

Satellite Data Processing

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- Image classification
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 - b) Supervised Image Classification

Satellite image Download (Landsat data)

- Go to <http://earthexplorer.usgs.gov/> and create new user account → Login

The screenshot shows the Earth Explorer website interface. The top navigation bar includes links for Home, Search Criteria, Data Sets, Additional Criteria, Results, Login, Register, RSS, Feedback, and Help. The main content area is titled '2. Select Your Data Set(s)' and includes a search criteria summary, a map, and a list of data sets. A 'Save As' dialog box is open, showing the file path and name.

Numbered annotations on the screenshot:

- 1: Login button
- 2: Register button
- 3: Home link
- 4: Search Criteria link
- 5: Data Sets link
- 6: Results link
- 7: Clear Criteria button
- 8: Download button for Level 1 GeoTIFF Data Product

Download Options:

- Download LandsatLook "Natural Color" Image (4.8 MB)
- Download LandsatLook "Thermal" Image (1.7 MB)
- Download LandsatLook "Quality" Image (1.0 MB)
- Download LandsatLook images with Geographic Reference (1.6 MB)
- Download Level 1 GeoTIFF Data Product (772.9 MB)

Save As dialog box:

File name: L013405120152955.GA400.L1
Save as type: WinRAR archive

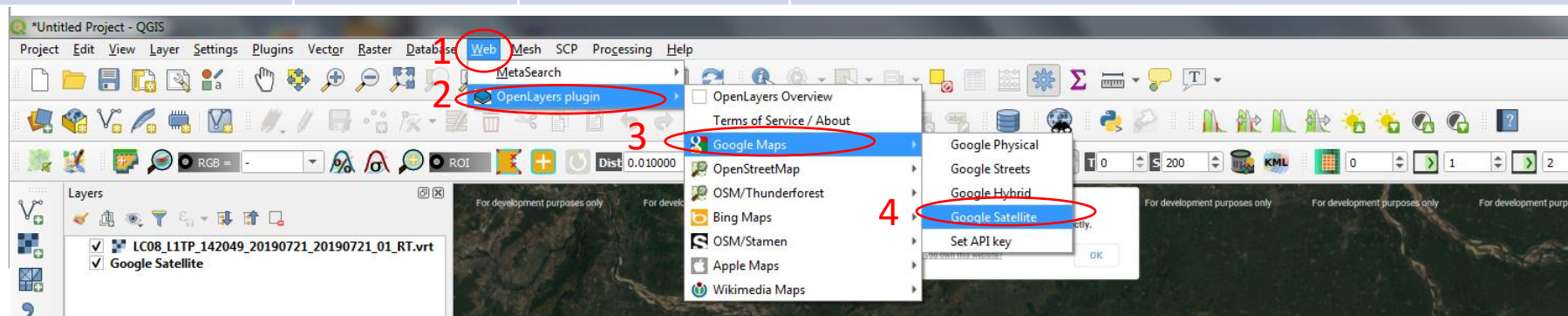
Give the path to save data and click on save

- Select clear and cloud free data
- Download Landsat 8 OLI Level-1 product data set
- After download unzip/uncompress the file

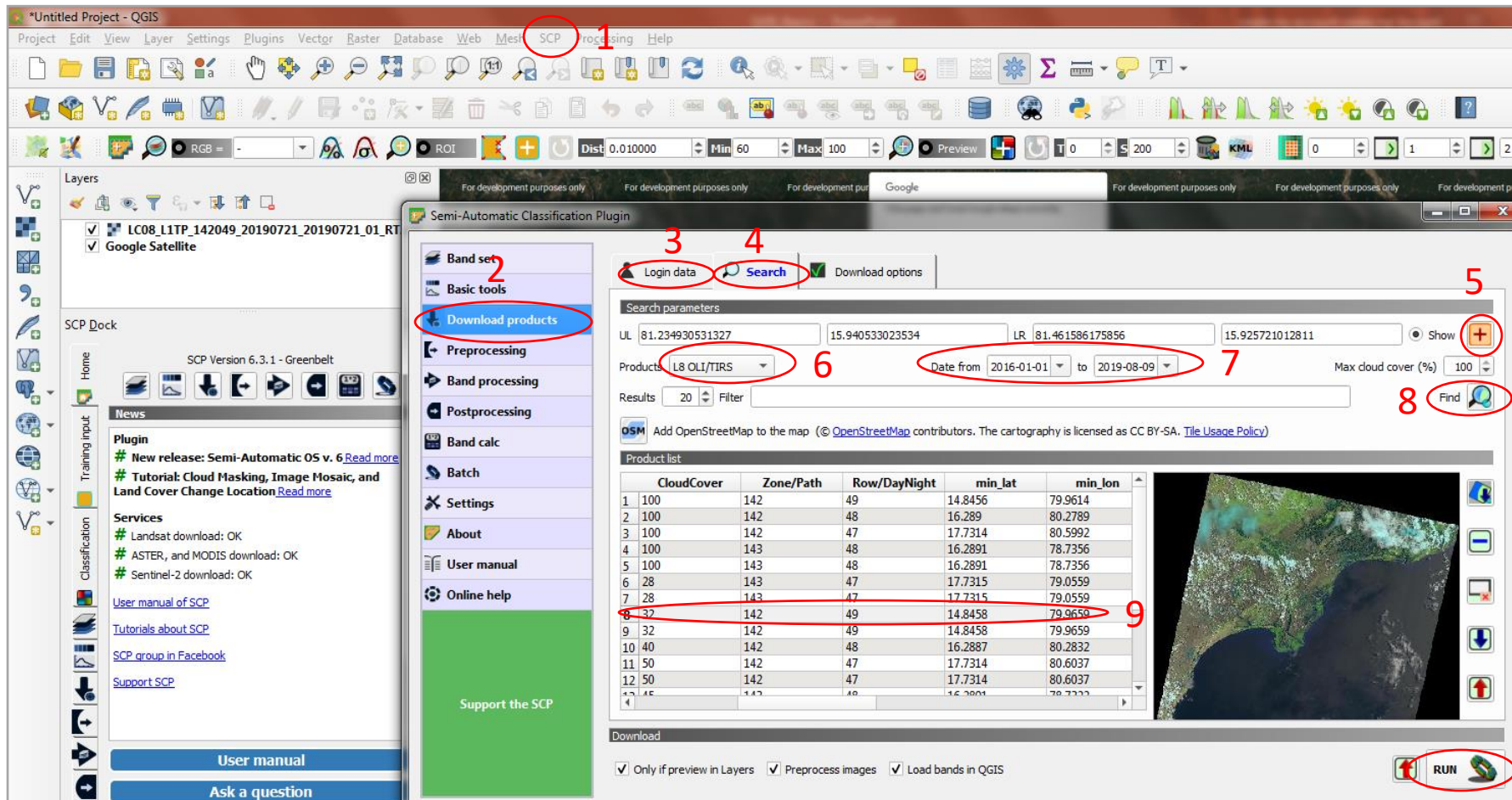
Landsat 9 OLI bands

Band	Wavelength	Spatial Resolution	Useful for mapping
Band 1 - coastal aerosol	0.43-0.45	30	Coastal and aerosol studies
Band 2 - blue	0.45-0.51	30	Bathymetric mapping, distinguishing soil from vegetation and deciduous from coniferous vegetation
Band 3 - green	0.53-0.59	30	Emphasizes peak vegetation, which is useful for assessing plant vigor
Band 4 - red	0.64-0.67	30	Discriminates vegetation slopes
Band 5 - Near Infrared (NIR)	0.85-0.88	30	Emphasizes biomass content and shorelines
Band 6 - Short-wave Infrared (SWIR) 1	1.57-1.65	30	Discriminates moisture content of soil and vegetation; penetrates thin clouds
Band 7 - Short-wave Infrared (SWIR) 2	2.11-2.29	30	Improved moisture content of soil and vegetation; penetrates thin clouds
Band 8 - Panchromatic	0.50-0.68	15	Sharper image definition
Band 9 - Cirrus	1.36-1.38	30	Improved detection of cirrus cloud contamination
Band 10 - TIRS 1	10.60-11.19	100	Thermal mapping and estimated soil moisture
Band 11 - TIRS 2	11.50-12.51	100	Improved thermal mapping and estimated soil moisture

Loading Google earth to QGIS:



- Now open Semi Automatic Classification → Download Products
- Click on login data enter login ID and Password (Need login in <https://ers.cr.usgs.gov/login/>)
- Click on search clock on + symbol → now go to QGIS window left click for UL, right click for UR
- Now coordinates will appear in UL and UR → Products select L8 OLI/TRS → Select Date
- Click on find image list will come select image → Click on run give path to save data



The screenshot shows the QGIS interface with the Semi-Automatic Classification Plugin (SCP) dock open. The SCP dock has a sidebar with various options, and the main panel shows search parameters and a product list. Red circles and numbers 1-10 highlight the steps for downloading raster data.

Search parameters:

- UL: 81.234930531327, 15.940533023534
- LR: 81.461586175856, 15.925721012811
- Products: L8 OLI/TRS
- Date from: 2016-01-01 to 2019-08-09
- Max cloud cover (%): 100

Product list:

	CloudCover	Zone/Path	Row/DayNight	min_lat	min_lon
1	100	142	49	14.8456	79.9614
2	100	142	48	16.289	80.2789
3	100	142	47	17.7314	80.5992
4	100	143	48	16.2891	78.7356
5	100	143	48	16.2891	78.7356
6	28	143	47	17.7315	79.0559
7	28	143	47	17.7315	79.0559
8	32	142	49	14.8458	79.9659
9	32	142	49	14.8458	79.9659
10	40	142	48	16.2887	80.2832
11	50	142	47	17.7314	80.6037
12	50	142	47	17.7314	80.6037

Download options:

- ☒ Only if preview in Layers
- ☒ Preprocess images
- ☒ Load bands in QGIS

Raster data opening in QGIS:

The screenshot illustrates the steps to add a raster layer in QGIS. The interface shows the 'Layer' menu (1) with 'Add Layer' (2) selected, leading to 'Add Raster Layer...' (3). The 'Data Source Manager | Raster' dialog (4) shows the 'File' source type. The 'Open GDAL Supported Raster Dataset(s)' dialog (5) shows the file selection process. The 'Add' button (6) in the 'Data Source Manager' dialog completes the process.

1. Layer menu

2. Add Layer

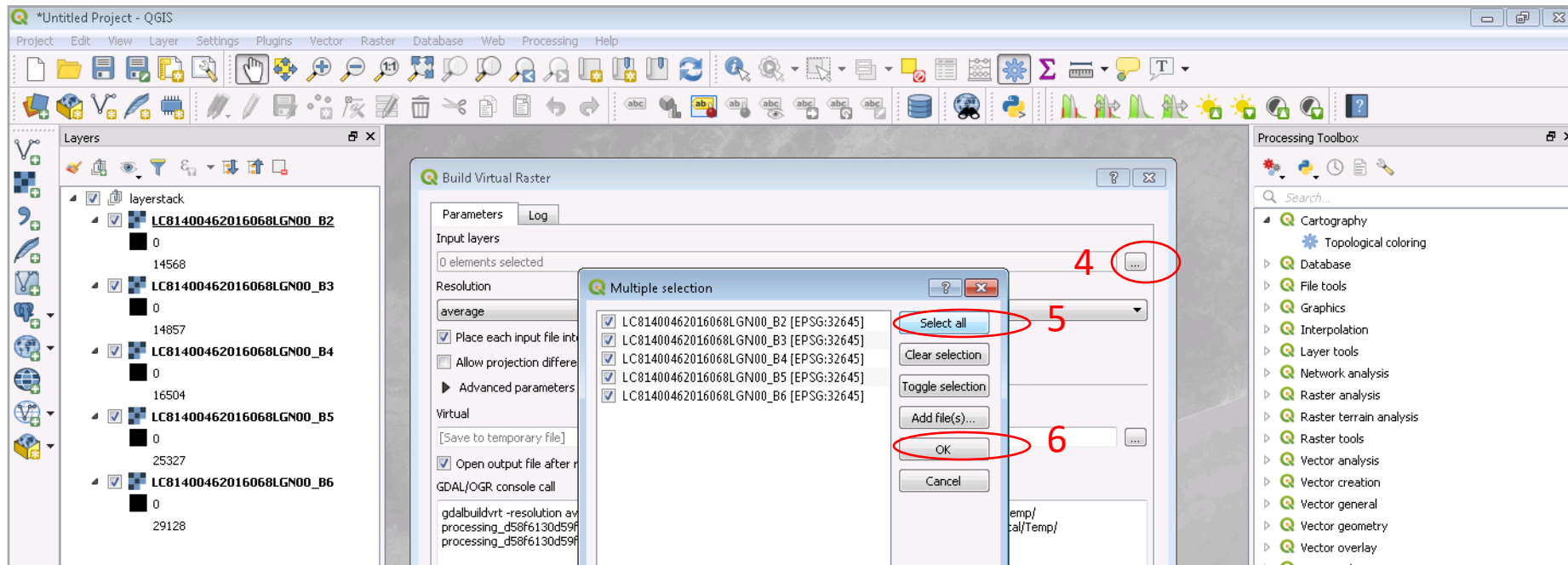
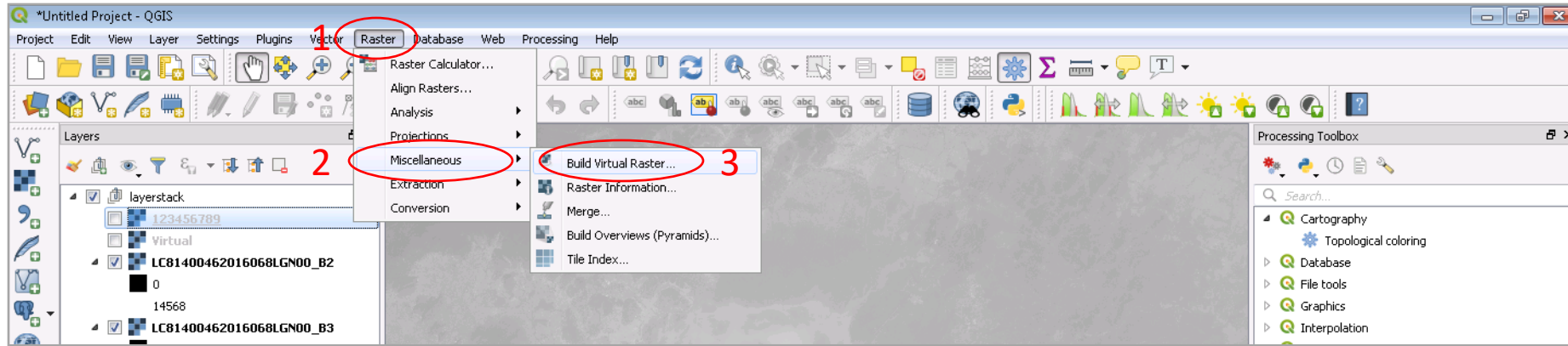
3. Add Raster Layer...

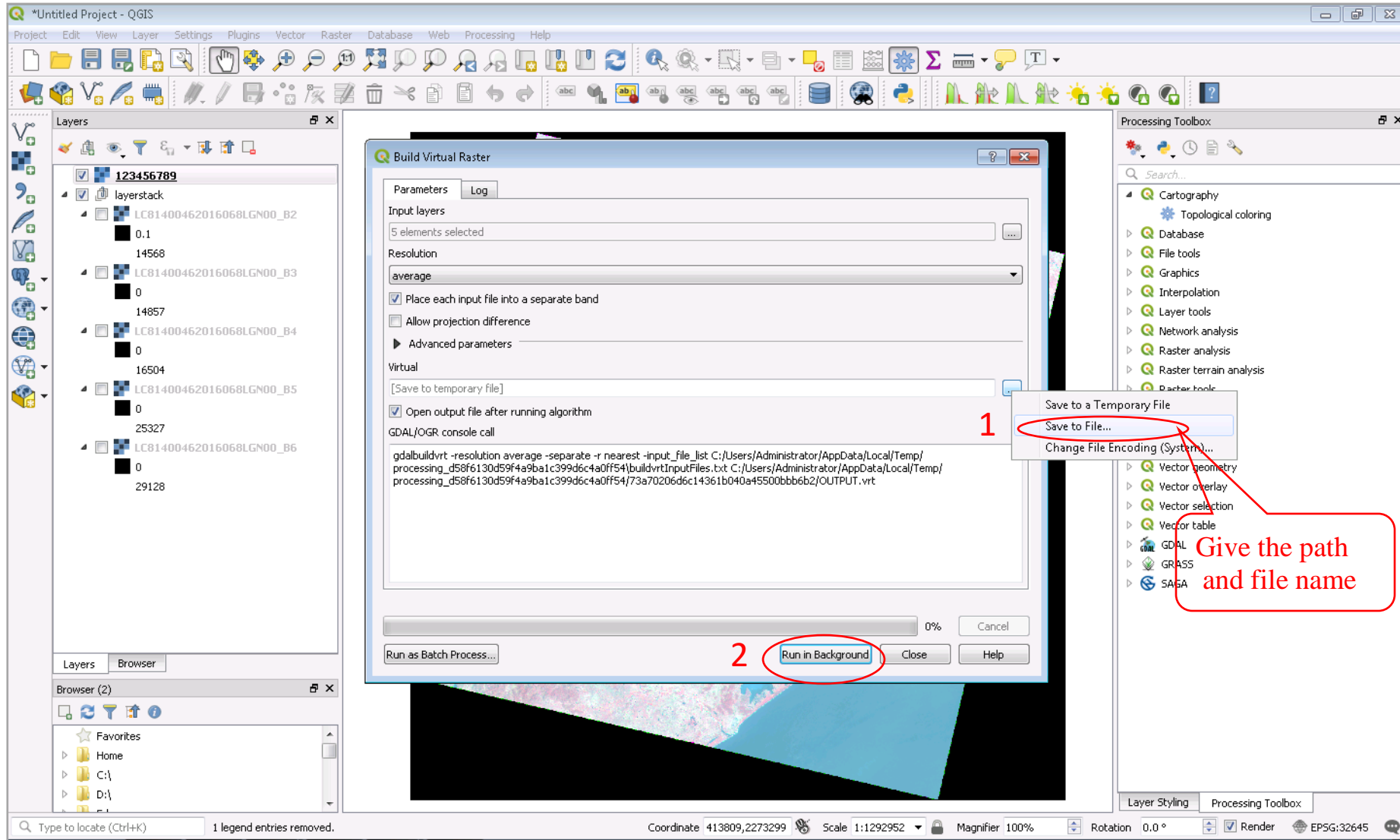
4. Source type/File

5. Open button in file dialog

6. Add button in Data Source Manager

Raster Band Composition:





➤ Open the FCC image

Change the band combination

➤ Select the FCC image → right click → properties

The screenshot illustrates the steps to change the band combination of a layer in QGIS. The process involves selecting the layer in the 'Layers' panel, right-clicking to open the context menu, and selecting 'Properties...'. This opens the 'Layer Properties - 123456789 | Symbology' dialog box. In the 'Symbology' tab, the 'Band rendering' section is configured with 'Multiband color' as the render type. The 'Red band' is set to 'Band 4', the 'Green band' is set to 'Band 4', and the 'Blue band' is set to 'Band 2'. The 'Color rendering' section shows 'Blending mode' set to 'Normal'. The 'OK' button is highlighted, indicating the final step to apply the changes.

Adding data to band set:

➤ Go to SCP click on band set → SCP plugin window opens.

The screenshot shows the QGIS SCP plugin window with the 'Band set' tab selected. The 'Multiband image list' is empty, and the 'Single band list' contains five items: LC08_L1TP_134051_20180131_20180207_01_T1_B2, LC08_L1TP_134051_20180131_20180207_01_T1_B3, LC08_L1TP_134051_20180131_20180207_01_T1_B4, and LC08_L1TP_134051_20180131_20180207_01_T1_B5. The 'Band set definition' section shows 'Band set 1' with a table for defining bands.

1. Click on 'SCP' in the QGIS menu bar.

2. Click on 'Band set' in the SCP menu.

3. Click on the 'Open file' icon (a green square with a white 'f') in the 'Multiband image list' section.

4. Click on the 'Refresh' icon (a circular arrow) in the 'Single band list' section.

5. Select the bands in the 'Single band list' that you want to create the band set from.

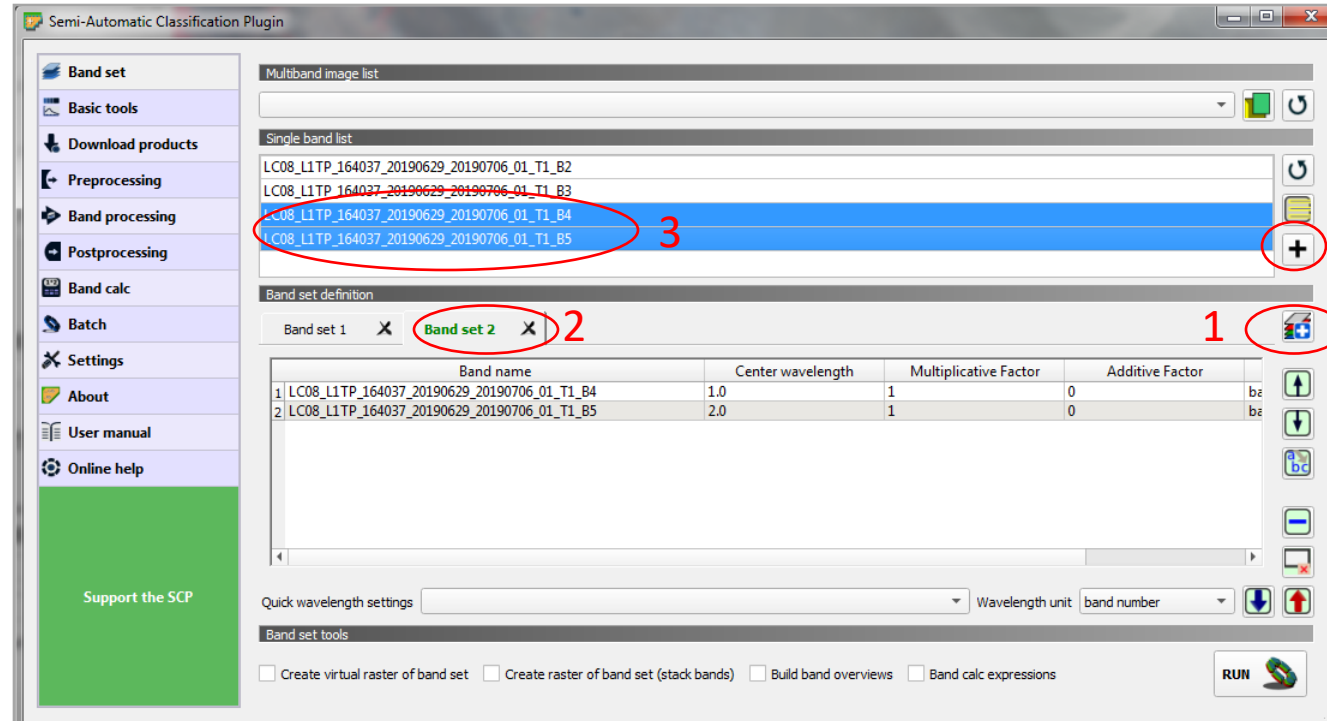
6. Click on the 'Add band to Band set' button (a plus sign) in the 'Band set definition' section.

If band data not added to QGIS window click on open file → Browse the image file

Now select the bands which you want to create band set or select all bands

Band name	Center wavelength	Multiplicative Factor	Additive Factor
LC08_L1TP_134051_20180131_20180207_01_T1_B2			
LC08_L1TP_134051_20180131_20180207_01_T1_B3			
LC08_L1TP_134051_20180131_20180207_01_T1_B4			
LC08_L1TP_134051_20180131_20180207_01_T1_B5			

➤ More band set creation



➤ After band creation if you want to remove any band from band set

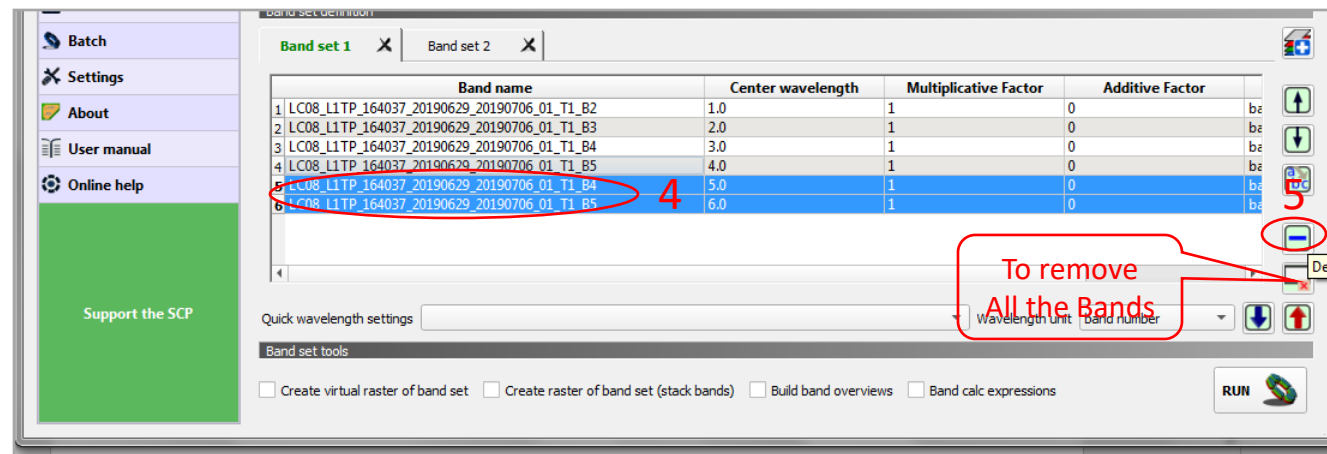
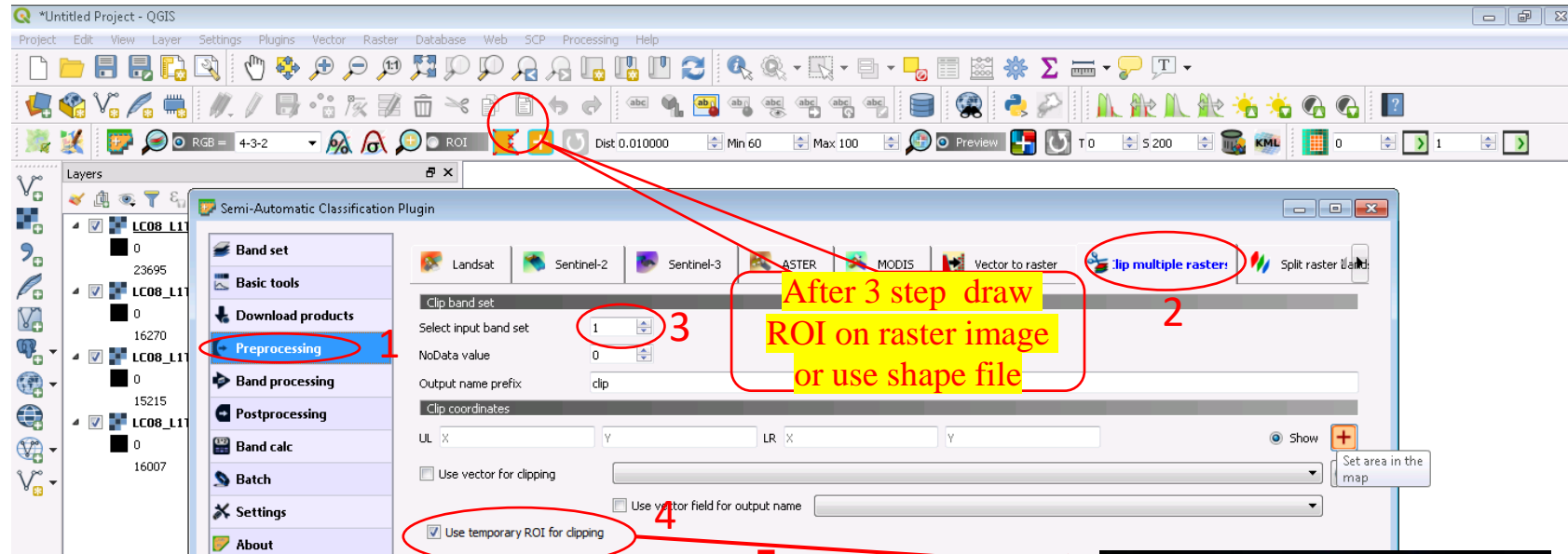
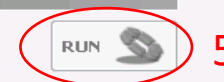
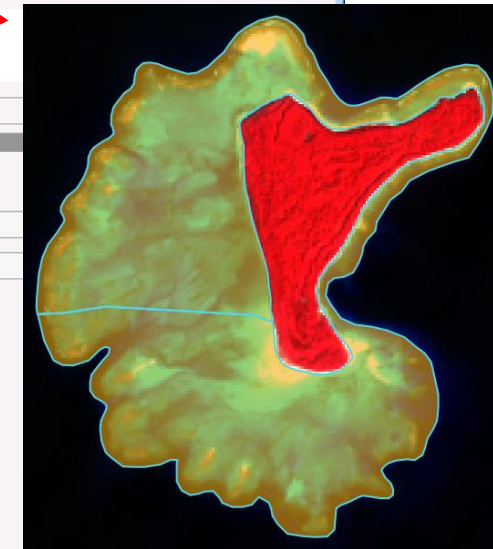
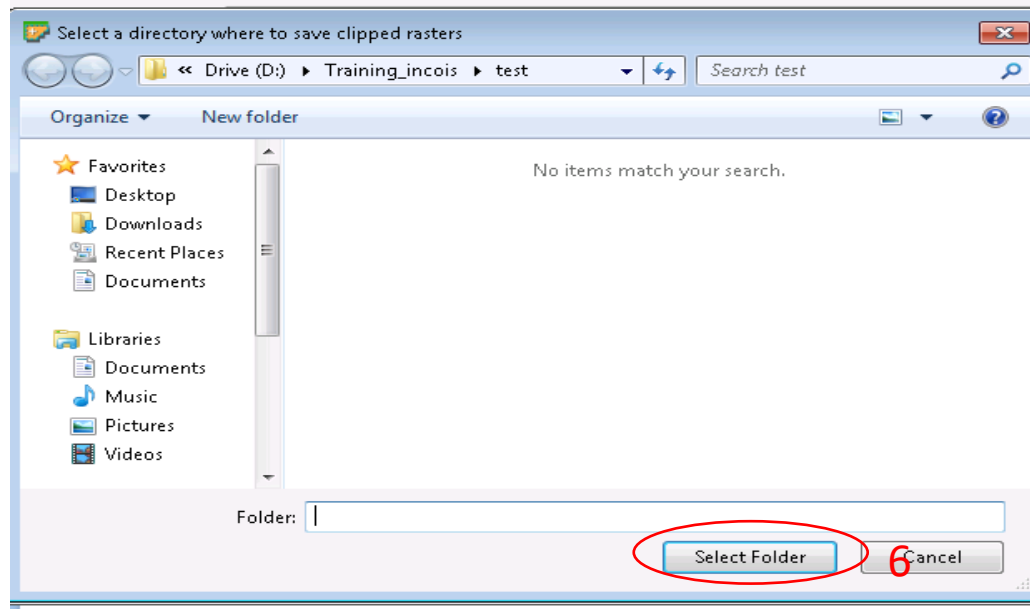


Image Clipping

➤ Go to SCP —————> processing —————> Landsat —————> Clip multiple rasters



➤ After 3 step draw ROI on raster image



Conversion to TOA Reflectance

Reflective band DN's can be converted to TOA reflectance using the rescaling coefficients in the MTL file:

$$\rho\lambda' = M\rho Q_{cal} + A\rho$$

where:

$\rho\lambda'$ = TOA planetary reflectance, without correction for solar angle.

Note that $\rho\lambda'$ does not contain a correction for the sun angle.

$M\rho$ = Band-specific multiplicative rescaling factor from the metadata (REFLECTANCE_MULT_BAND_x, where x is the band number)

$A\rho$ = Band-specific additive rescaling factor from the metadata (REFLECTANCE_ADD_BAND_x, where x is the band number)

Q_{cal} = Quantized and calibrated standard product pixel values (DN)

<https://yceo.yale.edu/how-convert-landsat-dns-top-atmosphere-toa-reflectance>

<https://www.usgs.gov/landsat-missions/using-usgs-landsat-level-1-data-product>

Go to SCP → create band set

Go to SCP → Bandcalc → write formula → run → output folder name.

LC08_L1TP_140047_20140404_20200911_02_T1_MTL - Notepad

```
File Edit Format View Help
"RADIANCE_ADD_BAND_9": "-11.94527",
"RADIANCE_ADD_BAND_10": "0.10000",
"RADIANCE_ADD_BAND_11": "0.10000",
"REFLECTANCE_MULT_BAND_1": "2.0000E-05",
"REFLECTANCE_MULT_BAND_2": "2.0000E-05",
"REFLECTANCE_MULT_BAND_3": "2.0000E-05",
"REFLECTANCE_MULT_BAND_4": "2.0000E-05",
"REFLECTANCE_MULT_BAND_5": "2.0000E-05",
"REFLECTANCE_MULT_BAND_6": "2.0000E-05",
"REFLECTANCE_MULT_BAND_7": "2.0000E-05",
"REFLECTANCE_MULT_BAND_8": "2.0000E-05",
"REFLECTANCE_MULT_BAND_9": "2.0000E-05",
"REFLECTANCE_ADD_BAND_1": "-0.100000",
"REFLECTANCE_ADD_BAND_2": "-0.100000",
"REFLECTANCE_ADD_BAND_3": "-0.100000",
"REFLECTANCE_ADD_BAND_4": "-0.100000",
"REFLECTANCE_ADD_BAND_5": "-0.100000",
"REFLECTANCE_ADD_BAND_6": "-0.100000",
"REFLECTANCE_ADD_BAND_7": "-0.100000",
"REFLECTANCE_ADD_BAND_8": "-0.100000",
"REFLECTANCE_ADD_BAND_9": "-0.100000",
},
"LEVEL1_THERMAL_CONSTANTS": {
  "K1_CONSTANT_BAND_10": "774.8853",
  "K2_CONSTANT_BAND_10": "1321.0789",
  "K1_CONSTANT_BAND_11": "480.8883",
  "K2_CONSTANT_BAND_11": "1201.1442"
}
```

Semi-Automatic Classification Plugin

Filter

Band set

- Basic tools
 - Algorithm band weight
 - Band set list
 - Export signatures
 - Import signatures
 - LCS threshold
 - Multiple ROI creation
 - RGB list
 - Signature threshold
- Download products
- Preprocessing
- Band processing
 - Band combination
 - Classification
 - Clustering
 - PCA
 - Random forest
 - Spectral distance
- Postprocessing
 - Accuracy
 - Classification dilation
 - Classification erosion
 - Classification report
 - Classification to vector
 - Classification sieve
 - Class signature
 - Cross classification
 - Edit raster
 - Land cover change
 - Reclassification
 - Zonal stat raster
- Band calc
- Batch
- Settings
- User manual
- Help
- About
- Support the SCP

Band list

Variable	Band name
4 raster4	LC08_L1TP_140047_20140404_20200911_02_T1_B5
5 raster5	LC08_L1TP_140047_20140404_20200911_02_T1_B6
6 raster6	bandset#b*
7 raster7	bandset#b1
8 raster8	bandset#b2
9 raster9	bandset#b3
10 raster10	bandset#b4
11 raster11	bandset#b5
12 raster12	bandset1b1
13 raster13	bandset1b2
14 raster14	bandset1b3
15 raster15	bandset1b4
16 raster16	bandset1b5
17 raster17	bandset1b*
18 raster18	bandset*b1
19 raster19	bandset*h2

Expression

```
("bandset#b1"*2.0000E-05)+(-0.100000)@CON#BANDSET #2
("bandset#b2"*2.0000E-05)+(-0.100000)@CON#BANDSET #3
("bandset#b3"*2.0000E-05)+(-0.100000)@CON#BANDSET #4
("bandset#b4"*2.0000E-05)+(-0.100000)@CON#BANDSET #5
("bandset#b5"*2.0000E-05)+(-0.100000)@CON#BANDSET #6
```

Functions

#BAND#

!function!

#BANDSET#

#DATE#

Input NoData as value Use value as NoData 0 Calculation data type Float32

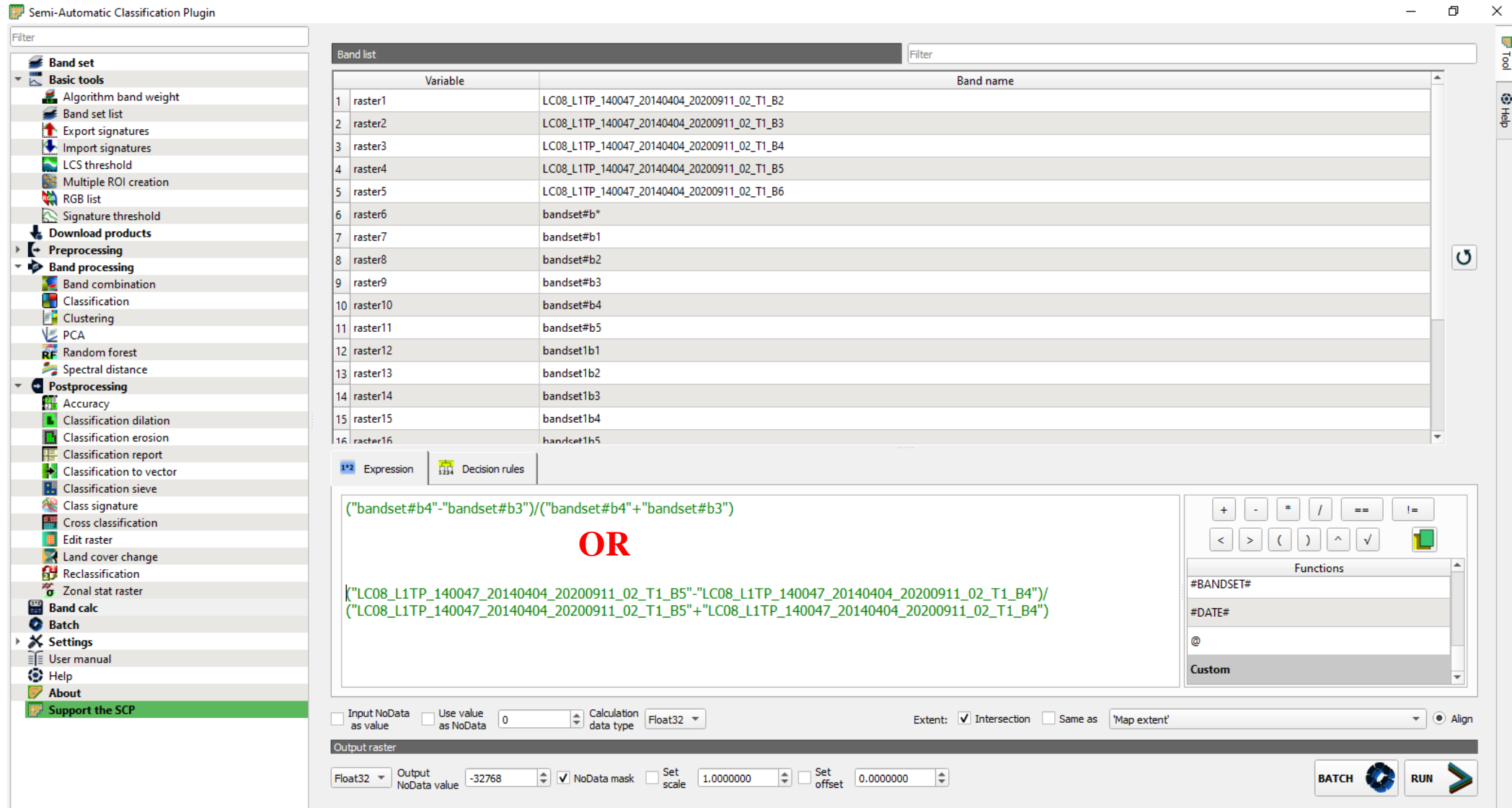
Extent: ☒ Intersection ☐ Same as 'Map extent' ☐ Align

Output raster

Float32 Output NoData value -32768 ☒ NoData mask ☐ Set scale 1.0000000 ☐ Set offset 0.0000000

BATCH RUN

Go to SCP → Bandcalc → write formula → run → output folder name.



The screenshot shows the 'Band calc' tool in the Semi-Automatic Classification Plugin (SCP). The interface includes a left sidebar with a tree view of tools, a central 'Band list' table, an 'Expression' field, and a 'Functions' list.

Band list table:

	Variable	Band name
1	raster1	LC08_L1TP_140047_20140404_20200911_02_T1_B2
2	raster2	LC08_L1TP_140047_20140404_20200911_02_T1_B3
3	raster3	LC08_L1TP_140047_20140404_20200911_02_T1_B4
4	raster4	LC08_L1TP_140047_20140404_20200911_02_T1_B5
5	raster5	LC08_L1TP_140047_20140404_20200911_02_T1_B6
6	raster6	bandset#b*
7	raster7	bandset#b1
8	raster8	bandset#b2
9	raster9	bandset#b3
10	raster10	bandset#b4
11	raster11	bandset#b5
12	raster12	bandset1b1
13	raster13	bandset1b2
14	raster14	bandset1b3
15	raster15	bandset1b4
16	raster16	bandset1b5

Expression field:

$$\frac{(\text{"bandset\#b4"} - \text{"bandset\#b3"})}{(\text{"bandset\#b4"} + \text{"bandset\#b3"})}$$

OR

$$\frac{(\text{"LC08_L1TP_140047_20140404_20200911_02_T1_B5"} - \text{"LC08_L1TP_140047_20140404_20200911_02_T1_B4"})}{(\text{"LC08_L1TP_140047_20140404_20200911_02_T1_B5"} + \text{"LC08_L1TP_140047_20140404_20200911_02_T1_B4"})}$$

Functions list:

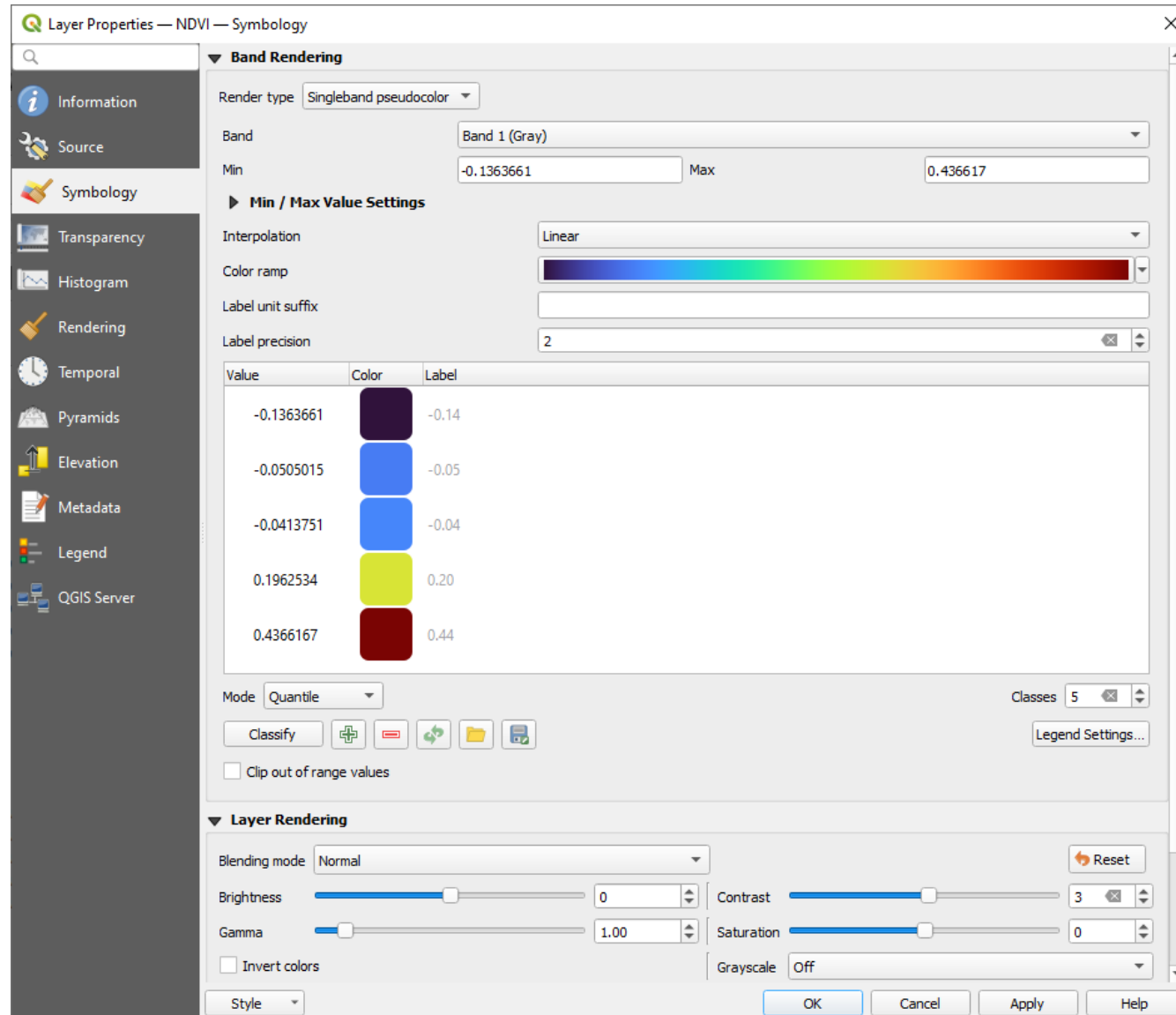
- #BANDSET#
- #DATE#
- @
- Custom

Output raster settings:

- Input NoData as value: ☐ Use value as NoData: 0 Calculation data type: Float32
- Extent: ☒ Intersection ☐ Same as 'Map extent' ☐ Align
- Output raster: Float32 Output NoData value: -32768 ☒ NoData mask ☐ Set scale: 1.0000000 ☐ Set offset: 0.0000000

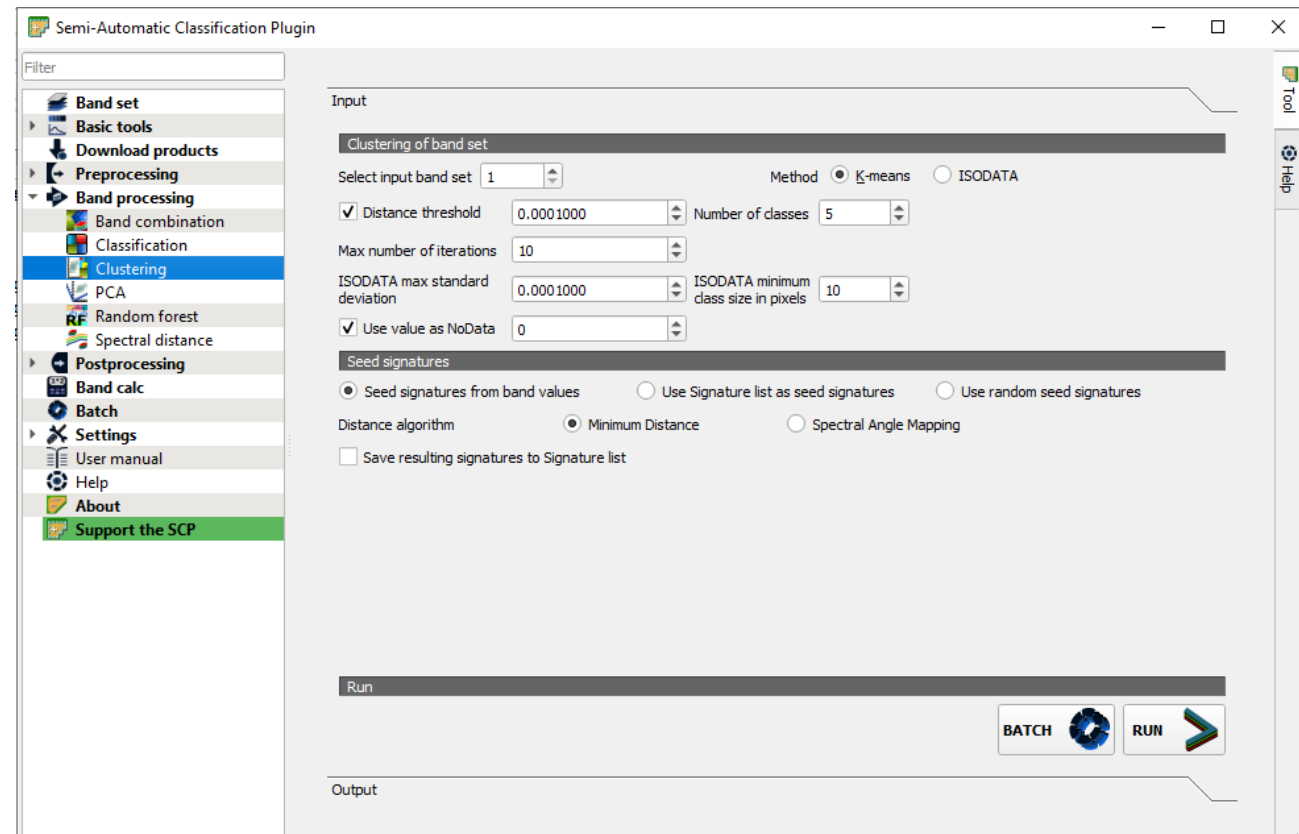
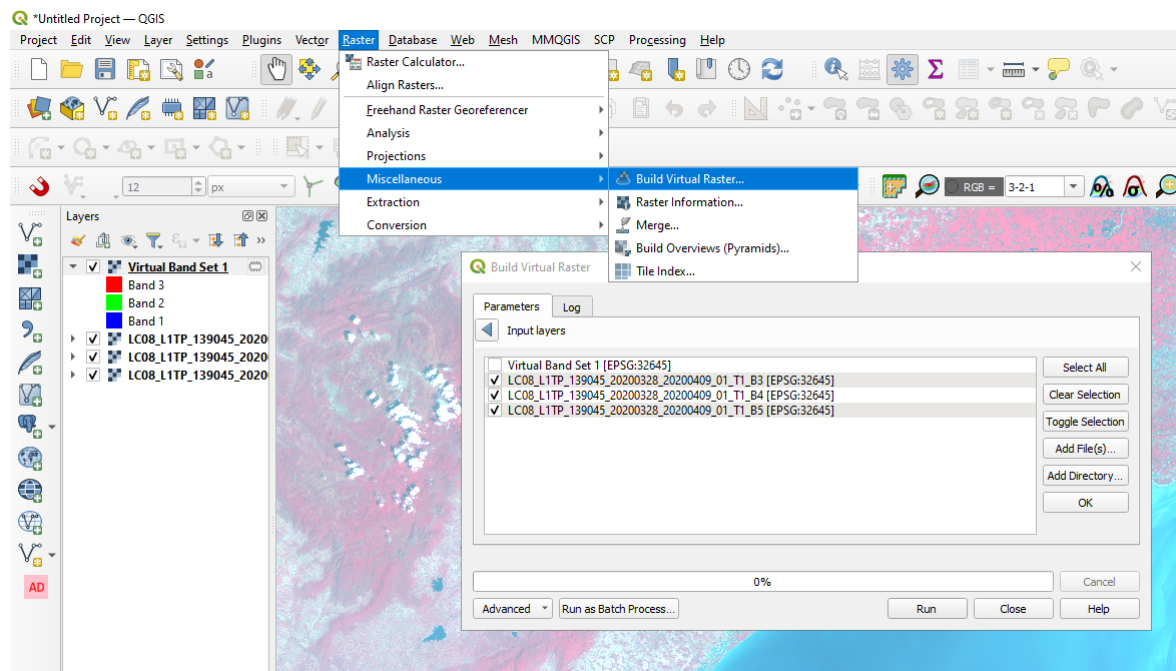
Buttons: BATCH RUN

Go to Layer → select the layer and right-click → Layer properties → Symbology Rendering type: Singleband Pseudocolour → Colour ramp: select colour → mode: Quantile → Classes: ex:5 → Apply → ok



Unsupervised Image Classification

- Open Raster Image in QGIS
- Go to raster → Miscellaneous → Build Virtual Raster → select bands → run
- Go to SCP → Band set → Select Multi band image → select our image → select band click on + to make Bandset.
- Go to Band processing → Clustering → select input band set: select out band set → Method: K-mean → Number of classes: as our requirement ex: 5 → check use values as No data: 0 → run → give output path and file name.
- Using MapSwipe Tool (plugin) swipe the classified image check with the original data (Go to plugin → MapSwipe tool).

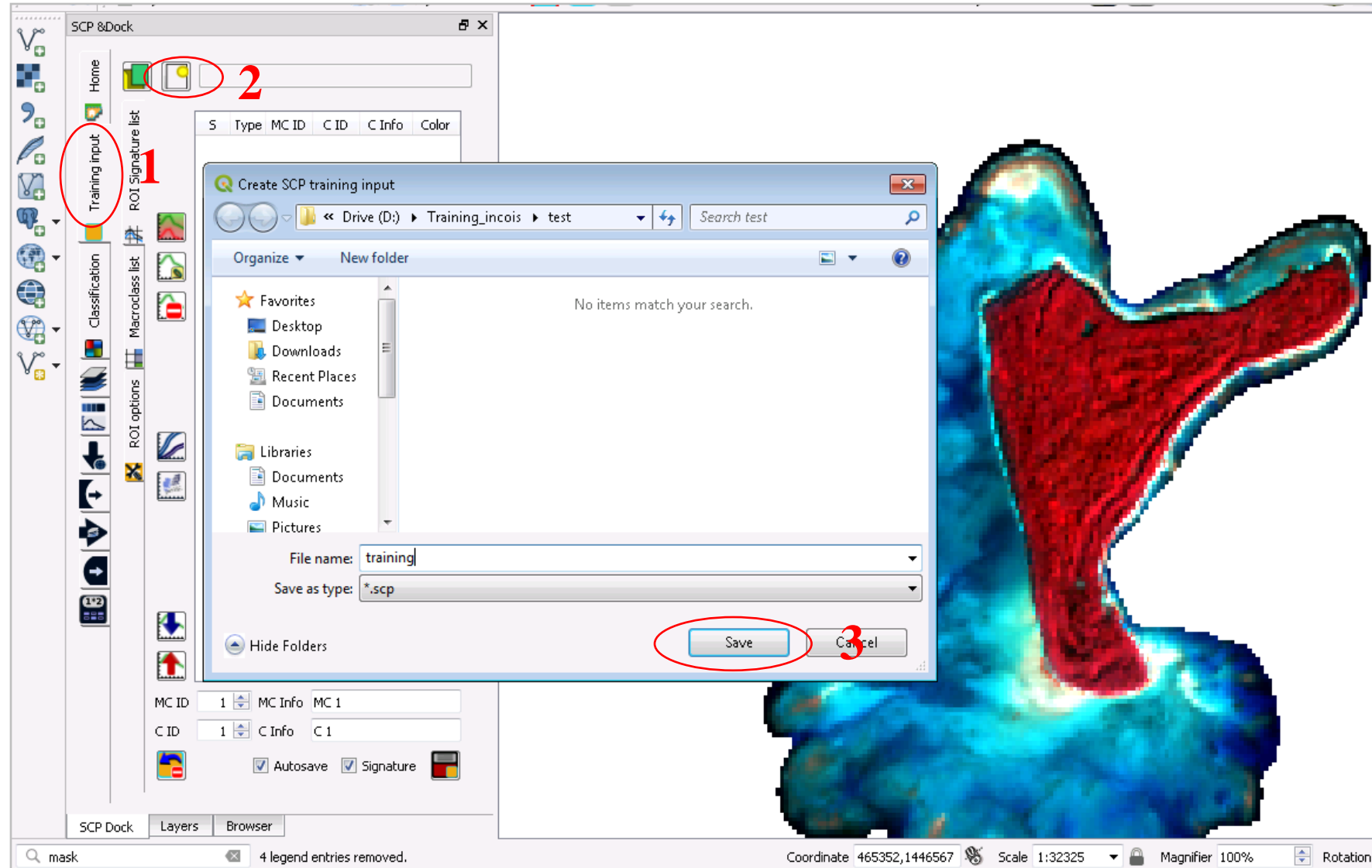


Supervised Image Classification



Create the training input file

Go to SCP Dock → Training input → Create SCP training input



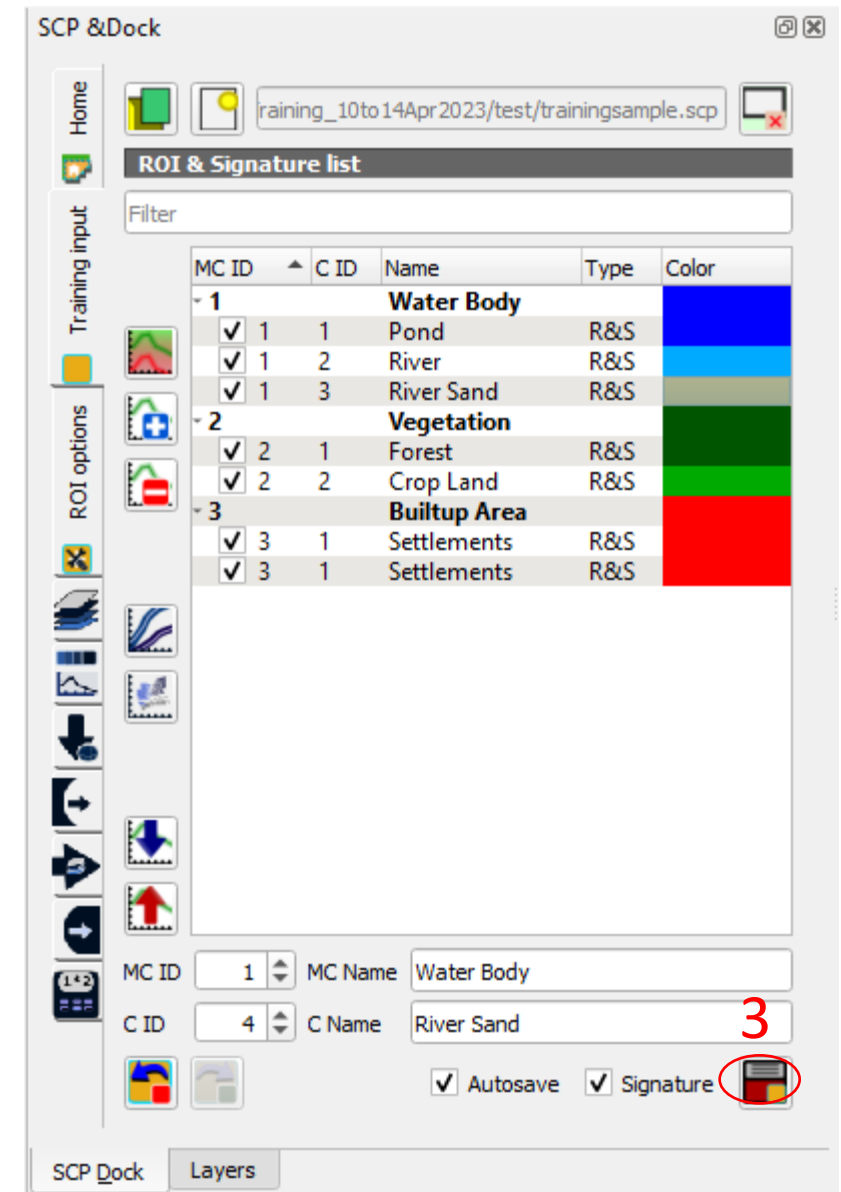
➤ Now go to the create ROI polygon and draw a polygon

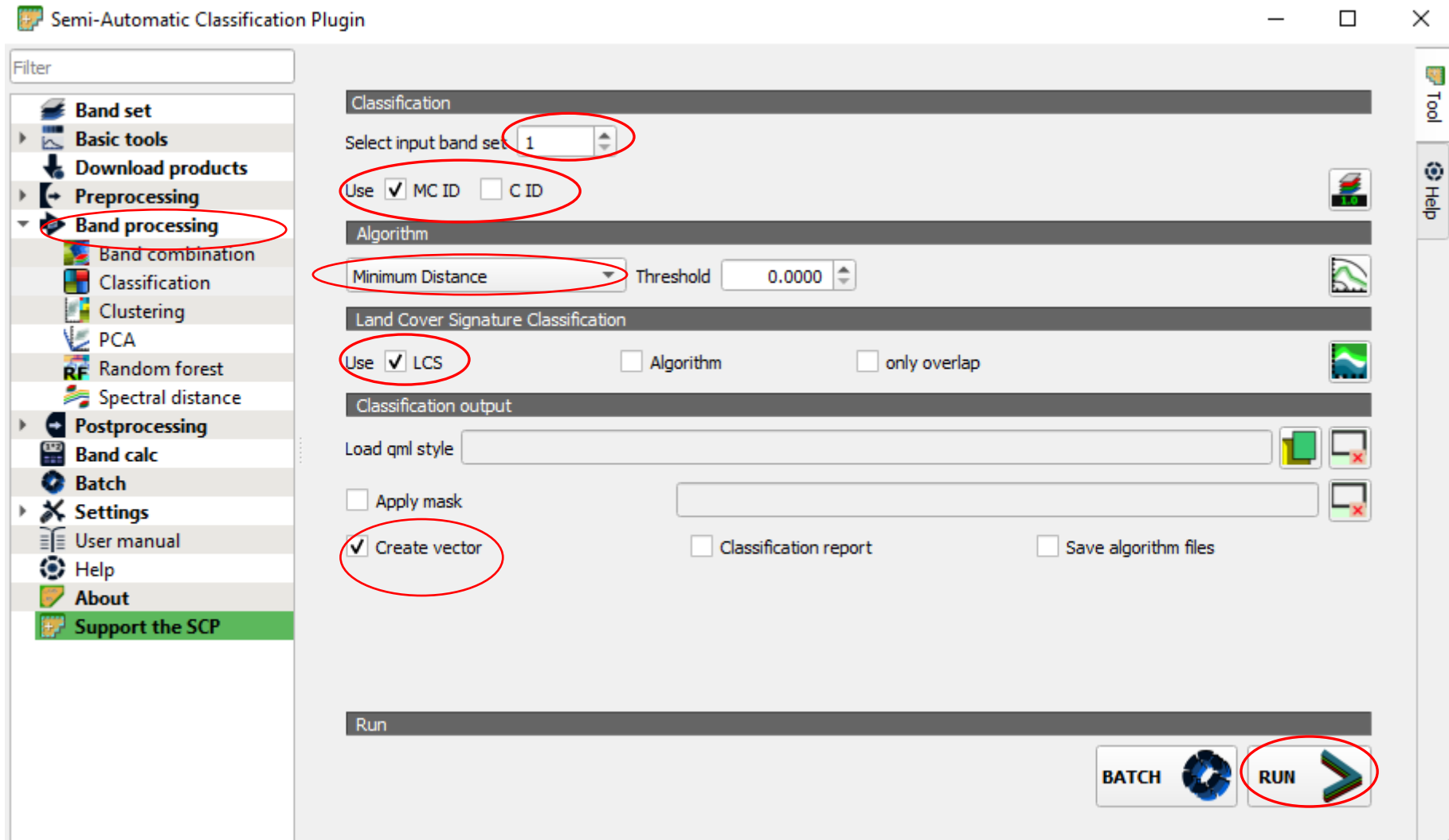


- Now click on save temporary ROI to training input
- Collect all training classes
- Based on class you have to changing MC Id and C ID

Example of Macroclasses

Macroclass name	Macroclass ID	Class name	Class ID
Vegetation	1	Grass	1
Vegetation	1	Trees	2
Built-up	2	Buildings	3
Built-up	2	Roads	4





- Go to SCP → Band Processing → Classification
- Use Micro ID or class ID
- Select algorithm → Landcover signature classification
- Click on run → give the path to save the classified image.



Thank you