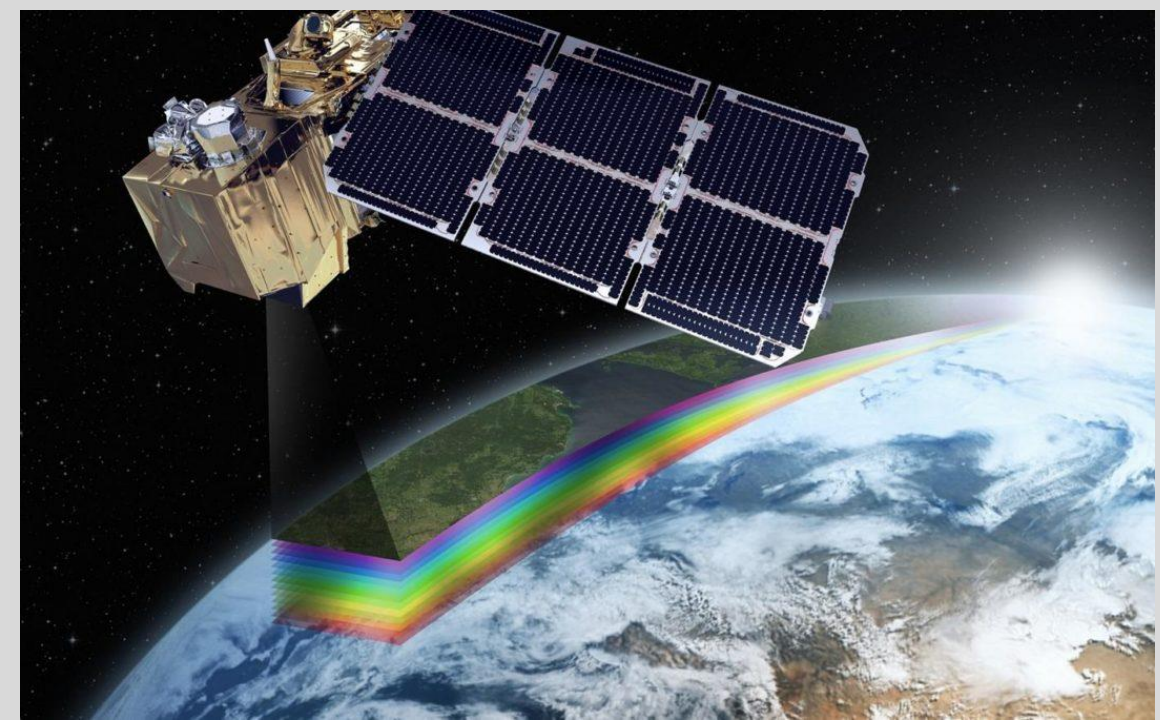


An aerial photograph of a tropical landscape, likely in Southeast Asia, showing a large river system with several tributaries. The river is dark blue, contrasting with the surrounding land. The land is a mix of green (forest) and brown/tan (deforested or agricultural land). There are some small, irregularly shaped green patches scattered throughout the landscape. The overall texture is grainy, typical of satellite imagery.

Introduction to land change

FOR-247 : Methods and Tools in Tropical Forestry

The deforestation crisis has been acknowledged as a threat for decades

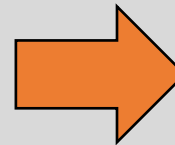


1987

Northern Pará, Brazil



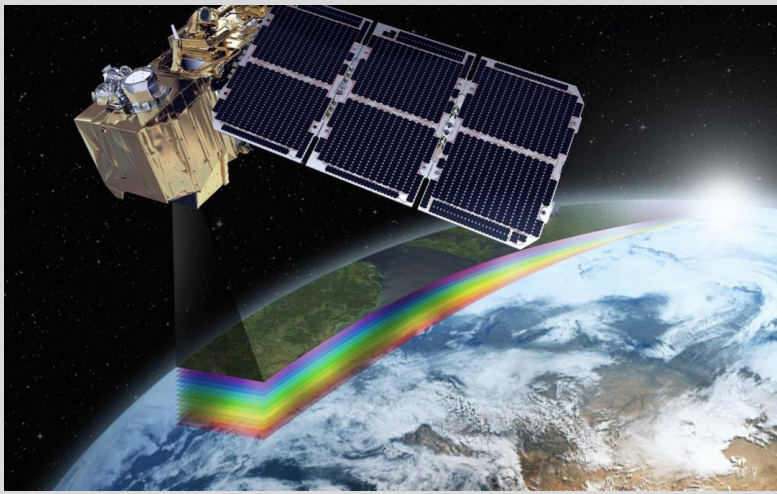
Imagery from space allowed humanity to get a novel perspective of land change and our impact



2020



Imagery over time revealed the extent and rate of landscape change

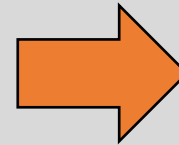
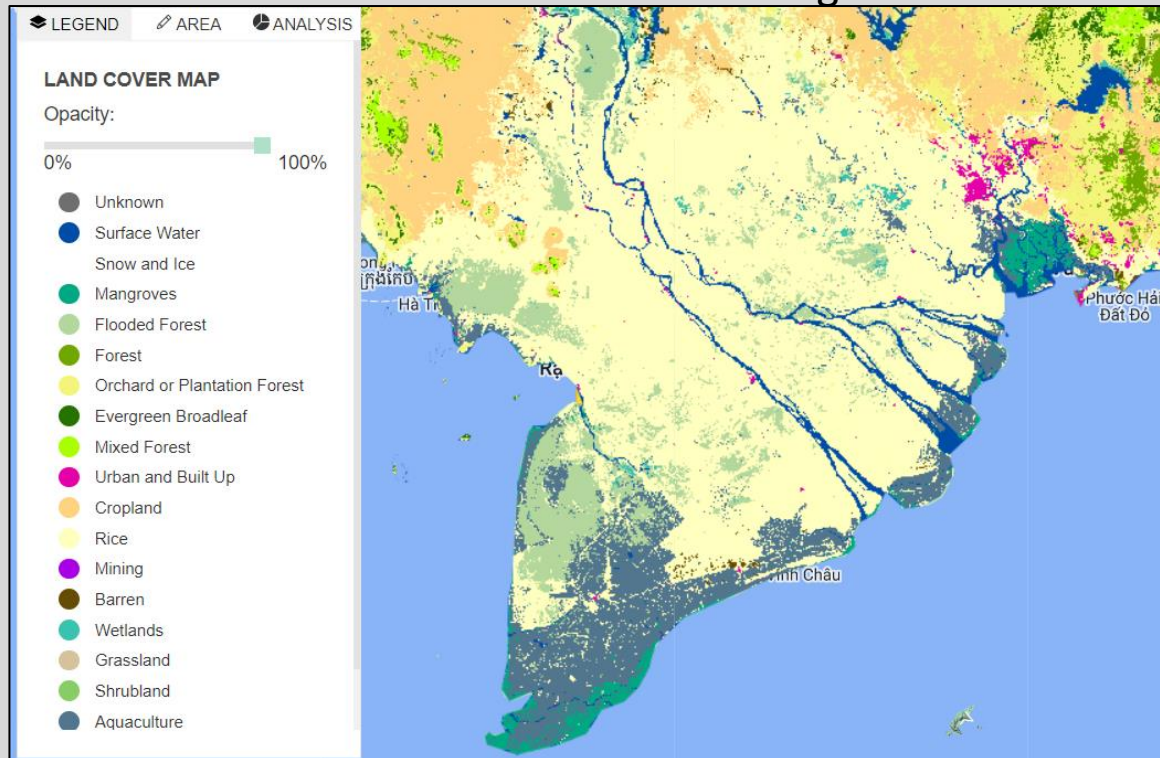


With improved sensors and increased computational power, satellite imagery could be used to create land cover maps through a process called **classification**.

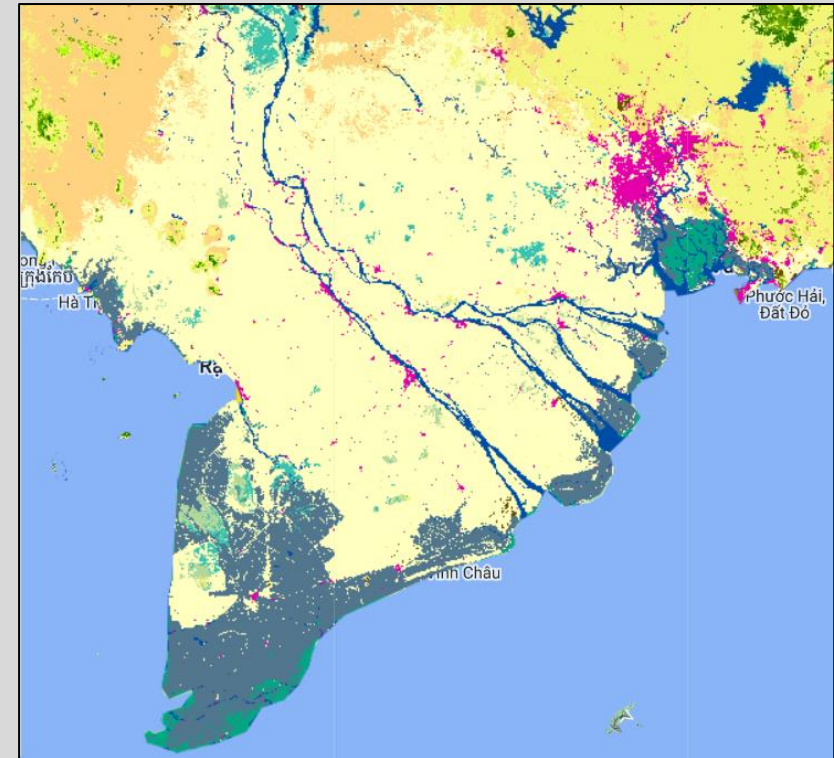
When land cover maps are created in sequence, the process of **land cover change** is revealed.

We can perform analyses to **quantify** different aspects of change.

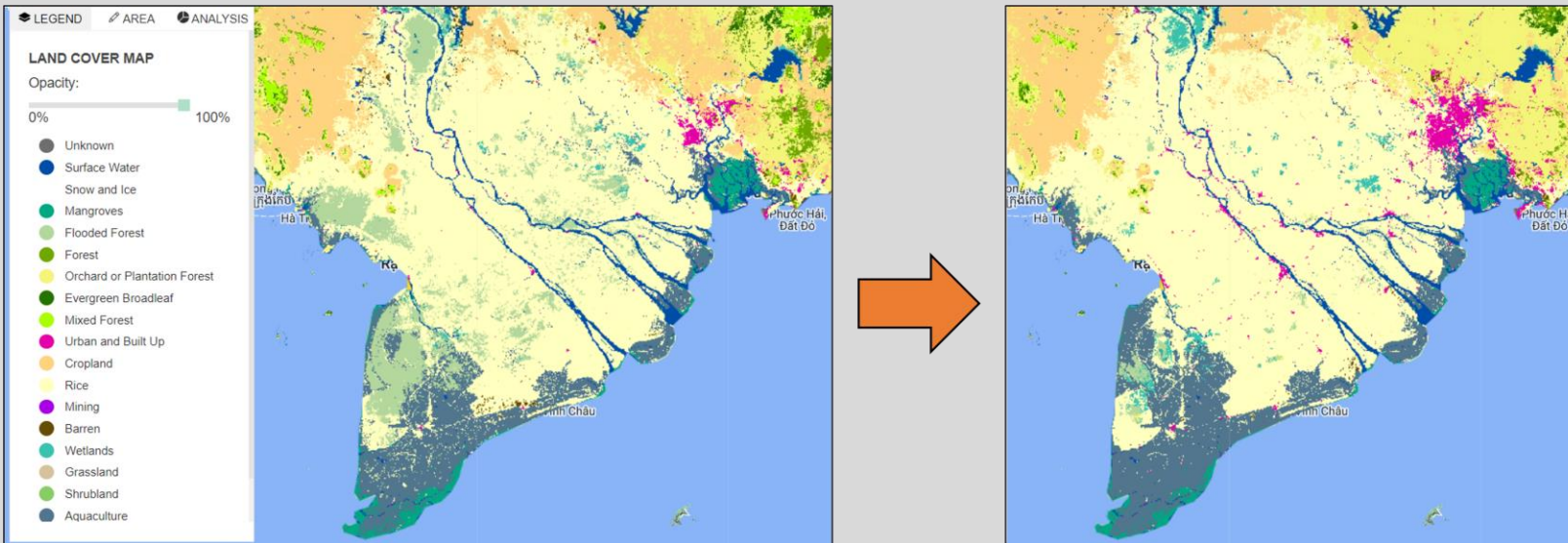
Mekong River delta 1987



2018



Land cover maps and their quantification over time (change analysis) establish spatiotemporal **patterns**.



But, what are the causes of those changes?

Drivers of land change

Proximate causes

Aquaculture expansion
Cropland expansion
Logging
Urbanization
Reforestation
Sea level rise



Underlying drivers

Trade policy
Foreign investment
Economics (inequity, opportunity)
Migration
Climate change



Drivers of land change

Proximate causes

Aquaculture expansion
Cropland expansion
Logging
Urbanization
Reforestation
Sea level rise



Underlying drivers

Trade policy
Foreign investment
Economics (inequity, opportunity)
Migration
Climate change

Objectives of the next three sessions:

Become familiar with geospatial data

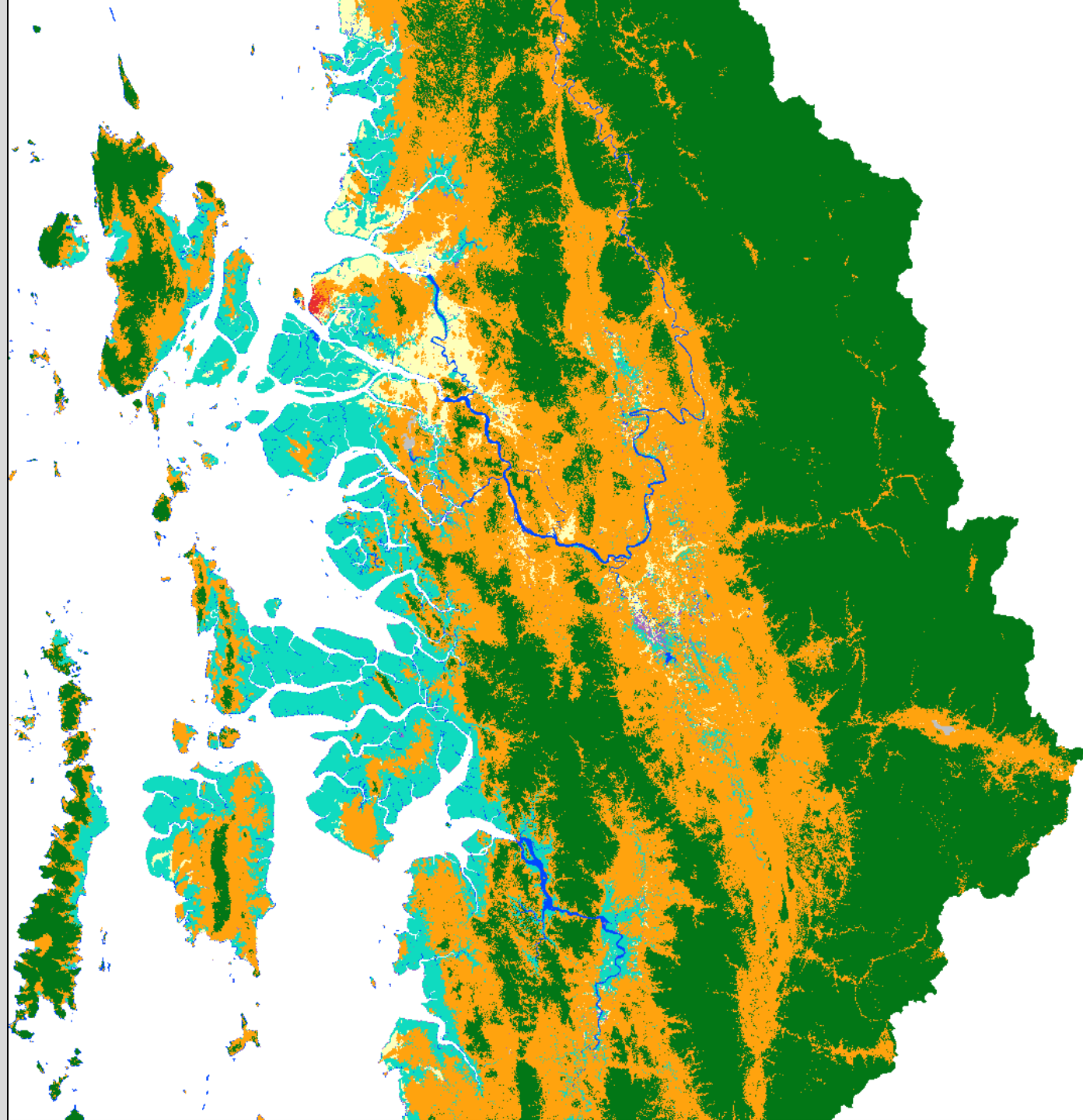
Visualize land cover maps in a GIS

Quantify land cover change over time

Present and interpret land cover change

Future sessions will introduce you to some of the field techniques used to collect information on the dynamics and drivers of land change, along with the impacts of change on livelihoods.

Slides prepared by
Johanness Jamaludin

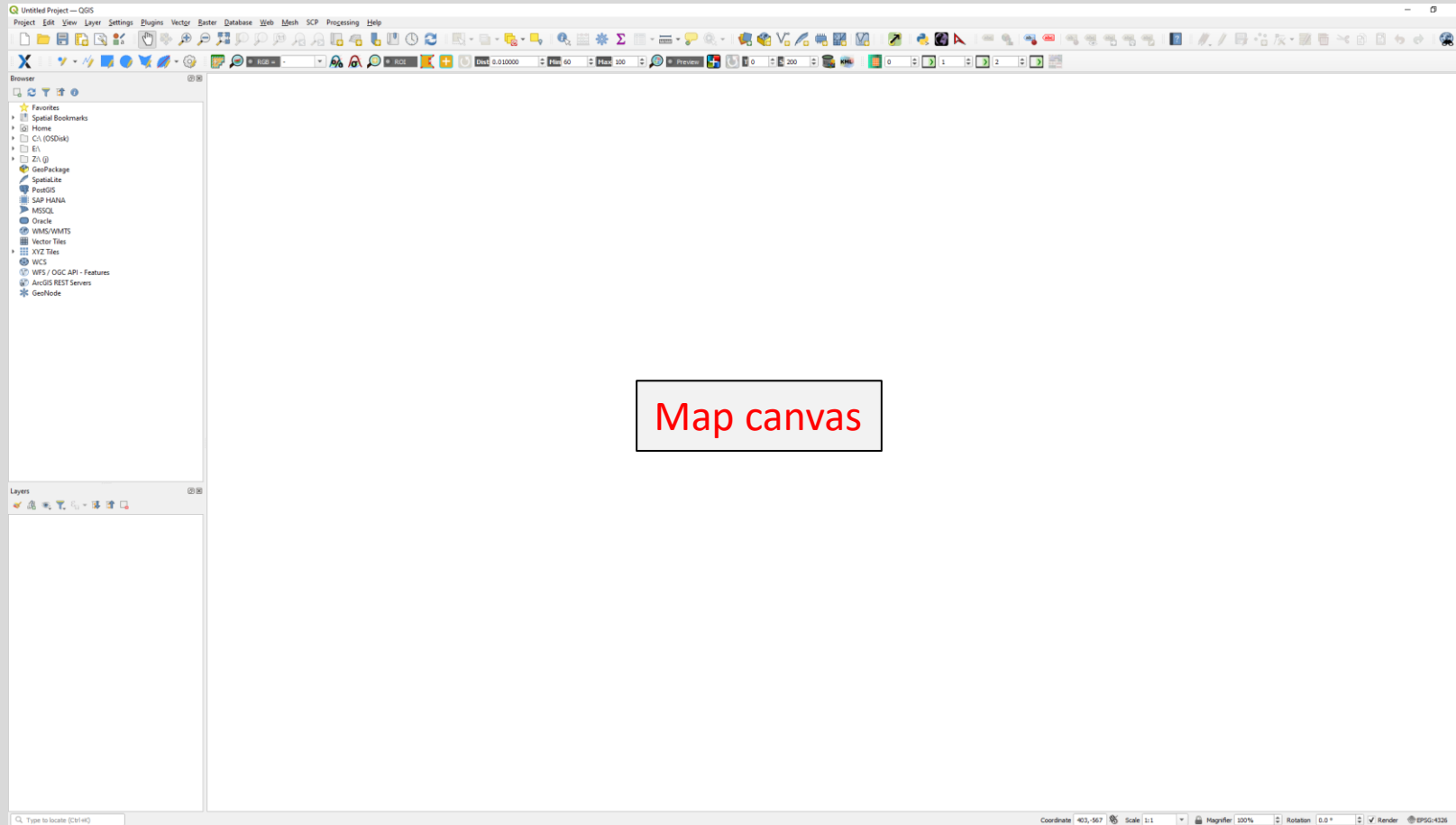




Slides prepared by
Johanness Jamaludin


QGIS Graphical User Interface

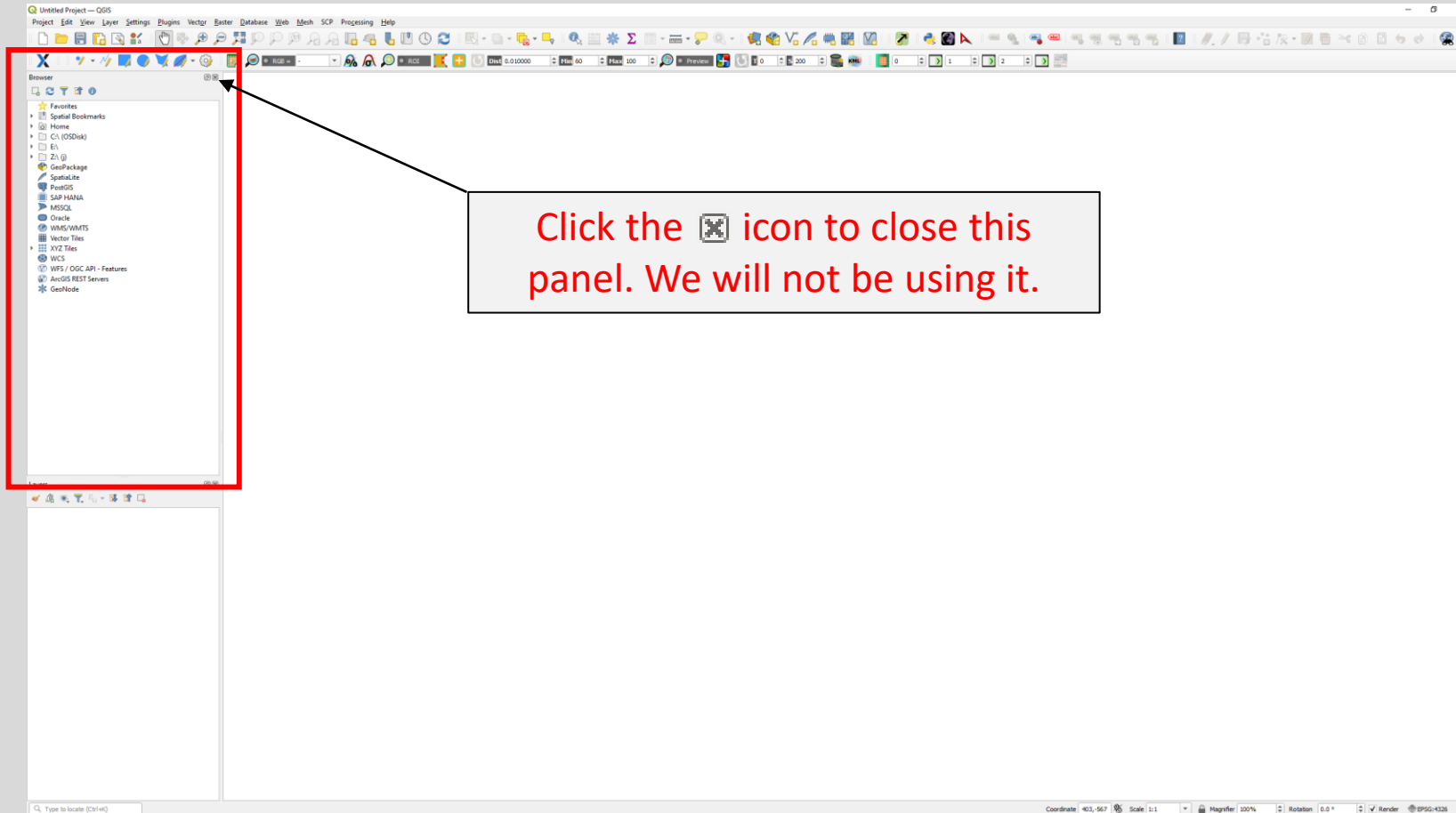
QGIS basics



QGIS Graphic User Interface

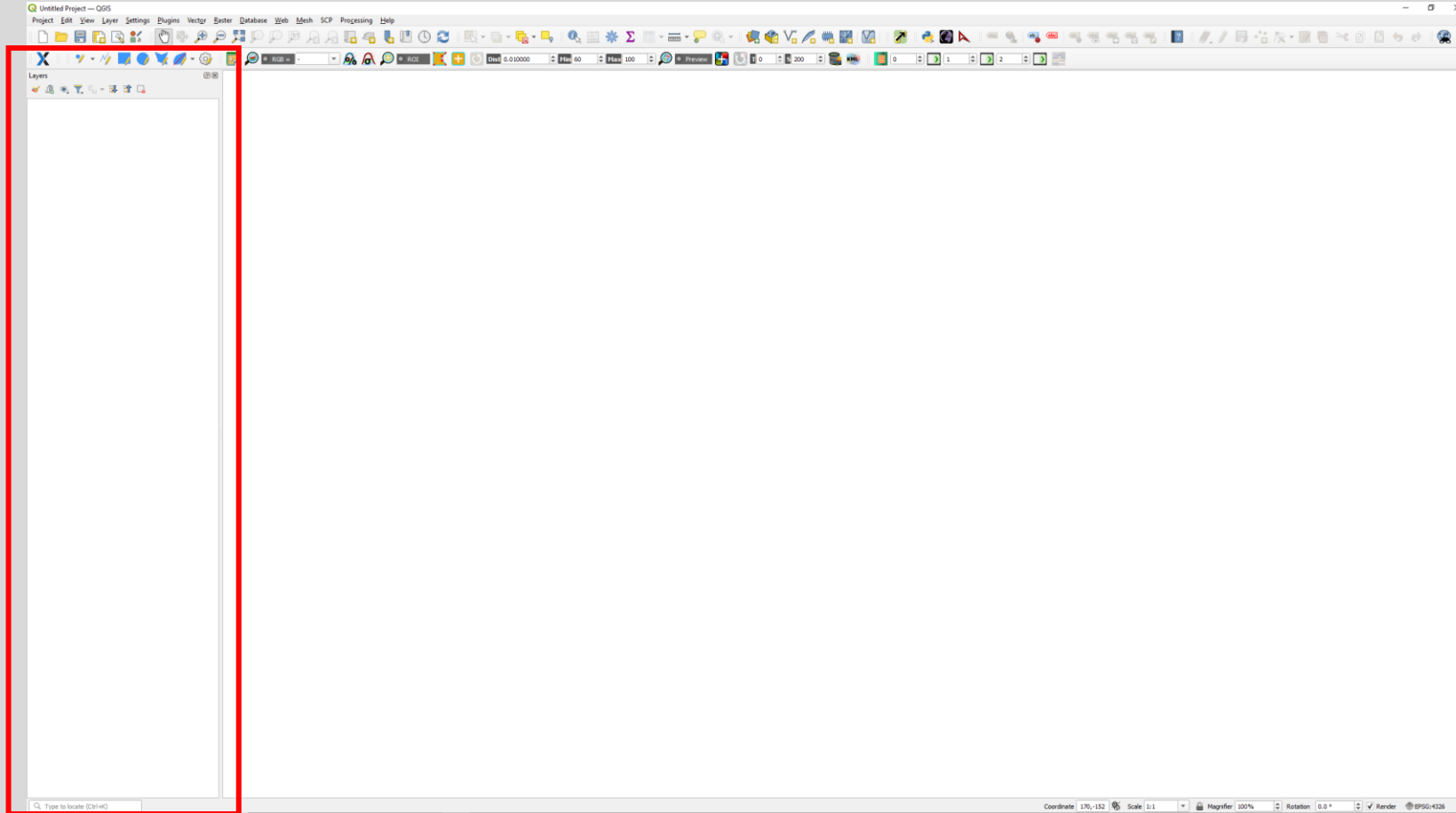
Browser panel

Click the  icon to close this panel. We will not be using it.

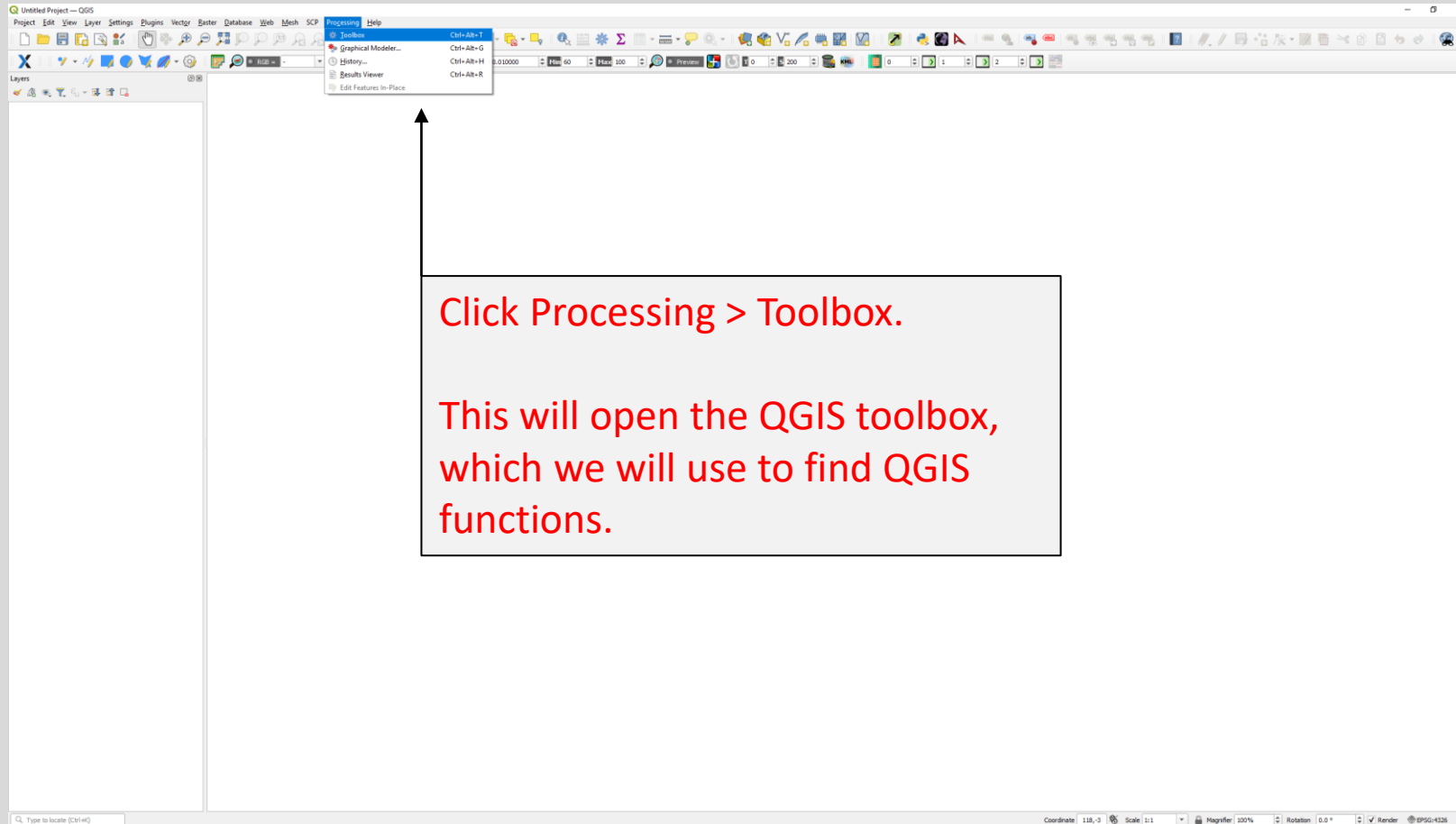


QGIS basics

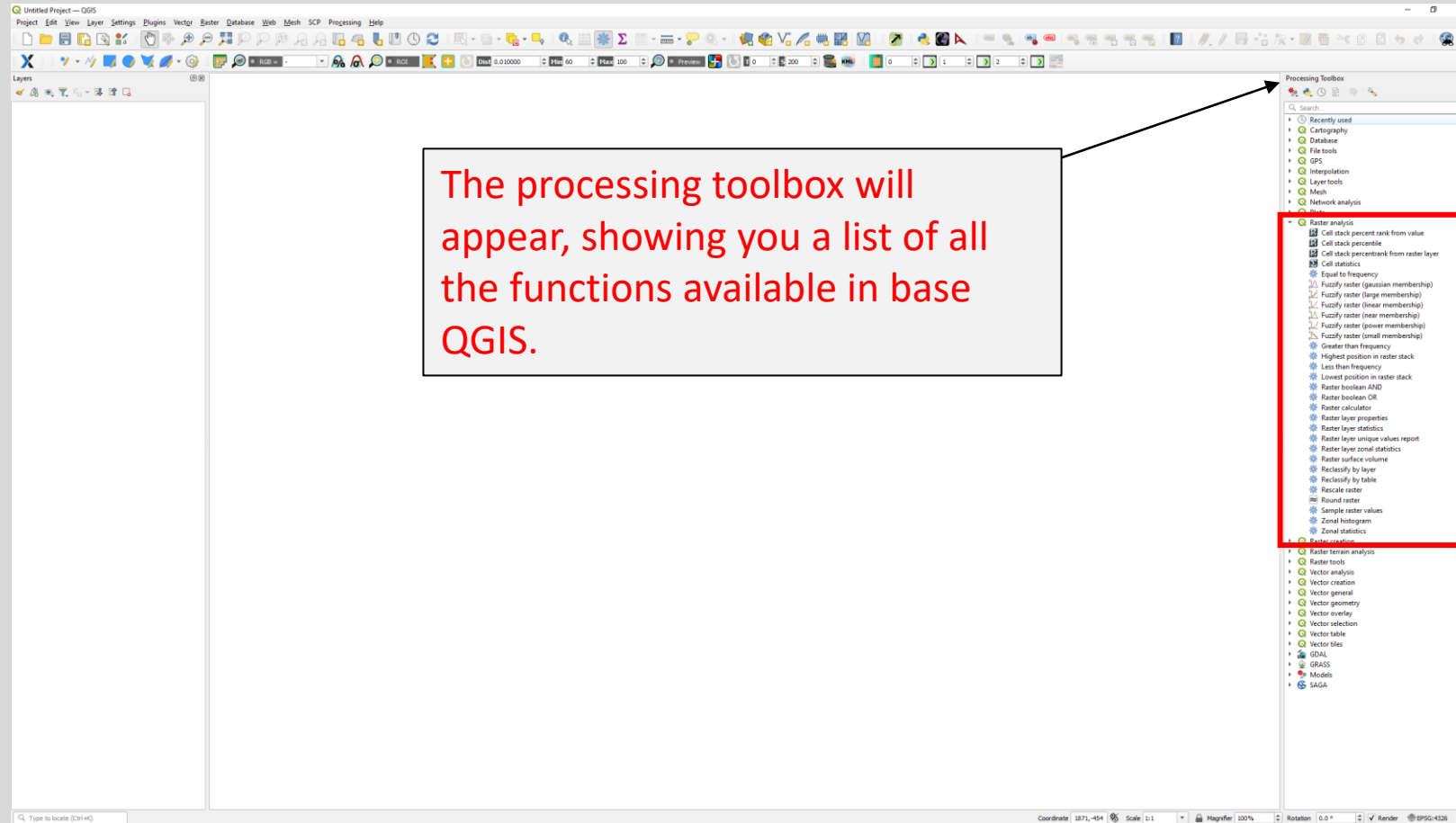
Layers panel



QGIS basics

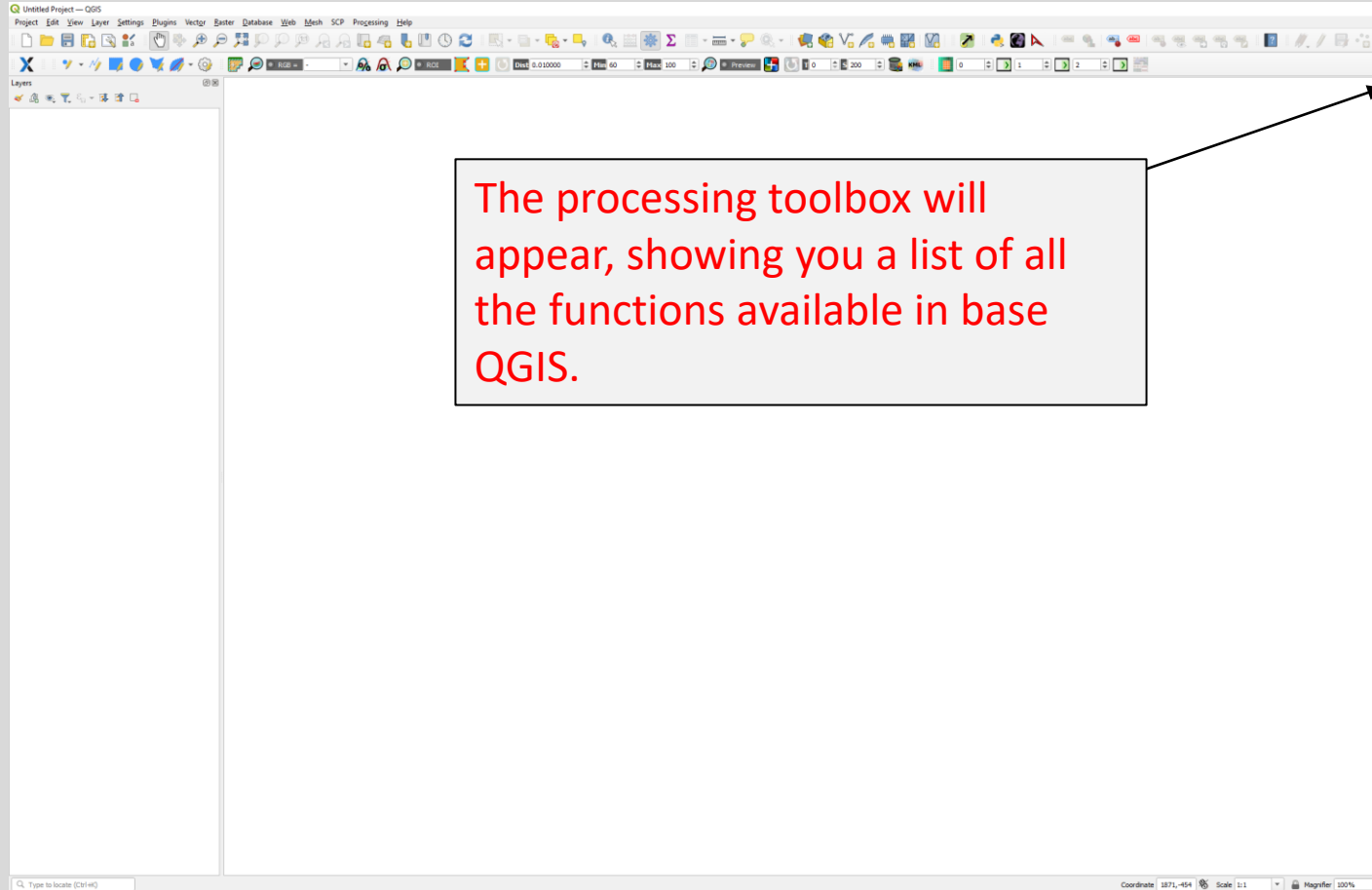


QGIS basics



The processing toolbox will appear, showing you a list of all the functions available in base QGIS.

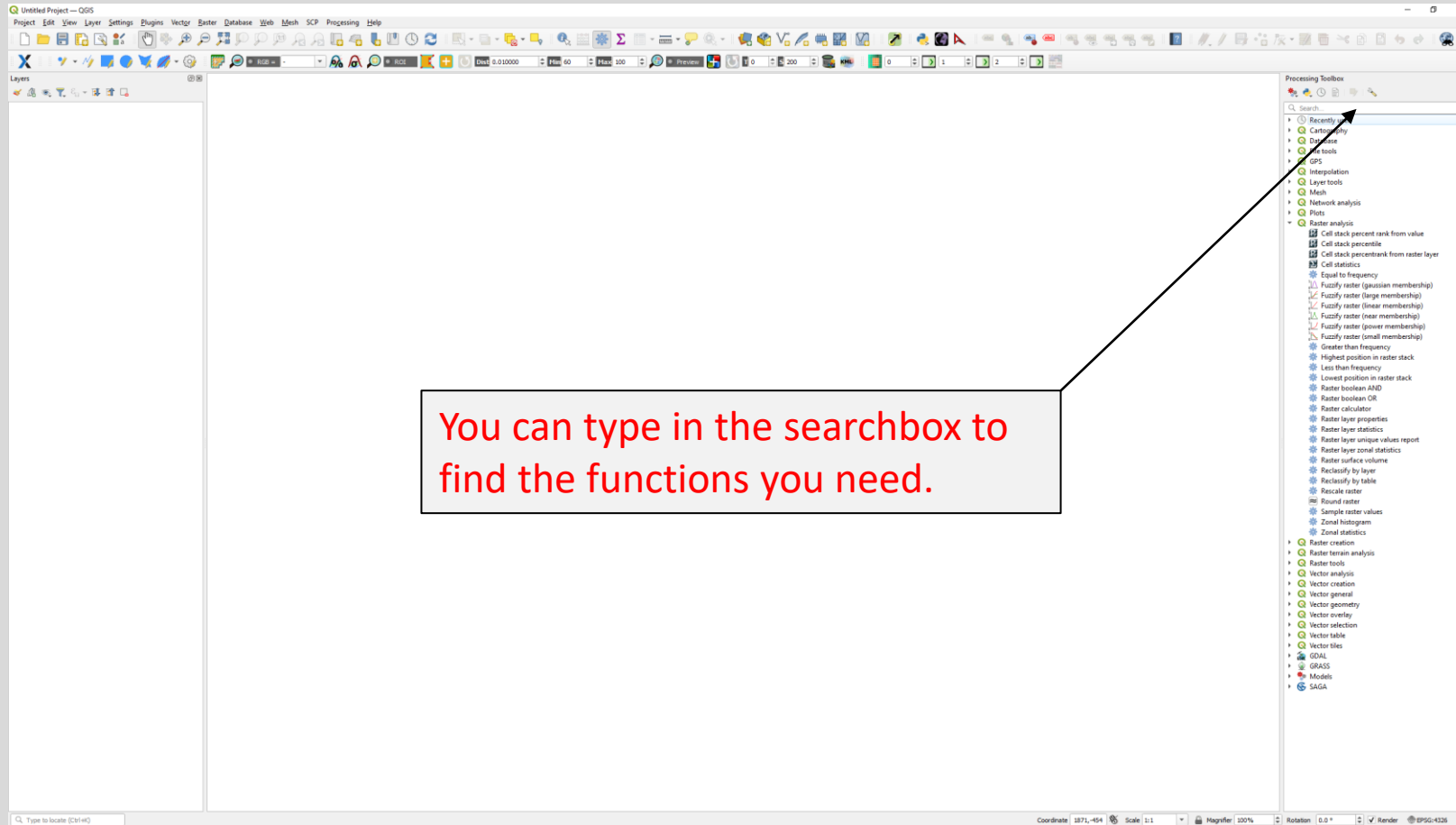
QGIS basics



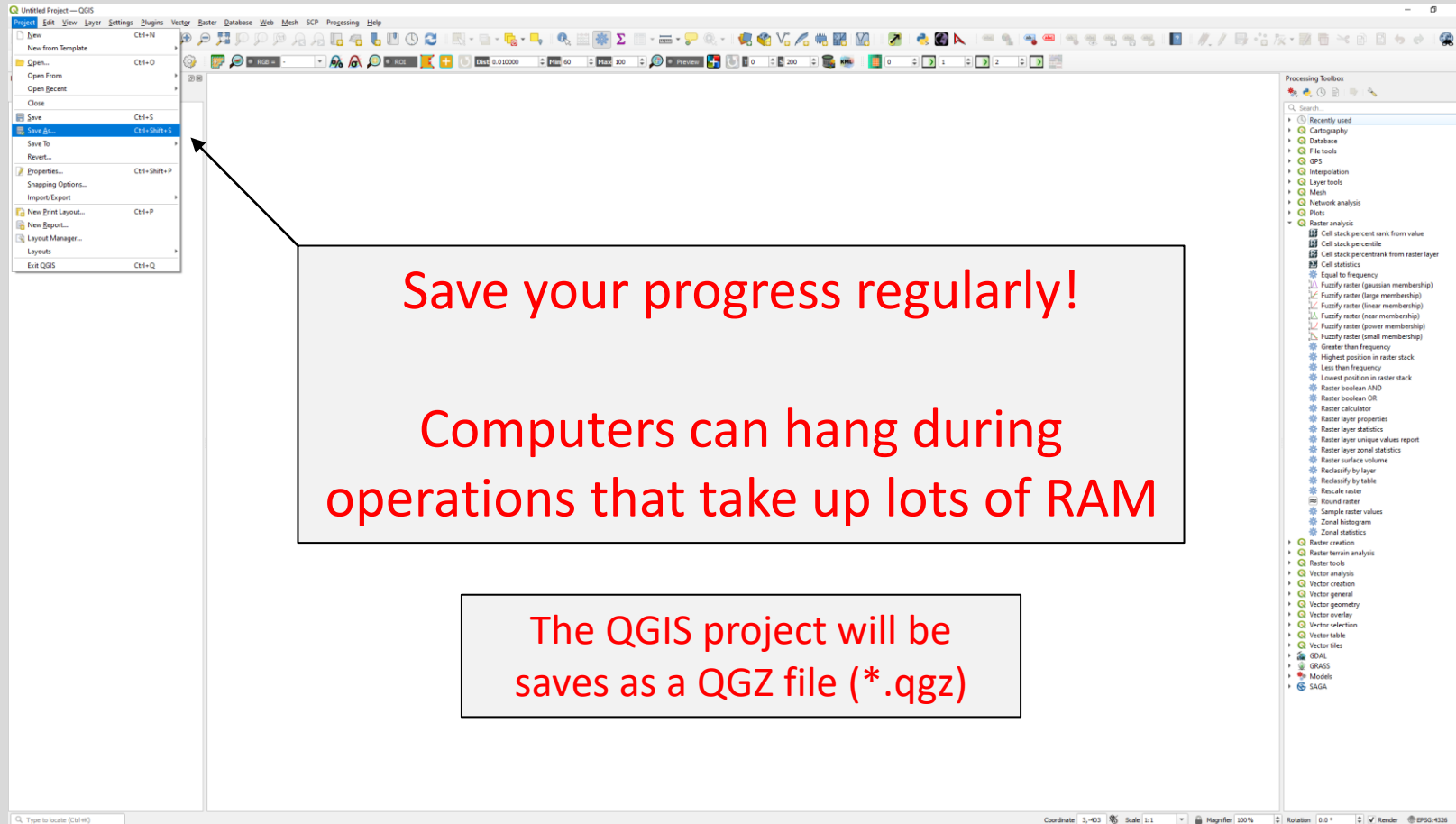
The processing toolbox will appear, showing you a list of all the functions available in base QGIS.

- ▼ Raster analysis
 - Cell stack percent rank from value
 - Cell stack percentile
 - Cell stack percentrank from raster layer
 - Cell statistics
 - Equal to frequency
 - Fuzzify raster (gaussian membership)
 - Fuzzify raster (large membership)
 - Fuzzify raster (linear membership)
 - Fuzzify raster (near membership)
 - Fuzzify raster (power membership)
 - Fuzzify raster (small membership)
 - Greater than frequency
 - Highest position in raster stack
 - Less than frequency
 - Lowest position in raster stack
 - Raster boolean AND
 - Raster boolean OR
 - Raster calculator
 - Raster layer properties
 - Raster layer statistics
 - Raster layer unique values report
 - Raster layer zonal statistics
 - Raster surface volume
 - Reclassify by layer
 - Reclassify by table
 - Rescale raster
 - Round raster
 - Sample raster values
 - Zonal histogram
 - Zonal statistics
- Raster creation

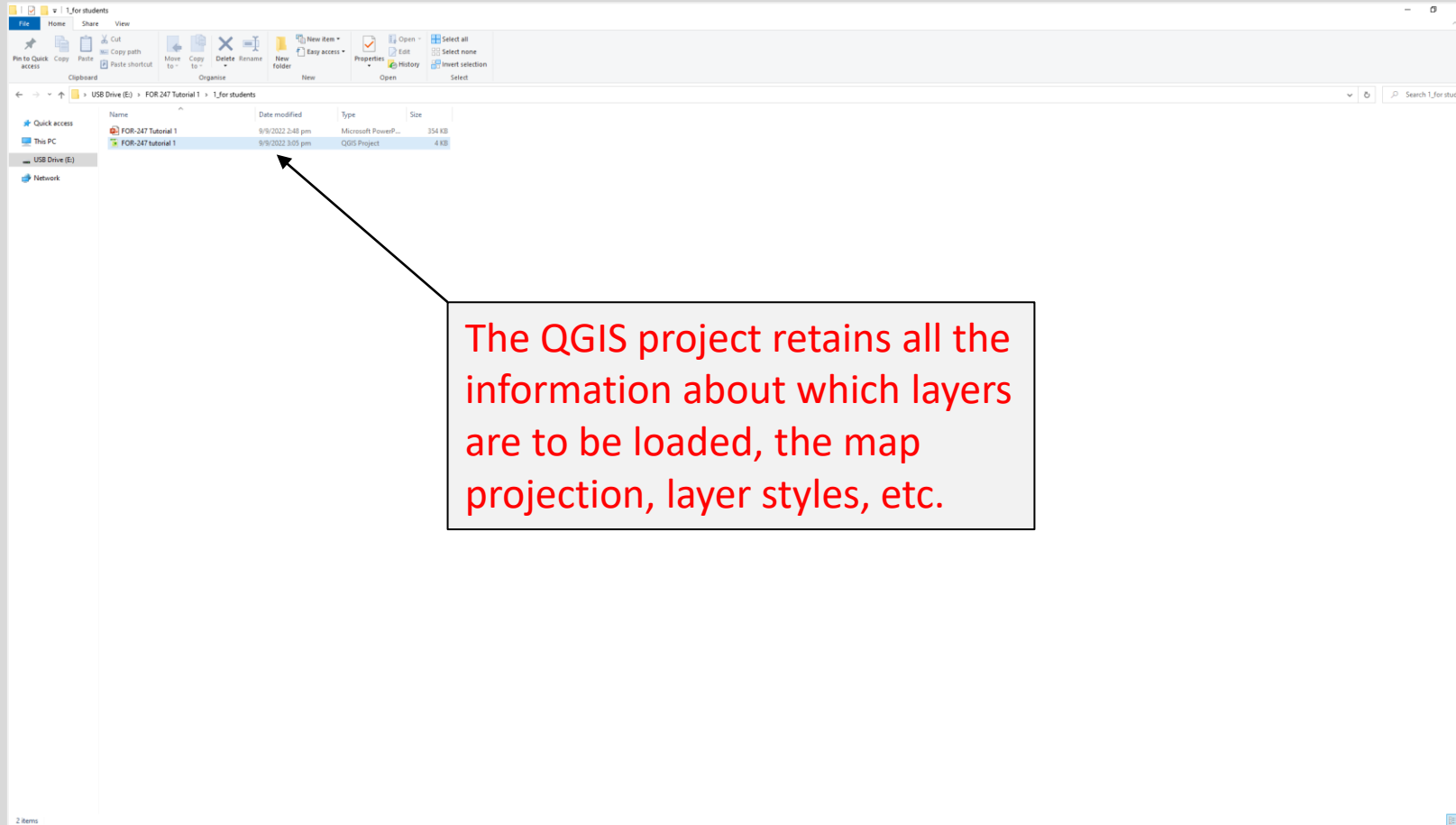
QGIS basics



QGIS basics

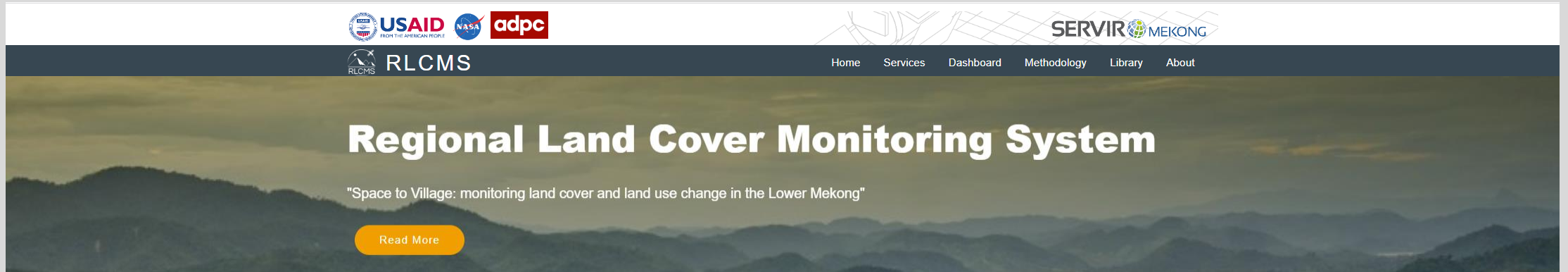


QGIS basics



Land cover data

SERVIR Mekong RLCMS

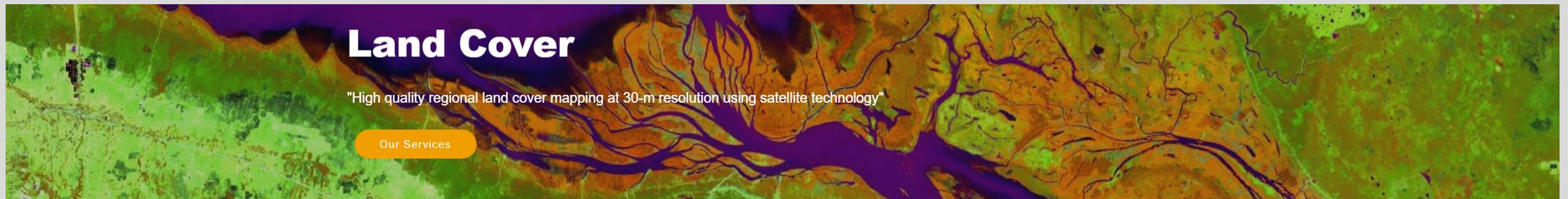


The banner features logos for USAID, NASA, and adpc on the left, and the SERVIR MEKONG logo on the right. Below the logos is a dark navigation bar with the RLCMS logo and the text "RLCMS" on the left, and a menu with "Home", "Services", "Dashboard", "Methodology", "Library", and "About" on the right. The main background is a landscape of mountains under a cloudy sky.

Regional Land Cover Monitoring System

"Space to Village: monitoring land cover and land use change in the Lower Mekong"

[Read More](#)

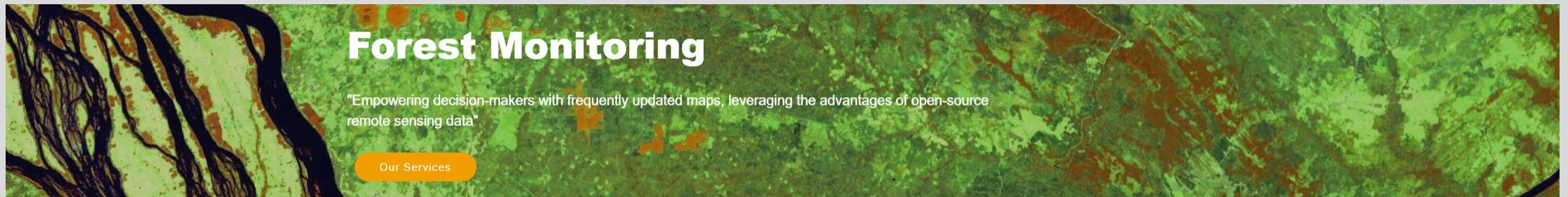


The banner has a background of a satellite map showing a river and surrounding land. The text is white and bold.

Land Cover

"High quality regional land cover mapping at 30-m resolution using satellite technology"

[Our Services](#)



The banner has a background of a satellite map showing a river and surrounding forest. The text is white and bold.

Forest Monitoring

"Empowering decision-makers with frequently updated maps, leveraging the advantages of open-source remote sensing data"

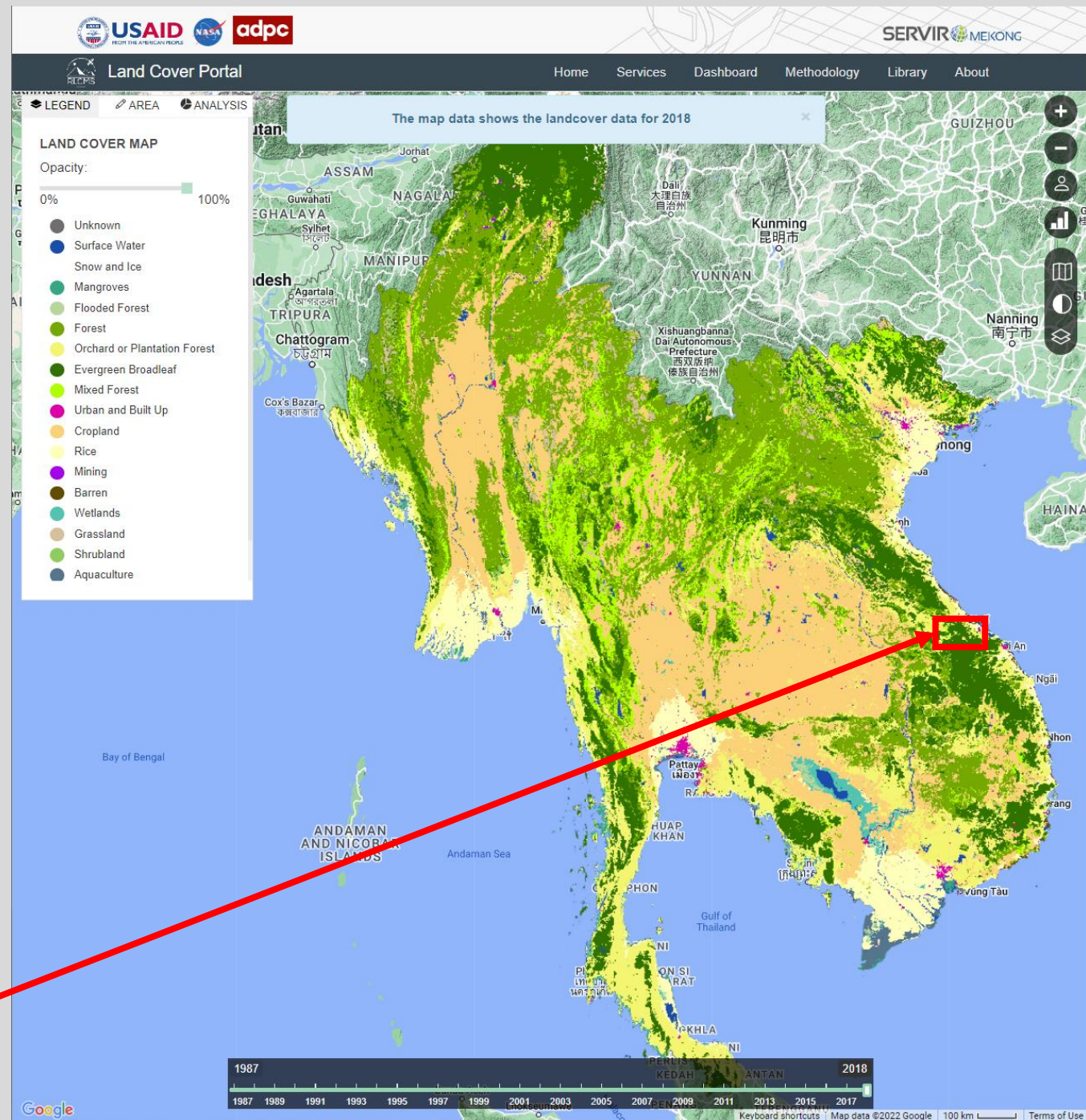
[Our Services](#)

General information

- Annual land cover from 1987–2018
- 30 m spatial resolution
- 17 land cover categories
- The data can be viewed and accessed from this link:

<https://www.landcovermapping.org/en/landcover/>

[Exploration of data using Hue, Vietnam as an example]

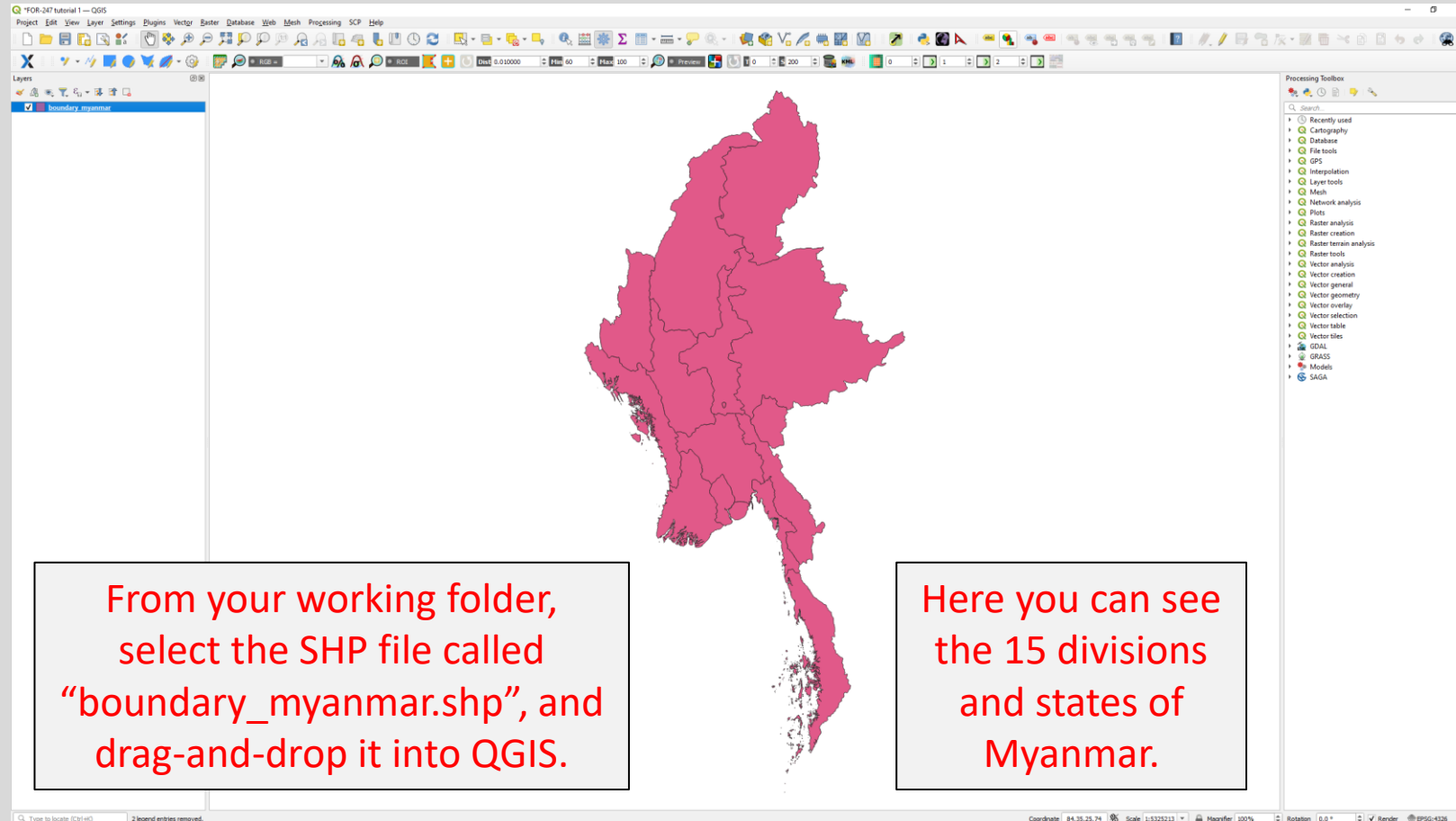


Land cover example: Tanintharyi, Myanmar

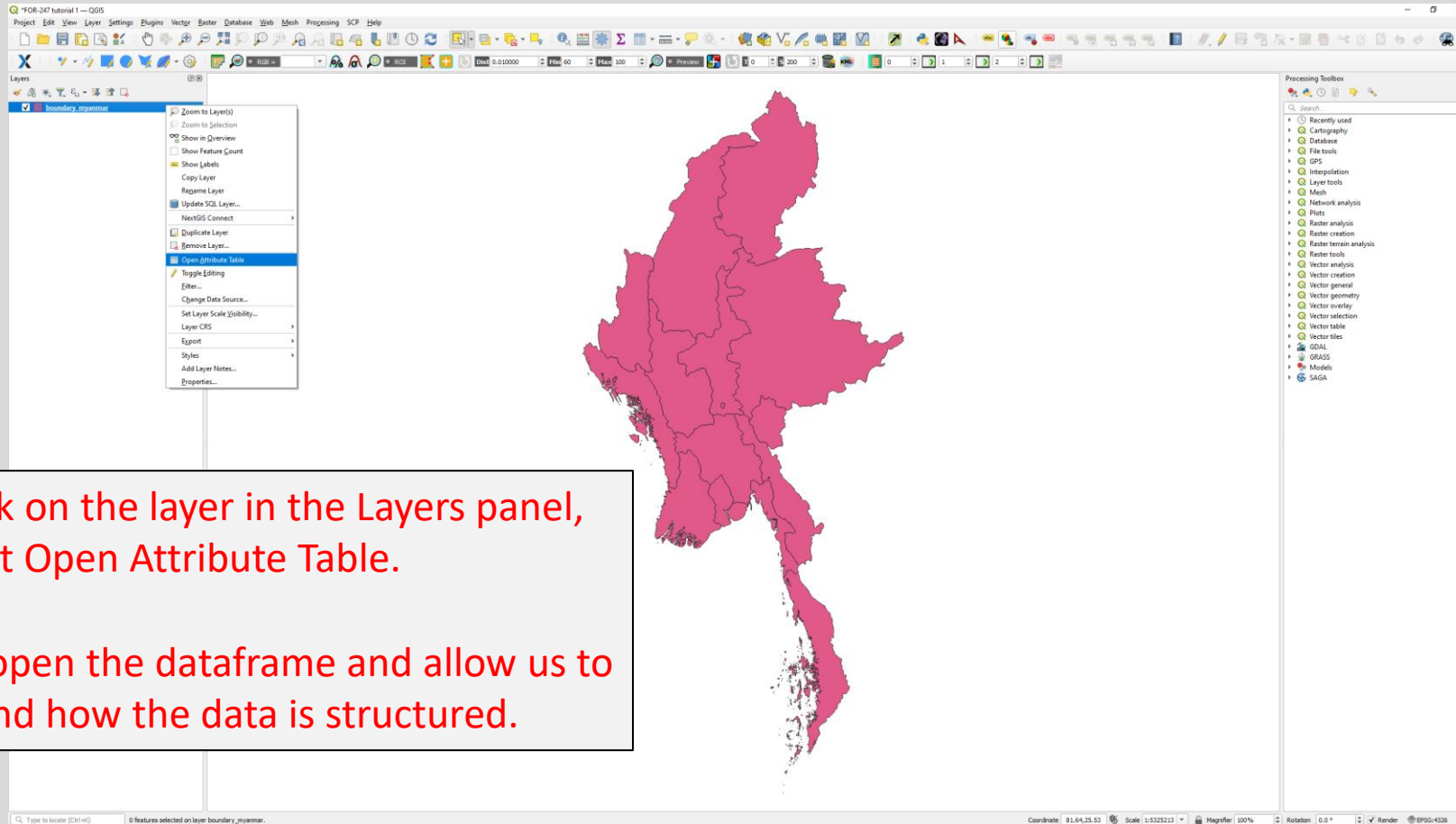
- You should have downloaded the data from the Moodle page
- The data are:
 1. SERVIR Mekong land cover data for 1987 and 2018
 2. Data on the subnational administrative boundaries of Myanmar (i.e., state, district etc.)

Vector data processing

Load the admin boundary data for Myanmar



Vector attribute table



Right-click on the layer in the Layers panel, and select Open Attribute Table.

This will open the dataframe and allow us to understand how the data is structured.

Vector attribute table

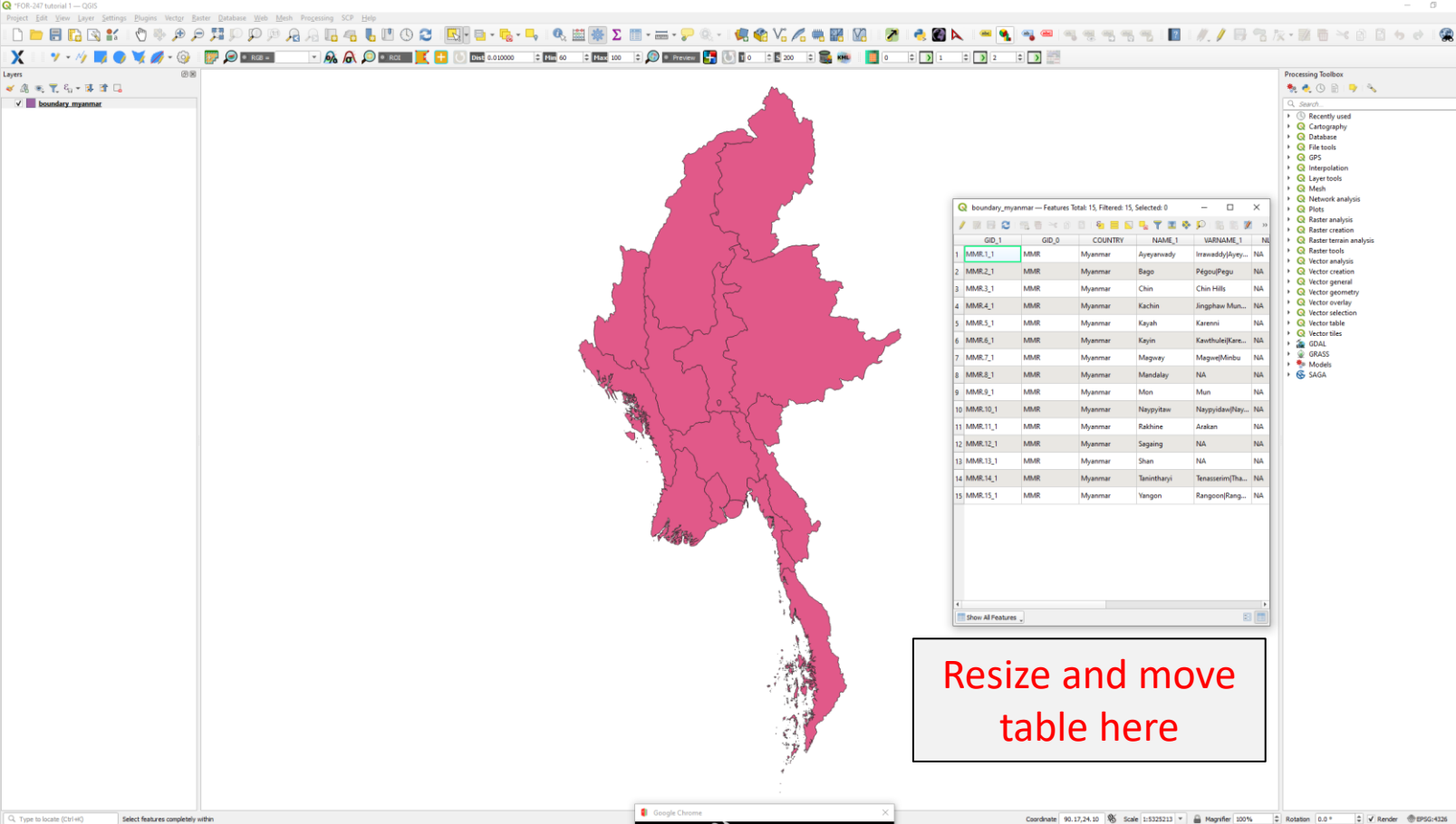
Each column contains different information on the naming and categorization of each region.

There are 15 rows in this table. Each row corresponds to one of the 15 administrative regions.

GID_1	GID_0	COUNTRY	NAME_1	VARNAME_1	NL_NAME_1	TYPE_1	ENGTTYPE_1	CC_1	HASC_1	ISO_1
1	MMR_1_1	Myanmar	Ayeyarwady	IrrawaddyAye...	NA	Yin	Division	NA	MMAY	MM-07
2	MMR_2_1	Myanmar	Bago	PegouPegu	NA	Yin	Division	NA	MMBA	MM-02
3	MMR_3_1	Myanmar	Chin	Chin Hills	NA	Pyine	State	NA	MMCH	NA
4	MMR_4_1	Myanmar	Kachin	Jingshaw Mun...	NA	Pyine	State	NA	MMKC	MM-11
5	MMR_5_1	Myanmar	Kayah	Karenni	NA	Pyine	State	NA	MMKH	MM-12
6	MMR_6_1	Myanmar	Kayah	Kawthule(Kare...	NA	Pyine	State	NA	MMKN	MM-13
7	MMR_7_1	Myanmar	Magway	Mague(Minbu	NA	Yin	Division	NA	MMMG	MM-03
8	MMR_8_1	Myanmar	Mandalay	NA	NA	Yin	Division	NA	MMMD	MM-04
9	MMR_9_1	Myanmar	Mon	Mun	NA	Pyine	State	NA	MMMO	MM-15
10	MMR_10_1	Myanmar	Naypyitaw	Naypyidaw(Nay...	NA	Union territory	Union territory	NA	MMNY	NA
11	MMR_11_1	Myanmar	Rakhine	Arakan	NA	Pyine	State	NA	MMRA	MM-16
12	MMR_12_1	Myanmar	Sagaing	NA	NA	Yin	Division	NA	MMSA	MM-01
13	MMR_13_1	Myanmar	Shan	NA	NA	Pyine	State	NA	MMSH	MM-17
14	MMR_14_1	Myanmar	Tsintharyi	Tenasserim(Tha...	NA	Yin	Division	NA	MMTN	MM-05
15	MMR_15_1	Myanmar	Yangon	Rangoon(Rang...	NA	Yin	Division	NA	MMYA	MM-06

An attribute table is equivalent to an Excel sheet

Vector attribute table



The screenshot displays the QGIS interface with a map of Myanmar. The attribute table for the 'boundary_myanmar' layer is open, showing 15 features. The table has columns for ID, GID_1, GID_2, COUNTRY, NAME_1, and NAME_2. The first feature is highlighted in green.

ID	GID_1	GID_2	COUNTRY	NAME_1	NAME_2
1	MMR_1_1	MMR	Myanmar	Ayeyarwady	Innawaddy(Shw...
2	MMR_2_1	MMR	Myanmar	Bago	Pagun(Pegu)
3	MMR_3_1	MMR	Myanmar	Chin	Chin Hills
4	MMR_4_1	MMR	Myanmar	Kachin	Jingphaw Mun...
5	MMR_5_1	MMR	Myanmar	Kayah	Karen
6	MMR_6_1	MMR	Myanmar	Kayah	Kawthule(Kar...
7	MMR_7_1	MMR	Myanmar	Magway	Magway(Monbu...
8	MMR_8_1	MMR	Myanmar	Mandalay	NA
9	MMR_9_1	MMR	Myanmar	Mon	Mun
10	MMR_10_1	MMR	Myanmar	Naypyitaw	Naypyidaw(Nay...
11	MMR_11_1	MMR	Myanmar	Rakhine	Arakan
12	MMR_12_1	MMR	Myanmar	Sagaing	NA
13	MMR_13_1	MMR	Myanmar	Shan	NA
14	MMR_14_1	MMR	Myanmar	Tanintharyi	Tanasserim(Tha...
15	MMR_15_1	MMR	Myanmar	Yangon	Rangoon(Rang...

Resize and move table here

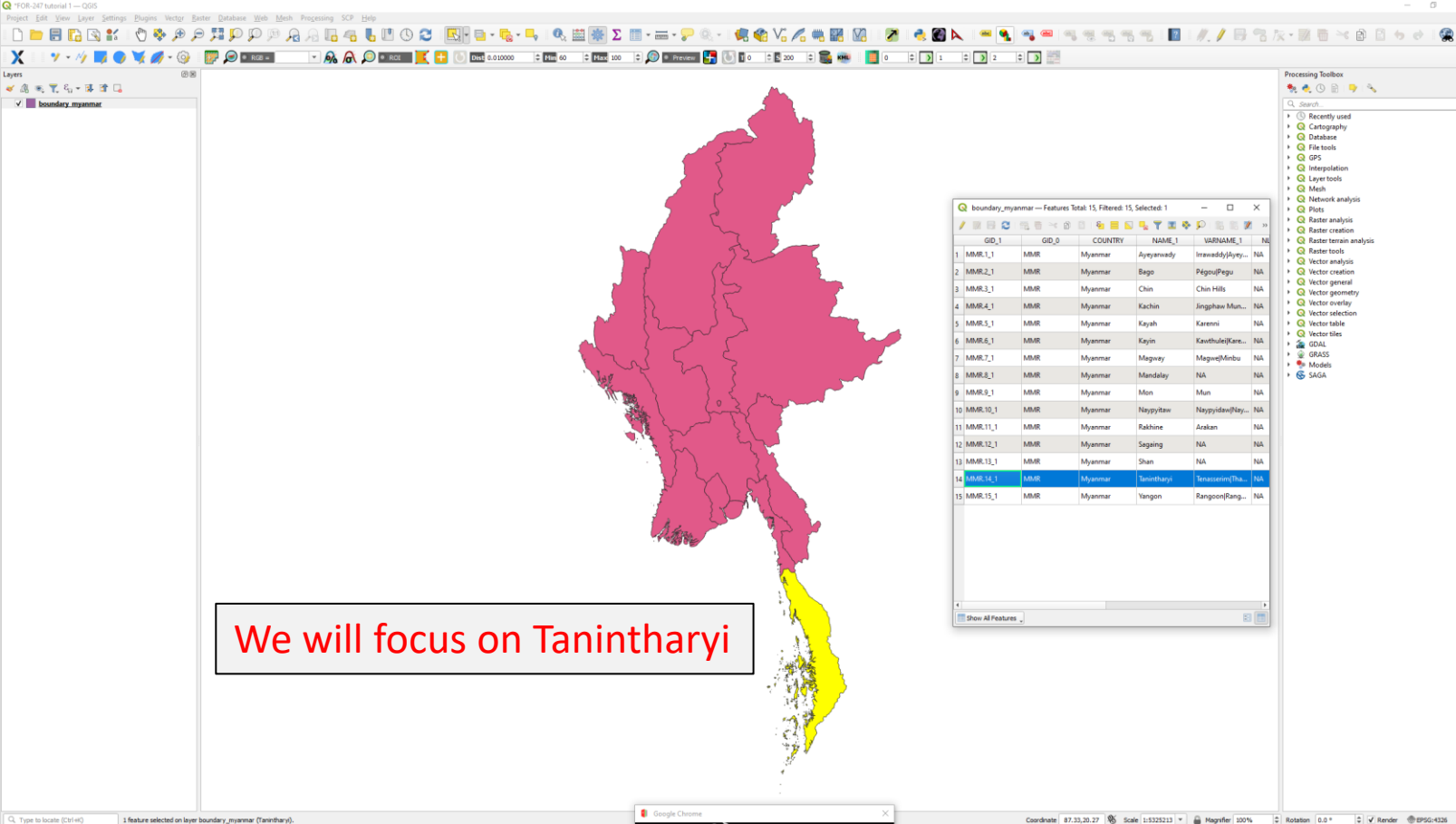
Vector attribute table

Select any region by clicking on the row

Ayeyarwady region

ID	GID_1	GID_0	COUNTRY	NAME_1	UNNAME_1	NAME_2
1	MMR_1_1	MMR	Myanmar	Ayeyarwady	Ayeyarwady	NA
2	MMR_2_1	MMR	Myanmar	Bago	PigouPegu	NA
3	MMR_3_1	MMR	Myanmar	Chin Hills	Chin Hills	NA
4	MMR_4_1	MMR	Myanmar	Kachin	Jingshaw Mun...	NA
5	MMR_5_1	MMR	Myanmar	Kayah	Karenni	NA
6	MMR_6_1	MMR	Myanmar	Kayin	Kawthule/Kare...	NA
7	MMR_7_1	MMR	Myanmar	Magway	Magway/Mebu...	NA
8	MMR_8_1	MMR	Myanmar	Mandalay	NA	NA
9	MMR_9_1	MMR	Myanmar	Mon	Mun	NA
10	MMR_10_1	MMR	Myanmar	Naypyitaw	Naypyidaw(Nay...	NA
11	MMR_11_1	MMR	Myanmar	Rakhine	Arakan	NA
12	MMR_12_1	MMR	Myanmar	Sagaing	NA	NA
13	MMR_13_1	MMR	Myanmar	Shan	NA	NA
14	MMR_14_1	MMR	Myanmar	Tanintharyi	Tanasserim(Tha...	NA
15	MMR_15_1	MMR	Myanmar	Yangon	Rangoon/Rang...	NA

Vector attribute table



The screenshot displays the QGIS interface with a map of Myanmar. A vector layer named 'boundary_myanmar' is selected in the Layers panel. The attribute table for this layer is open, showing 15 features. The table has columns: ID, GID_1, GID_0, COUNTRY, NAME_1, and NAME_2. The feature for Tanintharyi (ID 14) is highlighted in blue.

ID	GID_1	GID_0	COUNTRY	NAME_1	NAME_2
1	MMR_1_1	MMR	Myanmar	Ayeyarwady	Innawaddy(Shwemyithar)
2	MMR_2_1	MMR	Myanmar	Bago	Pagun(Pegu)
3	MMR_3_1	MMR	Myanmar	Chin	Chin Hills
4	MMR_4_1	MMR	Myanmar	Kachin	Jingphaw Mun...
5	MMR_5_1	MMR	Myanmar	Kayah	Karenzi
6	MMR_6_1	MMR	Myanmar	Kayah	Kawthule(Kare...
7	MMR_7_1	MMR	Myanmar	Magway	Magway(Monbu...
8	MMR_8_1	MMR	Myanmar	Mandalay	NA
9	MMR_9_1	MMR	Myanmar	Mon	Mun
10	MMR_10_1	MMR	Myanmar	Naypyitaw	Naypyidaw(Nay...
11	MMR_11_1	MMR	Myanmar	Rakhine	Arakan
12	MMR_12_1	MMR	Myanmar	Sagaing	NA
13	MMR_13_1	MMR	Myanmar	Shan	NA
14	MMR_14_1	MMR	Myanmar	Tanintharyi	Tanintharyi(Tha...
15	MMR_15_1	MMR	Myanmar	Yangon	Rangoon(Rang...

We will focus on Tanintharyi

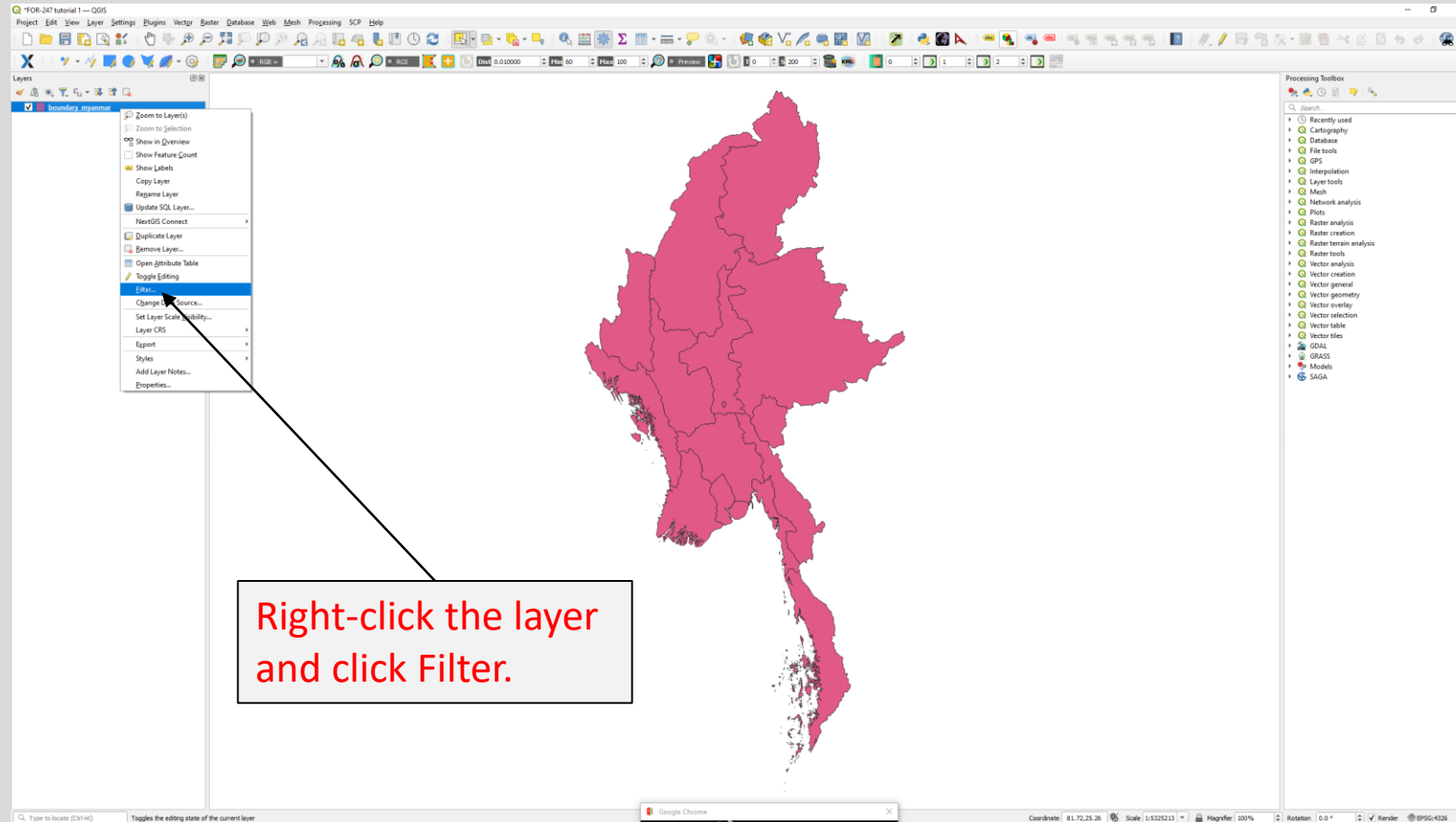
Vector attribute table

The screenshot displays the QGIS desktop environment. The main map area shows a pink-shaded outline of Myanmar. A red text box with a black border is overlaid on the map, containing the instruction: "Deselect all features by clicking this button [icon] .". An arrow points from this text box to a specific button in the attribute table window. The attribute table window, titled "boundary_myanmar -- Features Total: 15, Filtered: 15, Selected: 0", shows a table with columns: ID, GID_1, GID_0, COUNTRY, and a fourth column with state names. The fourth column is highlighted in green. The state "Kachin" is selected in the list.

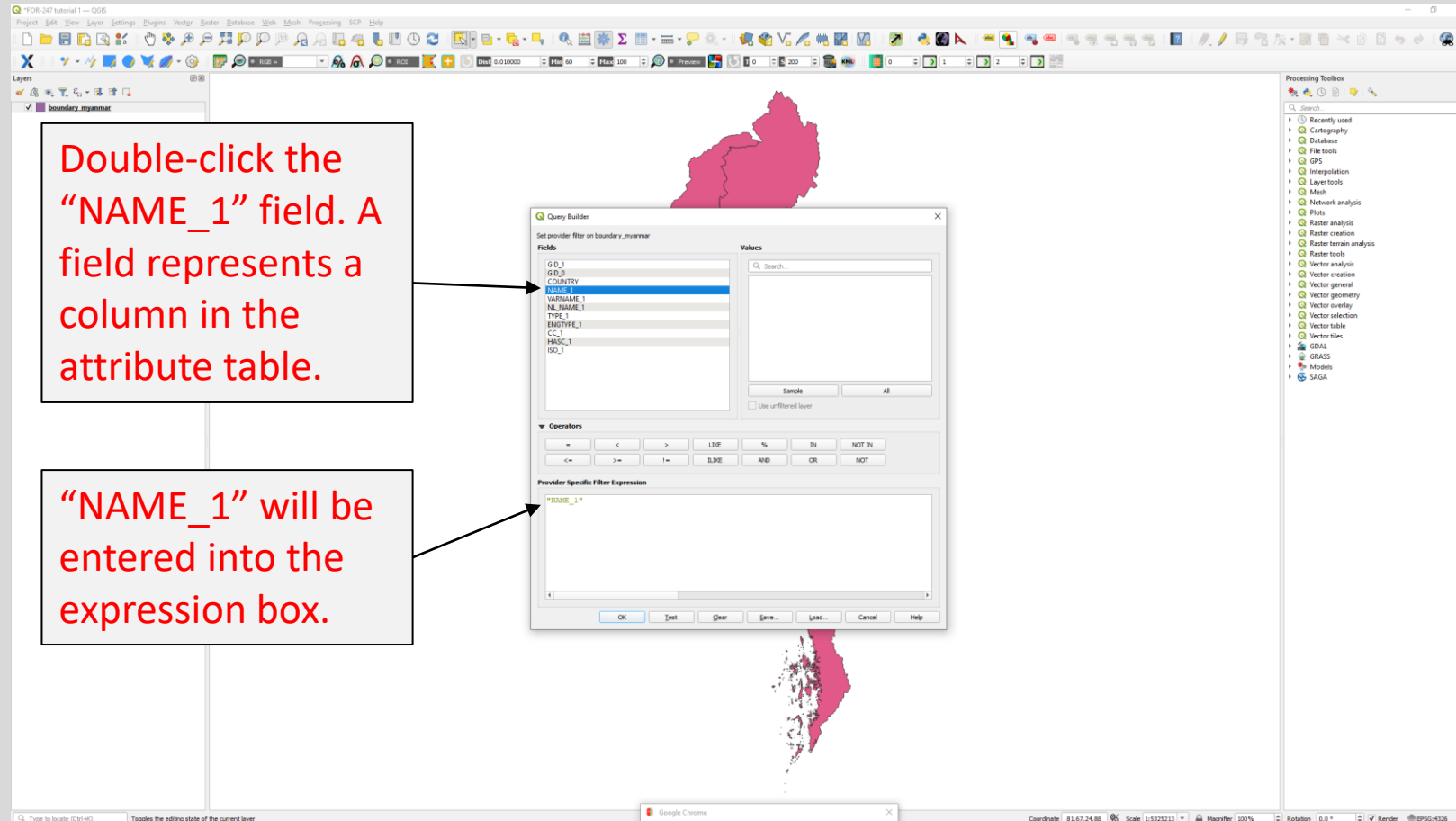
Deselect all features by clicking this button [icon] .

ID	GID_1	GID_0	COUNTRY	
1	MMR_1_1	MMR	Myanmar	Ayeyarwady Irrawaddy
2	MMR_2_1	MMR	Myanmar	Bago Bago
3	MMR_3_1	MMR	Myanmar	Chin Chin Hills
4	MMR_4_1	MMR	Myanmar	Kachin Kachin
5	MMR_5_1	MMR	Myanmar	Kayah Kayah
6	MMR_6_1	MMR	Myanmar	Kayah Kayah
7	MMR_7_1	MMR	Myanmar	Magway Magway
8	MMR_8_1	MMR	Myanmar	Mandalay Mandalay
9	MMR_9_1	MMR	Myanmar	Mon Mon
10	MMR_10_1	MMR	Myanmar	Naypyitaw Naypyitaw
11	MMR_11_1	MMR	Myanmar	Rakhine Rakhine
12	MMR_12_1	MMR	Myanmar	Sagaing Sagaing
13	MMR_13_1	MMR	Myanmar	Shan Shan
14	MMR_14_1	MMR	Myanmar	Tanintharyi Tanintharyi
15	MMR_15_1	MMR	Myanmar	Yangon Yangon

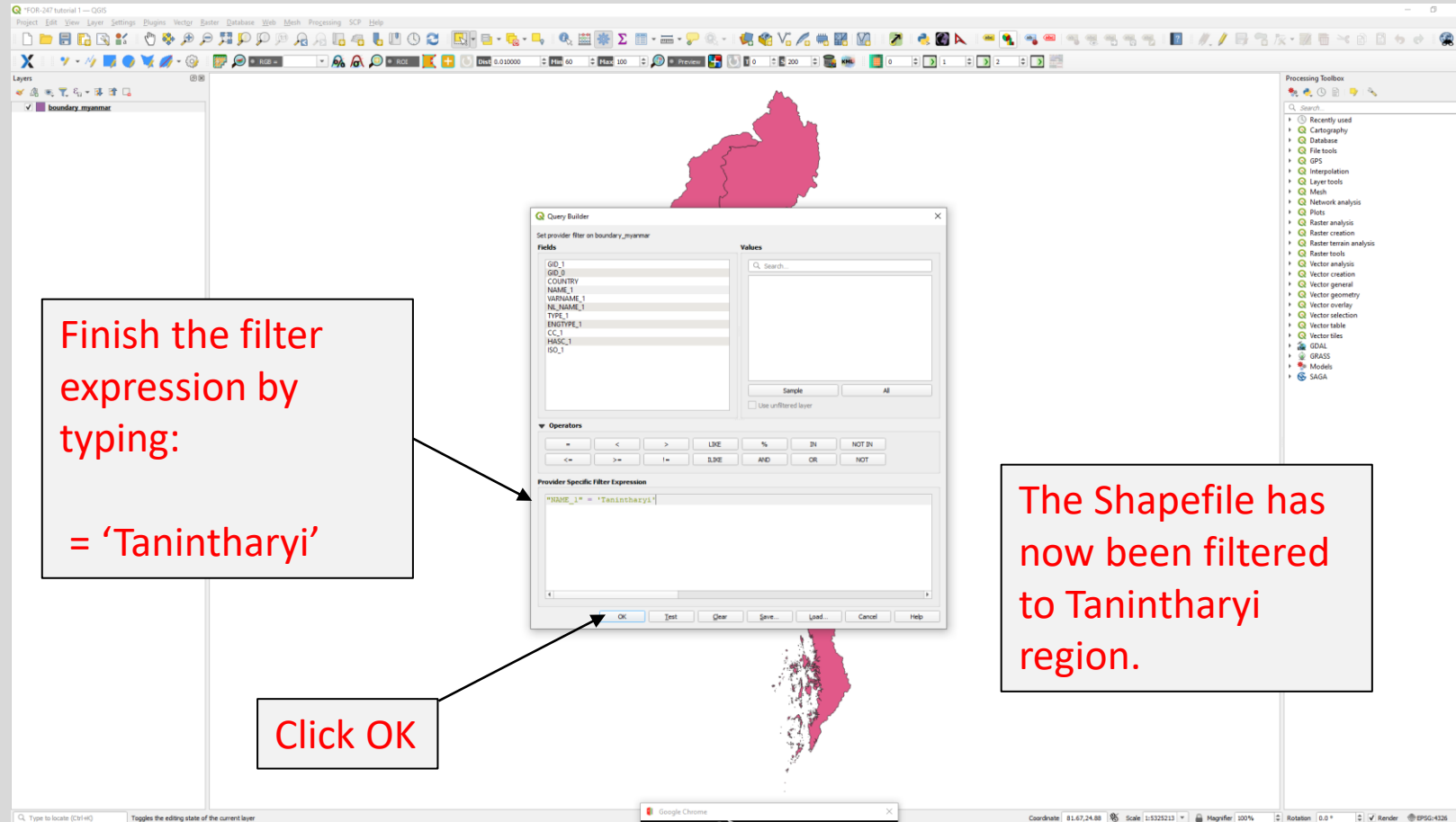
Filtering the Shapefile to Tanintharyi



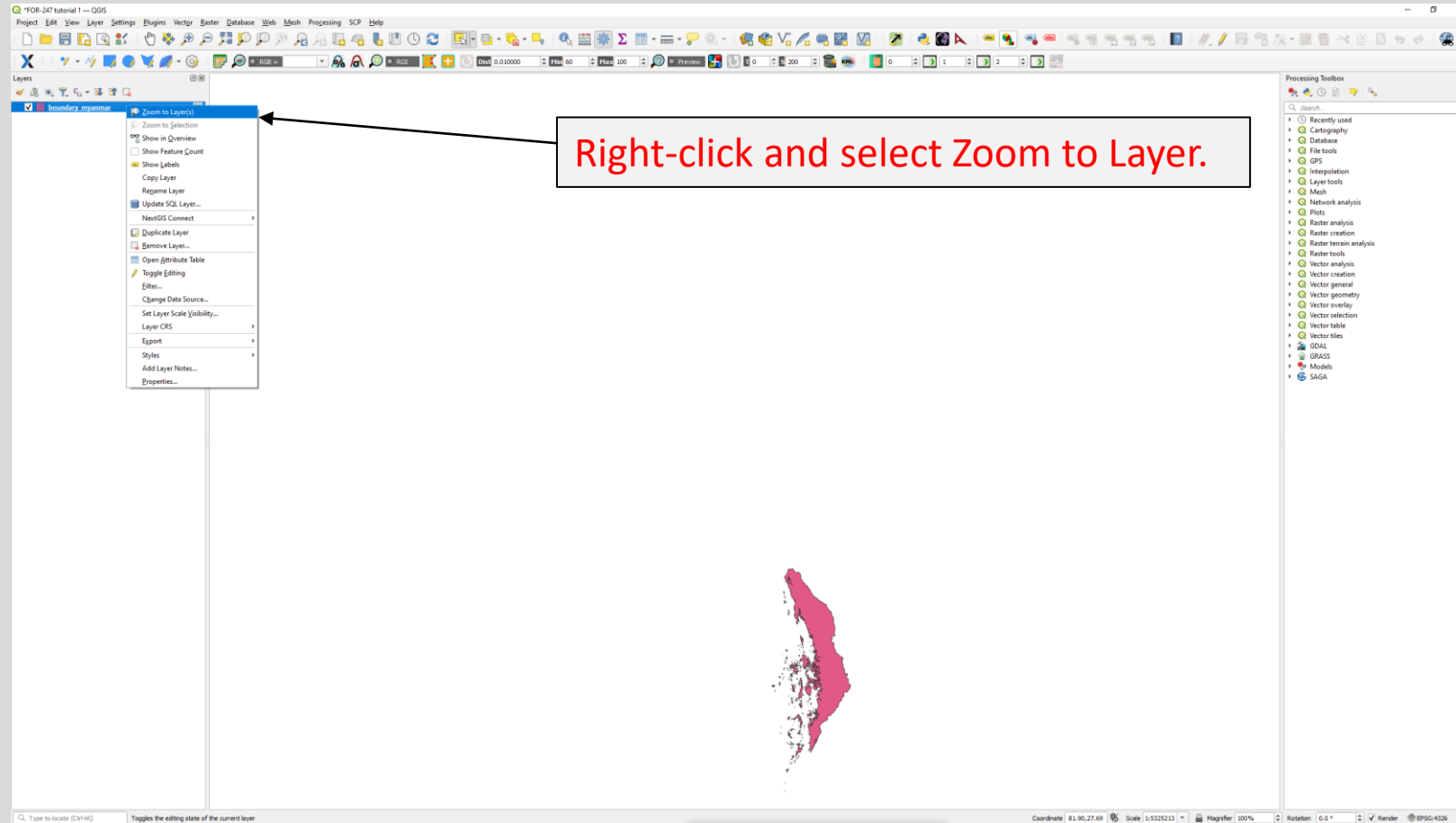
Filtering the Shapefile to Tanintharyi



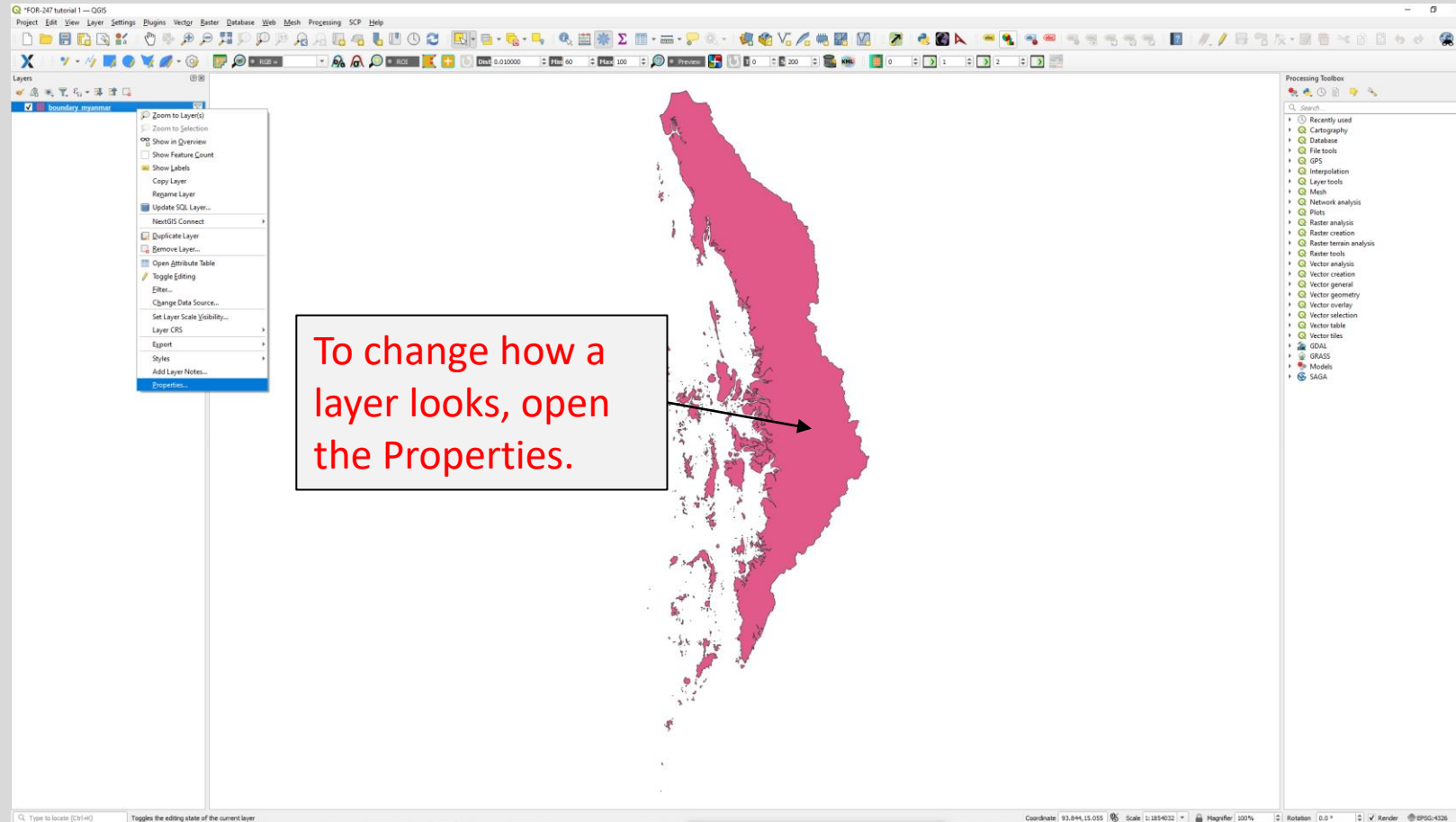
Filtering the Shapefile to Tanintharyi



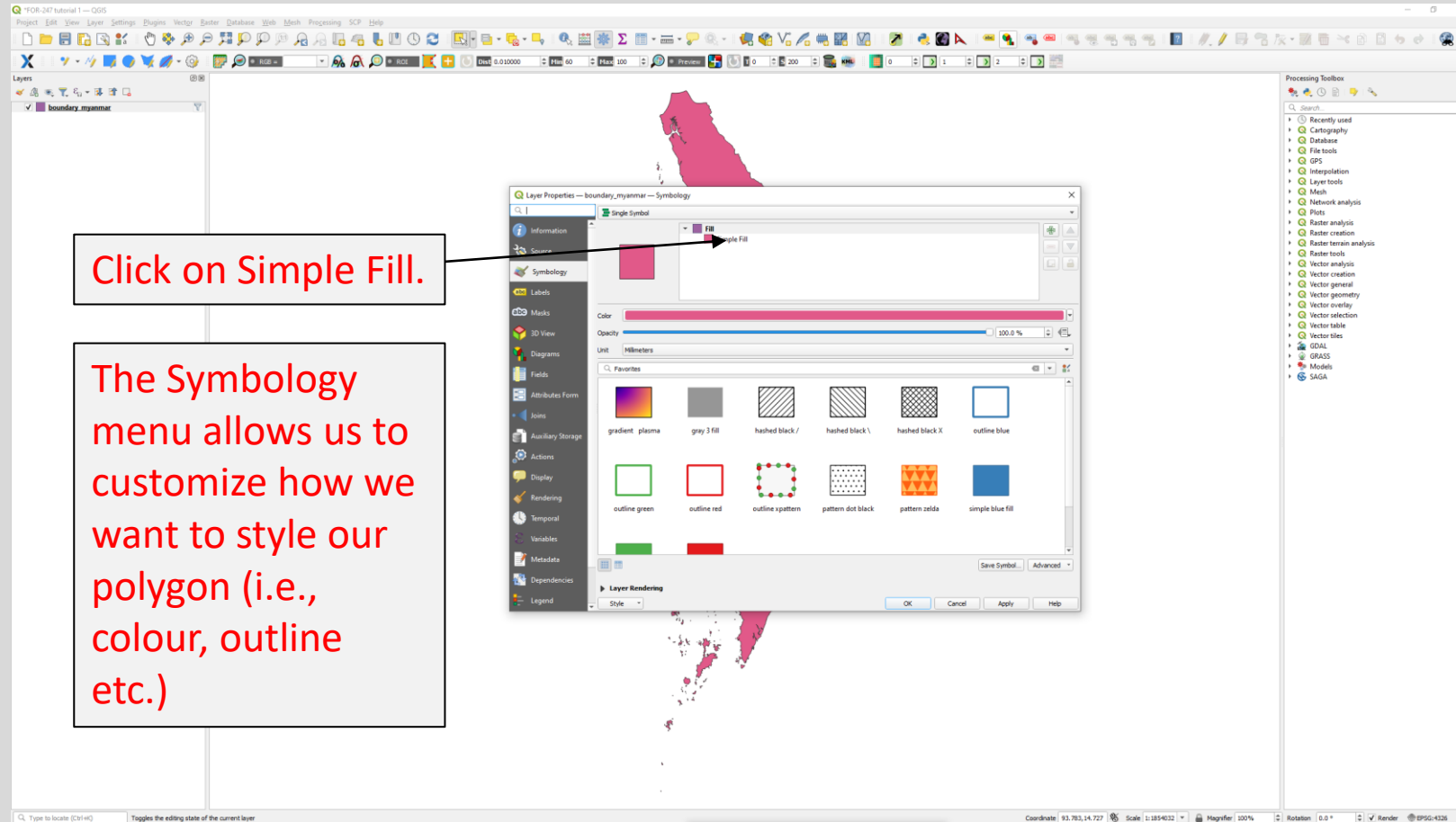
Filtering the Shapefile to Tanintharyi



Styling vector polygon data



Styling vector polygon data



Styling vector polygon data

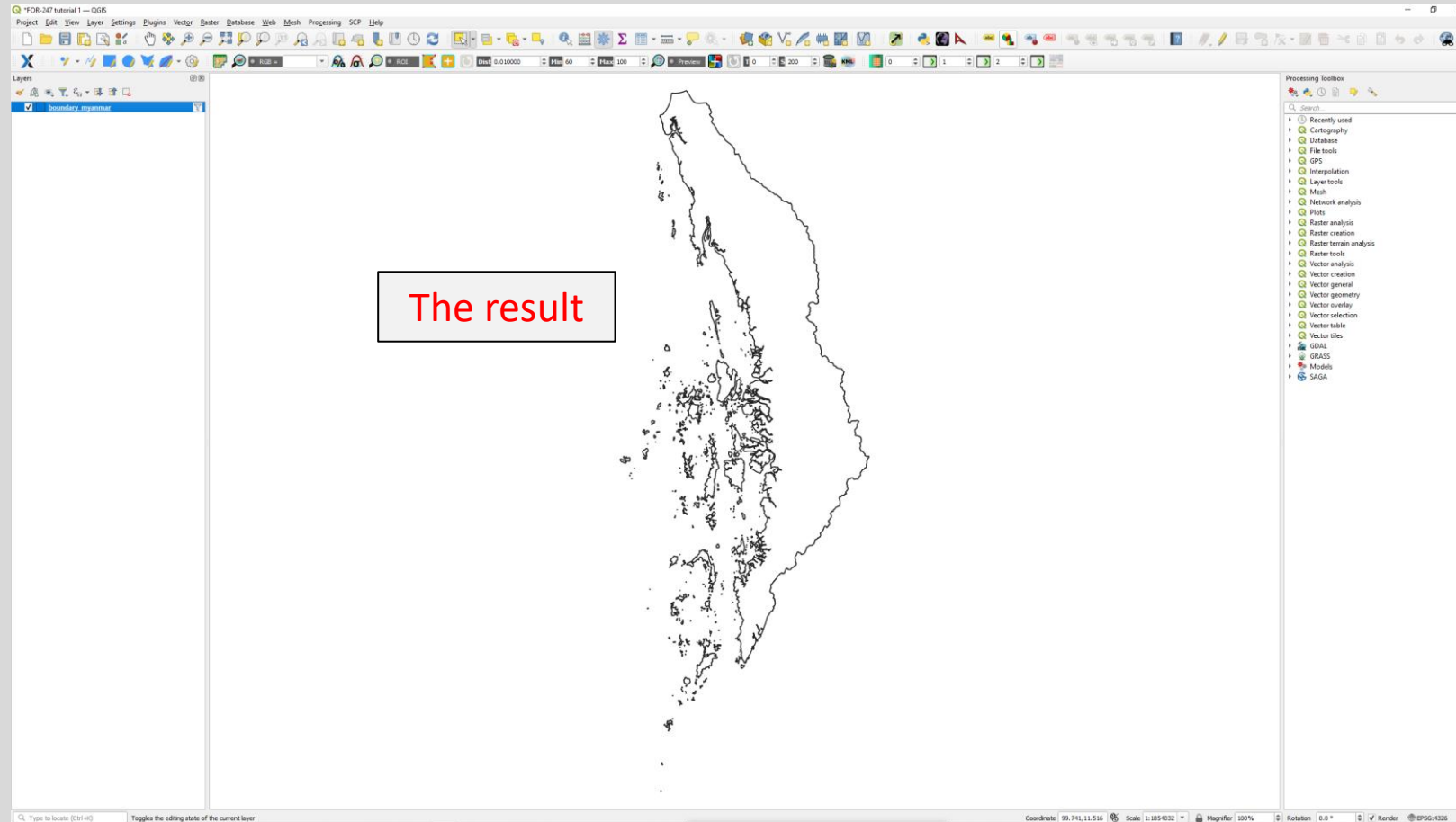
Change the following settings:

Fill style to No Brush

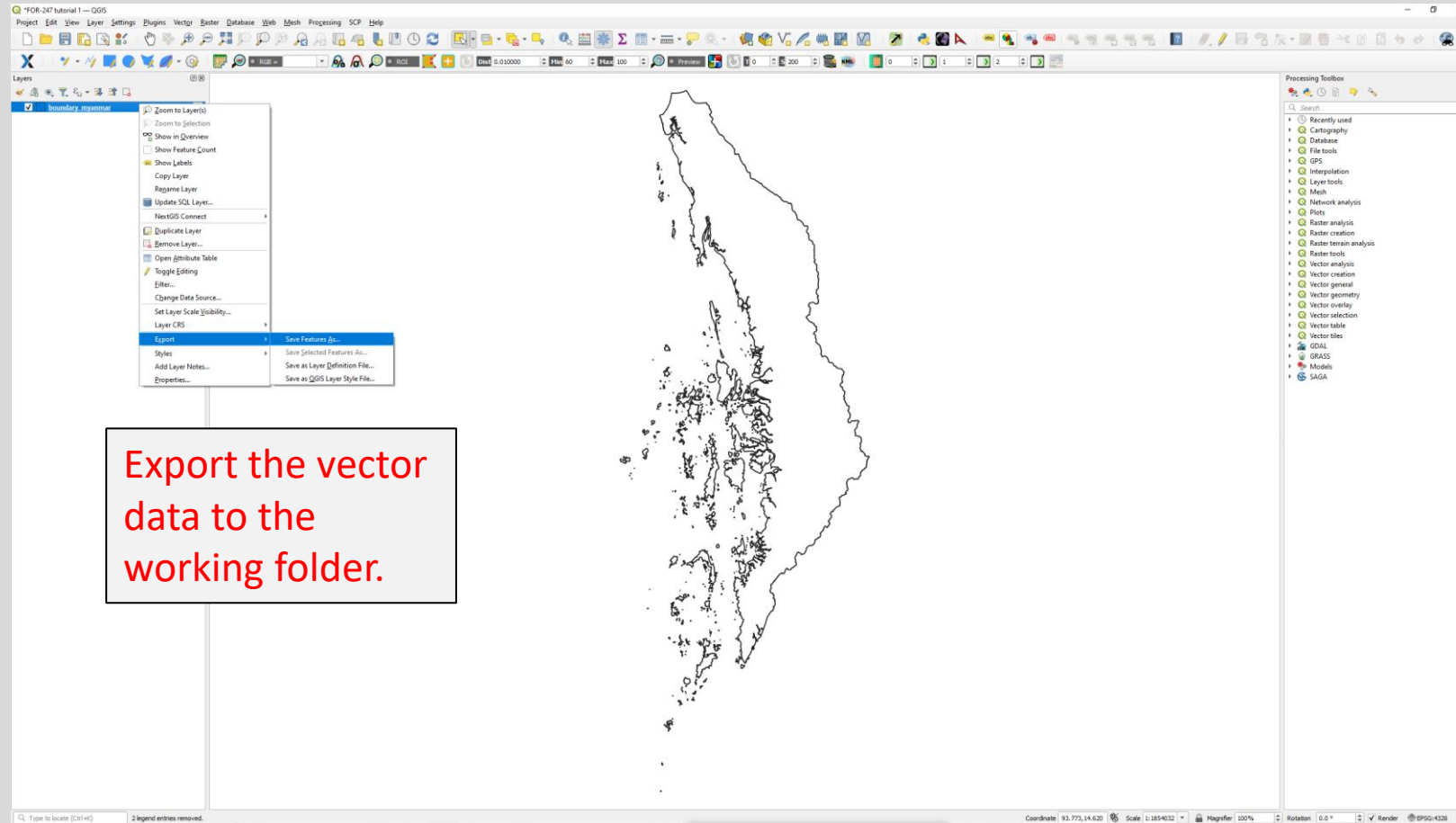
Width to 0.5 mm.

Click OK

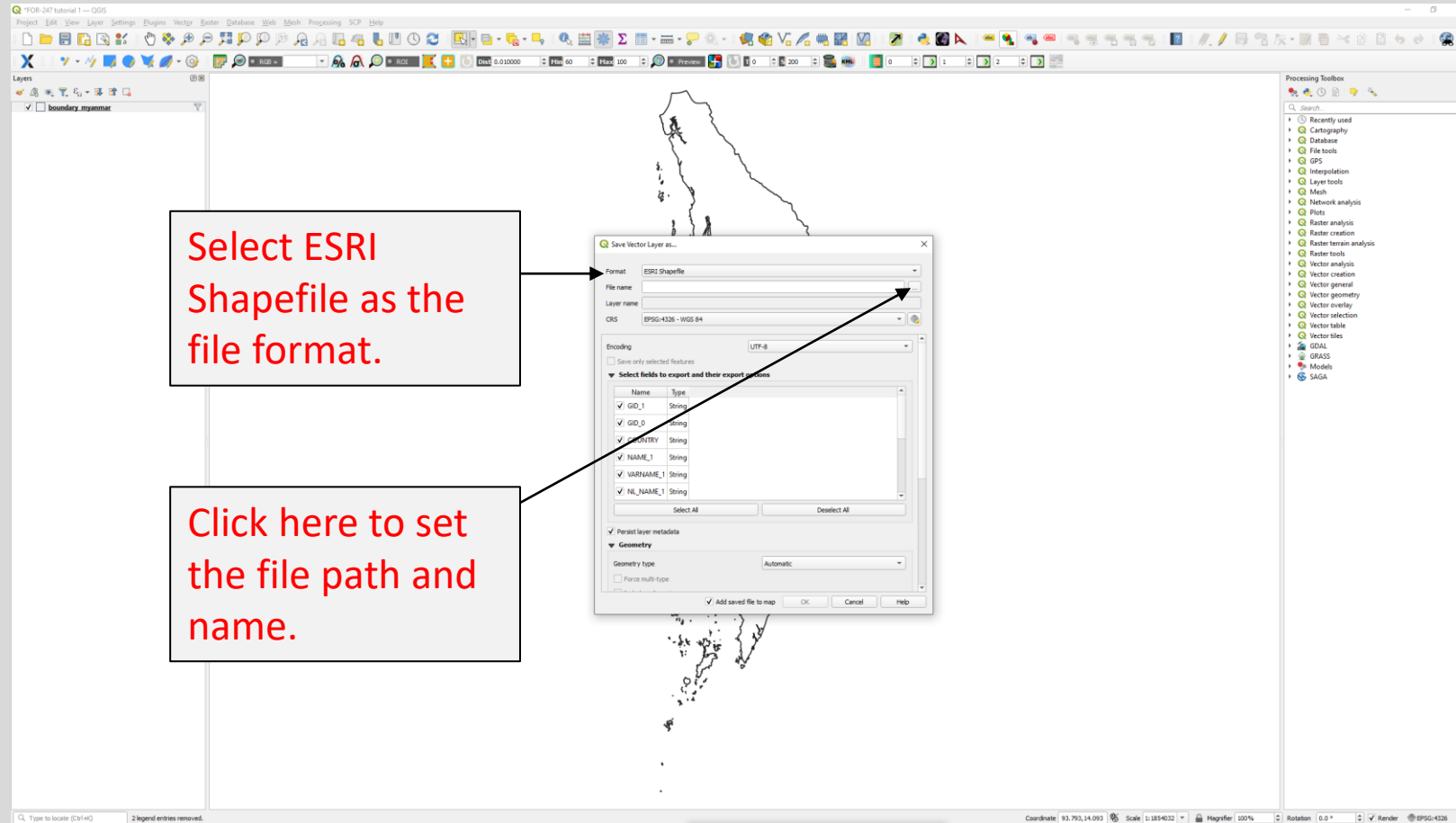
Styling vector polygon data



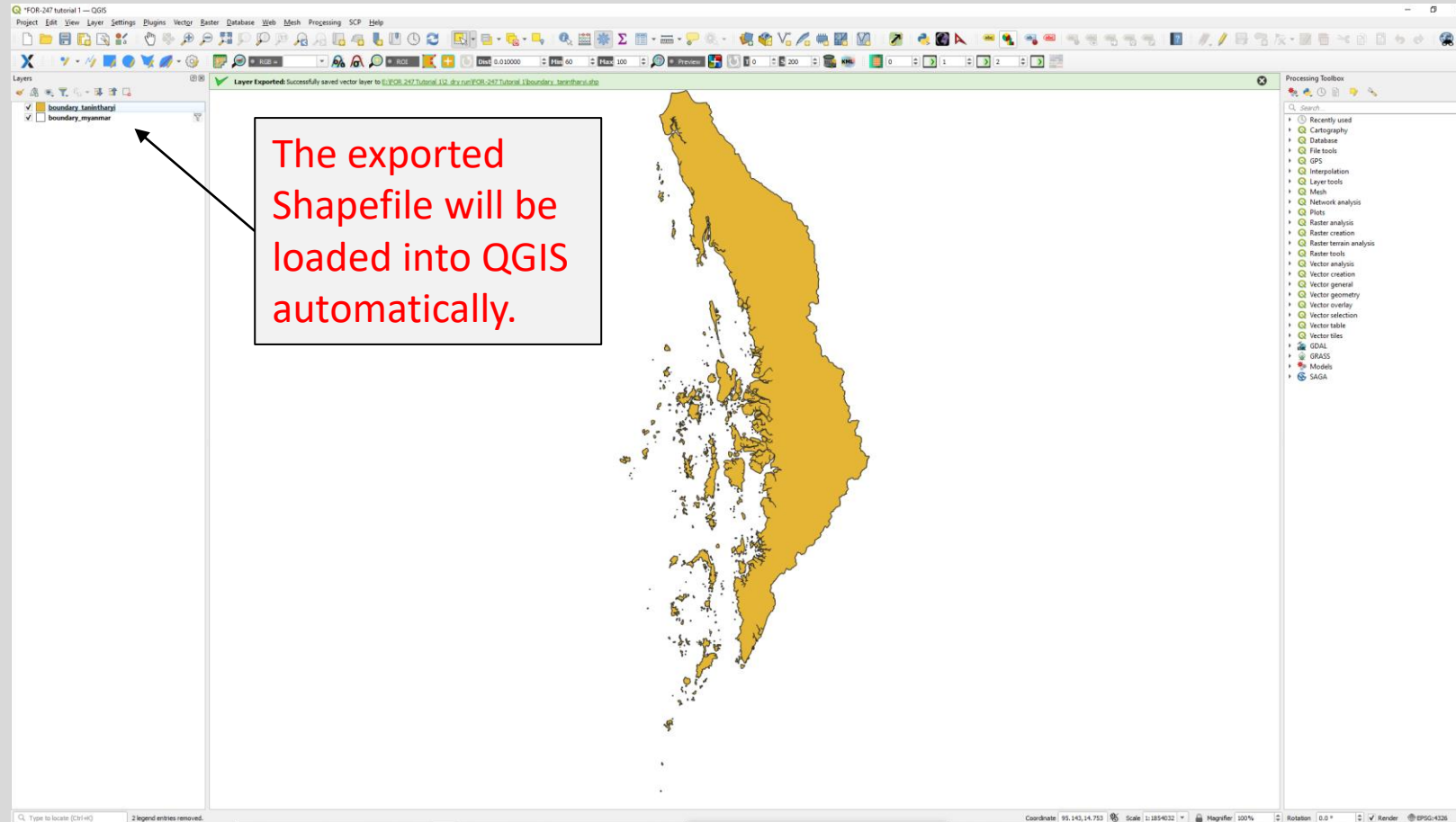
Exporting vector data



Exporting vector data



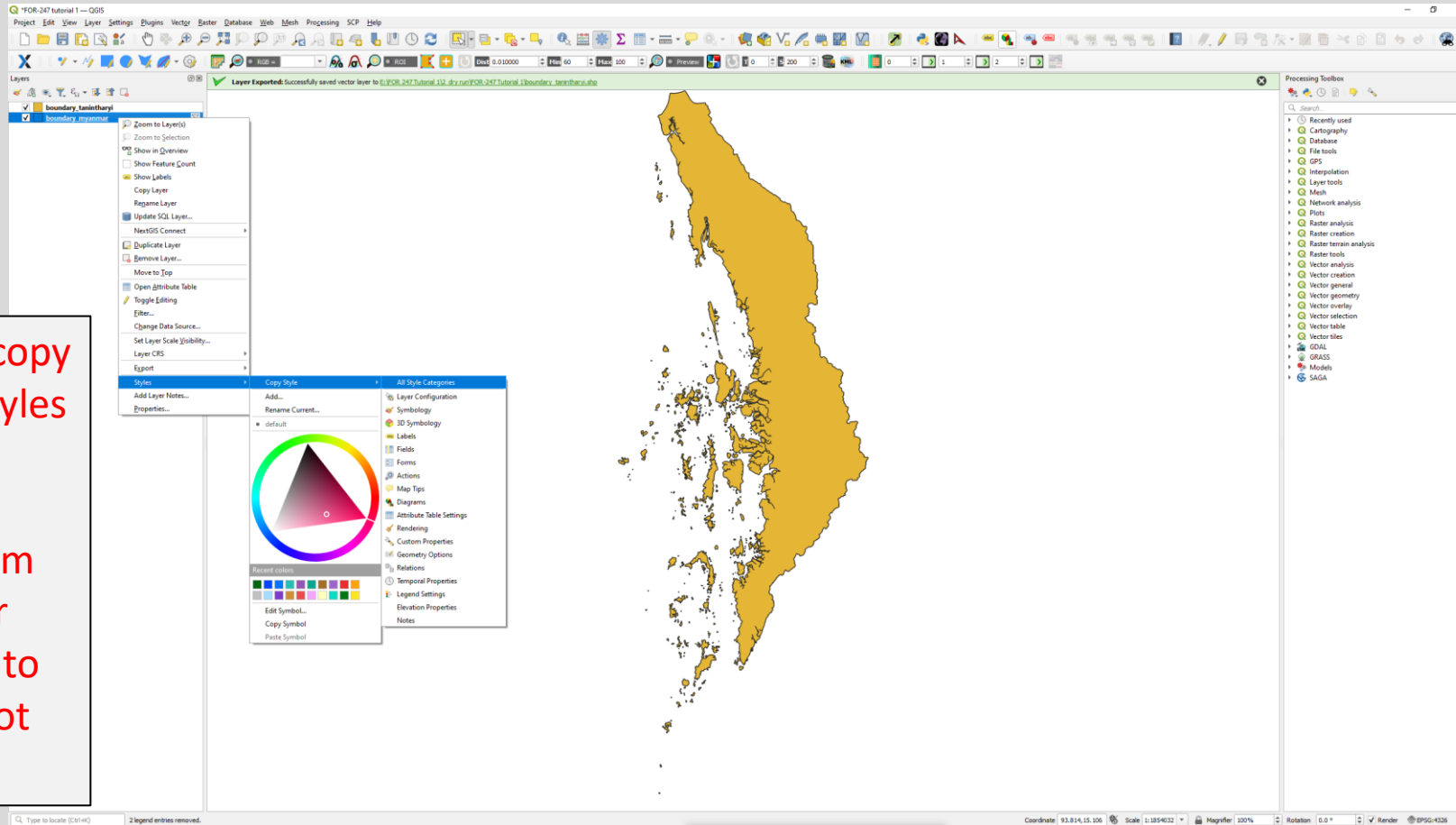
Exporting vector data



Exporting vector data

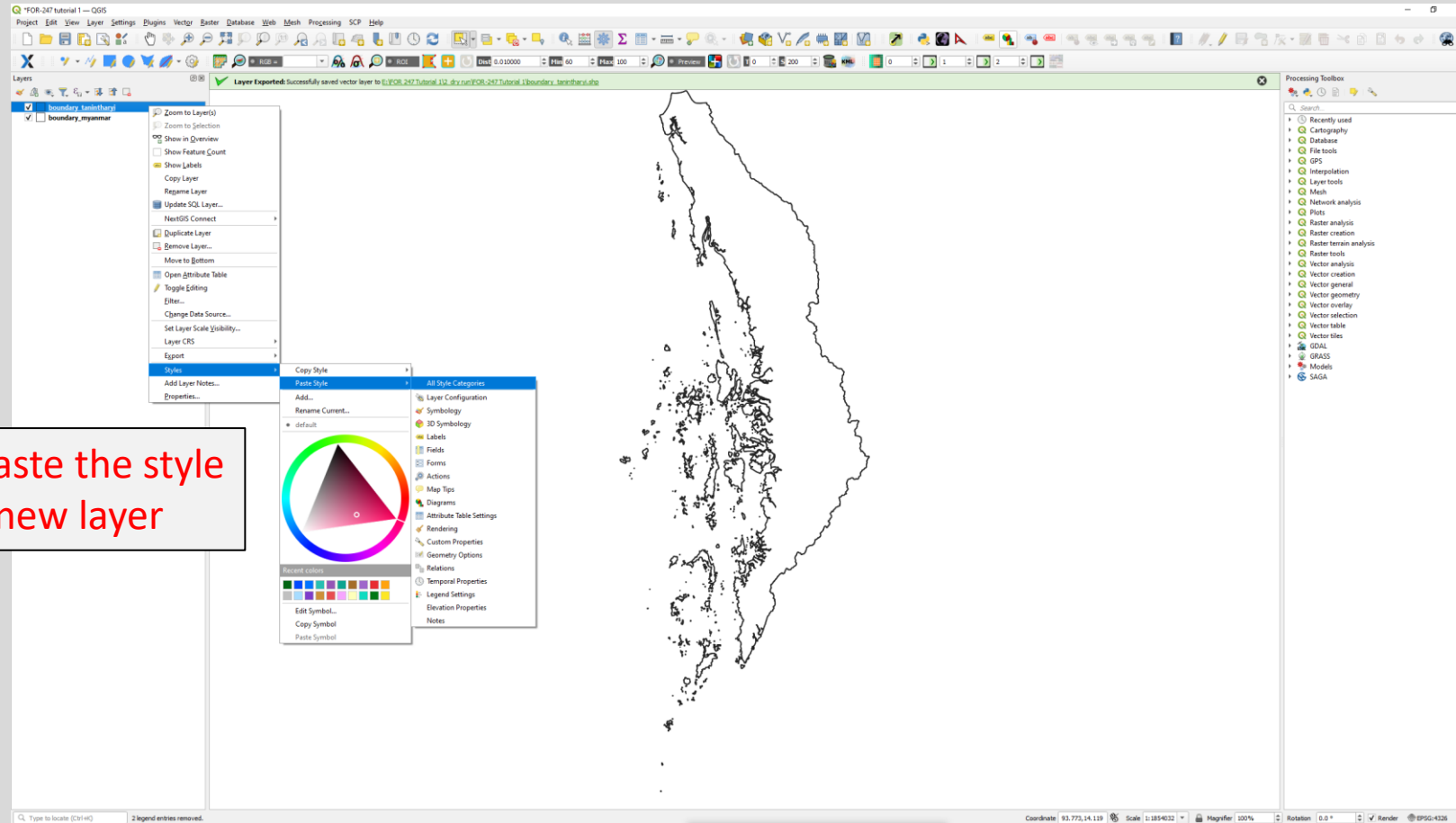
In QGIS, you can copy and paste layer styles and symbologies.

Copy the style from the filtered vector layer and apply it to the one we just got loaded into QGIS.

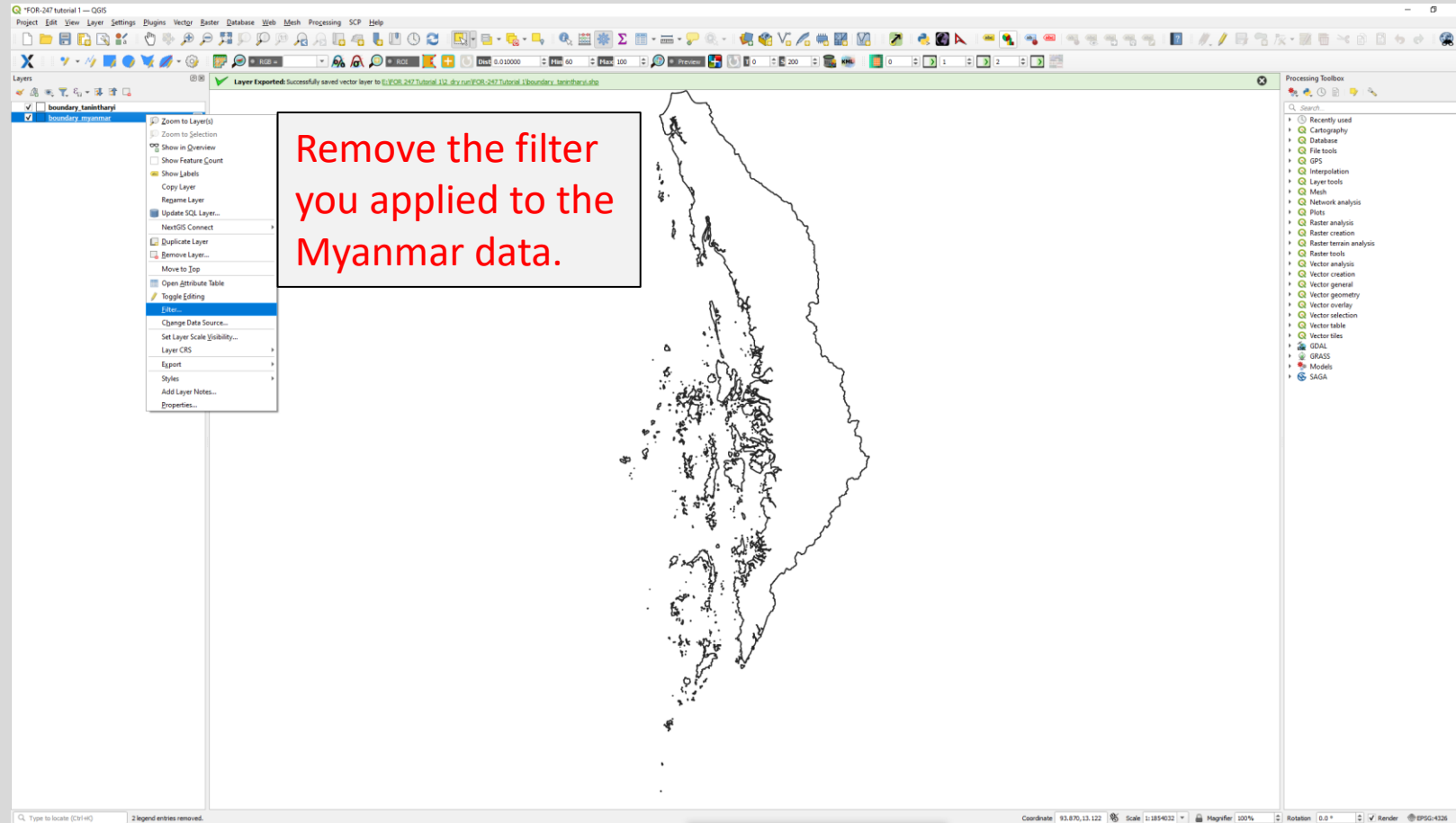


Exporting vector data

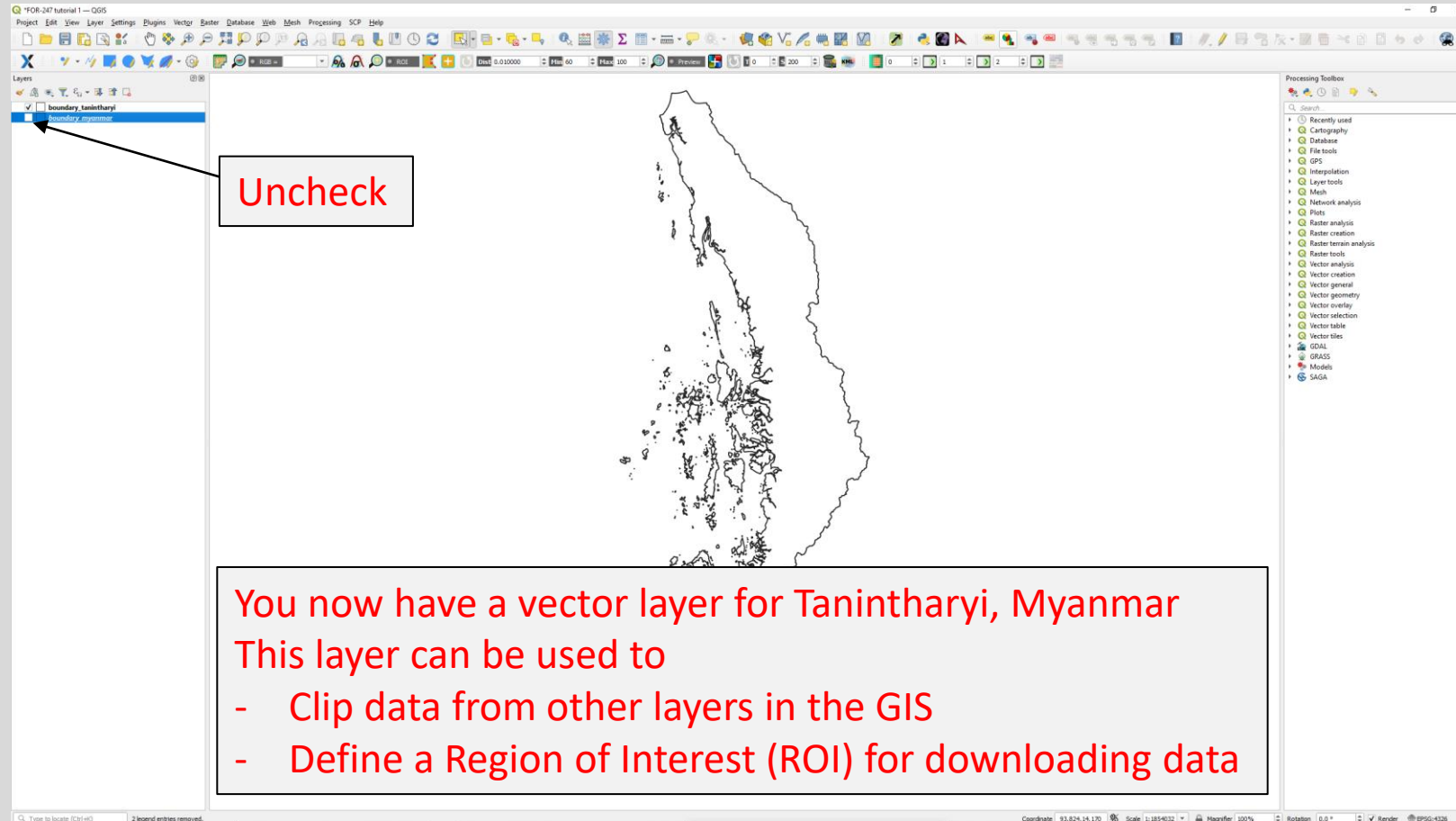
Now paste the style to the new layer



Removing the Shapefile filter



Turning off a layer from the canvas



Raster data processing

Loading raster data

Drag-and-drop the 2 land cover files from your working folder into QGIS.

By default, the raster maps will be styled using a grayscale colour ramp.

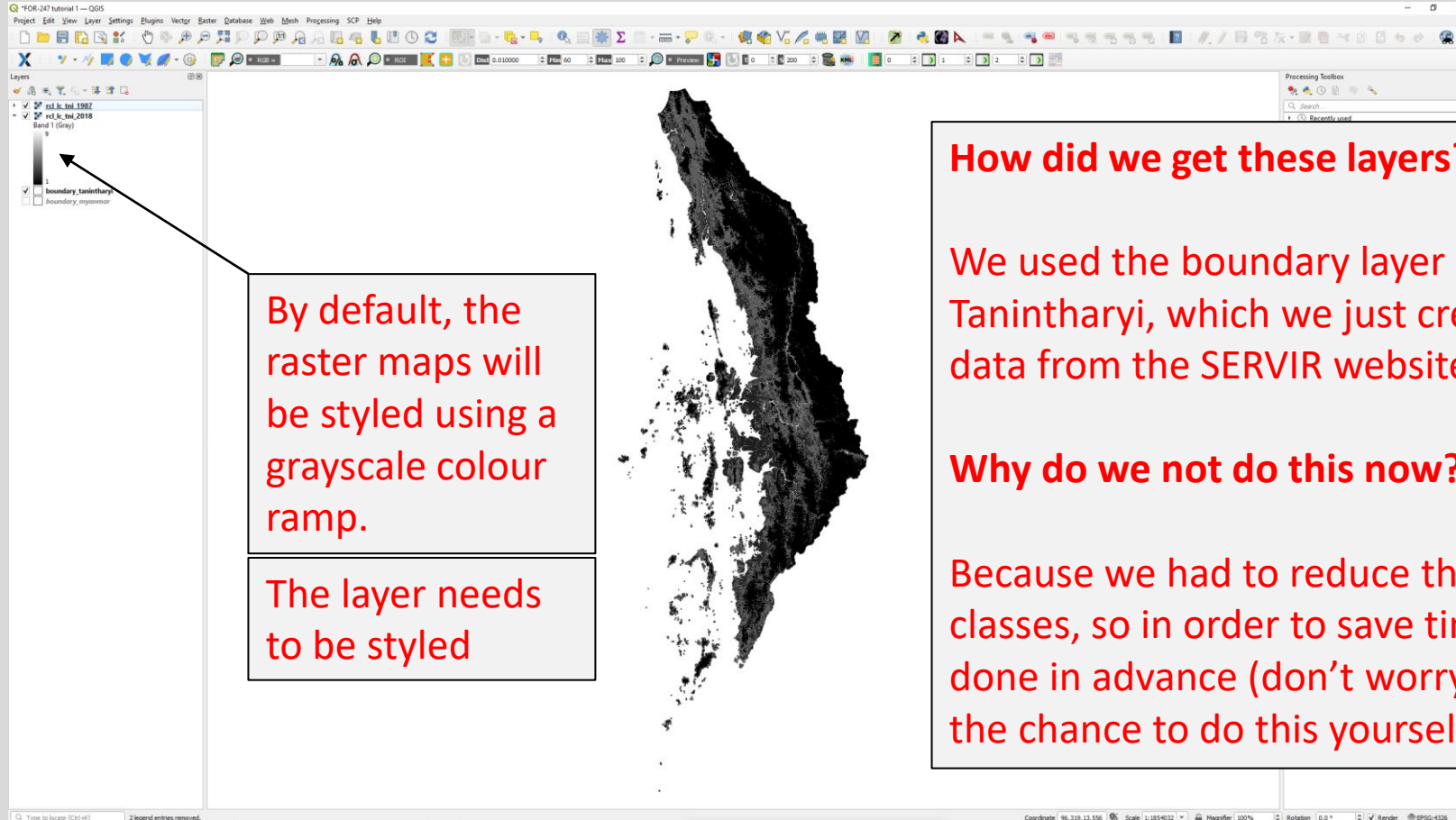
The layer needs to be styled

How did we get these layers?

We used the boundary layer of Tanintharyi, which we just created, to clip data from the SERVIR website.

Why do we not do this now?

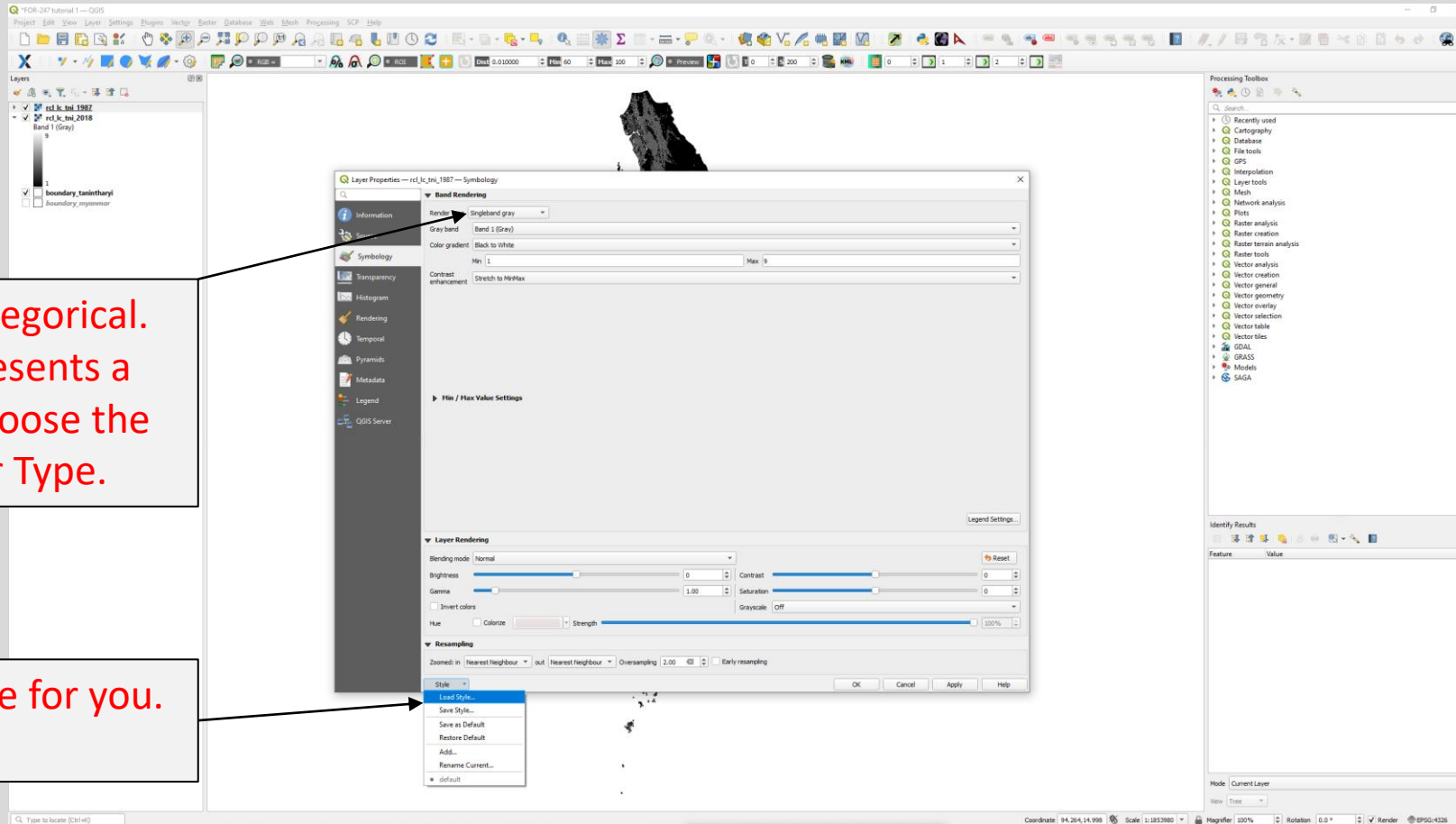
Because we had to reduce the number of classes, so in order to save time it was done in advance (don't worry, you will get the chance to do this yourself later)



Styling the landcover layers

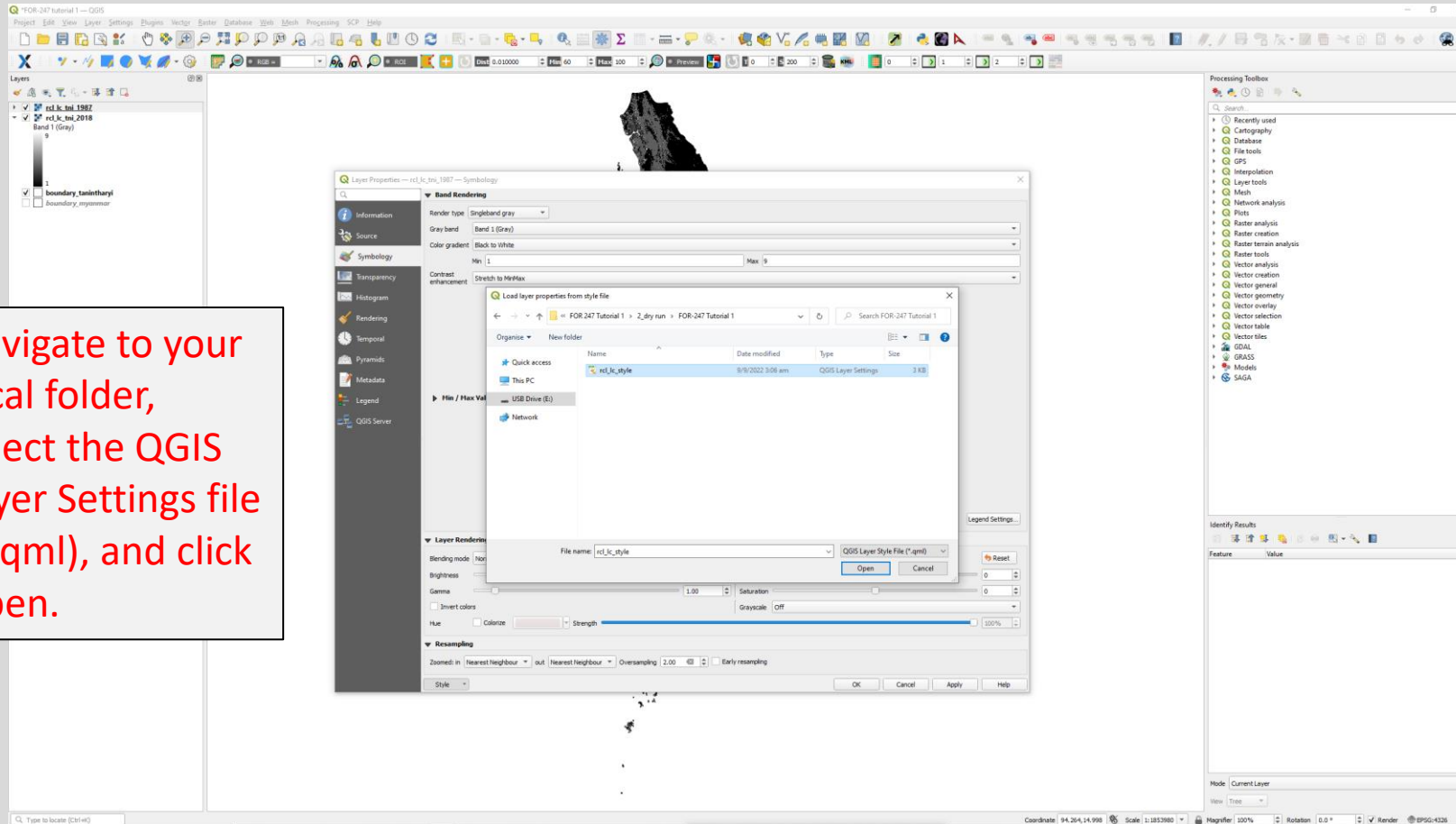
The map data is categorical.
Each category represents a
land cover type. Choose the
appropriate Render Type.

We made a GIS style for you.
Load it.



Styling the landcover layers

Navigate to your local folder, select the QGIS Layer Settings file (*.qml), and click Open.



Styling the landcover layers

Look through the raster colours and labels for pixel values 1–9.

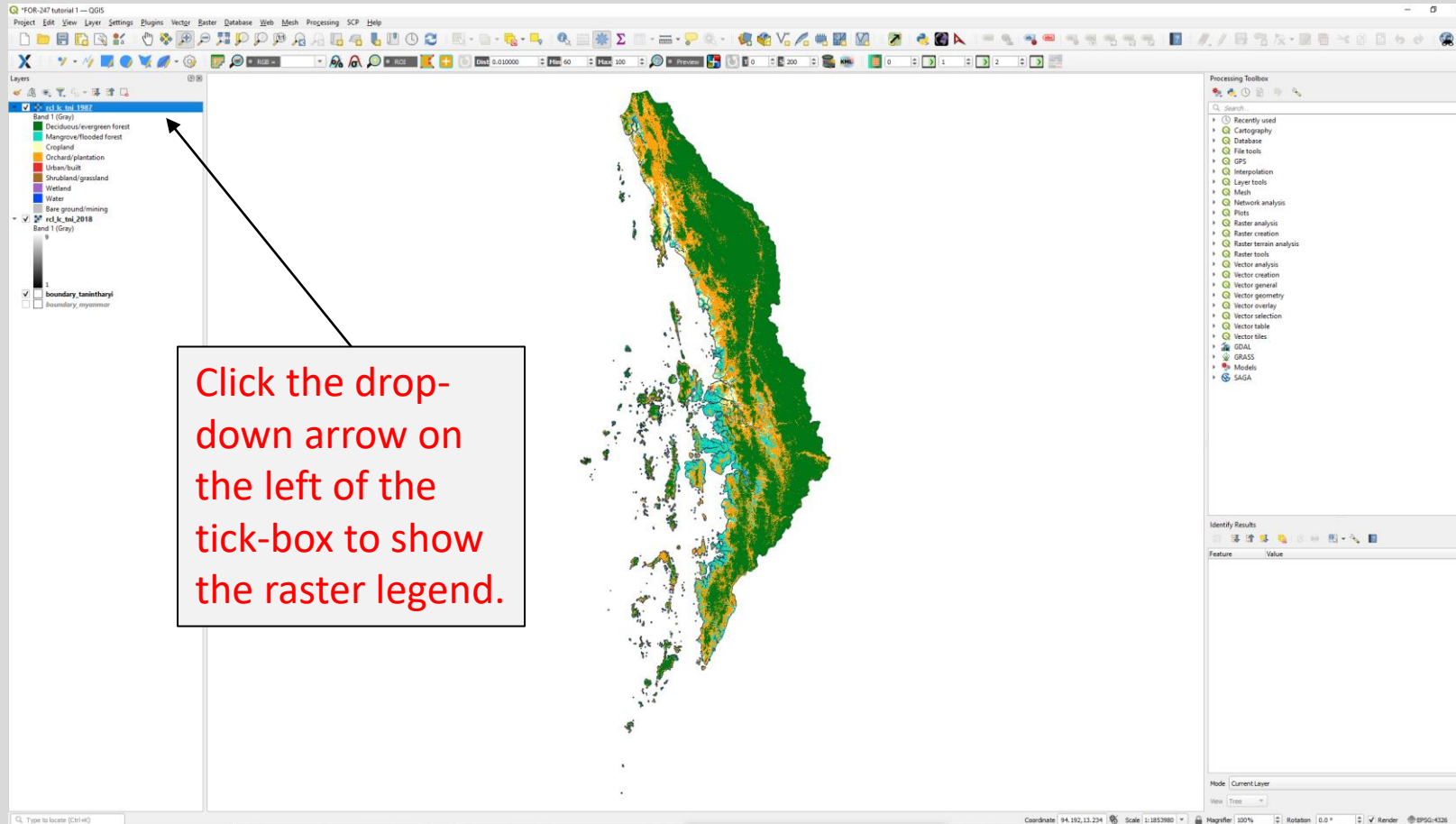
Click OK.

Recall that the original SERVIR data has 17 classes. These were reduced to 9 for your convenience.

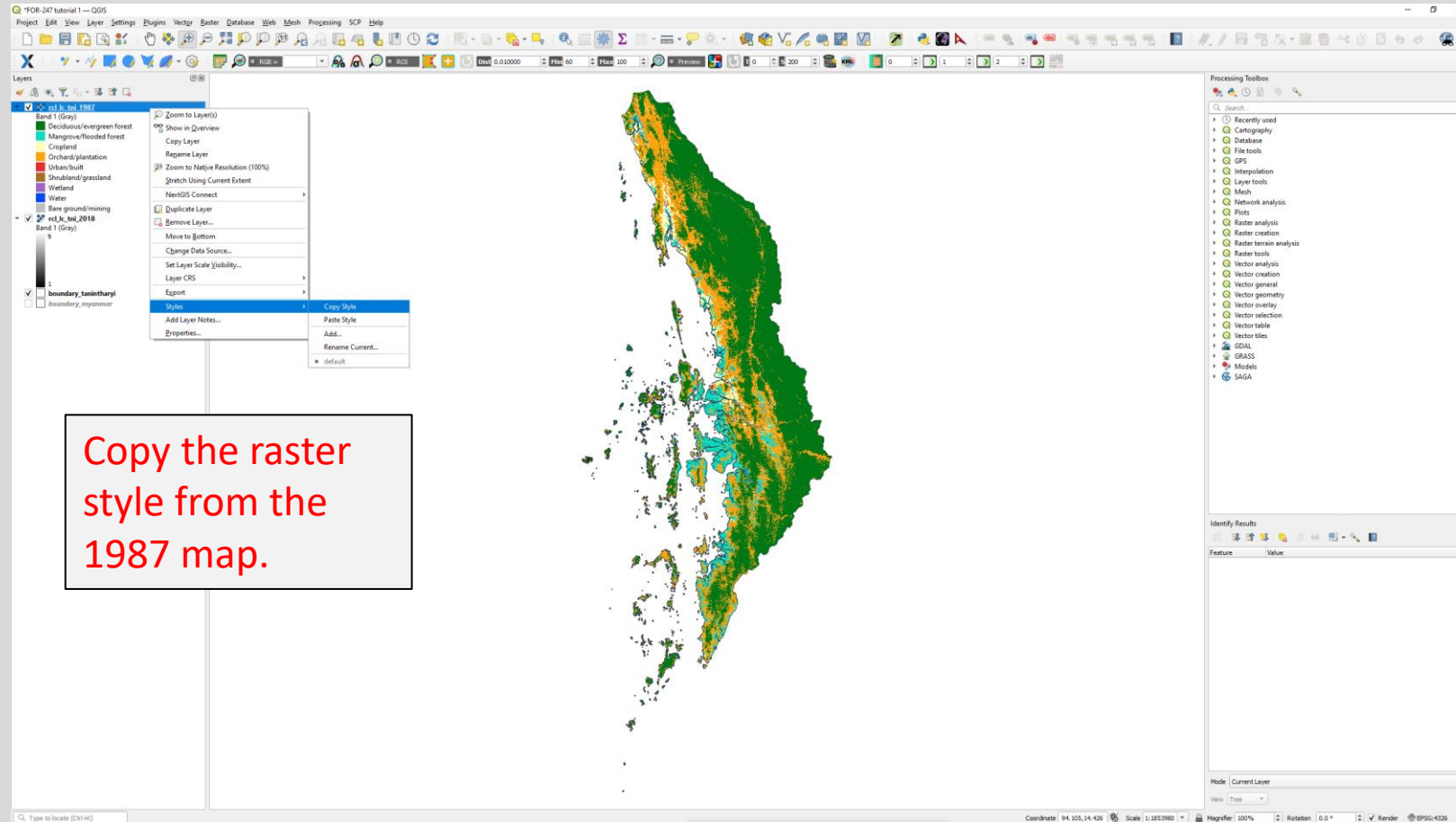
Value	Color	Label
1	Dark Green	Deciduous/evergreen forest
2	Light Green	Mangrove/flooded forest
3	Yellow	Cropland
4	Orange	Orchard/plantation
5	Red	Urban/built
6	Brown	Shrubland/grassland
7	Purple	Wetland
8	Blue	Water
9	Gray	Bare ground/mining

Visually interpreting land cover
change

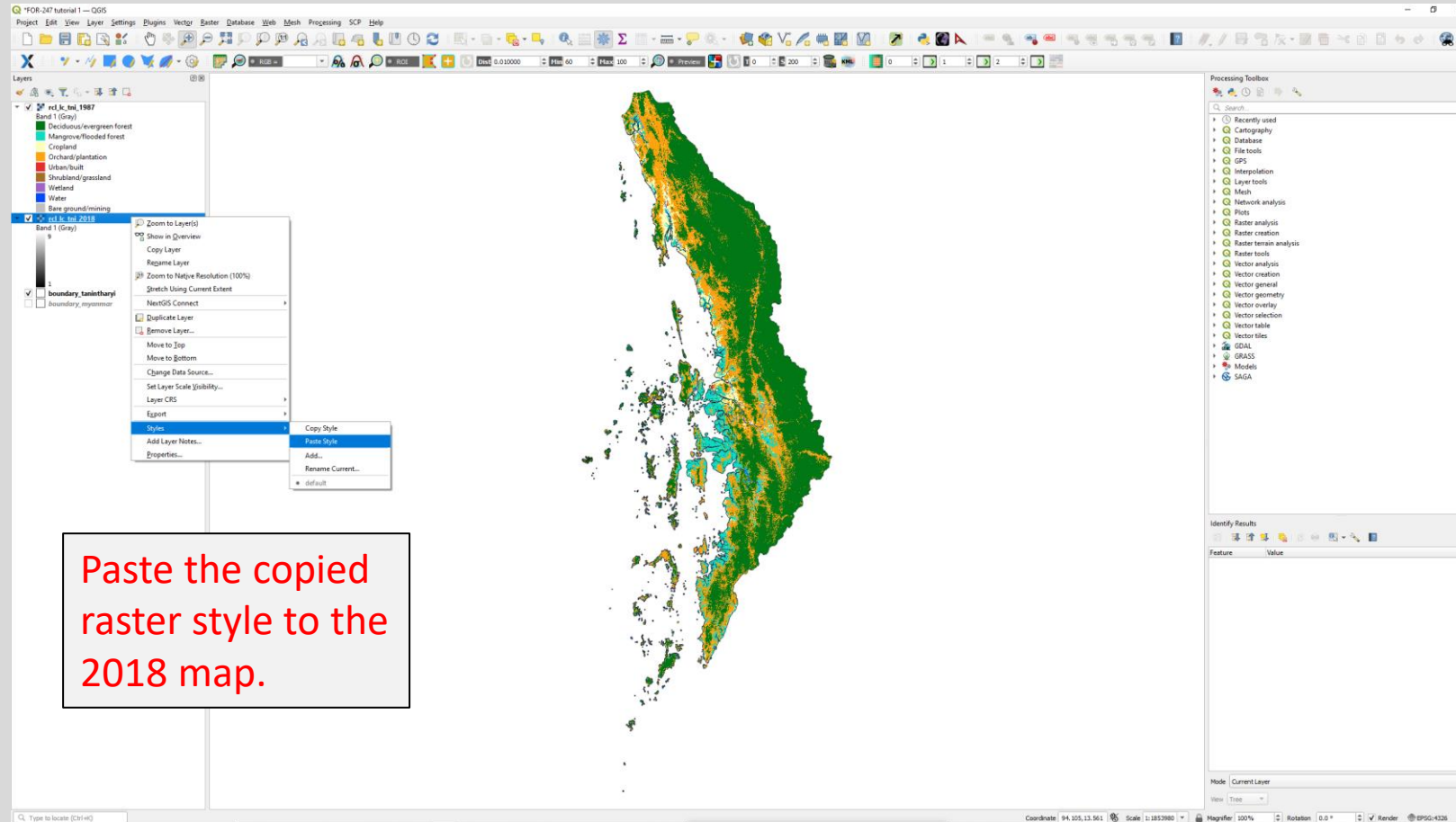
Visually interpreting land cover change



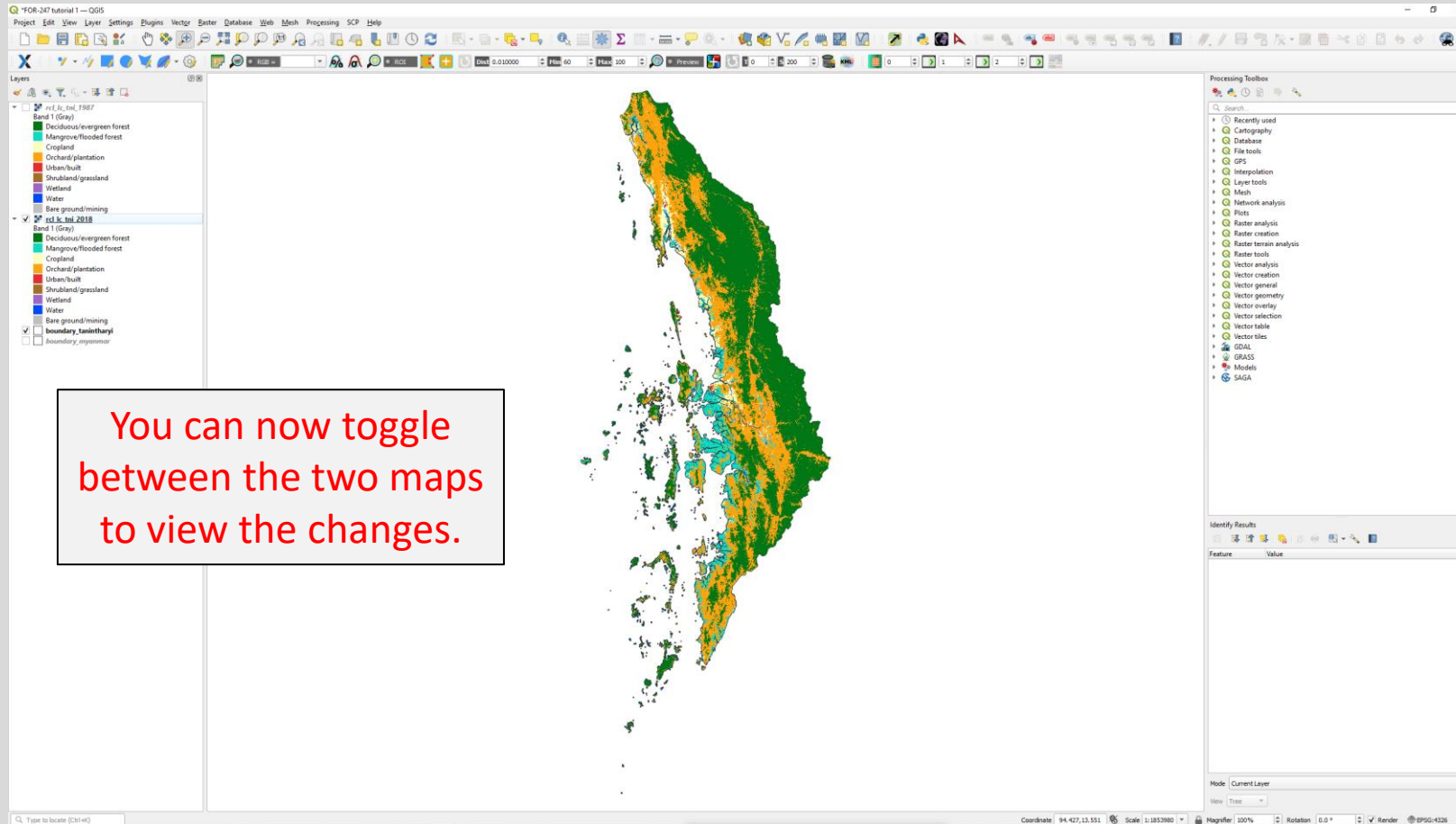
Visually interpreting land cover change



Visually interpreting land cover change



Visually interpreting land cover change



Visually interpreting land cover change

