

Tutorial on SAR, InSAR, PSInSAR

SARPROZ

The SAR processing tool by Periz

http://ihome.cuhk.edu.hk/~b122066/index_files/download.htm

Part III

Petronas University of Technology UTP

Amplitude Time Series

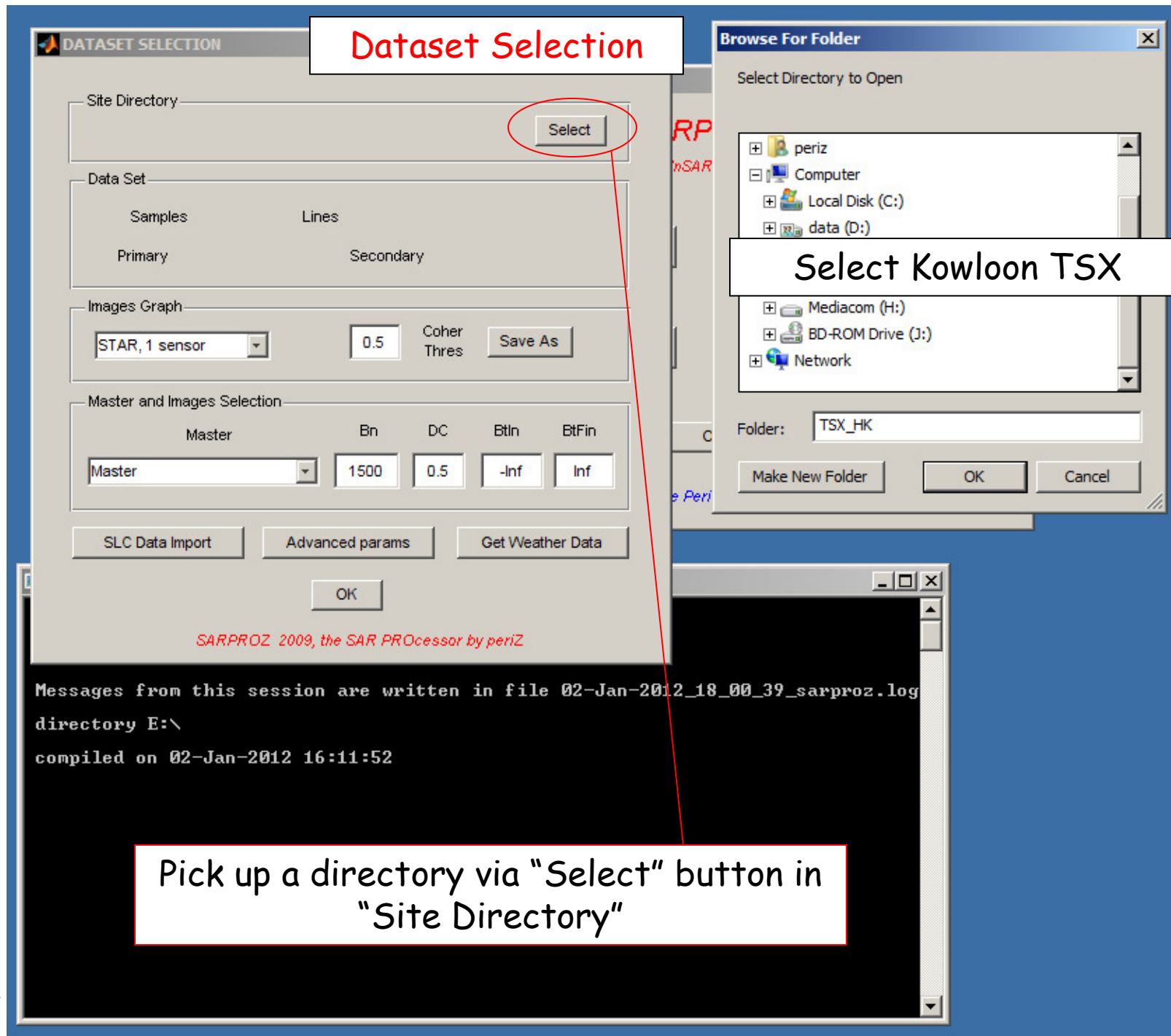
SARPROZ main window

Load data with "Select Dataset"



```
E:\main.exe

Welcome to SARPROZ
by Daniele Perissin, copyright 2009
Messages from this session are written in file 02-Jan-2012_18_00_39_sarproz.log
directory E:\
compiled on 02-Jan-2012 16:11:52
```



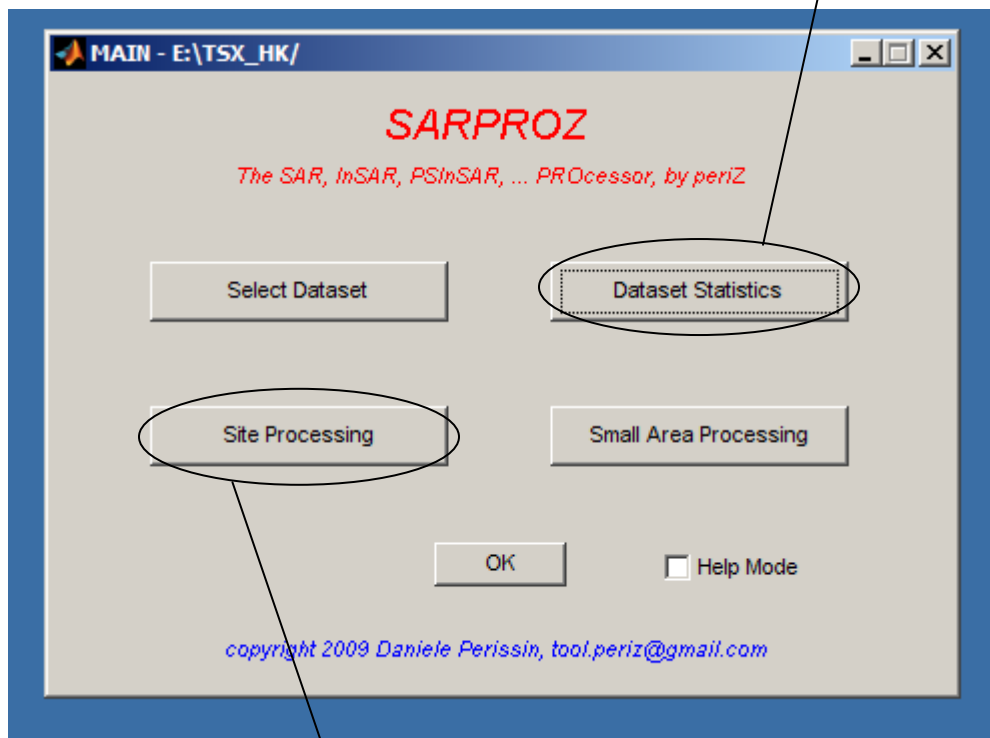
Dataset Selection

Select Kowloon TSX

Pick up a directory via "Select" button in "Site Directory"

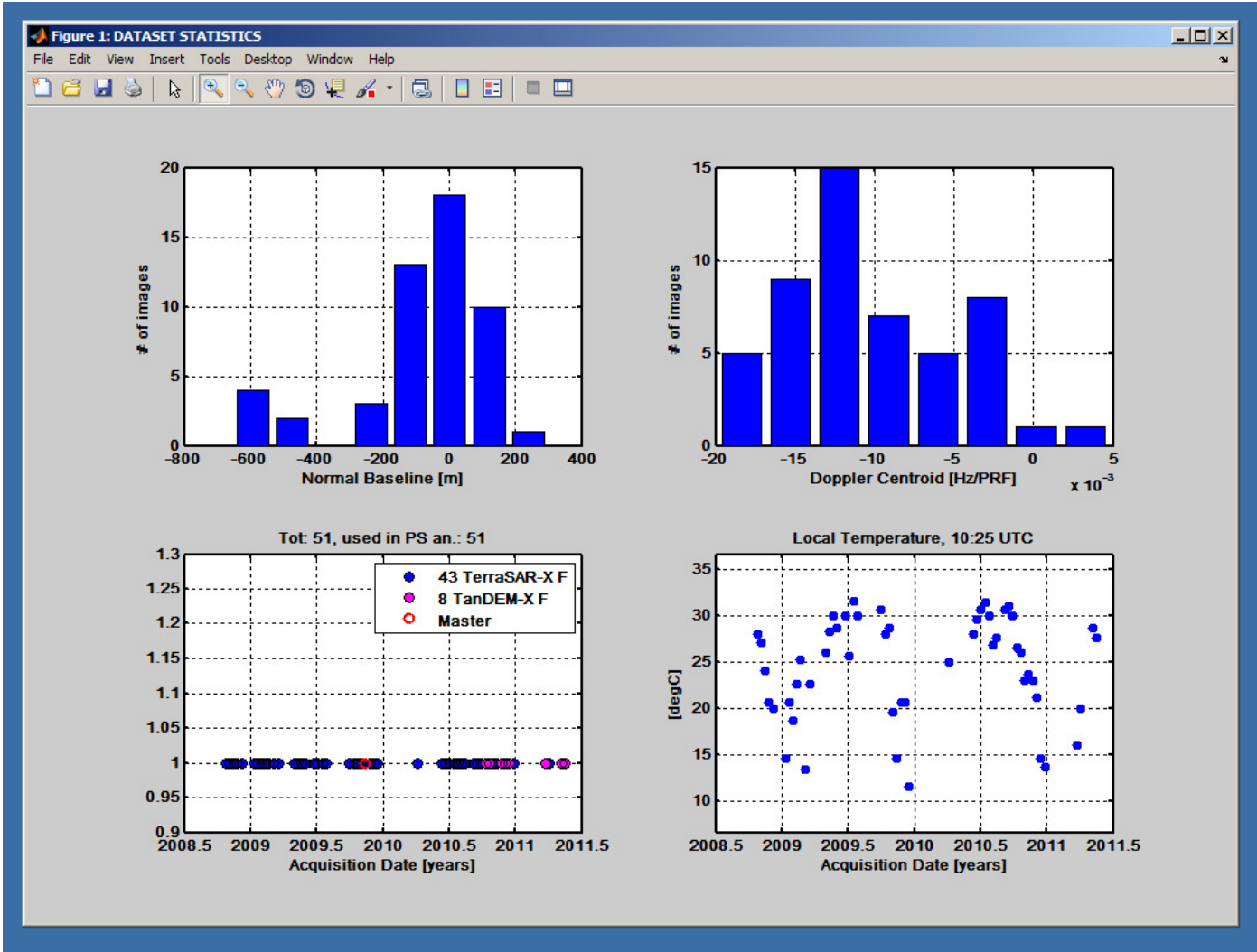
SARPROZ main window

Display the dataset parameters via button "Dataset Statistics"

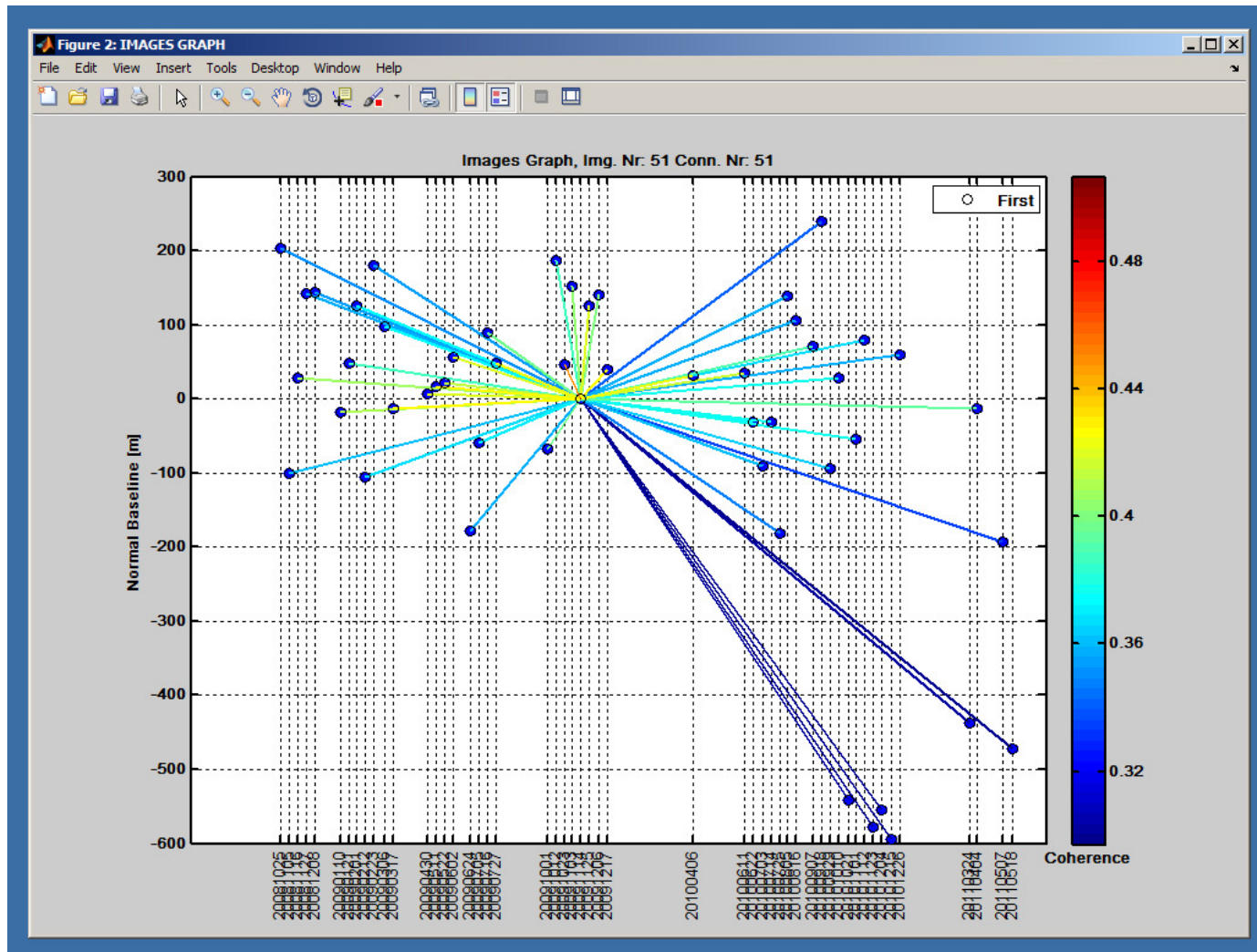


Processing modules are accessed through "Site Processing"

DataSet Parameters



Interferometric configuration



Site Processing

The screenshot displays the SARPROZ software interface for site processing. The window title is "SITE PROCESSING - C:\1SAR\KOWLOON_TSX/". The interface is organized into several panels, each containing a list of processing steps with "Go" buttons. The status of each step is indicated by the color of the "Go" button: green for completed or available, red for failed or in progress, and grey for disabled.

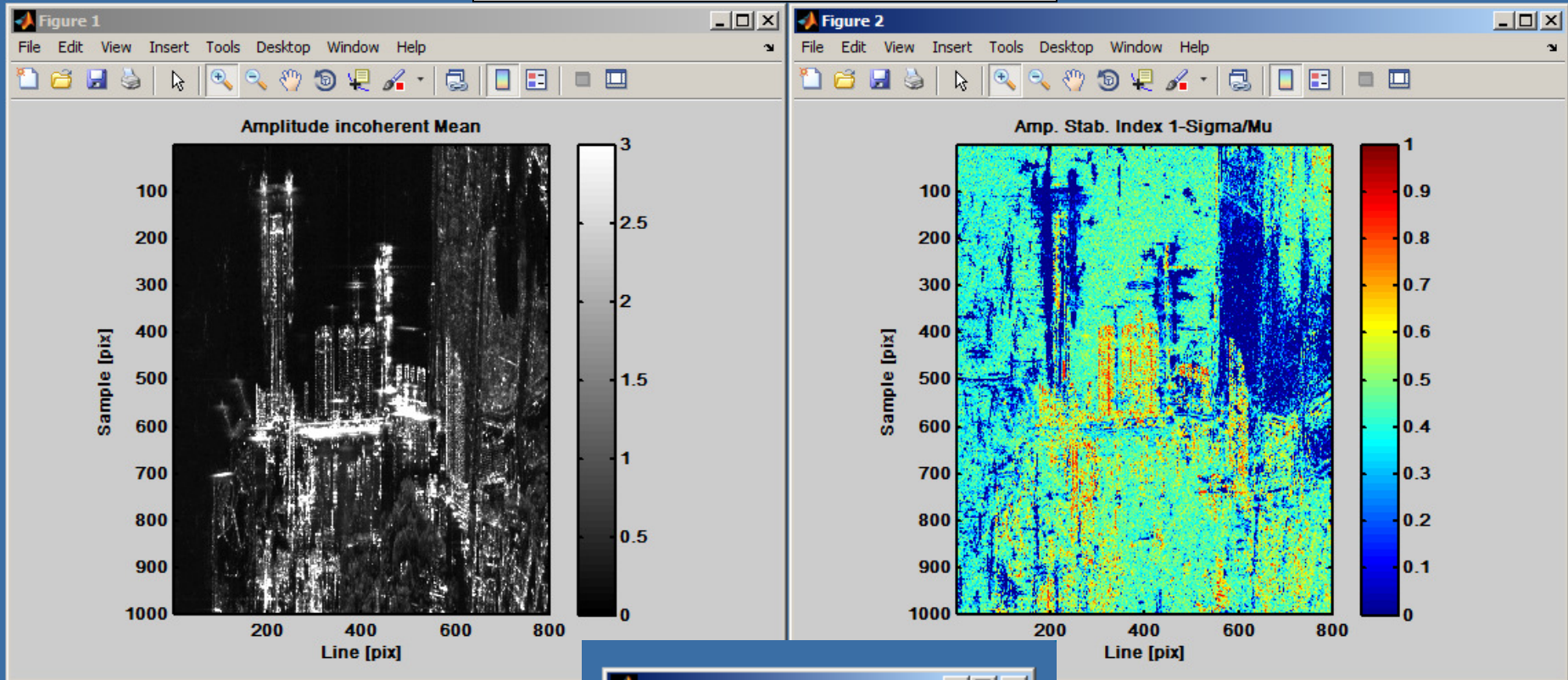
- Preliminary analysis:** Reflectivity map and amplitude stability index (Go), Mask for sparse points selection (Go).
- Preliminary geocoding:** External DEM selection (Go), Current: User defined, DEM visualization (Go), Geocoding through external DEM (Go), Geocoding through manual GCP selection (Go), External DEM and synthetic amplitude in SAR coordinates (Go).
- Auxiliary analysis:** Change detection (Go), Image classification (Go).
- InSAR processing:** Update new images only (checkbox), Phase to height constants generation (Go), Phase to flat constants generation (Go), MST estimation (Go), Residual fringes estimation and removal (Go), Second order fringes removal (Go), Interferograms processing (Go), Coherence map generation (Go), Synthetic aperture radar (Go), Single interferogram processing (Go).
- Sub-dataset extraction:** Selection and extraction (Go).
- Sparse points selection:** Load mask (Go), Amplitude time series analysis (Go), Sub-pixel positions analysis (Go), Flat Cartesian coordinates estimation (Go).
- Multi Image InSAR processing:** APS estimation (Go).
- Results exporting:** Extended geocoding (googleearth kml) (Go), Sparse geocoding (kml-dbf) (Go).
- Post-analysis:** Geographic coordinates (Go), DEM post-analysis (Go), PS classification (Go), Multi-sensor analysis (Go), Tests (Go).
- Visualization tools:** View parameters (Go), View interferograms (Go).

At the bottom of the window, there is a checkbox for "NO security prompt" and an "OK" button. The text "SARPROZ 2009, the SAR PROCessor by periz" is visible in the bottom left corner.

Annotations:

- A callout box points to the "Go" buttons in the "Preliminary analysis" and "Preliminary geocoding" sections, containing the text: "Process the preliminary steps if needed".
- A callout box points to the "View parameters" button in the "Visualization tools" section, containing the text: "To check the result, press 'View Parameters' in 'Visualization Tools'".

Plot Intensity Statistics



Reflectivity Map

Amplitude Stability Index 1-s/m

PLOT PARAMETERS

Parameter Max

Amp. Stab. Index 1-Sig... Min

SARPROZ © 2009
the SAR PROcessor by periz

Site Processing

The screenshot displays the SARPROZ software interface with the following sections and options:

- Preliminary analysis:** Reflectivity map and amplitude stability index (Go), Mask for sparse points selection (Go).
- Preliminary geocoding:** External DEM selection (Current: User defined) (Go), DEM visualization (Go), Geocoding through external DEM (Go), Geocoding through manual GCP selection (Go), External DEM and synthetic amplitude in SAR coordinates (Go).
- Auxiliary analysis:** Change detection (Go), Image classification (Go).
- InSAR processing:** Update new images only, Phase to height constants generation (Go), Phase to flat constants generation (Go), MST estimation (Go), Residual fringes estimation and removal (Go), Second order fringes removal (Go), Interferograms processing (Go), Coherence map generation (Go), Synthetic coherence map generation (Go), Single interferogram processing (Go), Sub-dataset extraction: Selection and extraction (Go).
- Sparse points selection:** Load mask (Go).
- Amplitude processing:** Images fine equalization (Go), Amplitude time series analysis (Go), Sub-pixel positions analysis (Go), Flat Cartesian coordinates estimation (Go).
- Post-analysis:** Geographic coordinates estimation (Go), UTM coordinates estimation (Go), DEM post-analysis (Go), PS classification (Go), Multi-sensor analysis (Go), Tests (Go), Sparse Points processing (Go), Scatter Plots (Go), View parameters (Go), View interferograms (Go).
- Results exporting:** Extended geocoding (googleearth kml) (Go), Sparse geocoding (kml-dbf) (Go).

A callout box with a white background and black border contains the text: "To visualize Amplitude Time Series, use the 'Image Classification' module". A black arrow points from this callout box to the "Image classification" button in the Auxiliary analysis section.

At the bottom of the interface, there is a red text string "SARPROZ 2009, the SAR PROCessor by periz", a checkbox for "NO security prompt", and an "OK" button.

Amplitude time series via Image Classification

Amplitude incoherent Mean

X: 583 Y: 62
Index: 3.203
RGB: 0.0159, 0.0159, 0.0159

Range

Azimuth

CLASSIFICATION TOOL - C:\1SAR\KOWLOON_TSX

Samples selection

Mouse options

Single Pixels Polygon

View Refl. Map

Back

Class

Index	Label	Number of samples
1		0
2		0
3		0

Visualization Tools

View Refl. Map

Plot Amp Series

Plot Amp. Ch. M.

Plot Coher. Matr.

Features for Classification

Coherence Matrix

Amplitude Changes Matrix

Save Load

Features Extraction

Method Go View

Classification

Go View

Parameters

Matr. Coher. Window 15 15 Downsampling 2 2

OK

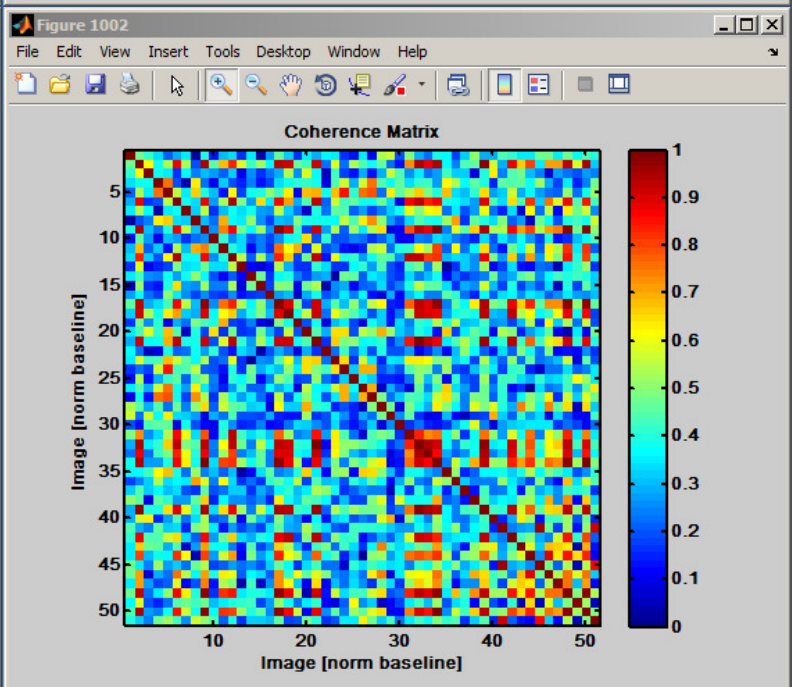
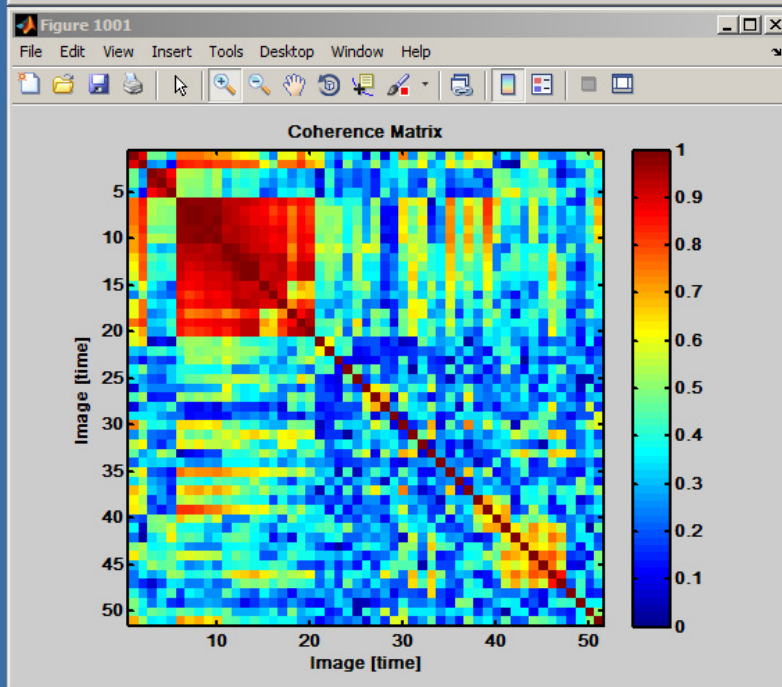
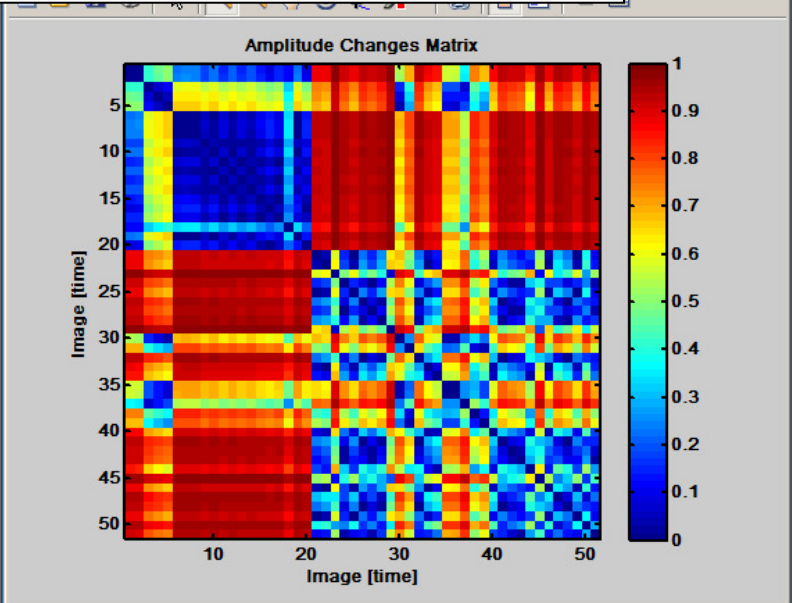
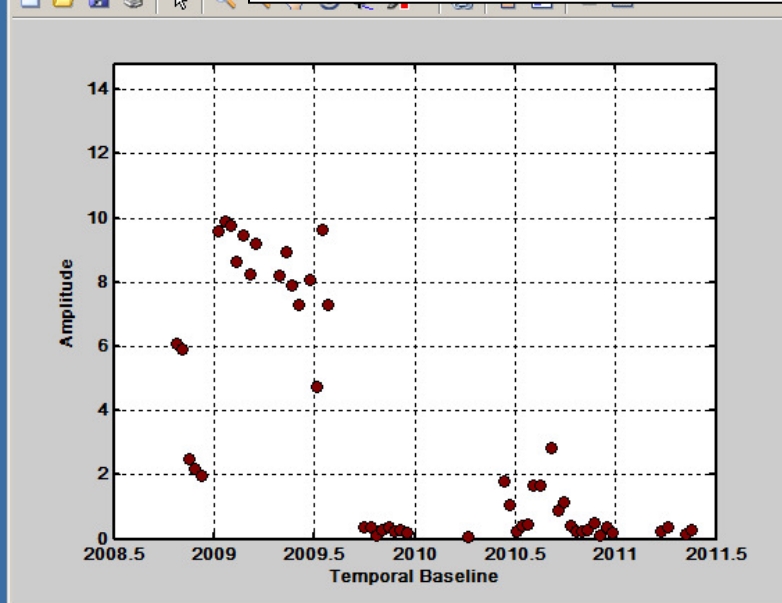
SARPROZ © 2009, the SAR PROCessor by periz

1. Visualize the Reflectivity Map
2. Check the Data Cursor Tool on the Image Map
3. Select a pixel in the Image
4. Plot Amplitude Time Series

Amplitude time series via Image Classification

The image displays two windows from the SARPROZ software. The left window, titled 'Figure 4', shows a plot of 'Amplitude incoherent Mean'. The plot has 'Range' on the vertical axis (0 to 1000) and 'Azimuth' on the horizontal axis (0 to 800). A data point is highlighted with a yellow box containing the text: 'X: 583 Y: 62', 'Index: 3.203', and 'RGB: 0.0159, 0.0159, 0.0159'. The right window is the 'CLASSIFICATION TOOL' interface. It includes sections for 'Samples selection' (with 'Single Pixels' selected), 'Visualization Tools' (with 'Plot Amp Ch. M.' and 'Plot Coher. Matr.' circled), 'Features for Classification' (with checkboxes for 'Coherence Matrix' and 'Amplitude Changes Matrix'), 'Features Extraction' (with a 'Method' dropdown), and 'Parameters' (with 'Matr. Coher. Window' set to 15 and 'Downsampling' set to 2). A central text box reads 'Amplitude Changes Matrix and Coherence Matrixes'. The bottom of the window shows 'SARPROZ © 2009, the SAR PROCessor by periz'.

Amplitude time series via Image Classification



Site Processing

The screenshot displays the SARPROZ software interface with the following sections and options:

- Preliminary analysis:** Reflectivity map and amplitude stability index (Go), Mask for sparse points selection (Go).
- Preliminary geocoding:** External DEM selection (Current: User defined) (Go), DEM visualization (Go), Geocoding through external DEM (Go), Geocoding through manual GCP selection (Go), External DEM and synthetic amplitude in SAR coordinates (Go).
- Auxiliary analysis:** Change detection (Go), Image classification (Go).
- InSAR processing:** Update new images only, Phase to height constants generation (Go), Phase to flat constants generation (Go), MST estimation (Go), Residual fringes estimation and removal (Go), Second order fringes removal (Go), Interferograms processing (Go), Coherence map generation (Go), Synthetic coherence map generation (Go), Single interferogram processing (Go).
- Sub-dataset extraction:** Selection and extraction (Go).
- Sparse points selection:** Load mask (Go).
- Amplitude processing:** Images fine equalization (Go), Amplitude time analysis (Go), Flat Cartesian coordinates estimation (Go).
- Multi Image InSAR processing:** APS estimation (Go), Sparse Points processing (Go).
- Results exporting:** Extended geocoding (googleearth kml) (Go), Sparse geocoding (kml-dbf) (Go).
- Post-analysis:** Geographic coordinates estimation (Go), UTM coordinates estimation (Go), DEM post-analysis (Go), multi-sensor analysis (Go), Tests (Go).
- Visualization tools:** Histograms (Go), Scatter Plots (Go), View parameters (Go), View interferograms (Go).

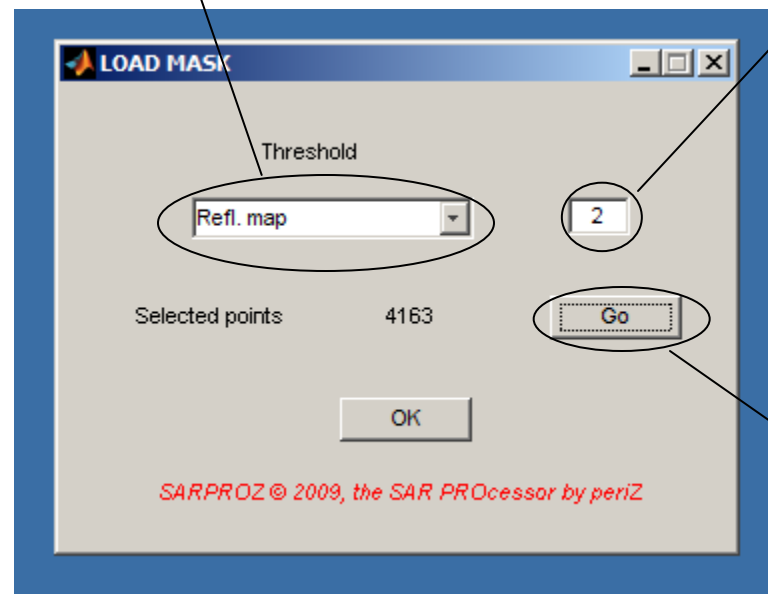
At the bottom, there is a red text label: *SARPROZ 2009, the SAR PROCessor by periz*, a checkbox for NO security prompt, and an OK button.

Sparse points selection

Sparse Points Selection

1. Choose a parameter for the selection
(e.g. "Reflectivity Map")

2. Apply a value as threshold
(e.g. "2")



3. Press *GO*

Site Processing

The screenshot displays the SARPROZ software interface with the following sections and buttons:

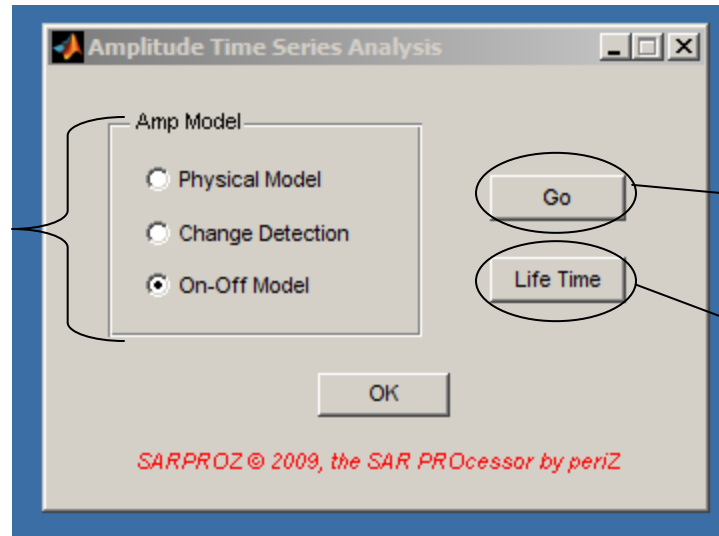
- Preliminary analysis:** Reflectivity map and amplitude stability index (Go), Mask for sparse points selection (Go).
- Preliminary geocoding:** External DEM selection (Current: User defined) (Go), DEM visualization (Go), Geocoding through external DEM (Go), Geocoding through manual GCP selection (Go), External DEM and synthetic amplitude in SAR coordinates (Go).
- Auxiliary analysis:** Change detection (Go), Image classification (Go).
- InSAR processing:** Update new images only, Phase to height constants generation (Go), Phase to flat constants generation (Go), MST estimation (Go), Residual fringes estimation and removal (Go), Second order fringes removal (Go), Interferograms processing (Go), Coherence map generation (Go), Synthetic coherence map generation (Go), Single interferogram processing (Go).
- Sub-dataset extraction:** Selection and extraction (Go).
- Sparse points selection:** Load mask (Go).
- Amplitude processing:** Images fine equalization (Go), **Amplitude time series analysis (Go)**, Sub-pixel positions analysis (Go), Flat Cartesian coordinates estimation (Go).
- Results exporting:** Extended geocoding (googleearth kml) (Go), Sparse geocoding (kml-dbf) (Go).
- Post-analysis:** Geographic coordinates estimation (Go), UTM coordinates estimation (Go), DEM post-analysis (Go), PS classification (Go), Multi-sensor analysis (Go), Tests (Go), Histograms (Go), Scatter Plots (Go), View parameters (Go), View interferograms (Go).

At the bottom of the interface, there is a red text string: *SARPROZ 2009, the SAR PROCessor by periz*, a checkbox for NO security prompt, and an OK button.

A callout box with the text "Amplitude Time Series Processing" points to the "Amplitude time series analysis" button.

Amplitude Time Series Processing

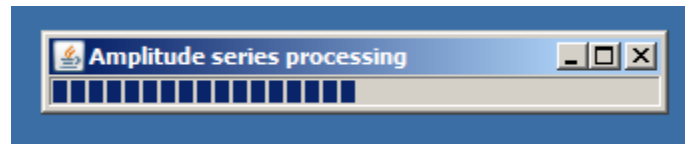
Choose a Model for the analysis ("On-Off Model")



2. Press Go

4. Press "Life Time"

3. Wait patiently...



Site Processing

SARPROZ 2009, the SAR PROCessor by periz NO security prompt

Preliminary analysis

- Reflectivity map and amplitude stability index
- Mask for sparse points selection

Preliminary geocoding

- External DEM selection
Current: User defined
- DEM visualization
- Geocoding through external DEM
- Geocoding through manual GCP selection
- External DEM and synthetic amplitude in SAR coordinates

Auxiliary analysis

- Change detection
- Image classification

InSAR processing

- Update new images only
- Phase to height constants generation
- Phase to flat constants generation
- MST estimation
- Residual fringes estimation and removal
- Second order fringes removal
- Interferograms processing
- Coherence map generation
- Synthetic coherence map generation
- Single interferogram processing

Sparse points selection

- Load mask

Amplitude processing

- Images fine equalization
- Amplitude time series analysis

Multi Image InSAR processing

- APS estimation
- Sparse Points processing

Results exporting

- Extended geocoding (googleearth kml)
- Sparse geocoding (kml-dbf)

Post-analysis

- Geographic coordinates estimation
- UTM coordinates estimation
- DEM post-analysis
- PS classification
- Tests

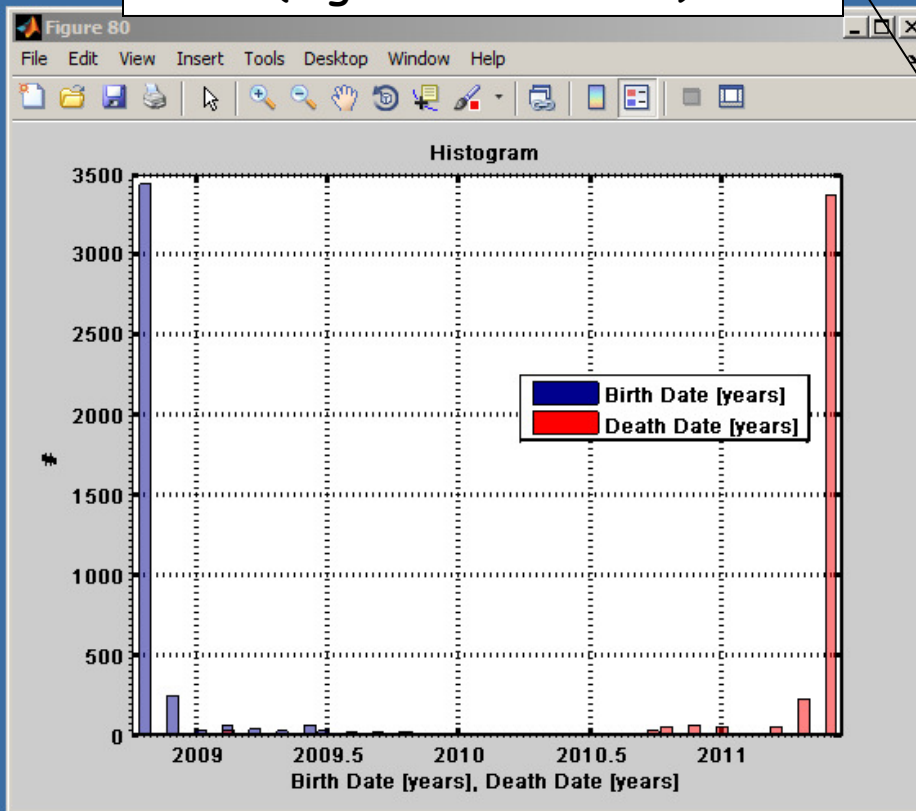
Visualization tools

- Histograms**
- Scatter Plots
- View parameters
- View interferograms

Histograms to look at the estimated parameters

Histograms

1. Select 1 or 2 parameters
(e.g. Ton and Toff)



HISTOGRAMS - C:\1SAR\KOWLOON_TSX/

Track #	Histogram Parameter	Track #	Thresholds
<input type="checkbox"/>	Ton	<input type="checkbox"/>	
<input type="checkbox"/>	Toff	<input type="checkbox"/>	
<input type="checkbox"/>		<input type="checkbox"/>	
<input type="checkbox"/>		<input type="checkbox"/>	
<input type="checkbox"/>		<input type="checkbox"/>	
<input type="checkbox"/>		<input type="checkbox"/>	
<input type="checkbox"/>		<input type="checkbox"/>	
<input type="checkbox"/>		<input type="checkbox"/>	

Bins Nr: 51 Count Points Nr: 4163

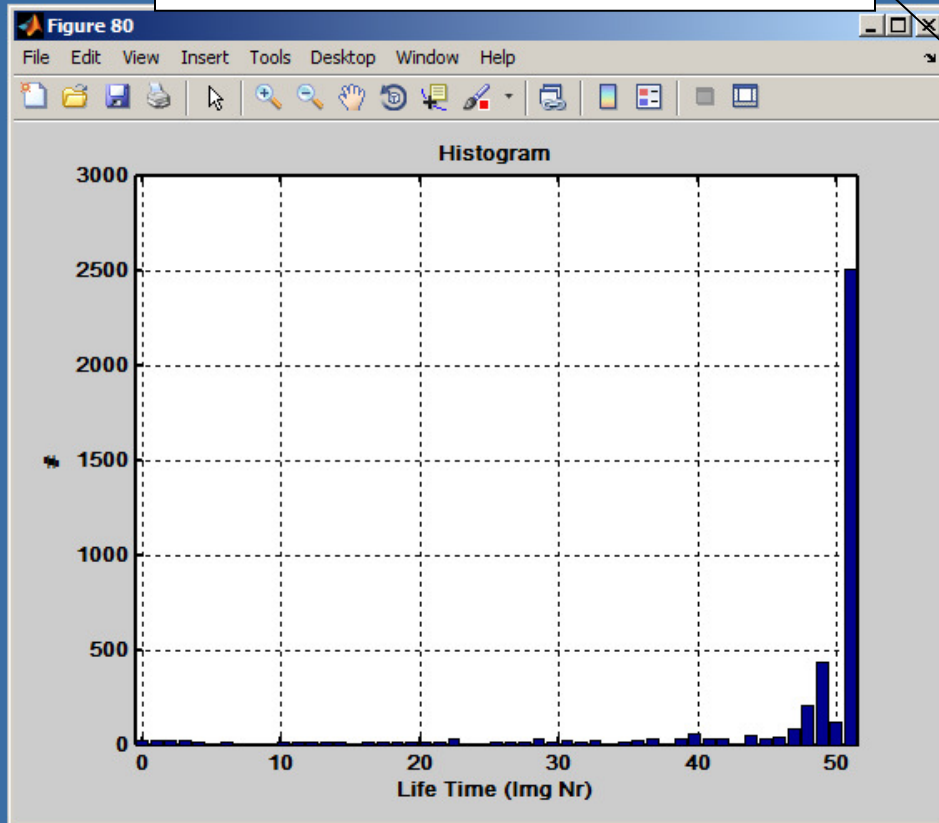
Buttons: Histogram, H(sel) / H(whole), Wrapped Hist., Amplitude Series, OK

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2. Press "Histogram"

Histograms

1. Select "Life Time"



The dialog box contains the following settings:

- Track // Histogram Parameter: Life Time
- Track // Thresholds: (empty)
- Bins Nr: 51
- Count: (empty)
- Points Nr: 4163
- Buttons: Histogram, Wrapped Hist., H(sel) / H(whole), Amplitude Series, OK

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2. Press "Histogram"

Site Processing

The screenshot shows the SARPROZ software interface for site processing. The title bar reads "SITE PROCESSING - C:\1SAR\KOWLOON_TSX/". The interface is organized into several panels:

- Preliminary analysis:** Reflectivity map and amplitude stability index (Go), Mask for sparse points selection (Go).
- Preliminary geocoding:** External DEM selection (Current: User defined) (Go), DEM visualization (Go), Geocoding through external DEM (Go), Geocoding through manual GCP selection (Go), External DEM and synthetic amplitude in SAR coordinates (Go).
- Auxiliary analysis:** Change detection (Go), Image classification (Go).
- InSAR processing:** Update new images only, Phase to height constants generation (Go), Phase to flat constants generation (Go), MST estimation (Go), Residual fringes estimation and removal (Go), Second order fringes removal, Interferograms processing (Go), Coherence map generation (Go), Synthetic coherence map generation (Go), Single interferogram processing (Go).
- Sparse points selection:** Load mask (Go).
- Amplitude processing:** Images fine equalization (Go), Amplitude time series analysis (Go), Sub-pixel positions (Go).
- Multi Image InSAR processing:** APS estimation (Go), Sparse Points processing (Go).
- Results exporting:** Extended geocoding (googleearth kml) (Go), Sparse geocoding (kml-dbf) (Go).
- Post-analysis:** Geographic coordinates estimation (Go), UTM coordinates estimation (Go), DEM post-analysis (Go), PS classification (Go).
- Visualization tools:** Histograms (Go), Scatter Plots (Go), View parameters (Go), View interferograms (Go).

A callout box points to the "Scatter Plots" button in the Visualization tools panel, containing the text: "Scatter Plots to make 2D or 3D plots of the estimated parameters".

At the bottom of the interface, there is a red text string "SARPROZ 2009, the SAR PROCessor by periz", a checkbox for "NO security prompt", and an "OK" button.

Scatter Plots

1. Select "Line" for the x-axis and "Sample" for the y-axis

The screenshot displays the SARPROZ software interface. On the left, a window titled 'Figure 82' shows a 'Cross-plot' with 'Samples [pix]' on the y-axis (ranging from 100 to 900) and 'Lines [pix]' on the x-axis (ranging from 200 to 600). The plot contains blue data points. On the right, the 'SCATTER-PLOTS' configuration panel is shown. The 'X axis' dropdown is set to 'Line' and the 'Y axis' dropdown is set to 'Sample'. The 'Count' button is circled in red. The 'nr points' field shows 584. The 'Plot' button is also circled in red. The 'Filter / matrix visualization' section includes checkboxes for 'Phase', 'radius' (1), 'd corr' (1), and 'Kml' (downsamp 10). The 'OK' button is at the bottom right.

2. Press "Plot"

Boolean conditions for applying a sub-selection

To apply the conditions, press "Count"

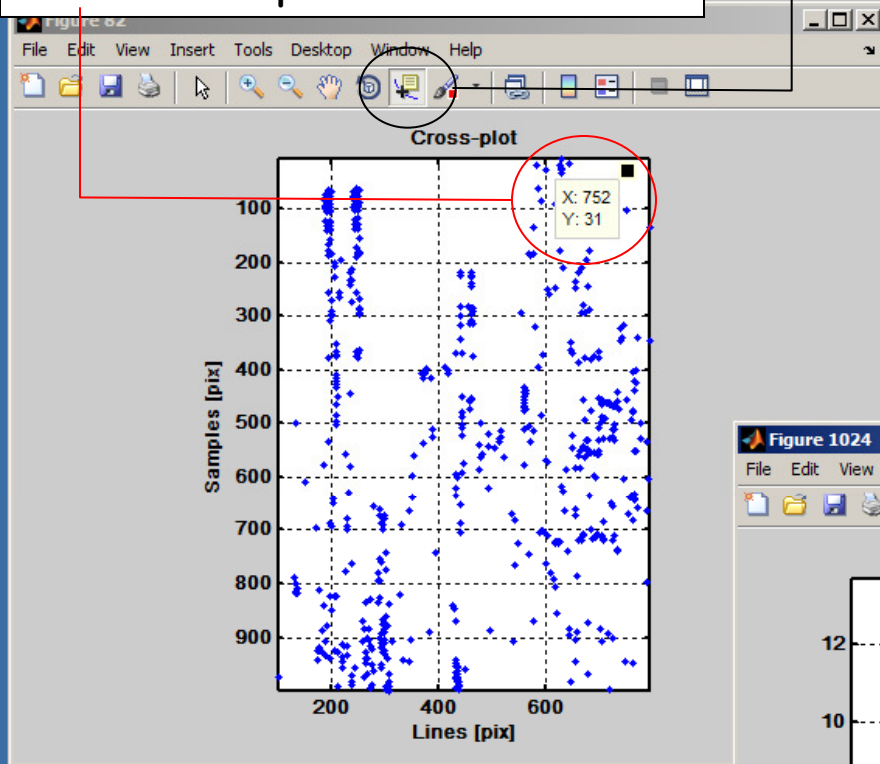
Scatter Plots

The image shows two windows from the SARPROZ software. On the left is a window titled 'Figure 82' displaying a 'Cross-plot' with 'Samples [pix]' on the y-axis (0 to 1000) and 'Lines [pix]' on the x-axis (0 to 800). The plot shows a dark background with blue and white speckles. On the right is the 'SCATTER-PLOTS' configuration dialog. It has several sections: 'Log', 'Track //', 'X axis', 'Y axis', 'Z axis', 'Colour', 'Replica +2pi', 'Track //', and 'Thresholds'. The 'X axis' is set to 'Line' and 'Y axis' to 'Sample'. The 'Count' section shows 'nr points' as 4163. The 'P dim' is set to 6. The 'RefMap' button is circled in red, and the 'Plot' button is also circled in red. Below these are 'Save Selection', 'Plot Ampl. Series', and 'Mod' (set to 0). The 'Density' section has 'nr bins X', 'nr bins Y', 'nr bins Z', and 'nr bins C' fields, along with 'Upper saturation' and a 'Go' button. The 'Filter / matrix visualization' section has 'Phase', 'radius' (1), 'd corr' (1), 'Kml', and 'downsamp' (5) fields, with 'Go' and 'Diff Hist' buttons. At the bottom, there is an 'OK' button and a copyright notice: 'SARPROZ © 2009 the SAR PROCESSOR by periz'.

To visualize the points on the Reflectivity Map, use "Refl Map" and then "Plot"

Amplitude time series

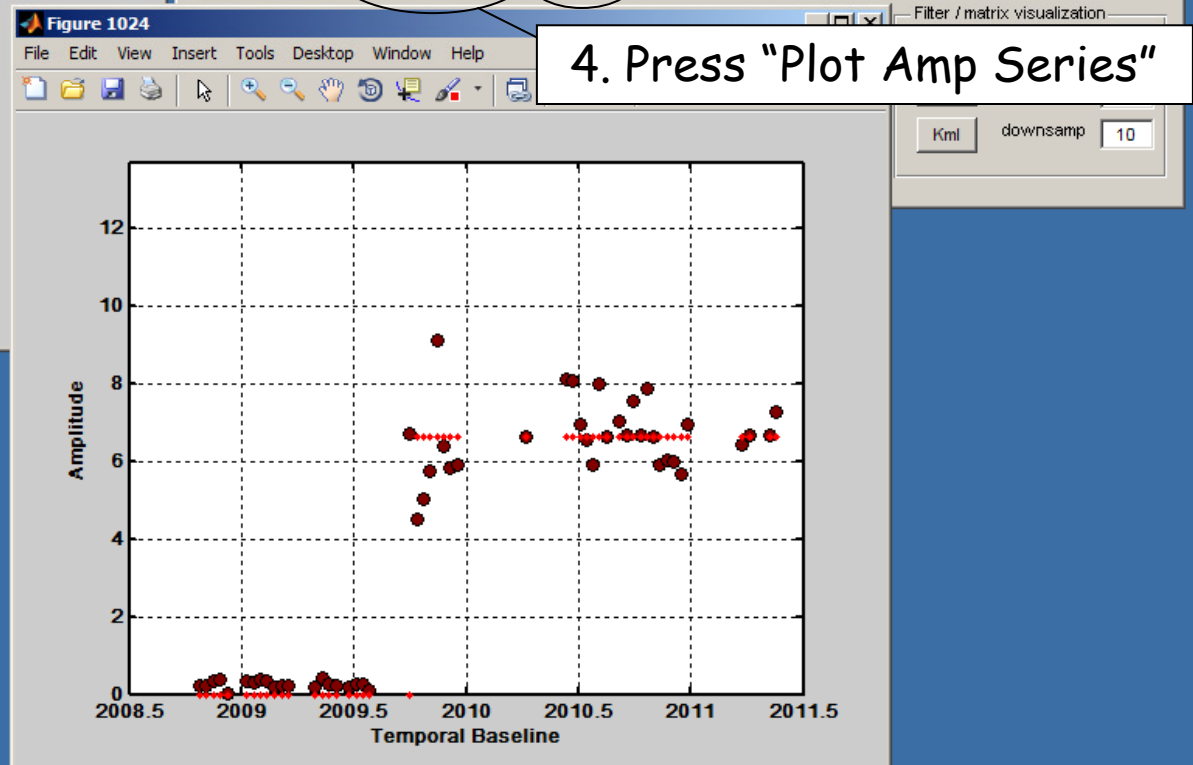
1. Select "Data Cursor" tool
2. Select a point



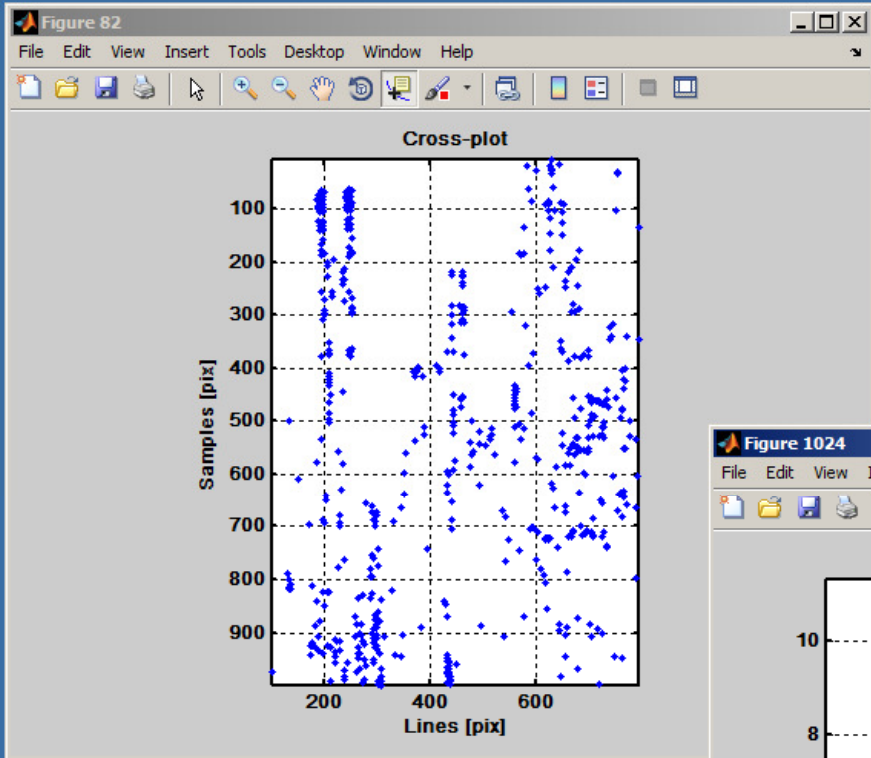
Life time less than 40 images

3. Select Model "2"

4. Press "Plot Amp Series"

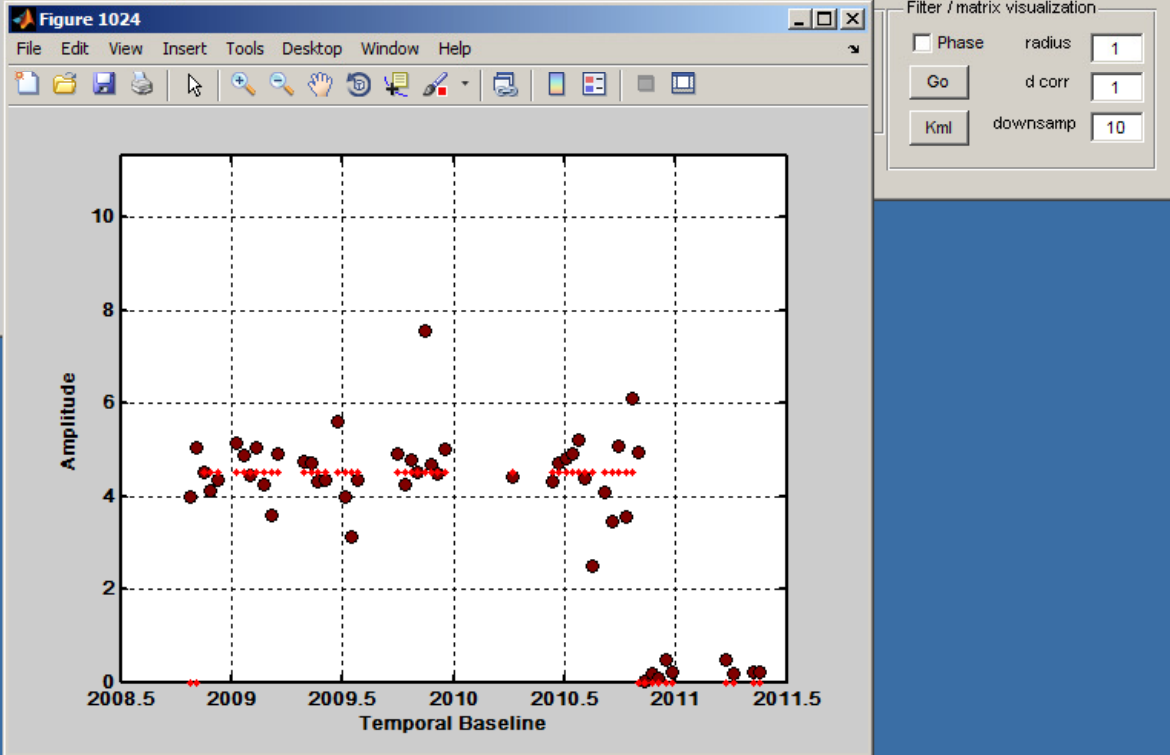


Amplitude time series



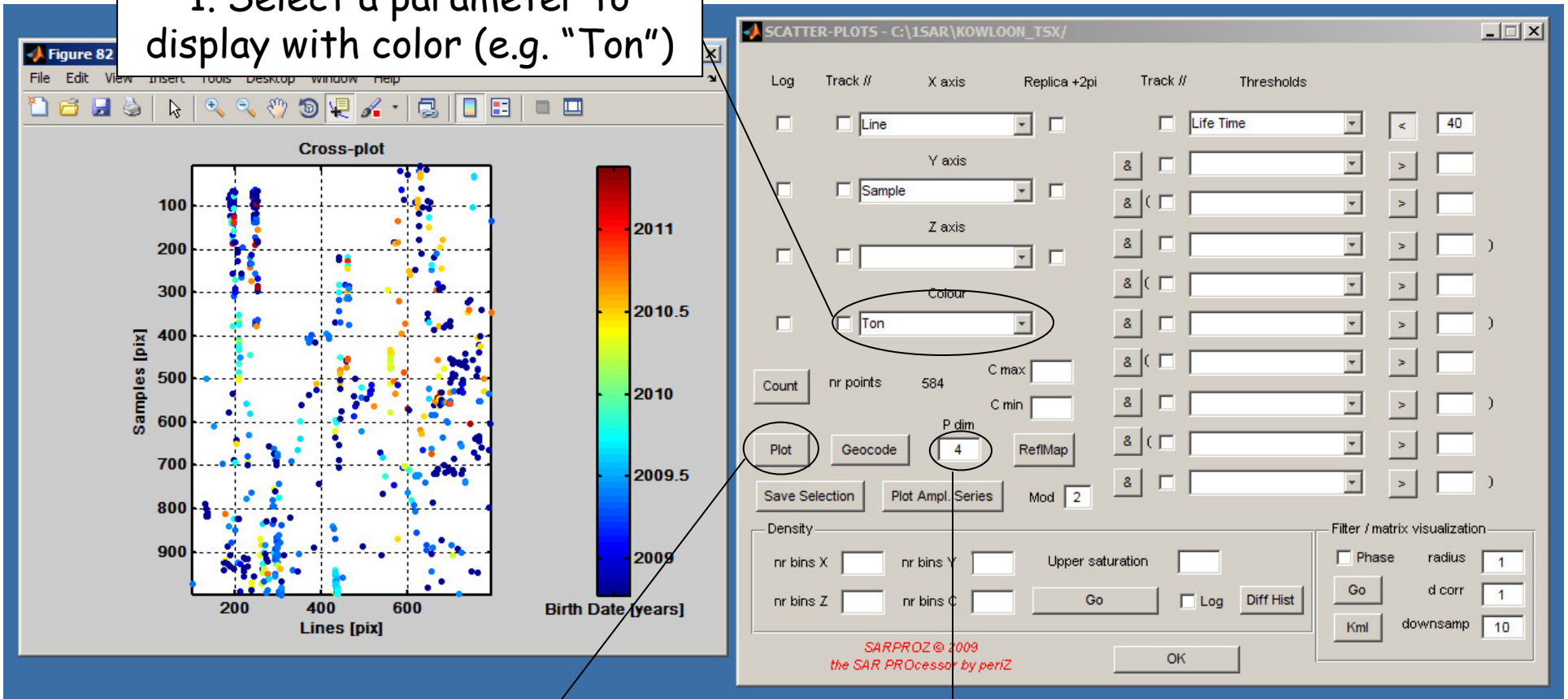
SCATTER-PLOTS - C:\1SAR\KOWLOON_TSX/

Log	Track //	X axis	Replica +2pi	Track //	Thresholds
<input type="checkbox"/>	<input type="checkbox"/>	Line	<input type="checkbox"/>	<input type="checkbox"/>	Life Time
		Y axis			< 40
<input type="checkbox"/>	<input type="checkbox"/>	Sample	<input type="checkbox"/>	<input type="checkbox"/>	
		Z axis			
<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>	
		Colour			
<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>	
Count		nr points	584	C max	
Plot		Geocode	4	C min	
Save Selection		Plot Ampl. Series	Mod	2	



Colored Scatter Plots

1. Select a parameter to display with color (e.g. "Ton")

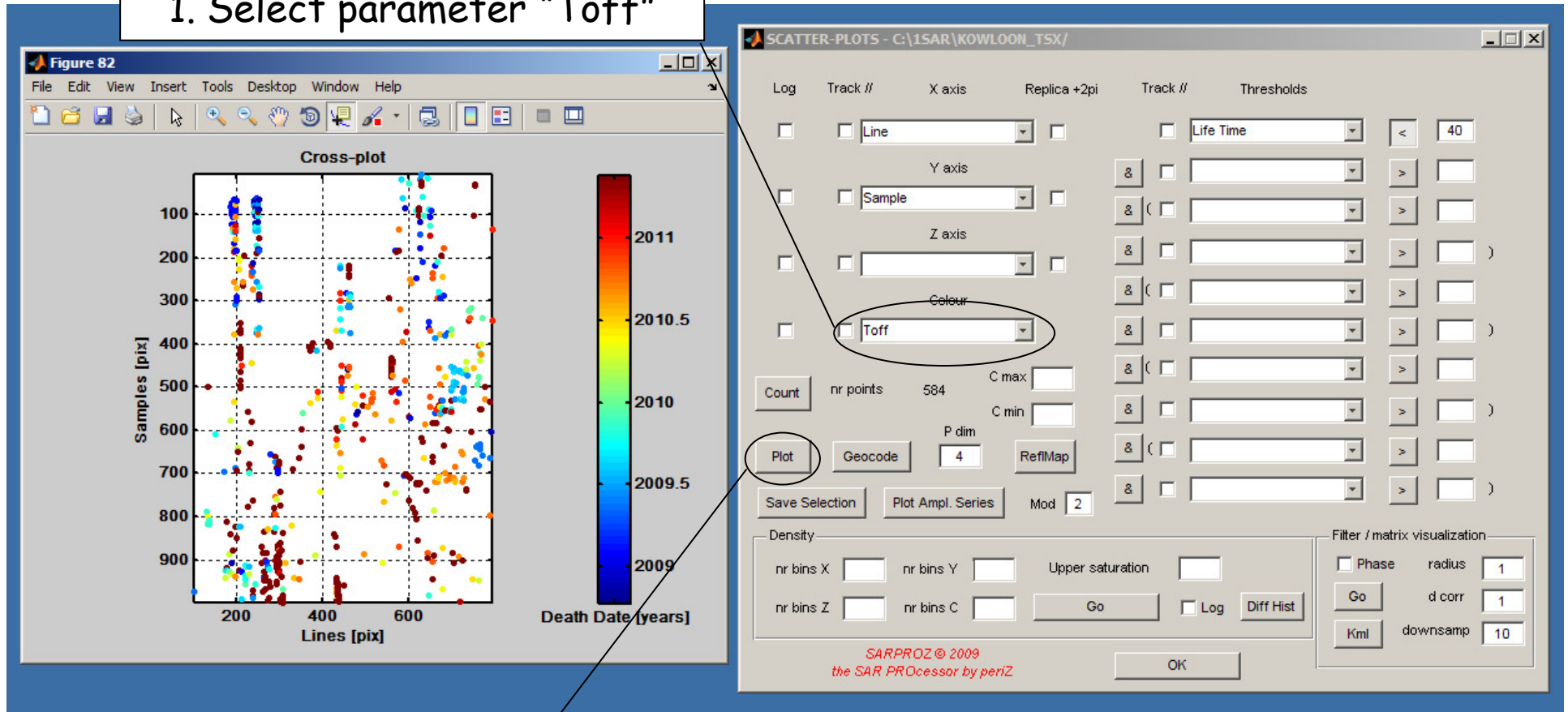


2. Press "Plot"

Adjust the dot size if needed

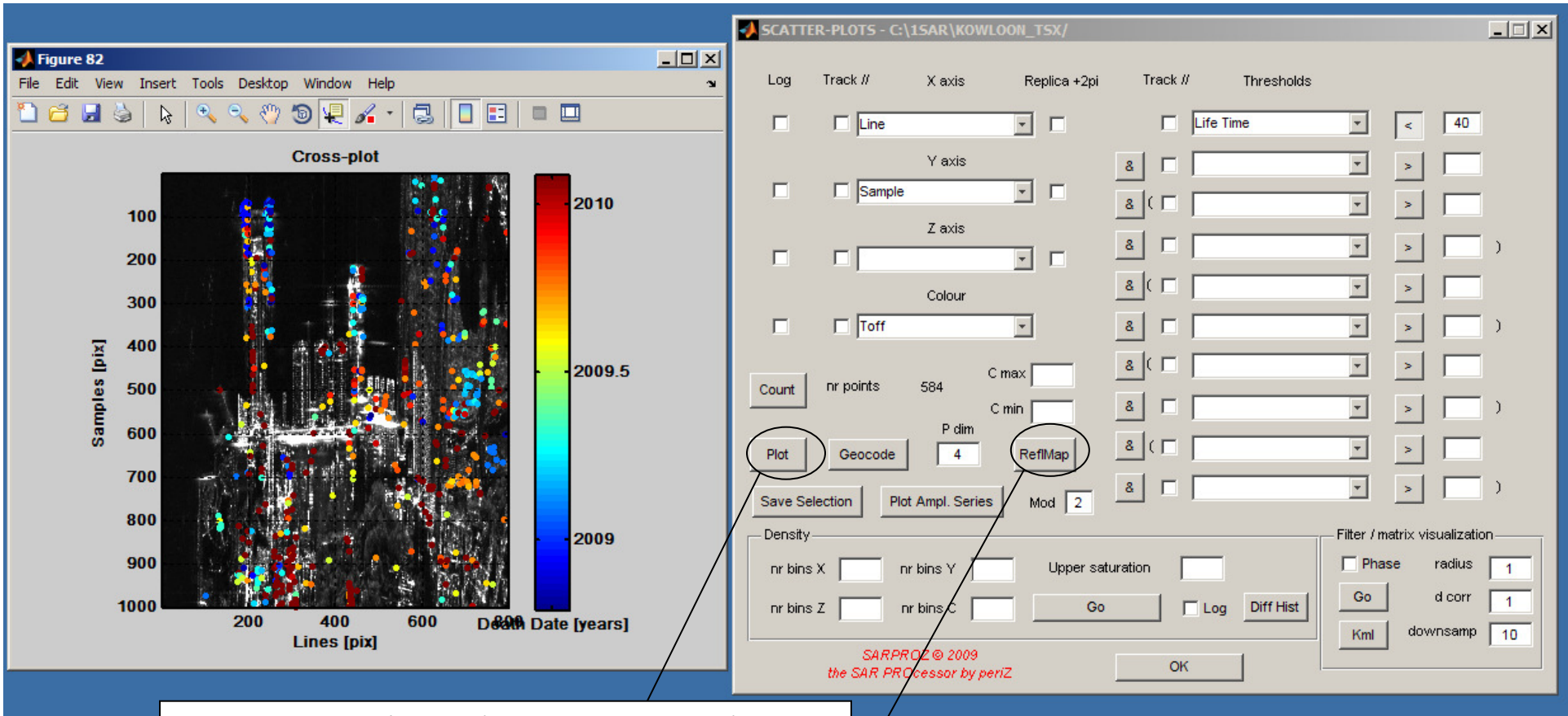
Colored Scatter Plots

1. Select parameter "Toff"



2. Press "Plot"

Colored Scatter Plots



To visualize the points on the Reflectivity Map, use "Refl Map" and then "Plot"

Colored Scatter Plots

Plotting points in geographic coordinates: select Longitude and Latitude

