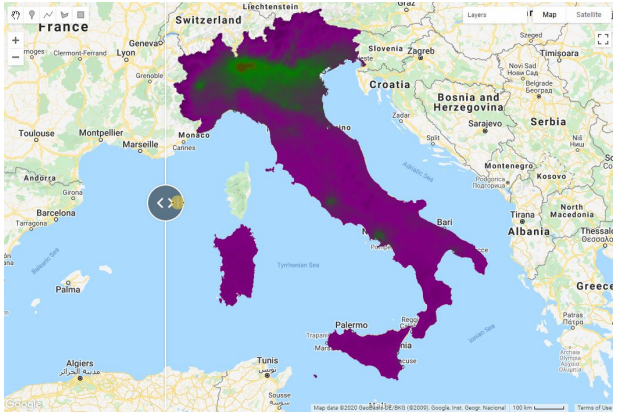
10 - Case Study: NO_2 concentration levels in Italy

Activity

Task: You need to retrieve, analyse, and visualise NO_2 concentration levels in Italy in 2019 and 2020.

In your groups, discuss the following:

- What datasets do you need?
- Briefly describe the steps taken to visualise NO_2 concentration levels in Italy in 2019 and 2020



Go to mentimeter.com

Type in your answer to the above questions

5 minutes

Tip: Sometimes, having an end in mind can help you with your workflow.

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Step 1: Importing Italy administrative boundaries

- Create a FeatureCollection called worldcountries with the boundaries of the world countries. Note that a Feature is a geographic data structure that corresponds to a vector data type and is composed of a geometry and a dictionary of properties, and a FeatureCollection is a collection of Features.
- The FeatureCollection worldcountries has a field called country_na with the names of the countries and we can use ee.Filter.eq() to select the boundaries of Italy.

```
var worldcountries = ee.FeatureCollection('USDOS/LSIB_SIMPLE/2017');
var filterCountry = ee.Filter.eq('country_na', 'Italy');
var country = worldcountries.filter(filterCountry);
```

```
Map.addLayer(country);
Map.centerObject(country, 6);
```

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Step 2: Importing NO_2 values

- Next, we import the NO_2 concentrations retrieved from Sentinel-5P NRTI NO_2: Near Real-Time Nitrogen Dioxide and with collection ID "COPERNICUS/S5P/NRTI/L3_NO2". This data is an ImageCollection where each Image corresponds to a raster data type that is composed of bands and a dictionary of properties. In the GEE's data catalog, we can see that the temporal availability of the dataset is from July 2018 to September 2020, and the band with name NO2_column_number_density provides the total vertical column of NO_2 (ratio of the slant column density of NO_2 and the total air mass factor) which is given in mol/m2. We create a variable called no2ic with the NO2_column_number_density band as follows:

```
var no2ic = ee.ImageCollection('COPERNICUS/S5P/NRTI/L3_NO2').select('NO2_column_number_density');
```

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Step 3: Filtering and Averaging NO_2 values

Then, we define a variable filterMonth with the months February to May, and use filter() to keep only images for these months.

```
var filterMonth = ee.Filter.calendarRange(2, 5, 'month');
var  no2 = no2ic.filter(filterMonth);
```

In order to be able to compare NO_2 values in 2019 and 2020, we calculate the NO_2 average values over each of these two years. Specifically, we create an Image called no2pre with the average values in 2019, and an Image called no2post with the average values in 2020. We multiply the average NO2 values by 1e6 and to convert the image units from mol/m2 to µmol/m2 . Finally, we use clip() to clip the images to the Italy border.

```
var filter19 = ee.Filter.calendarRange(2019, 2019, 'year');
var filter20 = ee.Filter.calendarRange(2020, 2020, 'year');

var no2pre  = no2.filter(filter19).mean().multiply(1e6).clip(country);
var no2post = no2.filter(filter20).mean().multiply(1e6).clip(country);
```

Note that we are averaging NO2 values over all days during February to May in 2019 and 2020. Before doing this, we could assess the quality of the values (for example checking which locations are covered by clouds) and preprocess the images before calculating the average values.

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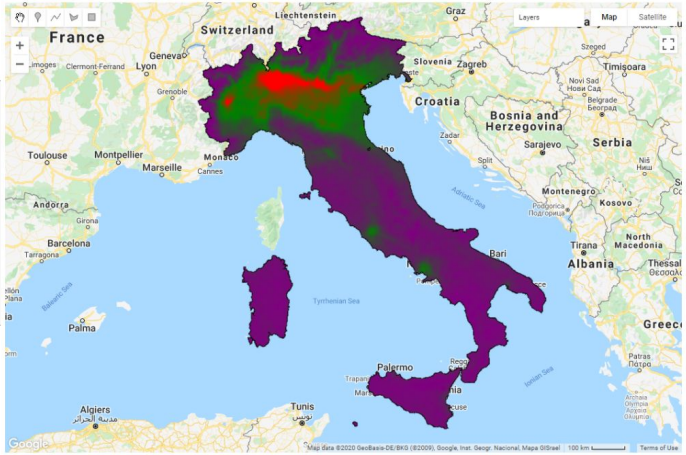
Step 4: Adding data to the map

We use Map.addLayer() to add the data to the map and be able to visualize the data. In the function, we specify the visualization parameters defined in vizParams with the minimum a maximum values and the color palette. We also give names no2pre and no2post to be able to identify the data in the map.

```
var vizParams = {
  min: 0,
  max: 200,
  palette: ['black', 'purple', 'green', 'red']
};

Map.addLayer(no2pre, vizParams, 'no2pre');
Map.addLayer(no2post, vizParams, 'no2post');
```



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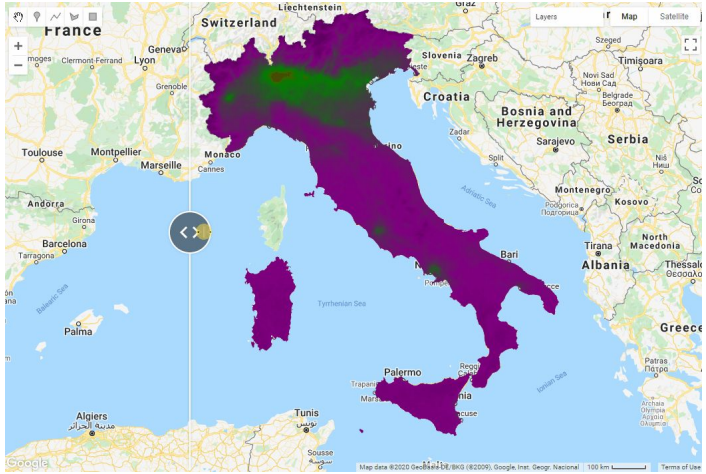
Step 5: Visualising maps using a screen split display

An alternative way to visualize the maps is using a screen split display that allows us to compare the maps side-by-side. The code to create this screen split visualization is the following:

```
// Add no2pre to the default Map
Map.addLayer(no2pre, vizParams, 'splitpre');

// Make another Map and add no2post to it
var Map2 = ui.Map();
Map2.addLayer(no2post, vizParams, 'splitpost');

// Link the default Map to the Map2
var linker = ui.Map.Linker([ui.root.widgets().get(0), Map2]);

// Create a SplitPanel which holds the linked maps side-by-side
// wipe is set to true to let the user swipe the handle back and forth between the two visualizations
var splitPanel = ui.SplitPanel({
  firstPanel: linker.get(0),
  secondPanel: linker.get(1),
  orientation: 'horizontal',
  wipe: true,
  style: {stretch: 'both'}
});

// Set the SplitPanel as the only thing in root
ui.root.widgets().reset([splitPanel]);

// Center the SplitPanel on coordinates (10, 44) and set zoom level to 6
linker.get(0).setCenter(10, 44, 6);
```



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Step 6: Saving maps

Finally, we can save the maps as images to our Google Drive account by using Export.image.toDrive(). In the function, we specify the region to export as country. If the region is not specified, the region will default to the viewport at the time of invocation.

```
Export.image.toDrive({image: no2pre,description: 'mappre', region: country});
Export.image.toDrive({image: no2post, description: 'mappost', region: country});
```

When we run this code, export tasks to save each of the images are created in the Code Editor Tasks tab. We need to click the Run buttons next to the tasks to start them. Then the images are created and we can access them in our Google Drive account.