ESA SNAP Toolbox Introduction
Detecting harvest from Sentinel-1 data

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Objectives

- Familiarizing with Sentinel-1 SLC prodcucts
- Calculation of backscatter intensity from Sentinel-1 SLC products
- Calculation of interferometric coherence
- Analysis of coherence and intensity false colour composites

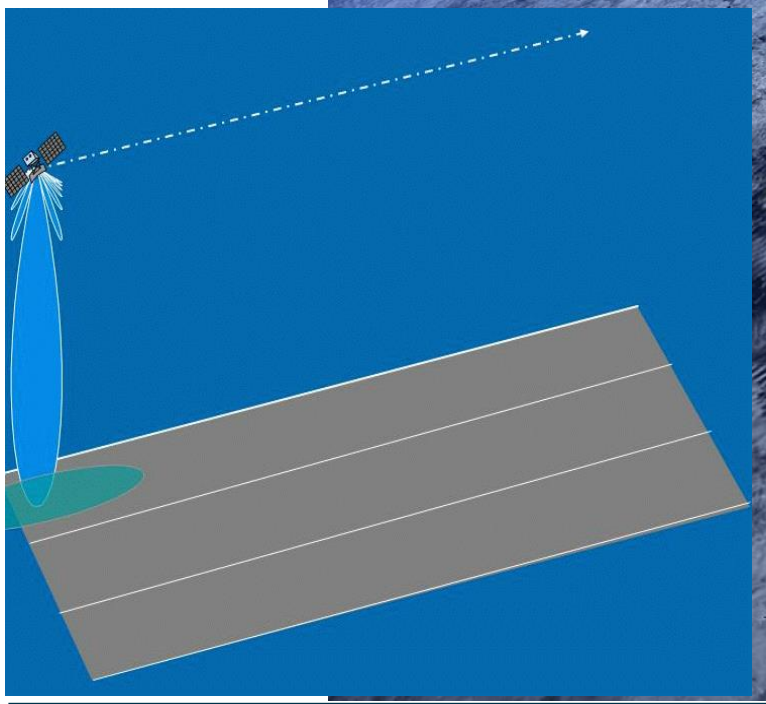
Introduction

Input data: set of two Sentinel-1 SLCs

S1A_IW_SLC__1SDV_20220308T044609_20220308T044636_042225_05083C_3949.zip
S1A_IW_SLC__1SDV_20220320T044609_20220320T044636_042400_050E29_C715.zip

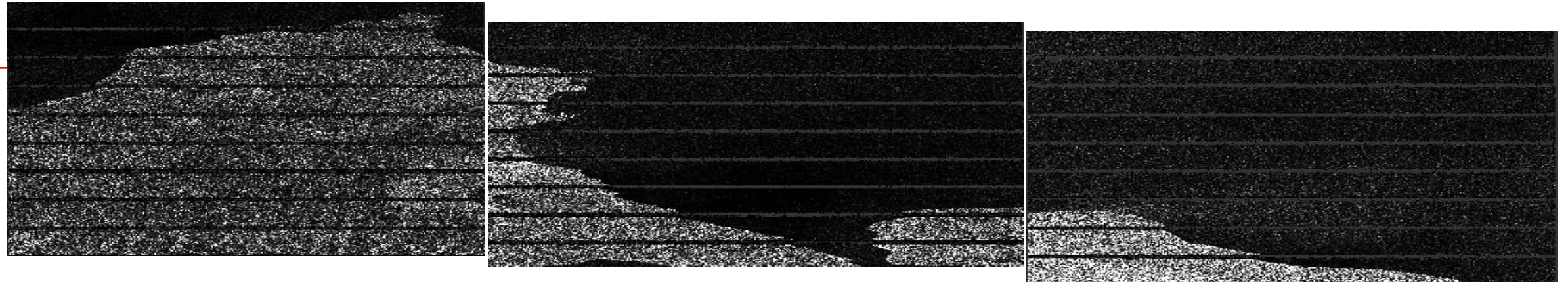
Output: coherence time series for harvest detection

Sentinel-1 data acquisition



Sentinel-1 TOPS Data Handling and Processing

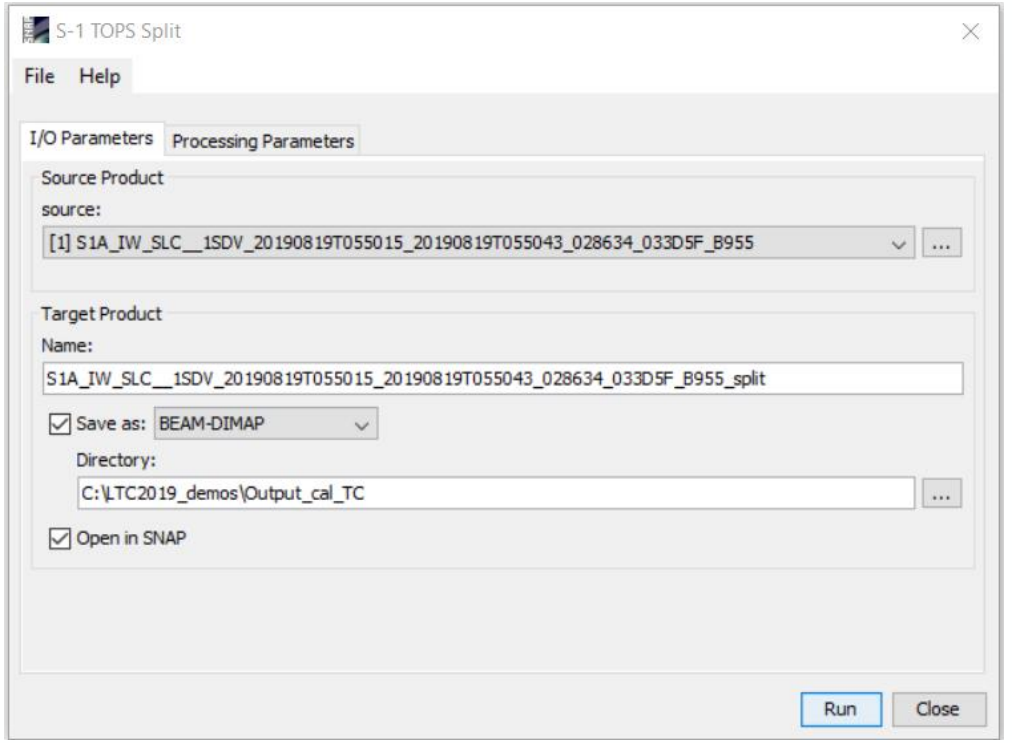
Bursted IW SLC

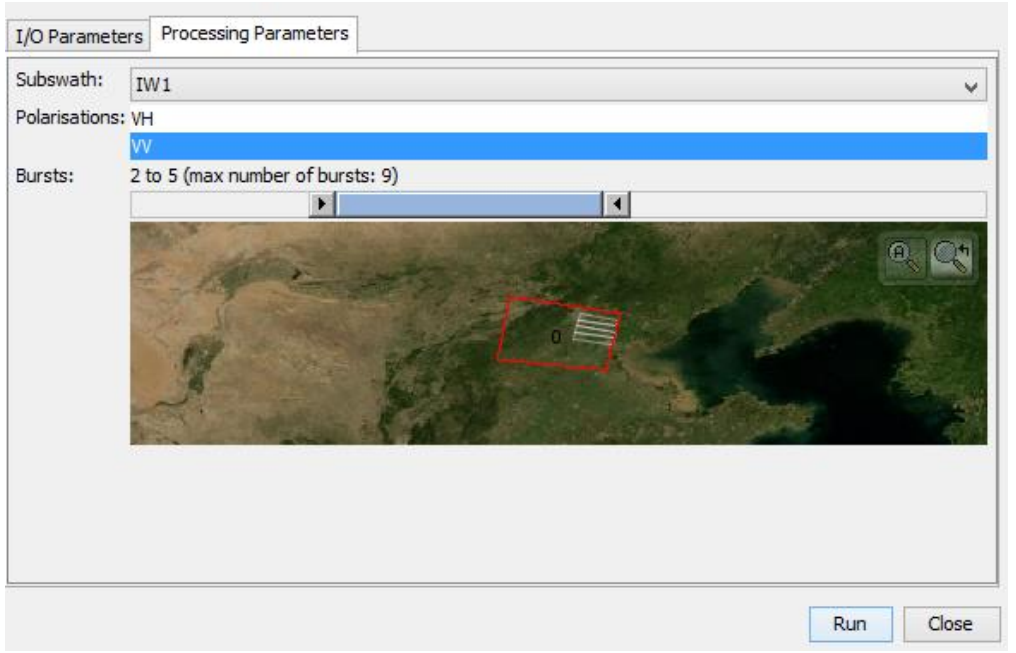


TOPSAR Split to choose a subswath and bursts for the AOI

Sentinel-1 TOPSAR Split

Radar/Sentinel-1 TOPS/S-1 TOPS Split





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

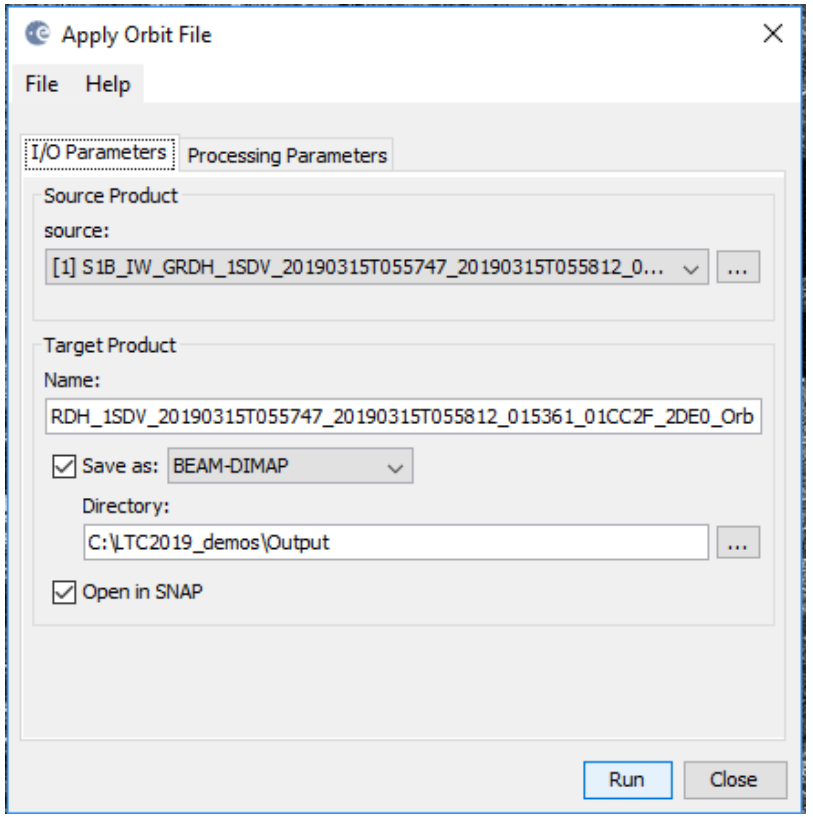
IW2

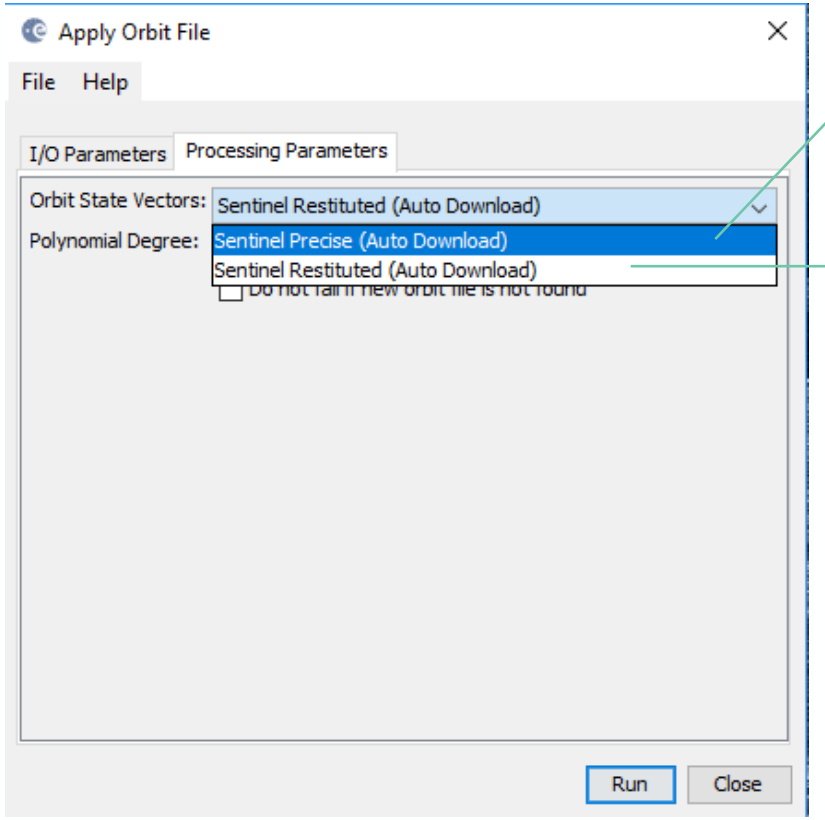
TOPS Split applied to both S-1 SLCs

STEP 1
Interferometric Coherence

Applying orbit files

The orbit file provides accurate satellite position and velocity information. Based on this information, the orbit state vectors in the abstract metadata of the product are updated.

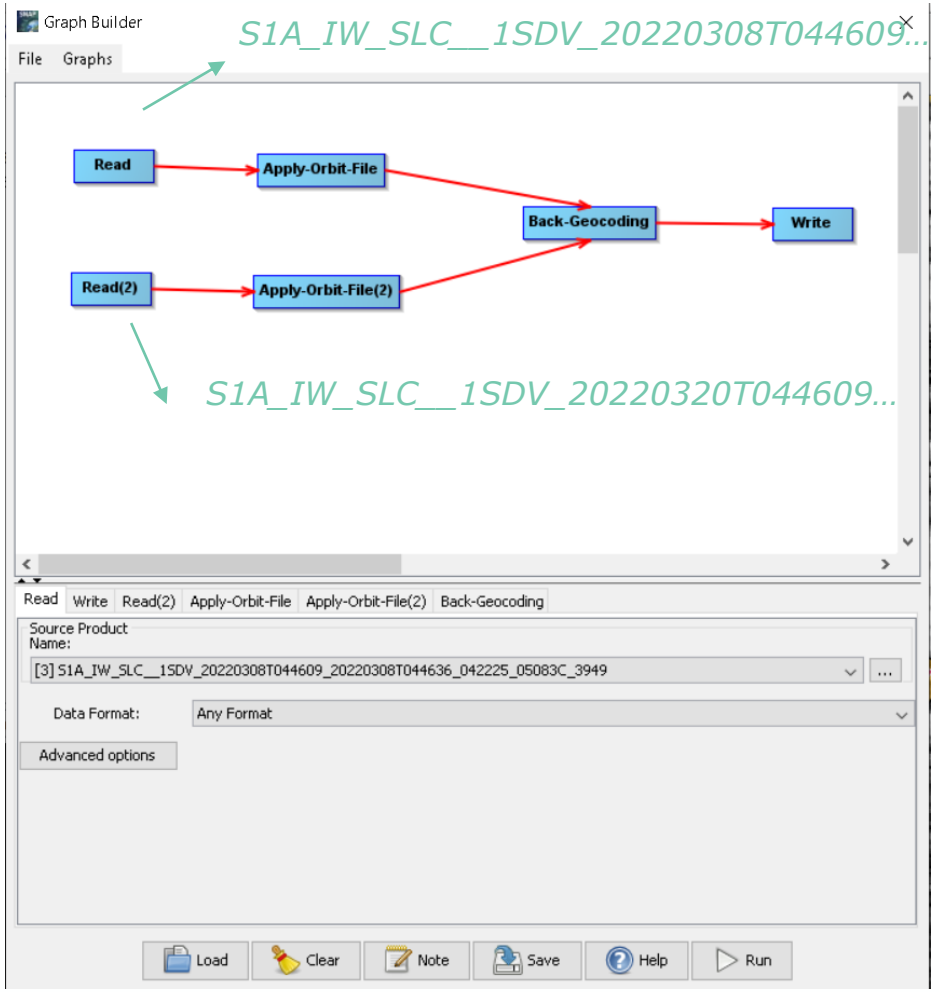




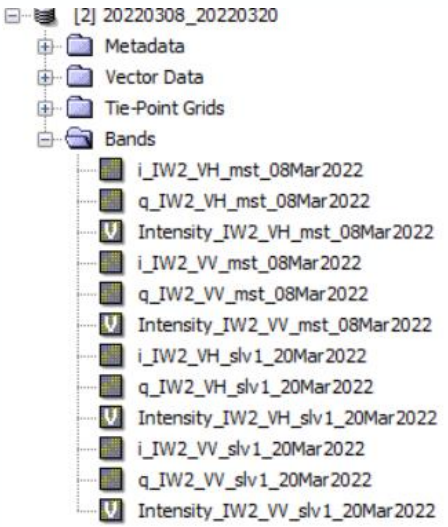
POEORB - few weeks after acq.

RESORB – within few hours

Coregistration



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



→ Coregistered bands in one product

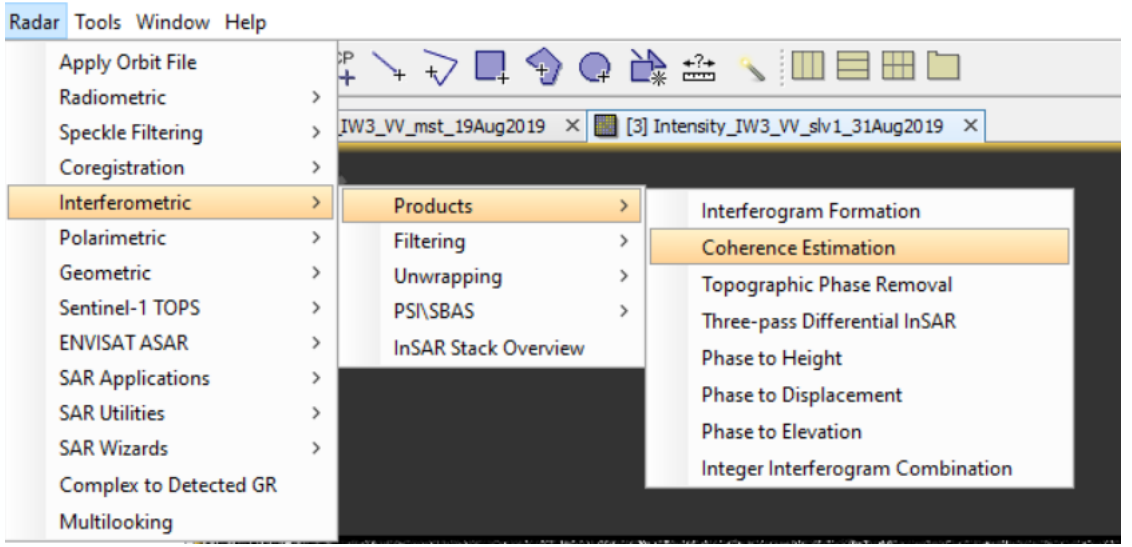
Interferometric Coherence

COHERENCE

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

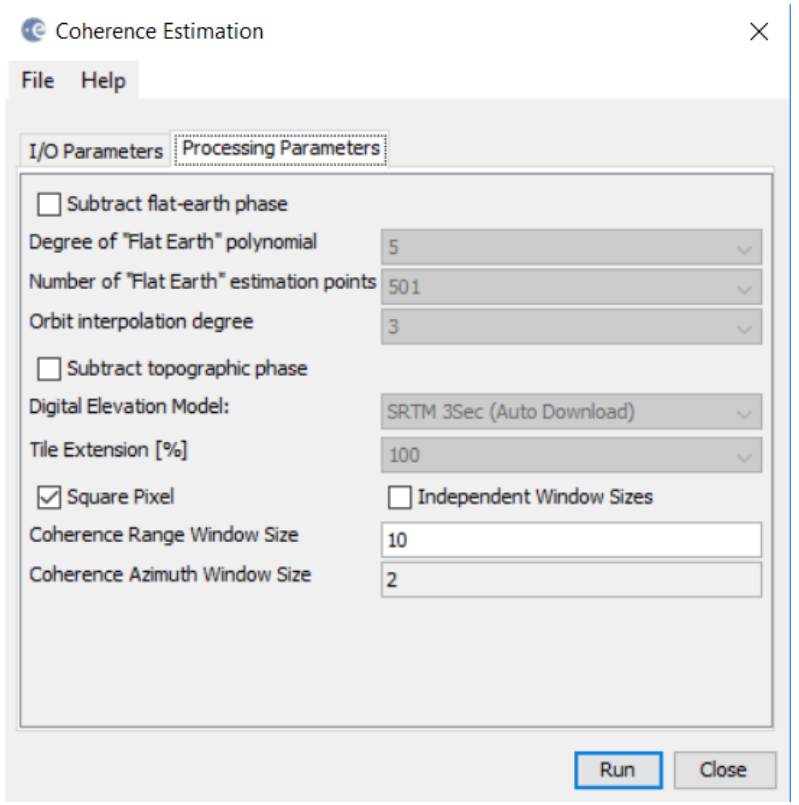
Coherence may be affected by:

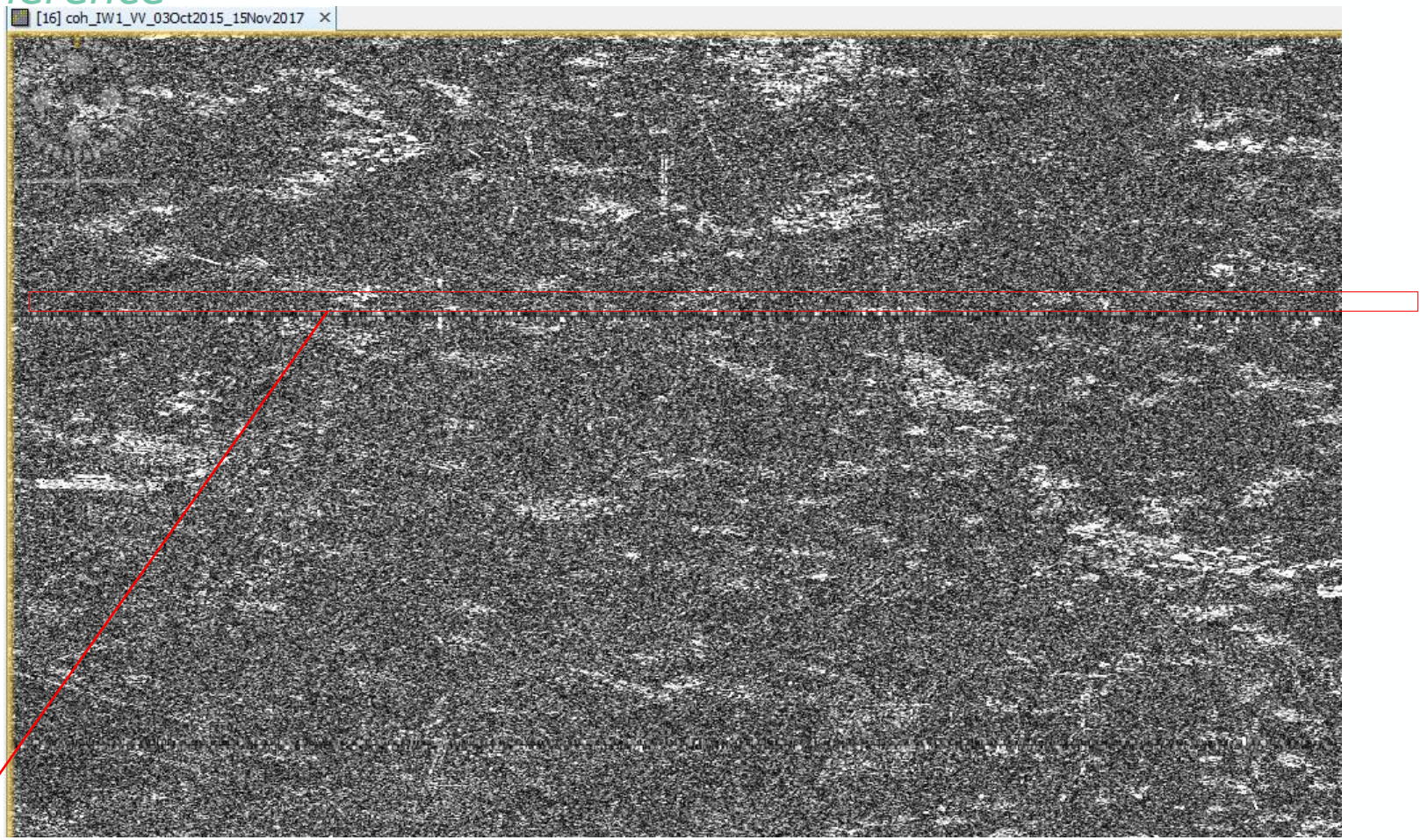
- Local slope
- Properties of the surface
- Time lag between acquisitions
- The perpendicular baseline
- Poor coregistration



Interferometric Coherence

Radar/Interferometric/Products/Coherence



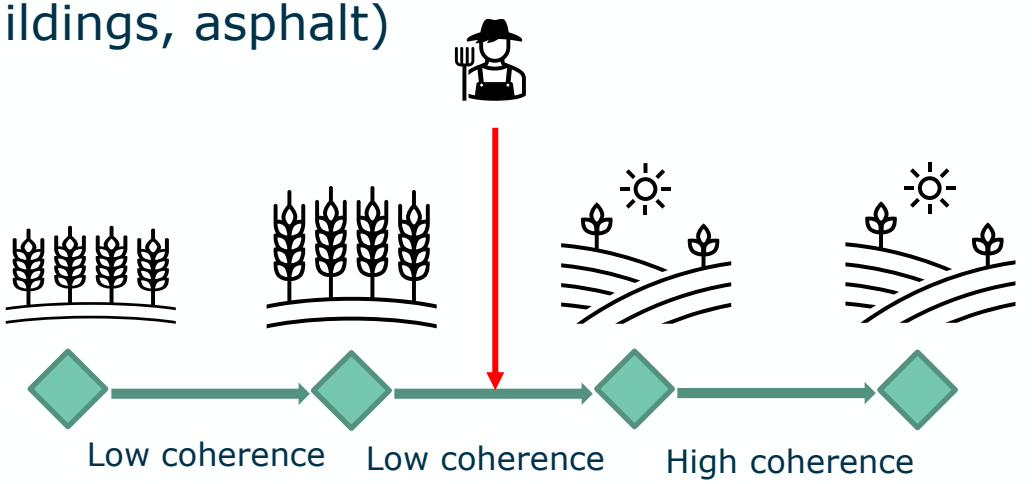


Demarcation black-filled line between bursts

Interferometric Coherence

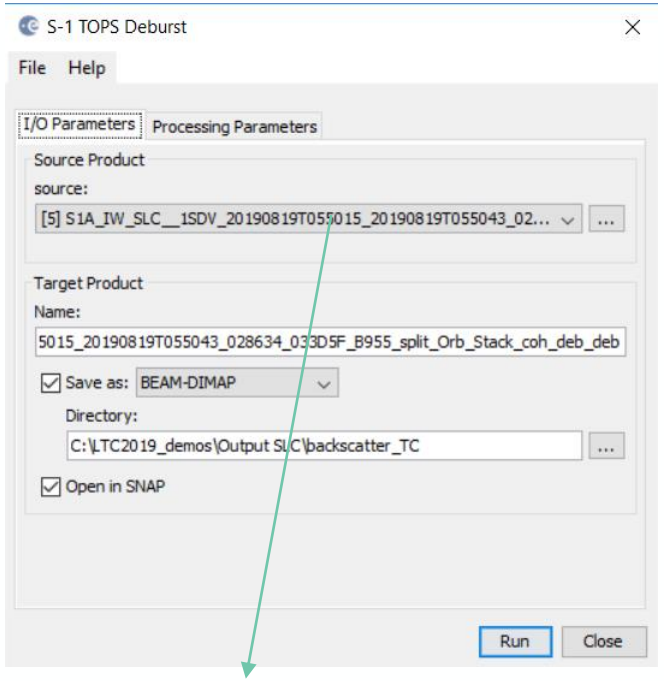
0 – no coherence, the area has changed (e.g. crop growth)

1 – high coherence, the area has not changed (e.g. buildings, asphalt)

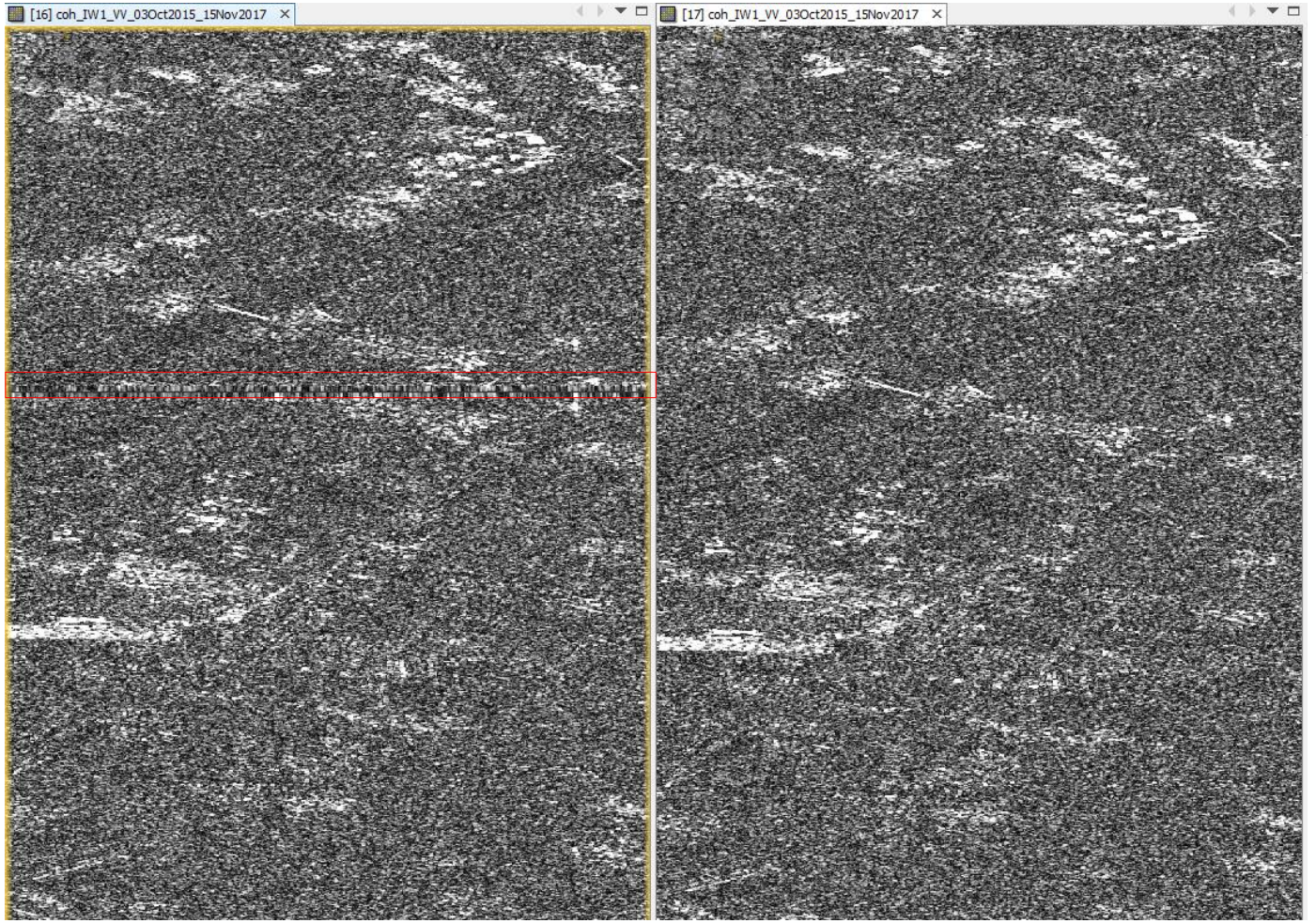


S-1 TOPS Debursting

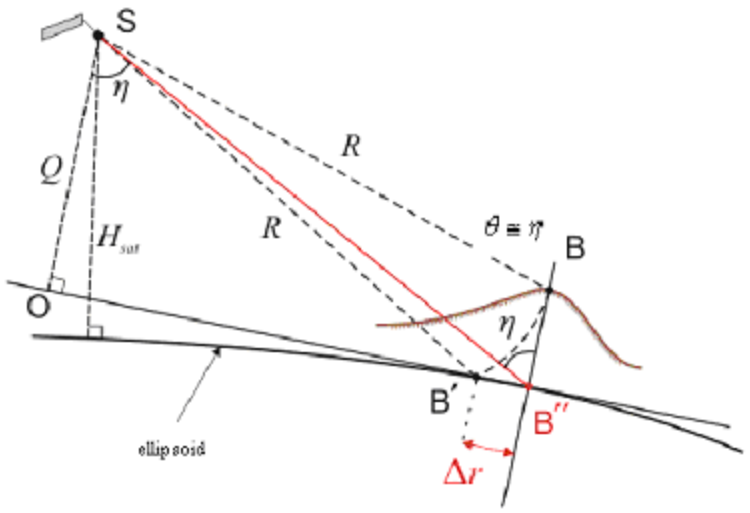
Radar/Sentinel-1 TOPS/S-1 TOPS Deburst



Input: Coherence



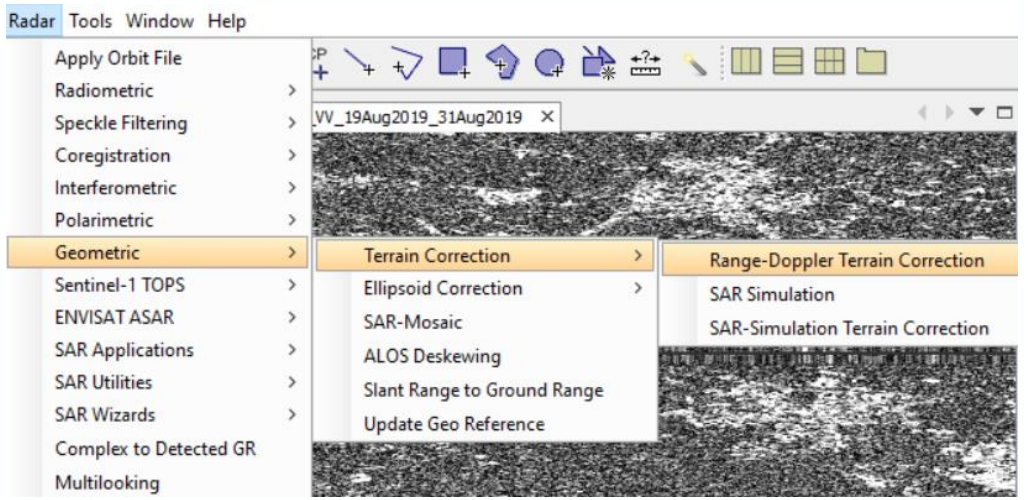
Terrain correction & Geocoding



Point **B** with elevation **h** above the ellipsoid is imaged at position B’ in SAR image, though its real position is **B"**. The offset Δr between B' and **B"** exhibits the effect of topographic distortions

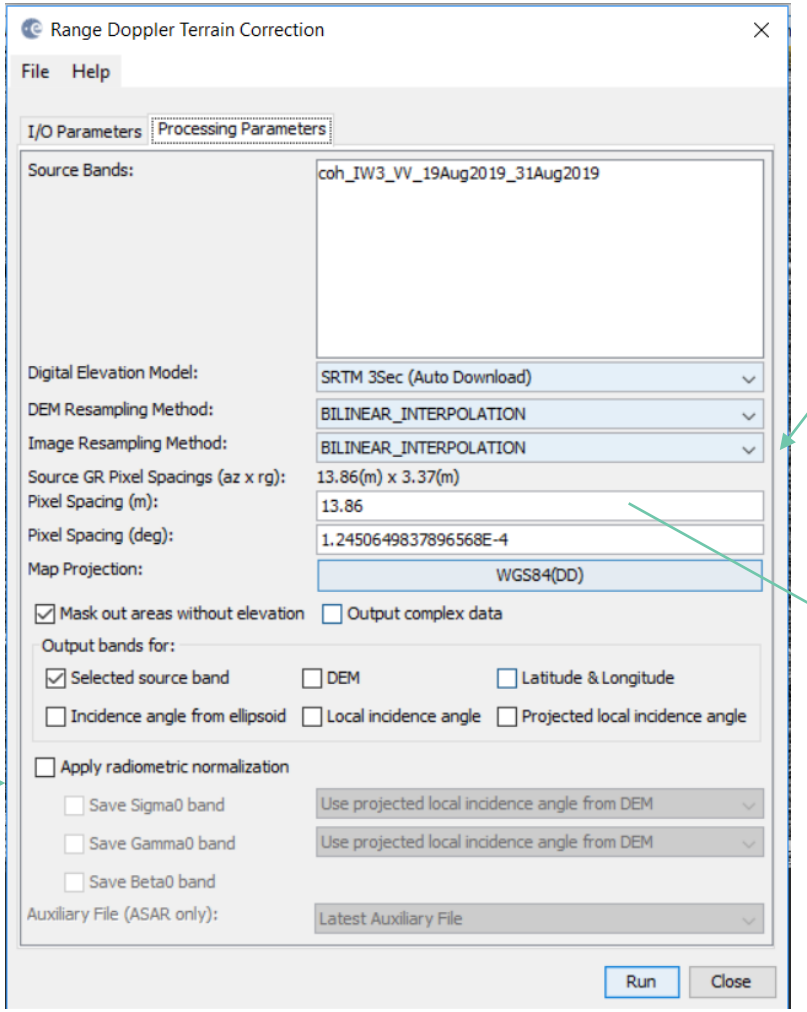
Terrain Correction allows geometric overlays of data from different sensors and/or geometries.

Terrain Correction



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

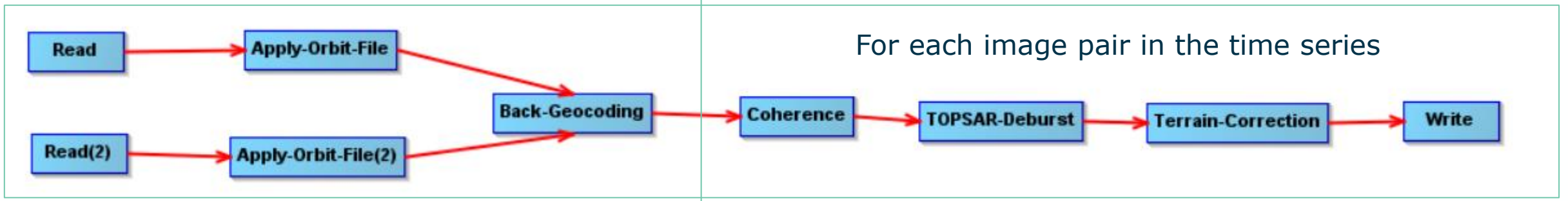
+ Geocoding



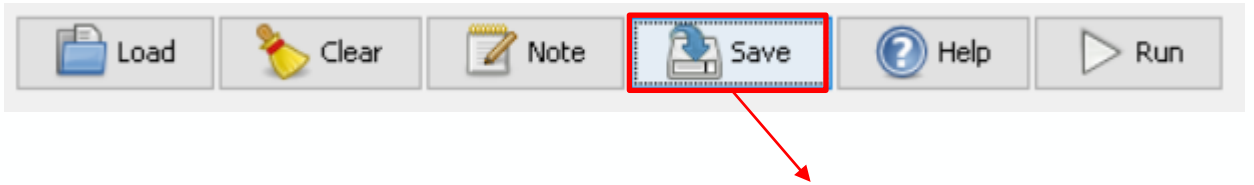
Select:
- DEM
- Resampling
- Pixel spacing
- Projection

Pixel spacing 20m

Processing of the coherence time series

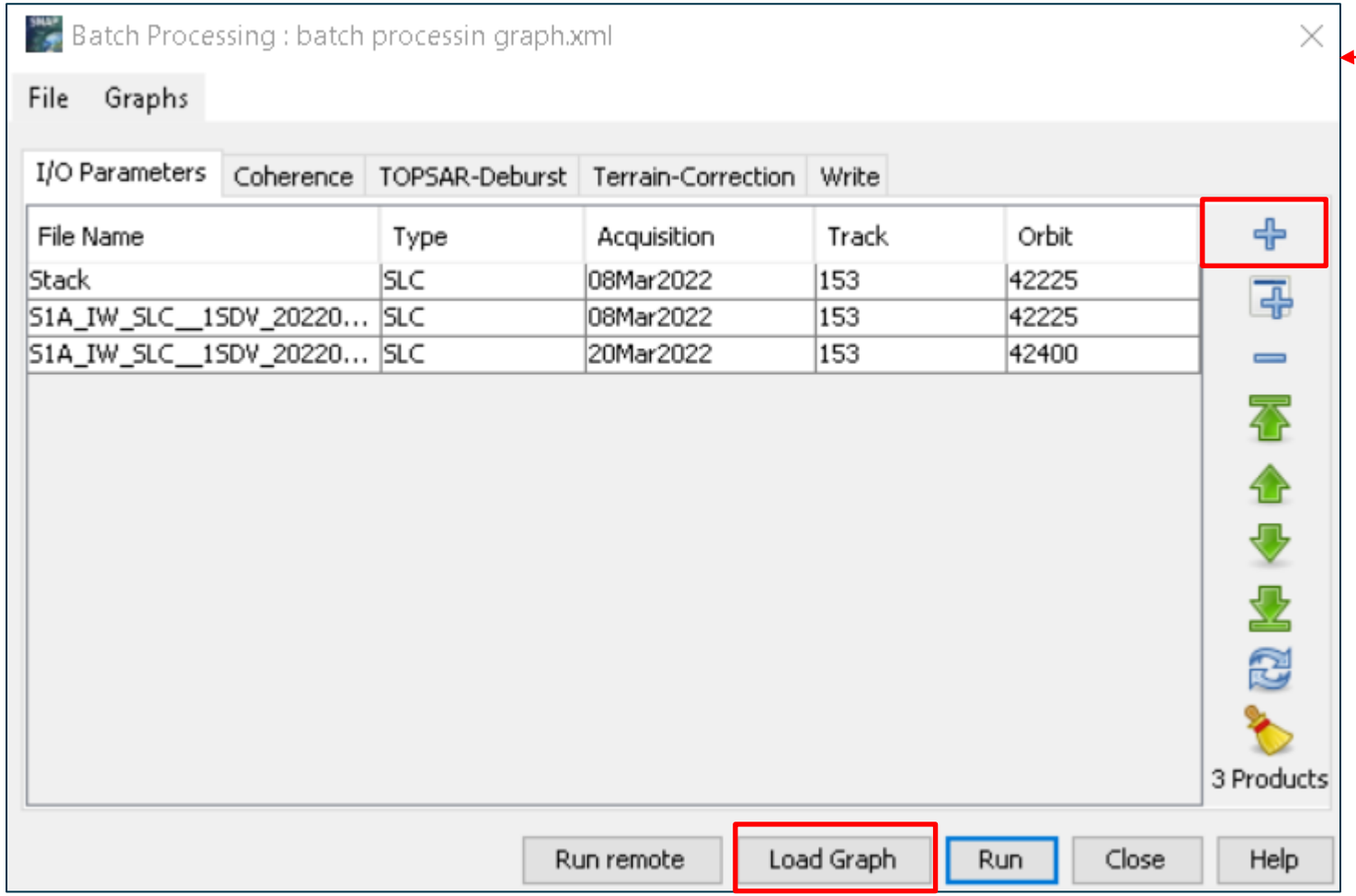


This part can be run in batch process



Save the graph and run batch processing

Batch processing

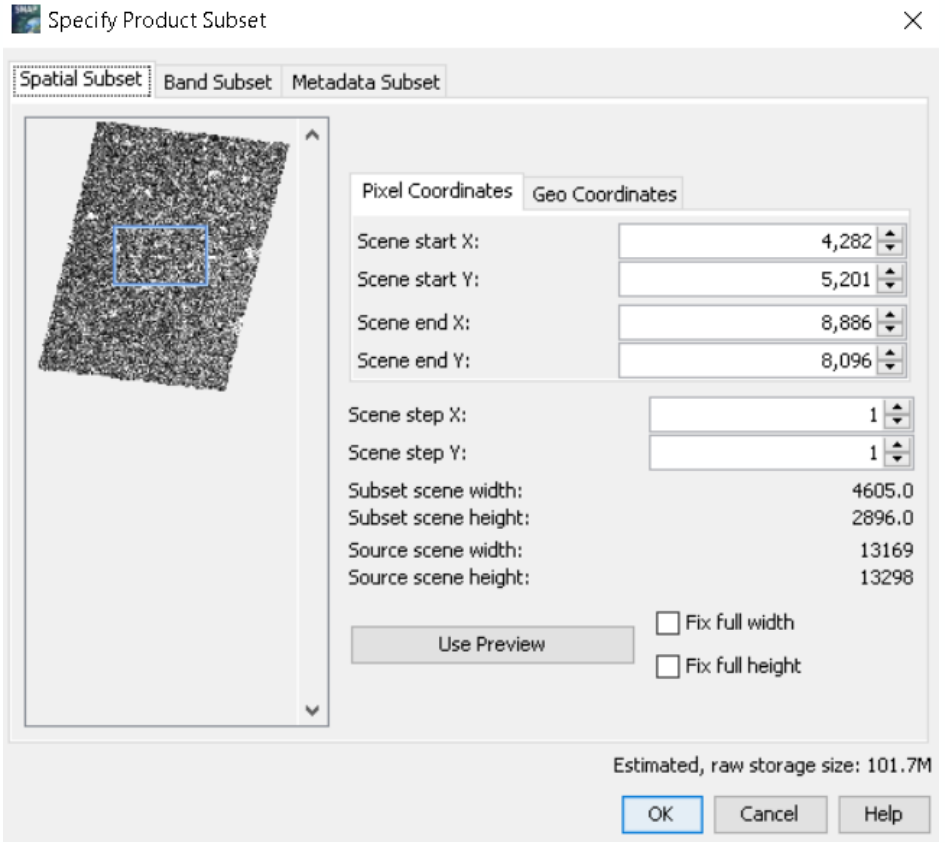


Add your data

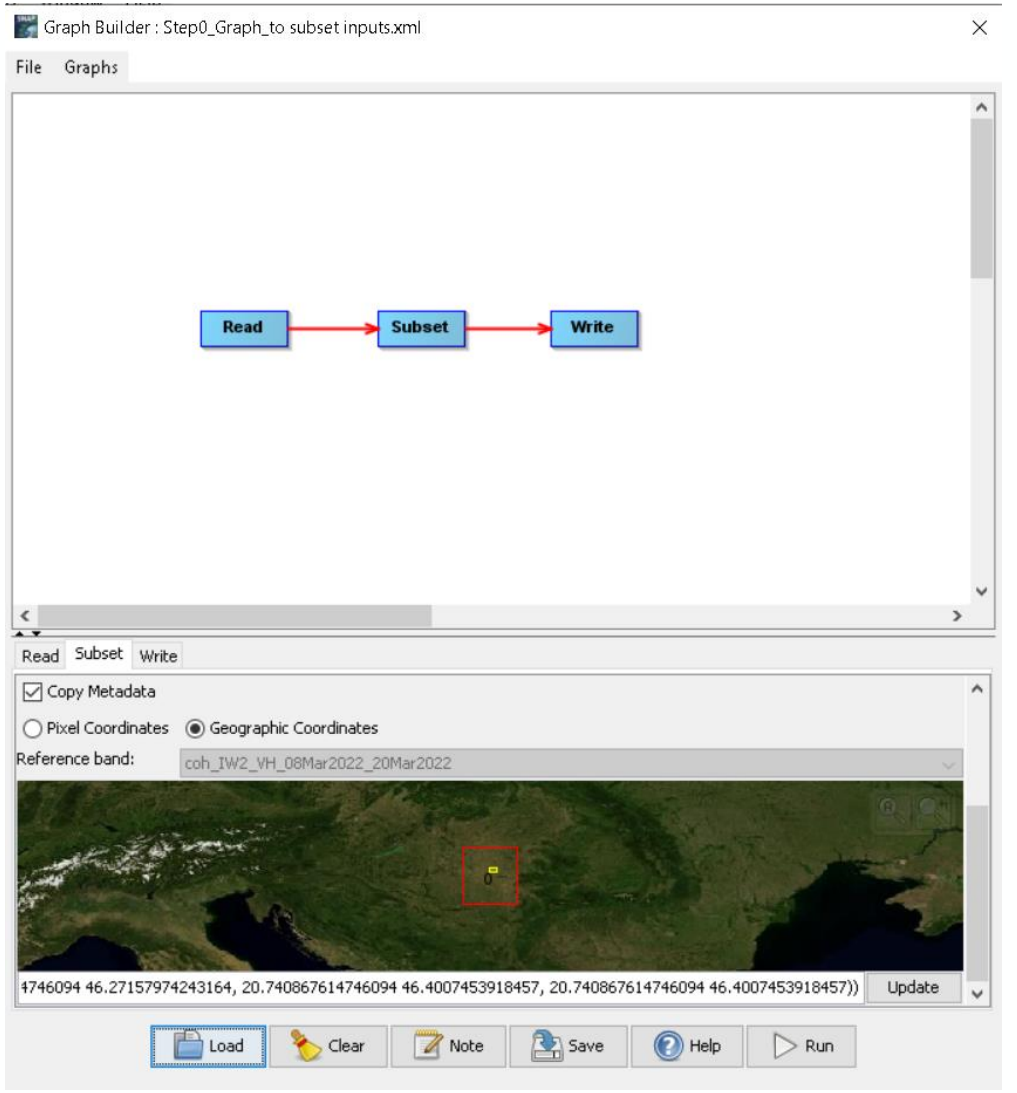
Load your saved graph

Spatial Subset

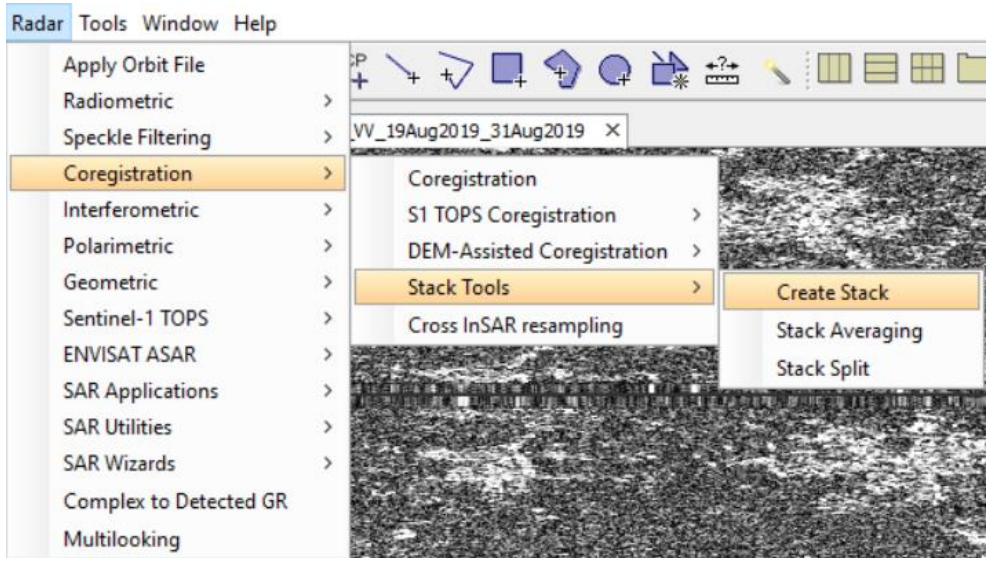
Raster/Subset



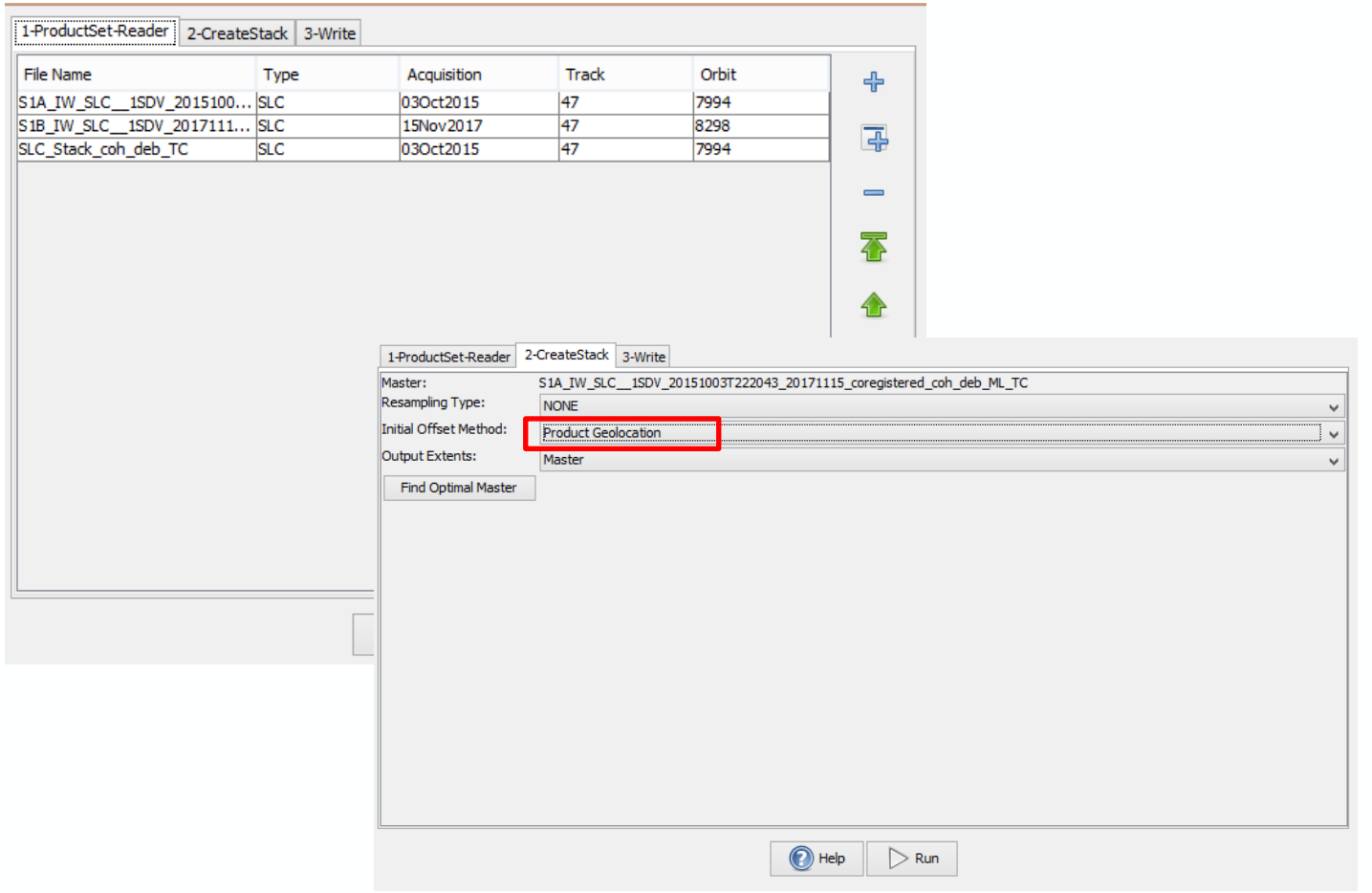
OR



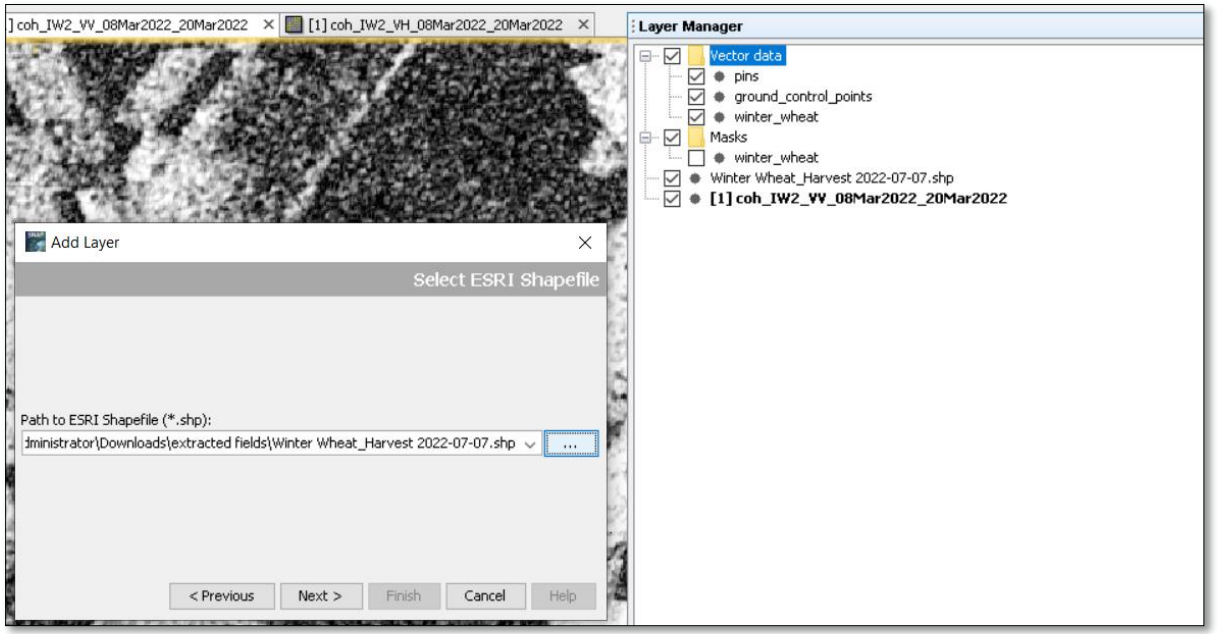
Creating Stack of coherence



Input: all coherence subset images



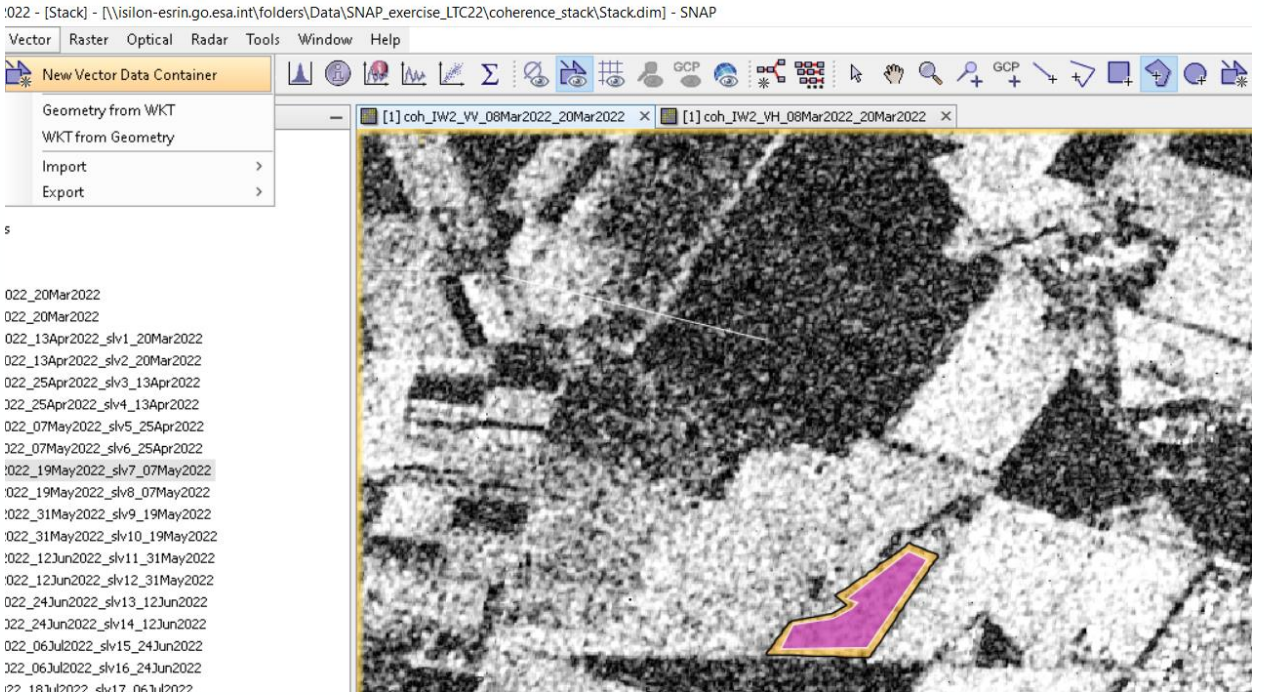
Time series analysis



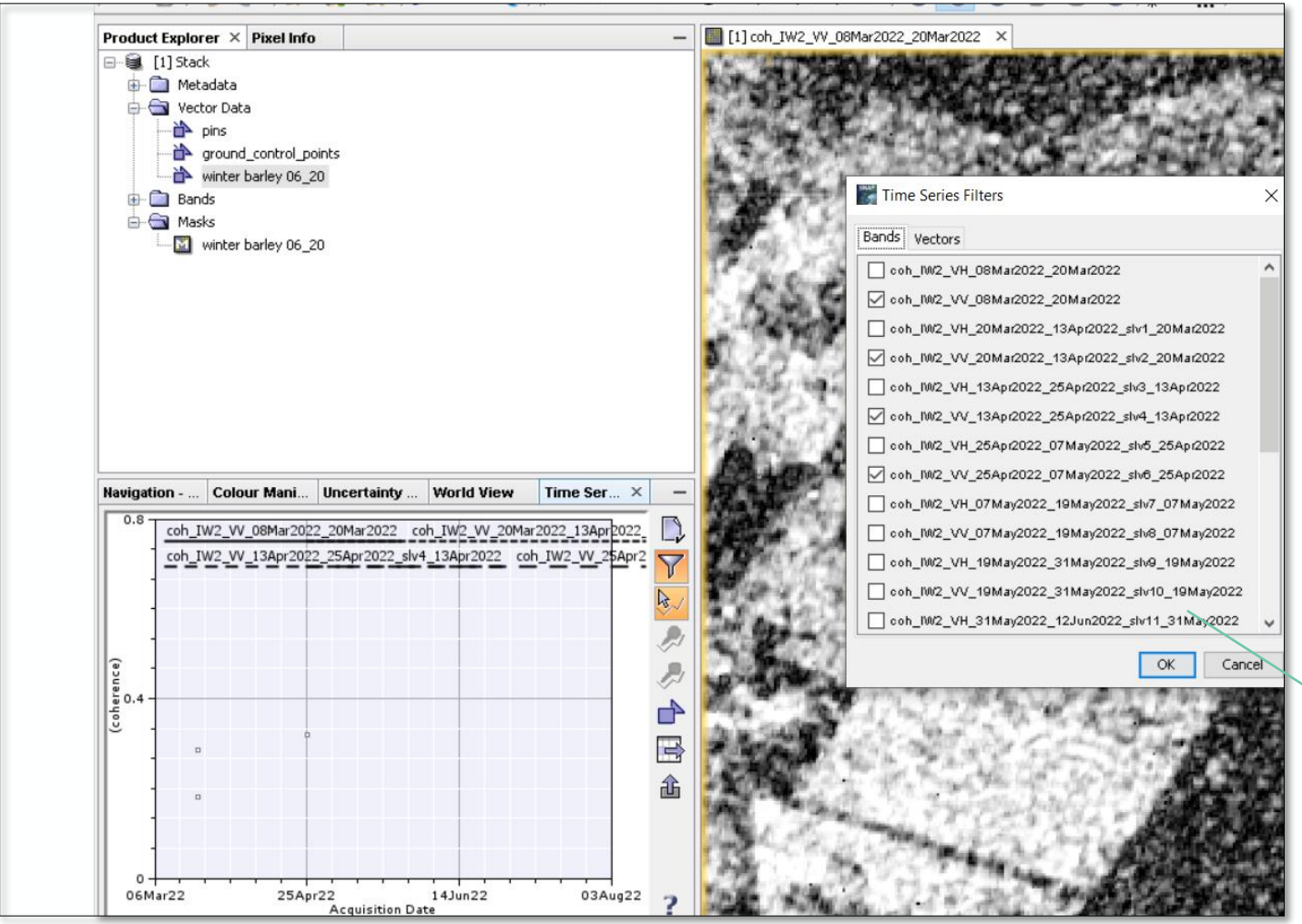
Add the layer with shapefiles of crops

View/Tool Windows/Radar/Time series

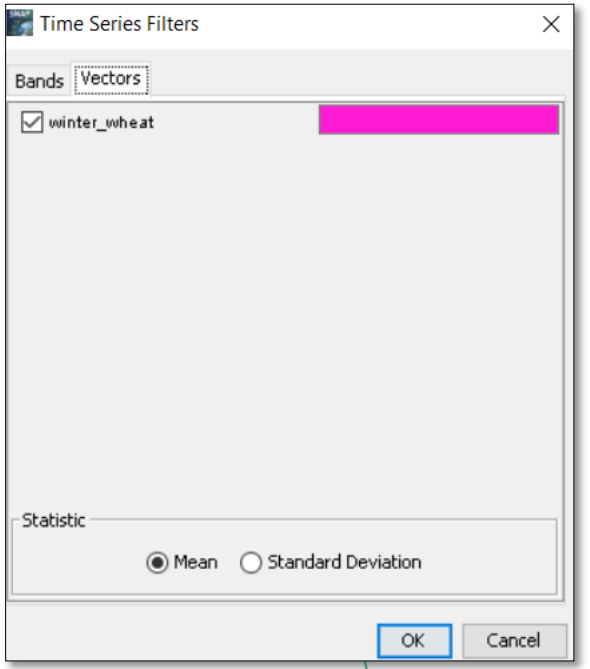
Draw your ROI



Time series analysis

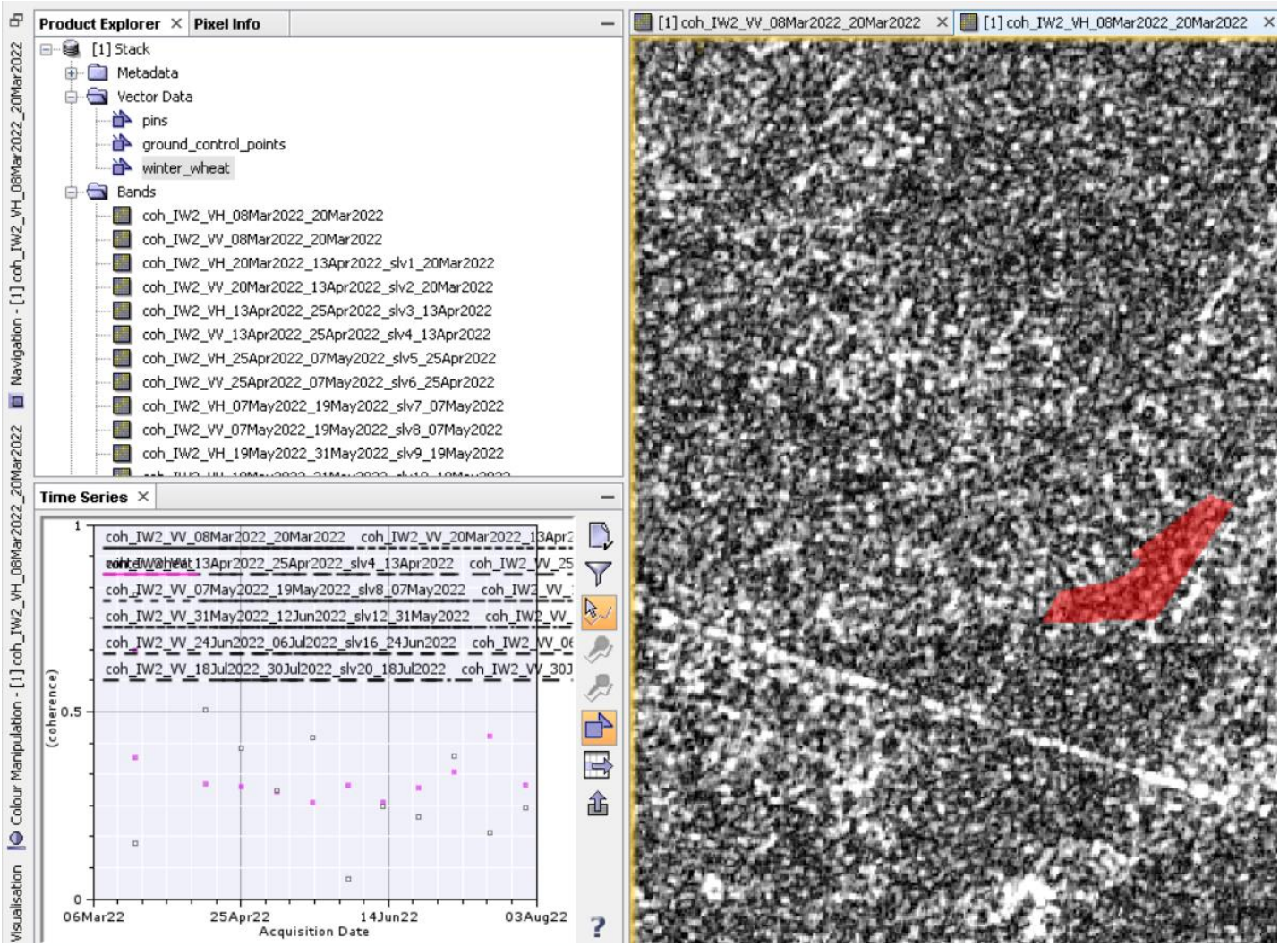


View/Tool Windows/Radar/Time series

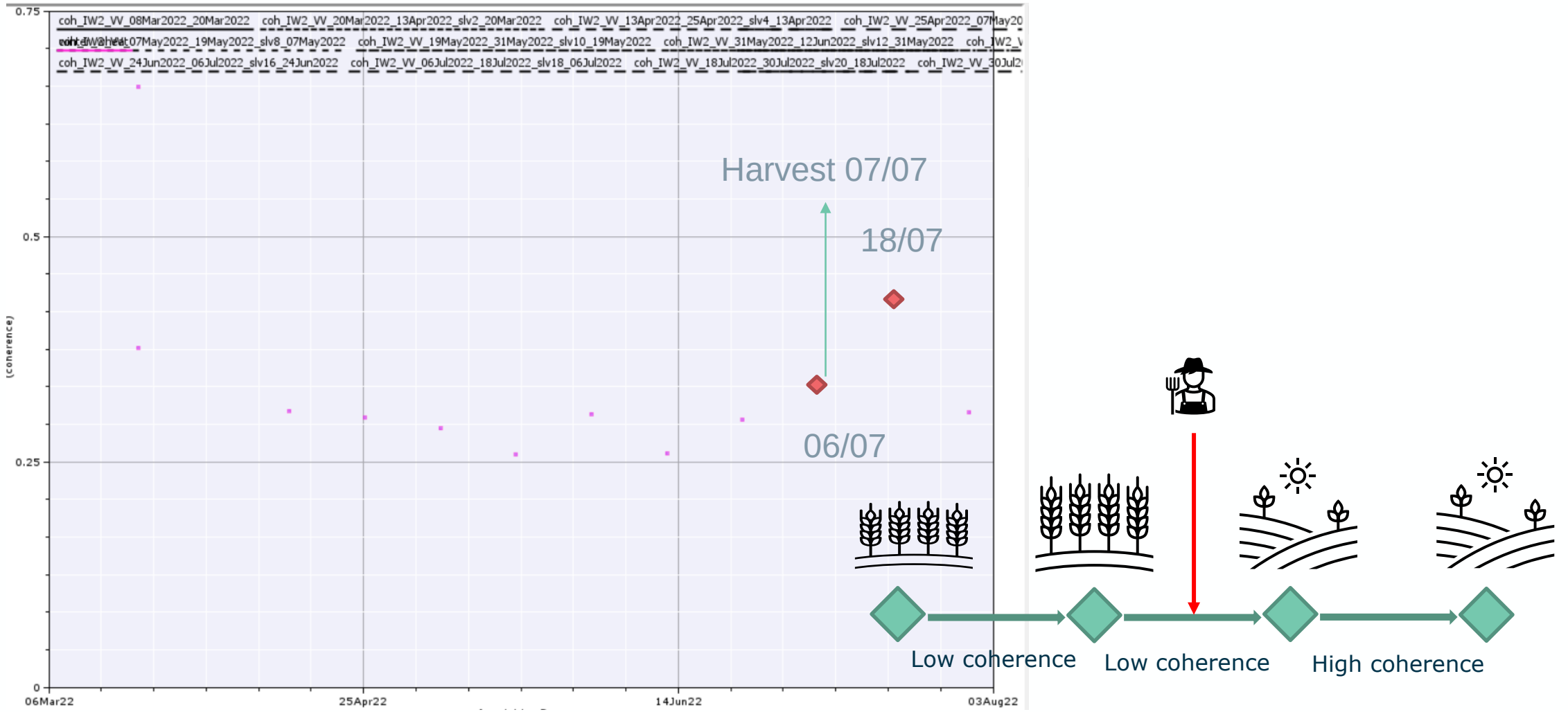


Select bands and mask (your geometry with the crop)

Time series analysis



Time series analysis



Radiometric Calibration

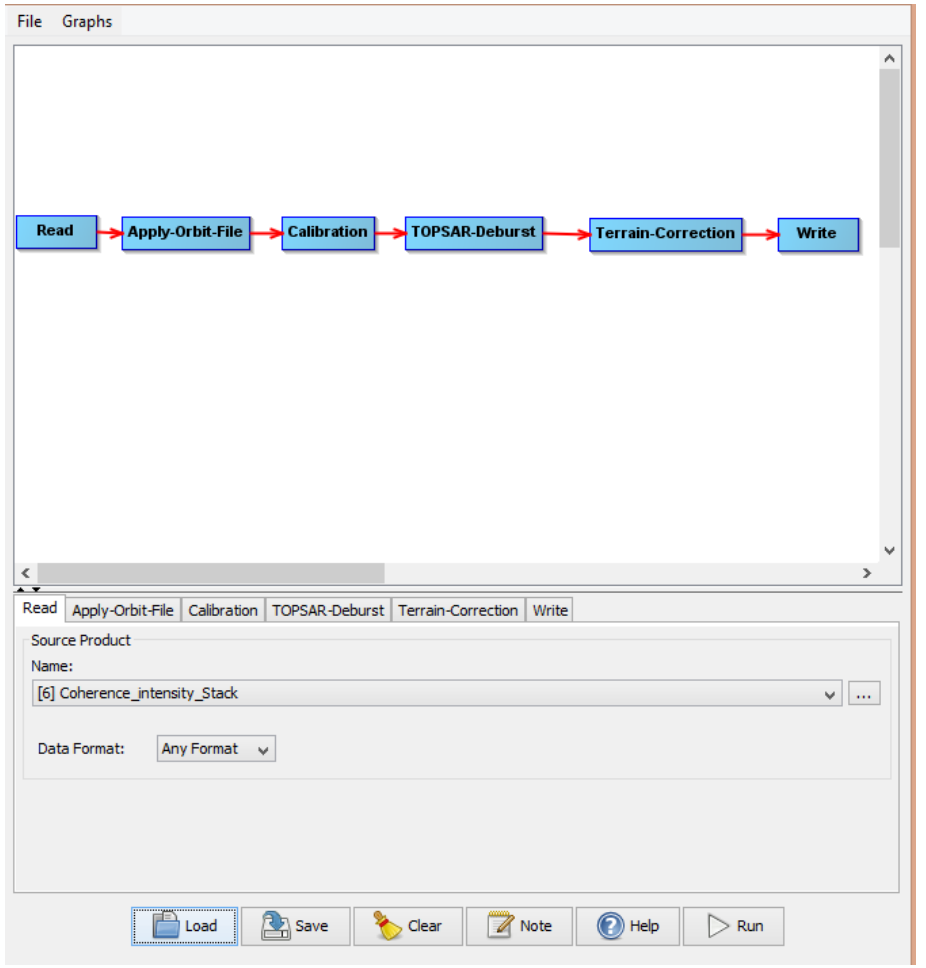
From image pixel values or digital numbers (DNs) we can derive:

Beta Naught – radar brightness coefficient, reflectivity per unit area in slant range which is dimensionless

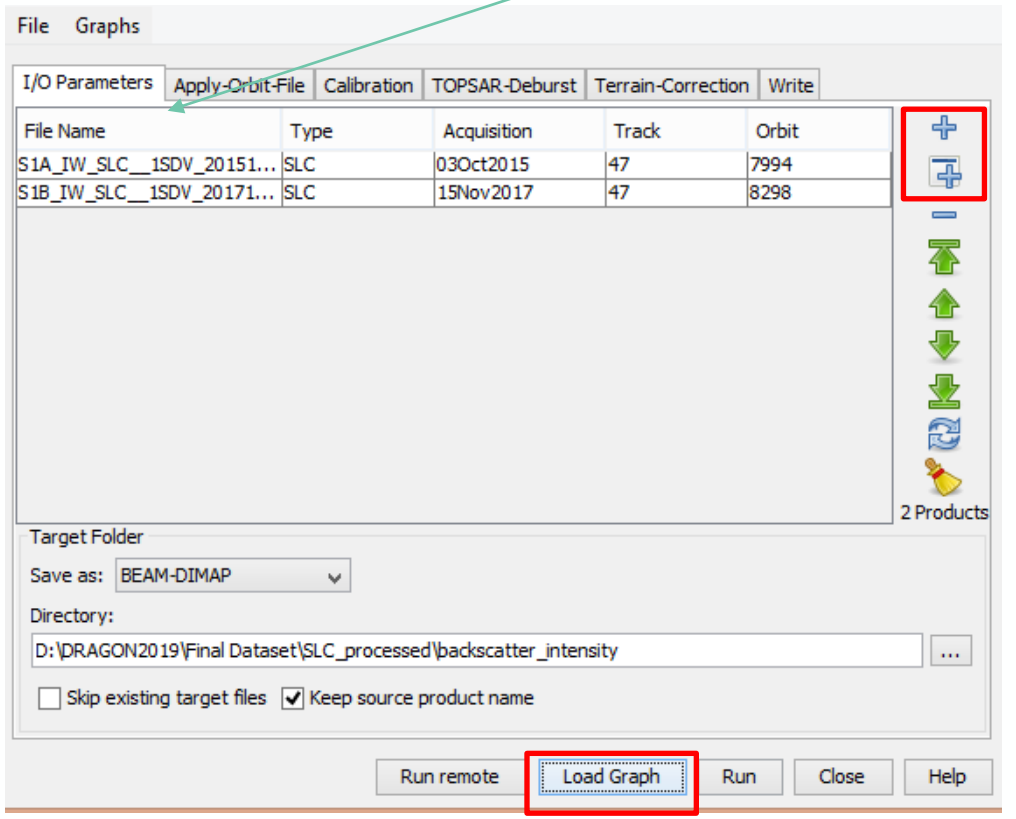
Sigma Naught – power returned to the antenna from the ground (distributed scatterer) in dB. A number comparing the strangth of the signal to that expected from and area of one square meter. It is defined with respect to the nominal horisontal plane and is varying with incidence angle, wavelength, polarisation and scattering surface itself

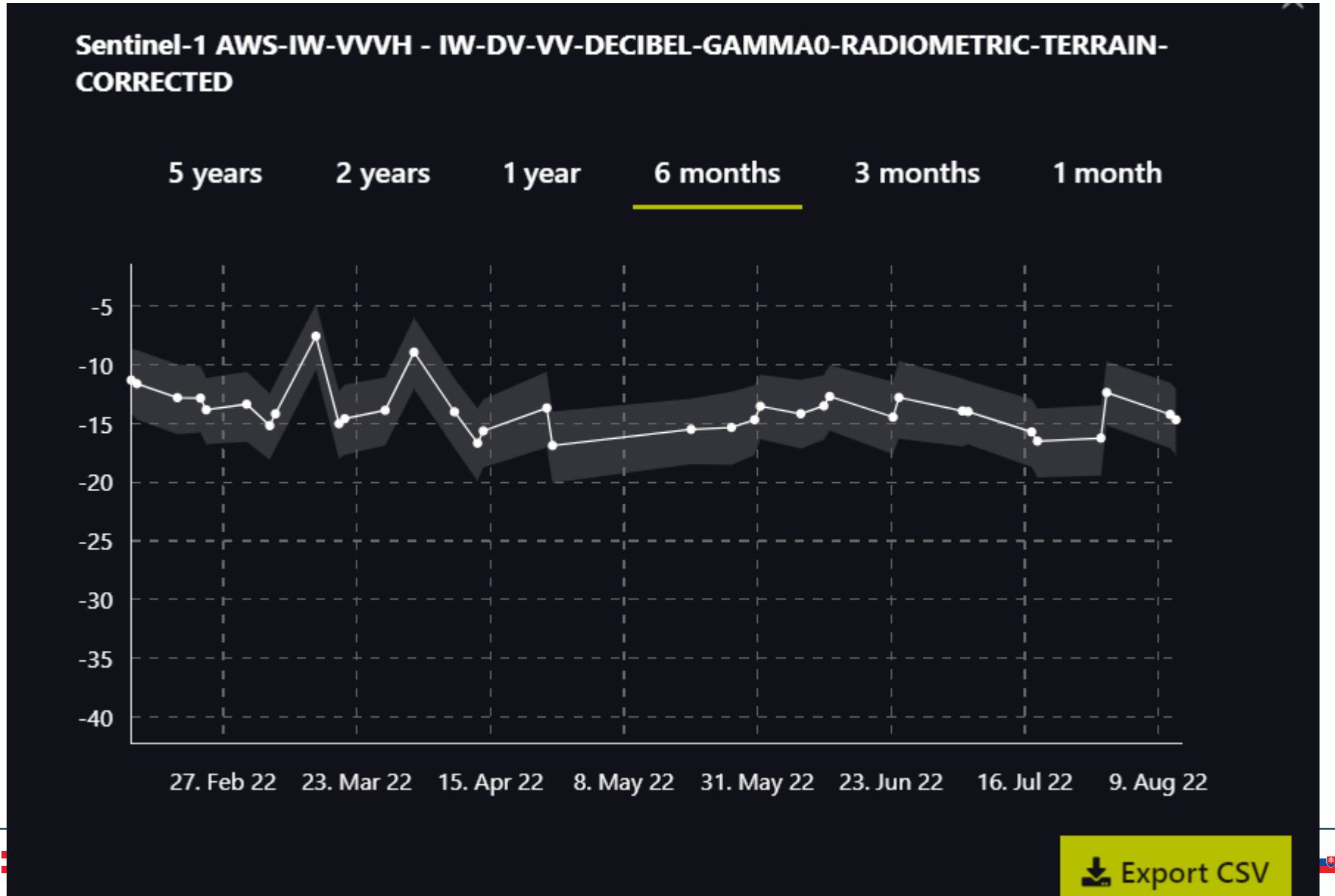
Backscatter Intensity product

MENU: *Graph Builder + Batch processing tool*



Input: Two splitted SLCs




Sentinel-1 AWS-IW-VVVH - IW-DV-VV-DECIBEL-GAMMA0-RADIOMETRIC-TERRAIN-CORRECTED
5 years
2 years
1 year
6 months
3 months
1 month
-5
-10
-15
-20
-25
-30
-35
-40
27. Feb 22
23. Mar 22
15. Apr 22
8. May 22
31. May 22
23. Jun 22
16. Jul 22
9. Aug 22
Export CSV

VH/VV


Sentinel-1 AWS-IW-VVVH - Custom
100%
Based on the last band of the custom script.
5 years
2 years
1 year
6 months
3 months
1 month
1
0.8
0.6
0.4
0.2
0
27. Feb 22
23. Mar 22
15. Apr 22
8. May 22
31. May 22
23. Jun 22
16. Jul 22
9. Aug 22
C0
C1
C2
Export CSV