



Sentinel-1 Toolbox

Interferometry Tutorial

Issued March 2015 Updated August 2016

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Interferometry Tutorial

The goal of this tutorial is to provide novice and experienced remote sensing users with step-bystep instructions on interferometric processing with SAR products.

In this tutorial you will process a pair of Stripmap Sentinel-1 products using interferometry.

What is Interferometry?

Interferometric synthetic aperture radar (InSAR) exploits the phase difference between two complex radar SAR observations taken from slightly different sensor positions and extracts information about the earth's surface.

A SAR signal contains amplitude and phase information. The amplitude is the strength of the radar response and the phase is the fraction of one complete sine wave cycle (a single SAR wavelength). The phase of the SAR image is determined primarily by the distance between the satellite antenna and the ground targets.

By combining the phase of these two images after coregistration, an interferogram can be generated whose phase is highly correlated to the terrain topography.

For an introduction to interferometric concepts, please see ESA's InSAR Principles: Guidelines for SAR Interferometry Processing and Interpretation (ESA TM-19).

Napa Valley Earthquake



The 2014 South Napa earthquake occurred in and around the city of Napa, California on August 24 at 3:20 a.m. local time, measuring at 6.0 on the moment magnitude scale.

This is the first earthquake for which the surface deformation has been measured by ESA's Sentinel-1 satellite.

Two Stripmap SLC data products are available at the links below. One product is acquired on 7 August and another captured on 31 August.

http://step.esa.int/auxdata/tutorials/s1tbx/NapaValley/S1A_S1_SLC__1SSV_20140807T 142342_20140807T142411_001835_001BC1_05AA.SAFE.zip

http://step.esa.int/auxdata/tutorials/s1tbx/NapaValley/S1A_S1_SLC__1SSV_20140831T 142335_20140831T142403_002185_002356_C2E5.SAFE.zip



Opening a Pair of SLC Products

In order to perform interferometric processing, the input products should be two or more Single Look Complex (SLC) products over the same area acquired from slightly different satellite positions.

The toolbox can support SLC products for InSAR from:

- SENTINEL-1
- RADARSAT-2
- TerraSAR-X
- ENVISAT ASAR
- ERS 1&2
- Cosmo-Skymed
- ALOS 1&2

Step 1 - Open the products: Use the **Open Product** button in the top toolbar and browse for the location of the products.

Select the manifest.xml file from each Sentinel-1 product folder and press Open Product.

If the products are zipped, you may also select the zip files.

Look in:	: 🕕 Napa Valle	ey 🔻	🏂 📂 🖽 -
	S1A_S1_S	SLC1SSV_20140807T142342_20140807T142411_001835_001BC1_05AA.SAFE.zip	
cent Items	<mark>▲</mark> S1A_S1_S	SLC1SSV_20140831T142335_20140831T142403_002185_002356_C2E5.SAFE.zip	-
Desktop			
1			
y Docum			
Computer			
	File name:	_S1_SLC1SSV_20140807T142342_20140807T142411_001835_001BC1_05AA.SAFE.zip	Open Product
Notwork			

Opening a Product

Step 2 - View the product: In the **Products View** you will see the opened products. Within the product bands, you will find two bands containing the real (i) and imaginary (q) parts of the complex data. The i and q bands are the bands that are actually in the product.





Products View

The virtual Intensity band is there to assist you in working with complex data.

Virtual bands are the result of creating a band using the Band Maths feature. If you hover the mouse over top of the Intensity virtual band, you will see the expression that it consists of. In this case, the Intensity is i x i + q x q.



Intensity Band Tool-tip

Step 3 - View a band: To view the data, double-click on the **Intensity_HH** band. Zoom in using the mouse wheel and pan by clicking and dragging the left mouse button.





Intensity Band

Pan and zoom to the hilly area in the middle of the scene.

Creating a Subset

To reduce the amount of processing needed, you may create a subset around the particular area in which you are interested.

Step 4 - Create a subset from the view: Once you have zoomed and panned to your area of interest, right click and select **Spatial Subset from View** in the **context** menu.

RAY

Geometry from WKT
WKT from Geometry
Export Transect Pixels
Export Mask Pixels
Export View as Google Earth KMZ
Export View as Image
Export Colour Palette as File
Export Colour Legend as Image
Spatial Subset from View 🔓
Copy Pixel-Info to Clipboard

Select Spatial Subset from View



The subset dialog will automatically select the area you were viewing.

Spatial Subset Band Subse	Tie-Point Grid Subset Metadata S	ubset
	Pixel Coordinates Geo Co Scene start X: Scene start Y: Scene end X: Scene end Y:	ordinates 6626 \$ 6691 \$ 9821 \$ 9926 \$
	Scene step Y: Subset scene width: Subset scene height: Source scene width: Source scene height:	1
	Use Preview	Fix full width
		Estimated, raw storage size: 19.7 OK Cancel Help

Specifying a Product Subset

By default all bands will be included in the subset. Press **OK** to create the subset.

For InSAR processing, you generally only need one polarization. If you have multiple polarizations in your input product, you may use the subset operator to select only co-polarized bands (HH or VV). Likewise, you could use the **BandSelect** operator to select all bands for a particular polarization.

When the new subset product appears in the products view, press the save button I to save the product.



Coregistering the Data

For interferometric processing, two or more images must be coregistered into a stack. One image is selected as the master and the other images are the slaves. The pixels in slave images will be moved to align with the master image to sub-pixel accuracy.

Coregistration ensures that each ground target contributes to the same (range, azimuth) pixel in both the master and the slave image.

Step	5	- (Coregister	the	images	into	а	stack:	Select	Coregistration	in	the	Coregistratio	on
menu														



Select Coregistration

Drag and drop the products from the **Products View** to the table in the **Coregistration** dialog.

Drag and drop first the subset product. This will be your **master** image. Then drag and drop the other product. This will be your **slave** image.



File Name	Туре	Acquisition	Track	Orbit	
S2-SLC-U12-ASC-04-M.	SLC	04May2008	99999	2022	
S2-SLC-U12-ASC-28-M.	. SLC	28May2008	99999	2365	
				_	_
	Dra	a and drop	products		
	5.0	ig und drop			
		into the ta	able		
	_				
					× 1
					۵
					2 Products
					2110000000

Add Products into the Coregistration Dialog

You could also press the **Add Opened** button to add all products currently open in the Products View.

In the **Create Stack** tab, the bands for the master image and the slave images should already be selected for you based on the order of the products given in the previous table.



	reateStack Cross-Correlation Warp Write							
Master:	RS2-SLC-U12-ASC-04-May-2008_01.30-PDS_00150450							
NONE								
nitial Offset Method:	Orbit 👻							
Output Extents:	Master							
Find Optimal Master								

Create Stack

For InSAR processing, it is best not to resample the images at this step. Select Resampling Type: **NONE** and Output Extents of the **Master.**

If you have several products to coregister, you may press **Find Optimal Master** to search for the best image to use as the master image based on perpendicular and temporal baselines.

In the **Cross-Correlation** tab, specify the number of Ground Control Points (GCPs) to use. The GCPs will be used as the center of a cross correlation window which will find the corresponding position from the slave image to the master image.

Trouble shooting: If after processing you receive an error such as "not enough GCPs survived", this means that the software failed to find a good correlation with the current parameters. Try increasing the number of GCPs to possibly 1000. If the offset between master and slave images is large, you will need to increase the coarse registration window dimensions to possibly 256 or 512.



roduciser reduci percucestaci			
umber of GCPs:		2000	
Test GCPs are on land		Apply Fine Registration for SLCs	
Coarse Registration		Fine Registration	
Estimate Initial Coarse Offse	t	Fine Window Width: 32 🔻	
Coarse Window Width:	128 🔻	Fine Window Height: 32 🔻	
Coarse Window Height:	128 🔻	Coherence Threshold: 0.6	
Row Interpolation Factor:	4 🔻	Cross-Correlation based registration	Ξ
Column Interpolation Factor:	4 🔻	Fine Accuracy in Azimuth: 16 🔻	
Max Iterations:	10	Fine Accuracy in Range: 16 🔻	
GCP Tolerance:	0.25	Fine Window oversampling factor: 16 🔻	
		Coherence based registration	
		Use Coherence Sliding Window	
		Coherence Window Size: 3	
			-

Define the Correlation Windows

In the **Warp** tab, specify the significance level for outlier removal (RMS threshold) to a pixel accuracy of 0.01 and select the interpolation method.

The lower you can get the RMS threshold while having enough GCPs surviving, the better the coregistration result will be. Coregistration accuracy plays a critical role in achieve good interferometric results.

The warp polynomial order applies a linear translation for order 1. Higher order warps should only be used when the images have been greatly distorted.



Coregistration	X
ProductSet-Reader CreateStac	k Cross-Correlation Warp Write
RMS Threshold (pixel accuracy):	0.05
Warp Polynomial Order:	1
Interpolation Method:	Cubic convolution (6 points)
Show Residuals	
	Run 🕞 Help

Specify the Significance Level via the RMS Threshold



In the Write tab, specify the output folder and the target product name.

Produ	ctSet-Reader CreateStack Cross-Correlation Warp Write
Targe	et Product
Name	e:
RS2-	SLC-U12-ASC-04-May-2008_01.30-PDS_00150450_Stack
V 5	ave as: BEAM-DIMAP
D	rectory:
e	:\out\
V (ipen in SNAP
	💽 Help 🕞 Run

Specify the output name, format and folder

Press **Process** to begin processing the coregistration.

The resulting coregistered stack product will appear in the **Products View**.





To view the results of the coregistration in a colour view, right-click on the product name and select **Open RGB Image View.**

E- [3] insar core-	and the state
i Identificati	Add Elevation Band
Tie-point g	Properties
i_HH_m	Create Subset
····□ q_HH_r □ Intensit ×	Close All
i_HH_sl 🗙	Close All Others
🛄 Intensit	Close Product
æ	Save Product As
	Create Vector Data Container
•	Open HSV Image View
	Open RGB Image View
Open	RGB Image View

In the RGB channel selection dialog, the Intensity bands for both images will automatically be selected. Select the master image in red and slave image in green then press **OK**.

Select	RGB-Image Channels
Profile:	
Red:	Intensity_VV_mst_07Aug2014
Green:	Intensity_VV_slv1_31Aug2014
Blue:	▼
Stor	e RGB channels as virtual bands in current product
	OK Cancel Help

Select master in red and slave in green



The RGB View can be useful for amplitude change detection. In this image, you will see things that have changed in red or green and things that have not changed in yellow. It is also a visual indication that the coregistration has properly aligned both images. The resulting RGB view should look mostly yellow. Poor registrations will have badly lined up terrain.



RGB View

What Interferometric Tools are Available?

Once the images have been accurately coregistered, you can use the interferometric tools available in the Toolbox including:

- Range and Azimuth Spectral Filtering
- Coherence Estimation
- Interferogram Formation
- Topographic Phase Removal
- Phase Filtering
- Phase Unwrapping
- Unwrapped Phase to Height Conversion

Spectral Filtering

Spectral filtering improves the signal-to-noise ratio (SNR) in the interferogram. This noise reduction results from filtering out non overlapping parts of the spectrum. This spectral non overlap in range between master and slave is caused by a slightly different viewing angle of both sensors. The longer the perpendicular baseline is, the smaller the overlapping part.

The Range Filter operator filters the spectras of a stack of SLC images in the range direction. This Azimuth Filter operator filters the spectras of stack of SLC images in the azimuth direction. Spectral filtering is optional and may sometimes not affect the data very much.



Interferogram Formation and Coherence Estimation

The interferogram is formed by cross multiplying the master image with the complex conjugate of the slave. The amplitude of both images is multiplied while the phase represents the phase difference between the two images.

The interferometric phase of each SAR image pixel would depend only on the difference in the travel paths from each of the two SARs to the considered resolution cell.

The interferometric phase variation $\Delta \phi$ is then proportional to ΔR divided by the transmitted wavelength λ .



Step 6 - Form the Interferogram: Select the stack and select **Interferogram Formation** from the **InSAR Products** menu.

Radar Tools Window Help				
Apply Orbit File Radiometric	•			
Speckle Filtering Coregistration	• •			
Interferometric		Products	+	Interferogram Formation
Polarimetric	•	Filtering	+	Coherence Estimation
Geometric		unwrapping	•	DEM Generation
Sentinel-1 TOPS		InSAR Stack Overview		Topographic Phase Removal
ASAR WSS	- • I			Three-pass Differential InSAR
Feature Extraction	- - -			

Select Interferogram Formation

The phase difference can have contributions from five different sources:

- $\Delta \phi flat$ is called flat Earth phase which is the phase contribution due to the earth curvature.
- $\Delta \phi e levation$ is the topographic contribution to the interferometric phase.
- $\Delta \phi displacement$ is the surface deformation contribution to the interferometric phase.



- $\Delta \phi$ atmosphere is the atmospheric contribution to the interferometric phase. It is introduced due to the atmospheric humidity, temperature and pressure change between the two acquisitions.
- $\Delta \phi$ noise is the phase noise introduced by temporal change of the scatterers, different look angle, and volume scattering.



Contributors to SAR Interferometric Phase

Through the interferometric processing, we shall try to eliminate other sources of error to be left with only the contributor of interest which is typically the elevation or the displacement.

In the interferogram formation step we shall remove the flat-Earth phase. The flat-Earth phase is the phase present in the interferometric signal due to the curvature of the reference surface. The flat-Earth phase is estimated using the orbital and metadata information and subtracted from the complex interferogram.

Interferogram Formation	X
File Help	
I/O Parameters Processing Parameters	
☑ Subtract flat-earth phase from interf	erogram
Degree of "Flat Earth" polynomial:	5 🗸
Number of 'Flat earth' estimation points:	501 🔻
Orbit interpolation degree:	3 🔹
Include coherence estimation	
Coherence Azimuth Window Size:	10
Coherence Range Window Size:	10
[
	Run Close

Interferogram Dialog

The interferogram product produced will contain a band for the interferometric phase.



Interferometric Phase Band





Interferometric Phase Band

Interferometric fringes represent a full 2π cycle. Fringes appear on an interferogram as cycles of arbitrary colours, with each cycle representing half the sensor's wavelength. Relative ground movement between two points can be calculated by counting the fringes and multiplying by half of the wavelength. The closer the fringes are together, the greater the strain on the ground.

Flat terrain should produce a series of regularly spaced, parallel fringes. Any deviation from a parallel fringe pattern can be interpreted as topographic variation.

With the same operator, you may also generate the coherence estimation in the same processing step as the interferogram.

The coherence between master and slave images can show you if the images have strong similarities and are therefore good candidates for generating a DEM. Loss of coherence can produce poor interferometric results.



Loss of coherence could be caused by temporal (time between acquisitions), geometric (orbit errors), volumetric (vegetation) or processing.



Coherence Contribution

The coherence band shows how similar each pixel is between the slave and master images in a scale from 0 to 1. Areas of high coherence will appear bright. Areas with poor coherence will be dark. In the image, vegetation is shown as having poor coherence and buildings have very high coherence.



Coherence Band



Topographic Phase Removal

The Interferogram can then be flattened by removing the topographic phase. The operator will simulate an interferogram based on a reference DEM and subtract it from the processed interferogram.

Step 7 - Remove Topographic Phase: Select the Interferogram product and go to the **Interferometric Products** menu. Select **Topographic Phase Removal**.



Select Topographic Phase Removal



C Topographic Phase Re	emoval
File Help	
I/O Parameters Processing	g Parameters
Orbit Interpolation Degree:	3
Digital Elevation Model:	SRTM 3Sec 🔹
Topo Phase Band Name:	topo_phase
Tile Extension [%]	100
	Run Close

Topographic Phase Removal Dialog

The resulting product will have an interferogram with topographic phase removed and a band for the topographic phase.



Topographic Phase





Topographic Phase Band





Topographic Phase Removed

Phase Filtering

Interferometric phase can be corrupted by noise from:

- Temporal decorrelation
- Geometric decorrelation
- Volume scattering
- Processing error

Where there is loss of coherence, the interference pattern is lost.

To be able to properly unwrap the phase, the signal-to-noise ratio needs to be increased by filtering the phase.



Step 8 - Phase Filtering: Select the Interferogram product and go to the **InSAR Tools** menu. Select **Goldstein Phase Filtering**.



Select Phase Filtering



Goldstein Phase Filtering	×
File Help	
I/O Parameters Processing Parar	neters
Adaptive Filter Exponent in (0,1]:	1.0
FFT Size:	64 🔹
Window Size:	3 🔻
	Run Close

Phase Filtering Dialog





Filtered Phase Band

Phase Unwrapping

In the interferogram, the interferometric phase is ambiguous and only known within 2π . In order to be able to relate the interferometric phase to the topographic height, the phase must first be unwrapped.

The altitude of ambiguity ha is defined as the altitude difference that generates an interferometric phase change of 2π after interferogram flattening.

$$h_a = \frac{\lambda R sin\theta}{2B_n}$$

Phase unwrapping solves this ambiguity by integrating phase difference between neighbouring pixels. After deleting any integer number of altitudes of ambiguity (equivalent to an integer number of 2π phase cycles), the phase variation between two points on the flattened interferogram provides a measurement of the actual altitude variation.



For optimal unwrapping results it is recommended to multi-look (i.e., square) and phase-filter (i.e., increase signal-to-noise and smooth) the interferogram.

The quality and reliability of unwrapped results very much depends on the input coherence. Reliable results can only be expected in areas with high coherence.

Unwrapped results should be interpreted as a relative height/displacement between two pixels. To obtain absolute estimates, a tie point can be used in the unwrapped phase to height operation.

Step 8 – Export to Snaphu: Export the filtered flattened interferogram to SNAPHU.



Export to Snaphu

Select TOPO mode for DEM generation. Select DEFO for deformation mapping.



Export data for SN	IAPHU unwrapping	
Read SnaphuExport		
Target folder:	e:\out\snaphu	
Statistical-cost mode:	DEFO 🔹	
Initial method:	MCF	
Processing completed in	n 30 seconds	
	Process	

SNAPHU Export

Unwrapping with SNAPHU

SNAPHU is a statistical-cost network-flow algorithm for phase unwrapping developed at Stanford University by Curtis Chen and Howard Zebker. http://nova.stanford.edu/sar_group/snaphu/

Snaphu is available for Linux only. Linux users simply need to install the software package by

apt-get install snaphu

Windows users can download a Linux VMW are virtual machine and use it to unwrap the phase.

http://sourceforge.net/projects/s1tbx/files/snaphu_vm/SAR%20Mint%2064.zip/download

The free VMWare Workstation Player can be downloaded from https://my.vmware.com/web/vmware/downloads

Open the VMware player and browse for the virtual machine.

Edit the virtual machine settings to increase the memory and setup a shared folder between Linux and Windows.





Edit Virtual Machine Settings

Increase the memory to suit your computer. Depending on the size of your images, you may need at least 8GB.

Sound Card Auto detect Printer Present Display Auto detect		32 GB - 16 GB - 8 GB - 4 GB - 2 GB - 1 GB - 512 MB - 256 MB - 128 MB - 64 MB - 32 MB - 16 MB - 8 MB - 4 MB -		 Maximum recommended memory (Memory swapping may occur beyond this size.) 28596 MB Recommended memory 384 MB Guest OS recommended minimum 32 MB
--	--	---	--	--

Increase Memory

Under the **options** tabs, add a shared folder. Select 'Always Enable'.



Settings	Summary	Folder sharing
settings General Power Shared Folders VMware Tools Unity Autologin	Summary Mint 64 Disabled Time sync off Not supported	A Shared folders expose your files to programs in the virtual machine. This may put your computer and your data at risk. Only enable shared folders if you trust the virtual machine with your data. Image: Disabled Image: Disabled Image: Disabled Image: Disabled <

Enable a Shared Folder

Save the wrapped phase output into the shared folder

After starting the Linux virtual machine, open a command terminal and you should see the data in /mnt/hgfs/

Start the virtual machine and login with: Login: sar Password: sar01

Go to the data folder in /mnt/hgfs/ and open the **snaphu.conf** file.

cd /mnt/hgfs/vmshare/data/target_snaphu/ gedit snaphu.conf &



📰 snaphu.conf 🗶	
# CONFIG FOR SNAPH	1U
<pre># Created by NEST #</pre>	software on: 11:16:49 20/03/2015
<pre># Command to call #</pre>	snaphu:
# snaphu -f	<pre>snaphu.conf Phase_ifg_srd_07Aug2014_31Aug2014.snaphu.img 18453</pre>
######################################	######################################
STATCOSTMODE D INITMETHOD M VERBOSE T	DEFO MCF TRUE

Copy the snaphu command and paste it into the command terminal and then run it.

snaphu -f snaphu.conf Phase_ifg_srd_07Aug2014_31Aug2014.snaphu.img 18453

SNAPHU uses an iterative optimization procedure; its execution time depends on the difficulty of the interferogram.

Unwrapping can use a lot of memory. If the unwrapping fails due to there being not enough memory, you could create a subset of your area of interest and try with SNAPHU again.

```
Terminal
Building azimuth cost arrays
Initializing flows with MCF algorithm
Setting up data structures for cs2 MCF solver
Running cs2 MCF solver
Running nonlinear network flow optimizer
Maximum flow on network: 12
Number of nodes in network: 32349493
Flow increment: 1 (Total improvements: 0)
1 incremental cost clipped to avoid overflow (0.000%)
Treesize: 32349493 Pivots: 581827 Improvements: 12560
Maximum flow on network: 3
Flow increment: 2 (Total improvements: 12560)
Treesize: 32349493 Pivots: 20
                                      Improvements: 0
Maximum flow on network: 3
Flow increment: 3 (Total improvements: 12560)
Treesize: 32349493 Pivots: 0 Improvements: 0
Maximum flow on network: 3
Total solution cost: 138196748
Integrating phase
Writing output to file Unw Phase.img
Program snaphu done
Elapsed processor time:
                         0:46:23.01
Elapsed wall clock time: 0:46:51
```

SNAPHU Output



Step 10 – Import Snaphu Unwrapped Phase:

Open the Unwrapped phase hdr file

Look in:	📜 subset_1_o	f_insar_coregistered_stack_ifg_dinsar_flt	•	€ 🕬 🕄 🕏
Recent Items	coh_07Au coh_07Au Phase_ifg	g2014_31Aug2014.snaphu.hdr g2014_31Aug2014.snaphu.img .srd_07Aug2014_31Aug2014.snaphu.hdr		
Desktop	Phase_ifg snaphu.co	srd_07Aug2014_31Aug2014.snaphu.img nf 9		
My Docum	UnwPhase UnwPhase	_ifg_srd_07Aug2014_31Aug2014.snaphu.hdr _ifg_srd_07Aug2014_31Aug2014.snaphu.img		
Computer				
Network	File name: Files of type:	UnwPhase_ifg_srd_07Aug2014_31Aug2014.snaphu.hdr All Files		Open Product Cancel

The opened unwrapped phase will not have any metadata or geocodings. We must apply the Snaphu import to join the wrapped phase product with the unwrap phase product.



Select **Snaphu Import** from the interferometric menu.



Snaphu Import

Select the wrapped phase in the **read phase** tab.

Select the unwrapped phase product in the **read unwrapped phase** tab.



1-Read-Phase 2-Read-Unwrapped-Phase 3-SnaphuImport 4-Write Source Product Name: UnwPhase_ifg_srd_07Aug2014_31Aug2014.snaphu	
Source Product Name: UnwPhase_ifg_srd_07Aug2014_31Aug2014.snaphu	
UnwPhase_ifg_srd_07Aug2014_31Aug2014.snaphu	_
🕜 Help 🛛 😜 Process	

Snaphu Import Dialog

Process and display the output unwrapped phase.





Unwrapped Phase



Step 11 – Geocode the product:

Apply Terrain Correction to the phase band to geocode the product.



Apply Range Doppler Terrain Correction



Select the wrapped and unwrapped phase bands.

O Parameters Processing Parameters	ters		
Source Bands:	i_ifg_srd_07Aug2014_31Aug2014 q_ifg_srd_07Aug2014_31Aug2014 Intensity_ifg_srd_07Aug2014_31Aug2014 Phase_ifg_srd_07Aug2014_31Aug2014 topo_phase_07Aug2014_31Aug2014 cob_07Aug2014_31Aug2014		
	Unw_Phase_ifg_07Aug2014_31Aug2014		
Digital Elevation Model:	SRTM 3Sec (Auto Download)		
DEM Resampling Method:	BILINEAR_INTERPOLATION		
Image Resampling Method:			
Source GR Pixel Spacings (az x rg): Pixel Spacing (m):	3.64(m) x 3.9(m) 3.9		
Pixel Spacing (deg):	3.503429608066134E-5		
Map Projection:	WGS84(DD)		
Mask out areas without elevation	1		
Output bands for:			
Selected source band	DEM Latitude & Longitude		
Incidence angle from ellipsoid	Local incidence angle Projected local incidence angle		
Apply radiometric normalization			
Save Sigma0 band	Use projected local incidence angle from DEM		
Save Gamma0 band	Use projected local incidence angle from DEM		
Save Beta0 band			

Select Phase Bands





Geocoded Interferogram



Geocoded Unwrapped Phase





For more tutorials visit the Sentinel Toolboxes website

http://step.esa.int/main/doc/tutorials/



Send comments to the SNAP Forum

http://forum.step.esa.int/