Earth Observation and Data Analysis
Homework 4

Submitted by:
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1. Data quality check

All the 4 bands of the two SAR products were visually inspected and all of them were in good quality with the presence of no significant noise.

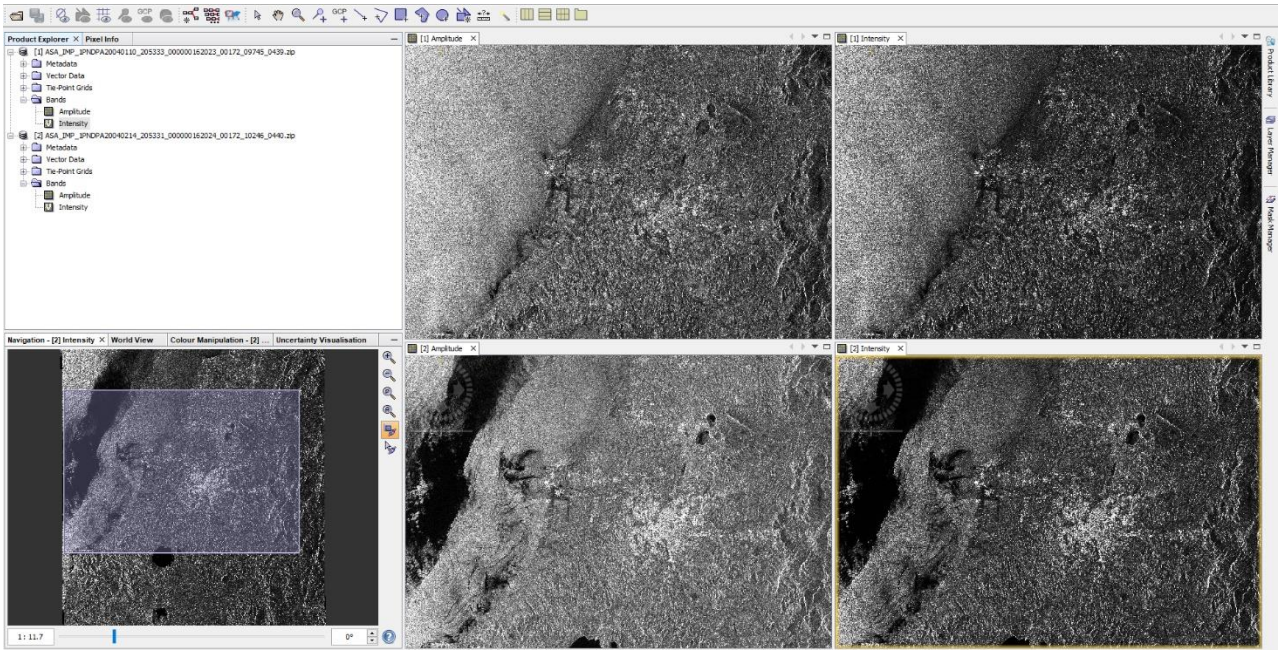

Fig 1.1. Visual overview of all the bands of the products

2. Open the SAR data and review the Metadata information

The following is a screenshot describing the “Specific Product Header” (SPH) of the first SAR product:

[1] SPH

Name	Value	Type	Unit	Description
SPH_DESCRIPTOR	Image Mode Precision Image	ascii		
STRIPLINE_CONTINUITY_INDICATOR	0	int32		
SLICE_POSITION	1	int32		
NUM_SLICES	1	int32		
FIRST_LINE_TIME	10-JAN-2004 20:53:33.914776	ascii		
LAST_LINE_TIME	10-JAN-2004 20:53:50.465565	ascii		
FIRST_NEAR_LAT	41311273	int32	10-6degN	
FIRST_NEAR_LONG	11969504	int32	10-6degE	
FIRST_MID_LAT	41412590	int32	10-6degN	
FIRST_MID_LONG	12589000	int32	10-6degE	
FIRST_FAR_LAT	41510620	int32	10-6degN	
FIRST_FAR_LONG	13210740	int32	10-6degE	
LAST_NEAR_LAT	42283567	int32	10-6degN	
LAST_NEAR_LONG	11674444	int32	10-6degE	
LAST_MID_LAT	42385574	int32	10-6degN	
LAST_MID_LONG	12304528	int32	10-6degE	
LAST_FAR_LAT	42484105	int32	10-6degN	
LAST_FAR_LONG	12936573	int32	10-6degE	
SWATH	IS2	ascii		
PASS	ASCENDING	ascii		
SAMPLE_TYPE	DETECTED	ascii		
ALGORITHM	RAN/DOP	ascii		
MDS1_TX_RX_POLAR	V/V	ascii		
MDS2_TX_RX_POLAR		ascii		
COMPRESSION	FBAQ4	ascii		
AZIMUTH_LOOKS	4	int32		
RANGE_LOOKS	1	int32		
RANGE_SPACING	12.5	float64	m	
AZIMUTH_SPACING	12.5	float64	m	
LINE_TIME_INTERVAL	0.00187056838	float64	s	
LINE_LENGTH	8498	int32	samples	
DATA_TYPE	UWORD	ascii		

Fig 2.1. The specific product header of ASA_IMP_1PNDPA20040110_*.N1.bz2

3. Computing the SAR backscattering image

3.1 Calibration

The calibration of the SAR product along with the conversion into dB were made using respectively the “Radar/Radiometric/Calibrate” and the “Raster/Data Conversion/Converts bands to/from dB” features of the SNAP tool as visible on the following screenshots.

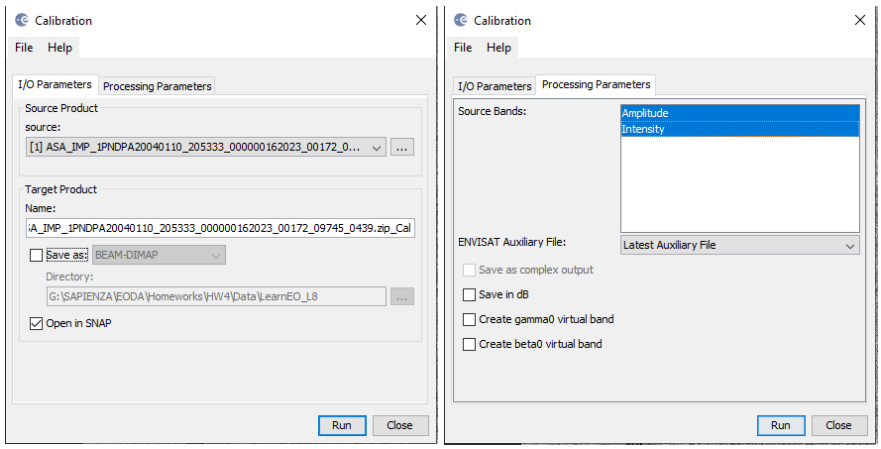

Fig 3.1. SNAP Radiometric calibration SNAP feature

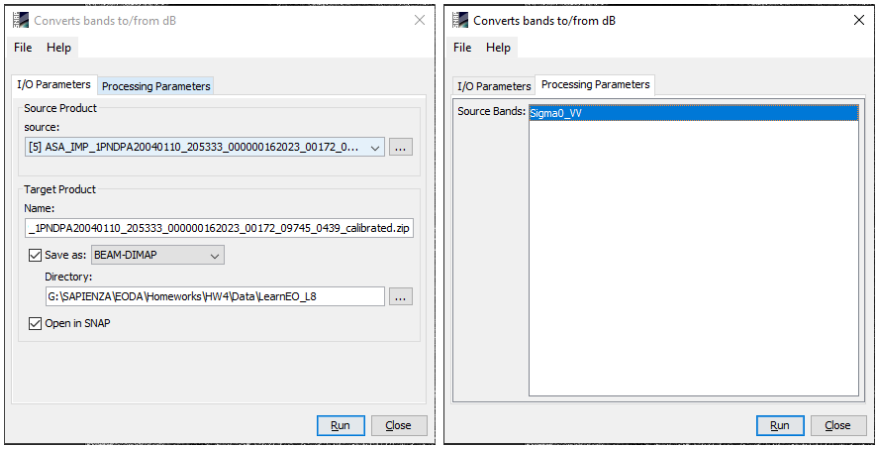

Fig 3.2. Bands conversion to/from dB SNAP feature

Calibration radiometrically corrects a SAR image so that the pixel values truly represent the radar backscatter of the reflecting surface. The following pictures show how the two calibrated and converted into dB images (the ones on the bottom) look like. The effects of the calibration are therefore clearly noticeable.

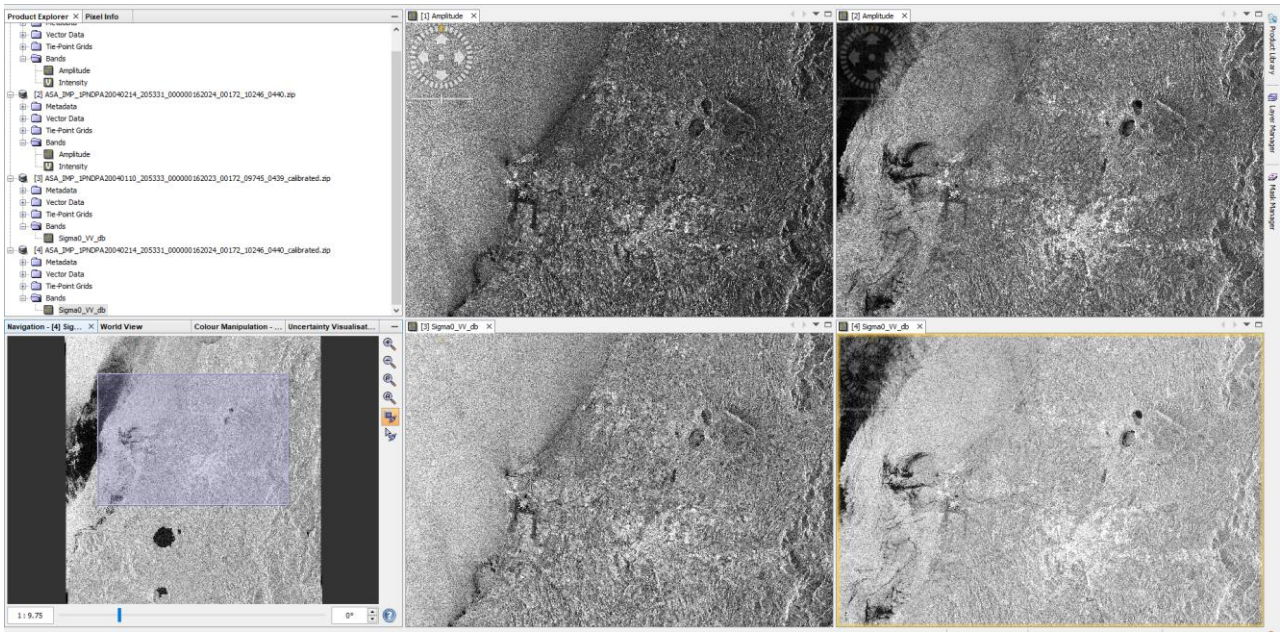

Fig 3.2. Calibration and dB conversion output

4. Co-registering the data

The first image (10/01/2004) was chosen as master image and the second image (14/02/2004) as slave image. The slave image was then overlayed (co-registered) to the master image based on the ground control points (GCP). The activity was conducted using SNAP tool.

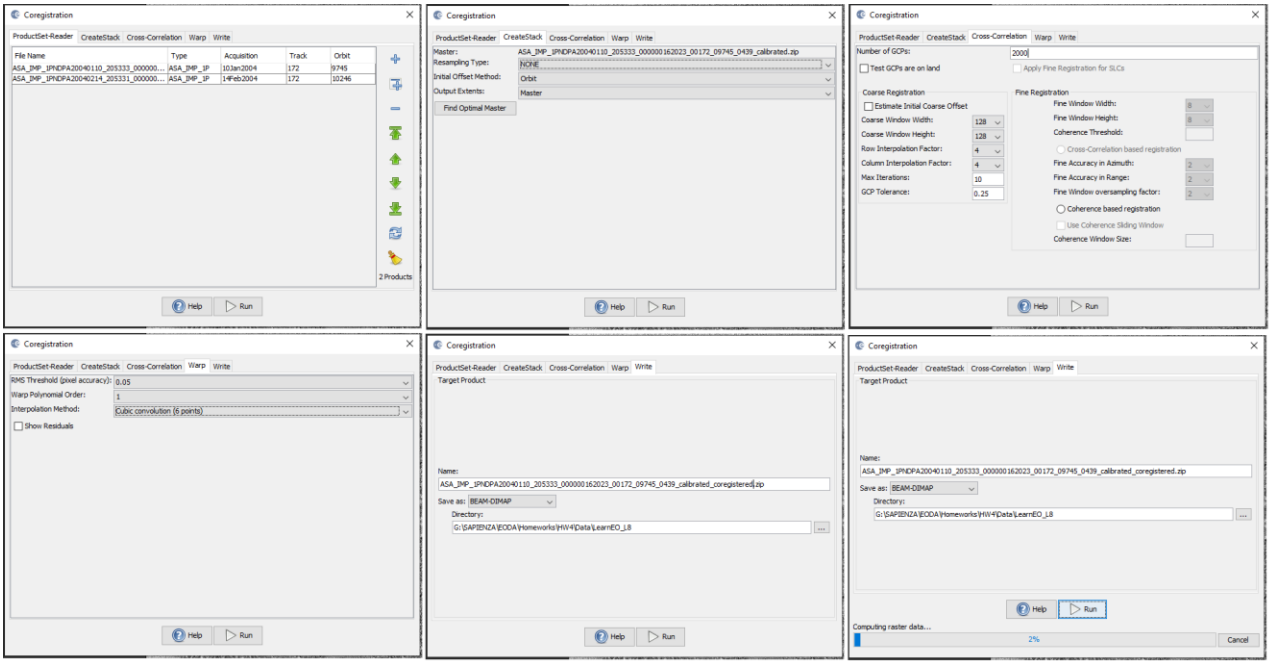

Fig 4.1. SNAP co-registration tool

Let's view in RGB the co-registered SAR product. In this image, we can see things that have changed in red or green and things that have not changed in yellow. It could also be a visual indication that the co-registration process has properly aligned both images.

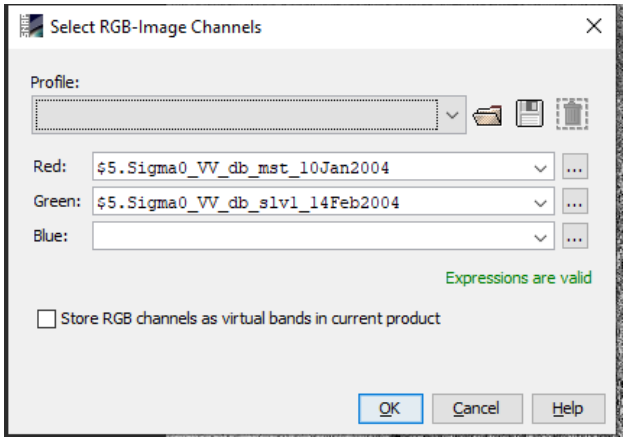

Fig 4.2 RGB co-registered image creation

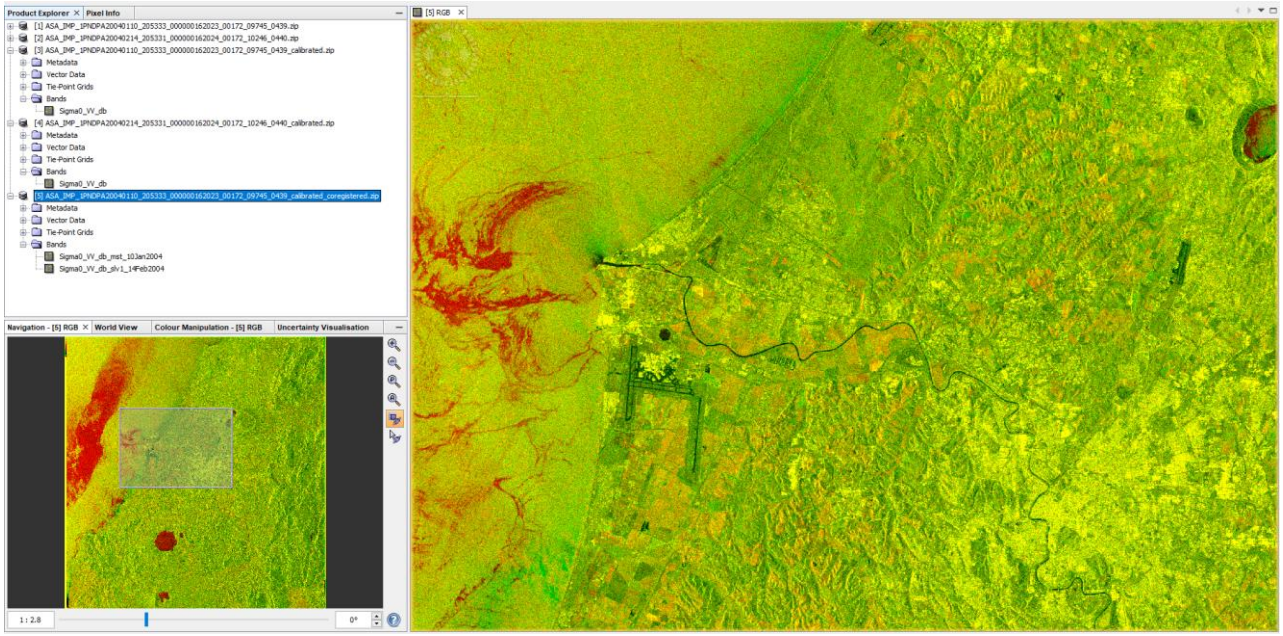

Fig 4.3 RGB co-registered image

5. Speckle Reduction

Speckle is caused by random constructive and destructive interference resulting in salt and pepper noise throughout the image. Thus, we applied it to the data to reduce the amount of speckle at the cost of blurred features or reduced resolution.

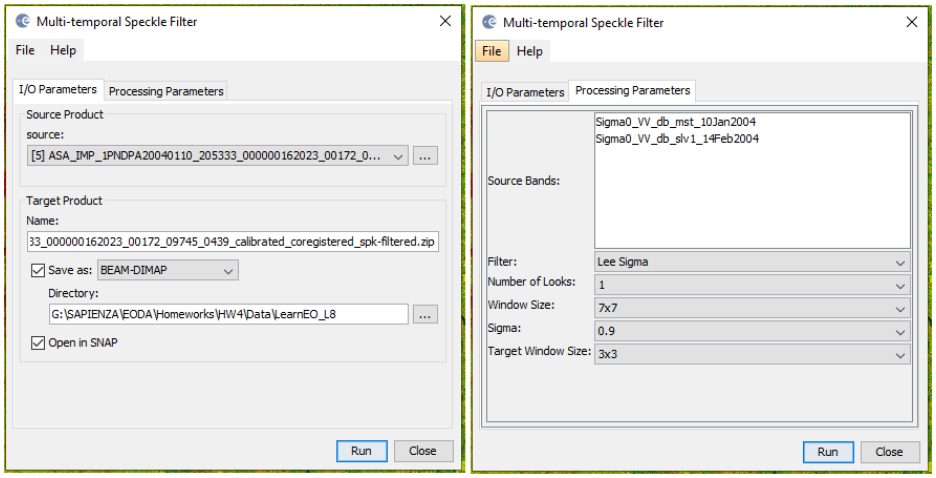

Fig 5.1 SNAP Speckle Filter feature

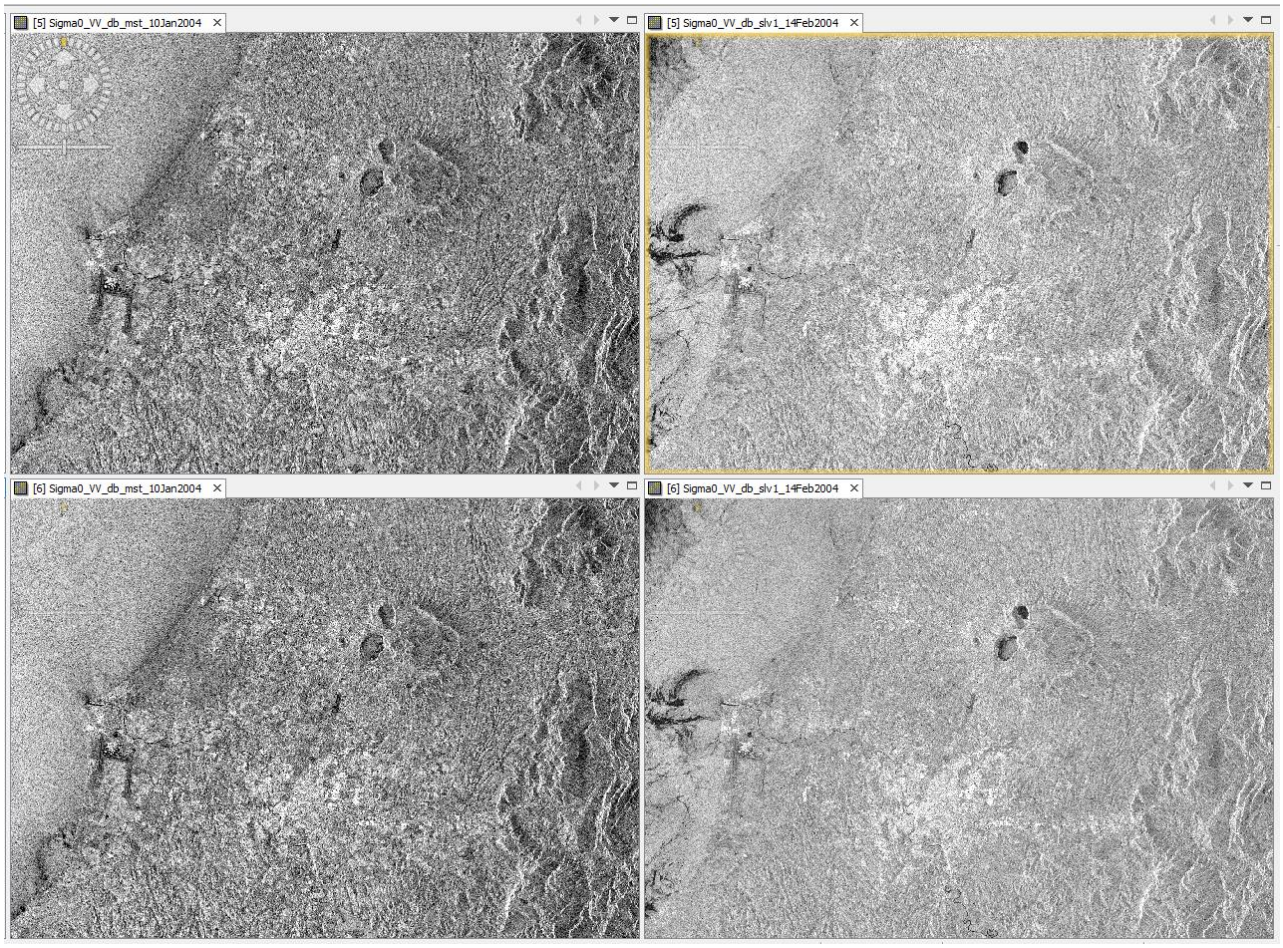

Fig 5.2 SAR Filtered images (the two bottom images)

6. Analysis of principal scattering mechanisms (in an urban context)

We calculated the mean and the standard deviation of backscattering values for thre different clusters of pixels (park, density residential area and asphalt surface). As we can se on the following image.

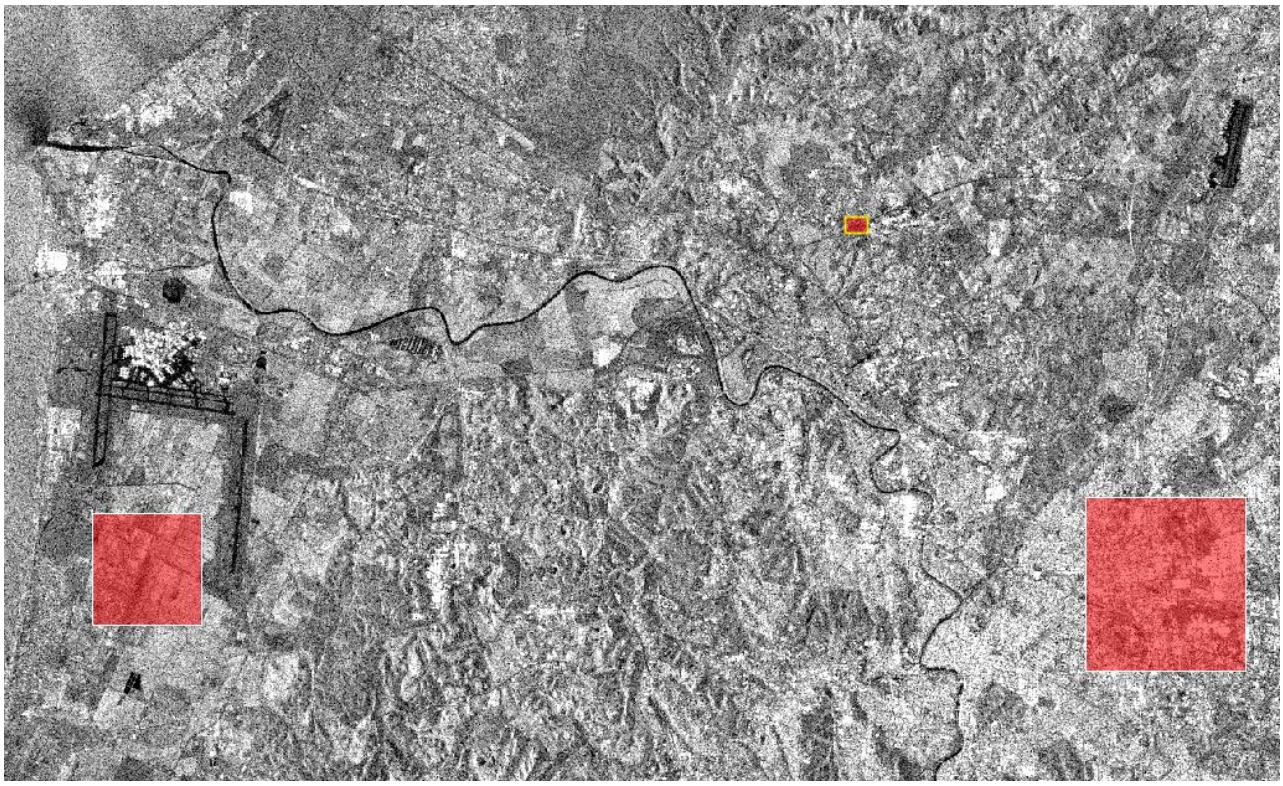

Fig 6.1 Clusters of pixels

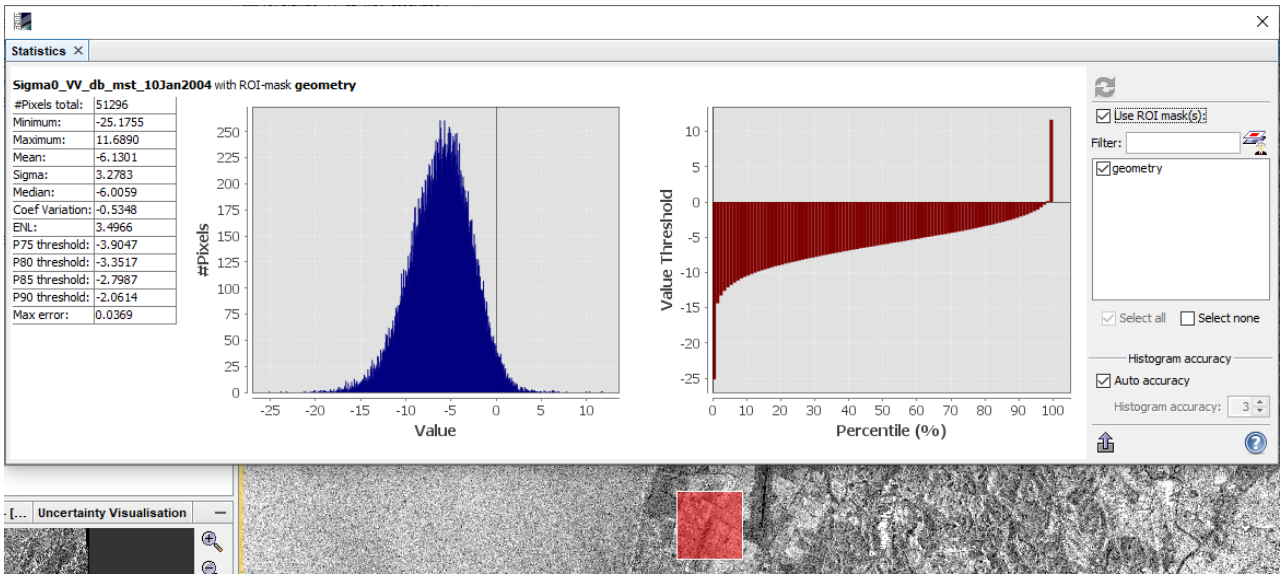

Fig 6.2 Statistics on park cluster

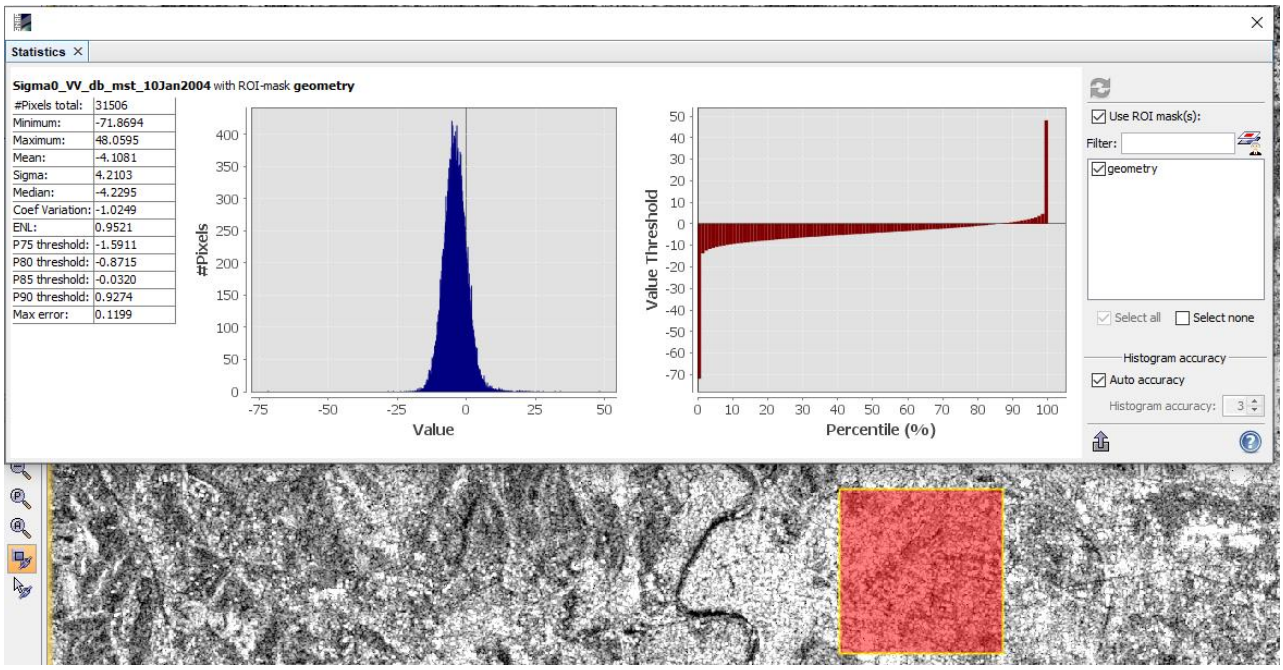

Fig 6.3 Statistics on density residential area cluster

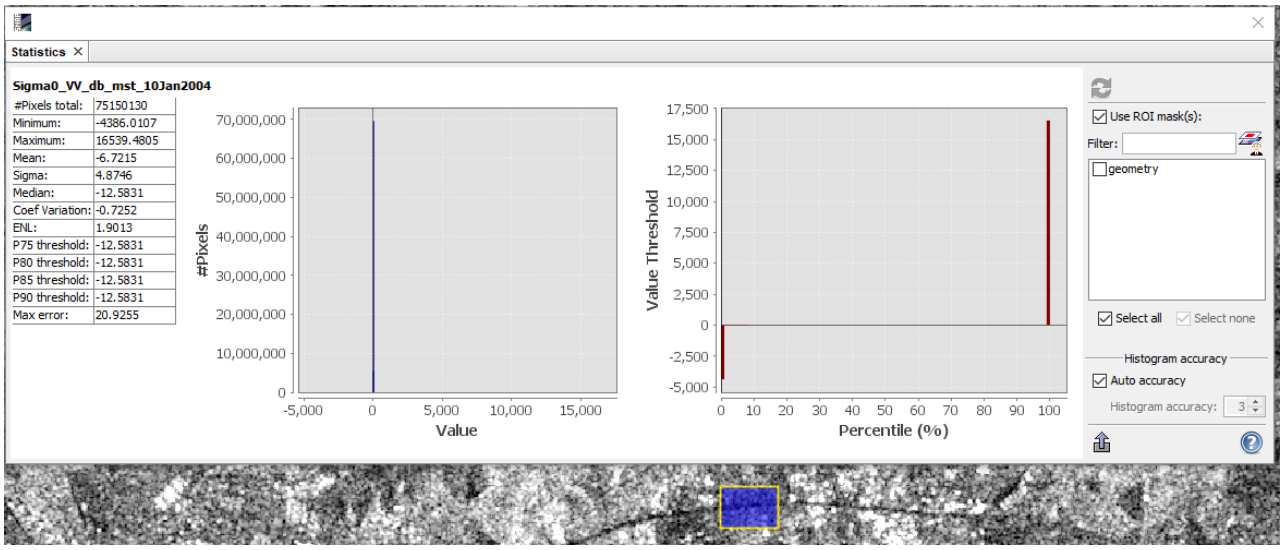

Fig 6.4 Statistics on asphalt surface cluster

7. Feature extraction for change detection in time domain

7.1 Color composite

As already shown in section 4, the “Open RGB image window” feature in the SNAP tool can be used to visualize the changes over time of a SAR product. On the following picture red and green represent changed pixels while yellow represents unchanged ones.

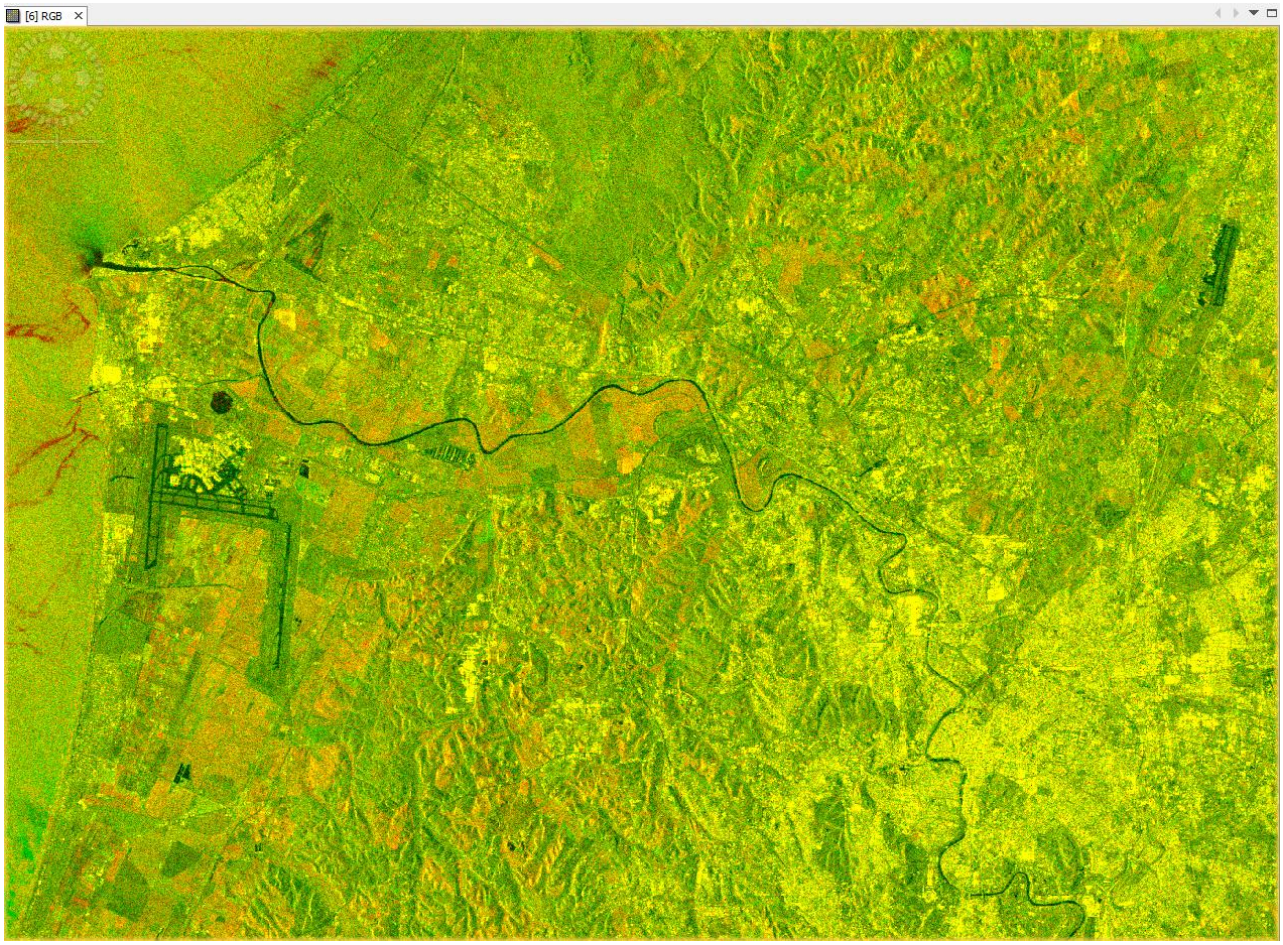

Fig 7.1 Color composite of 10 January and 14 February 2004

7.2 Changes in time

We used the “Radar/SAR Applications/Change Detection” feature to analyze the changes between the 10/01/2004 and the 14/02/2004 SAR images

Fig 7.2 SNAP change detection feature output

8. Change detection on a pixel base

In this section we used the SNAP classification tool to perform pixel-based change detection analysis. The following is a screenshot of the result where the purple color represents changed regions while yellow color represents unchanged ones.

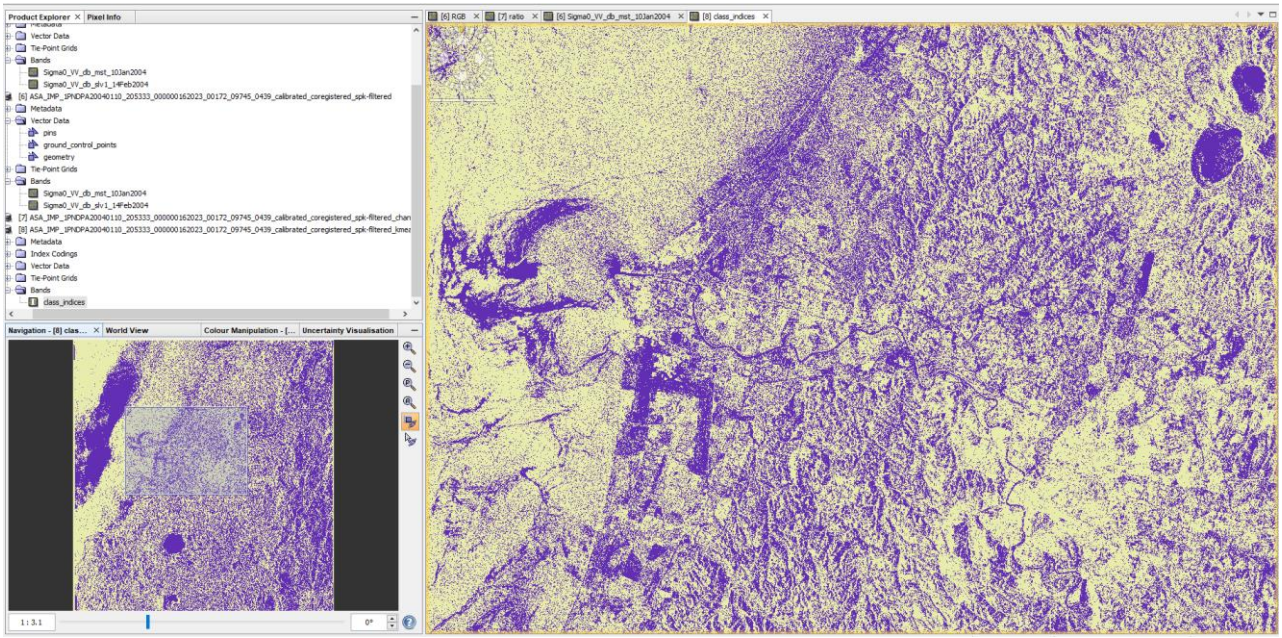

Fig 8.1 SNAP classification feature result