Tutorial for horizontal to vertical spectral ratio (H/V or HVSR) processing using SeisImager/SW
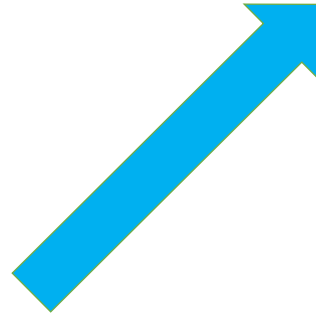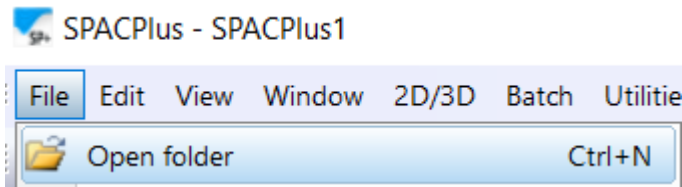
- Processing three component ambient noise data obtained by Atom.

- SeisImager/SW license is required.

- Download the latest installer from : https://seisimager.com/download/SeisImager.zip

- Download the example data from : http://seisimager.esy.es/GeophysicalDatabase/hvsr.zip

- See *"SeisImager/SW^{TM} Manual Addendum (H/V)"* or *"SeisImager/SW-Pro^{TM} Manual"* for more details
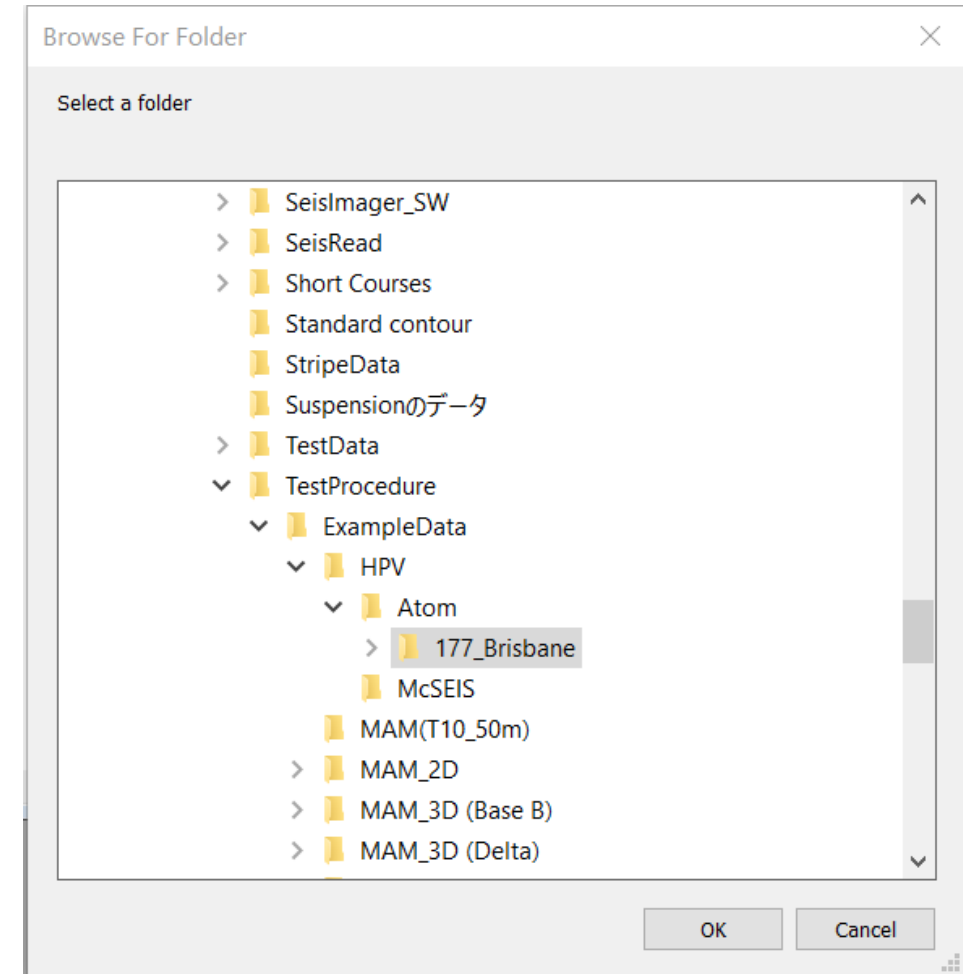
Import Atom data files

Double click icon to launch SPACPlus

Select "File", "Open folder".
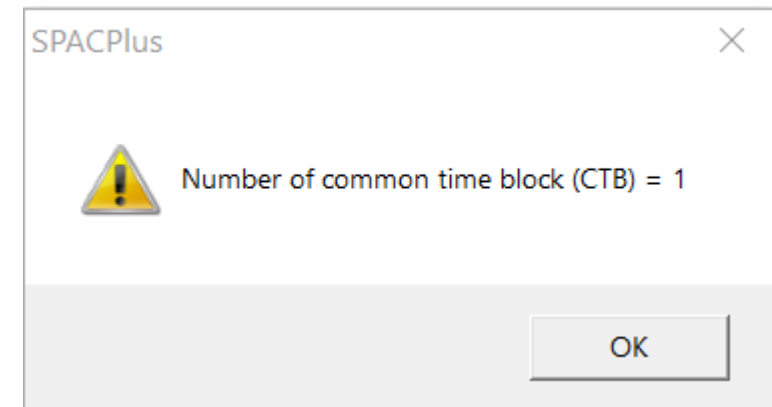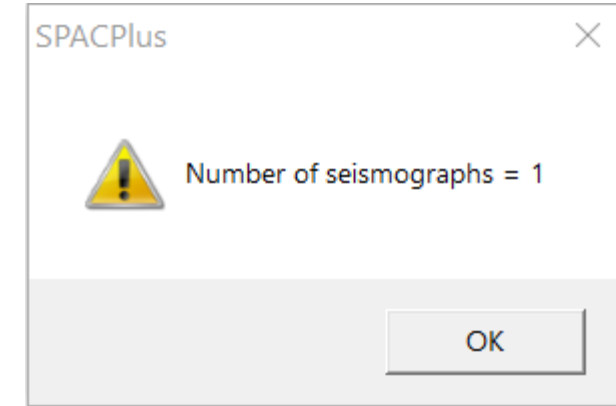

Select a root folder of data.

Import Atom data files
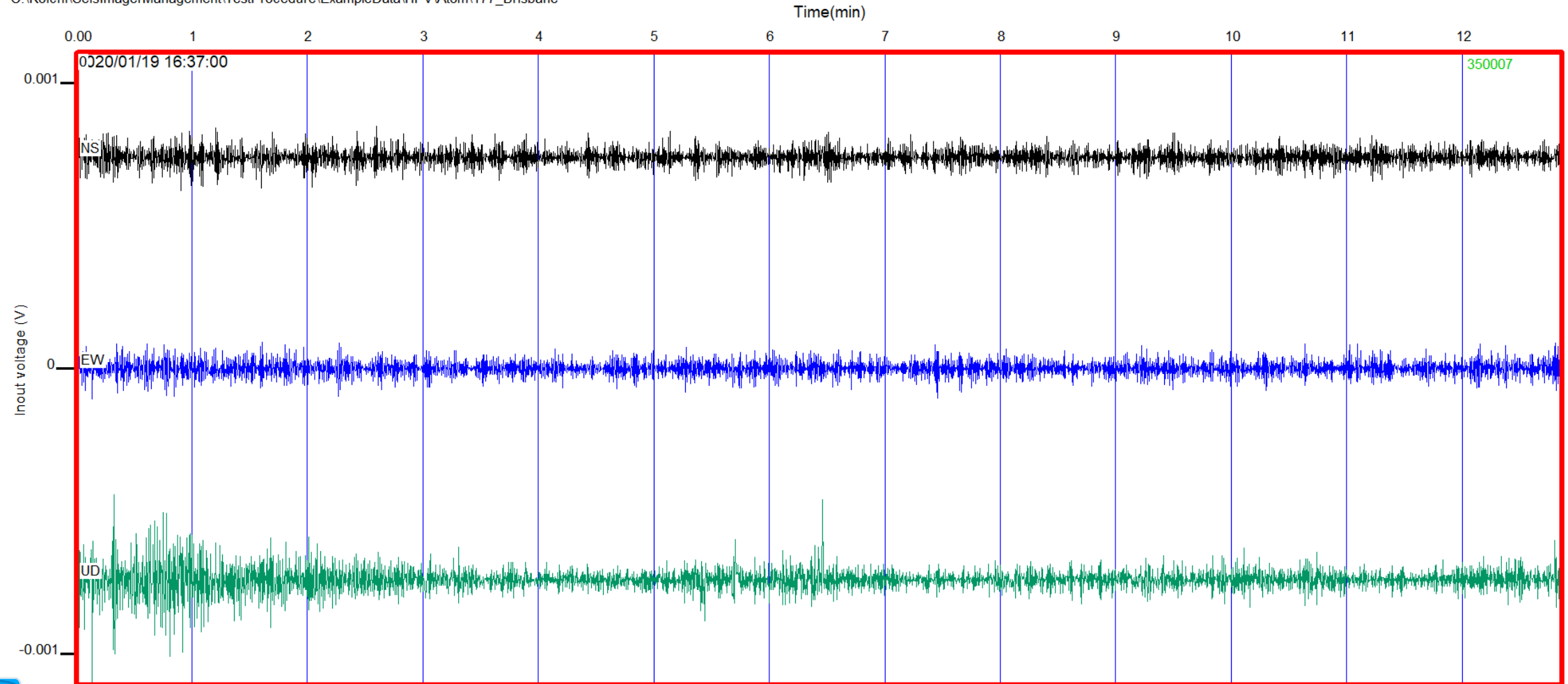
Confirm number of seismograph (Atom acquisition units).

Confirm number common time blocks (CTB).

SPACPlus ✕

⚠ Number of seismographs = 1

OK

SPACPlus ✕

⚠ Number of common time block (CTB) = 1

OK

Raw waveform data

C:\Koichi\SeisImagerManagement\TestProcedure\ExampleData\HPV\Atom\177_Brisbane
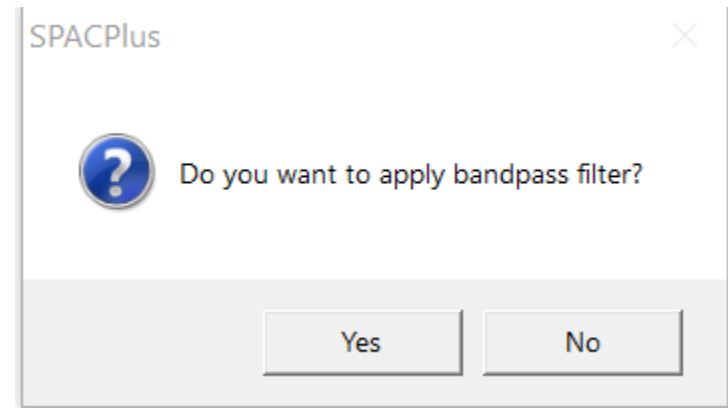
Select a common time block (CTB)
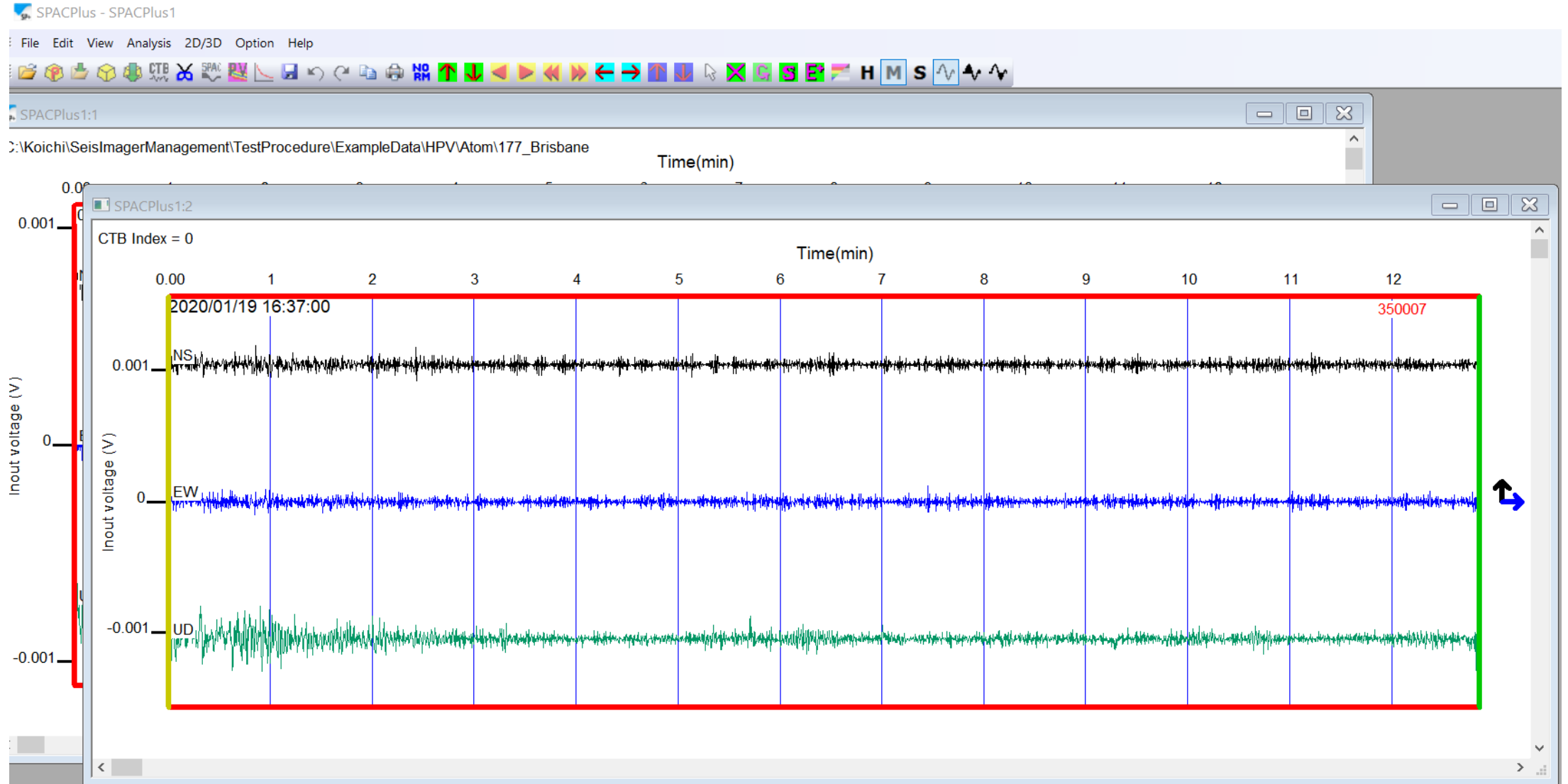
Click to select a common time block.

Bandpass filter is usually not necessary using 2Hz geophone.
Click "No" to continue.

SPACPlus

? Do you want to apply bandpass filter?

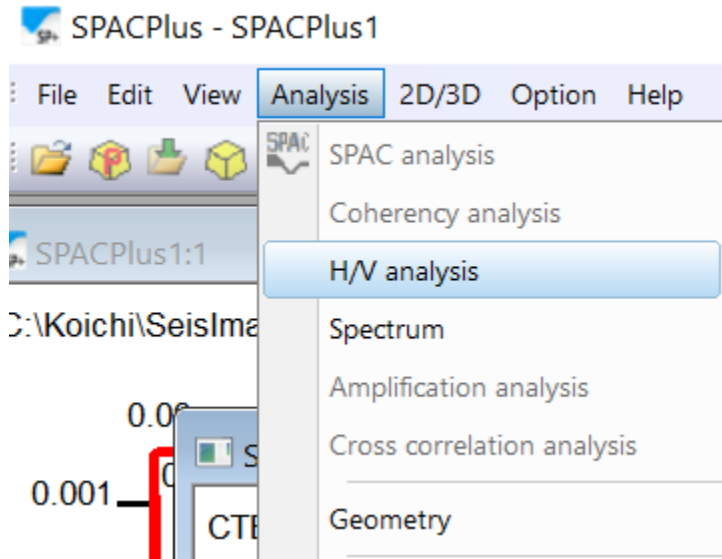Yes   No

Common time block (CTB)

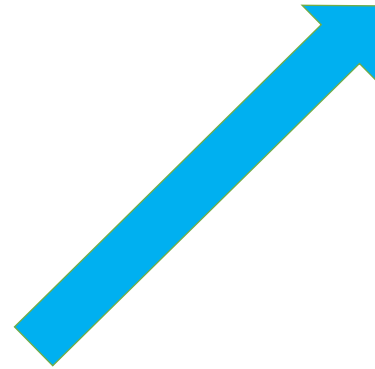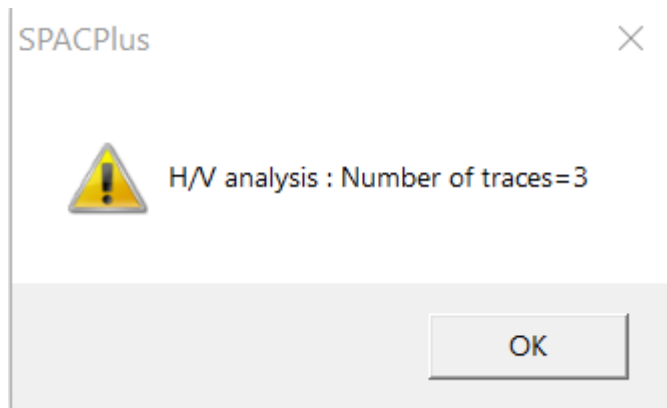Selected common time block (CTB) appears in different Window.

Calculate horizontal to vertical spectral ratio (H/V)

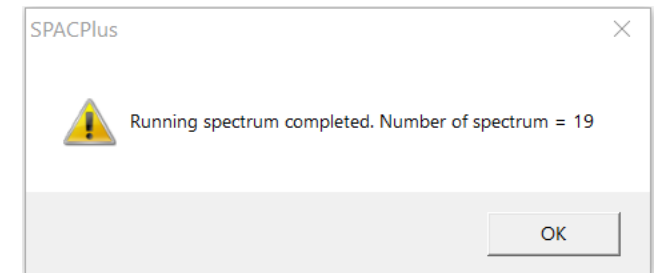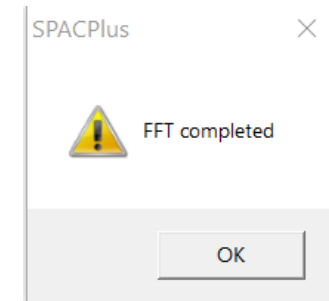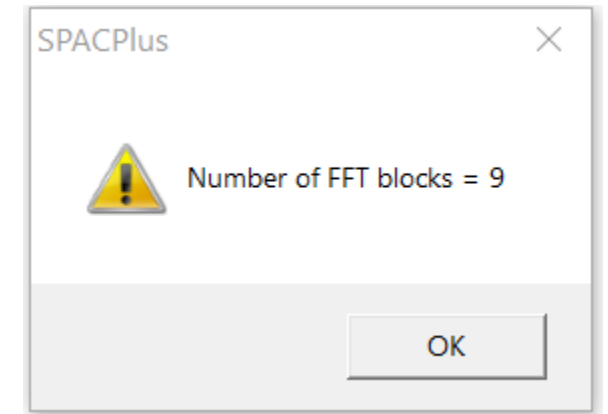Select "Analysis", "H/V analysis" to calculate H/V spectrum.

H/V spectra are calculated for each FFT block at first.
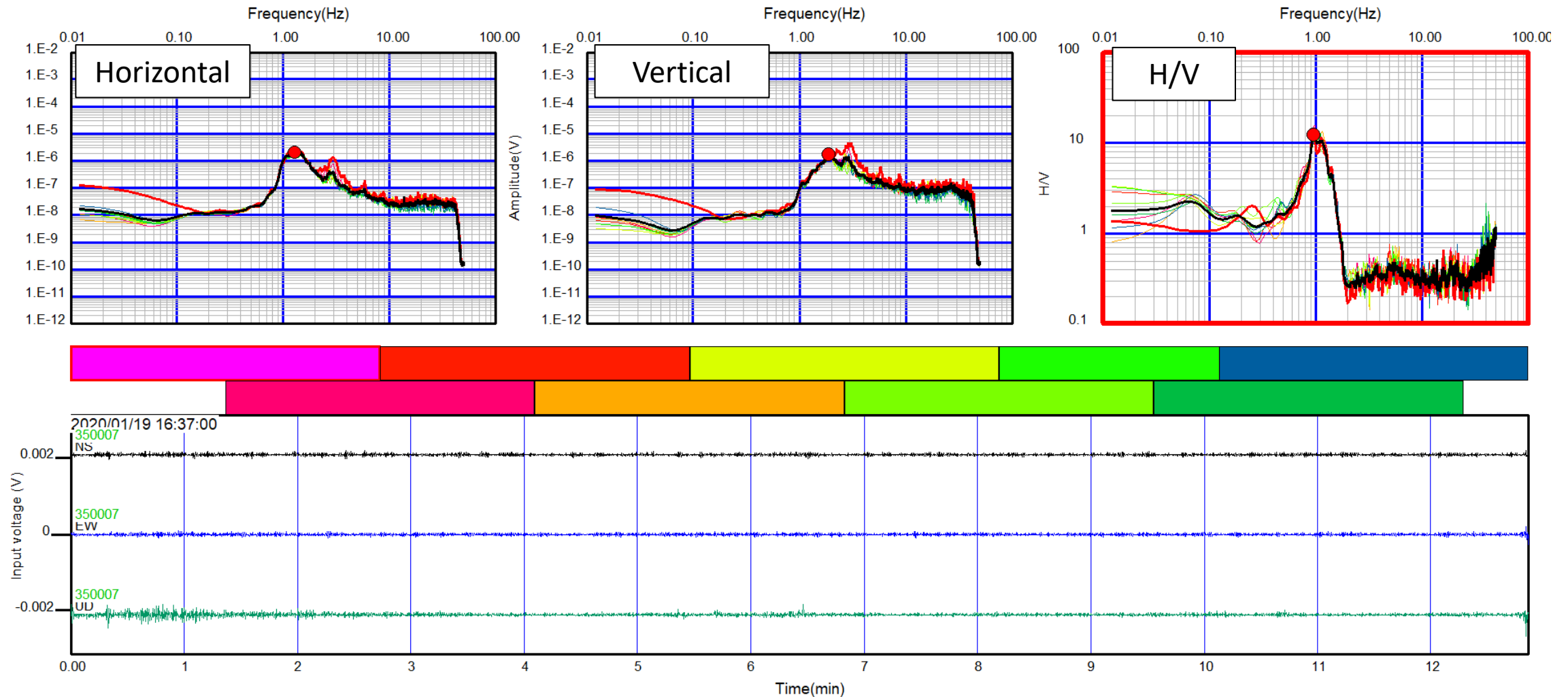

Confirm number of traces. It should be three.

Confirm messages.
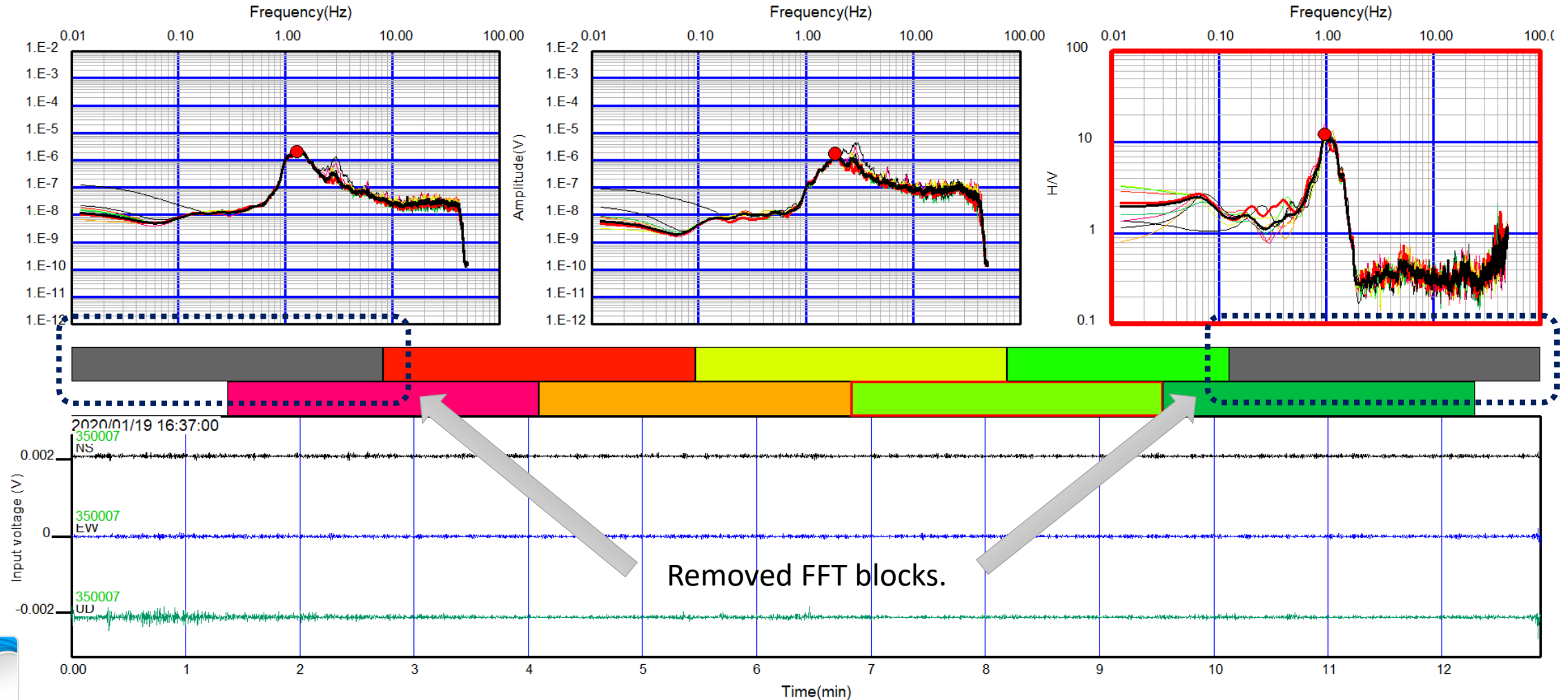
Show horizontal to vertical spectral ratio (H/V)

Horizontal, vertical, and H/V spectra are shown in new window. Color rectangles at the middle of the window indicates FFT blocks. Rectangle colors correspond to thin lines in the spectra. Bold black lines in the spectra indicate averaged spectra. Blocks including irregular noises can be removed by delete key. Deleted blocks are shown as gray.
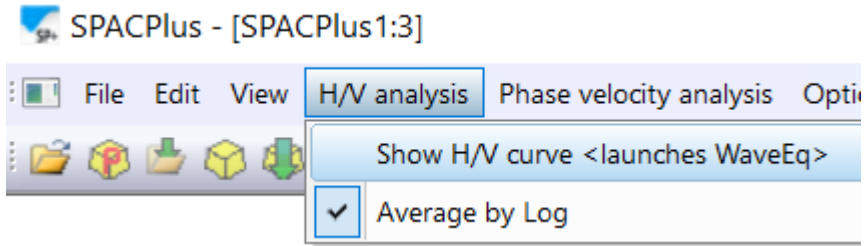
Edit horizontal to vertical spectral ratio (H/V)

The first and last FFT blocks were removed from average.

Removed FFT blocks.

Show H/V spectrum by WaveEq

Select "H/V analysis", "Show H/V curve <launches WaveEq>" for further processing.

WaveEq is automatically launched and H/V spectrum appears.

See *"SeisImager/SW™ Manual Addendum (H/V)"* or *"SeisImager/SW-Pro™ Manual"* for further processing.
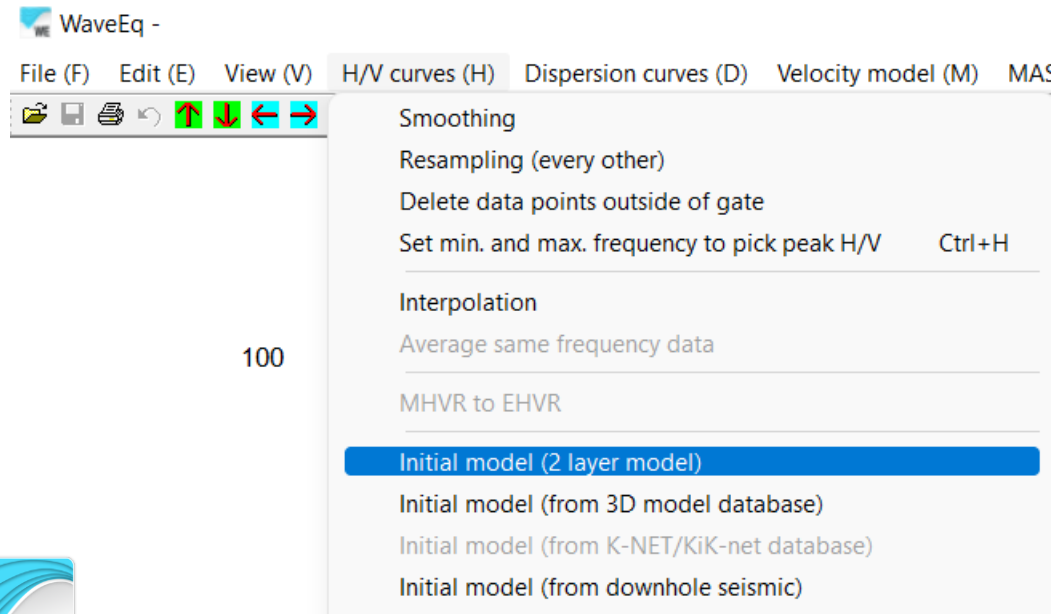
H/V spectrum :

H/V peak frequency = 0.977 Hz

Roughly estimate a bedrock depth based on H/V

Inversion of H/V is highly non-unique and it is difficult to estimate reliable velocity model only from H/V. Bedrock depth can be roughly estimated if H/V peak is clear and approximate geology of site is known. H/V peak frequency (F) is generally related to 1st layer S-wave velocity (Vs) and thick ness of the 1st layer (D) as shown in equation (1).

$$F = \frac{Vs}{4D} \qquad (1)$$
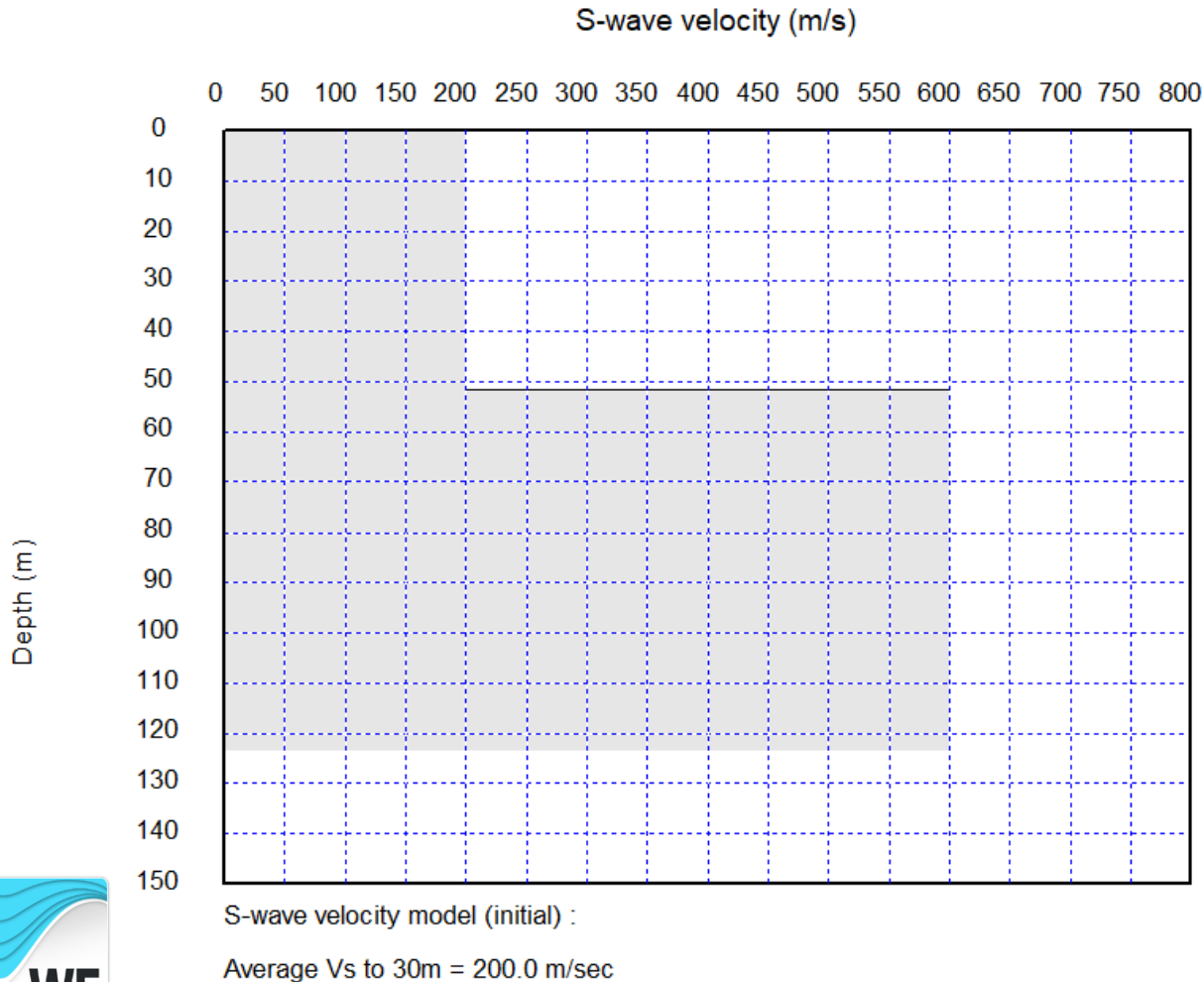
Select "H/V curves", "Initial model", "2 layer model".

Enter 1st layer S-wave velocity. It very depends on the geology of sites and typically varies from 100 to 500 m/s (from 330 to 1700 ft/sec).

Two-layer velocity model based on H/V peak

A two-layer S-wave velocity model appears. S-wave velocity of the 2nd layer is automatically set to the triple of the 1st layer velocity.

Click [star icon] to calculate theoretical H/V and make sure theoretical and observed H/V peak frequencies are consistent.

S-wave velocity model (initial) :

Average Vs to 30m = 200.0 m/sec

RMSE = 0.215664

H/V spectrum :

H/V peak frequency = 0.970 Hz (obs.) 1.135 Hz (cal.)

H/V peak amplitude = 12.182

H/V peak clarity = 47.825