COMPASS 3D-Component

Interactive Weak and Strong Motion Data Processing Software

Rev 2008.11.19 Document Rev C

2011.02.22

This COMPASS manual provides a detailed overview of using the 3D-Component menu of the COMPASS software to do 3D-motion studies for a 3-Component record.

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Revision History:

Revision	Date	Reason for change	Pages
C	**2008.12.22**	**New Version 2008Nov19**	**All**
B	**2008.07.08**	**Updated for COMPASS**	**All**
A	**2007.05.05**	**Update for REF TEK SM**	**All**
0.1	**2007.02.23**	**Initial Draft**	**All**

Notation Conventions

The following notation conventions are used throughout REF TEK documentation:

Notation	Description
ASCII	Indicates the entry conforms to the American Standard Code for Information Interchange definition of character (text) information.
Binary	Indicates the entry is a raw, numeric value.
Hex	Indicates hexadecimal notation. This is used with both ASCII characters (0 – 9, A – F) and numeric values.
BCD	Indicates the entry is a numeric value where each four bits represents a decimal digit.
FPn	Indicates the entry is the ASCII representation of a floating-point number with n places following the decimal point.
<n>	Indicates a single 8-bit byte. When the contents are numeric, it indicates a hexadecimal numeric value; i.e. <84> represents hexadecimal 84 (132 decimal). When the contents are capital letters, it represents a named ASCII control character; i.e. <SP> represents a space character, <CR> represents a carriage return character and <LF> represents a line feed character.
MSB	Most Significant Byte of a multi-byte value.
MSbit	Most Significant Bit of a binary number.
LSB	Least Significant Byte of a multi-byte value.
LSbit	Least Significant Bit (bit 0) of a binary number.
YYYY	Year as a 4-digit number
DDD	Day of year
HH	Hour of day in 24-hour format
MM	Minutes of hour
SS	Seconds of minute
TTT	Thousandths of a second (milliseconds)
IIII	Unit ID number

n, nS	nano, nanoSecond; 10-9 = 0.000000001
u, uS	micro, microSecond; 10-6 = 0.000001
m, mS	milli, milliSecond; 10-3 = 0.001
K, KHz	Kilo, KiloHertz; 103 = 1,000
M, MHz	Mega, MegaHertz; 106 = 1,000,000
G, GHz	Giga, GigaHertz; 109 = 1,000,000,000
Kb, KB	Kilobit, KiloByte; 210 = 1,024
Mb, MB	Megabit, MegaByte; 220 = 1,048,576
Gb, GB	Gigabit, GigaByte; 230 = 1,073,741,824

Related Manuals:

130-SMA System Documents	Number	PDF file
130-SMA Startup (Command Line)	Doc-SMA-Ops	130SMA_startup.pdf
Data Utilities Users Guide	Doc-Datautils	130_utilities.pdf
130-SMA Command Interface	**Number**	**PDF file**
130 Cmd Line - Theory of Operations	Doc-CmdL-Theory	130_CLtheory.pdf
130 Cmd Line - Release Notes	Doc-CmdL-Release	130_CLRN.pdf
130 Cmd Line - Reference	Doc-CmdL-Ref	130_CLcmd.pdf
130 Cmd Line - Recording Format	Doc-CmdL-Record	130_CLrecord.pdf
130-SM GUI Users Guide	Doc-130-SMGui	RT130SM.pdf
130-SMA Board Documents	**Number**	**PDF file**
RT608-B01 3 Channel 24-Bit A/D	Doc-130-RT608	RT608r.pdf
RT608-B02 6 Channel 24-Bit A/D	Doc-130-RT608	RT608r.pdf
RT506-B04 - CPU	Doc-130-RT506	RT506r.pdf
RT530 - B01 Lid Interconnect	Doc-130-RT530	RT530r.pdf
RT570 - B01 MicroDrive/Flash	Doc-130-RT570	RT570rB01.pdf
RT535 - Mass Memory Board	Doc-130-RT535	RT535rB01.pdf
Optional Manuals	**Number**	**PDF file**
SNDP Installation and Users Guide	SNDP-OP-003	SNDPUser.pdf
SNDP Reference Guide	SNDP-S-002	SNDPRef.pdf
RTCC Command / Control Users Guide	RTCC-S-006	RTCC.pdf
RT_Display Users Guide	RTD-S-007	RTDisplay.pdf
RT_View Users Guide	RTV-S-005	RTView.pdf
RTPMonitor Installation and Users Guide	RTPM-S-008	RTPM.pdf
RTPD Installation and Users Guide	RTPD-OP-005	RTPD.pdf
(part of RTPD manual) RTP Protocol		
Accelerometers		
131A-02/3 3G Triaxial Accelerometer	Doc-131A-03/2	131A023.pdf
131A-02/2 3G Triaxial Accelerometer	Doc-131A-02/2	131A022.pdf
131A-01/3 4G Triaxial Accelerometer	Doc-131B-01/3	131B013.pdf
131B-01/1 4G Unixial Accelerometer	Doc-131B-01/1	131B011.pdf

REF TEK Support and update notifications

As a valued user of REF TEK equipment we would like to provide the best support possible by keeping you up to date with our product updates.

If you would like to be notified of any REF TEK product updates please spend a couple of minutes to register with the REF TEK customer support team.

To register, enter your company information through the Register link on our website at http://support.reftek.com **.**

Our support team will send you a unique Username and Password allowing secured access to all product documentation and software sold to your company.

Once we register your contact we will only send necessary notifications via email. The same notifications will be shown on our website http://support.reftek.com **notifications page**

Thanks,

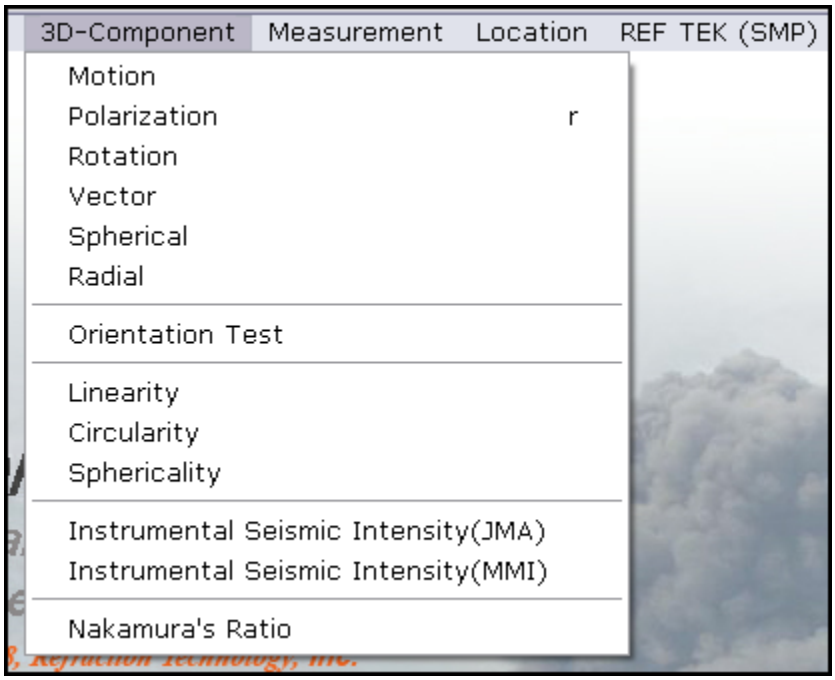
Your REF TEK support team

Software Version:

Current software and documentation is available on our web site. Some early units may require hardware modifications to use the latest software. Contact REF TEK if you have any queries on the compatibility of your unit(s) and the current software release.

About this manual:

This COMPASS Technical Reference manual provides a detailed overview of using the 3D-Component menu of the COMPASS software. It covers the following broad operational topics:



- Motion
- Polarization
- Rotation
- Vector
- Spherical
- Radial
- Linearity
- Circularity
- JMA – Instrumental Seismic Intensity
- MMI – Instrumental Seismic Intensity
- Nakamura's Ratio

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6 3D-Component

6.1 3D-Component menu

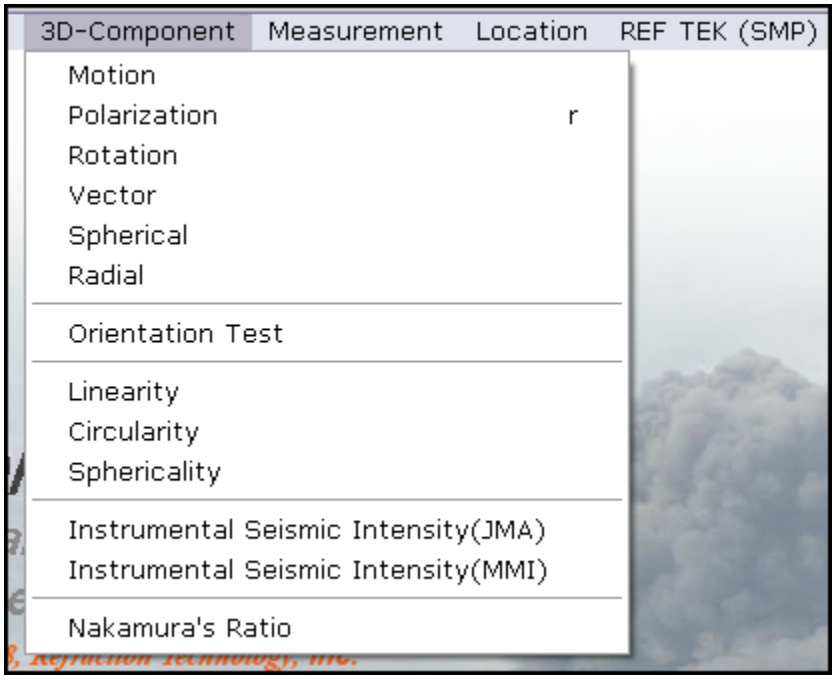
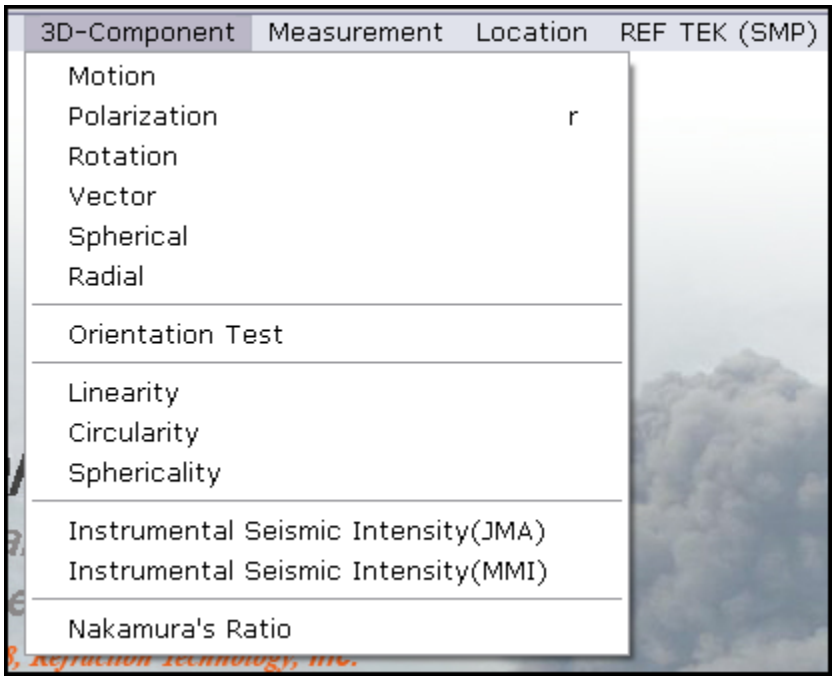


Figure 6-1 3D-Component Menu

6.2 3D-Motion Study Overview



6.2.1 Preview particle 3D-motion for a 3-Component record

For proper 3D-motion study and correct azimuth to source determination the following information is used:

- For every component the orientation of a channel is defined by two angles.
- The azimuth of the instrument in degrees from north (clockwise)
- The dip of the instrument (down from horizontal)
- The traditional orientation:

  - Z ----------Dip=-90,Azimuth 0
  - N ----------Dip= 0,Azimuth 0
  - E ----------Dip= 0,Azimuth 90

The program reads these values from FULLSEED data files or DATALESS SEED response files (Blockette N=52).

For RAW REF TEK records the program reads these values from **rt#DAS#.rtu** file located in the **RESPONSE** folder.

If the component's orientation is not traditional (but has the perpendicular axes) the program will try to correct this. The sample rate should be the same for all 3 channels.

6.2.2 Motion Preliminary steps

1. View an enlarged display of a segment of data (For example: the first part of P wave arrival), by selecting the **Zoom -> Zoom In** menu or use the hot key z.

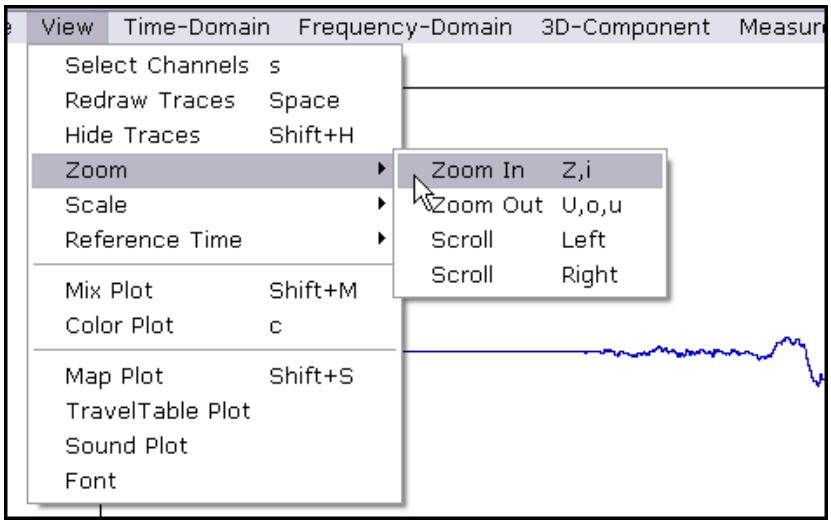


Figure 6-2 Zoom In

2. Select the time segment on the seismogram by clicking the mouse button with the cursor on the left endpoint (L).

3. Click on the (R) "L<R" right endpoint of the desired time segment as shown on picture below.

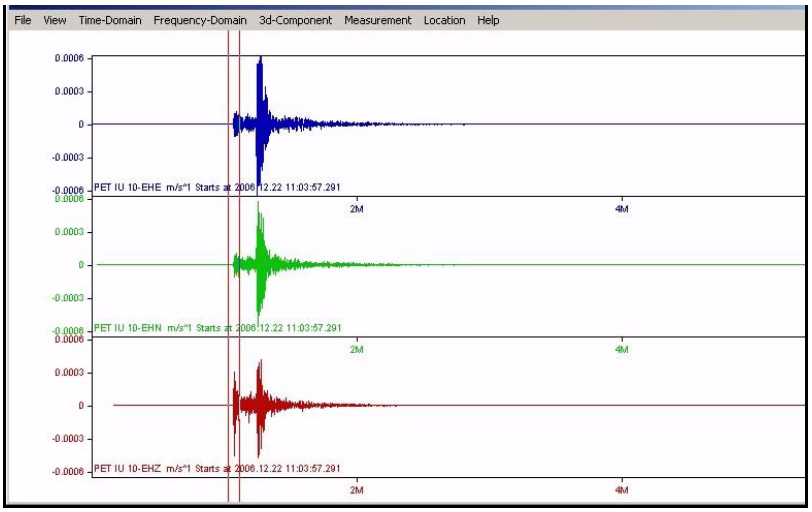
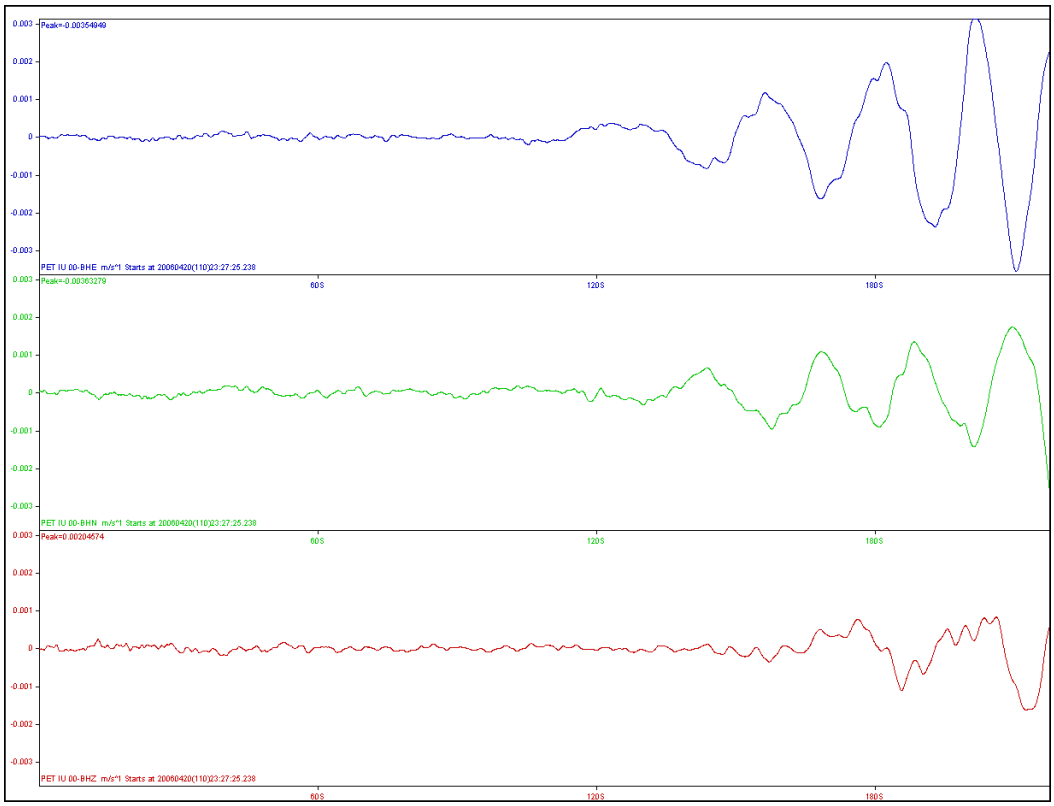
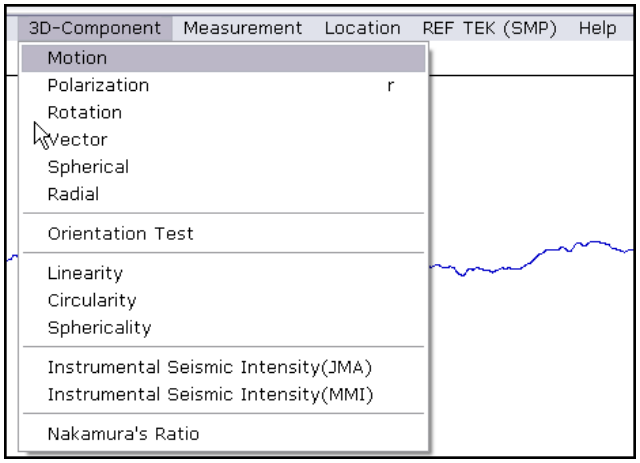


Figure 6-3 Define Zoom

4. The display redraws to show the updated area.

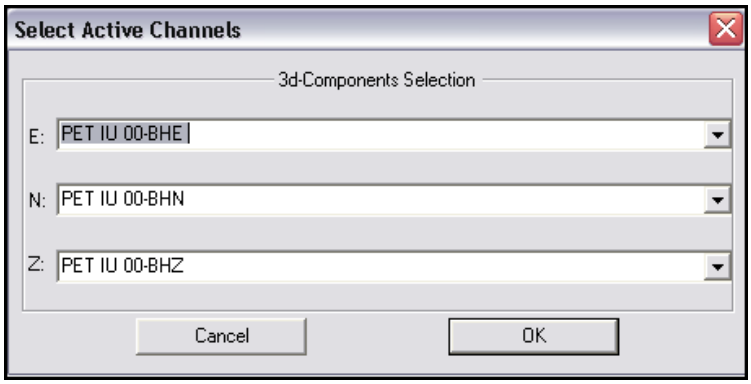


5. Click the **Motion** Menu option.



6. Select the corresponding 3 components for a motion plot.

7. Select the **OK** button to approve the selection.



8. On the following screen use F1,F2 keys to rotate the 3d image graph.

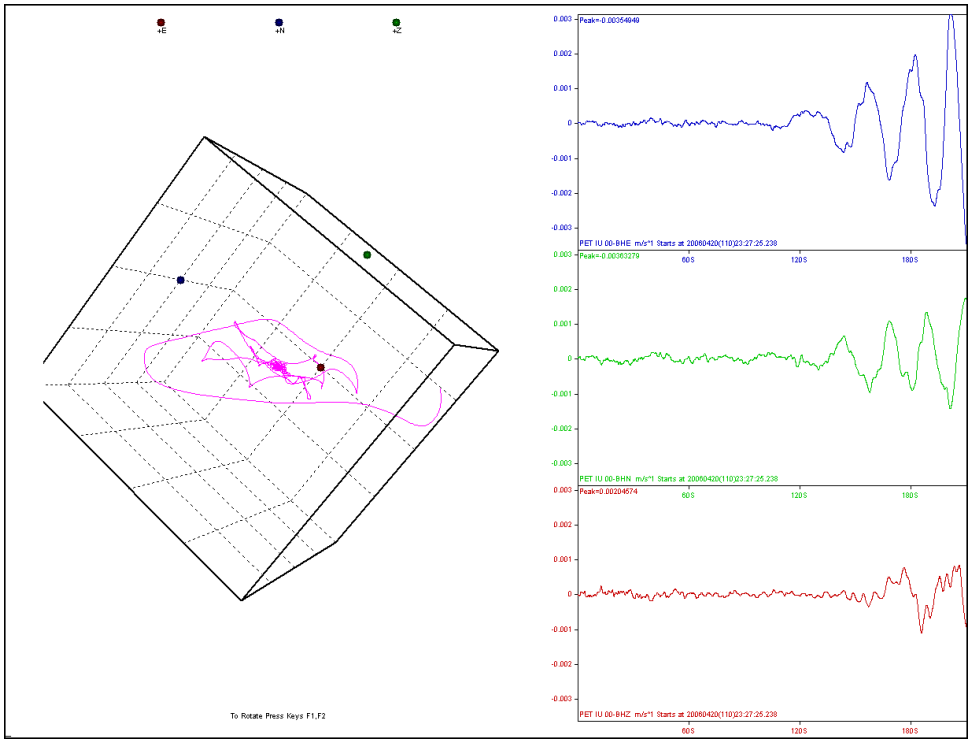


Figure 6-4 Motion Study Result

6.3 3D Polarization Study

Proper 3D-Polarization study involves computation of eigen values and eigen vectors of 3D-component covariance matrix in order to detect the directions of main axes 3D-ellipsoid.

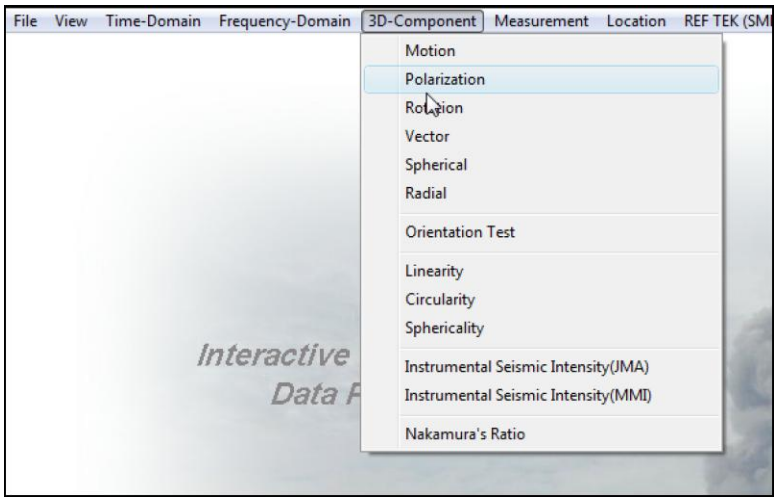


Figure 6-5 Polarization

For proper 3D-polarization study and correct azimuth to source determination the following information is used:

- For every component the orientation of channel is defined by two angles.
  - The azimuth of the instrument in degrees from north, clockwise.
  - The dip of the instrument, down from horizontal.
- The traditional orientation:
  - Z ----------Dip=-90 (Azimuth 0)
  - N ----------Dip= 0 (Azimuth 0)
  - E ----------Dip= 0 (Azimuth 90)

The program reads these values from FULLSEED data files or DATALESS SEED response files (Blockette N=52)

For RAW Reftek records the program reads these values from the **rt#DAS#.rtu** file located in the **RESPONSE** folder.

If the component's orientation is not traditional (but has the perpendicular axes) the program will try to correct this. The sample rate should be the same for all 3 channels.

6.3.1 3D-Polarization Study example

1. View an enlarged display of a segment of data (For example: the first part of P wave arrival) by selecting the **Zoom -> Zoom In** menu or use the hot key z.

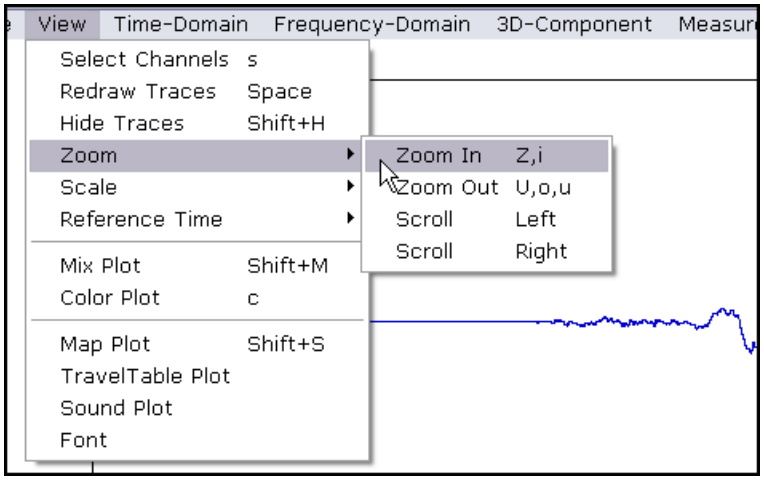
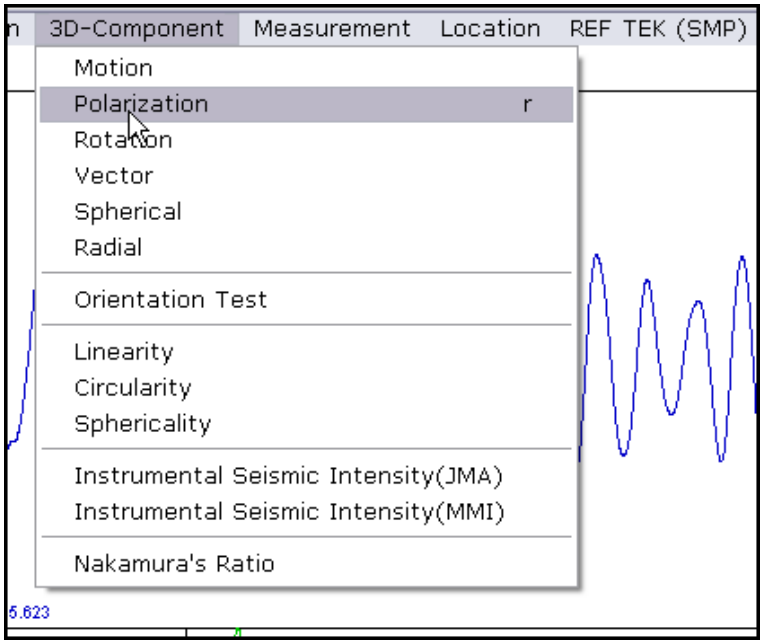


Figure 6-6 Zoom In

2. Select the time segment on the seismogram by clicking the mouse button cursor on the left endpoint (L).
3. Select the right endpoint (on the (R) "L<R") of the desired time segment as shown on picture below.
4. The display redraws to show the updated area.
5. Select the **Polarization** menu.



6. Select the corresponding 3 components for the plot.

7. Approve the selection with the **OK** button.

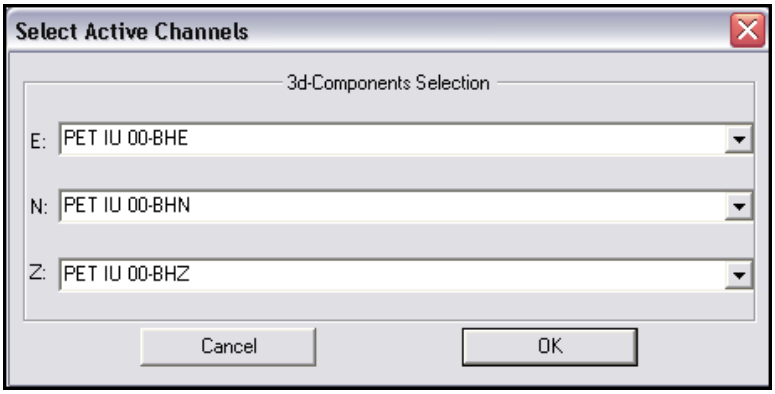


Figure 6-7 Polarization Study

8. The plot will show the Wulf Diagram of main axes with rectangles proportional to eigen values below.

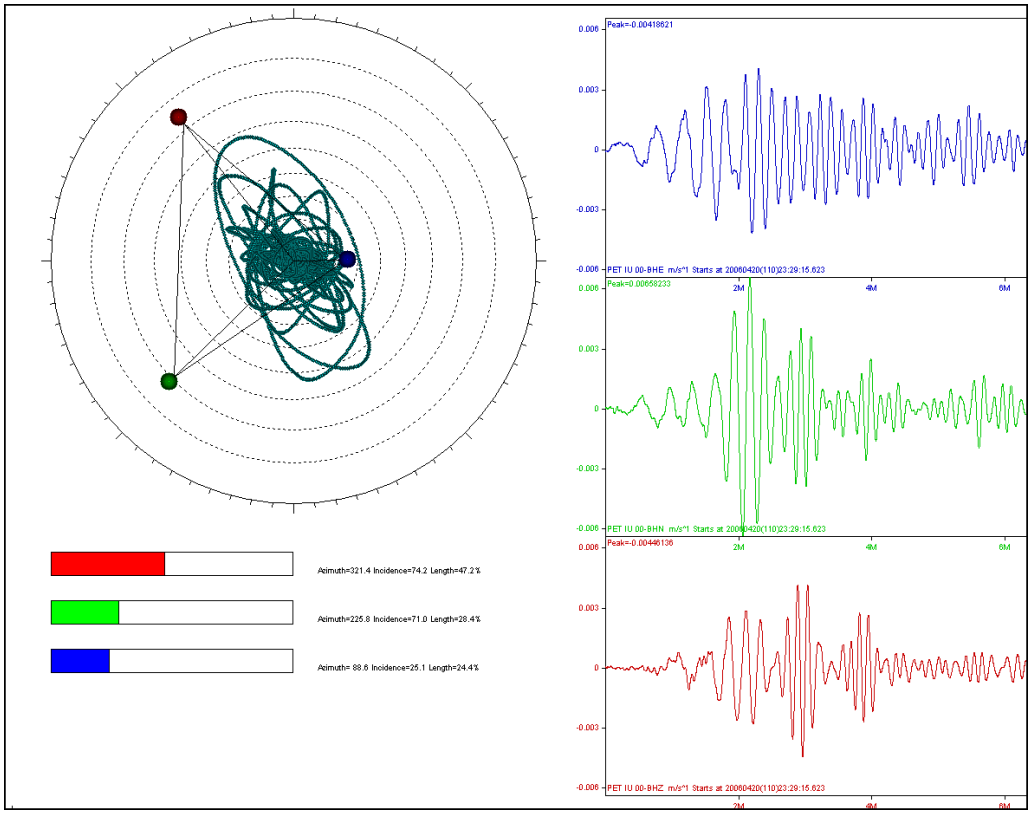


Figure 6-8 Wulf Diagram

6.4 3D-Component Rotation

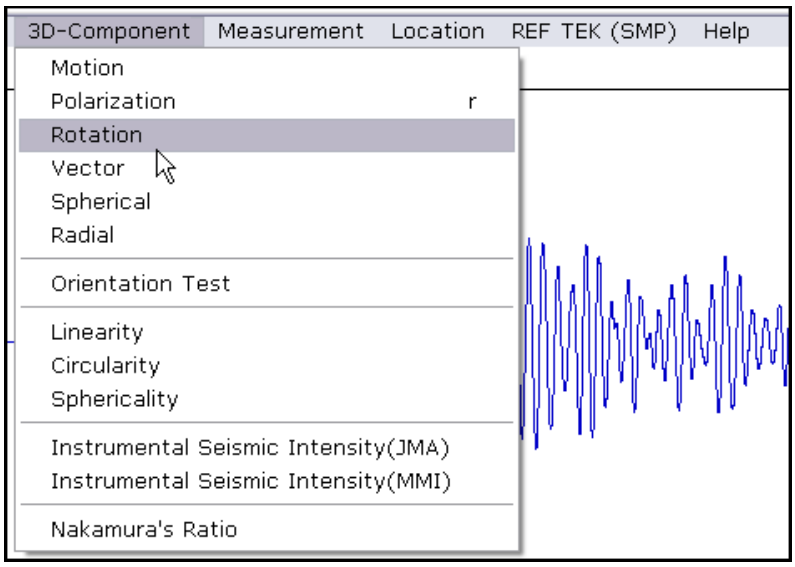


Figure 6-9 Rotation

For proper 3D-Rotation study and correct azimuth to source determination the following information is used:

- For every component the orientation of channel is defined by two angles.
  - The azimuth of the instrument in degrees from north (clockwise)
  - The dip of the instrument (down from horizontal)
- The traditional orientation:
  - Z ----------Dip=-90,Azimuth 0
  - N ----------Dip= 0,Azimuth 0
  - E ----------Dip= 0,Azimuth 90

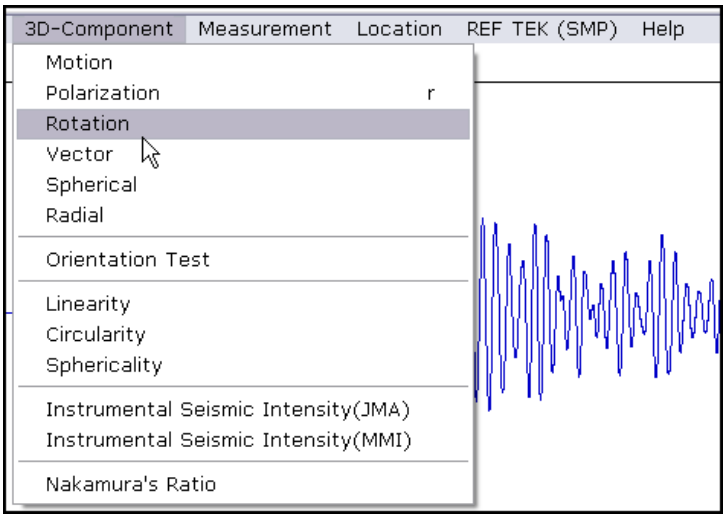
The program reads these values from FULLSEED data files or DATALESS SEED response files (Blockette N=52).

For RAW REF TEK records the program reads these values from the **rt#DAS#.rtu** file located in the **RESPONSE** folder.

If the component's orientation is not traditional (but has the perpendicular axes) the program will try to correct this. The sample rate should be the same for all 3 channels.

6.4.1 3D-Component Rotation example

1. Select the **Rotation** menu.



2. Select the corresponding 3 components for the motion plot.
3. Approve the selection with the **OK** button.

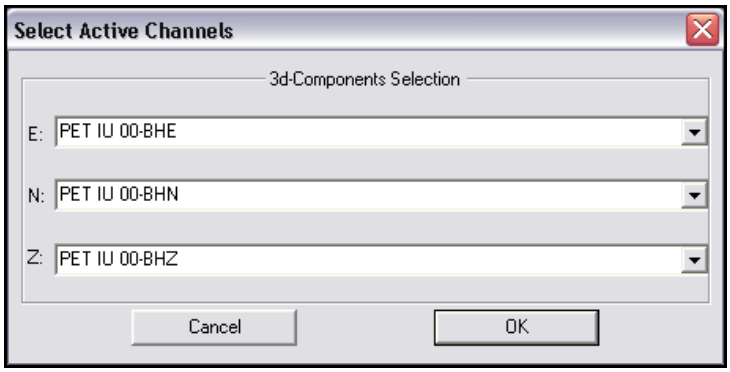


Figure 6-10 Component Selection

4. Edit the ray angles.
5. Select the **OK** button to approve the rotation.

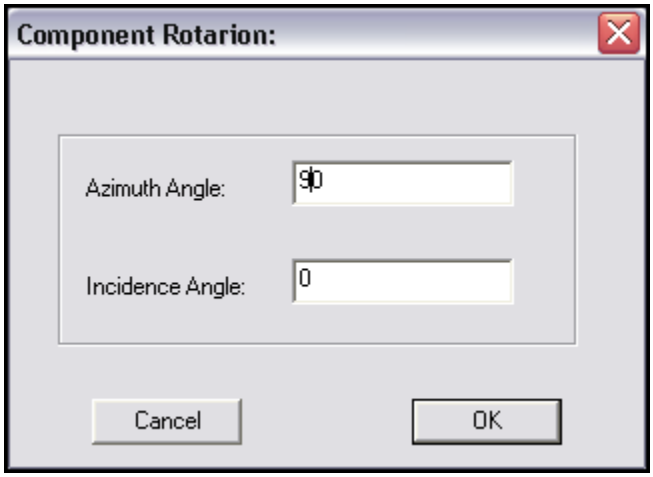


Figure 6-11 Component Rotate Ray Angles

6. The display redraws to show the results of the rotation procedure. The samples on top are the 3 original channels with 3 channels passed through rotation procedure on the bottom.

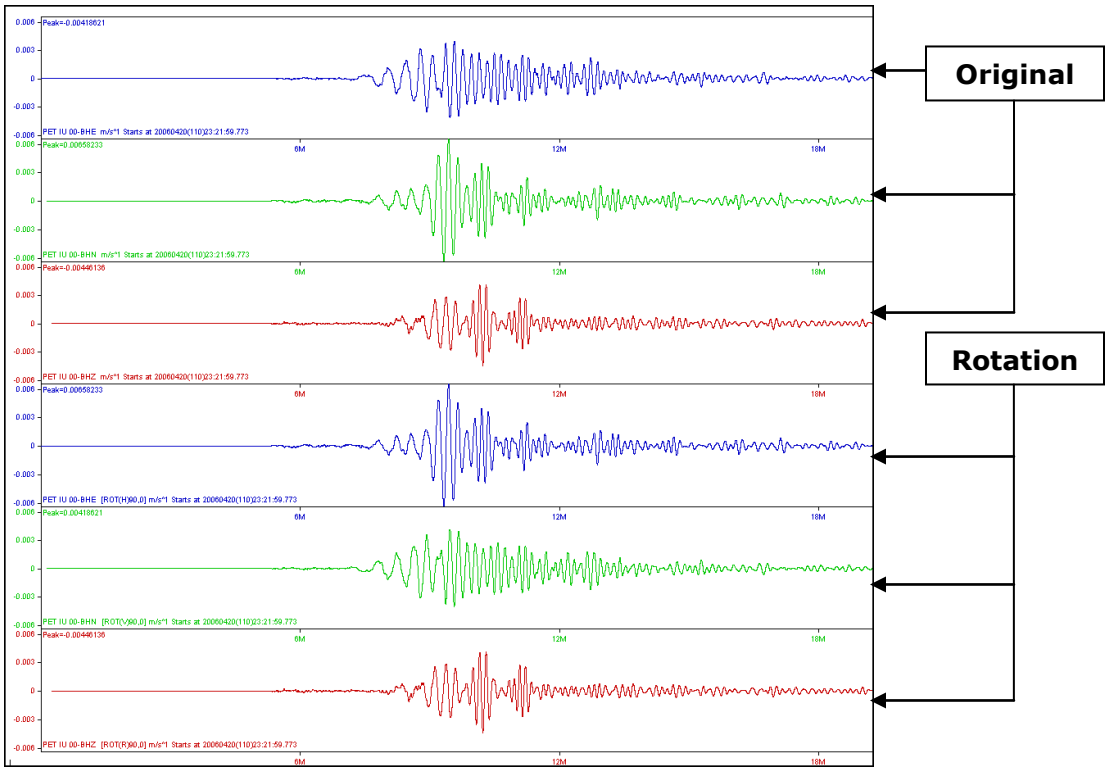


Figure 6-12 Rotation Process

6.5 3D-Vector

A 3D-Vector study involves production of a 3D-Component waveform on different directions.

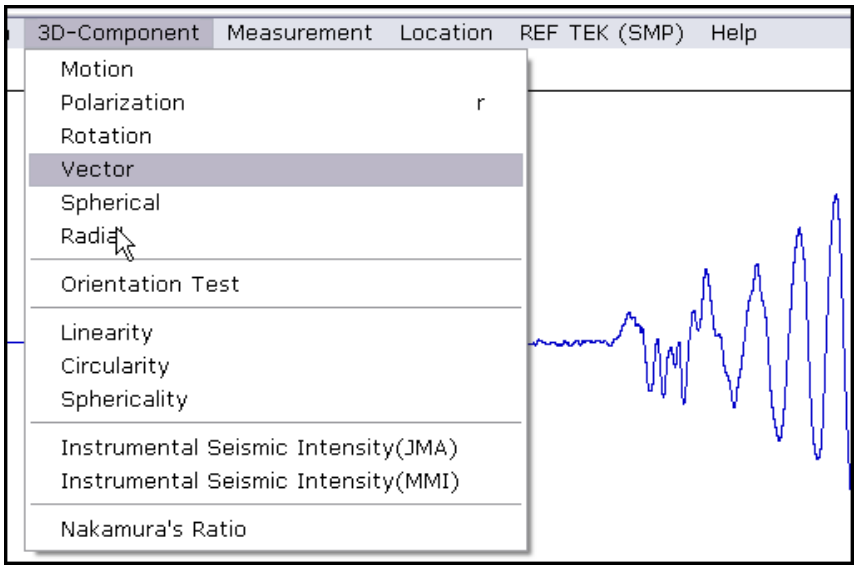


Figure 6-13 Vector Study

For proper 3D-Vector study and correct azimuth to source determination the following information is used:

- For every component the orientation of channel is defined by two angles.
  - The azimuth of the instrument in degrees from north, clockwise.
  - The dip of the instrument, down from horizontal.
- The traditional orientation:
  - Z ----------Dip=-90,Azimuth 0
  - N ----------Dip= 0,Azimuth 0
  - E ----------Dip= 0,Azimuth 90

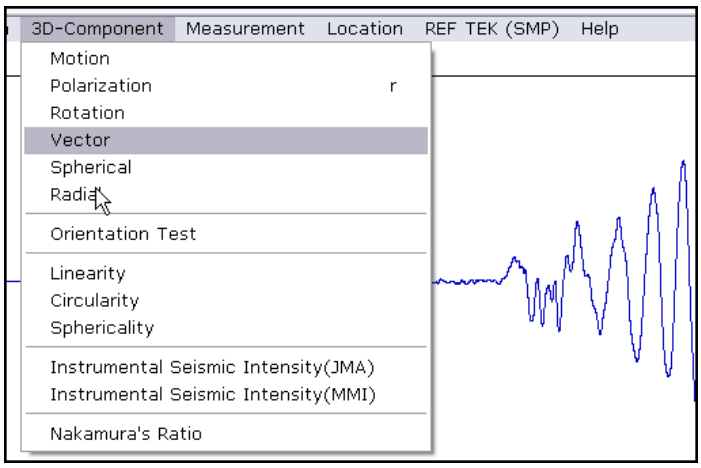
The program reads these values from FULLSEED data files or DATALESS SEED response files (Blockette N=52).

For RAW REF TEK records the program reads these values from the rt#DAS#.rtu file located in the RESPONSE folder.

If the component's orientation is not traditional (but has the perpendicular axes) the program will try to correct this. The sample rate should be the same for all 3 channels.

6.5.1 3D-Component Vector study

1. Select the **Vector** menu.



2. Select the corresponding 3 components for the motion plot.
3. Approve the selection with the **OK** button.

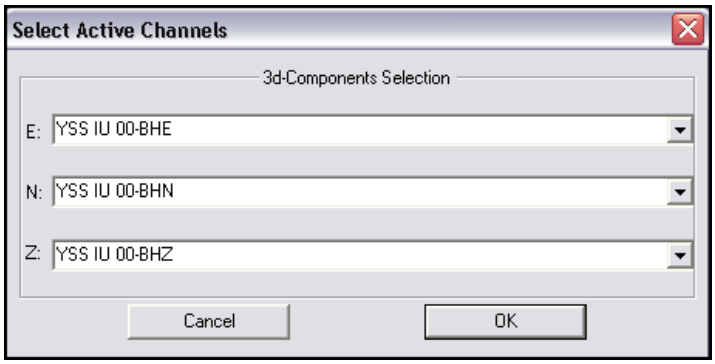
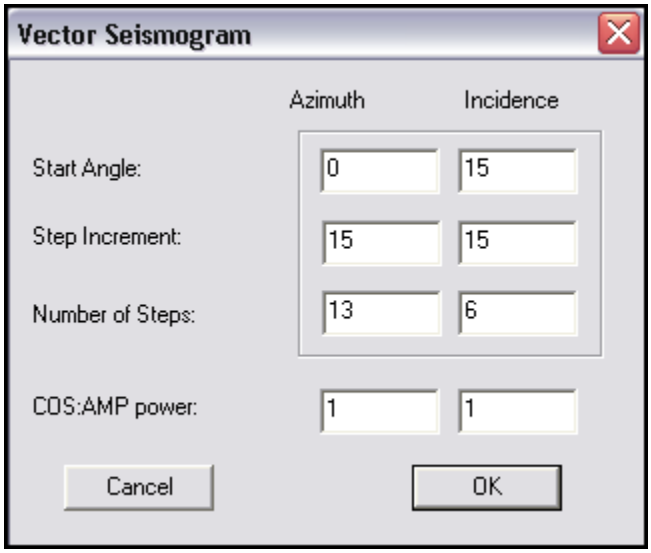


Figure 6-14 Select 3 Components

4. Edit the ray angle parameters.
5. Select the **OK** button to approve the parameters.



6. The example is shown on the display.

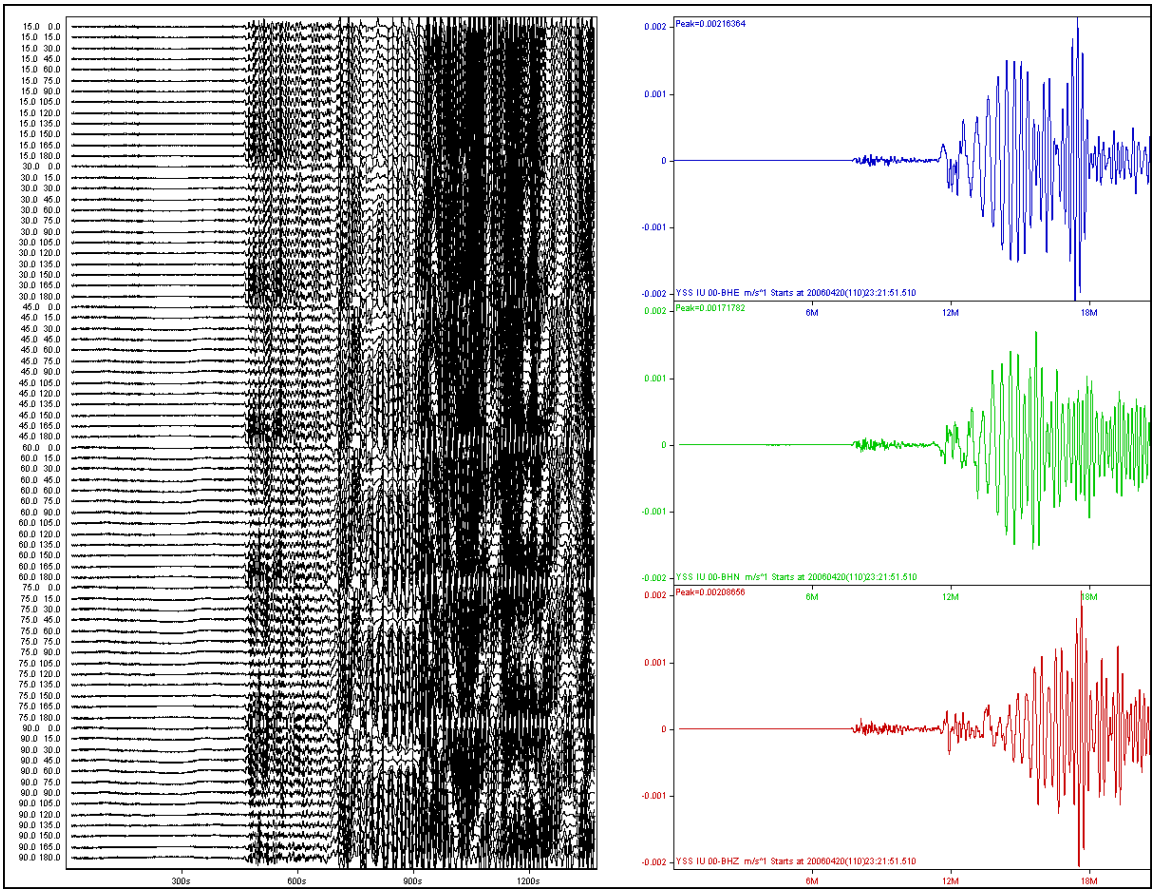


Figure 6-15 Vector Example

6.6 Spherical

Spherical study involves computation of the amplitude of 2-axes of an ellipse of quadrature of the signal using Hilbert transform and plotting both axes in polar coordinates.

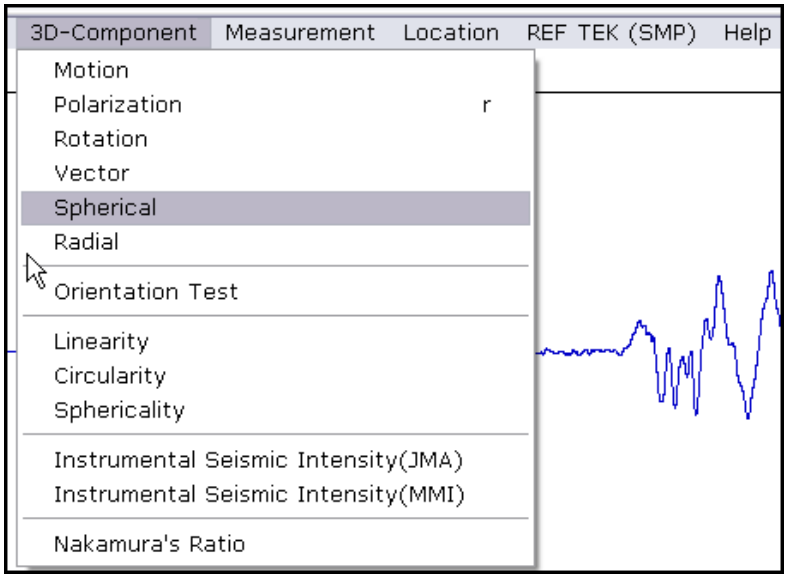


Figure 6-16 Spherical Study

For proper 3D-Polarization study and correct azimuth to source determination the following information is used:

- For every component the orientation of a channel is defined by two angles.
  - The azimuth of the instrument in degrees from north, clockwise.
  - The dip of the instrument, down from horizontal.
- The traditional orientation:
  - Z ----------Dip=-90,Azimuth 0
  - N ----------Dip= 0,Azimuth 0
  - E ----------Dip= 0,Azimuth 90

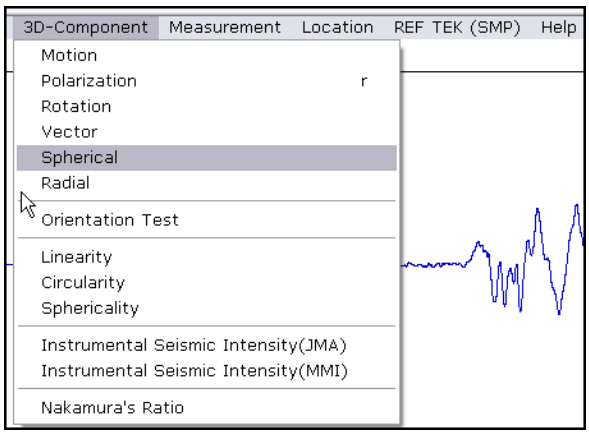
The program reads these values from FULLSEED data files or DATALESS SEED response files (Blockette N=52).

For RAW REF TEK records the program reads these values from the **rt#DAS#.rtu** file located in the **RESPONSE** folder.

If the component's orientation is not traditional (but has the perpendicular axes) the program will try to correct this. The sample rate should be the same for all 3 channels.

6.6.1 3D-Component Spherical

1. Select the **Spherical** menu.



2. Select the corresponding 3 components for the motion plot.
3. Approve the selection with the **OK** button.

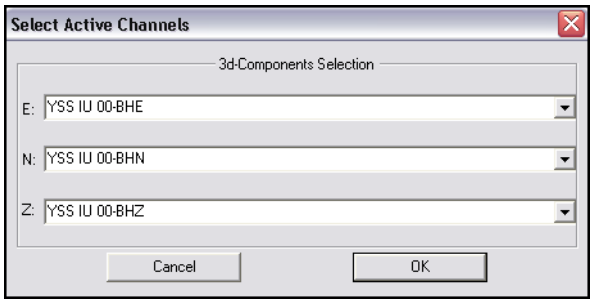


Figure 6-17 Select Active Channels

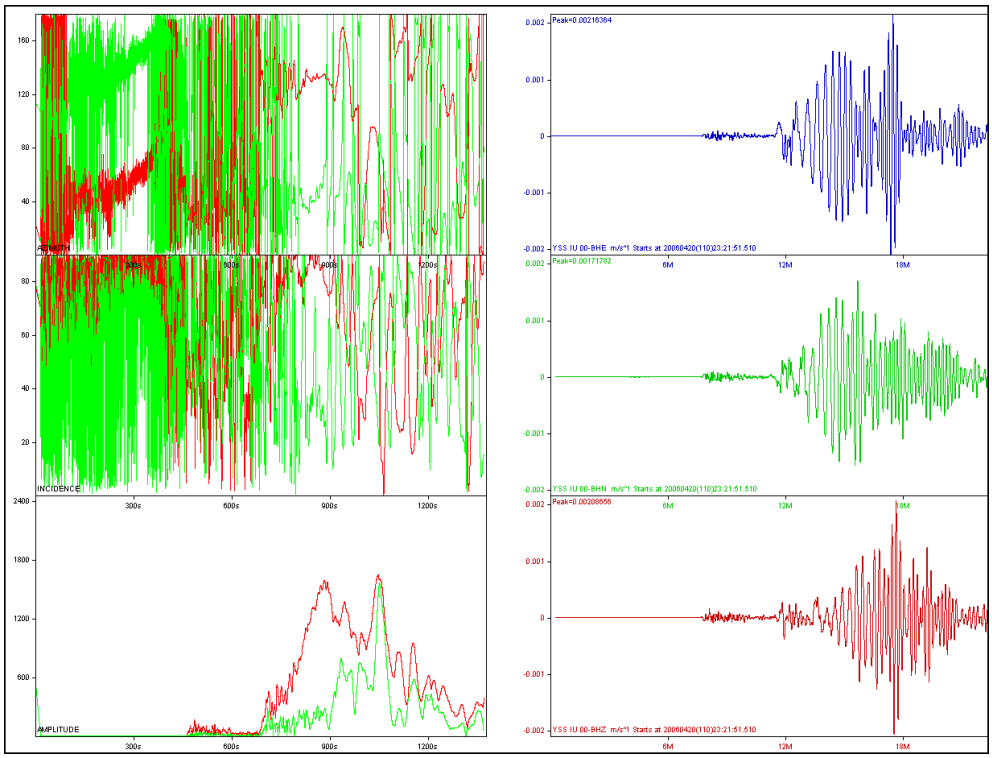


Figure 6-18 Spherical Plot

6.7 Radial

Radial study involves a computation of amplitude of a full 3d-vector =sqrt(E*E+N*N+Z*Z).

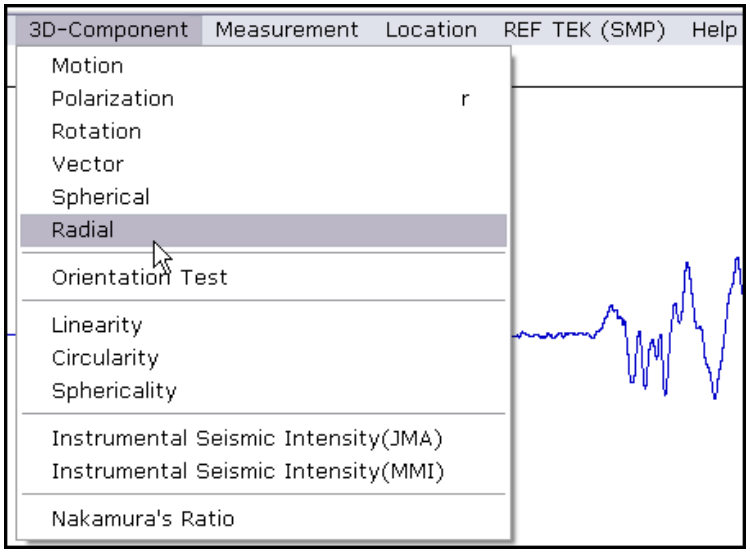


Figure 6-19 Radial

For proper 3D-Polarization study and correct azimuth to source determination the following information is used:

- For every component the orientation of a channel is defined by two angles.
  - The azimuth of the instrument in degrees from north, clockwise.
  - The dip of the instrument, down from horizontal.
- The traditional orientation:
  - Z ----------Dip=-90,Azimuth 0
  - N ----------Dip= 0,Azimuth 0
  - E ----------Dip= 0,Azimuth 90

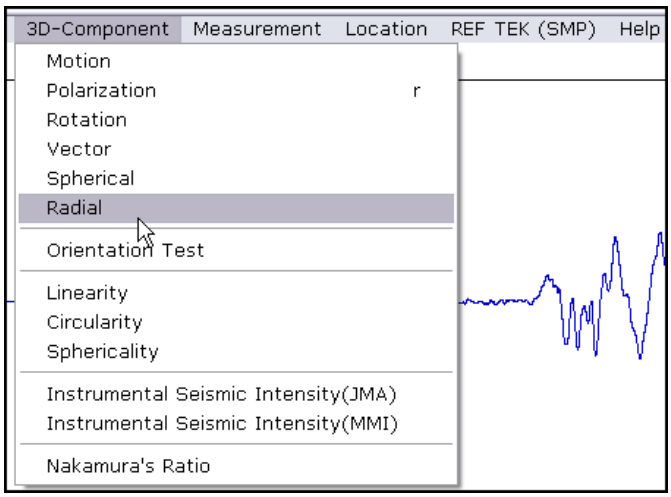
The program reads these values from FULLSEED data files or DATALESS SEED response files Blockette N=52.

For RAW REF TEK records the program reads these values from the **rt#DAS#.rtu** file located in the **RESPONSE** folder.

If the component's orientation is not traditional (but has the perpendicular axes). The program will try to correct this. The sample rate should be the same for all 3 channels.

6.7.1 3D-Component Radial study

1. Select **Radial** from the menu.



2. Select the corresponding 3 components for the motion plot.
3. Approve the selection with the **OK** button.

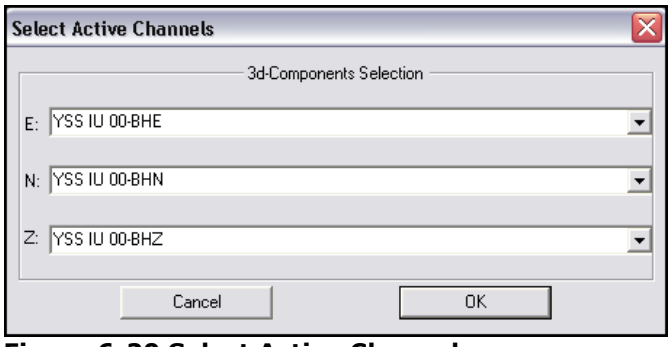


Figure 6-20 Select Active Channels

4. The display shows the sample plot.

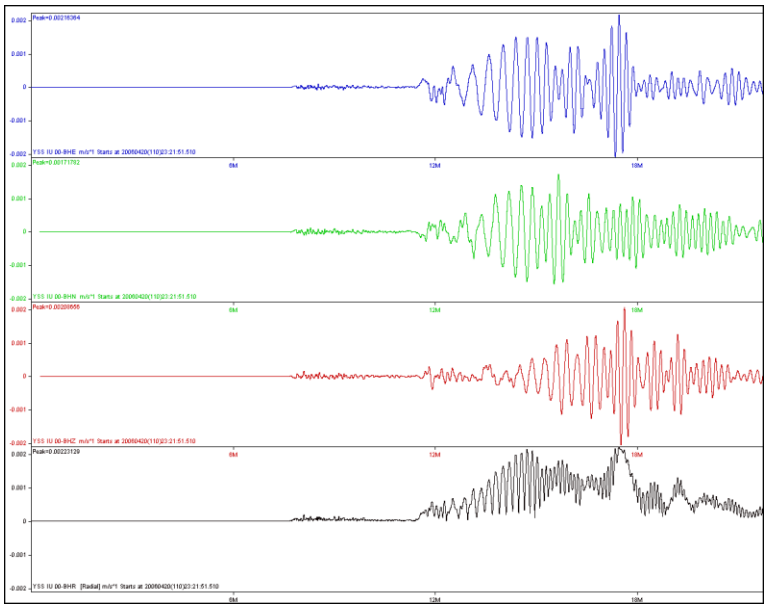


Figure 6-21 Radial Study

6.8 Orientation Test

Computation of 3-D Orientation Test

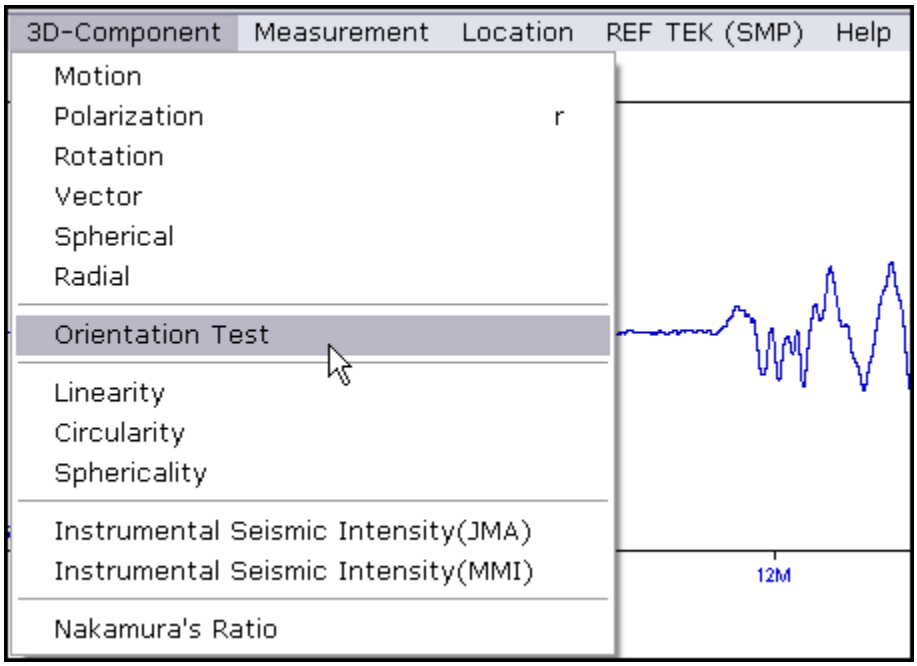


Figure 6-22 Orientation Test

6.8.1 Orientation Test Example

1. Select the **Orientation Test** command from the **3D-Component** pull-down menu.

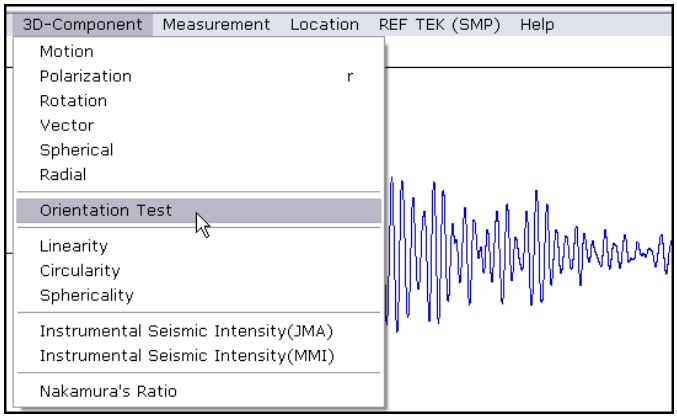


Figure 6-23 Orientation Test

2. Select the active channels for the study.
3. Approve the channels selected with the **OK** button.

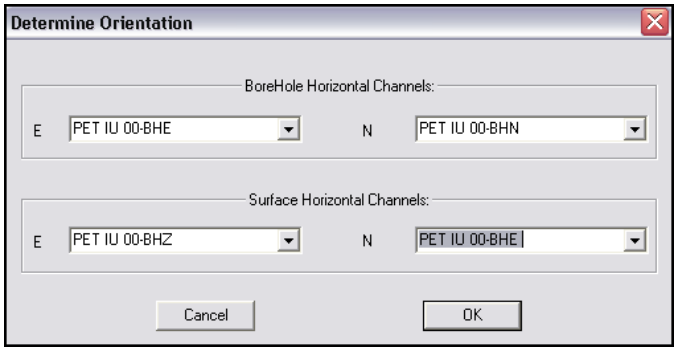
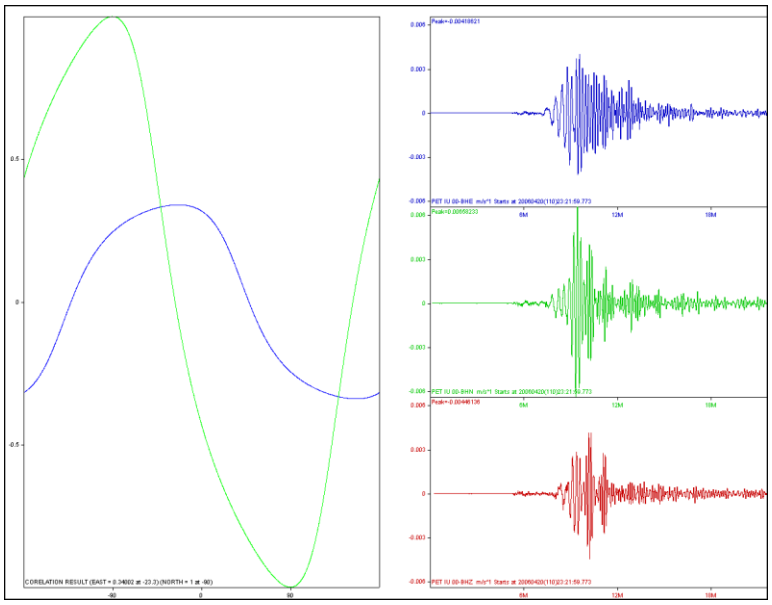


Figure 6-24 Select Active Channels

4. The display redraws to show the results.



6.9 Linearity

Computation of 3D-components axes ratio to detect how close the waves polarizations are to linear, elliptical or complex type, using a running average STA detector window.

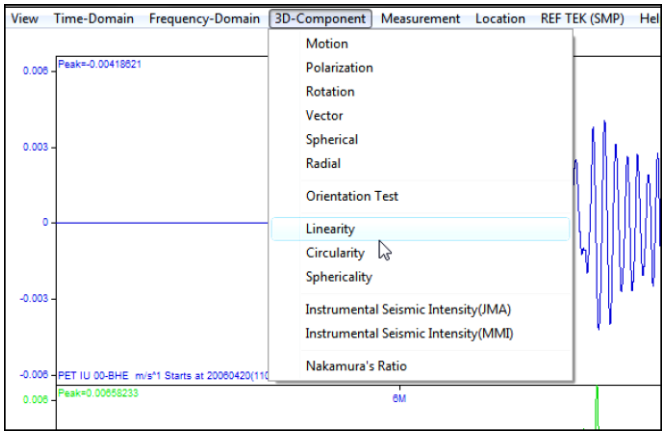


Figure 6-25 Linear

6.9.1 Linearity study example

1. Select the **Linearity** command from the **3D-Component** pull-down menu.

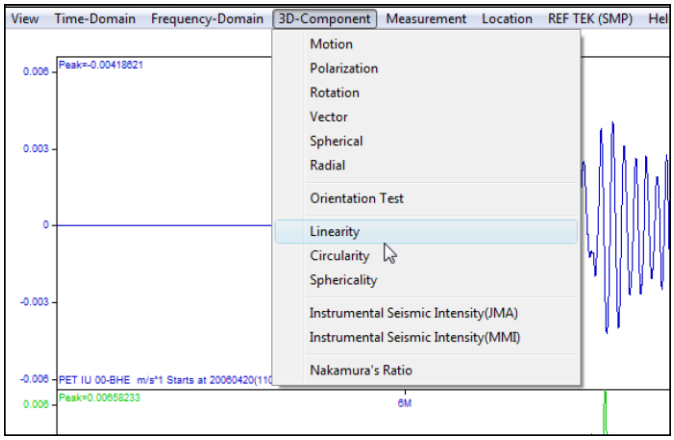


Figure 6-26 Linearity Study

2. Select the active channels for the study.
3. Approve the channels selected with the **OK** button.

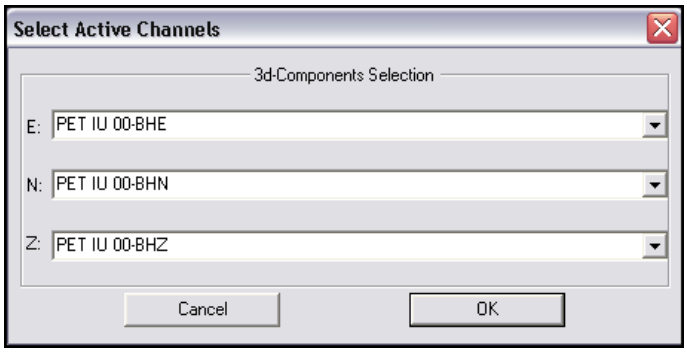


Figure 6-27 Select Active Channels

4. Fill in the STA time in seconds.
5. Select the **OK** button to approve the time settings.

6. The display redraws to shows the 3D-Component linearity study.

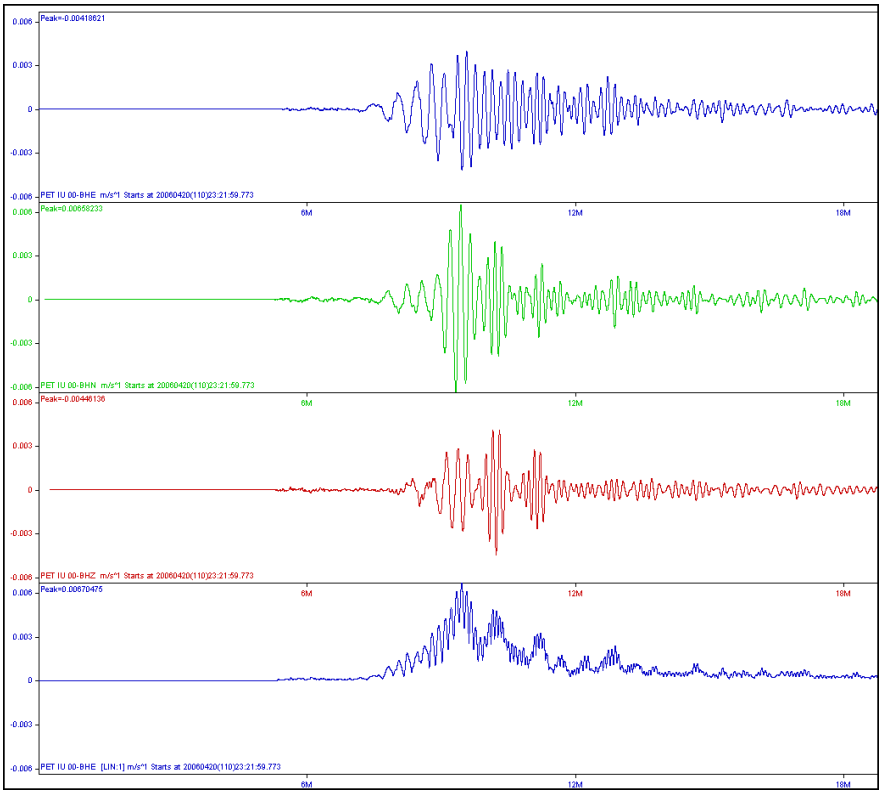


Figure 6-28 Linearity Results

6.9.2 Circularity study example

1. Select the **Circularity** command from the **3D-Component** pull-down menu.

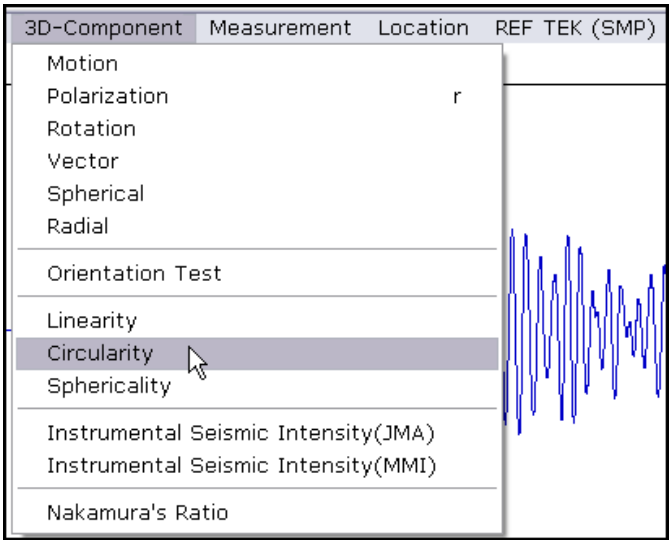


Figure 6-29 Circularity

2. Enter the active channel components.
3. Select the **OK** button to approve the settings.

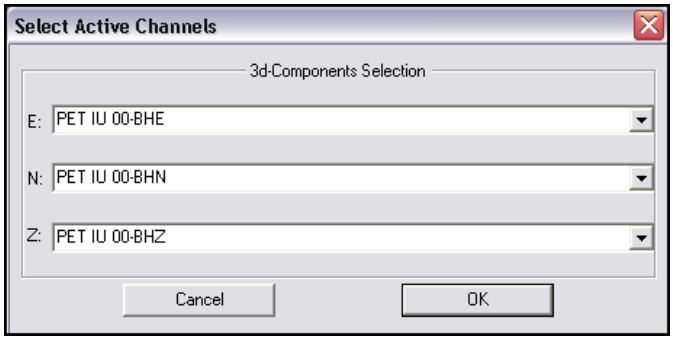


Figure 6-30 Select Active Channels

4. Enter the STA time in seconds.
5. Approve the time with the **OK** button.

Figure 6-31 STA Time

6. The display redraws to shows the **Circularity Study** results.

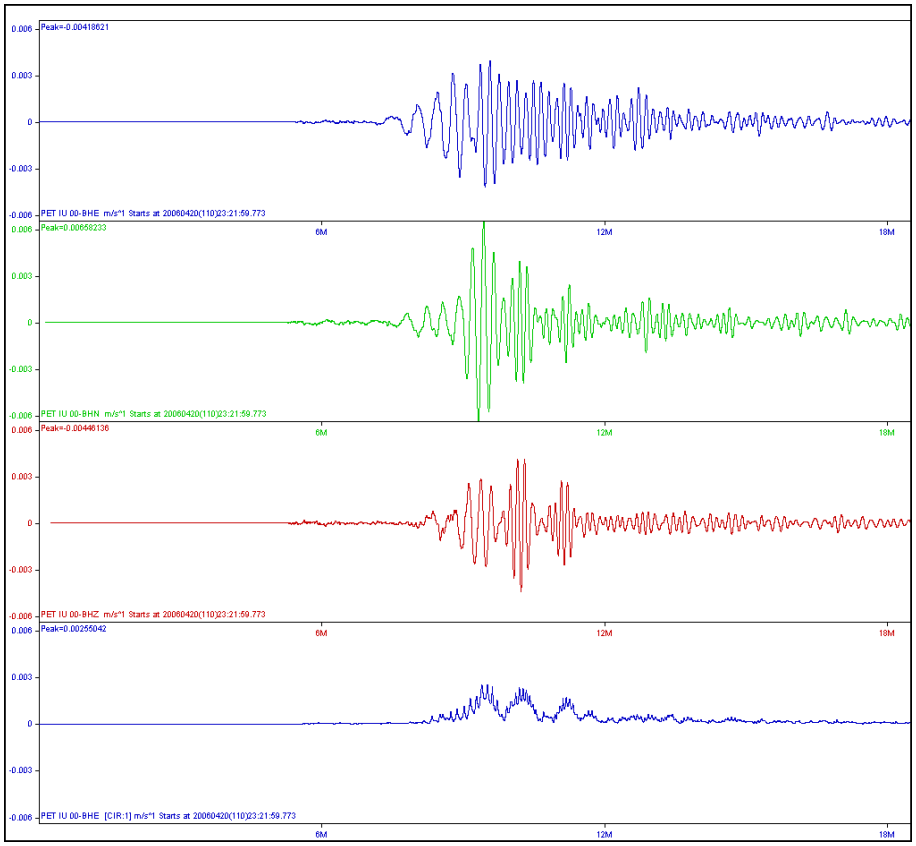


Figure 6-32 Circularity Results

6.9.3 Sphericality study

1. Select **Sphericality** from the **3D-Component** pull-down menu.

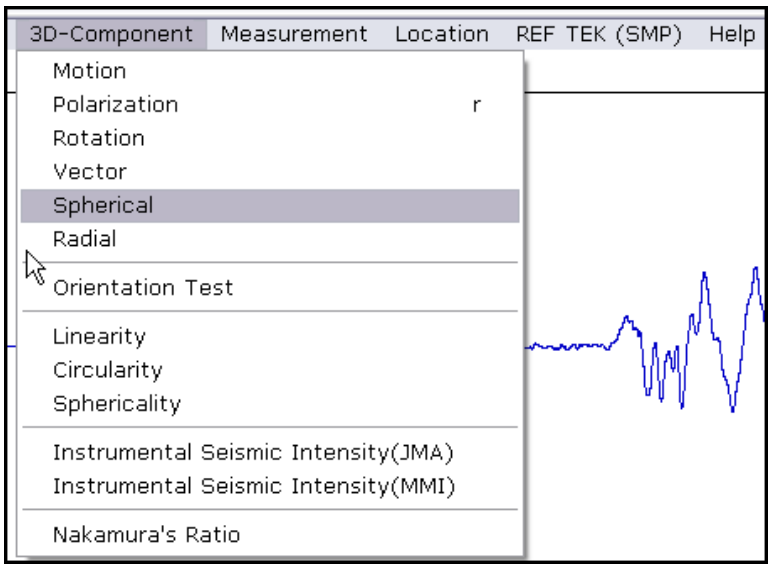


Figure 6-33 Sphericality

2. Select the desired Active channels.
3. Select the **OK** button to approve the channels.

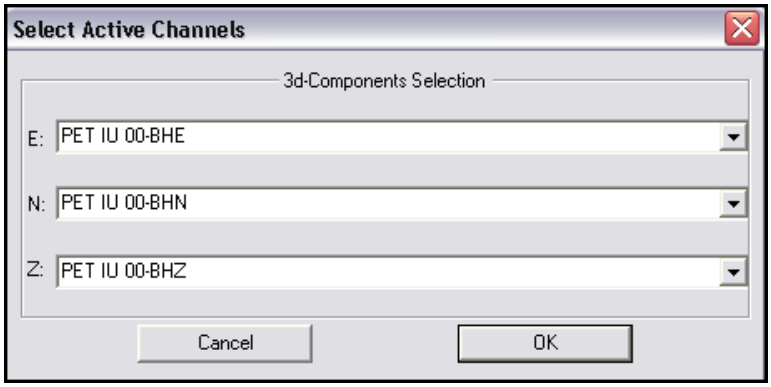
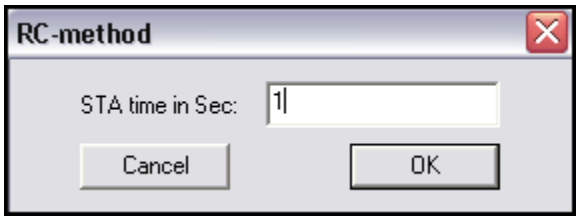


Figure 6-34 Select Active Channels

4. Enter the STA time in seconds.
5. Select the **OK** button to accept the time.



6. The results display on the screen.

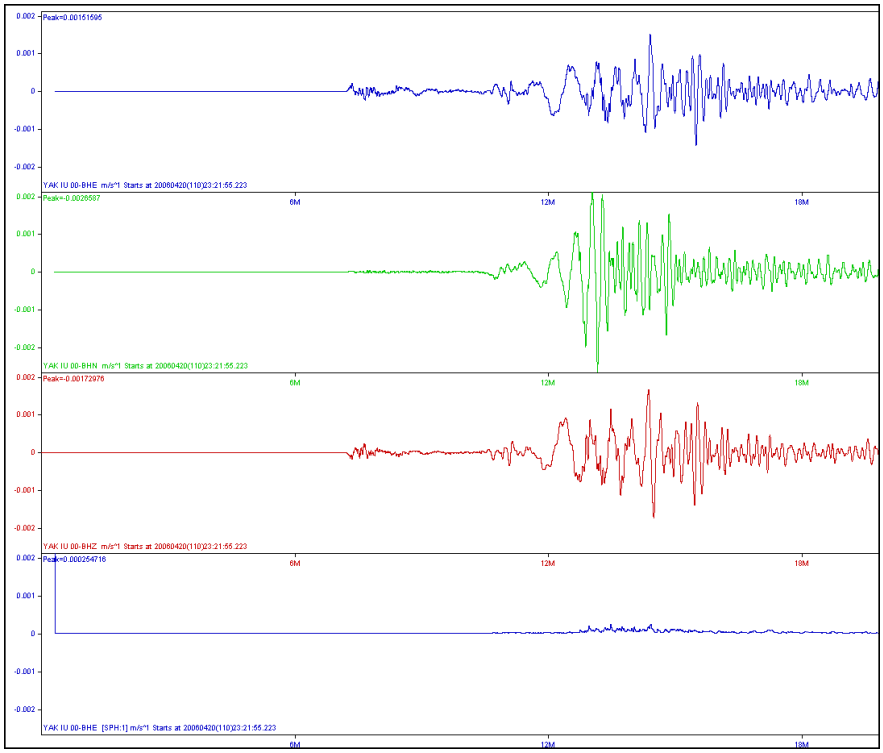


Figure 6-35 Sphericality Results

6.10 Instrumental Seismic Intensity (JMA)

Computation of JMA Seismic Intensity uses (Velocity * Acceleration) a filter within the 0.5 - 10 Hz frequency band.

1. Select the **Instrumental Seismic Intensity (JMA)** command from the **3D-Component** pull-down menu.

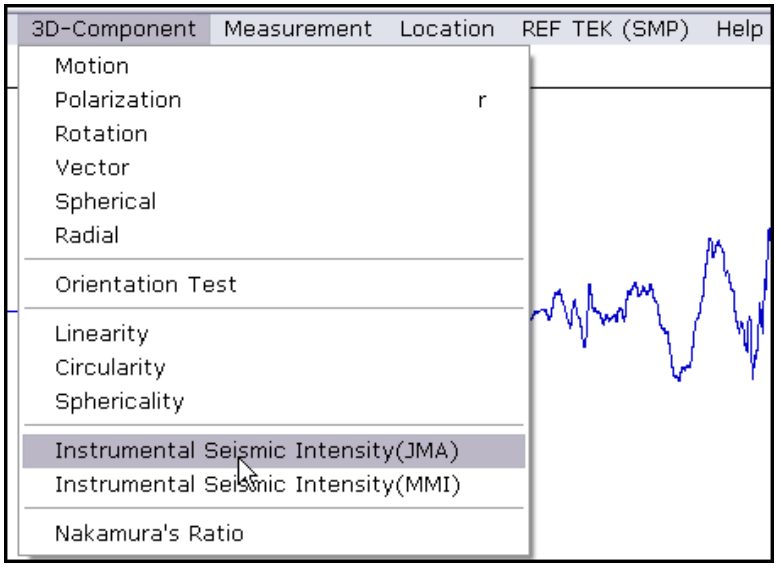


Figure 6-36 JMA

2. Select the desired Active channels.
3. Select the **OK** button to approve the channels.

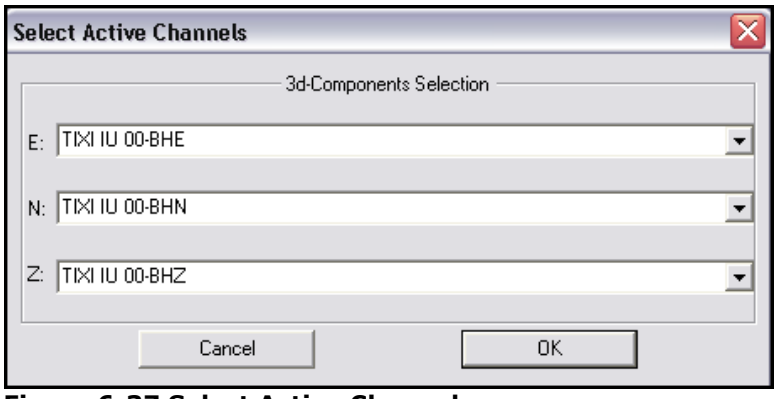


Figure 6-37 Select Active Channels

Note: The original 3D-Component record should be from a strong motion accelerometer.

4. The screen should display the results.

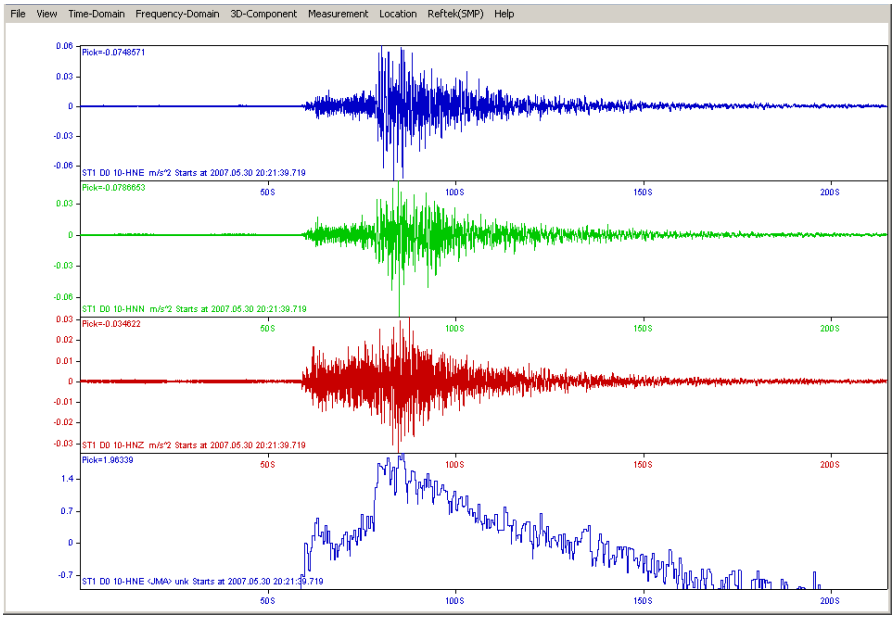


Figure 6-38 JMA Seismic Intensity

6.11 Instrumental Seismic Intensity (MMI)

Computation of MMI Seismic Intensity uses a filter (Velocity * Acceleration) within the 0.5 - 10 Hz frequency band.

1. Select the **Instrumental Seismic Intensity (MMI)** command from the **3D-Component** pull-down menu.

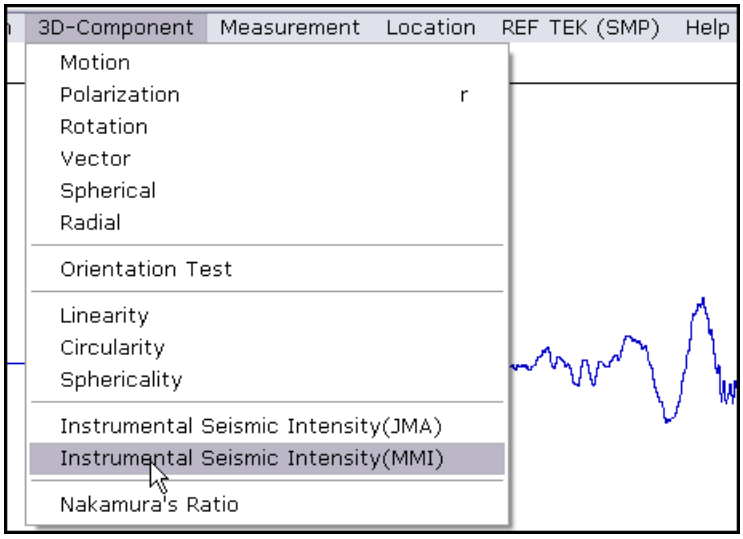


Figure 6-39 MMI Intensity

2. Select the desired Active channels.
3. Select the **OK** button to approve the channels.

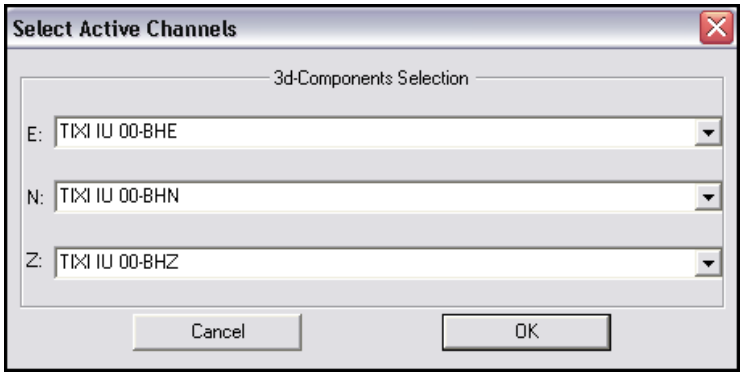


Figure 6-40 Select Active Channels

Note: The original 3D-Component record should be from a strong motion accelerometer.

4. The screen should display the results.

Figure 6-41 MMI Seismic Intensity

6.12 Nakamura's Ratio

Used for site effects estimation based on the H/V spectral ratio of ambient noise recordings. The determined peak frequencies are interpreted as the fundamental resonance frequencies of the investigated sites, thus providing information on shallow layer characteristics and geometry. The seismic noise is usually measured along two horizontal directions and one vertical so two Nakumura spectral ratios are obtained and in some cases show noteworthy differences.

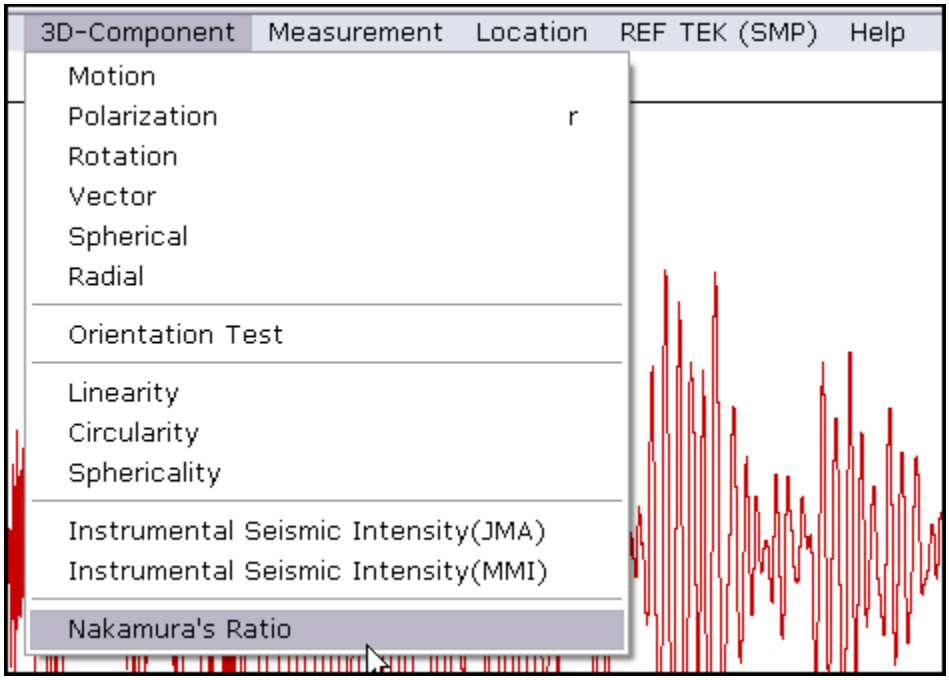


Figure 6-42 Nakamura's Ratio

6.12.1 Using Nakamura's Ratio

1. Select the **Nakamura's Ratio** command from the **3D-Component** pull-down menu.

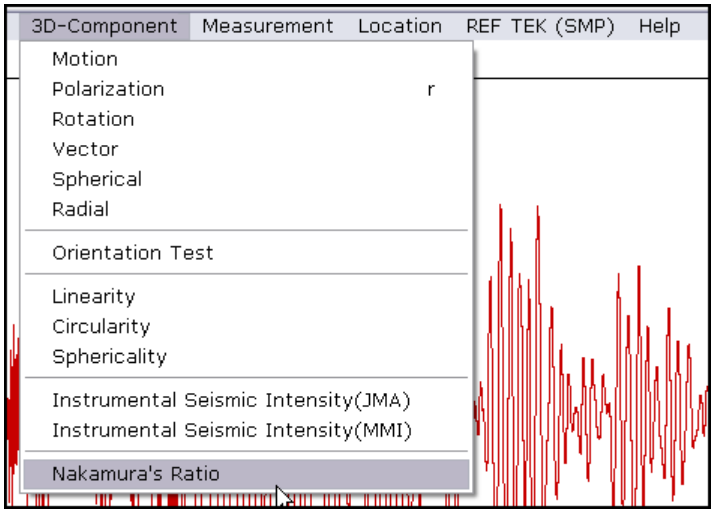


Figure 6-43 Nakamura's Ratio

2. Select the desired **Active Channels**.
3. Select the **OK** button to approve the channels.

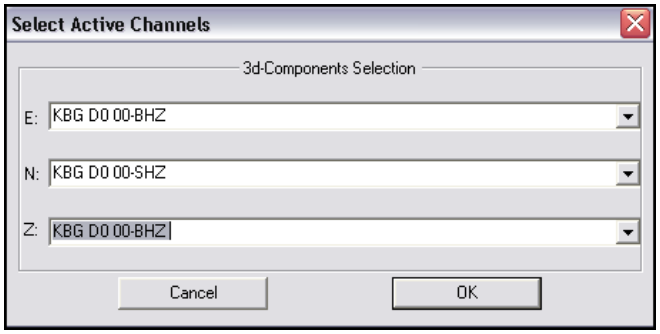
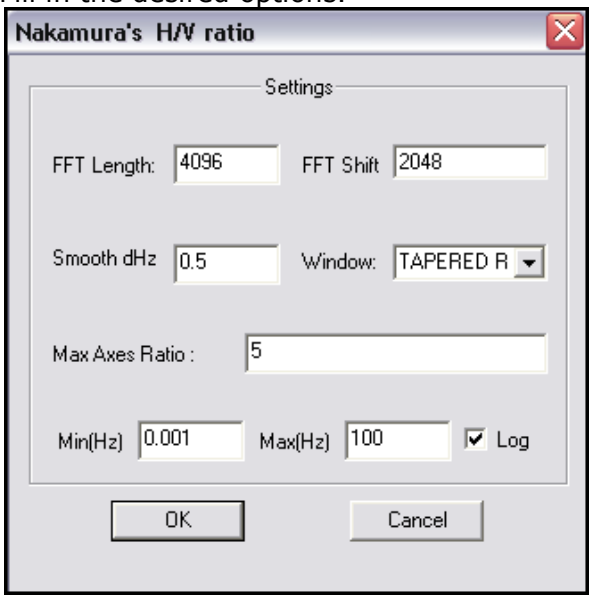


Figure 6-44 Select Active Channels

4. Fill in the desired options.



5. The screen should display the results.

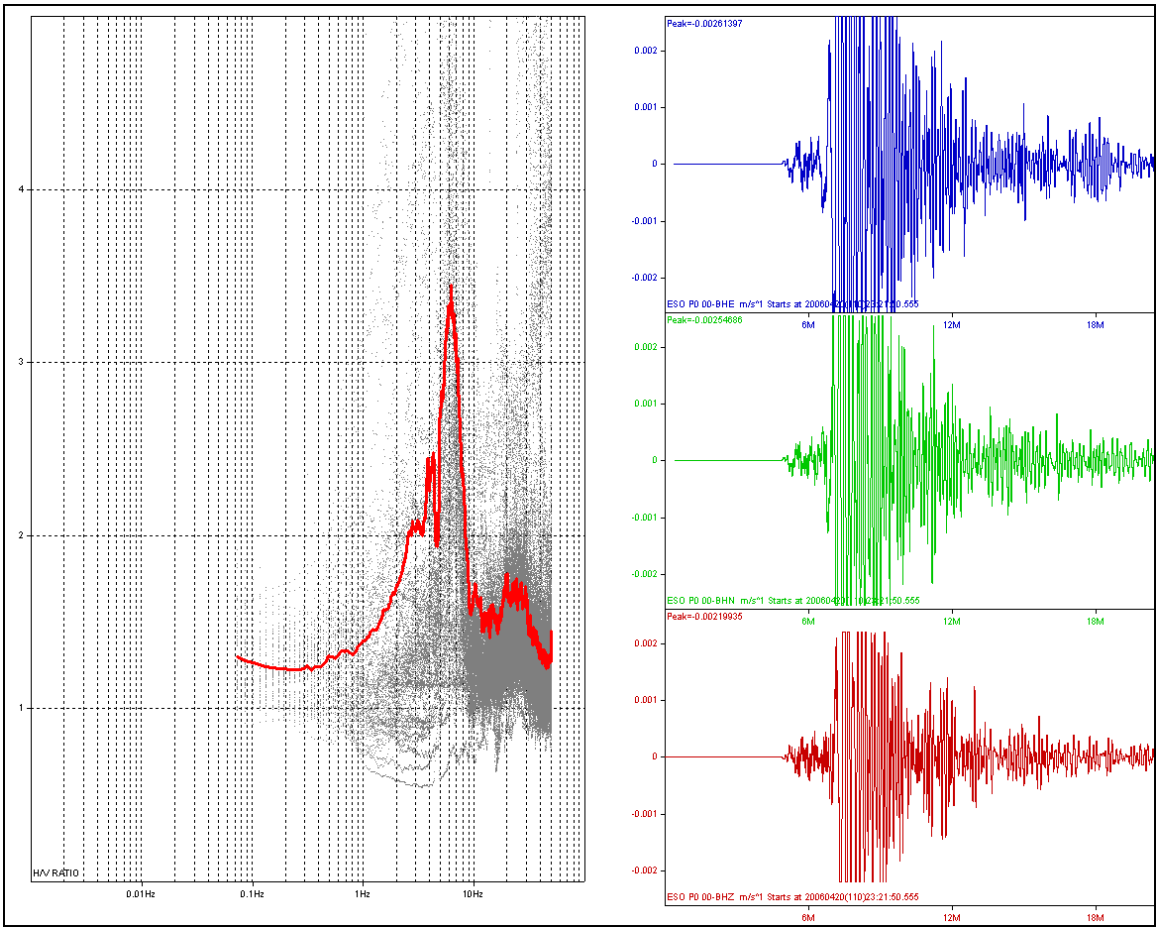


Figure 6-45 Nakamura's Ratio

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