



Tutorial for ambient noise tomography processing using SeisImager/SW-3D

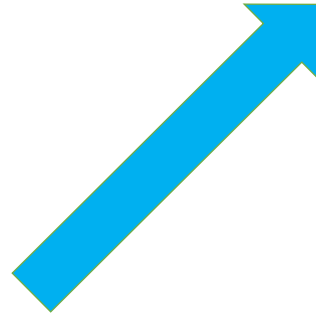
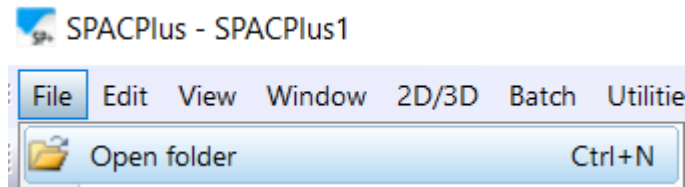
- Processing ambient noise data obtained by Atom.
- SeisImager/SW3D license is required.
- Download the latest installer from :
<https://seisimager.com/download/SeisImager.zip>
- Download the example data from :
http://seisimager.esy.es/GeophysicalDatabase/mam_3d.zip
- See *“2D/3D ambient noise tomography processing using SPACPlus and other SeisImager modules”* for more details

Import Atom data files

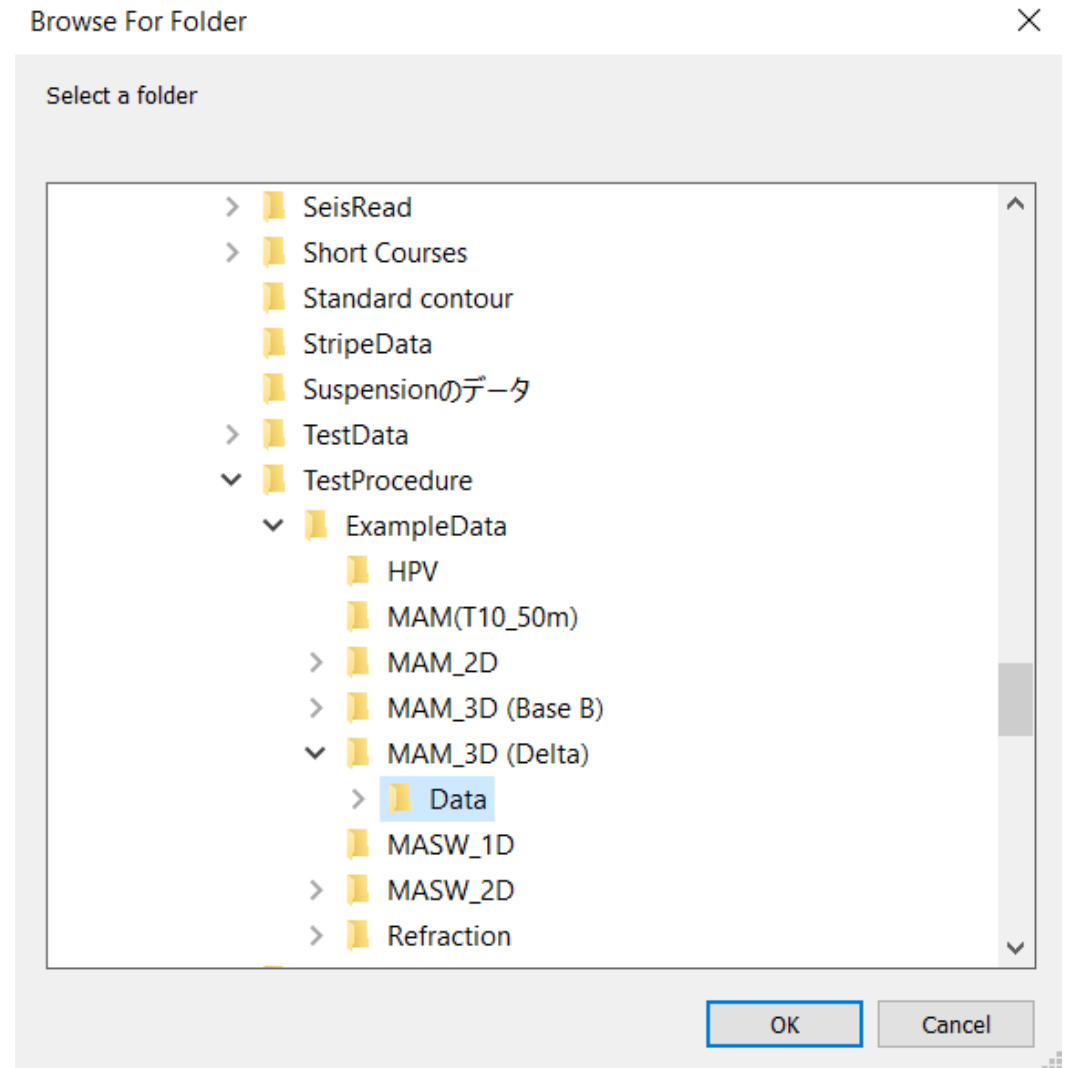
Double click icon to launch SPACPlus



Select "File", "Open folder".



Select a root folder of data.

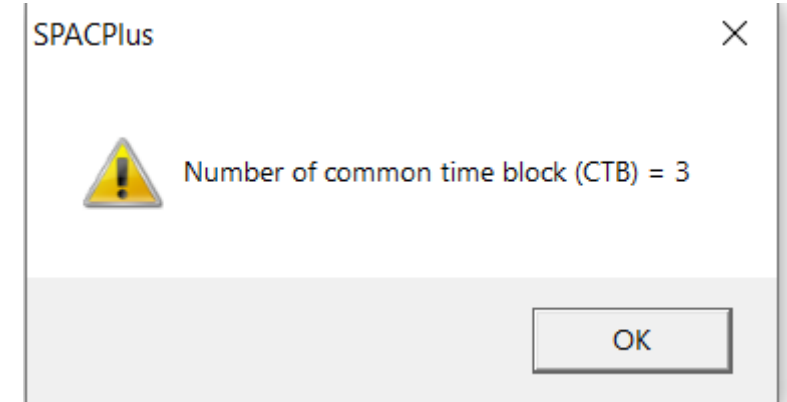
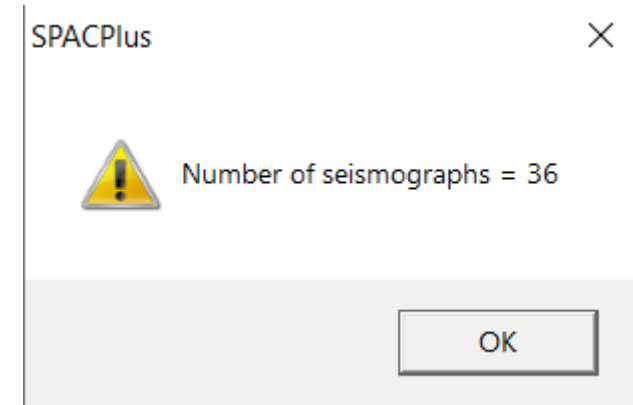


Import Atom data files

Confirm number of seismograph (Atom acquisition units).

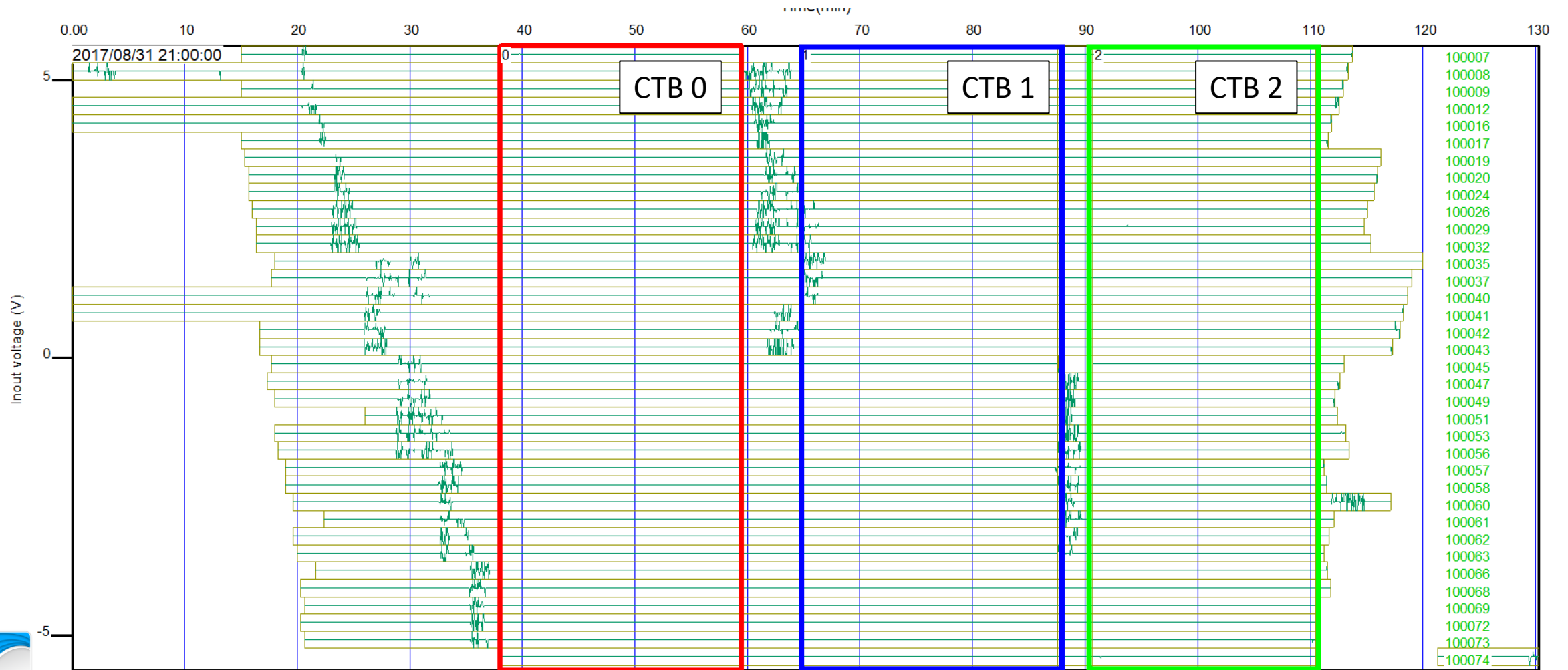


Confirm number common time blocks (CTB).



Common time blocks (CTBs)

The example data include three CTBs.

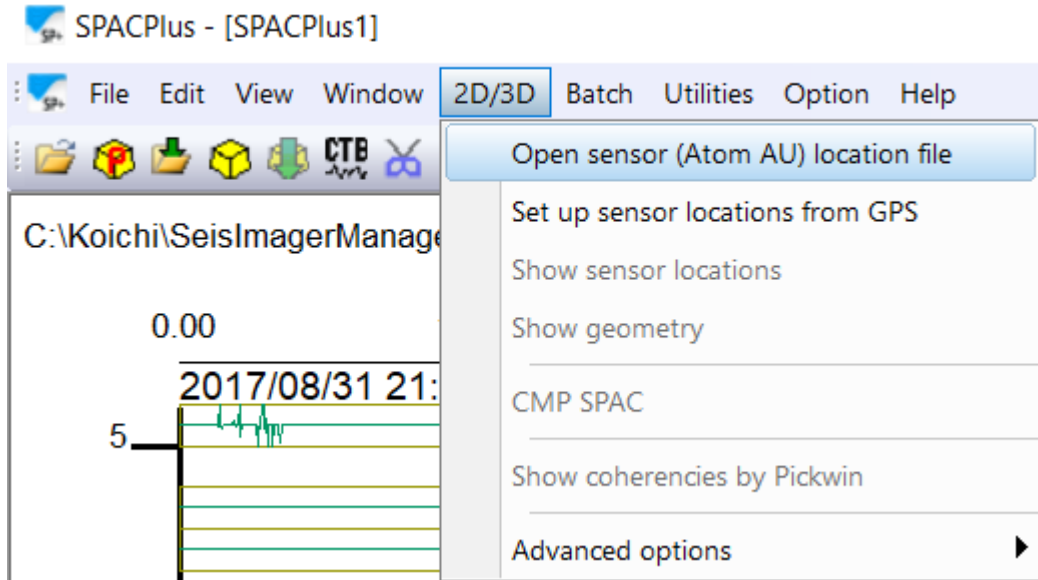


Prepare geometry file (array-all_geometry.txt)

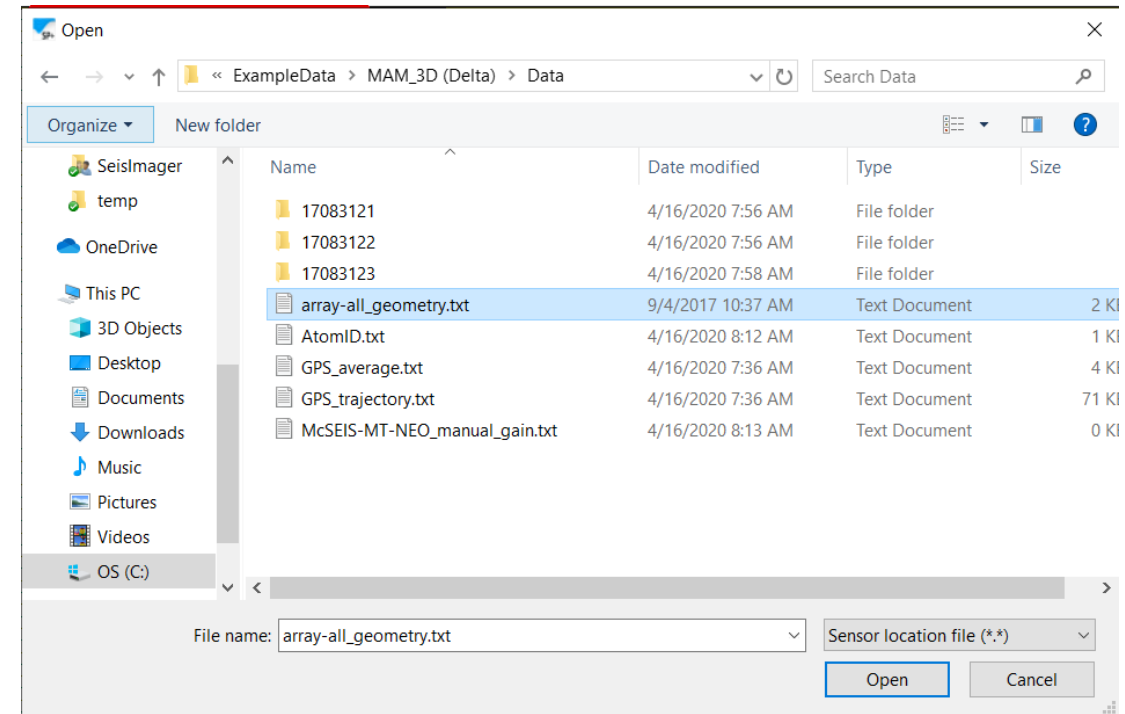
| CTB index | Atom ID | X | Y |
|-----------|---------|----|----|
| ↓ | ↓ | ↓ | ↓ |
| 0 | 100007 | 90 | 0 |
| 0 | 100008 | 90 | 9 |
| 0 | 100009 | 90 | 18 |
| 0 | 100012 | 90 | 27 |
| 0 | 100016 | 90 | 36 |
| 0 | 100017 | 90 | 45 |
| 0 | 100019 | 81 | 0 |
| 0 | 100020 | 81 | 9 |
| 0 | 100024 | 81 | 18 |
| 0 | 100026 | 81 | 27 |
| 0 | 100029 | 81 | 36 |
| 0 | 100032 | 81 | 45 |
| 0 | 100035 | 72 | 0 |
| | . | | |
| | . | | |
| 0 | 100066 | 45 | 0 |
| 0 | 100068 | 45 | 9 |
| 0 | 100069 | 45 | 18 |
| 0 | 100072 | 45 | 27 |
| 0 | 100073 | 45 | 36 |
| 0 | 100074 | 45 | 45 |
| 1 | 100007 | 36 | 0 |
| 1 | 100008 | 36 | 9 |
| 1 | 100009 | 36 | 18 |
| 1 | 100012 | 36 | 27 |
| 1 | 100016 | 36 | 36 |
| 1 | 100017 | 36 | 45 |
| 1 | 100019 | 27 | 0 |
| 1 | 100020 | 27 | 9 |

Import geometry file

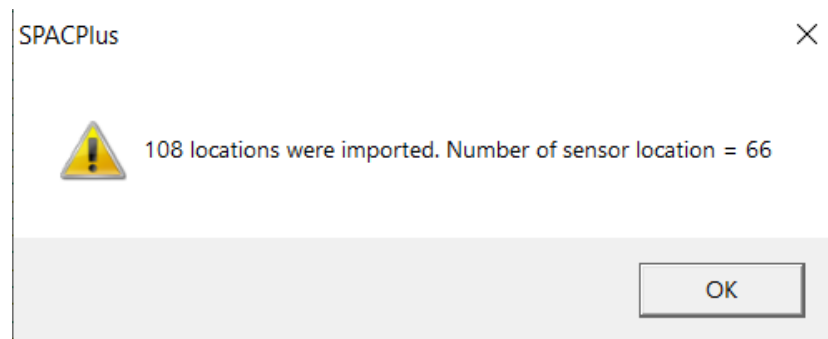
Select “2D/3D”, “Open sensor location file” Open sensor location file.



Select geometry file.



Confirm number of sensor locations.

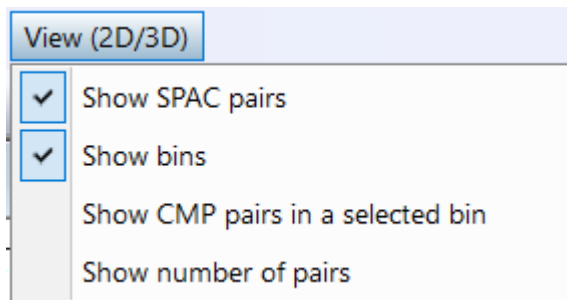
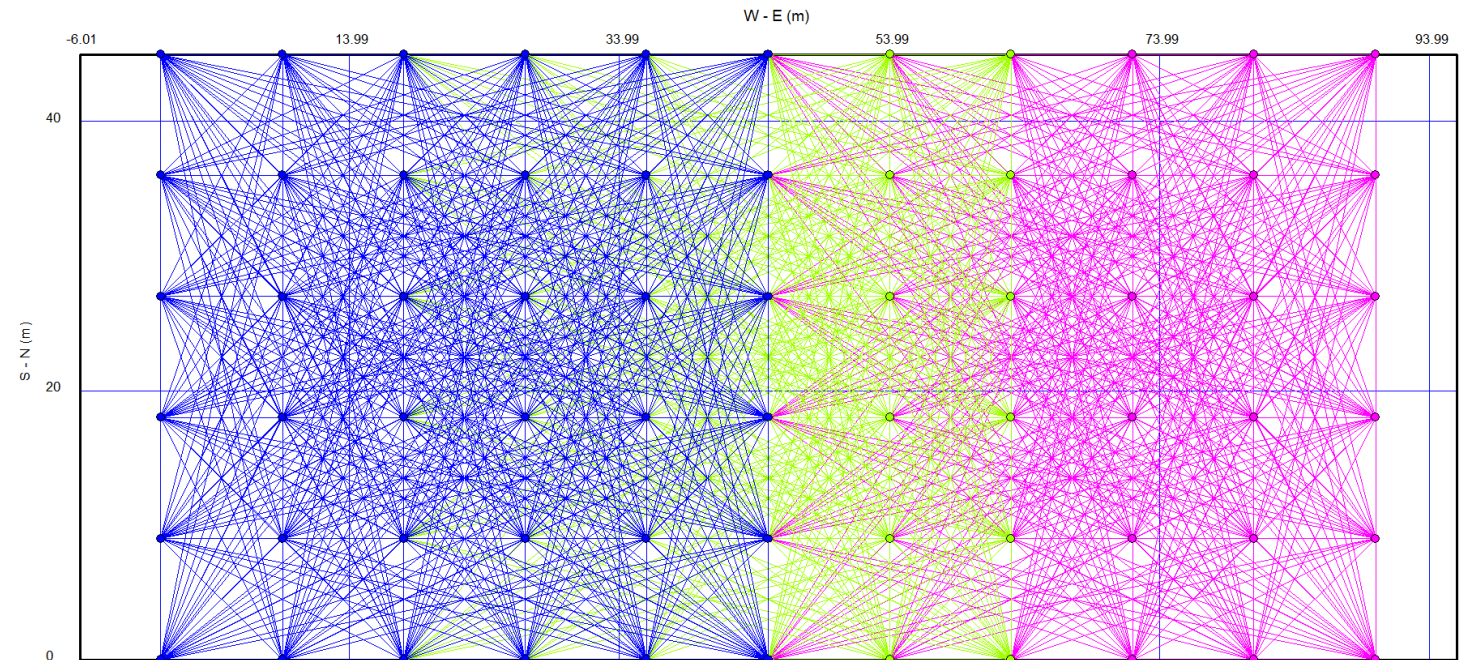
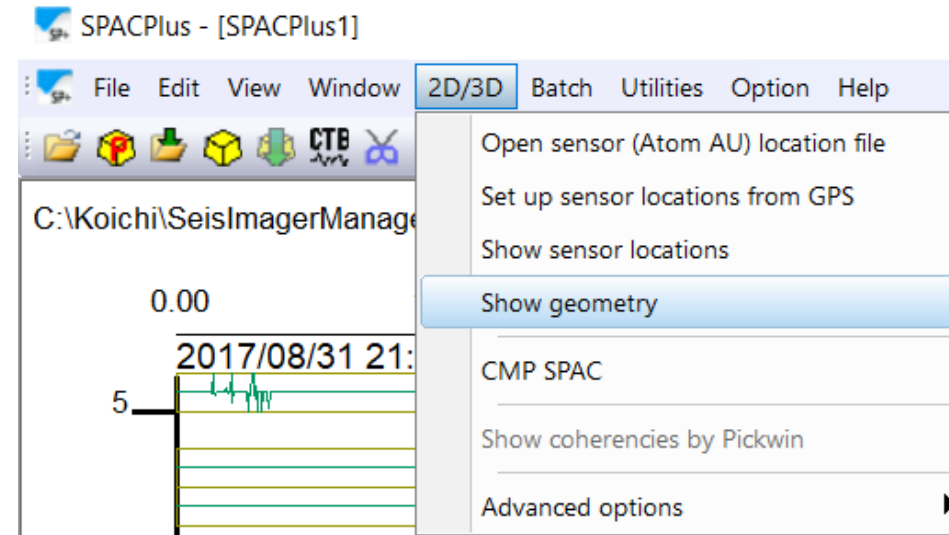


Show geometry

Select “2D/3D”, “Show geometry” to show geometry or sensor locations etc.

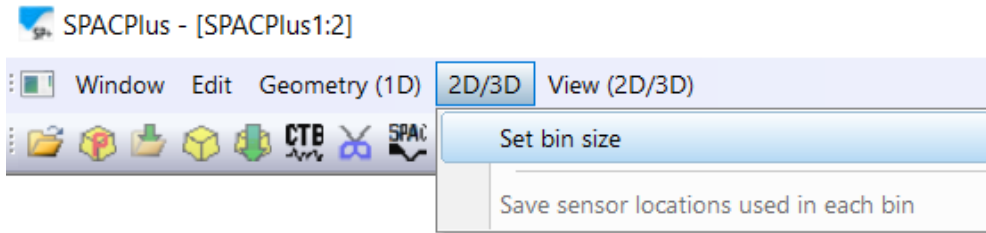


Sensor location, geometry, and/or receiver pairs appear. Use “View” menu to switch/select elements to be shown.



Set up bin size of CMP grids

Select “2D/3D”, “Set bin size” to set up bin (grid) size.

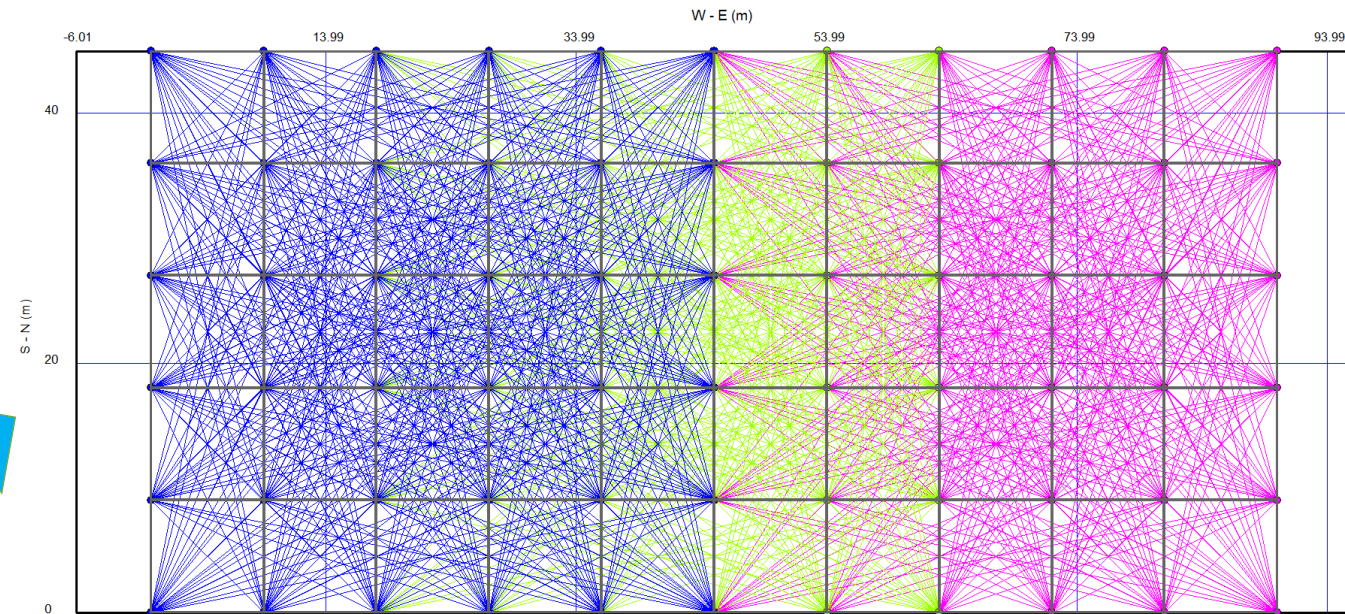


Set bin (grid) size and are of processing if necessary.

Bin size for CMP calculation

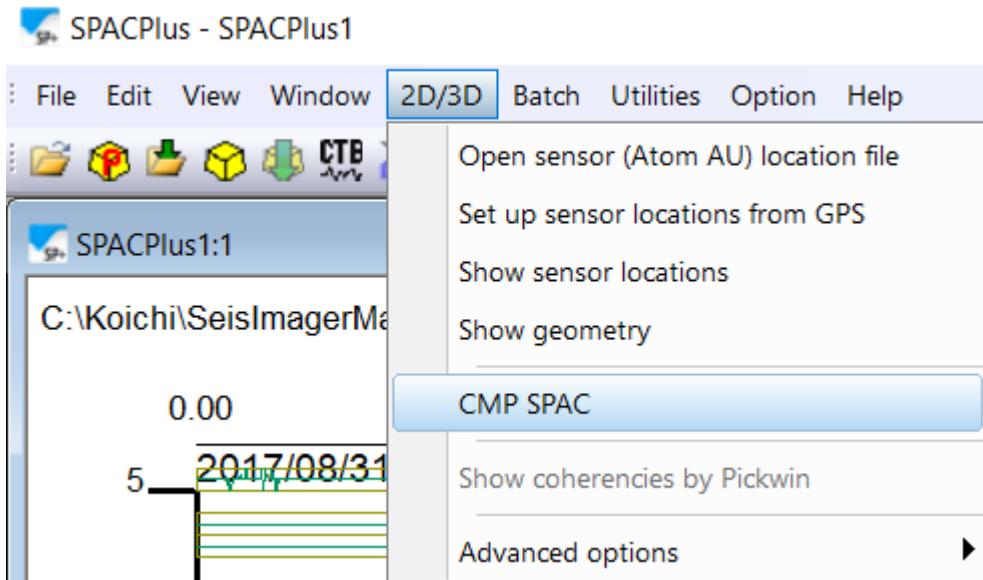
The dialog box titled 'Bin size for CMP calculation' has a close button (X) in the top right corner. It contains two columns of input fields for 'X' and 'Y' dimensions. The 'X' column has fields for 'Bin size' (value: 9), 'First distance' (value: 0), and 'Last distance' (value: 90). The 'Y' column has fields for 'Bin size' (value: 9), 'First distance' (value: 0), and 'Last distance' (value: 45). 'OK' and 'Cancel' buttons are located on the right side of the dialog. A large blue arrow points from this dialog towards the CMP grid visualization.

CMP grids appear on geometry.

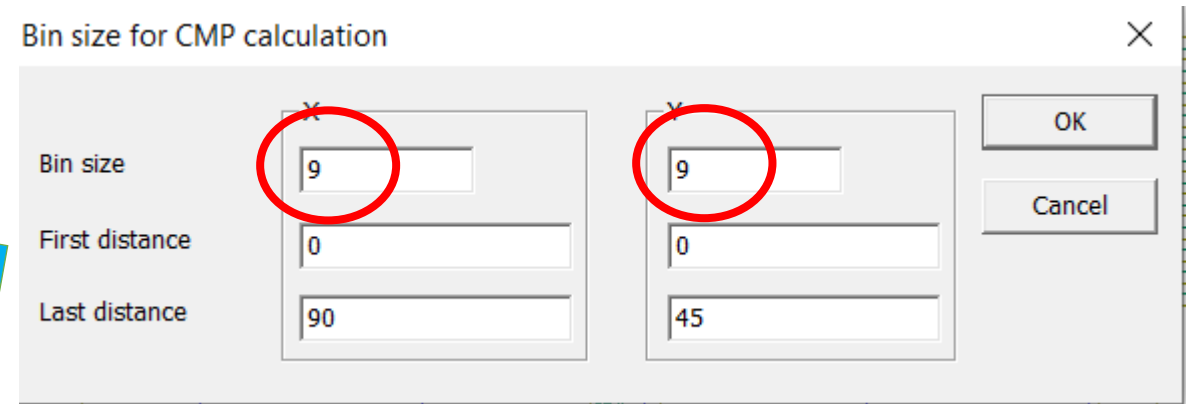
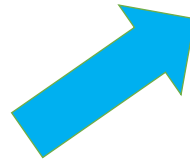


Calculate CMP-SPACs

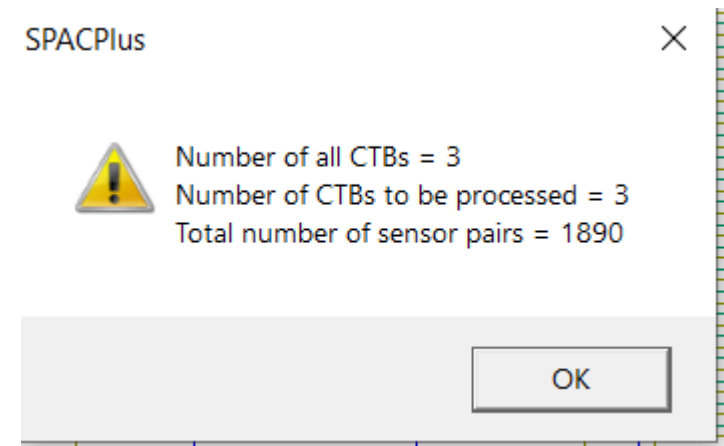
Select “2D/3D”, “CMP SPAC”.



Set (confirm) Bin size and click “OK” to start calculation.



Confirm number of CTBS etc.



Calculate CMP-SPACs

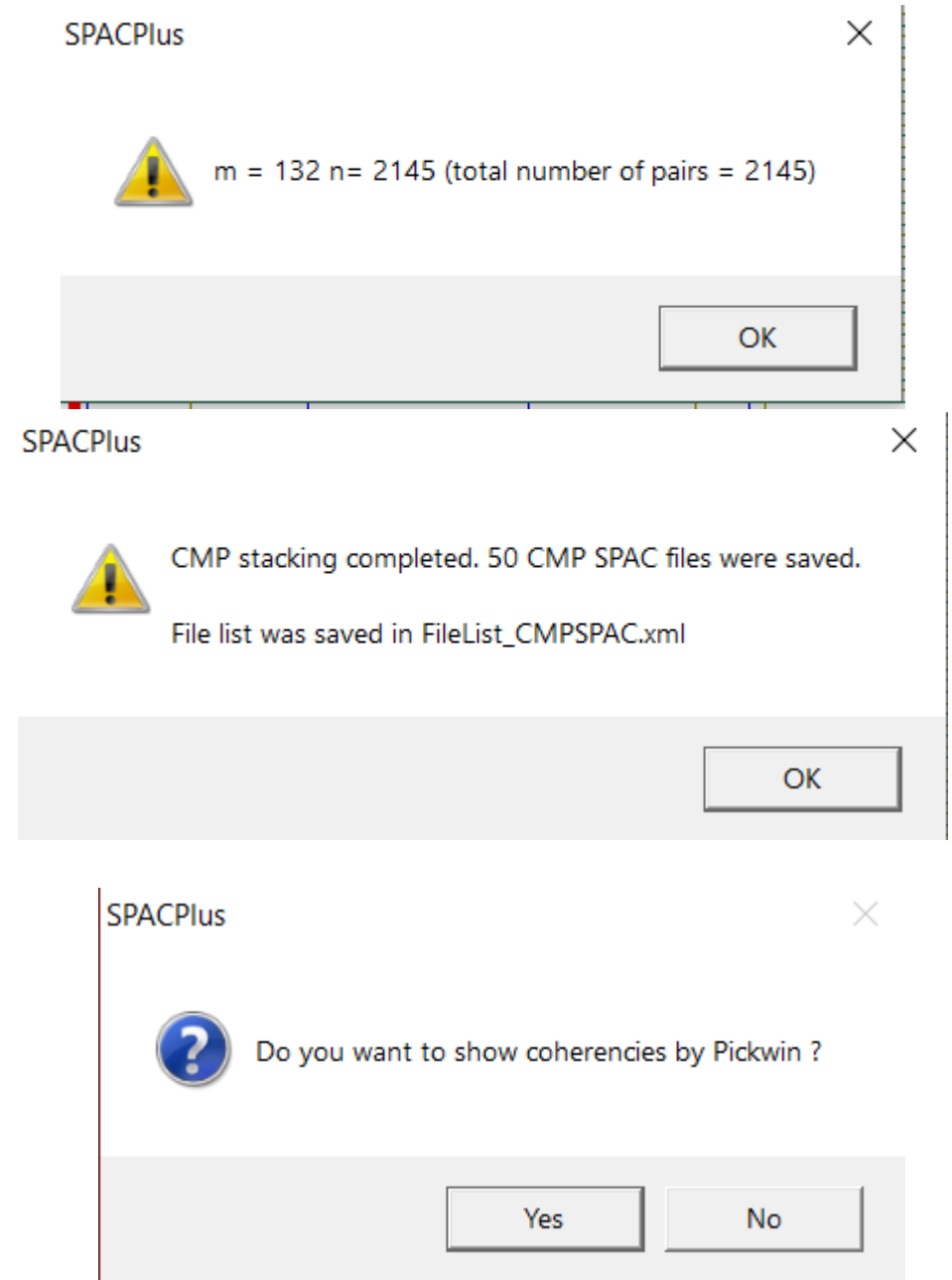
Several messages appear and confirm them.



Calculation will take several minutes.



After completing CMP-SPAC calculation, Pickwin shows CMPSPACs. Click “Yes” to continue.



Show CMP-SPACs by Pickwin

Pickwin is automatically launched and a file list of CMP-SPACs appear.
Click “OK” to continue.

File list

| Index | Edit | ID | CMP X (km) | CMP Y (km) | | # of aux. | |
|-------|--------------------------|----|------------|------------|---|-----------|-----------------------|
| 0 | <input type="checkbox"/> | 0 | 4.5 | 4.5 | 0 | 0 | 2020/4/16 9:48:25.000 |
| 1 | <input type="checkbox"/> | 0 | 4.5 | 13.5 | 0 | 0 | 2020/4/16 9:48:25.000 |
| 2 | <input type="checkbox"/> | 0 | 4.5 | 22.5 | 0 | 0 | 2020/4/16 9:48:25.000 |
| 3 | <input type="checkbox"/> | 0 | 4.5 | 31.5 | 0 | 0 | 2020/4/16 9:48:25.000 |
| 4 | <input type="checkbox"/> | 0 | 4.5 | 40.5 | 0 | 0 | 2020/4/16 9:48:25.000 |
| 5 | <input type="checkbox"/> | 1 | 13.5 | 4.5 | 0 | 0 | 2020/4/16 9:48:25.000 |
| 6 | <input type="checkbox"/> | 1 | 13.5 | 13.5 | 0 | 0 | 2020/4/16 9:48:25.000 |
| 7 | <input type="checkbox"/> | 1 | 13.5 | 22.5 | 0 | 0 | 2020/4/16 9:48:25.000 |
| 8 | <input type="checkbox"/> | 1 | 13.5 | 31.5 | 0 | 0 | 2020/4/16 9:48:26.000 |
| 9 | <input type="checkbox"/> | 1 | 13.5 | 40.5 | 0 | 0 | 2020/4/16 9:48:26.000 |

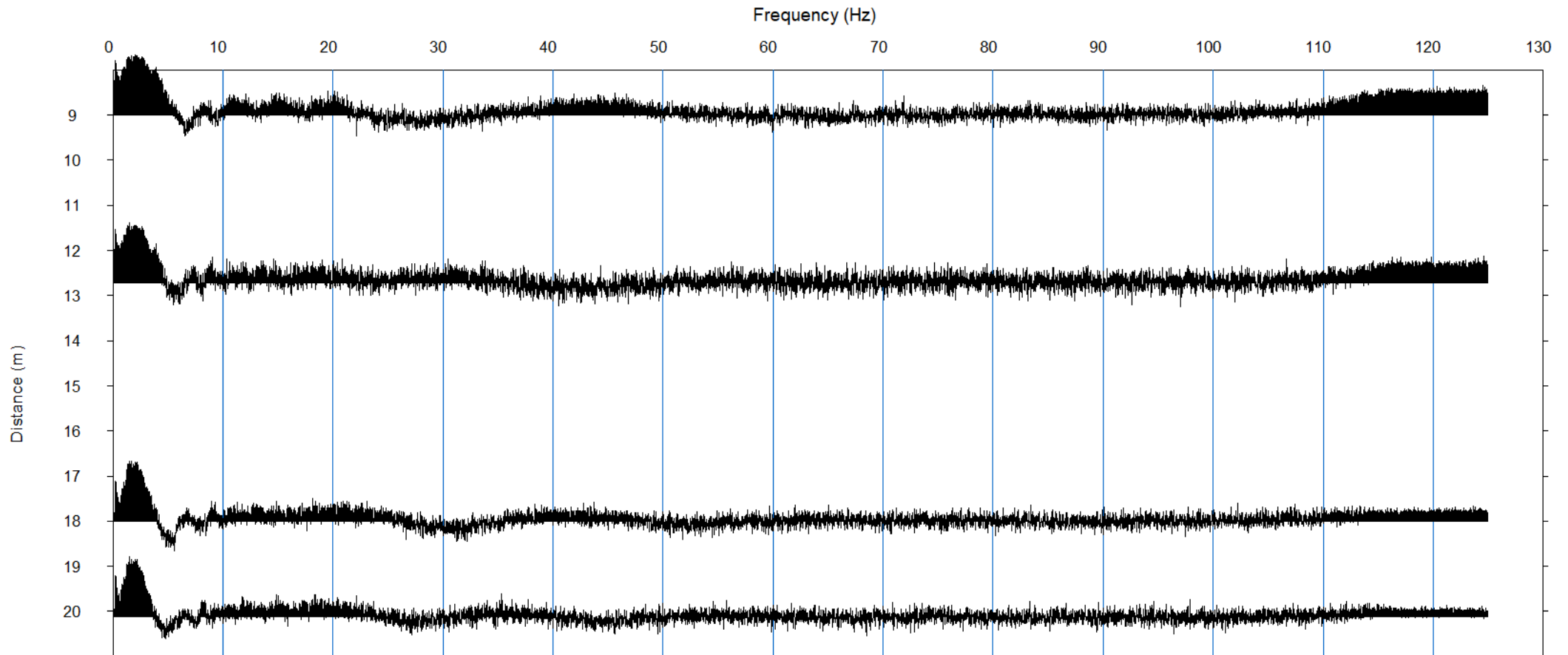
☒ Apply source coordinates from file header ☐ Active data
☒ Apply receiver coordinates from file header ☒ Passive data

OK
Cancel
Next
Back
Set up
Set # of aux.
Delete
Export
Import

Number of files
50


Show CMP-SPACs by Pickwin

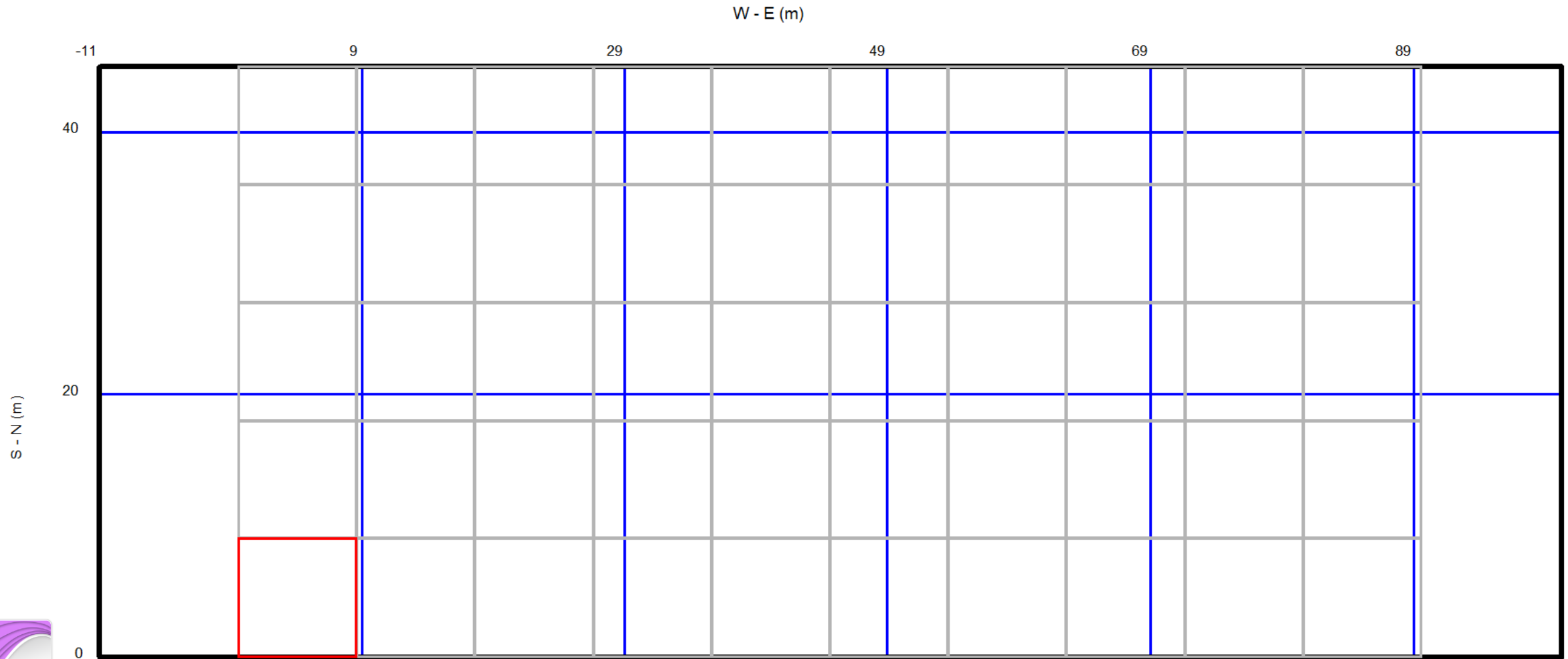
SPAC (coherence) appears. Use   buttons to scroll the bins (SPAC files).



Coherence : C:\Koichi\SeisImagerManagement\TestProcedure\ExampleData\MAM_3D (Delta)\Data\cmp_spac_0_0.coh

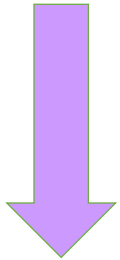
Show CMP-SPACs by Pickwin

Click  to show CMP grids.



Show CMP-SPACs by Pickwin

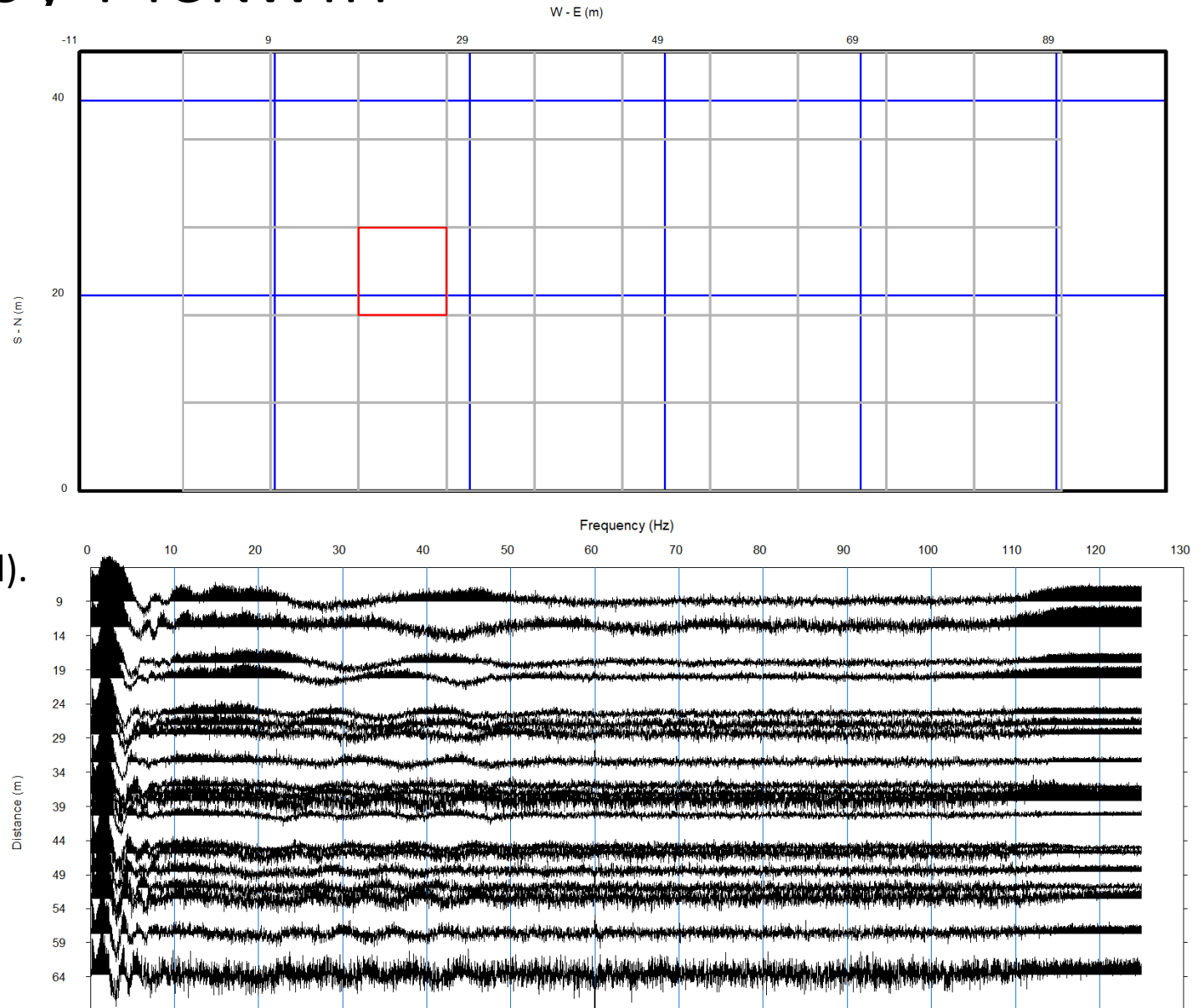
Select a bin (grid) using mouse.



Click



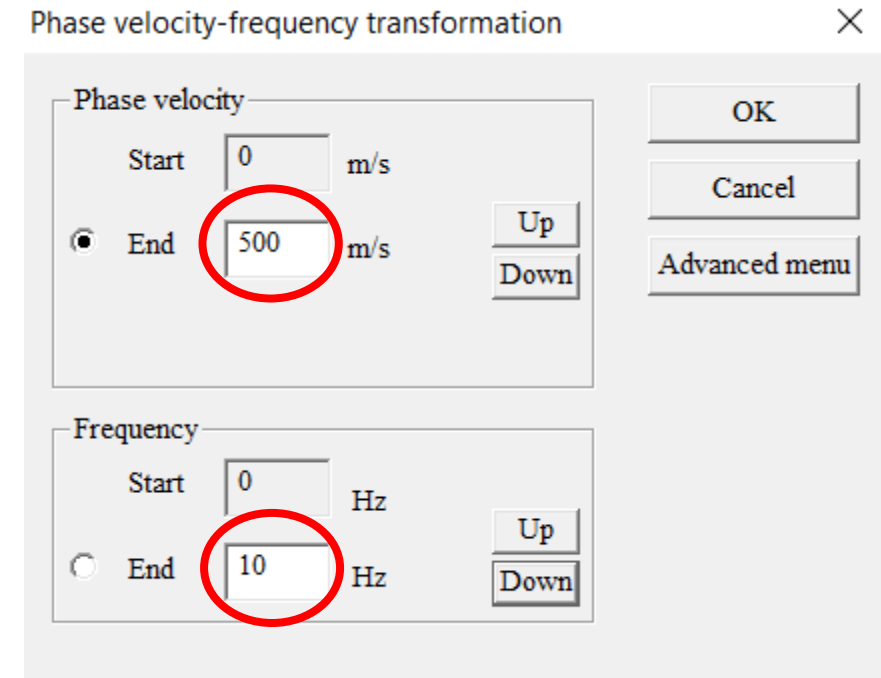
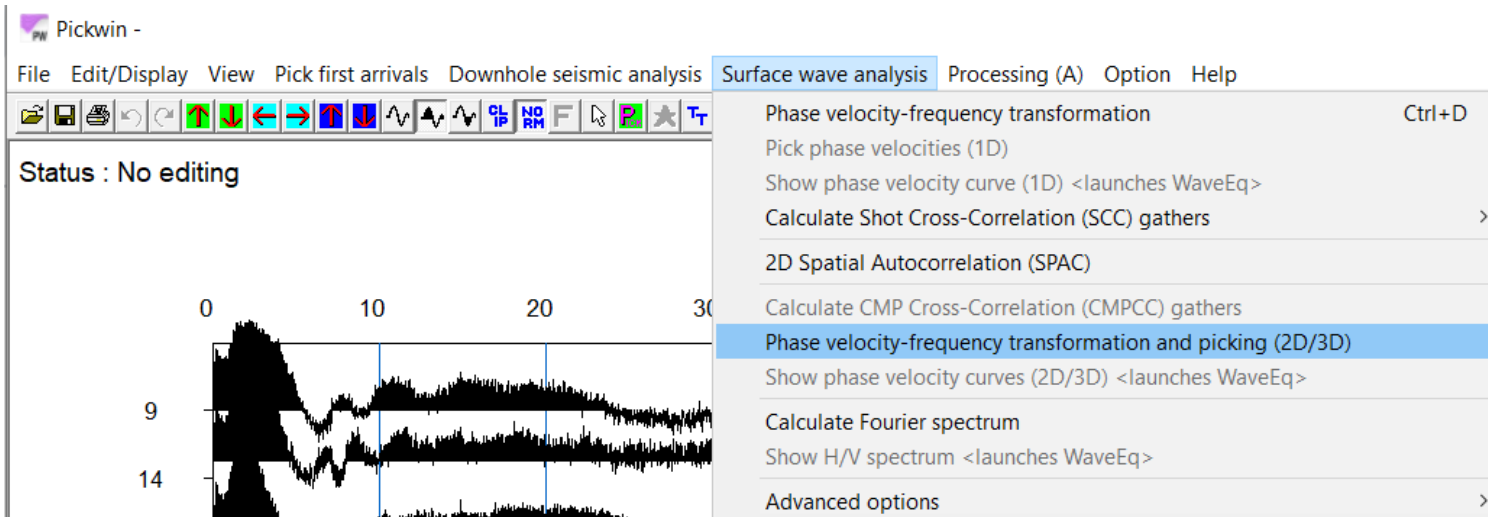
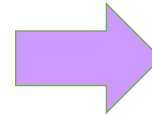
to show a CMPSPAC at selected bin (grid).



Calculate dispersion curves

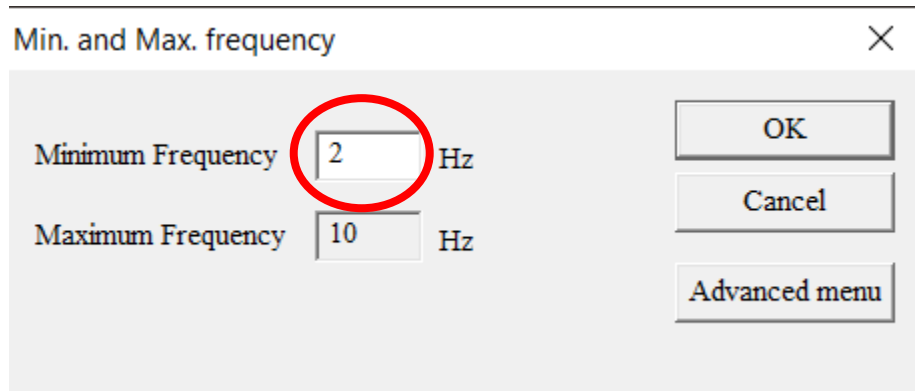
Select “Surface wave analysis”, “Phase velocity-frequency transformation and picking (2D/3D)”.

Set phase velocity and frequency ranges.



Calculate dispersion curves

Set minimum frequency.



Min. and Max. frequency

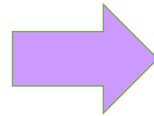
Minimum Frequency Hz

Maximum Frequency Hz

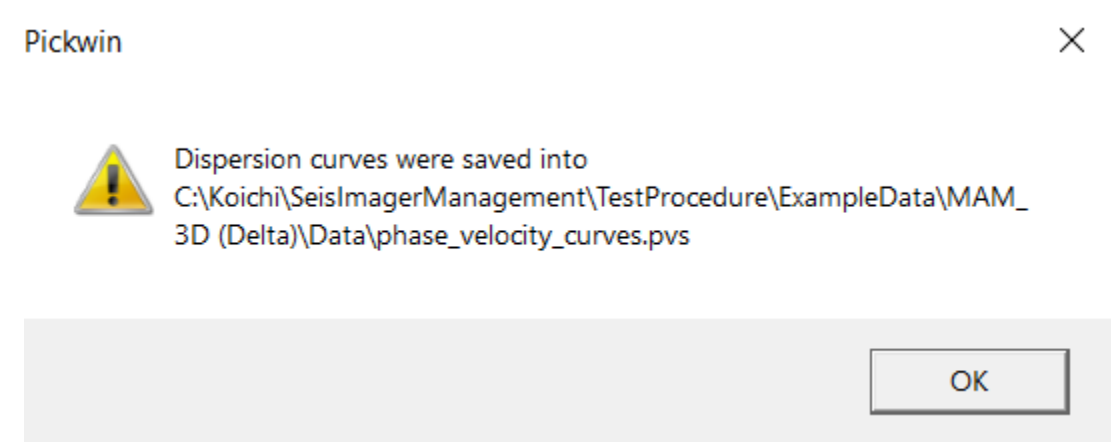
OK

Cancel

Advanced menu



It will take a while to complete the calculation.



Pickwin

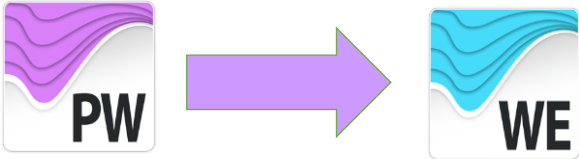
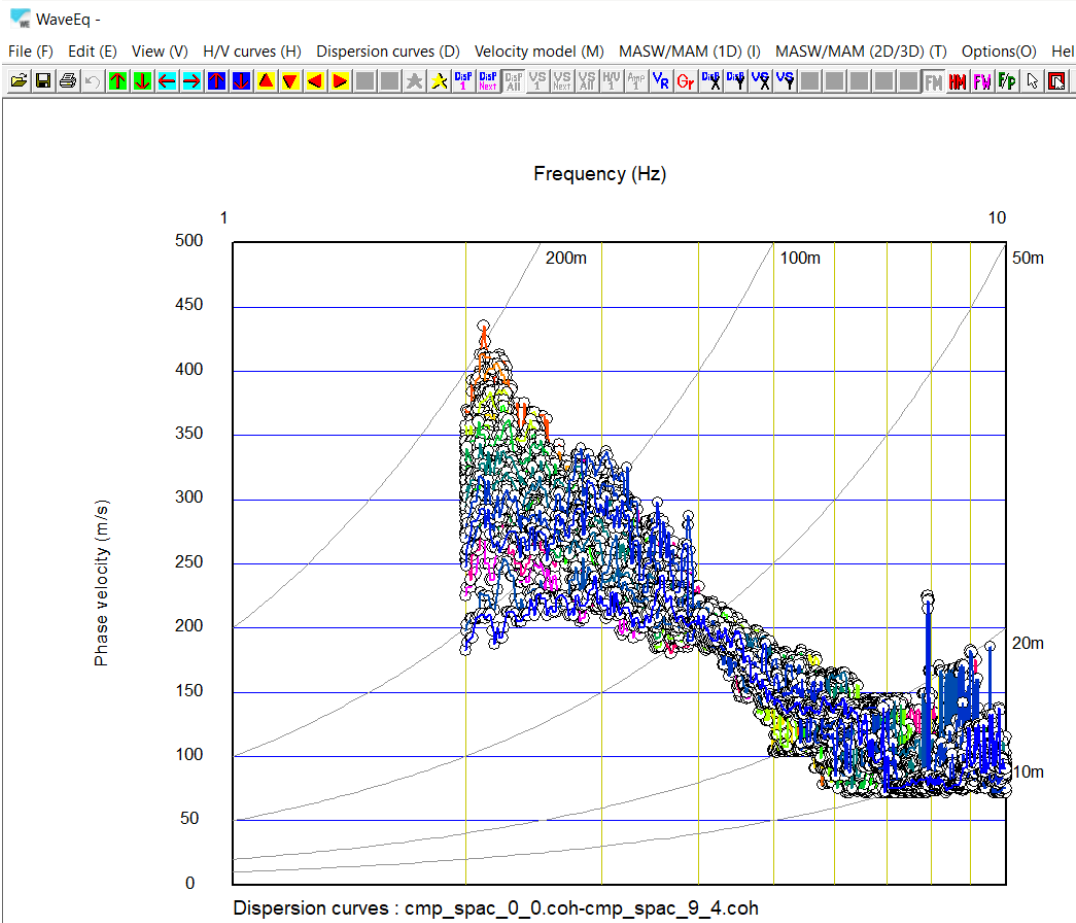
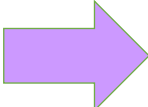
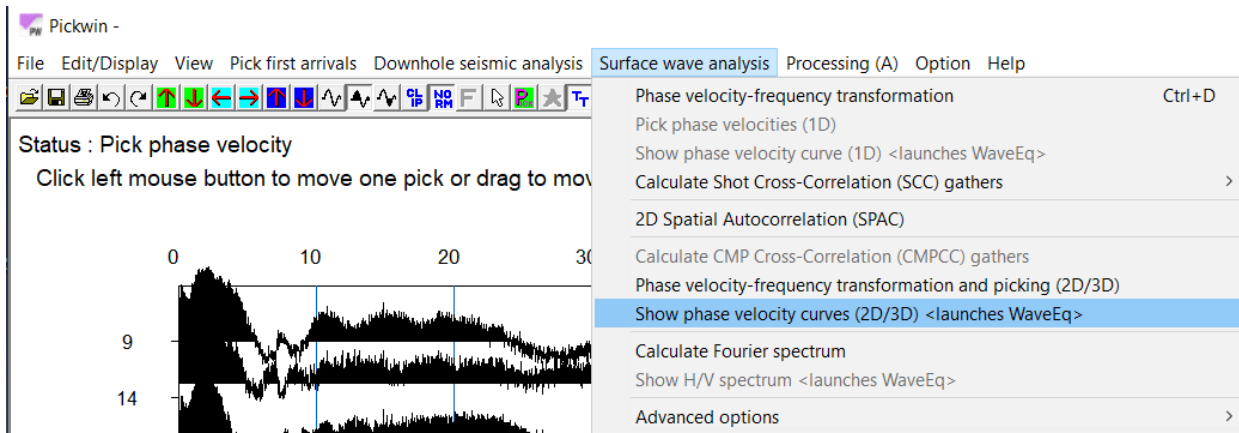
! Dispersion curves were saved into
C:\Koichi\SeisImagerManagement\TestProcedure\ExampleData\MAM_
3D (Delta)\Data\phase_velocity_curves.pvs

OK

Show dispersion curves by WaveEq

Select “Surface wave analysis”, “Show Phase velocity curves (2D/3D)”.


WaveEq is automatically launched and phase velocity curves appears.





Show dispersion curves by WaveEq

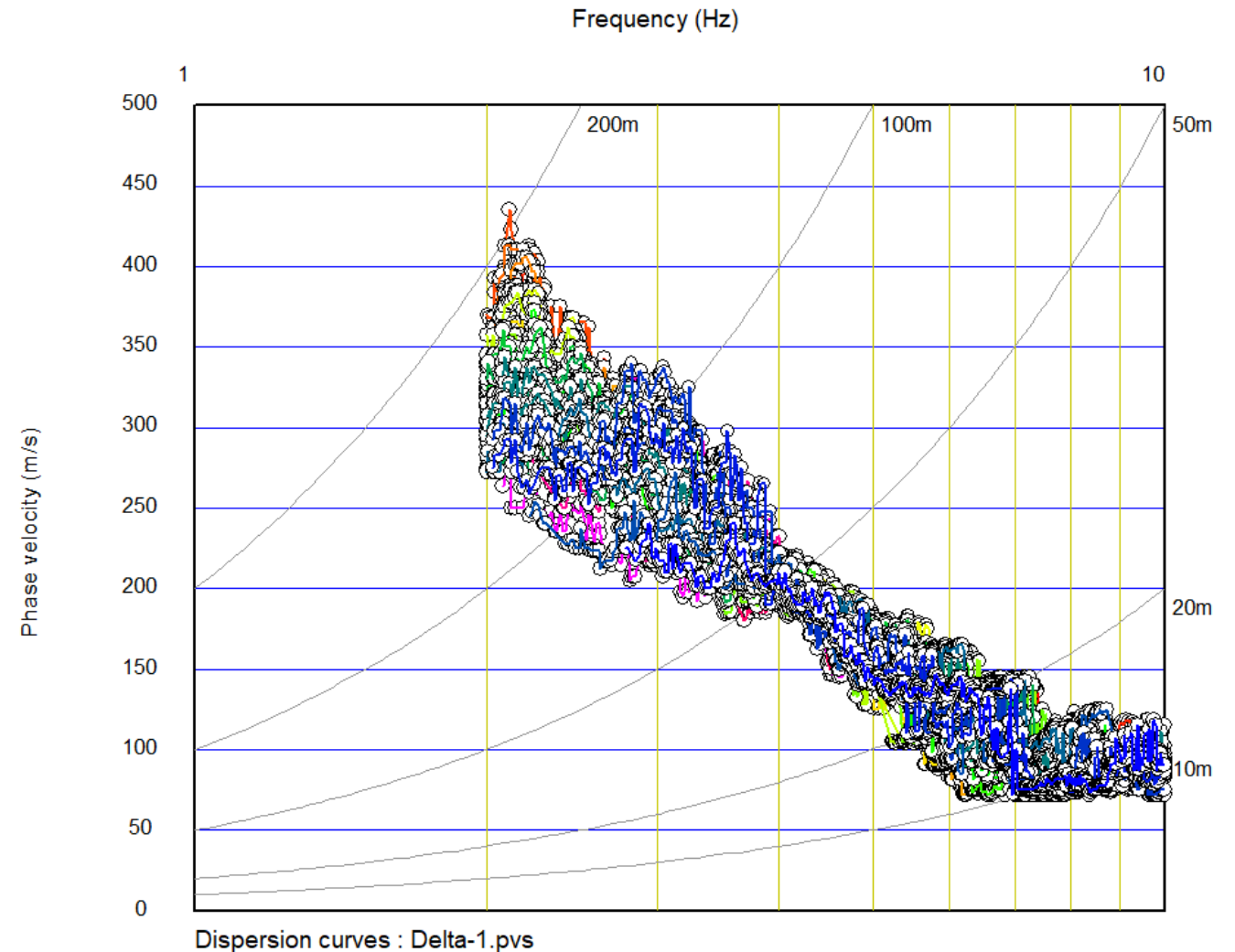
Delete noises or unnecessary phase velocities like 1D/2D processing.

Use  to scroll dispersion curves.

Use  to change how many dispersion curves are shown.

Click  to show CMP grids.

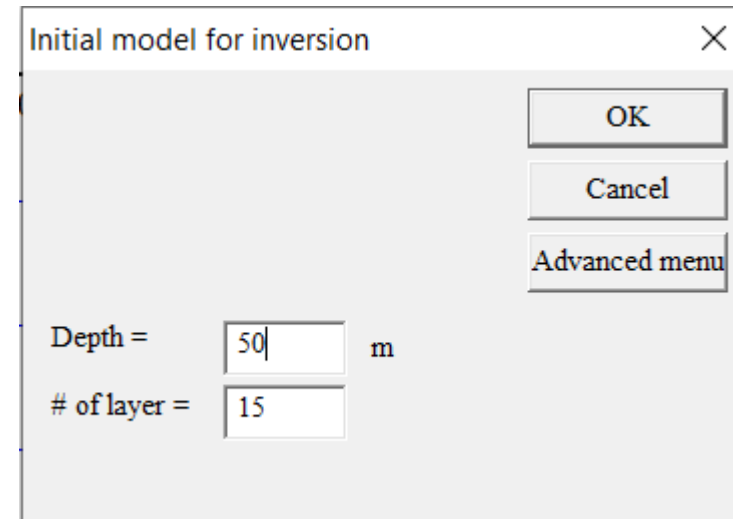
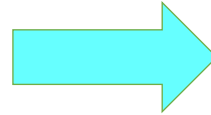
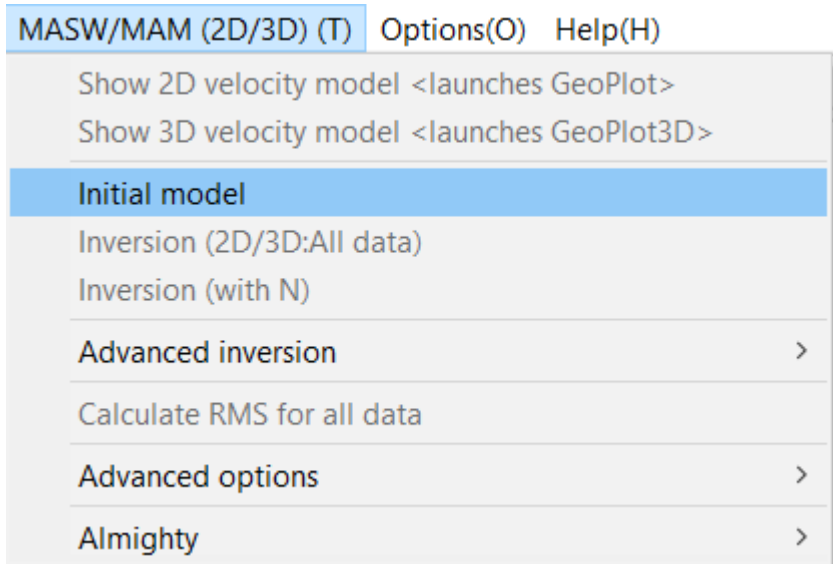
Use  to show dispersion curves in X or Y direction.



Create initial velocity model

Select “MASW (2D/3D)”, “Initial model”.

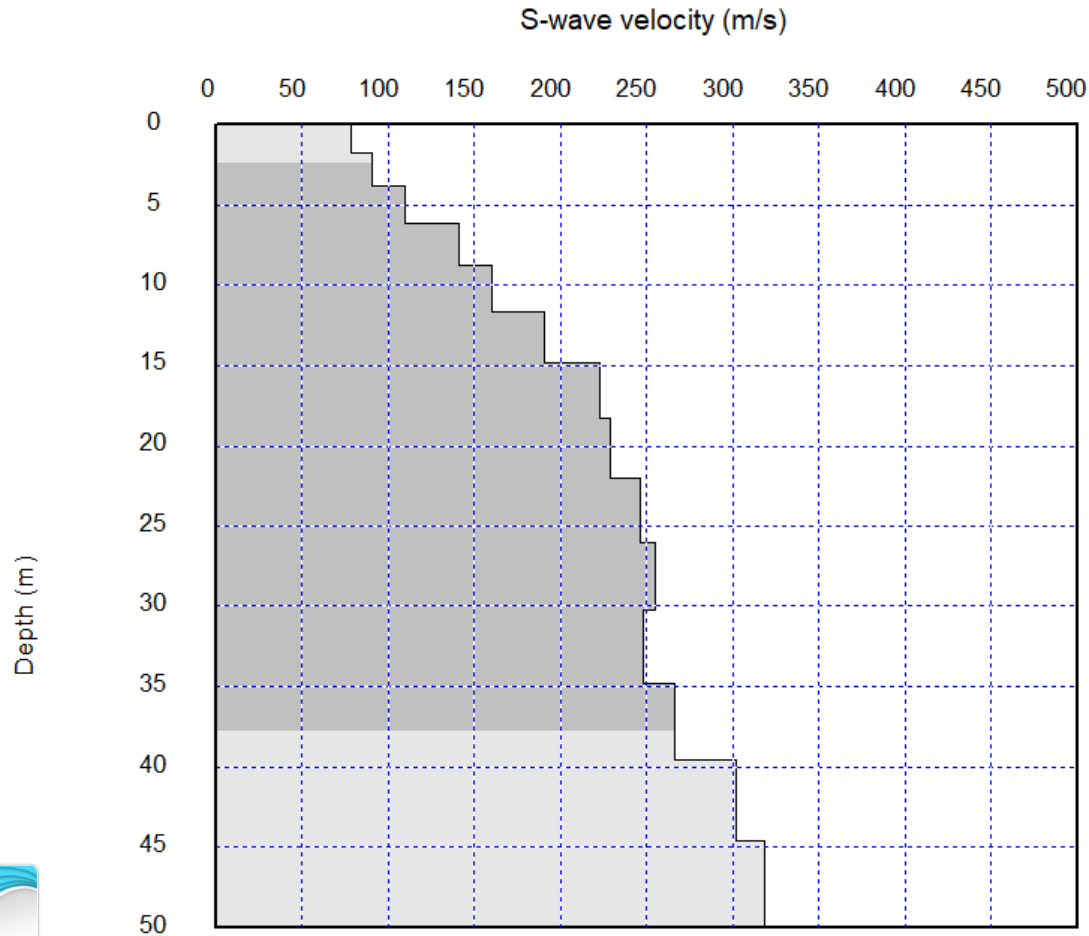
Set depth of model.








Create initial velocity model

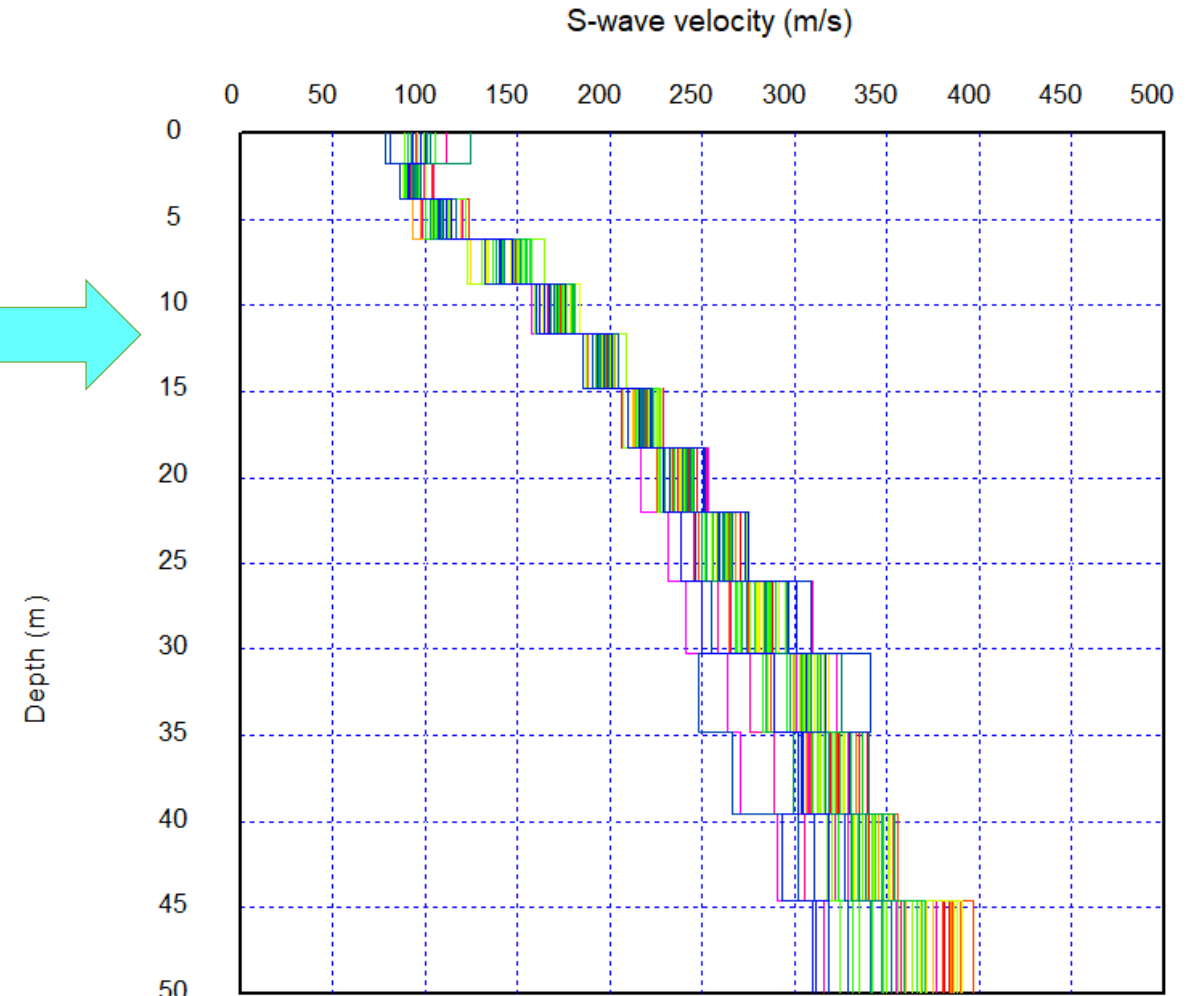
Initial velocity model appears.

Index=45 Station=CMP 45 (X=85.500000m Y=4.500000m)
Elevation=0.000000m



S-wave velocity model (initial) : Delta-2.pvs

Use    or   to change how many velocity profiles are shown like dispersion curves.

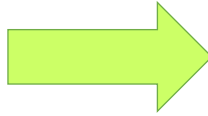
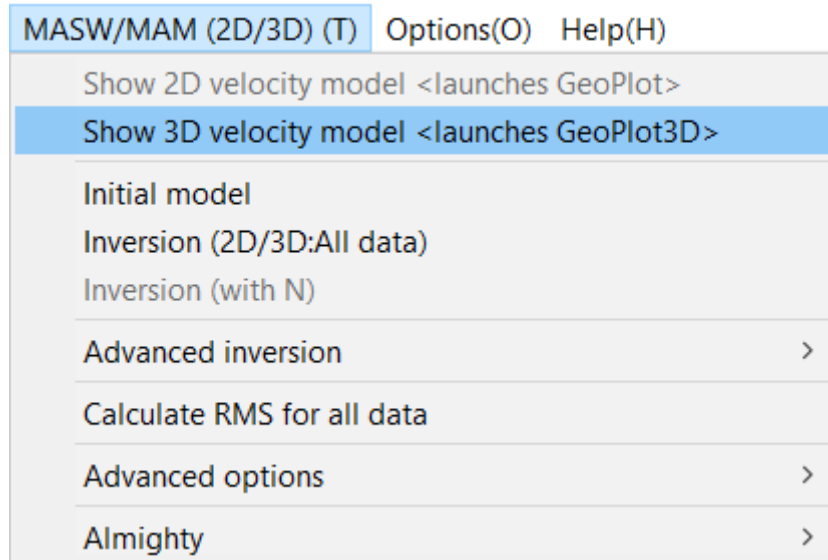


S-wave velocity models (initial) : Delta-2.pvs

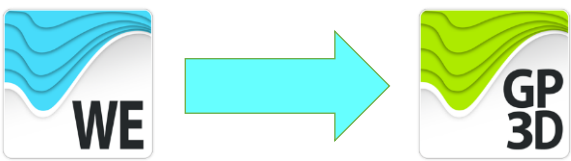
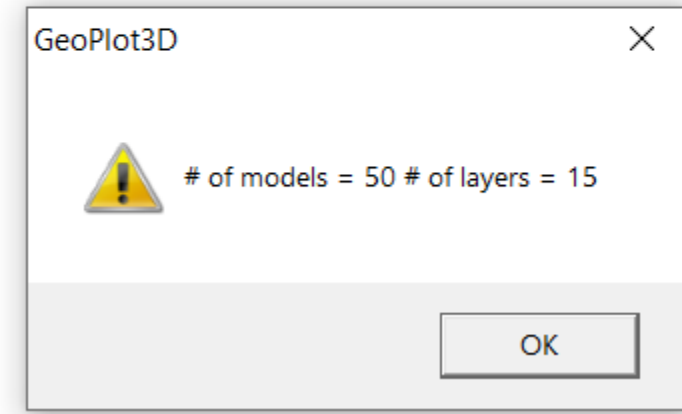
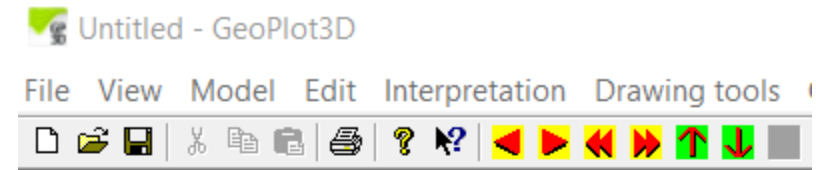


Show 3D velocity model by GeoPlot3D

Select “MASW (2D/3D)”, “Show 3D velocity model <launches GeoPlot3D>”. Note that you can apply inversion before showing 3D velocity model like 2D processing.



GeoPlot3D is automatically launched. Confirm number of models (dispersion curves) and layers.

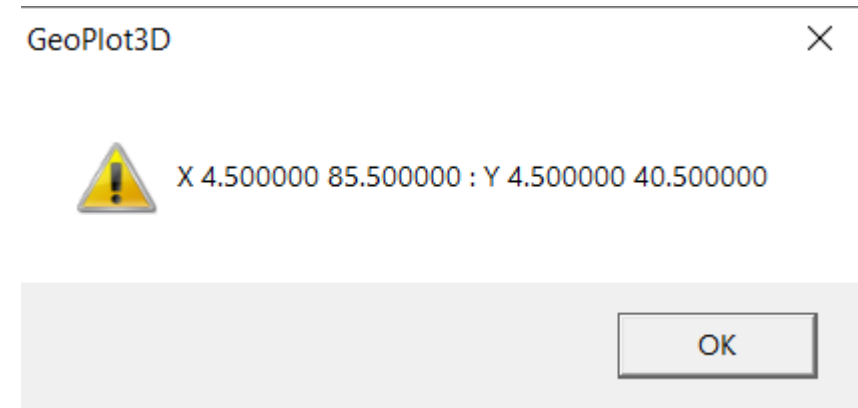
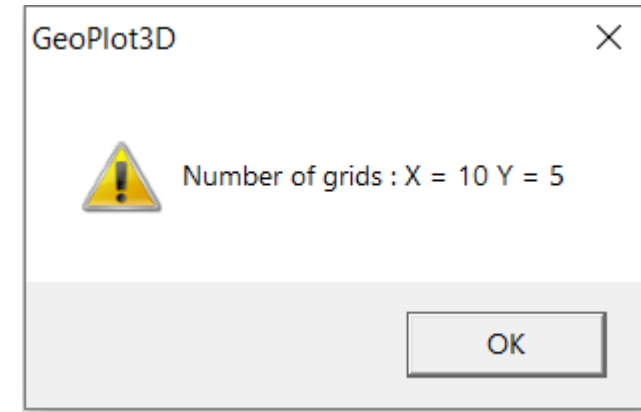


Show 3D velocity model by GeoPlot3D

Confirm number of CMP grids.



Processing area appears. It indicates the minimum and maximum X and Y location of CMPs.

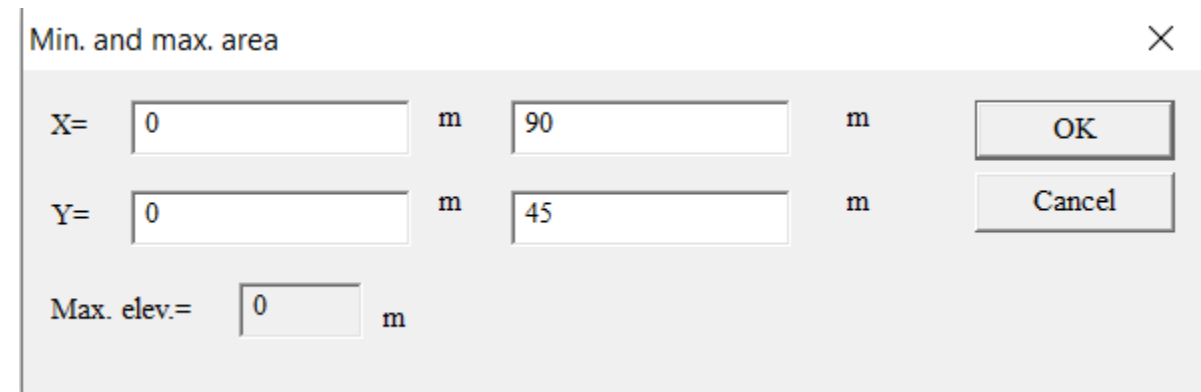
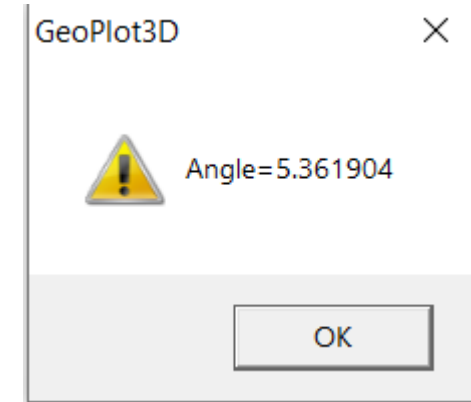


Show 3D velocity model by GeoPlot3D

Rotation of grids appear.



Set up drawing area in dialog box.
Usually do not need to change.



Define grid size for interpolation and generate topography.

Set up grid (cell) size for interpolation.
Usually do not need to change.



Surface topography appears. Default topography is flat. You can import topography file if necessary.

Model size

| | | | | |
|-----|----|-----|------|-------------------------|
| NX= | 40 | DX= | 2.25 | OK Cancel Refresh |
| NY= | 20 | DY= | 2.25 | |
| NZ= | 0 | DZ= | 2.5 | |

Topography

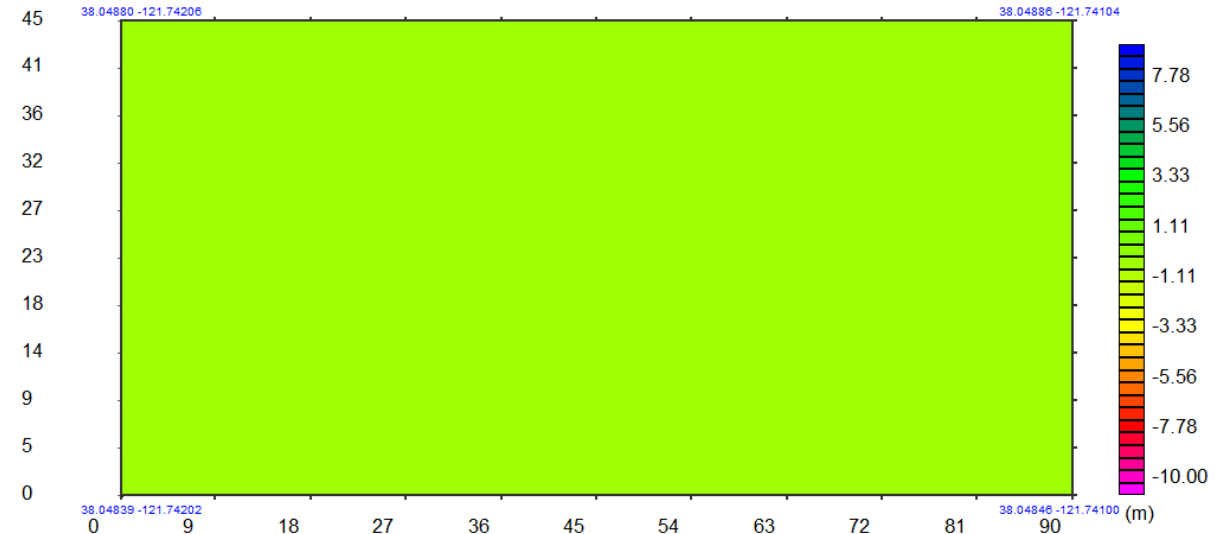
Number of section = 1

X cells = 40 Y cells = 20 # of planes = 0

NX = 40 NY = 20 NZ = 0

Min. = 0.000000 Max. = 0.000000 n = 36 (0)

Y (m)



X (m)

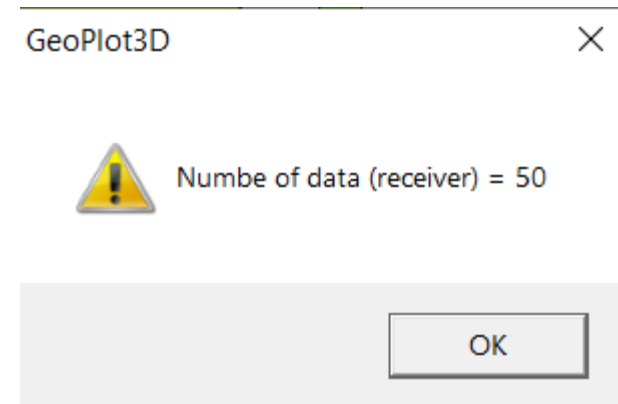
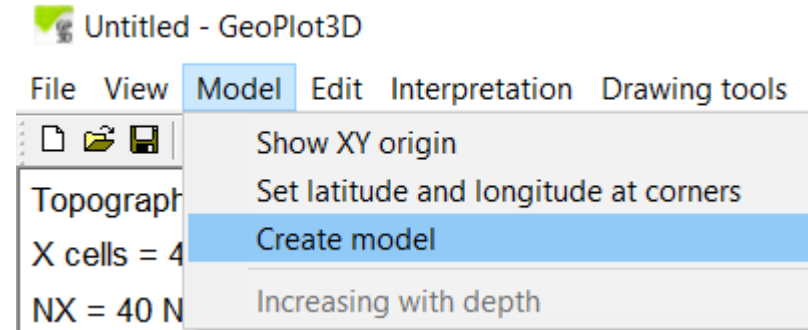


Create 3D velocity model

Select “Model”, “Create model”.



Confirm number of data.



Create 3D velocity model

Set number and size of cells. Model will be created to 50 m (20 x 2.5 m) depth in the example.

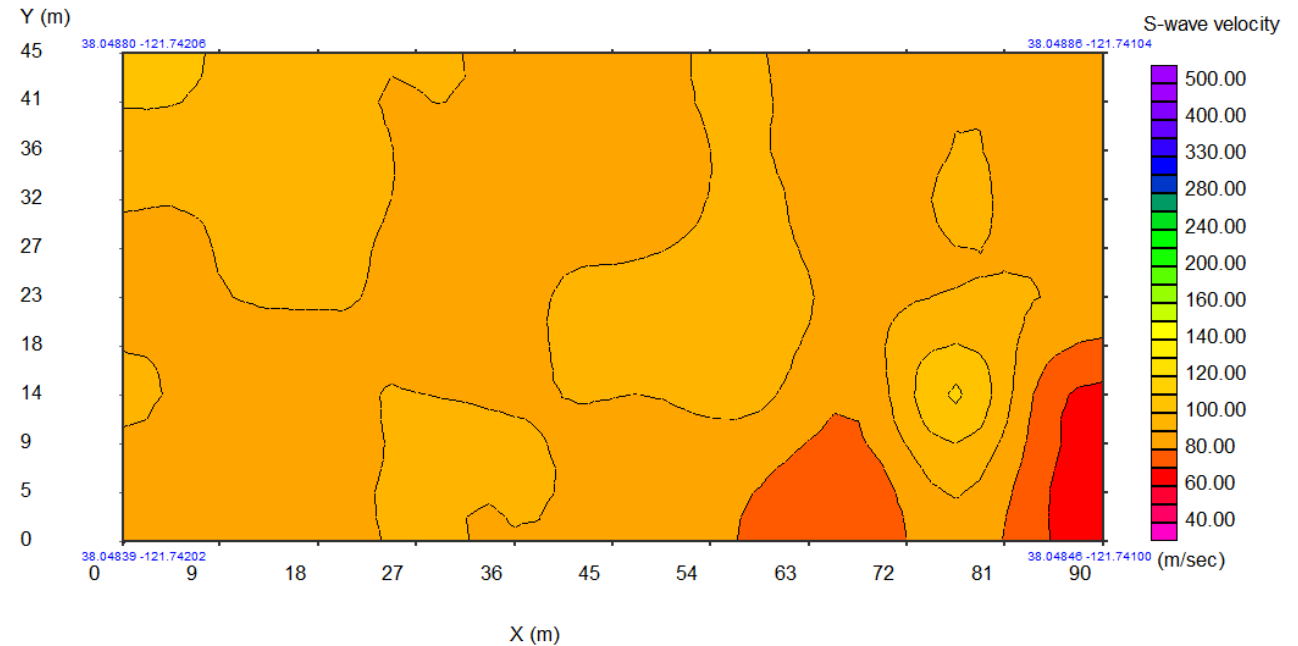
Model size

| | | | | |
|-----|----|-----|------|---------|
| NX= | 40 | DX= | 2.25 | OK |
| NY= | 20 | DY= | 2.25 | Cancel |
| NZ= | 20 | DZ= | 2.5 | Refresh |





3D velocity model is generated and a plan view appears.

Z plane : N = 0 (-2.5 to 0.0 m)
X cells = 40 Y cells = 20 # of planes = 20
NX = 40 NY = 20 NZ = 20
Min. = 0.000000 Max. = 0.000000 n = 26 (1)
Number of section = 1



Show 3D velocity model

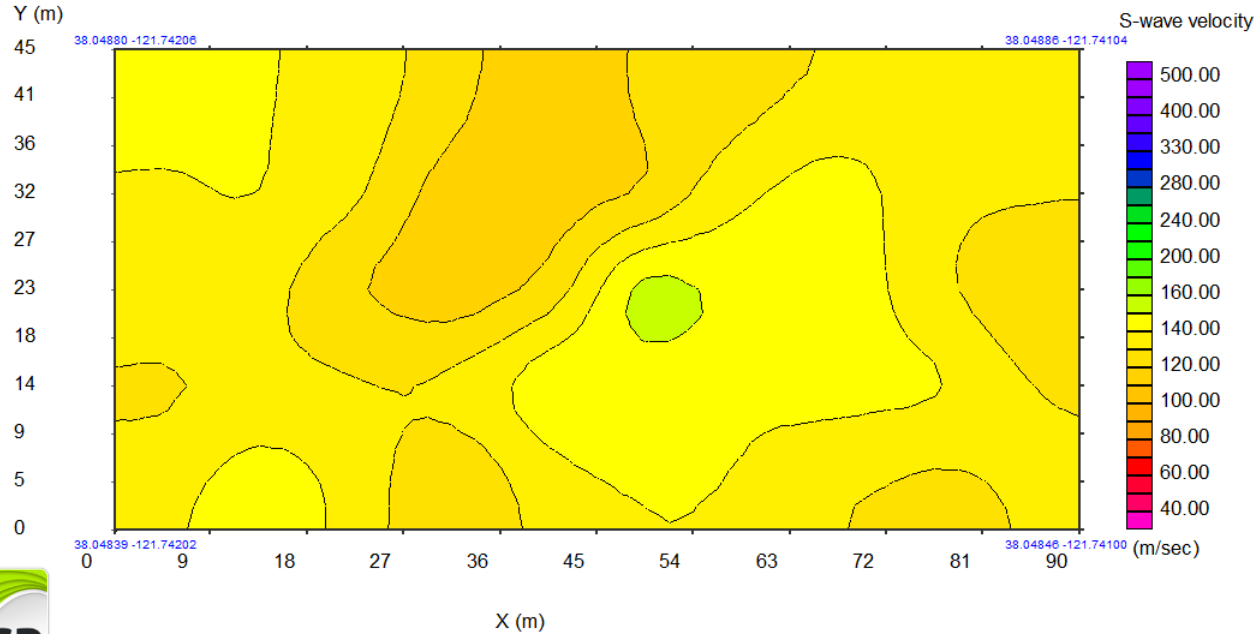
Use  to change plan view/cross sections to be shown.

Use  to scroll depth or distance of plan view/cross sections to be shown.

Z plane : N = 3 (-10.0 to -7.5 m)
X cells = 40 Y cells = 20 # of planes = 20
NX = 40 NY = 20 NZ = 20
Min. = 0.000000 Max. = 0.000000 n = 26 (1)

Number of section = 1

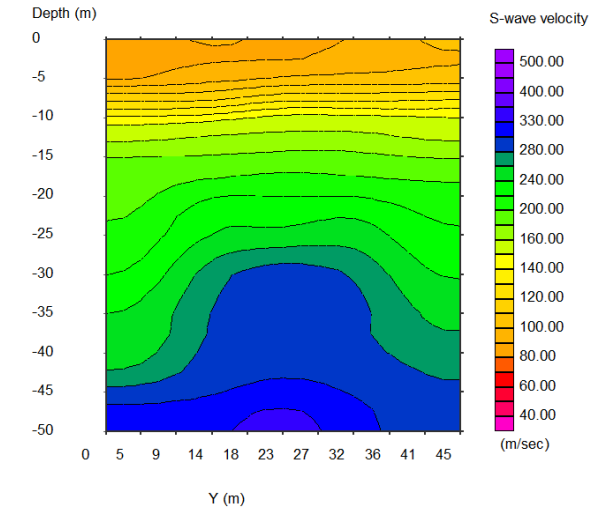
Plan view
(depth slice)



Cross section(X)

X plane : N = 0 (0.0 to 2.3 m)
X cells = 20 Y cells = 20 # of planes = 40
NX = 40 NY = 20 NZ = 20
Min. = 0.000000 Max. = 0.000000 n = 26 (1)

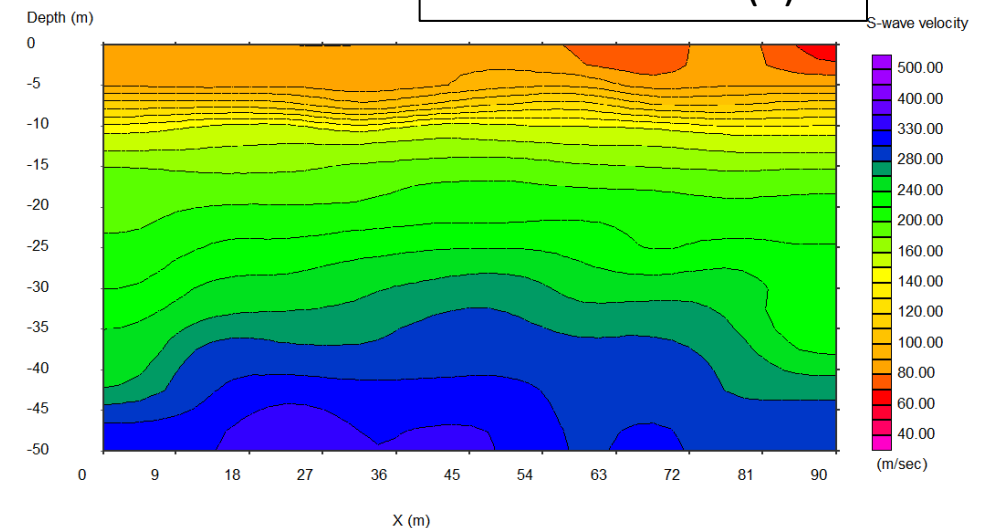
Number of section = 1



Y plane : N = 0 (0.0 to 2.3 m)
X cells = 40 Y cells = 20 # of planes = 20
NX = 40 NY = 20 NZ = 20
Min. = 0.000000 Max. = 0.000000 n = 26 (1)

Number of section = 1

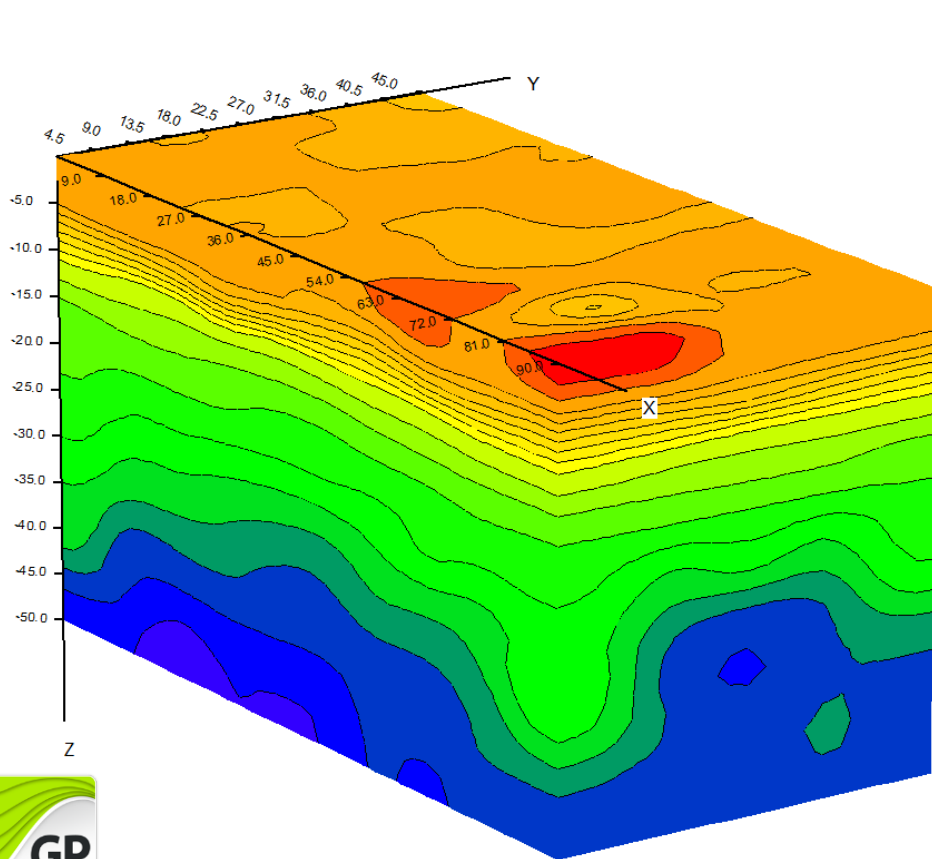
Cross section(Y)



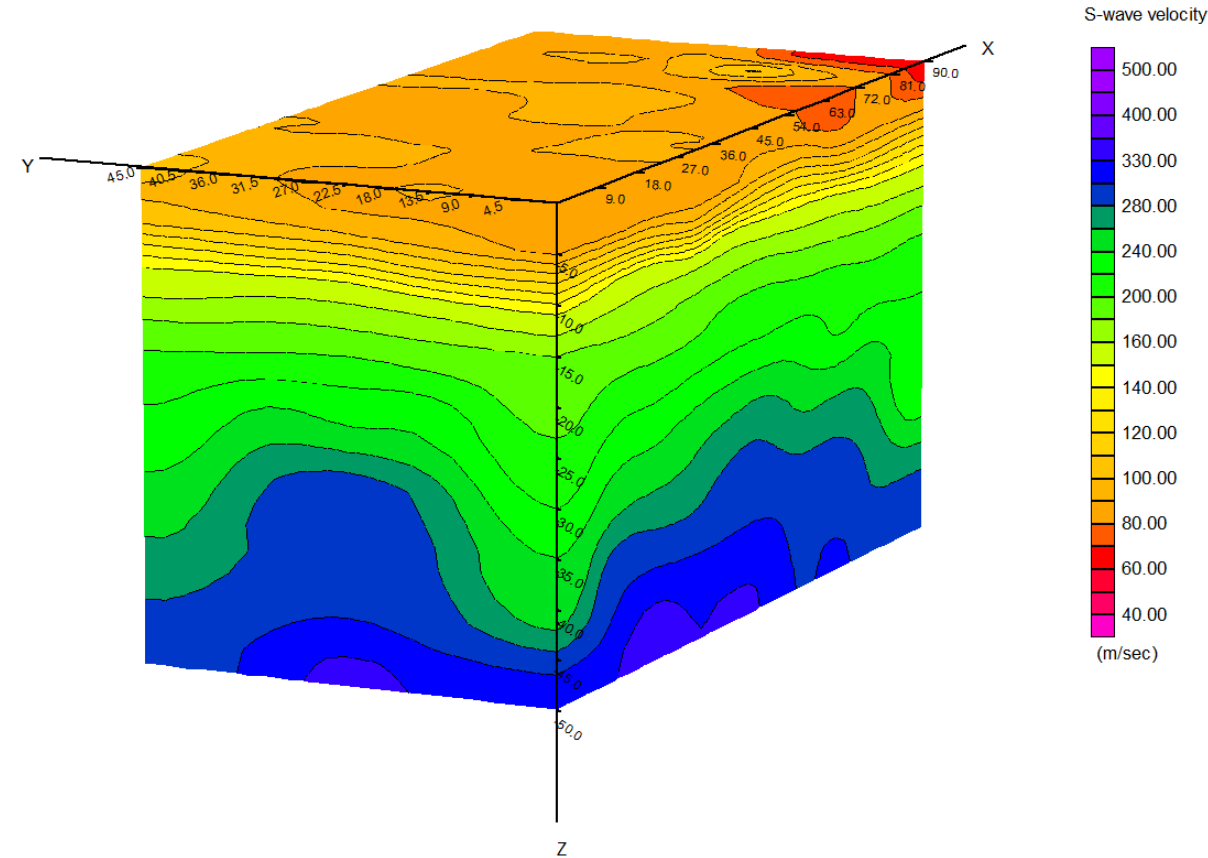
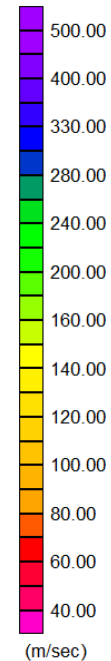
Show 3D velocity model

Click **3D** to draw 3D images.

Use  to rotate a model or change scale.



S-wave velocity



S-wave velocity

