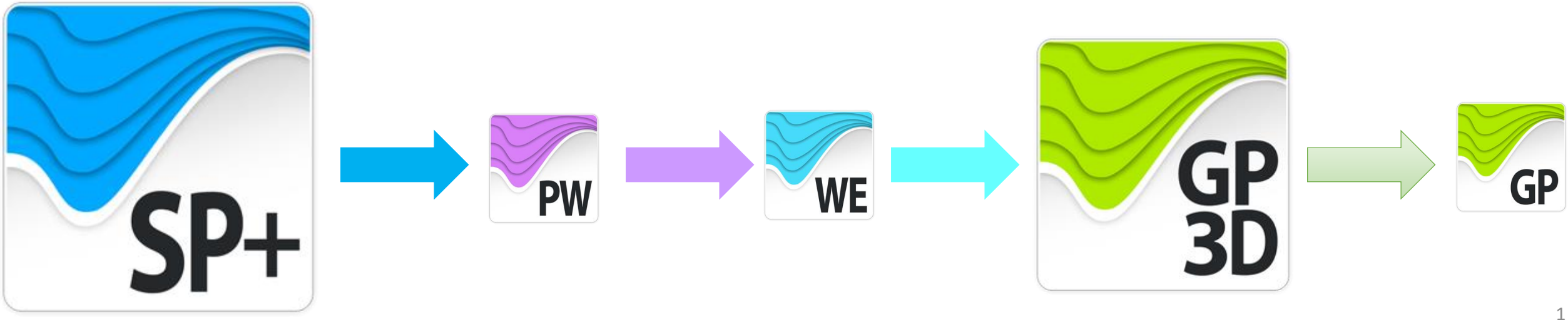
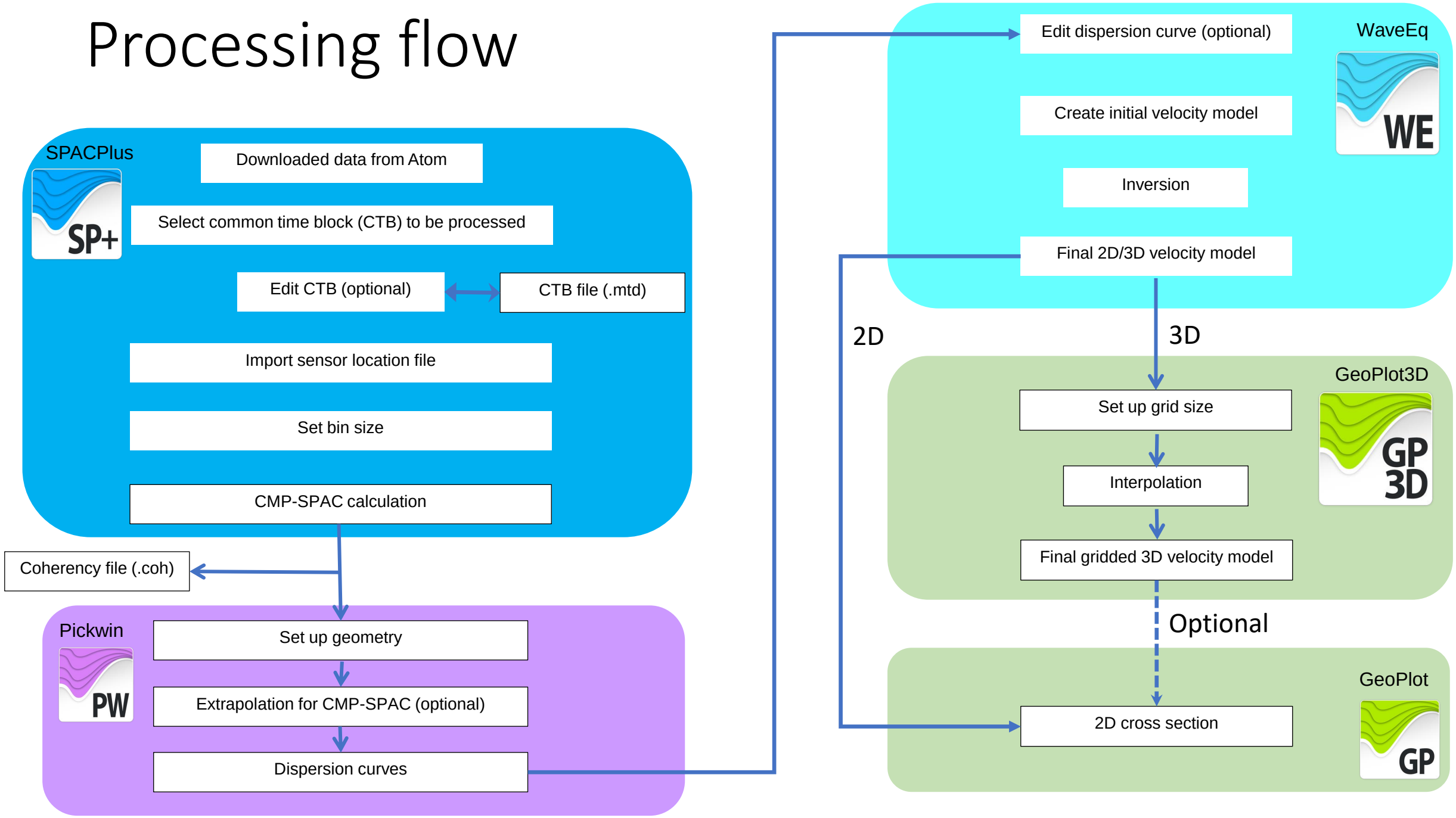
SeisImager/SW-3D

2D/3D ambient noise tomography processing using *SPACPlus* and other SeisImager modules

- Processing ambient noise data obtained by Atom.
- SeisImager/SW3D license is required.
- Download the latest installer from : *http://seisimager.com/download/SeisImager.zip*
- See "*SeisImager/SWTM Manual*", "*SeisImager/SWTM Manual Addendum (H/V)*" and "*SeisImager/SW-ProTM Manual*" for the detailed analysis of dispersion curves and/or H/V curves.

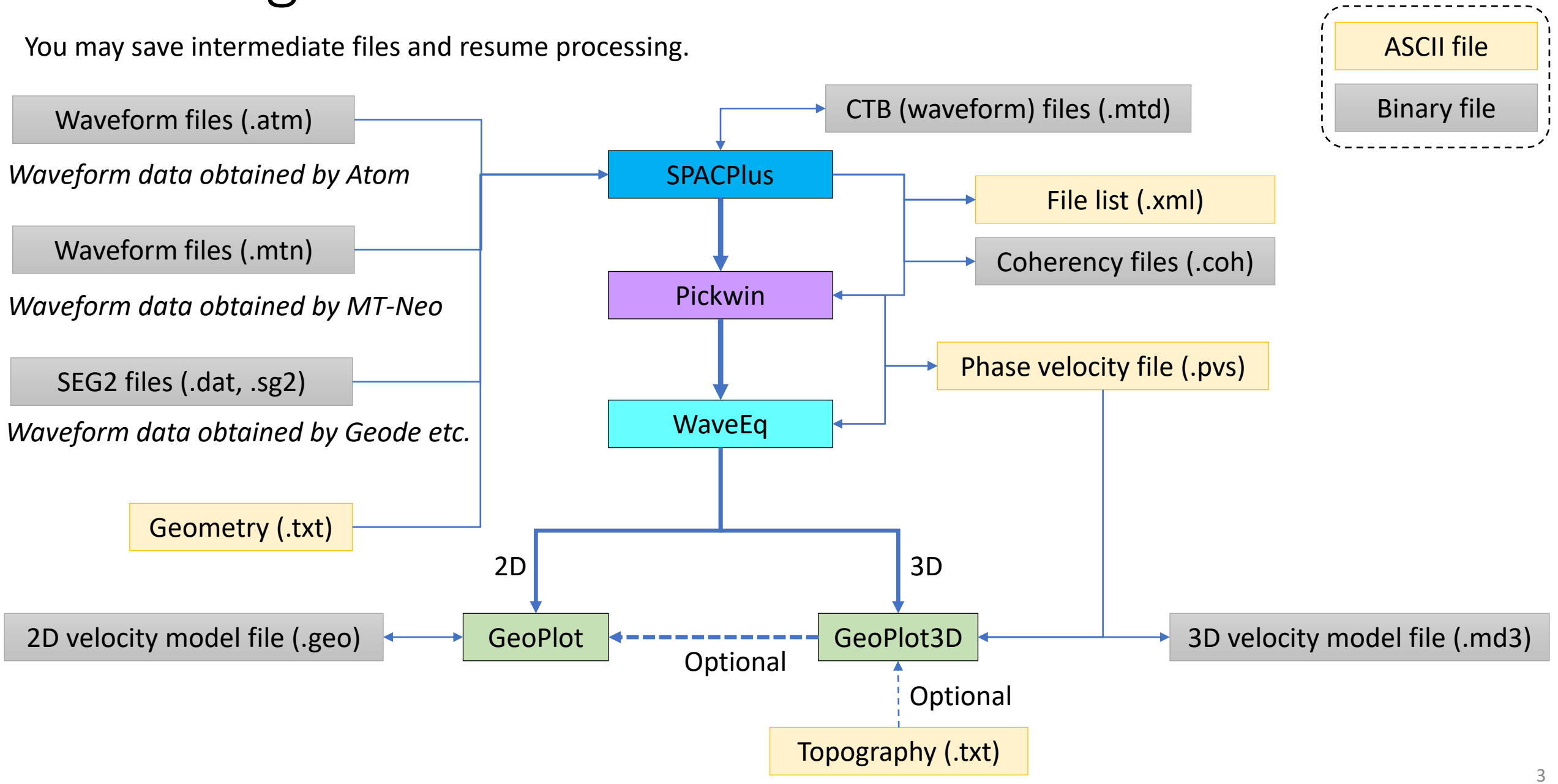


Processing flow



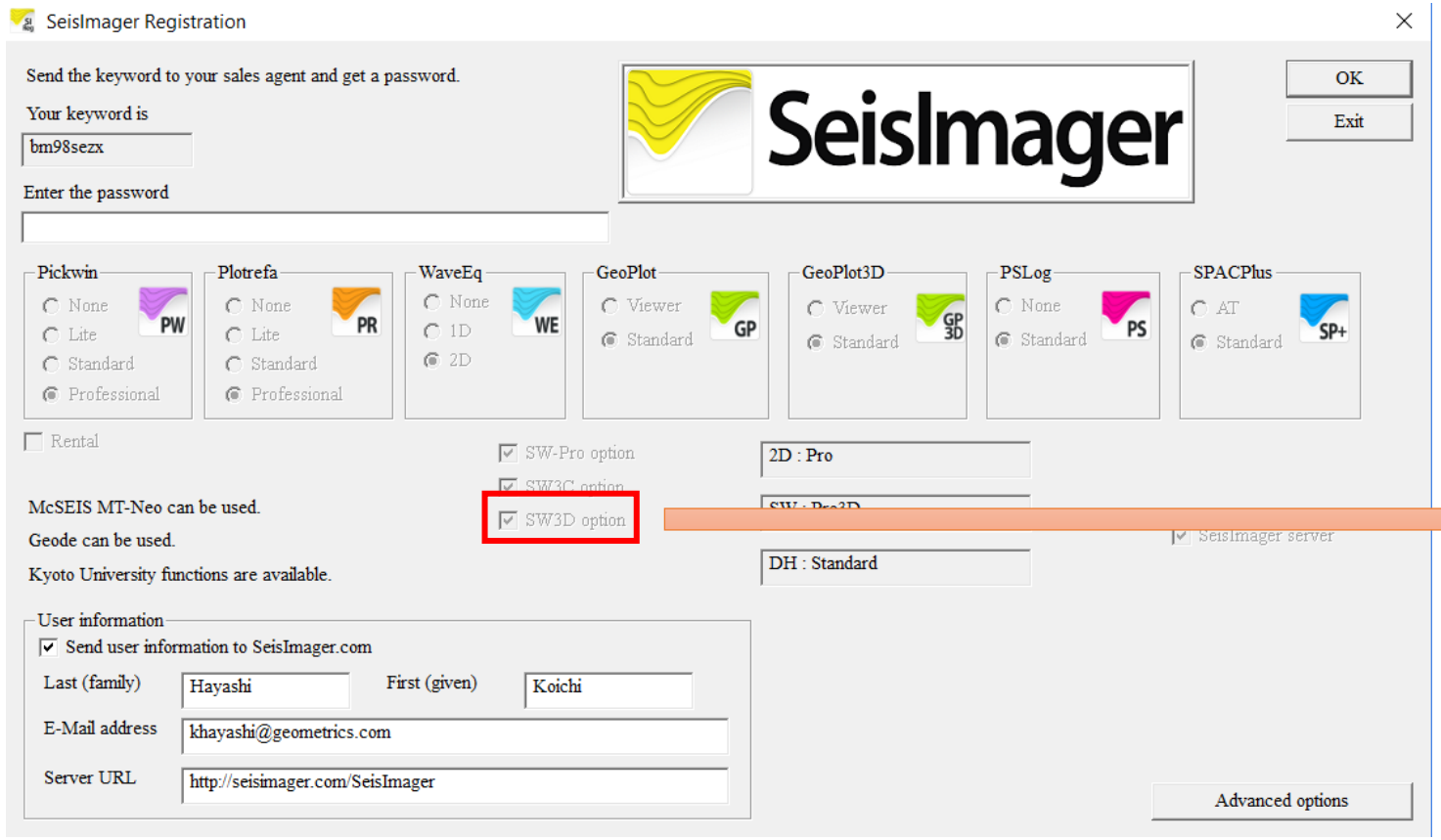
Processing flow with intermediate and resultant files

You may save intermediate files and resume processing.

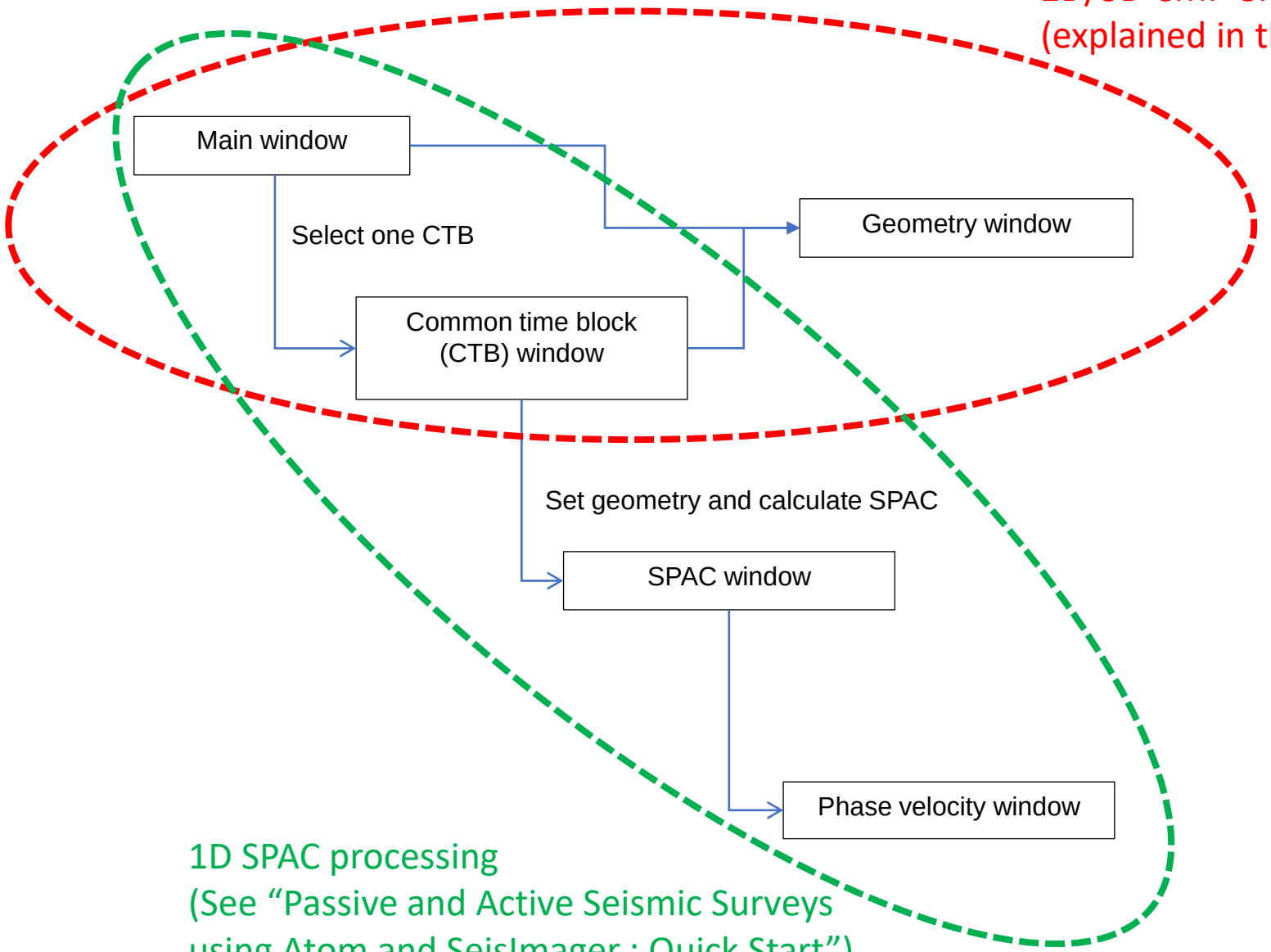


SW3D option in SeisImager

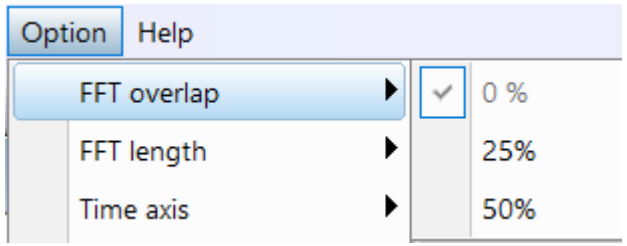
"SW3D option" should be checked in SeisImagerRegistarioan
to use 2D/3D ambient noise tomography processing functions.

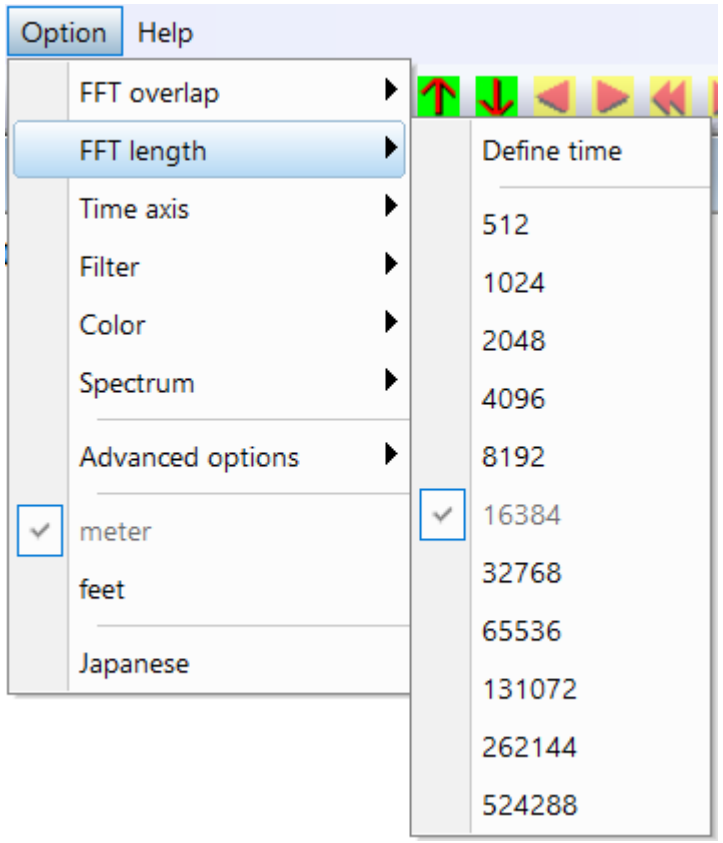


Window structure of SPACPlus



Setting of SPACPlus



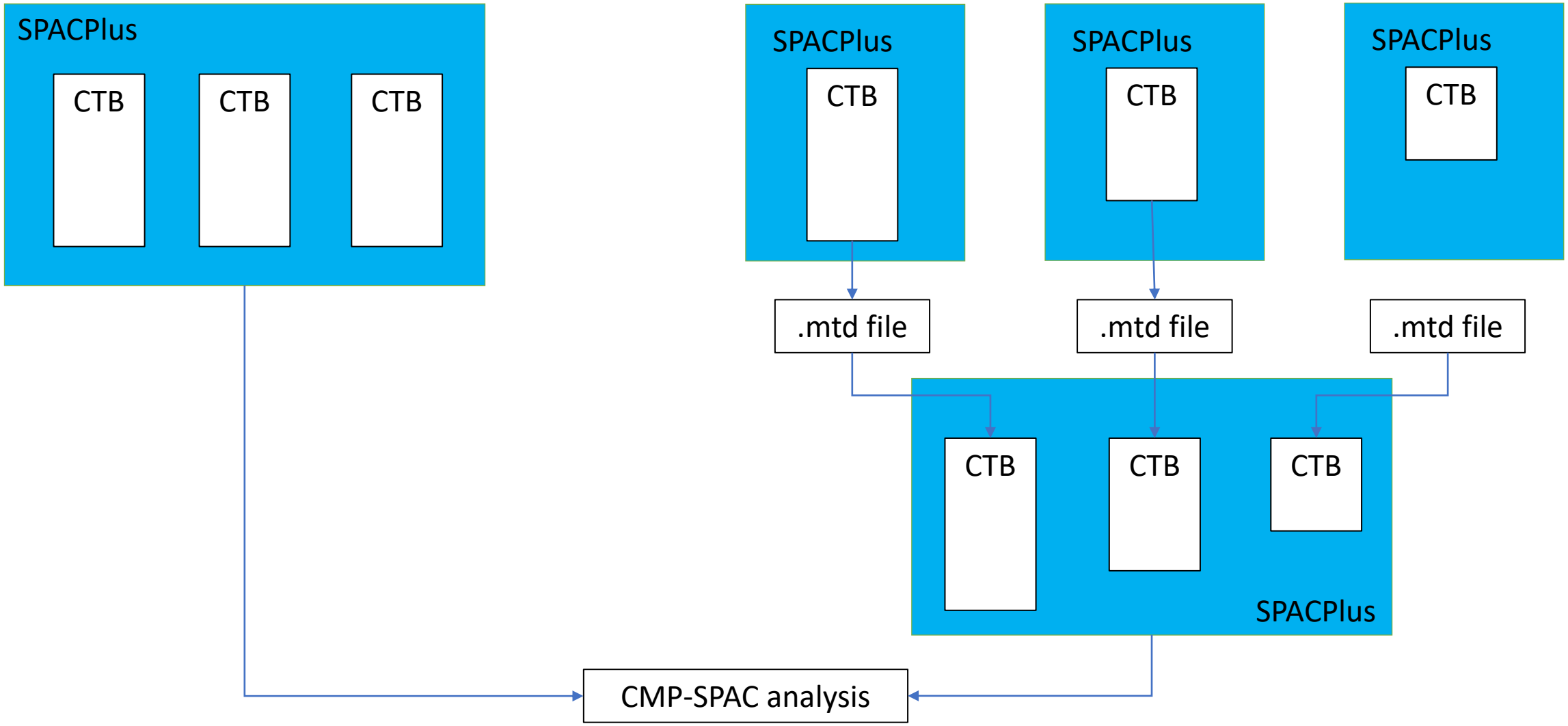


1. Import waveform data files

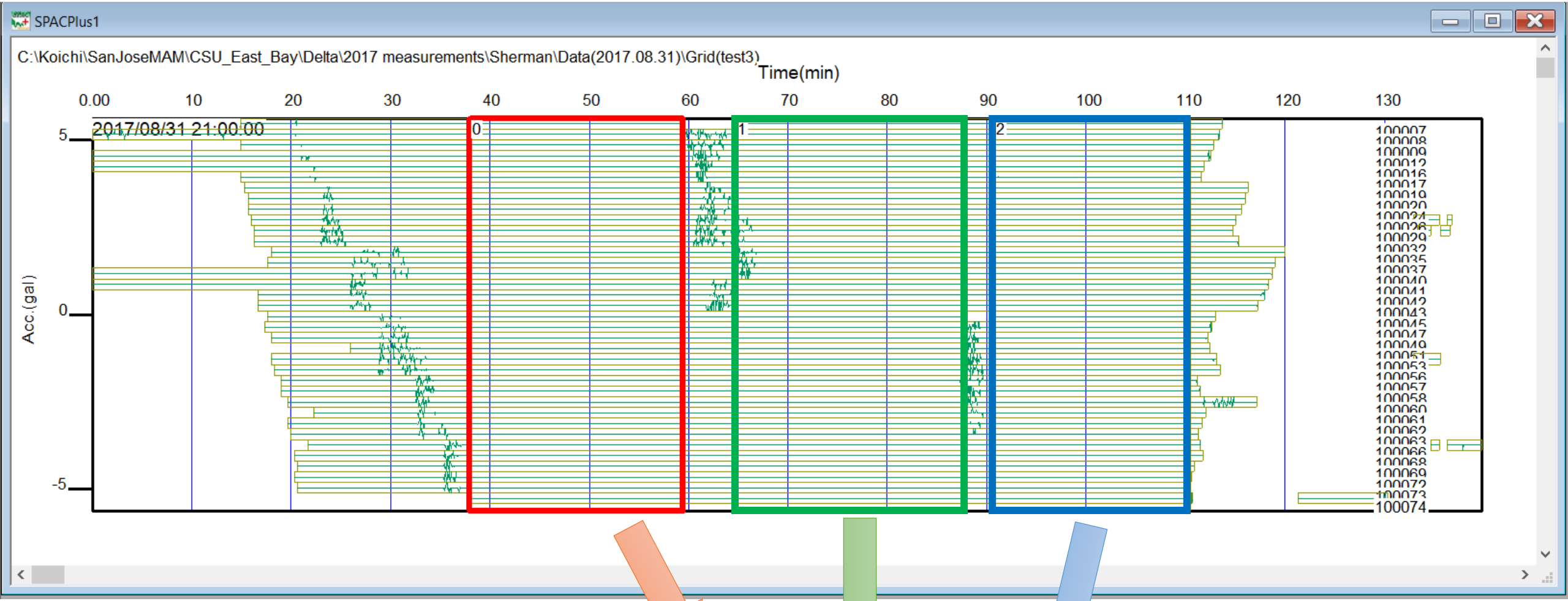
Geometry option of waveform data

A) All CTBs are in one set of data
(number of sensors must be identical)

B) CTBs are in several different sets
(number of sensors can be different)

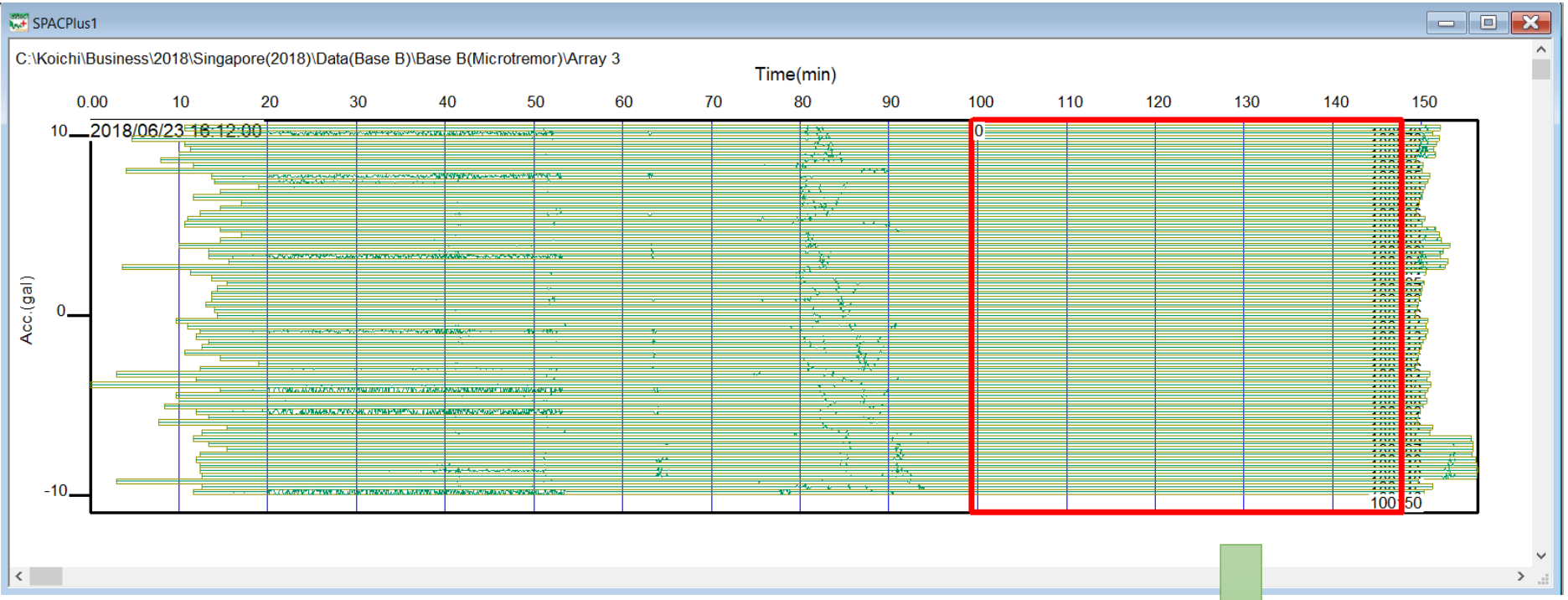


Example of data A



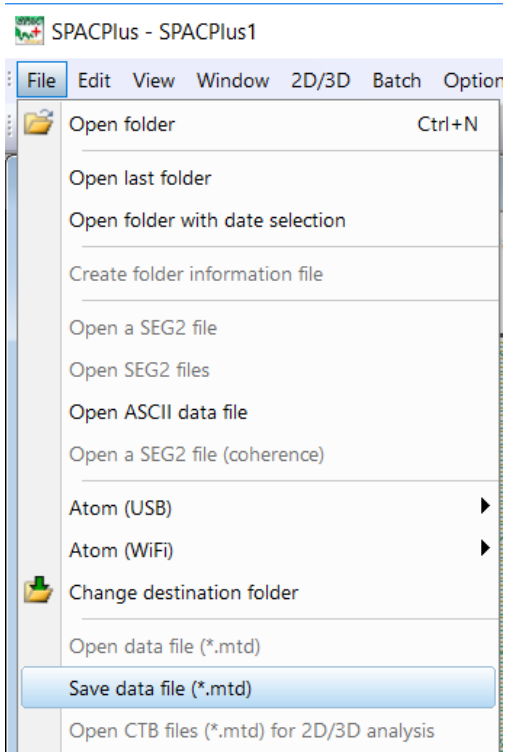
Common Time Blocks (CTBs)

Example of data B : save CTB as .mtd file

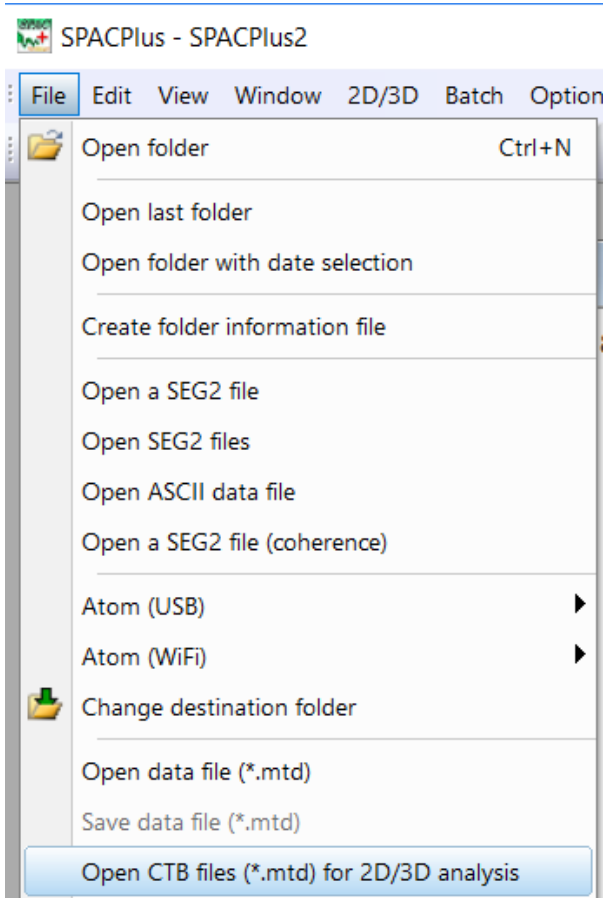


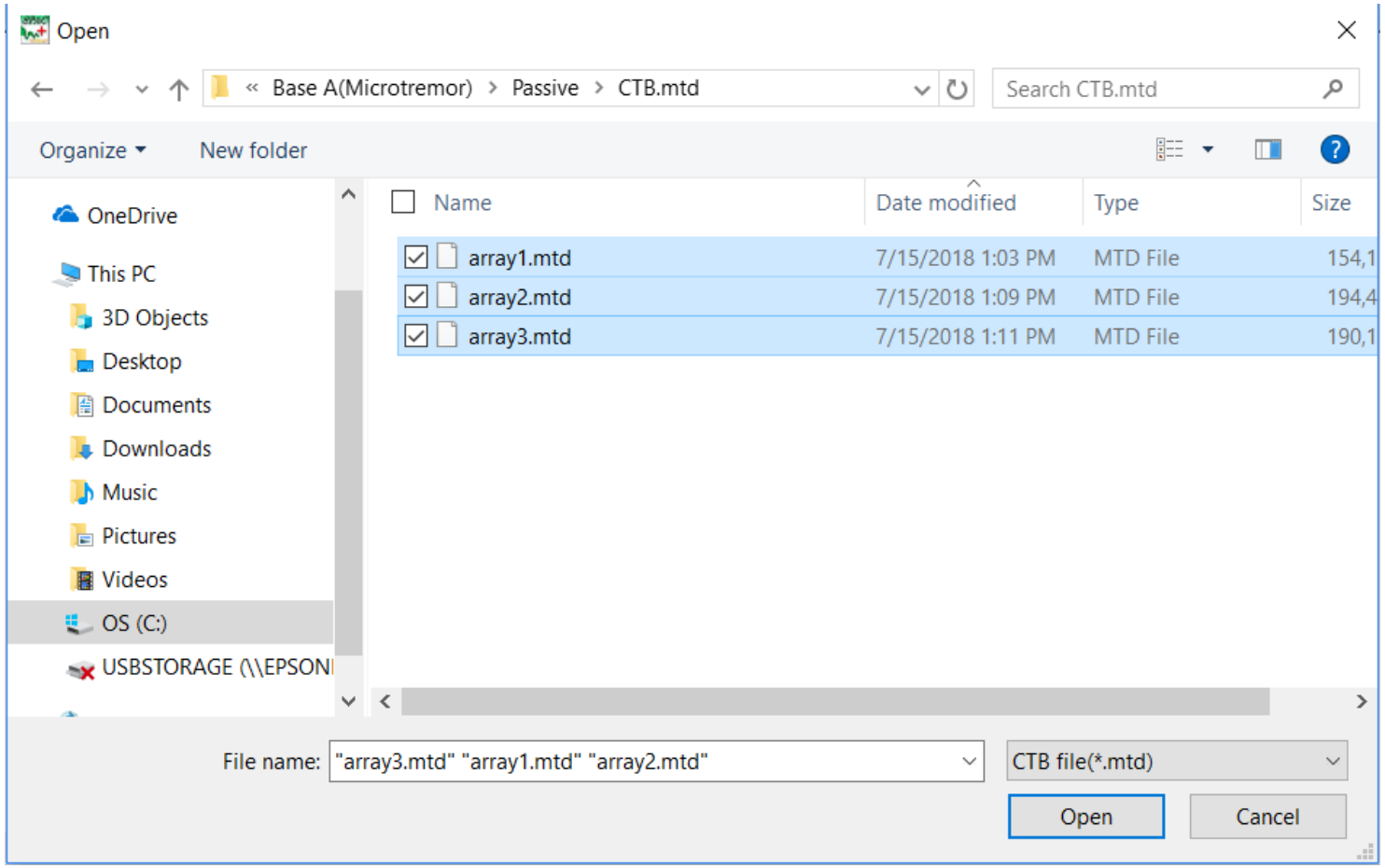
.mtd file

Select “File”, “Save data file (.mtd)” to save a CTB as .mtd file.

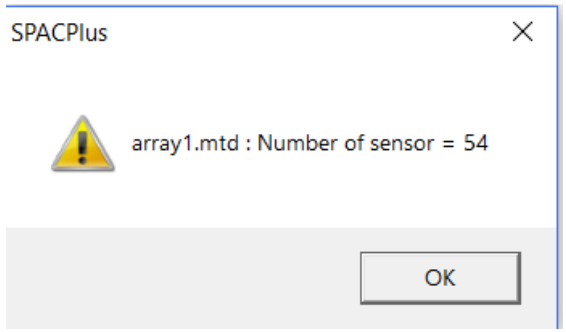


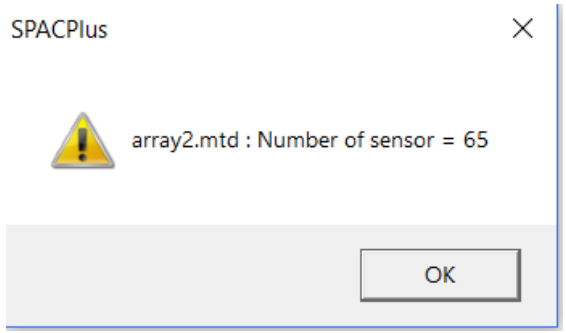
Example of data B : import several CTBs (.mtd files)

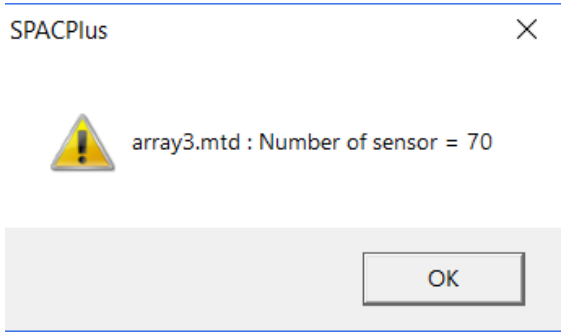


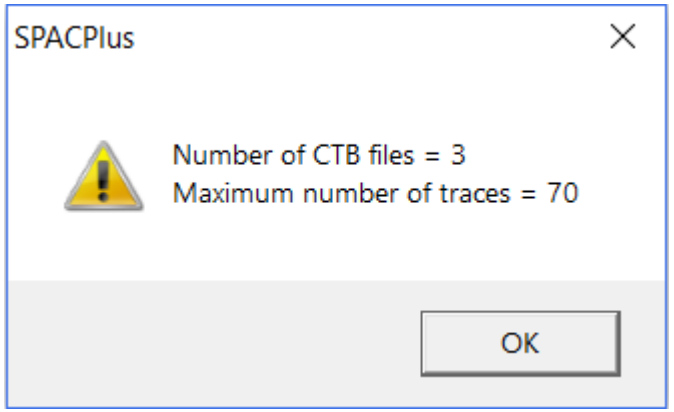


Example of data B : import several CTBs (.mtd files)

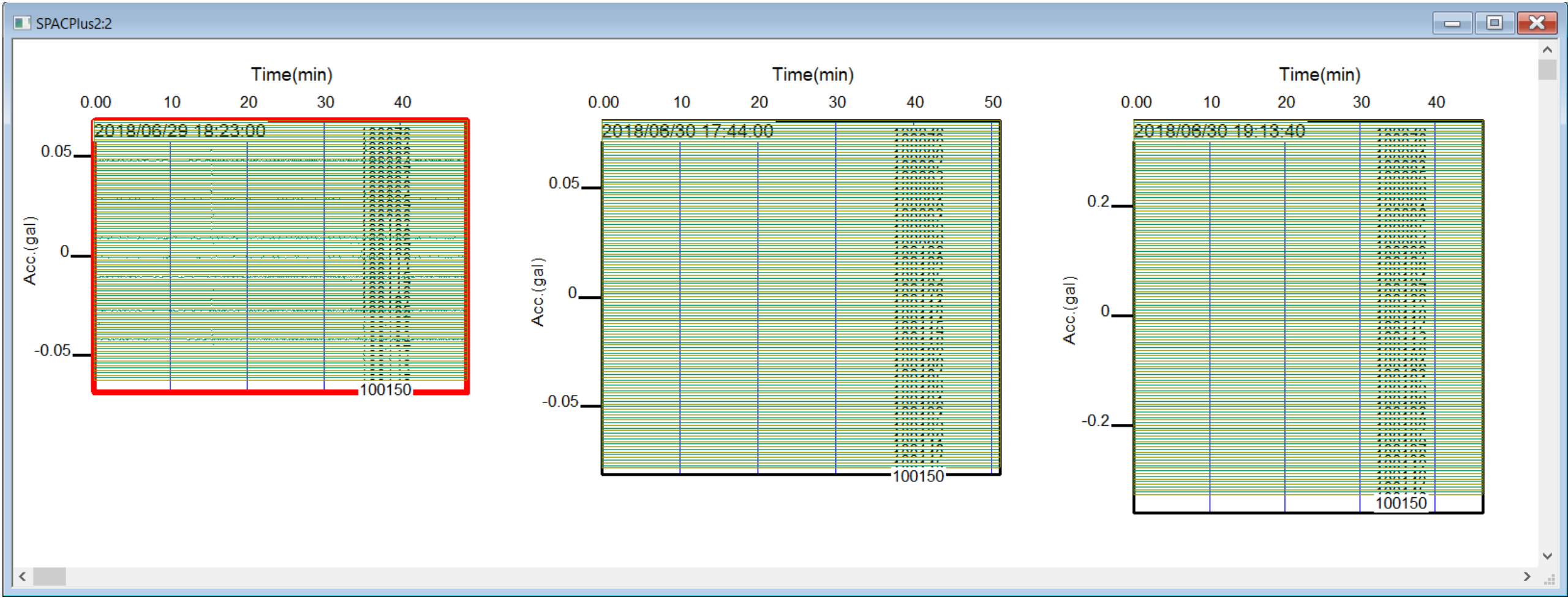






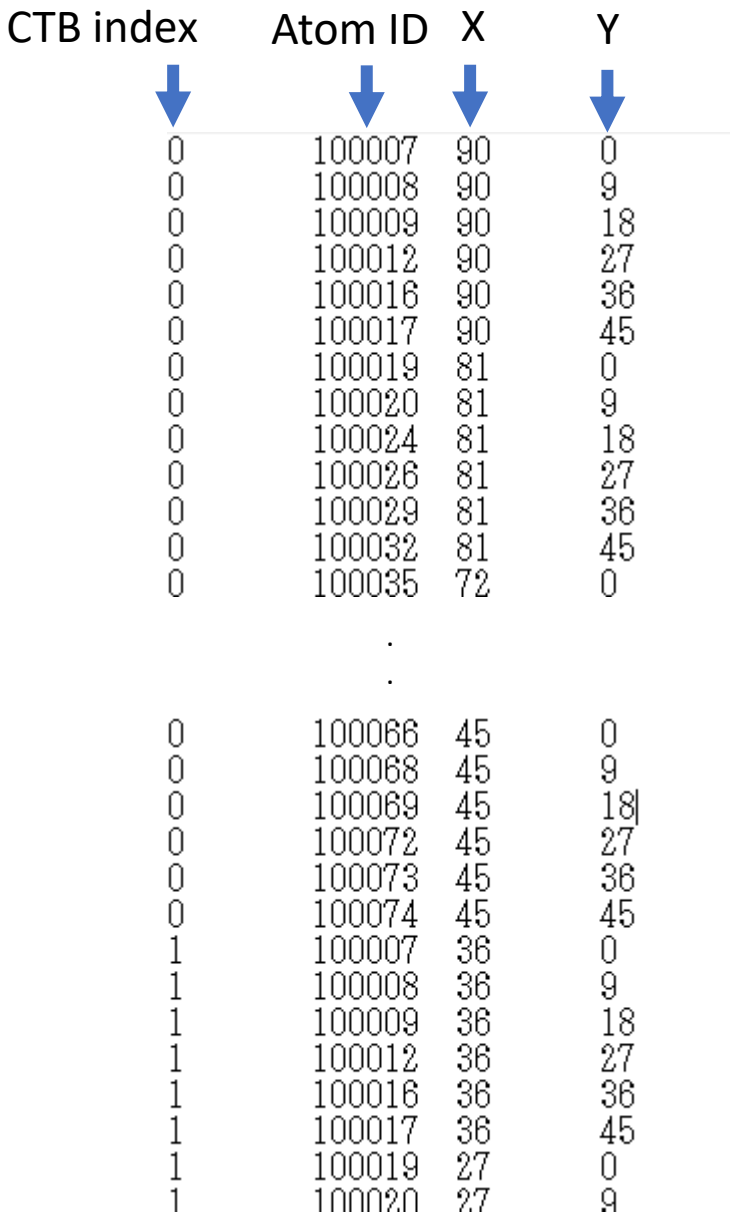


Example of data B : several CTBs with different receiver numbers



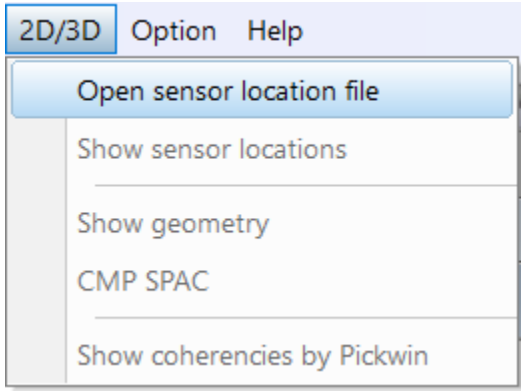
2. Prepare and import a geometry file

Prepare geometry file (ASCII file)

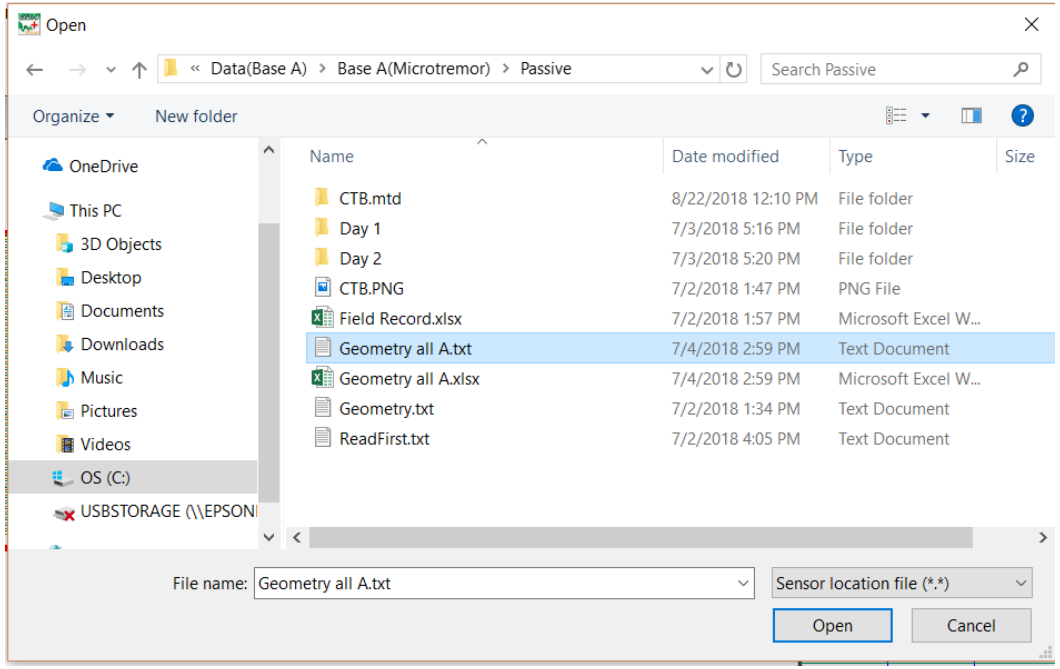


Import geometry file

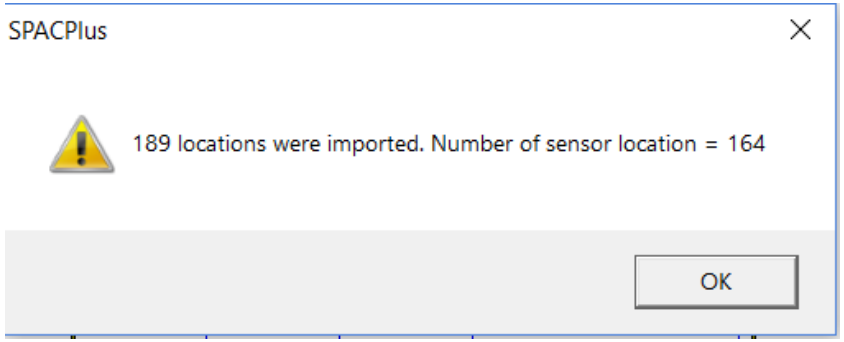
Select “2D/3D”, “Open sensor location file”
Open sensor location file.



Select geometry file.



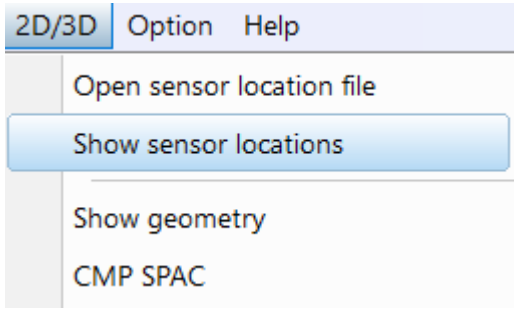
Confirm number of sensor locations.

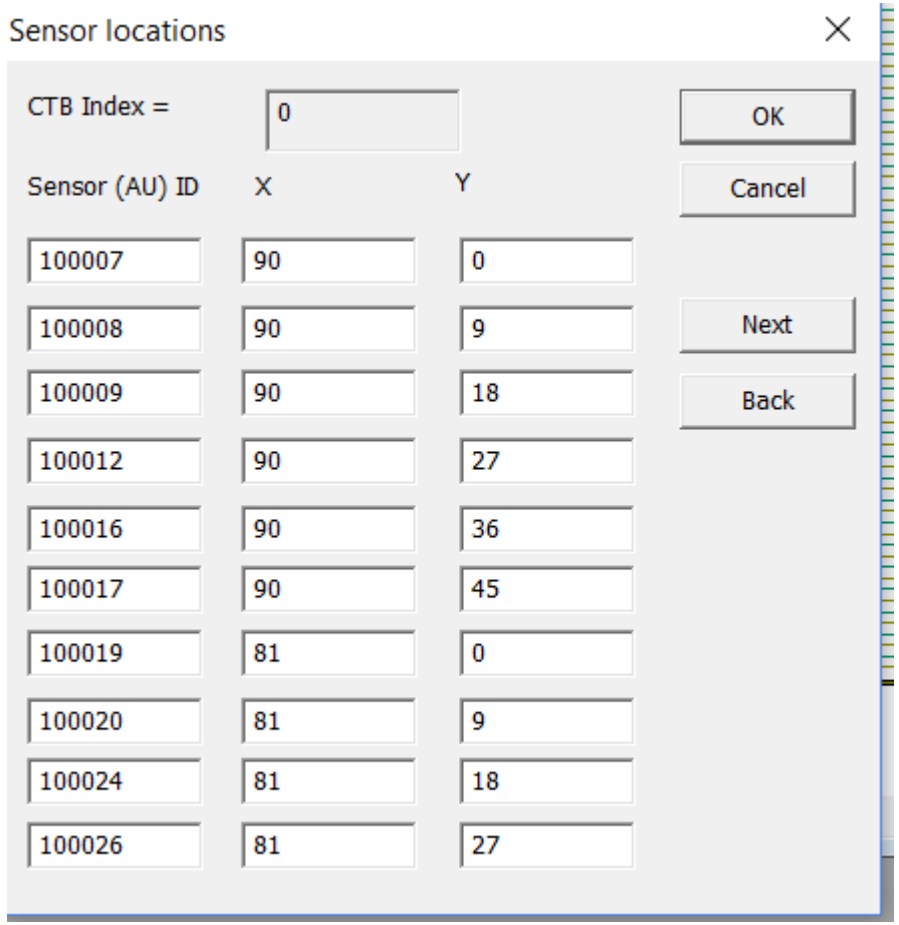


3. Show and edit sensor locations (geometry)

Show and edit sensor locations

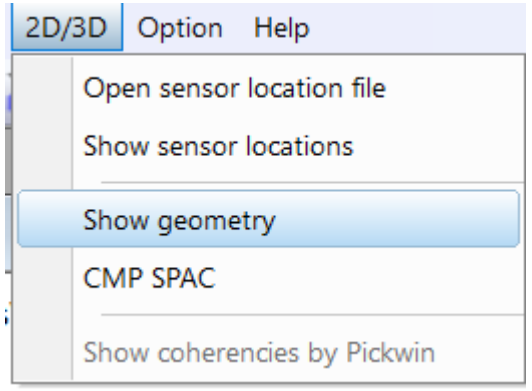
Select “2D/3D”, “Show sensor locations” to show or edit sensor locations.

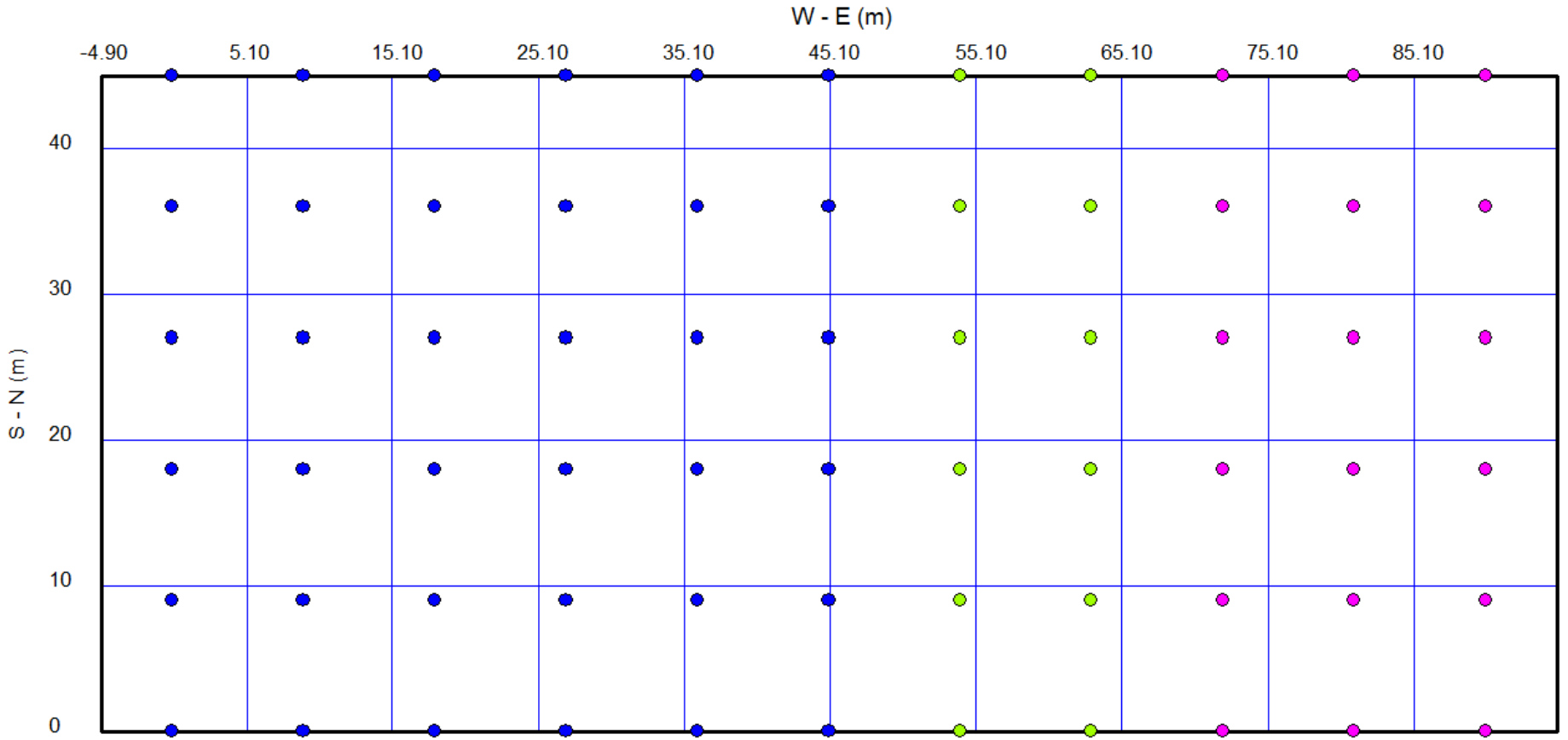




Show geometry

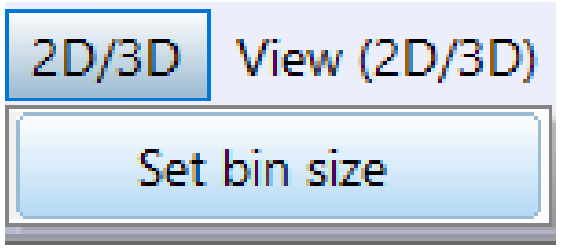
Select “2D/3D”, “Show geometry” to show sensor locations.

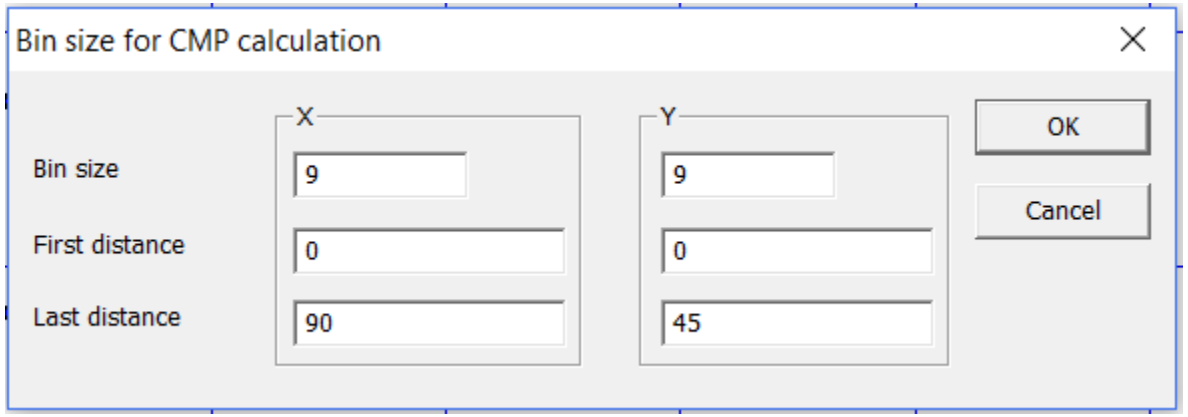


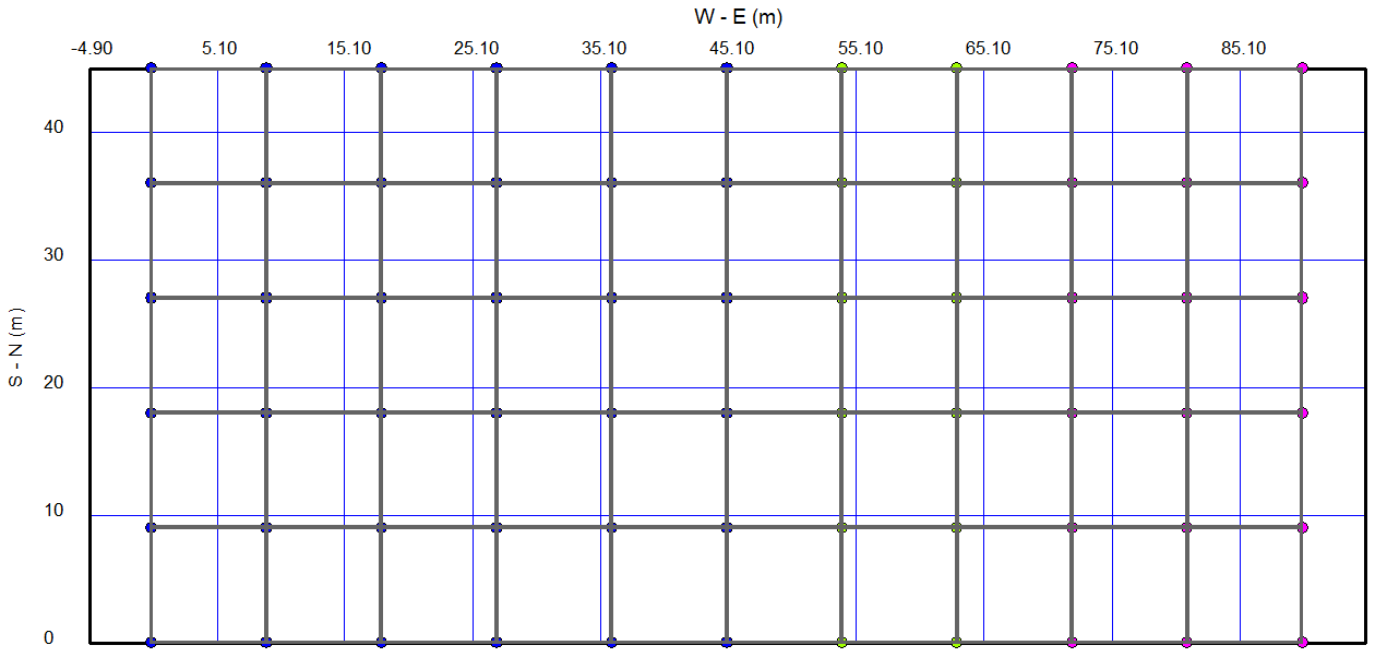


4. Set up bin size

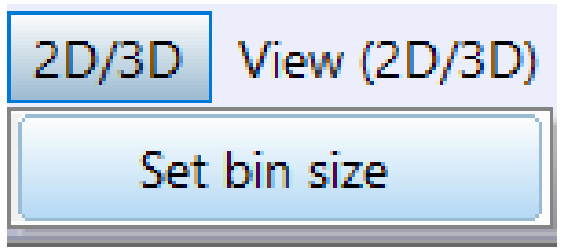
Set up bin size (3D processing)

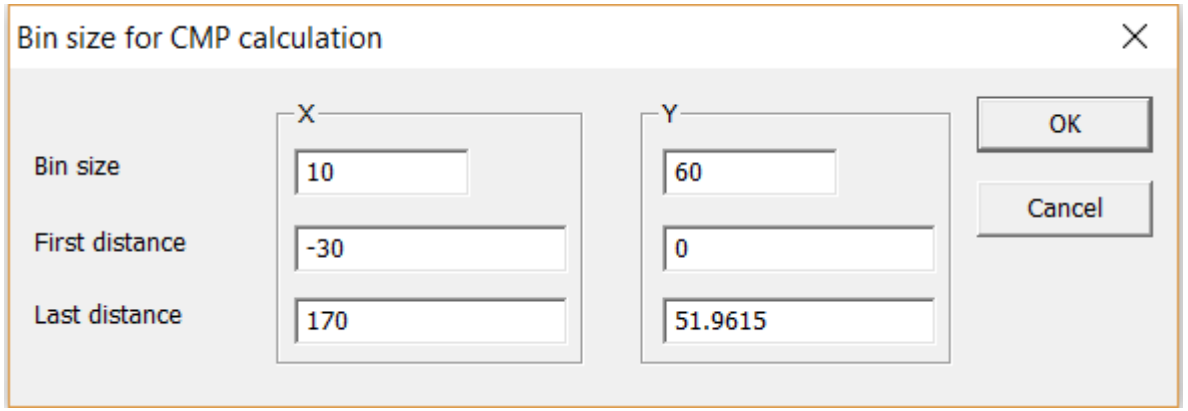


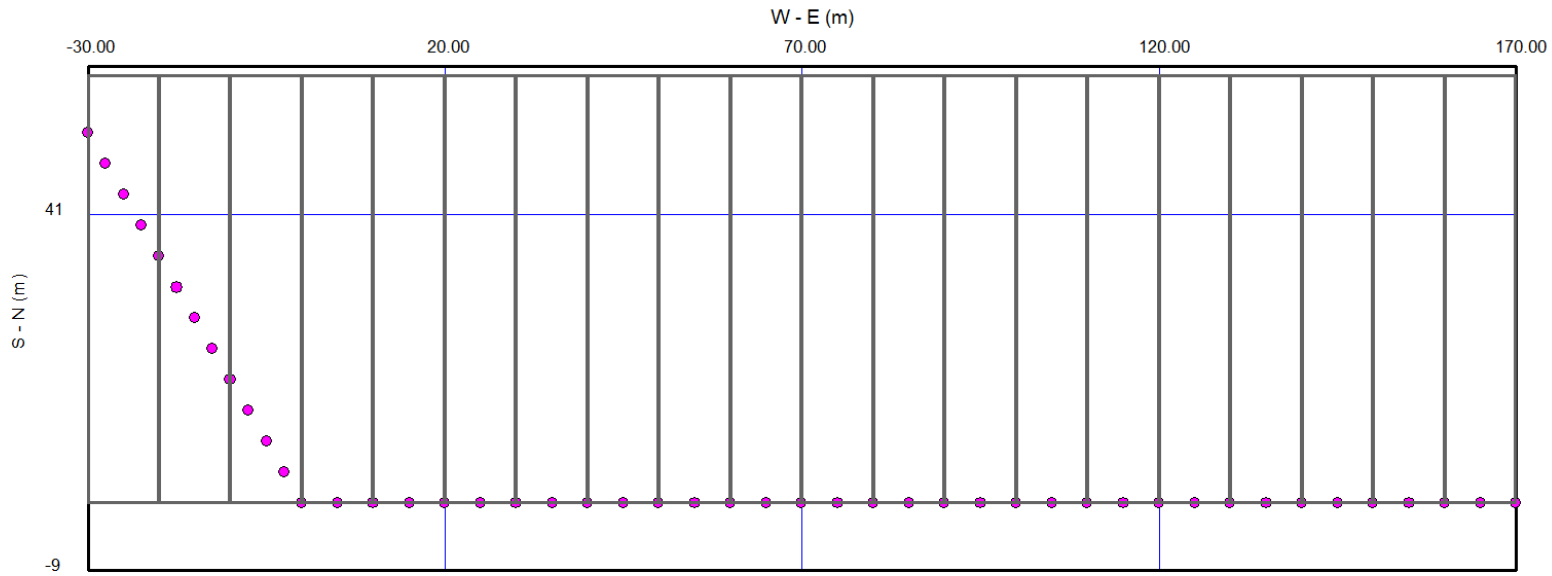




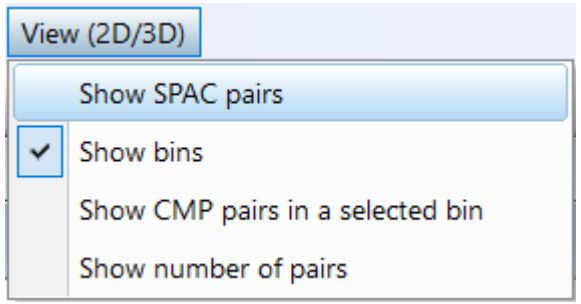
Set up bin size (2D processing)

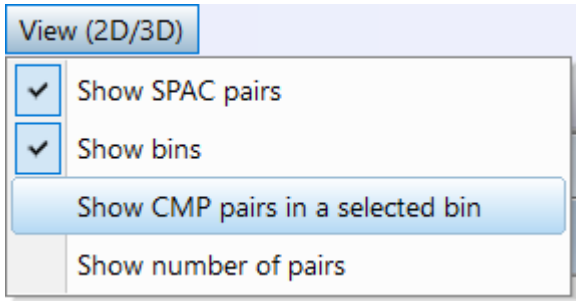


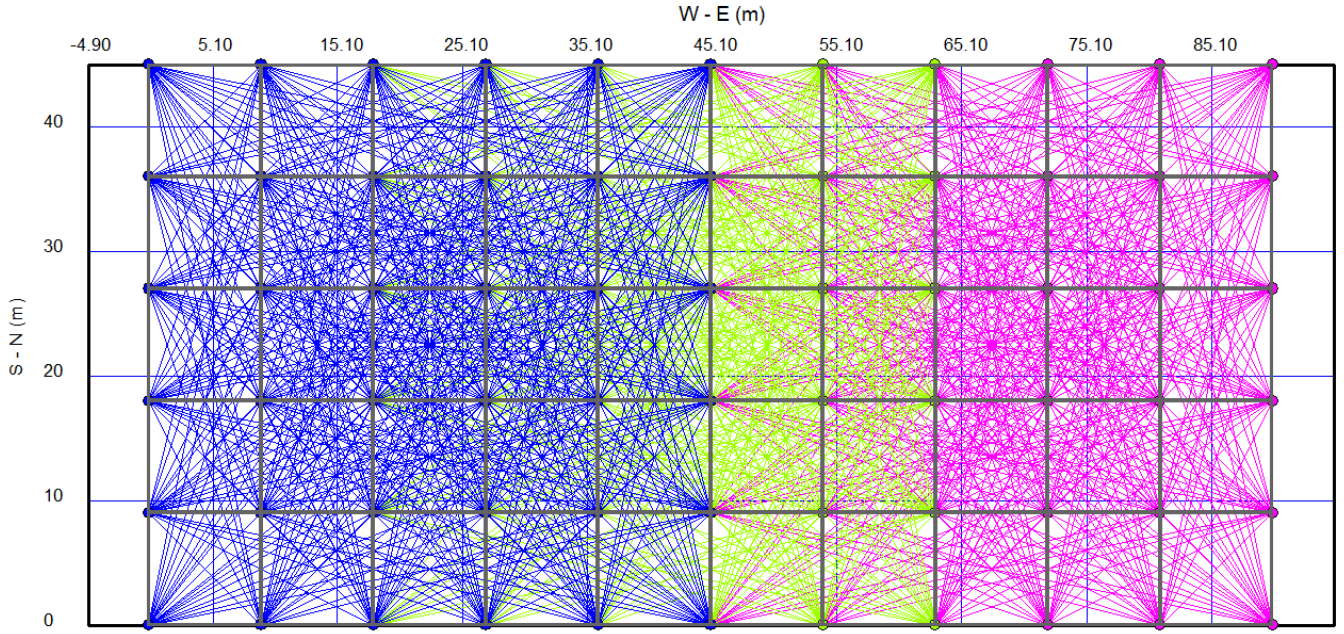


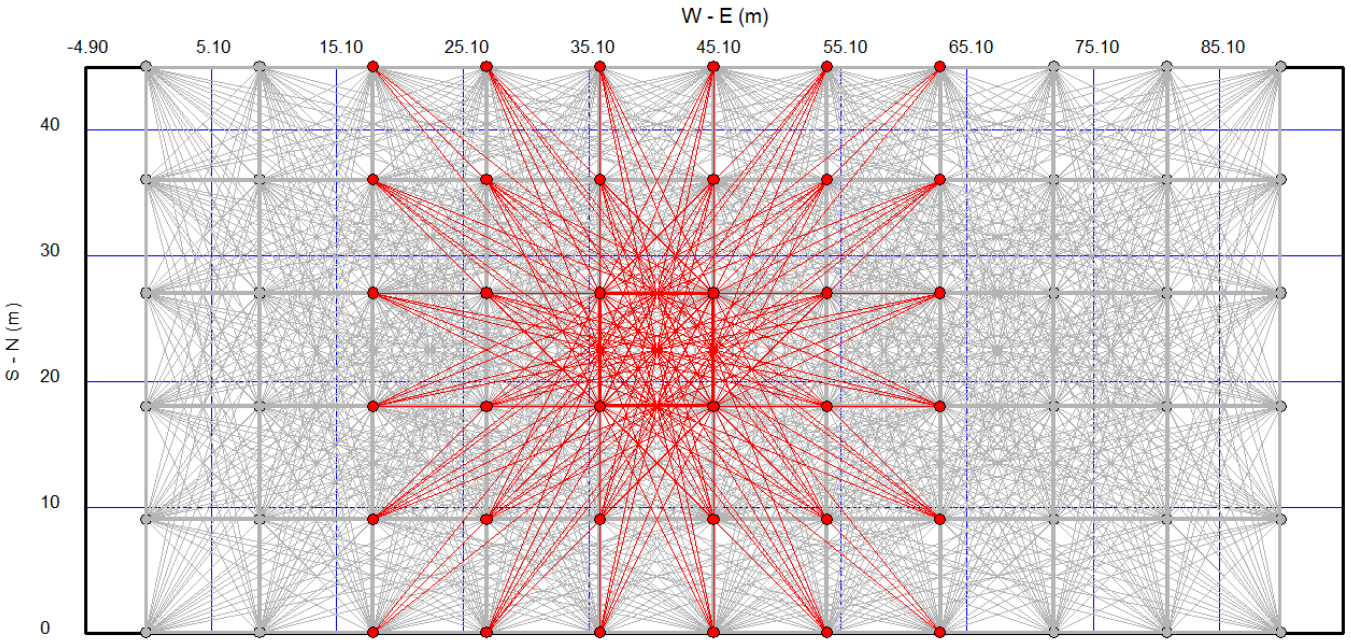


Show geometry



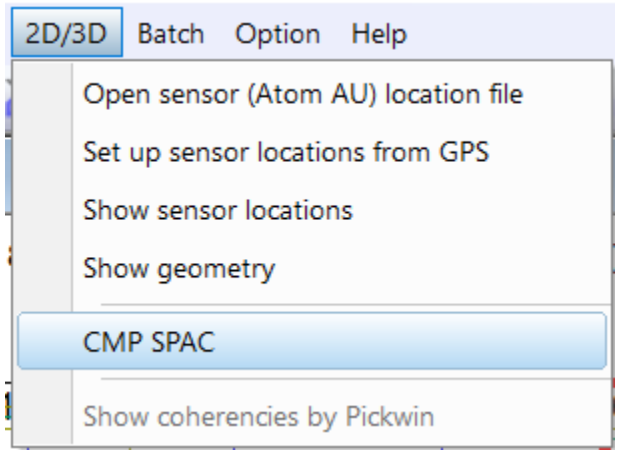




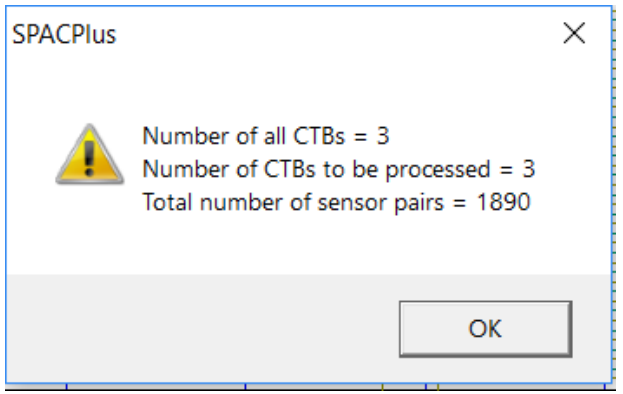


5. Calculate CMP-SPACs

Select “2D/3D”, “CMP SPAC”.

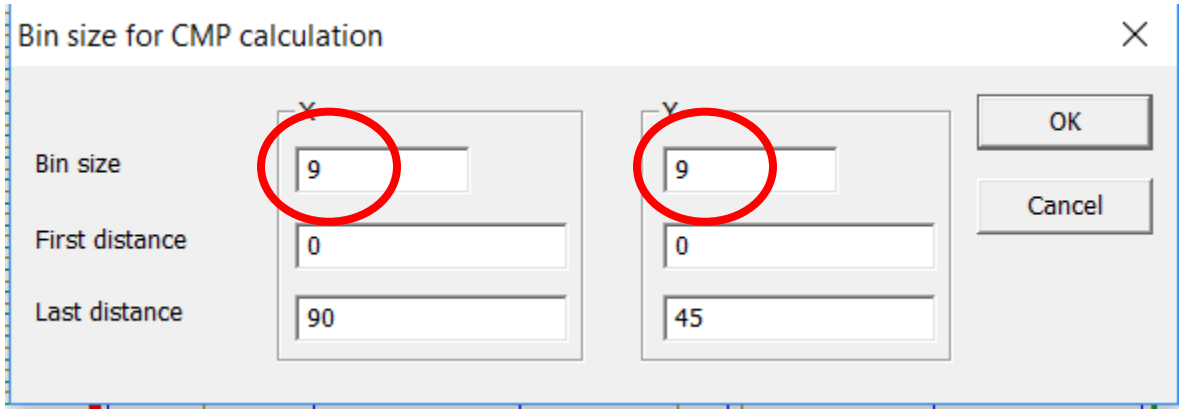


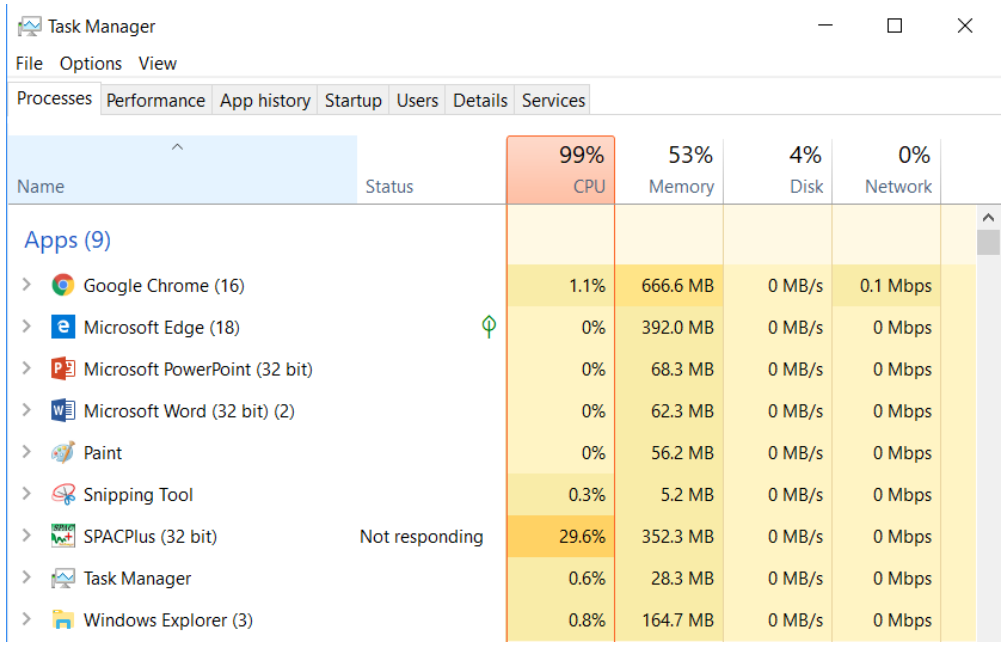
Confirm number of CTBS etc.



Calculation may use 0.5 ~ 3GB of memory.

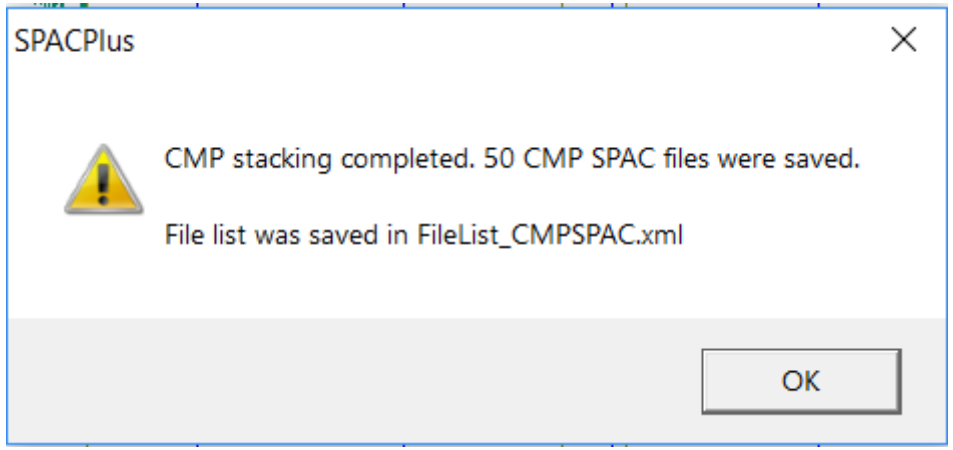
Set (confirm) Bin size and click “OK” to start calculation.





It will take several to several tens of minutes depending on the amount of data.

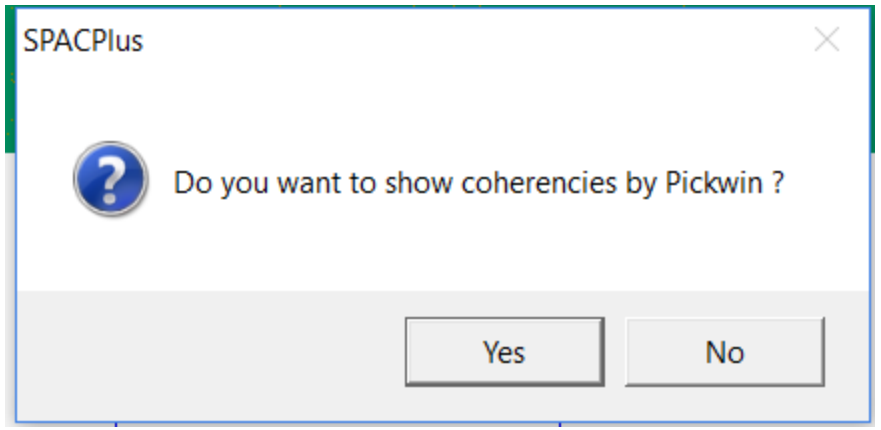
After the calculation,
SPAC or coherence files (.coh) and their file list (.xml) is saved.



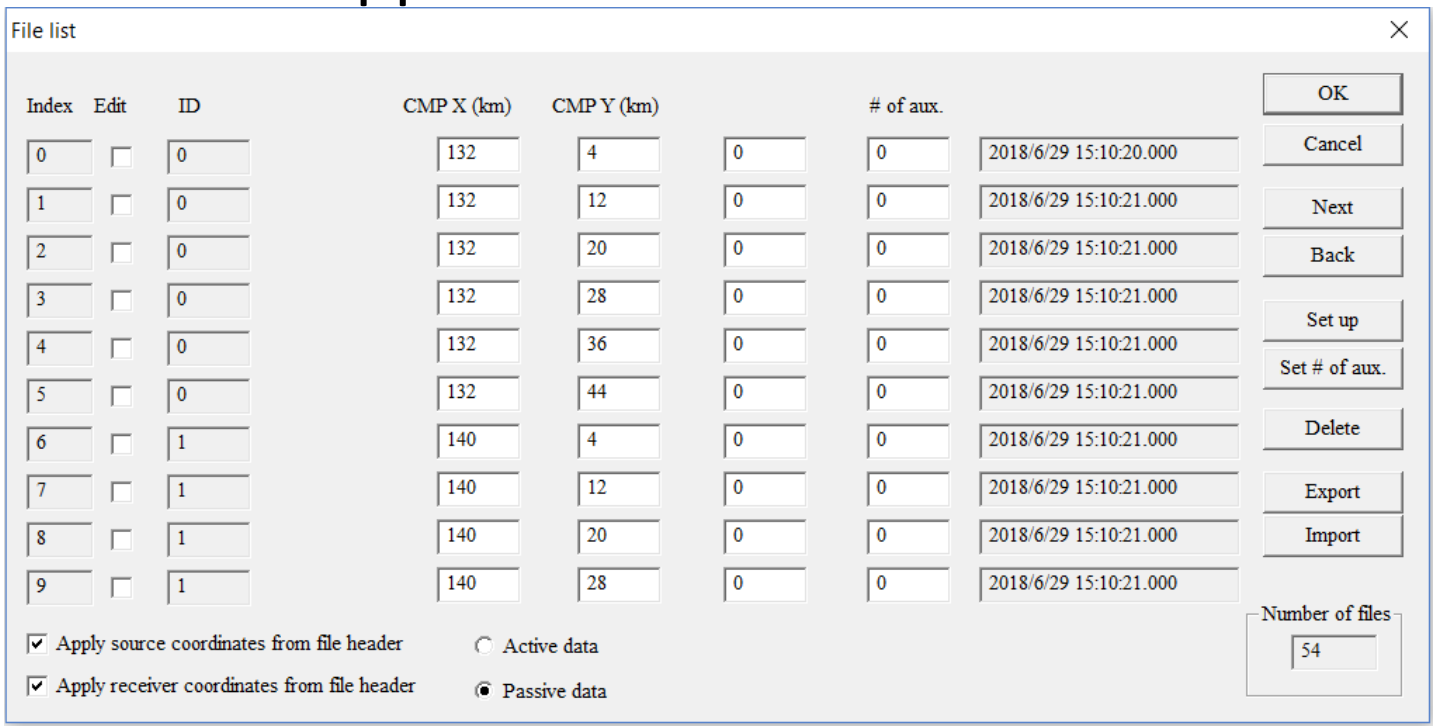
6. Show CMP-SPACs by Pickwin

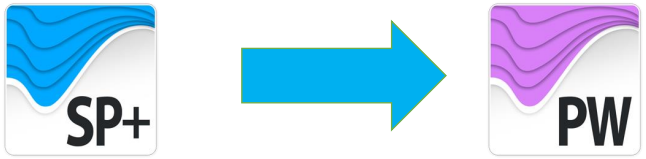
Crick OK to show SPAC by Pickwin.

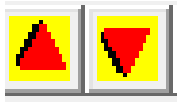
You can also manually open the file list (FileList_CMPSPAC.xml) by Pickwin.

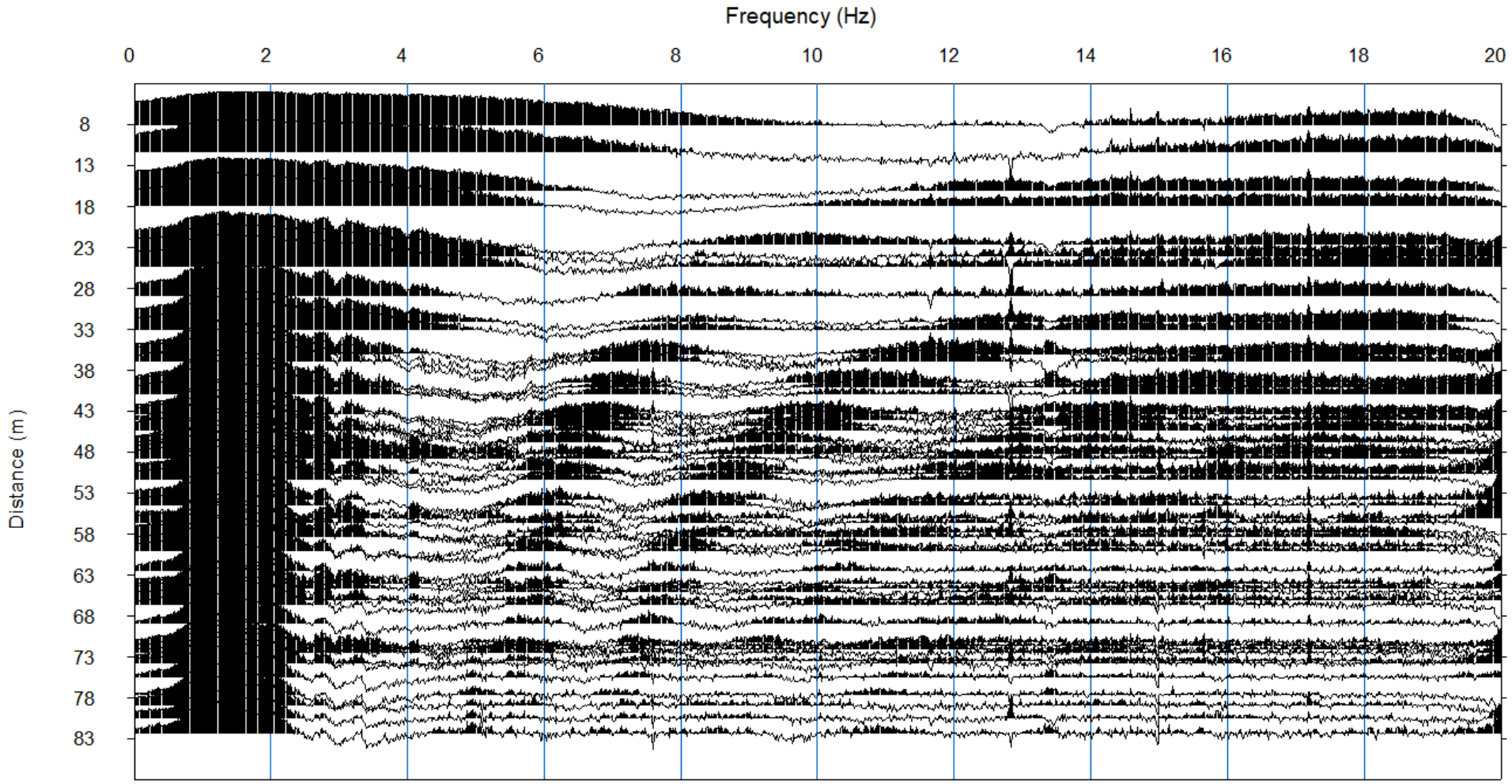


File list appears and click OK.





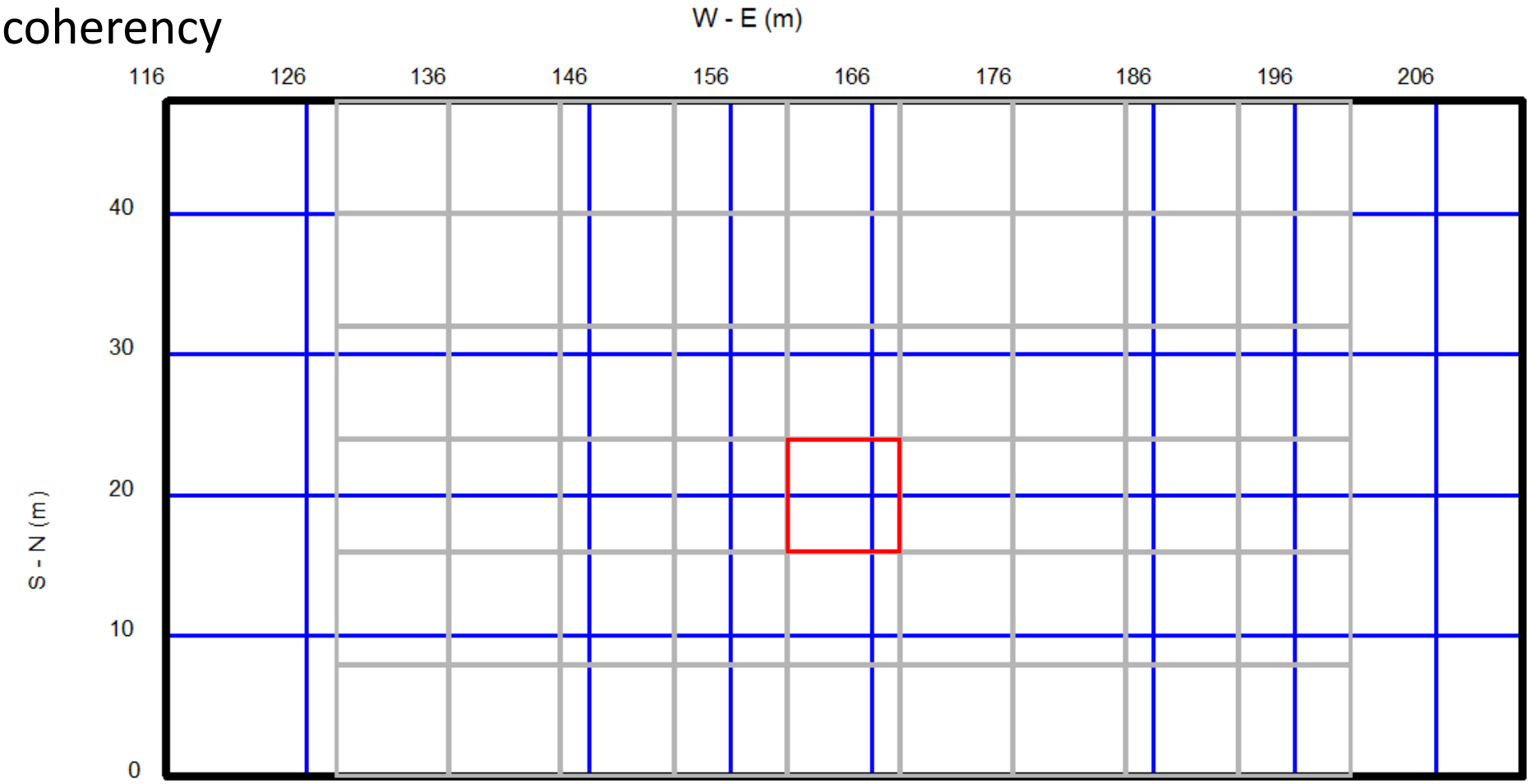
SPAC (coherence) appears. Use  buttons to scroll the bins (SPAC files).



Drawing geometry (CMP bins) in Pickwin

Click  to show geometry

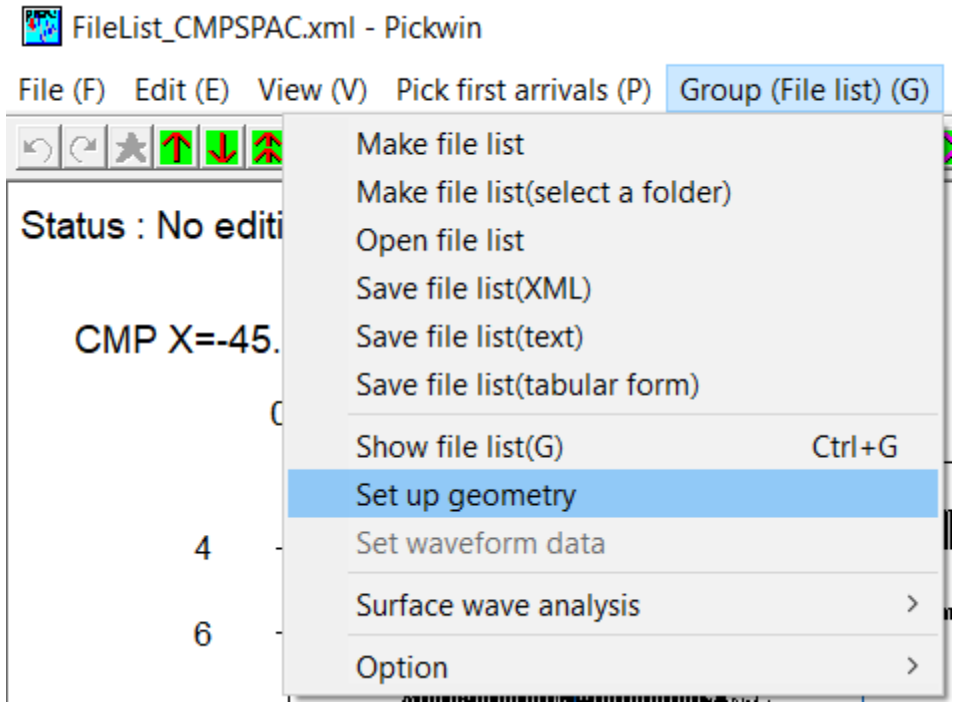
Click  to show coherency



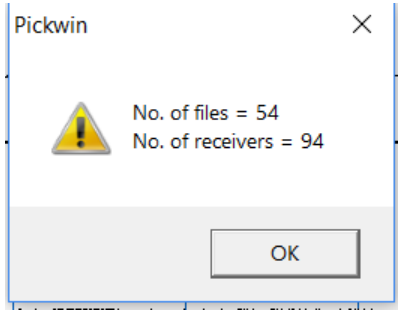
6.1 Set up geometry and extrapolate CMP-SPAC (optional)

If the number of coherencies have large difference among CMP-SPACs, the coherencies can be extrapolated to calculate stable and consistent dispersion curves. If you do not need to do the extrapolation, proceed step 7.

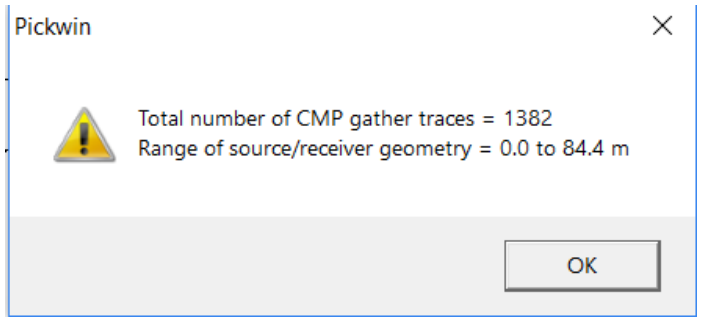
Select “Group (File list)”, ”Set up geometry.

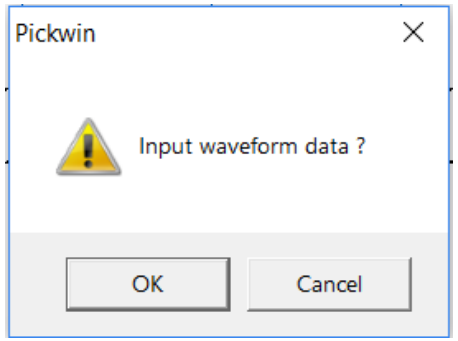


Confirm messages.

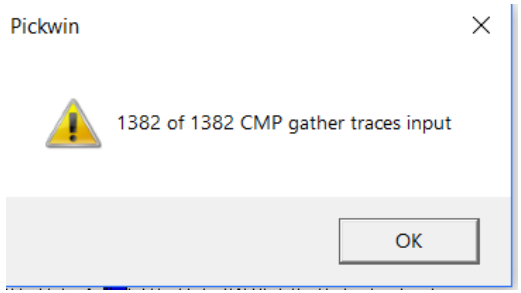


Confirm a message.

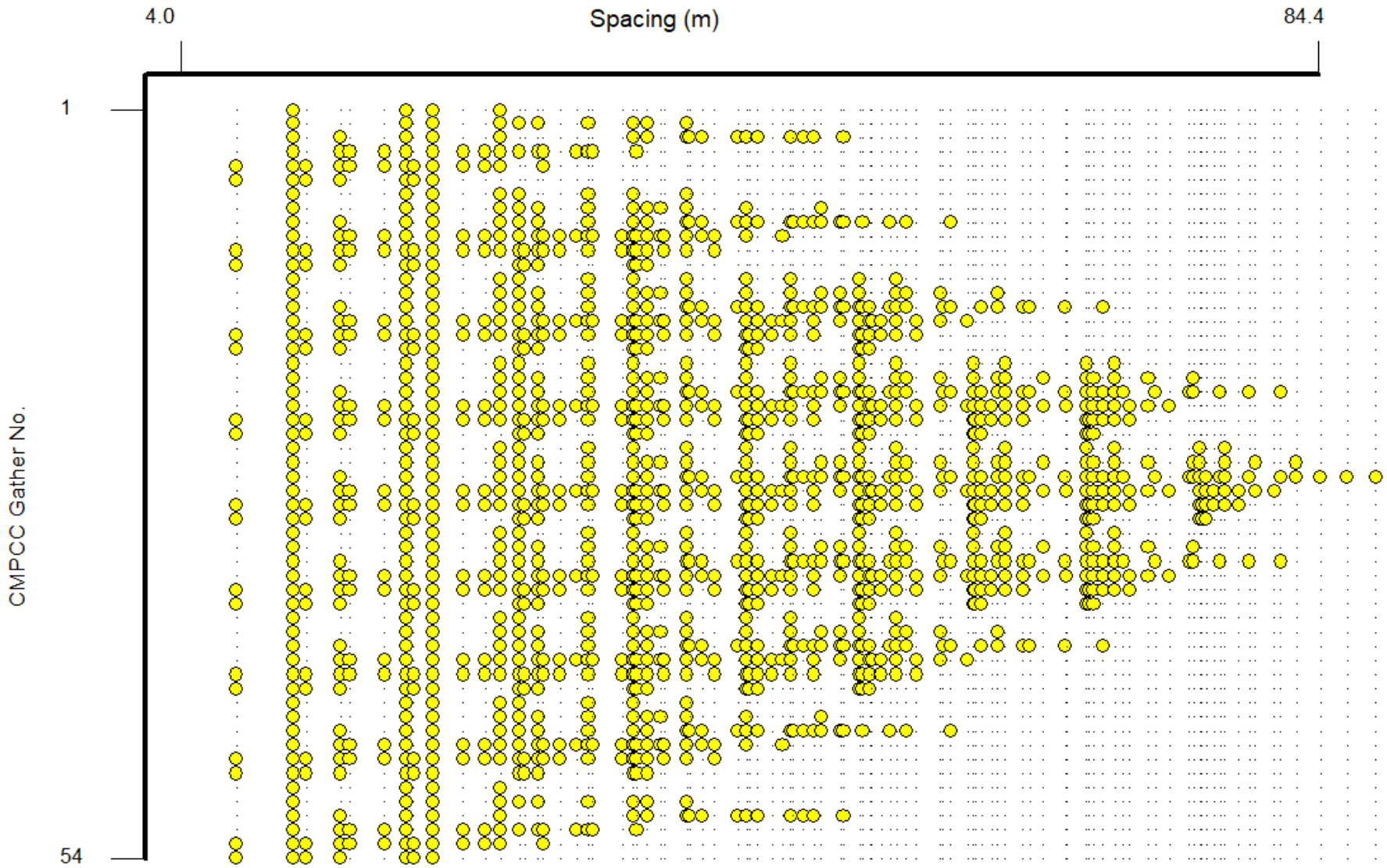




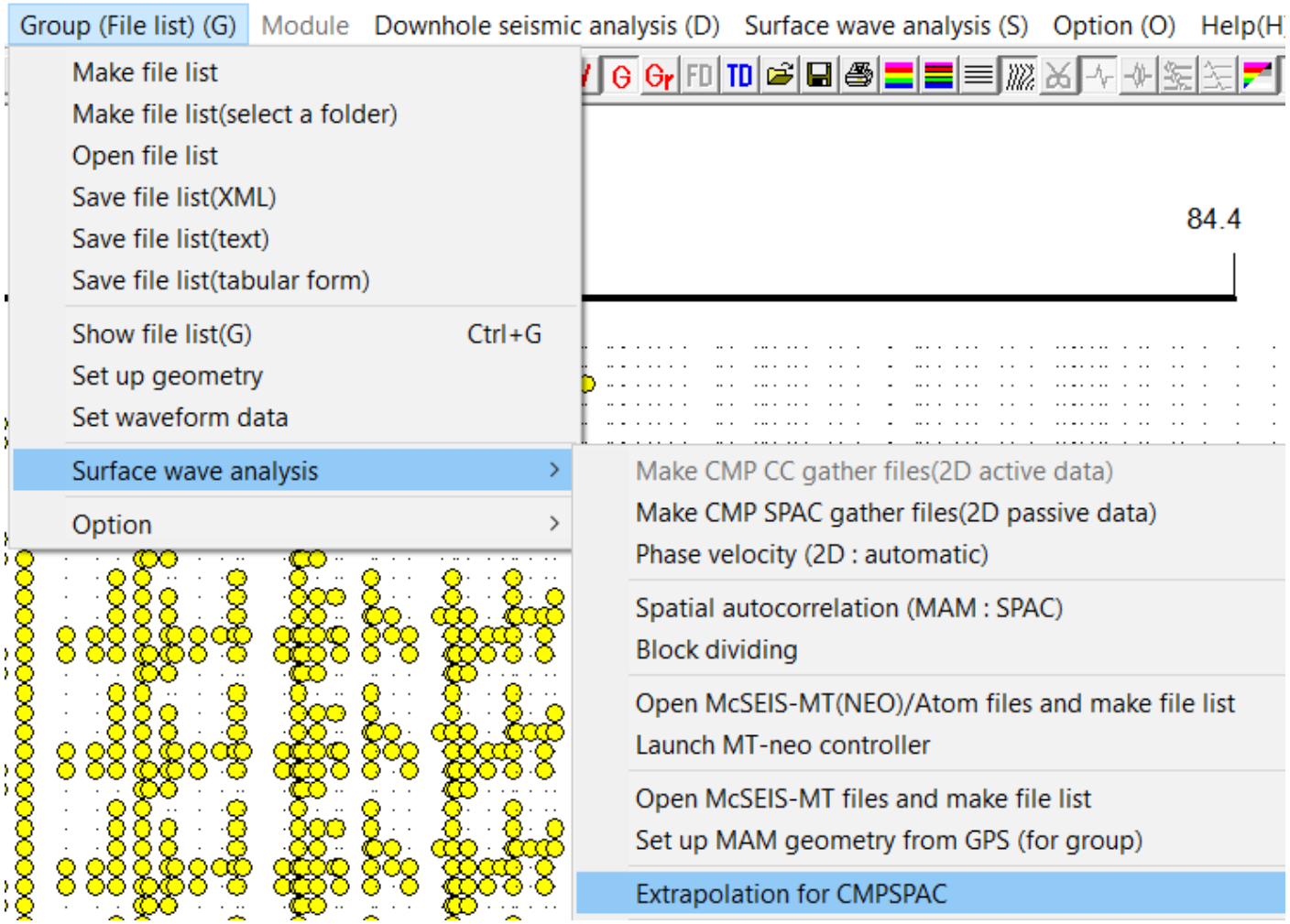
Crick OK to proceed.



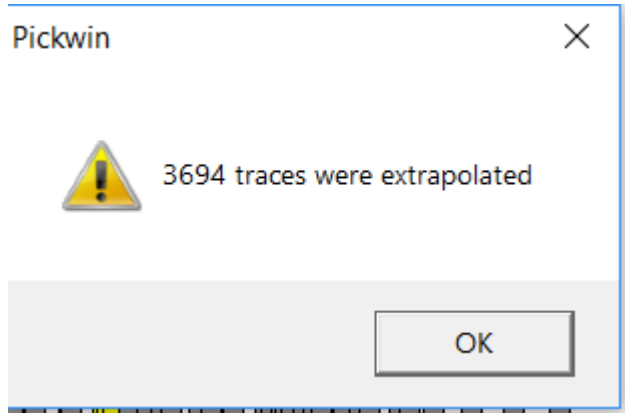
All coherencies are imported and geometry appears.



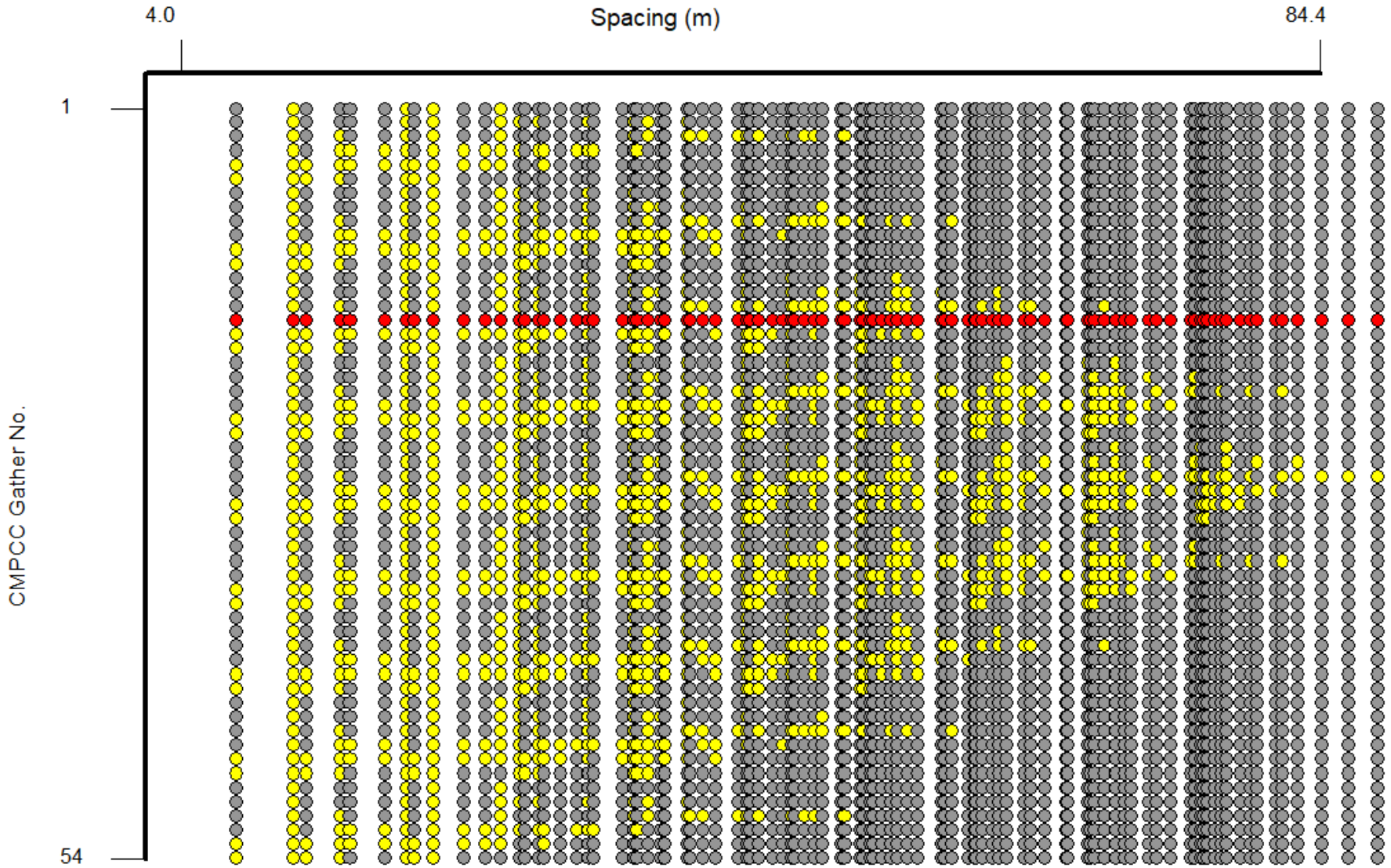
Extrapolation for CMP-SPAC (optional)



Set distance from CMP / receiver separation ratio.
Larger ratio makes more extrapolated traces

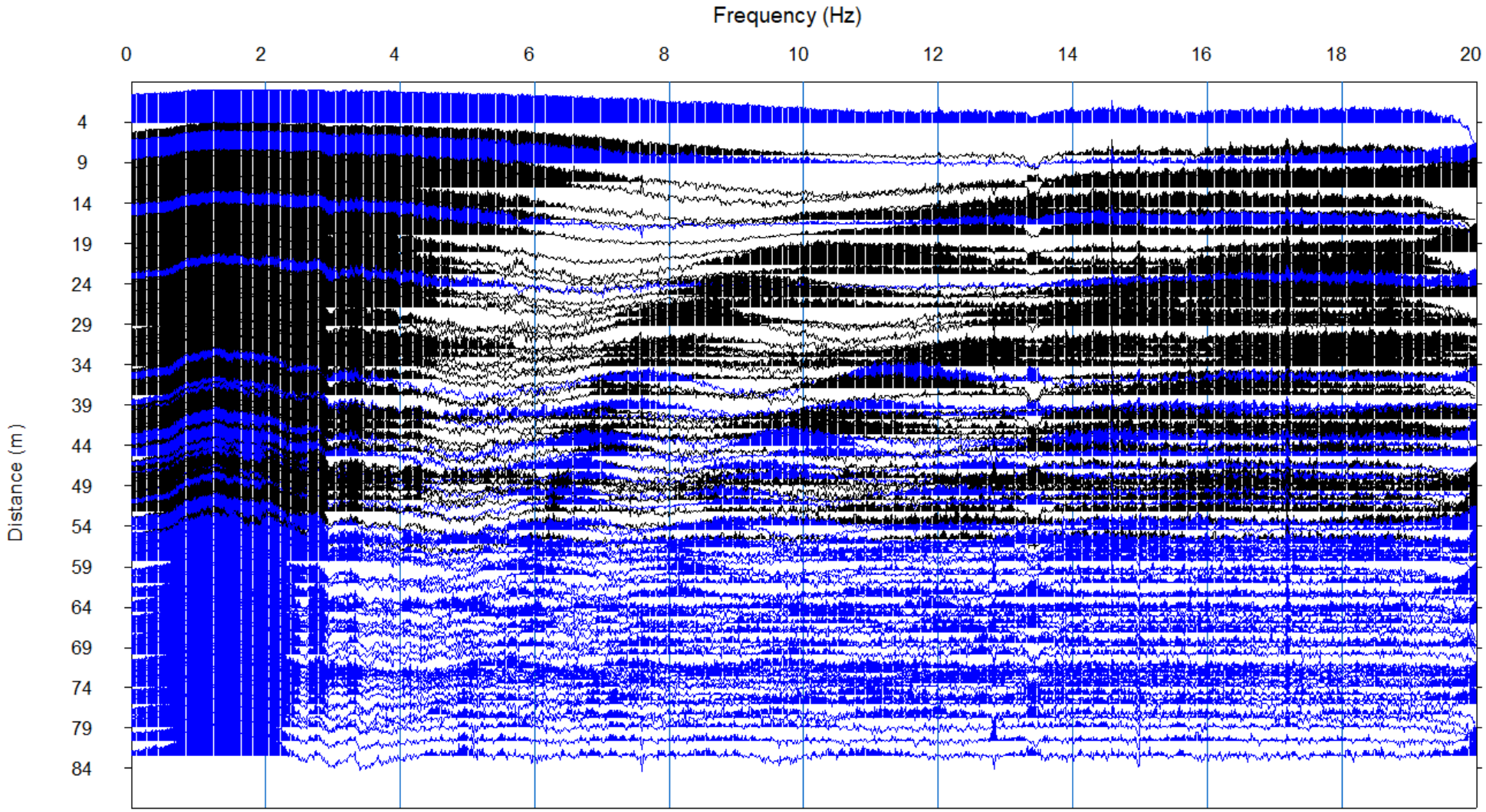


Extrapolation for CMP-SPAC (optional)



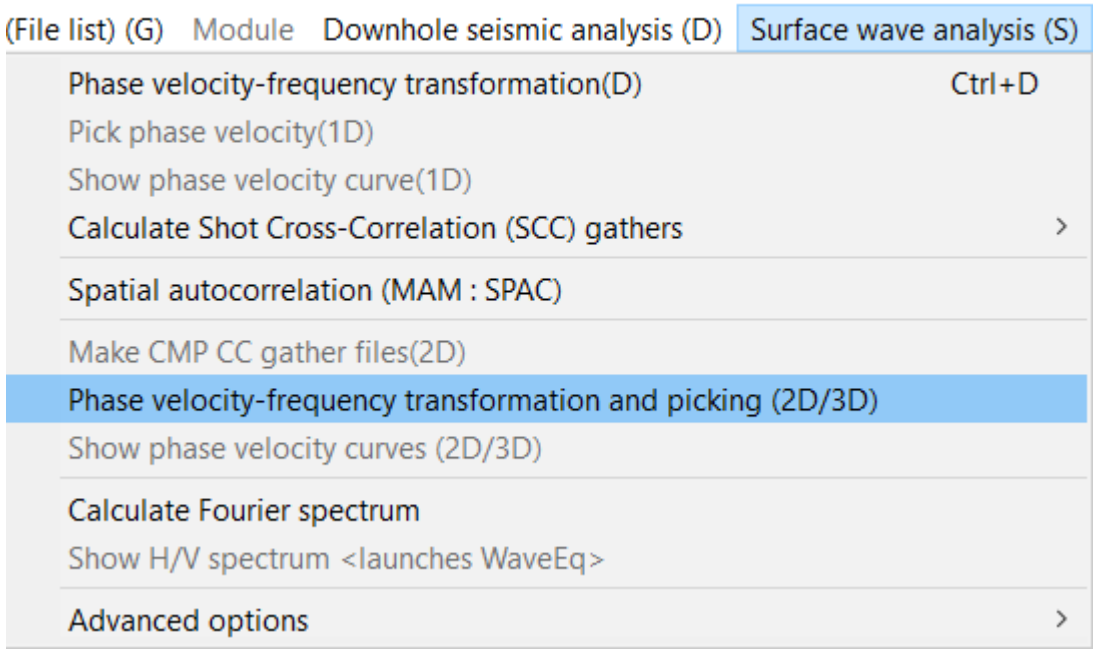
Extrapolation for CMP-SPAC (optional)

Blue color indicates extrapolated traces (SPACs).

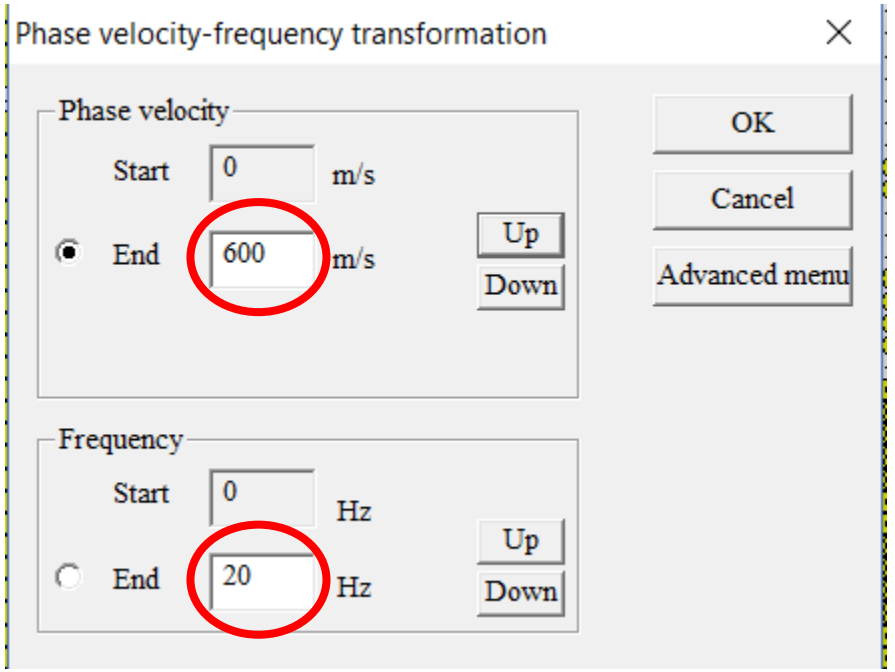


7. Calculate dispersion curves

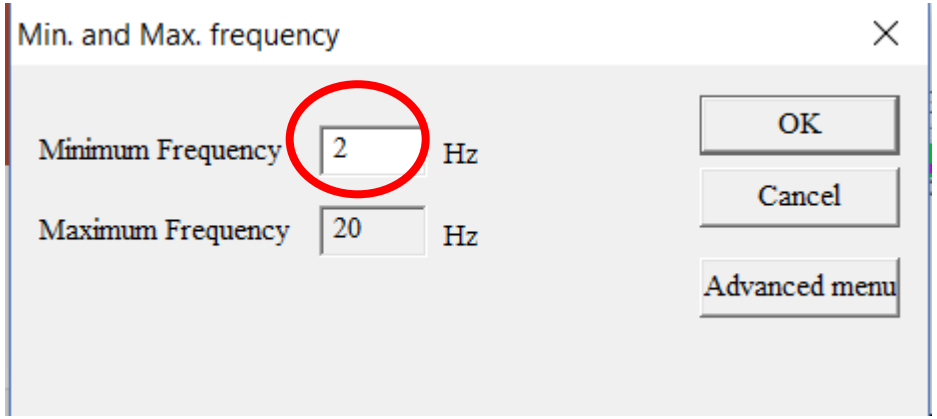
Select “Surface wave analysis”, “Phase velocity-frequency transformation and picking (2D/3D)”.
You can apply filer by “Option”, “Frequency domain”, “Parzen window” if you need.



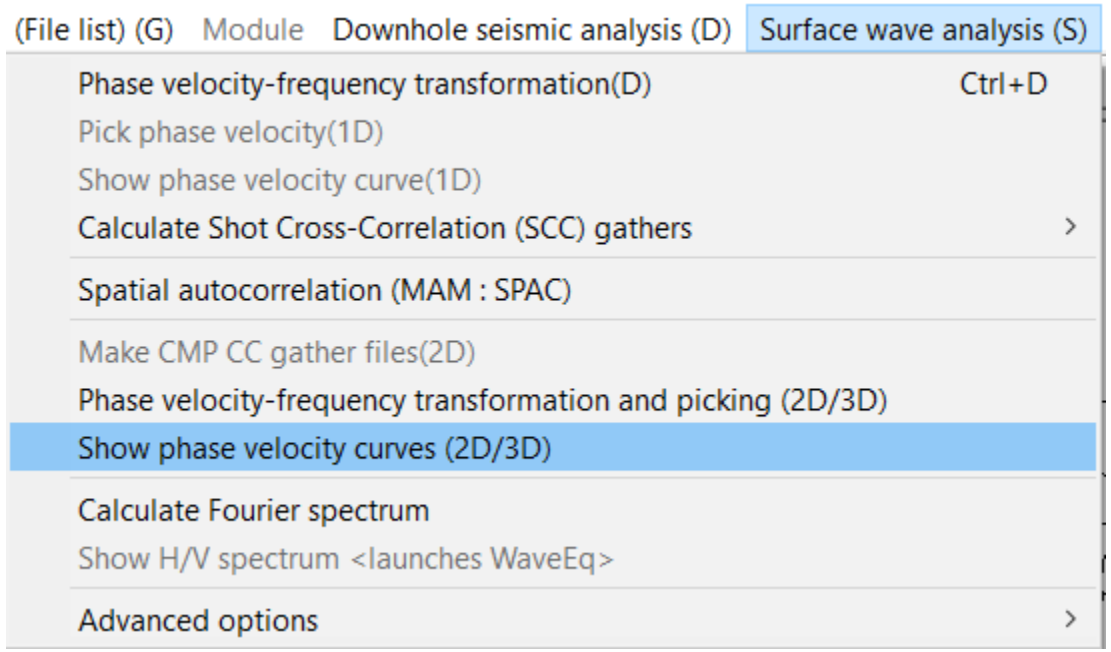
Set phase velocity and frequency.



Set minimum frequency.

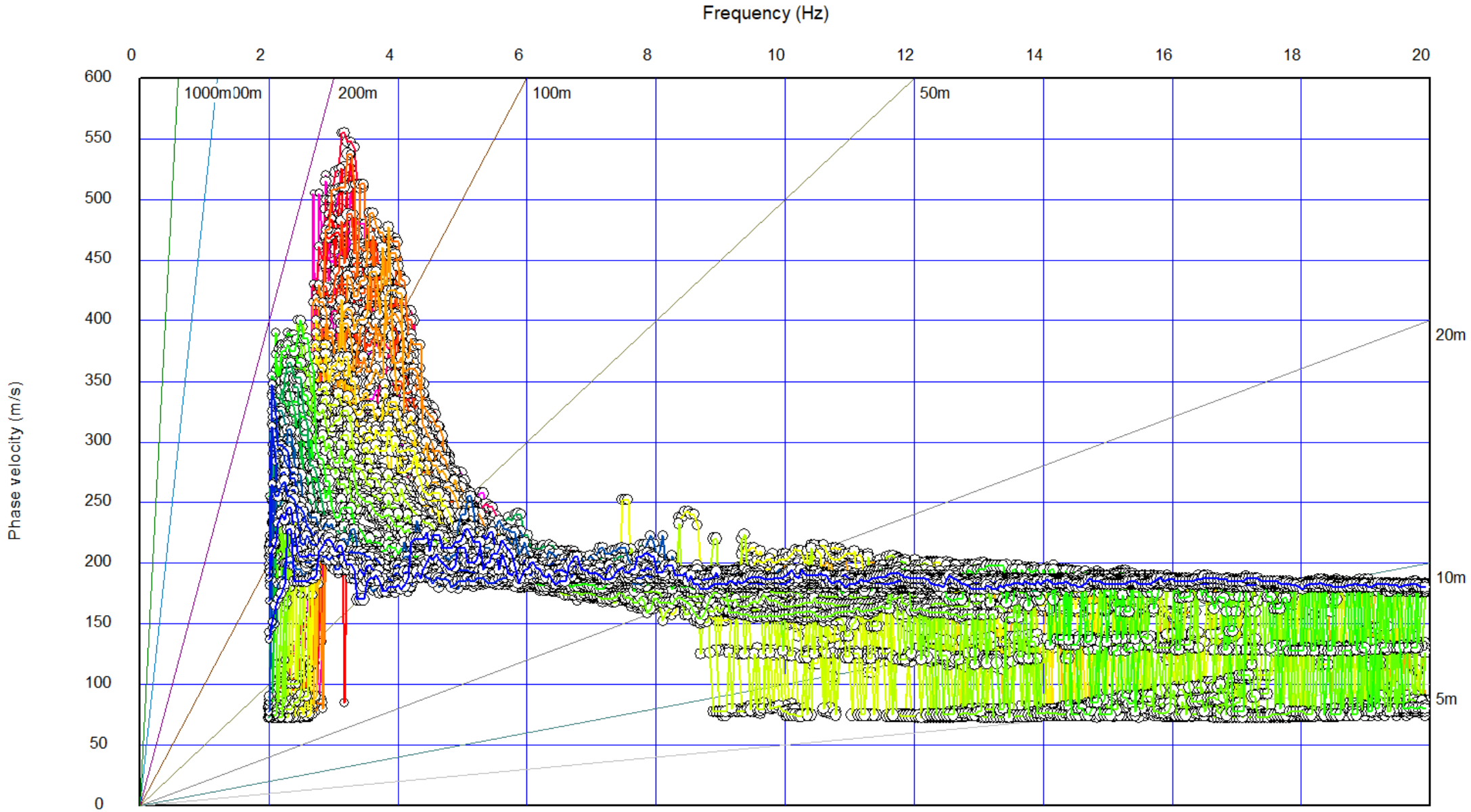


It will take a while.
Select “Surface wave analysis”, “Show Phase velocity curves (2D/3D)”.



8. Show and edit dispersion curves by WaveEq

WaveEq is automatically launched and phase velocity curves appears.

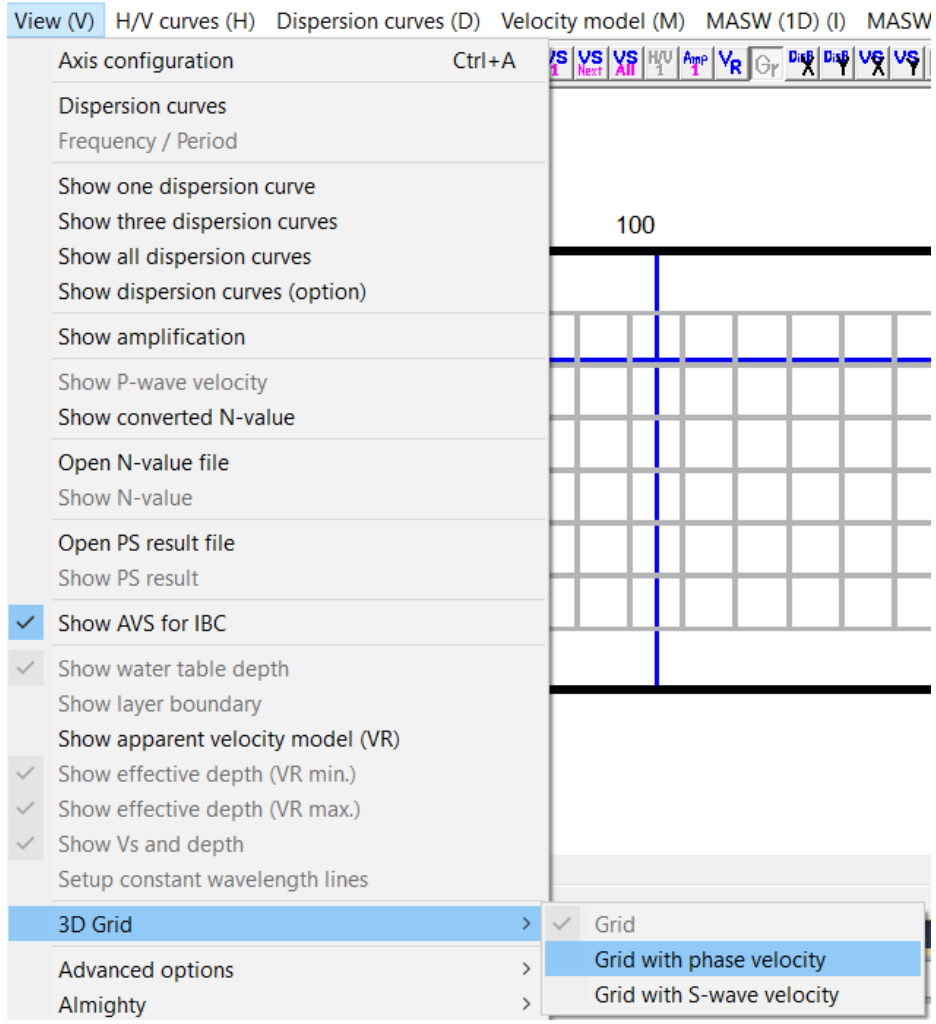


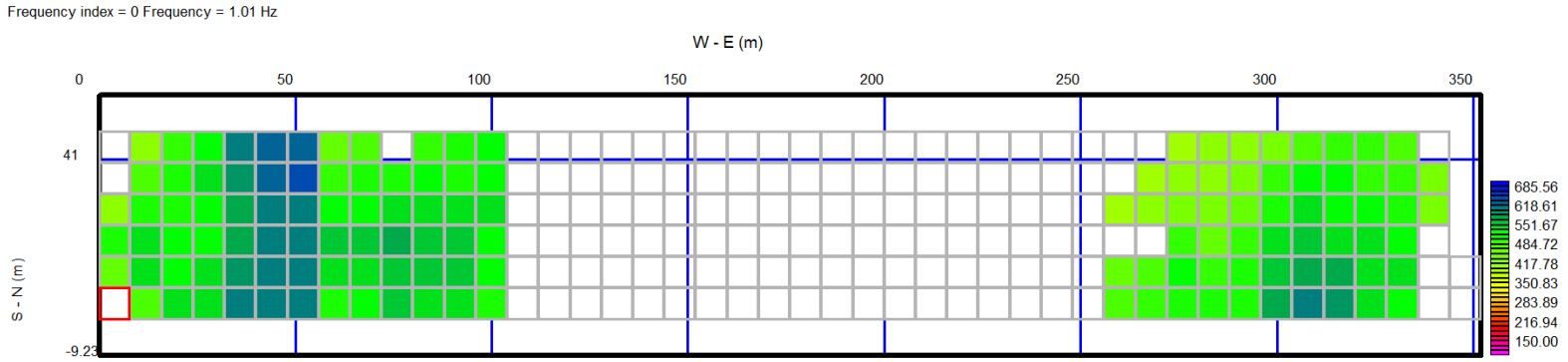
Drawing geometry (CMP bins) in WaveEq

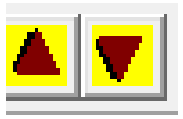
Click  to show geometry

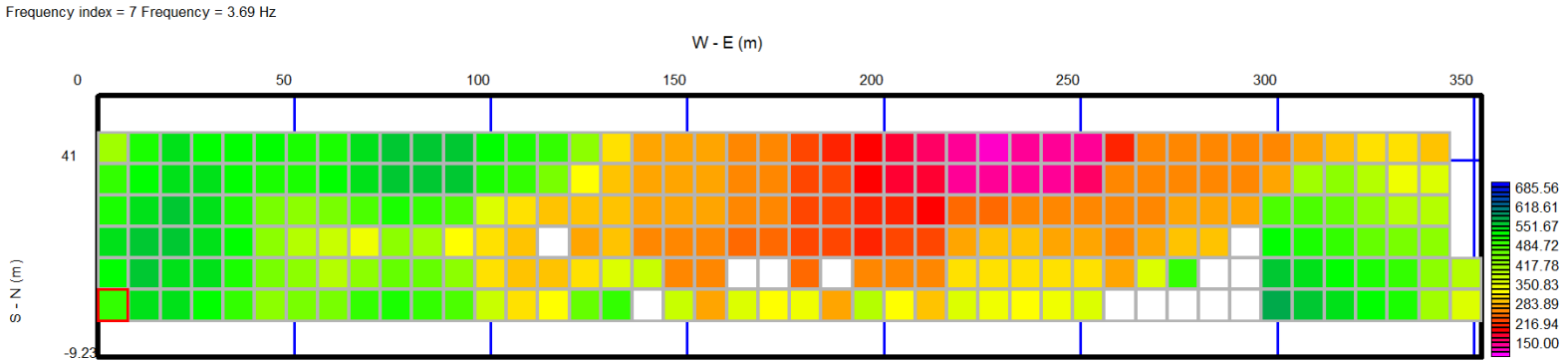
Drawing phase velocity on CMP bins in WaveEq

Select “View”, “3D Grid”, “Grid with phase velocity”.

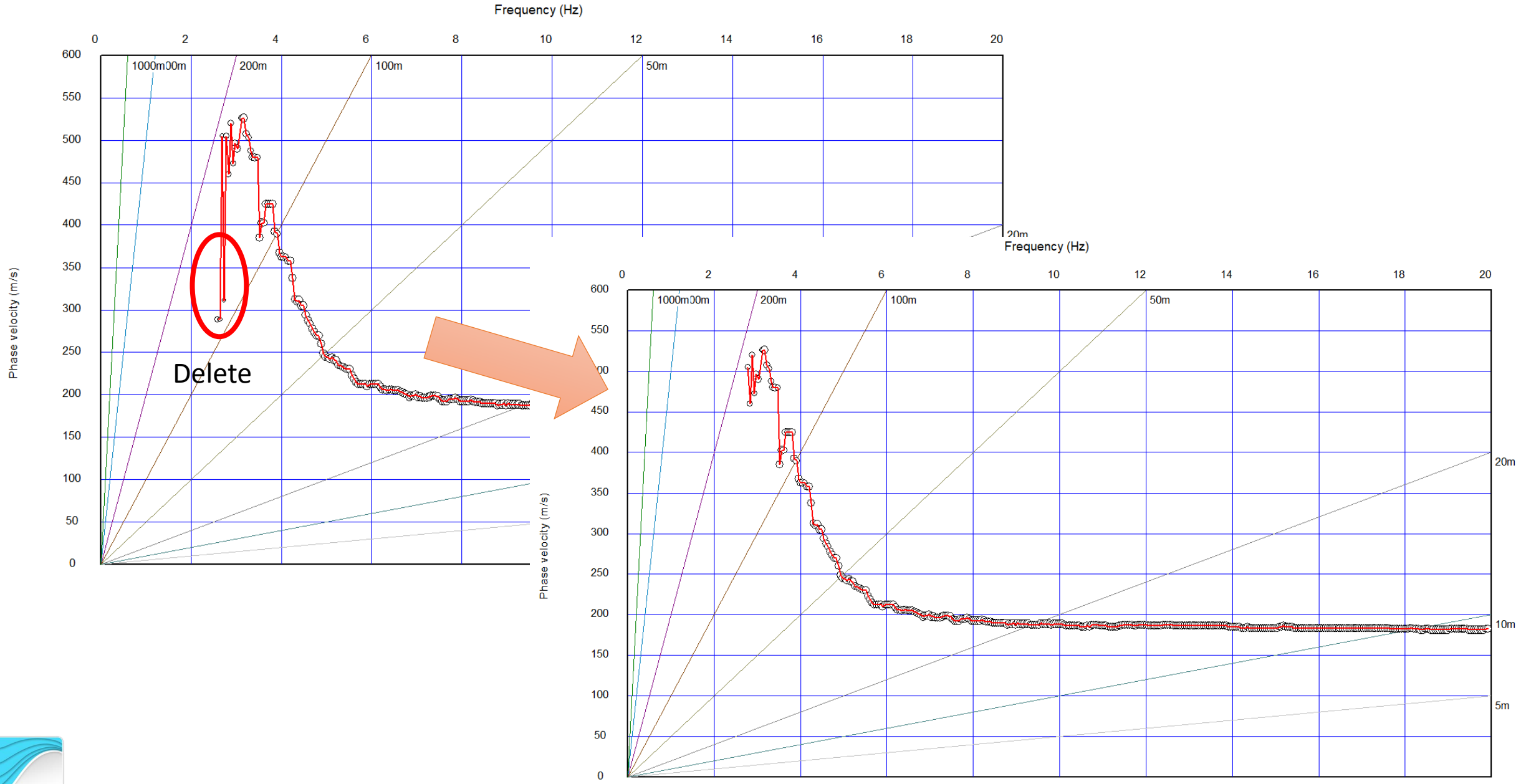




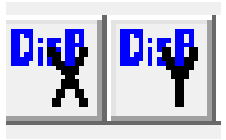
Use  to scroll a frequency to be shown.



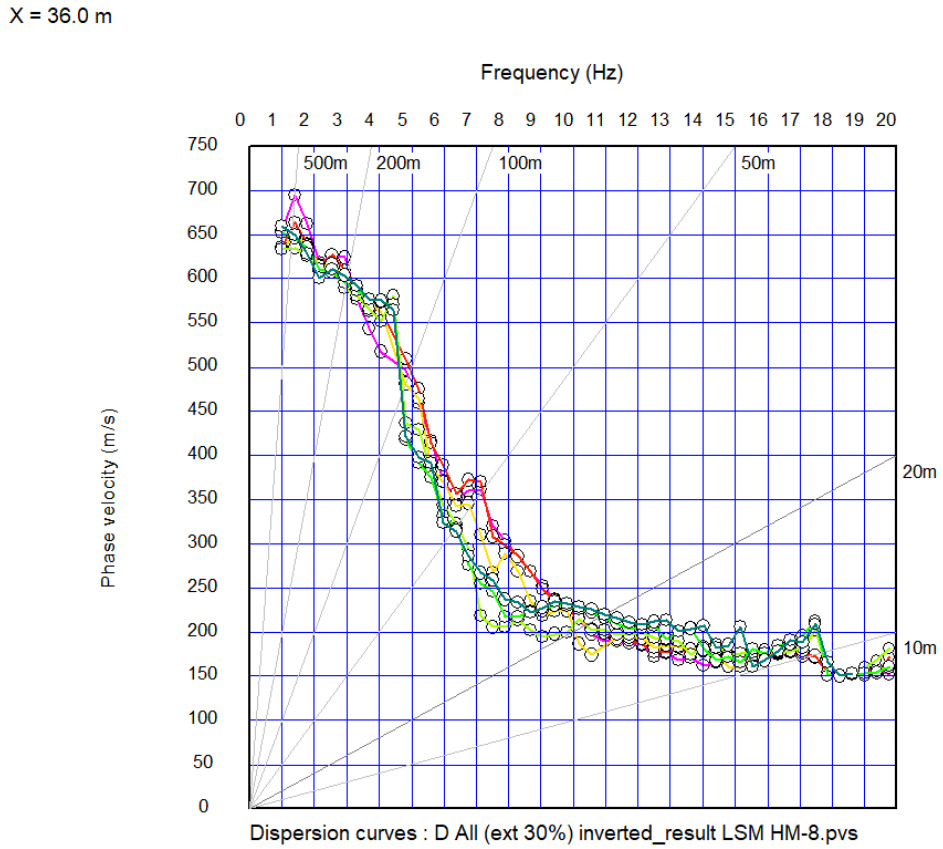
Edit dispersion curves as 2D data.



Dispersion curves in X or Y direction

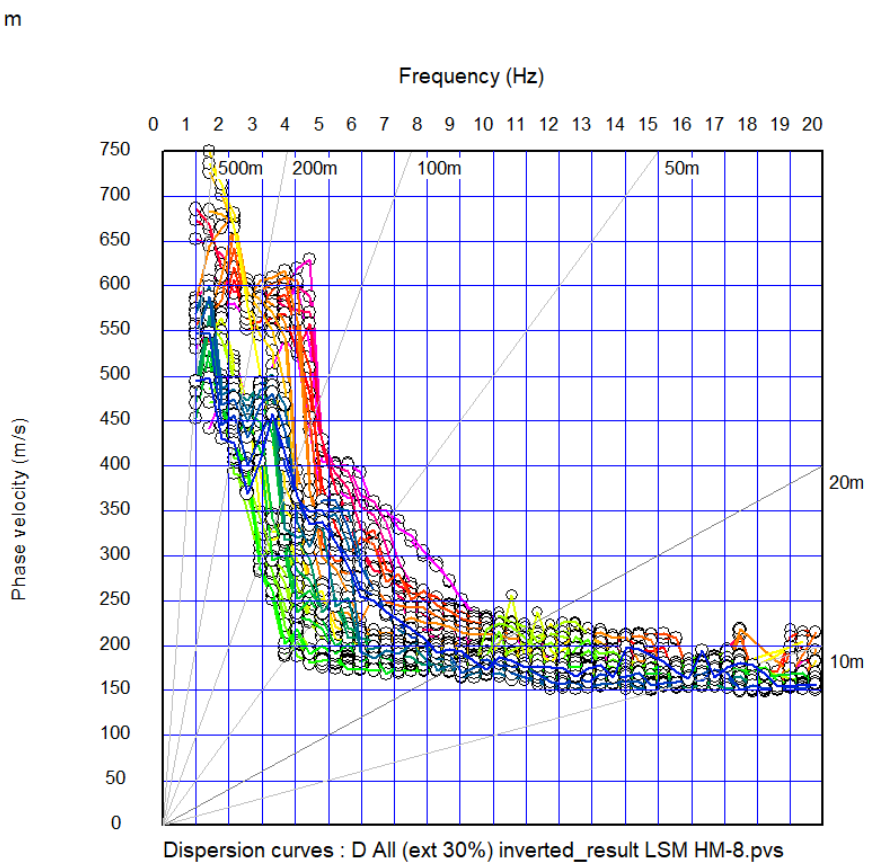
Use  to show dispersion curves in X or Y direction.

X direction (vertical direction)



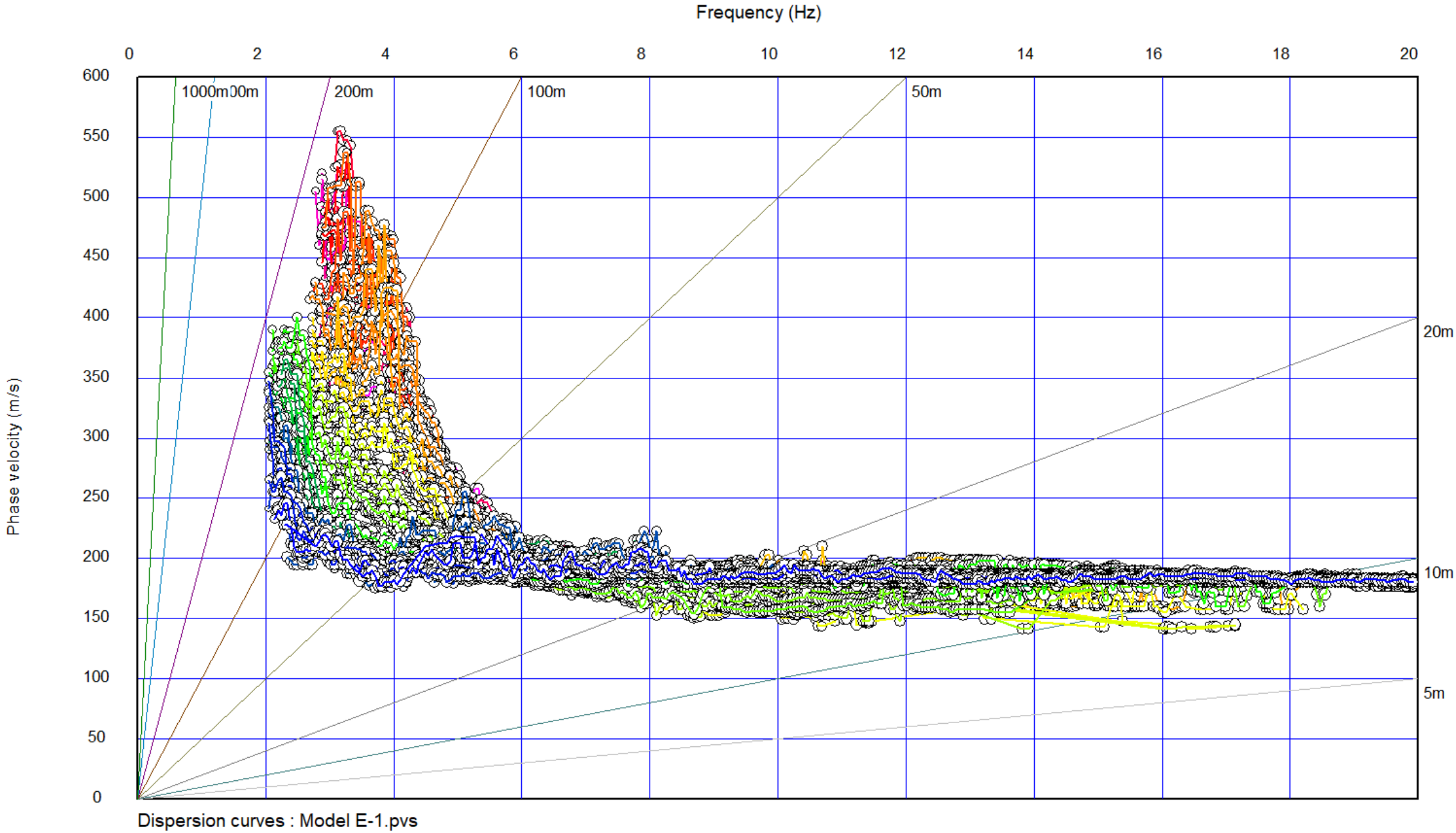
Use  to scroll dispersion curves to be shown.

Y direction (horizontal direction)



Use  to scroll dispersion curves to be shown.

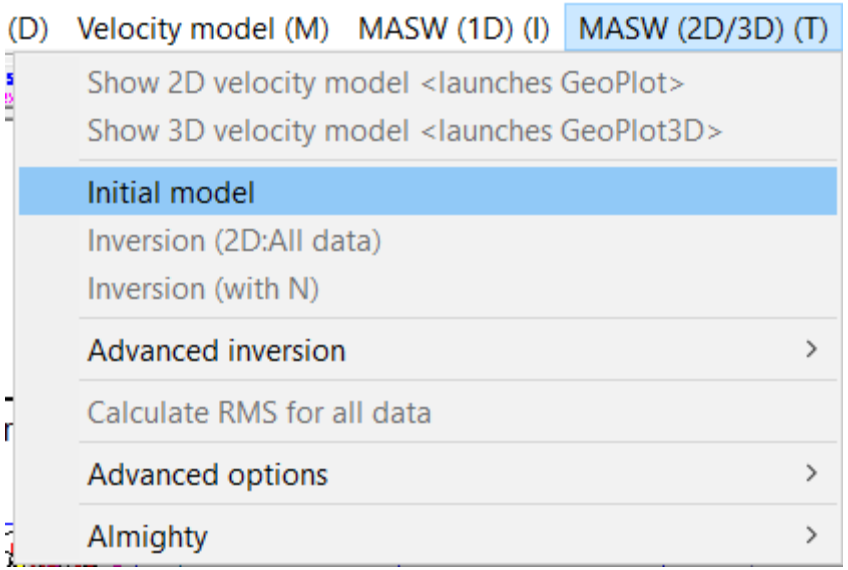
Edited dispersion curves



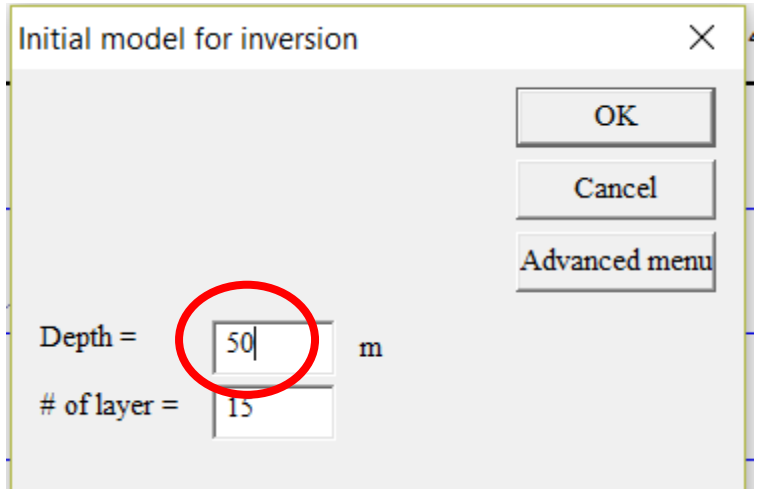
9. Create initial velocity model

Initial velocity model

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

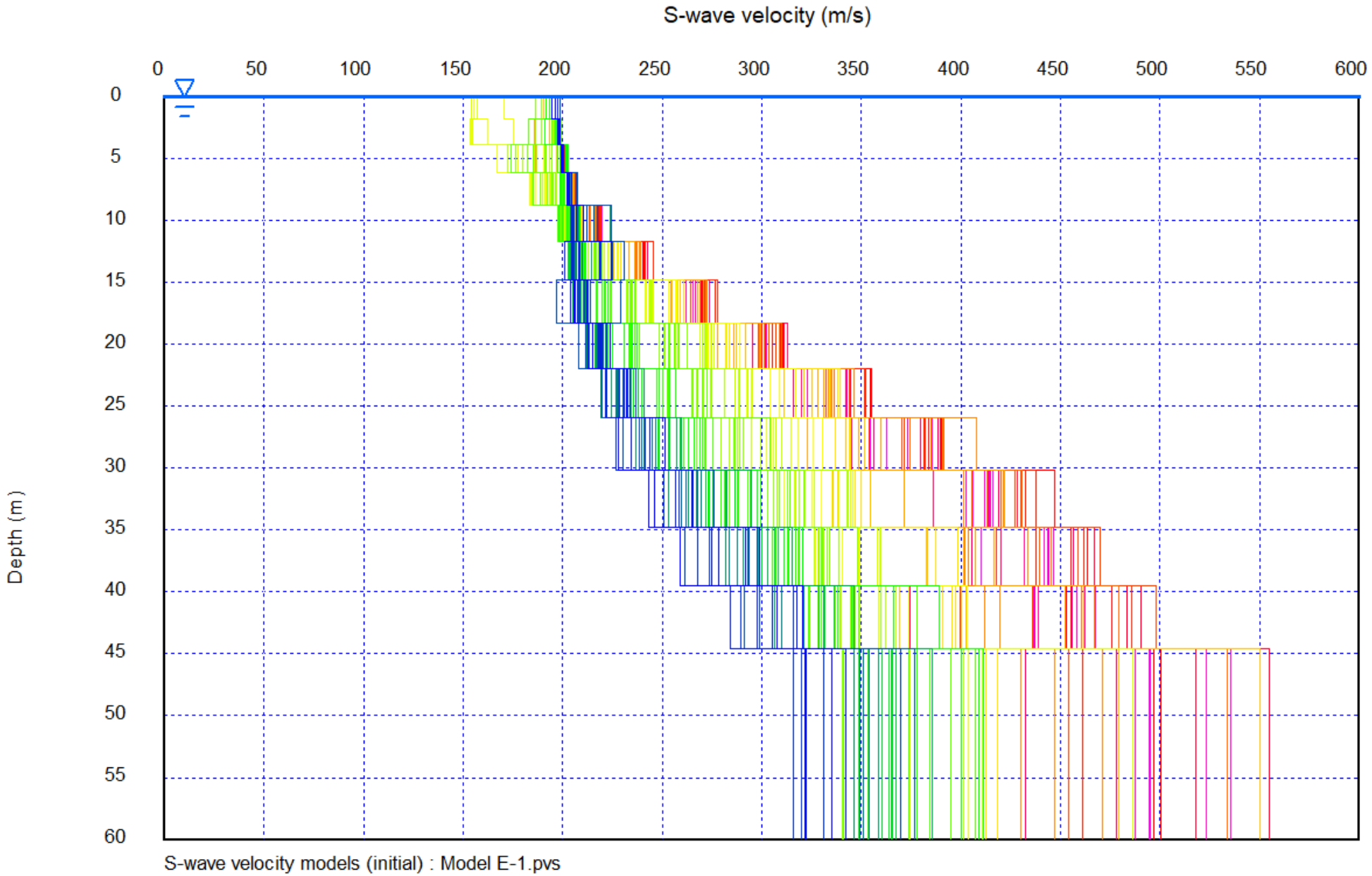


Set depth of model.



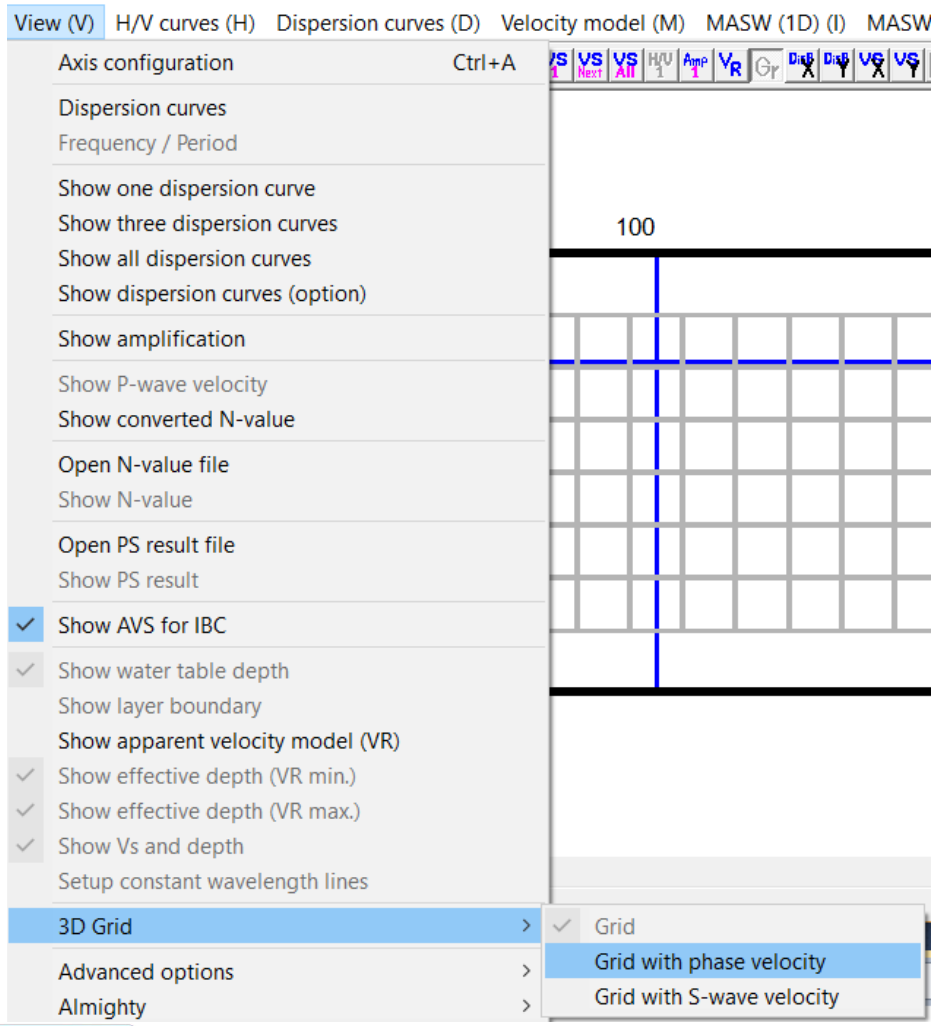
Note that horizontal regularization is just 2D.
3D has not completed yet.

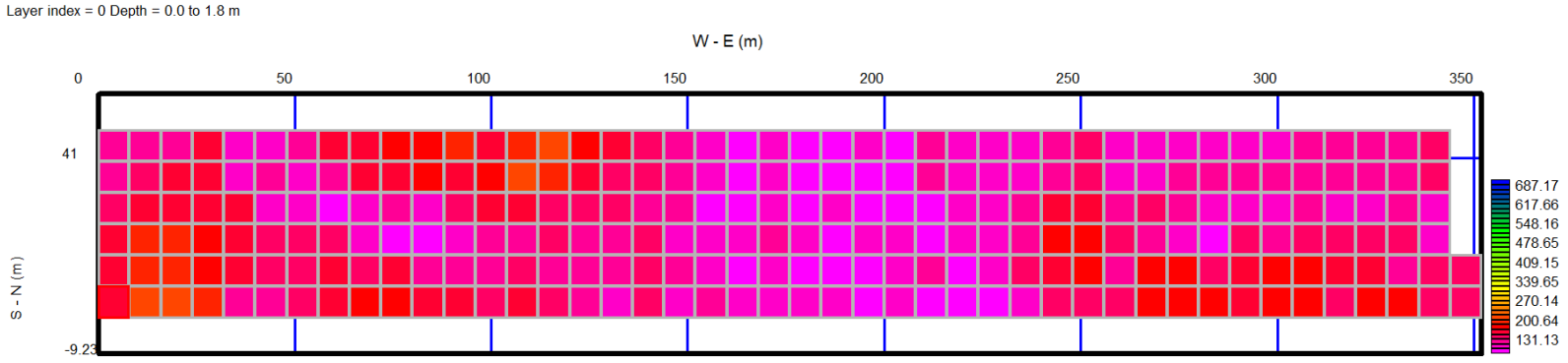
Initial velocity model appears. You can apply inversion if you like.
Note that horizontal regularization is just 2D. 3D has not completed yet.

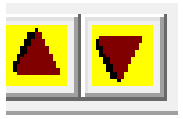


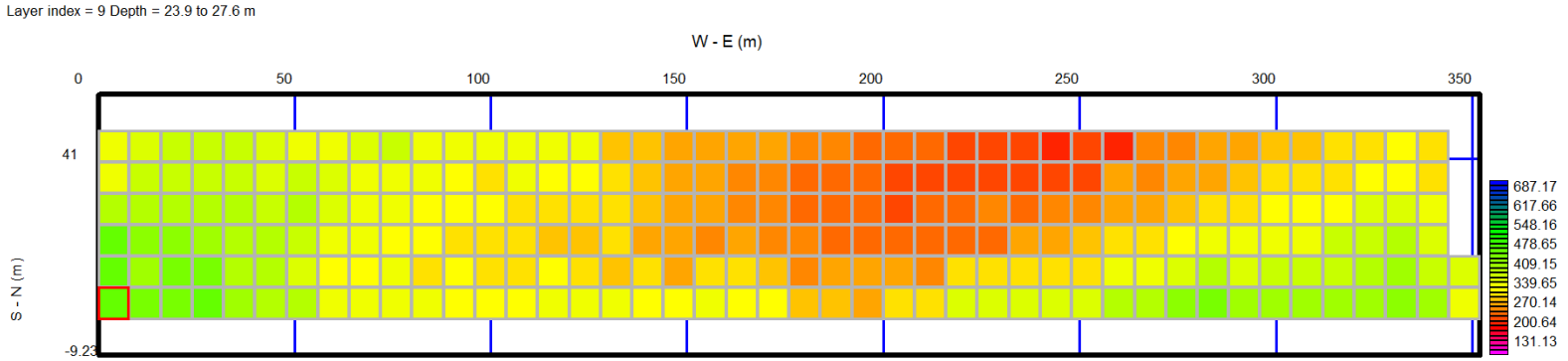
Drawing S-wave velocity on CMP bins in WaveEq

Select “View”, “3D Grid”, “Grid with S-wave velocity”.

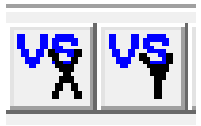




Use  to scroll a depth to be shown.

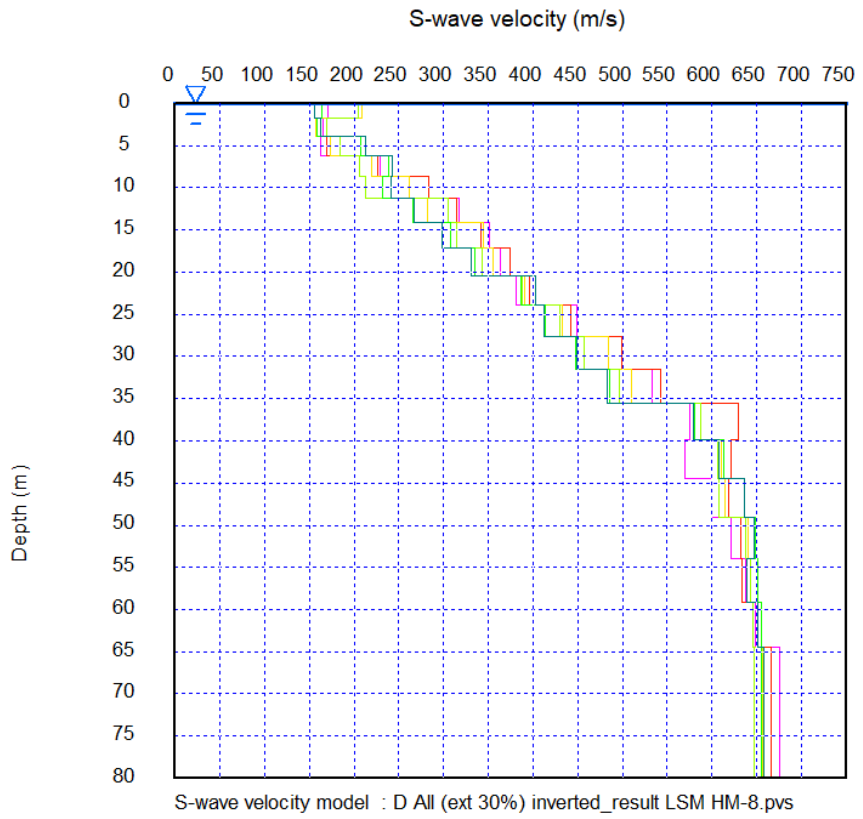


Velocity depth profiles in X or Y direction

Use  to show velocity depth profiles in X or Y direction.

X direction (vertical direction)

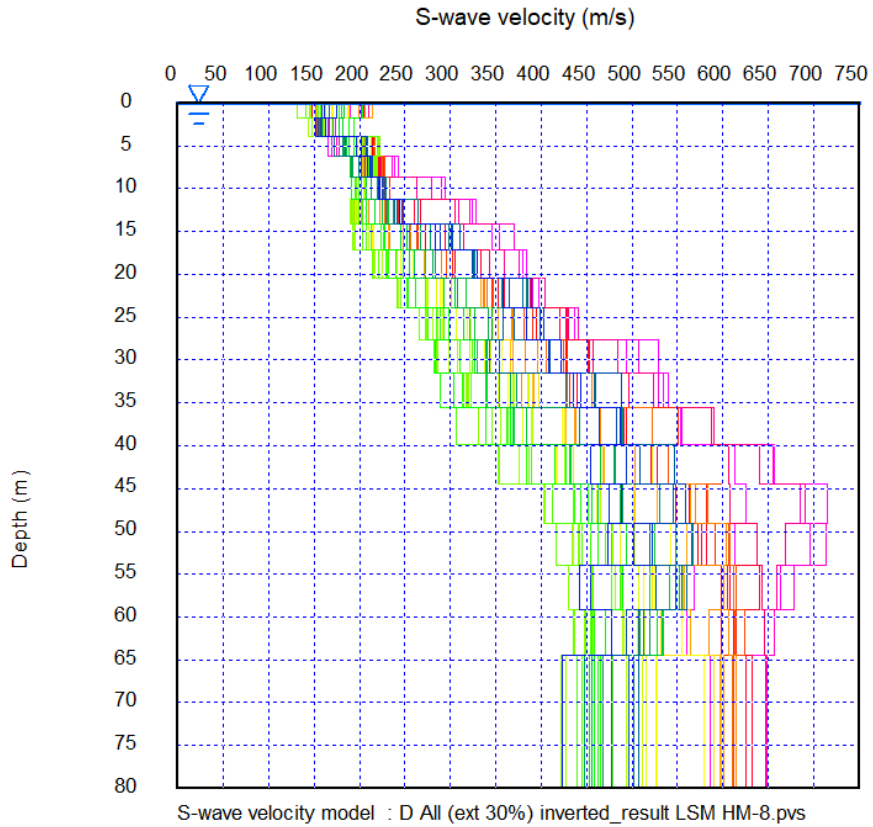
X = 36.0 m



Use  to scroll dispersion curves to be shown.

Y direction (horizontal direction)

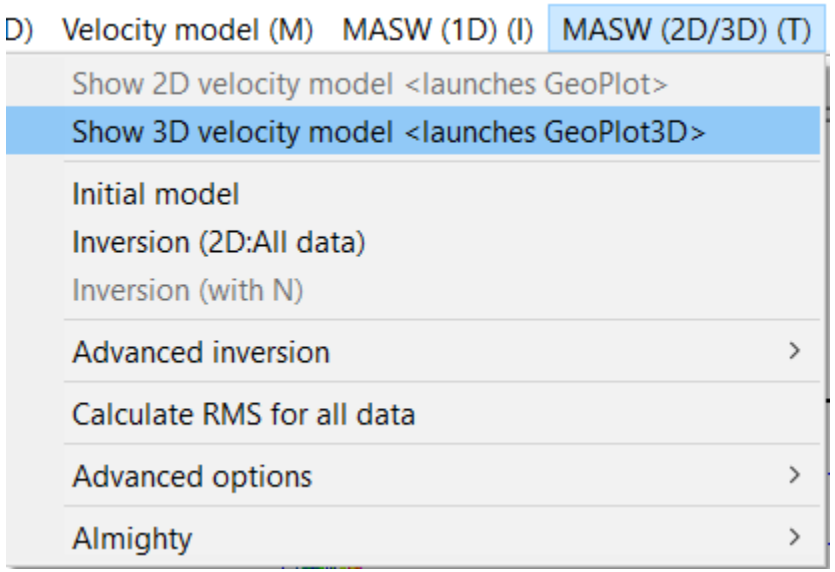
Y = 28.0 m



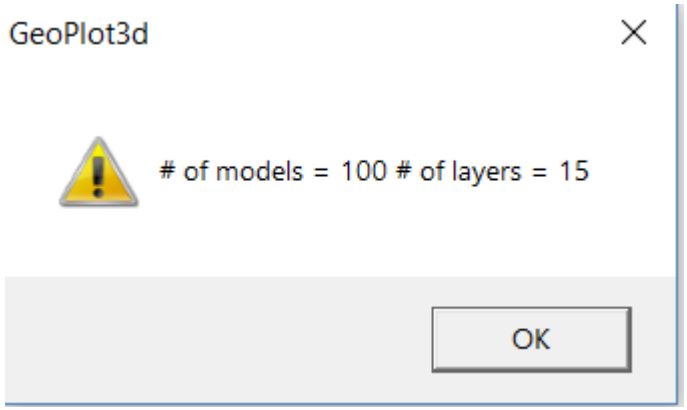
Use  to scroll dispersion curves to be shown.

10. Show 3D velocity model by GeoPlot3D

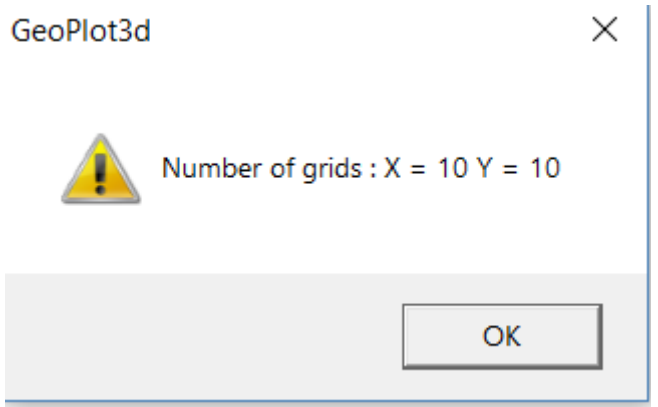
Select “MASW (2D/3D)”, “Show 3D velocity model <launches GeoPlot3D>”.



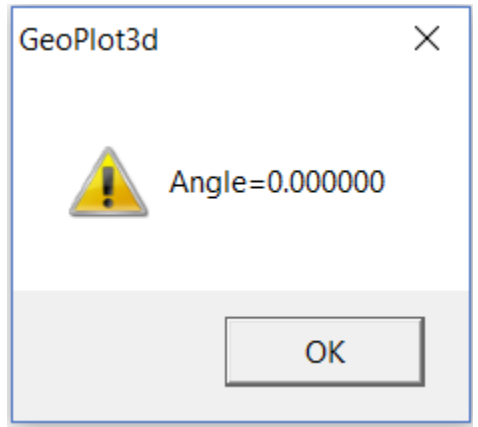
Confirm messages and click OK.



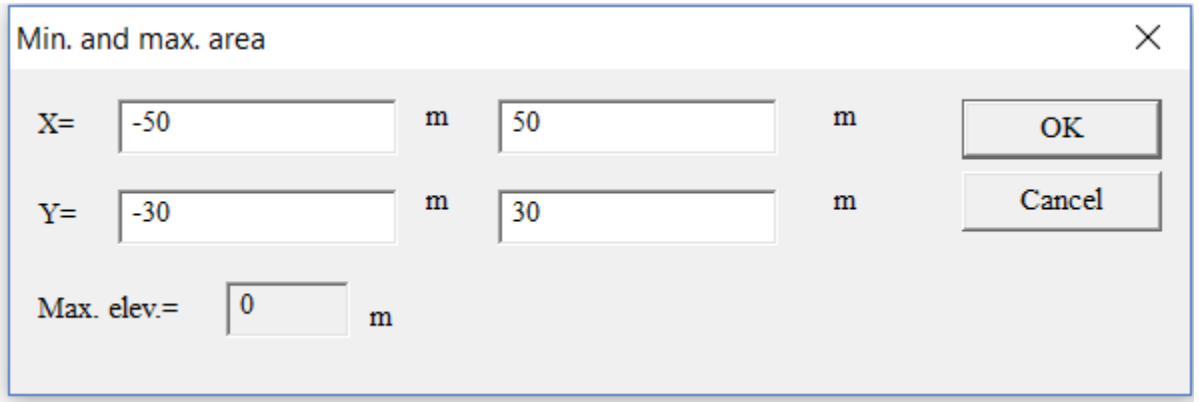
Confirm messages and click OK.



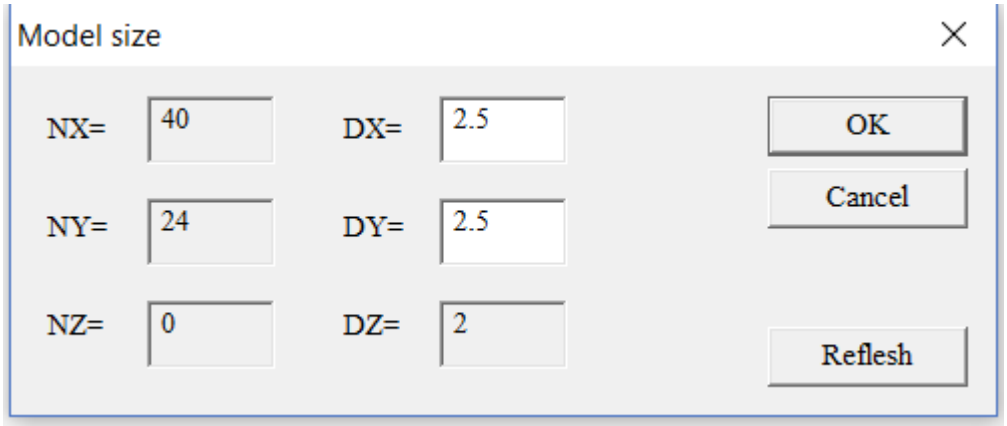
Click OK.



Click OK.

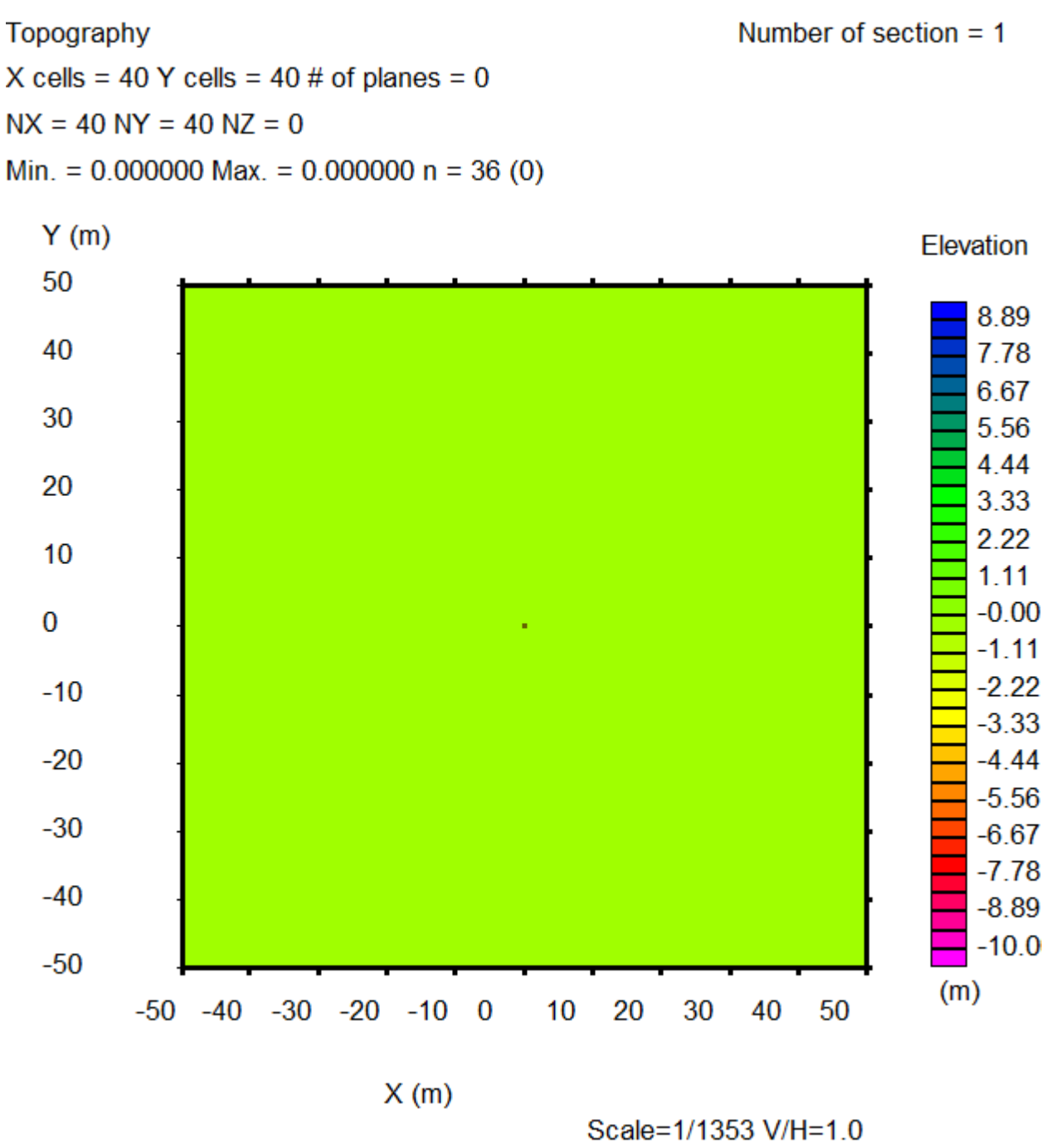


Change cell size if you need. Click OK.



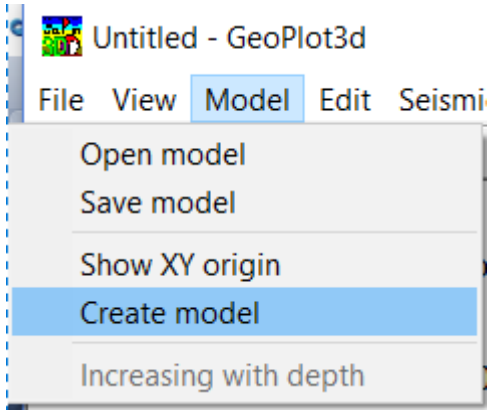
Surface topography

If surface topography is not flat,
see page 31 to include surface topography.

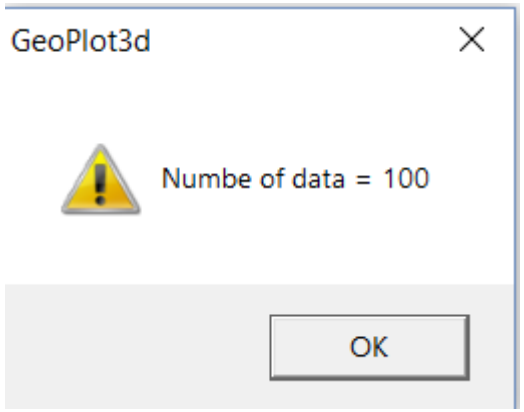


10.1 Create 3D velocity model by GeoPlot3D

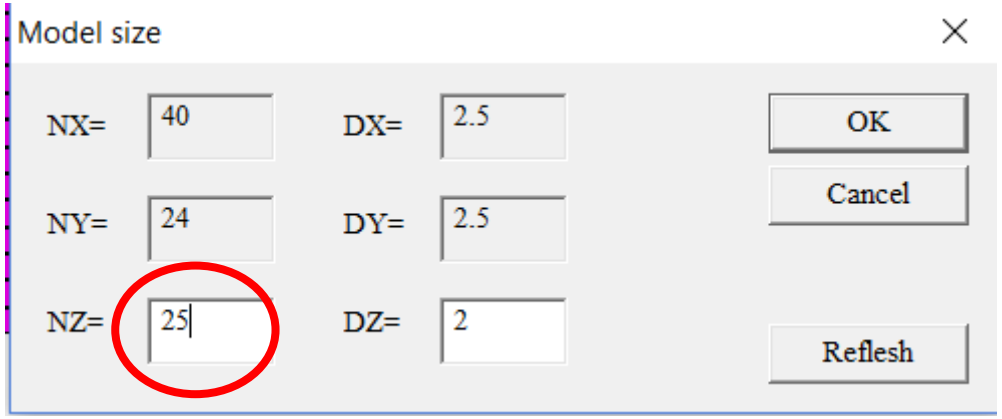
Select “Model”, “Create model”.



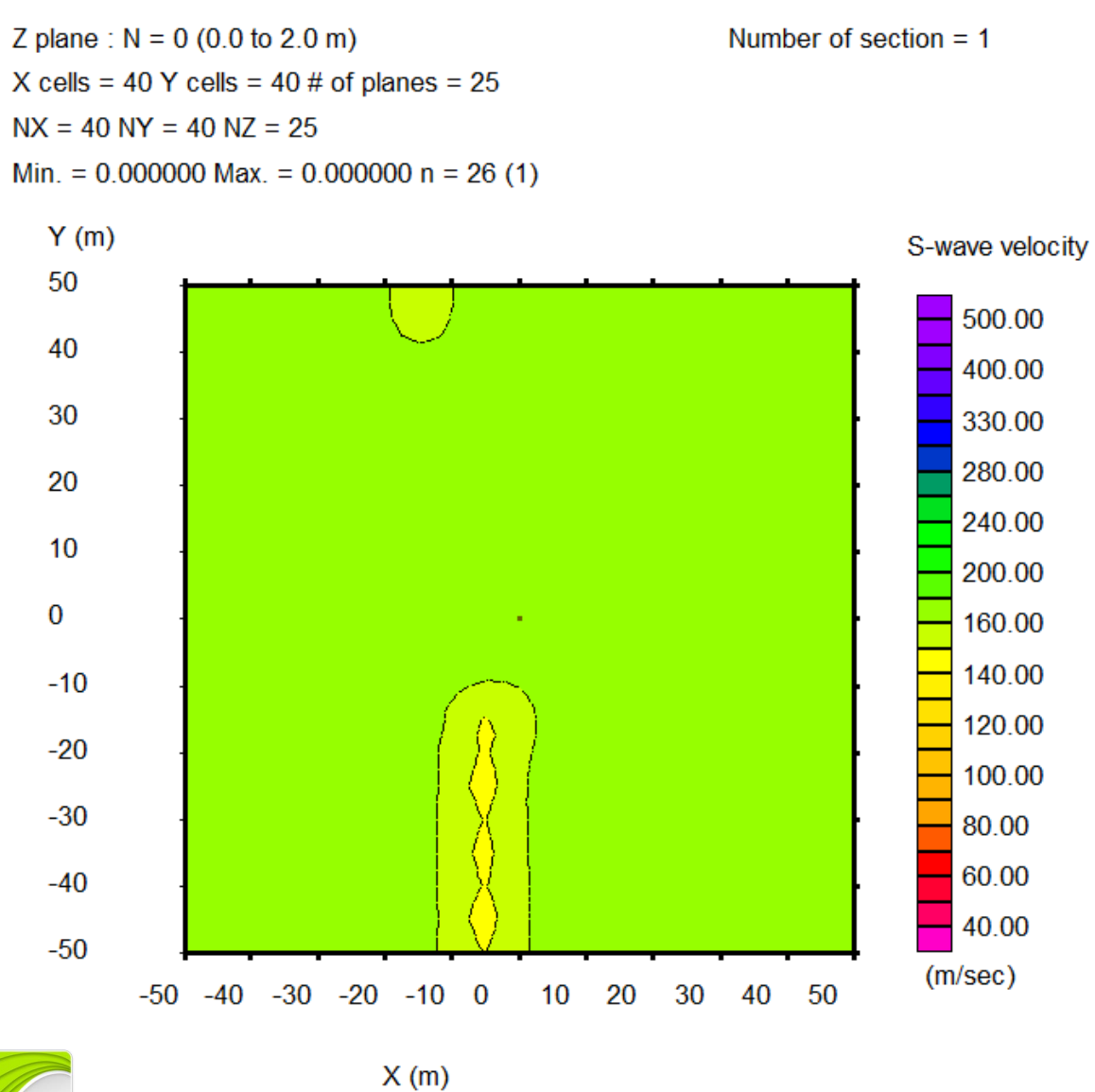
Confirm messages and click OK.

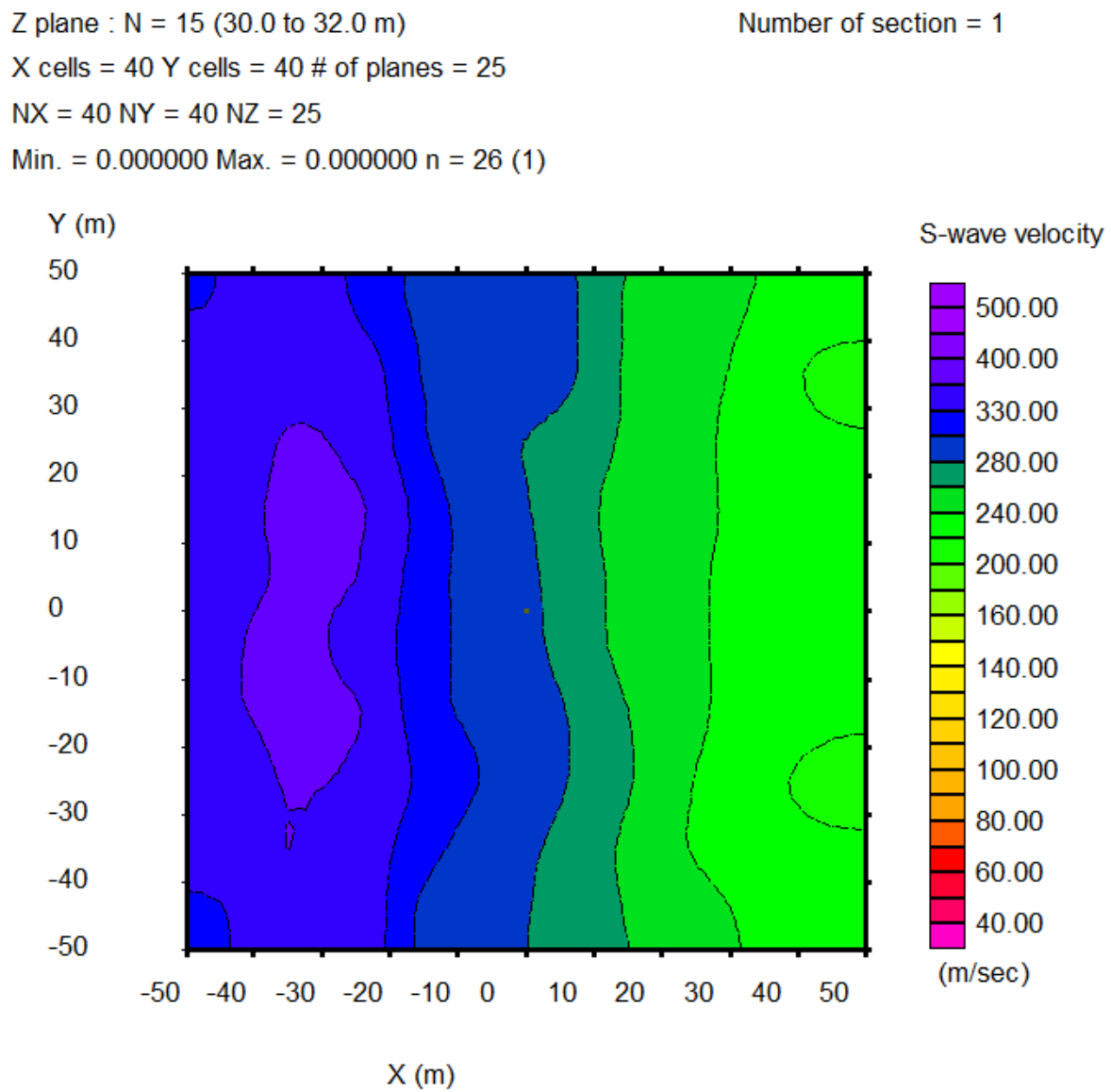


Set number and size of cells.

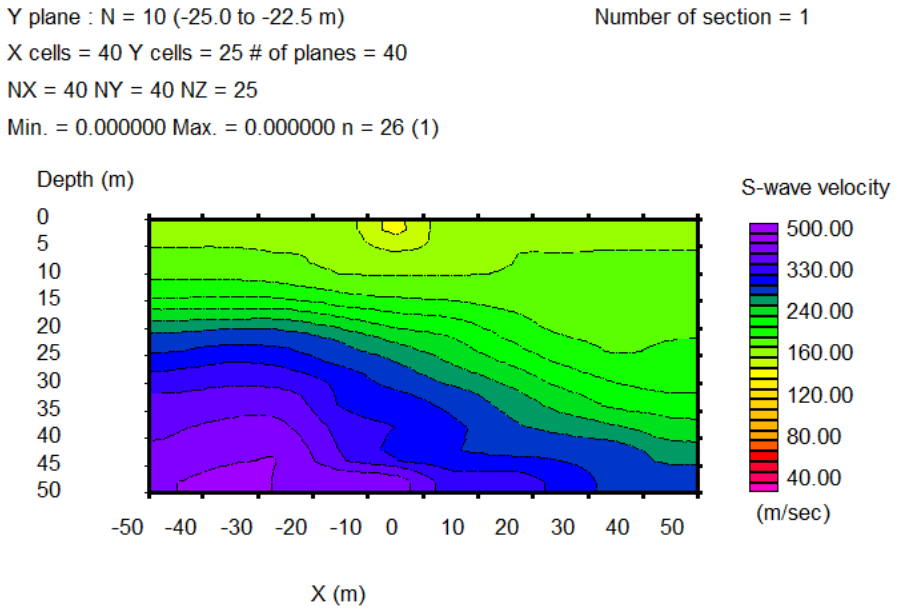


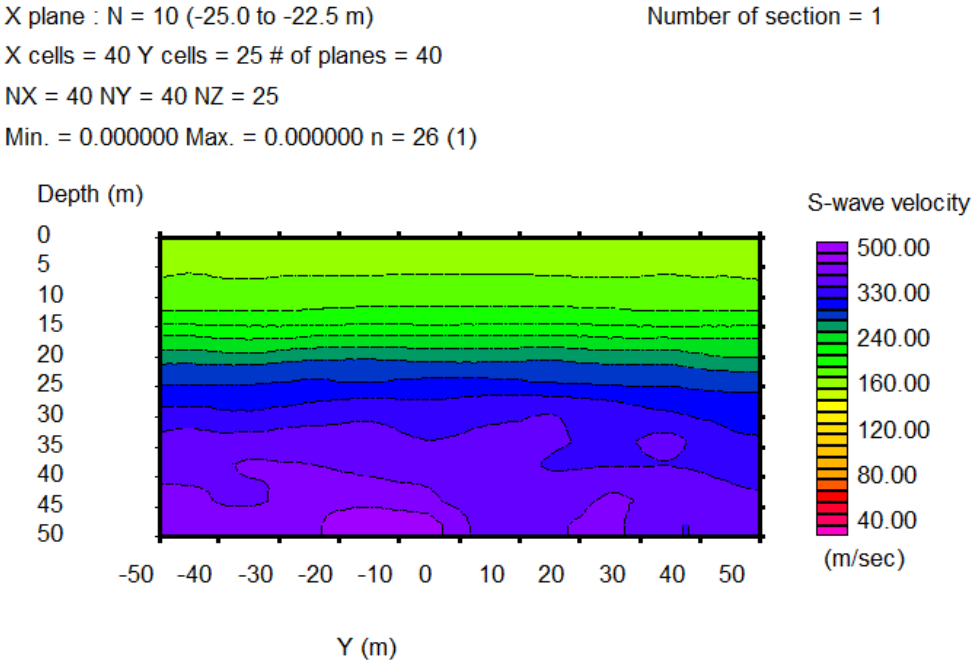
Use Z Y X buttons to change slice direction and ◀ ▶ ◀◀ ▶▶ buttons to scroll the position of slice.

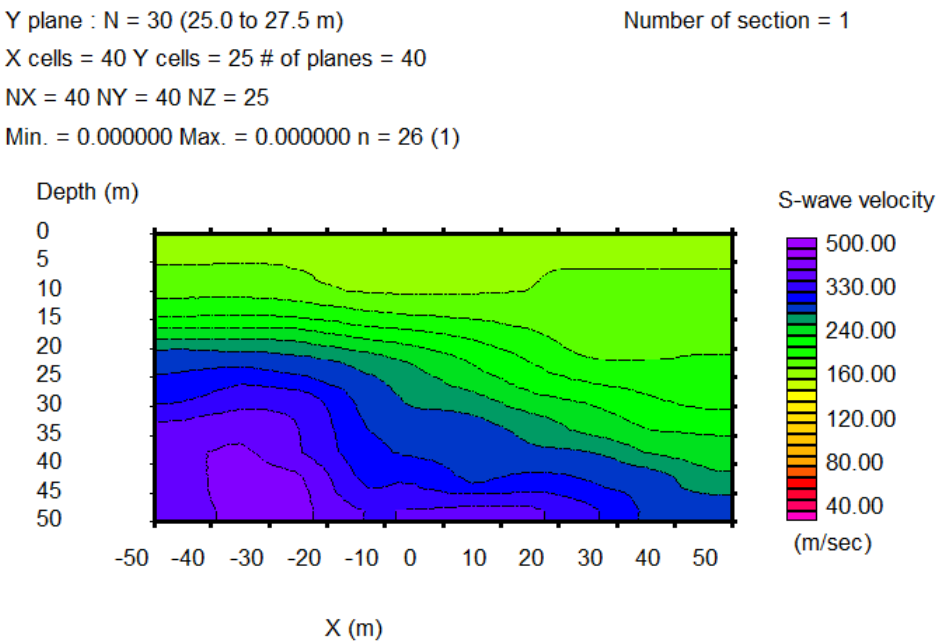


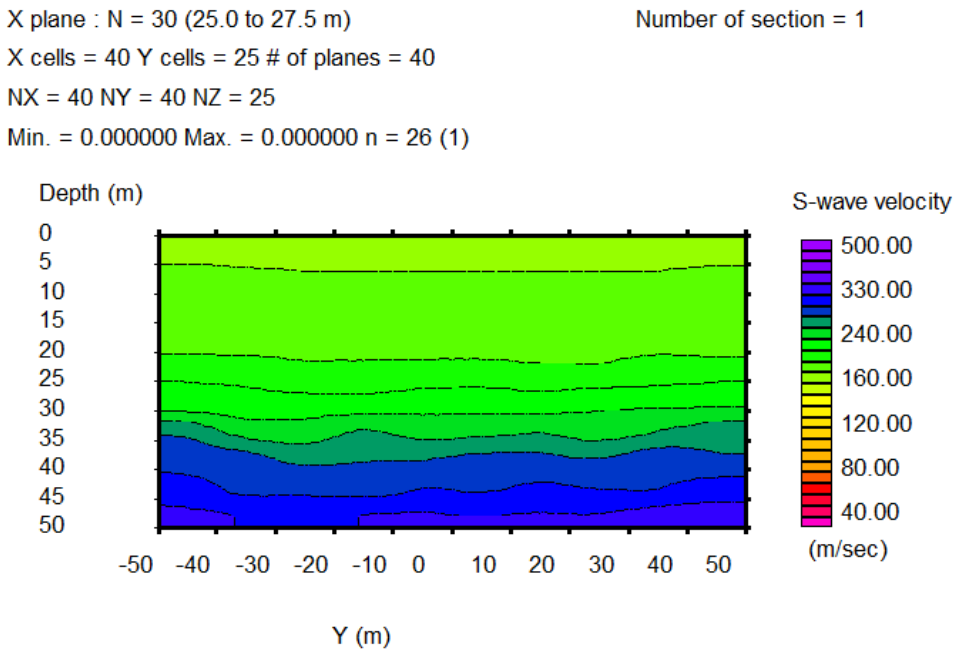


Use Z Y X buttons to change slice direction and ◀ ▶ ◀◀ ▶▶ buttons to scroll the position of slice.

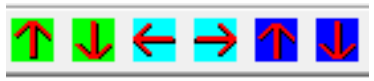


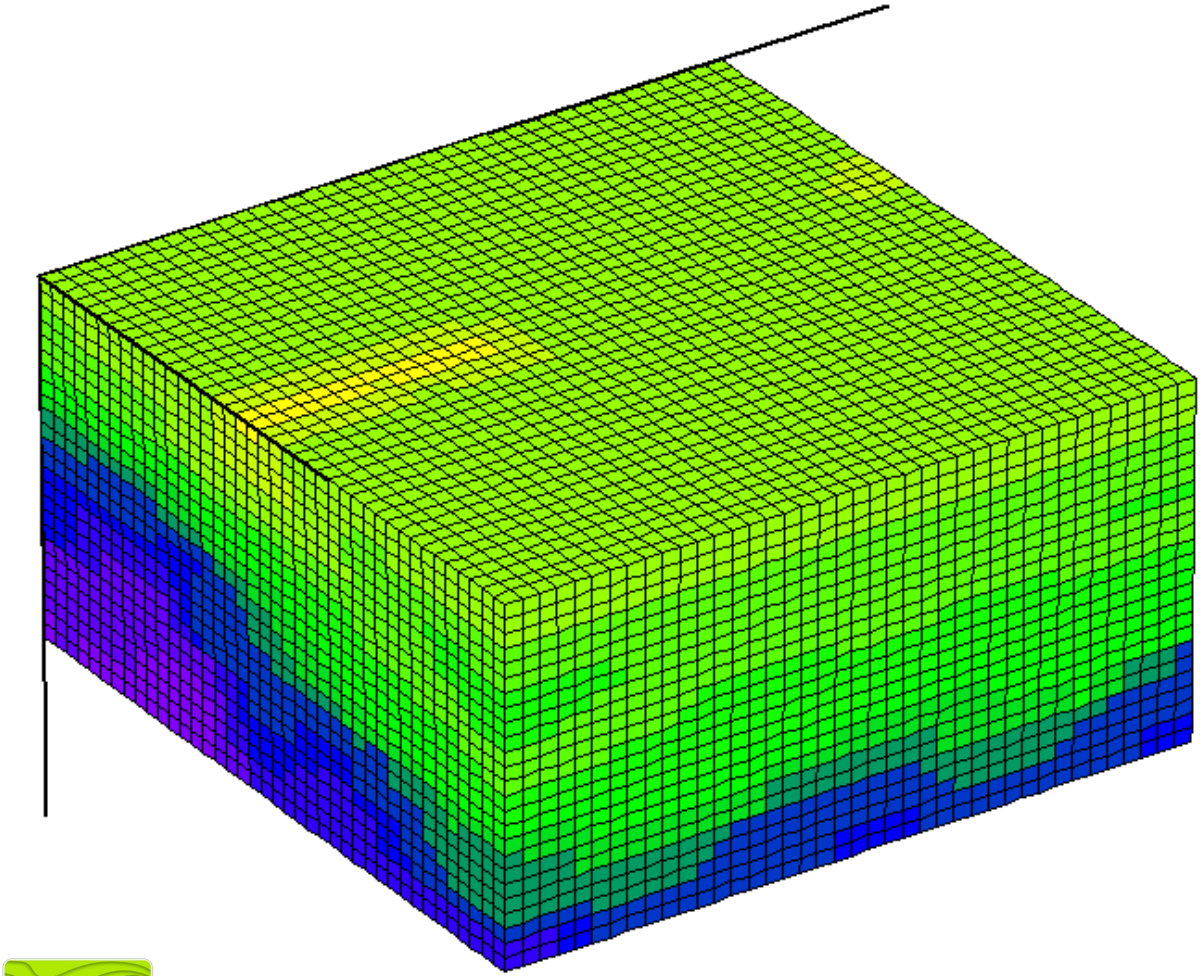


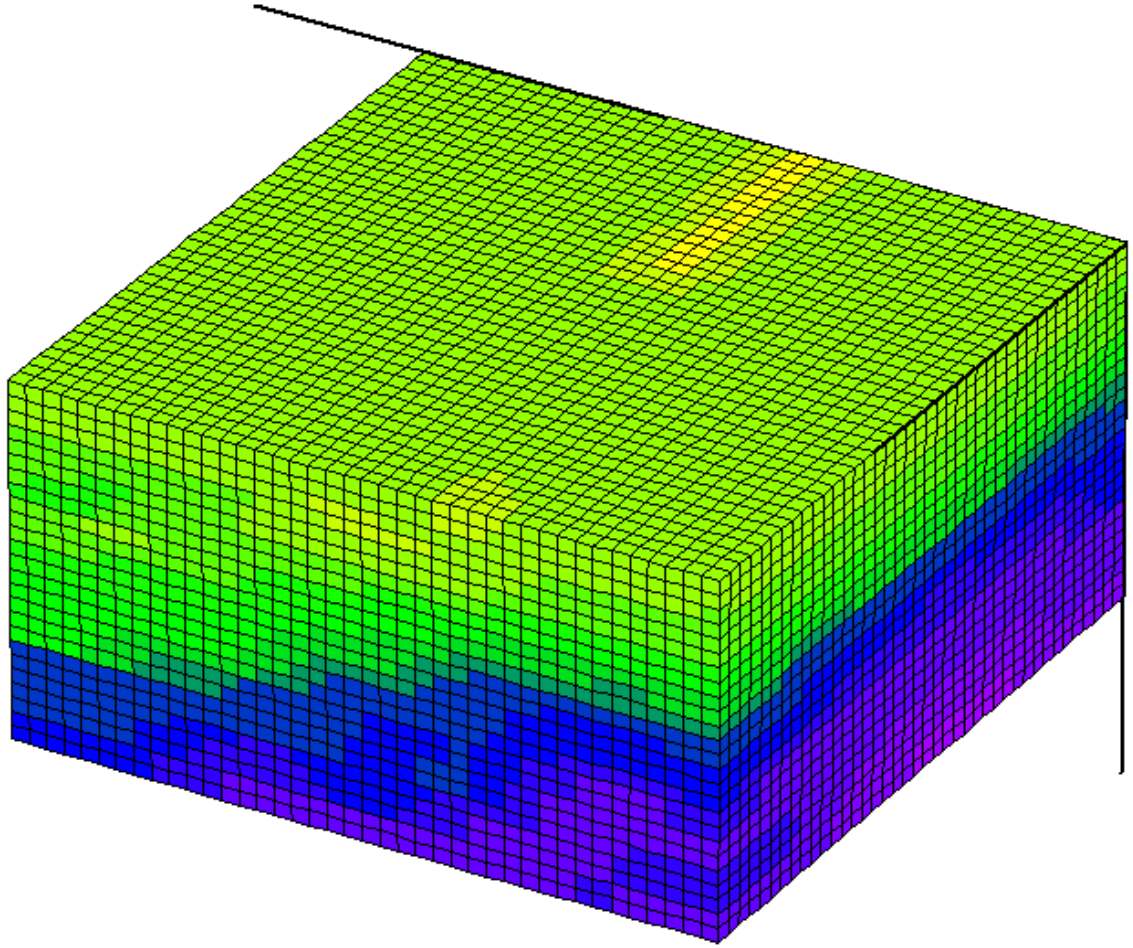




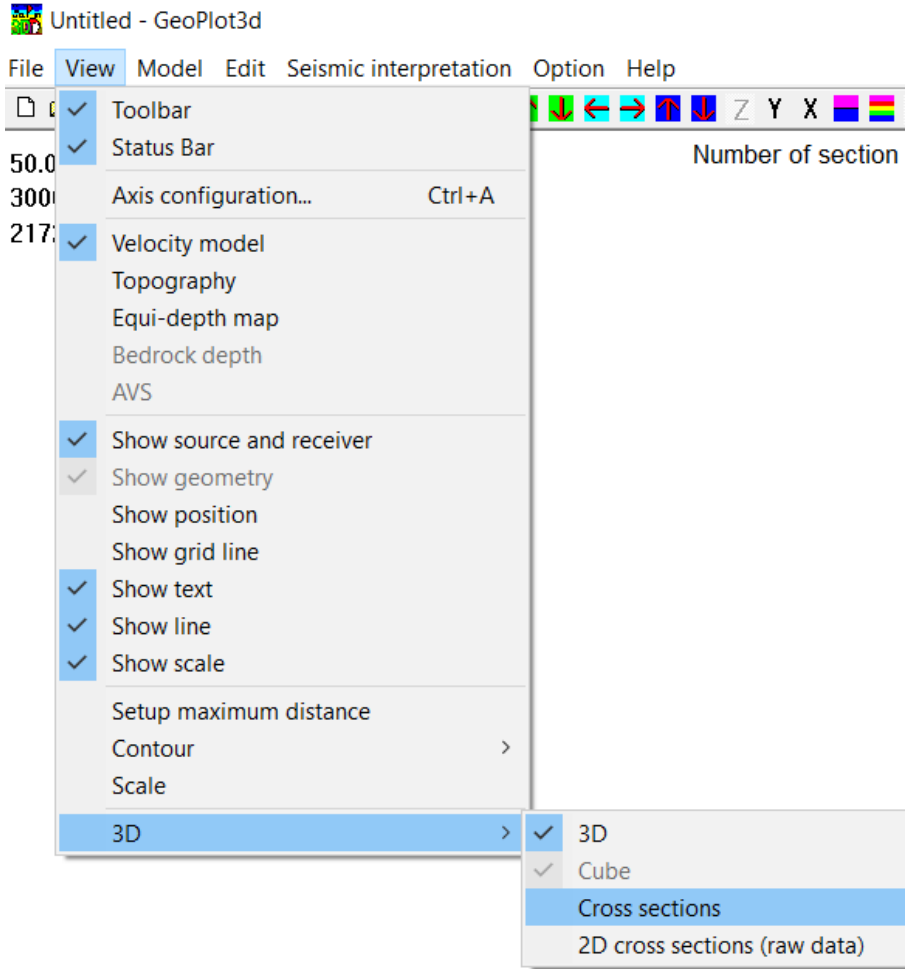
Click  to draw 3D images.

Use  to rotate a model.

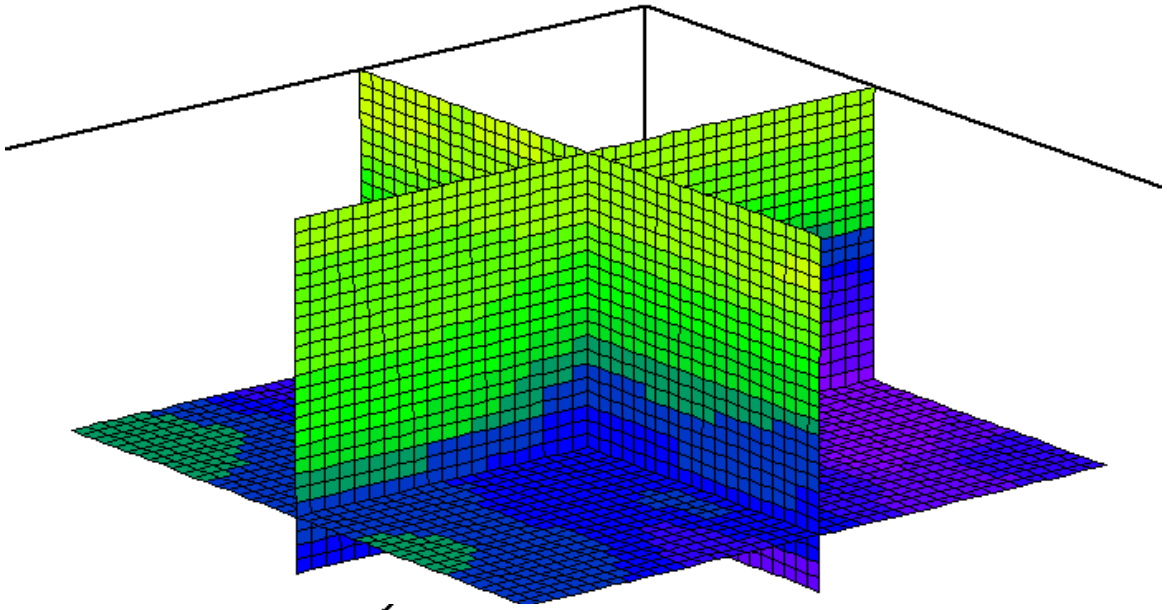


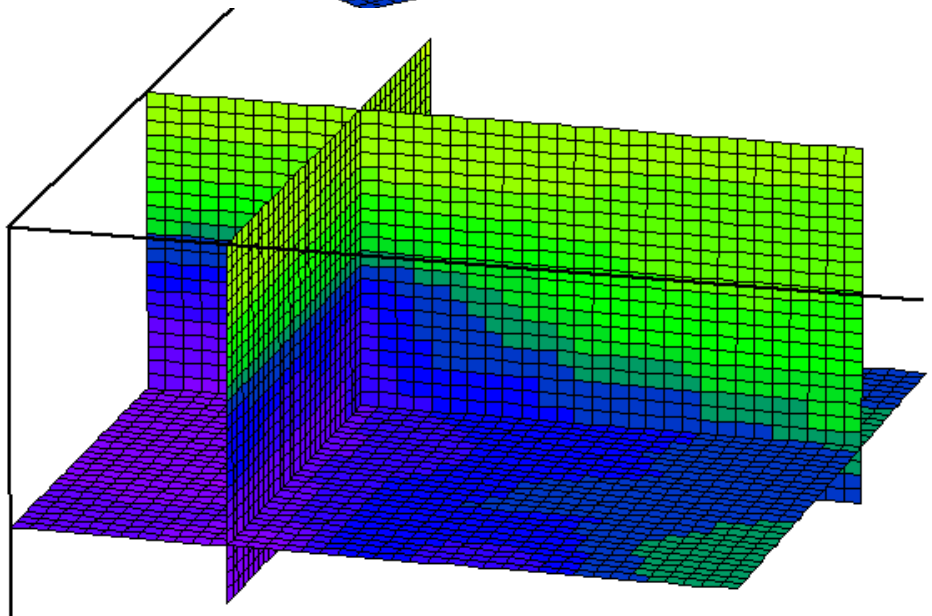


Select “View”, “3D”, “Cross sections” to show cross sections.



Use  and  to change positions of cross sections.





Include surface topography (optional)

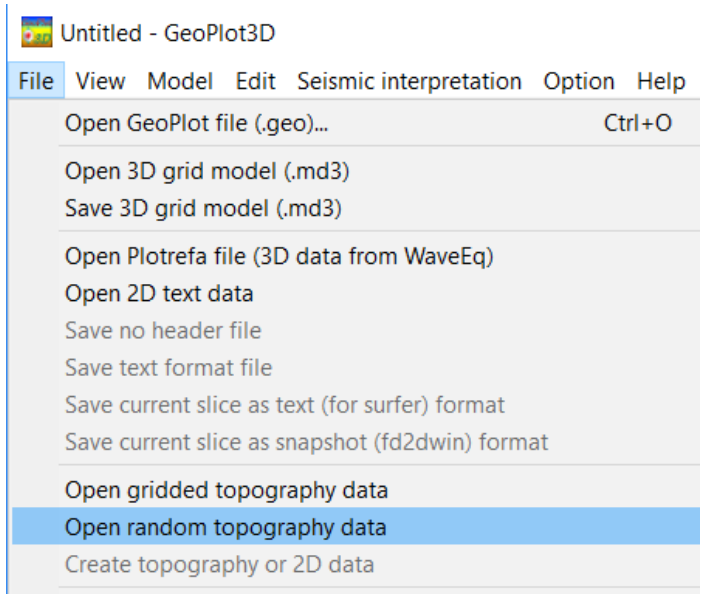
Prepare ASCII file of surface topography. X and Y can be random.

X	Y	Z
-50	-50	0
-50	-40	0
-50	-30	0
-50	-20	0
-50	-10	0
-50	0	0
-50	10	0
-50	20	0
-50	30	0
-50	40	0
-50	50	0
-40	-50	0
-40	-40	0
-40	-30	0
-40	-20	0
-40	-10	0
-40	0	0
-40	10	0
-40	20	0
-40	30	0
	.	
	.	
	.	

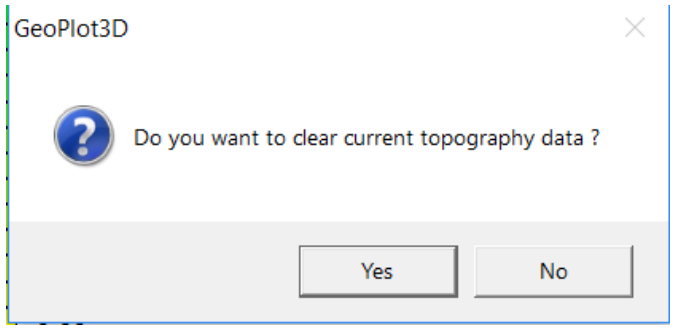
-10	30	0
-10	40	0
-10	50	0
0	-50	10
0	-40	10
0	-30	10
0	-20	10
0	-10	10
0	0	10
0	10	10
0	20	10
0	30	10
0	40	10
0	50	10
10	-50	20
10	-40	20
10	-30	20
10	-20	20
10	-10	20
10	0	20
10	10	20
10	20	20
	.	
	.	

	.	
	.	
	.	
40	-30	20
40	-20	20
40	-10	20
40	0	20
40	10	20
40	20	20
40	30	20
40	40	20
40	50	20
50	-50	20
50	-40	20
50	-30	20
50	-20	20
50	-10	20
50	0	20
50	10	20
50	20	20
50	30	20
50	40	20
50	50	20

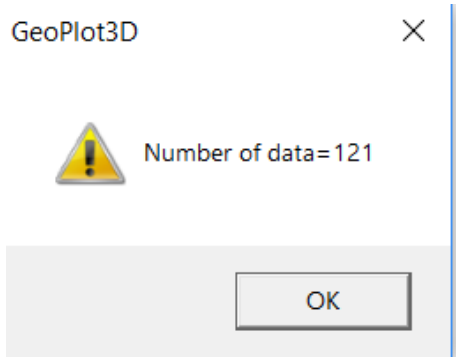
Select “File”, “Open random topography data”.



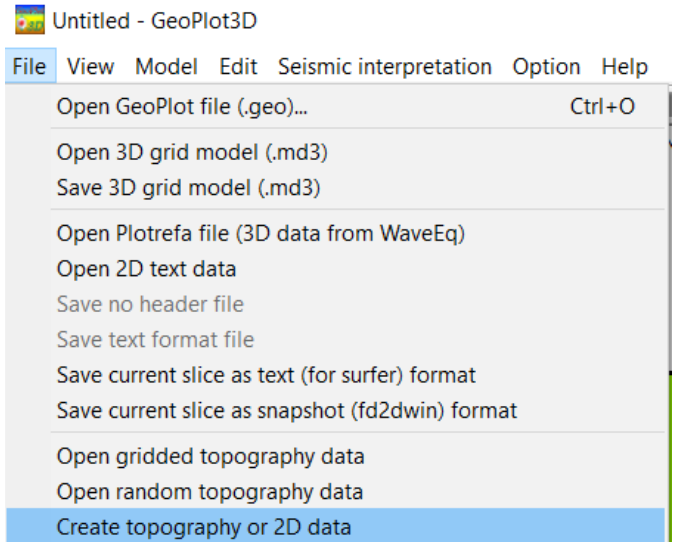
Click “Yes”.



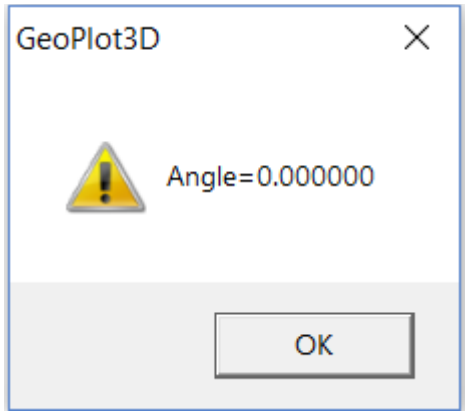
Open an ASCII topography file and confirm a number of data.



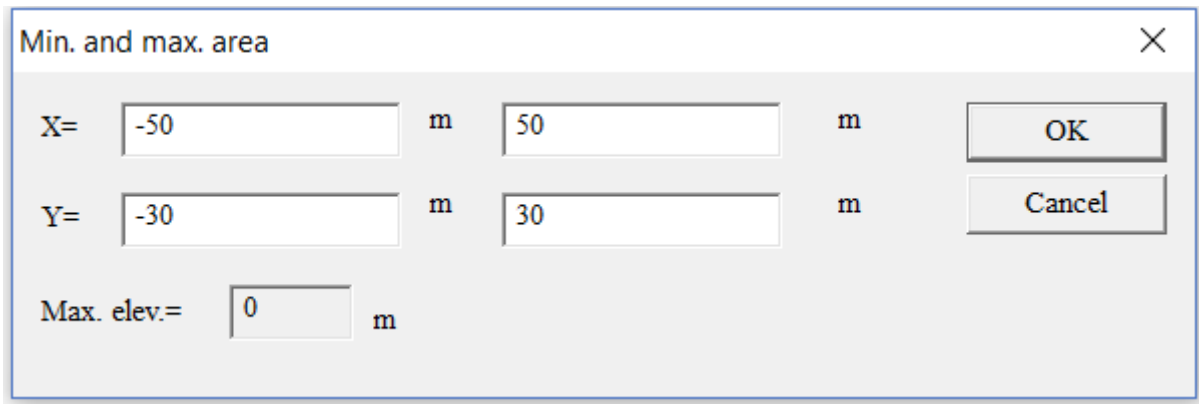
Select “File”, “Create topography or 2D data”.



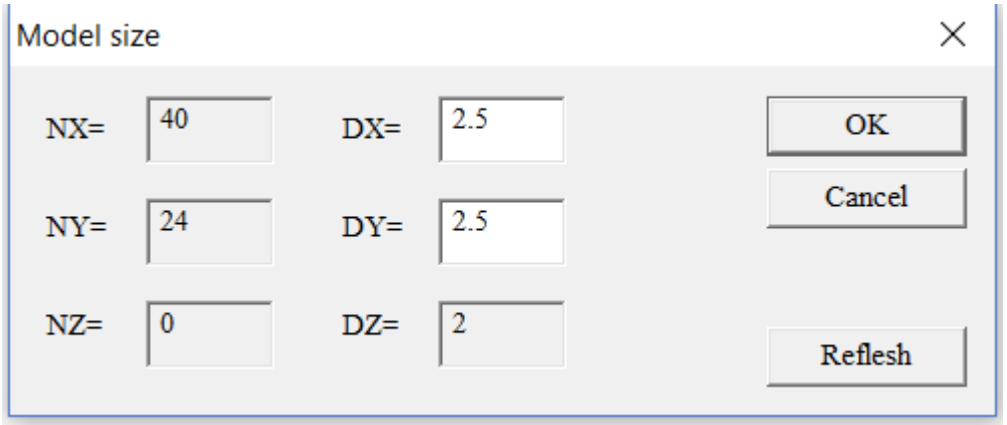
Click OK.



Confirm messages and click OK.

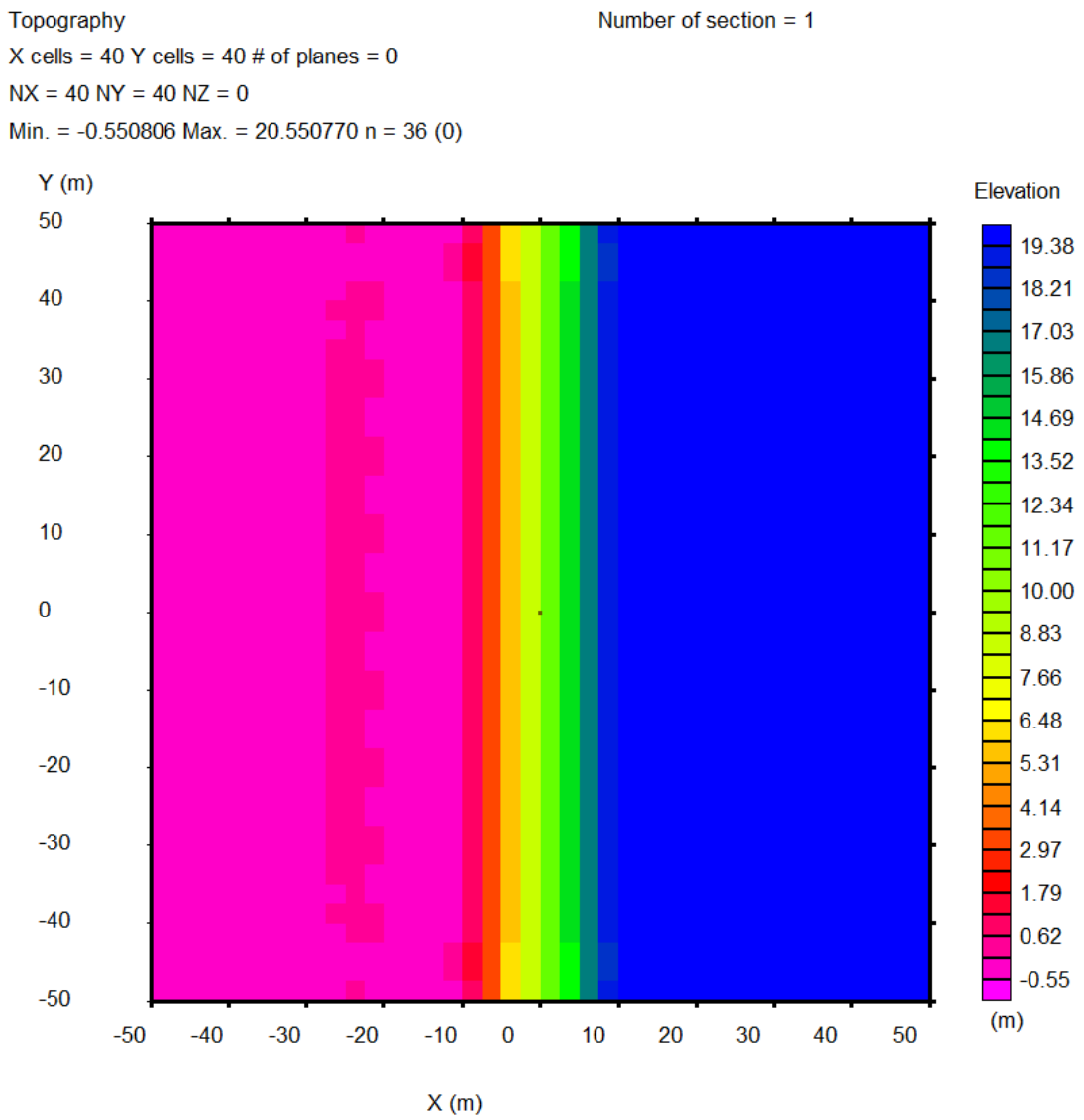


Confirm messages and click OK.



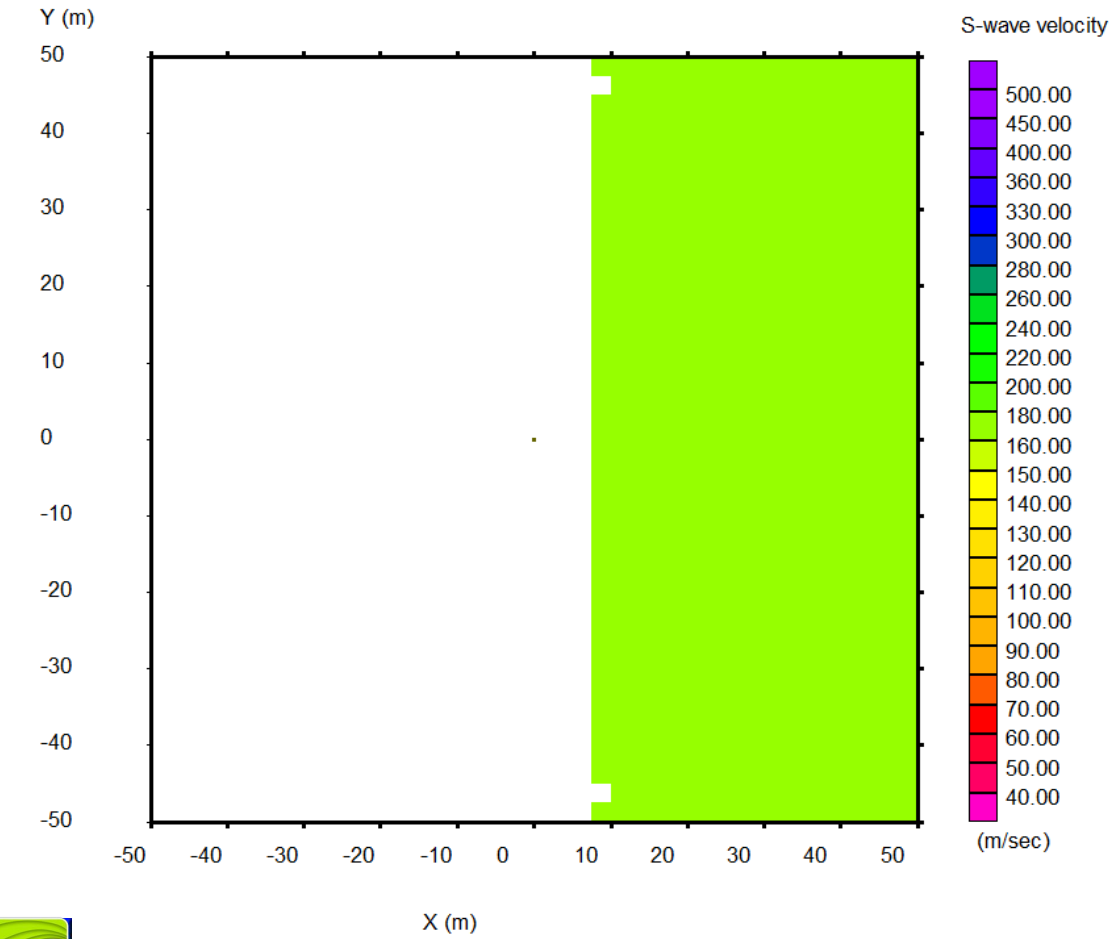
Surface topography appears.

Select “Model”, “Create model” to create 3D velocity model taking into account the surface topography.



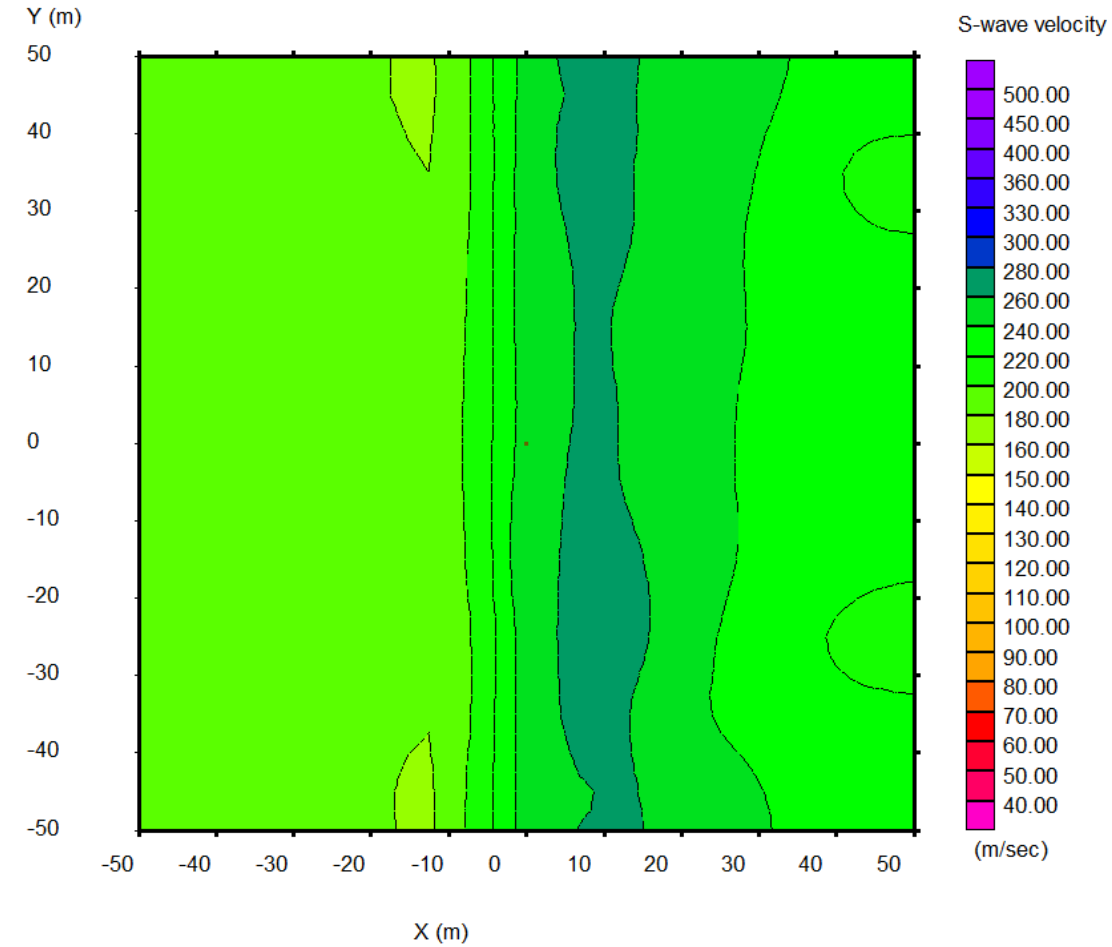
Z plane : N = 0 (0.0 to 2.0 m)
X cells = 40 Y cells = 40 # of planes = 25
NX = 40 NY = 40 NZ = 25
Min. = -0.550806 Max. = 20.550770 n = 26 (1)

Number of section = 1

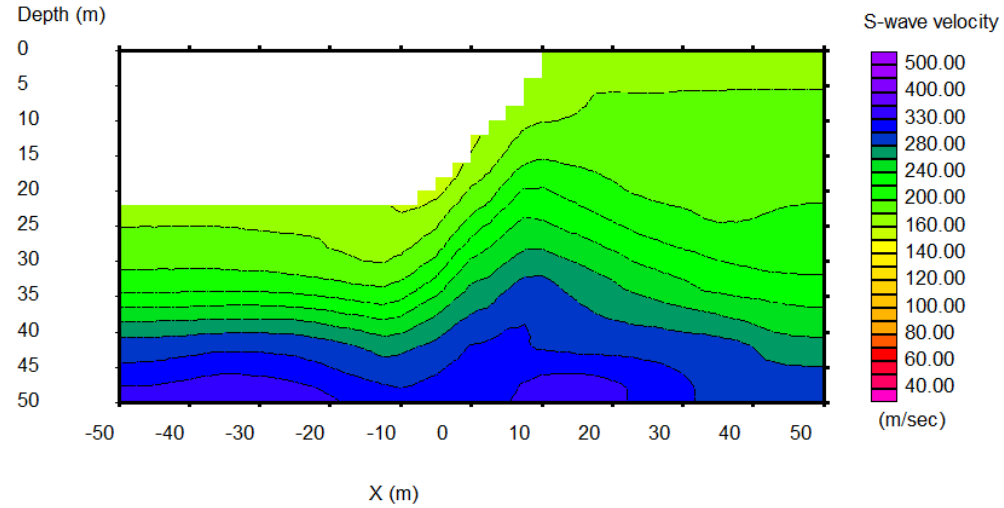


Z plane : N = 15 (30.0 to 32.0 m)
X cells = 40 Y cells = 40 # of planes = 25
NX = 40 NY = 40 NZ = 25
Min. = -0.550806 Max. = 20.550770 n = 26 (1)

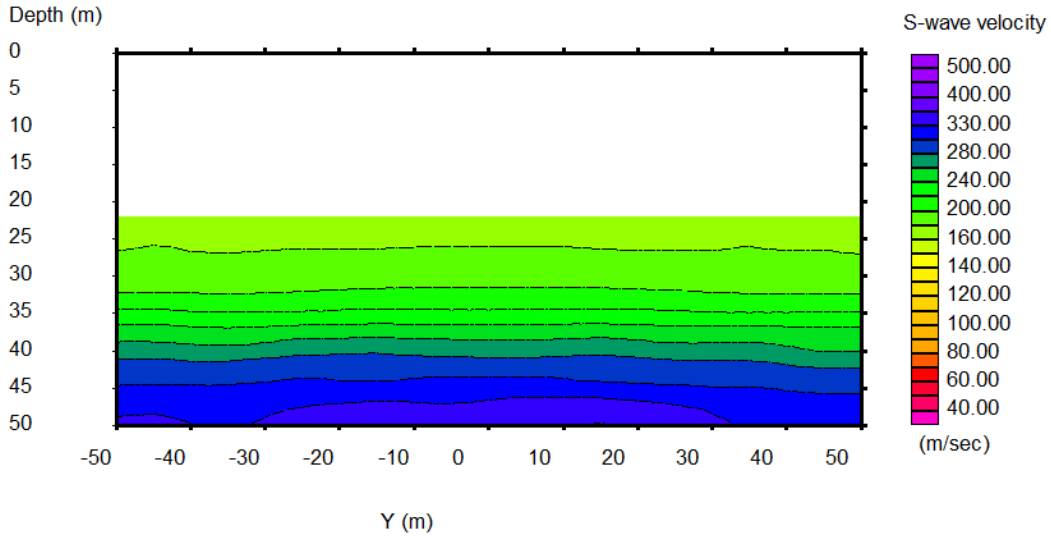
Number of section = 1



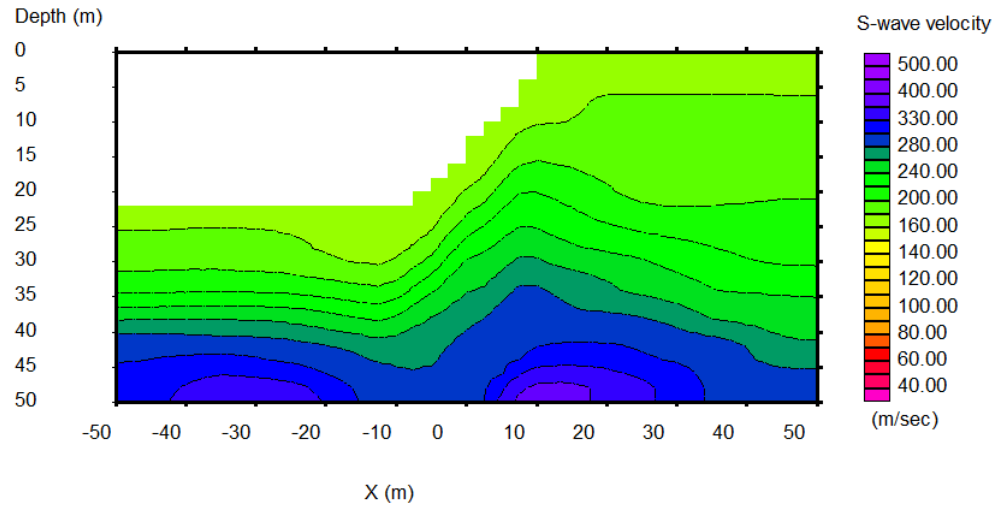
Y plane : N = 10 (-25.0 to -22.5 m)
Number of section = 1
X cells = 40 Y cells = 25 # of planes = 40
NX = 40 NY = 40 NZ = 25
Min. = -0.550806 Max. = 20.550770 n = 26 (1)



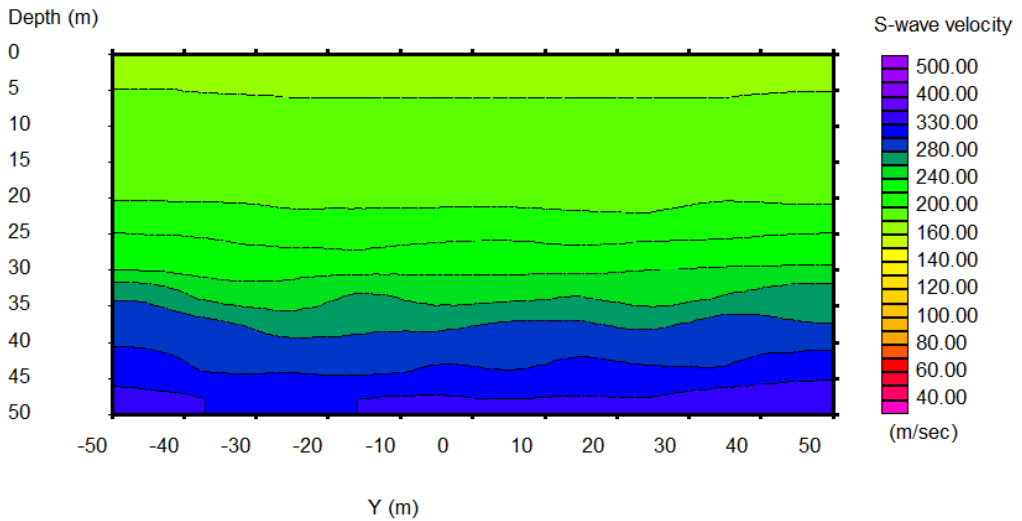
X plane : N = 10 (-25.0 to -22.5 m)
Number of section = 1
X cells = 40 Y cells = 25 # of planes = 40
NX = 40 NY = 40 NZ = 25
Min. = -0.550806 Max. = 20.550770 n = 26 (1)

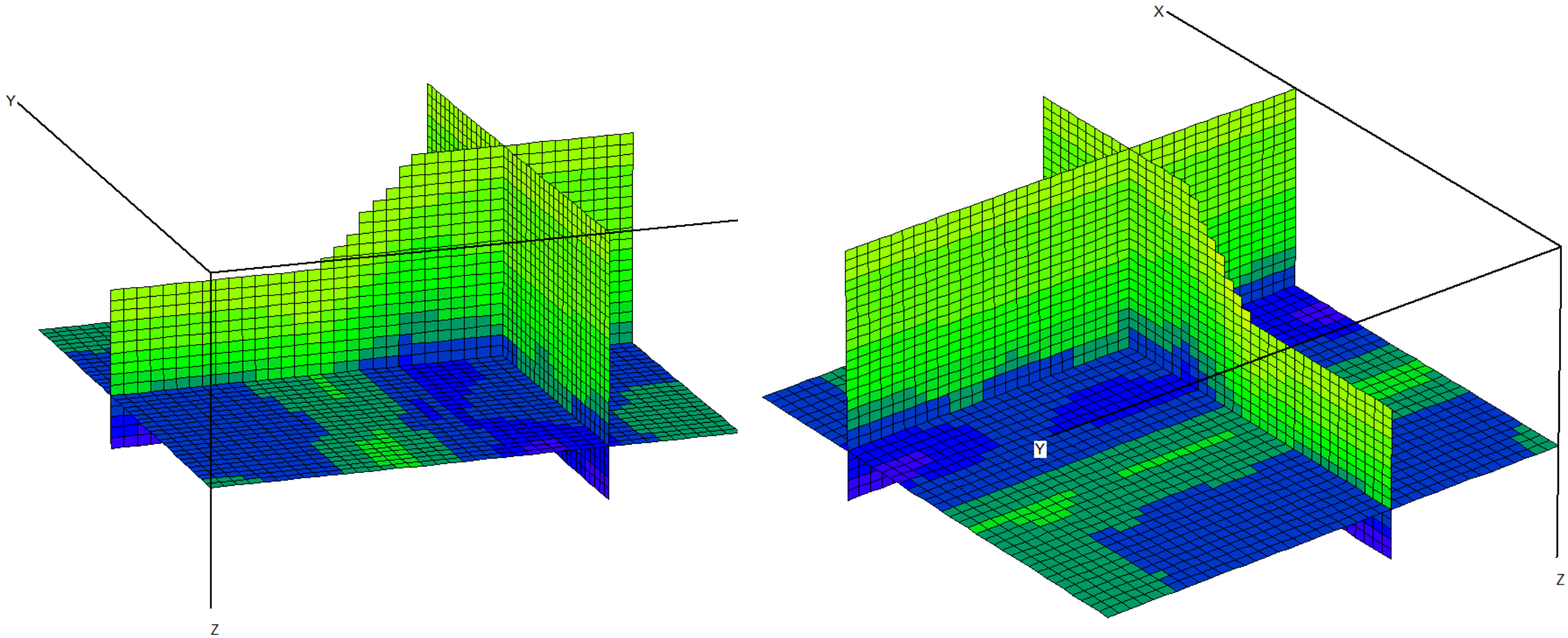


Y plane : N = 30 (25.0 to 27.5 m)
Number of section = 1
X cells = 40 Y cells = 25 # of planes = 40
NX = 40 NY = 40 NZ = 25
Min. = -0.550806 Max. = 20.550770 n = 26 (1)



X plane : N = 30 (25.0 to 27.5 m)
Number of section = 1
X cells = 40 Y cells = 25 # of planes = 40
NX = 40 NY = 40 NZ = 25
Min. = -0.550806 Max. = 20.550770 n = 26 (1)




Y
Z
X
Y
Z