Space Business Innovation Challenge

Beginner’s Guide for Downloading and Viewing Sentinel-2 Images

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BEGINNERS GUIDE OVERVIEW

This document is a beginner's guide designed to help users get started with accessing and analyzing satellite imagery. It covers:

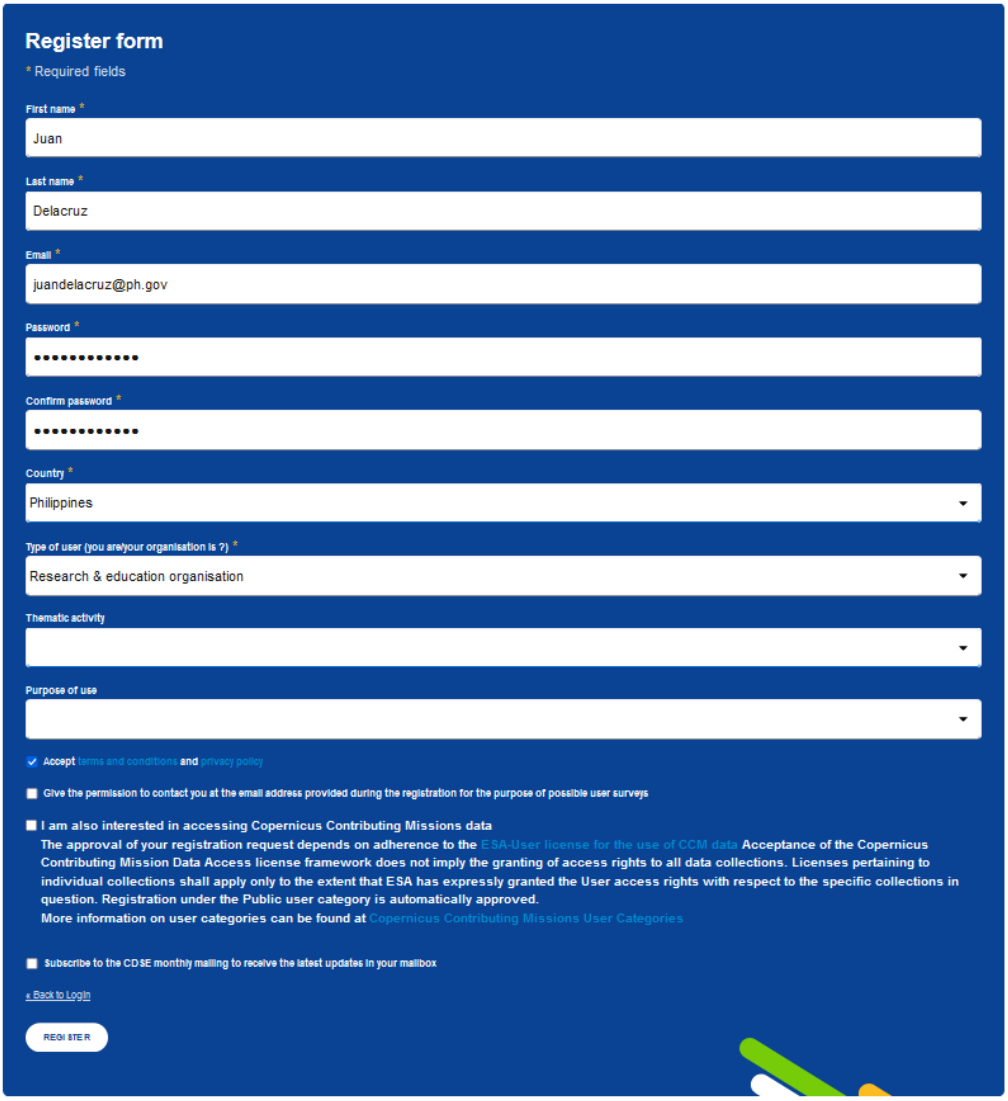
- Signing up for the **Copernicus website** to access Sentinel-2 images.
- Downloading Sentinel-2 images from the Copernicus platform.
- Installing **QGIS**, an open-source software for spatial data visualization and analysis.
- Loading raster datasets into QGIS.
- Creating polygon vector shapefiles.
- Populating the attribute table with relevant information.

This guide is intended for **beginners** and does not cover advanced techniques. It will be **periodically updated** to include new tips, resources, and references from other trusted sources to enhance learning and usability.

1. Creating an Account on the Copernicus Website

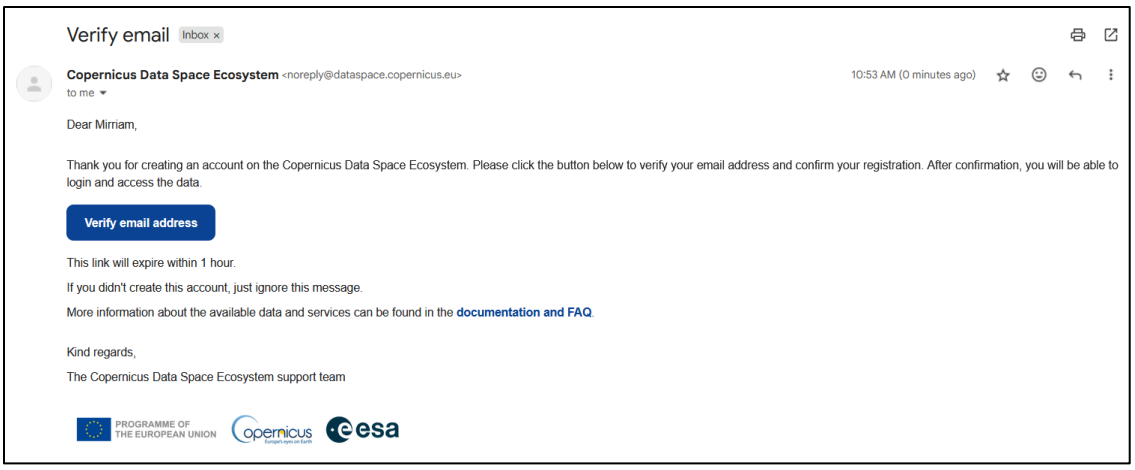
1.1. Account Registration

Register at the official Copernicus portal through this site.
Fill out the required fields.
For type of user, select **Research & education organization**
Check the box for Accept terms and conditions and privacy policy then click **Register.**



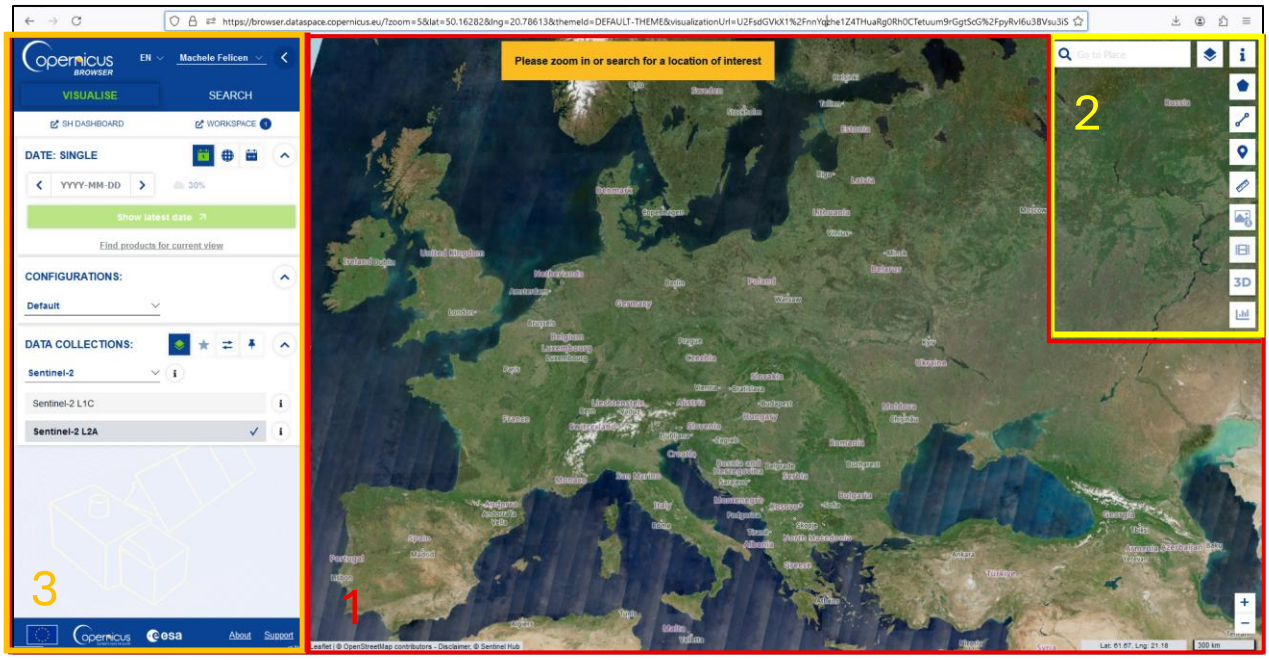
Note: Simply check the box for **"Accept terms and conditions and privacy policy"** and then click **Register**. The other boxes do not need to be selected.

Verify your email address by clicking the verification button on the confirmation email. Once verified, log in with your credentials to the previous site.



1.2 Viewing and Downloading of Datasets through the Copernicus Browser

After completing your registration, visit the Copernicus Browser website (site). The following are the composition of the Copernicus Browser.



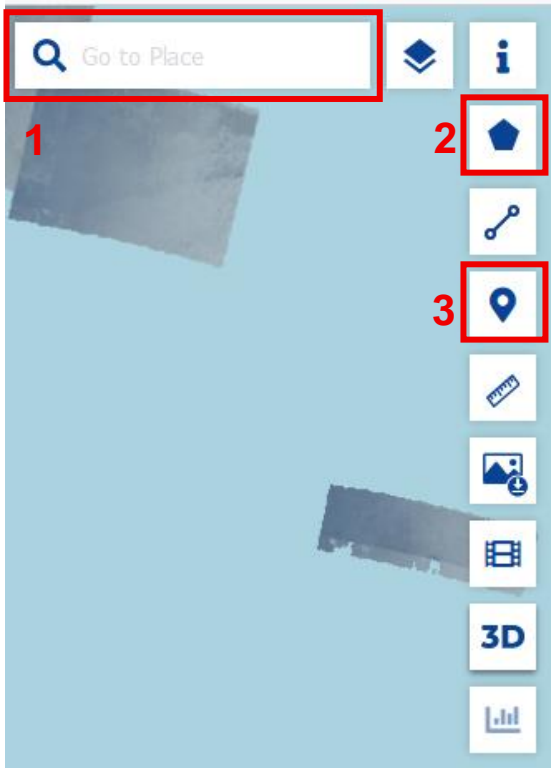
Box 1: Map Interface

The map interface serves as the central workspace in the Copernicus Browser, allowing users to interact with satellite imagery. Navigation is intuitive:

- **Panning**: Click and drag the left mouse button to move across the map.
- **Zooming**: Use the mouse scroll wheel to zoom in and out.
- **Location Search**: Enter a place name in the search bar to quickly navigate to a specific area.

Box 2: Map Operations

The operations panel provides tools to enhance map interaction.



Show Tutorial

Create an area of interest

Draw a line

Mark point of interest

Measure

Download image

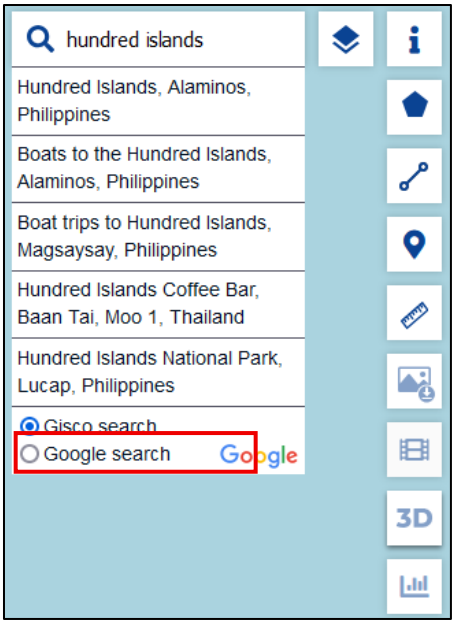
Create timelapse animation

Create 3D

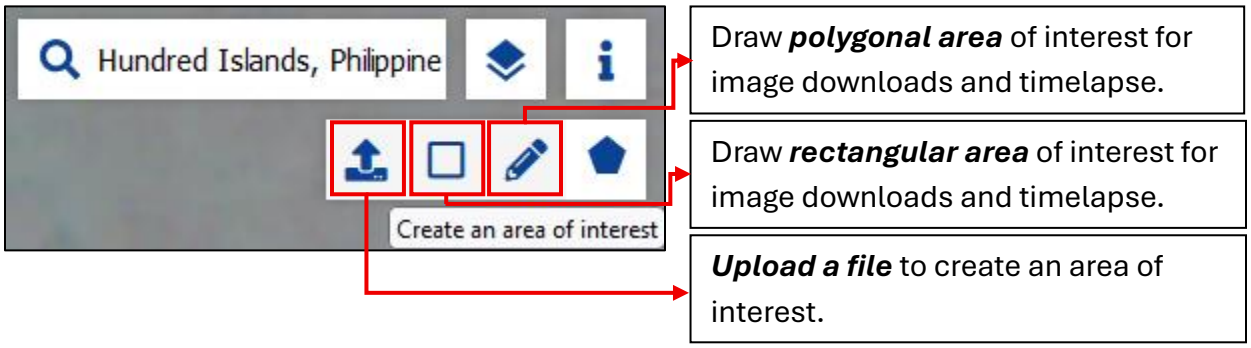
The highlighted sections help you navigate to your area of interest.

- **For 1:** Type the name of your desired location in the search field.

  At the bottom, select the **"Google Search"** button. Using Google Search provides a more precise location for the name you entered.

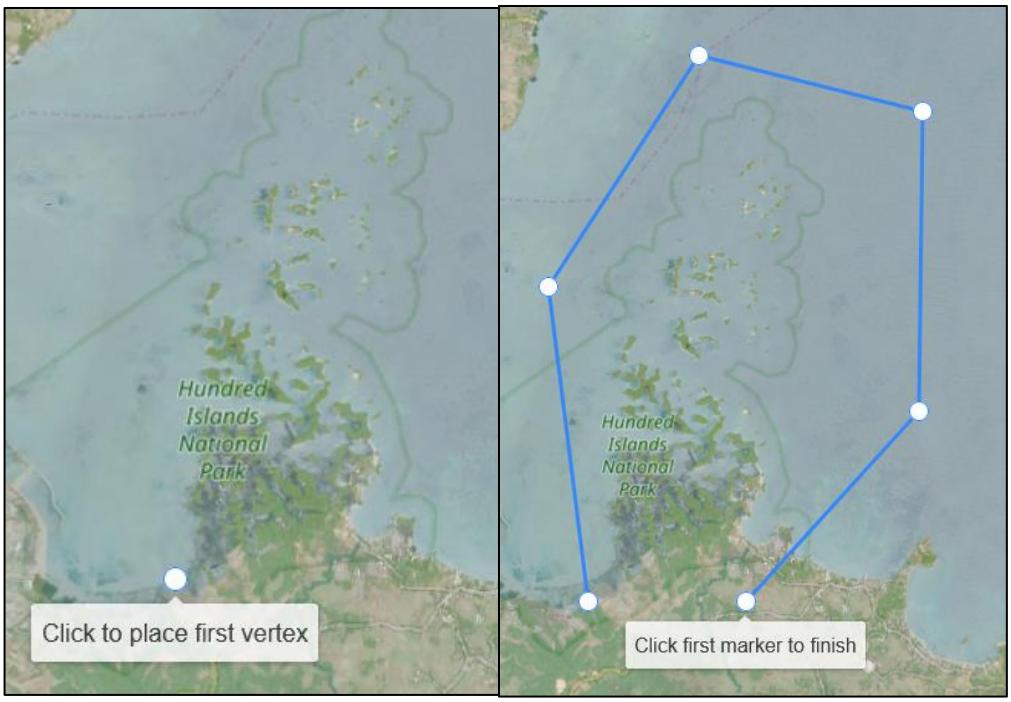


- **For 2:** You have several options.



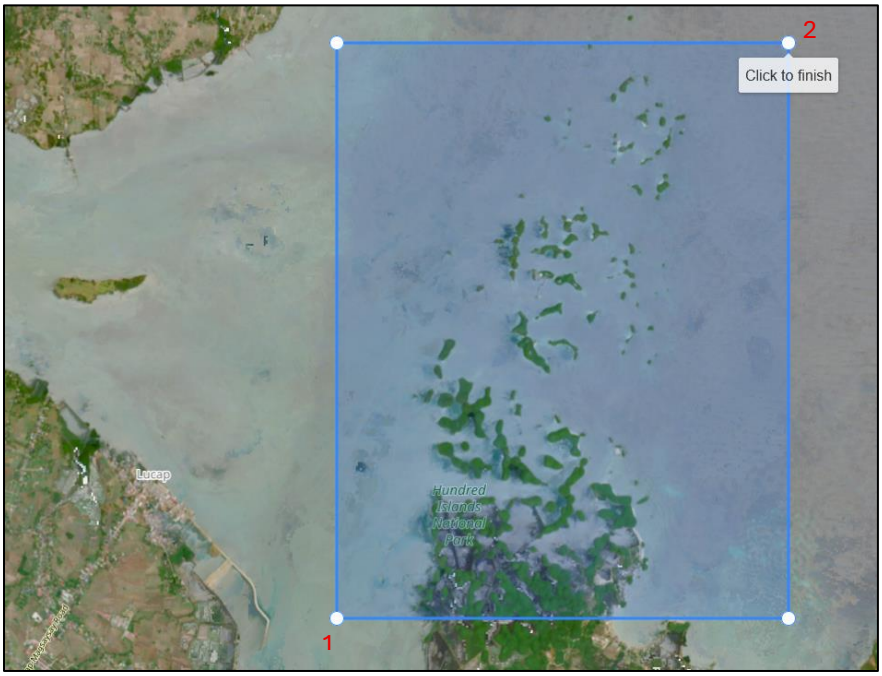
When you select the pencil icon  , you can define the boundaries of your target area by clicking points on the map.

- Click successive points to outline the area.
- To complete the polygon, click the **first point** again.



When you select the rectangle icon ▭, define your area by specifying two points:

- **First point:** the lower-left corner of the rectangle.
- **Second point:** the upper-right corner of the rectangle.



When you select the upload icon  , you will need to upload a file in one of the following formats:

- **Accepted formats:** zipped SHP, KML/KMZ, GPX, WKT, or GEOJSON/JSON.
- **Instructions:** Drag and drop your file into the File Upload dialog box.

Note: Only polygon files are supported. Uploading point files will result in errors.

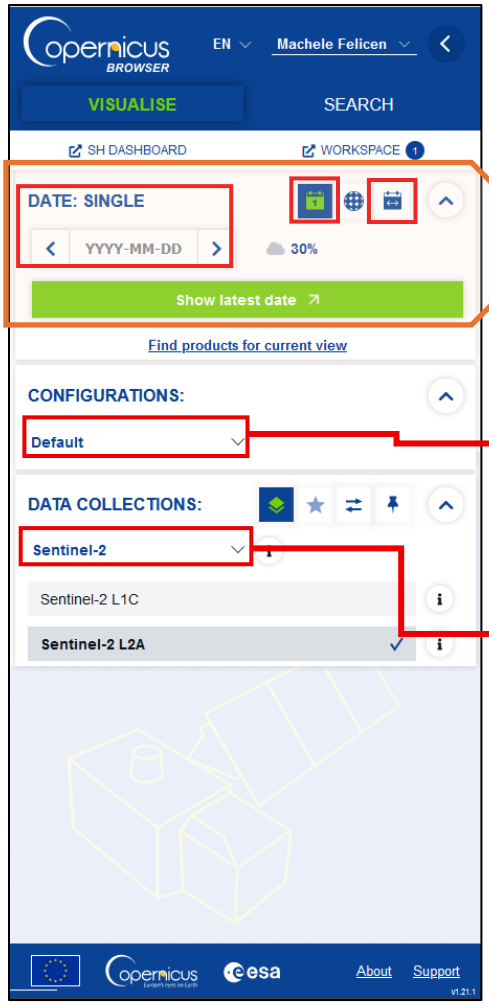
Once the polygon is loaded, its approximate area will be displayed automatically.

To remove the polygon and select a different area, click the cross icon . This will delete the currently displayed polygon.

- **For 3, You can also mark your point of interest by clicking the geotag/place marker** .

Box 3 contains the search panel, where you can define criteria for downloading images.

- Specify the **Area of Interest (AOI)**, **acquisition date(s)**, **satellite mission** (e.g., Sentinel-1, Sentinel-2), and **product type**, etc.
- You can also apply **filters**, such as the **maximum cloud cover percentage**, to refine your search results.

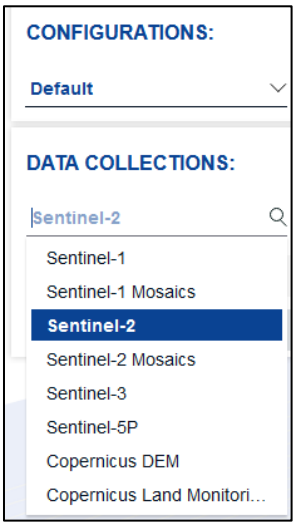


These options relate to the selection of dates.

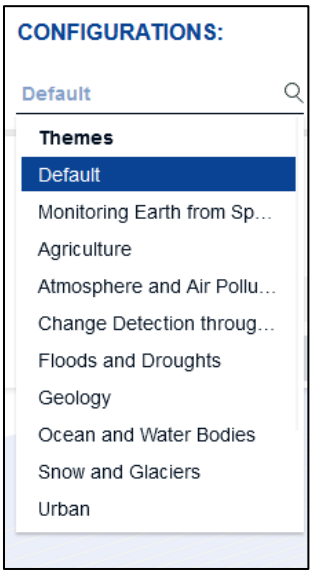
This is a drop-down menu that allows you to select the configuration or application to generate using Copernicus data.

This is a drop-down menu of Copernicus Data Collections, ranging from Sentinel-1 to Sentinel-5P.

The Date, Configurations, and Data Collections are interconnected. When the Configuration is set to "Default," all Sentinel satellite datasets become available in the Data Collections drop-down menu.

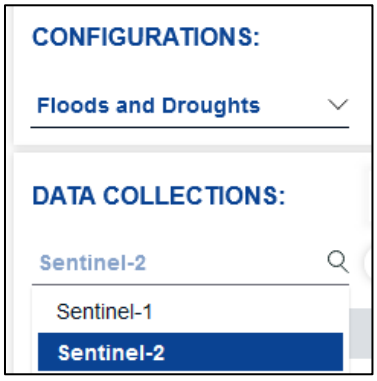


The remaining Configurations are listed below:



Selecting a different Configuration will update the available Data Collections, **as each Configuration corresponds to specific Sentinel datasets** that can generate the chosen application.

Example: Choosing the *Floods and Droughts* Configuration will display *Sentinel-1* and *Sentinel-2* in the Data Collections menu, since these datasets are commonly used to generate flood-related products.



For this exercise, set the Configuration to *Default* and select *Sentinel-2* as the Data Collection. Sentinel-2 provides two data products: L1C and L2A.

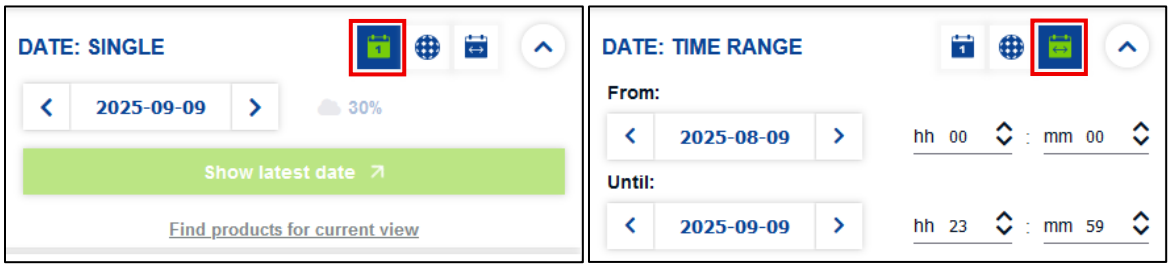
- **L1C (Level-1C):** Top-of-Atmosphere (TOA) reflectance. These images are radiometrically and geometrically corrected but still include atmospheric effects such as haze, dust, or water vapor.

- **L2A (Level-2A):** Bottom-of-Atmosphere (BOA) reflectance. These images are further processed using atmospheric correction, making them closer to true surface reflectance values.

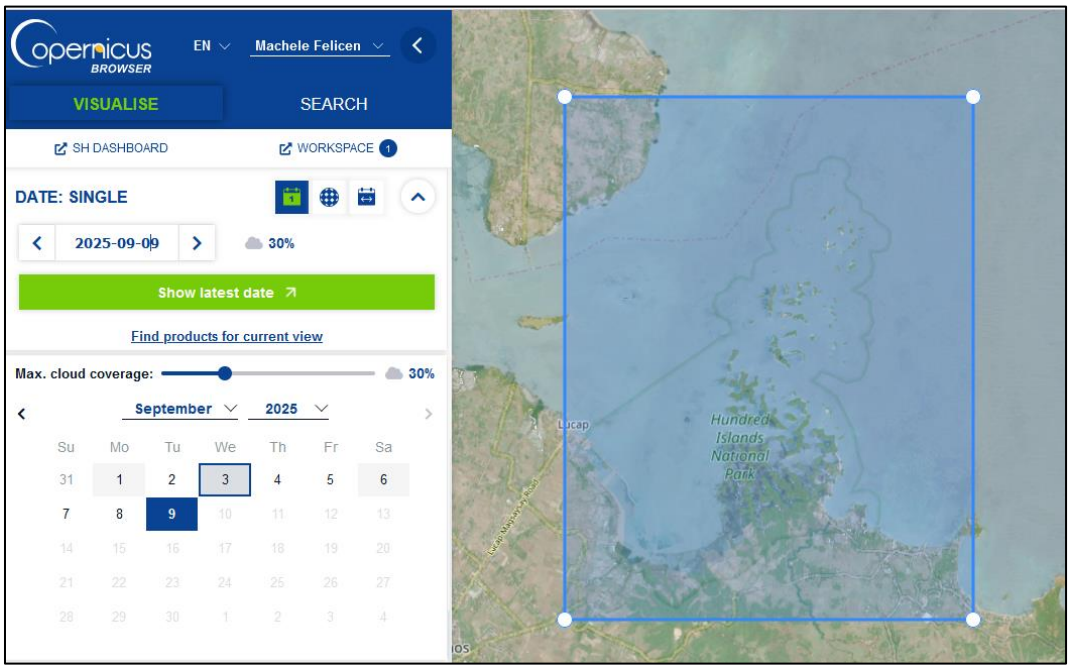
For this exercise, we will use *Sentinel-2 L2A* because it is already corrected for atmospheric effects, providing more accurate data for analysis.

Returning to the date settings:

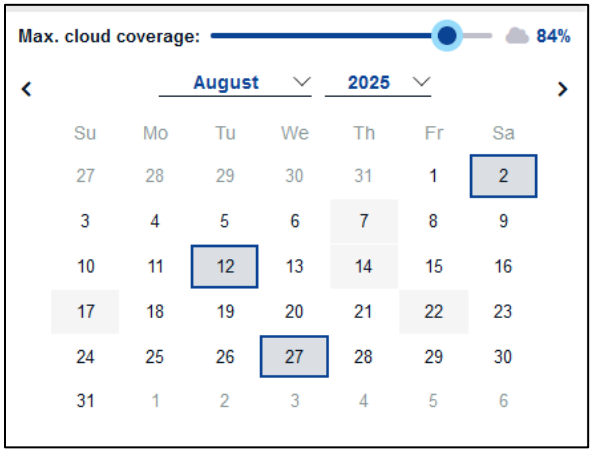
- Selecting  will display the date of the most recent Sentinel-2 image.
- Selecting  will show a one-month date range.

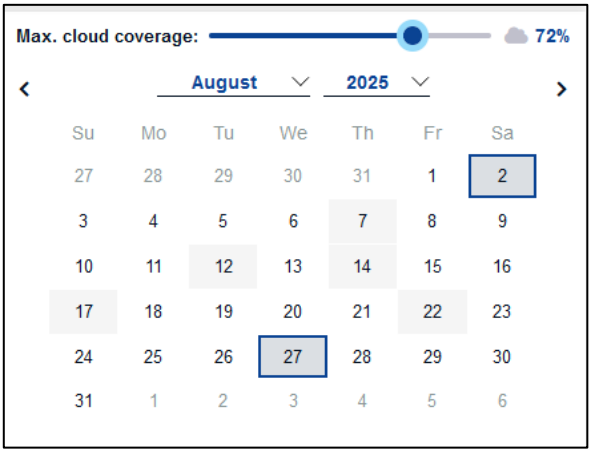


You can also click on the exact date (e.g., *2025-09-09*) to open the calendar. The calendar highlights the dates when Sentinel-2 captured images for your chosen area of interest. You may manually select another date or use the **"<"** and **">"** buttons to move backward or forward in time.



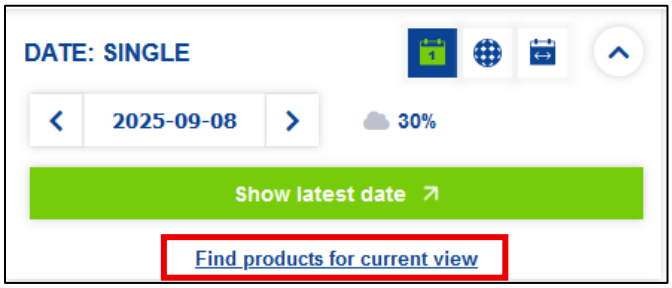
You can also adjust the cloud coverage filter by moving the slider on the bar. Setting a lower percentage will exclude images that exceed the specified cloud cover threshold, leaving only those that meet your criteria.

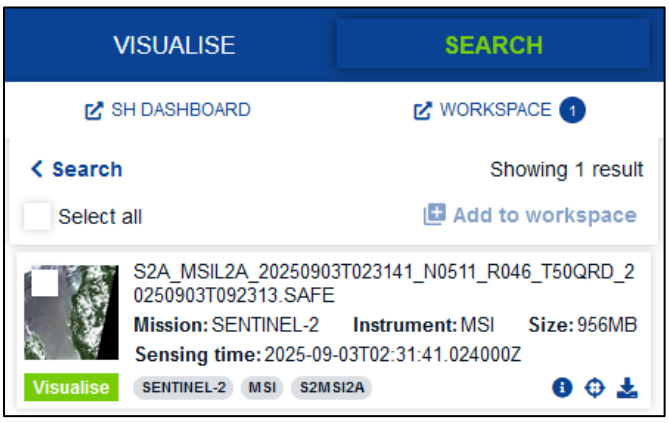




After selecting the date, click the down arrow beside it to expand the options.

Then, click the "Find products for current view" button located just below "Show latest date." This will display all products that match the selected criteria—date, cloud coverage, and the defined area of interest





At the bottom of the product are three icons  .

Product info – Displays basic information about the selected dataset.	Zoom to product – Adjusts the map view to zoom on the location of the selected image that covers the defined Area of Interest (AOI).	Download product – Downloads the selected product. *Note: You must be logged in before clicking this option.*

The goal is to download the product. There are several ways to do it.

Option 1. Use Download Product function

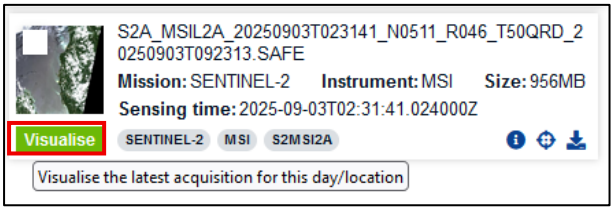
- Click **Download Product** at the bottom of the panel.
- This will download the full package, including metadata and all available image bands for the selected product.
- Note that the product size can exceed 1 GB.
- The downloaded file is compressed; you will need to extract (unzip) it before it can be opened in the QGIS software that we will use for viewing and analysis.

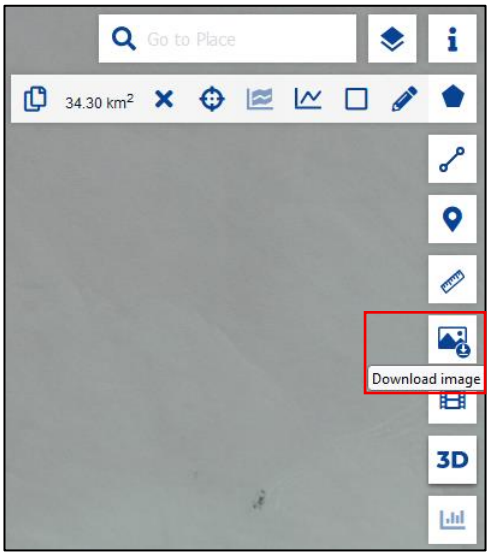
The extracted product contains extensive information about the scene. However, for this exercise, the required file is the **True Color Image (TCI)**. You can access it by navigating to:

GRANULE → IMG_DATA → "image_name" → R10m.

Option 2: Download Image Function (Box 1)

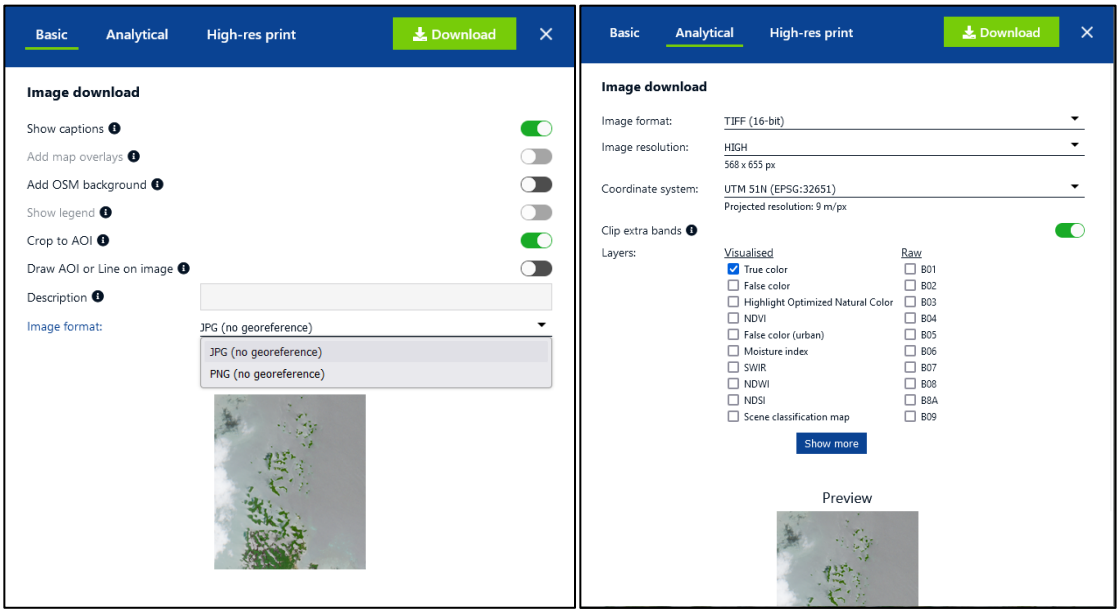
- To use this option, first click **Visualise** to activate the tools in Box 1.
- Then, select the **Download Image** function to save the visualized image according to your preferred format and settings.

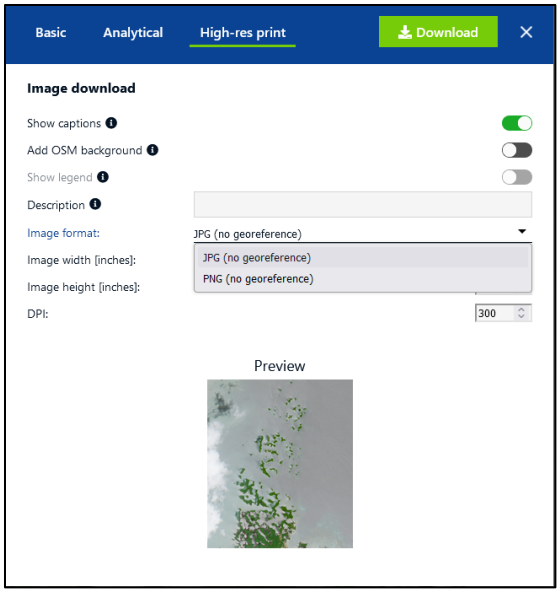




The ***Download Image*** **dialogue** provides three options for downloading images.

- **Basic** – Provides quick-view images in JPG or PNG format. These files are not georeferenced, meaning they are suitable for simple visualization but not for mapping or spatial analysis.
- **Analytical** – Provides images in multiple formats (TIFF, JPG, PNG) with full georeference information. These files can be used for detailed spatial analysis, measurements, and metric computations in GIS or remote sensing applications.
- **High-Resolution Print** – Provides print-quality images in JPG or PNG format optimized for presentation. These files are visually detailed but are not georeferenced, making them unsuitable for spatial analysis.





For this exercise, we will use the **Analytical Image** option with the following parameters:

Image Format	TIFF
Image Resolution	HIGH
Coordinate System	UTM Zone 51N (EPSG: 32651)
Layers	True Color (checked)

After setting these parameters, click **Download** to save the image.

2. Using of QGIS for Data Analysis

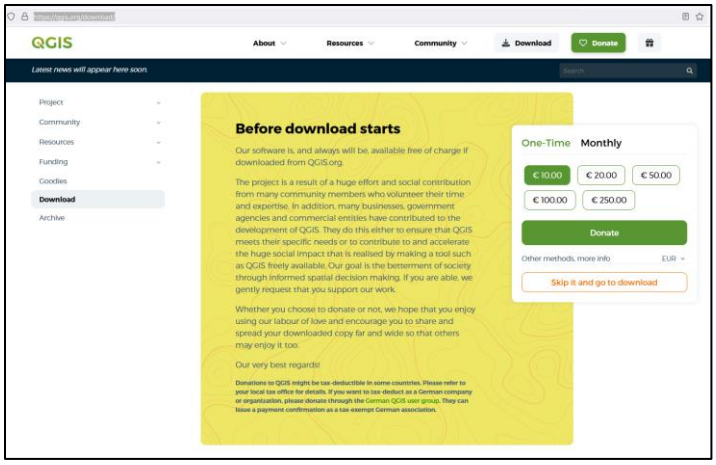
2.1 About QGIS

QGIS is a free and open-source geographic information system (GIS) software used for viewing, editing, analyzing, and visualizing geospatial data. It supports a wide range of vector, raster, and database formats, and its extensible plugin architecture allows users to perform specialized tasks such as remote sensing, spatial statistics, and 3D visualization.

2.2 Downloading QGIS

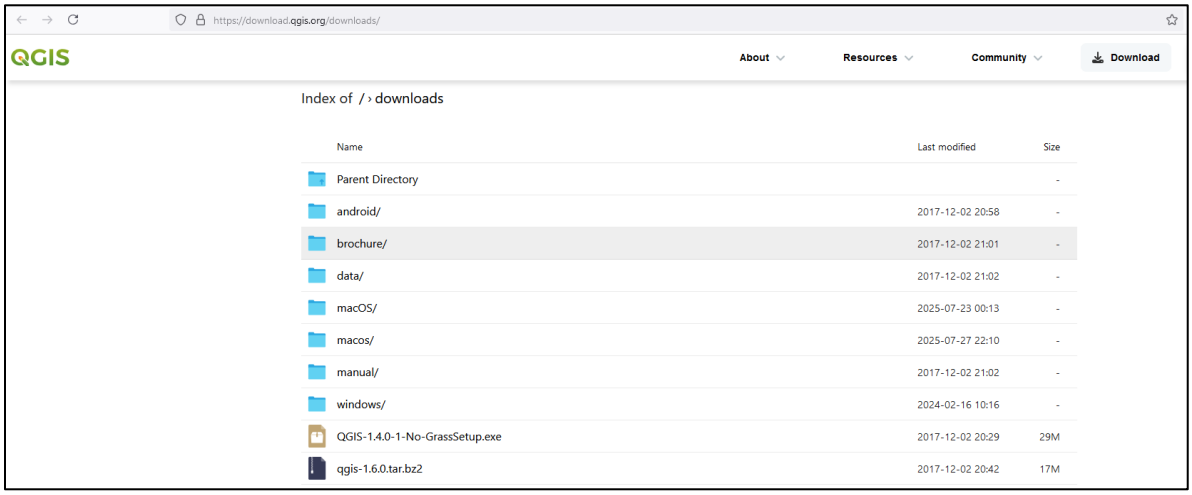
QGIS can be downloaded from the following official sources:

Option 1: https://qgis.org/download/

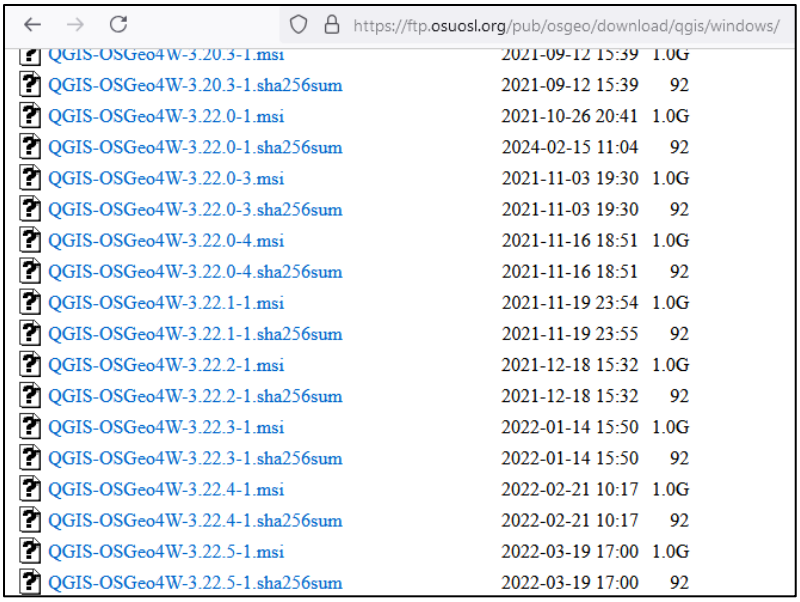


Option 2: https://download.qgis.org/downloads/

Select the QGIS installer that matches your operating system (Windows, macOS, or Linux).

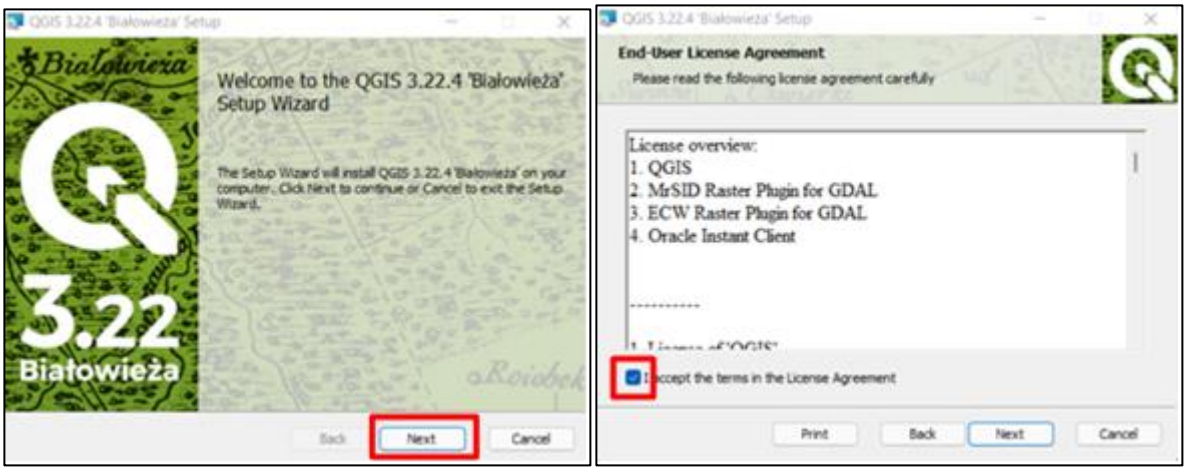


For this challenge, you will need **QGIS version 3.18 or later**. After selecting the appropriate installer, wait for the file to finish downloading before proceeding with the installation.

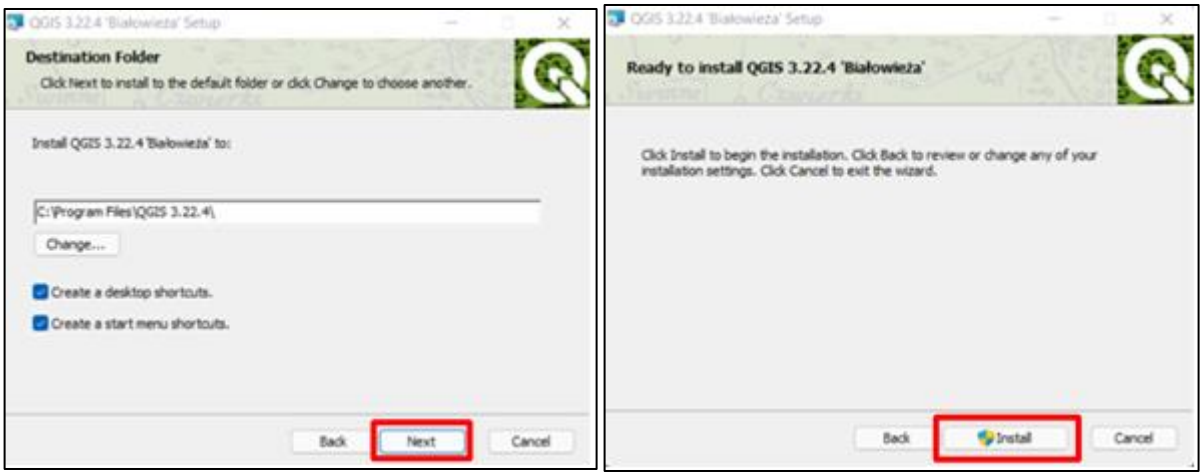


2.3 Installation of QGIS

After download, double-click the downloaded file and follow the series of steps below to install the software. The welcome page will show, click Next to proceed to the end-user license agreement page. Check the box to agree with the terms and conditions.



Click Next then the Install button. The software will automatically for installation.



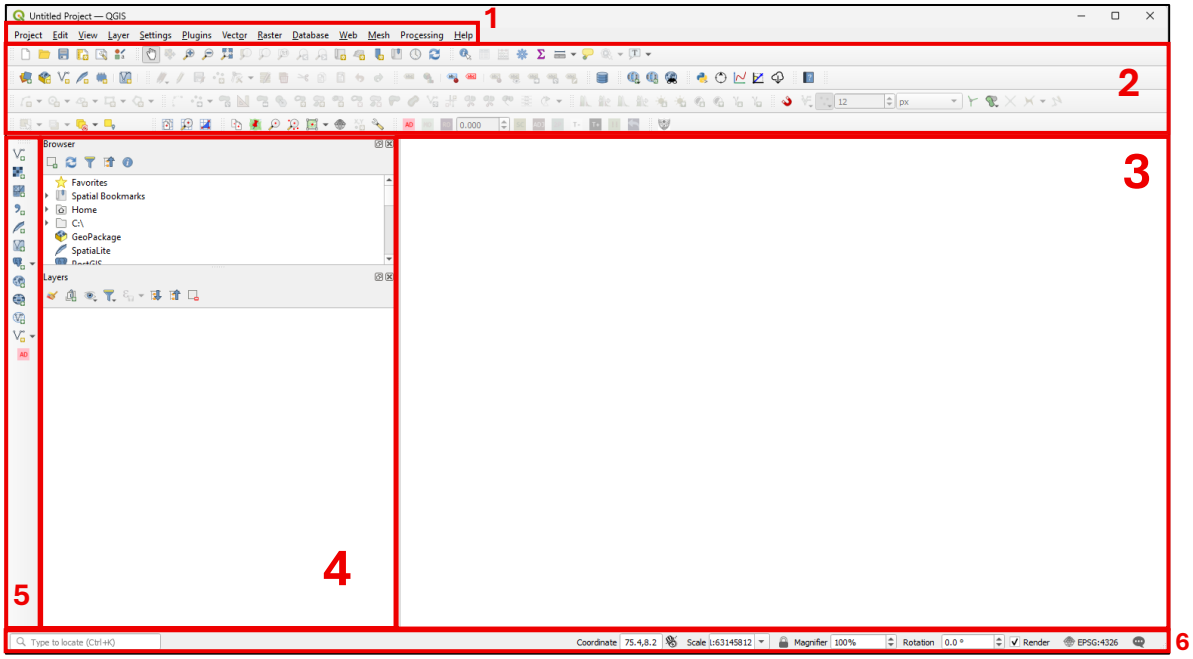
After the installation process, QGIS will create a desktop shortcut, which will be in a folder named QGIS 3.22.4. Look for the QGIS Desktop 3.22.4 (or a higher version – depending on the latest available version) and open the application - QGIS Desktop.

2.4. Introduction to the QGIS Interface

Open QGIS either by clicking the desktop shortcut or by searching for the program in your computer's start/search menu.

The **QGIS interface** is composed of several key components (see image below):

1. **Menu Bar**
2. **Toolbars**
3. **Map Canvas**
4. **Browser / Layer Panel**
5. **Side Toolbar**
6. **Status Bar**

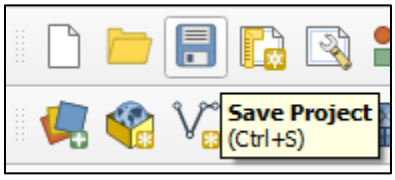


2.4.1. QGIS Interface

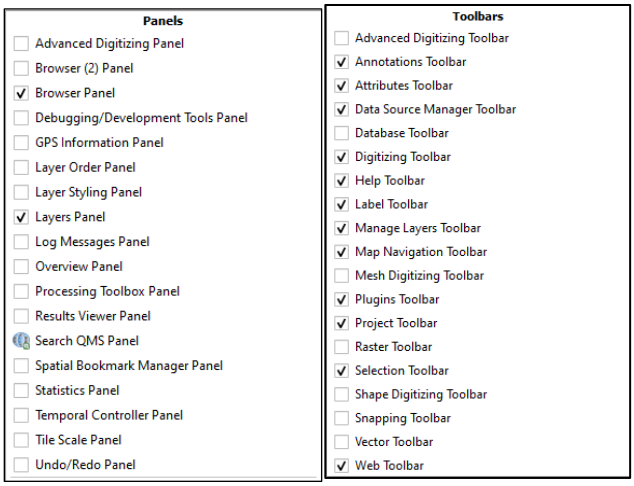
The **Menu Bar** in **QGIS** is the main toolbar at the top of the application window that organizes all of QGIS's functions into **categories of menus**. It allows users to access nearly every feature and operation in QGIS through drop-down menus. Each menu contains commands or tools grouped by function.

2.4.2. Toolbars

In **QGIS**, **Toolbars** are collections of buttons that give you **quick access to commonly used tools and functions** without having to go through the Menu Bar. They are usually located below the Menu Bar and can be customized based on your workflow. If you hover on an icon in the toolbar, it will tell you what that icon does.



Toolbars can be customized by enabling or disabling specific panels. To do this, right-click on any blank area of the toolbar. A checklist of available panels and toolbars will appear, allowing you to turn them on or off as needed.



2.4.3. Map Canvas

The **Map Canvas** is the main display area where the map is rendered. All loaded datasets and layers are visualized here.

2.4.4. Browser/Layer panel

- Browser Panel – Provides quick access to files and data sources. It displays folders, subfolders, and files available on your computer or connected databases.
- Layer Panel – Lists all the layers currently loaded in QGIS. From here, you can manage layer visibility, order, and styling.

2.4.5. Side Toolbar

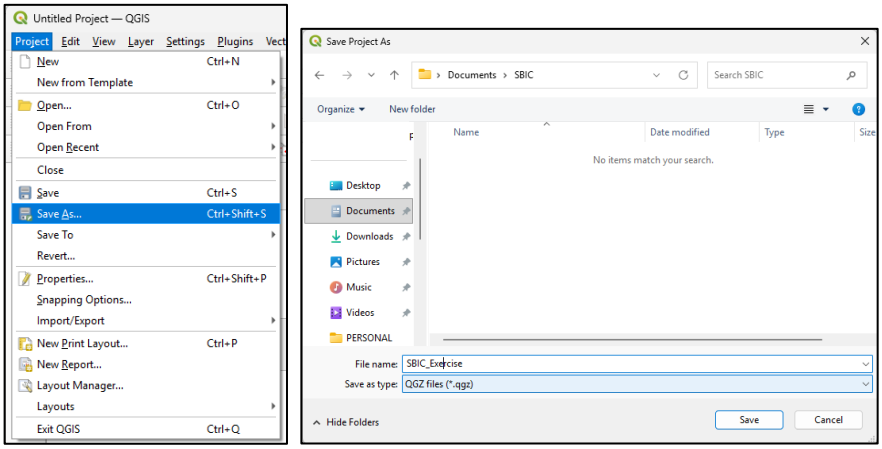
The **Side Toolbar** contains tools for adding data depending on the file format. In some QGIS installations, this toolbar may not be visible by default. To enable it, right-click on a blank area in the toolbar to open the list of toolbars and then check **Manage Layers Toolbar**.

2.4.6. Status Bar

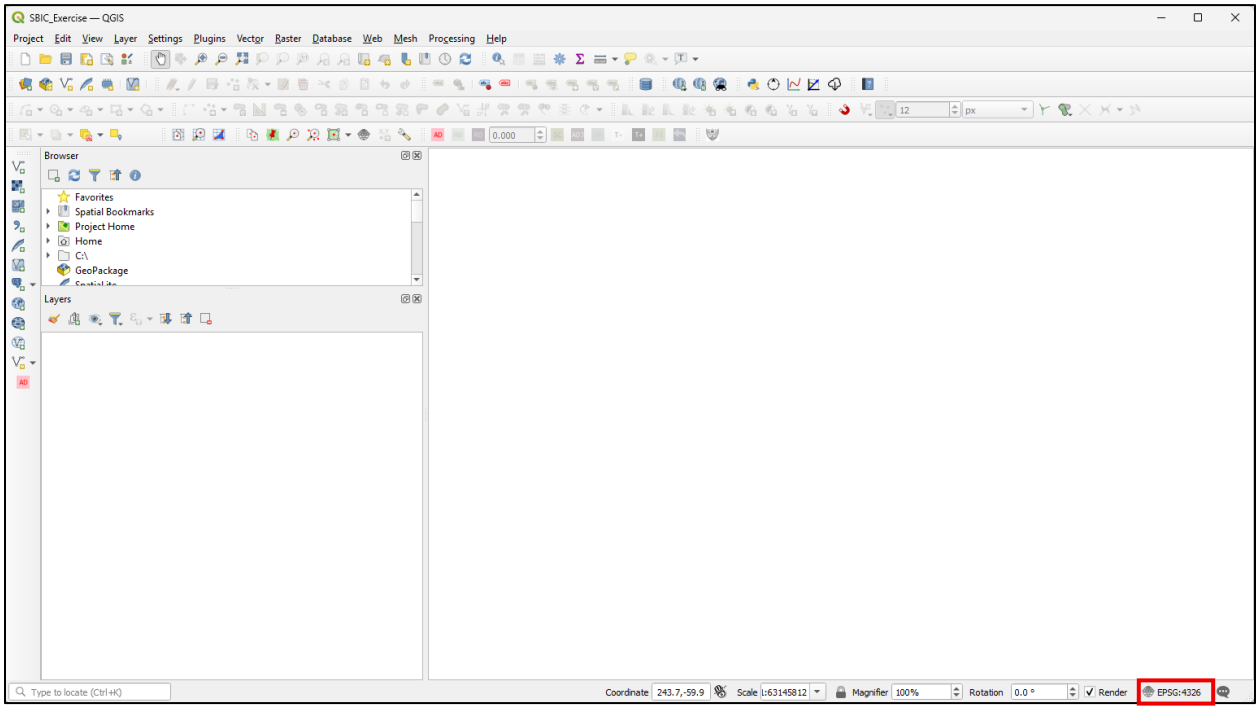
The **XY coordinates** (e.g., Easting/Northing or Longitude/Latitude) are displayed in the status bar and update dynamically as you move the cursor across the Map Canvas. This panel also allows you to view and adjust the **map scale** and set the **map orientation (northing)**.

2.5. Creating File and Setting Coordinate Reference System (CRS)

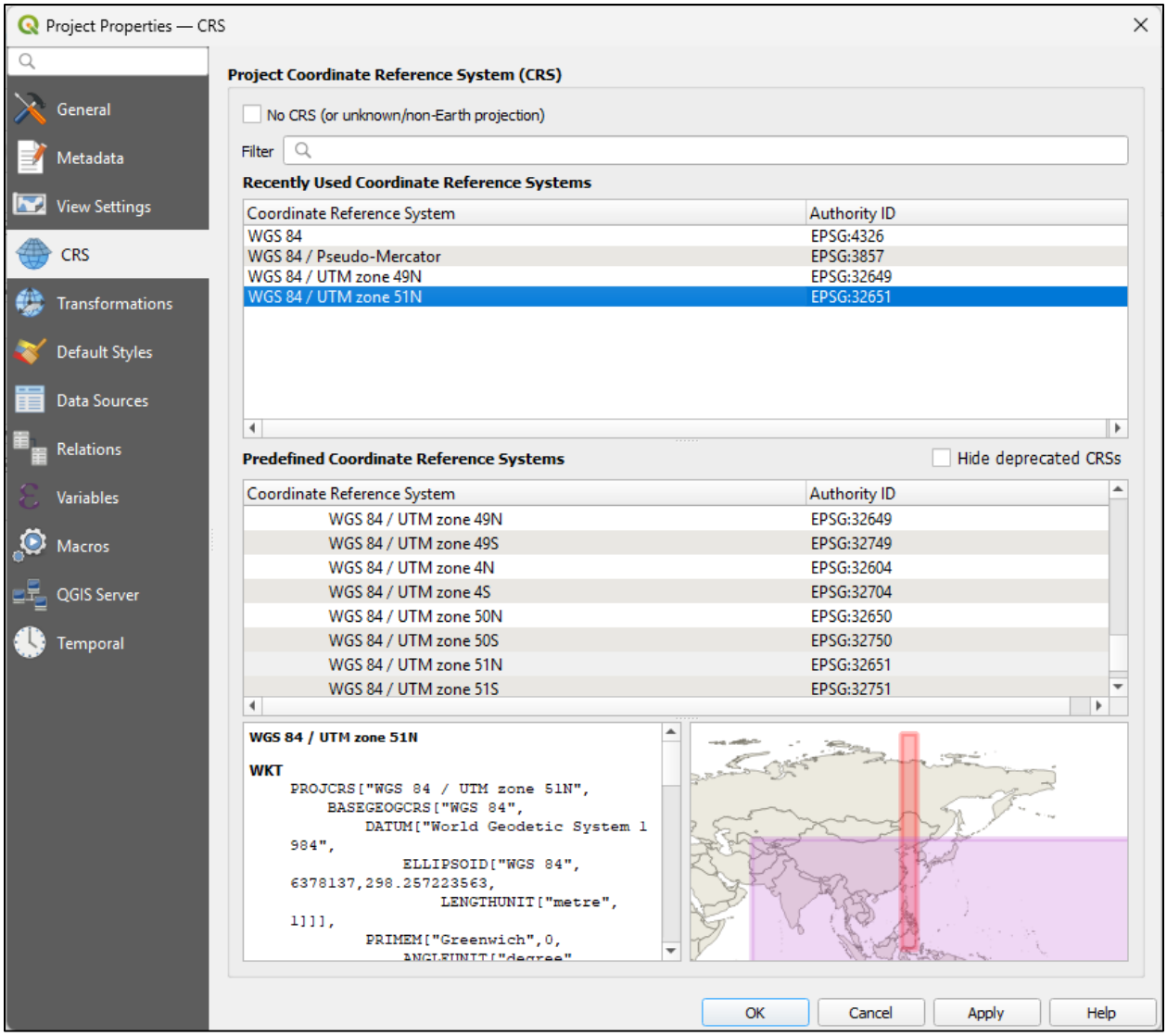
Upon opening QGIS, it will open a new file. To save your current file, click **Project** in the menu bar and select **Save As.** Save your file with your chosen file name and in its designated folder.



Once **Project** is created, set your CRS or Coordinate Reference System. You may do this by clicking the **EPSG** button (EPSG:4326) found on the lower right corner of your QGIS window.



Once clicked a **Project Properties – CRS** window will open. Under **Filter**, search on **WGS 84/ UTM Zone 51N or EPSG:32651.** Then click **Apply** and **OK.**



2.6. Adding Spatial Data

There are two primary types of data models used in Geographic Information Systems (GIS): **Vector data** and **Raster data**.

- **Vector Data** represents geographic features using points, lines, and polygons. It is ideal for discrete features such as roads, boundaries, buildings, or sampling locations. Vector data is highly precise and allows for the storage of both geometry and attribute information, making it suitable for tasks such as mapping infrastructure, analyzing networks, or defining administrative boundaries.
- **Raster Data** represents geographic information as a grid of cells (pixels), where each cell contains a value that corresponds to information such as color, temperature, elevation, or reflectance. Raster data is well-suited for continuous phenomena, such

as satellite imagery, aerial photographs, digital elevation models (DEMs), and land cover classifications. However, because it is grid-based, the precision of raster data depends on its resolution (cell size).

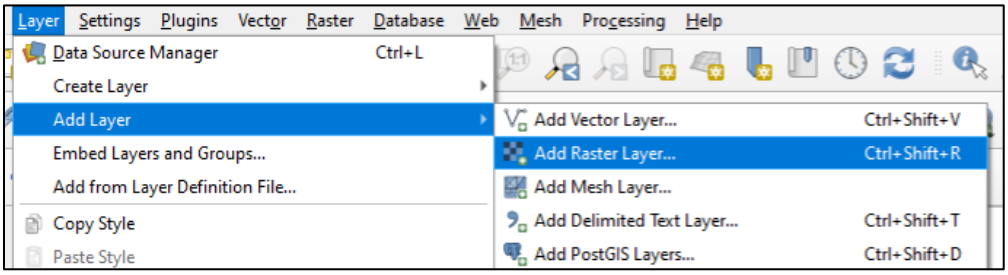
For the purposes of this challenge, we will focus only on **loading raster data** into QGIS and **creating polygon vector data**. Raster datasets are commonly used in remote sensing applications, making them a practical starting point for this exercise.

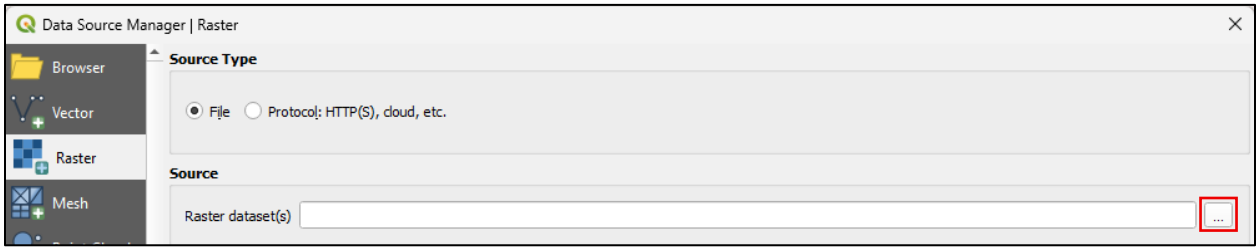
2.6.1 Adding Raster Data

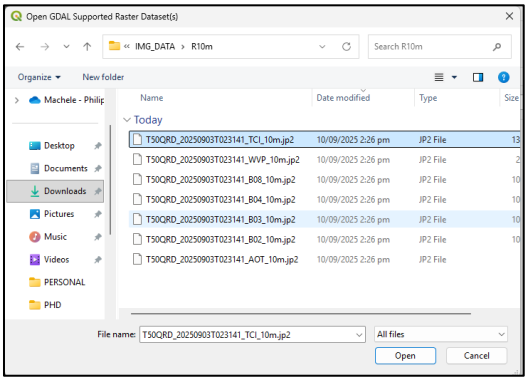
There are several ways to load raster data.

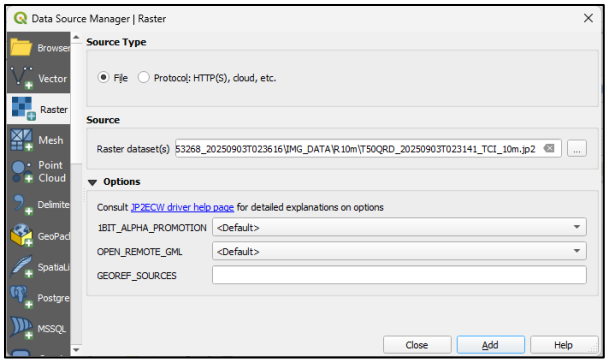
Option 1: Adding a Raster Layer through the Layer Menu Bar

1. In the top menu, go to **Layer > Add Layer > Add Raster Layer…**
2. Navigate to the folder where you saved the downloaded **True Color Image (TCI)** from the previous section.
3. Select the file and click **Add**.

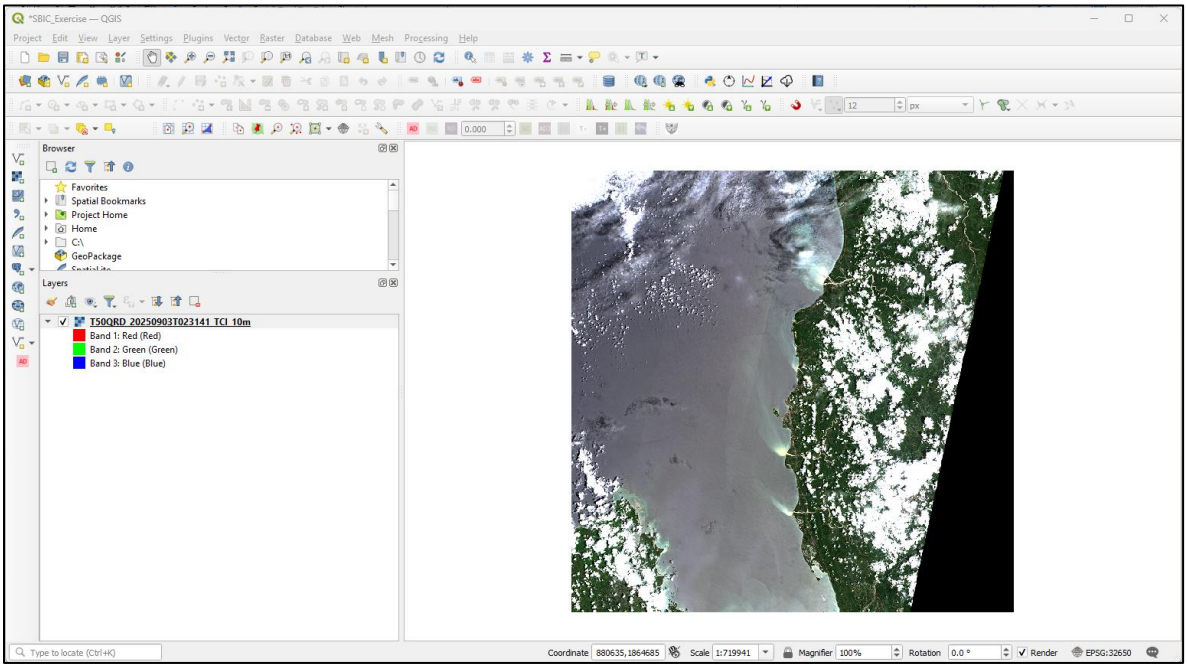






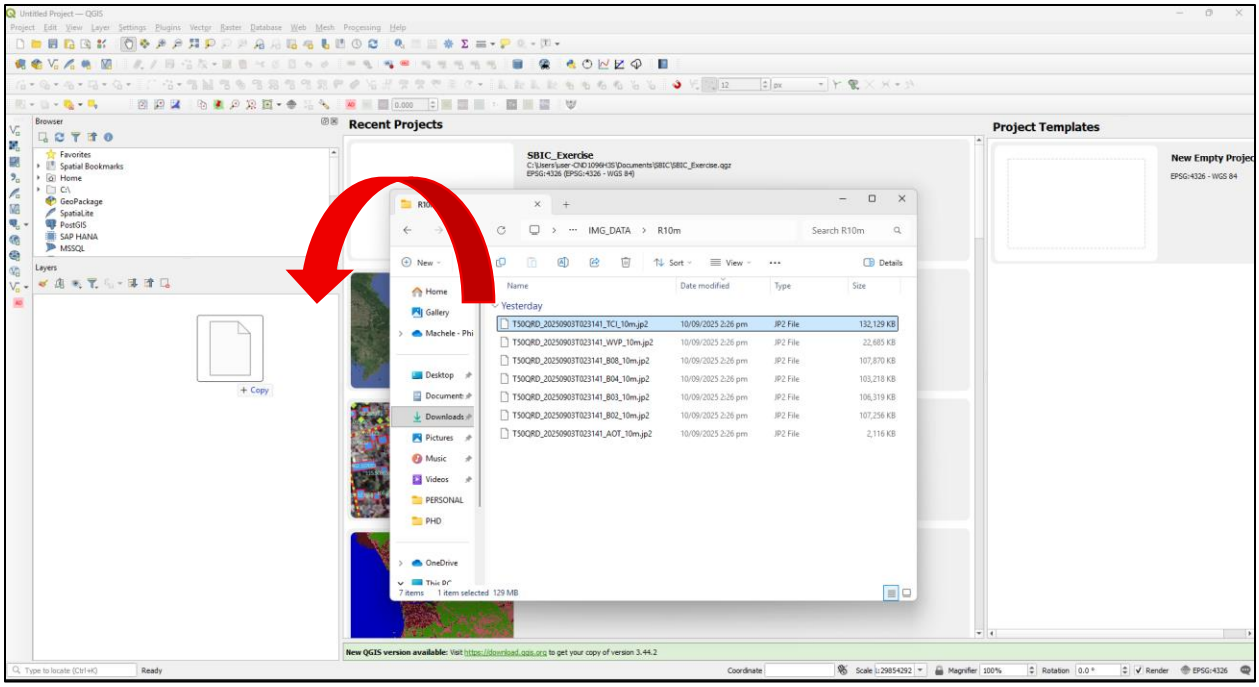


Once added, the raster image will appear in the **Map Canvas**, and its file name will be listed in the **Layers Panel**.

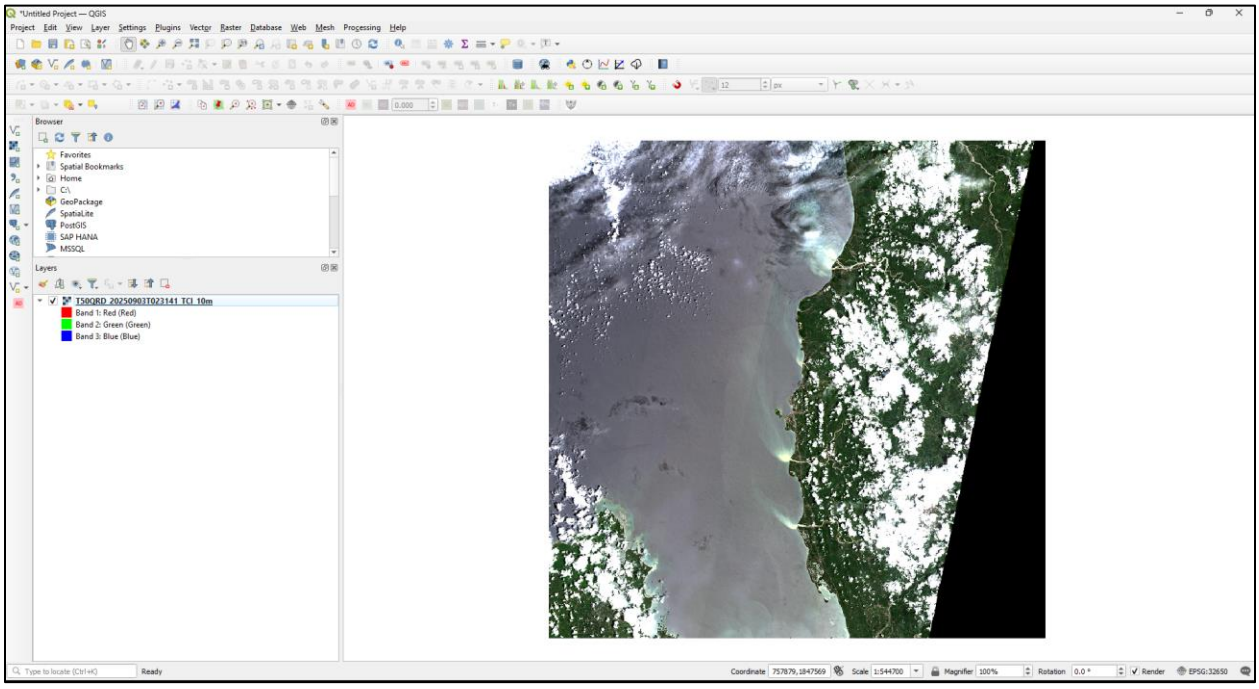


Option 2: Adding a Raster Layer via Drag and Drop

Locate the folder where the image file (e.g., TIFF or JP2 format) was downloaded. Simply drag the image file into the **Layers Panel** of QGIS to load it.



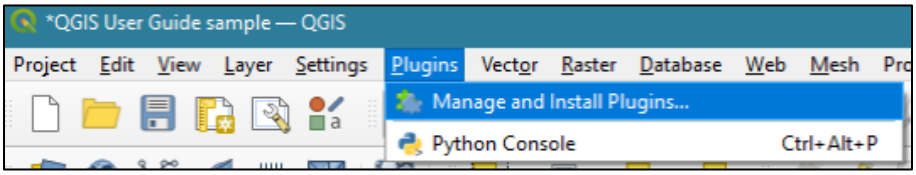
The result of this process will be similar with the first option.



2.7. Adding a Basemap

Basemaps provide a reference layer for overlaying and visualizing your spatial data, giving context to its location. Common examples include web maps (e.g., Google Maps, OpenStreetMap) and satellite imagery (e.g., Landsat, Google Satellite).

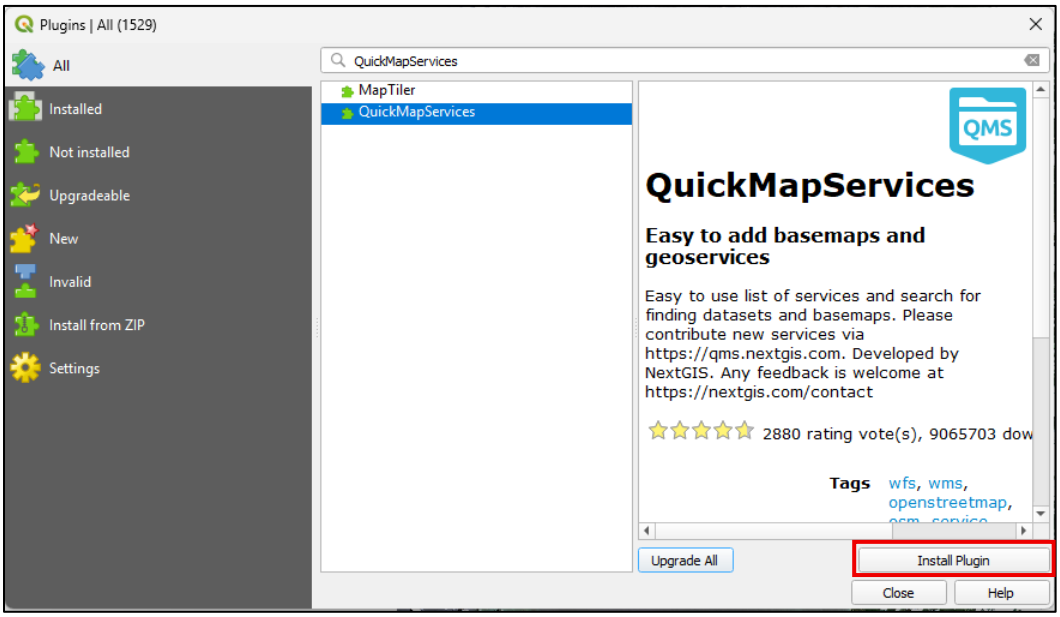
To add a basemap in QGIS, install the **QuickMapServices** plugin by navigating to **Menu Bar** → **Plugins** → **Manage and Install Plugins…**. This will open the Plugins window.



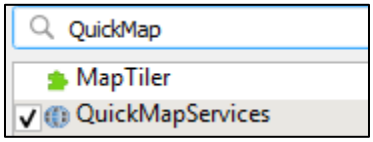
Option 1: Install via Search Bar

Note: An active internet connection is required for this.

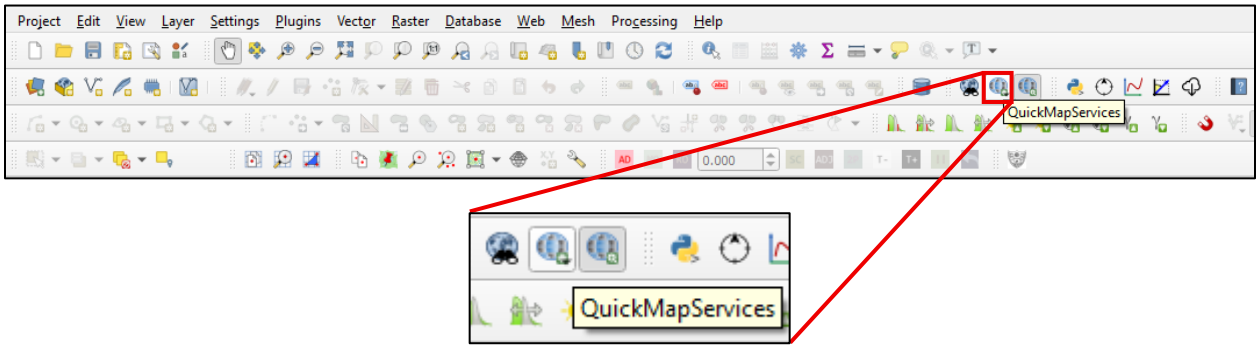
1. In the Plugins window, type **QuickMapServices** in the search bar.
2. From the list of available plugins, select **QuickMapServices**.
3. Click **Install Plugin** to automatically add it to QGIS.



4. Once installed, make sure that the said QuickMapServices is checked.



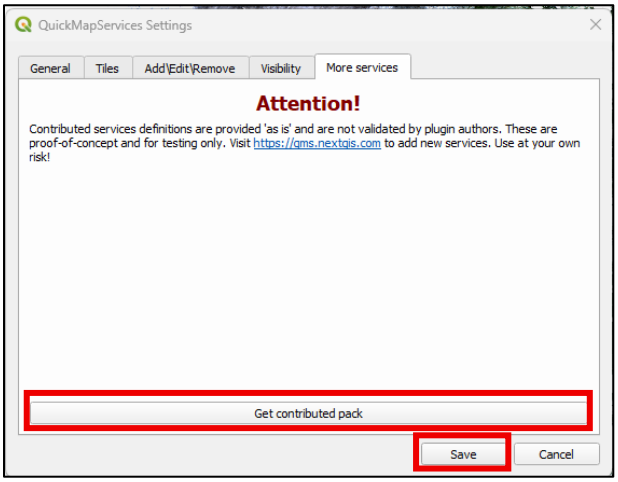
5. Once installation is complete, you may close the Plugins window. The QuickMapServices should appear in the Toolbars.



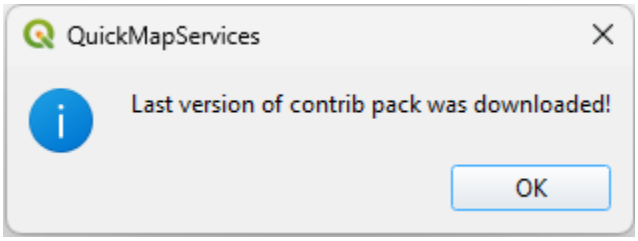
By default, **QuickMapServices** provides only a limited set of basemaps. To access a wider selection:

1. Open **QuickMapServices** and go to **Settings**.
2. In the **More Services** tab, click **Get Contributed Pack**.
3. Click **Save** to apply the changes.

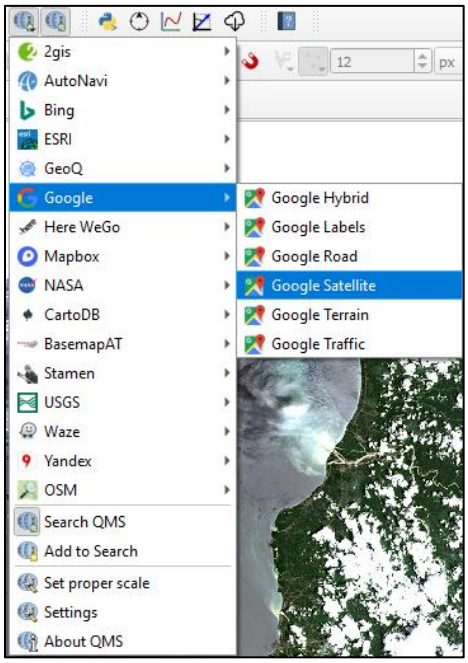
This will add many additional basemap options for use in QGIS.



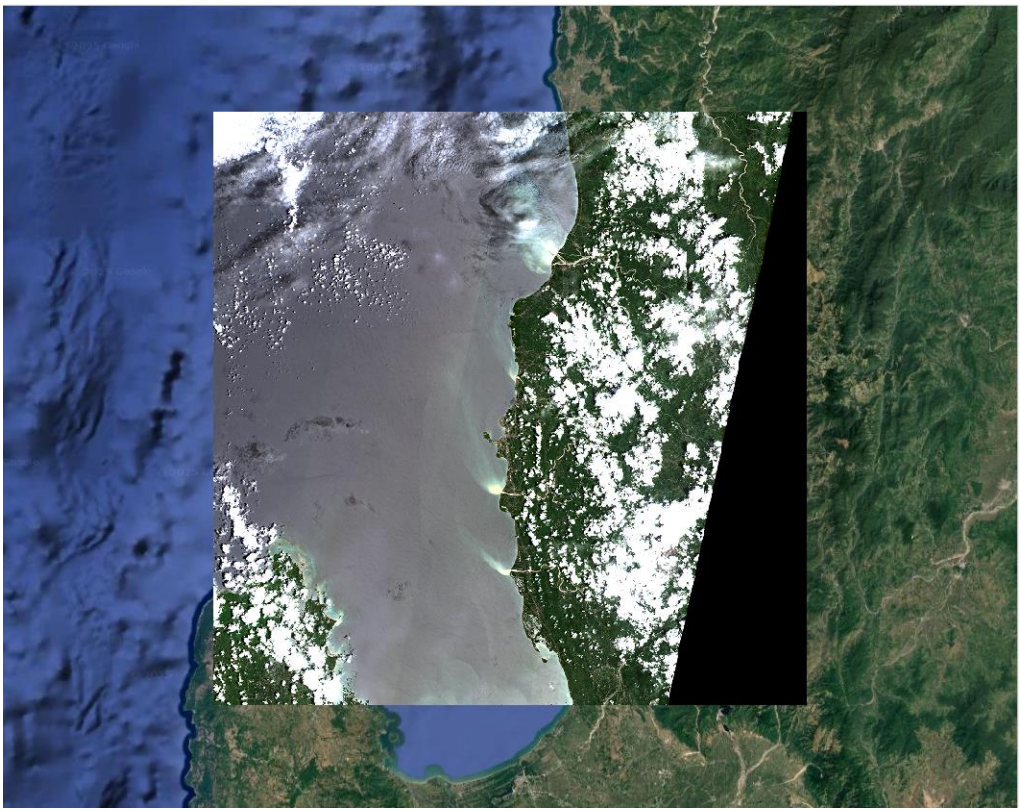
Once the contributed pack is downloaded, a pop-up message will confirm it.



To add a basemap, click the icon on QuickMapServices and select your preferred basemap.



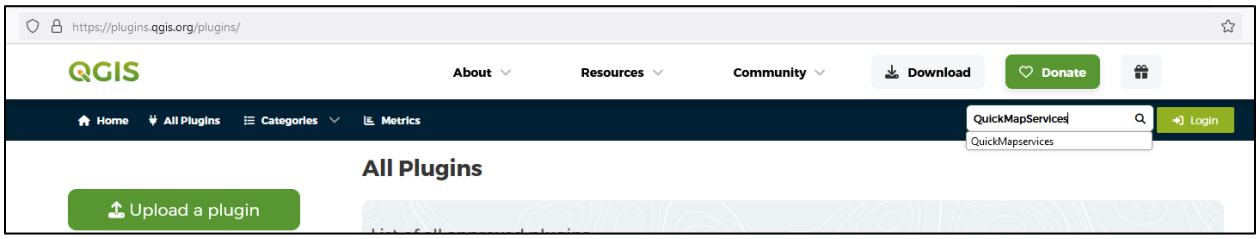
This will display the selected basemap in the map canvas as a background.



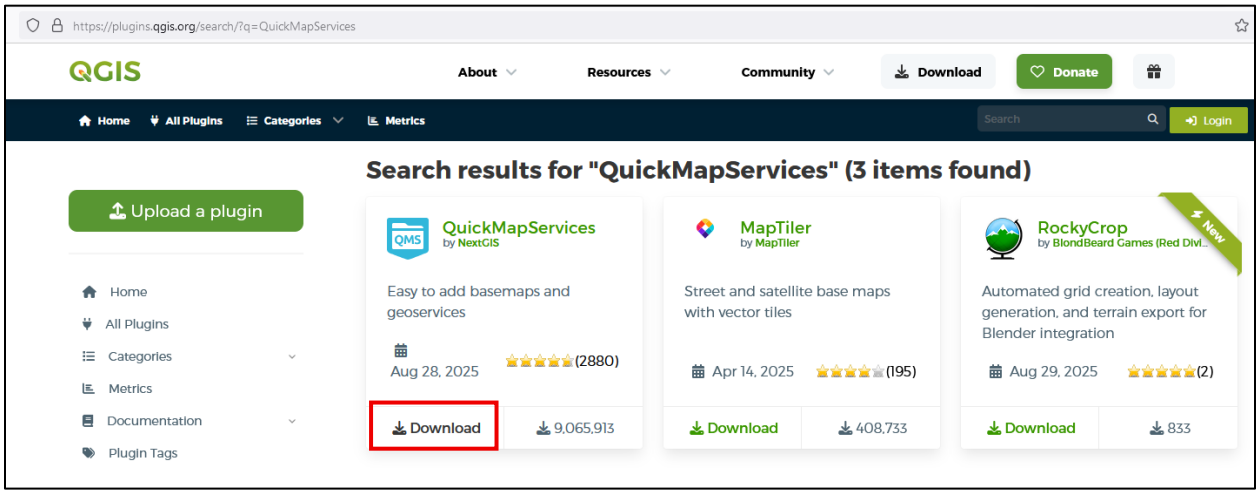
Option 2: Install from ZIP File

This method is useful when internet access is limited. You can download the plugin file in advance and install it offline.

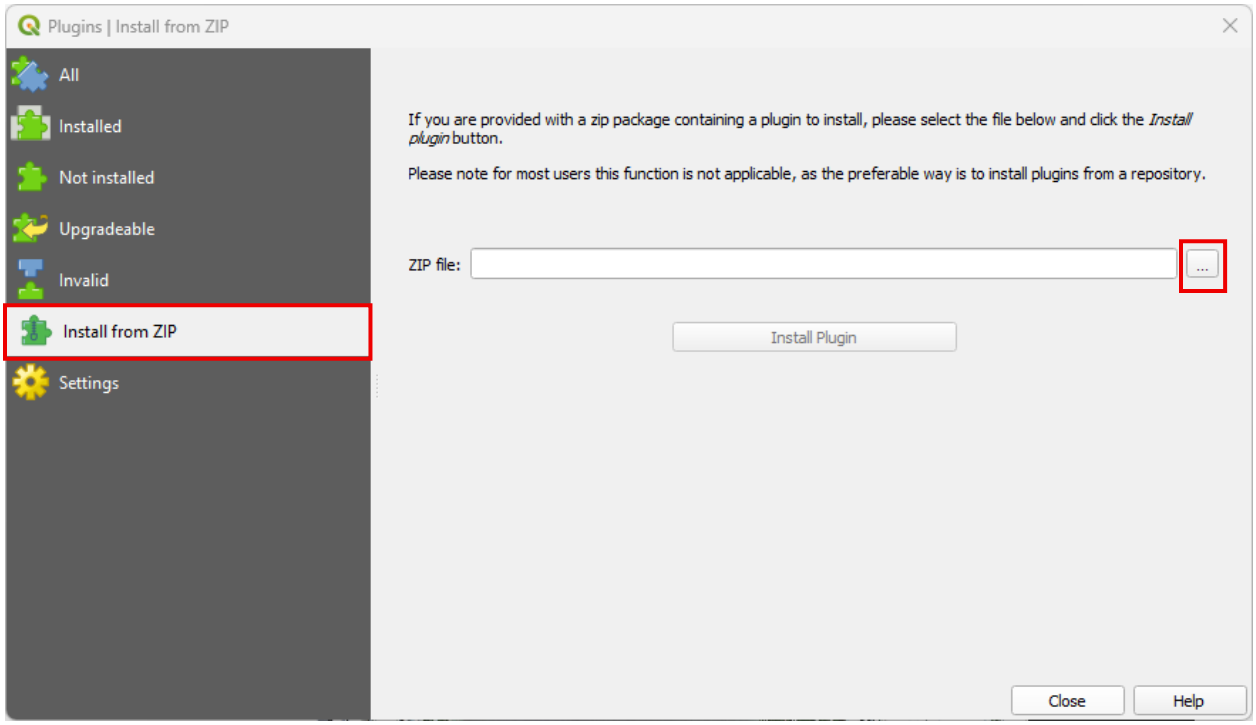
1. **Visit the QGIS Plugins Repository: https://plugins.qgis.org/plugins/**
2. In the search bar, type **QuickMapServices** and press **Enter**.

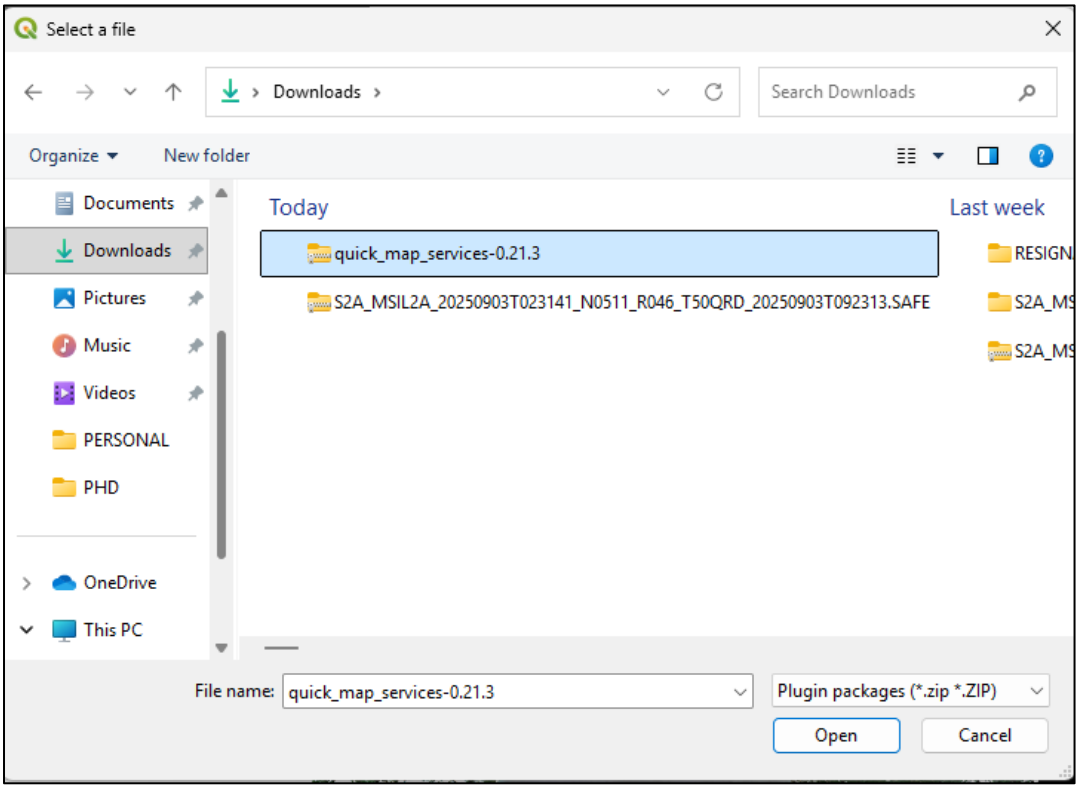


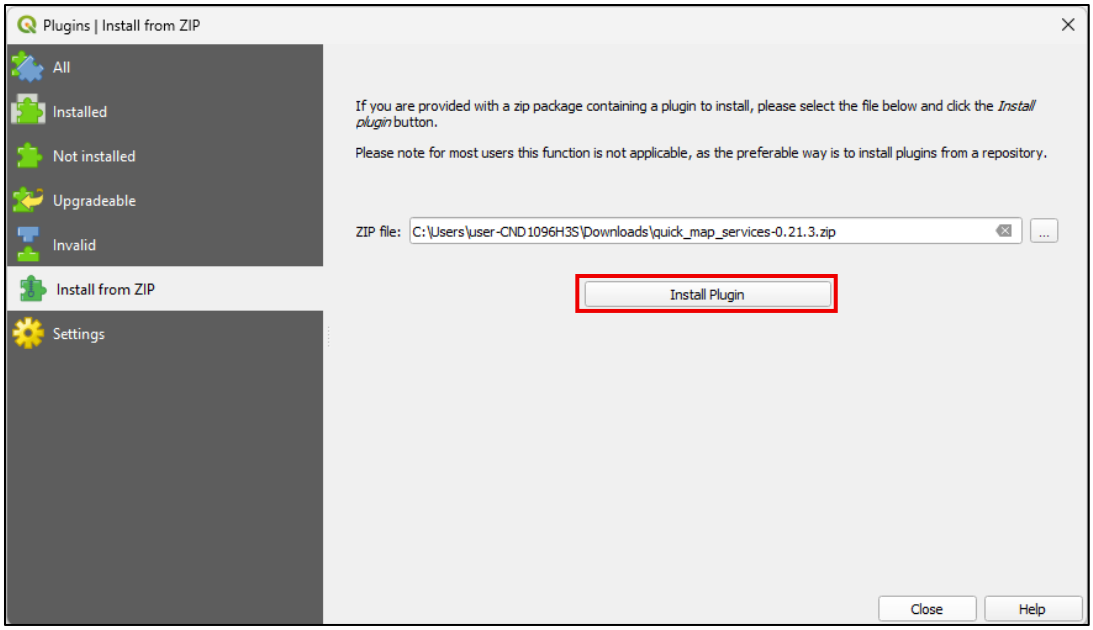
3. From the results, select **QuickMapServices** and click **Download** to obtain the ZIP file.



4. Return to the **Plugins** dialog in QGIS and select **Install from ZIP**.
5. Browse to the folder where you saved the downloaded plugin ZIP file, select it, and click **Install Plugin**.







2.8. Creating a new shapefile

A **Shapefile** is one of the most common formats for storing vector data such as points, lines (polylines), and polygons. Despite its name, a shapefile is not a single file but a collection of related files that work together to represent geographic features and their attributes.

The key files that make up a shapefile are:

- **.shp** – Stores the geometry of the features (points, lines, or polygons). *(Mandatory)*
- **.shx** – Contains the index of the feature geometry, allowing for quick access. *(Mandatory)*
- **.dbf** – Holds attribute data in tabular format, linked to each feature. *(Mandatory)*
- **.prj** – Defines the coordinate system and projection information of the dataset. *(Optional but highly recommended)*
- **.cpg** – Specifies the character encoding used for the attribute table (.dbf). *(Optional)*
- **.sbn / .sbx** – Spatial index files that improve drawing speed and query performance. *(Optional)*

- **.xml** – Metadata file that provides descriptive information about the dataset. *(Optional)*

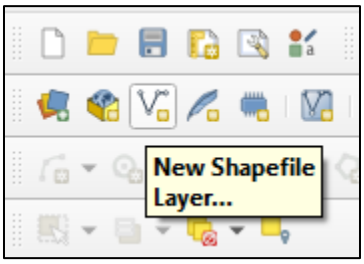
Mandatory files: .shp, .shx, and .dbf must always be present together for the shapefile to function properly.

Optional files: .prj, .cpg, .sbn, .sbx, and .xml enhance usability, performance, and interoperability but are not strictly required.

For this challenge we will be creating a polygon shapefile

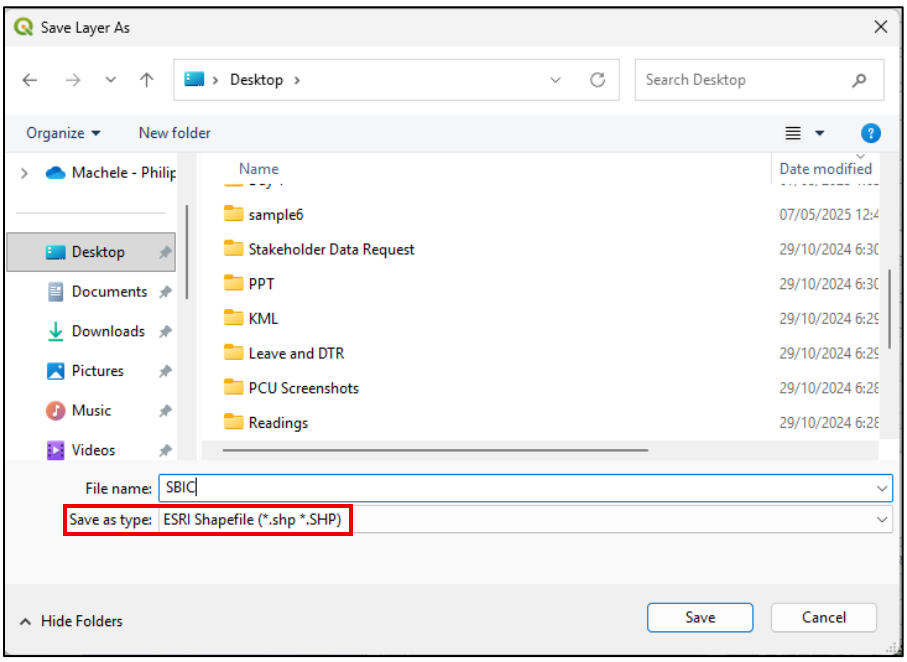
2.8.1. Creating a new polygon shapefile

1. In the toolbar, click **New Shapefile Layer…**



2. In the **New Shapefile Layer** dialog, set the following:

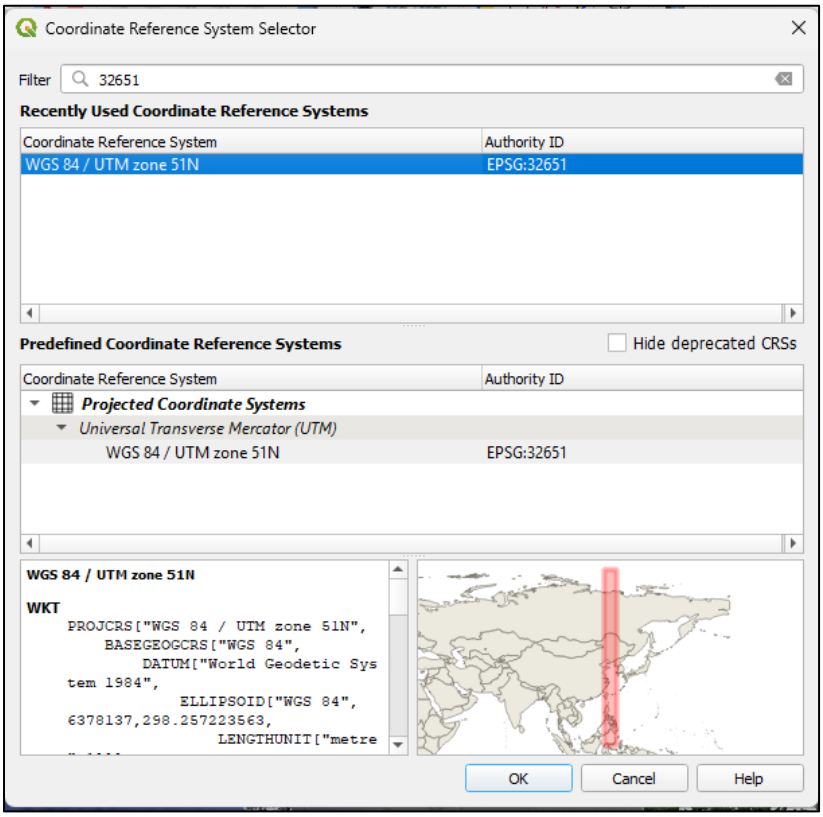
- **Filename**: Navigate to the folder where you want to save the shapefile, provide a name, and click **Save**. Make sure that the file will be saved as **ESRI Shapefile**.

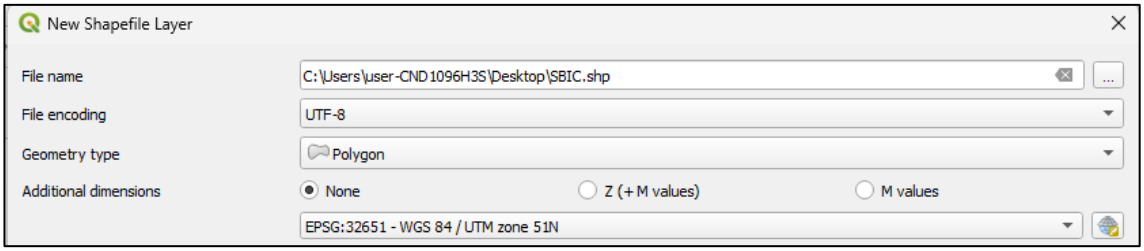


- **Geometry Type**: Select **Polygon**.

- **Coordinate Reference System (CRS)**: Ensure the CRS matches that of your image. Since we previously used **EPSG:32651 (UTM Zone 51N)** for the downloaded raster, the polygon shapefile must use the **same CRS** for proper alignment.

3. To set the CRS, click the **CRS icon**  . This opens the **Coordinate Reference System Selector** dialog.
4. In the filter box, type **32651**, select the correct CRS, and click **OK**.





Optional: Adding Attributes to a Shapefile

When creating a shapefile, you can also add **attributes**—additional information linked to each feature (polygon, line, or point). Attributes are stored in a table format, where each **field** represents a specific type of information you want to record.

A **field** is essentially a column in the attribute table that stores values for each feature. For example, if you are mapping land parcels, you may want to store details such as parcel name, size, owner, or cost.
If you already know what kind of information should be included in your shapefile, you can create these fields in advance. Later, you can populate them with data once the shapefile is in use.
Common examples of information and their corresponding data types include:

Information to Include	Data Type	Description
Name	Text (String)	For descriptive labels (e.g., Barangay Name, Project Name).
Address	Text (String)	For longer text entries such as street or site address.
Amount	Integer / Decimal	For numeric values such as cost, budget, or quantity.
Size	Integer / Decimal	For measurements such as area, length, or volume.
Date	Date	For storing dates (e.g., survey date, acquisition date)

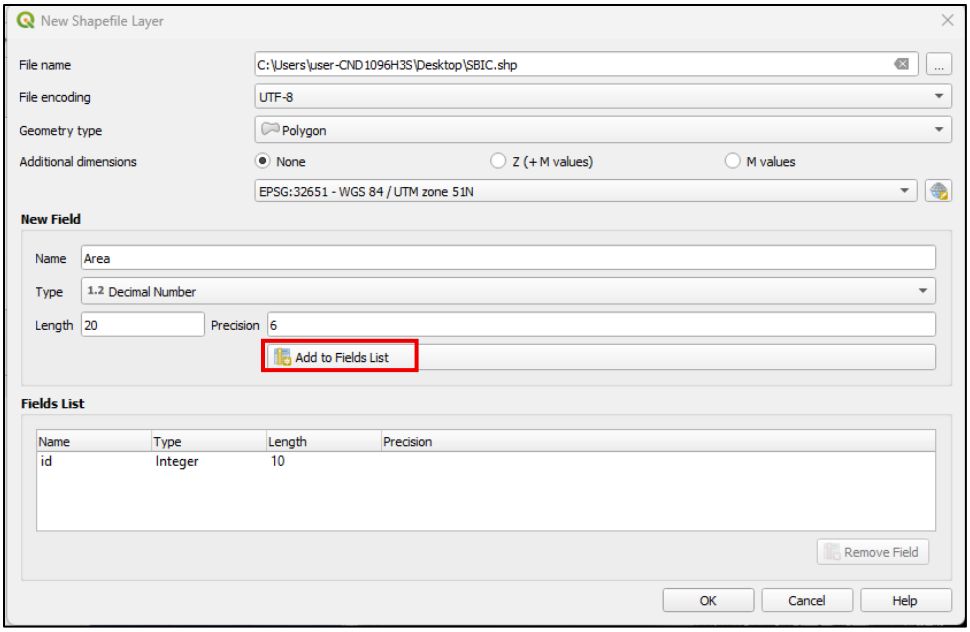
Optional

Adding a New Field

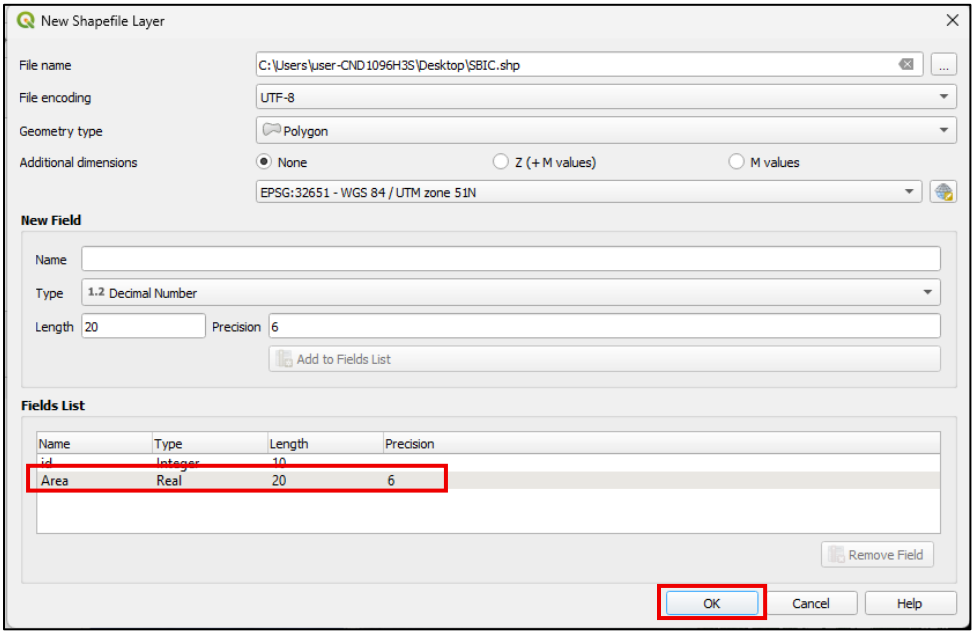
If you would like to include additional information in your shapefile, you can define it through the **New Field** parameters. For this exercise, let us add a new field with the following settings:

- **Name:** Area
- **Type:** Decimal Number

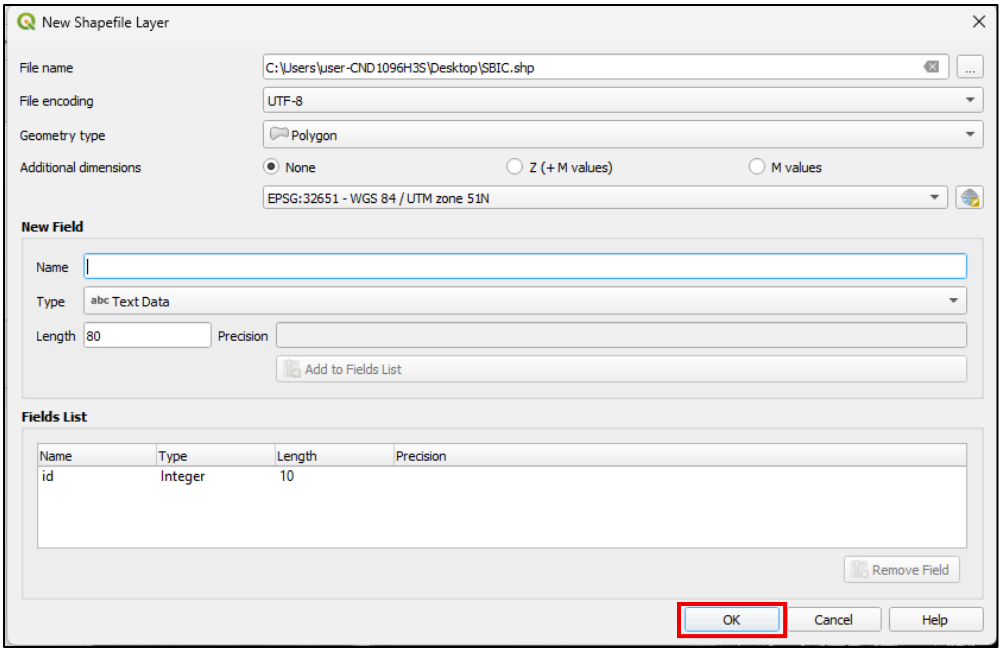
After entering the details, click **Add to Field List**.



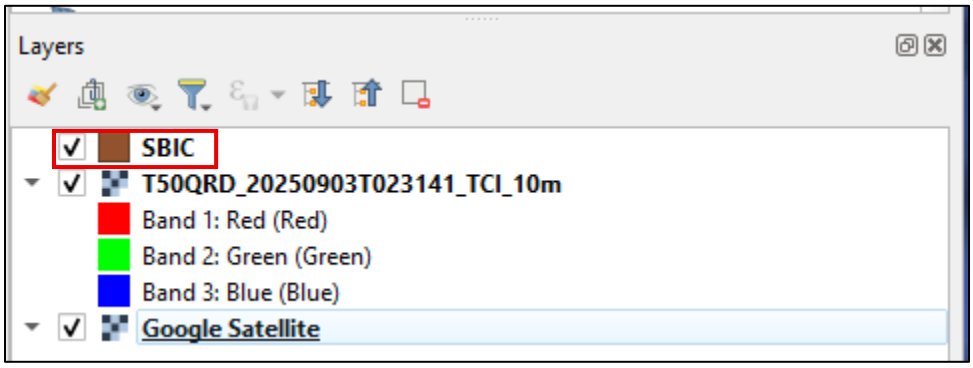
Once added, the field name will be displayed in the Field List.
Then click **OK** to confirm.



If you do not wish to add a new field at this stage, simply leave the **New Field** parameters blank and click **OK** to proceed.



Once the shapefile is created, its' name will appear in the Layers Panel.



2.9. Digitizing Specific Features

2.9.1. Navigating and Activating Editing Mode

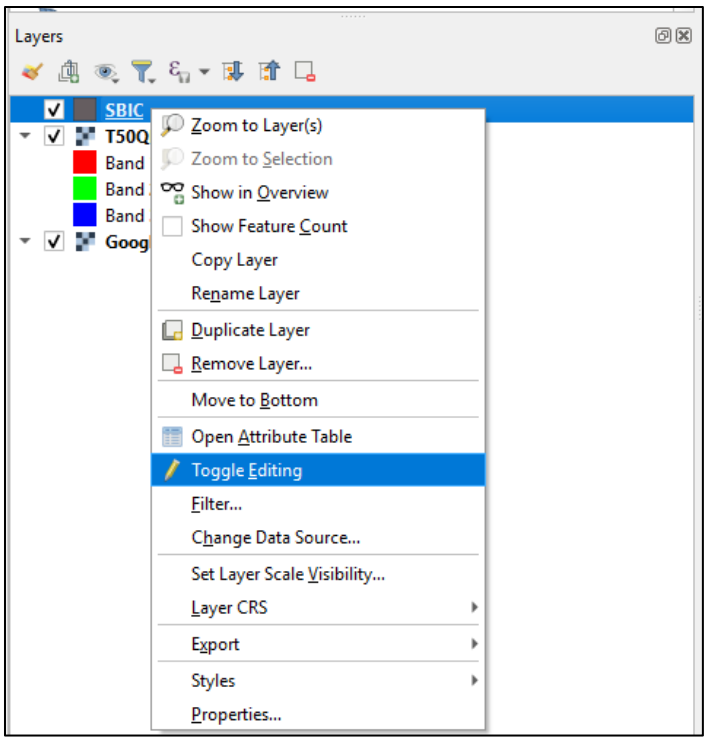
1. Use your mouse's scroll wheel or left-click and drag to zoom in or pan to your area of interest.

   Mouse's scroll wheel → to zoom -in or zoom -out

   Left click and drag → to pan

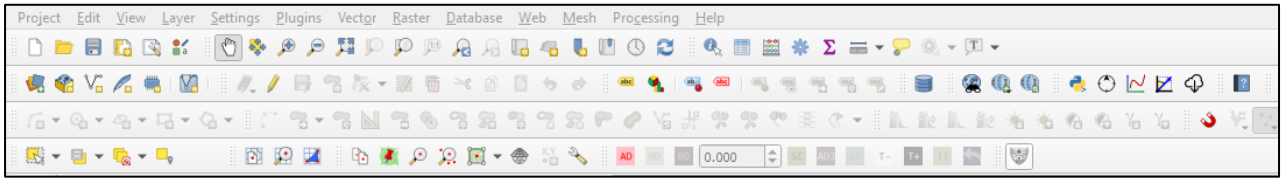
2. Once you have reached the desired zoom level, go to the Layers panel, left-click on the name of your created shapefile, and select Toggle Editing.

- This action will enable editing mode and activate the related functions/icons in the toolbar.

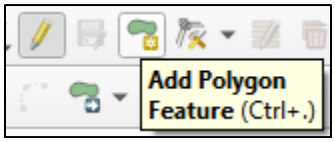


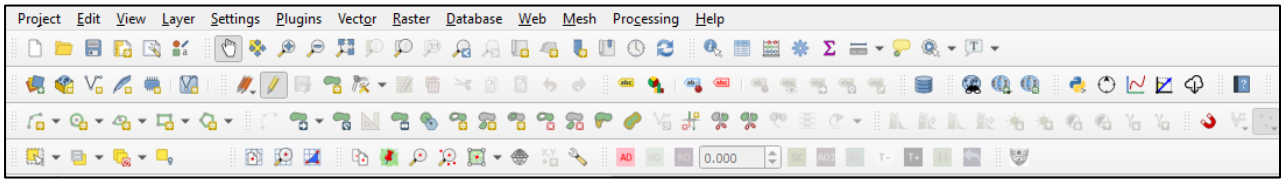
Toolbar View:

- *Before activating editing mode*: The toolbar shows limited options.



- *After activating editing mode*: The Toggle Editing button (pencil icon) becomes highlighted, and the Add Polygon Feature icon is also enabled. Other editing functions are also enabled

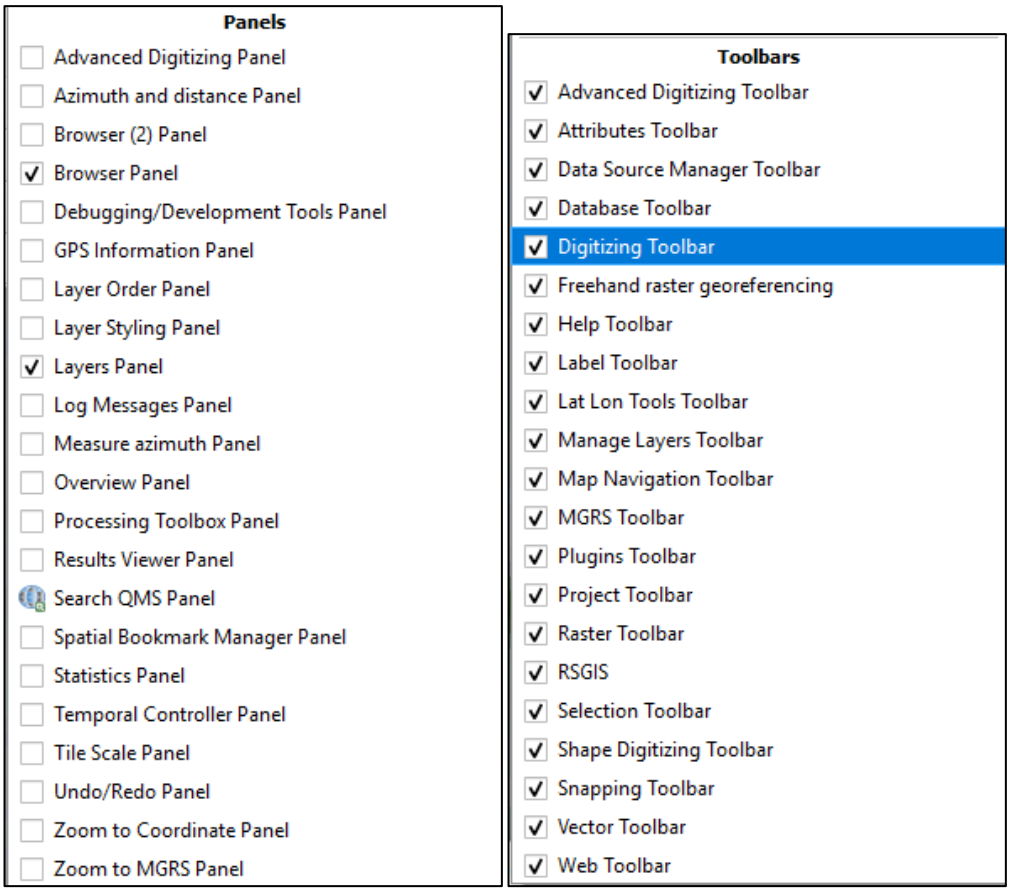




Note:

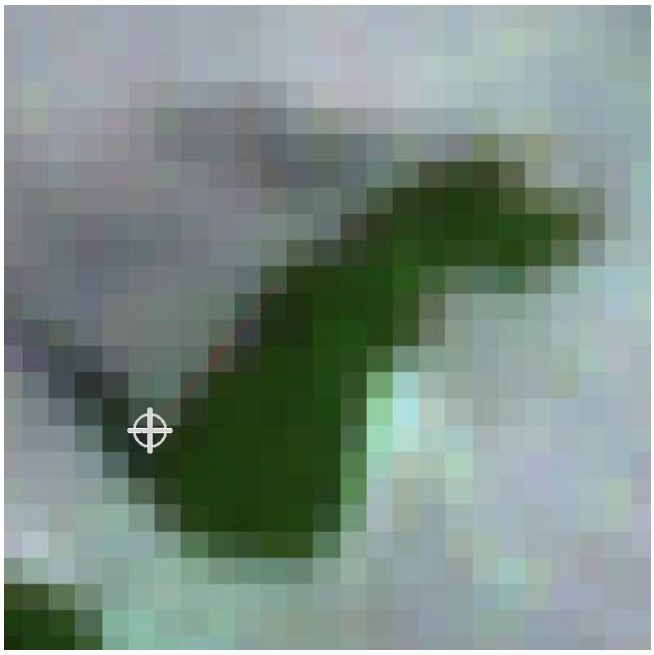
If the Add Polygon Feature icon is not visible, the corresponding toolbar may not be activated. To enable it:

- Right-click on a blank space in the toolbar area.
- From the list, check Digitizing Toolbar to make it visible.

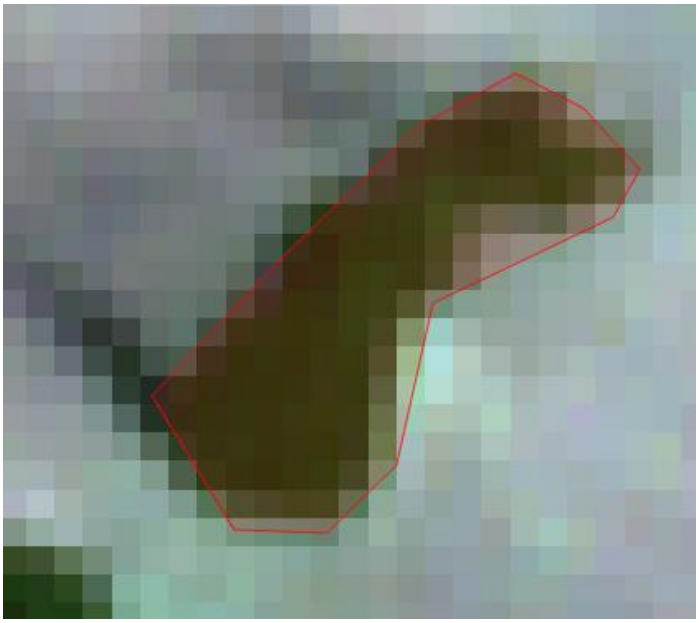


2.9.2. Adding a Polygon Feature

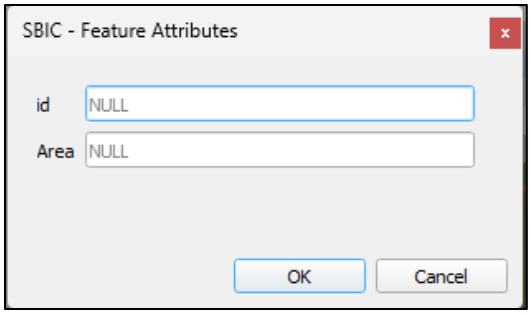
1. Click the Add Polygon Feature icon  .
2. In the Map Canvas, trace the corners of the island or area of interest:
    - Left-click on each corner to plot the vertices. A crosshair will appear as your cursor.



- Right-click to complete the polygon.



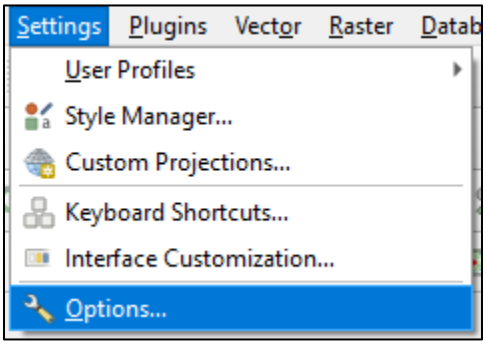
3. Once finished, a pop-up dialog box will appear showing the attribute table for the new feature. This box prompts you to enter information about the polygon.
    - For now, simply click OK without entering any data.



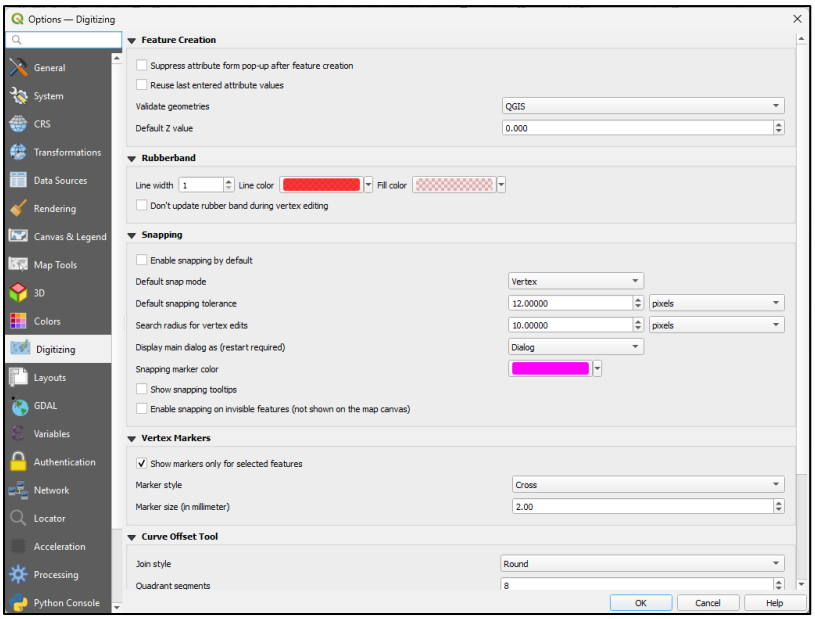
Optional: Suppressing the Attribute Pop-up

If you prefer not to see the attribute dialog box every time you create a feature, you can disable it:

- On the Menu Bar, go to Settings > Options…

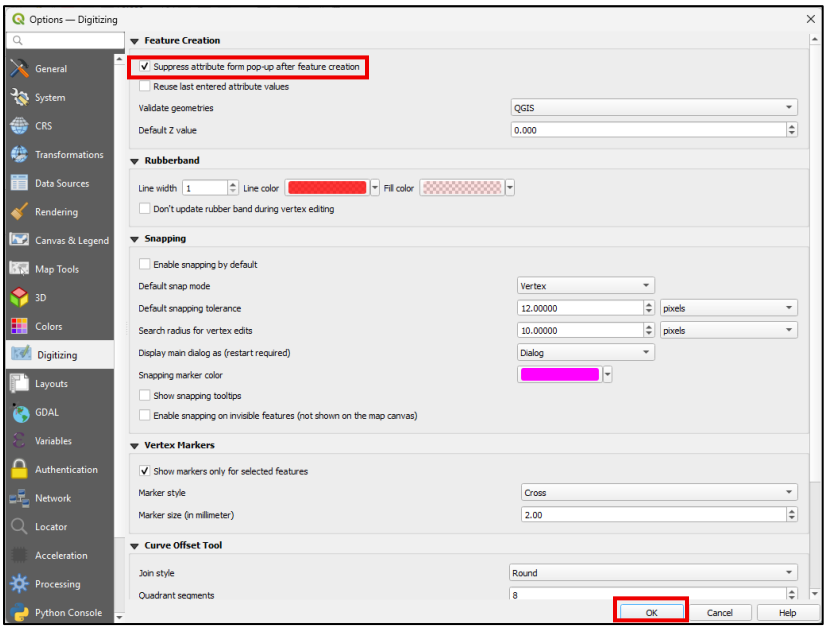


- In the Options window, select the Digitizing tab.



- Under Feature Creation, check the box for **Suppress attribute from pop-up after feature creation**.

- Click OK to save the changes.

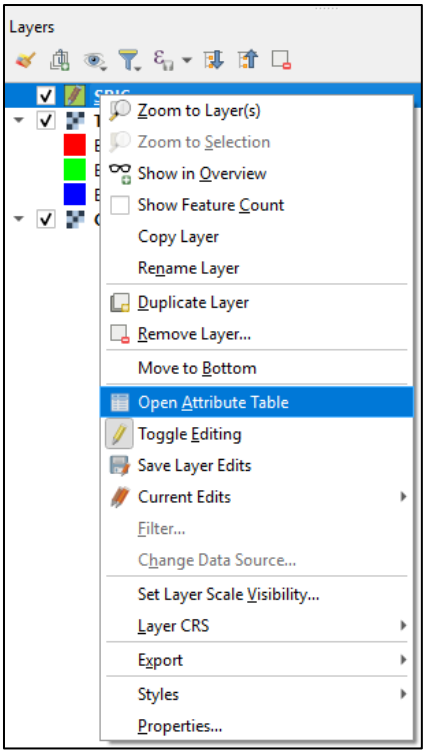


Note: If you wish to digitize additional features, simply repeat the steps for adding a polygon feature. Otherwise, you may proceed to the next section.

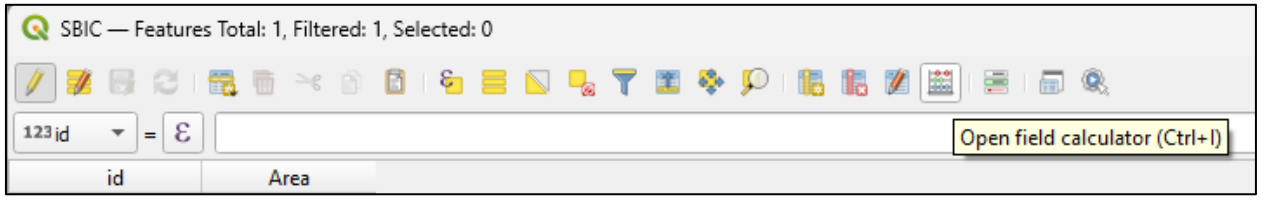
2.9.3. Populating the previously created Field in the Attribute Table

In the earlier steps, we created a field named "Area." We will now calculate and populate its values.

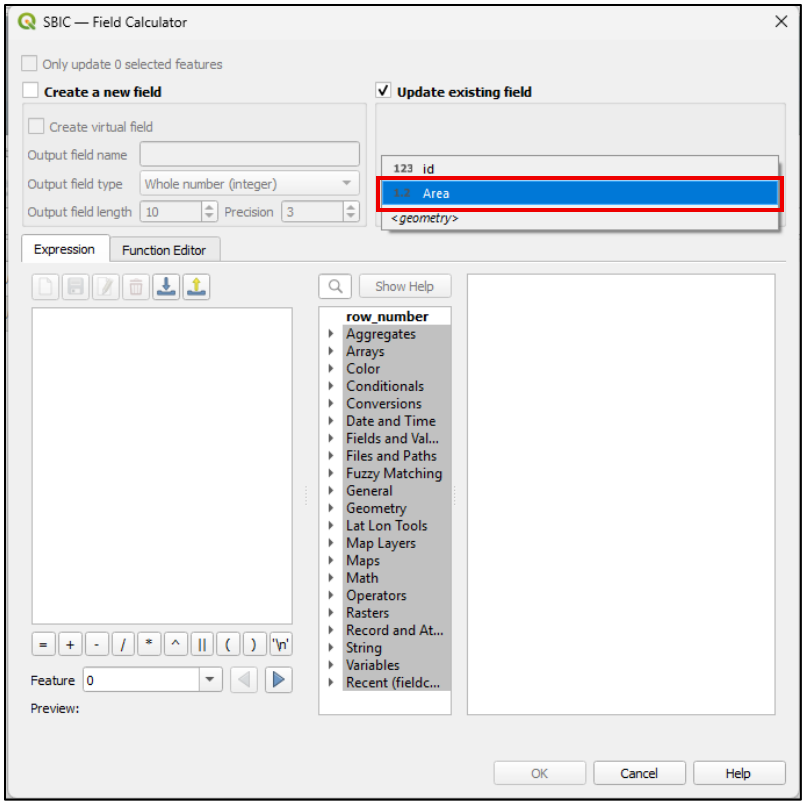
1. In the Layers Panel, right-click on the shapefile name.
    - Ensure that you are still in editing mode. You can confirm this if a pencil icon appears beside the shapefile.
2. From the drop-down menu, select Open Attribute Table.



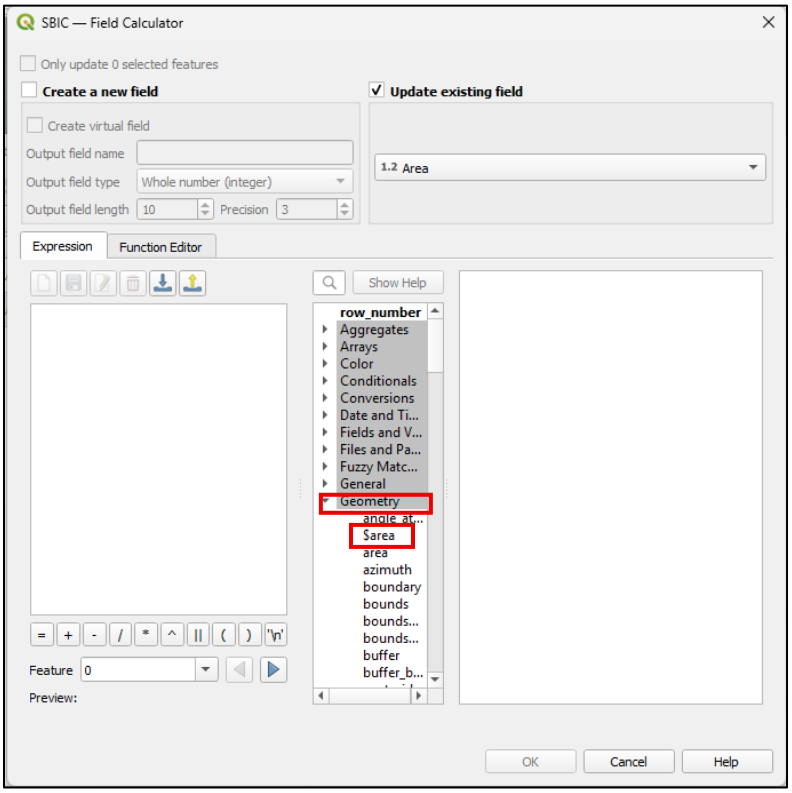
3. In the Attribute Table window:
    - Click the Open Field Calculator icon.



    - In the Field Calculator dialog, check the box Update existing field.
    - From the drop-down menu, select the field created earlier (Area).

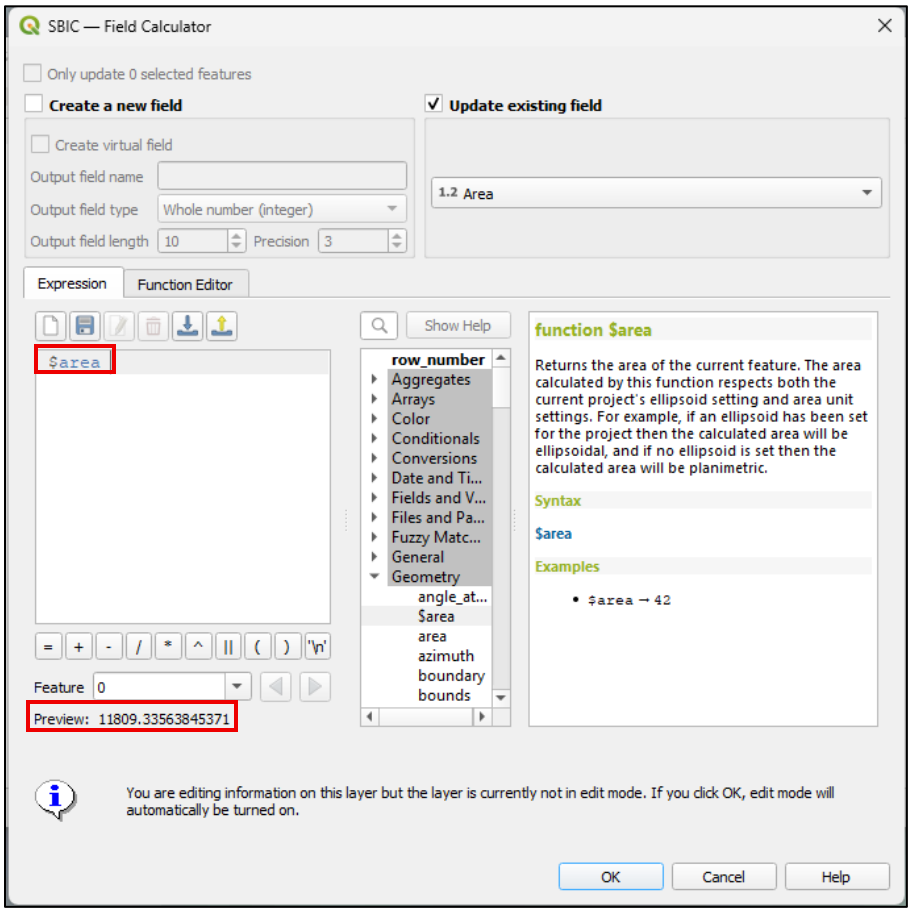


4. In the middle column, click Geometry, then double-click $area.

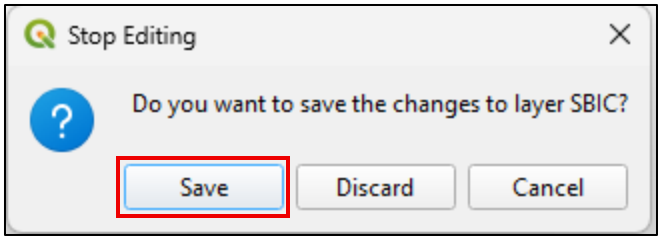


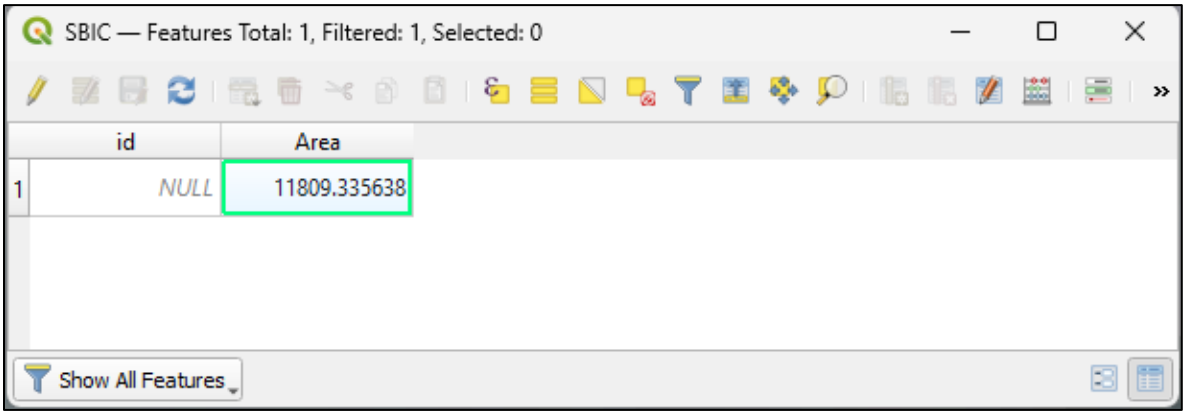
 |

- The **$area** expression will appear in the Expression box.
- If valid, the Preview value at the lower left will display the computed area.
- If invalid, an **error message in red** will appear instead.



5. Once confirmed, click OK.
   - A numerical value representing the computed area of your digitized feature will now appear in the attribute table.
6. To save your edits:
   - Click the Toggle Editing icon (found in either the attribute table or in the toolbar)  .
   - A prompt will ask if you want to save the changes made to the shapefile. Select Save.





2.9.4. Creating and Populating a New Field in the Attribute Table

1. Repeat Steps 1–2 from the previous section to open the Attribute Table of your shapefile.

2. In the Attribute Table, click the Open Field Calculator icon.

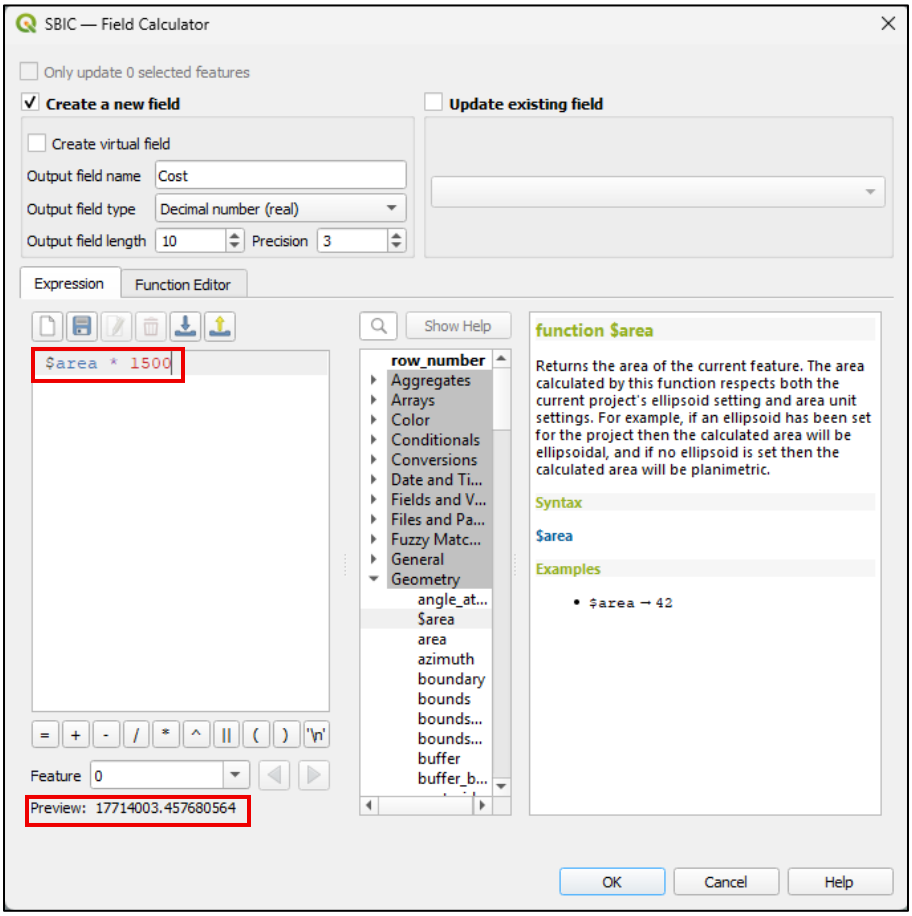
   - On the left side of the Field Calculator, you will see the section for creating a New Field.
   - In the Output field name box, type the name of the new field.
     - For this example, enter **Cost**.
   - Under Output field type, select Decimal Number from the drop-down menu.
   - *(For guidance, see Section 2.8: Optional – Adding Attributes to a Shapefile.)*

3. In the middle column, go to Geometry > $area, then type * 1500 after $area.

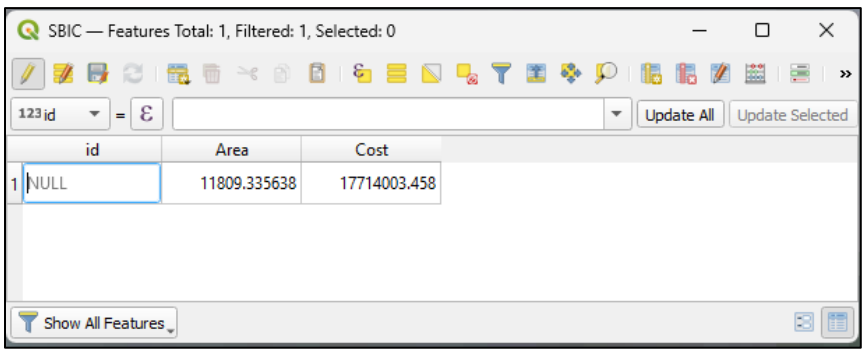
   The complete expression should be:

   $area * 1500

- This will calculate the cost of the land area, assuming a value of **₱1,500 per square meter**.
- The **preview pane** will display a sample computation.



4. Click OK to confirm.
5. A new field named Cost will now appear in the attribute table, containing the computed values.
6. Save your edits by repeating Step 6 from the previous section.



Note: The Field Calculator supports a wide range of expressions for calculations and data manipulation. For a complete list of available functions and their usage, you may refer to the official QGIS Expression Documentation:

👉 QGIS Expression Reference

