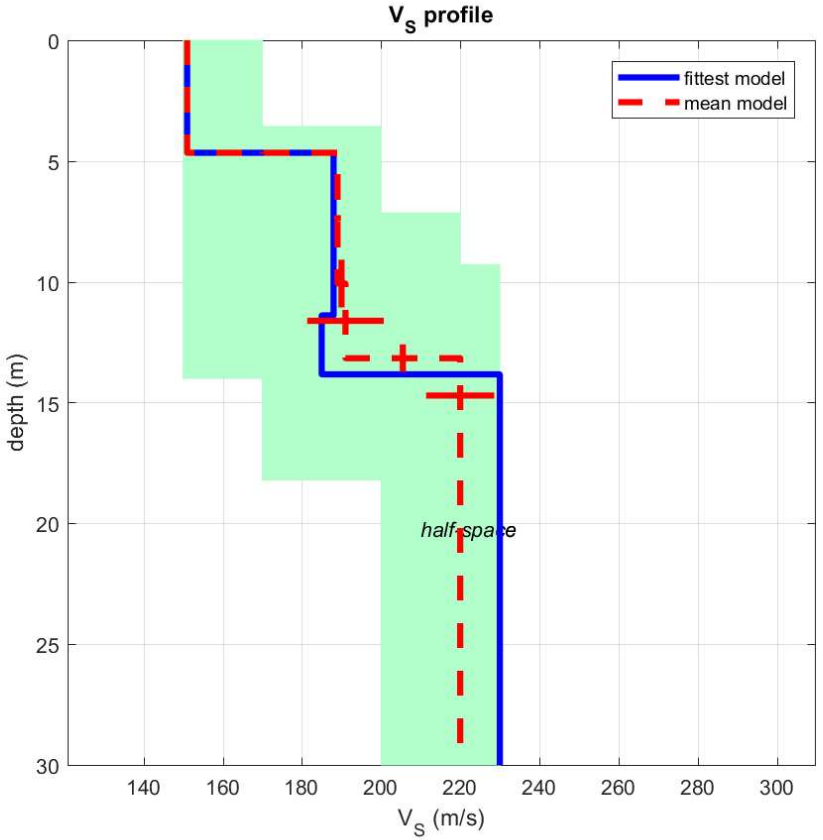
PROVA n. 5











www.winmasw.com

dataset: 57.sgy
dispersion curve: 57.cdp
Vs30 & VsE (best model): 200 200 m/s
Vs30 & VsE (mean model): 197 197 m/s

Mean model

Vs (m/s): 151, 189, 191, 220

Standard deviations (m/s): 0, 1, 10, 9

Thickness (m): 4.7, 5.4, 3.1

========== SECTION#1
dataset: 57.sgy
sampling (ms): 0.956
minimum offset (m): 5
geophone spacing (m): 2.5
offsets (m): 5 7.5 10 12.5 15 17.5
20 22.5 25 27.5 30 32.5
35 37.5 40 42.5 45 47.5
50 52.5 55 57.5 60 62.5
Dispersion curve: 57.cdp
Number of individuals: 32
Number of generations: 61

Rayleigh-wave dispersion analysis

Analyzing phase velocities

Adopted search space (minimum Vs): 150 150 170 200
Adopted search space (maximum Vs): 170 200 220 230

Adopted search space (minimum Poisson): 0.16516 0.17516 0.17484
0.17501
Adopted search space (maximum Poisson): 0.49549 0.499 0.499
0.499

Adopted search space (minimum Qs): 7.5 12 14.25 18
Adopted search space (maximum Qs): 15 24 28.5 36

Adopted search space (minimum reference frequency): 1
Adopted search space (maximum reference frequency): 36.0826

Adopted search space (minimum thickness): 3.5714 3.5714 2.1429
Adopted search space (maximum thickness): 7 7 4.2

Output folder:
C:\Users\Benedetta\Desktop\valdERA-esac\valdera-esac-5\output_disp

========== SECTION#2
Rayleigh-wave analysis
Optimizing Vs & Thickness - generation: 1; average & best misfits: -2.1945
-0.85033
Optimizing Vs & Thickness - generation: 2; average & best misfits: -1.8835
-0.75426
Optimizing Vs & Thickness - generation: 3; average & best misfits: -1.7943
-0.66789
Optimizing Vs & Thickness - generation: 4; average & best misfits: -1.6506
-0.66789
Optimizing Vs & Thickness - generation: 5; average & best misfits: -1.6639
-0.63782
Optimizing Vs & Thickness - generation: 6; average & best misfits: -1.7534
-0.47064
Optimizing Vs & Thickness - generation: 7; average & best misfits: -1.7298
-0.47064
Optimizing Vs & Thickness - generation: 8; average & best misfits: -1.7304
-0.40573
Optimizing Vs & Thickness - generation: 9; average & best misfits: -1.4754
-0.40573
Optimizing Vs & Thickness - generation: 10; average & best misfits: -1.7333
-0.40573
Optimizing Vs & Thickness - generation: 11; average & best misfits: -1.823
-0.40573
Optimizing Vs & Thickness - generation: 12; average & best misfits: -1.641
-0.37787
Optimizing Vs & Thickness - generation: 13; average & best misfits: -1.5316

-0.37787
Optimizing Vs & Thickness - generation: 14; average & best misfits: -1.6143
-0.37787
Optimizing Vs & Thickness - generation: 15; average & best misfits: -1.4417
-0.37787
Optimizing Vs & Thickness - generation: 16; average & best misfits: -1.6087
-0.37787
Optimizing Vs & Thickness - generation: 17; average & best misfits: -1.1371
-0.37732
Optimizing Vs & Thickness - generation: 18; average & best misfits: -1.4304
-0.37732
Optimizing Vs & Thickness - generation: 19; average & best misfits: -1.63
-0.37732
Optimizing Vs & Thickness - generation: 20; average & best misfits: -1.5025
-0.37732
Optimizing Vs & Thickness - generation: 21; average & best misfits: -1.4174
-0.37493
Optimizing Vs & Thickness - generation: 22; average & best misfits: -1.5972
-0.37493
Optimizing Vs & Thickness - generation: 23; average & best misfits: -1.5474
-0.37493
Optimizing Vs & Thickness - generation: 24; average & best misfits: -1.5705
-0.37493
Optimizing Vs & Thickness - generation: 25; average & best misfits: -1.4064
-0.37421
Optimizing Vs & Thickness - generation: 26; average & best misfits: -1.4171
-0.37391
Optimizing Vs & Thickness - generation: 27; average & best misfits: -1.4355
-0.37391
Optimizing Vs & Thickness - generation: 28; average & best misfits: -1.4561
-0.37391
Optimizing Vs & Thickness - generation: 29; average & best misfits: -1.2281
-0.36756
Optimizing Vs & Thickness - generation: 30; average & best misfits: -1.5348
-0.36756
Optimizing Vs & Thickness - generation: 31; average & best misfits: -1.3177
-0.36756
Optimizing Vs & Thickness - generation: 32; average & best misfits: -1.6846
-0.36756
Optimizing Vs & Thickness - generation: 33; average & best misfits: -1.4453
-0.36756
Optimizing Vs & Thickness - generation: 34; average & best misfits: -1.9215
-0.36756
Optimizing Vs & Thickness - generation: 35; average & best misfits: -1.4844
-0.36756
Optimizing Vs & Thickness - generation: 36; average & best misfits: -1.2969
-0.36756
Optimizing Vs & Thickness - generation: 37; average & best misfits: -1.5372
-0.36756
Optimizing Vs & Thickness - generation: 38; average & best misfits: -1.3783
-0.36756
Optimizing Vs & Thickness - generation: 39; average & best misfits: -1.4977
-0.36076
Optimizing Vs & Thickness - generation: 40; average & best misfits: -1.6695
-0.36076
Optimizing Vs & Thickness - generation: 41; average & best misfits: -2.0322
-0.36076
Optimizing Vs & Thickness - generation: 42; average & best misfits: -1.7298
-0.36076
Optimizing Vs & Thickness - generation: 43; average & best misfits: -1.7018
-0.36076
Optimizing Vs & Thickness - generation: 44; average & best misfits: -1.872
-0.36076
Optimizing Vs & Thickness - generation: 45; average & best misfits: -1.6278
-0.36076
Optimizing Vs & Thickness - generation: 46; average & best misfits: -1.6486
-0.36076
Optimizing Vs & Thickness - generation: 47; average & best misfits: -1.7674

-0.36076
Optimizing Vs & Thickness - generation: 48; average & best misfits: -1.2726
-0.36076
Optimizing Vs & Thickness - generation: 49; average & best misfits: -1.5479
-0.36024
Optimizing Vs & Thickness - generation: 50; average & best misfits: -1.8358
-0.36024
Optimizing Vs & Thickness - generation: 51; average & best misfits: -1.4515
-0.36024
Optimizing Vs & Thickness - generation: 52; average & best misfits: -1.176
-0.36024
Optimizing Vs & Thickness - generation: 53; average & best misfits: -1.5596
-0.36024
Optimizing Vs & Thickness - generation: 54; average & best misfits: -1.3153
-0.36024
Optimizing Vs & Thickness - generation: 55; average & best misfits: -1.823
-0.36024
Optimizing Vs & Thickness - generation: 56; average & best misfits: -1.5033
-0.36024
Optimizing Vs & Thickness - generation: 57; average & best misfits: -1.3431
-0.3599
Optimizing Vs & Thickness - generation: 58; average & best misfits: -1.0329
-0.3538
Optimizing Vs & Thickness - generation: 59; average & best misfits: -1.2129
-0.3538
Optimizing Vs & Thickness - generation: 60; average & best misfits: -1.1752
-0.34631
Optimizing Vs & Thickness - generation: 61; average & best misfits: -1.4055
-0.34631

Adopted search space (minimum Vs): 150 150 170 200
Adopted search space (maximum Vs): 170 200 220 230

Adopted search space (minimum Qs): 7.5 12 14.25 18
Adopted search space (maximum Qs): 15 24 28.5 36

Adopted search space (minimum reference frequency): 1
Adopted search space (maximum reference frequency): 36.0826

Adopted search space (minimum Poisson): 0.16516 0.17516 0.17484
0.17501
Adopted search space (maximum Poisson): 0.49549 0.497 0.497
0.497

Adopted search space (minimum thickness): 3.5714 3.5714 2.1429
Adopted search space (maximum thickness): 7 7 4.2

Now a finer search around the most promising search space area

Rayleigh-wave analysis
Optimizing Vs & Thickness - generation: 1; average & best misfits: -1.525
-0.34405
Optimizing Vs & Thickness - generation: 2; average & best misfits: -1.7983
-0.34405
Optimizing Vs & Thickness - generation: 3; average & best misfits: -1.7607
-0.34405
Optimizing Vs & Thickness - generation: 4; average & best misfits: -1.7286
-0.34405
Optimizing Vs & Thickness - generation: 5; average & best misfits: -1.7752
-0.34405
Optimizing Vs & Thickness - generation: 6; average & best misfits: -1.675
-0.34405
Optimizing Vs & Thickness - generation: 7; average & best misfits: -1.6661
-0.34405
Optimizing Vs & Thickness - generation: 8; average & best misfits: -1.4673
-0.34405
Optimizing Vs & Thickness - generation: 9; average & best misfits: -1.5403

-0.34405
Optimizing Vs & Thickness - generation: 10; average & best misfits: -1.3385
-0.34405
Optimizing Vs & Thickness - generation: 11; average & best misfits: -1.3245
-0.34096
Optimizing Vs & Thickness - generation: 12; average & best misfits: -1.3254
-0.34096
Optimizing Vs & Thickness - generation: 13; average & best misfits: -1.3537
-0.34096
Optimizing Vs & Thickness - generation: 14; average & best misfits: -1.6347
-0.34096
Optimizing Vs & Thickness - generation: 15; average & best misfits: -1.6469
-0.34096
Optimizing Vs & Thickness - generation: 16; average & best misfits: -2.2237
-0.34096

Model after the Vs & Thickness optimization (fixed Poisson values):
Vs (m/s): 151 188 185 230
Thickness (m): 4.7   6.7   2.4

Number of models considered to calculate the average model: 172

##
RESULTS
##

Dataset: 57.sgy
Analyzed curve/spectrum: 57.cdp

========== SECTION#3

Analyzing Phase Velocities

Analyzing Rayleigh-Wave Dispersion

==
MEAN MODEL

Vs (m/s):   151 189 191 220
Standard deviations (m/s): 0   1 10   9

Thickness (m):   4.7   5.4   3.1
Standard deviations (m): 0.0   1.0   0.6

Approximate values for Vp, density, Poisson & Shear modulus
Vp (m/s):   277 1642   382   411
Density (gr/cm3):   1.74   2.17   1.82   1.84
Vp/Vs ratio: 1.83   8.69   2.00   1.87
Poisson: 0.29   0.49   0.33   0.30
Shear modulus (MPa): 40   78   66   89
Estimated static shear modulus (MPa): 0   0   0   0

Fundamental mode
Mean model
 f(Hz)   VR(m/s)
3.55262   192.0819
6.17785   179.0257
7.20511   174.7681
9.65913   166.8509
12.3414   159.3792
13.3687   156.6282
15.0808   152.4687
17.0783   148.6311
22.1004   143.2962

27.9216 141.0405
36.0826 140.0909

First higher mode
Mean model
23.8696 188.815
27.6362 186.1597
31.0604 184.1679
35.8543 181.0605

========== SECTION#4

BEST MODEL

Vs (m/s): 151 188 185 230
thickness (m): 4.6598 6.7307 2.4399

Approximate values for Vp, density, Poisson & Shear modulus
Vp (m/s): 274 2434 349 404
Density (gr/cm3): 1.74 2.27 1.80 1.83
Vp/Vs ratio: 1.81 12.95 1.89 1.76
Poisson: 0.28 0.50 0.30 0.26
Shear modulus (MPa): 40 80 62 97
Estimated static shear modulus (MPa): 0 0 0 0

dispersion curve (frequency - velocity)

Fundamental mode)
best model
F(Hz) VR(m/s)
3.55262 195.9794
6.17785 178.7934
7.20511 174.1846
9.65913 166.5921
12.3414 159.5093
13.3687 156.7784
15.0808 152.5593
17.0783 148.6274
22.1004 143.1776
27.9216 140.8927
36.0826 139.938

First higher mode)
best model
23.8696 187.1366
27.6362 184.9594
31.0604 183.3023
35.8543 180.6015

========== SECTION#5

Maximum penetration depth according to the "Steady State Rayleigh Method": 30 m

Inversion quality: very good

Vs30 & VsE (mean model): 197 197 m/s
Vs30 & VsE (best model): 200 200 m/s

========== 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
"C:\Users\Benedetta\Desktop\valdERA-esac\valdera-esac-5\output_disp".

==========
winMASW - Surface Waves & Beyond
www.winmasw.com

Number of models used to define the mean model: 172
Vs30 for the best model: 200 200
Analyzing phase velocities

UNIONE DI COMUNI DELLA VALDERA

INDAGINE ESAC/MASW - COMUNE DI PONTEDERA

LOC. GELLO - POSTAZIONE n.6

documentazione fotografica

ubicazione scala 1:1.000

geometria ESAC

geof	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
x	-55	-50	-45	-40	-35	-30	-25	-20	-15	-10	-5	0	0	0	0	0	0	0	0	0	0	0	0	0
y	0	0	0	0	0	0	0	0	0	0	0	0	3	6	9	12	15	18	21	24	27	30	33	36

geometria MASW

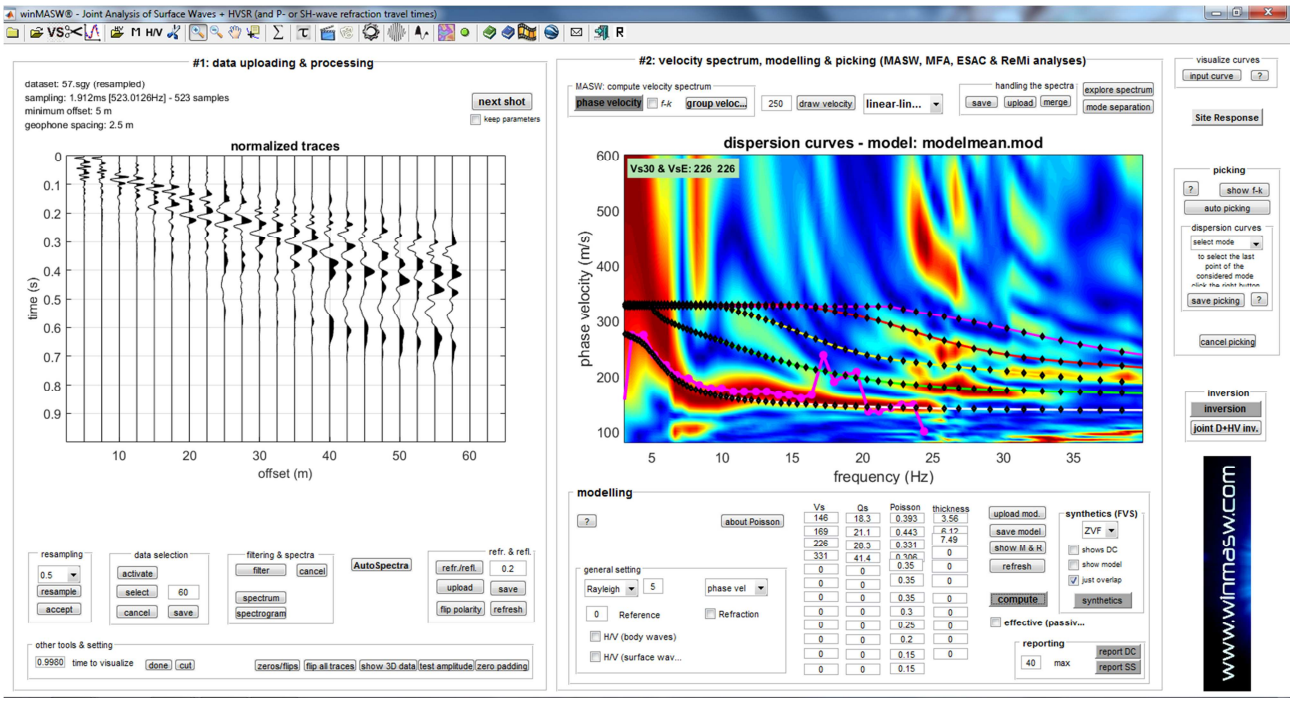
distanza geofonica 12 ch 5 m

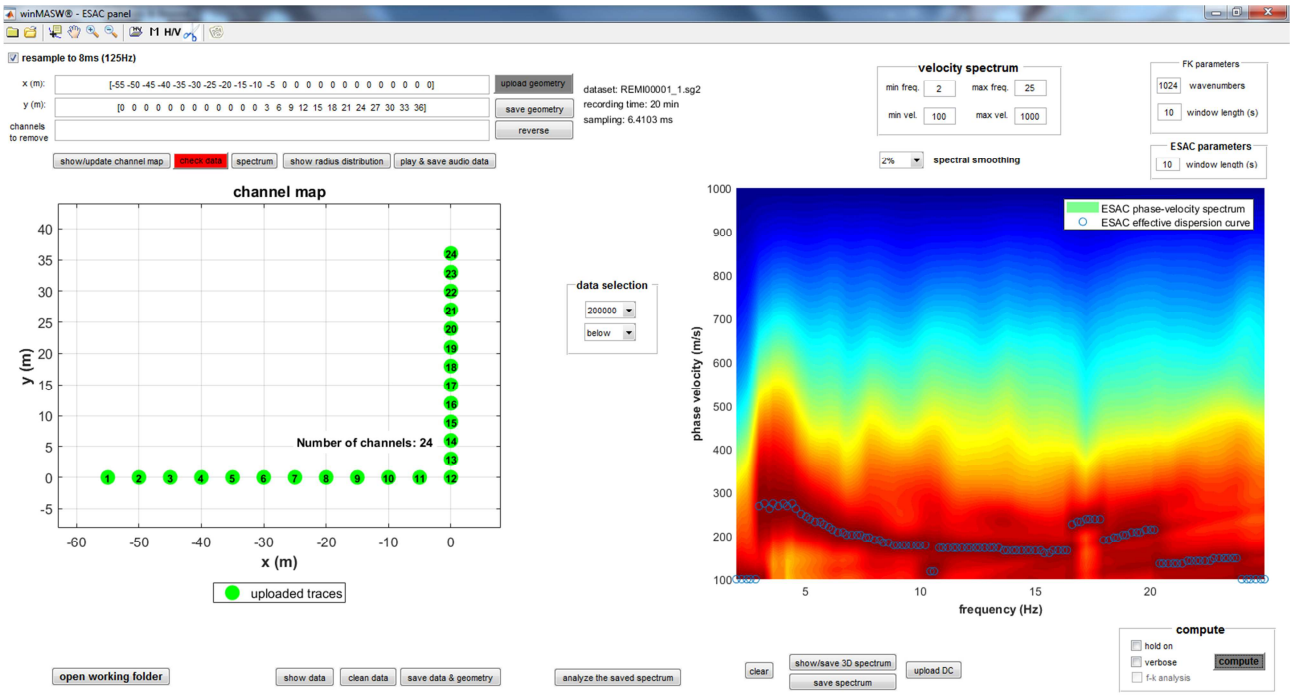
lunghezza linea 57.5 m

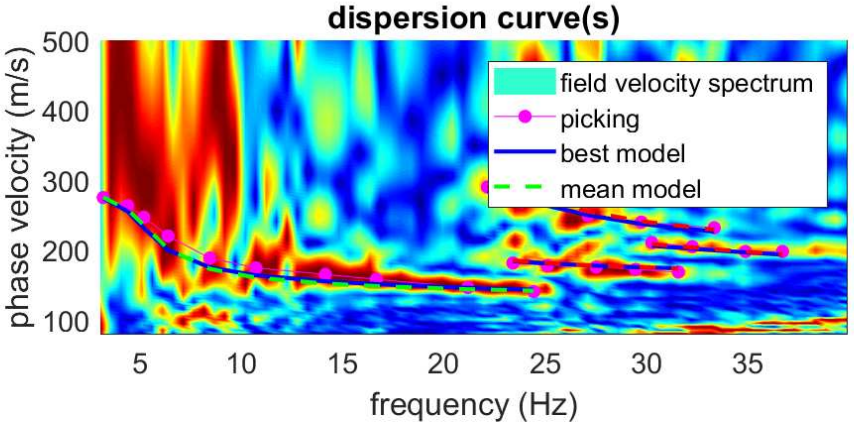
coordinate stazione 43°64’ 23.39” N 10°58’ 70.74” E

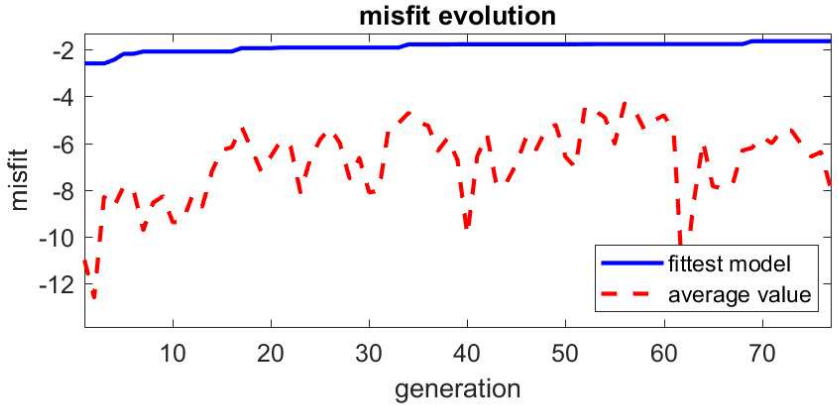
UNIONE VALDERA - Indagini sismiche MASW/ESAC

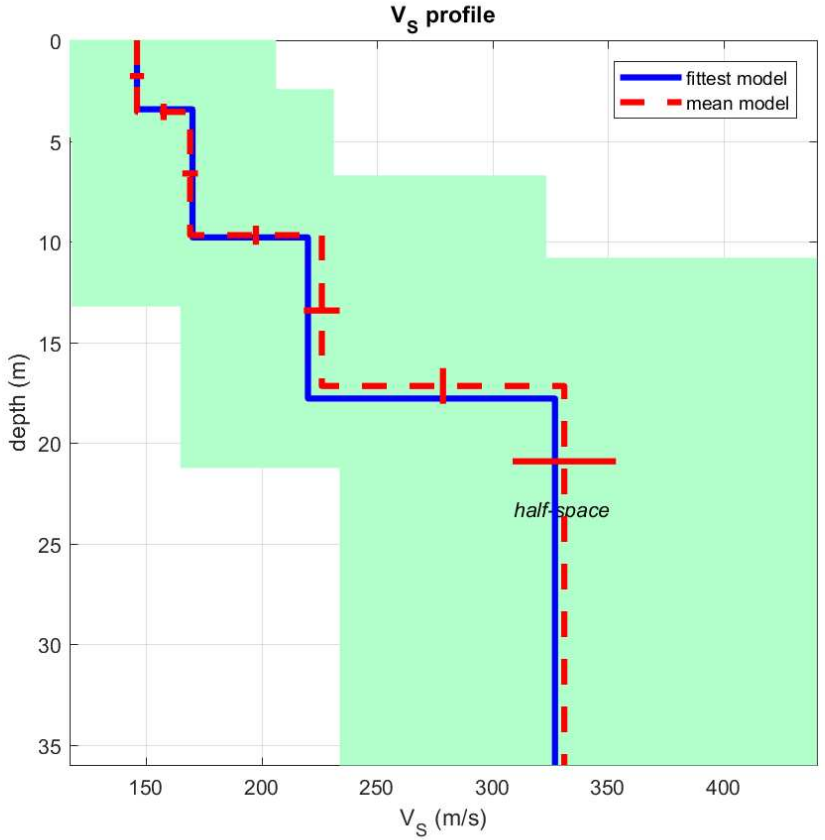
PROVA n. 6











www.winmasw.com

dataset: 57.sgy
dispersion curve: 57.cdp
Vs30 & VsE (best model): 223 223 m/s
Vs30 & VsE (mean model): 226 226 m/s

Mean model

Vs (m/s): 146, 169, 226, 331

Standard deviations (m/s): 3, 3, 8, 22

Thickness (m): 3.6, 6.1, 7.5

========== SECTION#1
dataset: 57.sgy
sampling (ms): 0.956
minimum offset (m): 5
geophone spacing (m): 2.5
offsets (m): 5 7.5 10 12.5 15 17.5
20 22.5 25 27.5 30 32.5
35 37.5 40 42.5 45 47.5
50 52.5 55 57.5 60 62.5
Dispersion curve: 57.cdp
Number of individuals: 32
Number of generations: 61

Rayleigh-wave dispersion analysis

Analyzing phase velocities

Adopted search space (minimum Vs): 105 118 165 234
Adopted search space (maximum Vs): 206 231 323 459

Adopted search space (minimum Poisson): 0.19252 0.22917 0.14656
0.15196
Adopted search space (maximum Poisson): 0.499 0.499 0.43968
0.45588

Adopted search space (minimum Qs): 13.7813 15.4688 21.6563
30.75
Adopted search space (maximum Qs): 27.5625 30.9375 43.3125
61.5

Adopted search space (minimum reference frequency): 1
Adopted search space (maximum reference frequency): 36.7104

Adopted search space (minimum thickness): 2.45 4.2857 4.0929
Adopted search space (maximum thickness): 4.802 8.4 8.022

Output folder:
C:\Users\Benedetta\Desktop\valdERA-esac\valdera-esac-6\output_disp

========== SECTION#2
Rayleigh-wave analysis
Optimizing Vs & Thickness - generation: 1; average & best misfits: -10.9913
-2.59642
Optimizing Vs & Thickness - generation: 2; average & best misfits: -12.6009
-2.59642
Optimizing Vs & Thickness - generation: 3; average & best misfits: -8.2982
-2.5964
Optimizing Vs & Thickness - generation: 4; average & best misfits: -8.7289
-2.445
Optimizing Vs & Thickness - generation: 5; average & best misfits: -7.8507
-2.1854
Optimizing Vs & Thickness - generation: 6; average & best misfits: -8.0038
-2.1854
Optimizing Vs & Thickness - generation: 7; average & best misfits: -9.7193
-2.0864
Optimizing Vs & Thickness - generation: 8; average & best misfits: -8.5478
-2.0864
Optimizing Vs & Thickness - generation: 9; average & best misfits: -8.2764
-2.0864
Optimizing Vs & Thickness - generation: 10; average & best misfits: -9.3878
-2.0864
Optimizing Vs & Thickness - generation: 11; average & best misfits: -9.3549
-2.0864
Optimizing Vs & Thickness - generation: 12; average & best misfits: -8.2436

-2.0864
Optimizing Vs & Thickness - generation: 13; average & best misfits: -8.7173
-2.0864
Optimizing Vs & Thickness - generation: 14; average & best misfits: -7.1943
-2.0864
Optimizing Vs & Thickness - generation: 15; average & best misfits: -6.301
-2.0864
Optimizing Vs & Thickness - generation: 16; average & best misfits: -6.1814
-2.0864
Optimizing Vs & Thickness - generation: 17; average & best misfits: -5.2945
-1.9438
Optimizing Vs & Thickness - generation: 18; average & best misfits: -6.2346
-1.9438
Optimizing Vs & Thickness - generation: 19; average & best misfits: -7.2069
-1.9438
Optimizing Vs & Thickness - generation: 20; average & best misfits: -6.5634
-1.9438
Optimizing Vs & Thickness - generation: 21; average & best misfits: -5.8993
-1.9178
Optimizing Vs & Thickness - generation: 22; average & best misfits: -6.1444
-1.9178
Optimizing Vs & Thickness - generation: 23; average & best misfits: -8.1044
-1.9178
Optimizing Vs & Thickness - generation: 24; average & best misfits: -6.6844
-1.9178
Optimizing Vs & Thickness - generation: 25; average & best misfits: -5.8544
-1.9178
Optimizing Vs & Thickness - generation: 26; average & best misfits: -5.3562
-1.9178
Optimizing Vs & Thickness - generation: 27; average & best misfits: -5.9898
-1.9178
Optimizing Vs & Thickness - generation: 28; average & best misfits: -7.5071
-1.9178
Optimizing Vs & Thickness - generation: 29; average & best misfits: -6.6398
-1.9178
Optimizing Vs & Thickness - generation: 30; average & best misfits: -8.1142
-1.9178
Optimizing Vs & Thickness - generation: 31; average & best misfits: -8.0336
-1.9178
Optimizing Vs & Thickness - generation: 32; average & best misfits: -5.3149
-1.9178
Optimizing Vs & Thickness - generation: 33; average & best misfits: -5.147
-1.9178
Optimizing Vs & Thickness - generation: 34; average & best misfits: -4.711
-1.7837
Optimizing Vs & Thickness - generation: 35; average & best misfits: -5.098
-1.7837
Optimizing Vs & Thickness - generation: 36; average & best misfits: -5.2585
-1.7837
Optimizing Vs & Thickness - generation: 37; average & best misfits: -6.3317
-1.7837
Optimizing Vs & Thickness - generation: 38; average & best misfits: -5.7809
-1.7837
Optimizing Vs & Thickness - generation: 39; average & best misfits: -6.7378
-1.7776
Optimizing Vs & Thickness - generation: 40; average & best misfits: -9.9482
-1.7776
Optimizing Vs & Thickness - generation: 41; average & best misfits: -6.5604
-1.7776
Optimizing Vs & Thickness - generation: 42; average & best misfits: -5.6421
-1.7776
Optimizing Vs & Thickness - generation: 43; average & best misfits: -7.884
-1.7776
Optimizing Vs & Thickness - generation: 44; average & best misfits: -7.6709
-1.7776
Optimizing Vs & Thickness - generation: 45; average & best misfits: -6.8777
-1.7776
Optimizing Vs & Thickness - generation: 46; average & best misfits: -5.7362

-1.7776
Optimizing Vs & Thickness - generation: 47; average & best misfits: -6.2735
-1.7776
Optimizing Vs & Thickness - generation: 48; average & best misfits: -5.4268
-1.7776
Optimizing Vs & Thickness - generation: 49; average & best misfits: -5.2275
-1.7776
Optimizing Vs & Thickness - generation: 50; average & best misfits: -6.5967
-1.7776
Optimizing Vs & Thickness - generation: 51; average & best misfits: -7.0354
-1.7776
Optimizing Vs & Thickness - generation: 52; average & best misfits: -4.4142
-1.7723
Optimizing Vs & Thickness - generation: 53; average & best misfits: -4.6207
-1.7713
Optimizing Vs & Thickness - generation: 54; average & best misfits: -4.9041
-1.7713
Optimizing Vs & Thickness - generation: 55; average & best misfits: -6.0242
-1.7713
Optimizing Vs & Thickness - generation: 56; average & best misfits: -4.3102
-1.7713
Optimizing Vs & Thickness - generation: 57; average & best misfits: -4.5664
-1.7713
Optimizing Vs & Thickness - generation: 58; average & best misfits: -5.4092
-1.7713
Optimizing Vs & Thickness - generation: 59; average & best misfits: -5.0438
-1.7713
Optimizing Vs & Thickness - generation: 60; average & best misfits: -4.8127
-1.7713
Optimizing Vs & Thickness - generation: 61; average & best misfits: -5.4584
-1.7713

Adopted search space (minimum Vs): 105 118 165 234
Adopted search space (maximum Vs): 206 231 323 459

Adopted search space (minimum Qs): 13.7813 15.4688 21.6563
30.75
Adopted search space (maximum Qs): 27.5625 30.9375 43.3125
61.5

Adopted search space (minimum reference frequency): 1
Adopted search space (maximum reference frequency): 36.7104

Adopted search space (minimum Poisson): 0.19252 0.22917 0.15
0.15196
Adopted search space (maximum Poisson): 0.497 0.497 0.43968
0.45588

Adopted search space (minimum thickness): 2.45 4.2857 4.0929
Adopted search space (maximum thickness): 4.802 8.4 8.022

Now a finer search around the most promising search space area

Rayleigh-wave analysis
Optimizing Vs & Thickness - generation: 1; average & best misfits: -12.4475
-1.77134
Optimizing Vs & Thickness - generation: 2; average & best misfits: -8.6563
-1.7713
Optimizing Vs & Thickness - generation: 3; average & best misfits: -5.9361
-1.7713
Optimizing Vs & Thickness - generation: 4; average & best misfits: -7.8551
-1.7713
Optimizing Vs & Thickness - generation: 5; average & best misfits: -7.9301
-1.7713
Optimizing Vs & Thickness - generation: 6; average & best misfits: -7.7779
-1.7713
Optimizing Vs & Thickness - generation: 7; average & best misfits: -6.3219

-1.7713
Optimizing Vs & Thickness - generation: 8; average & best misfits: -6.2
-1.646
Optimizing Vs & Thickness - generation: 9; average & best misfits: -5.7284
-1.646
Optimizing Vs & Thickness - generation: 10; average & best misfits: -6.0062
-1.646
Optimizing Vs & Thickness - generation: 11; average & best misfits: -5.4654
-1.646
Optimizing Vs & Thickness - generation: 12; average & best misfits: -5.4622
-1.646
Optimizing Vs & Thickness - generation: 13; average & best misfits: -6.0498
-1.646
Optimizing Vs & Thickness - generation: 14; average & best misfits: -6.5786
-1.646
Optimizing Vs & Thickness - generation: 15; average & best misfits: -6.384
-1.646
Optimizing Vs & Thickness - generation: 16; average & best misfits: -7.9414
-1.646

Model after the Vs & Thickness optimization (fixed Poisson values):
Vs (m/s): 146 170 220 327
Thickness (m): 3.4   6.4   8

Number of models considered to calculate the average model: 186

##
RESULTS
##

Dataset: 57.sgy
Analyzed curve/spectrum: 57.cdp

== SECTION#3

Analyzing Phase Velocities

Analyzing Rayleigh-Wave Dispersion

==
MEAN MODEL

Vs (m/s):   146 169 226 331
Standard deviations (m/s): 3   3   8 22

Thickness (m):   3.6   6.1   7.5
Standard deviations (m): 0.4   0.5   0.9

Approximate values for Vp, density, Poisson & Shear modulus
Vp (m/s):   348 528 450 626
Density (gr/cm3):   1.80   1.90   1.86   1.94
Vp/Vs ratio: 2.38   3.12   1.99   1.89
Poisson: 0.39   0.44   0.33   0.31
Shear modulus (MPa): 38   54   95   213
Estimated static shear modulus (MPa): 0   0   0   0

Fundamental mode
Mean model
 f(Hz)   VR(m/s)
 3.2102   275.1529
4.40867   257.7799
5.20765   235.6902
6.40613   201.4001
8.46065   172.7876

10.7435	160.2124
14.1677	151.6862
16.6788	148.01
21.1873	143.598
24.4403	141.5573

First higher mode
Mean model

23.413	184.836
25.1251	181.1911
27.5221	177.4755
29.4625	175.2731
31.5741	173.4151

Second higher mode
Mean model

30.2615	208.2899
32.2589	203.431
34.8841	197.3806
36.7104	193.6276

Third higher mode
Mean model

22.1575	291.8857
23.8125	278.5968
27.1226	254.8184
29.7478	240.8628
33.3433	228.8236

========== SECTION#4

BEST MODEL

Vs (m/s): 146 170 220 327
thickness (m): 3.43 6.366 8

Approximate values for Vp, density, Poisson & Shear modulus
Vp (m/s): 338 1291 658 546
Density (gr/cm3): 1.79 2.12 1.95 1.91
Vp/Vs ratio: 2.32 7.59 2.99 1.67
Poisson: 0.39 0.49 0.44 0.22
Shear modulus (MPa): 38 61 95 204
Estimated static shear modulus (MPa): 0 0 0 0

dispersion curve (frequency - velocity)

Fundamental mode)
best model

F(Hz)	VR(m/s)
3.2102	273.9822
4.40867	255.0864
5.20765	231.2018
6.40613	199.6657
8.46065	174.8676
10.7435	163.4961
14.1677	155.0672
16.6788	151.0064
21.1873	145.5662
24.4403	142.863

First higher mode)
best model

23.413	183.9633
25.1251	180.5975
27.5221	177.2194
29.4625	175.2483

31.5741 173.6081

Second higher mode)
best model
30.2615 205.8
32.2589 201.5464
34.8841 196.3431
36.7104 193.1171

Third higher mode)
best model
22.1575 284.6118
23.8125 271.8863
27.1226 249.6714
29.7478 237.0866
33.3433 226.2513

========== SECTION#5

Maximum penetration depth according to the "Steady State Rayleigh Method": 36 m

Inversion quality: very good

Vs30 & VsE (mean model): 226 226 m/s
Vs30 & VsE (best model): 223 223 m/s

========== 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
"C:\Users\Benedetta\Desktop\valdERA-esac\valdera-esac-6\output_disp".

==========

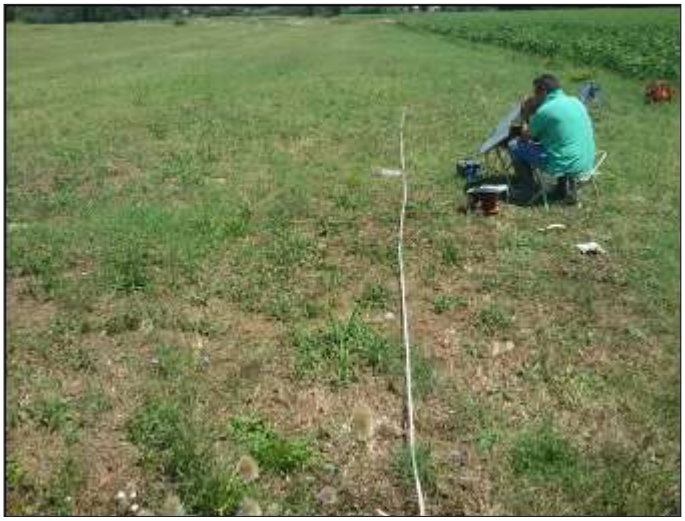
www.winmasw.com

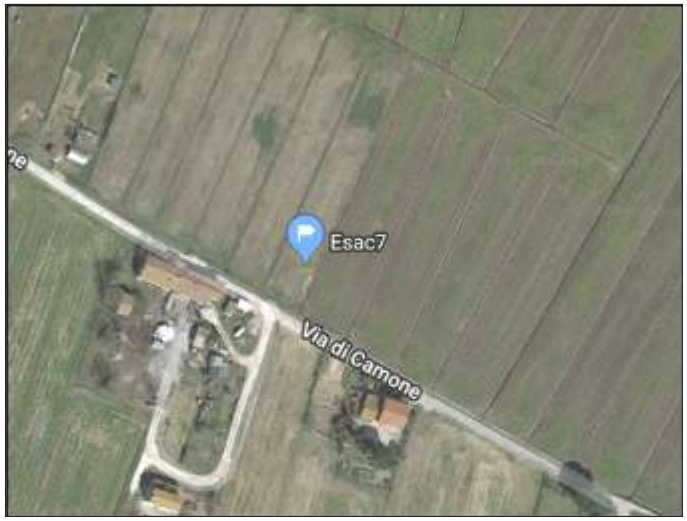
Number of models used to define the mean model: 186
Vs30 for the best model: 223 223
Analyzing phase velocities

UNIONE DI COMUNI DELLA VALDERA

INDAGINE ESAC/MASW - COMUNE DI PONTEDERA

LOC. CHIESINO COLLODI - POSTAZIONE n.7





documentazione fotografica

ubicazione scala 1:1.000

geometria ESAC

geof	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
x	55	50	45	40	35	30	25	20	15	10	5	0	0	0	0	0	0	0	0	0	0	0	0	0
y	0	0	0	0	0	0	0	0	0	0	0	0	3	6	9	12	15	18	21	24	27	30	33	36

geometria MASW

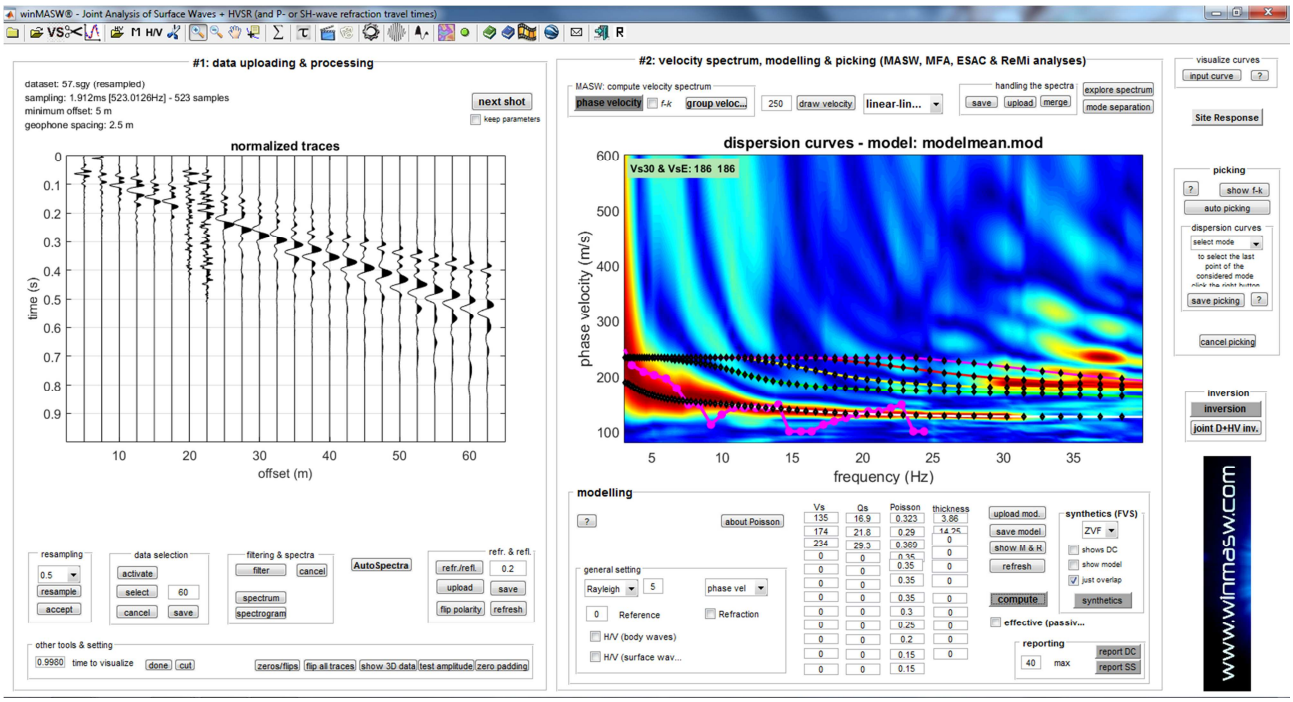
distanza geofonica 12 ch 5 m

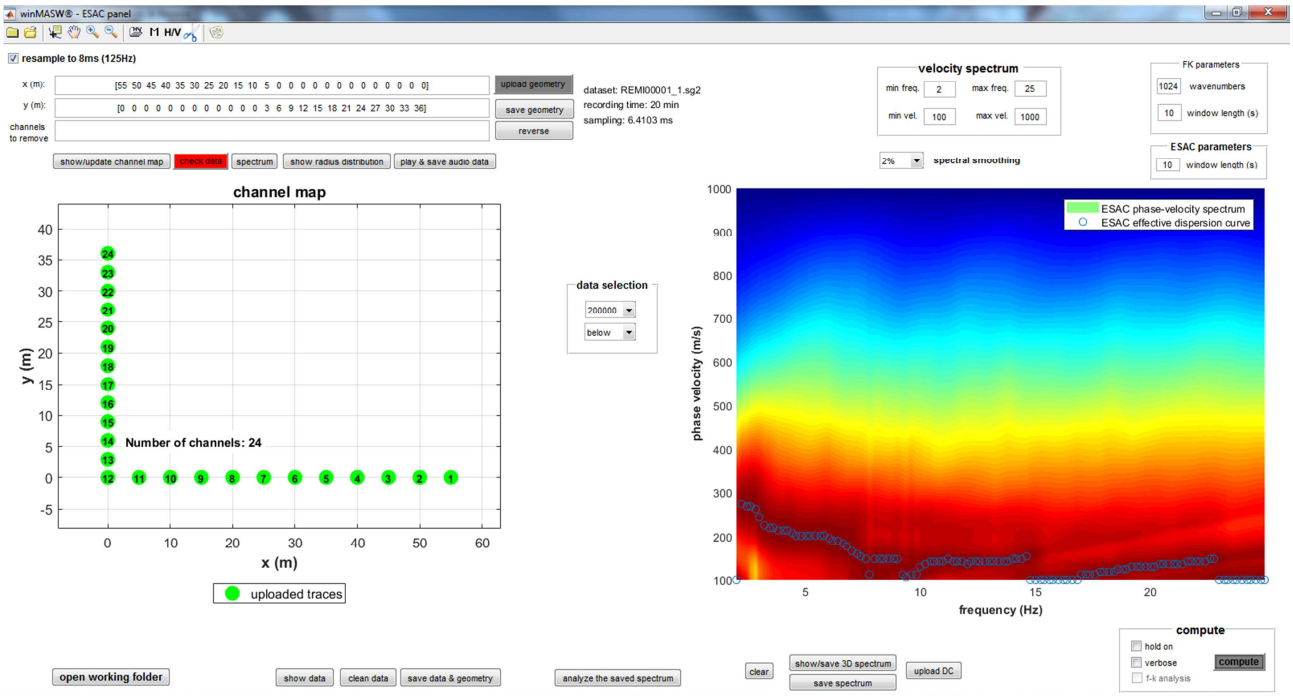
lunghezza linea 57.5 m

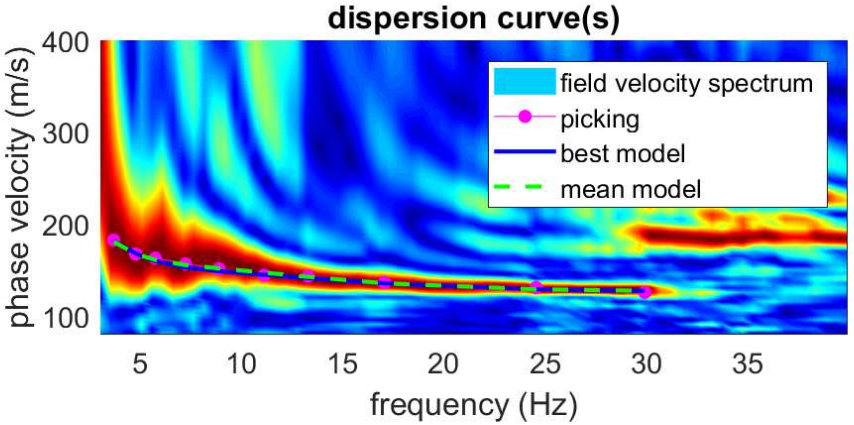
coordinate stazione 43°67’ 25.11” N 10°60’ 92.34” E

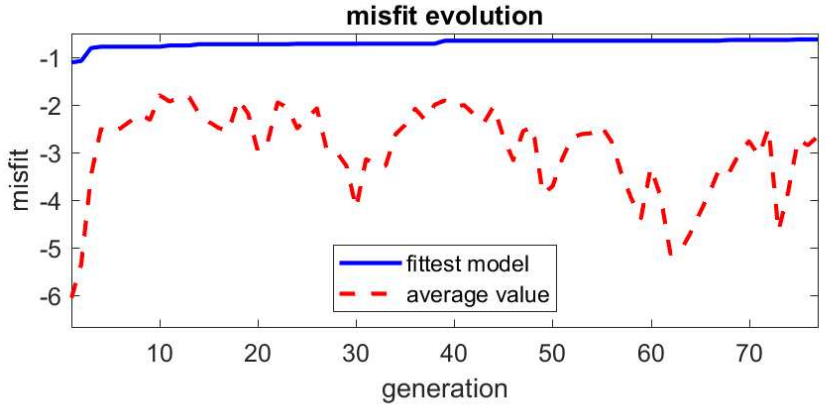
UNIONE VALDERA - Indagini sismiche MASW/ESAC

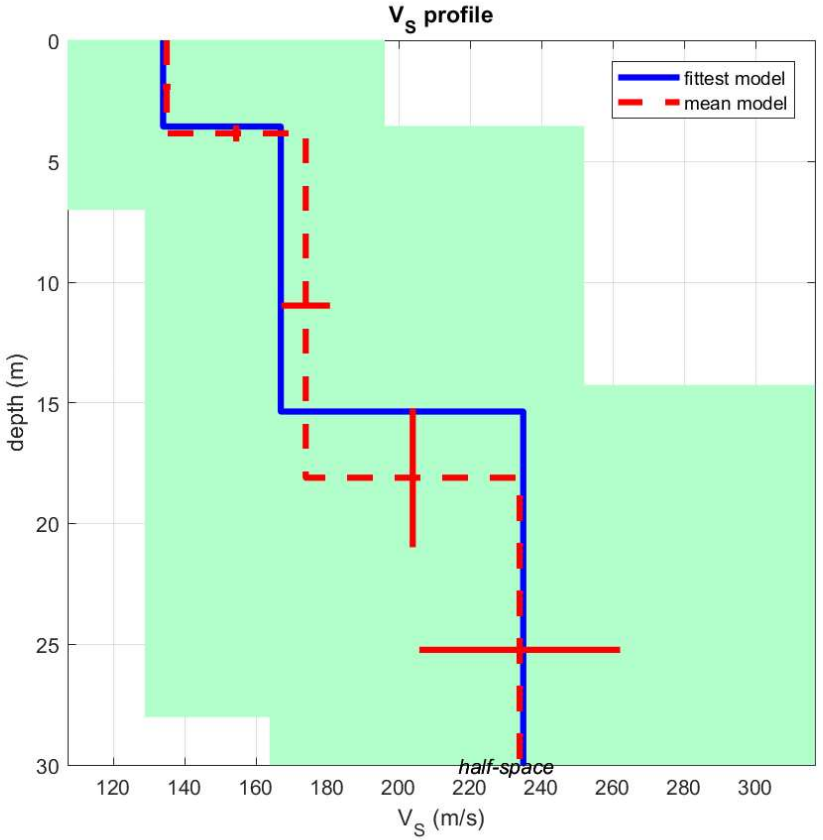
PROVA n. 7











www.winmasw.com

dataset: 57.sgy
dispersion curve: 57.cdp
Vs30 & VsE (best model): 188 188 m/s
Vs30 & VsE (mean model): 186 186 m/s

Mean model

Vs (m/s): 135, 174, 234

Standard deviations (m/s): 1, 7, 28

Thickness (m): 3.9, 14.3

========== SECTION#1
dataset: 57.sgy
sampling (ms): 0.956
minimum offset (m): 5
geophone spacing (m): 2.5
offsets (m): 5 7.5 10 12.5 15 17.5
20 22.5 25 27.5 30 32.5
35 37.5 40 42.5 45 47.5
50 52.5 55 57.5 60 62.5
Dispersion curve: 57.cdp
Number of individuals: 32
Number of generations: 61

Rayleigh-wave dispersion analysis

Analyzing phase velocities

Adopted search space (minimum Vs): 100 129 164
Adopted search space (maximum Vs): 196 252 322

Adopted search space (minimum Poisson): 0.16505 0.17516 0.17509
Adopted search space (maximum Poisson): 0.49516 0.499 0.499

Adopted search space (minimum Qs): 7.5 12 14.25
Adopted search space (maximum Qs): 15 24 28.5

Adopted search space (minimum reference frequency): 1
Adopted search space (maximum reference frequency): 29.919

Adopted search space (minimum thickness): 3.57143 10.7143
Adopted search space (maximum thickness): 7 21

Output folder:
C:\Users\Benedetta\Desktop\valdERA-esac\valdera-esac-7\output_disp

========== SECTION#2
Rayleigh-wave analysis
Optimizing Vs & Thickness - generation: 1; average & best misfits: -6.0525
-1.1081
Optimizing Vs & Thickness - generation: 2; average & best misfits: -5.3427
-1.0755
Optimizing Vs & Thickness - generation: 3; average & best misfits: -3.4784
-0.80576
Optimizing Vs & Thickness - generation: 4; average & best misfits: -2.5075
-0.77744
Optimizing Vs & Thickness - generation: 5; average & best misfits: -2.5571
-0.77744
Optimizing Vs & Thickness - generation: 6; average & best misfits: -2.4896
-0.77744
Optimizing Vs & Thickness - generation: 7; average & best misfits: -2.3382
-0.77744
Optimizing Vs & Thickness - generation: 8; average & best misfits: -2.1985
-0.77744
Optimizing Vs & Thickness - generation: 9; average & best misfits: -2.3092
-0.77744
Optimizing Vs & Thickness - generation: 10; average & best misfits: -1.7975
-0.77744
Optimizing Vs & Thickness - generation: 11; average & best misfits: -1.9263
-0.75095
Optimizing Vs & Thickness - generation: 12; average & best misfits: -1.8511
-0.75095
Optimizing Vs & Thickness - generation: 13; average & best misfits: -1.8397
-0.75095
Optimizing Vs & Thickness - generation: 14; average & best misfits: -2.1845

-0.72471
Optimizing Vs & Thickness - generation: 15; average & best misfits: -2.3539
-0.72471
Optimizing Vs & Thickness - generation: 16; average & best misfits: -2.4811
-0.72471
Optimizing Vs & Thickness - generation: 17; average & best misfits: -2.5536
-0.72471
Optimizing Vs & Thickness - generation: 18; average & best misfits: -1.8833
-0.72471
Optimizing Vs & Thickness - generation: 19; average & best misfits: -2.1827
-0.72471
Optimizing Vs & Thickness - generation: 20; average & best misfits: -2.9838
-0.72471
Optimizing Vs & Thickness - generation: 21; average & best misfits: -2.7687
-0.72471
Optimizing Vs & Thickness - generation: 22; average & best misfits: -1.9463
-0.72471
Optimizing Vs & Thickness - generation: 23; average & best misfits: -2.0555
-0.72471
Optimizing Vs & Thickness - generation: 24; average & best misfits: -2.4908
-0.71547
Optimizing Vs & Thickness - generation: 25; average & best misfits: -2.2728
-0.71547
Optimizing Vs & Thickness - generation: 26; average & best misfits: -2.0697
-0.71547
Optimizing Vs & Thickness - generation: 27; average & best misfits: -2.9409
-0.71547
Optimizing Vs & Thickness - generation: 28; average & best misfits: -2.9862
-0.71547
Optimizing Vs & Thickness - generation: 29; average & best misfits: -3.2754
-0.71547
Optimizing Vs & Thickness - generation: 30; average & best misfits: -4.1656
-0.71547
Optimizing Vs & Thickness - generation: 31; average & best misfits: -3.1398
-0.715
Optimizing Vs & Thickness - generation: 32; average & best misfits: -3.2442
-0.715
Optimizing Vs & Thickness - generation: 33; average & best misfits: -3.2774
-0.715
Optimizing Vs & Thickness - generation: 34; average & best misfits: -2.6168
-0.715
Optimizing Vs & Thickness - generation: 35; average & best misfits: -2.4165
-0.715
Optimizing Vs & Thickness - generation: 36; average & best misfits: -2.0787
-0.715
Optimizing Vs & Thickness - generation: 37; average & best misfits: -2.3065
-0.715
Optimizing Vs & Thickness - generation: 38; average & best misfits: -1.9949
-0.715
Optimizing Vs & Thickness - generation: 39; average & best misfits: -1.9062
-0.65099
Optimizing Vs & Thickness - generation: 40; average & best misfits: -2.0325
-0.65099
Optimizing Vs & Thickness - generation: 41; average & best misfits: -2.003
-0.65099
Optimizing Vs & Thickness - generation: 42; average & best misfits: -2.1943
-0.65099
Optimizing Vs & Thickness - generation: 43; average & best misfits: -2.3744
-0.65099
Optimizing Vs & Thickness - generation: 44; average & best misfits: -2.0273
-0.65099
Optimizing Vs & Thickness - generation: 45; average & best misfits: -2.6775
-0.65099
Optimizing Vs & Thickness - generation: 46; average & best misfits: -3.1584
-0.65099
Optimizing Vs & Thickness - generation: 47; average & best misfits: -2.545
-0.65099
Optimizing Vs & Thickness - generation: 48; average & best misfits: -2.4644

-0.65099
Optimizing Vs & Thickness - generation: 49; average & best misfits: -3.8652
-0.65099
Optimizing Vs & Thickness - generation: 50; average & best misfits: -3.7053
-0.65099
Optimizing Vs & Thickness - generation: 51; average & best misfits: -3.12
-0.65099
Optimizing Vs & Thickness - generation: 52; average & best misfits: -2.6843
-0.65099
Optimizing Vs & Thickness - generation: 53; average & best misfits: -2.609
-0.65099
Optimizing Vs & Thickness - generation: 54; average & best misfits: -2.5906
-0.65099
Optimizing Vs & Thickness - generation: 55; average & best misfits: -2.4523
-0.65099
Optimizing Vs & Thickness - generation: 56; average & best misfits: -2.7641
-0.65099
Optimizing Vs & Thickness - generation: 57; average & best misfits: -3.4265
-0.65099
Optimizing Vs & Thickness - generation: 58; average & best misfits: -3.9534
-0.65099
Optimizing Vs & Thickness - generation: 59; average & best misfits: -4.3732
-0.65099
Optimizing Vs & Thickness - generation: 60; average & best misfits: -3.3114
-0.65099
Optimizing Vs & Thickness - generation: 61; average & best misfits: -3.9134
-0.65099

Adopted search space (minimum Vs): 100 129 164
Adopted search space (maximum Vs): 196 252 322

Adopted search space (minimum Qs): 7.5 12 14.25
Adopted search space (maximum Qs): 15 24 28.5

Adopted search space (minimum reference frequency): 1
Adopted search space (maximum reference frequency): 29.919

Adopted search space (minimum Poisson): 0.16505 0.17516 0.17509
Adopted search space (maximum Poisson): 0.49516 0.497 0.497

Adopted search space (minimum thickness): 3.57143 10.7143
Adopted search space (maximum thickness): 7 21

Now a finer search around the most promising search space area

Rayleigh-wave analysis
Optimizing Vs & Thickness - generation: 1; average & best misfits: -5.119
-0.65099
Optimizing Vs & Thickness - generation: 2; average & best misfits: -5.0688
-0.65099
Optimizing Vs & Thickness - generation: 3; average & best misfits: -4.7049
-0.65099
Optimizing Vs & Thickness - generation: 4; average & best misfits: -4.2659
-0.65099
Optimizing Vs & Thickness - generation: 5; average & best misfits: -3.833
-0.65099
Optimizing Vs & Thickness - generation: 6; average & best misfits: -3.3284
-0.65099
Optimizing Vs & Thickness - generation: 7; average & best misfits: -3.4087
-0.63604
Optimizing Vs & Thickness - generation: 8; average & best misfits: -3.0236
-0.63522
Optimizing Vs & Thickness - generation: 9; average & best misfits: -2.7612
-0.63522
Optimizing Vs & Thickness - generation: 10; average & best misfits: -3.0604
-0.63522
Optimizing Vs & Thickness - generation: 11; average & best misfits: -2.4889

-0.63496
Optimizing Vs & Thickness - generation: 12; average & best misfits: -4.645
-0.63496
Optimizing Vs & Thickness - generation: 13; average & best misfits: -3.8102
-0.63496
Optimizing Vs & Thickness - generation: 14; average & best misfits: -2.727
-0.62496
Optimizing Vs & Thickness - generation: 15; average & best misfits: -2.8457
-0.62496
Optimizing Vs & Thickness - generation: 16; average & best misfits: -2.6614
-0.62496

Model after the Vs & Thickness optimization (fixed Poisson values):
Vs (m/s): 134 167 235
Thickness (m): 3.6   12

Number of models considered to calculate the average model: 173

##
RESULTS
##

Dataset: 57.sgy
Analyzed curve/spectrum: 57.cdp

== SECTION#3

Analyzing Phase Velocities

Analyzing Rayleigh-Wave Dispersion

==
MEAN MODEL

Vs (m/s):   135 174 234
Standard deviations (m/s): 1   7 28

Thickness (m):   3.9   14.3
Standard deviations (m): 0.3   2.9

Approximate values for Vp, density, Poisson & Shear modulus
Vp (m/s):   264 320 514
Density (gr/cm3):   1.73   1.78   1.89
Vp/Vs ratio: 1.96   1.84   2.20
Poisson: 0.32   0.29   0.37
Shear modulus (MPa): 32   54   104
Estimated static shear modulus (MPa): 0   0   0

Fundamental mode
Mean model
 f(Hz)   VR(m/s)
3.72383   180.2261
4.80816   167.1476
5.77836   160.4327
7.26218   154.9827
8.91722   151.2372
 11.143   146.6863
13.3116   142.0099
17.0783   134.9709
24.5544   128.4233
 29.919   126.8706

== SECTION#4

BEST MODEL

Vs (m/s): 134 167 235
thickness (m): 3.57143   11.7978

Approximate values for Vp, density, Poisson & Shear modulus
Vp (m/s):   278 292 395
Density (gr/cm3):   1.74   1.76   1.83
Vp/Vs ratio: 2.07   1.75   1.68
Poisson: 0.35   0.26   0.23
Shear modulus (MPa): 31   49   101
Estimated static shear modulus (MPa): 0   0   0

dispersion curve (frequency - velocity)

Fundamental mode)
best model

F(Hz)	VR(m/s)
3.72383	181.0437
4.80816	167.5182
5.77836	159.168
7.26218	152.2592
8.91722	148.1666
11.143	144.2652
13.3116	140.6841
17.0783	134.9407
24.5544	128.5435
29.919	126.7894

========== SECTION#5

Maximum penetration depth according to the "Steady State Rayleigh Method": 30 m

Inversion quality: very good

Vs30 & VsE (mean model): 186 186 m/s
Vs30 & VsE (best model): 188 188 m/s

========== 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
"C:\Users\Benedetta\Desktop\valdERA-esac\valdera-esac-7\output_disp".

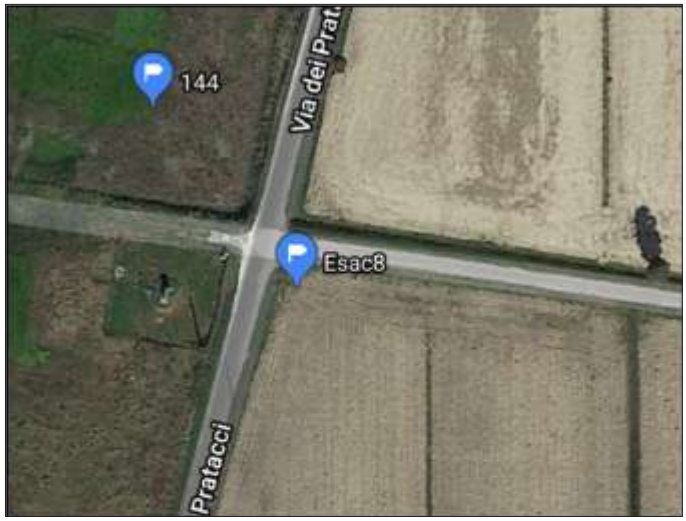
==========
winMASW - Surface Waves & Beyond
www.winmasw.com

Number of models used to define the mean model: 173
Vs30 for the best model: 188 188
Analyzing phase velocities

UNIONE DI COMUNI DELLA VALDERA

INDAGINE ESAC/MASW - COMUNE DI PONTEDERA

LOC. OLTRERA - POSTAZIONE n.8



documentazione fotografica

ubicazione scala 1:1.000

geometria ESAC

geof	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
x	55	50	45	40	35	30	25	20	15	10	5	0	0	0	0	0	0	0	0	0	0	0	0	0
y	0	0	0	0	0	0	0	0	0	0	0	0	3	6	9	12	15	18	21	24	27	30	33	36

geometria MASW

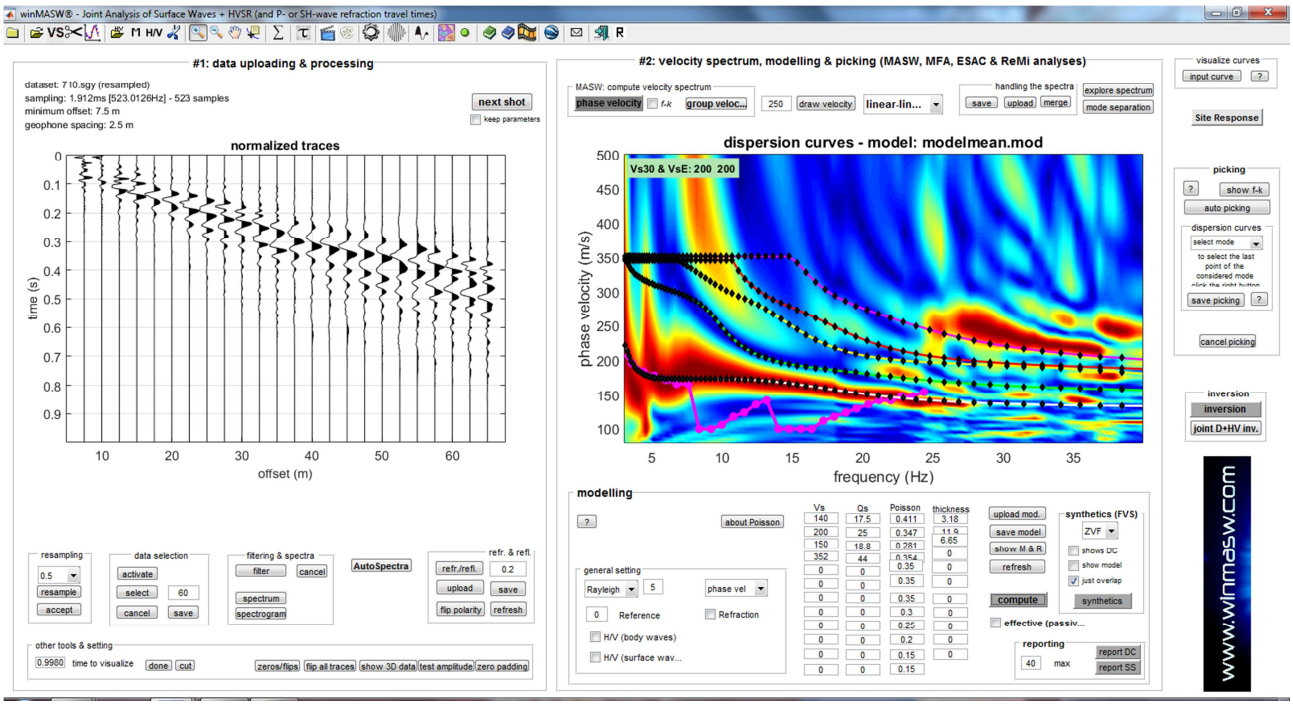
distanza geofonica 12 ch 5 m

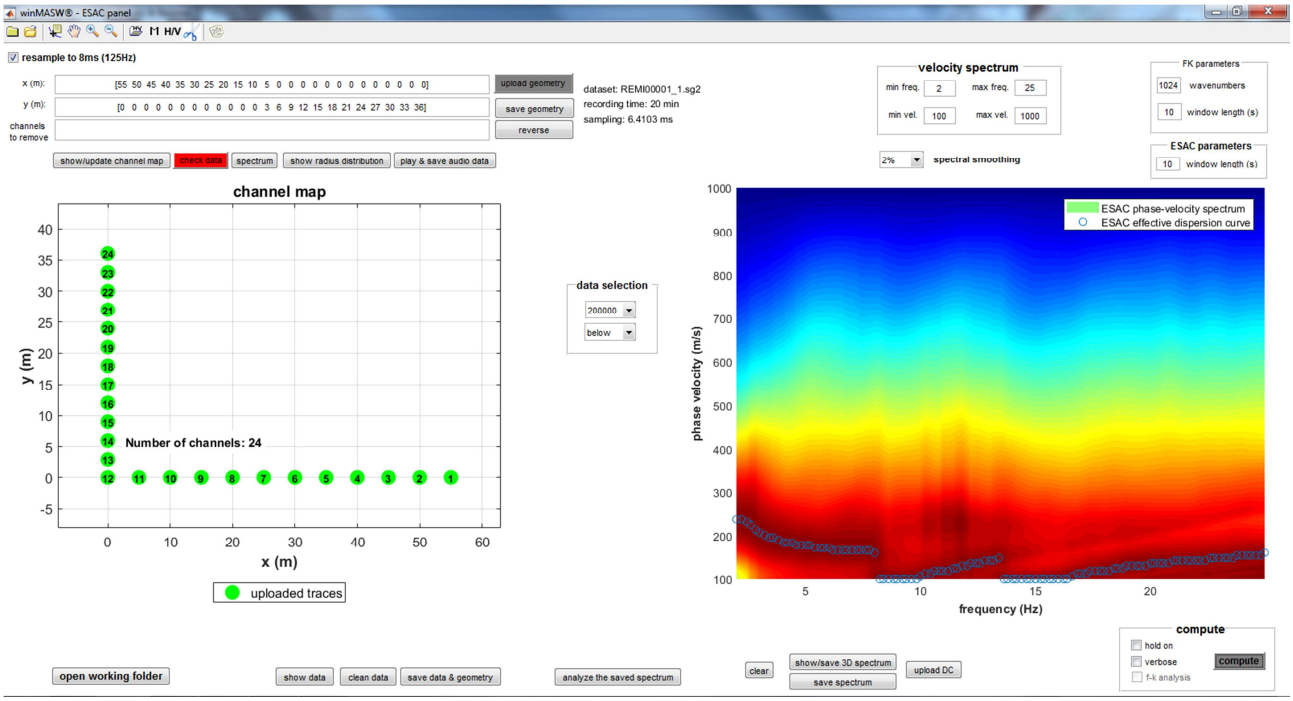
lunghezza linea 57.5 m

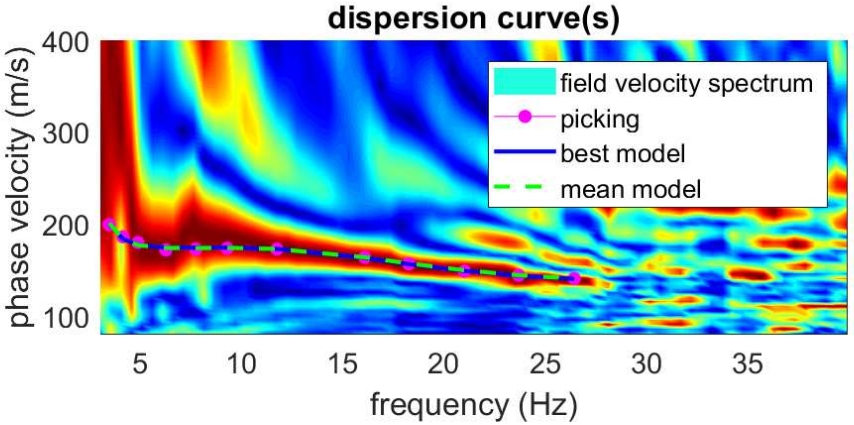
coordinate stazione 43°67’ 04.53” N 10°64’ 99.32” E

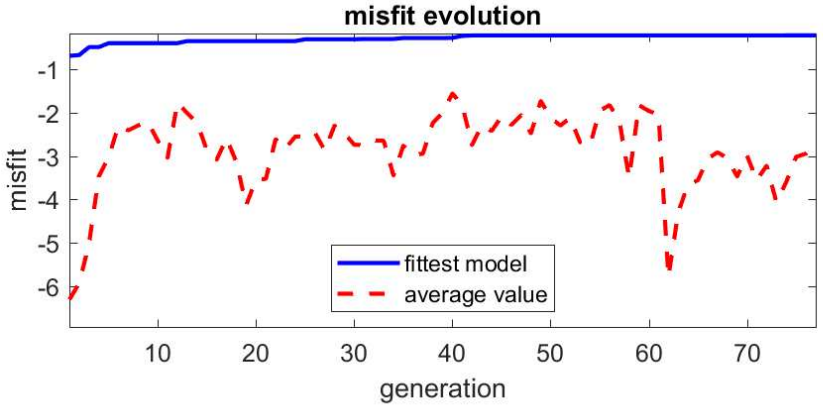
UNIONE VALDERA - Indagini sismiche MASW/ESAC

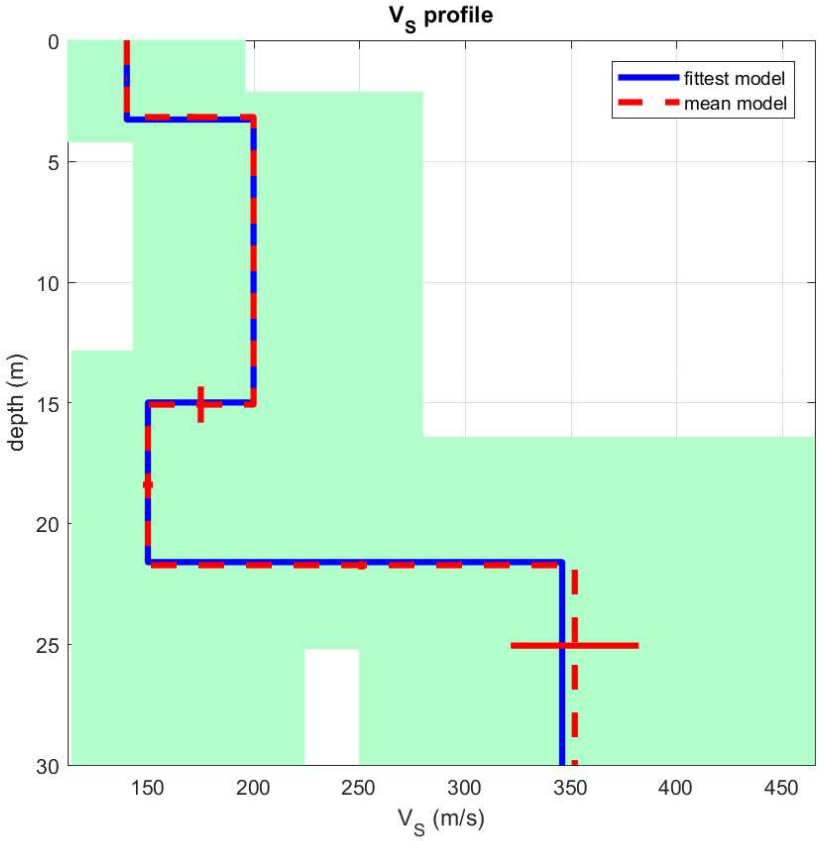
PROVA n. 8











dataset: 710.sgy
dispersion curve: 710.cdp
Vs30 & VsE (best model): 200 200 m/s
Vs30 & VsE (mean model): 200 200 m/s

Mean model

Vs (m/s): 140, 200, 150, 352

Standard deviations (m/s): 0, 0, 2, 30

Thickness (m): 3.2, 11.9, 6.7

========== SECTION#1
dataset: 710.sgy
sampling (ms): 0.956
minimum offset (m): 7.5
geophone spacing (m): 2.5
offsets (m): 7.5 10 12.5 15 17.5
20 22.5 25 27.5 30 32.5 35
37.5 40 42.5 45 47.5 50
52.5 55 57.5 60 62.5 65
Dispersion curve: 710.cdp
Number of individuals: 32
Number of generations: 61

Rayleigh-wave dispersion analysis

Analyzing phase velocities

Adopted search space (minimum Vs): 100 143 114 250
Adopted search space (maximum Vs): 196 280 224 490

Adopted search space (minimum Poisson): 0.16505 0.17484 0.17496
0.17511
Adopted search space (maximum Poisson): 0.49516 0.499 0.499
0.499

Adopted search space (minimum Qs): 7.5 12 14.25 22.5
Adopted search space (maximum Qs): 15 24 28.5 45

Adopted search space (minimum reference frequency): 1
Adopted search space (maximum reference frequency): 26.4378

Adopted search space (minimum thickness): 2.14286 10.7143 3.57143
Adopted search space (maximum thickness): 4.2 21 7

Output folder:
C:\Users\Benedetta\Desktop\valdERA-esac\valdera-esac-8\output_disp

========== SECTION#2
Rayleigh-wave analysis
Optimizing Vs & Thickness - generation: 1; average & best misfits: -6.31
-0.6867
Optimizing Vs & Thickness - generation: 2; average & best misfits: -5.9308
-0.67026
Optimizing Vs & Thickness - generation: 3; average & best misfits: -5.0176
-0.48603
Optimizing Vs & Thickness - generation: 4; average & best misfits: -3.4682
-0.48603
Optimizing Vs & Thickness - generation: 5; average & best misfits: -3.0166
-0.3954
Optimizing Vs & Thickness - generation: 6; average & best misfits: -2.303
-0.3954
Optimizing Vs & Thickness - generation: 7; average & best misfits: -2.4053
-0.3954
Optimizing Vs & Thickness - generation: 8; average & best misfits: -2.2929
-0.3954
Optimizing Vs & Thickness - generation: 9; average & best misfits: -2.2183
-0.3954
Optimizing Vs & Thickness - generation: 10; average & best misfits: -2.644
-0.3954
Optimizing Vs & Thickness - generation: 11; average & best misfits: -3.0351
-0.3954
Optimizing Vs & Thickness - generation: 12; average & best misfits: -1.7682
-0.3954
Optimizing Vs & Thickness - generation: 13; average & best misfits: -2.0092

-0.3476
Optimizing Vs & Thickness - generation: 14; average & best misfits: -2.2316
-0.3476
Optimizing Vs & Thickness - generation: 15; average & best misfits: -2.8616
-0.3476
Optimizing Vs & Thickness - generation: 16; average & best misfits: -3.0822
-0.3476
Optimizing Vs & Thickness - generation: 17; average & best misfits: -2.5923
-0.3476
Optimizing Vs & Thickness - generation: 18; average & best misfits: -3.1333
-0.3476
Optimizing Vs & Thickness - generation: 19; average & best misfits: -4.1326
-0.3476
Optimizing Vs & Thickness - generation: 20; average & best misfits: -3.5435
-0.3476
Optimizing Vs & Thickness - generation: 21; average & best misfits: -3.5271
-0.3476
Optimizing Vs & Thickness - generation: 22; average & best misfits: -2.6121
-0.3476
Optimizing Vs & Thickness - generation: 23; average & best misfits: -2.8237
-0.3476
Optimizing Vs & Thickness - generation: 24; average & best misfits: -2.5511
-0.3476
Optimizing Vs & Thickness - generation: 25; average & best misfits: -2.5403
-0.30628
Optimizing Vs & Thickness - generation: 26; average & best misfits: -2.4633
-0.30628
Optimizing Vs & Thickness - generation: 27; average & best misfits: -2.8669
-0.30628
Optimizing Vs & Thickness - generation: 28; average & best misfits: -2.2981
-0.30628
Optimizing Vs & Thickness - generation: 29; average & best misfits: -2.4705
-0.30628
Optimizing Vs & Thickness - generation: 30; average & best misfits: -2.7382
-0.30628
Optimizing Vs & Thickness - generation: 31; average & best misfits: -2.746
-0.29887
Optimizing Vs & Thickness - generation: 32; average & best misfits: -2.6413
-0.29887
Optimizing Vs & Thickness - generation: 33; average & best misfits: -2.6434
-0.29887
Optimizing Vs & Thickness - generation: 34; average & best misfits: -3.4467
-0.29887
Optimizing Vs & Thickness - generation: 35; average & best misfits: -2.7603
-0.27642
Optimizing Vs & Thickness - generation: 36; average & best misfits: -2.9703
-0.27642
Optimizing Vs & Thickness - generation: 37; average & best misfits: -2.9447
-0.27642
Optimizing Vs & Thickness - generation: 38; average & best misfits: -2.2395
-0.27642
Optimizing Vs & Thickness - generation: 39; average & best misfits: -2.0017
-0.27642
Optimizing Vs & Thickness - generation: 40; average & best misfits: -1.5554
-0.27393
Optimizing Vs & Thickness - generation: 41; average & best misfits: -1.8241
-0.2272
Optimizing Vs & Thickness - generation: 42; average & best misfits: -2.7425
-0.21766
Optimizing Vs & Thickness - generation: 43; average & best misfits: -2.2913
-0.21766
Optimizing Vs & Thickness - generation: 44; average & best misfits: -2.4224
-0.21766
Optimizing Vs & Thickness - generation: 45; average & best misfits: -2.0874
-0.21766
Optimizing Vs & Thickness - generation: 46; average & best misfits: -2.2808
-0.21766
Optimizing Vs & Thickness - generation: 47; average & best misfits: -2.0564

-0.21766
Optimizing Vs & Thickness - generation: 48; average & best misfits: -2.4775
-0.21766
Optimizing Vs & Thickness - generation: 49; average & best misfits: -1.7272
-0.21766
Optimizing Vs & Thickness - generation: 50; average & best misfits: -2.1126
-0.21766
Optimizing Vs & Thickness - generation: 51; average & best misfits: -2.2959
-0.21766
Optimizing Vs & Thickness - generation: 52; average & best misfits: -2.1184
-0.21766
Optimizing Vs & Thickness - generation: 53; average & best misfits: -2.6784
-0.21766
Optimizing Vs & Thickness - generation: 54; average & best misfits: -2.7565
-0.21766
Optimizing Vs & Thickness - generation: 55; average & best misfits: -1.9605
-0.21766
Optimizing Vs & Thickness - generation: 56; average & best misfits: -1.8213
-0.21766
Optimizing Vs & Thickness - generation: 57; average & best misfits: -2.1824
-0.21766
Optimizing Vs & Thickness - generation: 58; average & best misfits: -3.4958
-0.21766
Optimizing Vs & Thickness - generation: 59; average & best misfits: -1.8251
-0.21766
Optimizing Vs & Thickness - generation: 60; average & best misfits: -1.9584
-0.21766
Optimizing Vs & Thickness - generation: 61; average & best misfits: -2.0422
-0.21766

Adopted search space (minimum Vs): 100 143 114 250
Adopted search space (maximum Vs): 196 280 224 490

Adopted search space (minimum Qs): 7.5 12 14.25 22.5
Adopted search space (maximum Qs): 15 24 28.5 45

Adopted search space (minimum reference frequency): 1
Adopted search space (maximum reference frequency): 26.4378

Adopted search space (minimum Poisson): 0.16505 0.17484 0.17496
0.17511
Adopted search space (maximum Poisson): 0.49516 0.497 0.497
0.497

Adopted search space (minimum thickness): 2.14286 10.7143 3.57143
Adopted search space (maximum thickness): 4.2 21 7

Now a finer search around the most promising search space area

Rayleigh-wave analysis
Optimizing Vs & Thickness - generation: 1; average & best misfits: -5.7909
-0.21766
Optimizing Vs & Thickness - generation: 2; average & best misfits: -4.2961
-0.21766
Optimizing Vs & Thickness - generation: 3; average & best misfits: -3.65
-0.21691
Optimizing Vs & Thickness - generation: 4; average & best misfits: -3.5608
-0.21691
Optimizing Vs & Thickness - generation: 5; average & best misfits: -3.0575
-0.21691
Optimizing Vs & Thickness - generation: 6; average & best misfits: -2.9143
-0.21691
Optimizing Vs & Thickness - generation: 7; average & best misfits: -3.0458
-0.21691
Optimizing Vs & Thickness - generation: 8; average & best misfits: -3.4714
-0.21691
Optimizing Vs & Thickness - generation: 9; average & best misfits: -2.9861

-0.21691
Optimizing Vs & Thickness - generation: 10; average & best misfits: -3.5524
-0.21691
Optimizing Vs & Thickness - generation: 11; average & best misfits: -3.2221
-0.21691
Optimizing Vs & Thickness - generation: 12; average & best misfits: -4.0642
-0.21691
Optimizing Vs & Thickness - generation: 13; average & best misfits: -3.5985
-0.21567
Optimizing Vs & Thickness - generation: 14; average & best misfits: -3.0183
-0.21567
Optimizing Vs & Thickness - generation: 15; average & best misfits: -2.943
-0.21567
Optimizing Vs & Thickness - generation: 16; average & best misfits: -2.7489
-0.21567

Model after the Vs & Thickness optimization (fixed Poisson values):
Vs (m/s): 140 200 150 346
Thickness (m): 3.3 12 6.6

Number of models considered to calculate the average model: 55

##
RESULTS
##

Dataset: 710.sgy
Analyzed curve/spectrum: 710.cdp

========== SECTION#3

Analyzing Phase Velocities

Analyzing Rayleigh-Wave Dispersion

==
MEAN MODEL

Vs (m/s): 140 200 150 352
Standard deviations (m/s): 0 0 2 30

Thickness (m): 3.2 11.9 6.7
Standard deviations (m): 0.1 0.7 0.2

Approximate values for Vp, density, Poisson & Shear modulus
Vp (m/s): 360 413 272 741
Density (gr/cm3): 1.81 1.84 1.74 1.98
Vp/Vs ratio: 2.57 2.06 1.81 2.11
Poisson: 0.41 0.35 0.28 0.35
Shear modulus (MPa): 35 74 39 245
Estimated static shear modulus (MPa): 0 0 0 0

Fundamental mode
Mean model
 f(Hz) VR(m/s)
3.49555 200.5468
4.18039 183.1246
 4.9223 176.5718
6.29199 173.5567
7.77581 173.4598
9.31671 173.6249
11.7707 172.4129
16.1081 163.3023
18.2767 156.6917

21.0161	149.1449
23.6984	143.7354
26.4378	140.0253

========== SECTION#4

BEST MODEL

Vs (m/s): 140 200 150 346
thickness (m): 3.2847 11.7114 6.60811

Approximate values for Vp, density, Poisson & Shear modulus
Vp (m/s): 410 419 269 682
Density (gr/cm3): 1.84 1.84 1.74 1.96
Vp/Vs ratio: 2.93 2.10 1.79 1.97
Poisson: 0.43 0.35 0.27 0.33
Shear modulus (MPa): 36 74 39 235
Estimated static shear modulus (MPa): 0 0 0 0

dispersion curve (frequency - velocity)

Fundamental mode)
best model

F(Hz)	VR(m/s)
3.49555	199.8693
4.18039	183.2763
4.9223	176.8823
6.29199	173.893
7.77581	173.7682
9.31671	173.8868
11.7707	172.5185
16.1081	162.6843
18.2767	155.8564
21.0161	148.422
23.6984	143.2826
26.4378	139.8216

========== SECTION#5

Maximum penetration depth according to the "Steady State Rayleigh Method": 30 m

Inversion quality: very good

Vs30 & VsE (mean model): 200 200 m/s
Vs30 & VsE (best model): 200 200 m/s

========== 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
"C:\Users\Benedetta\Desktop\valdERA-esac\valdera-esac-8\output_disp".

==========
winMASW - Surface Waves & Beyond
www.winmasw.com

Number of models used to define the mean model: 55
Vs30 for the best model: 200 200
Analyzing phase velocities

UNIONE DI COMUNI DELLA VALDERA

INDAGINE ESAC/MASW - COMUNE DI CAPANNOLI

LOC. SAN PIETRO IN BELVEDERE - POSTAZIONE n.9

documentazione fotografica

ubicazione scala 1:1.000

geometria ESAC

geof	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
x	55	50	45	40	35	30	25	20	15	10	5	0	0	0	0	0	0	0	0	0	0	0	0	0
y	0	0	0	0	0	0	0	0	0	0	0	0	3	6	9	12	15	18	21	24	27	30	33	36

geometria MASW

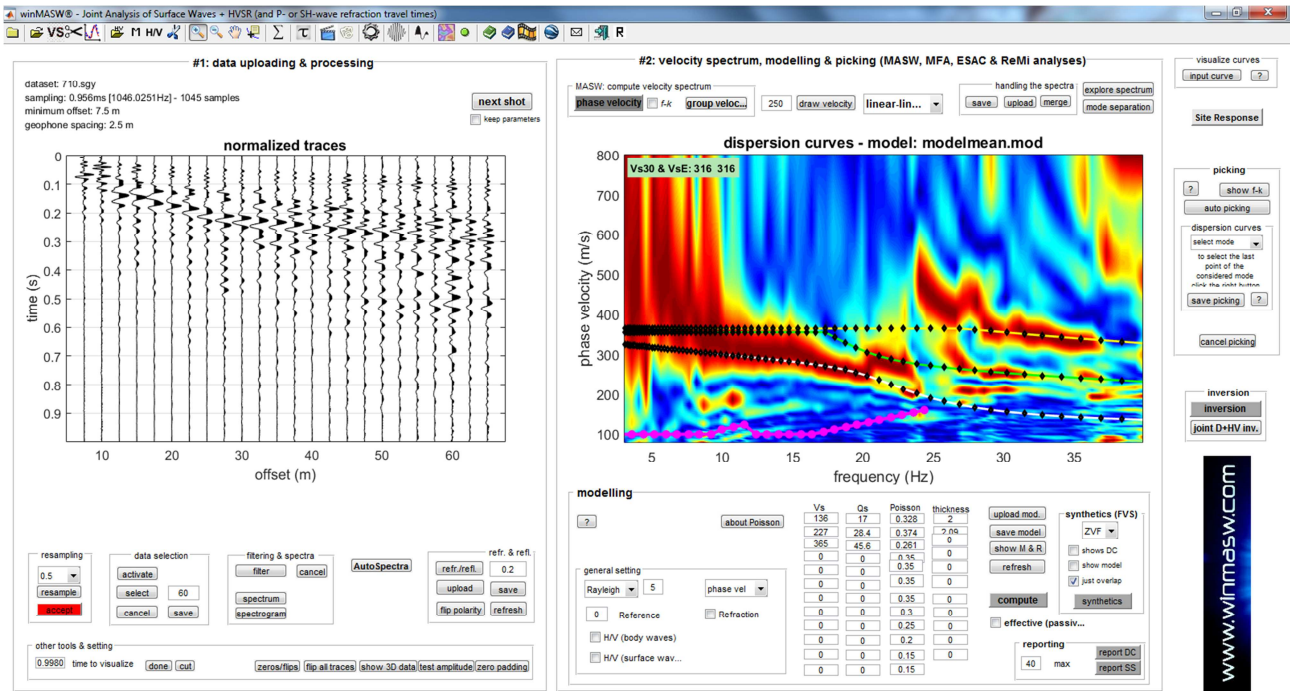
distanza geofonica 12 ch 5 m

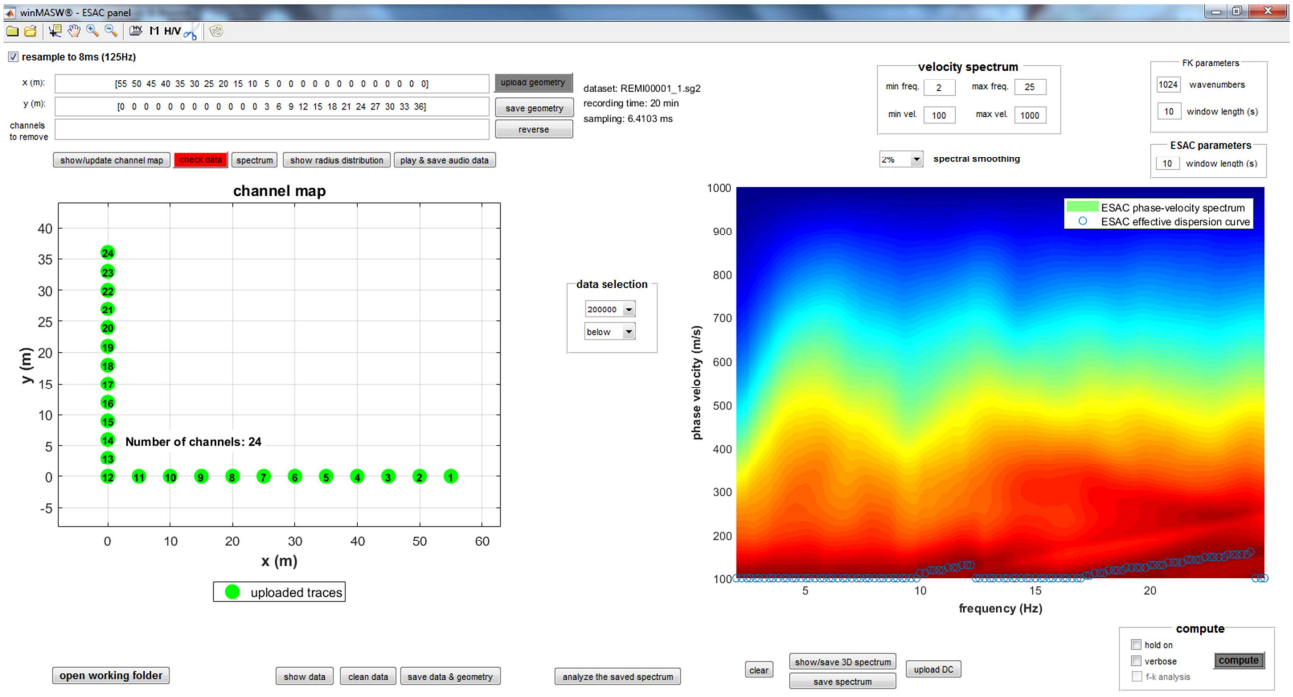
lunghezza linea 57.5 m

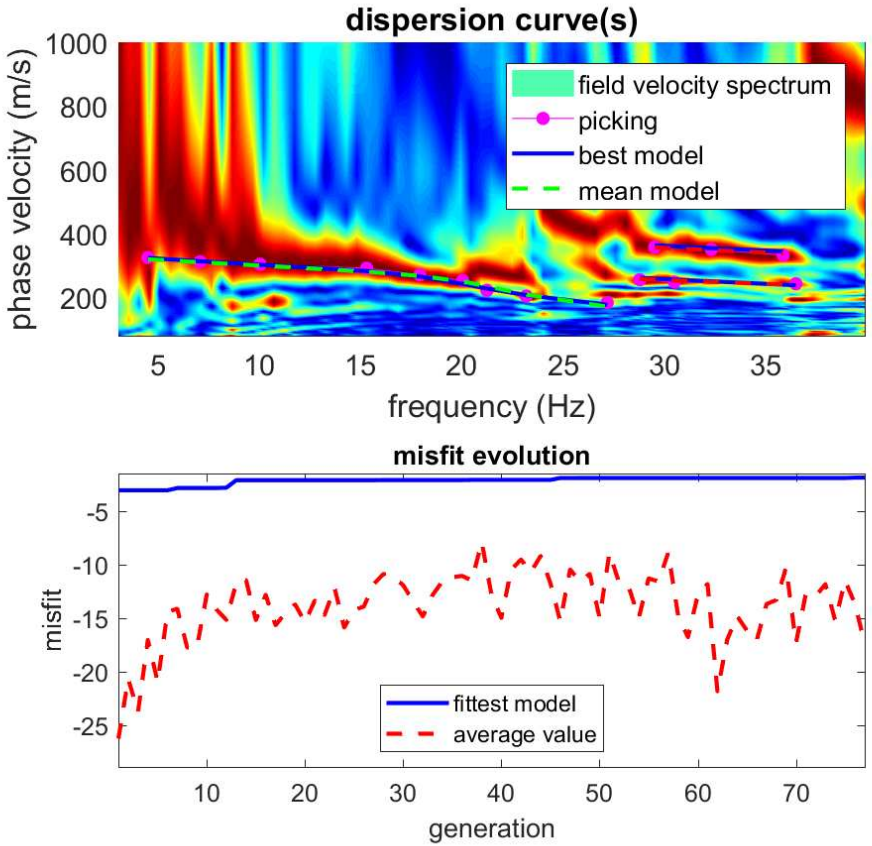
coordinate stazione 43°56’ 68.69” N 10°67’ 13.46” E

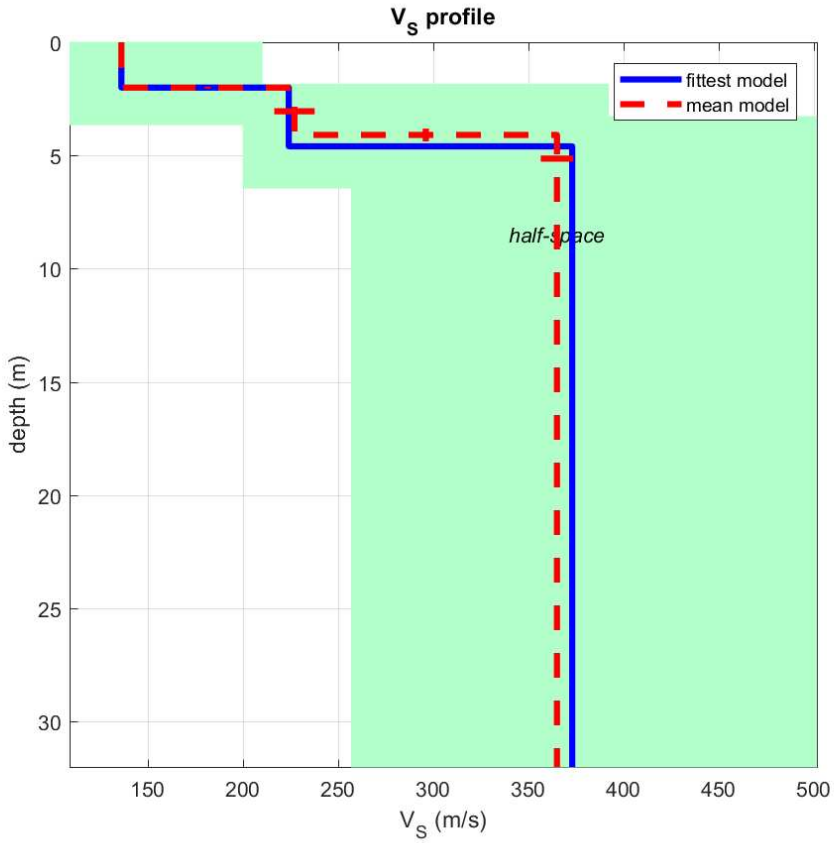
UNIONE VALDERA - Indagini sismiche MASW/ESAC

PROVA n. 9









www.winmasw.com

dataset: 710.sgy
dispersion curve: 710bis.cdp
Vs30 & VsE (best model): 318 318 m/s
Vs30 & VsE (mean model): 316 316 m/s

Mean model

Vs (m/s): 136, 227, 365

Standard deviations (m/s): 1, 11, 9

Thickness (m): 2.0, 2.1

========== SECTION#1
dataset: 710.sgy
sampling (ms): 0.956
minimum offset (m): 7.5
geophone spacing (m): 2.5
offsets (m): 7.5 10 12.5 15 17.5
20 22.5 25 27.5 30 32.5 35
37.5 40 42.5 45 47.5 50
52.5 55 57.5 60 62.5 65
Dispersion curve: 710bis.cdp
Number of individuals: 32
Number of generations: 61

Rayleigh-wave dispersion analysis

Analyzing phase velocities

Adopted search space (minimum Vs): 107 200 257
Adopted search space (maximum Vs): 210 392 504

Adopted search space (minimum Poisson): 0.15694 0.18942 0.16182
Adopted search space (maximum Poisson): 0.47082 0.499 0.48546

Adopted search space (minimum Qs): 15.8475 33.8475 35.91
Adopted search space (maximum Qs): 31.695 67.695 71.82

Adopted search space (minimum reference frequency): 1
Adopted search space (maximum reference frequency): 36.4821

Adopted search space (minimum thickness): 1.8571 1.4286
Adopted search space (maximum thickness): 3.64 2.8

Output folder:
C:\Users\Benedetta\Desktop\valdERA-esac\valdera-esac-9\output_disp

========== SECTION#2
Rayleigh-wave analysis
Optimizing Vs & Thickness - generation: 1; average & best misfits: -26.2623
-3.09686
Optimizing Vs & Thickness - generation: 2; average & best misfits: -20.6827
-3.09686
Optimizing Vs & Thickness - generation: 3; average & best misfits: -23.7459
-3.09686
Optimizing Vs & Thickness - generation: 4; average & best misfits: -17.0425
-3.09686
Optimizing Vs & Thickness - generation: 5; average & best misfits: -20.97
-3.09686
Optimizing Vs & Thickness - generation: 6; average & best misfits: -14.418
-3.09686
Optimizing Vs & Thickness - generation: 7; average & best misfits: -14.1512
-2.883
Optimizing Vs & Thickness - generation: 8; average & best misfits: -17.7596
-2.883
Optimizing Vs & Thickness - generation: 9; average & best misfits: -17.7157
-2.883
Optimizing Vs & Thickness - generation: 10; average & best misfits: -12.8094
-2.883
Optimizing Vs & Thickness - generation: 11; average & best misfits: -14.218
-2.883
Optimizing Vs & Thickness - generation: 12; average & best misfits: -15.1894
-2.85522
Optimizing Vs & Thickness - generation: 13; average & best misfits: -11.7247
-2.15684
Optimizing Vs & Thickness - generation: 14; average & best misfits: -11.478

-2.15684
Optimizing Vs & Thickness - generation: 15; average & best misfits: -15.1958
-2.15684
Optimizing Vs & Thickness - generation: 16; average & best misfits: -12.8396
-2.15684
Optimizing Vs & Thickness - generation: 17; average & best misfits: -15.6807
-2.15684
Optimizing Vs & Thickness - generation: 18; average & best misfits: -14.5497
-2.15684
Optimizing Vs & Thickness - generation: 19; average & best misfits: -13.7395
-2.15684
Optimizing Vs & Thickness - generation: 20; average & best misfits: -15.4066
-2.15684
Optimizing Vs & Thickness - generation: 21; average & best misfits: -13.3742
-2.15684
Optimizing Vs & Thickness - generation: 22; average & best misfits: -14.7196
-2.15684
Optimizing Vs & Thickness - generation: 23; average & best misfits: -12.1549
-2.15684
Optimizing Vs & Thickness - generation: 24; average & best misfits: -15.8878
-2.15684
Optimizing Vs & Thickness - generation: 25; average & best misfits: -14.2446
-2.15684
Optimizing Vs & Thickness - generation: 26; average & best misfits: -13.9278
-2.15684
Optimizing Vs & Thickness - generation: 27; average & best misfits: -11.8385
-2.15684
Optimizing Vs & Thickness - generation: 28; average & best misfits: -10.8914
-2.14313
Optimizing Vs & Thickness - generation: 29; average & best misfits: -11.1946
-2.14313
Optimizing Vs & Thickness - generation: 30; average & best misfits: -11.9404
-2.14313
Optimizing Vs & Thickness - generation: 31; average & best misfits: -13.42
-2.14313
Optimizing Vs & Thickness - generation: 32; average & best misfits: -14.8619
-2.14313
Optimizing Vs & Thickness - generation: 33; average & best misfits: -12.8528
-2.14313
Optimizing Vs & Thickness - generation: 34; average & best misfits: -11.5686
-2.14313
Optimizing Vs & Thickness - generation: 35; average & best misfits: -11.1971
-2.14313
Optimizing Vs & Thickness - generation: 36; average & best misfits: -11.0749
-2.14313
Optimizing Vs & Thickness - generation: 37; average & best misfits: -11.5112
-2.12882
Optimizing Vs & Thickness - generation: 38; average & best misfits: -7.9093
-2.1288
Optimizing Vs & Thickness - generation: 39; average & best misfits: -12.8811
-2.12882
Optimizing Vs & Thickness - generation: 40; average & best misfits: -14.9901
-2.12882
Optimizing Vs & Thickness - generation: 41; average & best misfits: -10.483
-2.12882
Optimizing Vs & Thickness - generation: 42; average & best misfits: -9.5527
-2.1288
Optimizing Vs & Thickness - generation: 43; average & best misfits: -10.7352
-2.12882
Optimizing Vs & Thickness - generation: 44; average & best misfits: -9.2067
-2.1288
Optimizing Vs & Thickness - generation: 45; average & best misfits: -11.7775
-2.12882
Optimizing Vs & Thickness - generation: 46; average & best misfits: -15.3092
-1.95182
Optimizing Vs & Thickness - generation: 47; average & best misfits: -10.4754
-1.95182
Optimizing Vs & Thickness - generation: 48; average & best misfits: -11.5959

-1.94829
Optimizing Vs & Thickness - generation: 49; average & best misfits: -10.8948
-1.94829
Optimizing Vs & Thickness - generation: 50; average & best misfits: -14.9837
-1.94829
Optimizing Vs & Thickness - generation: 51; average & best misfits: -8.9392
-1.9483
Optimizing Vs & Thickness - generation: 52; average & best misfits: -11.735
-1.94829
Optimizing Vs & Thickness - generation: 53; average & best misfits: -12.195
-1.94829
Optimizing Vs & Thickness - generation: 54; average & best misfits: -14.9762
-1.94829
Optimizing Vs & Thickness - generation: 55; average & best misfits: -11.3123
-1.94829
Optimizing Vs & Thickness - generation: 56; average & best misfits: -11.5885
-1.94829
Optimizing Vs & Thickness - generation: 57; average & best misfits: -8.9155
-1.9483
Optimizing Vs & Thickness - generation: 58; average & best misfits: -14.7709
-1.94829
Optimizing Vs & Thickness - generation: 59; average & best misfits: -16.7957
-1.94829
Optimizing Vs & Thickness - generation: 60; average & best misfits: -12.8502
-1.94829
Optimizing Vs & Thickness - generation: 61; average & best misfits: -11.8247
-1.94829

Adopted search space (minimum Vs): 107 200 257
Adopted search space (maximum Vs): 210 392 504

Adopted search space (minimum Qs): 15.8475 33.8475 35.91
Adopted search space (maximum Qs): 31.695 67.695 71.82

Adopted search space (minimum reference frequency): 1
Adopted search space (maximum reference frequency): 36.4821

Adopted search space (minimum Poisson): 0.15694 0.18942 0.16182
Adopted search space (maximum Poisson): 0.47082 0.497 0.48546

Adopted search space (minimum thickness): 1.8571 1.4286
Adopted search space (maximum thickness): 3.64 2.8

Now a finer search around the most promising search space area

Rayleigh-wave analysis
Optimizing Vs & Thickness - generation: 1; average & best misfits: -21.8387
-1.94829
Optimizing Vs & Thickness - generation: 2; average & best misfits: -17.0178
-1.94829
Optimizing Vs & Thickness - generation: 3; average & best misfits: -14.809
-1.94829
Optimizing Vs & Thickness - generation: 4; average & best misfits: -16.1651
-1.94829
Optimizing Vs & Thickness - generation: 5; average & best misfits: -17.101
-1.94829
Optimizing Vs & Thickness - generation: 6; average & best misfits: -13.7068
-1.94829
Optimizing Vs & Thickness - generation: 7; average & best misfits: -13.324
-1.94829
Optimizing Vs & Thickness - generation: 8; average & best misfits: -10.2862
-1.94829
Optimizing Vs & Thickness - generation: 9; average & best misfits: -17.3334
-1.94829
Optimizing Vs & Thickness - generation: 10; average & best misfits: -12.7703
-1.94829
Optimizing Vs & Thickness - generation: 11; average & best misfits: -12.9694

-1.94829
Optimizing Vs & Thickness - generation: 12; average & best misfits: -11.8413
-1.94829
Optimizing Vs & Thickness - generation: 13; average & best misfits: -15.262
-1.94829
Optimizing Vs & Thickness - generation: 14; average & best misfits: -11.5189
-1.94829
Optimizing Vs & Thickness - generation: 15; average & best misfits: -13.6727
-1.91429
Optimizing Vs & Thickness - generation: 16; average & best misfits: -17.4163
-1.91429

Model after the Vs & Thickness optimization (fixed Poisson values):
Vs (m/s): 136 224 373
Thickness (m): 2   2.6

Number of models considered to calculate the average model: 150

##
RESULTS
##

Dataset: 710.sgy
Analyzed curve/spectrum: 710bis.cdp

========== SECTION#3

Analyzing Phase Velocities

Analyzing Rayleigh-Wave Dispersion

==
MEAN MODEL

Vs (m/s):   136 227 365
Standard deviations (m/s): 1 11   9

Thickness (m):   2.0   2.1
Standard deviations (m): 0.0   0.3

Approximate values for Vp, density, Poisson & Shear modulus
Vp (m/s):   269 506 642
Density (gr/cm3):   1.74   1.89   1.95
Vp/Vs ratio: 1.98   2.23   1.76
Poisson: 0.33   0.37   0.26
Shear modulus (MPa): 32   97   259
Estimated static shear modulus (MPa): 0   0   0

Fundamental mode
Mean model
 f(Hz)   VR(m/s)
4.52281   319.539
7.09097   310.2815
10.0586   299.9288
15.3091   280.7093
17.9343   267.4833
20.0459   249.7845
21.2444   235.0735
23.1848   208.8465
27.1797   171.0862

First higher mode
Mean model
28.7776   257.6577

30.4897 252.9195
36.4821 239.0775

Second higher mode
Mean model
29.5196 356.7708
32.316 348.0749
35.8543 338.273

========== SECTION#4

BEST MODEL

Vs (m/s): 136 224 373
thickness (m): 2.0029 2.5928

Approximate values for Vp, density, Poisson & Shear modulus
Vp (m/s): 438 428 653
Density (gr/cm3): 1.85 1.85 1.95
Vp/Vs ratio: 3.22 1.91 1.75
Poisson: 0.45 0.31 0.26
Shear modulus (MPa): 34 93 271
Estimated static shear modulus (MPa): 0 0 0

dispersion curve (frequency - velocity)

Fundamental mode)
best model
F(Hz) VR(m/s)
4.52281 323.8115
7.09097 313.4413
10.0586 302.6179
15.3091 282.8059
17.9343 265.5285
20.0459 242.3224
21.2444 227.8164
23.1848 207.025
27.1797 177.0953

First higher mode)
best model
28.7776 261.4526
30.4897 255.8764
36.4821 238.122

Second higher mode)
best model
29.5196 363.5094
32.316 354.5419
35.8543 344.3855

========== SECTION#5

Maximum penetration depth according to the "Steady State Rayleigh Method": 32 m

Inversion quality: very good

Vs30 & VsE (mean model): 316 316 m/s
Vs30 & VsE (best model): 318 318 m/s

========== 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
"C:\Users\Benedetta\Desktop\valdERA-esac\valdera-esac-9\output_disp".

==========
winMASW - Surface Waves & Beyond
www.winmasw.com

Number of models used to define the mean model: 150
Vs30 for the best model: 318 318
Analyzing phase velocities

UNIONE DI COMUNI DELLA VALDERA

INDAGINE ESAC/MASW - COMUNE DI CAPANNOLI

LOC. IL PIANO - POSTAZIONE n.10

documentazione fotografica

ubicazione scala 1:1.000

geometria ESAC

geof	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
x	55	50	45	40	35	30	25	20	15	10	5	0	0	0	0	0	0	0	0	0	0	0	0	0
y	0	0	0	0	0	0	0	0	0	0	0	0	3	6	9	12	15	18	21	24	27	30	33	36

geometria MASW

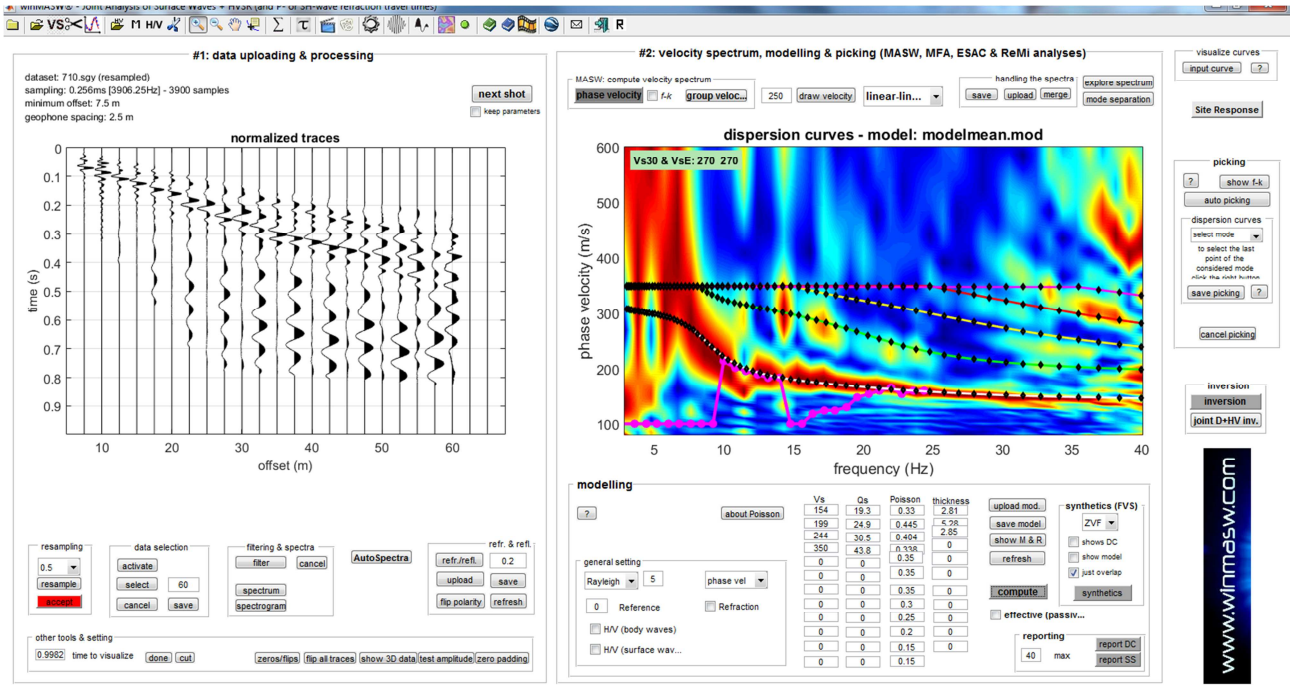
distanza geofonica 12 ch 5 m

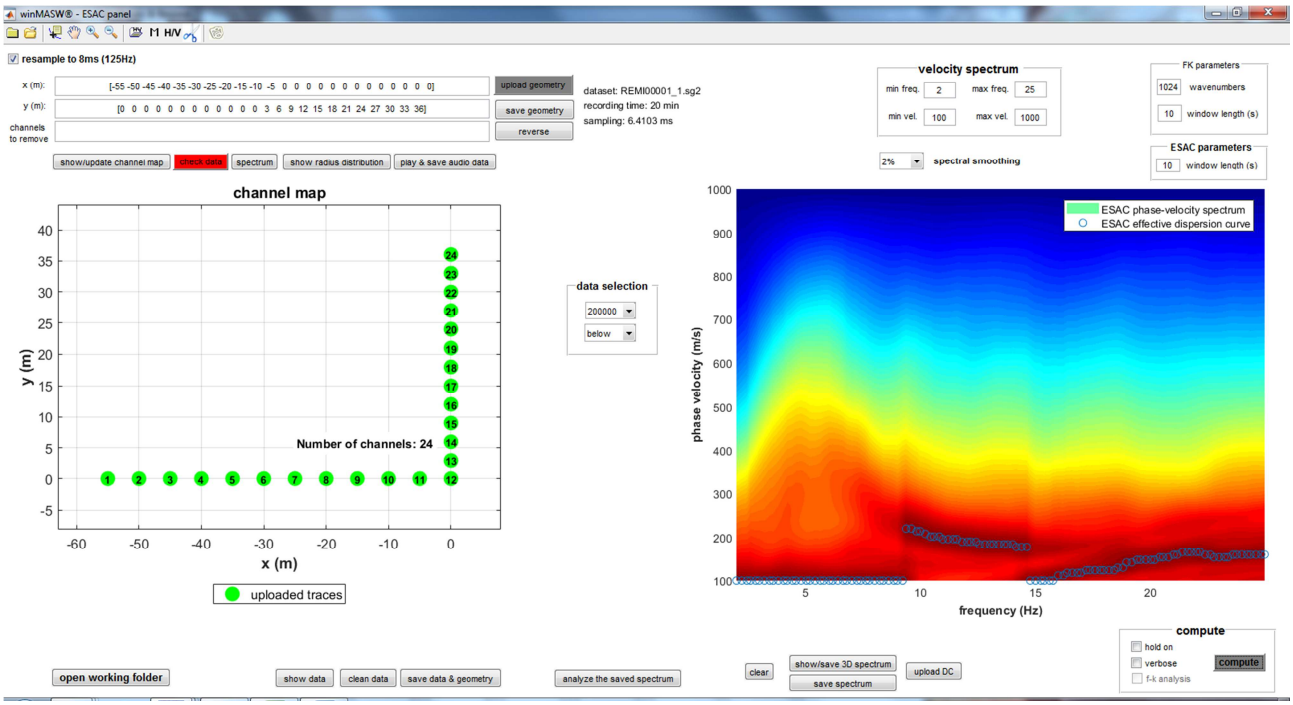
lunghezza linea 57.5 m

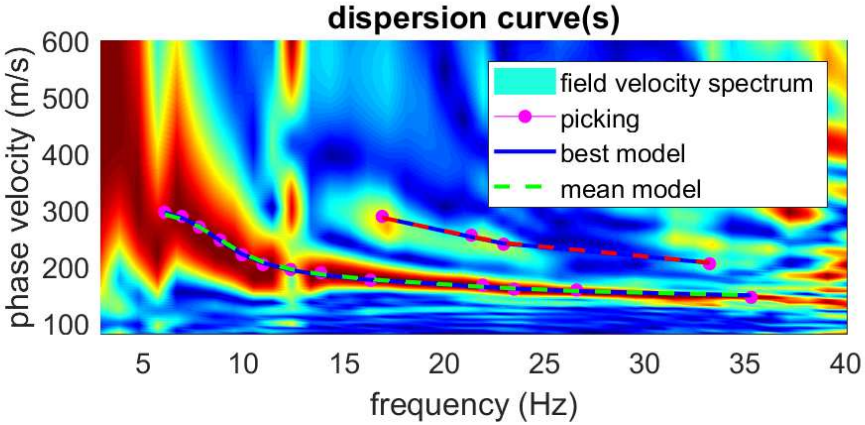
coordinate stazione 43°59’ 61.209” N 10°66’ 45.04” E

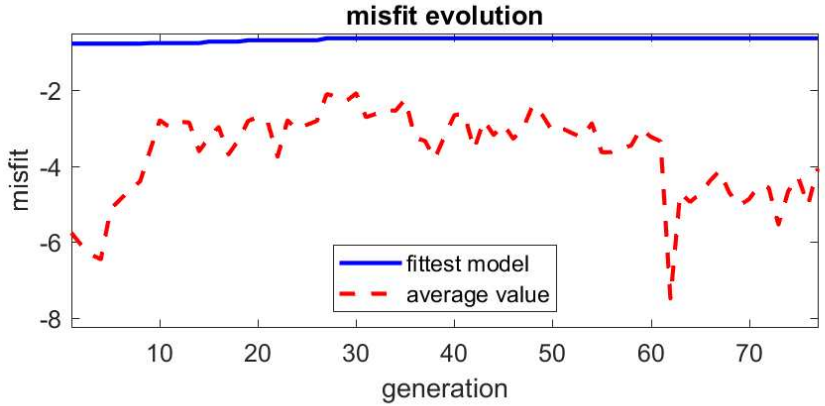
UNIONE VALDERA - Indagini sismiche MASW/ESAC

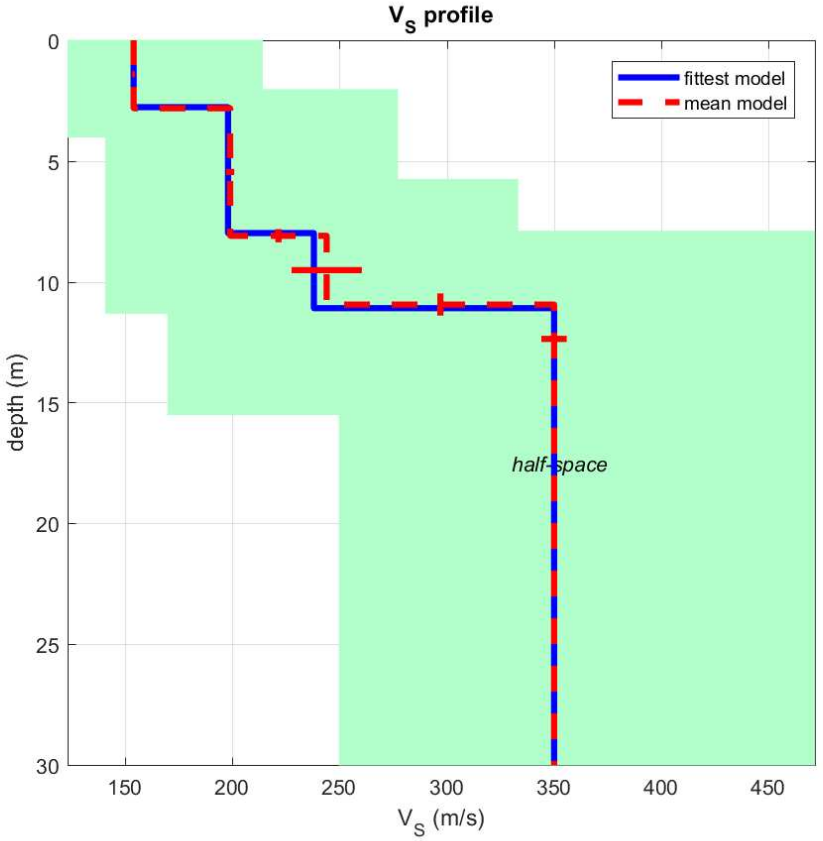
PROVA n. 10











www.winmasw.com

dataset: 710.sgy
dispersion curve: 710bis.cdp
Vs30 & VsE (best model): 269 269 m/s
Vs30 & VsE (mean model): 270 270 m/s

Mean model

Vs (m/s): 154, 199, 244, 350

Standard deviations (m/s): 1, 2, 16, 6

Thickness (m): 2.8, 5.3, 2.8

```
========================================================= SECTION#1
dataset: 710.sgy
sampling (ms): 0.256
minimum offset (m): 7.5
geophone spacing (m): 2.5
offsets (m): 7.5           10          12.5           15          17.5
20          22.5           25          27.5           30          32.5           35
       37.5           40          42.5           45          47.5           50
     52.5           55          57.5           60          62.5           65
Dispersion curve: 710bis.cdp
Number of individuals: 32
Number of generations: 61

Rayleigh-wave dispersion analysis

Analyzing phase velocities

Adopted search space (minimum Vs): 109  141  170  250
Adopted search space (maximum Vs): 214  277  333  490

Adopted search space (minimum Poisson): 0.17151     0.22771     0.22389
0.17511
Adopted search space (maximum Poisson): 0.499       0.499       0.499
0.499

Adopted search space (minimum Qs): 14.3475      18.5625      22.3125
37.5
Adopted search space (maximum Qs): 28.695       37.125       44.625           75

Adopted search space (minimum reference frequency): 1
Adopted search space (maximum reference frequency): 35.3143

Adopted search space (minimum thickness): 2.0429      3.7214      2.1429
Adopted search space (maximum thickness): 4.004       7.294         4.2

Output folder:
C:\Users\Benedetta\Desktop\valdERA-esac\valdera-esac-10bis\output_disp



========================================================= SECTION#2
Rayleigh-wave analysis
Optimizing Vs & Thickness - generation: 1; average & best misfits: -5.765
-0.77426
Optimizing Vs & Thickness - generation: 2; average & best misfits: -6.0844
-0.77426
Optimizing Vs & Thickness - generation: 3; average & best misfits: -6.3366
-0.77426
Optimizing Vs & Thickness - generation: 4; average & best misfits: -6.4595
-0.77426
Optimizing Vs & Thickness - generation: 5; average & best misfits: -5.1303
-0.77426
Optimizing Vs & Thickness - generation: 6; average & best misfits: -4.8767
-0.77426
Optimizing Vs & Thickness - generation: 7; average & best misfits: -4.6241
-0.77426
Optimizing Vs & Thickness - generation: 8; average & best misfits: -4.4073
-0.77426
Optimizing Vs & Thickness - generation: 9; average & best misfits: -3.6032
-0.76023
Optimizing Vs & Thickness - generation: 10; average & best misfits: -2.7958
-0.76023
Optimizing Vs & Thickness - generation: 11; average & best misfits: -2.9762
-0.76023
Optimizing Vs & Thickness - generation: 12; average & best misfits: -2.8362
-0.76023
```

Optimizing Vs & Thickness - generation: 13; average & best misfits: -2.8545
-0.76023
Optimizing Vs & Thickness - generation: 14; average & best misfits: -3.6131
-0.76023
Optimizing Vs & Thickness - generation: 15; average & best misfits: -3.2514
-0.72053
Optimizing Vs & Thickness - generation: 16; average & best misfits: -2.974
-0.72053
Optimizing Vs & Thickness - generation: 17; average & best misfits: -3.6946
-0.72053
Optimizing Vs & Thickness - generation: 18; average & best misfits: -3.3244
-0.72053
Optimizing Vs & Thickness - generation: 19; average & best misfits: -2.8119
-0.68543
Optimizing Vs & Thickness - generation: 20; average & best misfits: -2.7084
-0.68543
Optimizing Vs & Thickness - generation: 21; average & best misfits: -2.8472
-0.68543
Optimizing Vs & Thickness - generation: 22; average & best misfits: -3.7548
-0.68543
Optimizing Vs & Thickness - generation: 23; average & best misfits: -2.7974
-0.68543
Optimizing Vs & Thickness - generation: 24; average & best misfits: -3.0399
-0.68543
Optimizing Vs & Thickness - generation: 25; average & best misfits: -2.9137
-0.68543
Optimizing Vs & Thickness - generation: 26; average & best misfits: -2.8115
-0.68543
Optimizing Vs & Thickness - generation: 27; average & best misfits: -2.1009
-0.63322
Optimizing Vs & Thickness - generation: 28; average & best misfits: -2.1749
-0.63322
Optimizing Vs & Thickness - generation: 29; average & best misfits: -2.2882
-0.63322
Optimizing Vs & Thickness - generation: 30; average & best misfits: -2.0837
-0.63322
Optimizing Vs & Thickness - generation: 31; average & best misfits: -2.7139
-0.63322
Optimizing Vs & Thickness - generation: 32; average & best misfits: -2.6269
-0.63322
Optimizing Vs & Thickness - generation: 33; average & best misfits: -2.5242
-0.63322
Optimizing Vs & Thickness - generation: 34; average & best misfits: -2.5443
-0.63322
Optimizing Vs & Thickness - generation: 35; average & best misfits: -2.2444
-0.63322
Optimizing Vs & Thickness - generation: 36; average & best misfits: -3.2638
-0.63322
Optimizing Vs & Thickness - generation: 37; average & best misfits: -3.3359
-0.63322
Optimizing Vs & Thickness - generation: 38; average & best misfits: -3.811
-0.63322
Optimizing Vs & Thickness - generation: 39; average & best misfits: -3.2143
-0.63322
Optimizing Vs & Thickness - generation: 40; average & best misfits: -2.6612
-0.63322
Optimizing Vs & Thickness - generation: 41; average & best misfits: -2.6171
-0.63322
Optimizing Vs & Thickness - generation: 42; average & best misfits: -3.5619
-0.63322
Optimizing Vs & Thickness - generation: 43; average & best misfits: -2.7974
-0.63322
Optimizing Vs & Thickness - generation: 44; average & best misfits: -3.1822
-0.63322
Optimizing Vs & Thickness - generation: 45; average & best misfits: -2.906
-0.63322
Optimizing Vs & Thickness - generation: 46; average & best misfits: -3.2825
-0.63322

```
Optimizing Vs & Thickness - generation: 47; average & best misfits: -3.0088
-0.63322
Optimizing Vs & Thickness - generation: 48; average & best misfits: -2.3881
-0.63322
Optimizing Vs & Thickness - generation: 49; average & best misfits: -2.6746
-0.63322
Optimizing Vs & Thickness - generation: 50; average & best misfits: -3.0879
-0.63322
Optimizing Vs & Thickness - generation: 51; average & best misfits: -3.0111
-0.63322
Optimizing Vs & Thickness - generation: 52; average & best misfits: -3.1346
-0.63322
Optimizing Vs & Thickness - generation: 53; average & best misfits: -3.2515
-0.63322
Optimizing Vs & Thickness - generation: 54; average & best misfits: -2.8742
-0.63322
Optimizing Vs & Thickness - generation: 55; average & best misfits: -3.6401
-0.63322
Optimizing Vs & Thickness - generation: 56; average & best misfits: -3.635
-0.63322
Optimizing Vs & Thickness - generation: 57; average & best misfits: -3.5337
-0.63322
Optimizing Vs & Thickness - generation: 58; average & best misfits: -3.4617
-0.63322
Optimizing Vs & Thickness - generation: 59; average & best misfits: -3.0123
-0.63322
Optimizing Vs & Thickness - generation: 60; average & best misfits: -3.2315
-0.63322
Optimizing Vs & Thickness - generation: 61; average & best misfits: -3.3511
-0.63322

Adopted search space (minimum Vs): 109  141  170  250
Adopted search space (maximum Vs): 214  277  333  490

Adopted search space (minimum Qs): 14.3475      18.5625      22.3125
37.5
Adopted search space (maximum Qs): 28.695       37.125       44.625           75

Adopted search space (minimum reference frequency): 1
Adopted search space (maximum reference frequency): 35.3143

Adopted search space (minimum Poisson): 0.17151     0.22771     0.22389
0.17511
Adopted search space (maximum Poisson): 0.497       0.497       0.497
0.497

Adopted search space (minimum thickness): 2.0429      3.7214      2.1429
Adopted search space (maximum thickness): 4.004       7.294         4.2


Now a finer search around the most promising search space area

Rayleigh-wave analysis
Optimizing Vs & Thickness - generation: 1; average & best misfits: -7.4971
-0.63322
Optimizing Vs & Thickness - generation: 2; average & best misfits: -4.7064
-0.63322
Optimizing Vs & Thickness - generation: 3; average & best misfits: -4.9488
-0.63322
Optimizing Vs & Thickness - generation: 4; average & best misfits: -4.7357
-0.63322
Optimizing Vs & Thickness - generation: 5; average & best misfits: -4.4015
-0.63322
Optimizing Vs & Thickness - generation: 6; average & best misfits: -4.1262
-0.63322
Optimizing Vs & Thickness - generation: 7; average & best misfits: -4.7061
-0.63322
Optimizing Vs & Thickness - generation: 8; average & best misfits: -5.0449
```

-0.63322
Optimizing Vs & Thickness - generation: 9; average & best misfits: -4.8777
-0.63322
Optimizing Vs & Thickness - generation: 10; average & best misfits: -4.5307
-0.63322
Optimizing Vs & Thickness - generation: 11; average & best misfits: -4.5676
-0.63322
Optimizing Vs & Thickness - generation: 12; average & best misfits: -5.5476
-0.63322
Optimizing Vs & Thickness - generation: 13; average & best misfits: -4.6627
-0.63322
Optimizing Vs & Thickness - generation: 14; average & best misfits: -4.2844
-0.63322
Optimizing Vs & Thickness - generation: 15; average & best misfits: -5.0438
-0.63322
Optimizing Vs & Thickness - generation: 16; average & best misfits: -4.0683
-0.63322

Model after the Vs & Thickness optimization (fixed Poisson values):
Vs (m/s): 154 198 238 350
Thickness (m): 2.8 5.2 3.1

Number of models considered to calculate the average model: 155

##
RESULTS
##

Dataset: 710.sgy
Analyzed curve/spectrum: 710bis.cdp

========== SECTION#3

Analyzing Phase Velocities

Analyzing Rayleigh-Wave Dispersion

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

Vs (m/s): 154 199 244 350
Standard deviations (m/s): 1 2 16 6

Thickness (m): 2.8 5.3 2.8
Standard deviations (m): 0.0 0.3 0.5

Approximate values for Vp, density, Poisson & Shear modulus
Vp (m/s): 306 631 607 708
Density (gr/cm3): 1.77 1.94 1.93 1.97
Vp/Vs ratio: 1.99 3.17 2.49 2.02
Poisson: 0.33 0.44 0.40 0.34
Shear modulus (MPa): 42 77 115 241
Estimated static shear modulus (MPa): 0 0 0 0

Fundamental mode
Mean model
 f(Hz) VR(m/s)
6.06434 291.5486
6.92972 282.9619
 7.7951 269.3259
8.83356 246.3251
9.92971 222.9823
10.9682 207.3203
12.3528 194.1135

13.8528	185.2432
16.3335	176.0504
21.9297	163.0993
23.4874	160.2985
26.6028	155.6304
35.3143	148.2663

First higher mode
Mean model

16.9105	285.5259
21.3528	252.2714
22.9682	240.8783
33.2374	206.1035

========== SECTION#4

BEST MODEL

Vs (m/s): 154 198 238 350
thickness (m): 2.7714 5.21 3.1116

Approximate values for Vp, density, Poisson & Shear modulus
Vp (m/s): 294 692 672 826
Density (gr/cm3): 1.76 1.96 1.96 2.01
Vp/Vs ratio: 1.91 3.49 2.82 2.36
Poisson: 0.31 0.46 0.43 0.39
Shear modulus (MPa): 42 77 111 246
Estimated static shear modulus (MPa): 0 0 0 0

dispersion curve (frequency - velocity)

Fundamental mode)
best model

F(Hz)	VR(m/s)
6.06434	294.6059
6.92972	285.2181
7.7951	269.9945
8.83356	244.8727
9.92971	220.8629
10.9682	205.4371
12.3528	192.6693
13.8528	184.1443
16.3335	175.2967
21.9297	162.7033
23.4874	159.9459
26.6028	155.3128
35.3143	147.9029

First higher mode)
best model

16.9105	285.7838
21.3528	251.4172
22.9682	239.9974
33.2374	205.5595

========== SECTION#5

Maximum penetration depth according to the "Steady State Rayleigh Method": 30 m

Inversion quality: very good

Vs30 & VsE (mean model): 270 270 m/s
Vs30 & VsE (best model): 269 269 m/s

========== 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
"C:\Users\Benedetta\Desktop\valdERA-esac\valdera-esac-10bis\output_disp".

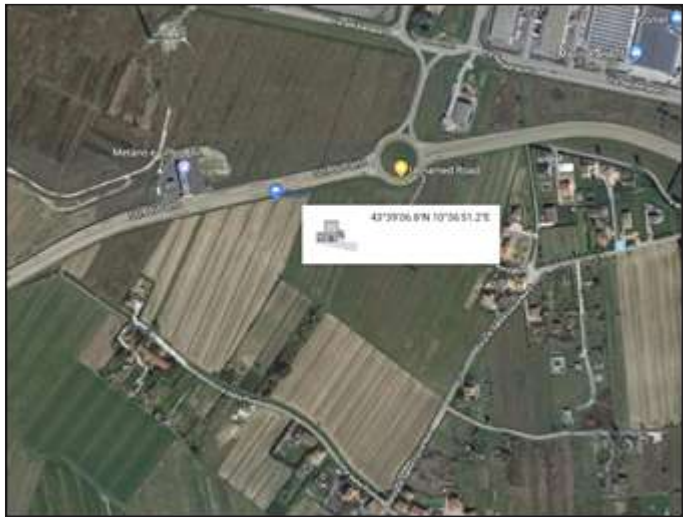
==========
winMASW - Surface Waves & Beyond
www.winmasw.com

Number of models used to define the mean model: 155
Vs30 for the best model: 269 269
Analyzing phase velocities

UNIONE DI COMUNI DELLA VALDERA

INDAGINE ESAC/MASW - COMUNE DI PONTEDERA

LOC. VIALE EUROPA - POSTAZIONE n.11



documentazione fotografica

ubicazione scala 1:1.000

geometria ESAC

geof	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
x	55	50	45	40	35	30	25	20	15	10	5	0	0	0	0	0	0	0	0	0	0	0	0	0
y	0	0	0	0	0	0	0	0	0	0	0	0	3	6	9	12	15	18	21	24	27	30	33	36

geometria MASW

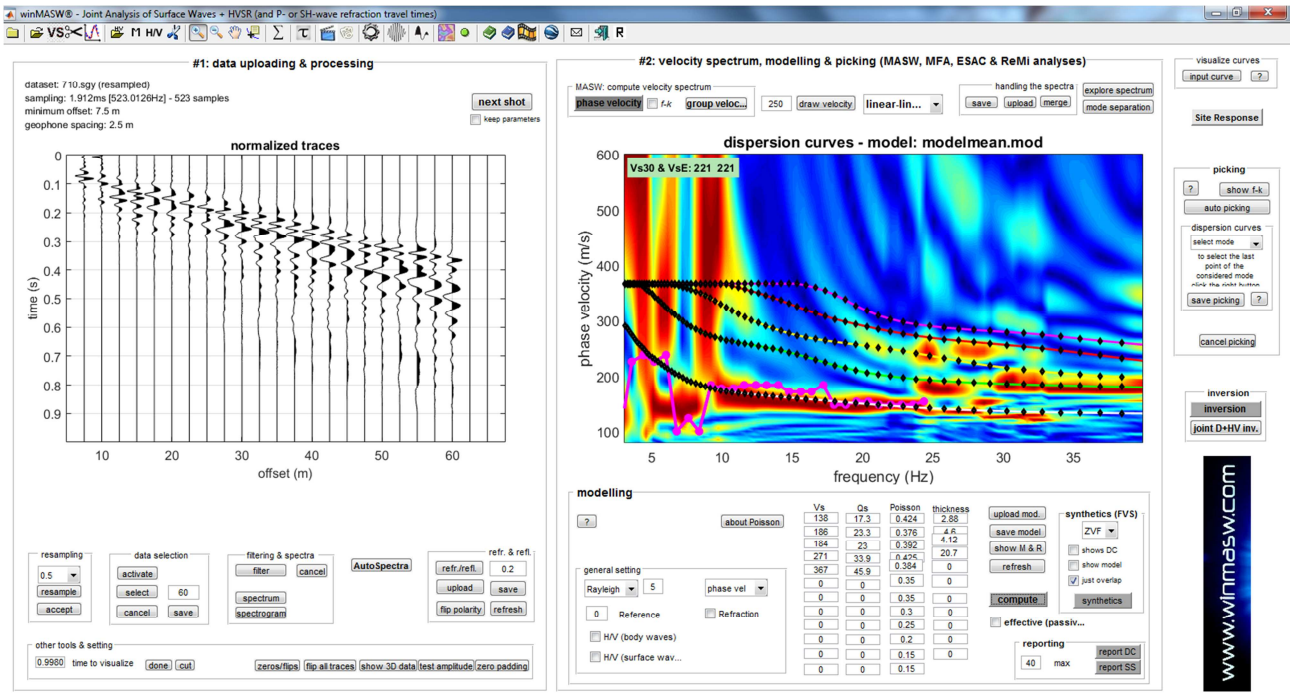
distanza geofonica 12 ch 5 m

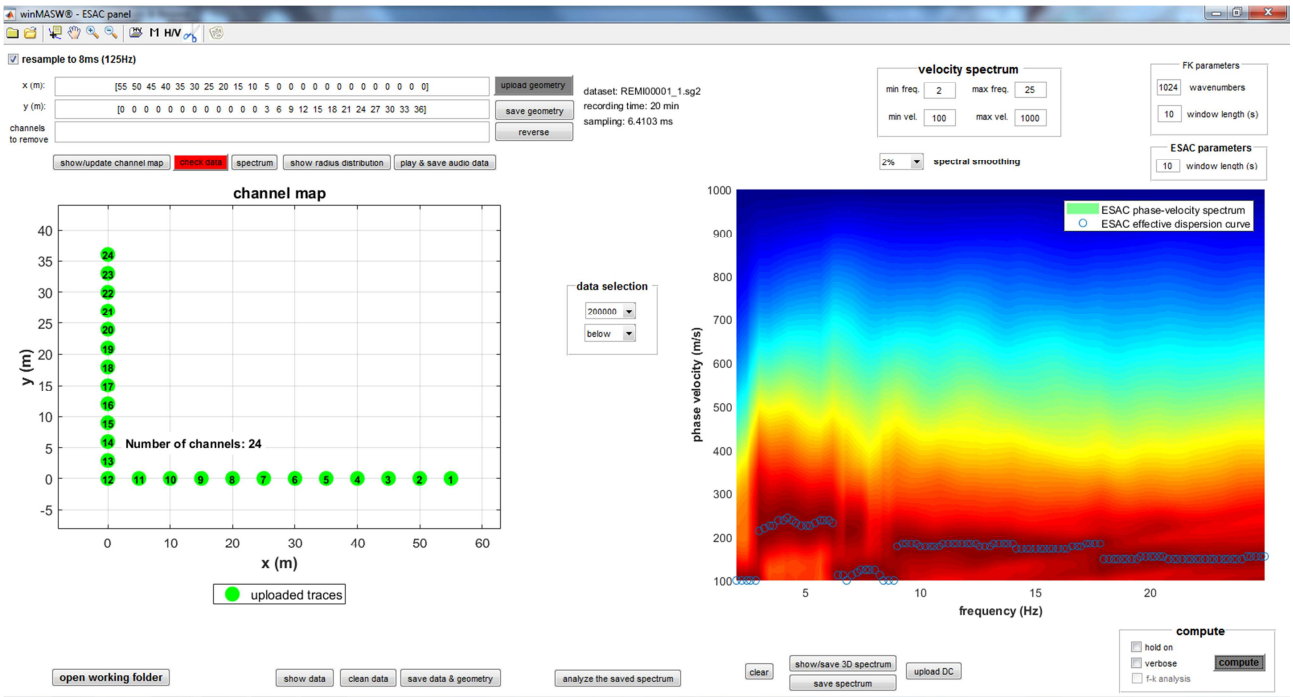
lunghezza linea 57.5 m

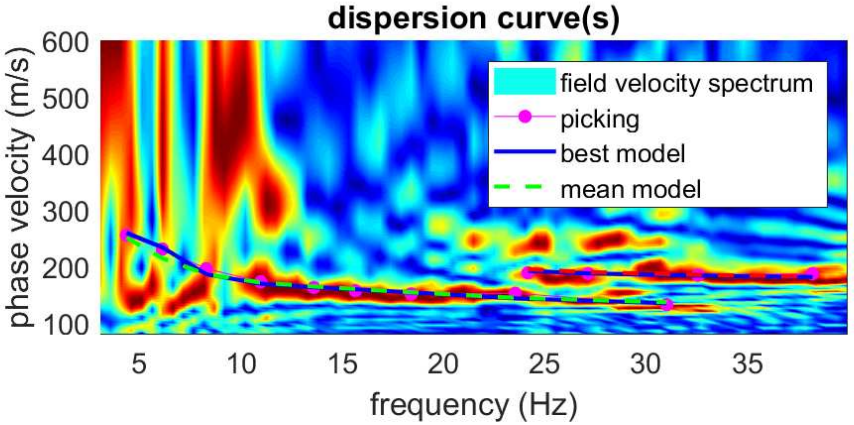
coordinate stazione 43°65’ 19.00” N 10°61’ 44.05” E

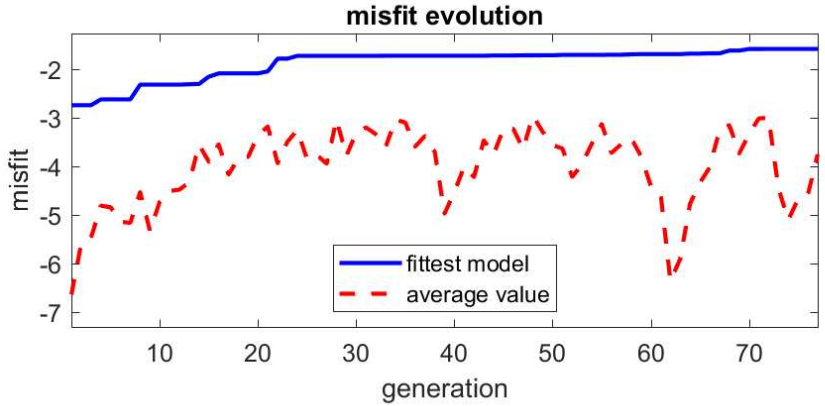
UNIONE VALDERA - Indagini sismiche MASW/ESAC

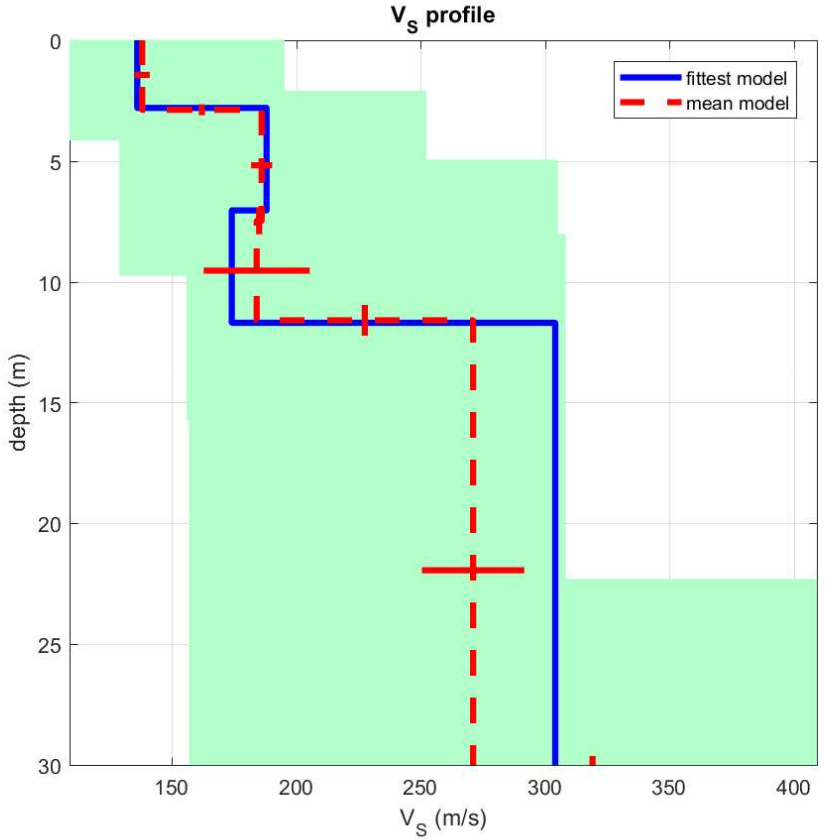
PROVA n. 11











www.winmasw.com

dataset: 710.sgy
dispersion curve: 710bis.cdp
Vs30 & VsE (best model): 231 231 m/s
Vs30 & VsE (mean model): 221 221 m/s

Mean model

Vs (m/s): 138, 186, 184, 271, 367

Standard deviations (m/s): 3, 4, 21, 21, 64

Thickness (m): 2.9, 4.6, 4.1, 20.7

```
========================================================== SECTION#1
dataset: 710.sgy
sampling (ms): 1.912
minimum offset (m): 7.5
geophone spacing (m): 2.5
offsets (m): 7.5           10          12.5           15          17.5
20          22.5           25          27.5           30          32.5           35
        37.5           40          42.5           45          47.5           50
     52.5           55          57.5           60          62.5           65
Dispersion curve: 710bis.cdp
Number of individuals: 32
Number of generations: 61

Rayleigh-wave dispersion analysis

Analyzing phase velocities

Adopted search space (minimum Vs): 99  129  156  157  286
Adopted search space (maximum Vs): 195  252  305  308  560

Adopted search space (minimum Poisson): 0.19527     0.16605     0.15535
0.19366     0.17508
Adopted search space (maximum Poisson): 0.499     0.49814     0.46606
0.499       0.499

Adopted search space (minimum Qs): 13.035       16.125      20.4375       16.875
        37.5
Adopted search space (maximum Qs): 26.07        32.25       40.875        33.75
         75

Adopted search space (minimum reference frequency): 1
Adopted search space (maximum reference frequency): 38.2316

Adopted search space (minimum thickness): 2.10714      2.85714      3.07143
14.2857
Adopted search space (maximum thickness): 4.13          5.6         6.02
  28

Output folder:
C:\Users\Benedetta\Desktop\valdERA-esac\valdera-esac-11\output_disp



========================================================== SECTION#2
Rayleigh-wave analysis
Optimizing Vs & Thickness - generation: 1; average & best misfits: -6.6328
-2.7425
Optimizing Vs & Thickness - generation: 2; average & best misfits: -5.5903
-2.7402
Optimizing Vs & Thickness - generation: 3; average & best misfits: -5.4636
-2.7402
Optimizing Vs & Thickness - generation: 4; average & best misfits: -4.8042
-2.622
Optimizing Vs & Thickness - generation: 5; average & best misfits: -4.8377
-2.622
Optimizing Vs & Thickness - generation: 6; average & best misfits: -5.1346
-2.622
Optimizing Vs & Thickness - generation: 7; average & best misfits: -5.1588
-2.622
Optimizing Vs & Thickness - generation: 8; average & best misfits: -4.5272
-2.3185
Optimizing Vs & Thickness - generation: 9; average & best misfits: -5.3224
-2.3185
Optimizing Vs & Thickness - generation: 10; average & best misfits: -4.7234
-2.3185
Optimizing Vs & Thickness - generation: 11; average & best misfits: -4.5021
```

-2.3185
Optimizing Vs & Thickness - generation: 12; average & best misfits: -4.4766
-2.3185
Optimizing Vs & Thickness - generation: 13; average & best misfits: -4.3258
-2.3109
Optimizing Vs & Thickness - generation: 14; average & best misfits: -3.5516
-2.3039
Optimizing Vs & Thickness - generation: 15; average & best misfits: -3.9068
-2.1546
Optimizing Vs & Thickness - generation: 16; average & best misfits: -3.5435
-2.0862
Optimizing Vs & Thickness - generation: 17; average & best misfits: -4.166
-2.0862
Optimizing Vs & Thickness - generation: 18; average & best misfits: -3.833
-2.0862
Optimizing Vs & Thickness - generation: 19; average & best misfits: -3.8017
-2.0862
Optimizing Vs & Thickness - generation: 20; average & best misfits: -3.3627
-2.0862
Optimizing Vs & Thickness - generation: 21; average & best misfits: -3.1778
-2.0459
Optimizing Vs & Thickness - generation: 22; average & best misfits: -3.9318
-1.7854
Optimizing Vs & Thickness - generation: 23; average & best misfits: -3.4907
-1.7854
Optimizing Vs & Thickness - generation: 24; average & best misfits: -3.2541
-1.7274
Optimizing Vs & Thickness - generation: 25; average & best misfits: -3.8492
-1.7274
Optimizing Vs & Thickness - generation: 26; average & best misfits: -3.7659
-1.7274
Optimizing Vs & Thickness - generation: 27; average & best misfits: -3.9431
-1.7274
Optimizing Vs & Thickness - generation: 28; average & best misfits: -3.036
-1.7274
Optimizing Vs & Thickness - generation: 29; average & best misfits: -3.7814
-1.7274
Optimizing Vs & Thickness - generation: 30; average & best misfits: -3.3114
-1.7274
Optimizing Vs & Thickness - generation: 31; average & best misfits: -3.1975
-1.7274
Optimizing Vs & Thickness - generation: 32; average & best misfits: -3.3378
-1.7274
Optimizing Vs & Thickness - generation: 33; average & best misfits: -3.6008
-1.726
Optimizing Vs & Thickness - generation: 34; average & best misfits: -3.0346
-1.7259
Optimizing Vs & Thickness - generation: 35; average & best misfits: -3.0974
-1.7259
Optimizing Vs & Thickness - generation: 36; average & best misfits: -3.5923
-1.7259
Optimizing Vs & Thickness - generation: 37; average & best misfits: -3.3738
-1.7259
Optimizing Vs & Thickness - generation: 38; average & best misfits: -3.6972
-1.7259
Optimizing Vs & Thickness - generation: 39; average & best misfits: -4.9672
-1.7259
Optimizing Vs & Thickness - generation: 40; average & best misfits: -4.5269
-1.7259
Optimizing Vs & Thickness - generation: 41; average & best misfits: -3.9997
-1.7259
Optimizing Vs & Thickness - generation: 42; average & best misfits: -4.2165
-1.7259
Optimizing Vs & Thickness - generation: 43; average & best misfits: -3.4619
-1.7259
Optimizing Vs & Thickness - generation: 44; average & best misfits: -3.7479
-1.72
Optimizing Vs & Thickness - generation: 45; average & best misfits: -3.2266

```
 -1.72
Optimizing Vs & Thickness - generation: 46; average & best misfits: -3.2286
 -1.72
Optimizing Vs & Thickness - generation: 47; average & best misfits: -3.6402
-1.7165
Optimizing Vs & Thickness - generation: 48; average & best misfits: -2.9577
-1.7165
Optimizing Vs & Thickness - generation: 49; average & best misfits: -3.2886
-1.7159
Optimizing Vs & Thickness - generation: 50; average & best misfits: -3.5601
-1.7159
Optimizing Vs & Thickness - generation: 51; average & best misfits: -3.631
-1.7073
Optimizing Vs & Thickness - generation: 52; average & best misfits: -4.2141
-1.7073
Optimizing Vs & Thickness - generation: 53; average & best misfits: -3.9516
-1.7073
Optimizing Vs & Thickness - generation: 54; average & best misfits: -3.5292
-1.7073
Optimizing Vs & Thickness - generation: 55; average & best misfits: -3.1256
-1.7073
Optimizing Vs & Thickness - generation: 56; average & best misfits: -3.723
-1.7044
Optimizing Vs & Thickness - generation: 57; average & best misfits: -3.5387
-1.7044
Optimizing Vs & Thickness - generation: 58; average & best misfits: -3.414
-1.6962
Optimizing Vs & Thickness - generation: 59; average & best misfits: -3.7862
-1.6923
Optimizing Vs & Thickness - generation: 60; average & best misfits: -4.395
-1.6923
Optimizing Vs & Thickness - generation: 61; average & best misfits: -4.5518
-1.6923

Adopted search space (minimum Vs): 99  129  156  157  286
Adopted search space (maximum Vs): 195  252  305  308  560

Adopted search space (minimum Qs): 13.035       16.125      20.4375       16.875
        37.5
Adopted search space (maximum Qs): 26.07        32.25       40.875        33.75
         75

Adopted search space (minimum reference frequency): 1
Adopted search space (maximum reference frequency): 38.2316

Adopted search space (minimum Poisson): 0.19527     0.16605     0.15535
0.19366     0.17508
Adopted search space (maximum Poisson): 0.497       0.497     0.46606
0.497       0.497

Adopted search space (minimum thickness): 2.10714      2.85714      3.07143
14.2857
Adopted search space (maximum thickness): 4.13          5.6         6.02
  28


Now a finer search around the most promising search space area

Rayleigh-wave analysis
Optimizing Vs & Thickness - generation: 1; average & best misfits: -6.3529
-1.6923
Optimizing Vs & Thickness - generation: 2; average & best misfits: -5.8971
-1.6923
Optimizing Vs & Thickness - generation: 3; average & best misfits: -4.7641
-1.6816
Optimizing Vs & Thickness - generation: 4; average & best misfits: -4.3358
-1.6816
Optimizing Vs & Thickness - generation: 5; average & best misfits: -4.0178
```

-1.676
Optimizing Vs & Thickness - generation: 6; average & best misfits: -3.2492
-1.676
Optimizing Vs & Thickness - generation: 7; average & best misfits: -3.1502
-1.6191
Optimizing Vs & Thickness - generation: 8; average & best misfits: -3.7343
-1.6191
Optimizing Vs & Thickness - generation: 9; average & best misfits: -3.3388
-1.5866
Optimizing Vs & Thickness - generation: 10; average & best misfits: -3.0133
-1.5866
Optimizing Vs & Thickness - generation: 11; average & best misfits: -2.9976
-1.5855
Optimizing Vs & Thickness - generation: 12; average & best misfits: -4.4519
-1.5855
Optimizing Vs & Thickness - generation: 13; average & best misfits: -5.0992
-1.5855
Optimizing Vs & Thickness - generation: 14; average & best misfits: -4.6682
-1.5855
Optimizing Vs & Thickness - generation: 15; average & best misfits: -4.5773
-1.5855
Optimizing Vs & Thickness - generation: 16; average & best misfits: -3.7513
-1.5855

Model after the Vs & Thickness optimization (fixed Poisson values):
Vs (m/s): 136 188 174 304 296
Thickness (m): 2.8   4.2   4.7   22

Number of models considered to calculate the average model: 575

##
RESULTS
##

Dataset: 710.sgy
Analyzed curve/spectrum: 710bis.cdp

== SECTION#3

Analyzing Phase Velocities

Analyzing Rayleigh-Wave Dispersion

==
MEAN MODEL

Vs (m/s):   138 186 184 271 367
Standard deviations (m/s): 3   4 21 21 64

Thickness (m):   2.9   4.6   4.1   20.7
Standard deviations (m): 0.2   0.6   0.6   2.7

Approximate values for Vp, density, Poisson & Shear modulus
Vp (m/s):   381 417 436 749 847
Density (gr/cm3):   1.82   1.84   1.85   1.98   2.01
Vp/Vs ratio: 2.76   2.24   2.37   2.76   2.31
Poisson: 0.42   0.38   0.39   0.42   0.38
Shear modulus (MPa): 35   64   63   146   271
Estimated static shear modulus (MPa): 0   0   0   0
 0

Fundamental mode
Mean model
 f(Hz)   VR(m/s)

4.35586	250.3943
6.12677	213.7867
8.29755	185.3325
10.9825	170.6344
13.6103	163.7279
15.6668	159.3621
18.4089	153.4964
23.5502	143.5517
31.0337	135.7818

First higher mode
Mean model

24.1786	194.1279
27.1491	189.2802
32.5761	184.4141
38.2316	181.1642

========== SECTION#4

BEST MODEL

Vs (m/s): 136 188 174 304 296
thickness (m): 2.80145 4.24163 4.65079 22.1852

Approximate values for Vp, density, Poisson & Shear modulus
Vp (m/s): 358 378 523 1432 642
Density (gr/cm3): 1.81 1.82 1.90 2.14 1.95
Vp/Vs ratio: 2.63 2.01 3.01 4.71 2.17
Poisson: 0.42 0.34 0.44 0.48 0.37
Shear modulus (MPa): 33 64 57 198 171
Estimated static shear modulus (MPa): 0 0 0 0
0

dispersion curve (frequency - velocity)

Fundamental mode)
best model

F(Hz)	VR(m/s)
4.35586	258.9471
6.12677	233.0711
8.29755	185.4013
10.9825	168.5556
13.6103	162.4018
15.6668	158.6174
18.4089	153.0769
23.5502	142.5605
31.0337	134.0942

First higher mode)
best model

24.1786	191.2446
27.1491	186.8256
32.5761	182.8702
38.2316	180.4694

========== SECTION#5

Maximum penetration depth according to the "Steady State Rayleigh Method": 30 m

Inversion quality: very good

Vs30 & VsE (mean model): 221 221 m/s
Vs30 & VsE (best model): 231 231 m/s

========== 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
"C:\Users\Benedetta\Desktop\valdERA-esac\valdera-esac-11\output_disp".

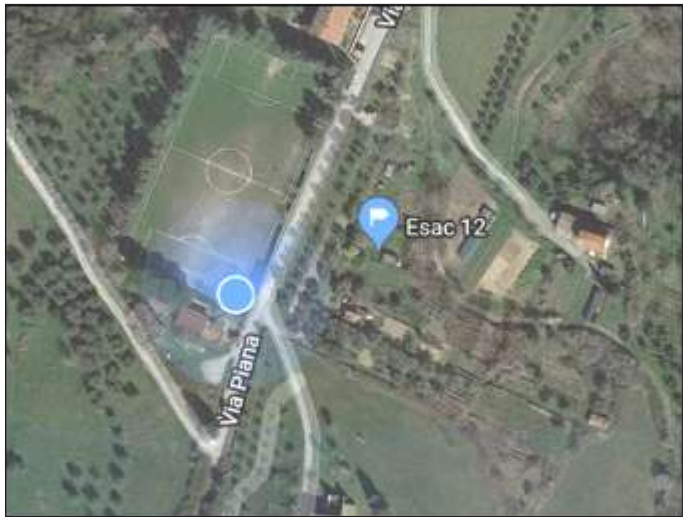
==========
winMASW - Surface Waves & Beyond
www.winmasw.com

Number of models used to define the mean model: 575
Vs30 for the best model: 231 231
Analyzing phase velocities

UNIONE DI COMUNI DELLA VALDERA

INDAGINE ESAC/MASW - COMUNE DI PALAIA

LOC. MONTEFOSCOLI - POSTAZIONE n.12



documentazione fotografica

ubicazione scala 1:1.000

geometria ESAC

geof	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
x	-55	-50	-45	-40	-35	-30	-25	-20	-15	-10	-5	0	0	0	0	0	0	0	0	0	0	0	0	0
y	0	0	0	0	0	0	0	0	0	0	0	0	3	6	9	12	15	18	21	24	27	30	33	36

geometria MASW

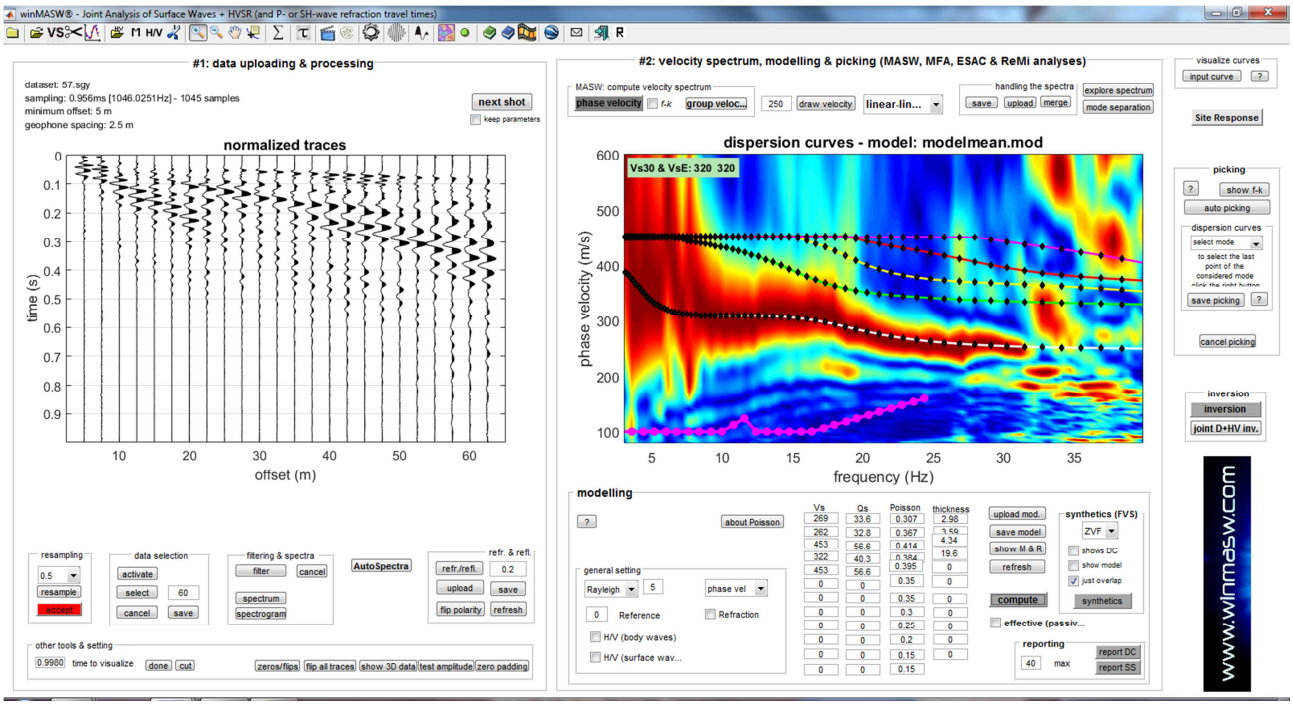
distanza geofonica 12 ch 5 m

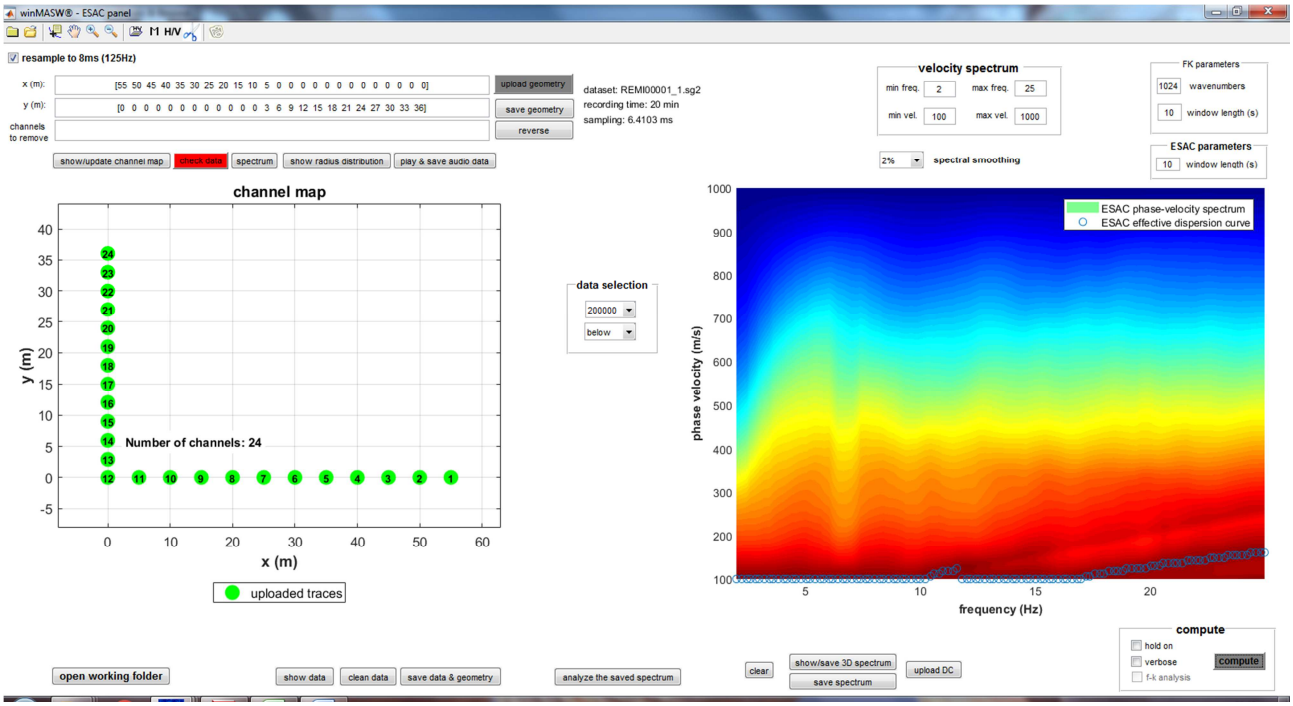
lunghezza linea 57.5 m

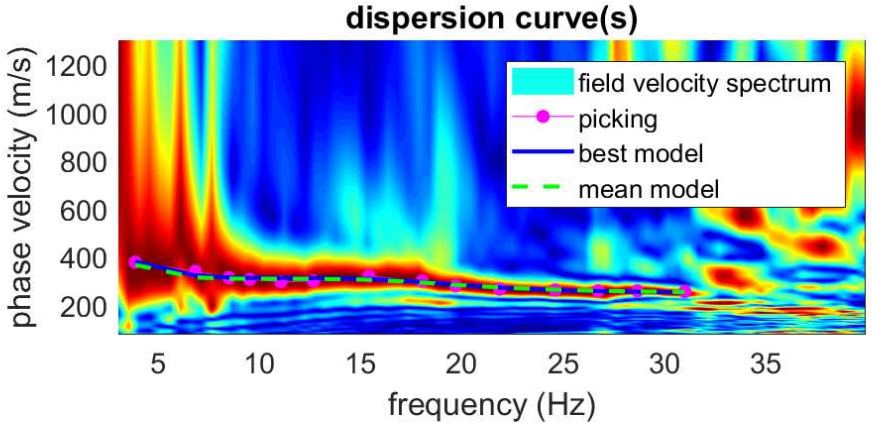
coordinate stazione 43°57’ 17.96” N 10°75’ 14.44” E

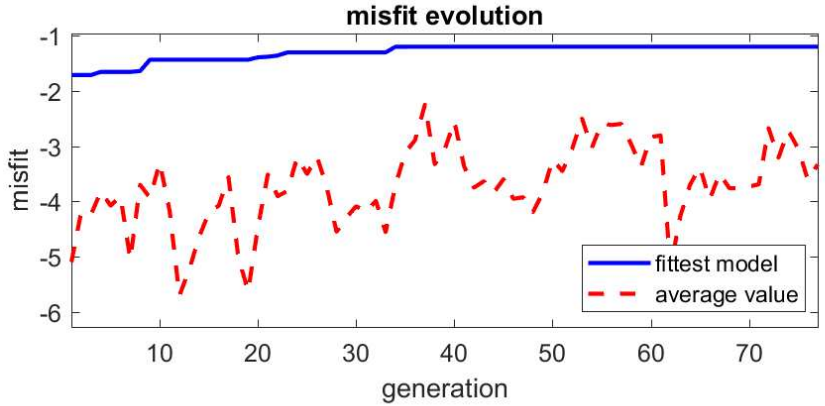
UNIONE VALDERA - Indagini sismiche MASW/ESAC

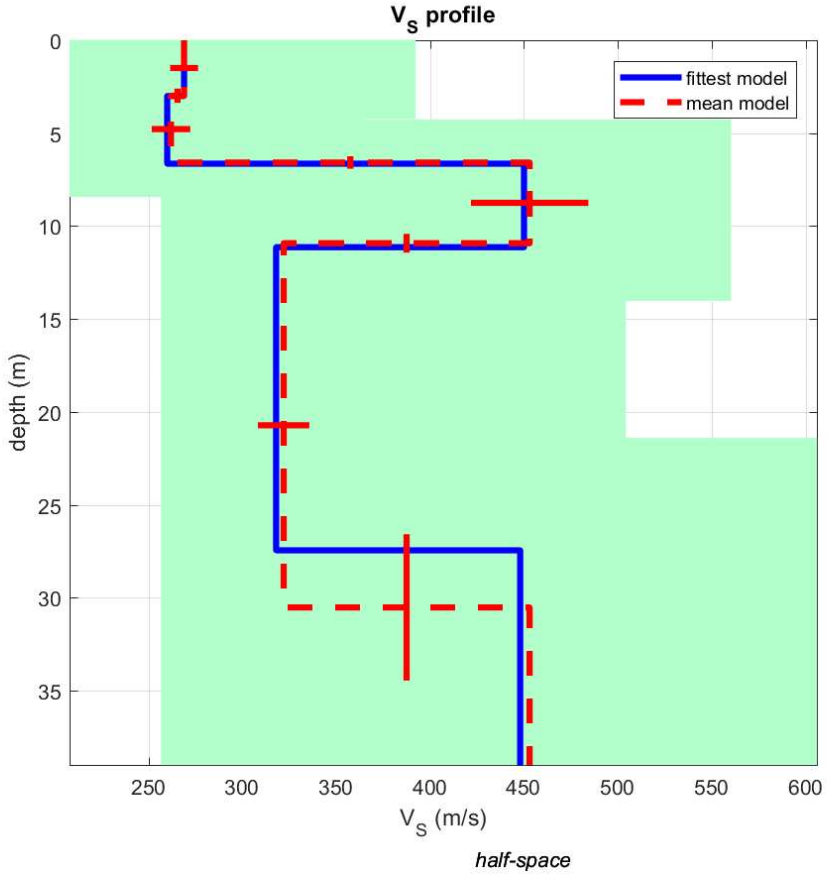
PROVA n. 12











dataset: 57.sgy
dispersion curve: 57.cdp
Vs30 & VsE (best model): 326 326 m/s
Vs30 & VsE (mean model): 320 320 m/s

www.winmasw.com

Mean model

Vs (m/s): 269, 262, 453, 322, 453

Standard deviations (m/s): 7, 10, 31, 14, 46

Thickness (m): 3.0, 3.6, 4.3, 19.6

========== SECTION#1
dataset: 57.sgy
sampling (ms): 0.956
minimum offset (m): 5
geophone spacing (m): 2.5
offsets (m): 5 7.5 10 12.5 15 17.5
20 22.5 25 27.5 30 32.5
35 37.5 40 42.5 45 47.5
50 52.5 55 57.5 60 62.5
Dispersion curve: 57.cdp
Number of individuals: 32
Number of generations: 61

Rayleigh-wave dispersion analysis

Analyzing phase velocities

Adopted search space (minimum Vs): 200 186 286 257 321
Adopted search space (maximum Vs): 392 364 560 504 630

Adopted search space (minimum Poisson): 0.16505 0.17492 0.17508
0.1749 0.17505
Adopted search space (maximum Poisson): 0.49516 0.499 0.499
0.499 0.499

Adopted search space (minimum Qs): 7.5 12 14.25 18
21
Adopted search space (maximum Qs): 15 24 28.5 36
42

Adopted search space (minimum reference frequency): 1
Adopted search space (maximum reference frequency): 31.0034

Adopted search space (minimum thickness): 2.14286 2.14286 2.85714
14.2857
Adopted search space (maximum thickness): 4.2 4.2 5.6
28

Output folder:
C:\Users\Benedetta\Desktop\valdERA-esac\valdera-esac-12\output_disp

========== SECTION#2
Rayleigh-wave analysis
Optimizing Vs & Thickness - generation: 1; average & best misfits: -5.0982
-1.7083
Optimizing Vs & Thickness - generation: 2; average & best misfits: -4.1933
-1.7083
Optimizing Vs & Thickness - generation: 3; average & best misfits: -4.2352
-1.7083
Optimizing Vs & Thickness - generation: 4; average & best misfits: -3.817
-1.6522
Optimizing Vs & Thickness - generation: 5; average & best misfits: -4.0743
-1.6522
Optimizing Vs & Thickness - generation: 6; average & best misfits: -3.9043
-1.6522
Optimizing Vs & Thickness - generation: 7; average & best misfits: -5.0473
-1.6522
Optimizing Vs & Thickness - generation: 8; average & best misfits: -3.6986
-1.6359
Optimizing Vs & Thickness - generation: 9; average & best misfits: -3.9317
-1.4304
Optimizing Vs & Thickness - generation: 10; average & best misfits: -3.2977
-1.4304
Optimizing Vs & Thickness - generation: 11; average & best misfits: -4.1628

-1.4304
Optimizing Vs & Thickness - generation: 12; average & best misfits: -5.7019
-1.4304
Optimizing Vs & Thickness - generation: 13; average & best misfits: -5.2332
-1.4304
Optimizing Vs & Thickness - generation: 14; average & best misfits: -4.6419
-1.4304
Optimizing Vs & Thickness - generation: 15; average & best misfits: -4.2019
-1.4304
Optimizing Vs & Thickness - generation: 16; average & best misfits: -4.0752
-1.4304
Optimizing Vs & Thickness - generation: 17; average & best misfits: -3.559
-1.4304
Optimizing Vs & Thickness - generation: 18; average & best misfits: -5.0092
-1.4304
Optimizing Vs & Thickness - generation: 19; average & best misfits: -5.6241
-1.4304
Optimizing Vs & Thickness - generation: 20; average & best misfits: -4.4563
-1.3884
Optimizing Vs & Thickness - generation: 21; average & best misfits: -3.5103
-1.3771
Optimizing Vs & Thickness - generation: 22; average & best misfits: -3.9031
-1.3553
Optimizing Vs & Thickness - generation: 23; average & best misfits: -3.8082
-1.2985
Optimizing Vs & Thickness - generation: 24; average & best misfits: -3.1999
-1.2985
Optimizing Vs & Thickness - generation: 25; average & best misfits: -3.5017
-1.2985
Optimizing Vs & Thickness - generation: 26; average & best misfits: -3.1836
-1.2985
Optimizing Vs & Thickness - generation: 27; average & best misfits: -3.7329
-1.2985
Optimizing Vs & Thickness - generation: 28; average & best misfits: -4.55
-1.2985
Optimizing Vs & Thickness - generation: 29; average & best misfits: -4.2923
-1.2985
Optimizing Vs & Thickness - generation: 30; average & best misfits: -4.084
-1.2985
Optimizing Vs & Thickness - generation: 31; average & best misfits: -4.191
-1.2985
Optimizing Vs & Thickness - generation: 32; average & best misfits: -3.9869
-1.2985
Optimizing Vs & Thickness - generation: 33; average & best misfits: -4.5534
-1.2985
Optimizing Vs & Thickness - generation: 34; average & best misfits: -3.7044
-1.1962
Optimizing Vs & Thickness - generation: 35; average & best misfits: -3.1121
-1.1962
Optimizing Vs & Thickness - generation: 36; average & best misfits: -2.8865
-1.1953
Optimizing Vs & Thickness - generation: 37; average & best misfits: -2.2464
-1.1953
Optimizing Vs & Thickness - generation: 38; average & best misfits: -3.3247
-1.1953
Optimizing Vs & Thickness - generation: 39; average & best misfits: -3.0659
-1.1953
Optimizing Vs & Thickness - generation: 40; average & best misfits: -2.5488
-1.1953
Optimizing Vs & Thickness - generation: 41; average & best misfits: -3.3671
-1.1953
Optimizing Vs & Thickness - generation: 42; average & best misfits: -3.7468
-1.1953
Optimizing Vs & Thickness - generation: 43; average & best misfits: -3.6311
-1.1953
Optimizing Vs & Thickness - generation: 44; average & best misfits: -3.8388
-1.1953
Optimizing Vs & Thickness - generation: 45; average & best misfits: -3.5953

```
-1.1953
Optimizing Vs & Thickness - generation: 46; average & best misfits: -3.9505
-1.1953
Optimizing Vs & Thickness - generation: 47; average & best misfits: -3.9232
-1.1953
Optimizing Vs & Thickness - generation: 48; average & best misfits: -4.1919
-1.1953
Optimizing Vs & Thickness - generation: 49; average & best misfits: -3.8433
-1.1953
Optimizing Vs & Thickness - generation: 50; average & best misfits: -3.2395
-1.1953
Optimizing Vs & Thickness - generation: 51; average & best misfits: -3.4494
-1.1953
Optimizing Vs & Thickness - generation: 52; average & best misfits: -3.0445
-1.1953
Optimizing Vs & Thickness - generation: 53; average & best misfits: -2.4976
-1.1953
Optimizing Vs & Thickness - generation: 54; average & best misfits: -3.0261
-1.1953
Optimizing Vs & Thickness - generation: 55; average & best misfits: -2.5835
-1.1953
Optimizing Vs & Thickness - generation: 56; average & best misfits: -2.6134
-1.1953
Optimizing Vs & Thickness - generation: 57; average & best misfits: -2.593
-1.1953
Optimizing Vs & Thickness - generation: 58; average & best misfits: -2.9581
-1.1953
Optimizing Vs & Thickness - generation: 59; average & best misfits: -3.3734
-1.1953
Optimizing Vs & Thickness - generation: 60; average & best misfits: -2.8307
-1.1953
Optimizing Vs & Thickness - generation: 61; average & best misfits: -2.8033
-1.1953

Adopted search space (minimum Vs): 200  186  286  257  321
Adopted search space (maximum Vs): 392  364  560  504  630

Adopted search space (minimum Qs): 7.5           12        14.25           18
       21
Adopted search space (maximum Qs): 15           24         28.5           36
      42

Adopted search space (minimum reference frequency): 1
Adopted search space (maximum reference frequency): 31.0034

Adopted search space (minimum Poisson): 0.16505     0.17492     0.17508
0.1749     0.17505
Adopted search space (maximum Poisson): 0.49516       0.497       0.497
0.497       0.497

Adopted search space (minimum thickness): 2.14286      2.14286      2.85714
14.2857
Adopted search space (maximum thickness): 4.2          4.2          5.6
 28


Now a finer search around the most promising search space area

Rayleigh-wave analysis
Optimizing Vs & Thickness - generation: 1; average & best misfits: -5.2122
-1.1953
Optimizing Vs & Thickness - generation: 2; average & best misfits: -4.2715
-1.1953
Optimizing Vs & Thickness - generation: 3; average & best misfits: -3.6942
-1.1953
Optimizing Vs & Thickness - generation: 4; average & best misfits: -3.3778
-1.1953
Optimizing Vs & Thickness - generation: 5; average & best misfits: -3.9639
```

-1.1953
Optimizing Vs & Thickness - generation: 6; average & best misfits: -3.4945
-1.1953
Optimizing Vs & Thickness - generation: 7; average & best misfits: -3.7571
-1.1953
Optimizing Vs & Thickness - generation: 8; average & best misfits: -3.7614
-1.1953
Optimizing Vs & Thickness - generation: 9; average & best misfits: -3.7273
-1.1953
Optimizing Vs & Thickness - generation: 10; average & best misfits: -3.6894
-1.1953
Optimizing Vs & Thickness - generation: 11; average & best misfits: -2.6712
-1.1953
Optimizing Vs & Thickness - generation: 12; average & best misfits: -3.2058
-1.1953
Optimizing Vs & Thickness - generation: 13; average & best misfits: -2.7157
-1.1953
Optimizing Vs & Thickness - generation: 14; average & best misfits: -3.0388
-1.1953
Optimizing Vs & Thickness - generation: 15; average & best misfits: -3.6085
-1.1953
Optimizing Vs & Thickness - generation: 16; average & best misfits: -3.3292
-1.1953

Model after the Vs & Thickness optimization (fixed Poisson values):
Vs (m/s): 269 260 450 318 448
Thickness (m): 3   3.6   4.5   16

Number of models considered to calculate the average model: 418

##
RESULTS
##

Dataset: 57.sgy
Analyzed curve/spectrum: 57.cdp

== SECTION#3

Analyzing Phase Velocities

Analyzing Rayleigh-Wave Dispersion

==
MEAN MODEL

Vs (m/s):   269 262 453 322 453
Standard deviations (m/s): 7 10 31 14 46

Thickness (m):   3.0   3.6   4.3   19.6
Standard deviations (m): 0.4   0.3   0.5   3.9

Approximate values for Vp, density, Poisson & Shear modulus
Vp (m/s):   510   572 1184   743 1086
Density (gr/cm3):   1.89   1.92   2.09   1.98   2.07
Vp/Vs ratio: 1.90   2.18   2.61   2.31   2.40
Poisson: 0.31   0.37   0.41   0.38   0.39
Shear modulus (MPa): 137   132   430   205   426
Estimated static shear modulus (MPa): 0   0   0   0
 0

Fundamental mode
Mean model
 f(Hz)   VR(m/s)

3.89504	366.0671
6.86269	313.8317
8.51772	309.2519
9.54499	308.6298
11.0859	308.5923
12.6838	308.3583
15.4232	304.3896
18.0484	292.923
19.7035	283.2188
21.8721	272.175
24.6115	262.8884
26.7231	258.407
28.6635	255.6045
31.0034	253.3174

========== SECTION#4

BEST MODEL

Vs (m/s): 269 260 450 318 448
thickness (m): 3 3.64526 4.49283 16.3111

Approximate values for Vp, density, Poisson & Shear modulus
Vp (m/s): 490 667 1827 1194 1242
Density (gr/cm3): 1.88 1.96 2.20 2.10 2.11
Vp/Vs ratio: 1.82 2.57 4.06 3.75 2.77
Poisson: 0.28 0.41 0.47 0.46 0.43
Shear modulus (MPa): 136 132 446 212 423
Estimated static shear modulus (MPa): 0 0 0 0
0

dispersion curve (frequency - velocity)

Fundamental mode)
best model

F(Hz)	VR(m/s)
3.89504	379.5872
6.86269	321.6283
8.51772	313.736
9.54499	312.2312
11.0859	311.6447
12.6838	311.3336
15.4232	307.5476
18.0484	295.1356
19.7035	284.0838
21.8721	271.7643
24.6115	261.8338
26.7231	257.1917
28.6635	254.3414
31.0034	252.0507

========== SECTION#5

Maximum penetration depth according to the "Steady State Rayleigh Method": 39 m

Inversion quality: very good

Vs30 & VsE (mean model): 320 320 m/s
Vs30 & VsE (best model): 326 326 m/s

========== 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
"C:\Users\Benedetta\Desktop\valdERA-esac\valdera-esac-12\output_disp".

==========
winMASW - Surface Waves & Beyond
www.winmasw.com

Number of models used to define the mean model: 418
Vs30 for the best model: 326 326
Analyzing phase velocities

UNIONE DI COMUNI DELLA VALDERA

INDAGINE ESAC/MASW - COMUNE DI PALAIA

LOC. PIAN DELLA TOSOLA - POSTAZIONE n.13

documentazione fotografica

ubicazione scala 1:1.000

geometria ESAC

geof	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
x	55	50	45	40	35	30	25	20	15	10	5	0	0	0	0	0	0	0	0	0	0	0	0	0
y	0	0	0	0	0	0	0	0	0	0	0	0	3	6	9	12	15	18	21	24	27	30	33	36

geometria MASW

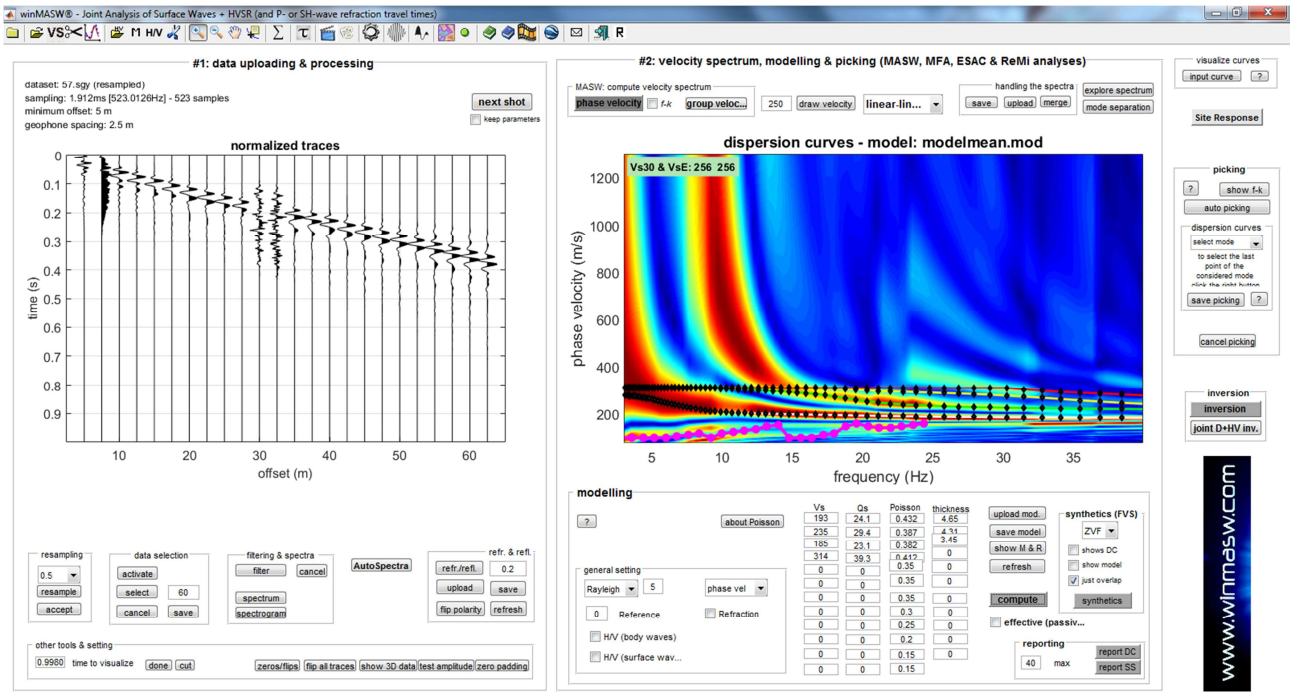
distanza geofonica 12 ch 5 m

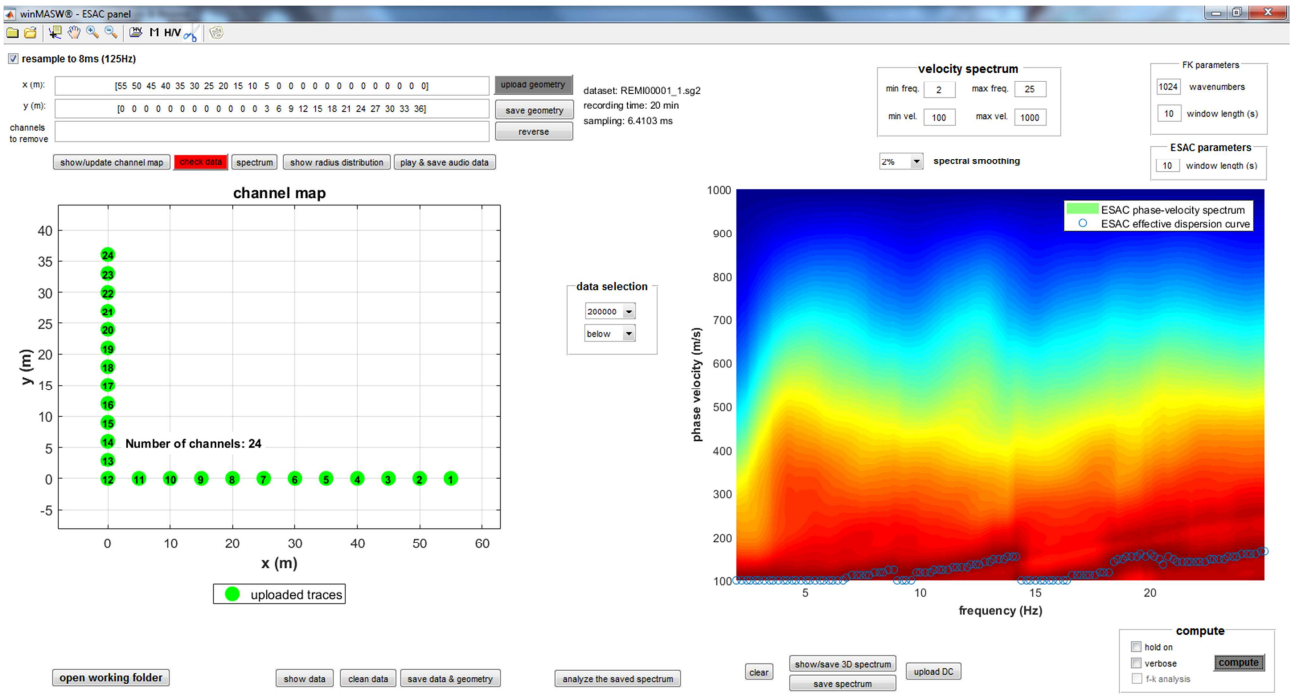
lunghezza linea 57.5 m

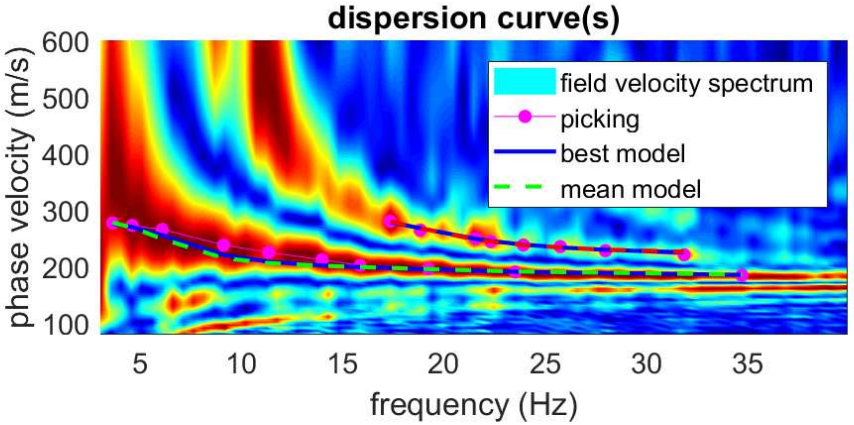
coordinate stazione 43°58’ 86.68” N 10°73’ 35.47” E

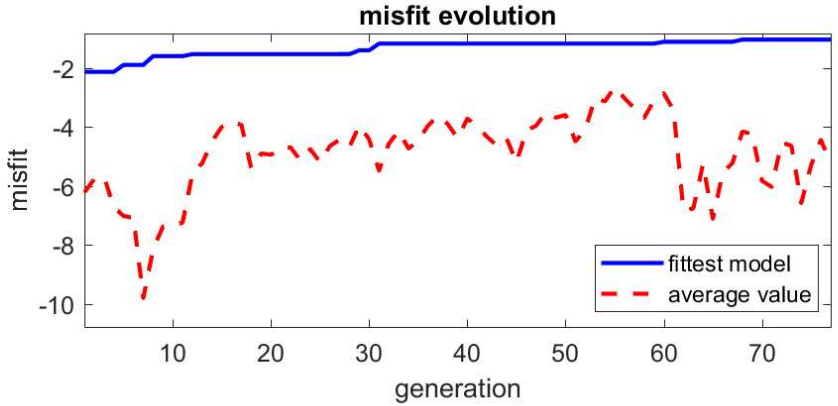
UNIONE VALDERA - Indagini sismiche MASW/ESAC

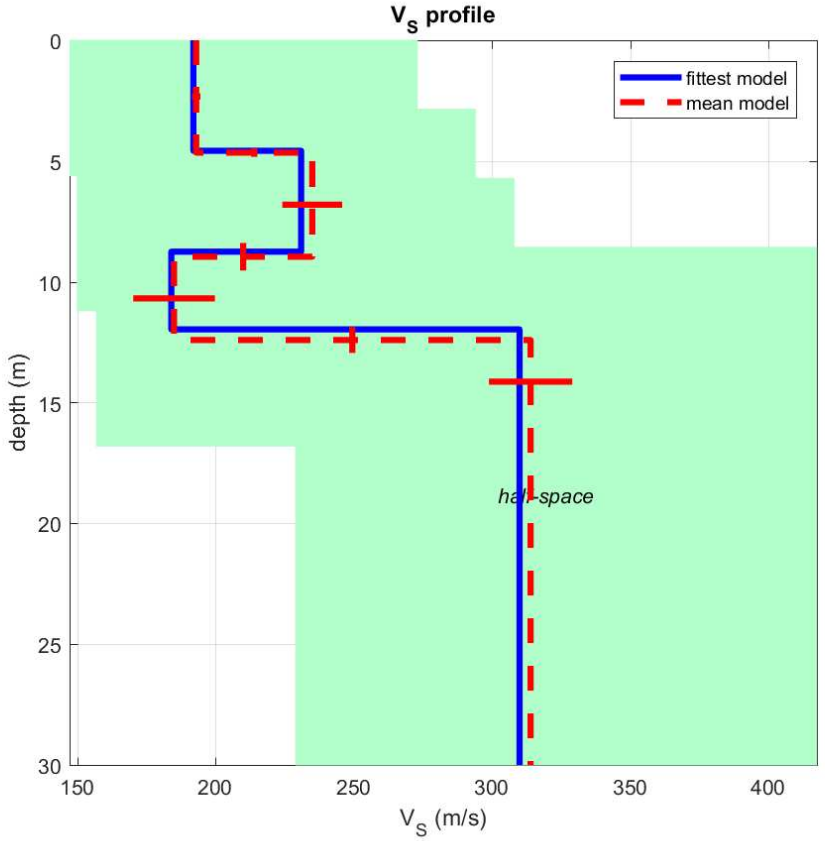
PROVA n. 13











www.winmasw.com

dataset: 57.sgy
dispersion curve: 57.cdp
Vs30 & VsE (best model): 255 255 m/s
Vs30 & VsE (mean model): 256 256 m/s

Mean model

Vs (m/s): 193, 235, 185, 314

Standard deviations (m/s): 2, 11, 15, 15

Thickness (m): 4.7, 4.3, 3.4

========== SECTION#1
dataset: 57.sgy
sampling (ms): 0.956
minimum offset (m): 5
geophone spacing (m): 2.5
offsets (m): 5 7.5 10 12.5 15 17.5
20 22.5 25 27.5 30 32.5
35 37.5 40 42.5 45 47.5
50 52.5 55 57.5 60 62.5
Dispersion curve: 57.cdp
Number of individuals: 32
Number of generations: 61

Rayleigh-wave dispersion analysis

Analyzing phase velocities

Adopted search space (minimum Vs): 139 150 157 229
Adopted search space (maximum Vs): 273 294 308 448

Adopted search space (minimum Poisson): 0.16493 0.17493 0.17501
0.17496
Adopted search space (maximum Poisson): 0.49478 0.499 0.499
0.499

Adopted search space (minimum Qs): 7.5 12 14.25 18
Adopted search space (maximum Qs): 15 24 28.5 36

Adopted search space (minimum reference frequency): 1
Adopted search space (maximum reference frequency): 34.7129

Adopted search space (minimum thickness): 2.8571 2.8571 2.8571
Adopted search space (maximum thickness): 5.6 5.6 5.6

Output folder:
C:\Users\Benedetta\Desktop\valdERA-esac\valdera-esac-13\output_disp

========== SECTION#2
Rayleigh-wave analysis
Optimizing Vs & Thickness - generation: 1; average & best misfits: -6.2187
-2.1265
Optimizing Vs & Thickness - generation: 2; average & best misfits: -5.7599
-2.1265
Optimizing Vs & Thickness - generation: 3; average & best misfits: -5.6937
-2.1265
Optimizing Vs & Thickness - generation: 4; average & best misfits: -6.7171
-2.1265
Optimizing Vs & Thickness - generation: 5; average & best misfits: -7.0202
-1.8911
Optimizing Vs & Thickness - generation: 6; average & best misfits: -7.0764
-1.8911
Optimizing Vs & Thickness - generation: 7; average & best misfits: -9.799
-1.8911
Optimizing Vs & Thickness - generation: 8; average & best misfits: -8.1408
-1.5927
Optimizing Vs & Thickness - generation: 9; average & best misfits: -7.3734
-1.5927
Optimizing Vs & Thickness - generation: 10; average & best misfits: -7.3338
-1.5927
Optimizing Vs & Thickness - generation: 11; average & best misfits: -7.2412
-1.5927
Optimizing Vs & Thickness - generation: 12; average & best misfits: -5.5804
-1.5271
Optimizing Vs & Thickness - generation: 13; average & best misfits: -5.2247

-1.5271
Optimizing Vs & Thickness - generation: 14; average & best misfits: -4.4833
-1.5271
Optimizing Vs & Thickness - generation: 15; average & best misfits: -3.9878
-1.5271
Optimizing Vs & Thickness - generation: 16; average & best misfits: -3.8164
-1.5271
Optimizing Vs & Thickness - generation: 17; average & best misfits: -3.9309
-1.5255
Optimizing Vs & Thickness - generation: 18; average & best misfits: -5.4051
-1.5255
Optimizing Vs & Thickness - generation: 19; average & best misfits: -4.8967
-1.5255
Optimizing Vs & Thickness - generation: 20; average & best misfits: -4.9363
-1.5255
Optimizing Vs & Thickness - generation: 21; average & best misfits: -4.6898
-1.5255
Optimizing Vs & Thickness - generation: 22; average & best misfits: -4.6915
-1.5255
Optimizing Vs & Thickness - generation: 23; average & best misfits: -5.13
-1.5255
Optimizing Vs & Thickness - generation: 24; average & best misfits: -4.7462
-1.5255
Optimizing Vs & Thickness - generation: 25; average & best misfits: -5.19
-1.5255
Optimizing Vs & Thickness - generation: 26; average & best misfits: -4.6445
-1.5255
Optimizing Vs & Thickness - generation: 27; average & best misfits: -4.4231
-1.5247
Optimizing Vs & Thickness - generation: 28; average & best misfits: -4.6675
-1.5247
Optimizing Vs & Thickness - generation: 29; average & best misfits: -3.939
-1.3974
Optimizing Vs & Thickness - generation: 30; average & best misfits: -4.4232
-1.3974
Optimizing Vs & Thickness - generation: 31; average & best misfits: -5.4732
-1.1699
Optimizing Vs & Thickness - generation: 32; average & best misfits: -4.5681
-1.1699
Optimizing Vs & Thickness - generation: 33; average & best misfits: -4.1257
-1.1699
Optimizing Vs & Thickness - generation: 34; average & best misfits: -4.7264
-1.1699
Optimizing Vs & Thickness - generation: 35; average & best misfits: -4.4655
-1.1699
Optimizing Vs & Thickness - generation: 36; average & best misfits: -3.9467
-1.1699
Optimizing Vs & Thickness - generation: 37; average & best misfits: -3.6285
-1.1699
Optimizing Vs & Thickness - generation: 38; average & best misfits: -3.895
-1.1699
Optimizing Vs & Thickness - generation: 39; average & best misfits: -4.3769
-1.1699
Optimizing Vs & Thickness - generation: 40; average & best misfits: -3.7131
-1.1699
Optimizing Vs & Thickness - generation: 41; average & best misfits: -3.9753
-1.1699
Optimizing Vs & Thickness - generation: 42; average & best misfits: -4.3287
-1.1699
Optimizing Vs & Thickness - generation: 43; average & best misfits: -4.6261
-1.1699
Optimizing Vs & Thickness - generation: 44; average & best misfits: -4.3862
-1.1699
Optimizing Vs & Thickness - generation: 45; average & best misfits: -5.2027
-1.1699
Optimizing Vs & Thickness - generation: 46; average & best misfits: -4.12
-1.1699
Optimizing Vs & Thickness - generation: 47; average & best misfits: -3.9531

-1.1699
Optimizing Vs & Thickness - generation: 48; average & best misfits: -3.5097
-1.1699
Optimizing Vs & Thickness - generation: 49; average & best misfits: -3.6785
-1.1699
Optimizing Vs & Thickness - generation: 50; average & best misfits: -3.589
-1.1699
Optimizing Vs & Thickness - generation: 51; average & best misfits: -4.484
-1.1699
Optimizing Vs & Thickness - generation: 52; average & best misfits: -4.0931
-1.1699
Optimizing Vs & Thickness - generation: 53; average & best misfits: -3.0145
-1.1699
Optimizing Vs & Thickness - generation: 54; average & best misfits: -3.1322
-1.1699
Optimizing Vs & Thickness - generation: 55; average & best misfits: -2.6428
-1.1699
Optimizing Vs & Thickness - generation: 56; average & best misfits: -3.0209
-1.1699
Optimizing Vs & Thickness - generation: 57; average & best misfits: -3.354
-1.1699
Optimizing Vs & Thickness - generation: 58; average & best misfits: -3.6855
-1.1699
Optimizing Vs & Thickness - generation: 59; average & best misfits: -3.0954
-1.1699
Optimizing Vs & Thickness - generation: 60; average & best misfits: -2.8551
-1.1078
Optimizing Vs & Thickness - generation: 61; average & best misfits: -3.4329
-1.1078

Adopted search space (minimum Vs): 139 150 157 229
Adopted search space (maximum Vs): 273 294 308 448

Adopted search space (minimum Qs): 7.5 12 14.25 18
Adopted search space (maximum Qs): 15 24 28.5 36

Adopted search space (minimum reference frequency): 1
Adopted search space (maximum reference frequency): 34.7129

Adopted search space (minimum Poisson): 0.16493 0.17493 0.17501
0.17496
Adopted search space (maximum Poisson): 0.49478 0.497 0.497
0.497

Adopted search space (minimum thickness): 2.8571 2.8571 2.8571
Adopted search space (maximum thickness): 5.6 5.6 5.6

Now a finer search around the most promising search space area

Rayleigh-wave analysis
Optimizing Vs & Thickness - generation: 1; average & best misfits: -6.8207
-1.1078
Optimizing Vs & Thickness - generation: 2; average & best misfits: -6.7646
-1.1078
Optimizing Vs & Thickness - generation: 3; average & best misfits: -5.2516
-1.1078
Optimizing Vs & Thickness - generation: 4; average & best misfits: -7.1093
-1.1078
Optimizing Vs & Thickness - generation: 5; average & best misfits: -5.5445
-1.1078
Optimizing Vs & Thickness - generation: 6; average & best misfits: -5.2184
-1.1078
Optimizing Vs & Thickness - generation: 7; average & best misfits: -4.1523
-1.0331
Optimizing Vs & Thickness - generation: 8; average & best misfits: -4.2309
-1.0331
Optimizing Vs & Thickness - generation: 9; average & best misfits: -5.8227

-1.0331
Optimizing Vs & Thickness - generation: 10; average & best misfits: -6.0299
-1.0331
Optimizing Vs & Thickness - generation: 11; average & best misfits: -4.5213
-1.0331
Optimizing Vs & Thickness - generation: 12; average & best misfits: -4.6355
-1.0331
Optimizing Vs & Thickness - generation: 13; average & best misfits: -6.5781
-1.0331
Optimizing Vs & Thickness - generation: 14; average & best misfits: -5.2914
-1.0331
Optimizing Vs & Thickness - generation: 15; average & best misfits: -4.4371
-1.0331
Optimizing Vs & Thickness - generation: 16; average & best misfits: -5.241
-1.0331

Model after the Vs & Thickness optimization (fixed Poisson values):
Vs (m/s): 192 231 184 310
Thickness (m): 4.6 4.2 3.2

Number of models considered to calculate the average model: 87

##
RESULTS
##

Dataset: 57.sgy
Analyzed curve/spectrum: 57.cdp

========== SECTION#3

Analyzing Phase Velocities

Analyzing Rayleigh-Wave Dispersion

==
MEAN MODEL

Vs (m/s): 193 235 185 314
Standard deviations (m/s): 2 11 15 15

Thickness (m): 4.7 4.3 3.4
Standard deviations (m): 0.2 0.6 0.5

Approximate values for Vp, density, Poisson & Shear modulus
Vp (m/s): 559 548 424 813
Density (gr/cm3): 1.91 1.91 1.85 2.00
Vp/Vs ratio: 2.90 2.33 2.29 2.59
Poisson: 0.43 0.39 0.38 0.41
Shear modulus (MPa): 71 105 63 198
Estimated static shear modulus (MPa): 0 0 0 0

Fundamental mode
Mean model
 f(Hz) VR(m/s)
3.66676 276.6536
4.63695 268.2572
6.12078 247.9478
 9.1455 213.8135
11.3712 205.1497
13.9965 200.4658
15.8798 198.1755
19.2469 194.4799
23.5272 190.2783

34.7129 184.729

First higher mode
Mean model
17.3636 279.6366
18.8474 266.5945
21.5868 246.7065
22.3287 243.0802
23.9267 237.1828
25.7529 232.668
27.9787 229.0817
31.8594 225.3687

========== SECTION#4

BEST MODEL

Vs (m/s): 192 231 184 310
thickness (m): 4.5769 4.173 3.2188

Approximate values for Vp, density, Poisson & Shear modulus
Vp (m/s): 644 568 1412 699
Density (gr/cm3): 1.95 1.92 2.14 1.97
Vp/Vs ratio: 3.35 2.46 7.67 2.25
Poisson: 0.45 0.40 0.49 0.38
Shear modulus (MPa): 72 102 72 189
Estimated static shear modulus (MPa): 0 0 0 0

dispersion curve (frequency - velocity)

Fundamental mode)
best model
F(Hz) VR(m/s)
3.66676 274.7793
4.63695 268.9401
6.12078 254.4194
9.1455 219.4512
11.3712 207.5437
13.9965 200.9543
15.8798 197.99
19.2469 193.854
23.5272 189.6988
34.7129 184.3143

First higher mode)
best model
17.3636 277.6387
18.8474 266.8608
21.5868 247.9947
22.3287 244.2122
23.9267 237.8446
25.7529 232.7807
27.9787 228.6277
31.8594 224.2074

========== SECTION#5

Maximum penetration depth according to the "Steady State Rayleigh Method": 30 m

Inversion quality: very good

Vs30 & VsE (mean model): 256 256 m/s
Vs30 & VsE (best model): 255 255 m/s

========== 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
"C:\Users\Benedetta\Desktop\valdERA-esac\valdera-esac-13\output_disp".

==========
winMASW - Surface Waves & Beyond
www.winmasw.com

Number of models used to define the mean model: 87
Vs30 for the best model: 255 255
Analyzing phase velocities

UNIONE DI COMUNI DELLA VALDERA

INDAGINE ESAC/MASW - COMUNE DI PALAIA

LOC. STRADA PIAN DI ROGLIO - POSTAZIONE n.14

documentazione fotografica

ubicazione scala 1:1.000

geometria ESAC

geof	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
x	-55	-50	-45	-40	-35	-30	-25	-20	-15	-10	-5	0	0	0	0	0	0	0	0	0	0	0	0	0
y	0	0	0	0	0	0	0	0	0	0	0	0	3	6	9	12	15	18	21	24	27	30	33	36

geometria MASW

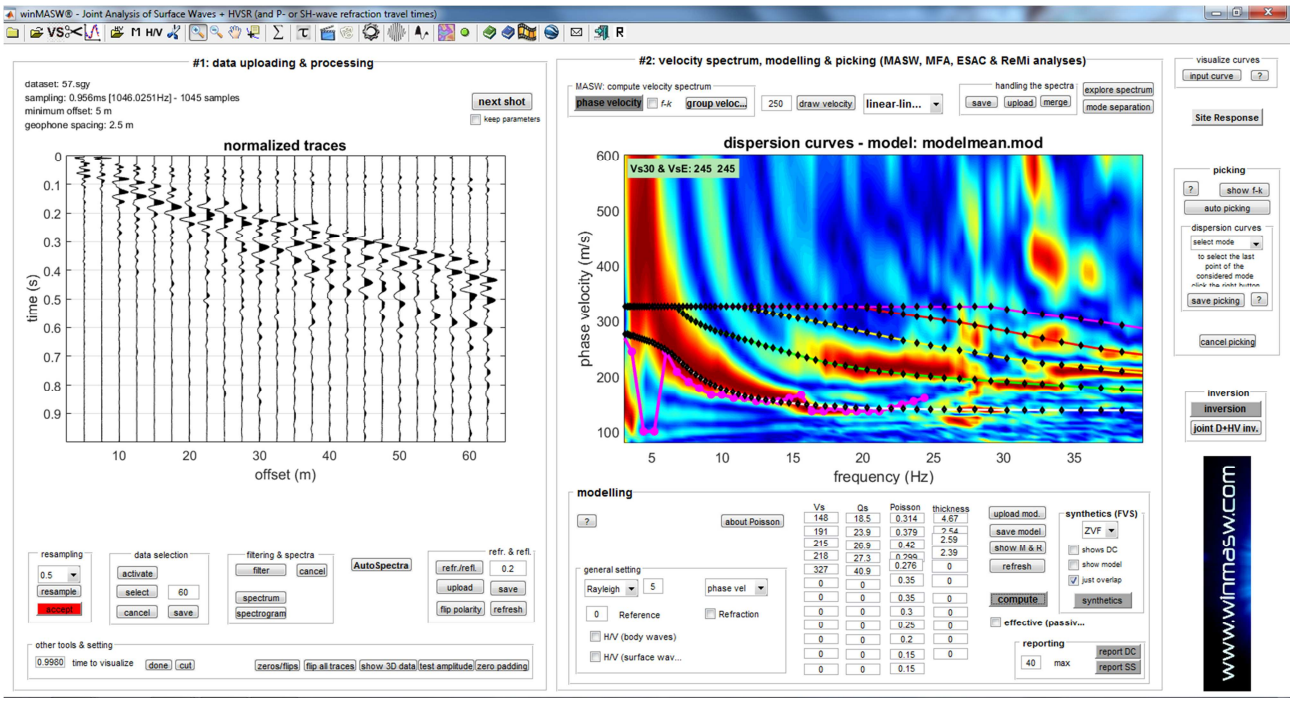
distanza geofonica 12 ch 5 m

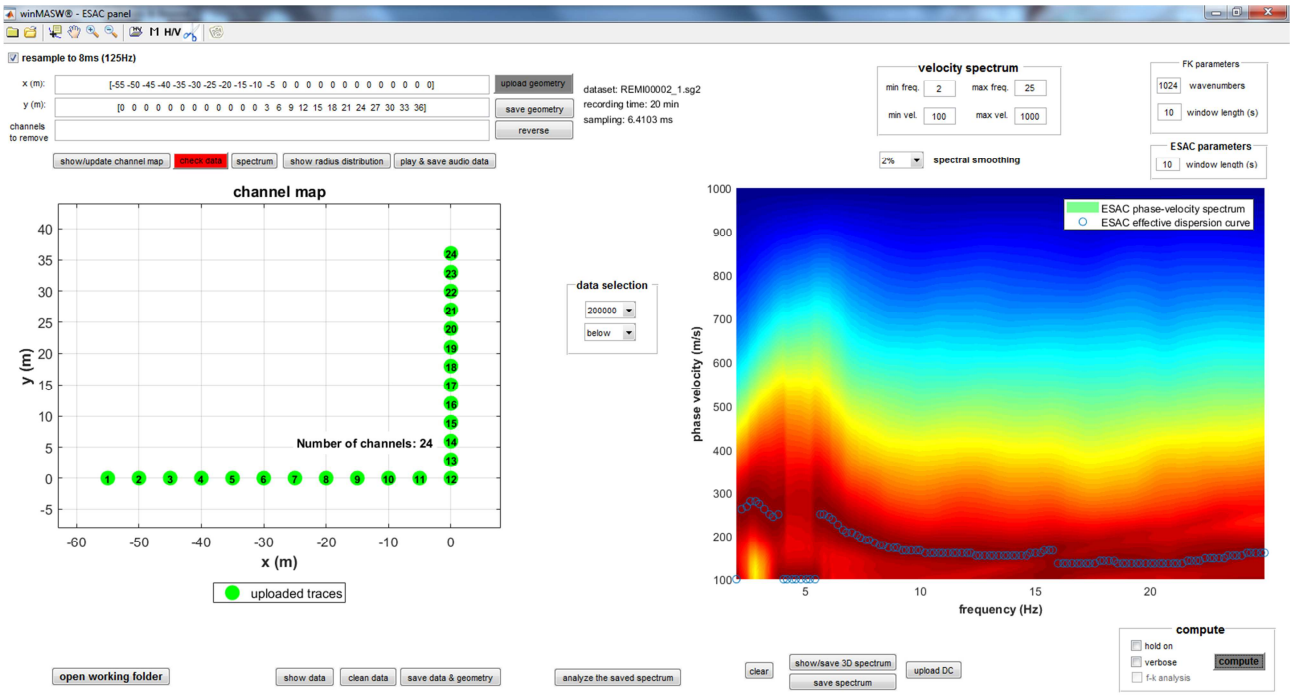
lunghezza linea 57.5 m

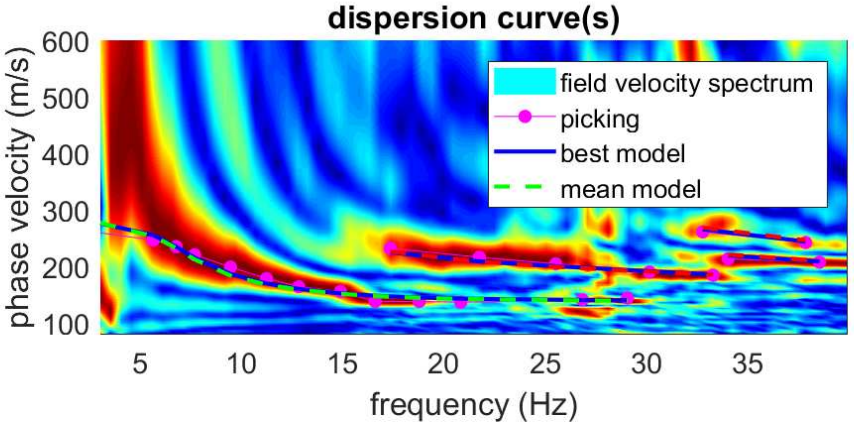
coordinate stazione 43°59’ 37.80” N 10°68’ 90.77” E

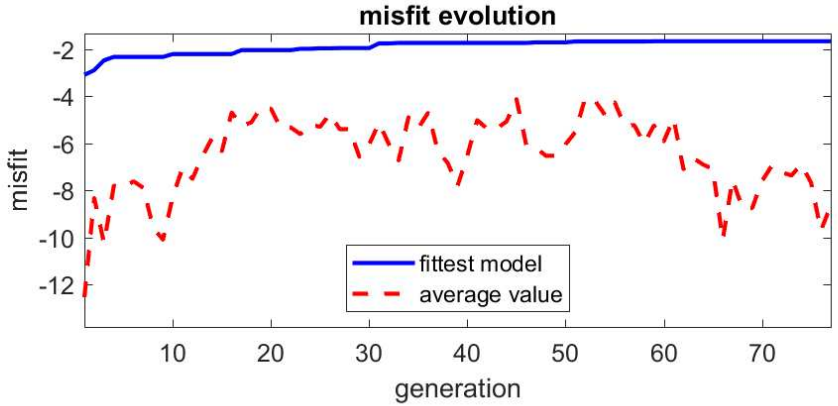
UNIONE VALDERA - Indagini sismiche MASW/ESAC

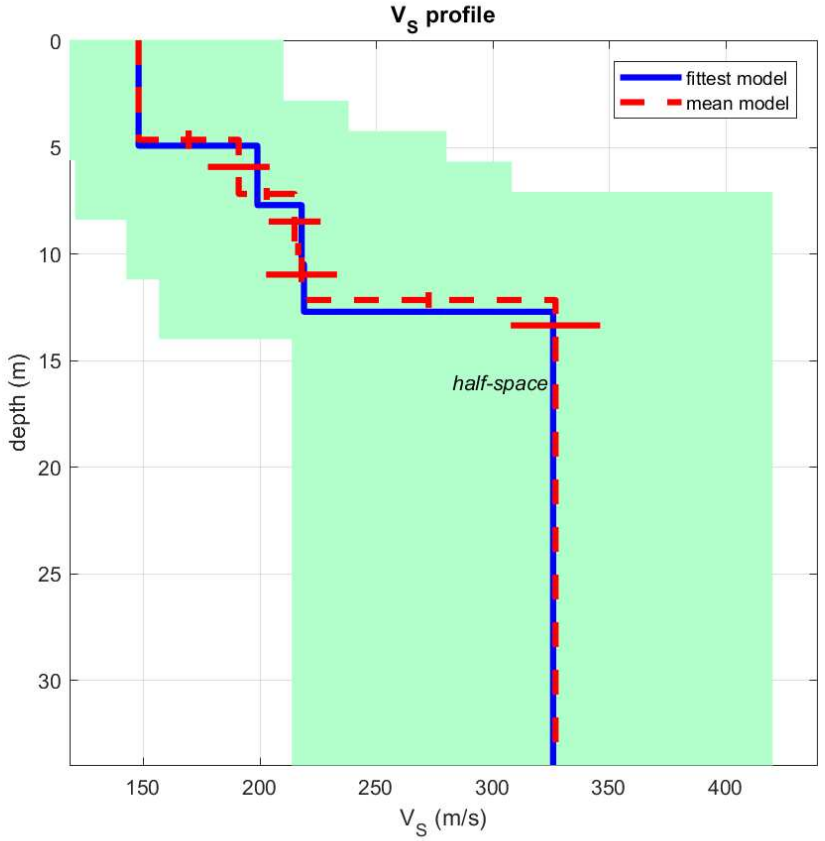
PROVA n. 14











www.winmasw.com

dataset: 57.sgy
dispersion curve: 57.cdp
Vs30 & VsE (best model): 243 243 m/s
Vs30 & VsE (mean model): 245 245 m/s

Mean model

Vs (m/s): 148, 191, 215, 218, 327

Standard deviations (m/s): 1, 13, 11, 15, 19

Thickness (m): 4.7, 2.5, 2.6, 2.4

========== SECTION#1
dataset: 57.sgy
sampling (ms): 0.956
minimum offset (m): 5
geophone spacing (m): 2.5
offsets (m): 5 7.5 10 12.5 15 17.5
20 22.5 25 27.5 30 32.5
35 37.5 40 42.5 45 47.5
50 52.5 55 57.5 60 62.5
Dispersion curve: 57.cdp
Number of individuals: 32
Number of generations: 61

Rayleigh-wave dispersion analysis

Analyzing phase velocities

Adopted search space (minimum Vs): 107 121 143 157 214
Adopted search space (maximum Vs): 210 238 280 308 420

Adopted search space (minimum Poisson): 0.16516 0.17506 0.17484
0.17501 0.17484
Adopted search space (maximum Poisson): 0.49549 0.499 0.499
0.499 0.499

Adopted search space (minimum Qs): 7.5 12 14.25 18
21
Adopted search space (maximum Qs): 15 24 28.5 36
42

Adopted search space (minimum reference frequency): 1
Adopted search space (maximum reference frequency): 38.5366

Adopted search space (minimum thickness): 2.8571 1.4286 1.4286
1.4286
Adopted search space (maximum thickness): 5.6 2.8 2.8
2.8

Output folder:
C:\Users\Benedetta\Desktop\valdERA-esac\valdera-esac-14\output_disp

========== SECTION#2
Rayleigh-wave analysis
Optimizing Vs & Thickness - generation: 1; average & best misfits: -12.5622
-3.08406
Optimizing Vs & Thickness - generation: 2; average & best misfits: -8.3308
-2.887
Optimizing Vs & Thickness - generation: 3; average & best misfits: -10.2547
-2.46855
Optimizing Vs & Thickness - generation: 4; average & best misfits: -7.8095
-2.3213
Optimizing Vs & Thickness - generation: 5; average & best misfits: -7.8885
-2.3213
Optimizing Vs & Thickness - generation: 6; average & best misfits: -7.6169
-2.3213
Optimizing Vs & Thickness - generation: 7; average & best misfits: -7.8998
-2.3213
Optimizing Vs & Thickness - generation: 8; average & best misfits: -9.5875
-2.3213
Optimizing Vs & Thickness - generation: 9; average & best misfits: -10.1063
-2.32134
Optimizing Vs & Thickness - generation: 10; average & best misfits: -8.2668
-2.1997
Optimizing Vs & Thickness - generation: 11; average & best misfits: -7.0393

-2.1997
Optimizing Vs & Thickness - generation: 12; average & best misfits: -7.5116
-2.1997
Optimizing Vs & Thickness - generation: 13; average & best misfits: -6.5661
-2.1997
Optimizing Vs & Thickness - generation: 14; average & best misfits: -5.7827
-2.1997
Optimizing Vs & Thickness - generation: 15; average & best misfits: -6.3347
-2.1997
Optimizing Vs & Thickness - generation: 16; average & best misfits: -4.6843
-2.1997
Optimizing Vs & Thickness - generation: 17; average & best misfits: -5.2607
-2.0322
Optimizing Vs & Thickness - generation: 18; average & best misfits: -5.1077
-2.0322
Optimizing Vs & Thickness - generation: 19; average & best misfits: -4.4664
-2.0322
Optimizing Vs & Thickness - generation: 20; average & best misfits: -4.5332
-2.0322
Optimizing Vs & Thickness - generation: 21; average & best misfits: -5.3494
-2.0322
Optimizing Vs & Thickness - generation: 22; average & best misfits: -5.3214
-2.0322
Optimizing Vs & Thickness - generation: 23; average & best misfits: -5.6109
-1.9755
Optimizing Vs & Thickness - generation: 24; average & best misfits: -5.1989
-1.9755
Optimizing Vs & Thickness - generation: 25; average & best misfits: -5.2966
-1.9541
Optimizing Vs & Thickness - generation: 26; average & best misfits: -4.7504
-1.9541
Optimizing Vs & Thickness - generation: 27; average & best misfits: -5.3991
-1.9457
Optimizing Vs & Thickness - generation: 28; average & best misfits: -5.3954
-1.9457
Optimizing Vs & Thickness - generation: 29; average & best misfits: -6.5728
-1.9457
Optimizing Vs & Thickness - generation: 30; average & best misfits: -6.0454
-1.9457
Optimizing Vs & Thickness - generation: 31; average & best misfits: -5.1312
-1.7469
Optimizing Vs & Thickness - generation: 32; average & best misfits: -6.031
-1.7469
Optimizing Vs & Thickness - generation: 33; average & best misfits: -6.729
-1.7262
Optimizing Vs & Thickness - generation: 34; average & best misfits: -4.8889
-1.7262
Optimizing Vs & Thickness - generation: 35; average & best misfits: -5.3456
-1.7262
Optimizing Vs & Thickness - generation: 36; average & best misfits: -4.7028
-1.7262
Optimizing Vs & Thickness - generation: 37; average & best misfits: -6.3202
-1.7262
Optimizing Vs & Thickness - generation: 38; average & best misfits: -6.8404
-1.7262
Optimizing Vs & Thickness - generation: 39; average & best misfits: -7.8137
-1.7262
Optimizing Vs & Thickness - generation: 40; average & best misfits: -6.5127
-1.7262
Optimizing Vs & Thickness - generation: 41; average & best misfits: -5.0106
-1.7262
Optimizing Vs & Thickness - generation: 42; average & best misfits: -5.3764
-1.7262
Optimizing Vs & Thickness - generation: 43; average & best misfits: -5.3728
-1.726
Optimizing Vs & Thickness - generation: 44; average & best misfits: -5.0622
-1.726
Optimizing Vs & Thickness - generation: 45; average & best misfits: -4.118

```
-1.726
Optimizing Vs & Thickness - generation: 46; average & best misfits: -6.08
-1.726
Optimizing Vs & Thickness - generation: 47; average & best misfits: -6.1943
-1.701
Optimizing Vs & Thickness - generation: 48; average & best misfits: -6.5314
-1.701
Optimizing Vs & Thickness - generation: 49; average & best misfits: -6.5284
-1.701
Optimizing Vs & Thickness - generation: 50; average & best misfits: -6.0414
-1.701
Optimizing Vs & Thickness - generation: 51; average & best misfits: -5.5161
-1.6621
Optimizing Vs & Thickness - generation: 52; average & best misfits: -4.0624
-1.6621
Optimizing Vs & Thickness - generation: 53; average & best misfits: -4.1833
-1.6621
Optimizing Vs & Thickness - generation: 54; average & best misfits: -4.7888
-1.6621
Optimizing Vs & Thickness - generation: 55; average & best misfits: -4.254
-1.6621
Optimizing Vs & Thickness - generation: 56; average & best misfits: -5.2369
-1.6621
Optimizing Vs & Thickness - generation: 57; average & best misfits: -5.2279
-1.6621
Optimizing Vs & Thickness - generation: 58; average & best misfits: -6.0133
-1.6621
Optimizing Vs & Thickness - generation: 59; average & best misfits: -5.2384
-1.6557
Optimizing Vs & Thickness - generation: 60; average & best misfits: -5.9164
-1.6557
Optimizing Vs & Thickness - generation: 61; average & best misfits: -4.9303
-1.6557

Adopted search space (minimum Vs): 107  121  143  157  214
Adopted search space (maximum Vs): 210  238  280  308  420

Adopted search space (minimum Qs): 7.5           12        14.25           18
       21
Adopted search space (maximum Qs): 15           24         28.5           36
      42

Adopted search space (minimum reference frequency): 1
Adopted search space (maximum reference frequency): 38.5366

Adopted search space (minimum Poisson): 0.16516     0.17506     0.17484
0.17501     0.17484
Adopted search space (maximum Poisson): 0.49549       0.497       0.497
0.497       0.497

Adopted search space (minimum thickness): 2.8571      1.4286      1.4286
1.4286
Adopted search space (maximum thickness): 5.6         2.8         2.8
2.8


Now a finer search around the most promising search space area

Rayleigh-wave analysis
Optimizing Vs & Thickness - generation: 1; average & best misfits: -7.1008
-1.6557
Optimizing Vs & Thickness - generation: 2; average & best misfits: -6.6237
-1.6557
Optimizing Vs & Thickness - generation: 3; average & best misfits: -6.9049
-1.6557
Optimizing Vs & Thickness - generation: 4; average & best misfits: -7.0888
-1.6557
Optimizing Vs & Thickness - generation: 5; average & best misfits: -10.1157
```

-1.65572
Optimizing Vs & Thickness - generation: 6; average & best misfits: -7.5475
-1.6557
Optimizing Vs & Thickness - generation: 7; average & best misfits: -8.7413
-1.6557
Optimizing Vs & Thickness - generation: 8; average & best misfits: -8.762
-1.6557
Optimizing Vs & Thickness - generation: 9; average & best misfits: -7.6089
-1.6557
Optimizing Vs & Thickness - generation: 10; average & best misfits: -6.9543
-1.6557
Optimizing Vs & Thickness - generation: 11; average & best misfits: -7.2293
-1.6557
Optimizing Vs & Thickness - generation: 12; average & best misfits: -7.3704
-1.6557
Optimizing Vs & Thickness - generation: 13; average & best misfits: -6.8949
-1.6557
Optimizing Vs & Thickness - generation: 14; average & best misfits: -7.6767
-1.6557
Optimizing Vs & Thickness - generation: 15; average & best misfits: -9.7207
-1.6557
Optimizing Vs & Thickness - generation: 16; average & best misfits: -8.6393
-1.6557

Model after the Vs & Thickness optimization (fixed Poisson values):
Vs (m/s): 148 199 218 219 326
Thickness (m): 4.9 2.8 2.8 2.2

Number of models considered to calculate the average model: 221

##
RESULTS
##

Dataset: 57.sgy
Analyzed curve/spectrum: 57.cdp

== SECTION#3

Analyzing Phase Velocities

Analyzing Rayleigh-Wave Dispersion

==
MEAN MODEL

Vs (m/s): 148 191 215 218 327
Standard deviations (m/s): 1 13 11 15 19

Thickness (m): 4.7 2.5 2.6 2.4
Standard deviations (m): 0.4 0.3 0.3 0.4

Approximate values for Vp, density, Poisson & Shear modulus
Vp (m/s): 284 432 579 407 588
Density (gr/cm3): 1.75 1.85 1.92 1.84 1.93
Vp/Vs ratio: 1.92 2.26 2.69 1.87 1.80
Poisson: 0.31 0.38 0.42 0.30 0.28
Shear modulus (MPa): 38 68 89 87 206
Estimated static shear modulus (MPa): 0 0 0 0
 0

Fundamental mode
Mean model
 f(Hz) VR(m/s)

3.03899	276.5725
5.66422	252.6975
6.80562	231.7063
7.71874	211.5404
9.48792	182.897
11.2571	166.9705
12.8551	158.0102
14.9096	150.6451
16.6217	146.7241
18.7904	143.5153
20.8449	141.593
26.8373	138.9593
29.063	138.5261

First higher mode
Mean model

17.3636	225.3711
21.758	207.6112
25.5246	198.4879
30.1473	189.8658
33.2862	184.5697

Second higher mode
Mean model

34.0281	220.3339
38.5366	208.9522

Third higher mode
Mean model

32.7726	268.1416
37.8518	245.4797

========== SECTION#4

BEST MODEL

Vs (m/s): 148 199 218 219 326
thickness (m): 4.9475 2.7858 2.771 2.2316

Approximate values for Vp, density, Poisson & Shear modulus
Vp (m/s): 308 473 779 489 541
Density (gr/cm3): 1.77 1.87 1.99 1.88 1.91
Vp/Vs ratio: 2.08 2.38 3.57 2.23 1.66
Poisson: 0.35 0.39 0.46 0.37 0.21
Shear modulus (MPa): 39 74 95 90 202
Estimated static shear modulus (MPa): 0 0 0 0 0

dispersion curve (frequency - velocity)

Fundamental mode)
best model

F(Hz)	VR(m/s)
3.03899	275.5349
5.66422	254.8064
6.80562	234.2456
7.71874	214.4144
9.48792	185.6655
11.2571	168.932
12.8551	159.3022
14.9096	151.4496
16.6217	147.3659
18.7904	144.1035
20.8449	142.1929
26.8373	139.6473
29.063	139.24

First higher mode)
best model
17.3636 224.0218
21.758 208.0386
25.5246 199.607
30.1473 190.8344
33.2862 184.9072

Second higher mode)
best model
34.0281 218.5882
38.5366 208.0494

Third higher mode)
best model
32.7726 264.9133
37.8518 243.3209

========== SECTION#5

Maximum penetration depth according to the "Steady State Rayleigh Method": 34 m

Inversion quality: very good

Vs30 & VsE (mean model): 245 245 m/s
Vs30 & VsE (best model): 243 243 m/s

========== 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
"C:\Users\Benedetta\Desktop\valdERA-esac\valdera-esac-14\output_disp".

winMASW - Surface Waves & Beyond
www.winmasw.com

Number of models used to define the mean model: 221
Vs30 for the best model: 243 243
Analyzing phase velocities

UNIONE DI COMUNI DELLA VALDERA

INDAGINE ESAC/MASW - COMUNE DI PALAIA

LOC. CAMPO SPORTIVO PALAIA - POSTAZIONE n.15

documentazione fotografica

ubicazione scala 1:1.000

geometria ESAC

geof	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
x	-55	-50	-45	-40	-35	-30	-25	-20	-15	-10	-5	0	0	0	0	0	0	0	0	0	0	0	0	0
y	0	0	0	0	0	0	0	0	0	0	0	0	3	6	9	12	15	18	21	24	27	30	33	36

geometria MASW

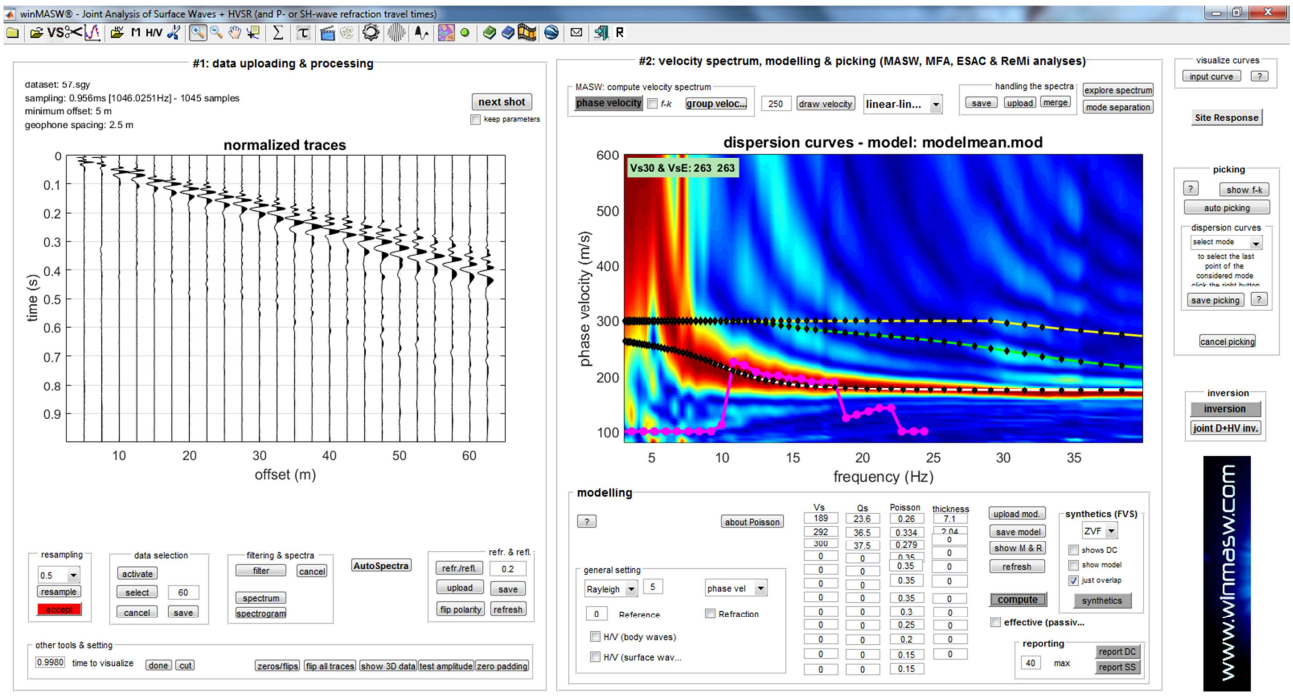
distanza geofonica 12 ch 5 m

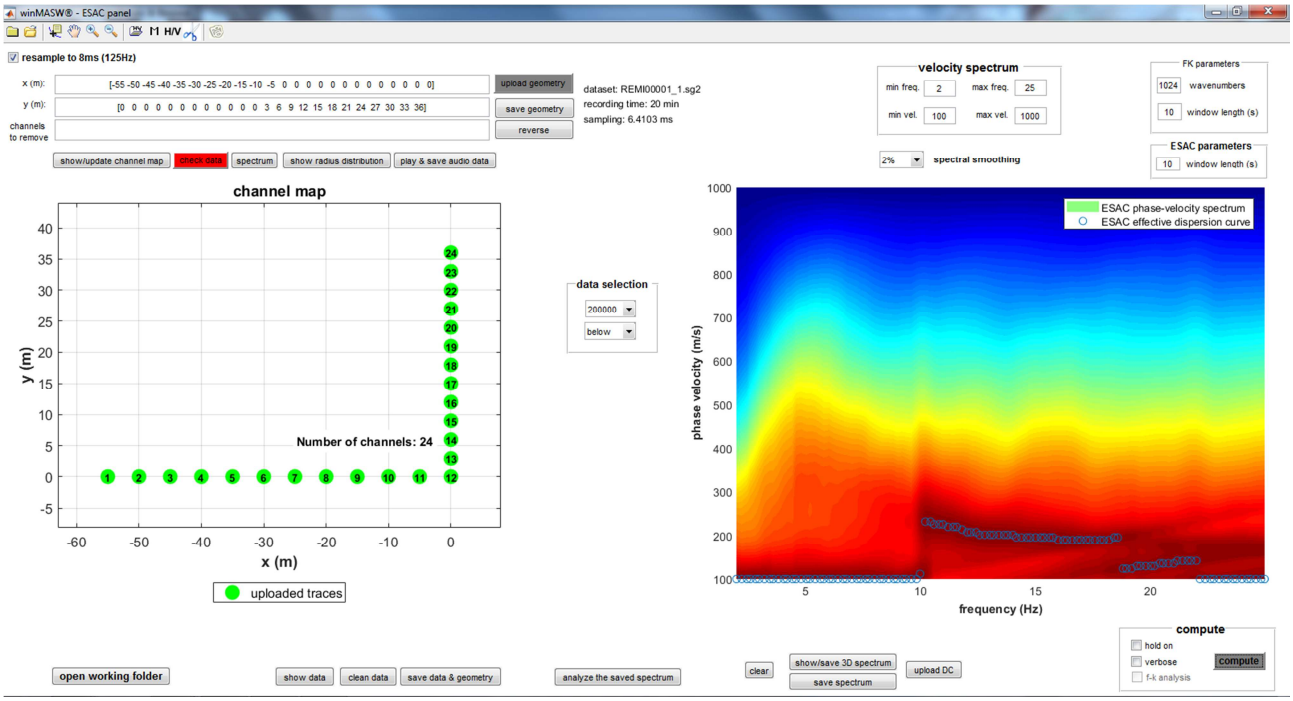
lunghezza linea 57.5 m

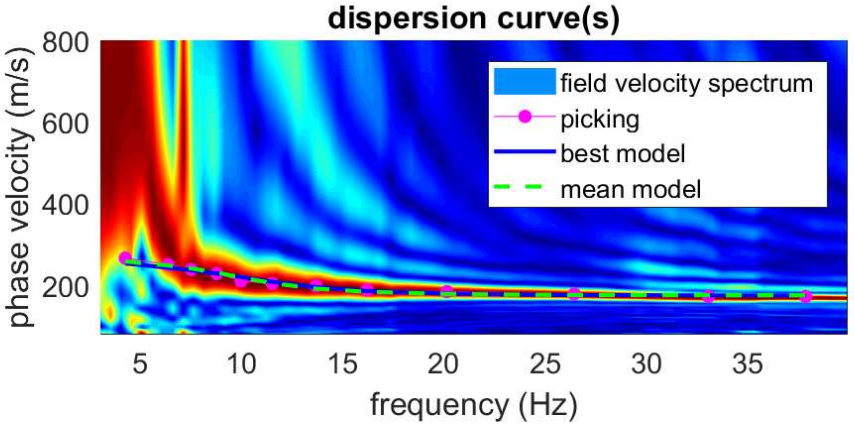
coordinate stazione 43°58’ 98.73” N 10°67’ 60.13” E

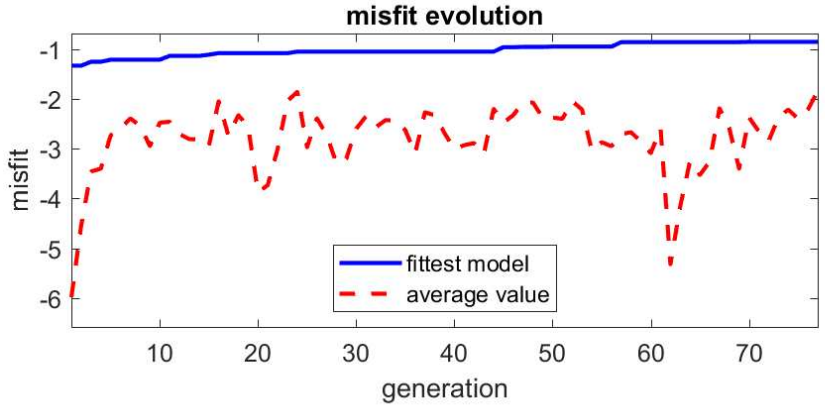
UNIONE VALDERA - Indagini sismiche MASW/ESAC

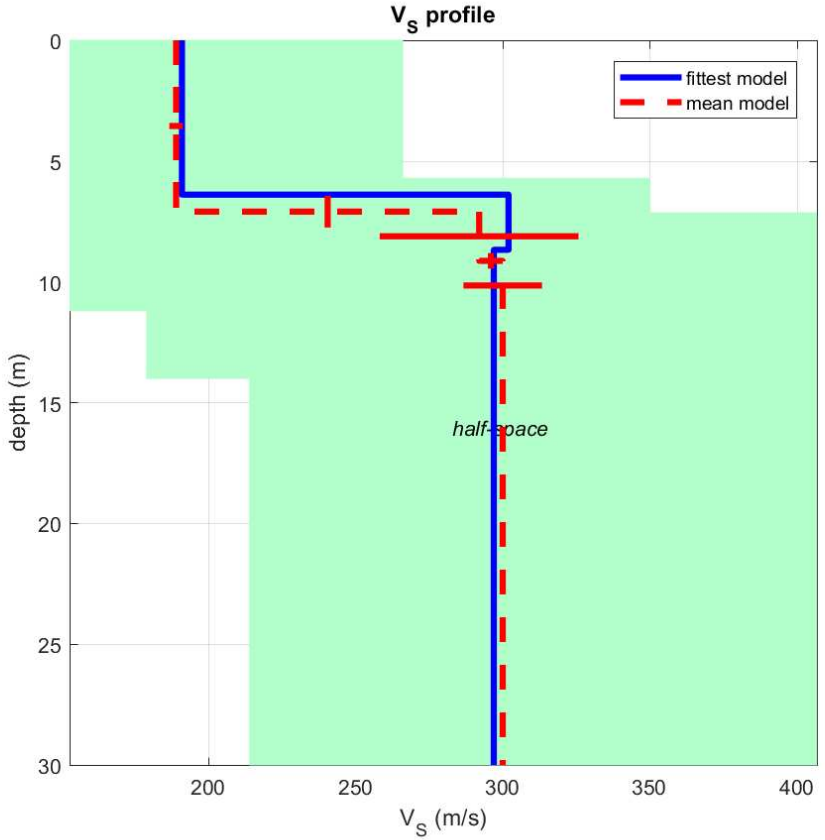
PROVA n. 15











www.winmasw.com

dataset: 57.sgy
dispersion curve: 57.cdp
Vs30 & VsE (best model): 266 266 m/s
Vs30 & VsE (mean model): 263 263 m/s

Mean model

Vs (m/s): 189, 292, 300

Standard deviations (m/s): 2, 34, 13

Thickness (m): 7.1, 2.0

========== SECTION#1
dataset: 57.sgy
sampling (ms): 0.956
minimum offset (m): 5
geophone spacing (m): 2.5
offsets (m): 5 7.5 10 12.5 15 17.5
20 22.5 25 27.5 30 32.5
35 37.5 40 42.5 45 47.5
50 52.5 55 57.5 60 62.5
Dispersion curve: 57.cdp
Number of individuals: 32
Number of generations: 61

Rayleigh-wave dispersion analysis

Analyzing phase velocities

Adopted search space (minimum Vs): 136 179 214
Adopted search space (maximum Vs): 266 350 420

Adopted search space (minimum Poisson): 0.16488 0.17484 0.17484
Adopted search space (maximum Poisson): 0.49465 0.499 0.499

Adopted search space (minimum Qs): 7.5 12 14.25
Adopted search space (maximum Qs): 15 24 28.5

Adopted search space (minimum reference frequency): 1
Adopted search space (maximum reference frequency): 37.8518

Adopted search space (minimum thickness): 5.7143 1.4286
Adopted search space (maximum thickness): 11.2 2.8

Output folder:
C:\Users\Benedetta\Desktop\valdERA-esac\valdera-esac-15\output_disp

========== SECTION#2
Rayleigh-wave analysis
Optimizing Vs & Thickness - generation: 1; average & best misfits: -5.9882
-1.3239
Optimizing Vs & Thickness - generation: 2; average & best misfits: -4.5391
-1.3239
Optimizing Vs & Thickness - generation: 3; average & best misfits: -3.4561
-1.2451
Optimizing Vs & Thickness - generation: 4; average & best misfits: -3.3971
-1.2451
Optimizing Vs & Thickness - generation: 5; average & best misfits: -2.7269
-1.2031
Optimizing Vs & Thickness - generation: 6; average & best misfits: -2.5908
-1.2031
Optimizing Vs & Thickness - generation: 7; average & best misfits: -2.3847
-1.2031
Optimizing Vs & Thickness - generation: 8; average & best misfits: -2.5377
-1.2031
Optimizing Vs & Thickness - generation: 9; average & best misfits: -2.9431
-1.2031
Optimizing Vs & Thickness - generation: 10; average & best misfits: -2.47
-1.2031
Optimizing Vs & Thickness - generation: 11; average & best misfits: -2.4547
-1.1265
Optimizing Vs & Thickness - generation: 12; average & best misfits: -2.7013
-1.1265
Optimizing Vs & Thickness - generation: 13; average & best misfits: -2.8022
-1.1265
Optimizing Vs & Thickness - generation: 14; average & best misfits: -2.8099

-1.1265
Optimizing Vs & Thickness - generation: 15; average & best misfits: -2.9362
-1.102
Optimizing Vs & Thickness - generation: 16; average & best misfits: -2.042
-1.0716
Optimizing Vs & Thickness - generation: 17; average & best misfits: -2.7396
-1.0716
Optimizing Vs & Thickness - generation: 18; average & best misfits: -2.3206
-1.0716
Optimizing Vs & Thickness - generation: 19; average & best misfits: -2.554
-1.0716
Optimizing Vs & Thickness - generation: 20; average & best misfits: -3.871
-1.0716
Optimizing Vs & Thickness - generation: 21; average & best misfits: -3.7303
-1.0716
Optimizing Vs & Thickness - generation: 22; average & best misfits: -3.0012
-1.0716
Optimizing Vs & Thickness - generation: 23; average & best misfits: -2.0376
-1.0716
Optimizing Vs & Thickness - generation: 24; average & best misfits: -1.8493
-1.0406
Optimizing Vs & Thickness - generation: 25; average & best misfits: -2.967
-1.0406
Optimizing Vs & Thickness - generation: 26; average & best misfits: -2.3817
-1.0406
Optimizing Vs & Thickness - generation: 27; average & best misfits: -2.7234
-1.0406
Optimizing Vs & Thickness - generation: 28; average & best misfits: -3.2917
-1.0406
Optimizing Vs & Thickness - generation: 29; average & best misfits: -3.1952
-1.0406
Optimizing Vs & Thickness - generation: 30; average & best misfits: -2.5944
-1.0406
Optimizing Vs & Thickness - generation: 31; average & best misfits: -2.3437
-1.0406
Optimizing Vs & Thickness - generation: 32; average & best misfits: -2.5629
-1.0406
Optimizing Vs & Thickness - generation: 33; average & best misfits: -2.4202
-1.0406
Optimizing Vs & Thickness - generation: 34; average & best misfits: -2.4308
-1.0406
Optimizing Vs & Thickness - generation: 35; average & best misfits: -2.6201
-1.0406
Optimizing Vs & Thickness - generation: 36; average & best misfits: -3.0952
-1.0406
Optimizing Vs & Thickness - generation: 37; average & best misfits: -2.263
-1.0406
Optimizing Vs & Thickness - generation: 38; average & best misfits: -2.3204
-1.0406
Optimizing Vs & Thickness - generation: 39; average & best misfits: -2.6832
-1.0406
Optimizing Vs & Thickness - generation: 40; average & best misfits: -3.0056
-1.0406
Optimizing Vs & Thickness - generation: 41; average & best misfits: -2.925
-1.0406
Optimizing Vs & Thickness - generation: 42; average & best misfits: -2.883
-1.0406
Optimizing Vs & Thickness - generation: 43; average & best misfits: -3.1
-1.0406
Optimizing Vs & Thickness - generation: 44; average & best misfits: -2.1928
-1.0405
Optimizing Vs & Thickness - generation: 45; average & best misfits: -2.4724
-0.95182
Optimizing Vs & Thickness - generation: 46; average & best misfits: -2.3185
-0.95182
Optimizing Vs & Thickness - generation: 47; average & best misfits: -2.061
-0.94548
Optimizing Vs & Thickness - generation: 48; average & best misfits: -2.0666

-0.94548
Optimizing Vs & Thickness - generation: 49; average & best misfits: -2.3711
-0.94548
Optimizing Vs & Thickness - generation: 50; average & best misfits: -2.3684
-0.93958
Optimizing Vs & Thickness - generation: 51; average & best misfits: -2.3943
-0.93958
Optimizing Vs & Thickness - generation: 52; average & best misfits: -2.0396
-0.93958
Optimizing Vs & Thickness - generation: 53; average & best misfits: -2.2082
-0.93958
Optimizing Vs & Thickness - generation: 54; average & best misfits: -3.0369
-0.93958
Optimizing Vs & Thickness - generation: 55; average & best misfits: -2.8642
-0.93958
Optimizing Vs & Thickness - generation: 56; average & best misfits: -2.947
-0.93958
Optimizing Vs & Thickness - generation: 57; average & best misfits: -2.701
-0.84932
Optimizing Vs & Thickness - generation: 58; average & best misfits: -2.6649
-0.84932
Optimizing Vs & Thickness - generation: 59; average & best misfits: -2.8562
-0.84932
Optimizing Vs & Thickness - generation: 60; average & best misfits: -3.086
-0.84932
Optimizing Vs & Thickness - generation: 61; average & best misfits: -2.5914
-0.84917

Adopted search space (minimum Vs): 136 179 214
Adopted search space (maximum Vs): 266 350 420

Adopted search space (minimum Qs): 7.5 12 14.25
Adopted search space (maximum Qs): 15 24 28.5

Adopted search space (minimum reference frequency): 1
Adopted search space (maximum reference frequency): 37.8518

Adopted search space (minimum Poisson): 0.16488 0.17484 0.17484
Adopted search space (maximum Poisson): 0.49465 0.497 0.497

Adopted search space (minimum thickness): 5.7143 1.4286
Adopted search space (maximum thickness): 11.2 2.8

Now a finer search around the most promising search space area

Rayleigh-wave analysis
Optimizing Vs & Thickness - generation: 1; average & best misfits: -5.3248
-0.84917
Optimizing Vs & Thickness - generation: 2; average & best misfits: -4.1539
-0.84825
Optimizing Vs & Thickness - generation: 3; average & best misfits: -3.2472
-0.84825
Optimizing Vs & Thickness - generation: 4; average & best misfits: -3.526
-0.84825
Optimizing Vs & Thickness - generation: 5; average & best misfits: -3.254
-0.84825
Optimizing Vs & Thickness - generation: 6; average & best misfits: -2.1828
-0.84825
Optimizing Vs & Thickness - generation: 7; average & best misfits: -2.589
-0.84825
Optimizing Vs & Thickness - generation: 8; average & best misfits: -3.3996
-0.84825
Optimizing Vs & Thickness - generation: 9; average & best misfits: -2.3642
-0.84435
Optimizing Vs & Thickness - generation: 10; average & best misfits: -2.6482
-0.84435
Optimizing Vs & Thickness - generation: 11; average & best misfits: -2.8408

-0.84435
Optimizing Vs & Thickness - generation: 12; average & best misfits: -2.3699
-0.84435
Optimizing Vs & Thickness - generation: 13; average & best misfits: -2.2072
-0.84435
Optimizing Vs & Thickness - generation: 14; average & best misfits: -2.3954
-0.84435
Optimizing Vs & Thickness - generation: 15; average & best misfits: -2.2095
-0.84435
Optimizing Vs & Thickness - generation: 16; average & best misfits: -1.8347
-0.84435

Model after the Vs & Thickness optimization (fixed Poisson values):
Vs (m/s): 191 302 297
Thickness (m): 6.4   2.3

Number of models considered to calculate the average model: 370

##
RESULTS
##

Dataset: 57.sgy
Analyzed curve/spectrum: 57.cdp

========== SECTION#3

Analyzing Phase Velocities

Analyzing Rayleigh-Wave Dispersion

==
MEAN MODEL

Vs (m/s):   189 292 300
Standard deviations (m/s): 2 34 13

Thickness (m):   7.1   2.0
Standard deviations (m): 0.7   0.3

Approximate values for Vp, density, Poisson & Shear modulus
Vp (m/s):   332 585 542
Density (gr/cm3):   1.79   1.92   1.91
Vp/Vs ratio: 1.76   2.00   1.81
Poisson: 0.26   0.33   0.28
Shear modulus (MPa): 64   164   172
Estimated static shear modulus (MPa): 0   0   0

Fundamental mode
Mean model
 f(Hz)   VR(m/s)
4.29453   257.3232
6.40613   247.3997
7.54753   240.1516
8.80308   229.7637
10.0015   218.0644
11.5424   203.9433
13.7111   190.6474
16.2222   182.7369
  20.16   177.5006
26.4378   174.9711
33.0579   174.3188
37.8518   174.1786

========== SECTION#4

BEST MODEL

Vs (m/s): 191 302 297
thickness (m): 6.3913 2.2818

Approximate values for Vp, density, Poisson & Shear modulus
Vp (m/s): 307 515 525
Density (gr/cm3): 1.77 1.89 1.90
Vp/Vs ratio: 1.61 1.71 1.77
Poisson: 0.18 0.24 0.26
Shear modulus (MPa): 65 173 167
Estimated static shear modulus (MPa): 0 0 0

dispersion curve (frequency - velocity)

Fundamental mode)
best model

F(Hz)	VR(m/s)
4.29453	252.3065
6.40613	242.0905
7.54753	235.8149
8.80308	227.7718
10.0015	218.9824
11.5424	207.3113
13.7111	194.0295
16.2222	184.8169
20.16	178.1771
26.4378	174.7635
33.0579	173.8288
37.8518	173.6176

========== SECTION#5

Maximum penetration depth according to the "Steady State Rayleigh Method": 30 m

Inversion quality: very good

Vs30 & VsE (mean model): 263 263 m/s
Vs30 & VsE (best model): 266 266 m/s

========== 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
"C:\Users\Benedetta\Desktop\valdERA-esac\valdera-esac-15\output_disp".

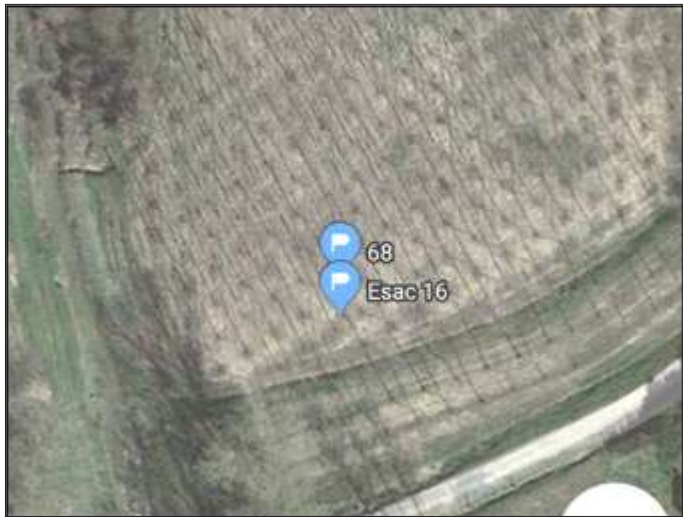
==========
winMASW - Surface Waves & Beyond
www.winmasw.com

Number of models used to define the mean model: 370
Vs30 for the best model: 266 266
Analyzing phase velocities

UNIONE DI COMUNI DELLA VALDERA

INDAGINE ESAC/MASW - COMUNE DI PONTEDERA

LOC. TREGGIAIA - POSTAZIONE n.16



documentazione fotografica

ubicazione scala 1:1.000

geometria ESAC

geof	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
x	55	50	45	40	35	30	25	20	15	10	5	0	0	0	0	0	0	0	0	0	0	0	0	0
y	0	0	0	0	0	0	0	0	0	0	0	0	3	6	9	12	15	18	21	24	27	30	33	36

geometria MASW

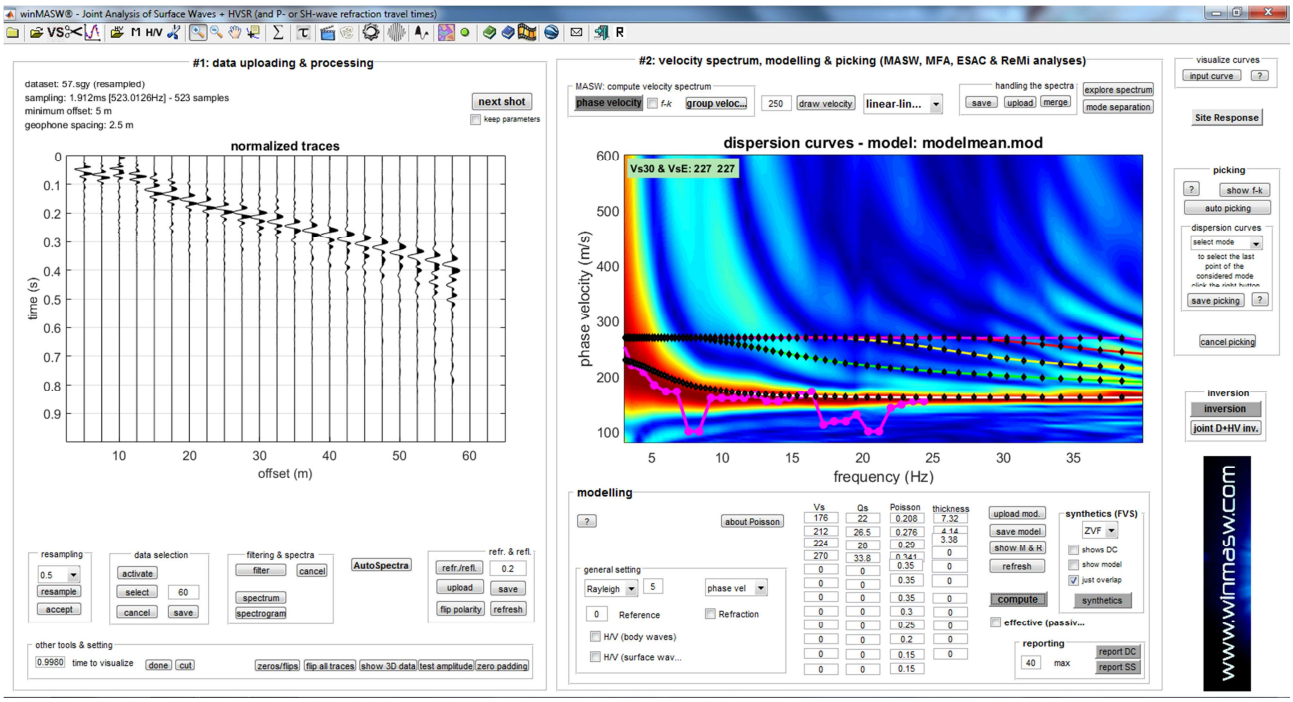
distanza geofonica 12 ch 5 m

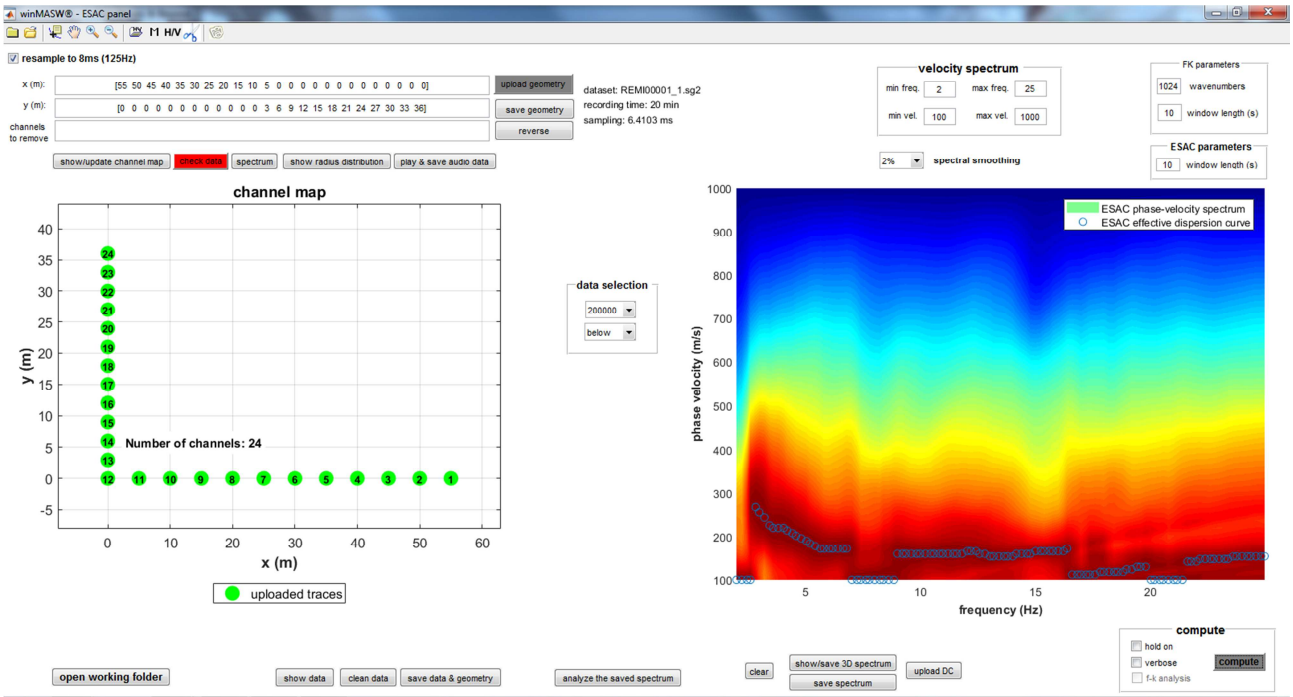
lunghezza linea 57.5 m

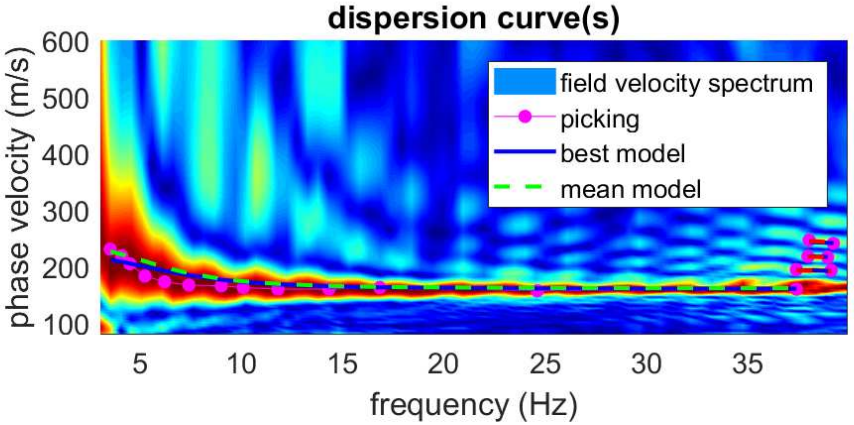
coordinate stazione 43°61’ 34.30” N 10°67’ 41.50” E

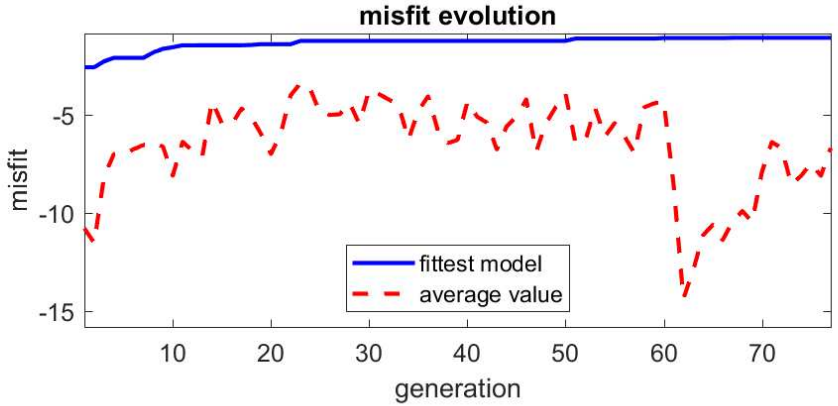
UNIONE VALDERA - Indagini sismiche MASW/ESAC

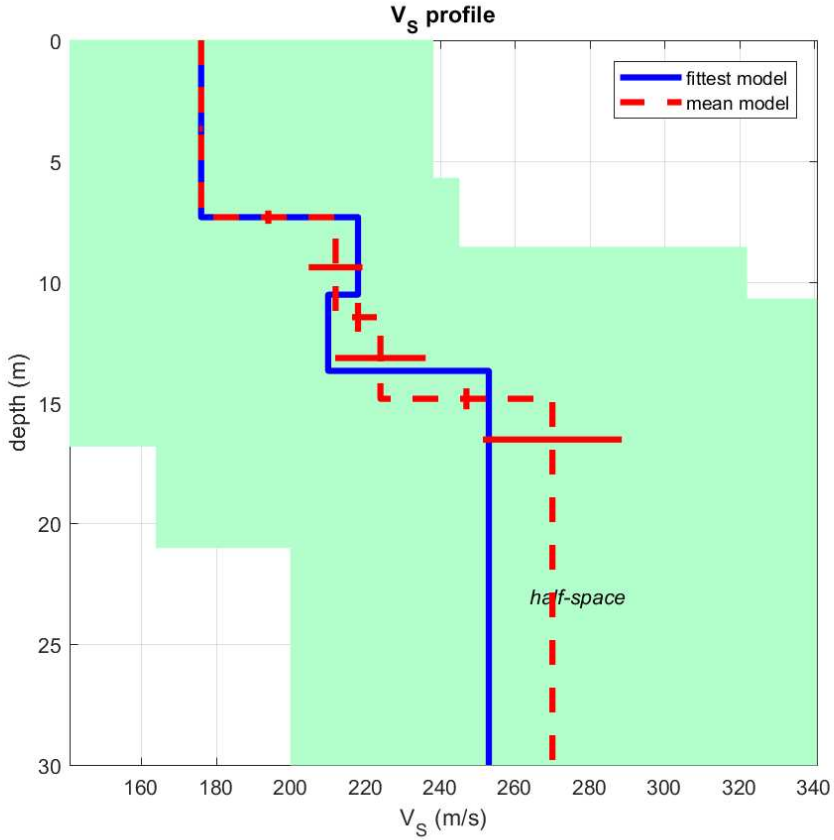
PROVA n. 16











www.winmasw.com

dataset: 57.sgy
dispersion curve: 57.cdp
Vs30 & VsE (best model): 221 221 m/s
Vs30 & VsE (mean model): 227 227 m/s

Mean model

Vs (m/s): 176, 212, 224, 270

Standard deviations (m/s): 0, 7, 12, 19

Thickness (m): 7.3, 4.1, 3.4

========== SECTION#1
dataset: 57.sgy
sampling (ms): 0.956
minimum offset (m): 5
geophone spacing (m): 2.5
offsets (m): 5 7.5 10 12.5 15 17.5
20 22.5 25 27.5 30 32.5
35 37.5 40 42.5 45 47.5
50 52.5 55 57.5 60 62.5
Dispersion curve: 57.cdp
Number of individuals: 32
Number of generations: 61

Rayleigh-wave dispersion analysis

Analyzing phase velocities

Adopted search space (minimum Vs): 121 125 164 200
Adopted search space (maximum Vs): 238 245 322 392

Adopted search space (minimum Poisson): 0.16467 0.17484 0.17509
0.17504
Adopted search space (maximum Poisson): 0.494 0.499 0.499
0.499

Adopted search space (minimum Qs): 7.5 12 14.25 18
Adopted search space (maximum Qs): 15 24 28.5 36

Adopted search space (minimum reference frequency): 1
Adopted search space (maximum reference frequency): 39.2215

Adopted search space (minimum thickness): 5.7143 2.8571 2.1429
Adopted search space (maximum thickness): 11.2 5.6 4.2

Output folder:
C:\Users\Benedetta\Desktop\valdERA-esac\valdera-esac-16\output_disp

========== SECTION#2
Rayleigh-wave analysis
Optimizing Vs & Thickness - generation: 1; average & best misfits: -10.7721
-2.59187
Optimizing Vs & Thickness - generation: 2; average & best misfits: -11.5199
-2.59187
Optimizing Vs & Thickness - generation: 3; average & best misfits: -8.1565
-2.2926
Optimizing Vs & Thickness - generation: 4; average & best misfits: -7.0001
-2.1159
Optimizing Vs & Thickness - generation: 5; average & best misfits: -7.0325
-2.1159
Optimizing Vs & Thickness - generation: 6; average & best misfits: -6.758
-2.1159
Optimizing Vs & Thickness - generation: 7; average & best misfits: -6.5456
-2.1159
Optimizing Vs & Thickness - generation: 8; average & best misfits: -6.4085
-1.8424
Optimizing Vs & Thickness - generation: 9; average & best misfits: -6.6216
-1.6551
Optimizing Vs & Thickness - generation: 10; average & best misfits: -8.0986
-1.574
Optimizing Vs & Thickness - generation: 11; average & best misfits: -6.3766
-1.4763
Optimizing Vs & Thickness - generation: 12; average & best misfits: -6.8388
-1.4763
Optimizing Vs & Thickness - generation: 13; average & best misfits: -7.1275

-1.4759
Optimizing Vs & Thickness - generation: 14; average & best misfits: -4.3103
-1.4759
Optimizing Vs & Thickness - generation: 15; average & best misfits: -5.4384
-1.4759
Optimizing Vs & Thickness - generation: 16; average & best misfits: -5.4936
-1.4759
Optimizing Vs & Thickness - generation: 17; average & best misfits: -4.6887
-1.4759
Optimizing Vs & Thickness - generation: 18; average & best misfits: -5.1211
-1.4576
Optimizing Vs & Thickness - generation: 19; average & best misfits: -5.991
-1.4201
Optimizing Vs & Thickness - generation: 20; average & best misfits: -6.9973
-1.4201
Optimizing Vs & Thickness - generation: 21; average & best misfits: -5.9521
-1.4201
Optimizing Vs & Thickness - generation: 22; average & best misfits: -4.0147
-1.4201
Optimizing Vs & Thickness - generation: 23; average & best misfits: -3.4007
-1.2527
Optimizing Vs & Thickness - generation: 24; average & best misfits: -3.6995
-1.2527
Optimizing Vs & Thickness - generation: 25; average & best misfits: -4.9118
-1.2527
Optimizing Vs & Thickness - generation: 26; average & best misfits: -5.0112
-1.2527
Optimizing Vs & Thickness - generation: 27; average & best misfits: -4.9804
-1.2527
Optimizing Vs & Thickness - generation: 28; average & best misfits: -4.405
-1.2527
Optimizing Vs & Thickness - generation: 29; average & best misfits: -5.4622
-1.2527
Optimizing Vs & Thickness - generation: 30; average & best misfits: -3.7456
-1.2527
Optimizing Vs & Thickness - generation: 31; average & best misfits: -3.9601
-1.2527
Optimizing Vs & Thickness - generation: 32; average & best misfits: -4.2288
-1.2527
Optimizing Vs & Thickness - generation: 33; average & best misfits: -4.5317
-1.2527
Optimizing Vs & Thickness - generation: 34; average & best misfits: -6.2644
-1.2527
Optimizing Vs & Thickness - generation: 35; average & best misfits: -4.8157
-1.2527
Optimizing Vs & Thickness - generation: 36; average & best misfits: -4.0607
-1.2527
Optimizing Vs & Thickness - generation: 37; average & best misfits: -5.8136
-1.2527
Optimizing Vs & Thickness - generation: 38; average & best misfits: -6.4418
-1.2527
Optimizing Vs & Thickness - generation: 39; average & best misfits: -6.2779
-1.2527
Optimizing Vs & Thickness - generation: 40; average & best misfits: -4.347
-1.2527
Optimizing Vs & Thickness - generation: 41; average & best misfits: -5.1064
-1.2527
Optimizing Vs & Thickness - generation: 42; average & best misfits: -5.408
-1.2527
Optimizing Vs & Thickness - generation: 43; average & best misfits: -6.7618
-1.2527
Optimizing Vs & Thickness - generation: 44; average & best misfits: -5.5936
-1.2527
Optimizing Vs & Thickness - generation: 45; average & best misfits: -5.0943
-1.2527
Optimizing Vs & Thickness - generation: 46; average & best misfits: -4.2236
-1.2527
Optimizing Vs & Thickness - generation: 47; average & best misfits: -6.8924

-1.2527
Optimizing Vs & Thickness - generation: 48; average & best misfits: -5.436
-1.2527
Optimizing Vs & Thickness - generation: 49; average & best misfits: -4.6143
-1.2506
Optimizing Vs & Thickness - generation: 50; average & best misfits: -3.9412
-1.2506
Optimizing Vs & Thickness - generation: 51; average & best misfits: -6.4147
-1.1339
Optimizing Vs & Thickness - generation: 52; average & best misfits: -6.3407
-1.1339
Optimizing Vs & Thickness - generation: 53; average & best misfits: -4.6499
-1.1339
Optimizing Vs & Thickness - generation: 54; average & best misfits: -6.1132
-1.1339
Optimizing Vs & Thickness - generation: 55; average & best misfits: -5.4312
-1.1339
Optimizing Vs & Thickness - generation: 56; average & best misfits: -6.1044
-1.1339
Optimizing Vs & Thickness - generation: 57; average & best misfits: -6.9332
-1.1339
Optimizing Vs & Thickness - generation: 58; average & best misfits: -4.6286
-1.1339
Optimizing Vs & Thickness - generation: 59; average & best misfits: -4.4263
-1.1339
Optimizing Vs & Thickness - generation: 60; average & best misfits: -4.3159
-1.1076
Optimizing Vs & Thickness - generation: 61; average & best misfits: -8.552
-1.1076

Adopted search space (minimum Vs): 121 125 164 200
Adopted search space (maximum Vs): 238 245 322 392

Adopted search space (minimum Qs): 7.5 12 14.25 18
Adopted search space (maximum Qs): 15 24 28.5 36

Adopted search space (minimum reference frequency): 1
Adopted search space (maximum reference frequency): 39.2215

Adopted search space (minimum Poisson): 0.16467 0.17484 0.17509
0.17504
Adopted search space (maximum Poisson): 0.494 0.497 0.497
0.497

Adopted search space (minimum thickness): 5.7143 2.8571 2.1429
Adopted search space (maximum thickness): 11.2 5.6 4.2

Now a finer search around the most promising search space area

Rayleigh-wave analysis
Optimizing Vs & Thickness - generation: 1; average & best misfits: -14.3487
-1.10763
Optimizing Vs & Thickness - generation: 2; average & best misfits: -12.8918
-1.10763
Optimizing Vs & Thickness - generation: 3; average & best misfits: -11.1239
-1.10763
Optimizing Vs & Thickness - generation: 4; average & best misfits: -10.591
-1.10763
Optimizing Vs & Thickness - generation: 5; average & best misfits: -11.3667
-1.10763
Optimizing Vs & Thickness - generation: 6; average & best misfits: -10.4356
-1.09623
Optimizing Vs & Thickness - generation: 7; average & best misfits: -9.8938
-1.0962
Optimizing Vs & Thickness - generation: 8; average & best misfits: -10.4468
-1.09623
Optimizing Vs & Thickness - generation: 9; average & best misfits: -7.9043

-1.0962
Optimizing Vs & Thickness - generation: 10; average & best misfits: -6.3918
-1.0962
Optimizing Vs & Thickness - generation: 11; average & best misfits: -6.6992
-1.0962
Optimizing Vs & Thickness - generation: 12; average & best misfits: -8.5586
-1.0962
Optimizing Vs & Thickness - generation: 13; average & best misfits: -8.0955
-1.0962
Optimizing Vs & Thickness - generation: 14; average & best misfits: -7.4716
-1.0962
Optimizing Vs & Thickness - generation: 15; average & best misfits: -8.1074
-1.0962
Optimizing Vs & Thickness - generation: 16; average & best misfits: -6.6956
-1.0962

Model after the Vs & Thickness optimization (fixed Poisson values):
Vs (m/s): 176 218 210 253
Thickness (m): 7.3   3.2   3.2

Number of models considered to calculate the average model: 116

##
RESULTS
##

Dataset: 57.sgy
Analyzed curve/spectrum: 57.cdp

========== SECTION#3

Analyzing Phase Velocities

Analyzing Rayleigh-Wave Dispersion

==
MEAN MODEL

Vs (m/s):   176 212 224 270
Standard deviations (m/s): 0   7 12 19

Thickness (m):   7.3   4.1   3.4
Standard deviations (m): 0.3   0.6   0.4

Approximate values for Vp, density, Poisson & Shear modulus
Vp (m/s):   290 381 412 550
Density (gr/cm3):   1.76   1.82   1.84   1.91
Vp/Vs ratio: 1.65   1.80   1.84   2.04
Poisson: 0.21   0.28   0.29   0.34
Shear modulus (MPa): 54   82   92   139
Estimated static shear modulus (MPa): 0   0   0   0

Fundamental mode
Mean model
 f(Hz)   VR(m/s)
3.55262   225.5241
4.12332   220.4385
4.52281   216.472
5.26472   208.4165
6.23492   197.76
7.43339   186.8481
9.03136   177.137
10.1157   172.8395
11.8278   168.3516

14.3389	164.6819
16.85	162.7991
24.6115	160.9538
37.3952	160.6255

First higher mode
Mean model

37.3952	192.1495
39.1073	190.5878

Second higher mode
Mean model

37.9659	216.548
38.9361	215.3581

Third higher mode
Mean model

38.023	244.3956
39.2215	241.8092

========== SECTION#4

BEST MODEL

Vs (m/s): 176 218 210 253
thickness (m): 7.3235 3.2109 3.1508

Approximate values for Vp, density, Poisson & Shear modulus
Vp (m/s): 283 381 358 444
Density (gr/cm3): 1.75 1.82 1.81 1.86
Vp/Vs ratio: 1.61 1.75 1.70 1.75
Poisson: 0.18 0.26 0.24 0.26
Shear modulus (MPa): 54 87 80 119
Estimated static shear modulus (MPa): 0 0 0 0

dispersion curve (frequency - velocity)

Fundamental mode)
best model

F(Hz)	VR(m/s)
3.55262	211.0694
4.12332	207.2739
4.52281	204.4153
5.26472	198.8004
6.23492	191.4386
7.43339	183.4632
9.03136	175.5868
10.1157	171.7894
11.8278	167.5938
14.3389	163.9887
16.85	162.0866
24.6115	160.2093
37.3952	159.8838

First higher mode)
best model

37.3952	192.8738
39.1073	191.198

Second higher mode)
best model

37.9659	217.1907
38.9361	216.1748

Third higher mode)
best model

 38.023   242.5507
39.2215   240.5467

========== SECTION#5

Maximum penetration depth according to the "Steady State Rayleigh Method": 30 m

Inversion quality: very good

Vs30 & VsE (mean model): 227 227 m/s
Vs30 & VsE (best model): 221 221 m/s

========== 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
"C:\Users\Benedetta\Desktop\valdERA-esac\valdera-esac-16\output_disp".

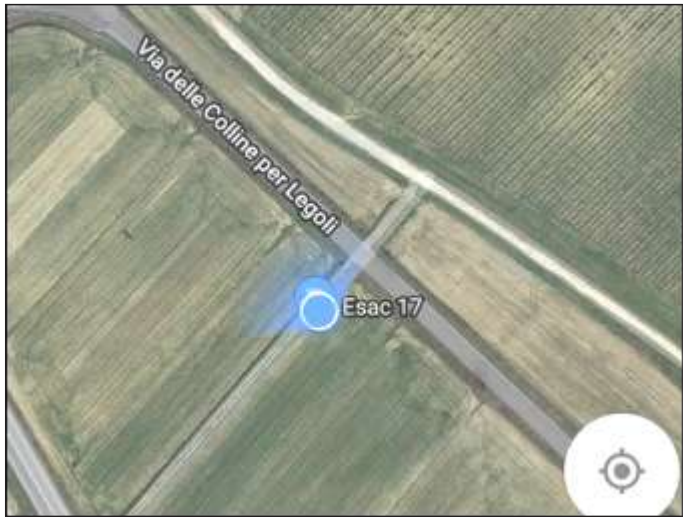
==========
winMASW - Surface Waves & Beyond
www.winmasw.com

Number of models used to define the mean model: 116
Vs30 for the best model: 221 221
Analyzing phase velocities

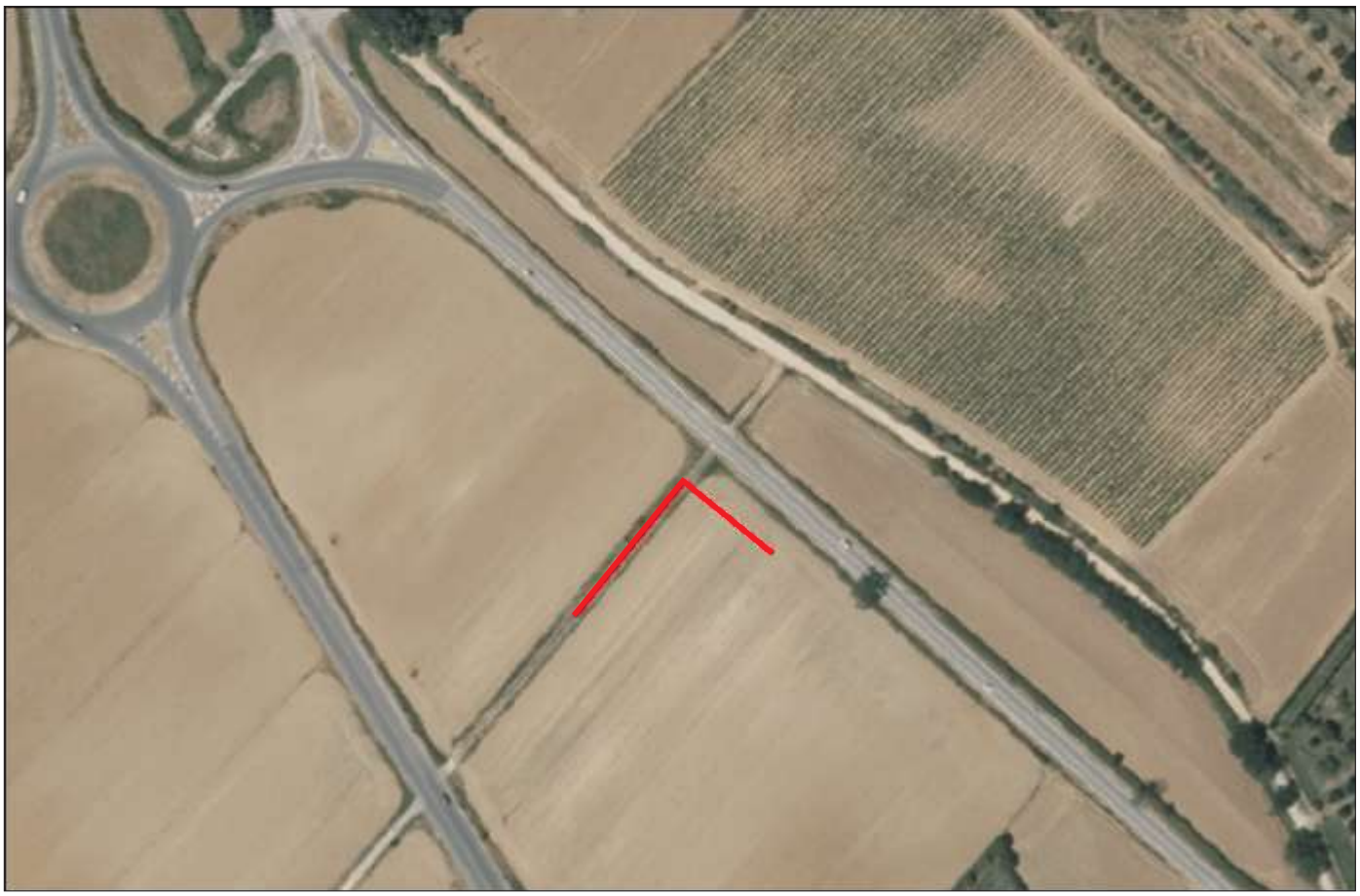
UNIONE DI COMUNI DELLA VALDERA

INDAGINE ESAC/MASW - COMUNE DI PONTEDERA

LOC. TREGGIAIA - POSTAZIONE n.17



documentazione fotografica



ubicazione scala 1:1.000

geometria ESAC

geof	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
x	55	50	45	40	35	30	25	20	15	10	5	0	0	0	0	0	0	0	0	0	0	0	0	0
y	0	0	0	0	0	0	0	0	0	0	0	0	3	6	9	12	15	18	21	24	27	30	33	36

geometria MASW

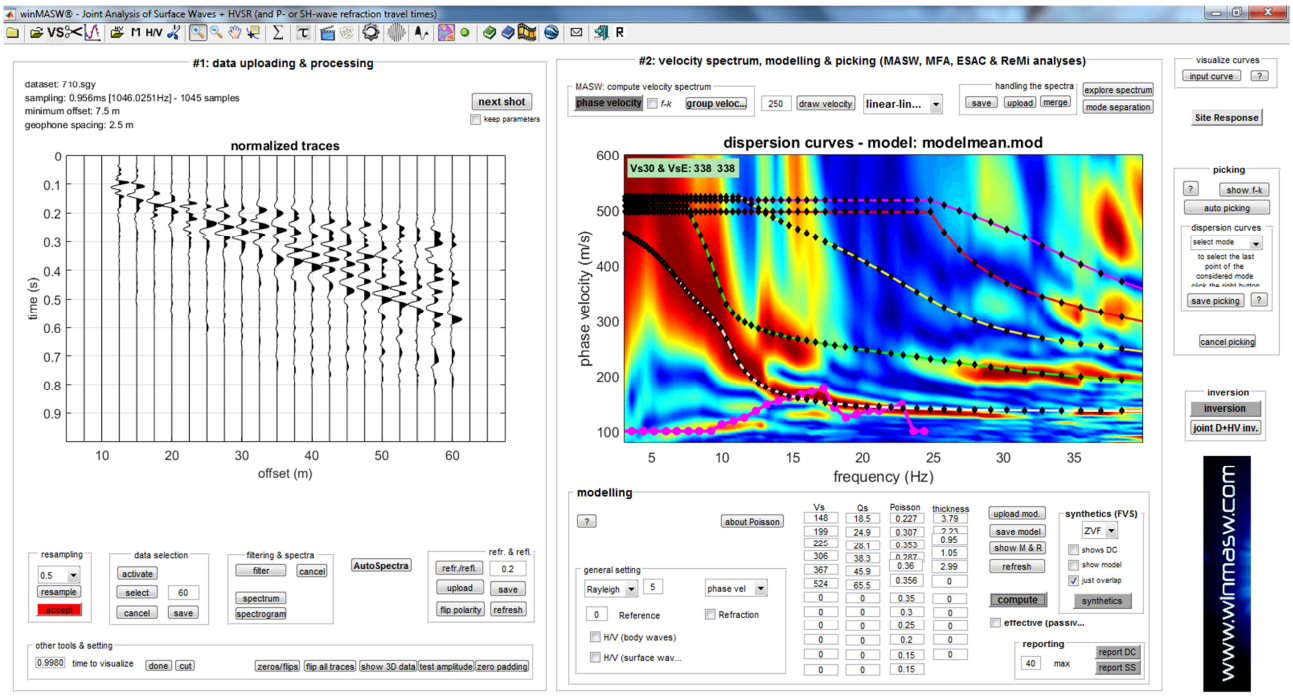
distanza geofonica 12 ch 5 m

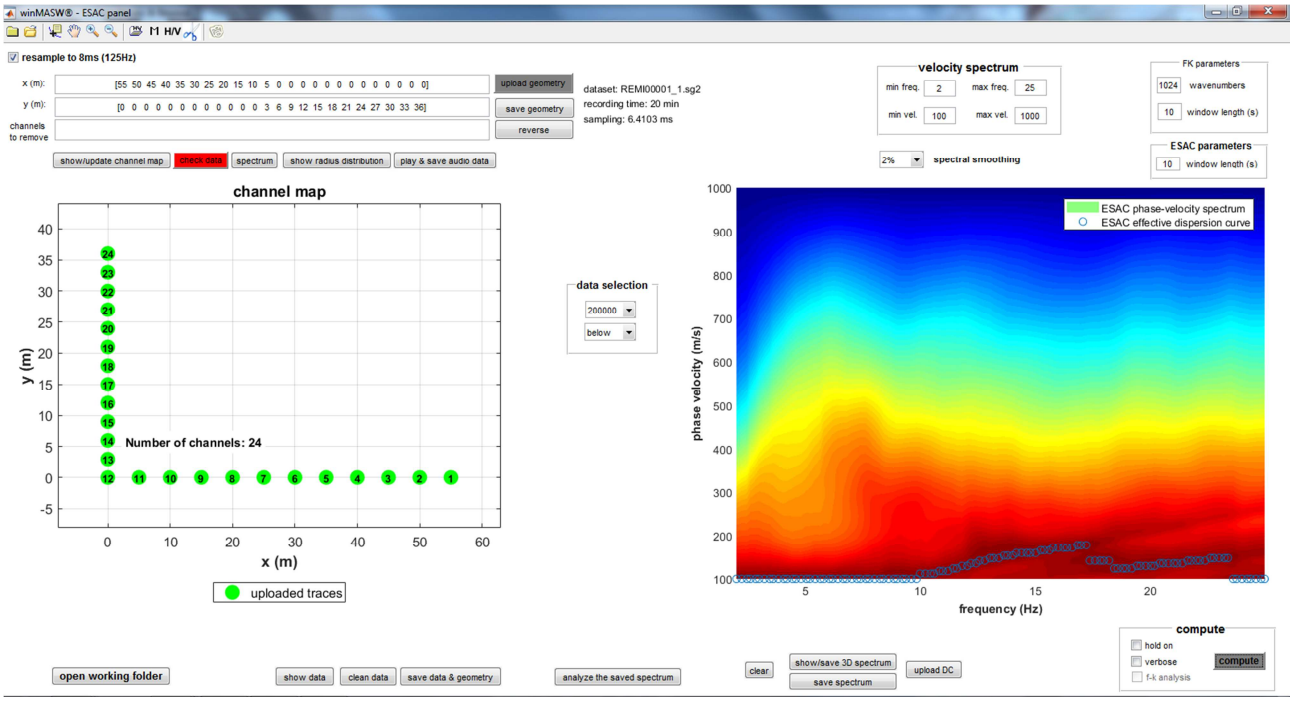
lunghezza linea 57.5 m

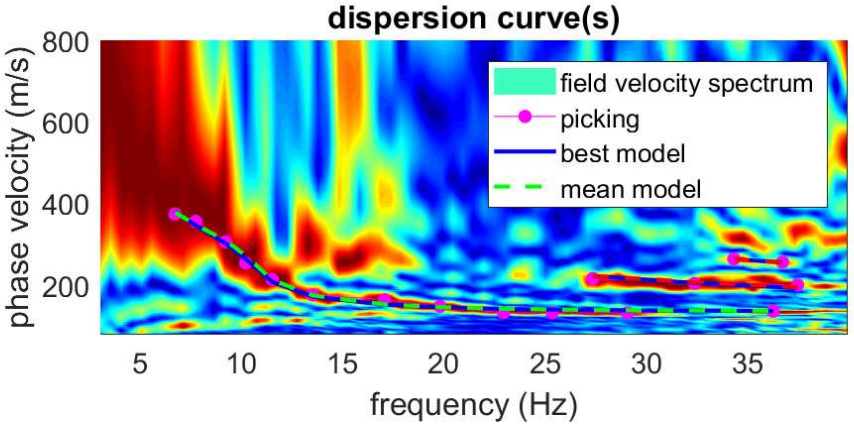
coordinate stazione 43°62’ 72.96” N 10°66’ 25.06” E

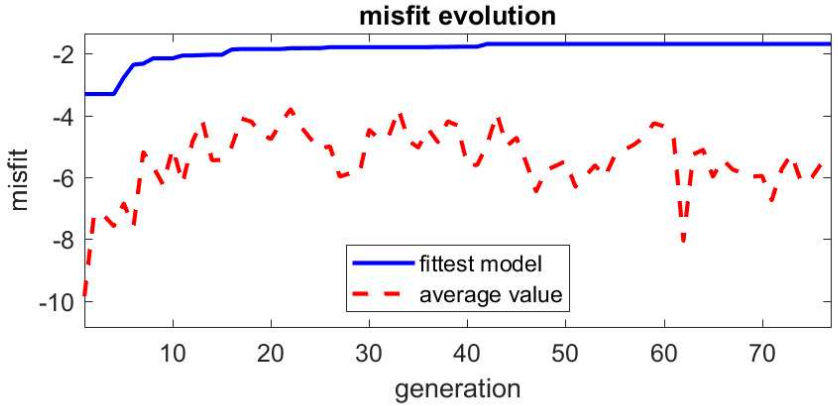
UNIONE VALDERA - Indagini sismiche MASW/ESAC

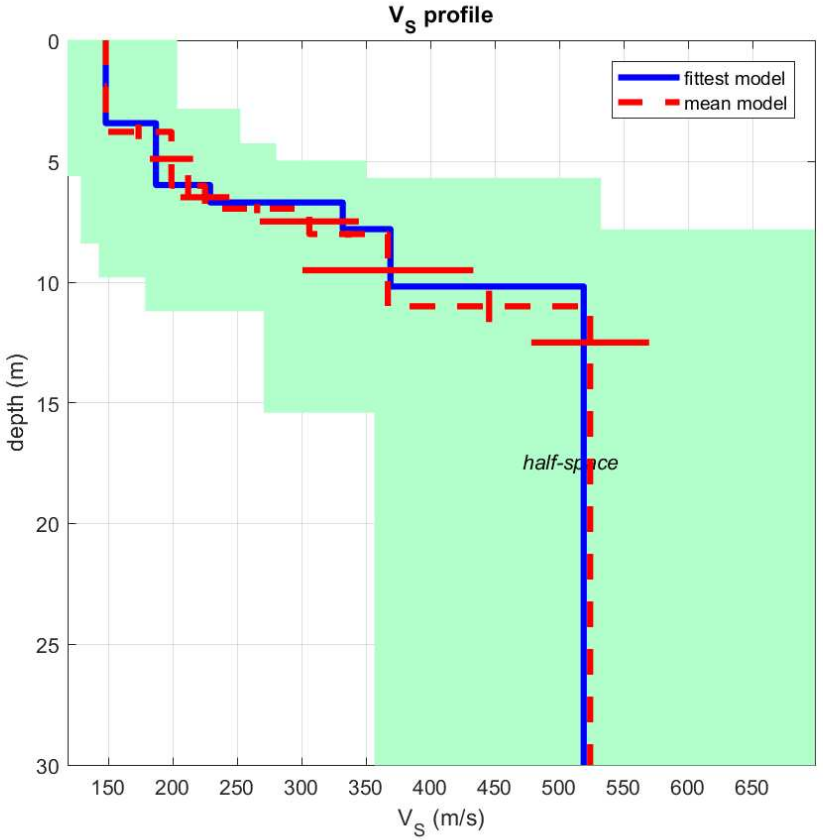
PROVA n. 17











www.winmasw.com

dataset: 710.sgy
dispersion curve: 710.cdp
Vs30 & VsE (best model): 341 341 m/s
Vs30 & VsE (mean model): 338 338 m/s

Mean model

Vs (m/s): 148, 199, 225, 306, 367, 524

Standard deviations (m/s): 1, 17, 19, 38, 66, 46

Thickness (m): 3.8, 2.2, 0.9, 1.1, 3.0

```
========================================================== SECTION#1
dataset: 710.sgy
sampling (ms): 0.956
minimum offset (m): 7.5
geophone spacing (m): 2.5
offsets (m): 7.5           10          12.5           15          17.5
20          22.5           25          27.5           30          32.5           35
       37.5           40          42.5           45          47.5           50
     52.5           55          57.5           60          62.5           65
Dispersion curve: 710.cdp
Number of individuals: 32
Number of generations: 61

Rayleigh-wave dispersion analysis

Analyzing phase velocities

Adopted search space (minimum Vs): 104  129  143  179  271  357
Adopted search space (maximum Vs): 203  252  280  350  532  700

Adopted search space (minimum Poisson): 0.16511     0.17516     0.17484
0.17484     0.17499     0.17503
Adopted search space (maximum Poisson): 0.49533       0.499       0.499
0.499       0.499       0.499

Adopted search space (minimum Qs): 7.5           12        14.25           18
       21        23.25
Adopted search space (maximum Qs): 15           24          28.5           36
      42          46.5

Adopted search space (minimum reference frequency): 1
Adopted search space (maximum reference frequency): 37.4523

Adopted search space (minimum thickness): 2.8571      1.4286     0.71429
0.71429      2.1429
Adopted search space (maximum thickness): 5.6         2.8          1.4
1.4          4.2

Output folder:
C:\Users\Benedetta\Desktop\valdERA-esac\valdera-esac-17\output_disp



========================================================== SECTION#2
Rayleigh-wave analysis
Optimizing Vs & Thickness - generation: 1; average & best misfits: -9.8552
-3.3105
Optimizing Vs & Thickness - generation: 2; average & best misfits: -7.1648
-3.3105
Optimizing Vs & Thickness - generation: 3; average & best misfits: -7.2456
-3.3105
Optimizing Vs & Thickness - generation: 4; average & best misfits: -7.5768
-3.3105
Optimizing Vs & Thickness - generation: 5; average & best misfits: -6.8474
-2.782
Optimizing Vs & Thickness - generation: 6; average & best misfits: -7.5871
-2.3594
Optimizing Vs & Thickness - generation: 7; average & best misfits: -5.1909
-2.3279
Optimizing Vs & Thickness - generation: 8; average & best misfits: -5.6556
-2.1548
Optimizing Vs & Thickness - generation: 9; average & best misfits: -6.2324
-2.1548
Optimizing Vs & Thickness - generation: 10; average & best misfits: -5.0612
-2.1548
Optimizing Vs & Thickness - generation: 11; average & best misfits: -6.2007
```

-2.0625
Optimizing Vs & Thickness - generation: 12; average & best misfits: -4.8514
-2.0625
Optimizing Vs & Thickness - generation: 13; average & best misfits: -4.1663
-2.051
Optimizing Vs & Thickness - generation: 14; average & best misfits: -5.4526
-2.0388
Optimizing Vs & Thickness - generation: 15; average & best misfits: -5.4365
-2.0388
Optimizing Vs & Thickness - generation: 16; average & best misfits: -5.0097
-1.8707
Optimizing Vs & Thickness - generation: 17; average & best misfits: -4.1019
-1.854
Optimizing Vs & Thickness - generation: 18; average & best misfits: -4.2026
-1.854
Optimizing Vs & Thickness - generation: 19; average & best misfits: -4.5875
-1.854
Optimizing Vs & Thickness - generation: 20; average & best misfits: -4.7685
-1.854
Optimizing Vs & Thickness - generation: 21; average & best misfits: -4.2347
-1.854
Optimizing Vs & Thickness - generation: 22; average & best misfits: -3.8049
-1.8295
Optimizing Vs & Thickness - generation: 23; average & best misfits: -4.344
-1.8295
Optimizing Vs & Thickness - generation: 24; average & best misfits: -4.7463
-1.8256
Optimizing Vs & Thickness - generation: 25; average & best misfits: -5.0822
-1.8256
Optimizing Vs & Thickness - generation: 26; average & best misfits: -4.9962
-1.7945
Optimizing Vs & Thickness - generation: 27; average & best misfits: -5.9796
-1.7945
Optimizing Vs & Thickness - generation: 28; average & best misfits: -5.8786
-1.7945
Optimizing Vs & Thickness - generation: 29; average & best misfits: -5.8877
-1.7945
Optimizing Vs & Thickness - generation: 30; average & best misfits: -4.4696
-1.7945
Optimizing Vs & Thickness - generation: 31; average & best misfits: -4.7596
-1.7945
Optimizing Vs & Thickness - generation: 32; average & best misfits: -4.6654
-1.7945
Optimizing Vs & Thickness - generation: 33; average & best misfits: -3.8084
-1.7945
Optimizing Vs & Thickness - generation: 34; average & best misfits: -4.8193
-1.7945
Optimizing Vs & Thickness - generation: 35; average & best misfits: -5.0364
-1.7945
Optimizing Vs & Thickness - generation: 36; average & best misfits: -4.4372
-1.7945
Optimizing Vs & Thickness - generation: 37; average & best misfits: -4.865
-1.7864
Optimizing Vs & Thickness - generation: 38; average & best misfits: -4.192
-1.7864
Optimizing Vs & Thickness - generation: 39; average & best misfits: -4.3262
-1.7802
Optimizing Vs & Thickness - generation: 40; average & best misfits: -5.6185
-1.7802
Optimizing Vs & Thickness - generation: 41; average & best misfits: -5.6022
-1.7802
Optimizing Vs & Thickness - generation: 42; average & best misfits: -4.9564
-1.6904
Optimizing Vs & Thickness - generation: 43; average & best misfits: -3.9375
-1.6904
Optimizing Vs & Thickness - generation: 44; average & best misfits: -4.9903
-1.6904
Optimizing Vs & Thickness - generation: 45; average & best misfits: -4.7261

```
-1.6904
Optimizing Vs & Thickness - generation: 46; average & best misfits: -5.5337
-1.6904
Optimizing Vs & Thickness - generation: 47; average & best misfits: -6.456
-1.6904
Optimizing Vs & Thickness - generation: 48; average & best misfits: -5.7736
-1.6904
Optimizing Vs & Thickness - generation: 49; average & best misfits: -5.6308
-1.6904
Optimizing Vs & Thickness - generation: 50; average & best misfits: -5.4785
-1.6904
Optimizing Vs & Thickness - generation: 51; average & best misfits: -6.3037
-1.6904
Optimizing Vs & Thickness - generation: 52; average & best misfits: -5.9717
-1.6904
Optimizing Vs & Thickness - generation: 53; average & best misfits: -5.6167
-1.6904
Optimizing Vs & Thickness - generation: 54; average & best misfits: -5.9921
-1.6904
Optimizing Vs & Thickness - generation: 55; average & best misfits: -5.3029
-1.6904
Optimizing Vs & Thickness - generation: 56; average & best misfits: -5.1077
-1.6904
Optimizing Vs & Thickness - generation: 57; average & best misfits: -4.9421
-1.6904
Optimizing Vs & Thickness - generation: 58; average & best misfits: -4.6947
-1.6904
Optimizing Vs & Thickness - generation: 59; average & best misfits: -4.2532
-1.6904
Optimizing Vs & Thickness - generation: 60; average & best misfits: -4.3494
-1.6904
Optimizing Vs & Thickness - generation: 61; average & best misfits: -4.7011
-1.6904

Adopted search space (minimum Vs): 104  129  143  179  271  357
Adopted search space (maximum Vs): 203  252  280  350  532  700

Adopted search space (minimum Qs): 7.5           12        14.25           18
       21        23.25
Adopted search space (maximum Qs): 15           24         28.5           36
      42         46.5

Adopted search space (minimum reference frequency): 1
Adopted search space (maximum reference frequency): 37.4523

Adopted search space (minimum Poisson): 0.16511     0.17516     0.17484
0.17484     0.17499     0.17503
Adopted search space (maximum Poisson): 0.49533       0.497       0.497
0.497       0.497       0.497

Adopted search space (minimum thickness): 2.8571      1.4286     0.71429
0.71429      2.1429
Adopted search space (maximum thickness): 5.6         2.8         1.4
1.4         4.2


Now a finer search around the most promising search space area

Rayleigh-wave analysis
Optimizing Vs & Thickness - generation: 1; average & best misfits: -8.0551
-1.6904
Optimizing Vs & Thickness - generation: 2; average & best misfits: -5.2607
-1.6904
Optimizing Vs & Thickness - generation: 3; average & best misfits: -5.1124
-1.6904
Optimizing Vs & Thickness - generation: 4; average & best misfits: -5.9835
-1.6904
Optimizing Vs & Thickness - generation: 5; average & best misfits: -5.4284
```

-1.6904
Optimizing Vs & Thickness - generation: 6; average & best misfits: -5.7471
-1.6904
Optimizing Vs & Thickness - generation: 7; average & best misfits: -5.8696
-1.6904
Optimizing Vs & Thickness - generation: 8; average & best misfits: -5.979
-1.6904
Optimizing Vs & Thickness - generation: 9; average & best misfits: -5.956
-1.6904
Optimizing Vs & Thickness - generation: 10; average & best misfits: -6.7415
-1.6904
Optimizing Vs & Thickness - generation: 11; average & best misfits: -5.743
-1.6904
Optimizing Vs & Thickness - generation: 12; average & best misfits: -5.2516
-1.6904
Optimizing Vs & Thickness - generation: 13; average & best misfits: -6.167
-1.6904
Optimizing Vs & Thickness - generation: 14; average & best misfits: -6.042
-1.6904
Optimizing Vs & Thickness - generation: 15; average & best misfits: -5.5774
-1.6904
Optimizing Vs & Thickness - generation: 16; average & best misfits: -5.6438
-1.6904

Model after the Vs & Thickness optimization (fixed Poisson values):
Vs (m/s): 148 187 229 332 369 519
Thickness (m): 3.4 2.6 0.72 1.1 2.4

Number of models considered to calculate the average model: 399

##
RESULTS
##

Dataset: 710.sgy
Analyzed curve/spectrum: 710.cdp

== SECTION#3

Analyzing Phase Velocities

Analyzing Rayleigh-Wave Dispersion

==
MEAN MODEL

Vs (m/s): 148 199 225 306 367 524
Standard deviations (m/s): 1 17 19 38 66 46

Thickness (m): 3.8 2.2 0.9 1.1 3.0
Standard deviations (m): 0.3 0.4 0.2 0.1 0.7

Approximate values for Vp, density, Poisson & Shear modulus
Vp (m/s): 249 377 472 560 785 1108
Density (gr/cm3): 1.72 1.82 1.87 1.91 2.00 2.08
Vp/Vs ratio: 1.68 1.89 2.10 1.83 2.14 2.11
Poisson: 0.23 0.31 0.35 0.29 0.36 0.36
Shear modulus (MPa): 38 72 95 179 269 571
Estimated static shear modulus (MPa): 0 0 0 0 0 0

Fundamental mode
Mean model
 f(Hz) VR(m/s)

6.74855	378.0093
7.77581	347.0949
9.25964	308.095
10.2298	271.7684
11.5424	211.8643
13.5399	173.8912
17.0783	151.8798
19.8176	145.1019
22.9565	141.0322
25.3534	139.2261
29.063	137.5768
36.2538	136.2027

First higher mode
Mean model

27.3509	222.0884
32.3731	206.3034
37.4523	194.4397

Second higher mode
Mean model

34.3134	262.4491
36.7104	254.3539

========== SECTION#4

BEST MODEL

Vs (m/s): 148 187 229 332 369 519
thickness (m): 3.4334 2.561 0.72175 1.1034 2.3714

Approximate values for Vp, density, Poisson & Shear modulus
Vp (m/s): 241 313 577 602 1371 1072
Density (gr/cm3): 1.71 1.77 1.92 1.93 2.13 2.07
Vp/Vs ratio: 1.63 1.67 2.52 1.81 3.72 2.07
Poisson: 0.20 0.22 0.41 0.28 0.46 0.35
Shear modulus (MPa): 37 62 101 213 290 558
Estimated static shear modulus (MPa): 0 0 0 0
0 0

dispersion curve (frequency - velocity)

Fundamental mode)
best model

F(Hz)	VR(m/s)
6.74855	379.895
7.77581	345.5061
9.25964	300.8783
10.2298	263.5839
11.5424	206.9488
13.5399	171.2897
17.0783	151.0163
19.8176	144.6932
22.9565	140.7644
25.3534	138.9478
29.063	137.2154
36.2538	135.6718

First higher mode)
best model

27.3509	221.5756
32.3731	204.3295
37.4523	192.0656

Second higher mode)
best model

34.3134 262.9588
36.7104 254.9616

========== SECTION#5

Maximum penetration depth according to the "Steady State Rayleigh Method": 30 m

Inversion quality: very good

Vs30 & VsE (mean model): 338 338 m/s
Vs30 & VsE (best model): 341 341 m/s

========== 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
"C:\Users\Benedetta\Desktop\valdERA-esac\valdera-esac-17\output_disp".

==========
winMASW - Surface Waves & Beyond
www.winmasw.com

Number of models used to define the mean model: 399
Vs30 for the best model: 341 341
Analyzing phase velocities

UNIONE DI COMUNI DELLA VALDERA

INDAGINE ESAC/MASW - COMUNE DI PONTEDERA

LOC. CIMITERO DELLA MISERICORDIA - POSTAZIONE n.18

documentazione fotografica

ubicazione scala 1:1.000

geometria ESAC

geof	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
x	55	50	45	40	35	30	25	20	15	10	5	0	0	0	0	0	0	0	0	0	0	0	0	0
y	0	0	0	0	0	0	0	0	0	0	0	0	3	6	9	12	15	18	21	24	27	30	33	36

geometria MASW

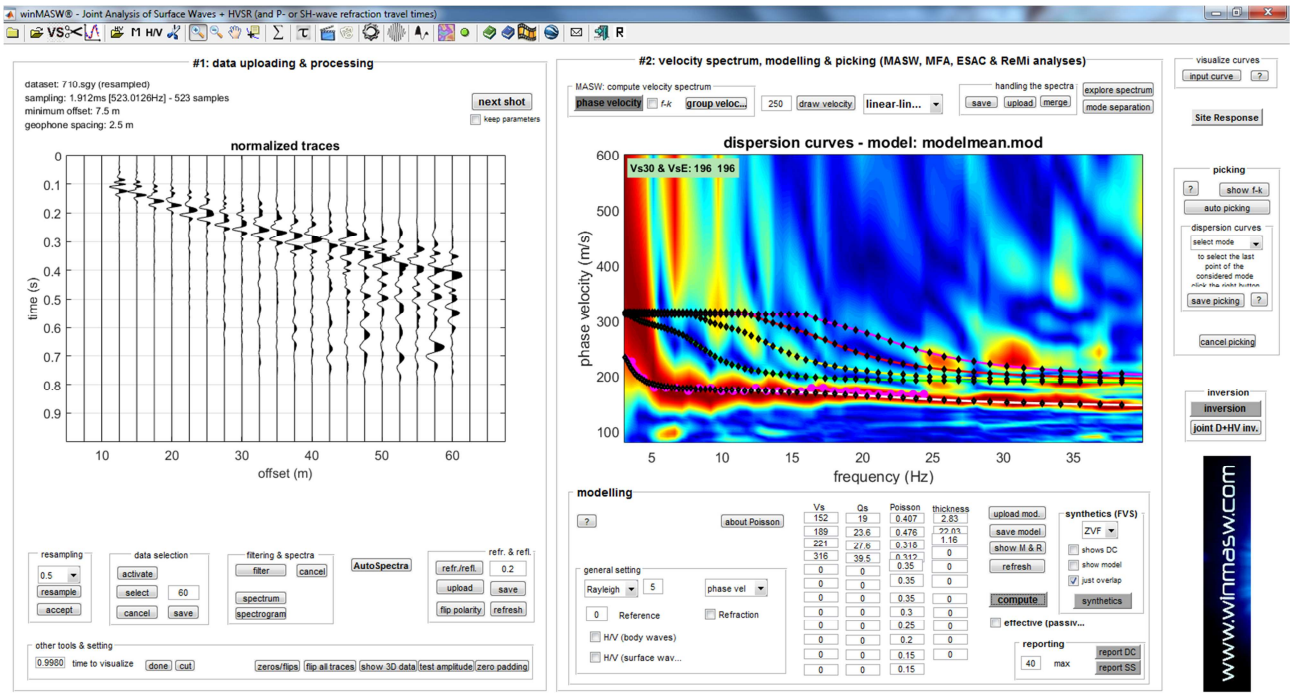
distanza geofonica 12 ch 5 m

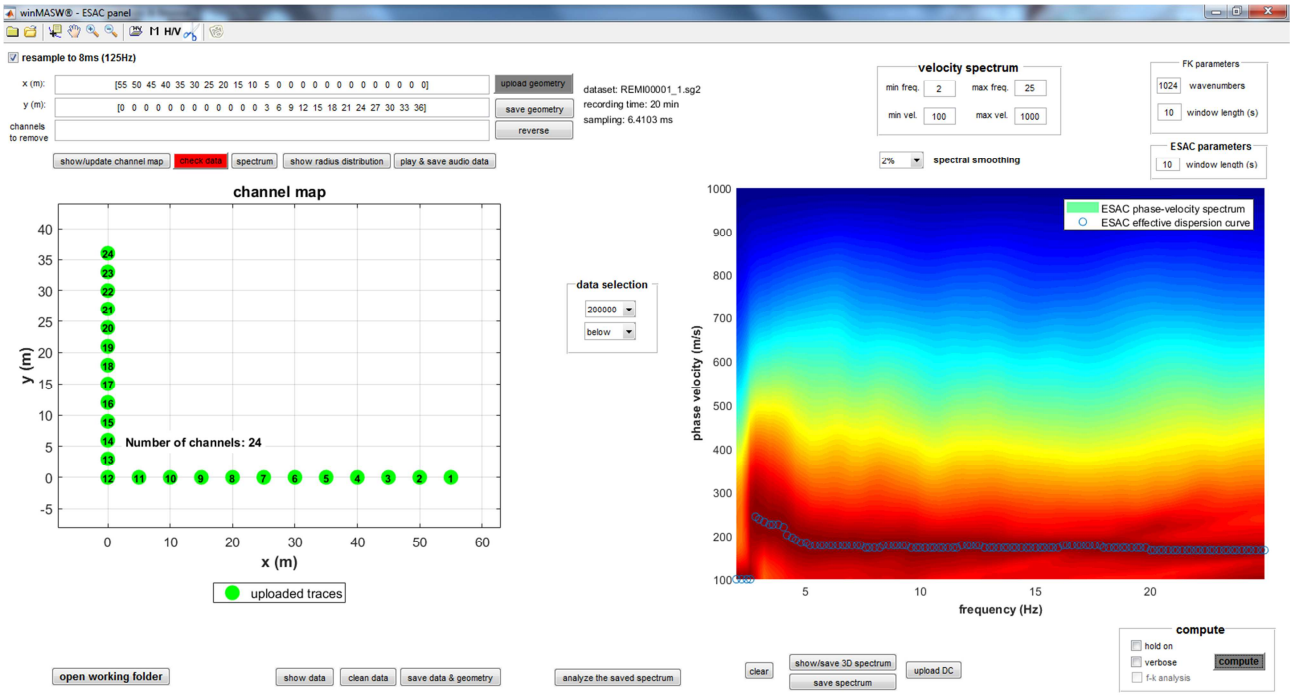
lunghezza linea 57.5 m

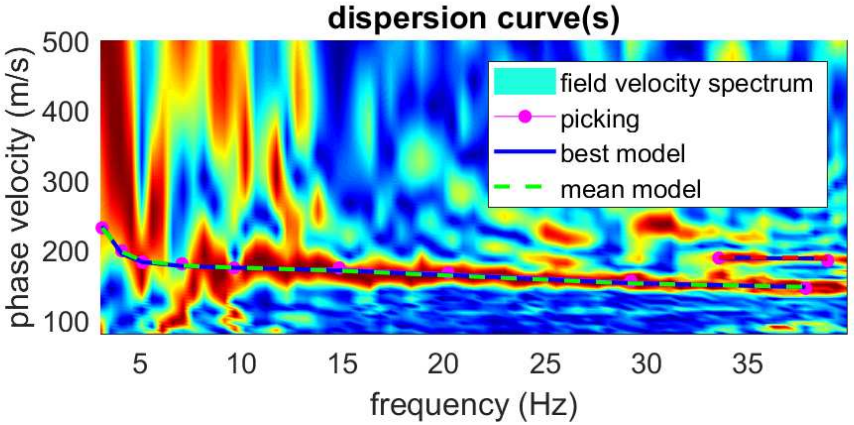
coordinate stazione 43°65’ 12.79” N 10°63’ 00.41” E

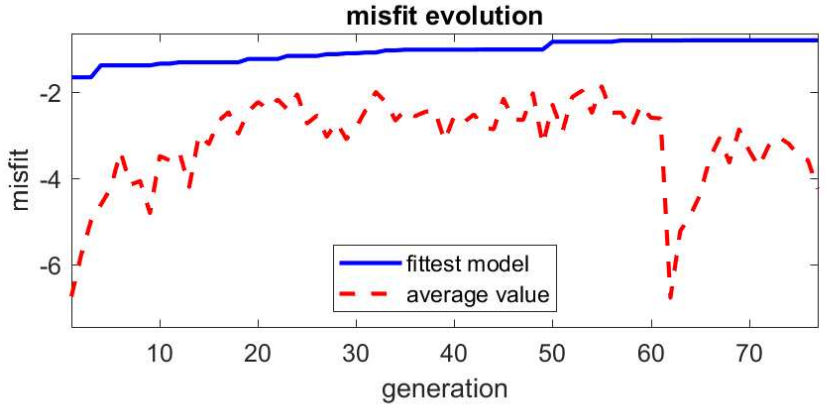
UNIONE VALDERA - Indagini sismiche MASW/ESAC

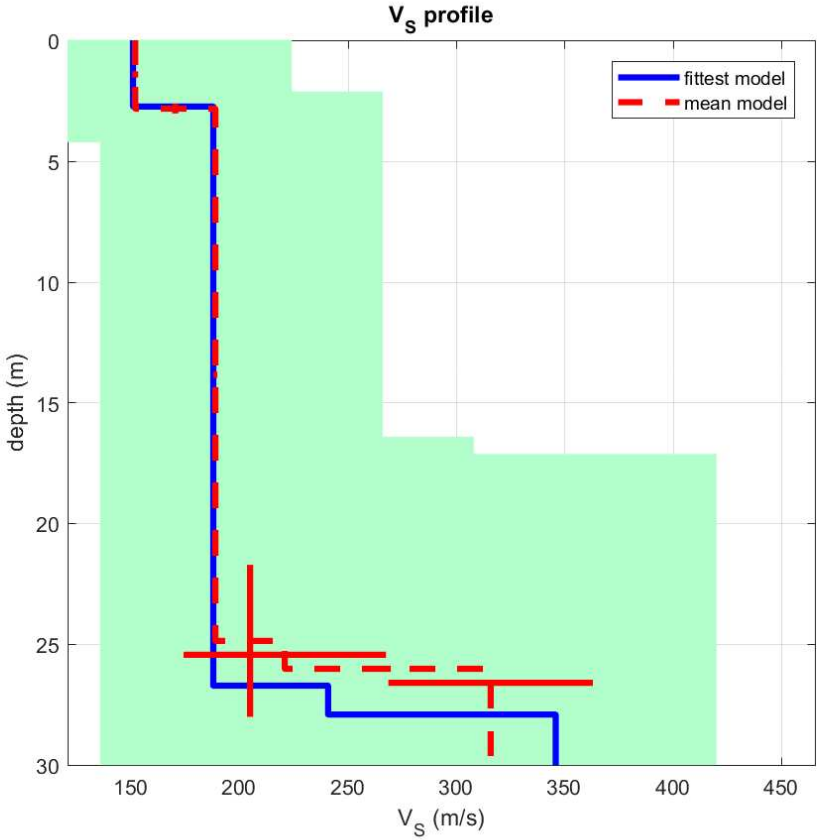
PROVA n. 18











www.winmasw.com

dataset: 710.sgy
dispersion curve: 710.cdp *half-space*
Vs30 & VsE (best model): 191 191 m/s
Vs30 & VsE (mean model): 196 196 m/s

Mean model

Vs (m/s): 152, 189, 221, 316

Standard deviations (m/s): 1, 1, 47, 47

Thickness (m): 2.8, 22.0, 1.2

========== SECTION#1
dataset: 710.sgy
sampling (ms): 0.956
minimum offset (m): 7.5
geophone spacing (m): 2.5
offsets (m): 7.5 10 12.5 15 17.5
20 22.5 25 27.5 30 32.5 35
37.5 40 42.5 45 47.5 50
52.5 55 57.5 60 62.5 65
Dispersion curve: 710.cdp
Number of individuals: 32
Number of generations: 61

Rayleigh-wave dispersion analysis

Analyzing phase velocities

Adopted search space (minimum Vs): 114 136 157 214
Adopted search space (maximum Vs): 224 266 308 420

Adopted search space (minimum Poisson): 0.16526 0.17524 0.17501
0.17484
Adopted search space (maximum Poisson): 0.49578 0.499 0.499
0.499

Adopted search space (minimum Qs): 7.5 12 14.25 18
Adopted search space (maximum Qs): 15 24 28.5 36

Adopted search space (minimum reference frequency): 1
Adopted search space (maximum reference frequency): 38.9361

Adopted search space (minimum thickness): 2.14286 14.2857 0.714286
Adopted search space (maximum thickness): 4.2 28 1.4

Output folder:
C:\Users\Benedetta\Desktop\valdERA-esac\valdera-esac-18\output_disp

========== SECTION#2
Rayleigh-wave analysis
Optimizing Vs & Thickness - generation: 1; average & best misfits: -6.753
-1.6541
Optimizing Vs & Thickness - generation: 2; average & best misfits: -5.7782
-1.6541
Optimizing Vs & Thickness - generation: 3; average & best misfits: -4.9898
-1.6541
Optimizing Vs & Thickness - generation: 4; average & best misfits: -4.6175
-1.3766
Optimizing Vs & Thickness - generation: 5; average & best misfits: -4.2349
-1.3766
Optimizing Vs & Thickness - generation: 6; average & best misfits: -3.381
-1.3766
Optimizing Vs & Thickness - generation: 7; average & best misfits: -4.1513
-1.3766
Optimizing Vs & Thickness - generation: 8; average & best misfits: -4.0659
-1.3766
Optimizing Vs & Thickness - generation: 9; average & best misfits: -4.8094
-1.3766
Optimizing Vs & Thickness - generation: 10; average & best misfits: -3.485
-1.3361
Optimizing Vs & Thickness - generation: 11; average & best misfits: -3.5856
-1.3361
Optimizing Vs & Thickness - generation: 12; average & best misfits: -3.3987
-1.3053
Optimizing Vs & Thickness - generation: 13; average & best misfits: -4.2027

-1.3053
Optimizing Vs & Thickness - generation: 14; average & best misfits: -2.9823
-1.3053
Optimizing Vs & Thickness - generation: 15; average & best misfits: -3.2065
-1.3053
Optimizing Vs & Thickness - generation: 16; average & best misfits: -2.6644
-1.3053
Optimizing Vs & Thickness - generation: 17; average & best misfits: -2.4664
-1.3053
Optimizing Vs & Thickness - generation: 18; average & best misfits: -2.965
-1.3053
Optimizing Vs & Thickness - generation: 19; average & best misfits: -2.4502
-1.2279
Optimizing Vs & Thickness - generation: 20; average & best misfits: -2.228
-1.2279
Optimizing Vs & Thickness - generation: 21; average & best misfits: -2.3945
-1.2279
Optimizing Vs & Thickness - generation: 22; average & best misfits: -2.1704
-1.2279
Optimizing Vs & Thickness - generation: 23; average & best misfits: -2.3999
-1.1576
Optimizing Vs & Thickness - generation: 24; average & best misfits: -2.0501
-1.1576
Optimizing Vs & Thickness - generation: 25; average & best misfits: -2.7277
-1.1576
Optimizing Vs & Thickness - generation: 26; average & best misfits: -2.5445
-1.1576
Optimizing Vs & Thickness - generation: 27; average & best misfits: -3.0383
-1.1173
Optimizing Vs & Thickness - generation: 28; average & best misfits: -2.7026
-1.1173
Optimizing Vs & Thickness - generation: 29; average & best misfits: -3.0885
-1.0959
Optimizing Vs & Thickness - generation: 30; average & best misfits: -2.8164
-1.0959
Optimizing Vs & Thickness - generation: 31; average & best misfits: -2.4046
-1.0772
Optimizing Vs & Thickness - generation: 32; average & best misfits: -1.9958
-1.0772
Optimizing Vs & Thickness - generation: 33; average & best misfits: -2.2285
-1.0287
Optimizing Vs & Thickness - generation: 34; average & best misfits: -2.6569
-1.0287
Optimizing Vs & Thickness - generation: 35; average & best misfits: -2.4145
-1.0111
Optimizing Vs & Thickness - generation: 36; average & best misfits: -2.5565
-1.0111
Optimizing Vs & Thickness - generation: 37; average & best misfits: -2.4583
-1.0111
Optimizing Vs & Thickness - generation: 38; average & best misfits: -2.413
-1.0111
Optimizing Vs & Thickness - generation: 39; average & best misfits: -3.1315
-1.0111
Optimizing Vs & Thickness - generation: 40; average & best misfits: -2.5446
-1.0111
Optimizing Vs & Thickness - generation: 41; average & best misfits: -2.6913
-1.0111
Optimizing Vs & Thickness - generation: 42; average & best misfits: -2.5176
-1.0111
Optimizing Vs & Thickness - generation: 43; average & best misfits: -2.8168
-1.0073
Optimizing Vs & Thickness - generation: 44; average & best misfits: -2.864
-1.0073
Optimizing Vs & Thickness - generation: 45; average & best misfits: -2.156
-1.0073
Optimizing Vs & Thickness - generation: 46; average & best misfits: -2.6312
-1.0073
Optimizing Vs & Thickness - generation: 47; average & best misfits: -2.6442

-1.0073
Optimizing Vs & Thickness - generation: 48; average & best misfits: -2.0271
-1.0073
Optimizing Vs & Thickness - generation: 49; average & best misfits: -3.2205
-1.0073
Optimizing Vs & Thickness - generation: 50; average & best misfits: -2.2946
-0.82698
Optimizing Vs & Thickness - generation: 51; average & best misfits: -2.9209
-0.82698
Optimizing Vs & Thickness - generation: 52; average & best misfits: -2.1122
-0.82698
Optimizing Vs & Thickness - generation: 53; average & best misfits: -1.9672
-0.82698
Optimizing Vs & Thickness - generation: 54; average & best misfits: -2.4783
-0.82698
Optimizing Vs & Thickness - generation: 55; average & best misfits: -1.8664
-0.82698
Optimizing Vs & Thickness - generation: 56; average & best misfits: -2.4785
-0.82698
Optimizing Vs & Thickness - generation: 57; average & best misfits: -2.4725
-0.79766
Optimizing Vs & Thickness - generation: 58; average & best misfits: -2.8374
-0.79766
Optimizing Vs & Thickness - generation: 59; average & best misfits: -2.2958
-0.79766
Optimizing Vs & Thickness - generation: 60; average & best misfits: -2.5928
-0.79766
Optimizing Vs & Thickness - generation: 61; average & best misfits: -2.611
-0.79766

Adopted search space (minimum Vs): 114 136 157 214
Adopted search space (maximum Vs): 224 266 308 420

Adopted search space (minimum Qs): 7.5 12 14.25 18
Adopted search space (maximum Qs): 15 24 28.5 36

Adopted search space (minimum reference frequency): 1
Adopted search space (maximum reference frequency): 38.9361

Adopted search space (minimum Poisson): 0.16526 0.17524 0.17501
0.17484
Adopted search space (maximum Poisson): 0.49578 0.497 0.497
0.497

Adopted search space (minimum thickness): 2.14286 14.2857 0.714286
Adopted search space (maximum thickness): 4.2 28 1.4

Now a finer search around the most promising search space area

Rayleigh-wave analysis
Optimizing Vs & Thickness - generation: 1; average & best misfits: -6.7799
-0.79766
Optimizing Vs & Thickness - generation: 2; average & best misfits: -5.2307
-0.79766
Optimizing Vs & Thickness - generation: 3; average & best misfits: -4.8749
-0.79468
Optimizing Vs & Thickness - generation: 4; average & best misfits: -4.3973
-0.79468
Optimizing Vs & Thickness - generation: 5; average & best misfits: -3.5391
-0.79468
Optimizing Vs & Thickness - generation: 6; average & best misfits: -3.0675
-0.79468
Optimizing Vs & Thickness - generation: 7; average & best misfits: -3.6349
-0.79468
Optimizing Vs & Thickness - generation: 8; average & best misfits: -2.8676
-0.79468
Optimizing Vs & Thickness - generation: 9; average & best misfits: -3.3466

-0.79468
Optimizing Vs & Thickness - generation: 10; average & best misfits: -3.7385
-0.79468
Optimizing Vs & Thickness - generation: 11; average & best misfits: -3.2468
-0.79468
Optimizing Vs & Thickness - generation: 12; average & best misfits: -3.0425
-0.79468
Optimizing Vs & Thickness - generation: 13; average & best misfits: -3.1886
-0.79468
Optimizing Vs & Thickness - generation: 14; average & best misfits: -3.4529
-0.79468
Optimizing Vs & Thickness - generation: 15; average & best misfits: -3.5826
-0.79463
Optimizing Vs & Thickness - generation: 16; average & best misfits: -4.2458
-0.79463

Model after the Vs & Thickness optimization (fixed Poisson values):
Vs (m/s): 151 188 241 346
Thickness (m): 2.7 24 1.2

Number of models considered to calculate the average model: 185

##
RESULTS
##

Dataset: 710.sgy
Analyzed curve/spectrum: 710.cdp

========== SECTION#3

Analyzing Phase Velocities

Analyzing Rayleigh-Wave Dispersion

==
MEAN MODEL

Vs (m/s): 152 189 221 316
Standard deviations (m/s): 1 1 47 47

Thickness (m): 2.8 22.0 1.2
Standard deviations (m): 0.2 3.1 0.1

Approximate values for Vp, density, Poisson & Shear modulus
Vp (m/s): 383 877 428 604
Density (gr/cm3): 1.82 2.02 1.85 1.93
Vp/Vs ratio: 2.52 4.64 1.94 1.91
Poisson: 0.41 0.48 0.32 0.31
Shear modulus (MPa): 42 72 90 193
Estimated static shear modulus (MPa): 0 0 0 0

Fundamental mode
Mean model
 f(Hz) VR(m/s)
3.15313 231.553
4.12332 197.1166
5.15058 184.2848
7.09097 177.3578
9.65913 174.672
14.8525 170.287
20.2171 163.3088
29.2342 151.992
37.8518 146.9488

First higher mode
Mean model
33.5715 189.509
38.9361 188.414

========== SECTION#4

BEST MODEL

Vs (m/s): 151 188 241 346
thickness (m): 2.74315 23.9745 1.19469

Approximate values for Vp, density, Poisson & Shear modulus
Vp (m/s): 392 1177 497 649
Density (gr/cm3): 1.83 2.09 1.88 1.95
Vp/Vs ratio: 2.60 6.26 2.06 1.88
Poisson: 0.41 0.49 0.35 0.30
Shear modulus (MPa): 42 74 109 233
Estimated static shear modulus (MPa): 0 0 0 0

dispersion curve (frequency - velocity)

Fundamental mode)
best model
F(Hz) VR(m/s)
3.15313 233.5059
4.12332 194.2463
5.15058 182.6228
7.09097 176.7231
9.65913 174.492
14.8525 170.683
20.2171 164.1778
29.2342 152.3231
37.8518 146.6713

First higher mode)
best model
33.5715 188.4965
38.9361 187.51

========== SECTION#5

Maximum penetration depth according to the "Steady State Rayleigh Method": 30 m

Inversion quality: very good

Vs30 & VsE (mean model): 196 196 m/s
Vs30 & VsE (best model): 191 191 m/s

========== 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
"C:\Users\Benedetta\Desktop\valdERA-esac\valdera-esac-18\output_disp".

==========
winMASW - Surface Waves & Beyond
www.winmasw.com

Number of models used to define the mean model: 185
Vs30 for the best model: 191 191
Analyzing phase velocities

UNIONE DI COMUNI DELLA VALDERA

INDAGINE ESAC/MASW - COMUNE DI PONTEDERA

LOC. PARDOSSI - POSTAZIONE n.19

documentazione fotografica

ubicazione scala 1:1.000

geometria ESAC

geof	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
x	-55	-50	-45	-40	-35	-30	-25	-20	-15	-10	-5	0	0	0	0	0	0	0	0	0	0	0	0	0
y	0	0	0	0	0	0	0	0	0	0	0	0	3	6	9	12	15	18	21	24	27	30	33	36

geometria MASW

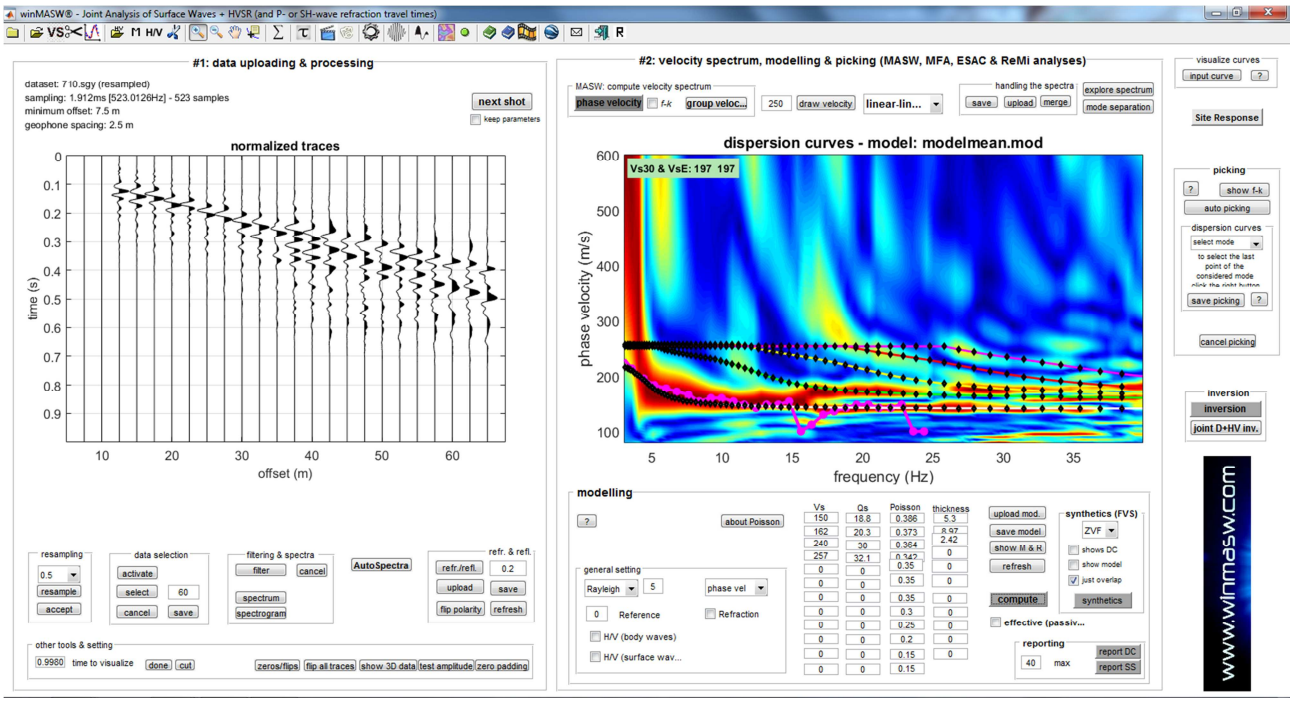
distanza geofonica 12 ch 5 m

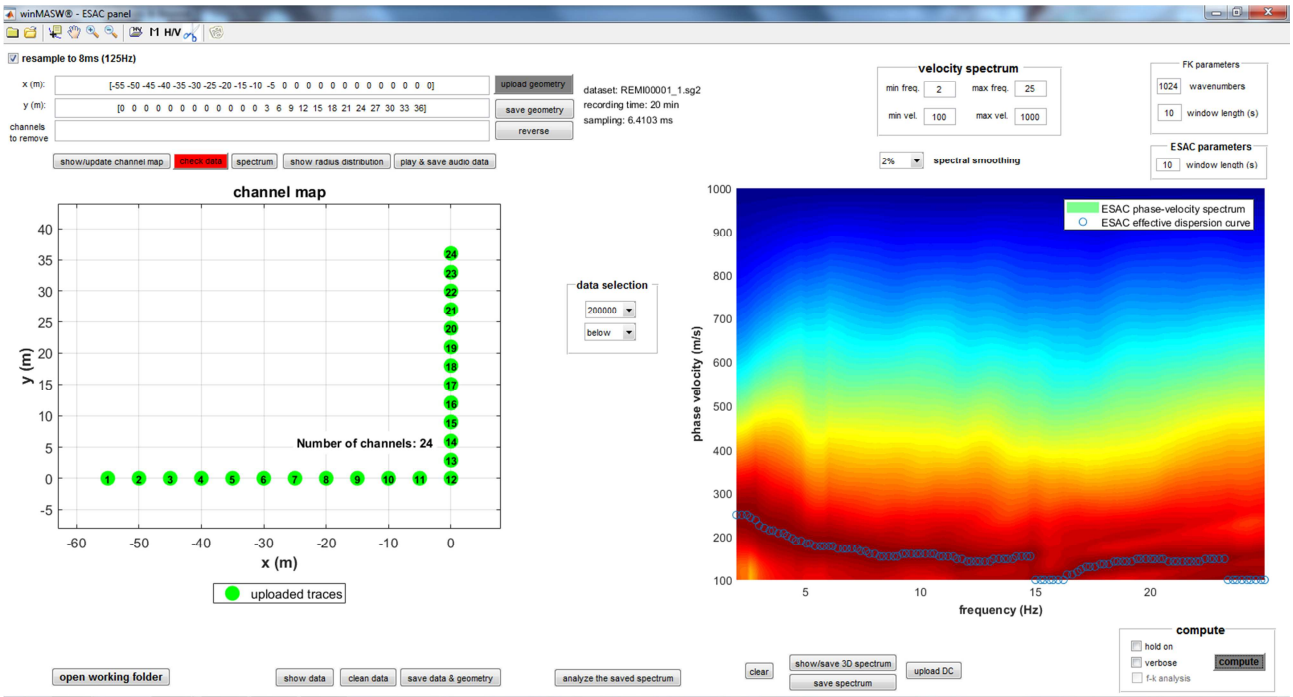
lunghezza linea 57.5 m

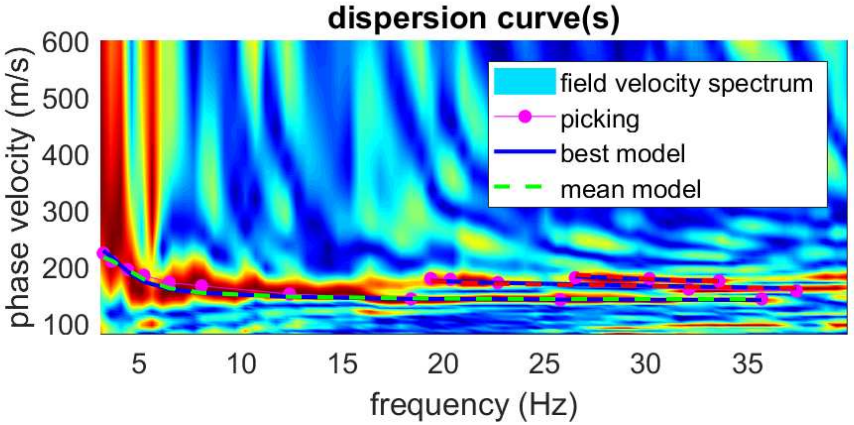
coordinate stazione 43°66’ 76.11” N 10°57’ 42.94” E

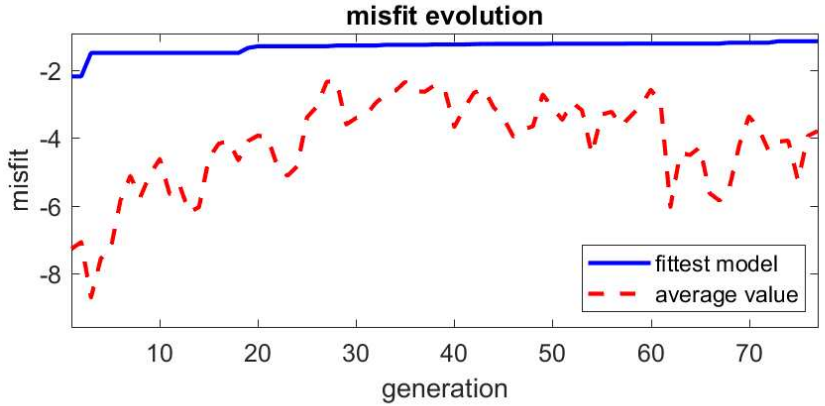
UNIONE VALDERA - Indagini sismiche MASW/ESAC

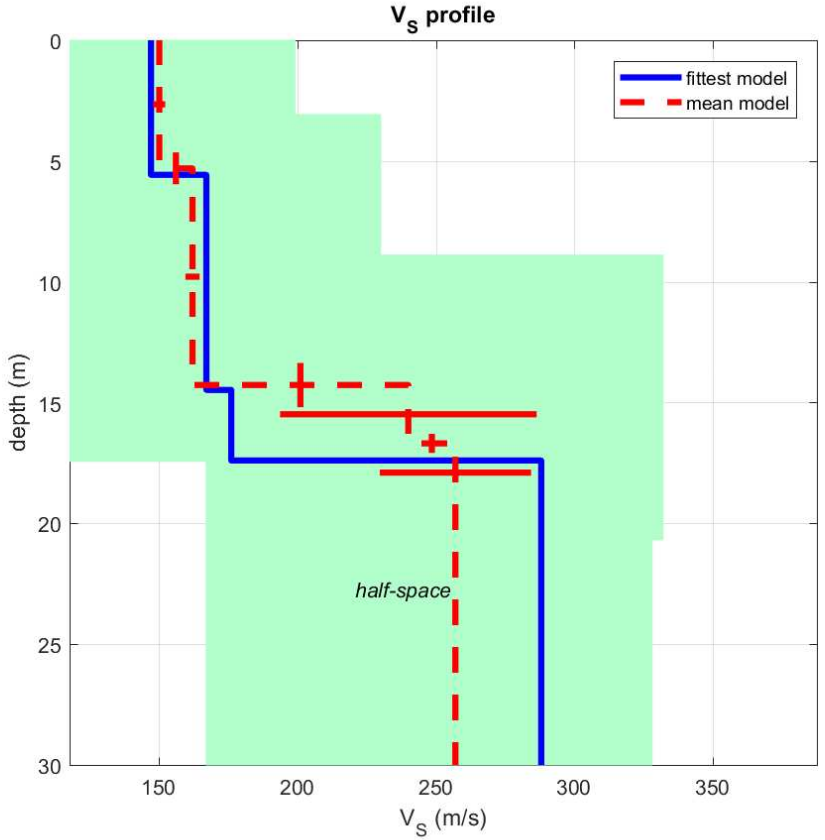
PROVA n. 19











www.winmasw.com

dataset: 710.sgy
dispersion curve: 710bis.cdp
Vs30 & VsE (best model): 198 198 m/s
Vs30 & VsE (mean model): 197 197 m/s

Mean model

Vs (m/s): 150, 162, 240, 257

Standard deviations (m/s): 2, 3, 46, 27

Thickness (m): 5.3, 9.0, 2.4

========== SECTION#1
dataset: 710.sgy
sampling (ms): 1.912
minimum offset (m): 7.5
geophone spacing (m): 2.5
offsets (m): 7.5 10 12.5 15 17.5
20 22.5 25 27.5 30 32.5 35
37.5 40 42.5 45 47.5 50
52.5 55 57.5 60 62.5 65
Dispersion curve: 710bis.cdp
Number of individuals: 32
Number of generations: 61

Rayleigh-wave dispersion analysis

Analyzing phase velocities

Adopted search space (minimum Vs): 101 117 169 167
Adopted search space (maximum Vs): 199 230 332 328

Adopted search space (minimum Poisson): 0.21987 0.20451 0.15578
0.1712
Adopted search space (maximum Poisson): 0.499 0.499 0.46735
0.499

Adopted search space (minimum Qs): 13.3125 15.375 22.2188
21.9375
Adopted search space (maximum Qs): 26.625 30.75 44.4375 43.875

Adopted search space (minimum reference frequency): 1
Adopted search space (maximum reference frequency): 37.4318

Adopted search space (minimum thickness): 3.0714 5.8214 1.6571
Adopted search space (maximum thickness): 6.02 11.41 3.248

Output folder:
C:\Users\Benedetta\Desktop\valdERA-esac\valdera-esac-19\output_disp

========== SECTION#2
Rayleigh-wave analysis
Optimizing Vs & Thickness - generation: 1; average & best misfits: -7.28
-2.1867
Optimizing Vs & Thickness - generation: 2; average & best misfits: -7.0755
-2.1867
Optimizing Vs & Thickness - generation: 3; average & best misfits: -8.7118
-1.4906
Optimizing Vs & Thickness - generation: 4; average & best misfits: -7.5634
-1.4906
Optimizing Vs & Thickness - generation: 5; average & best misfits: -7.2796
-1.4906
Optimizing Vs & Thickness - generation: 6; average & best misfits: -5.8486
-1.4906
Optimizing Vs & Thickness - generation: 7; average & best misfits: -5.1247
-1.4906
Optimizing Vs & Thickness - generation: 8; average & best misfits: -5.7592
-1.4906
Optimizing Vs & Thickness - generation: 9; average & best misfits: -5.0823
-1.4906
Optimizing Vs & Thickness - generation: 10; average & best misfits: -4.623
-1.4906
Optimizing Vs & Thickness - generation: 11; average & best misfits: -5.6569
-1.4906
Optimizing Vs & Thickness - generation: 12; average & best misfits: -5.384
-1.4906

Optimizing Vs & Thickness - generation: 13; average & best misfits: -6.2008
-1.4906
Optimizing Vs & Thickness - generation: 14; average & best misfits: -6.0439
-1.4906
Optimizing Vs & Thickness - generation: 15; average & best misfits: -4.5991
-1.4906
Optimizing Vs & Thickness - generation: 16; average & best misfits: -4.173
-1.4906
Optimizing Vs & Thickness - generation: 17; average & best misfits: -4.0836
-1.4906
Optimizing Vs & Thickness - generation: 18; average & best misfits: -4.6618
-1.4906
Optimizing Vs & Thickness - generation: 19; average & best misfits: -4.0925
-1.3424
Optimizing Vs & Thickness - generation: 20; average & best misfits: -3.9294
-1.2949
Optimizing Vs & Thickness - generation: 21; average & best misfits: -3.9992
-1.2949
Optimizing Vs & Thickness - generation: 22; average & best misfits: -4.8662
-1.2949
Optimizing Vs & Thickness - generation: 23; average & best misfits: -5.1195
-1.2949
Optimizing Vs & Thickness - generation: 24; average & best misfits: -4.8385
-1.2949
Optimizing Vs & Thickness - generation: 25; average & best misfits: -3.3889
-1.2949
Optimizing Vs & Thickness - generation: 26; average & best misfits: -3.0747
-1.2949
Optimizing Vs & Thickness - generation: 27; average & best misfits: -2.3446
-1.2949
Optimizing Vs & Thickness - generation: 28; average & best misfits: -2.321
-1.2726
Optimizing Vs & Thickness - generation: 29; average & best misfits: -3.6015
-1.2726
Optimizing Vs & Thickness - generation: 30; average & best misfits: -3.4097
-1.2726
Optimizing Vs & Thickness - generation: 31; average & best misfits: -3.33
-1.2726
Optimizing Vs & Thickness - generation: 32; average & best misfits: -2.9639
-1.2726
Optimizing Vs & Thickness - generation: 33; average & best misfits: -2.7228
-1.2525
Optimizing Vs & Thickness - generation: 34; average & best misfits: -2.6089
-1.2525
Optimizing Vs & Thickness - generation: 35; average & best misfits: -2.3418
-1.2525
Optimizing Vs & Thickness - generation: 36; average & best misfits: -2.6201
-1.2525
Optimizing Vs & Thickness - generation: 37; average & best misfits: -2.6375
-1.2523
Optimizing Vs & Thickness - generation: 38; average & best misfits: -2.439
-1.2409
Optimizing Vs & Thickness - generation: 39; average & best misfits: -2.5516
-1.2409
Optimizing Vs & Thickness - generation: 40; average & best misfits: -3.6744
-1.2409
Optimizing Vs & Thickness - generation: 41; average & best misfits: -3.1205
-1.2409
Optimizing Vs & Thickness - generation: 42; average & best misfits: -2.6663
-1.2323
Optimizing Vs & Thickness - generation: 43; average & best misfits: -2.5516
-1.2259
Optimizing Vs & Thickness - generation: 44; average & best misfits: -3.1
-1.2256
Optimizing Vs & Thickness - generation: 45; average & best misfits: -3.4151
-1.2256
Optimizing Vs & Thickness - generation: 46; average & best misfits: -3.9578
-1.2256

```
Optimizing Vs & Thickness - generation: 47; average & best misfits: -3.7585
-1.2256
Optimizing Vs & Thickness - generation: 48; average & best misfits: -3.6541
-1.2256
Optimizing Vs & Thickness - generation: 49; average & best misfits: -2.7191
-1.2253
Optimizing Vs & Thickness - generation: 50; average & best misfits: -3.1141
-1.2194
Optimizing Vs & Thickness - generation: 51; average & best misfits: -3.4677
-1.2194
Optimizing Vs & Thickness - generation: 52; average & best misfits: -2.952
-1.2192
Optimizing Vs & Thickness - generation: 53; average & best misfits: -3.1874
-1.2192
Optimizing Vs & Thickness - generation: 54; average & best misfits: -4.4796
-1.2192
Optimizing Vs & Thickness - generation: 55; average & best misfits: -3.314
-1.2192
Optimizing Vs & Thickness - generation: 56; average & best misfits: -3.2287
-1.2192
Optimizing Vs & Thickness - generation: 57; average & best misfits: -3.6483
-1.2192
Optimizing Vs & Thickness - generation: 58; average & best misfits: -3.3422
-1.2158
Optimizing Vs & Thickness - generation: 59; average & best misfits: -3.0485
-1.2158
Optimizing Vs & Thickness - generation: 60; average & best misfits: -2.5809
-1.2158
Optimizing Vs & Thickness - generation: 61; average & best misfits: -2.9408
-1.2158

Adopted search space (minimum Vs): 101  117  169  167
Adopted search space (maximum Vs): 199  230  332  328

Adopted search space (minimum Qs): 13.3125       15.375      22.2188
21.9375
Adopted search space (maximum Qs): 26.625        30.75      44.4375       43.875

Adopted search space (minimum reference frequency): 1
Adopted search space (maximum reference frequency): 37.4318

Adopted search space (minimum Poisson): 0.21987     0.20451     0.15578
0.1712
Adopted search space (maximum Poisson): 0.497       0.497     0.46735
0.497

Adopted search space (minimum thickness): 3.0714      5.8214      1.6571
Adopted search space (maximum thickness): 6.02        11.41        3.248


Now a finer search around the most promising search space area

Rayleigh-wave analysis
Optimizing Vs & Thickness - generation: 1; average & best misfits: -6.0403
-1.2158
Optimizing Vs & Thickness - generation: 2; average & best misfits: -4.4491
-1.2158
Optimizing Vs & Thickness - generation: 3; average & best misfits: -4.5042
-1.2158
Optimizing Vs & Thickness - generation: 4; average & best misfits: -4.2759
-1.2158
Optimizing Vs & Thickness - generation: 5; average & best misfits: -5.6375
-1.2158
Optimizing Vs & Thickness - generation: 6; average & best misfits: -5.8518
-1.2158
Optimizing Vs & Thickness - generation: 7; average & best misfits: -5.4811
-1.1892
Optimizing Vs & Thickness - generation: 8; average & best misfits: -4.2279
```

-1.1892
Optimizing Vs & Thickness - generation: 9; average & best misfits: -3.3657
-1.1892
Optimizing Vs & Thickness - generation: 10; average & best misfits: -3.7305
-1.1892
Optimizing Vs & Thickness - generation: 11; average & best misfits: -4.3774
-1.1892
Optimizing Vs & Thickness - generation: 12; average & best misfits: -4.1112
-1.147
Optimizing Vs & Thickness - generation: 13; average & best misfits: -4.0814
-1.147
Optimizing Vs & Thickness - generation: 14; average & best misfits: -5.2688
-1.147
Optimizing Vs & Thickness - generation: 15; average & best misfits: -3.9412
-1.147
Optimizing Vs & Thickness - generation: 16; average & best misfits: -3.796
-1.147

Model after the Vs & Thickness optimization (fixed Poisson values):
Vs (m/s): 147 167 176 288
Thickness (m): 5.6 8.9 2.9

Number of models considered to calculate the average model: 626

##
RESULTS
##

Dataset: 710.sgy
Analyzed curve/spectrum: 710bis.cdp

========== SECTION#3

Analyzing Phase Velocities

Analyzing Rayleigh-Wave Dispersion

==
MEAN MODEL

Vs (m/s): 150 162 240 257
Standard deviations (m/s): 2 3 46 27

Thickness (m): 5.3 9.0 2.4
Standard deviations (m): 0.7 0.9 0.4

Approximate values for Vp, density, Poisson & Shear modulus
Vp (m/s): 348 360 519 524
Density (gr/cm3): 1.80 1.81 1.89 1.90
Vp/Vs ratio: 2.32 2.22 2.16 2.04
Poisson: 0.39 0.37 0.36 0.34
Shear modulus (MPa): 40 47 109 125
Estimated static shear modulus (MPa): 0 0 0 0

Fundamental mode
Mean model
 f(Hz) VR(m/s)
3.21334 215.2268
3.61322 209.6704
4.41299 193.5231
5.21275 176.4324
6.46952 160.6902
8.06905 152.3867
12.4106 145.5445

18.4089 142.681
25.7781 141.5139
35.718 141.1245

First higher mode
Mean model
19.38 173.0633
20.3511 171.3838
22.6933 168.4211
32.1191 162.8903
37.4318 161.116

Second higher mode
Mean model
26.5208 184.6908
30.1768 177.0859
33.6044 172.5748

========== SECTION#4

BEST MODEL

Vs (m/s): 147 167 176 288
thickness (m): 5.5737 8.9014 2.921

Approximate values for Vp, density, Poisson & Shear modulus
Vp (m/s): 559 303 637 498
Density (gr/cm3): 1.91 1.77 1.94 1.89
Vp/Vs ratio: 3.80 1.81 3.62 1.73
Poisson: 0.46 0.28 0.46 0.25
Shear modulus (MPa): 41 49 60 156
Estimated static shear modulus (MPa): 0 0 0 0

dispersion curve (frequency - velocity)

Fundamental mode)
best model
F(Hz) VR(m/s)
3.21334 227.0733
3.61322 216.567
4.41299 189.9809
5.21275 171.9615
6.46952 159.0816
8.06905 152.2928
12.4106 145.2969
18.4089 141.6792
25.7781 140.293
35.718 139.8522

First higher mode)
best model
19.38 173.8042
20.3511 172.5292
22.6933 170.1347
32.1191 163.7111
37.4318 160.4196

Second higher mode)
best model
26.5208 181.4562
30.1768 176.2578
33.6044 173.2962

========== SECTION#5

Maximum penetration depth according to the "Steady State Rayleigh Method": 30 m

Inversion quality: very good

Vs30 & VsE (mean model): 197 197 m/s
Vs30 & VsE (best model): 198 198 m/s

========== 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
"C:\Users\Benedetta\Desktop\valdERA-esac\valdera-esac-19\output_disp".

==========
winMASW - Surface Waves & Beyond
www.winmasw.com

Number of models used to define the mean model: 626
Vs30 for the best model: 198 198
Analyzing phase velocities

UNIONE DI COMUNI DELLA VALDERA

INDAGINE ESAC/MASW - COMUNE DI PONTEDERA

LOC. GIARDINO DEI PINI - POSTAZIONE n.20

documentazione fotografica

ubicazione scala 1:1.000

geometria ESAC

geof	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
x	55	50	45	40	35	30	25	20	15	10	5	0	0	0	0	0	0	0	0	0	0	0	0	0
y	0	0	0	0	0	0	0	0	0	0	0	0	3	6	9	12	15	18	21	24	27	30	33	36

geometria MASW

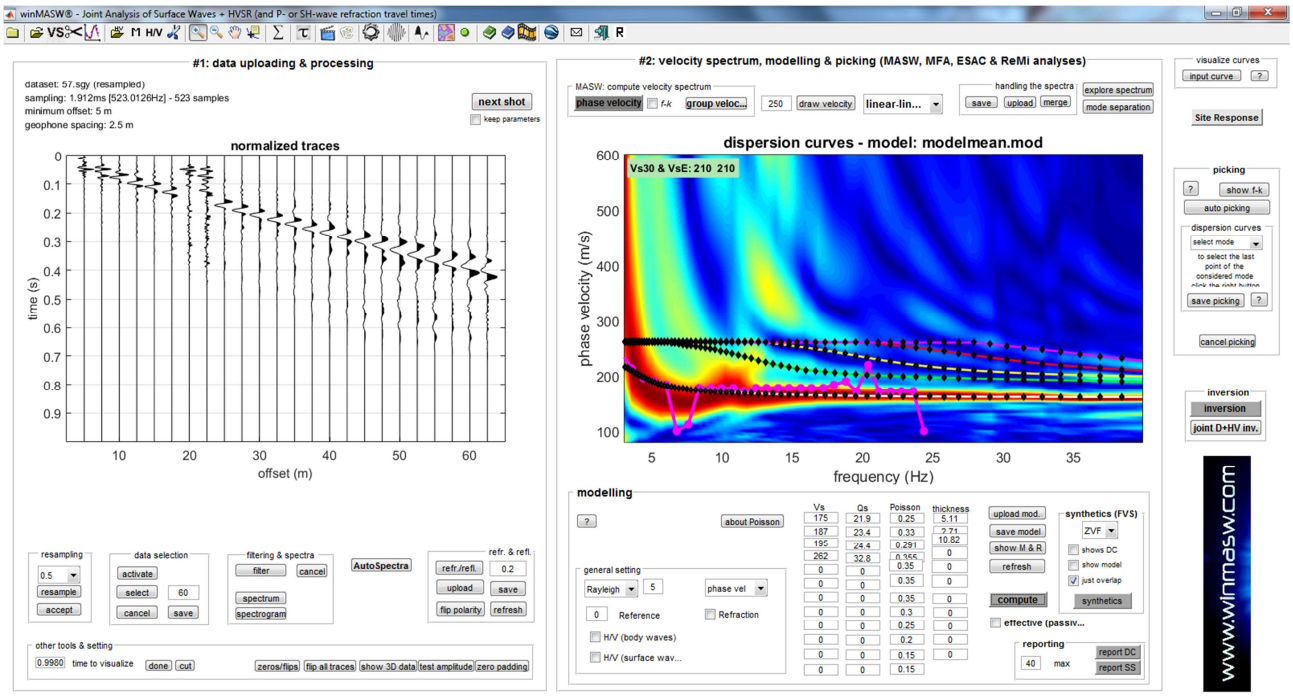
distanza geofonica 12 ch 5 m

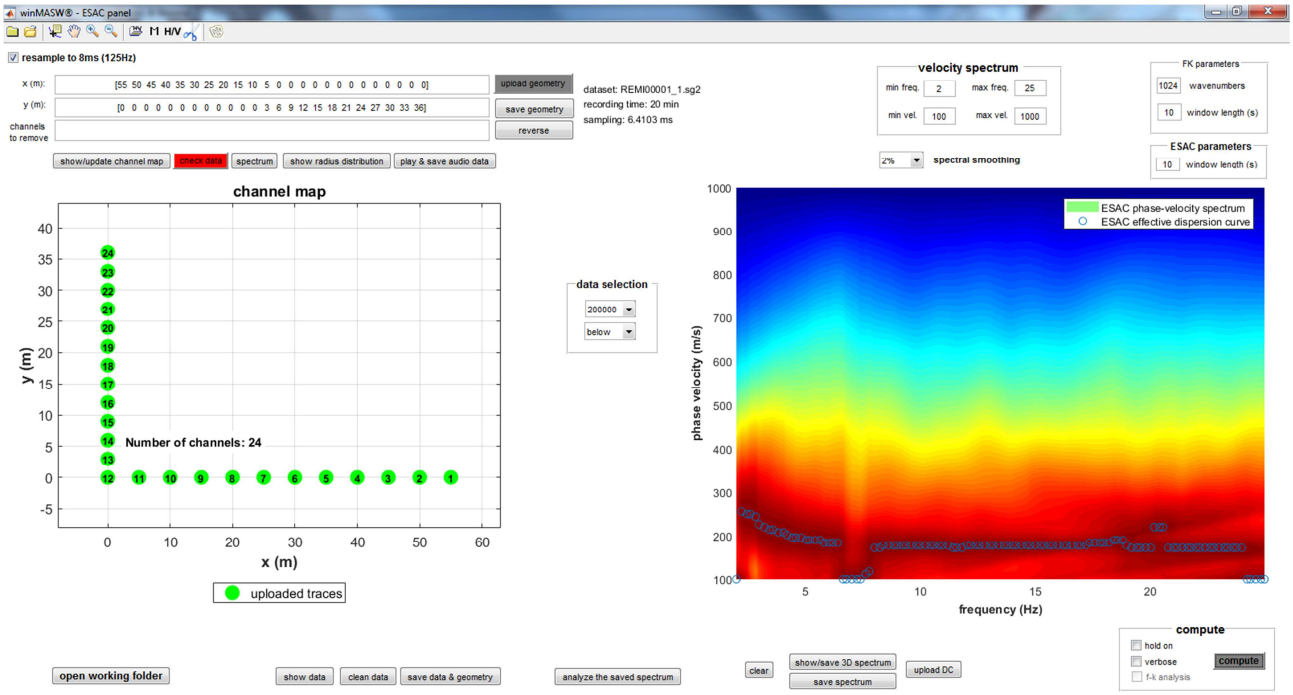
lunghezza linea 57.5 m

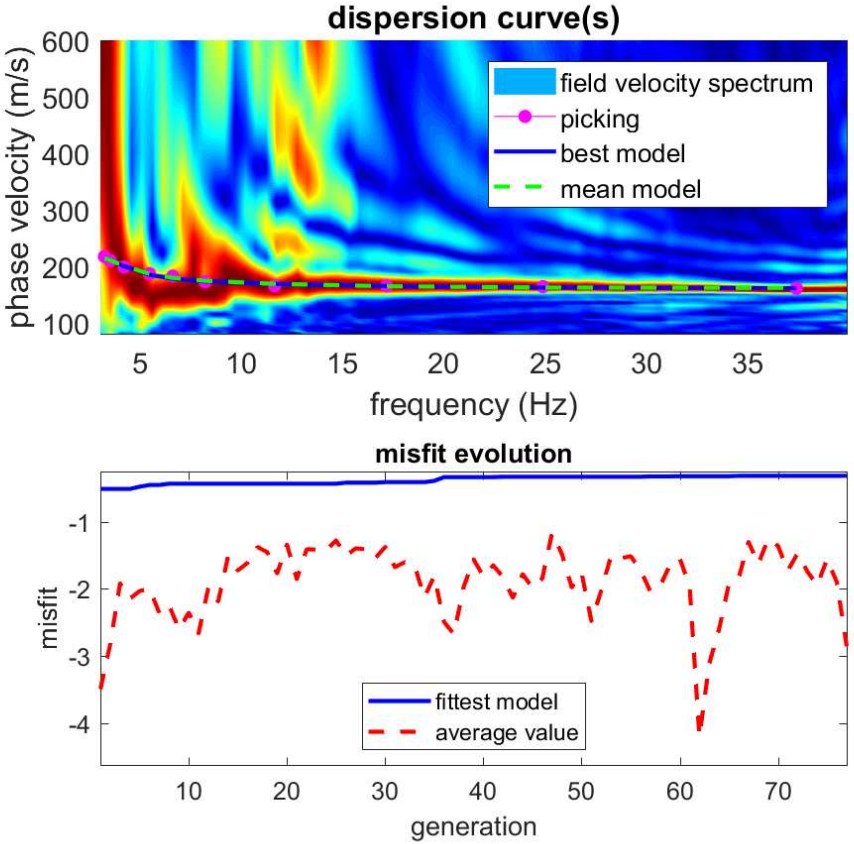
coordinate stazione 43°66’ 69.31” N 10°62’ 16.92” E

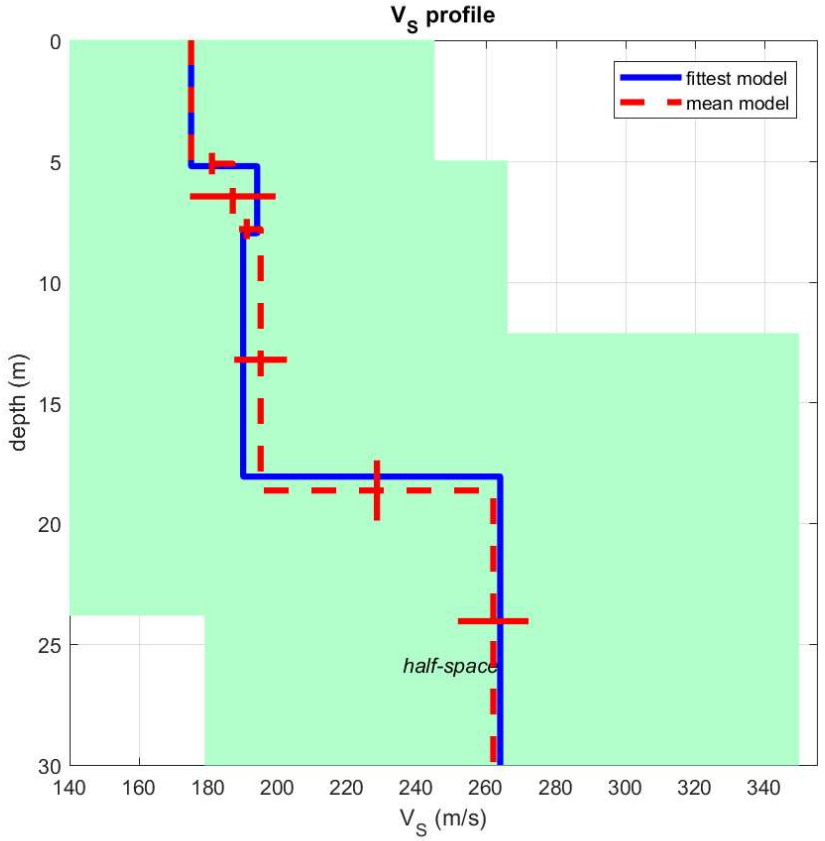
UNIONE VALDERA - Indagini sismiche MASW/ESAC

PROVA n. 20









www.winmasw.com

dataset: 57.sgy
dispersion curve: 57.cdp
Vs30 & VsE (best model): 211 211 m/s
Vs30 & VsE (mean model): 210 210 m/s

Mean model

Vs (m/s): 175, 187, 195, 262

Standard deviations (m/s): 0, 12, 8, 10

Thickness (m): 5.1, 2.7, 10.8

========== SECTION#1
dataset: 57.sgy
sampling (ms): 0.956
minimum offset (m): 5
geophone spacing (m): 2.5
offsets (m): 5 7.5 10 12.5 15 17.5
20 22.5 25 27.5 30 32.5
35 37.5 40 42.5 45 47.5
50 52.5 55 57.5 60 62.5
Dispersion curve: 57.cdp
Number of individuals: 32
Number of generations: 61

Rayleigh-wave dispersion analysis

Analyzing phase velocities

Adopted search space (minimum Vs): 125 118 136 179
Adopted search space (maximum Vs): 245 231 266 350

Adopted search space (minimum Poisson): 0.16473 0.17473 0.17524
0.17484
Adopted search space (maximum Poisson): 0.49418 0.499 0.499
0.499

Adopted search space (minimum Qs): 7.5 12 14.25 18
Adopted search space (maximum Qs): 15 24 28.5 36

Adopted search space (minimum reference frequency): 1
Adopted search space (maximum reference frequency): 37.3952

Adopted search space (minimum thickness): 2.8571 2.1429 7.1429
Adopted search space (maximum thickness): 5.6 4.2 14

Output folder:
C:\Users\Benedetta\Desktop\valdERA-esac\valdera-esac-20\output_disp

========== SECTION#2
Rayleigh-wave analysis
Optimizing Vs & Thickness - generation: 1; average & best misfits: -3.491
-0.51397
Optimizing Vs & Thickness - generation: 2; average & best misfits: -2.8207
-0.51397
Optimizing Vs & Thickness - generation: 3; average & best misfits: -1.9175
-0.51397
Optimizing Vs & Thickness - generation: 4; average & best misfits: -2.1422
-0.51397
Optimizing Vs & Thickness - generation: 5; average & best misfits: -2.0305
-0.48148
Optimizing Vs & Thickness - generation: 6; average & best misfits: -1.9947
-0.45564
Optimizing Vs & Thickness - generation: 7; average & best misfits: -2.3571
-0.45564
Optimizing Vs & Thickness - generation: 8; average & best misfits: -2.2433
-0.43652
Optimizing Vs & Thickness - generation: 9; average & best misfits: -2.5988
-0.43652
Optimizing Vs & Thickness - generation: 10; average & best misfits: -2.352
-0.43652
Optimizing Vs & Thickness - generation: 11; average & best misfits: -2.6577
-0.43652
Optimizing Vs & Thickness - generation: 12; average & best misfits: -1.976
-0.43652
Optimizing Vs & Thickness - generation: 13; average & best misfits: -2.1856

-0.43652
Optimizing Vs & Thickness - generation: 14; average & best misfits: -1.5131
-0.43652
Optimizing Vs & Thickness - generation: 15; average & best misfits: -1.7255
-0.43652
Optimizing Vs & Thickness - generation: 16; average & best misfits: -1.6092
-0.43652
Optimizing Vs & Thickness - generation: 17; average & best misfits: -1.3753
-0.43652
Optimizing Vs & Thickness - generation: 18; average & best misfits: -1.4553
-0.43652
Optimizing Vs & Thickness - generation: 19; average & best misfits: -1.7684
-0.43652
Optimizing Vs & Thickness - generation: 20; average & best misfits: -1.3409
-0.43652
Optimizing Vs & Thickness - generation: 21; average & best misfits: -1.8539
-0.43652
Optimizing Vs & Thickness - generation: 22; average & best misfits: -1.4094
-0.43652
Optimizing Vs & Thickness - generation: 23; average & best misfits: -1.4149
-0.43652
Optimizing Vs & Thickness - generation: 24; average & best misfits: -1.4241
-0.43652
Optimizing Vs & Thickness - generation: 25; average & best misfits: -1.2794
-0.43652
Optimizing Vs & Thickness - generation: 26; average & best misfits: -1.5083
-0.42134
Optimizing Vs & Thickness - generation: 27; average & best misfits: -1.397
-0.42134
Optimizing Vs & Thickness - generation: 28; average & best misfits: -1.4086
-0.42134
Optimizing Vs & Thickness - generation: 29; average & best misfits: -1.5404
-0.42134
Optimizing Vs & Thickness - generation: 30; average & best misfits: -1.376
-0.4131
Optimizing Vs & Thickness - generation: 31; average & best misfits: -1.6761
-0.4131
Optimizing Vs & Thickness - generation: 32; average & best misfits: -1.6008
-0.4131
Optimizing Vs & Thickness - generation: 33; average & best misfits: -1.6583
-0.4131
Optimizing Vs & Thickness - generation: 34; average & best misfits: -2.1217
-0.4131
Optimizing Vs & Thickness - generation: 35; average & best misfits: -1.8078
-0.39451
Optimizing Vs & Thickness - generation: 36; average & best misfits: -2.4901
-0.3389
Optimizing Vs & Thickness - generation: 37; average & best misfits: -2.6701
-0.3389
Optimizing Vs & Thickness - generation: 38; average & best misfits: -1.9684
-0.3389
Optimizing Vs & Thickness - generation: 39; average & best misfits: -1.5582
-0.3389
Optimizing Vs & Thickness - generation: 40; average & best misfits: -1.815
-0.3389
Optimizing Vs & Thickness - generation: 41; average & best misfits: -1.6489
-0.3389
Optimizing Vs & Thickness - generation: 42; average & best misfits: -1.8224
-0.33374
Optimizing Vs & Thickness - generation: 43; average & best misfits: -2.1312
-0.33374
Optimizing Vs & Thickness - generation: 44; average & best misfits: -1.7796
-0.33374
Optimizing Vs & Thickness - generation: 45; average & best misfits: -1.9816
-0.33374
Optimizing Vs & Thickness - generation: 46; average & best misfits: -1.8422
-0.33374
Optimizing Vs & Thickness - generation: 47; average & best misfits: -1.1689

-0.33374
Optimizing Vs & Thickness - generation: 48; average & best misfits: -1.4822
-0.33374
Optimizing Vs & Thickness - generation: 49; average & best misfits: -1.9771
-0.33374
Optimizing Vs & Thickness - generation: 50; average & best misfits: -1.7629
-0.33374
Optimizing Vs & Thickness - generation: 51; average & best misfits: -2.4766
-0.33374
Optimizing Vs & Thickness - generation: 52; average & best misfits: -2.027
-0.33374
Optimizing Vs & Thickness - generation: 53; average & best misfits: -1.5081
-0.33374
Optimizing Vs & Thickness - generation: 54; average & best misfits: -1.5461
-0.33374
Optimizing Vs & Thickness - generation: 55; average & best misfits: -1.5119
-0.33374
Optimizing Vs & Thickness - generation: 56; average & best misfits: -1.7204
-0.33374
Optimizing Vs & Thickness - generation: 57; average & best misfits: -2.0341
-0.32799
Optimizing Vs & Thickness - generation: 58; average & best misfits: -1.9554
-0.32799
Optimizing Vs & Thickness - generation: 59; average & best misfits: -1.6442
-0.32799
Optimizing Vs & Thickness - generation: 60; average & best misfits: -1.5475
-0.32523
Optimizing Vs & Thickness - generation: 61; average & best misfits: -1.9498
-0.32523

Adopted search space (minimum Vs): 125 118 136 179
Adopted search space (maximum Vs): 245 231 266 350

Adopted search space (minimum Qs): 7.5 12 14.25 18
Adopted search space (maximum Qs): 15 24 28.5 36

Adopted search space (minimum reference frequency): 1
Adopted search space (maximum reference frequency): 37.3952

Adopted search space (minimum Poisson): 0.16473 0.17473 0.17524
0.17484
Adopted search space (maximum Poisson): 0.49418 0.497 0.497
0.497

Adopted search space (minimum thickness): 2.8571 2.1429 7.1429
Adopted search space (maximum thickness): 5.6 4.2 14

Now a finer search around the most promising search space area

Rayleigh-wave analysis
Optimizing Vs & Thickness - generation: 1; average & best misfits: -4.1939
-0.32523
Optimizing Vs & Thickness - generation: 2; average & best misfits: -3.1098
-0.32523
Optimizing Vs & Thickness - generation: 3; average & best misfits: -2.5966
-0.32523
Optimizing Vs & Thickness - generation: 4; average & best misfits: -1.9285
-0.32523
Optimizing Vs & Thickness - generation: 5; average & best misfits: -1.8371
-0.32008
Optimizing Vs & Thickness - generation: 6; average & best misfits: -1.3025
-0.32008
Optimizing Vs & Thickness - generation: 7; average & best misfits: -1.6276
-0.32008
Optimizing Vs & Thickness - generation: 8; average & best misfits: -1.2564
-0.32008
Optimizing Vs & Thickness - generation: 9; average & best misfits: -1.3586

-0.32008
Optimizing Vs & Thickness - generation: 10; average & best misfits: -1.7261
-0.32008
Optimizing Vs & Thickness - generation: 11; average & best misfits: -1.4725
-0.31982
Optimizing Vs & Thickness - generation: 12; average & best misfits: -1.7429
-0.31982
Optimizing Vs & Thickness - generation: 13; average & best misfits: -1.9461
-0.31982
Optimizing Vs & Thickness - generation: 14; average & best misfits: -1.5544
-0.31982
Optimizing Vs & Thickness - generation: 15; average & best misfits: -1.9015
-0.31982
Optimizing Vs & Thickness - generation: 16; average & best misfits: -2.8513
-0.31938

Model after the Vs & Thickness optimization (fixed Poisson values):
Vs (m/s): 175 194 190 264
Thickness (m): 5.2 2.8 10

Number of models considered to calculate the average model: 105

##
RESULTS
##

Dataset: 57.sgy
Analyzed curve/spectrum: 57.cdp

========== SECTION#3

Analyzing Phase Velocities

Analyzing Rayleigh-Wave Dispersion

==
MEAN MODEL

Vs (m/s): 175 187 195 262
Standard deviations (m/s): 0 12 8 10

Thickness (m): 5.1 2.7 10.8
Standard deviations (m): 0.4 0.4 1.2

Approximate values for Vp, density, Poisson & Shear modulus
Vp (m/s): 303 371 359 552
Density (gr/cm3): 1.77 1.81 1.81 1.91
Vp/Vs ratio: 1.73 1.98 1.84 2.11
Poisson: 0.25 0.33 0.29 0.35
Shear modulus (MPa): 54 63 69 131
Estimated static shear modulus (MPa): 0 0 0 0

Fundamental mode
Mean model
 f(Hz) VR(m/s)
3.26727 214.4129
3.55262 210.324
4.23746 200.1689
5.49301 185.957
6.63441 178.9147
8.23237 173.7325
11.6566 168.3976
17.1924 164.1486
24.8969 161.8803

37.3952 161.0538

========== SECTION#4

BEST MODEL

Vs (m/s): 175 194 190 264
thickness (m): 5.21089 2.77634 10.0739

Approximate values for Vp, density, Poisson & Shear modulus
Vp (m/s): 299 350 363 532
Density (gr/cm3): 1.76 1.80 1.81 1.90
Vp/Vs ratio: 1.71 1.80 1.91 2.02
Poisson: 0.24 0.28 0.31 0.34
Shear modulus (MPa): 54 68 65 133
Estimated static shear modulus (MPa): 0 0 0 0

dispersion curve (frequency - velocity)

Fundamental mode)
best model

F(Hz)	VR(m/s)
3.26727	215.0086
3.55262	210.6601
4.23746	199.6598
5.49301	184.4666
6.63441	177.4321
8.23237	172.7044
11.6566	168.2999
17.1924	164.3175
24.8969	161.7337
37.3952	160.7462

========== SECTION#5

Maximum penetration depth according to the "Steady State Rayleigh Method": 30 m

Inversion quality: very good

Vs30 & VsE (mean model): 210 210 m/s
Vs30 & VsE (best model): 211 211 m/s

========== 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
"C:\Users\Benedetta\Desktop\valdERA-esac\valdera-esac-20\output_disp".

==========
winMASW - Surface Waves & Beyond
www.winmasw.com

Number of models used to define the mean model: 105
Vs30 for the best model: 211 211
Analyzing phase velocities

UNIONE DI COMUNI DELLA VALDERA

INDAGINE ESAC/MASW - COMUNE DI PONTEDERA

LOC. LAGHI BRACCINI - POSTAZIONE n.21

documentazione fotografica

ubicazione scala 1:1.000

geometria ESAC

geof	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
x	55	50	45	40	35	30	25	20	15	10	5	0	0	0	0	0	0	0	0	0	0	0	0	0
y	0	0	0	0	0	0	0	0	0	0	0	0	3	6	9	12	15	18	21	24	27	30	33	36

geometria MASW

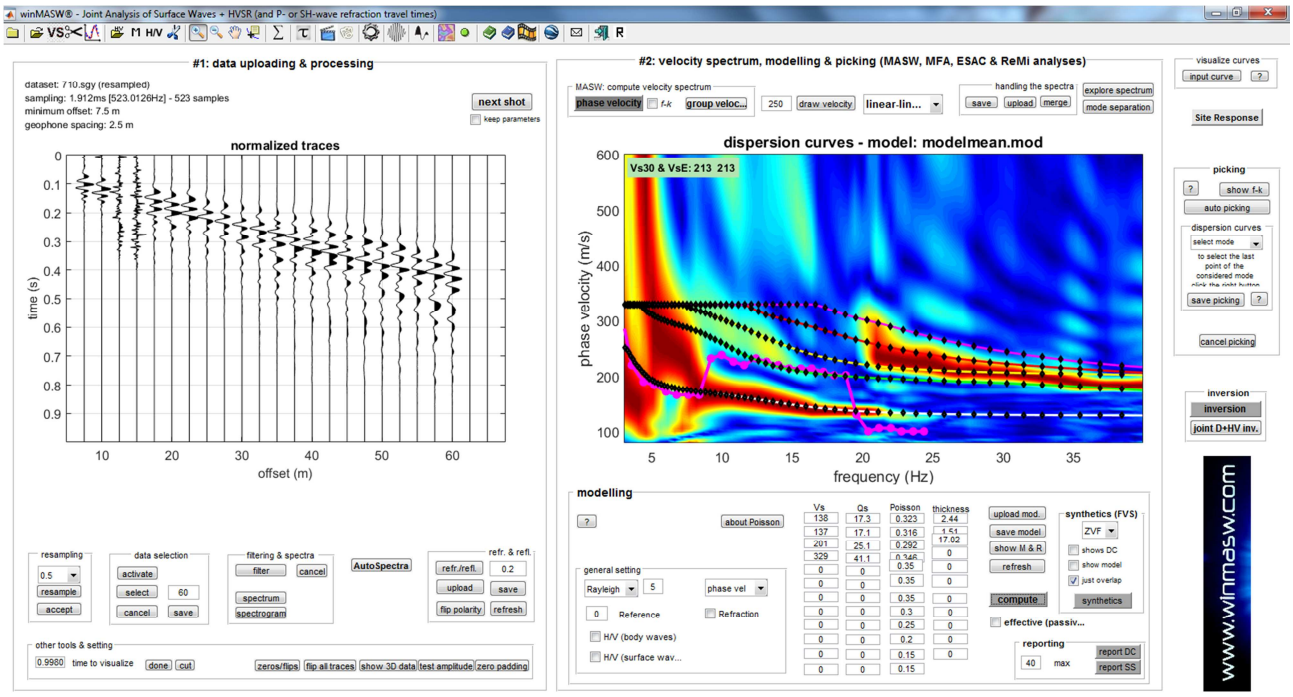
distanza geofonica 12 ch 5 m

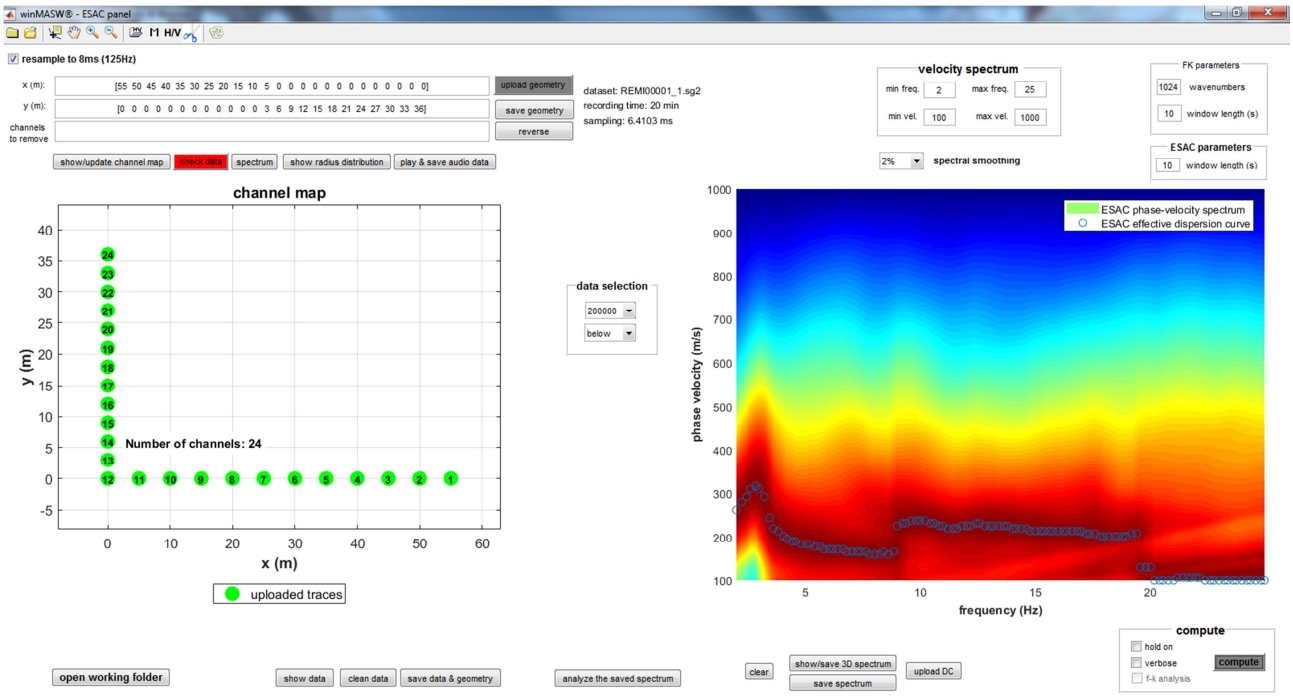
lunghezza linea 57.5 m

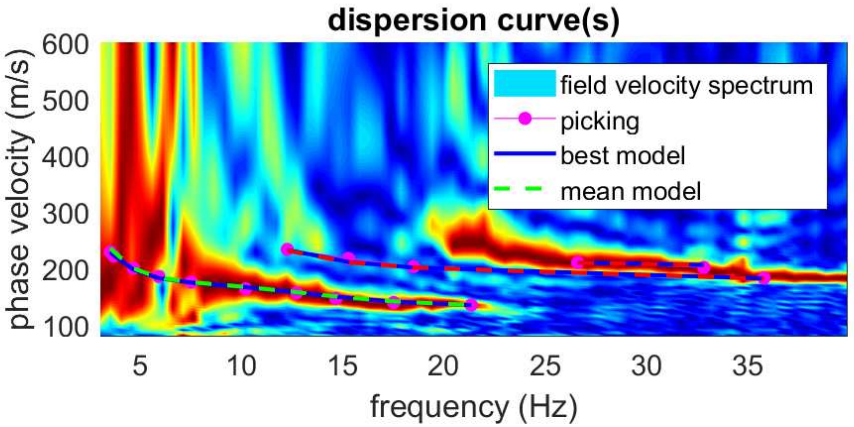
coordinate stazione 43°66’ 27.42” N 10°65’ 99.17” E

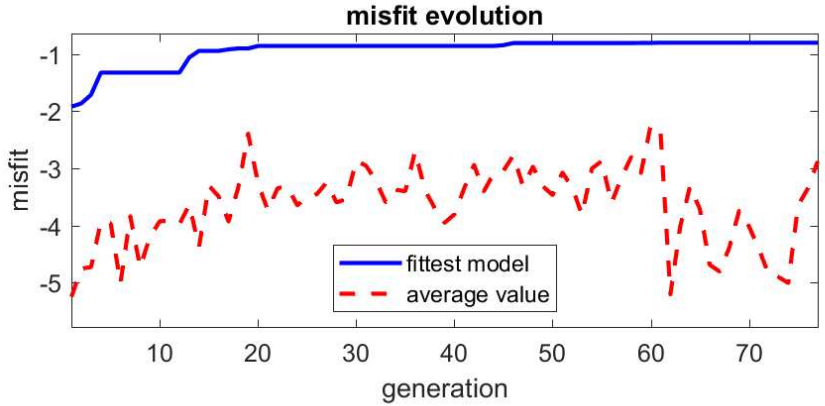
UNIONE VALDERA - Indagini sismiche MASW/ESAC

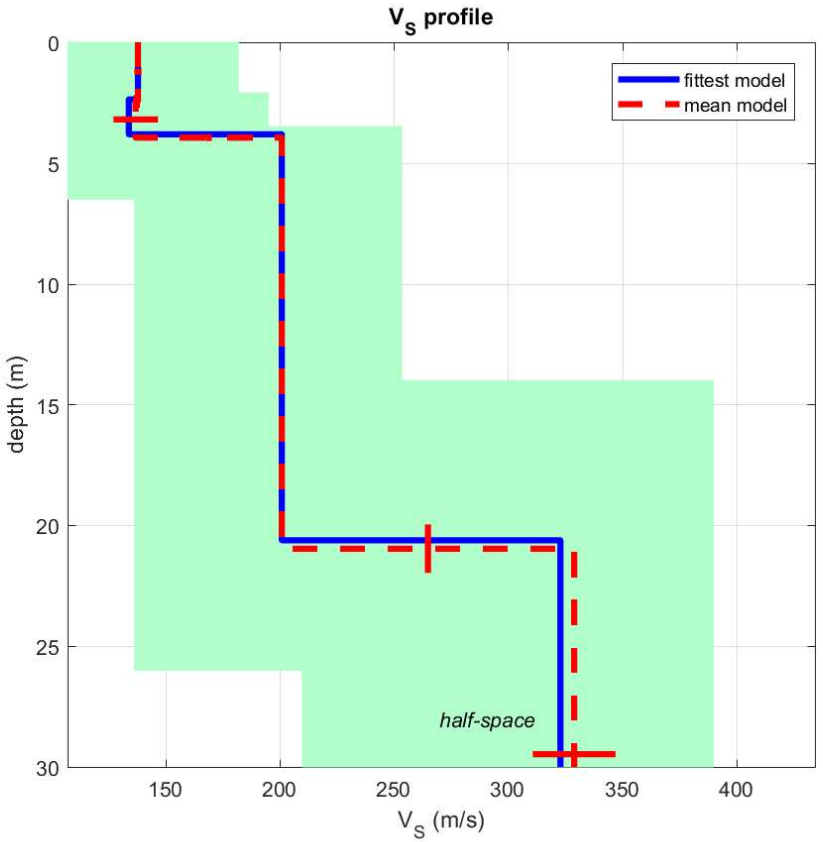
PROVA n. 21











www.winmasw.com

dataset: 710.sgy
dispersion curve: 710.cdp
Vs30 & VsE (best model): 213 213 m/s
Vs30 & VsE (mean model): 213 213 m/s

Mean model

Vs (m/s): 138, 137, 201, 329

Standard deviations (m/s): 2, 10, 1, 18

Thickness (m): 2.4, 1.5, 17.0

========== SECTION#1
dataset: 710.sgy
sampling (ms): 0.956
minimum offset (m): 7.5
geophone spacing (m): 2.5
offsets (m): 7.5 10 12.5 15 17.5
20 22.5 25 27.5 30 32.5 35
37.5 40 42.5 45 47.5 50
52.5 55 57.5 60 62.5 65
Dispersion curve: 710.cdp
Number of individuals: 32
Number of generations: 61

Rayleigh-wave dispersion analysis

Analyzing phase velocities

Adopted search space (minimum Vs): 98 105 136.5 210
Adopted search space (maximum Vs): 182 195 253.5 390

Adopted search space (minimum Poisson): 0.231 0.245 0.245
0.245
Adopted search space (maximum Poisson): 0.429 0.455 0.455
0.455

Adopted search space (minimum Qs): 7 11.2 13.3 16.8
Adopted search space (maximum Qs): 13 20.8 24.7 31.2

Adopted search space (minimum reference frequency): 1
Adopted search space (maximum reference frequency): 35.7973

Adopted search space (minimum thickness): 2.1 1.4 10.5
Adopted search space (maximum thickness): 3.9 2.6 19.5

Output folder:
C:\Users\Benedetta\Desktop\valdERA-esac\valdera-esac-21\output_disp

========== SECTION#2
Rayleigh-wave analysis
Optimizing Vs & Thickness - generation: 1; average & best misfits: -5.2488
-1.9219
Optimizing Vs & Thickness - generation: 2; average & best misfits: -4.7549
-1.8679
Optimizing Vs & Thickness - generation: 3; average & best misfits: -4.7279
-1.7147
Optimizing Vs & Thickness - generation: 4; average & best misfits: -3.9348
-1.3281
Optimizing Vs & Thickness - generation: 5; average & best misfits: -3.9612
-1.3281
Optimizing Vs & Thickness - generation: 6; average & best misfits: -5.0072
-1.3281
Optimizing Vs & Thickness - generation: 7; average & best misfits: -3.8374
-1.3281
Optimizing Vs & Thickness - generation: 8; average & best misfits: -4.7306
-1.3281
Optimizing Vs & Thickness - generation: 9; average & best misfits: -4.1982
-1.3281
Optimizing Vs & Thickness - generation: 10; average & best misfits: -3.9251
-1.3281
Optimizing Vs & Thickness - generation: 11; average & best misfits: -3.9158
-1.3281
Optimizing Vs & Thickness - generation: 12; average & best misfits: -3.9787
-1.3281
Optimizing Vs & Thickness - generation: 13; average & best misfits: -3.6399

-1.0651
Optimizing Vs & Thickness - generation: 14; average & best misfits: -4.3756
-0.94786
Optimizing Vs & Thickness - generation: 15; average & best misfits: -3.3024
-0.94786
Optimizing Vs & Thickness - generation: 16; average & best misfits: -3.4942
-0.94786
Optimizing Vs & Thickness - generation: 17; average & best misfits: -3.9292
-0.92199
Optimizing Vs & Thickness - generation: 18; average & best misfits: -3.3304
-0.90526
Optimizing Vs & Thickness - generation: 19; average & best misfits: -2.3936
-0.90526
Optimizing Vs & Thickness - generation: 20; average & best misfits: -3.2601
-0.86244
Optimizing Vs & Thickness - generation: 21; average & best misfits: -3.7351
-0.86244
Optimizing Vs & Thickness - generation: 22; average & best misfits: -3.3475
-0.86244
Optimizing Vs & Thickness - generation: 23; average & best misfits: -3.3204
-0.86244
Optimizing Vs & Thickness - generation: 24; average & best misfits: -3.6468
-0.86244
Optimizing Vs & Thickness - generation: 25; average & best misfits: -3.5079
-0.86244
Optimizing Vs & Thickness - generation: 26; average & best misfits: -3.4507
-0.86244
Optimizing Vs & Thickness - generation: 27; average & best misfits: -3.2473
-0.86244
Optimizing Vs & Thickness - generation: 28; average & best misfits: -3.5982
-0.86244
Optimizing Vs & Thickness - generation: 29; average & best misfits: -3.538
-0.86244
Optimizing Vs & Thickness - generation: 30; average & best misfits: -2.8685
-0.86244
Optimizing Vs & Thickness - generation: 31; average & best misfits: -2.955
-0.86244
Optimizing Vs & Thickness - generation: 32; average & best misfits: -3.2144
-0.86244
Optimizing Vs & Thickness - generation: 33; average & best misfits: -3.5923
-0.86244
Optimizing Vs & Thickness - generation: 34; average & best misfits: -3.3758
-0.86244
Optimizing Vs & Thickness - generation: 35; average & best misfits: -3.4012
-0.86244
Optimizing Vs & Thickness - generation: 36; average & best misfits: -2.7047
-0.86244
Optimizing Vs & Thickness - generation: 37; average & best misfits: -3.3817
-0.86244
Optimizing Vs & Thickness - generation: 38; average & best misfits: -3.6963
-0.86244
Optimizing Vs & Thickness - generation: 39; average & best misfits: -3.9513
-0.86244
Optimizing Vs & Thickness - generation: 40; average & best misfits: -3.8061
-0.86244
Optimizing Vs & Thickness - generation: 41; average & best misfits: -3.35
-0.86244
Optimizing Vs & Thickness - generation: 42; average & best misfits: -2.941
-0.86244
Optimizing Vs & Thickness - generation: 43; average & best misfits: -3.403
-0.86244
Optimizing Vs & Thickness - generation: 44; average & best misfits: -3.0922
-0.86244
Optimizing Vs & Thickness - generation: 45; average & best misfits: -3.0434
-0.84834
Optimizing Vs & Thickness - generation: 46; average & best misfits: -2.7755
-0.81128
Optimizing Vs & Thickness - generation: 47; average & best misfits: -3.3179

-0.81128
Optimizing Vs & Thickness - generation: 48; average & best misfits: -2.9717
-0.81128
Optimizing Vs & Thickness - generation: 49; average & best misfits: -3.3132
-0.81128
Optimizing Vs & Thickness - generation: 50; average & best misfits: -3.4668
-0.81128
Optimizing Vs & Thickness - generation: 51; average & best misfits: -3.0742
-0.81128
Optimizing Vs & Thickness - generation: 52; average & best misfits: -3.3358
-0.81128
Optimizing Vs & Thickness - generation: 53; average & best misfits: -3.8144
-0.81128
Optimizing Vs & Thickness - generation: 54; average & best misfits: -3.0047
-0.81128
Optimizing Vs & Thickness - generation: 55; average & best misfits: -2.8756
-0.81128
Optimizing Vs & Thickness - generation: 56; average & best misfits: -3.6072
-0.81128
Optimizing Vs & Thickness - generation: 57; average & best misfits: -3.1689
-0.81128
Optimizing Vs & Thickness - generation: 58; average & best misfits: -2.8054
-0.81128
Optimizing Vs & Thickness - generation: 59; average & best misfits: -3.0806
-0.80895
Optimizing Vs & Thickness - generation: 60; average & best misfits: -2.2443
-0.80895
Optimizing Vs & Thickness - generation: 61; average & best misfits: -2.3865
-0.80517

Adopted search space (minimum Vs): 98 105 136.5 210
Adopted search space (maximum Vs): 182 195 253.5 390

Adopted search space (minimum Qs): 7 11.2 13.3 16.8
Adopted search space (maximum Qs): 13 20.8 24.7 31.2

Adopted search space (minimum reference frequency): 1
Adopted search space (maximum reference frequency): 35.7973

Adopted search space (minimum Poisson): 0.231 0.245 0.245
0.245
Adopted search space (maximum Poisson): 0.429 0.455 0.455
0.455

Adopted search space (minimum thickness): 2.1 1.4 10.5
Adopted search space (maximum thickness): 3.9 2.6 19.5

Now a finer search around the most promising search space area

Rayleigh-wave analysis
Optimizing Vs & Thickness - generation: 1; average & best misfits: -5.2046
-0.80517
Optimizing Vs & Thickness - generation: 2; average & best misfits: -4.0164
-0.80517
Optimizing Vs & Thickness - generation: 3; average & best misfits: -3.315
-0.80517
Optimizing Vs & Thickness - generation: 4; average & best misfits: -3.7136
-0.80517
Optimizing Vs & Thickness - generation: 5; average & best misfits: -4.6858
-0.80517
Optimizing Vs & Thickness - generation: 6; average & best misfits: -4.8038
-0.80517
Optimizing Vs & Thickness - generation: 7; average & best misfits: -4.3861
-0.80517
Optimizing Vs & Thickness - generation: 8; average & best misfits: -3.7423
-0.80517
Optimizing Vs & Thickness - generation: 9; average & best misfits: -4.0138

-0.80517
Optimizing Vs & Thickness - generation: 10; average & best misfits: -4.4051
-0.80517
Optimizing Vs & Thickness - generation: 11; average & best misfits: -4.8546
-0.80517
Optimizing Vs & Thickness - generation: 12; average & best misfits: -4.9002
-0.80517
Optimizing Vs & Thickness - generation: 13; average & best misfits: -5.005
-0.80517
Optimizing Vs & Thickness - generation: 14; average & best misfits: -3.6489
-0.80517
Optimizing Vs & Thickness - generation: 15; average & best misfits: -3.3514
-0.80517
Optimizing Vs & Thickness - generation: 16; average & best misfits: -2.8773
-0.80517

Model after the Vs & Thickness optimization (fixed Poisson values):
Vs (m/s): 138 134 201 323
Thickness (m): 2.4   1.4   17

Number of models considered to calculate the average model: 170

##
RESULTS
##

Dataset: 710.sgy
Analyzed curve/spectrum: 710.cdp

========== SECTION#3

Analyzing Phase Velocities

Analyzing Rayleigh-Wave Dispersion

==
MEAN MODEL

Vs (m/s):   138 137 201 329
Standard deviations (m/s): 2 10   1 18

Thickness (m):   2.4   1.5   17.0
Standard deviations (m): 0.3   0.1   1.0

Approximate values for Vp, density, Poisson & Shear modulus
Vp (m/s):   270 264 371 678
Density (gr/cm3):   1.74   1.73   1.81   1.96
Vp/Vs ratio: 1.96   1.93   1.85   2.06
Poisson: 0.32   0.32   0.29   0.35
Shear modulus (MPa): 33   33   73   212
Estimated static shear modulus (MPa): 0   0   0   0

Fundamental mode
Mean model
 f(Hz)   VR(m/s)
3.55262   235.3922
3.72383   228.8272
4.69402   199.2275
5.94957   182.8987
7.54753   174.7408
10.2298   166.3906
12.7409   157.1187
14.6813   149.4407
17.5348   140.7216

21.3585 134.3953

First higher mode
Mean model
12.2844 230.8278
15.3091 209.9869
18.505 200.7595
35.7973 180.8451

Second higher mode
Mean model
26.609 209.2329
32.8296 205.268

========== SECTION#4

BEST MODEL

Vs (m/s): 138 134 201 323
thickness (m): 2.36631 1.44299 16.8096

Approximate values for Vp, density, Poisson & Shear modulus
Vp (m/s): 272 249 358 568
Density (gr/cm3): 1.74 1.72 1.81 1.92
Vp/Vs ratio: 1.97 1.86 1.78 1.76
Poisson: 0.33 0.30 0.27 0.26
Shear modulus (MPa): 33 31 73 200
Estimated static shear modulus (MPa): 0 0 0 0

dispersion curve (frequency - velocity)

Fundamental mode)
best model
F(Hz) VR(m/s)
3.55262 228.3188
3.72383 222.7678
4.69402 197.1822
5.94957 182.0015
7.54753 174.0857
10.2298 165.8902
12.7409 156.7748
14.6813 149.1287
17.5348 140.3376
21.3585 133.9595

First higher mode)
best model
12.2844 231.9624
15.3091 210.5259
18.505 200.8386
35.7973 181.3571

Second higher mode)
best model
26.609 209.4861
32.8296 205.4782

========== SECTION#5

Maximum penetration depth according to the "Steady State Rayleigh Method": 30 m

Inversion quality: very good

Vs30 & VsE (mean model): 213 213 m/s
Vs30 & VsE (best model): 213 213 m/s

========== 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
"C:\Users\Benedetta\Desktop\valdERA-esac\valdera-esac-21\output_disp".

==========
winMASW - Surface Waves & Beyond
www.winmasw.com

Number of models used to define the mean model: 170
Vs30 for the best model: 213 213
Analyzing phase velocities

UNIONE DI COMUNI DELLA VALDERA

INDAGINE ESAC/MASW - COMUNE DI PONTEDERA

LOC. GIARDINO DELLE PRATA - POSTAZIONE n.22

documentazione fotografica

ubicazione scala 1:1.000

geometria ESAC

geof	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
x	55	50	45	40	35	30	25	20	15	10	5	0	0	0	0	0	0	0	0	0	0	0	0	0
y	0	0	0	0	0	0	0	0	0	0	0	0	3	6	9	12	15	18	21	24	27	30	33	36

geometria MASW

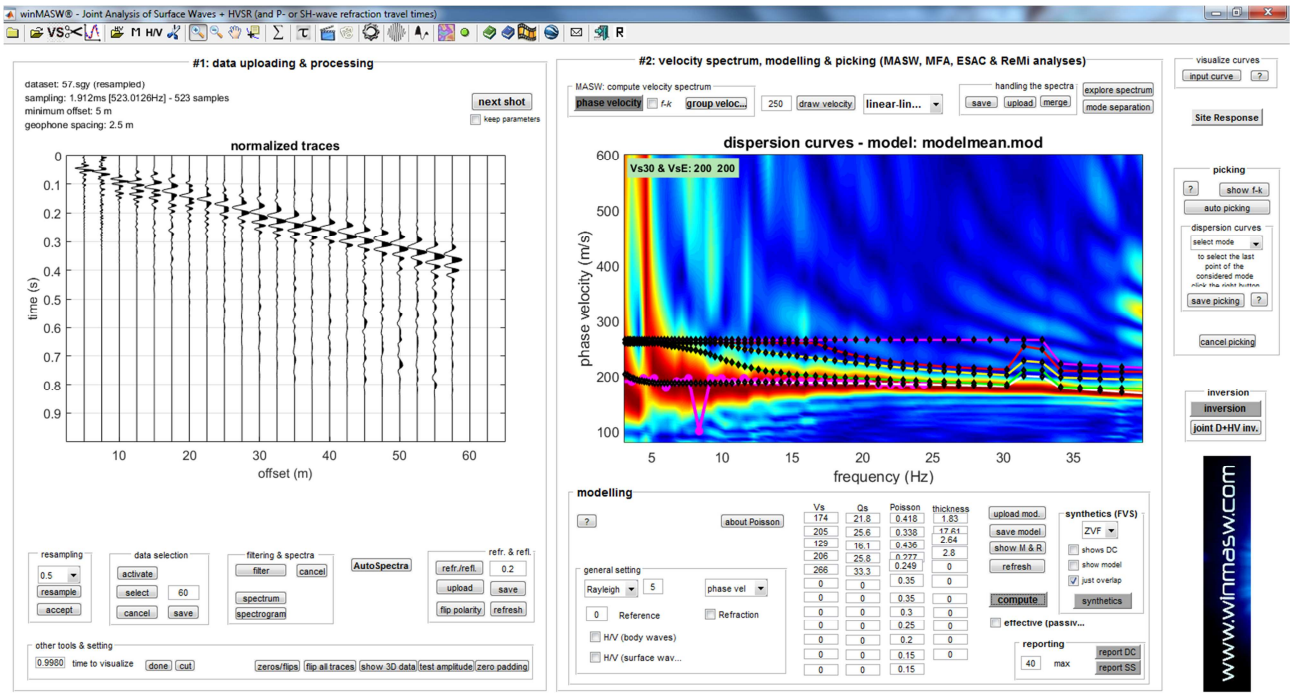
distanza geofonica 12 ch 5 m

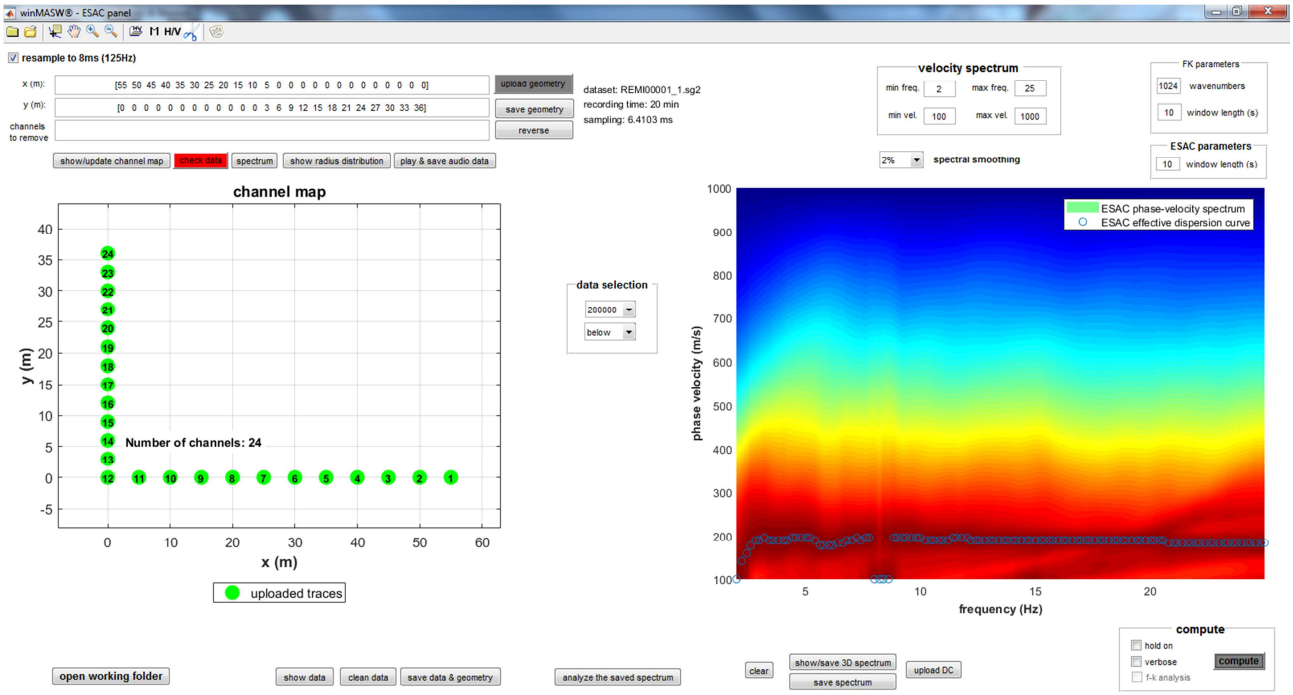
lunghezza linea 57.5 m

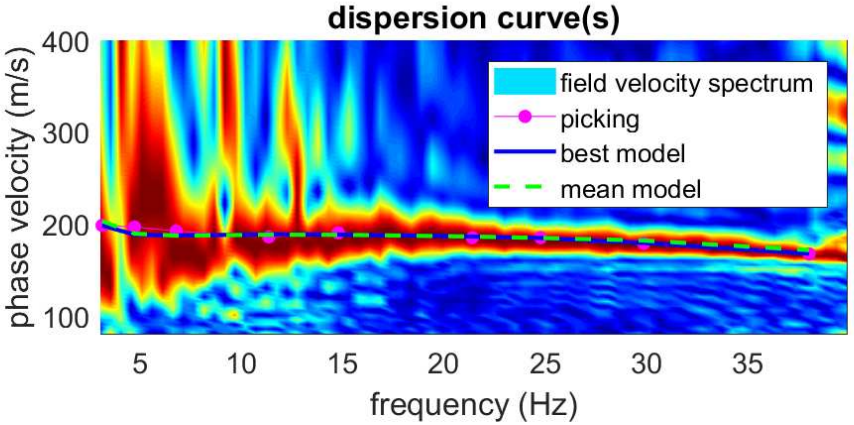
coordinate stazione 43°66’ 28.65” N 10°64’ 21.35” E

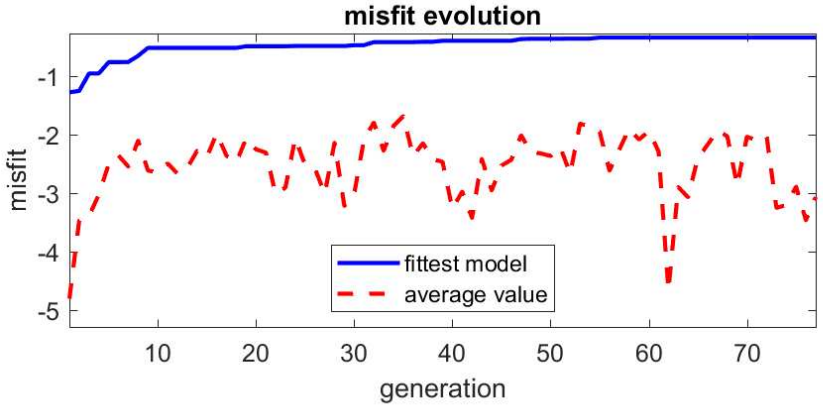
UNIONE VALDERA - Indagini sismiche MASW/ESAC

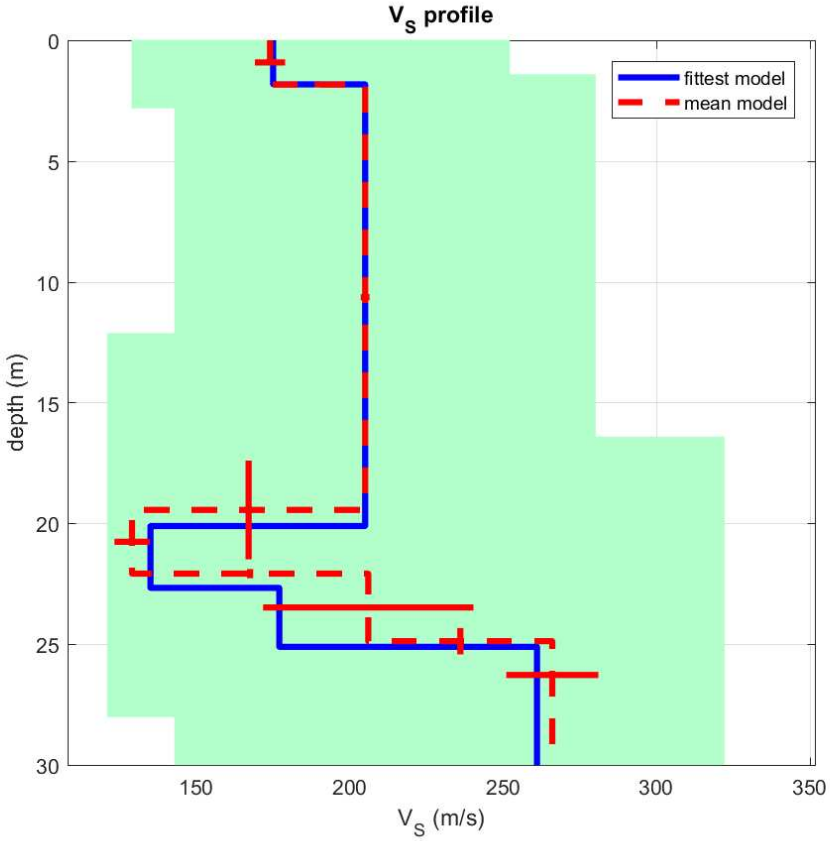
PROVA n. 22











dataset: 57.sgy
dispersion curve: 57.cdp
Vs30 & VsE (best model): 199 199 m/s
Vs30 & VsE (mean model): 200 200 m/s

www.winmasw.com

Mean model

Vs (m/s): 174, 205, 129, 206, 266

Standard deviations (m/s): 5, 1, 6, 34, 15

Thickness (m): 1.8, 17.6, 2.6, 2.8

========== SECTION#1
dataset: 57.sgy
sampling (ms): 0.956
minimum offset (m): 5
geophone spacing (m): 2.5
offsets (m): 5 7.5 10 12.5 15 17.5
20 22.5 25 27.5 30 32.5
35 37.5 40 42.5 45 47.5
50 52.5 55 57.5 60 62.5
Dispersion curve: 57.cdp
Number of individuals: 32
Number of generations: 61

Rayleigh-wave dispersion analysis

Analyzing phase velocities

Adopted search space (minimum Vs): 129 143 121 143 164
Adopted search space (maximum Vs): 252 280 238 280 322

Adopted search space (minimum Poisson): 0.16478 0.17484 0.17506
0.17484 0.17509
Adopted search space (maximum Poisson): 0.49434 0.499 0.499
0.499 0.499

Adopted search space (minimum Qs): 7.5 12 14.25 18
21
Adopted search space (maximum Qs): 15 24 28.5 36
42

Adopted search space (minimum reference frequency): 1
Adopted search space (maximum reference frequency): 38.023

Adopted search space (minimum thickness): 1.42857 10.7143 2.14286
2.14286
Adopted search space (maximum thickness): 2.8 21 4.2
4.2

Output folder:
C:\Users\Benedetta\Desktop\valdERA-esac\valdera-esac-22\output_disp

========== SECTION#2
Rayleigh-wave analysis
Optimizing Vs & Thickness - generation: 1; average & best misfits: -4.8124
-1.2779
Optimizing Vs & Thickness - generation: 2; average & best misfits: -3.4743
-1.2543
Optimizing Vs & Thickness - generation: 3; average & best misfits: -3.396
-0.95526
Optimizing Vs & Thickness - generation: 4; average & best misfits: -3.0279
-0.95526
Optimizing Vs & Thickness - generation: 5; average & best misfits: -2.5058
-0.76194
Optimizing Vs & Thickness - generation: 6; average & best misfits: -2.3587
-0.76194
Optimizing Vs & Thickness - generation: 7; average & best misfits: -2.5503
-0.75948
Optimizing Vs & Thickness - generation: 8; average & best misfits: -2.1044
-0.65265
Optimizing Vs & Thickness - generation: 9; average & best misfits: -2.6188
-0.51784
Optimizing Vs & Thickness - generation: 10; average & best misfits: -2.6451
-0.51784
Optimizing Vs & Thickness - generation: 11; average & best misfits: -2.4943

-0.51784
Optimizing Vs & Thickness - generation: 12; average & best misfits: -2.6695
-0.51784
Optimizing Vs & Thickness - generation: 13; average & best misfits: -2.5707
-0.51784
Optimizing Vs & Thickness - generation: 14; average & best misfits: -2.281
-0.51784
Optimizing Vs & Thickness - generation: 15; average & best misfits: -2.3862
-0.51784
Optimizing Vs & Thickness - generation: 16; average & best misfits: -1.9819
-0.51784
Optimizing Vs & Thickness - generation: 17; average & best misfits: -2.3635
-0.51784
Optimizing Vs & Thickness - generation: 18; average & best misfits: -2.4748
-0.51784
Optimizing Vs & Thickness - generation: 19; average & best misfits: -2.067
-0.48988
Optimizing Vs & Thickness - generation: 20; average & best misfits: -2.2546
-0.48988
Optimizing Vs & Thickness - generation: 21; average & best misfits: -2.3083
-0.48988
Optimizing Vs & Thickness - generation: 22; average & best misfits: -3.016
-0.48988
Optimizing Vs & Thickness - generation: 23; average & best misfits: -2.908
-0.48988
Optimizing Vs & Thickness - generation: 24; average & best misfits: -2.0633
-0.48546
Optimizing Vs & Thickness - generation: 25; average & best misfits: -2.5197
-0.48546
Optimizing Vs & Thickness - generation: 26; average & best misfits: -2.579
-0.48546
Optimizing Vs & Thickness - generation: 27; average & best misfits: -3.0143
-0.48546
Optimizing Vs & Thickness - generation: 28; average & best misfits: -2.1417
-0.48546
Optimizing Vs & Thickness - generation: 29; average & best misfits: -3.2238
-0.48546
Optimizing Vs & Thickness - generation: 30; average & best misfits: -3.0189
-0.47186
Optimizing Vs & Thickness - generation: 31; average & best misfits: -2.0848
-0.47168
Optimizing Vs & Thickness - generation: 32; average & best misfits: -1.796
-0.41944
Optimizing Vs & Thickness - generation: 33; average & best misfits: -2.2766
-0.41944
Optimizing Vs & Thickness - generation: 34; average & best misfits: -1.8542
-0.41944
Optimizing Vs & Thickness - generation: 35; average & best misfits: -1.6852
-0.41877
Optimizing Vs & Thickness - generation: 36; average & best misfits: -2.3724
-0.41877
Optimizing Vs & Thickness - generation: 37; average & best misfits: -2.1506
-0.41384
Optimizing Vs & Thickness - generation: 38; average & best misfits: -2.4205
-0.41384
Optimizing Vs & Thickness - generation: 39; average & best misfits: -2.4694
-0.39556
Optimizing Vs & Thickness - generation: 40; average & best misfits: -3.2734
-0.39556
Optimizing Vs & Thickness - generation: 41; average & best misfits: -2.9761
-0.39556
Optimizing Vs & Thickness - generation: 42; average & best misfits: -3.4266
-0.39556
Optimizing Vs & Thickness - generation: 43; average & best misfits: -2.4191
-0.39556
Optimizing Vs & Thickness - generation: 44; average & best misfits: -2.9564
-0.39556
Optimizing Vs & Thickness - generation: 45; average & best misfits: -2.5322

-0.39556
Optimizing Vs & Thickness - generation: 46; average & best misfits: -2.4338
-0.39556
Optimizing Vs & Thickness - generation: 47; average & best misfits: -2.0133
-0.36737
Optimizing Vs & Thickness - generation: 48; average & best misfits: -2.3021
-0.36181
Optimizing Vs & Thickness - generation: 49; average & best misfits: -2.3235
-0.36181
Optimizing Vs & Thickness - generation: 50; average & best misfits: -2.368
-0.36181
Optimizing Vs & Thickness - generation: 51; average & best misfits: -2.2236
-0.36181
Optimizing Vs & Thickness - generation: 52; average & best misfits: -2.6707
-0.35905
Optimizing Vs & Thickness - generation: 53; average & best misfits: -1.8156
-0.35905
Optimizing Vs & Thickness - generation: 54; average & best misfits: -1.866
-0.35905
Optimizing Vs & Thickness - generation: 55; average & best misfits: -1.9513
-0.34065
Optimizing Vs & Thickness - generation: 56; average & best misfits: -2.6181
-0.34065
Optimizing Vs & Thickness - generation: 57; average & best misfits: -2.2585
-0.34065
Optimizing Vs & Thickness - generation: 58; average & best misfits: -1.898
-0.34065
Optimizing Vs & Thickness - generation: 59; average & best misfits: -2.0879
-0.34065
Optimizing Vs & Thickness - generation: 60; average & best misfits: -1.9416
-0.34065
Optimizing Vs & Thickness - generation: 61; average & best misfits: -2.2899
-0.34065

Adopted search space (minimum Vs): 129 143 121 143 164
Adopted search space (maximum Vs): 252 280 238 280 322

Adopted search space (minimum Qs): 7.5 12 14.25 18
21
Adopted search space (maximum Qs): 15 24 28.5 36
42

Adopted search space (minimum reference frequency): 1
Adopted search space (maximum reference frequency): 38.023

Adopted search space (minimum Poisson): 0.16478 0.17484 0.17506
0.17484 0.17509
Adopted search space (maximum Poisson): 0.49434 0.497 0.497
0.497 0.497

Adopted search space (minimum thickness): 1.42857 10.7143 2.14286
2.14286
Adopted search space (maximum thickness): 2.8 21 4.2
4.2

Now a finer search around the most promising search space area

Rayleigh-wave analysis
Optimizing Vs & Thickness - generation: 1; average & best misfits: -4.6717
-0.34065
Optimizing Vs & Thickness - generation: 2; average & best misfits: -2.8998
-0.34065
Optimizing Vs & Thickness - generation: 3; average & best misfits: -3.0733
-0.34065
Optimizing Vs & Thickness - generation: 4; average & best misfits: -2.4011
-0.34065
Optimizing Vs & Thickness - generation: 5; average & best misfits: -2.1733

-0.34065
Optimizing Vs & Thickness - generation: 6; average & best misfits: -1.9299
-0.34065
Optimizing Vs & Thickness - generation: 7; average & best misfits: -2.0318
-0.34065
Optimizing Vs & Thickness - generation: 8; average & best misfits: -2.8743
-0.34065
Optimizing Vs & Thickness - generation: 9; average & best misfits: -2.0389
-0.34065
Optimizing Vs & Thickness - generation: 10; average & best misfits: -2.0992
-0.33964
Optimizing Vs & Thickness - generation: 11; average & best misfits: -2.0313
-0.33964
Optimizing Vs & Thickness - generation: 12; average & best misfits: -3.2553
-0.33964
Optimizing Vs & Thickness - generation: 13; average & best misfits: -3.2062
-0.33964
Optimizing Vs & Thickness - generation: 14; average & best misfits: -2.8941
-0.33964
Optimizing Vs & Thickness - generation: 15; average & best misfits: -3.4669
-0.33964
Optimizing Vs & Thickness - generation: 16; average & best misfits: -3.0703
-0.33964

Model after the Vs & Thickness optimization (fixed Poisson values):
Vs (m/s): 175 205 135 177 261
Thickness (m): 1.8 18 2.6 2.4

Number of models considered to calculate the average model: 93

##
RESULTS
##

Dataset: 57.sgy
Analyzed curve/spectrum: 57.cdp

========== SECTION#3

Analyzing Phase Velocities

Analyzing Rayleigh-Wave Dispersion

==
MEAN MODEL

Vs (m/s): 174 205 129 206 266
Standard deviations (m/s): 5 1 6 34 15

Thickness (m): 1.8 17.6 2.6 2.8
Standard deviations (m): 0.1 2.0 0.2 0.5

Approximate values for Vp, density, Poisson & Shear modulus
Vp (m/s): 463 414 382 371 460
Density (gr/cm3): 1.87 1.84 1.82 1.81 1.87
Vp/Vs ratio: 2.66 2.02 2.96 1.80 1.73
Poisson: 0.42 0.34 0.44 0.28 0.25
Shear modulus (MPa): 57 77 30 77 132
Estimated static shear modulus (MPa): 0 0 0 0
 0

Fundamental mode
Mean model
 f(Hz) VR(m/s)

3.15313	202.8732
4.75109	189.0599
6.80562	186.9144
11.3712	187.9726
14.7954	187.9158
21.4156	185.9393
24.7827	184.4052
29.862	181.6935
38.023	171.1423

========== SECTION#4

BEST MODEL

Vs (m/s): 175 205 135 177 261
thickness (m): 1.82506 18.285 2.56074 2.44075

Approximate values for Vp, density, Poisson & Shear modulus
Vp (m/s): 1006 378 388 298 423
Density (gr/cm3): 2.06 1.82 1.83 1.76 1.85
Vp/Vs ratio: 5.75 1.84 2.87 1.68 1.62
Poisson: 0.48 0.29 0.43 0.23 0.19
Shear modulus (MPa): 63 76 33 55 126
Estimated static shear modulus (MPa): 0 0 0 0
0

dispersion curve (frequency - velocity)

Fundamental mode)
best model

F(Hz)	VR(m/s)
3.15313	197.9789
4.75109	188.0455
6.80562	187.076
11.3712	188.3657
14.7954	188.1638
21.4156	185.9199
24.7827	184.3507
29.862	178.9302
38.023	167.3103

========== SECTION#5

Maximum penetration depth according to the "Steady State Rayleigh Method": 30 m

Inversion quality: very good

Vs30 & VsE (mean model): 200 200 m/s
Vs30 & VsE (best model): 199 199 m/s

========== 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
"C:\Users\Benedetta\Desktop\valdERA-esac\valdera-esac-22\output_disp".

==========
winMASW - Surface Waves & Beyond
www.winmasw.com

Number of models used to define the mean model: 93
Vs30 for the best model: 199 199
Analyzing phase velocities

UNIONE DI COMUNI DELLA VALDERA

INDAGINE ESAC/MASW - COMUNE DI PALAIA

LOC. CHIECINELLA - POSTAZIONE n.23

documentazione fotografica

ubicazione scala 1:1.000

geometria ESAC

geof	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
x	55	50	45	40	35	30	25	20	15	10	5	0	0	0	0	0	0	0	0	0	0	0	0	0
y	0	0	0	0	0	0	0	0	0	0	0	0	3	6	9	12	15	18	21	24	27	30	33	36

geometria MASW

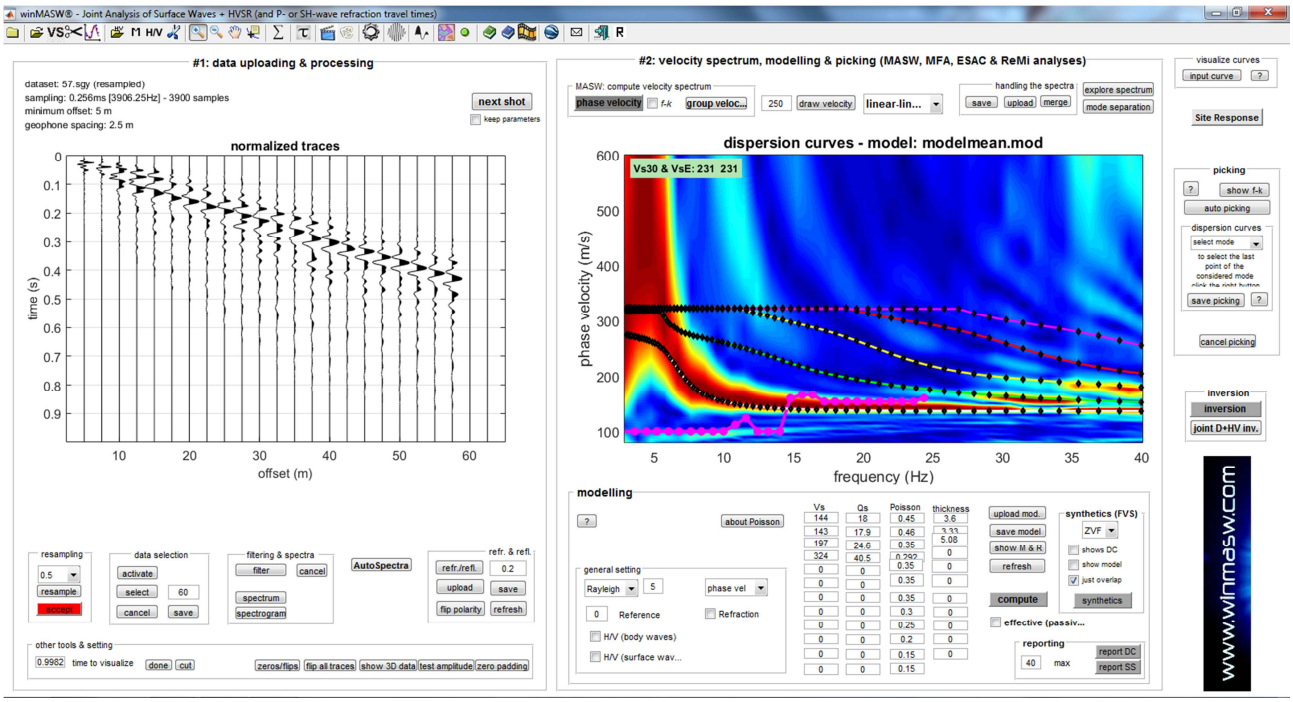
distanza geofonica 12 ch 5 m

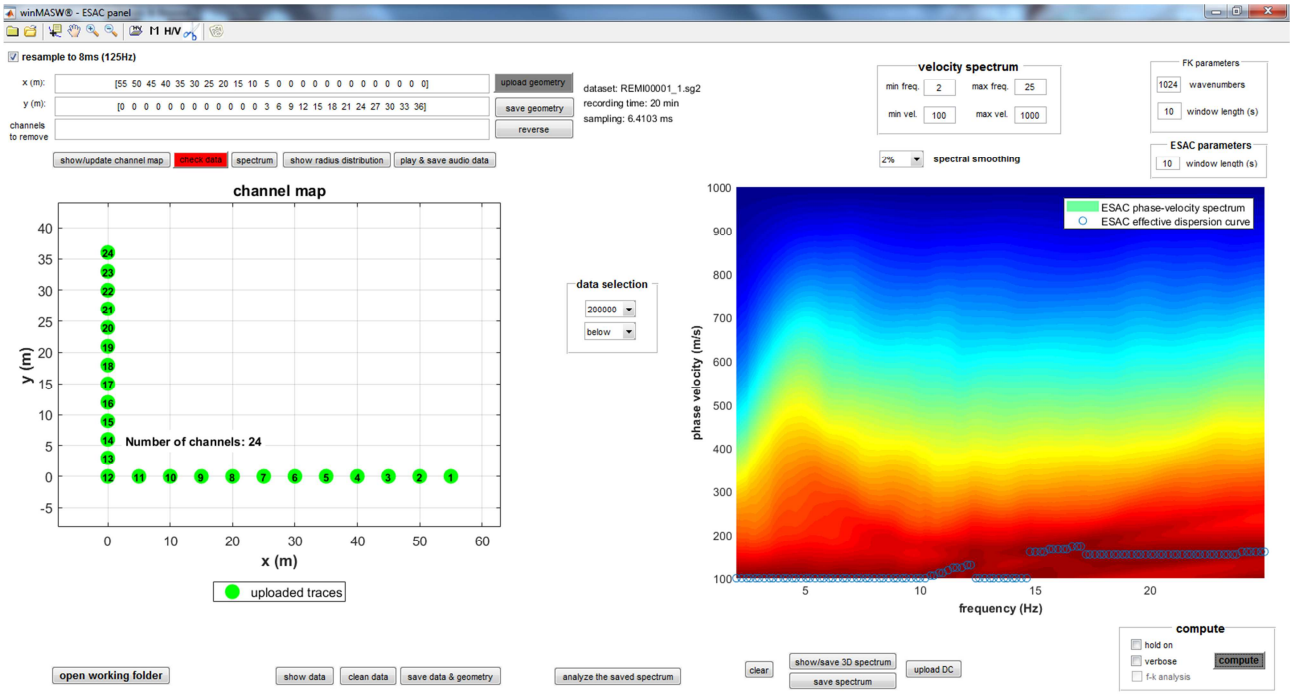
lunghezza linea 57.5 m

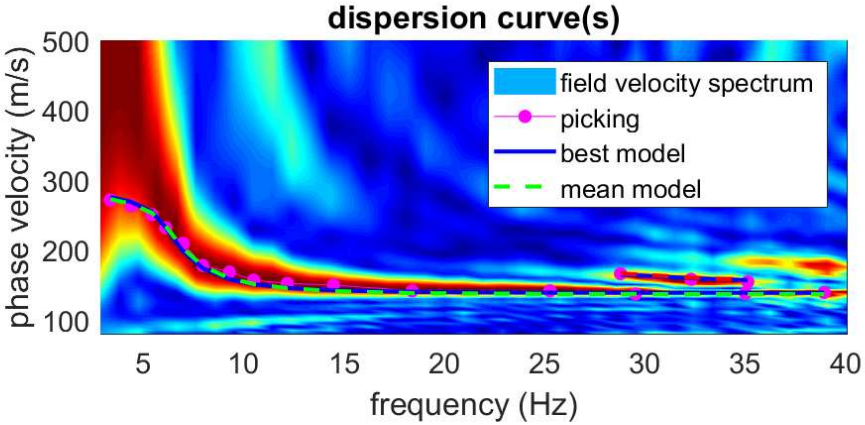
coordinate stazione 43°63’ 46.26” N 10°77’ 03.48” E

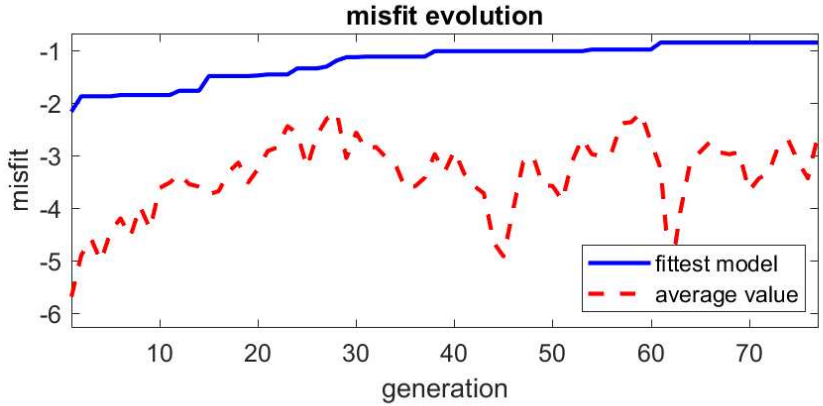
UNIONE VALDERA - Indagini sismiche MASW/ESAC

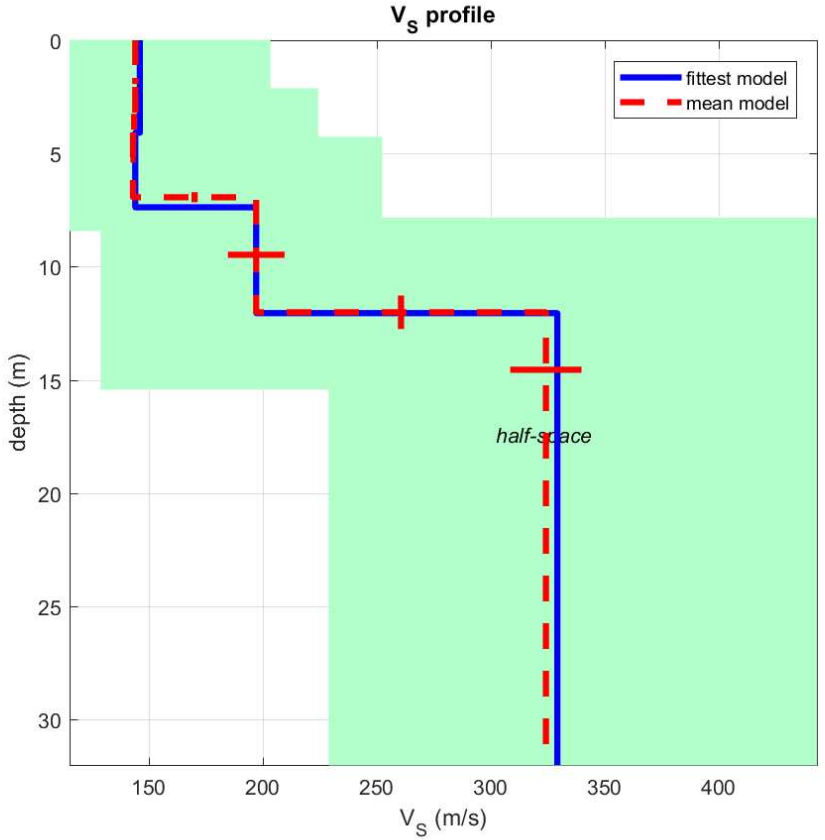
PROVA n. 23











www.winmasw.com

dataset: 57.sgy
dispersion curve: 57.cdp
Vs30 & VsE (best model): 232 232 m/s
Vs30 & VsE (mean model): 231 231 m/s

Mean model

Vs (m/s): 144, 143, 197, 324

Standard deviations (m/s): 1, 1, 12, 16

Thickness (m): 3.6, 3.3, 5.1

========== SECTION#1
dataset: 57.sgy
sampling (ms): 0.128
minimum offset (m): 5
geophone spacing (m): 2.5
offsets (m): 5 7.5 10 12.5 15 17.5
20 22.5 25 27.5 30 32.5
35 37.5 40 42.5 45 47.5
50 52.5 55 57.5 60 62.5
Dispersion curve: 57.cdp
Number of individuals: 32
Number of generations: 61

Rayleigh-wave dispersion analysis

Analyzing phase velocities

Adopted search space (minimum Vs): 104 114 129 229
Adopted search space (maximum Vs): 203 224 252 448

Adopted search space (minimum Poisson): 0.16511 0.17496 0.17516
0.17496
Adopted search space (maximum Poisson): 0.49533 0.499 0.499
0.499

Adopted search space (minimum Qs): 7.5 12 14.25 18
Adopted search space (maximum Qs): 15 24 28.5 36

Adopted search space (minimum reference frequency): 1
Adopted search space (maximum reference frequency): 38.9394

Adopted search space (minimum thickness): 2.1429 2.1429 3.5714
Adopted search space (maximum thickness): 4.2 4.2 7

Output folder:
C:\Users\Benedetta\Desktop\valdERA-esac\valdera-esac-23\output_disp

========== SECTION#2
Rayleigh-wave analysis
Optimizing Vs & Thickness - generation: 1; average & best misfits: -5.6888
-2.1729
Optimizing Vs & Thickness - generation: 2; average & best misfits: -4.8996
-1.8798
Optimizing Vs & Thickness - generation: 3; average & best misfits: -4.582
-1.8798
Optimizing Vs & Thickness - generation: 4; average & best misfits: -5.0077
-1.8798
Optimizing Vs & Thickness - generation: 5; average & best misfits: -4.4468
-1.8798
Optimizing Vs & Thickness - generation: 6; average & best misfits: -4.194
-1.8563
Optimizing Vs & Thickness - generation: 7; average & best misfits: -4.5435
-1.8563
Optimizing Vs & Thickness - generation: 8; average & best misfits: -3.9707
-1.8563
Optimizing Vs & Thickness - generation: 9; average & best misfits: -4.3963
-1.8563
Optimizing Vs & Thickness - generation: 10; average & best misfits: -3.618
-1.8563
Optimizing Vs & Thickness - generation: 11; average & best misfits: -3.5192
-1.8563
Optimizing Vs & Thickness - generation: 12; average & best misfits: -3.3635
-1.7747
Optimizing Vs & Thickness - generation: 13; average & best misfits: -3.5476

-1.7747
Optimizing Vs & Thickness - generation: 14; average & best misfits: -3.5938
-1.7747
Optimizing Vs & Thickness - generation: 15; average & best misfits: -3.7415
-1.4962
Optimizing Vs & Thickness - generation: 16; average & best misfits: -3.6817
-1.4962
Optimizing Vs & Thickness - generation: 17; average & best misfits: -3.3175
-1.4962
Optimizing Vs & Thickness - generation: 18; average & best misfits: -3.1377
-1.4962
Optimizing Vs & Thickness - generation: 19; average & best misfits: -3.5174
-1.4962
Optimizing Vs & Thickness - generation: 20; average & best misfits: -3.2591
-1.4845
Optimizing Vs & Thickness - generation: 21; average & best misfits: -2.9163
-1.4656
Optimizing Vs & Thickness - generation: 22; average & best misfits: -2.8484
-1.4656
Optimizing Vs & Thickness - generation: 23; average & best misfits: -2.4463
-1.4656
Optimizing Vs & Thickness - generation: 24; average & best misfits: -2.5826
-1.3506
Optimizing Vs & Thickness - generation: 25; average & best misfits: -3.2249
-1.3506
Optimizing Vs & Thickness - generation: 26; average & best misfits: -2.623
-1.3506
Optimizing Vs & Thickness - generation: 27; average & best misfits: -2.3069
-1.3146
Optimizing Vs & Thickness - generation: 28; average & best misfits: -2.1746
-1.2026
Optimizing Vs & Thickness - generation: 29; average & best misfits: -3.0539
-1.1378
Optimizing Vs & Thickness - generation: 30; average & best misfits: -2.5671
-1.1378
Optimizing Vs & Thickness - generation: 31; average & best misfits: -2.8859
-1.1269
Optimizing Vs & Thickness - generation: 32; average & best misfits: -2.8394
-1.1269
Optimizing Vs & Thickness - generation: 33; average & best misfits: -3.0298
-1.1269
Optimizing Vs & Thickness - generation: 34; average & best misfits: -3.1733
-1.1269
Optimizing Vs & Thickness - generation: 35; average & best misfits: -3.6243
-1.1269
Optimizing Vs & Thickness - generation: 36; average & best misfits: -3.5876
-1.1269
Optimizing Vs & Thickness - generation: 37; average & best misfits: -3.4232
-1.1269
Optimizing Vs & Thickness - generation: 38; average & best misfits: -2.976
-1.0238
Optimizing Vs & Thickness - generation: 39; average & best misfits: -3.3167
-1.0238
Optimizing Vs & Thickness - generation: 40; average & best misfits: -2.9133
-1.0238
Optimizing Vs & Thickness - generation: 41; average & best misfits: -3.3472
-1.0238
Optimizing Vs & Thickness - generation: 42; average & best misfits: -3.5807
-1.0238
Optimizing Vs & Thickness - generation: 43; average & best misfits: -3.7209
-1.0238
Optimizing Vs & Thickness - generation: 44; average & best misfits: -4.6545
-1.0238
Optimizing Vs & Thickness - generation: 45; average & best misfits: -4.9198
-1.0238
Optimizing Vs & Thickness - generation: 46; average & best misfits: -4.0184
-1.0238
Optimizing Vs & Thickness - generation: 47; average & best misfits: -3.1322

-1.0238
Optimizing Vs & Thickness - generation: 48; average & best misfits: -3.0082
-1.0238
Optimizing Vs & Thickness - generation: 49; average & best misfits: -3.5645
-1.0238
Optimizing Vs & Thickness - generation: 50; average & best misfits: -3.583
-1.0238
Optimizing Vs & Thickness - generation: 51; average & best misfits: -3.8598
-1.0238
Optimizing Vs & Thickness - generation: 52; average & best misfits: -3.1118
-1.0238
Optimizing Vs & Thickness - generation: 53; average & best misfits: -2.6816
-1.0238
Optimizing Vs & Thickness - generation: 54; average & best misfits: -2.9787
-0.99302
Optimizing Vs & Thickness - generation: 55; average & best misfits: -3.0178
-0.99302
Optimizing Vs & Thickness - generation: 56; average & best misfits: -2.95
-0.99302
Optimizing Vs & Thickness - generation: 57; average & best misfits: -2.3946
-0.99302
Optimizing Vs & Thickness - generation: 58; average & best misfits: -2.3707
-0.99302
Optimizing Vs & Thickness - generation: 59; average & best misfits: -2.1968
-0.99302
Optimizing Vs & Thickness - generation: 60; average & best misfits: -2.7367
-0.99302
Optimizing Vs & Thickness - generation: 61; average & best misfits: -3.2478
-0.86023

Adopted search space (minimum Vs): 104 114 129 229
Adopted search space (maximum Vs): 203 224 252 448

Adopted search space (minimum Qs): 7.5 12 14.25 18
Adopted search space (maximum Qs): 15 24 28.5 36

Adopted search space (minimum reference frequency): 1
Adopted search space (maximum reference frequency): 38.9394

Adopted search space (minimum Poisson): 0.16511 0.17496 0.17516
0.17496
Adopted search space (maximum Poisson): 0.49533 0.497 0.497
0.497

Adopted search space (minimum thickness): 2.1429 2.1429 3.5714
Adopted search space (maximum thickness): 4.2 4.2 7

Now a finer search around the most promising search space area

Rayleigh-wave analysis
Optimizing Vs & Thickness - generation: 1; average & best misfits: -5.3038
-0.86023
Optimizing Vs & Thickness - generation: 2; average & best misfits: -4.0877
-0.86023
Optimizing Vs & Thickness - generation: 3; average & best misfits: -3.1358
-0.86023
Optimizing Vs & Thickness - generation: 4; average & best misfits: -2.9404
-0.86023
Optimizing Vs & Thickness - generation: 5; average & best misfits: -2.7489
-0.86023
Optimizing Vs & Thickness - generation: 6; average & best misfits: -2.9442
-0.86023
Optimizing Vs & Thickness - generation: 7; average & best misfits: -2.9795
-0.86023
Optimizing Vs & Thickness - generation: 8; average & best misfits: -2.9403
-0.86023
Optimizing Vs & Thickness - generation: 9; average & best misfits: -3.6776

-0.86023
Optimizing Vs & Thickness - generation: 10; average & best misfits: -3.4391
-0.86023
Optimizing Vs & Thickness - generation: 11; average & best misfits: -3.343
-0.86023
Optimizing Vs & Thickness - generation: 12; average & best misfits: -2.816
-0.86023
Optimizing Vs & Thickness - generation: 13; average & best misfits: -2.7088
-0.86023
Optimizing Vs & Thickness - generation: 14; average & best misfits: -3.1198
-0.86023
Optimizing Vs & Thickness - generation: 15; average & best misfits: -3.4371
-0.86023
Optimizing Vs & Thickness - generation: 16; average & best misfits: -2.6368
-0.86023

Model after the Vs & Thickness optimization (fixed Poisson values):
Vs (m/s): 146 144 197 329
Thickness (m): 4.1 3.3 4.7

Number of models considered to calculate the average model: 130

##
RESULTS
##

Dataset: 57.sgy
Analyzed curve/spectrum: 57.cdp

========== SECTION#3

Analyzing Phase Velocities

Analyzing Rayleigh-Wave Dispersion

==
MEAN MODEL

Vs (m/s): 144 143 197 324
Standard deviations (m/s): 1 1 12 16

Thickness (m): 3.6 3.3 5.1
Standard deviations (m): 0.4 0.2 0.7

Approximate values for Vp, density, Poisson & Shear modulus
Vp (m/s): 476 525 410 598
Density (gr/cm3): 1.87 1.90 1.84 1.93
Vp/Vs ratio: 3.31 3.67 2.08 1.85
Poisson: 0.45 0.46 0.35 0.29
Shear modulus (MPa): 39 39 71 203
Estimated static shear modulus (MPa): 0 0 0 0

Fundamental mode
Mean model
f(Hz)	VR(m/s)
3.35199	272.6782
4.39019	265.813
5.4284	252.9674
6.12053	233.6193
6.98571	201.8986
7.96623	176.7491
9.29283	159.3132
10.5041	151.1402
12.1767	145.0381

14.4839	140.9231
18.406	138.1606
25.2697	136.9105
29.5378	136.7245
35.0173	136.6504
38.9394	136.6366

First higher mode
Mean model

28.788	166.1894
32.3064	160.2853
35.1326	156.9095

========== SECTION#4

BEST MODEL

Vs (m/s): 146 144 197 329
thickness (m): 4.0864 3.2899 4.6731

Approximate values for Vp, density, Poisson & Shear modulus
Vp (m/s): 517 654 398 592
Density (gr/cm3): 1.89 1.95 1.83 1.93
Vp/Vs ratio: 3.54 4.54 2.02 1.80
Poisson: 0.46 0.47 0.34 0.28
Shear modulus (MPa): 40 40 71 209
Estimated static shear modulus (MPa): 0 0 0 0

dispersion curve (frequency - velocity)

Fundamental mode)
best model

F(Hz)	VR(m/s)
3.35199	275.6435
4.39019	268.7734
5.4284	254.5736
6.12053	231.6807
6.98571	197.6967
7.96623	173.6396
9.29283	157.9138
10.5041	150.7625
12.1767	145.5305
14.4839	142.0734
18.406	139.8093
25.2697	138.8327
29.5378	138.7023
35.0173	138.6598
38.9394	138.6564

First higher mode)
best model

28.788	164.5532
32.3064	159.4216
35.1326	156.5268

========== SECTION#5

Maximum penetration depth according to the "Steady State Rayleigh Method": 32 m

Inversion quality: very good

Vs30 & VsE (mean model): 231 231 m/s
Vs30 & VsE (best model): 232 232 m/s

========== 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
"C:\Users\Benedetta\Desktop\valdERA-esac\valdera-esac-23\output_disp".

==========
winMASW - Surface Waves & Beyond
www.winmasw.com

Number of models used to define the mean model: 130
Vs30 for the best model: 232 232
Analyzing phase velocities

UNIONE DI COMUNI DELLA VALDERA

INDAGINE ESAC/MASW - COMUNE DI PALAIA

LOC. MONTEFOSCOLI - POSTAZIONE n.24

documentazione fotografica

ubicazione scala 1:1.000

geometria ESAC

geof	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
x	55	50	45	40	35	30	25	20	15	10	5	0	0	0	0	0	0	0	0	0	0	0	0	0
y	0	0	0	0	0	0	0	0	0	0	0	0	3	6	9	12	15	18	21	24	27	30	33	36

geometria MASW

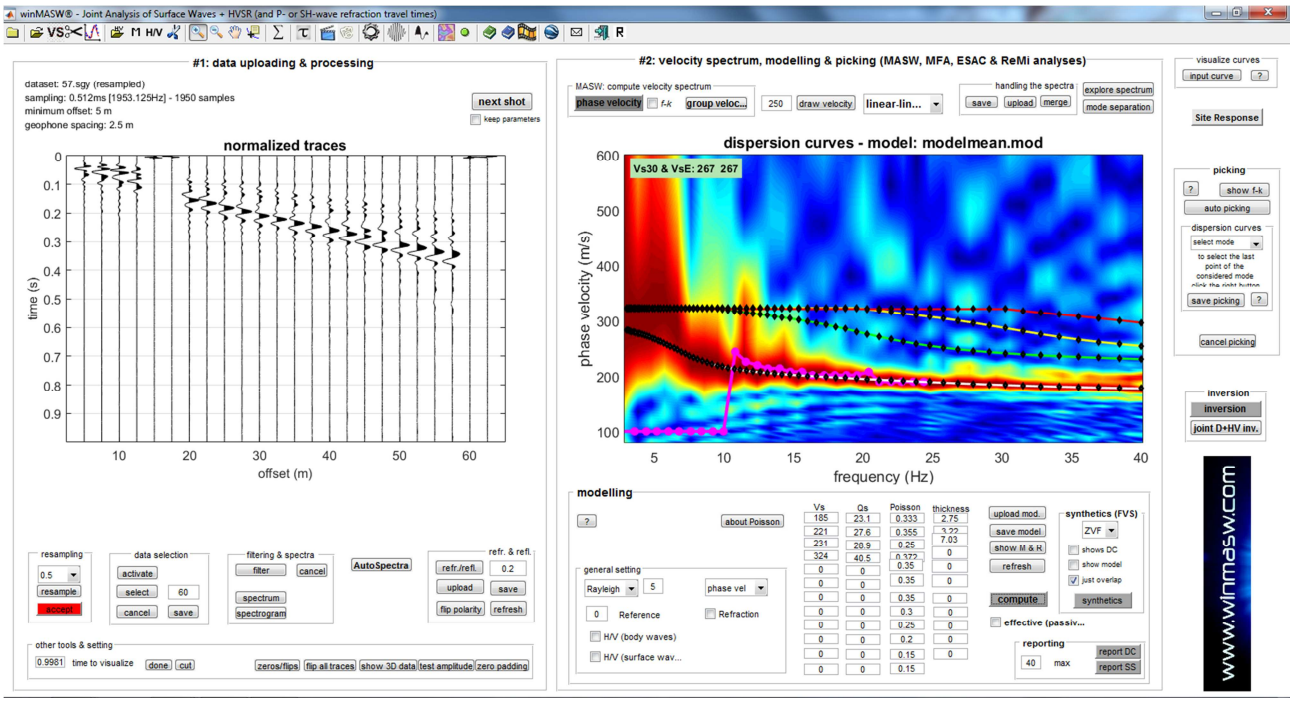
distanza geofonica 12 ch 5 m

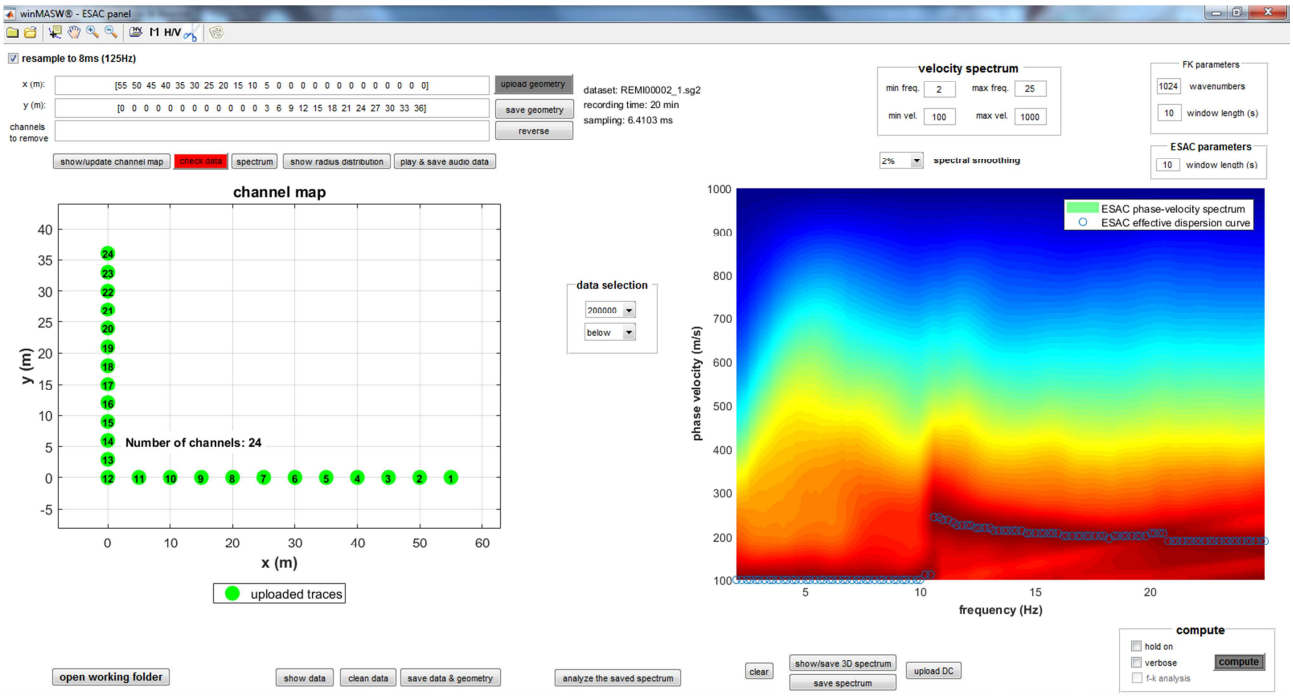
lunghezza linea 57.5 m

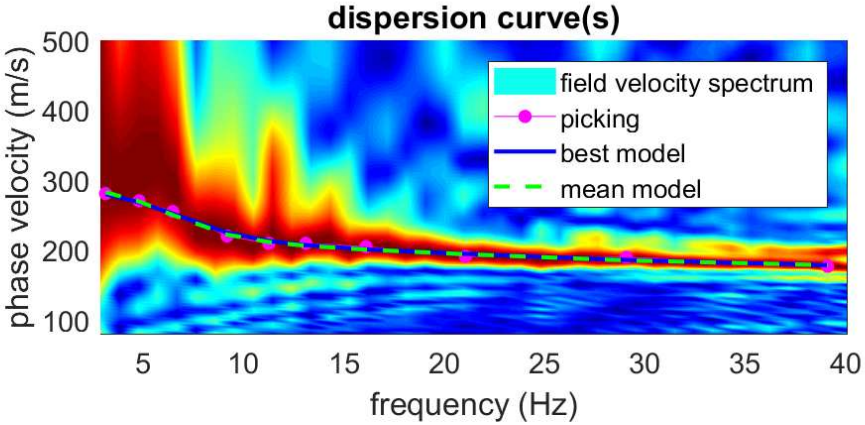
coordinate stazione 43°57’ 99.94” N 10°72’ 96.41” E

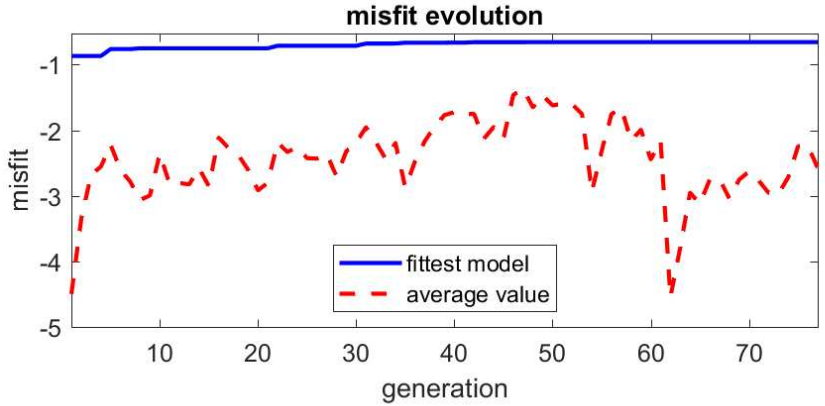
UNIONE VALDERA - Indagini sismiche MASW/ESAC

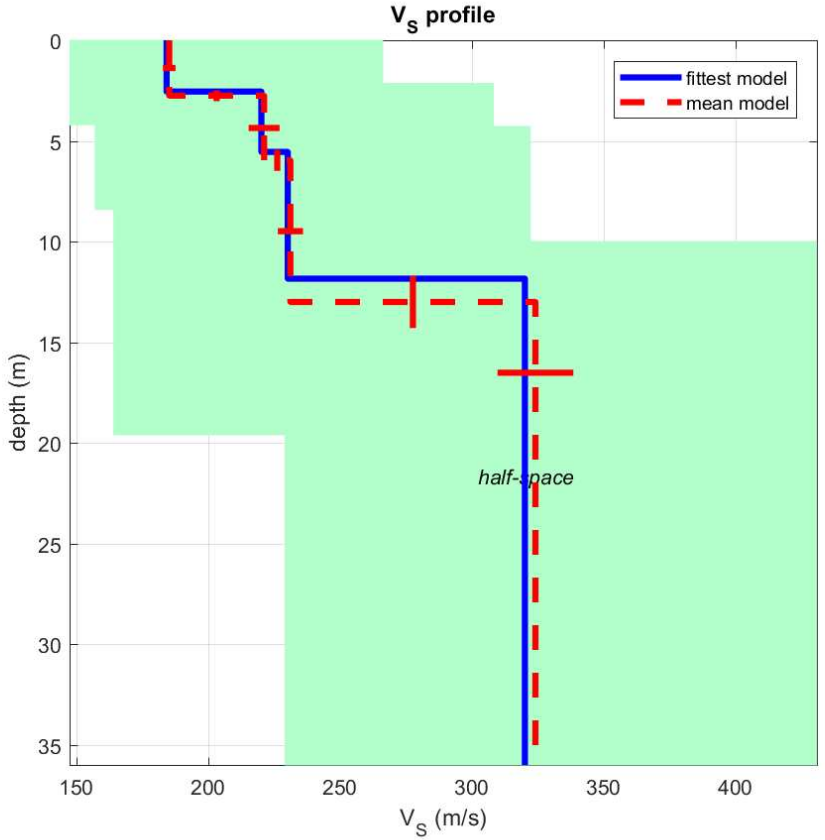
PROVA n. 24











www.winmasw.com

dataset: 57.sgy
dispersion curve: 57.cdp
Vs30 & VsE (best model): 269 269 m/s
Vs30 & VsE (mean model): 267 267 m/s

Mean model

Vs (m/s): 185, 221, 231, 324

Standard deviations (m/s): 2, 6, 5, 14

Thickness (m): 2.8, 3.2, 7.0

========== SECTION#1
dataset: 57.sgy
sampling (ms): 0.256
minimum offset (m): 5
geophone spacing (m): 2.5
offsets (m): 5 7.5 10 12.5 15 17.5
20 22.5 25 27.5 30 32.5
35 37.5 40 42.5 45 47.5
50 52.5 55 57.5 60 62.5
Dispersion curve: 57.cdp
Number of individuals: 32
Number of generations: 61

Rayleigh-wave dispersion analysis

Analyzing phase velocities

Adopted search space (minimum Vs): 136 157 164 229
Adopted search space (maximum Vs): 266 308 322 448

Adopted search space (minimum Poisson): 0.16488 0.17501 0.17509
0.17496
Adopted search space (maximum Poisson): 0.49465 0.499 0.499
0.499

Adopted search space (minimum Qs): 7.5 12 14.25 18
Adopted search space (maximum Qs): 15 24 28.5 36

Adopted search space (minimum reference frequency): 1
Adopted search space (maximum reference frequency): 39.122

Adopted search space (minimum thickness): 2.1429 2.1429 5.7143
Adopted search space (maximum thickness): 4.2 4.2 11.2

Output folder:
C:\Users\Benedetta\Desktop\valdERA-esac\valdera-esac-24\output_disp

========== SECTION#2
Rayleigh-wave analysis
Optimizing Vs & Thickness - generation: 1; average & best misfits: -4.4991
-0.86773
Optimizing Vs & Thickness - generation: 2; average & best misfits: -3.3539
-0.86773
Optimizing Vs & Thickness - generation: 3; average & best misfits: -2.6829
-0.86773
Optimizing Vs & Thickness - generation: 4; average & best misfits: -2.5557
-0.86773
Optimizing Vs & Thickness - generation: 5; average & best misfits: -2.2253
-0.76143
Optimizing Vs & Thickness - generation: 6; average & best misfits: -2.6032
-0.76143
Optimizing Vs & Thickness - generation: 7; average & best misfits: -2.7864
-0.76143
Optimizing Vs & Thickness - generation: 8; average & best misfits: -3.064
-0.74959
Optimizing Vs & Thickness - generation: 9; average & best misfits: -2.9938
-0.74959
Optimizing Vs & Thickness - generation: 10; average & best misfits: -2.3572
-0.74959
Optimizing Vs & Thickness - generation: 11; average & best misfits: -2.8233
-0.74959
Optimizing Vs & Thickness - generation: 12; average & best misfits: -2.8055
-0.74959
Optimizing Vs & Thickness - generation: 13; average & best misfits: -2.825

-0.74959
Optimizing Vs & Thickness - generation: 14; average & best misfits: -2.5801
-0.74959
Optimizing Vs & Thickness - generation: 15; average & best misfits: -2.8543
-0.74959
Optimizing Vs & Thickness - generation: 16; average & best misfits: -2.1117
-0.74959
Optimizing Vs & Thickness - generation: 17; average & best misfits: -2.2717
-0.74959
Optimizing Vs & Thickness - generation: 18; average & best misfits: -2.3773
-0.74959
Optimizing Vs & Thickness - generation: 19; average & best misfits: -2.6055
-0.74959
Optimizing Vs & Thickness - generation: 20; average & best misfits: -2.917
-0.74959
Optimizing Vs & Thickness - generation: 21; average & best misfits: -2.8017
-0.74959
Optimizing Vs & Thickness - generation: 22; average & best misfits: -2.1868
-0.71117
Optimizing Vs & Thickness - generation: 23; average & best misfits: -2.3332
-0.71117
Optimizing Vs & Thickness - generation: 24; average & best misfits: -2.2553
-0.71117
Optimizing Vs & Thickness - generation: 25; average & best misfits: -2.4259
-0.71117
Optimizing Vs & Thickness - generation: 26; average & best misfits: -2.4325
-0.71117
Optimizing Vs & Thickness - generation: 27; average & best misfits: -2.3641
-0.71117
Optimizing Vs & Thickness - generation: 28; average & best misfits: -2.7034
-0.71117
Optimizing Vs & Thickness - generation: 29; average & best misfits: -2.3193
-0.71117
Optimizing Vs & Thickness - generation: 30; average & best misfits: -2.1879
-0.71117
Optimizing Vs & Thickness - generation: 31; average & best misfits: -1.9549
-0.67729
Optimizing Vs & Thickness - generation: 32; average & best misfits: -2.1836
-0.67729
Optimizing Vs & Thickness - generation: 33; average & best misfits: -2.4364
-0.67729
Optimizing Vs & Thickness - generation: 34; average & best misfits: -2.1947
-0.6768
Optimizing Vs & Thickness - generation: 35; average & best misfits: -2.8734
-0.6645
Optimizing Vs & Thickness - generation: 36; average & best misfits: -2.4732
-0.6645
Optimizing Vs & Thickness - generation: 37; average & best misfits: -2.1629
-0.6645
Optimizing Vs & Thickness - generation: 38; average & best misfits: -1.9441
-0.6645
Optimizing Vs & Thickness - generation: 39; average & best misfits: -1.7681
-0.6645
Optimizing Vs & Thickness - generation: 40; average & best misfits: -1.7239
-0.66288
Optimizing Vs & Thickness - generation: 41; average & best misfits: -1.7541
-0.66288
Optimizing Vs & Thickness - generation: 42; average & best misfits: -1.7495
-0.65662
Optimizing Vs & Thickness - generation: 43; average & best misfits: -2.1303
-0.65662
Optimizing Vs & Thickness - generation: 44; average & best misfits: -1.9507
-0.65662
Optimizing Vs & Thickness - generation: 45; average & best misfits: -2.1246
-0.65662
Optimizing Vs & Thickness - generation: 46; average & best misfits: -1.4616
-0.65662
Optimizing Vs & Thickness - generation: 47; average & best misfits: -1.3681

-0.65662
Optimizing Vs & Thickness - generation: 48; average & best misfits: -1.6515
-0.65515
Optimizing Vs & Thickness - generation: 49; average & best misfits: -1.4678
-0.65515
Optimizing Vs & Thickness - generation: 50; average & best misfits: -1.622
-0.65515
Optimizing Vs & Thickness - generation: 51; average & best misfits: -1.5947
-0.65515
Optimizing Vs & Thickness - generation: 52; average & best misfits: -1.6042
-0.65515
Optimizing Vs & Thickness - generation: 53; average & best misfits: -1.7551
-0.65515
Optimizing Vs & Thickness - generation: 54; average & best misfits: -2.9373
-0.65515
Optimizing Vs & Thickness - generation: 55; average & best misfits: -2.314
-0.65515
Optimizing Vs & Thickness - generation: 56; average & best misfits: -1.7542
-0.65515
Optimizing Vs & Thickness - generation: 57; average & best misfits: -1.6611
-0.65515
Optimizing Vs & Thickness - generation: 58; average & best misfits: -2.1607
-0.65515
Optimizing Vs & Thickness - generation: 59; average & best misfits: -1.9919
-0.65515
Optimizing Vs & Thickness - generation: 60; average & best misfits: -2.4461
-0.65515
Optimizing Vs & Thickness - generation: 61; average & best misfits: -2.1587
-0.65515

Adopted search space (minimum Vs): 136 157 164 229
Adopted search space (maximum Vs): 266 308 322 448

Adopted search space (minimum Qs): 7.5 12 14.25 18
Adopted search space (maximum Qs): 15 24 28.5 36

Adopted search space (minimum reference frequency): 1
Adopted search space (maximum reference frequency): 39.122

Adopted search space (minimum Poisson): 0.16488 0.17501 0.17509
0.17496
Adopted search space (maximum Poisson): 0.49465 0.497 0.497
0.497

Adopted search space (minimum thickness): 2.1429 2.1429 5.7143
Adopted search space (maximum thickness): 4.2 4.2 11.2

Now a finer search around the most promising search space area

Rayleigh-wave analysis
Optimizing Vs & Thickness - generation: 1; average & best misfits: -4.5464
-0.65515
Optimizing Vs & Thickness - generation: 2; average & best misfits: -3.7903
-0.65515
Optimizing Vs & Thickness - generation: 3; average & best misfits: -2.9538
-0.65515
Optimizing Vs & Thickness - generation: 4; average & best misfits: -3.1197
-0.65515
Optimizing Vs & Thickness - generation: 5; average & best misfits: -2.7546
-0.65515
Optimizing Vs & Thickness - generation: 6; average & best misfits: -2.7447
-0.65515
Optimizing Vs & Thickness - generation: 7; average & best misfits: -3.0414
-0.65515
Optimizing Vs & Thickness - generation: 8; average & best misfits: -2.7545
-0.65515
Optimizing Vs & Thickness - generation: 9; average & best misfits: -2.6297

-0.65515
Optimizing Vs & Thickness - generation: 10; average & best misfits: -2.7705
-0.65515
Optimizing Vs & Thickness - generation: 11; average & best misfits: -2.955
-0.65515
Optimizing Vs & Thickness - generation: 12; average & best misfits: -2.9714
-0.65515
Optimizing Vs & Thickness - generation: 13; average & best misfits: -2.7164
-0.65515
Optimizing Vs & Thickness - generation: 14; average & best misfits: -2.2447
-0.65515
Optimizing Vs & Thickness - generation: 15; average & best misfits: -2.2345
-0.65515
Optimizing Vs & Thickness - generation: 16; average & best misfits: -2.5764
-0.65515

Model after the Vs & Thickness optimization (fixed Poisson values):
Vs (m/s): 184 220 230 320
Thickness (m): 2.5 3 6.3

Number of models considered to calculate the average model: 270

##
RESULTS
##

Dataset: 57.sgy
Analyzed curve/spectrum: 57.cdp

========== SECTION#3

Analyzing Phase Velocities

Analyzing Rayleigh-Wave Dispersion

==
MEAN MODEL

Vs (m/s): 185 221 231 324
Standard deviations (m/s): 2 6 5 14

Thickness (m): 2.8 3.2 7.0
Standard deviations (m): 0.3 0.5 1.3

Approximate values for Vp, density, Poisson & Shear modulus
Vp (m/s): 370 466 400 717
Density (gr/cm3): 1.81 1.87 1.83 1.97
Vp/Vs ratio: 2.00 2.11 1.73 2.21
Poisson: 0.33 0.35 0.25 0.37
Shear modulus (MPa): 62 91 98 207
Estimated static shear modulus (MPa): 0 0 0 0

Fundamental mode
Mean model
 f(Hz) VR(m/s)
3.12204 282.4516
4.79511 269.2711
6.46818 249.9084
9.17972 221.7882
11.2566 211.2329
13.1028 205.9087
16.1028 200.4019
21.0643 193.7407
29.0835 184.9434

 39.122   178.1792

========== SECTION#4

BEST MODEL

Vs (m/s): 184 220 230 320
thickness (m): 2.5493   3   6.2942

Approximate values for Vp, density, Poisson & Shear modulus
Vp (m/s):   359 480 373 723
Density (gr/cm3):   1.81   1.88   1.82   1.98
Vp/Vs ratio: 1.95   2.18   1.62   2.26
Poisson: 0.32   0.37   0.19   0.38
Shear modulus (MPa): 61   91   96   202
Estimated static shear modulus (MPa): 0   0   0   0

dispersion curve (frequency - velocity)

Fundamental mode)
best model
 F(Hz)   VR(m/s)
3.12204   279.9489
4.79511   268.0874
6.46818   251.7509
9.17972   224.6295
11.2566   212.809
13.1028   206.7554
16.1028   200.7872
21.0643   194.2194
29.0835   185.5712
 39.122   178.2242

========== SECTION#5

Maximum penetration depth according to the "Steady State Rayleigh Method": 36 m

Inversion quality: very good

Vs30 & VsE (mean model): 267 267 m/s
Vs30 & VsE (best model): 269 269 m/s

========== 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
"C:\Users\Benedetta\Desktop\valdERA-esac\valdera-esac-24\output_disp".

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winMASW - Surface Waves & Beyond
www.winmasw.com

Number of models used to define the mean model: 270
Vs30 for the best model: 269 269
Analyzing phase velocities