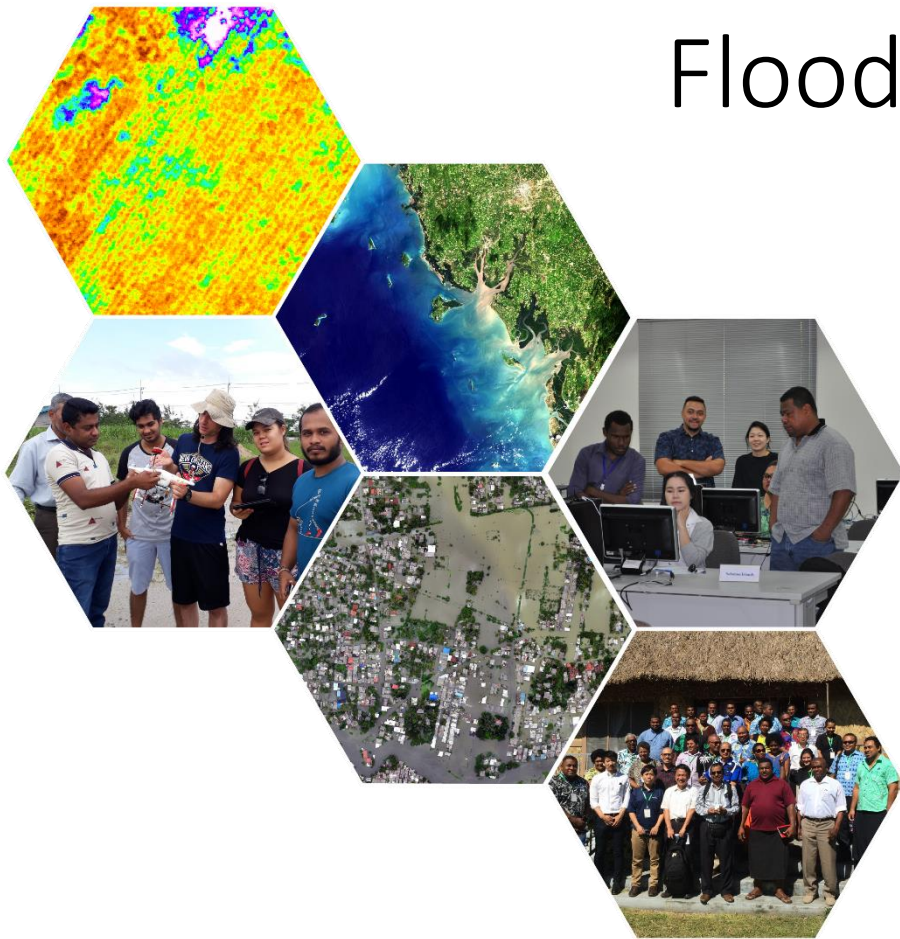


# Flood Mapping with Sentinel-2 imagery



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# 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?

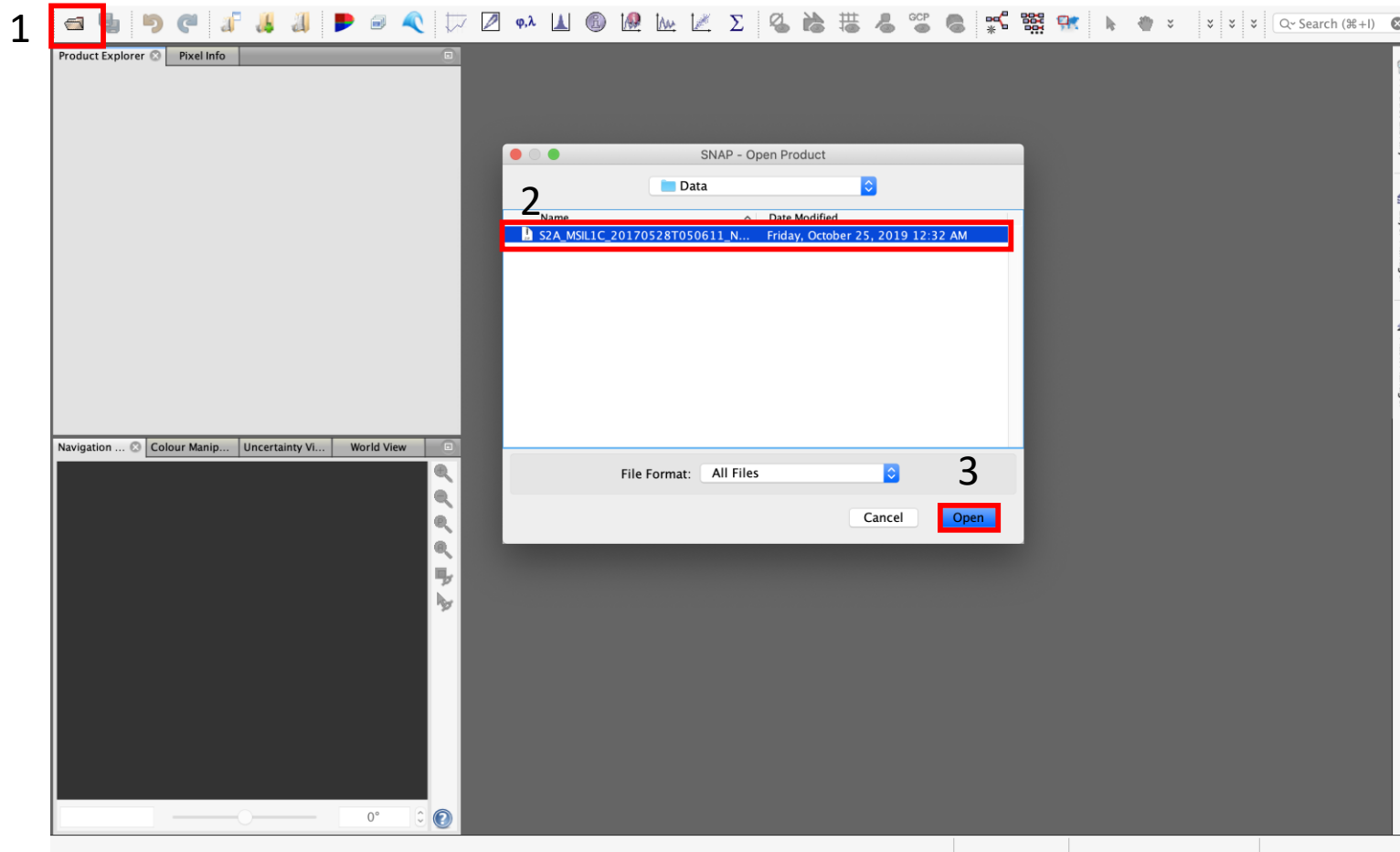
- Open data product
- Create a subset image
- Calculate NDWI
- Extract water areas using threshold
- Export result to other format (ex. tif) for map layouting

An aerial photograph of a river delta, showing a complex network of channels and distributaries. The water is a deep blue, and the surrounding land is a mix of green and brown. A semi-transparent white rectangular box is centered over the image, containing the text "Hands on exercise".

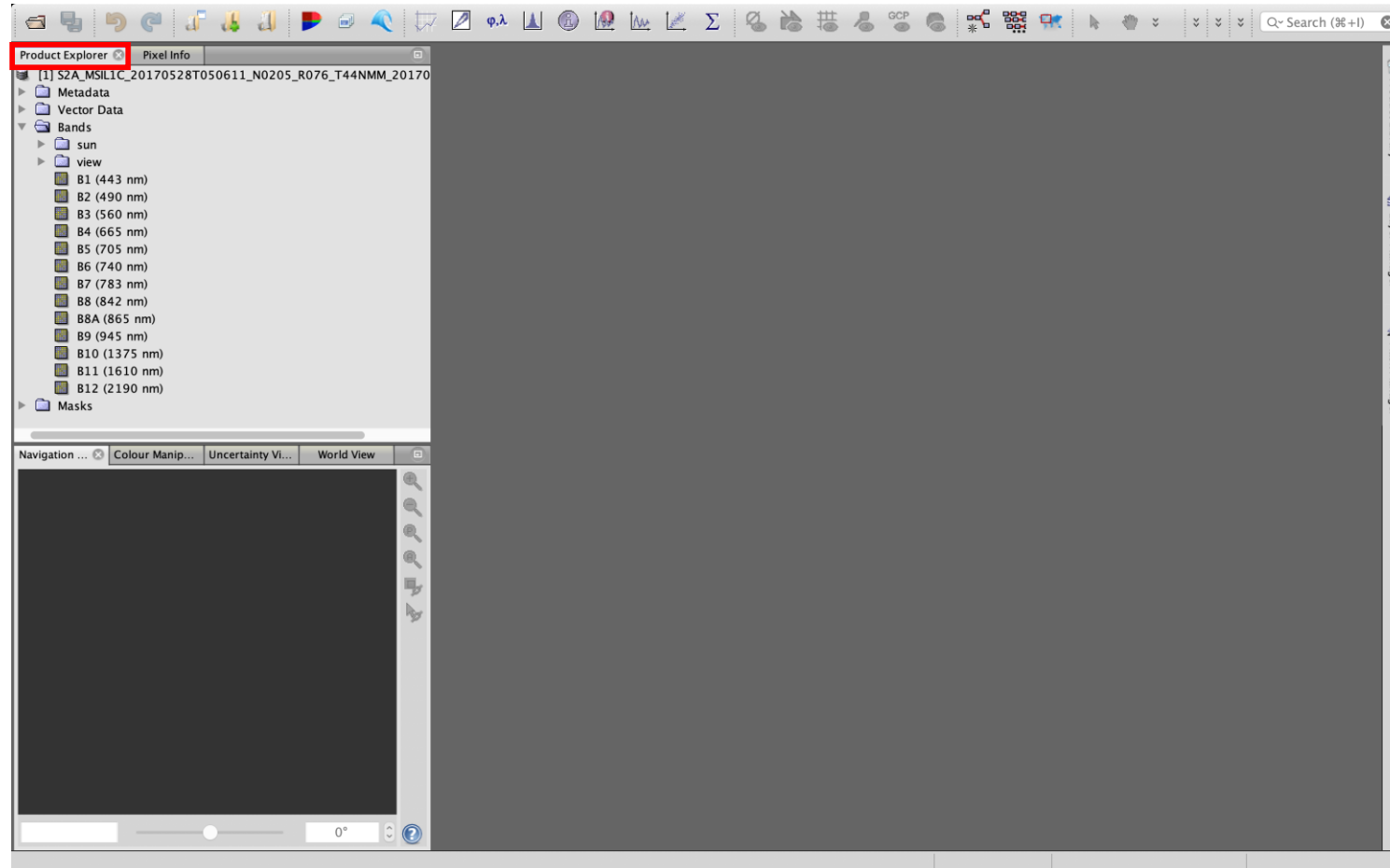
Hands on exercise

# Open Sentinel-2 data

Use the Open Product button



# Product Explorer



# Open RGB image window

1

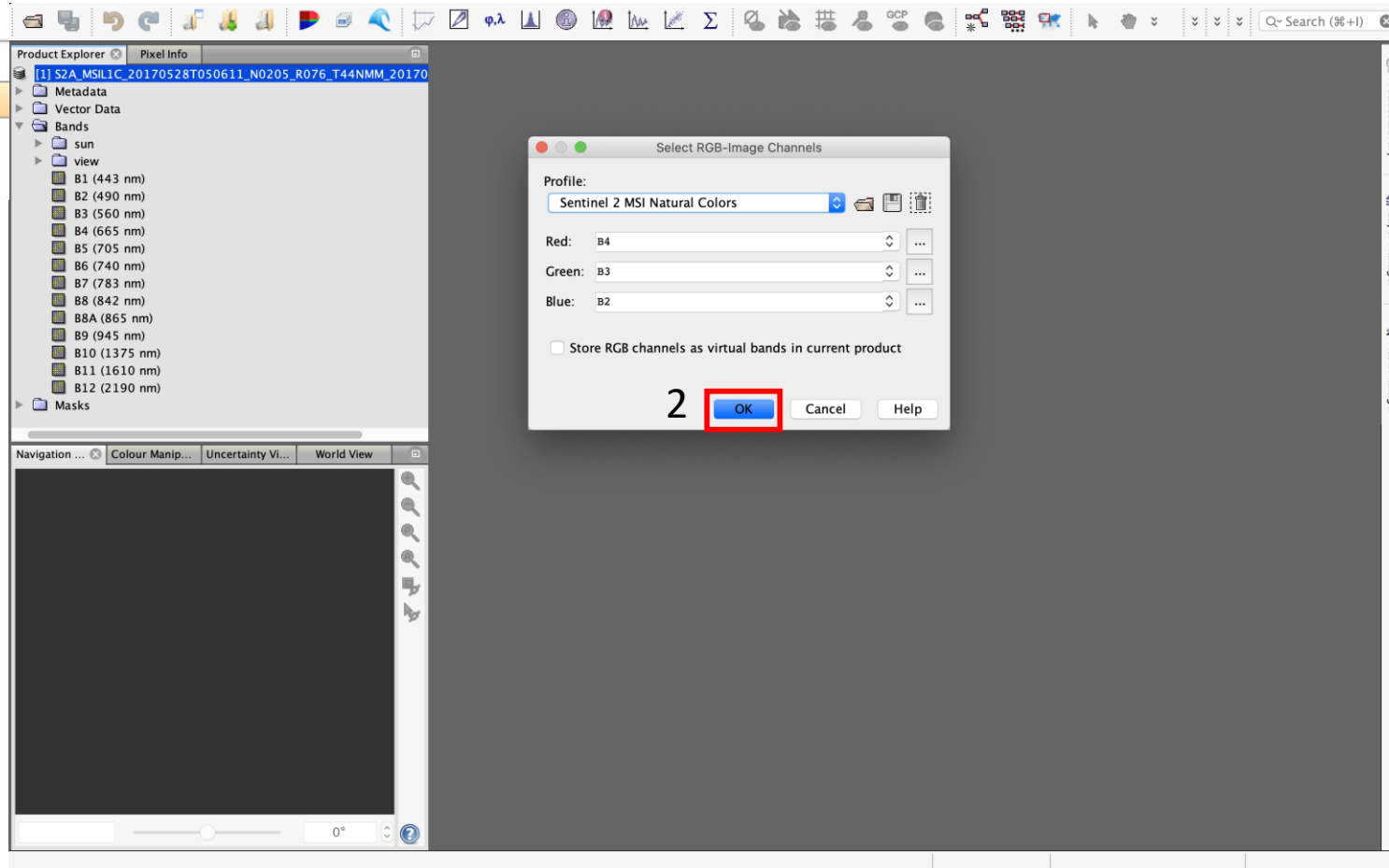
Window Help

Open Image Window

**Open RGB Image Window**

Open HSV Image Window

Open Metadata Window



2

OK

Cancel

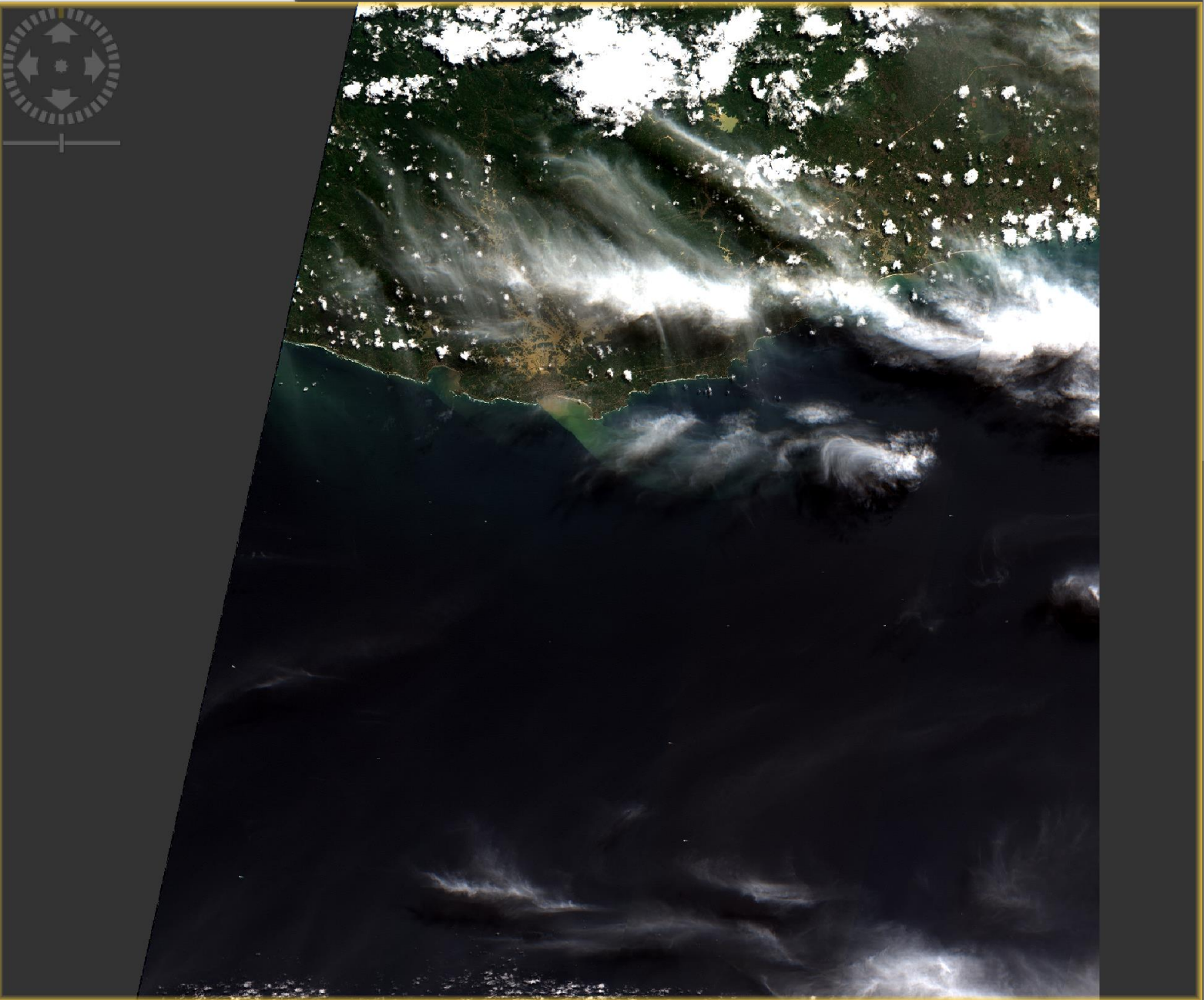
Help



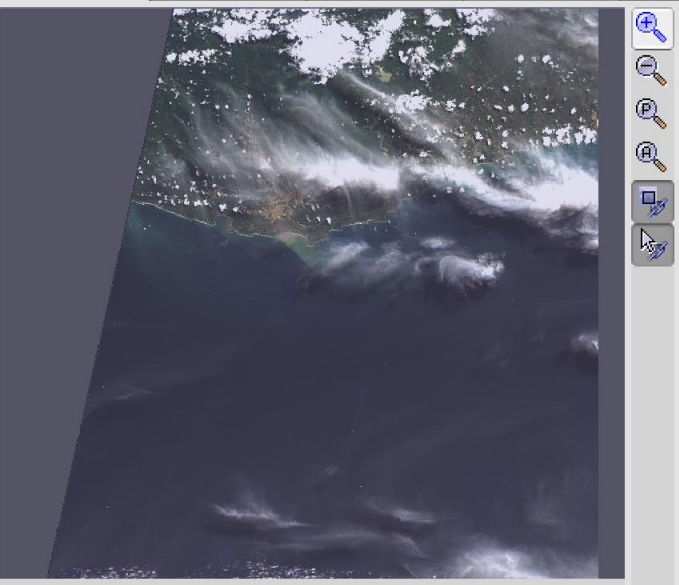
Search (Ctrl+F)

Product Explorer Pixel Info [1] Sentinel 2 MSI Natural Colors RGB

- [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°

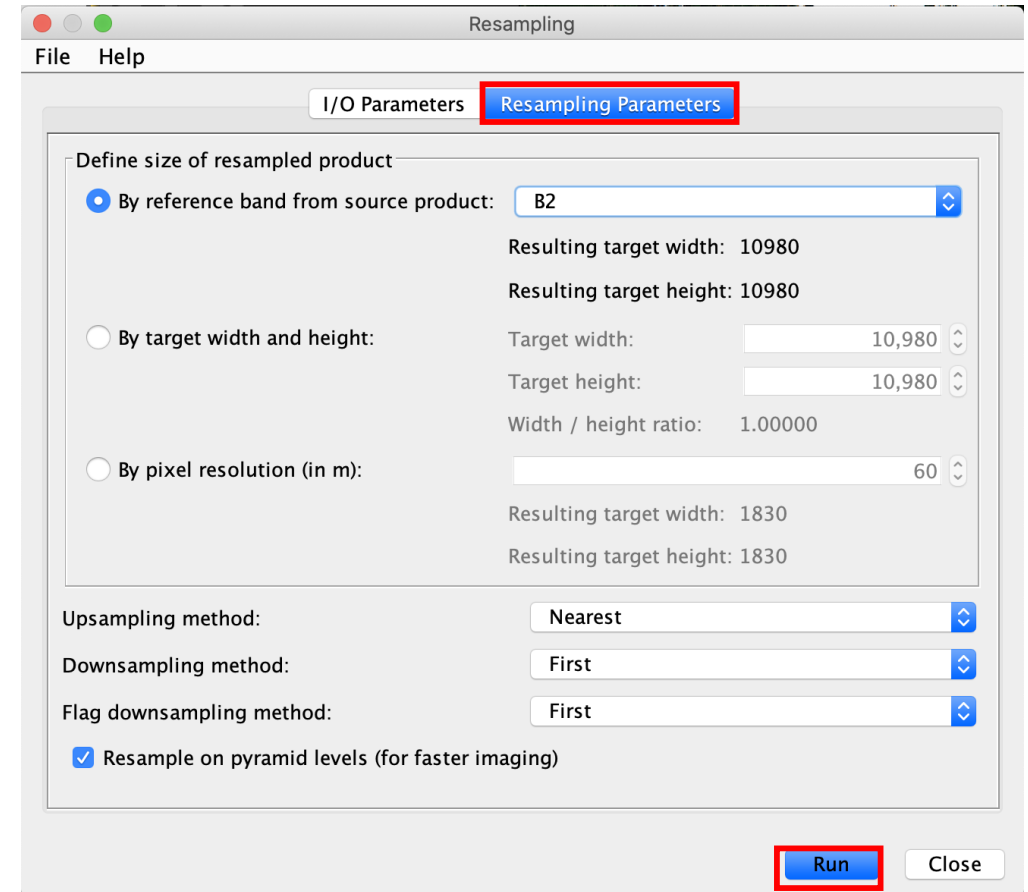
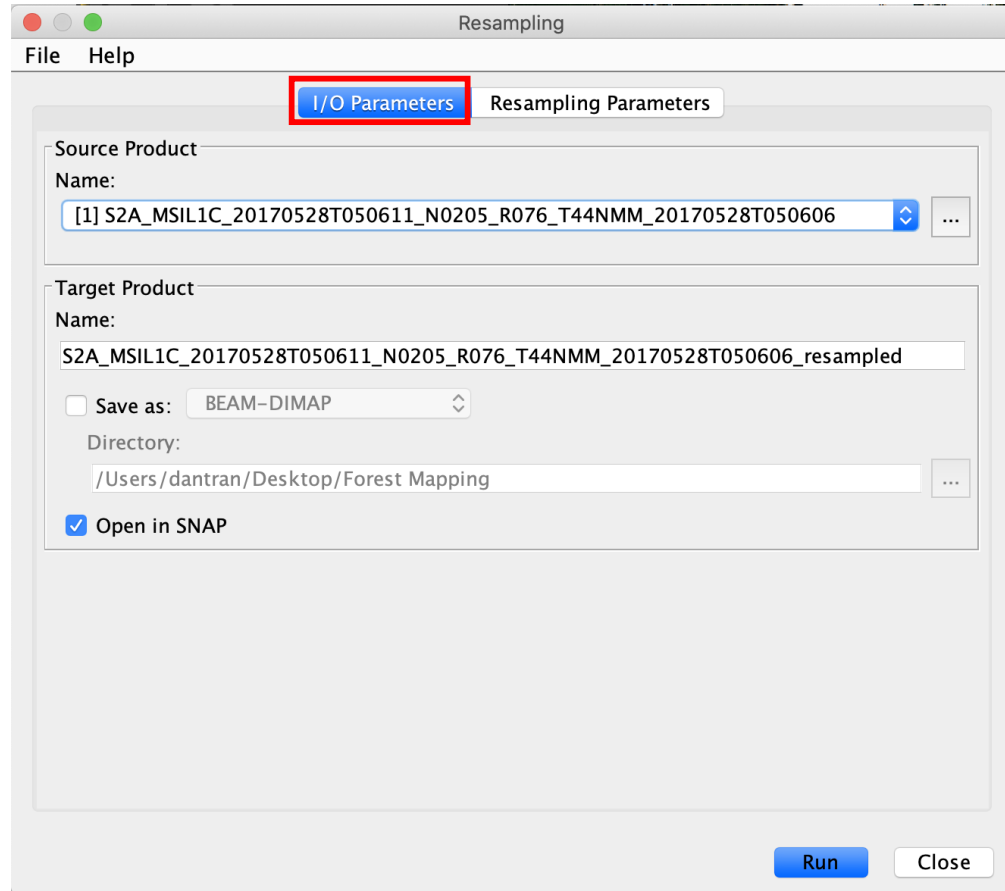
X -- Y -- Lat -- Lon -- Zoom -- Level --

Product Library Layer Manager Mask Manager

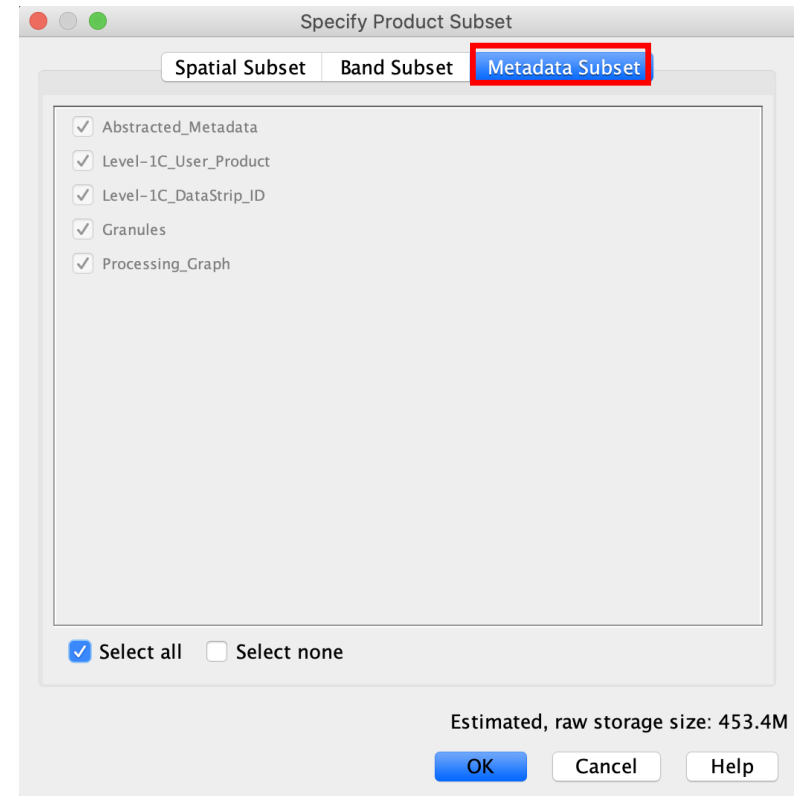
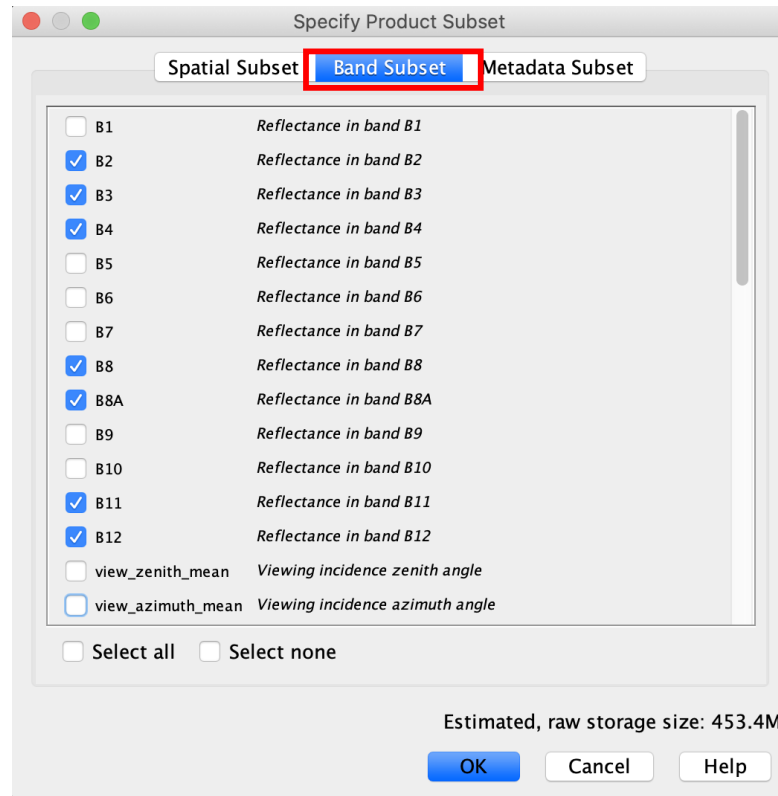
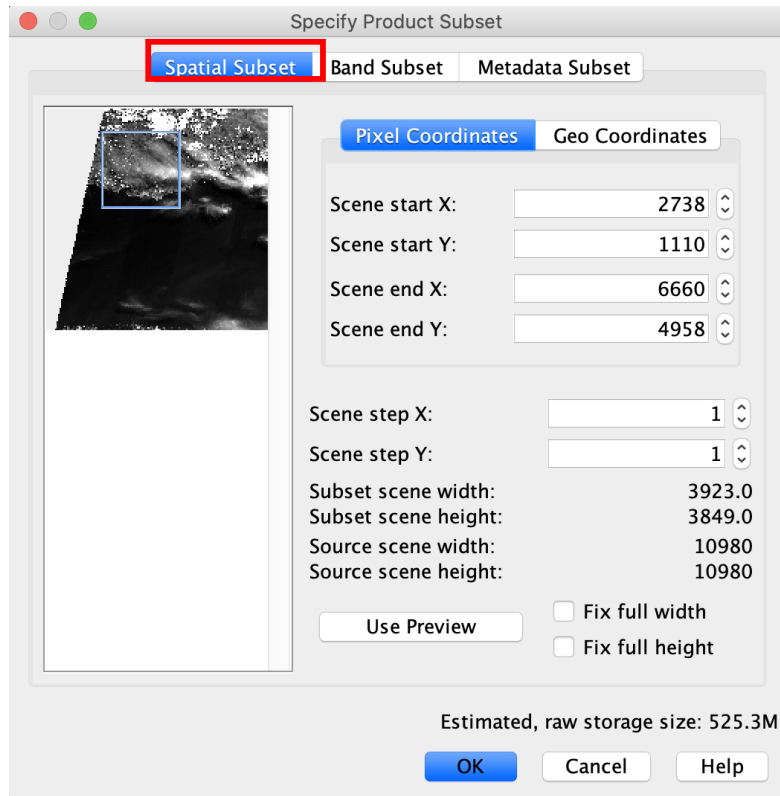


# Creating a subset image

From the Raster menu, select Subset...



# Creating a subset image



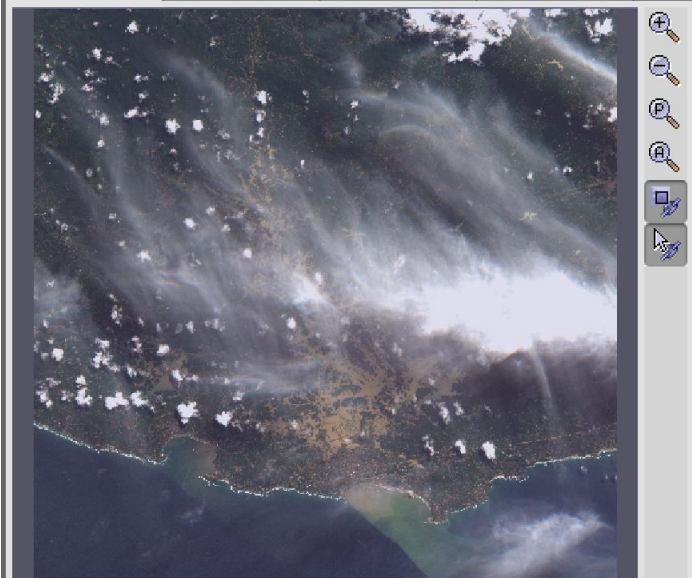


Product Explorer Pixel Info

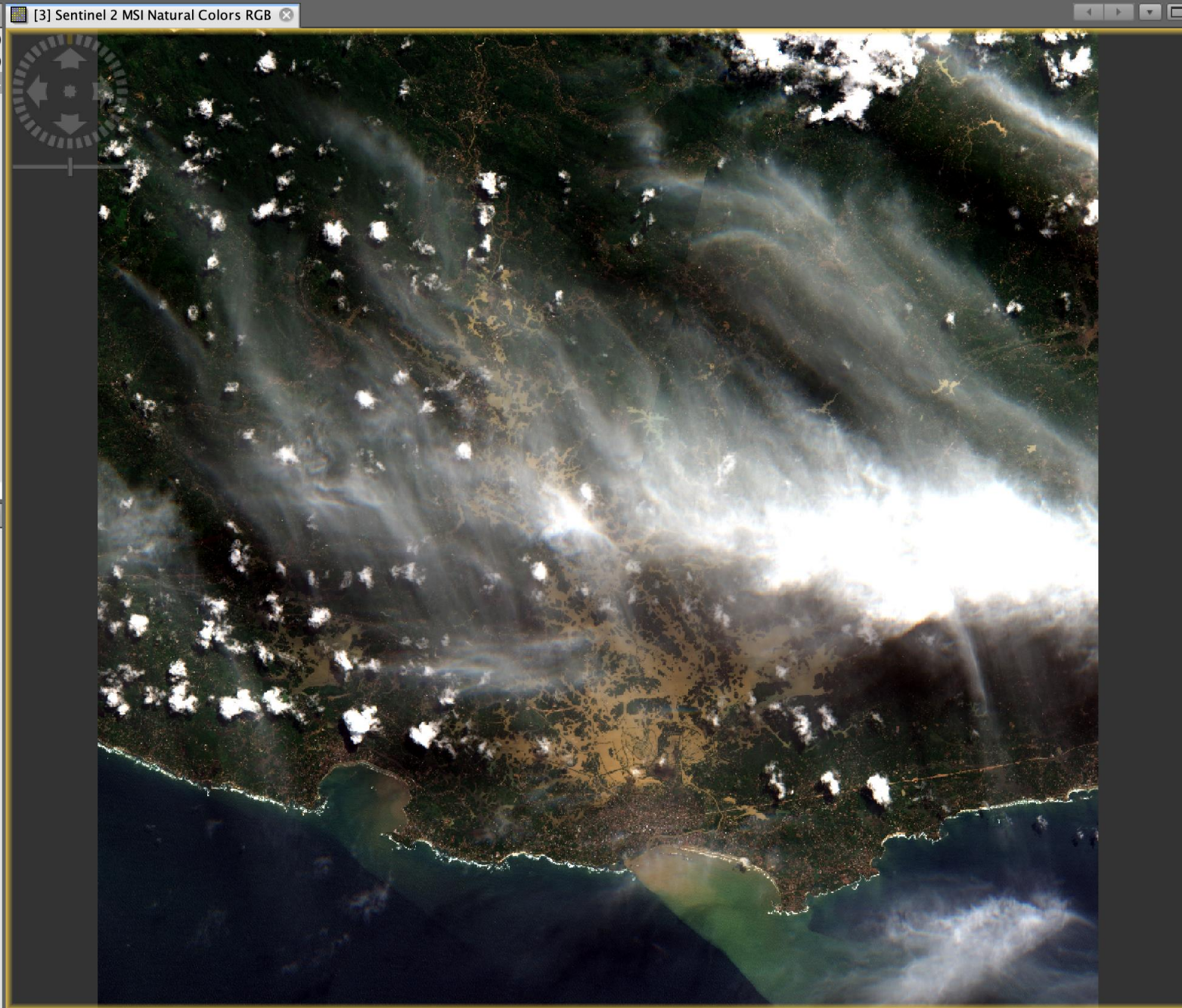
- [1] S2A\_MSIL1C\_20170528T050611\_N0205\_R076\_T44NMM\_20170
- [2] S2A\_MSIL1C\_20170528T050611\_N0205\_R076\_T44NMM\_20170
- [3] subset\_0\_of\_S2A\_MSIL1C\_20170528T050611\_N0205\_R076\_T44

- 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



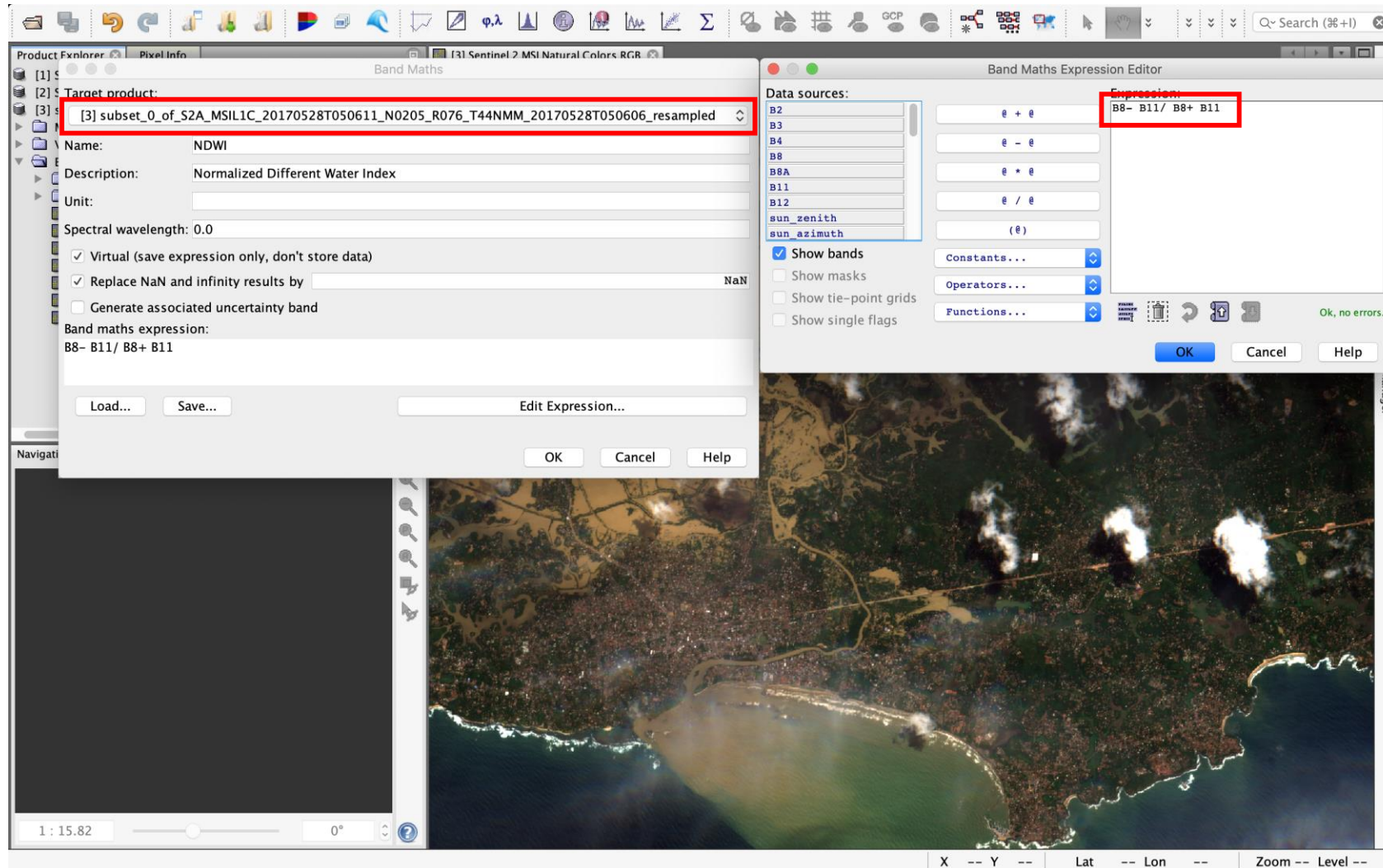
1 : 47.46 0°



Product Library Layer Manager Mask Manager

# Calculate NDWI

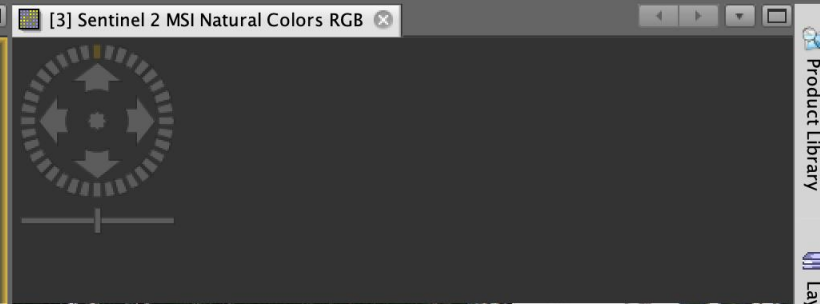
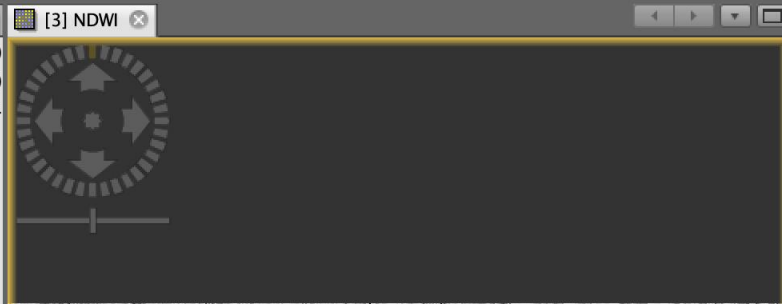
From the Raster menu, select Band Maths





Product Explorer

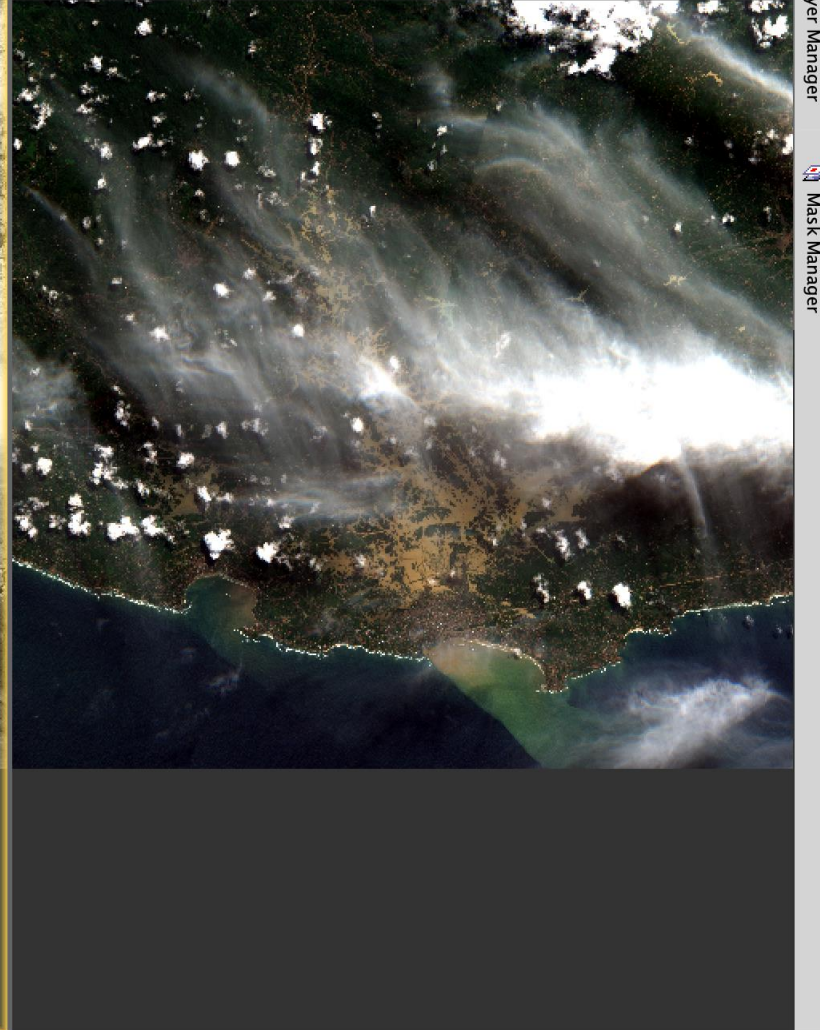
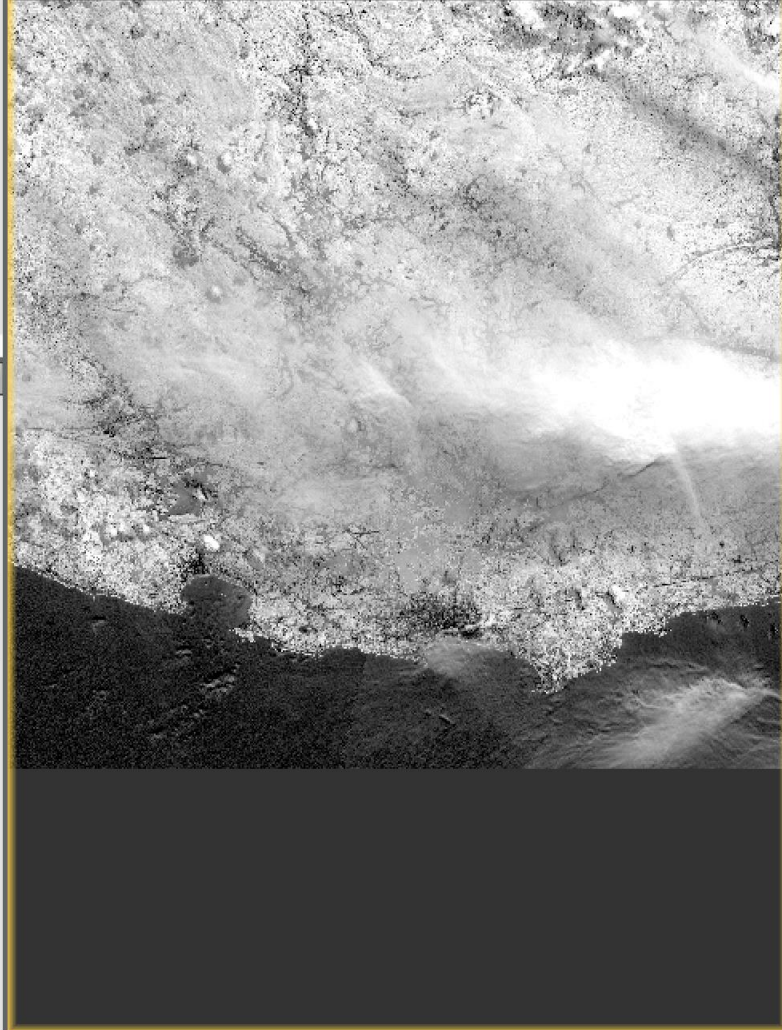
- [1] S2A\_MSIL1C\_20170528T050611\_N0205\_R076\_T44NMM\_20170
- [2] S2A\_MSIL1C\_20170528T050611\_N0205\_R076\_T44NMM\_20170
- [3] subset\_0\_of\_S2A\_MSIL1C\_20170528T050611\_N0205\_R076\_T44
- Metadata
- Vector Data
- Bands
  - sun
  - view
  - B2 (490 nm)
  - B3 (560 nm)
  - B4 (665 nm)
  - B8 (842 nm)
  - B8A (865 nm)
  - B11 (1610 nm)
  - B12 (2190 nm)
  - NDWI



Navigation ... Colour Manip... Uncertainty Vi... World View

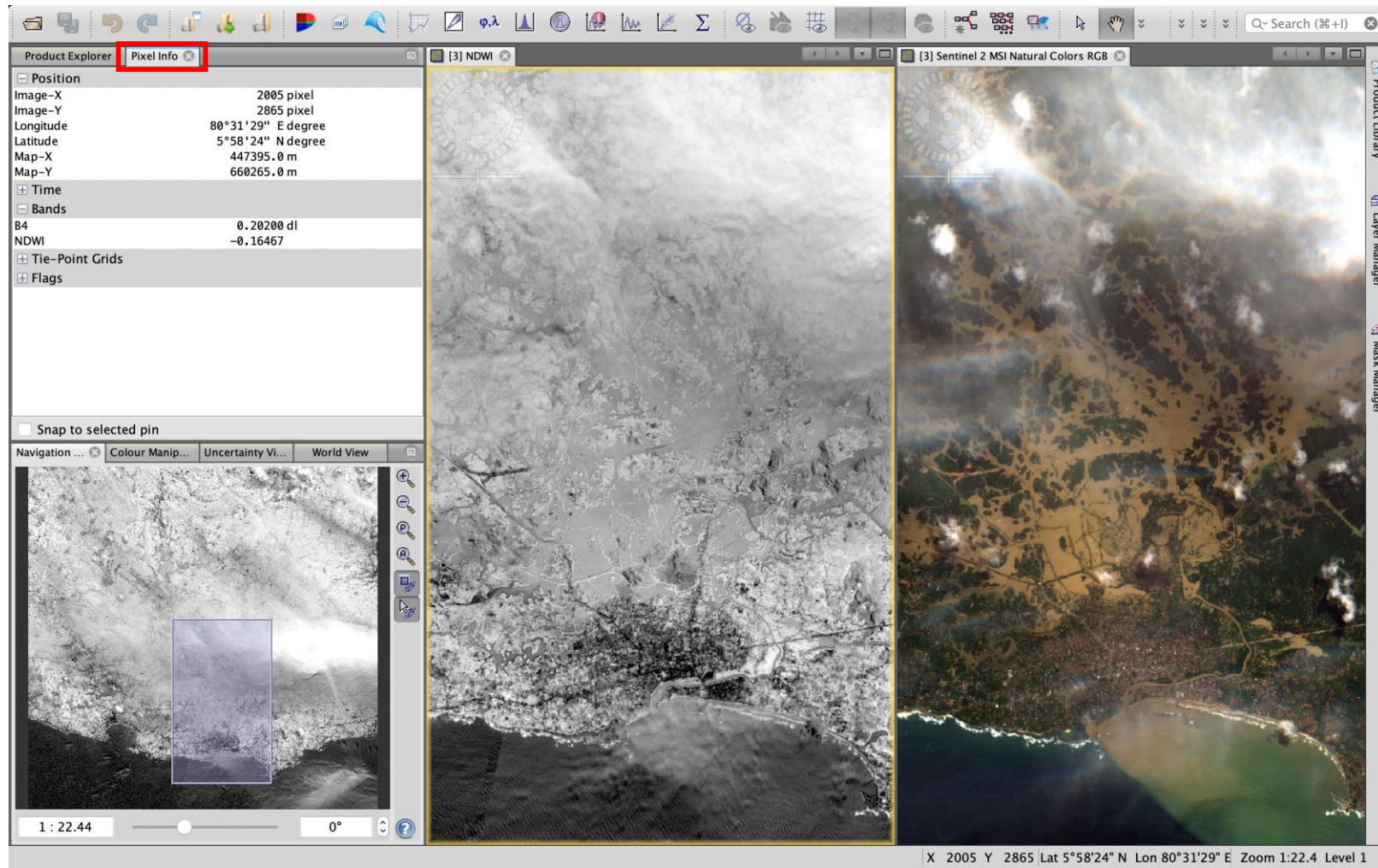


1 : 80.39 0°



Product Library Layer Manager Mask Manager

# Find threshold to extract water

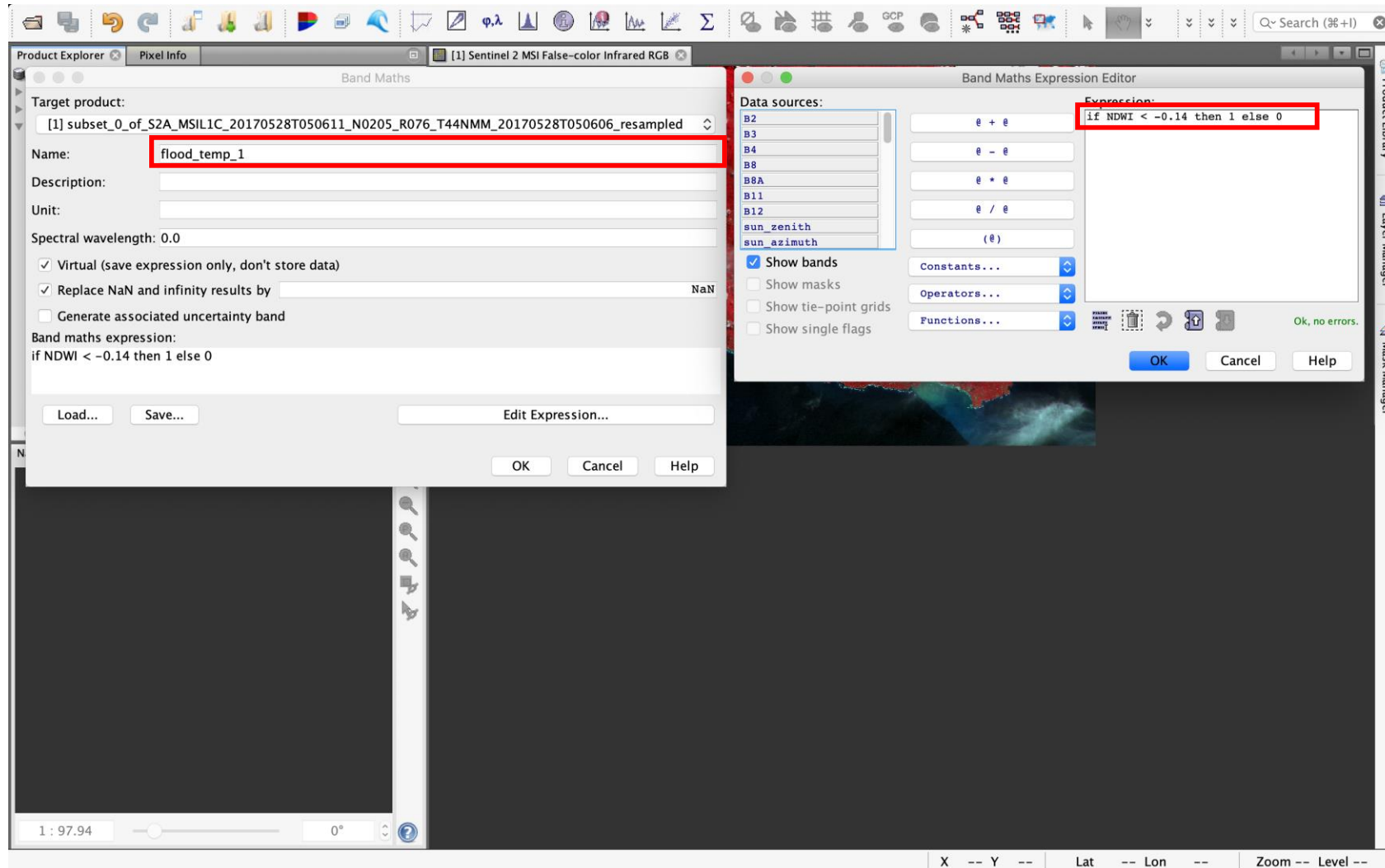


The screenshot shows a GIS application interface with the following components:

- Product Explorer:** Contains a 'Pixel Info' panel (highlighted with a red box) displaying the following data:
 

Position	
Image-X	2005 pixel
Image-Y	2865 pixel
Longitude	80°31'29" E degree
Latitude	5°58'24" N degree
Map-X	447395.0 m
Map-Y	660265.0 m
Time	
Bands	
B4	0.20200 dl
NDWI	-0.16467
Tie-Point Grids	
Flags	
- Main View:** Displays two side-by-side satellite images. The left image is a grayscale NDWI (Normalized Difference Water Index) map, and the right image is a Sentinel 2 MSI Natural Colors RGB image of the same area.
- Navigation Panel:** Located at the bottom left, showing a zoom level of 1:22.44 and a rotation of 0°.
- Bottom Status Bar:** Displays the coordinates and zoom level: X 2005 Y 2865 Lat 5°58'24" N Lon 80°31'29" E Zoom 1:22.4 Level 1.

# Extract water using threshold



The screenshot displays the QGIS interface with the Band Maths Expression Editor dialog box open. The dialog box is titled "Band Maths Expression Editor" and contains the following fields and options:

- Target product:** [1] subset\_0\_of\_S2A\_MSIL1C\_20170528T050611\_N0205\_R076\_T44NMM\_20170528T050606\_resampled
- Name:** flood\_temp\_1
- Description:**
- Unit:**
- Spectral wavelength:** 0.0
- Virtual (save expression only, don't store data)
- Replace NaN and infinity results by NaN
- Generate associated uncertainty band
- Band maths expression:** if NDWI < -0.14 then 1 else 0
- Buttons:** Load..., Save..., Edit Expression..., OK, Cancel, Help

The Expression Editor dialog box is also visible, showing the expression "if NDWI < -0.14 then 1 else 0" in the Expression field. The Data sources list includes B2, B3, B4, B8, B8A, B11, B12, sun\_zenith, and sun\_azimuth. The Expression field is highlighted with a red box.

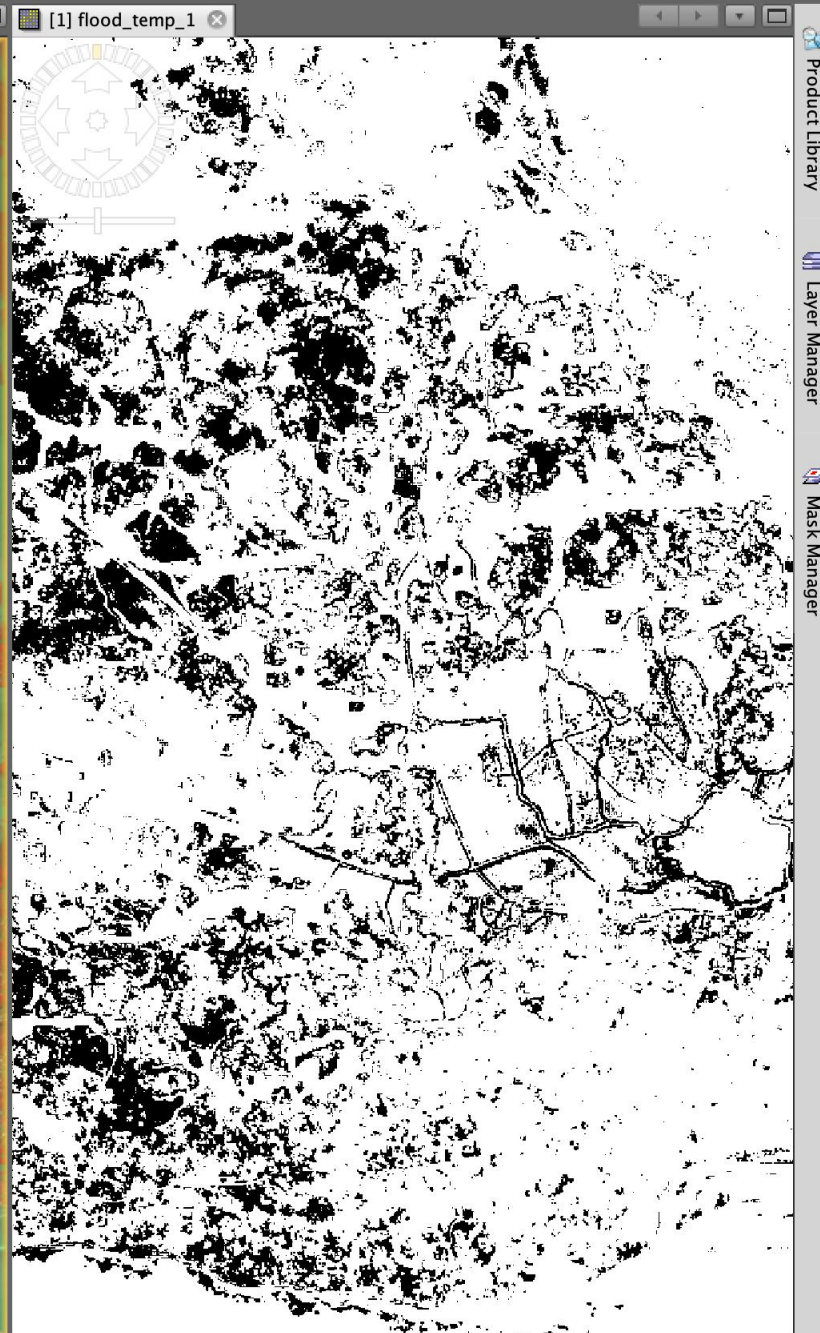
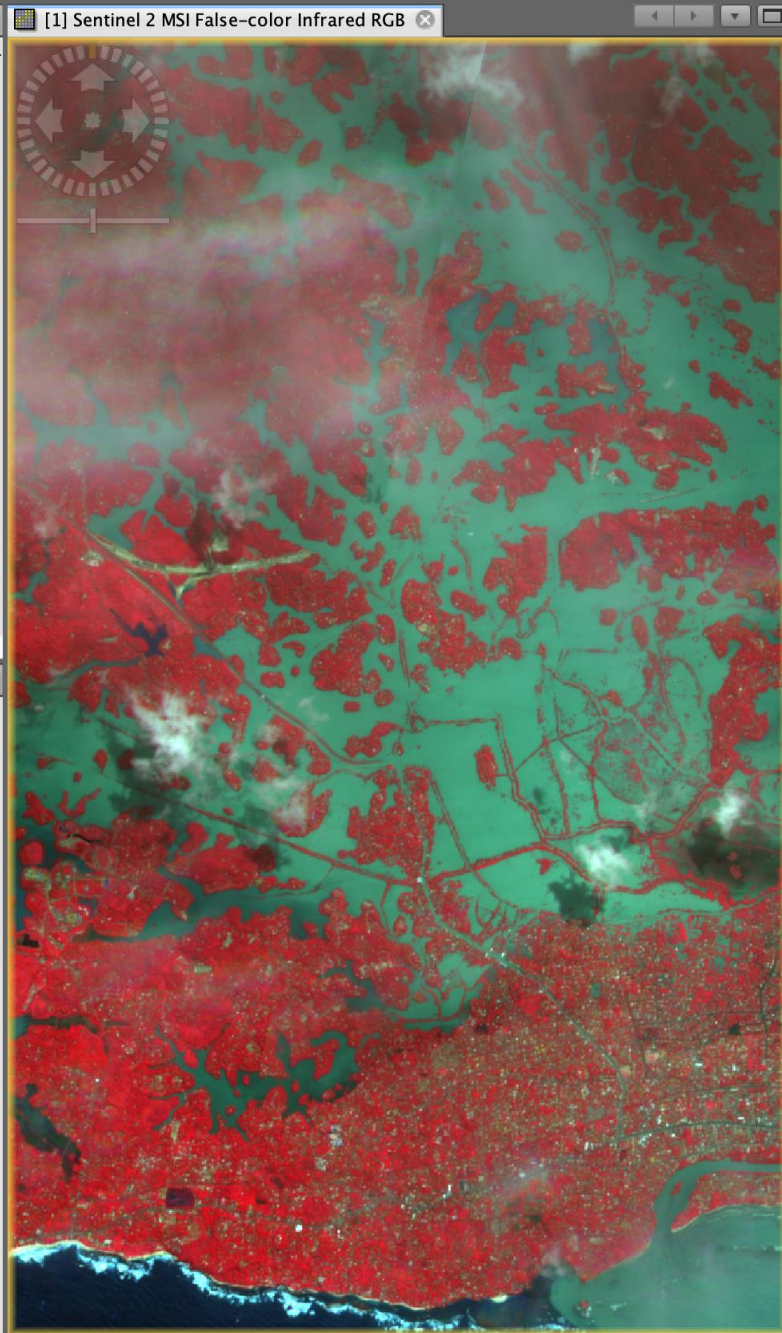


Search (Ctrl+F)

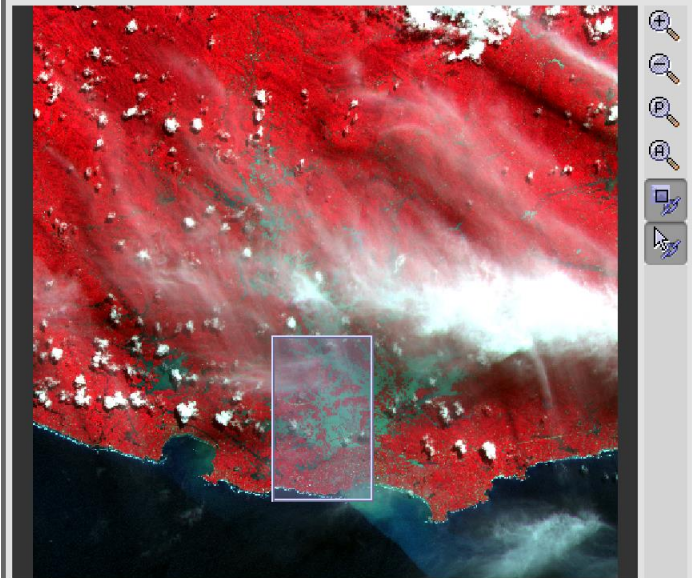


Product Explorer

- 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°

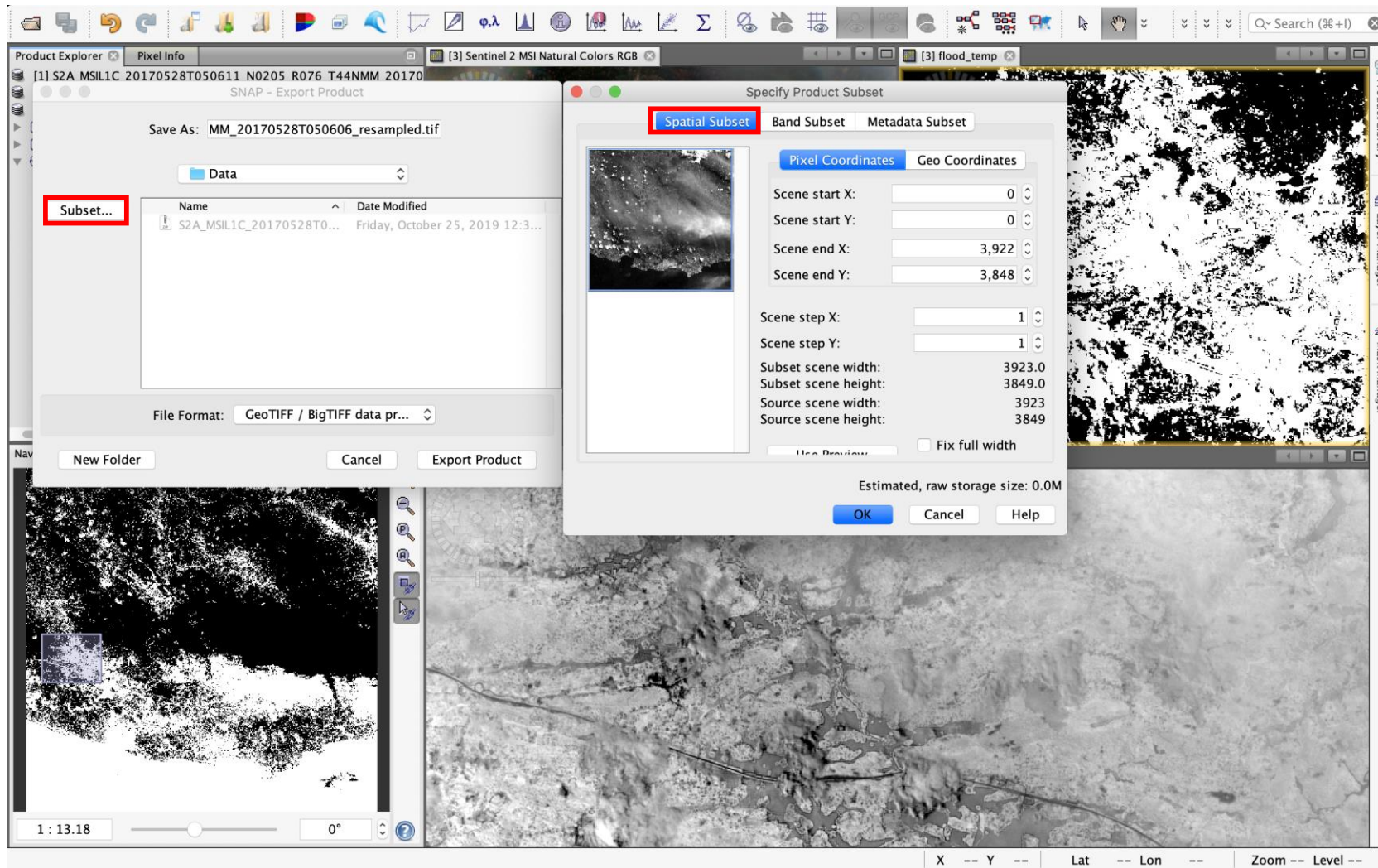
Product Library Layer Manager Mask Manager

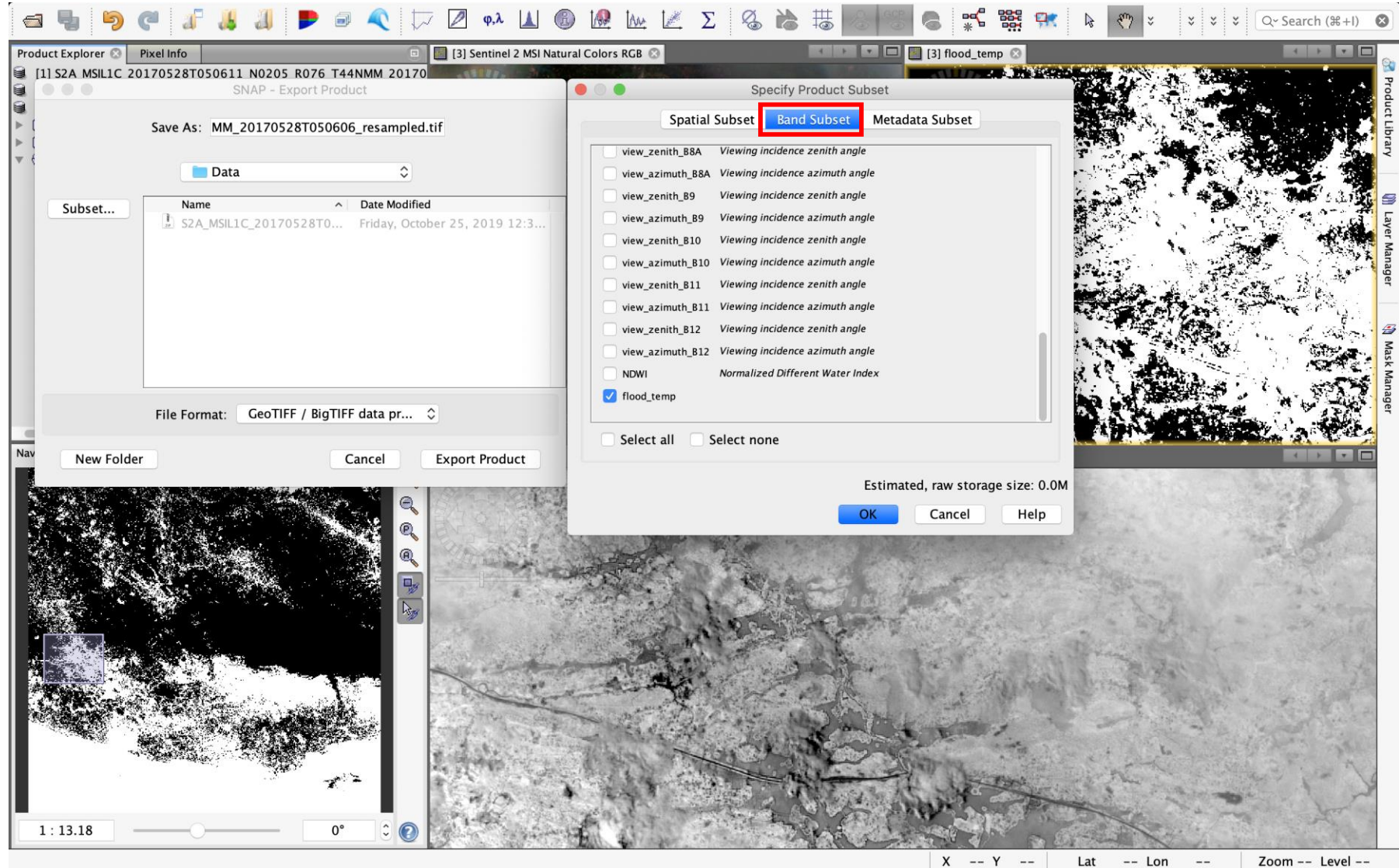


# Export result to other format for further analysis



From the File menu, select Export, then select GeoTIFF





The screenshot displays the SNAP (Sentinel Application Platform) interface. A 'Specify Product Subset' dialog box is open, allowing users to select specific bands for export. The 'Band Subset' tab is active, showing a list of available bands. The 'flood\_temp' band is selected with a checked checkbox. The estimated raw storage size for the selected subset is 0.0M.

**Specify Product Subset Dialog:**

- Spatial Subset:** (Unselected)
- Band Subset:** (Selected)
  - 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
- Metadata Subset:** (Unselected)

Buttons: Select all, Select none, OK, Cancel, Help

Estimated, raw storage size: 0.0M

**SNAP - Export Product Window:**

- Save As: MM\_20170528T050606\_resampled.tif
- File Format: GeoTIFF / BigTIFF data pr...
- Buttons: New Folder, Cancel, Export Product

**Product Explorer:**

- [1] S2A\_MSIL1C\_20170528T050611\_N0205\_R076\_T44NMM\_20170...

**Product Library:**

- Layer Manager
- Mask Manager

**Map View:**

- Scale: 1 : 13.18
- Angle: 0°
- Coordinates: X -- Y -- Lat -- Lon -- Zoom -- Level --



### 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

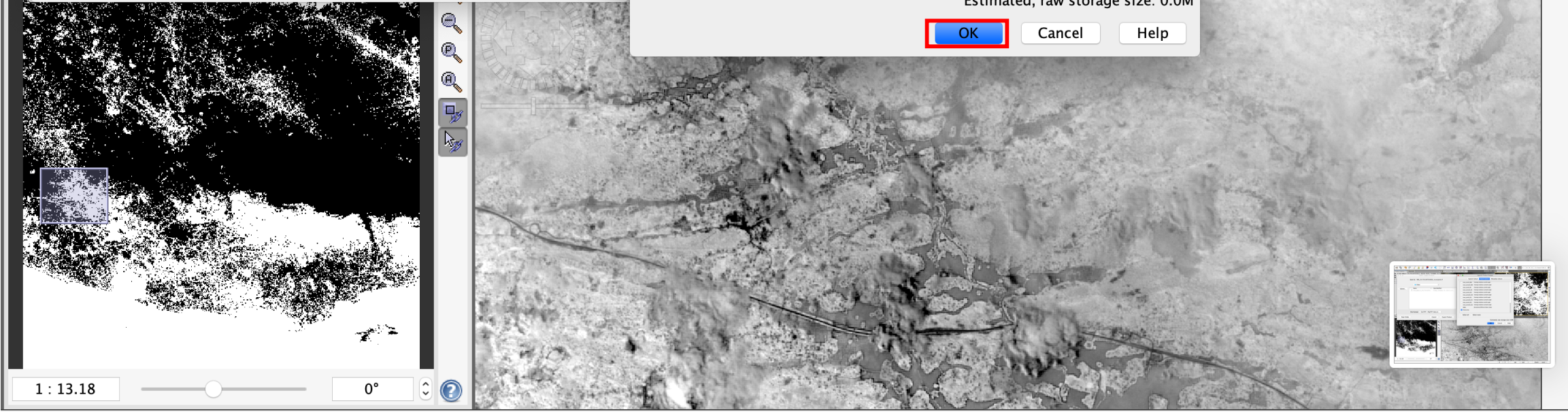
Spatial Subset Band Subset **Metadata Subset**

- 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



Mac OS Finder window titled "Data".

Navigation: Back, Forward, View (Grid, Compare, Web, Info), Settings, Share, Preview, Search.

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...IMAF
▶ 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...IMAF
▶ subset_0_of_S2A_MS...50606_resampled.tif	Nov 11, 2019 at 00:09	142.7 MB	TIFF image

Left sidebar (Favorites, Locations, Tags):

- Favorites:** iCloud Drive
- Locations:** Dan's Mac..., Network
- Tags:** Work, Gray, Green, Home, Purple, Red, Important

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

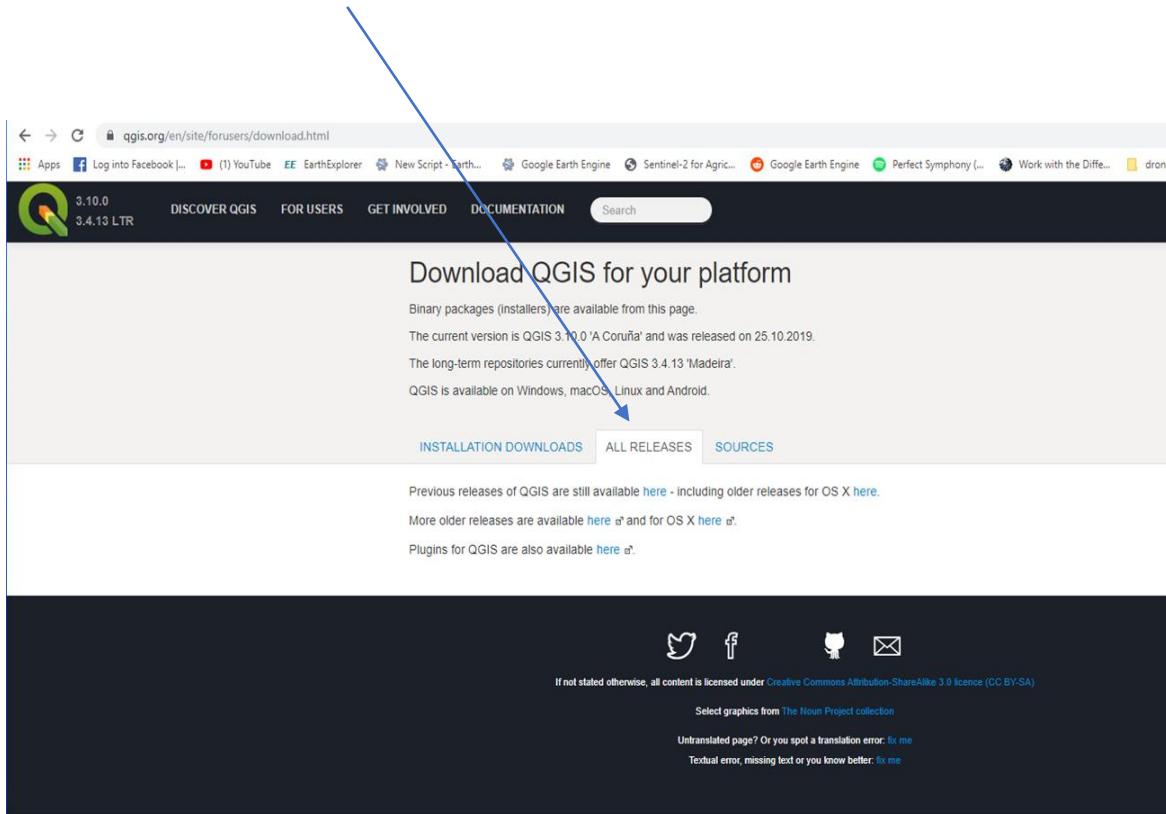
Dr. Dan Tran (AIT)

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 →

	<a href="#">QGIS-OSGeo4W-3.4.6-2-Setup-x86.exe</a>	28-Mar-2019 02:55	446M
	<a href="#">QGIS-OSGeo4W-3.4.6-2-Setup-x86.exe.md5sum</a>	28-Mar-2019 02:55	69
	<a href="#">QGIS-OSGeo4W-3.4.6-2-Setup-x86_64.exe</a>	28-Mar-2019 03:11	483M
	<a href="#">QGIS-OSGeo4W-3.4.6-2-Setup-x86_64.exe.md5sum</a>	28-Mar-2019 03:11	72
	<a href="#">QGIS-OSGeo4W-3.4.7-1-Setup-x86.exe</a>	20-Apr-2019 12:27	446M
	<a href="#">QGIS-OSGeo4W-3.4.7-1-Setup-x86.exe.md5sum</a>	20-Apr-2019 12:27	69
	<a href="#">QGIS-OSGeo4W-3.4.7-1-Setup-x86_64.exe</a>	20-Apr-2019 12:44	483M
	<a href="#">QGIS-OSGeo4W-3.4.7-1-Setup-x86_64.exe.md5sum</a>	20-Apr-2019 12:44	72
	<a href="#">QGIS-OSGeo4W-3.4.8-1-Setup-x86.exe</a>	18-May-2019 02:47	445M
	<a href="#">QGIS-OSGeo4W-3.4.8-1-Setup-x86.exe.md5sum</a>	18-May-2019 02:47	69
	<a href="#">QGIS-OSGeo4W-3.4.8-1-Setup-x86_64.exe</a>	18-May-2019 02:55	482M
	<a href="#">QGIS-OSGeo4W-3.4.8-1-Setup-x86_64.exe.md5sum</a>	18-May-2019 02:55	72
	<a href="#">QGIS-OSGeo4W-3.4.9-1-Setup-x86.exe</a>	22-Jun-2019 10:51	445M
	<a href="#">QGIS-OSGeo4W-3.4.9-1-Setup-x86.exe.md5sum</a>	22-Jun-2019 10:51	69
	<a href="#">QGIS-OSGeo4W-3.4.9-1-Setup-x86_64.exe</a>	22-Jun-2019 10:59	482M

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

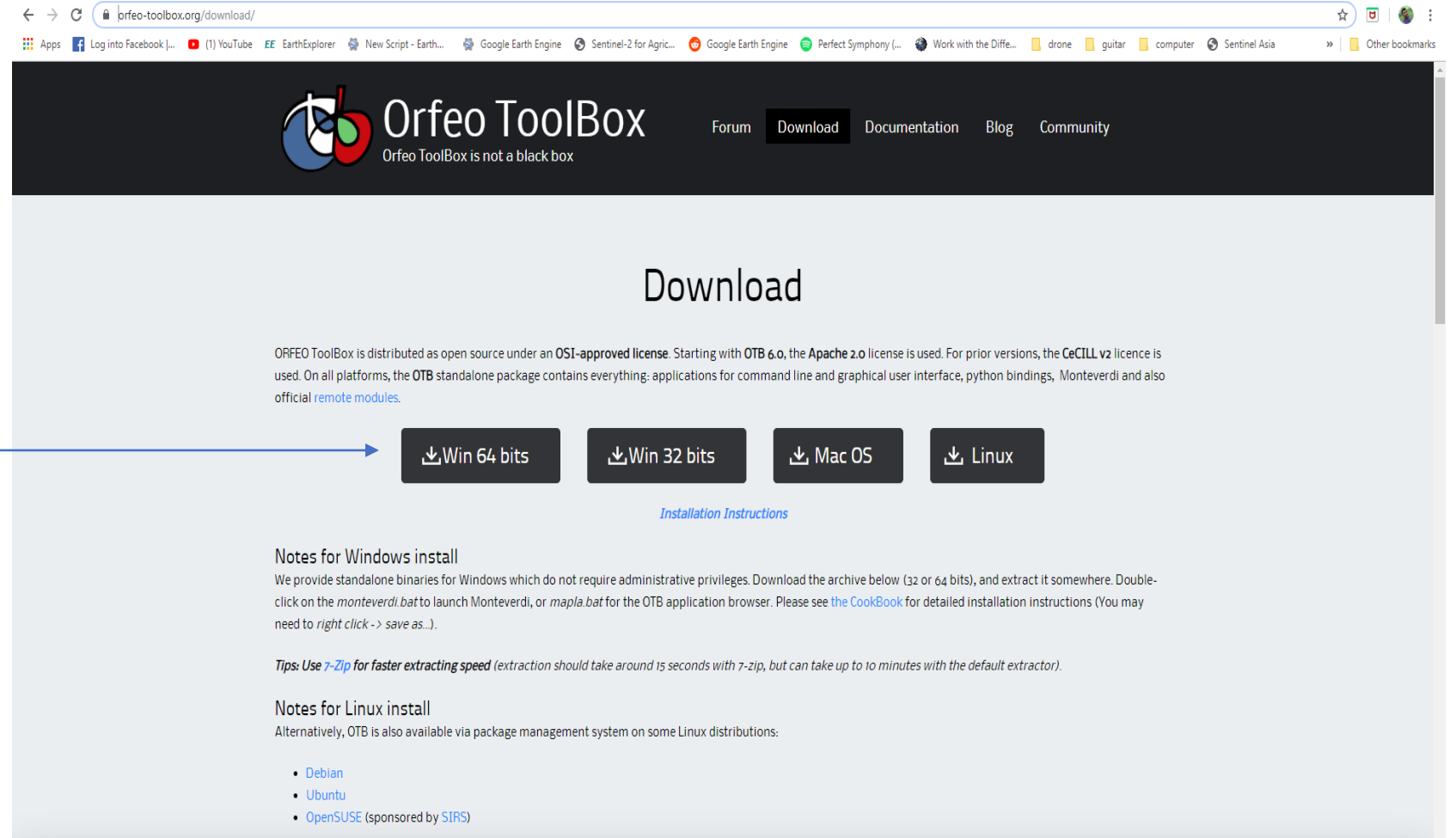
## (2) Installing Orfeo toolbox for remote sensing image processing

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



The screenshot shows the Orfeo Toolbox website's download page. The browser's address bar displays 'orfeo-toolbox.org/download/'. The website header features the Orfeo Toolbox logo and the tagline 'Orfeo ToolBox is not a black box'. Navigation links include 'Forum', 'Download', 'Documentation', 'Blog', and 'Community'. The main heading is 'Download'. Below this, a paragraph explains the open-source license: 'ORFEO ToolBox is distributed as open source under an OSI-approved license. Starting with OTB 6.0, the Apache 2.0 license is used. For prior versions, the CeCILL v2 licence is used. On all platforms, the OTB standalone package contains everything: applications for command line and graphical user interface, python bindings, Monteverdi and also official remote modules.' Four download buttons are provided: 'Win 64 bits', 'Win 32 bits', 'Mac OS', and 'Linux'. A blue arrow points from the text 'Eg: Windows 64 bits' to the 'Win 64 bits' button. Below the buttons is a link for 'Installation Instructions'. The page also contains 'Notes for Windows install' and 'Notes for Linux install' sections.

ORFEO ToolBox is distributed as open source under an **OSI-approved license**. Starting with OTB 6.0, the **Apache 2.0** license is used. For prior versions, the **CeCILL v2** licence is used. On all platforms, the OTB standalone package contains everything: applications for command line and graphical user interface, python bindings, Monteverdi and also official [remote modules](#).

[↓ Win 64 bits](#)   [↓ Win 32 bits](#)   [↓ Mac OS](#)   [↓ Linux](#)

[Installation Instructions](#)

### Notes for Windows install

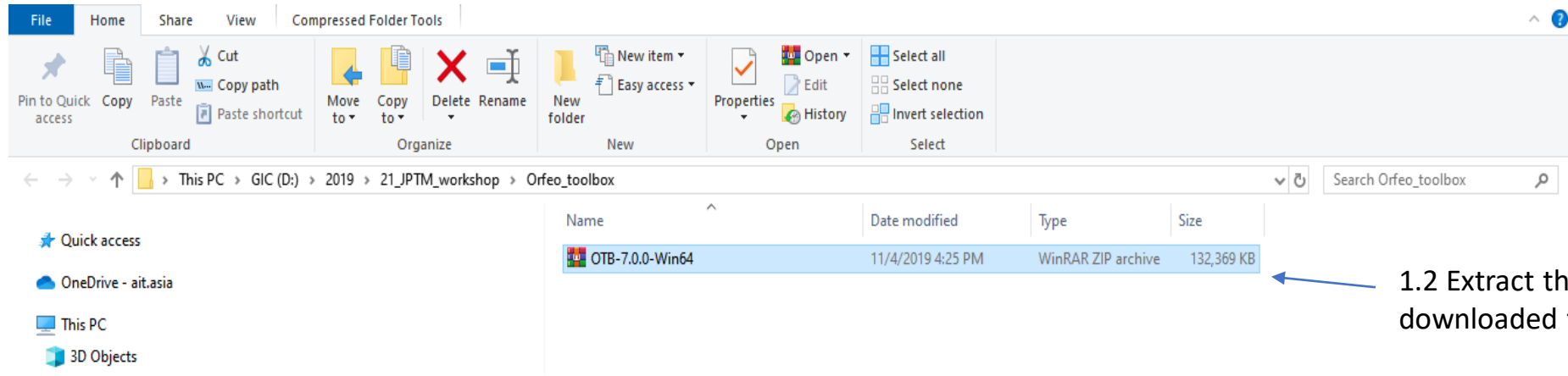
We provide standalone binaries for Windows which do not require administrative privileges. Download the archive below (32 or 64 bits), and extract it somewhere. Double-click on the *monteverdi.bat* to launch Monteverdi, or *mapla.bat* for the OTB application browser. Please see [the Cookbook](#) for detailed installation instructions (You may need to *right click* -> *save as...*).

*Tips: Use 7-Zip for faster extracting speed (extraction should take around 15 seconds with 7-zip, but can take up to 10 minutes with the default extractor).*

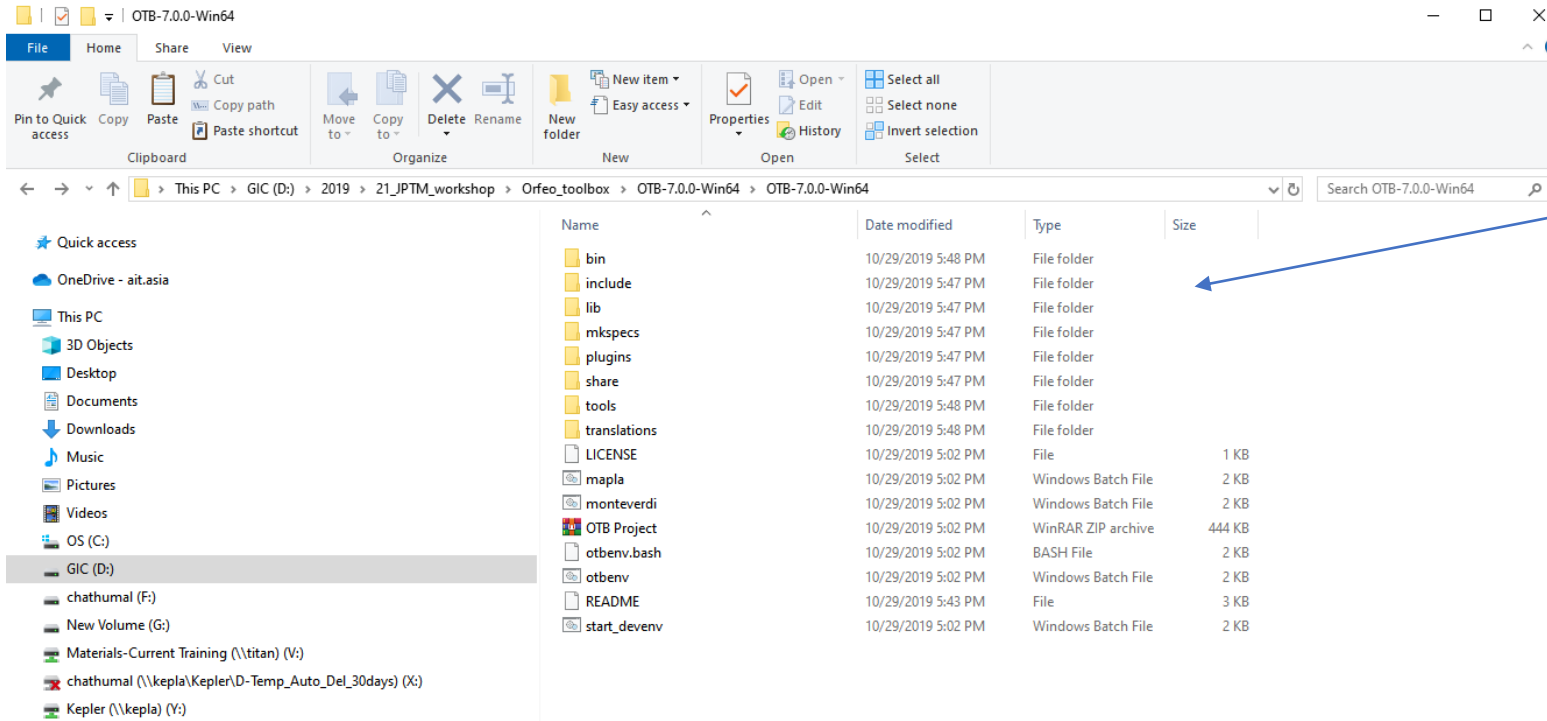
### Notes for Linux install

Alternatively, OTB is also available via package management system on some Linux distributions:

- [Debian](#)
- [Ubuntu](#)
- [OpenSUSE](#) (sponsored by [SIRS](#))



1.2 Extract this downloaded file.

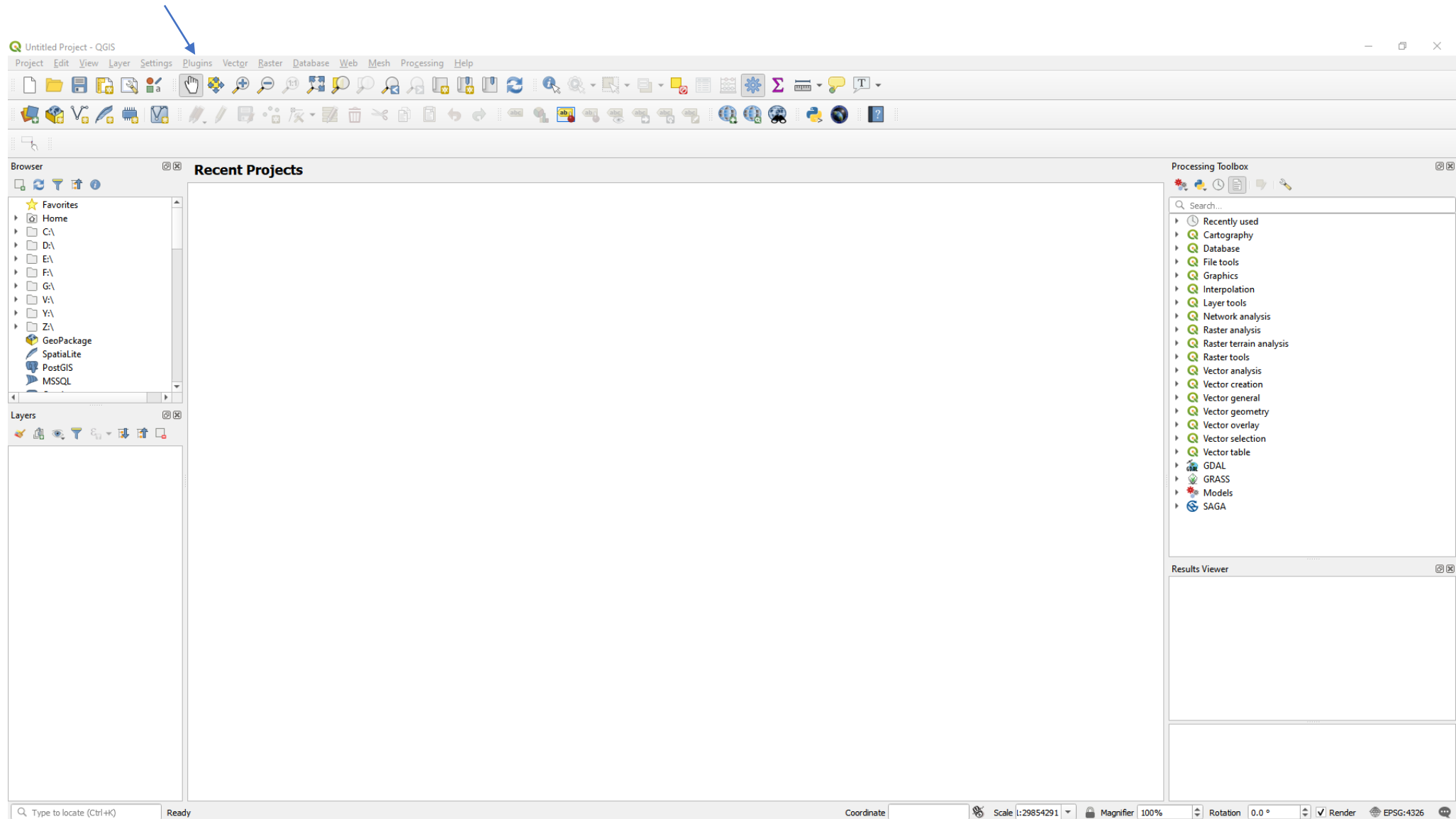


1.3 In the extracted folder you will see folders like below. Copy all the files in the extracted folder.

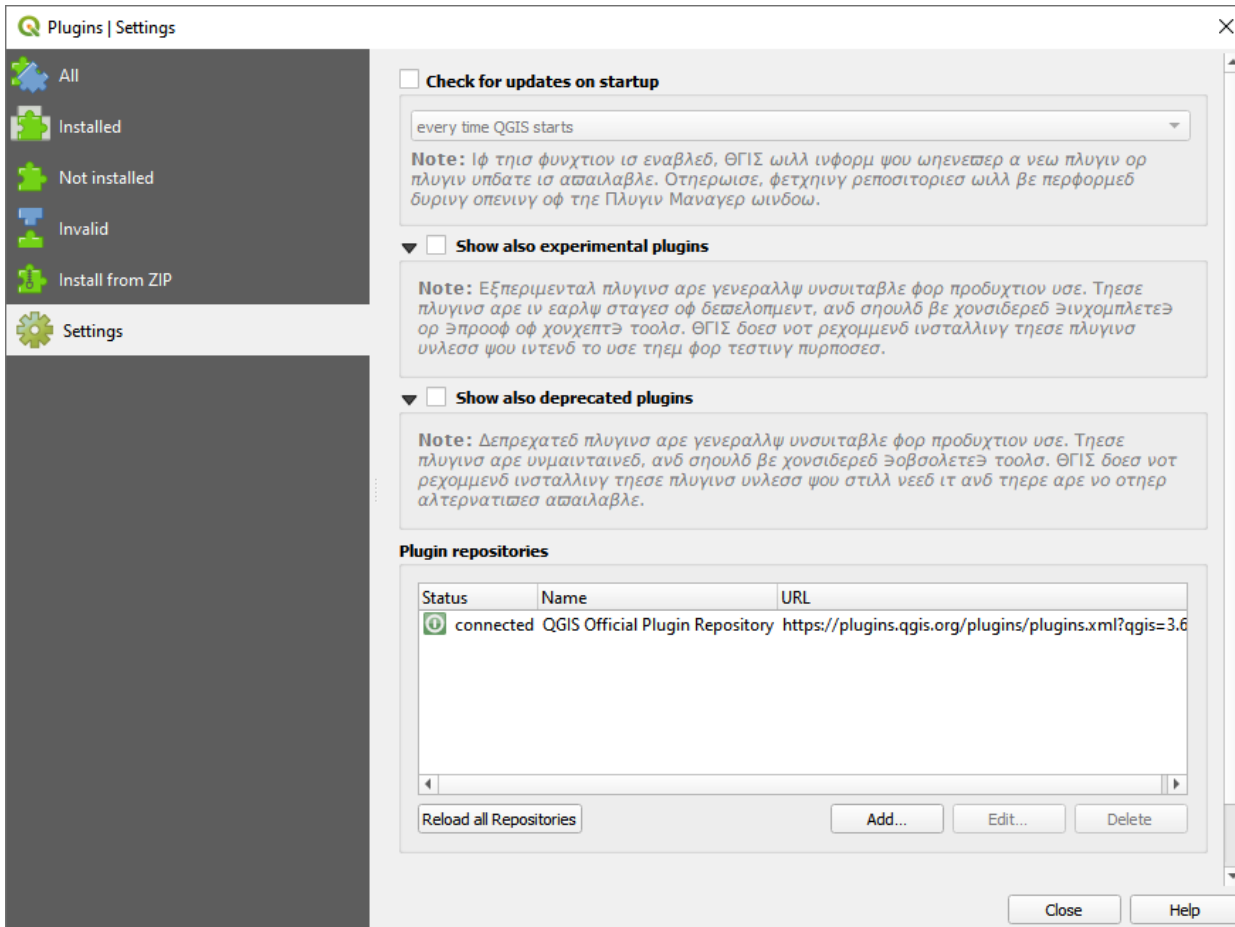
1.4 Create a folder in C drive (according to your preference) and paste these files in a folder and name it as **OTB**



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



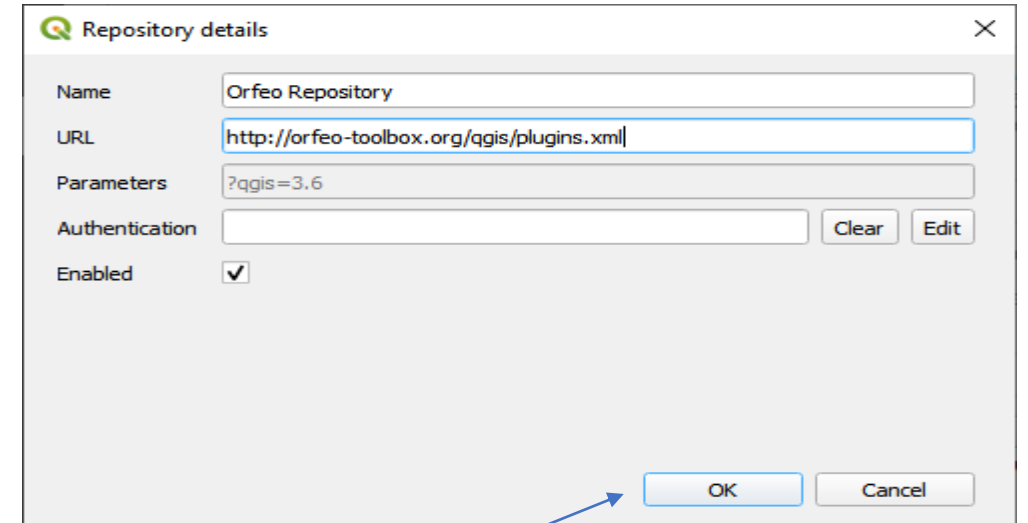
## 1.6 Goto Plugins > Settings Click Add under Plugin repository



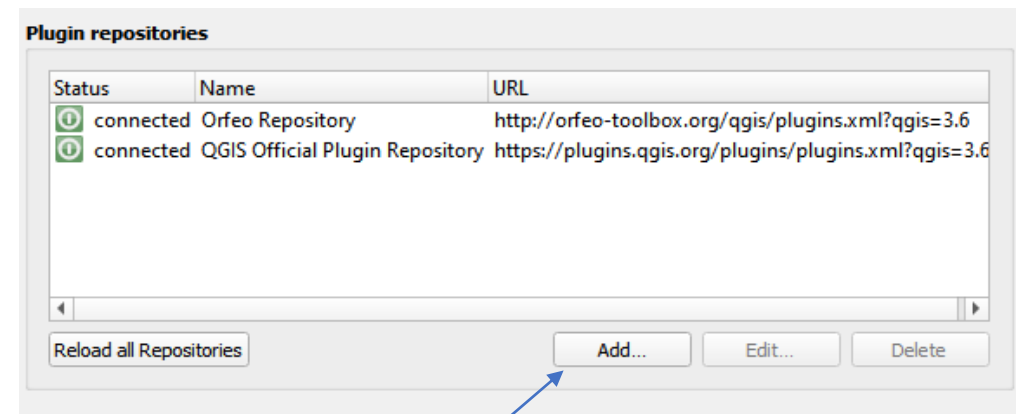
1.7 Add these details in the following tabs.

Name: Orfeo Repository

URL : <http://orfeo-toolbox.org/qgis/plugins.xml>

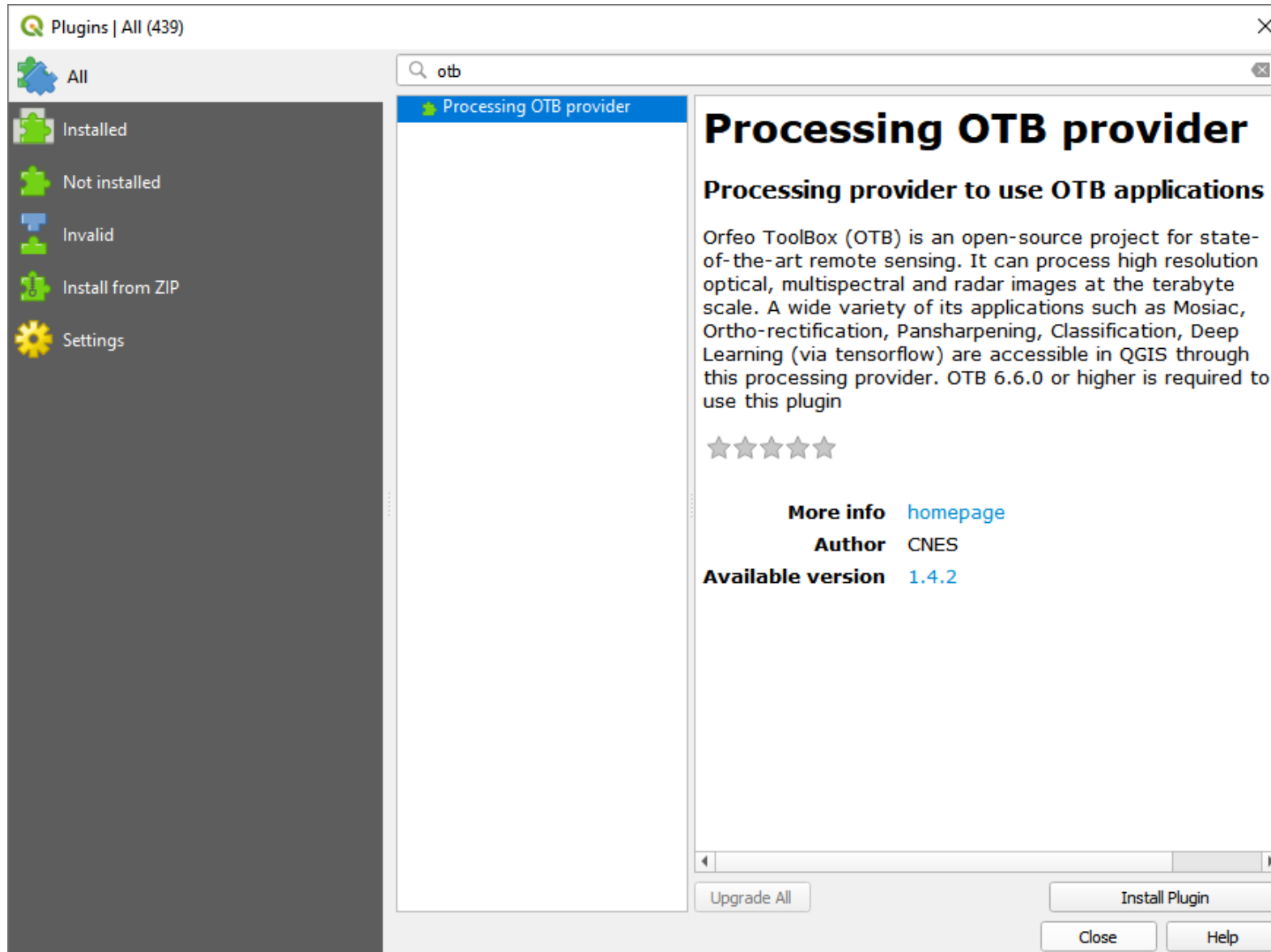


After adding information Press OK



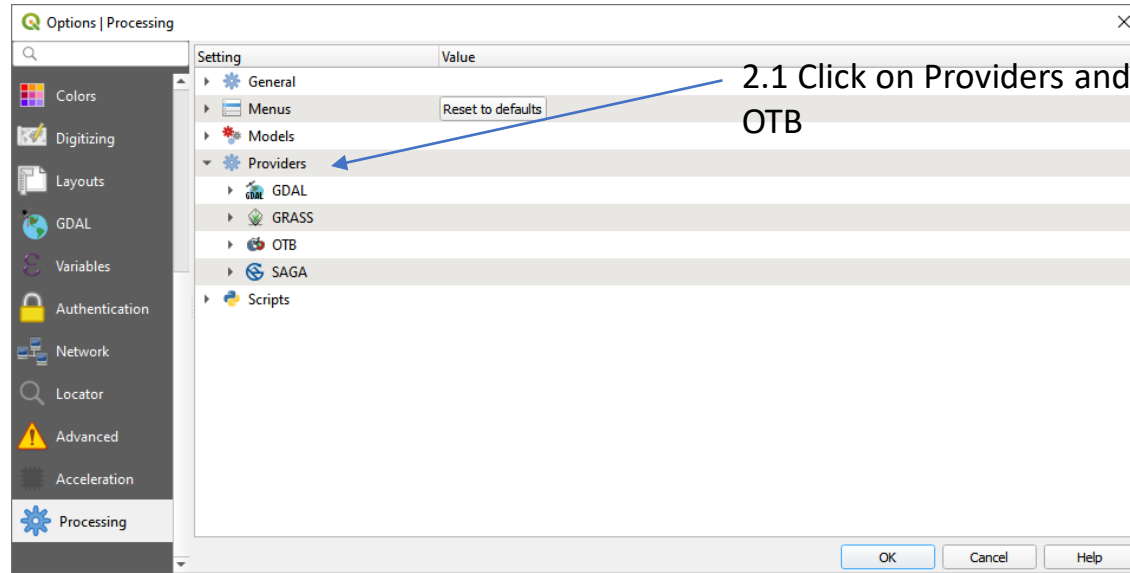
Click Add

## 1.8 Goto Plugins > Manage and Install Plugins

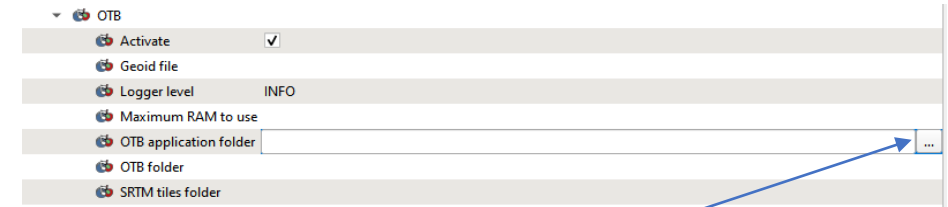


1.9 Type **otb** in the search bar and click on **install plugin**

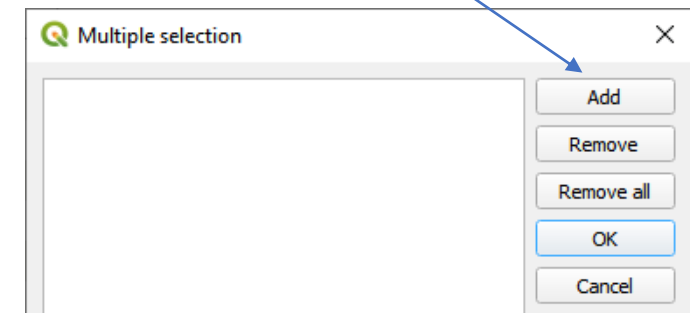
## 2.0 Goto Settings > options > Processing



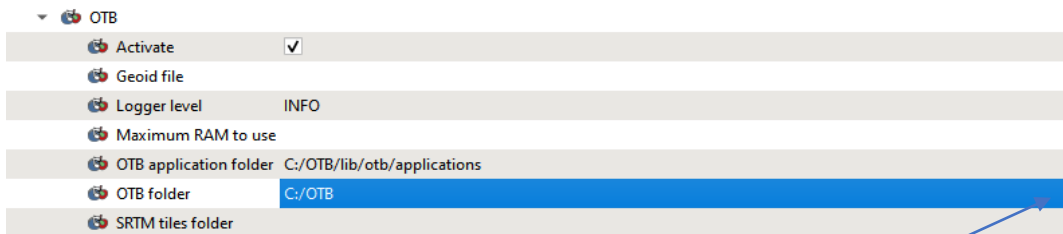
2.1 Click on Providers and select OTB



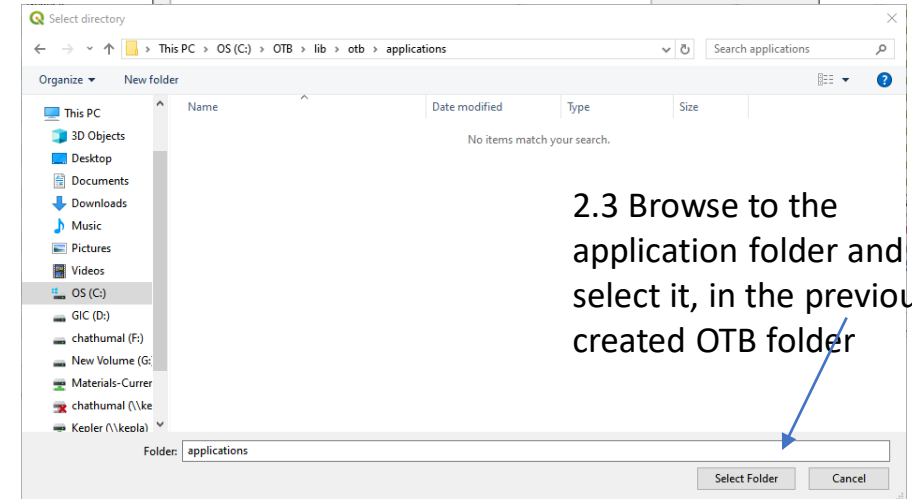
2.2 Click here and click on Add on the Multiple selection tab.



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



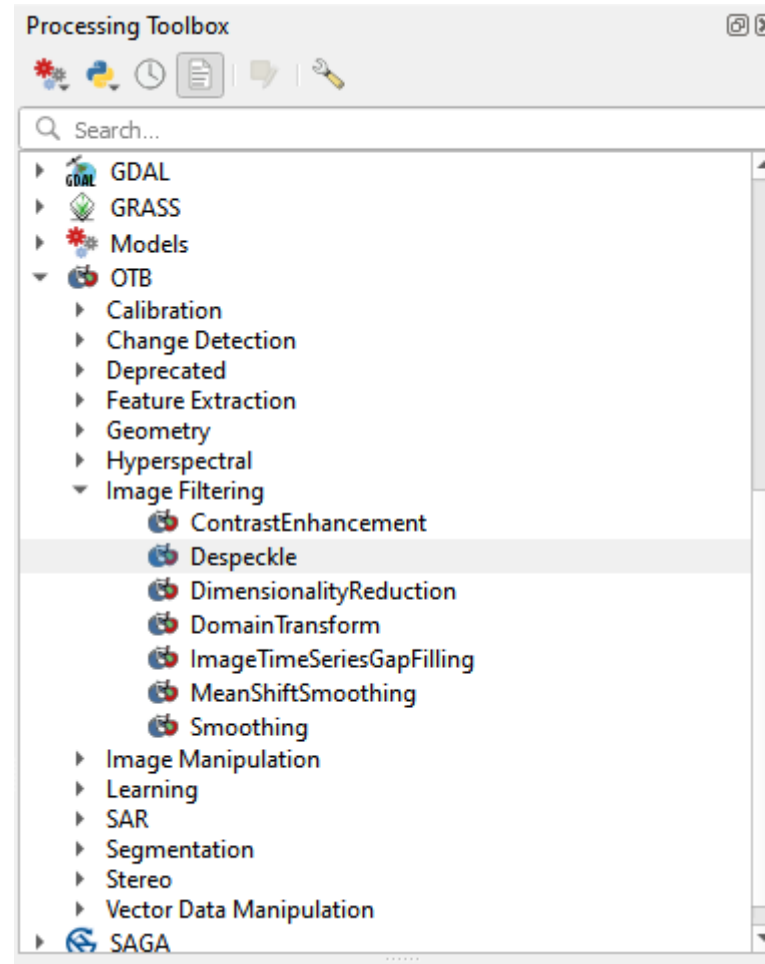
2.4 Click here and do the same process and select the OTB folder this time



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
  - Calibration
  - Change Detection
  - Deprecated
  - Feature Extraction
  - Geometry
  - Hyperspectral
  - Image Filtering
  - Image Manipulation
  - Learning
  - SAR
  - Segmentation
  - Stereo
  - Vector Data Manipulation

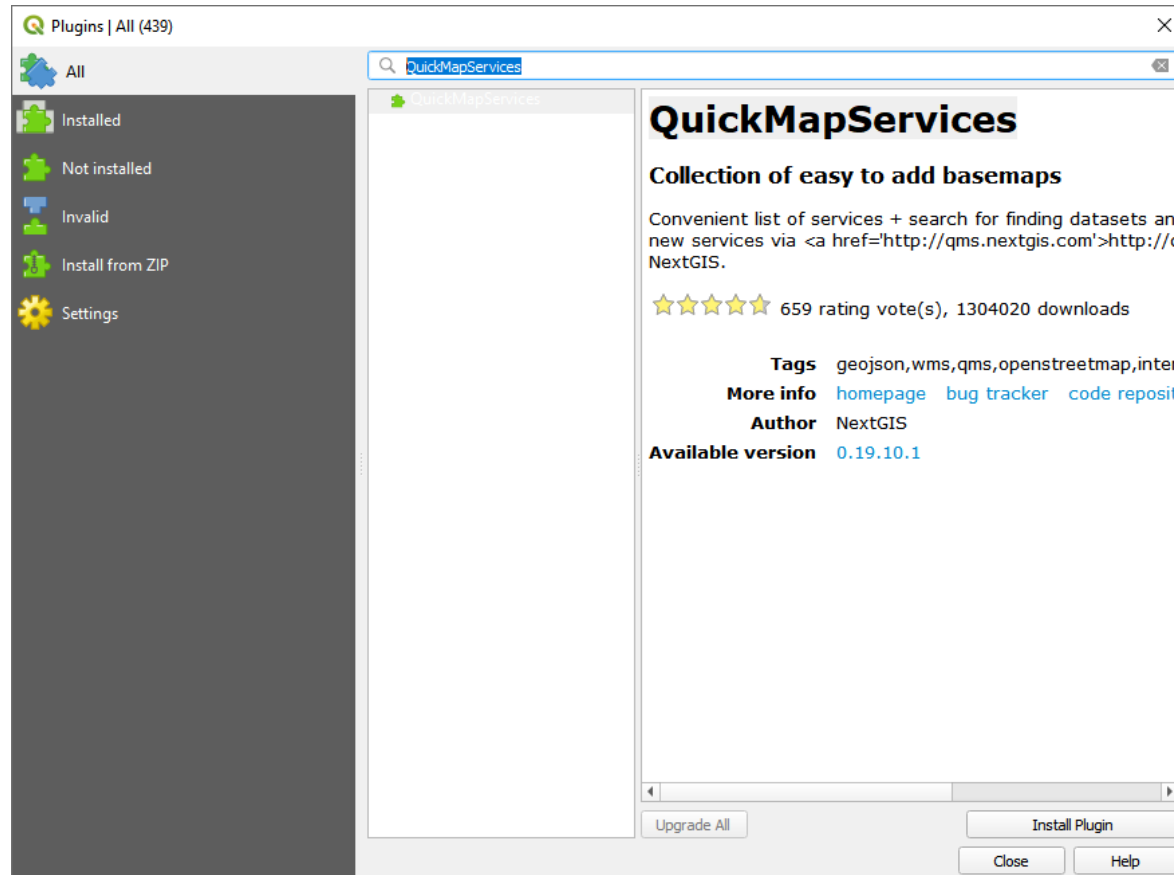


**OTB toolbox installation procedure is same for the other operating systems.**

### (3) Adding base maps for QGIS

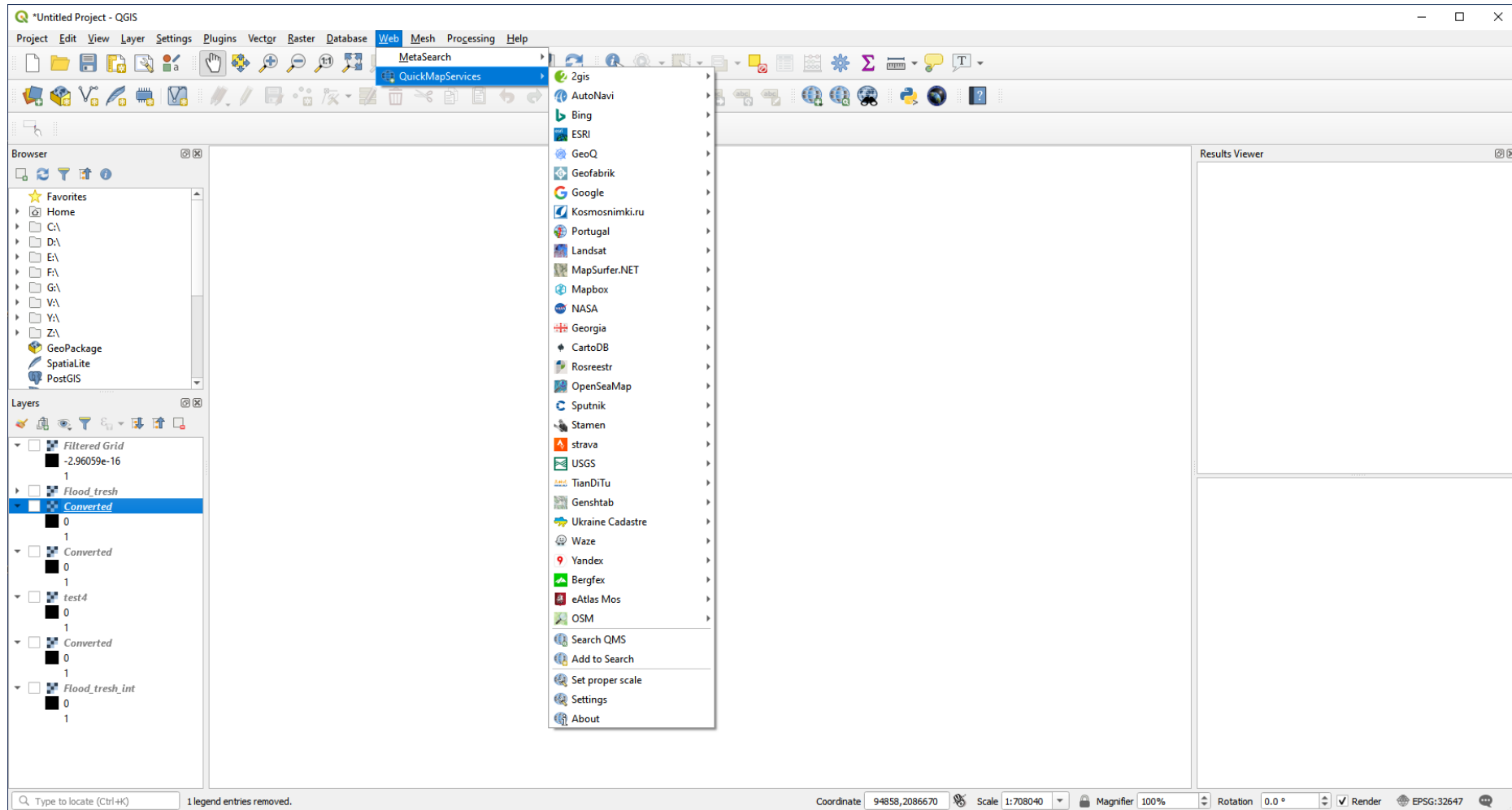
1.1 Goto **Plugins > Settings** Click **Add** under **Plugin repository**

1.2 Type **QuickMapServices** in the search bar



1.3 click on install plugin

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



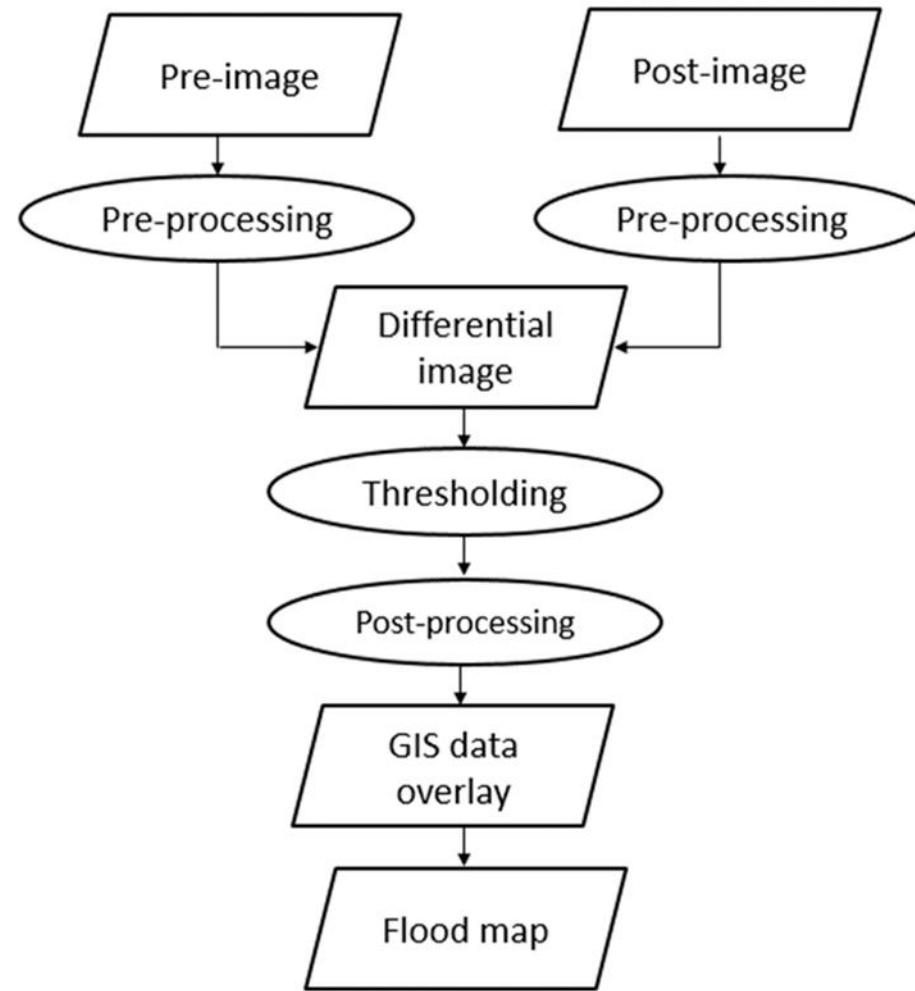
Thank you



# Flood Extraction Using ALOS 2 PALSAR 2 Data

**Chathumal Madhuranga (AIT)**

# Methodology behind the Flood extraction



## ALOS 2 PALSAR 2 Data Calibration

$$\sigma^0 [\text{dB}] = 10 \log_{10} (DN)^2 + CF$$

$\sigma^0$  – Radar Backscatter

$DN$  – Pixel DN values

$CF$  - Calibration Factor

1 Open QGIS installed on your computer

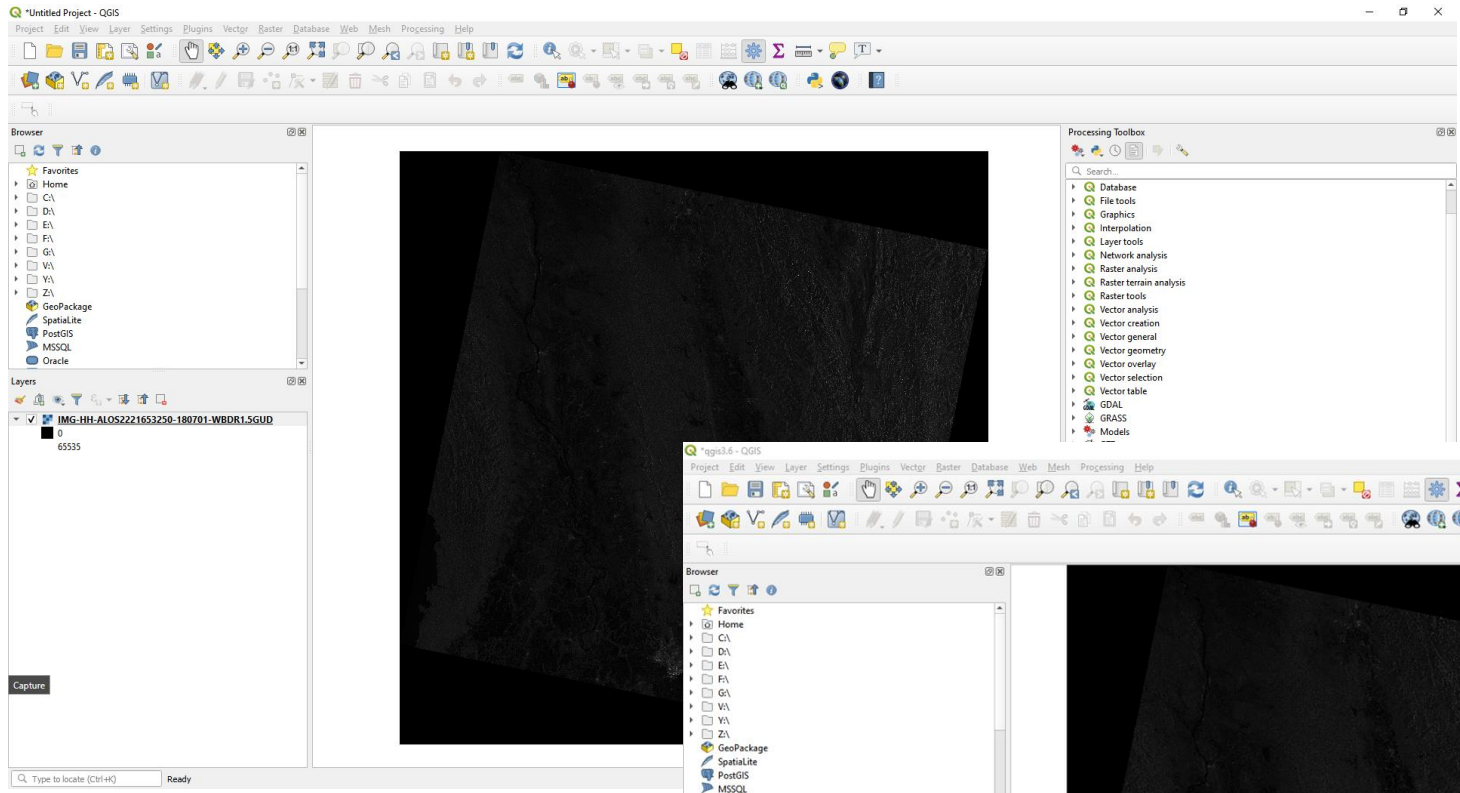
1.1 Goto Layer > Add Layer > Add Raster Layer

1.2 Browse the path to your image

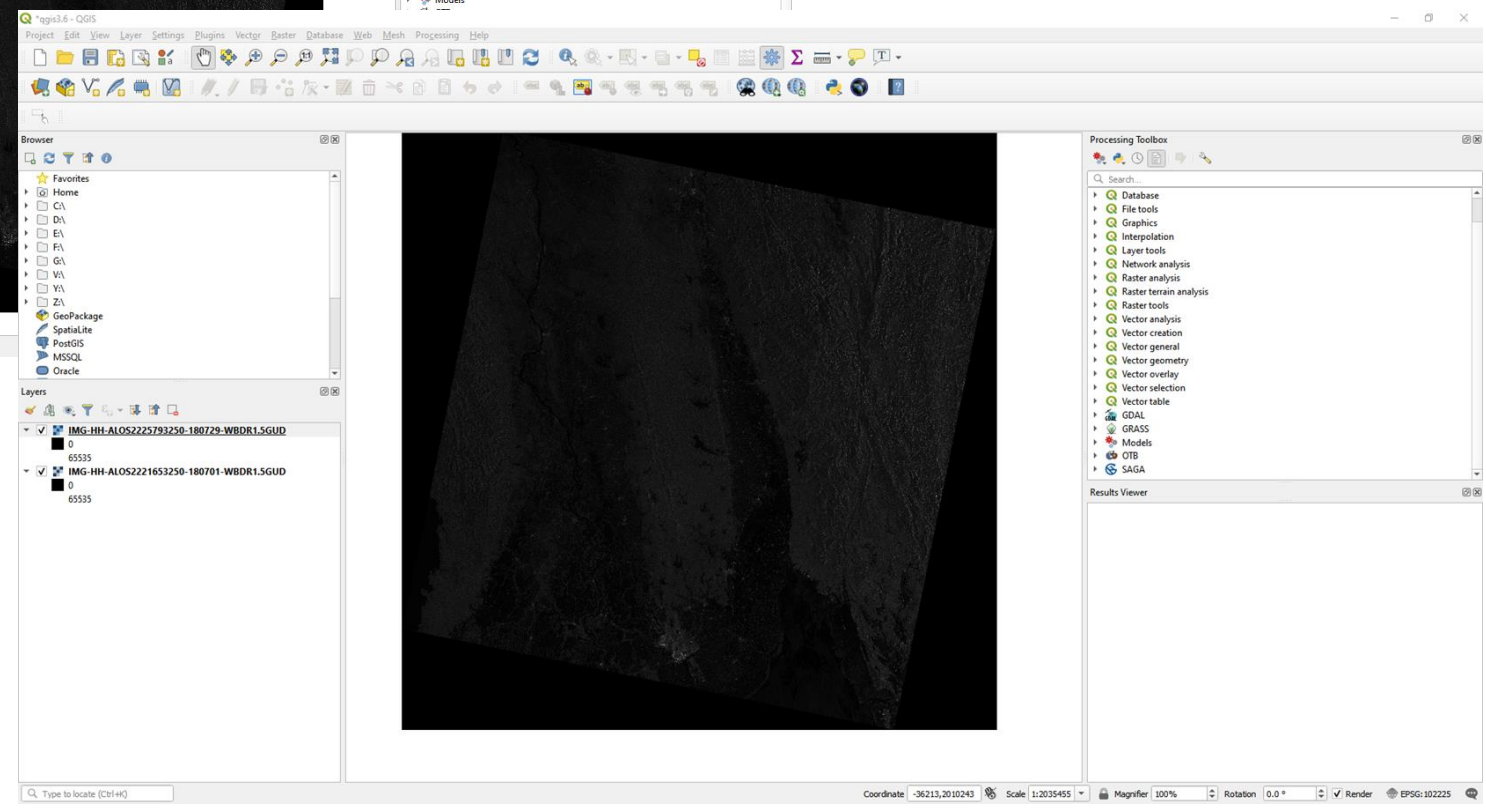
QGIS interface showing the process of adding a raster layer. The 'Data Source Manager | Raster' dialog is open, and the 'Open GDAL Supported Raster Dataset(s)' file browser is also open, showing a list of files. A blue arrow points from the 'Layer > Add Layer > Add Raster Layer' menu path to the 'Data Source Manager' dialog. Another blue arrow points from the 'Browse the path to your image' text to the file browser. A third blue arrow points from the '1.3 Select the HH polarized image [Pre-Image (18/07/01)]' text to the selected file in the file browser.

Name	Date modified	Type	Size
ALOS2221653250-180701-WBDR1.5GUD	7/30/2018 9:13 AM	KML	4 KB
BRS-HH-ALOS2221653250-180701-WBDR1.5GUD	7/30/2018 9:13 AM	JPG File	106 KB
BRS-HV-ALOS2221653250-180701-WBDR1.5GUD	7/30/2018 9:13 AM	JPG File	105 KB
IMG-HH-ALOS2221653250-180701-WBDR1.5GUD	7/30/2018 9:13 AM	TIF File	553,937 KB
IMG-HH-ALOS2221653250-180701-WBDR1.5GUD.tif.aux	10/24/2019 10:17 PM	XML Document	1 KB
IMG-HV-ALOS2221653250-180701-WBDR1.5GUD	7/30/2018 9:13 AM	TIF File	553,937 KB
LUT-HH-ALOS2221653250-180701-WBDR1.5GUD	7/30/2018 9:13 AM	Text Document	377 KB
LUT-HV-ALOS2221653250-180701-WBDR1.5GUD	7/30/2018 9:13 AM	Text Document	377 KB
summary	7/30/2018 9:13 AM	Text Document	3 KB

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

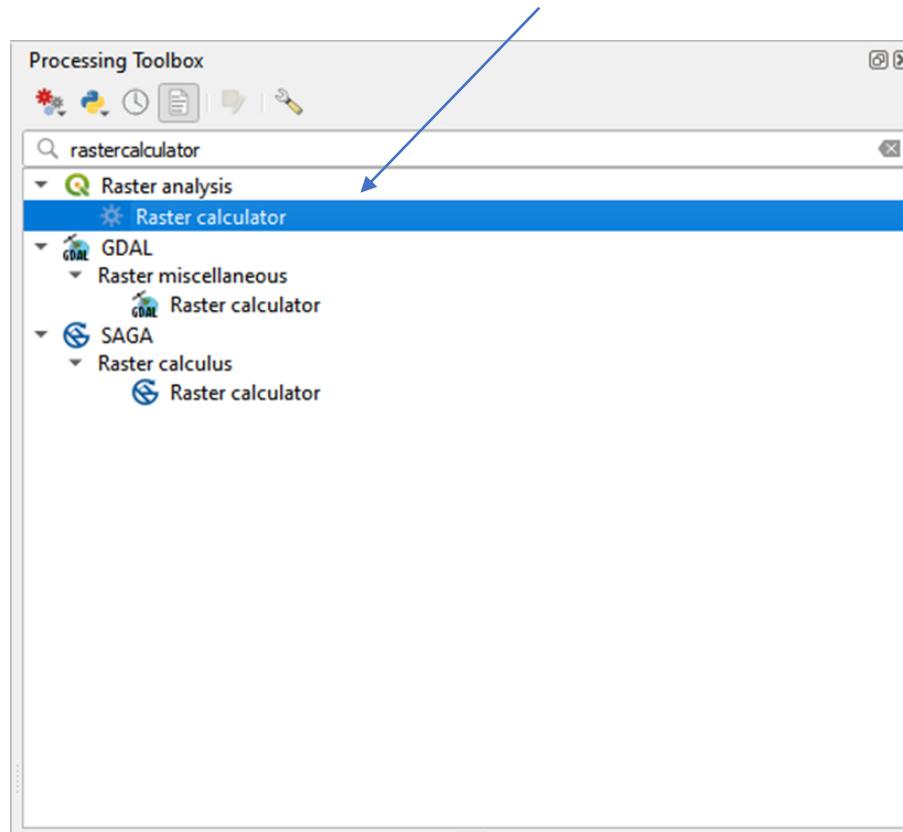


1.4 Similarly add the Post Image →  
[Post-Image (18/07/29)]

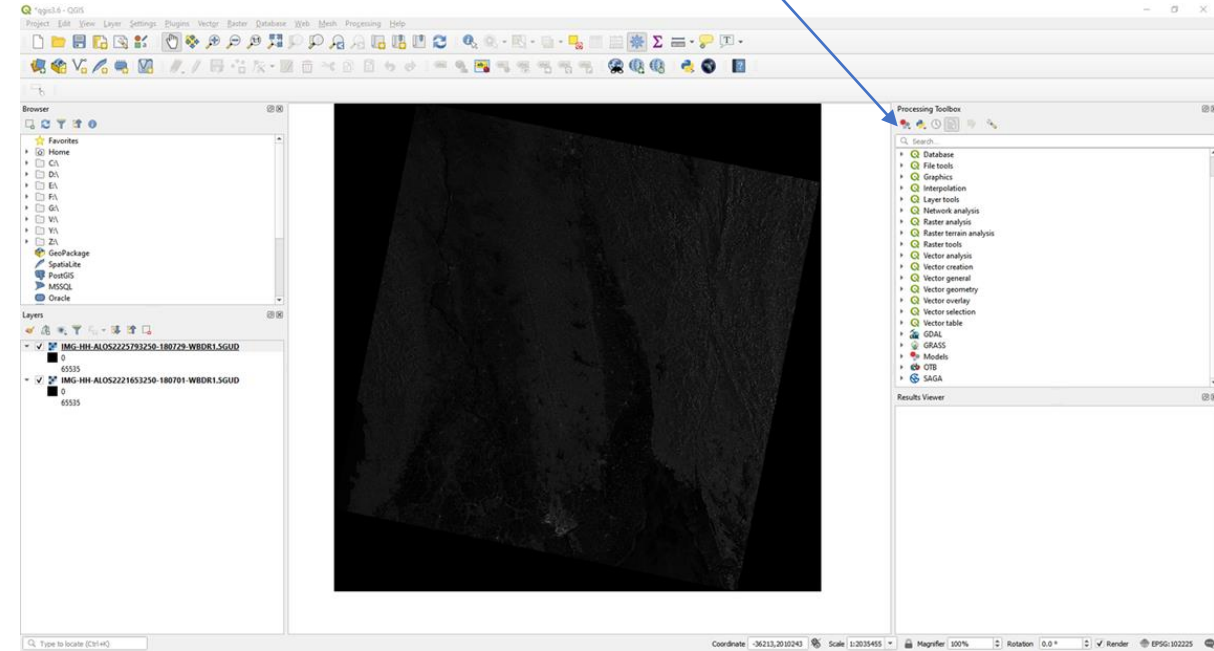


## 2 Image Calibration

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



2.1 In Processing toolbox search bar type raster calculator.



2.3 Input the Calibration Expression here

**Raster Calculator**

Parameters Log

Expression

Layers

- IMG-HH-ALOS2221653250-180701-WBDR1.5GUD@1
- IMG-HH-ALOS2225793250-180729-WBDR1.5GUD@1

Operators

Expression

(20 \* log10((IMG-HH-ALOS2221653250-180701-WBDR1.5GUD@1)) - 83

Predefined expressions

NDVI

Reference layer(s) (used for automated extent, cellsize, and CRS) [optional]

1 elements selected

Cell size (use 0 or empty to set it automatically) [optional]

0.000000

Output extent (xmin, xmax, ymin, ymax) [optional]

[Leave blank to use min covering extent]

Output CRS [optional]

Project CRS: EPSG:102225 - MONREF\_1997\_UTM\_Zone\_47N

Output

D:/2019/21\_JPTM\_workshop/Results/Pre\_Calib.tif

Open output file after running algorithm

0%

Run as Batch Process...

Run Close Help

**Raster calculator**

This algorithm allows performing algebraic operations using raster layers.

The resulting layer will have its values computed according to an expression. The expression can contain numerical values, operators and references to any of the layers in the current project. The following functions are also supported:

- sin(), cos(), tan(), atan2(), ln(), log10()

The extent, cell size, and output CRS can be defined by the user. If the extent is not specified, the minimum extent that covers selected reference layer(s) will be used. If the cell size is not specified, the minimum cell size of selected reference layer(s) will be used. If the output CRS is not specified, the CRS of the first reference layer will be used.

The cell size is assumed to be the same in both X and Y axes.

Layers are referred by their name as displayed in the layer list and the number of the band to use (based on 1), using the pattern 'layer\_name@band number'. For instance, the first band from a layer named DEM will be referred as DEM@1.

When using the calculator in the batch interface or from the console, the files to use have to be specified. The corresponding layers are referred using the base name of the file (without the full path). For instance, if using a layer at path/to/my/rasterfile.tif, the first band of that layer will be referred as rasterfile.tif@1.

2.4 Click on this icon and select a reference layer

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

2.7 Click Run

**Raster Calculator**

Parameters Log

Expression

Layers

- IMG-HH-ALOS2221653250-180701-WBDR1.5GUD@1
- IMG-HH-ALOS2225793250-180729-WBDR1.5GUD@1

Operators

Expression

(20 \* log10((IMG-HH-ALOS2221653250-180701-WBDR1.5GUD@1)) - 83

Predefined expressions

NDVI

Reference layer(s) (used for automated extent, cellsize, and CRS) [optional]

1 elements selected

Cell size (use 0 or empty to set it automatically) [optional]

0.000000

Output extent (xmin, xmax, ymin, ymax) [optional]

[Leave blank to use min covering extent]

Output CRS [optional]

Project CRS: EPSG:102225 - MONREF\_1997\_UTM\_Zone\_47N

Output

D:/2019/21\_JPTM\_workshop/Results/Pre\_Calib.tif

Open output file after running algorithm

0%

Run as Batch Process...

Run Close Help

2.6 Click OK

**Multiple selection**

- IMG-HH-ALOS2221653250-180701-WBDR1.5GUD [EPSG:102225]
- IMG-HH-ALOS2225793250-180729-WBDR1.5GUD [EPSG:102225]

Select All

Clear Selection

Toggle Selection

Add File(s)...

OK

Cancel

7

## 2.8 Do the same calibration for the post image

**Raster Calculator**

Parameters Log

Expression

**Layers**

- IMG-HH-ALOS2221653250-180701-WBDR1.5GUD@1
- IMG-HH-ALOS2225793250-180729-WBDR1.5GUD@1

**Operators**

+	*	cos	sin	log10	AND
-	/	acos	asin	ln	OR
^	sqrt	tan	atan	(	)
<	>	=	!=	<=	>=

**Expression**

```
(20*log10(''IMG-HH-ALOS2225793250-180729-WBDR1.5GUD@1'')) - 83
```

**Predefined expressions**

NDVI Add... Save...

Reference layer(s) (used for automated extent, cellsize, and CRS) [optional]  
1 elements selected

Cell size (use 0 or empty to set it automatically) [optional]  
0.000000

Output extent (xmin, xmax, ymin, ymax) [optional]  
[Leave blank to use min covering extent]

Output CRS [optional]  
Project CRS: EPSG:102225 - MONREF\_1997\_UTM\_Zone\_47N

Output  
D:/2019/21\_JPTM\_workshop/Results/Post\_Calb.tif

Open output file after running algorithm

0%

Run as Batch Process... Run Close Help

**Raster calculator**

This algorithm allows performing algebraic operations using raster layers.

The resulting layer will have its values computed according to an expression. The expression can contain numerical values, operators and references to any of the layers in the current project. The following functions are also supported:

- sin(), cos(), tan(), atan2(), ln(), log10()

The extent, cell size, and output CRS can be defined by the user. If the extent is not specified, the minimum extent that covers selected reference layer(s) will be used. If the cell size is not specified, the minimum cell size of selected reference layer(s) will be used. If the output CRS is not specified, the CRS of the first reference layer will be used.

The cell size is assumed to be the same in both X and Y axes.

Layers are referred by their name as displayed in the layer list and the number of the band to use (based on 1), using the pattern 'layer\_name@band number'. For instance, the first band from a layer named DEM will be referred as DEM@1.

When using the calculator in the batch interface or from the console, the files to use have to be specified. The corresponding layers are referred using the base name of the file (without the full path). For instance, if using a layer at path/to/my/rasterfile.tif, the first band of that layer will be referred as rasterfile.tif@1.



## 3 Speckle filtering

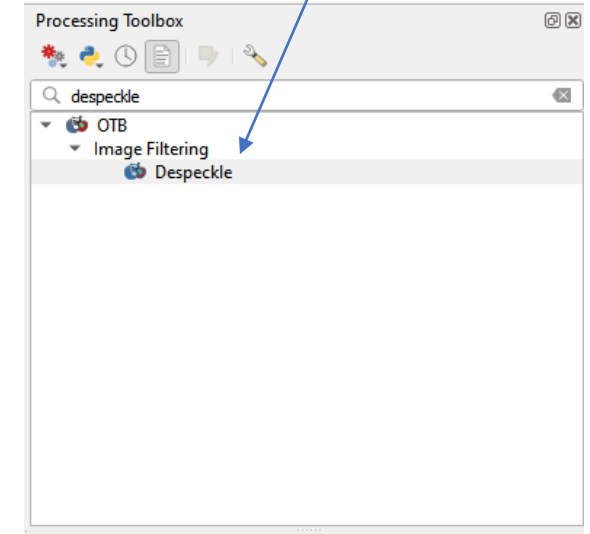
3.1 Type **Despeckle** in processing toolbox search bar Select the Despeckle in OTB toolbox.

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)

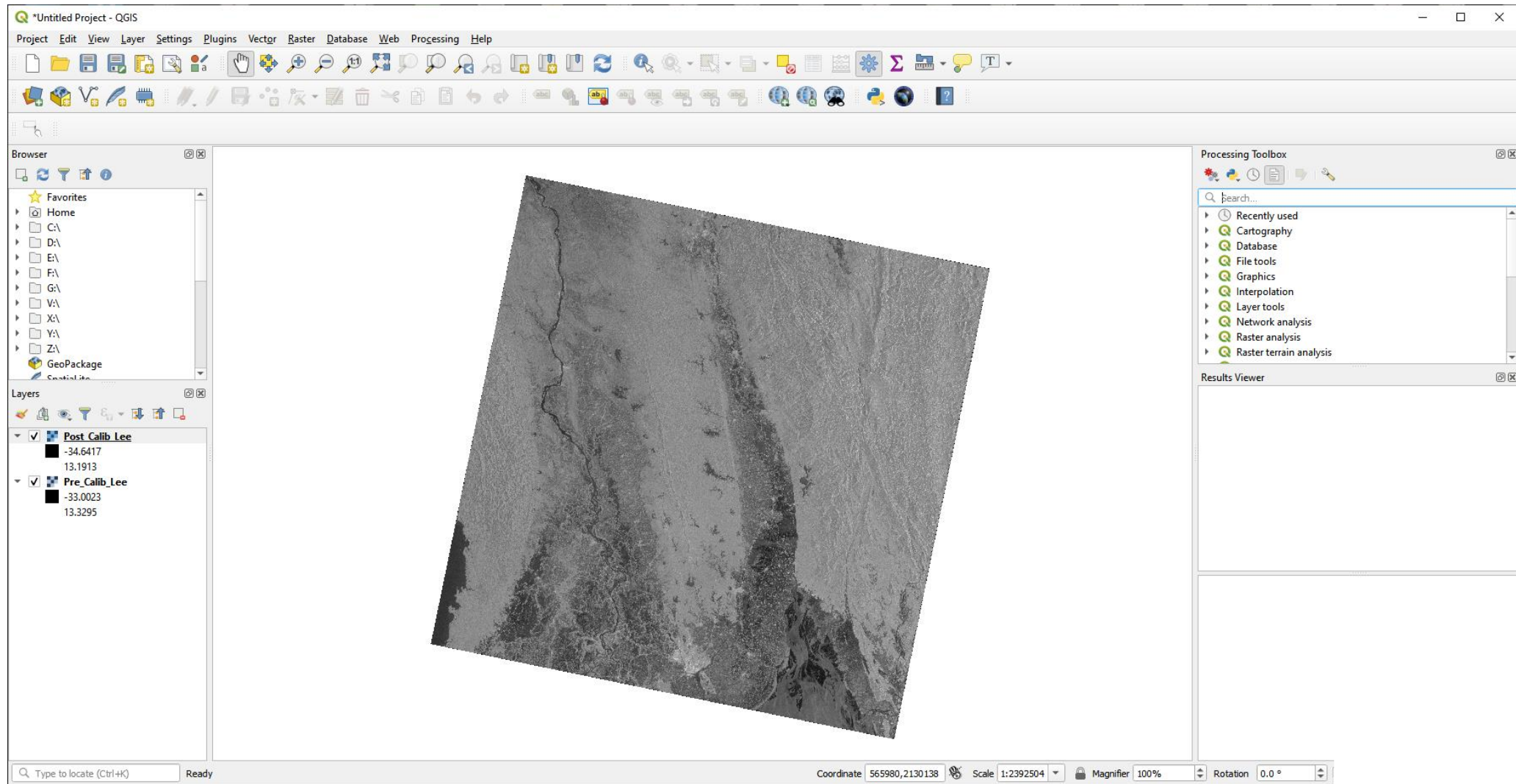
3.5 Browse to output folder and give it a relevant name and **.tif** file type



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

The screenshot shows the QGIS Processing Toolbox on the right and the 'Warp (Reproject)' dialog box on the left. The toolbox search bar contains 'Warp', and the 'Warp (reproject)' tool is selected under the 'GDAL' category. The dialog box is configured with the following parameters:

- Input layer: Pre\_Calib\_Lee [EPSG:102225]
- Source CRS [optional]:
- Target CRS: EPSG:4326 - WGS 84
- Resampling method to use: Nearest neighbour
- Nodata value for output bands [optional]: Not set
- Output file resolution in target georeferenced units [optional]: Not set
- Advanced parameters: Reprojected
- Output file path: D:/2019/21\_JPTM\_workshop/New/Pre\_Calib\_Lee\_Prj.tif
- Open output file after running algorithm:

The GDAL/OGR console call is shown at the bottom of the dialog:

```
gdalwarp -t_srs EPSG:4326 -r near -of GTiff D:/2019/21_JPTM_workshop/Results/Pre_Calib_Lee.tif D:/2019/21_JPTM_workshop/New/Pre_Calib_Lee_Prj.tif
```

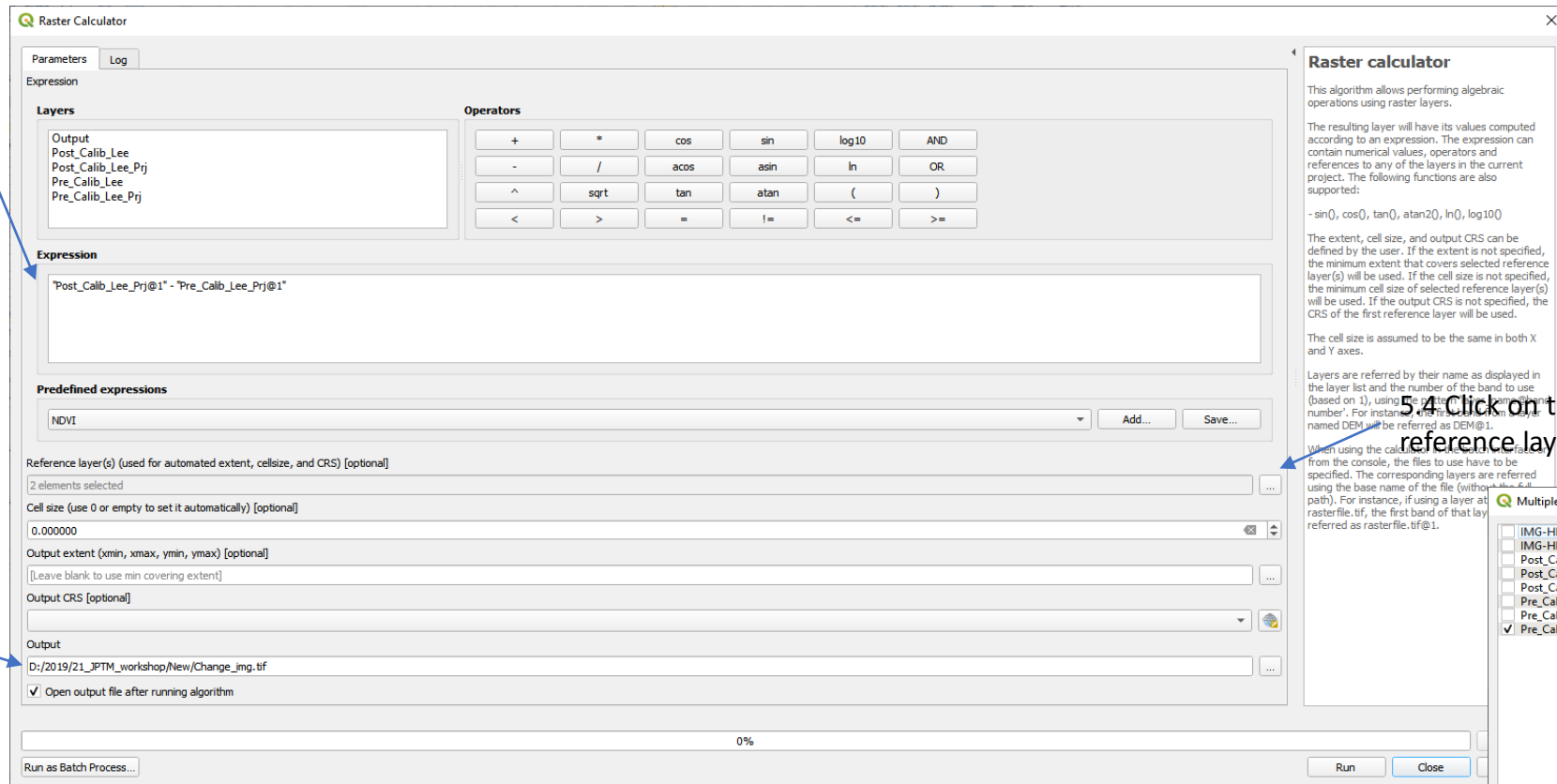
The 'Run' button is highlighted with a blue arrow pointing to it from the text '4.6 Click Run'.

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**

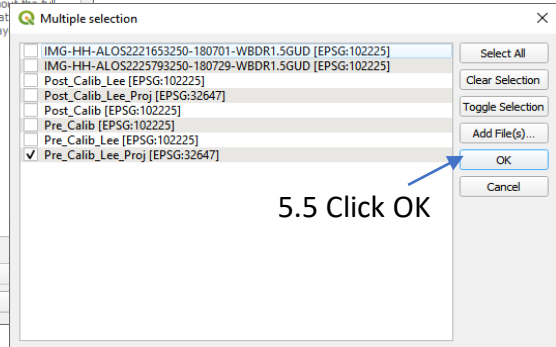
5.2 Obtain the difference between projected pre and post images by Inputting the Expression as follows



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

**Raster calculator**  
This algorithm allows performing algebraic operations using raster layers.  
The resulting layer will have its values computed according to an expression. The expression can contain numerical values, operators and references to any of the layers in the current project. The following functions are also supported:  
- sin(), cos(), tan(), atan2(), ln(), log10()  
The extent, cell size, and output CRS can be defined by the user. If the extent is not specified, the minimum extent that covers selected reference layer(s) will be used. If the cell size is not specified, the minimum cell size of selected reference layer(s) will be used. If the output CRS is not specified, the CRS of the first reference layer will be used.  
The cell size is assumed to be the same in both X and Y axes.  
Layers are referred by their name as displayed in the layer list and the number of the band to use (based on 1), using the following format: 'layername@bandnumber'. For instance, if the layer name is 'DEM' and the first band is used, the layer will be referred as DEM@1.  
When using the calculator, the files to use have to be specified. The corresponding layers are referred using the base name of the file (without the extension). For instance, if using a layer at rasterfile.tif, the first band of that layer is referred as rasterfile.tif@1.

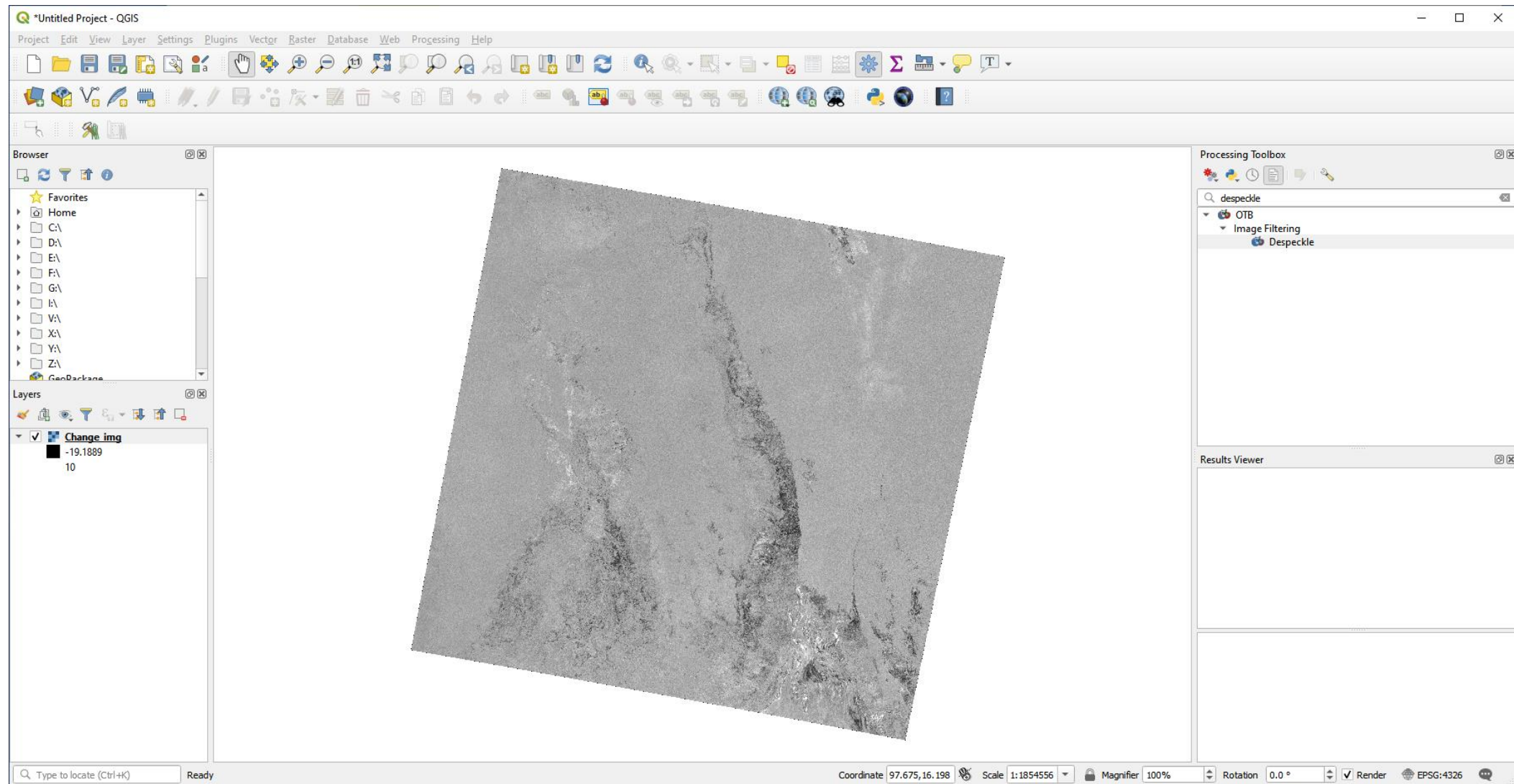
5.4 Click on this icon and select a reference layer



5.5 Click OK

5.6 Click Run

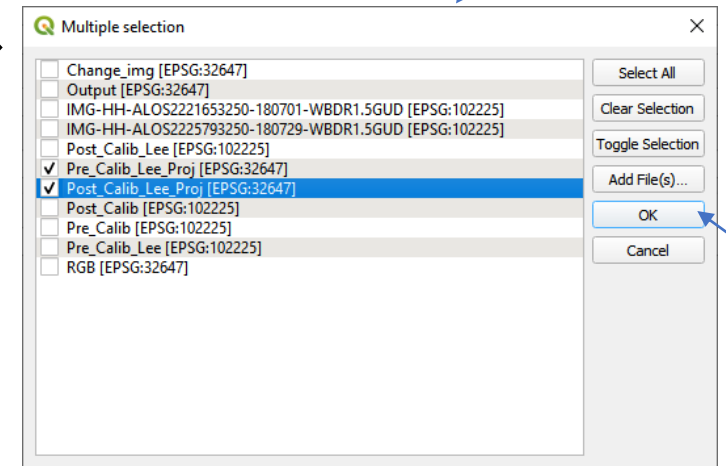
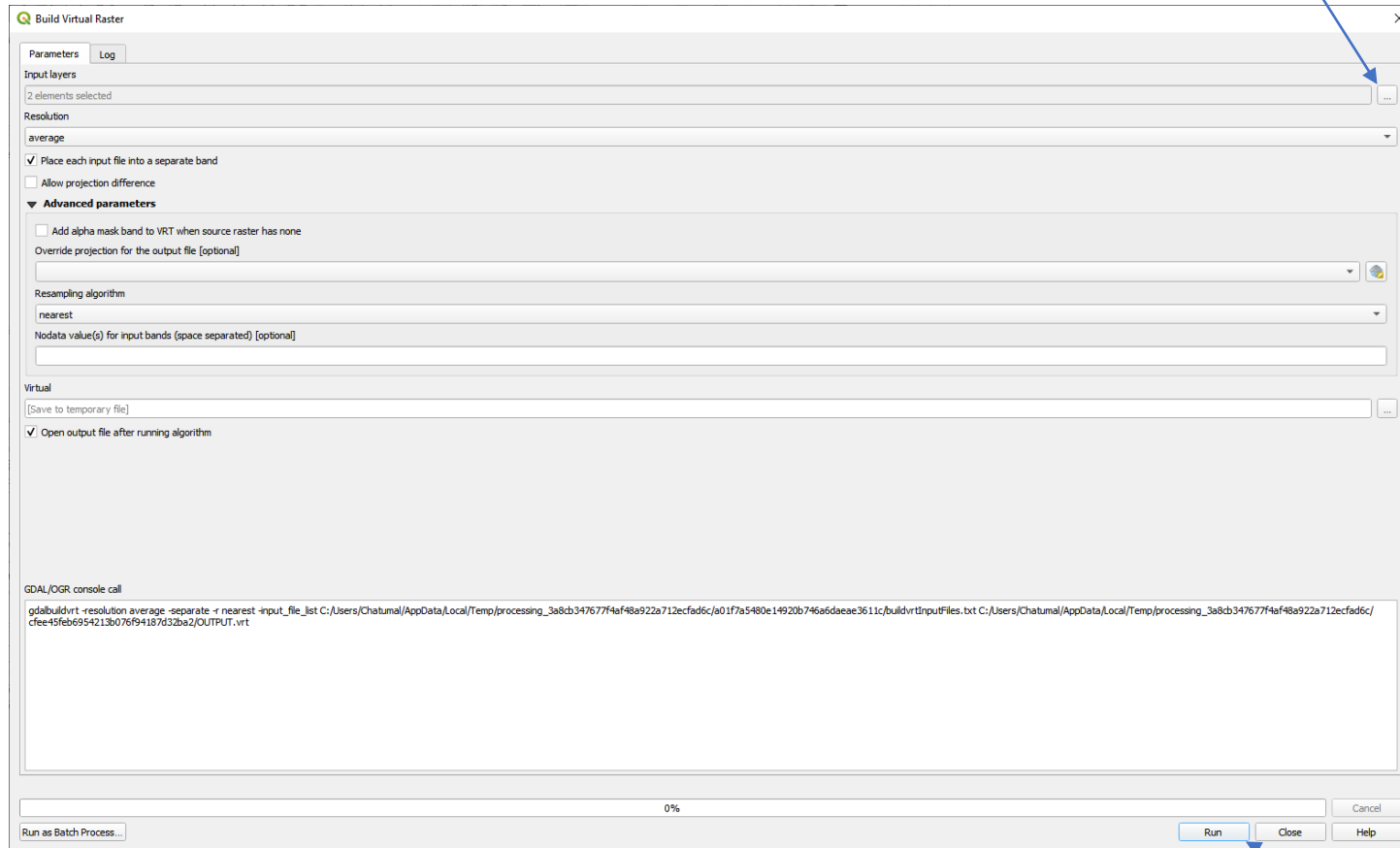
## Change Image after raster calculation



## 6 RGB visualization of post and pre-images

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

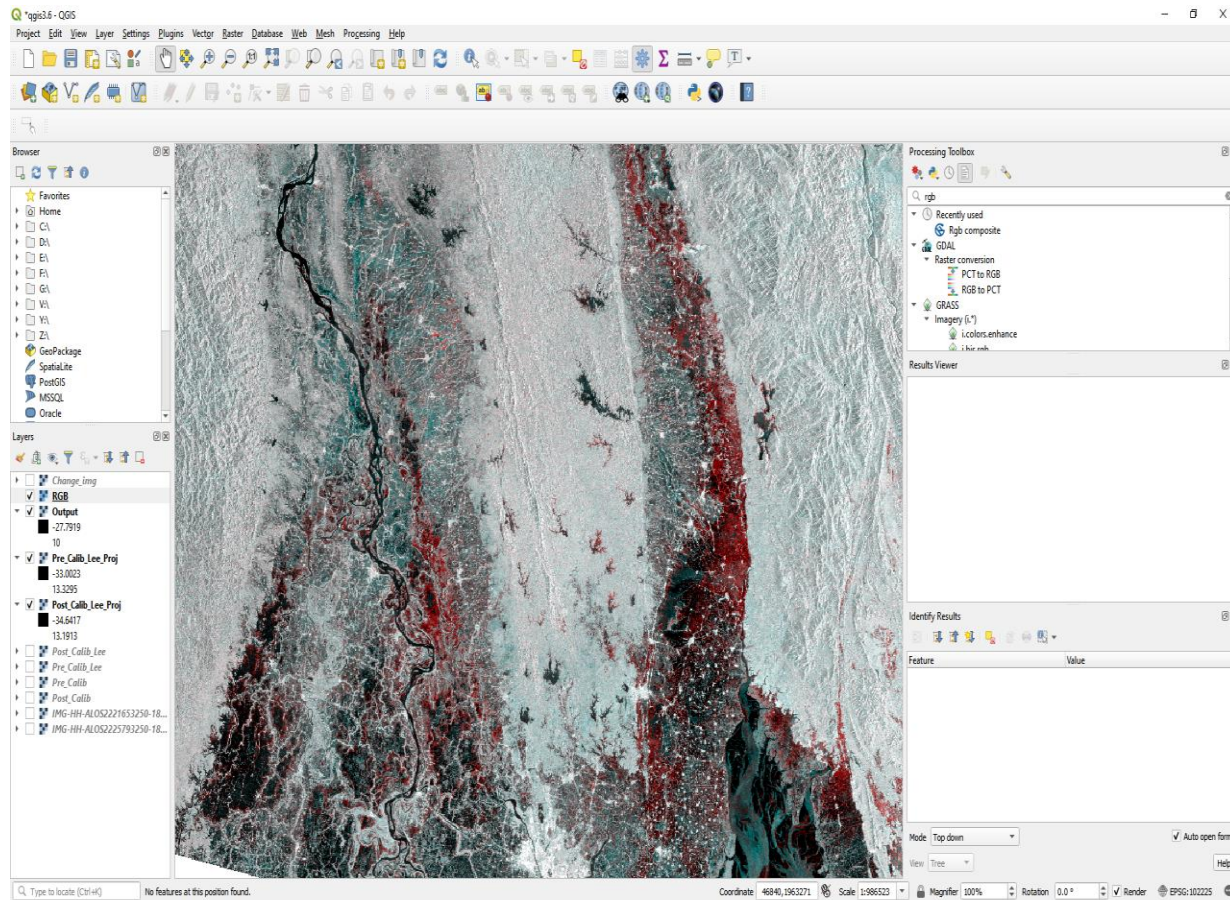
6.2 Click this icon and select the Pre-Processed, pre and post images from this tab



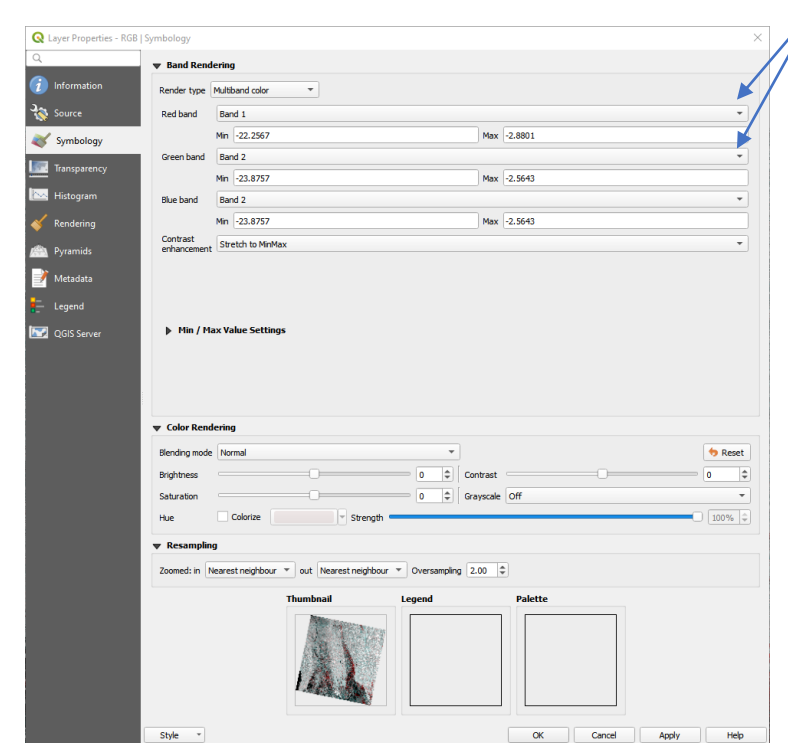
6.3 Click OK

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

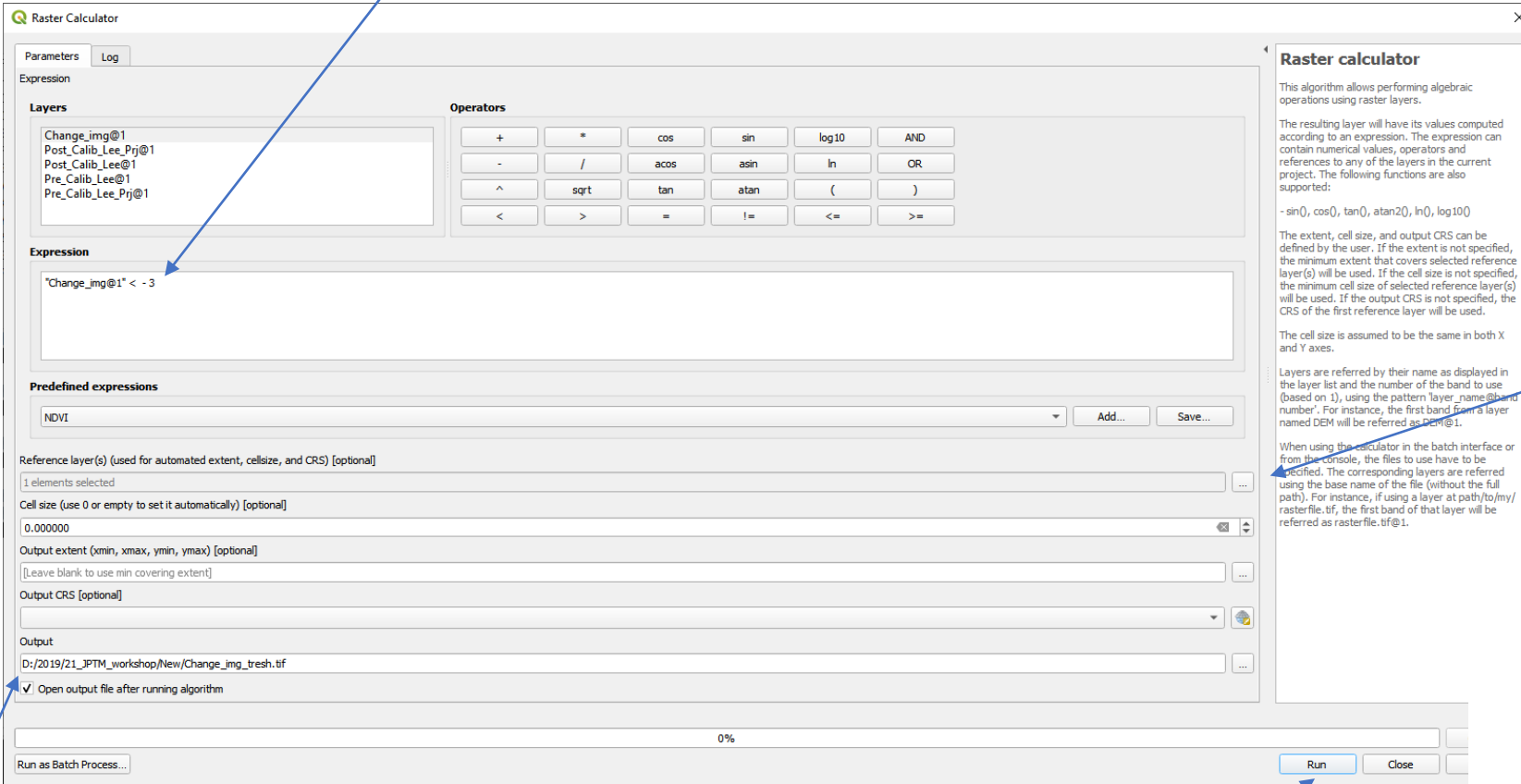


Red Band : Pre-image  
Green band: Post-image  
Blue Band : Post-image

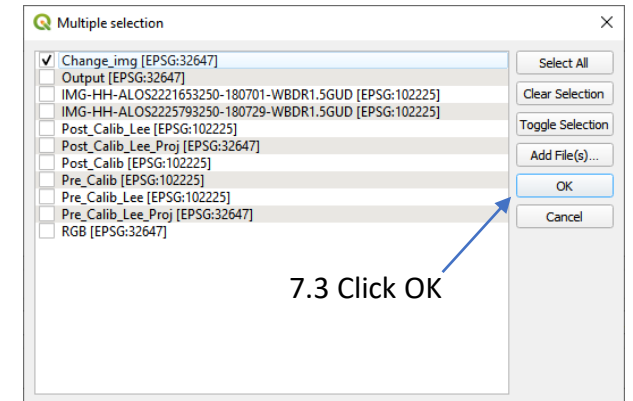
The areas likely to be flooded will appear as **red**, under this particular band combination. Observing change image and this RGB visualization, you can find the radar backscatter value range in the flood region. A threshold value can be selected for delineate the flood extent.

# 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



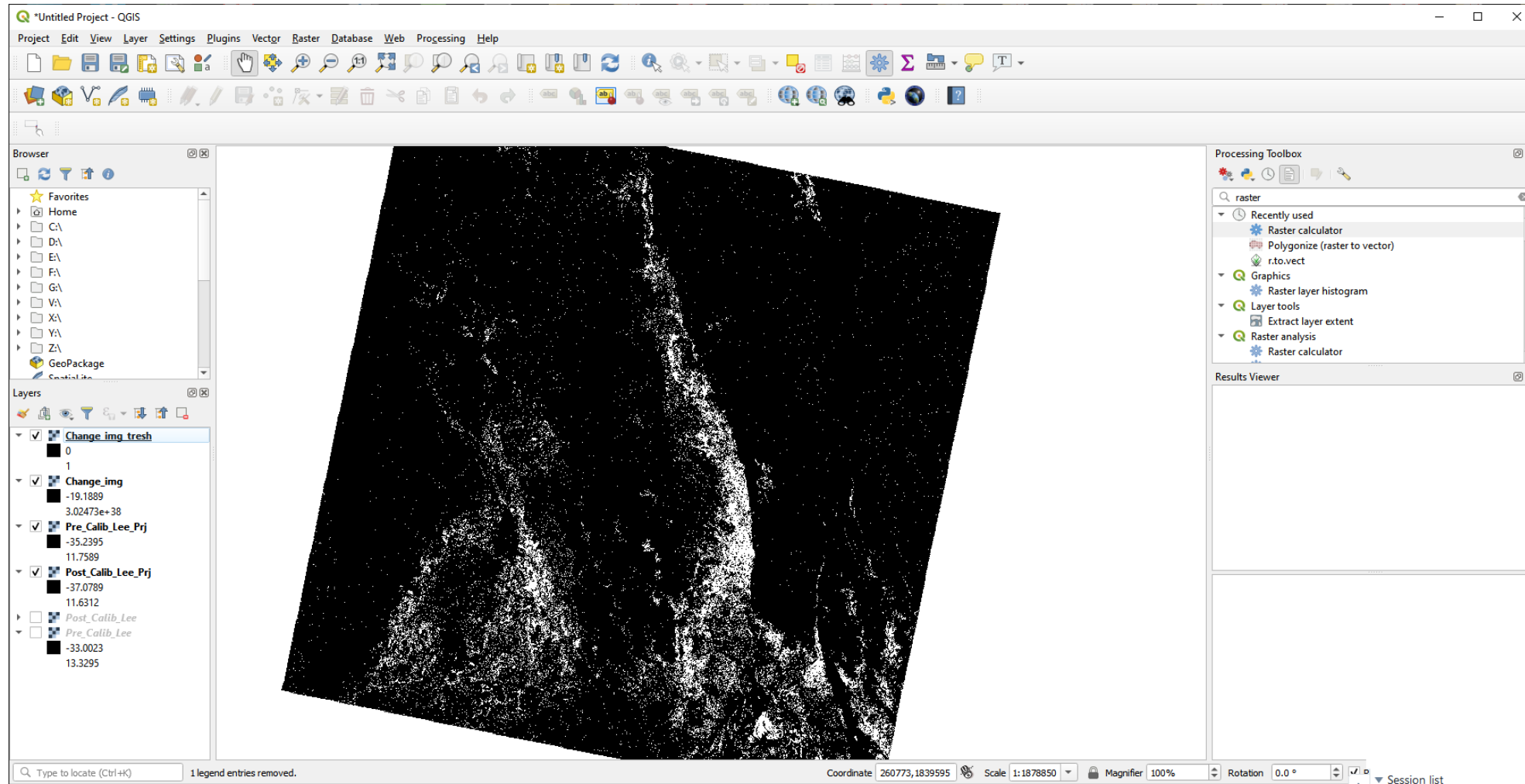
7.3 Click OK

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

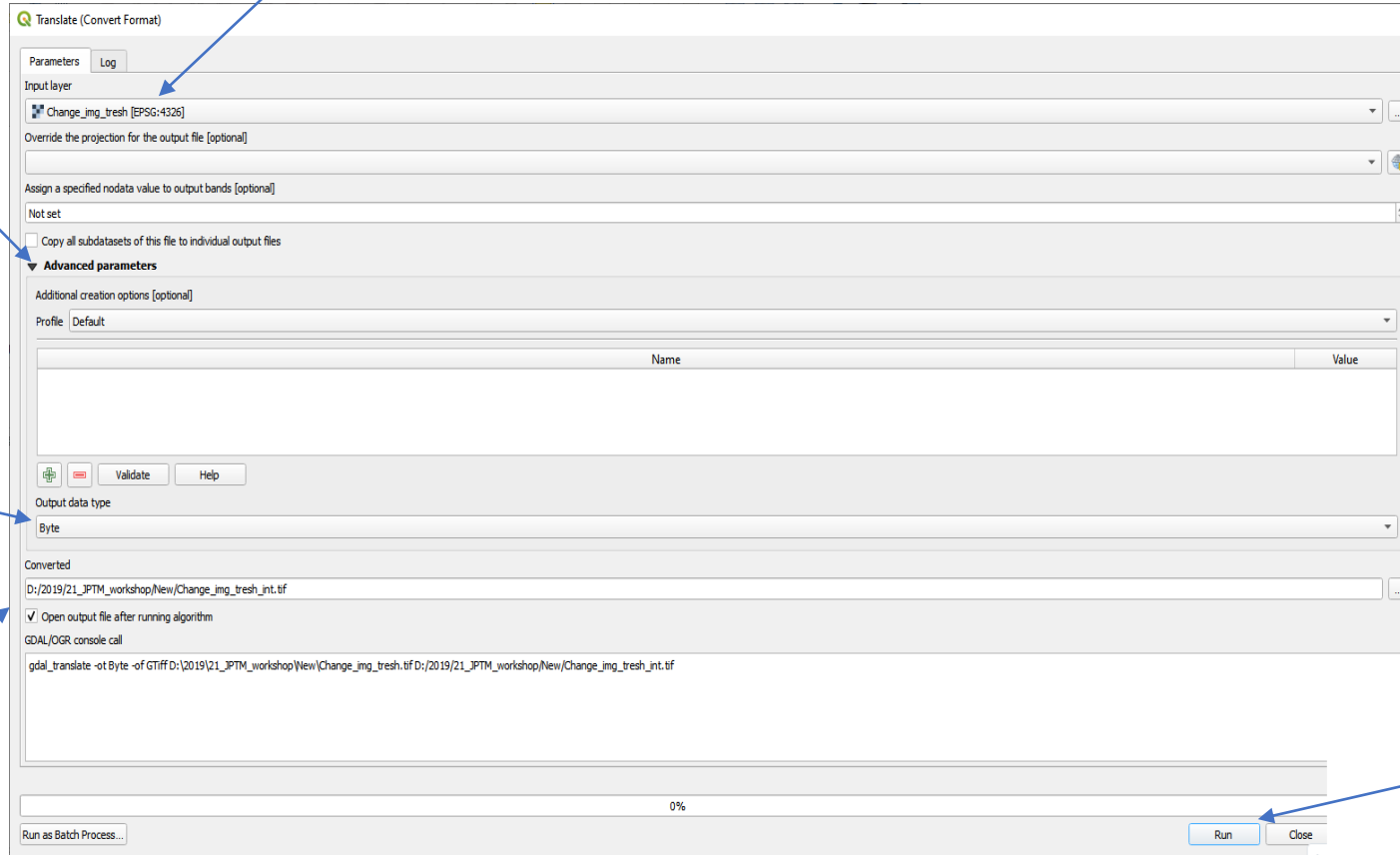
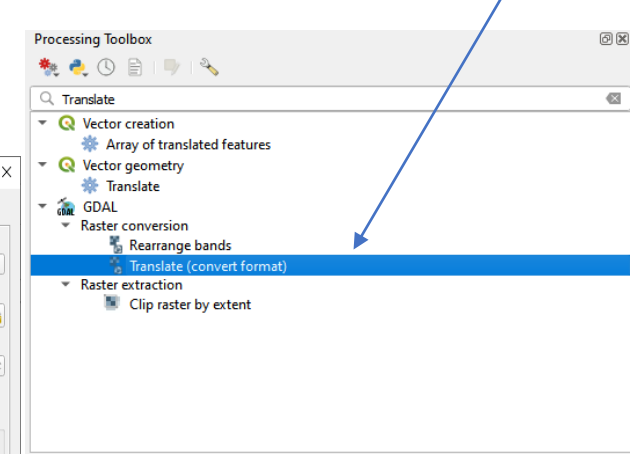
8.1 Type **Translate** in processing toolbox search bar and select the **Translate(convert format)** under **GDAL**

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



## 9 Application of majority filter to reduce the noise pixels

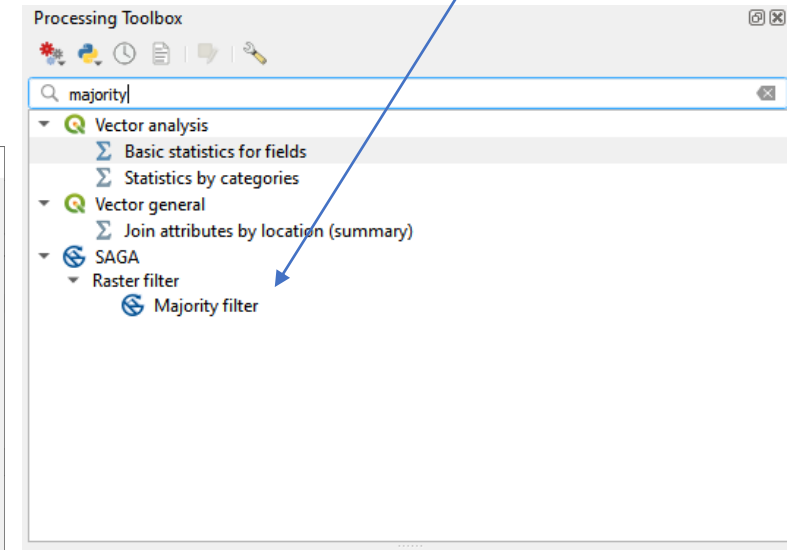
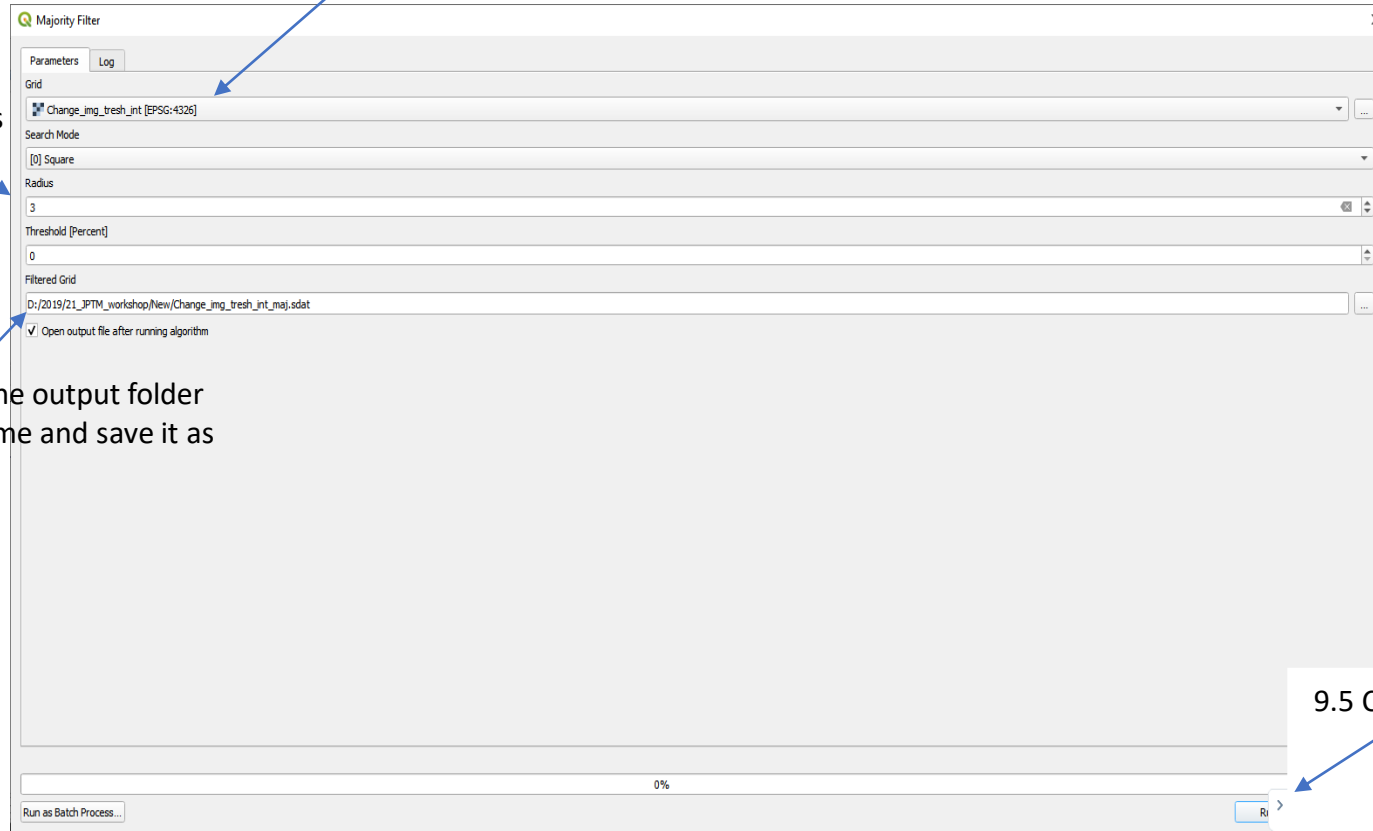
9.1 Type **Majority** in processing toolbox search bar and select the **Majority filter** under **SAGA**

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

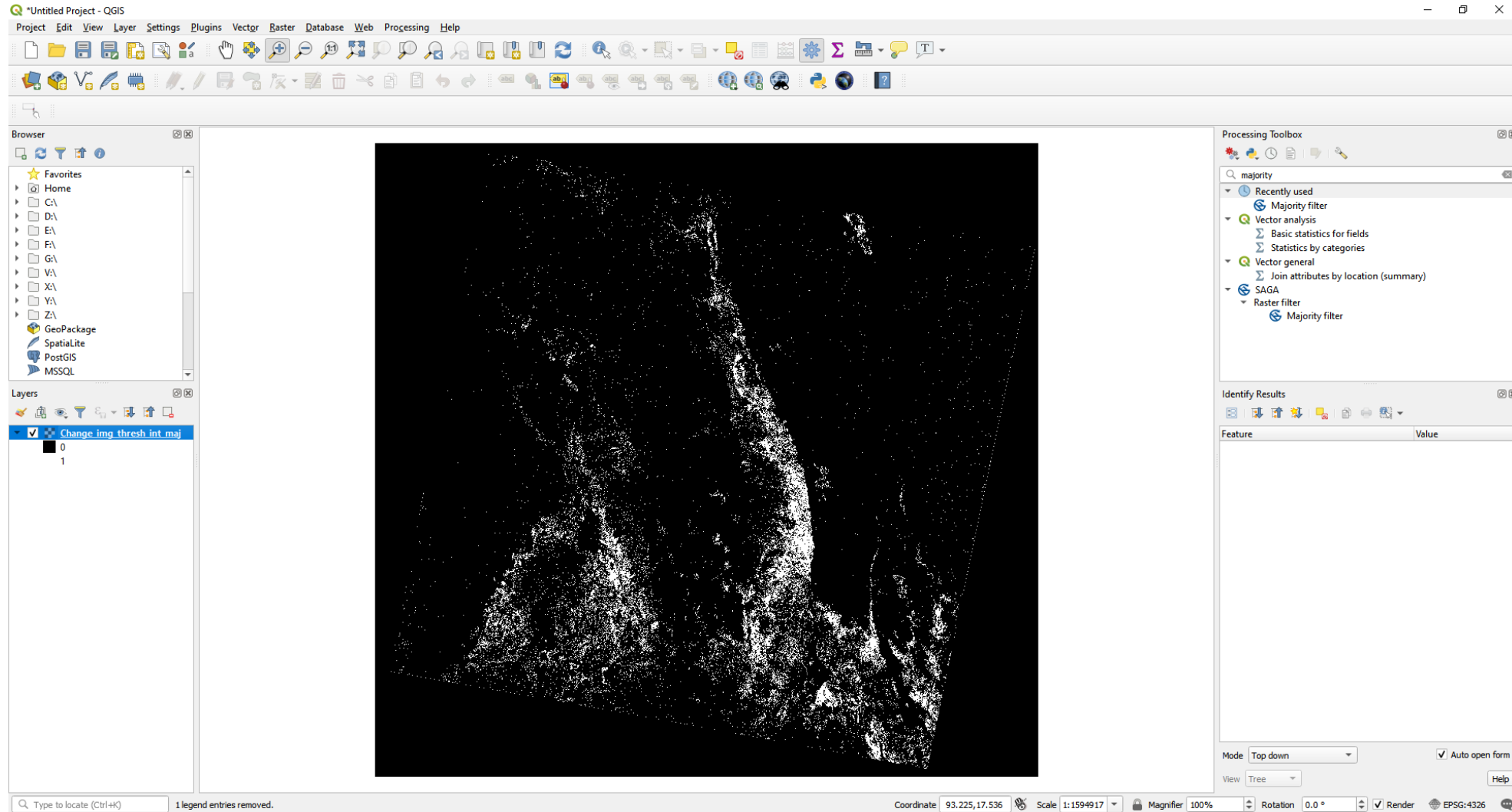
9.3 Input radius as 3 (5\*5)

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

9.5 Click Run

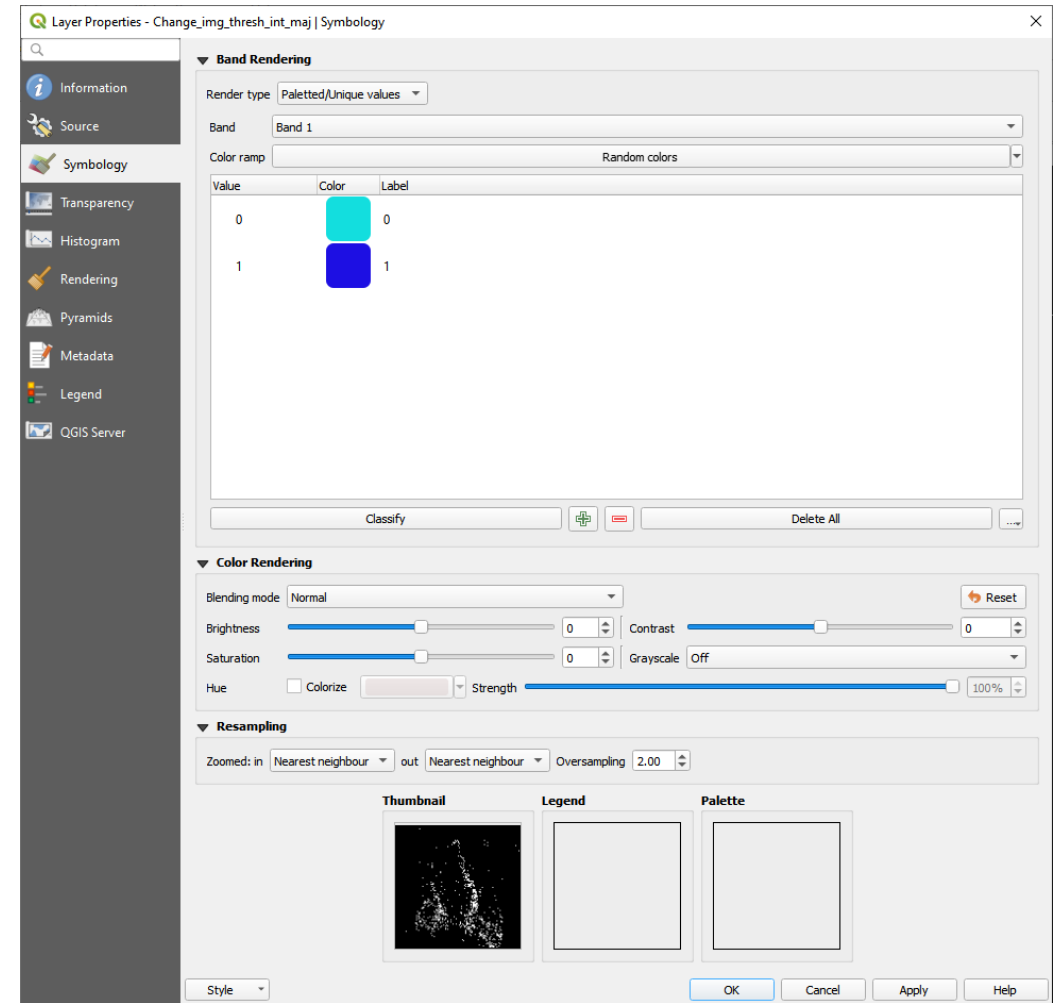
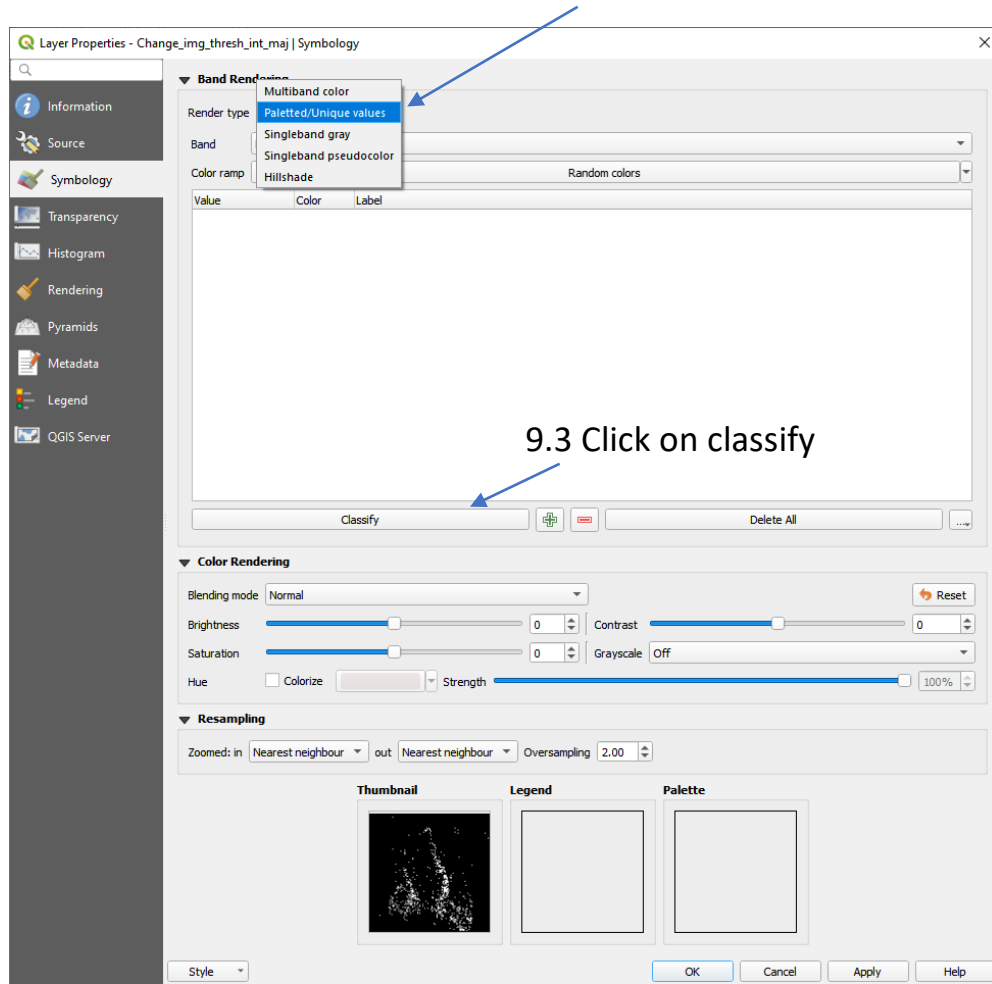


# Majority filtered image



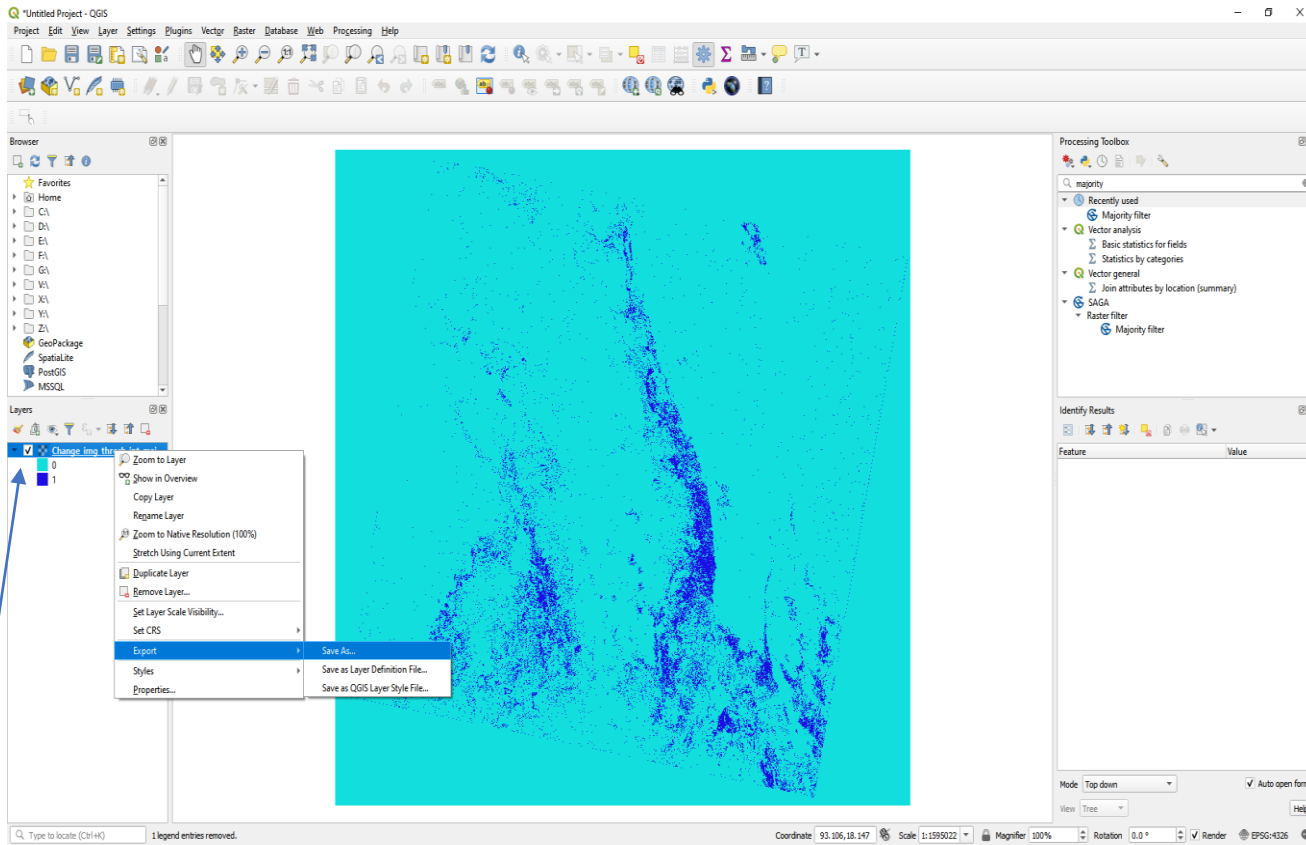
9.6 Right click on the majority filtered image > **Properties**

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



9.8 Click OK

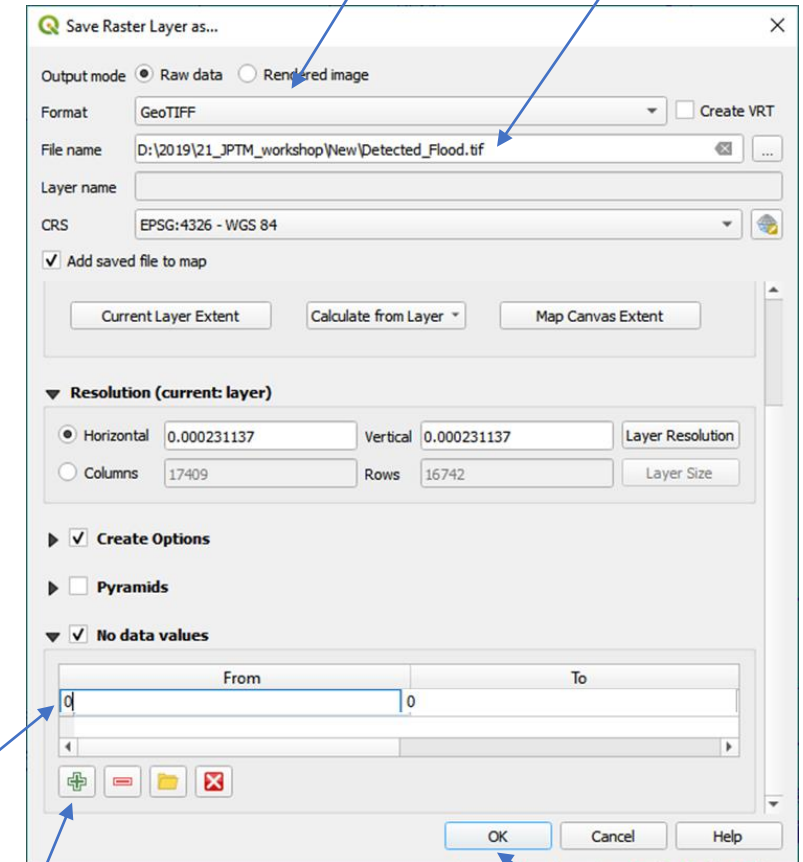
# Classified image ( water-1, non water-0)



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

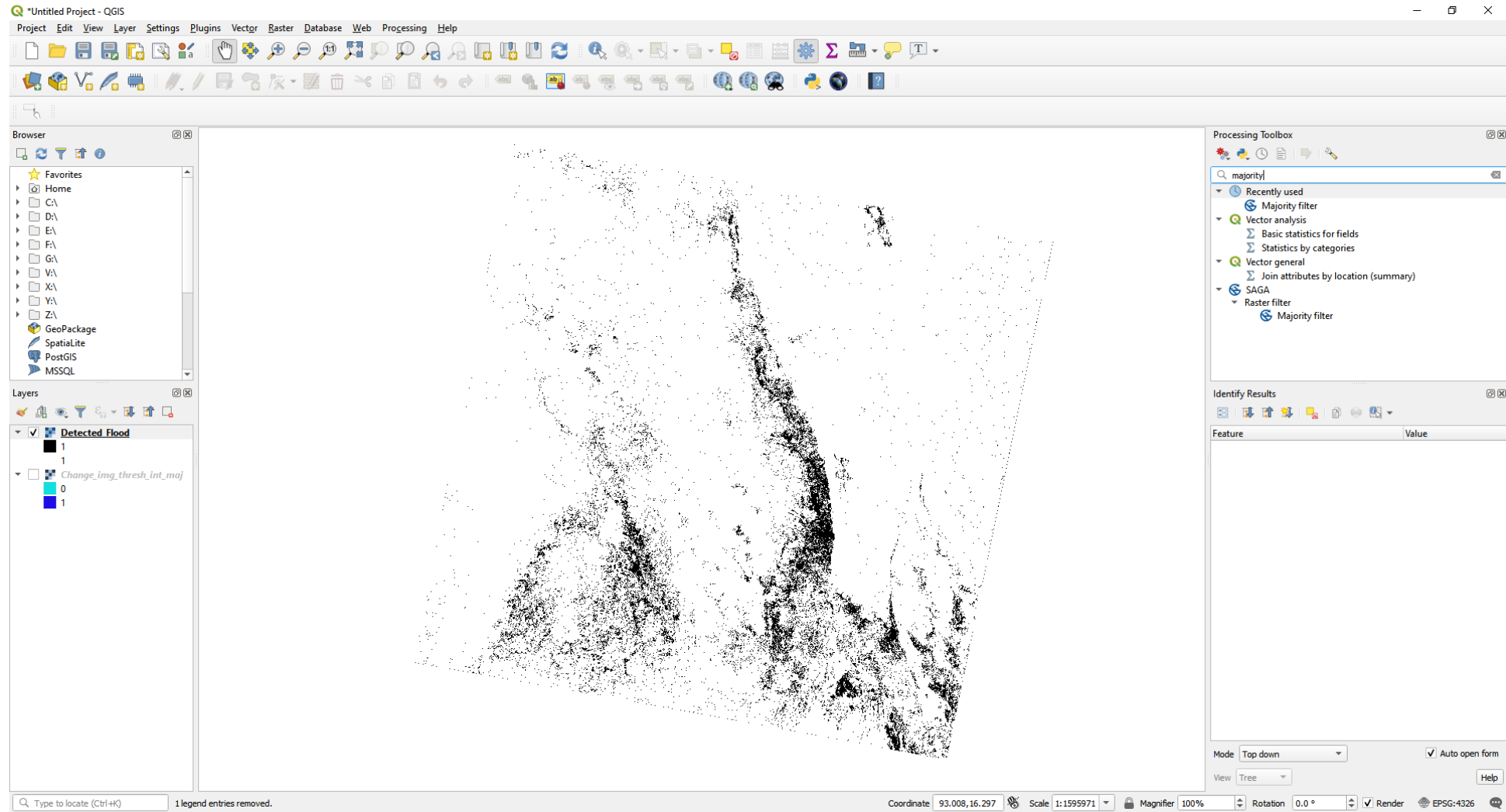


9.13 type 0 here

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

9.14 click OK

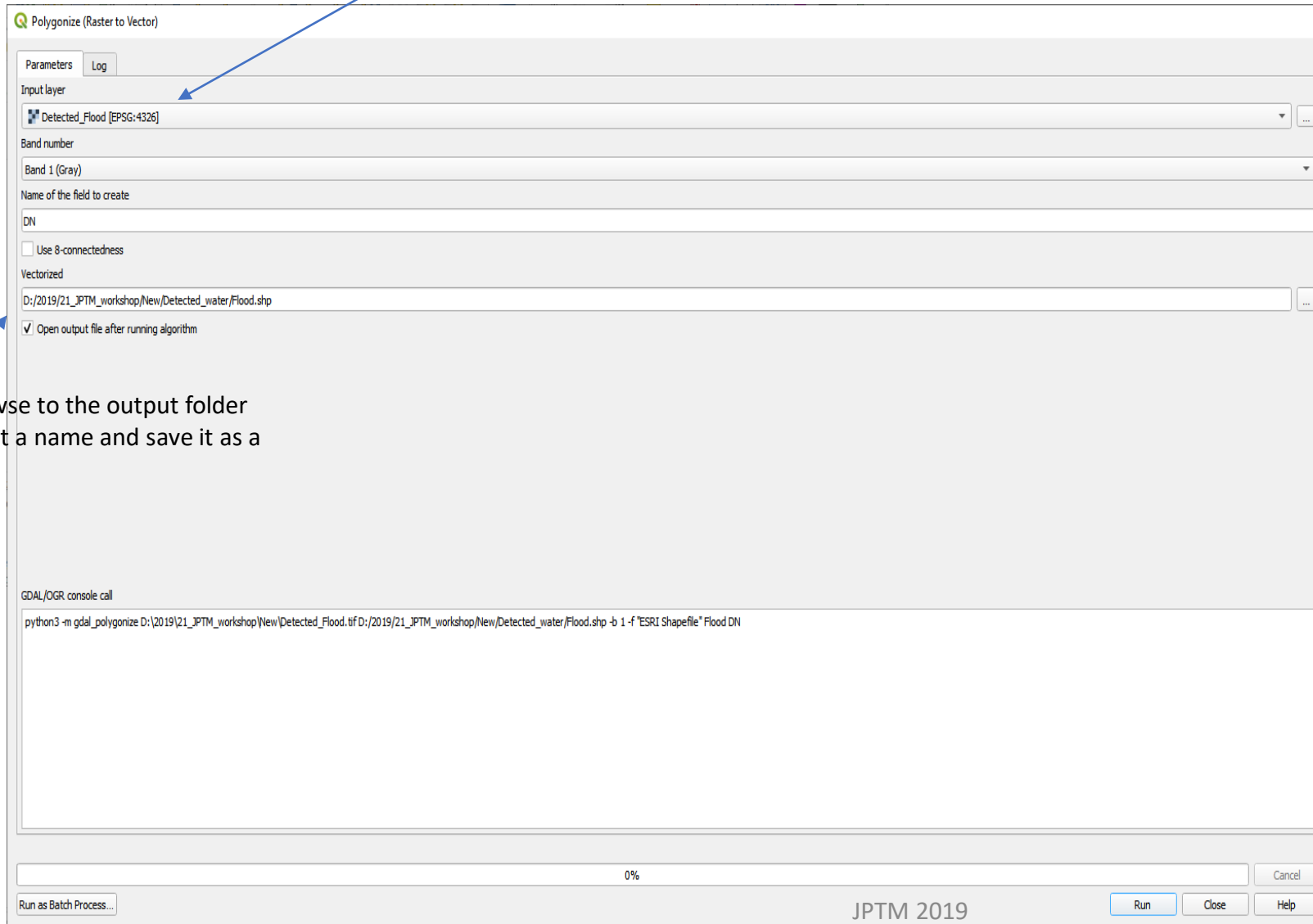
# Detected Flood raster image.



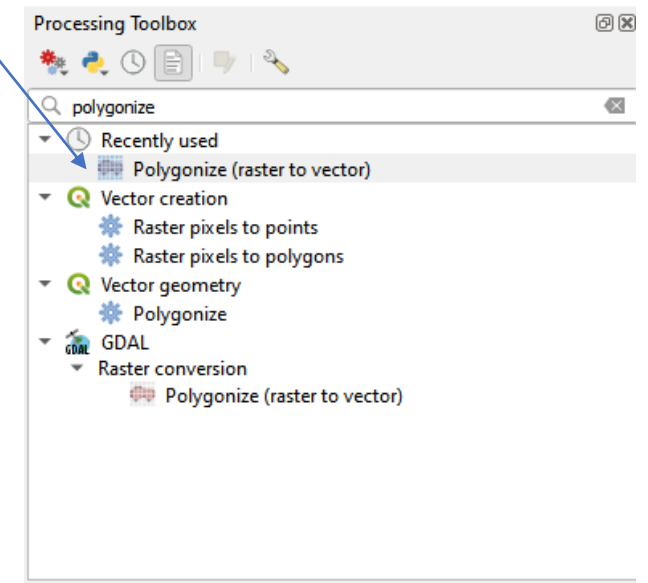
## 10 Conversion the **Detected Flood** raster file into a vector file

### 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.

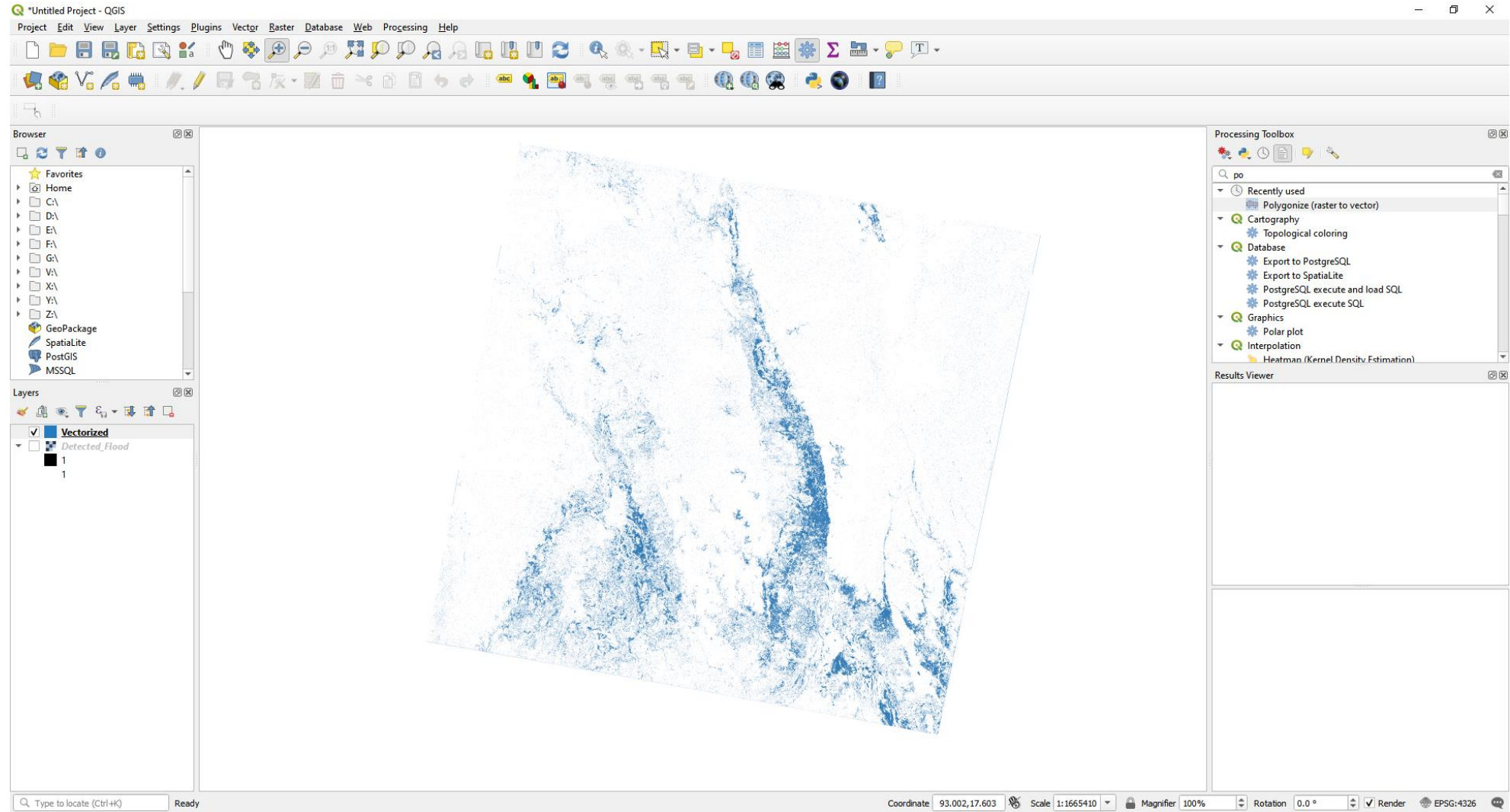


### 10.3 Browse to the output folder and give it a name and save it as a .shp file

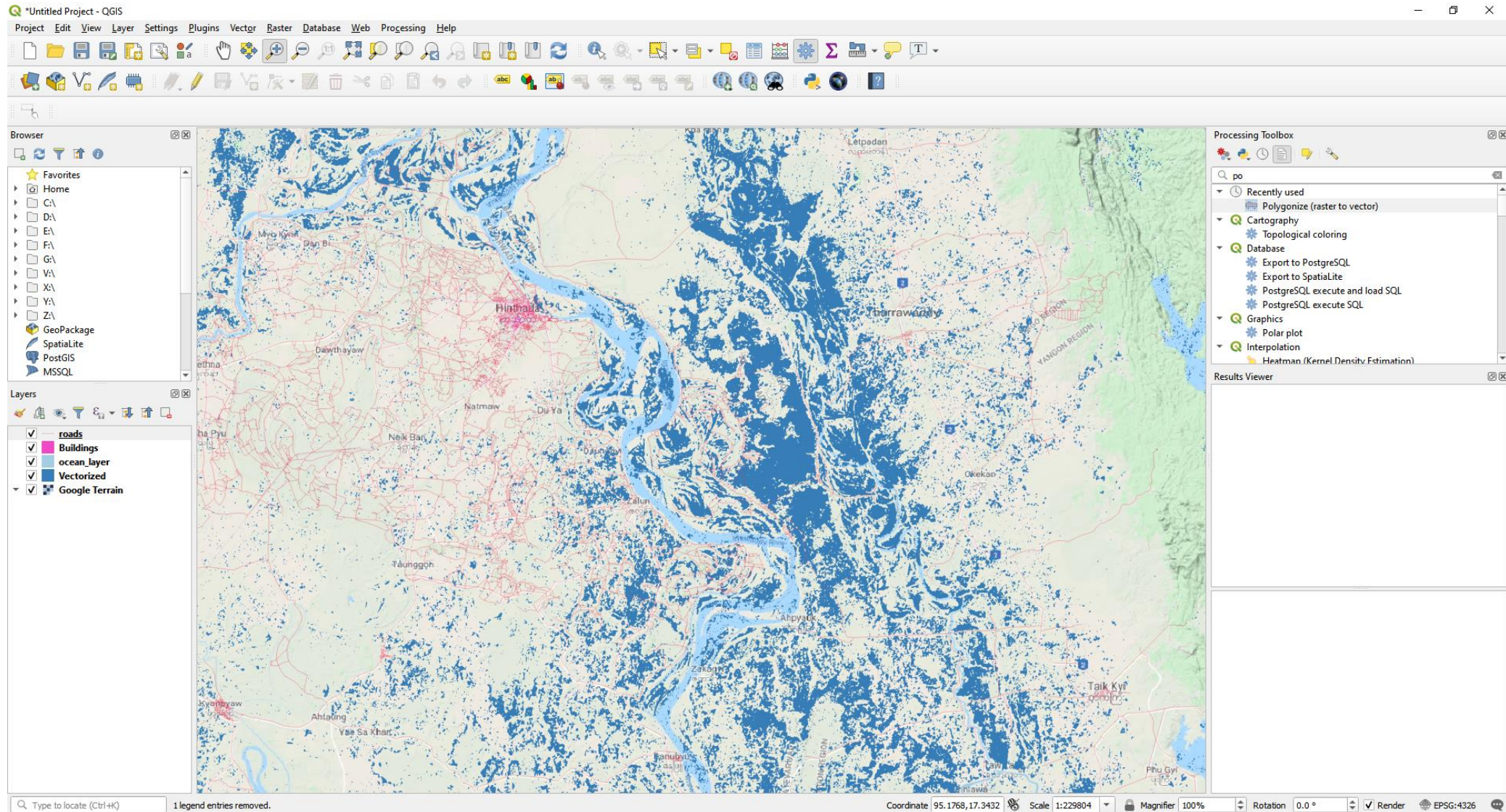




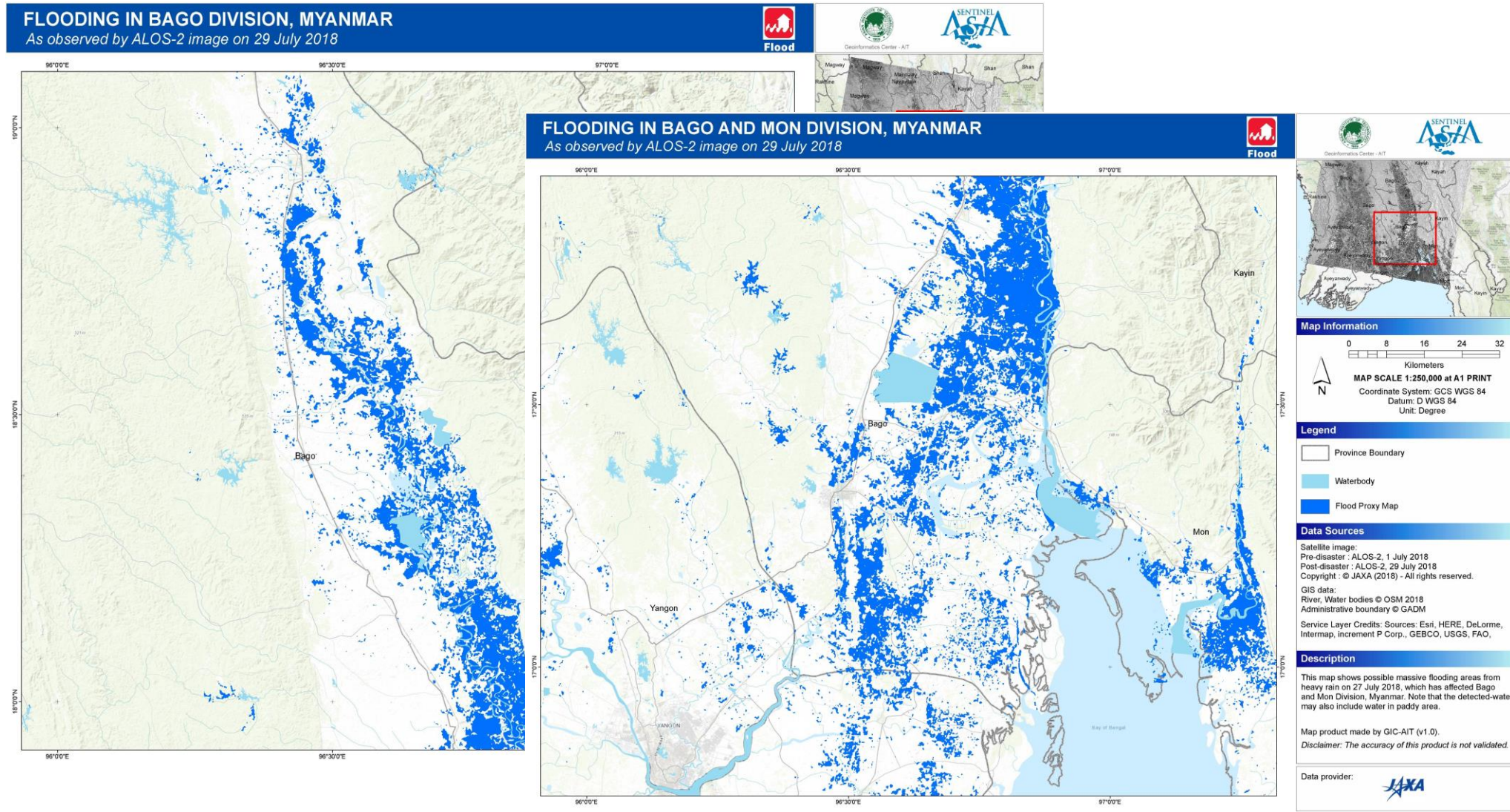
# Detected Flood in Vector format



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!