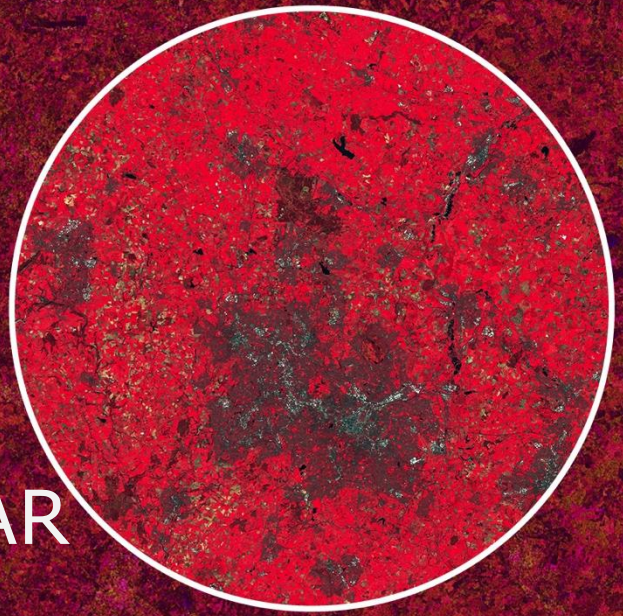
National Centre for Earth Observation
NATURAL ENVIRONMENT RESEARCH COUNCIL

UNIVERSITY OF LEICESTER

esa

→ 8th ADVANCED TRAINING COURSE ON LAND REMOTE SENSING

10–14 September 2018
University of Leicester | United Kingdom



Multitemporal analysis using SAR

Magdalena Fitrzyk

11/09/2018

Introduction

Input data: Sentinel-1 GRDH images over UK

S1B_IW_GRDH_1SDV_20180309T174910_20180309T174935_009958_0120AF_4CB8.SAFE
S1B_IW_GRDH_1SDV_20180402T174911_20180402T174936_010308_012C0D_5BA1.SAFE
S1B_IW_GRDH_1SDV_20180508T174912_20180508T174937_010833_013CEF_4F5C.SAFE
S1B_IW_GRDH_1SDV_20180601T174913_20180601T174938_011183_014840_B8F6.SAFE
S1B_IW_GRDH_1SDV_20180707T174916_20180707T174941_011708_015894_C5B7.SAFE

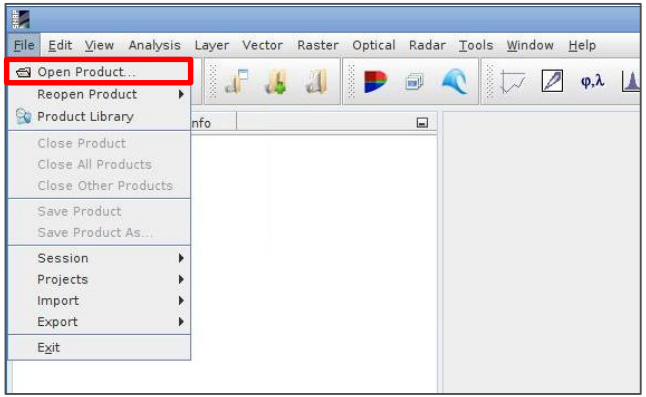
Output data: temporal backscatter signatures for various land cover types

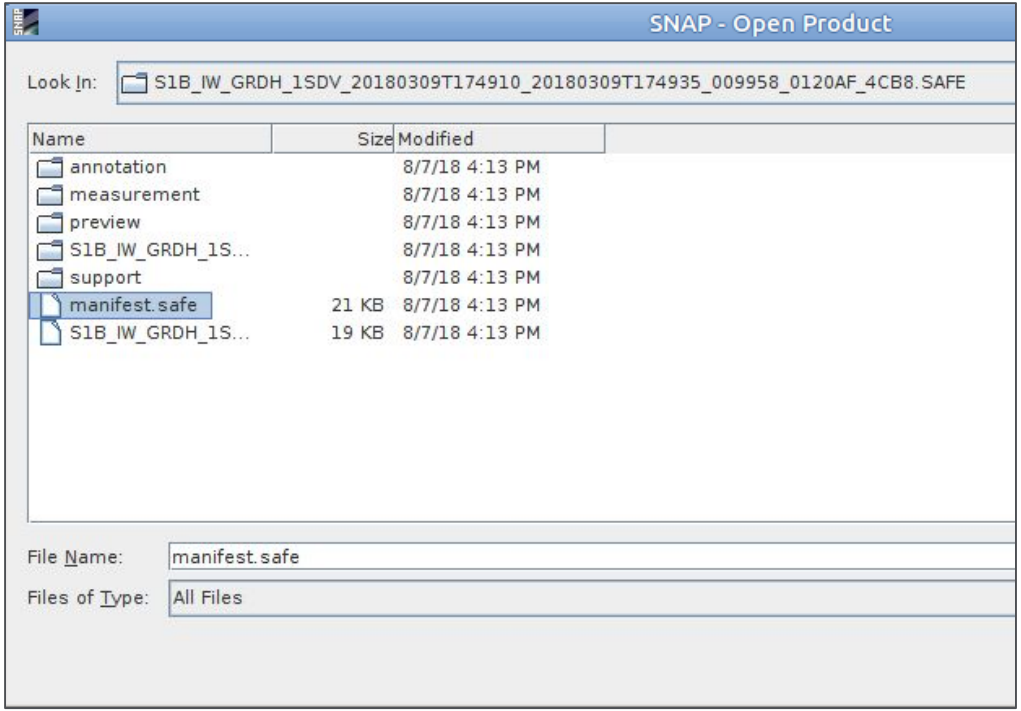
Data processing

- Creating a subset of S1 GRDH images
  Spatial subset depending on the AOI
- Radiometric calibration
  Conversion of image intensity to sigma0 providing the radar backscatter
- Terrain correction
  Compensate for geometric distortions caused by topographical variations of a scene and the tilt of satellite sensor
- Creating a multitemporal stack
  Collocation spatially overlapping products (based on geolocation)
- Speckle filtering
  Filtering the inherent salt and pepper like texturing called speckles
- Linear to dB conversion
  Compensate for very high dynamic range in visualisation
- Stack statistics
  Analysis of temporal backscatter signatures

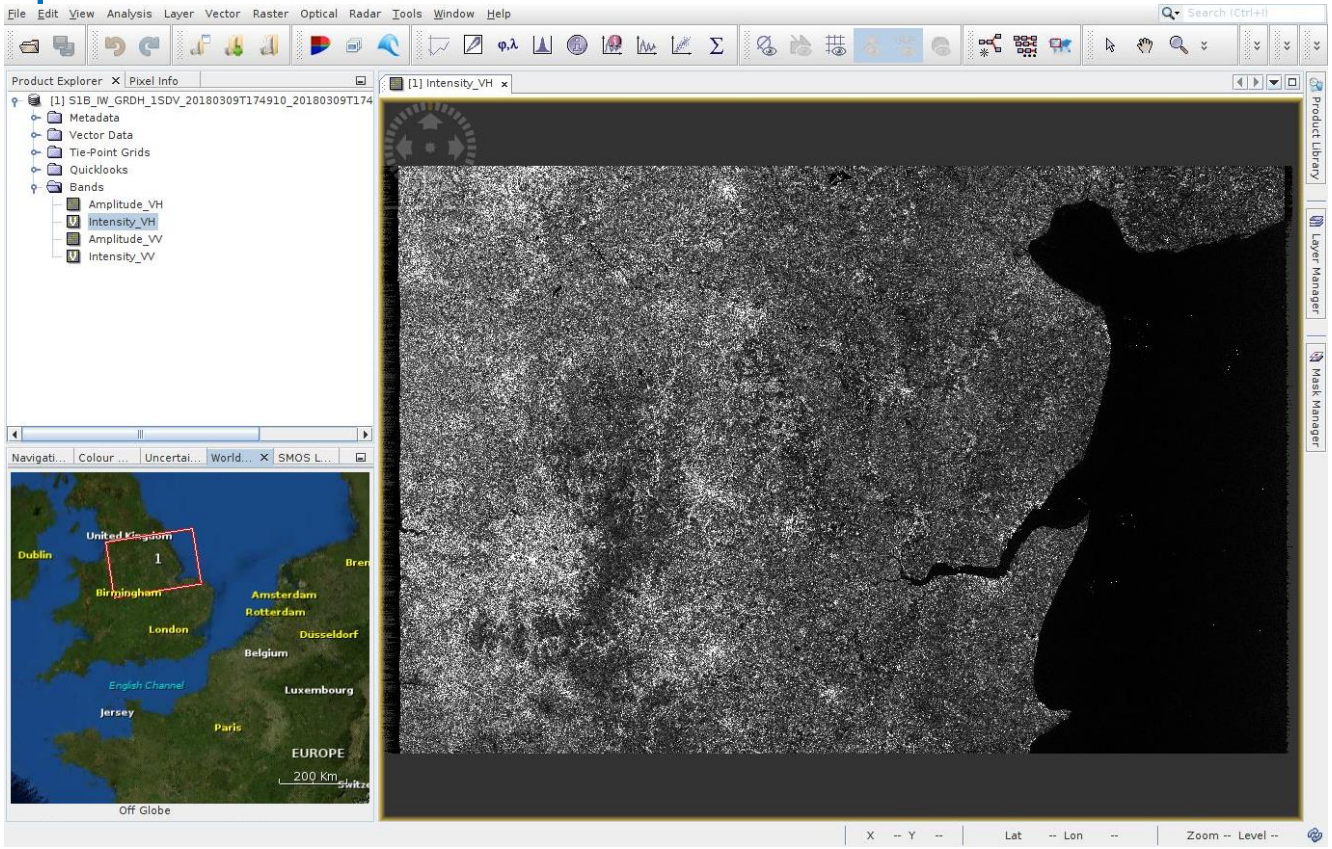
Data preparation

1. Opening the S1 data

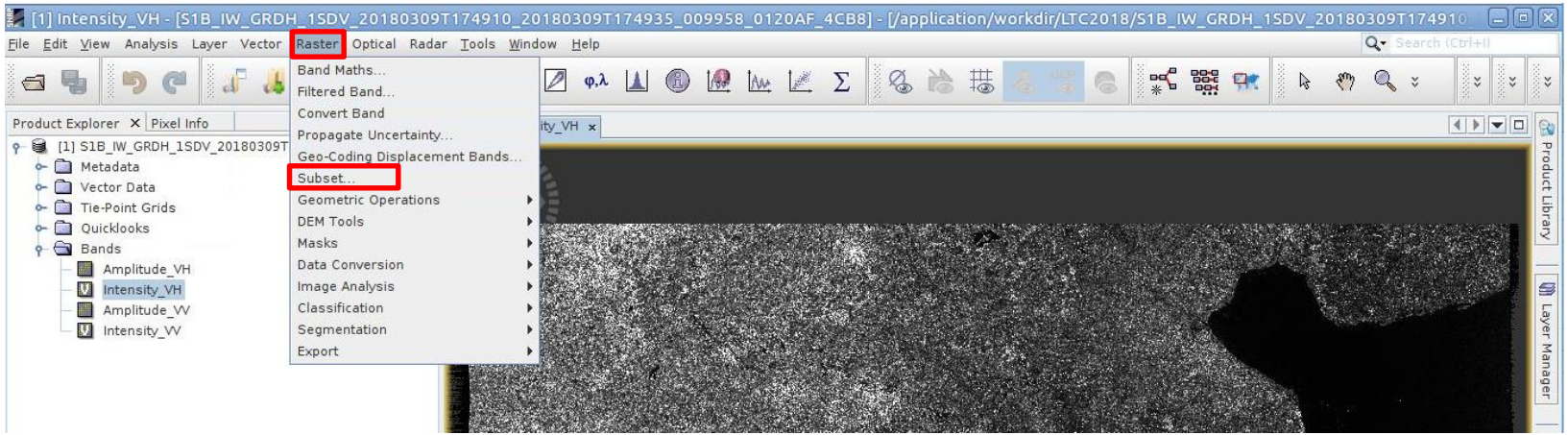




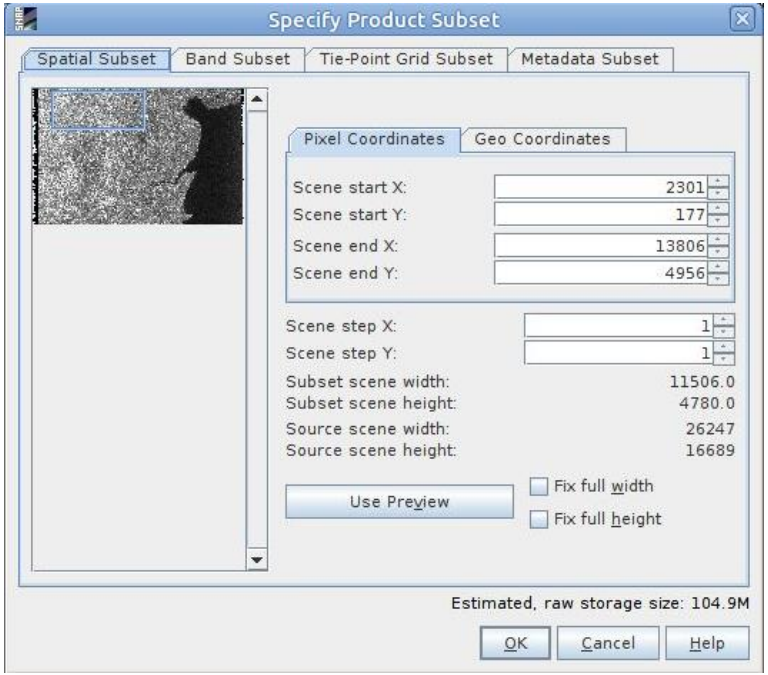
Data preparation

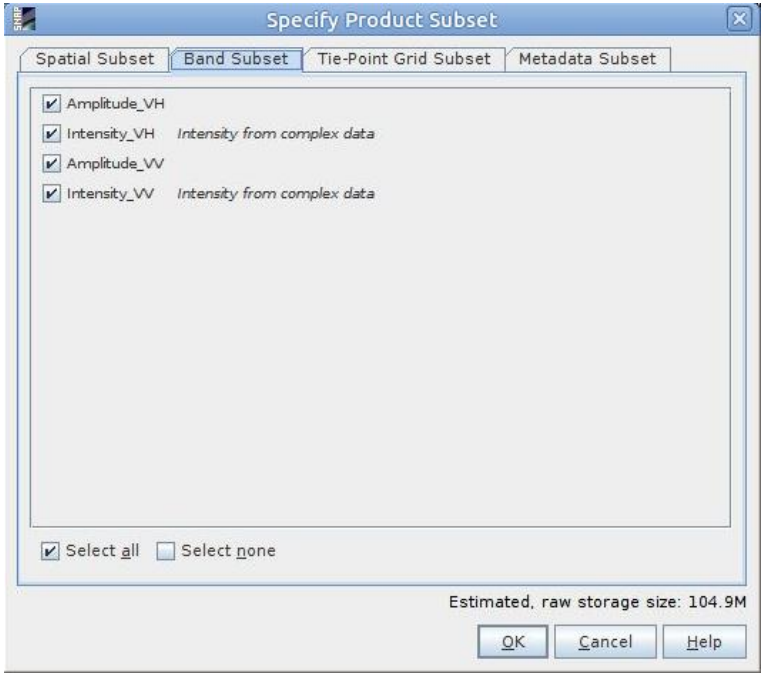


Spatial subset

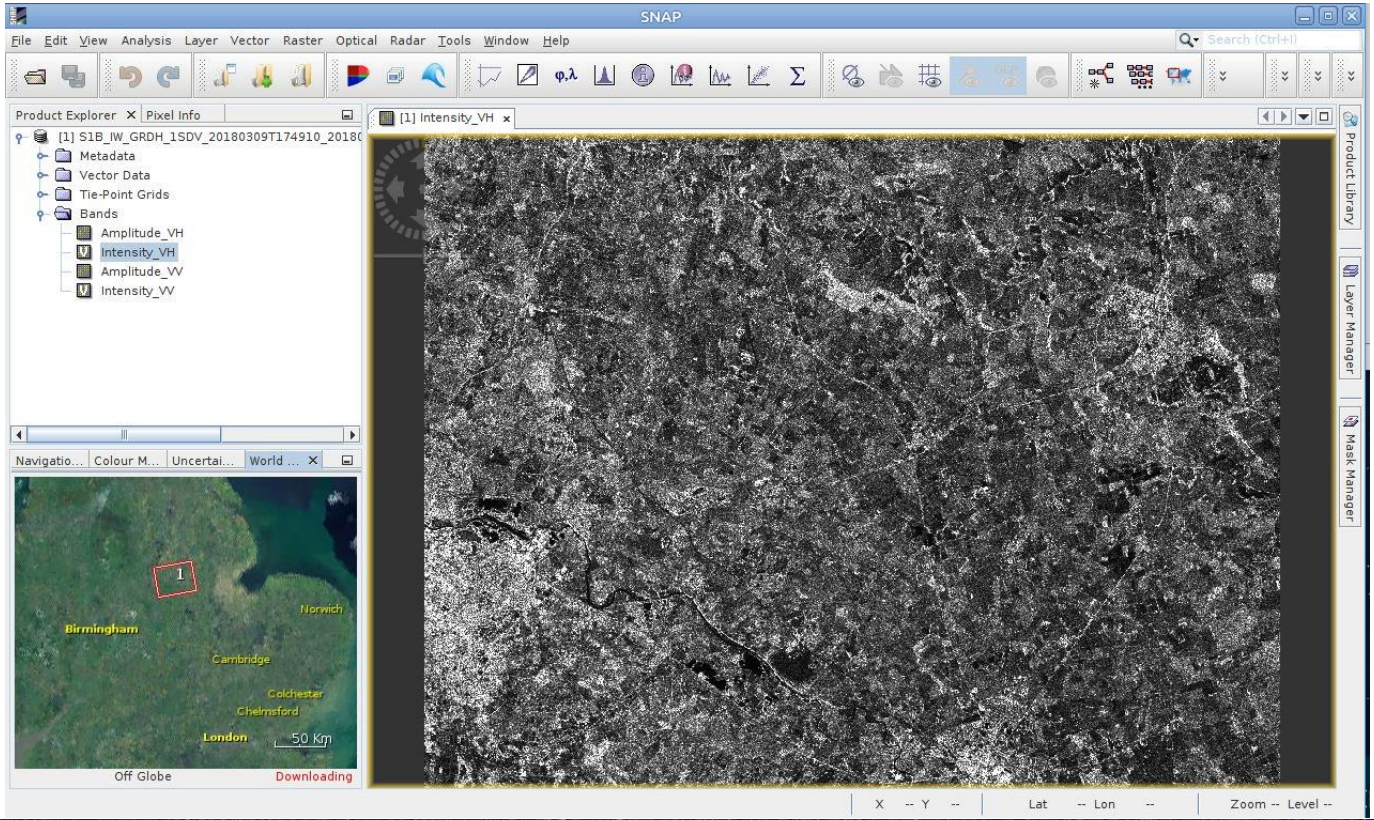


Spatial subset - parameters





Data check


SNAP
File Edit View Analysis Layer Vector Raster Optical Radar Tools Window Help
Search (Ctrl+I)
Product Explorer
Pixel Info
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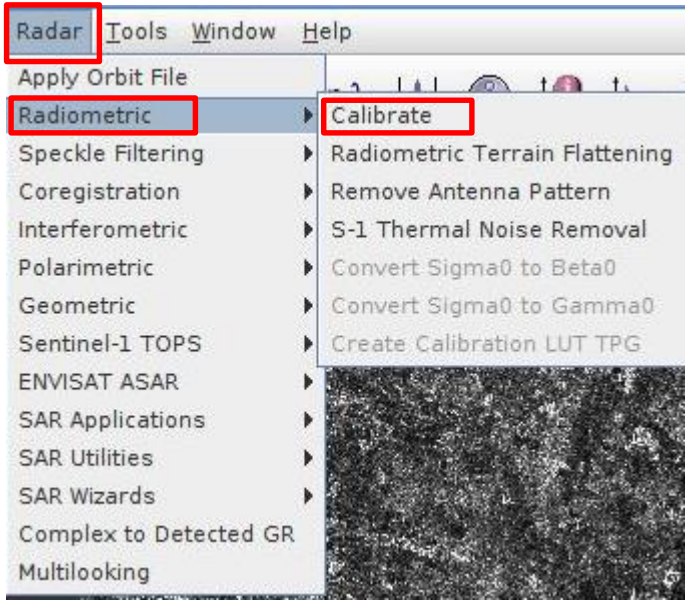
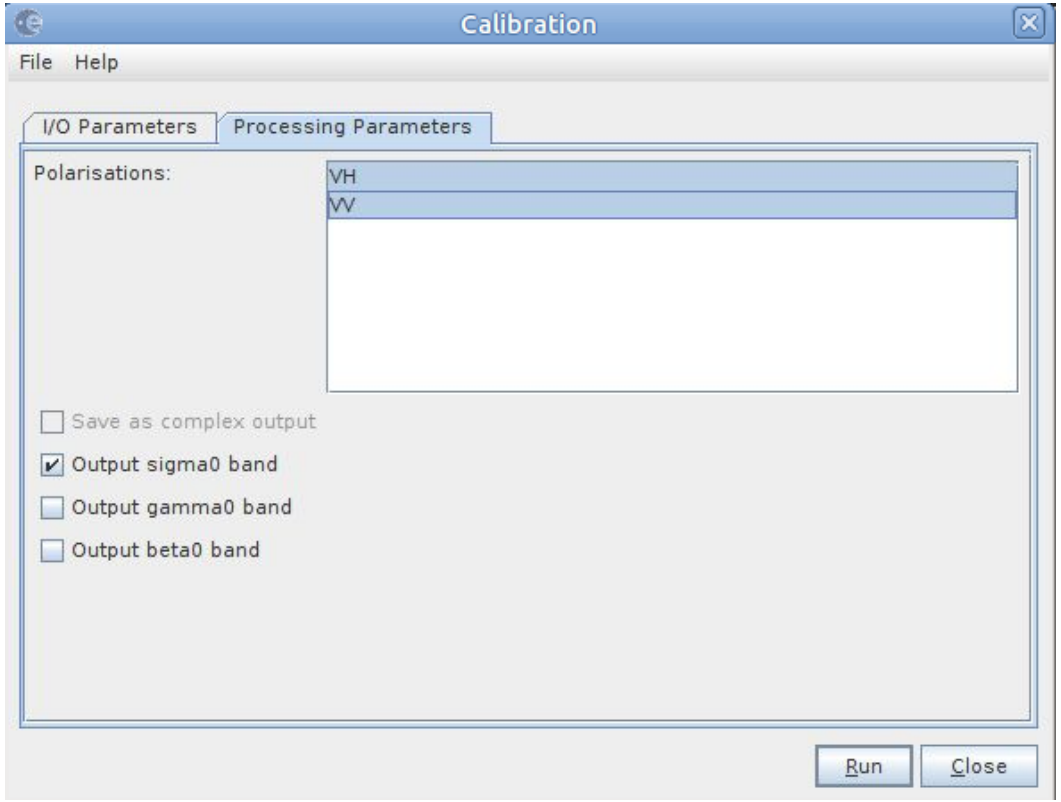
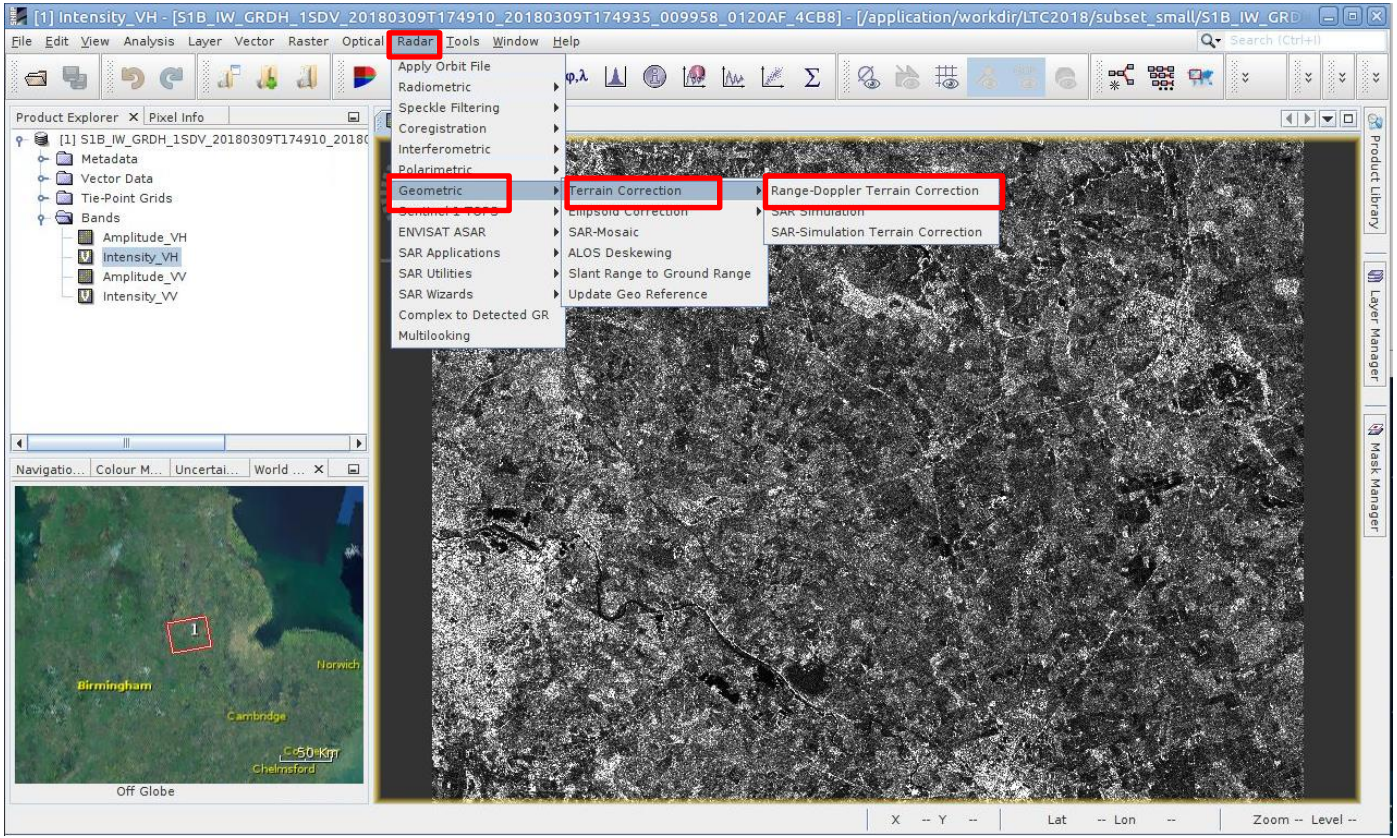
Metadata
Vector Data
Tie-Point Grids
Bands
Amplitude_VH
Intensity_VH
Amplitude_VV
Intensity_VV
[1] Intensity_VH
Navigatio...
Colour M...
Uncertai...
World ...
Birmingham
Norwich
Cambridge
Colchester
Chelmsford
London
50 Km
Off Globe
Downloading
Product Library
Layer Manager
Mask Manager
X -- Y --
Lat -- Lon --
Zoom -- Level --

Radiometric Calibration





Geocoding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File Edit View Analysis Layer Vector Raster Optical Radar Tools Window Help
Search (Ctrl+I)
Apply Orbit File
Radiometric
Speckle Filtering
Coregistration
Interferometric
Polarimetric
Geometric
Sentinel-1 TOPS
ENVISAT ASAR
SAR Applications
SAR Utilities
SAR Wizards
Complex to Detected GR
Multilooking
Terrain Correction
Ellipsoid Correction
SAR-Mosaic
ALOS Deskewing
Slant Range to Ground Range
Update Geo Reference
Range-Doppler Terrain Correction
SAR Simulation
SAR-Simulation Terrain Correction
Product Explorer
Pixel Info
[1] S1B_IW_GRDH_1SDV_20180309T174910_2018
Metadata
Vector Data
Tie-Point Grids
Bands
Amplitude_VH
Intensity_VH
Amplitude_VV
Intensity_VV
Navigatio...
Colour M...
Uncertai...
World ...
Birmingham
Norwich
Cambridge
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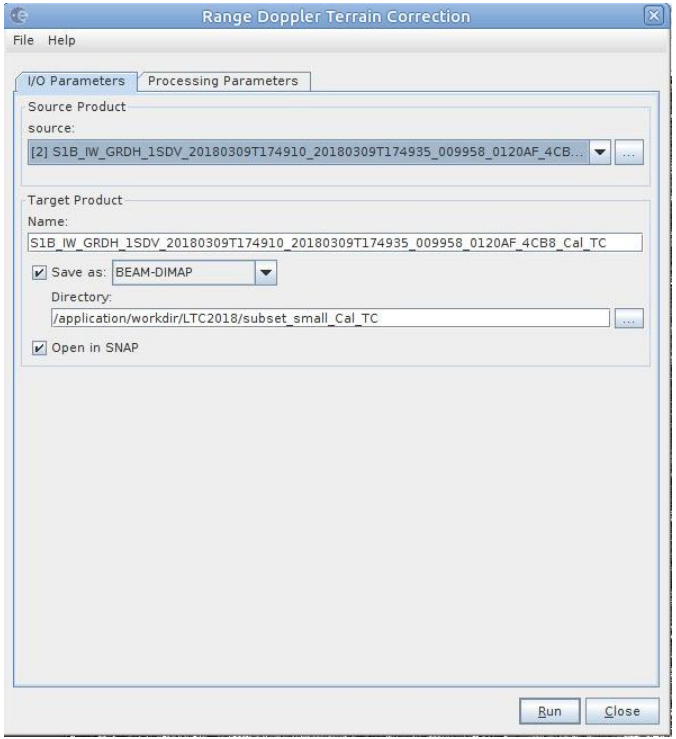
50 Km
Off Globe
Product Library
Layer Manager
Mask Manager
X -- Y --
Lat -- Lon --
Zoom -- Level --

Geocoding


Range Doppler Terrain Correction
File Help
I/O Parameters
Processing Parameters
Source Product
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Target Product
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Save as:
BEAM-DIMAP
Directory:
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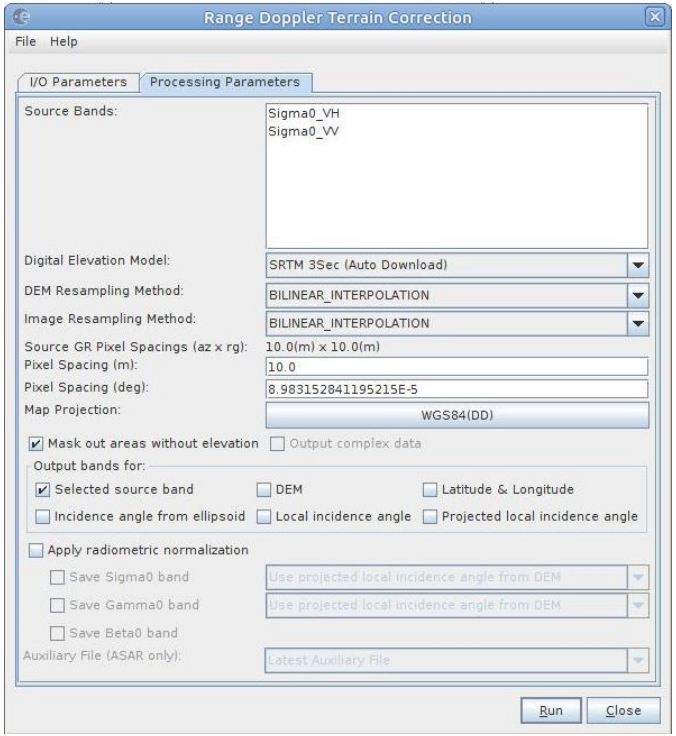
Open in SNAP
Run
Close


Range Doppler Terrain Correction
File Help
I/O Parameters
Processing Parameters
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Sigma0_VH
Sigma0_VV
Digital Elevation Model:
SRTM 3Sec (Auto Download)
DEM Resampling Method:
BILINEAR_INTERPOLATION
Image Resampling Method:
BILINEAR_INTERPOLATION
Source GR Pixel Spacings (az x rg):
10.0(m) x 10.0(m)
Pixel Spacing (m):
10.0
Pixel Spacing (deg):
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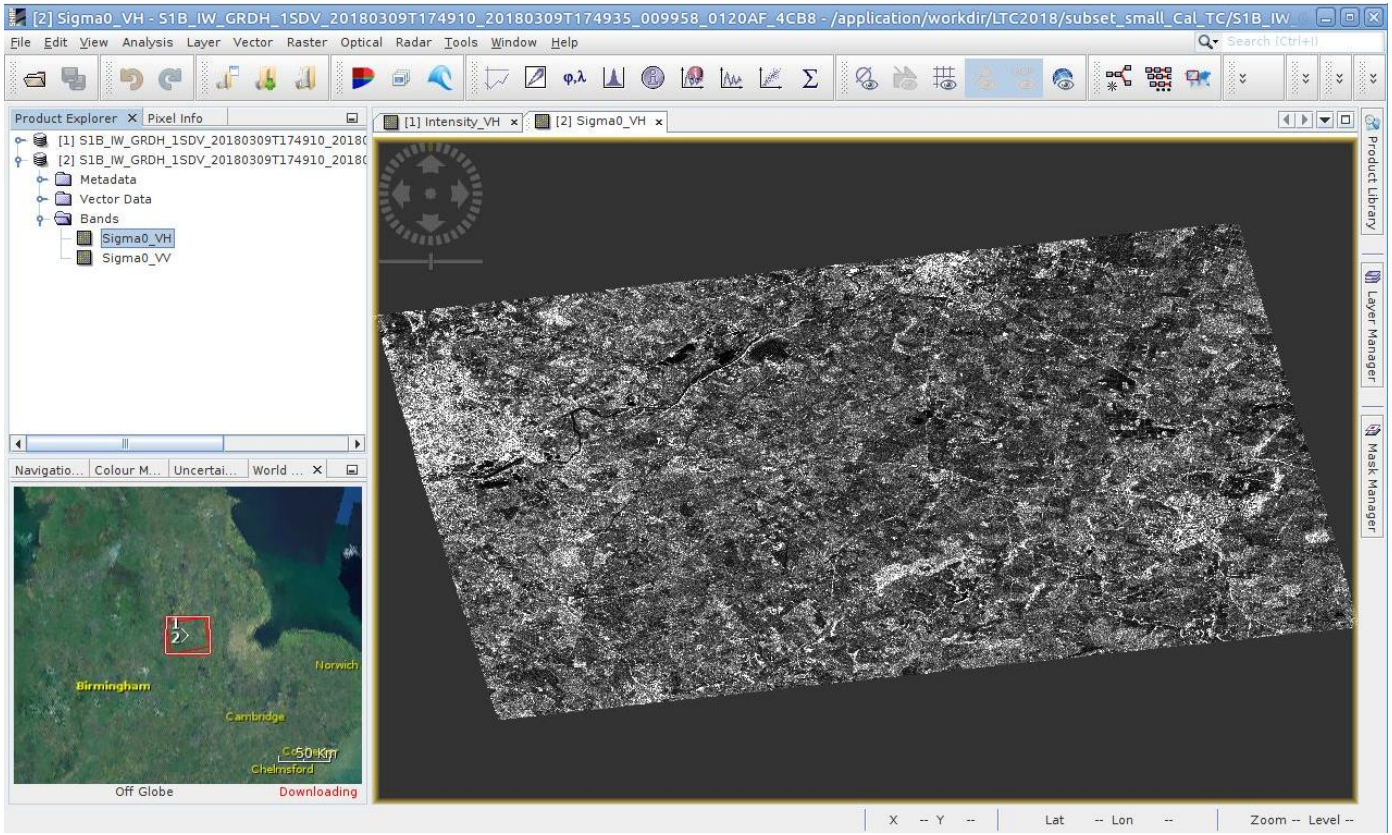
Map Projection:
WGS84(DD)
Mask out areas without elevation
Output complex data
Output bands for:
Selected source band
DEM
Latitude & Longitude
Incidence angle from ellipsoid
Local incidence angle
Projected local incidence angle
Apply radiometric normalization
Save Sigma0 band
Save Gamma0 band
Save Beta0 band
Auxiliary File (ASAR only):
Latest Auxiliary File
Run
Close

Data check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File Edit View Analysis Layer Vector Raster Optical Radar Tools Window Help
Product Explorer
Pixel Info
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Metadata
Vector Data
Bands
Sigma0_VH
Sigma0_VV
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[2] Sigma0_VH
Product Library
Layer Manager
Mask Manager
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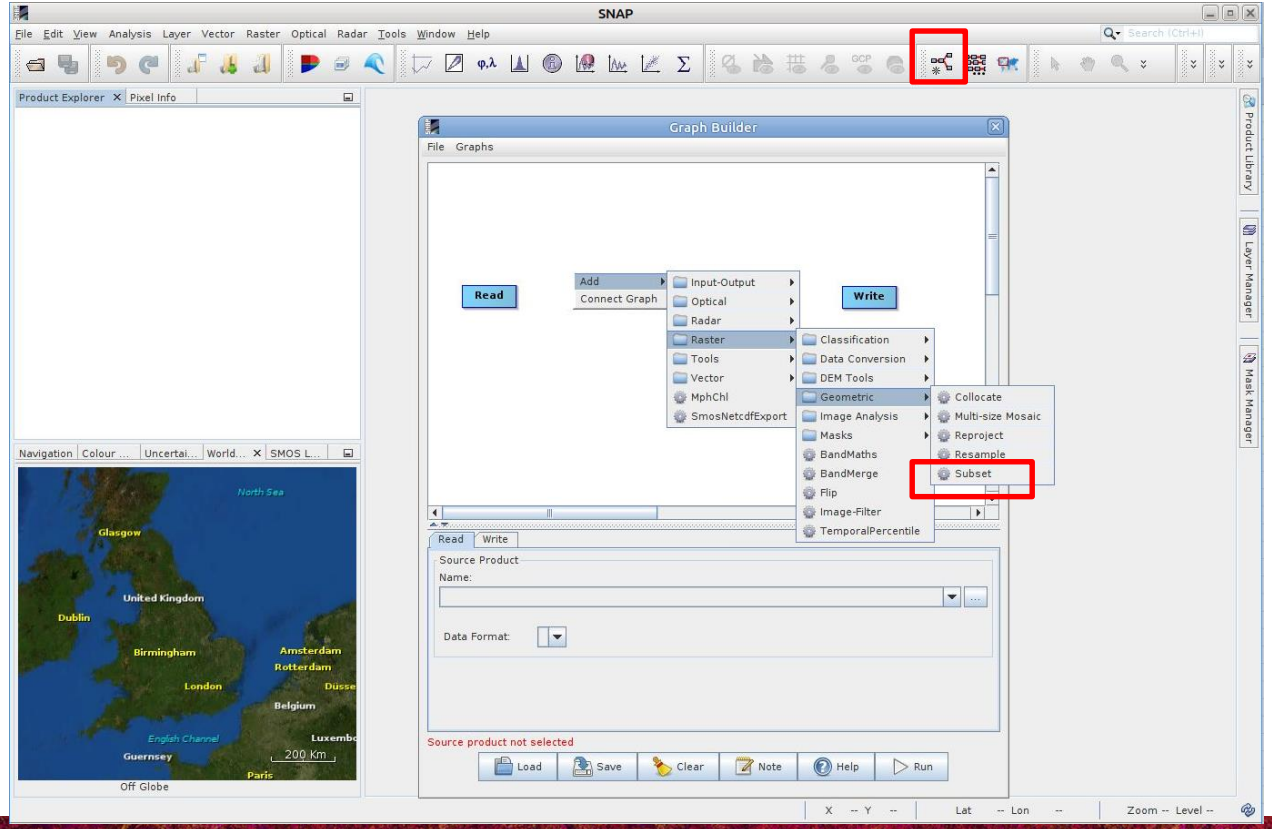
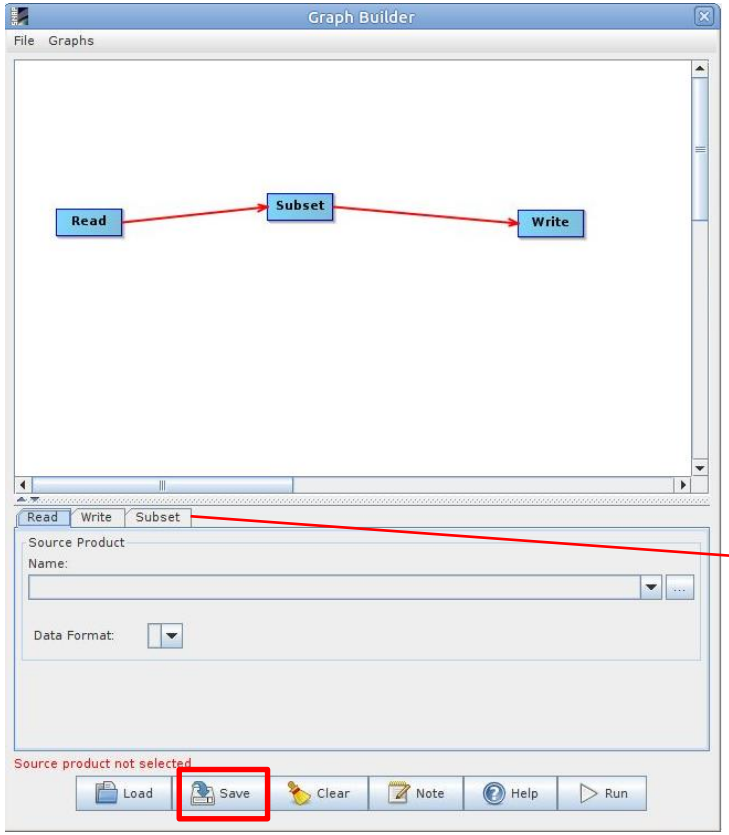
Colour M...
Uncertai...
World ...
Birmingham
Norwich
Cambridge
Chelmsford
50 Km
Off Globe
Downloading
X -- Y --
Lat -- Lon --
Zoom -- Level --

Spatial subset – batch processing with automatic processing graph

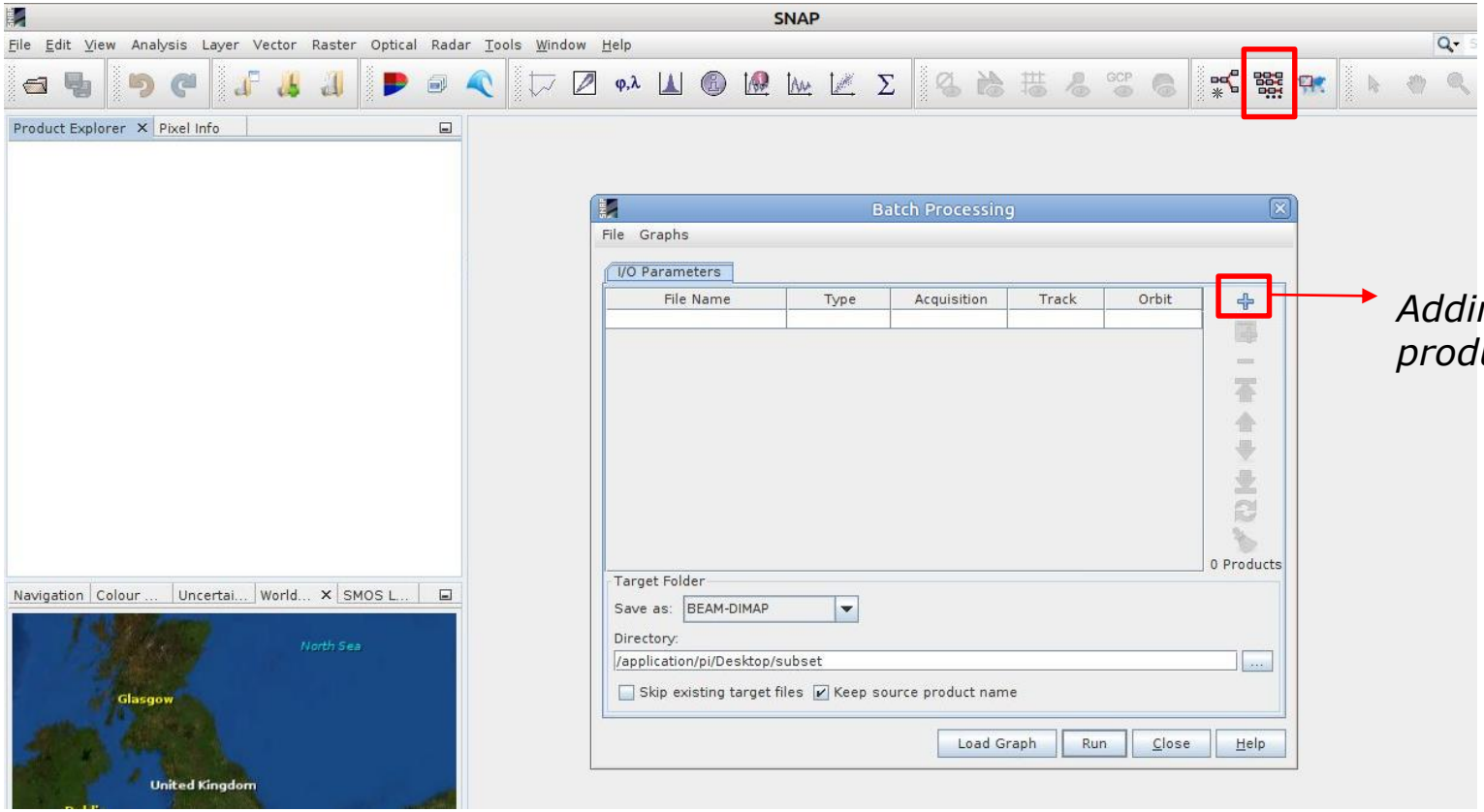


Spatial subset - automatic processing graph



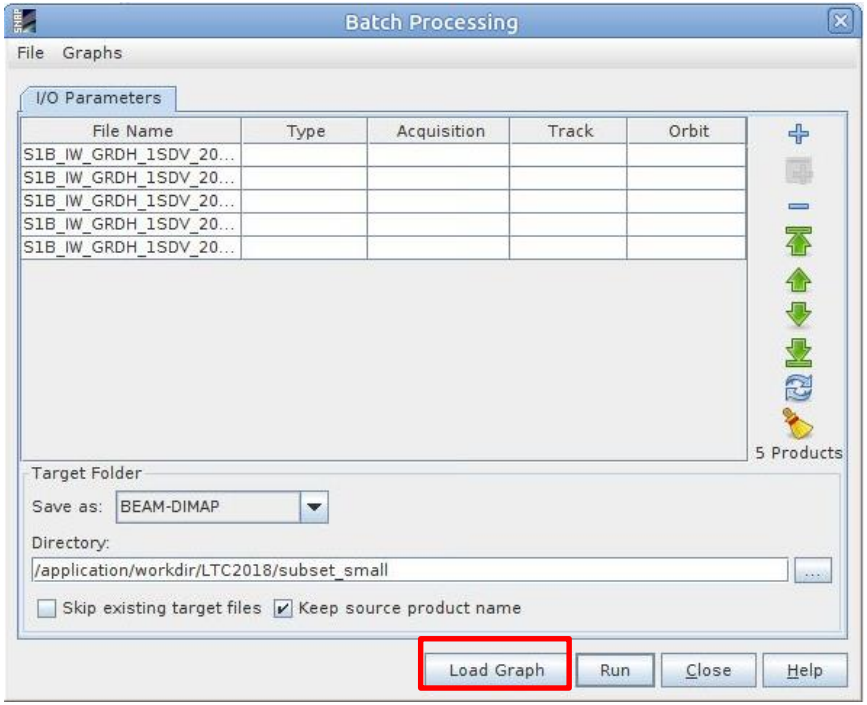
Parameters of the subset (e.g. spatial extent)

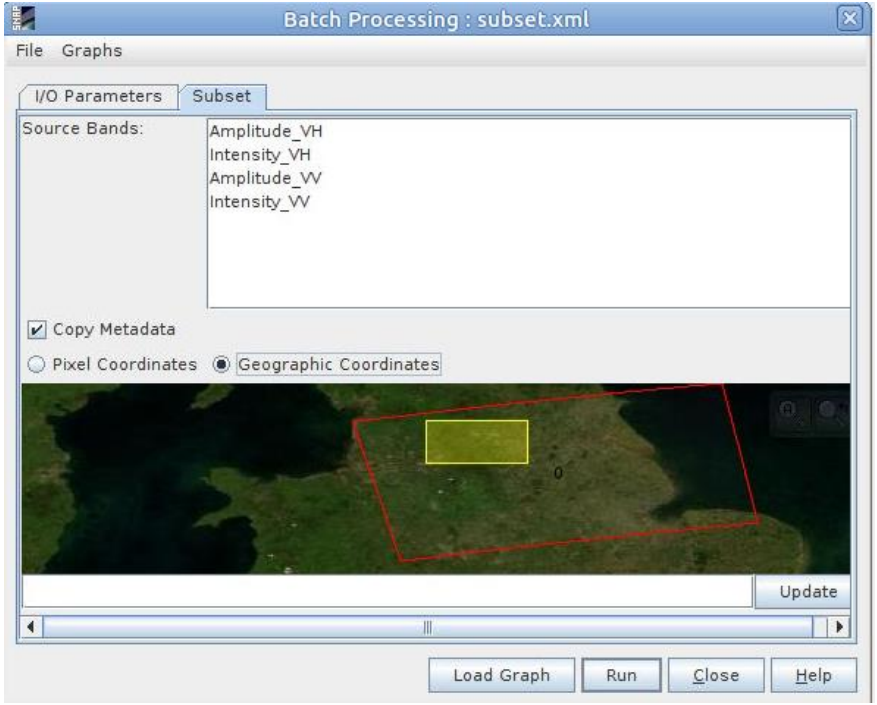
Spatial subset – batch processing



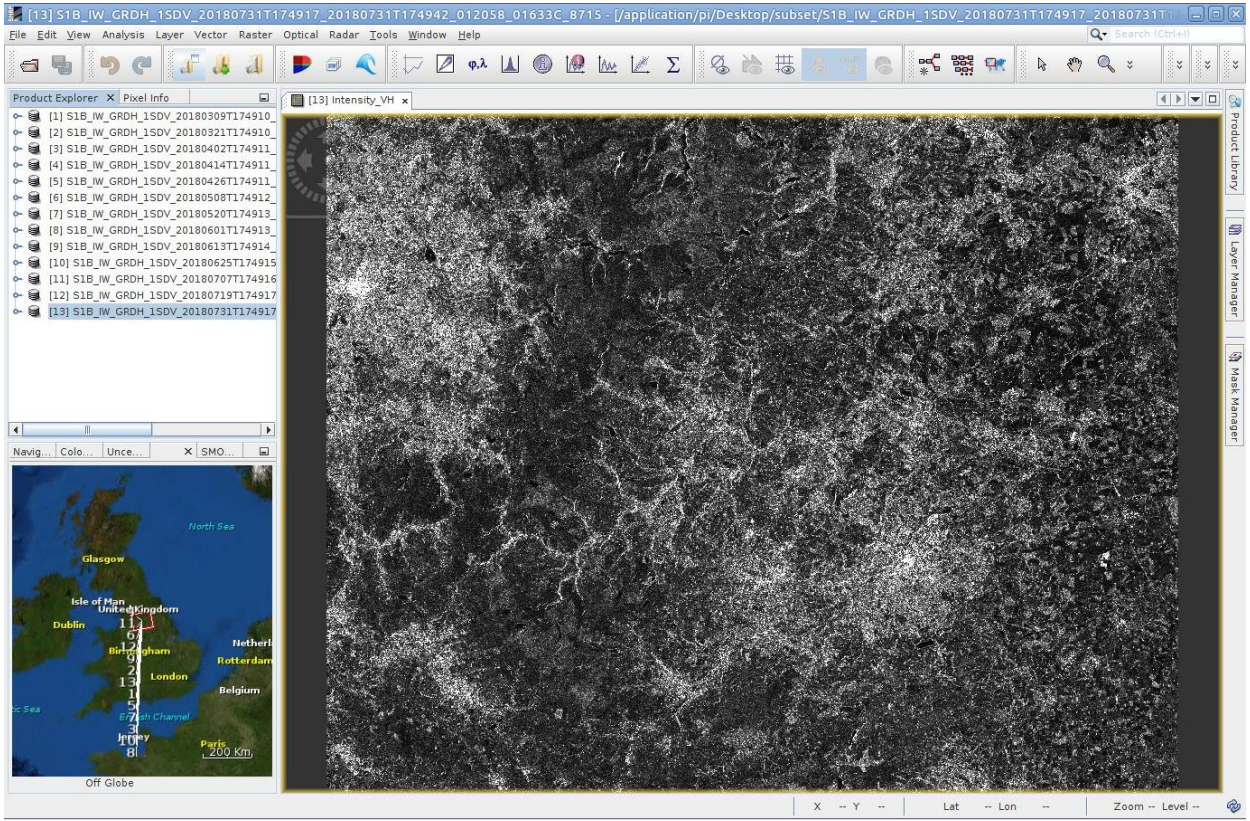
Adding data products

Spatial subset – batch processing





Data check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Search (Ctrl+I)
Product Explorer
Pixel Info
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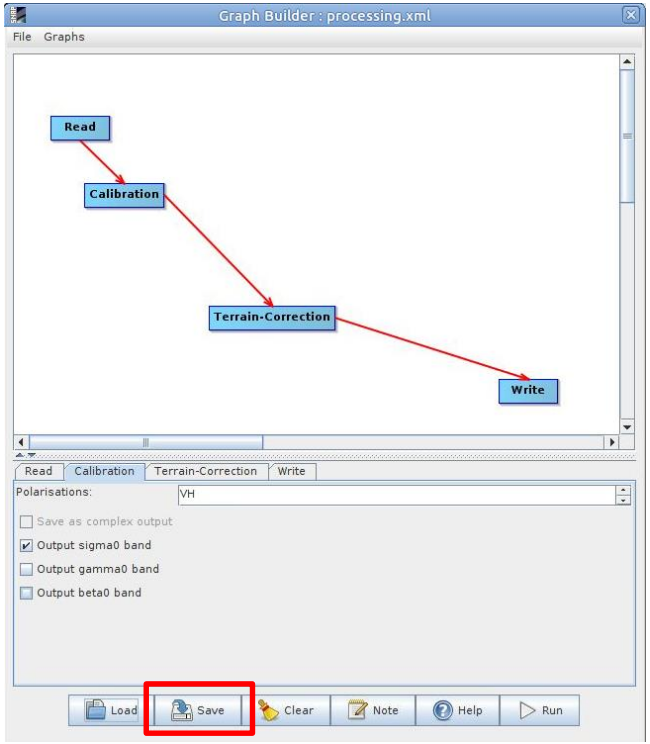
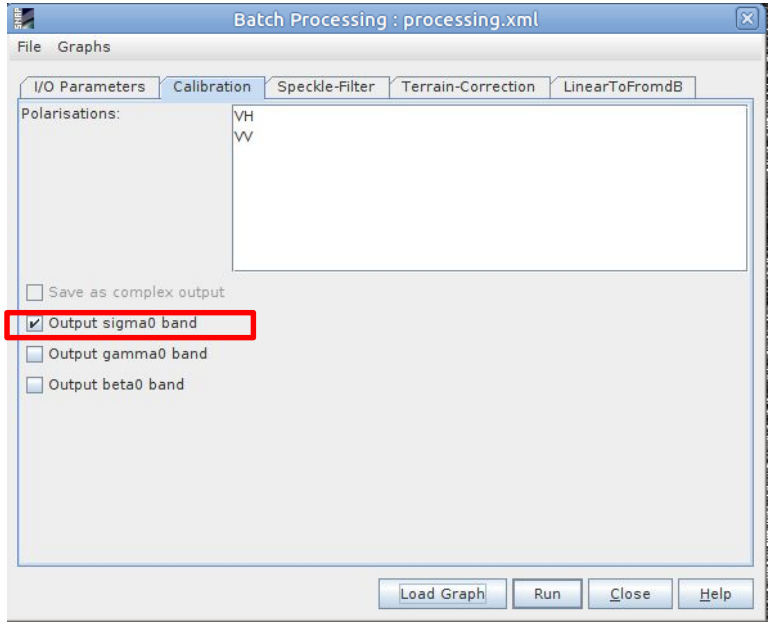
[13] Intensity_VH
Navig... Colo... Unce... SMO...
North Sea
Glasgow
Isle of Man
United Kingdom
Dublin
Netherl
Rotterdam
London
Belgium
Paris
200 Km
Off Globe
Product Library
Layer Manager
Mask Manager
X -- Y --
Lat -- Lon --
Zoom -- Level --

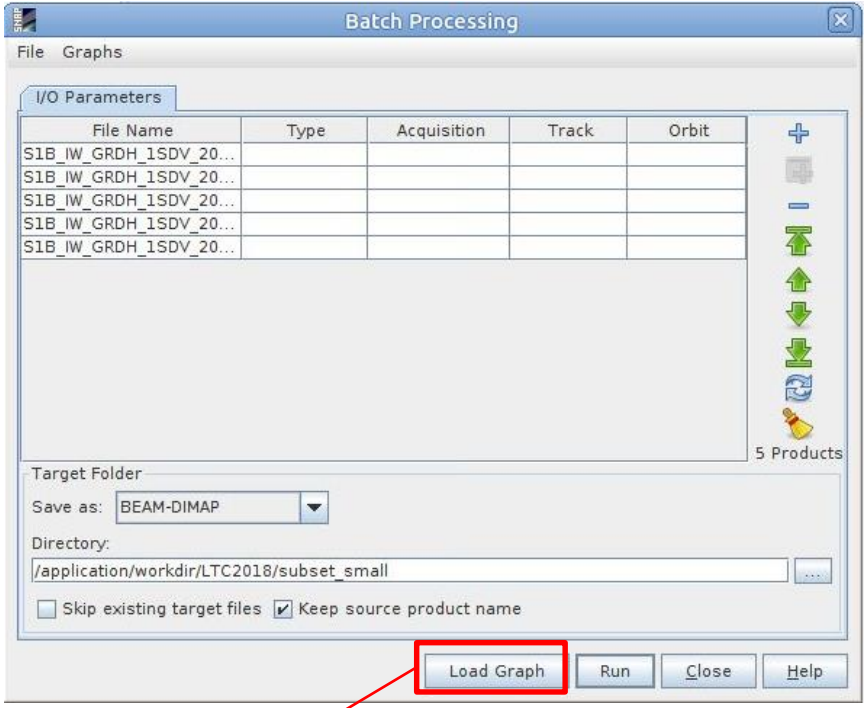
Automatic Processing Graph - Calibration

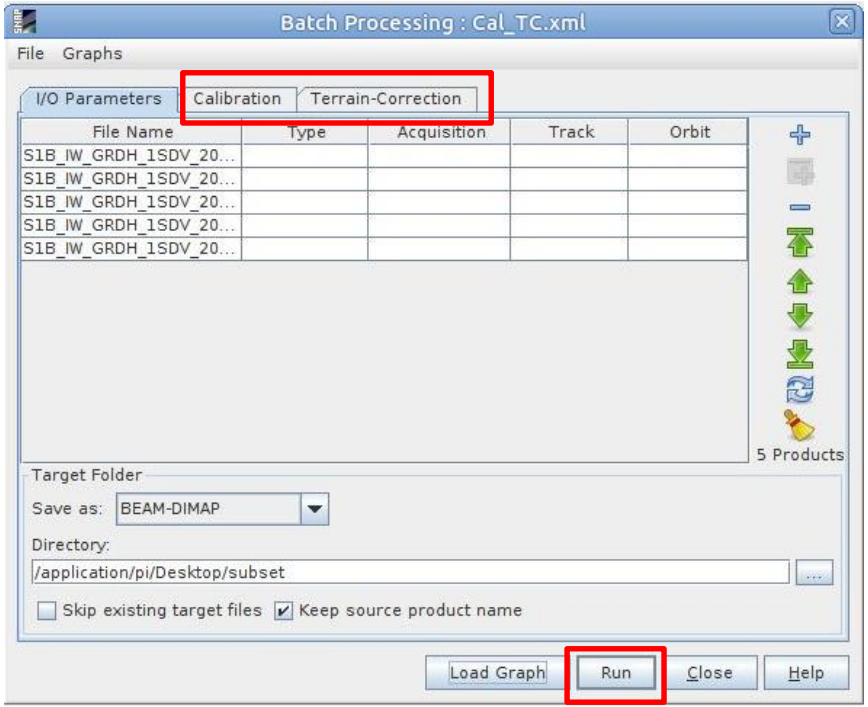




save as e.g. Cal_TC.xml

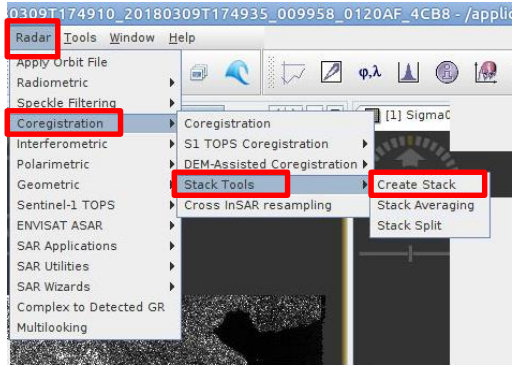
Spatial subset – batch processing

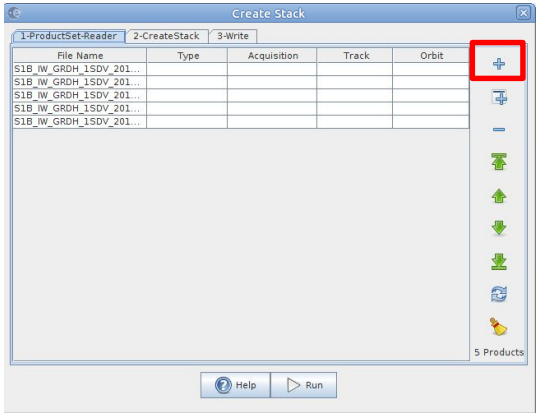


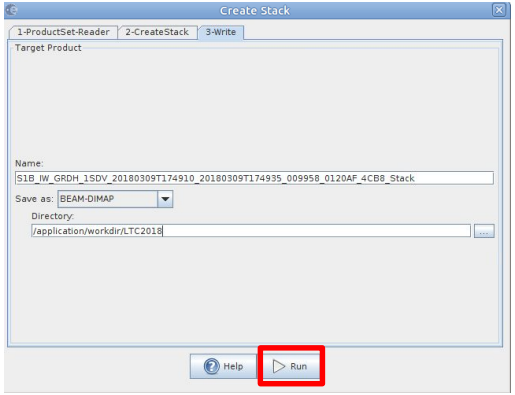


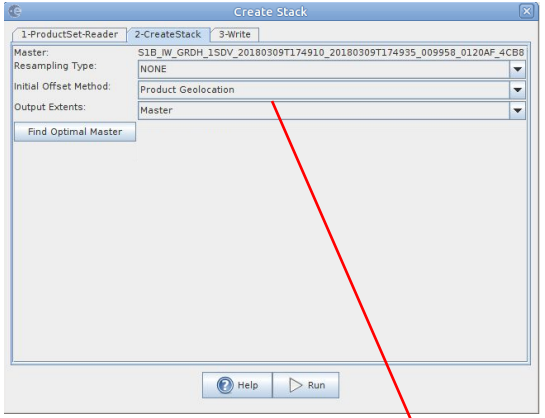
Open previously saved graph Cal_TC.xml

Creating multitemporal stack



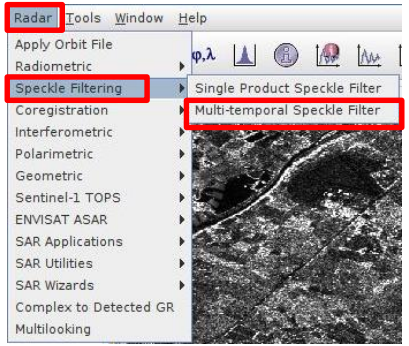


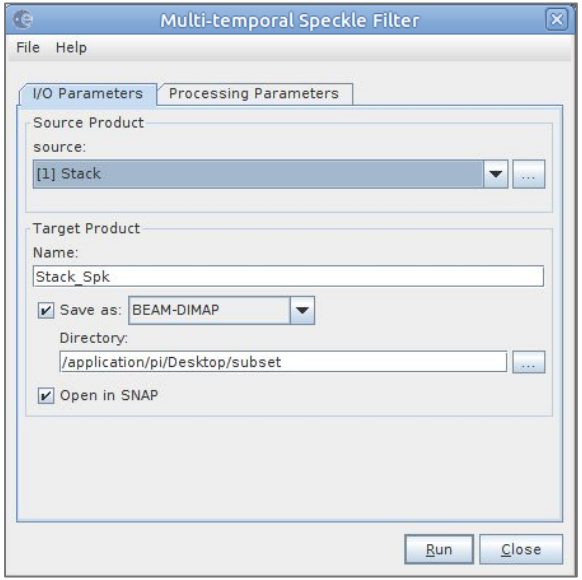


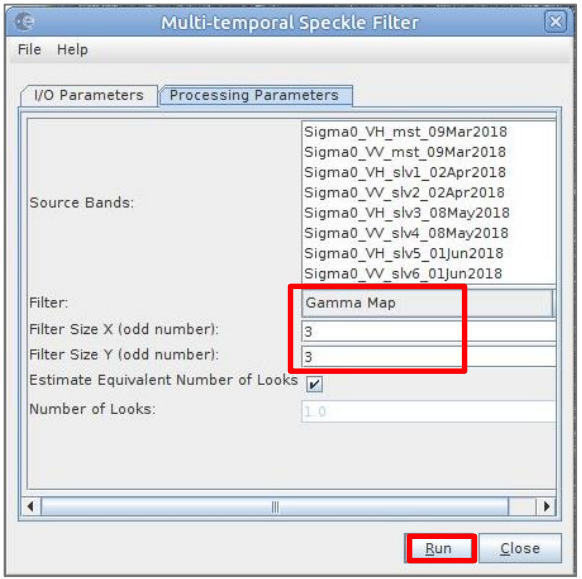


- *Product geolocation (if terrain corrected)*
- *Orbits (not terrain corrected)*

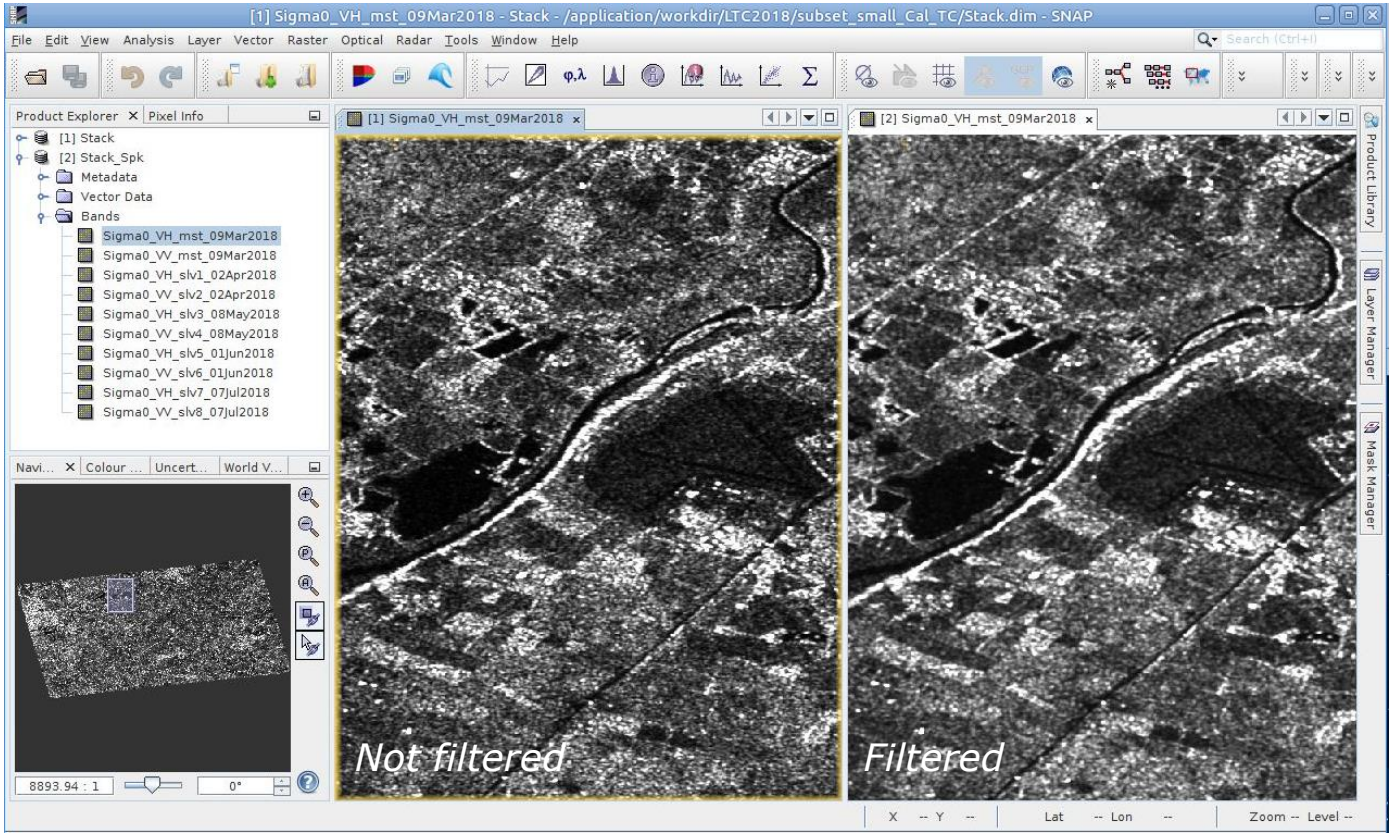
Multitemporal speckle filtering



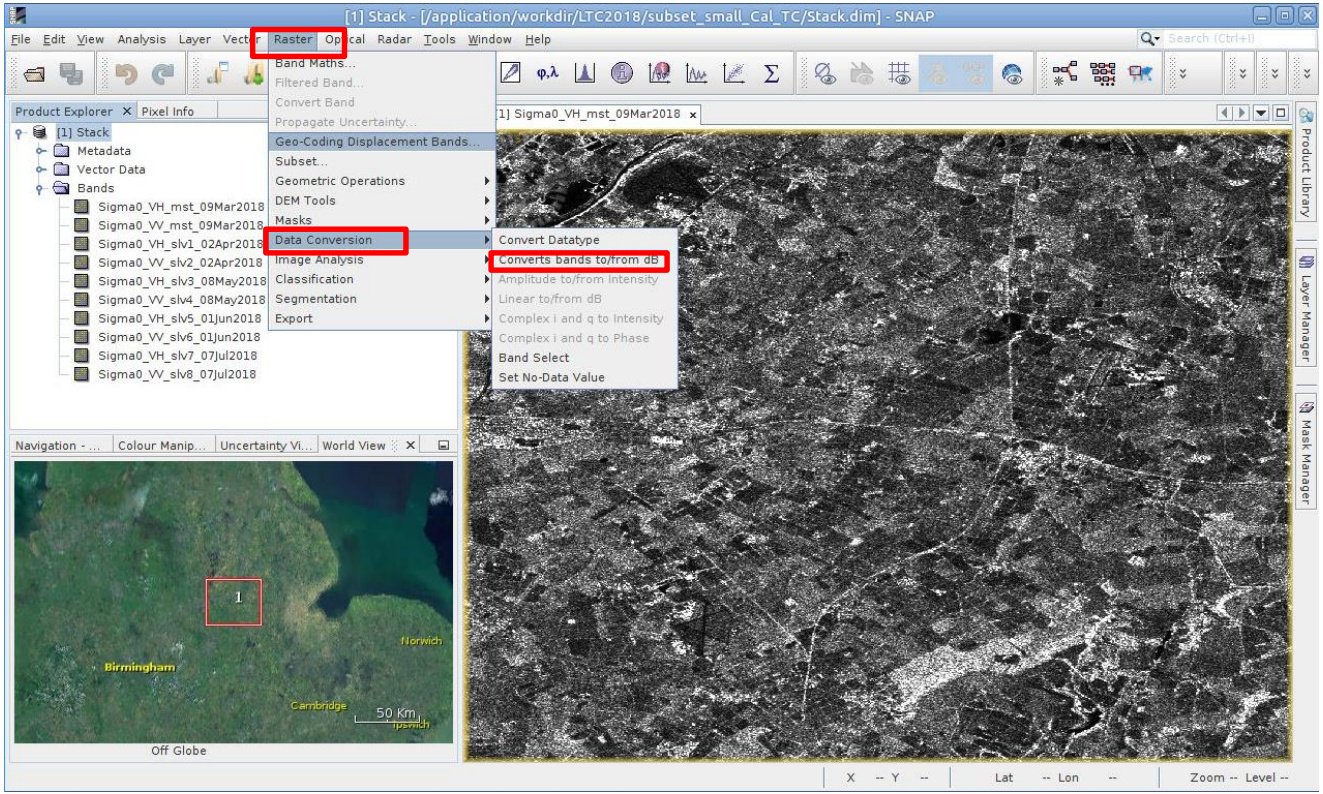




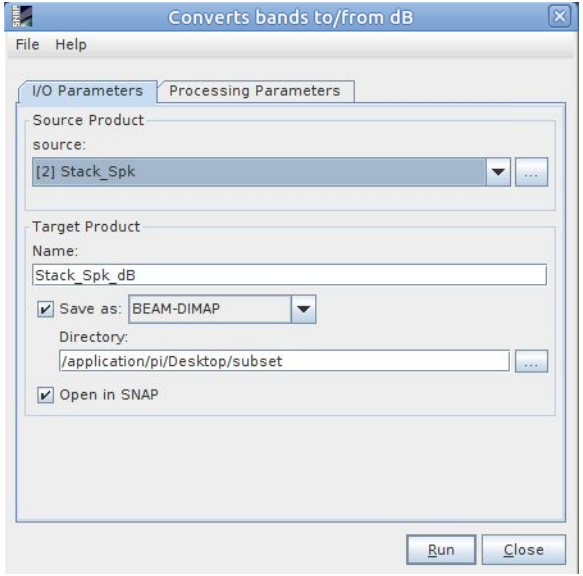
Multitemporal speckle filtering

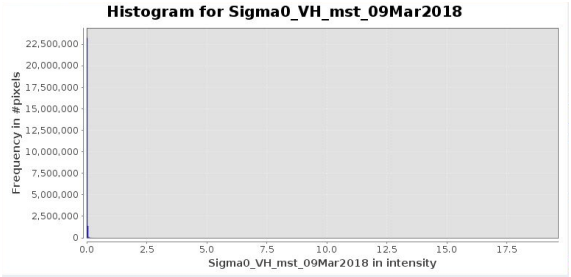


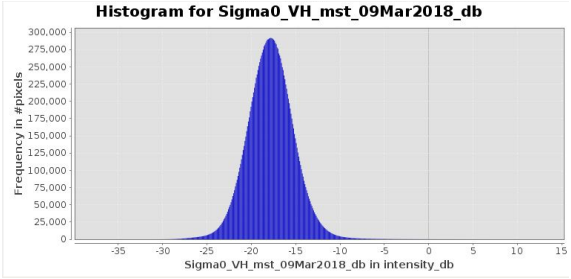
Conversion from linear to dB



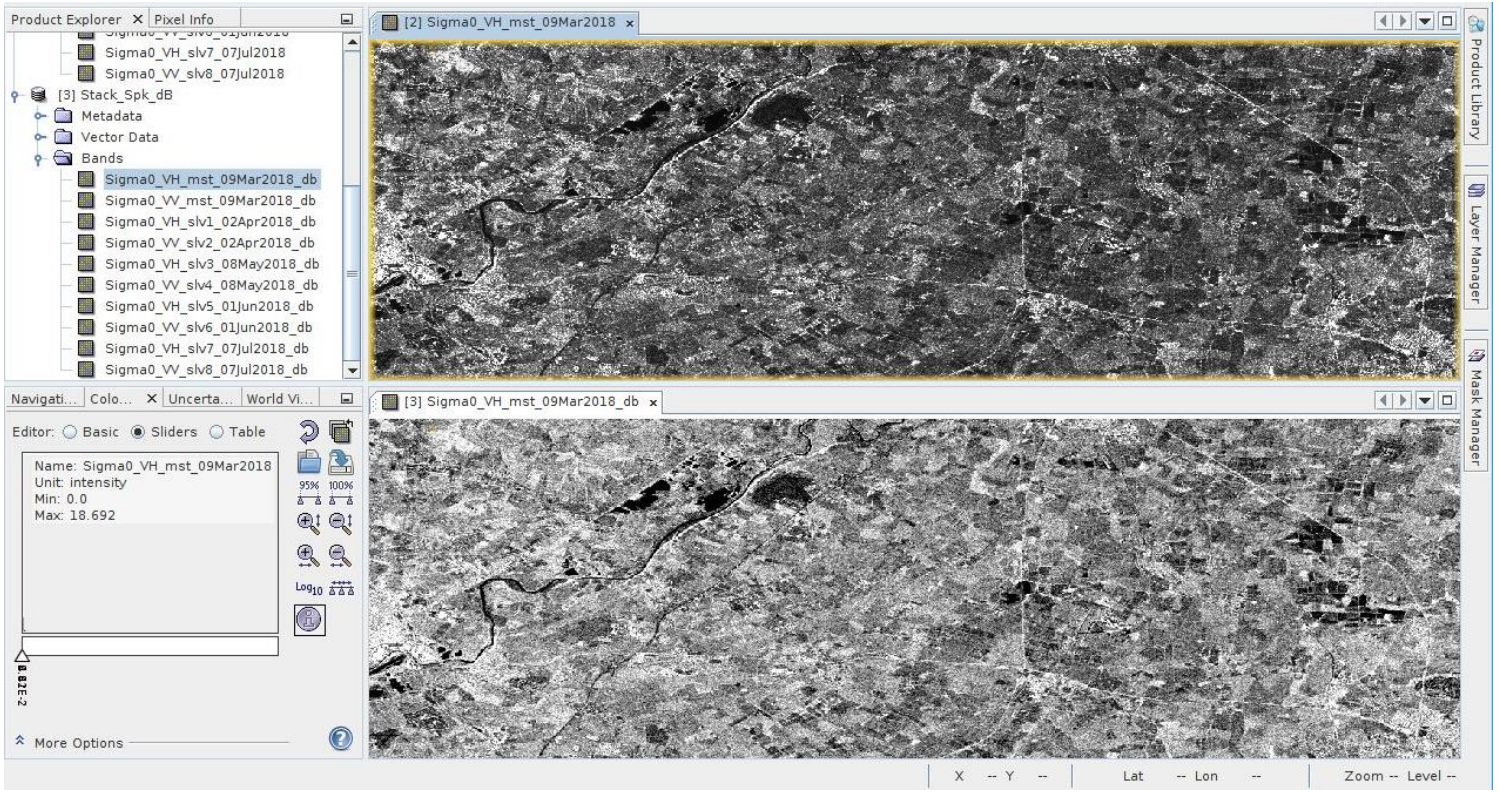
Conversion from linear to dB



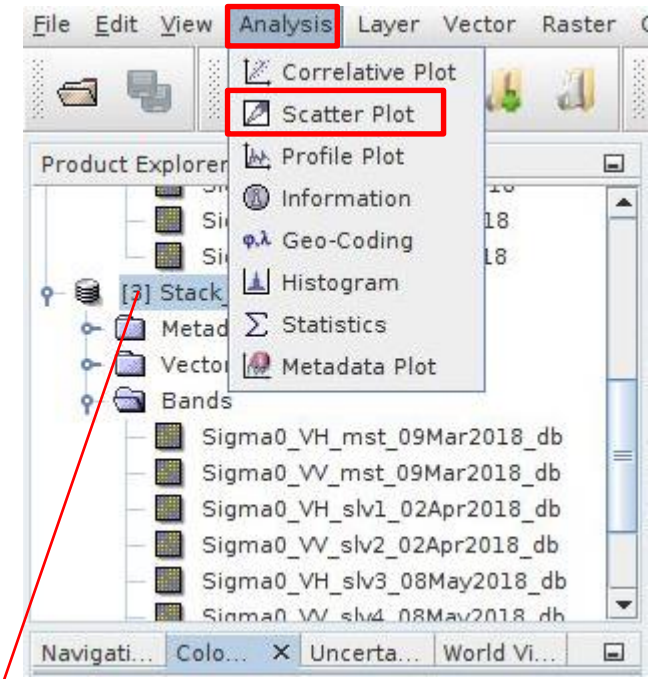




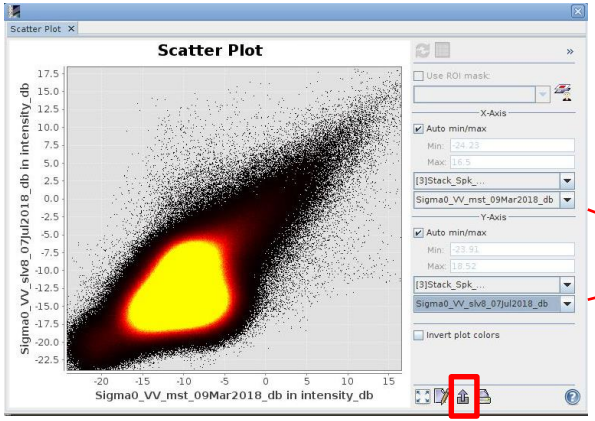
Linear vs dB comparison

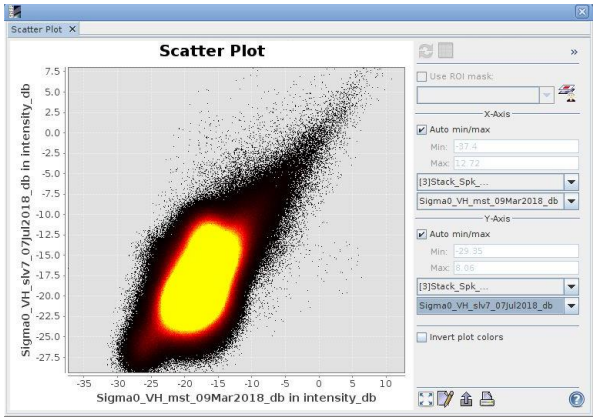


Scatterplots



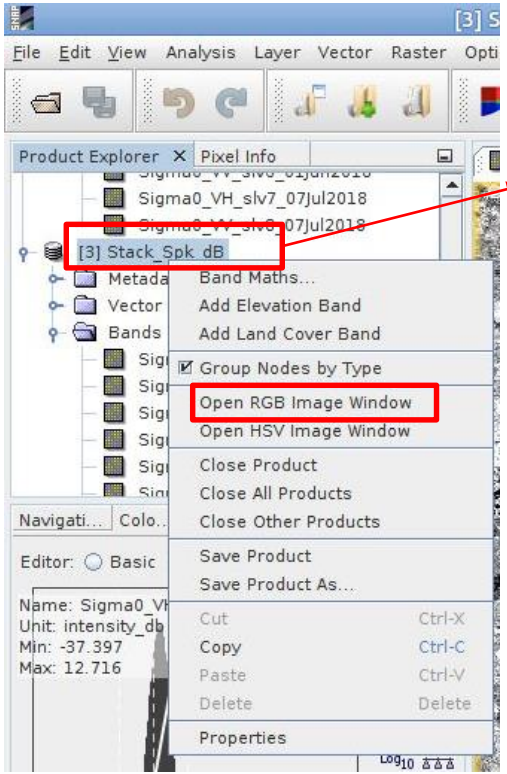
Select your data stack



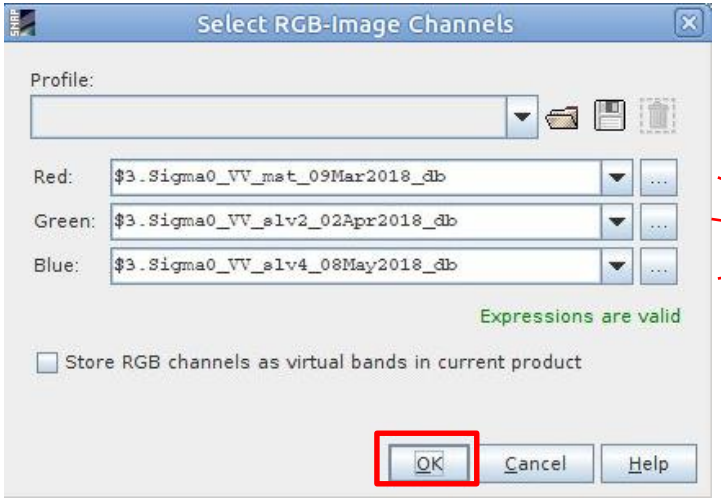


Select bands that you want to plot

RGB Composite

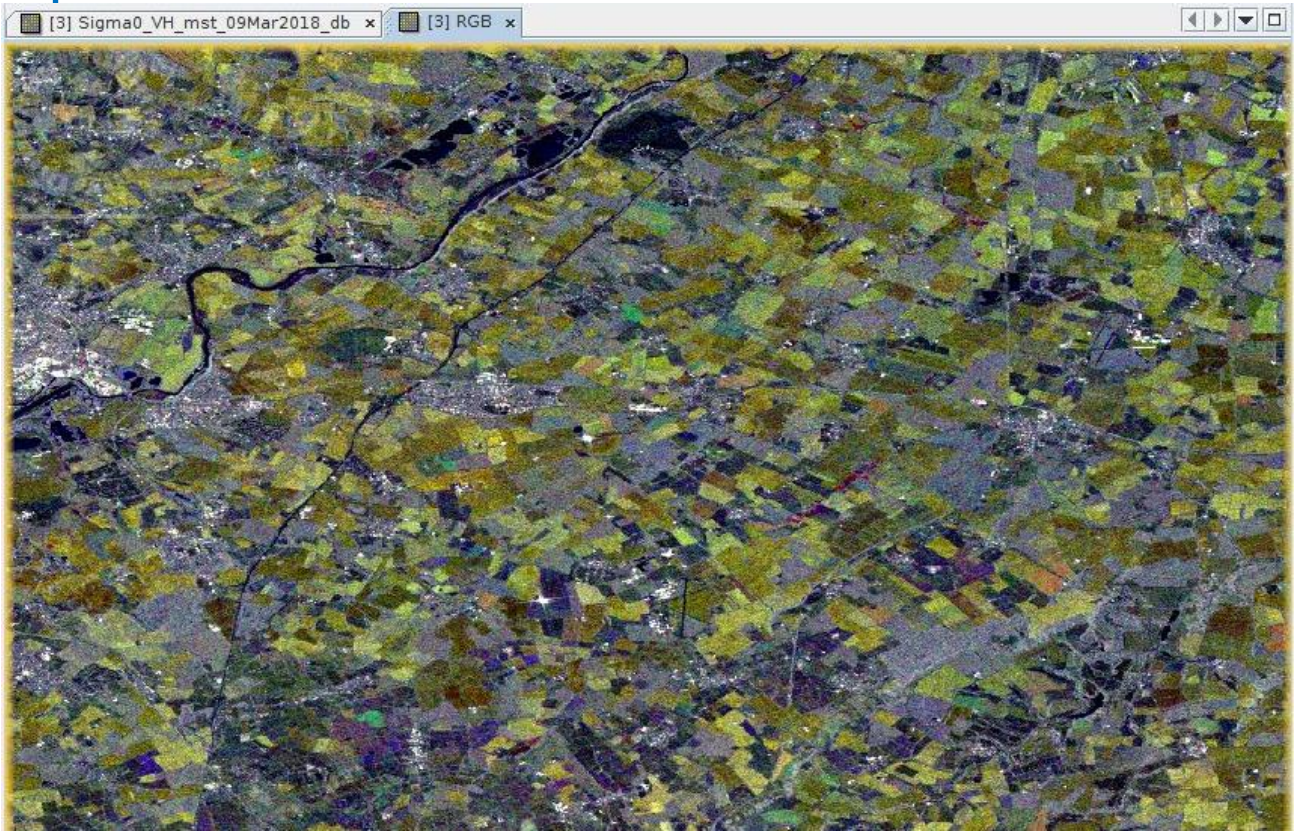


Right click on the product

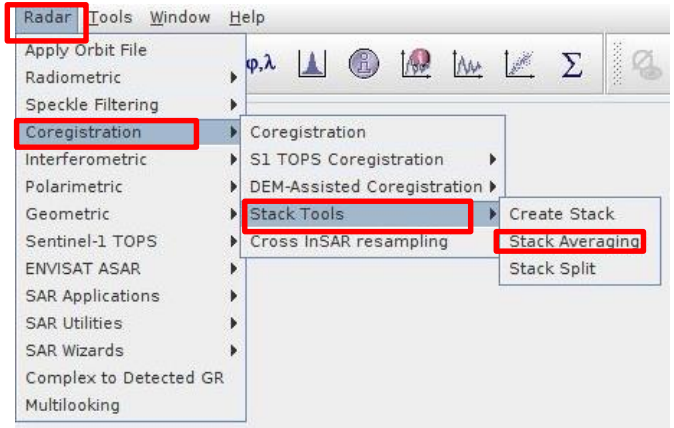


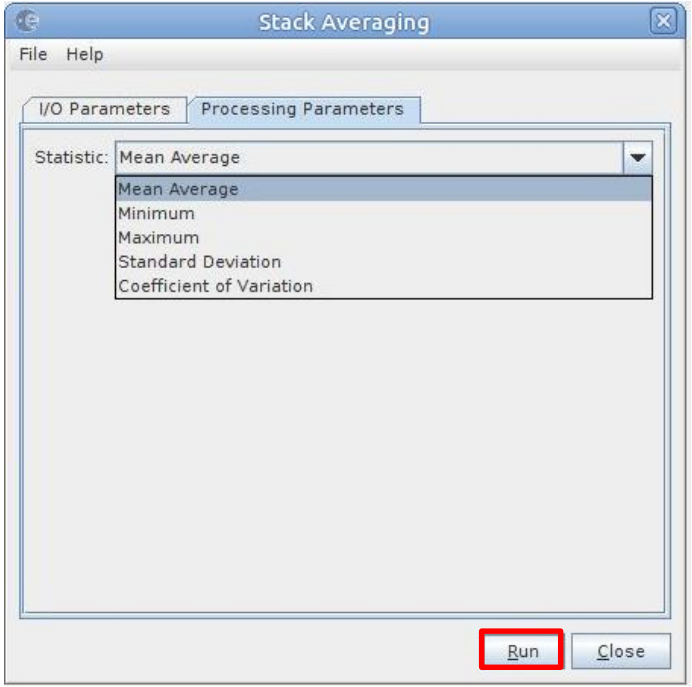
Band selection

RGB Composite

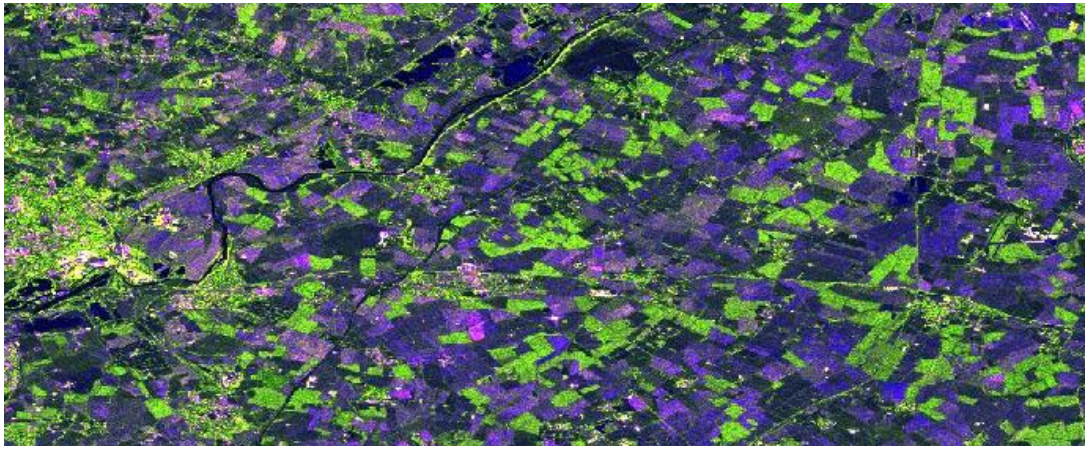


Stack averaging





Stack averaging – RGB Composite



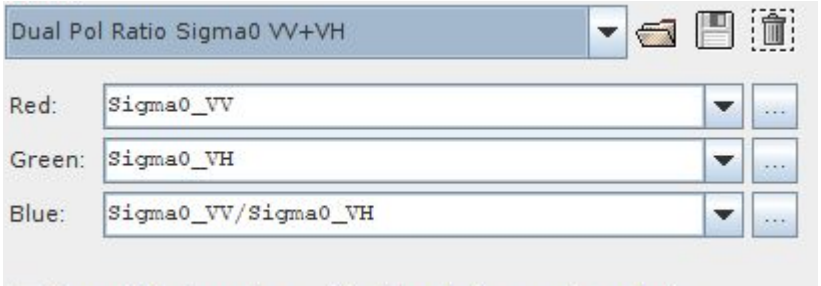
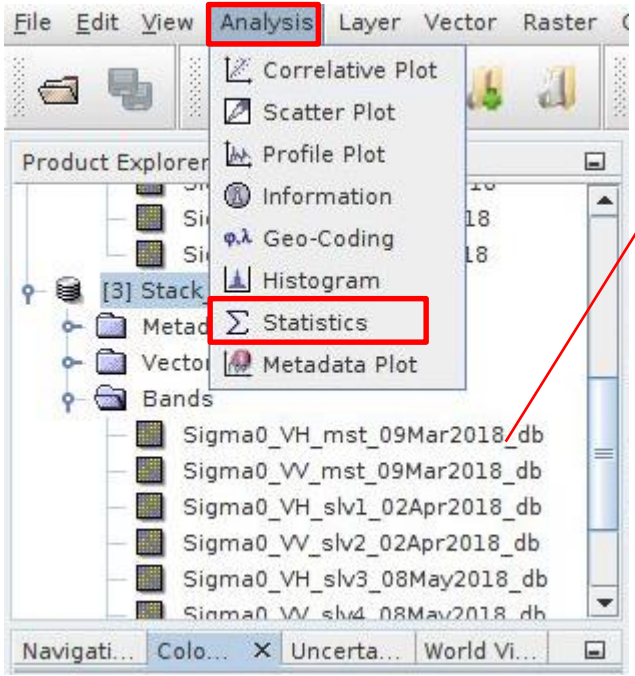
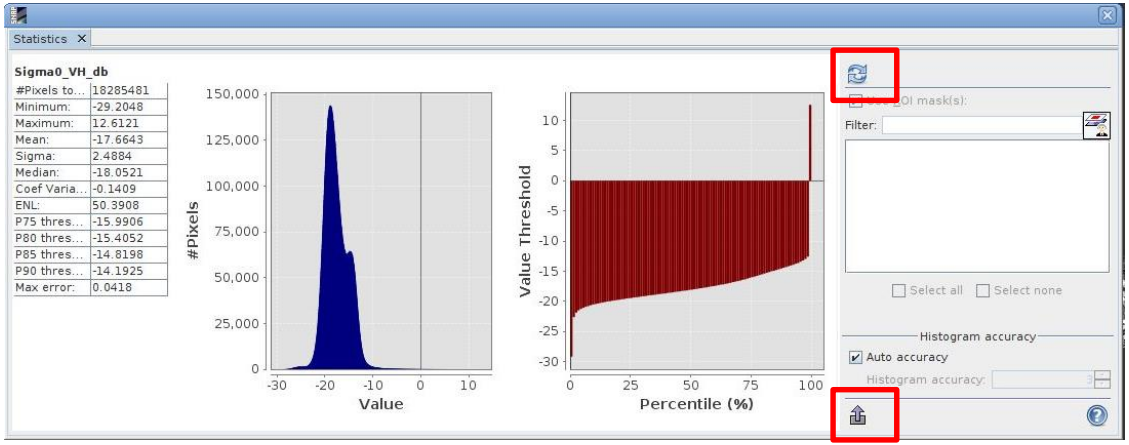


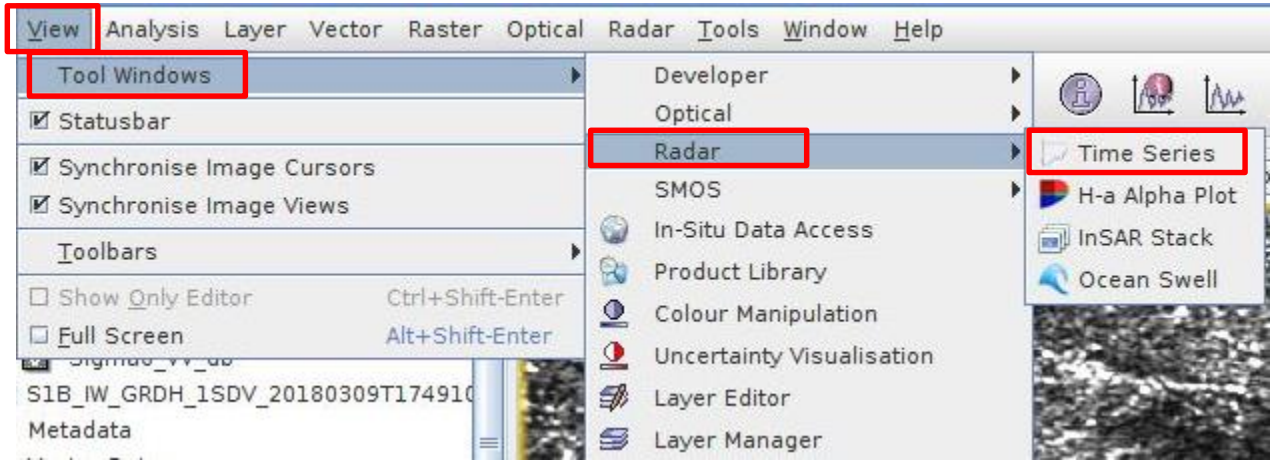
Image statistics

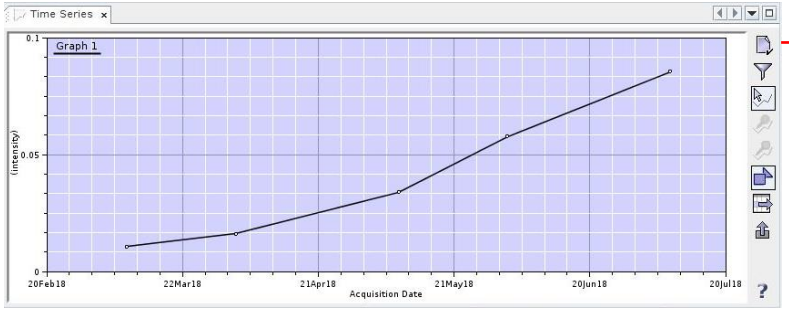


Choose your band



Time series analysis

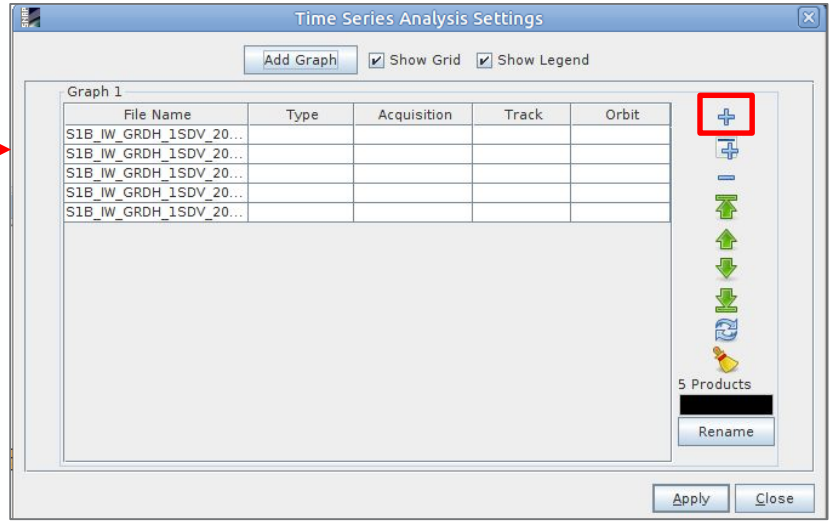


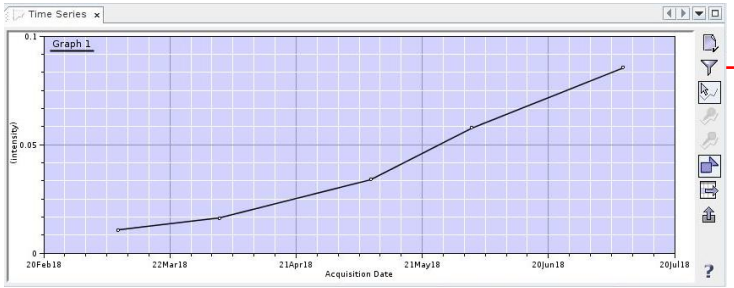


Add your data products

Time series analysis

Choose your processed data products (NOT a stack!)

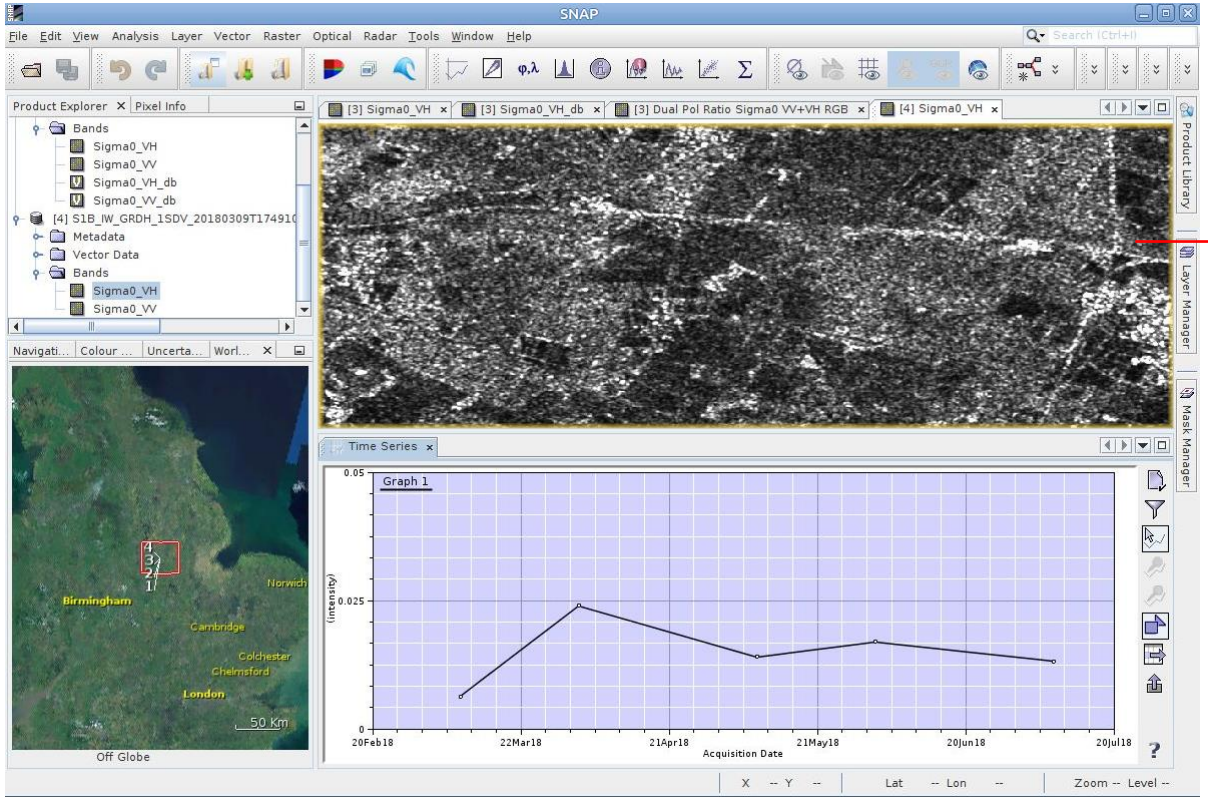




Bands filter

Show plot at cursor position

Time series analysis



One of the plottet bands has to be opened