# Introduction to ESA toolboxes

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# Introduction

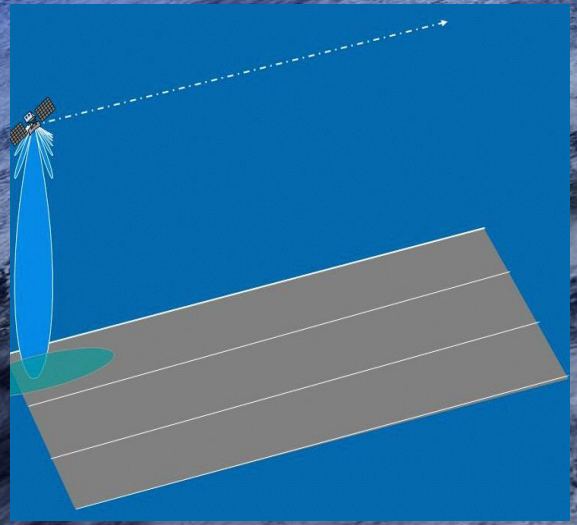
Input data: set of Sentinel-1 SLCs

*S1A_IW_SLC__1SDV_20190819T055015_20190819T055043_028634_033D5F_B955*
*S1A_IW_SLC__1SDV_20190831T055016_20190831T055043_028809_03437F_6942*

Output: coherence – intensity false colour composites for land cover mapping

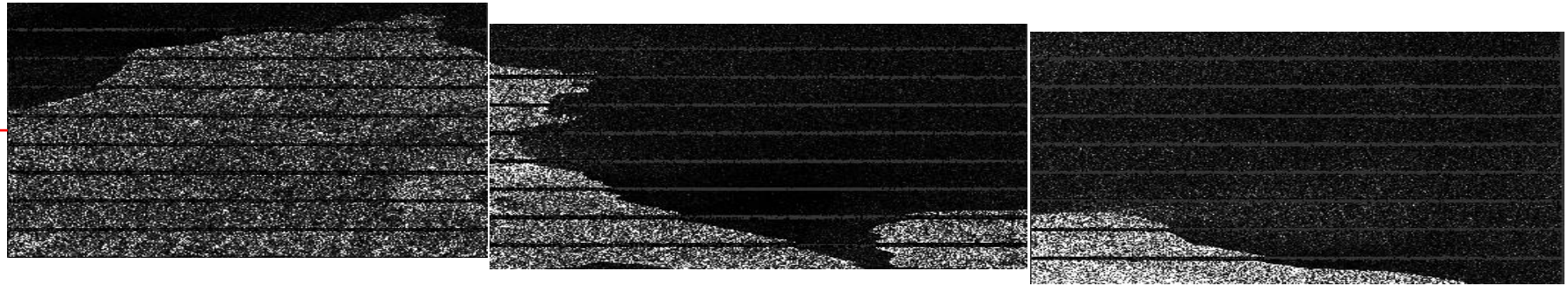
# Sentinel-1 data acquisition

**T**errain **O**bservation
by **P**rogressive **S**cans
(TOPS)



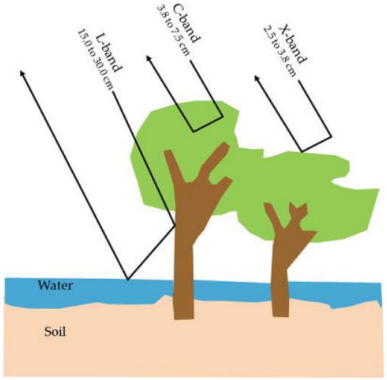
# Sentinel-1 TOPS Data Handling and Processing

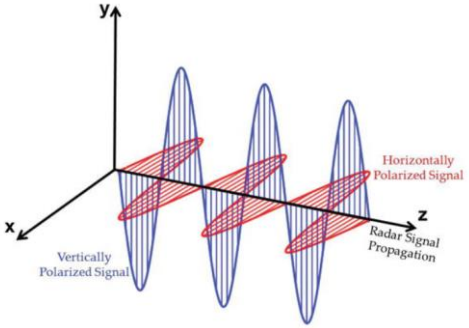
Bursted IW SLC

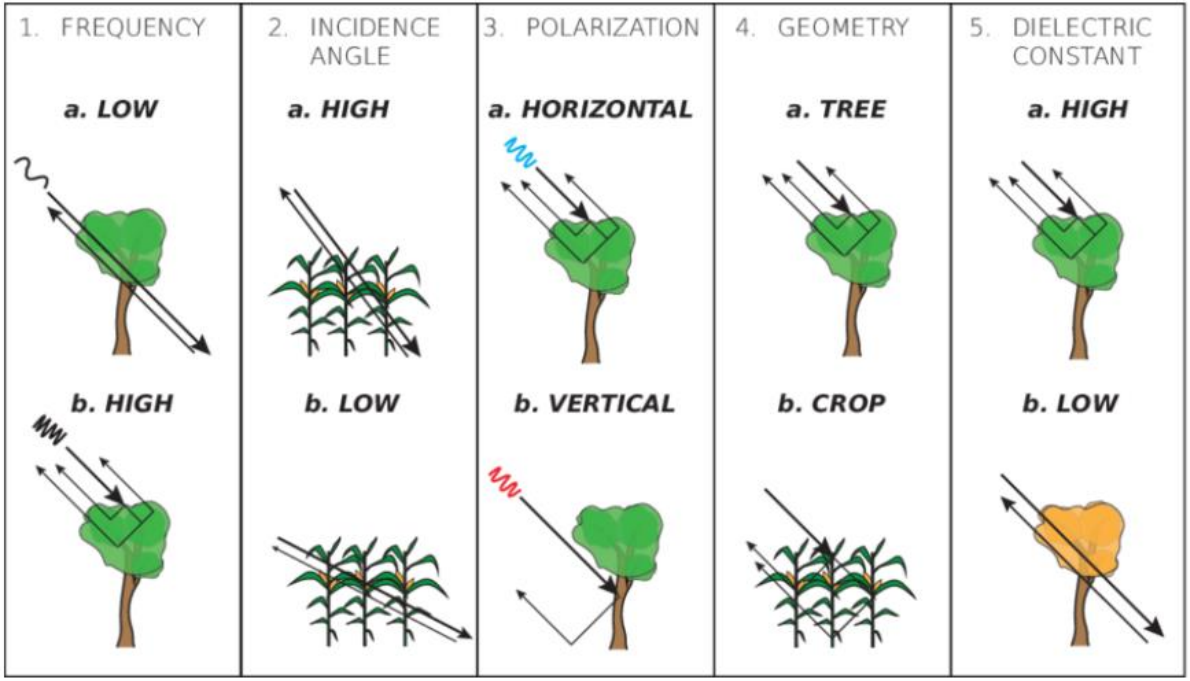


TOPSAR Split to choose a subswath and bursts for the AOI

# Scattering mechanisms

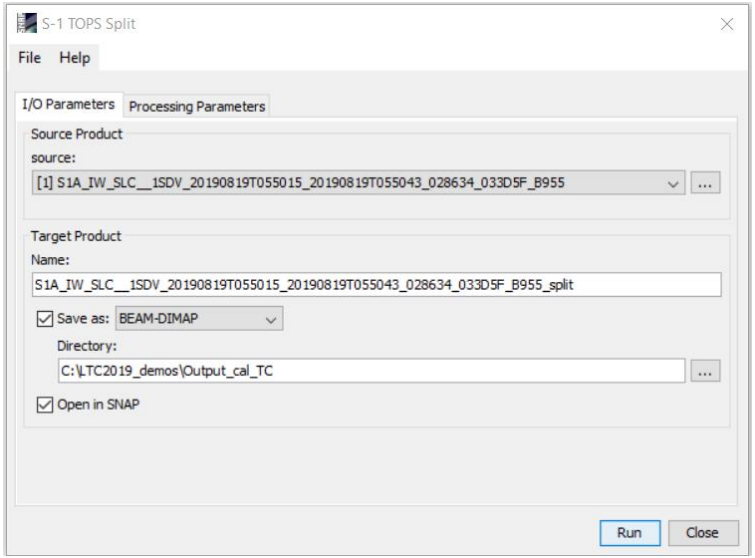


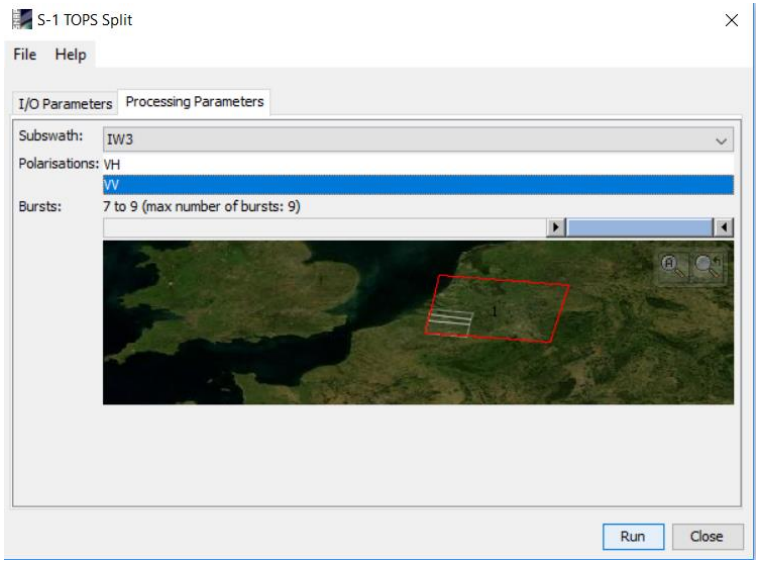



# Sentinel-1 TOPSAR Split

MENU: *Radar/Sentinel-1 TOPS/S-1 TOPS Split*



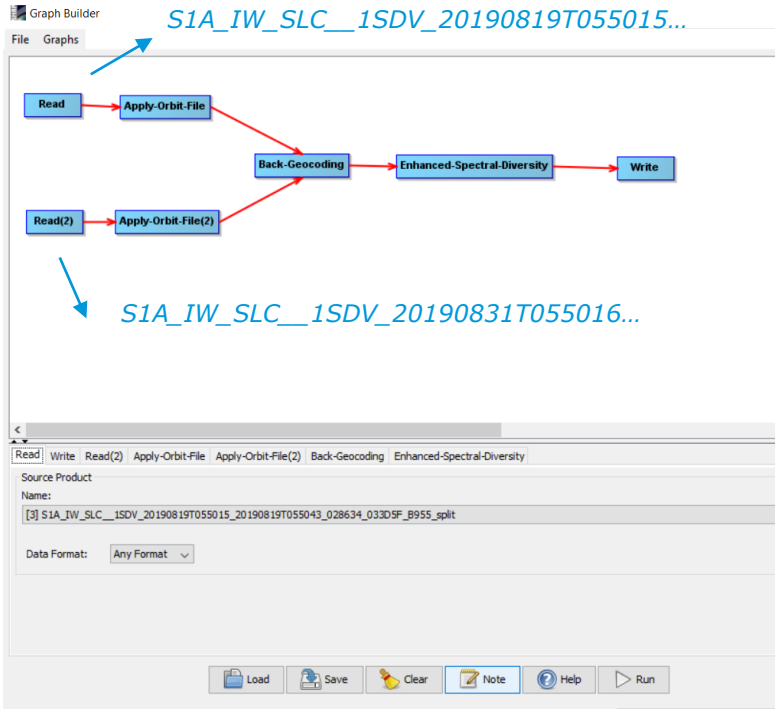

→ Selection of subswath
→ Selection of polarization
→ Selection of bursts

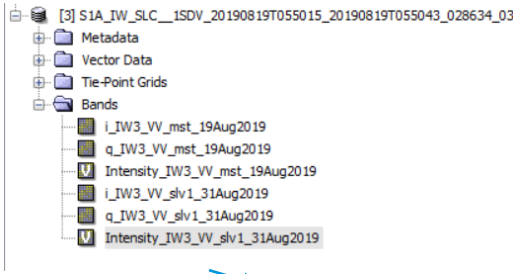
IW3
VV
7-9

TOPS Split applied to both S-1 SLCs

# STEP 1
# Interferometric Coherence

# Coregistration



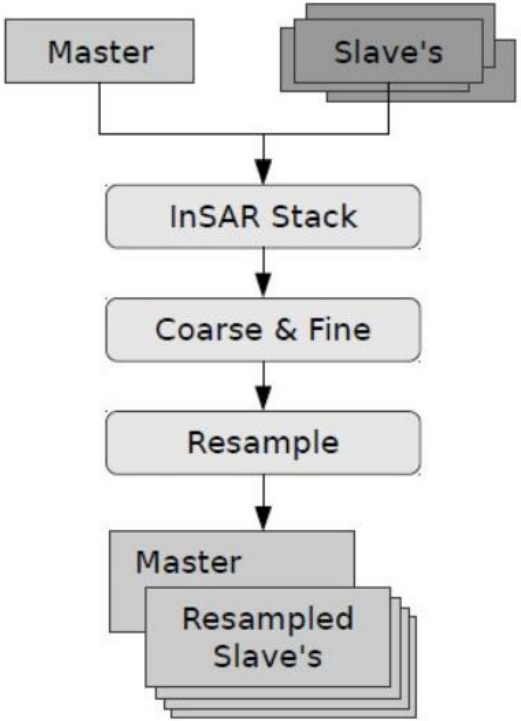




Coregistered bands in one product

Co-registration of two S-1 SLC split products (master and slave) of the same sub-swath using the orbits of the two products and a Digital Elevation Model (DEM).

ESD estimates the range and azmiuth offset (exploiting the data at the overlapped area of the adjacent bursts) and performs range and azimuth corrections for every burst in the slave image

# Coregistration




The Cross Correlation operator creates an alignment between master and slave images (matching automatically distributed correlation optimization windows between master and slave)

First on coarse level, with large windows and lower oversampling factors, later on fine level, with smaller windows and higher oversampling factors.

With the master-slave offsets computed, a coregistration polynomial (CPM) is estimated by the Warp operator, which resamples pixels in the slave image into pixels in the master image.

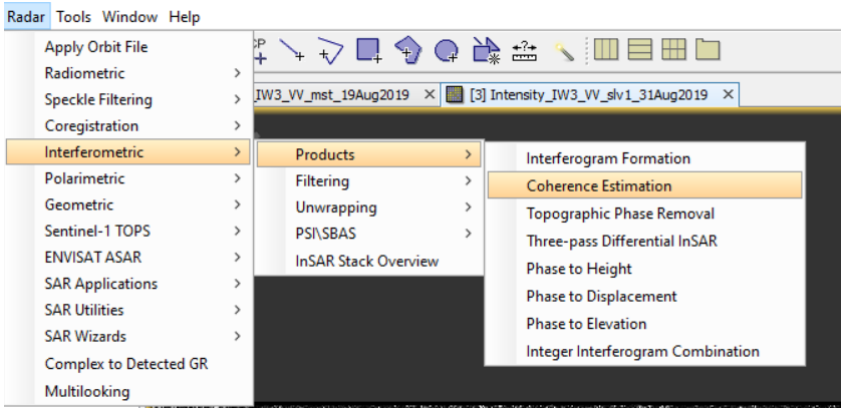
# Interferometric Coherence

## COHERENCE

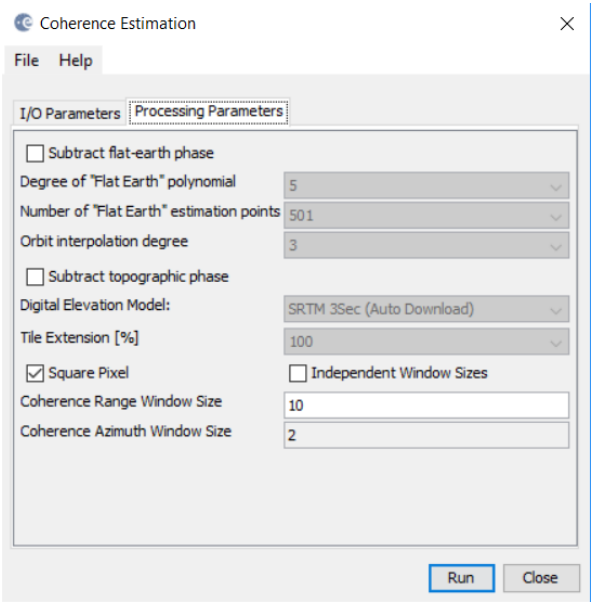
Measure of correlation between phase in two SAR complex images
Ranging from 0 (no correlation) to 1

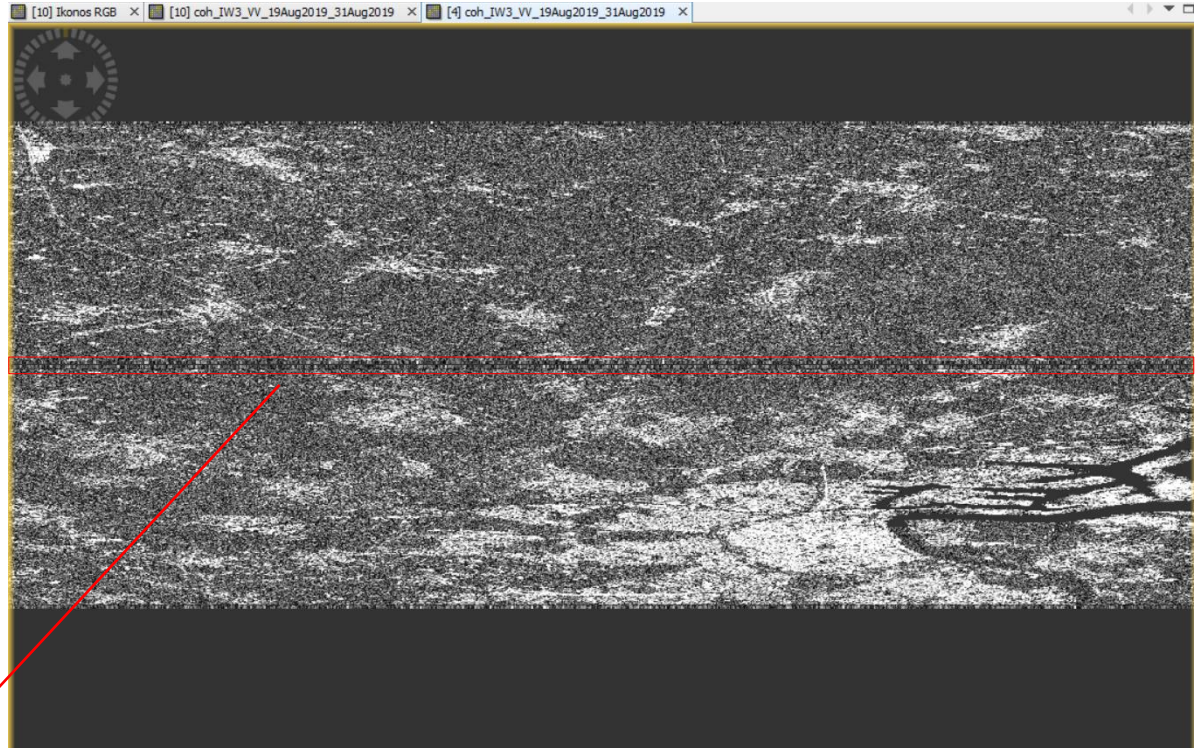
Coherence may be affected by:

- Local slope
- Properties of the surface
- Time lag between acquisitions
- The perpendicular baseline
- Poor coregistration



# Interferometric Coherence

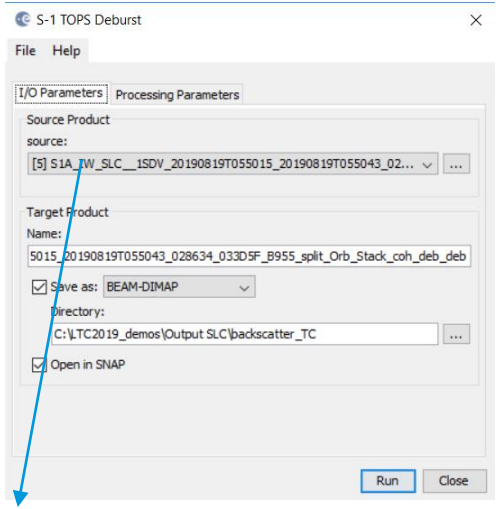


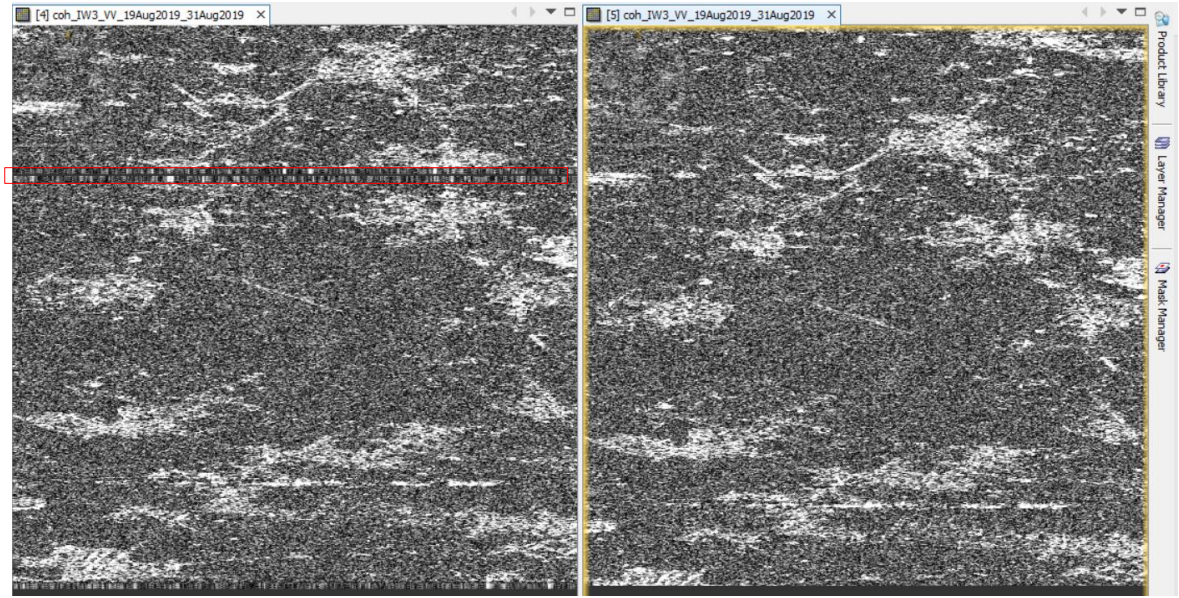

*Demarcation black-filled line between bursts*

# S-1 TOPS Debursting

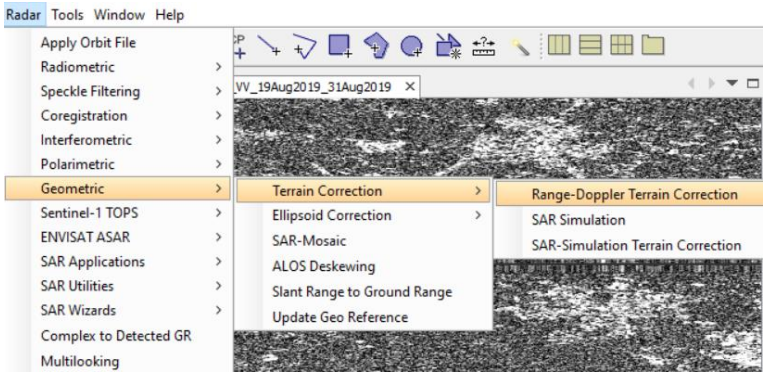
MENU: *Radar/Sentinel-1 TOPS/S-1 TOPS Deburst*




Input: Coherence

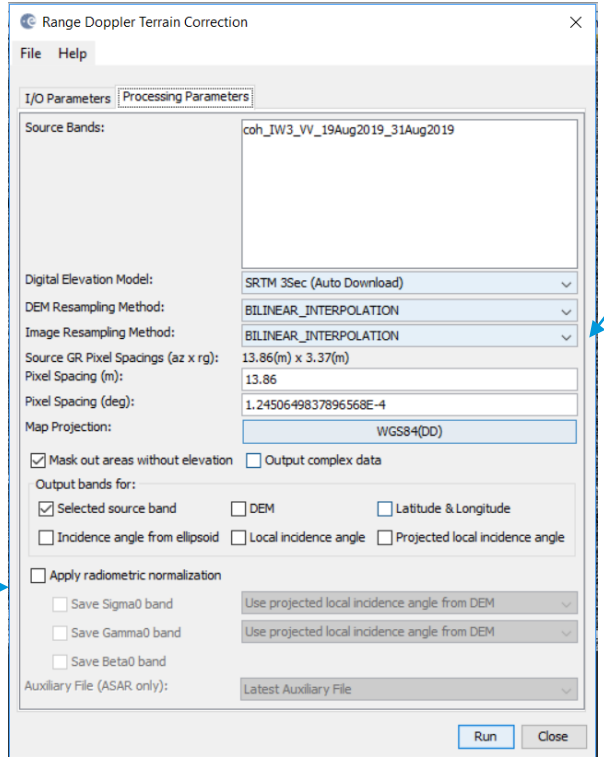


# Terrain Correction




Compensate for geometric distortions caused by topographical variations of a scene and the tilt of satellite sensor

+ Geocoding

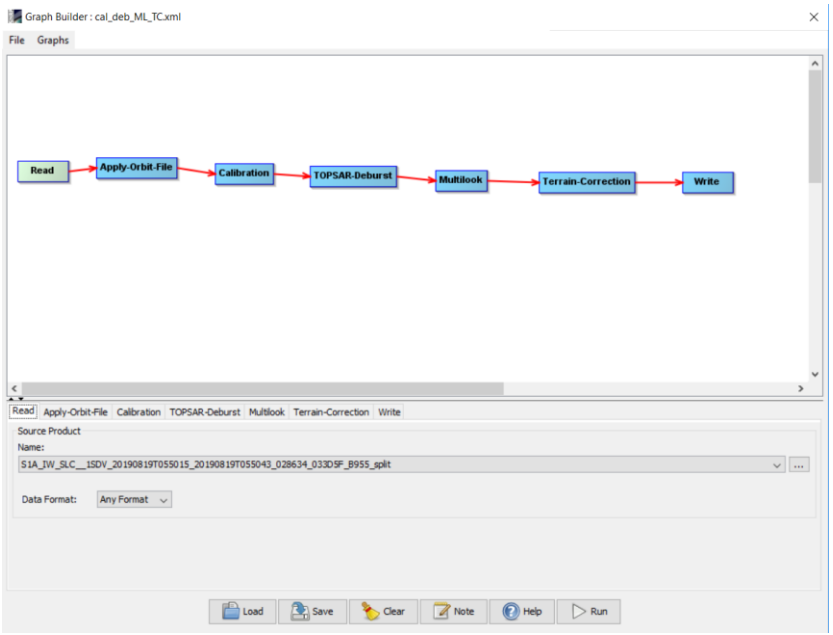



Select:
- DEM
- Resampling
- Pixel spacing
- Projection

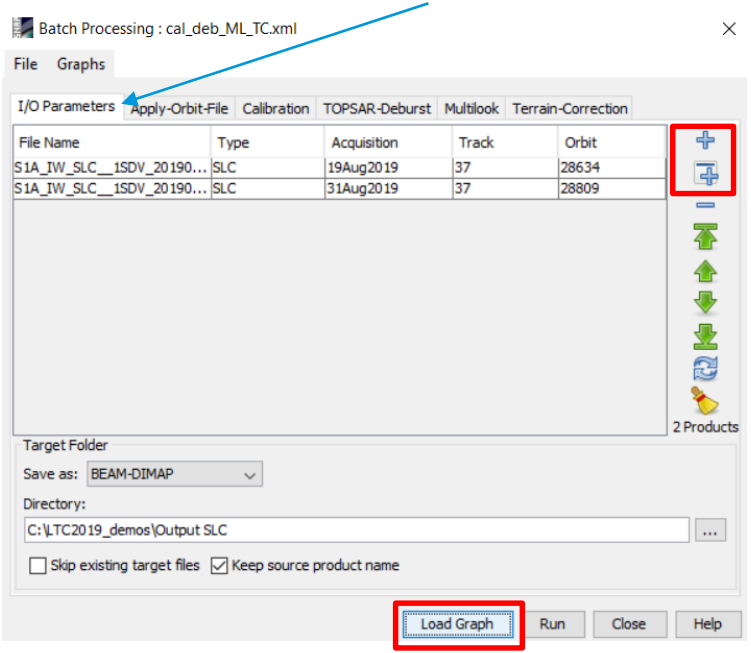
# STEP 2
# Backscatter Intensity

# Backscatter Intensity product

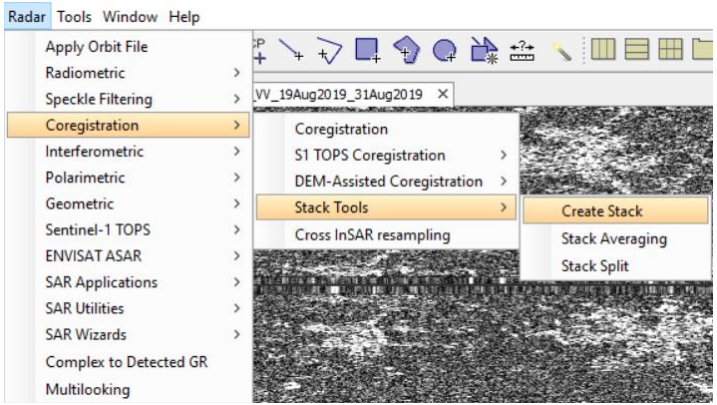
MENU: *Graph Builder + Batch processing tool*



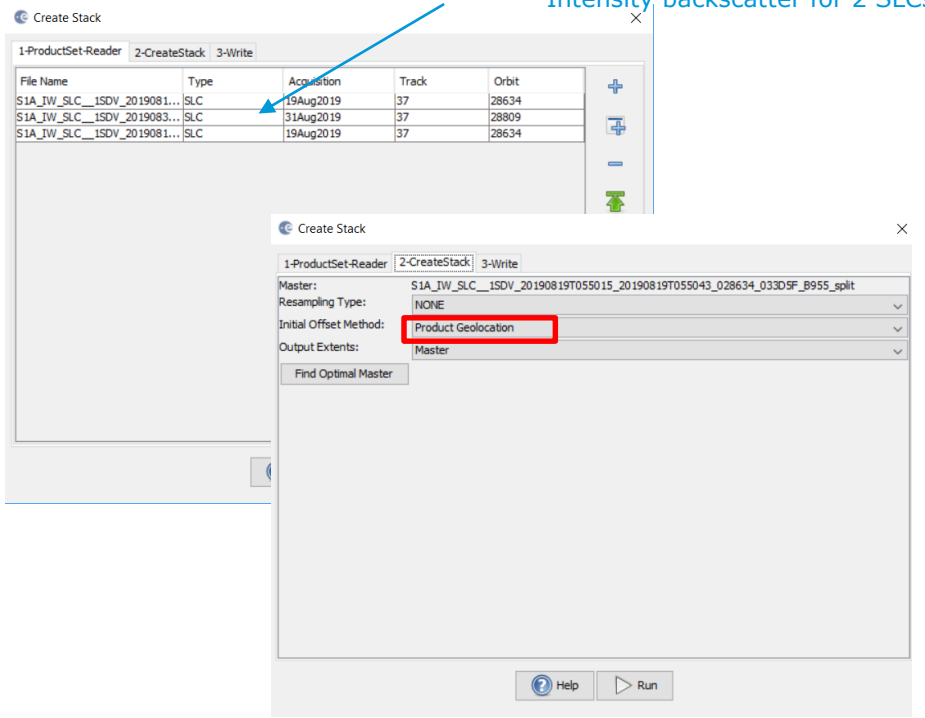

Input: Two splitted SLCs



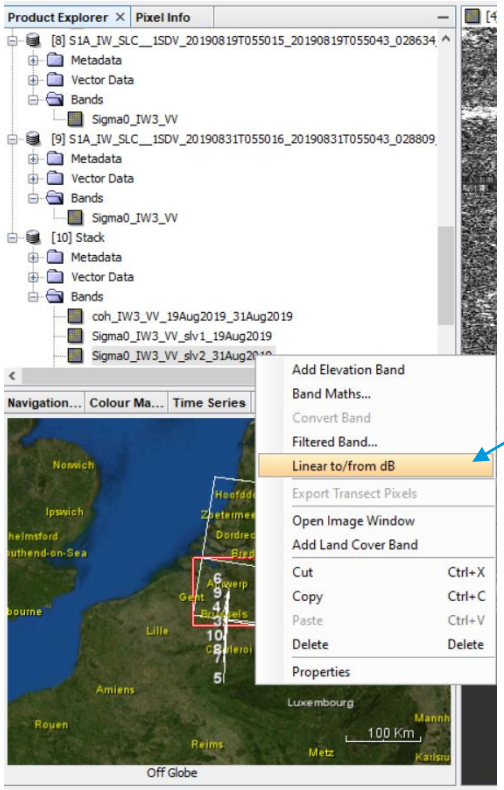
# Creating a stack




Input: Coherence from STEP 1
Intensity backscatter for 2 SLCs from STEP 2

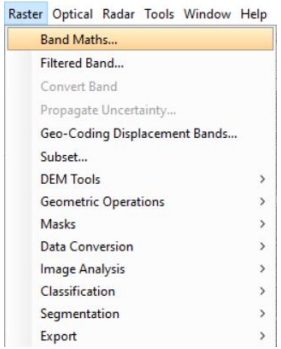


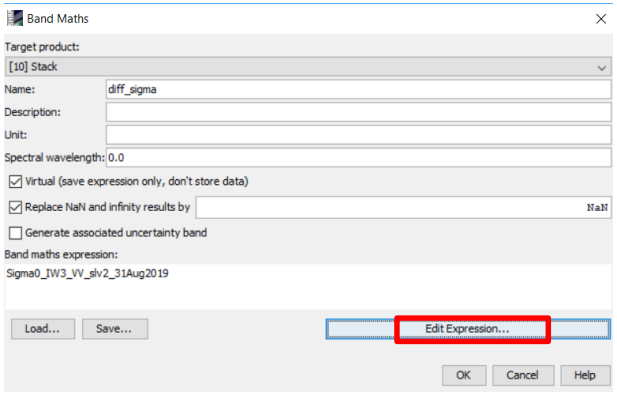
# Conversion of sigma0 to db



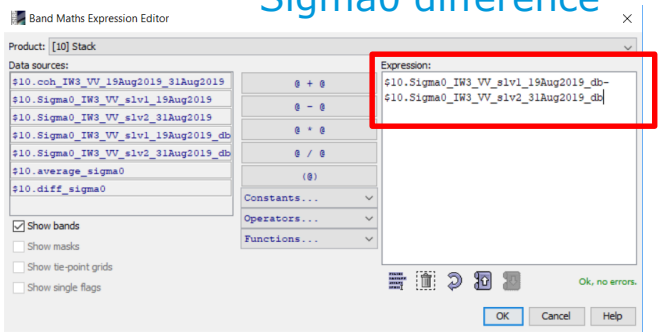

- Right click on the sigma0 band
- Conversion linear to/from db
- Right click on the sigma0_db virtual band
- Select „convert band”
- Save the product: File/Save product

# Band math: average sigma 0 and difference

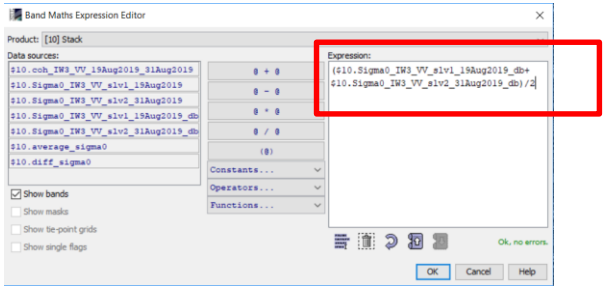


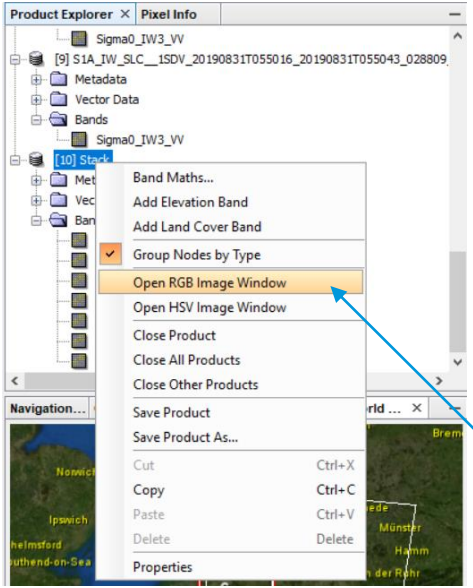

## Sigma0 difference

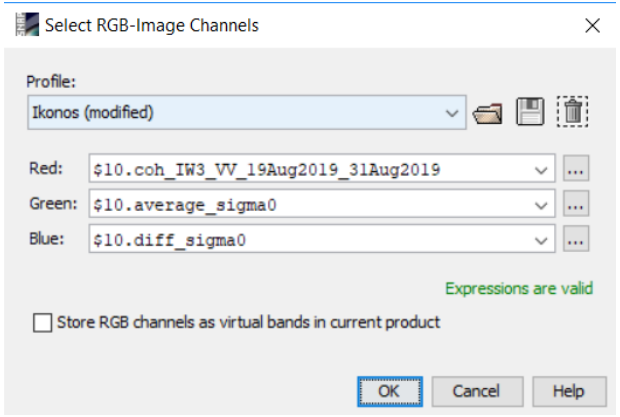



## Sigma0 average



# Creating RGB false composite



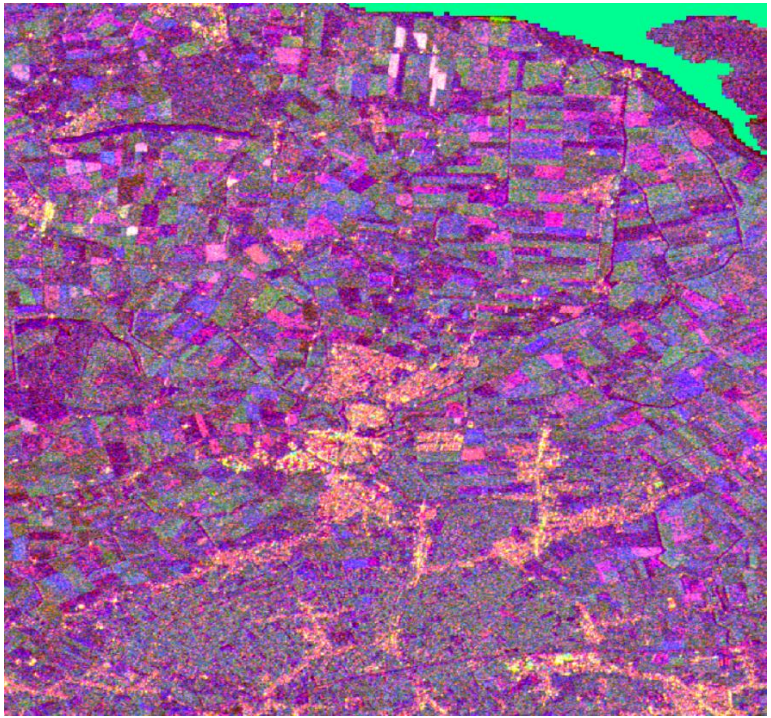




Select RGB bands:

R: coherence
G: average sigma0
B: difference sigma0

- Right click on the stack product
- Open RGB Image Window

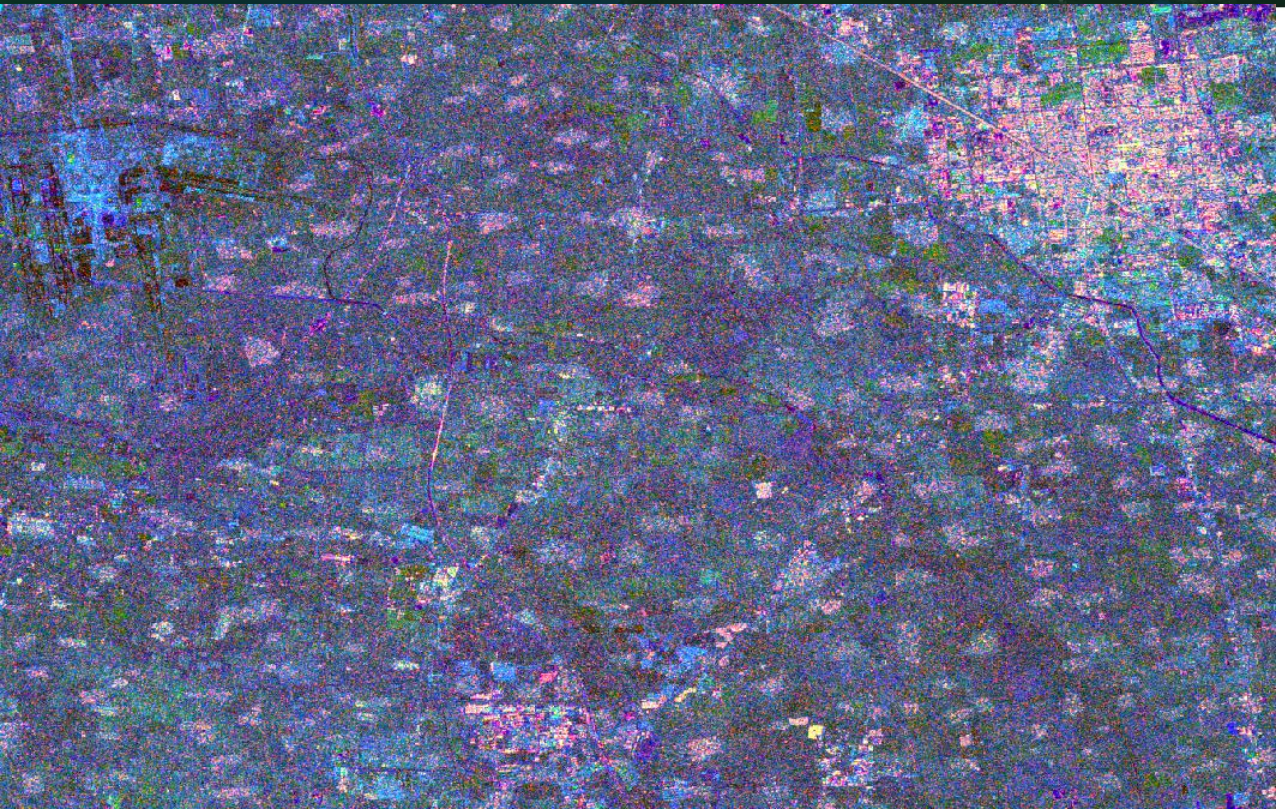
# Resulting RGB false composite



Multi-temporal 12-day product (August 2019)

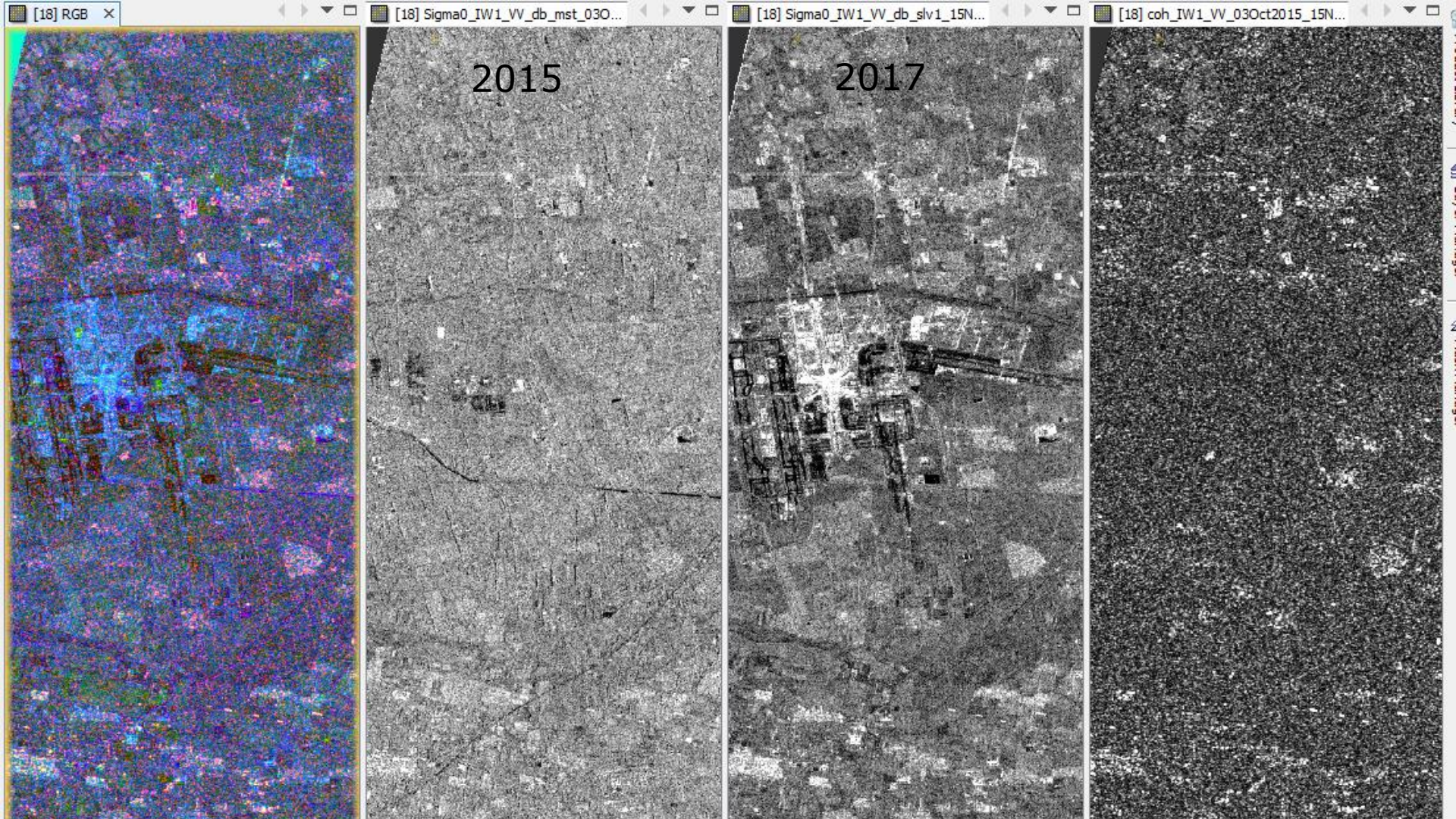
Yellow: Urban centers
Magenta: objects not changing
Green: Vegetated lands and forests
Blue: objects changing in 12 days (e.g. ploughing)

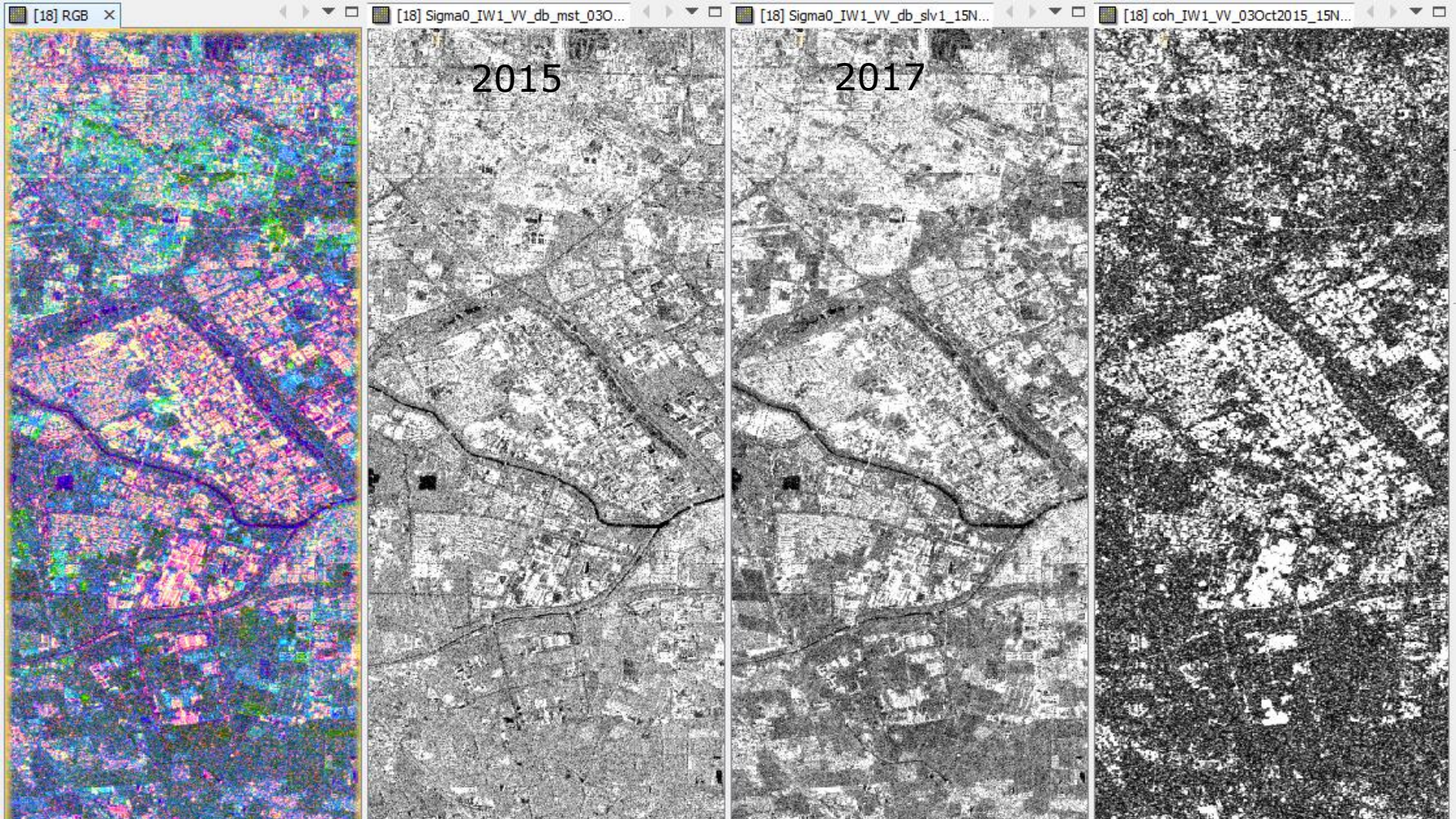
# Resulting RGB false composite



Multi-temporal product (2015-2017)

Yellow: Urban centers
Magenta: objects not changing
Green: Vegetated lands and forests
Blue: objects that changed


[18] RGB
[18] Sigma0_IW1_VV_db_mst_03O...
2015
[18] Sigma0_IW1_VV_db_slv1_15N...
2017
[18] coh_IW1_VV_03Oct2015_15N...


[18] RGB
[18] Sigma0_IW1_VV_db_mst_03O...
[18] Sigma0_IW1_VV_db_slv1_15N...
[18] coh_IW1_VV_03Oct2015_15N...
2015
2017

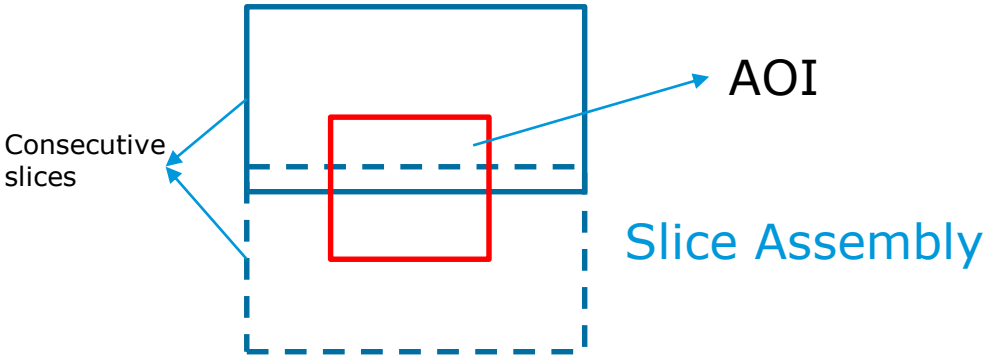
# Answers to your questions

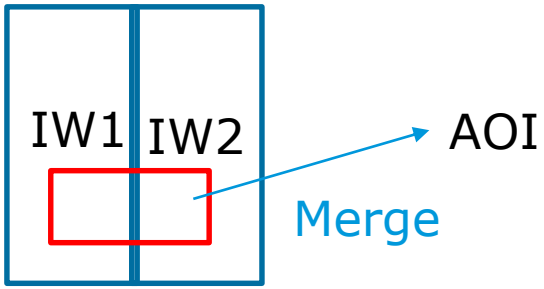
What is the difference between Range Doppler TC and SAR Simulated TC?

*SAR Simulation TC : generates simulated SAR image using DEM and orbit vectors from orginal file, coregisters the simulated SAR image and original one, terrain correct – for each pixel of DEM finding corresponding position in the simulated image and corresponding pxel position in the original SAR image*

*The Range Doppler Terrain Correction Operator implements the Range Doppler orthorectification. It uses: orbit state vector information in the metadata,the radar timing annotations, the slant to ground range conversion parameters together with the reference DEM data to derive the precise geolocation information.*

# What do we do if my AOI is in two products?





## SAR Mosaic

*It shall be TC and Calibrated before