Modern Tools for NTDs Control Programmes
Practical 1

Becoming familiar with QGIS interface and GIS features
Aim of practical

This first practical aims to familiarize the trainees with the QGIS interface (latest version available*) and GIS features by exploring the elements in the menu bar, using the main tools to display geographical data and managing the layer attributes.

Key learning skills

In this practical, you will:

- Organize and manipulate data layers
- Use symbology
- Create a base map
- Access layer’s properties menu
- Create a choropleth (graduated) map

*At the time of this course, QGIS 2.18.9-Las Palmas is the latest version available

This work is licensed under a Creative Commons Attribution-NonCommercial-NoDerivs 3.0 Unported License. This means that users are free to copy and share this material with others. Requests for creating new derivatives should be sent to Jorge Cano Ortega (jorge.cano@lshtm.ac.uk).
What is a Geographic Information System (GIS)?

A Geographical Information System (GIS) is an organised collection of computer **hardware, software** and **data** used to link, analyse and display geographically referenced information.

The foundation of GIS is the ability to locate objects and events (streams, villages, disease cases) and link them with appropriate information in order to identify patterns and provide a basis for map making and analysis. Key types of geographical data, represented as separate map layers in a GIS, are outlined in the table below.

<table>
<thead>
<tr>
<th>Data Type</th>
<th>Examples</th>
<th>Image</th>
</tr>
</thead>
<tbody>
<tr>
<td>Points</td>
<td>Villages, houses, wells</td>
<td><img src="image1.png" alt="Image" /></td>
</tr>
<tr>
<td>Lines</td>
<td>Rivers, roads</td>
<td><img src="image2.png" alt="Image" /></td>
</tr>
<tr>
<td>Polygons</td>
<td>Administrative boundaries, census tracts</td>
<td><img src="image3.png" alt="Image" /></td>
</tr>
<tr>
<td>Rasters</td>
<td>Pixel or grid data that can provide continuous data over a geographical area (i.e. satellite-derived data like temperature or elevation)</td>
<td><img src="image4.png" alt="Image" /></td>
</tr>
</tbody>
</table>
Vector data. A representation of the world using points, lines, and polygons. Vector models are useful for storing data that has discrete boundaries, such as country borders, land parcels, and streets.

- **Point features**: A map feature that has neither length nor area at a given scale, such as a city on a world map or a building on a city map.
- **Line features**: A map feature that has length but not area at a given scale, such as a river on a world map or a street on a city map.
- **Polygon features**: A map feature that bounds an area at a given scale, such as a country on a world map or a district on a city map.

Raster data. A representation of the world as a surface divided into a regular grid of cells. Raster models are useful for storing data that varies continuously, as in an aerial photograph, a satellite image, a surface of chemical concentrations, or an elevation surface.

With a GIS application, you can open digital maps on your computer, create new spatial information to add to a map, create printed maps customised to your needs and perform spatial analysis.

What is QGIS?

QGIS is a user friendly Open Source GIS application licensed under the GNU General Public License. QGIS is an official project of the Open Source Geospatial Foundation (OSGeo). It runs on Linux, Unix, Mac OSX, Windows and Android and supports numerous vector, raster, and database formats and functionalities.

QGIS provides a graphical user interface allowing display of map layers and manipulation of data for analyses and map-making.

If you received this practical in printed form, you should have received a copy of QGIS with it. If not, download it from [http://www.qgis.org](http://www.qgis.org).

System Requirements

Windows OS:
Minimum: Pentium III / 256 MB RAM.
Recommended: 1 GB of RAM and 1.6 GHz processor.
Operation System: Platforms Windows and Linux (Win XP or newer, Linux Suse 8.2/9.0/9.2, Linux Debian (Lliurex))

MAC OS:
PC/Desktop with at least Pentium IV
Tiger OS, Leopard OS
Data set description

Two types of data sets are provided: geographical data and epidemiological data.

- Geographical data set: Cameroon administrative boundaries, populated locations, hydrology, transport network (railways and road) and Digital Elevation Model (DEM).
- Epidemiological data set: records of morbidity cases related to lymphatic filariasis collected in 2015.

<table>
<thead>
<tr>
<th>File name</th>
<th>Description</th>
<th>Columns</th>
</tr>
</thead>
<tbody>
<tr>
<td>CMR_locations_PopEst2015.shp</td>
<td>Contains a sample of 690 locations in Cameroon with estimated population sizes</td>
<td>latitude, longitude, location (name), PopEst2015</td>
</tr>
<tr>
<td>CMR_adm0.shp</td>
<td>Country boundaries for Cameroon (ESRI shapefile) Digital Chart of the World</td>
<td></td>
</tr>
<tr>
<td>CMR_adm1.shp</td>
<td>Regional boundaries for Cameroon (ESRI shapefile) Digital Chart of the World</td>
<td></td>
</tr>
<tr>
<td>CMR_adm2.shp</td>
<td>District boundaries for Cameroon (ESRI shapefile)</td>
<td></td>
</tr>
<tr>
<td>CMR_water_areas.shp</td>
<td>Major water bodies for Cameroon, (ESRI shapefile)</td>
<td></td>
</tr>
<tr>
<td>CMR_water_lines.shp</td>
<td>Major rivers for Cameroon (ESRI shapefile)</td>
<td></td>
</tr>
<tr>
<td>CMR_roads.shp</td>
<td>Main roads for Cameroon (ESRI shapefile)</td>
<td></td>
</tr>
<tr>
<td>CMR_rails.shp</td>
<td>Main railways for Cameroon (ESRI shapefile)</td>
<td></td>
</tr>
<tr>
<td>DEM_1km.tif</td>
<td>Digital Elevation Model (DEM) over 1 km² spatial resolution, GeoTIFF format Obtained from SRTM 30 (USGS)</td>
<td></td>
</tr>
</tbody>
</table>

For this session, you will use the geographical datasets to learn about the QGIS’ basic functions and capabilities. At the end of this session - you will have working knowledge of QGIS’ environment for plotting maps.

1 Digital Chart of the World available in DIVA-GIS website; [http://www.diva-gis.org/gdata](http://www.diva-gis.org/gdata)
QGIS main interface

When you first open QGIS, you will see a new window like the example below.

QGIS interfaces change from one project to another depending on the required interface of the project. Below are the basic menus that you will encounter in QGIS during the practical session.

1. **Title of the Project**
2. **Menu Bar** - This provides access to various QGIS features.
3. **Toolbars** - These provide access to most of the same functions as the menus, plus additional tools for interacting with the map.
4. **Table of Contents/Map Legend (TOC)** - Shows the layers that can be turned on or off and the legend, attributes symbols and query symbols available.
5. **Display Window** - Displays feature/s turned on from the TOC.
Status Bar - Displays current position in map coordinates (e.g. metres or decimal degrees). Button to the left of the coordinate display toggles between coordinate position or the map view.

Data sources browser -. In QGIS 2.18.9 the QGIS browser is integrated into the QGIS framework to enable users to explore spatial data sets.

**QGIS toolbars and some other components**

Toolbars are divided by thematic (greyed icons mean they are inactive because the appropriate conditions to use them are not fulfilled). Some of them are included by default in QGIS and others can be added/removed from the interface:

File

Manage Layers (vertical)

Map Navigation

Attributes

Label

Raster

Editing/Digitizing

GRASS plugin

Advanced Digitation
Key functions

Here, you will learn how to use QGIS’ different mapping tools and other components that you will be using in this practical.

**File Options**

**New Project**
create a new project.

**Open Project**
open an existing/previous project created in QGIS.

**Save Project**

**Save Project As**
save the project in another format.

**Displaying Layers**

**Add Vector Layer**
Add any readable existing vector format layer.

**Add Raster Layer**
Add any readable existing raster format layer.

**Table of Contents. Menu**

**Turns layer on or off**
Click the box to turn on ✗ or off ☐ the layer/s.

**Folder icon in the TOC**
This represents a group of layers in the TOC.
Grayed colour means only selected layers are visible in the group of layers.
**Navigation toolbars**

**Zoom in**
Zoom in or drag a box over the particular area.

**Zoom out**
Click once in the map.

**Panning**
Click in the map, hold down the mouse button, and drag in any direction.

**Zoom to Full**
Return to default view or view the full map layer/s.

**Zoom to Selection**
View the selected part of map layer/s.

**Zoom to Layer**
View a particular map layer.

**Object Information**

**Identify Features**
Activate and point to the layers you want to view the information.

**Open Attribute Table**
Open the attribute table of a layer.
Practical 1

1. Creation of a GIS File Directory

Always, it is important to work orderly. For that, we suggest a simple way to store the spatial and epidemiological data provided and save the new spatial data or features to be created.

- Right click on Start menu and select Open Windows Explorer or Explore, depending on your version of Windows.

  Note: In Windows 7 you can find an icon in the taskbar which provides a direct access to Explore option.

- Create a folder on your C: drive called QGIS_training (C:\QGIS_training).

- Copy over the Cameroon_project folder (provided together with QGIS Application) into this folder.

- Inside the Cameroon_project folder, you will find the following sub-folders to use during this training: Raster_layers, Tables and Vector_layers.

  Every time you create a new layer or feature, or you have collected new files, you should place them in any of these folders according to the type of data.

  Note: QGIS does not store files within the programme, but rather references the programme to the correct location.

Explore the spatial and epidemiological data available for this project using the QGIS Browser which is installed along with QGIS 2.18.9 Desktop.

- Start QGIS Browser.

- Open the folder containing project information to view the practical’s files. These are the paths you will use when you have to find data:
  
  ✔ C:\QGIS_training\Cameroon_project\Vector_layers  
  ✔ C:\QGIS_training\Cameroon_project\Tables  
  ✔ C:\QGIS_training\Cameroon_project\Raster_layers
Always open and review the files you have downloaded before saving them in your preferred directory.

The *Browser* functionality is included in the QGIS interface as a panel beneath the *Layers Panel*. From the *Browser Panel* tab, you can explore the spatial dataset available as you have done previously with the application *QGIS Browser*. 
2. Displaying geographical data

There are two types of geographical data: vector and raster.

2.1. Exploring different formats of spatial data I: vector layers.

Display the geographical information by adding layers. The steps to add layers are:

- Click on Add Vector Layer button in the tool bar or type ‘Ctrl-Shift-V.’ This will bring up a new window.

- From the available options check File and click Browse. This will allow you to navigate the file system to “C:\QGIS_training\Cameroon_project\Vector_layers.”

- Click on CMR_adm0.shp and then on Open to load it into QGIS.

The outline of Cameroon will appear in the map display window and will be listed in the Layers Panel.

You should see a little checkbox on the left-side for each layer listed in the Layers Panel.

- If you want to turn off a layer, just click the checkbox.
- Click again in the checkbox to turn on the layer.
Now, add to your map project the rest of the vector layers included in the Vector_layers folder.
- CMR_adm1
- CMR_adm2
- CMR_water_areas
- CMR_water_lines
- CMR_rails
- CMR_roads

**Note:** Select at once all Vector layers that you want to display by holding down the Ctrl key and select the layers to load at the same time.
Never mind if the map looks unreadable at this point! In the next sections we are going to explore different tools to improve our results and personalize our maps.

2.2. **Exploring different formats of spatial data II: raster layers.**

- Click on Add Raster Layer icon in the tool bar or press ‘Ctrl-Shift-R.’ This will bring up a new window.

- Browse the file system to select the *Raster_layers* folder (“C:\...\Cameroon_project\Raster_layers”).

- Click on *DEM_1km.tif* and then on Open to load into QGIS.

*Note: QGIS has been developed to work with different raster formats. Select the type of raster that you want to add to your map project in File type tab if it is known, otherwise select “All files (*)” option.*

- As a raster file is a continuous grid, when loading this type of file to the map project other open layers will become hidden. We will proceed to turn off the *DEM_1km.tif* layer as it is hiding the rest of layers. We will return to this raster file later.
2.3. Managing layers

Currently, you have multiple layers displayed together on one map, i.e. they are displayed on top of each other. As well as adding and deleting layers, layers can be grouped together so that they can be turned off and on together.
• Right click in the **Layers Panel** beneath the list of layers, a small menu should appear. Here, select **Add New Group**.

• Right click on “group1” and select **Rename**. Rename this group of layers “Basemap”.

• Repeat the above process to create another new group, and rename this as “Rastermap”.

![Diagram of layers panel and map](image-url)
Click and drag all vector layers (highlighted in red box) under the new created group “Basemap.” Likewise, click and drag any raster layers to the group “Rastermap”. They can now be turned off and on at once by checking the group box in the Layers Panel.

Note: QGIS draws layers one at a time; the layer at the bottom of the legend first and the one at the top last. Layers should be organised so raster datasets are arranged at the bottom, followed by polygons, lines and points at the top.
• To change the order in the Layers Panel, move the cursor over the layer name in the Layers Panel and, holding the left mouse button down; drag this layer to its new location.

• Change the order in your legend to (from top to bottom) CMR_water_lines, CMR_roads, CMR_rails, CMR_water_areas, CMR_adm2, CMR_adm1 and CMR_adm0. The group “Rastemap” which contains the raster layer DEM_1km should be beneath group “Basemap”.

2.4. Using Navigation Toolbars

At present, your map project is displayed at a high scale (low spatial resolution) and you might be interested in the data displayed in a particular area at a lower scale. There are several ways to zoom in and out of maps and we will explore some of these.

• Click on the Zoom In button in the tool bar.

• Click again on the Zoom In button. Decide on an area you wish to zoom towards. Move the cursor to the top area of interest, then holding the left mouse button down, drag out a box to cover the area required and release the mouse button.
• To get back to a full overview of your map project, move the cursor over the entry for either CMR_adm0, CMR_adm1 or CMR_adm2 in the Layers Panel, and right-click on the mouse to open the layer’s Properties and choose Zoom to layer from the available options.

• Alternatively, under View in the menu bar, choose Zoom Full. This will zoom to the area covered by the largest layer. Also, you can use the Full Extent button found in the toolbar.
• Click on the **Zoom Out** button, place the cursor somewhere in the map display area and click once.

• To move or pan around the view use the hand or **Pan** tool on the menu bar to click and grab the screen.

**Note:** You can also easily zoom in and out placing the cursor somewhere in the map and using the mouse's center scroll wheel if available.

3. Layer properties. Exploring properties of geographical data

3.1. **Vector properties dialog**

The **LAYER PROPERTIES** dialogue box for a layer provides information about the layer, symbology settings and labelling options.

• To access the **LAYER PROPERTIES** dialogue box, double-click on any layer in the **Layers Panel** and LAYER PROPERTIES pop-up menu will appear. Alternatively, right-click on any of the vector layers and select **Properties** from the pop-up menu.
• **Style** tab enables us to change the symbology of features included in the vector layer. There are three types of symbols: marker symbols (for points), line symbols (for lines) and fill and outline symbols (for polygons). Symbols can consist of one or more symbol layers. It is possible to define the colour of a symbol and this colour is then defined for all symbol layers.

• **Labels** tab. The *old labelling* in the Labels tab allows you to enable labelling features and control a number of options related to fonts, placement, style, alignment and buffering.
• **Join tab** allows you to join a loaded attribute table to a loaded vector layer. As key columns you have to define a join layer, a join field and a target field.

![Join tab](image)

3.2. **Raster properties dialog**

To view and set the properties for a raster layer, double click on the layer name in the **Layers Panel** or right click on the layer name and choose **Properties** from the context menu.

• **Style tab.** QGIS offers four different **render types**. The renderer chosen is dependent on the data type.

1. **Multiband color** - if the file comes as a multi band with several bands (e.g. used with a satellite image with several bands)
2. **Paletted** - if a single band file comes with an indexed palette (e.g. used with a digital topographic map)
3. **Singleband gray** - (one band of) the image will be rendered as gray, QGIS will choose this renderer if the file neither has multi bands, nor has an indexed palette nor has a continuous palette (e.g. used with a shaded relief map)
4. **Singleband pseudocolor** - this renderer is possible for files with a continuous palette, e.g. the file has got a color map (e.g. used with an elevation map)

![Raster properties dialog](image)
3.3. Changing symbols: vector layers

As you should have noticed from the map of Cameroon on your screen, QGIS randomly chooses the symbol and colour used to display a layer. To change symbology in a vector layer: i) select the layer; ii) change the type of symbol and colour; and iii) apply the changes.

- Open the LAYER PROPERTIES dialogue box by double-clicking on the vector layer’s name or by right-clicking on the name and choosing Properties from the pop-up menu. To change the symbology of CMR_adm2.shp (i.e. districts):

1. Turn off the layers placed above CMR_adm2.shp to clearly visualize the changes that will be applied on this layer’s symbology.

2. Click on the Style tab at the top of this menu. To alter the symbol properties, click on the Simply Fill under the Style, which will cause the Symbol layer type menu to appear within Style’s panel. Here, you can choose to change the symbology of the polygon with the following settings: Fill, Outline, Fill style, as well as levels of transparency (i.e. how concentrated the colour may appear for a polygon).
3. If you only want to change the symbol colour and style you might also click on the Fill option to switch the right panel into a menu which will only let us change shape and colour. Click on the Colour option located below the transparency bar. Select the colour ochre to display the districts of Cameroon.
4. Click OK to accept the changes made, and OK again to close the LAYER PROPERTIES dialogue box. The changes will be applied to the map display.

These procedures are the same whether you are changing point, line or polygon symbols.

Now, it’s your turn. Try to change the symbology for the named vector layers included in the Basemap group so that you may display a more readable and comprehensible map.
Your map should look something like this:

![Map Image]

Settings applied to the symbology of all vector layers loaded:

<table>
<thead>
<tr>
<th>Vector layer</th>
<th>Options</th>
<th>Settings</th>
</tr>
</thead>
<tbody>
<tr>
<td>CMR_water_lines</td>
<td>Symbol layer type: Simple line</td>
<td>Fill (colour): Blue</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Pen width: 0.2 (mm)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Pen style: Solid line</td>
</tr>
<tr>
<td>CMR_water_areas</td>
<td>Symbol layer type: Simple fill</td>
<td>Fill (colour): Blue</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Fill style: Solid</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Outline (colour): Blue</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Outline style: No Pen</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Border width: Hairline</td>
</tr>
<tr>
<td>CMR_adm2</td>
<td>Symbol layer type: Simple fill</td>
<td>Fill (colour): Ochre/Bone</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Fill style: Solid</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Border colour: Black</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Border style: Solid line</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Border width: 0.26 (mm)</td>
</tr>
<tr>
<td>CMR_adm1</td>
<td>Symbol layer type: Simple fill</td>
<td>Fill (colour): None</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Fill style: No Brush</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Outline (colour): Black</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Outline style: Solid line</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Outline width: 0.46 (mm)</td>
</tr>
<tr>
<td>CMR_adm0</td>
<td>Symbol layer type: Simple fill</td>
<td></td>
</tr>
</tbody>
</table>

www.thiswormyworld.org | 27
4. Categorized symbology

Details of railway lines and roads are available from CMR_rails and CMR_roads, respectively. You can apply a distinctive symbology which differentiates the type of
railway lines and roads using CMR_rails and CMR_roads, the following the steps show how:

Roads have been classified as Primary and Secondary routes according to the level of importance for the national road network, we have applied a different symbology to each one.

- Open the LAYER PROPERTIES and select Style by clicking on this tab. There are different types of symbols depending on the nature of the data included in the attribute table: Single symbol, Categorized and Graduated. Choose Categorized as roads have been grouped in two categories.

- In the Column option, select RTT_DESCR which classifies each stretch of road as a primary, secondary or unknown route. Click on Classify to display the different classes or categories included in this field.
• You can see three different categories: primary, secondary routes, unknown and a fourth category (in blank) which corresponds to *undetermined* stretch of road (in blank). Select the latter and click on the delete button.

• Double-click on each category to change the symbology. When clicking on each class a small dialogue box called SYMBOL SELECTOR pops up, enabling us to change the symbology. For primary routes, search and click on the *road* symbol in **Style manager**, and finally click on **Change** to adjust symbol properties.

• This symbol applied to primary roads is composed of two simple lines: a white 1.2600-pen width, and a black 2.26-pen width line. To design our new symbol, switch the former to red 0.55752-width simple line and the latter to black 1 width simple line. Click **OK** to return to the **Style** tab.
• For the secondary routes select simple line, red colour, **solid** line and pen width equal to 0.26.

• For unknown routes select simple line, red colour, **dash** line and pen width equal to 0.26.

• Click **OK** to accept the changes, and **OK** again to close the LAYER PROPERTIES dialogue box. The changes will be applied to the map displayed.

Now, it’s your turn. We have managed to include the road networks, try to include the railways. Use **EXS_DESCRI** to differentiate between railway lines that are operational or unexamined/unsurveyed.

Your map should look something like this:
• Now might be a good time to save your work. Create a new folder within “C:\...\Cameroon_project” and name it as “projects”. Click on the icon “Save as” and save your work as Cameroon_practical_1.qgs, within the “C:\...\Cameroon_project\Projects” folder.
5. Managing layer attributes

Every spatial unit or feature, such as a polygon, point, or pixel may be assigned several values that are associated with relevant attributes. These values are stored in the database file (.dbf) and may be viewed in an attribute table or using the identify tool.

5.1. Getting information on features

Each geographical dataset has at least simple attributes, such as NAME or CODE, and other features assigned to every spatial unit (e.g. population data at district or community level, prevalence data of certain diseases, and so on).

- Using the Zoom In Button, zoom in somewhere on the map where you can see many features.
• You can see that each layer has many different features displayed on our map. There are many different red lines, for example, each representing a different road; blue lines which represents streams and rivers; and yellow/ochre polygons correspond to districts.

• To inspect the attributes of a single feature, select the layer that we want on the left panel or legend, and then click on an object using the Identify Features tool.

• Click on CMR_adm2.shp on the layers panel on the left. Then on the top panel of QGIS, click on the Identify Features icon.

• When you click on a district a new panel will pop up at the right side of QGIS interface, displaying the attributes linked to the selected feature.
You should notice that for the districts, the following attribute are provided: ID_0 (country code), ISO (3-letter country code), NAME_0 (country name), ID_1 (province code), NAME_1 (province name), ID_2 (district code), NAME_2 (district name) and so on. There are always two attributes included in the shapefile which relate to the feature’s geometry - Shape_Leng (perimeter in m²) and Shape_Area (area in m²).

- Practice clicking on different features in different layers (e.g. rivers or water bodies) and examining their attributes.

- When you are finished with the Identify tool, you can close the right panel by clicking on X button at the rightest top corner of the panel. The panel will be prompted any time we use the Identify tool again.

5.2. **Layer attributes table**

The attributes are held in a table called **Layer attribute table**.

- Right-click on *CMR_adm1.shp* in the **Layers Panel** and select **Open attribute table** from the layer menu.

- Each table row corresponds to a spatial feature (administrative district) and each column represents an attribute.
To better visualize the changes on *CMR_adm1.shp* when operating with the Attribute table tools, turn off the rest of the vector layers within Basemap group, and switch the fill colour of districts to white. You can access the Style tab from the layer’s properties by double-clicking on the layer.
• Click on the grey box at the beginning of a row, and the corresponding feature is highlighted in yellow on the map. For instance, you can select the fourth feature in the table which correspond to ‘Adamaoua’ province.

• The selected province will turn blue in the attribute table and the corresponding feature will be highlighted yellow in the map.

• Click the **Zoom to Selection** button either in the tool bar or in the **Attribute table** tools, and the map zooms in to the selected feature.
5.3. **Displaying features using attributes values**

The most useful are the maps that reflect actual attribute values, i.e. maps showing disease rates per village or administrative area, maps of land use or annual rainfall, and maps of population characteristics.
Let’s use an example to display the estimated total population at point locations in Cameroon. The steps to display features using attributes are:

- Keep the following layers under the group “Basemap” active (i.e. CMR_adm0, CMR_adm1 and CMR_adm2), and turn-off all remaining layers.
- From the folder “C:\...\Cameroon_projects\Vector_layer”, add the point layer CMR_locations_PopEst2015.shp into the “Basemap” group at the TOP. This shapefile contains population estimates for 690 sampled locations across Cameroon.
- Change the symbol to represent attribute values. To do this you can choose to use the following options:
  1. Single Symbol: One symbol used for all features in the same layer.
  2. Categorized: One symbol for each unique attribute value.
- The first stage is therefore to choose how the attribute values are to be represented. In this case we want to produce a map which shows variation in population estimates for 2015 by point location. Therefore, we want to set up different classes based on population estimates and use a distinctive symbology to display geographic variation in total estimated population for the sampled locations in 2016.
- Right-click on the layer CMR_locations_PopEst2015 and select Properties. In the Layer Properties menu, click on the Style tab and change the Single Symbol to Graduated type.
• In the drop-down menu for Column select EstPop2016. These settings will assign colour to each location based on the value provided by this field. Click the “Classify” button to add the field for classification.

• Set up 5 classes, the precision to “Precision 0” (to remove decimals), choose Oranges as the Colour ramp and Natural Breaks (Jenks) as Mode. Click on Apply button and finally OK to close the LAYER PROPERTY window.

• Once you have finished, save your work. Open File in menu bar and then click on Save Project.