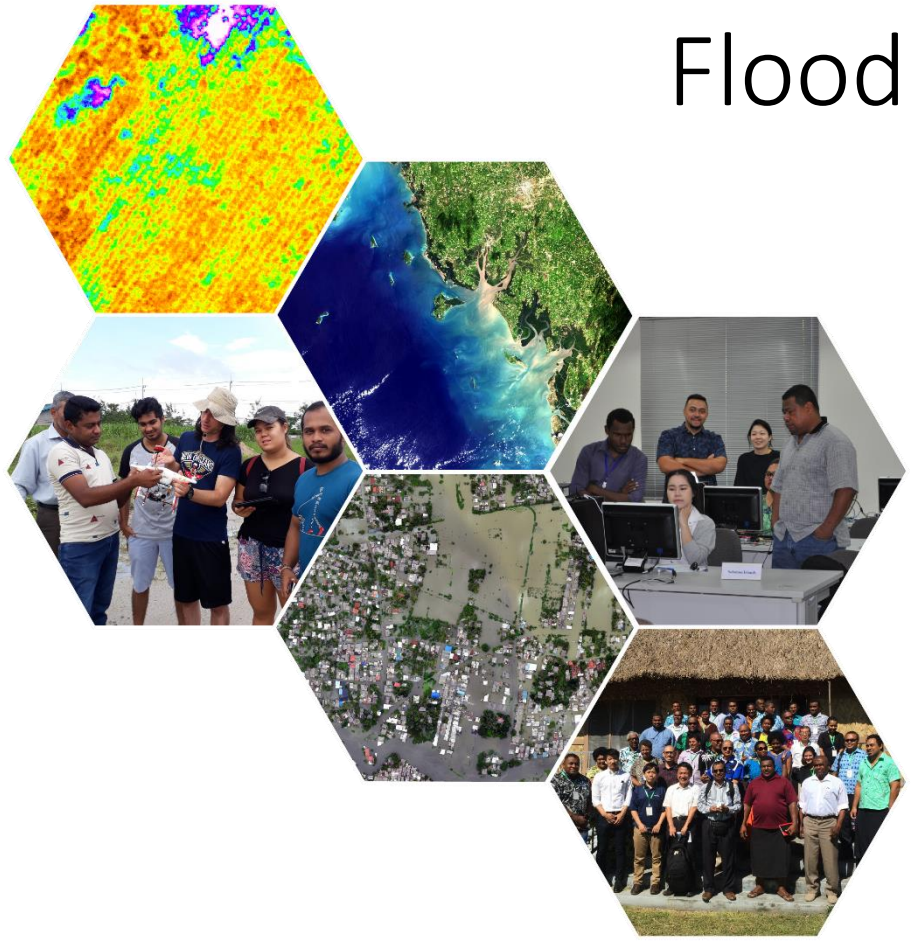

Flood Mapping with Sentinel-2 imagery

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chathumal@ait.asia

Objective

- The main objective of this hands-on exercise is to extract water body areas using Sentinel-2 imagery.

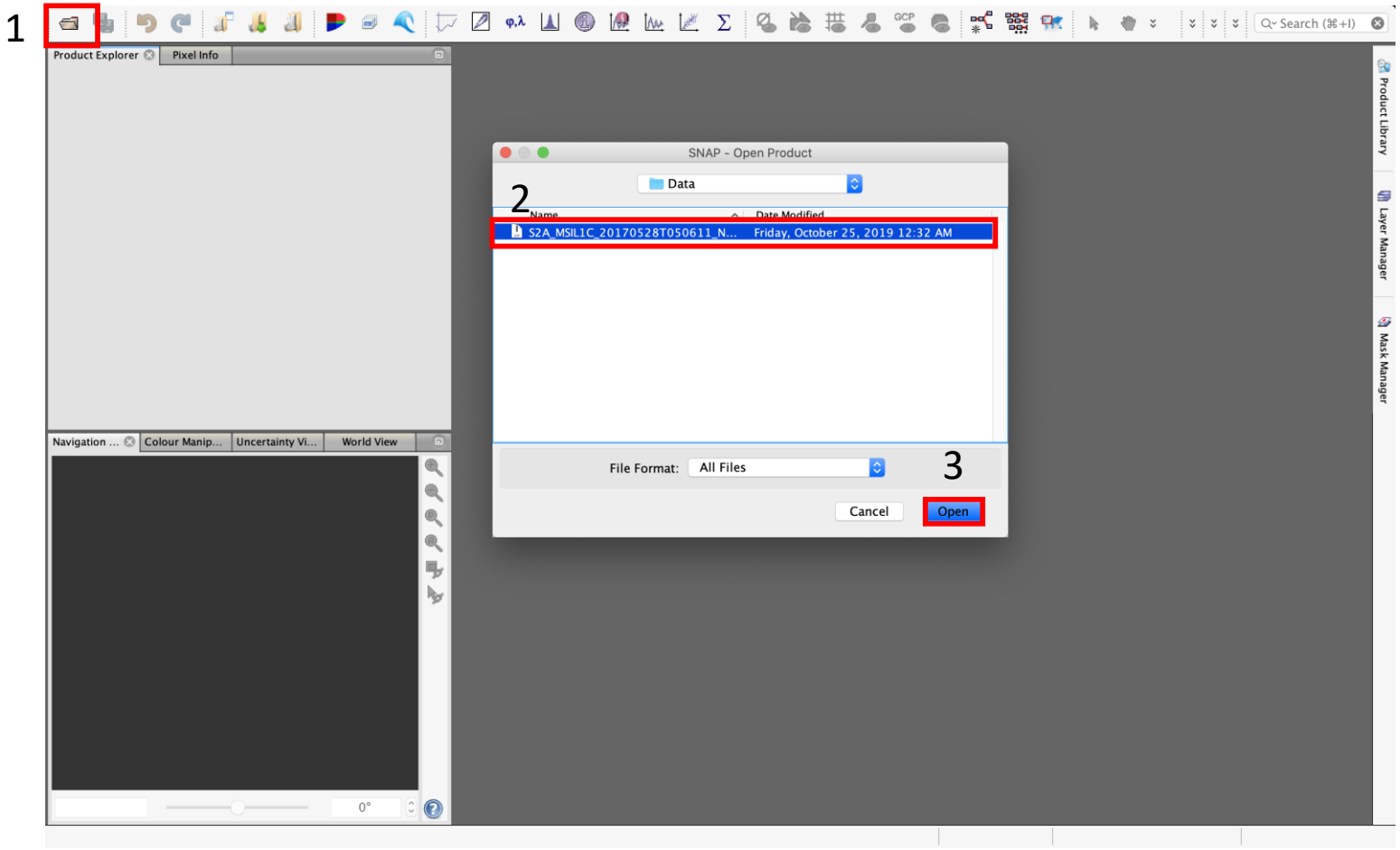
How to map flood areas from Sentinel-2 data?

- Open data product
- Create a subset image
- Calculate NDWI
- Extract water areas using threshold
- Export result to other format (ex. tif) for map layouting

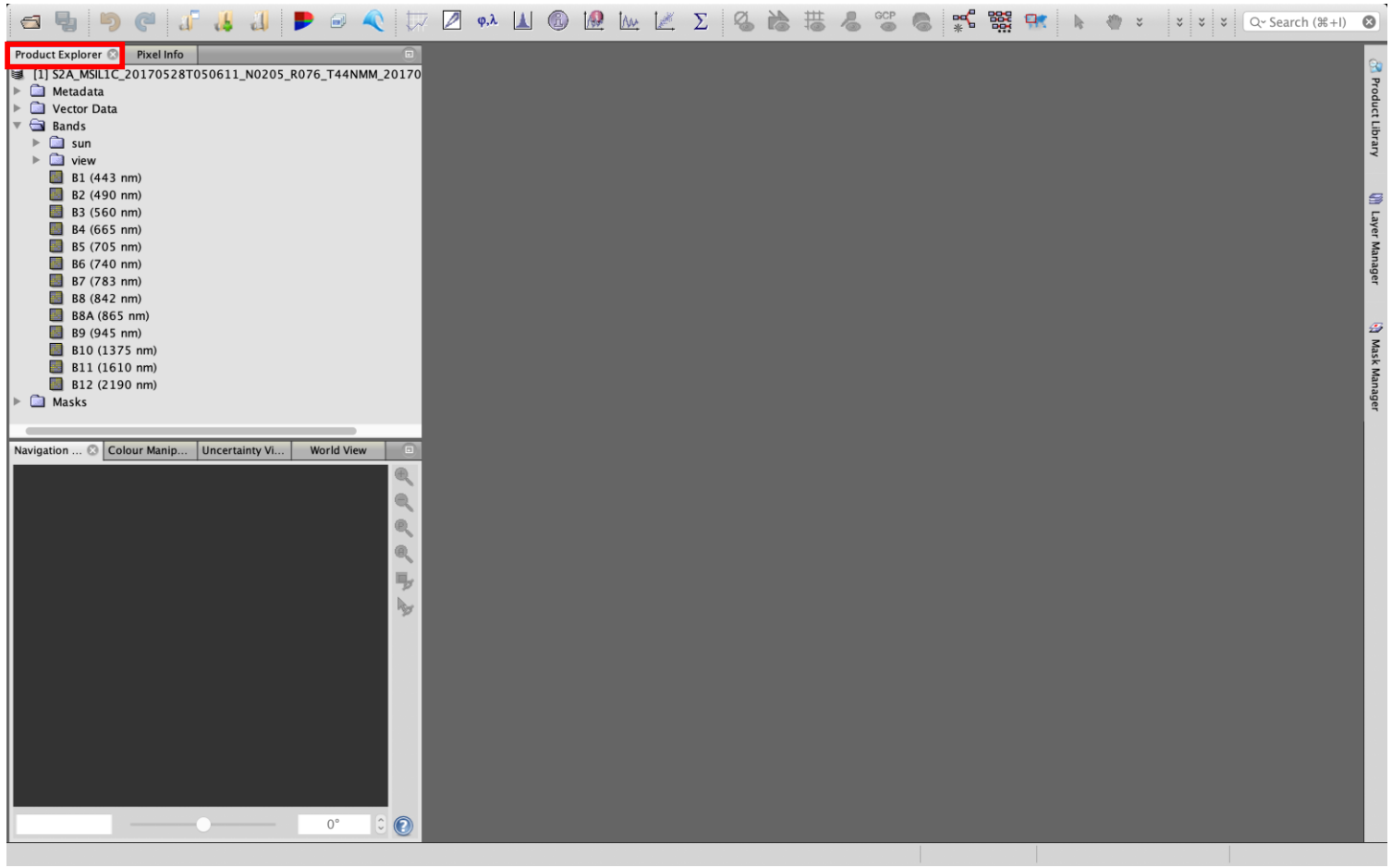

Hands on exercise

Open Sentinel-2 data

Use the Open Product button

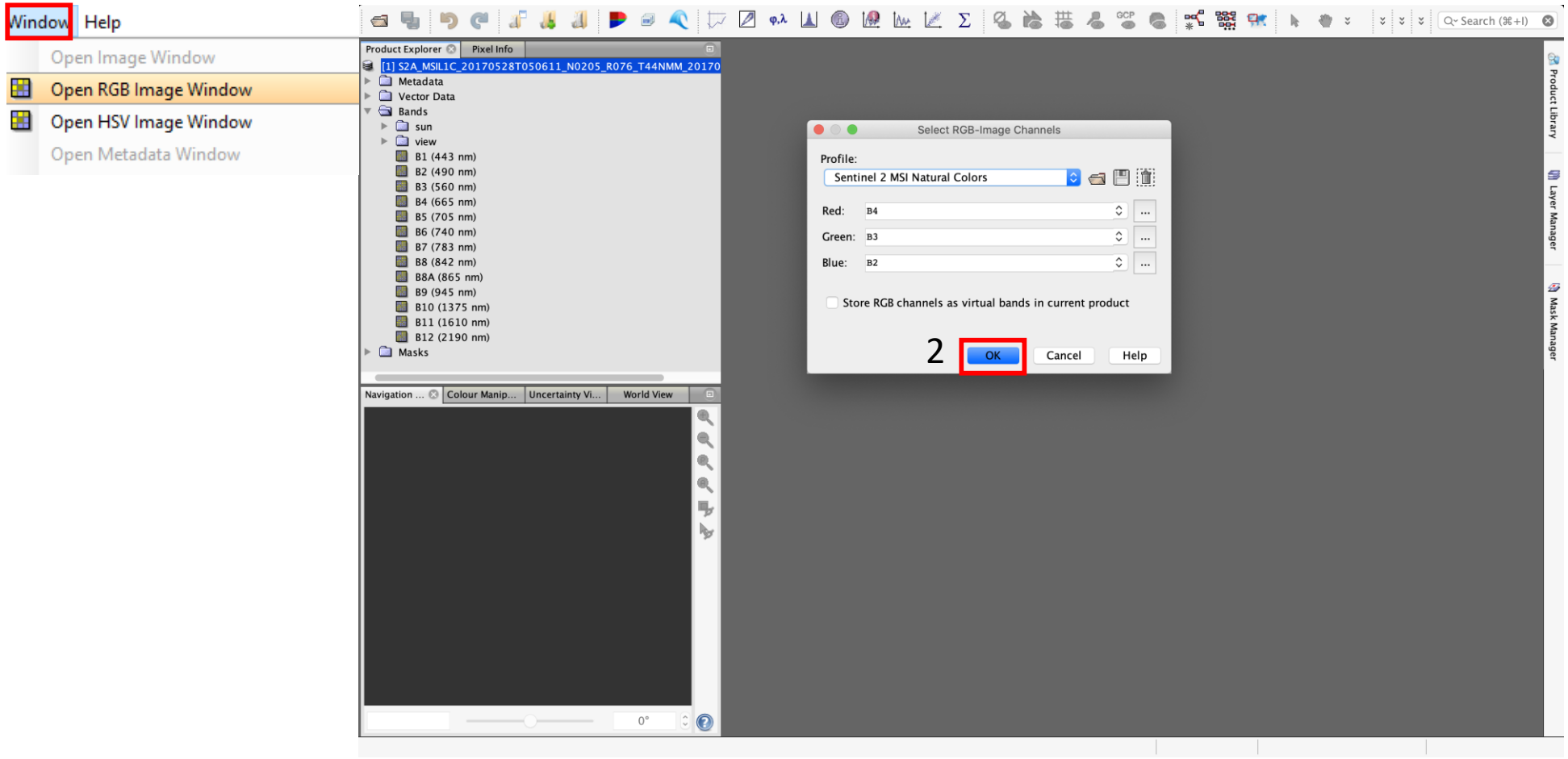


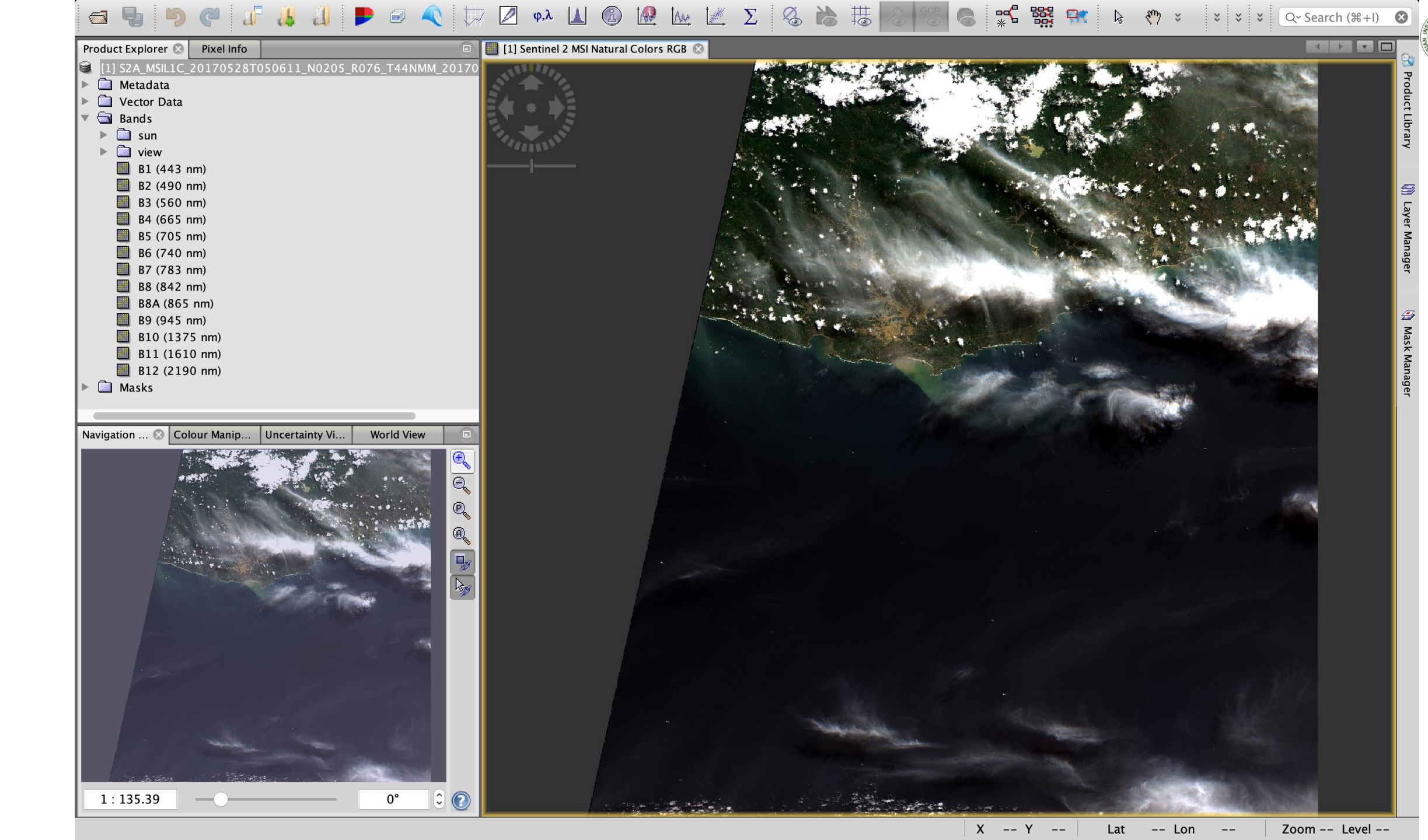
Product Explorer



Open RGB image window

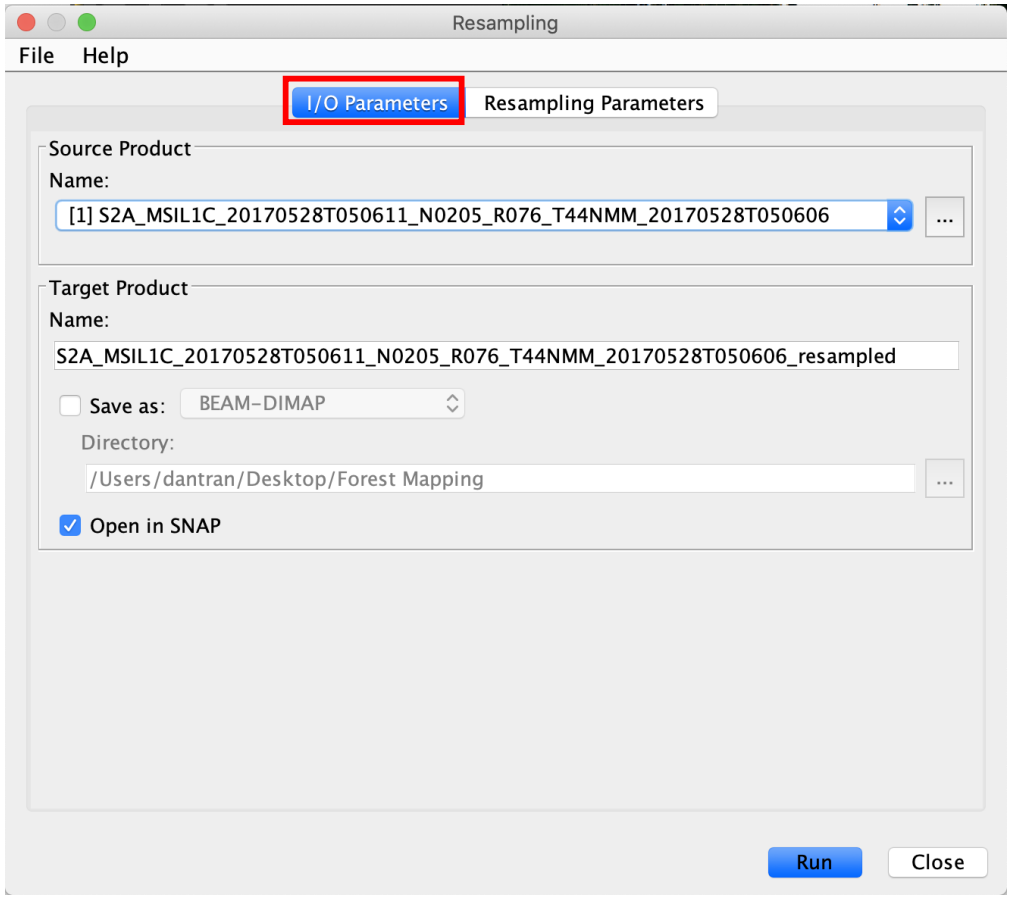
1

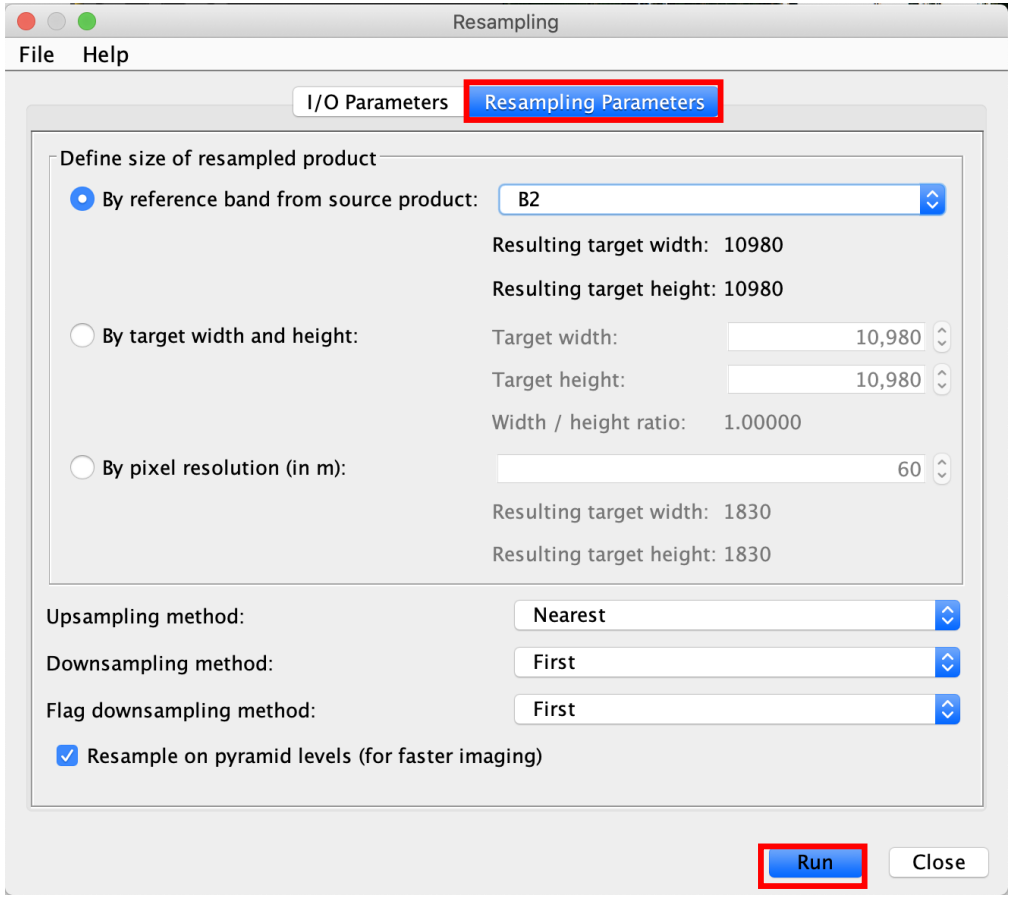



Search (⌘+I)
Product Explorer
Pixel Info
[1] S2A_MSIL1C_20170528T050611_N0205_R076_T44NMM_20170
Metadata
Vector Data
Bands
sun
view
B1 (443 nm)
B2 (490 nm)
B3 (560 nm)
B4 (665 nm)
B5 (705 nm)
B6 (740 nm)
B7 (783 nm)
B8 (842 nm)
B8A (865 nm)
B9 (945 nm)
B10 (1375 nm)
B11 (1610 nm)
B12 (2190 nm)
Masks
Navigation ...
Colour Manip...
Uncertainty Vi...
World View
1 : 135.39
0°
[1] Sentinel 2 MSI Natural Colors RGB
Product Library
Layer Manager
Mask Manager
X -- Y --
Lat -- Lon --
Zoom -- Level --

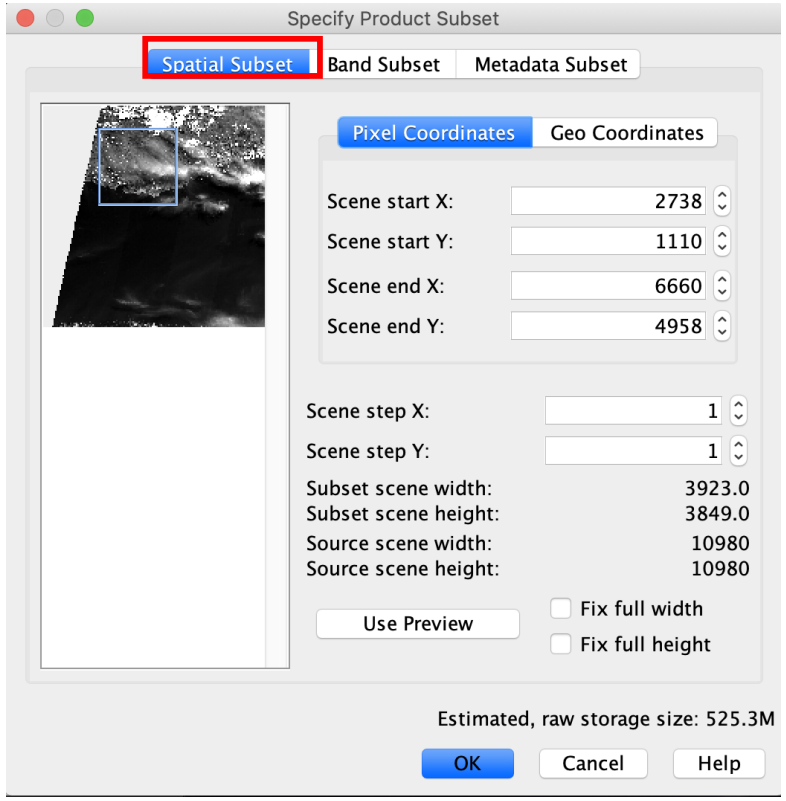
Creating a subset image

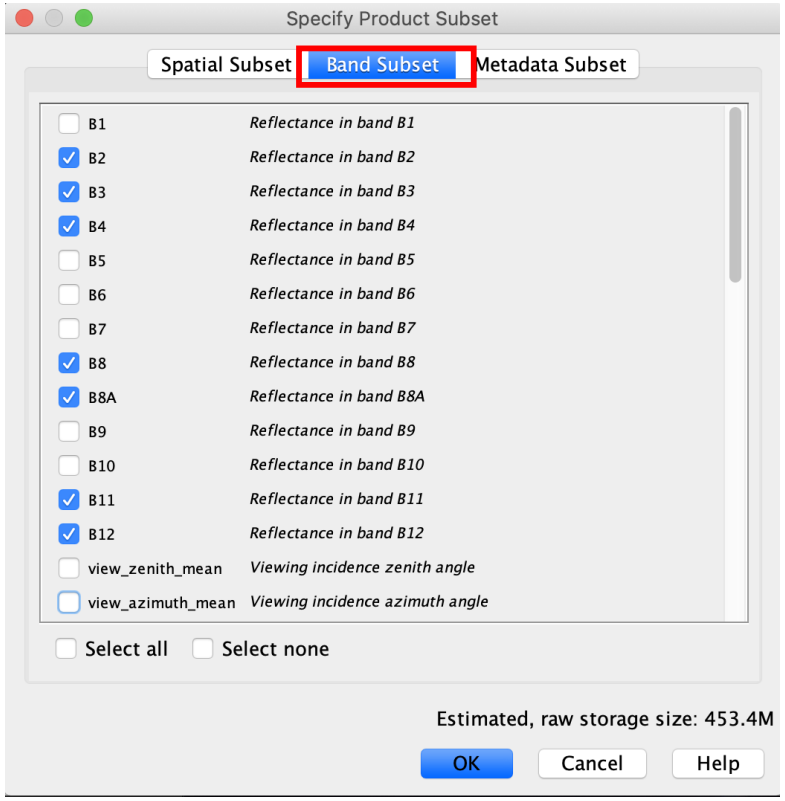
From the Raster menu, select Subset…

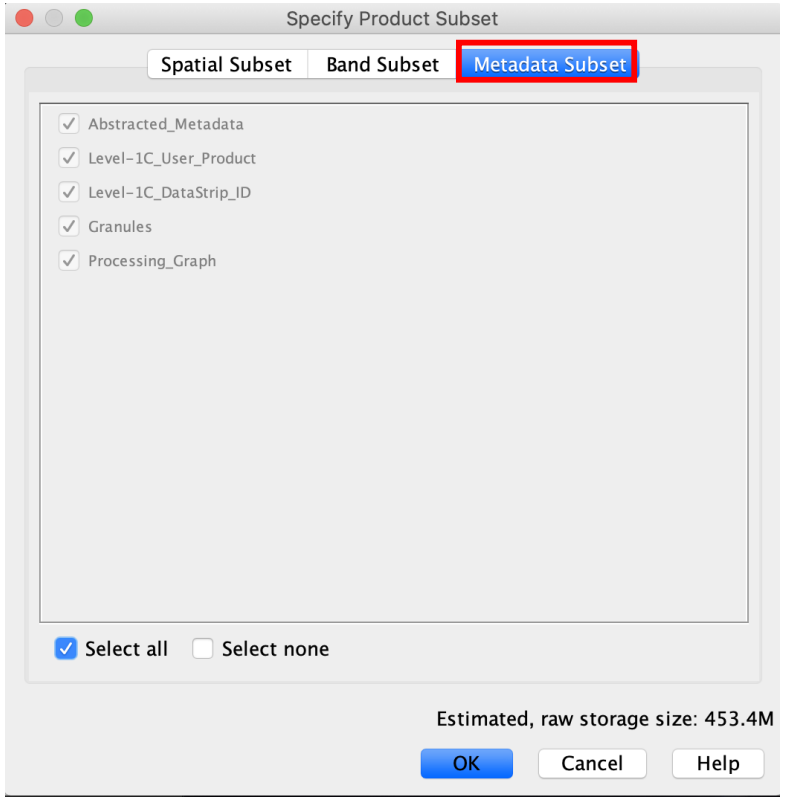


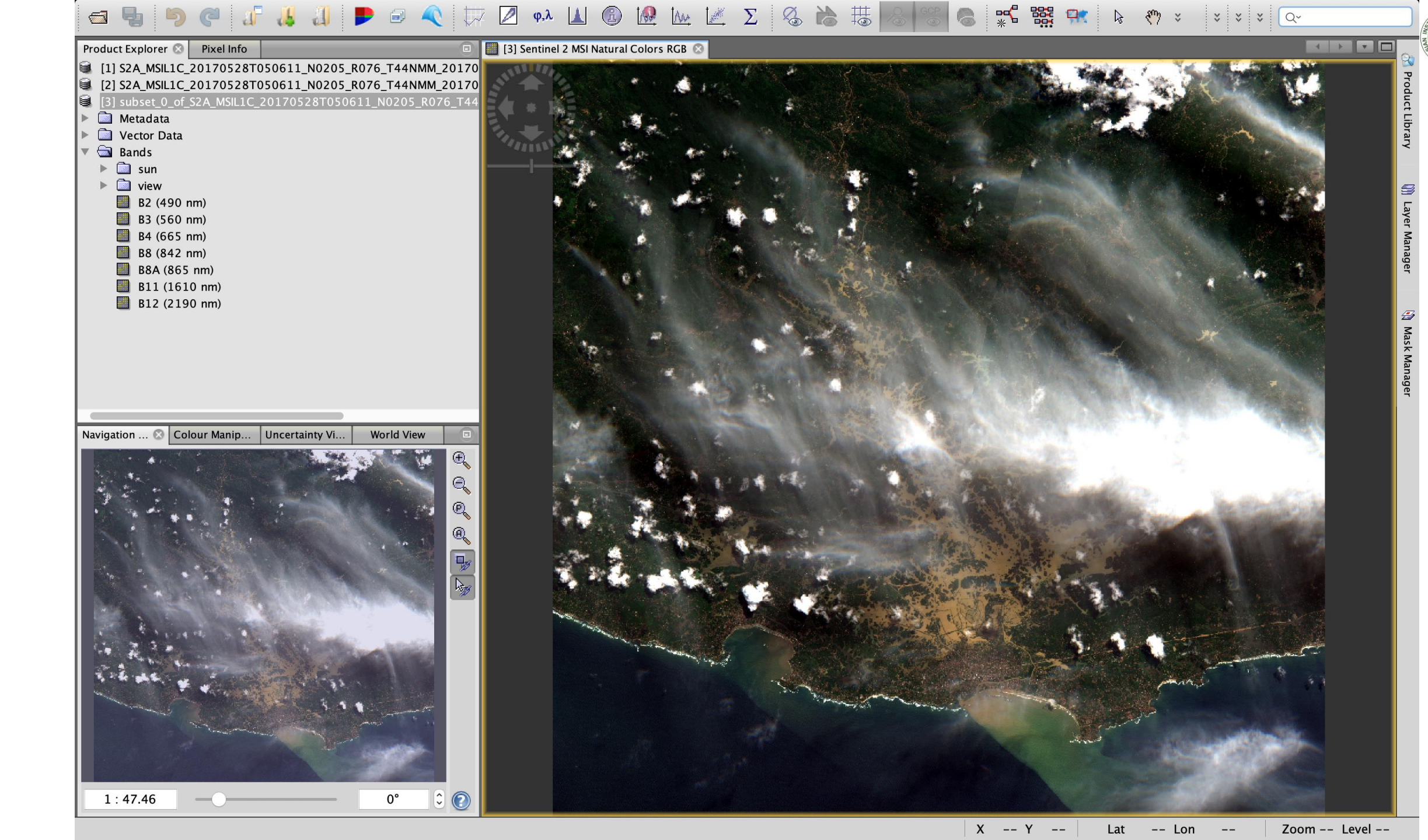


Creating a subset image



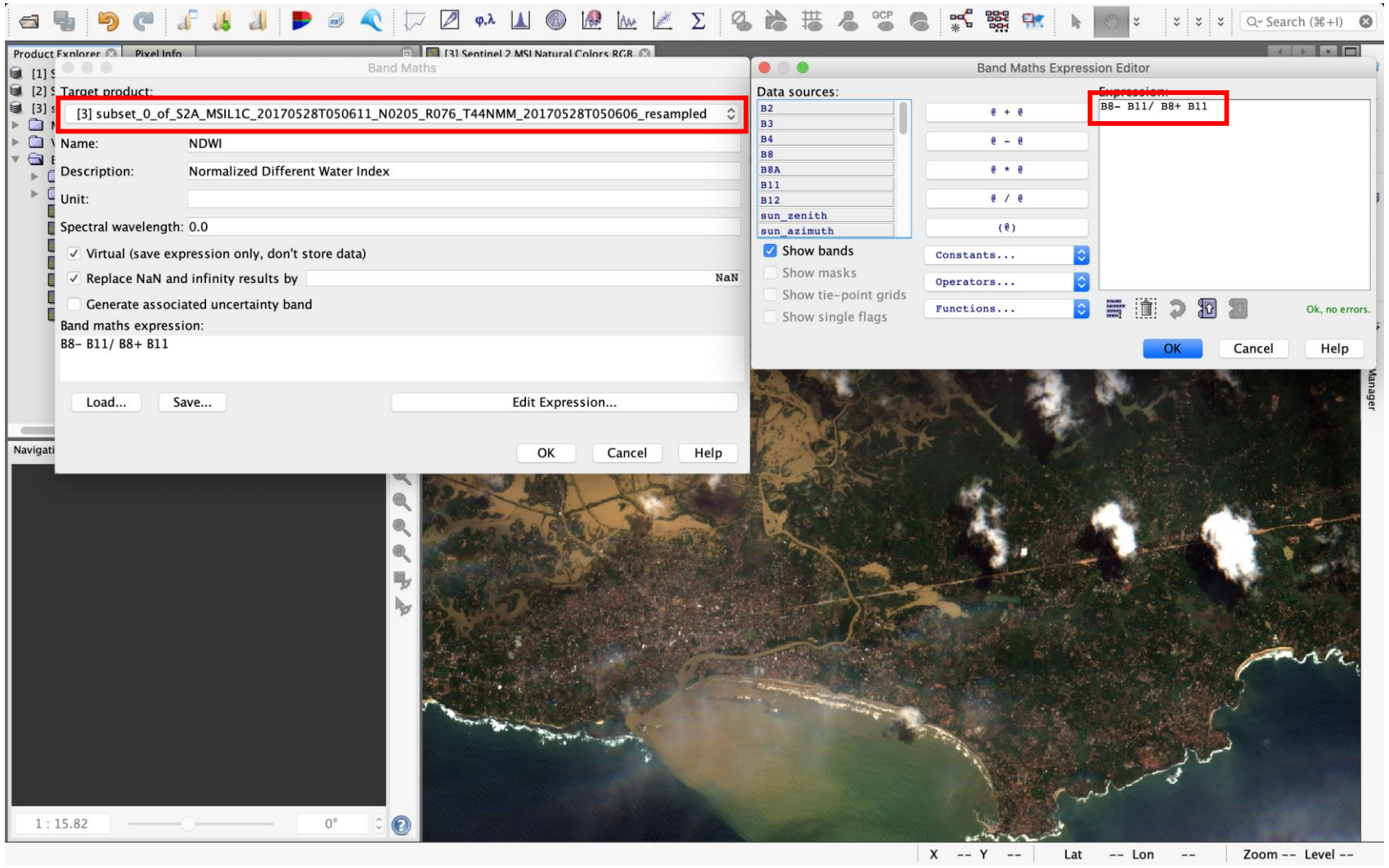


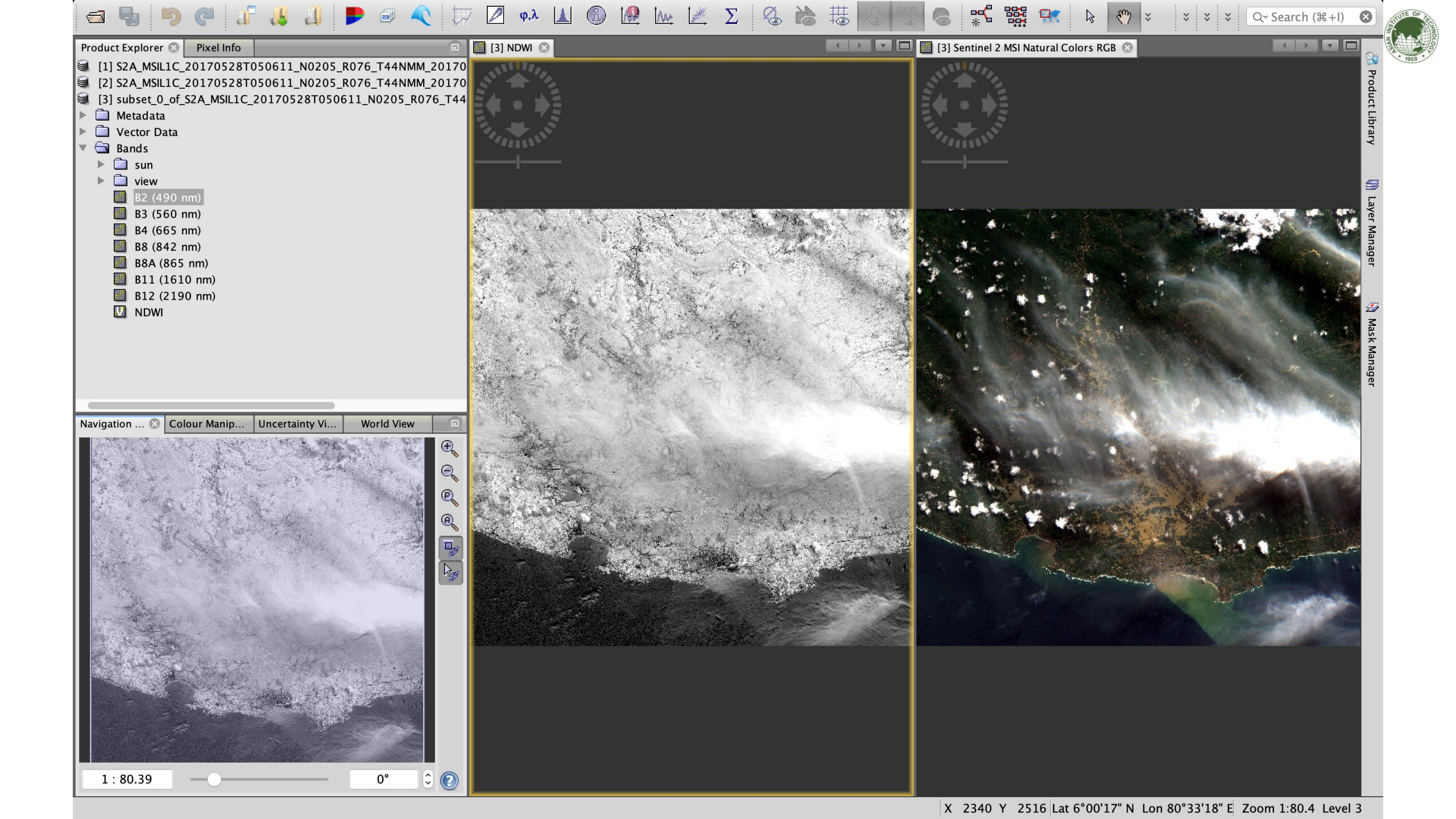



Product Explorer
Pixel Info
[1] S2A_MSIL1C_20170528T050611_N0205_R076_T44NMM_20170
[2] S2A_MSIL1C_20170528T050611_N0205_R076_T44NMM_20170
[3] subset_0_of_S2A_MSIL1C_20170528T050611_N0205_R076_T44
Metadata
Vector Data
Bands
sun
view
B2 (490 nm)
B3 (560 nm)
B4 (665 nm)
B8 (842 nm)
B8A (865 nm)
B11 (1610 nm)
B12 (2190 nm)
Navigation ...
Colour Manip...
Uncertainty Vi...
World View
1 : 47.46
0°
[3] Sentinel 2 MSI Natural Colors RGB
Product Library
Layer Manager
Mask Manager
X -- Y --
Lat -- Lon --
Zoom -- Level --

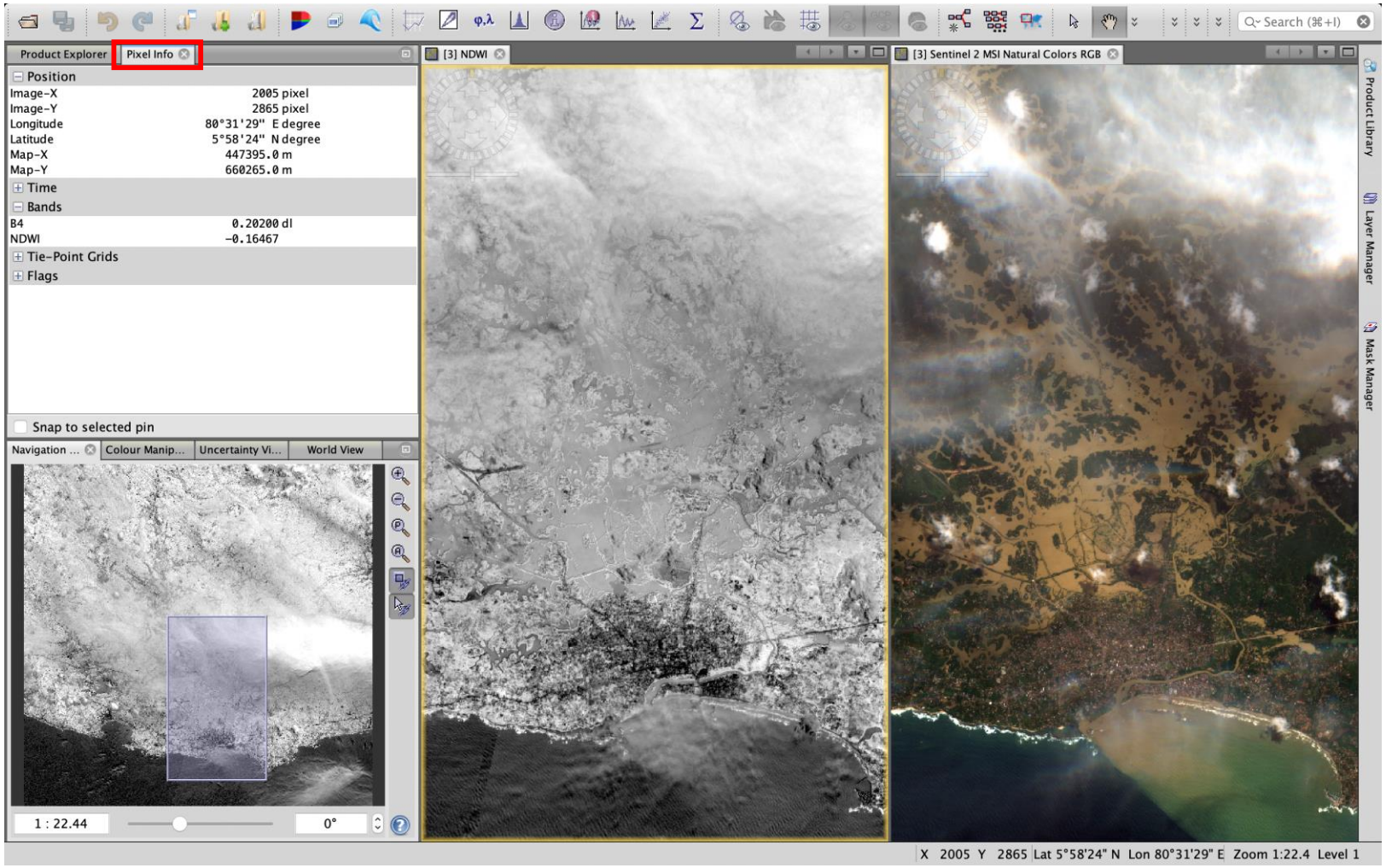
Calculate NDWI

From the Raster menu, select Band Maths

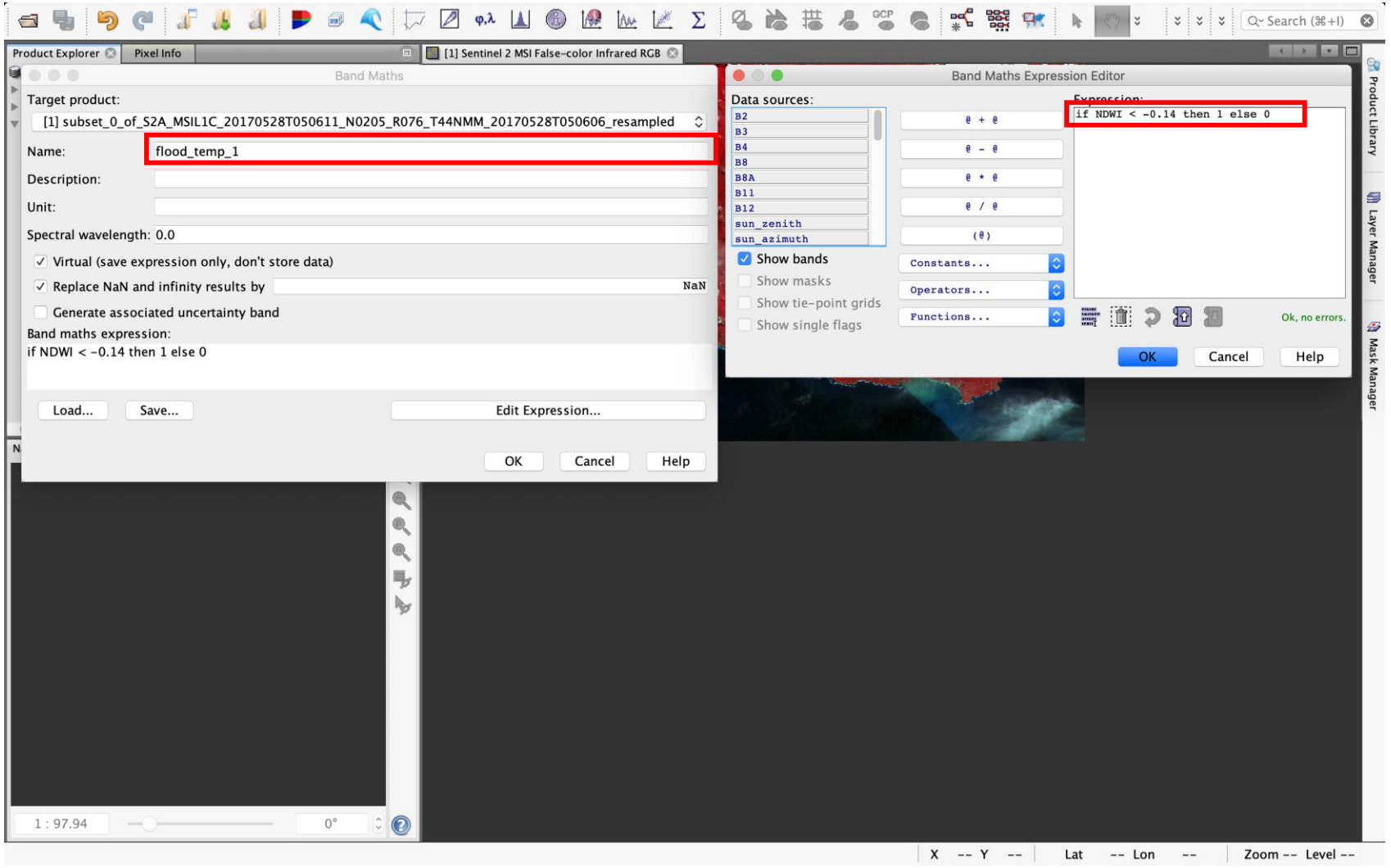


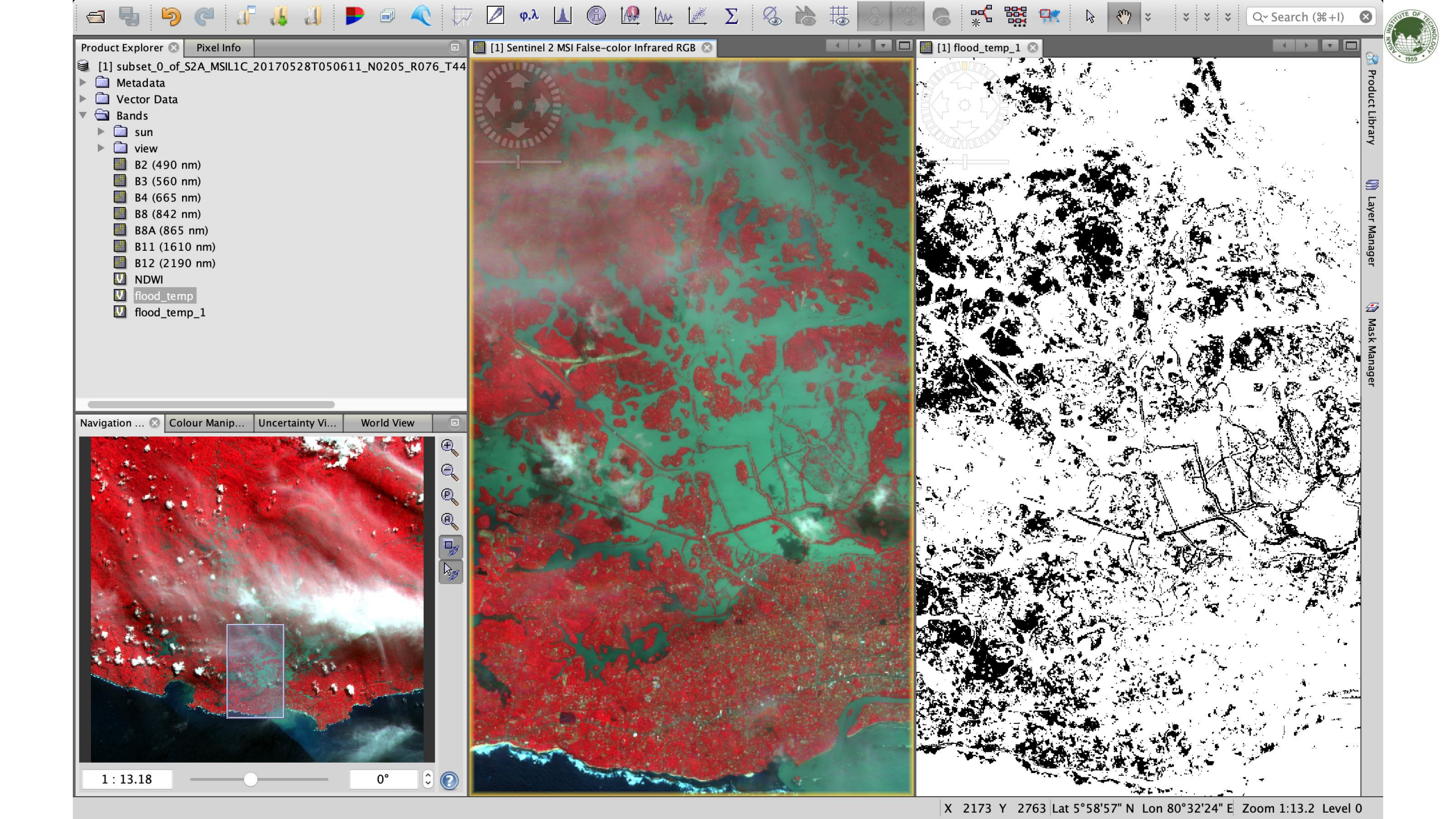

Product Explorer
Pixel Info
[1] S2A_MSIL1C_20170528T050611_N0205_R076_T44NMM_20170
[2] S2A_MSIL1C_20170528T050611_N0205_R076_T44NMM_20170
[3] subset_0_of_S2A_MSIL1C_20170528T050611_N0205_R076_T44
Metadata
Vector Data
Bands
sun
view
B2 (490 nm)
B3 (560 nm)
B4 (665 nm)
B8 (842 nm)
B8A (865 nm)
B11 (1610 nm)
B12 (2190 nm)
NDWI
Navigation ...
Colour Manip...
Uncertainty Vi...
World View
1 : 80.39
0°
[3] NDWI
[3] Sentinel 2 MSI Natural Colors RGB
Search (⌘+I)
Product Library
Layer Manager
Mask Manager
X 2340 Y 2516 Lat 6°00'17" N Lon 80°33'18" E Zoom 1:80.4 Level 3

Find threshold to extract water



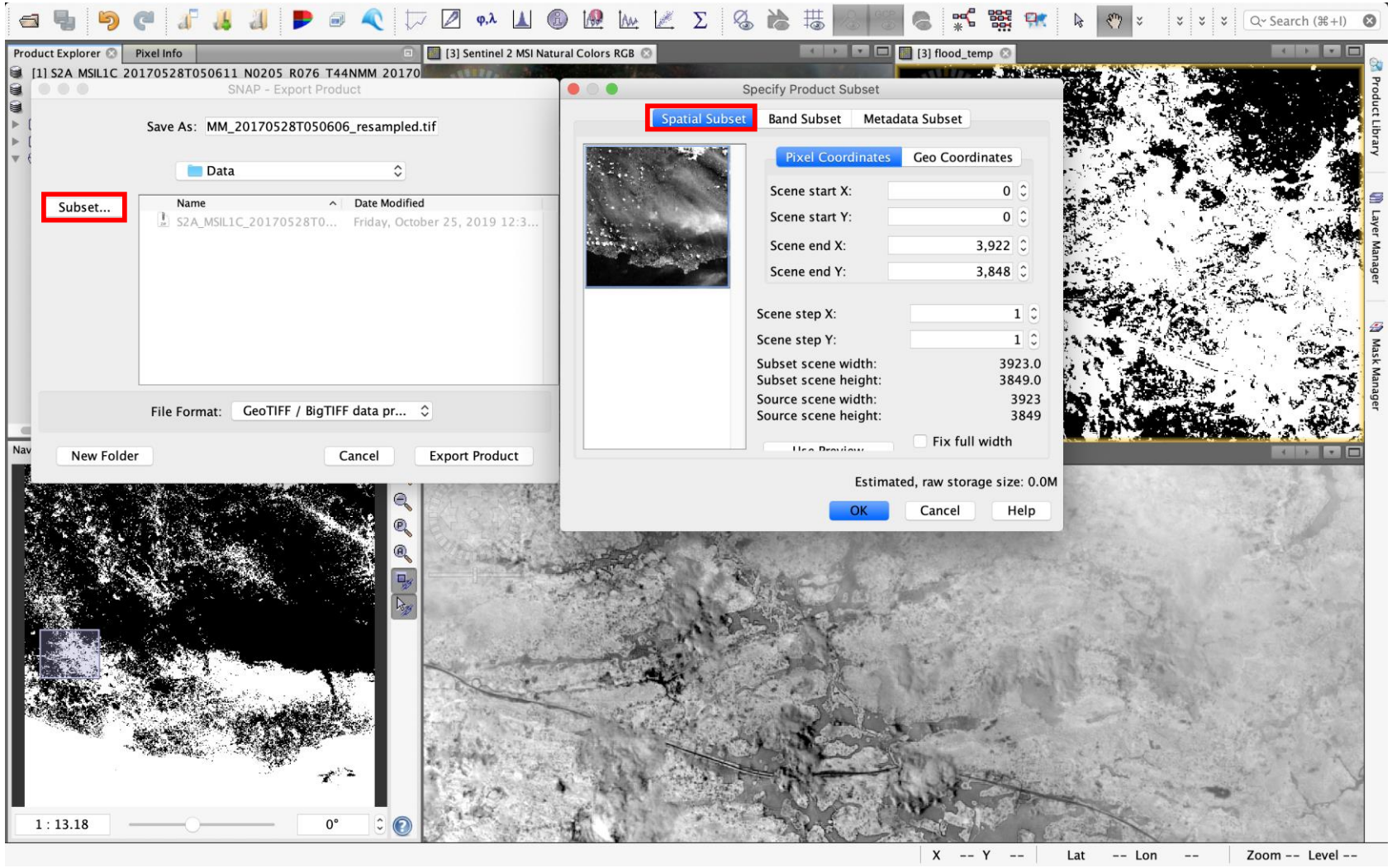
Extract water using threshold

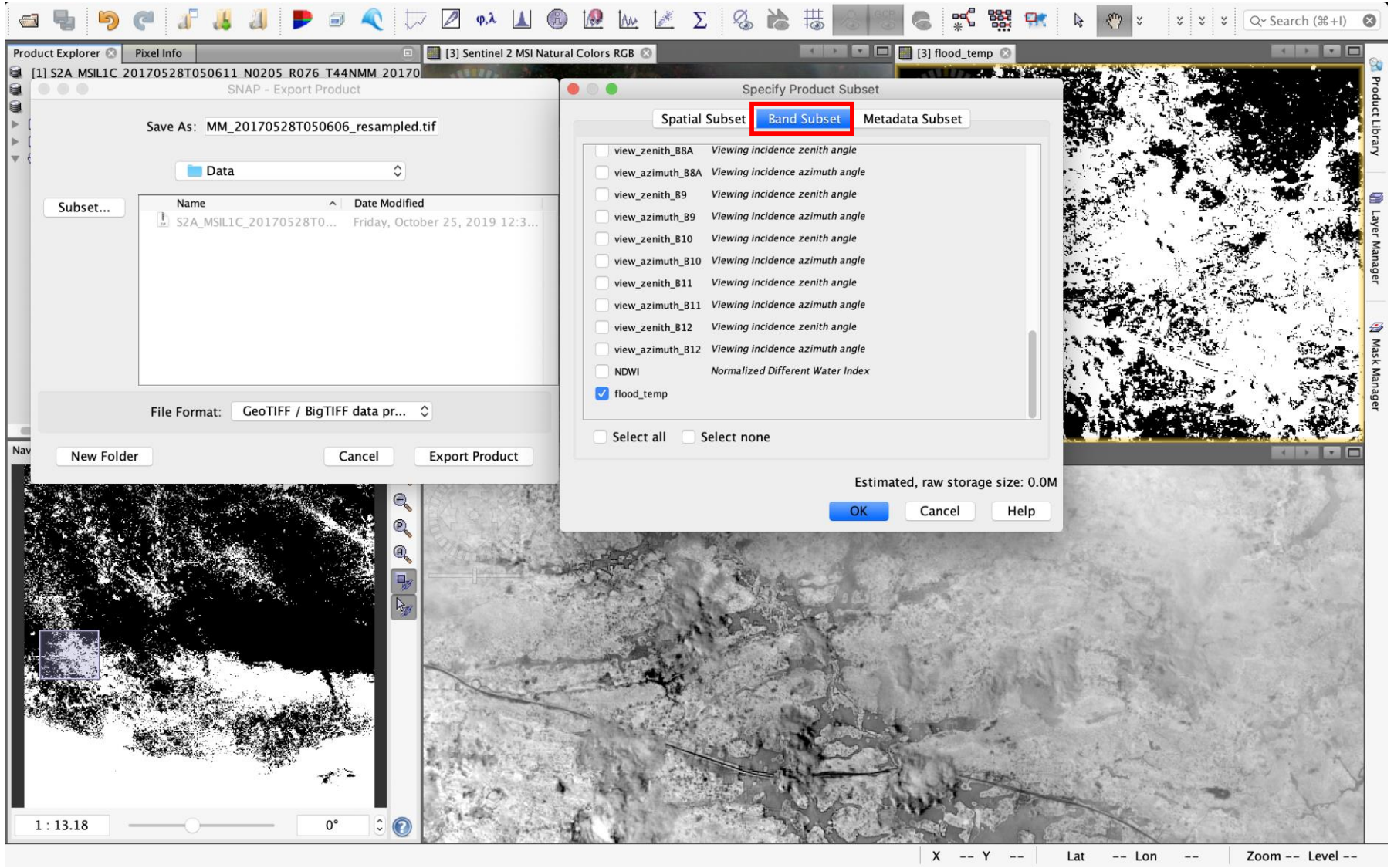


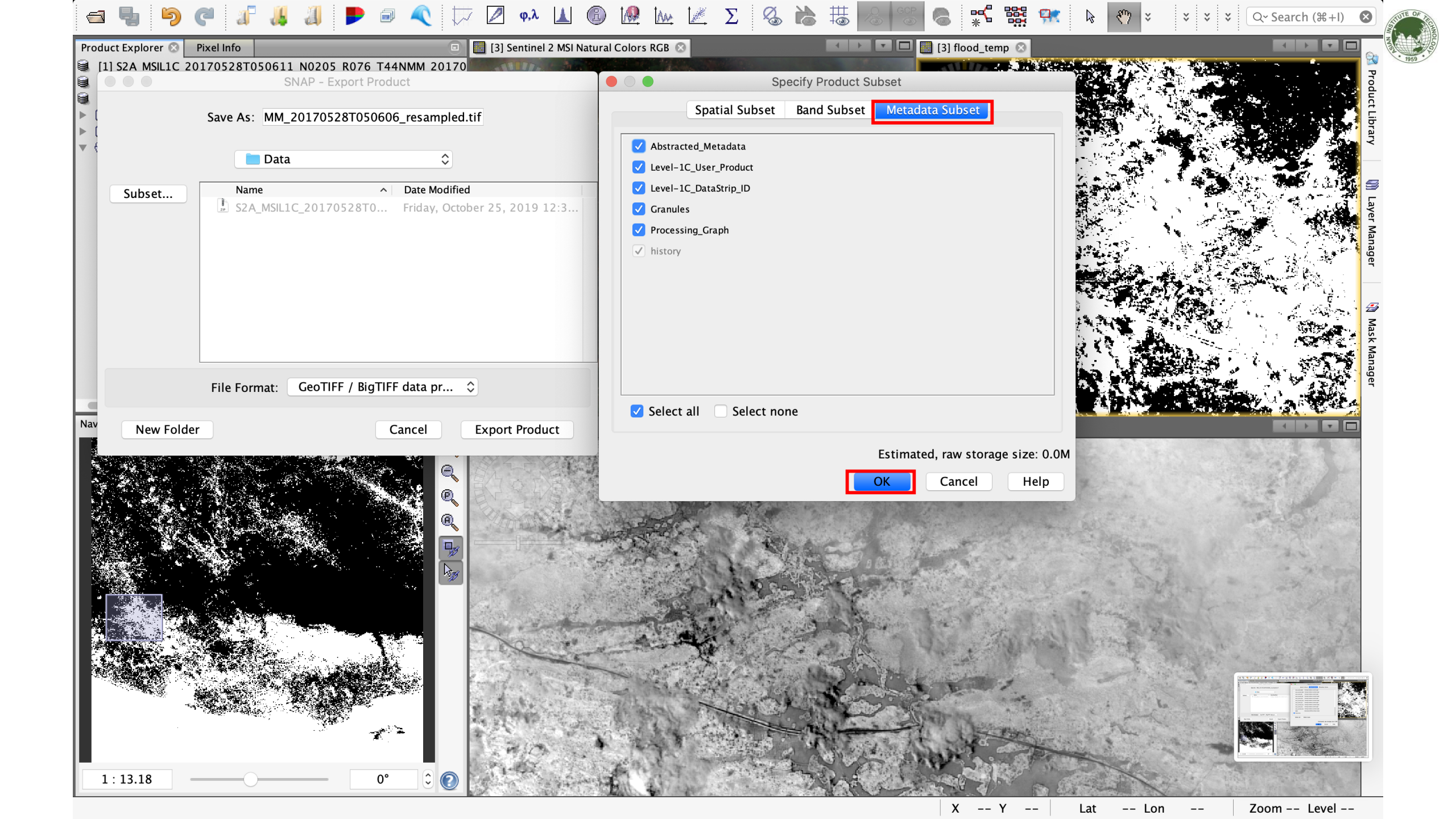

Product Explorer
Pixel Info
[1] subset_0_of_S2A_MSIL1C_20170528T050611_N0205_R076_T44
Metadata
Vector Data
Bands
sun
view
B2 (490 nm)
B3 (560 nm)
B4 (665 nm)
B8 (842 nm)
B8A (865 nm)
B11 (1610 nm)
B12 (2190 nm)
NDWI
flood_temp
flood_temp_1
Navigation ...
Colour Manip...
Uncertainty Vi...
World View
1 : 13.18
0°
[1] Sentinel 2 MSI False-color Infrared RGB
[1] flood_temp_1
Product Library
Layer Manager
Mask Manager
Search (⌘+I)
X 2173 Y 2763 Lat 5°58'57" N Lon 80°32'24" E Zoom 1:13.2 Level 0

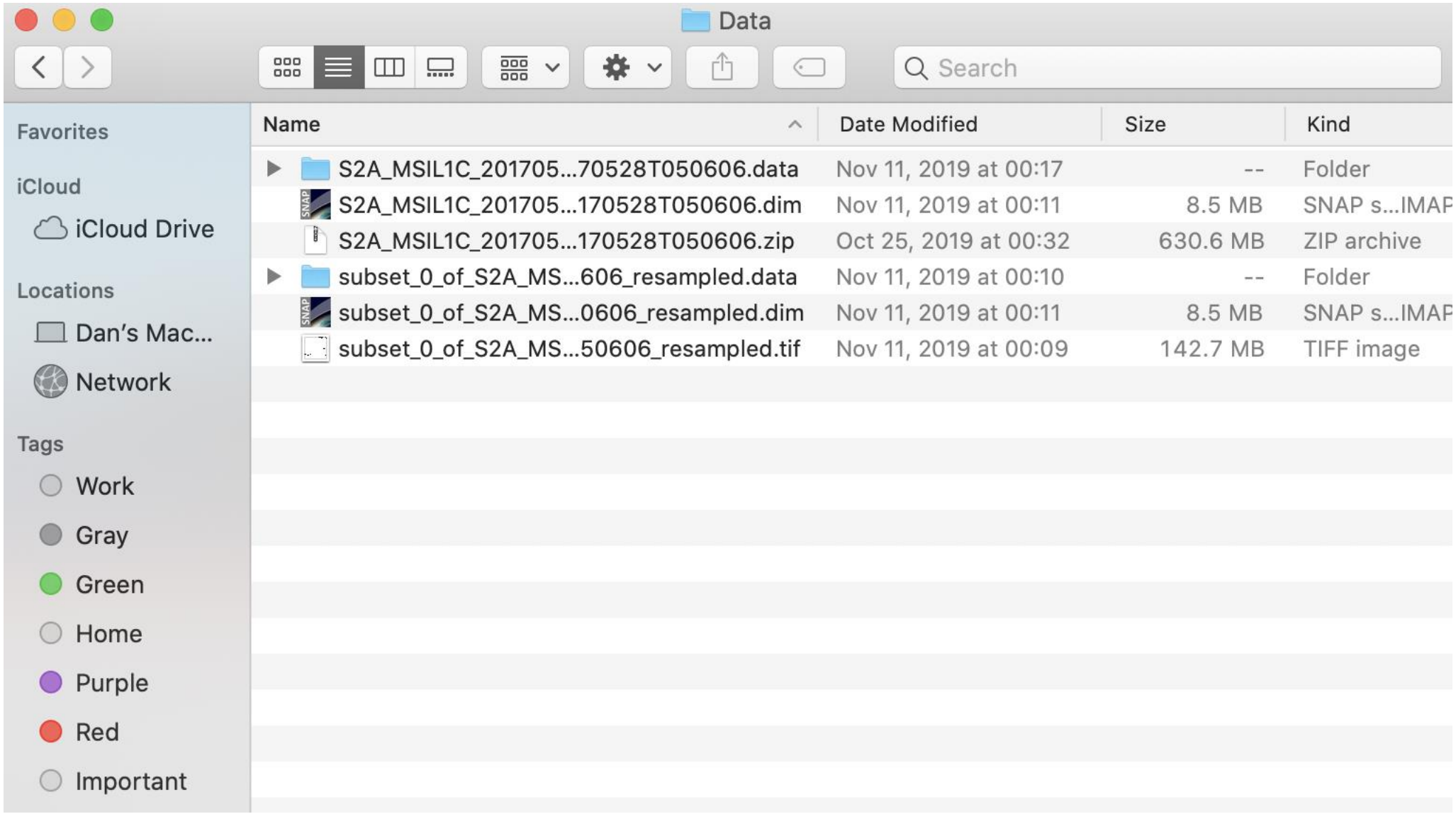
Export result to other format for further analysis

From the File menu, select Export, hen select GeoTIFF




Product Explorer
Pixel Info
[1] S2A_MSIL1C_20170528T050611_N0205_R076_T44NMM_20170
[3] Sentinel 2 MSI Natural Colors RGB
[3] flood_temp
SNAP - Export Product
Save As: MM_20170528T050606_resampled.tif
Data
Subset...
Name
Date Modified
S2A_MSIL1C_20170528T0...
Friday, October 25, 2019 12:3...
File Format: GeoTIFF / BigTIFF data pr...
New Folder
Cancel
Export Product
Specify Product Subset
Spatial Subset
Band Subset
Metadata Subset
view_zenith_B8A Viewing incidence zenith angle
view_azimuth_B8A Viewing incidence azimuth angle
view_zenith_B9 Viewing incidence zenith angle
view_azimuth_B9 Viewing incidence azimuth angle
view_zenith_B10 Viewing incidence zenith angle
view_azimuth_B10 Viewing incidence azimuth angle
view_zenith_B11 Viewing incidence zenith angle
view_azimuth_B11 Viewing incidence azimuth angle
view_zenith_B12 Viewing incidence zenith angle
view_azimuth_B12 Viewing incidence azimuth angle
NDWI Normalized Different Water Index
flood_temp
Select all
Select none
Estimated, raw storage size: 0.0M
OK
Cancel
Help
Product Library
Layer Manager
Mask Manager
1 : 13.18
0°
X -- Y --
Lat -- Lon --
Zoom -- Level --


Product Explorer
Pixel Info
[1] S2A_MSIL1C_20170528T050611_N0205_R076_T44NMM_20170
[3] Sentinel 2 MSI Natural Colors RGB
[3] flood_temp
SNAP - Export Product
Save As: MM_20170528T050606_resampled.tif
Data
Subset...
Name
Date Modified
S2A_MSIL1C_20170528T0...
Friday, October 25, 2019 12:3...
File Format: GeoTIFF / BigTIFF data pr...
New Folder
Cancel
Export Product
Specify Product Subset
Spatial Subset
Band Subset
Metadata Subset
Abstracted_Metadata
Level-1C_User_Product
Level-1C_DataStrip_ID
Granules
Processing_Graph
history
Select all
Select none
Estimated, raw storage size: 0.0M
OK
Cancel
Help
Product Library
Layer Manager
Mask Manager
1 : 13.18
0°
X -- Y --
Lat -- Lon --
Zoom -- Level --


Data
Search
Favorites
iCloud
iCloud Drive
Locations
Dan's Mac...
Network
Tags
Work
Gray
Green
Home
Purple
Red
Important
Name
Date Modified
Size
Kind
S2A_MSIL1C_201705...70528T050606.data
Nov 11, 2019 at 00:17
--
Folder
S2A_MSIL1C_201705...170528T050606.dim
Nov 11, 2019 at 00:11
8.5 MB
SNAP s...IMAP
S2A_MSIL1C_201705...170528T050606.zip
Oct 25, 2019 at 00:32
630.6 MB
ZIP archive
subset_0_of_S2A_MS...606_resampled.data
Nov 11, 2019 at 00:10
--
Folder
subset_0_of_S2A_MS...0606_resampled.dim
Nov 11, 2019 at 00:11
8.5 MB
SNAP s...IMAP
subset_0_of_S2A_MS...50606_resampled.tif
Nov 11, 2019 at 00:09
142.7 MB
TIFF image

Advanced Preparation for the Training Course : “How to process satellite data (optical and SAR) to produce VAP with particular foci on flood and water-related disasters”

6 Nov 2019

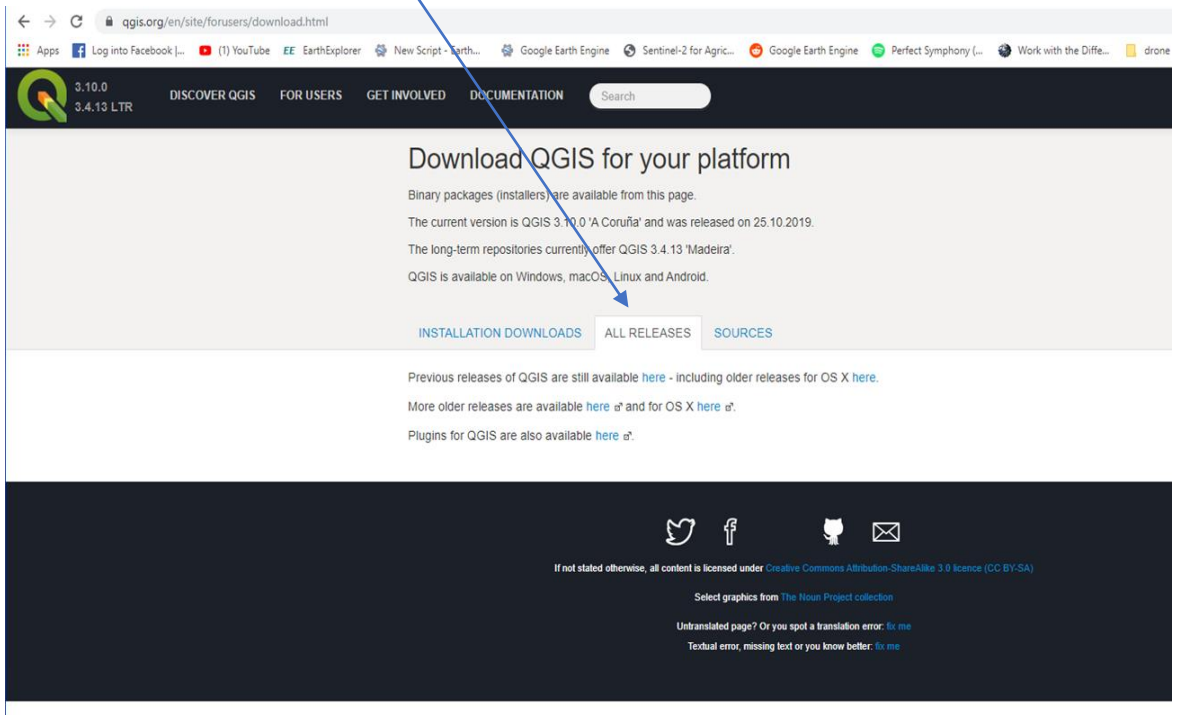
Dr. Dan Tran (AIT)

Mr. Chathumal (AIT)

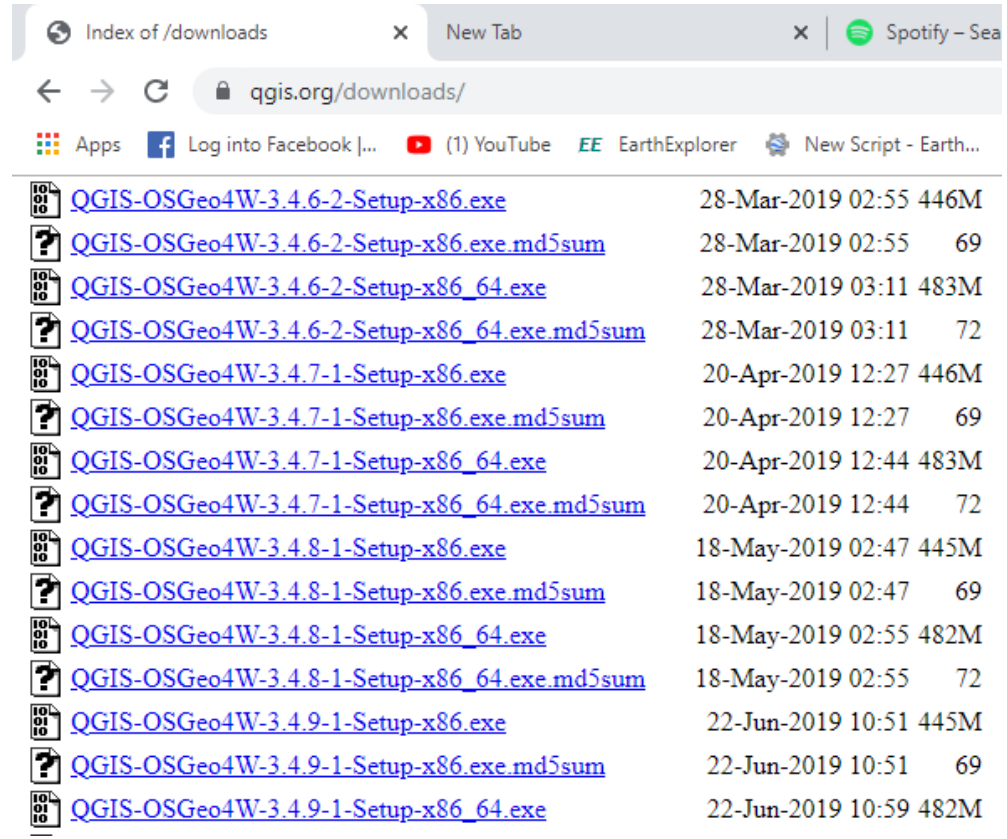
(1) Installing the QGIS software into your personal computer.

1.1 Copy and paste the following link in a web browser https://qgis.org/en/site/forusers/download.html

1.2 Goto All releases and find an installer **(QGIS 3.4.8 version** is preferred**)** depending on your system specification



Eg: Windows 64bit



1.3 Download the installer (32 bit/64 bit) according to operating system and install the software.

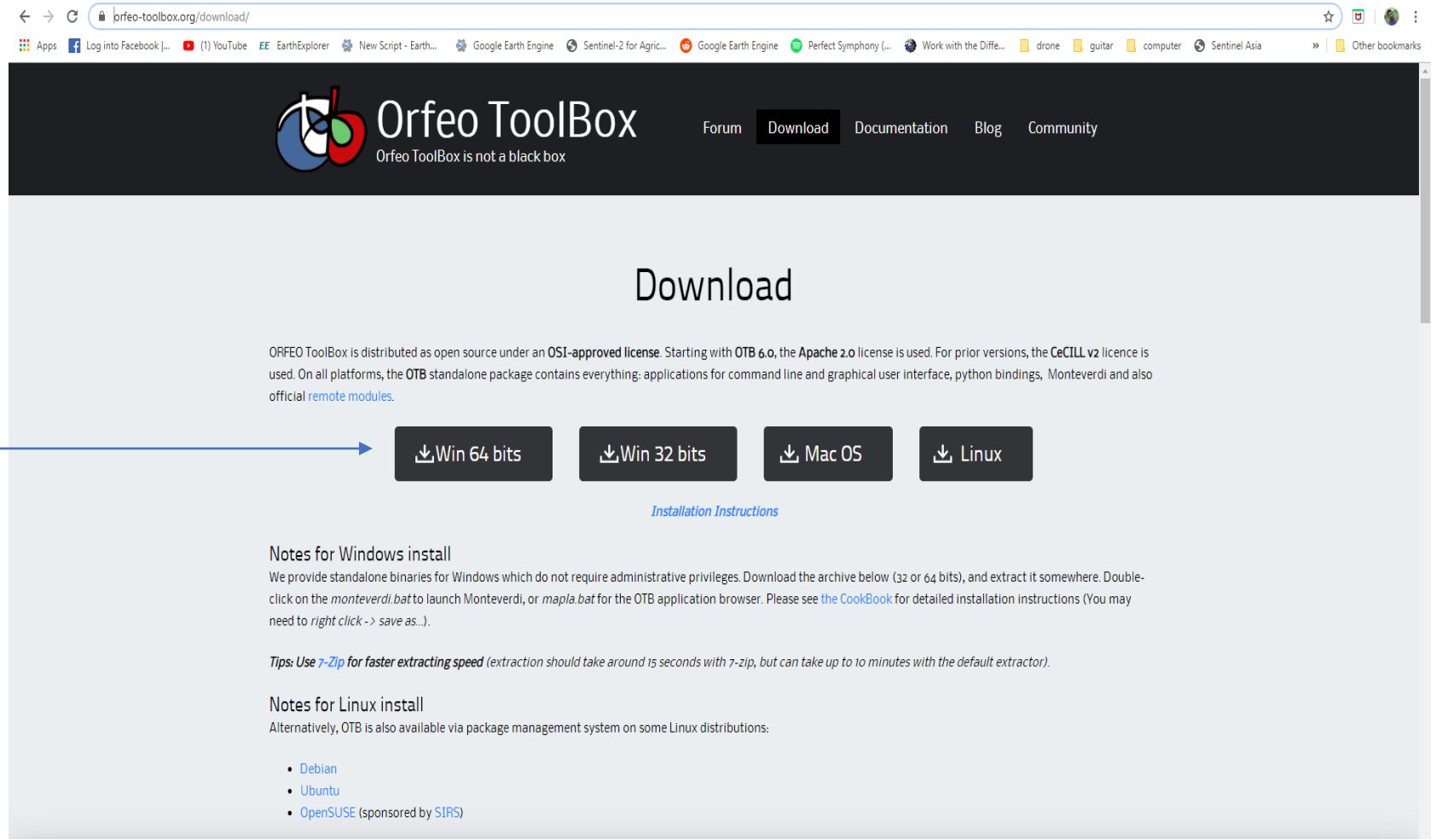
(2) Installing Orfeo toolbox for remote sensing image processing

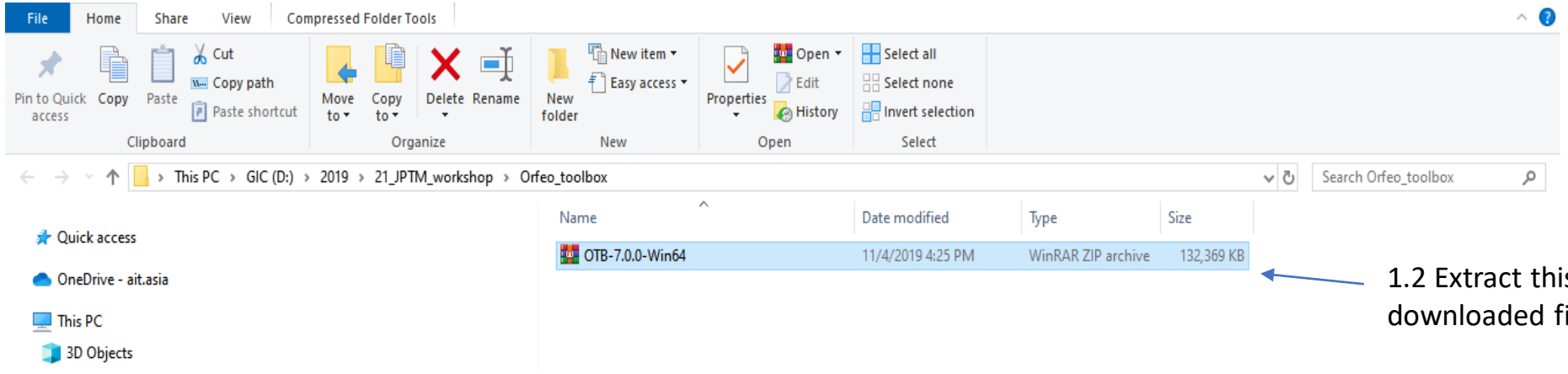
1.1 Copy and paste the following link in a web browser

https://www.orfeo-toolbox.org/download/

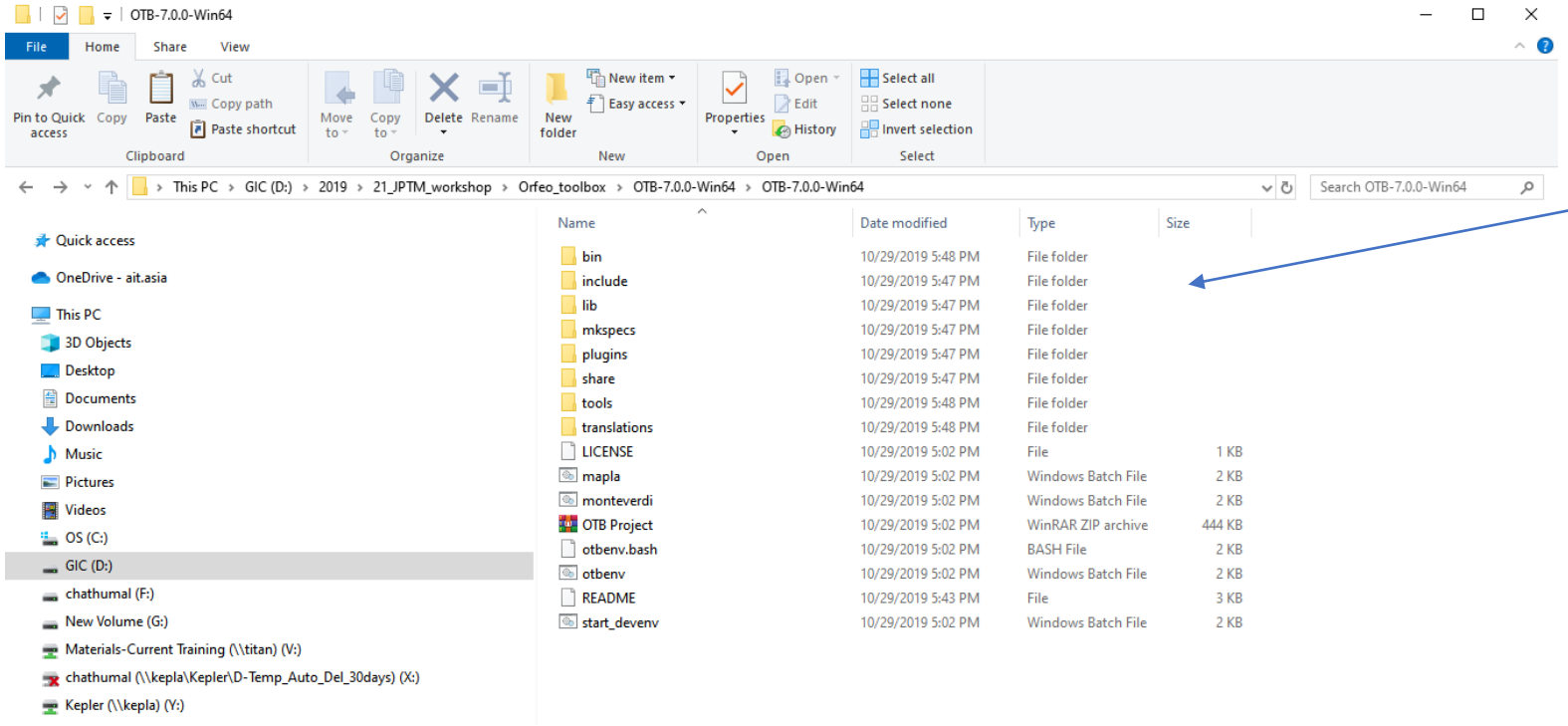
Choose installer according to your operating system and download.

Eg: Windows 64 bits





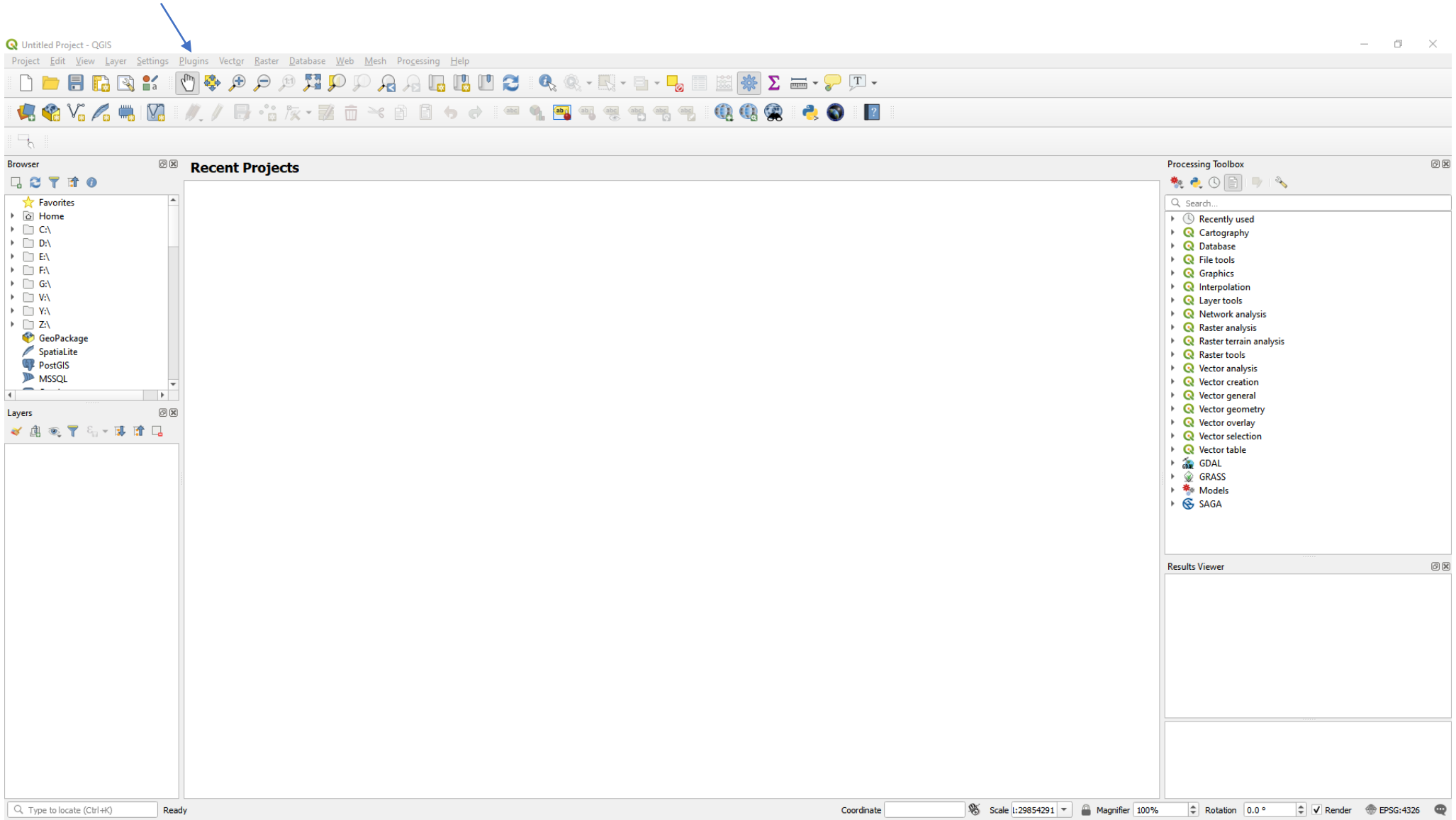
1.2 Extract this downloaded file.



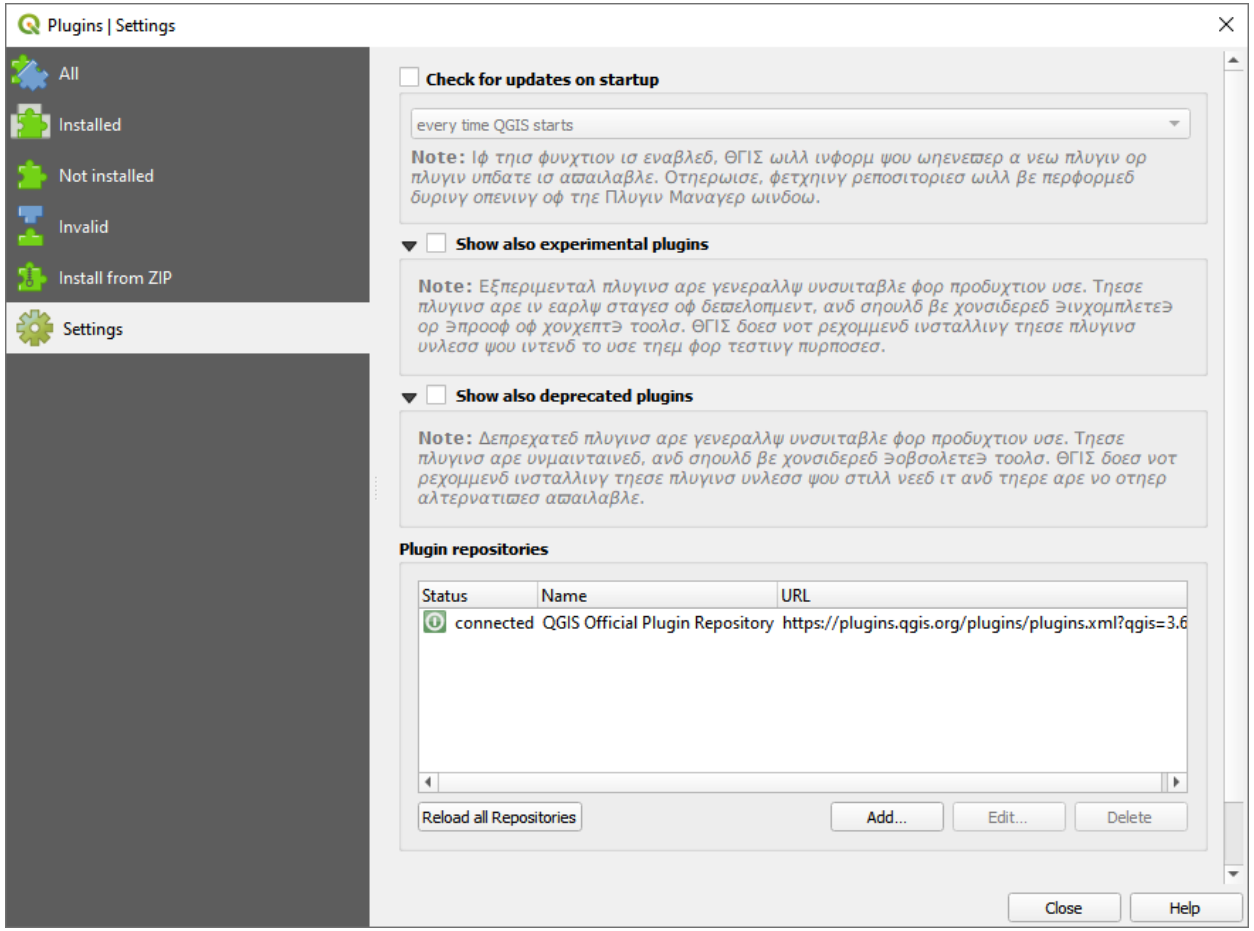
1.3 In the extracted folder you will see folders like below. Copy all the files in the extracted folder.

1.4 Create a folder in C drive (according to your preference) and paste these files in a folder and name it as **OTB**

1.5 Open **QGIS** software and click on **Plugins**

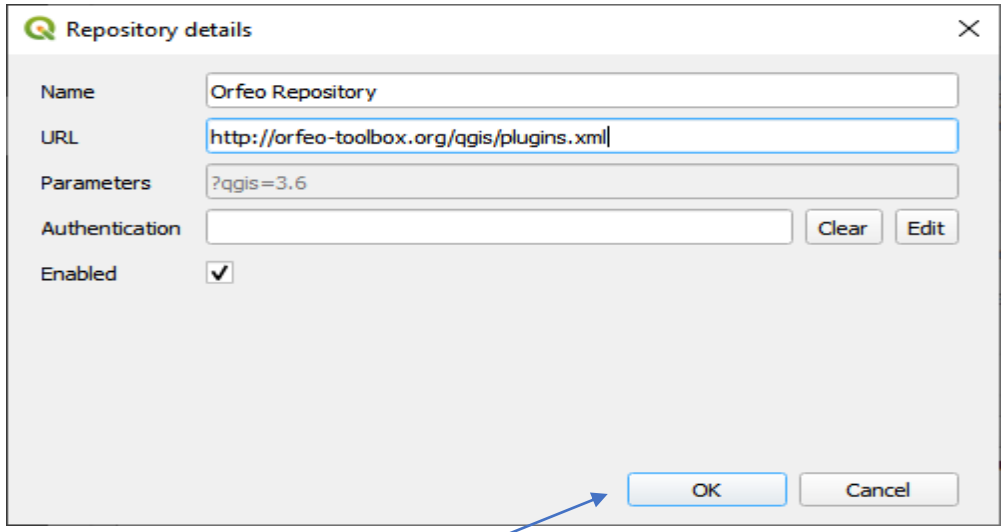


1.6 Goto **Plugins** > **Settings** Click **Add** under **Plugin repository**

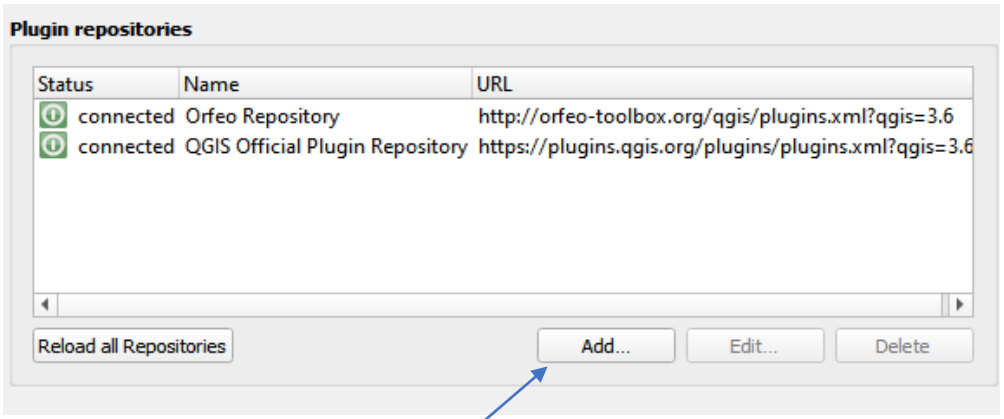


1.7 Add these details in the following tabs.

Name: Orfeo Repository
URL : http://orfeo-toolbox.org/qgis/plugins.xml

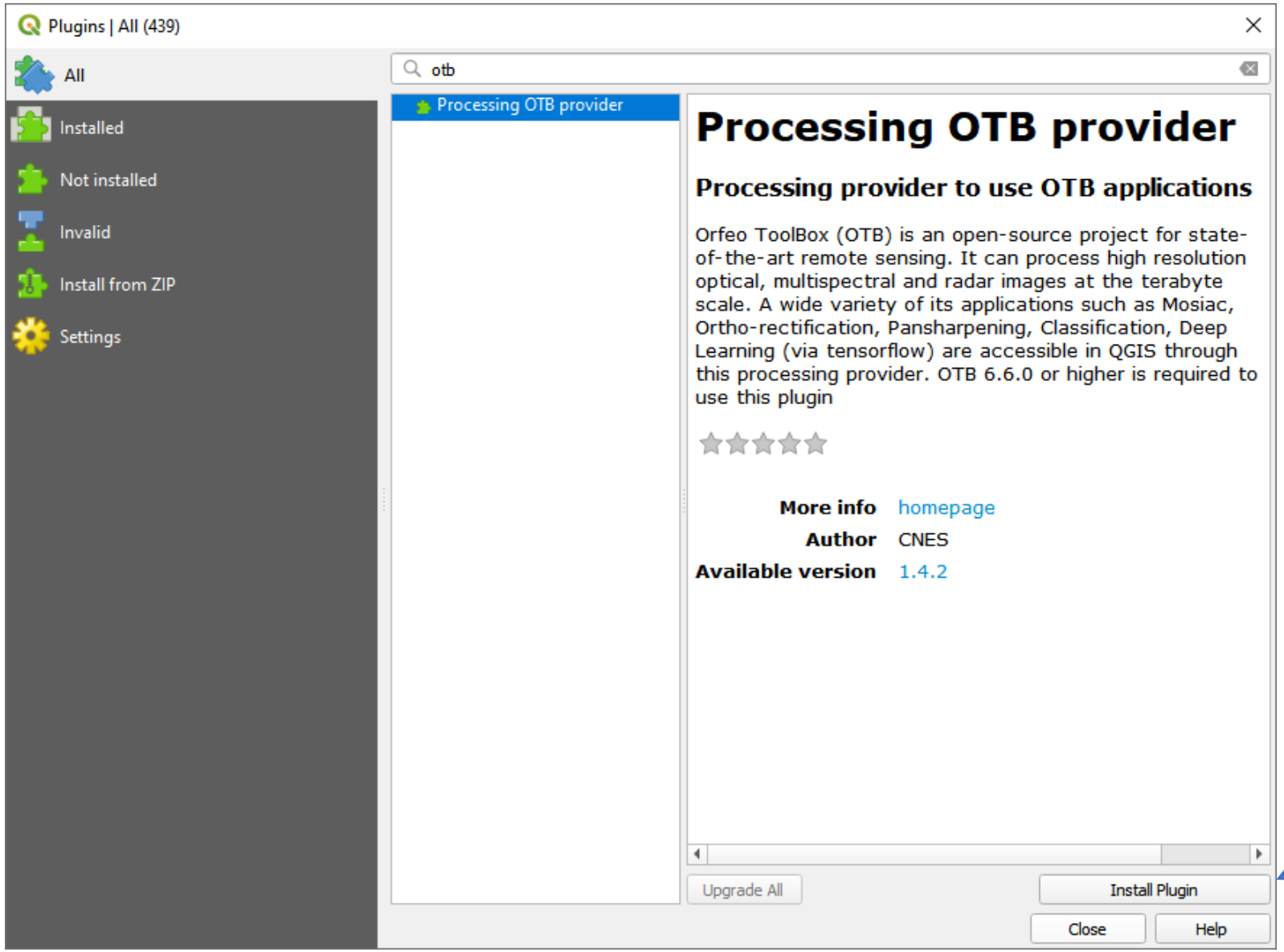


After adding information Press OK



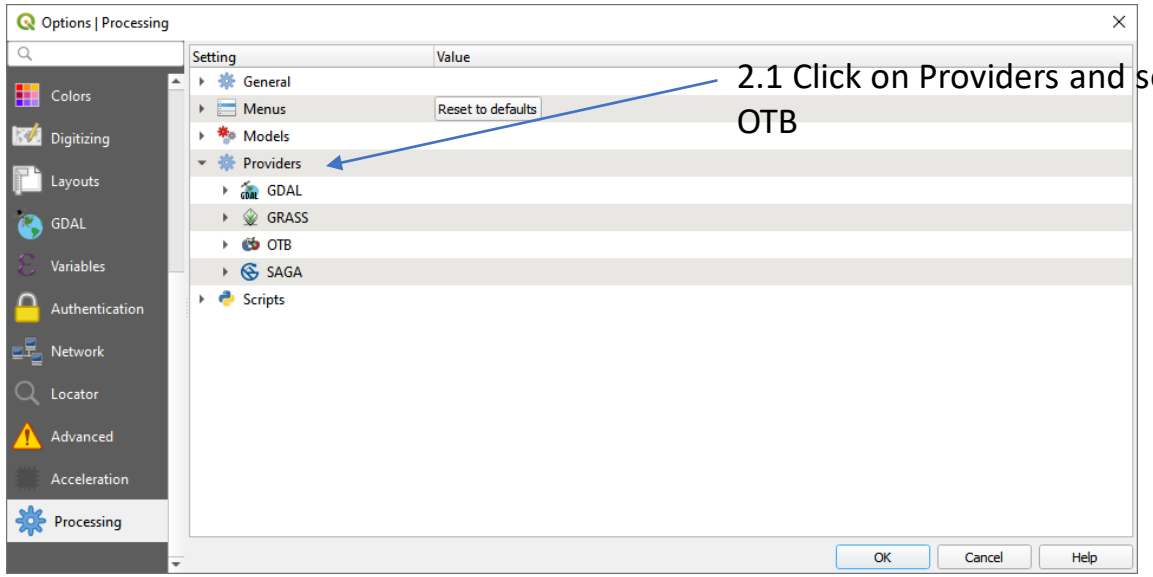
Click Add

1.8 Goto **Plugins > Manage and Install Plugins**

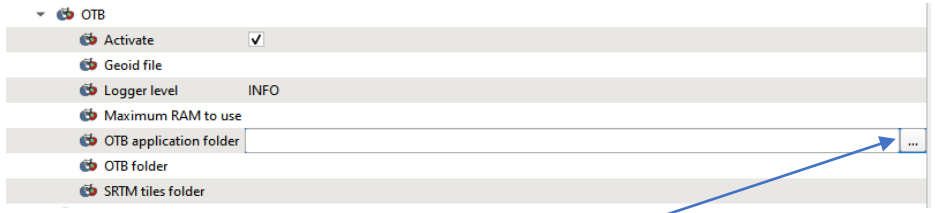


1.9 Type **otb** in the search bar and click on **install plugin**

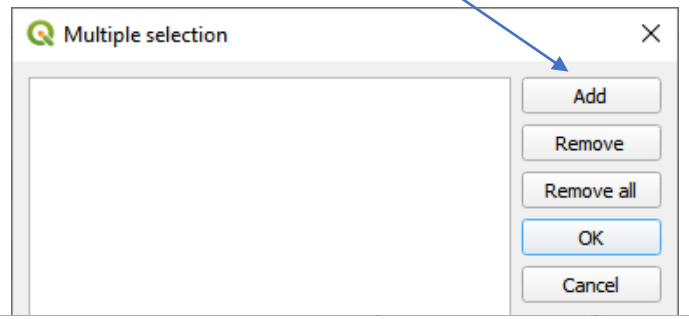
2.0 Goto **Settings > options > Processing**

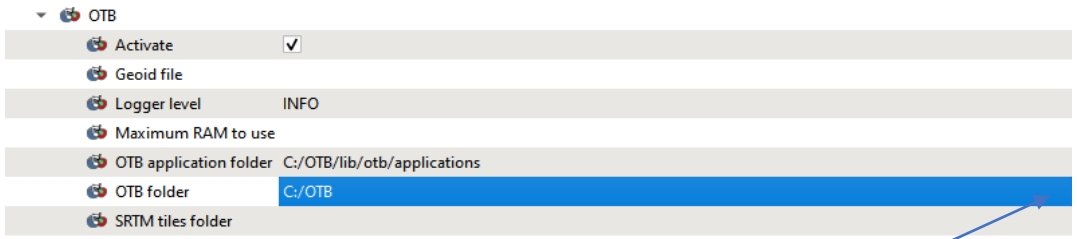


2.1 Click on Providers and select OTB

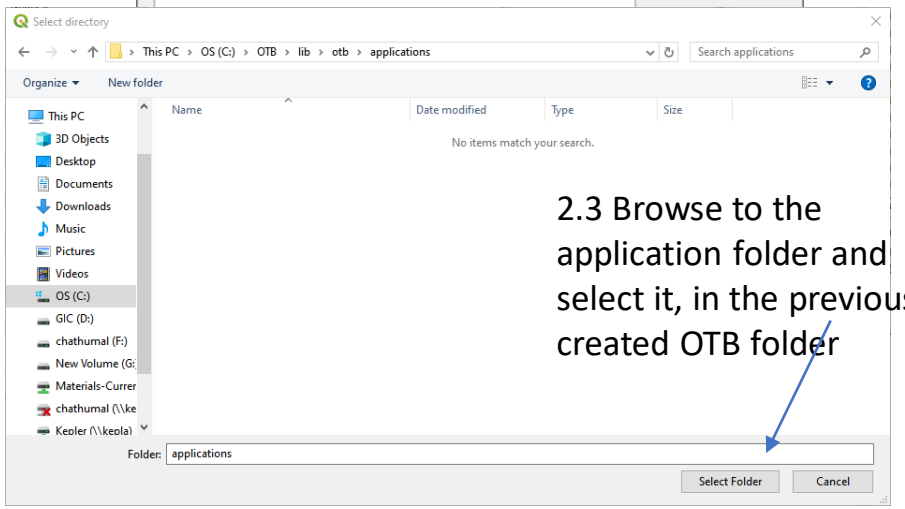


2.2 Click here and click on **Add** on the **Multiple selection** tab.



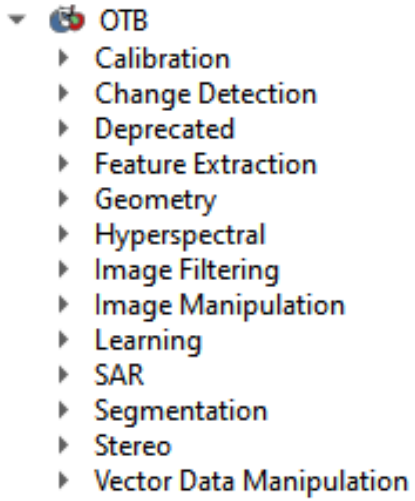


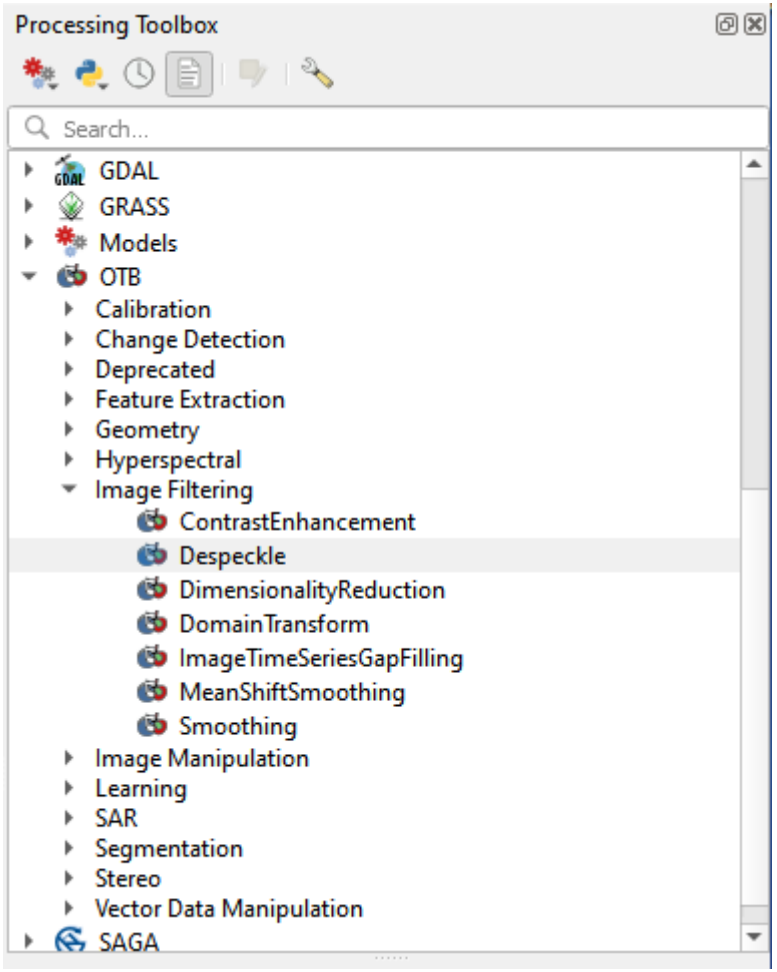
2.4 Click here and do the same process and select the OTB folder this time



2.3 Browse to the application folder and select it, in the previously created OTB folder

Then you can access all the tools under OTB



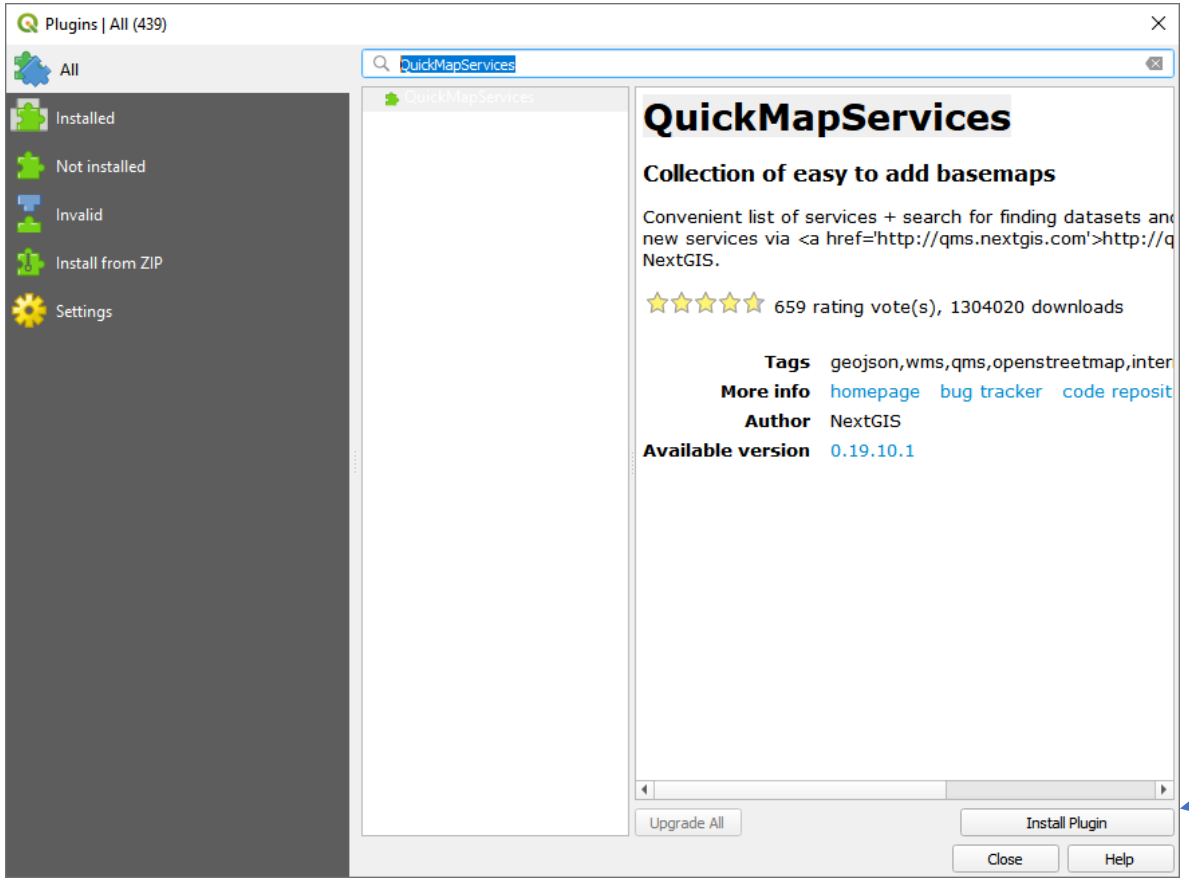


OTB toolbox installation procedure is same for the other operating systems.

(3) Adding base maps for QGIS

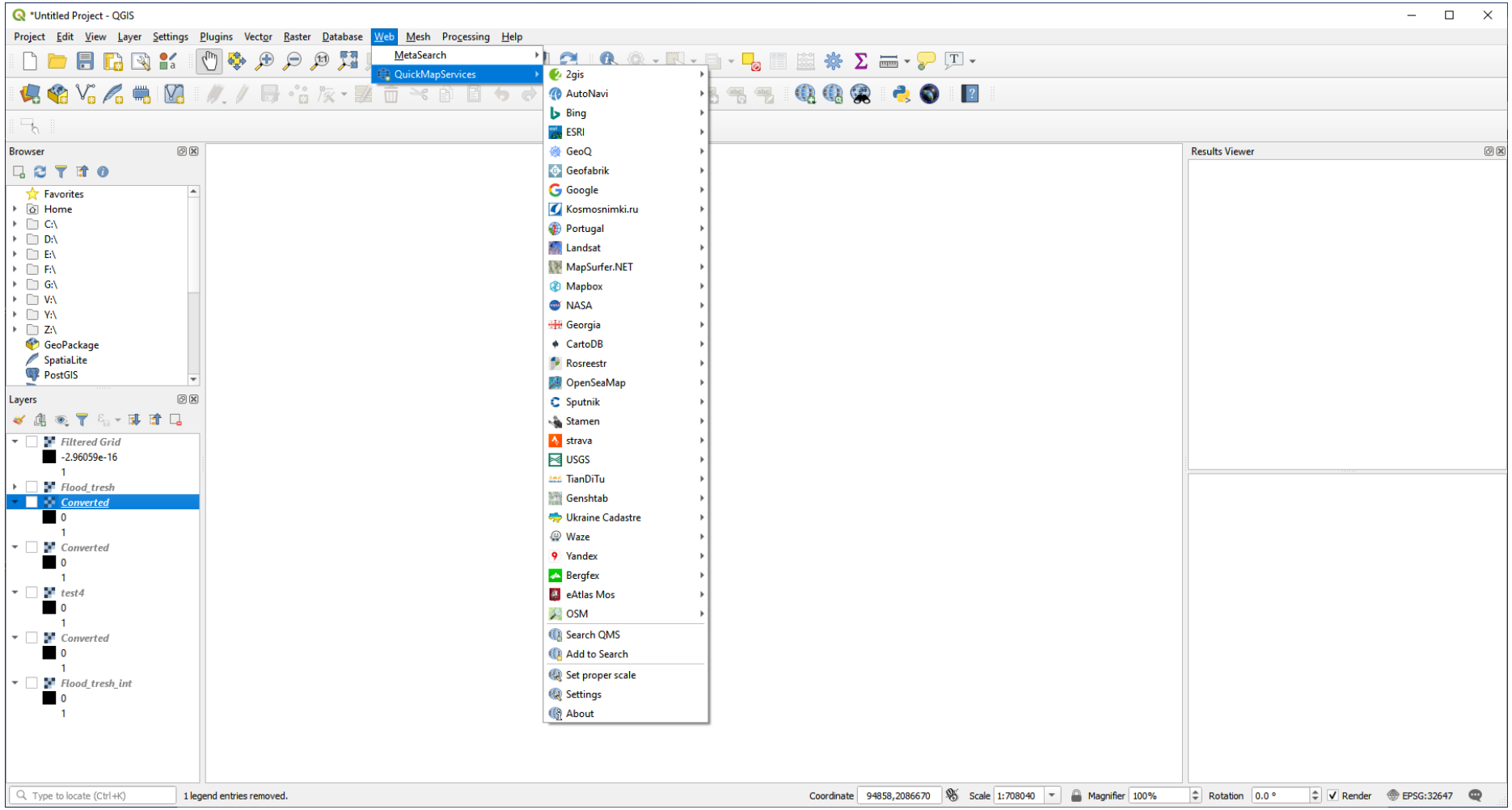
1.1 Goto **Plugins** > **Settings** Click **Add** under **Plugin repository**

1.2 Type **QuickMapServices** in the search bar



1.3 click on install plugin

1.3 Goto **Web** > **QuickMapServices** To access the Base maps.

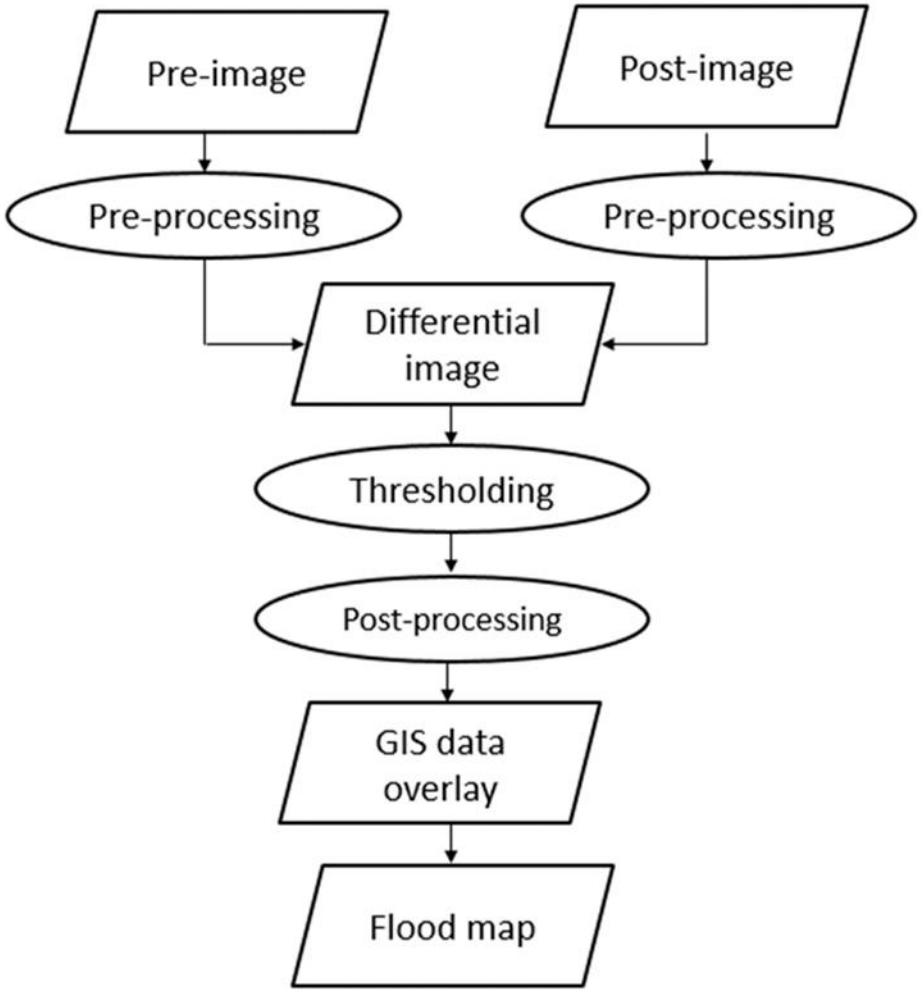


Thank you

Flood Extraction Using ALOS 2 PALSAR 2 Data

Chathumal Madhuranga (AIT)

Methodology behind the Flood extraction



ALOS 2 PALSAR 2 Data Calibration

$$\sigma^0[\mathrm{d}B] = 10\log_{10}(DN)^2 + CF$$

$\boldsymbol{\sigma^0}$ – Radar Backscatter

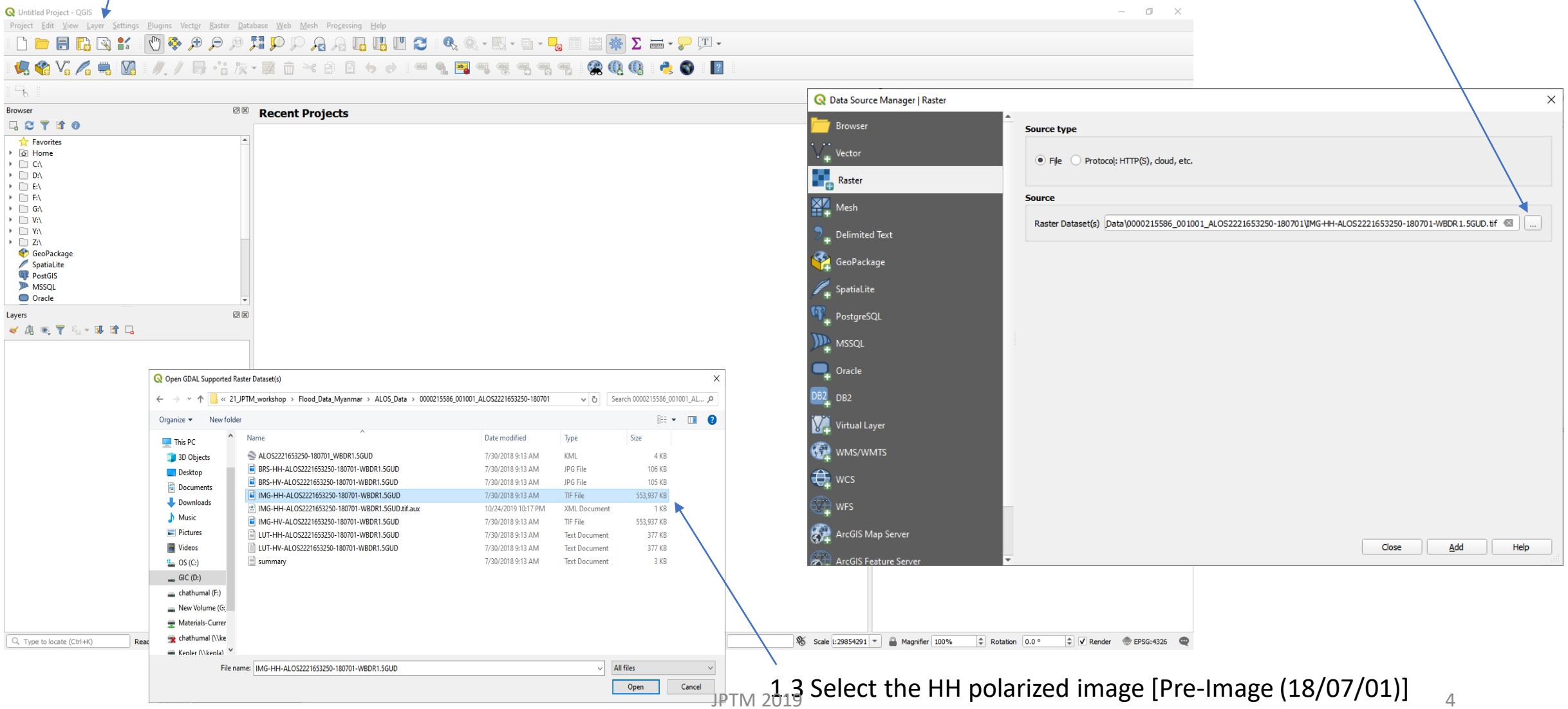
DN – Pixel DN values

CF - Calibration Factor

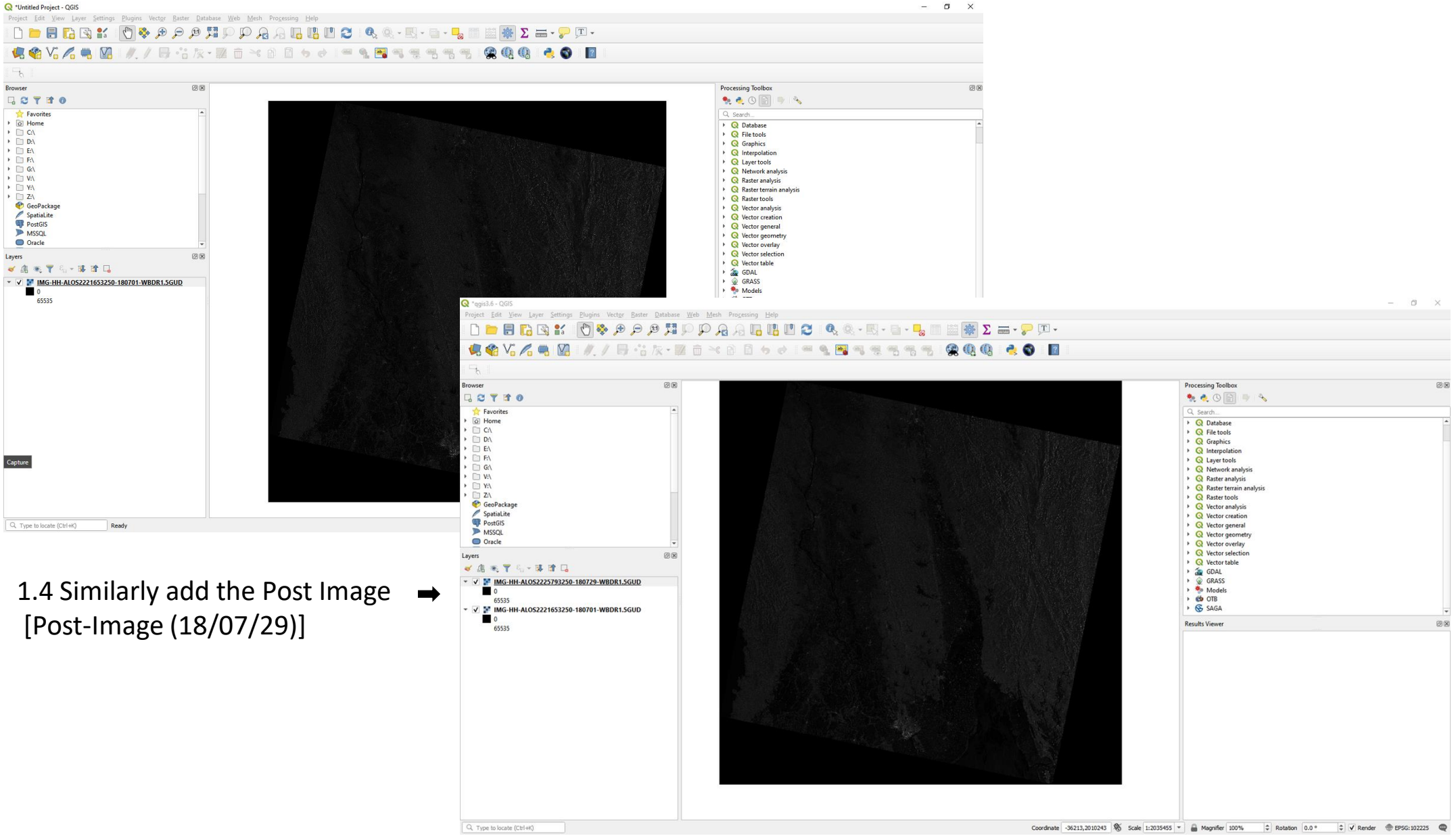
1 Open **QGIS** installed on your computer

1.1 Goto **Layer > Add Layer > Add Raster Layer**

1.2 Browse the path to your image



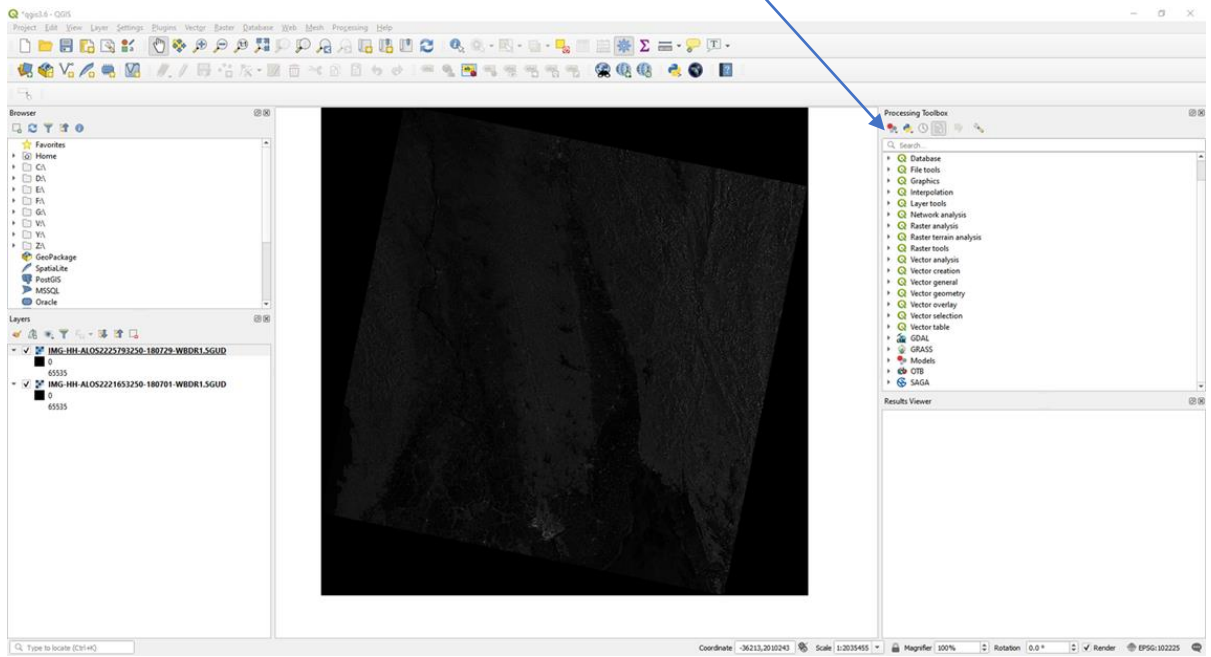
1.3 Select the HH polarized image [Pre-Image (18/07/01)]



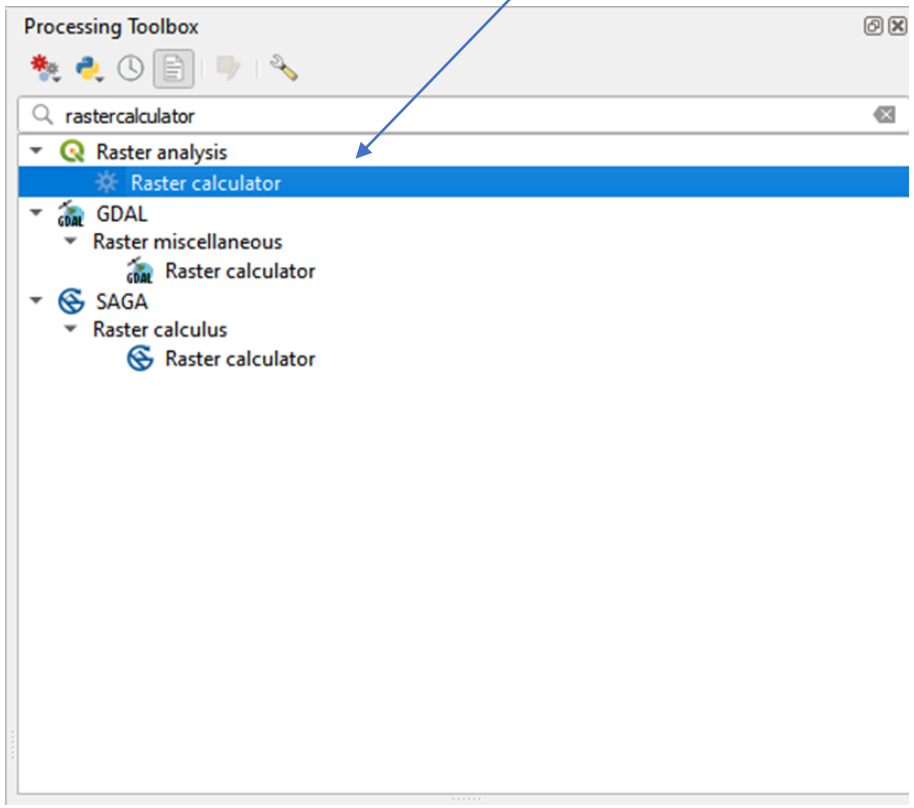
1.4 Similarly add the Post Image [Post-Image (18/07/29)] ➡

2 Image Calibration

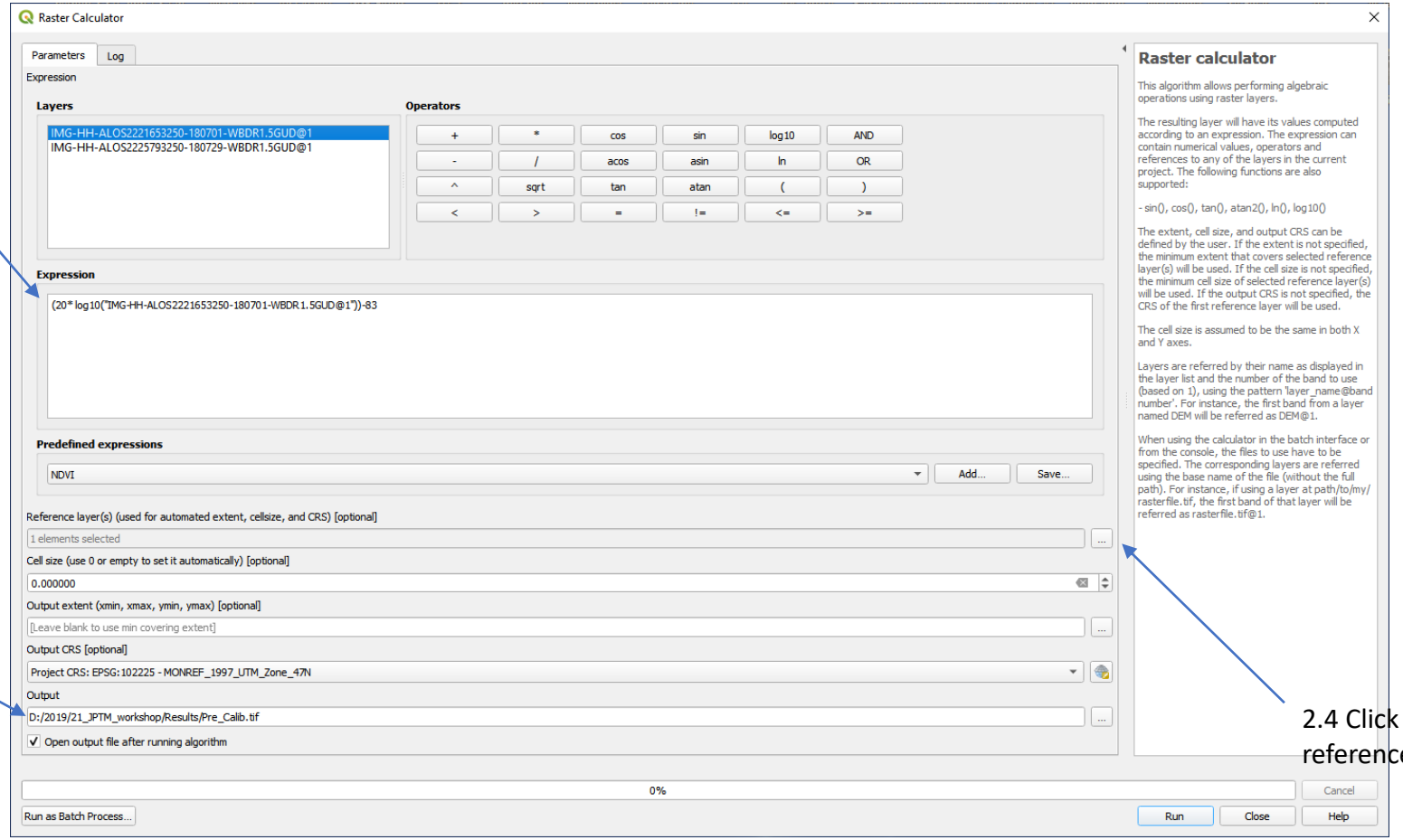
2.1 In Processing toolbox search bar type raster calculator.



2.2 Select the **Raster calculator** under QGIS processing tools.

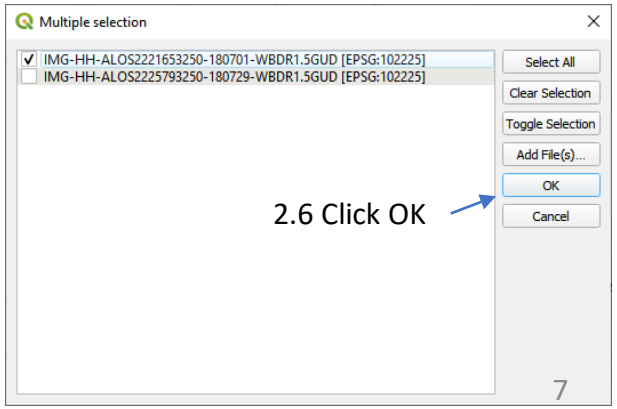


2.3 Input the Calibration Expression here

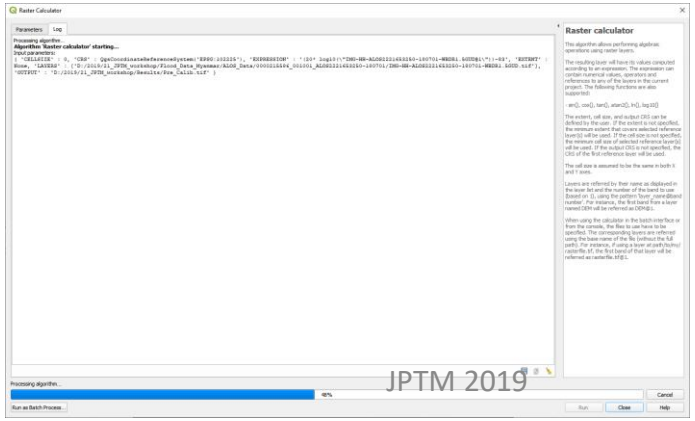


2.5 Browse to the output folder and give it a name and save it as a .tif file

2.4 Click on this icon and select a reference layer

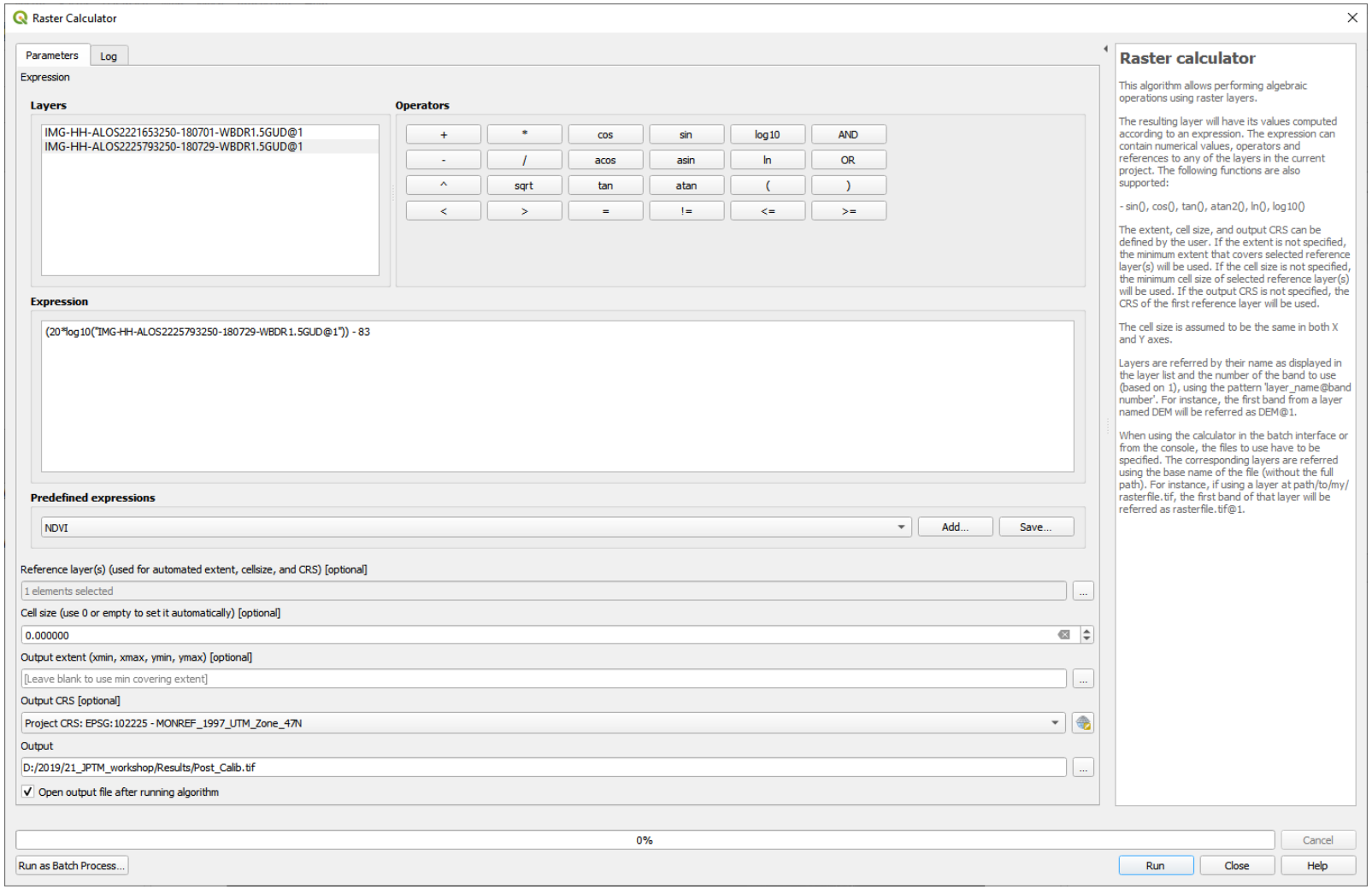


2.6 Click OK



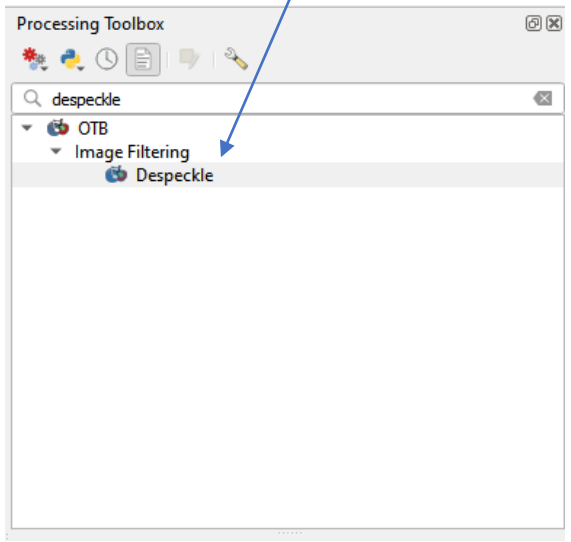
2.7 Click Run

2.8 Do the same calibration for the post image



3 Speckle filtering

3.1 Type **Despeckle** in processing toolbox search bar Select the Despeckle in OTB toolbox.



3.2 Select the calibrated **pre-image** from the drop down.

3.3 Select the filter type as **Lee**

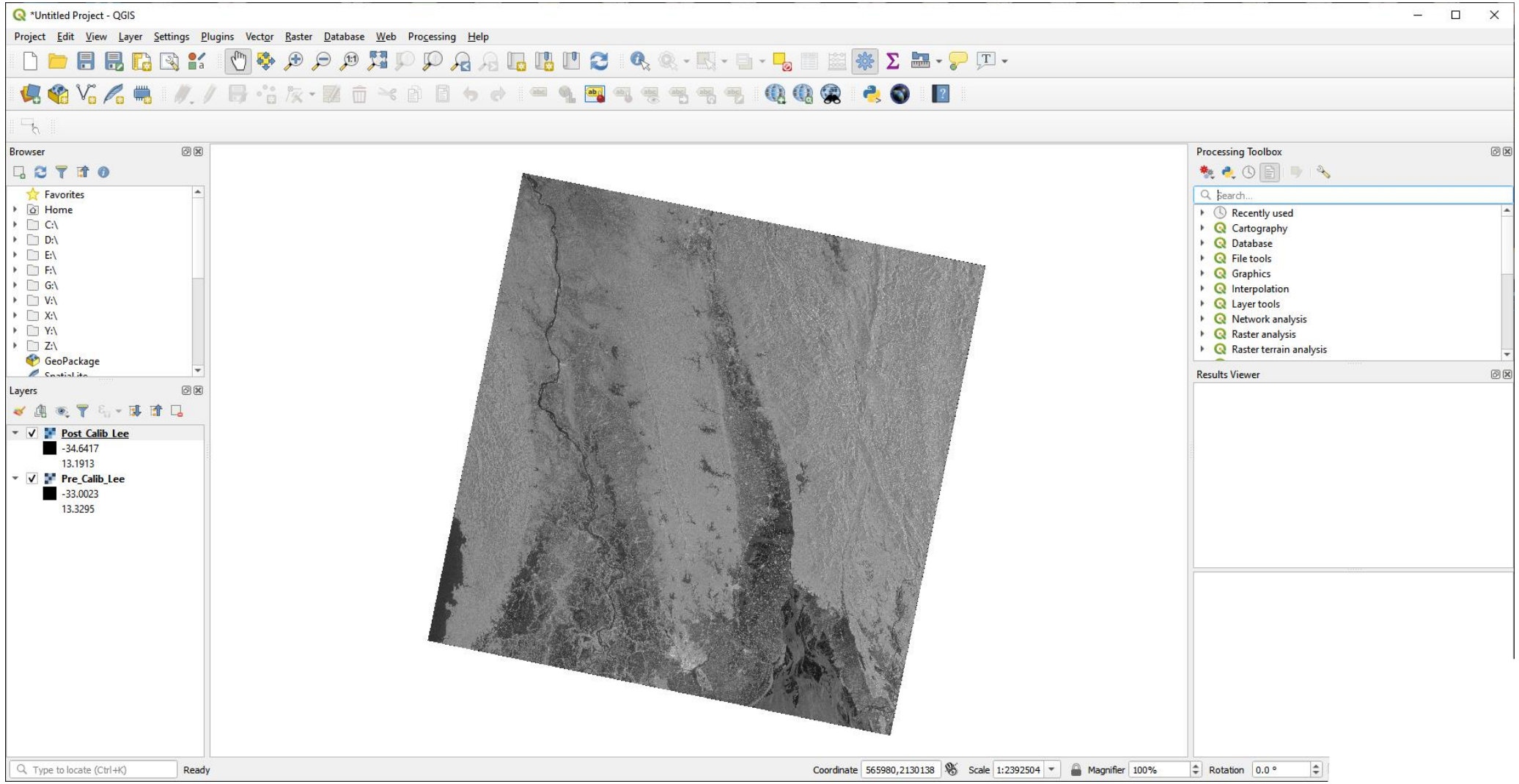
3.4 Specify radius of the filter as **1** (3*3)

3.5 Browse to output folder and give it a relevant name and **.tif** file type

3.6 Click **Run**

Do the same process for the **post image**

Images after speckle filtering



4 Re-project images into WGS84 system

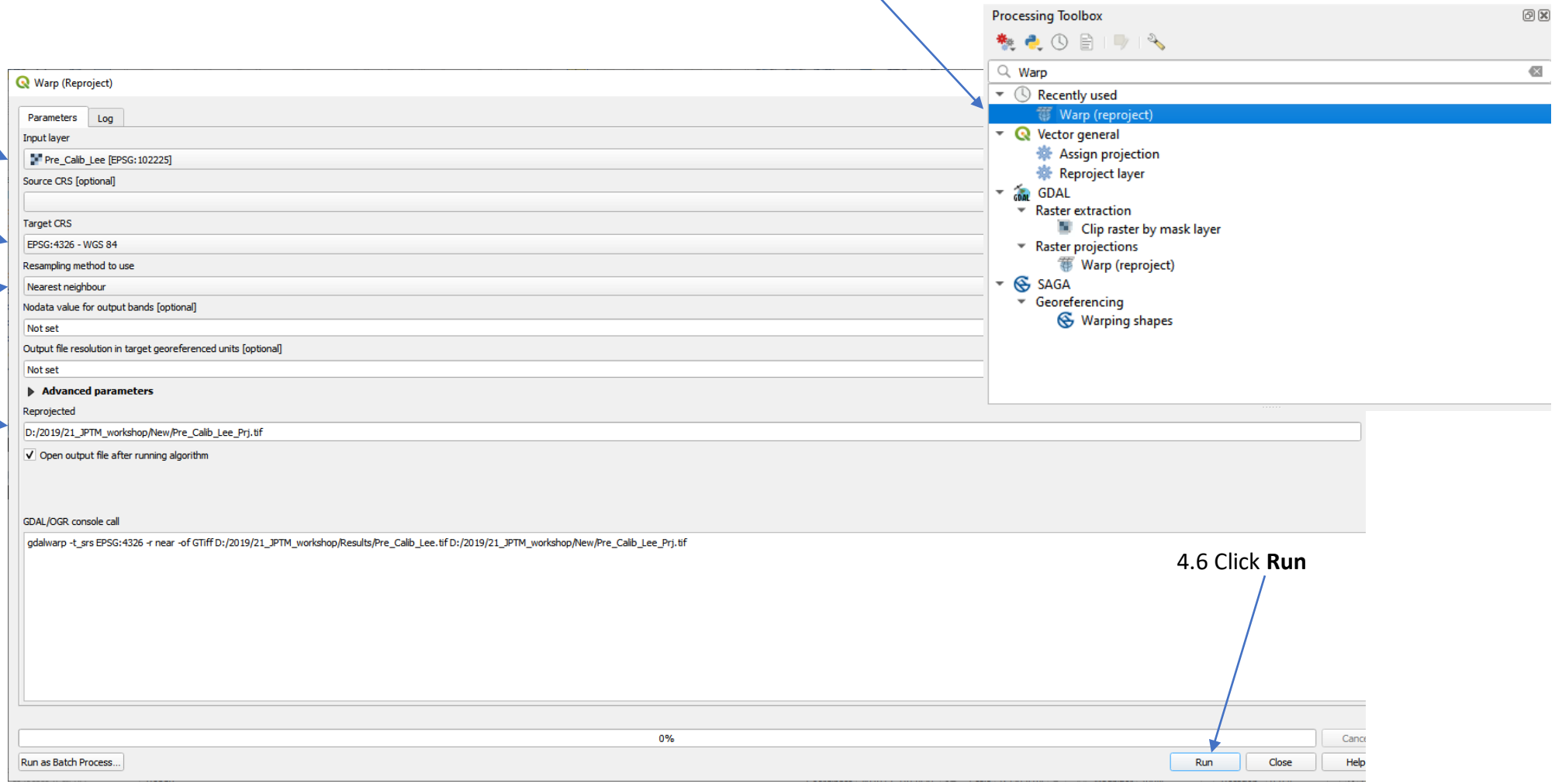
4.1 Type **Warp** in processing toolbox search bar Select the Warp under **GDAL**

4.2 Select the filtered **pre-image** from the drop down.

4.3 Select the Target CRS as EPSG: 4326

4.4 Specify the resampling as Nearest neighbor

4.5 Browse to output folder and give it a relevant name and **.tif** file type



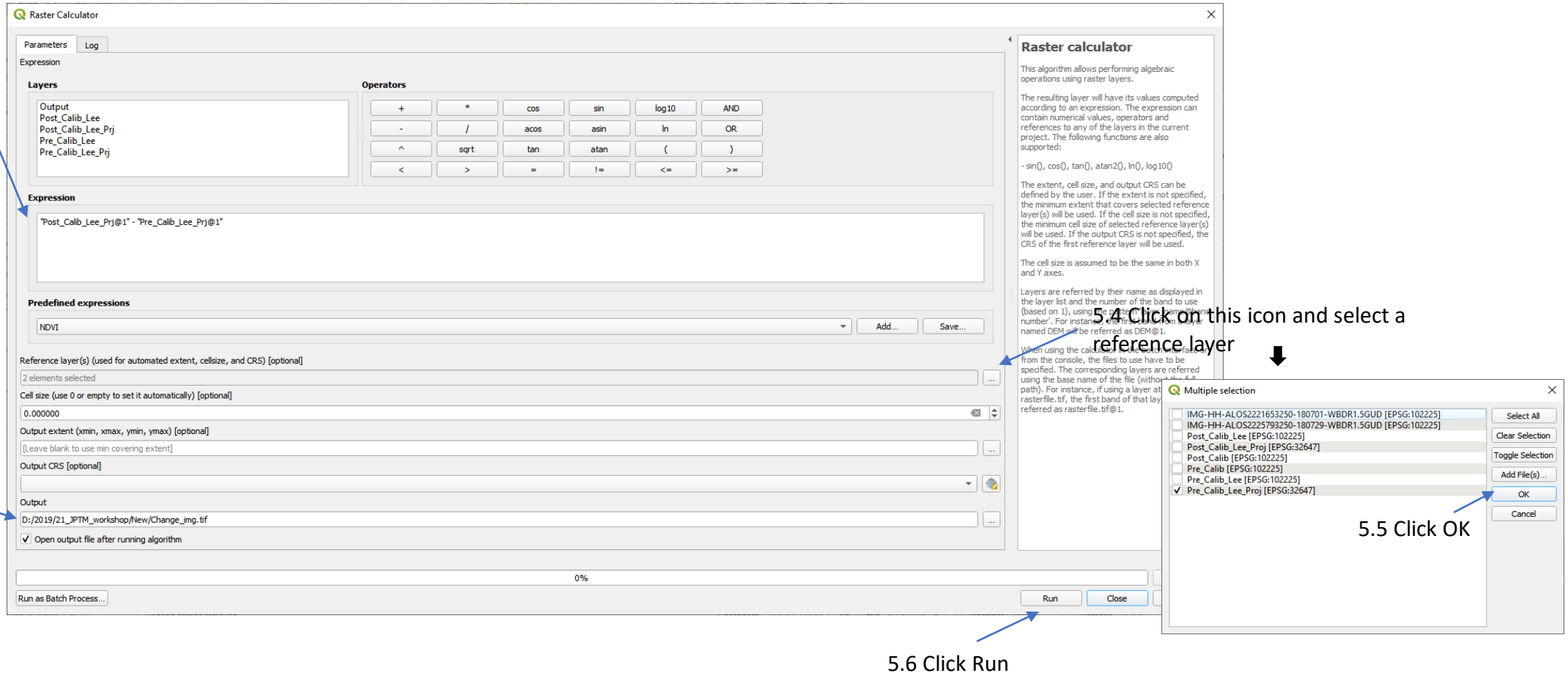
4.6 Click **Run**

Do the same process for the **post filtered image**

5 Generating the pre-post difference image

5.1 Type **Raster calculator** in processing toolbox search bar Select the **Raster calculator** under **QGIS tools**

5.2 Obtain the difference between projected pre and post images by Inputting the Expression as follows



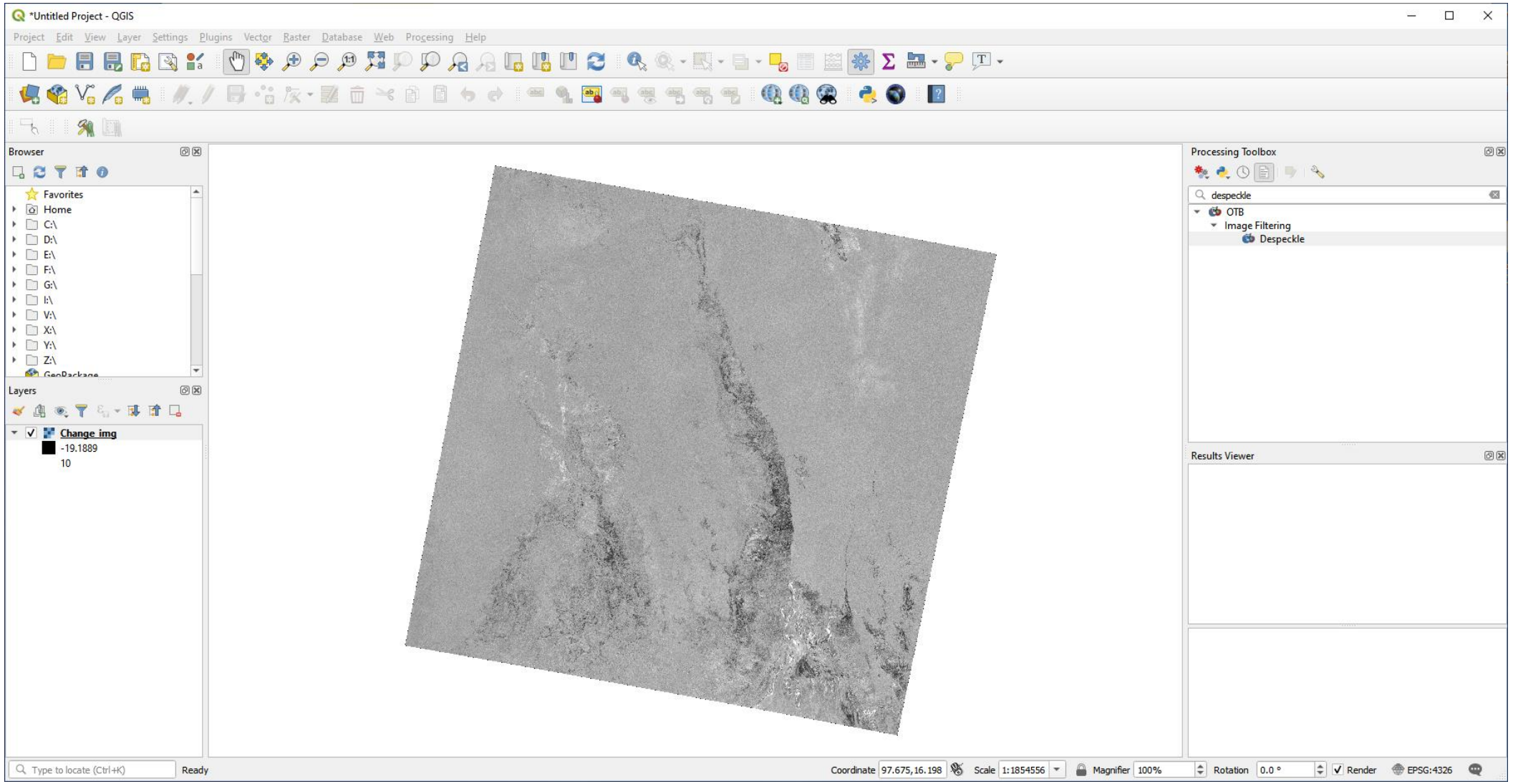
5.3 Browse to the output folder and give it a name and save it as a .tif file

5.4 Click on this icon and select a reference layer

5.5 Click OK

5.6 Click Run

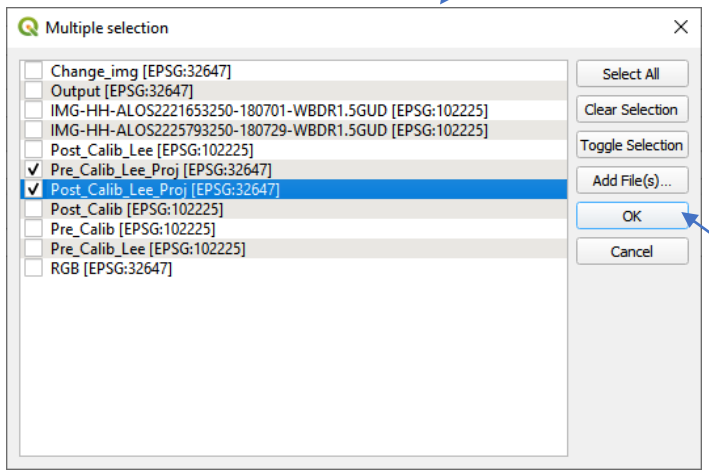
Change Image after raster calculation



6 RGB visualization of post and pre-images

6.1 Goto **Raster > Miscellaneous > Build virtual raster**

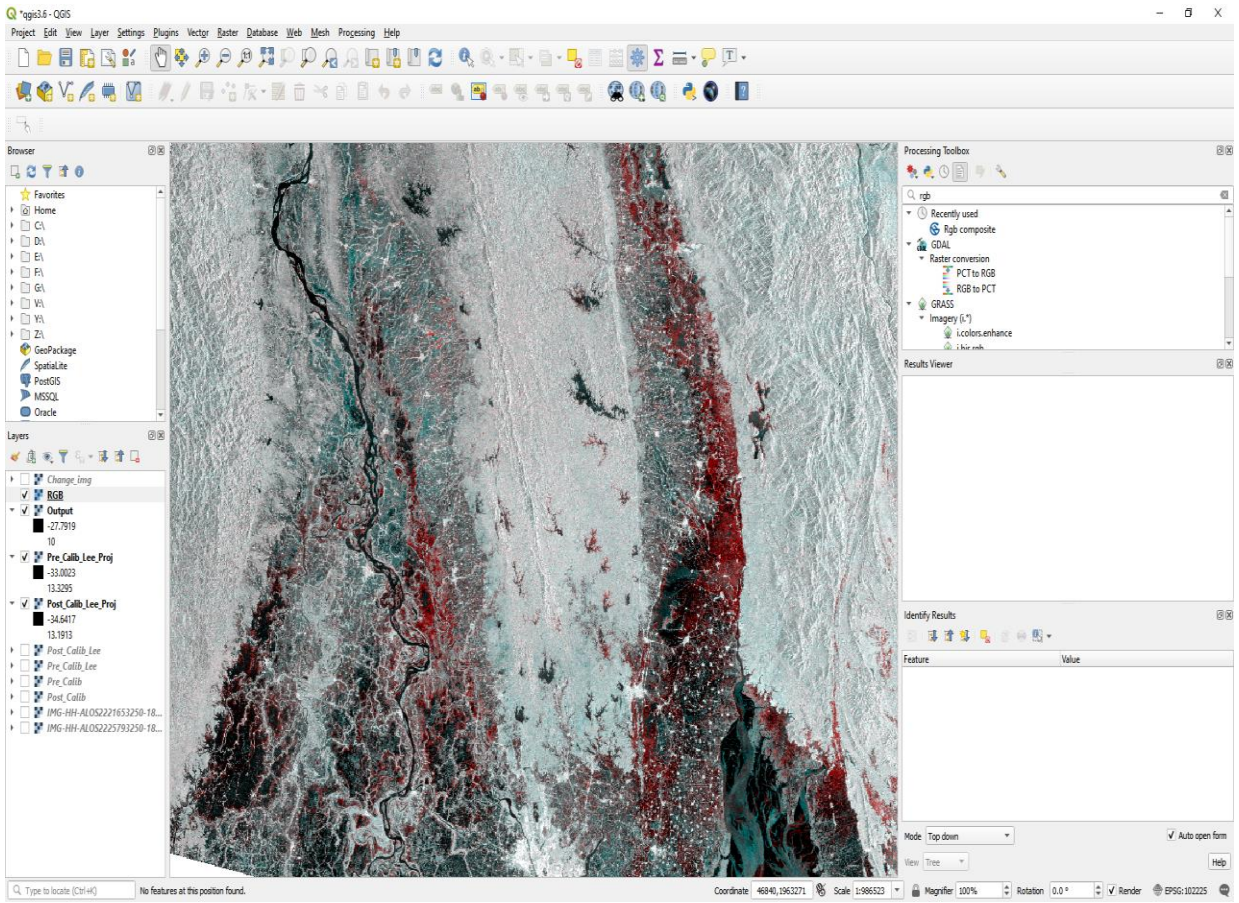
6.2 Click this icon and select the Pre-Processed, pre and post images from this tab



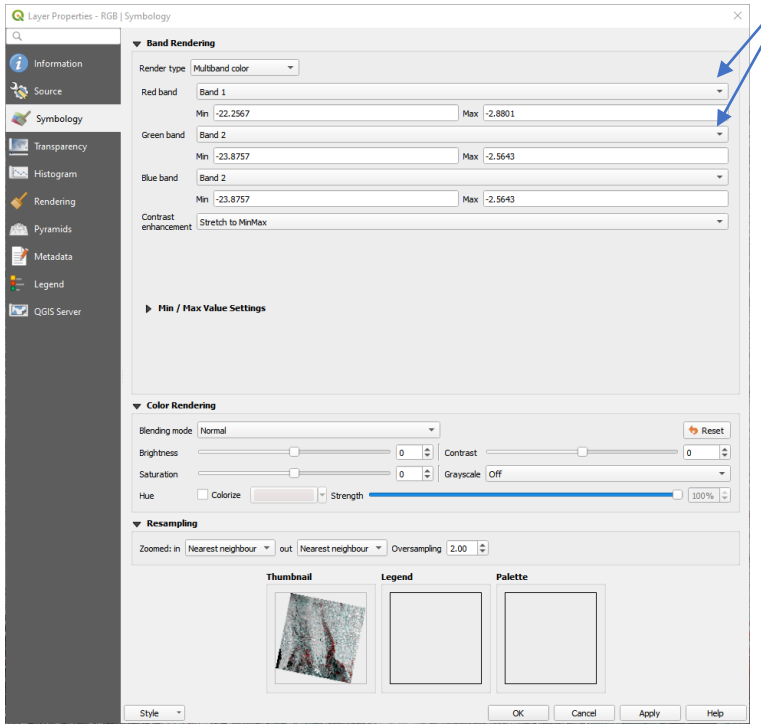
6.3 Click OK

6.4 Click Run.

6.5 Right click on the created virtual band and select **Properties > Symbology**



6.6 Select band 1(pre), band 2(post) from the dropdowns as follows

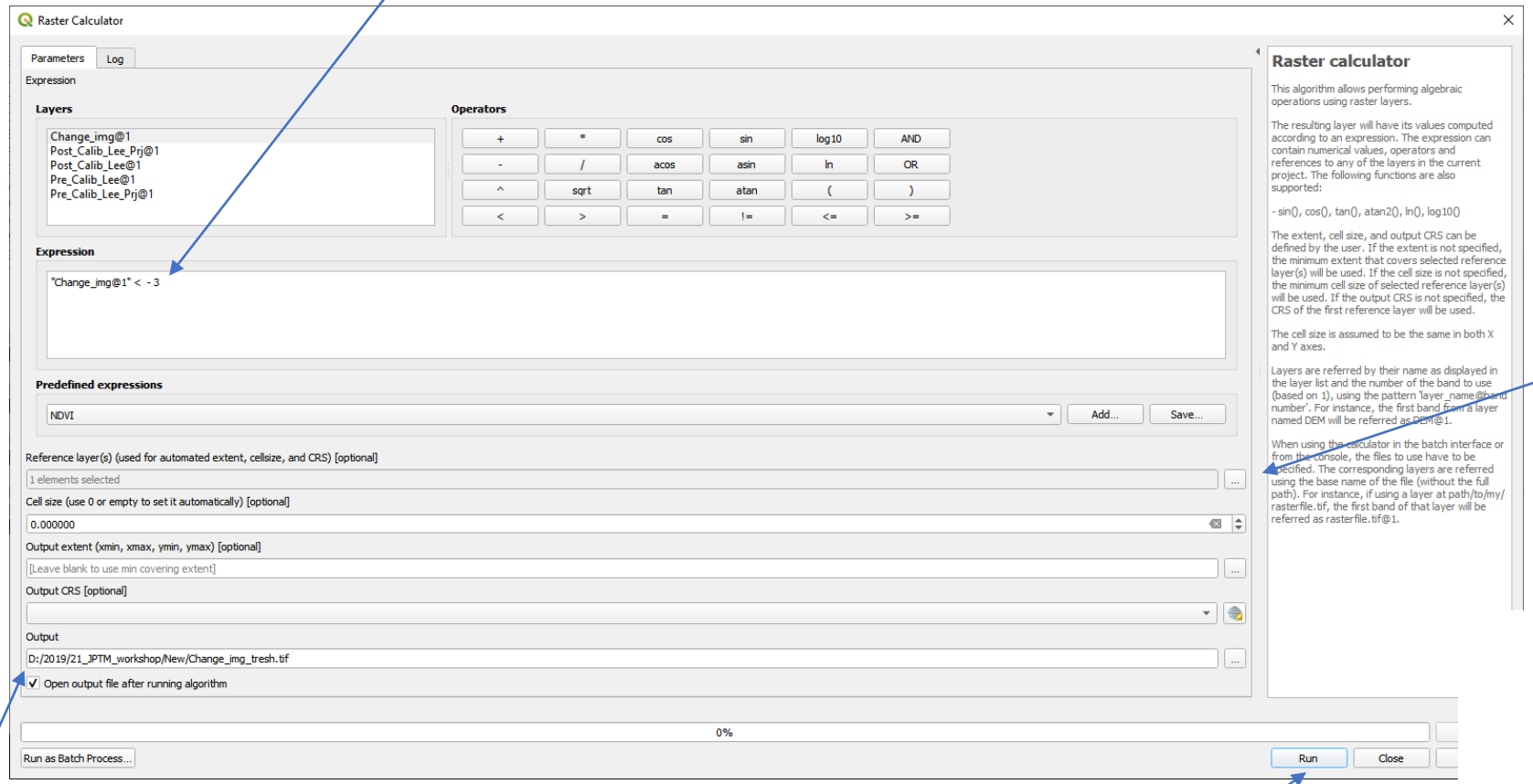


Red Band : Pre-image
Green band: Post-image
Blue Band : Post-image

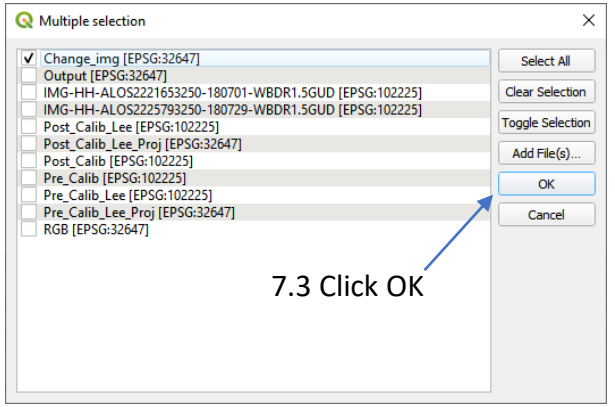
The areas likely to be flooded will appear as red, under this particular band combination. Observing change image and this RGB visualization, you can find the radar backscatter value range in the flood region. A threshold value can be selected for delineate the flood extent.

7 thresholding the Pre, Post difference image

7.1 Input Expression as follows (threshold value for detected water selected as -3 here)



7.2 Click on this icon and select a reference layer

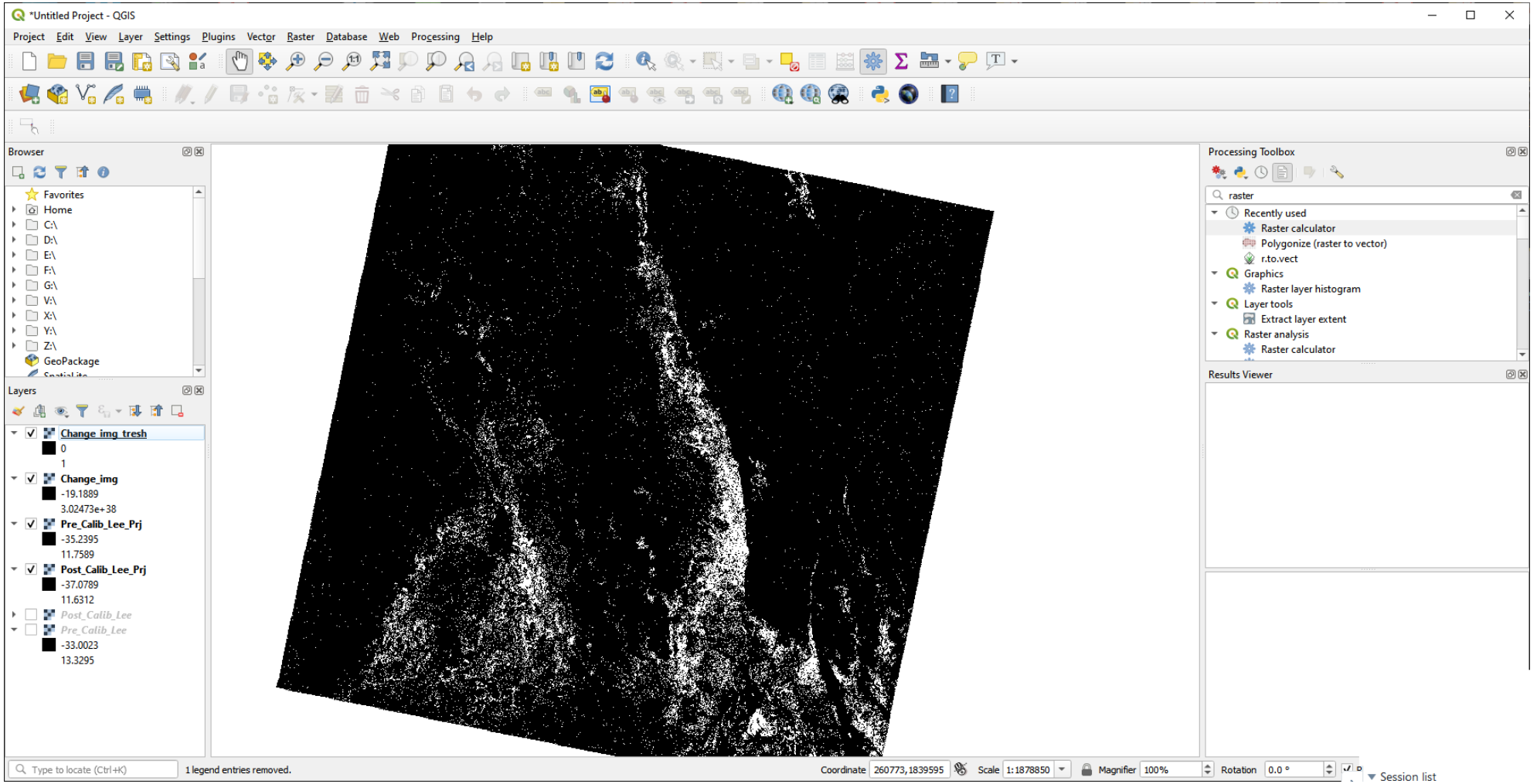


7.3 Click OK

7.4 Browse to the output folder and give it a name and save it as a .tif file

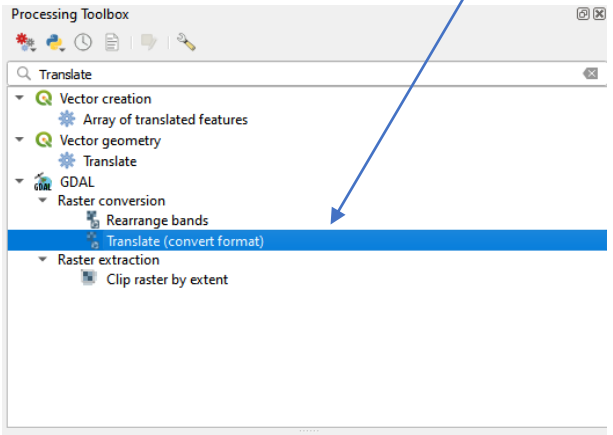
7.5 Click Run

Change Image after thresholding



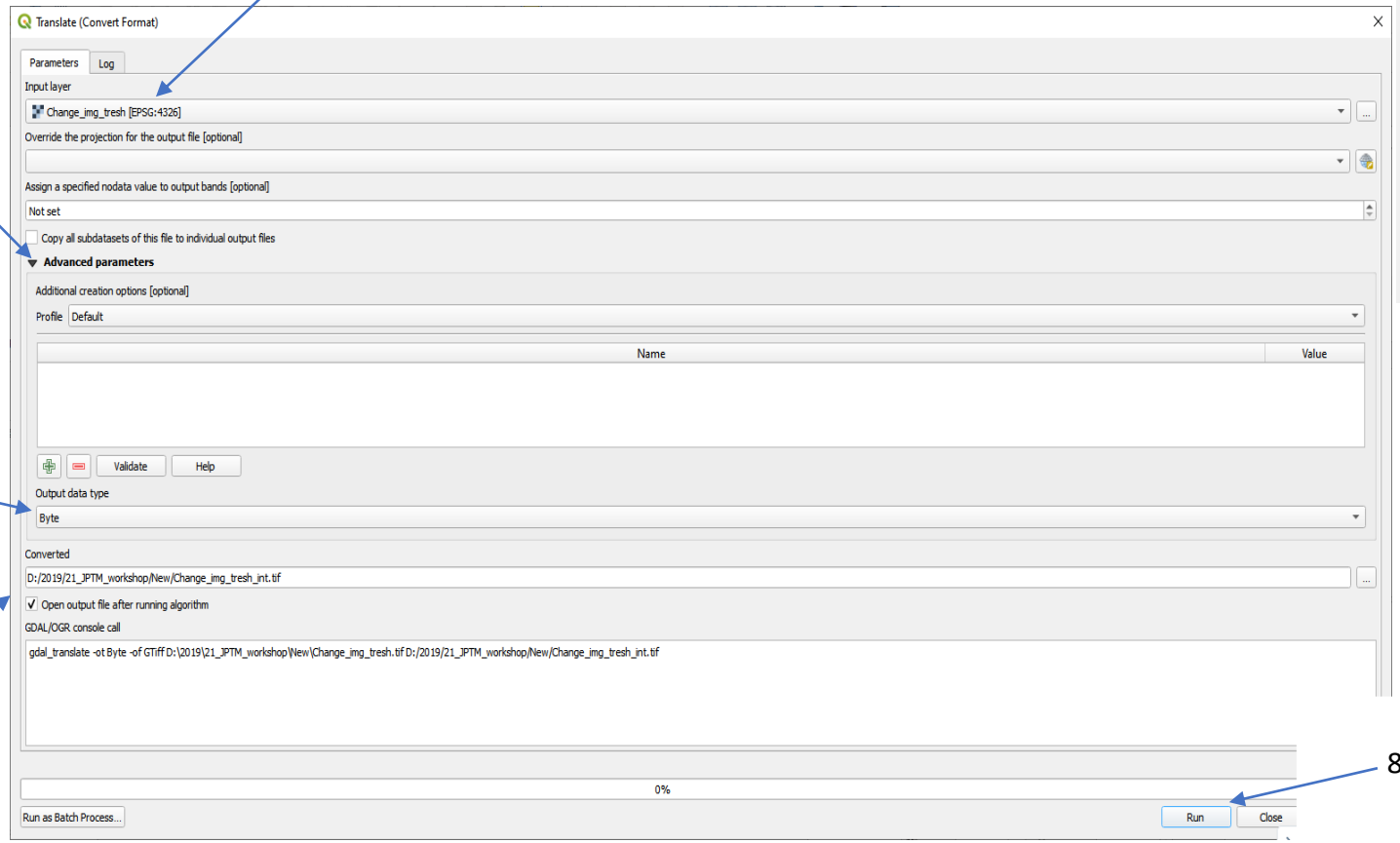
8 Converting the data type of the threshold image

8.1 Type **Translate** in processing toolbox search bar and select the **Translate(convert format)** under **GDAL**



8.2 Select the **threshold image** from the drop down.

8.3 click on advanced parameters



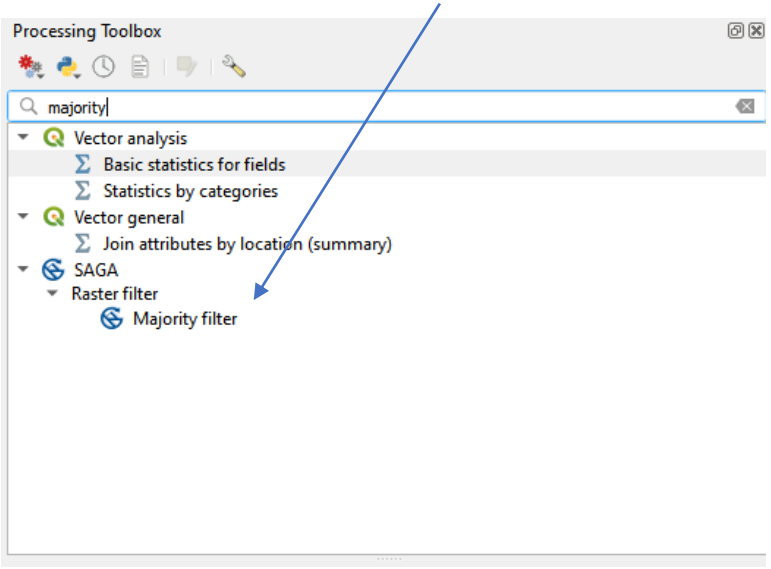
8.4 Change the output datatype as **byte**

8.5 Browse to the output folder and give it a name and save it as a .tif file

8.6 Click **Run**

9 Application of majority filter to reduce the noise pixels

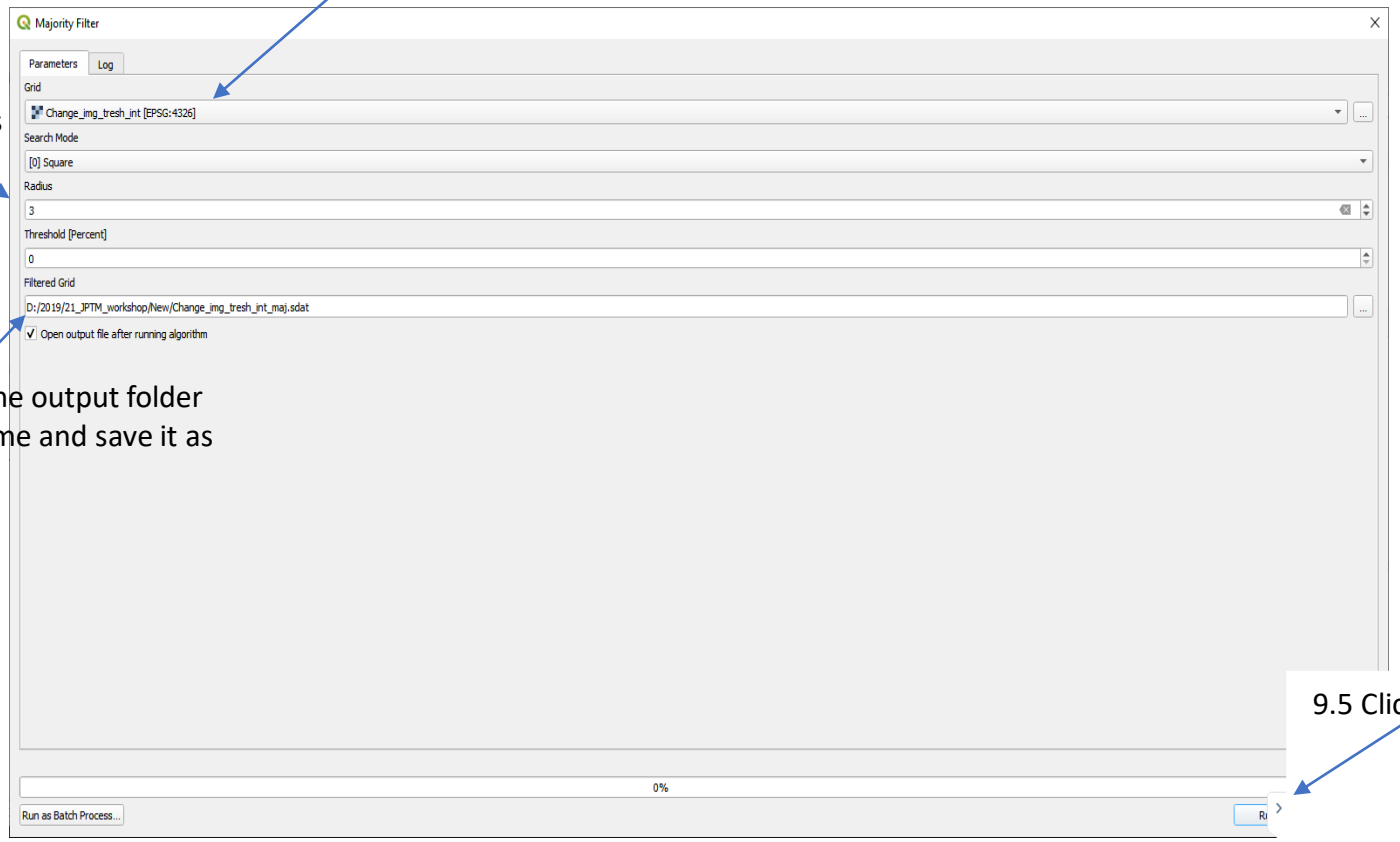
9.1 Type **Majority** in processing toolbox search bar and select the **Majority filter** under **SAGA**



9.2 Select the **threshold image (Byte)** from the drop down.

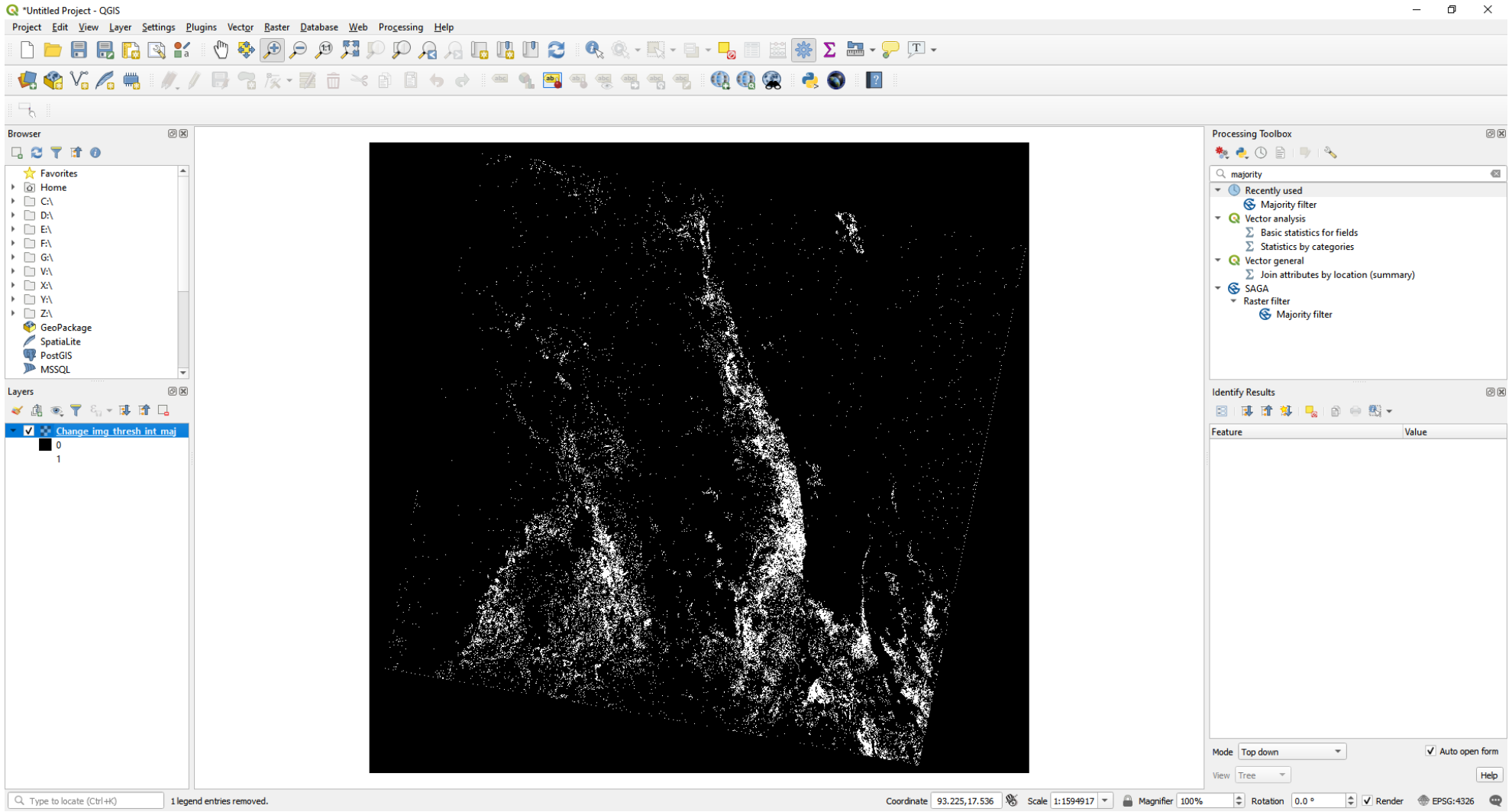
9.3 Input radius as 3 (5*5)

9.4 Browse to the output folder and give it a name and save it as a .sdat file



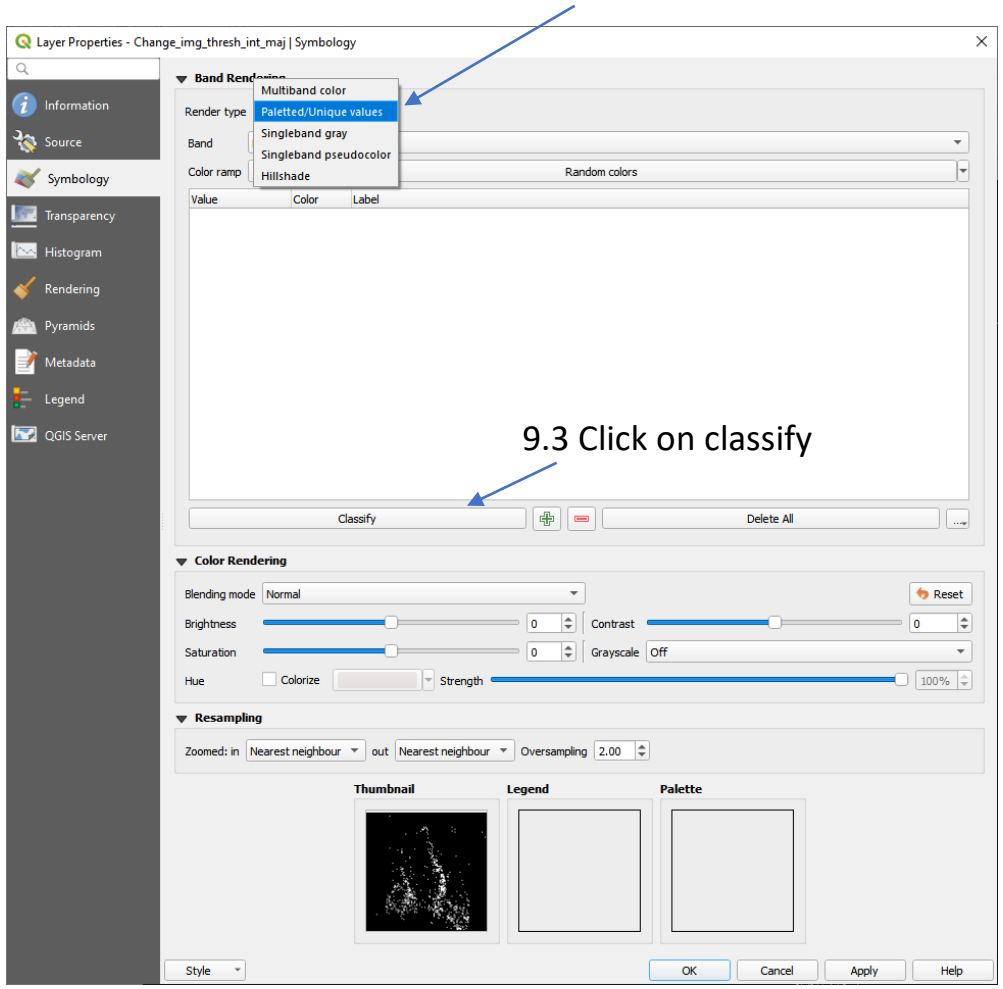
9.5 Click **Run**

Majority filtered image

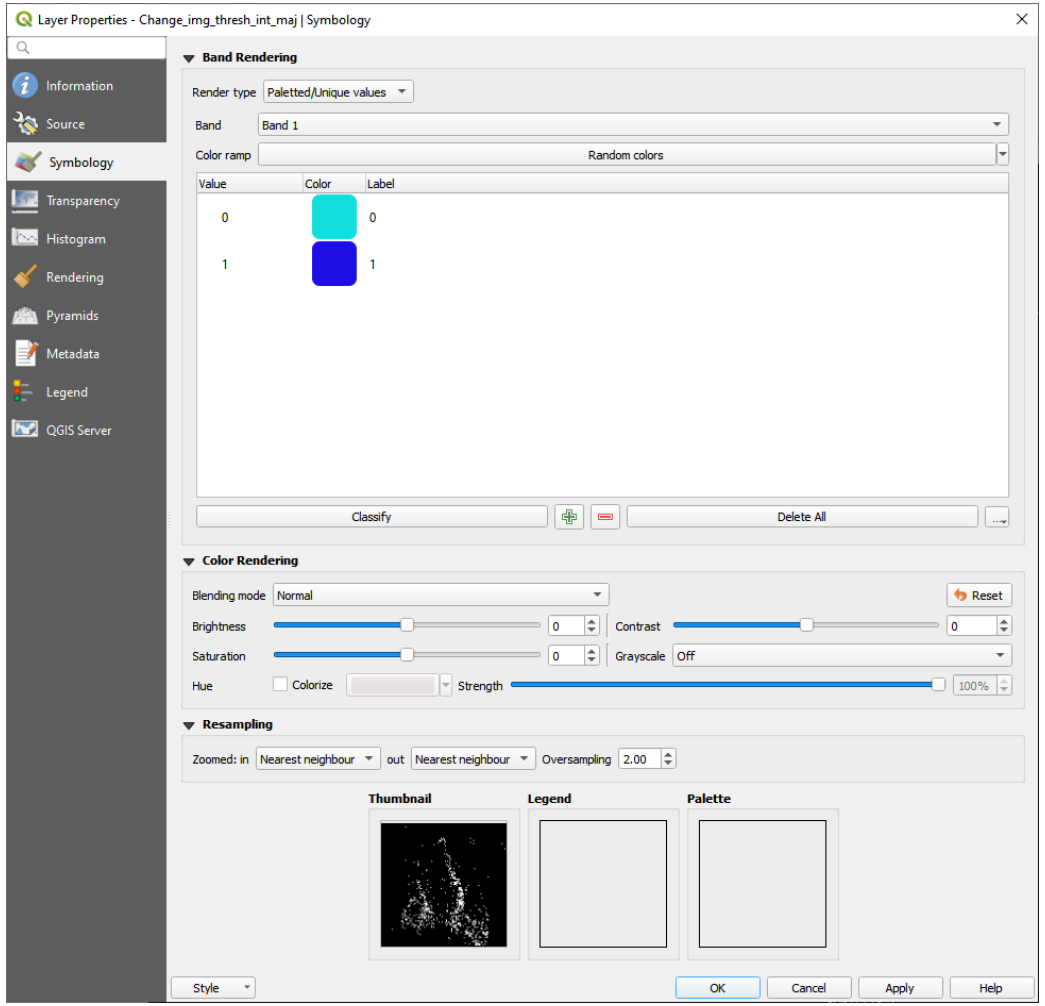


9.6 Right click on the majority filtered image> **Properties**

9.7 select symbology and under render type select **unique values**

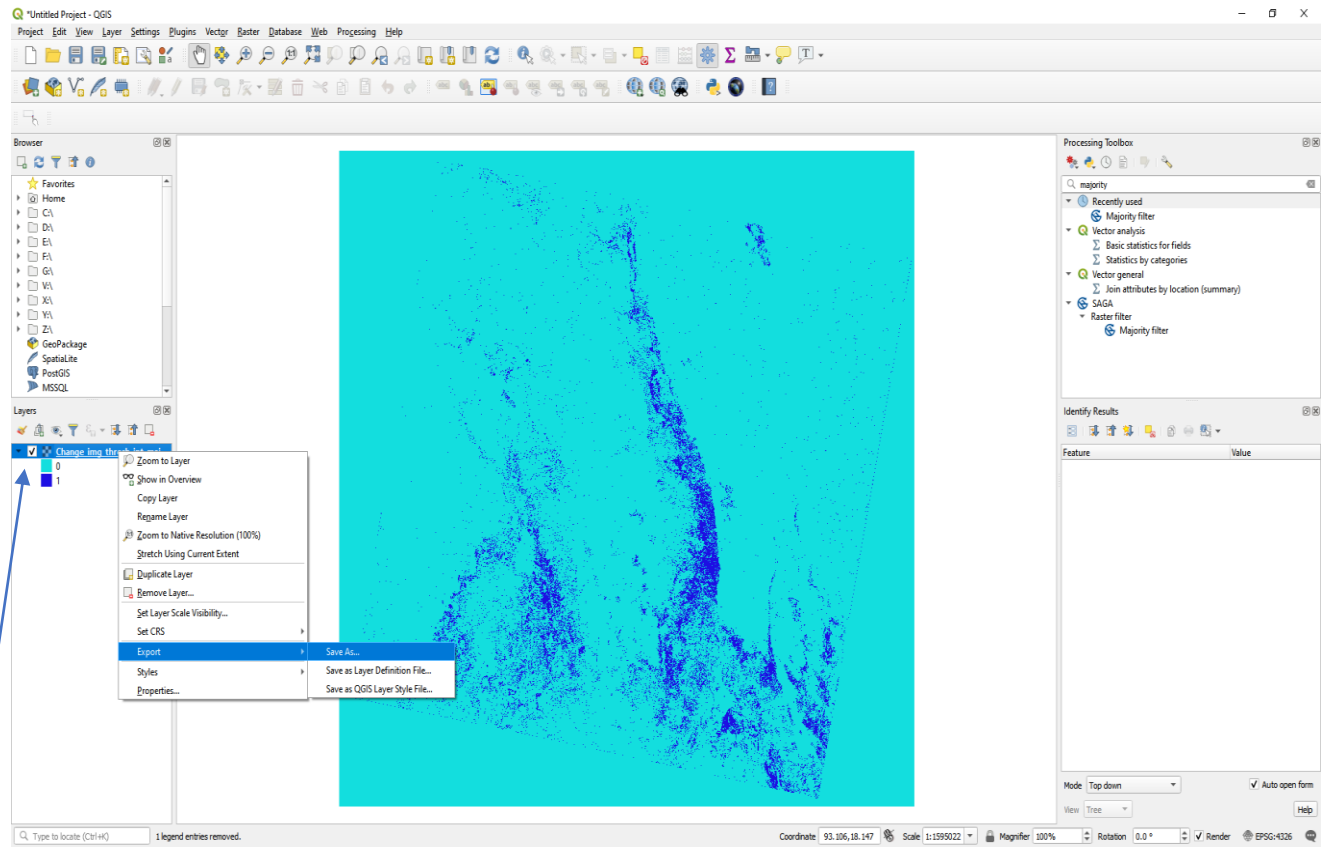


9.3 Click on classify



9.8 Click OK

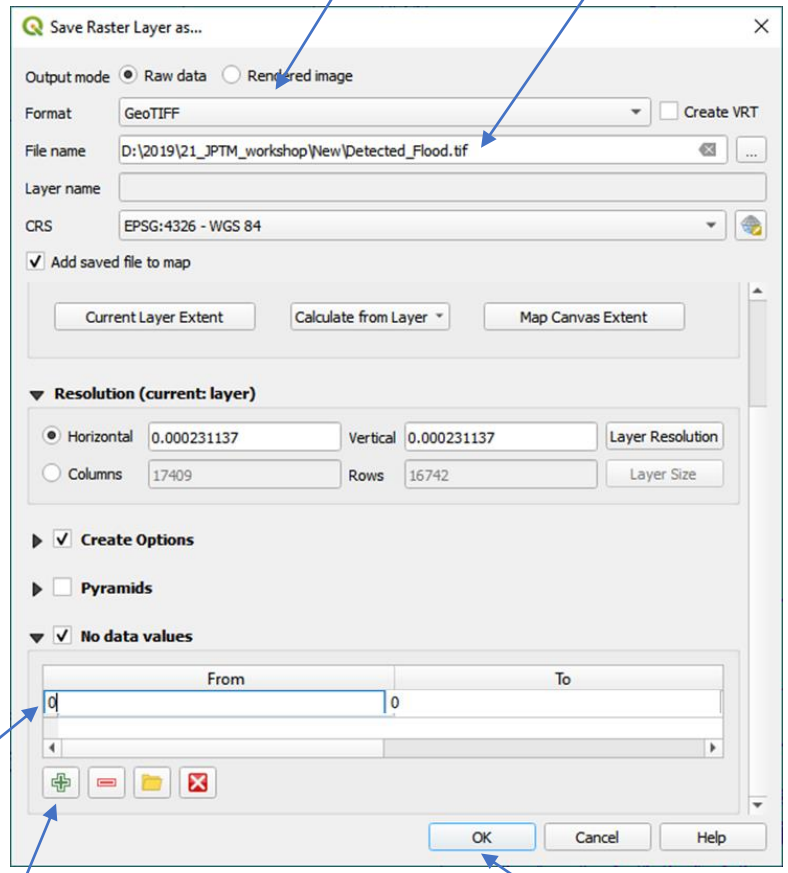
Classified image (water-1, non water-0)



9.9 Right click on the classified image > **Export > Save As**

9.10 Set the format as Geotiff

9.11 Browse to the output folder and give it a name and save it as a .tif file

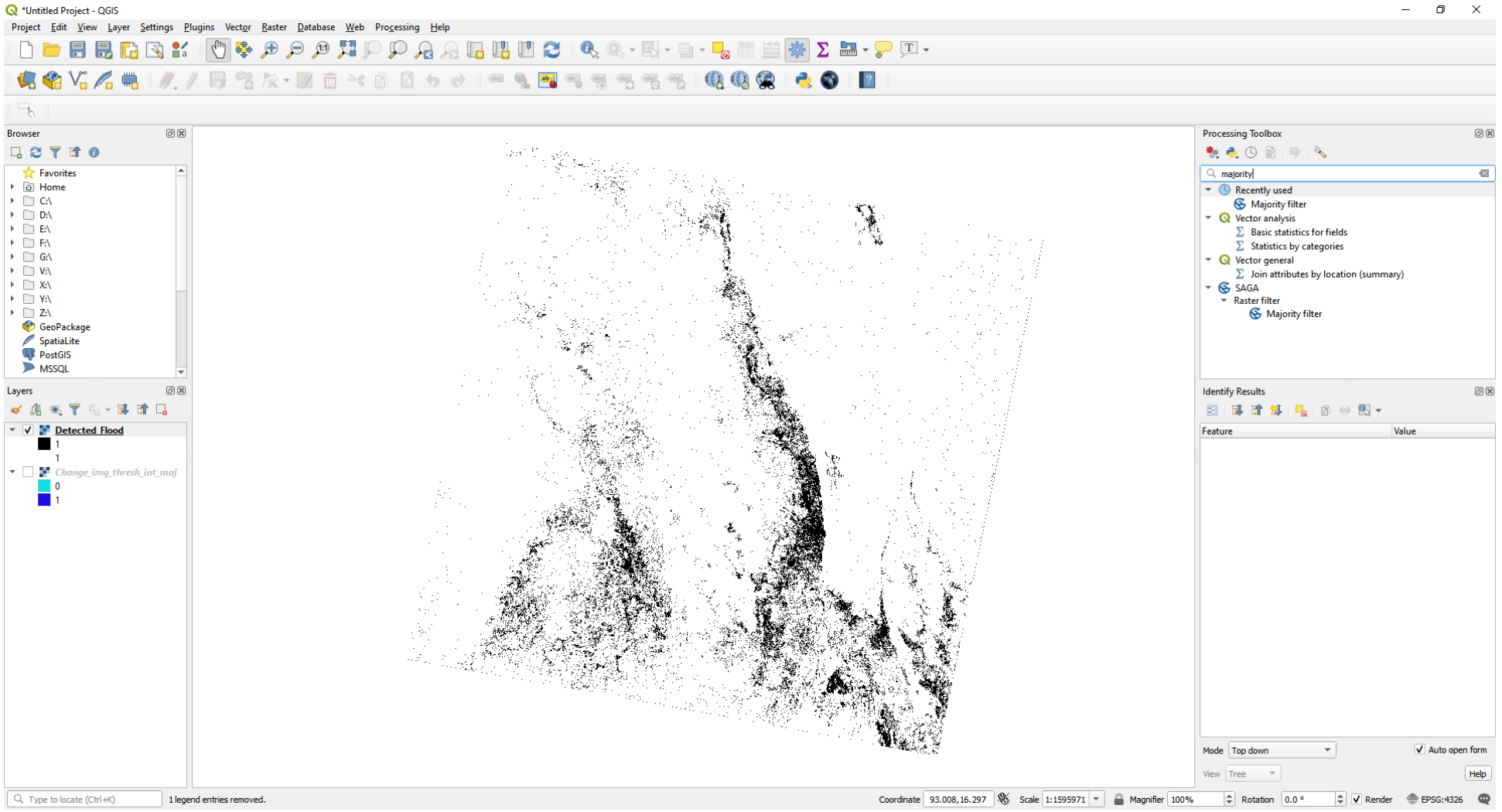


9.13 type 0 here

9.12 Add the no data value as 0 by click on this icon

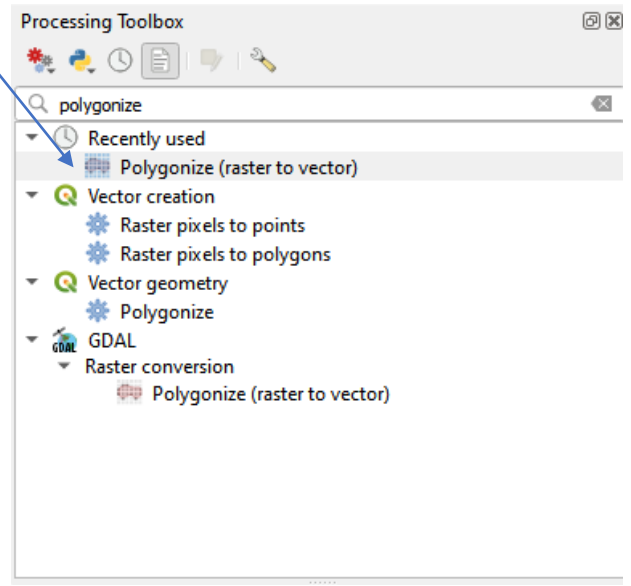
9.14 click OK

Detected Flood raster image.

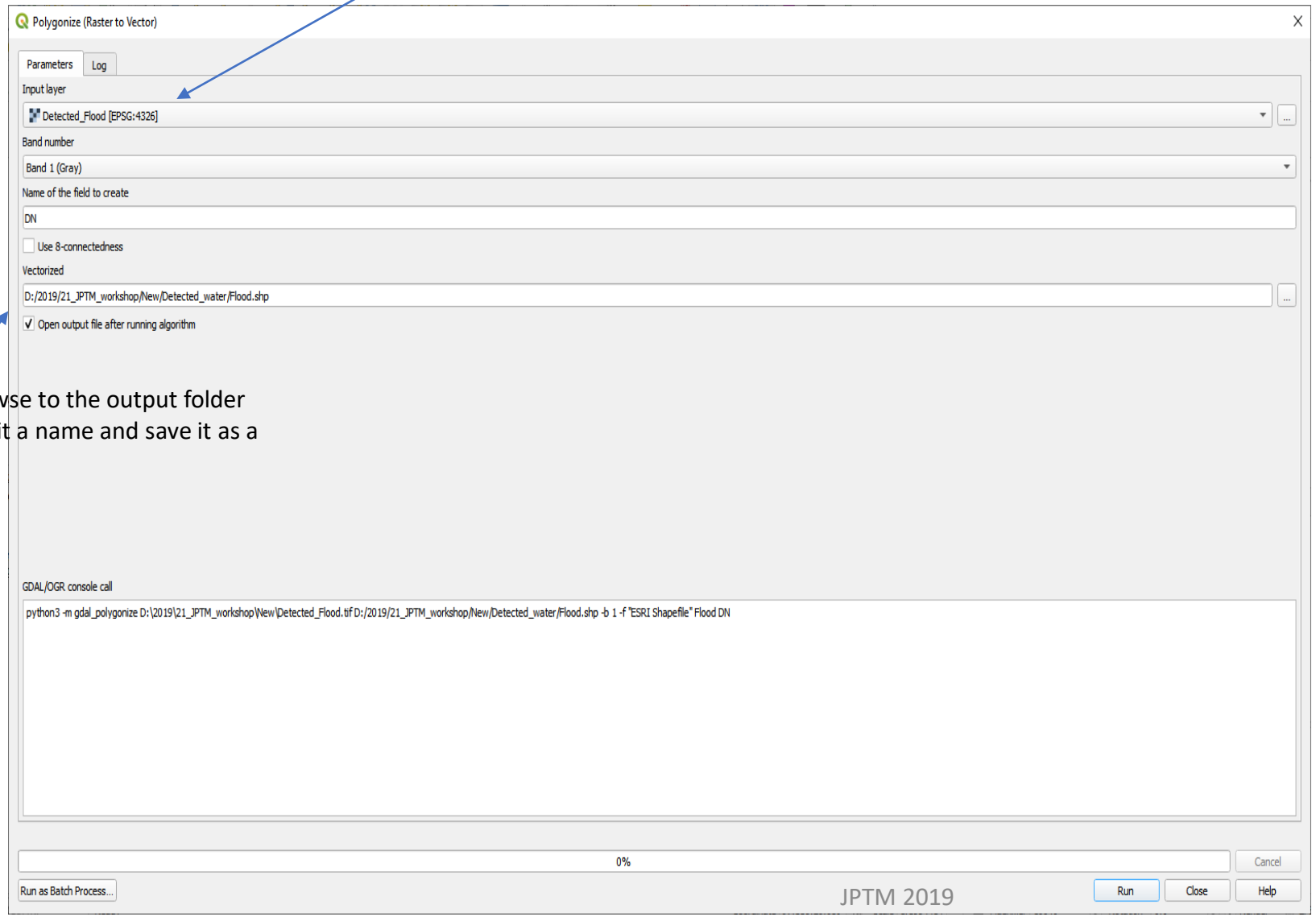


10 Conversion the **Detected Flood** raster file into a vector file

10.1 Type **polygonize** in processing toolbox search bar and select the **Polygonize** under **GDAL**

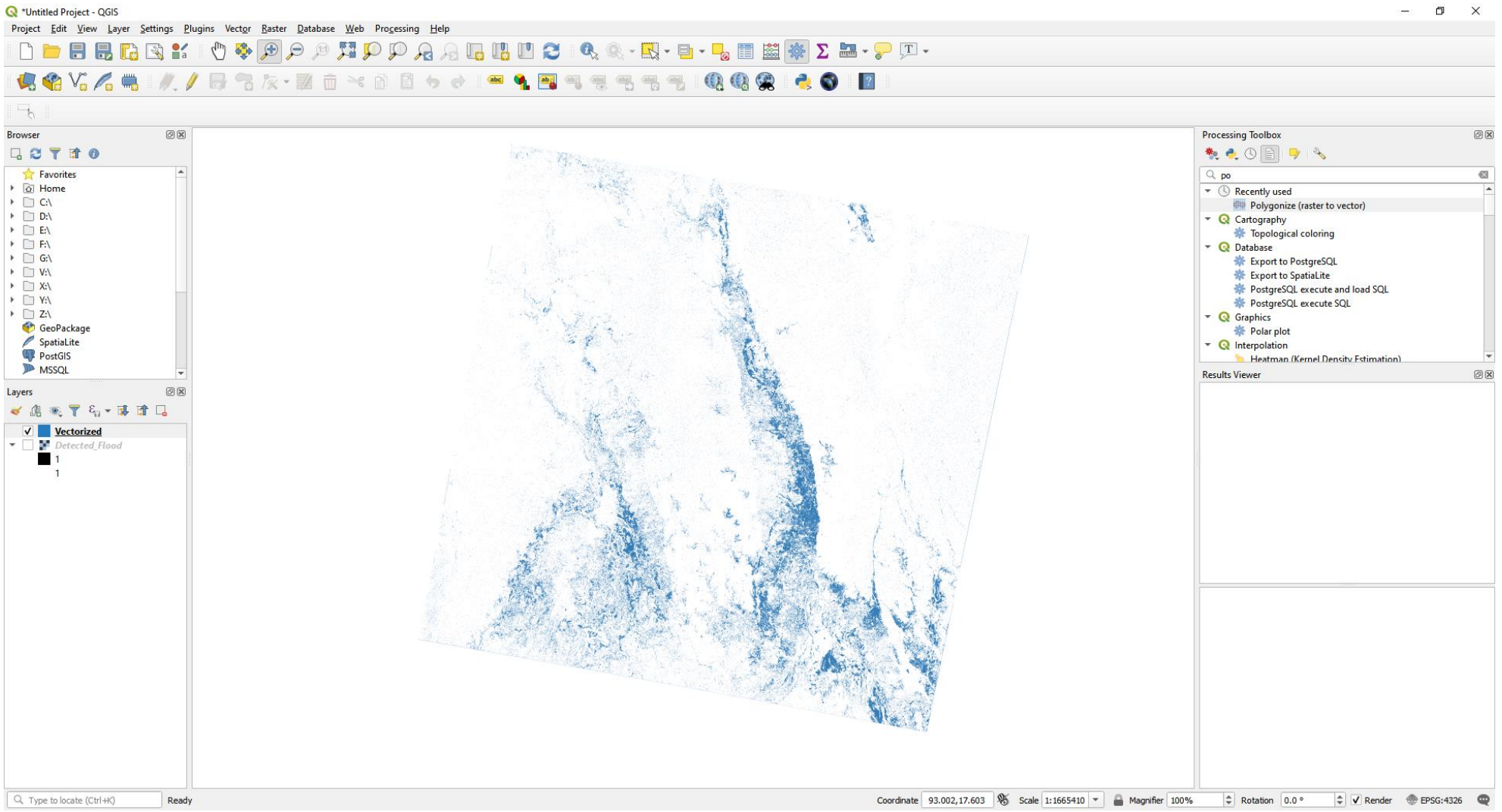


10.2 Select the **Detected flood** raster from the drop down.

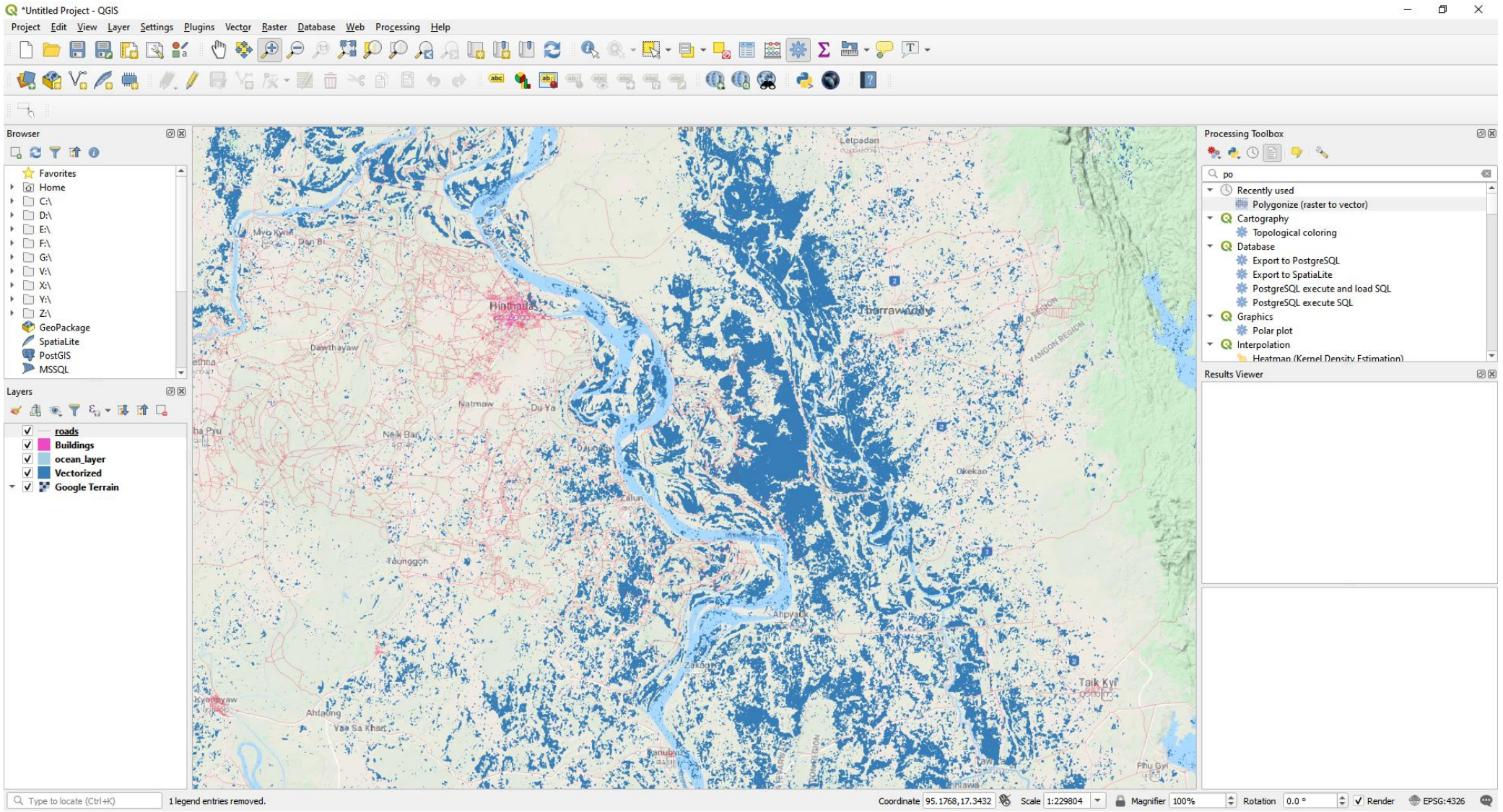


10.3 Browse to the output folder and give it a name and save it as a .shp file

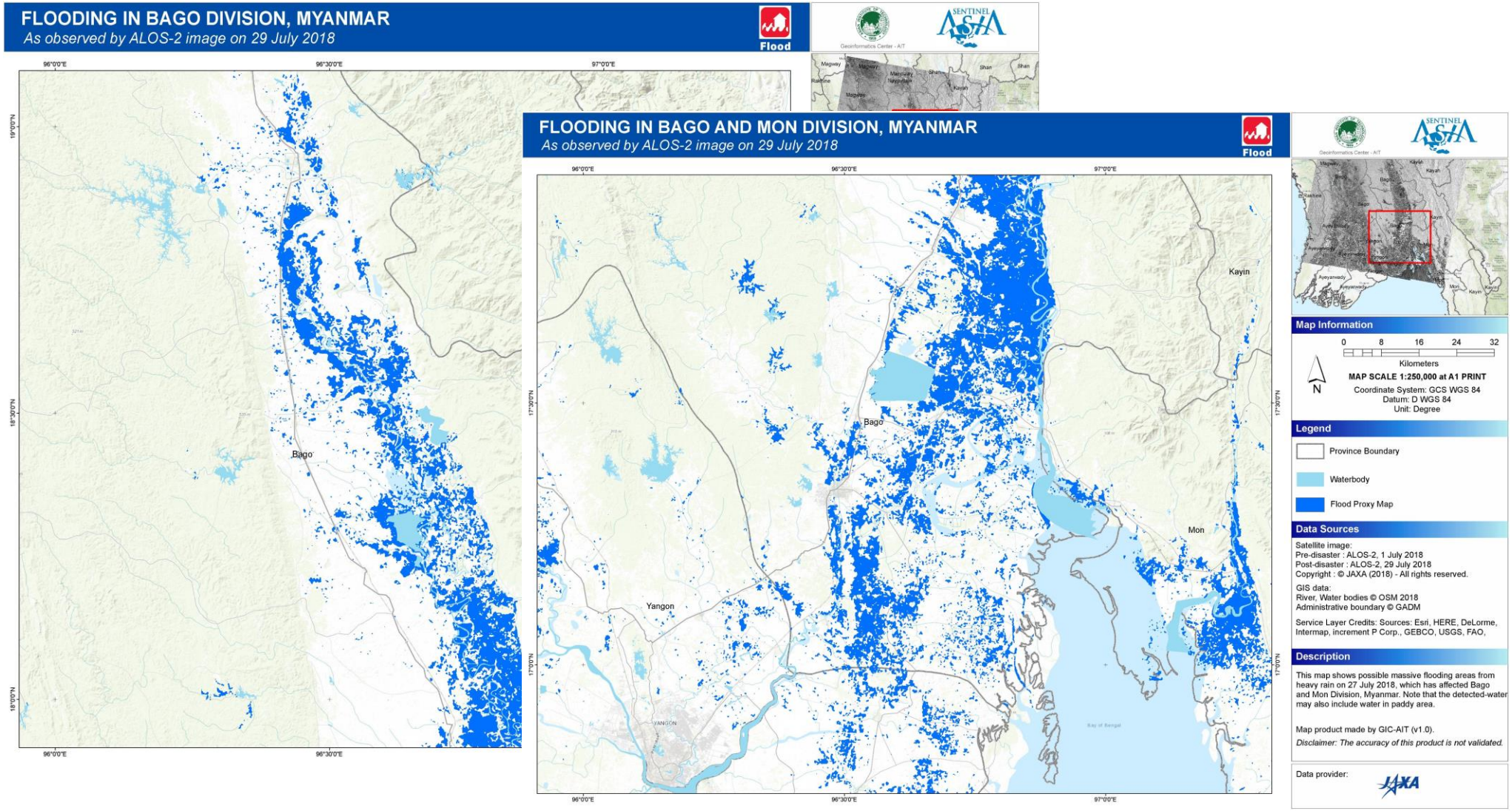
Detected Flood in Vector format



To make Value Added Product more informative, you can combine OSM data with these processed product.



Value added products after combined with more information



Useful links:

OSM Data Download : https://download.geofabrik.de/

Marine region shape file Download : http://www.marineregions.org/gazetteer.php?p=details&id=1904

Thank You!