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KA220-SCH-A710136B

Climate Action and Light Pollution Threat

CliC-PoLi

Earth Observation & Light Pollution monitoring in your classroom

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Workshop outline

- Educational activity description
- General objectives
- Lesson Plan template
- Using digital tools to monitor Light Pollution
- Case Study
- Outcomes

Description

- Students will gain an understanding of **what light pollution is**, **how we map light pollution** and **how we can work with real data** in order to **identify changes in light pollution patterns**.
- How we are using satellite **data to map spatial – temporal patterns**.
- **What digital tools are needed** in order to analyze and visualize this type of data.
- **Students will also analyze and present their findings** using short reports or poster presentation in order to communicate their explanations.

GENERAL OBJECTIVES

- Describe what light pollution is along with the different types of light pollution.
- To recognise some sources of light pollution and describe how these affect how we see stars in the night sky.
- To conduct an experiment to find out how light pollution patterns are changing.
- Use the scientific method and structures to analyze your data and validate your results.

QUESTION ELICITING ACTIVITY

Task 1: Introduction to Light Pollution (45 minutes)

1.1 Eliciting questions and Background Exploration (20 minutes)

Start by leading a brainstorm about how we use light in our daily lives.

Video: Light Pollution explained (1 min and 16 sec.)

QUESTION ELICITING ACTIVITY

1.2 Light pollution monitoring and mapping (20 minutes)

You can ask students if we can see Light Pollution from space! Is this possible and how?

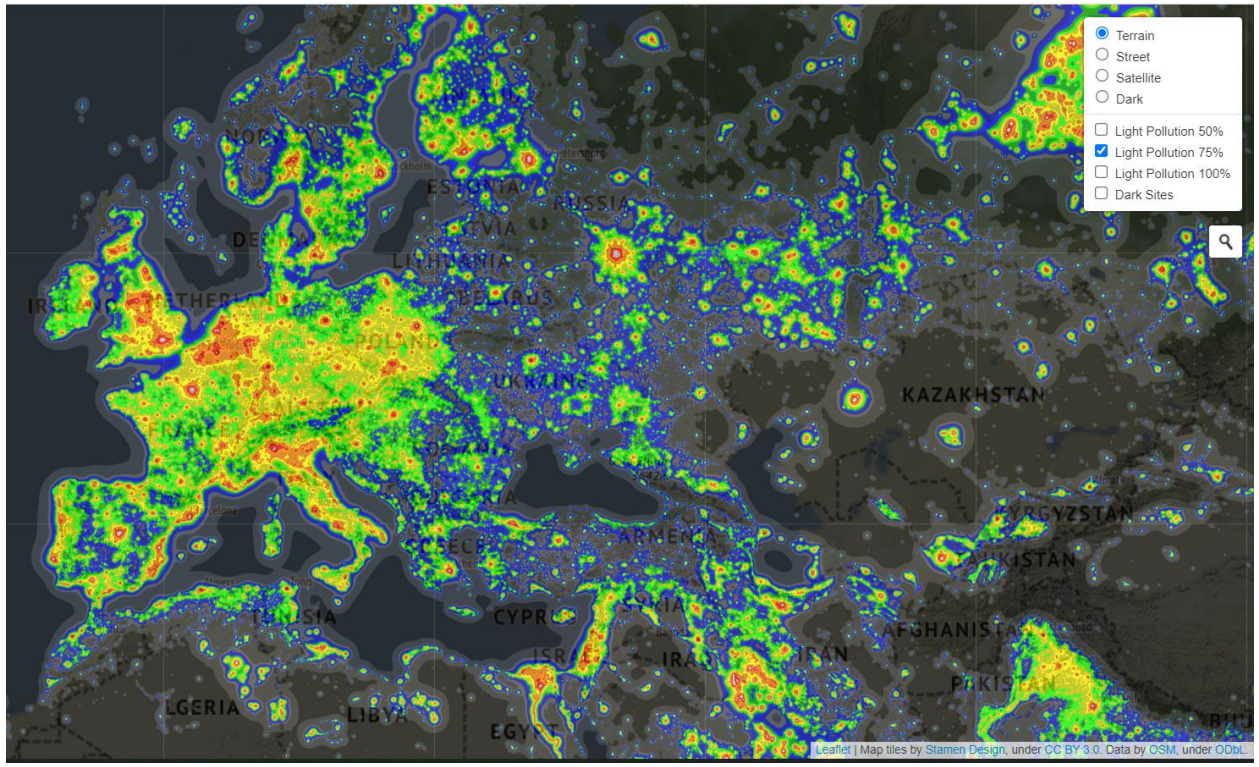
Video: Light Pollution mapping (2 mins and 25 sec.)

- Now let's use an online Geographic Information Systems platform to monitor light pollution at a global scale!

Dark Site Finder

EXPLORE PREVIOUS KNOWLEDGE

- Let the students to navigate on the map and identify different areas of increased light pollution.
- Discuss with the students their thoughts and if any correlation exists between the sites of increased light pollution and the number of people live there (big cities, industrial areas, roads etc.).



This map is real, however, is a little bit enhanced in terms of the light pollution distribution, spread and colours.

What is next? TO WORK WITH REAL DATA AND DIGITAL TOOLS! LET'S DO THIS!

CASE STUDY

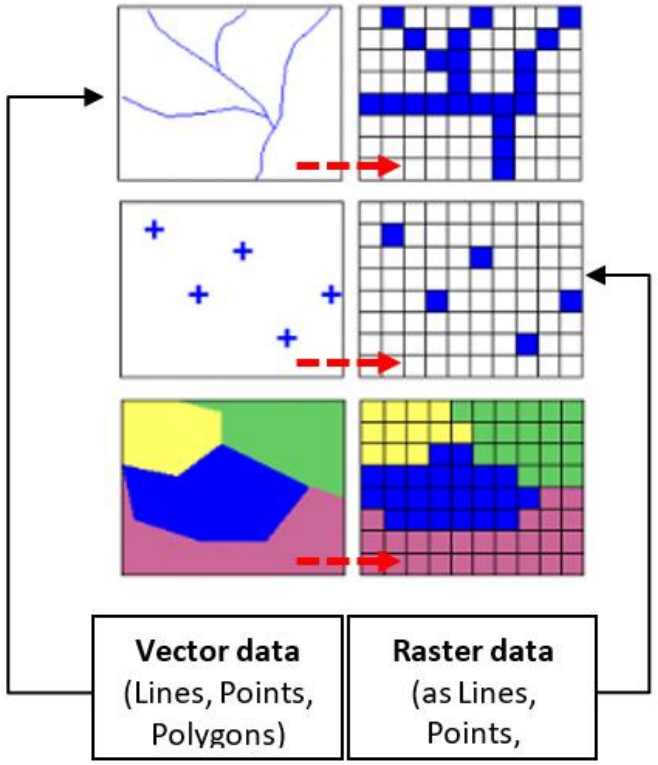
- 1.3 Light pollution in our area/city/region using real data and tools (45 minutes)
- Introduction (Video)
- How can we quantify these changes using real data?

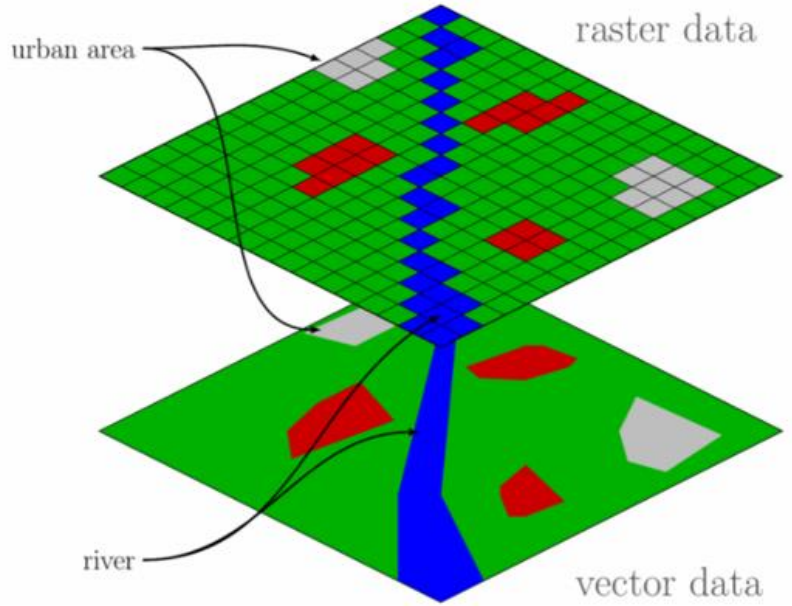
Case Study Background information

In order to better understand **what type of data we will use** and how we "translate" or model the Earth surface and processes, **we have to discuss first about spatial data structures** (type of data and how spatial information is stored, data types etc.)

Vector and Raster data:

Some useful examples on how we can model a river, a mark on the map or an area using vector and raster data structures!

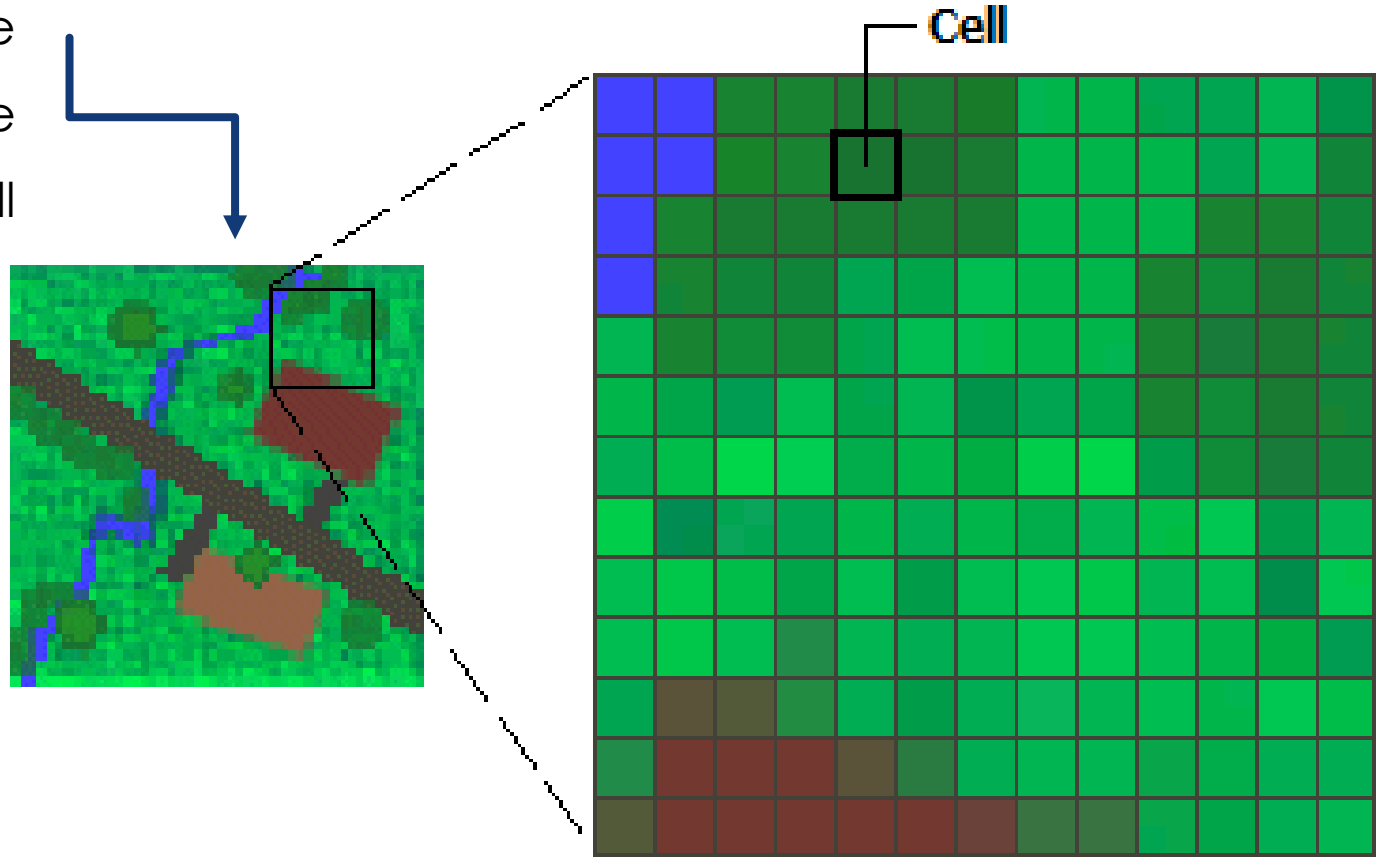




An example

Case Study Background information

Indicative example of a raster dataset (i.e satellite image) expressed as a grid of multiple cells with different (or the same) pixel/cell values, for example, light pollution density



How do we manage and process this type of data?

Using Geographic Information Systems (GIS) and specific GIS-based applications and platforms!

GIS definitions: https://www.esri.com/en-us/what-is-gis/overview

GIS software and platforms (see QGIS):

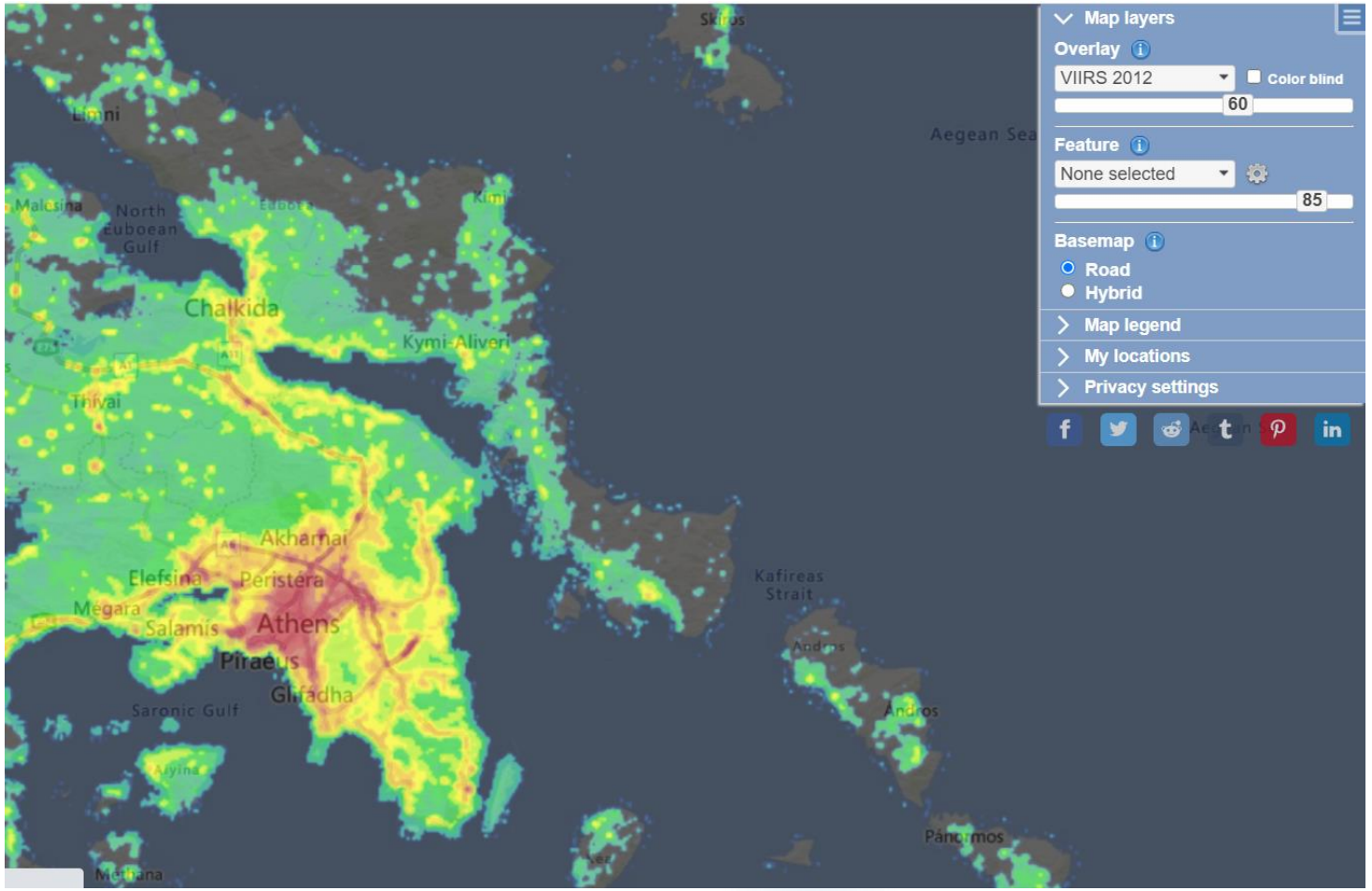
https://en.wikipedia.org/wiki/List_of_geographic_information_systems_software

Case Study- Download tools

Before we begin, students have to download data and install QGIS platform!

QGIS Platform Download (version 3.18.1)

Download **Light Pollution data**



What's the difference with the Dark Sky Finder app?

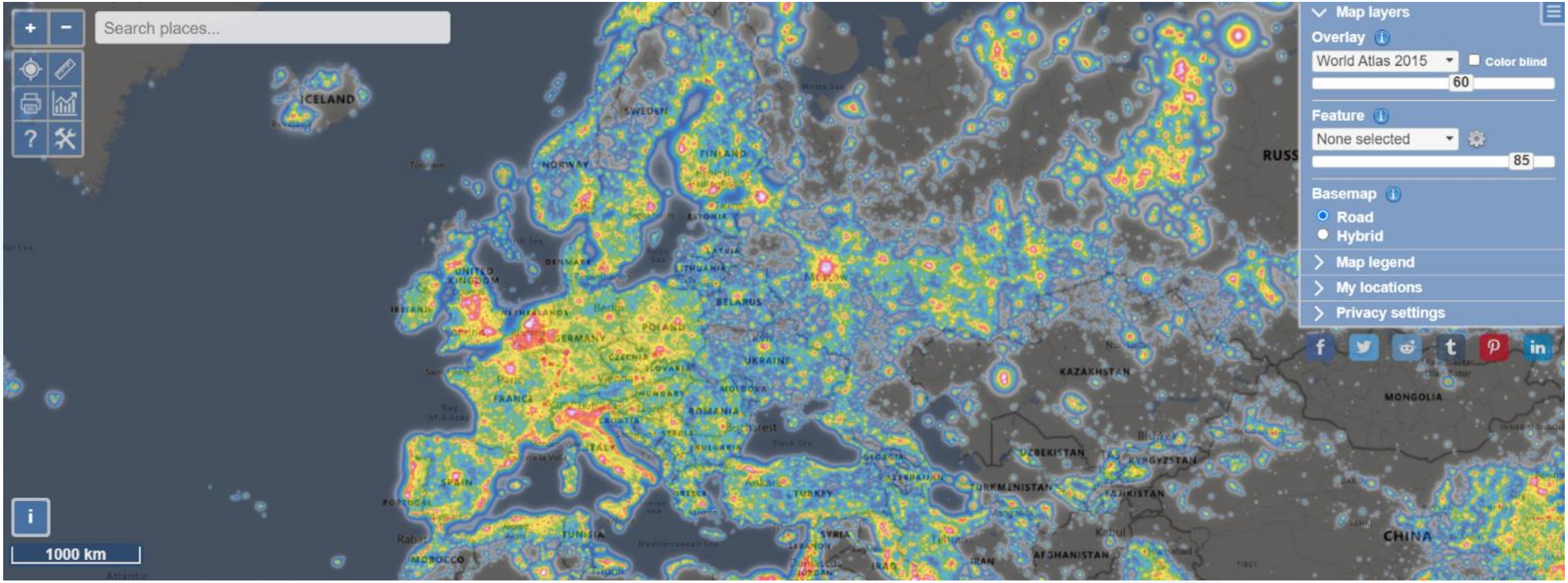
Now we can download spatial data (i.e. on each cell we know the light pollution impact and not a colour value)!

Case Study- Platform overview

In the platform you can see the **light pollution levels at global scale**.

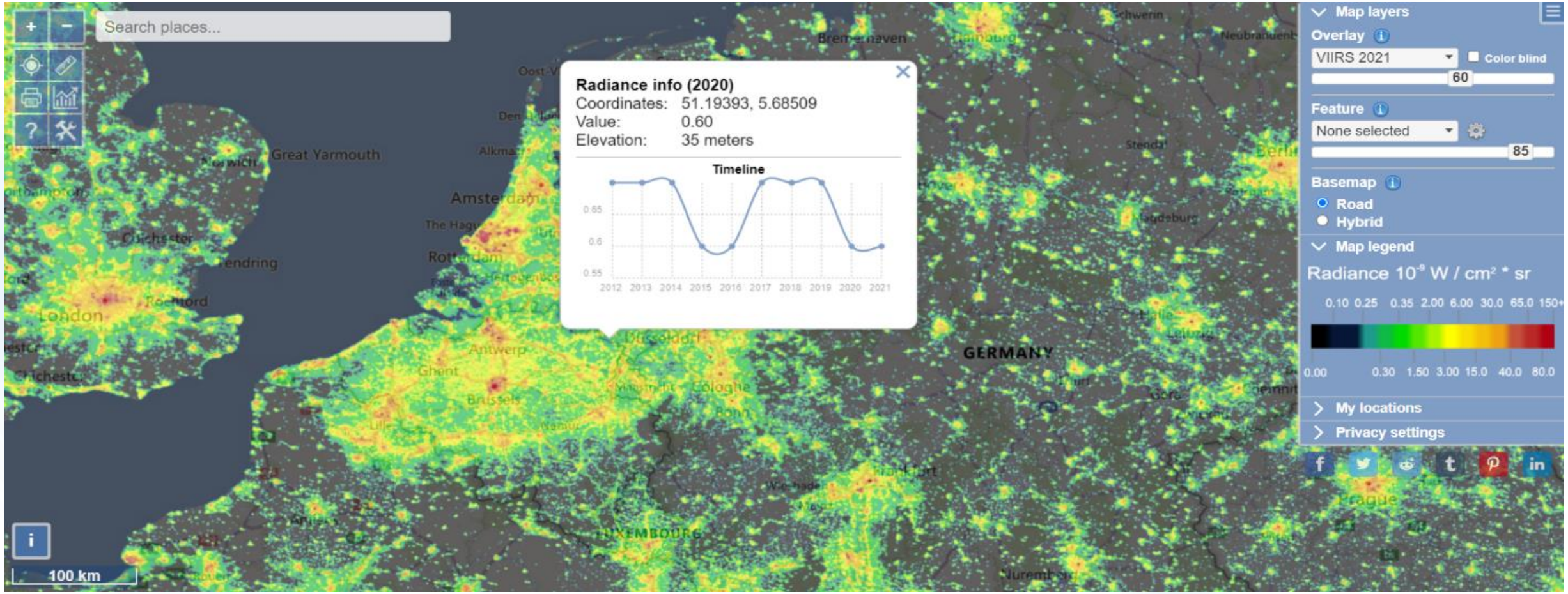
In particular, you see the **radiance levels at night**, as seen from the satellites.

On the right corner you may select different light pollution maps per year (i.e. from 2012 - 2021), you can change the basemap layer, change the transparency level, see the map legend or even to save different locations around the world.



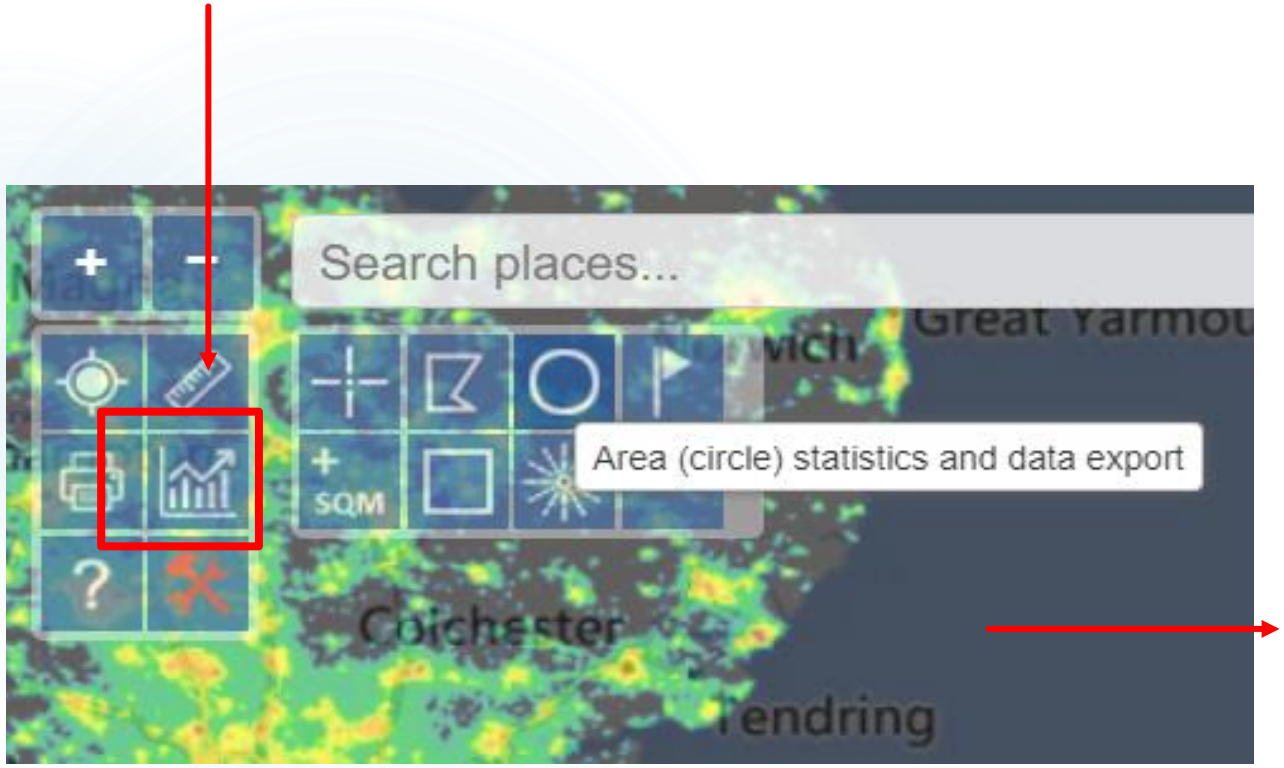
Case Study- Platform overview

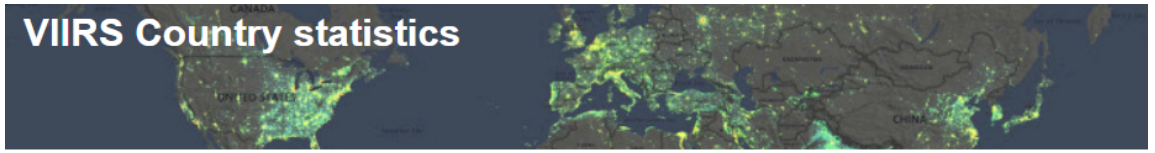
While you select one of the VIIRS mission rasters (maps), you can zoom in wherever you want and you can left-click a specific area (pixel). Then a graph appears showing the temporal changes on Light Pollution levels from 2012 – 2021, the exact coordinates and the elevation as shown below.



Case Study- Platform overview

In case you want to download data or see further information and statistics at a country level, you can use the toolbar on the left as shown below:





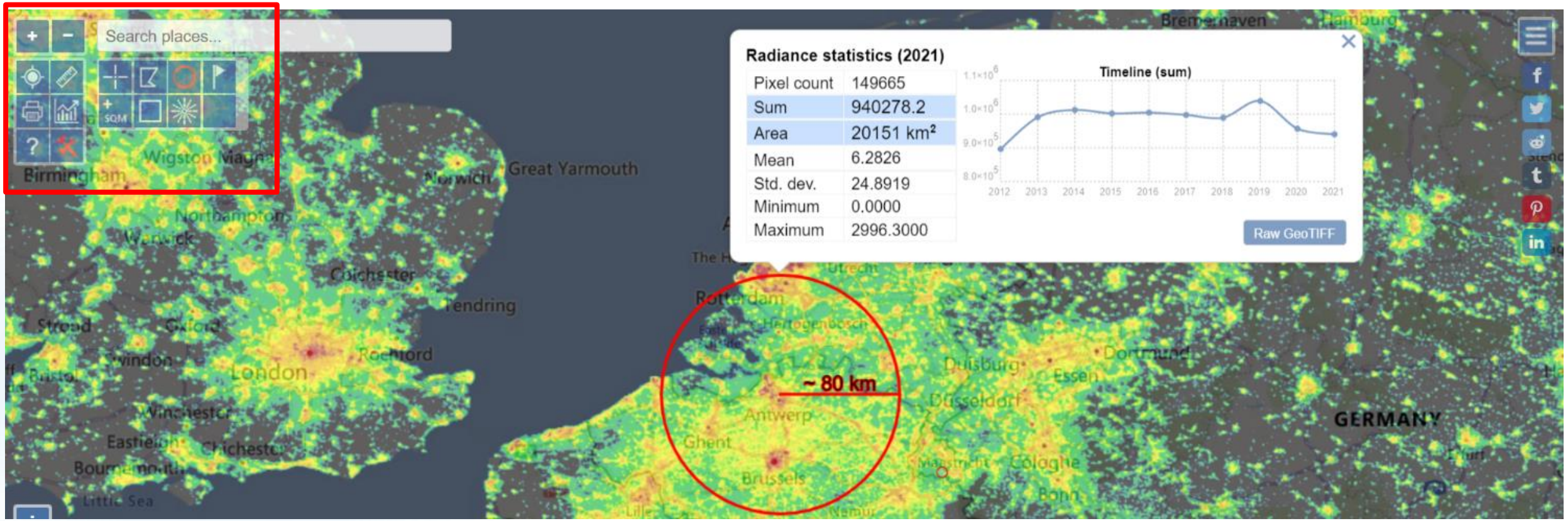
○ ALL COUNTRIES ◉ OECD ○ EEA +UK +CH ○ G20

Country	Population	Area (sq. km)	Avg. Sum	Trend	Rad./1k pop	Avg. Mean
Austria	8,869,537	83,859.51	253,137	+0.30 %	28.5	0.649
Belgium	11,473,875	30,790.18	678,162	-0.15 %	59.1	4.740
Canada *	37,553,100	10,133,038.69	2,595,954	-1.78 %	69.1	0.225
Denmark *	5,811,413	48,270.28	156,676	+1.17 %	27.0	0.698
France	67,009,000	554,494.12	3,508,310	-3.15 %	52.4	1.361
Germany	83,019,200	360,625.87	1,880,617	-0.27 %	22.7	1.122
Greece	10,741,165	144,280.45	763,727	+0.14 %	71.1	1.139
Ireland	4,857,000	74,321.77	200,591	-2.55 %	41.3	0.581
Italy	60,359,546	307,441.81	4,541,647	-0.28 %	75.2	3.178
Luxembourg	613,894	2,581.40	43,896	+0.93 %	71.5	3.660
Netherlands	17,332,500	38,586.10	941,819	-1.09 %	54.3	5.251
Norway *	5,334,762	351,481.18	448,615	-0.06 %	84.1	0.490
Portugal	10,276,617	93,928.59	1,046,697	-1.85 %	101.9	2.397

Aurora may interfere in * countries. Read Help on how statistics are calculated.

Case Study- Platform overview

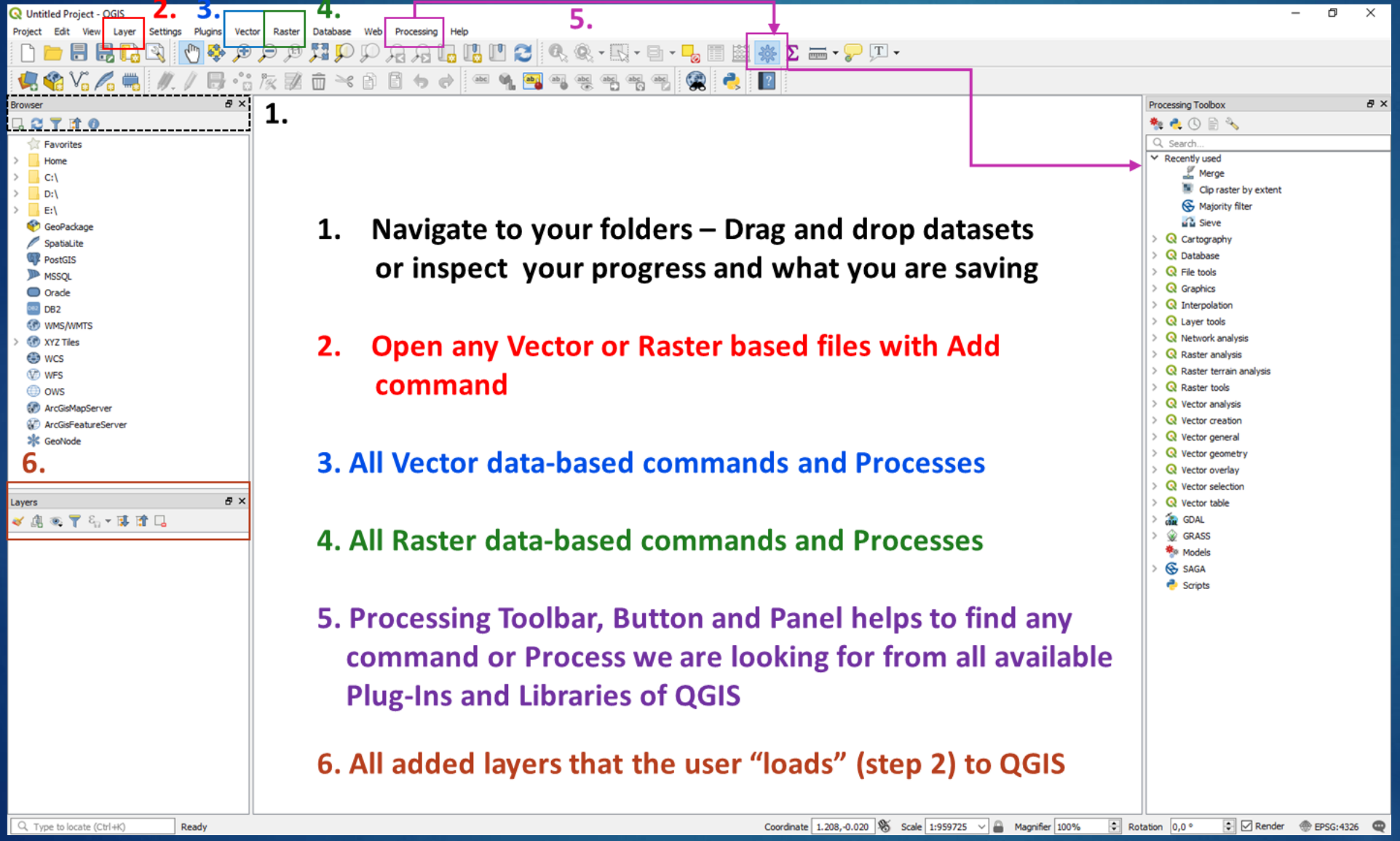
In order to download data, you select the tools icon (bottom right) and then you click on the circle to select a specific area based on the circle's radius as shown below:



While you select the circle's radium you left click and a pop-up window appears with all descriptive characteristics for this area and the option to download the data in GeoTiff format (bottom right corner).

Repeat the above-mentioned process for both the VIIRS 2014 AND VIIRS 2021 images using always the same circles center and radius.

Case Study- QGIS Platform overview

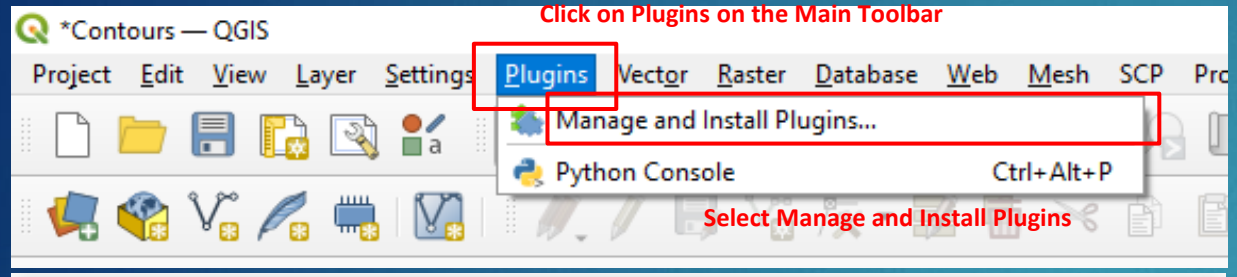


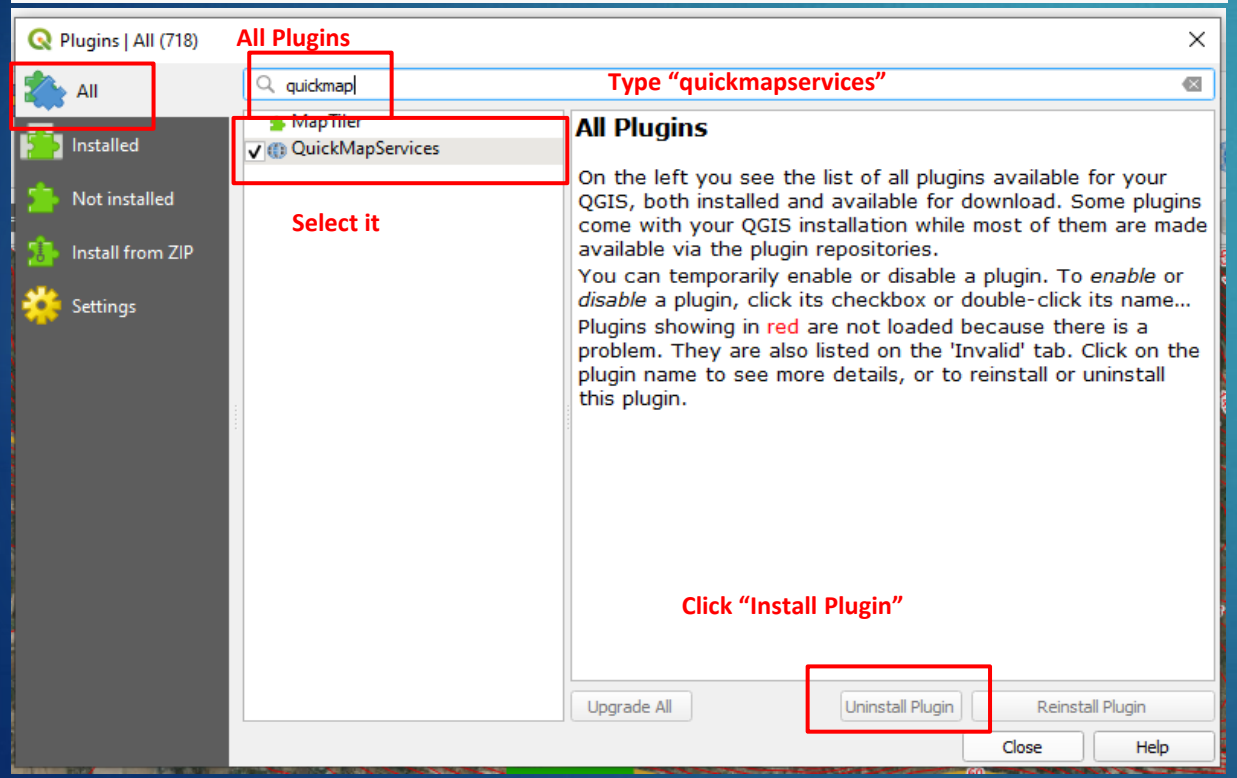
Some technical guidelines considering the tools (QGIS Platform) we will use during this Activity!

Load data: In general, data can be loaded in four ways.

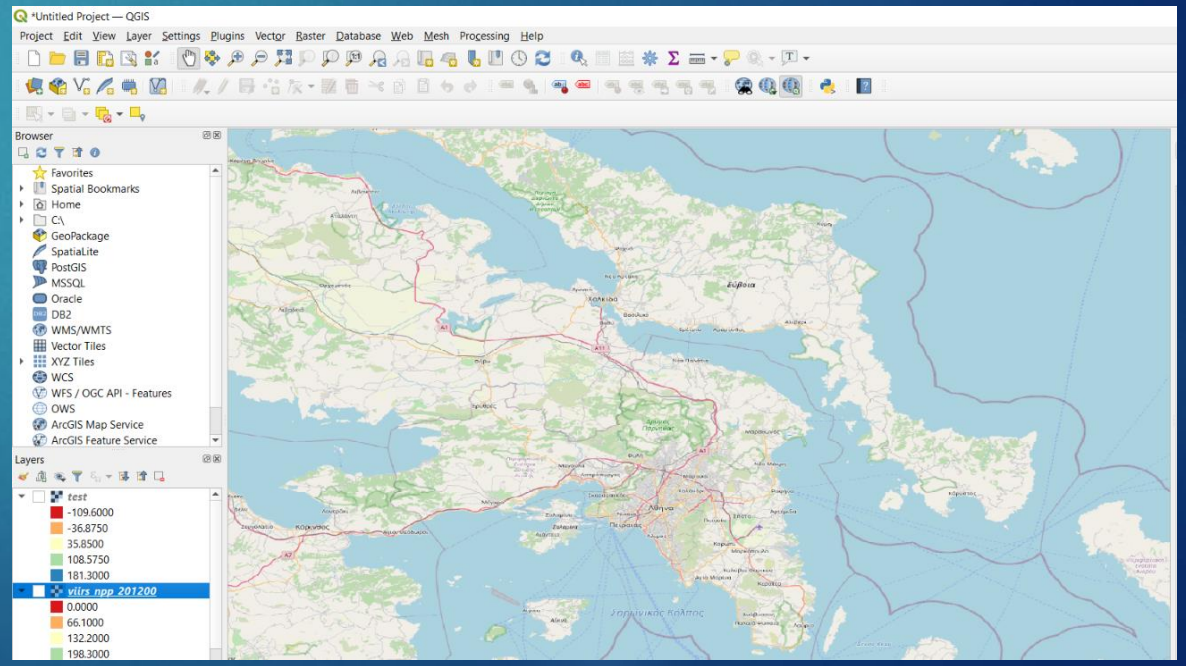
Case Study- QGIS Platform overview

Step 1: Install the Plugins needed to run the activity (QuickMapServices)





You can load the Basemap using the Main Toolbar on top: **Web > quickMapServices > OSM > OSM Standard. The result is shown below!**



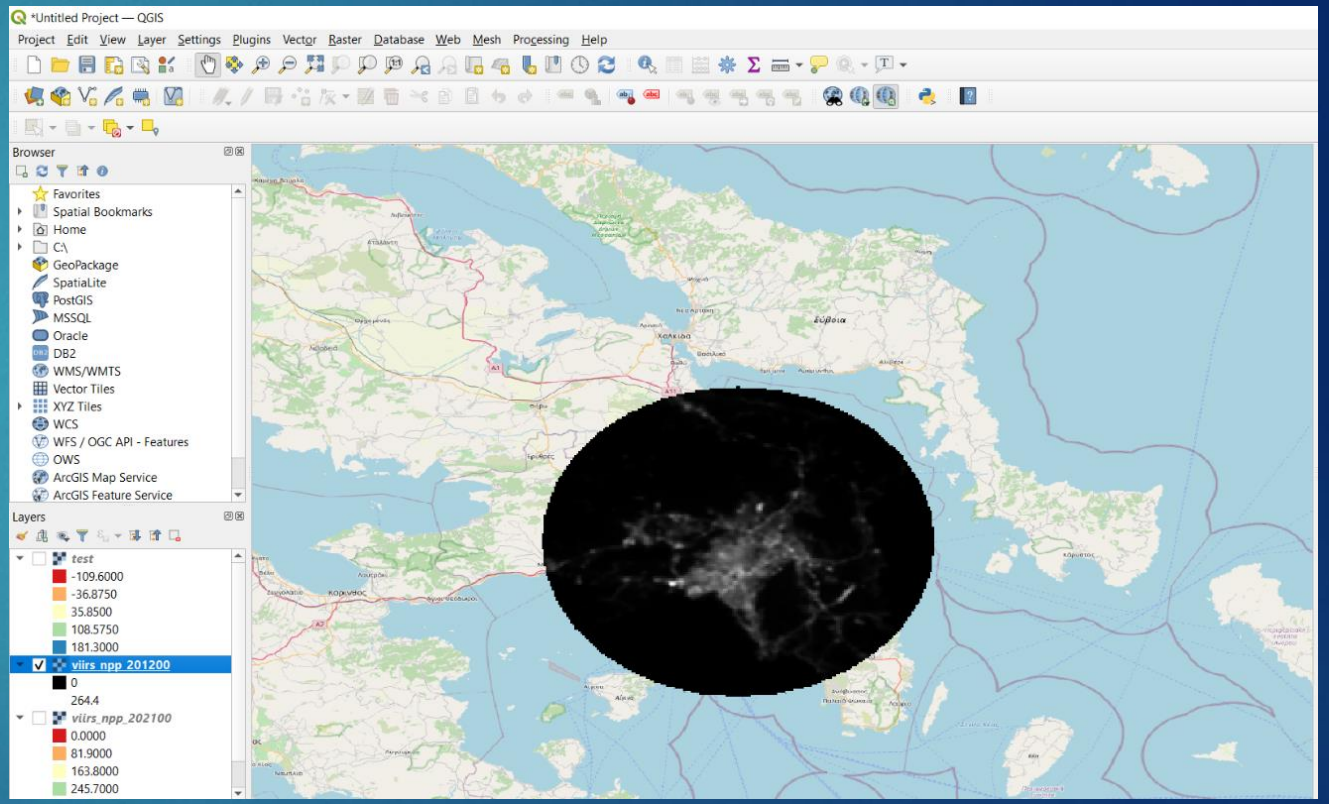
Case Study- QGIS Platform overview

Step 2 - Based on the above-mentioned instructions you can start with:

During the first step of the Activity, load the Light Pollution files you have downloaded (VIIRS 2012 and 2021) on the QGIS platform.

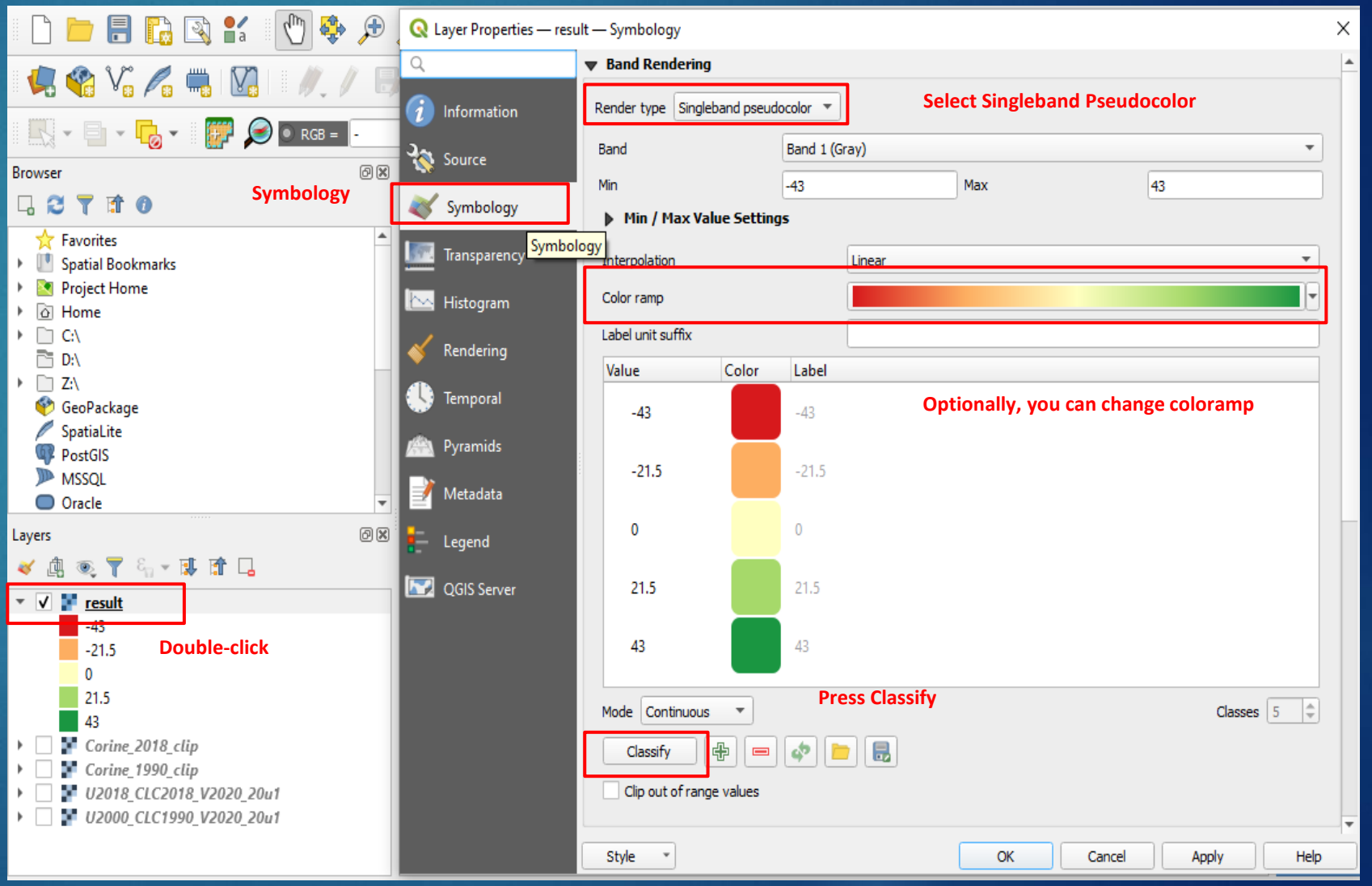
Use the Main toolbar (top of the screen) -> Layers -> Raster Layer -> Navigate to your folder and select viirs_npp_201200.tif and viirs_npp_202100.tif

The results on the map will look like this, having only black and white colours for both images:



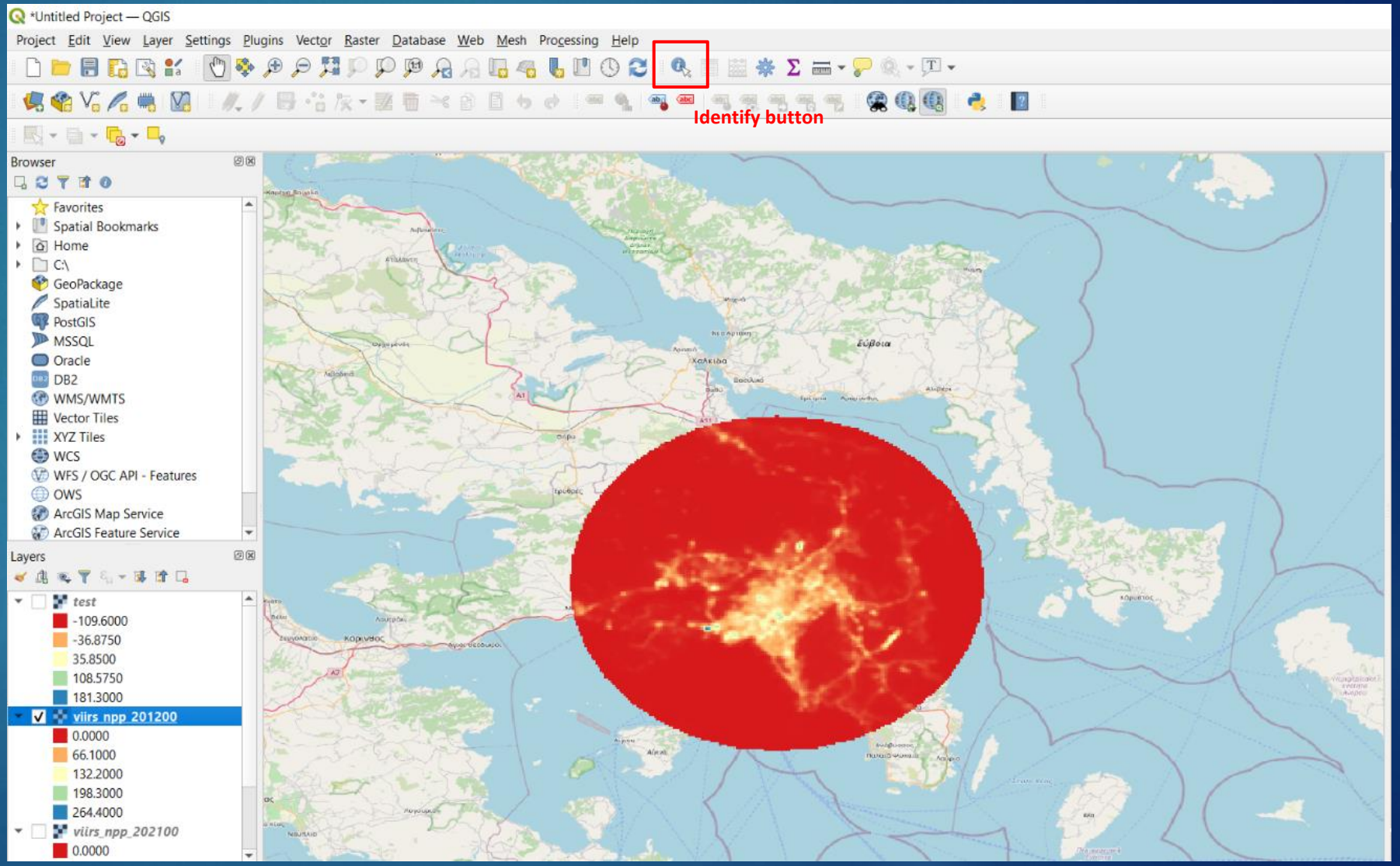
Case Study- QGIS Platform overview

Change layout colors using Layer Properties (double-click on the .tif image you have loaded) ***-> Symbology -> Single-band Pseudocolor -> Classify****. See image below*



Case Study- QGIS Platform overview

Identify areas of increased light pollution (blue and yellow colors) or the differences between 2012 and 2021 by checking and un-checking each map on the Layers panel. Alternatively, you can use the identify button (see the image above) in order to extract the exact light pollution values (in terms of illumination levels).



Case Study- QGIS Platform overview

BUT HOW WE QUANTIFY THE DIFFERENCES AND THE DIFFERENCES TO LIGHT POLLUTION LEVELS AMONG DIFFERENT YEARS???

Case Study- Quantify differences

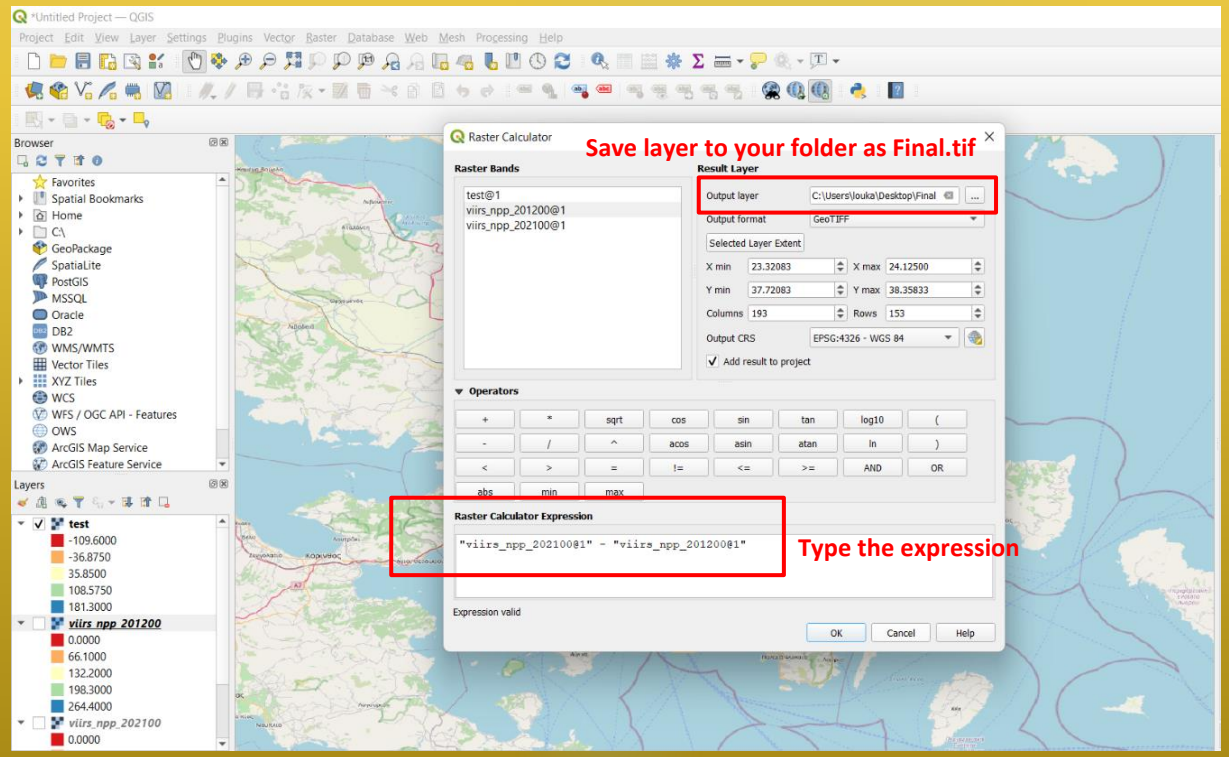
Step 3 – Quantify changes of Light Pollution levels

We have to simply compare each pixel's value from viirs_npp_201200.tif and viirs_npp_202100.tif and we have to do this for all pixels! To succeed that, we need a specific tool called **"Raster Calculator"**. Using this tools we can run through different math operations and conditional statements between different rasters (images).

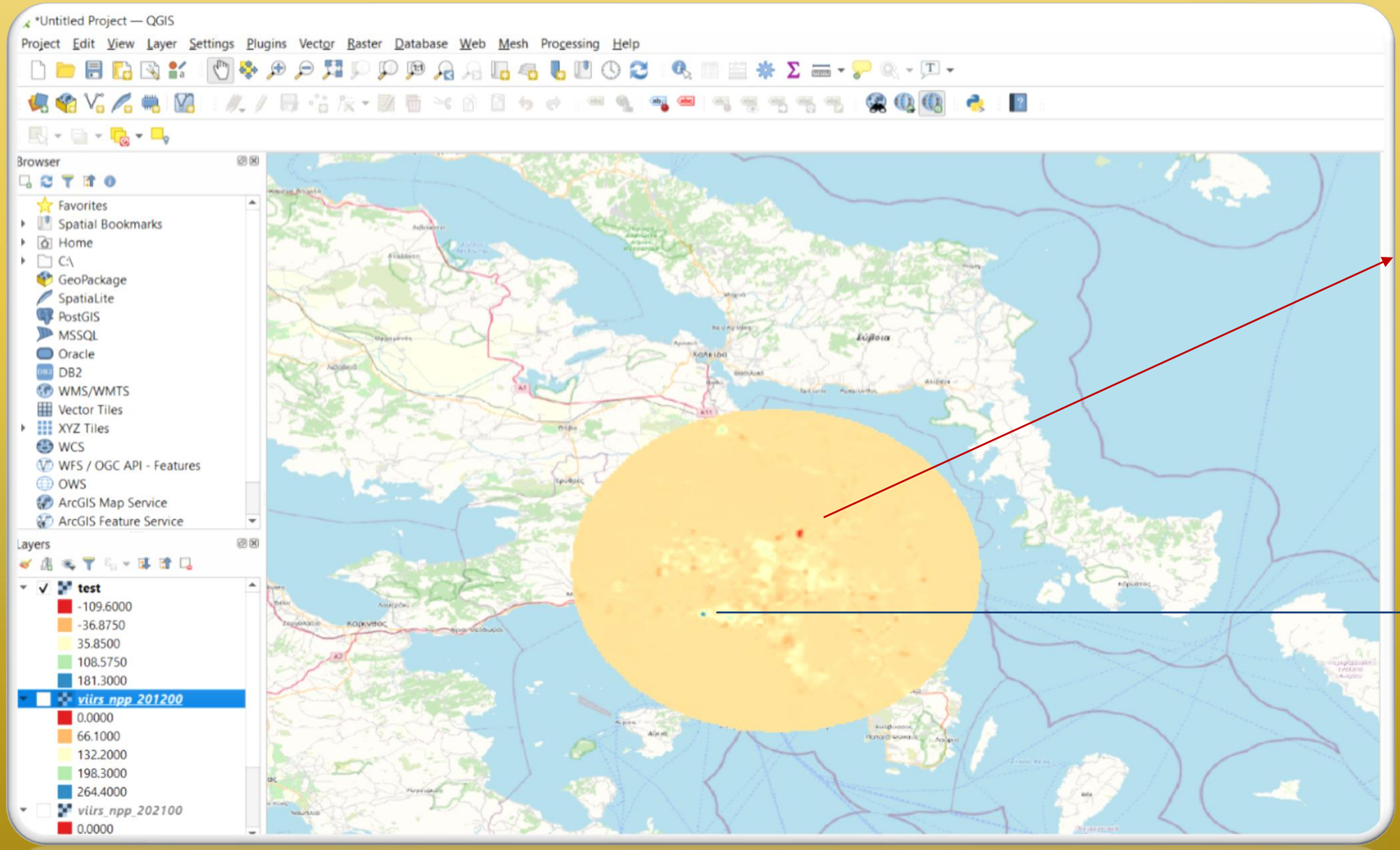
A simplified measure to compare pixels' values is by subtracting the pixel values of viirs_npp_202100.tif from viirs_npp_201200.tif!

Hence, open Raster Calculator via the main toolbar > Raster > Raster Calculator and type:

"viirs_npp_202100@1" - "viirs_npp_201200@1"



Case Study- Map differences



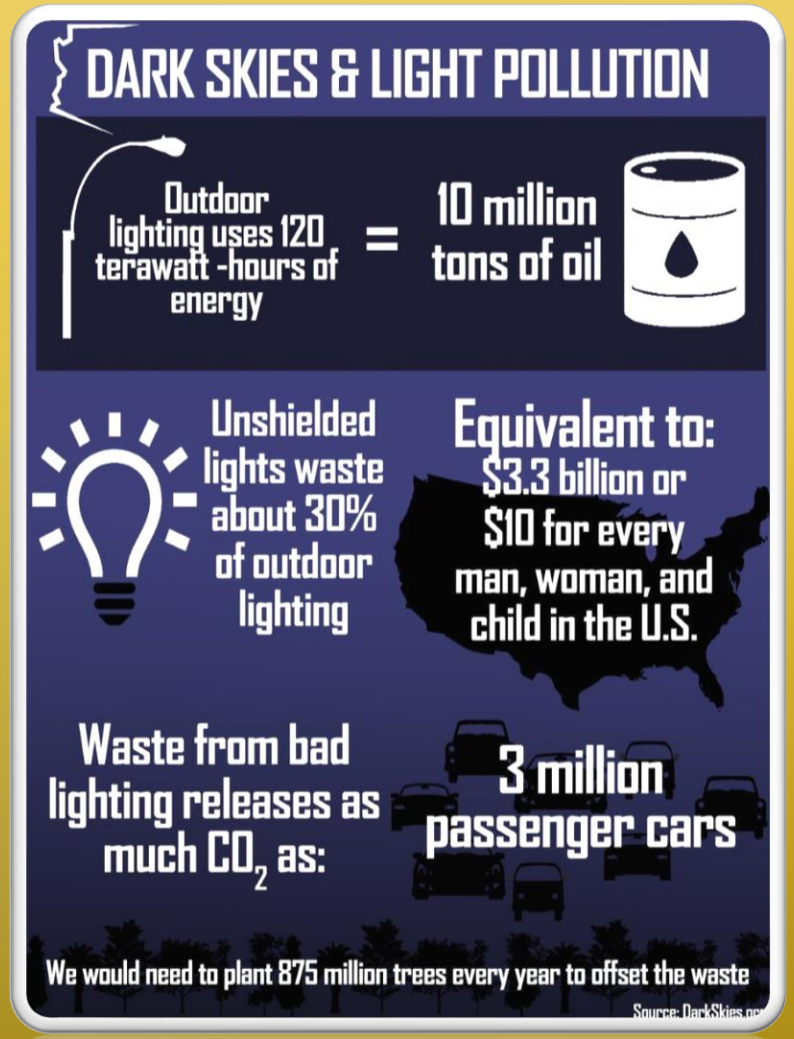
Red areas indicate a reduction of light pollution levels between 2012 and 2021 (Athens airport – COVID-19)

Blue areas indicate that light pollution levels increased between 2012 and 2021 (Piraeus port and Cosco investments)

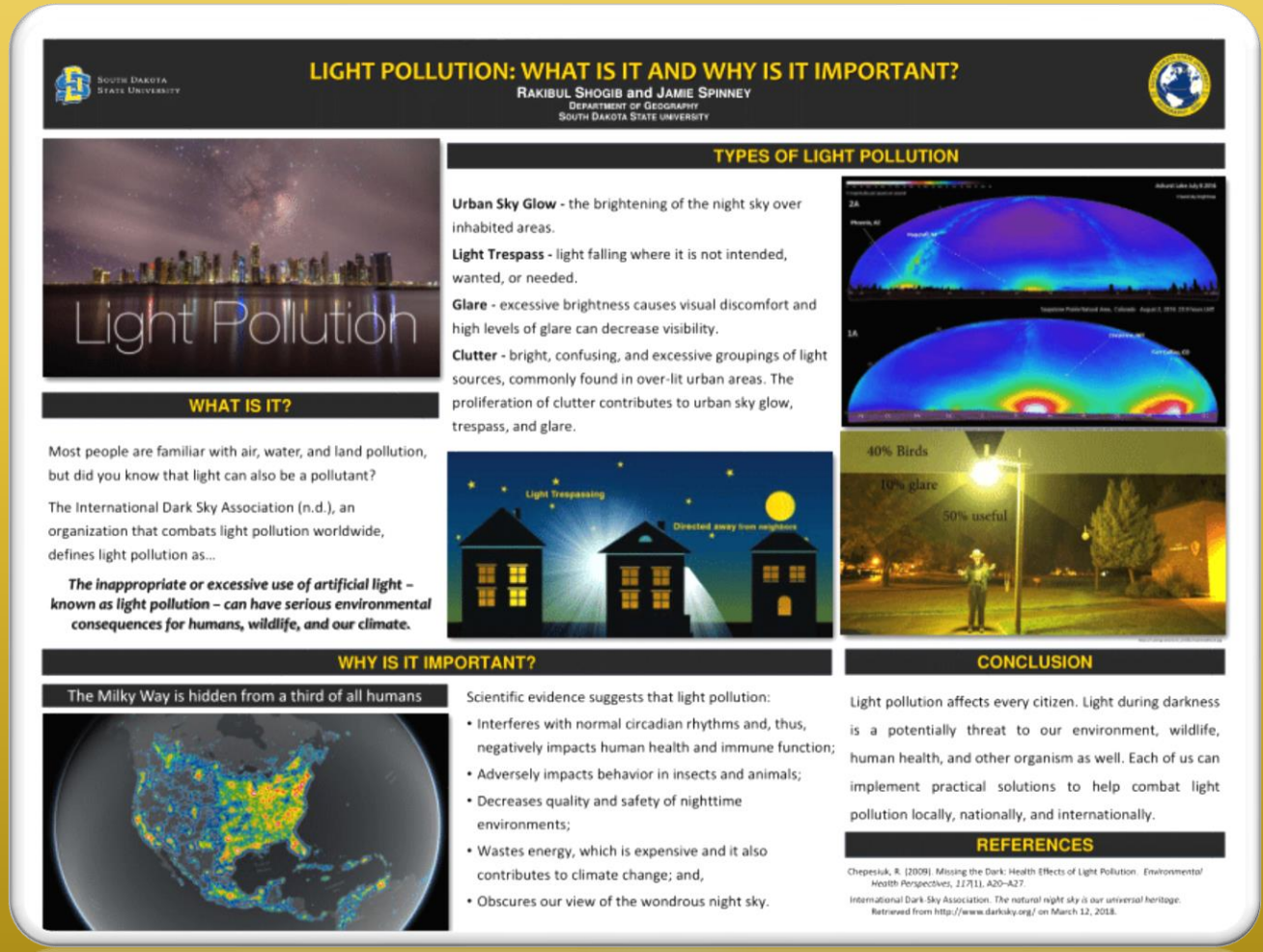
Results

Present your results and communicate your findings.

Create a flyer or a leaflet to start a campaign

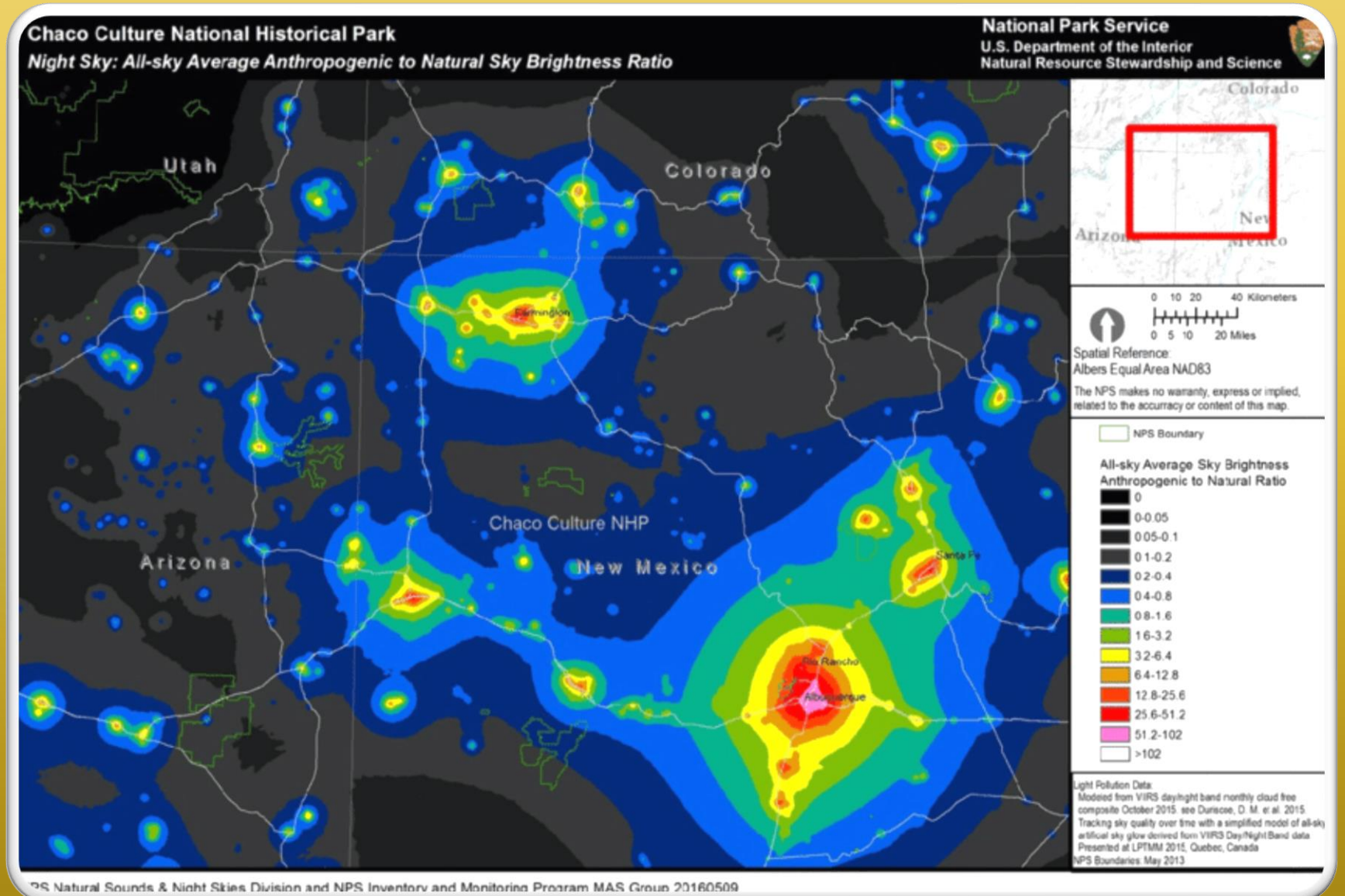


Create a scientific poster



Results (2)

Present your results and communicate your findings.



Create a map (or set of maps) demonstrating light pollution differences in different areas and timescales.

Thank you!

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