

RASTER PROCESSING TUTORIAL (Q-GIS)

REDD+

Training session of 24 to 28 November 2014



Objectives:

- Open a raster layer (SPOT image)
- Georeference a raster layer
- Use the raster tools
- Generate filters for layers
- Digitize deforested areas and impacted waterways

1. Open a raster layer



- Click on the raster layer icon in the management layer bar:
- Select the raster file *IMAGERY_demo_687_340* in the file *Training_session_QGIS\Raster* and open.

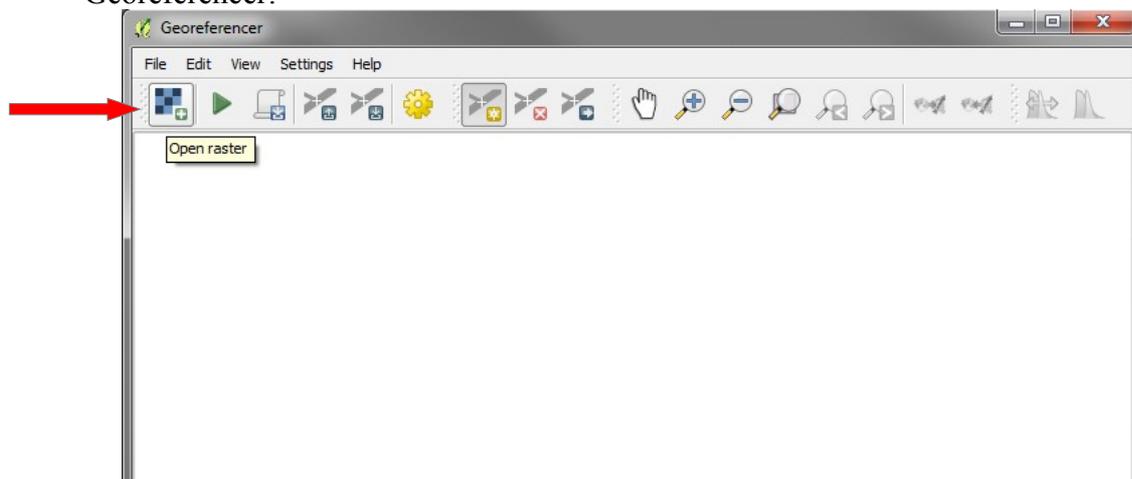
2. Georeferencing

The satellite photos of SPOT are already georeferenced but it is possible that it is slightly shifted. To verify that, the layer “system_water” will be used as a reference:

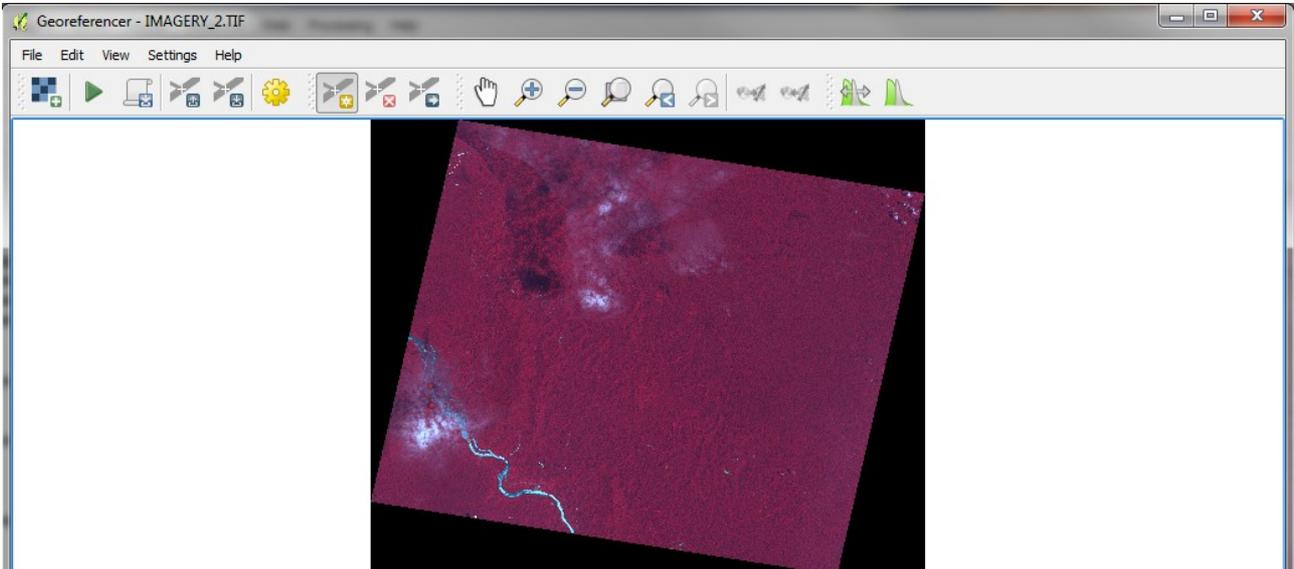
- Open the vector layer *Water_system (Training_session_QGIS\Shape)* by clicking the vector layer icon:



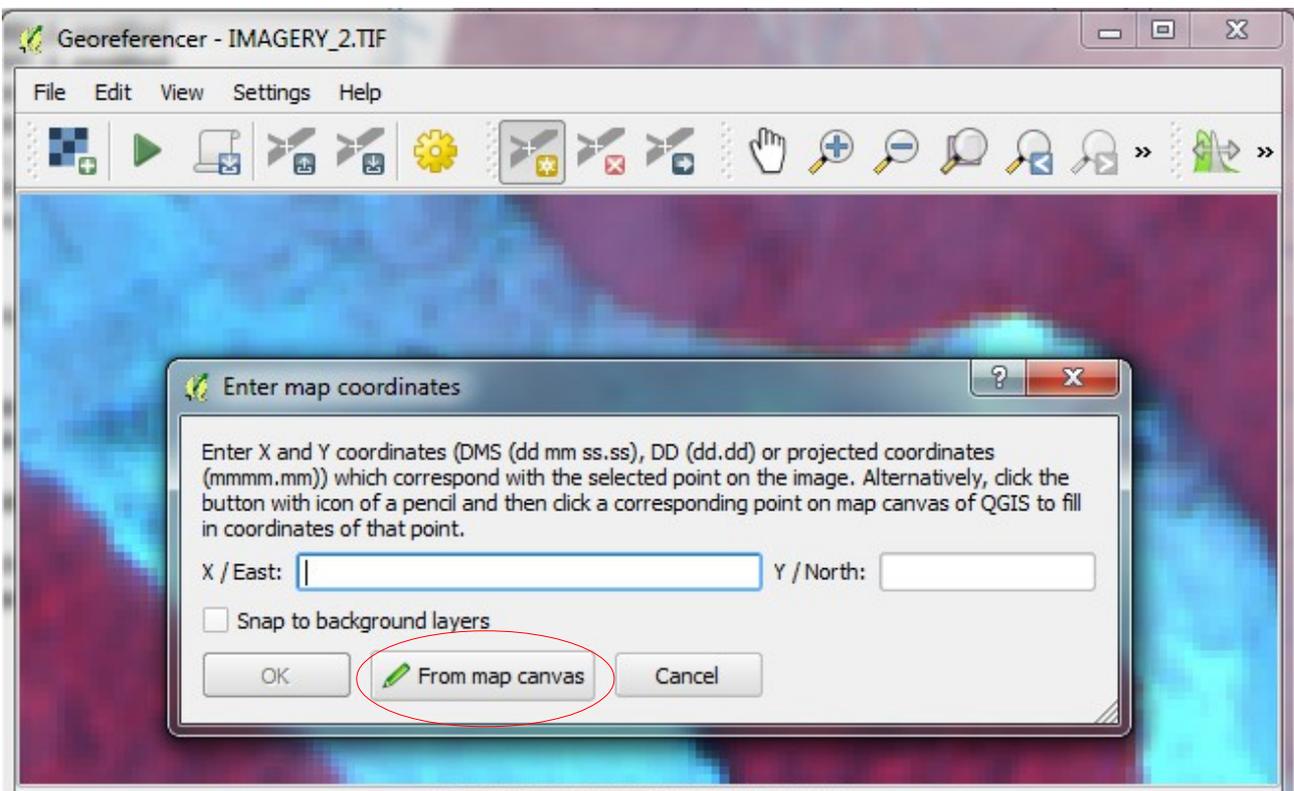
- Check if there is a shift between the waterways of the vector layer and the satellite image.
- If this is the case, click on: *Menu \ Raster \ Georeferencer*.
- Open the raster layer *IMAGERY_demo_687_340 (Training_session_QGIS\Raster)* with Georeferencer:



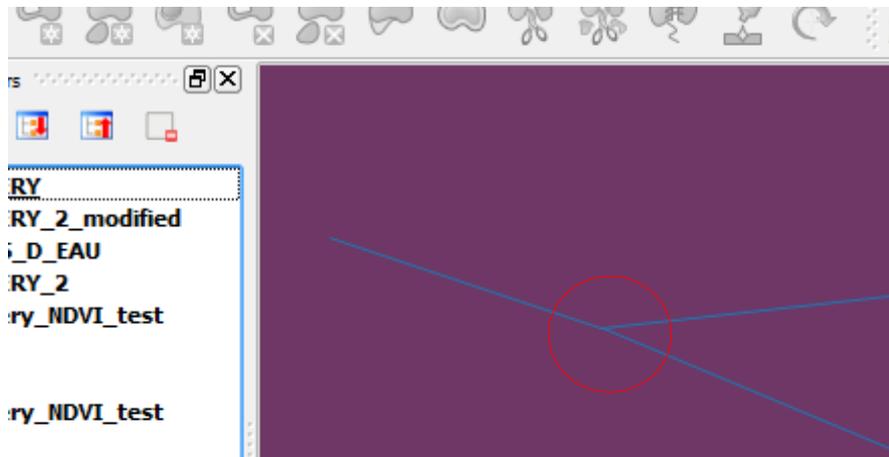
- Add an anchor point:



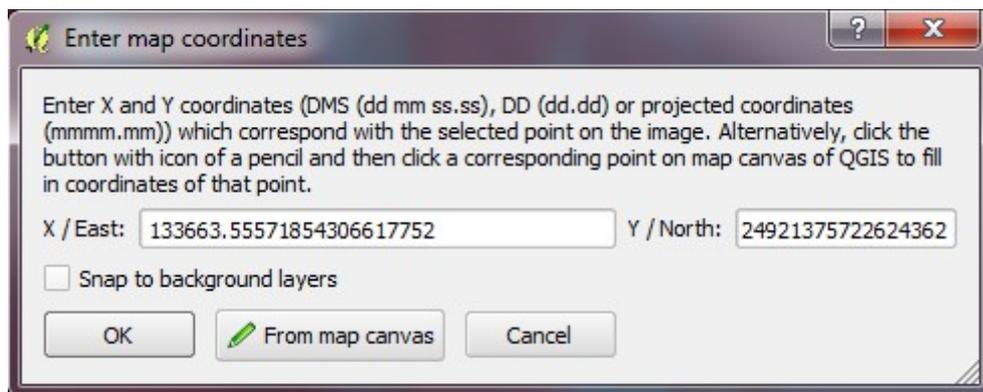
- Choice an remarkable point on a waterways as anchor point (zoom to be precise) and enter the coordinates to click a corresponding point on map canvas:



- On the map canvas, click on the waterways corresponding of the vector layer *Water_system* (zoom to be precise):



- Validate the anchor point and restart until to get six points.



GCP table								
on/off	id	srcX	srcY	dstX	dstY	dX[pixels]	dY[pixels]	residual[pixels]
✘	0	134684.17	434195.12	132809.80	434918.66	0.00	0.00	0.00
✘	1	135166.51	434265.90	133745.90	435043.76	0.00	0.00	0.00
✘	2	134979.08	433999.83	133241.18	434478.65	0.00	0.00	0.00

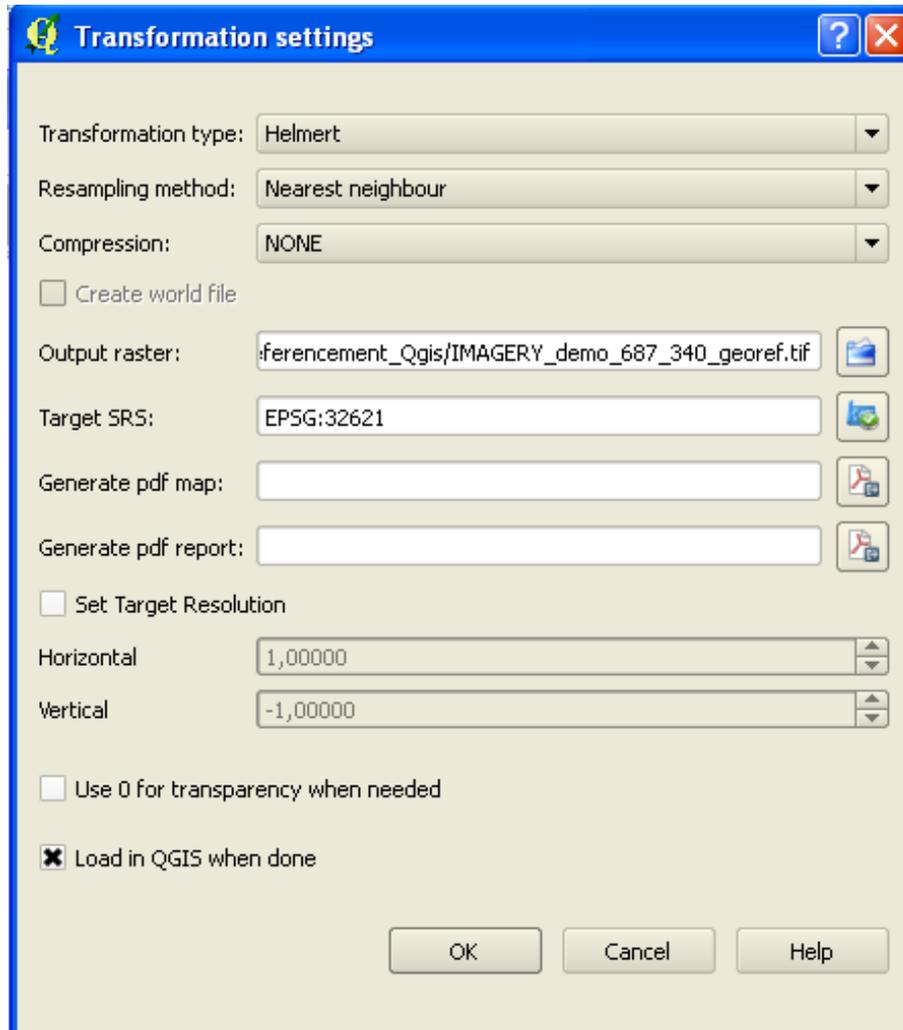
You can remove or delete a point with the buttons:



- Click on *Transformation settings*:



Use the Helmert transformation and name the output raster *IMAGERY_demo_687_340_georef*



and save in the file *Training_session_QGIS\Processing_data\Raster*

An affine (linear) transformation is used when the image is referenced in the same projection as the reference image (three points are sufficient). The polynomial transformations are used when deformations are important. Four minimum points are needed for a first-order polynomial transformation, six and ten points for a second-order transformation and a third-order transformation.

Once the settings performed, click the green arrow to start the process of transformation.

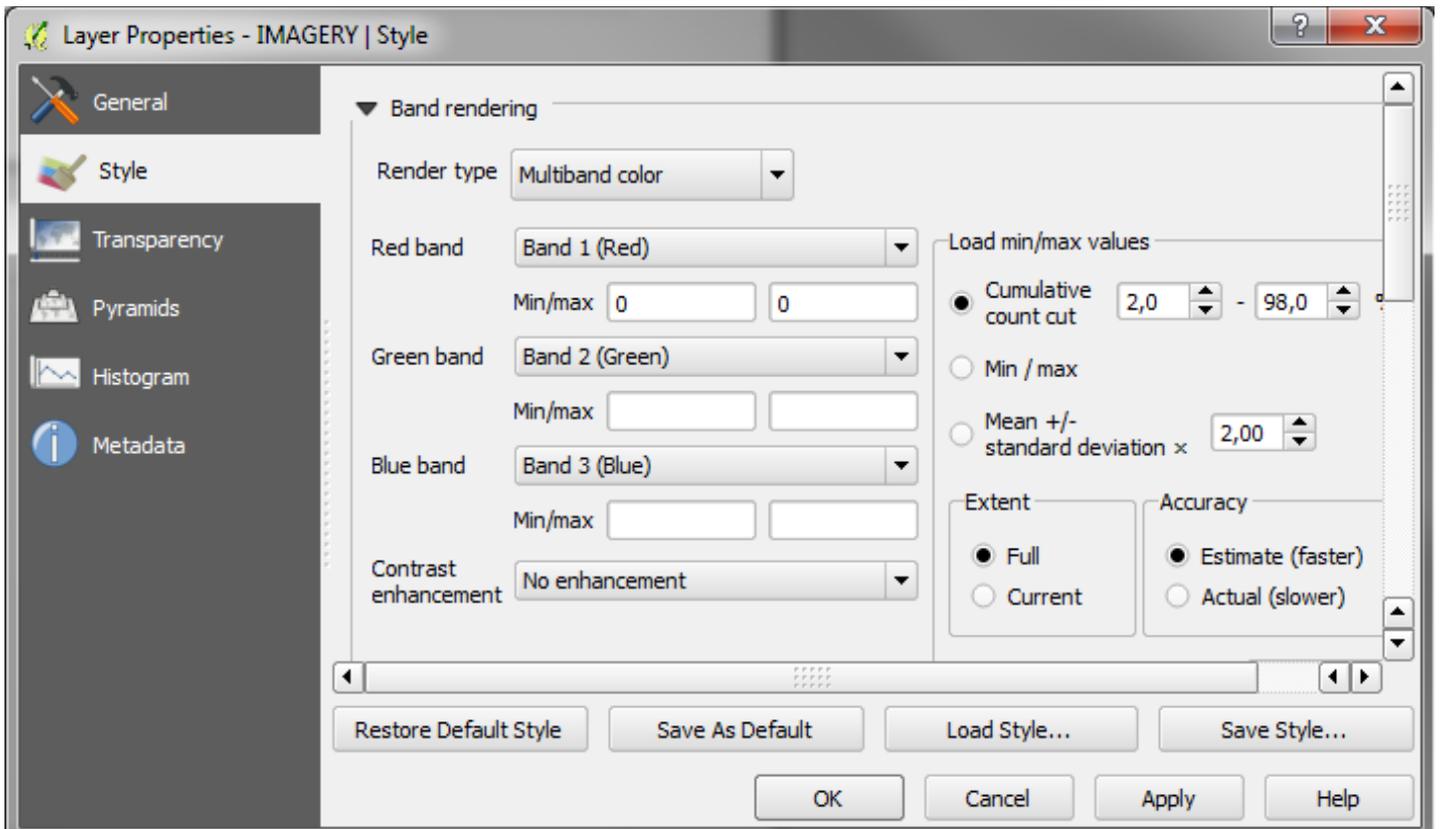
3. Rendering of raster bands

SPOT 4 & 5 has four spectral bands (10m colors):

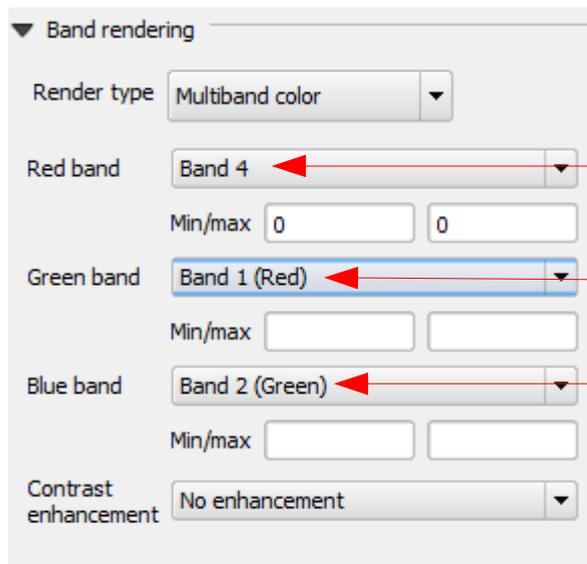
- B1 (green : 0,50 – 0,59 μm)
- B2 (red: 0,61 – 0,68 μm)
- B3 (near infrared : 0,78 – 0,89 μm)
- B4 (short wavelengths infrared : 1,58 – 1,75 μm)

Automatically, QGIS attributes the red band to the first spectral band (B1 green) of the satellite photo, the green band to B2 (red) and the blue band to B3 (NIR). So, every green objects (the forest for example) appears red... However, it is possible to modificate the order of the spectral band to bring up some objects.

- Double-click on the raster layer *IMAGERY_demo_687_340_georef* and choose the *Style* tab



- To get an image in “true colors”, attribute the *band 4* to the *Red band*, the *band 1* to the *Green band*, and the *band 2* to the *Blue band*.



B4 (MIR)

B1 (Green)

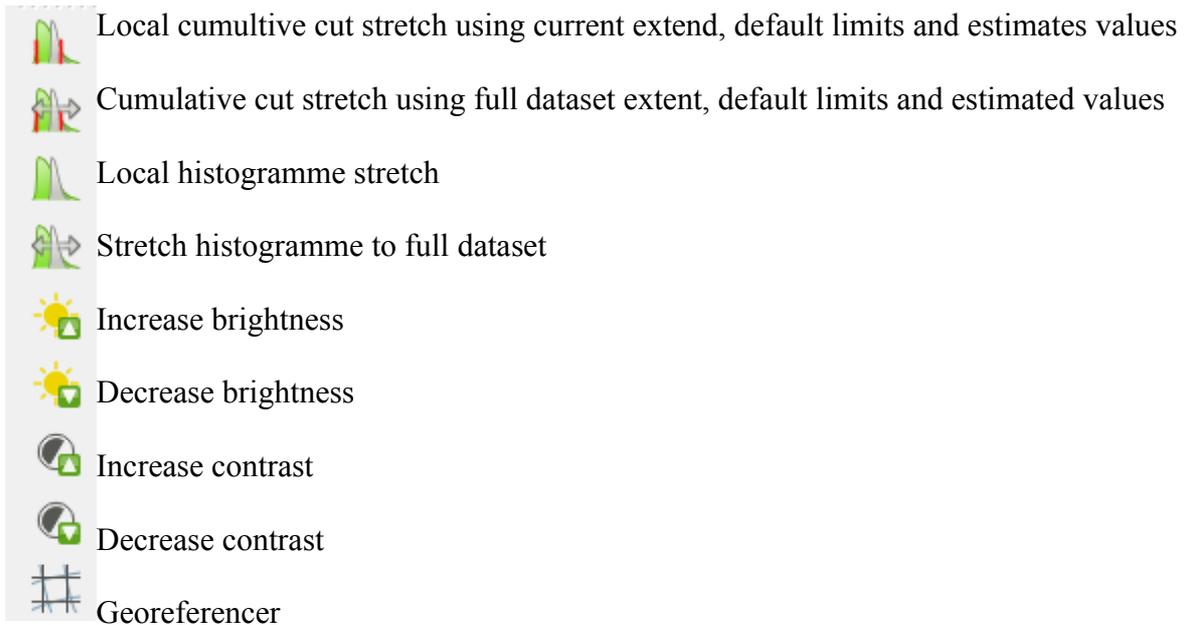
B2 (Red)

Image in “true colors”



On “true colors” display, the turbid water appears clear and the clear water appears dark.

- Use the Raster toolbar: right-click on the toolbar and check *Raster* bar.



Play with this functions (and the zoom) to improve the visibility of the image.

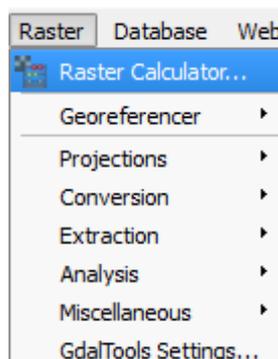
- Use the Raster calculator :Generate a NDVI layer.

The index of normalized difference vegetation (NDVI) is built from red channel (R) and near infrared (NIR). The Normalized Difference Vegetation Index highlights the difference between the visible red band and near infrared band. $NDVI = (NIR - R) / (NIR + R)$.

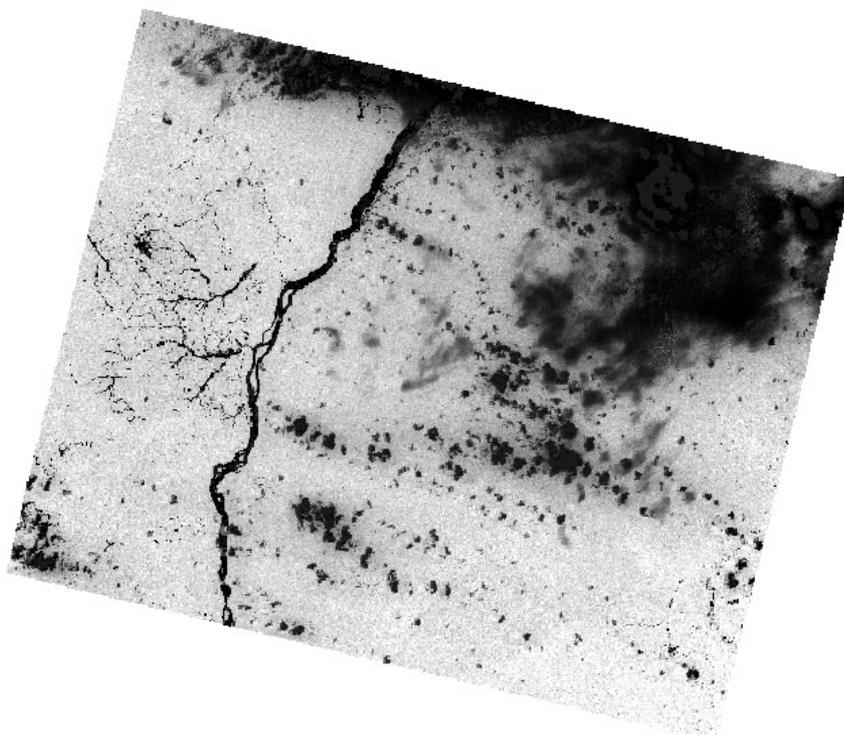
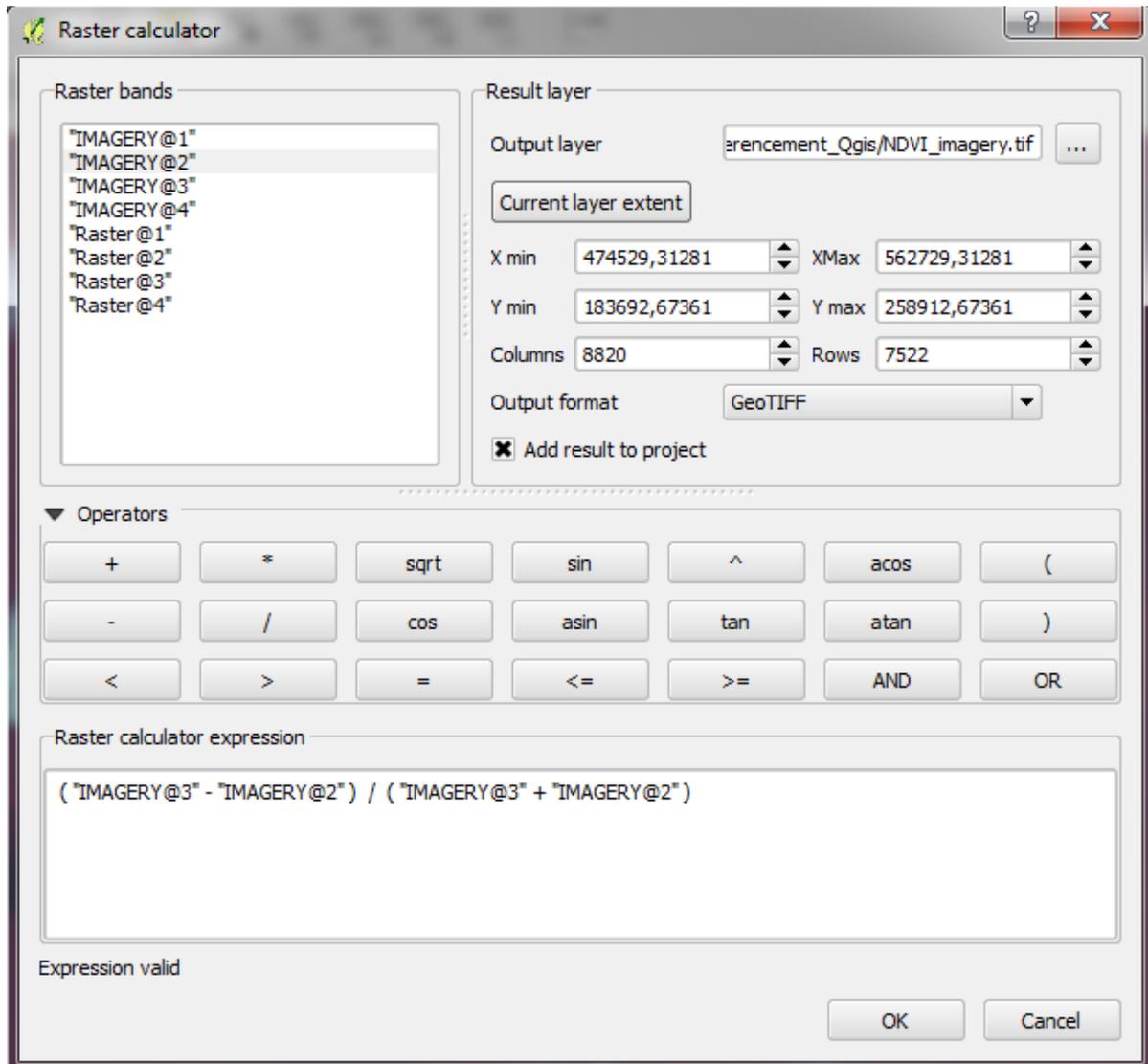
This index is sensitive to the strength and quantity of vegetation. The NDVI values range from -1 to +1, with negative values corresponding to the surfaces other than vegetation cover, such as snow, water or clouds for which the reflectance in the red is greater than that of near infrared. For bare soils, reflectance is roughly of the same order of magnitude in the red and near infrared, the NDVI is close to 0.

The vegetation has positive NDVI values, generally between 0.1 and 0.7. The highest values corresponding to the most dense vegetation cover.

- Click on *Raster calculator*:



- Tape the expression of the NDVI and save the output layer *NDVI_IMAGERY_demo_687_340* in *Training_session_QGIS\Processing_data\Raster*



- Same exercise with the NDWI.

Following the same principle as NDVI, Normalized Difference Water Index (NDWI) uses the near infrared band and infrared band at short wavelengths ('short-wave infrared' SWIR). Instead of the red band, where the reflectance is affected by the chlorophyll, the NDWI uses infrared band to shorter wavelengths (between 1.5 and 1.75µm), where water has an absorption peak. The near infrared band (NIR) is the same as the NDVI because the water does not absorb in this region of the electromagnetic spectrum.

The NDWI index is calculated using the following equation:

$$NDWI = (NIR - SWIR) / (NIR + SWIR)$$

- Generate a bare soil filter.

To locate “more easily” the bare soil zones, we will generate a filter by crossing a NDWI band filter and a SWIR band filter.

NDWI which is an indicator of the presence of water allows, in our case (because the vegetation cover contains water), a proper identification of bare soils (low values of the index).

Near infrared (very reflected by the cloud) removes, in part, the residual clouds unfiltered by the NDWI.

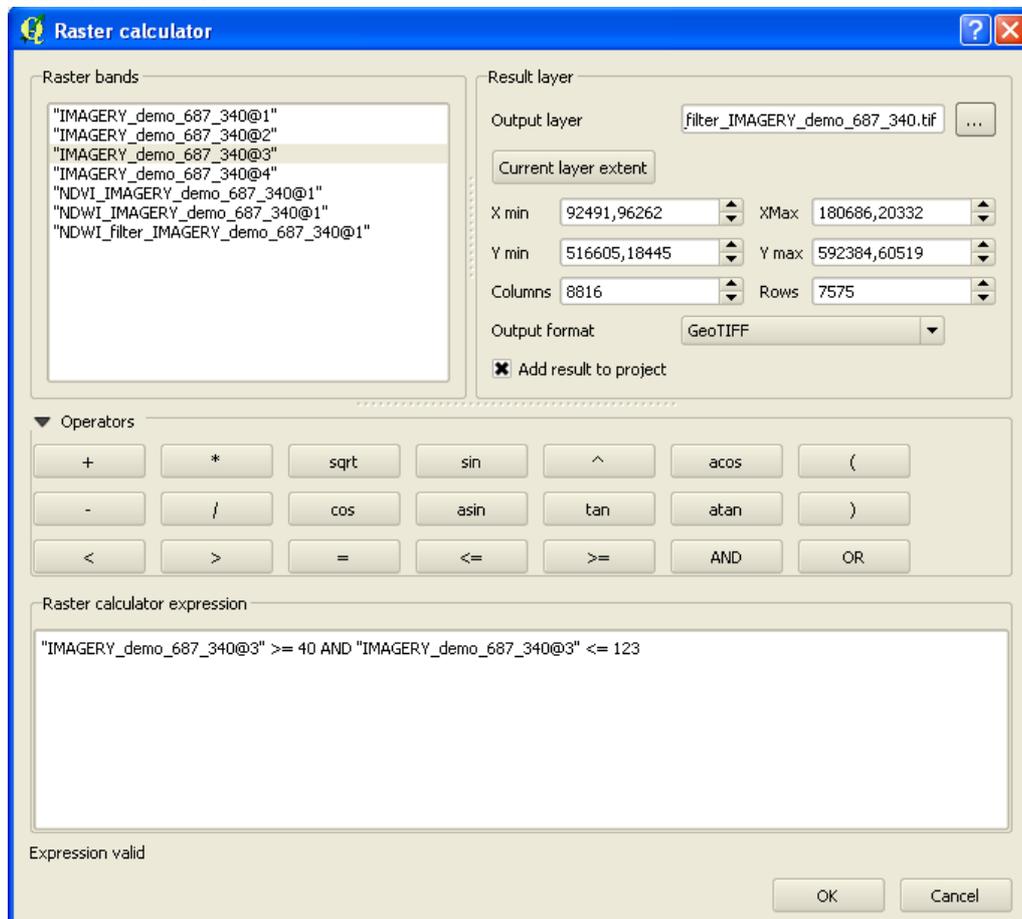
Spectral thresholds selected to build the semi-automatic detection bare soil:

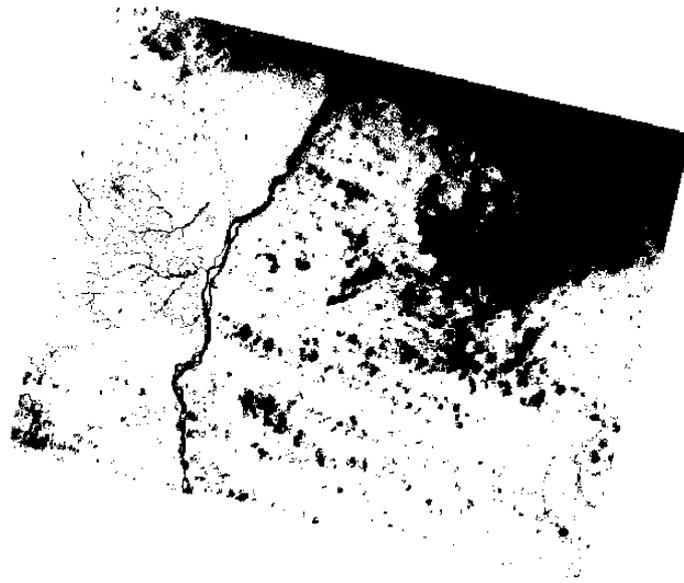
$$NDWI = [-0.55 : -0.18]$$

$$NIR = [40 : 123]$$

Four steps:

1. Realize a raster layer NDWI (already done).
2. Produce a filter with the **Raster calculator** from the NIR band (B3) to select the appropriate spectral thresholds:





3. Produce a filter with the **Raster calculator** from the NDWI layer (*NDWI_filter_IMAGERY_demo_687_340*) to select the appropriate spectral thresholds:

Raster calculator

Raster bands

- "IMAGERY_demo_687_340@1"
- "IMAGERY_demo_687_340@2"
- "IMAGERY_demo_687_340@3"
- "IMAGERY_demo_687_340@4"
- "NDWI_IMAGERY_demo_687_340@1"
- "NDWI_IMAGERY_demo_687_340@1"
- "NIR_filter_IMAGERY_demo_687_340@1"

Result layer

Output layer: VI_filter_IMAGERY_demo_687_340

Current layer extent

X min: 92491,96262 XMax: 180686,20332

Y min: 516605,18445 Y max: 592384,60519

Columns: 8816 Rows: 7575

Output format: GeoTIFF

Add result to project

Operators

+ * sqrt sin ^ acos (

- / cos asin tan atan)

< > = <= >= AND OR

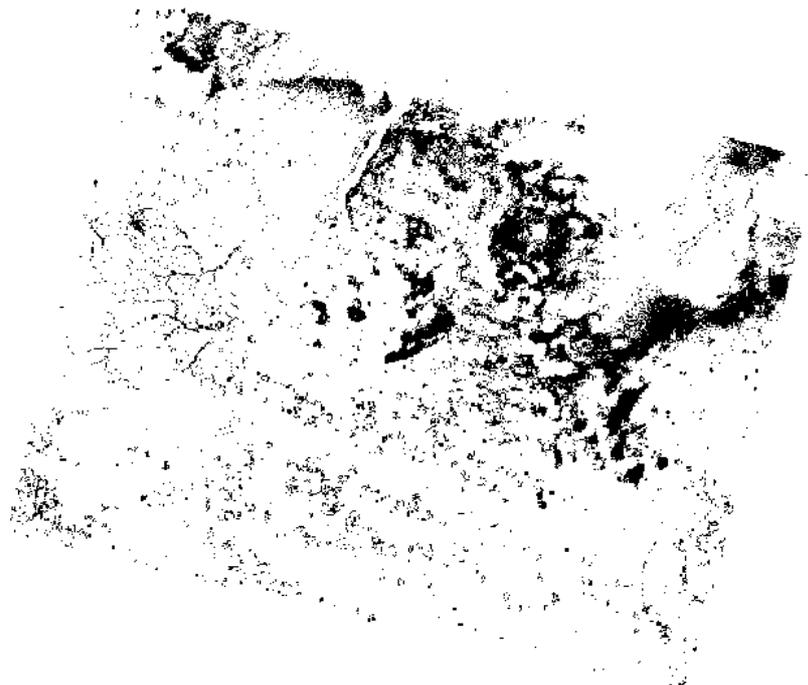
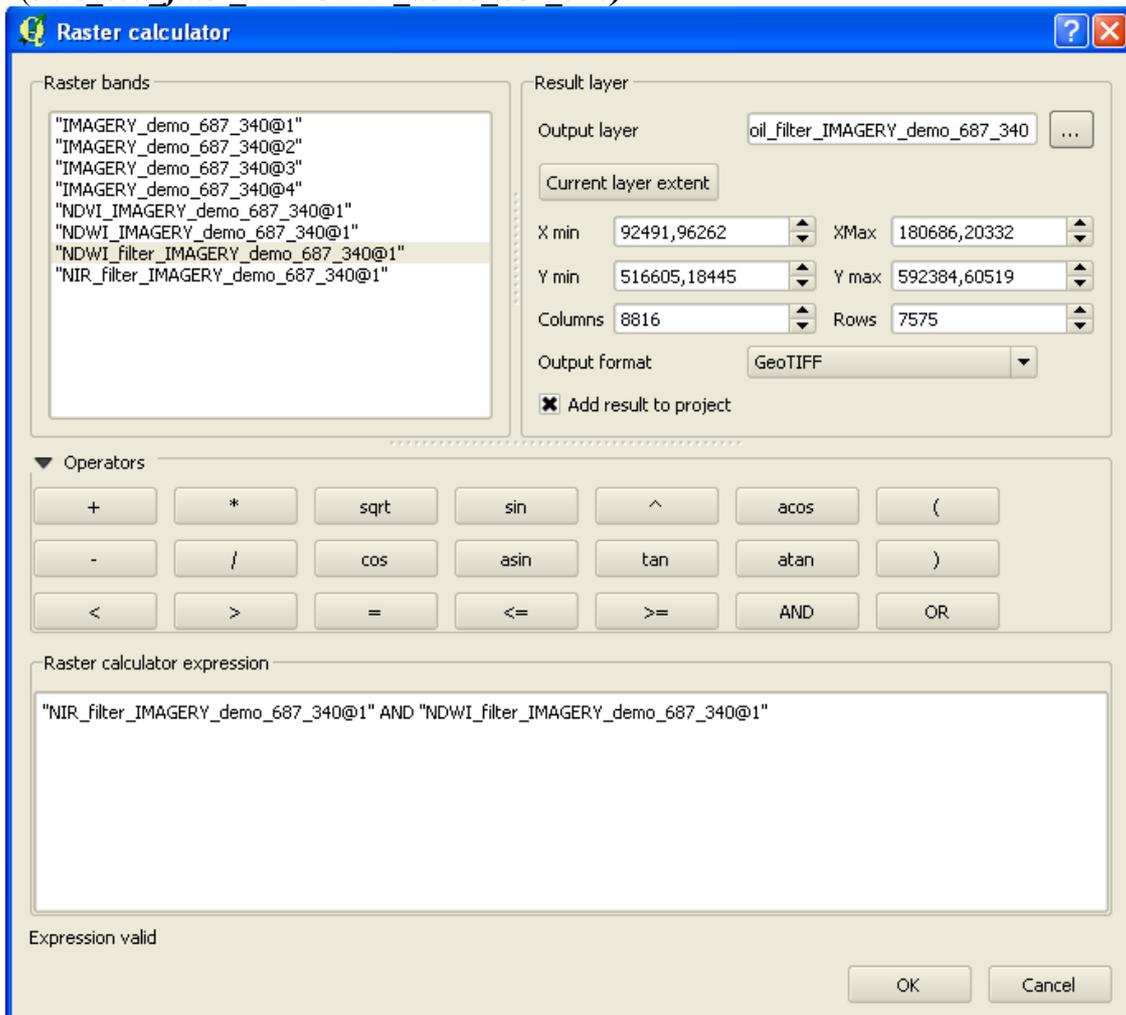
Raster calculator expression

"NDWI_IMAGERY_demo_687_340@1" >= - 0.55 AND "NDWI_IMAGERY_demo_687_340@1" <= - 0.18

Expression valid

OK Cancel

4. Produce the bare soil filter by crossing the NDWI filter and the NIR filter
(*bare soil filter IMAGERY_demo_687_340*)



4. Digitizing

- Open the vector layer *surf_expl.shp* (exploited surface).
- Update this vector layer by digitizing extensions of exploited surface and the new exploited surfaces from the observation of raster layer *IMAGERY_demo_687_340_georef* (scale 1/5000).
- Save the project in *Training_session_QGIS\QGIS_project*