

GIS for Economists 4

Giorgio Chiovelli Sebastian Hohmann

17/03/2020

Table of contents

Overview

- The plan for the session

Geocoding

- The MMQGIS Geocoder

- Geocoding examples

Data Visualization

- Making a Map

- Heatmaps

Georeferencing and Digitizing an Old Map

- Georeferencing

- Digitizing

Overview

The plan for today

Geocoding in QGIS

- turning address data into latitude/longitude with MMQGIS Geocoder
- Example: cities, costa Coffeeshops in London

Making a map

- Visualizing data
- The Print Layout
- Adding a legend
- Exporting to high quality image

Creating a heatmap

- Passenger numbers in London tube stations

Geocoding

The MMQGIS Geocoder

Suppose we have address data

| country | city | post code | street name | number |
|---------|--------|-----------|---------------|--------|
| UK | London | NW1 4SA | Sussex Place | 26 |
| UK | London | NW1 5PT | Marylebone Rd | 117 |

- How do you go from this to latitude/longitude?
- Answer: **Geocoding**. Like a phone book for co-ordinates. Many ways. One way, google maps: Goole the address → find the place you are looking for → right-click → "What's here?"
- Not very scalable. Want to automate → API providers: Google maps, Geonames, Open Street Map, ...
- Integrated into MMQGIS. (if don't have MMQGIS plugin (in the top menu bar), go to Plugins → Manage and Install Plugins → Search for MMQGIS → Install)

Geocoding

Geocoding example 1

Geocoding simple example: cities

- locate the file *geocode_example.csv* (part of *GIS data* for this session on the google drive)
- Click on MMQGIS → Geocode → Geocode CSV with Google / OpenStreetMap
- Browse to the cities file
- Select fields for Address, City, State, and Country (leave blank what you don't have)
- Use the OSM geocoder (you can sign up for a google API key for bigger applications and possibly better results)
- specify shapefile and list of addresses not found and run it
- it may take a moment depending on the size of the .csv (there are query limits)
- inspect the .csv with the addresses not found (it should have found all)

Geocoding

Geocoding exercise

Geocoding exercise: Costa Coffeeshops

- Locate *costa_locations.csv* (scraped from costa coffee website), inspect the data (look at the “city” column, may be not 100% clean)
- repeat the above steps (make call which variables should go where)
- are you able to geocode all addresses?

Making a Map

- Load your data on the Canvas
- Rename the layer with the appropriate name you want to be shown in the Map Legend
- From the Project menu select New Print Layout
- Type a Title for your Print Layout

Making a Map

- Inside the New Print Layout screenshot, use the Add Item to add:
 - Maps
 - Legend
- You have to drag the arrow to select the area where you would like each map element to appear
- Let us produce on Map of London and the UK and export it to pdf

How to visualize Spatial Pattern in your data

- Heat Map

Advantages

- Help you detecting spatial patterns: cluster, spatial correlations
- Appreciated by policy-makers and practitioners

Data Visualization Tools

Heat Map

Heat Map

- Represents the geographic density of features on a map
- Useful for layers with a large number of features

Example: Spatial pattern of crime in London

Data

- You can download data on street level crime from all UK
- <https://data.police.uk/data/>
- Monthly frequency (2016 to present)
- Let us focus on Central London

Example: Spatial pattern of crime in London

- Load the OpenStreetMap layer under XYZ Tiles
- Import the crime data CSV
 - use Add Layer Delimited Text
 - or use MMQGIS to automatically a shapefile out of the CSV
- Now let us play around with the Layer Styling Panel (shortcut F7)

Example: Spatial pattern of crime in London

- Select the option Heatmap from the menu
- We can now set different parameters altering the visualization
 - Colour
 - Opacity
 - Radius: assume the crime event will impact 500 meters from its gps location
 - Kernel shape: regulates the distance decay from the centroid

Example: Spatial pattern of crime in London

- We can now set the visualization to take be weighted by events importance
- Let us give more weights to Violence and Sexual Assault and Criminal Damages
- Open the Attribute Table and Select the Open Field Calculator
- Select the function CASE (Show Help will help you understanding the syntax)
- Type the following statement

```
CASE  
WHEN "Crime type" LIKE 'Violence%' THEN 10  
WHEN "Crime type" LIKE 'Criminal%' THEN 5  
ELSE 1  
END
```

- Let us now takes the newly created weights into account

Example: Spatial pattern of crime in London

- To further modify the heatmap (different kernels or dynamic radius) we need to save it as permanent raster
- Reproject the raster in projected coordinate system
- And now run the Heatmap (Kernel Density Estimation)

How to Georeference in QGIS?

- Georeferencing means to associate something with locations in physical space.
- Basically you assign latitude and longitude information to the map

Let us try to Georeference and Digitize

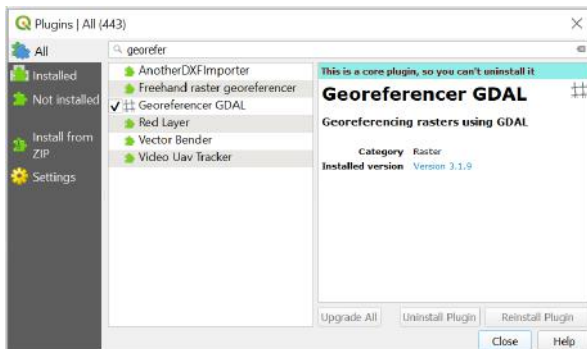
- **Niassa Company - Mozambique**

https://drive.google.com/file/d/1dKy6CU-BYdbe_8LX033mjqSexjagLwTM/view

Georeference and QGIS

GDAL is going to be your best friend

- Georeferencing in QGIS is done via the **Georeferencer GDAL** plugin.

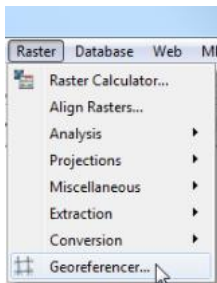


- Go to “Plugins” → “Manage and Install Plugins” and enable the Georeferencer GDAL plugin

How to Access GDAL

Access GDAL from Raster menu

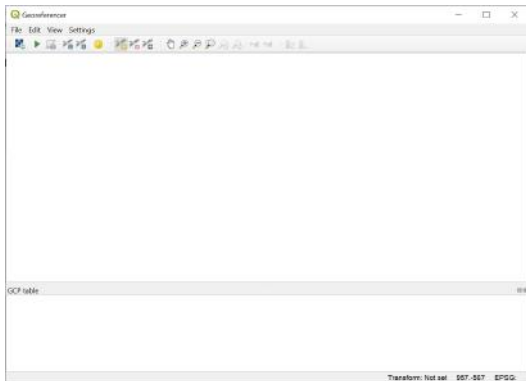
- Click on Raster → Georeferencer to open the plugin.



GDAL Georeferencer

How the Georeferencer looks like?

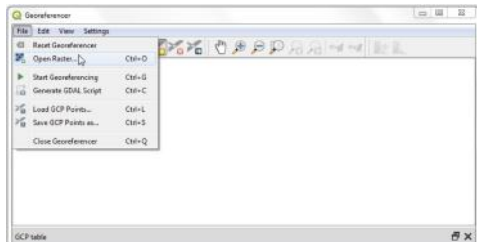
- The plugin window is divided into 2 sections.



- The top section where the image will be displayed
- The bottom section where a table showing your GCPs will appear.

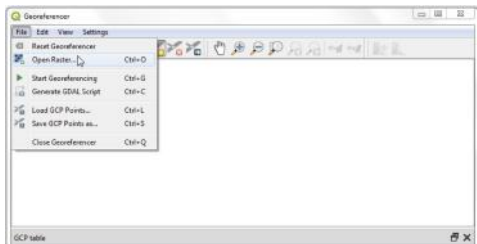
GDAL Georeferencer

- To open our image, go to File → Open Raster. Browse to the folder storing the scanned map and click Open.



GDAL Georeferencer

- To open our image, go to File → Open Raster. Browse to the folder storing the scanned map and click Open.



- you will be asked to choose the coordinate reference system (CRS). Click Cancel as we will assign this later.

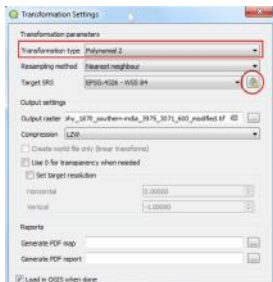
- We need to assign coordinates to some points on this map.
- Almost all the maps of the project will have coordinate grid with markings.
- These are Latitude and Longitude grid lines.
- you will be asked to choose the coordinate reference system (CRS). Click Cancel as we will assign this later.

GDAL Georeferencer

- We start adding Ground Control Points (GCP)
- We need to define the Transformation Settings. Go to Settings → Transformation settings.



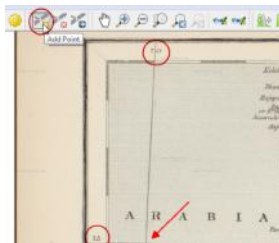
GDAL Georeferencer



- Choose the Transformation type as Polynomial 1 (we will see later the implications of this choice).
- Name your output raster as the **name of the map**
- Choose LZW as the Compression.
- Make sure the Load in QGIS when done option is checked.
- Click OK.

GDAL Georeferencer

- Now we can start adding the Ground Control Points (GCP).
- The intersections of the grid lines will serve as the ground-truth in our case.
- As the grid lines are labeled, we can determine the X and Y coordinates of the points using them.
- Click Add Point.



GDAL Georeferencer

- In the pop-up window, enter the coordinates. Remember that X=longitude and Y=latitude.



- Remember we will be working with African countries
- Latitude may be positive (above the Equator) or negative (below)
- Longitude may be positive (right of Greenwich) or negative (left)

Latitude and Longitude Africa



Negative Lon



Positive Lon



Negative Lat



Positive Lat

GDAL Georeferencer

- You will notice the GCP table now has a row with details of your first GCP.

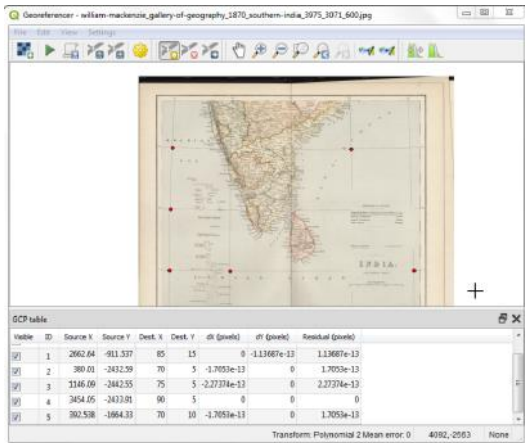


| Visible | ID | Source X | Source Y | Dest. X | Dest. Y | dx (pixels) | dy (pixels) | Residual (pixels) |
|-------------------------------------|----|----------|----------|---------|---------|-------------|-------------|-------------------|
| <input checked="" type="checkbox"/> | 0 | 438.428 | 4892.289 | 76 | 15 | | | |

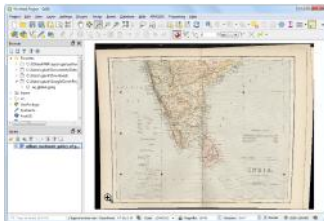
- Add at least more GCPs covering the entire image.
- The more points you have, the more accurate your image is registered to the target coordinates.

GDAL Georeferencer

- Different Transformation Types:
 - Linear: most simple. Rotation and rescaling of the image.
 - The higher the polynomial, the larger the number of GPCs you need
 - For example, the Polynomial 2 transform requires at least 6 GCPs.



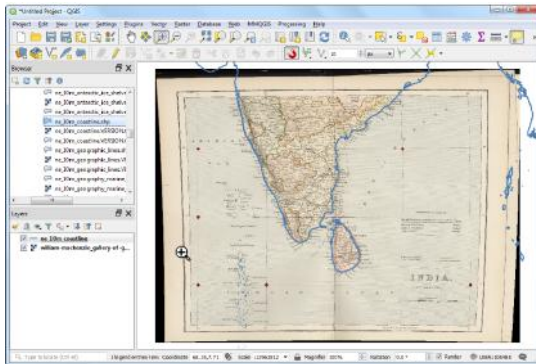
GDAL Georeferencer



- Once the process finishes, you will see the georeferenced layer loaded in QGIS.
- The georeferencing is now complete.

GDAL Georeferencer

- Last check: How do we check if our georeferencing is accurate?
- You can load the boundary shapefile from a trusted source like the Natural Earth dataset and compare them.



Digitization

Now we can start Digitizing the map

- Digitizing means creating a shapefile
- It allows us to create new data!

Digitizing

Create a New Shapefile

- Let us create an empty shapefile
 - Select Layer → New → New Shapefile Layer



Digitizing

Create a New Shapefile II

- Select the Geometry type: Points, Line, Polygons
- Structure your Attribute Table by creating the Fields you need to be in the shapefile

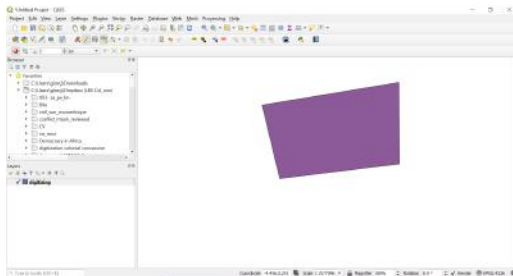
Digitizing Toolbar

- Right-click on the upper bars above the canvas and check:

- Digitizing Toolbar



- To enter digitization mode, click on the “Toggle Editing”
- To start drawing, click on the “Add Polygon Feature”

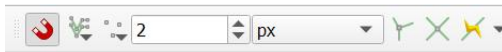


- To finish your sketch, right-click and insert the Field Values

Snapping Toolbar

Use existing shapefiles to improve our digitization.

- We can snap existing line/polygons to improve the precision of our digitization (e.g. coast, country borders, etc)
- Right-click on the upper bars above the canvas and check:
 - Snapping Toolbar → Enable Tracing



- To enter snapping mode, click on the “Enable Snapping”
- To trace an existing feature, click on the “Enable Tracing”
- **TRACE** tool to automatically capture the vertices, instead of manually clicking to snap.



Saving your Digitization

- Good practice is to save the digitized elements as you create them
 - Click on “Save Layer Edits”
- Once you finish the digitization, click again on “Toggle Editing”
- Now you are done! You can use your new data for your analysis!