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Generation of an interferogram over the ETNA Vulcano, Sicily (Italy), using a ERS1&2 Tandem couple

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Contents

- InSAR functionality review of NEST
- Objective and Main Processing Steps
- Hands-on exercise

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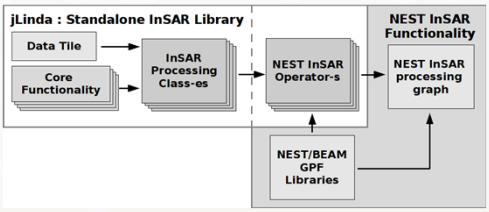
InSAR functionality of NEST

The InSAR functionality of NEST is structured in two layers:

- The core layer is formed by **JLinda** (Java Library for interferometric data analysis) which is a standalone API/InSAR library, independent from the NEST/BEAM core, encapsulating the classes, functionalities and algorithms for the interferometric processing.
- The NEST InSAR operators are built on top of core classes from JLinda package by using the NEST/BEAM Graph Processing Framework (GPF) and libraries.



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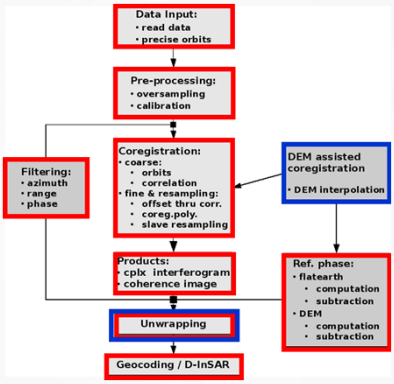
InSAR functionality of NEST



Available in 509 beta

Unwrapping via 3rd party sw (SNAPHU)

Available in 5A

Fully integrated and featured InSAR processor within NEST

- Coregistration and resampling
- **DEM assisted coregistration**
- Products: interferogram and coherence
- Filtering: both spectral and phase
- Geo-coding
- **Unwrapping**
- DEM product
- Differential InSAR
- **Cross InSAR (ERS-ENVISAT)**

Only zero doppler and strip map data are fully supported

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Objective

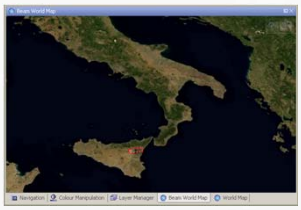
Generation of an Inteferogram over the ETNA Volcano, Sicily (Italy), using an ERS1&2 Tandem couple acquired on 1/2 August 1996.

ERS-1 SAR_SLC ORBIT 21159 – DATE 1-AUG-1995

ERS-2 SAR_SLC ORBIT 1486 – DATE 2-AUG-1995

Btemp [days]: -1 (Temporal baseline),
Bperp [m]: -66.8 (Perpendicular baseline)

Height of ambiguity ~ 9300/66.8 = 139.2



N.B.: The slide deck is centred on the **processing workflow** and does not contain any explanation about the InSAR theoretical principles behind.

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Main Processing Steps

The exercise* will be done using the NEST **DAT (interface**) and consist mainly in:

1. Open and inspect the ERS Complex products;
2. Baseline evaluation using the InSAR Stack Operator;
3. Create a project;
4. Subset the products;
5. Apply Precise (Delft) Orbits;
6. Co-registration of Subsets;
7. Flattened Interferogram generation;
8. Coherence computation;
9. Comparison interferogram vs coherence;
10. Interferogram Phase filtering;
11. Multilooking of filtered phase;
12. Geocoding of flattened interferogram
13. Export of results to Google Earth

* Please keep in mind that the proposed workflow is only an example of feasible processing

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Dataset and Results

The original data and full processing results (project) are freely available at:

SFTP (port 22): nestbox.esrin.esa.int
Username: nestuser
Password: password

Folder: DATA/ETNA-ERS

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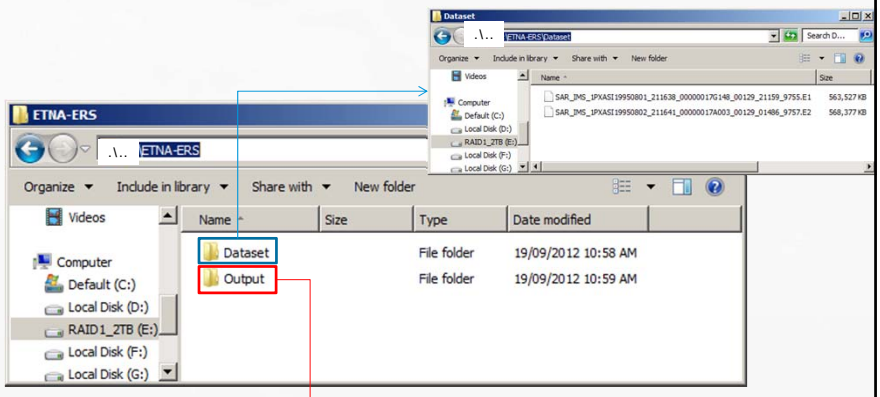
Exercise folders framework

Default exercise folders framework

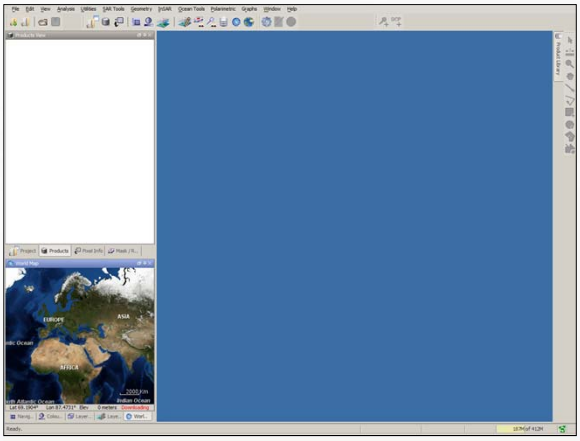
C:\LTC2013\Practical\D4P2a_NEST\ETNA-ERS



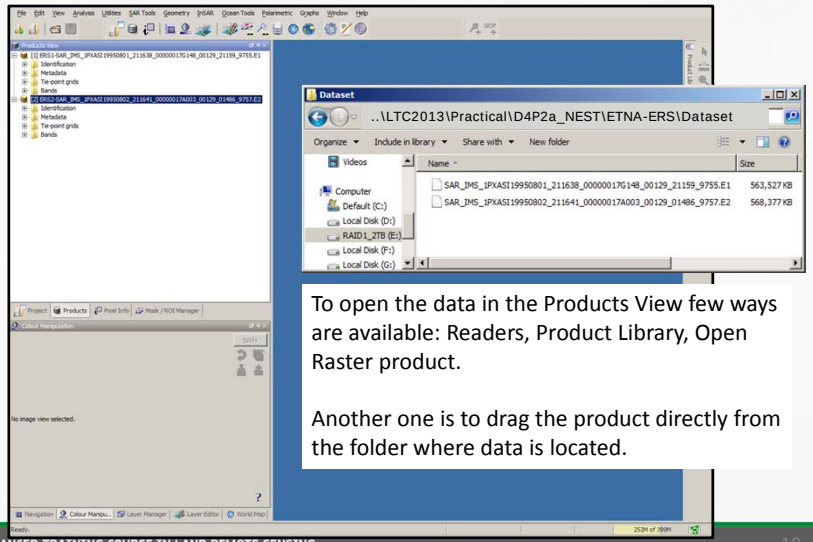
NEST DAT

Double click on NEST icon for launching NEST

DAT
(Display and Analysis Tool)



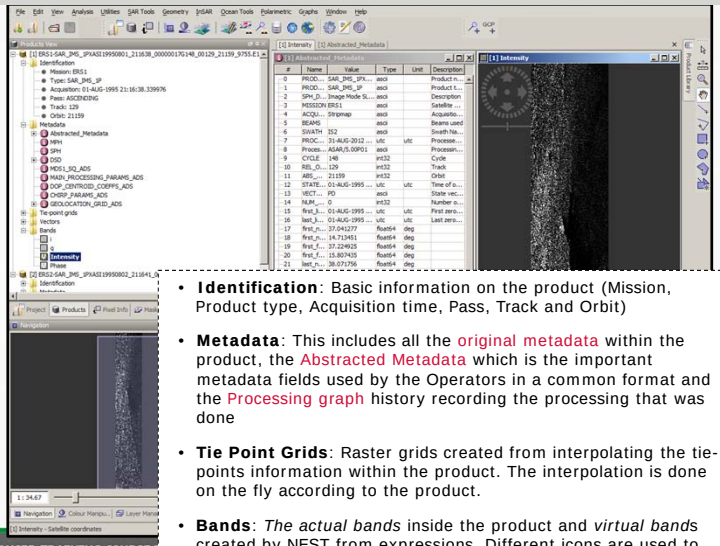
Open the ERS Complex products



To open the data in the Products View few ways are available: Readers, Product Library, Open Raster product.

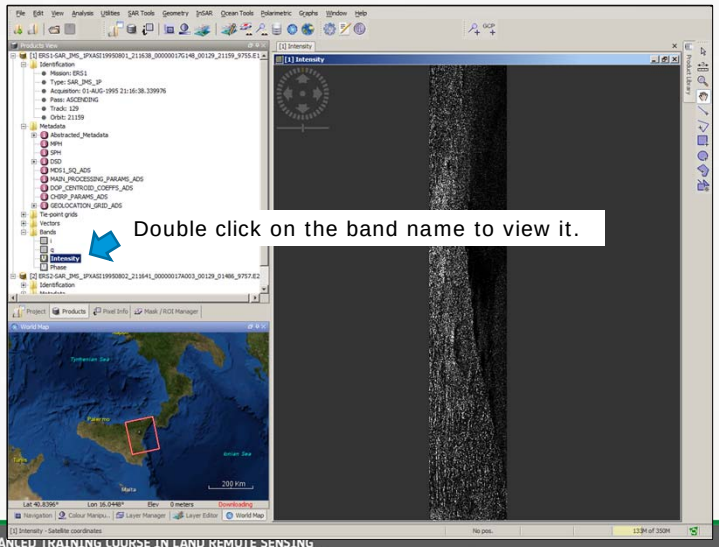
Another one is to drag the product directly from the folder where data is located.

Inspect the product



- **Identification**: Basic information on the product (Mission, Product type, Acquisition time, Pass, Track and Orbit)
- **Metadata**: This includes all the original metadata within the product, the Abstracted Metadata which is the important metadata fields used by the Operators in a common format and the Processing graph history recording the processing that was done
- **Tie Point Grids**: Raster grids created from interpolating the tie-points information within the product. The interpolation is done on the fly according to the product.
- **Bands**: *The actual bands* inside the product and *virtual bands* created by NEST from expressions. Different icons are used to distinguish these bands.

View the bands product



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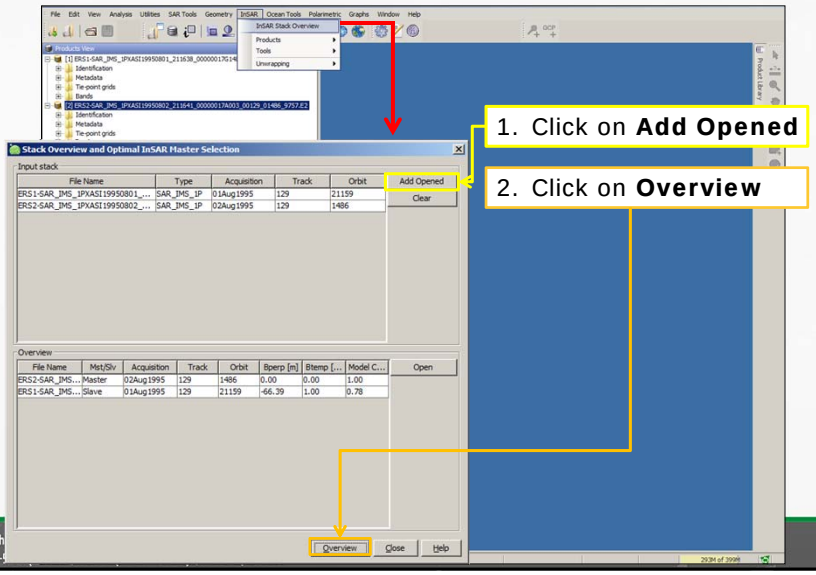
Baseline evaluation using the InSAR Stack Operator



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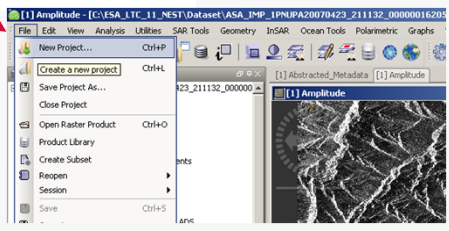
Create a project

Why create a project

1. A Project will help organize your data by storing all related work in one folder.
2. The project folders mirror the file structure of the physical hard disk. Therefore any change you make to the physical project folders on disk will be reflected in your project.

To create a project, select New Project from the File menu.



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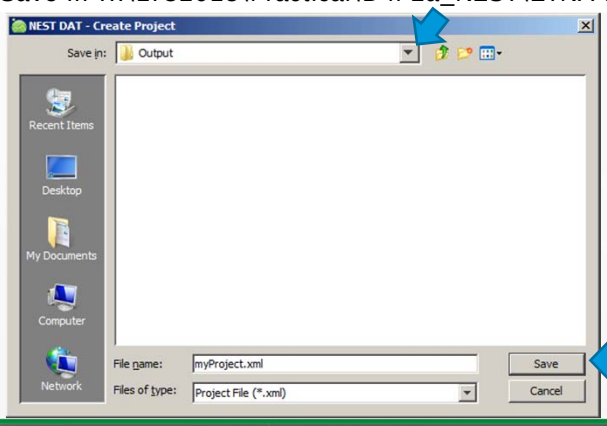
Create a project (cont.)

A dialog will prompt you for a project folder location and project file name.

1. Save in :..\LTC2013\Practical\D4P2a_NEST\ETNA-ERS \Output



2. Click on Save

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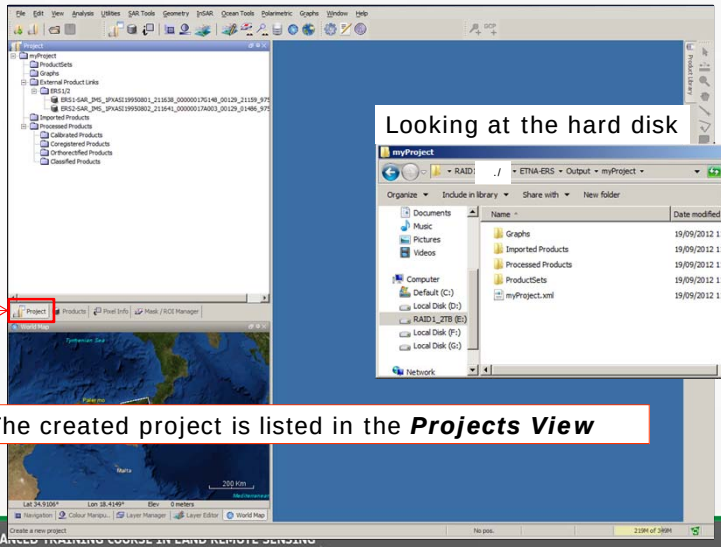
Create a project (cont.)



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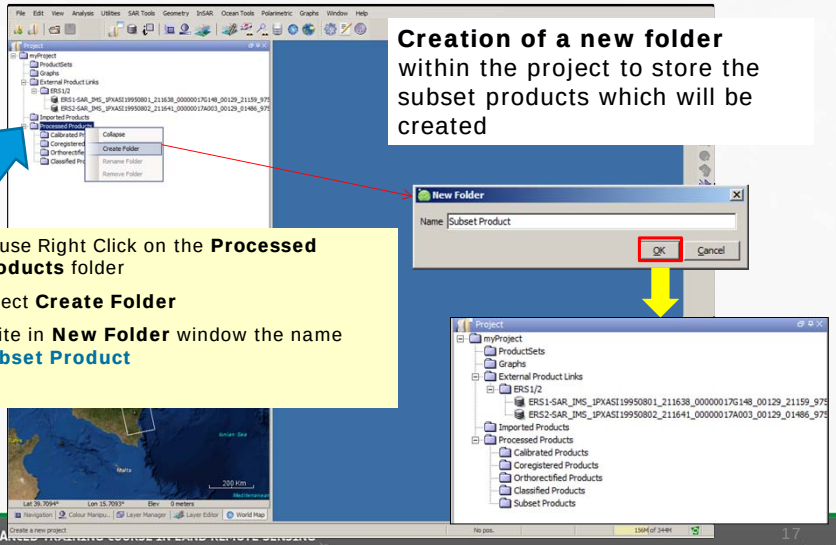
Subset the products



Creation of a new folder within the project to store the subset products which will be created

1. Mouse Right Click on the **Processed Products** folder
2. Select **Create Folder**
3. Write in **New Folder** window the name **Subset Product**
4. OK

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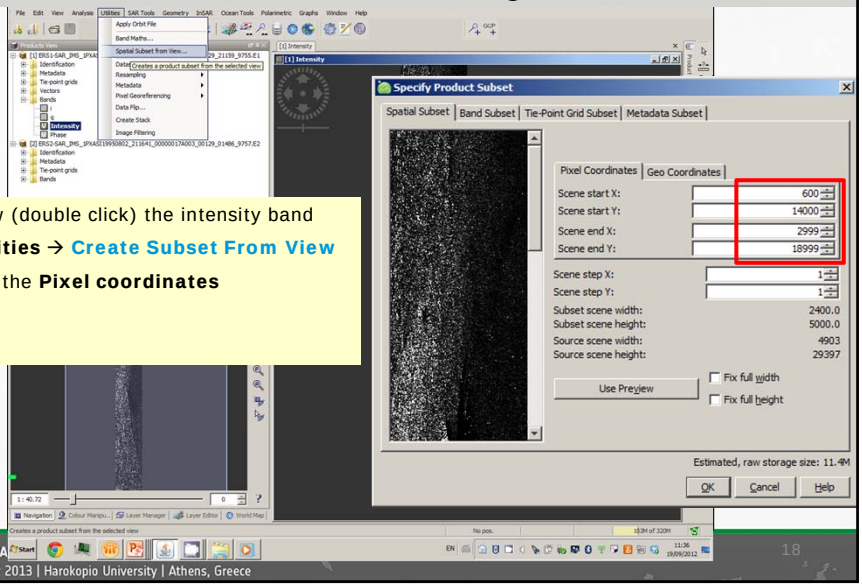
Subset ERS 1 image



1. View (double click) the intensity band
2. **Utilities** → **Create Subset From View**
3. Edit the **Pixel coordinates**
4. Ok

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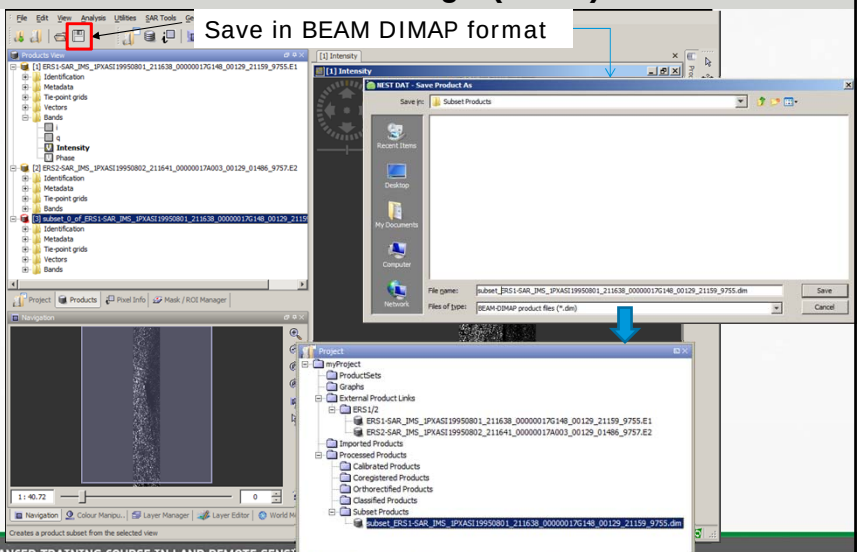
Subset ERS 1 image (cont.)



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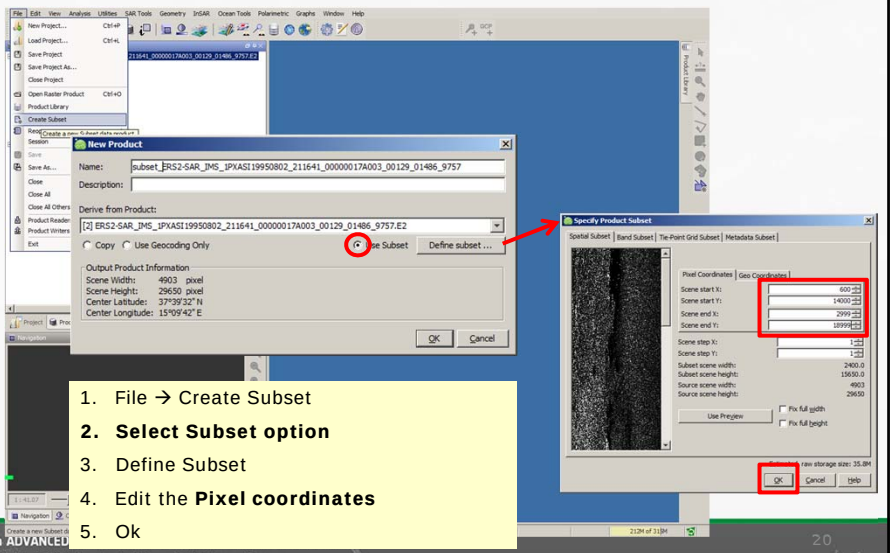
Subset ERS 2 image: alternative way



1. File → Create Subset
2. **Select Subset option**
3. Define Subset
4. Edit the **Pixel coordinates**
5. Ok

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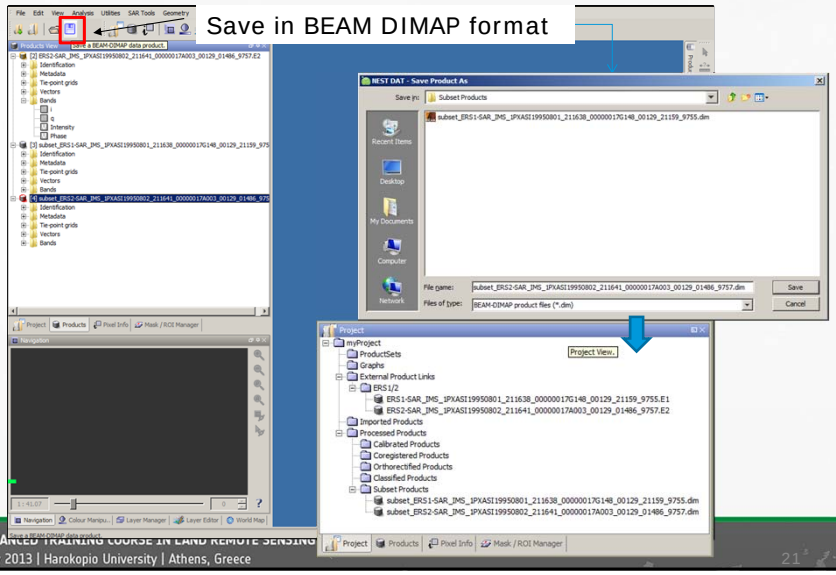
Subset ERS 2 image (cont.)



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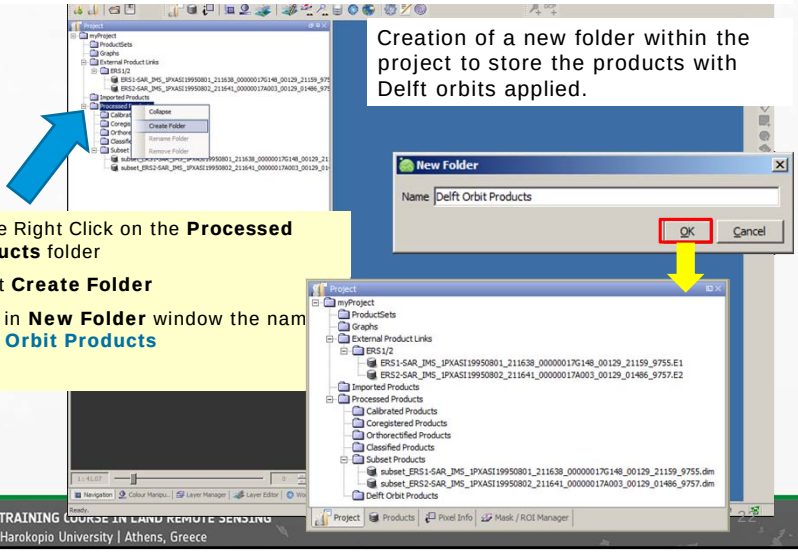
Apply Precise (Delft) Orbits

The orbit file provides accurate satellite position and velocity information.



1. Mouse Right Click on the **Processed Products** folder
2. Select **Create Folder**
3. Write in **New Folder** window the nam **Delft Orbit Products**
4. OK

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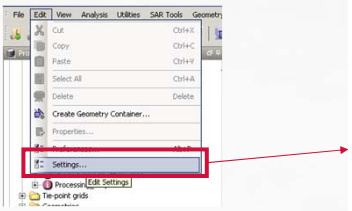
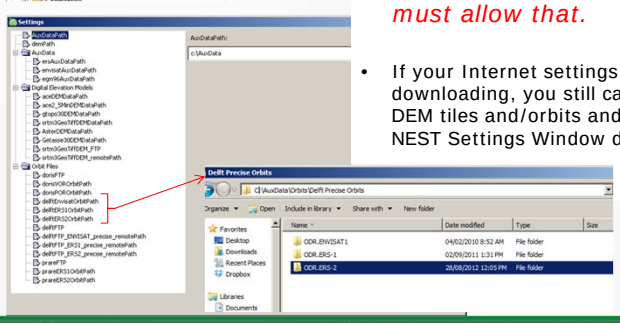
The Settings window





- NEST is able to download automatically few auxiliary data like the STRM v.4 (3" tiles) (JRC FTP (xftp.jrc.it)), Delft and ESA orbits.
- Auxiliary data downloaded into default folders according to the Settings Windows
- *Internet is required! And The firewall must allow that.*
- If your Internet settings are preventing the downloading, you still can download by yourself the DEM tiles and/orbits and put these manually in the NEST Settings Window directories.

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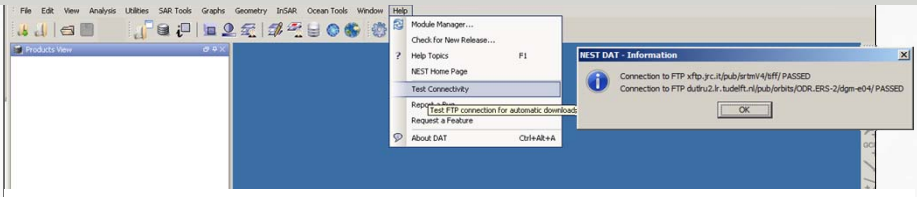
The Test Connectivity



In the HELP tab there is a "Test Connectivity" capability to check if the connection works well.
Sometime even if Connection testing is successful, PC settings could prevent the downloading.

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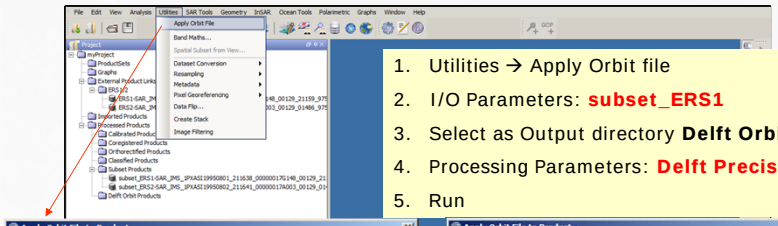
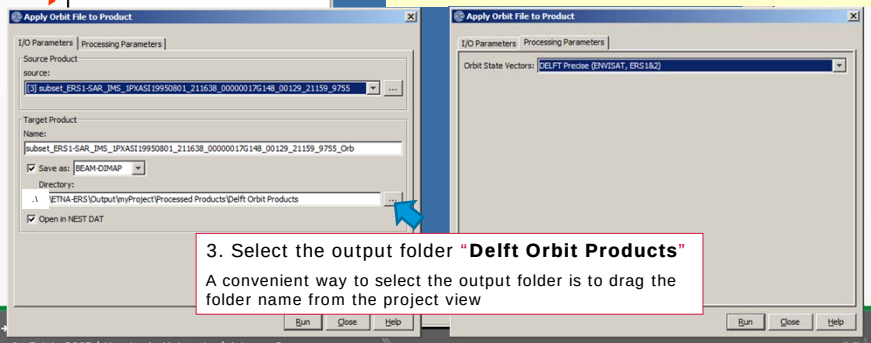
Apply Precise (Delft) Orbits



1. Utilities → Apply Orbit file
2. I/O Parameters: **subset_ERS1**
3. Select as Output directory **Delft Orbit Products**
4. Processing Parameters: **Delft Precise Vor**
5. Run



3. Select the output folder "**Delft Orbit Products**"

A convenient way to select the output folder is to drag the folder name from the project view

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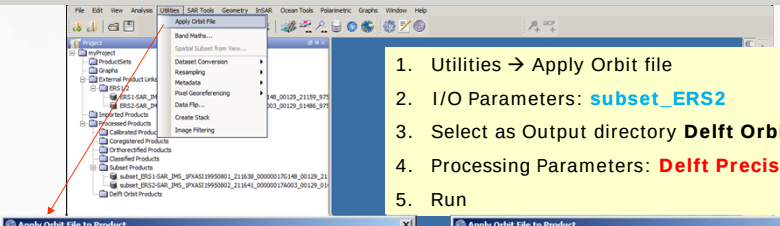
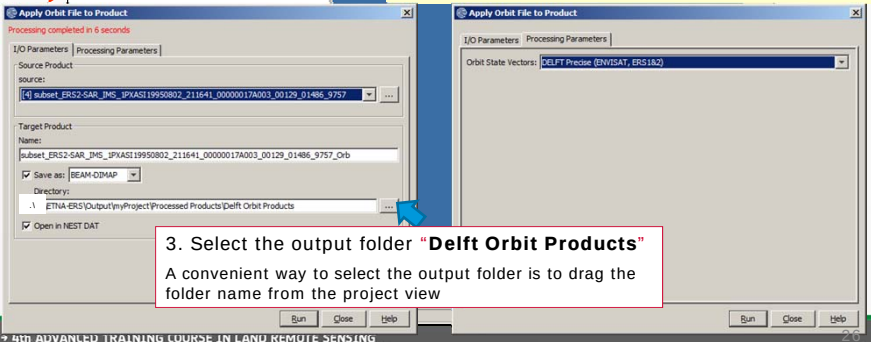
Apply Precise (Delft) Orbits



1. Utilities → Apply Orbit file
2. I/O Parameters: **subset_ERS2**
3. Select as Output directory **Delft Orbit Products**
4. Processing Parameters: **Delft Precise Vor**
5. Run



3. Select the output folder "**Delft Orbit Products**"

A convenient way to select the output folder is to drag the folder name from the project view

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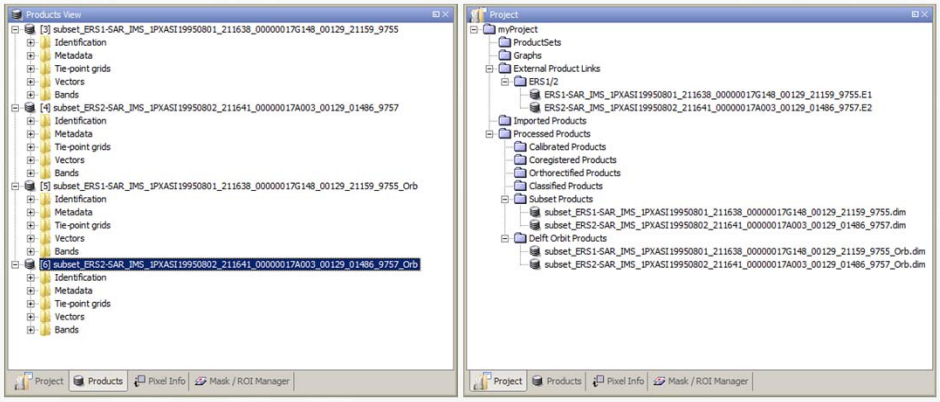
Apply Precise (Delft) Orbits



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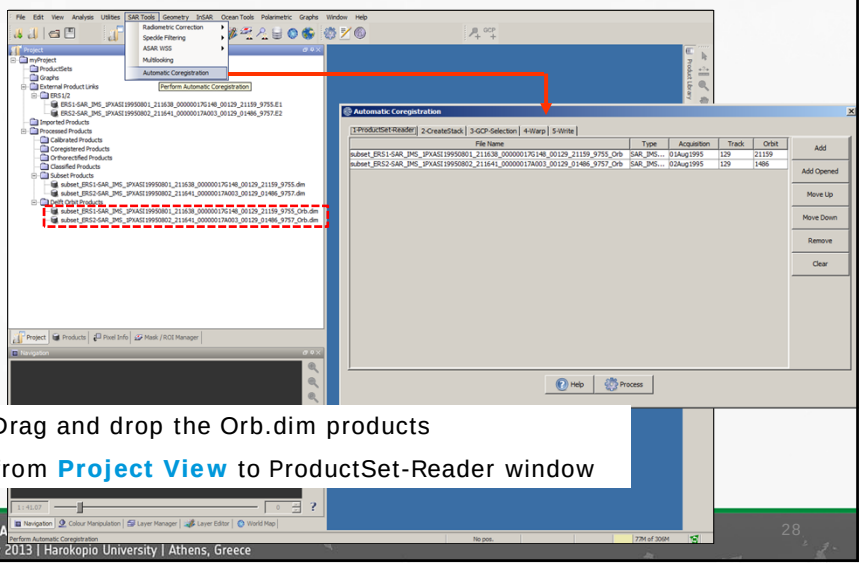
Coregistration of Subsets_Orb



1. Drag and drop the Orb.dim products from **Project View** to ProductSet-Reader window

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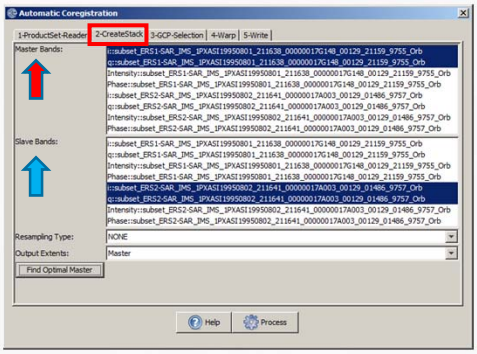
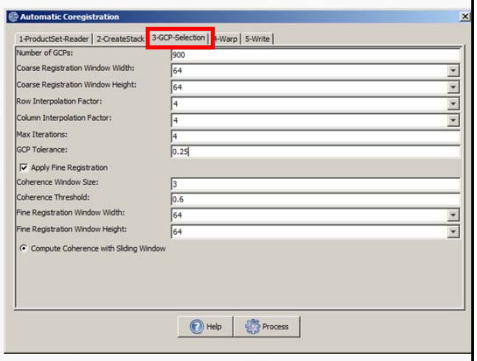
Coregistration: parameters





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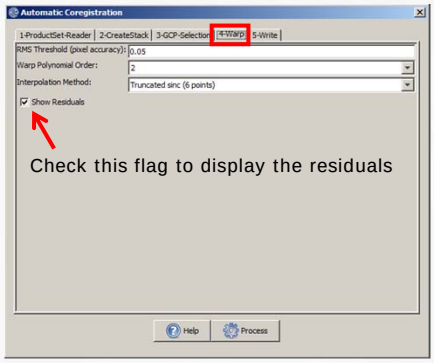
Coregistration: parameters



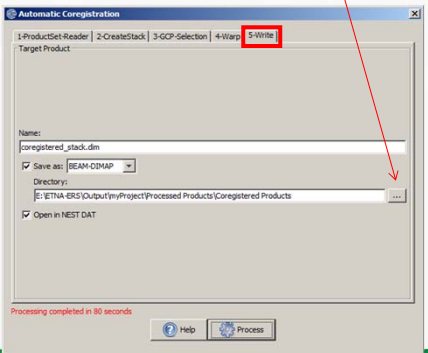
Check this flag to display the residuals

- Select as target directory

"Coregistered Products"

A convenient way to select the folder is to drag the folder name from the project view

- Click **Process**



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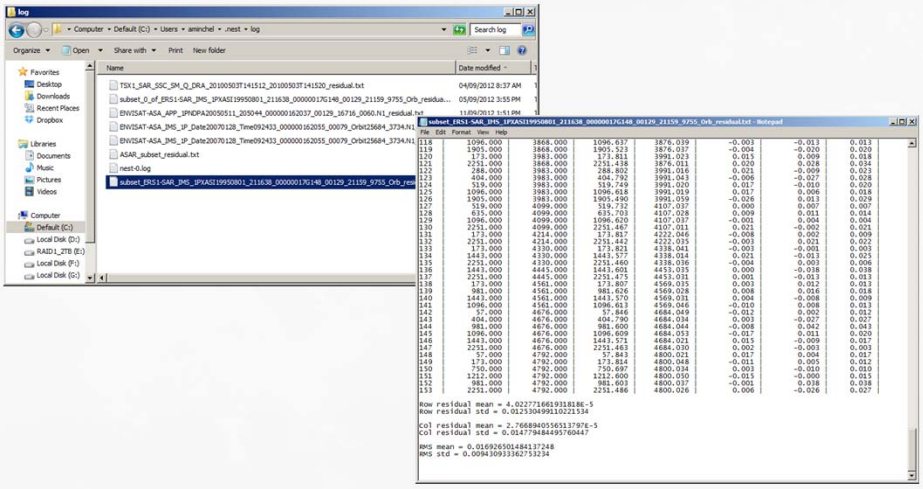
The residual.txt file within C:\Users\User_profile\.nest\log



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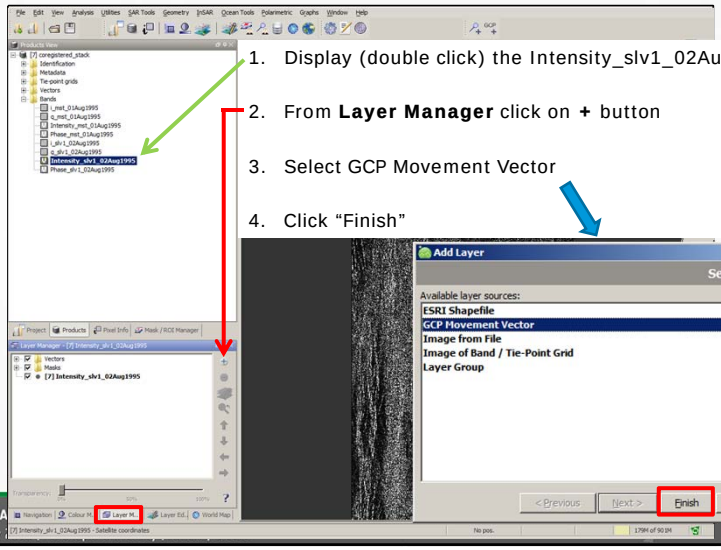
Display the survived GCP on slave image



1. Display (double click) the Intensity_slv1_02Aug1995
2. From **Layer Manager** click on **+** button
3. Select GCP Movement Vector
4. Click “Finish”

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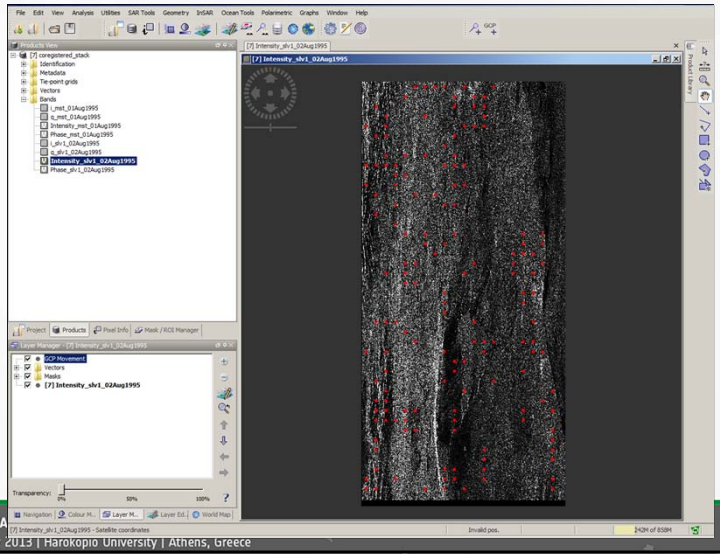
Display the survived GCP on slave image



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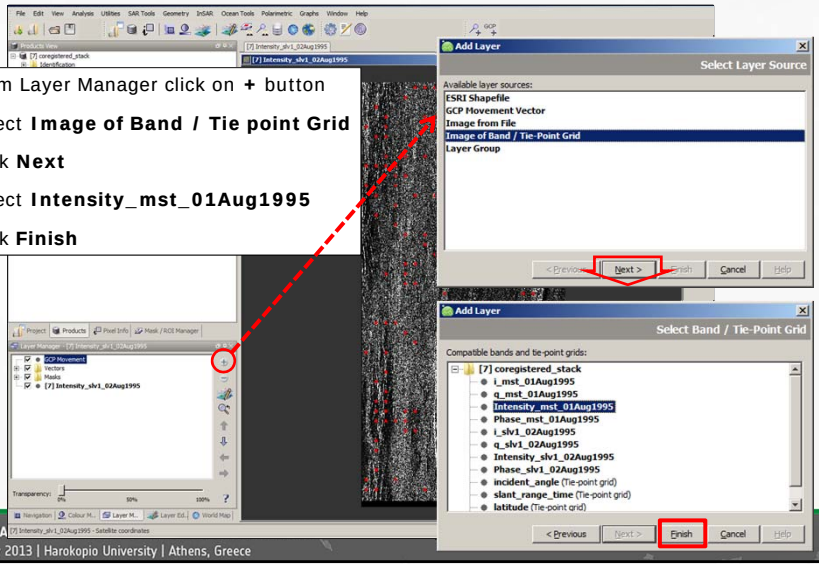
Coregistered data: Overlay Master and Slave

1. From Layer Manager click on **+** button
2. Select **Image of Band / Tie point Grid**
3. Click **Next**
4. Select **Intensity_mst_01Aug1995**
5. Click **Finish**



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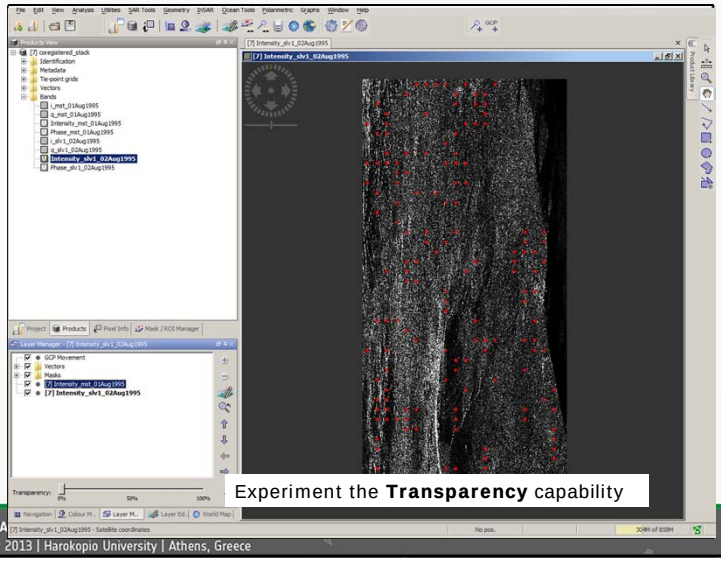
Coregistered data: Overlay Master and Slave



Experiment the **Transparency** capability

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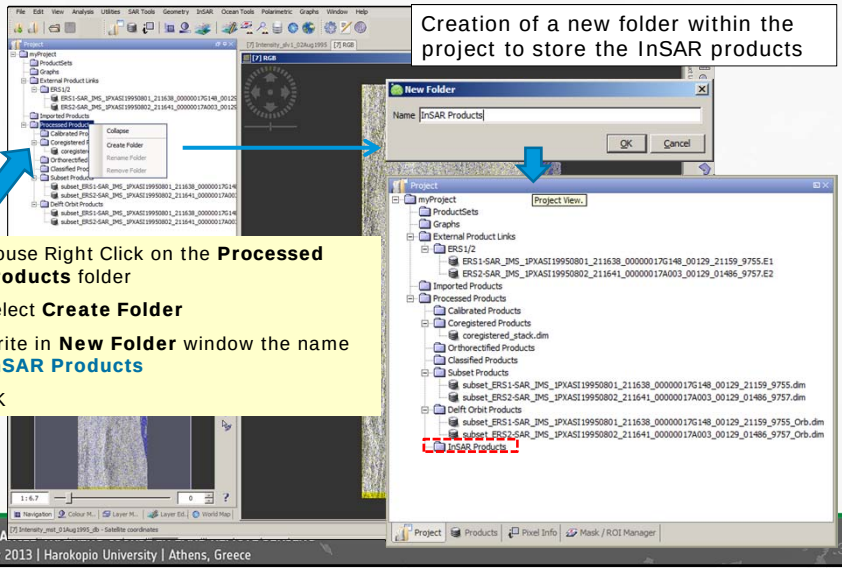
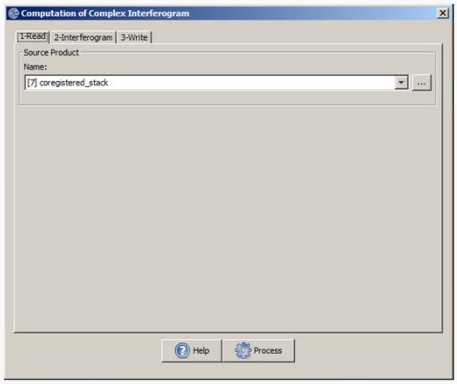
Interferogram generation (Flattened)

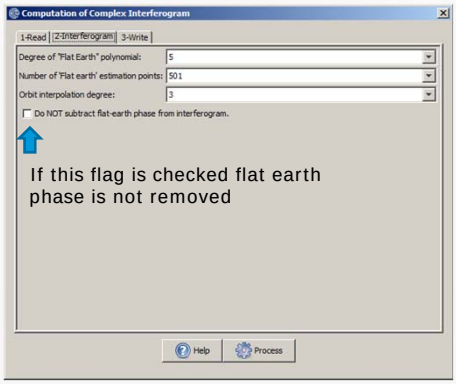


Creation of a new folder within the project to store the InSAR products

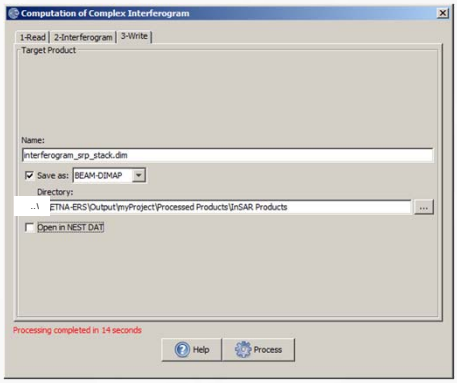
1. Mouse Right Click on the **Processed Products** folder
2. Select **Create Folder**
3. Write in **New Folder** window the name **InSAR Products**
4. OK

Interferogram generation (Flattened)





Interferogram generation (Flattened)

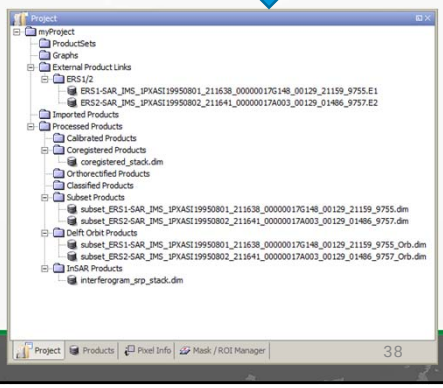


- Select as target directory

"InSAR Products"

A convenient way to select the folder is to drag the folder name from the project view

- Click **Process**



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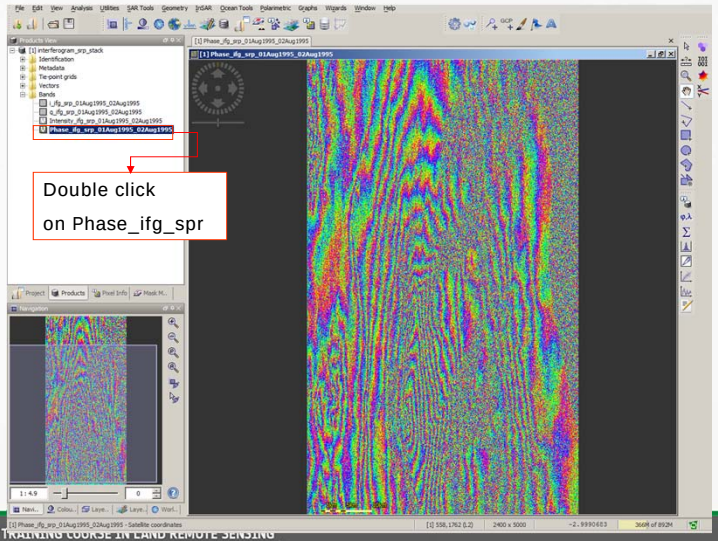
Visualisation of flattened Interferogram



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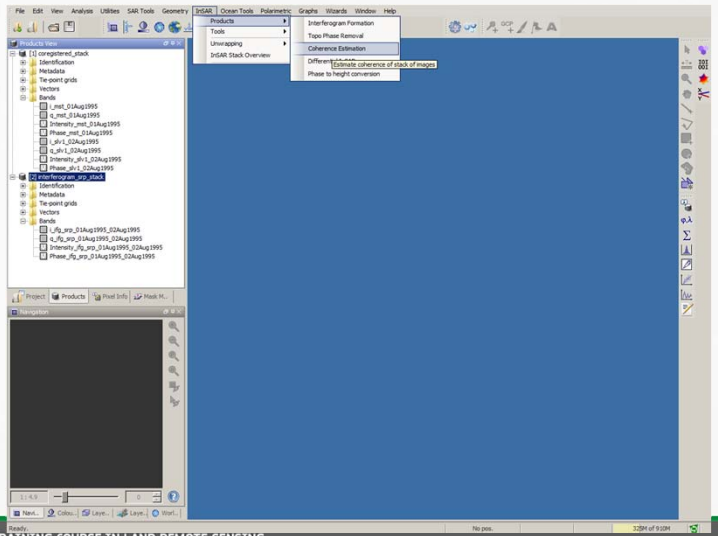
Coherence estimation



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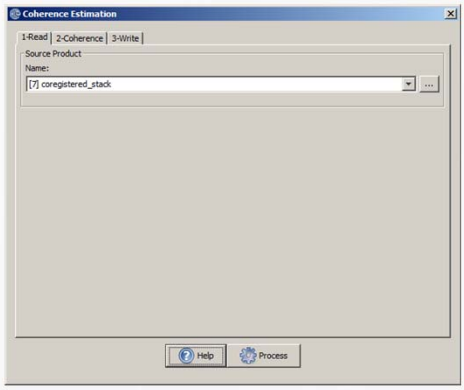
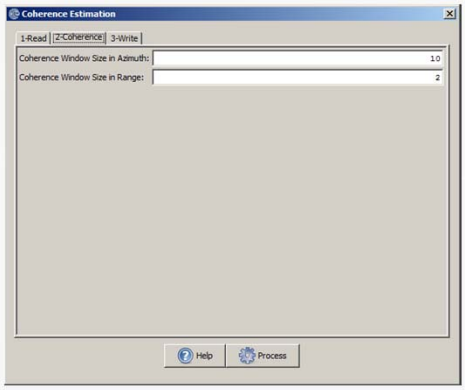
Coherence estimation





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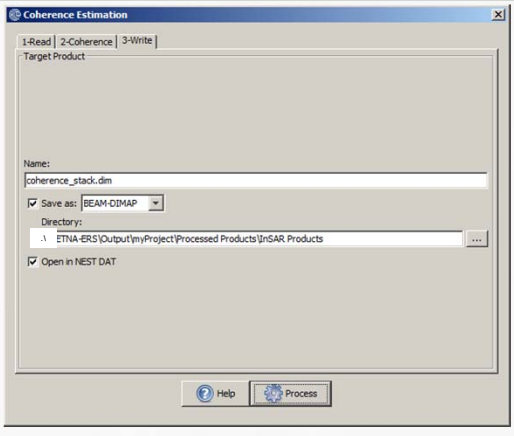
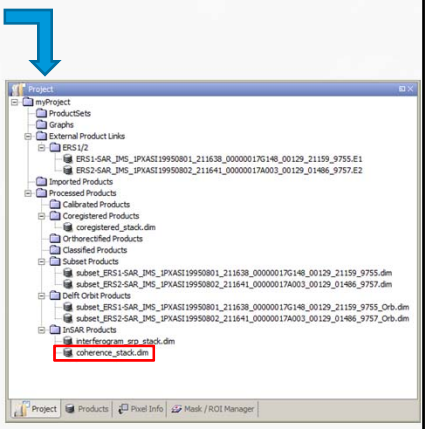
Coherence estimation





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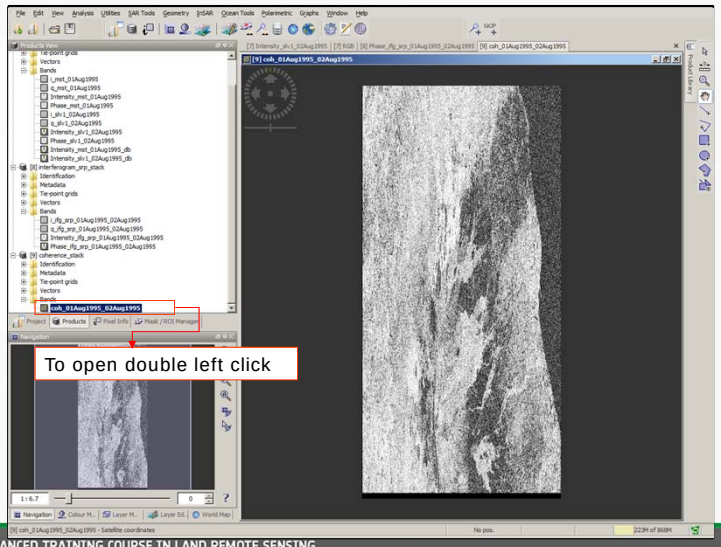
Coherence estimation



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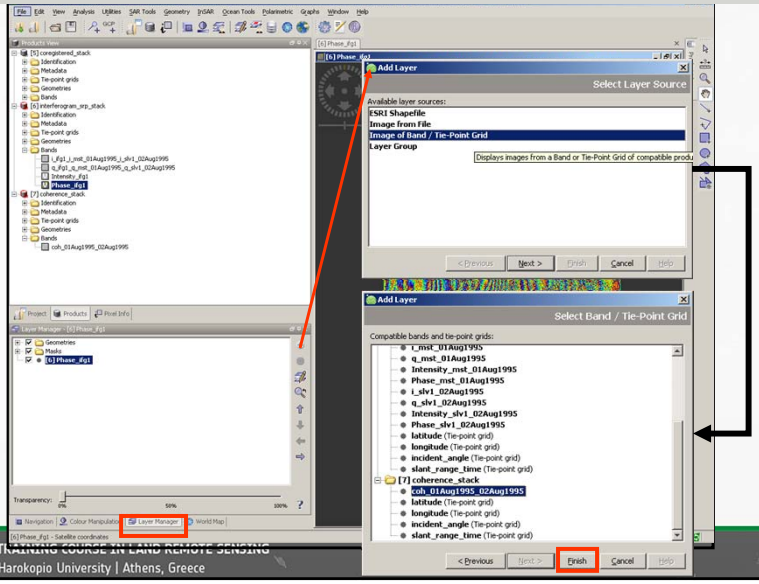
Layer manager: Interf. Vs coherence



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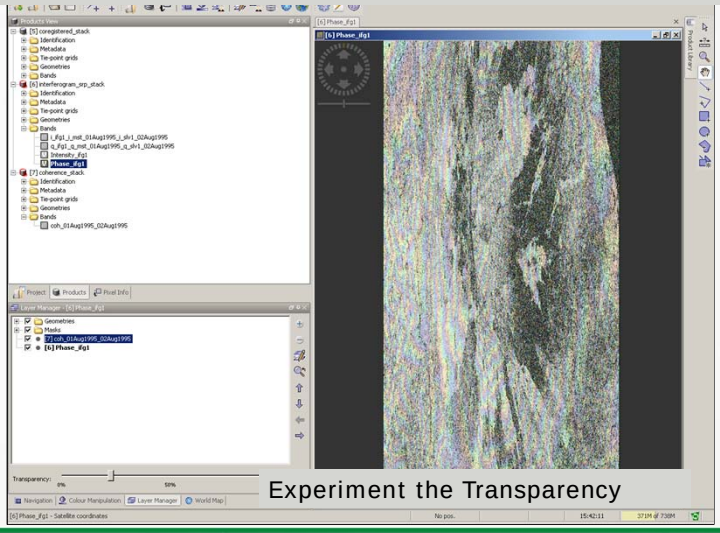
Layer manager: Interf. Vs coherence



Experiment the Transparency

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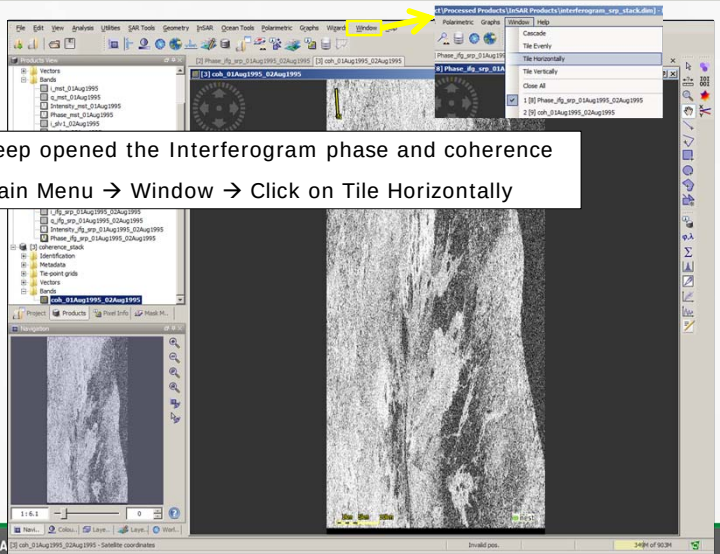
Interf. Phase vs coherence



1. Keep opened the Interferogram phase and coherence
2. Main Menu → Window → Click on Tile Horizontally

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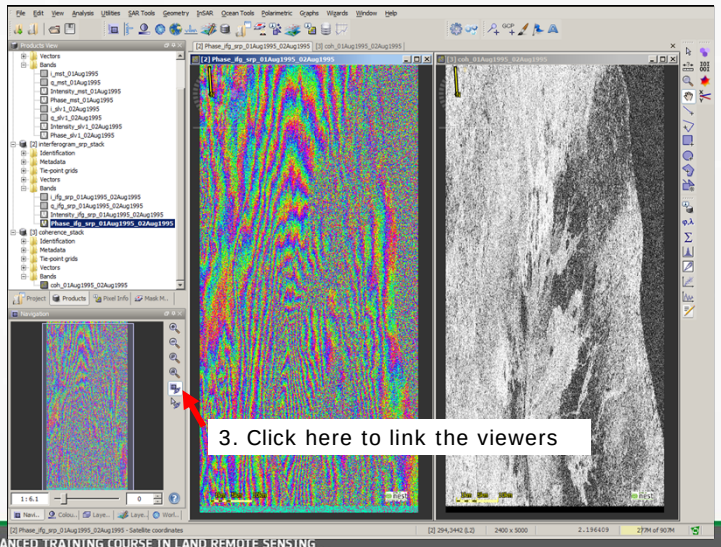
Interf. Phase vs coherence



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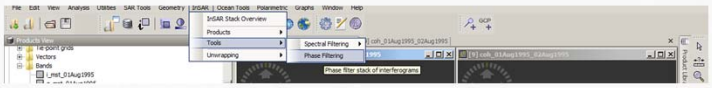
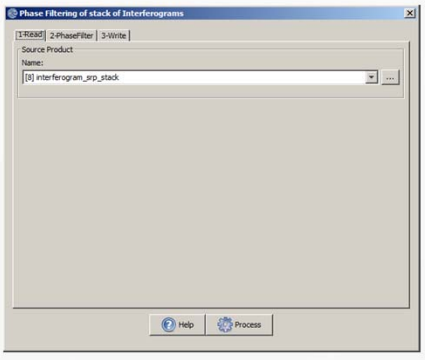
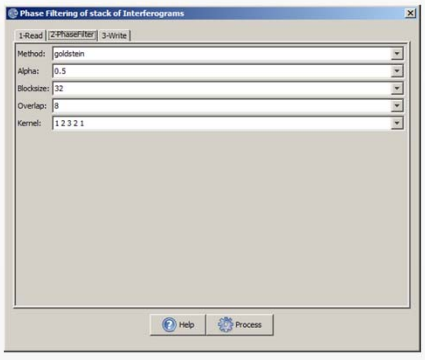
(interferogram) Phase filtering







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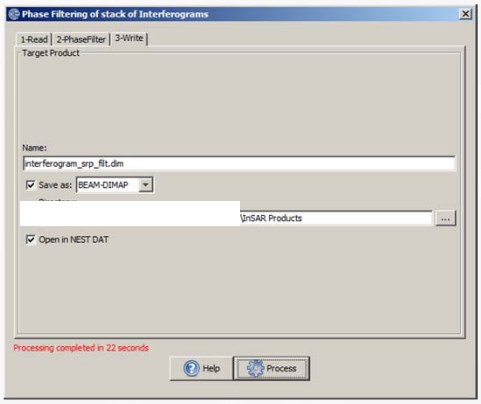
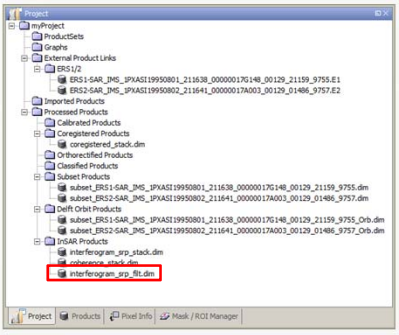
(interferogram) Phase filtering





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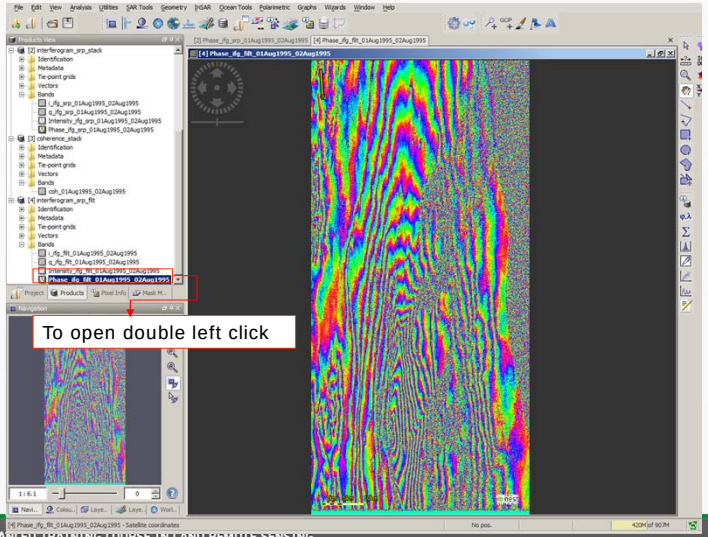
Display filtered (inteferogram) phase



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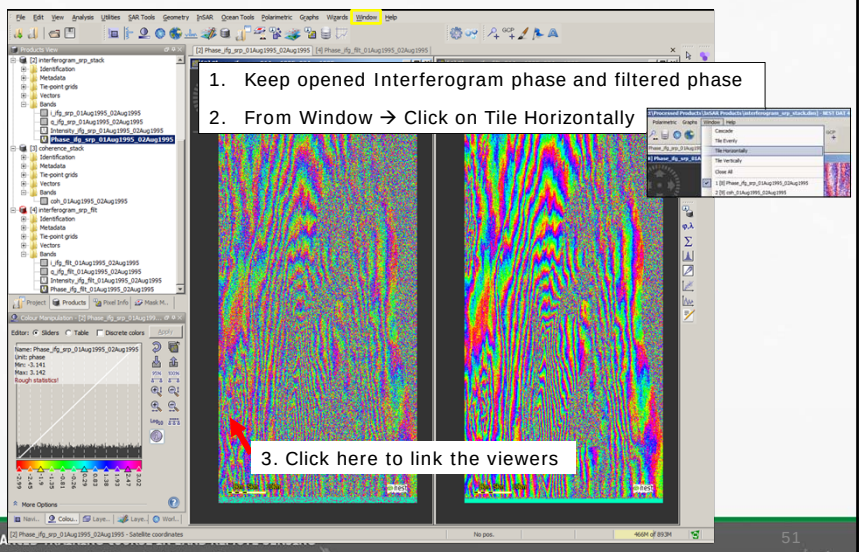
Interf. Phase vs filtered Phase



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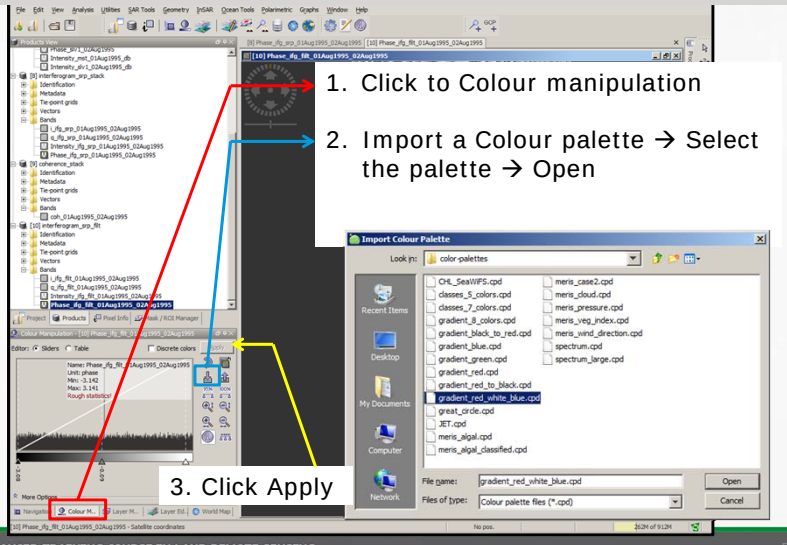
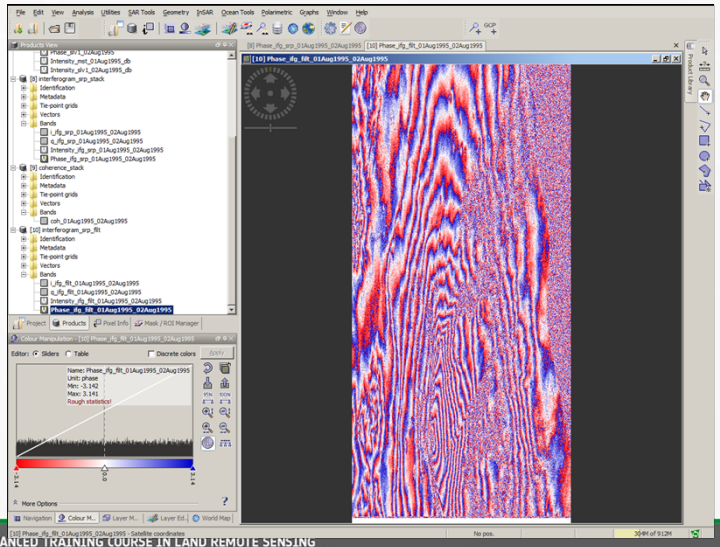
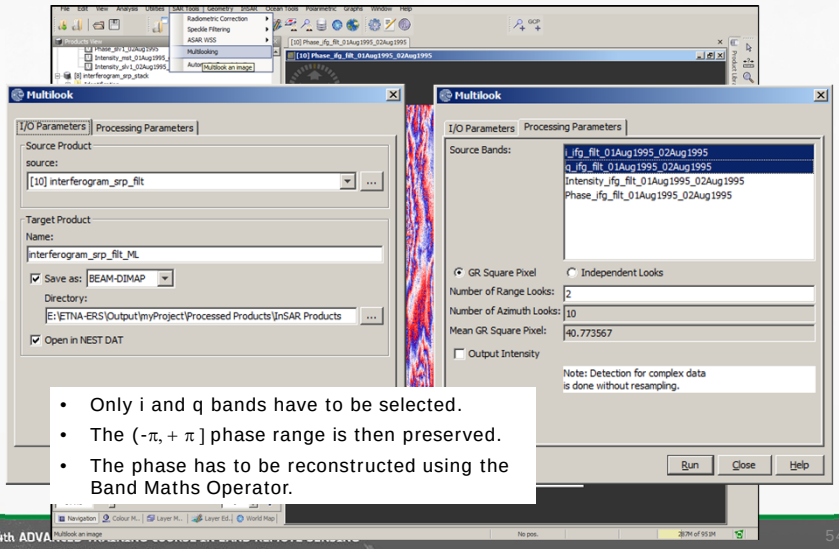
Change Look Up Table (LUT)



Change Look Up Table (LUT)



Multilooking (2;10) for filtered phase



- Only i and q bands have to be selected.
- The $(-\pi, +\pi]$ phase range is then preserved.
- The phase has to be reconstructed using the Band Maths Operator.

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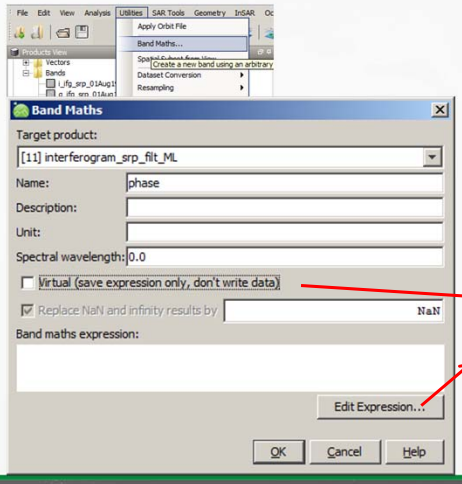
Reconstruct the phase after Multilooking by using the Band Maths Op



1. Utility → Band Maths Op
2. Select Target product
3. **Name**: write in **phase**
4. Uncheck Virtual option
5. Click to Edit Expression

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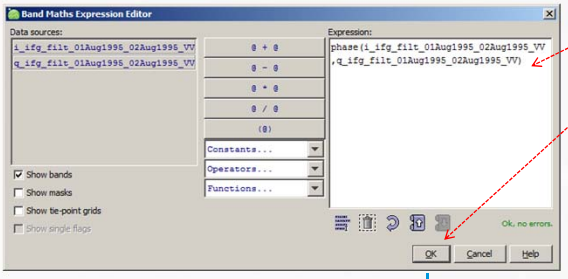
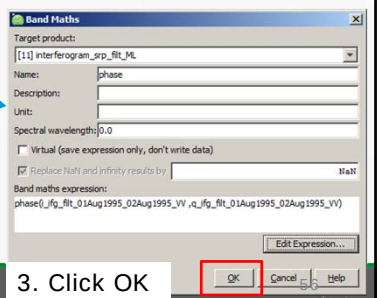


1. Write the expression
2. Click OK



3. Click OK

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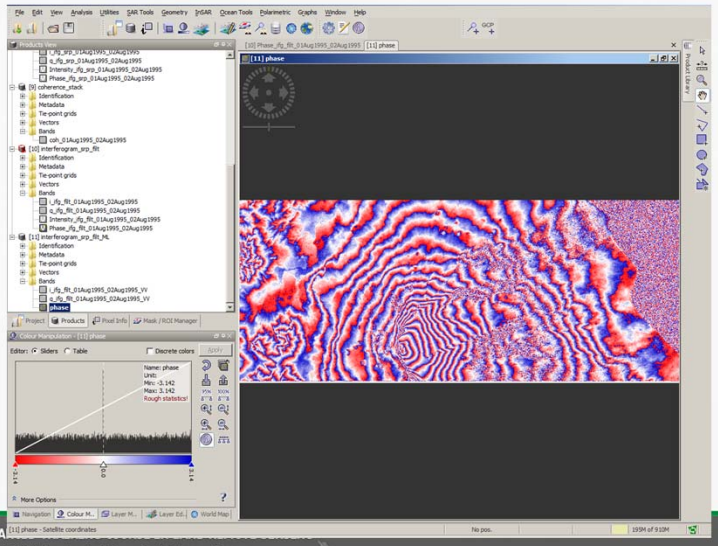
Display ML filtered phase



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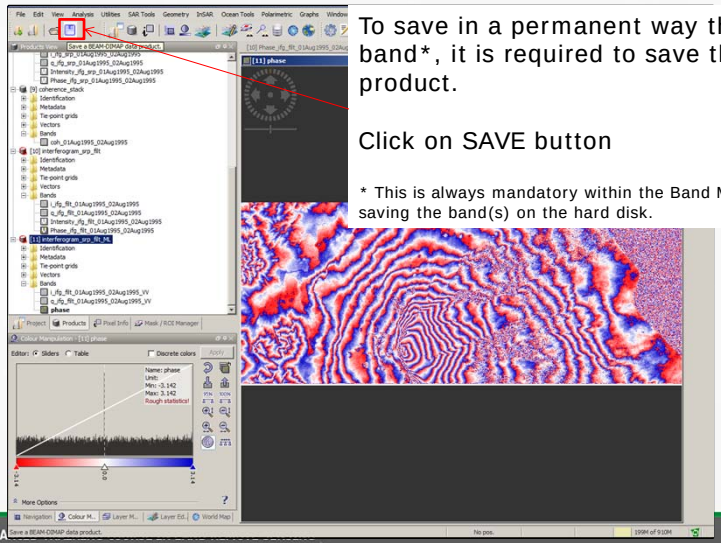
Save (permanently) ML filtered phase



To save in a permanent way the phase band*, it is required to save the product.

Click on SAVE button

* This is always mandatory within the Band Math Op for saving the band(s) on the hard disk.

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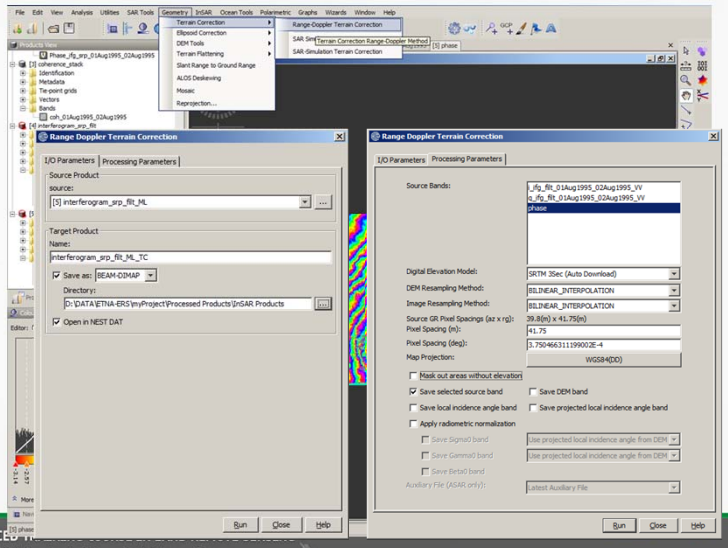
Geocoding of multilooked interf.



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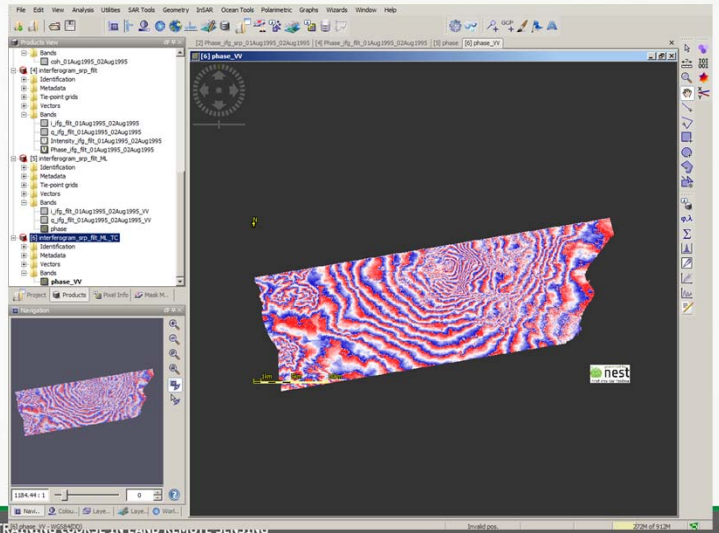
Geocoding of multilooked interf.



→ 4th ADVANCED TRAINING COURSE IN LAND REMOTE SENSING
1–5 July 2013 | Harokopio University | Athens, Greece

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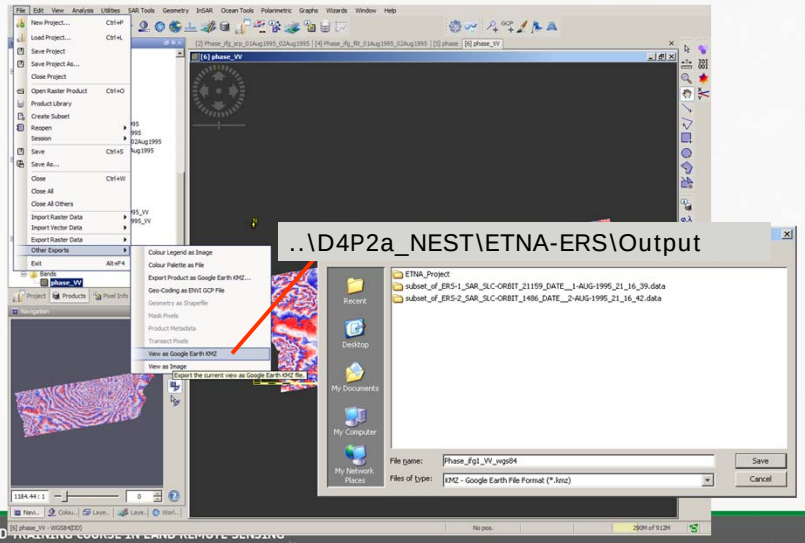
Export to Google Earth



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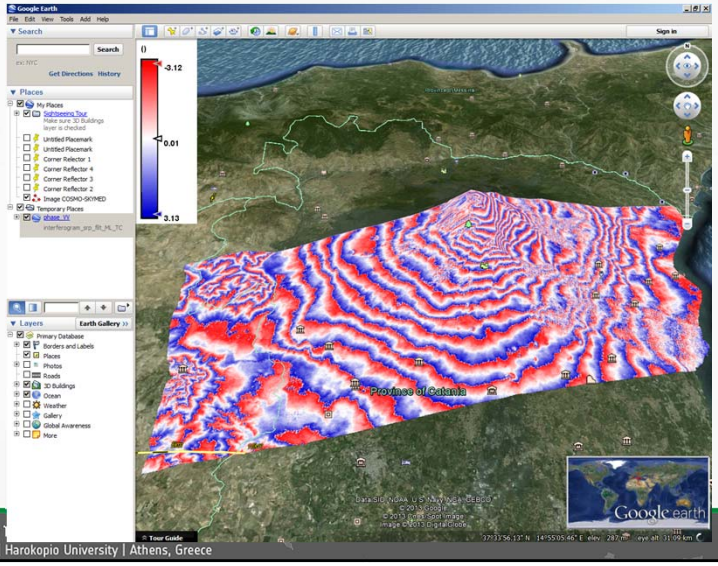
Export to Google Earth



THANK YOU for your attention!