

Using Ambient Vibration Array Techniques for Site Characterisation

Single station measurement: H/V

Tutorial

Data are in /.../.../...../EXERCISES/HV
...../FK
...../STRUCTURES
...../INVERSION

SESARRAY PACKAGE

GEOPSY

array tools

H/V

damping

FK

Capon

MSPAC

MASW

figue

figures

gp tools

*Dispersion curves
Ellipticity curves
Autocorr. Curves
...*

build_array

Array response

Post-processing

max2curve

spac2disp

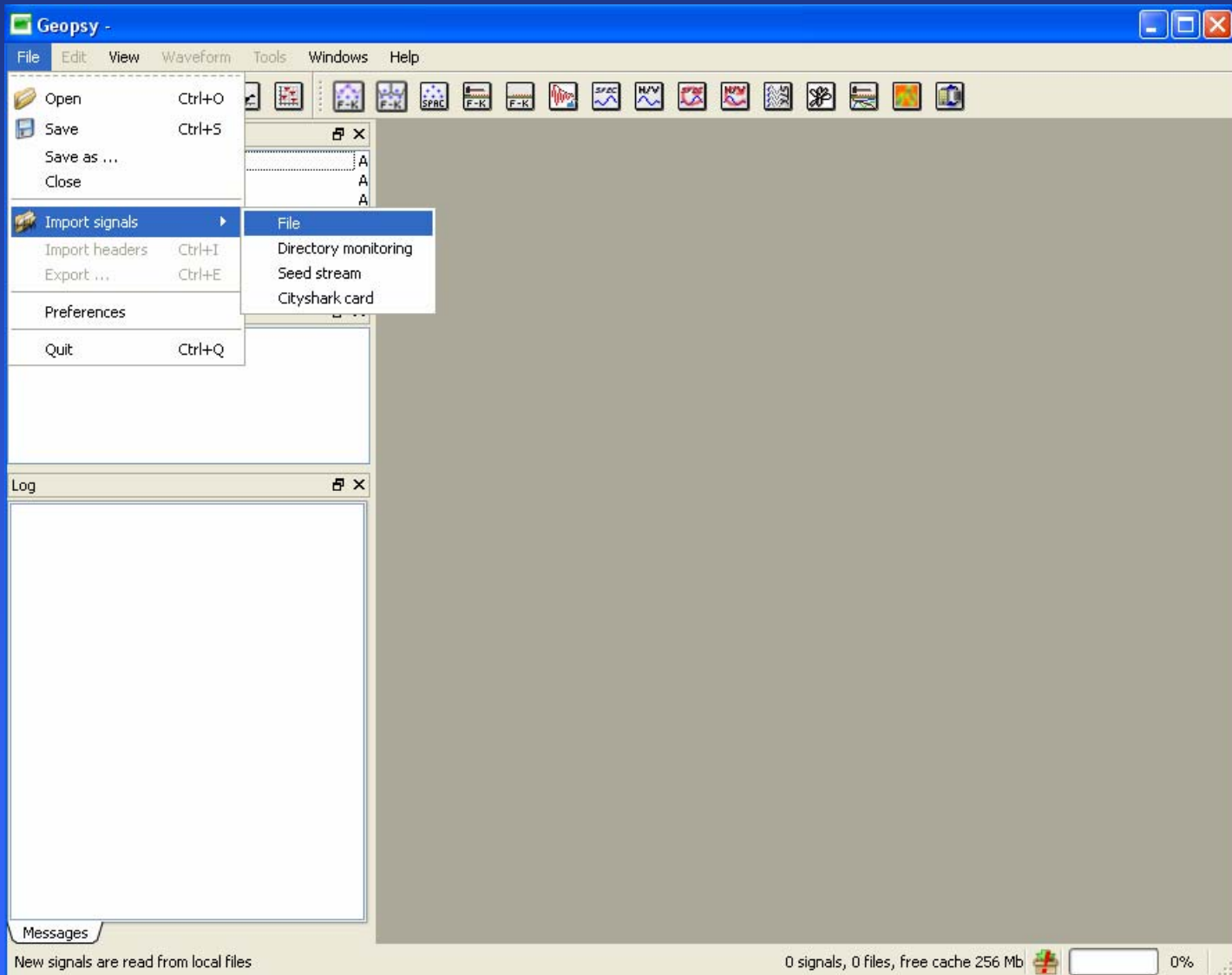
DINVER

inversion

H/V measurements

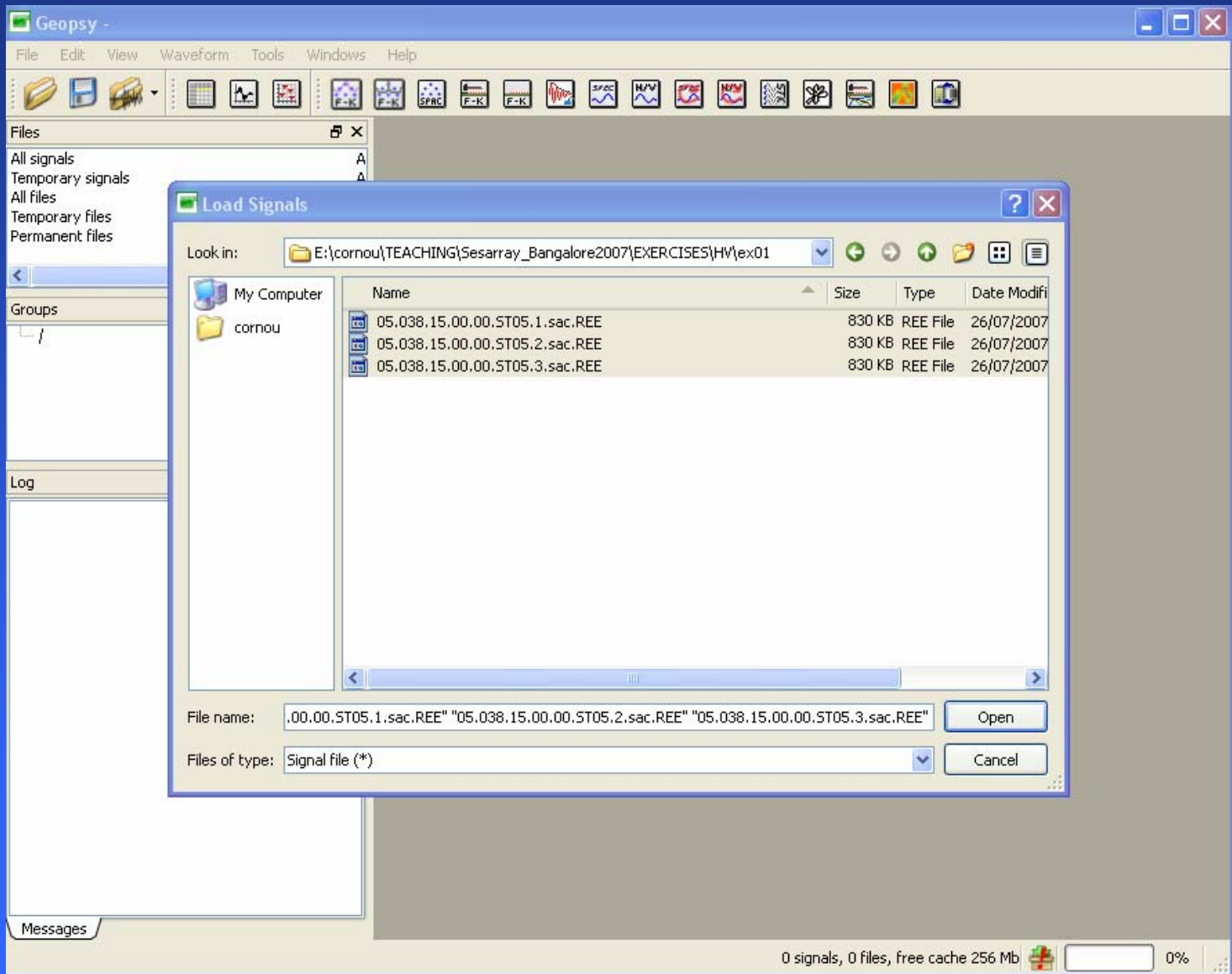
- 1) Influence of parameters in H/V processing (window length, smoothing, etc ...)
- 2) Correlation between H/V peak frequencies and geology

Loading signals Directory EXERCISES_HV/EX01



Loading signals

Directory EXERCISES_HV/EX01



Geopsy -

File Edit View Waveform Tools Windows Help

Files

- All signals
- Temporary signals
- All files
- Temporary files
- Permanent files

Groups

Log

Messages

0 signals, 0 files, free cache 256 Mb 0%

Load Signals

Look in: E:\cornou\TEACHING\Sesarray_Bangalore2007\EXERCISES\HV\ex01

Name	Size	Type	Date Modified
05.038.15.00.00.ST05.1.sac.REE	830 KB	REE File	26/07/2007
05.038.15.00.00.ST05.2.sac.REE	830 KB	REE File	26/07/2007
05.038.15.00.00.ST05.3.sac.REE	830 KB	REE File	26/07/2007

File name: .00.00.ST05.1.sac.REE" "05.038.15.00.00.ST05.2.sac.REE" "05.038.15.00.00.ST05.3.sac.REE"

Files of type: Signal file (*)

Open Cancel

Display signals

Directory EXERCISES_HV/EX01

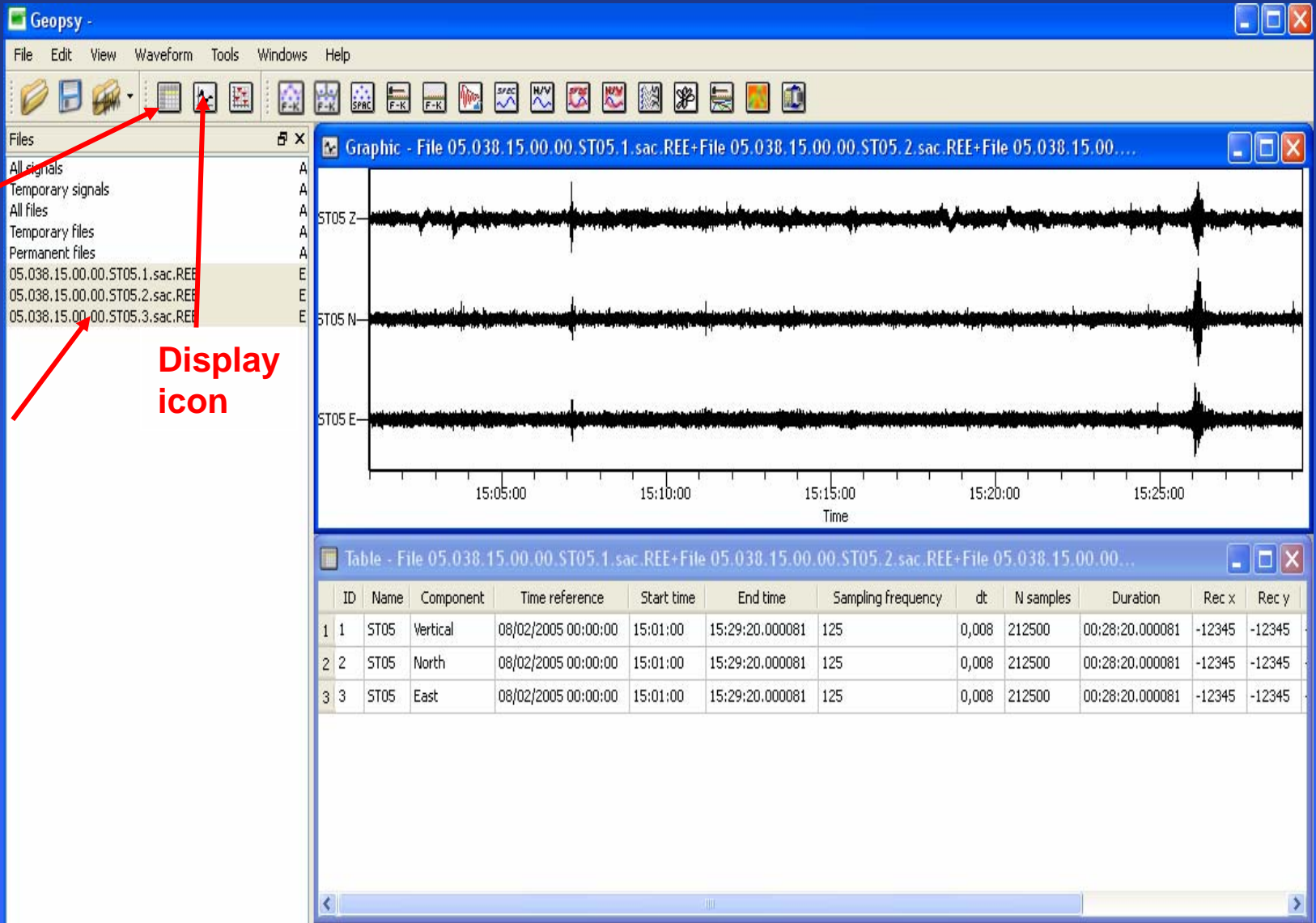


table icon → (points to the table icon in the toolbar)
Loaded files → (points to the file list in the left pane)
Display icon → (points to the display icon in the toolbar)

Graphic - File 05.038.15.00.00.ST05.1.sac.REE+File 05.038.15.00.00.ST05.2.sac.REE+File 05.038.15.00.00...

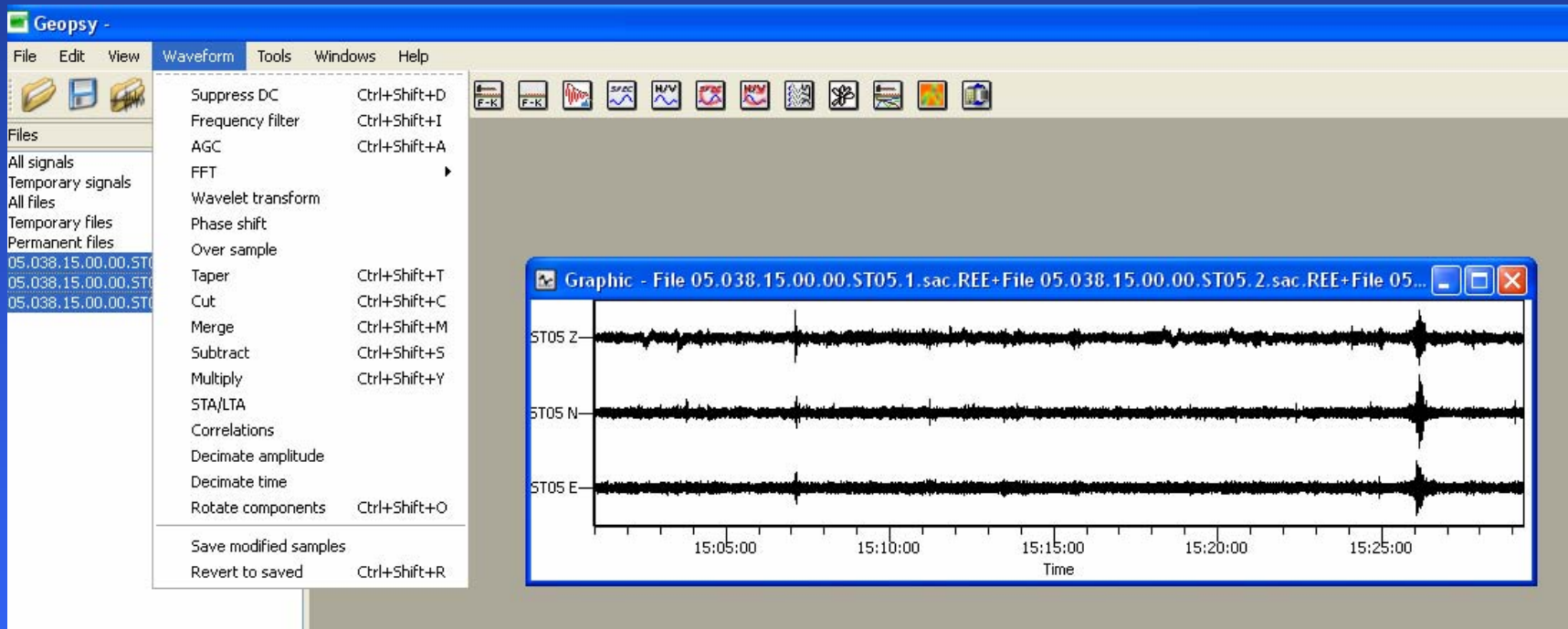
ST05 Z
 ST05 N
 ST05 E

15:05:00 15:10:00 15:15:00 15:20:00 15:25:00
 Time

Table - File 05.038.15.00.00.ST05.1.sac.REE+File 05.038.15.00.00.ST05.2.sac.REE+File 05.038.15.00.00...

ID	Name	Component	Time reference	Start time	End time	Sampling frequency	dt	N samples	Duration	Rec x	Rec y	
1	1	ST05	Vertical	08/02/2005 00:00:00	15:01:00	15:29:20.000081	125	0,008	212500	00:28:20.000081	-12345	-12345
2	2	ST05	North	08/02/2005 00:00:00	15:01:00	15:29:20.000081	125	0,008	212500	00:28:20.000081	-12345	-12345
3	3	ST05	East	08/02/2005 00:00:00	15:01:00	15:29:20.000081	125	0,008	212500	00:28:20.000081	-12345	-12345

Waveform tool: filtering, cutting, Fourier spectra, etc ...



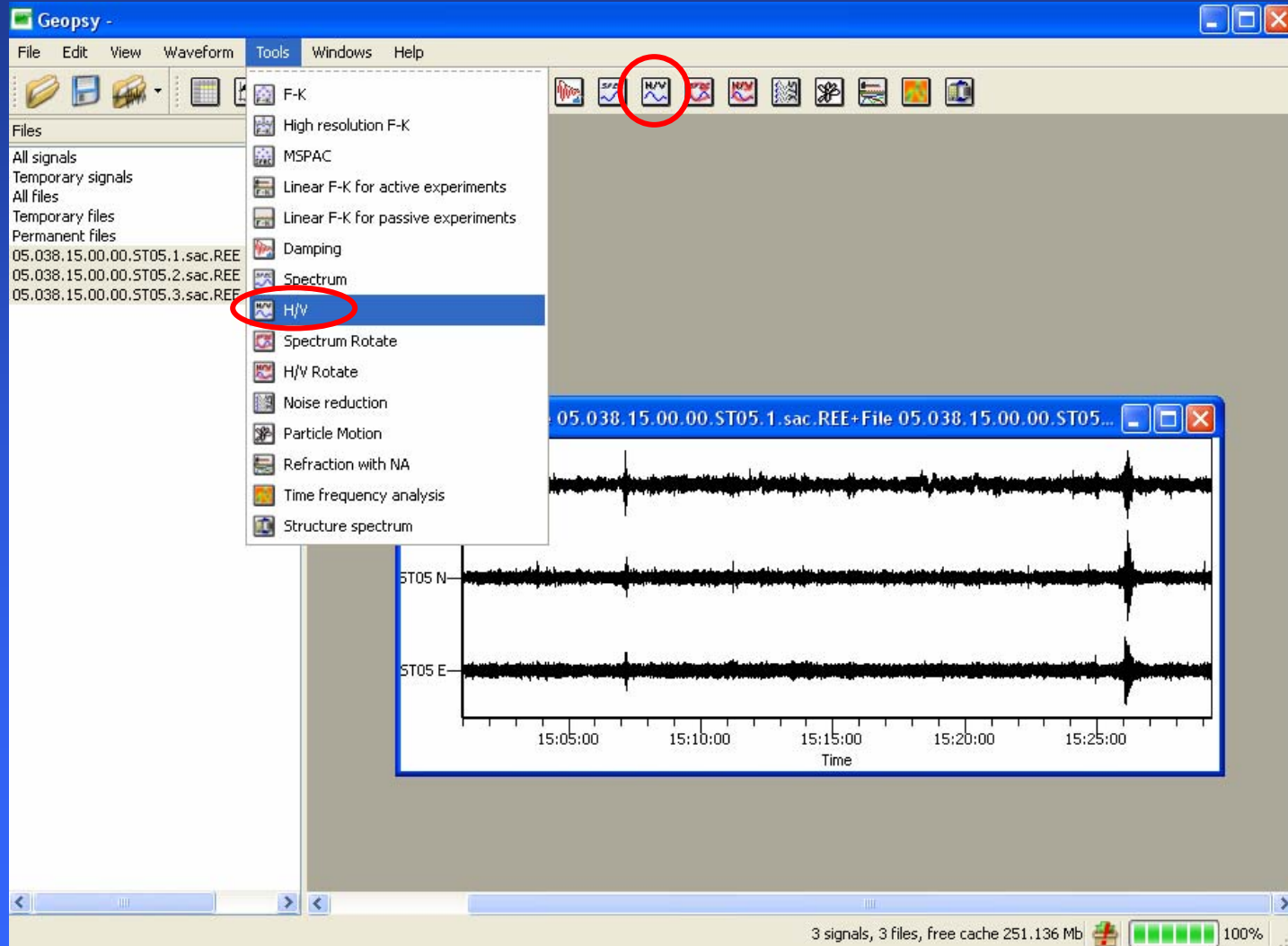
The screenshot displays the Geopsy software interface. The 'Tools' menu is open, listing various processing options with their corresponding keyboard shortcuts:

Tool	Shortcut
Suppress DC	Ctrl+Shift+D
Frequency filter	Ctrl+Shift+I
AGC	Ctrl+Shift+A
FFT	
Wavelet transform	
Phase shift	
Over sample	
Taper	Ctrl+Shift+T
Cut	Ctrl+Shift+C
Merge	Ctrl+Shift+M
Subtract	Ctrl+Shift+S
Multiply	Ctrl+Shift+Y
STA/LTA	
Correlations	
Decimate amplitude	
Decimate time	
Rotate components	Ctrl+Shift+O
Save modified samples	
Revert to saved	Ctrl+Shift+R

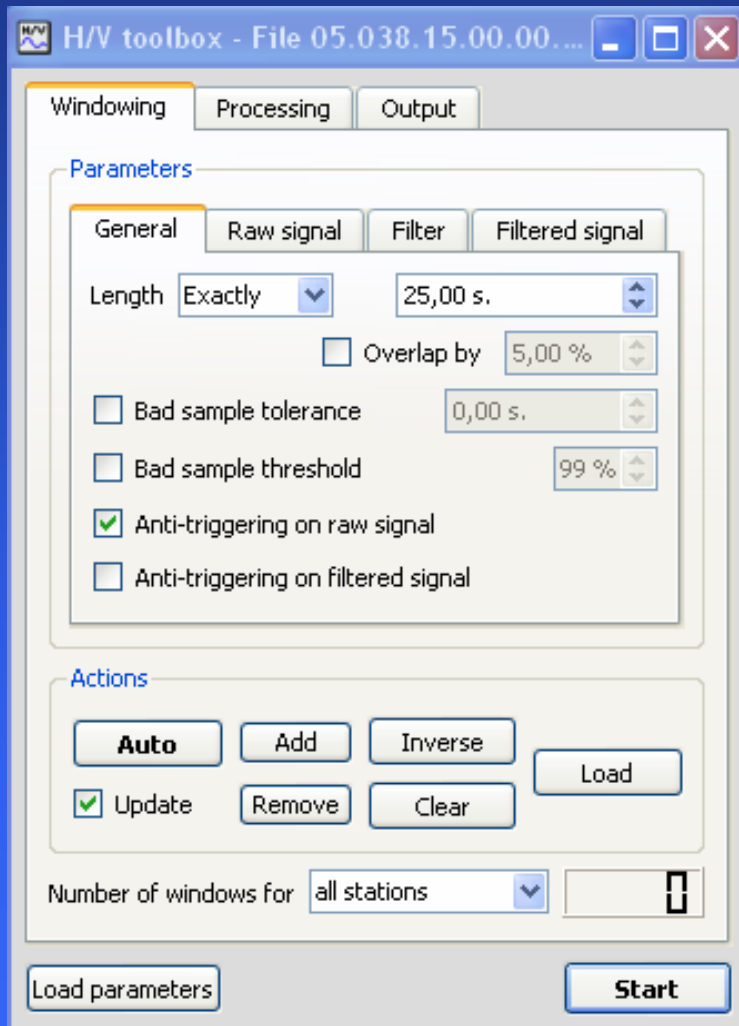
The main window shows a multi-channel seismic plot titled 'Graphic - File 05.038.15.00.00.ST05.1.sac.REE+ File 05.038.15.00.00.ST05.2.sac.REE+ File 05...'. The plot displays three channels: ST05 Z, ST05 N, and ST05 E. The x-axis is labeled 'Time' and ranges from 15:05:00 to 15:25:00. The y-axis represents amplitude for each channel. A prominent seismic event is visible around 15:23:00.

HV toolbox

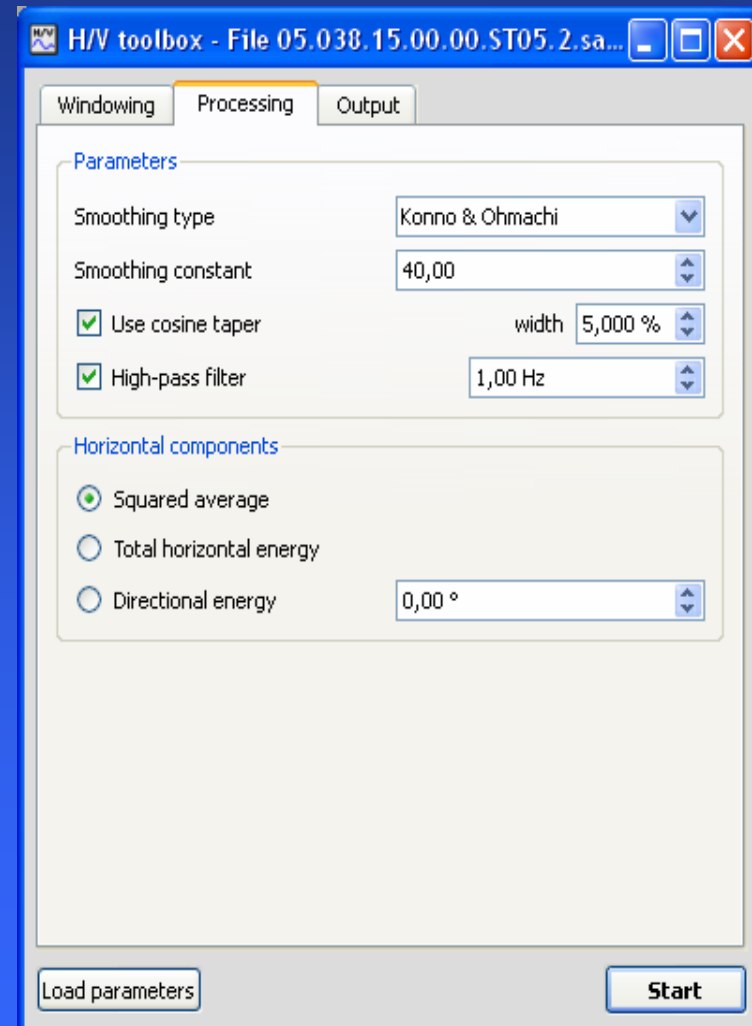
Click on H/V icon or select H/V in “Tools” toolbox



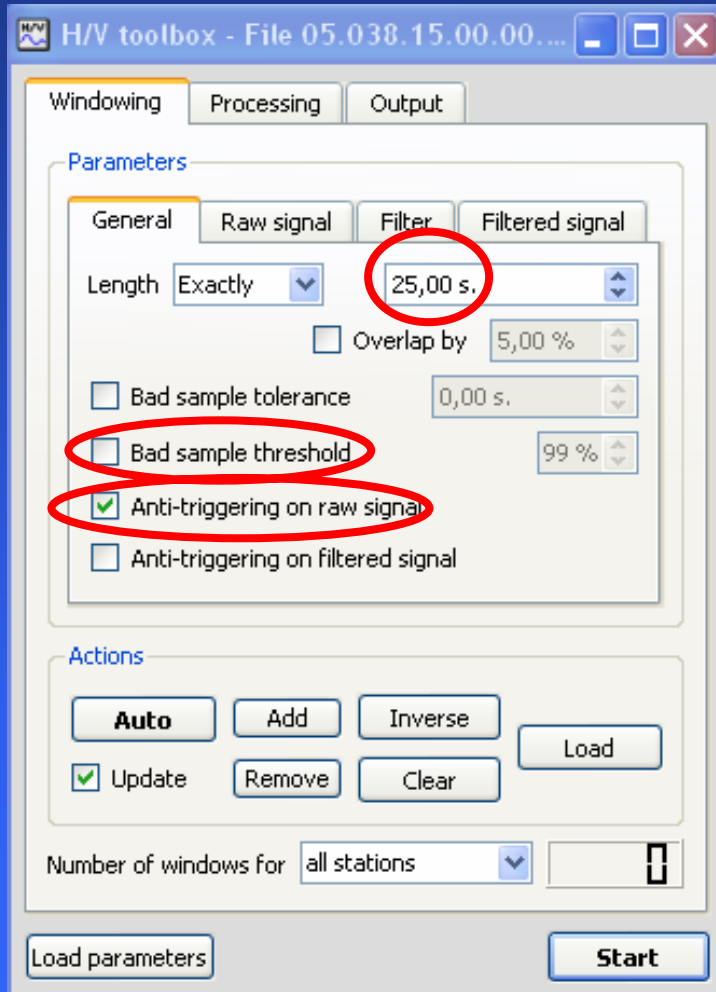
Window selection



Processing parameters



HV toolbox: selection of windows



H/V toolbox - File 05.038.15.00.00...

Windowing Processing Output

Parameters

General Raw signal Filter Filtered signal

Length Exactly 25,00 s.

Overlap by 5,00 %

Bad sample tolerance 0,00 s.

Bad sample threshold

Anti-triggering on raw signal

Anti-triggering on filtered signal

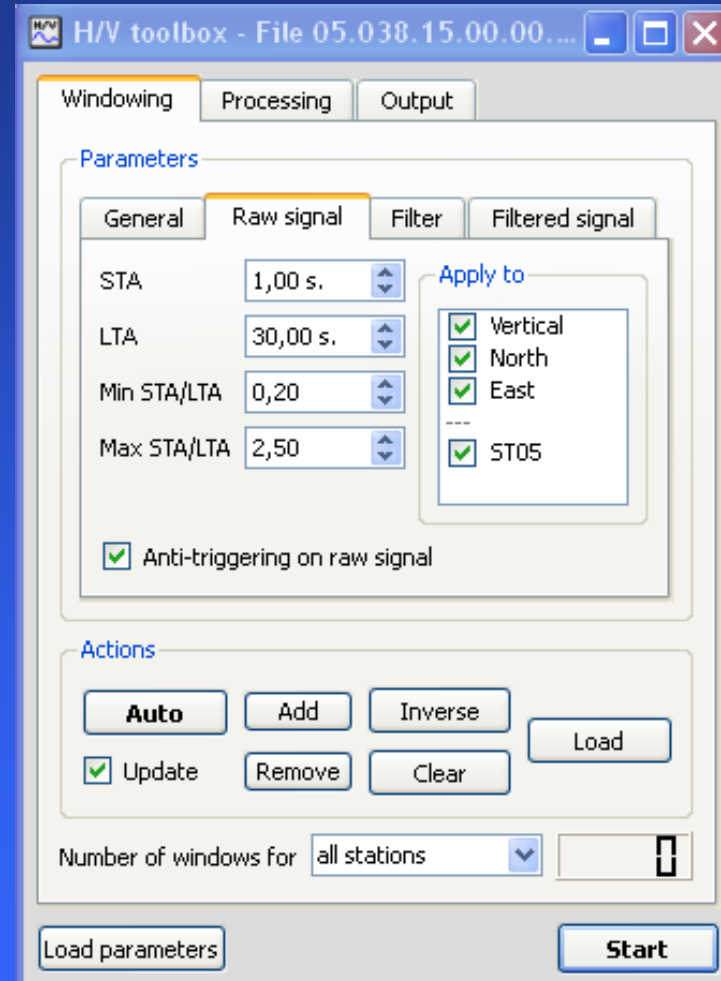
Actions

Auto Add Inverse Load

Update Remove Clear

Number of windows for all stations

Load parameters Start



H/V toolbox - File 05.038.15.00.00...

Windowing Processing Output

Parameters

General Raw signal Filter Filtered signal

STA 1,00 s.

LTA 30,00 s.

Min STA/LTA 0,20

Max STA/LTA 2,50

Apply to

- Vertical
- North
- East
-
- ST05

Anti-triggering on raw signal

Actions

Auto Add Inverse Load

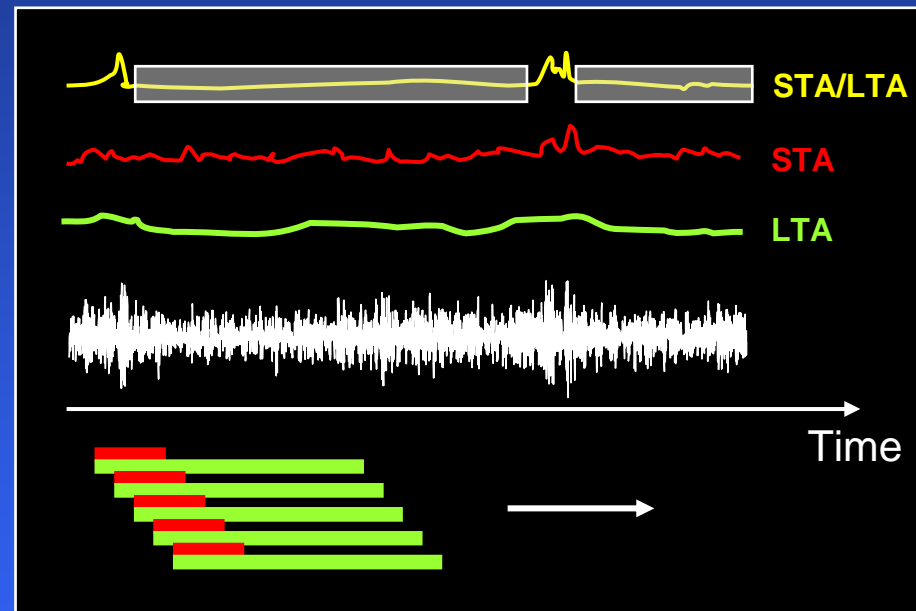
Update Remove Clear

Number of windows for all stations

Load parameters Start

Computation of H/V : STA/LTA anti-triggering algorithm (as implemented in Geopsy)

- Constructs $|n(t)|$, $|z(t)|$ and $|ew(t)|$
- Computes running averages **STA(t)** and **LTA(t)** for the three components
(Typically, $tsta = 0.5$ to 2.0 s and $tlta = 15$ to 50 s)
- Computes the ratios **STA(t)/LTA(t)** for the 3 comp.
- Compares it with given thresholds : **Csmin** (typically 0.1 to 0.5) and **Csmax** (typically 1.5 to 2)
- Keep windows for which **Csmin < STA(t)/LTA(t) < Csmax** is fulfilled simultaneously on the three component for a minimum time **tlong** (typically, $tlong = 15$ to 40 s)



Computation of H/V : STA/LTA anti-triggering algorithm

STA-LTA
window
length

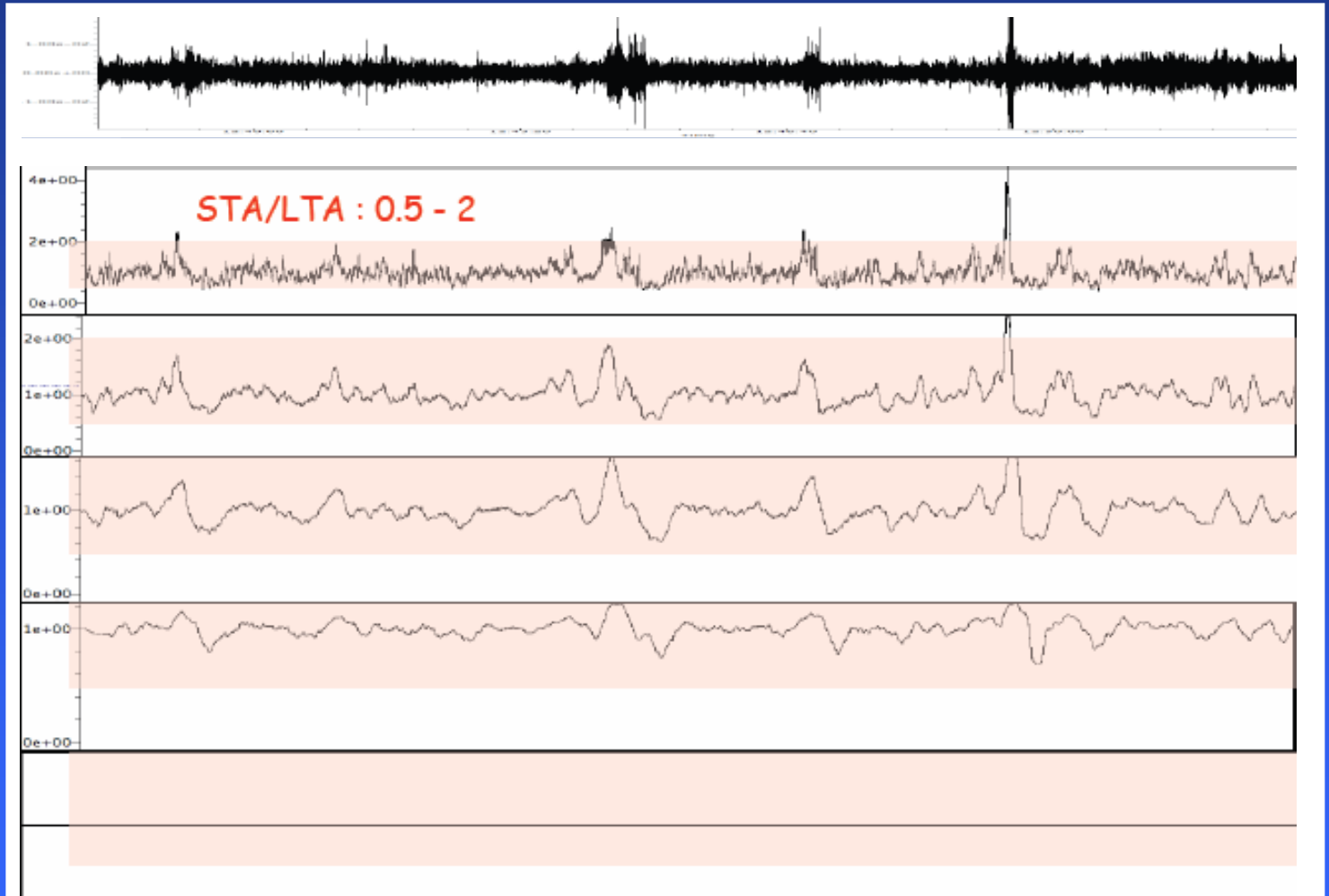
1-30

5-30

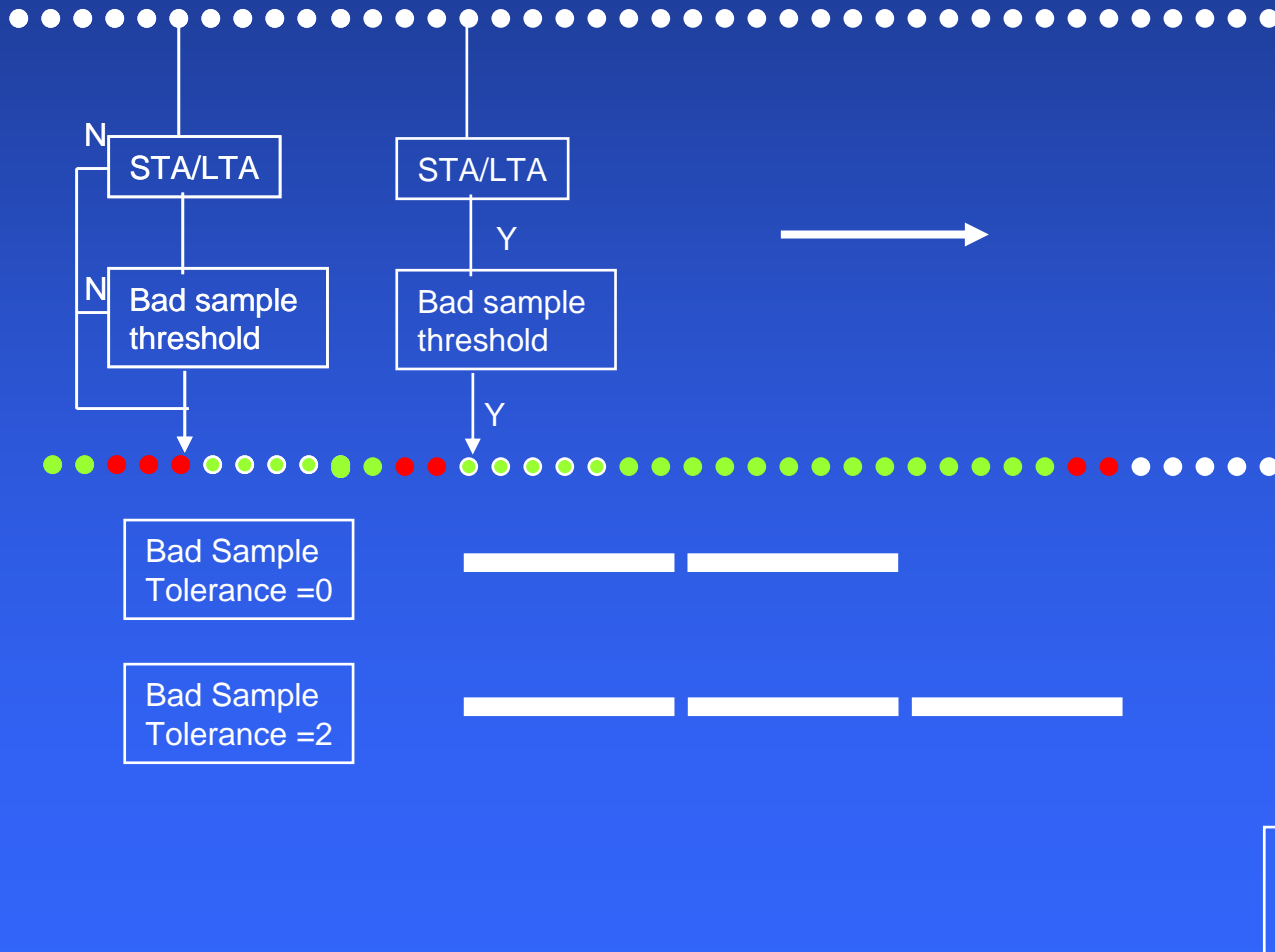
10-30

20-30

30-30



Computation of H/V : handling bad samples (as implemented in Geopsy)



HV toolbox: smoothing spectra

Smoothing with the "Konno-Ohmachi" function

$$\frac{\sin\left(\left(\log_{10}\left(\frac{f}{f_c}\right)\right)^b\right)}{\left(\left(\log_{10}\left(\frac{f}{f_c}\right)\right)^b\right)^4}$$

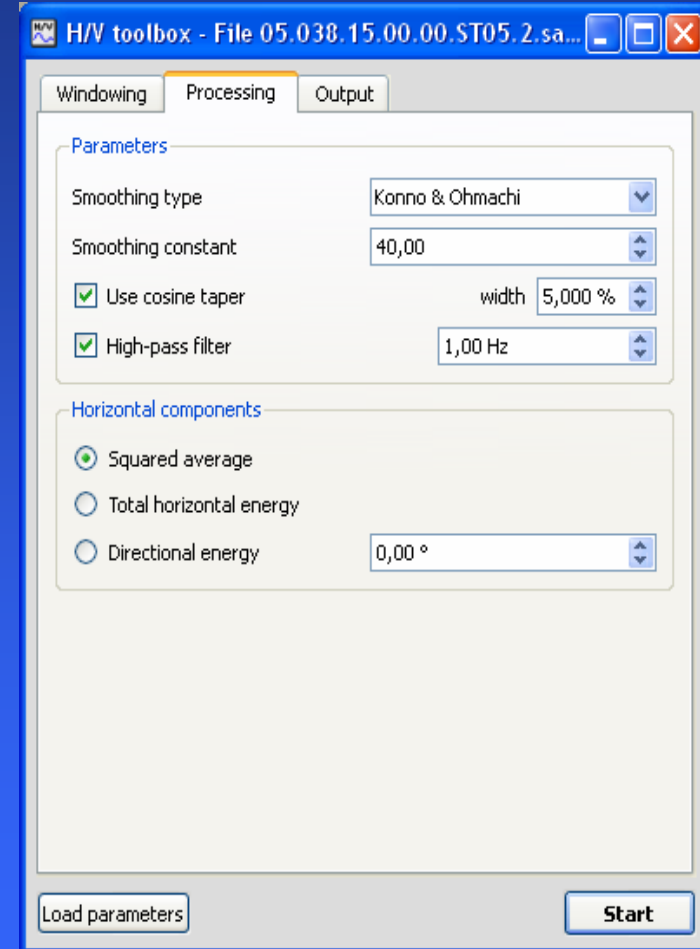
f is the frequency,
 fc is the central frequency,
 b is the bandwidth coefficient.

Constant

The smoothing function has a triangular shape centered on the current frequency and its width is equal to "Band width"

Proportional

The smoothing function has a triangular shape and its width depends upon the current frequency. The half width is defined by percentage*Frequency. The value of "percentage" cannot be greater or equal to 100%.



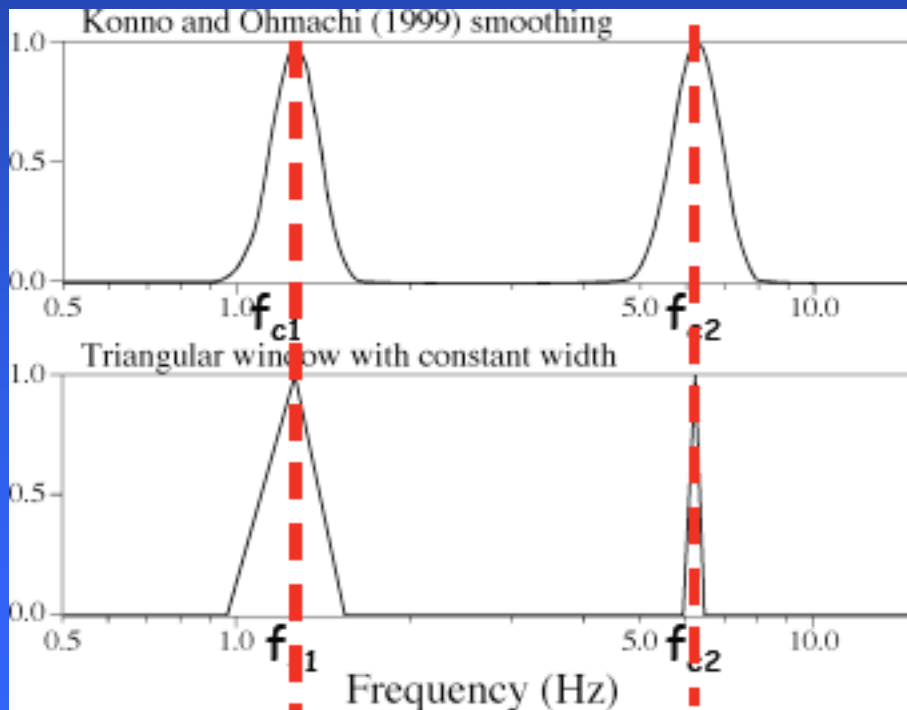
Computation of H/V :

Konno and Ohmachi (1999) smoothing

- constant bandwidth in a logarithmic scale
- recommended as it accounts for the different number of points at low and high frequencies

Konno and Ohmachi

Triangular window with a constant width



Computation of H/V (as implemented in Geopsy)

Squared average

- Fourier amplitude spectra
- combination of horizontal spectra

$$H(f) = \sqrt{\frac{N^2(f) + E^2(f)}{2}}$$

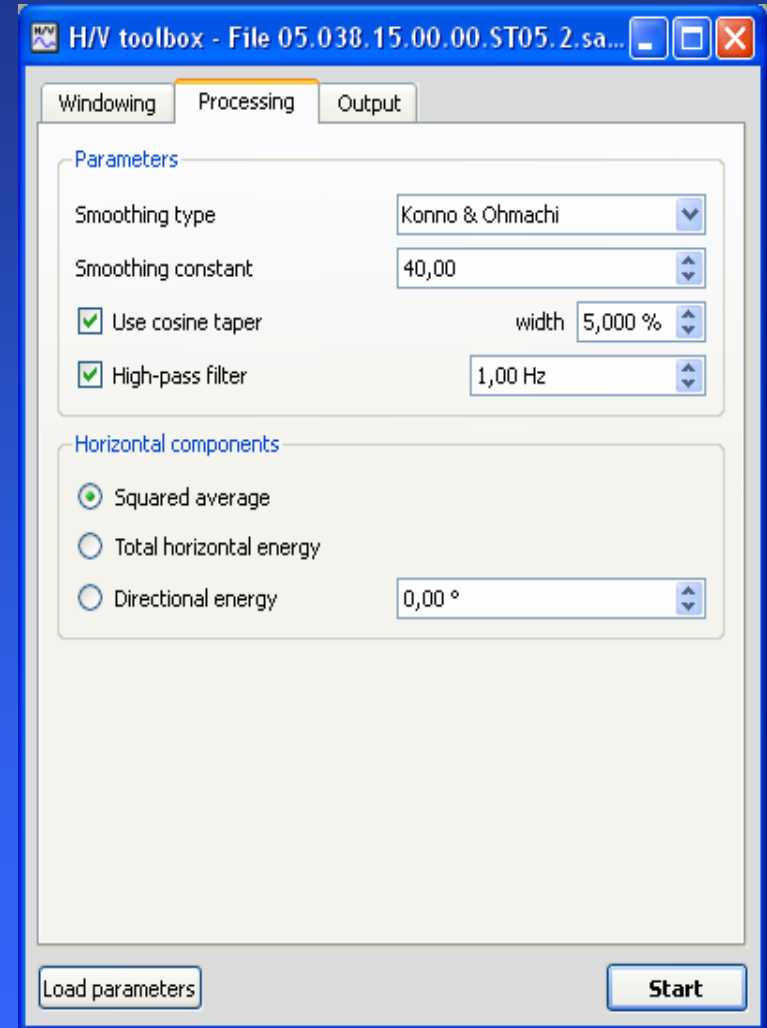
- smooth of H and V
- computation of H/V

Based on total horizontal energy

- Fourier amplitude spectra
- combination of horizontal spectra

$$H(f) = \sqrt{N^2(f) + E^2(f)}$$

- smooth of H and V
- computation of H/V



Computation of H/V (as implemented in Geopsy)

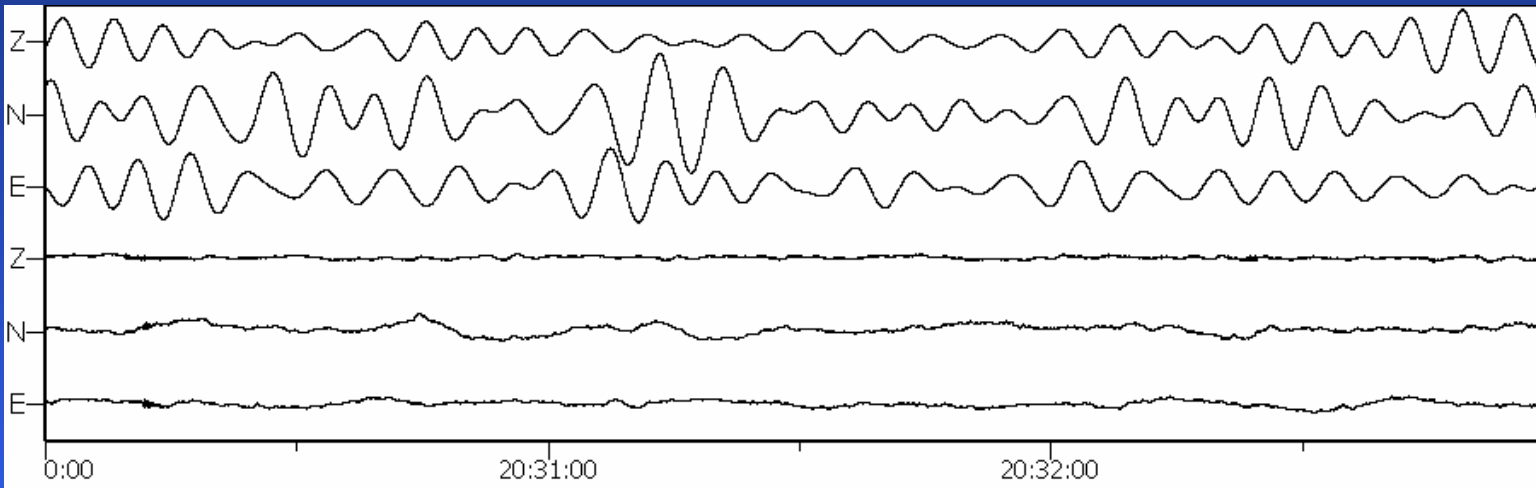
Sometimes, the taper size used in the pre-processing has a strong influence at low frequency. If the signal contains a strong and very low frequency component, then cutting into short time windows may strongly distort the observed spectra and H/V. Even when using the minimum window length criteria according SESAME reports (i.e. 10 times the corresponding period for the minimum frequency of interest) may be not enough to ensure a reliable H/V estimation.

In order to avoid such “tapering effects”, signals are high-pass filtered before computing the H/V and spectra curves.

The corner frequency of the high-pass filter is half the minimum ‘reliable’ frequency, i.e. $5/\text{window_length}$.

Tapering effects

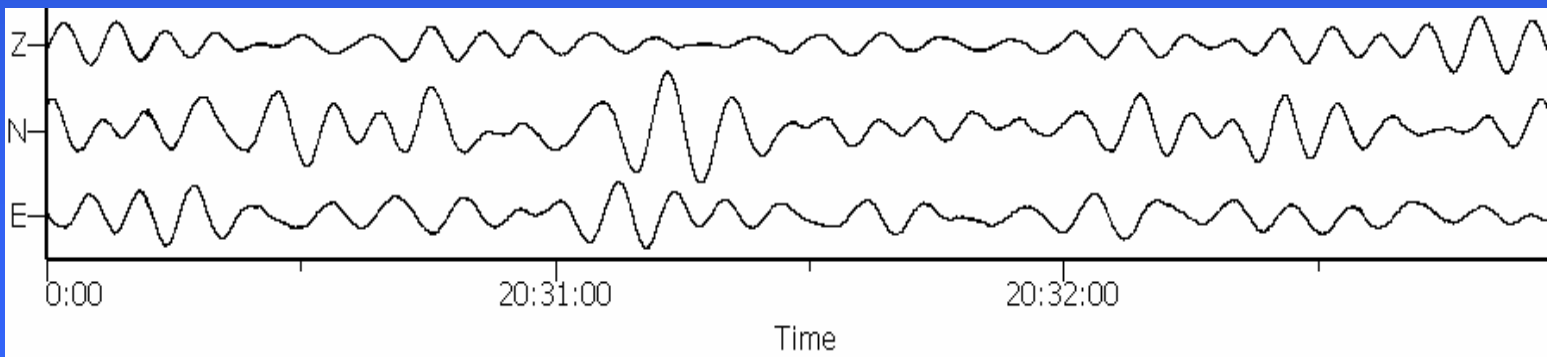
- signal at a site having a resonance frequency around 1 Hz
- add of a low frequency component within [0.1 0.2 Hz]



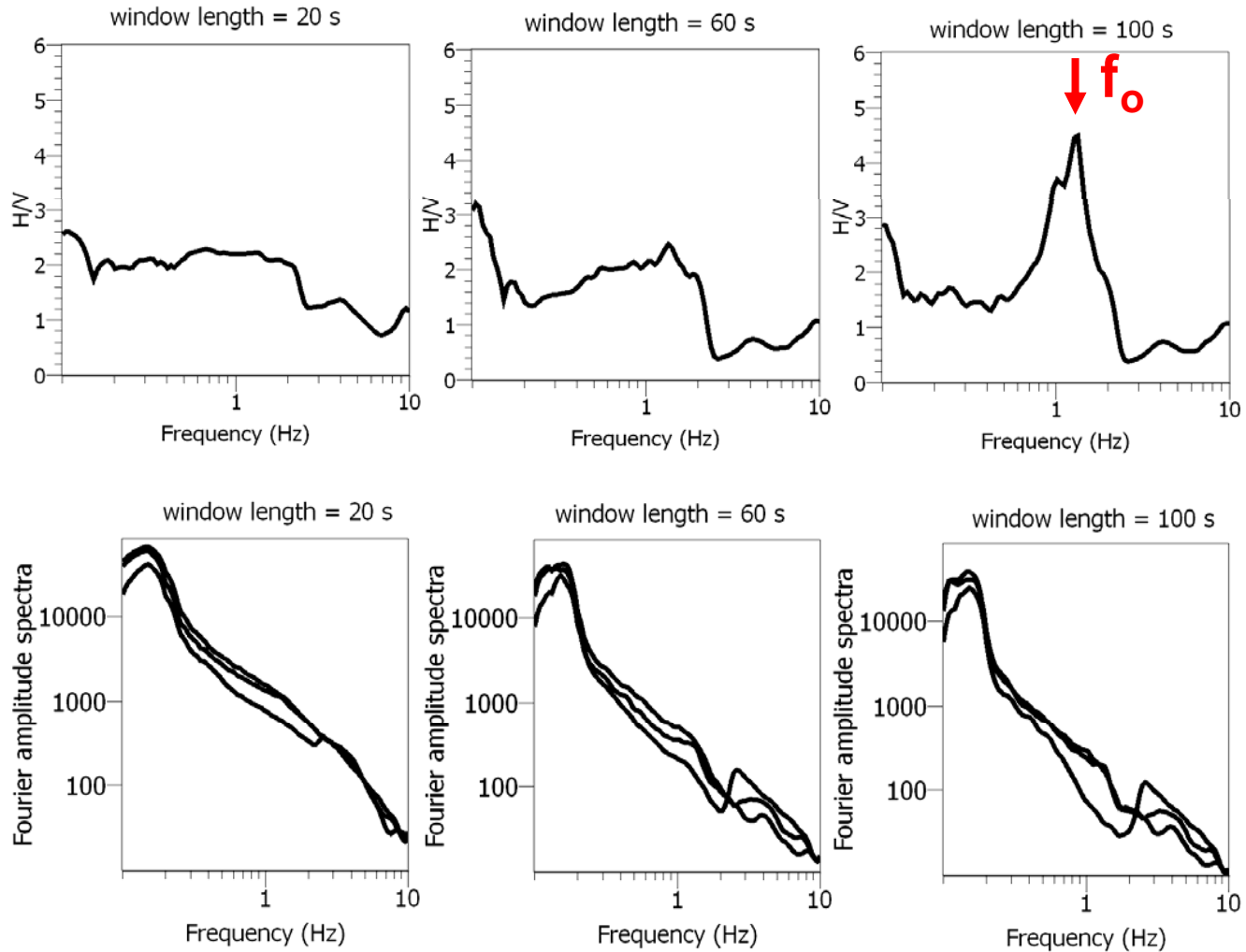
Low freq.
component

+

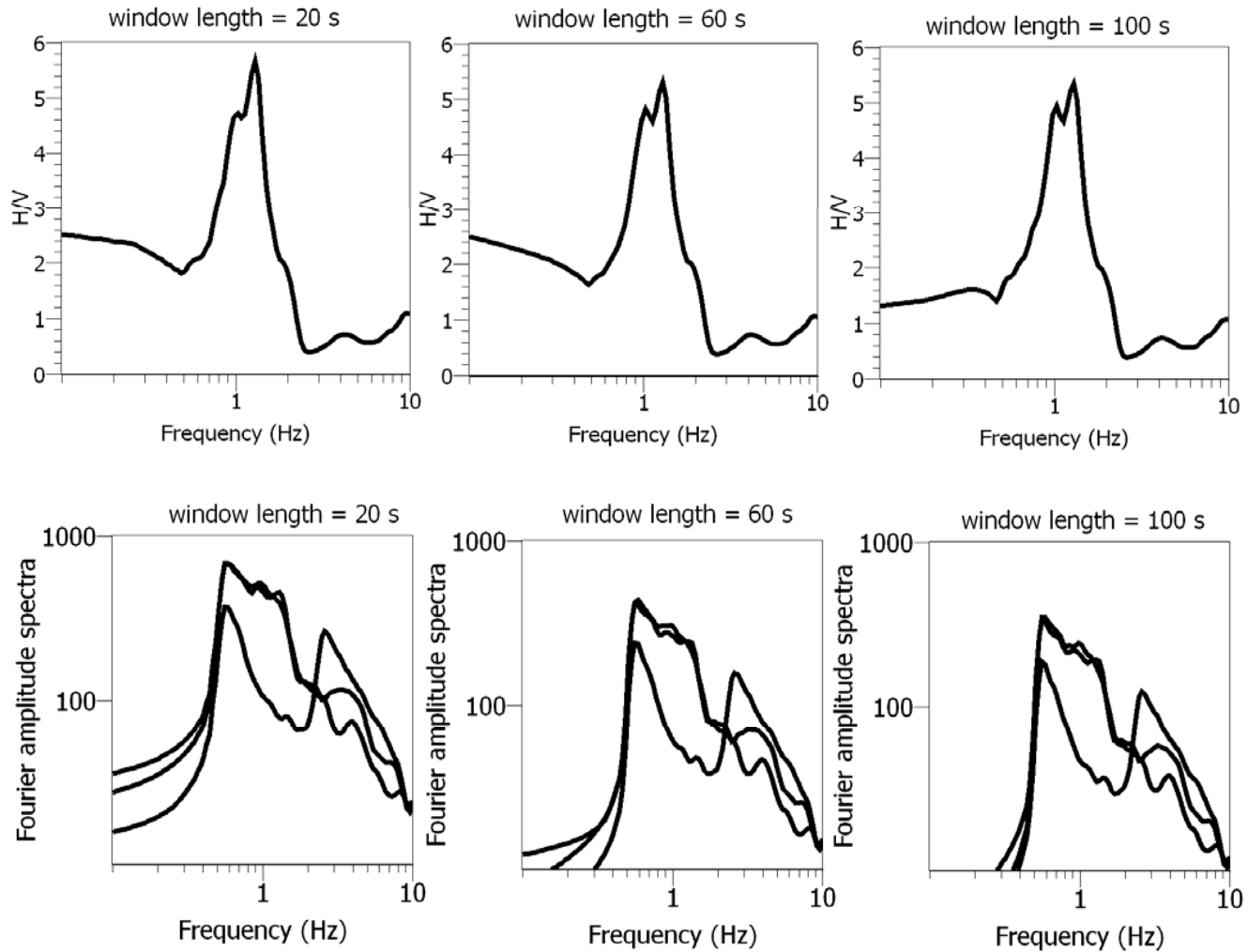
broad band
signal



no high pass filter



high-pass filter at 0.5 Hz



Use the following parameters

H/V toolbox - File 05.038.15.00.00...

Windowing Processing Output

Parameters

General Raw signal Filter Filtered signal

Length Exactly 50,00 s.

Overlap by 5,00 %

Bad sample tolerance 0,00 s.

Bad sample threshold 99 %

Anti-triggering on raw signal

Anti-triggering on filtered signal

Actions

Auto Add Inverse Load

Update Remove Clear

Number of windows for all stations

Load parameters Start

H/V toolbox - File 05.038.15.00.00...

Windowing Processing Output

Parameters

General Raw signal Filter Filtered signal

STA 1,00 s.

LTA 60,00 s.

Min STA/LTA 0,50

Max STA/LTA 2,00

Apply to

- Vertical
- North
- East
-
- ST05

Anti-triggering on raw signal

Actions

Auto Add Inverse Load

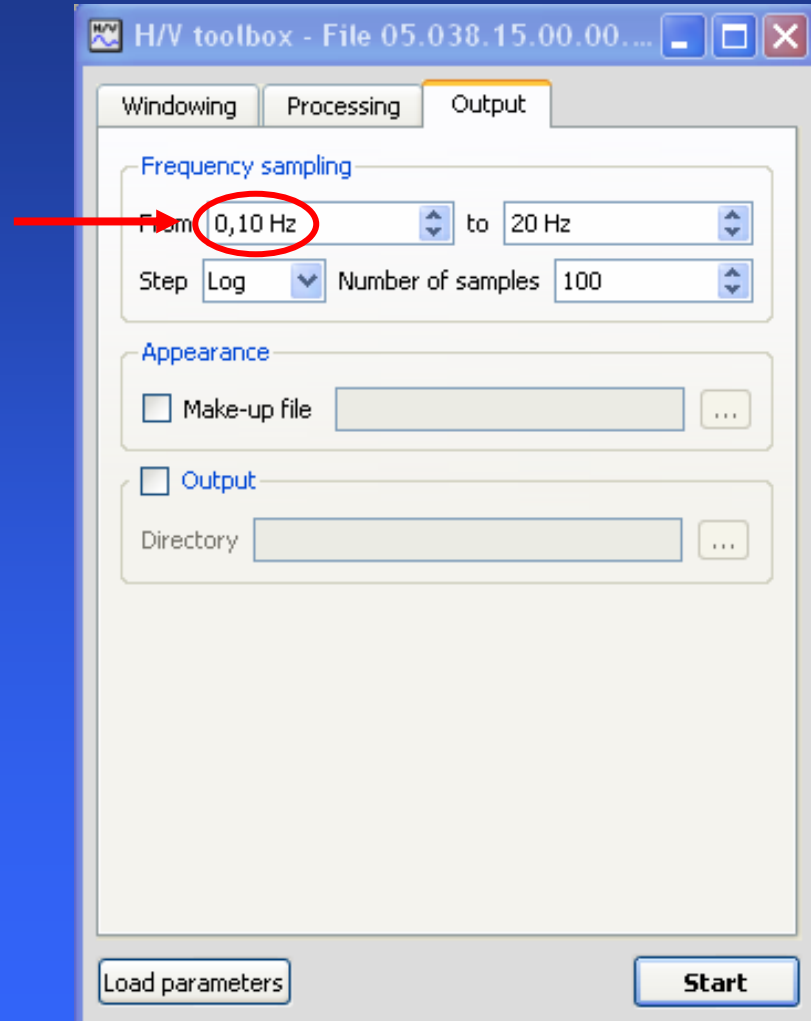
Update Remove Clear

Number of windows for all stations

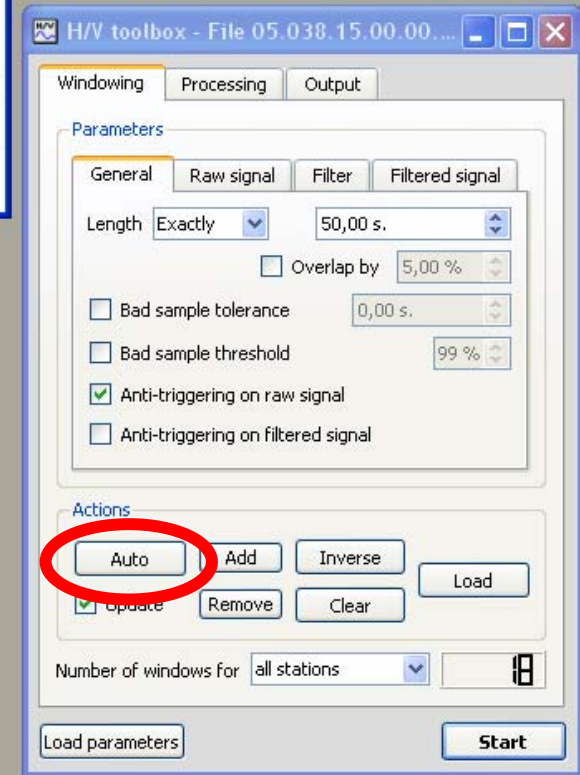
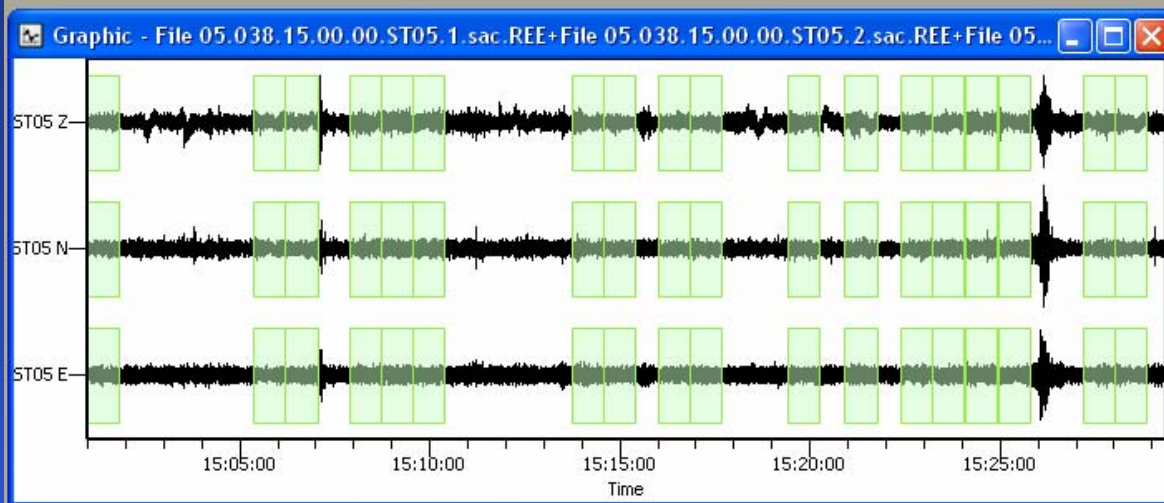
Load parameters Start

Use the following parameters

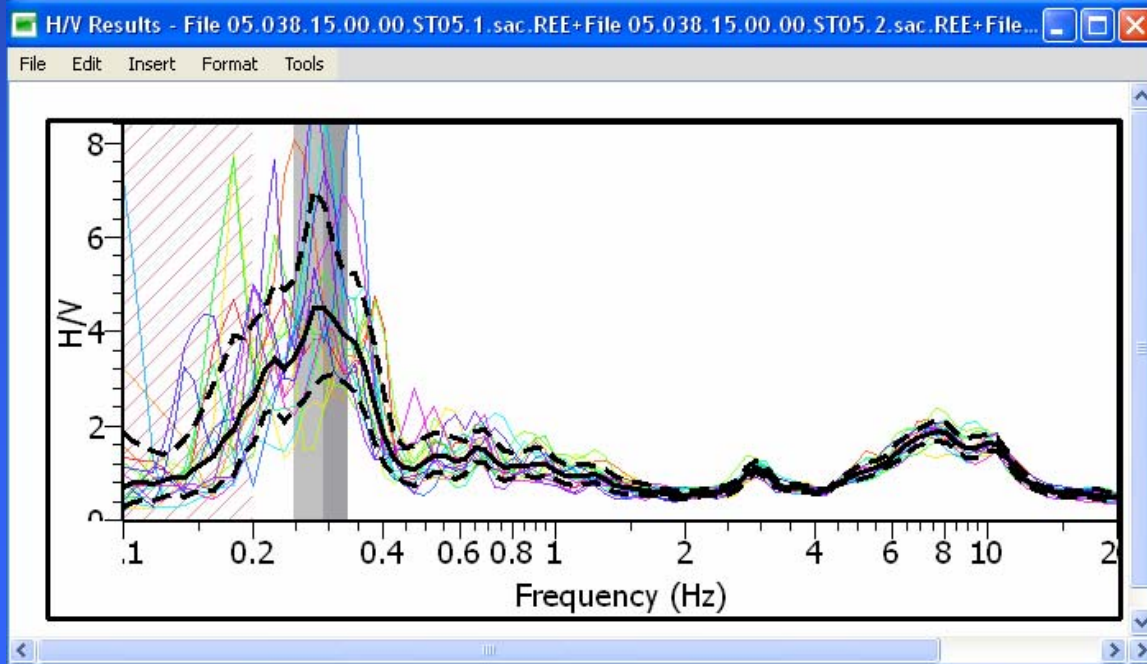
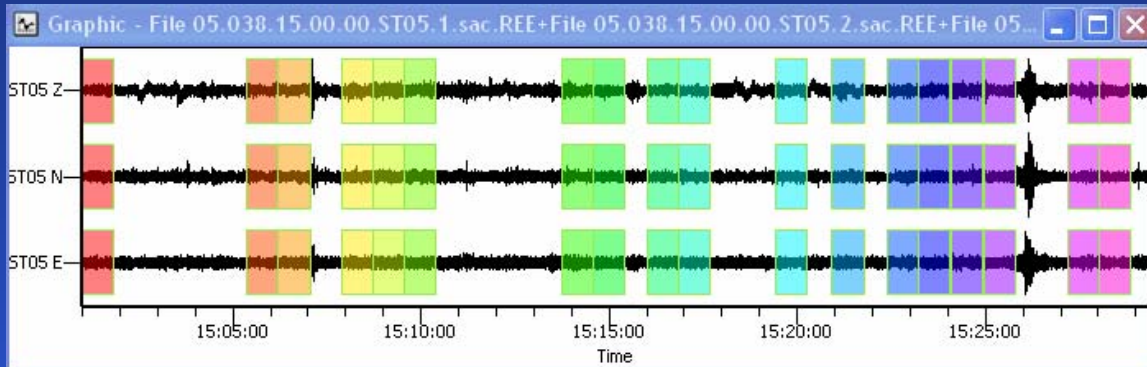
Recommendation: cut-off
frequency of the sensor



Selection of most stationary time windows



- “auto”** : automatic selection of windows
- “add”** : manual add of windows
- “remove”** : manual delete of windows
- “inverse”** : inverse selection



H/V toolbox - File 05.038.15.00.00...

Windowing Processing Output

Parameters

General Raw signal Filter Filtered signal

Length Exactly 50,00 s.

Overlap by 5,00 %

Bad sample tolerance 0,00 s.

Bad sample threshold 99 %

Anti-triggering on raw signal

Anti-triggering on filtered signal

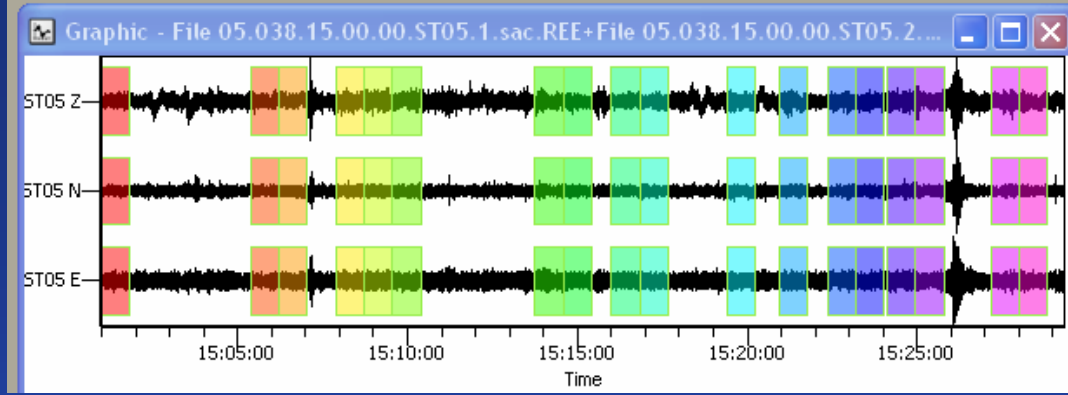
Actions

Auto Add Inverse Load

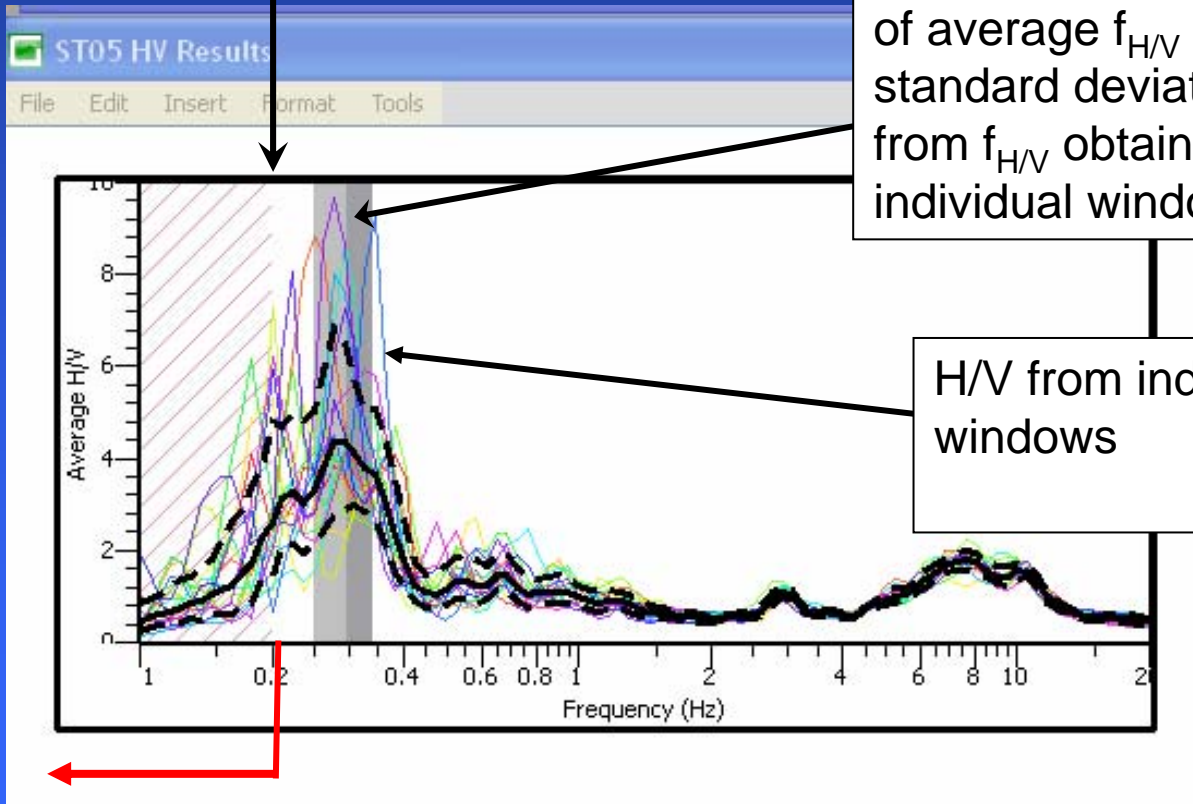
Update Remove Clear

Number of windows for all stations

Load parameters Start



$10/\text{window_length}$
 (here $10/50\text{s}$)

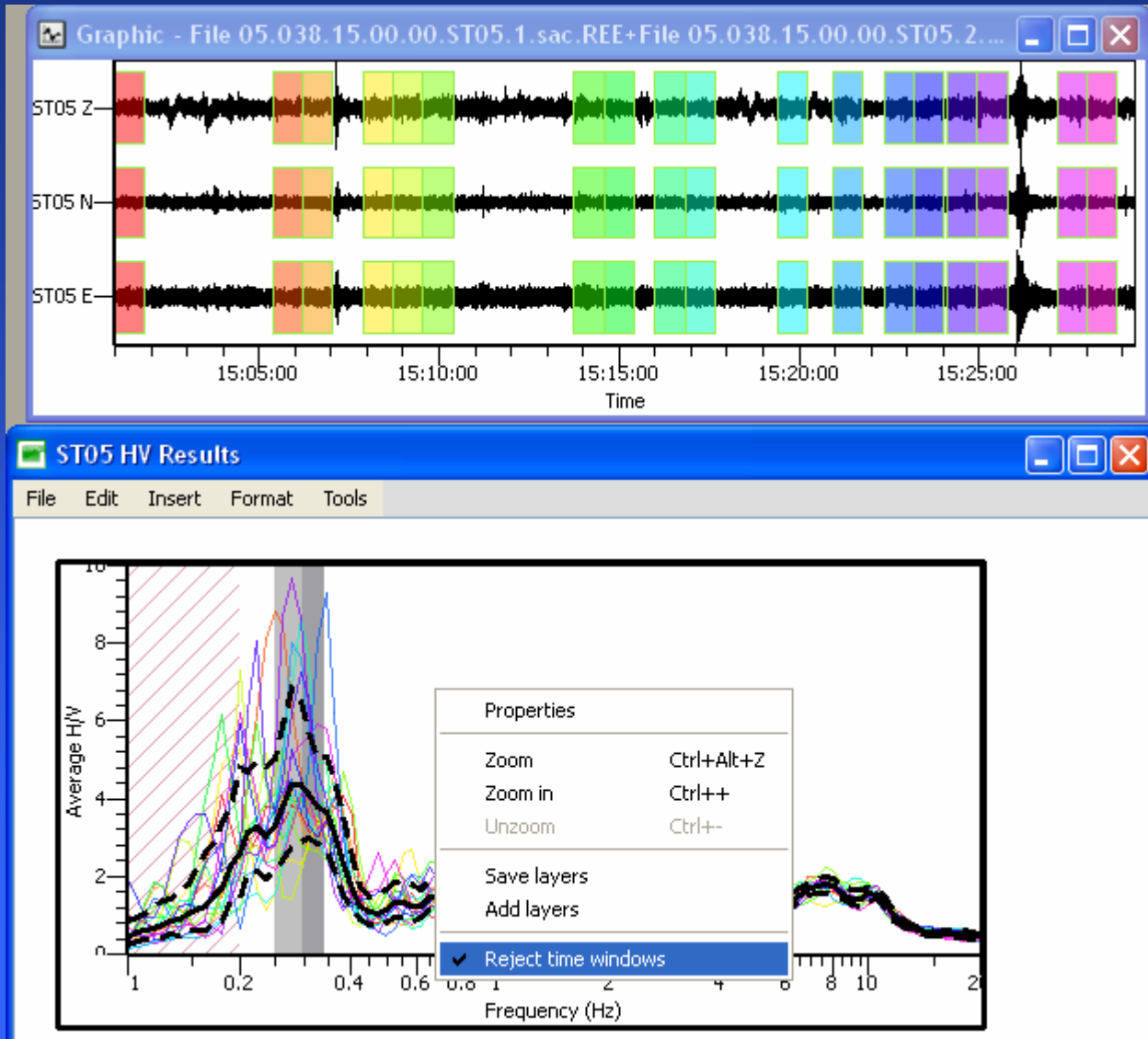


Automatic estimation
 of average $f_{H/V}$ and
 standard deviation
 from $f_{H/V}$ obtained for
 individual windows

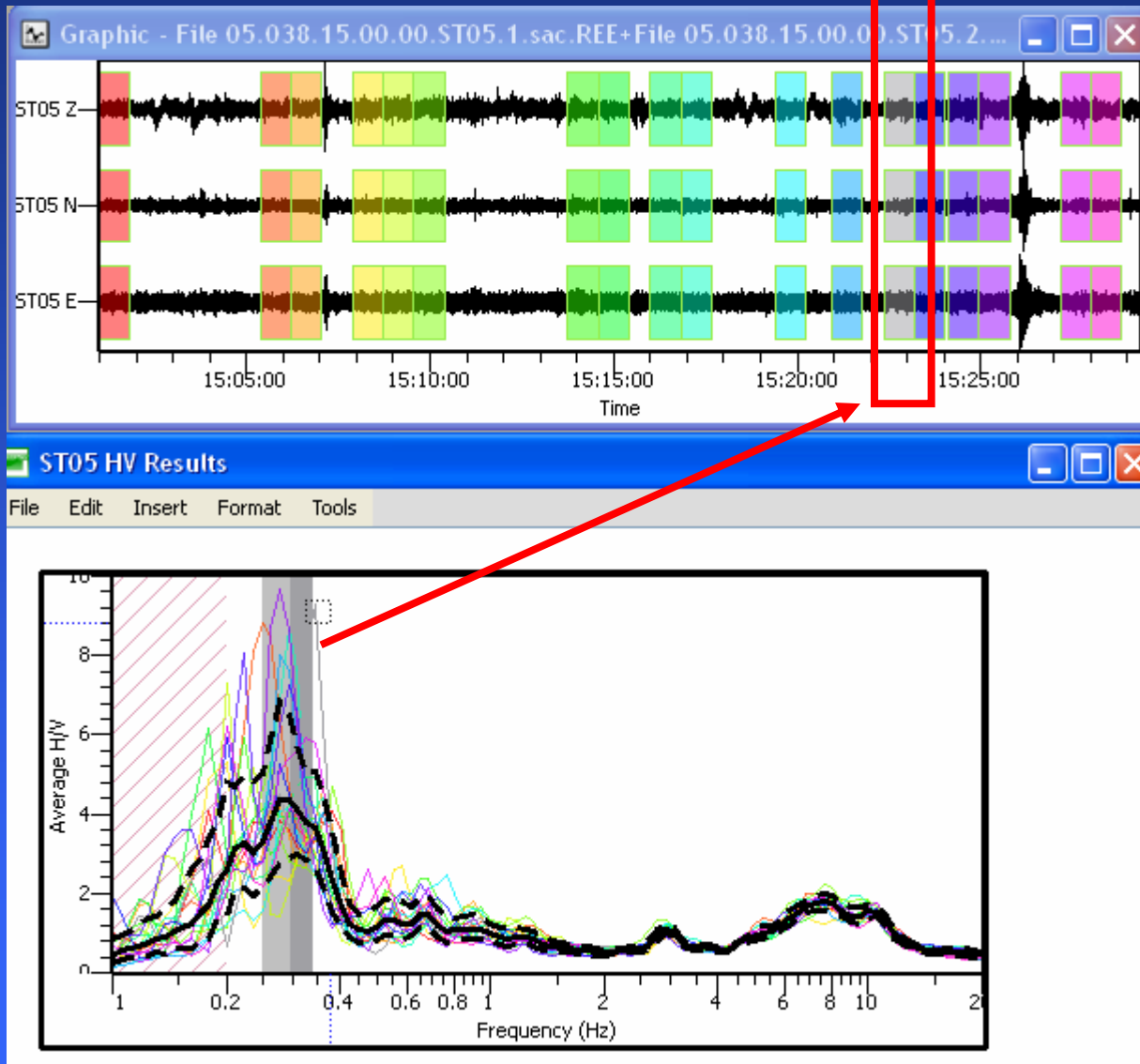
H/V from individual
 windows

Unreliable results

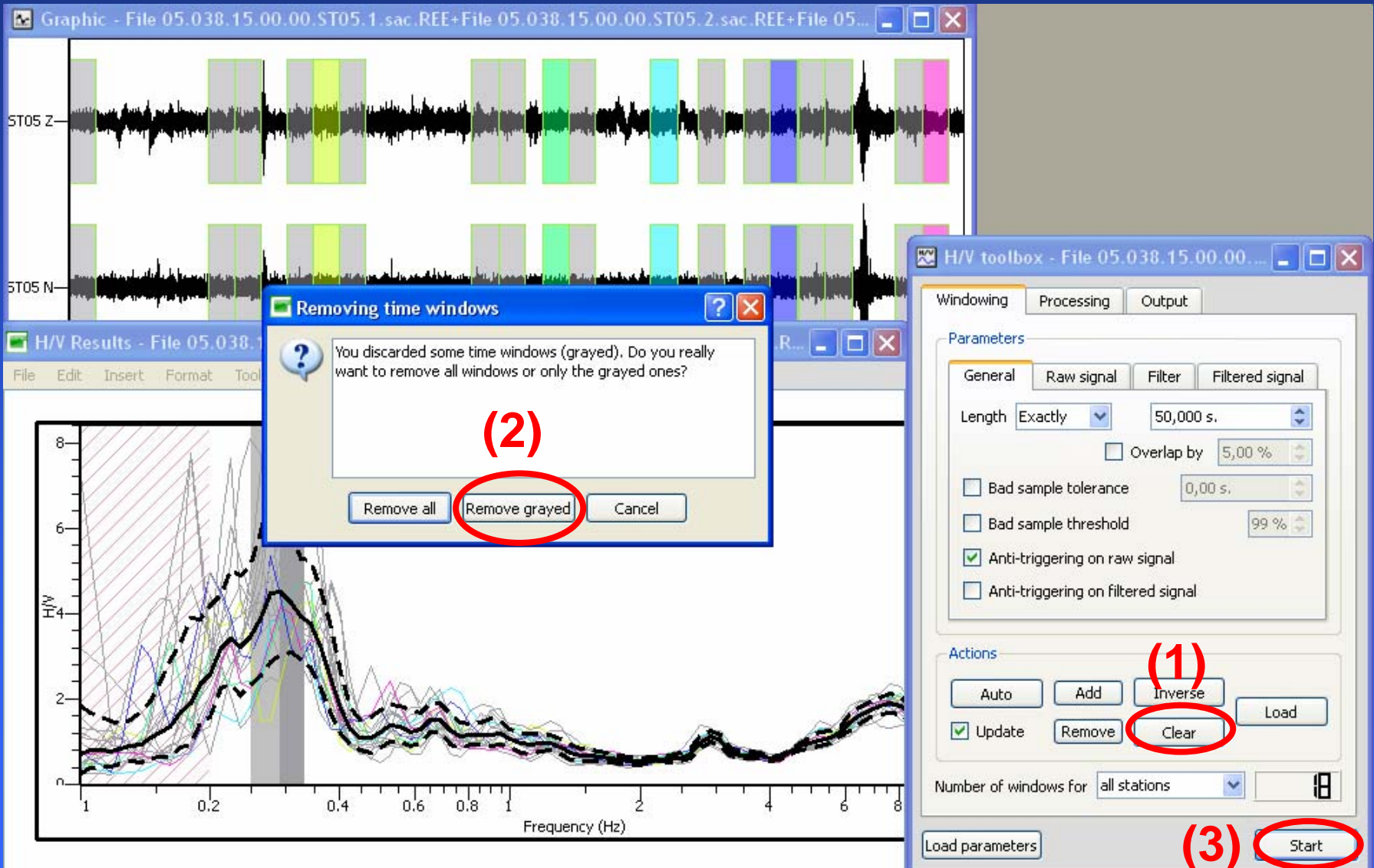
How to select/reject time windows ?



How to select/reject time windows ?



How to select/reject time windows ?

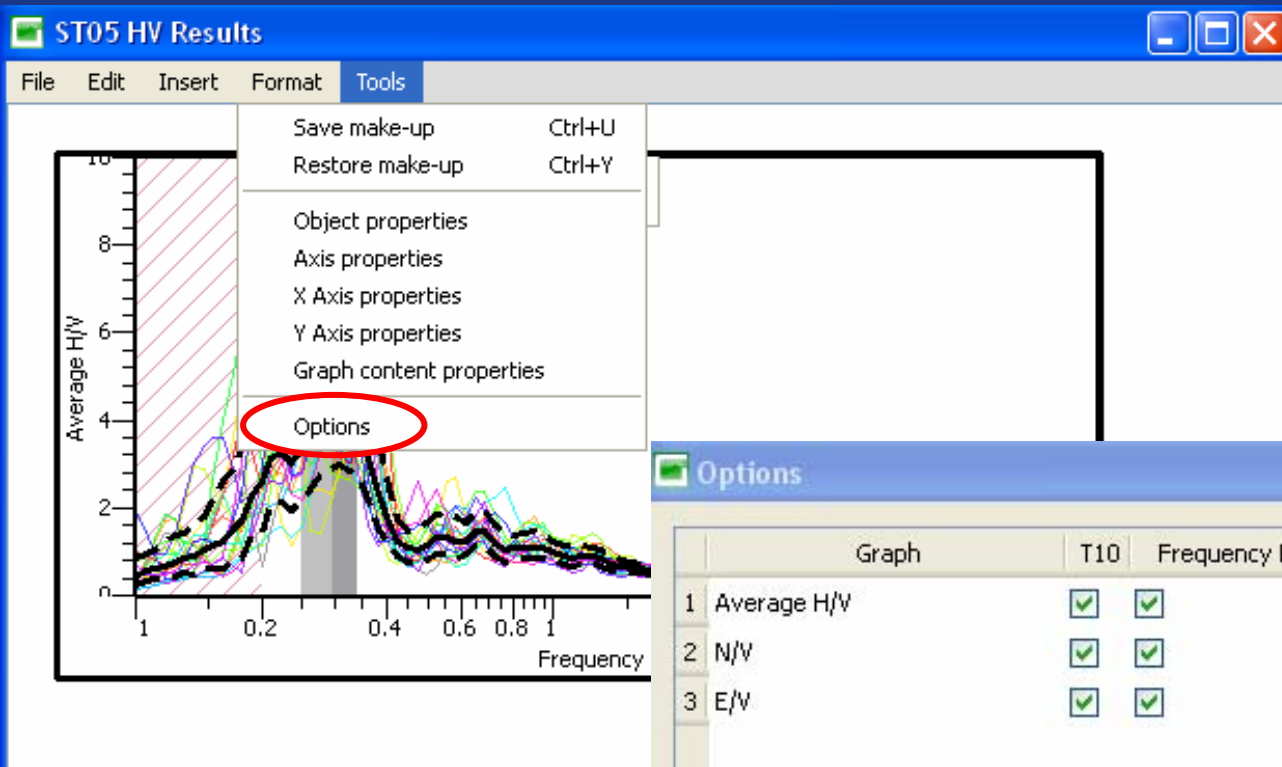
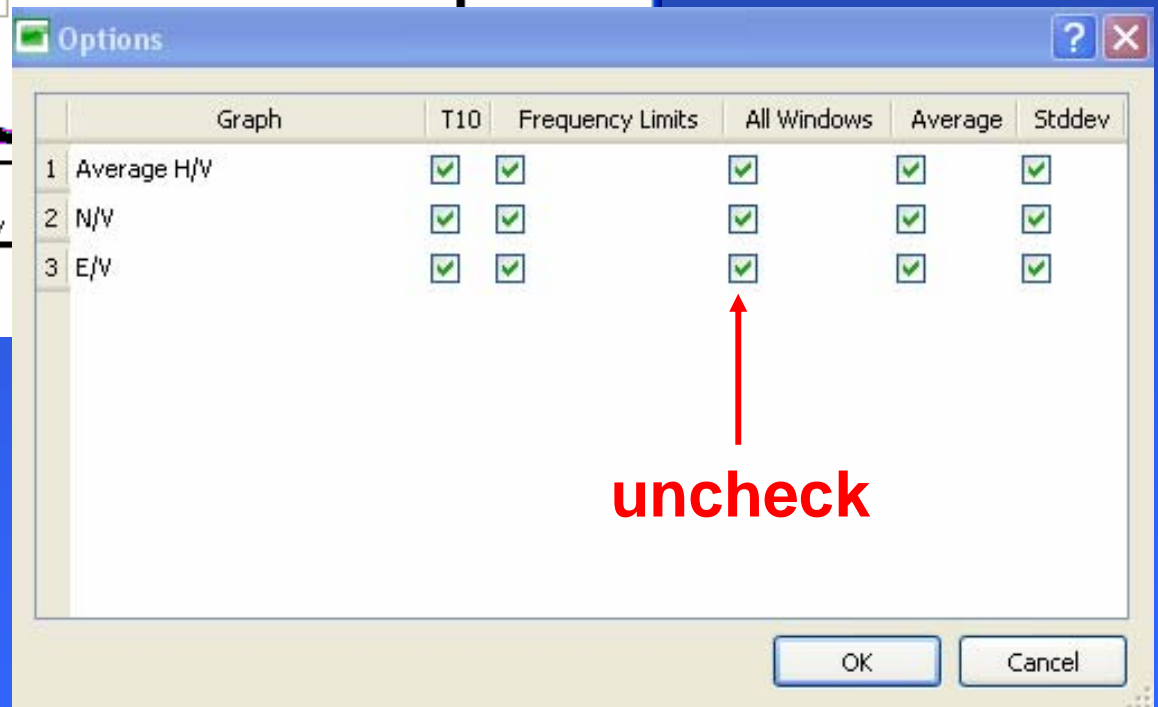


The screenshot displays a seismic data processing interface. At the top, a window titled "Graphic - File 05.038.15.00.00.ST05.1.sac.REE+File 05.038.15.00.00.ST05.2.sac.REE+File 05..." shows two time-series plots for stations ST05 Z and ST05 N. The plots are overlaid with various colored vertical bars representing time windows. A dialog box titled "Removing time windows" is open, asking: "You discarded some time windows (grayed). Do you really want to remove all windows or only the grayed ones?". The "Remove grayed" button is circled in red and labeled with a red "(2)".

Below the time-series plots, a window titled "H/V Results - File 05.038..." shows a plot of H/V ratio versus Frequency (Hz). The plot shows multiple colored lines representing different time windows. A gray shaded region is visible on the plot, corresponding to the grayed-out time windows.

On the right side, a window titled "H/V toolbox - File 05.038.15.00.00..." is open. It has tabs for "Windowing", "Processing", and "Output". The "Windowing" tab is active. Under "Parameters", there are options for "General", "Raw signal", "Filter", and "Filtered signal". The "Length" is set to "Exactly" and "50,000 s.". There are checkboxes for "Bad sample tolerance", "Bad sample threshold", "Anti-triggering on raw signal", and "Anti-triggering on filtered signal". Under "Actions", there are buttons for "Auto", "Add", "Inverse", "Load", "Update", "Remove", "Clear", and "Start". The "Clear" button is circled in red and labeled with a red "(1)". The "Start" button is circled in red and labeled with a red "(3)".

How to display only average estimates ?

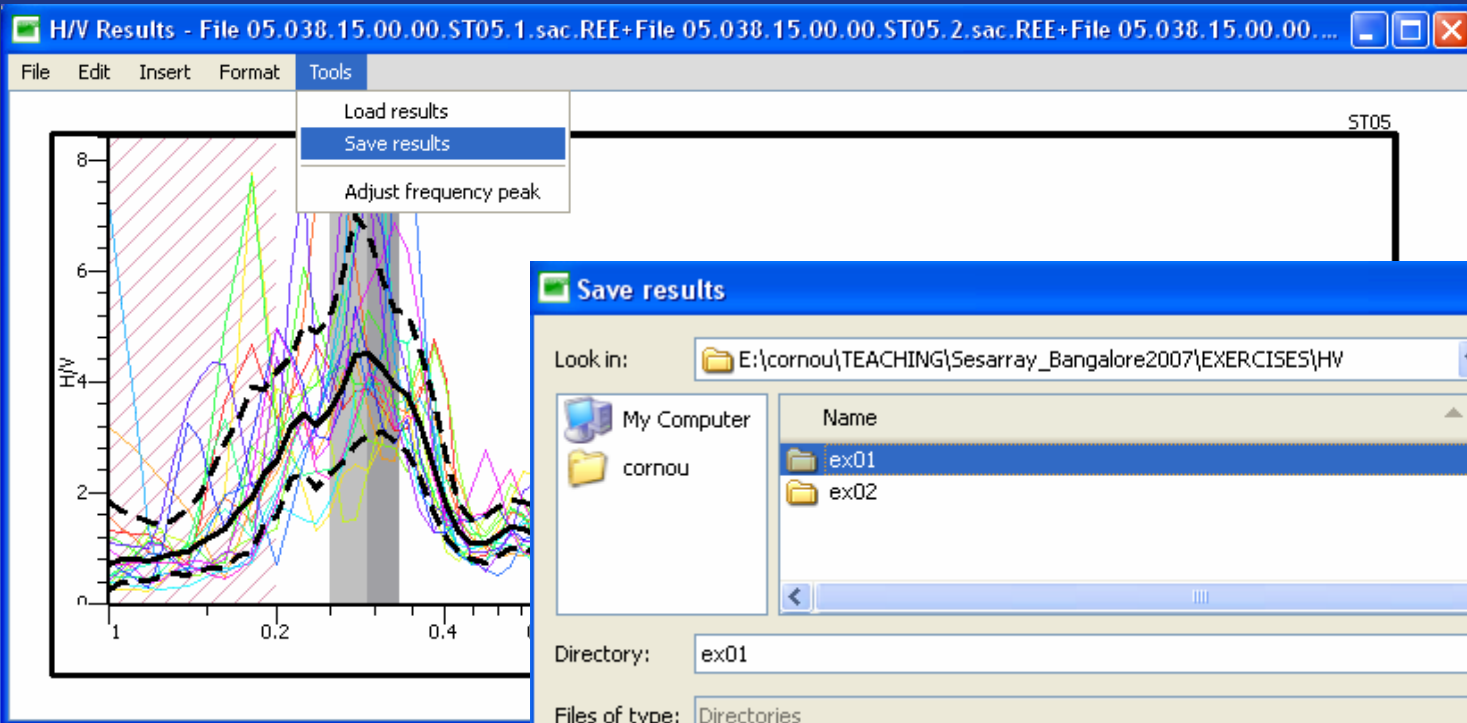
Options

	Graph	T10	Frequency Limits	All Windows	Average	Stddev
1	Average H/V	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
2	N/V	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
3	E/V	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>

uncheck

OK Cancel

How to export the H/V results ?

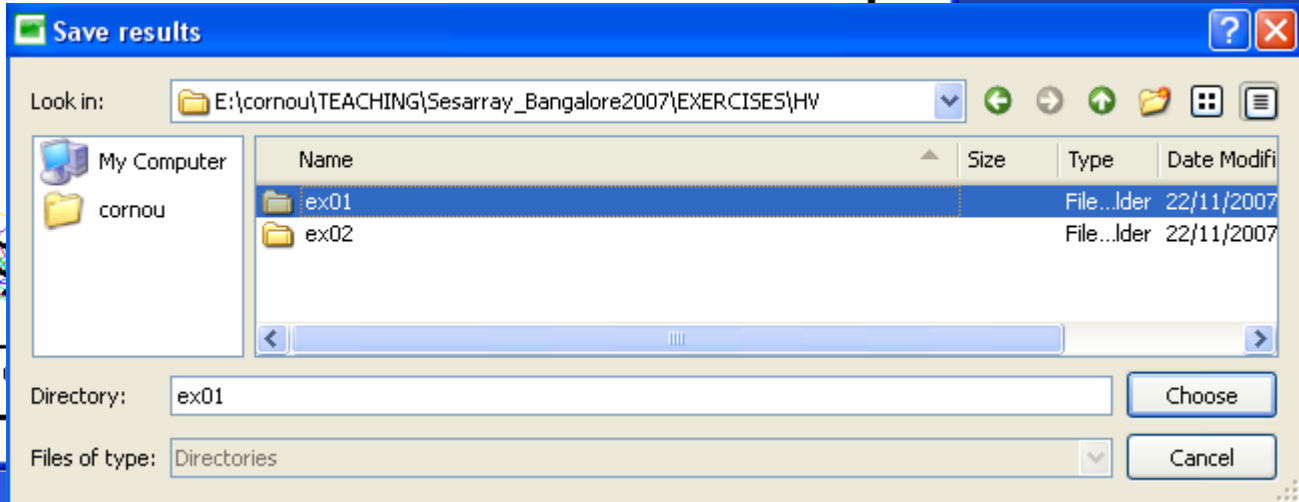


H/V Results - File 05.038.15.00.00.ST05.1.sac.REE+File 05.038.15.00.00.ST05.2.sac.REE+File 05.038.15.00.00...

File Edit Insert Format **Tools**

- Load results
- Save results**
- Adjust frequency peak

The graph displays H/V results for station ST05. The y-axis is labeled 'H/V' and ranges from 0 to 8. The x-axis shows frequency values from 1 to 0.4. Multiple colored lines represent different data series, and a thick black dashed line indicates a specific result. A shaded vertical region is visible around a frequency of approximately 0.3.



Save results

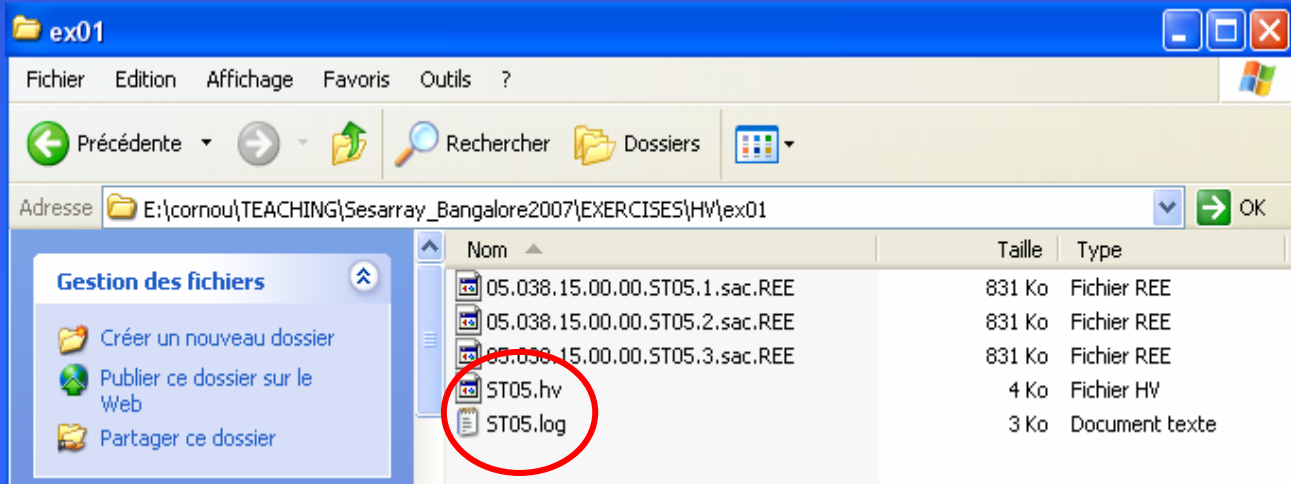
Look in: E:\cornou\TEACHING\Sesarray_Bangalore2007\EXERCISES\HV

Name	Size	Type	Date Modifi
ex01		File...lder	22/11/2007
ex02		File...lder	22/11/2007

Directory: ex01

Files of type: Directories

Buttons: Choose, Cancel



ex01

Fichier Edition Affichage Favoris Outils ?

Adresse: E:\cornou\TEACHING\Sesarray_Bangalore2007\EXERCISES\HV\ex01

Nom	Taille	Type
05.038.15.00.00.ST05.1.sac.REE	831 Ko	Fichier REE
05.038.15.00.00.ST05.2.sac.REE	831 Ko	Fichier REE
05.038.15.00.00.ST05.3.sac.REE	831 Ko	Fichier REE
ST05.hv	4 Ko	Fichier HV
ST05.log	3 Ko	Document texte

The files 'ST05.hv' and 'ST05.log' are circled in red in the original image.

H/V results + log file

“station_name”.hv

“station_name”.log

Format of file .hv

```

ST05.hv + (E:\cornou\TEACH...07\EXERCISES\HV\lex01) - GVIM
Fichier Edition Outils Syntaxe Tampons Fenêtre Aide
# GEOPSY output version 1.1
# Number of windows = 18
# f0 from average      0.291645
# Number of windows for f0 = 18
# f0 from windows      0.291073 0.248826 0.333321
# Frequency      Average Min      Max
0.1              0.709827      0.273353      1.84324
0.105498         0.798671      0.381085      1.67384
0.111298         0.817818      0.425664      1.57126
0.117416         0.773149      0.404181      1.47894
0.123871         0.82891       0.489569      1.40346
0.130681         0.911641      0.552656      1.50381
0.137866         0.922052      0.5023        1.69257
0.145445         1.09816       0.609894      1.97733
0.153441         1.23695       0.636734      2.40295
0.161877         1.36324       0.638612      2.9101
0.170776         1.70741       0.870868      3.3475
0.180165         1.9082        0.935987      3.89024
0.19007          2.36343       1.44406       3.86812
0.200519         2.58545       1.59374       4.19426
0.211543         3.17493       2.26585       4.44875
    
```

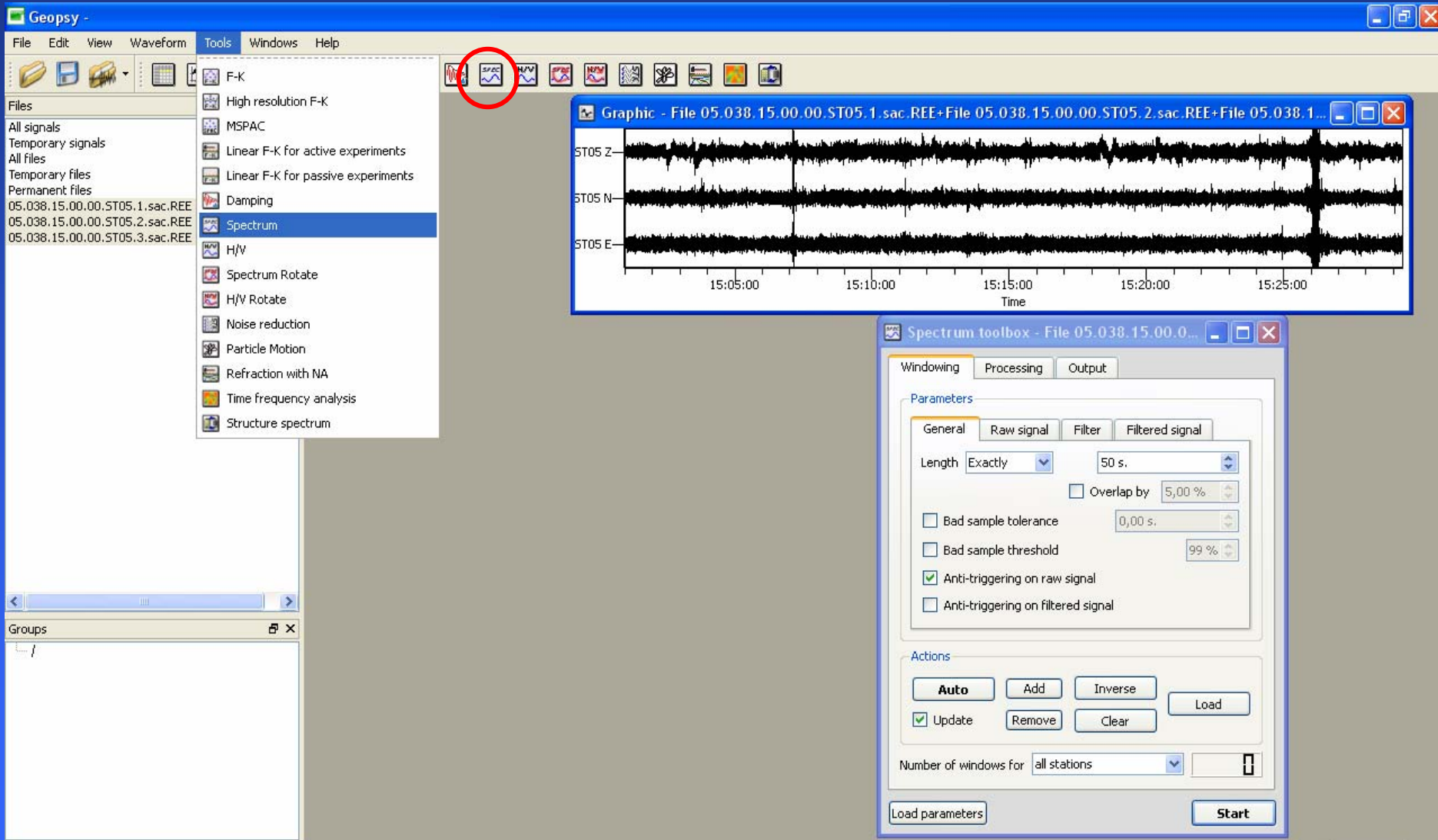
Min = Average / std
Max = Average * std

Format of file .log

```
### Parameters ###
SIGNAL FILE NAME = 05.038.15.00.00.ST05.1.sac.REE
WINDOW MIN LENGTH (s) = 50
WINDOW MAX LENGTH (s) = 50
WINDOW LENGTH TYPE (at least/exactly/freq. dep.) = exactly
DO BAD SAMPLE TOLERANCE (y/n) = n
BAD SAMPLE TOLERANCE (s) = 0
DO WINDOW OVERLAP (y/n) = n
WINDOW OVERLAP (%) = 5
DO BAD SAMPLE THRESHOLD (y/n) = n
BAD SAMPLE THRESHOLD (%) = 99
ANTI-TRIGGERING ON RAW SIGNAL (y/n) = y
USED RAW COMPONENTS = y, y, y, n, y
RAW STA (s) = 1
RAW LTA (s) = 60
RAW MIN SLTA = 0.5
RAW MAX SLTA = 2
ANTI-TRIGGERING ON FILTERED SIGNAL (y/n) = n
FILTER TYPE (low pass/high pass/band pass/band reject) = low pas
s
FILTER METHOD (butterworth/taper) = taper
FILTER MIN FREQUENCY (Hz) = 5
FILTER MAX FREQUENCY (Hz) = 10
FILTER CAUSAL (y/n) = n
FILTER ORDER = 1
FILTER WIDTH = 0.1
USED FILTERED COMPONENTS = y, y, y, n, y
```

1,1 Haut

Computation of spectra



The screenshot displays the Geopsy software interface. The 'Tools' menu is open, highlighting the 'Spectrum' option. A 'Spectrum toolbox' dialog box is also open, showing parameters for spectrum computation.

Tools Menu:

- F-K
- High resolution F-K
- MSPAC
- Linear F-K for active experiments
- Linear F-K for passive experiments
- Damping
- Spectrum**
- H/V
- Spectrum Rotate
- H/V Rotate
- Noise reduction
- Particle Motion
- Refraction with NA
- Time frequency analysis
- Structure spectrum

Spectrum toolbox - File 05.038.15.00.0...

Windowing | Processing | Output

Parameters

General | Raw signal | Filter | Filtered signal

Length: Exactly | 50 s.

Overlap by: 5,00 %

Bad sample tolerance: 0,00 s.

Bad sample threshold: 99 %

Anti-triggering on raw signal

Anti-triggering on filtered signal

Actions

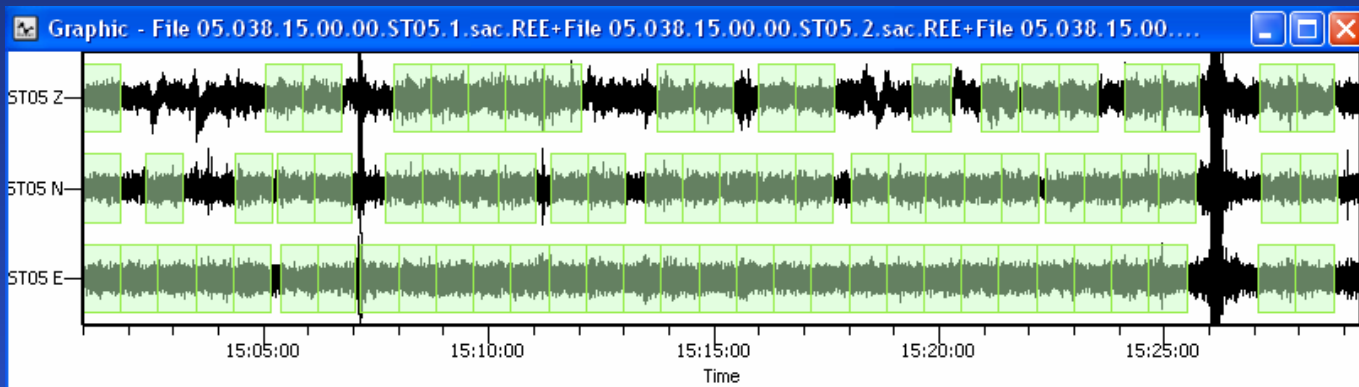
Auto | Add | Inverse | Load

Update | Remove | Clear

Number of windows for: all stations

Load parameters | Start

Computation of spectra



Stationary windows are computed separately for each component

Windowing Processing Output

Parameters

General Raw signal Filter Filtered signal

STA 1,00 s.

LTA 60,00 s.

Min STA/LTA 0,50

Max STA/LTA 2,00

Apply to

- Any component
- ST05 Z
- ST05 N
- ST05 E

Anti-triggering on raw signal

Actions

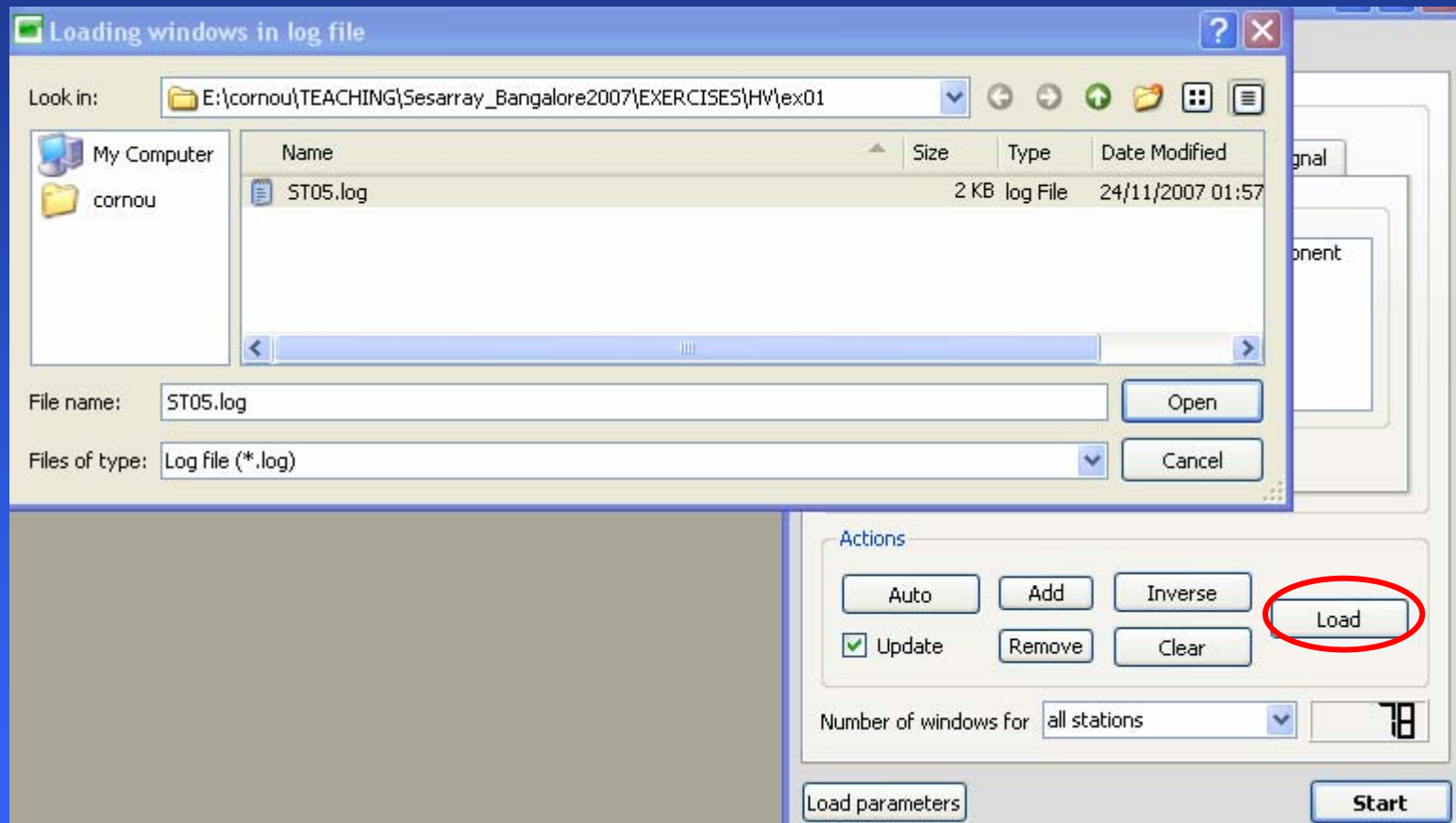
Auto Add Inverse Load

Update Remove Clear

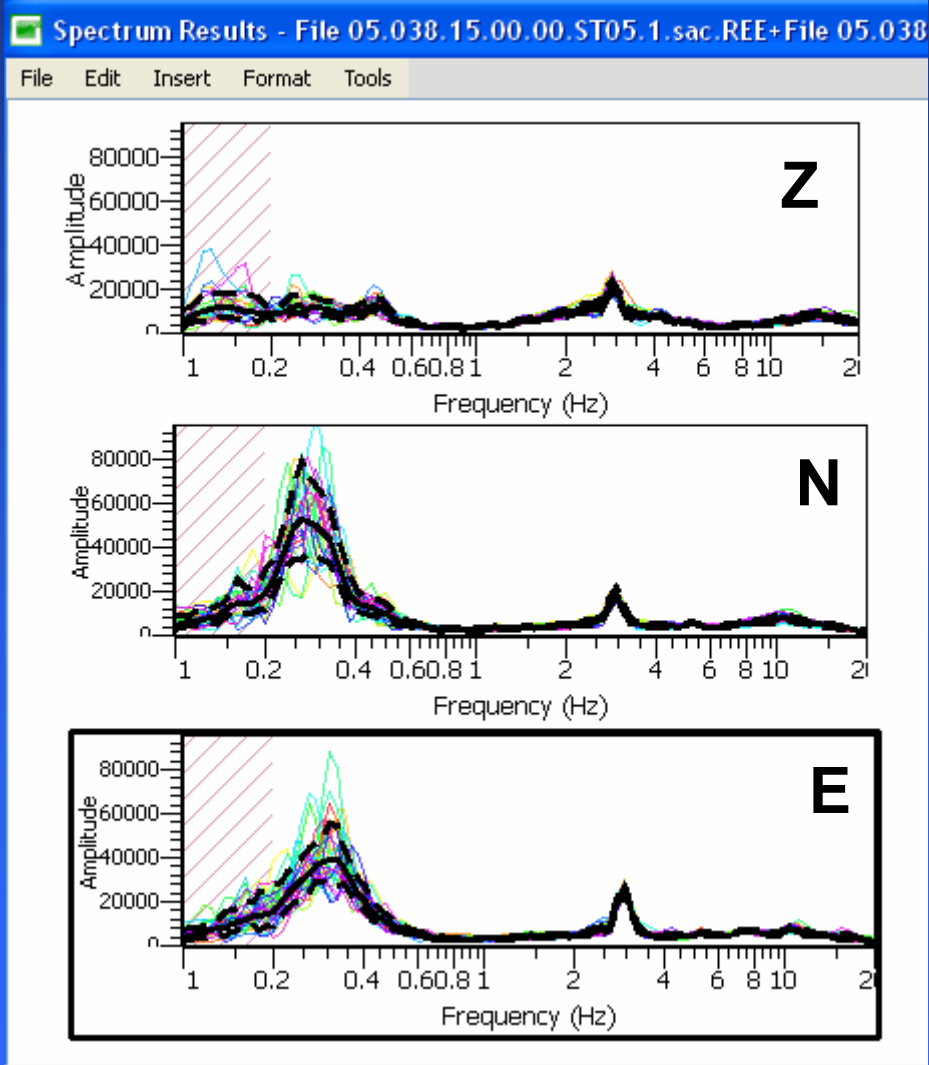
Number of windows for all stations 78

Load parameters Start

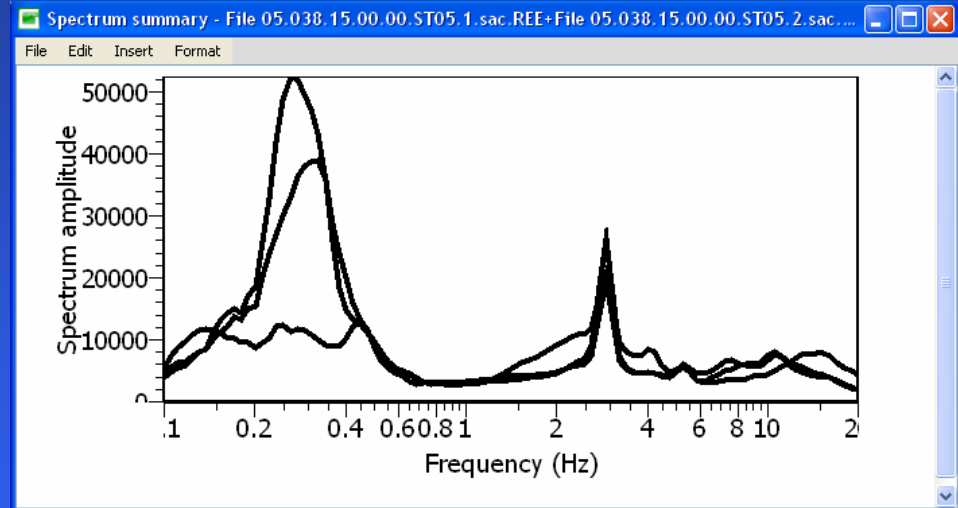
Selection of the same time windows as the ones used for H/V computation



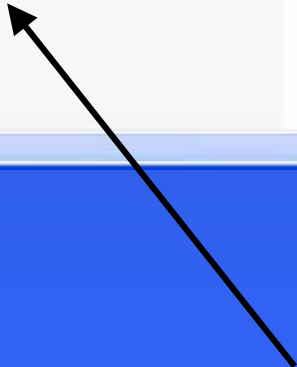
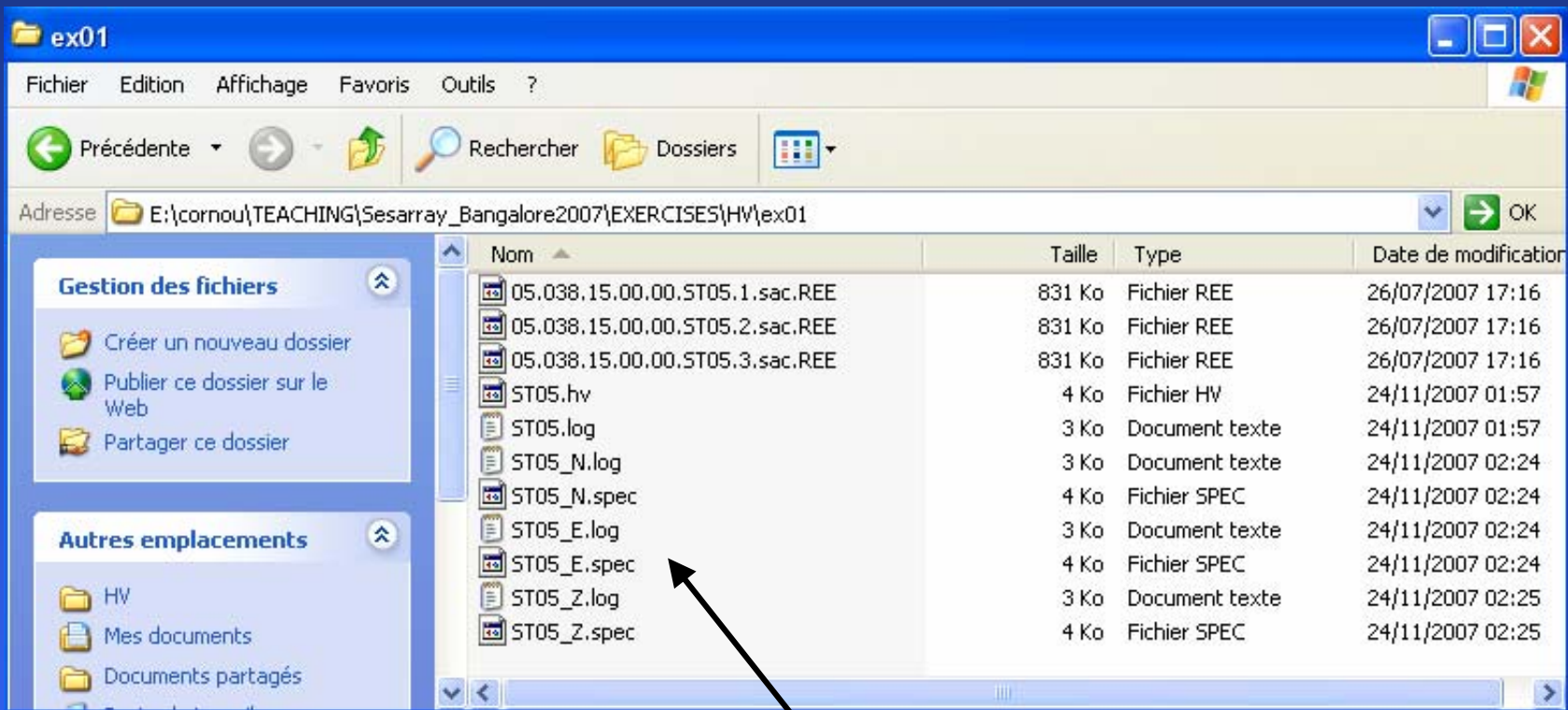
Amplitude spectra for the three components



Average amplitude spectra for the three components



Export of the amplitude spectra results



Spectra and log files

Format of the amplitude spectra results

ST05_Z.spec (E:\c...ESHV\ex01) - GVIM2

Fichier Edition Outils Syntaxe Tampons Fenêtre Aide

```

# GEOPSY output version 1.1
# Number of windows = 18
# f0 from average      2.91267

# Frequency      Average Min      Max
0.1      6061.63 3373.87 10890.5
0.105498    7761.29 5116.97 11772.1
0.111298    8873.55 5371.35 14659.2
0.117416    9706.73 5182.14 18181.8
0.123871   10717.7 6141.15 18704.7
0.130681   11329.2 7048.06 18210.8
0.137866   11159.7 6340.28 19642.5
0.145445   11657.4 7264.71 18706.2
0.153441   11652.2 7144.34 19004.4
0.161877   10794.6 5700.93 20439.5
0.170776   10424.1 6227.55 17448.5
0.180165    9196.9 5431.67 15572.2
0.19007 9179.12 6546.41 12870.6
0.200519    8358.52 5610.97 12451.5
0.211543    8812.7 6767.86 11475.4
0.223173    9444.39 6948.04 12837.7

                                1,1
                                Haut
          
```

ST05_Z.log (E:\corn...CISESHV\ex01) - GVIM3

Fichier Edition Outils Syntaxe Tampons Fenêtre Aide

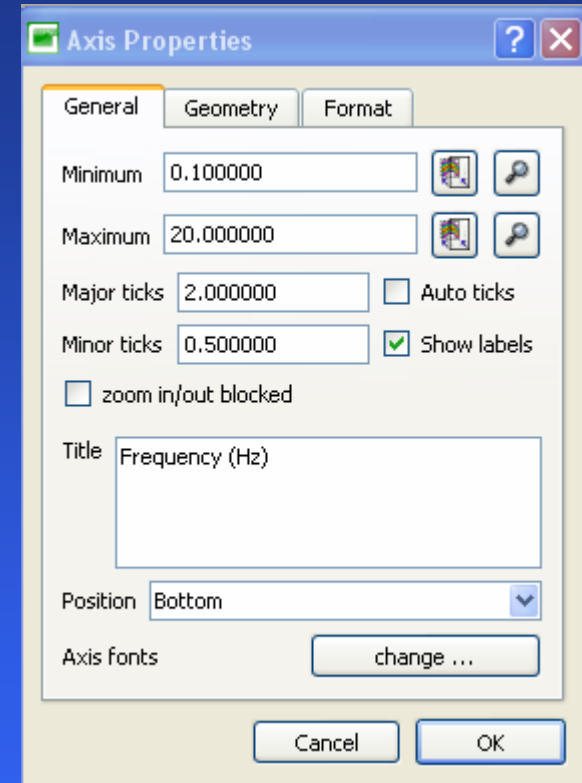
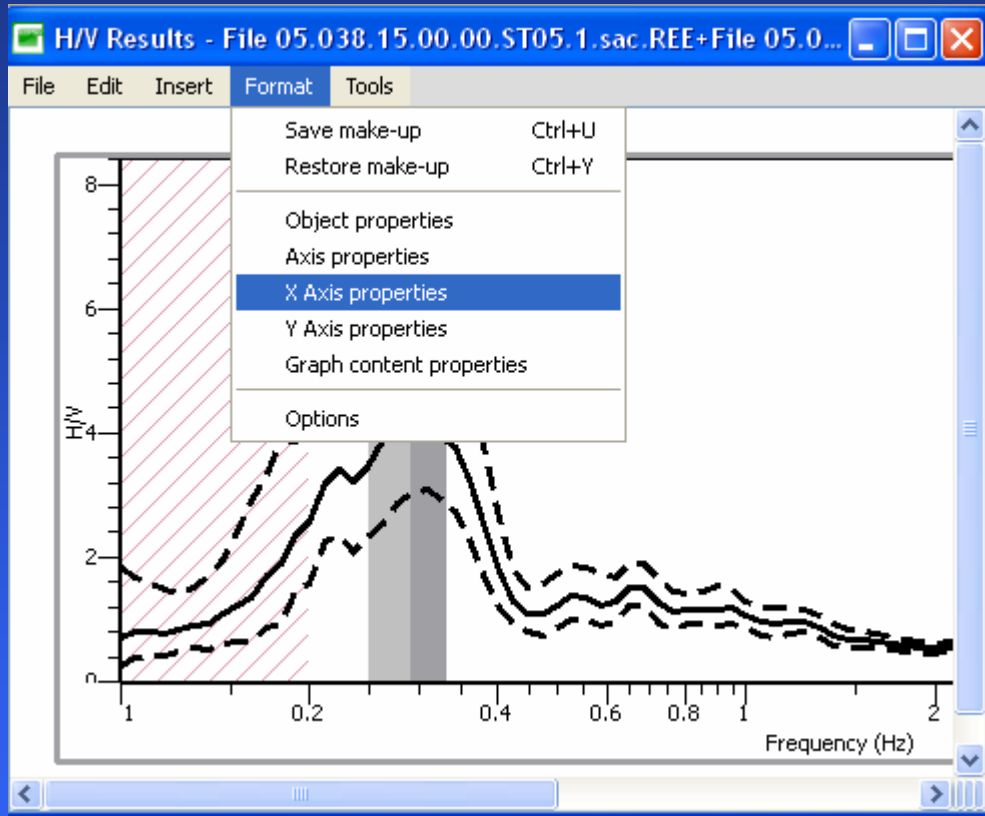
```

### Parameters ###
SIGNAL FILE NAME = 05.038.15.00.00.ST05.1.sac.REE
WINDOW MIN LENGTH (s) = 50
WINDOW MAX LENGTH (s) = 50
WINDOW LENGTH TYPE (at least/exactly/freq. dep.) = e
xactly
DO BAD SAMPLE TOLERANCE (y/n) = n
BAD SAMPLE TOLERANCE (s) = 0
DO WINDOW OVERLAP (y/n) = n
WINDOW OVERLAP (%) = 5
DO BAD SAMPLE THRESHOLD (y/n) = n
BAD SAMPLE THRESHOLD (%) = 99
ANTI-TRIGGERING ON RAW SIGNAL (y/n) = y
USED RAW COMPONENTS = y, n, y, y, y
RAW STA (s) = 1
RAW LTA (s) = 60
RAW MIN SLTA = 0.5
RAW MAX SLTA = 2
ANTI-TRIGGERING ON FILTERED SIGNAL (y/n) = n
FILTER TYPE (low pass/high pass/band pass/band rejec
t) = low pass

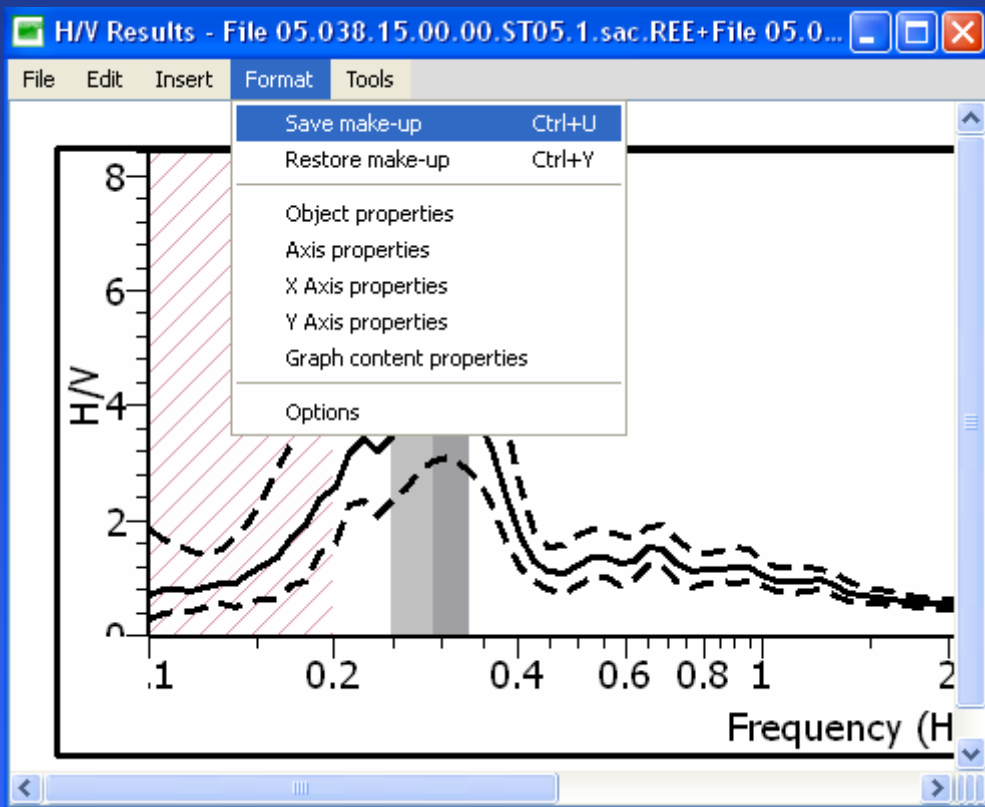
                                1,1
                                Haut
          
```

Min = Average / std
Max = Average * std

Make-up and export of figures

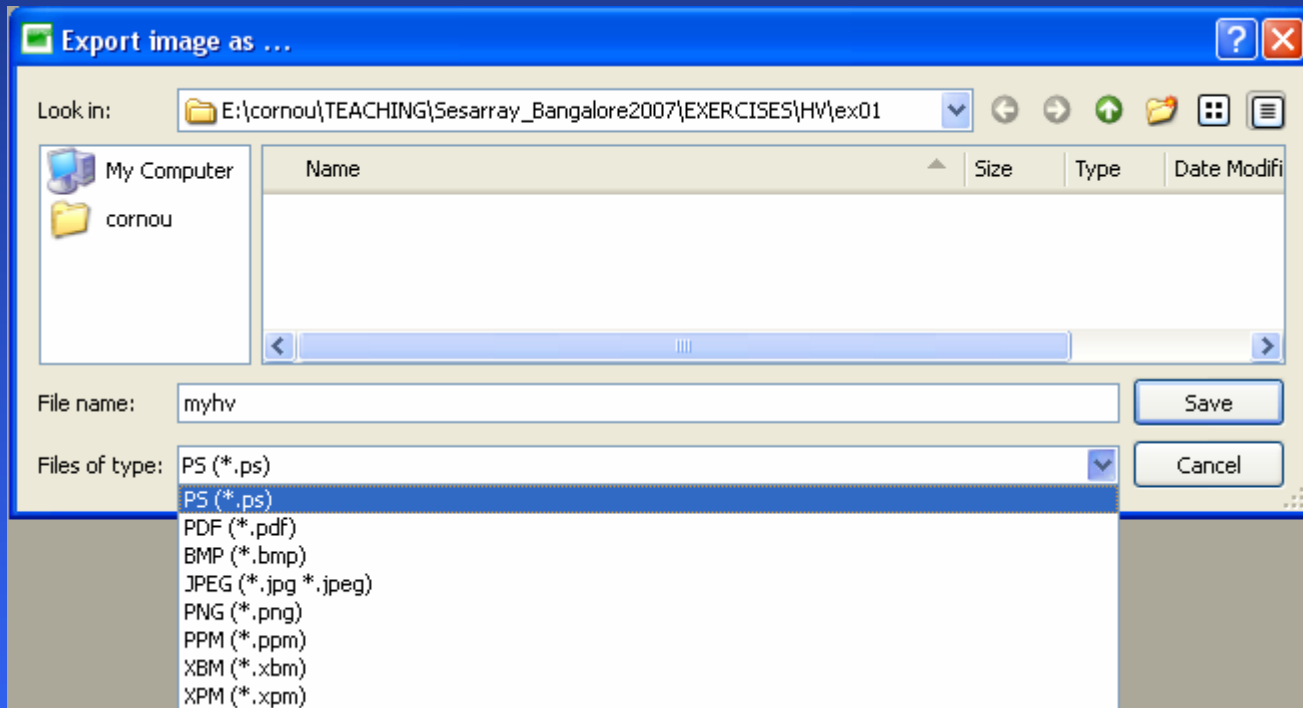


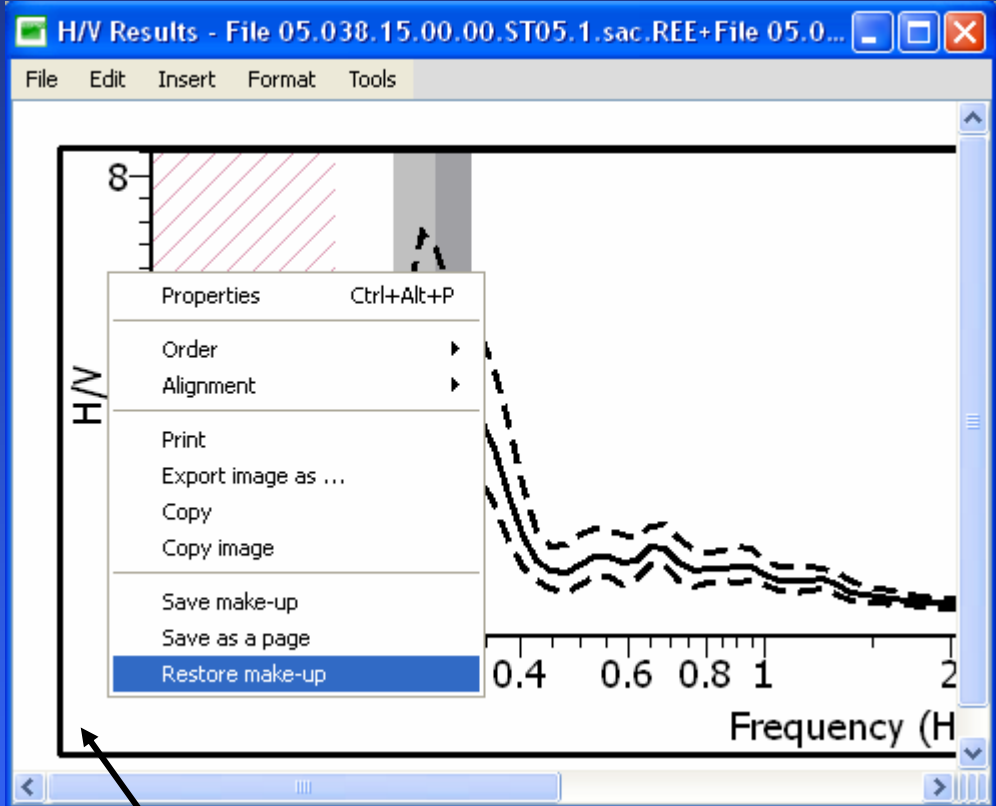
Saving the make-up



- Save the make-up
- next time H/V will be computed you can then apply the make-up

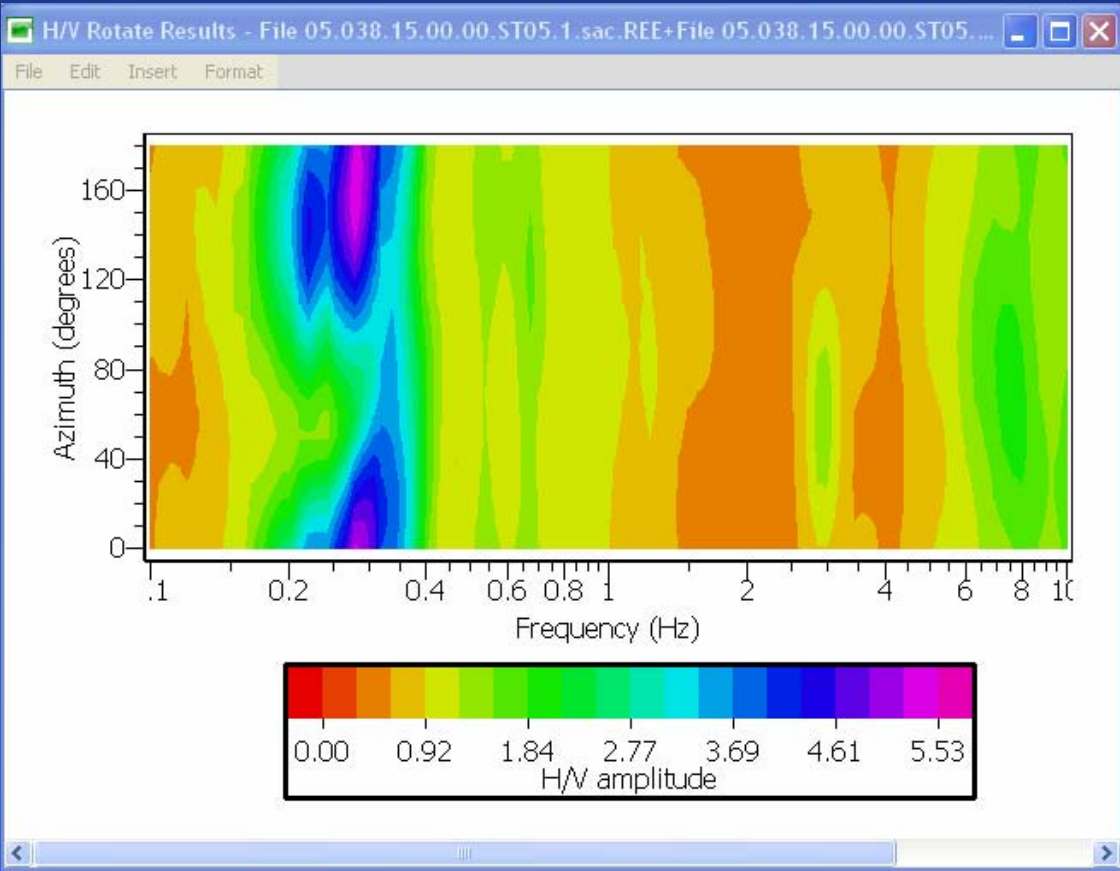
Exporting the figures





Click on the lower left corner

The H/V rotate toolbox



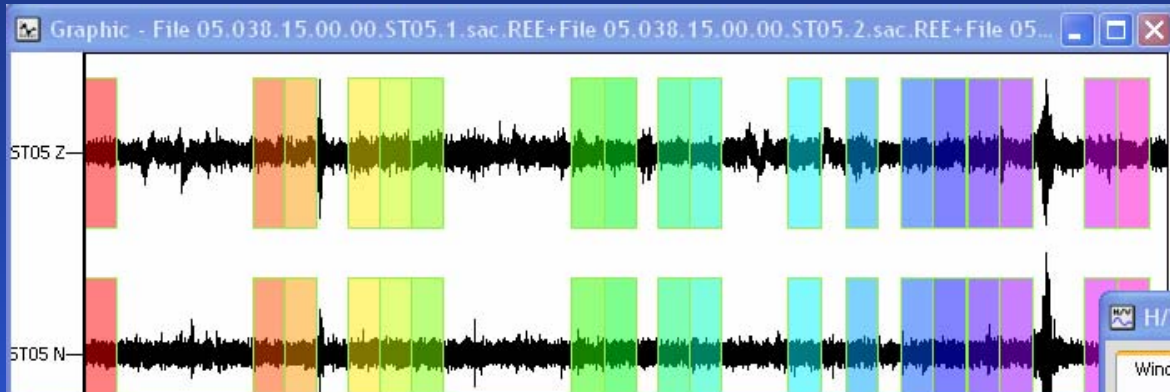
- Compute H/Vs with an horizontal component spanning different azimuths
- Azimuth is counted clockwise from the North
- Usefull to check whether a site is 1D

Test of the influence of the following parameters on the H/V curve

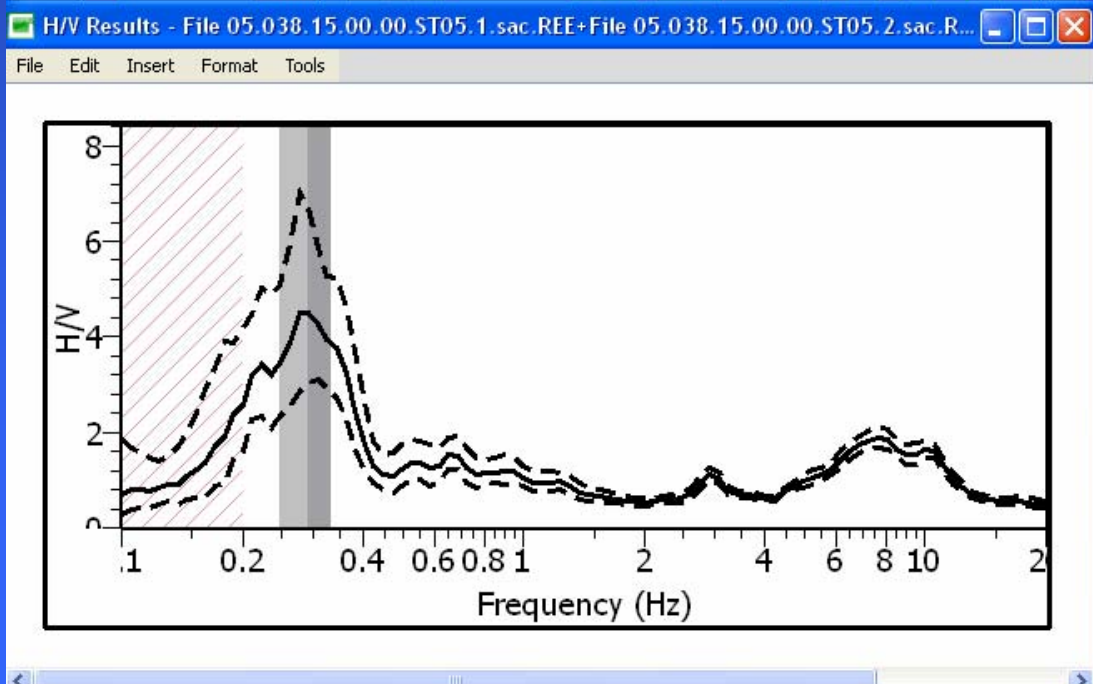
Parameters that most influence the results:

- frequency range (depends on site features and sensor cut-off frequency)
- window length (see H/V guideline)
- smoothing
- tapering
- transients (anti-triggering)

Influence of window length



50 s window
 ⇒ Clear peak
 at 0.3 Hz



H/V toolbox - File 05.038.15.00.00...

Windowing Processing Output

Parameters

General Raw signal Filter Filtered signal

Length Exactly **50,000 s.**

Overlap by 5,00 %

Bad sample tolerance 0,00 s.

Bad sample threshold 99 %

Anti-triggering on raw signal

Anti-triggering on filtered signal

Actions

Auto Add Inverse Load

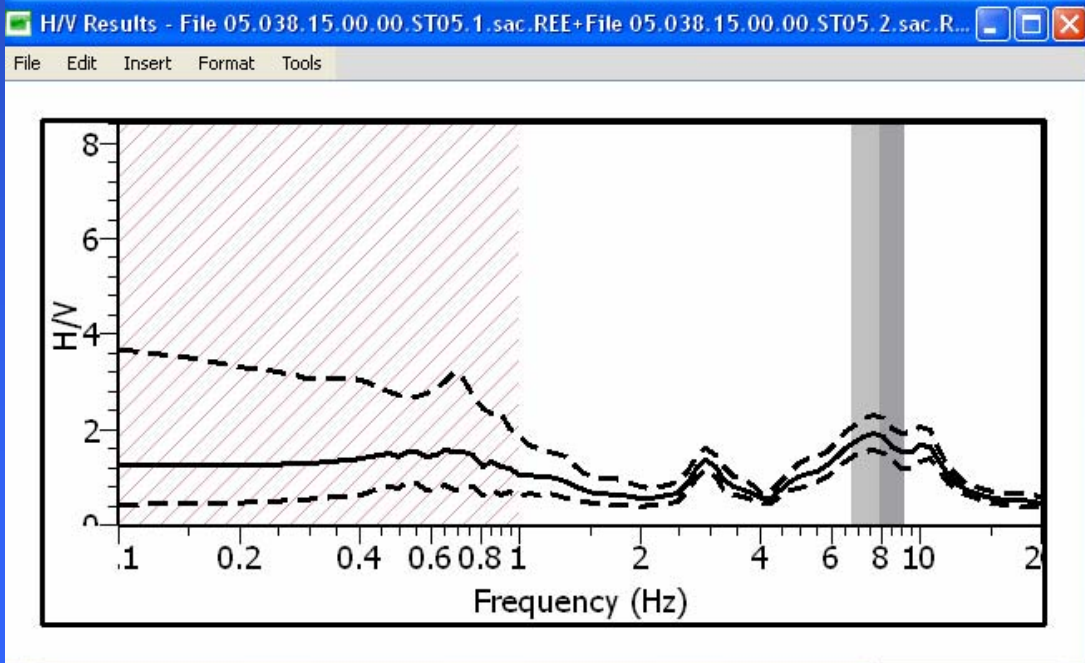
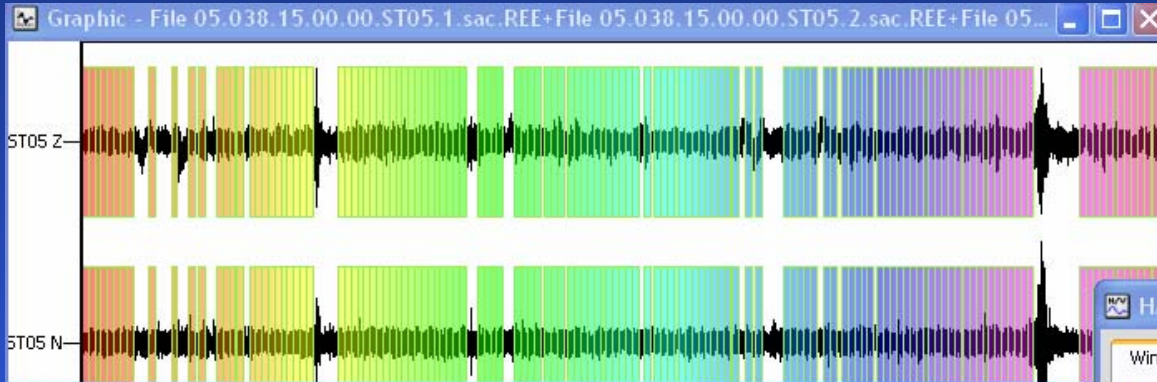
Update Remove Clear

Number of windows for all stations

Load parameters Start

Influence of window length

10 s window
 ⇒ No clear peak !
 ⇒ lack of resolution
 at low frequency



H/V toolbox - File 05.038.15.00.00...

Windowing Processing Output

Parameters

General Raw signal Filter Filtered signal

Length Exactly 10,000 s.

Overlap by 5,00 %

Bad sample tolerance 0,00 s.

Bad sample threshold 99 %

Anti-triggering on raw signal

Anti-triggering on filtered signal

Actions

Auto Add Inverse Load

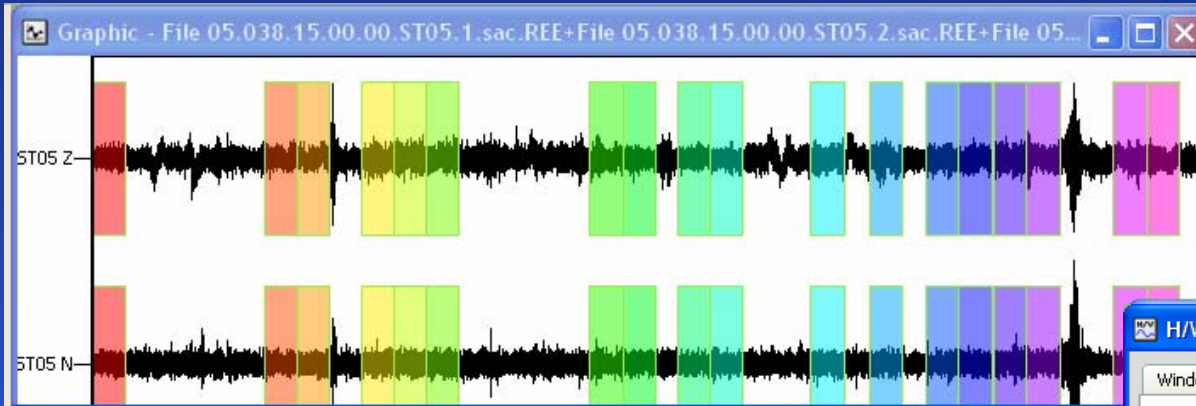
Update Remove Clear

Number of windows for all stations 132

Load parameters Start

Influence of smoothing

Smoothing
 $b=10$
⇒ Large smoothing



H/V Results - File 05.038.15.00.00.ST05.1.sac.REE+File 05.038.15.00.00.ST05.2.sac.R...

H/V toolbox - File 05.038.15.00.00.ST05.2.sa...

Windowing Processing Output

Parameters

Smoothing type: Konno & Ohmachi

Smoothing constant: 10,00

Use cosine taper width: 5,000 %

High-pass filter: 0,10 Hz

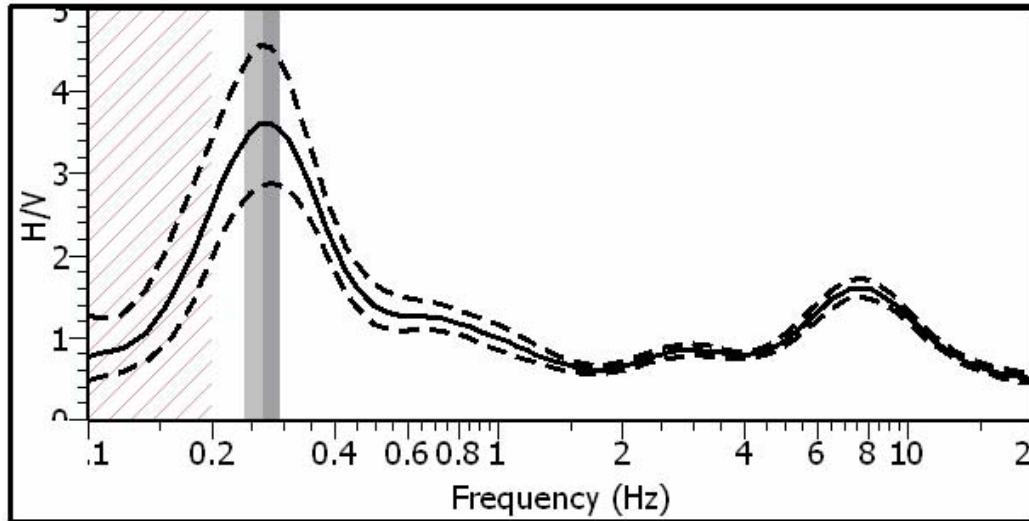
Horizontal components

Squared average

Total horizontal energy

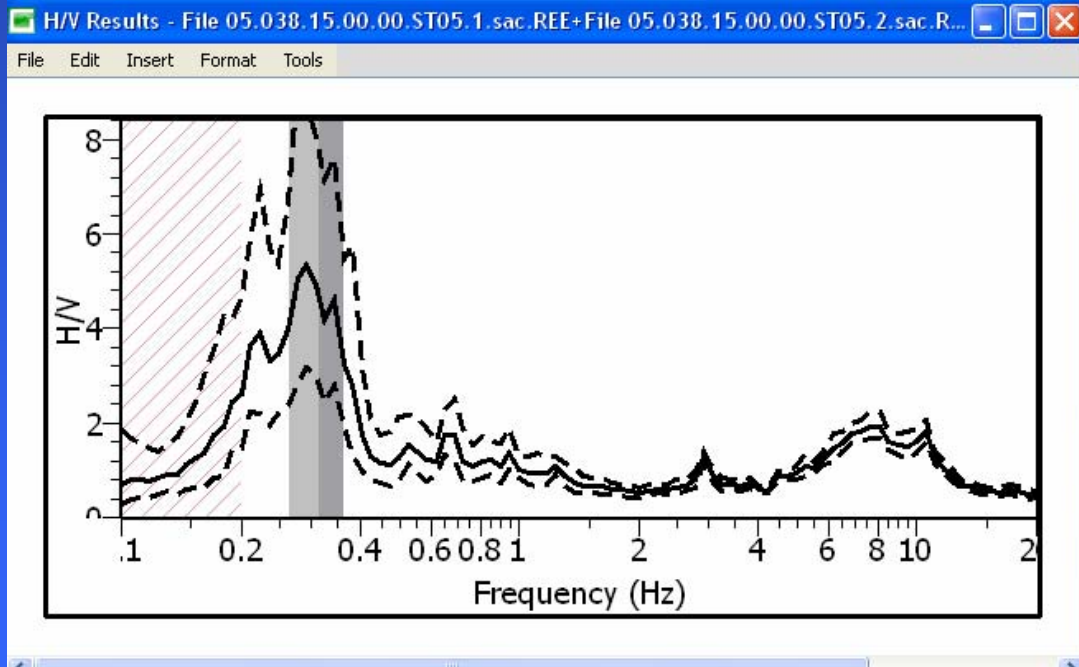
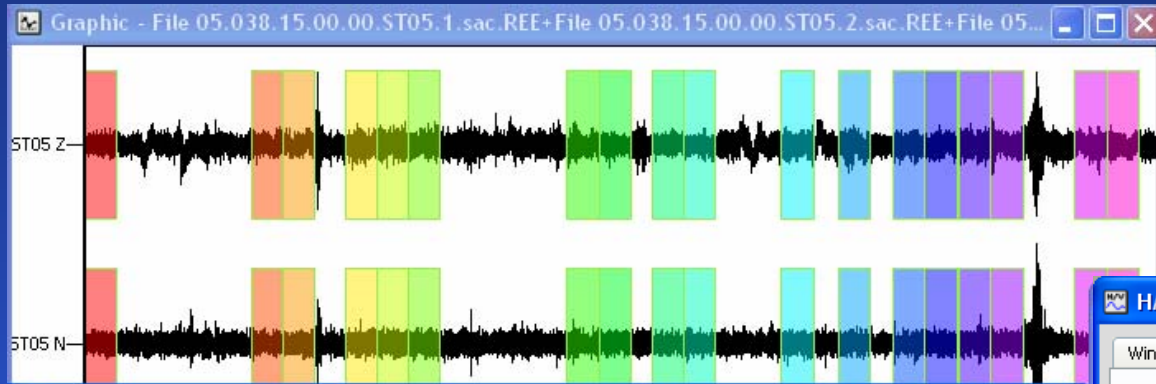
Directional energy: 0,00 °

Load parameters Start



Influence of smoothing

Smoothing $b=80$
⇒ low smoothing



H/V toolbox - File 05.038.15.00.00.ST05.2.sa...

Windowing Processing Output

Parameters

Smoothing type: Konno & Ohmachi

Smoothing constant: 80,00

Use cosine taper width: 5,000 %

High-pass filter: 0,10 Hz

Horizontal components

Squared average

Total horizontal energy

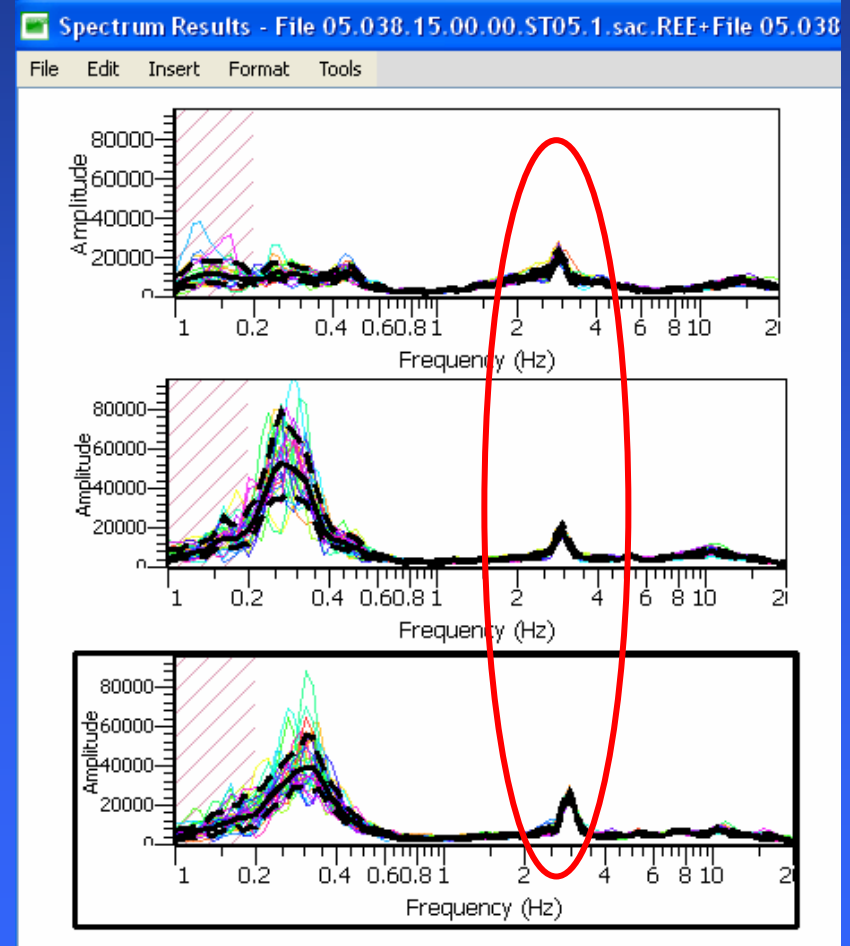
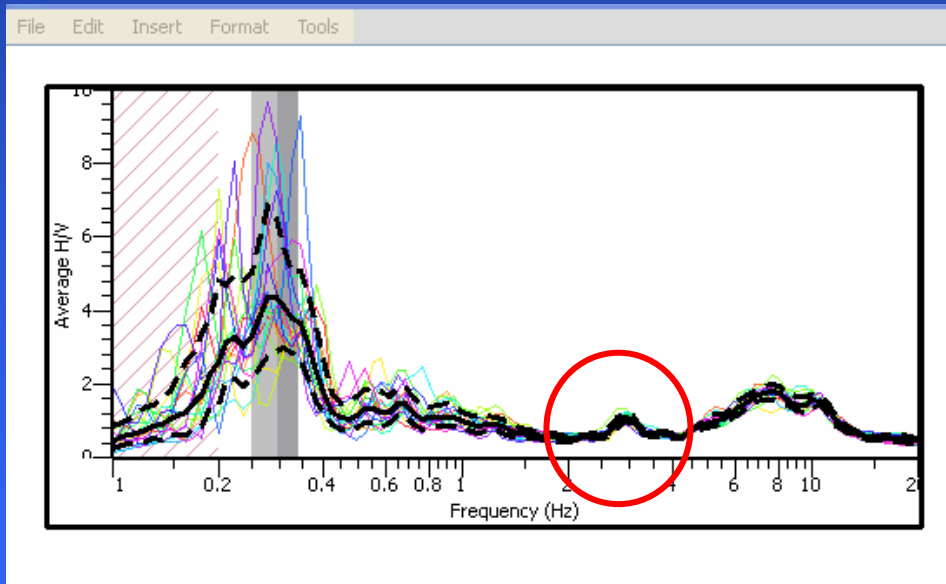
Directional energy: 0,00 °

Load parameters Start

Detection of industrial peak

Fourier spectra

H/V



Detection of industrial peak

Damping toolbox

Filter signals before processing

Band pass ▼ From 2,00 Hz to 4,00 Hz

Filter method

Butterworth filter (outphasing) Causal
 Order of Butterworth's filter 1

Cosine taper Width 0,1

Time limits

From this time : ▼ 15:01:00.0000

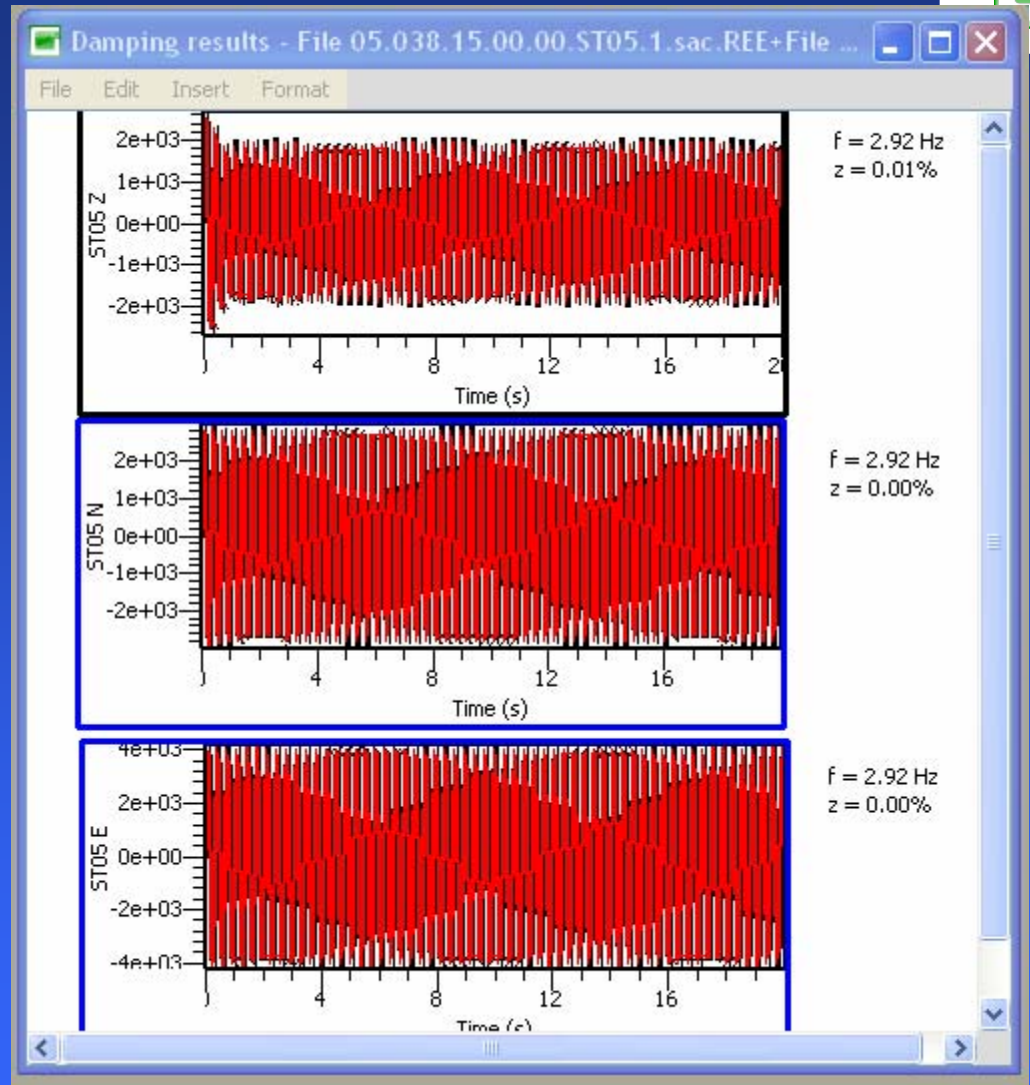
To this time : ▼ 15:29:20.0001

Use properties of first signal only (signal named ST05)

Window length 20 seconds

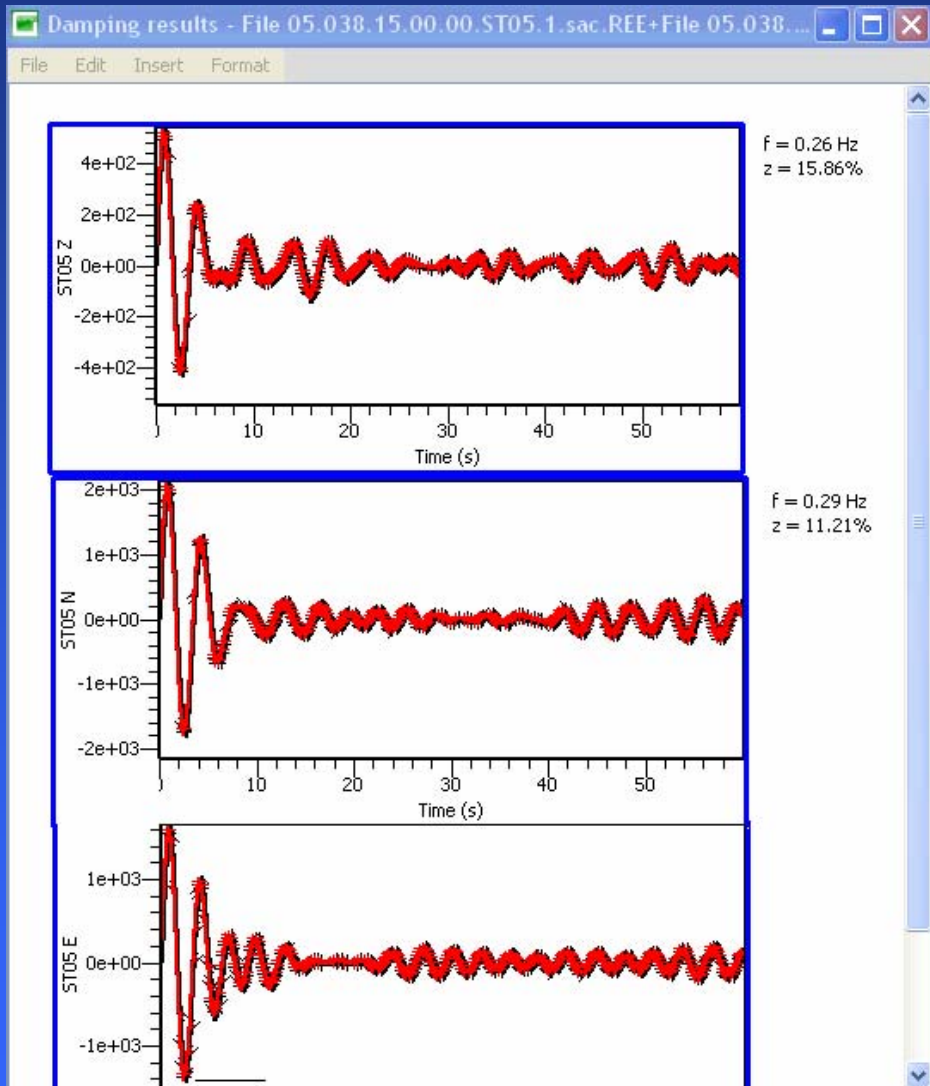
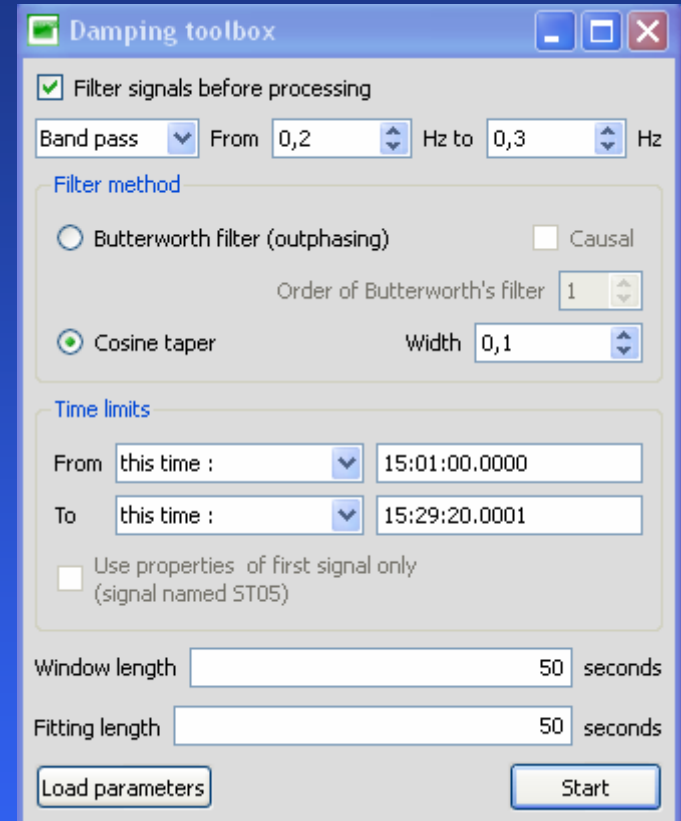
Fitting length 20 seconds

Load parameters Start



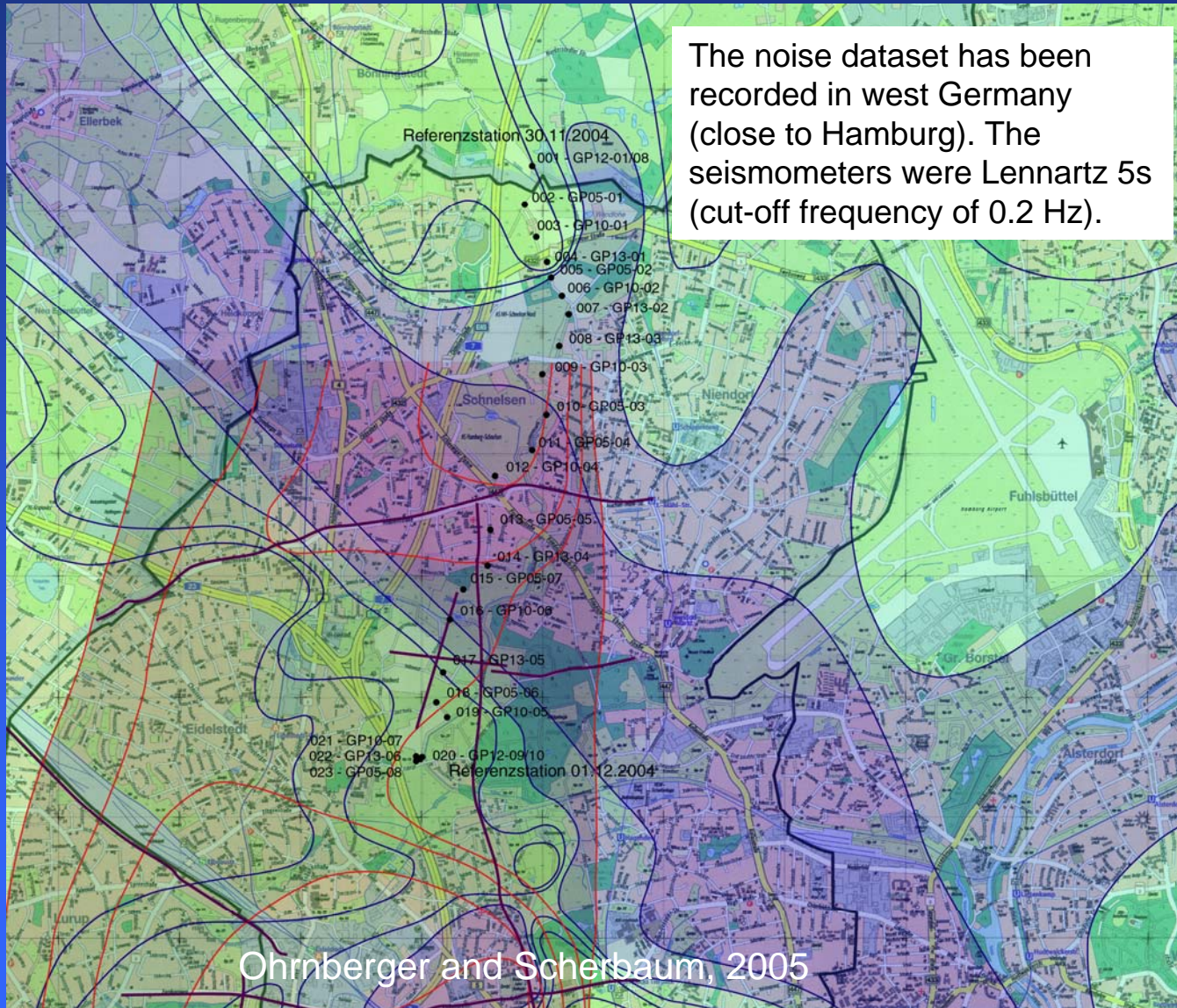
Damping $\ll 1\%$
 \Rightarrow Sustained frequency
 \Rightarrow Industrial origin !

Detection of industrial peak

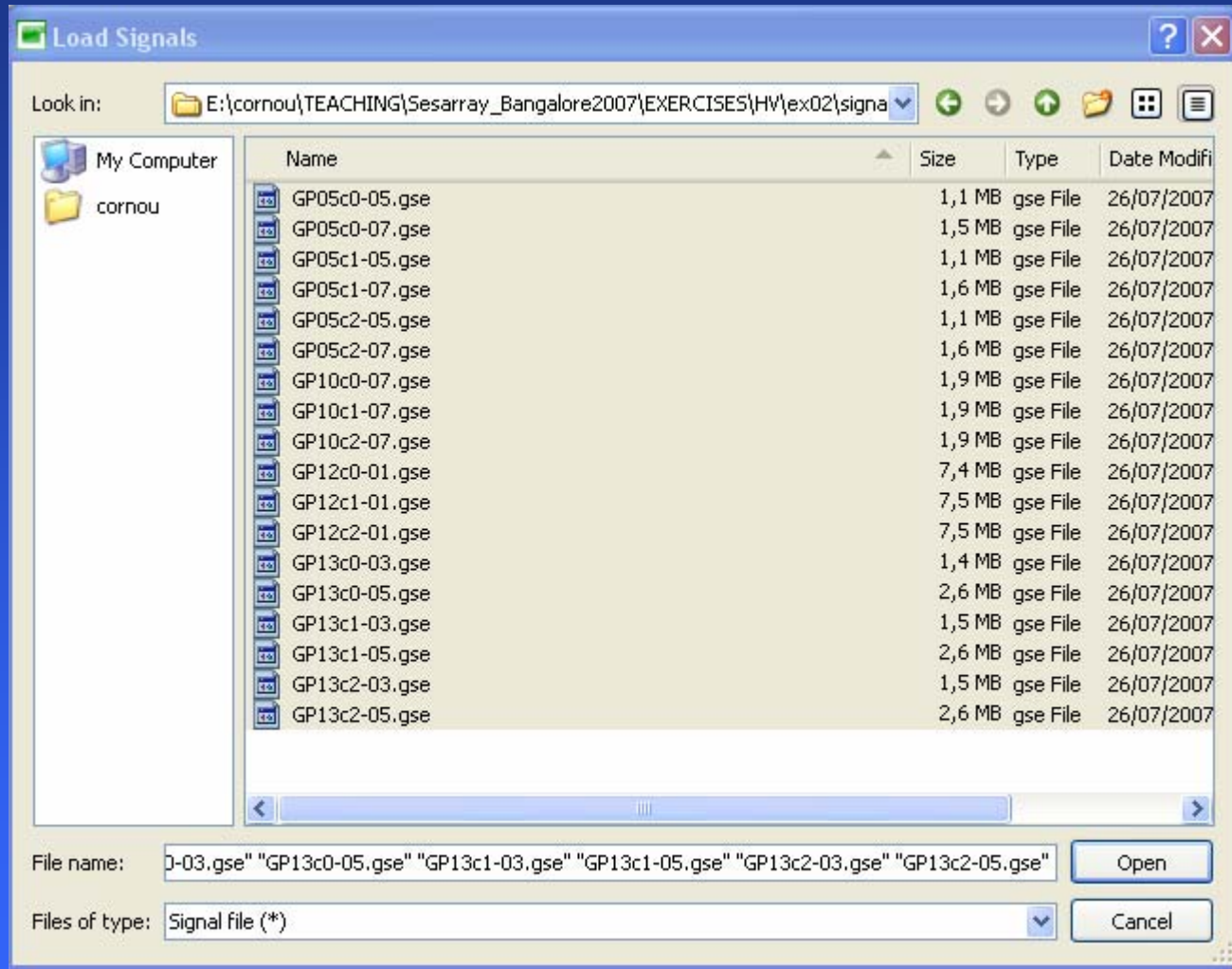
=> No sustained frequency

Correlation between H/V peak frequencies and geology



Loading signals

Directory EXERCISES_HV/EX02



Change of station name and coordinates

Table - File GP05c0-05.gse+File GP05c0-07.gse+File GP05c1-05.gse+File GP05c1-07.gse+File GP05c2-05.g...

ID	Name	Component	Time reference	Start time	End time	Sampling freq.	dt	N samples	Duration	Rec x	Rec y	Rec z	Type	
1	7	GP05	Vertical	30/11/2004 00:00:00	14:57:04.000000	15:34:16.000000	125	0,008	279000	00:37:12.000000	0	0	0	Waveform
2	8	GP05	Vertical	01/12/2004 00:00:00	10:06:24.000000	11:03:52.000000	125	0,008	431000	00:57:28.000000	0	0	0	Waveform
3	9	GP05	North	30/11/2004 00:00:00	14:57:04.000000	15:34:16.000000	125	0,008	279000	00:37:12.000000	0	0	0	Waveform
4	10	GP05	North	01/12/2004 00:00:00	10:06:24.000000	11:03:52.000000	125	0,008	431000	00:57:28.000000	0	0	0	Waveform
5	11	GP05	East	30/11/2004 00:00:00	14:57:04.000000	15:34:16.000000	125	0,008	279000	00:37:12.000000	0	0	0	Waveform
6	12	GP05	East	01/12/2004 00:00:00	10:06:24.000000	11:03:52.000000	125	0,008	431000	00:57:28.000000	0	0	0	Waveform
7	13	GP10	Vertical	01/12/2004 00:00:00	11:29:20.000000	12:37:28.000000	125	0,008	511000	01:08:08.000000	0	0	0	Waveform
8	14	GP10	North	01/12/2004 00:00:00	11:29:20.000000	12:37:28.000000	125	0,008	511000	01:08:08.000000	0	0	0	Waveform
9	15	GP10	East	01/12/2004 00:00:00	11:29:20.000000	12:37:28.000000	125	0,008	511000	01:08:08.000000	0	0	0	Waveform
10	16	GP12	Vertical	30/11/2004 00:00:00	07:38:44.000000	12:00:00	125	0,008	1959500	04:21:16.000000	0	0	0	Waveform
11	17	GP12	North	30/11/2004 00:00:00	07:38:44.000000	12:00:00	125	0,008	1959500	04:21:16.000000	0	0	0	Waveform
12	18	GP12	East	30/11/2004 00:00:00	07:38:44.000000	12:00:00	125	0,008	1959500	04:21:16.000000	0	0	0	Waveform
13	19	GP13	Vertical	30/11/2004 00:00:00	12:11:44.000000	13:03:52.000000	125	0,008	391000	00:52:08.000000	0	0	0	Waveform
14	20	GP13	Vertical	01/12/2004 00:00:00	09:04:32.000000	10:40:40.000000	125	0,008	721000	01:36:08.000000	0	0	0	Waveform
15	21	GP13	North	30/11/2004 00:00:00	12:11:44.000000	13:03:52.000000	125	0,008	391000	00:52:08.000000	0	0	0	Waveform
16	22	GP13	North	01/12/2004 00:00:00	09:04:32.000000	10:40:40.000000	125	0,008	721000	01:36:08.000000	0	0	0	Waveform
17	23	GP13	East	30/11/2004 00:00:00	12:11:44.000000	13:03:52.000000	125	0,008	391000	00:52:08.000000	0	0	0	Waveform
18	24	GP13	East	01/12/2004 00:00:00	09:04:32.000000	10:40:40.000000	125	0,008	721000	01:36:08.000000	0	0	0	Waveform

Set correct station names (load file: set_station_names.headequ)

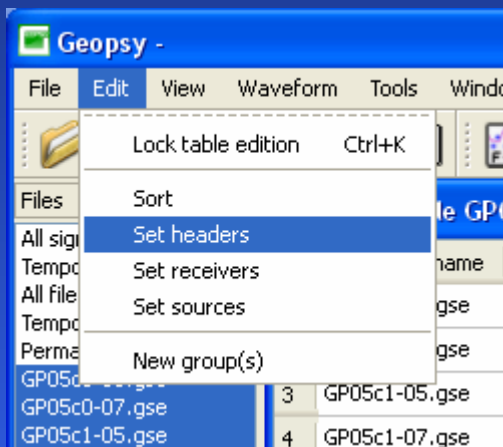


Table - File GP05c0-05.gse+File GP05c0-07.gse+File GP05c1-05.gse+File GP05c1-07.gse+File GP05c...

	Short file name	ID	Name	Component	Time reference	Start time	End time	Sampling freq
1	GP05c0-05.gse	1	GP05-05	Vertical	30/11/2004 00:00:00	14:57:04.000000	15:34:16.000000	125
2	GP05c0-07.gse	2	GP05-07	Vertical	01/12/2004 00:00:00	10:06:24.000000	11:03:52.000000	125
3	GP05c1-05.gse	3	GP05c1-05.gse					
4	GP05c1-07.gse	4	GP05c1-07.gse					
5	GP05c2-05.gse	5						
6	GP05c2-07.gse	6						
7	GP10c0-07.gse	7						
8	GP10c1-07.gse	8						
9	GP10c2-07.gse	9						
10	GP12c0-01.gse	10						
11	GP12c1-01.gse	11						
12	GP12c2-01.gse	12						
13	GP13c0-03.gse	13						
14	GP13c0-05.gse	14						
15	GP13c1-03.gse	15						
16	GP13c1-05.gse	16						
17	GP13c2-03.gse	17						
18	GP13c2-05.gse	18						

Set header

The equations must be terminated by ";". They are executed once for all signals of the current viewer. You can use "/" and "*" ... "*" like C syntax to comment equations.

Name+="-" +left(right(ShortFileName,6),2);

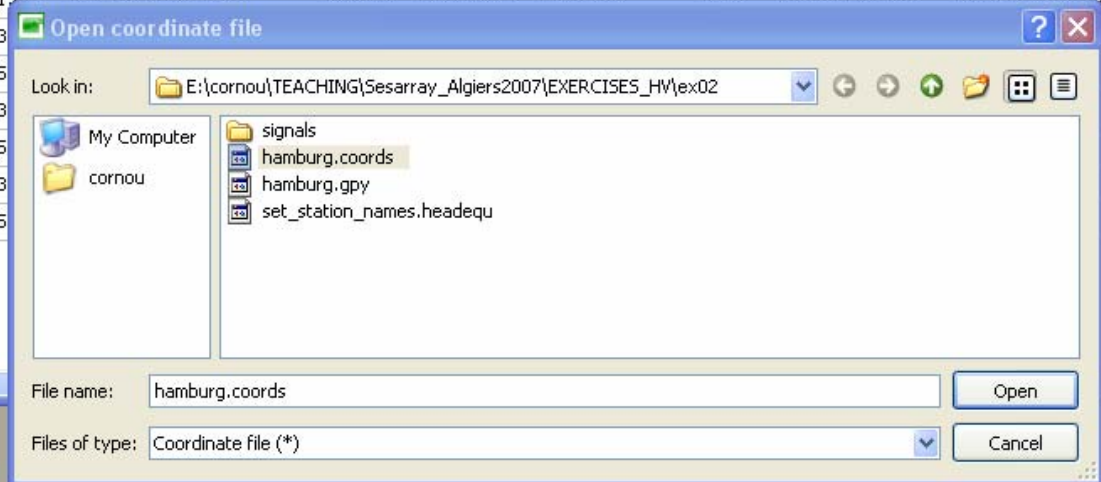
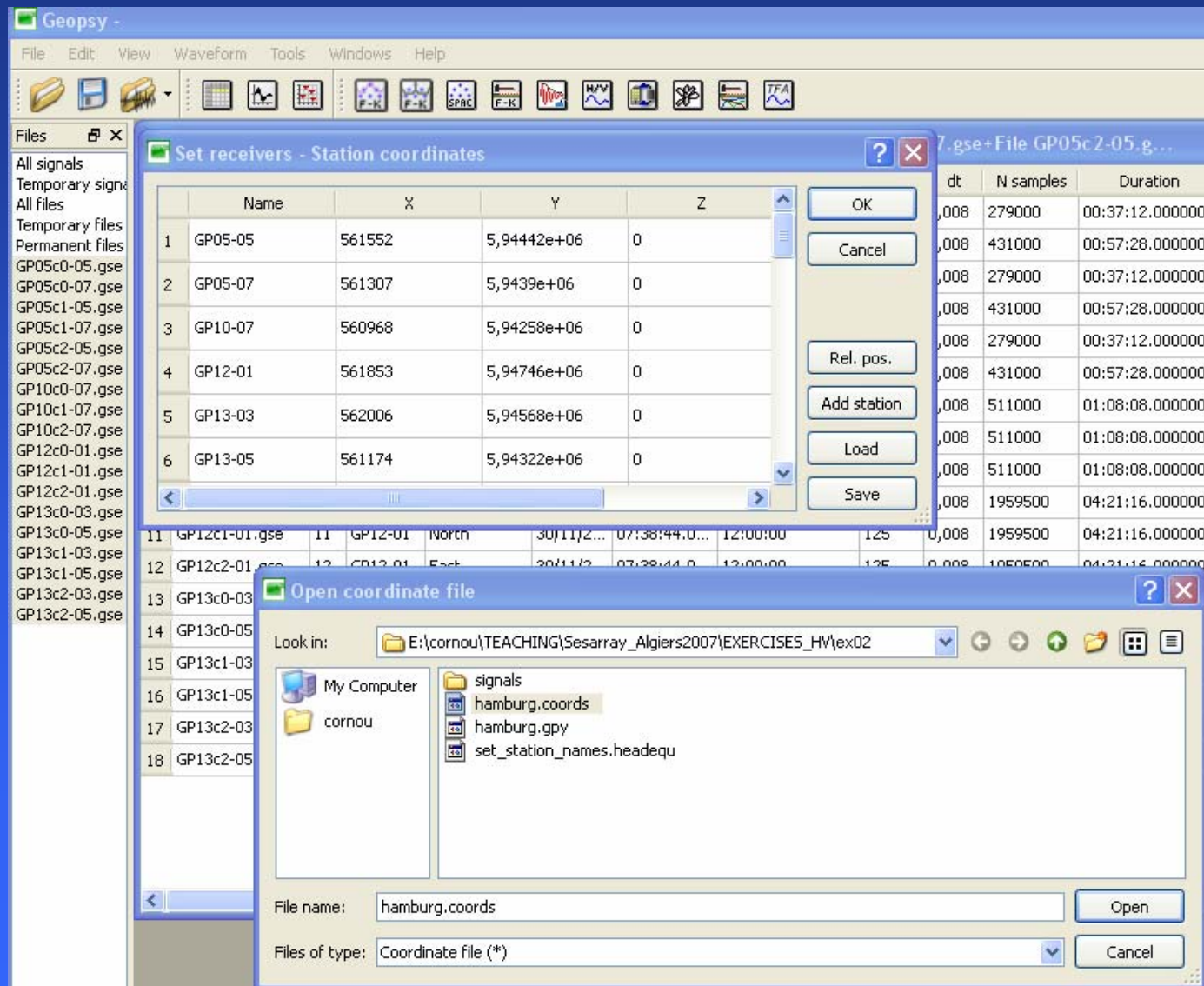
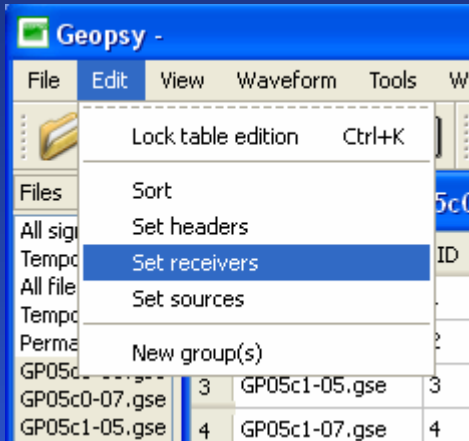
Signal data: SourceX [dropdown] **Load** Save

Operators: = [dropdown]

Functions: if(<condition>, <true>, <false>) [dropdown]

(1, 37) **Apply** Close

Set coordinates of stations (load file: hamburg.coord)



Save data in a database

Geopsy - File Edit View Waveform Tools Windows Help

Table - File GP05c0-05.gse+File GP05c0-07.gse+File GP05c1-05.gse+File GP05c1-07.gse+File GP05c2-05.g...

	Short file name	ID	Name	Component	Time reference	Start time	End time	Sampling frequency	dt	N samples	
1	GP05c0-05.gse	1	GP05-05	Vertical	30/11/2004 00:00:00	14:57:04.000000	15:34:16.000000	125	0,008	279000	00:37
2	GP05c0-07.gse	2	GP05-07	Vertical	01/12/2004 00:00:00	10:06:24.000000	11:03:52.000000	125	0,008	431000	00:57
3	GP05c1-05.gse	3	GP05-05	North	30/11/2004 00:00:00	14:57:04.000000	15:34:16.000000	125	0,008	279000	00:37
4	GP05c1-07.gse	4	GP05-07	North	01/12/2004 00:00:00	10:06:24.000000	11:03:52.000000	125	0,008	431000	00:57
5	GP05c2-05.gse	5	GP05-05	East	30/11/2004 00:00:00	14:57:04.000000	15:34:16.000000	125	0,008	279000	00:37
6	GP05c2-07.gse	6	GP05-07	East	01/12/2004 00:00:00	10:06:24.000000	11:03:52.000000	125	0,008	431000	00:57
7	GP10c0-07.gse	7	GP10-07	Vertical	01/12/2004 00:00:00	11:29:20.000000	12:37:28.000000	125	0,008	511000	01:08
8	GP10c1-07.gse	8	GP10-07	North	01/12/2004 00:00:00	11:29:20.000000	12:37:28.000000	125	0,008	511000	01:08
9	GP10c2-07.gse	9	GP10-07								
10	GP12c0-01.gse	10	GP12-01								
11	GP12c1-01.gse	11	GP12-01								
12	GP12c2-01.gse	12	GP12-01								
13	GP13c0-03.gse	13	GP13-03								
14	GP13c0-05.gse	14	GP13-05								
15	GP13c1-03.gse	15	GP13-03								
16	GP13c1-05.gse	16	GP13-05								
17	GP13c2-03.gse	17	GP13-03								
18	GP13c2-05.gse	18	GP13-05								

Save current database as ...

Look in: E:\cornou\TEACHING\Sesarray_Algiers2007\EXERCISES_HV

My Computer
cornou
ex02

File name: database-ex02 Save

Files of type: Geopsy database (*.gpy) Cancel

Compute H/V and display the H/V curves along the profile

