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**Project number:**

**2021-1-IE01-KA220-SCH-000027825**

# Earth Observation & Light Pollution

**Age:** 14+

**Topics:** Light Pollution, Understanding, Mapping, Satellite Data, Spatial-Temporal Patterns, Data Analysis, Visualization, Digital Tools, Student Learning, Q-GIS Introduction.

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## Understanding of Light pollution, observation and detection methods by using digital mapping strategy

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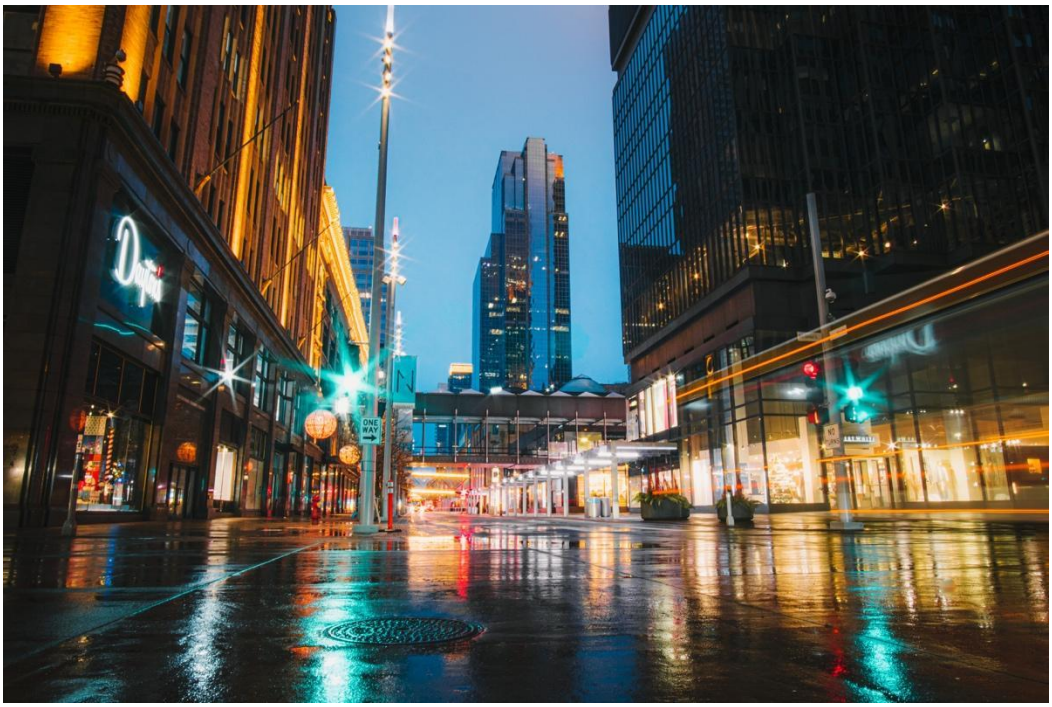
## OBJECTIVES

- Define and Explain Light Pollution
- Identify Various Types of Light Pollution
- Recognize Sources of Light Pollution
- Describe Impact of Light Pollution on Night Sky Visibility
- Conduct Experiment on Changing Light Pollution Patterns
- Apply Scientific Method to Data Collection and Analysis
- Utilize Structured Approach to Validate Results



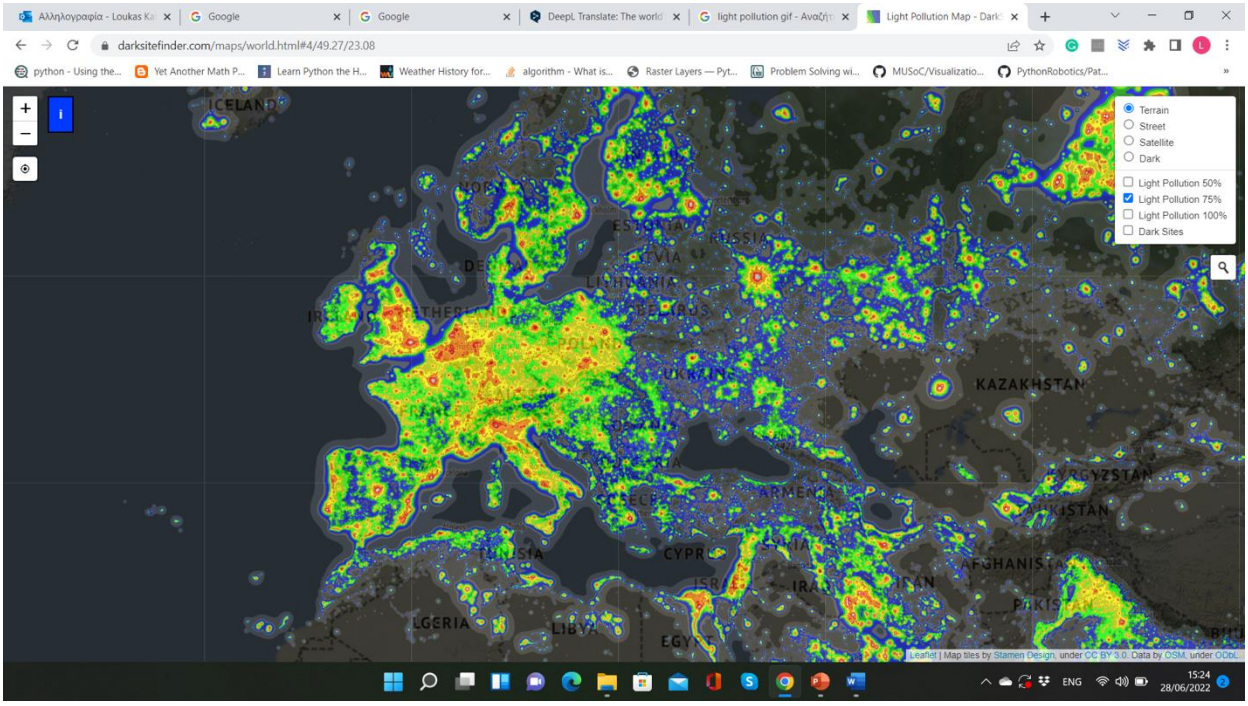
## 1.Pre-ACTIVITY: Introduction to Light Pollution (45 minutes)

**Presenting Questions and Background Exploration (20 minutes):**

- Begin with a brainstorm session to explore how light is used in daily life.
- Initiate a discussion on the various ways we rely on light.
- Show a concise video *explaining light pollution. Suggested: https://education.nationalgeographic.org/resource/light-pollution-101/*

**Light Pollution Monitoring and Mapping (20 minutes):**

- Pose the question: Can we see Light Pollution from space? Discuss possibilities.
- Introduce the online Geographic Information Systems (GIS) platform - Dark Site Finder ( https://darksitefinder.com/maps/world.html#7/40.591/22.634 ).
- Guide students to navigate the map and identify areas with high light pollution.
- Engage in discussions about correlations between light pollution and human activity.




⇒ *Note to Teachers:*

- The map is authentic but slightly enhanced for clarity.
- Prepare for the next step - Working with real data and digital tools!

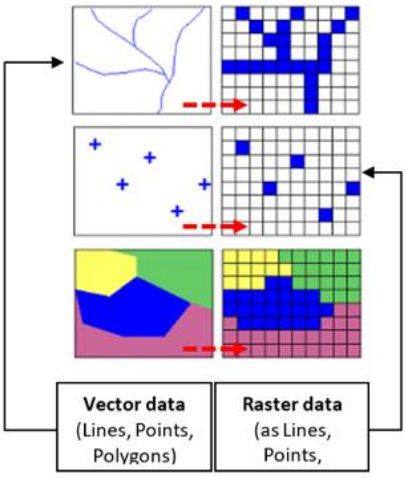
## 2. Activity: Exploring Light Pollution Patterns Using Real Data and Tools

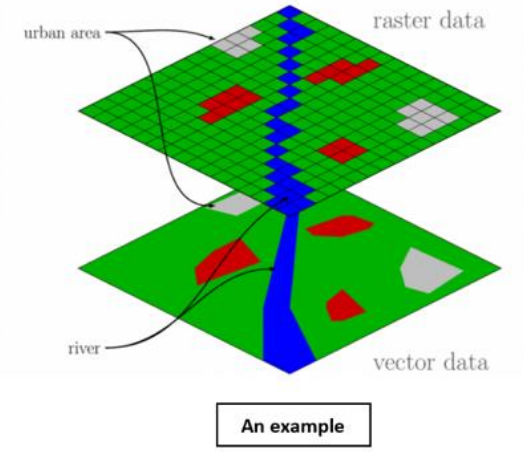
### 2.1 Introduction and Data Quantification:

- Explore how we can measure changes in light pollution using real data.
- Provide a case study background to contextualise the activity.

### 2.2 Understanding Spatial Data Structures and Modelling:

- *Discuss spatial data structures* and their significance.
- *Introduce raster datasets* with an example, like a satellite image depicting light pollution density.
- Define the difference between Vector and Raster Data set (i.e. satellite image) by using the examples e.g. river marks

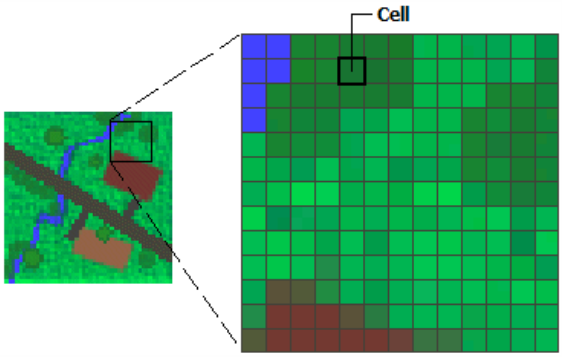



Support Material for Vector and Raster data: https://gisgeography.com/spatial-data-types-

**2.3 Managing and Processing Data with GIS:**

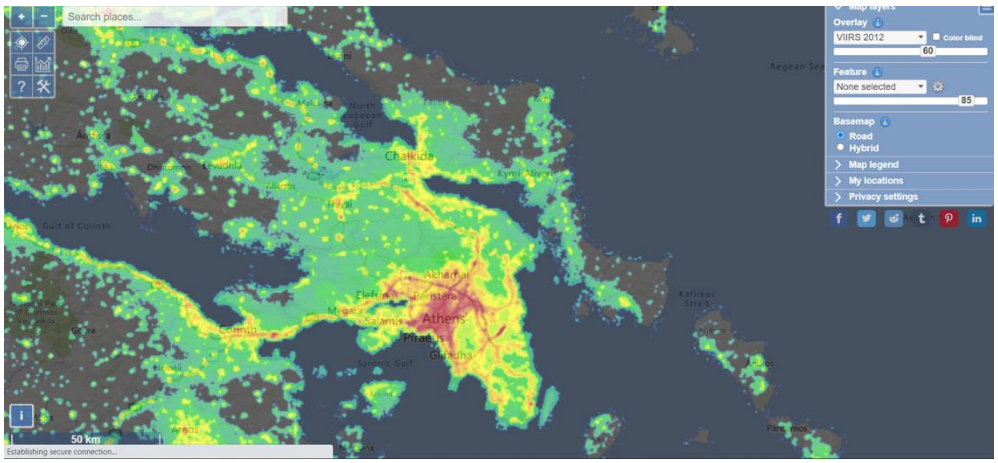
- Explain the role of Geographic Information Systems (GIS).
- Provide definitions and references for GIS concepts.
- Introducing QGIS software as a tool for analysis.




**2.4 Case Study Setup - Data Download and Tool Installation:**

- Guide students to download QGIS version 3.18.1. (https://qgis.org/downloads/)

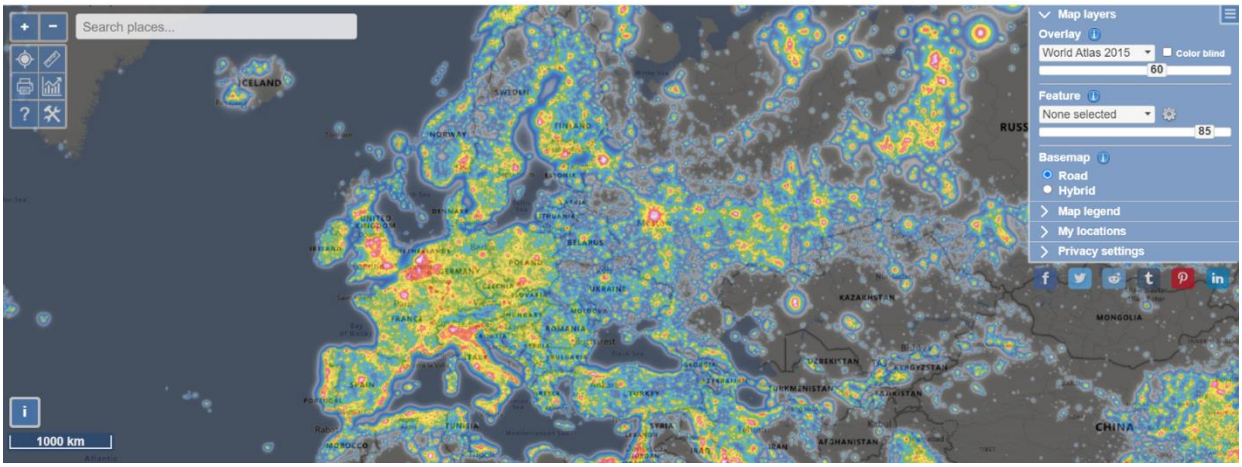
- Instruct students to download light pollution data. (https://www.lightpollutionmap.info/#zoom=8.15&lat=38.2410&lon=23.9360&layers=B0FFFFFFFFFFTFFFFFFF)



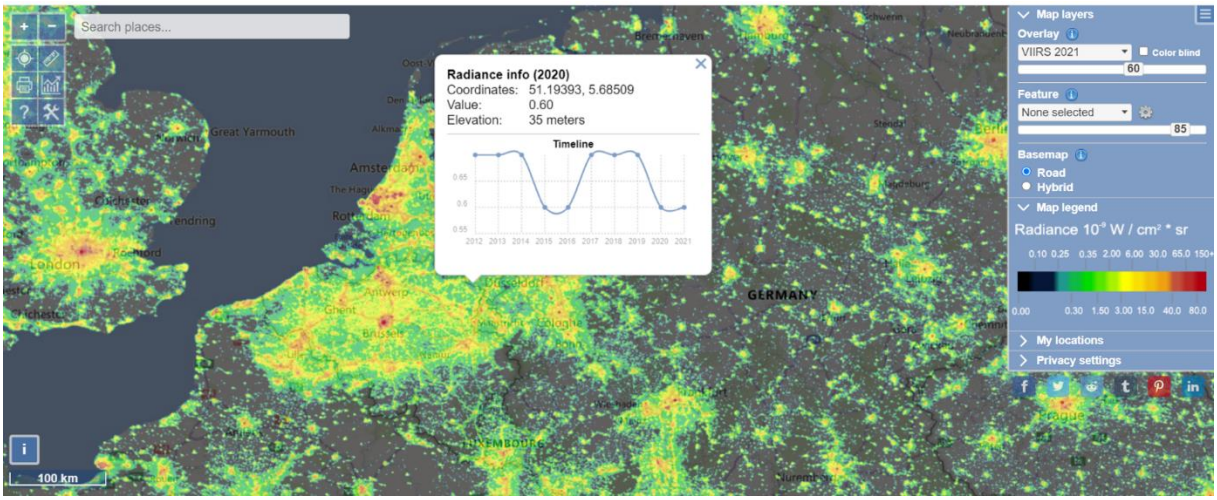

- Highlight the difference between data sources, like the Dark Sky Finder app.

**2.5 Exploring the Platform: Light Pollution Mapping (https://www.lightpollutionmap.info/ ):**

- Give an overview of the platform's capabilities.
- Demonstrate accessing global light pollution levels.
- Explain how to customize views (year, basemap, transparency, etc.).




- Show how to select specific areas and view temporal changes.
- Example: Display the graph of light pollution levels from 2012 to 2021.




## 2.6 Data Download and Analysis:

- Describe how to access detailed statistics and country-level data (click the statistics sign in the toolbar-shown with red rectangle).
- Instruct on downloading data for analysis (GeoTiff format).

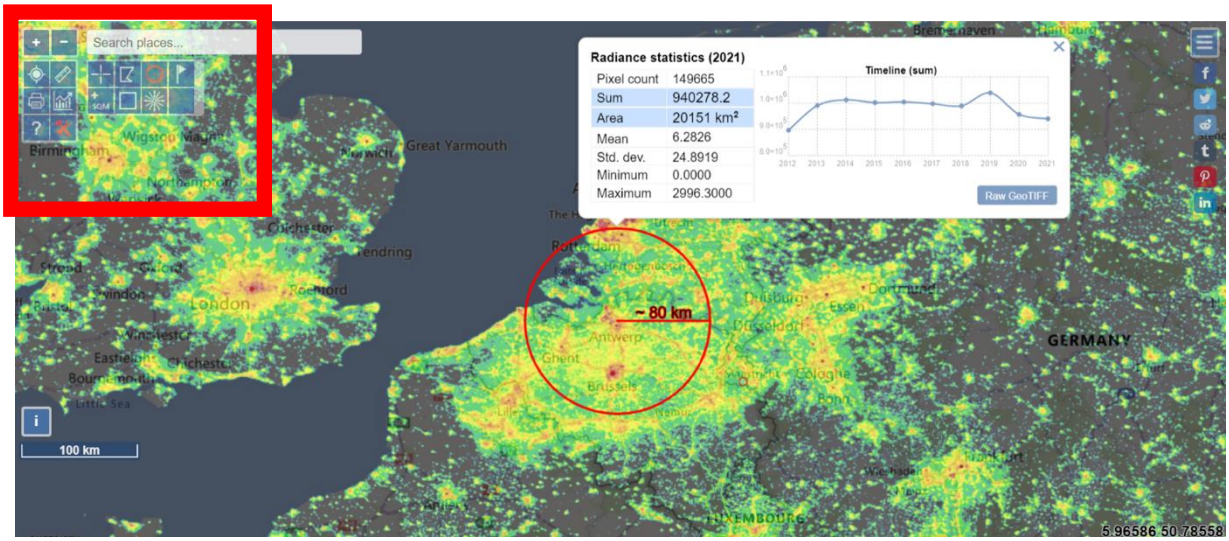
VIIRS Country statistics

○ 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.

- Download the data by selecting the Tools icon (bottom right and click on the circle to select the respective area)




- Select the circle's radius and left click, the pop-up window presents all descriptions and data of the selected area.
- Guide students to repeat the process for different years (VIIRS 2014 and VIIRS 2021).

⇒ <u>Note to Educators:</u>

- This activity empowers students to explore light pollution using real data and GIS tools.
- Encourage thorough data analysis and interpretation.

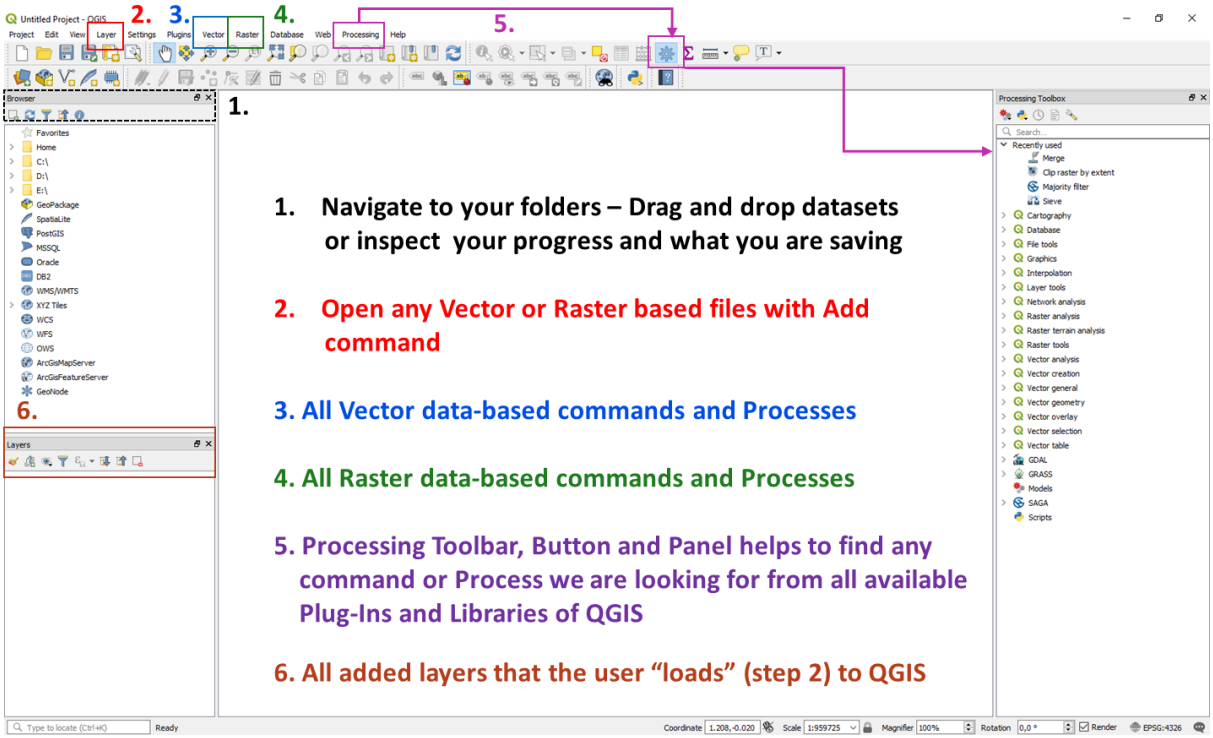
⇒ <u>Concluding Remark</u>: This activity encourages students to delve into practical applications of data analysis and spatial tools to gain insights into light pollution patterns within their region.

## Enjoy facilitating these engaging activities!

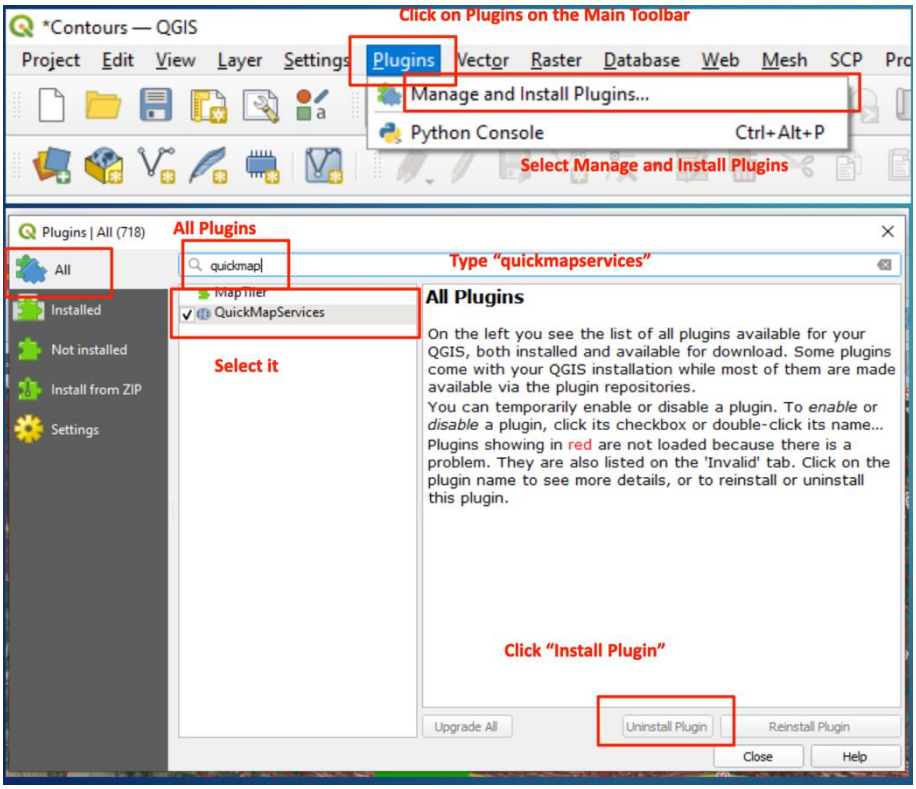
# 3. QGIS PLATFORM OVERVIEW and TECHNICAL GUIDELINES

**Step 1**

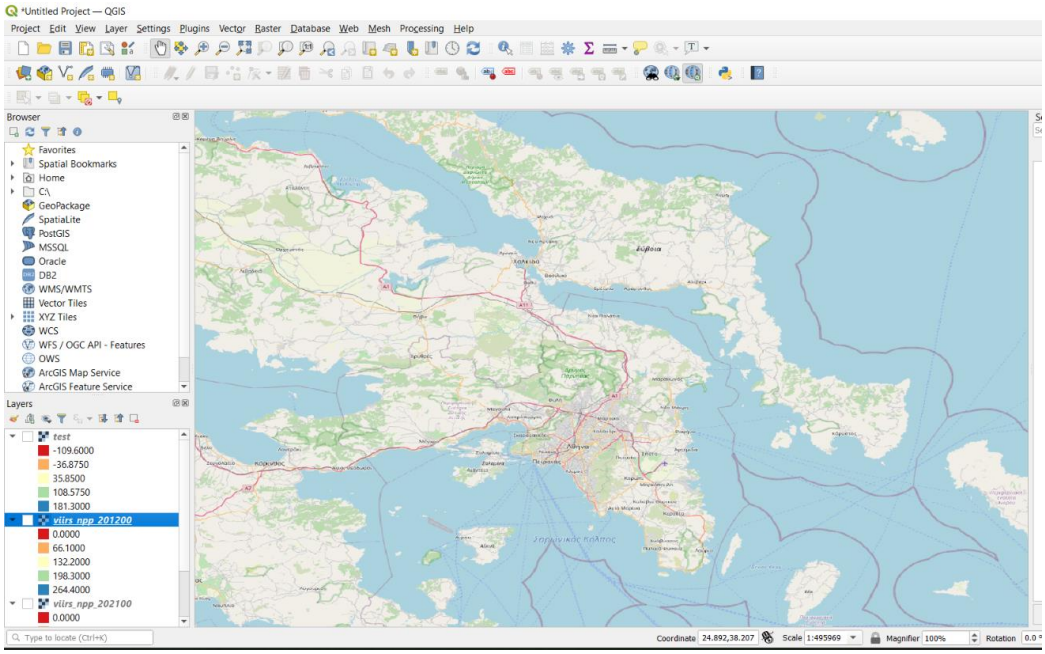
- Loading Data: Data can be loaded in four ways (shown on image)




- Install required plugins :



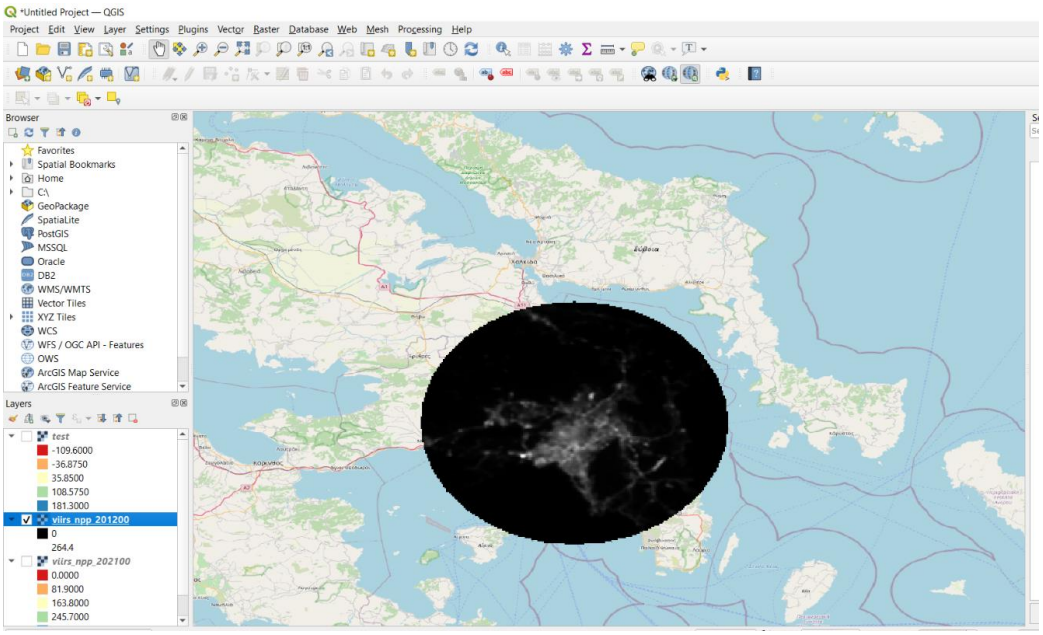

- Basemap Loading: Load Basemap using Main Toolbar: Web > quickMapServices > OSM > OSM Standard.



**Step 2**

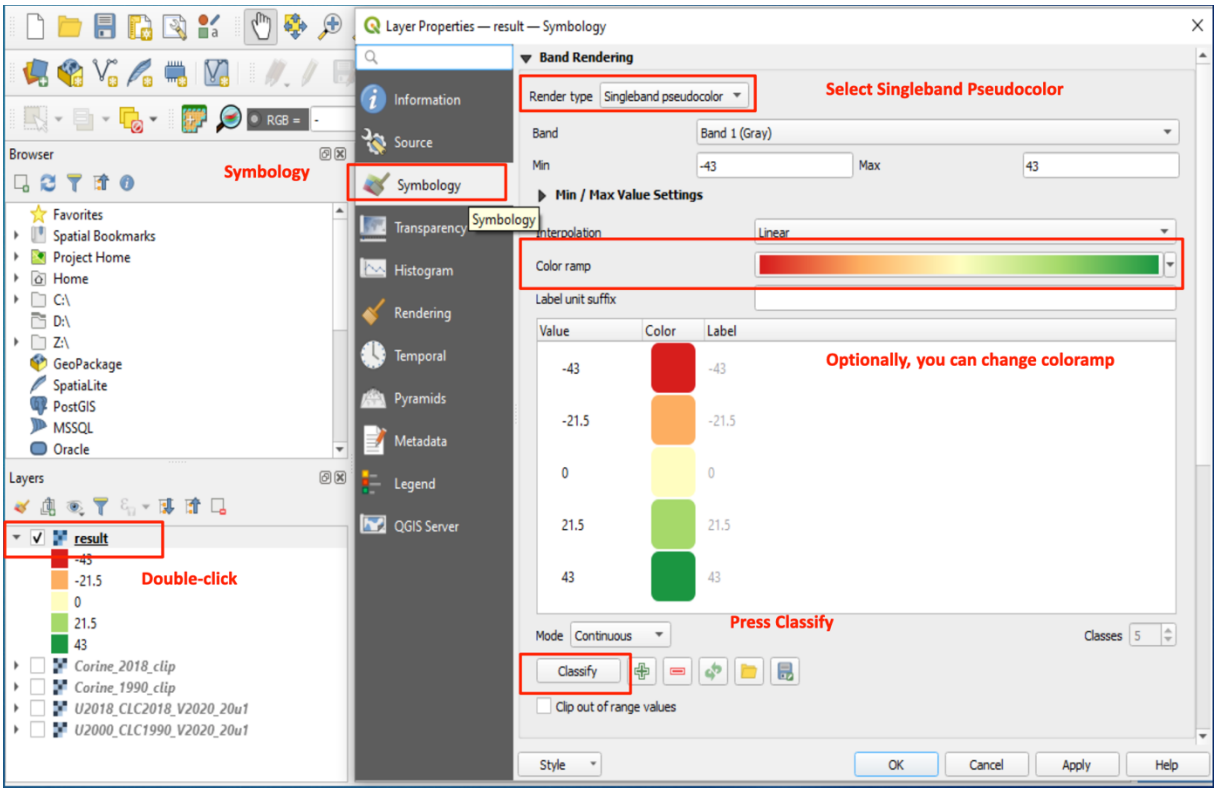
*Starting the Activity:*

- In the initial step, load downloaded Light Pollution files (VIIRS 2012 and 2021) onto QGIS.
- Main toolbar: Layers > Raster Layer > Navigate to folder > Select viirs_npp_201200.tif and viirs_npp_202100.tif.
- Initial map display will be black and white for both images.

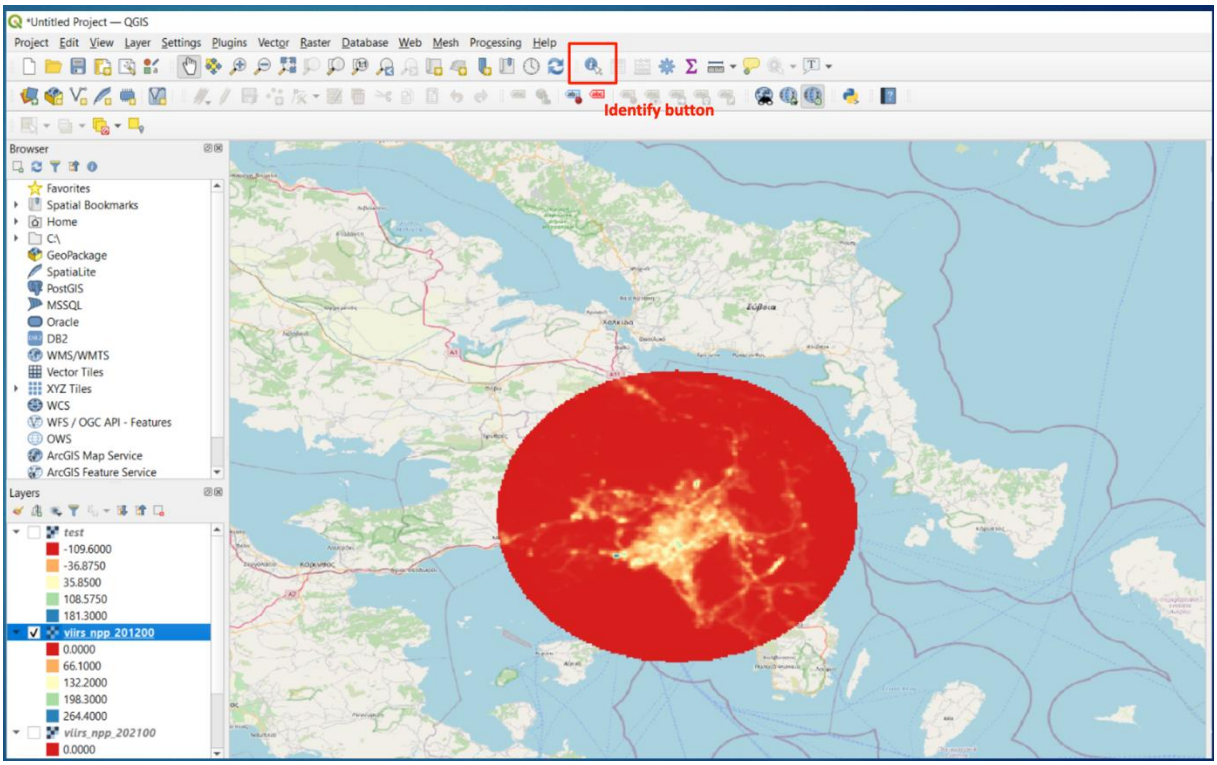



*Color Layout Adjustment:*

- Modify layout colors using Layer Properties.
- Double-click on .tif image > Symbology > Single-band Pseudocolor > Classify.




- Identify areas of increased light pollution or differences between years by checking/unchecking maps or using the identify button.

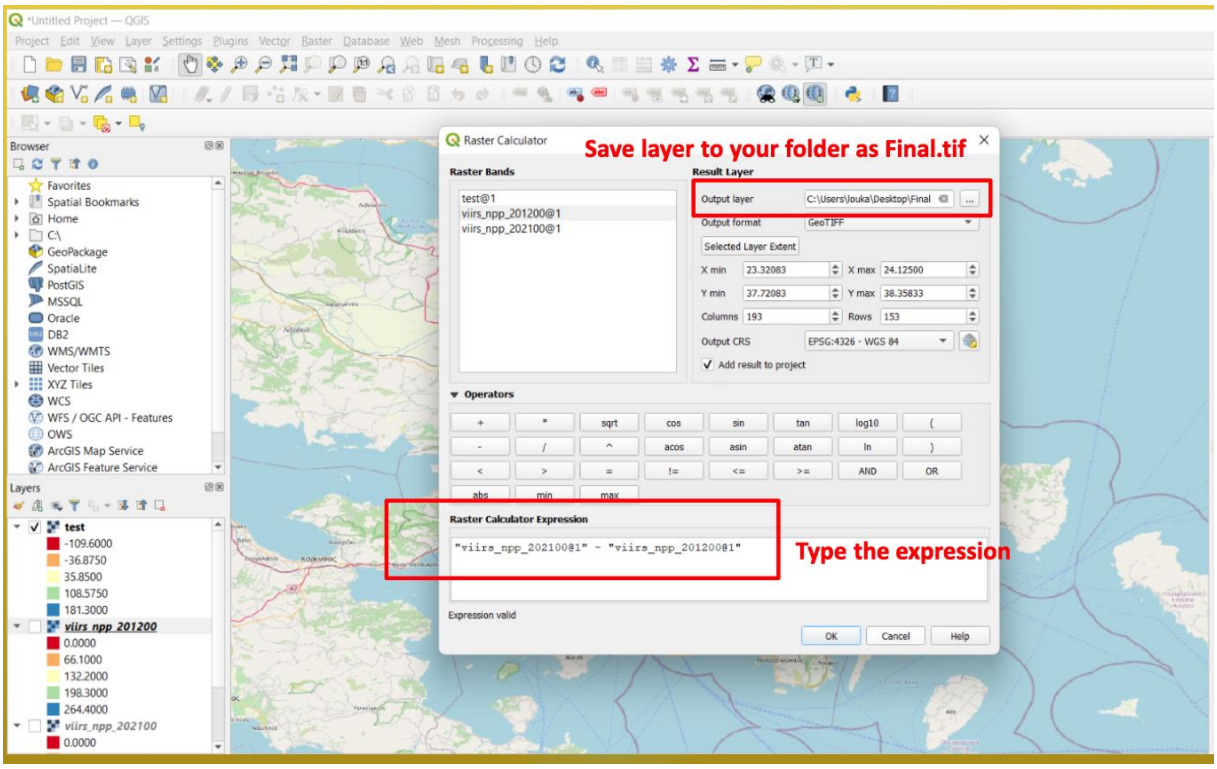


**Step 3: Quantifying Changes of Light Pollution Levels**

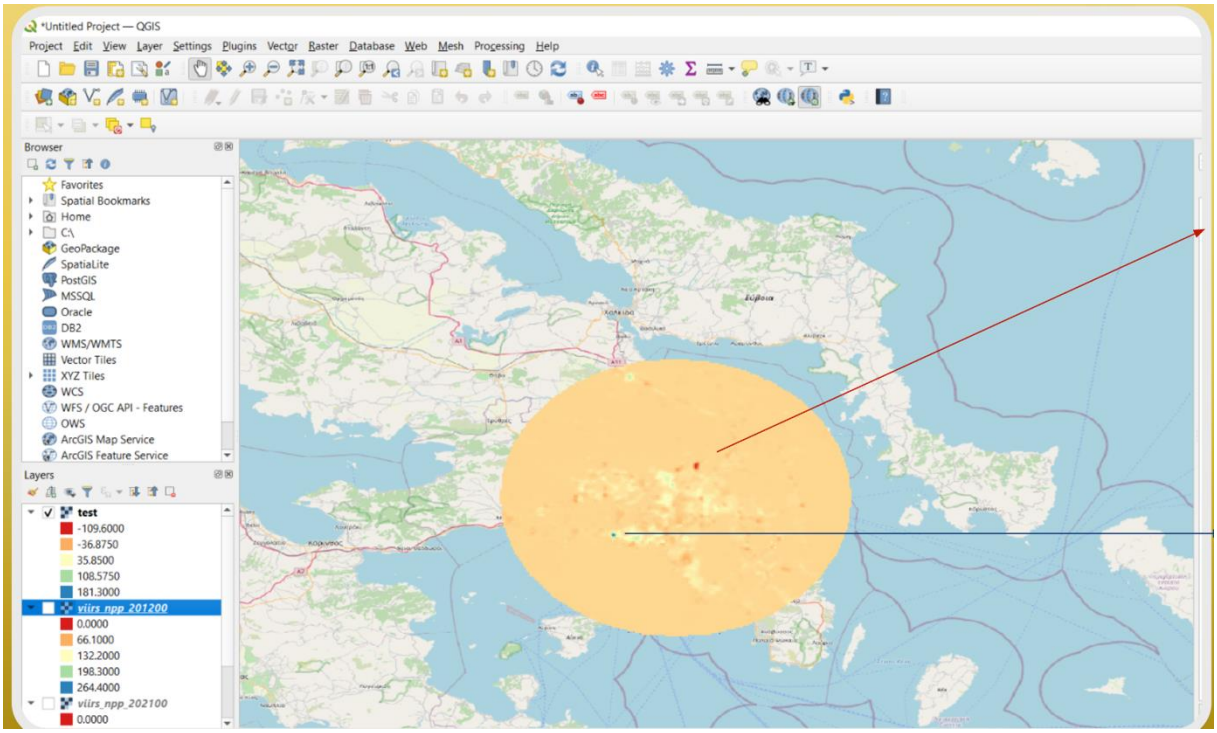
- Compare each pixel's value from viirs_npp_201200.tif and viirs_npp_202100.tif.
- Use the "Raster Calculator" tool for mathematical operations and conditional statements between rasters (images).

*Simple Comparison Measure:*

- Subtract pixel values of viirs_npp_201200.tif from viirs_npp_202100.tif.
- Open Raster Calculator via Main Toolbar: Raster > Raster Calculator.
- Enter: "viirs_npp_202100@1" - "viirs_npp_201200@1".



- Red areas indicate reduced light pollution levels (2012-2021) – Athens Airport -COVID-19.
- Blue areas indicate increased light pollution levels (2012-2021) – Piraeus port and Cosco investments.

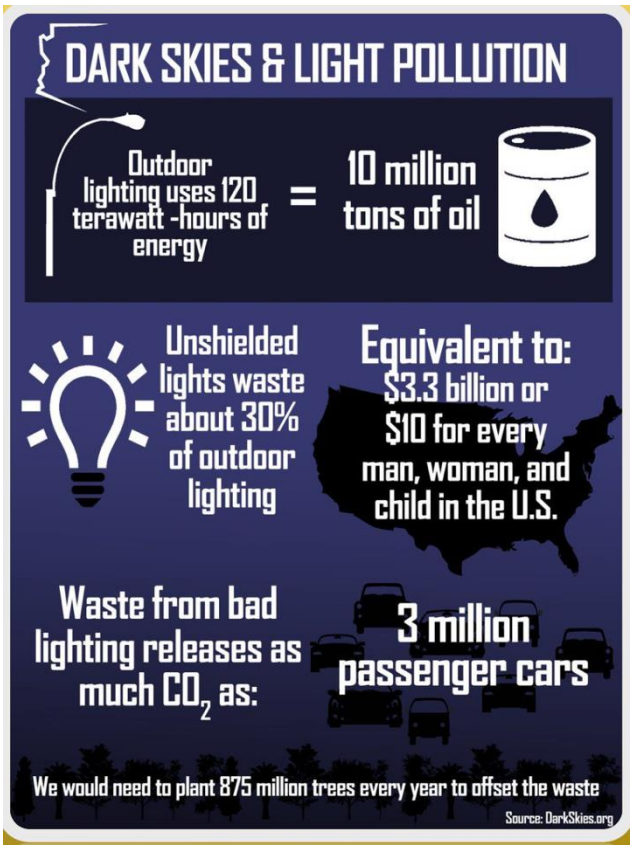


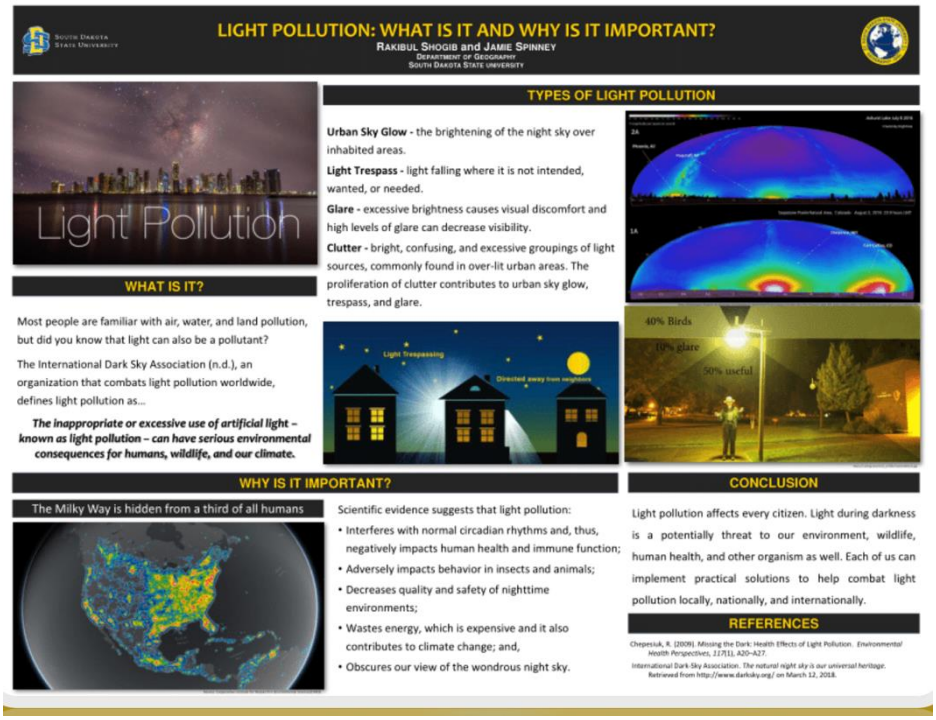

## Results Presentation

- Communicate findings from the analysis.
- Share insights on areas with decreased and increased light pollution.
- Discuss observed changes, such as implications of COVID-19 on light pollution levels.

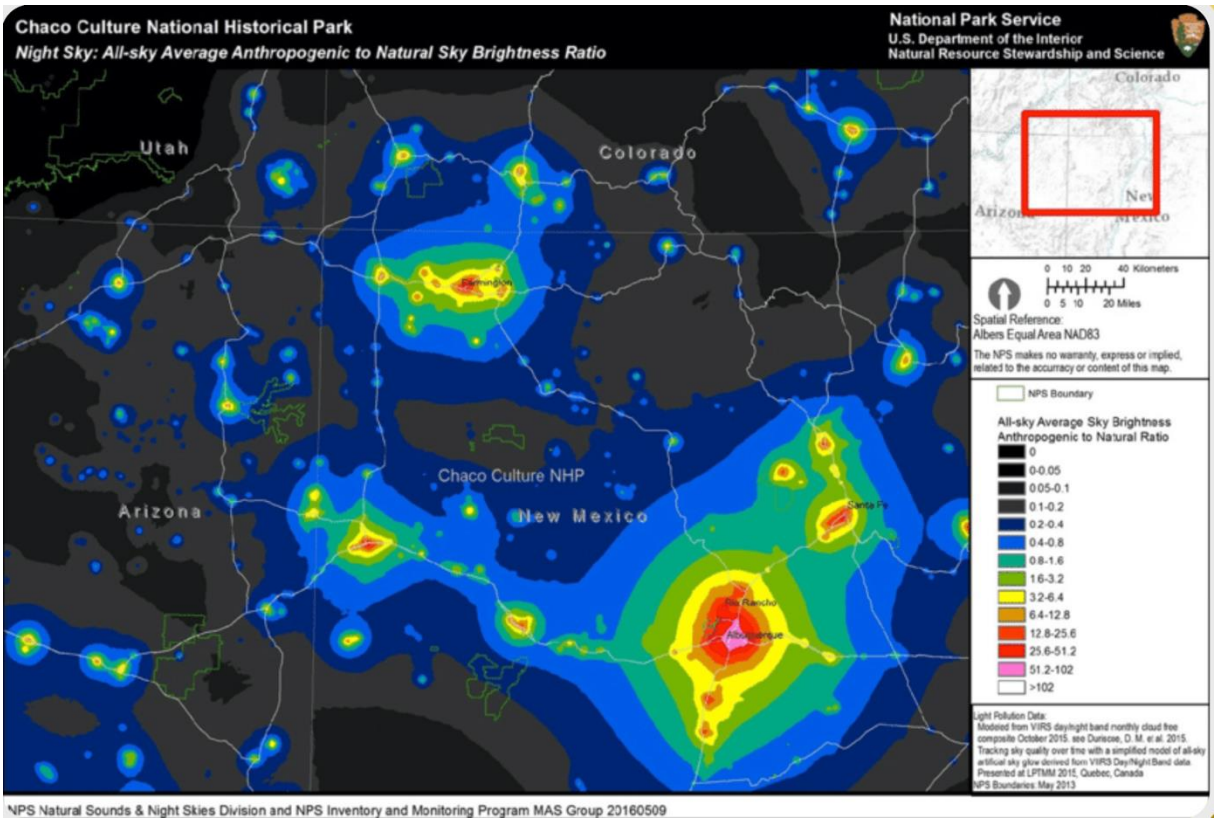
## STUDENT TASKS

⇒ **Create a flyer to start a campaign or a scientific poster**



⇒ **Create a map demonstrating light pollution differences in multiple areas and timescales.**




⇒ <u>Educational Note:</u>

Utilizing the QGIS platform and associated tools, students engage in meaningful analysis and interpretation of real-world spatial data, gaining valuable insights into changing light pollution patterns.

## ENJOY THE ACTIVITIES!