

# Using Ambient Vibration Array Techniques for Site Characterisation

## Spatial Autocorrelation

## Tutorial

# 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*

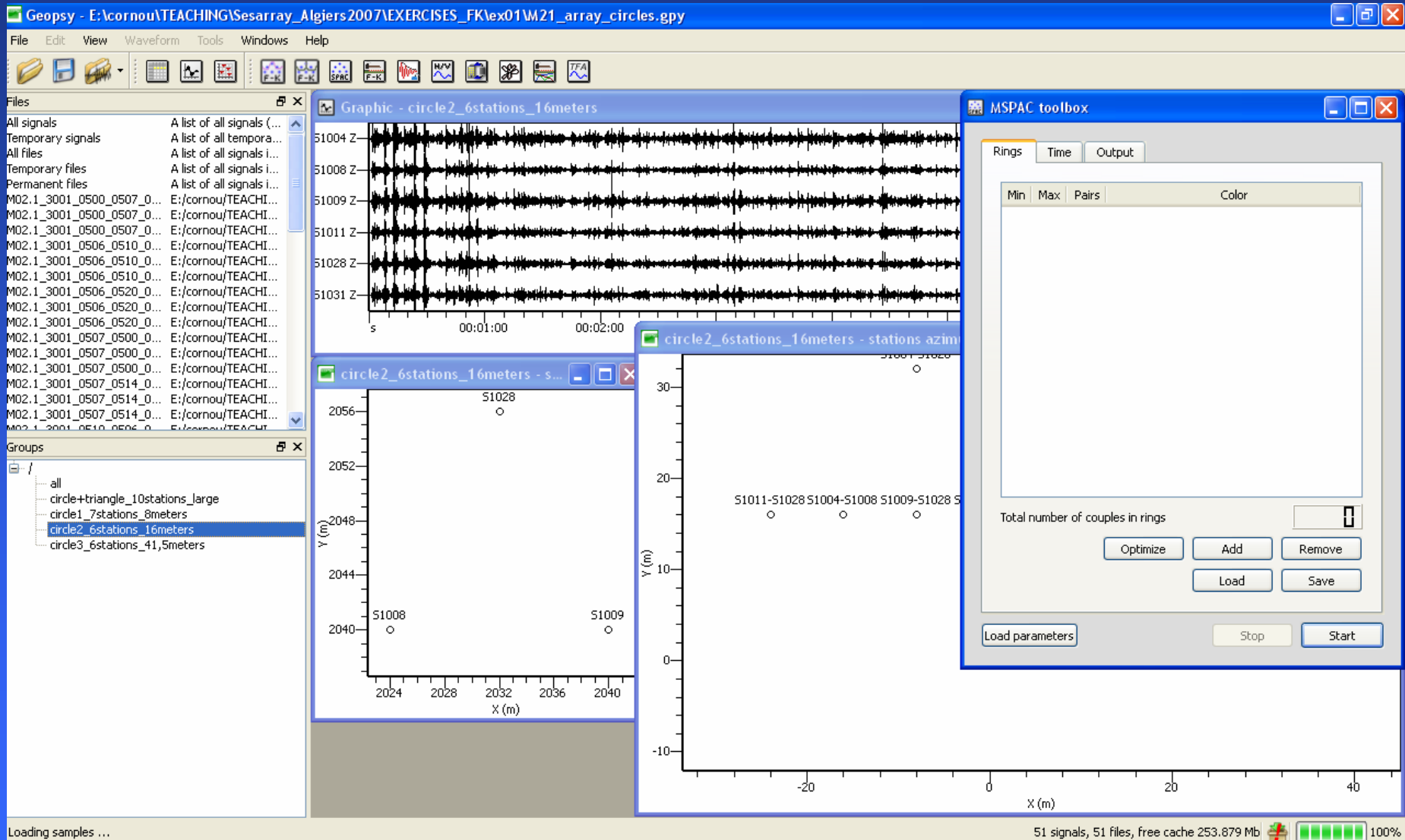
**max2curve**

**spac2disp**

**DINVER**

*inversion*

# Loading database and launch spac *EX01/M21\_array\_circles.gpy*



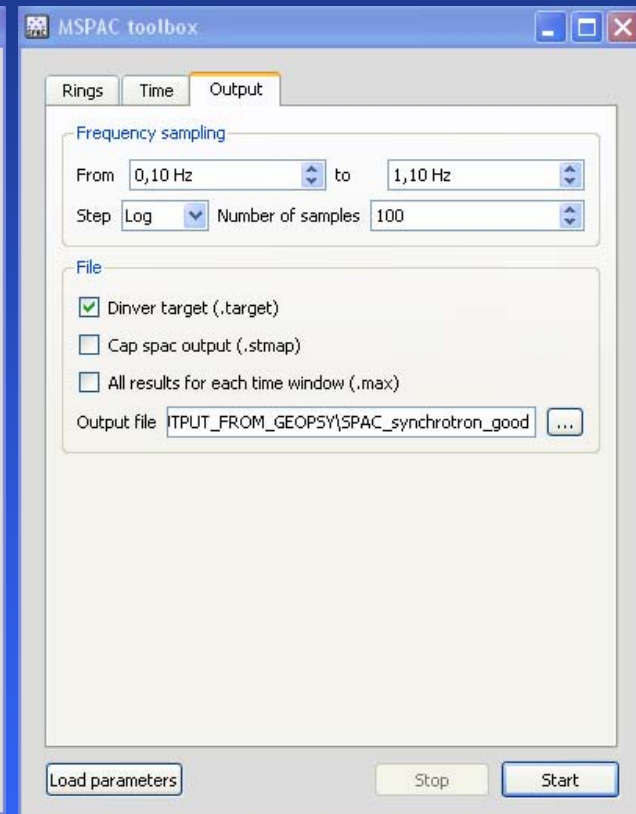
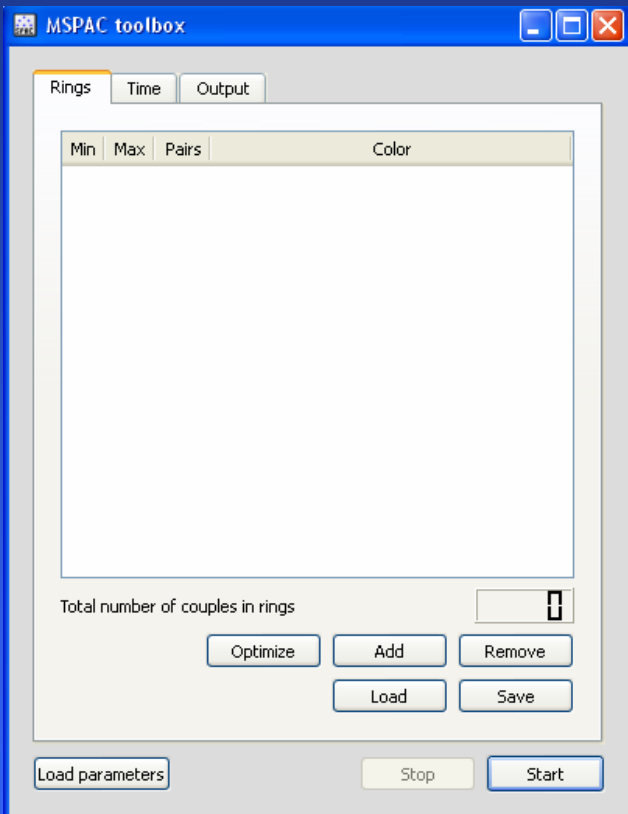
The screenshot displays the Geopsy software interface. The main window shows a list of signals on the left and a waveform plot in the center. The waveform plot displays multiple seismic traces labeled with station IDs: 51004 Z, 51008 Z, 51009 Z, 51011 Z, 51028 Z, and 51031 Z. The x-axis represents time in seconds, ranging from 00:01:00 to 00:02:00.

Below the waveform plot, there are two station location plots. The left plot, titled "circle2\_6stations\_16meters - s...", shows a scatter plot of station locations in the X-Y plane (meters). The x-axis ranges from 2024 to 2040, and the y-axis ranges from 2040 to 2056. Station 51028 is located at approximately (2032, 2056), 51008 at (2024, 2040), and 51009 at (2040, 2040).

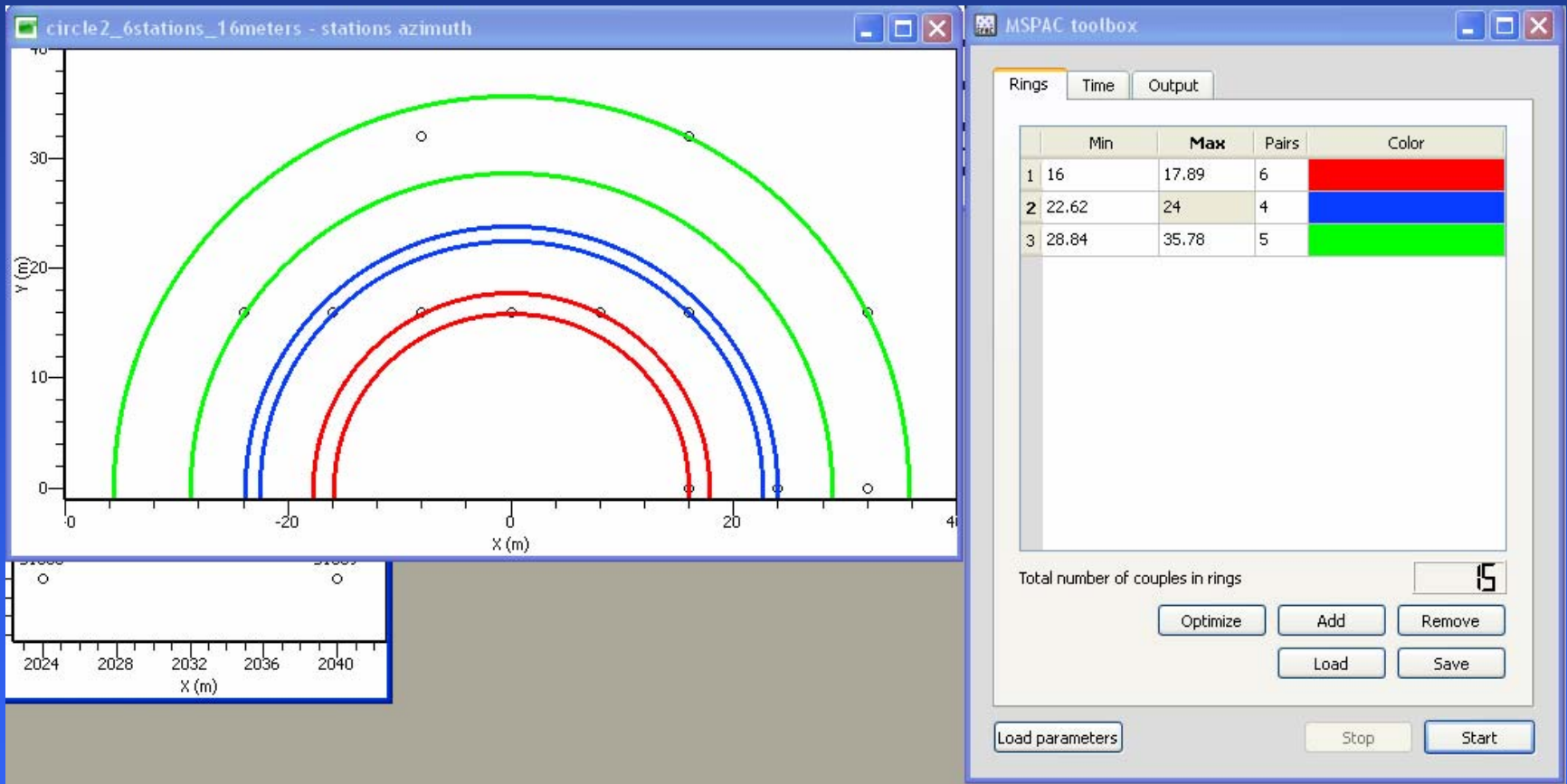
The right plot, titled "circle2\_6stations\_16meters - stations azimuth", shows a scatter plot of station locations in the X-Y plane (meters). The x-axis ranges from -20 to 40, and the y-axis ranges from -10 to 30. Station 51011-51028 is located at approximately (-15, 18), 51004-51008 at (-10, 18), and 51009-51028 at (10, 18).

On the right side of the interface, the "MSPAC toolbox" is open, showing options for "Rings", "Time", and "Output". The "Rings" tab is selected, and the "Total number of couples in rings" is set to 0. Buttons for "Optimize", "Add", "Remove", "Load", "Save", "Load parameters", "Stop", and "Start" are visible.

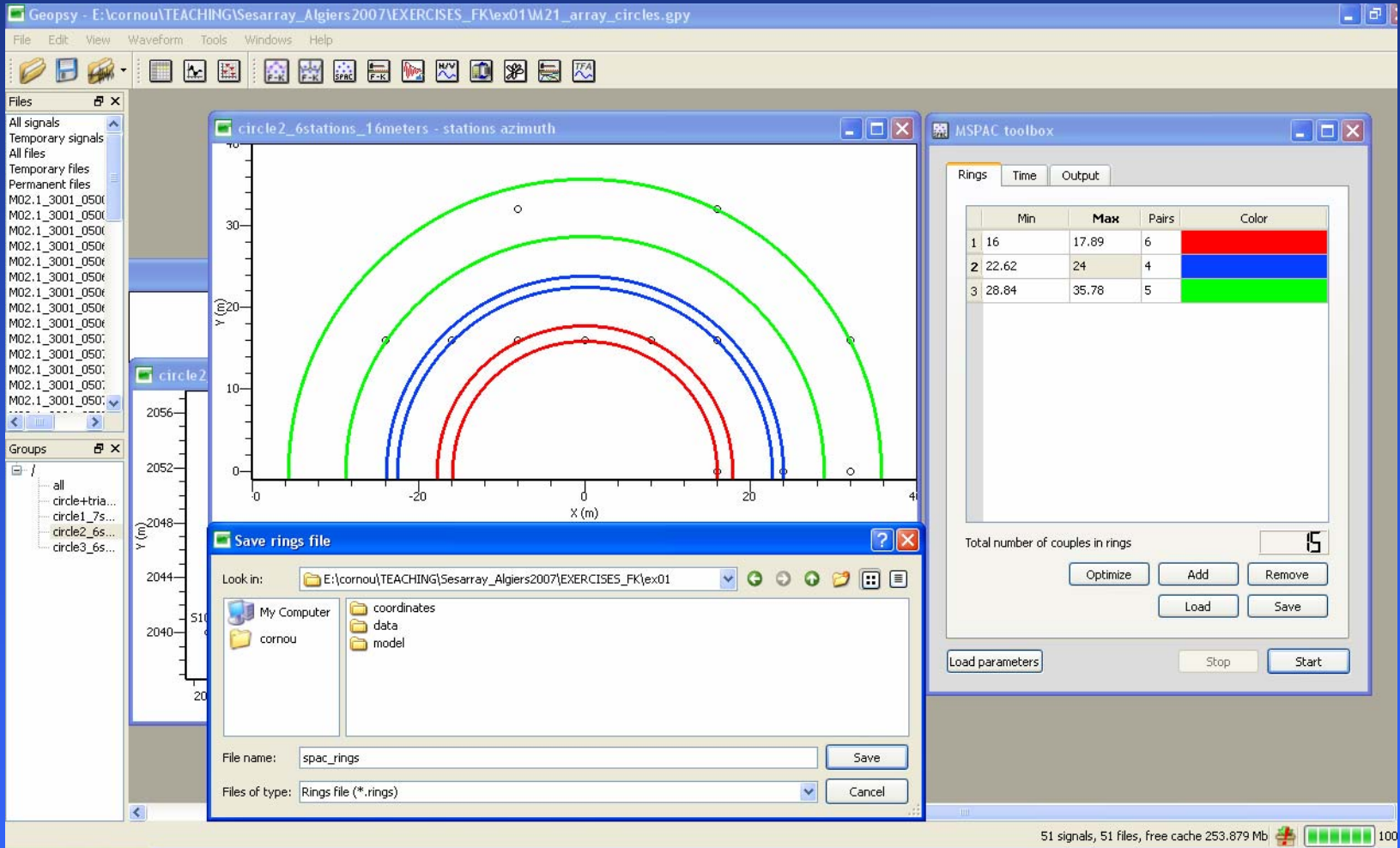
The status bar at the bottom indicates "Loading samples ..." and "51 signals, 51 files, free cache 253.879 Mb".



# Design the rings



# Save the rings



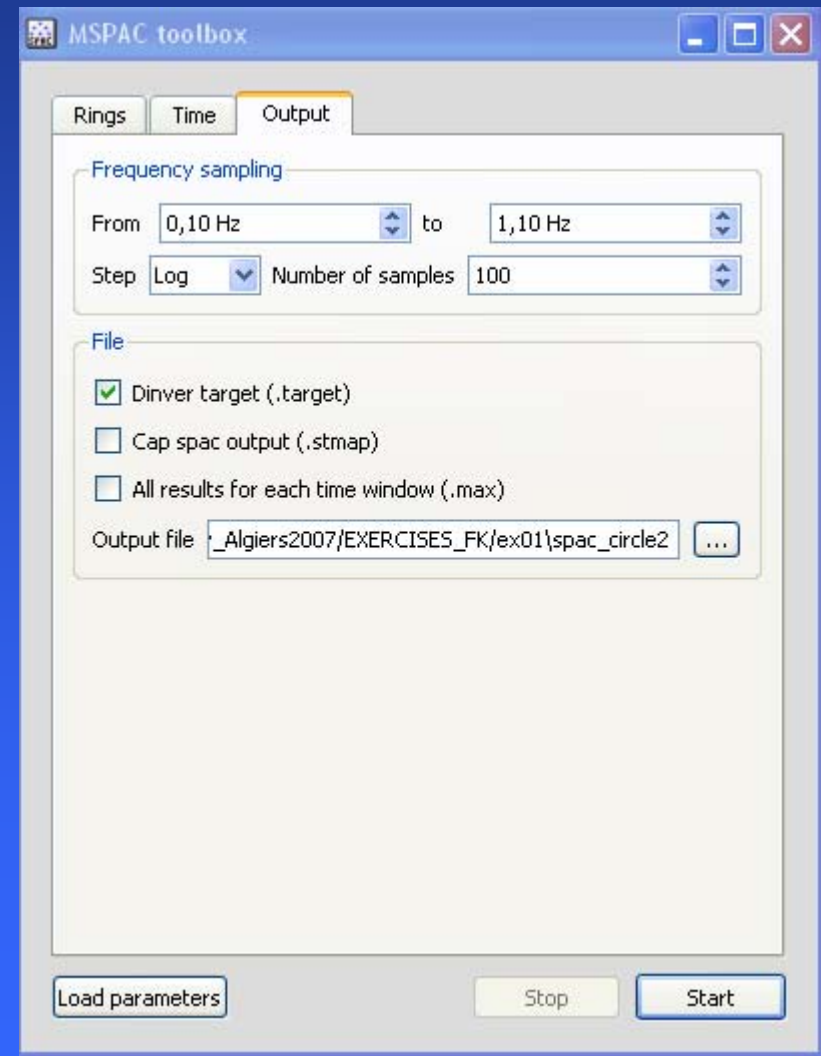
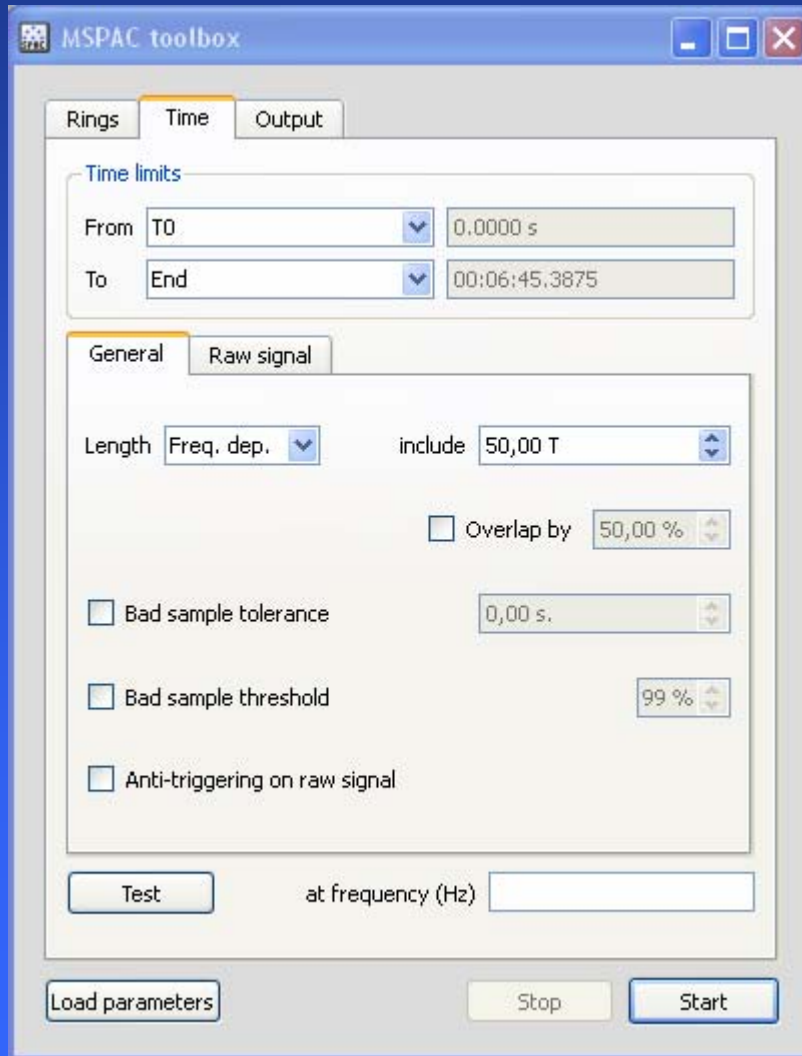
The screenshot shows the Geopsy software interface with the following components:

- Main Window:** A plot titled "circle2\_6stations\_16meters - stations azimuth" showing concentric semi-circular rings in green, blue, and red on a coordinate system with X (m) on the horizontal axis and Y (m) on the vertical axis.
- MSPAC toolbox:** A panel on the right with tabs for "Rings", "Time", and "Output". It contains a table with the following data:
 

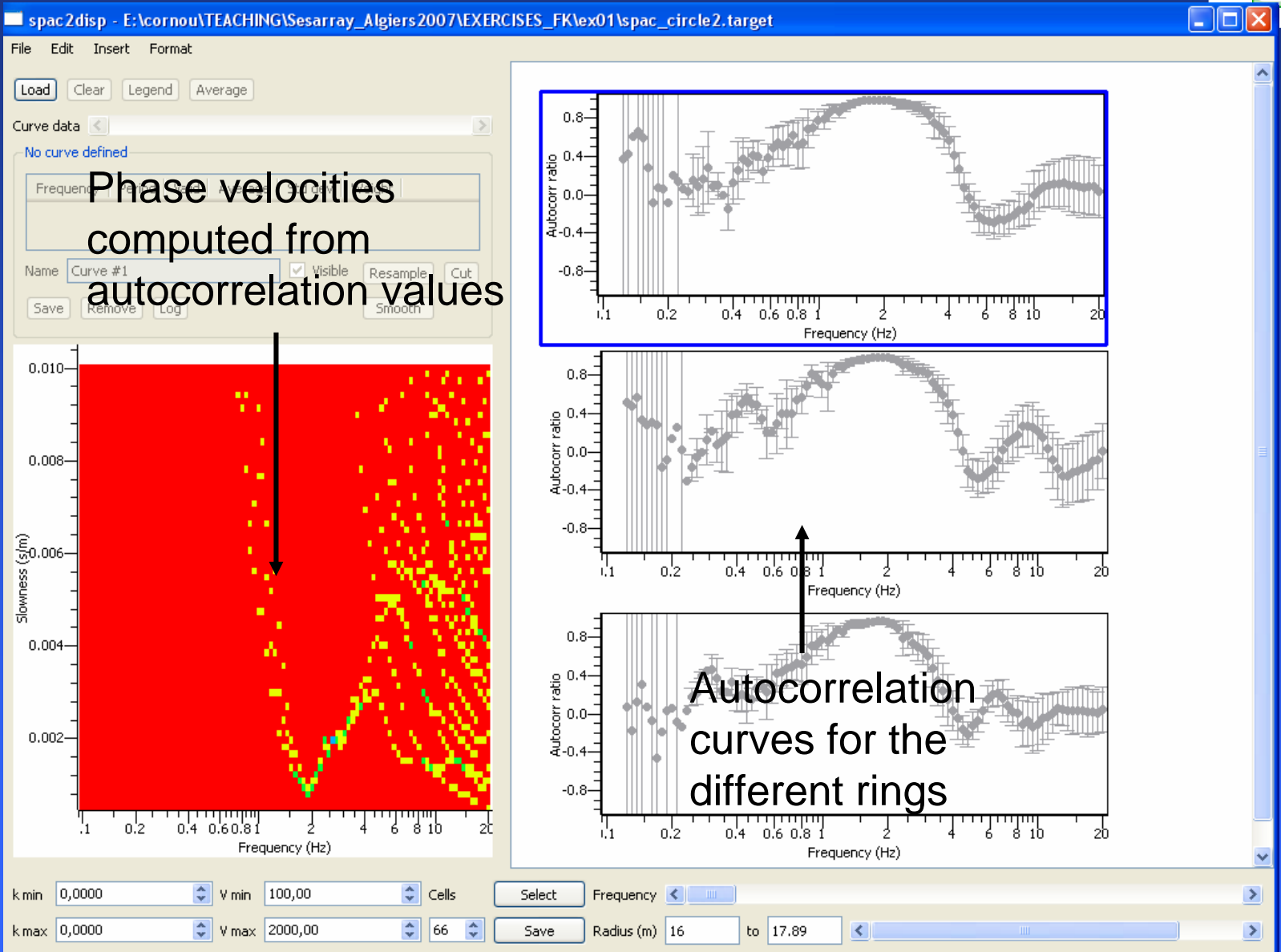
	Min	Max	Pairs	Color
1	16	17.89	6	Red
2	22.62	24	4	Blue
3	28.84	35.78	5	Green

 Below the table, it shows "Total number of couples in rings" as 15, and buttons for "Optimize", "Add", "Remove", "Load", "Save", "Load parameters", "Stop", and "Start".
- Save rings file dialog:** A modal dialog box in the foreground with "Look in:" set to "E:\cornou\TEACHING\Sesarray\_Algiers2007\EXERCISES\_FK\ex01". It shows a file explorer view with folders "coordinates", "data", and "model". The "File name:" field contains "spac\_rings" and "Files of type:" is set to "Rings file (\*.rings)".
- Files Panel:** On the left, a list of files including "circle2\_6s...", "circle1\_7s...", and "circle+tria...".
- Status Bar:** At the bottom right, it displays "51 signals, 51 files, free cache 253.879 Mb" and a progress indicator at 100%.

# Run MSPAC

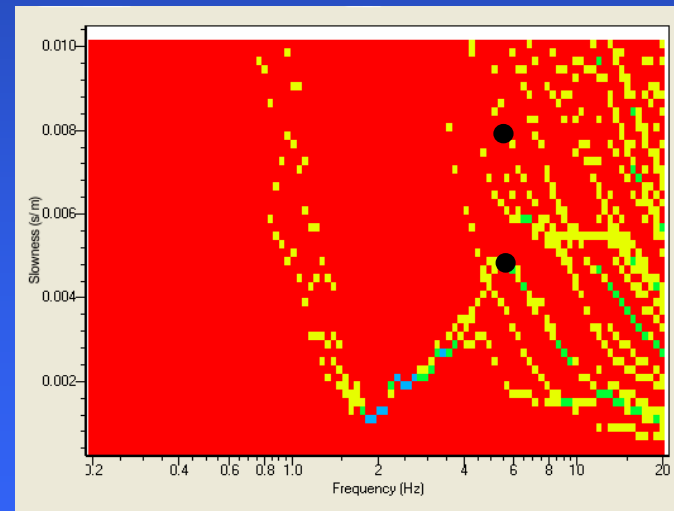
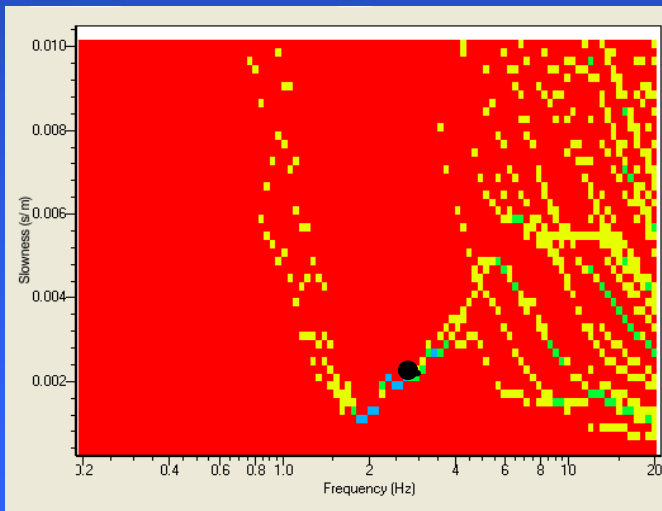
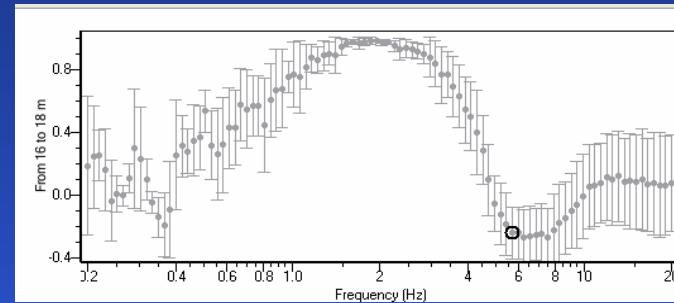
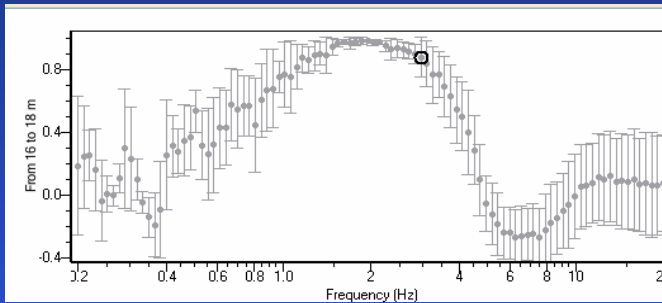


# Display MSPAC results using *pac2disp*





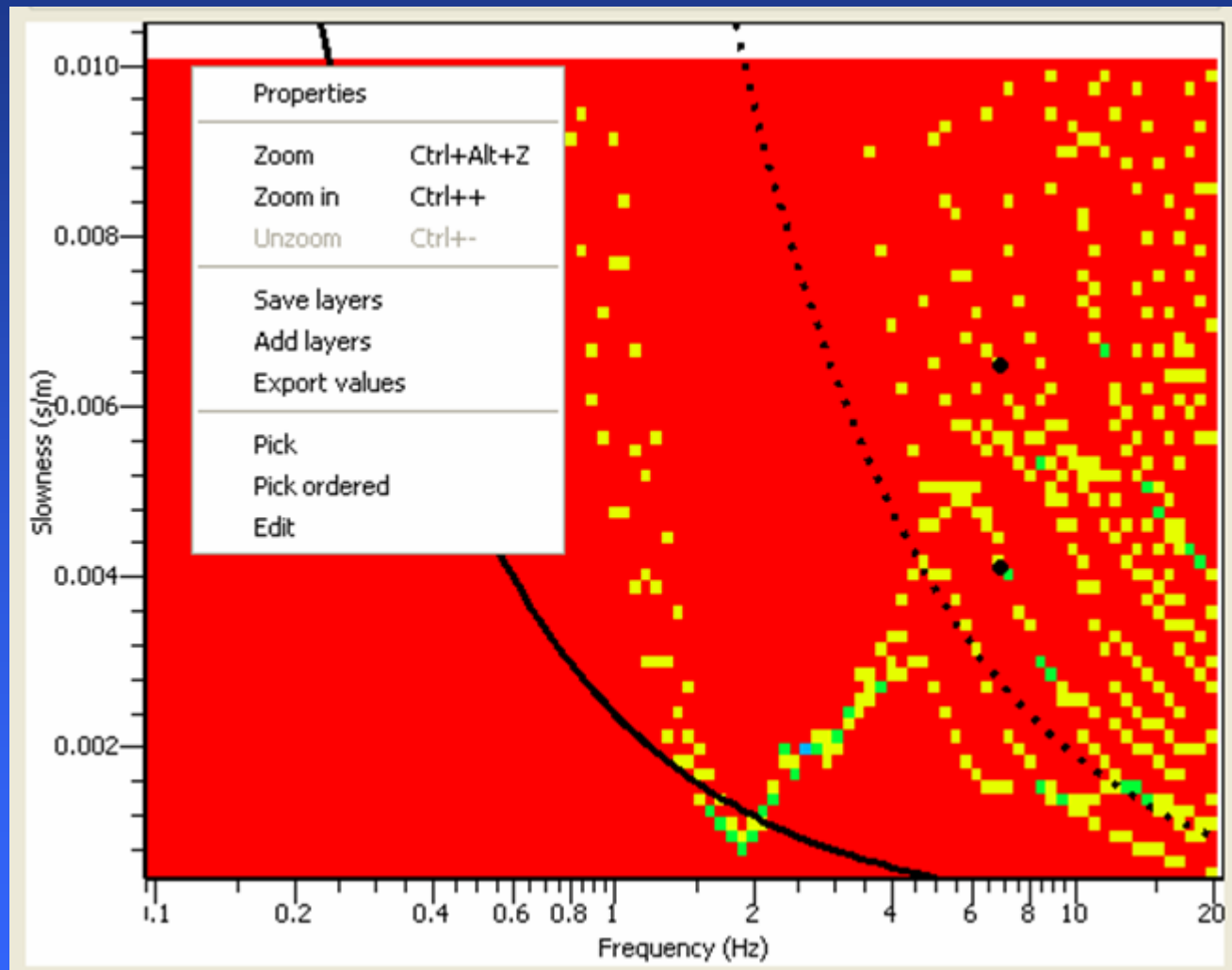
# Relationship between autocorrelation coefficients and phase velocities



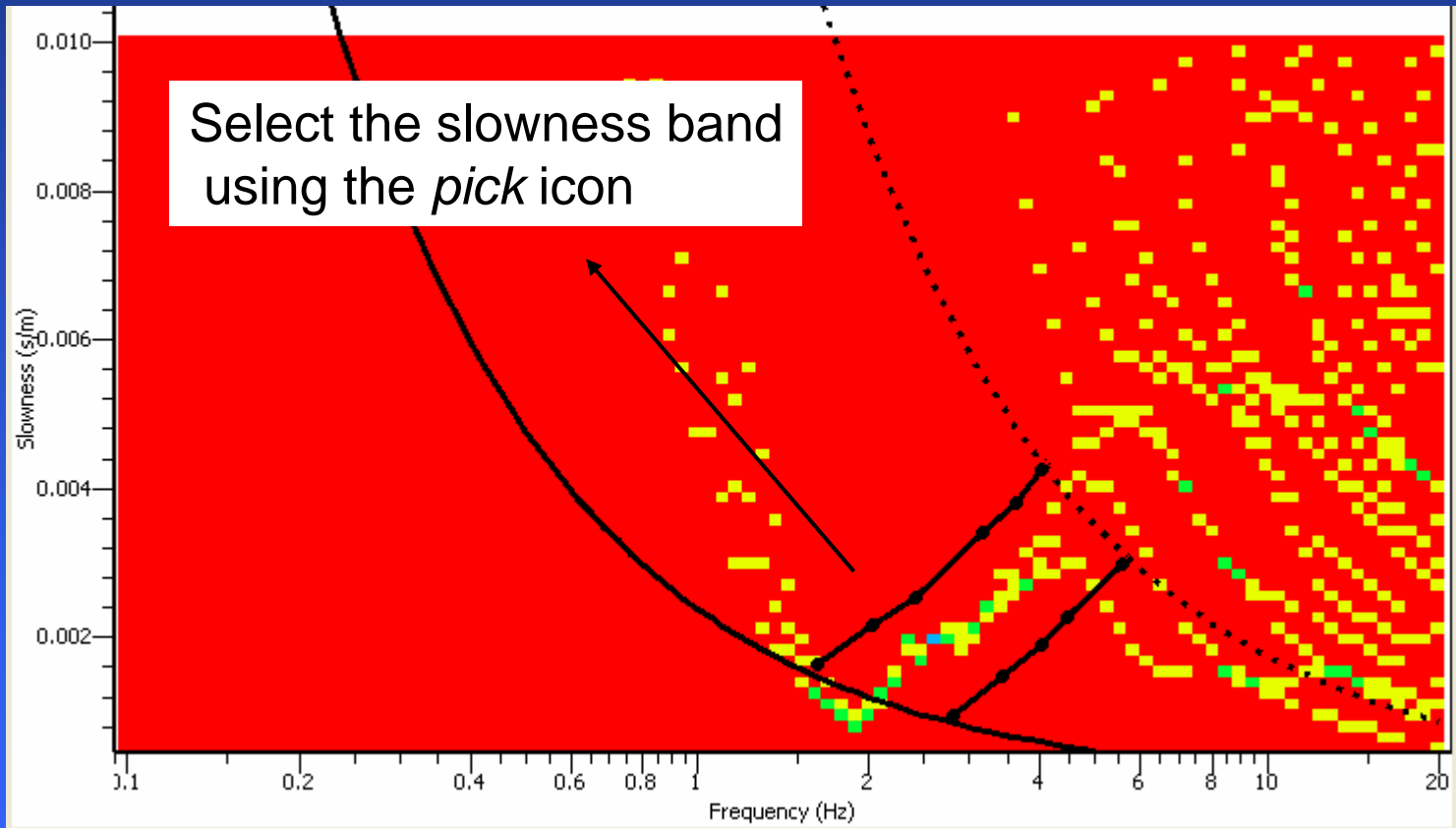
Uniqueness of phase velocity

Non-uniqueness of phase velocity

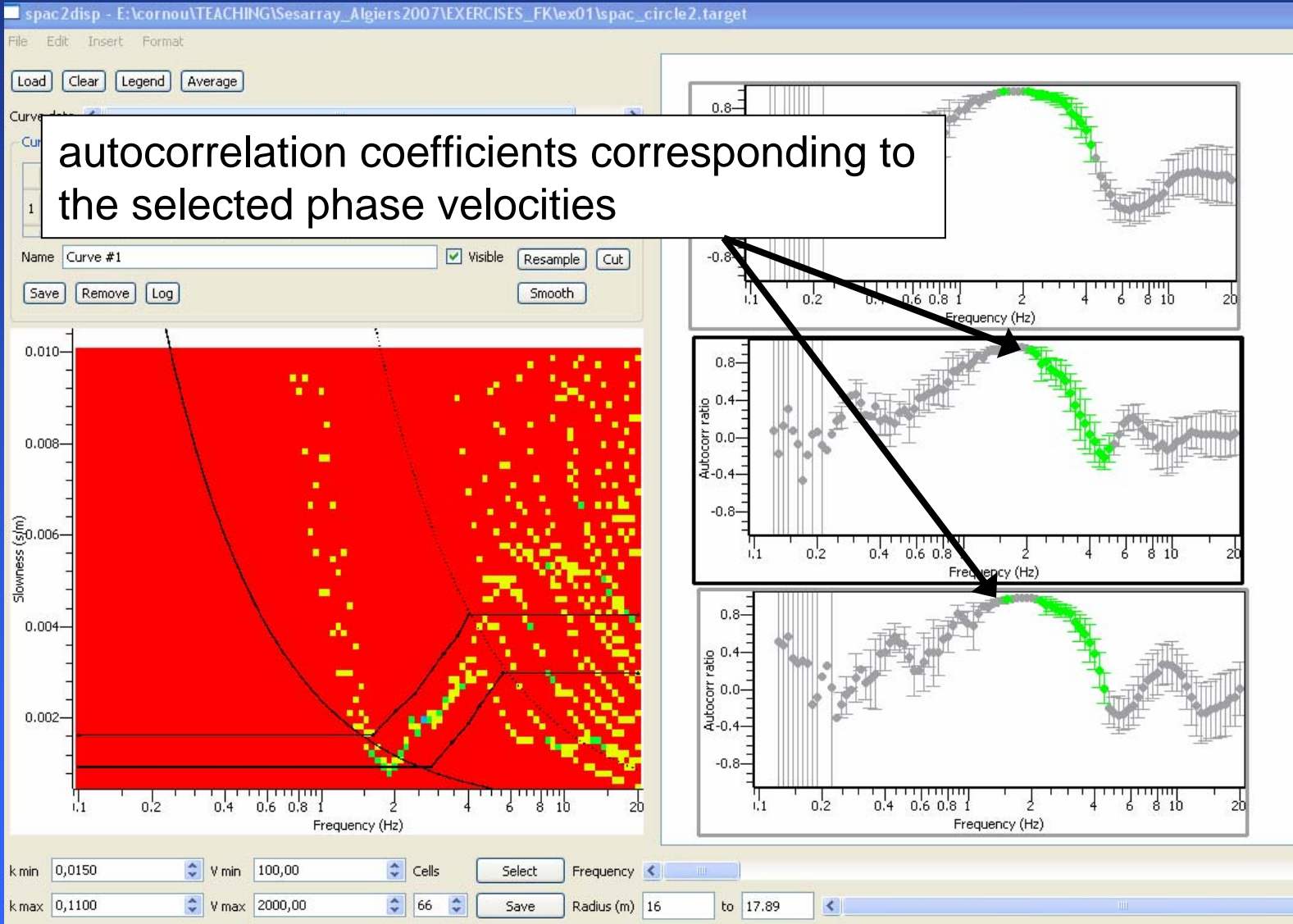
# Selection of the autocorrelation coefficients



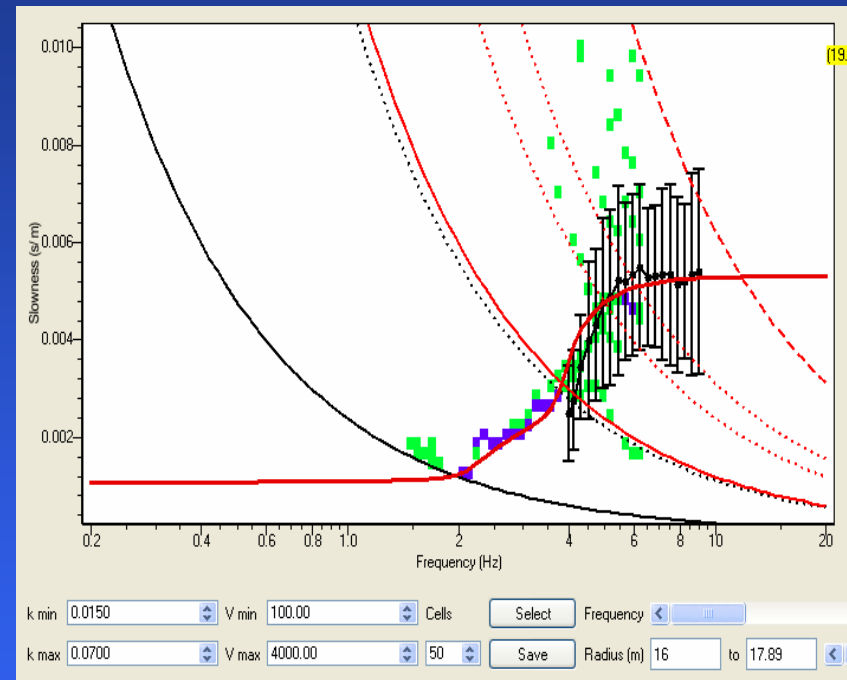
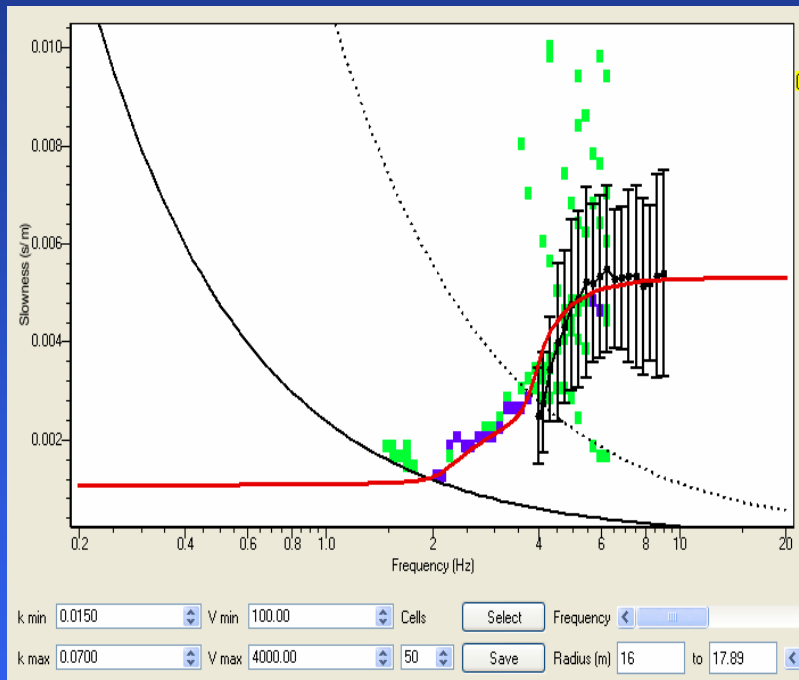
# Selection of the autocorrelation coefficients



# Selection of the autocorrelation coefficients



# Comparison between DC estimated by MSPAC and FK analysis (load DC obtained with FK or HRFK)



In this case, resolution of MSPAC (FK) is better at low frequency (high frequency)

# Do the same exercise with the two other predefined arrays

- Rings design
- MSPAC computation
- Selection of reliable autocorrelation coefficients
- Comparison of DC estimated by MSPAC and FK