Simone Boesso 1800408, Exercise 3

The aim of this exercise is to detect and to quantify the extension of areas (pixels) characterized by healthy vegetation (NDVI > 0.4) through the analysis of an aggregated (median) image produced from the from Sentinel 2 Surface Reflectance images collected in a given area of interest (AOI) for a temporal period of interest

- **1.** So the first step was to load the collection.
  Then I decided to focus my analysis in the area of Fiano Romano near Rome.

And so I got the following coordinates:

```
Imports (1 entry)
  var geometry: Point (12.59, 42.17)
    type: Point
    coordinates: [12.592183190942414,42.16908791124467]
```

- **2.** Following the guidelines. I had to set the constraints about the place and time on the collection of images.

```
// first step is to load the images from the Sentinel-2 Level-2A (Surface Reflectance) collection
var Collection_sentinel_S2 = ee.ImageCollection("COPERNICUS/S2_SR_HARMONIZED");

// Here i filter the collection using the time interval, the geometry and the cloud property
var filtered_S2_Collection = Collection_sentinel_S2
                    .filterDate ('2020-01-01', '2020-04-30')
                    .filterBounds(geometry)
                    .filter(ee.Filter.lt('CLOUDY_PIXEL_PERCENTAGE', 40));
```

  In particular I set: Interval time: 2020-01-01 to 2020-04-30 and the cloud property has to be lower than 40

- **3.** I proceed applying radiometric scaling factor to all images in the filtered collection.

```
// The scaling factor  is used to convert these digital number values (integers) to actual physical reflectance values.
//The scaling is performed by multiplying the digital number values by 0.0001.
var apply_radiometric_scale = function (image)
{
  return image.multiply(0.0001);
};
var scaled_filtered_S2 = filtered_S2_Collection.map(apply_radiometric_scale);
```

- **4.** I Aggregate the images of the filtered collection selecting only the R,G,B, NIR bands

```
// Now i proceed with creating an aggregated median image
var image = scaled_filtered_S2.median().select( ['B2', 'B3', 'B4', 'B8']);
```

- **5.** I compute the NDVI

```
// now I want to compute the NDVI
var RED = image.select('B4');
var NIR = image.select('B8');
var numerator = NIR.subtract(RED);
var denominator = NIR.add(RED);
//Here I compute the Normalized Difference Vegetation Index (NDVI)
// here I can use the javascript operator to perform the division
var NDVI = numerator.divide(denominator);
print('NDVI',NDVI);
```

- **6.** Rename the band of NDVI image

```
// I proceed with renaming
NDVI = NDVI.rename('my_ndvi');
print('NDVI',NDVI);
```

- **7**. I Visualize the RGB image (true color composite), the NIR band, and the NDVI index

```
Map.addLayer(image, {'bands': ['B4', 'B3', 'B2'], min: 0,   max: 0.3}, 'image (RGB - true color)');
Map.addLayer(NIR, {'bands': ['B8'], min: 0,   max: 0.3}, 'NIR');
Map.addLayer(RED, {'bands': ['B4'], min: 0,   max: 0.3}, 'RED');
Map.addLayer(NDVI, {min:-1, max:1}, 'NDVI');
Map.centerObject(geometry);
```

True color composite

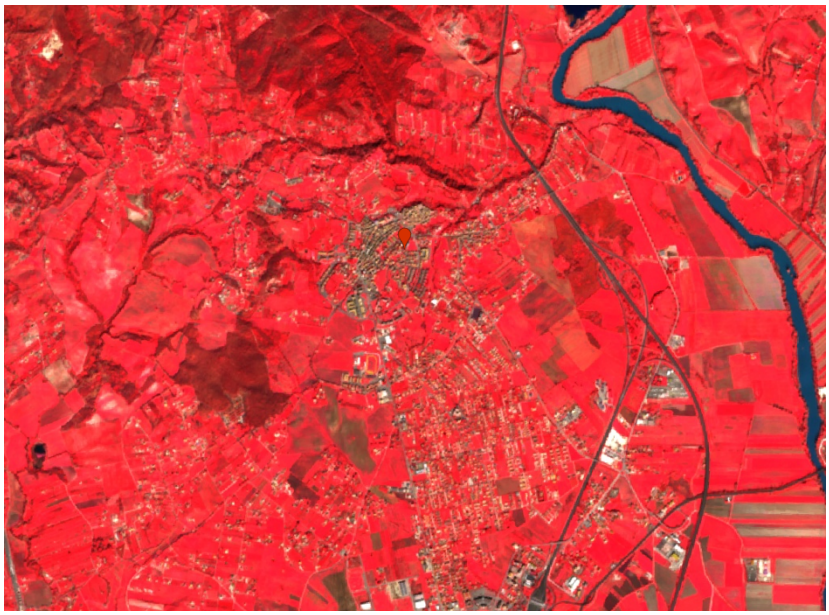
NIR Band

NDVI index

- **8**. Visualize a false-color layer using NIR, red, green bands for RGB:

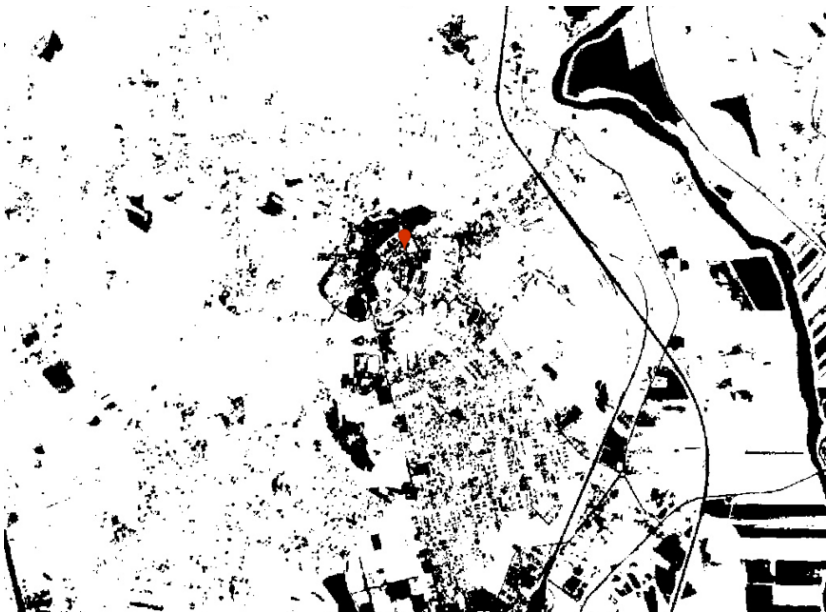
```
// let's visualize a false-color layer using NIR,
Map.addLayer(image, {bands: [ 'B8','B4', 'B3'], min:0, max:0.3}, 'NIR-RED-GREEN false-color composite');
```

False color composite



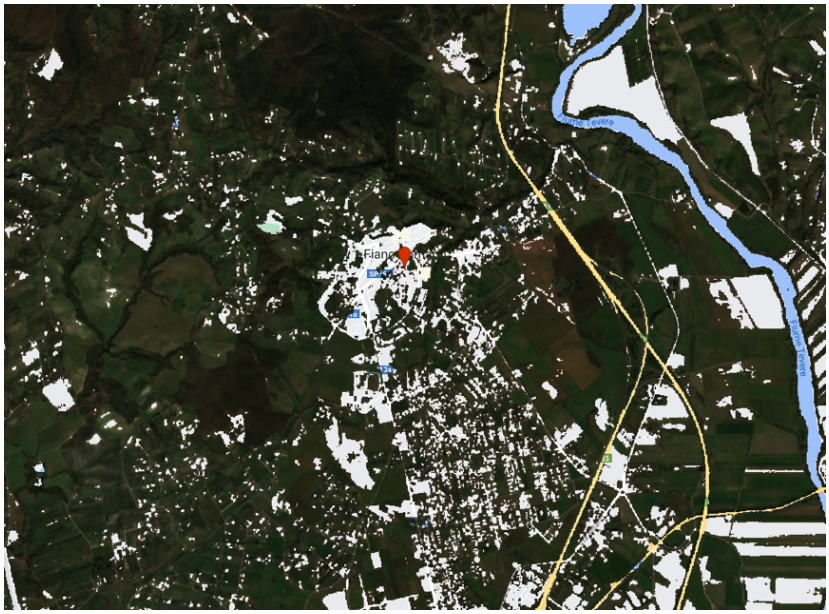
- **9**. Create a mask for areas (pixels) with healthy vegetation by setting a threshold on the NDVI values

```
// Let's use the mask to identify and extract the areas with healthy vegetation from
// the original image
var mask_NDVI = NDVI.gt(0.4);
Map.addLayer(mask_NDVI,{}, 'mask_NDVI');
```



- **10**. Use the mask to identify and extract the areas with healthy vegetation from the original image

```
// Let's use the mask to identify and extract the areas with healthy vegetation from the original image
var masked_image = image.updateMask(mask_NDVI);
Map.addLayer(masked_image, {'bands': ['B4', 'B3', 'B2'], min: 0,   max: 0.4}, 'masked image (RGB)');
```



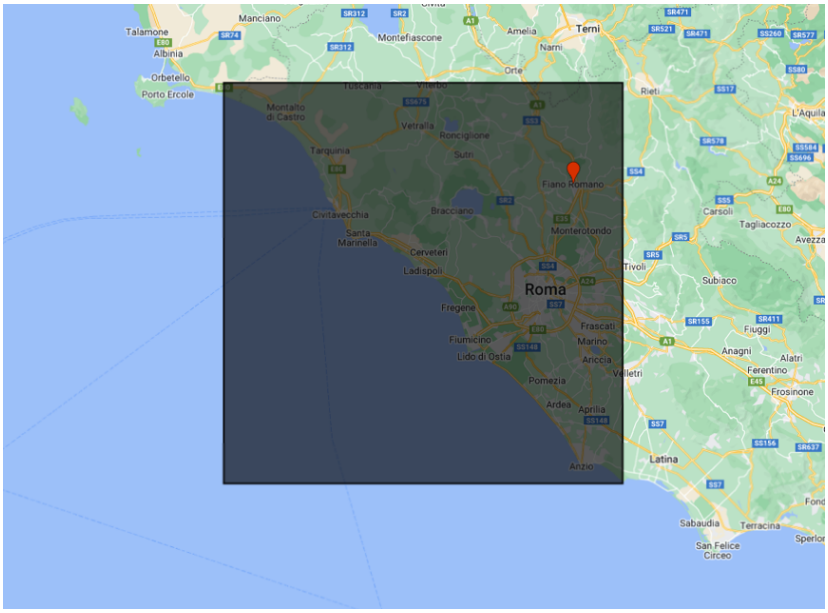
- **11**. Retrieve the nominal spatial resolution of the filtered collection from the first image

```
// Let's retrieve the nominal spatial resolution of the filtered collection from the first
//image of the collection
var nominal_spatial_resolution = filtered_S2_Collection.first().select('B8').projection().nominalScale();
print('nominal_spatial_resolution B8',nominal_spatial_resolution);
```

The nominal spatial resolution is 10

- **12**. Retrieve the bounding box of the first image of the filtered collection using the geometry and bounds methods.

```
// Let's retrieve the bounding box of the first image of the filtered collection
var image_bounding_box = filtered_S2_Collection.first().geometry().bounds(nominal_spatial_resolution);
Map.addLayer(image_bounding_box, {}, 'first image bounding box', false);
```



- **13**. Count the number of pixels with healthy vegetation on the previously masked image

```
// Let's count the number of pixels with healthy vegetation on the previously masked image
var n_pixels_from_reducer = masked_image.reduceRegion(
          {
            reducer: ee.Reducer.count(),
            maxPixels: 1e29,
            scale: nominal_spatial_resolution,
            bestEffort: false,
            geometry: image_bounding_box,
            tileScale:1//default is 1
          });
print('n_pixels_from_reducer',n_pixels_from_reducer);
print('number of pixels with healty vegetation (B8-> NIR)',n_pixels_from_reducer.get('B8') );
```

The number of pixels is 73077715

- **14**. Multiply the number of pixels with healthy vegetation by the spatial resolution used to compute the reducer to estimate the extension of the area covered by healthy vegetation.

```
// Let's multiply the the number of pixels with healthy vegetation by the spatial
// resolution to estimate the extension of the area covered by healthy vegetation
var area_m2 =ee.Number(n_pixels_from_reducer.get('B8')).multiply(nominal_spatial_resolution).multiply(nominal_spatial_resolution);
var area_km2 = area_m2.divide(1000).divide(1000);
print('healty vegetation area (km2)', area_km2);
```

The healthy vegetation area is 7307.7715 km2

The link is here