Satellite Applications

Practical Session:

Combining Backscatter and coherence information from Sentinel-1

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ESA Summer School 2016
ESA-Esrin, Frascati, Rome

Innovate UK
Technology Strategy Board

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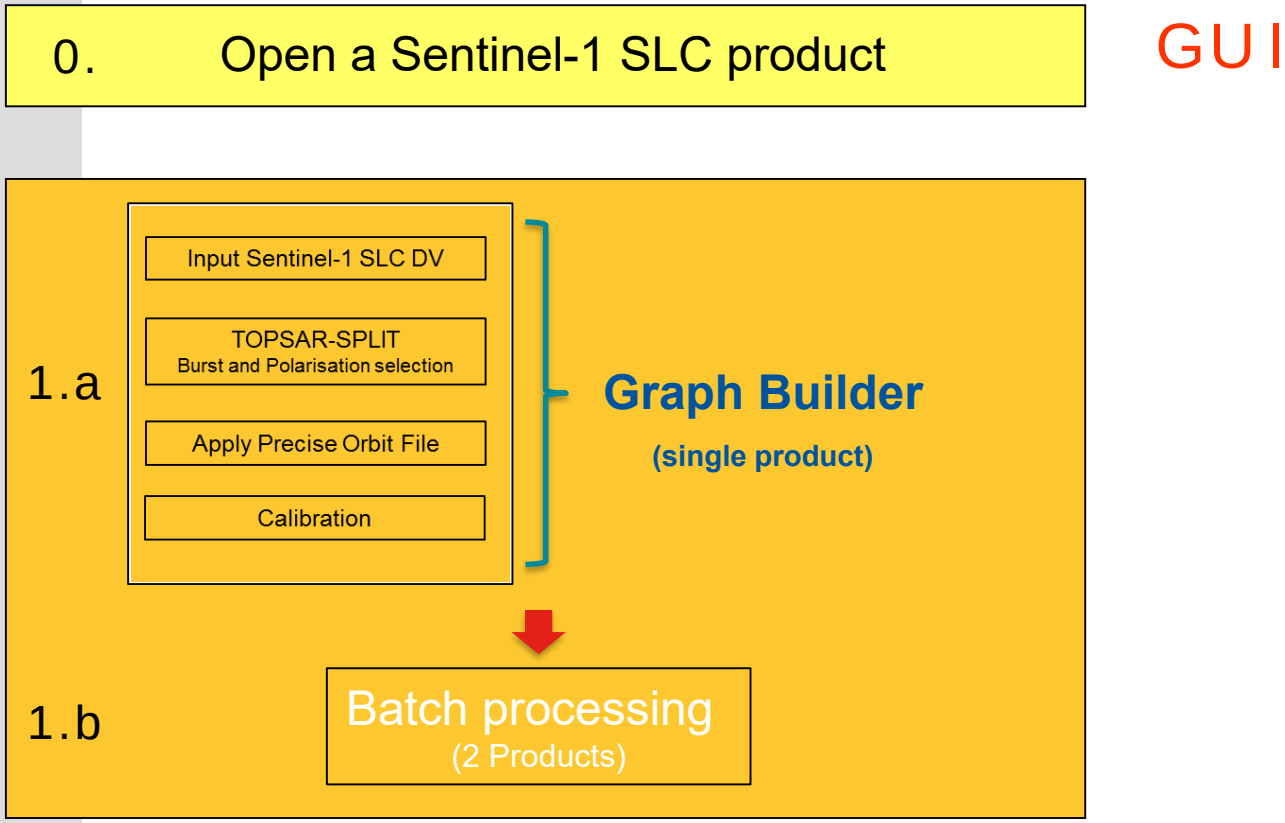
Objective

To show how processing a pair (12 days a part) of Sentinel-1 TOPS SLC DV images to derive and combine backscatter and coherence information.

In particular:

- 4 bursts with VV polarisation only will be exploited
- Exercise will use Graph Builder, Batch Processing, GUI
- SNAP version 4 used

Processing Steps



Classification: CATAPULT OPEN

Processing Steps

2. TOPSAR Coregistration — **Graph Builder**

3. Coherence and backscatter stack generation — **Graph Builder**

4. Multilooking
   Subset
   Terrain Correction
   — **GUI**

5. Linear to db
   Ratio 2May/12 May
   RGB Backscatters and ratio
   RGB Coherence and Backscatters
   Export to Google Earth
   — **GUI**
   (RGB Backscatters and ratio, RGB Coherence and Backscatters: Analysis)

Classification: CATAPULT OPEN

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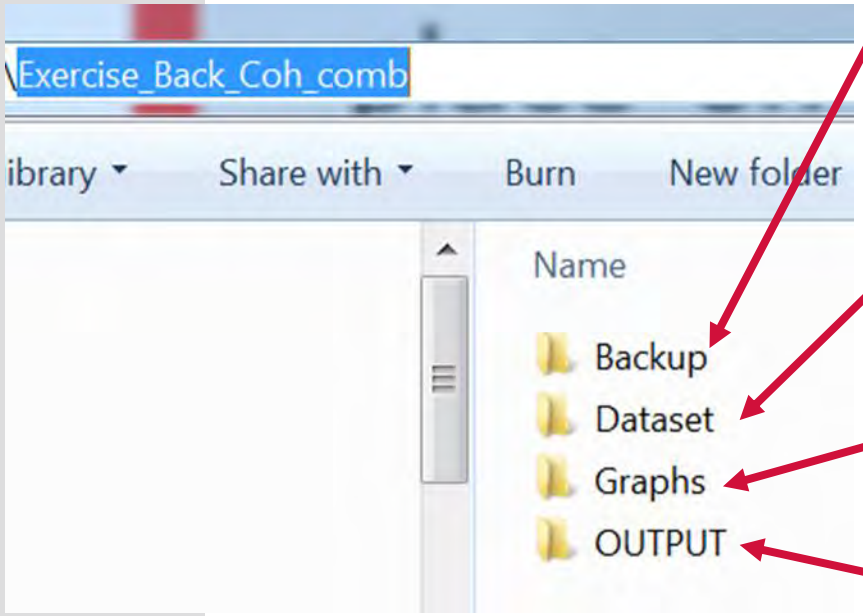
Exercise folders



BACKUP folder with results and graphs

Dataset folder containing the input for the exercise

Folder where save the graphs

The OUTPUT of the exercise will be stored here

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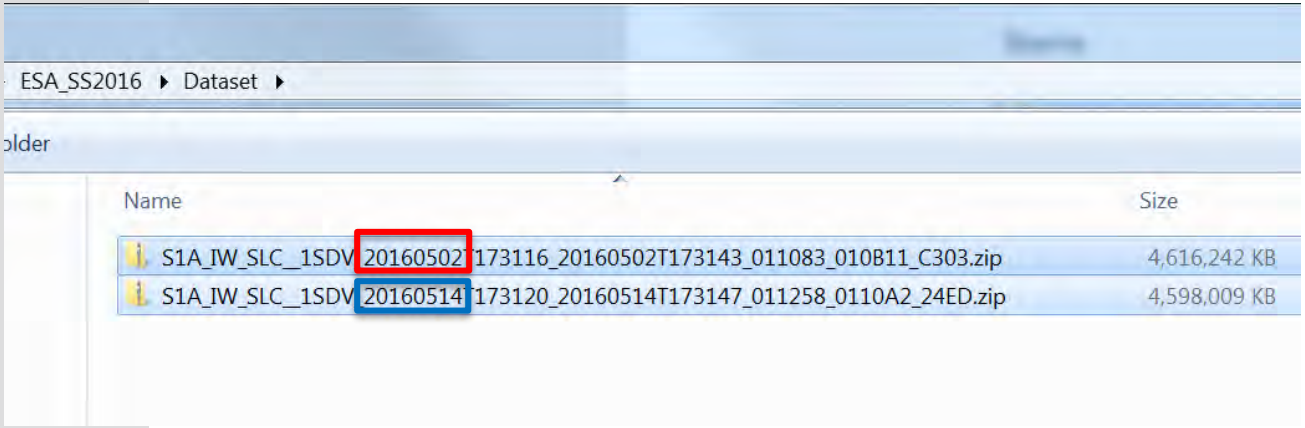
Dataset



Product type: IW_SLC_1SDV

Acquisition mode: Interferometric wide swath
Product type: SLC
Polarisation: VV and VH
Orbit: Ascending

Location: Switzerland/France

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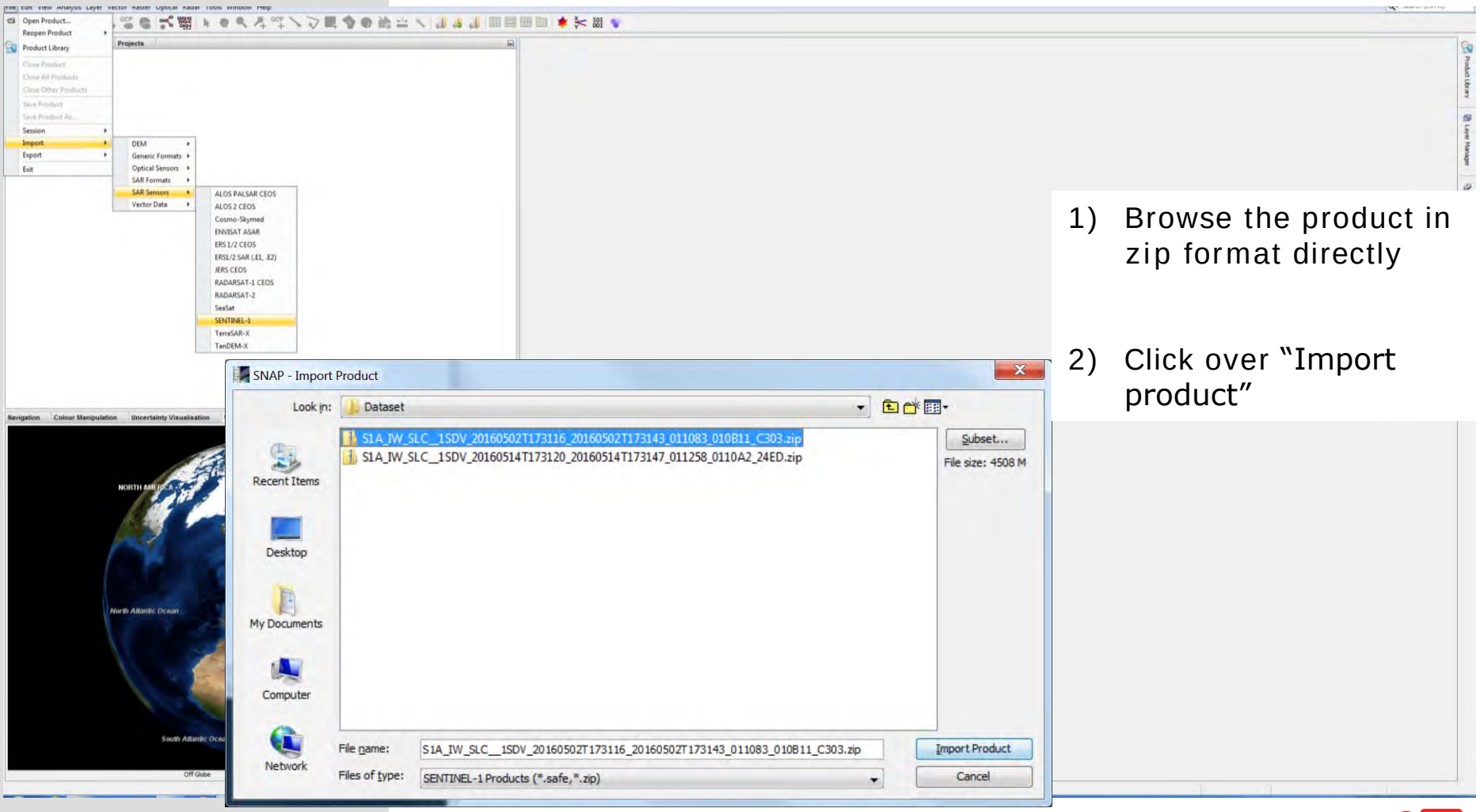
Step 0: Open product (02/05/2016)



1) Browse the product in zip format directly

2) Click over "Import product"

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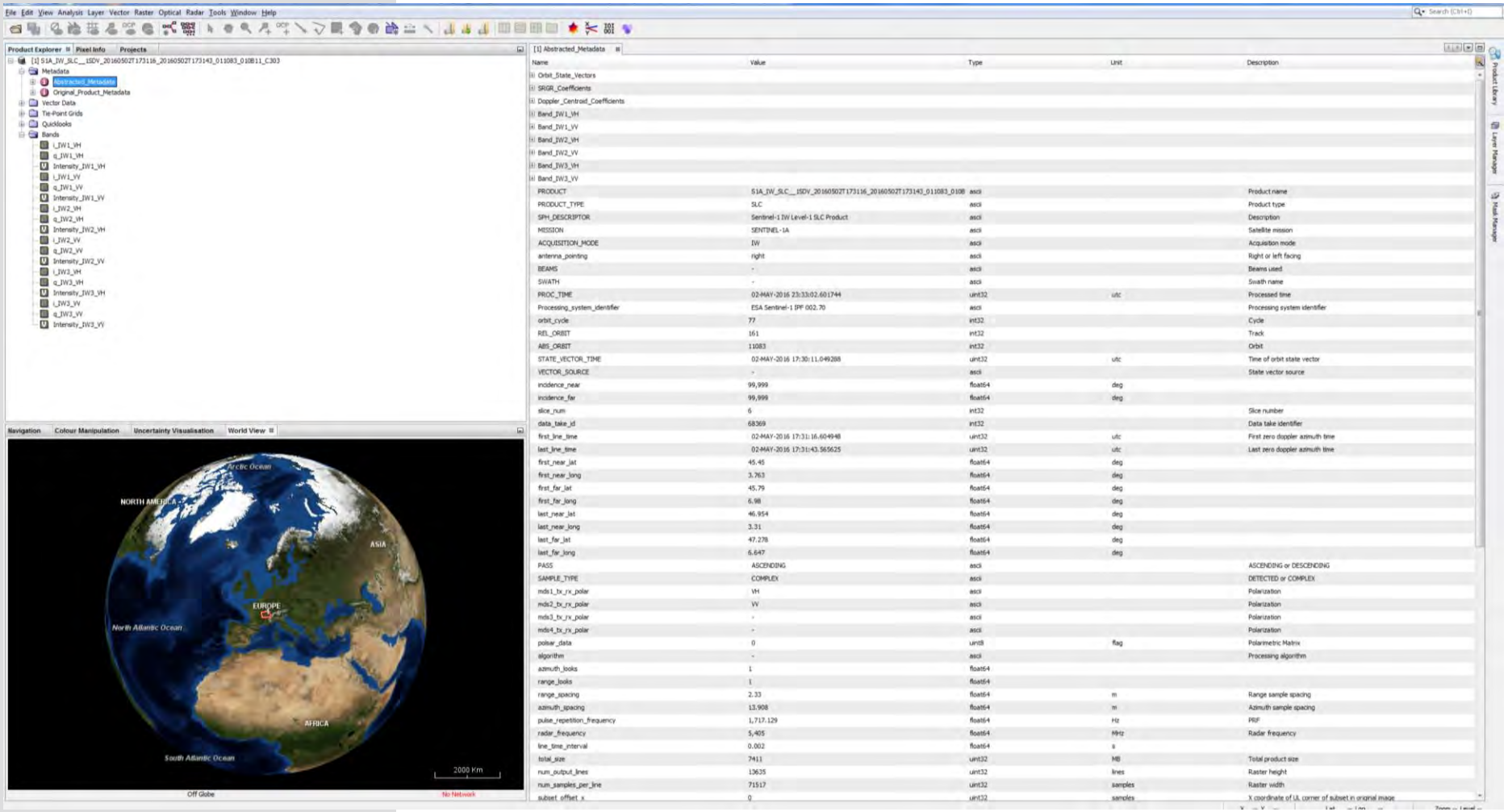
Inspecting the abstracted metadata



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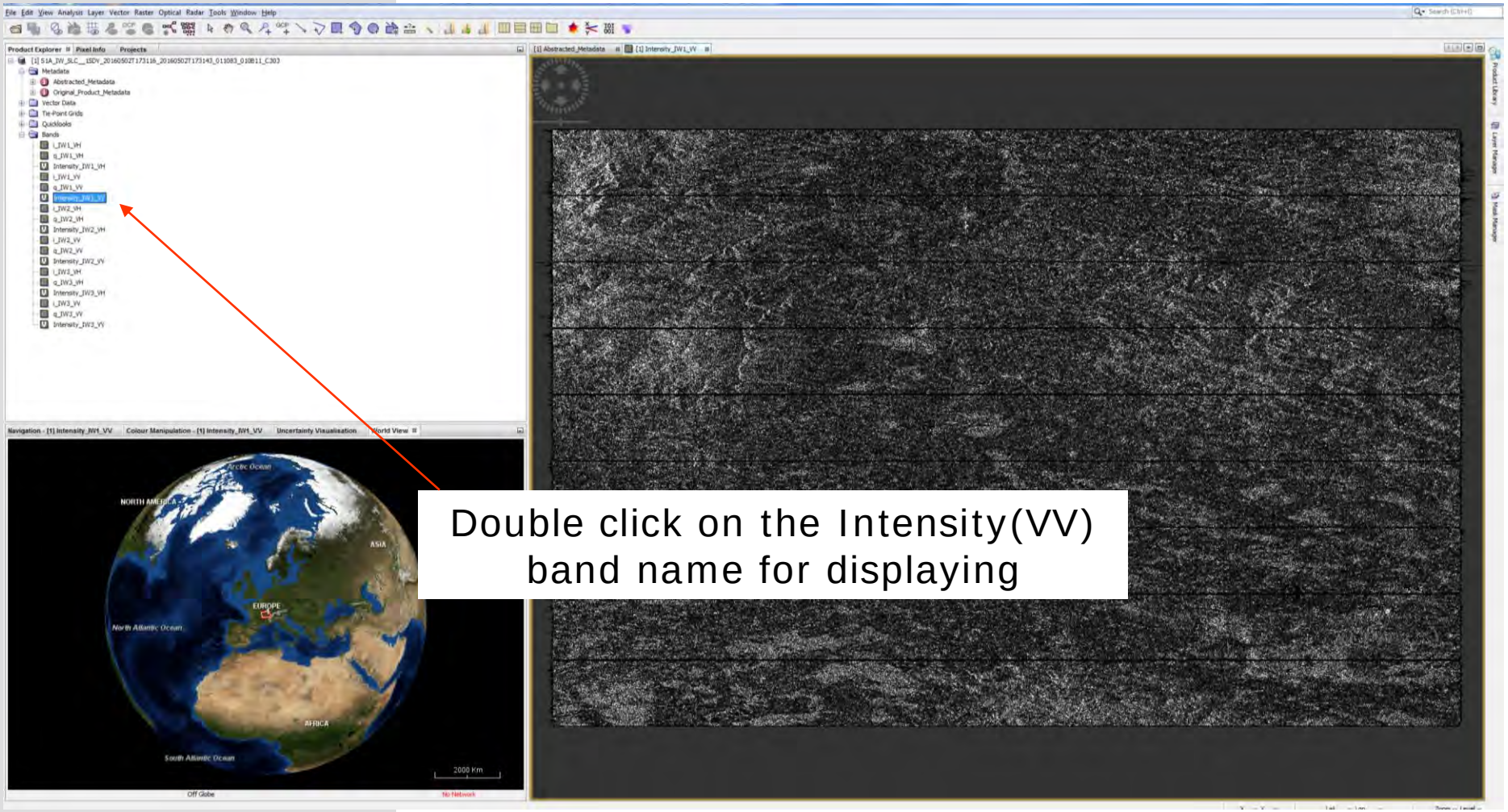
Display a band (Intensity VV)



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Step 1.a

Input Sentinel-1 SLC DV

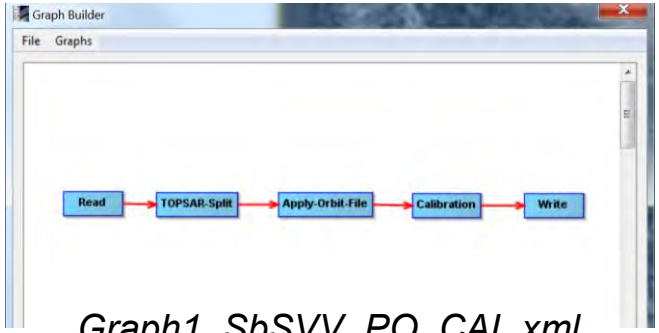
TOPSAR-SPLIT
Burst selection (2-5)
Polarisation selection (VV)

Apply Precise Orbit File
Sentinel Precise Orbit (POEORB)

Calibration (i, q)

Graph Builder

(single product)



Graph1_SbSVV_PO_CAL.xml

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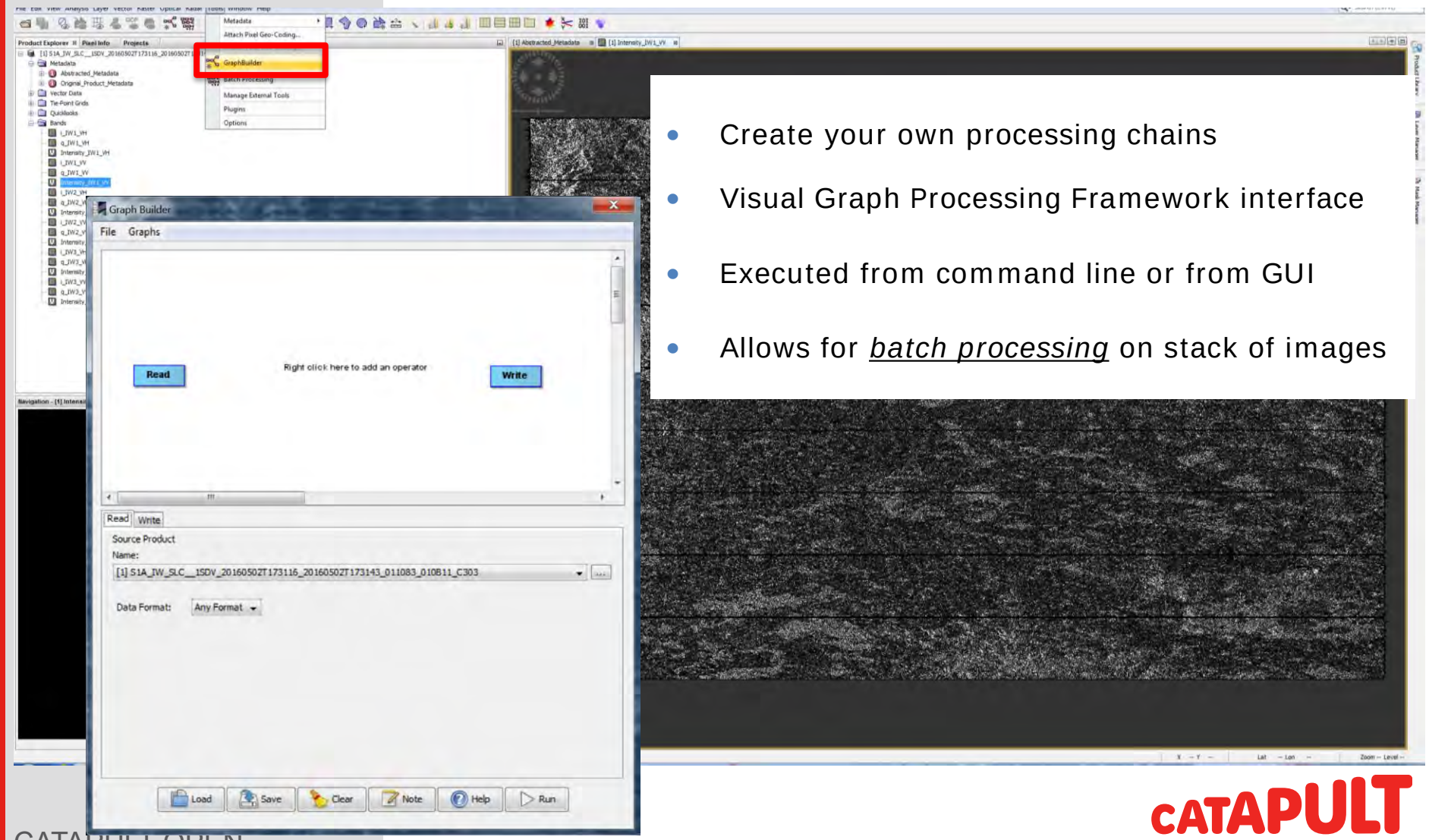
The GRAPH BUILDER



- Create your own processing chains
- Visual Graph Processing Framework interface
- Executed from command line or from GUI
- Allows for *batch processing* on stack of images

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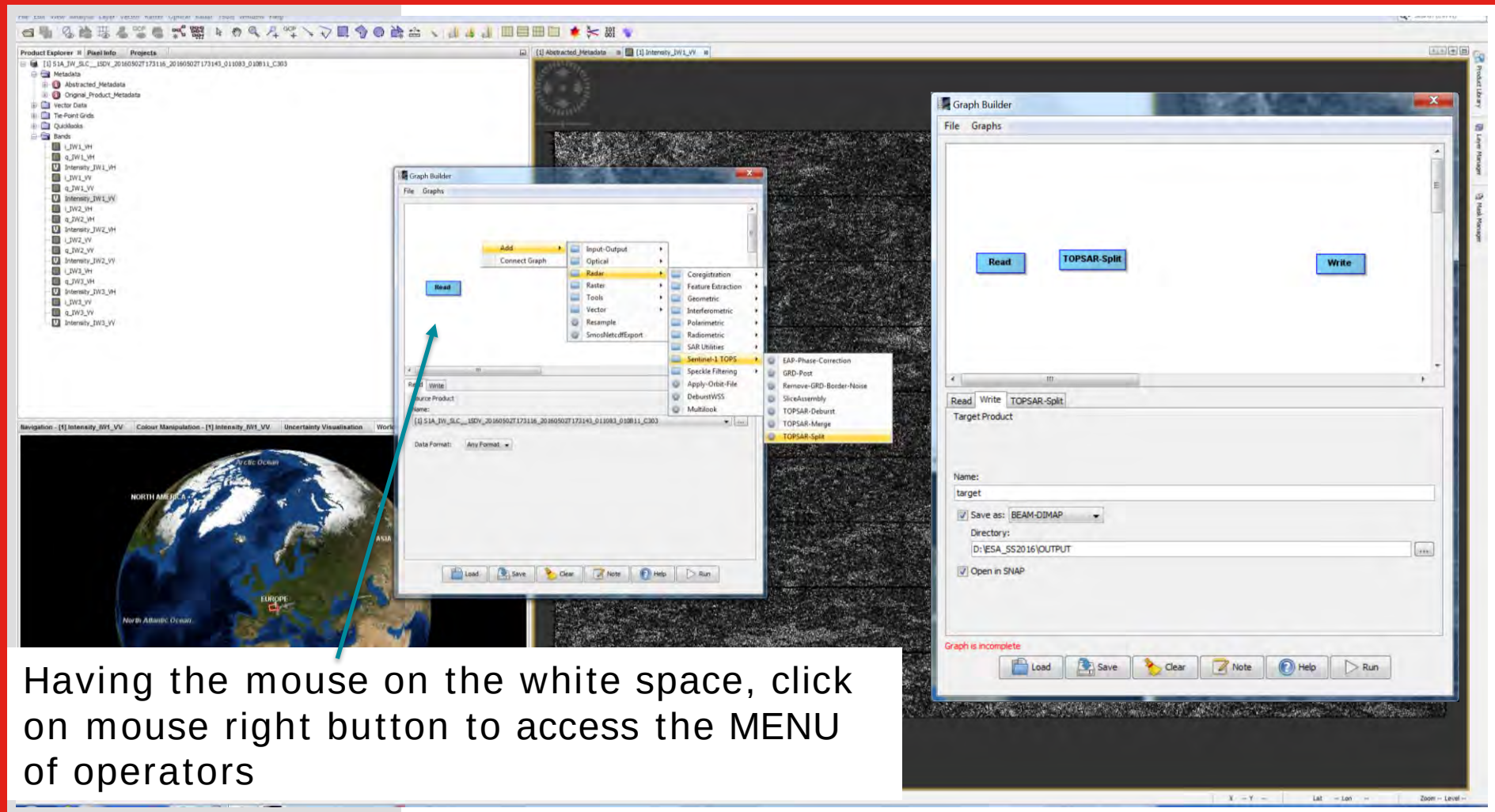
1.a - Buiding the chain → “TOPSAR-Split” operator



Having the mouse on the white space, click on mouse right button to access the MENU of operators

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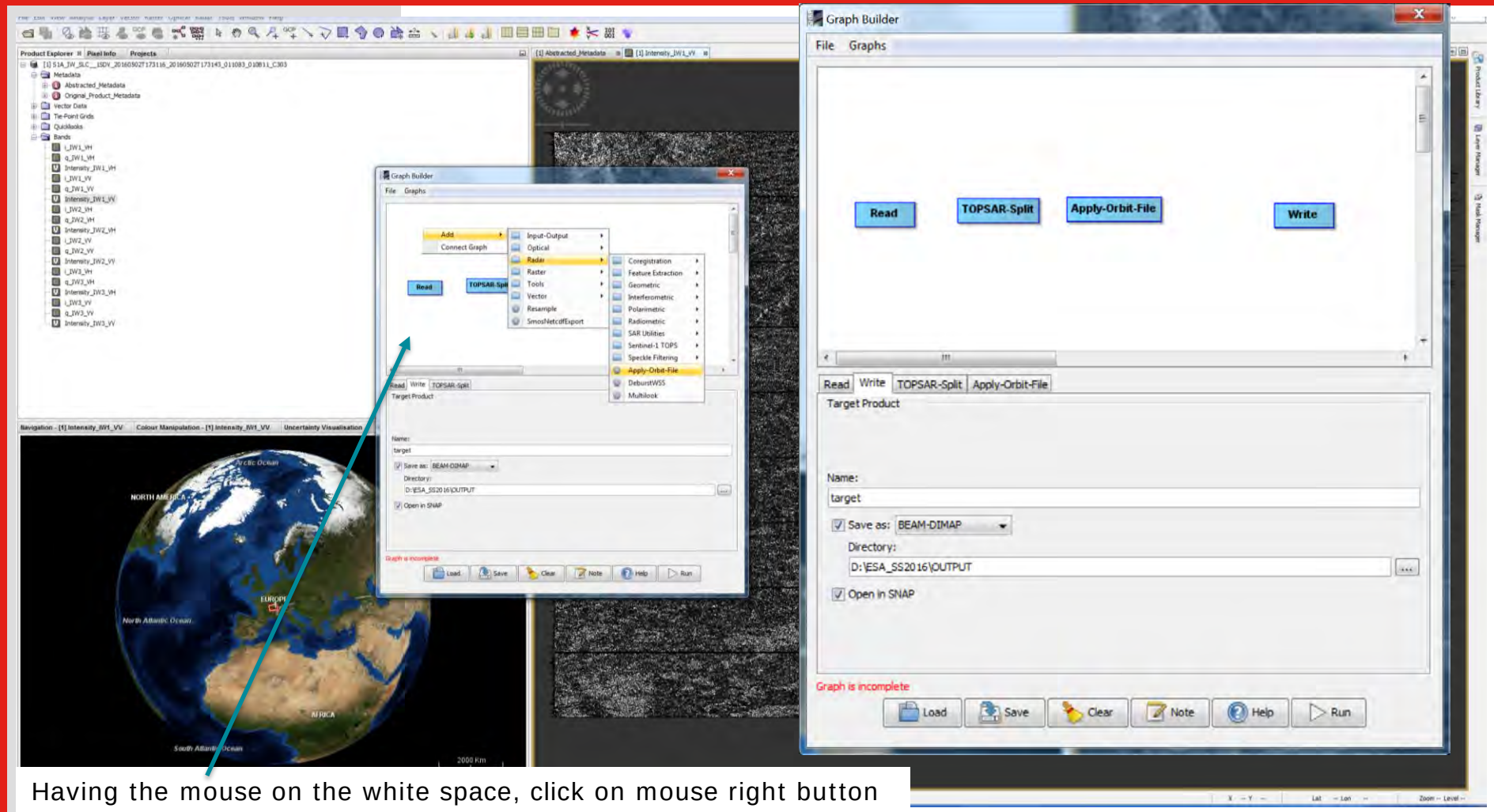
1.a - Buiding the chain → “Apply Orbit File” operator



Having the mouse on the white space, click on mouse right button to access the MENU of operators

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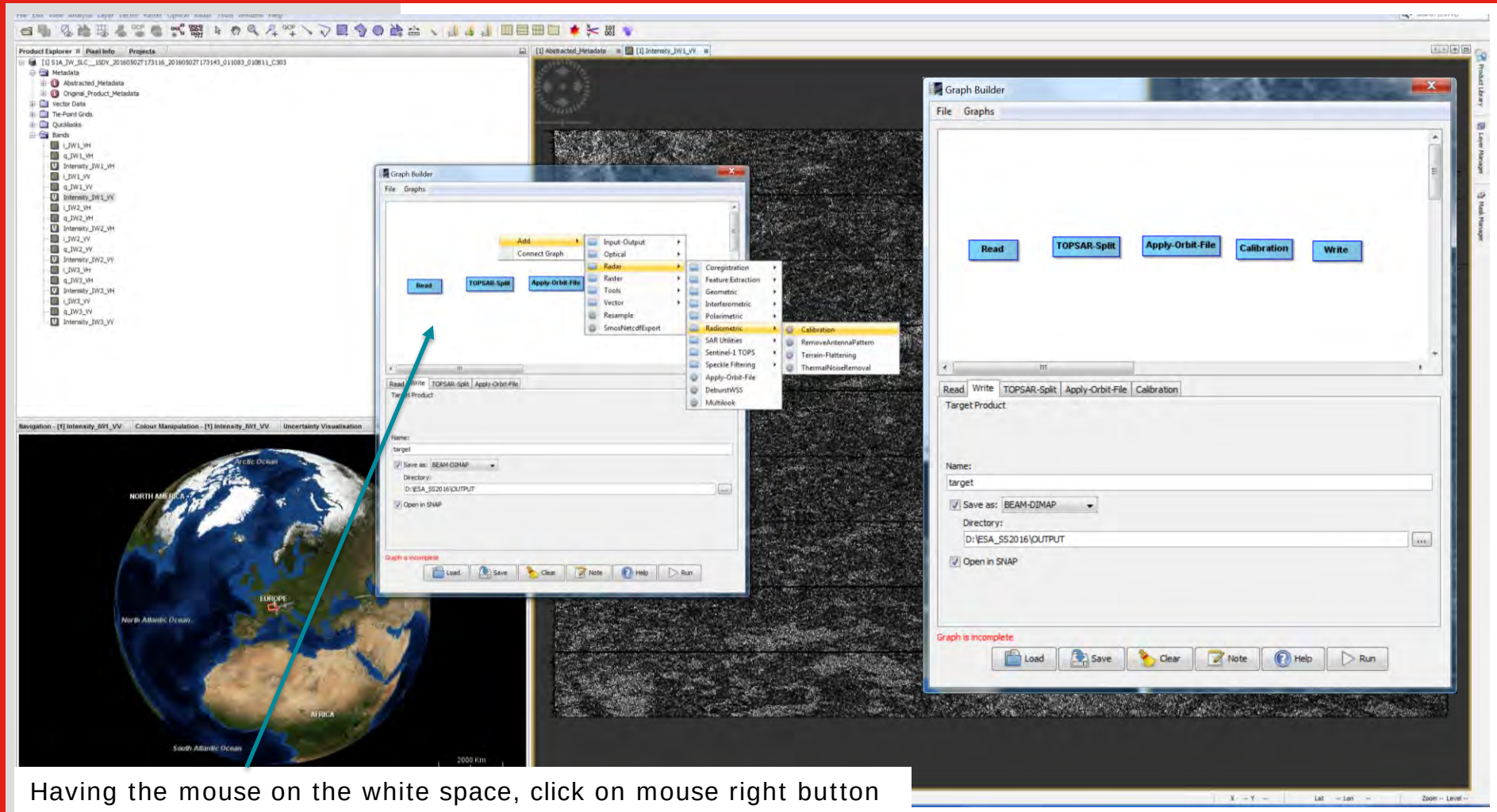
1.a - Buiding the chain → “Calibration” operator



Having the mouse on the white space, click on mouse right button to access the MENU of operators

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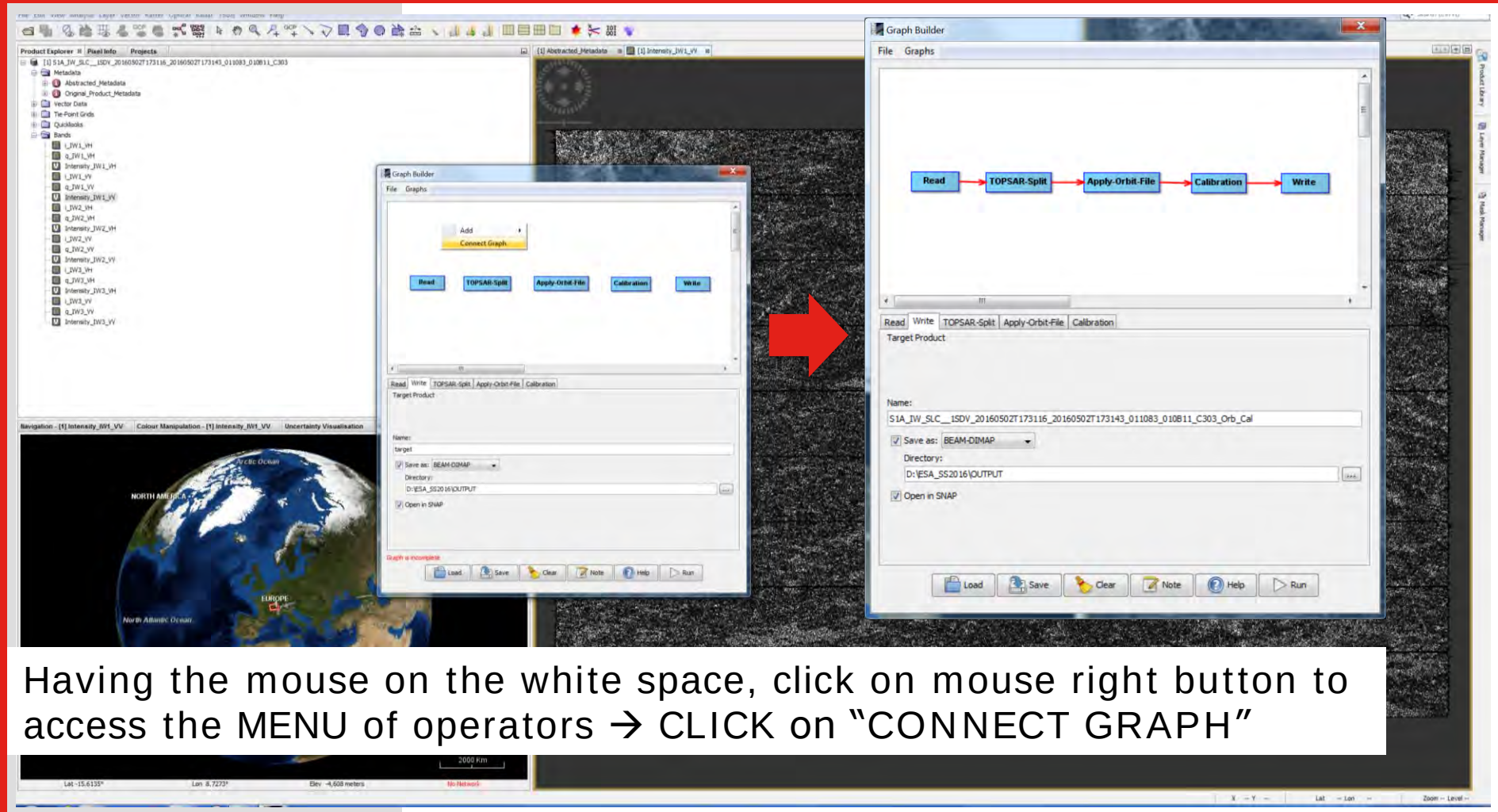
1.a - GB: Connecting the blocks



Having the mouse on the white space, click on mouse right button to access the MENU of operators → CLICK on "CONNECT GRAPH"

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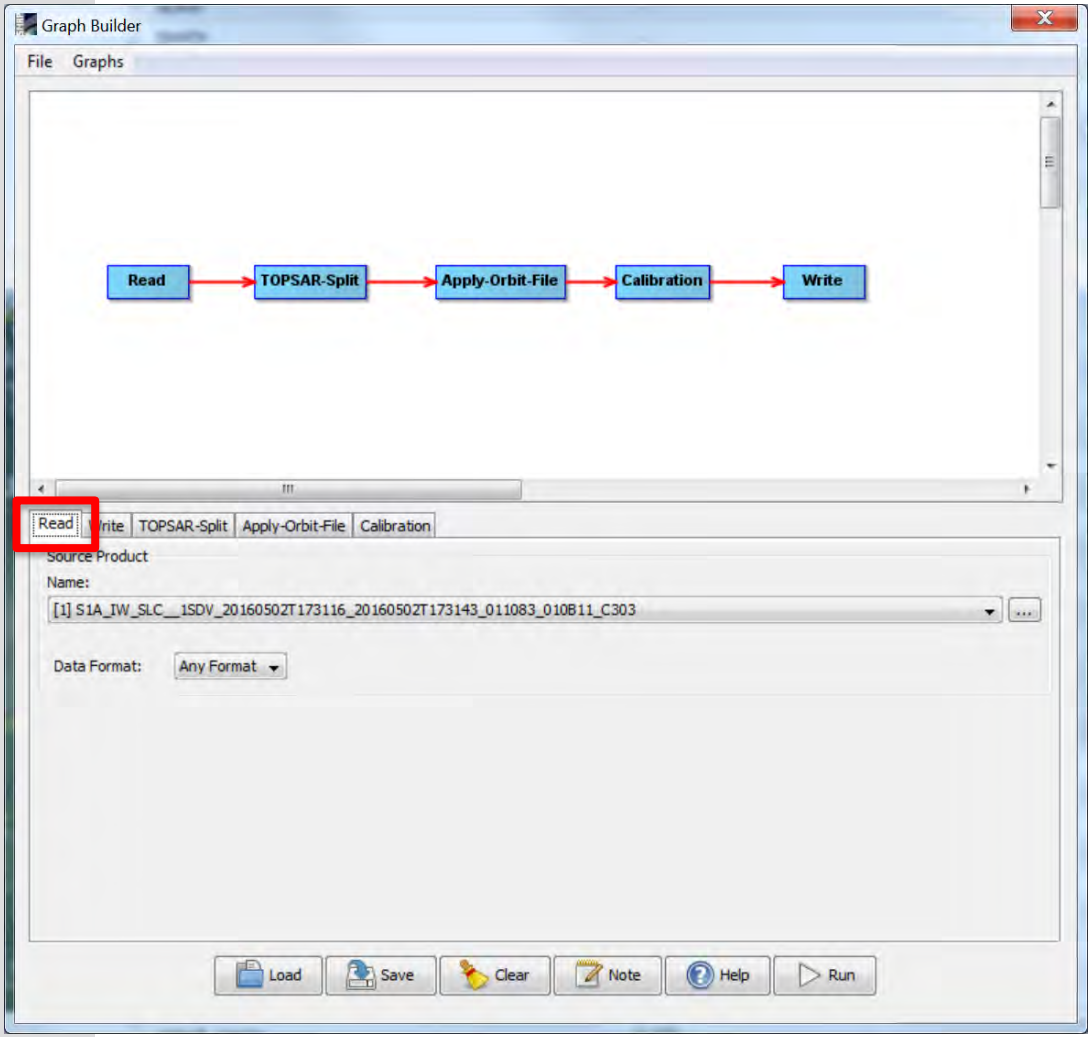
1.a - GB: Inserting the parameters



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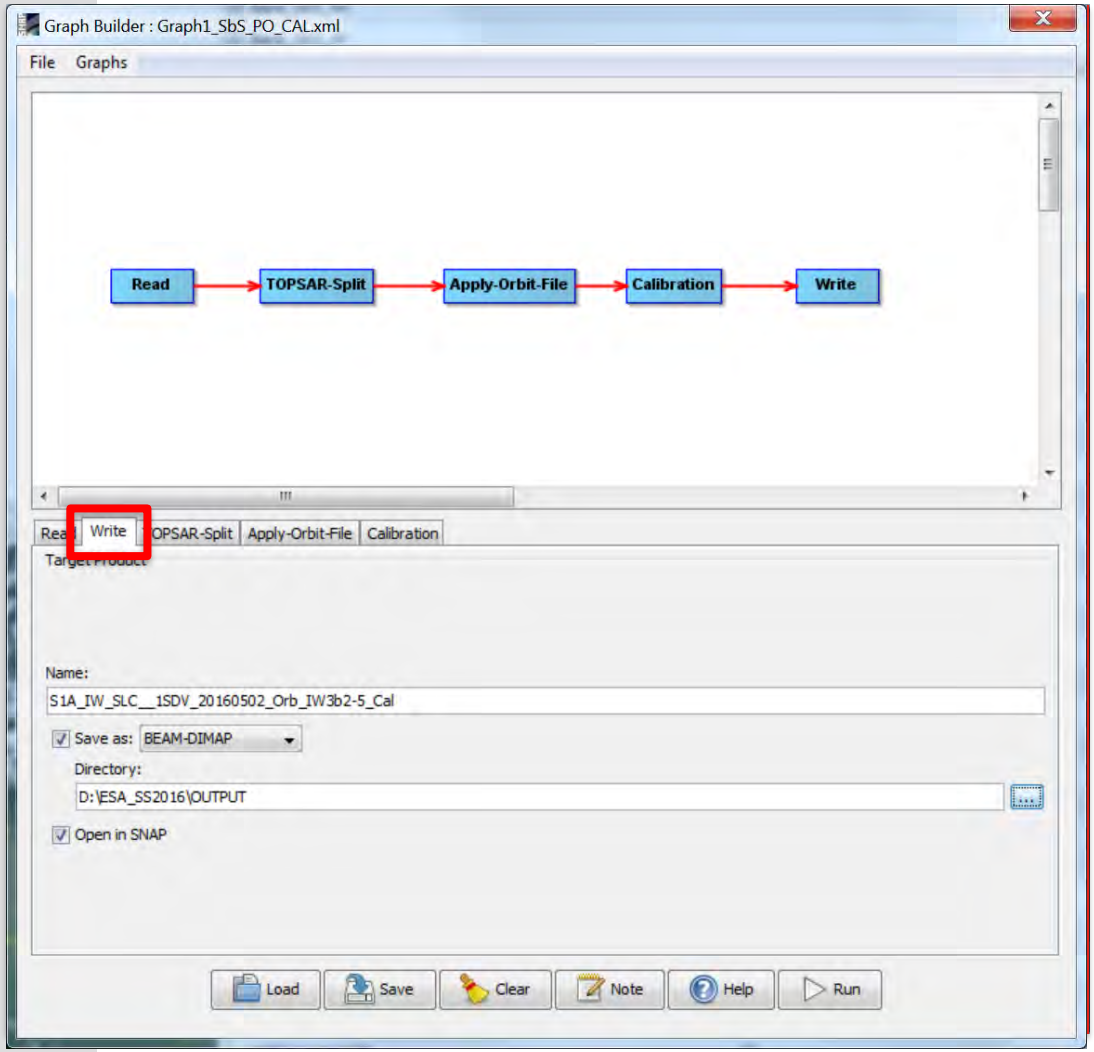
1.a - GB: Inserting the parameters



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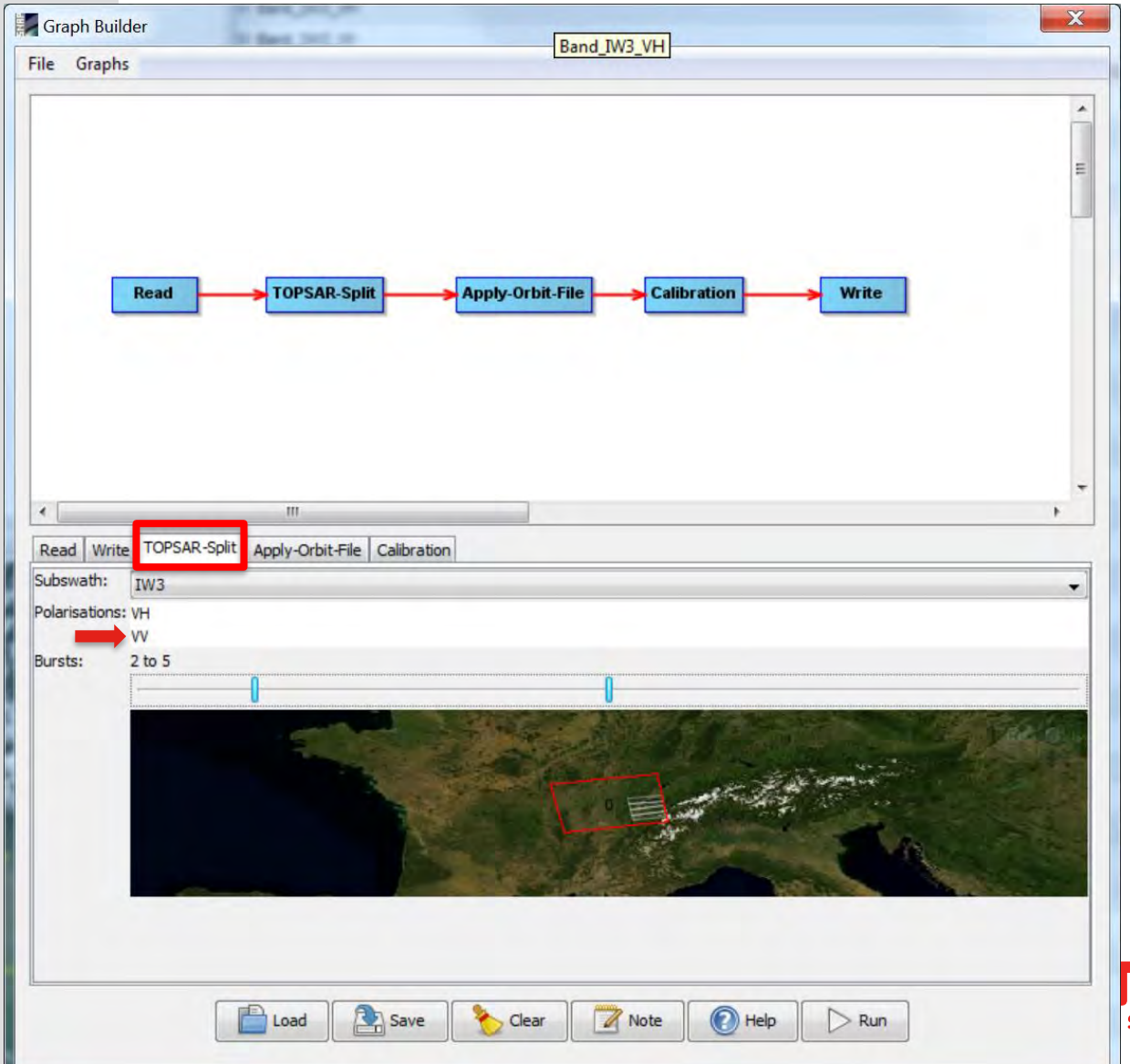
1.a - GB: Inserting the parameters



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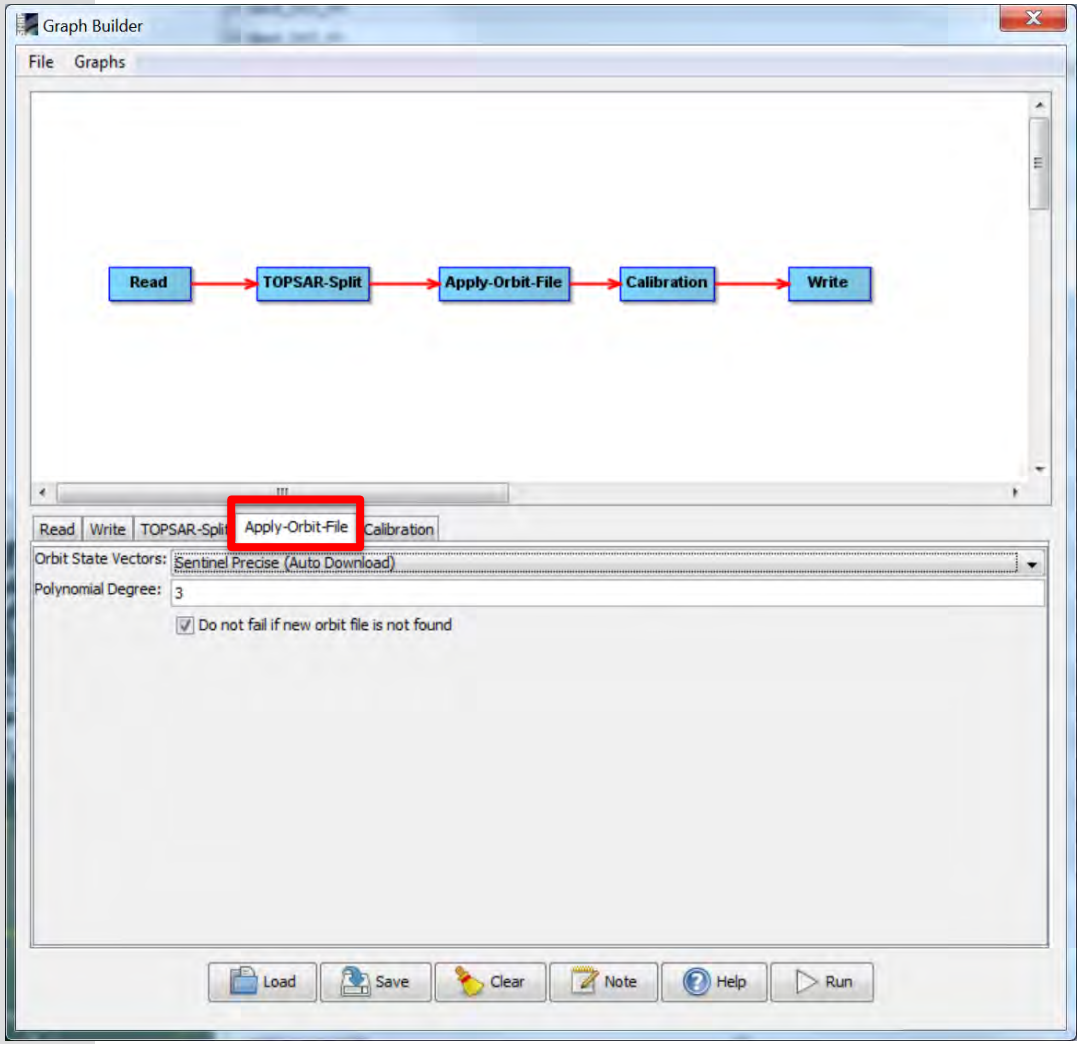
1.a - GB: Inserting the parameters



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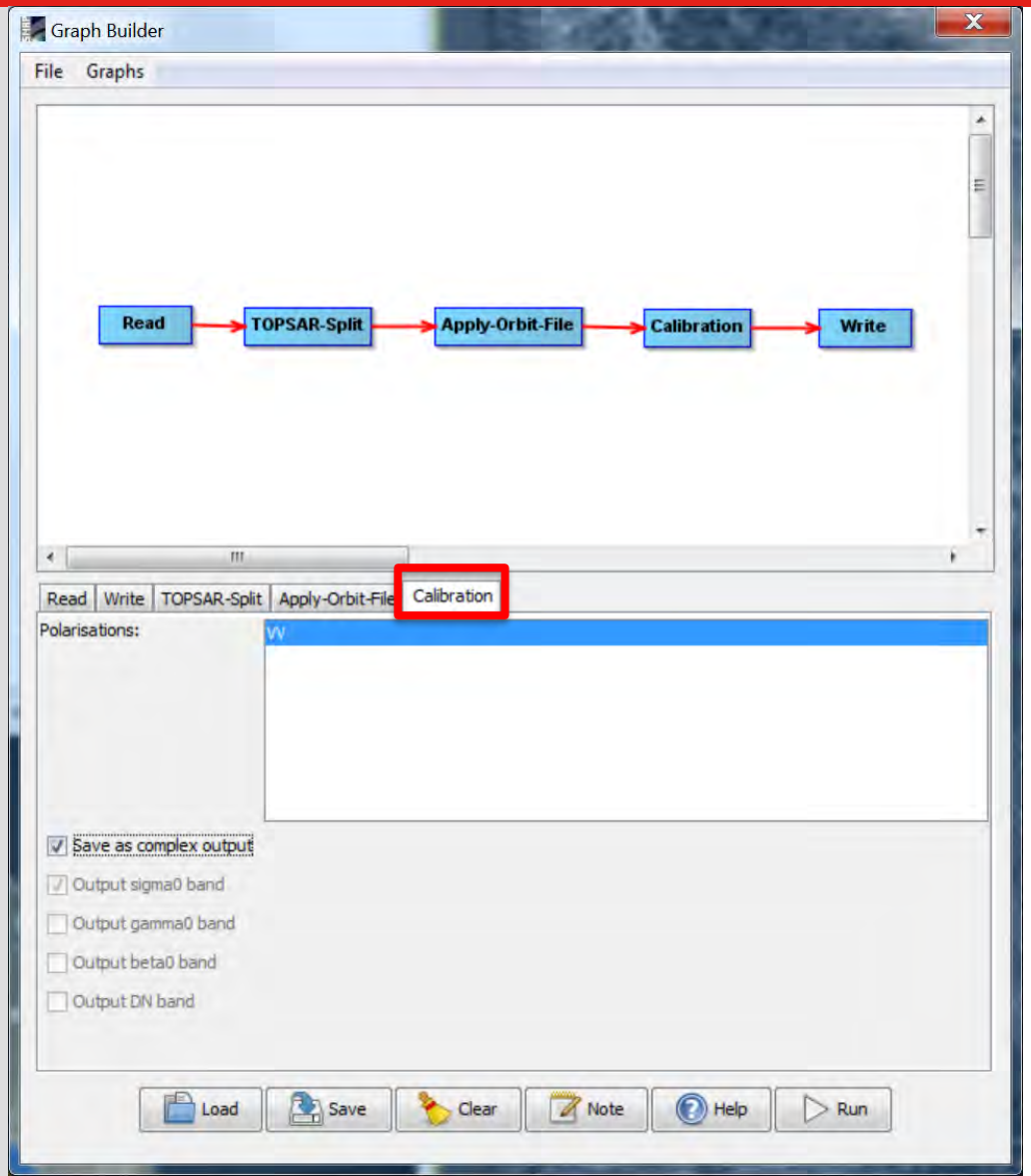
1.a - GB: Inserting the parameters



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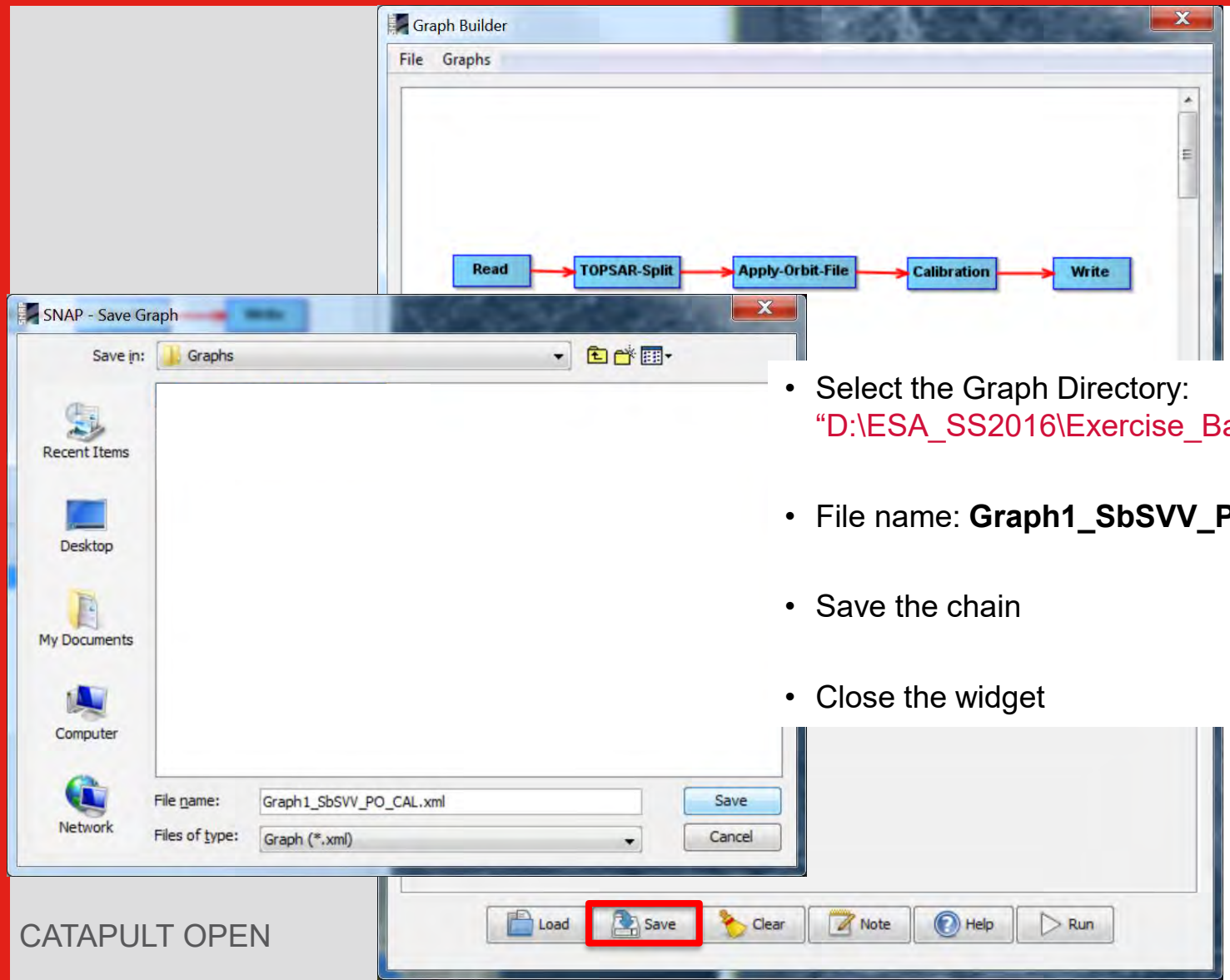
1.a - GB: Saving the chain



- Select the Graph Directory: "D:\ESA_SS2016\Exercise_Back_Coh_comb\Graphs"
- File name: **Graph1_SbSVV_PO_CAL.xml**
- Save the chain
- Close the widget

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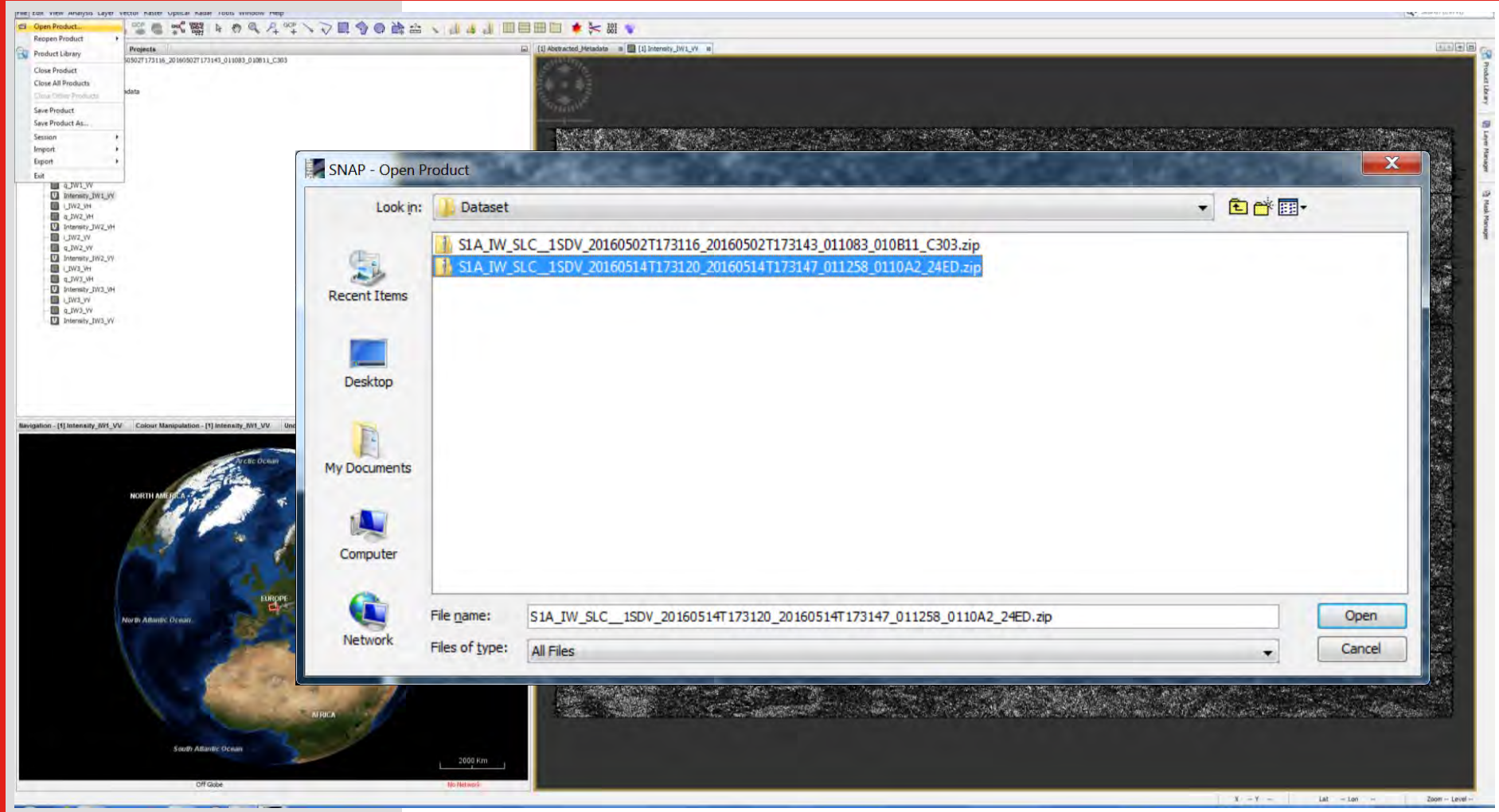
Open product 14/05/2016



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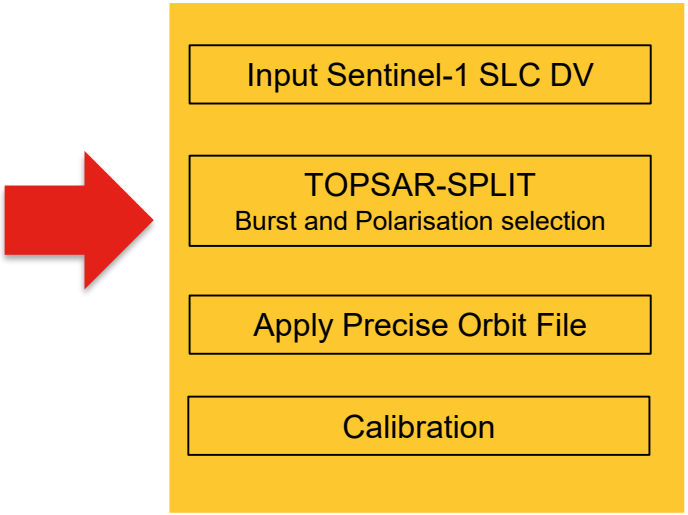
Step 1.b: Batch processing Tool

The Chain "**Graph1_SbSVV_PO_CAL.xml**" has been defined for one product.



Now we want to run the chain over the

2 SLC dataset via

batch processing tool

Remember we will select 4 bursts and VV polarisation only

Batch processing
(2 Products)

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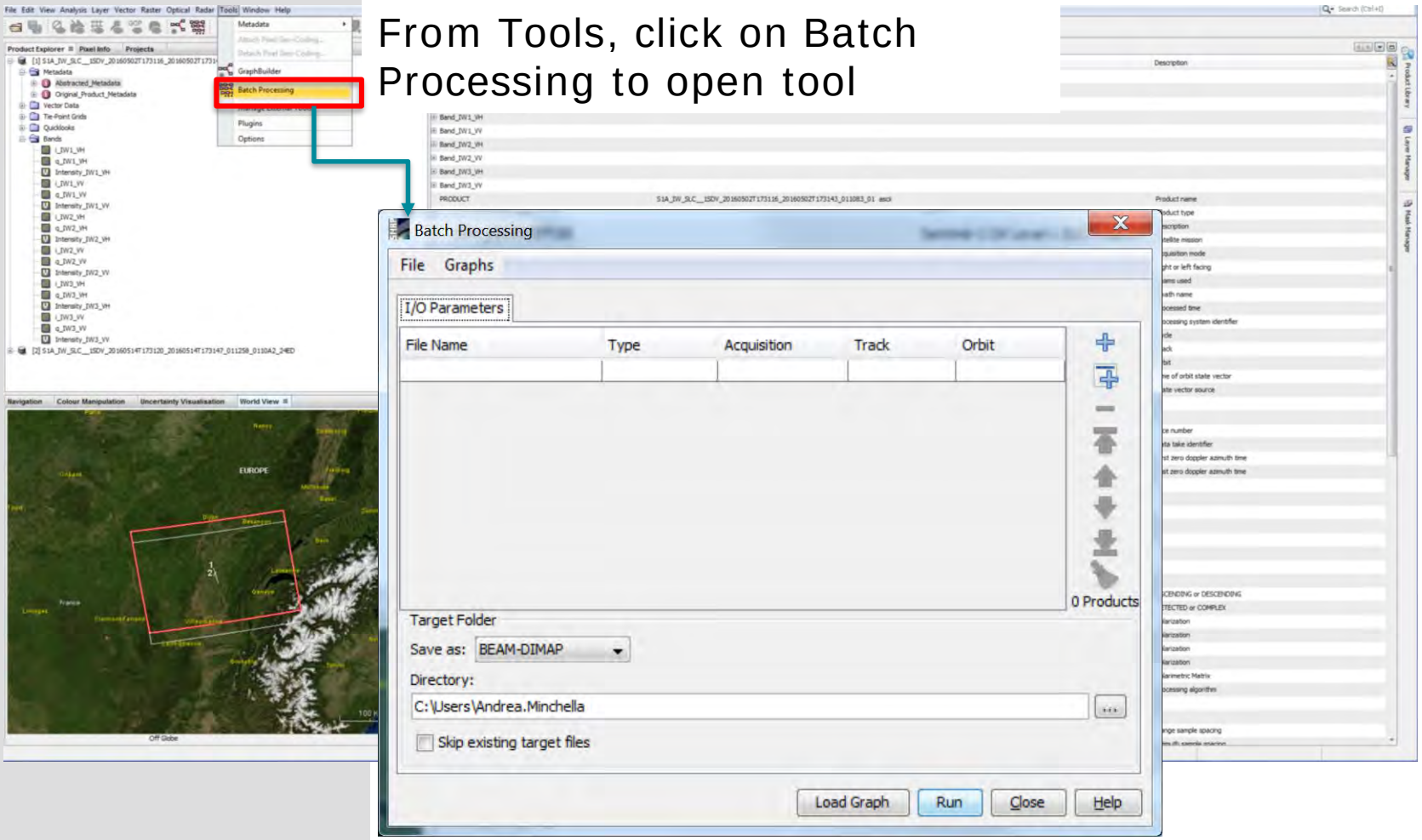
1.b - Batch Processing Tool

From Tools, click on Batch Processing to open tool



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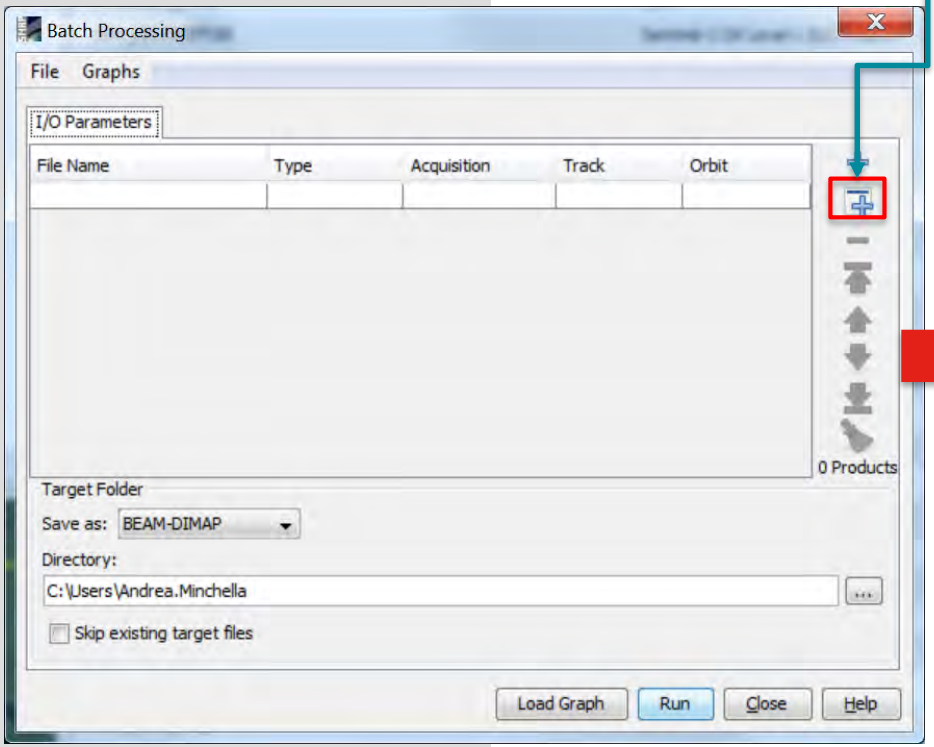
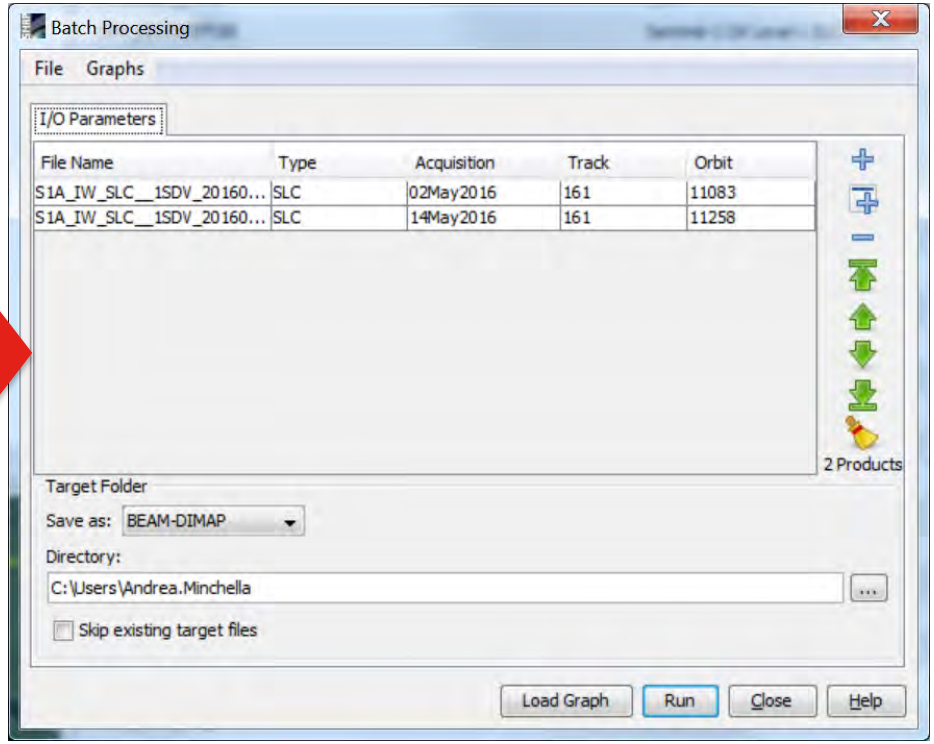
1.b - Batch processing

Click on: “Add Opened”: all products listed in the **Products View** will be added





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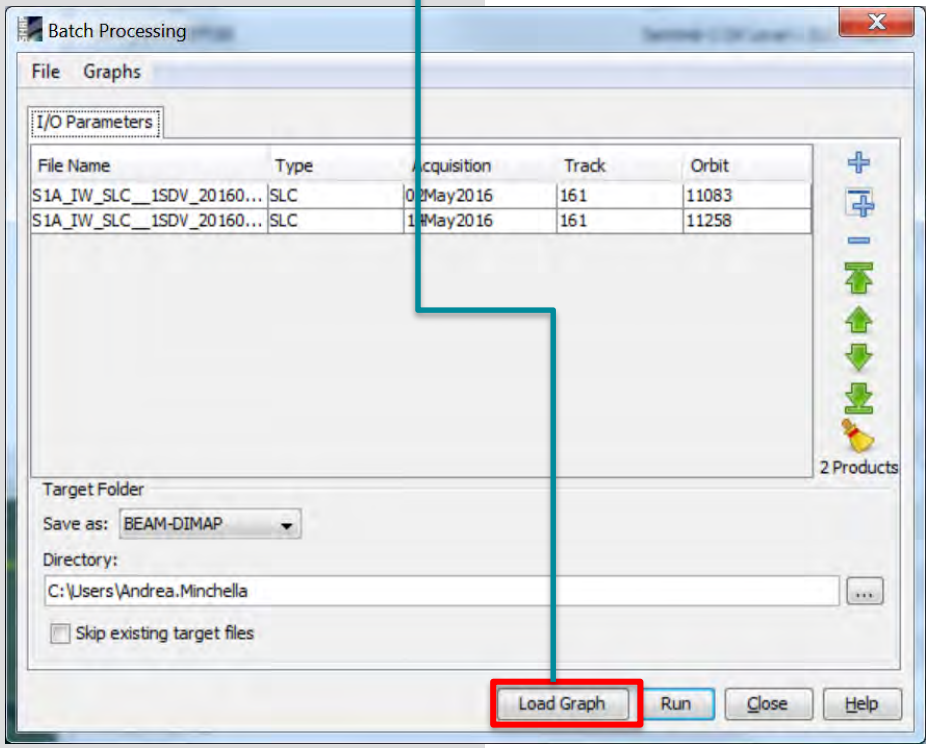
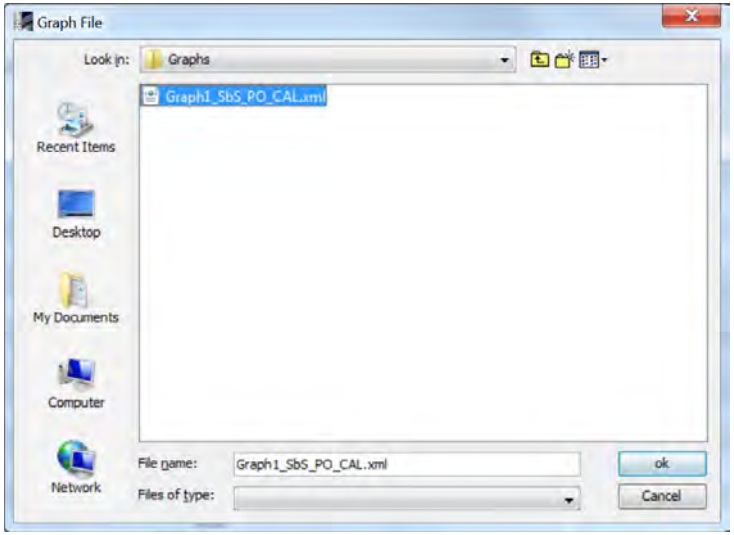
1.b - BP: Loading the graph (.xml)

1. By using “**LOAD GRAPH”**, select the created chain

Graph1_SbSVV_PO_CAL.xml

from “D:\ESA_SS2016\Exercise_Back_Coh_comb\Graphs”





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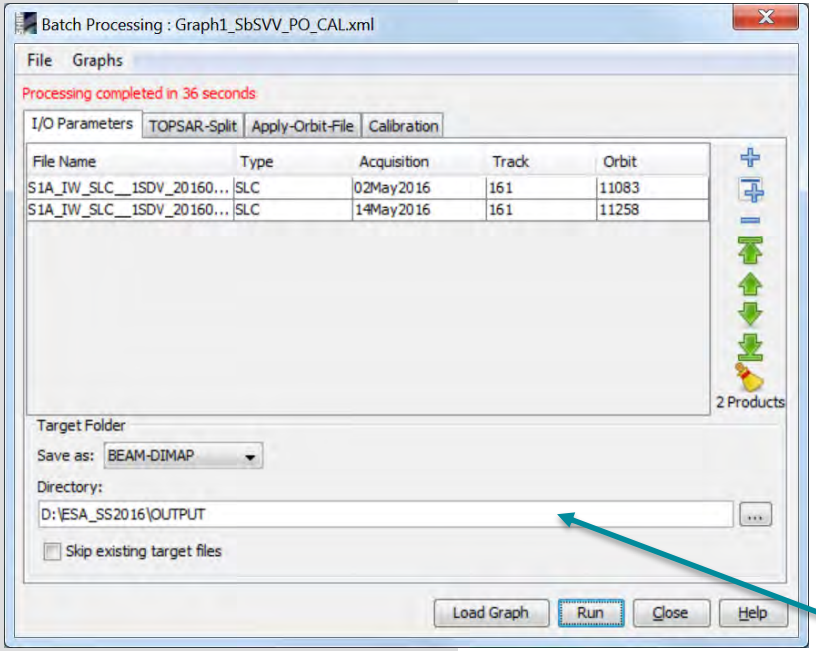
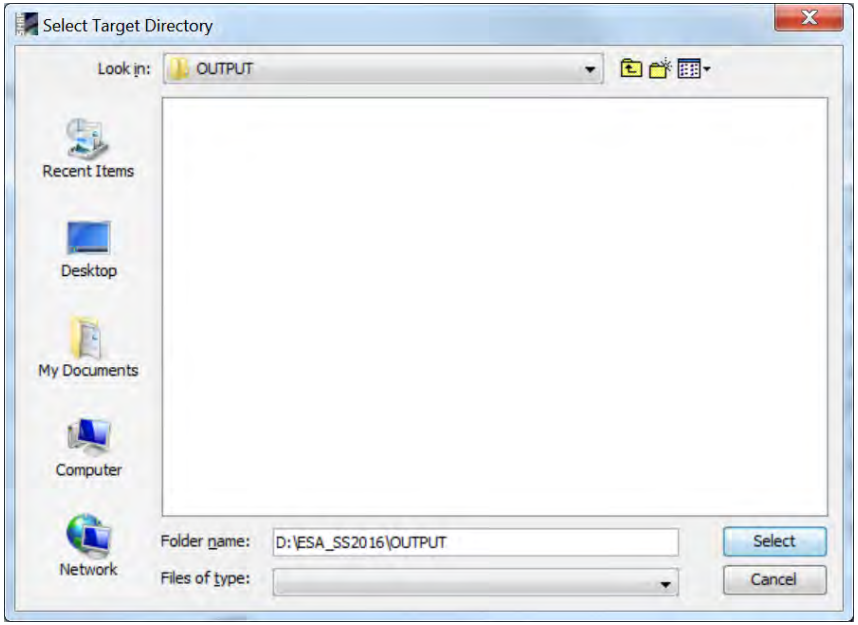
1.b - BP: executing the graph (.xml)





2. Select the OUTPUT directory
3. Cross Check parameters (recommended)
4. Click Run

N.B.: In the Batch Processing Tool we can't specify the name of the output product but the input name will be kept

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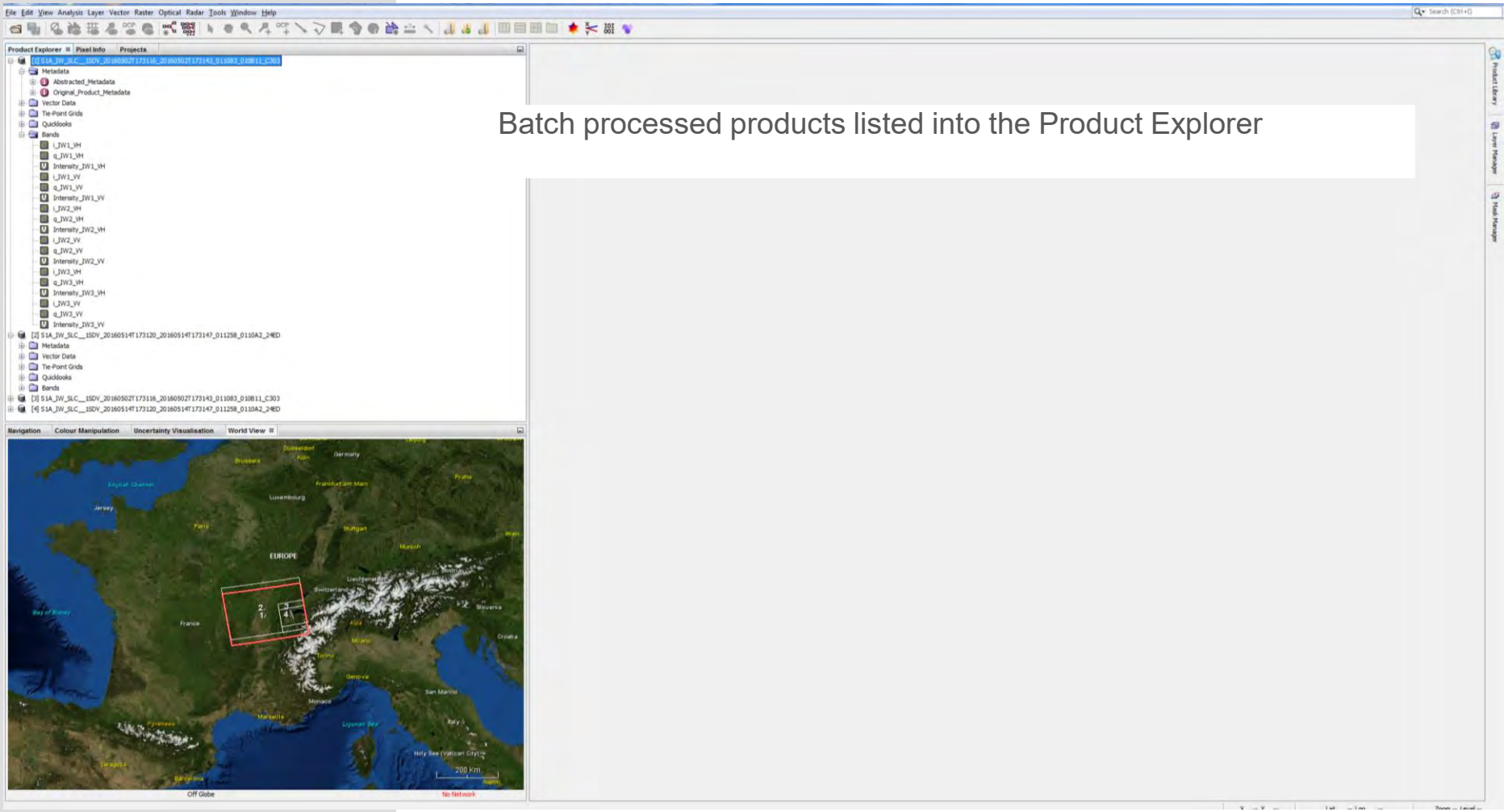
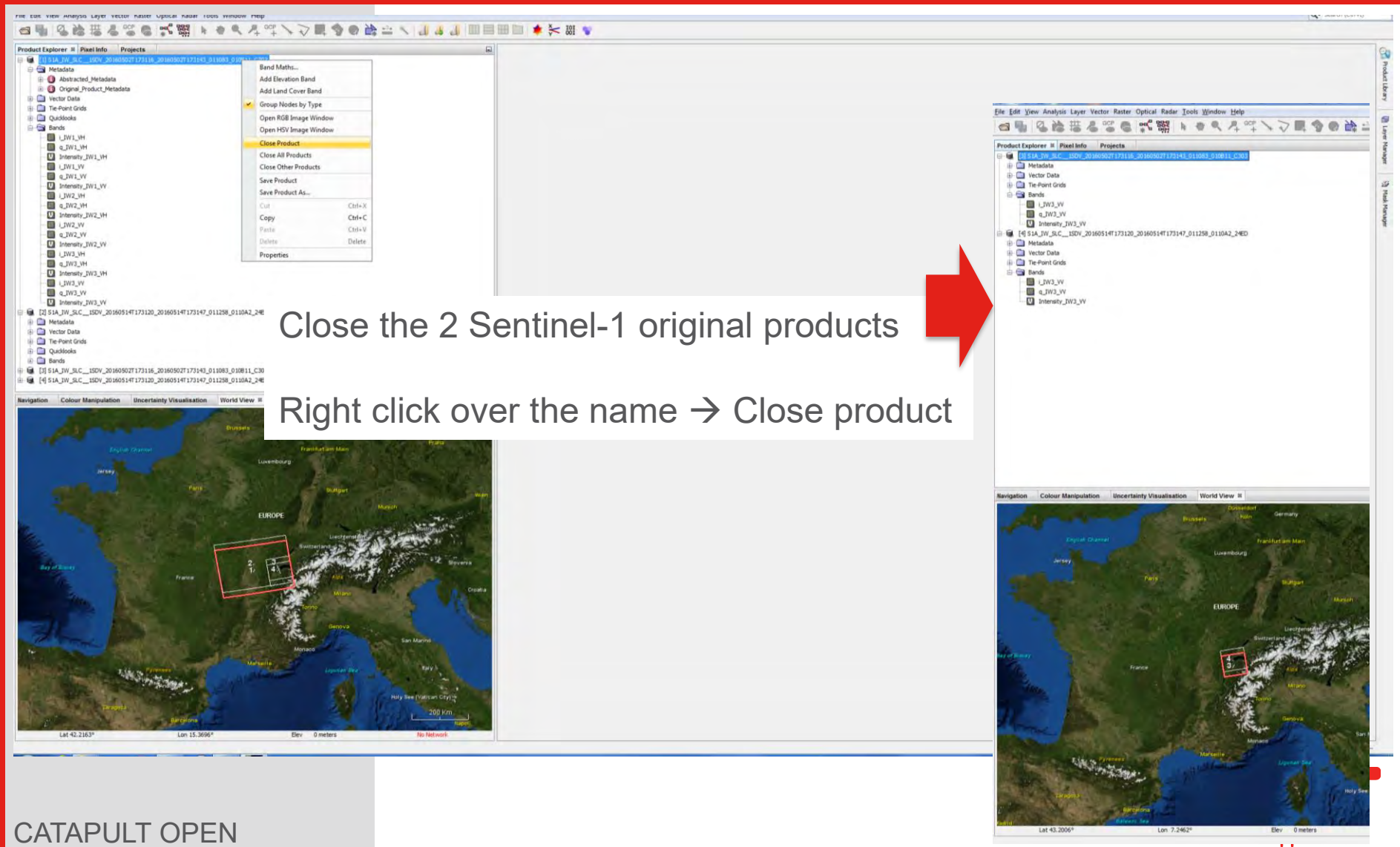
1.b - Batch processing: results



1.b - Batch processing: results



Step 2: TOPSAR Coregistration

MASTER

TOPSAR-SPLIT
Burst and Polarisation selection

Apply Precise Orbit File

Calibration

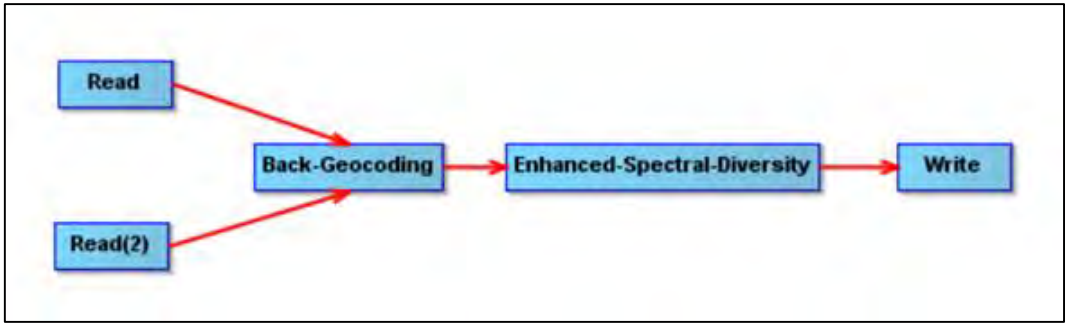
SLAVE

TOPSAR-SPLIT
Burst and Polarisation selection

Apply Precise Orbit File

Calibration

BACK GEOCODING → Enhanced Spectral Diversity → Coregistered Images



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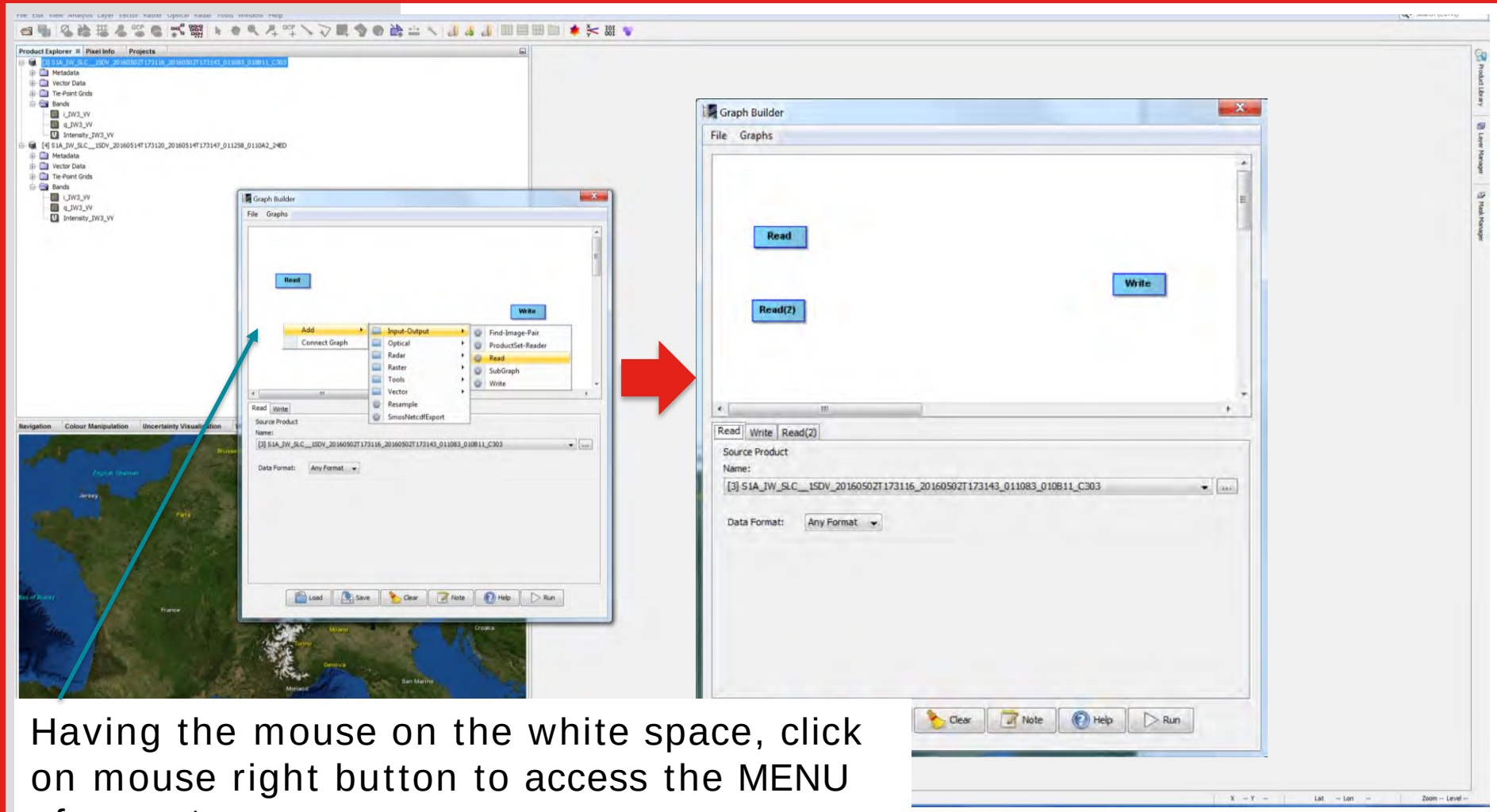
TOPSAR Coregistration via GB



Having the mouse on the white space, click on mouse right button to access the MENU of operators

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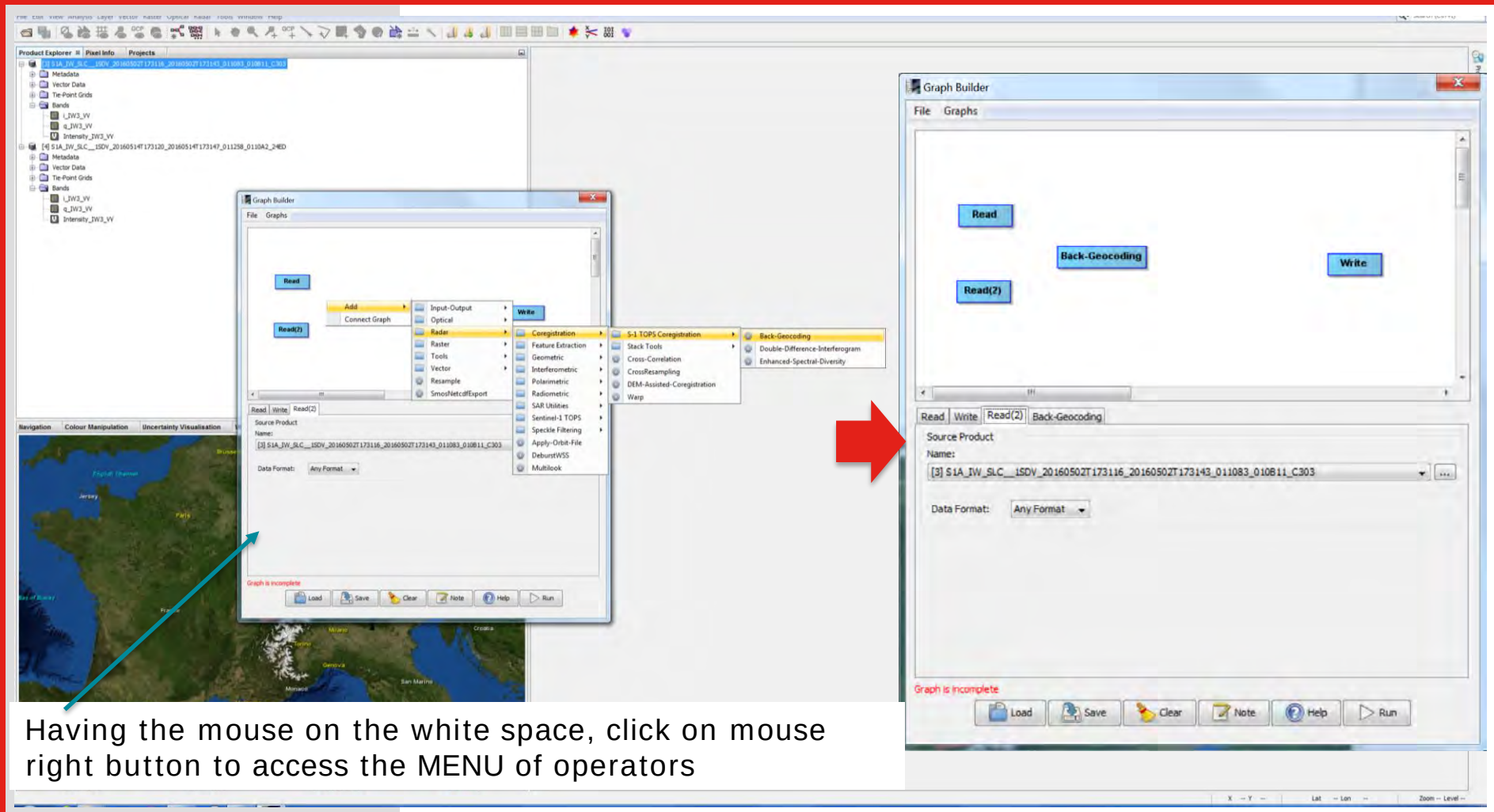
TOPSAR Coregistration via GB



Having the mouse on the white space, click on mouse right button to access the MENU of operators

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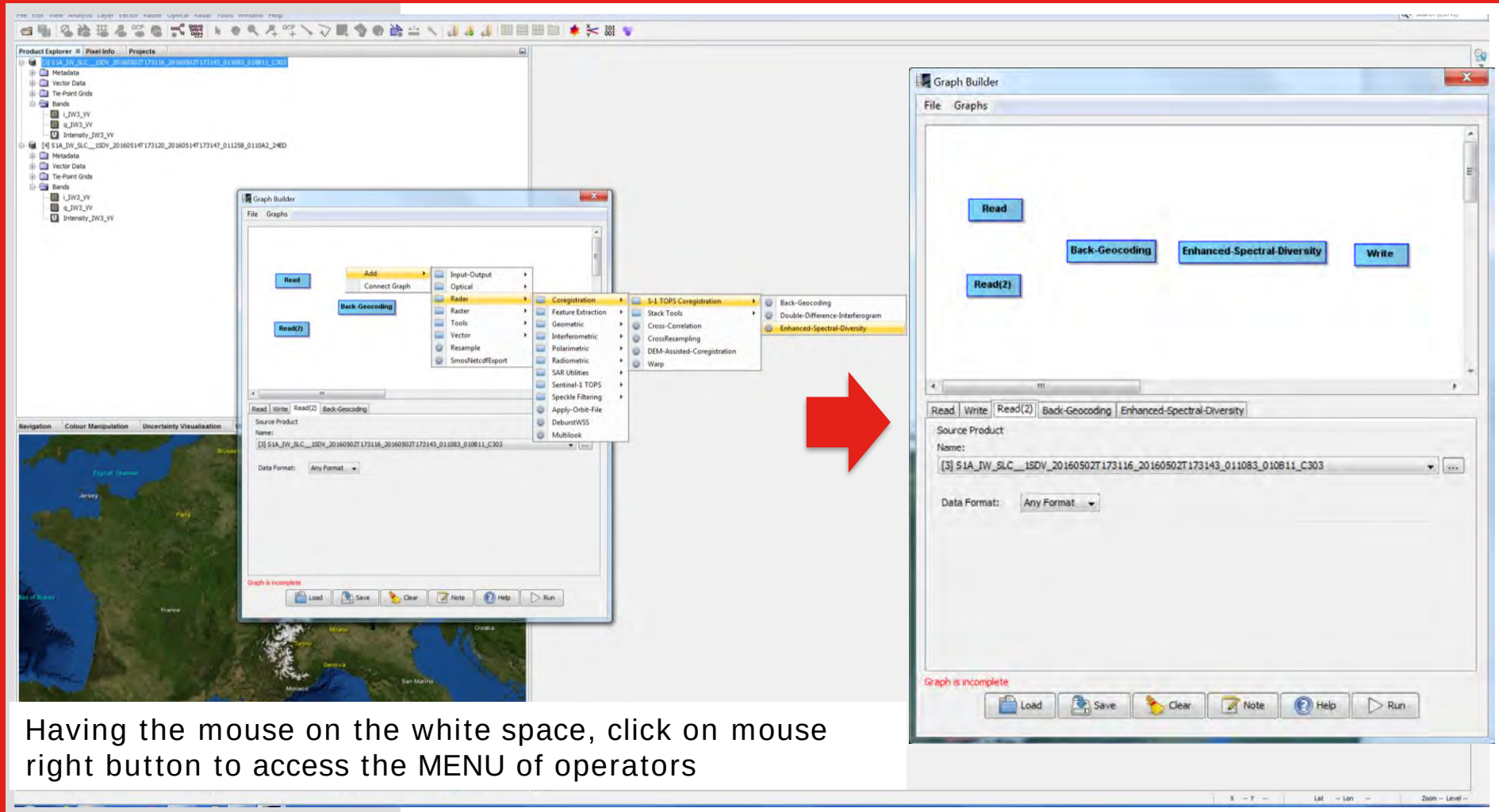
TOPSAR Coregistration via GB



Having the mouse on the white space, click on mouse right button to access the MENU of operators

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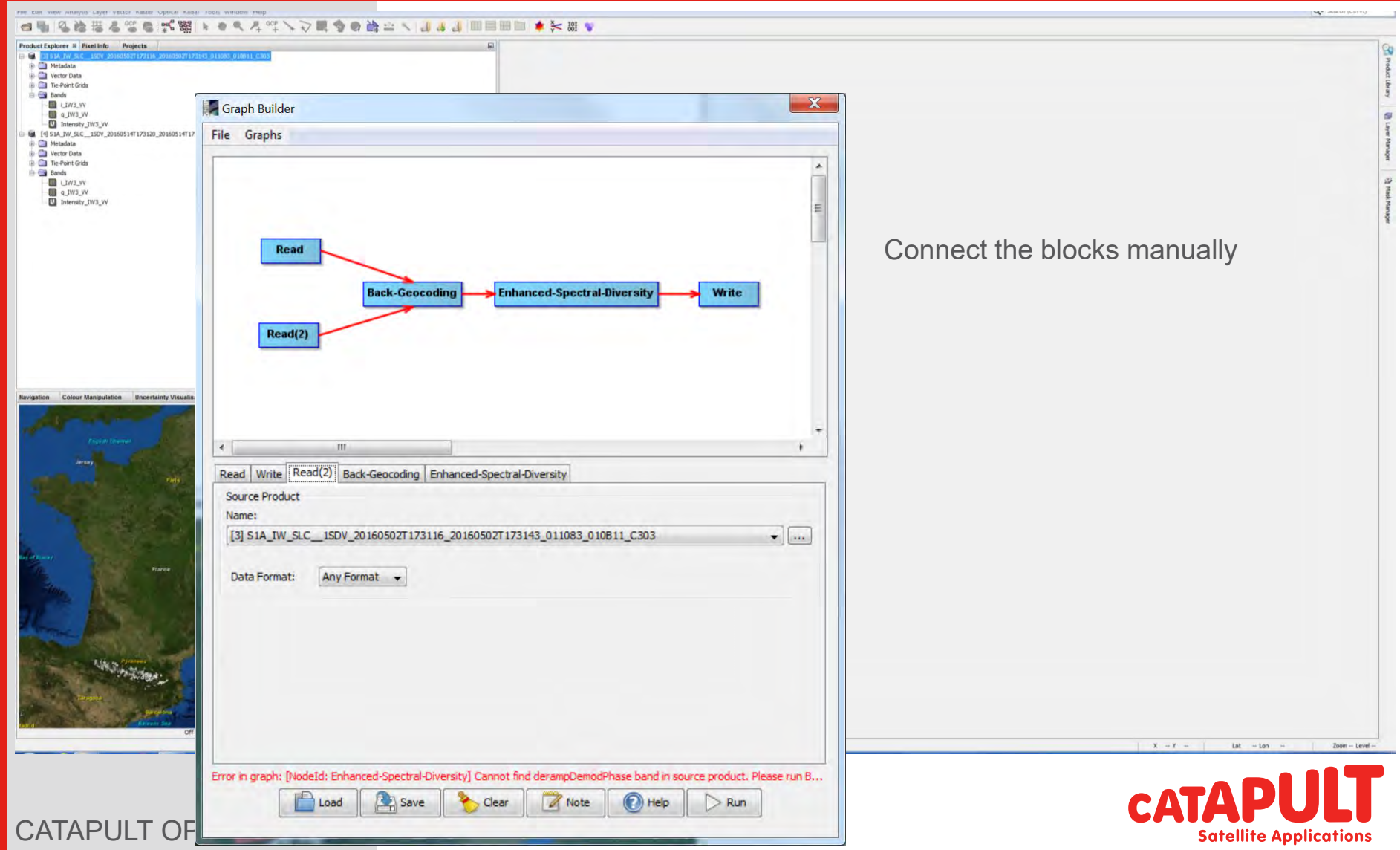
GB: Connecting the blocks



Connect the blocks manually

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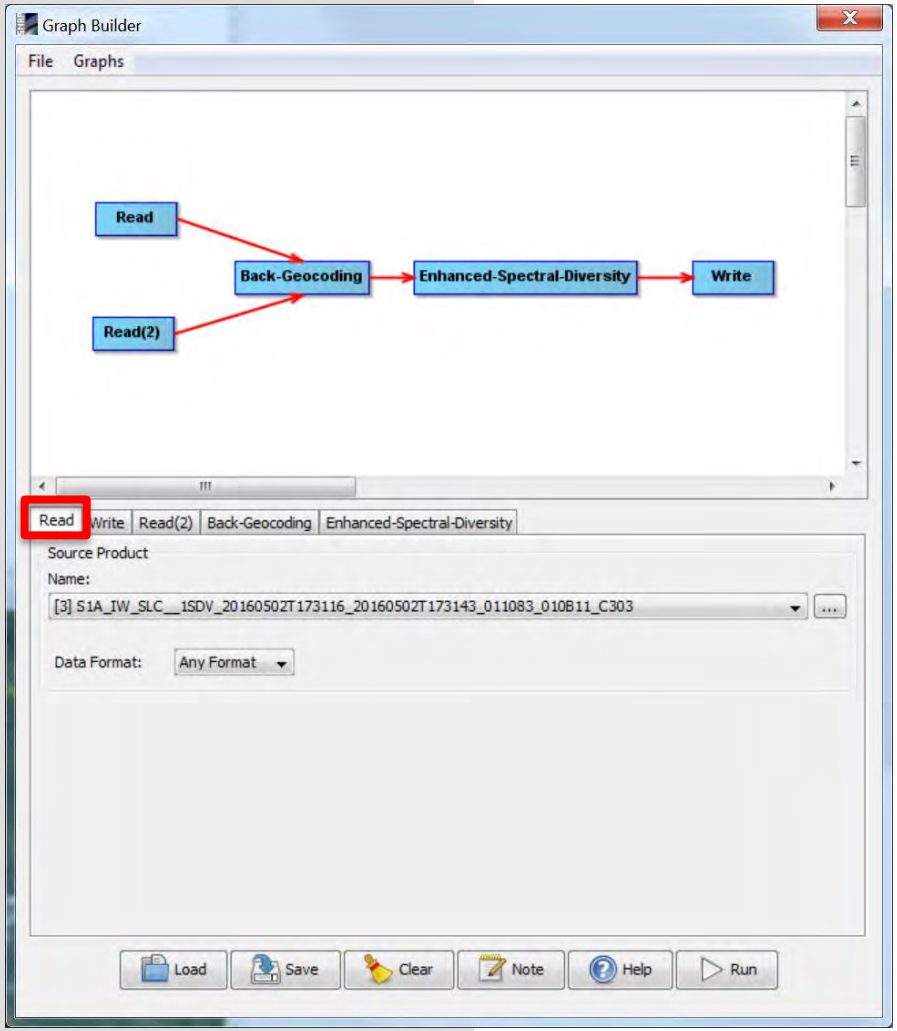
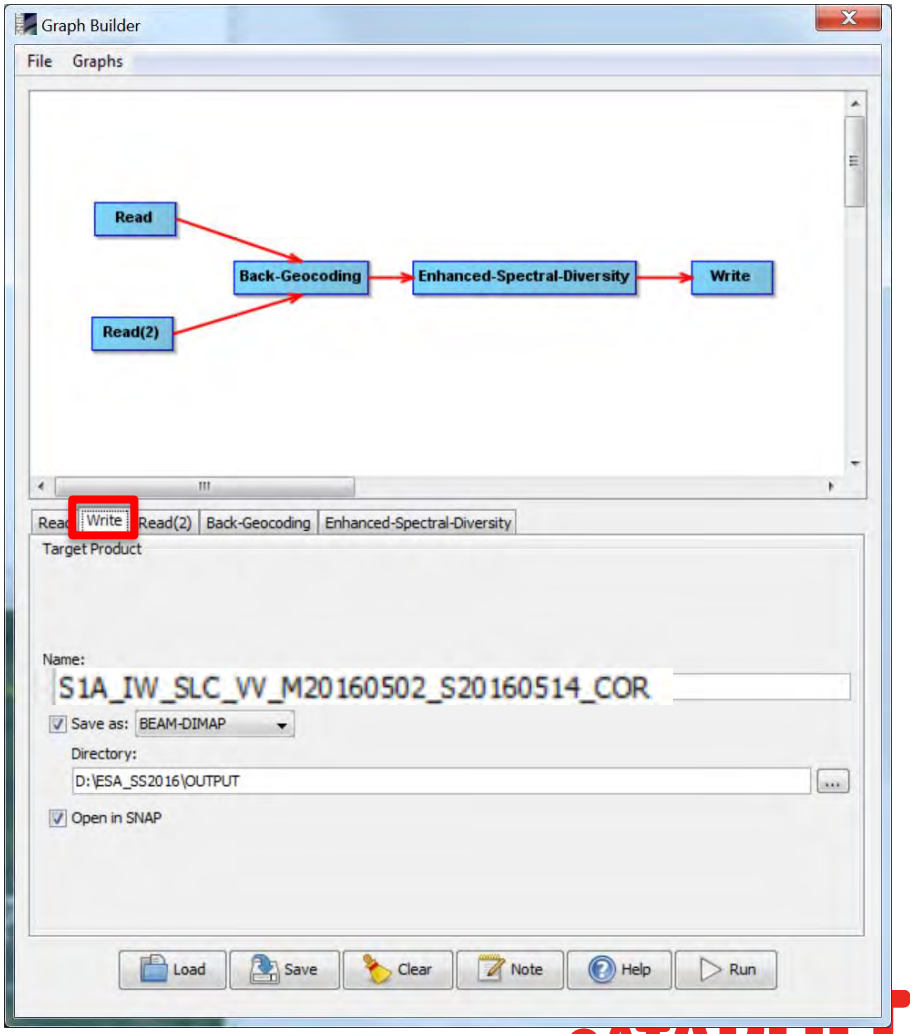
Inserting the parameters





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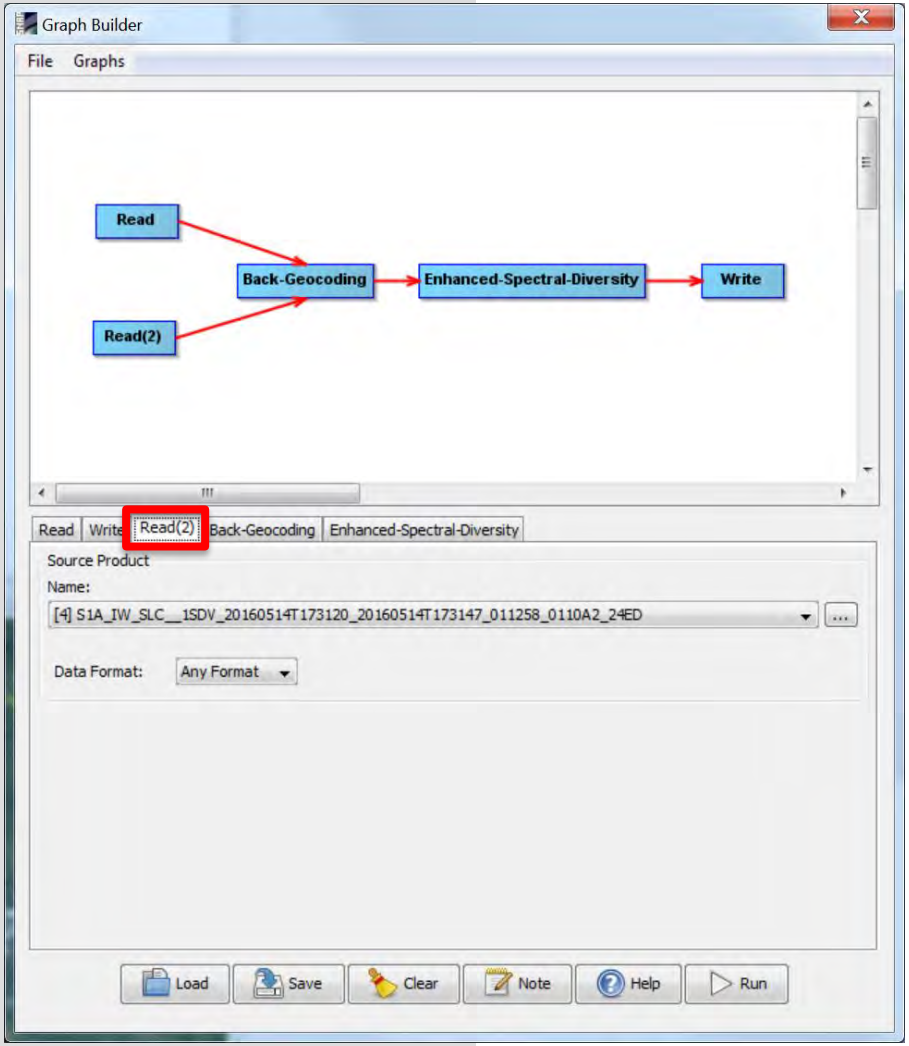
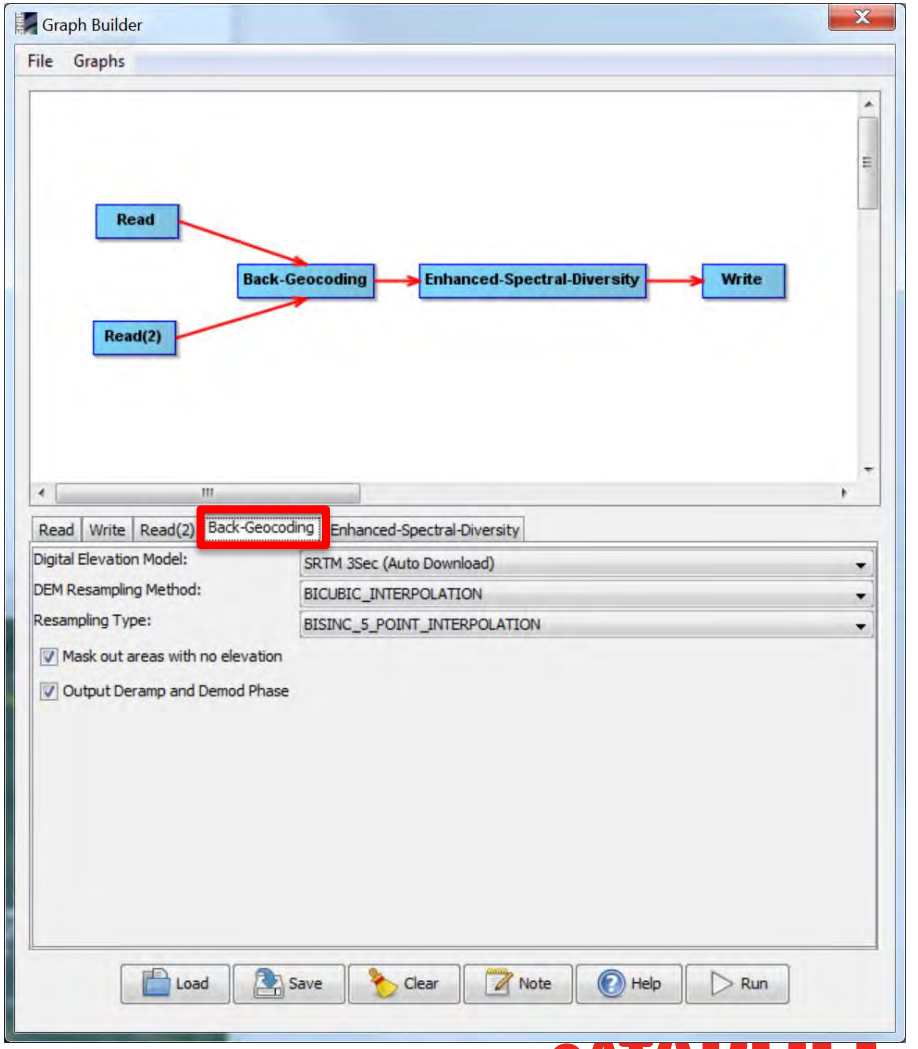
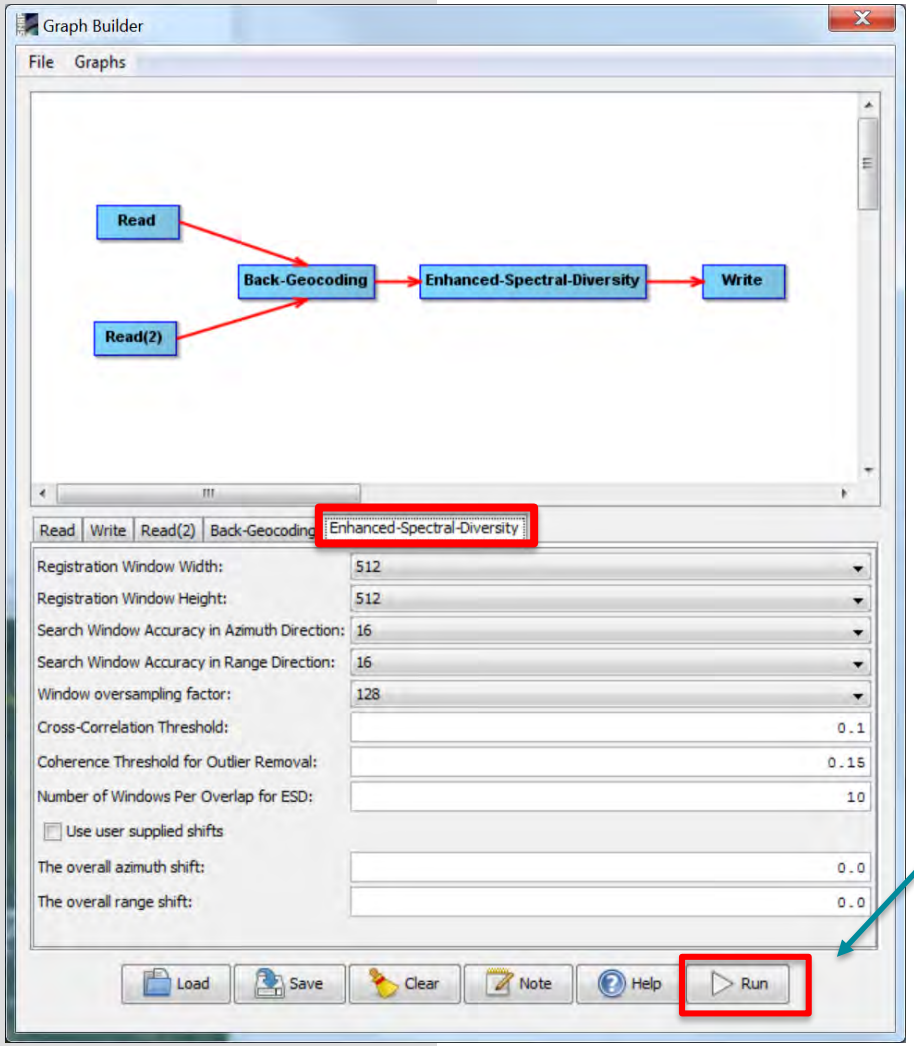
Inserting the parameters





Inserting the parameters



After inserting the parameters in the operators, execute the chain

N.B.: in the backup folder Graph2_TOPSAR_COR.xml

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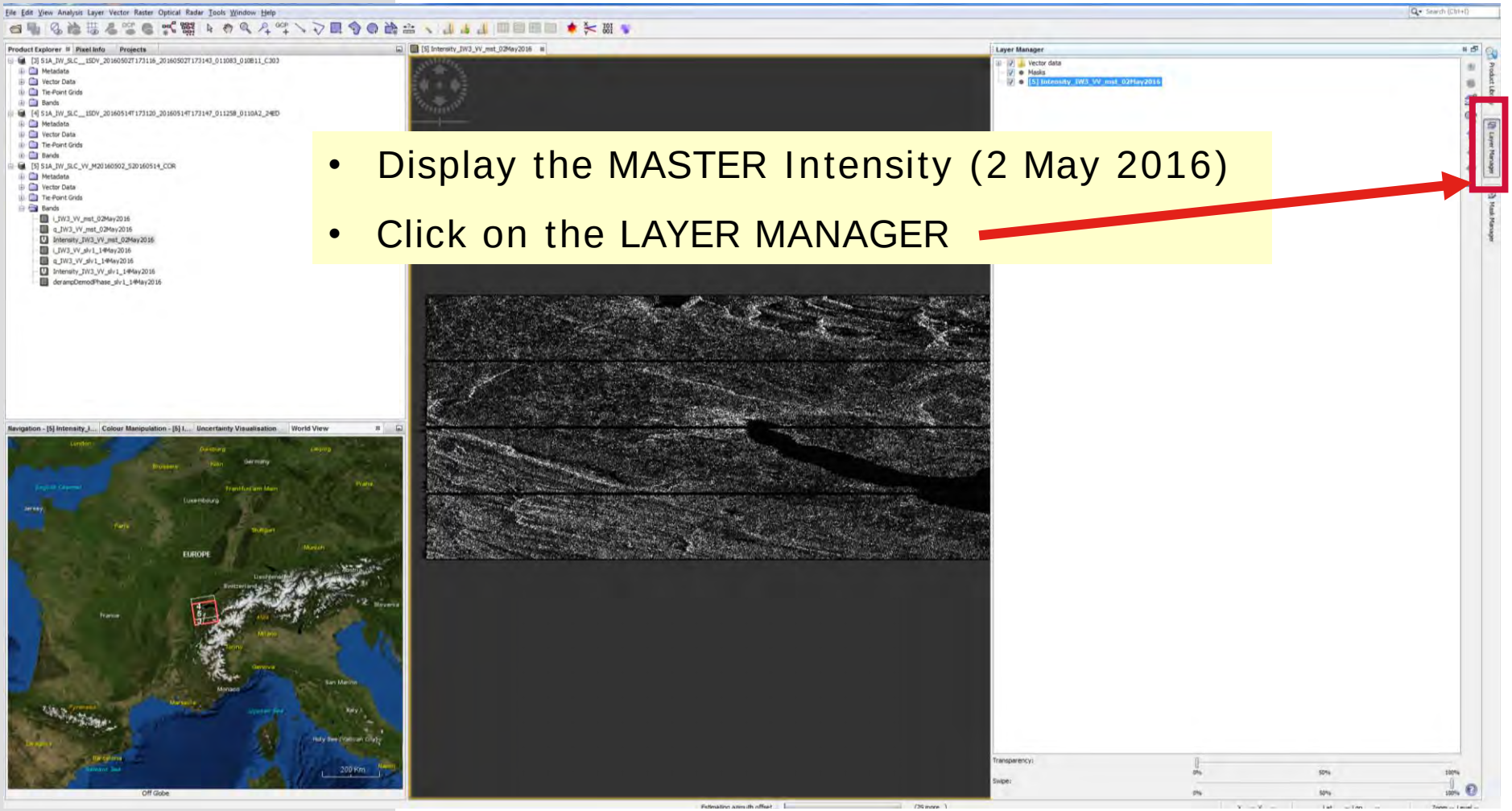
Overlay Master and Slave: the Layer Manager



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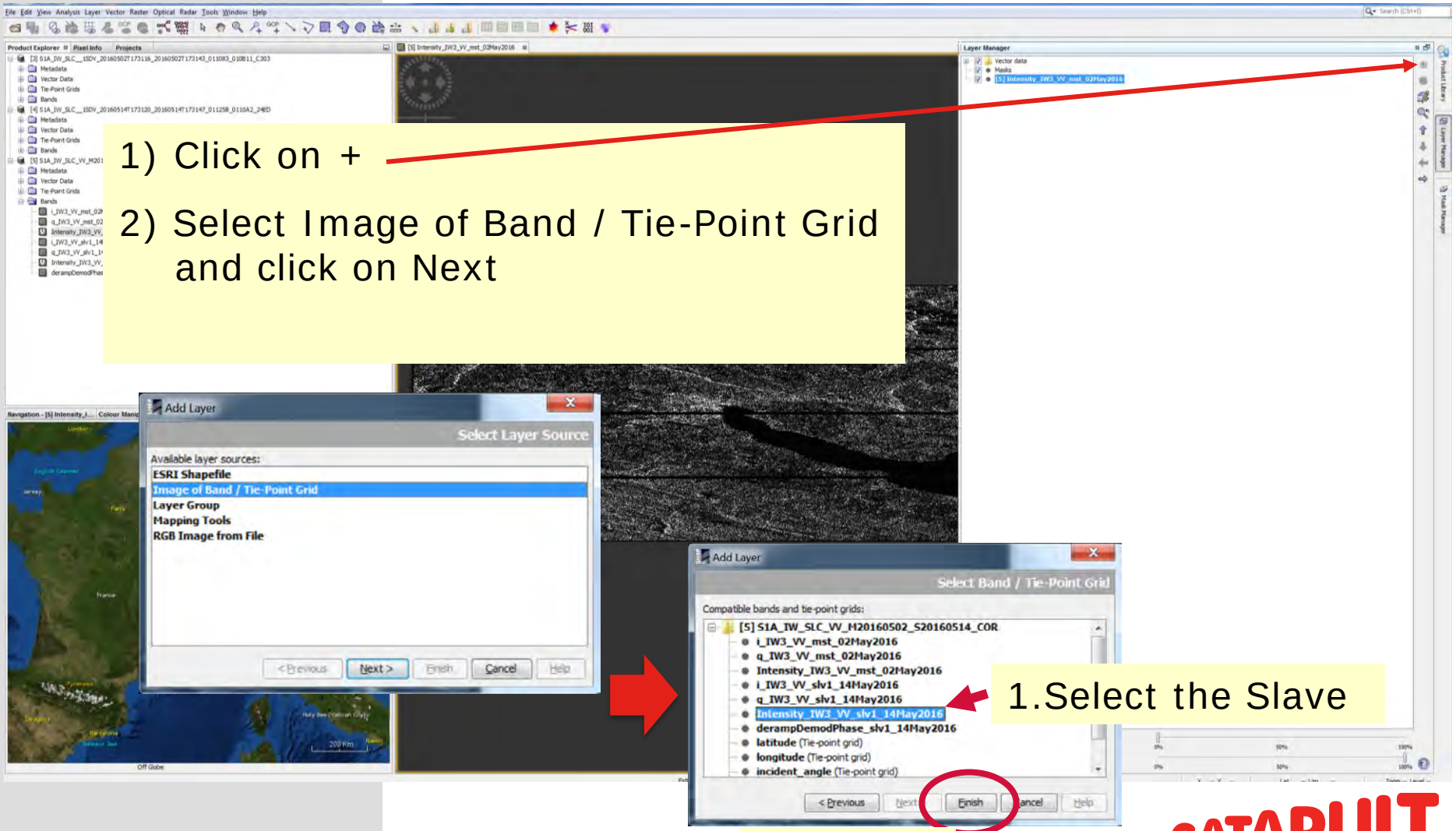
Overlay Master and Slave: the Layer Manager



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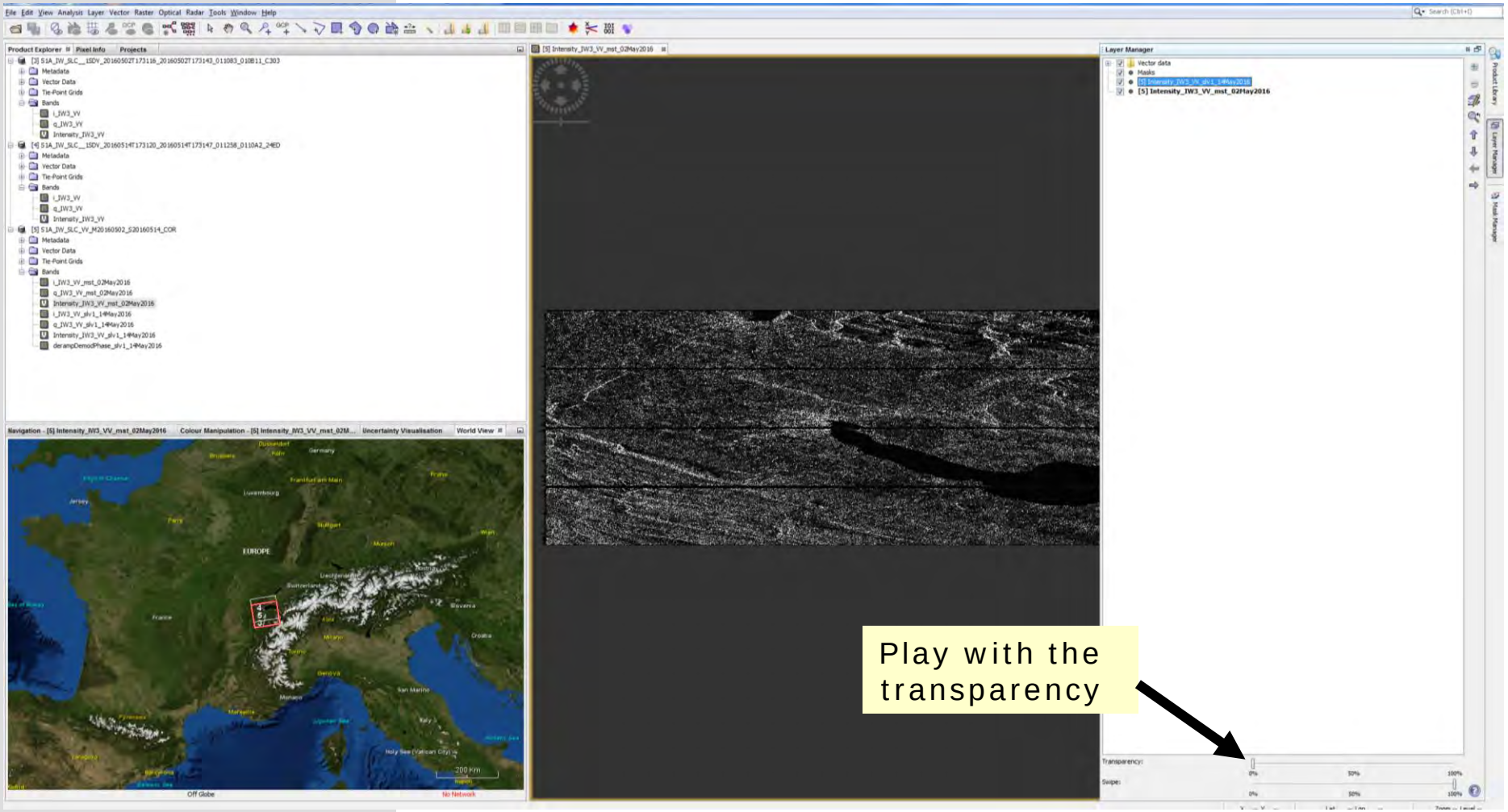
Overlay Master and Slave: the Layer Manager



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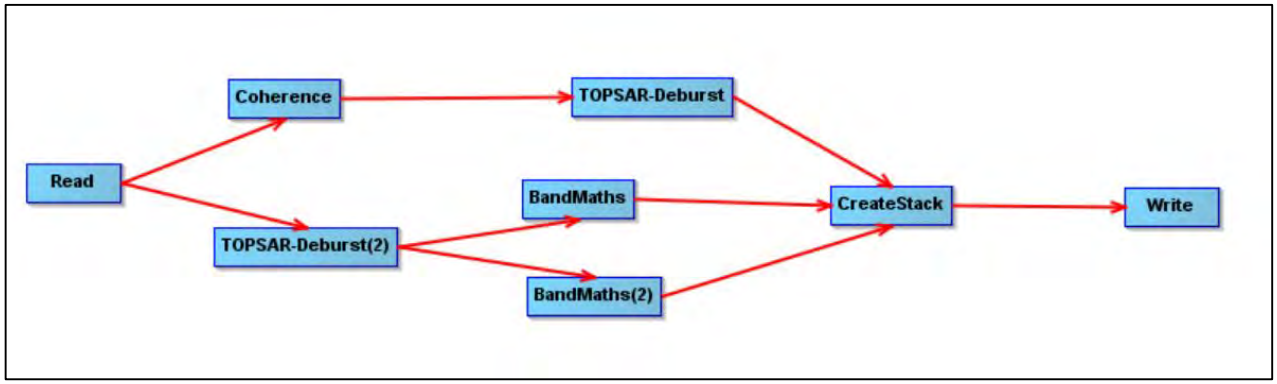
3 STEP: Coherence and Backscatter stack generation

Coregistered Images



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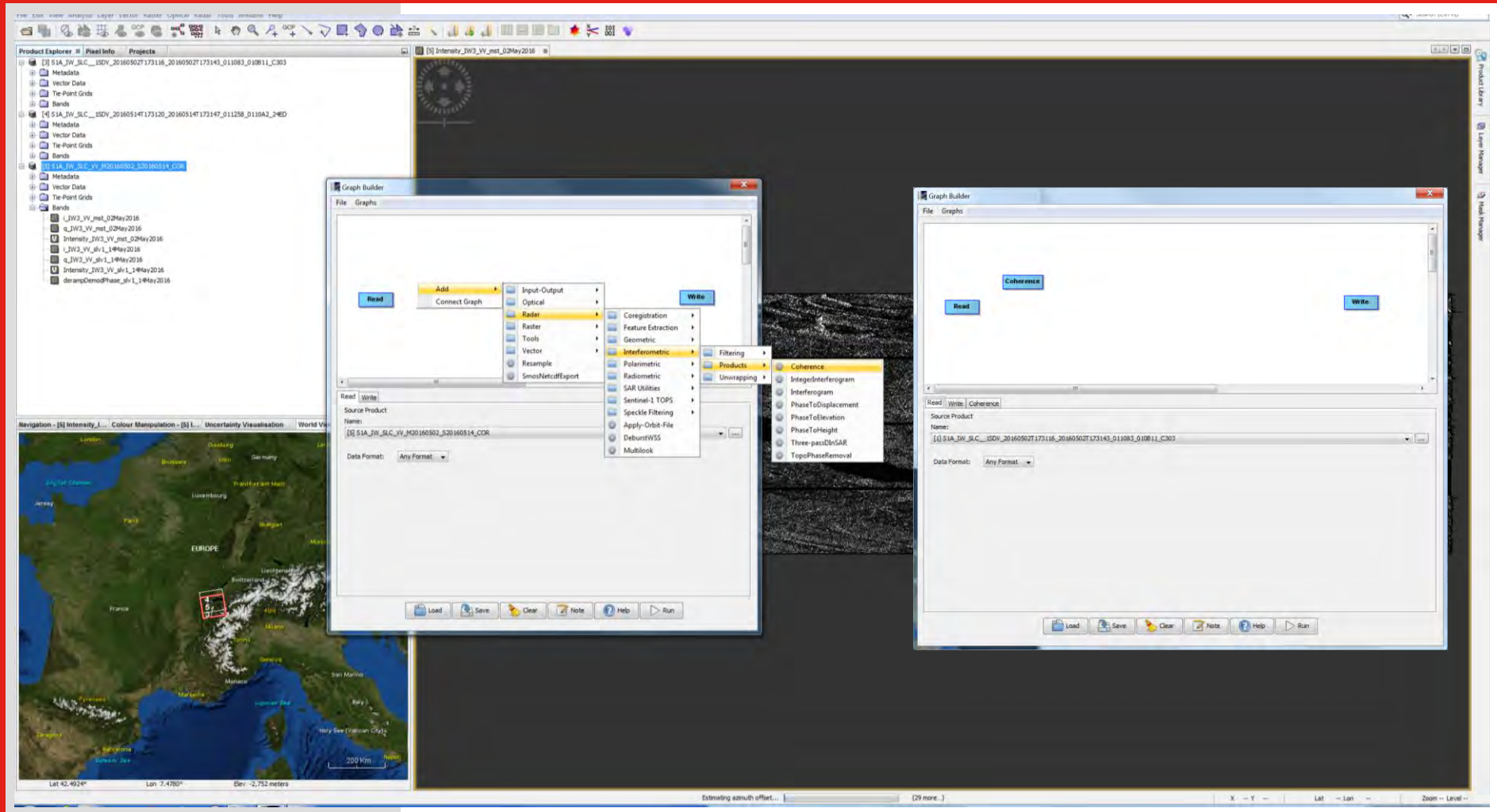
3 STEP: Coherence and Backscatter stack generation



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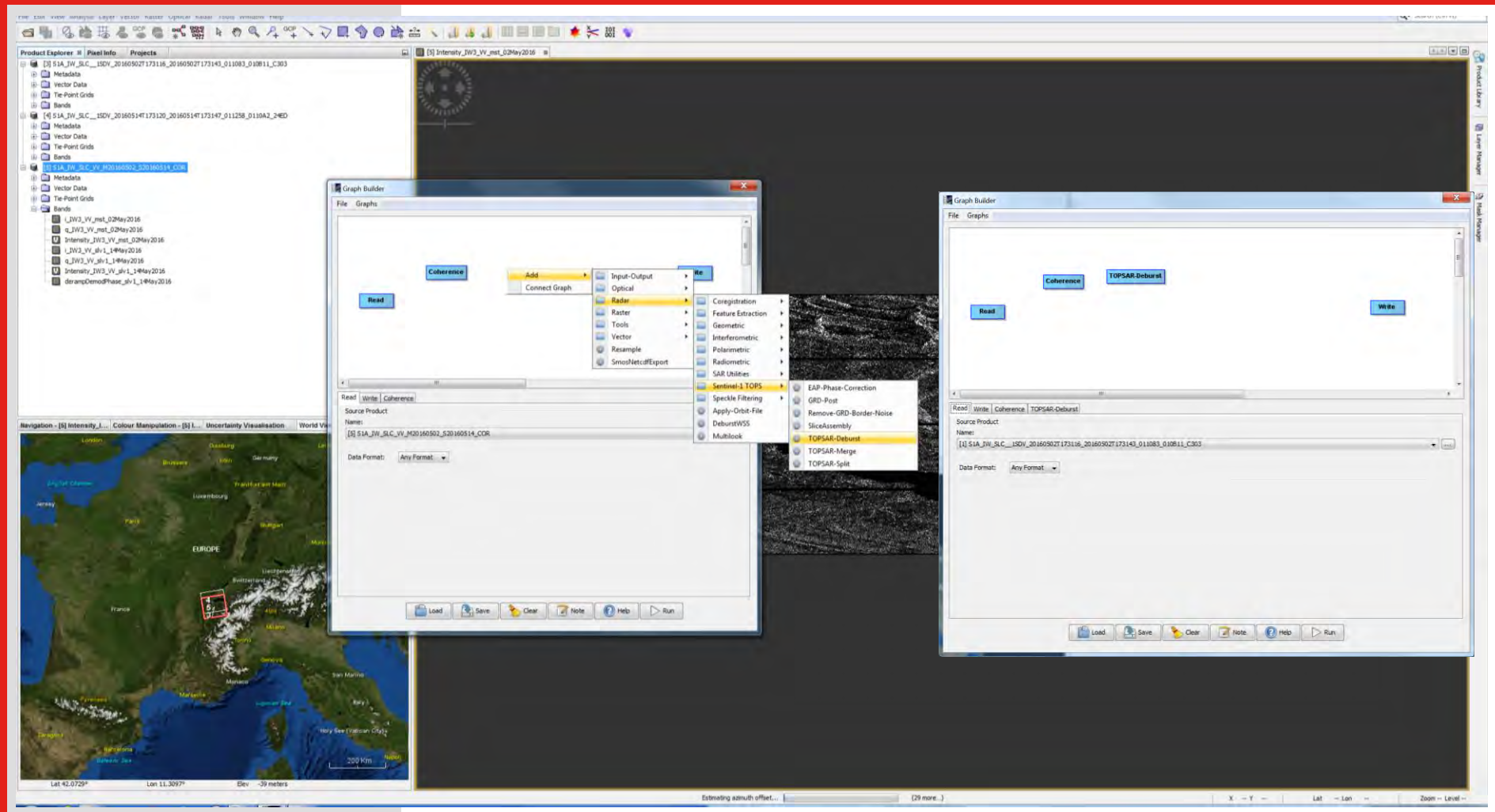
3 STEP: Coherence and Backscatter stack generation



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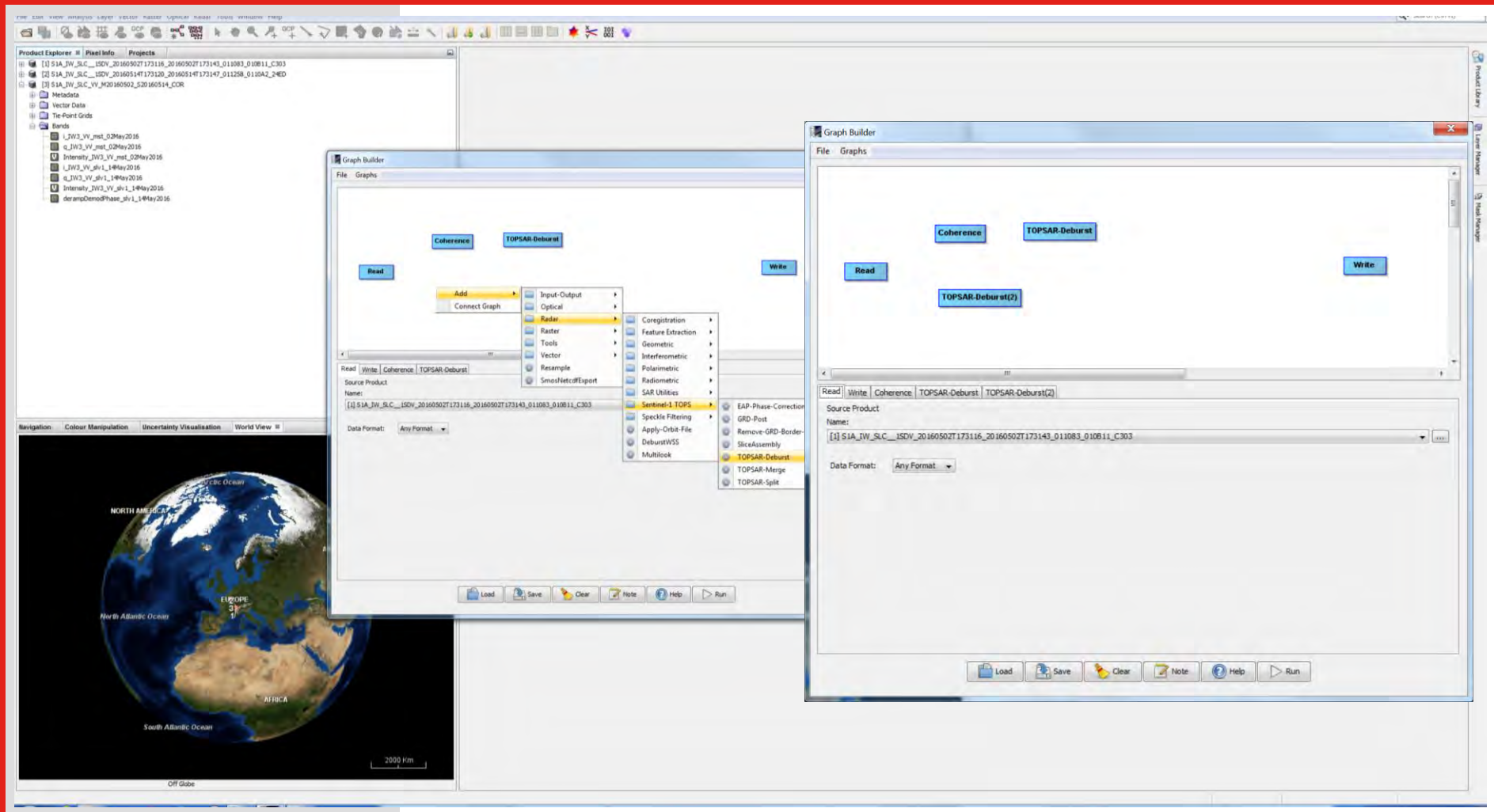
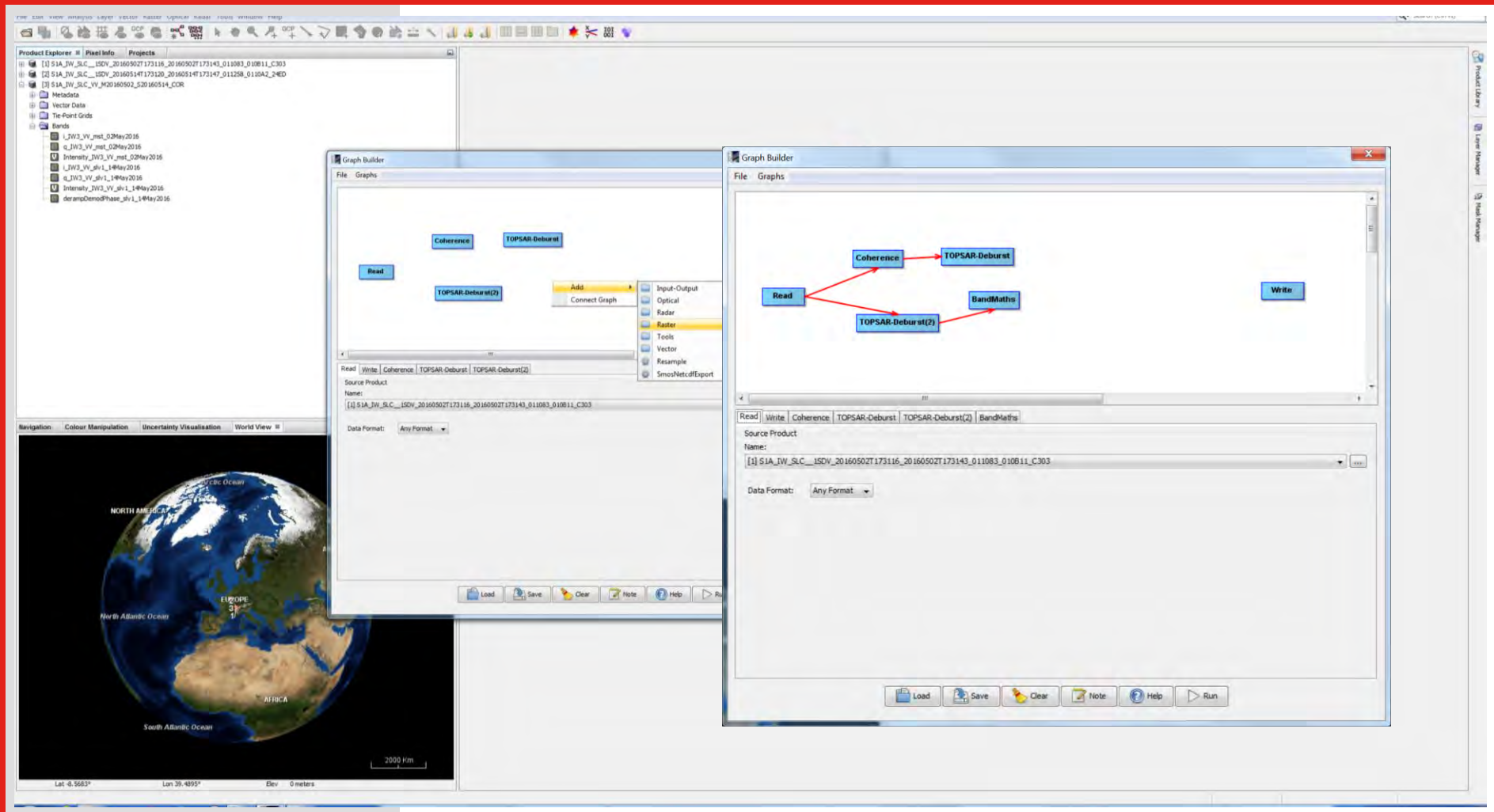
3 STEP: Coherence and Backscatter stack generation



CATAPULT Satellite Applications

3 STEP: Coherence and Backscatter stack generation



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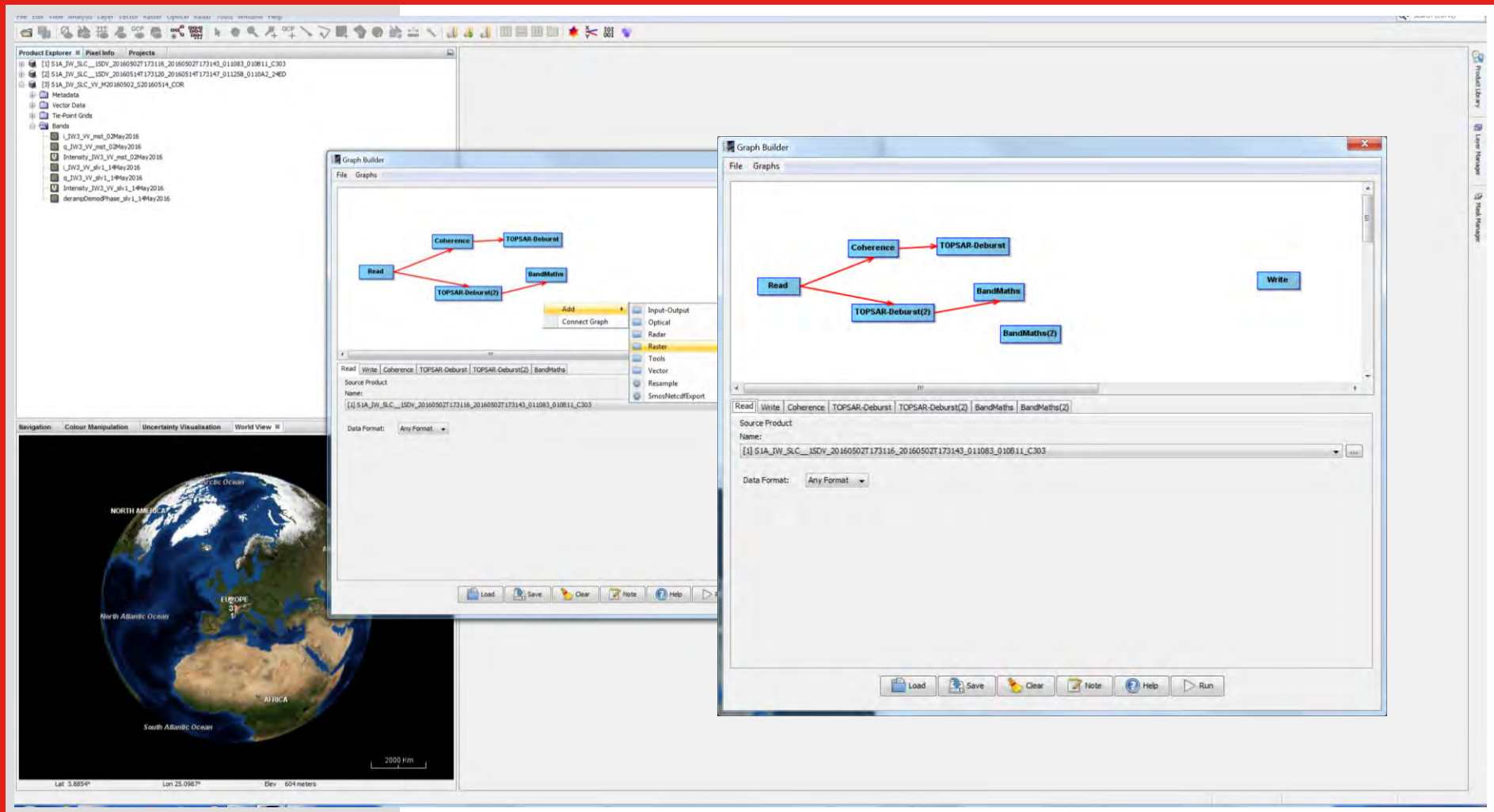
3 STEP: Coherence and Backscatter stack generation



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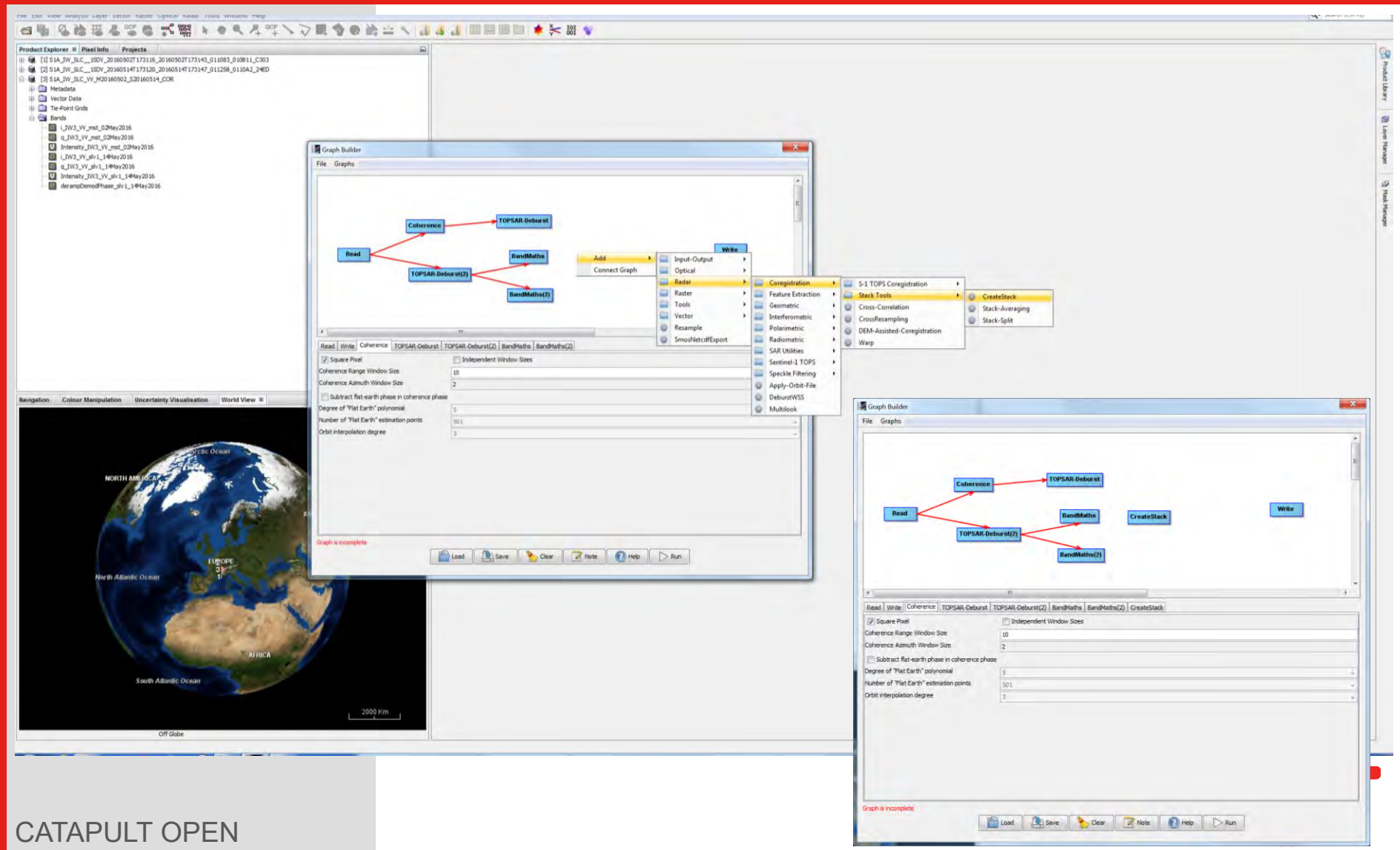
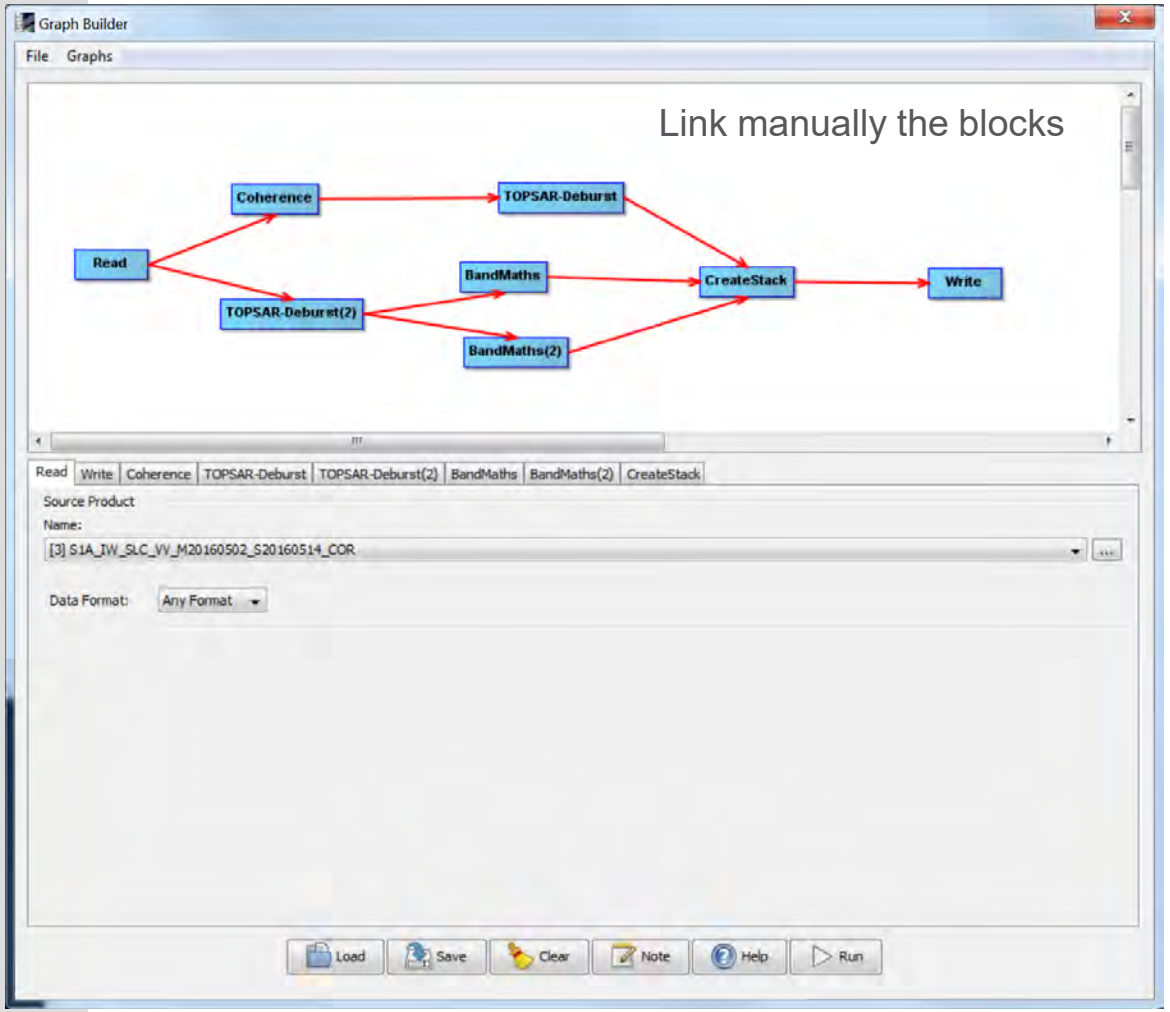
3 STEP: Coherence and Backscatter stack generation



3 STEP: Coherence and Backscatter stack generation



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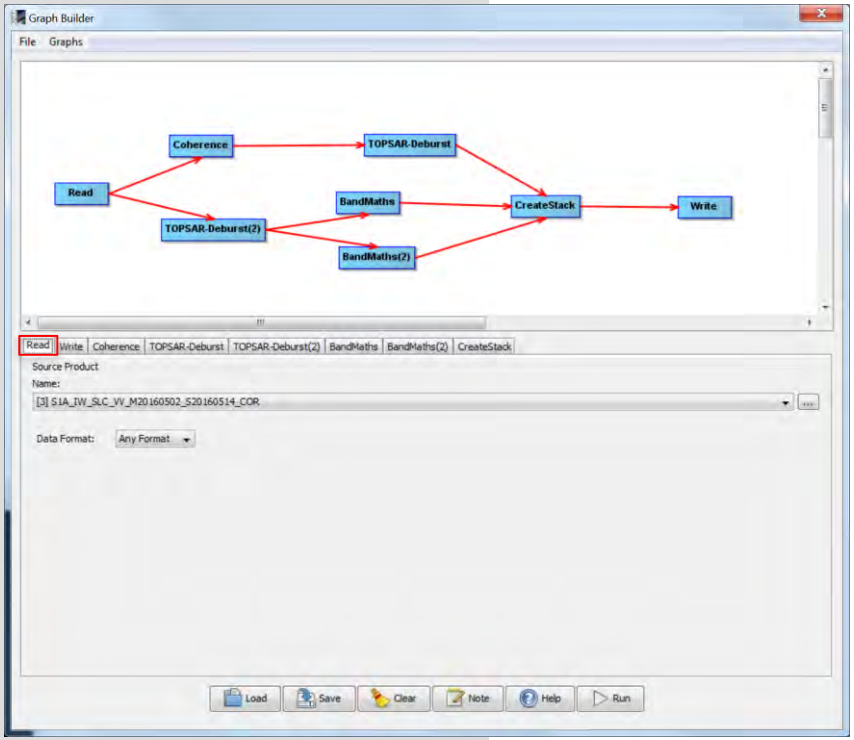
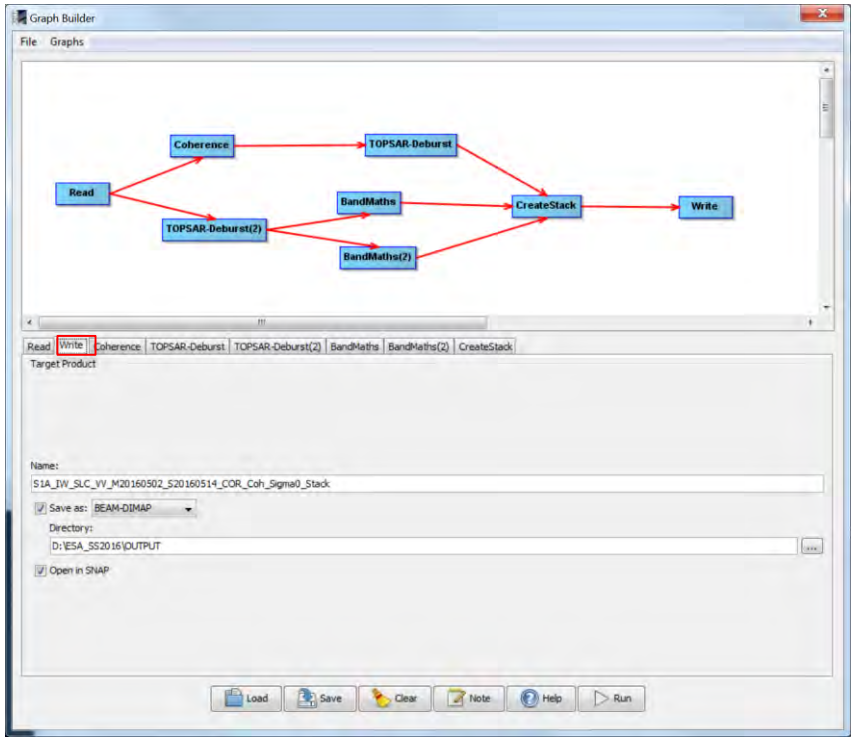
3 STEP: Parameters





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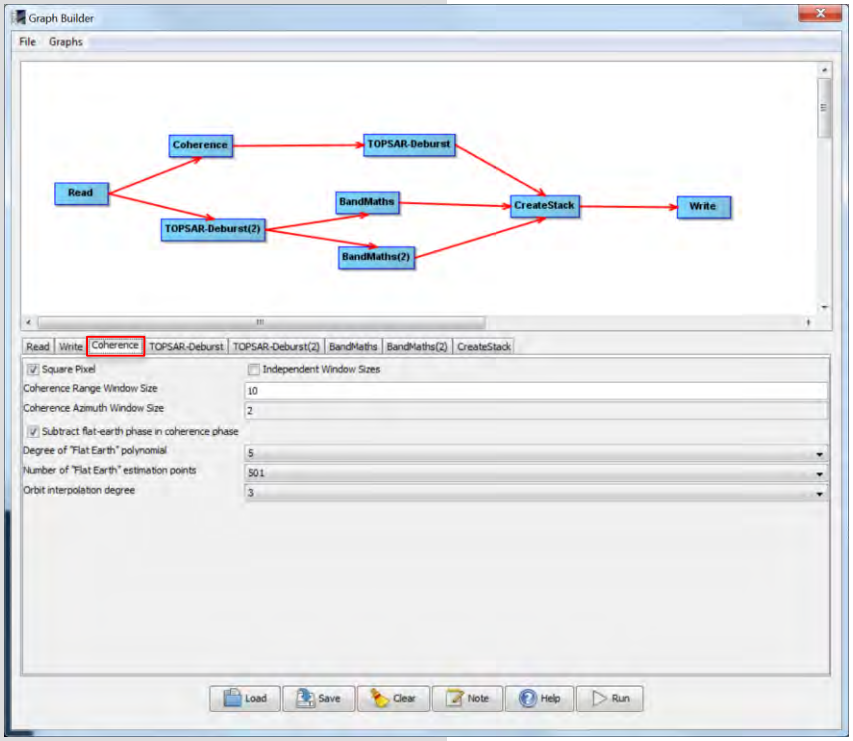
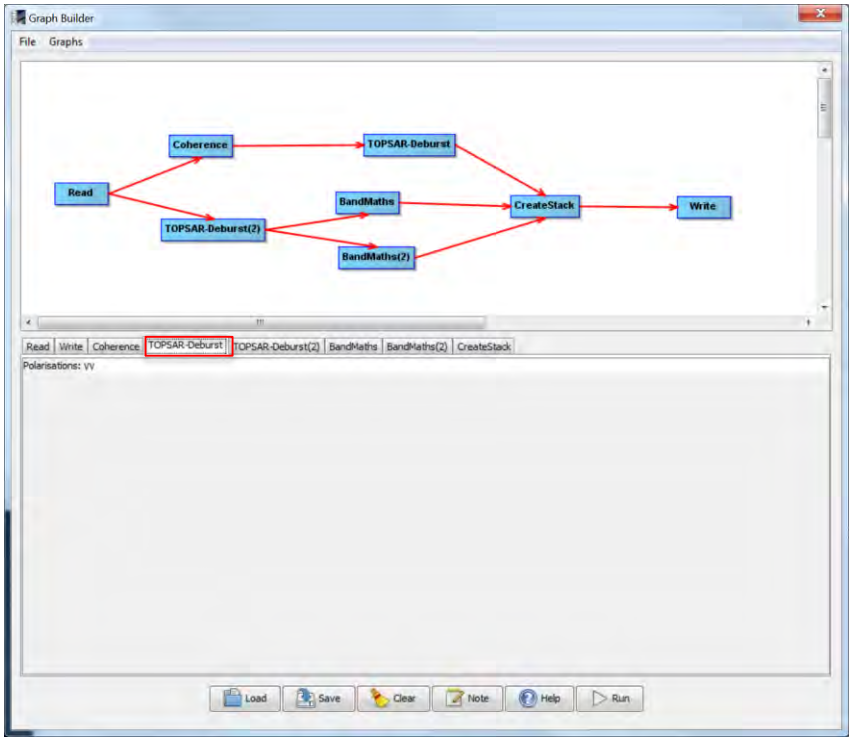
3 STEP: Parameters





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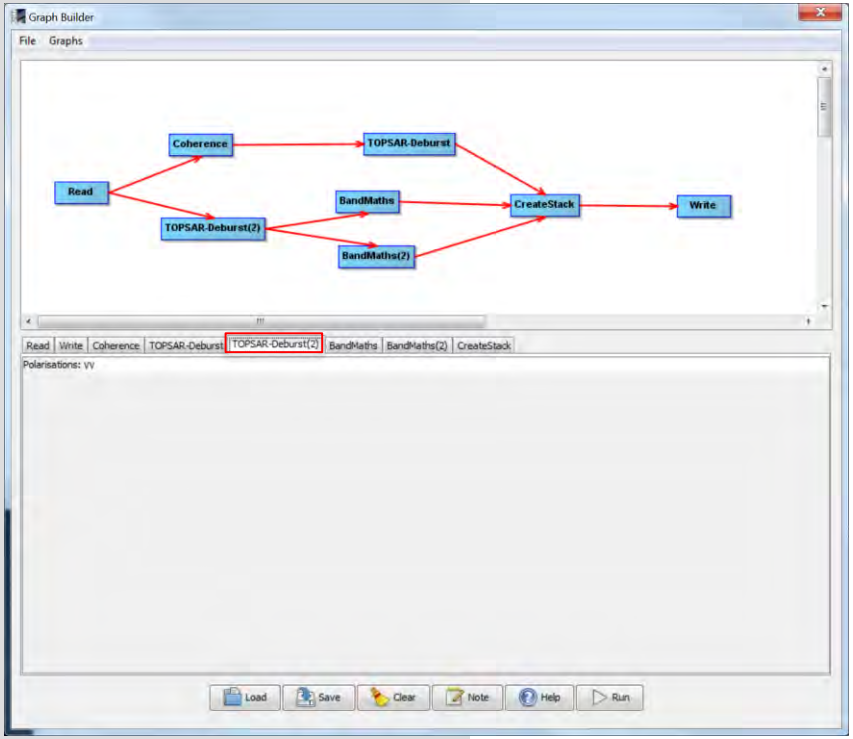
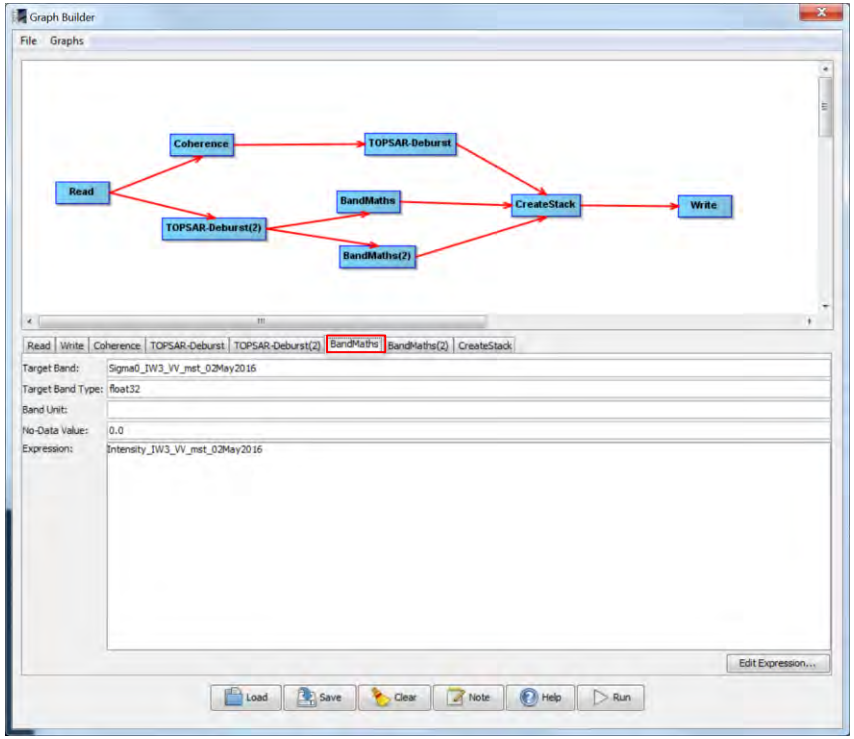
3 STEP: Parameters





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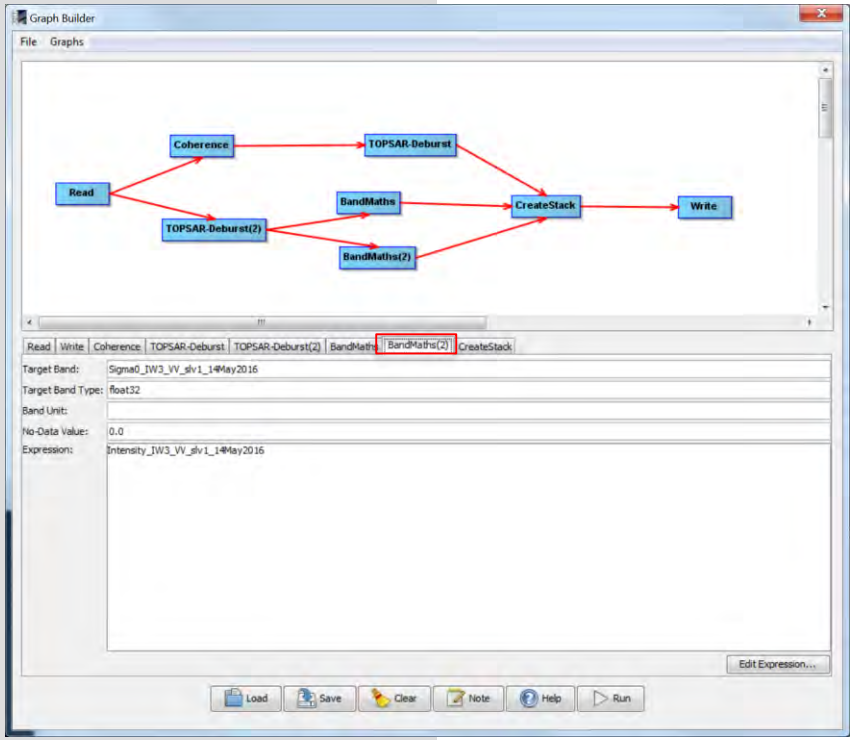
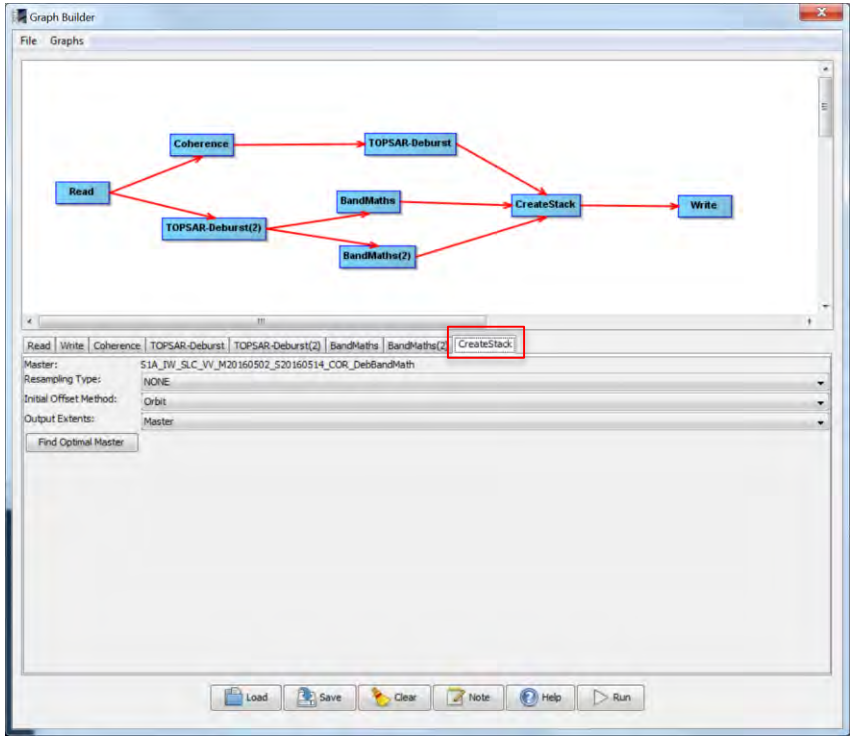
3 STEP: Parameters





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4 Step: ML, Subset, Terrain Correction

Stack of
- Sigma0_VV_2 May2016
- Sigma0_VV_12 May2016
- Coherence 2may-12may

4.

Multilooking

Subset

Terrain Correction

GUI

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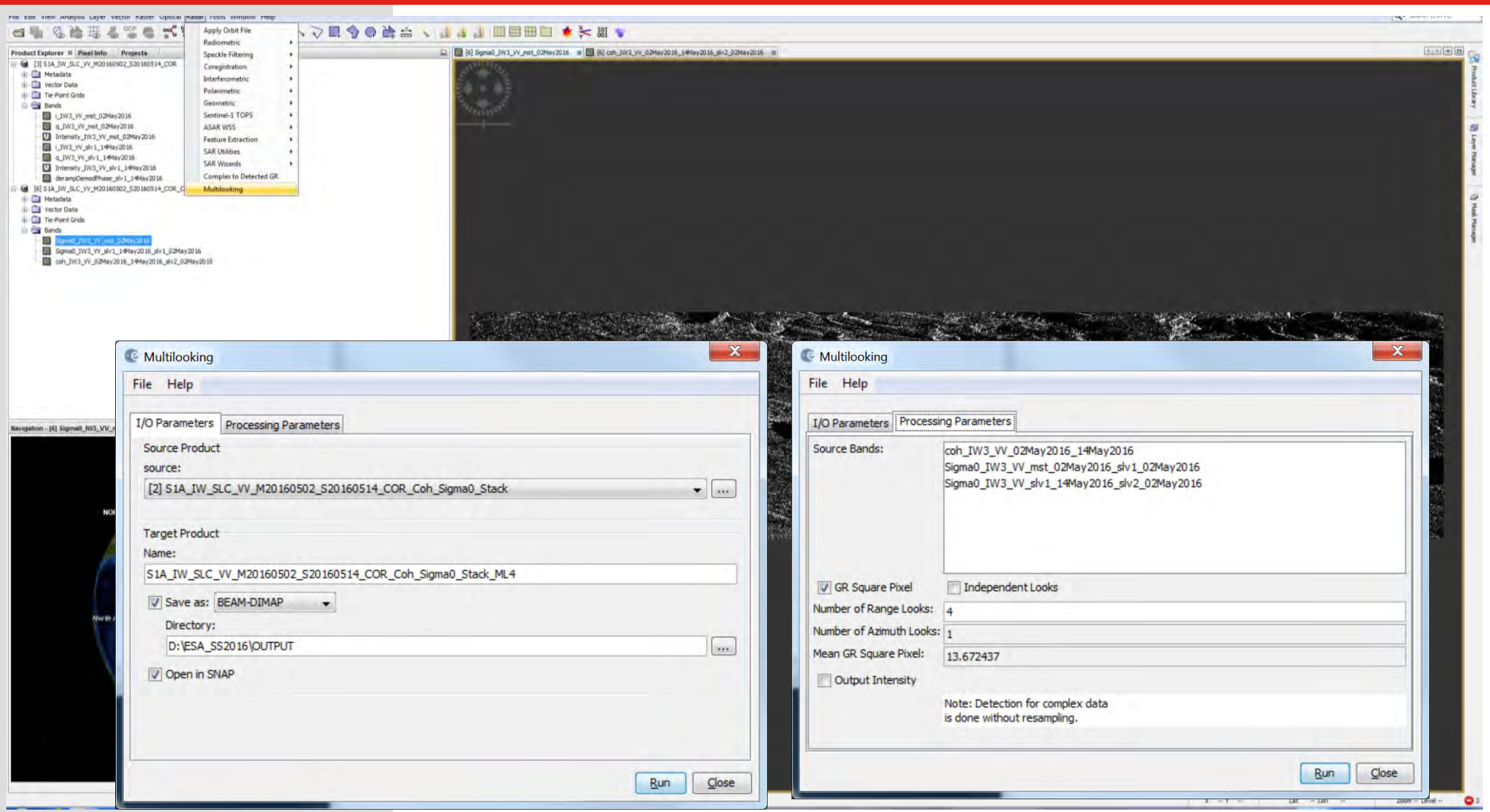
4 Step: ML



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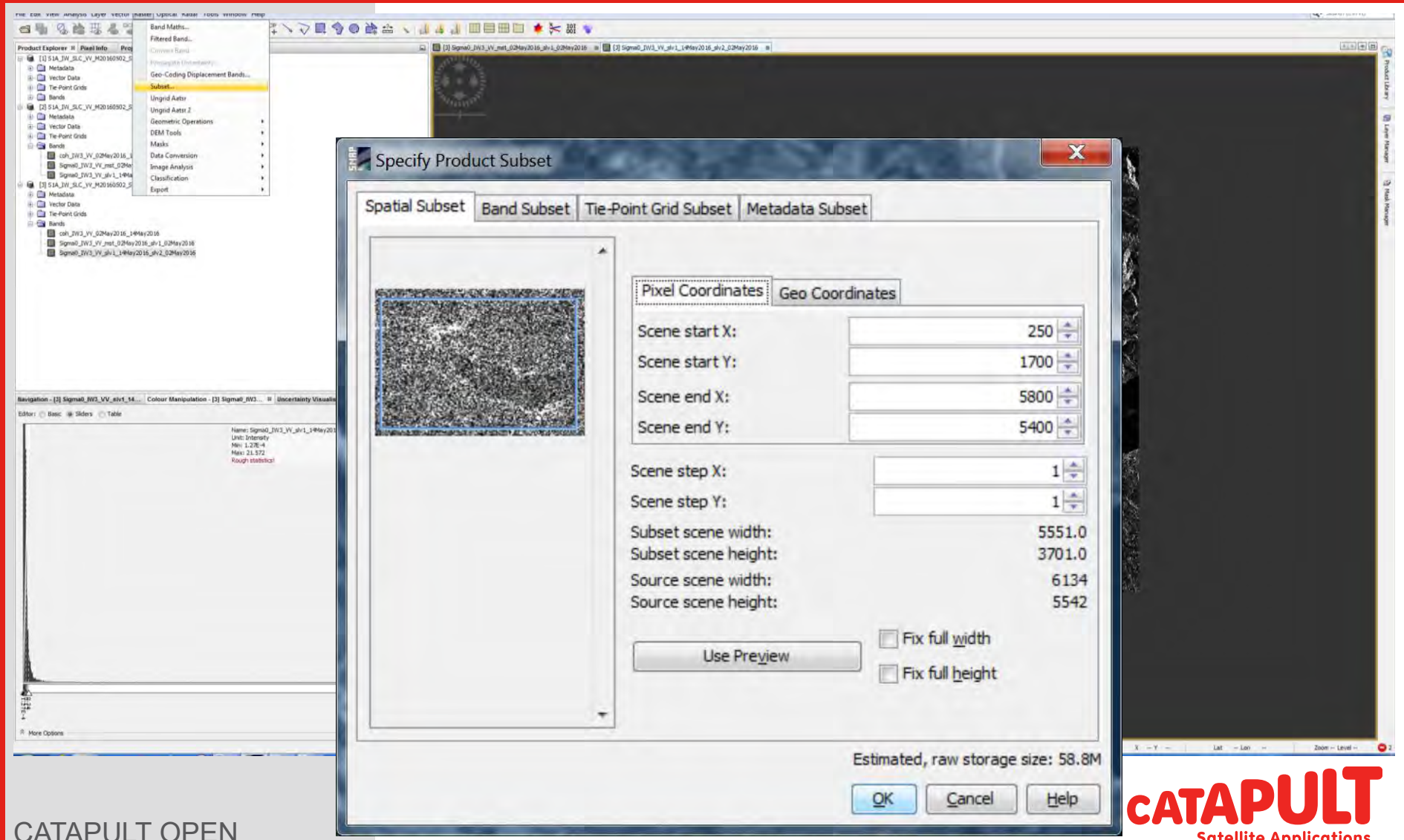
4 Step: Subset



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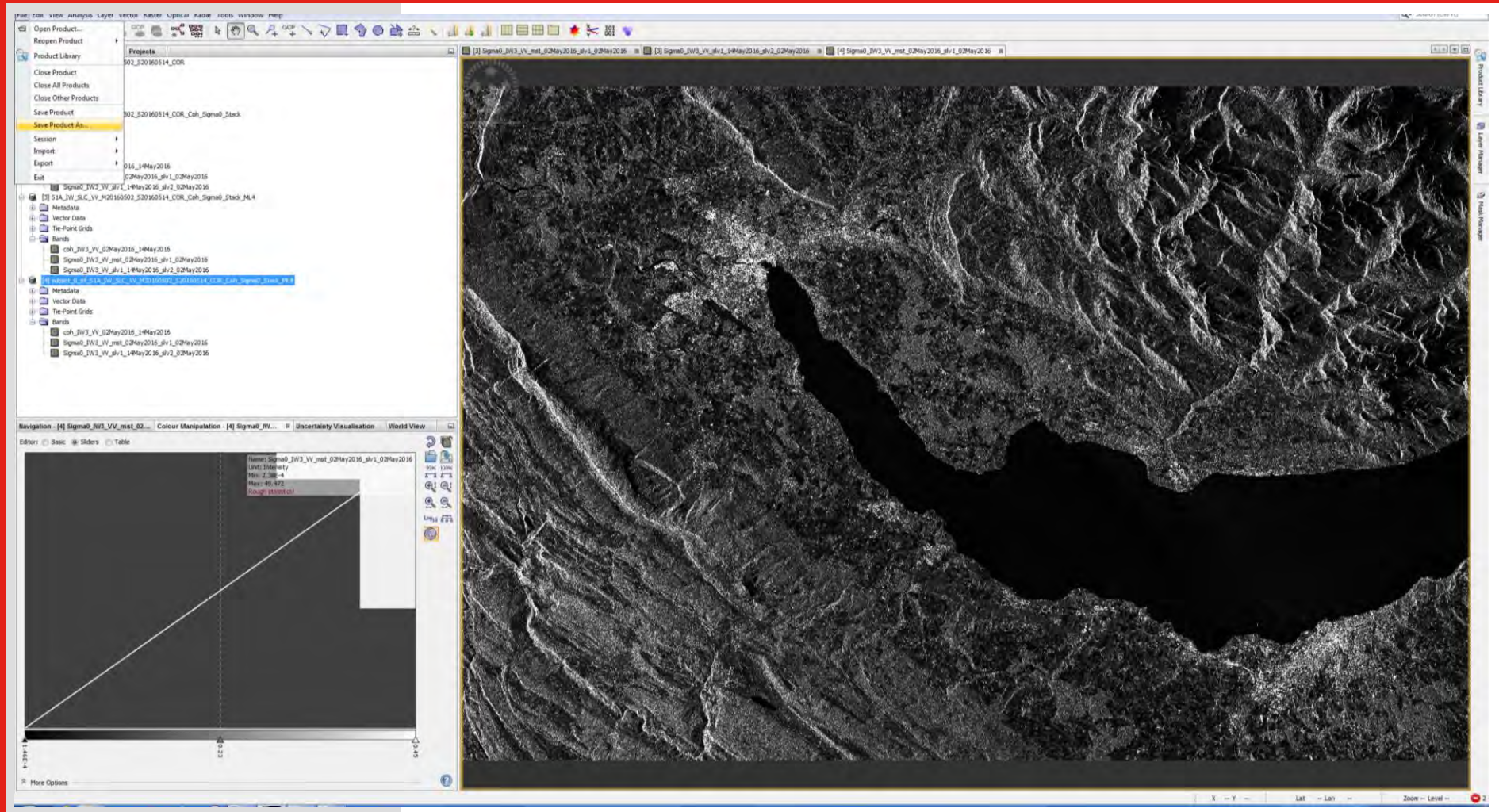
4 Step: Saving the subset



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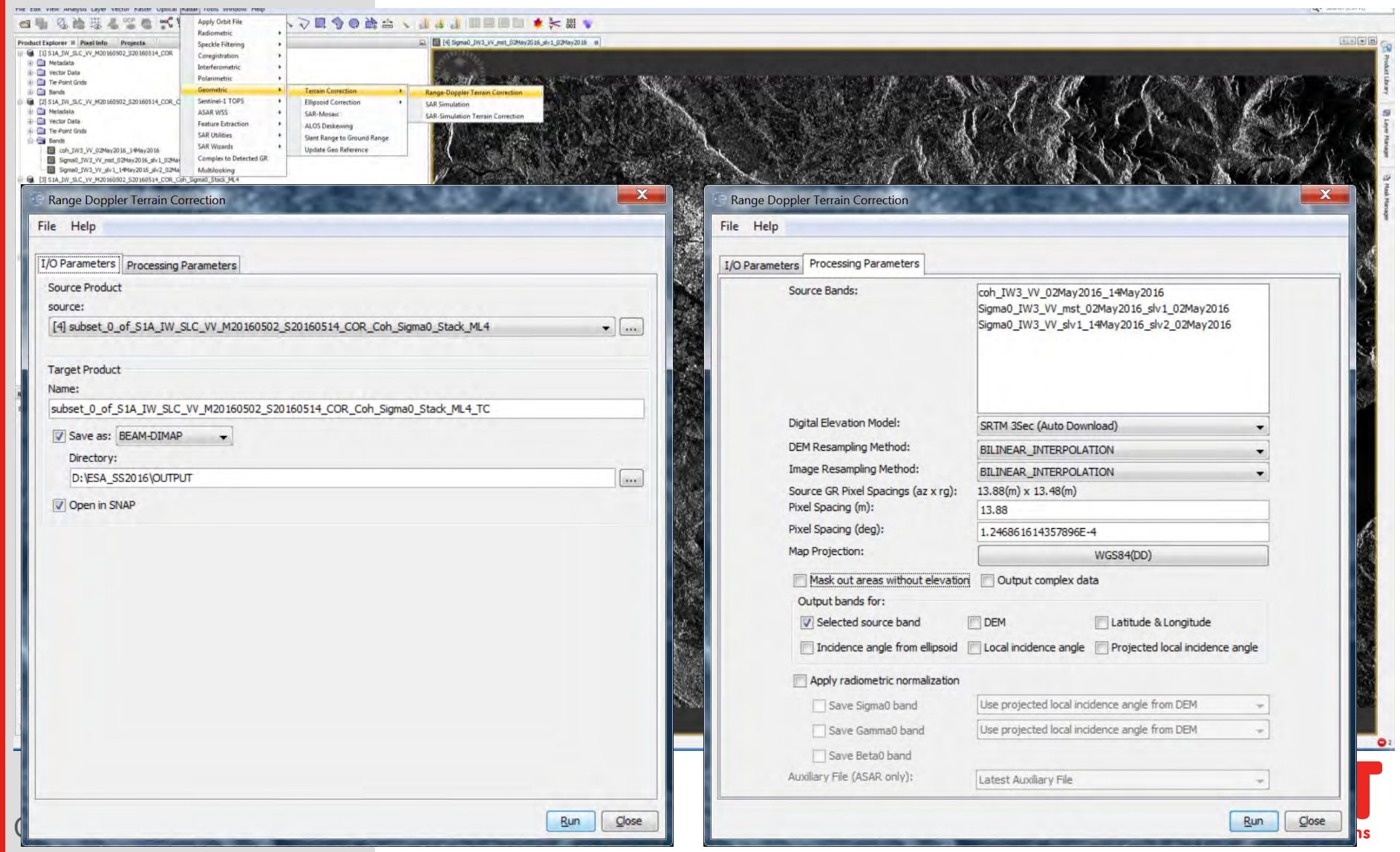
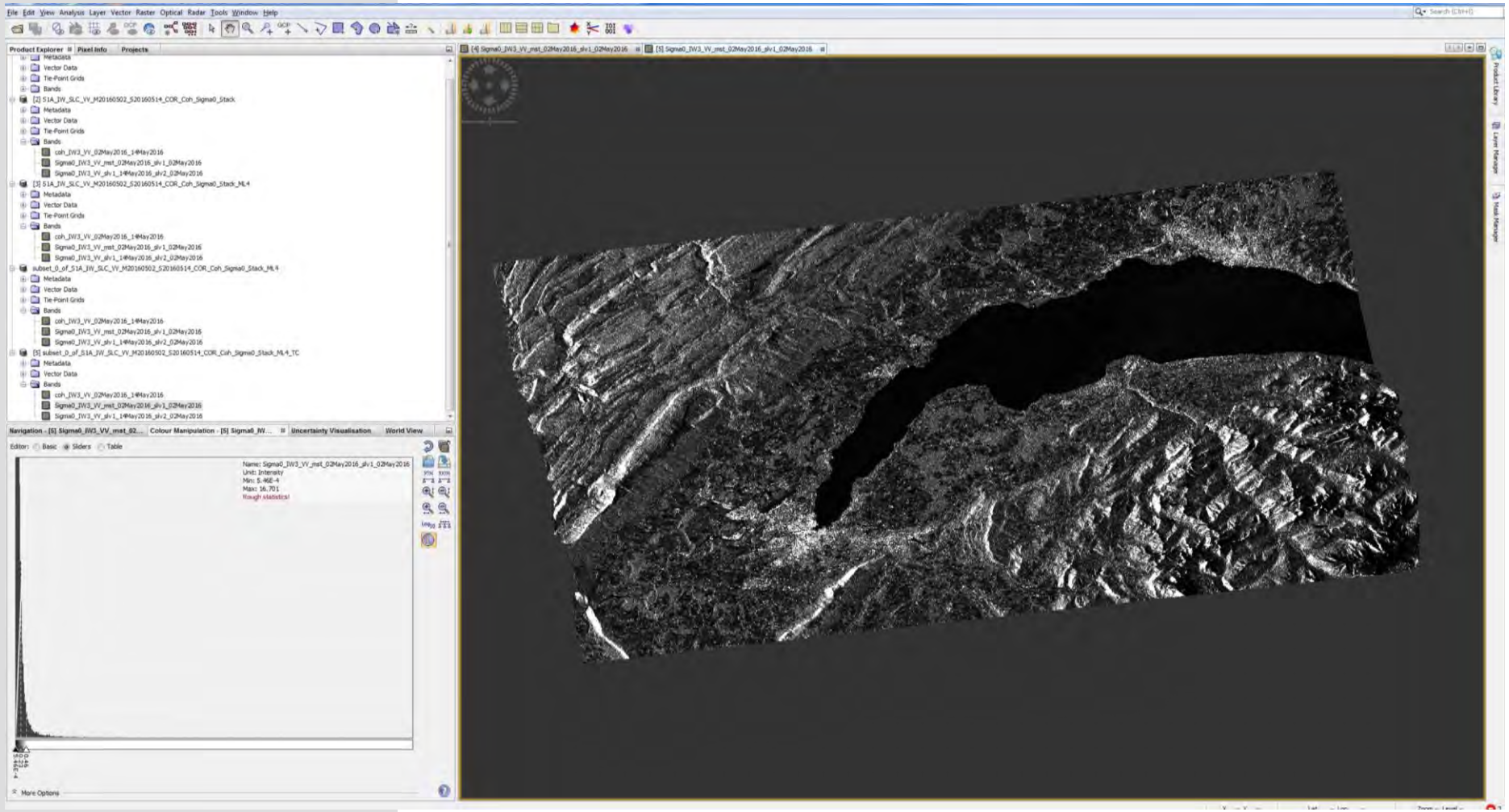
4 Step: Terrain Correction



Step 5 - Analysis



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Step 5 - Analysis

Stack of Multilooked and terrain corrected

- Sigma0_VV_2 May2016
- Sigma0_VV_12 May2016
- Coherence 2may-12may

5.

- Linear to db
- Ratio 2May/12 May
- RGB Backscatters and Backscatter ratio
- RGB Coherence and Backscatter
- Export to Google Earth

GUI

Analysis

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5 Step – Change detection

- Backscatter intensity and the interferometric correlation are relatively independent quantities containing complementary thematic information.
- The additional information contained in the interferometric correlation can be used for land-use classification and the retrieval of geophysical and biophysical parameters.

RGB composite = R $Sigma0_{1date}$, G $Sigma0_{2\ date}$, B Ratio $Sigma0_{1date}$/ $Sigma0_{2\ date}$

RGB composite = R $Coherence_{1date\text{-}2date}$, G $Sigma0_{1date}$, B Ratio $Sigma0_{1date}$/ $Sigma0_{2\ date}$

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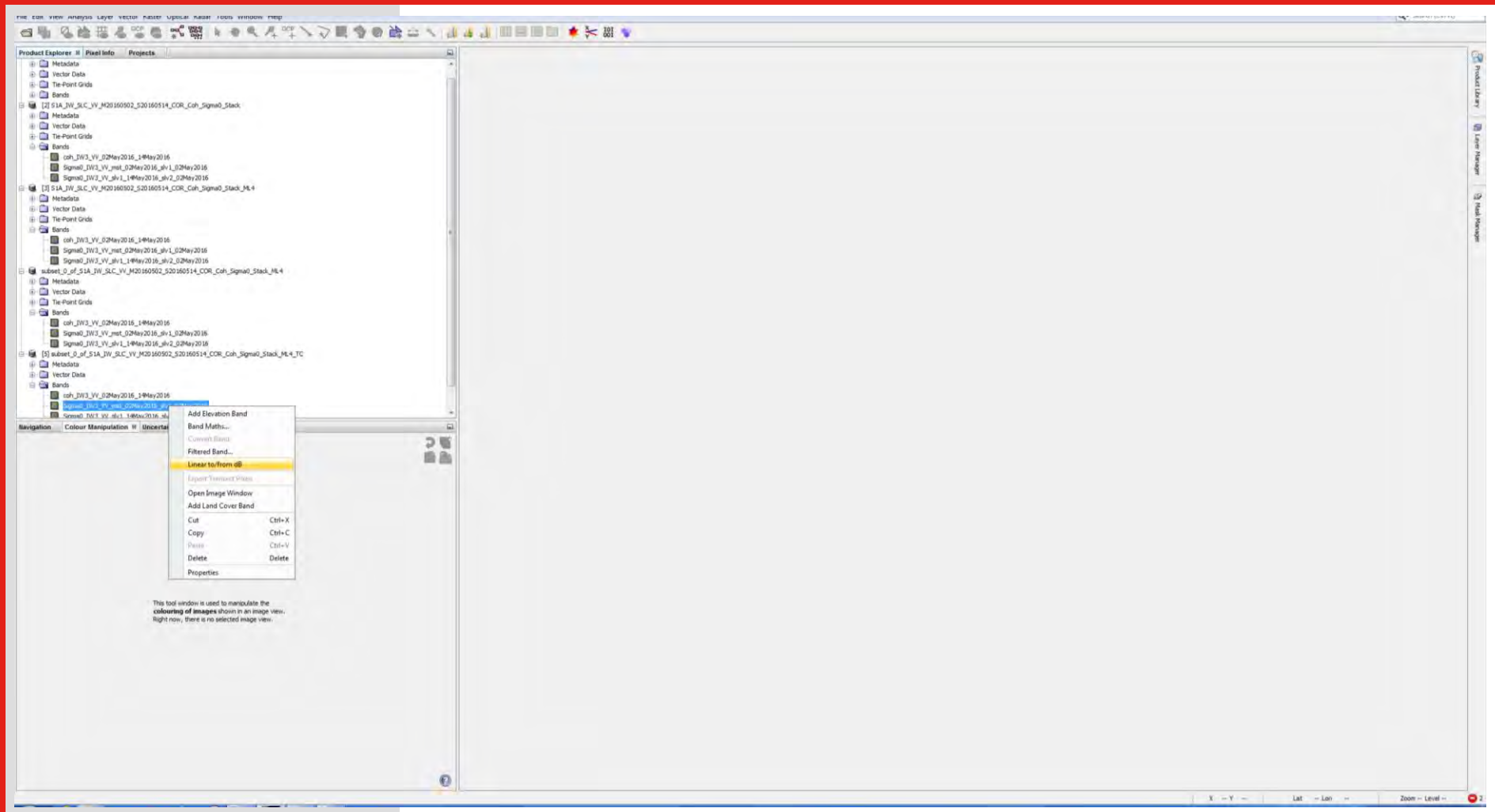
Step 5: Linear to db



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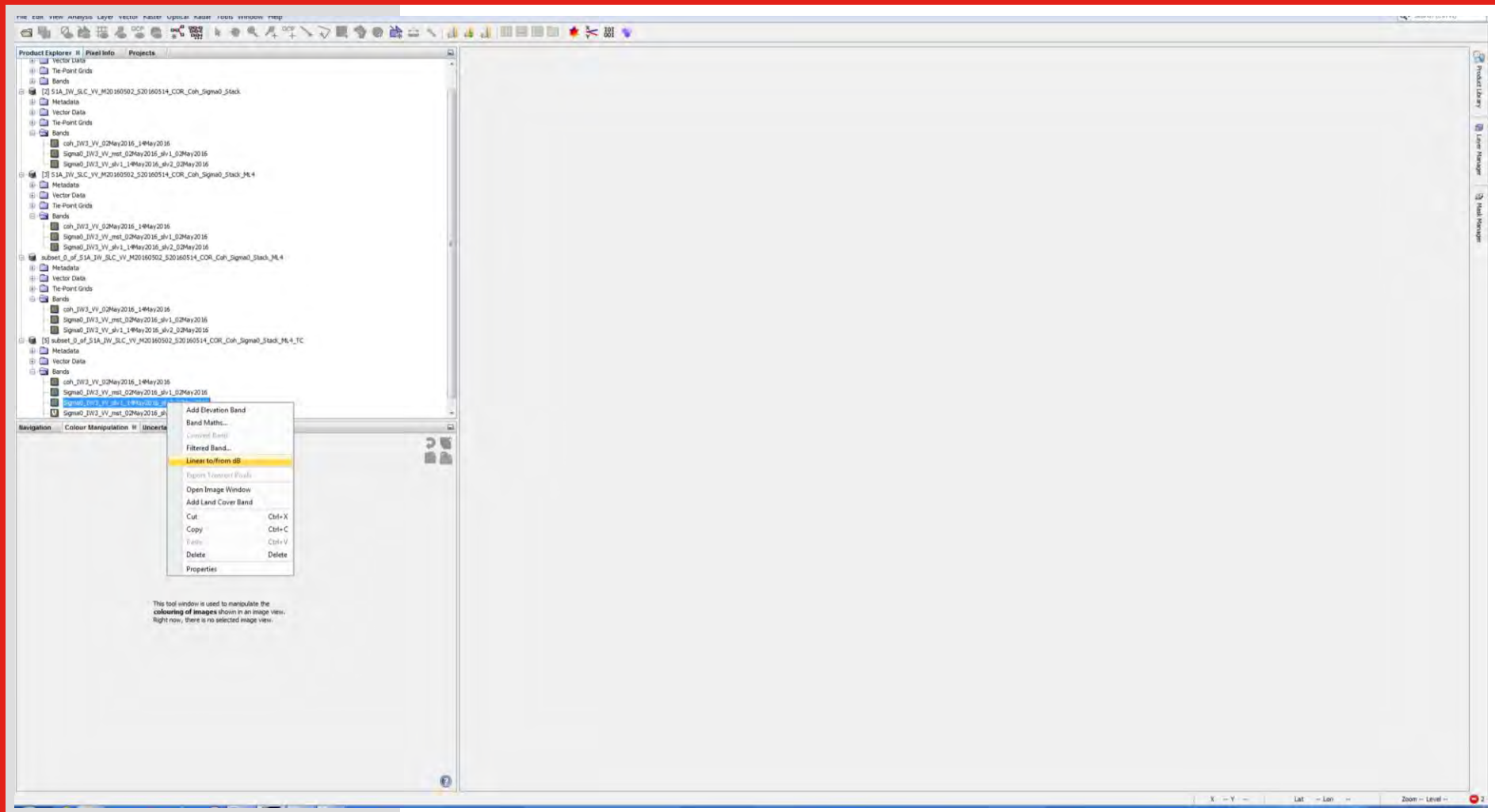
Step 5: Linear to db



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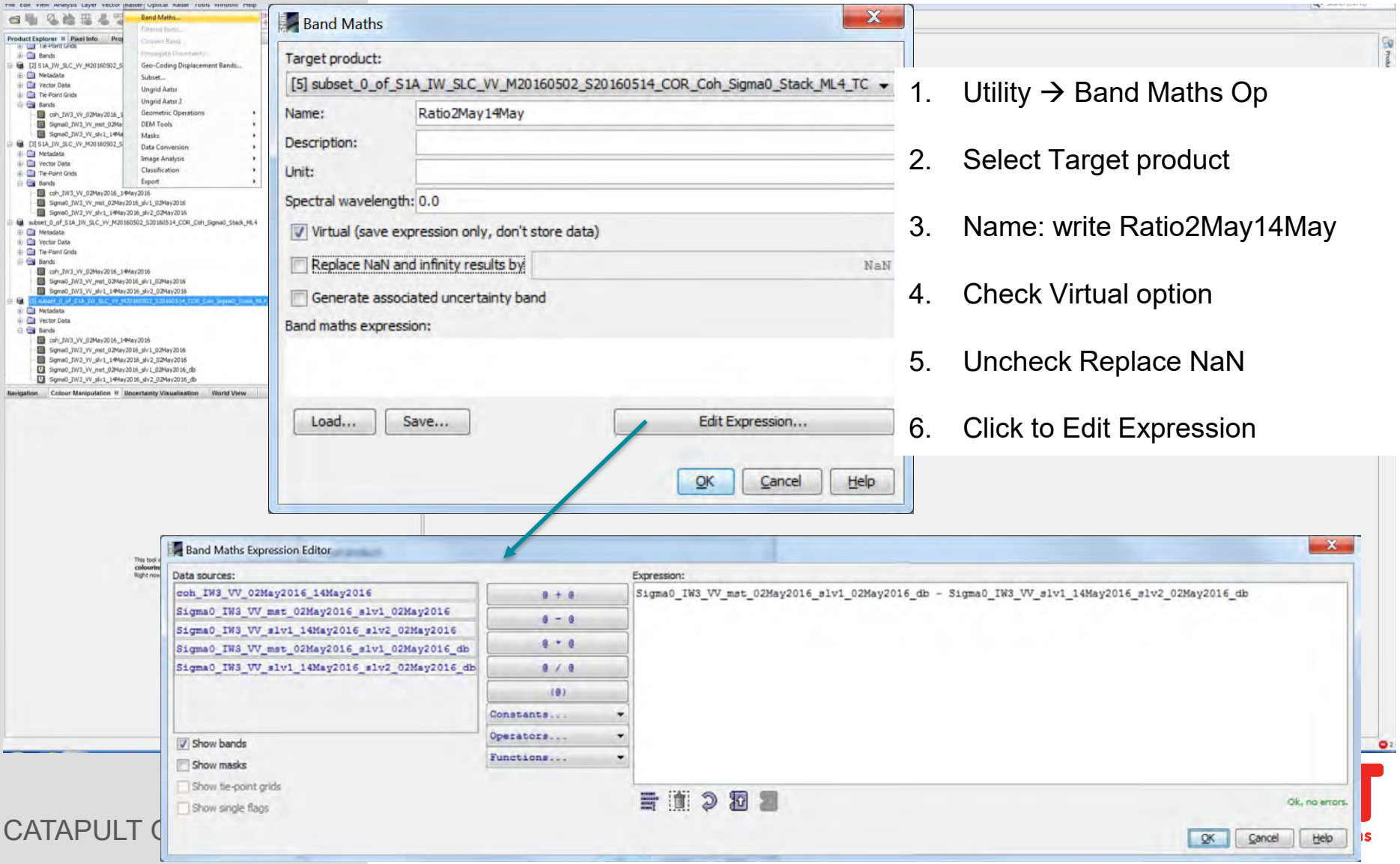
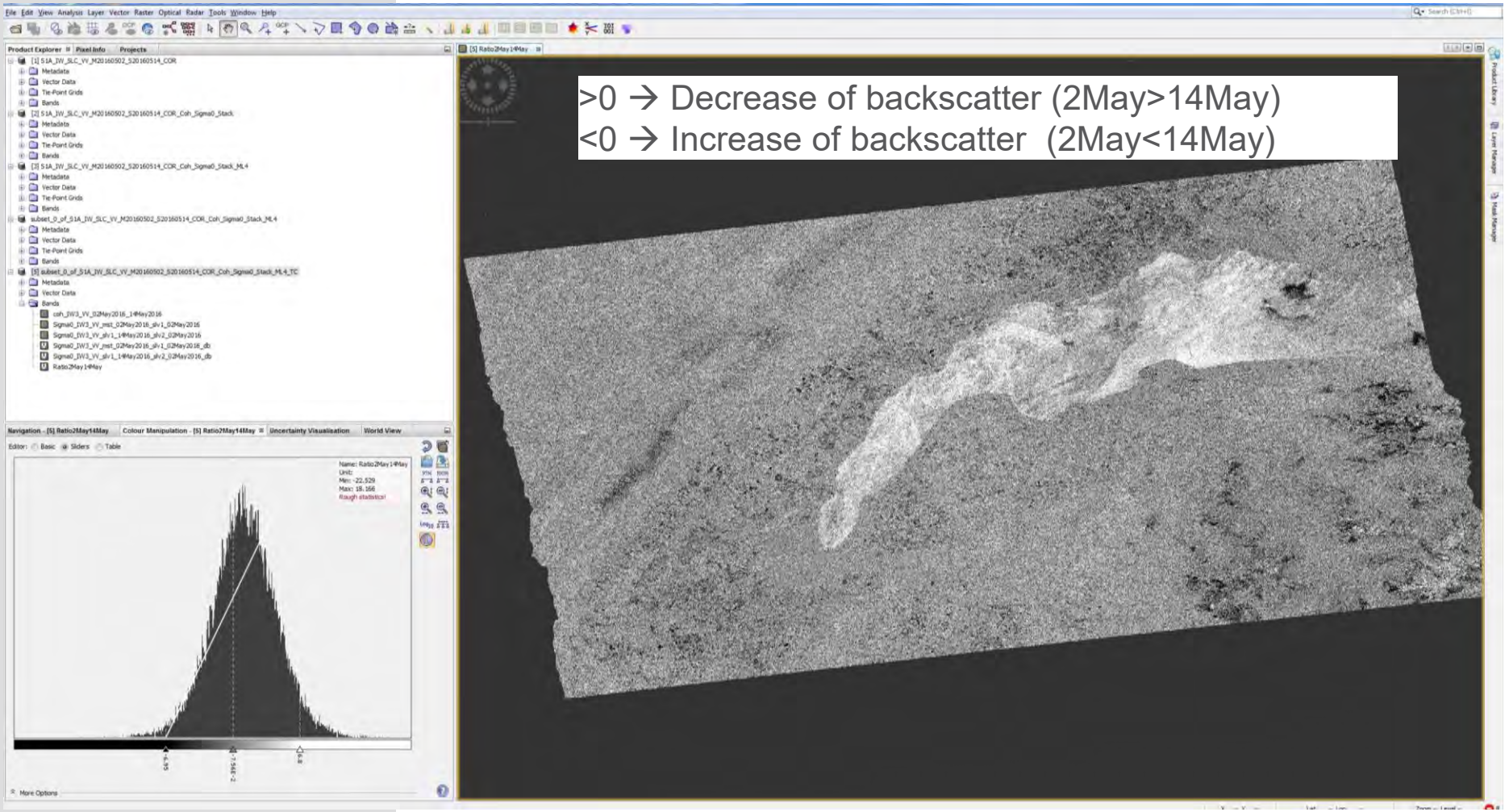
Step 5: Ratio 2May/12 May (band maths Op)



1. Utility → Band Maths Op
2. Select Target product
3. Name: write Ratio2May14May
4. Check Virtual option
5. Uncheck Replace NaN
6. Click to Edit Expression

Step 5: Ratio 2May/12 May



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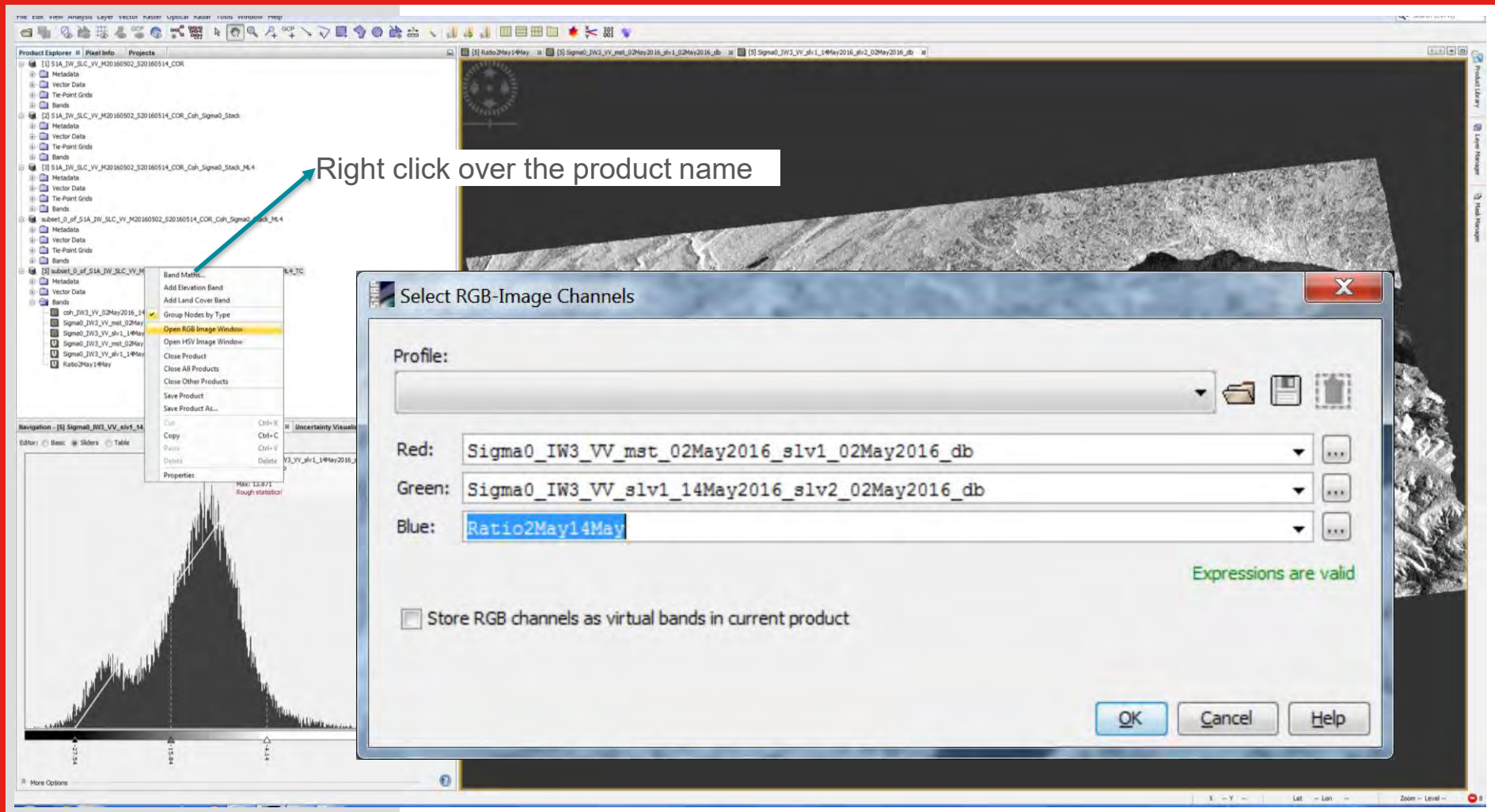
Step 5: Visualisation RGB (Backscatter and ratio)



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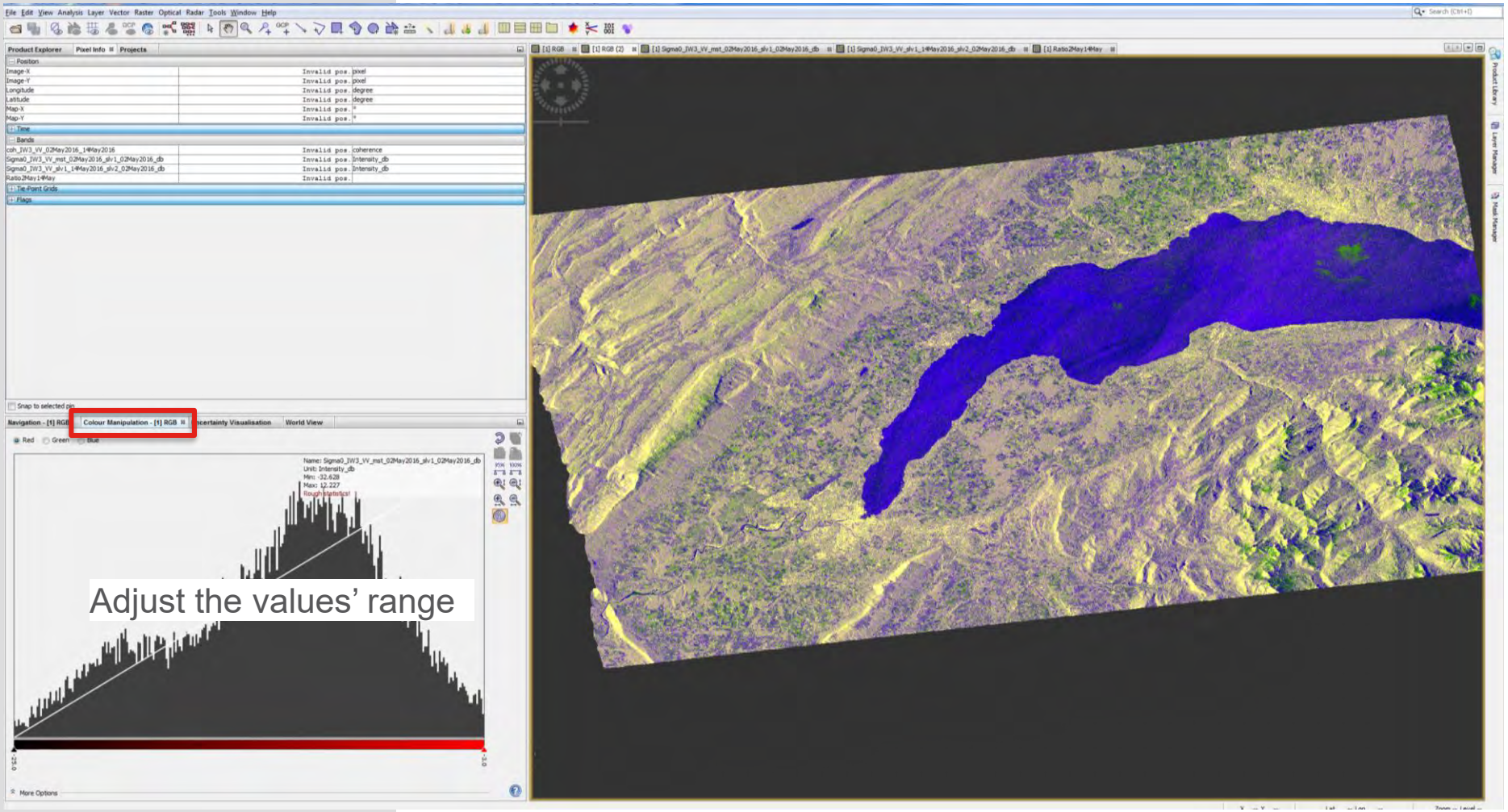
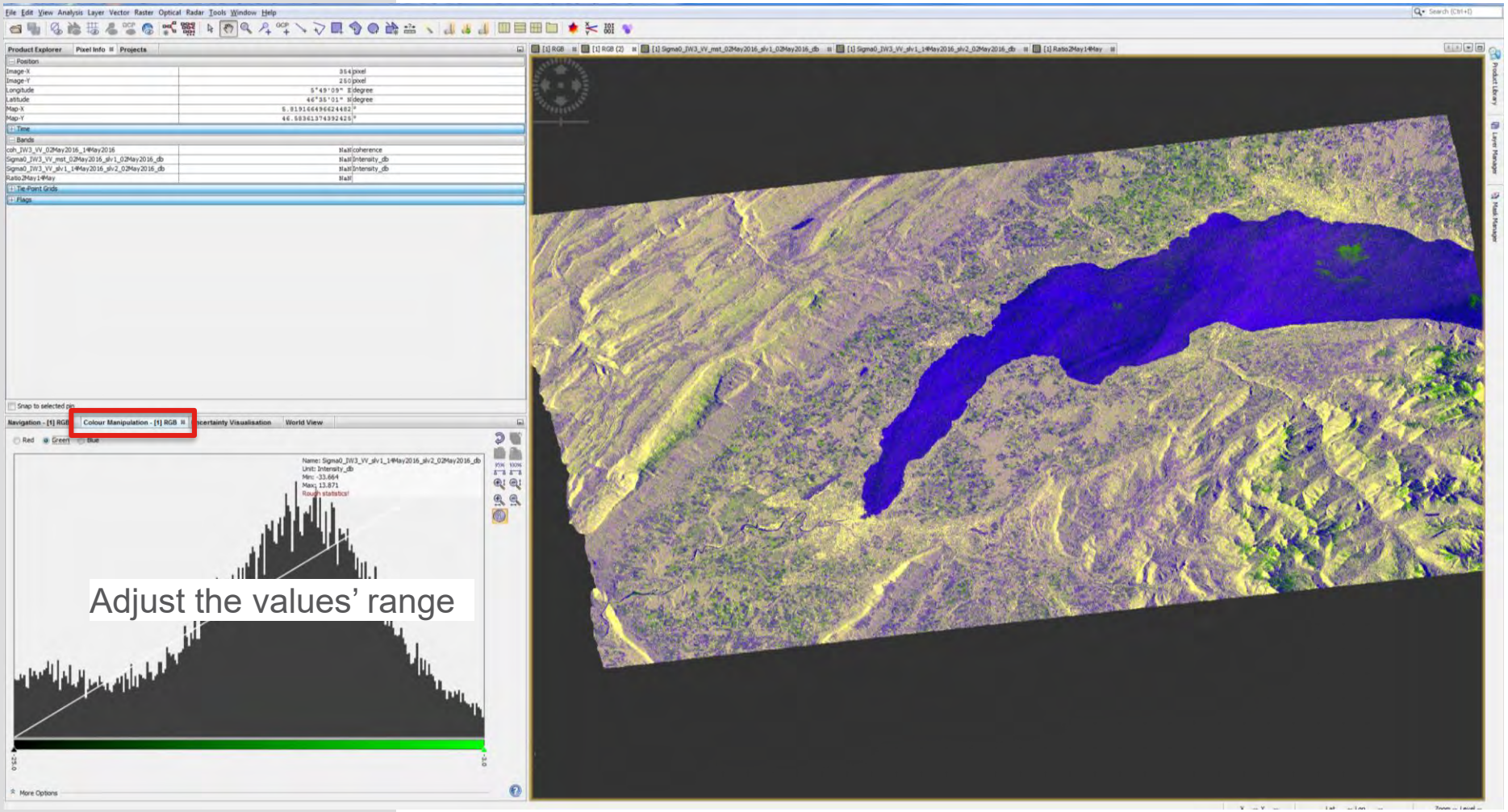
Step 5: Adjusting the range (Backscatter and ratio)



CATAPULT Satellite Applications

Step 5: Adjusting the range (Backscatter and ratio)



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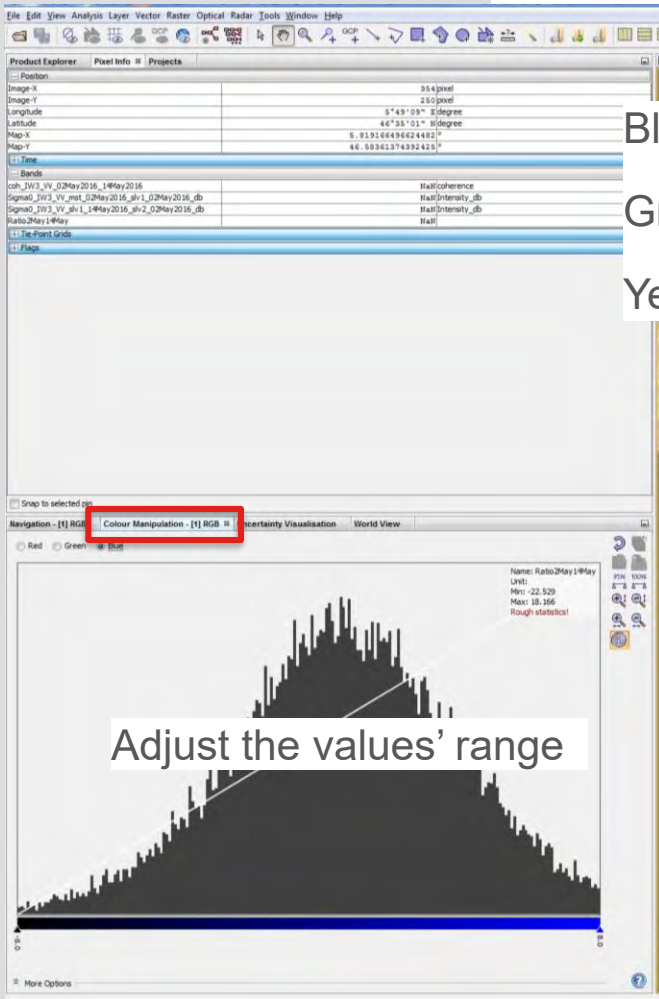
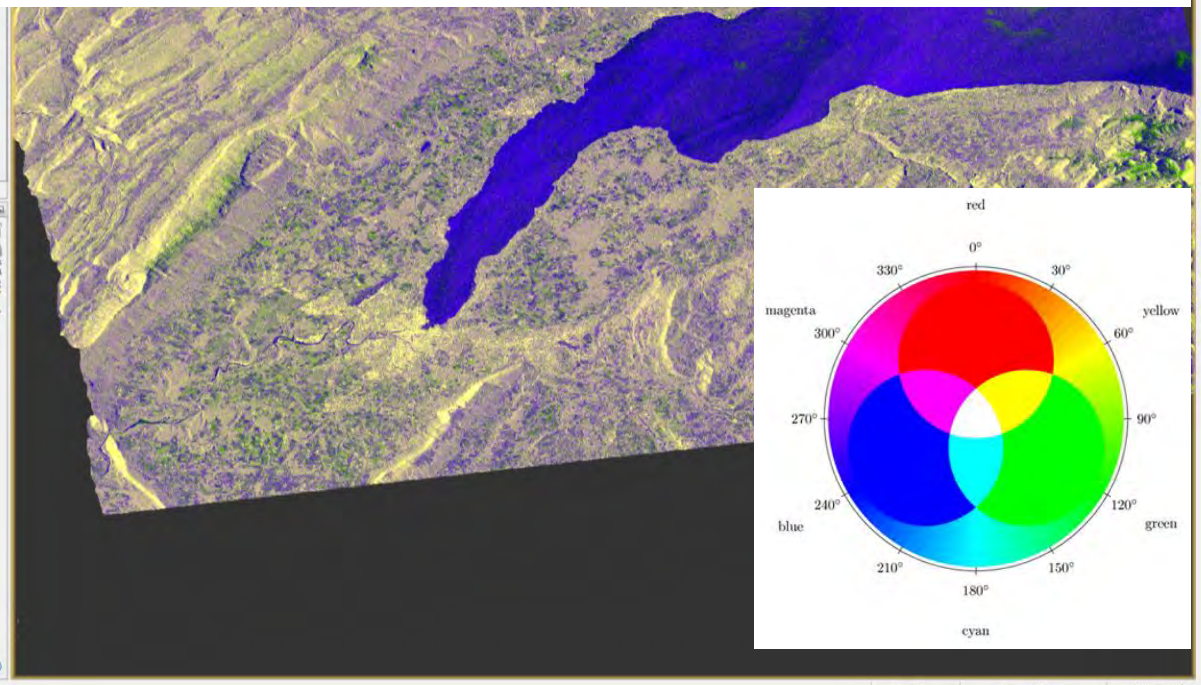
Step 5: Adjusting the range (Backscatter and ratio)

Blue - Magenta→ Decrease of backscatter (2May>14May)

Green → Increase of backscatter (2May<14May)

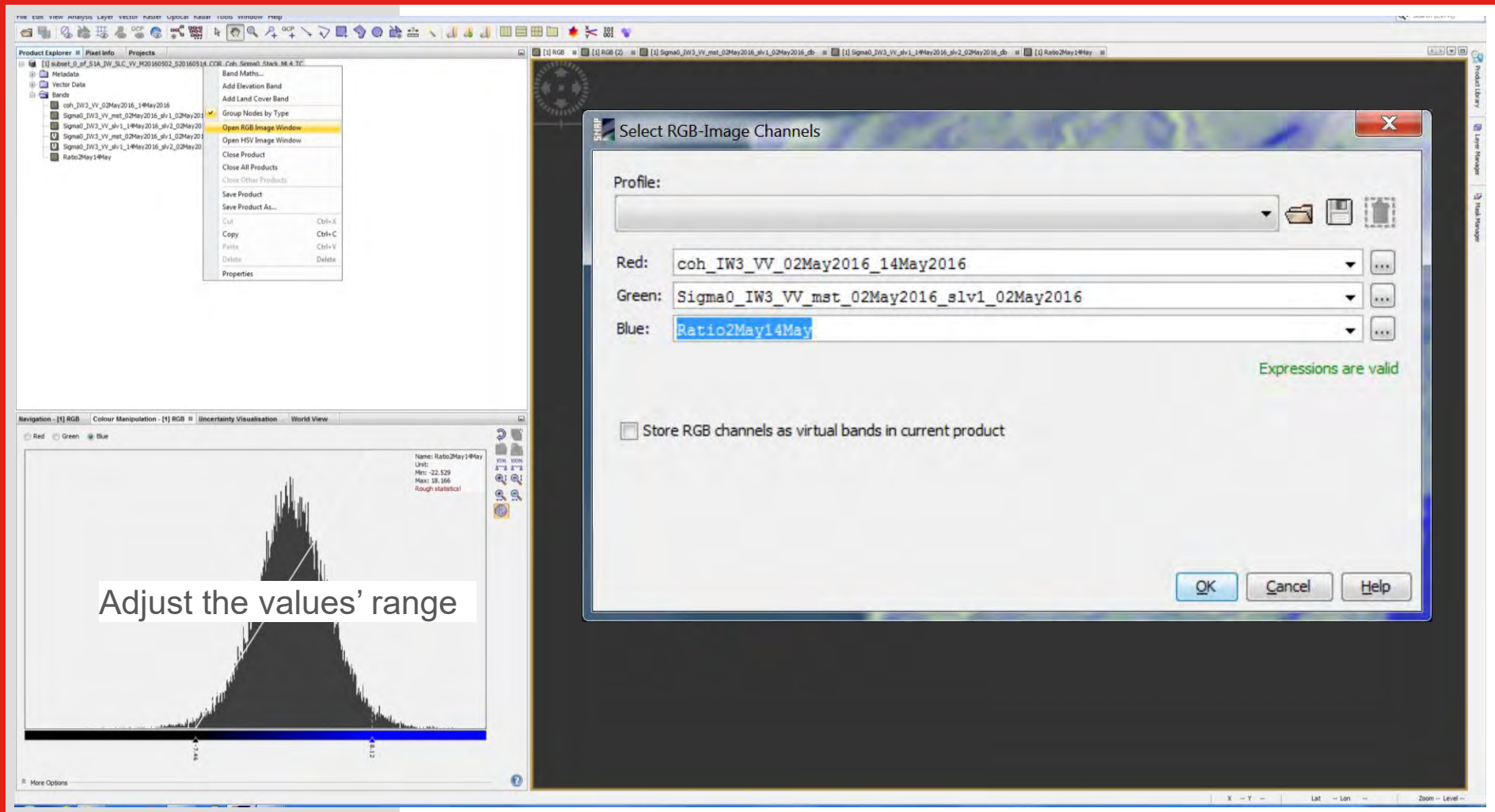
Yellow = Stable





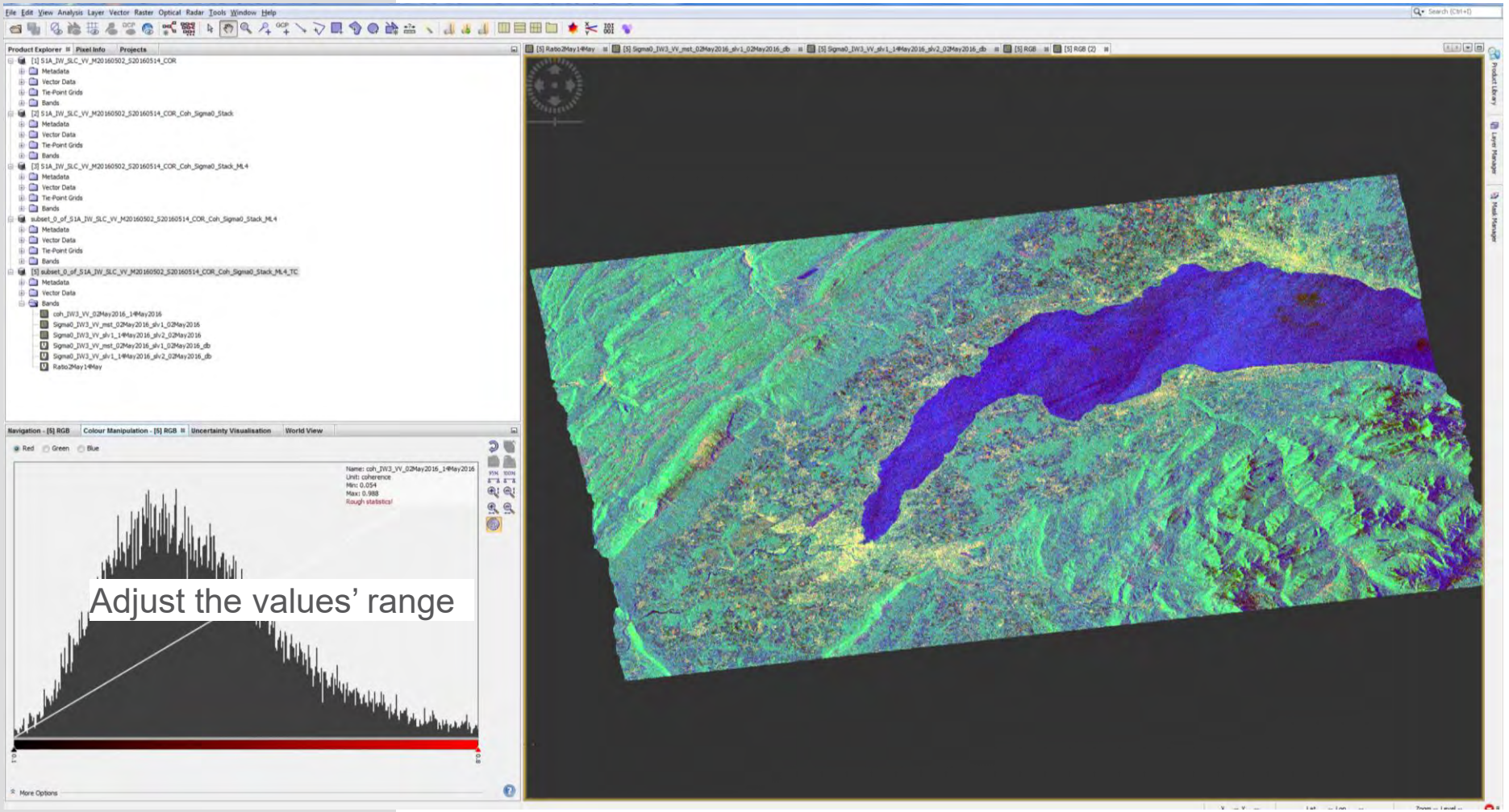
CATAPULT Satellite Applications

Step 5: Visualisation RGB (Coherence and Backscatter)



CATAPULT Satellite Applications

Step 5: Visualisation RGB (Coherence and Backscatter)



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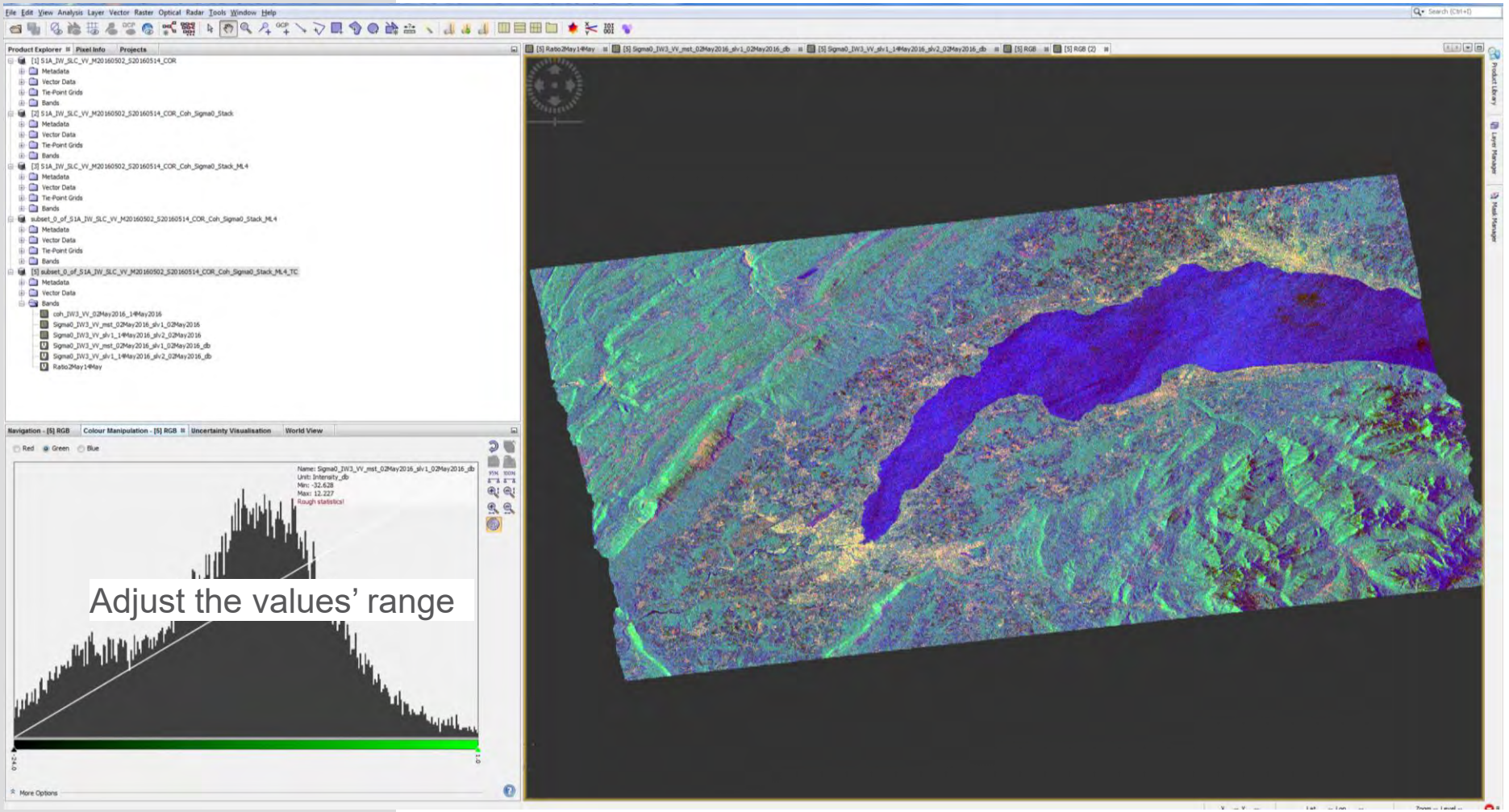
Step 5: RGB - Coherence and Backscatter



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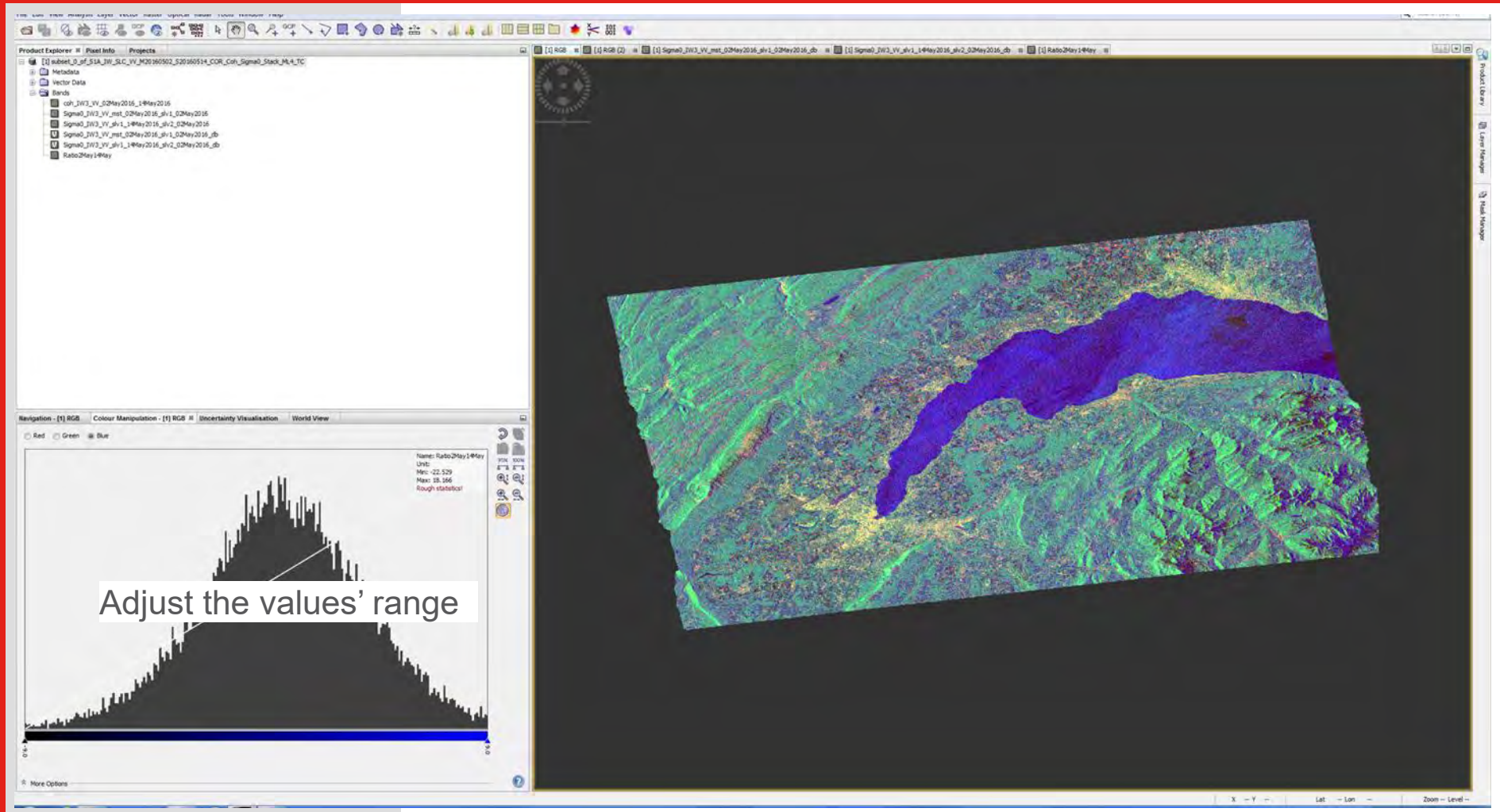
Step 5: RGB - Coherence and Backscatter



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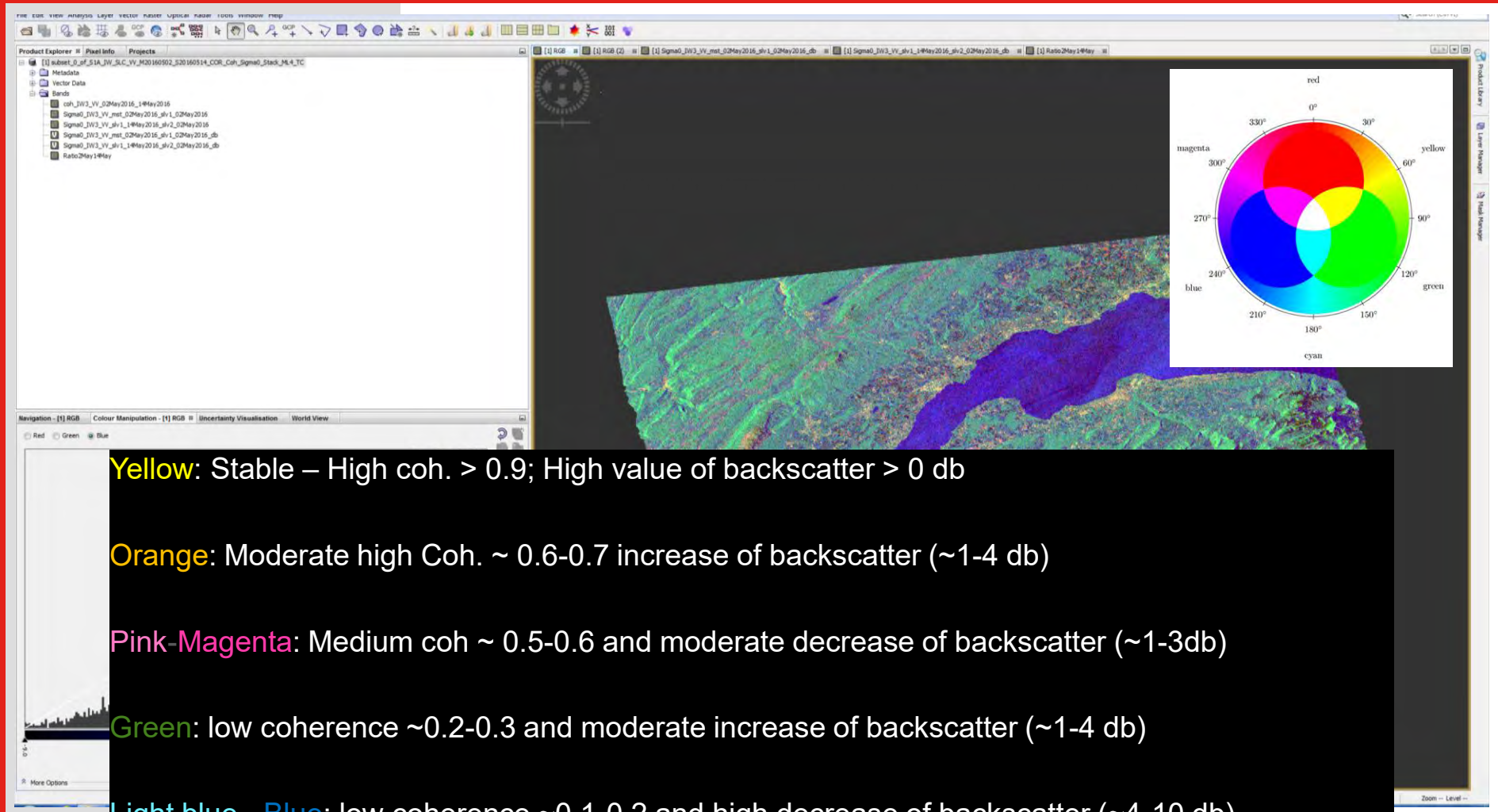
Step 5: RGB - Coherence and Backscatter



Yellow: Stable – High coh. > 0.9; High value of backscatter > 0 db

Orange: Moderate high Coh. ~ 0.6-0.7 increase of backscatter (~1-4 db)

Pink-Magenta: Medium coh ~ 0.5-0.6 and moderate decrease of backscatter (~1-3db)

Green: low coherence ~0.2-0.3 and moderate increase of backscatter (~1-4 db)

Light blue - Blue: low coherence ~0.1-0.2 and high decrease of backscatter (~4-10 db)

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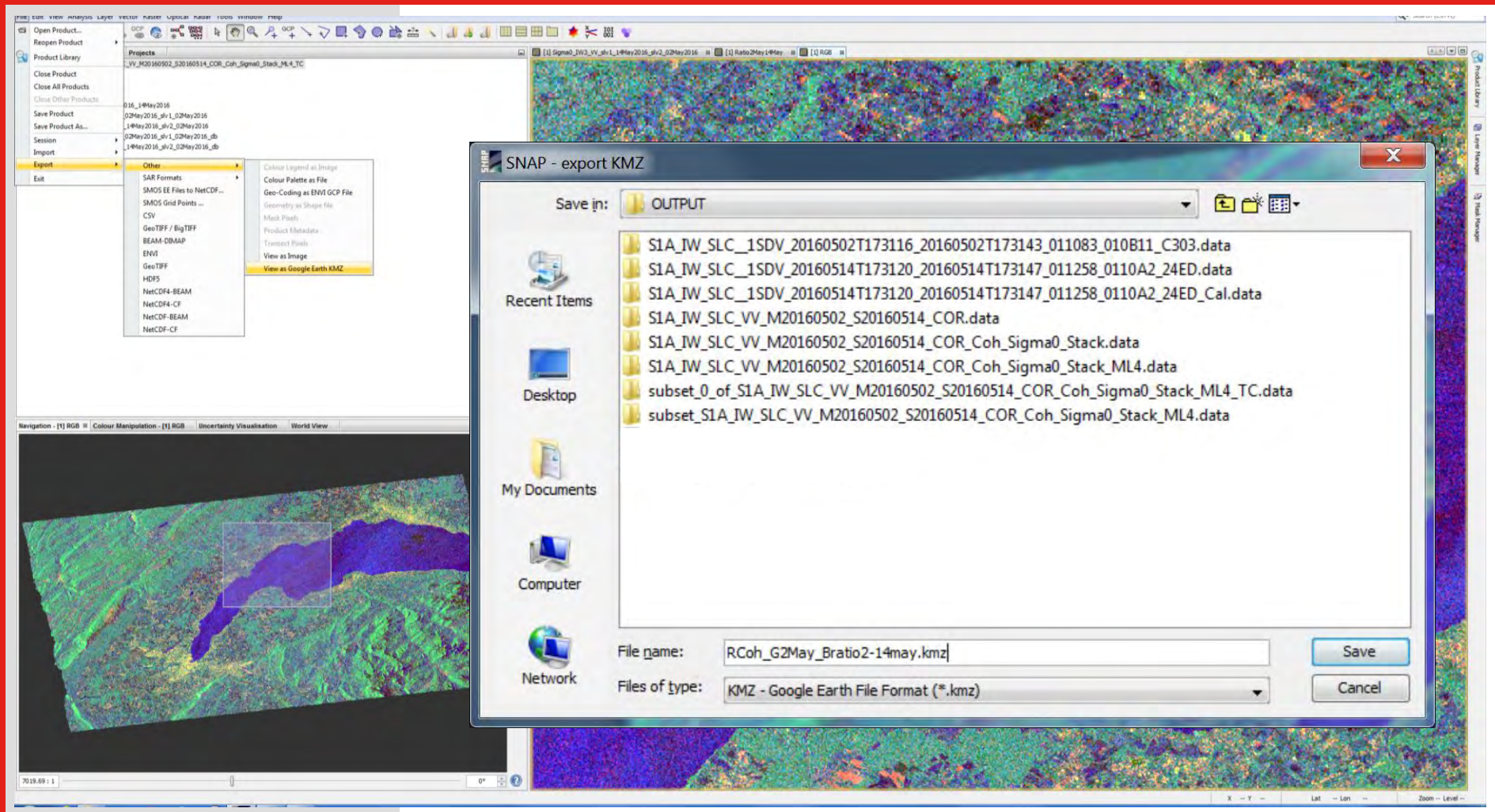
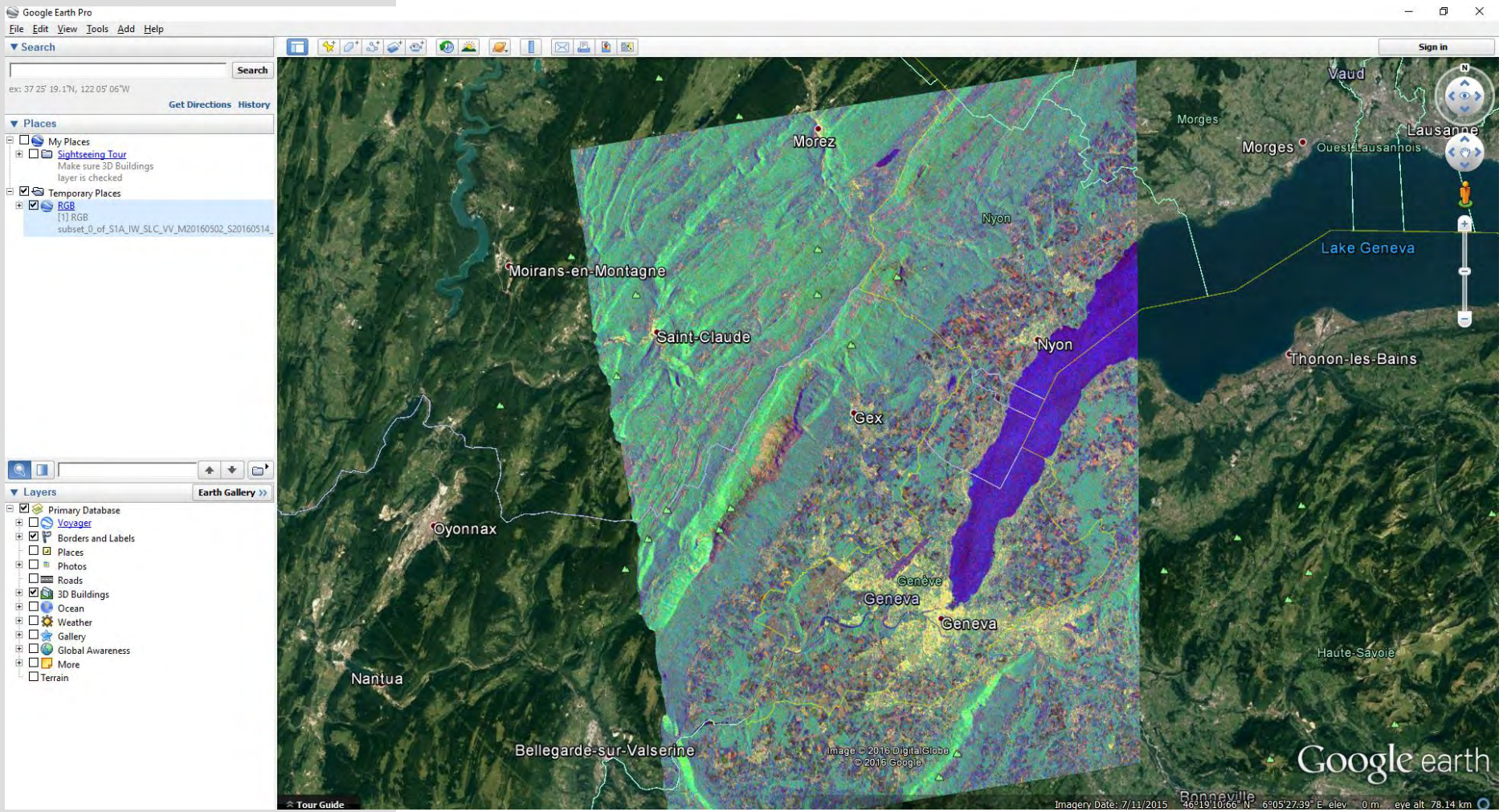
RGB Coherence and Backscatter: Export to Google Earth



CATAPULT Satellite Applications

RGB Coherence and Backscatter: Export to Google Earth



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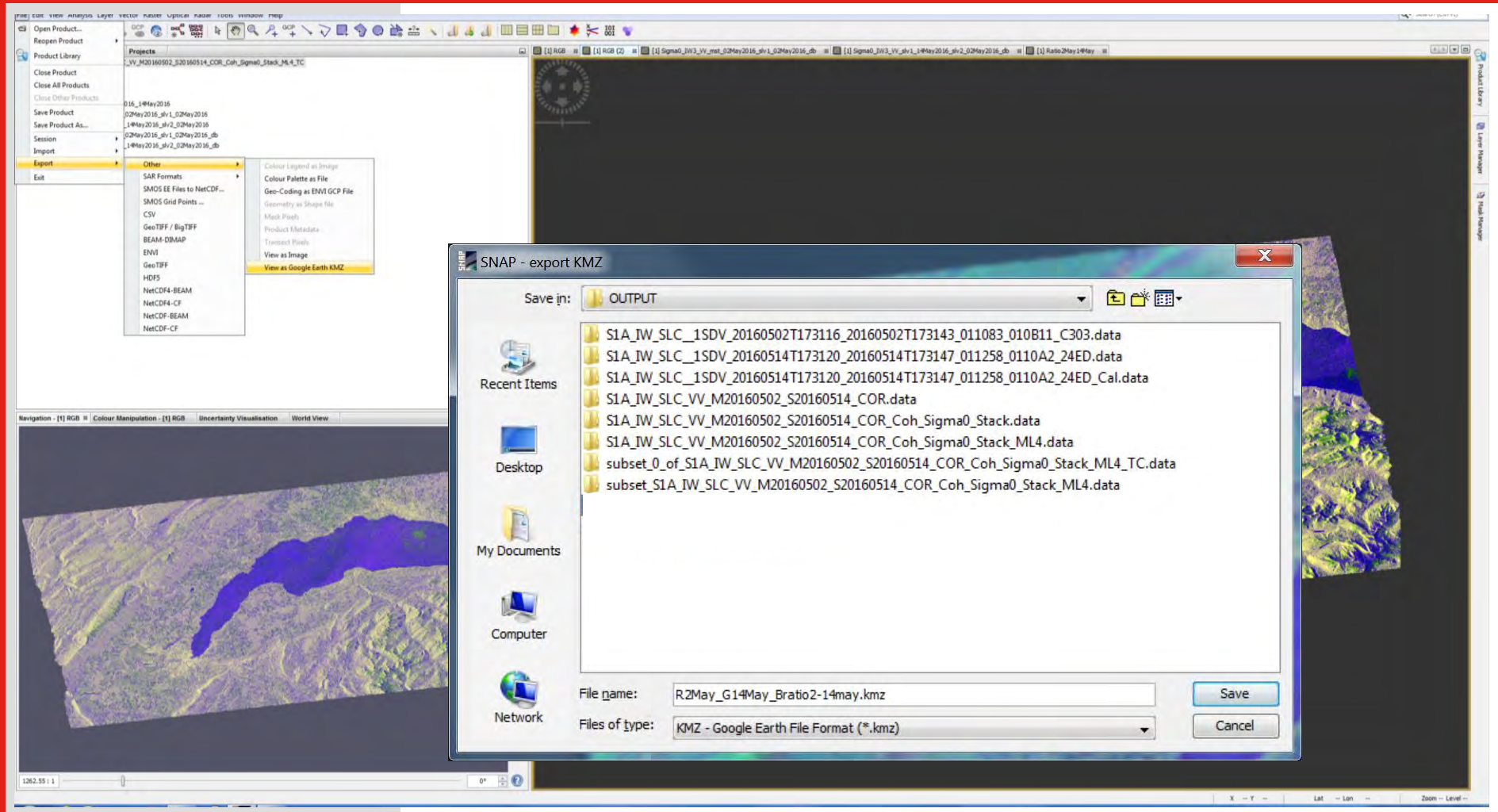
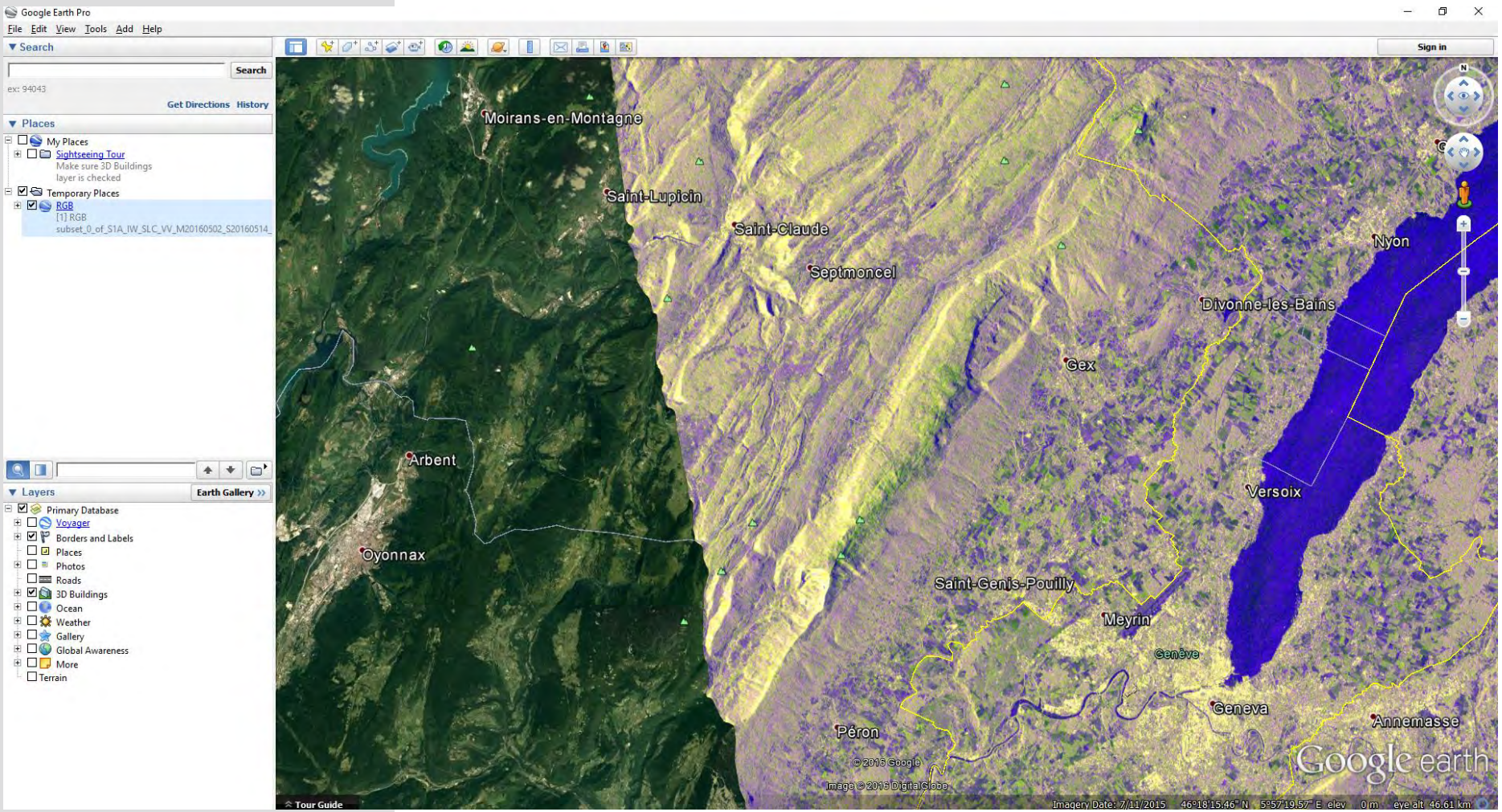
RGB Backscatters and ratio: Export to Google Earth



CATAPULT Satellite Applications

RGB Backscatters and ratio: Export to Google Earth



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Any Question?