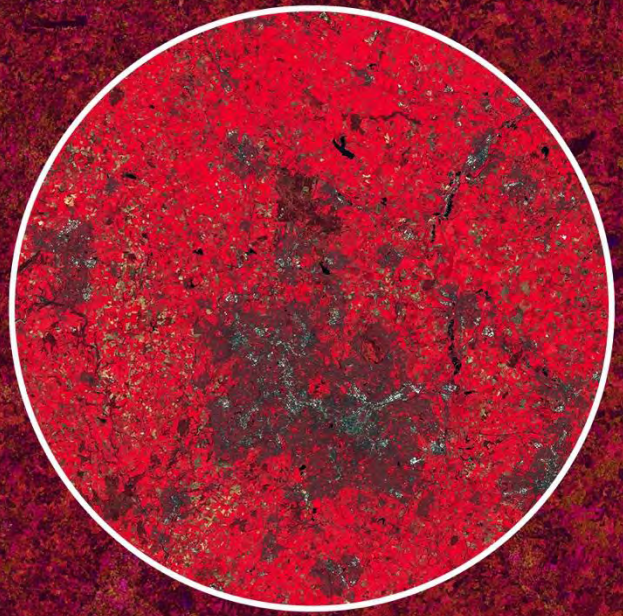
National Centre for Earth Observation
NATURAL ENVIRONMENT RESEARCH COUNCIL

UNIVERSITY OF LEICESTER

esa

→ 8th ADVANCED TRAINING COURSE ON LAND REMOTE SENSING

10–14 September 2018
University of Leicester | United Kingdom



Flood mapping pratical

Dr Hervé YESOU

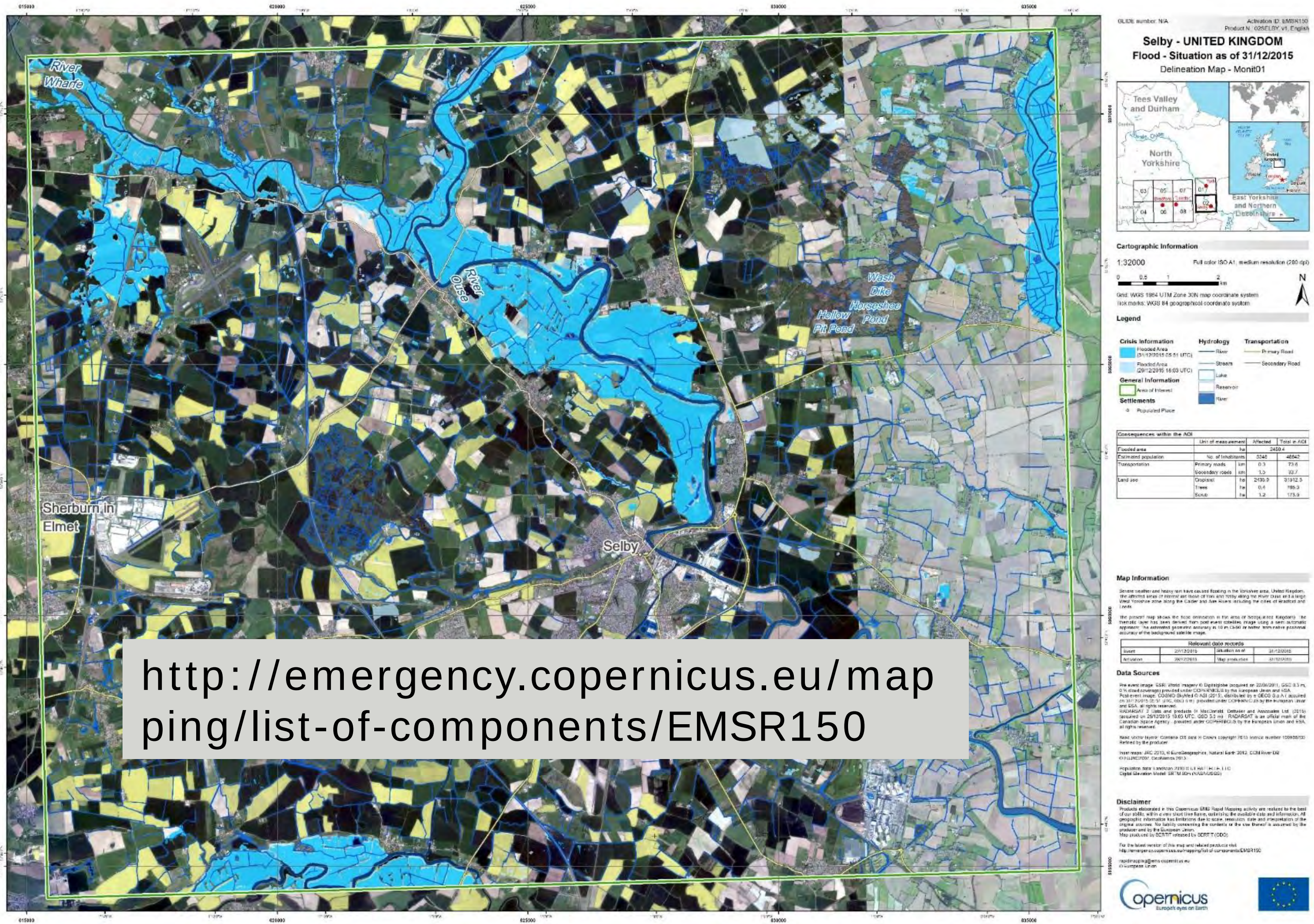
14 September 2018

ICUBE

sertit

Practical case: December 2015 Yorkshire flood

EMS Copernicus, EMSR 150: A series of downpours leading to extensive flooding in the Yorkshire area (Area Descriptor: Northern England) with the City of York, City of Selby, the River Ouse and West Yorkshire along Calder and Aire rivers (Bradfoods and Leeds cities)



http://emergency.copernicus.eu/mapping/list-of-components/EMSR150

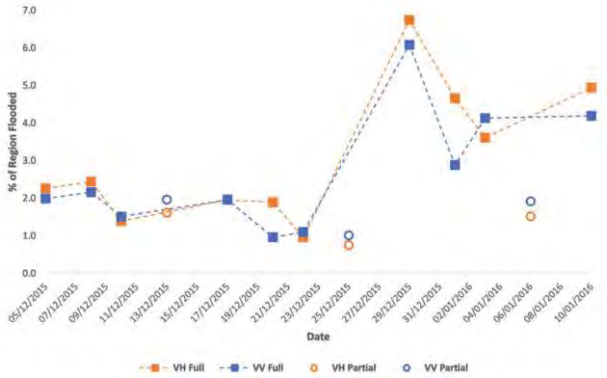
See also

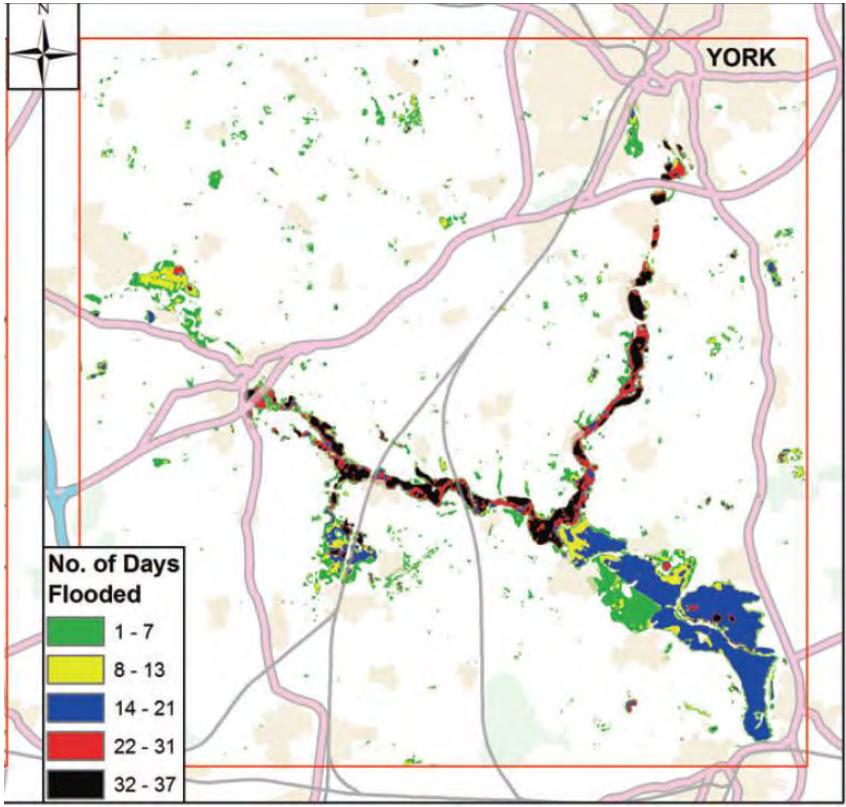
Multi-temporal synthetic aperture radar flood mapping using change detection

M.A. Clement[1], C.G. Kilsby[1,2] and P. Moore[1]

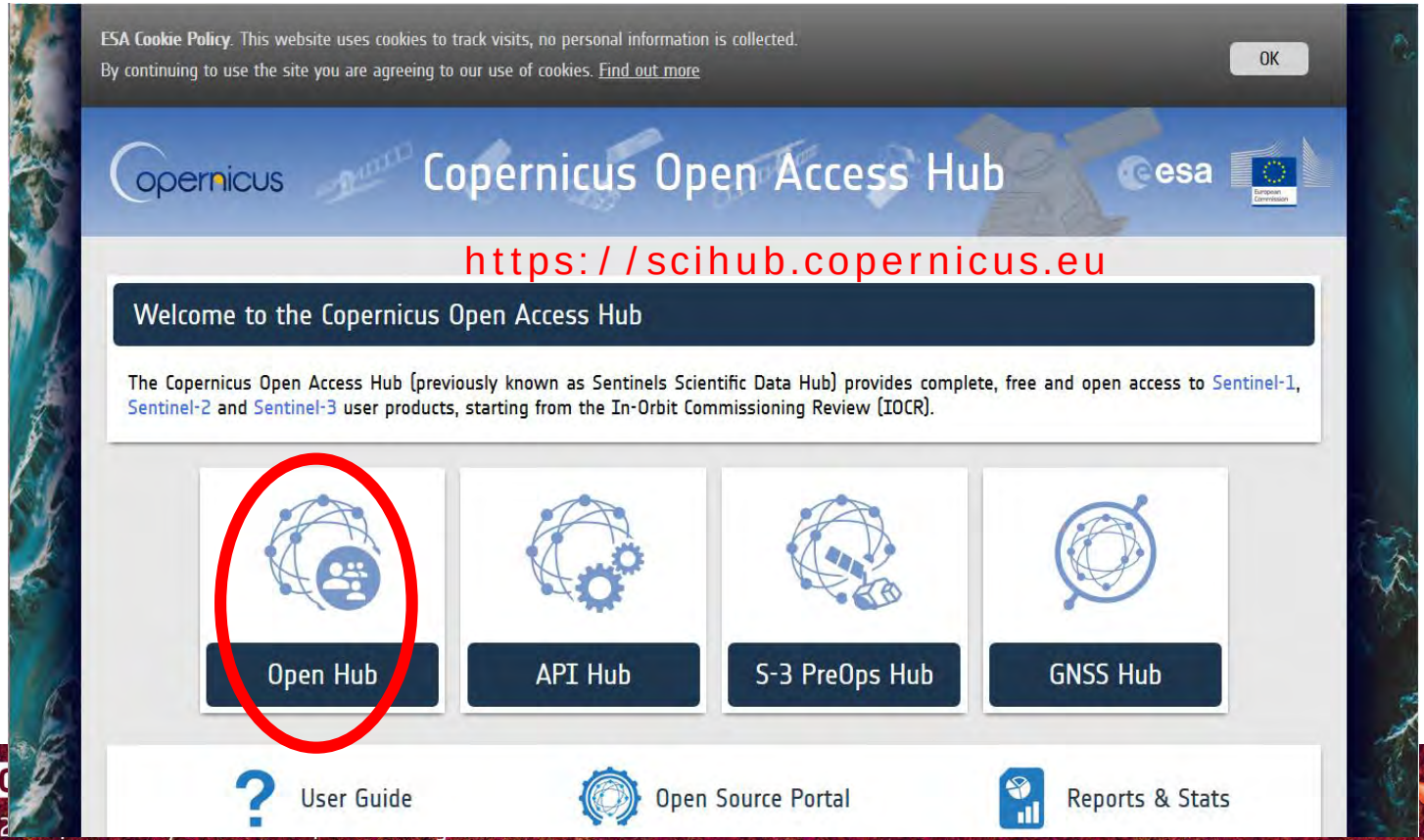
Journal of
Flood Risk Management

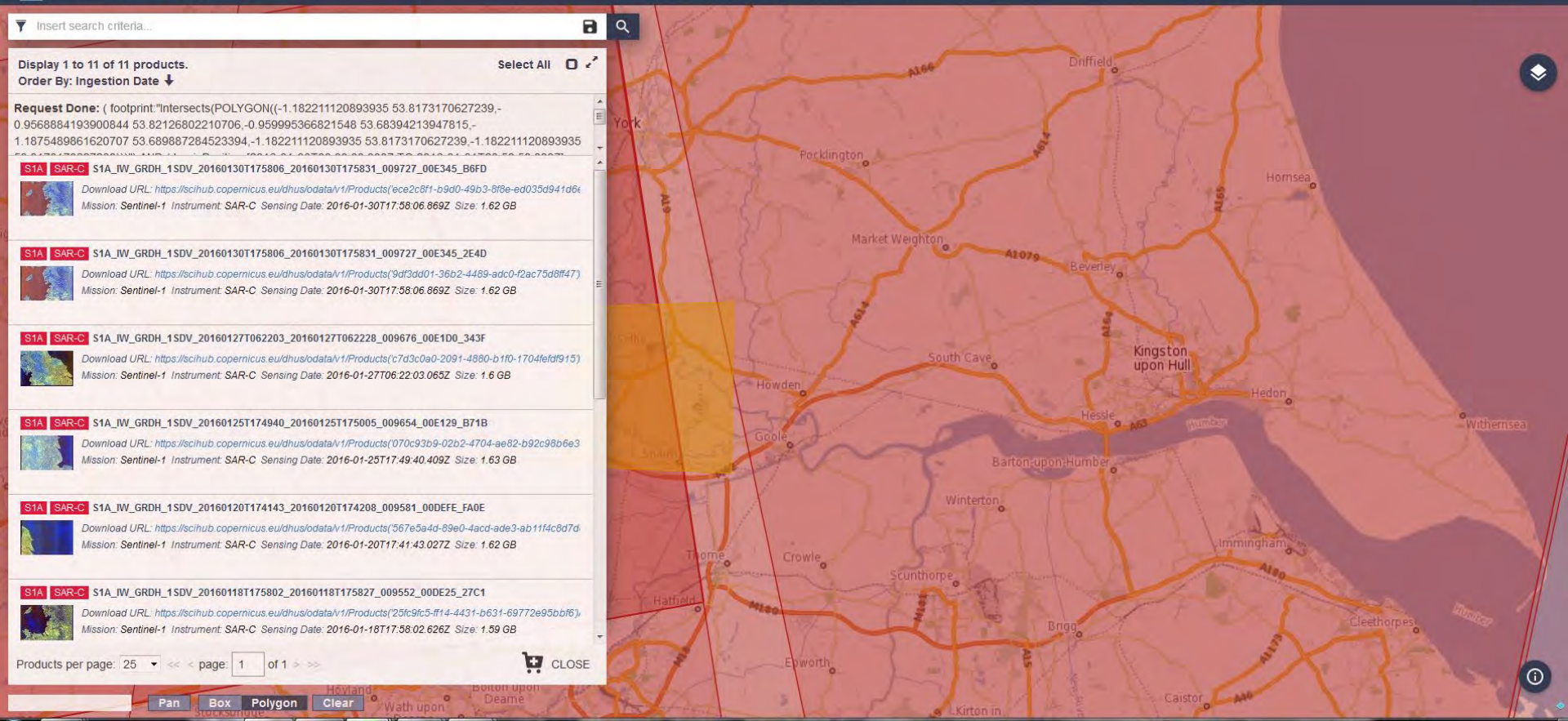
DOI: 10.1111/jfr3.12303





Data access: Sentinel 1 & 2

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Pocklington
Hornsea
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Beverley
Kingston upon Hull
South Cave
Howden
Hedon
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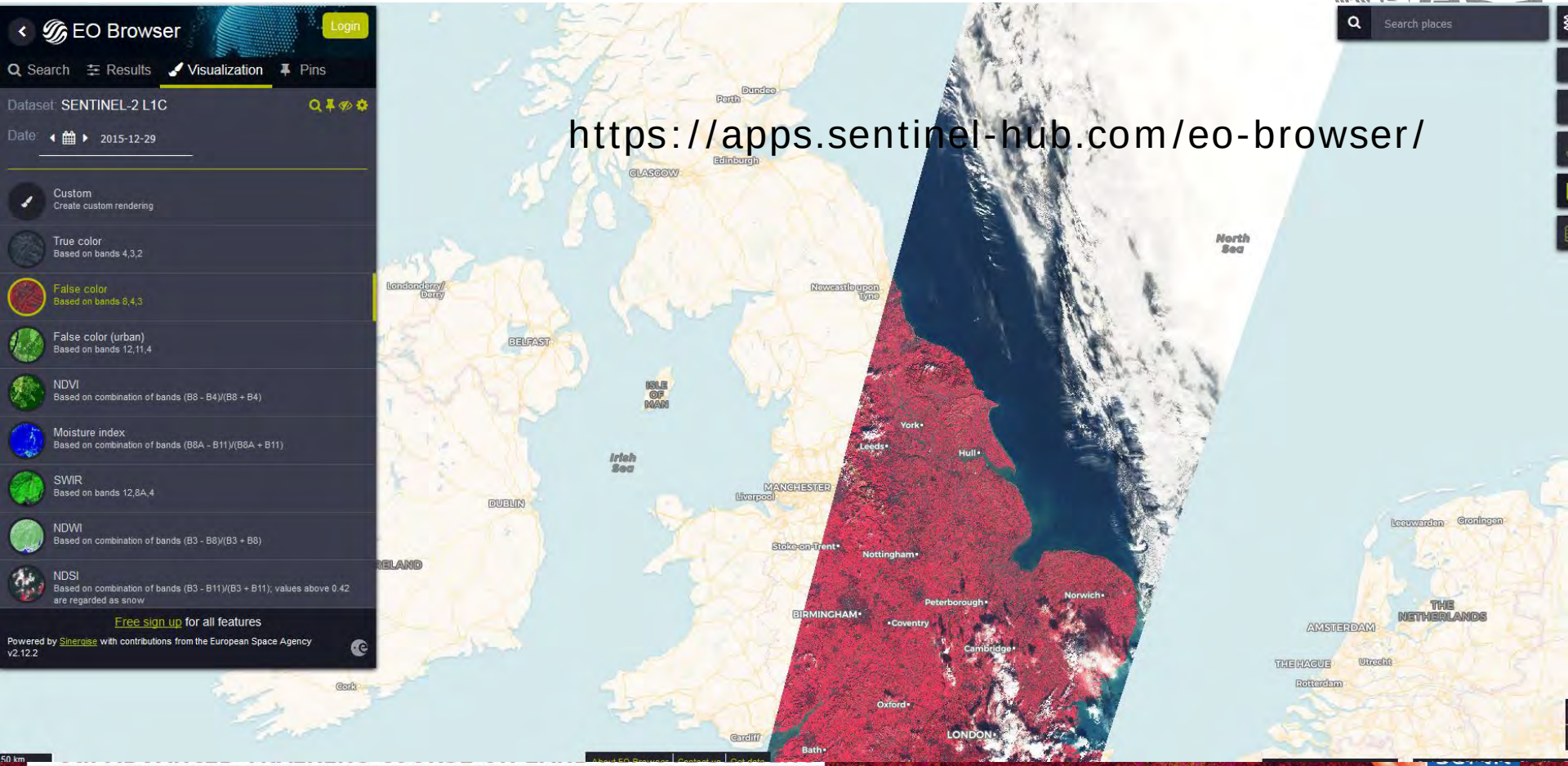
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Login
Search
Results
Visualization
Pins
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Date: 2015-12-29
Custom
Create custom rendering
True color
Based on bands 4,3,2
False color
Based on bands 8,4,3
False color (urban)
Based on bands 12,11,4
NDVI
Based on combination of bands (B8 - B4)/(B8 + B4)
Moisture index
Based on combination of bands (B8A - B11)/(B8A + B11)
SWIR
Based on bands 12,8A,4
NDWI
Based on combination of bands (B3 - B8)/(B3 + B8)
NDSI
Based on combination of bands (B3 - B11)/(B3 + B11); values above 0.42 are regarded as snow
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https://apps.sentinel-hub.com/eo-browser/
Dundee
Perth
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North Sea
Londonderry/ Derry
Newcastle upon Tyne
BELFAST
ISLE OF MAN
Irish Sea
York
Leeds
Hull
MANCHESTER
Liverpool
DUBLIN
Stoke-on-Trent
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Leeuwarden
Groningen
Norwich
Peterborough
BIRMINGHAM
Coventry
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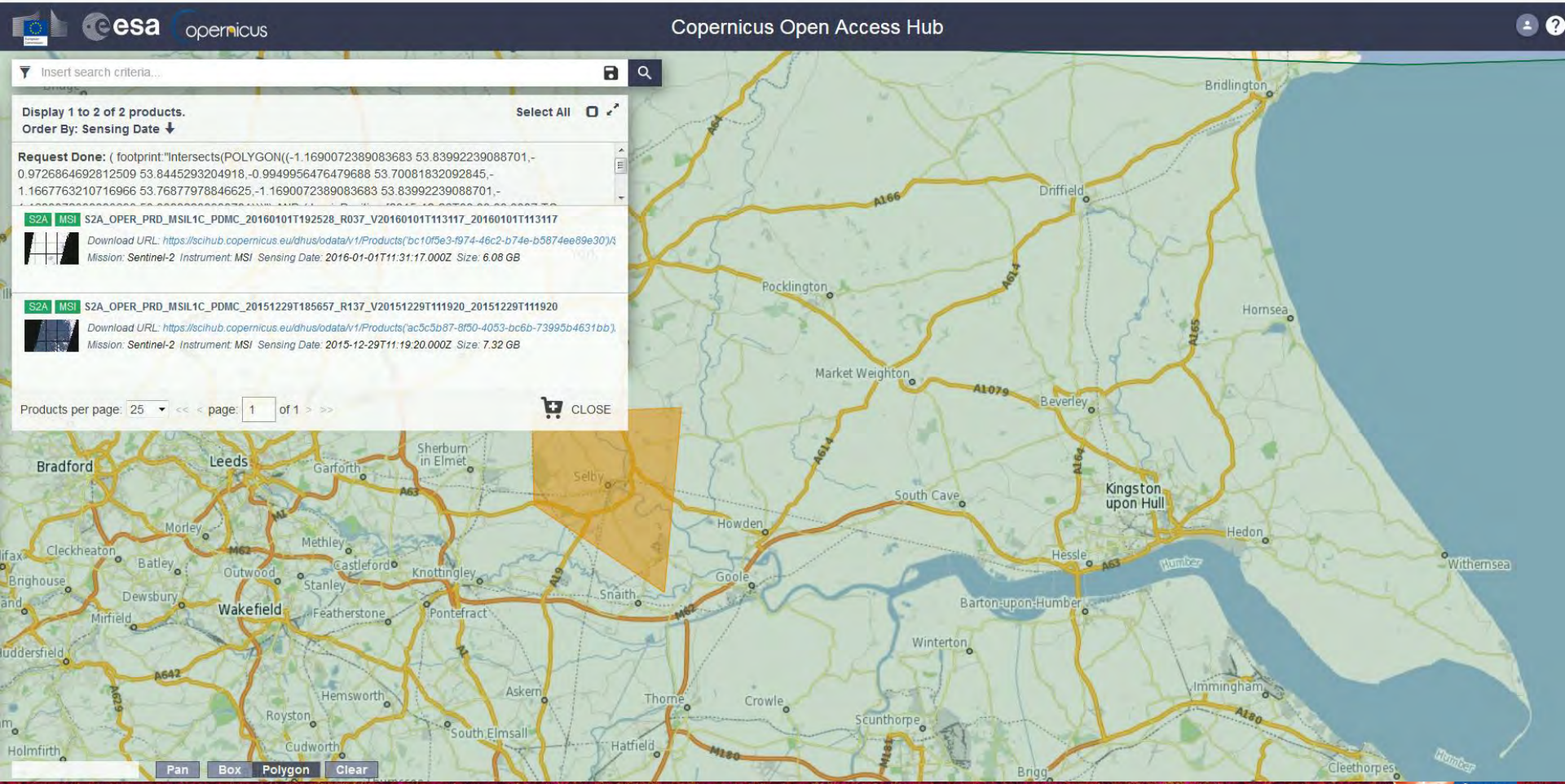
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Leeds
Sherburn in Elmet
Selby
South Cave
Kingston upon Hull
Howden
Hedon
Hessle
Withernsea
Goole
Barton-upon-Humber
Wakefield
Pontefract
Snaith
Winterton
Immingham
Askern
Thorne
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Cleethorpes
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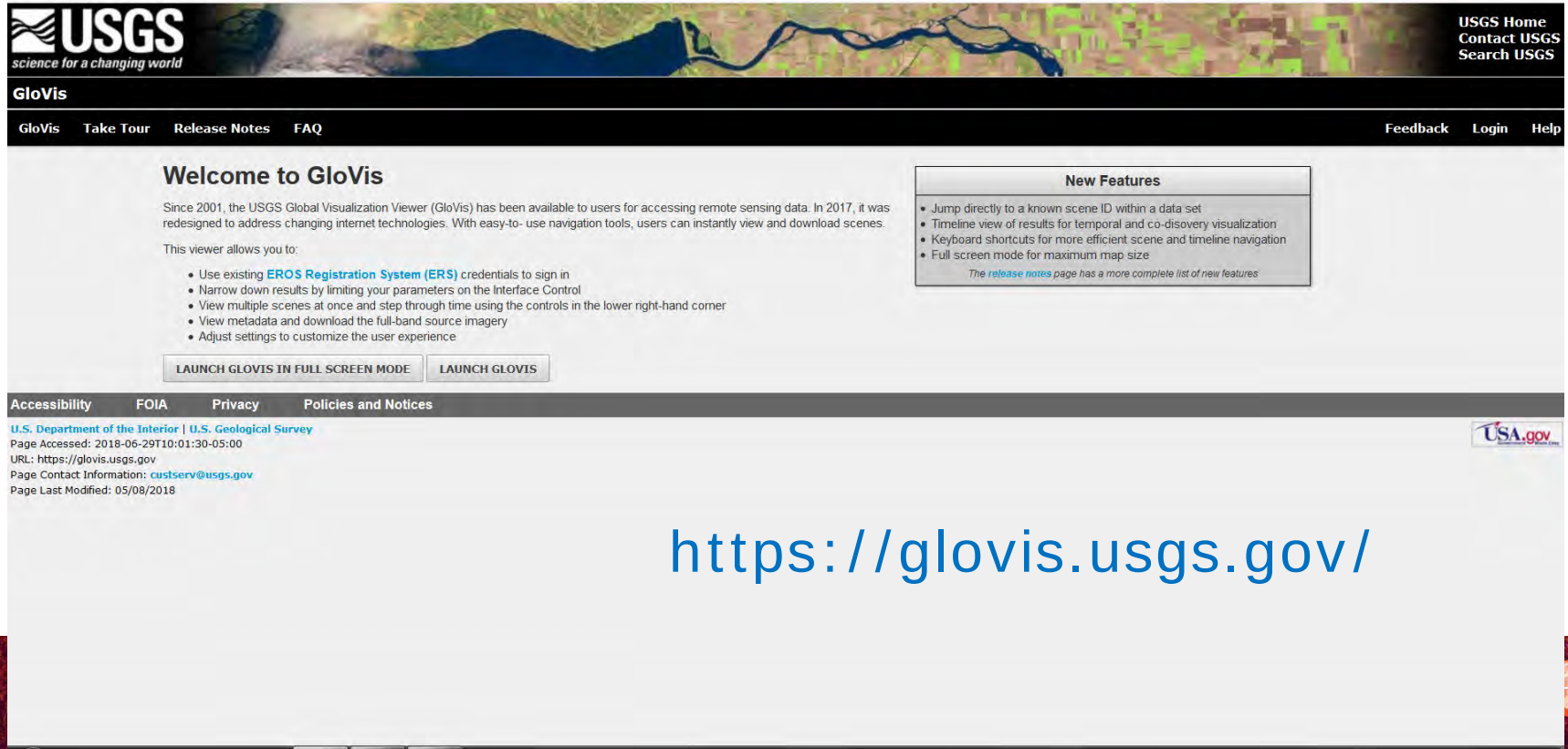
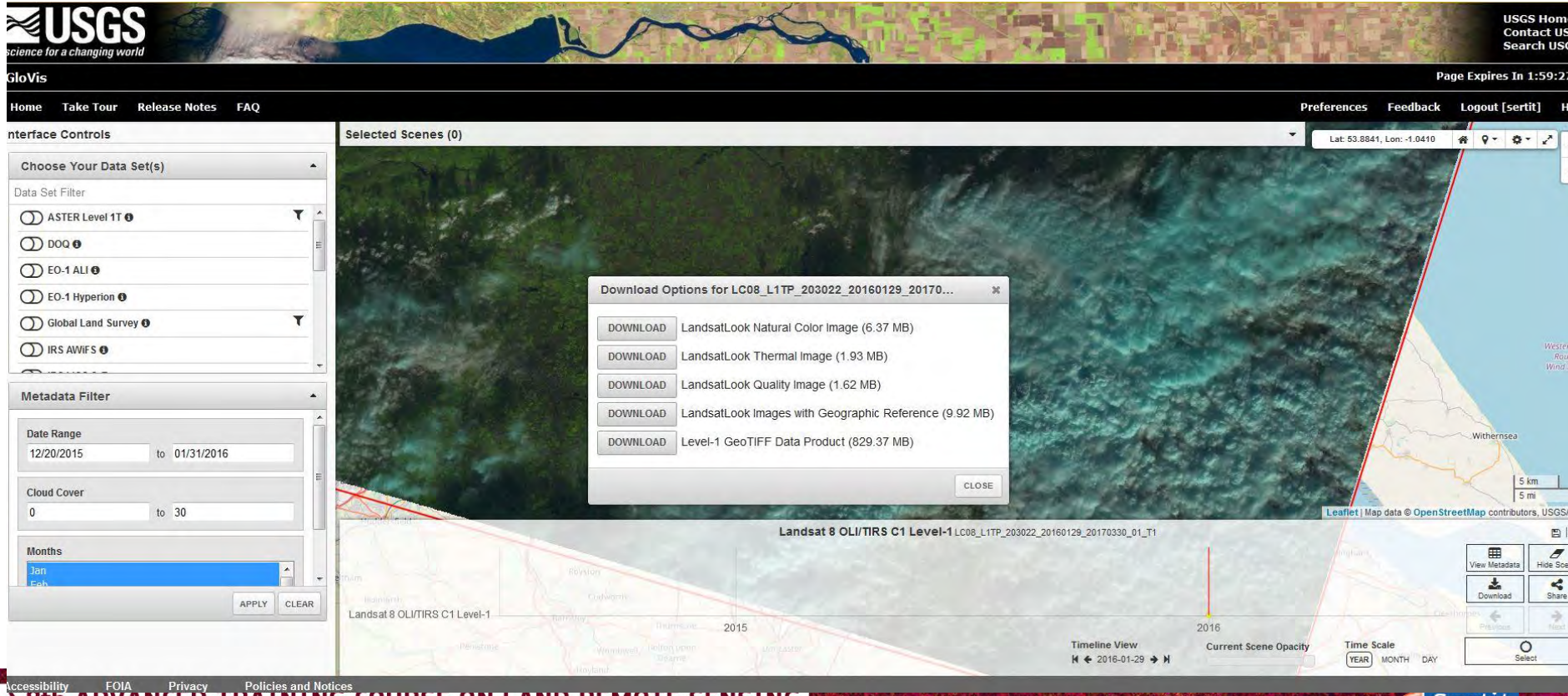
Sentinel 2 like search : ie Landsat search

GLOVIS



https://glovis.usgs.gov/

Sentinel 2 like search : ie Landsat search

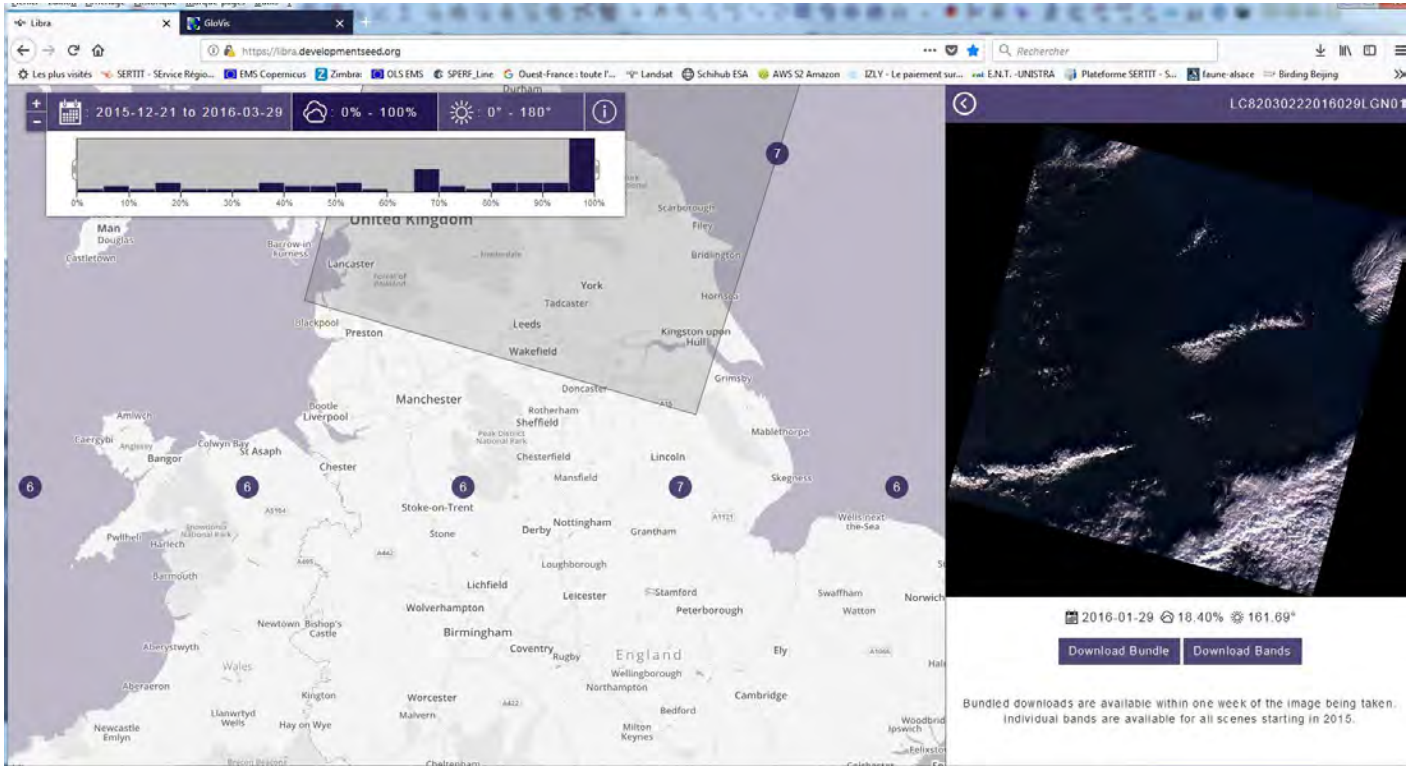


Sentinel 2 like search : ie Landsat search

LIBRA

Sentinel 2 like search : ie Landsat search

LIBRA



EO training data covering the flood event (none exhaustive)

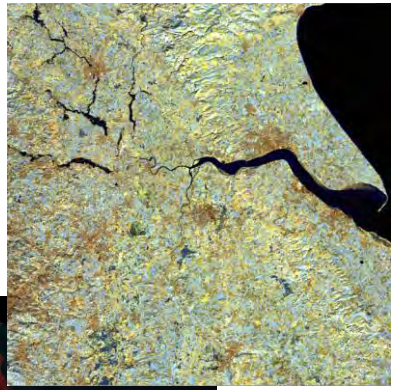
Sentinel1

- 2015 12 29
- 2016 01 01
- 2016 01 03
- ~~2016 01 06~~
- 2016 01 10
- 2016 01 13

- 2016 01 25
- 2016 01 27

Sentinel 2

- 2015 12 29



Landsat data

- 2016 01 29 (cloudy)

Sentinel1 data processing

Preprocessing steps:

- Calibration
- Terrain correction
- Speckle correction
- Subset

Water extraction procedure

- Image analysis (VV versus VH)
- Simple threshold
- Dynamic

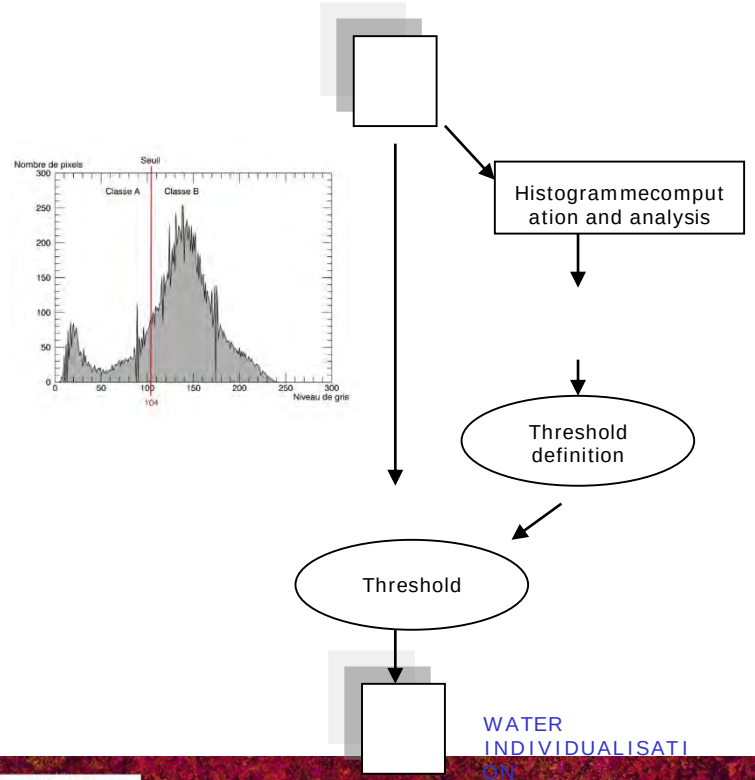
Flood mapping based on SAR data

Water extraction by thresholding performed on:

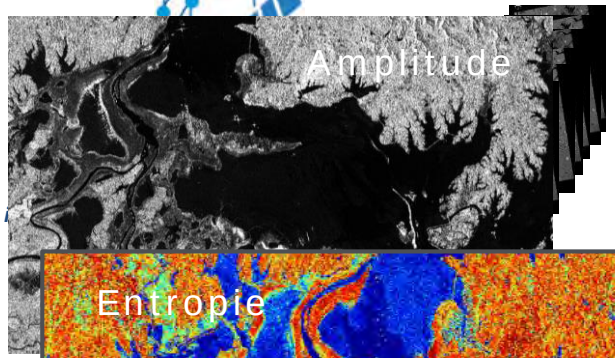
- Amplitude data (median sliding window)
- Coherence
- Polarimetry approach (Shannon Entropy)

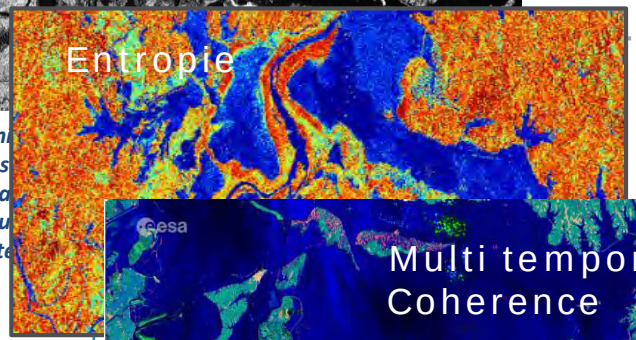
Methods of classification

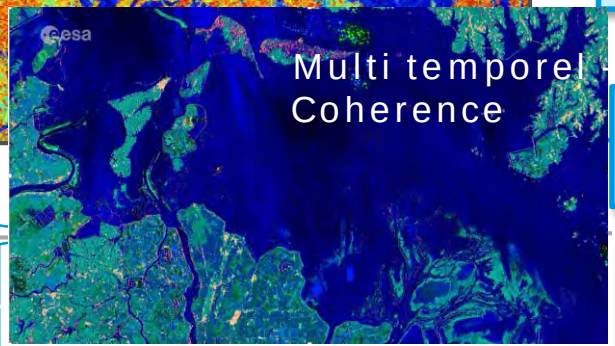
- Supervised
- None supervised
- Oriented object methods
- SVM
- Snake detection
- ...



Schematic processing flow for Sentinel1 Sar data

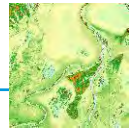






PrePocessing

DEM



Amplitude
texture
Polarmetric
primitives
Coherence

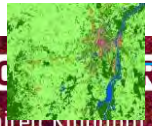
Extraction

Geometry

Validation

Water product

Database



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Methods
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Sentinel1 data processing

Preprocessing steps:

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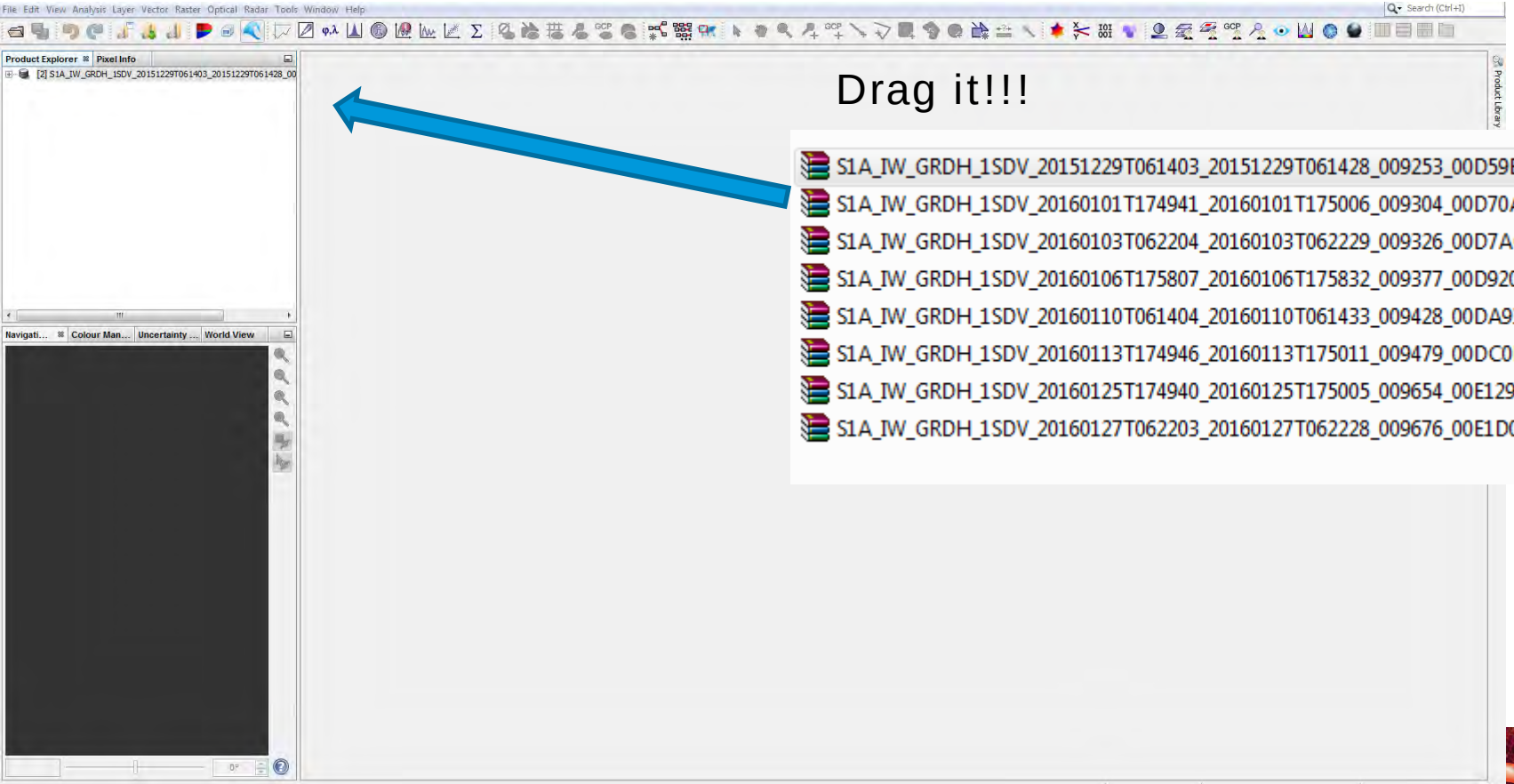
Opening one image



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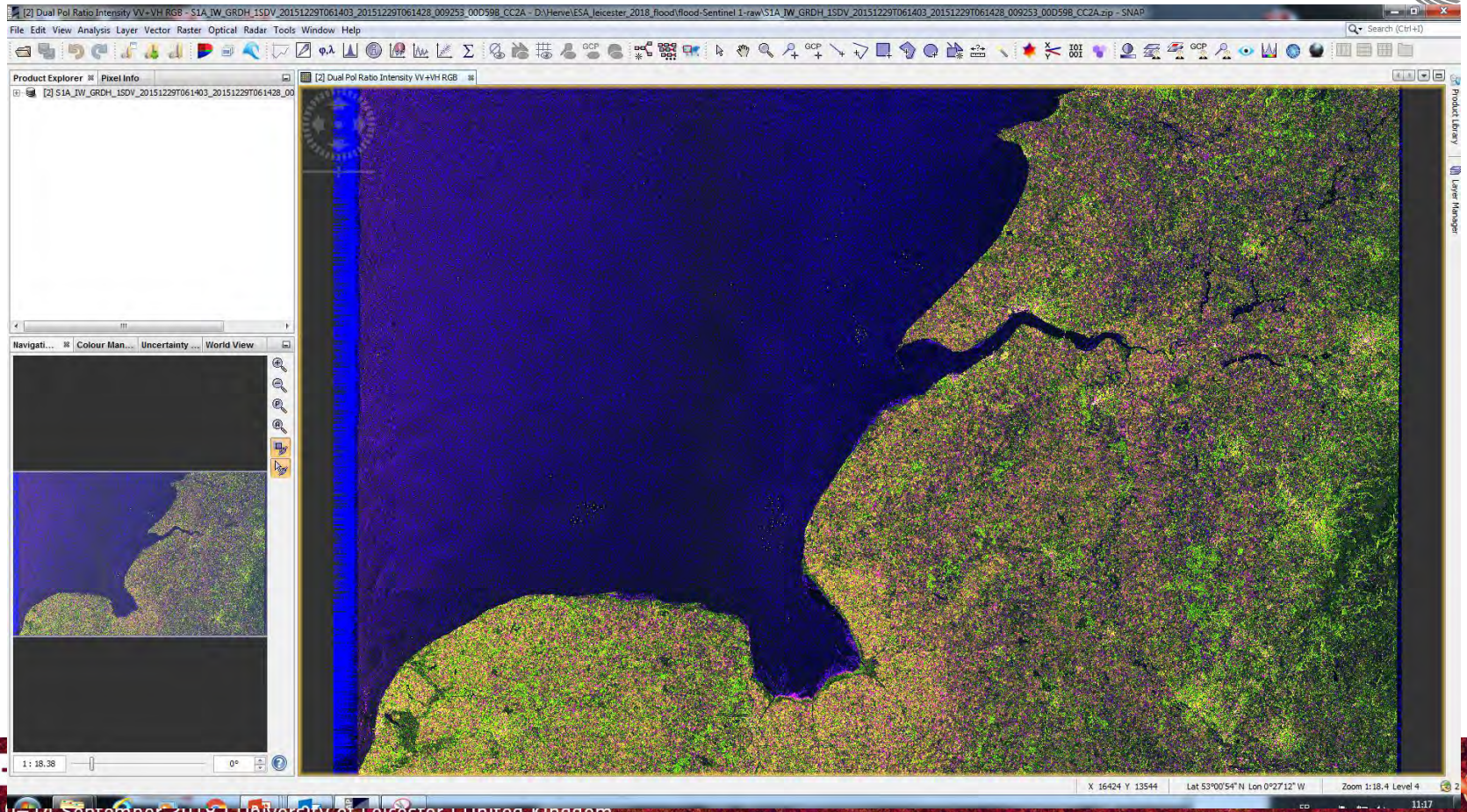

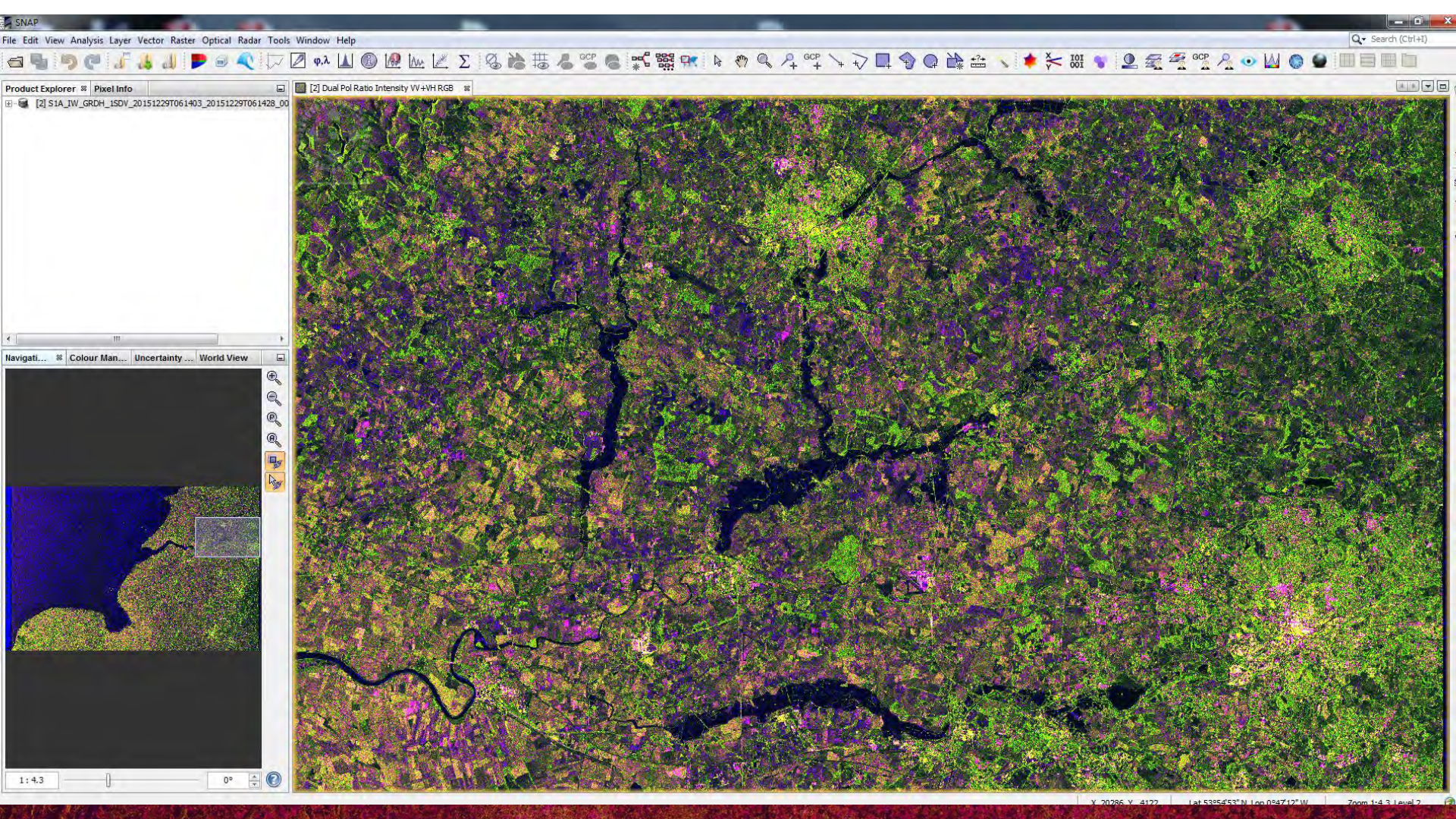
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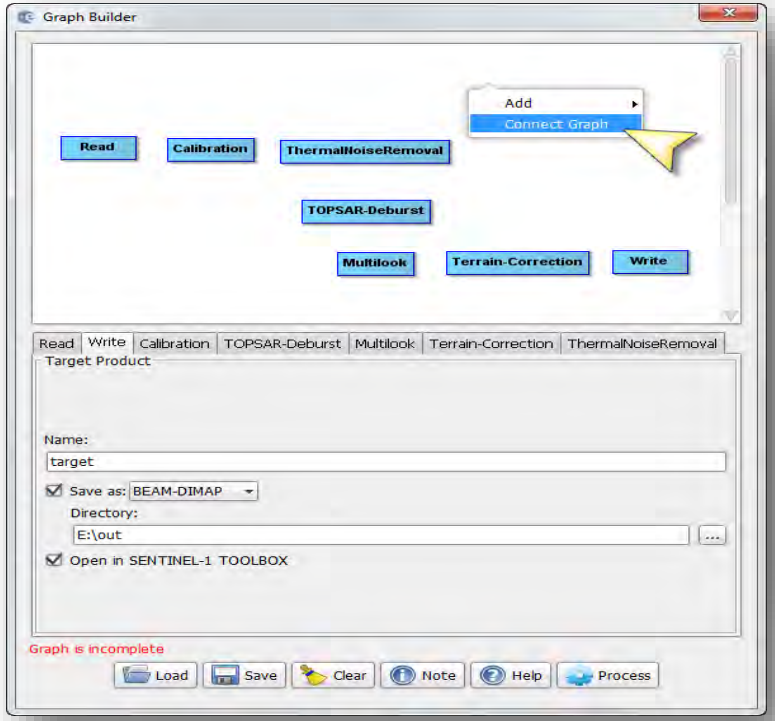
Navigati...
Colour Man...
Uncertainty ...
World View
1 : 4.3
0°

Preprocessing steps: Calculation of geocoded backscatter coefficients (sigma0).

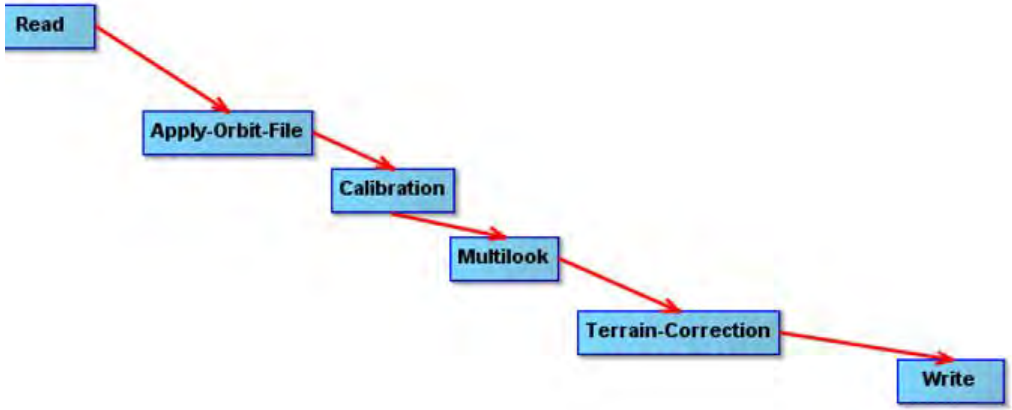
SNAP Graph Building

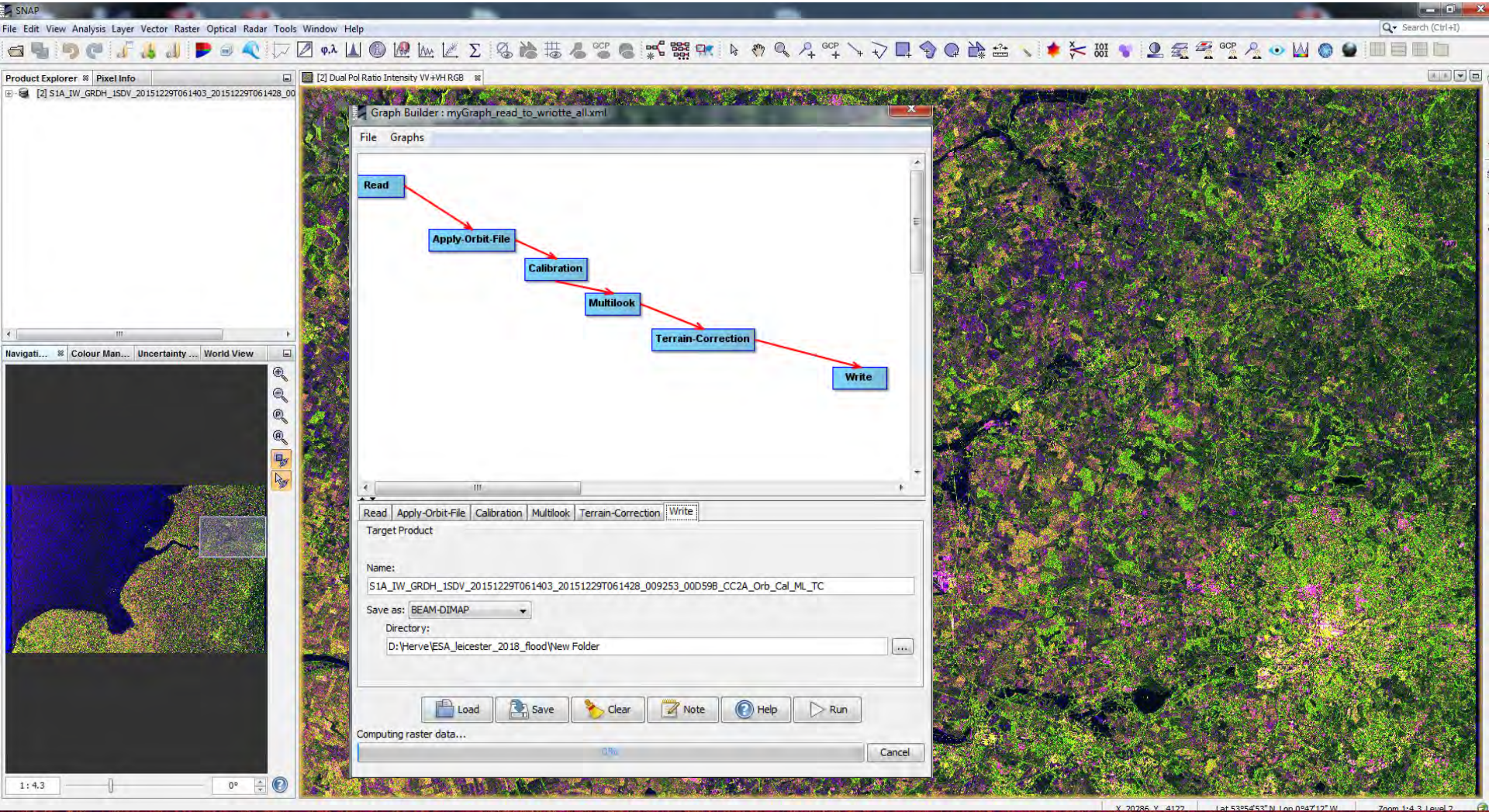
Right click to add operators from
the context menu:

- Calibration
- Thermal Noise Removal
- Deburst & Merge
- Multilook
- Range Doppler Terrain Correction
- Connect the graph



Preprocessing steps:Calculation of geocoded backscatter coefficients (sigma0).

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Navigati... Colour Man... Uncertainty ... World View
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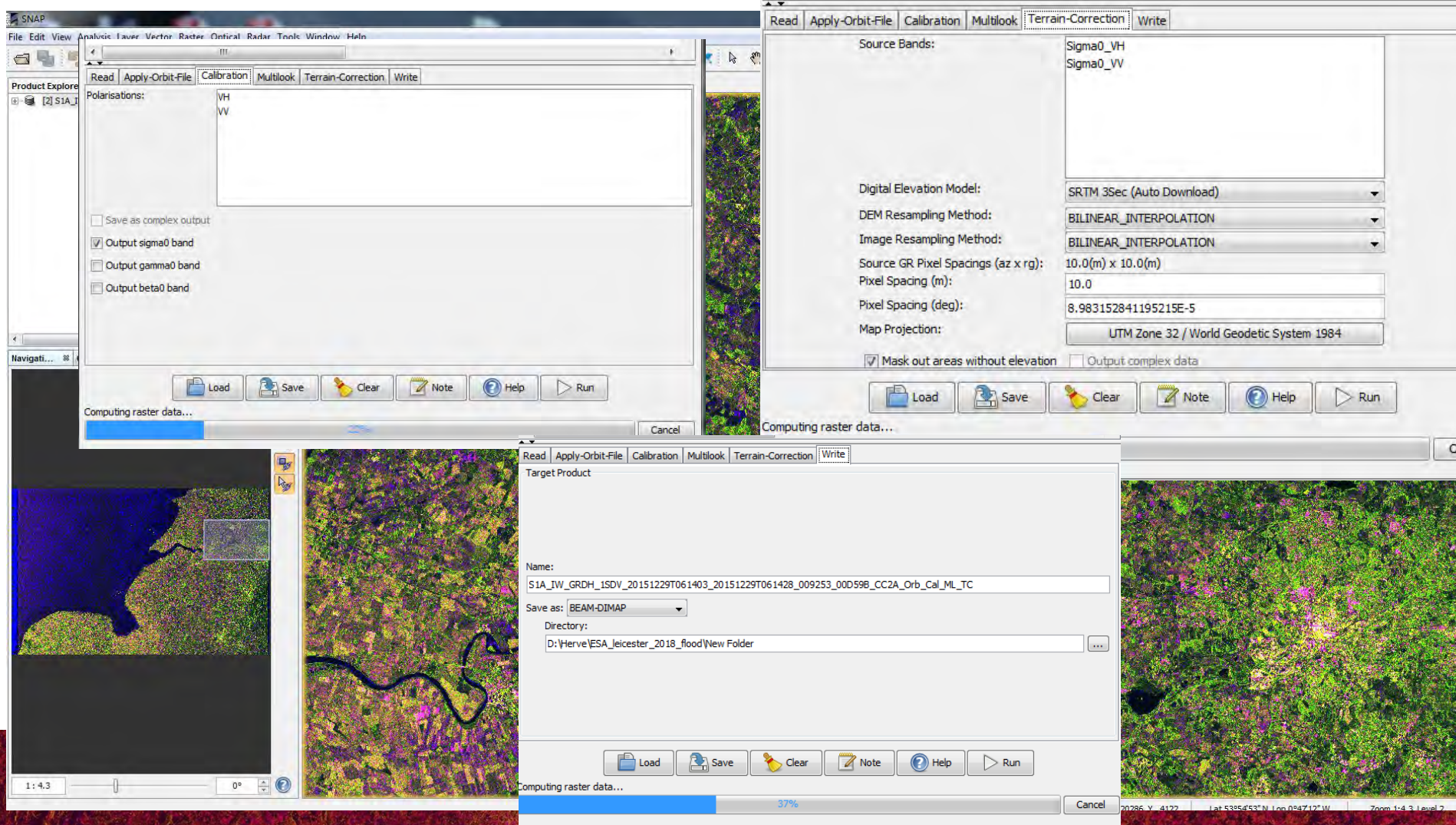
SNAP
File Edit View Analysis Layer Vector Raster Optical Radar Tools Window Help
Product Explore
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Polarisations:
VH
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Save as complex output
Output sigma0 band
Output gamma0 band
Output beta0 band
Load Save Clear Note Help Run
Computing raster data...
Cancel
Read Apply-Orbit-File Calibration Multilook Terrain-Correction Write
Source Bands:
Sigma0_VH
Sigma0_VV
Digital Elevation Model:
SRTM 3Sec (Auto Download)
DEM Resampling Method:
BILINEAR_INTERPOLATION
Image Resampling Method:
BILINEAR_INTERPOLATION
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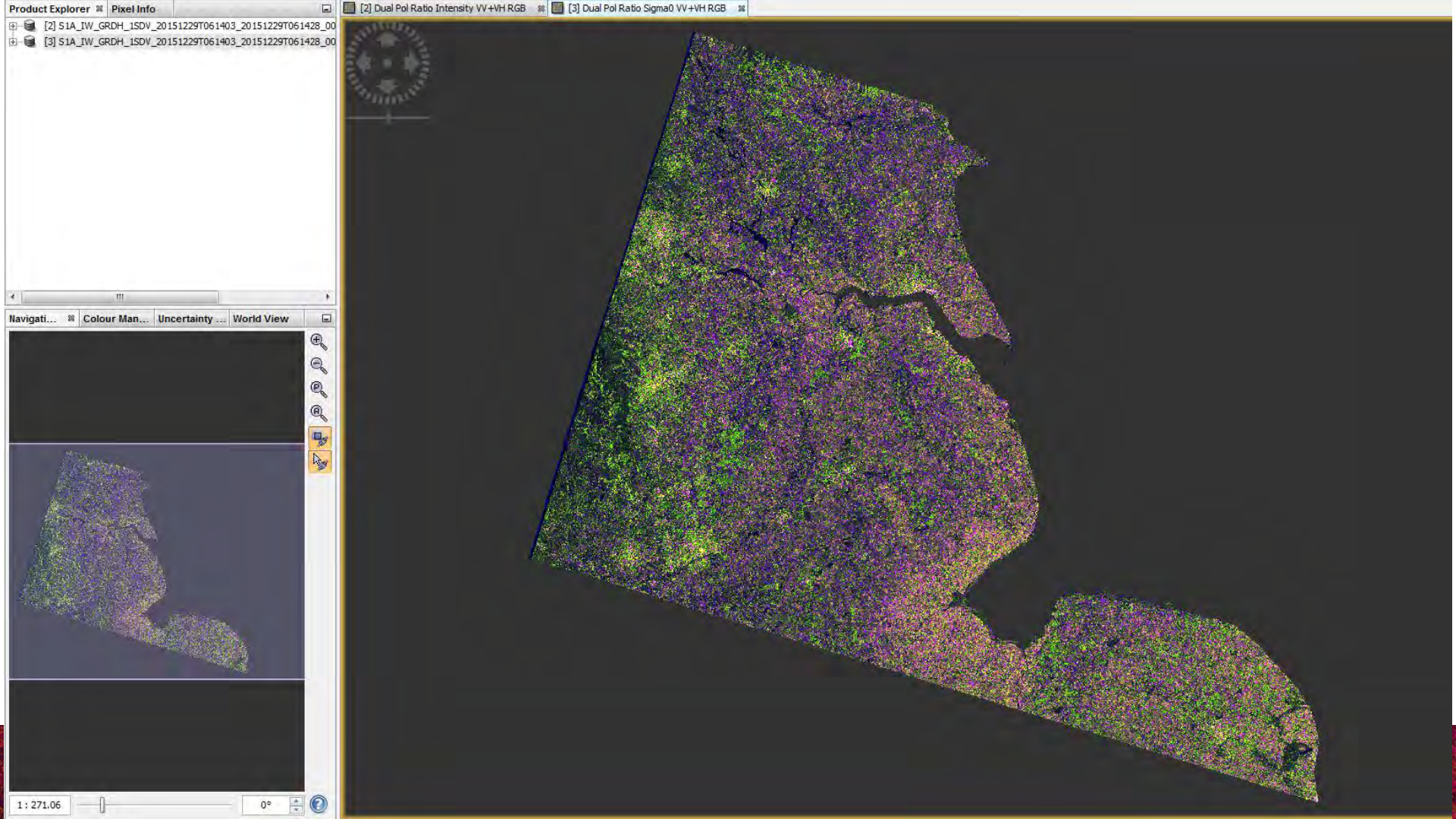
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Uncertainty ...
World View
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Product Explorer
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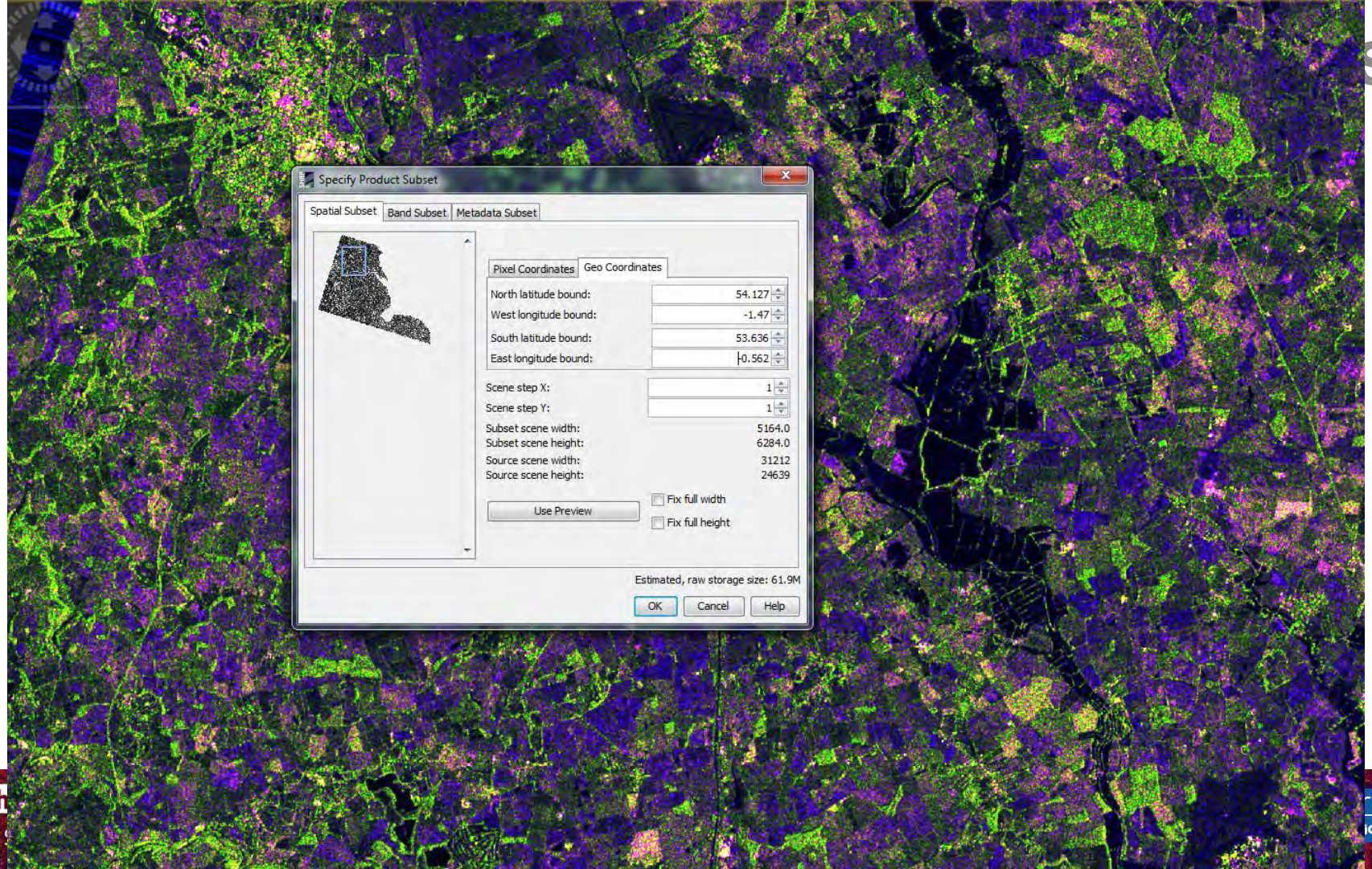
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Band Subset
Metadata Subset
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Scene step Y:
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Subset scene height:
6284.0
Source scene width:
31212
Source scene height:
24639
Use Preview
Fix full width
Fix full height
Estimated, raw storage size: 61.9M
OK
Cancel
Help

Sentinel1 data processing

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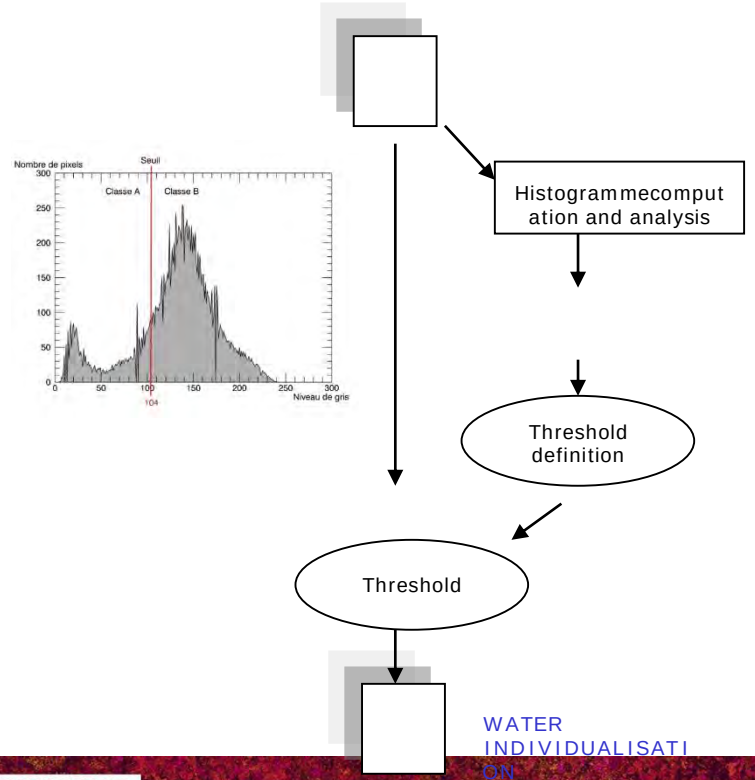
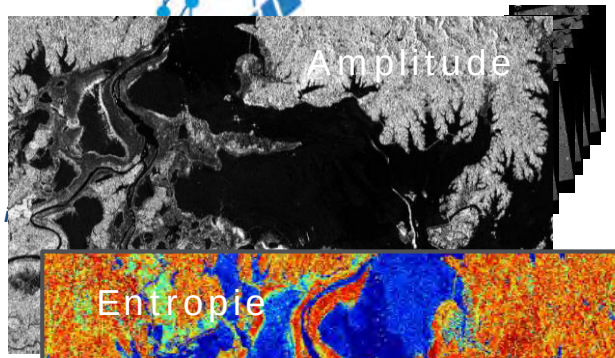
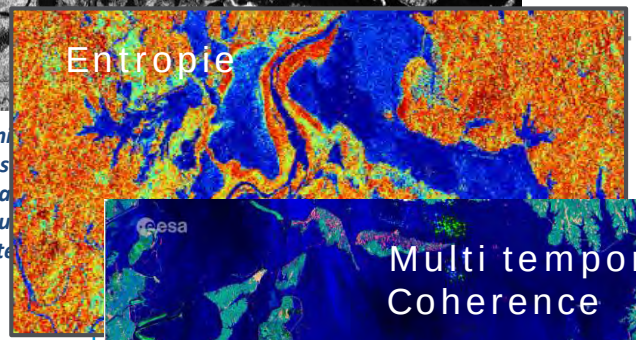
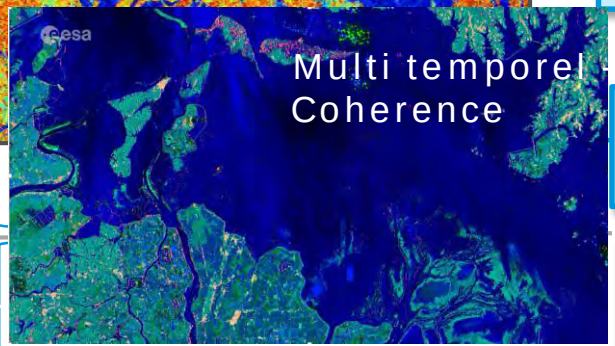
- Snake detection
- ...



Schematic processing flow for Sentinel1 Sar data

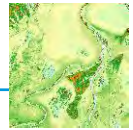






PrePocessing

DEM



Amplitude
texture
Polarmetric
primitives
Coherence

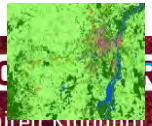
Extraction

Geometry

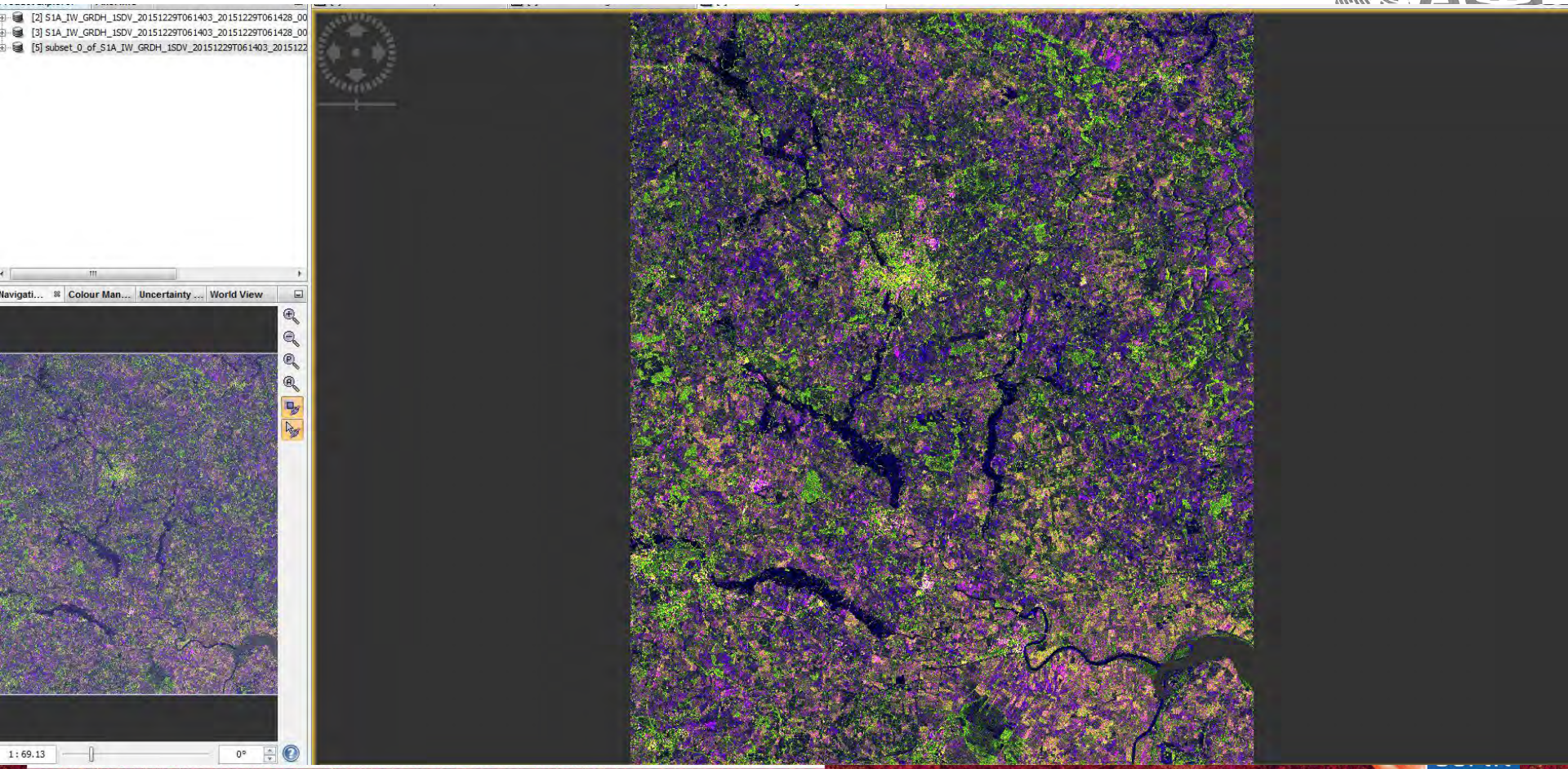
Validation

Water product

Database



Prim
Ima
featu
patte
Methods
Geometry
Validatio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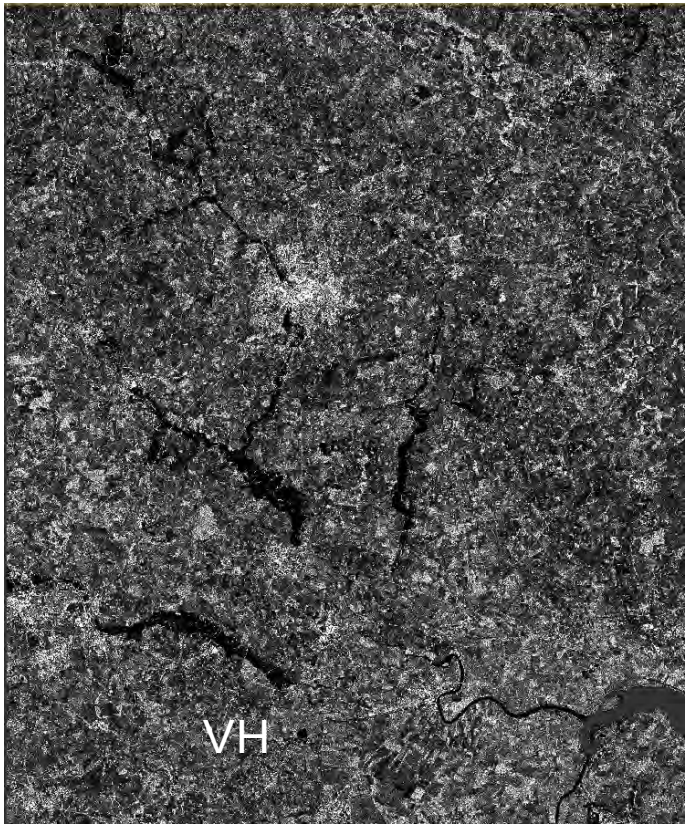
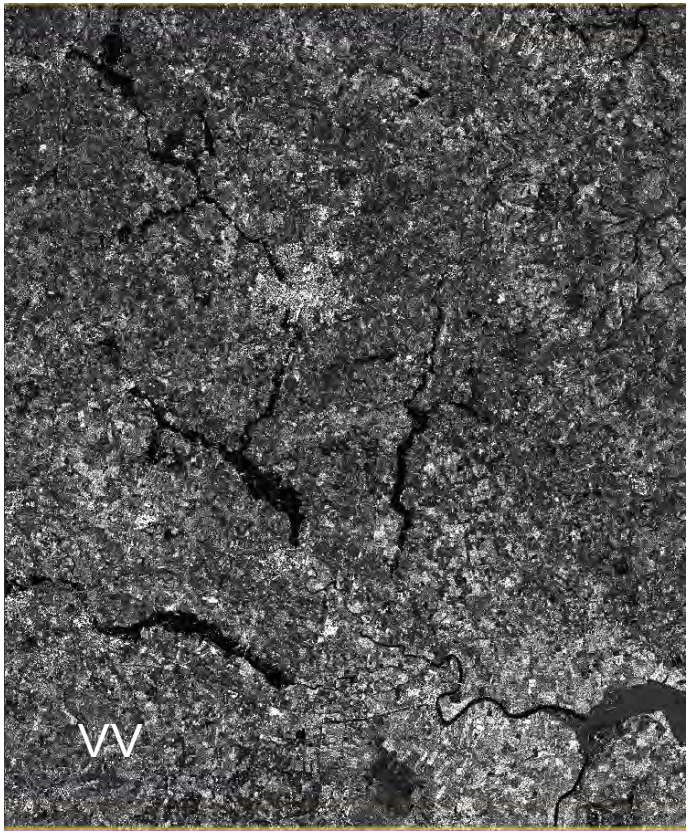
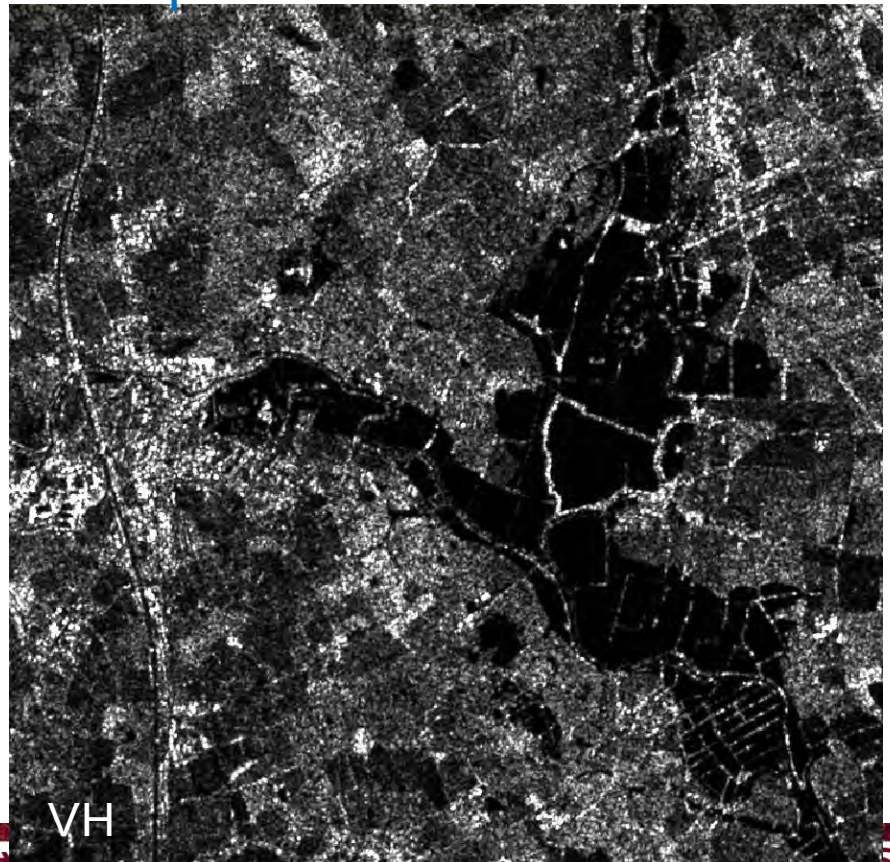
[3] S1A_IW_GRDH_1SDV_20151229T061403_20151229T061428_00
[5] subset_0_of_S1A_IW_GRDH_1SDV_20151229T061403_2015122
Navigati...
Colour Man...
Uncertainty ...
World View
1 : 69.13
0°

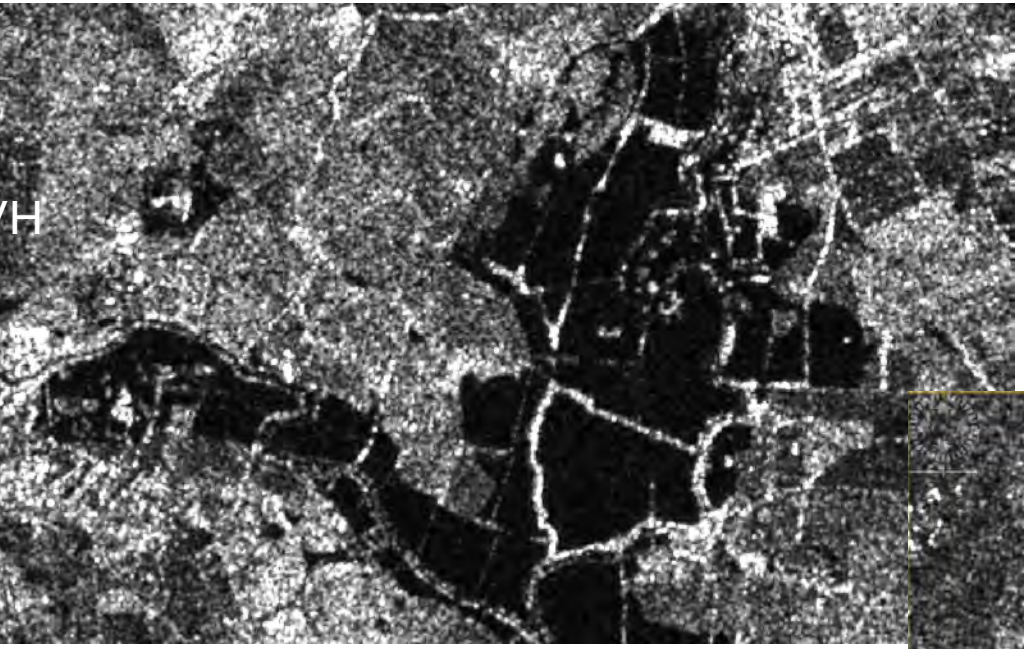
Compare VV and VH bands





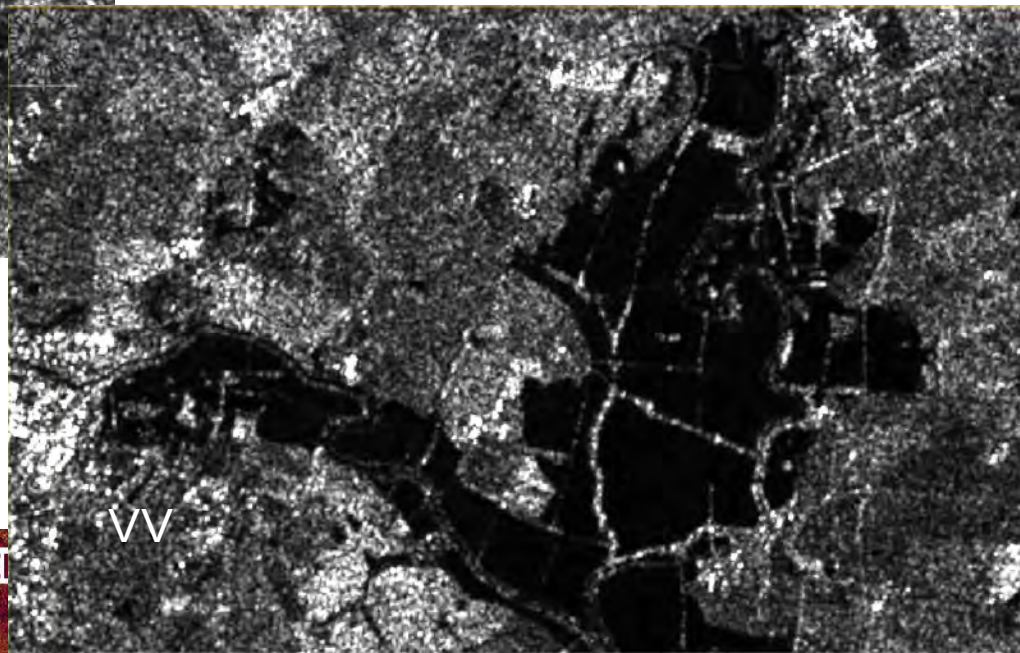
Compare VV and VH bands

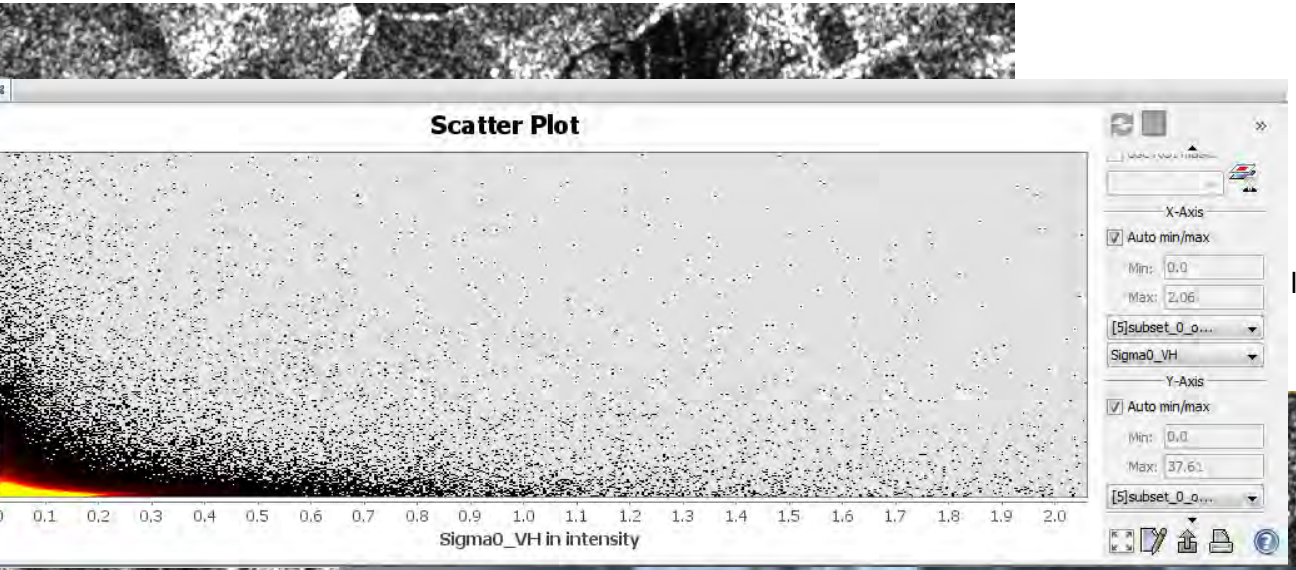




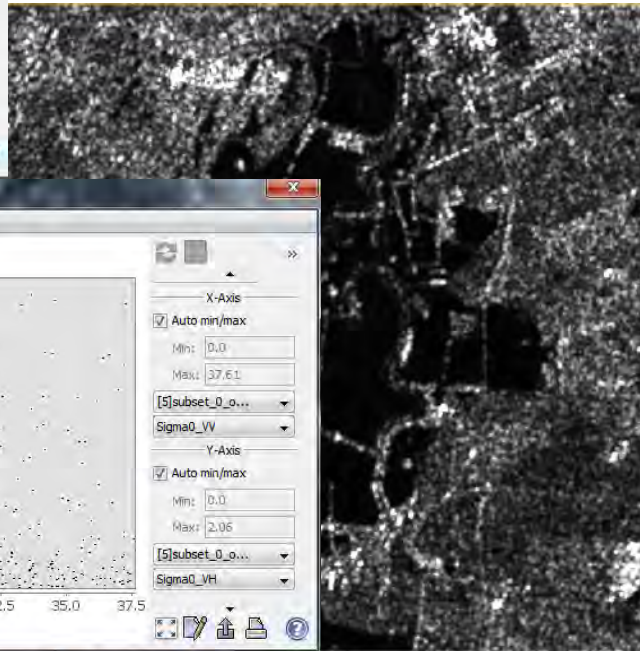
VH : More influence of vegetation
(hedges, submerged vegetation)

VV : villages more structured

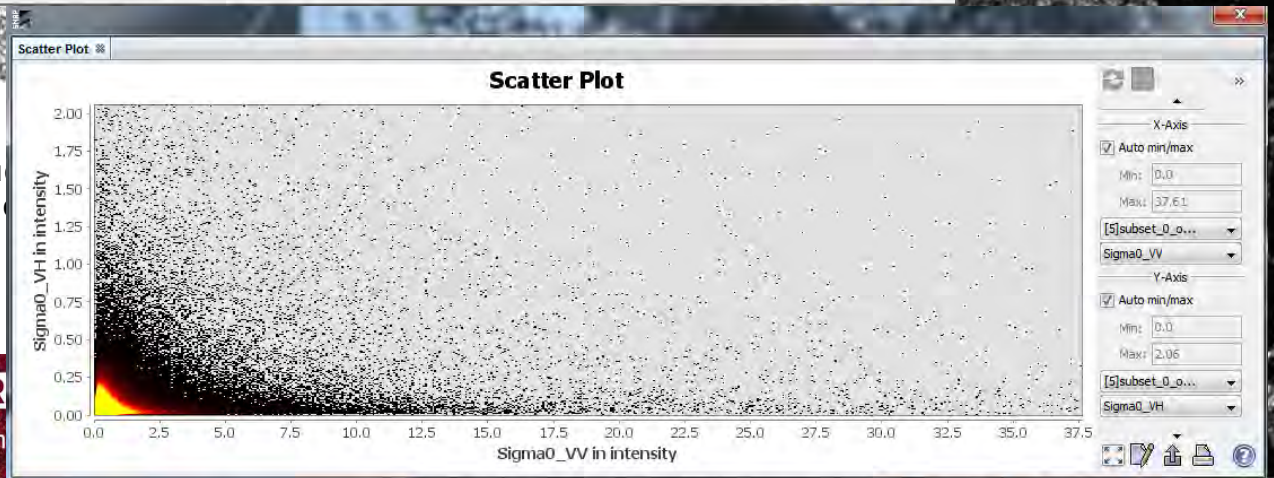


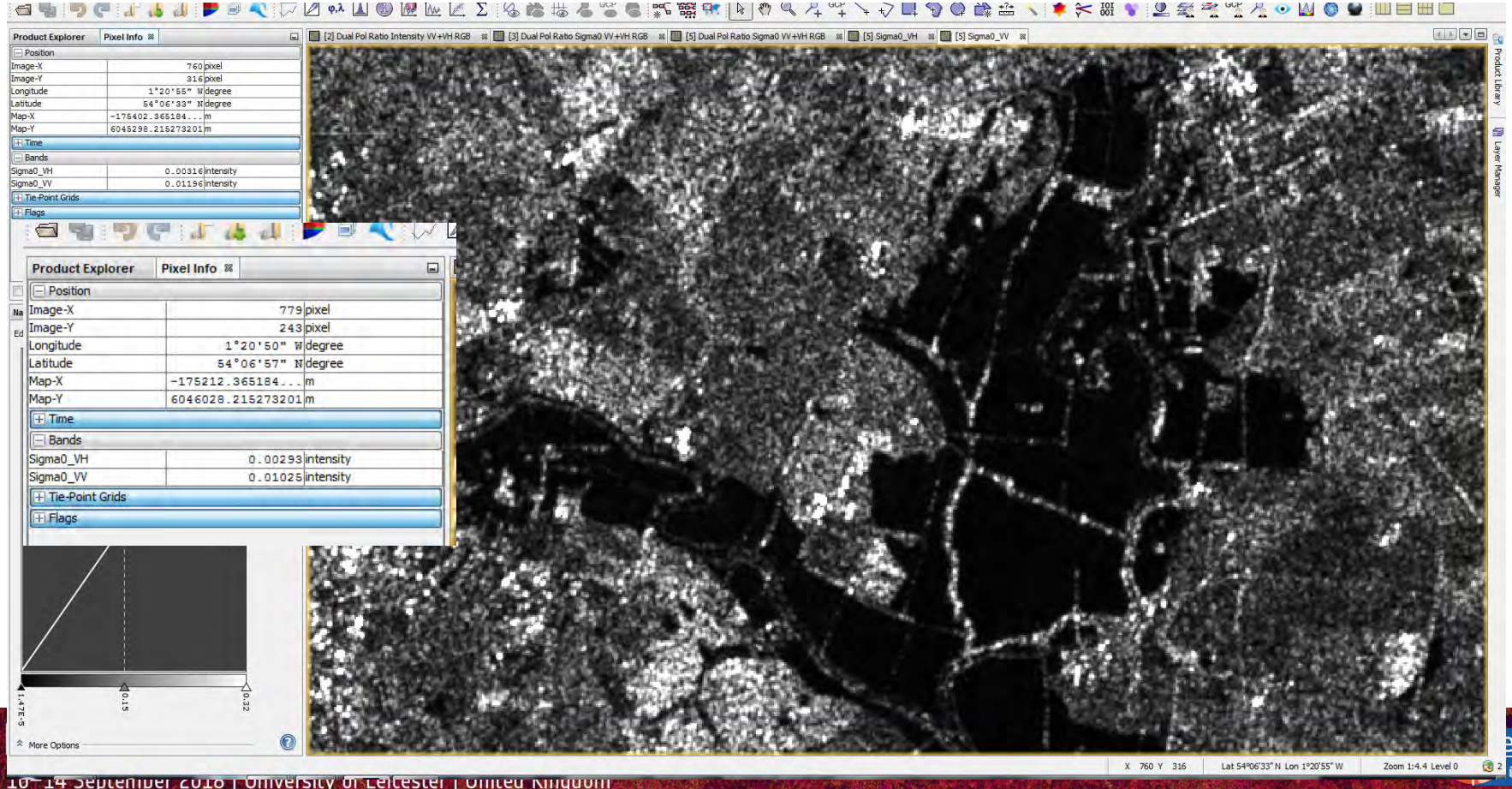


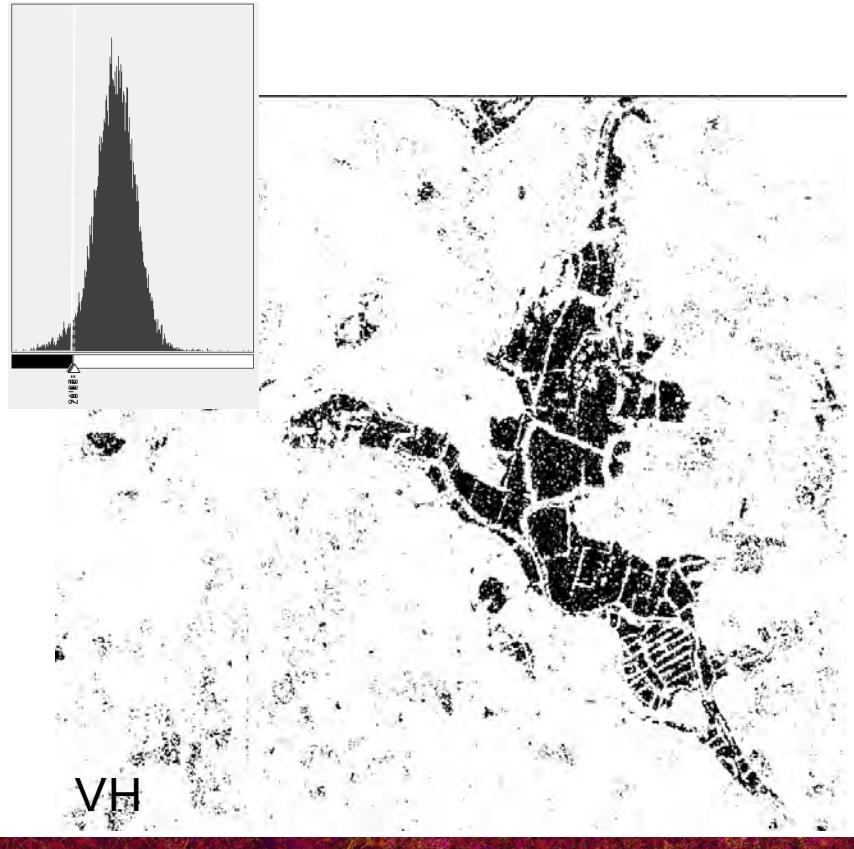
lages more structured

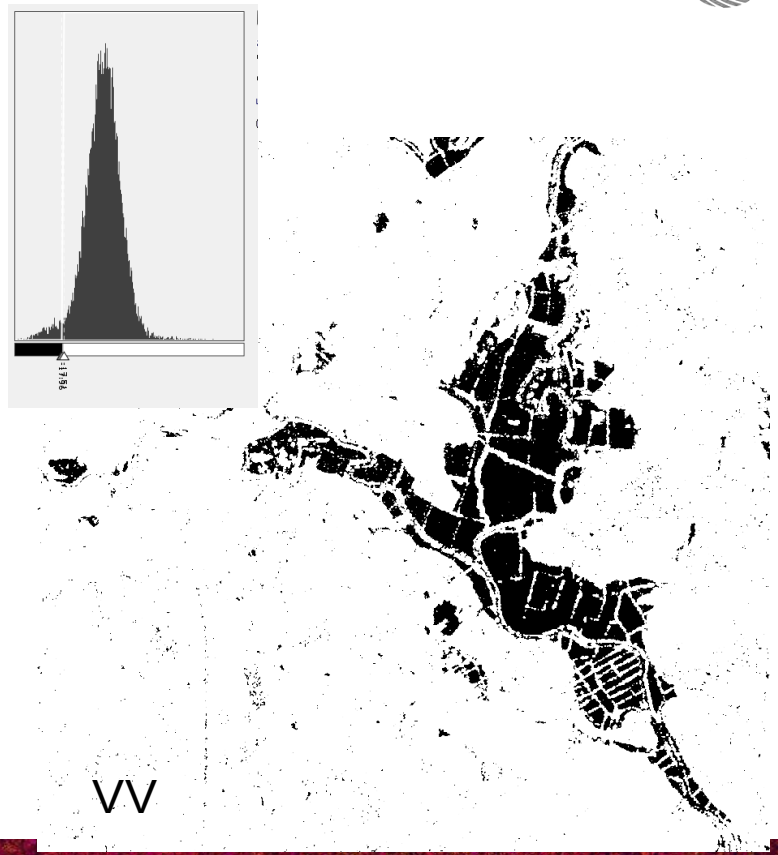


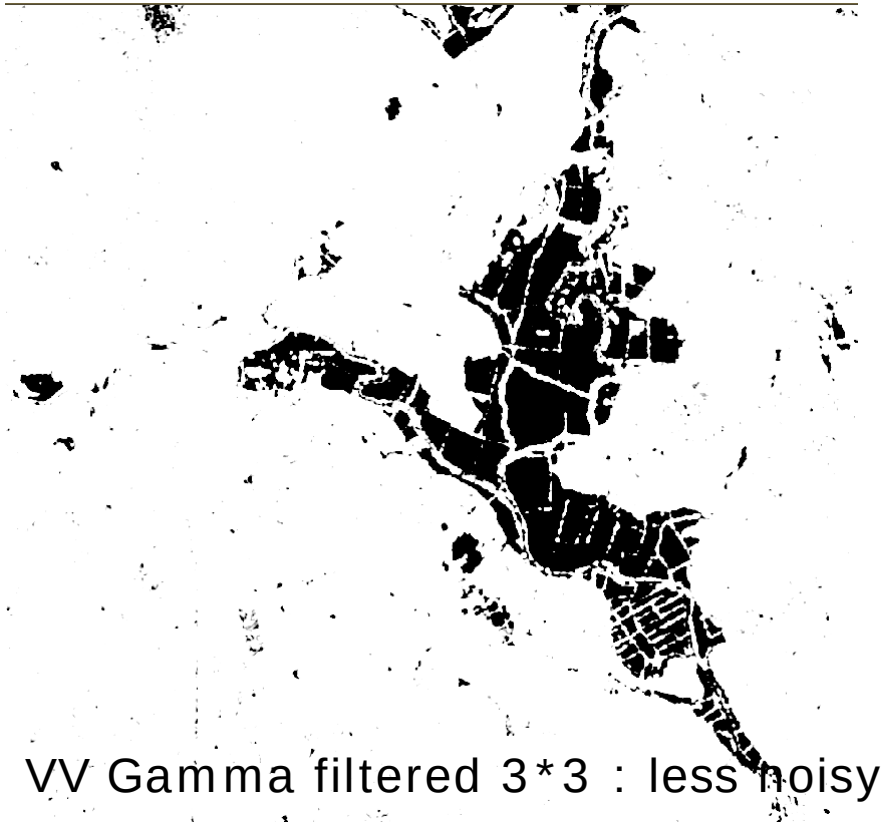
VH : More influ
(hedges, subm



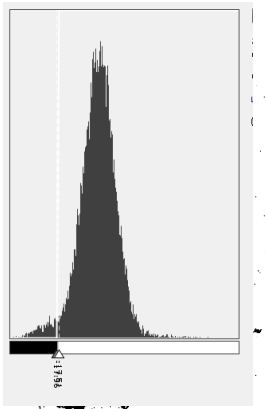

Product Explorer
Pixel Info
Position
Image-X 760 pixel
Image-Y 316 pixel
Longitude 1°20'55" W degree
Latitude 54°06'33" N degree
Map-X -175402.365184... m
Map-Y 6045298.215273201 m
Time
Bands
Sigma0_VH 0.00316 intensity
Sigma0_VV 0.01196 intensity
Tie-Point Grids
Flags
Product Explorer
Pixel Info
Position
Image-X 779 pixel
Image-Y 243 pixel
Longitude 1°20'50" W degree
Latitude 54°06'57" N degree
Map-X -175212.365184... m
Map-Y 6046028.215273201 m
Time
Bands
Sigma0_VH 0.00293 intensity
Sigma0_VV 0.01025 intensity
Tie-Point Grids
Flags
1.47E-5
0.15
0.32
More Options
[2] Dual Pol Ratio Intensity VV+VH RGB
[3] Dual Pol Ratio Sigma0 VV+VH RGB
[5] Dual Pol Ratio Sigma0 VV+VH RGB
[5] Sigma0_VH
[5] Sigma0_VV
Product Library
Layer Manager
X 760 Y 316
Lat 54°06'33" N Lon 1°20'55" W
Zoom 1:4.4 Level 0


VH

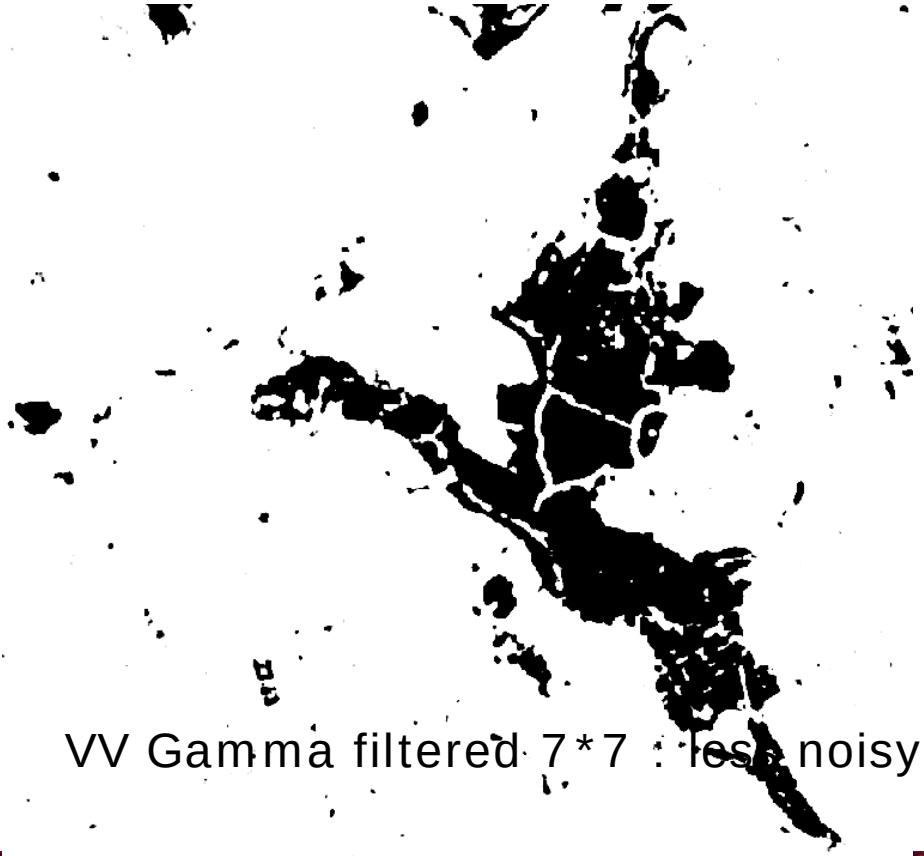

VV



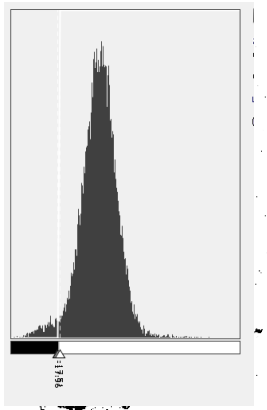
VV Gamma filtered 3*3 : less noisy



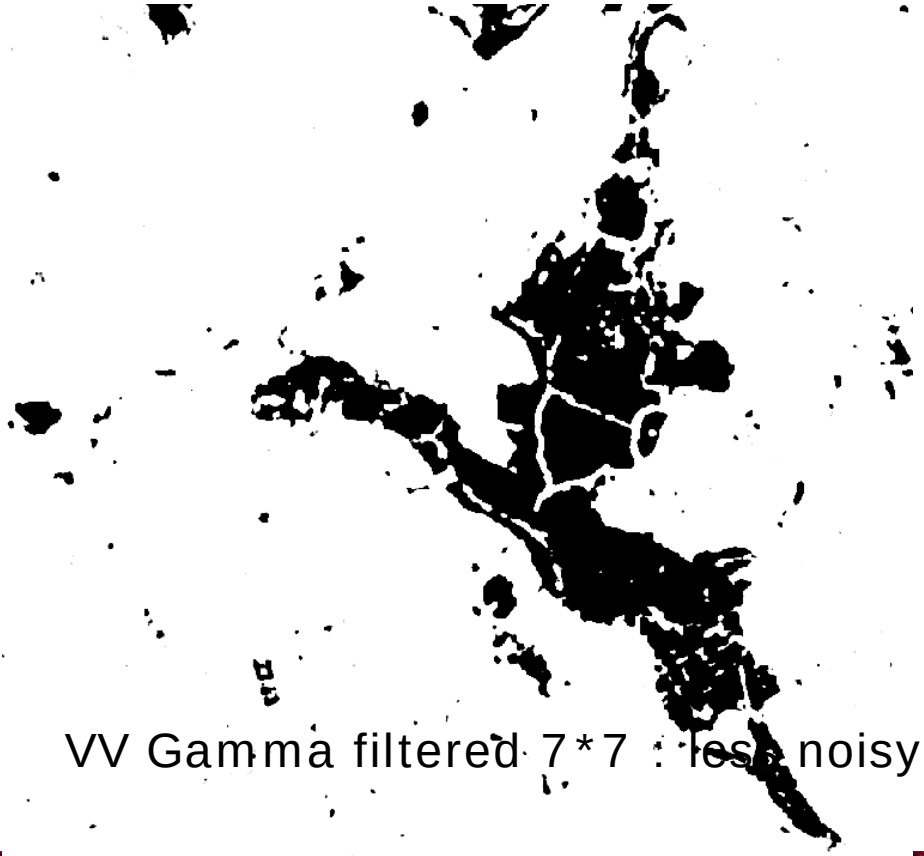
VV



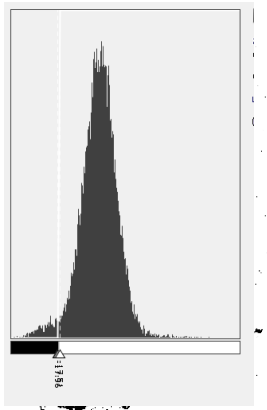
VV Gamma filtered 7*7 : less noisy



VV



VV Gamma filtered 7*7 : less noisy

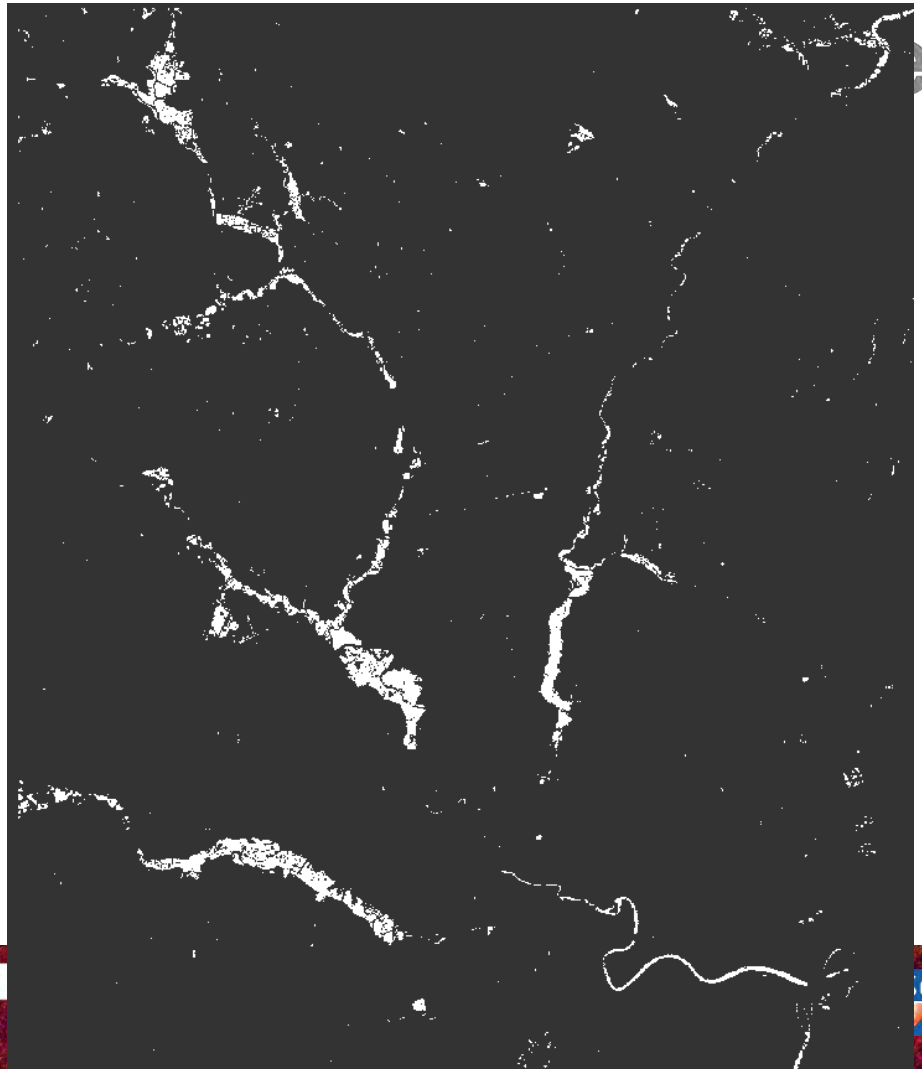


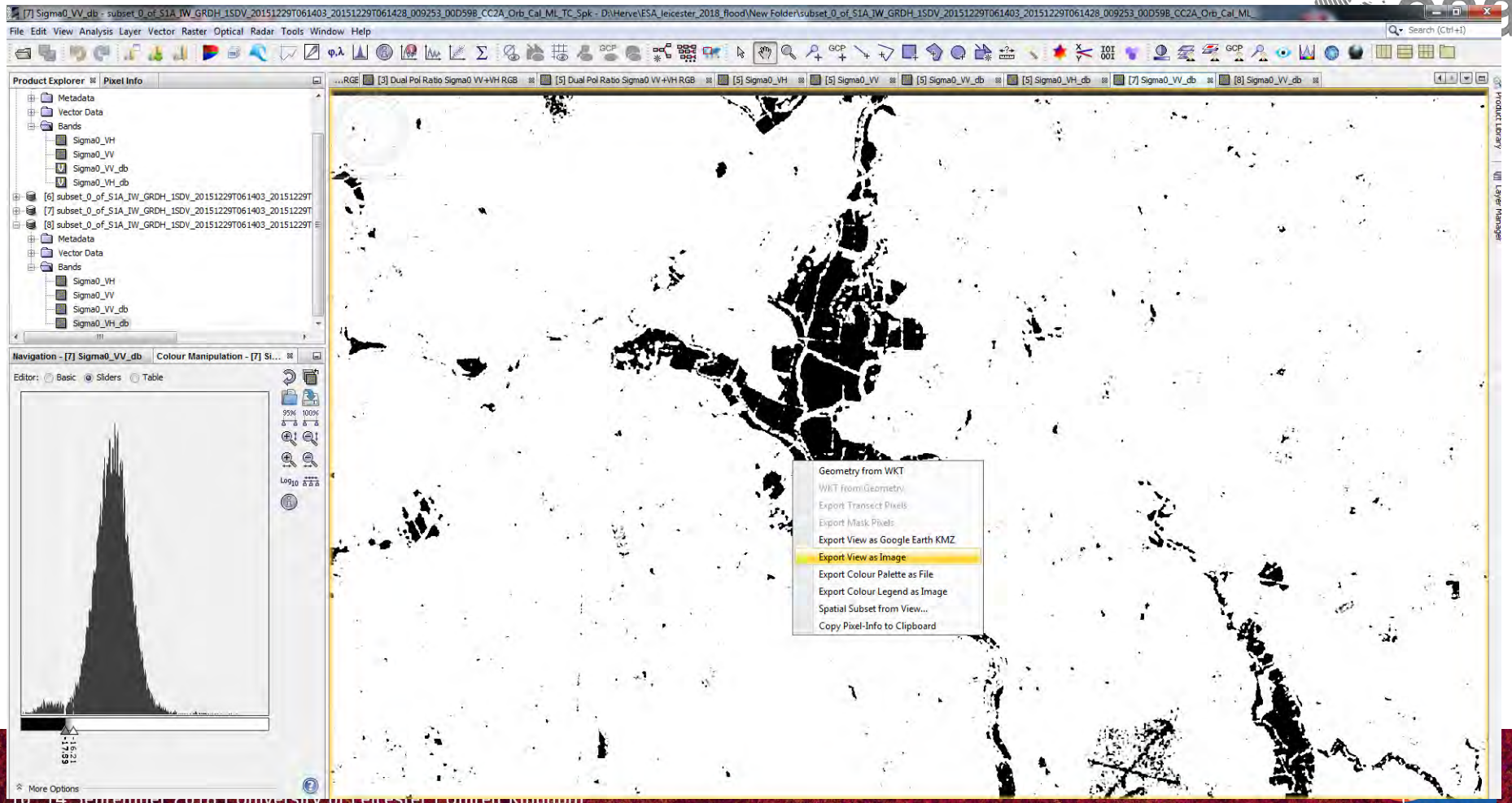
VV

Water extraction

Thresholding based on VV db filtrered Gama 7*7

```
if Sigma0_VV_db <= -17.53 then 1 else NaN
```

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File Edit View Analysis Layer Vector Raster Optical Radar Tools Window Help
Product Explorer
Pixel Info
Metadata
Vector Data
Bands
Sigma0_VH
Sigma0_VV
Sigma0_VV_db
Sigma0_VH_db
[6] subset_0_of_S1A_IW_GRDH_1SDV_20151229T061403_20151229T
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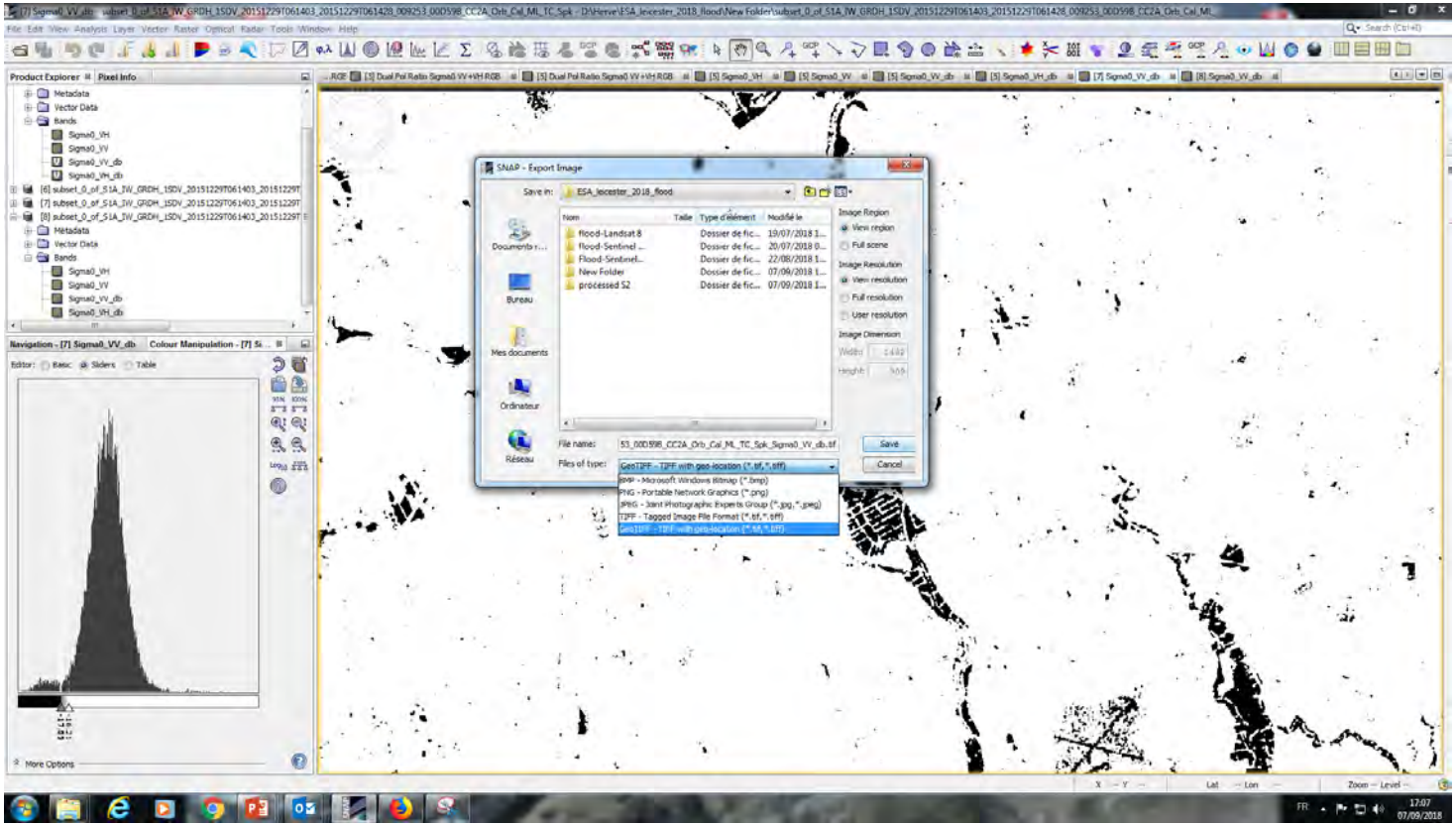
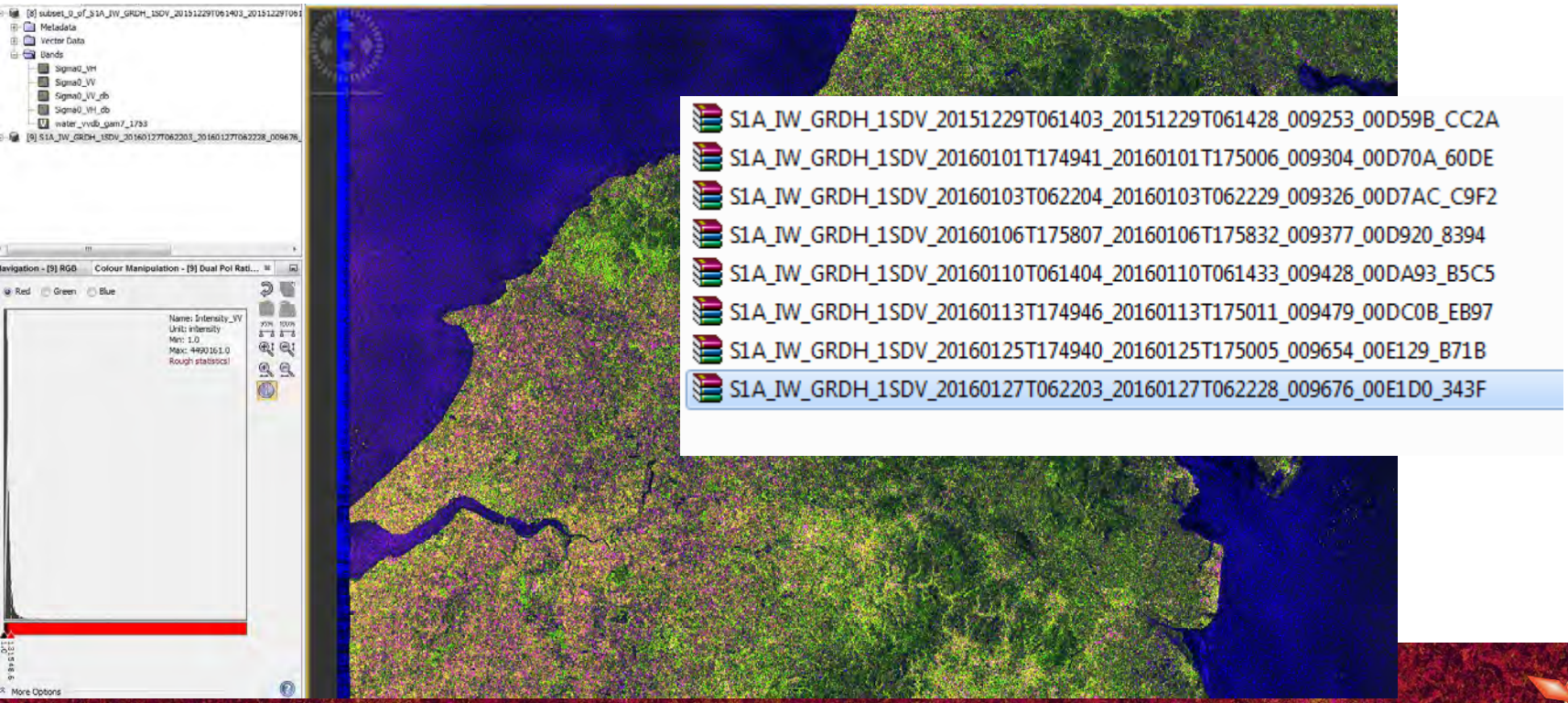
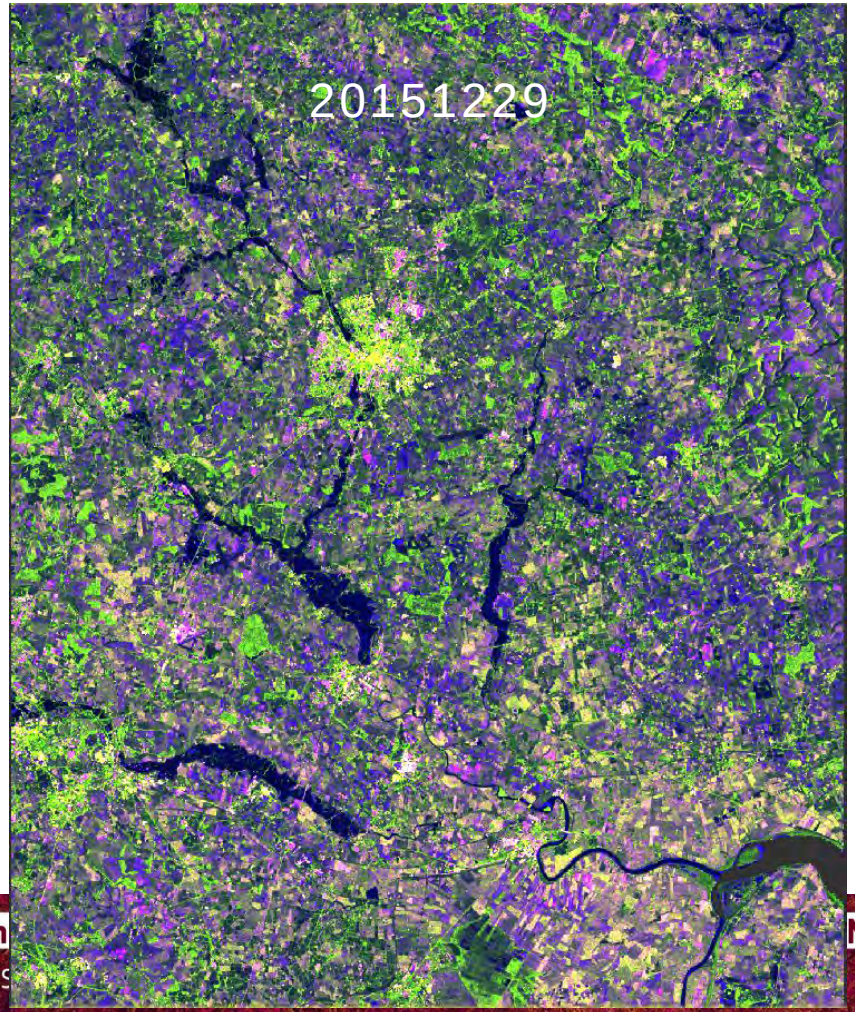
Metadata
Vector Data
Bands
Sigma0_VH
Sigma0_VV
Sigma0_VV_db
Sigma0_VH_db
Navigation - [7] Sigma0_VV_db
Colour Manipulation - [7] Si...
Editor: Basic Sliders Table
95%
100%
Log10
More Options
...RGE
[3] Dual Pol Ratio Sigma0 VV+VH RGB
[5] Dual Pol Ratio Sigma0 VV+VH RGB
[5] Sigma0_VH
[5] Sigma0_VV
[5] Sigma0_VV_db
[5] Sigma0_VH_db
[7] Sigma0_VV_db
[8] Sigma0_VV_db
Geometry from WKT
WKT from Geometry
Export Transect Pixels
Export Mask Pixels
Export View as Google Earth KMZ
Export View as Image
Export Colour Palette as File
Export Colour Legend as Image
Spatial Subset from View...
Copy Pixel-Info to Clipboard
Product Library
Layer Manager

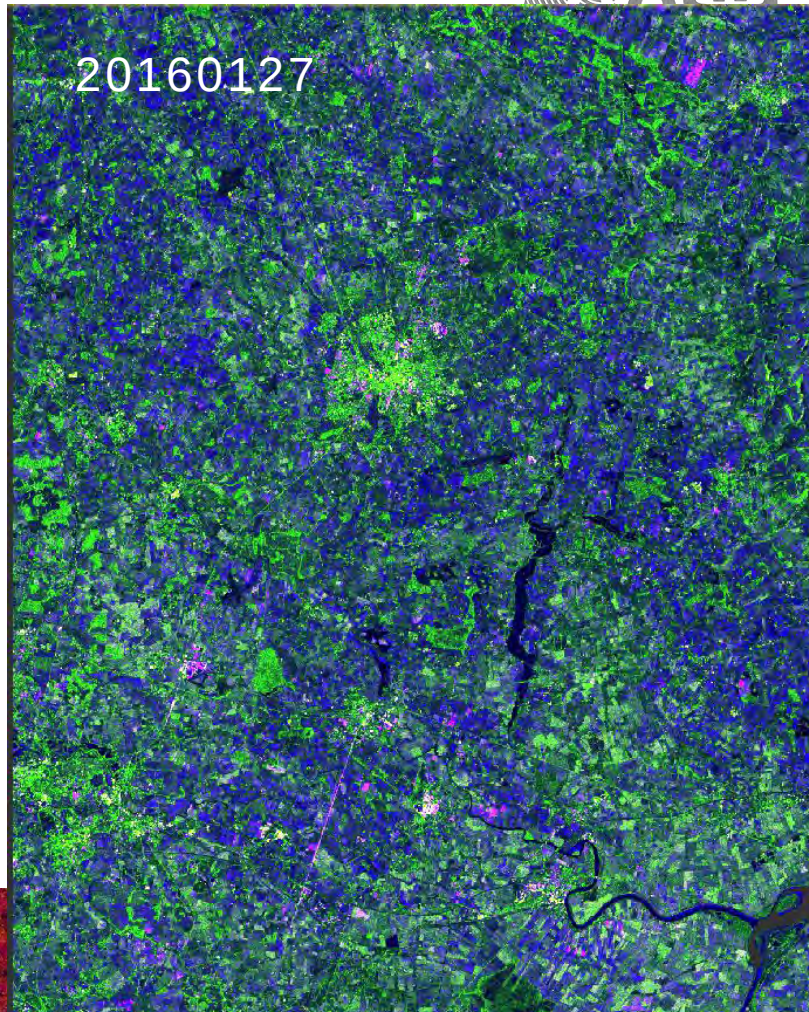

SNAP - Export Image
Save in:
ESA_leicester_2018_flood
Nom
Taille
Type d'élément
Modifié le
flood-Landsat 8
flood-Sentinel ...
Flood-Sentinel...
New Folder
processed S2
Image Region
View region
Full scene
Image Resolution
View resolution
Full resolution
User resolution
Image Dimension
Width:
Height:
File name:
Files of type:
Save
Cancel
BMP - Microsoft Windows Bitmap (*.bmp)
PNG - Portable Network Graphics (*.png)
JPEG - Joint Photographic Experts Group (*.jpg,*.jpeg)
TIFF - Tagged Image File Format (*.tif,*.tiff)
GeoTIFF - TIFF with geo-location (*.tif,*.tiff)

Home work to be done... **flood monitoring:**

Preprocessing steps to be done



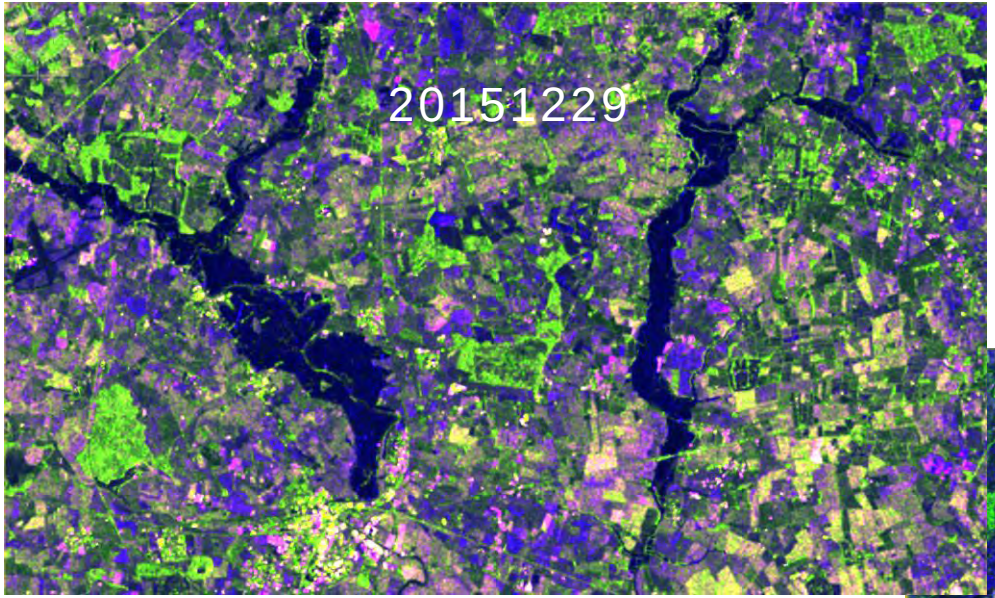


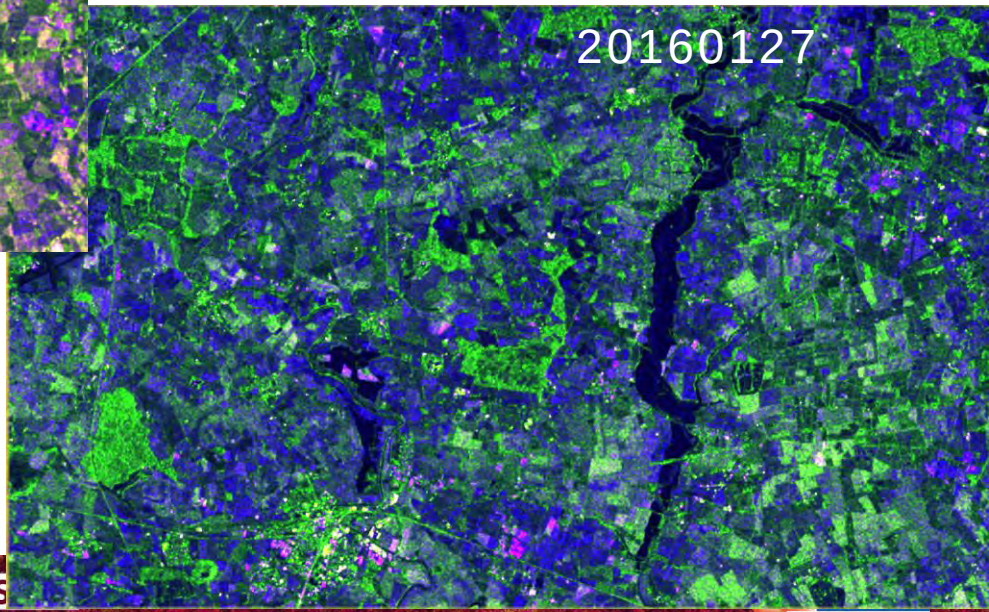


→ 8th

NG

10–14 S


20151229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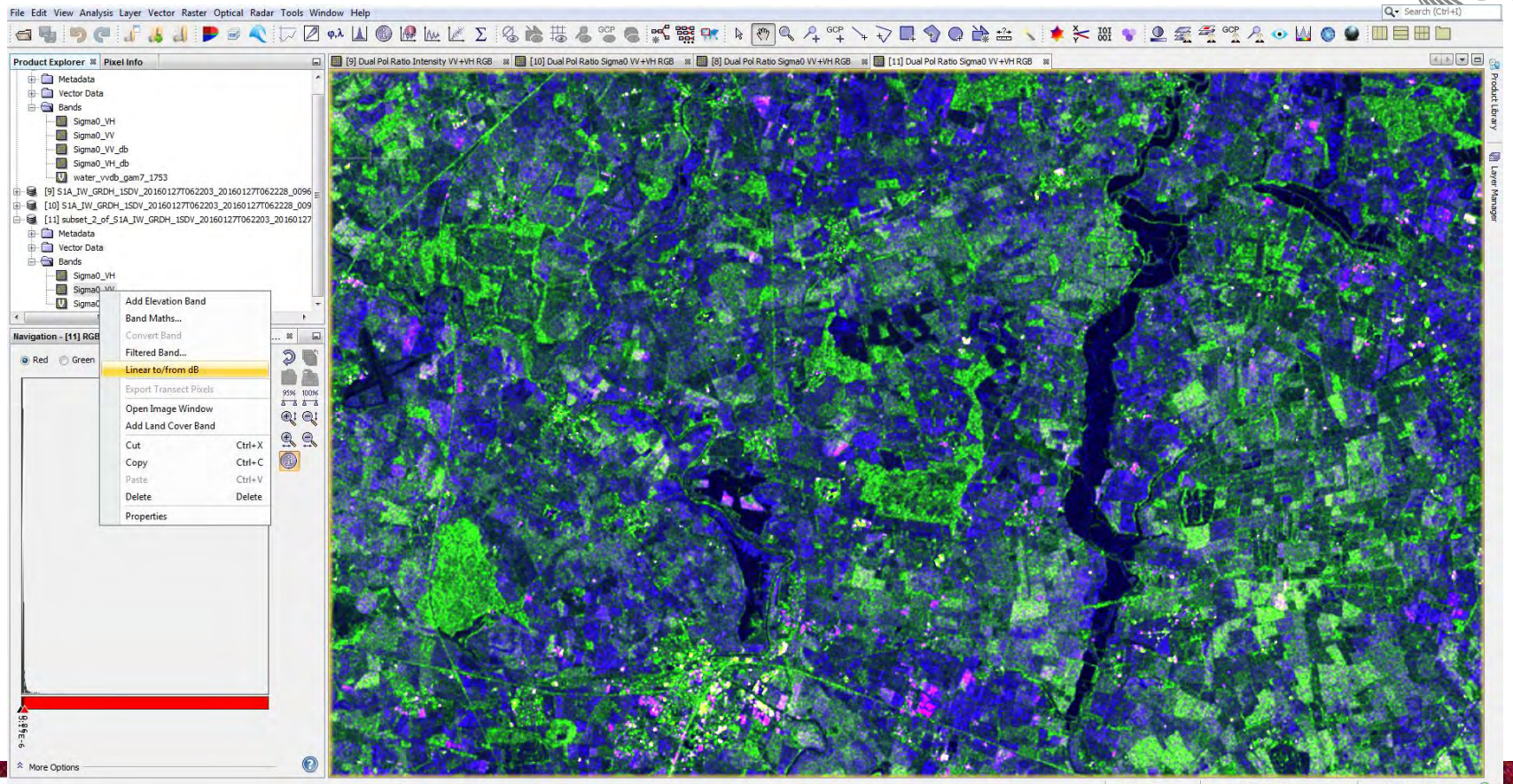
File Edit View Analysis Layer Vector Raster Optical Radar Tools Window Help
Product Explorer
Pixel Info
Metadata
Vector Data
Bands
Sigma0_VH
Sigma0_VV
Sigma0_VV_db
Sigma0_VH_db
water_vvdb_gam7_1753
[9] S1A_IW_GRDH_1SDV_20160127T062203_20160127T062228_0096
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Add Elevation Band
Band Maths...
Convert Band
Filtered Band...
Linear to/from dB
Export Transect Pixels
Open Image Window
Add Land Cover Band
Cut Ctrl+X
Copy Ctrl+C
Paste Ctrl+V
Delete Delete
Properties
Navigation - [11] RGB
Red
Green
More Options
[9] Dual Pol Ratio Intensity VV+VH RGB
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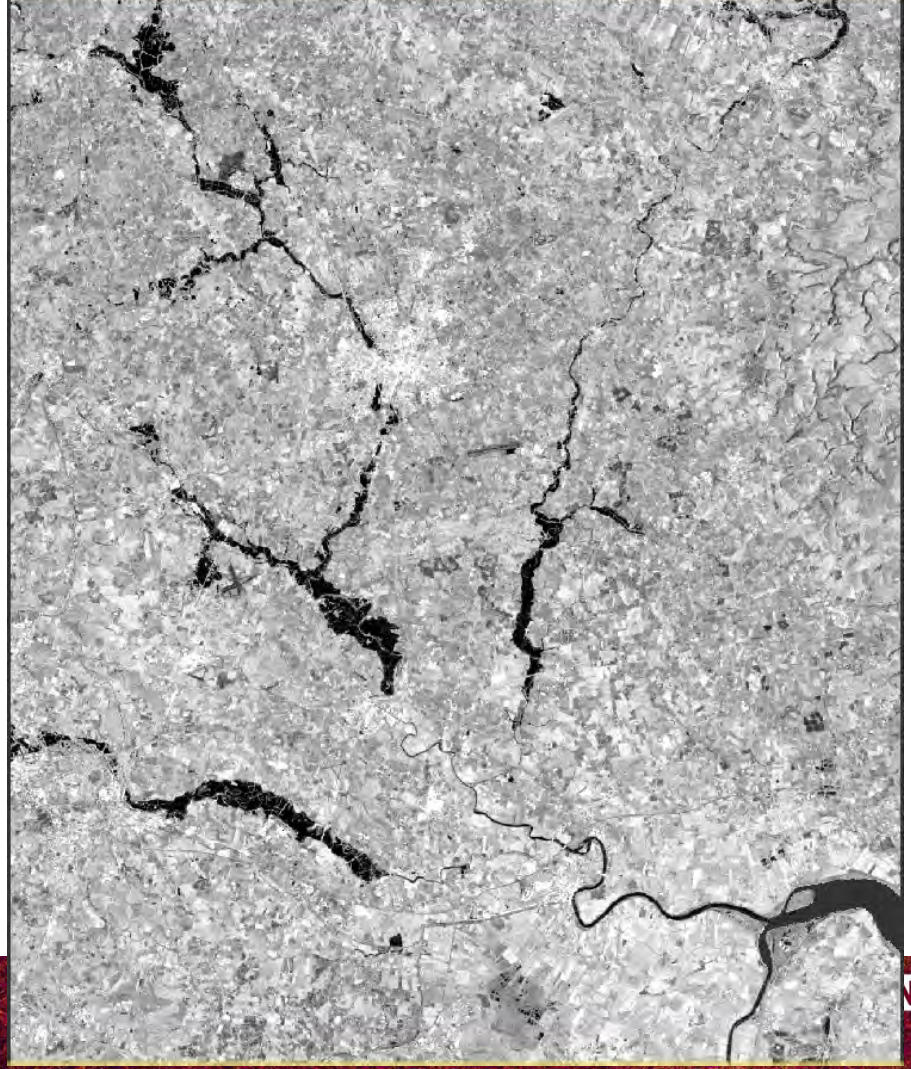
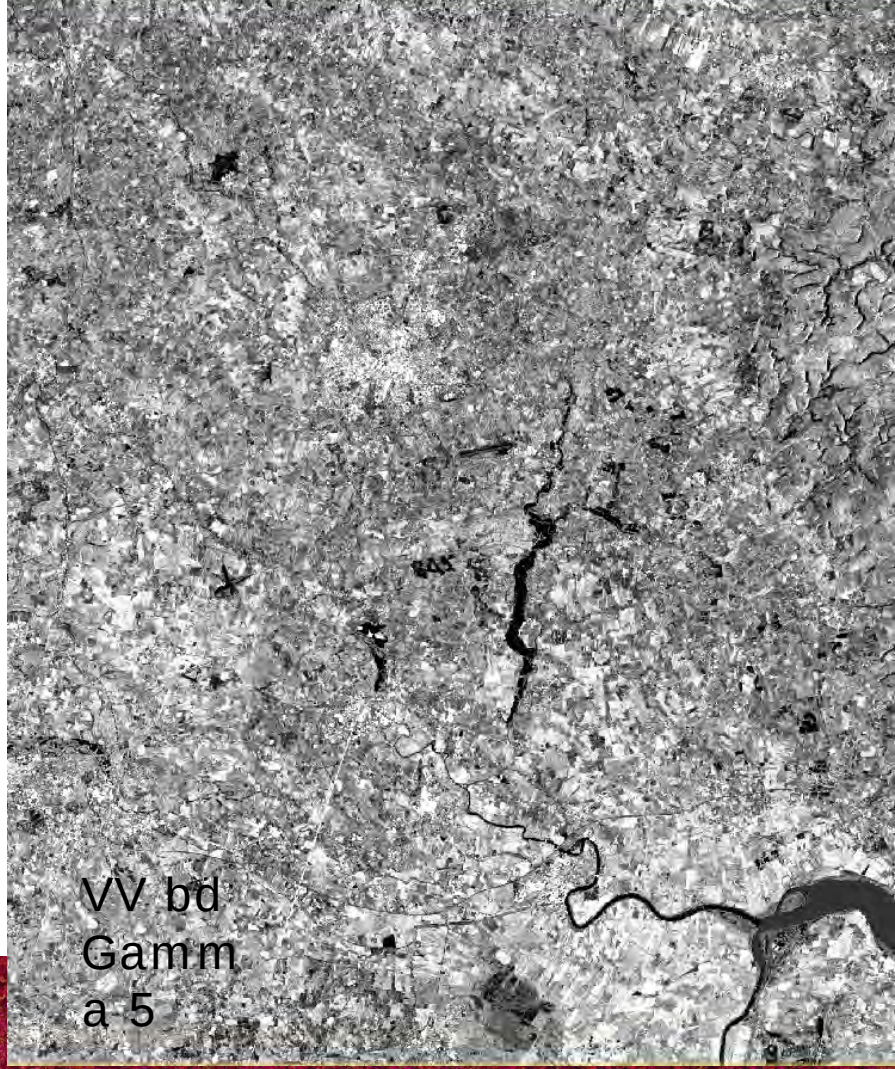
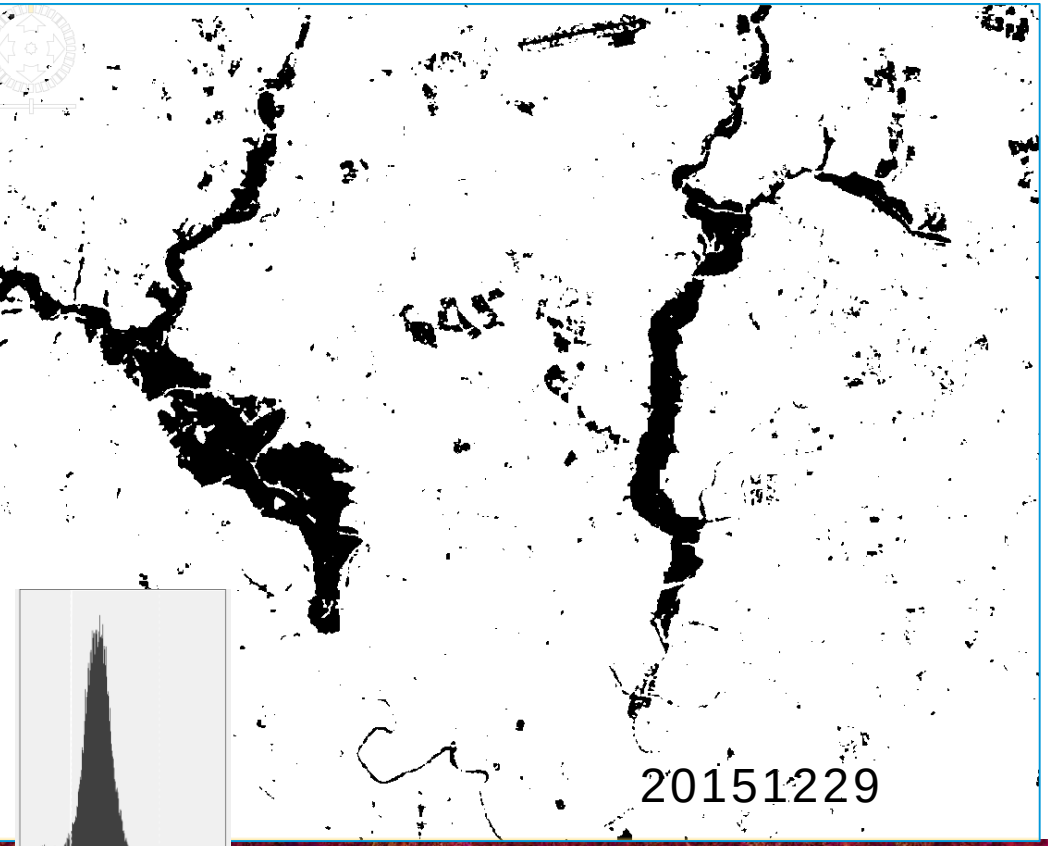
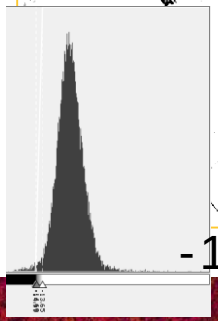
[8] Dual Pol Ratio Sigma0 VV+VH RGB
[11] Dual Pol Ratio Sigma0 VV+VH RGB
Product Library
Layer Manager





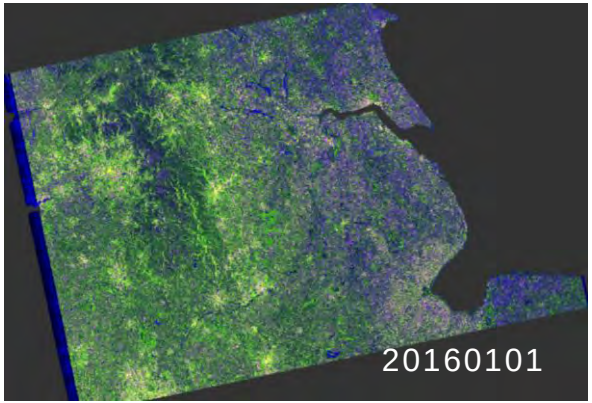
NSING

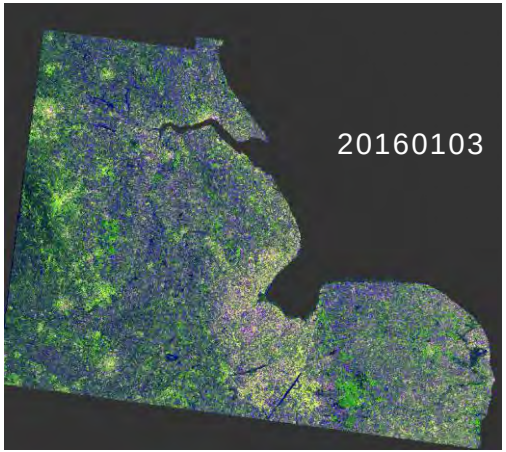


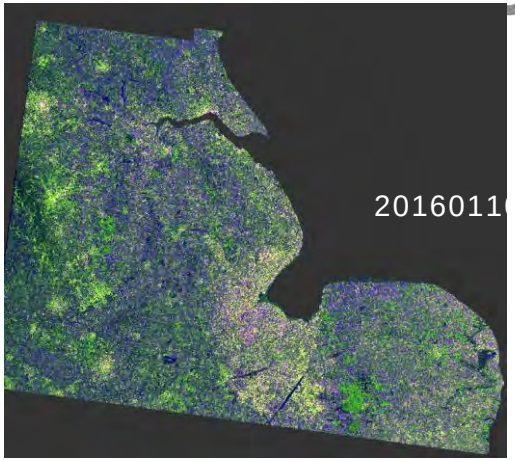


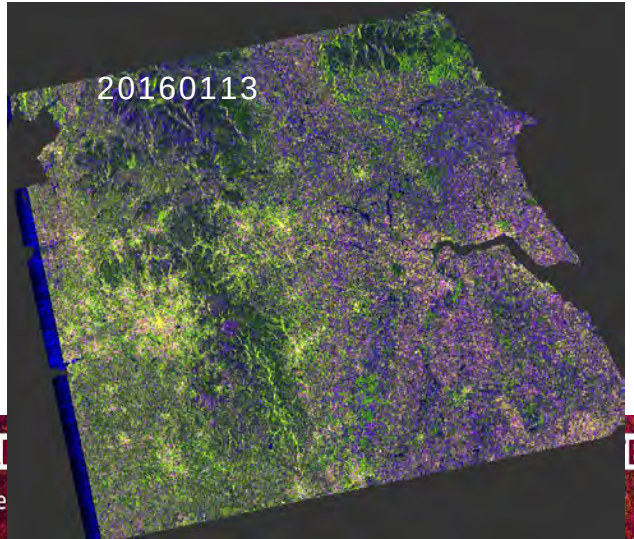
-14,987

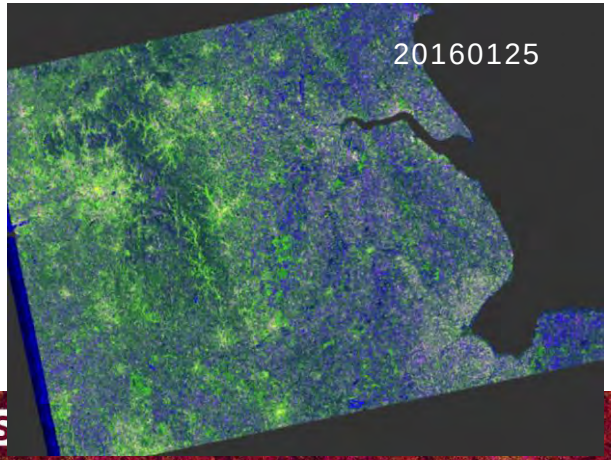
Home work to be done... more flood monitoring:



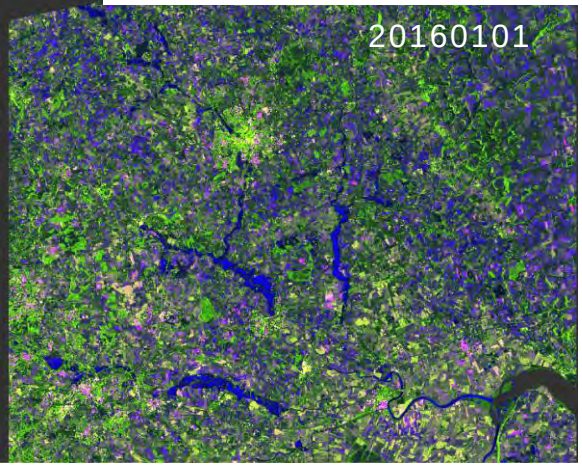


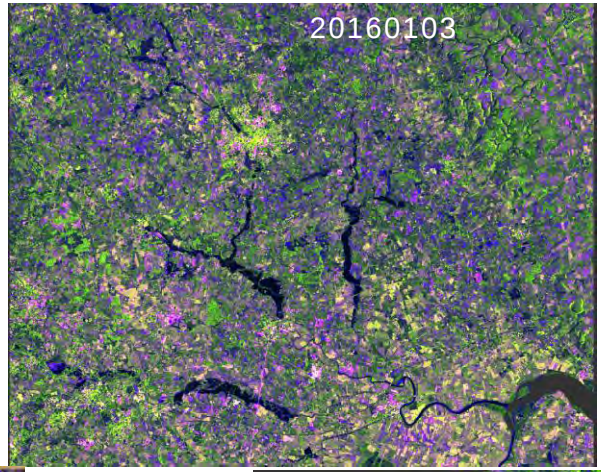


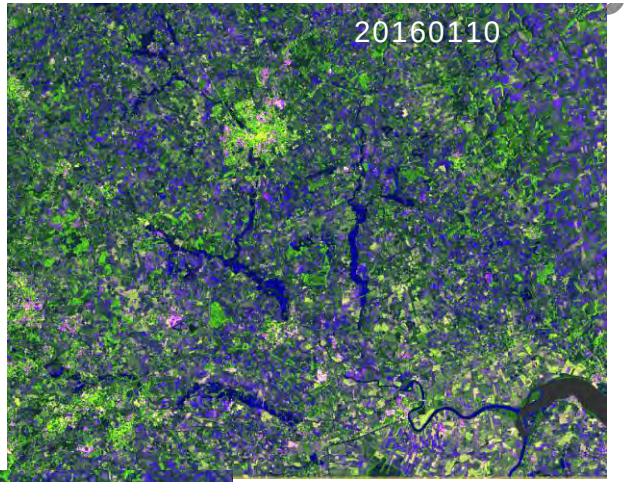


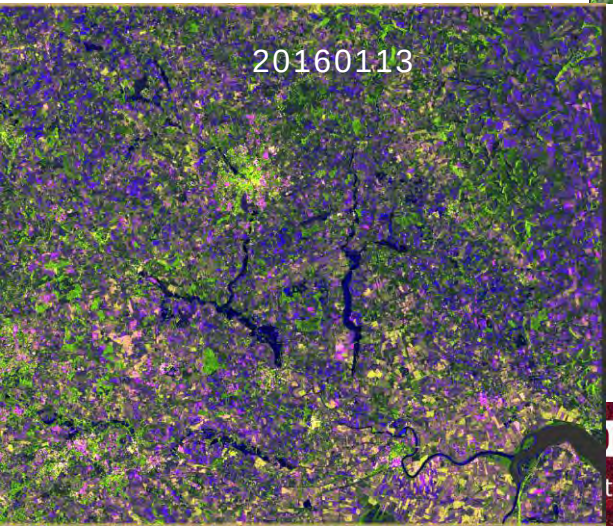


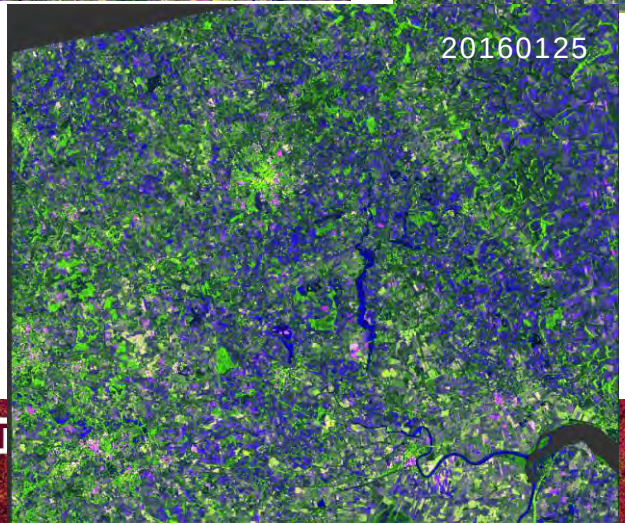
Home work to be done... more flood monitoring:











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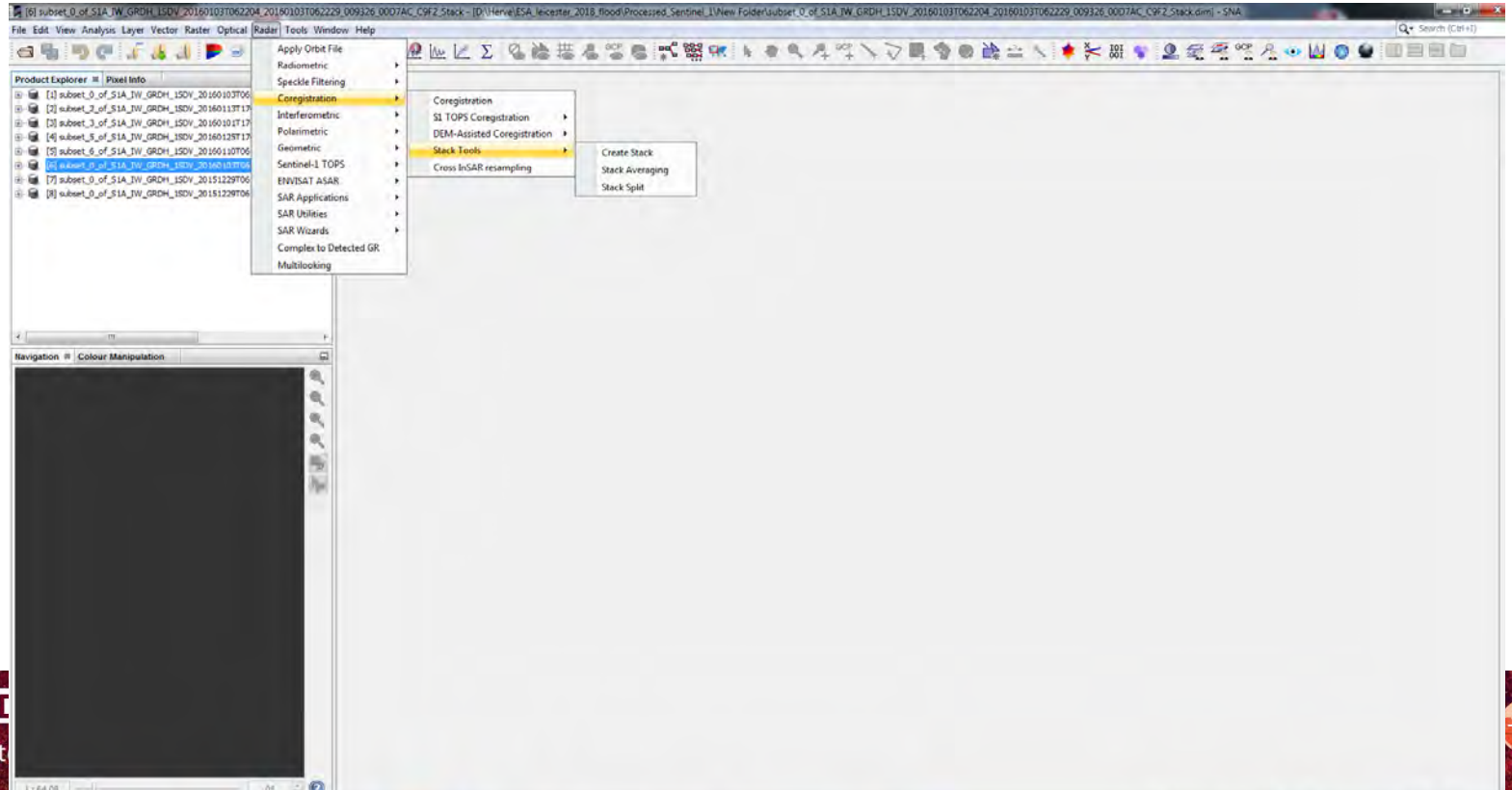
ICUBE

Layer stack tool



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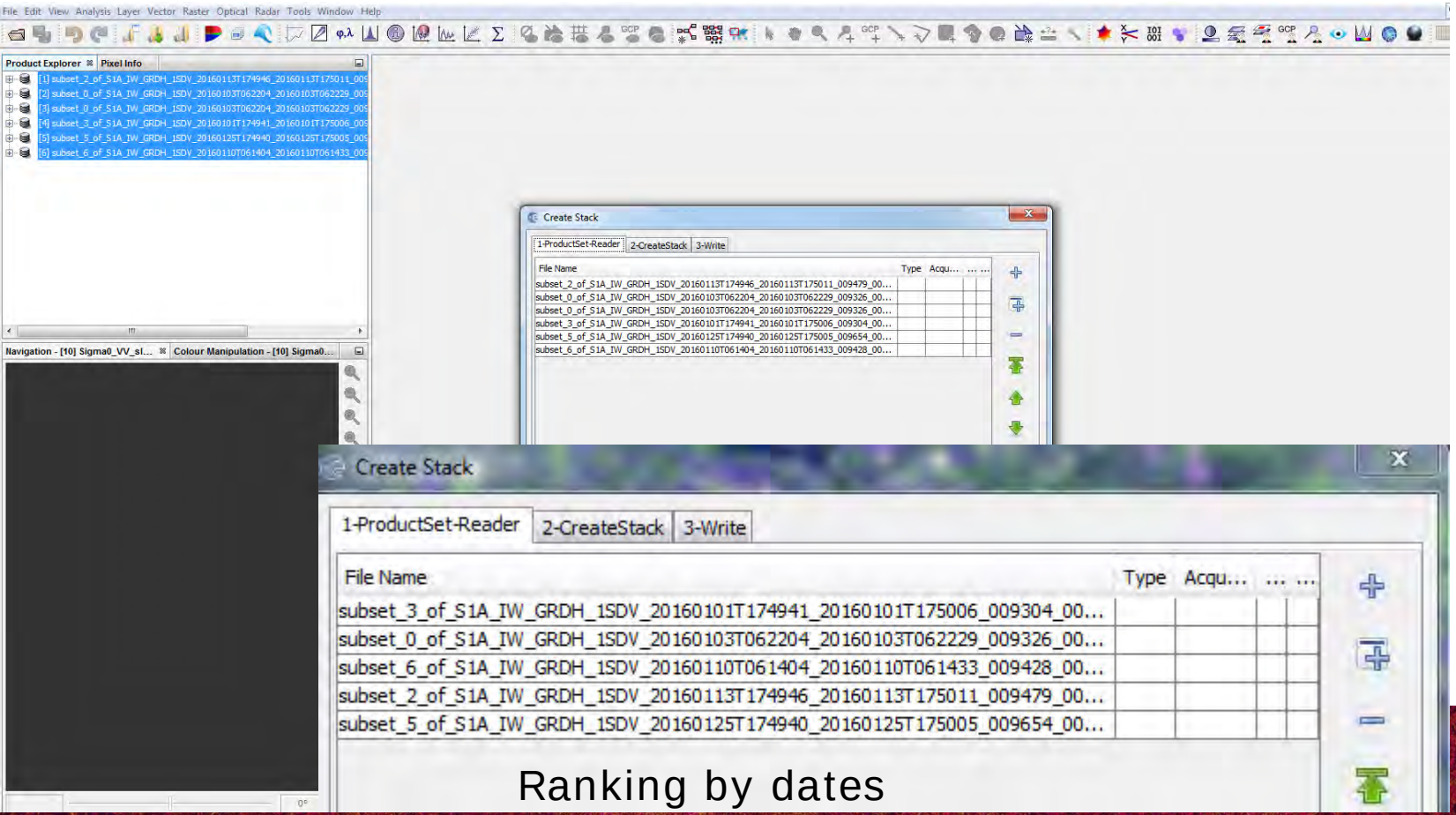
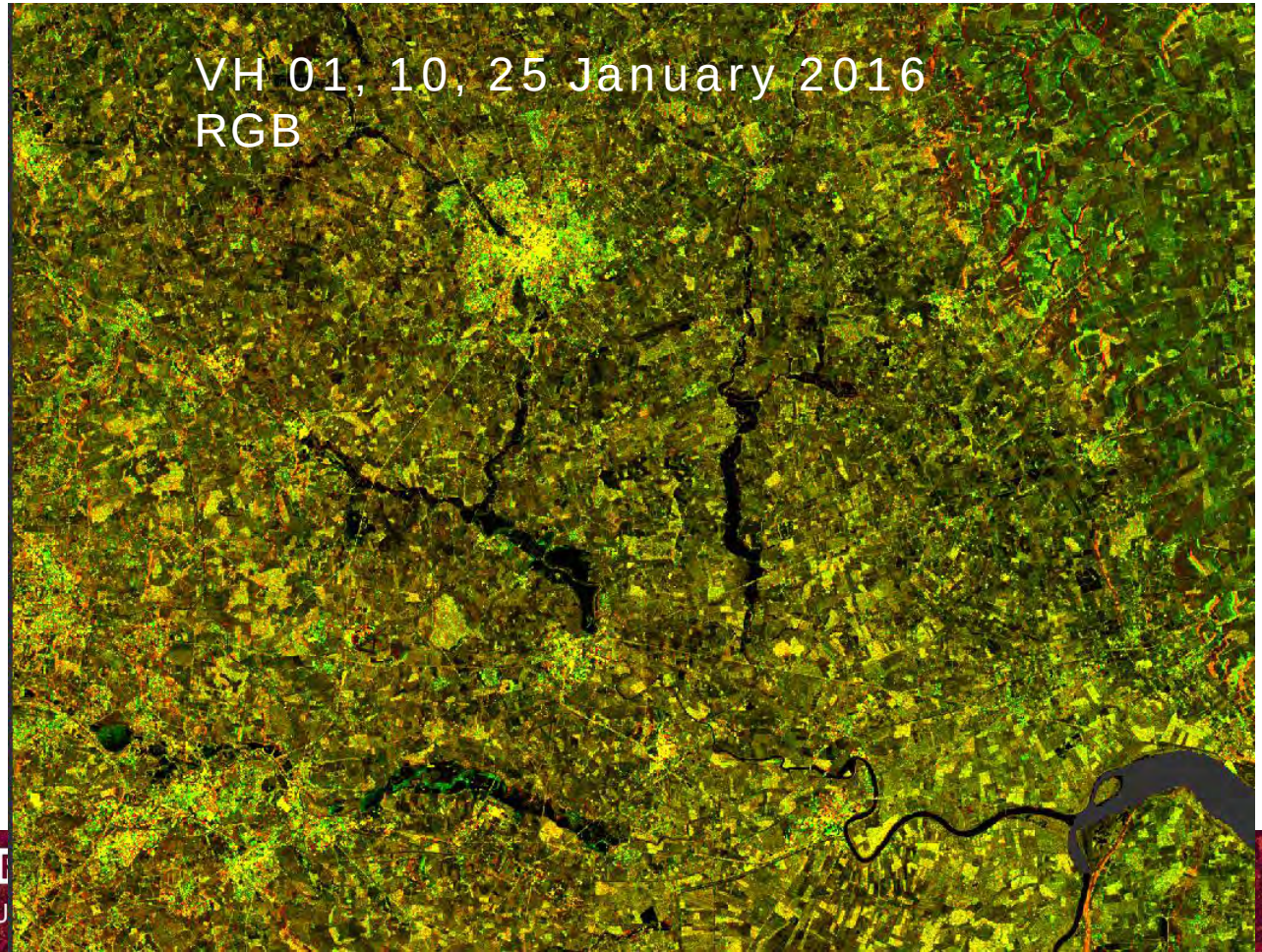
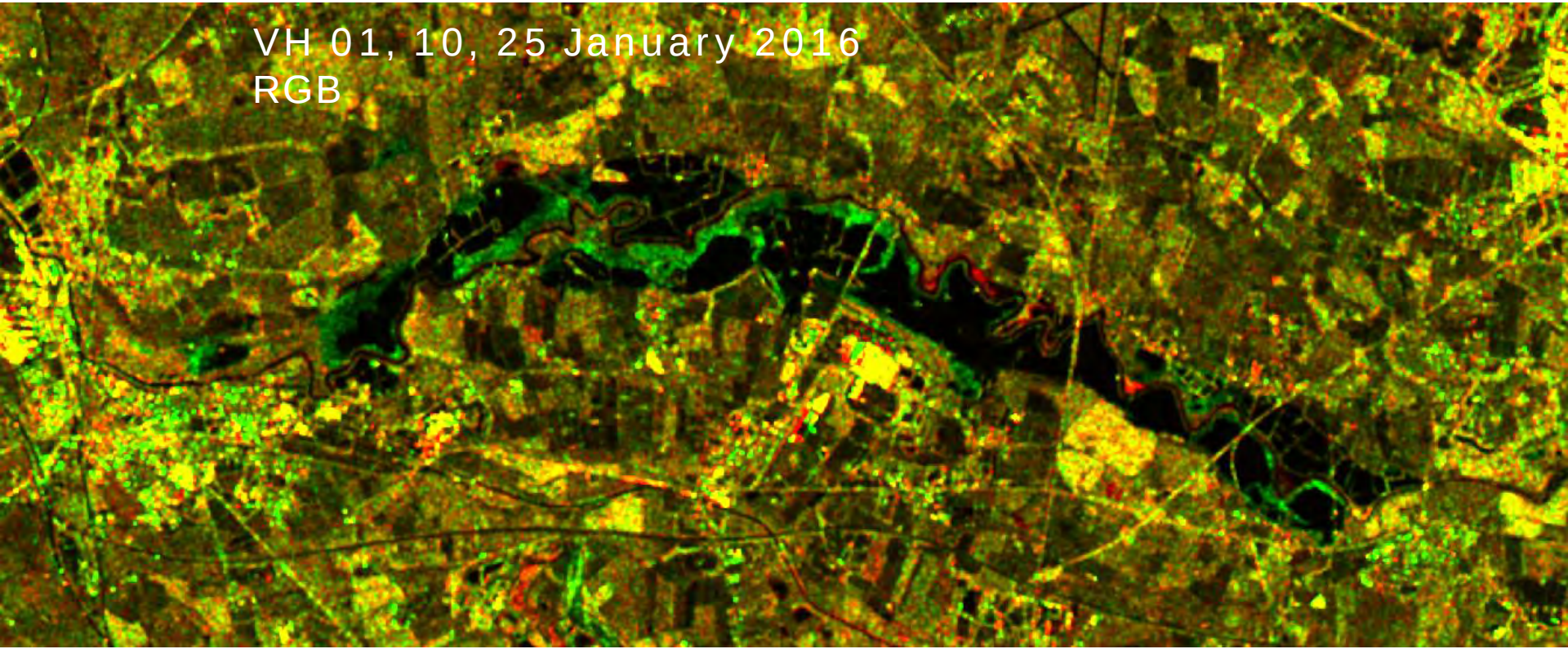


Flood dynamic analysis based on multitemporal composite



Flood dynamic analysis based on multitemporal composite



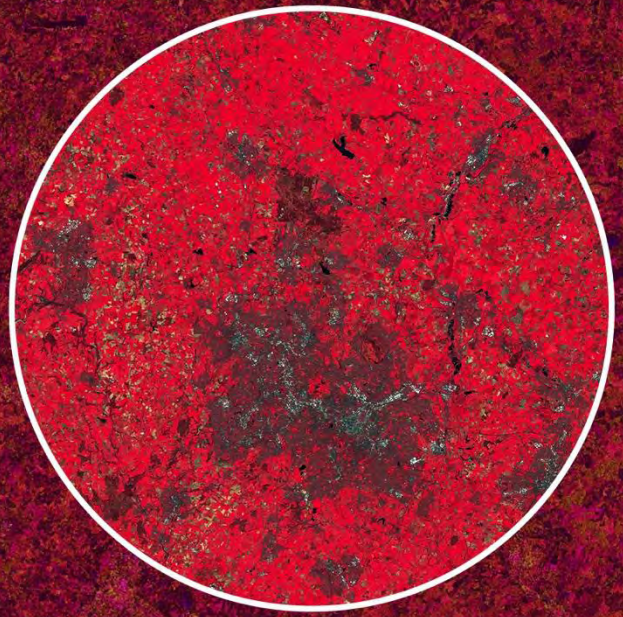
National Centre for Earth Observation
NATURAL ENVIRONMENT RESEARCH COUNCIL

UNIVERSITY OF LEICESTER

esa

→ 8th ADVANCED TRAINING COURSE ON LAND REMOTE SENSING

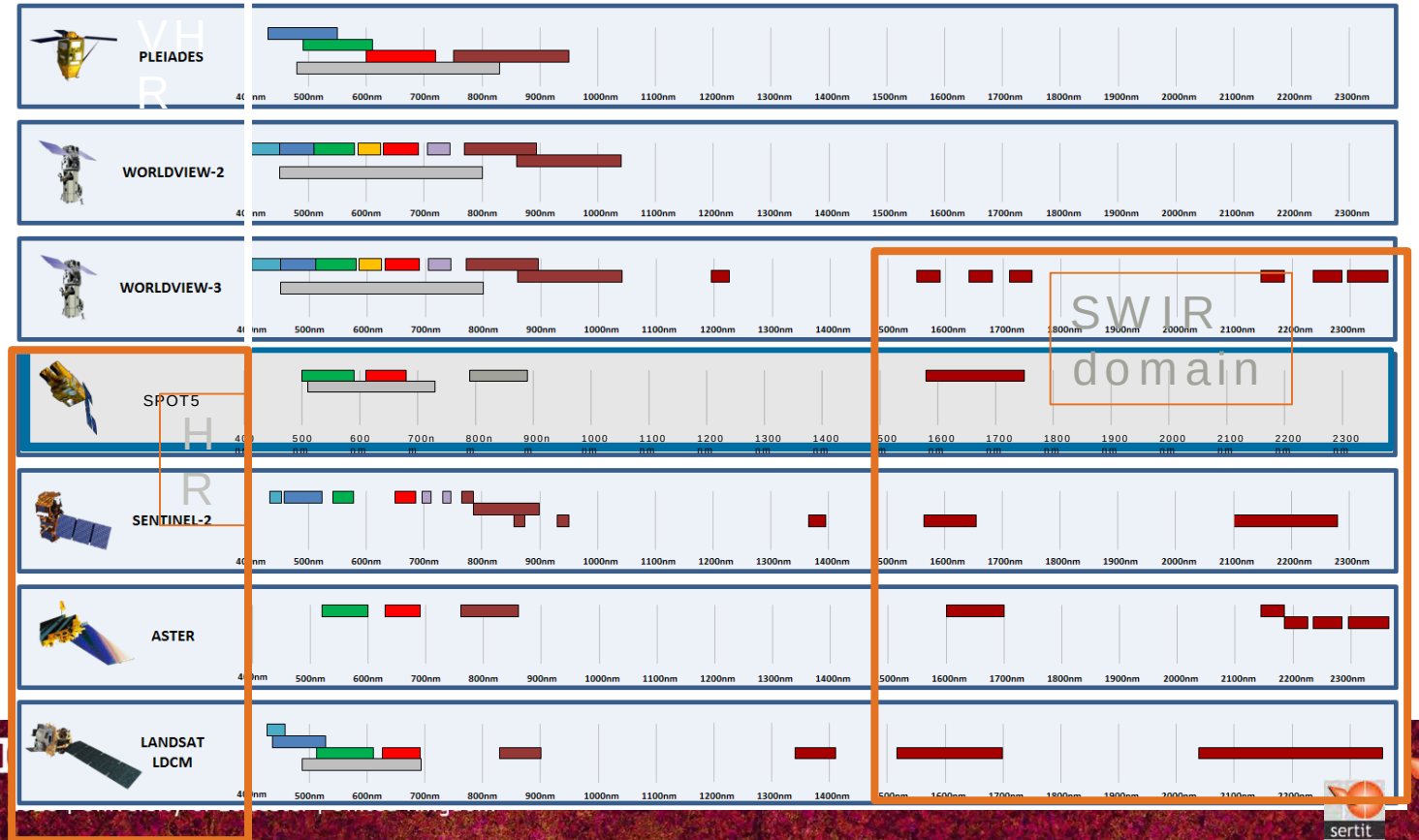
10–14 September 2018
University of Leicester | United Kingdom



Optical data for flood mapping

Spectral basis for water bodies mapping: VIS & SWIR

Actual and future optical sensors more or less suitable for water surface mapping



Sentinel 2 data processing

Preprocessing steps:

- Reading
- Tile identification
- Resampling
- Subset

Water extraction procedure on optical image

- Bands combination
- Simple threshold on MNWDI and AWAEI
- Double threshold AWAEI and BRIGNTNESS
- Dynamic : Sentinel2 and Landsat

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- Double threshold AWAEI and BRIGNTNESS
- Dynamic : Sentinel2 and Landsat

Reading Sentinel2 image

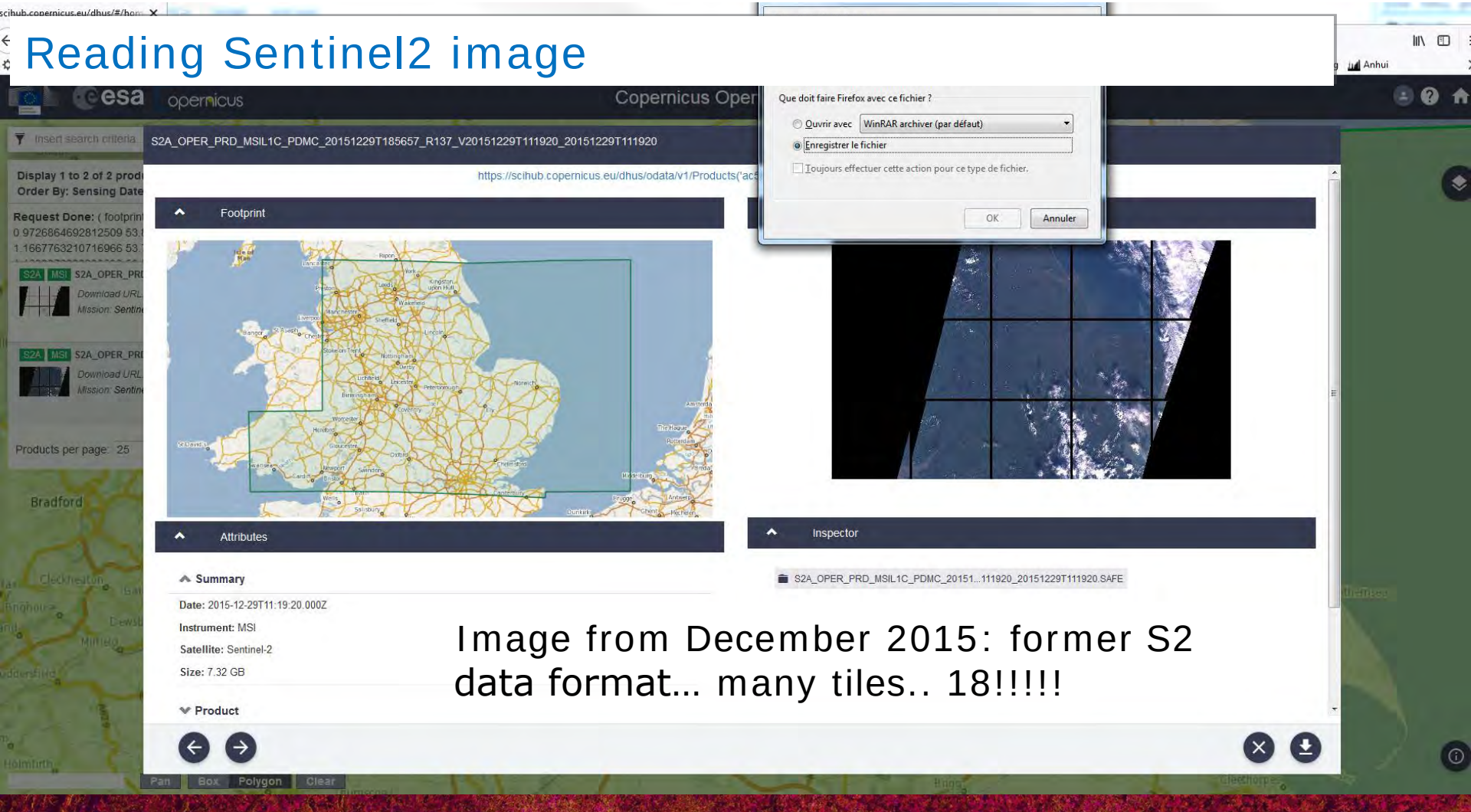

Image from December 2015: former S2 data format… many tiles.. 18!!!!!

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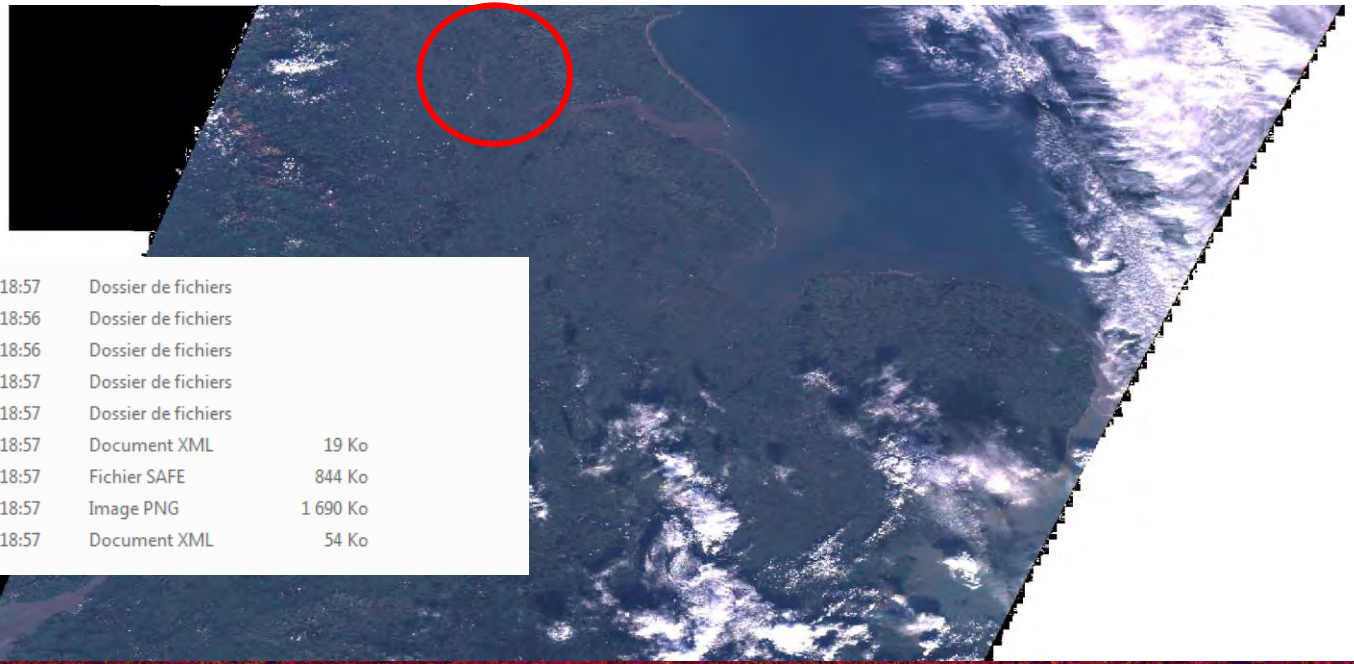

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manifest.safe	29/12/2015 18:57	Fichier SAFE	844 Ko
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S2A_OPER_MTD_SAFL1C_PDMC_2015122...	29/12/2015 18:57	Document XML	54 Ko

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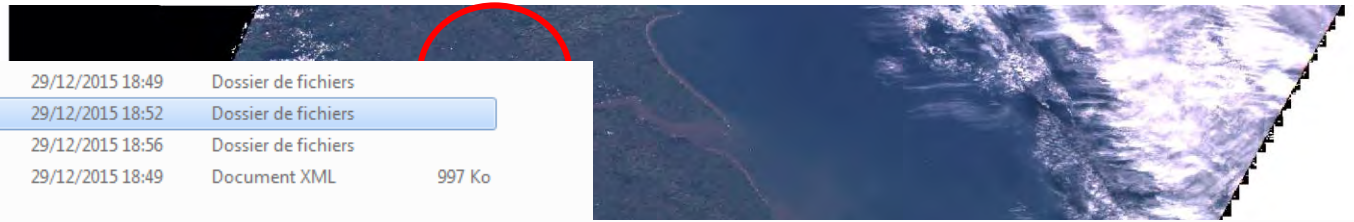

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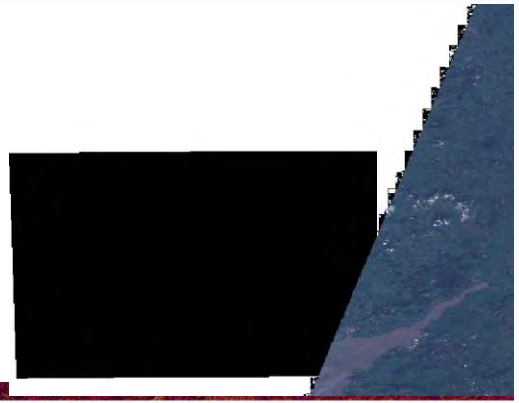

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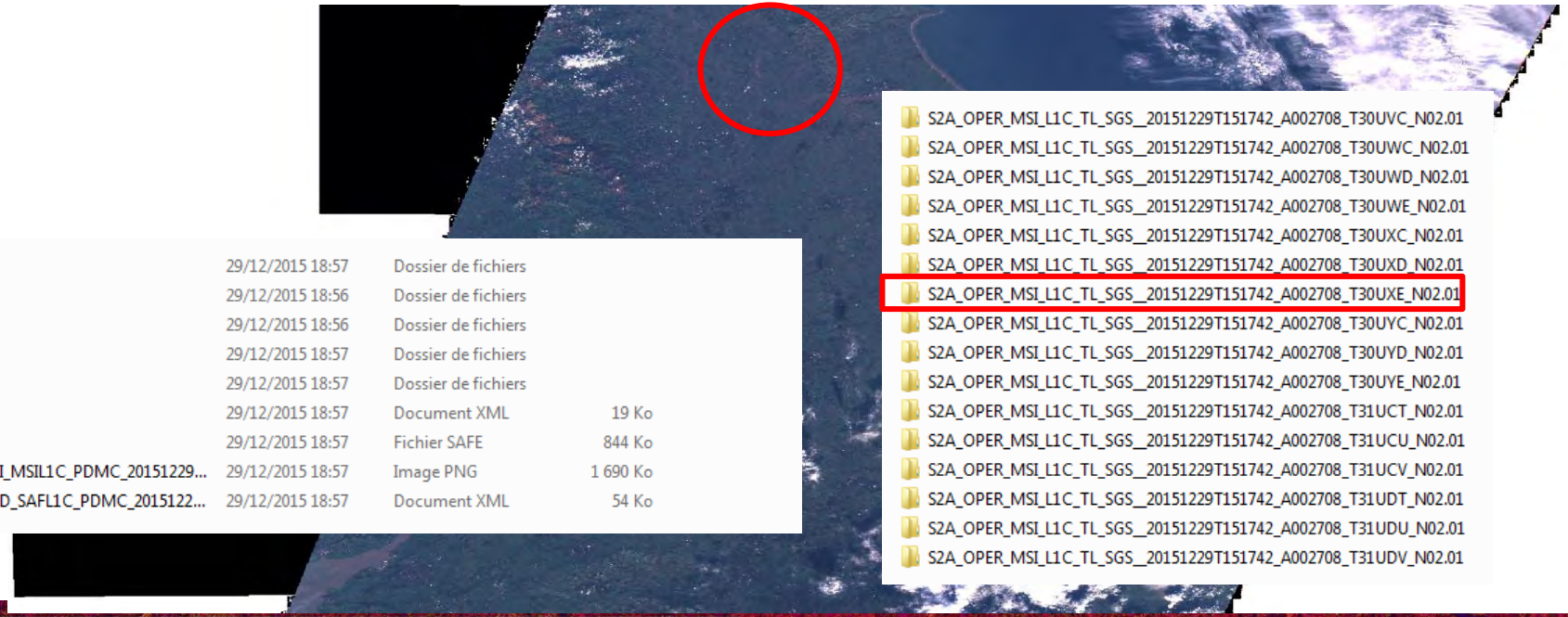

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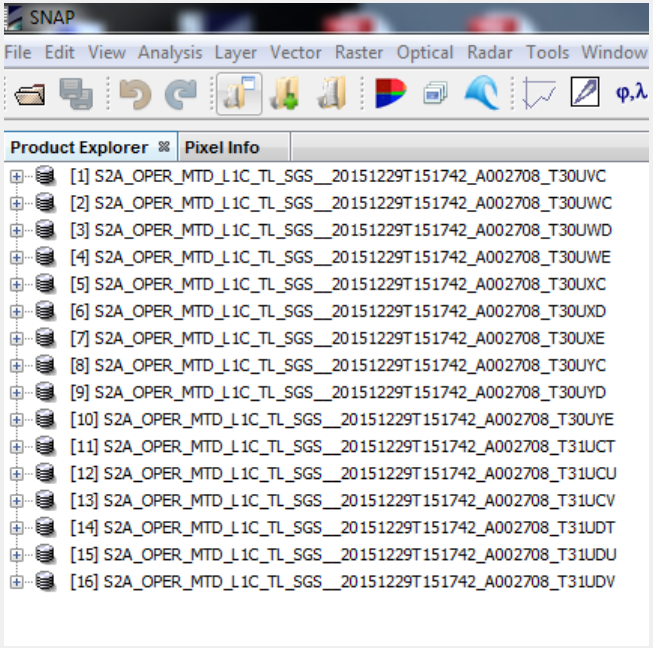
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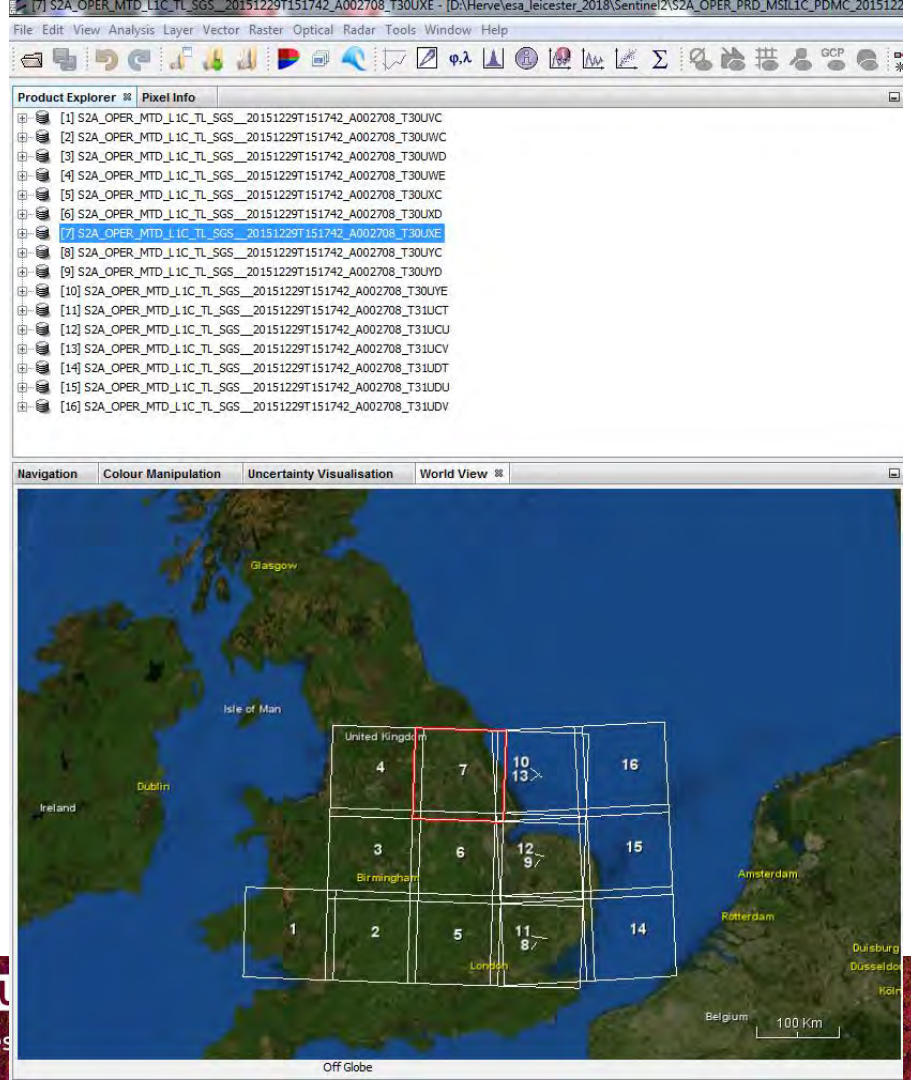
Navigation | Colour Manipulation | Uncertainty Visualisation | World View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Colour Manipulation
Uncertainty Visualisation
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United Kingdom
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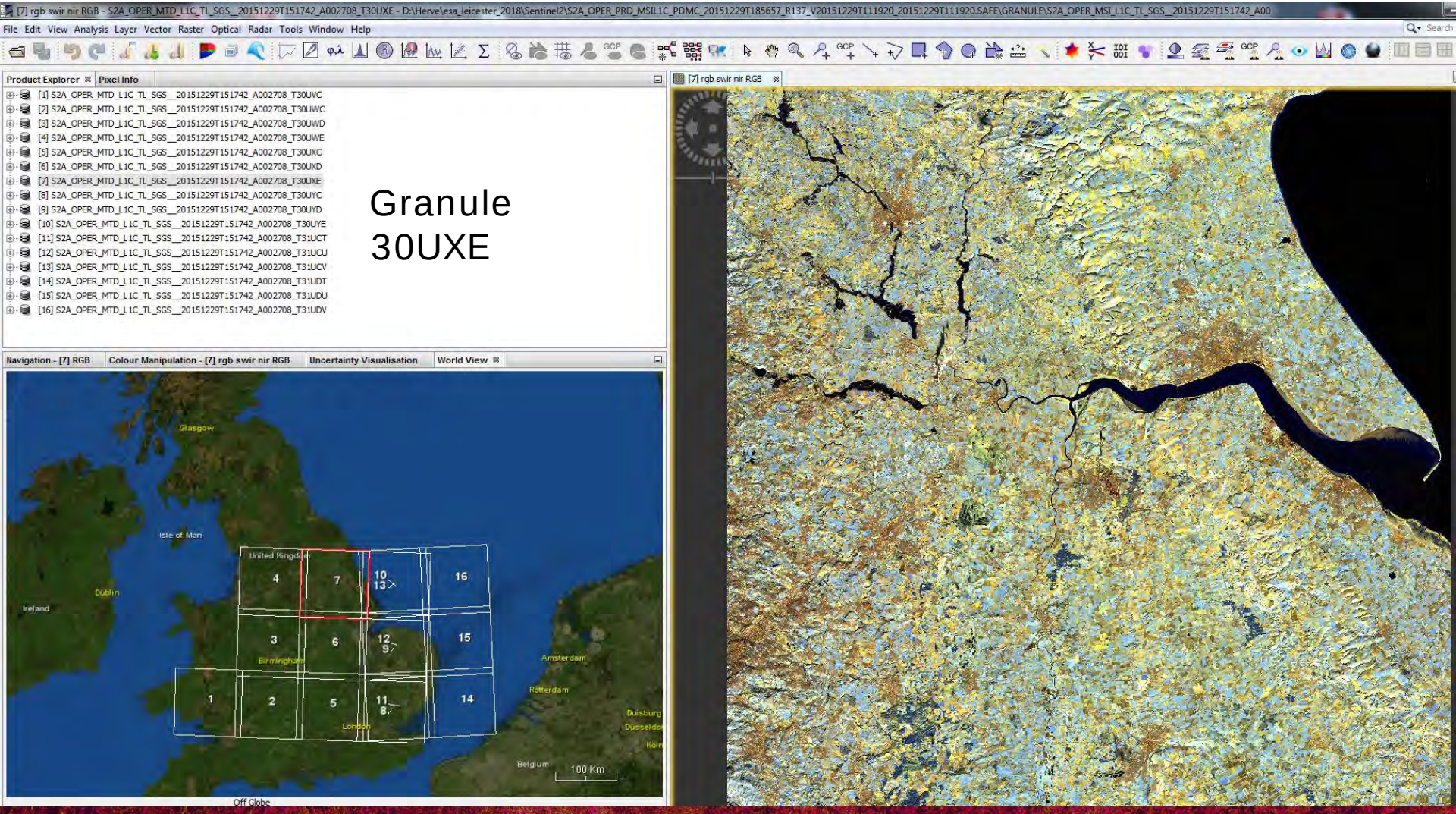
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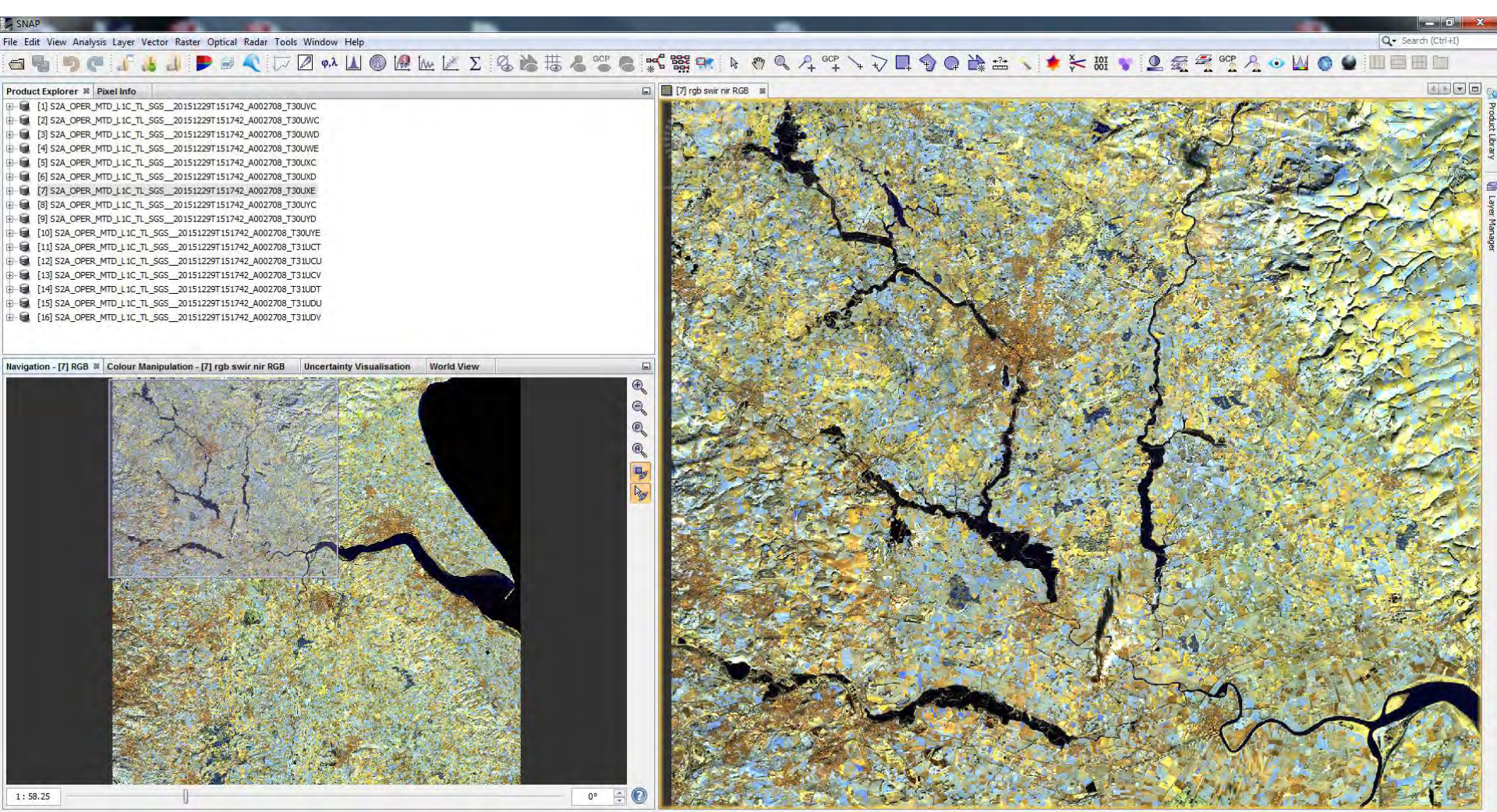
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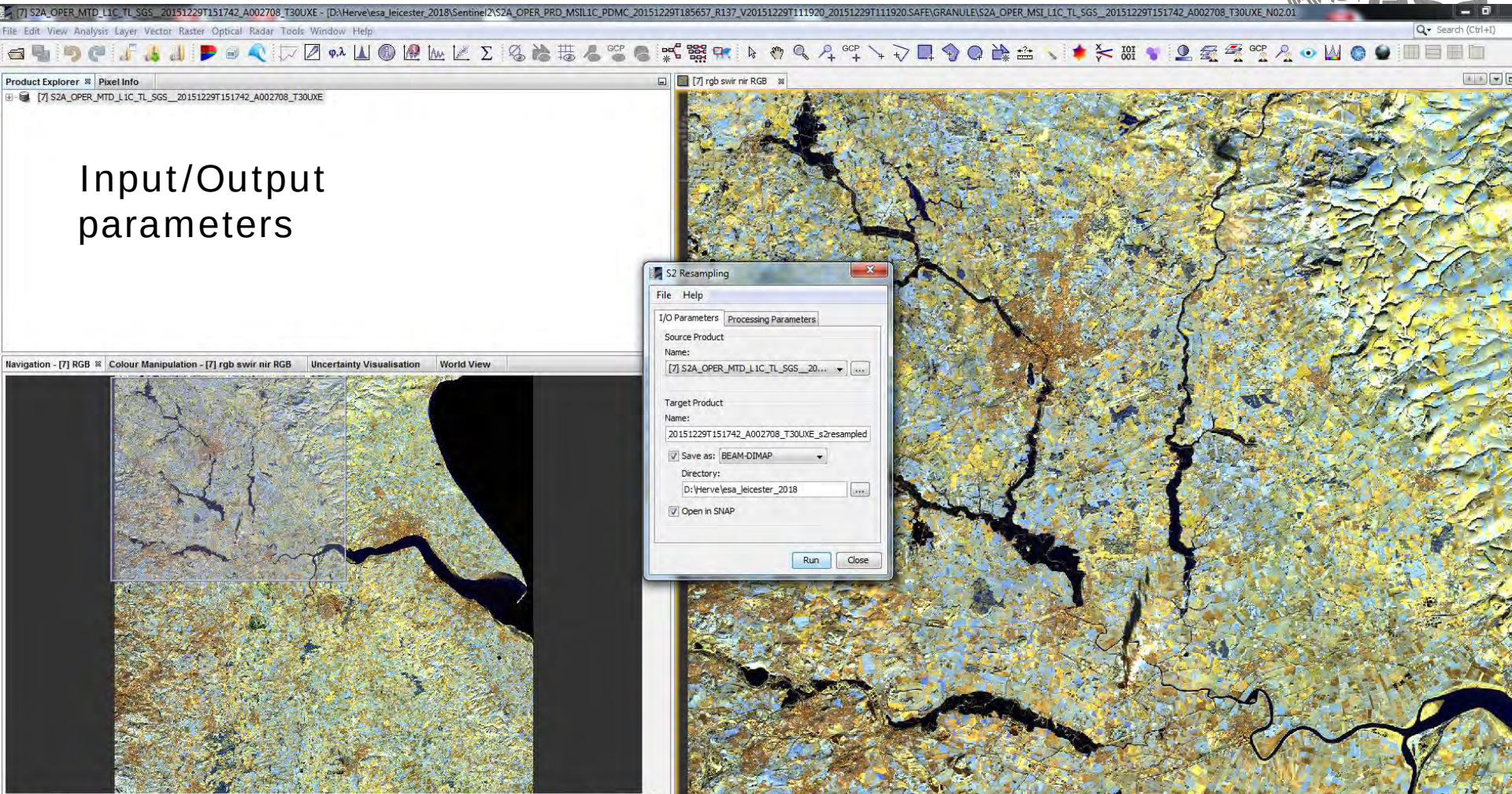
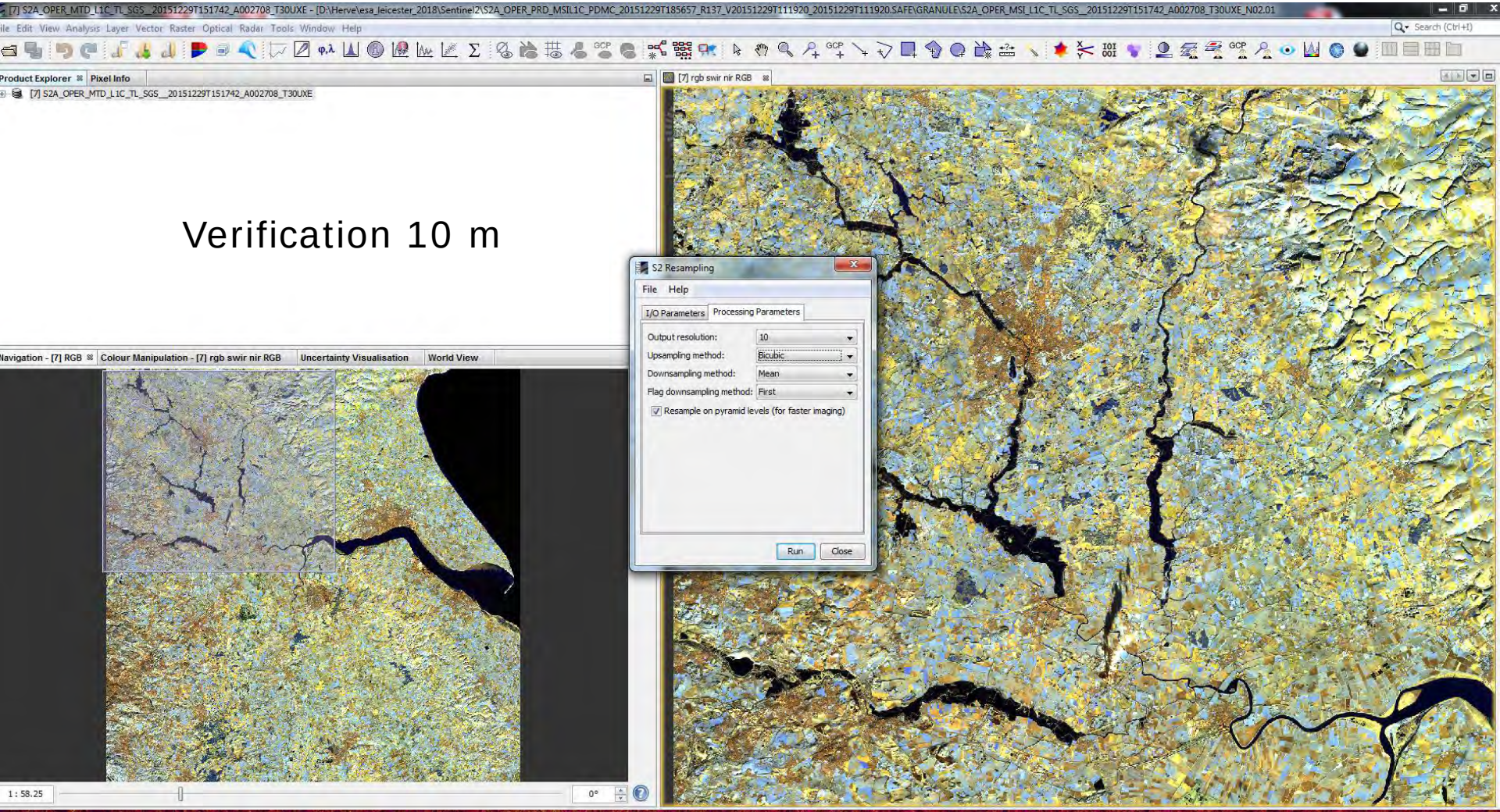
Navigation - [7] RGB
Colour Manipulation - [7] rgb swir nir RGB
Uncertainty Visualisation
World View
1 : 58.25
0°
[7] rgb swir nir RGB
Product Library
Layer Manager
X -- Y --
Lat -- Lon --
Zoom -- Level --

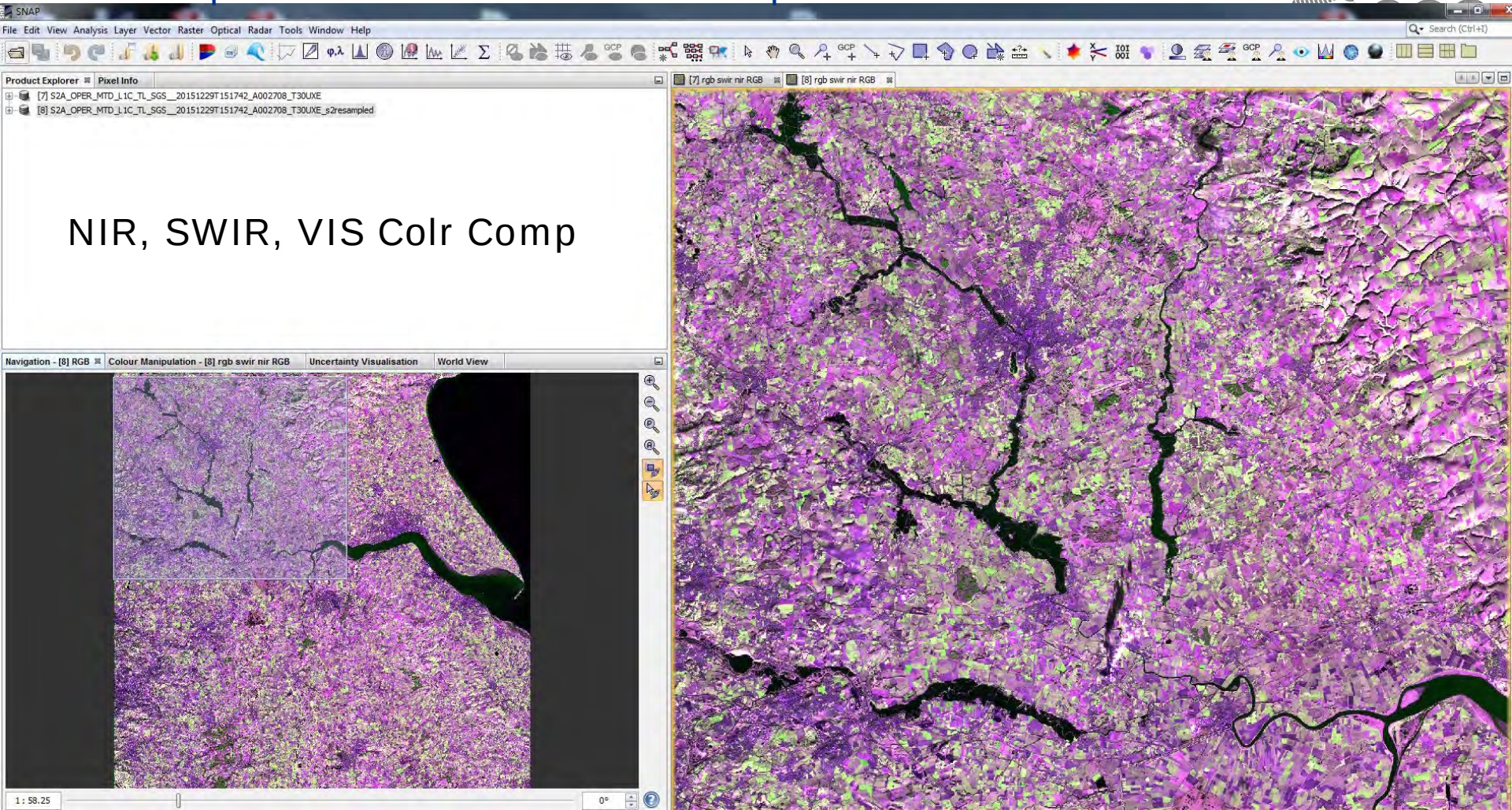
First step: Sentinel2 Image resampling: 10m VIS NIR SWIR bands

Input/Output parameters

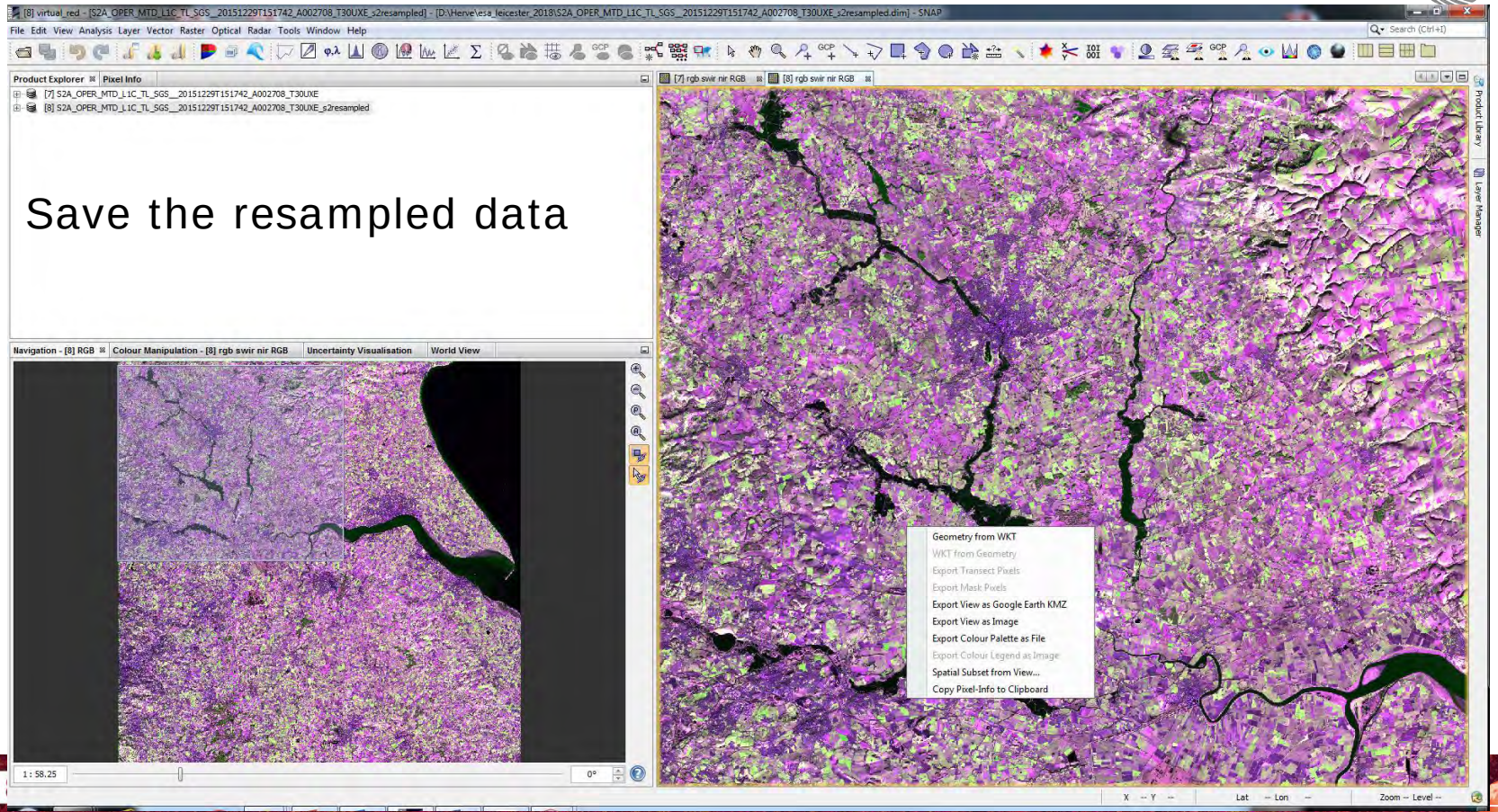



[7] S2A_OPER_MTD_L1C_TL_SGS__20151229T151742_A002708_T30UXE - [D:\Herve\esa_leicester_2018\Sentinel2\S2A_OPER_PRD_MSIL1C_PDMC_20151229T185657_R137_V20151229T111920_20151229T111920.SAFE\GRANULE\S2A_OPER_MSI_L1C_TL_SGS__20151229T151742_A002708_T30UXE_N02.01
Product Explorer
Pixel Info
[7] S2A_OPER_MTD_L1C_TL_SGS__20151229T151742_A002708_T30UXE
Verification 10 m
[7] rgb swir nir RGB
S2 Resampling
File
Help
I/O Parameters
Processing Parameters
Output resolution:
10
Upsampling method:
Bicubic
Downsampling method:
Mean
Flag downsampling method:
First
Resample on pyramid levels (for faster imaging)
Run
Close
Navigation - [7] RGB
Colour Manipulation - [7] rgb swir nir RGB
Uncertainty Visualisation
World View
1 : 58.25
0°

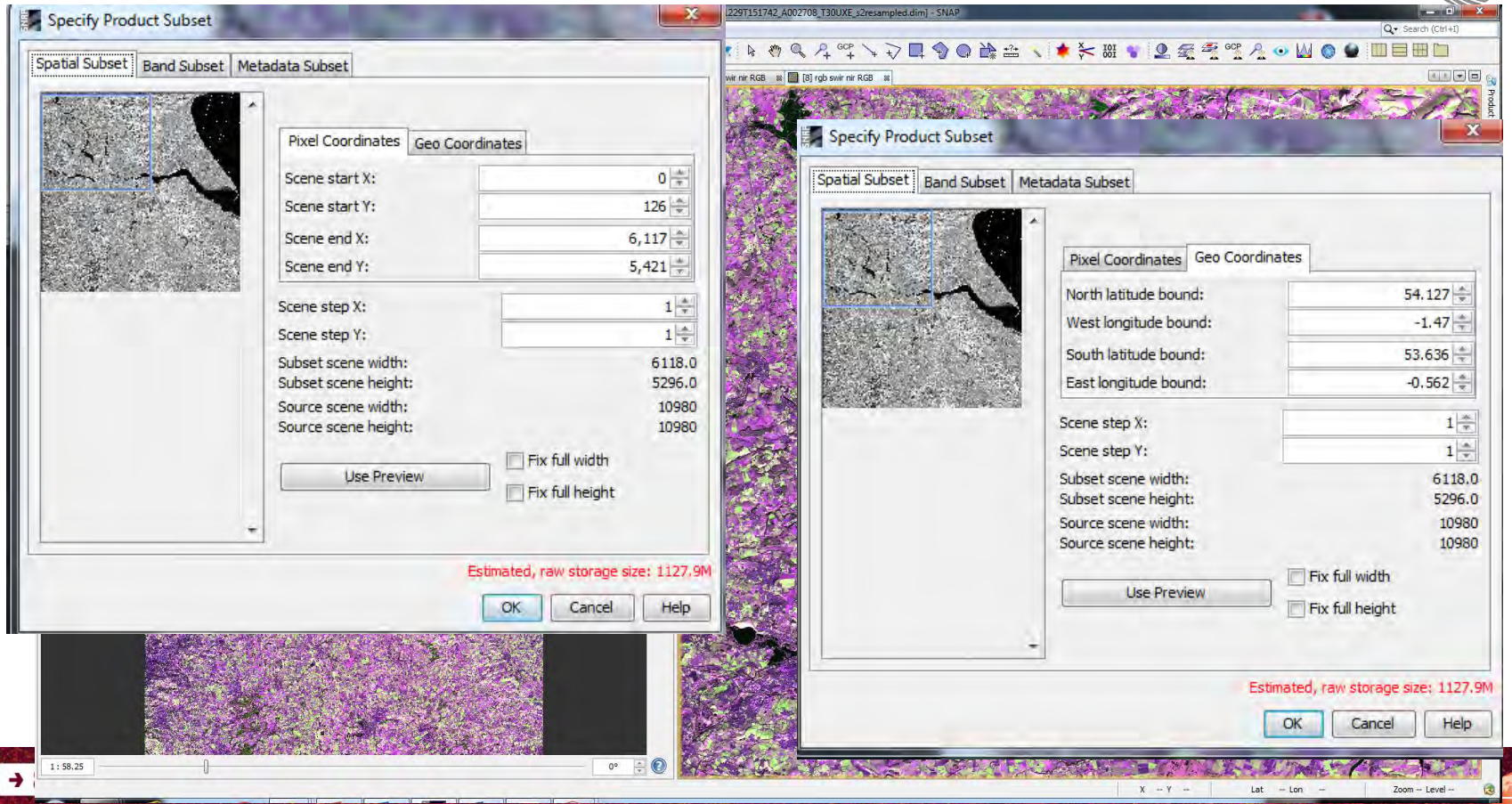
Step 2 visualization of resampled data



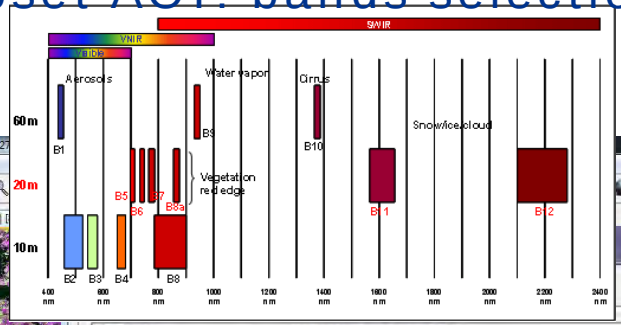
Save the resampled data

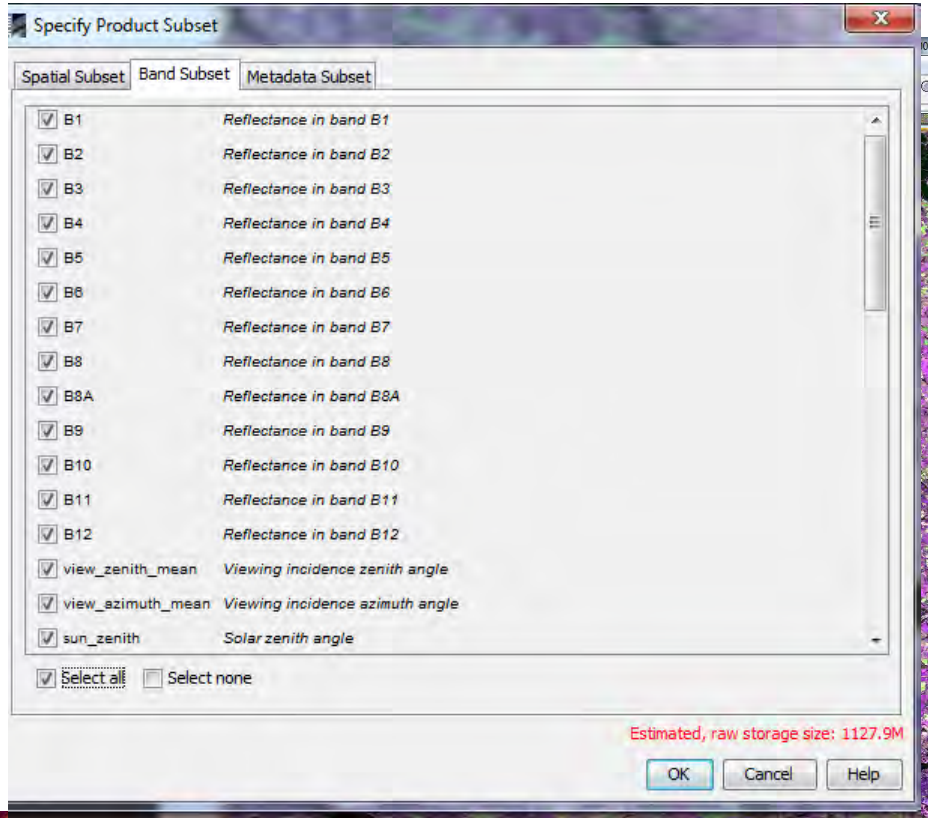


Third step: Sentinel2 Image : subset AOI

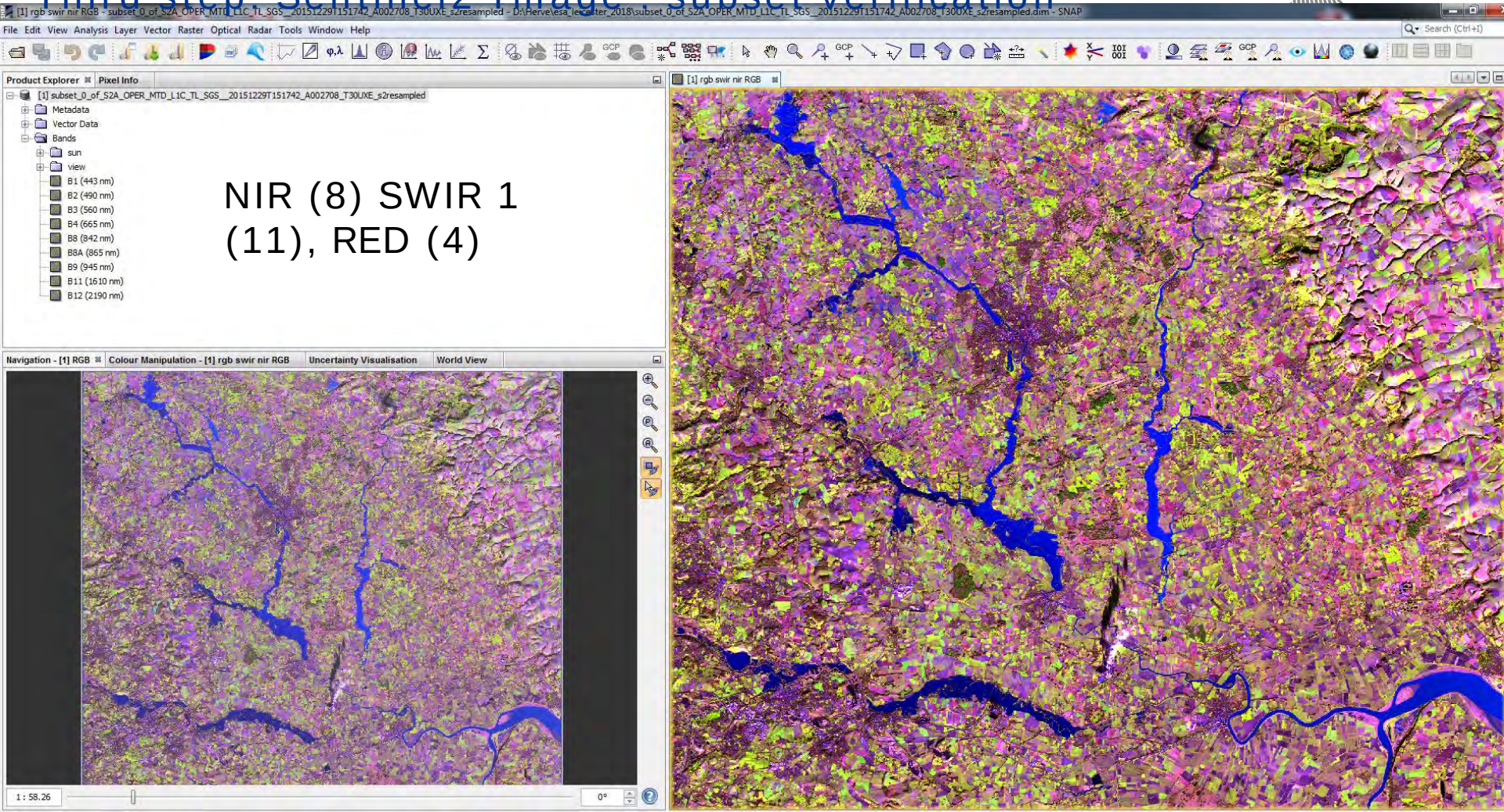


Third step: Sentinel2 Image : subset AOI: bands selection





Third step: Sentinel2 Image : subset verification



Sentinel 2 data processing

Preprocessing steps:

- Reading
- Tile identification
- Resampling
- Subset

Water extraction procedure on optical image

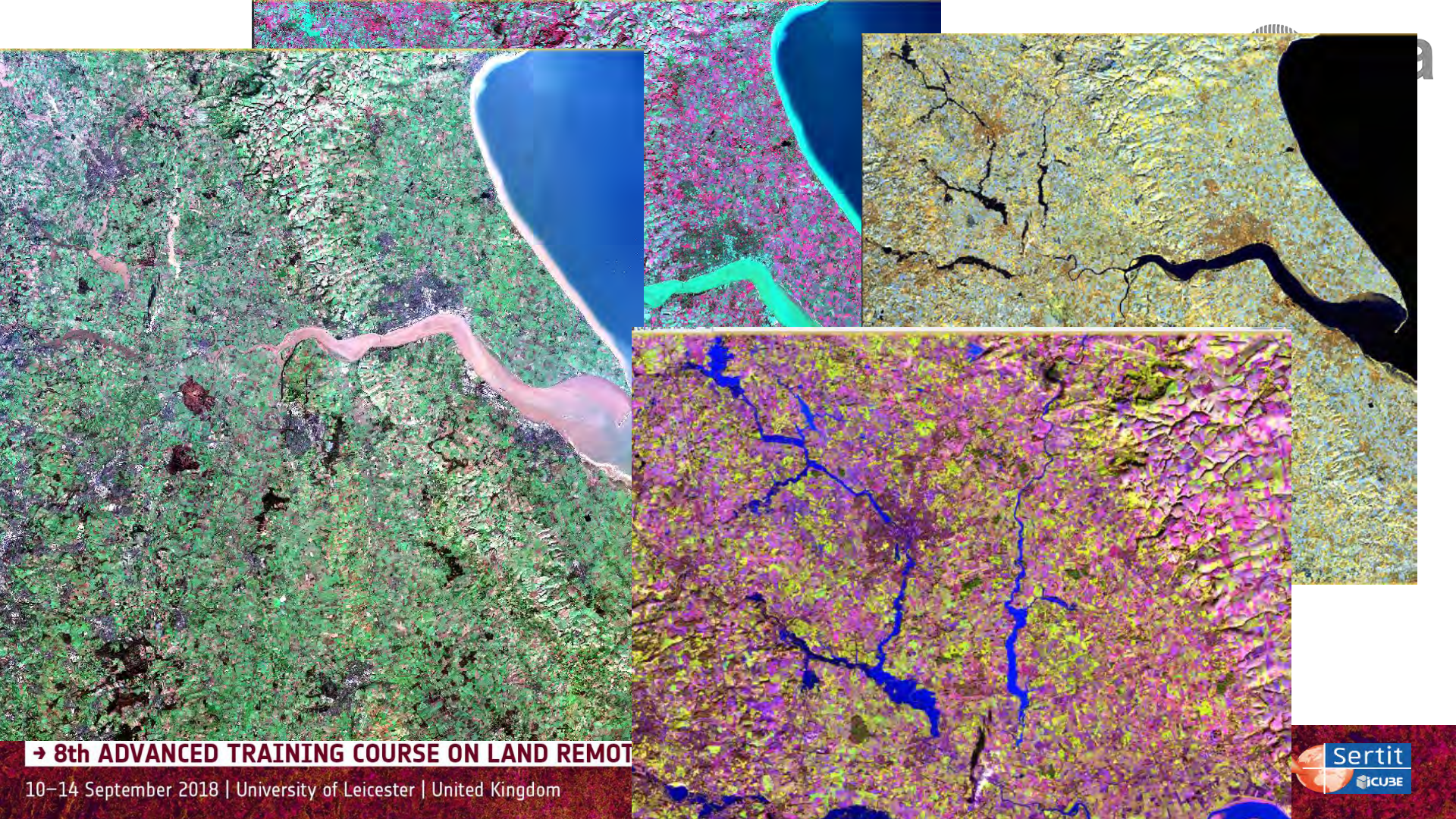
- Bands combination
- Simple threshold on MNWDI and AWEI
- Double threshold AWEI and BRIGNTNESS
- Dynamic : Sentinel2 and Landsat

Water bodies recognition and extraction

Analyze the water spectral answer exploiting different Color Composites

Such as….

- B4, B3, B2 : Natural color composite, in RGB
- B8, B4, B3: classical false color composite
- B12, B11, B8 or B8A
- B8, B11, B4



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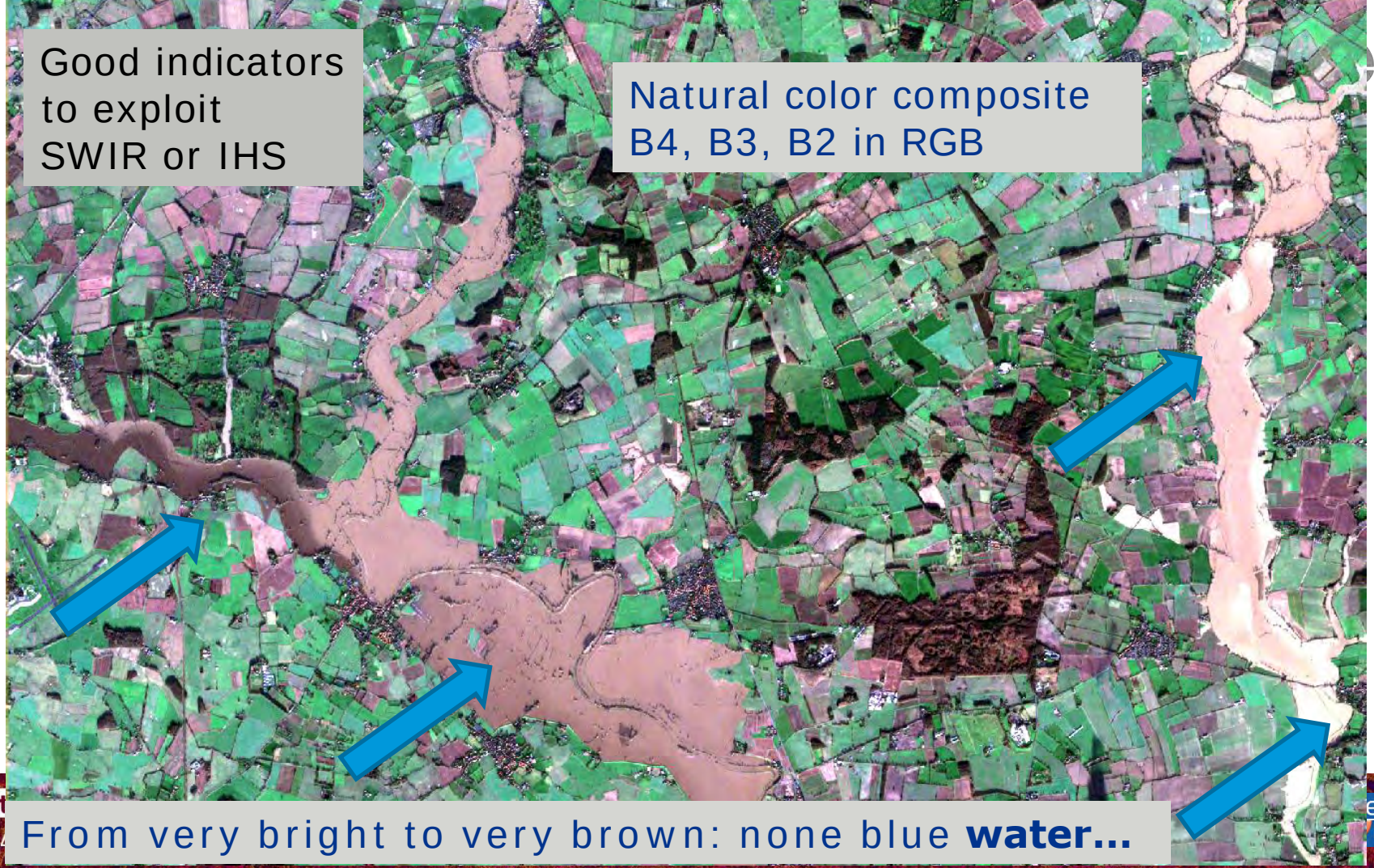
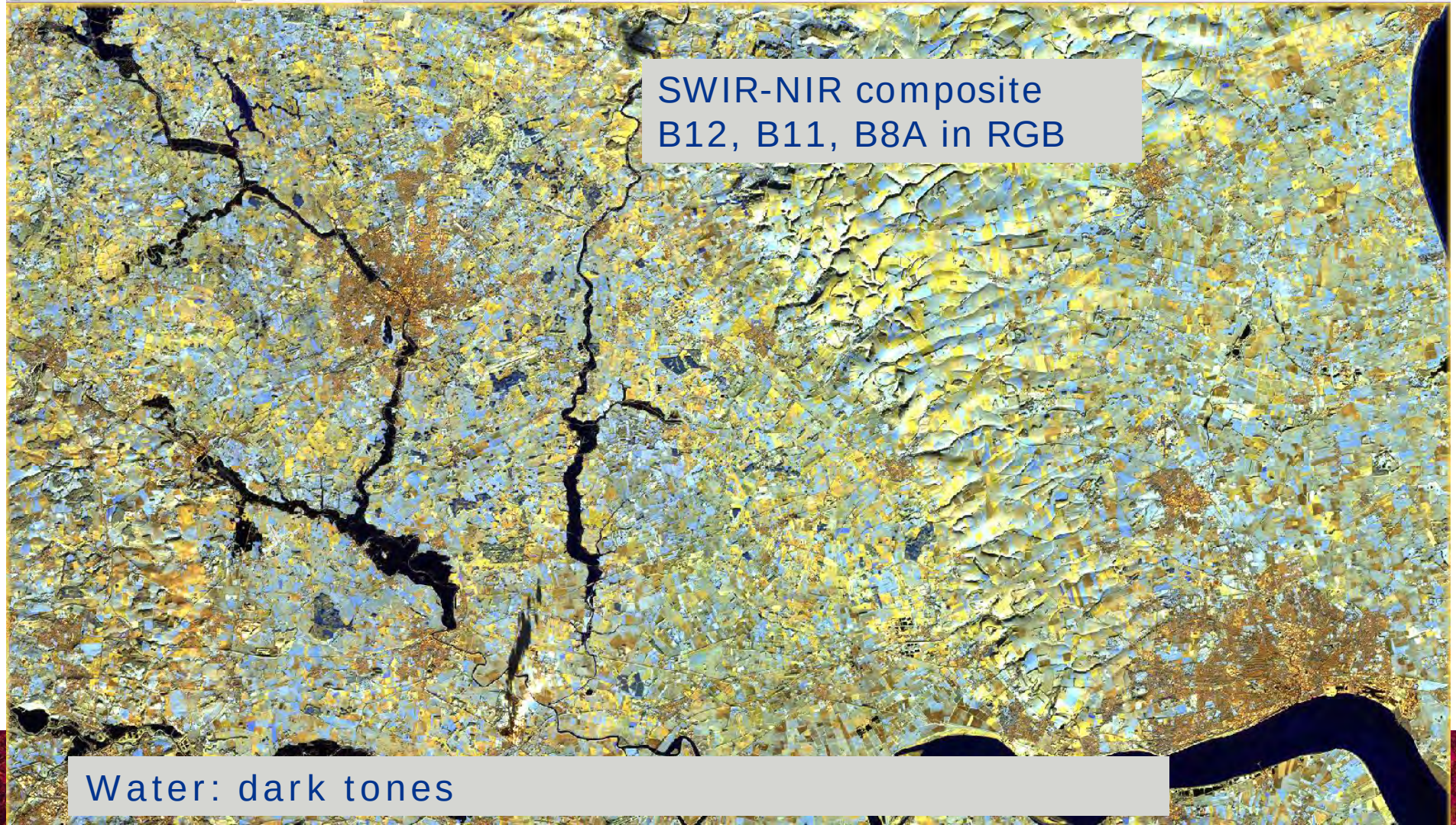

Good indicators to exploit SWIR or IHS
Natural color composite B4, B3, B2 in RGB
From very bright to very brown: none blue **water…**


SWIR-NIR composite
B12, B11, B8A in RGB
Water: dark tones

Sentinel 2 data processing

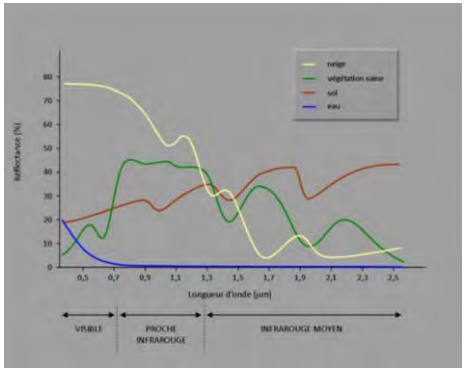
Preprocessing steps:

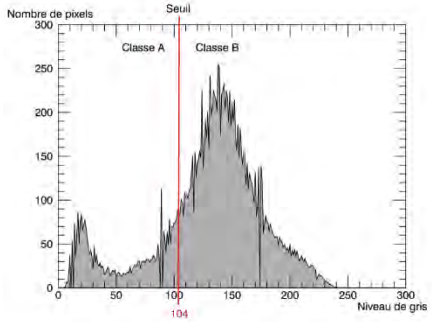
- Reading
- Tile identification
- Resampling
- Subset

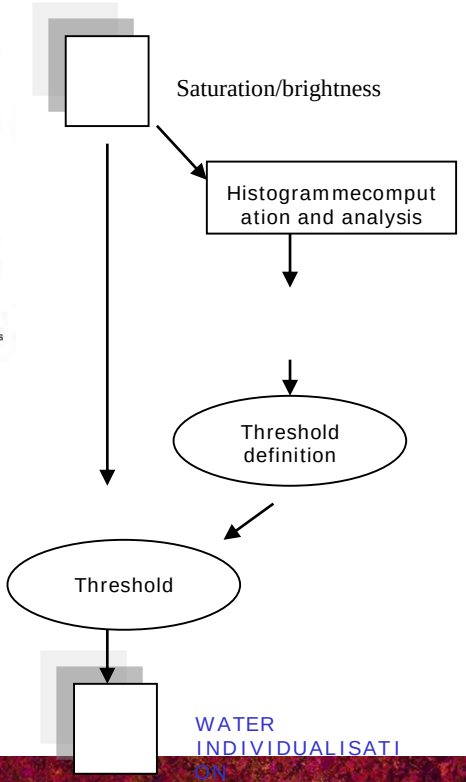
Water extraction procedure on optical image

- Bands combination
- Simple threshold on MNWDI and AWEI
- Double threshold AWEI and BRIGNTNESS
- Dynamic : Sentinel2 and Landsat

Flood mapping based on thresholding of raw channel and /or indice







Fundamentals: : water areas can be very bright if containing suspended materials

Extraction of water bodies from:

- Thematical indices
- First component of a PCA,
- Saturation indices of a HIS transformation

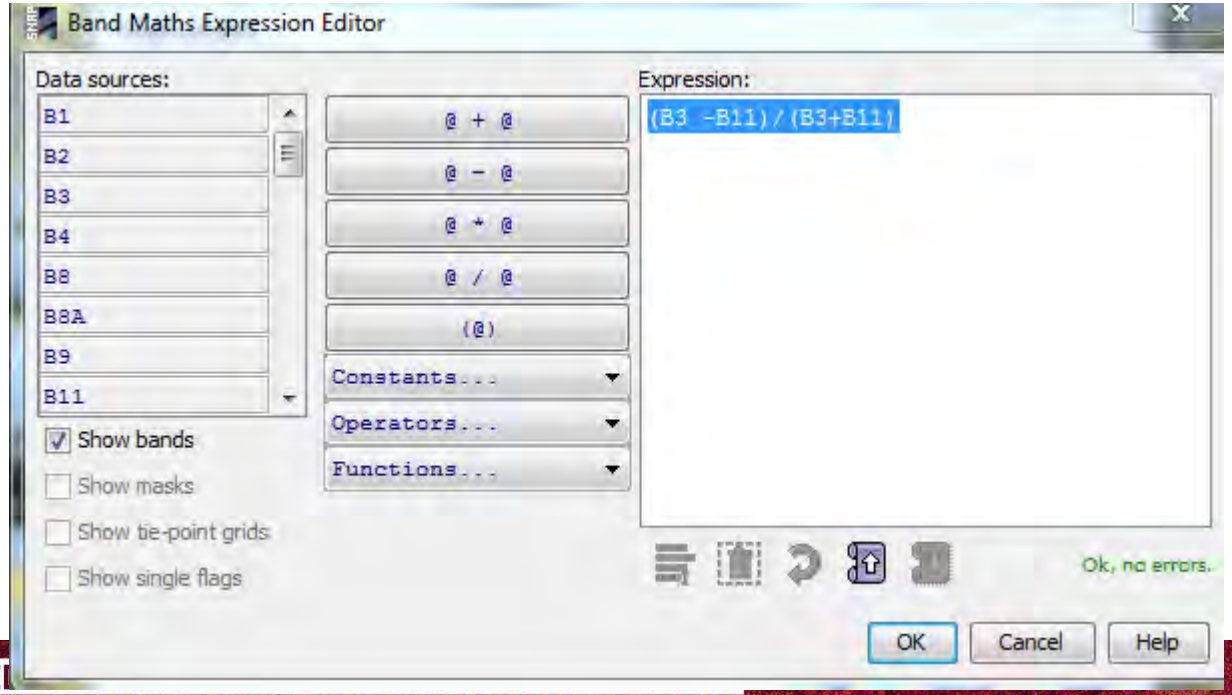
Classical water bodies related indices

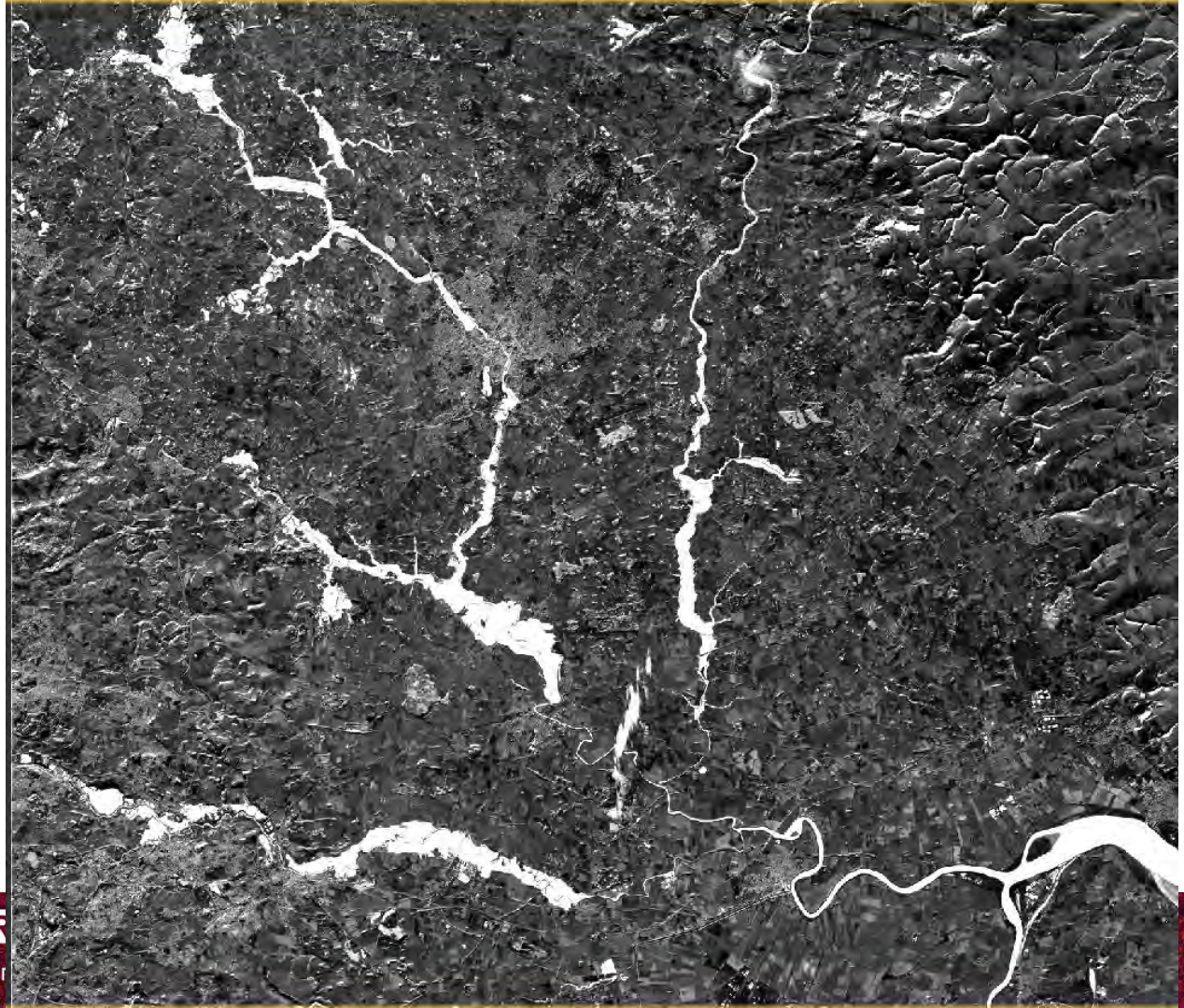
Index	Equation	Remark
Normalized Difference Water Index	NDWI = (Green − NIR)/(Green + NIR)	Water has positive value
Normalized Difference Moisture Index	NDMI = (NIR − MIR)/(NIR + MIR)	Water has positive value
Modified Normalized Difference Water Index	MNDWI = (Green − MIR)/(Green + MIR)	Water has positive value
Water Ratio Index	WRI = (Green + Red)/(NIR + MIR)	Value of water body is greater than 1
Normalized Difference Vegetation Index	NDVI = (NIR − Red)/(NIR + Red)	Water has negative value
Automated Water Extraction Index	AWEI = 4 × (Green-MIR) − (0.25 × NIR + 2.75 × SWIR)	Water has positive value

Selected indices: MNWDI indice

MNWI= (Green − SWIR) /(Green + SWIR)

(B3 -B11)/(B3+B11)





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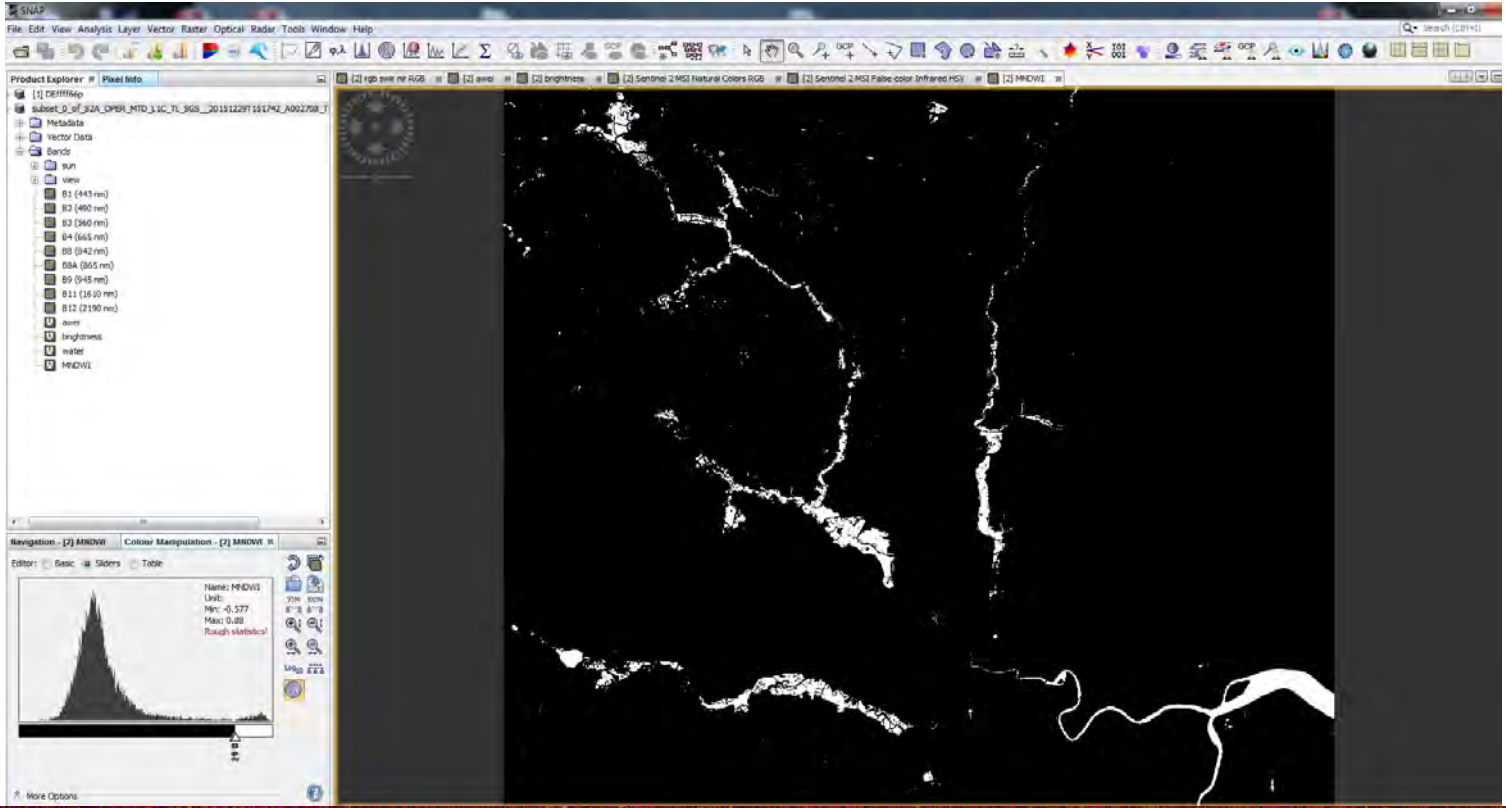
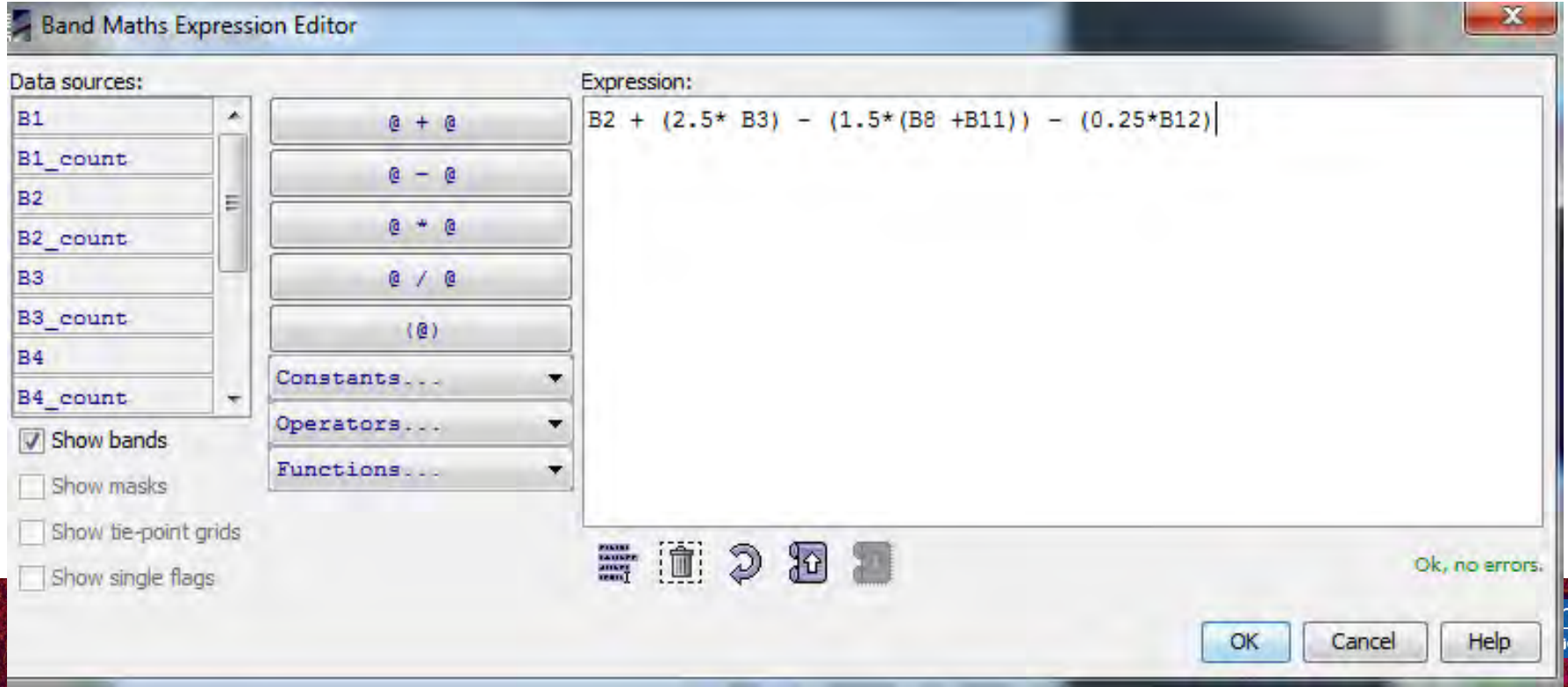

SNAP
File Edit View Analysis Layer Vector Raster Optical Radar Tools Window Help
Product Explorer
Pixel Info
Metadata
Vector Data
Bands
sun
view
B1 (443 nm)
B2 (490 nm)
B3 (560 nm)
B4 (665 nm)
B8 (842 nm)
B8A (865 nm)
B9 (945 nm)
B11 (1610 nm)
B12 (2190 nm)
auvel
brightness
water
MNDWI
Navigation - [2] MNDWI
Colour Manipulation - [2] MNDWI
Editor: Basic Sliders Table
Name: MNDWI
Unit:
Min: -0.577
Max: 0.08
Rough statistics!
More Options

Selected indices: AWEI indice

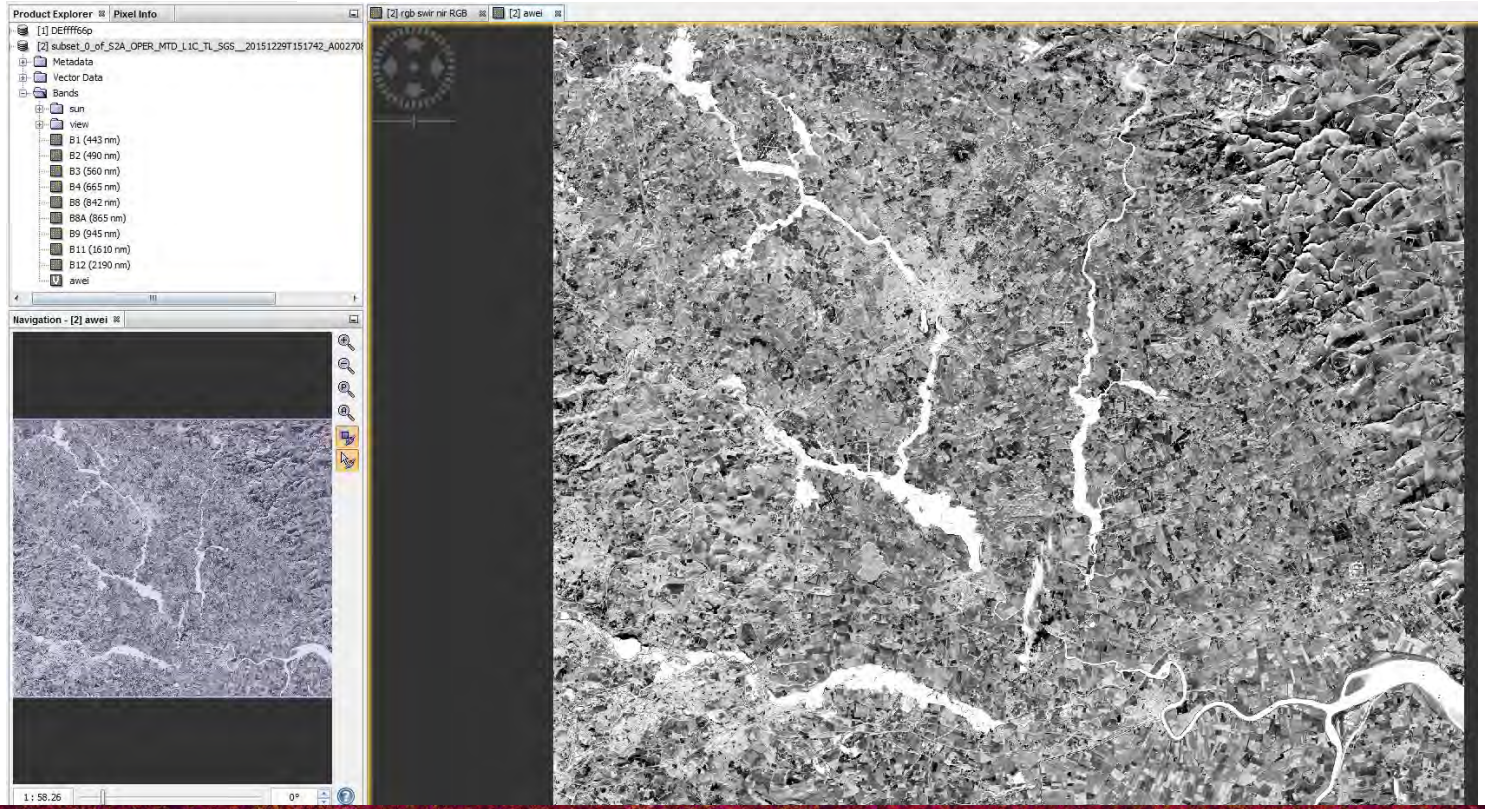
$$AWEI_{sh} = Blue_{band} + (2.5 * Green_{band}) - 1.5 * (NIR_{band} + SWIR1_{band}) - (0.25 * SWIR2_{band})$$

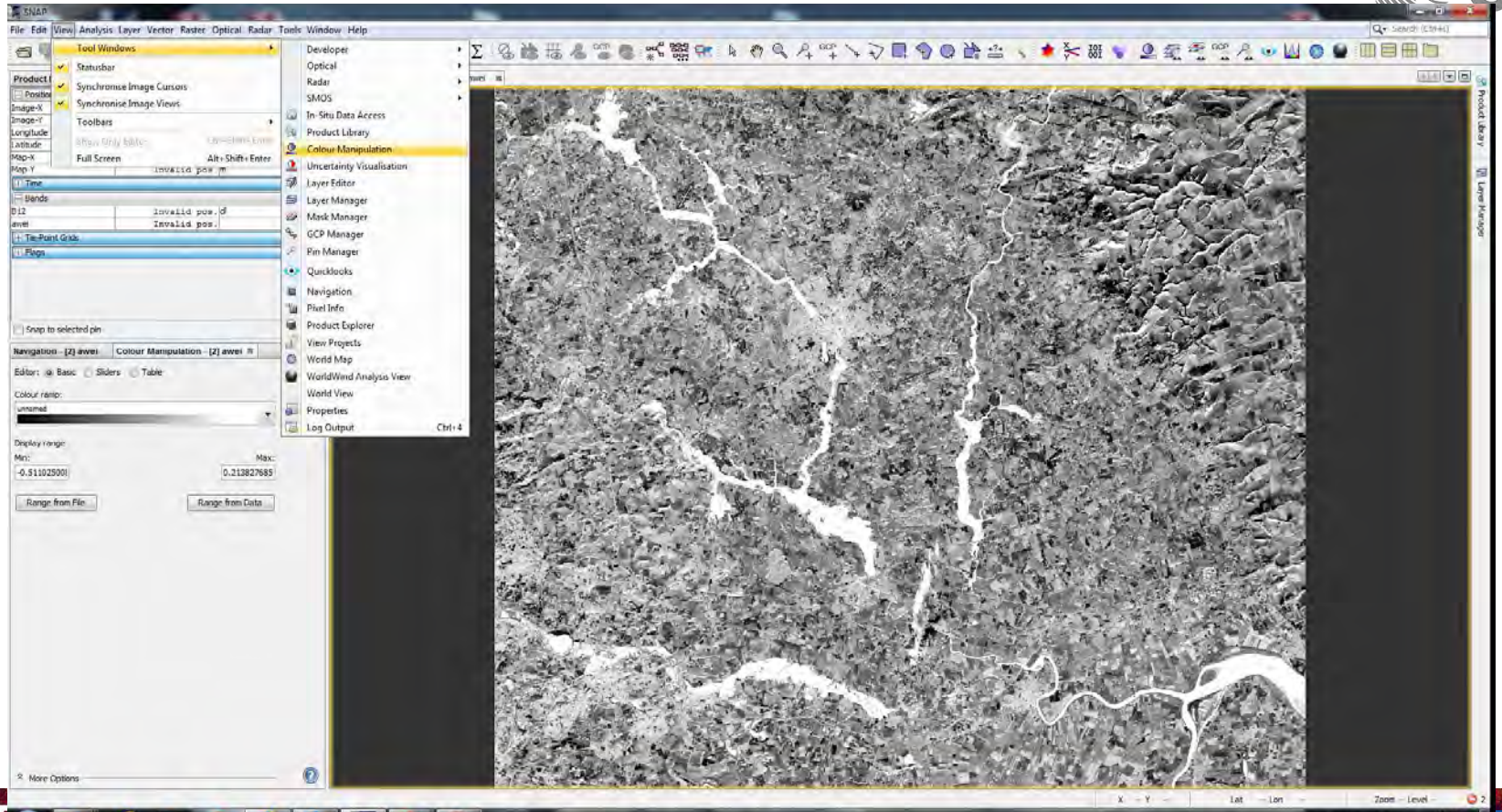
B2 + (2.5 * B3) - (1.5 * (B8 + B11)) - (0.25 * B12)

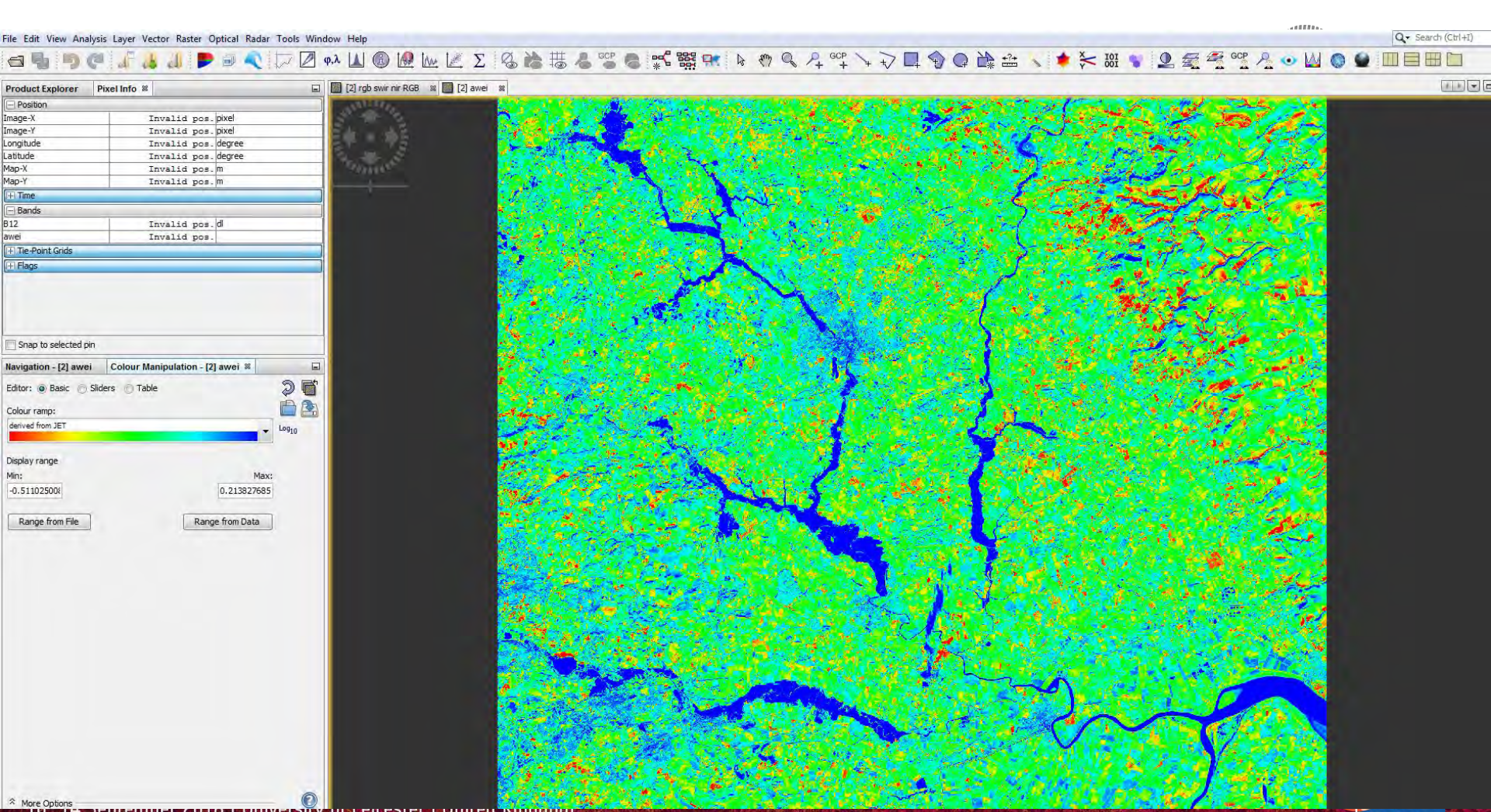


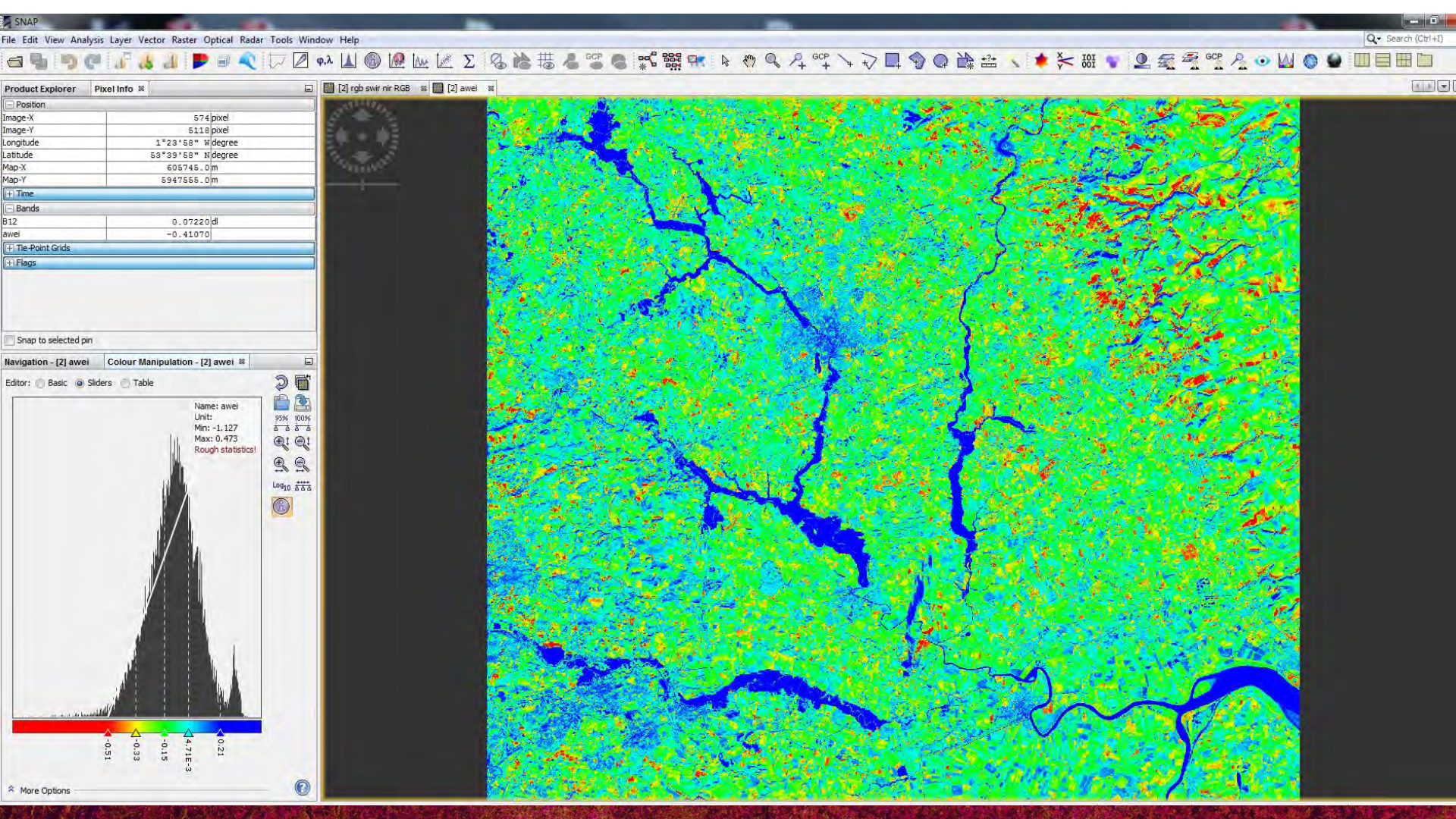
Selected indices: AWEI indice

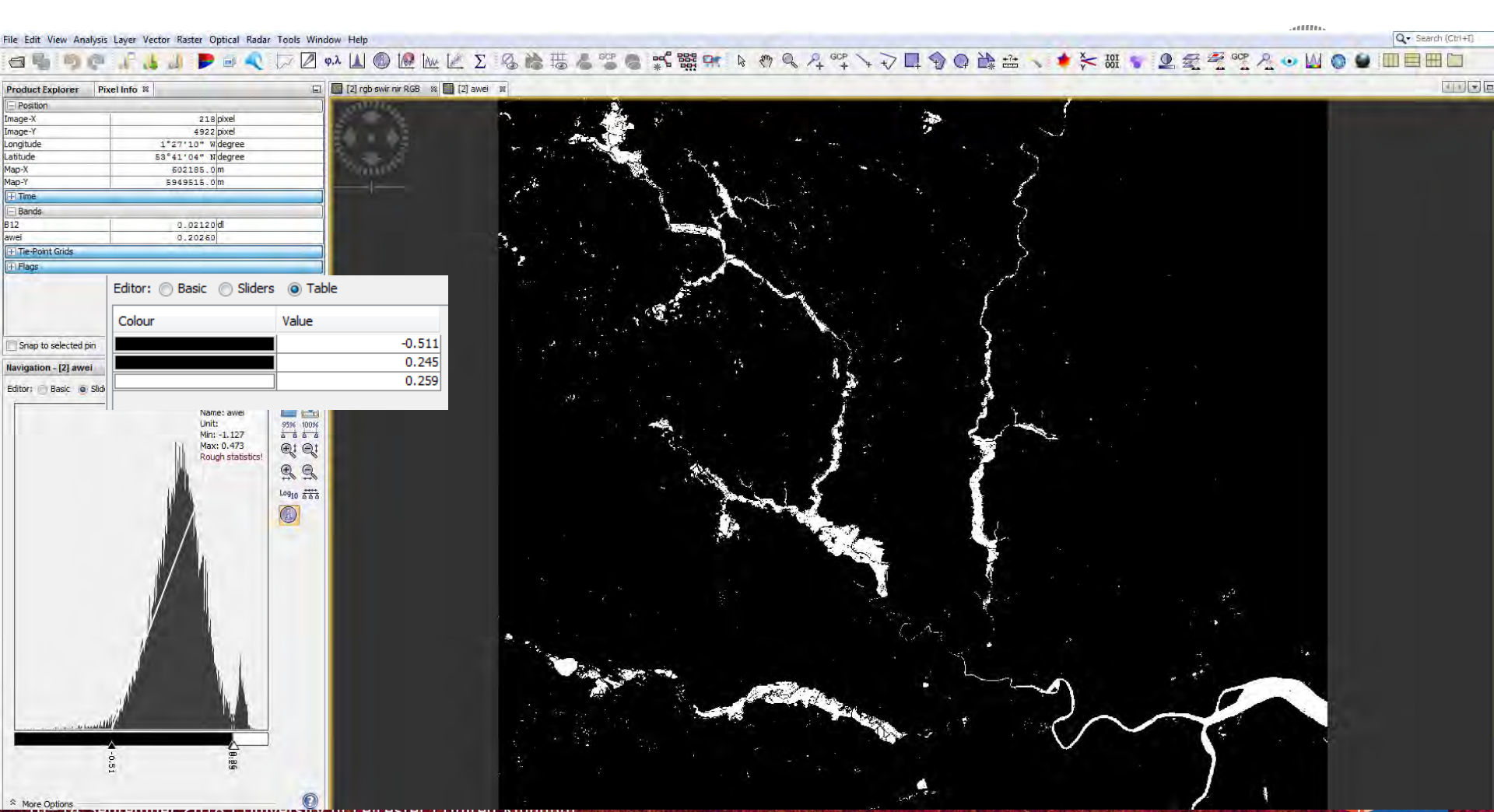
B2 + (2.5 * B3) - (1.5 * (B8 + B11)) - (0.25 * B12)



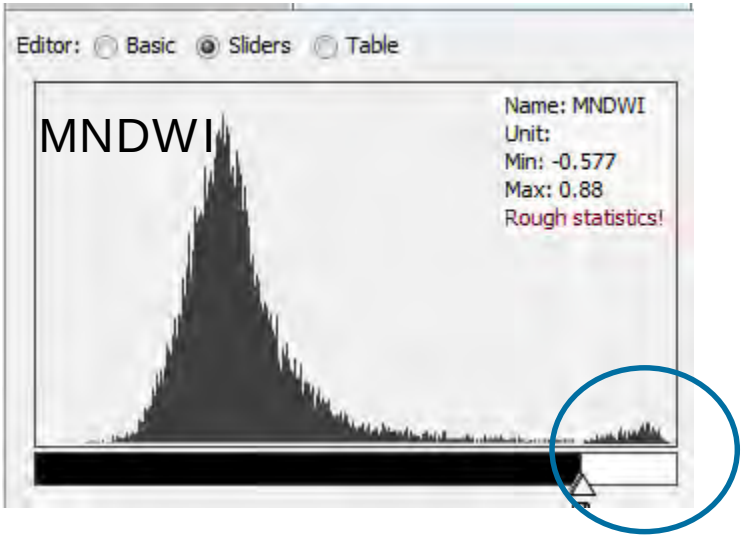

File Edit View Analysis Layer Vector Raster Optical Radar Tools Window Help
Tool Windows
Statusbar
Synchronise Image Cursors
Synchronise Image Views
Toolbars
Full Screen Alt+Shift+Enter
Developer
Optical
Radar
SMOS
In-Situ Data Access
Product Library
Colour Manipulation
Uncertainty Visualisation
Layer Editor
Layer Manager
Mask Manager
GCP Manager
Pin Manager
Quicklooks
Navigation
Pixel Info
Product Explorer
View Projects
World Map
WorldWind Analysis View
World View
Properties
Log Output Ctrl+4
Time
Bands
Tie-Point Grids
Flags
Snap to selected pin
Navigation - [2] awei
Colour Manipulation - [2] awei
Editor: Basic Sliders Table
Colour ramp:
unnamed
Display range:
Min:
-0.511025001
Max:
0.213827685
Range from File
Range from Data
More Options


File Edit View Analysis Layer Vector Raster Optical Radar Tools Window Help
Search (Ctrl+I)
Product Explorer
Pixel Info
Position
Image-X Invalid pos. pixel
Image-Y Invalid pos. pixel
Longitude Invalid pos. degree
Latitude Invalid pos. degree
Map-X Invalid pos. m
Map-Y Invalid pos. m
Time
Bands
B12 Invalid pos. dl
awei Invalid pos.
Tie-Point Grids
Flags
Snap to selected pin
Navigation - [2] awei
Colour Manipulation - [2] awei
Editor: Basic Sliders Table
Colour ramp:
derived from JET
Log10
Display range
Min:
Max:
-0.51102500
0.213827685
Range from File
Range from Data
More Options
[2] rgb swir nir RGB
[2] awei

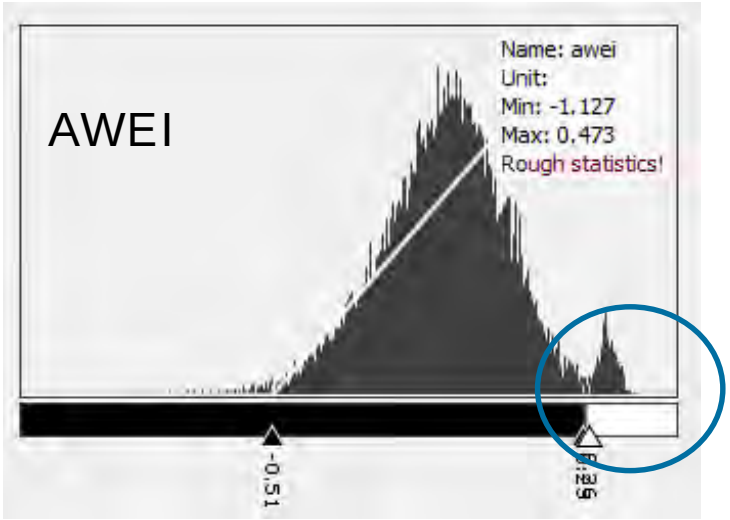

SNAP
File Edit View Analysis Layer Vector Raster Optical Radar Tools Window Help
Search (Ctrl+I)
Product Explorer
Pixel Info
Position
Image-X 574 pixel
Image-Y 5118 pixel
Longitude 1°23'58" W degree
Latitude 53°39'58" N degree
Map-X 605745.0 m
Map-Y 5947555.0 m
Time
Bands
B12 0.07220 dl
awei -0.41070
Tie-Point Grids
Flags
Snap to selected pin
Navigation - [2] awei
Colour Manipulation - [2] awei
Editor: Basic Sliders Table
Name: awei
Unit:
Min: -1.127
Max: 0.473
Rough statistics!
95%
100%
Log10
-0.51
-0.33
-0.15
4.71E-3
0.21
More Options
[2] rgb swir nir RGB
[2] awei


File Edit View Analysis Layer Vector Raster Optical Radar Tools Window Help
Product Explorer
Pixel Info
[2] rgb swir nir RGB
[2] awei
Position
Image-X 218 pixel
Image-Y 4922 pixel
Longitude 1°27'10" W degree
Latitude 53°41'04" N degree
Map-X 602185.0 m
Map-Y 5949515.0 m
Time
Bands
B12 0.02120 dl
awei 0.20260
Tie-Point Grids
Flags
Editor: Basic Sliders Table
Colour
Value
-0.511
0.245
0.259
Snap to selected pin
Navigation - [2] awei
Name: awei
Unit:
Min: -1.127
Max: 0.473
Rough statistics!
-0.511
0.259
More Options

Remarks: MNDWI versus AWEI



Water



(B3 -B11)/(B3+B11)

B2 + (2.5 * B3) - (1.5 * (B8 + B11)) - (0.25 * B12)

Sentinel 2 data processing

Preprocessing steps:

- Reading
- Tile identification
- Resampling
- Subset

Water extraction procedure on optical image

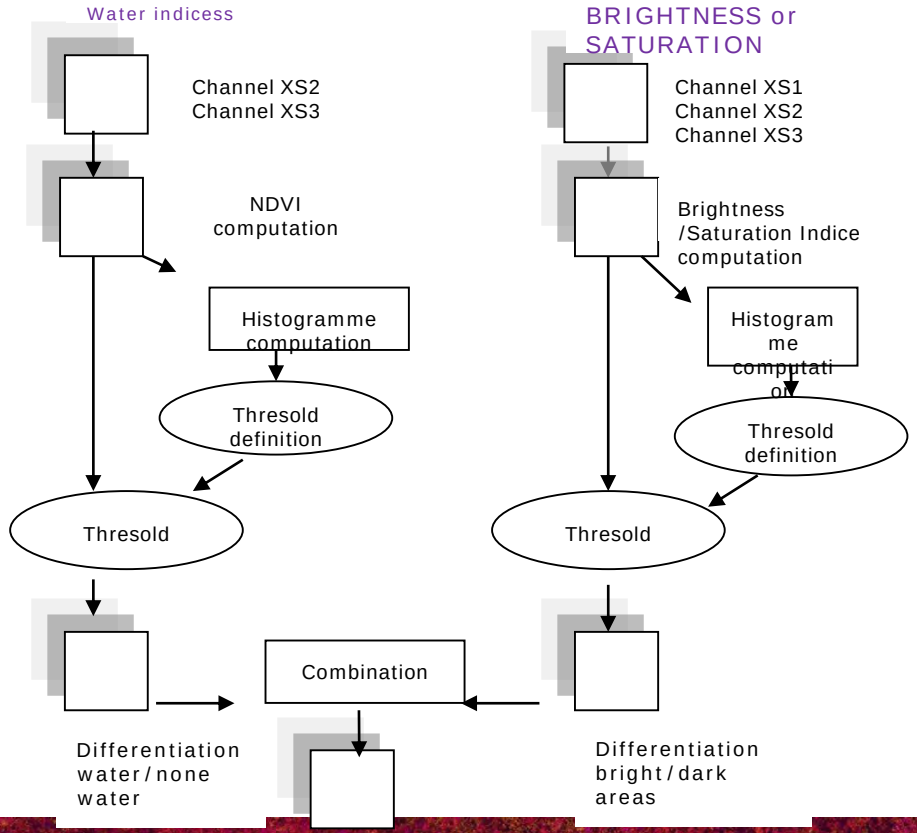
- Bands combination
- Simple threshold on MNWDI and AWEI
- Double threshold AWEI and BRIGNTNESS
- Dynamic : Sentinel2 and Landsat

Water bodies mapping based on optical data : combination of indices

Fundamentals: water areas can be very bright if containing suspended materials

Extraction of water bodies from:

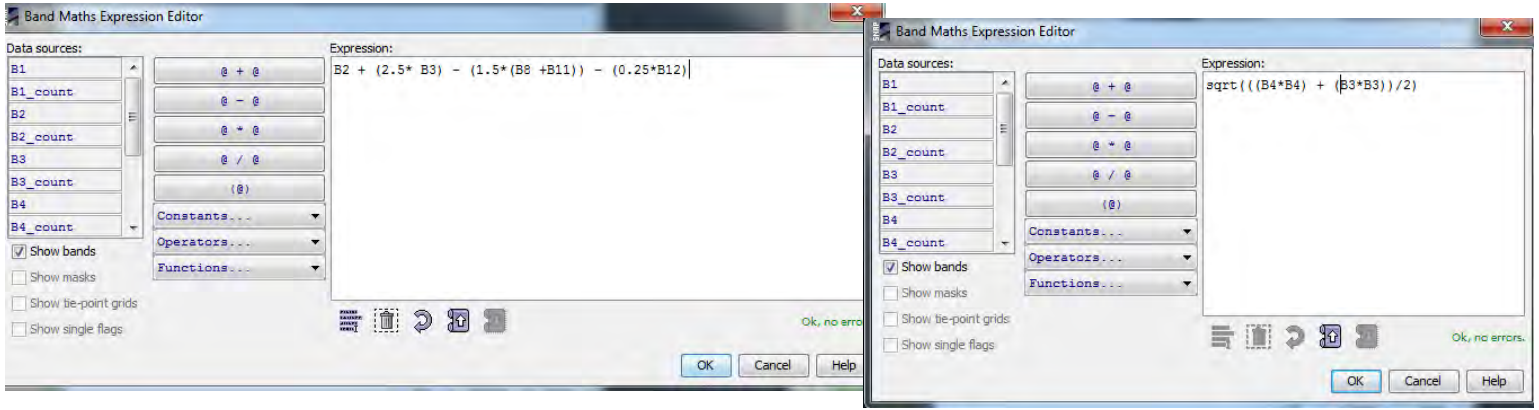
- Brightness Standard or Tasseled Cap
- First component of a PCA,
- Saturation indices of a HIS transformation
- Indices



Selected indices: AWEI and Brightness indices

$$AWEI_{sh} = Blue_{band} + (2.5 * Green_{band}) - 1.5 * (NIR_{band} + SWIR1_{band}) - (0.25 * SWIR2_{band})$$

B2 + (2.5 * B3) - (1.5 * (B8 + B11)) - (0.25 * B12)



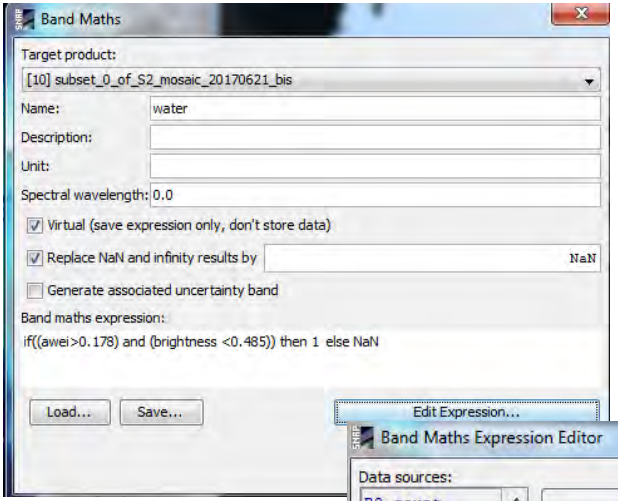
For brightness indices:
Different formula can be applied
sqrt(((B4*B4)+(B3*B3)+(B2*B2))/3

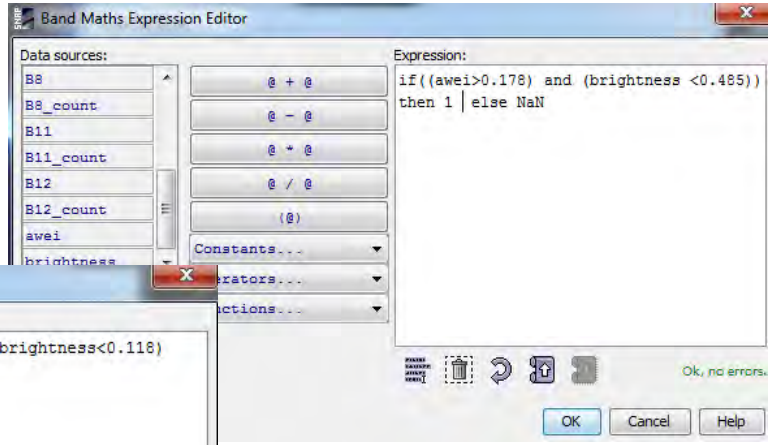
$$BI = \sqrt{\frac{(Red_{factor} * Red_{band}) + (Green_{factor} * Green_{band})}{2}}$$

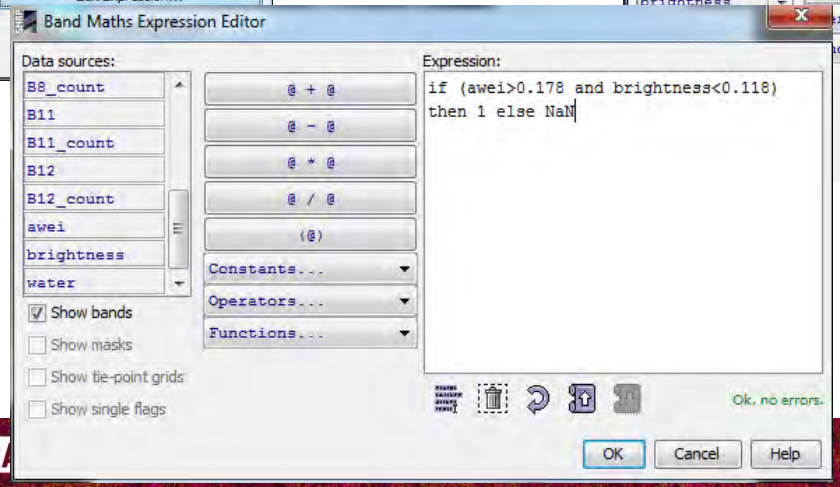
sqrt (((B4 * B4) + (B3 * B3)) / 2)

Water bodies mapping based on optical data : combination of indices

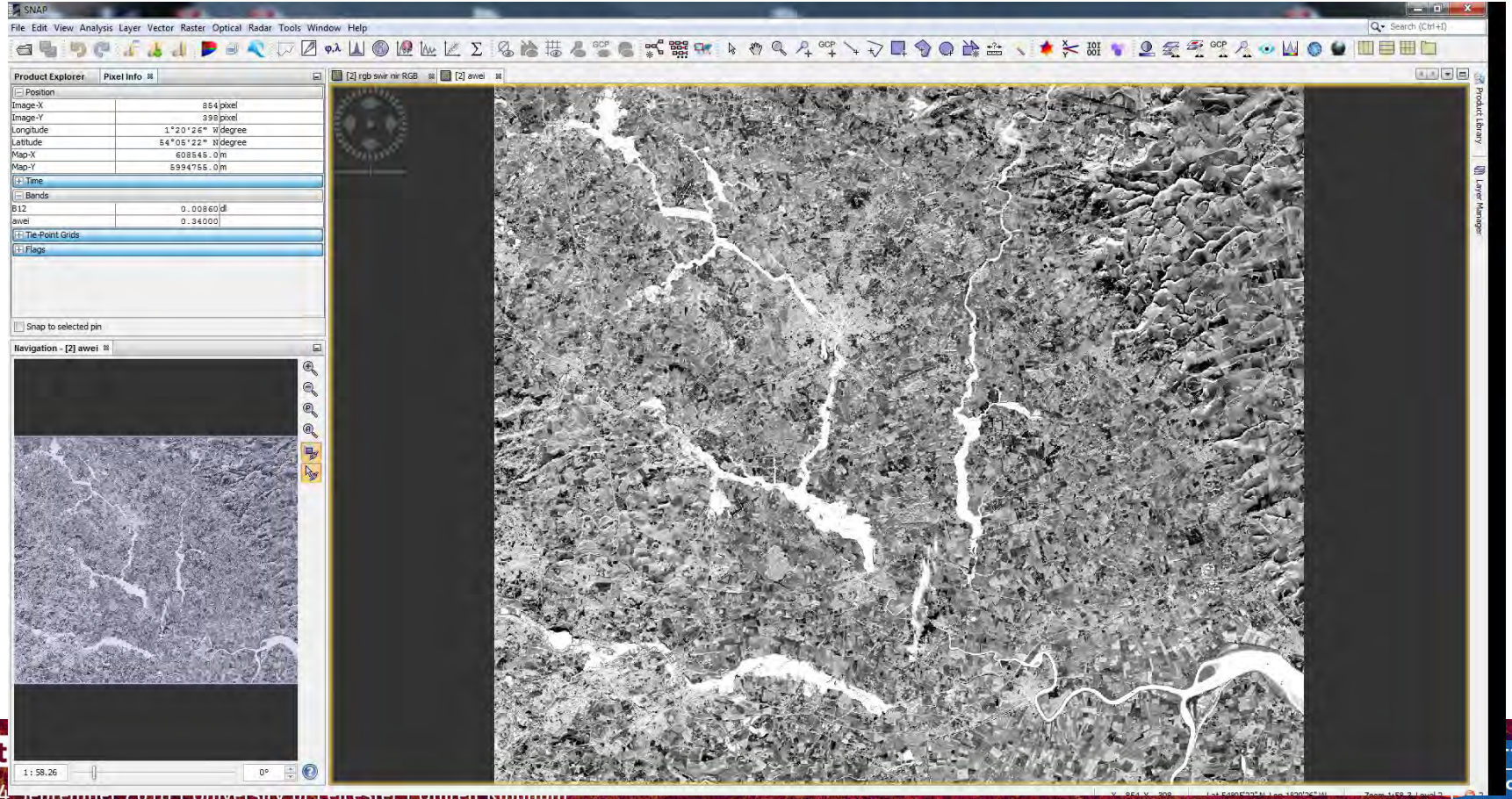
Water mask generation







Test different values on IB


SNAP
File Edit View Analysis Layer Vector Raster Optical Radar Tools Window Help
Product Explorer
Pixel Info
Position
Image-X 864 pixel
Image-Y 398 pixel
Longitude 1°20'26" W degree
Latitude 54°05'22" N degree
Map-X 608545.0 m
Map-Y 5994755.0 m
Time
Bands
B12 0.00860 dl
awei 0.34000
Tie-Point Grids
Flags
Snap to selected pin
Navigation - [2] awei
[2] rgb swir nir RGB
[2] awei
Product Library
Layer Manager

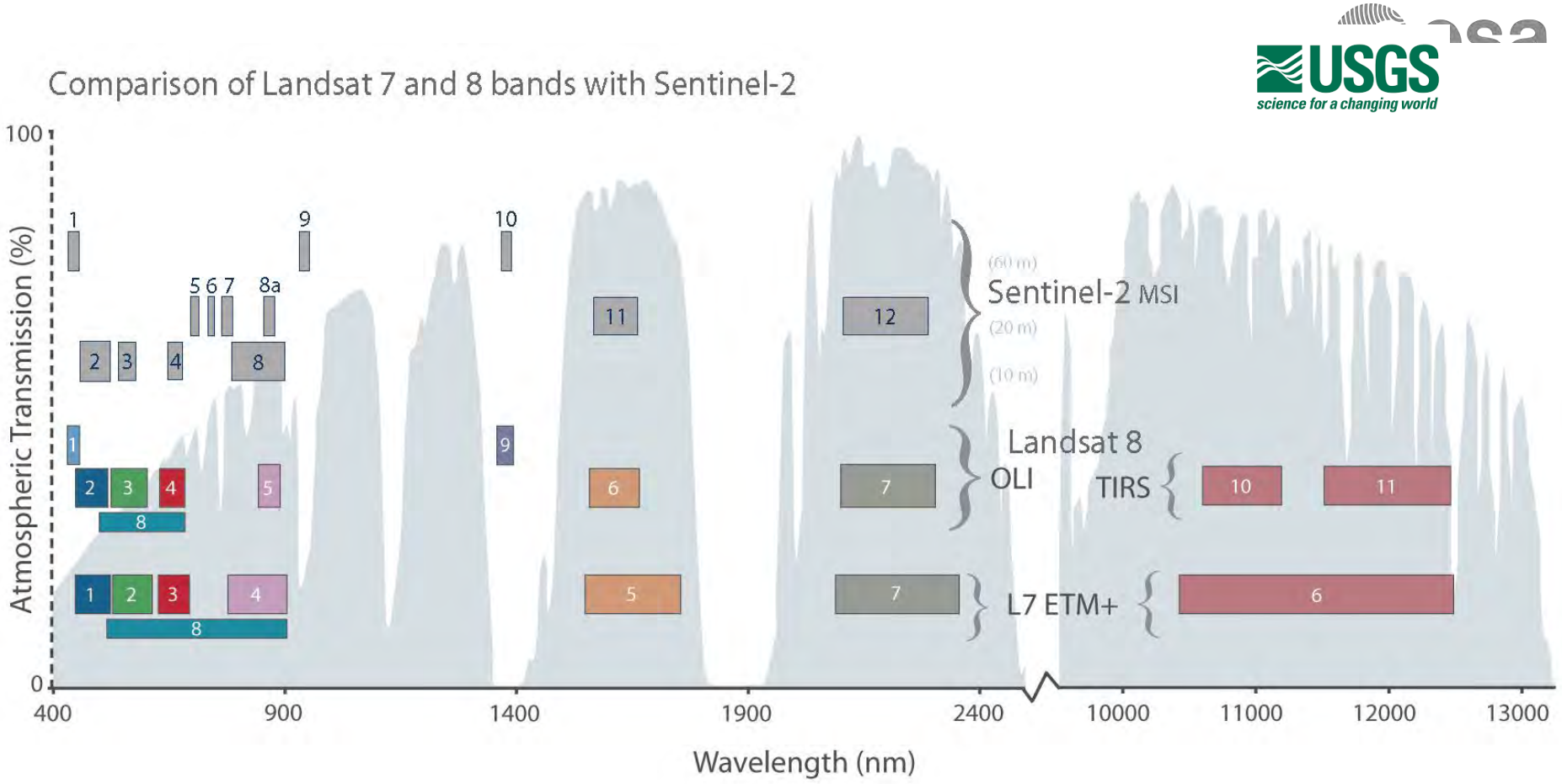
Sentinel 2 data processing

Preprocessing steps:

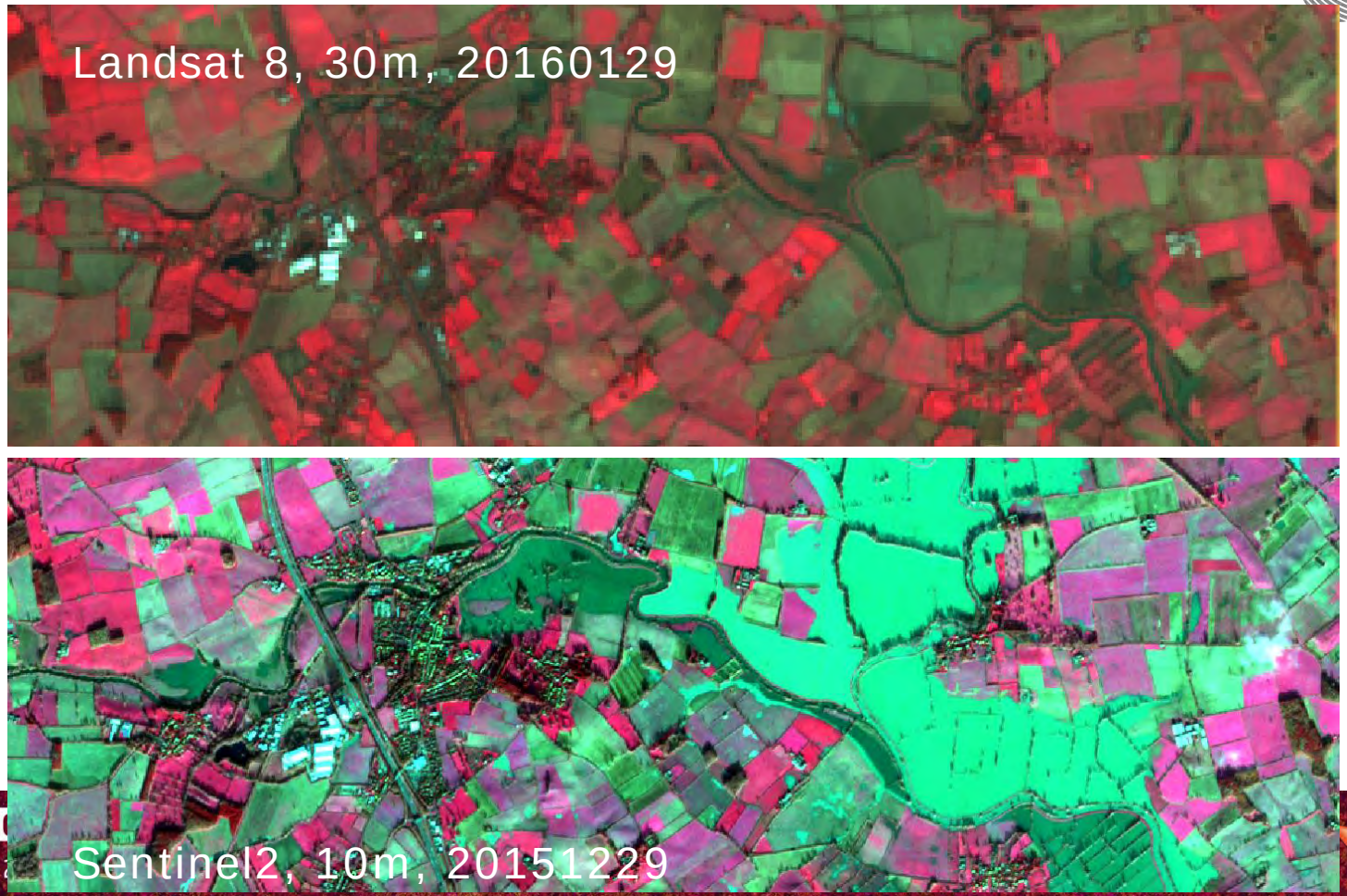
- Reading
- Tile identification
- Resampling
- Subset

Water extraction procedure on optical image

- Bands combination
- Simple threshold on MNWDI and AWAEI
- Double threshold AWEI and BRIGNTNESS
- Dynamic : Sentinel2 and Landsat


Comparison of Landsat 7 and 8 bands with Sentinel-2
USGS
science for a changing world
Atmospheric Transmission (%)
100
0
400
900
1400
1900
2400
10000
11000
12000
13000
Wavelength (nm)
1
9
10
5 6 7
8a
2
3
4
8
11
12
(60 m)
Sentinel-2 MSI
(20 m)
(10 m)
1
9
2
3
4
5
6
7
8
Landsat 8
OLI
TIRS
10
11
1
2
3
4
5
7
8
L7 ETM+
6

Comparison Sentinel2 and Landsat family: spatial

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Release Notes
FAQ
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Login
Help
Interface Controls
Selected Scenes (0)
Choose Your Data Set(s)
Data Set Filter
Landsat 1-5 MSS C1 Level-1
Landsat 4-5 TM C1 Level-1
Landsat 7 ETM+ C1 Level-1
Landsat 8 OLI/TIRS C1 Level-1
1 scenes match your criteria.
OrbView-3
Sentinel-2
Metadata Filter
Date Range
12/20/2015
to
01/31/2016
Cloud Cover
0
to
30
Months
Jan
APPLY
CLEAR
Withernsea
Leaflet | Map data © OpenStreetMap contributors, USGS/EROS
Landsat 8 OLI/TIRS C1 Level-1
Landsat 8 OLI/TIRS C1 Level-1
2015
2016
Timeline View
Current Scene Opacity
Time Scale
YEAR
MONTH
DAY
View Metadata
Hide Scene
Share
Select

File Edit View Analysis Layer Vector Raster Optical Radar Tools Window Help

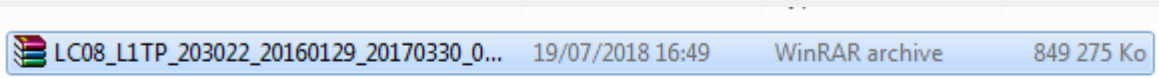
Search (Ctrl+I)

Product Explorer | Pixel Info

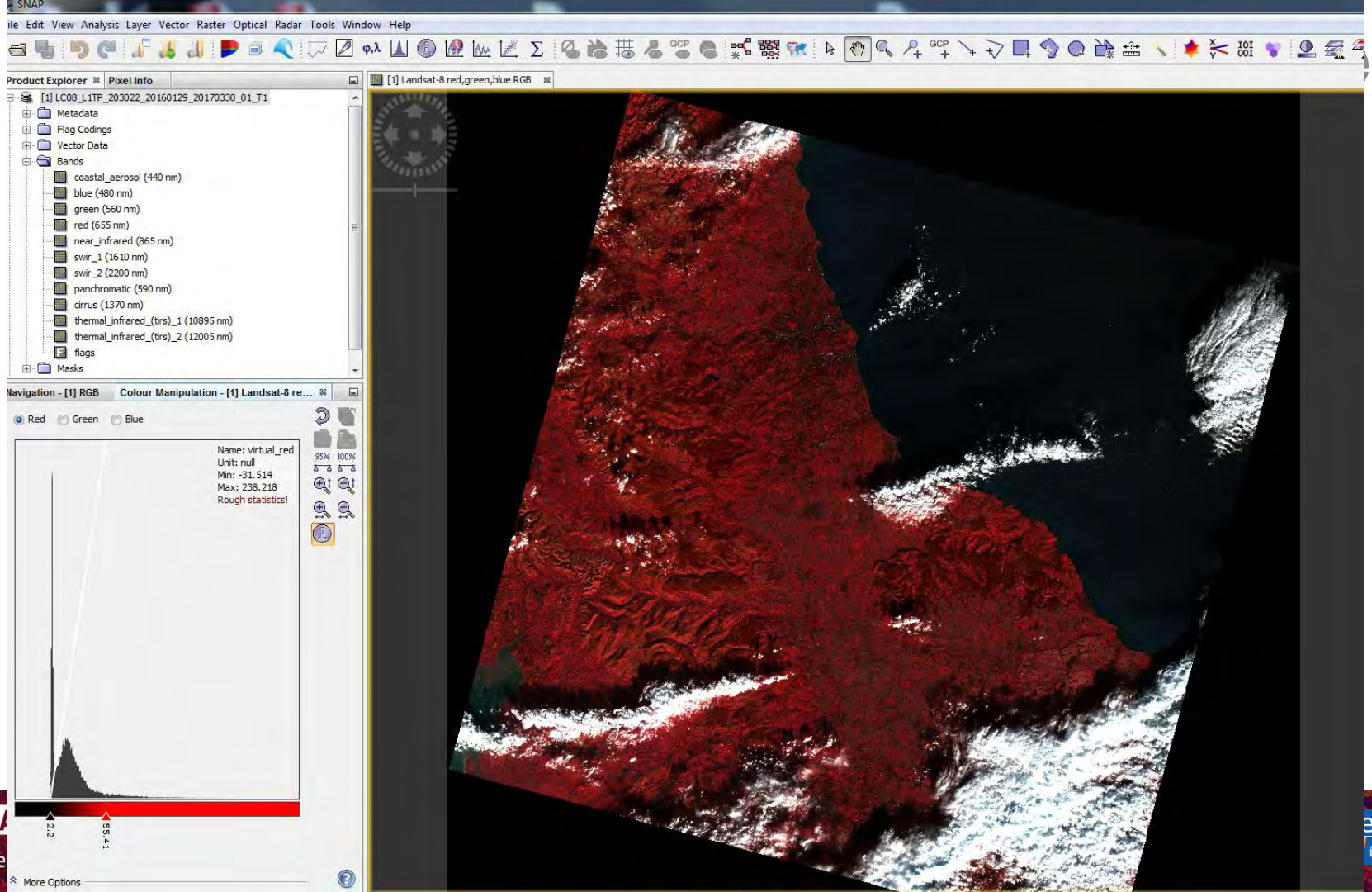
- [1] LC08_L1TP_203022_20160129_20170330_01_T1
  - Metadata
  - Flag Codings
  - Vector Data
  - Bands
    - coastal_aerosol (440 nm)
    - blue (480 nm)
    - green (560 nm)
    - red (655 nm)
    - near_infrared (865 nm)
    - swir_1 (1610 nm)
    - swir_2 (2200 nm)
    - panchromatic (590 nm)
    - cirrus (1370 nm)
    - thermal_infrared_(tirs)_1 (10895 nm)
    - thermal_infrared_(tirs)_2 (12005 nm)
    - flags
  - Masks

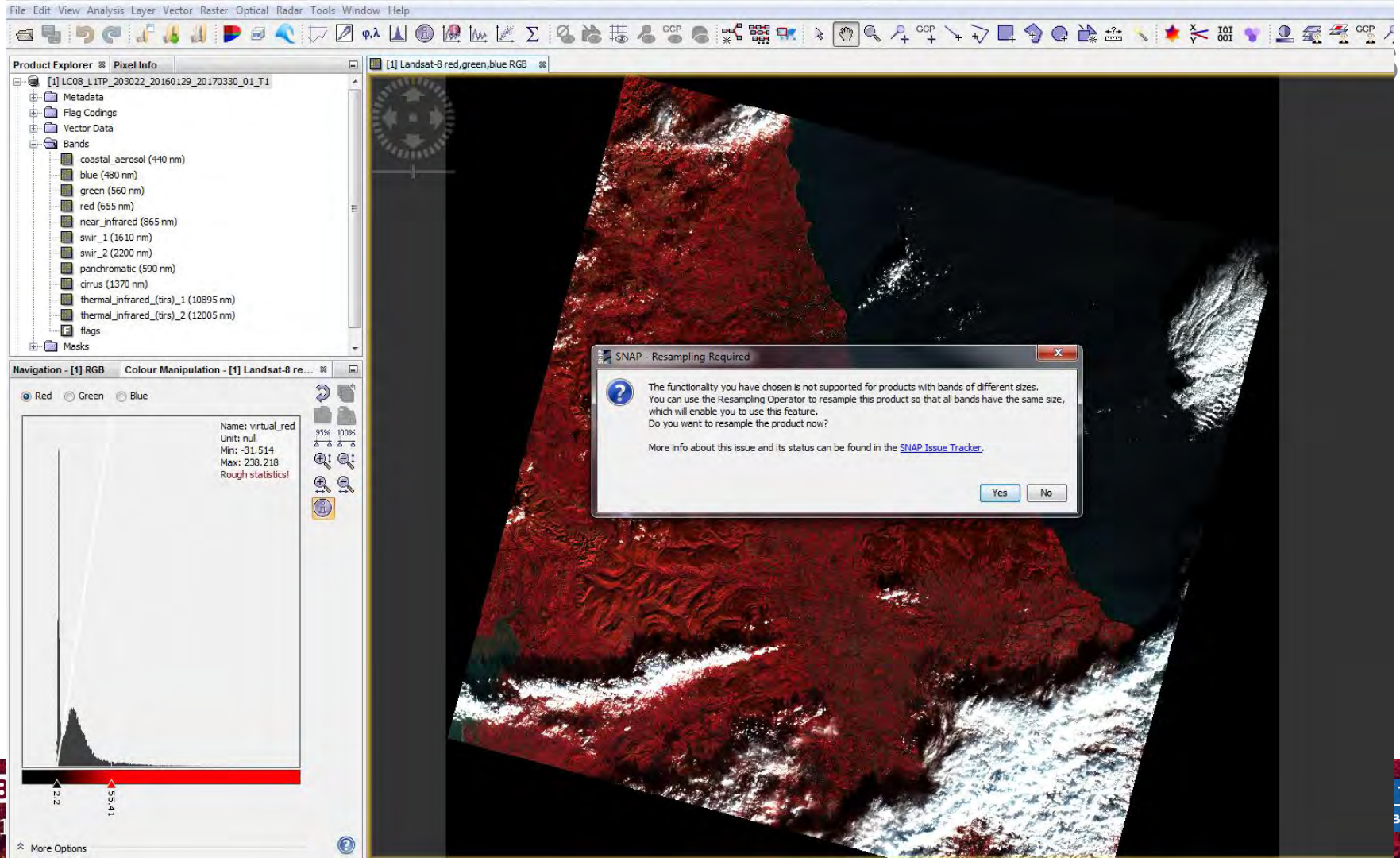
Navigation | Colour Manipulation

This tool window is used to manipulate the **colouring of images** shown in an image view.
Right now, there is no selected image view.



Reading LC08_L1TP_203022_20160129_20170330_01_T1.tar.gz


SNAP
File Edit View Analysis Layer Vector Raster Optical Radar Tools Window Help
Product Explorer
Pixel Info
[1] LC08_L1TP_203022_20160129_20170330_01_T1
Metadata
Flag Codings
Vector Data
Bands
coastal_aerosol (440 nm)
blue (480 nm)
green (560 nm)
red (655 nm)
near_infrared (865 nm)
swir_1 (1610 nm)
swir_2 (2200 nm)
panchromatic (590 nm)
cirrus (1370 nm)
thermal_infrared_(tirs)_1 (10895 nm)
thermal_infrared_(tirs)_2 (12005 nm)
flags
Masks
Navigation - [1] RGB
Colour Manipulation - [1] Landsat-8 re...
Red
Green
Blue
Name: virtual_red
Unit: null
Min: -31.514
Max: 238.218
Rough statistics!
2.2
55.41
More Options
[1] Landsat-8 red,green,blue RGB


File Edit View Analysis Layer Vector Raster Optical Radar Tools Window Help
Product Explorer
Pixel Info
[1] LC08_L1TP_203022_20160129_20170330_01_T1
Metadata
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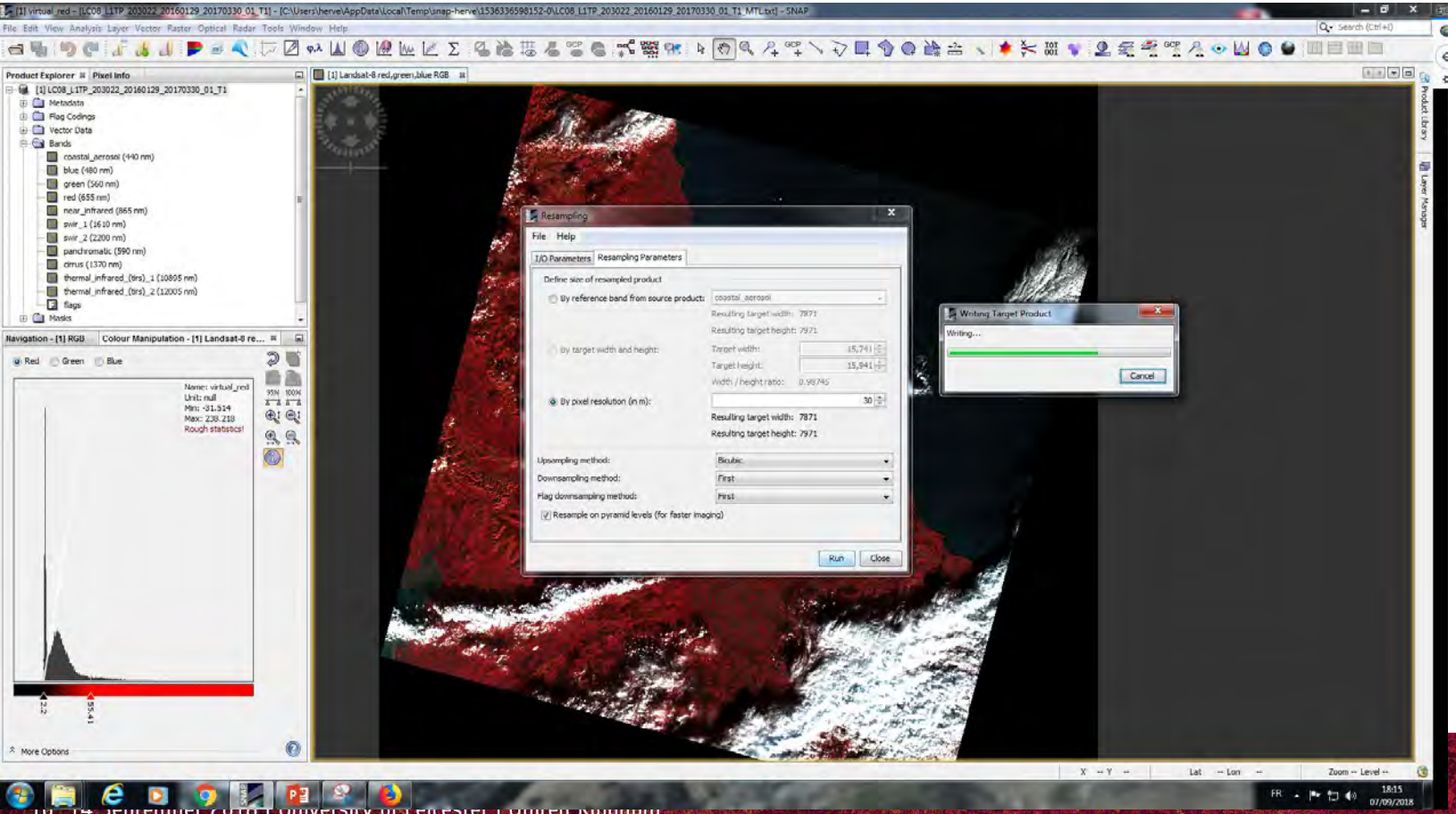
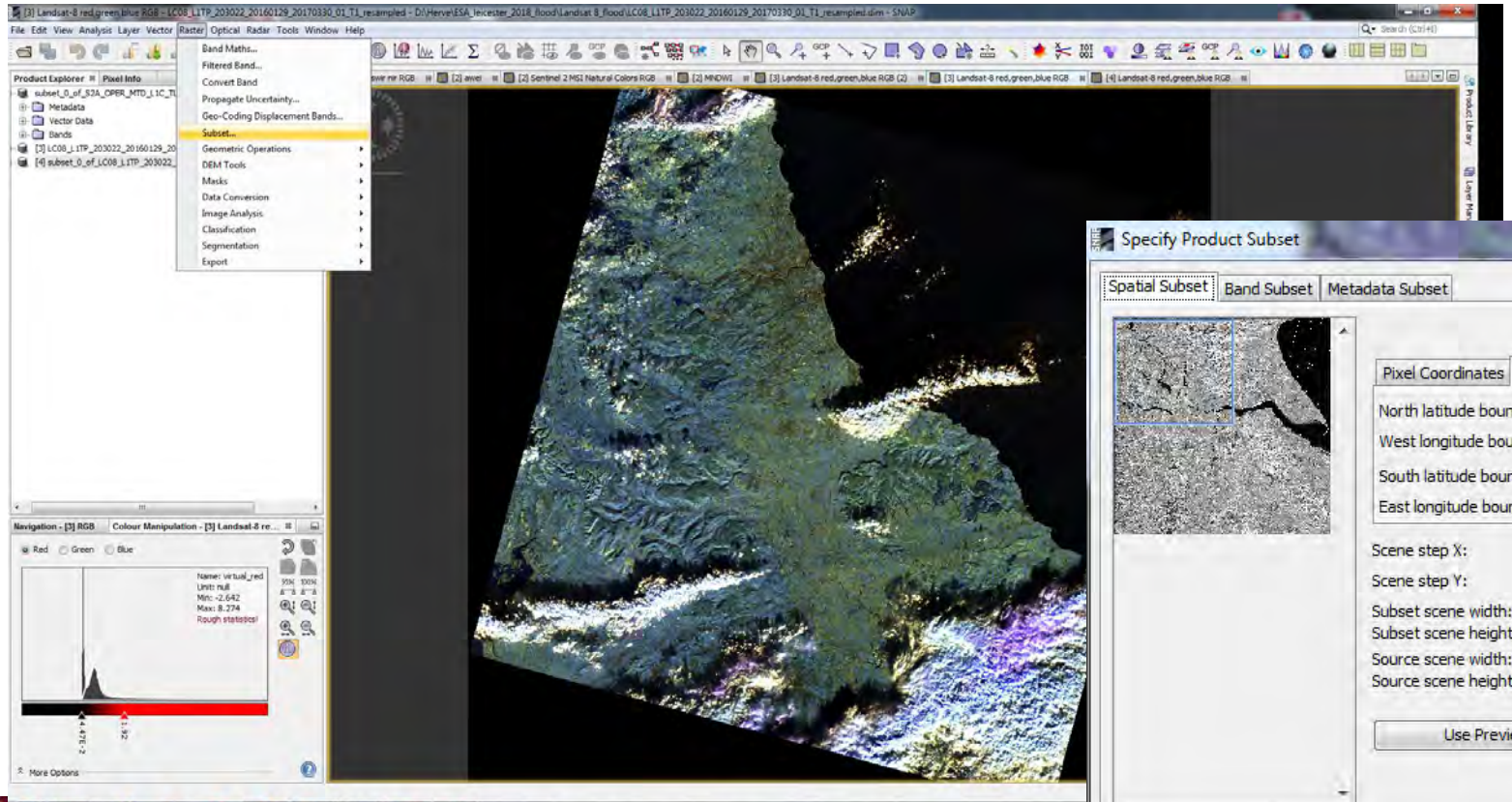
Blue
Name: virtual_red
Unit: null
Min: -31.514
Max: 238.218
Rough statistics!
2.2
55.41
More Options
[1] Landsat-8 red,green,blue RGB
SNAP - Resampling Required
The functionality you have chosen is not supported for products with bands of different sizes.
You can use the Resampling Operator to resample this product so that all bands have the same size, which will enable you to use this feature.
Do you want to resample the product now?
More info about this issue and its status can be found in the SNAP Issue Tracker.
Yes
No

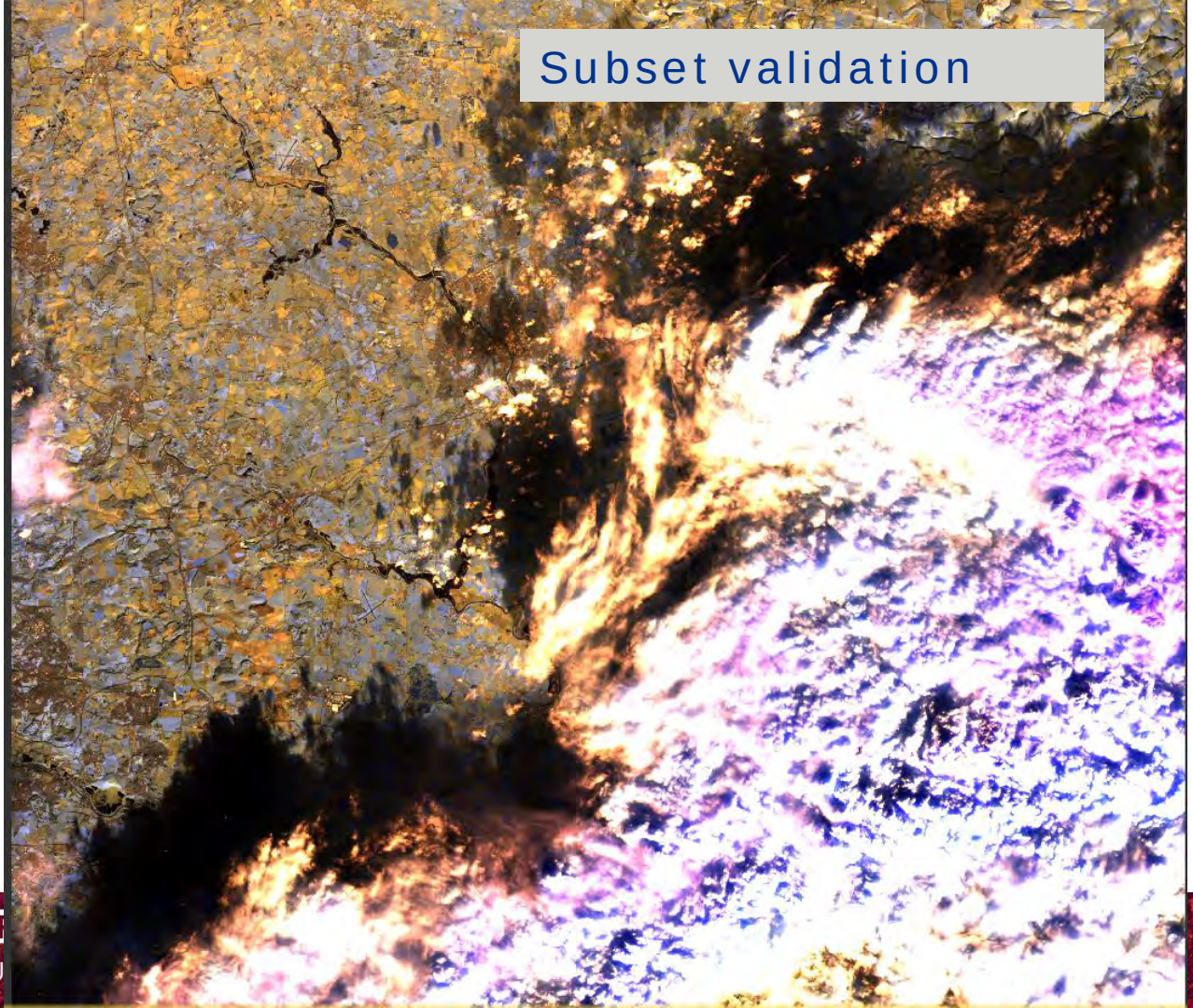
Resampling 30 m

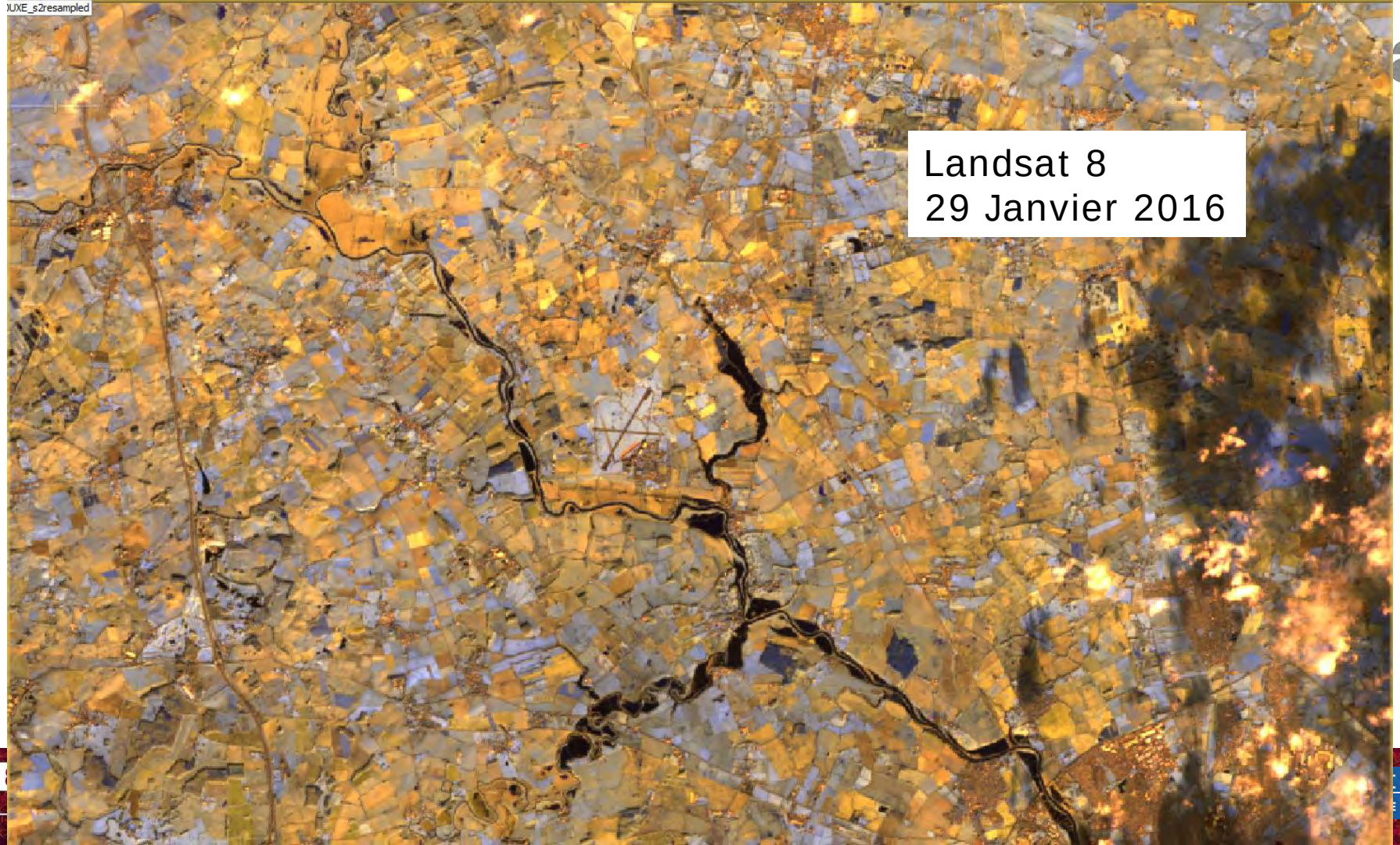


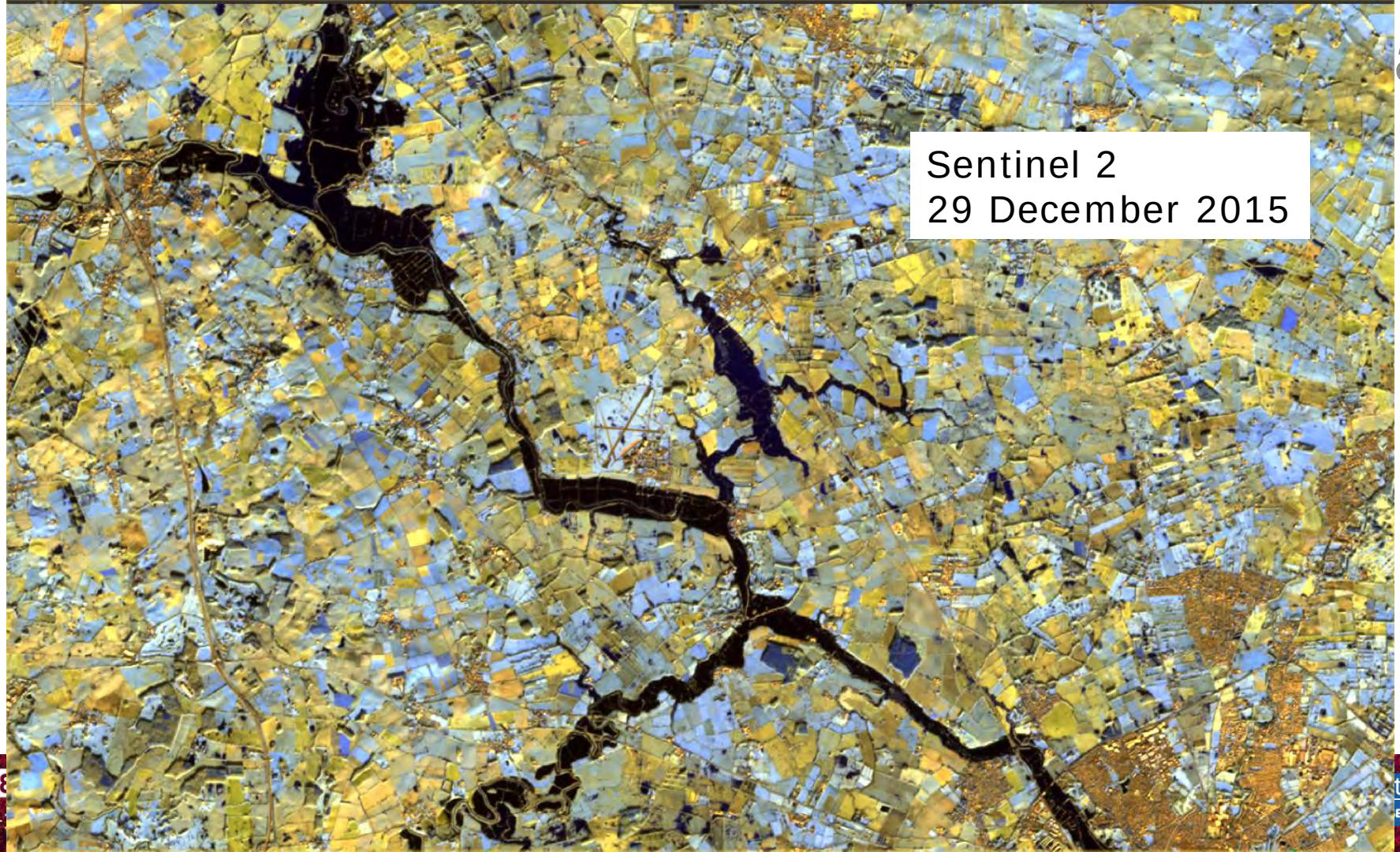
Subset


Band Maths...
Filtered Band...
Convert Band
Propagate Uncertainty...
Geo-Coding Displacement Bands...
Subset...
Geometric Operations
DEM Tools
Masks
Data Conversion
Image Analysis
Classification
Segmentation
Export
Specify Product Subset
Spatial Subset
Band Subset
Metadata Subset
Pixel Coordinates
Geo Coordinates
North latitude bound: 54.127
West longitude bound: -1.47
South latitude bound: 53.636
East longitude bound: -0.562
Scene step X:
Scene step Y:
Subset scene width: 61
Subset scene height: 52
Source scene width: 10
Source scene height: 10
Use Preview
Fix full width
Fix full height
Estimated, raw storage size: 11
OK
Cancel

Subset validation




)UXE_s2resampled
Landsat 8
29 Janvier 2016


Sentinel 2
29 December 2015

National Centre for Earth Observation
NATURAL ENVIRONMENT RESEARCH COUNCIL

UNIVERSITY OF LEICESTER

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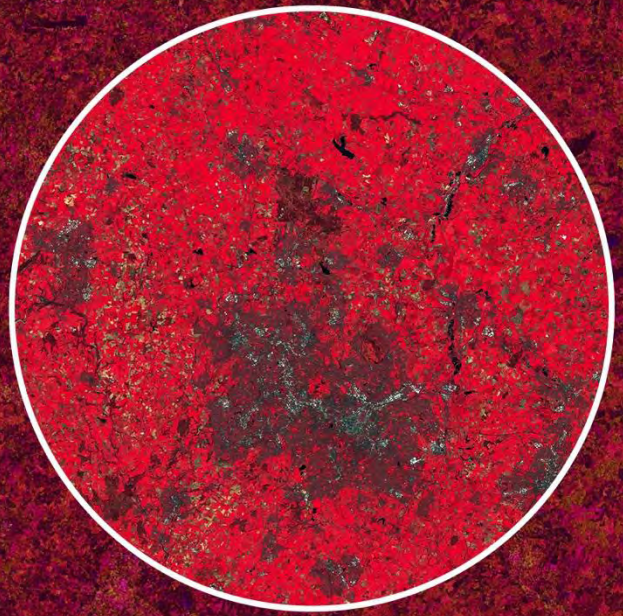
→ 8th ADVANCED TRAINING COURSE ON LAND REMOTE SENSING

10–14 September 2018
University of Leicester | United Kingdom



Flood mapping pratical

Dr Hervé YESOU

14 September 2018

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ICUBE

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