GIS Project: Analyzing skatepark location in New York city in relation with complaints about requests on graffiti cleaning

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Part 1: GIS Project

The objective of this project is to show the main functionalities of a GIS open source software. These ones are some of the objectives:

- Create new views and work in different reference systems.
- Reproject vector layers to work in a same reference system.
- Create event layers from an attribute table where there are two fields with point coordinates.
- Label layers and change symbology.
- Create a layout with scale, north, legend...
- Add hyperlinks to image files.
- Load remote layer from external services.
- Use field calculator for operation.
- Create files to be loaded in Google Earth.
- Edit a shapefile graphically and the attribute table associated to a shapefile.
- Analyze different situations using geoprocessing tools.
- Apply color tables in order to see the results of an analysis easily.

Data of the project

At this project we are going to use several layers:

- Skateparks of New York.
This layer contains the skateparks of New York city. It is a SHP file available in EPSG 4326 reference system (geodetic coordinates, WGS84).

- Graffiti complaints.
This is a CSV file that contains the graffiti complaints in New York city. It has two fields with Latitude and Longitude values, that will be used to get a point layer. Its reference system will be EPSG 4326.

- Streets of New York.
This layer is in SHP format, and contains the streets of New York city, that we will have as reference in the View. The reference system of this layer is EPSG 26918 (NAD 1983 UTM Zone 18N).

- Neighborhood Tabulation Areas of New York.
This is a polygon layer that contains the different neighborhood areas of New York city. It is available in EPSG 4326 reference system.

- Population of the Neighborhood Tabulation Areas of New York.
This is a table that contains the population of the neighborhood areas in New York. It is available in XLS format.

- Orthophoto of New York city.
This is an ortho imagery of a small area of New York city. It is available in SID format.

Introduction

Geographic information is information that can be associated with a place name, a street address, a zip code, or coordinates.

A great number of government functions require geographic information. A high percentage of the information used by governments is geographically referenced. For example, infrastructure and transportation management, agriculture, safety and emergencies, property records and assessment, planning, natural resource management, economic development planning, health...

All of these applications consider the location of certain features on the landscape in relation to other features. A geographic information system (GIS) allows the user to examine and visualize these relationships.

At this mini-project we want to analyze the skateparks location in New York city in relation with the complaints about requests on graffiti cleaning.

Picture 1. Graffiti in New York city

We will load the different layers in a View, reprojecting some of them in order to work in a same reference system. If they are not reprojected, they won't be able to be visualized correctly, over the other ones.

We will apply a first symbology by district to the neighborhood layer. It will allow us to see the different districts easily by different colors, and we will label the neighborhood areas too by their name.

We also will link some image to a neighborhood. It will be a photography characteristic of that area. When we click on the polygon we get that image. At this point we will edit a layer alphanumerically, adding a new field to the attribute table and filling it in.

Picture 2. New York neighborhood

An Excel file will be imported too with the population of every neighborhood area. At that table there's a field with neighborhood codes, and other one with the names. Both ones are included at the neighborhood layer too, and we will join both tables in order to add the population value to the neighborhood layer. Every polygon will have the population after that. To join the tables we will do it through a common field. We will have to take into account that the neighborhood name can be different in both tables (one of them can have the article “the” for example, so it wouldn't be joined). To avoid that problem we will use the neighborhood codes because they are the same in both tables.

At that point we will have population and area for every polygon, so we will calculate the density for every neighborhood. Area is available in squared meters, but we will calculate inhabitants per squared kilometer. With the field calculator it can be calculated with a simple operation. That tool allows the user to calculate areas of polygons, length of lines, coordinates of points, to split strings or concatenate them, fill in the registers of a field with a value easily...

After having a new field with the densities, we also will obtain the media of all of them. There's an option to get the maximum and minimum values, media...

We will apply a new type of symbology in order to visualize the neighborhoods with higher density in an easy way. Using a legend by intervals, with a graduation from a light color to a dark one, we will show it.

Having the neighborhoods by density we will create a layout. The layout is the graphical representation of a view, the “paper” space, where we can add scale, north, legend, images, titles... It would be able to be printed directly, or exported to a PDF file.

We also will load a raster file over the neighborhood layer. As the raster file will cover the vector layer we will apply transparency to the image in order to see the symbology of the neighborhoods applied previously. Other tools for raster files are: Brightness, contrast, filters... that allow users to do analysis, for example to find the areas with high humidity, coastal boundaries...

We have skateparks and neighborhoods layers in a view at this moment, and we will want to get the neighborhoods that have the biggest skateparks of the city. For that we will select the skateparks, the area of which are more than 15000 squared meters firstly, and then we will intersect the results with the neighborhood layer.

Besides loading local files, we also have the possibility to load remote layers, from external services. There are a lot of public servers available that we can connect to, and at this project we are going to connect to a national server in USA, to load an orthophoto, and to a worldwide service, where we will load a layer with country boundaries. We could work with this last layer like a local vector file. We could select elements, export to a shapefile, do geoprocessing, apply symbology and labeling...

Apart from editing alphanumerical information of a layer, like we have done in a previous step, we also can edit a layer graphically, creating new elements, moving them, scaling them, applying rotation, autocompleting a polygon... We will create a new layer, and we will edit it then.

If we have a vector layer, it can be exported to a format supported by Google Earth. We will do it. Then, that layer can be loaded in Google Earth, where we can get the information of the attributes, change its symbology, create animations following a line...

After loading the previous layers, a point layer will be created from the attribute table got with the graffiti complaints. The table has two fields with Latitude and Longitude values, and a point layer will be created from it, in Geodetic coordinates, and then it will be reprojected to work in the same reference system than the other layers.

At that point, the final analysis will start. For that, the first step would be to get an estimated area of influence from the skateparks. It will be the estimated area around the skateparks where the skaters would be able to work, going by walk or skating.

Picture 3. Graffiti in a Skatepark

Then, for the point layer with the complaints, a density map will be got, where the values will be different where there's a higher density of points (complaints).

The results will be a raster layer, and a color table will be applied on that layer in order to

see the areas with more graffiti complaints in an easier way for a better analysis.

Finally, visualizing the information that have been got at this point, we will be able to analyze if the skateparks location in New York city has any relationship with the complaints about requests on graffiti cleaning. We will see if the area of influence of each skatepark contains the areas with highest density of complaints.

Part 2: Using gvSIG for analysis

Exercise 1: Installing gvSIG

To download the application we will access to the gvSIG website (http://www.gvsig.com), and then to the Products->gvSIG Desktop section.

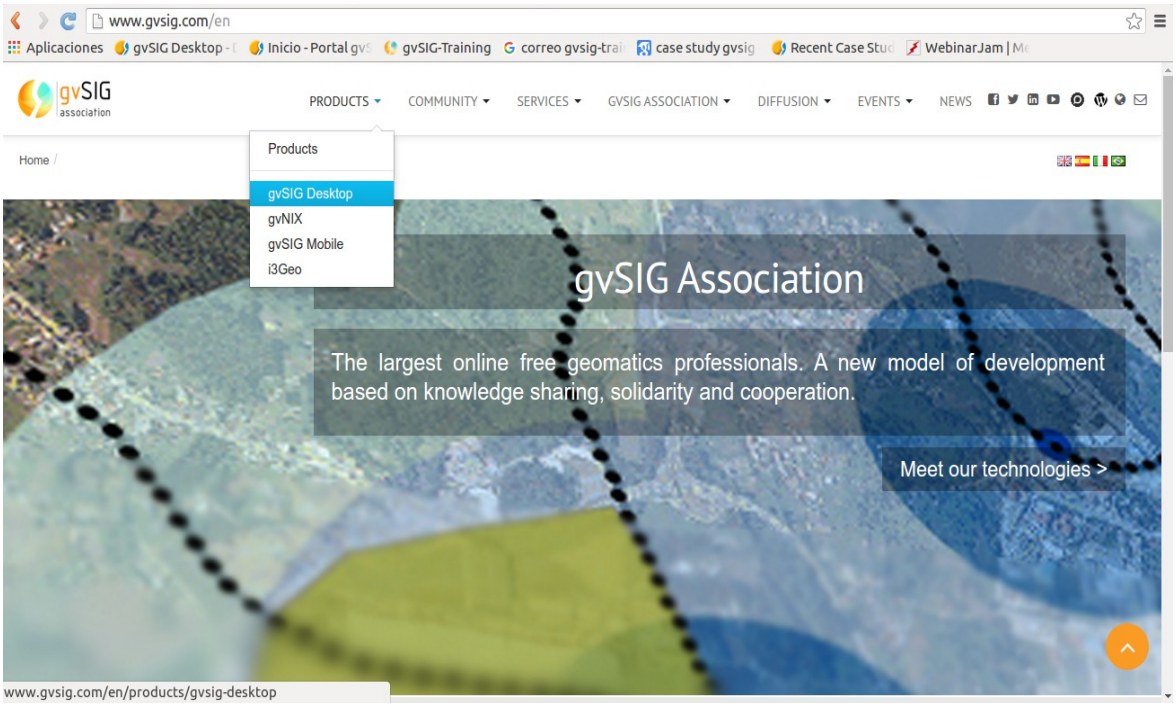


Figure 1. gvSIG website homepage

At the gvSIG Desktop we will access to the “Downloads” section, from the menu at the right side. At this section the latest final gvSIG version is available to download (in this case it is gvSIG 2.2).

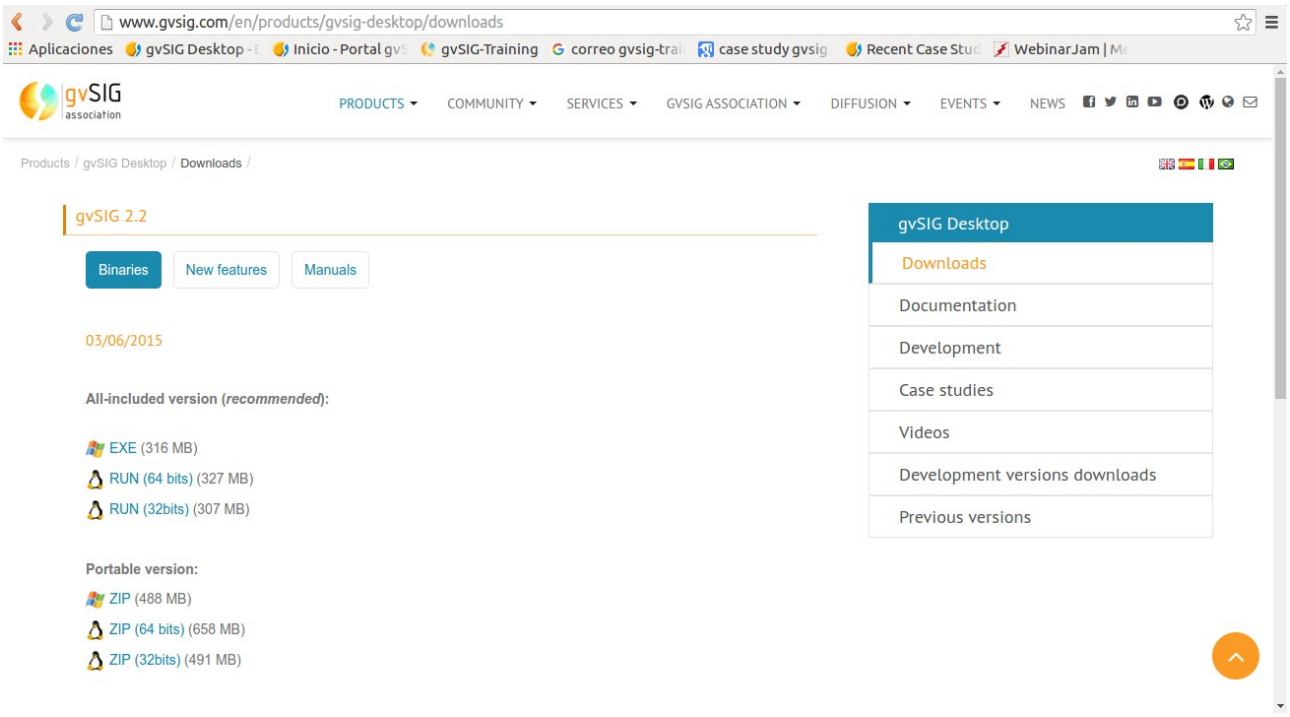


Figure 2. gvSIG downloads web page

There are two different distributions:

- All-included version: It is a version to be installed on the computer.
- Portable version: It is a ZIP file to be unzipped, and the file to run gvSIG is available in the unzipped folder. It's very useful to install in a pen-drive to run it in different computers.

If you download the “All-included version” you will have to install it, following the instructions.

Exercise 2: Download the layers to be used at the project

We will download the cartography from public servers, and we will use the open source GIS software called gvSIG.

The data for the project can be download from https://nycopendata.socrata.com/.

- Skateparks:

At the previous web page we can look for “Skateparks” at the “Searching” text box. The first result will be: Skateparks, (Directory of Skateparks)

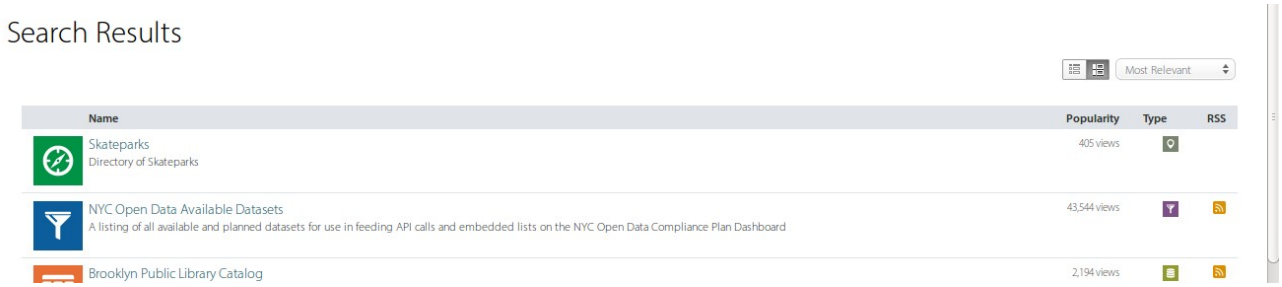


Figure 3. Search results for "Skateparks" expression

We will click on the "Skateparks" link, and a new web page will be opened with a viewer.

At the right side, there's a button to export the layer (the blue one).

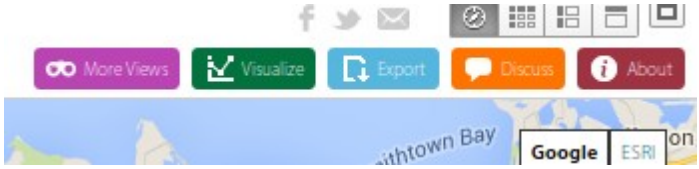


Figure 4. Main menu at the Viewer

When we click on it we get the export options for the current layer. At the "Download Geospatial Data" section we can select the file format to be exported. We will select the shapefile format, that can be loaded in gvSIG. When we download it we will get a .ZIP file, that we can save in our hard disk.

Then we will access to the folder where we've saved it ans we unzip the ZIP file. We'll see the shapefile, that is composed by 4 files (.shp, .shx, .dbf and .prj files).

We have to take into account the Reference System of the layers in order to load them correctly in gvSIG (from gvSIG 2.3, if the layer has the prj file attached, it will be loaded correctly).

If we open the prj file, we can see the reference system of this layer. We can see "GEOGCS["WGS84(DD)", DATUM["WGS84", SPHEROID["WGS84", 6378137.0, 298.257223563]], PRIMEM["Greenwich", 0.0], UNIT["degree", 0.0174532925199433295], AXIS["Geodetic longitude", EAST], AXIS["Geodetic latitude", NORTH]]", so that means that its reference system is EPSG 4326 (Geodetic coordinates, WGS84).

- Graffiti complaints:

At the same webpage, https://nycopendata.socrata.com/, we can look for "graffiti" at the "Searching" text box. At the "Search Results" section we will see: "311 Service Requests from 2010 to Present", where the 311 Service Requests are compiled in a database.

We can filter by type of complaint in order to get the graffiti complaints. For that we will click on the "filter" option at the right side, and we will display the pull-down menu to select:

“Complaint Type” is,

and we will write

“graffiti”

and then we mark that option.

At the attribute table we can see that there are registers where the Latitude and Longitude fields are empty. So they can't be georeferenced. We will apply another filter then to remove these registers. Firstly we have to press “Add a New Filter Condition”, and we will display the pull-down menu to select:

“Latitude” is greater than

and we will write “0”.

Here we can see the filter applied:

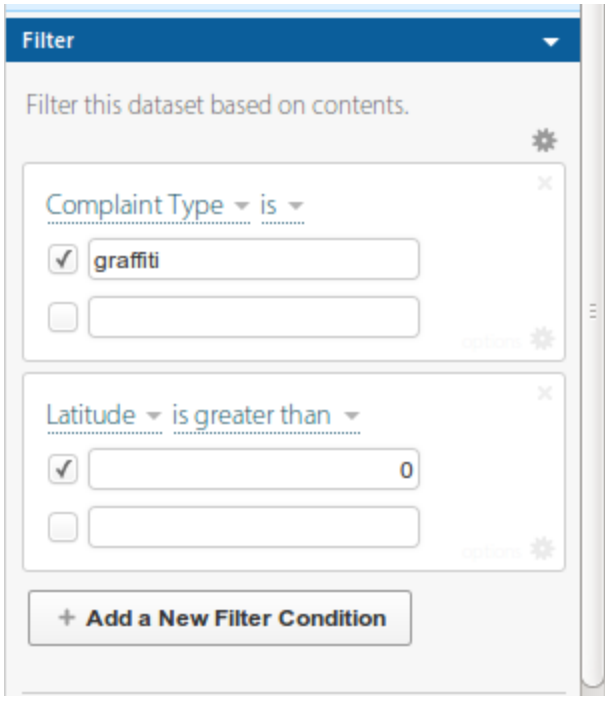


Figure 5. Filter options to be applied

The filter is applied automatically. We will see only the complaints related to “graffiti” issues (we can check it at the “Complaint type” column”), and all the Latitude values completed.

In addition, as there are a lot of columns without information, and other ones with less important information, we can reduce the number of fields, keeping only the important ones. We will access to the “Manage” option (the brown menu), where we can select the fields to show or hide.

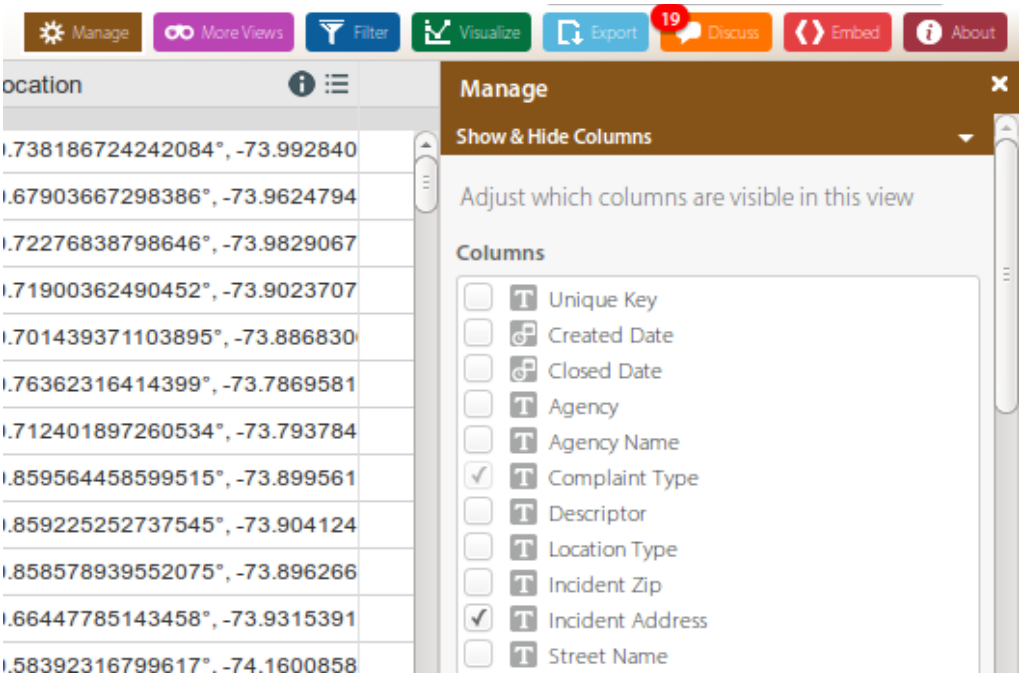


Figure 6. Selection of fields to be exported

We will hide all of them, excepting “Complaint type”, “Incident address”, “City”, “Latitude” and “Longitude”, and then we will press “Apply”. We will see only five columns.

	Complaint Type	Incident Address	City	Latitude	Longitude
1	Graffiti	48 CYPRESS AVENUE	BROOKLYN	40.70841987068637	-73.92025126305457
2	Graffiti	446 HIMROD STREET	BROOKLYN	40.70502352999103	-73.91492819272159
3	Graffiti	194 CYPRESS AVENUE	BROOKLYN	40.70525131600889	-73.91488822791456
4	Graffiti	142-20 FRANKLIN AVENUE	Flushing	40.756523268499144	-73.8230940725963
5	Graffiti	7 WEST 17 STREET	NEW YORK	40.738186724242084	-73.99284069840155
6	Graffiti	836 DEAN STREET	BROOKLYN	40.67903667298386	-73.96247945090056
7	Graffiti	38 AVENUE B	NEW YORK	40.72276838798646	-73.98290679257309

Figure 7. Visualization of the table to be exported

And finally we will click on the “Export” button at the top part (the blue one):

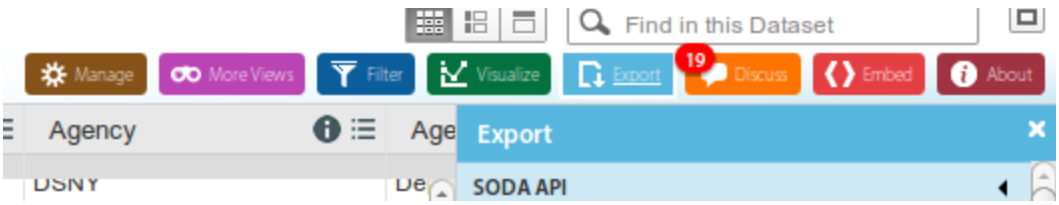


Figure 8. Export menu

and then on the “CSV” format to download the results. We will save the file in the folder where we are saving the cartography. We can name it “graffiti_complaints.csv”.

About the reference system, in this case, the Latitude and Longitude fields indicate that

the data are in EPSG 4326 (Geodetic coordinates, WGS84).

- Streets of New York:

We are going to use a layer with the streets of New York. To download it we will access to http://gis.ny.gov/gisdata/inventories/details.cfm?DSID=932, and we have the option " NYS Streets – Public ", inside the "Files available to the Public" section, where we can download a SHP file.

Files available to the Public

Files	Download	Metadata
NYS Streets – Public	SHAPE Revised: September 2015	Metadata
Simplified NYS Streets for Labeling	GEODATABASE Revised: December 2015 SHAPE Revised: December 2015	Metadata Metadata

Figure 9. NY Streets layer to be exported

Firstly we have to accept the conditions, and then clicking on "Download the NYS Streets – Public File" we will save it in our computer. We will unzip the ZIP file finally.

About the reference system of the layer, if we open the PRJ file we can read "NAD_1983_UTM_Zone_18N". If we search in Google that string, and "EPSG" word, we can find that the EPSG code for that layer is 26918 (http://spatialreference.org/ref/epsg/nad83-utm-zone-18n/)

- Neighborhood Tabulation Areas of New York:

We also will use the Neighborhood Tabulation Areas layer of the city. We can download it from:
https://data.cityofnewyork.us/City-Government/Neighborhood-Tabulation-Areas/cpf4-rkhq.

We press "Export" like we did with the Skatepark layer, and then we select the Shapefile format. Se save the layer in our disk, and we will unzip the ZIP file.

About the reference system of the layer, if we open the PRJ file we can see that it is in EPSG 4326.

- Population of the Neighborhood Tabulation Areas of New York:

We will use a table with the population of every Neighborhood Tabulation Area in New York, that we will join to the graphical part. It can be downloaded from:
https://data.cityofnewyork.us/City-Government/New-York-City-Population-By-Neighborhood-Tabulatio/swpk-hqdp

We will press "Export" at the right side, like in the previous layers, and we will export it as a XLS file. We will call it: New_York_City_Population.xls

- Ortophotography of an area in New York city:

We will use an ortho imagery of New York city, in SID format. It can be downloaded from ftp://ftporthos.dhses.ny.gov/napp%5CI9/Jersey_CityNE_tile2.zip

After unzip the file we will have a file called Jersey_CityNE_tile2.sid.

It is available in EPSG 26918 (NAD_1983_UTM_Zone_18N) reference system.

Exercise 3: Starting with gvSIG

Now we run gvSIG, and when it opens we will see a window called “Project Manager”, where we can manage our project.

gvSIG allows to work with different types of documents. These documents allow to work with data from different points of view: data as a map, as a alphanumeric table, as graphics... Each document has a series of menus and buttons.

When we save a session or project in gvSIG, this is saved in a file with a “.gvsproj” extension.

In gvSIG there are the following documents:

- Views: It allows to work with geographical data. The geographical information is represented as a set of layers.
- Tables: It allows to work with alphanumeric data.
- Maps: It allows to design maps with the different cartographic elements which make a map (View, legend, scale...) to print it or export it as a PDF.

First step would be to create a new View in our gvSIG project. For that we would select the View icon at the Project Manager, and then we would choose the “New” button. The View will be created and opened automatically, with the name “Untitled”.

We can change the name by clicking the button “Rename” from the project manager (The View that we want to rename should be selected). Then a dialog box appears where we can type the new name.

We also can rename the View from the View Properties window (at the View, accessing to the View->Properties menu).

From the View Properties window we also can change the Reference System of the View.

In our project we had some layers in EPSG 4326 (Geodetic coords.-WGS84) and other ones in EPSG 26918 (NAD_1983_UTM_Zone_18N, in Meters). As they are different reference systems, we have to decide the CRS to use. In our case we will work in EPSG 26918 (coordinates are in Meters and some geoprocesses work better).

So we will change the reference system in our first View. From the View Properties window we will access to the “Current projection” section.

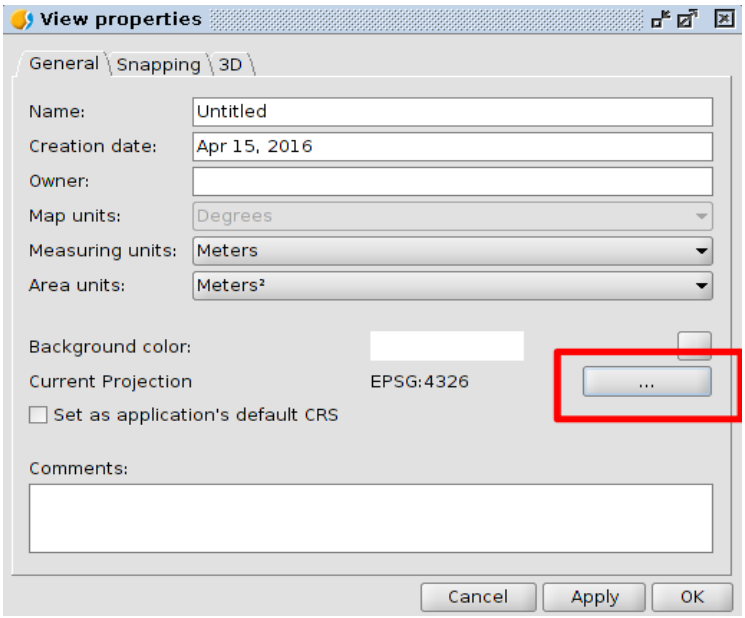


Figure 10. Window where reference system of a View can be changed in gvSIG

At the new window we will select Type EPSG, and we will search “26918”, at the “By code” option. We get only one reference system.

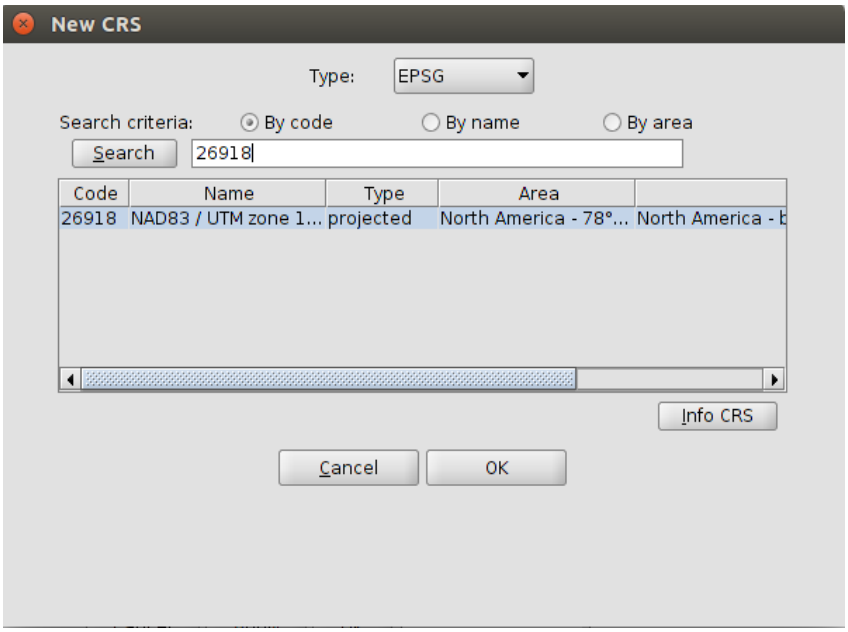


Figure 11. Selecting the reference system of the current View in gvSIG

Then we accept it, and we also accept the View properties window.

If we open the View we can see its reference system at the bottom line.

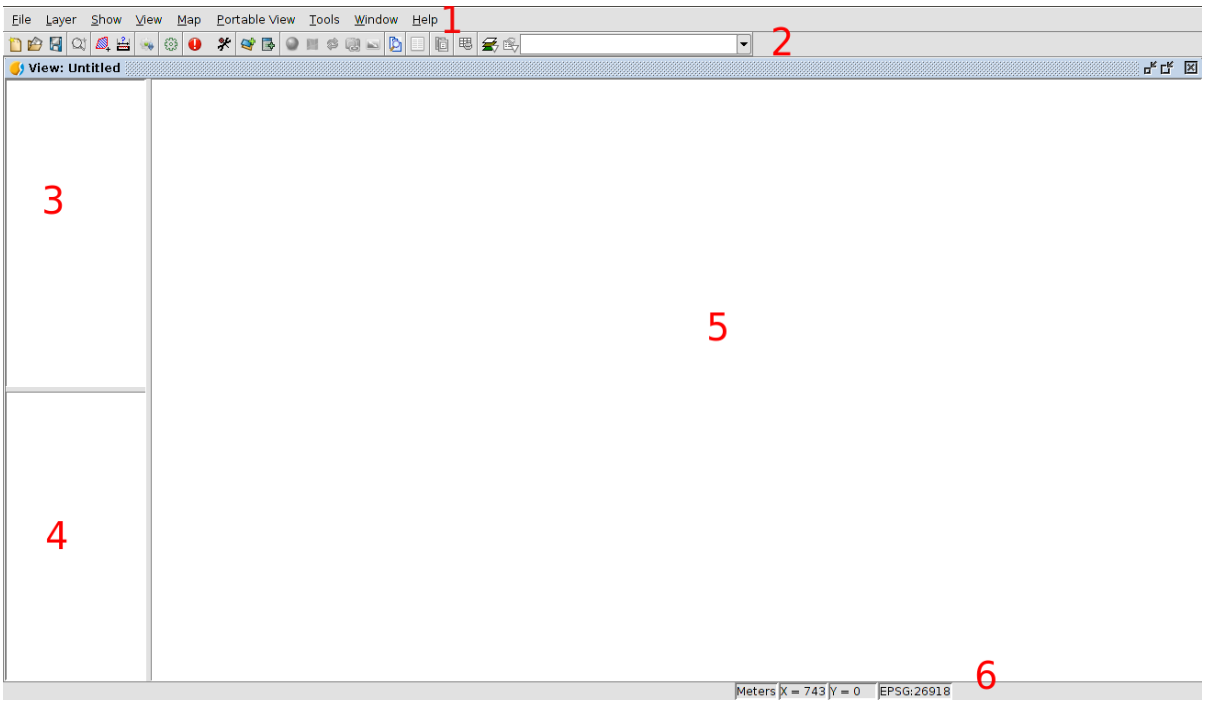


Figure 12. Parts of the "View" document in gvSIG

The parts of the View are:

1. Menu toolbar.
2. Buttons bar.
3. Table of contents (ToC): All the layers containing in the View and the Legend representing the symbology of each layer are listed.
4. Locator. Displays the current frame in the total work area.
5. Visualization area. Workspace where the geographical information is displayed and the main work is taken place (navigation, selection, edition, etc.).
6. Status Bar. Displays information of the View coordinate system, scale, coordinates and units. The information resulting from the use of certain tools is shown in the status bar.

The 3, 4 and 5 components are resizables, dragging its edge to the right/left and for the Locator and the TOC from up/down.

Once the View is open we are going to add our first layer. It will be the NY streets shapefile. We will access to the "View->Add layer" menu, or through the button at the Toolbar 

A new window will be open where we can select the type of layer that we want to add. We can add vector and raster local files (File tab), or remote services (WMS, WFS, WCS, OSM... tabs). At the File tab we will press on the "Add" button at the right side.

We will look for the file "StreetSegmentPublic.shp", that will be at the folder where we downloaded the cartography, and we will load it. We can see that the assumed reference system is the same than the View, and it's correct because the layer is at that CRS.

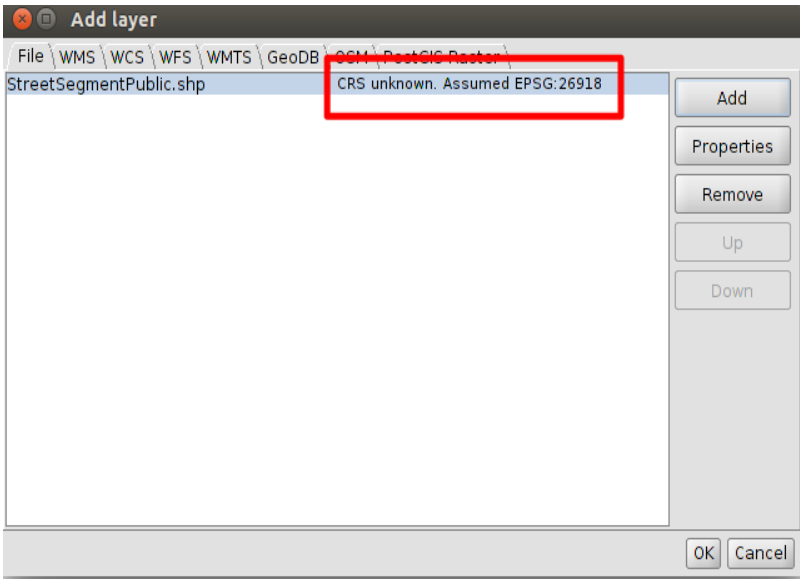


Figure 13. Reference system of the layer when it's not indicated

NOTE: From gvSIG 2.3, if the SHP file includes a PRJ file, if the projection of the layer is different than the View, it will be indicated at that point (something like “CRS xxxxx, Reprojected on the fly”).

We finally click on the “OK” button and the layer is added to the View (it is a big layer so it can last some time in being loaded).

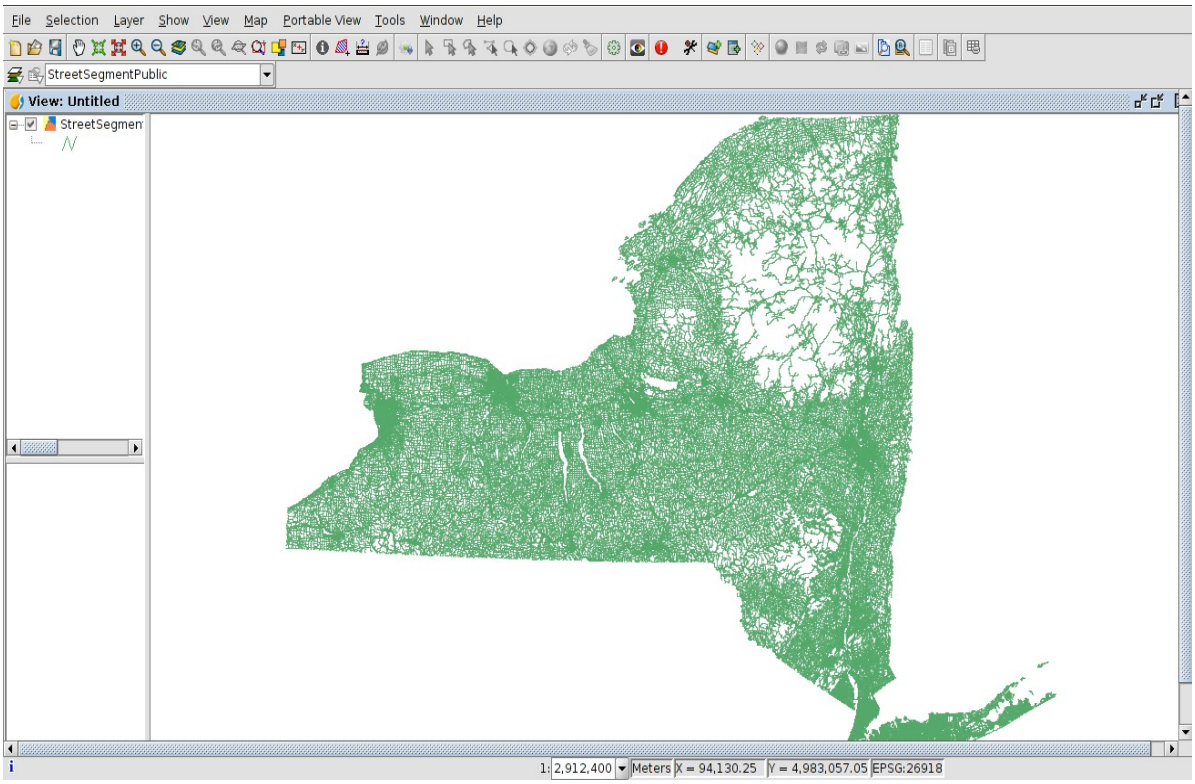


Figure 14. Layer loaded in a View in gvSIG

Exercise 4: Reprojecting vector layers

Now we are going to load the layer about Neighborhoods. We open the “View->Add layer” menu again, and at the “File” tab we click on “Add” button. We select the shapefile about the Neighborhood-Tabulation-Areas (its name starts with “geo_export...”, and the rest of the name is different every time is downloaded). In this case, after selecting it, at the “Add layer” window we have to indicate that this layer is in another reference system. For that we press “Properties”, and at the Properties window we access to the CRS option.

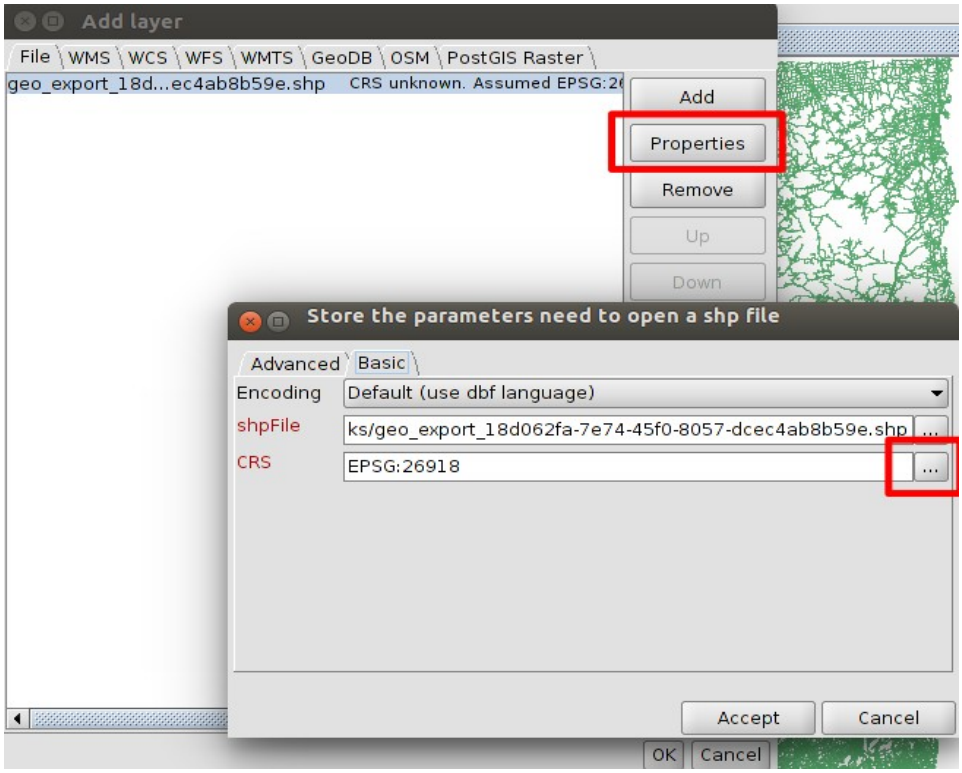


Figure 15. Changing the reference system of a layer, when it's different than the View

At the new window, if we see the EPSG 4326 at the “Recent” Type (because it is the CRS by default in gvSIG), we select it and press “Finish”. In case it's not available at the “Recent” CRS's, we will select “EPSG” type, and we will search “By code” and “4326”, and we press Finish.

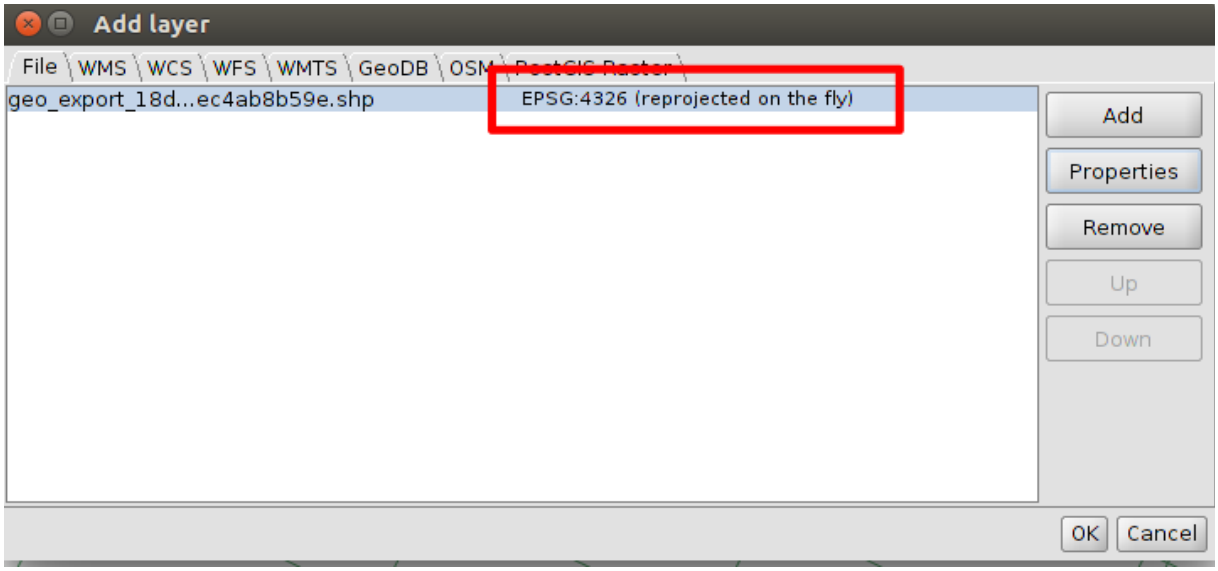


Figure 16. Reference system of a layer, when it is different than the View one

We finally accept the “Add layer” window and the Neighborhood layer will be reprojected on the fly at the View.

As the window says, the layer is reprojected on the fly, but if we want to do analysis (geoprocesses...), it will be done on the original coordinates, so we need to have the layer at the View CRS physicality. For that, we will export the reprojected layer (on the fly) to a new layer. The new one will be in the View CRS.

Firstly we have to put the layer active, clicking on it at the ToC. And then we go to the “Layer->Export to” menu.

At the new window we will select “Shape format”, then we press “Next, and we will access to the “...” button in order to select the folder where the file will be saved, and the file name. We can name it “Neighborhood_26918.shp” (because it will be its new CRS). Then we press “Next”, and “All records” option, and we finally press “Export”. We indicate that we want to add that layer to the View, and we close the Window.

A new layer is added to the View, and its CRS is the same than the View.

We can delete the old layer from the View, clicking on it (the “geo_export...”), and with the secondary button a contextual menu is open, where we select “Delete layer”.

We can see the attribute table associated to the Neighborhood layer. For that we active it and we press on  .

The attribute table contains different fields with the data of each neighborhood.

We can order the field about the neighborhoods (“ntaname” field). For that, we click on the field name, and then we press  .

The field values are ordered alphabetically.

Question 1:
After ordering neighborhood field, look for the value "Manhattanville" and select it. Which is the area of that neighborhood (the value of the "shape_area" field)? Take into account that the three last numbers are the decimal ones.

Now we are going to load the layer about Skateparks. We will follow the same steps than the Neighborhood layer previously. We open the "View->Add layer" menu again, and at the "File" tab we click on "Add" button. We select the shapefile about the Skateparks (its name starts with "geo_export..."). After selecting it, at the "Add layer" window we have to indicate that this layer is in another reference system. For that we press "Properties", and at the Properties window we access to the CRS option.

At the new window, if we see the EPSG 4326 at the "Recent" Type, we select it and press "Finish".

We finally accept the "Add layer" window and the Skateparks layer will be reprojected on the fly at the View.

We also are going to export the reprojected layer (on the fly) to a new layer in order to have the new one in the View CRS, like we did with Neighborhood layer.

Firstly we have to put the layer active, clicking on it at the ToC. And then we go to the "Layer->Export to" menu.

At the new window we will select "Shape format", then we press "Next, and we will access to the "..." button in order to select the folder where the file will be saved, and the file name. We can name it "Skateparks_26918.shp" (because it will be its new CRS). Then we press "Next", and "All records" option, and we finally press "Export". We indicate that we want to add that layer to the View, and we close the Window.

A new layer is added to the View, and its CRS is the same than the View.

We can delete the old layer from the View, clicking on it (the "geo_export..."), and with the secondary button a contextual menu is open, where we select "Delete layer".

Exercise 5: Changing symbology

We will keep visible only the Neighborhood layer at the View (we unmark the check for Streets and Streetparks layers).

We are going to apply a legend to the Neighborhood layer.

For that, press double click on the layer at the View, and the Properties layer window will be opened. Then press "Symbols" tab.

Now we will open "Categories" section and we press "Unique values". Then we select "boro_name" field, and we select a table color with assorted colors. We press "Add all". If

colors are different we press “Apply” firstly and finally “OK”.

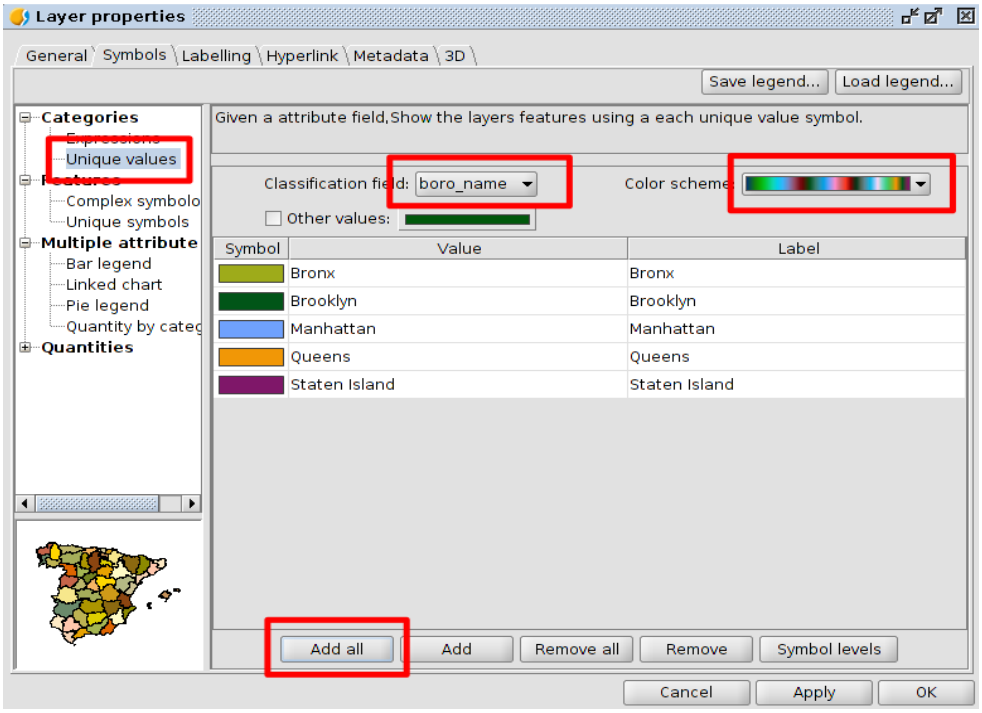


Figure 17. Symbology configuration

We will be able to see the different districts of New York at the Neighborhood layer.

Exercise 6: Labeling a layer

Now we are going to label the neighborhoods by their name. Open the Properties layer window again and press “Labeling” tab, and enable the labeling. Now we will label by “ntaname” field, with 200 for “fixed height” value, and “Meters” for units. We will change the label color, and we select red or yellow for example. Then we accept that window, and labels will be added.

Now use the “Center view to point” tool  (or in the View->Navigation menu), and center the View to X=600000, Y=4509000.

Question 2:
After applying symbology and adding labels, and zooming to the specified point, which is the neighborhood under that point?

Exercise 7: Hyperlink

Now we are going to use hyperlink tool to link an element of the Neighborhood layer to an

image.

Firstly we will download this image to our computer, and we can save it in a short path (for example C:\temp\), and name it “chinatown.jpg”:

http://www.newyork.com/articles/wp-content/uploads/2013/04/manhattan-chinatown_a_540x340_2013424-450x235.jpg

Then we are going to active the Neighborhood layer at the View and we are going to “Start editing”.

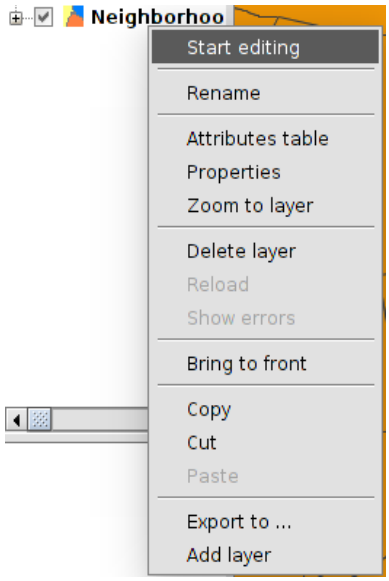


Figure 18. Start editing option

Then we open its attribute table, and we access to the “Table->Add column” menu.

We will add a new string field called “Link”, and size “100”.

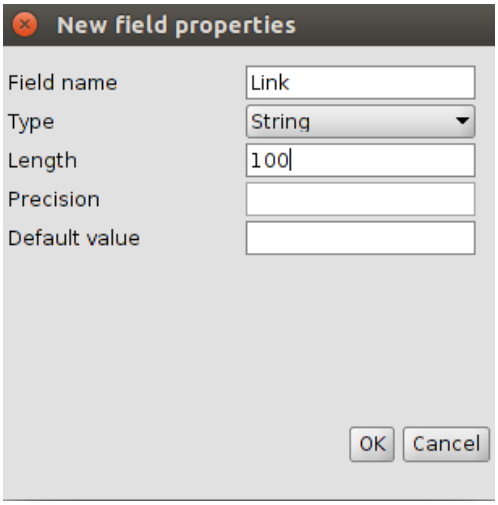


Figure 19. New field configuration

After accepting we will have the new field.

Now we are going to use the “Select by attribute” tool to select one of the elements. We want to select the neighborhood “Chinatown”. So we will write this sentence (or clicking on the field and value): ntaname = 'Chinatown'

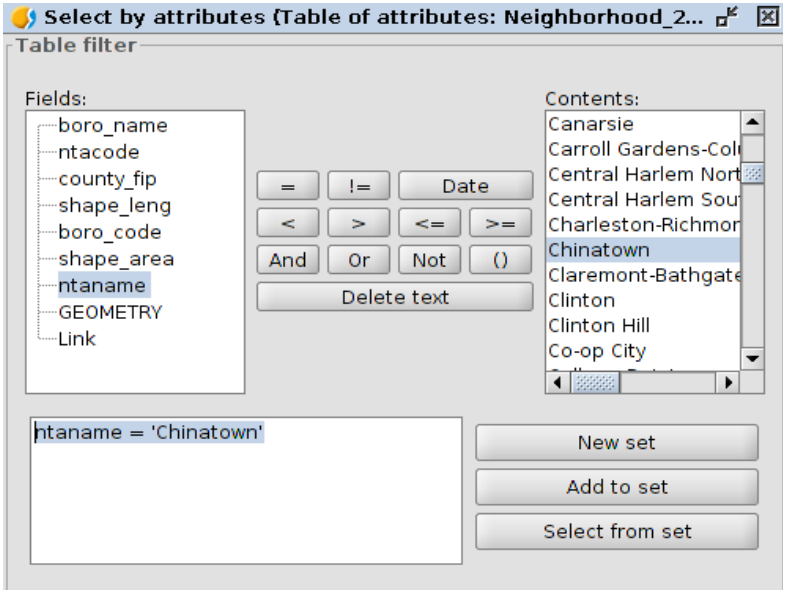


Figure 20. “Select by attribute” tool

Clicking on “New set” the Chinatown register will be selected on the View and in the Table.

If we press the “Move up selection” button we can see it at the first line.

Then we can use the “Zoom to selection” button to see it on the View.

At the table, at that register, we will fill in the “Link” field with our path to the “chinatown.jpg” image.

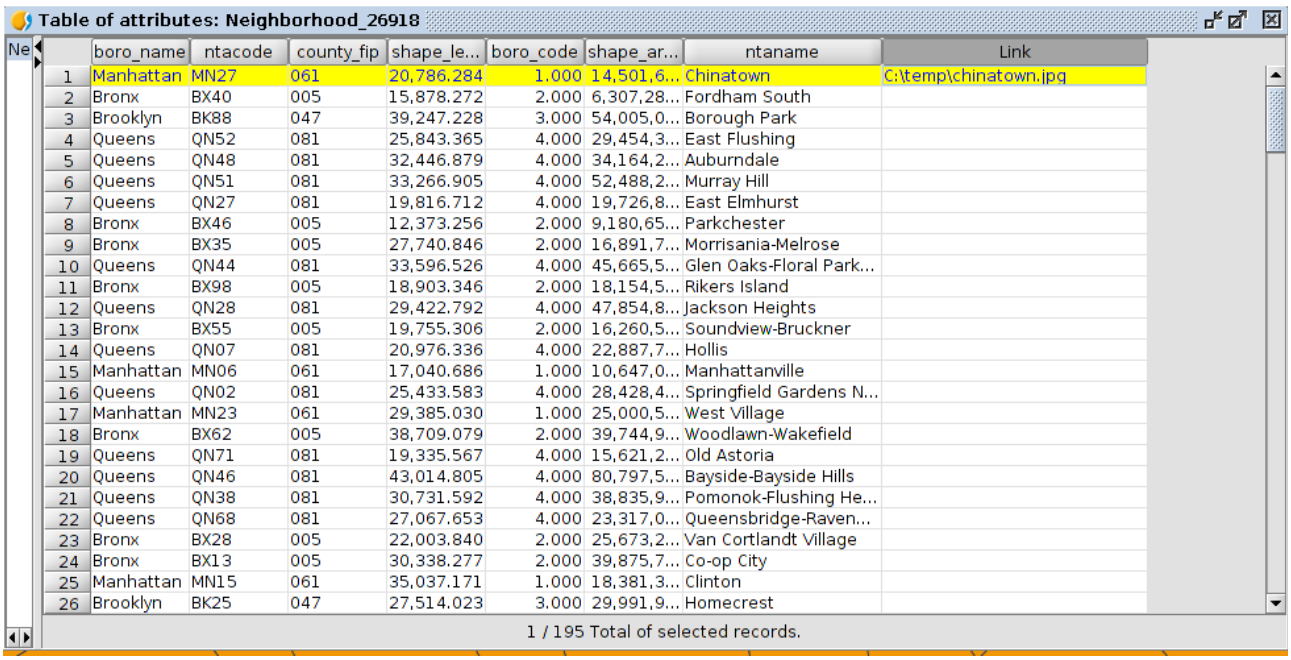


Figure 21. Path to the image for the hyperlink tool

Then we will close the table and using the secondary button of the mouse on the "Neighborhood" layer we will finish editing mode. We will have a zoom to Chinatown neighborhood at that moment.

Now we have to configure the Hyperlink properties. We will open the Neighborhood layer properties (double-click, or secondary button of the mouse). Then we will access to the "Hyperlink" tab.

At that window, we will enable the Hyperlink, we will select the "Link" field at the display, and "Link to image files". Then we accept it.

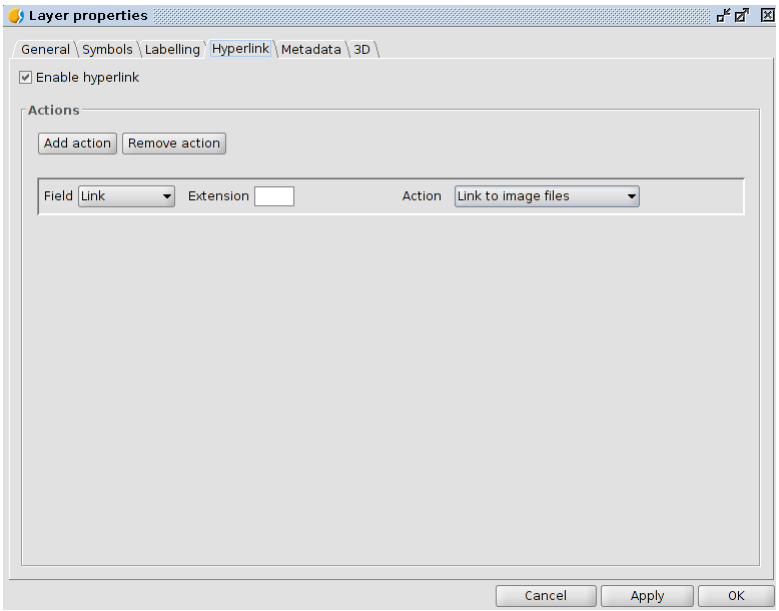


Figure 22. Hyperlink settings

At the View we will use the “Hyperlink” tool and we will click on the “Chinatown” polygon. The Chinatown image will appear in gvSIG.

Exercise 8: Loading Excel files

At this point we are going to join the fields of a table to another one. First of all we will load an Excel file, that we have downloaded at the beginning. The file is called New_York_City_Population.xls.

We will open the Project Manager (from the “Show->Project manager” menu), and we select “Table” document. Then we press “New”, and at the “File” tab we press “Add”. We select the “New_York_City_Population.xls” file that we saved in our cartography folder, downloaded from the NY website.

When the XLS file appears at the “New table” window, we will have to configure it to be loaded correctly, so we have to select the table and press “Properties”.

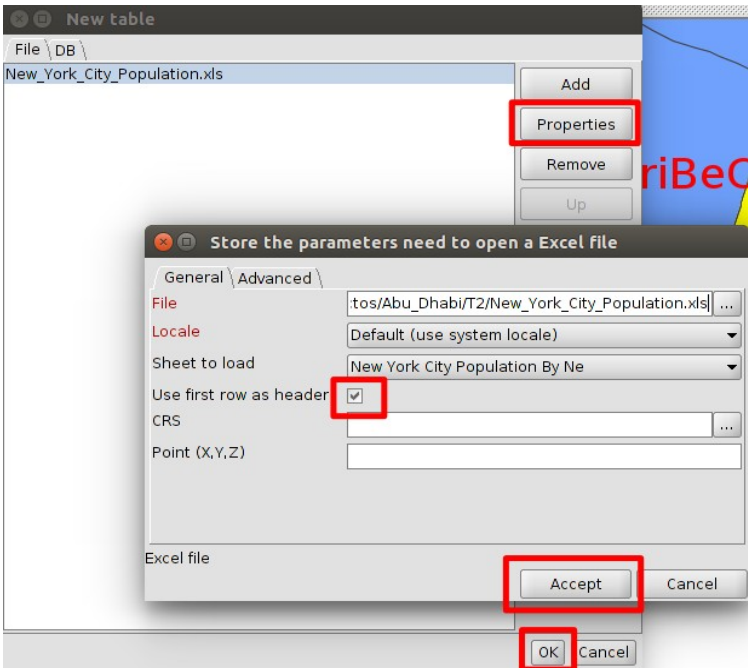


Figure 23. Loading an Excel file

Then, at the “General” tab, we will mark the “Use first row as header” option. We accept both windows and the table will be open in gvSIG.

We can see a field called “NTA Code” that contains the Neighborhood codes, like we had at the “Neigborhood” layer. We also have a field with the population of every neighborhood. We are going to include that population to the Neighborhood shapefile attribute table.

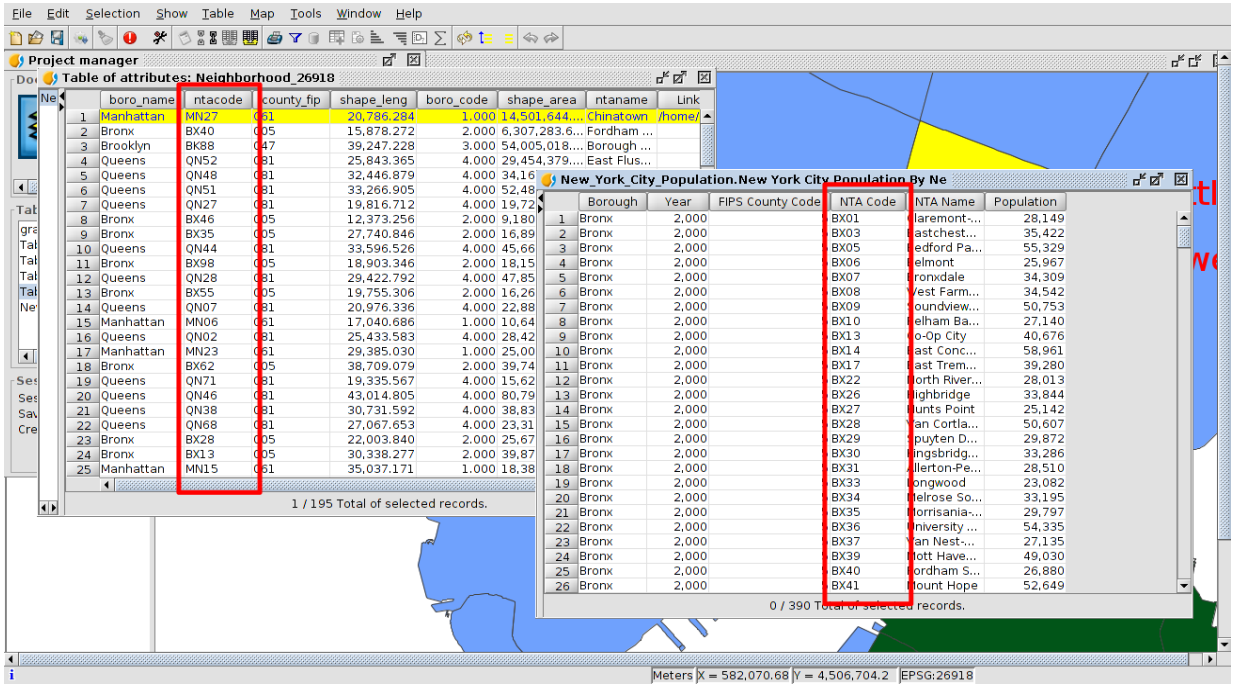


Figure 24. Common fields to join tables

Exercise 9: Joining tables

We are going to open the View, and we will open the Neighborhood attribute table. Then we will open the “Create join” tool (or in the Table menu). At the new window we will select “Neighborhood_26918” table as data store, and then we press Next. Then we select Neighborhood_population table as second data store. Then at the next window we select “ntacode” for field of the first table, “NTA Code” for the second one, “N” as a prefix for the first tabla (from “Neighborhood”), and “P” for the second one (from “Population”), and we select “Population” field to be imported.

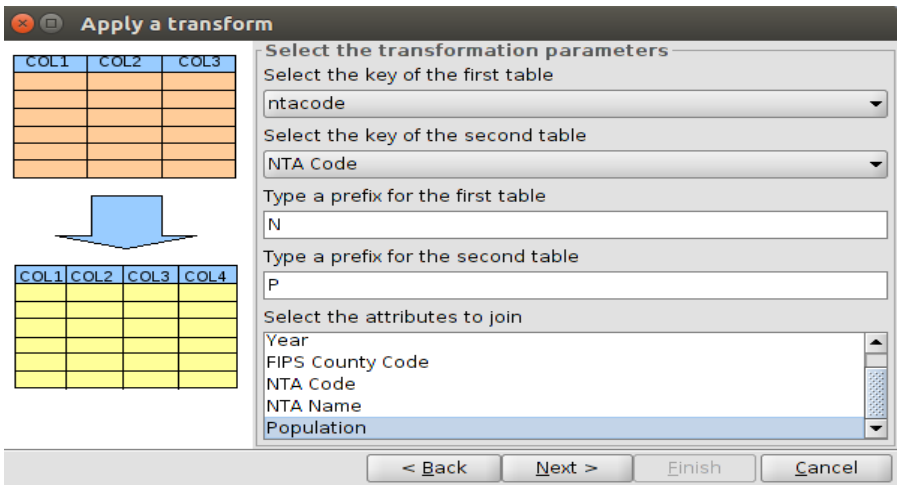


Figure 25. Table join settings

Then we press “Next” and at the last window we mark the option to load the transformation as a layer, and we select the “Untitled” view (it was the first one, in EPSG 32918). Then we press Finish and a virtual layer called “Join” is loaded at the View. If we open its attribute table we can see that the Population field has been added at the end.

We can order the field about the neighborhoods (“N_ntaname” field). For that, we click on the field name, and then we press .

The field values are ordered alphabetically.

Question 3:
After ordering neighborhood field, look for the value “Erasmus” and select it. How many population does it have?

Exercise 10: Field calculator

Now that we have the population and area values of every neighborhood we want to calculate their density. For that we will use the field calculator.

As the “Join” layer that we created from the join of tables is a “virtual” layer, we will have to export to a new SHP file in order to work on it. So we put the “Join” layer active qat the View, and we go to “Layer->Export to” menu, like we did previously. Then we will select Shapefile, and at the next window we access to the “...” button to select the output layer. We will name it “Neigborhood_population.shp”, and we will export all the registers. We finally will add it to the current View. We can see that some fields will be renamed because the field names of dbf files can't have more than 10 characters.

Now we will put the new layer active and we will start editing (second button on it). We will open its attribute table, and we will go to “Table->Column manager” menu. We will click on “New field” and we will add a new field called “Density”, type: “Double”, and size: 50. The new field will be added at the end of the table.

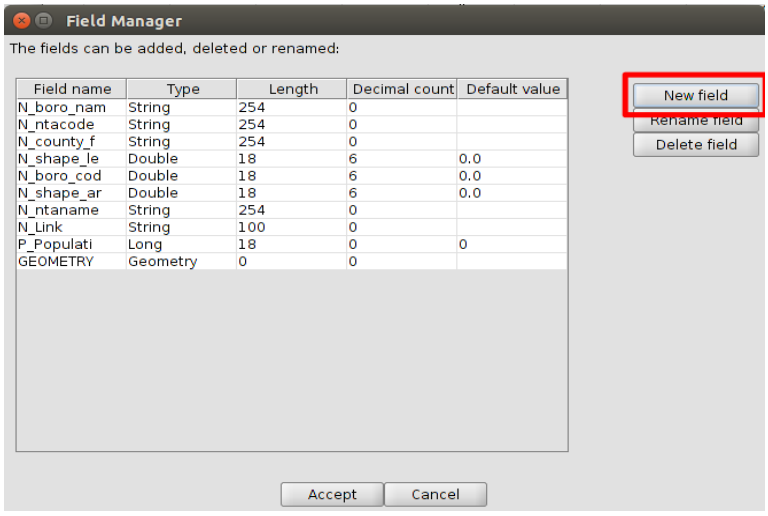


Figure 26. Creating new field in a table

Then we put it active and we open the Field calculator  .

We have to take into account that area value is available in meters, so the density won't be clear. We will need to convert it to squared meters. So we have to write this operation:

[P_Populati]/([N_shape_ar]/1000000)

(we can double-click on the field names to add them to the Expression box)

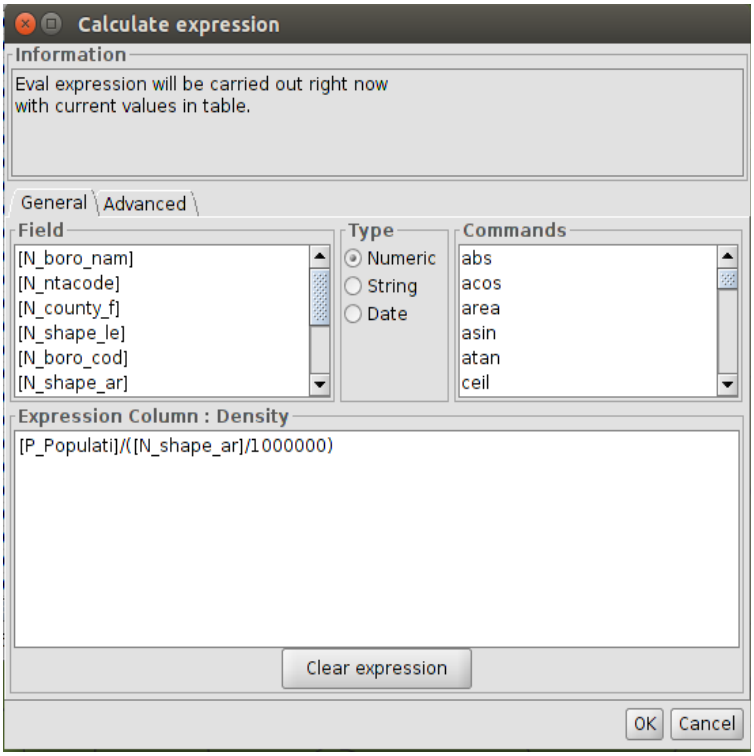


Figure 27. Field calculator

If we press OK, the density of every neighborhood will be added to the table (the last 3 characters are the decimals).

We finish editing of the layer.

Question 4:
After ordering neighborhood field again, look for the value "Hollis" and select it. How much density does it have?

We also can see the main statistics of a field. For that, keeping the "Density" field active, we can press "Statistics".  Then we will see the Maximum and minimum values, Media...

Question 5:
What's the media of the population density in New York?

Now we are going to apply a symbology by intervals, where we can see what neighborhood areas are more populated in an easy visualization.

Firstly we will zoom to the Neighborhood_population layer. We put it active, and then secondary button of the mouse, and finally “Zoom to layer”.

Then we will double-click on the Neighborhood_population layer to open its properties, and we access to the Symbols tab.

Then we access to Quantities-> Intervals.

Now we select “Density” as Classification field, “Equal intervals”, and 5 intervals. We select the white color as origin one, and a dark color (we can keep the blue one that is by default). Finally we press “Compute intervals”, and then “Apply” and “OK”.

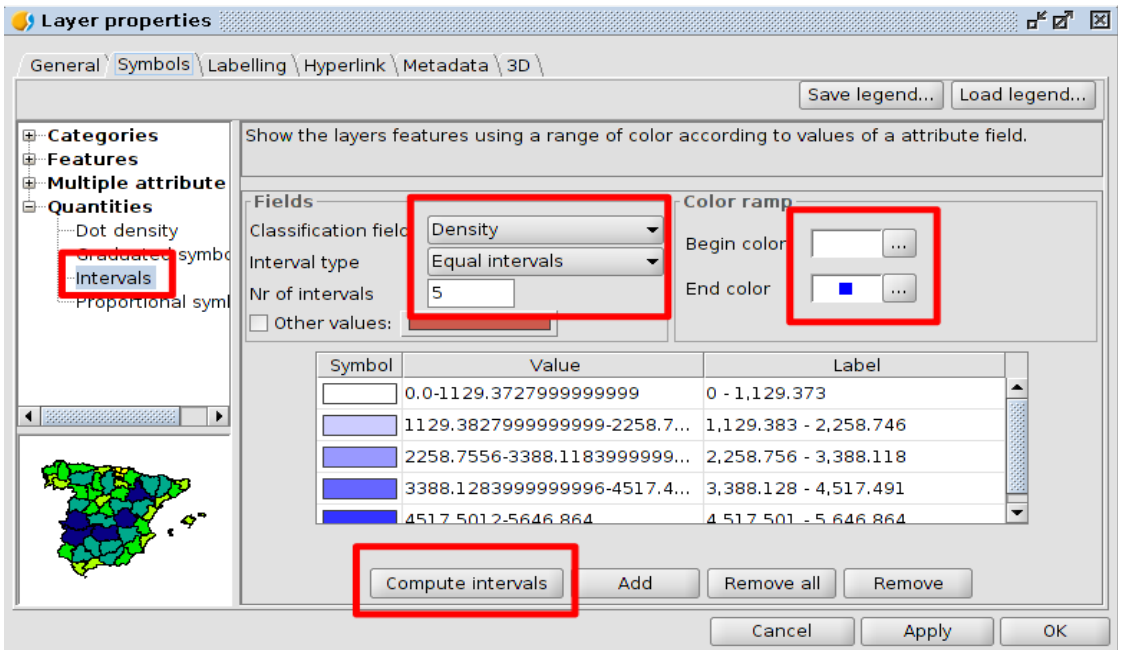


Figure 28. Symbology by intervals configuration

We will able to see the areas with a high density in an easy way.

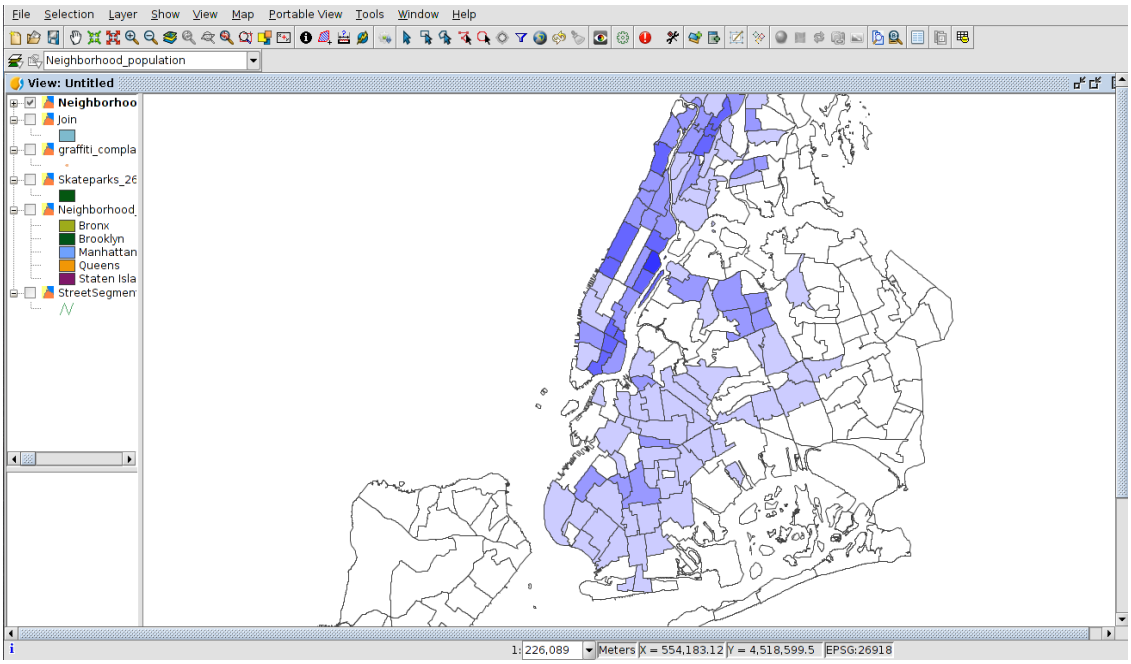


Figure 29. Symbology by intervals for neighborhood density of population

Exercise 11: Cartographic representation

Now we are going to create a map with the cartography of the last view. We also will include a legend, north arrow, scale...

At the current view ("Untitled"), we are going to keep only the Neighborhood_population layer visible, with the legend by density.

Firstly we will download this image in our disk:
https://cdn.civitatis.com/guias/nuevayork/fotos/thumbs/nueva-york.jpg

Now, to create a map, we will open the Project manager ("Show-Project manager" menu), and we click on the Layout document. Then we press "New", and a new window is opened.

We will select "Page Size": A4, "Horizontal", and we select the "Untitled" view. A new layout is created with that view.

Now we can reduce its size, to have enough space for the different elements.

Then we can access to the "Map->Insert" menu, and we will insert:

- Legend: We will draw a rectangle on the map, and we will select the view that we have at the layout. We select only Neighborhood_population layer for the legend.

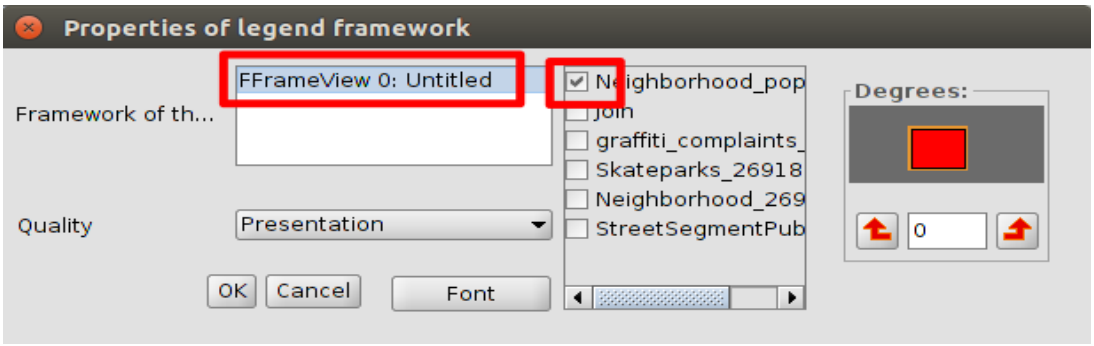


Figure 30. Legend settings at the layout

- Scale: We will draw a rectangle where the scale will be inserted, and we will select the view that we have at the layout. Then we will choose a graphical scale.

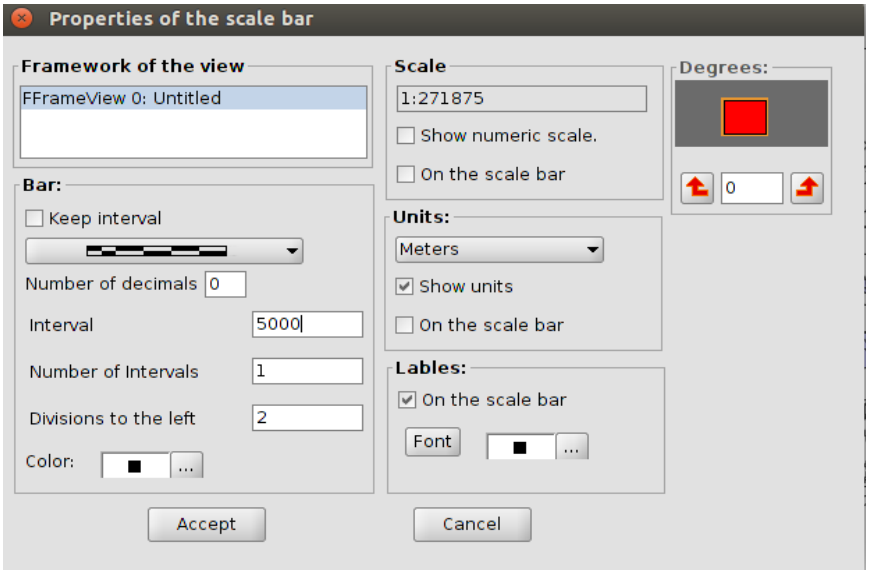


Figure 31. Scale settings at the layout

- North: We will draw a rectangle where the north will be inserted, and we will select the view that we have at the layout, and the type of north arrow. At this way, if we rotate the view at the layout, the north arrow rotates at the same time.

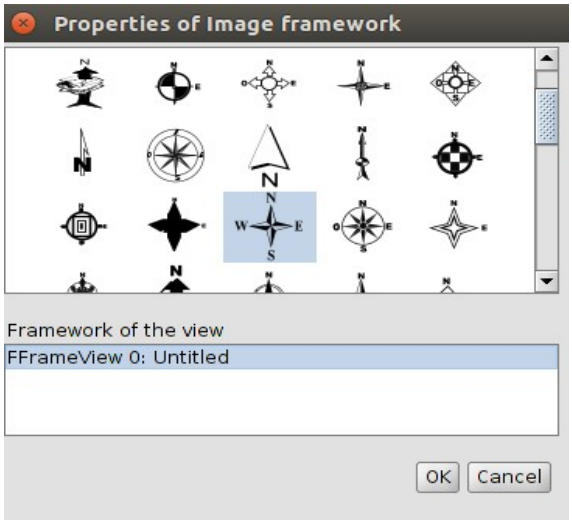


Figure 32. North settings at the layout

- Image: We will draw a rectangle where the image will be inserted, and we will select the image that we have downloaded (nueva-york.jpg), accessing to “Browse”. The image will be added to the layout.

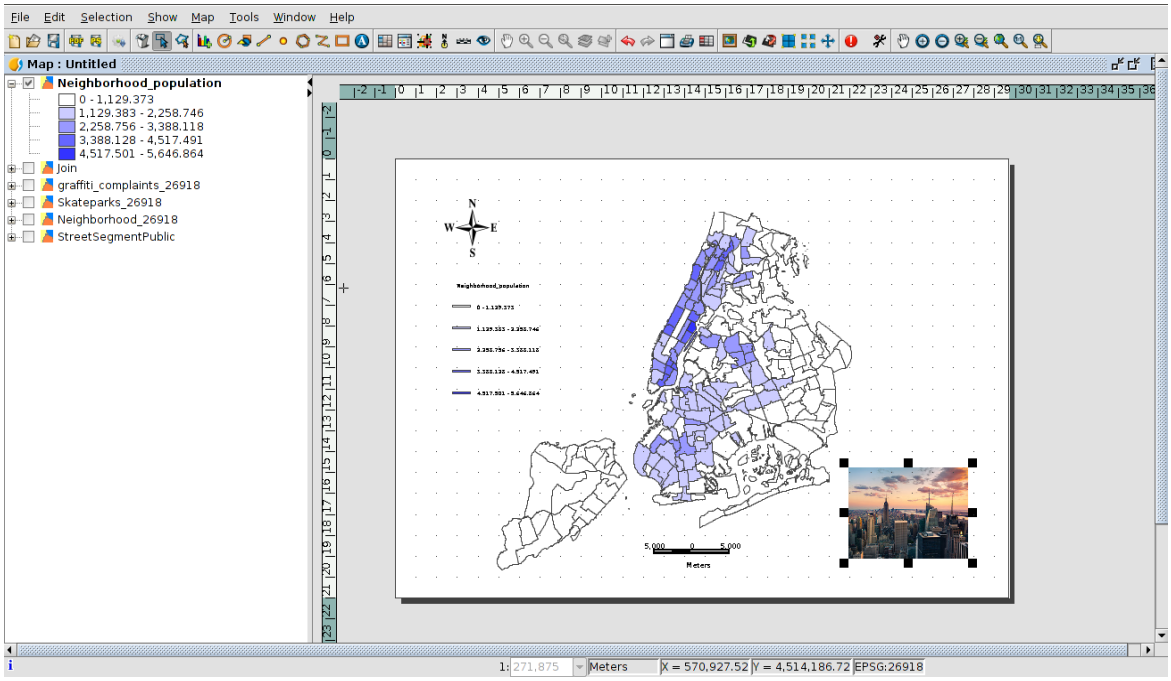


Figure 33. Layout in gvSIG

Now we can export it to a PDF file (from).

Question 6:
Create a PDF file with the map of densities in New York neighborhoods.

Exercise 12: Adding raster files

We are going to add a raster file at the View now, so we are going to open it (the view “Untitled”, from “View->Project manager” menu).

Then we press “Add layer”  (or from the View menu), and at the File tab we press “Add”. We look for the file “Jersey_CityNE_tile2.sid” that we downloaded at the beginning (it is an orthophotography). And after accepting it, the image is added to the view.

We can zoom to it, clicking on the active layer, and then using the secondary button of the mouse, we select “Zoom to layer”. We will see the image on the Neighborhood layer.

We can apply transparency to the raster layer in order to see the neighborhood layer symbology too (the density).

For that we put the Jersey_CityNE_tile2.sid layer active, and with the secondary button of the mouse we select “Raster properties”.

Then we go to the “Transparency” tab, we active “Opacity” and we apply about 40%. We finally press “Apply” and “Accept”. We will see the colors of the Neighborhood layer and the image.

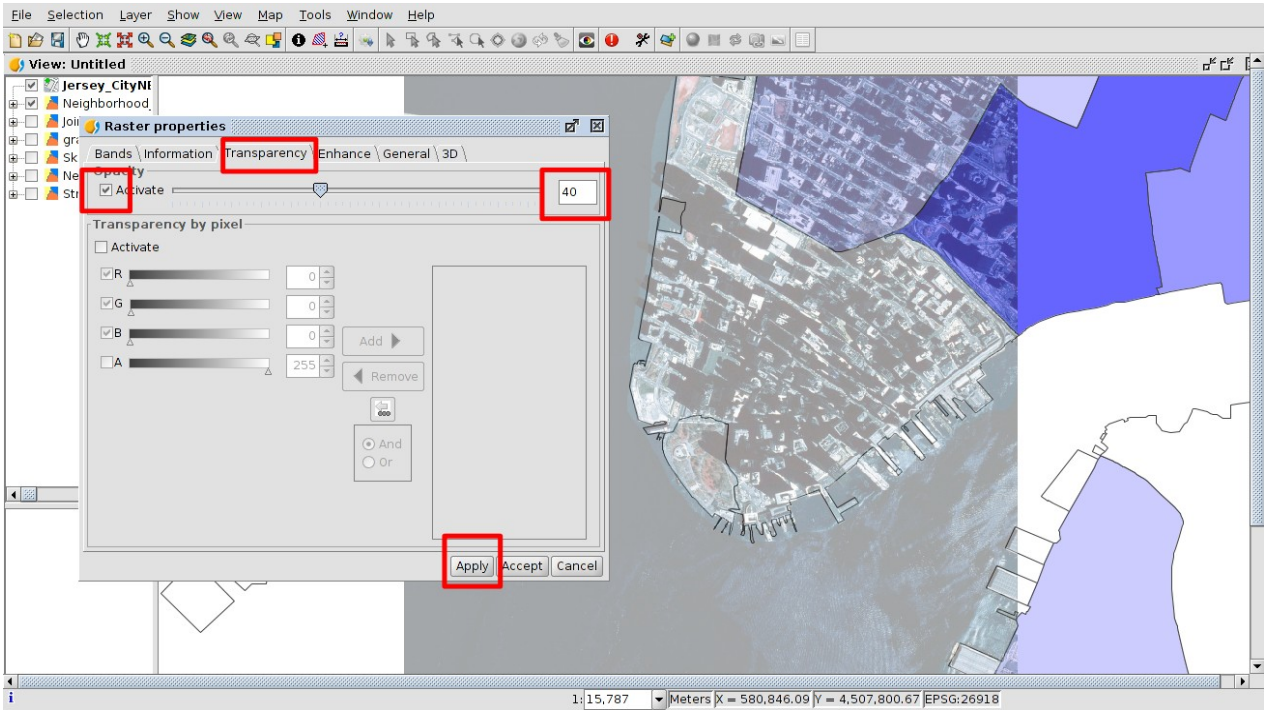


Figure 34. Applying transparency to a raster file

Exercise 13: Geographical selection

At this section we are going to use some selection tools. For example we want to select the biggest skateparks in New York city and know their neighborhood area.

For that we will put the Skatepark layer active, and we will open its attribute table. Then we will open the “Select by attribute” tool  . We want to select the skateparks the area of which is bigger than 15000m2, So we will write this sentence (clicking on the field name):

shape_area > 15000

and then we press “New set”. They will be selected on the table and on the view.

Then we go back to the view, and we put the neighborhood_population layer active. We want to know the neighborhood that have the selected skateparks. For that we will open the “Select by layer” tool (at the Selection menu), and we configure it at this way:

Select items from active layer that...
Intersect with

Selected items of a layer
Skateparks_26918

we finally press “New set”. If we close that window, we can see them on the view, and if we open its attribute table and we use “Move up selection” tool we can see them at the top of the table.

Question 7:
How many neighborhoods have big skateparks (the records that have been selected)?

Exercise 14: Loading WMS servers

We are going to load some remote layers, from different servers. There are several types of servers. We are going to use Web Map Service (WMS), where the origin layers can be raster or vector ones, and it's loaded as an image in Geographic Information Systems, and Web Feature Servers (WFS), when data are in vector format and it is loaded as a vector layer too, having access to the attribute information.

We are going to load some layers in EPSG 4326 (Geodetic coordinates, WGS84), so we are going to create a new view in that reference system. For that, we will open the Project Manager (“Show->Project Manager” menu), and we will select the “View” document. We press “New” to create a new one, and a new View is created in EPSG 4326 (because it's selected by default at the gvSIG Preferences; if we change it, the new Views would be created in the selected CRS). We can check it at the bottom of the View. It's called “Untitled-1”.

Now we are going to load a layer from a remote server. It will be the ortho of USA. For that we will press “Add layer”, and we open the “WMS” tab.

Now we will connect to this URL:
http://services.nationalmap.gov/arcgis/services/USGSNAIPPlus/MapServer/WMSServer?

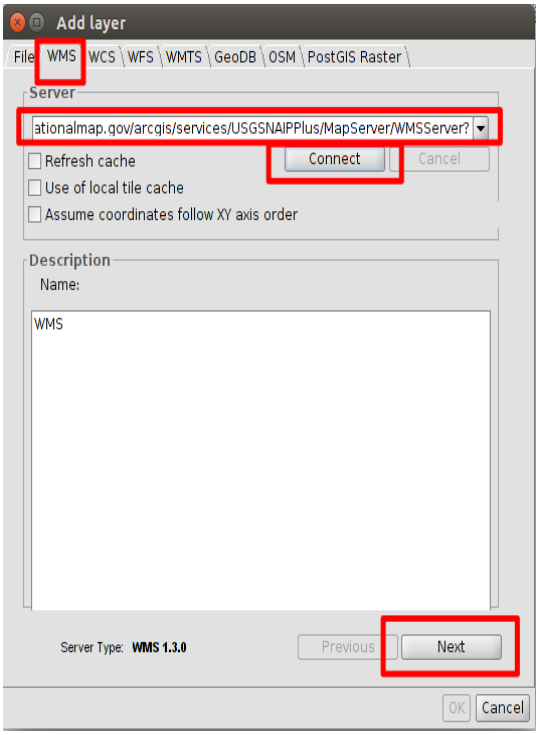


Figure 35. Connecting to WMS server

Then we press “Next”. At the next window we open the “USGSNAIPImagery” folder, we select “Image” and we press “Add”.

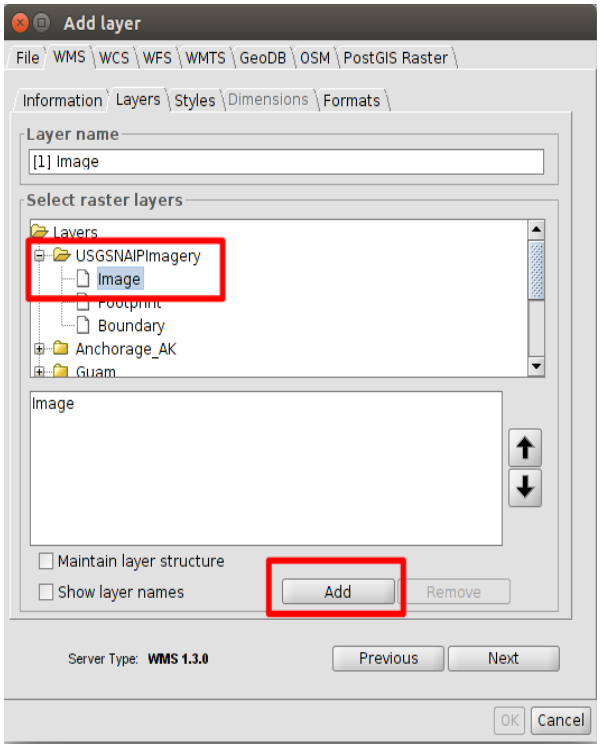


Figure 36. Selection of layers in a WMS server

At the next window, we will keep the styles by default, and at the “Formats” tab we will select:

- Format: png
- SRS: 4326
- Text format: application/vnd.esri.wms_raw_xml

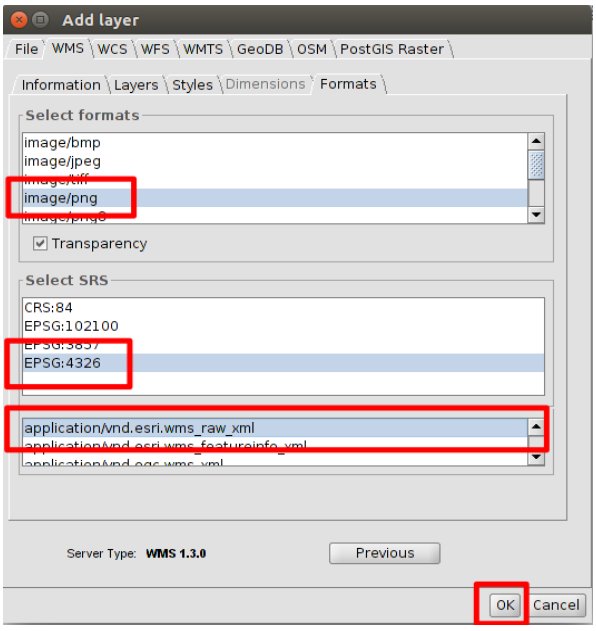


Figure 37. Selecting image format, reference system and text format in a WMS service

We will press “OK” and the USA ortho imagery will be loaded. It will take some seconds because it has to connect to the server.

Exercise 15: Creating new layers, graphical editing

Now we are going to create a new layer, from “View->New layer” menu. At the first window we will select “Shapefile”, and at the next one we will access to “...” button to select the folder where it will be saved and its name. We can call it “buildings”.

At the next window we will change the “Type” of the shapefile to “SURFACE” (it will be a polygon layer), and we will add one field that we can call “buildings”.

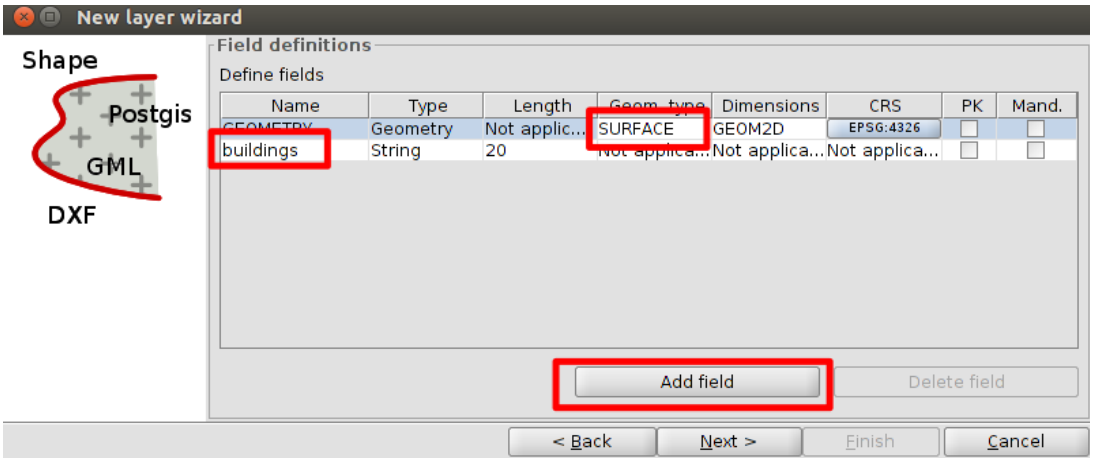


Figure 38. Configuring geometry type and fields in a shapefile

Then at the last window we keep it by default and we finish. The layer is added to the view.

Now we are going to zoom to a neighborhood area and we are going to add elements to the layer, concretely some buildings, so we put it active and we start editing mode.

Then we press “Insert polygon” tool.

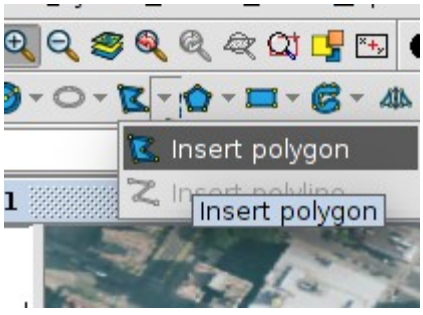


Figure 39. “Insert polygon” tool

And we can start to draw a polygon, and with secondary button of the mouse we can finish it.

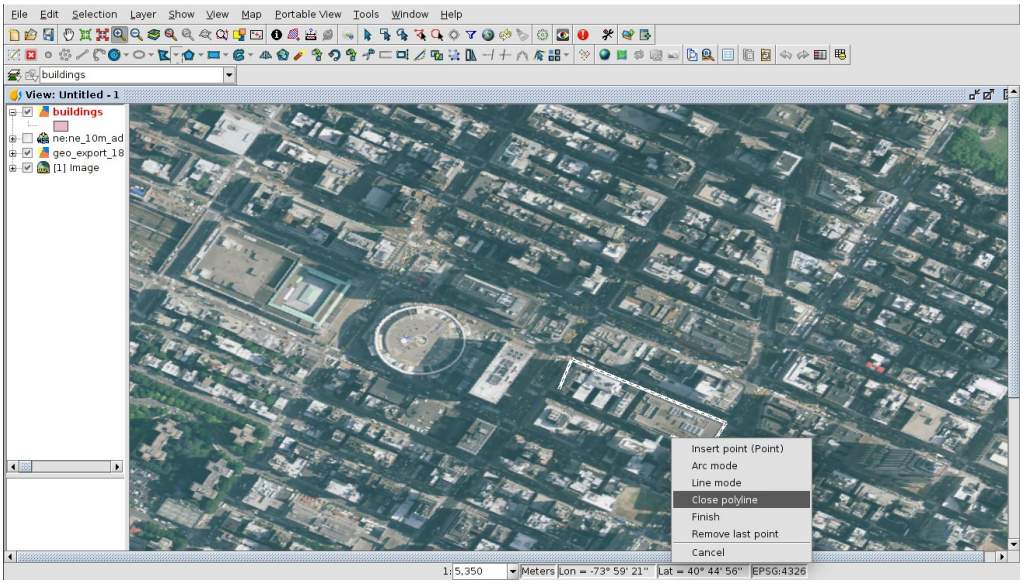


Figure 40. Drawing polygons in editing mode in a vector layer

We can draw several polygons,

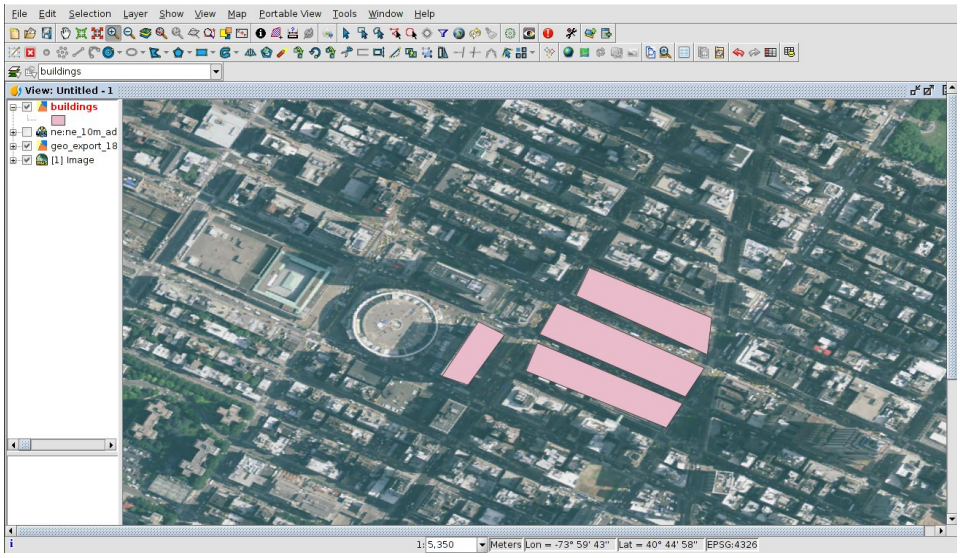


Figure 41. Polygons created in a shapefile

We also can move them, changing their location (it's a supposed case). For that we will select a building and we will use “Move geometry” tool  to move the geometry from the current position to other one at the view.

After that we will finish editing and we save changes.

Exercise 16: Creating KML file to be loaded in Google Earth

We can export the “buildings.shp” layer to a KML format in order to load it in Google Earth. For that we put it active and go to “Layer->Export to” menu. We select KML format at the first window, and at the next one we mark the “Show attributes in balloon” option (to show the attribute information in GE. At the next window we access to “...” button to select its name and folder. We call it “buildings-GE.kml”, and we export all registers. If we open that file in Google Earth we can see it (we will have to change the color of the lines to see them easily).

Exercise 17: Loading WFS servers

Now we are going to load a Web Feature Service (WFS). For that we will “Add layer”, and we'll go to “WFS” tab.

Then we will connect to http://demo.opengeo.org/geoserver/wfs?

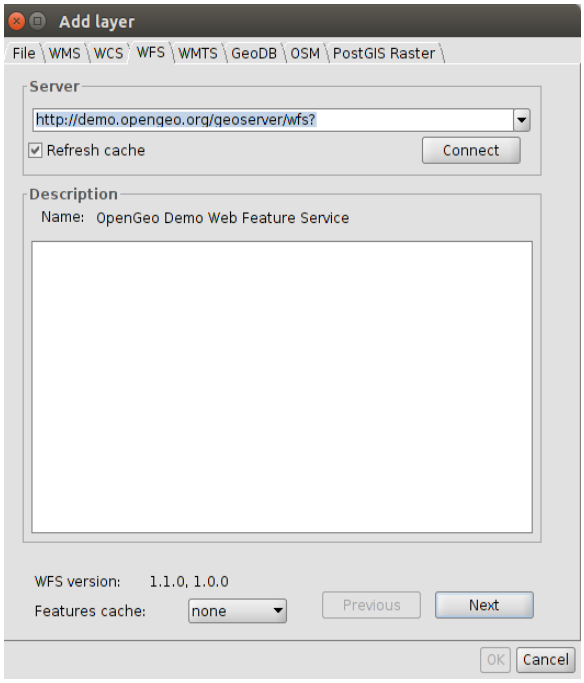


Figure 42. Connecting to WFS service

At the next window we will select “Countries” layer.

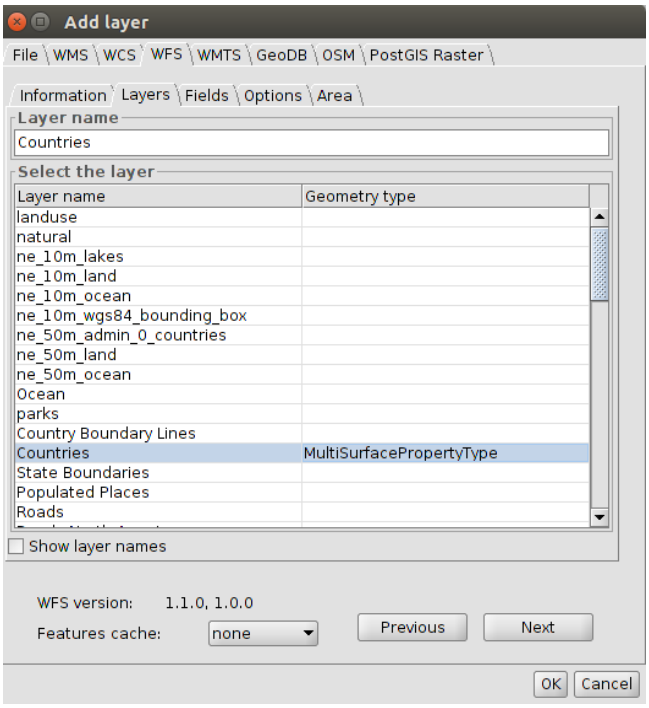


Figure 43. Selecting layers in a WFS service

At the next window we can select the fields to be loaded. We keep all of them. And at the Options window we check that EPSG is 4326.

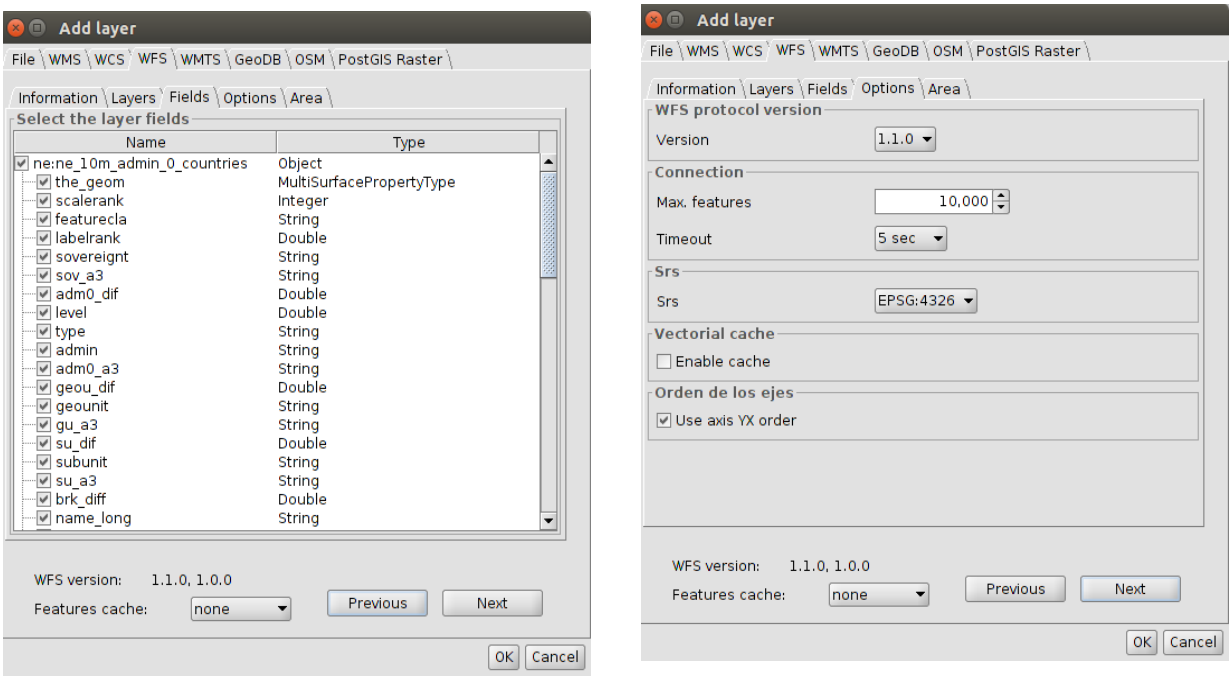


Figure 44. Fields and general options settings in a WFS service

At the last window we could load only the elements from a location, but we are going to load all of them. So we press “OK”.

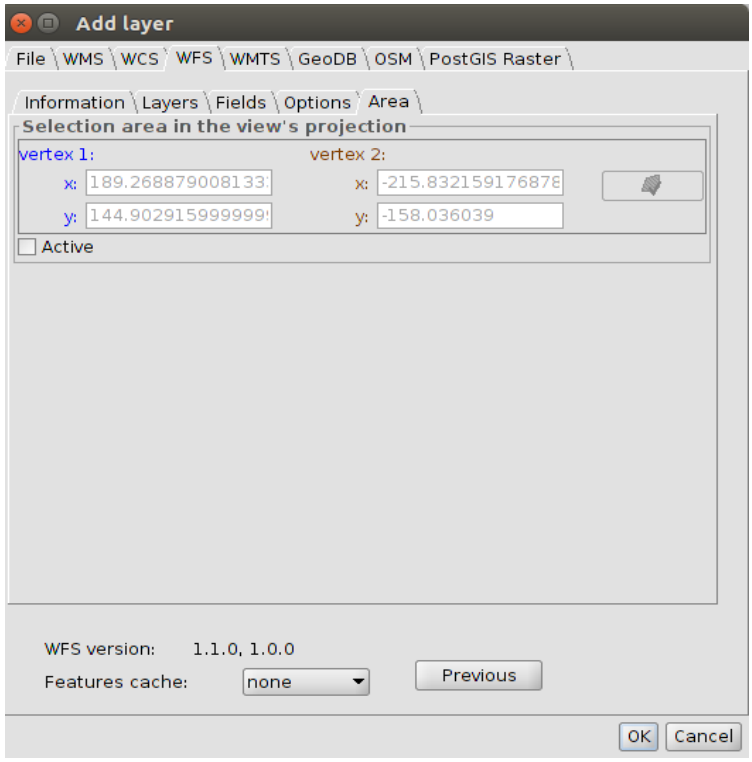


Figure 45. Selecting the area of a layer in a WFS service

The layer will be loaded after some seconds (it will take more than WMS because it manages more data). We can do a “Zoom extent” to see the new layer.

We can put it active at the view, and open its attribute table. We could select elements, change symbology... At the WMS we couldn't do it because it was loaded as an image.

Question 8:
Which is the country with “postal” = “DZ”?

Exercise 18: Adding an event layer

The other data that we have is an attribute table, in CSV format, with the graffiti complaints, but they don't have geographical component, only two columns with Latitude and Longitude. At gvSIG we can load that table, and create a point layer from it, where Latitude and Longitude fields are used to georeference the complaints.

We can open the CSV file with a text editor (Notepad, gedit, kate...) to check how it is created, and we can see that field separators are comma.

Firstly we have to load the attribute table in gvSIG. We will open the Project Manager (from the “Show->Project manager” menu), and we select “Table” document. Then we press “New”, and at the “File” tab we press “Add”. We select the “graffiti_complaints.csv” file that we saved in our cartography folder, downloaded from the NY website.

When the CSV file appears at the “New table” window, we will have to configure it to be

loaded correctly, so we have to select the table and press “Properties”.

Then, at the “Basic” tab, we will select the “Standard (double quote, comma and crif)” option in “profile”. That's because the field separators at the CSV file are “,”.

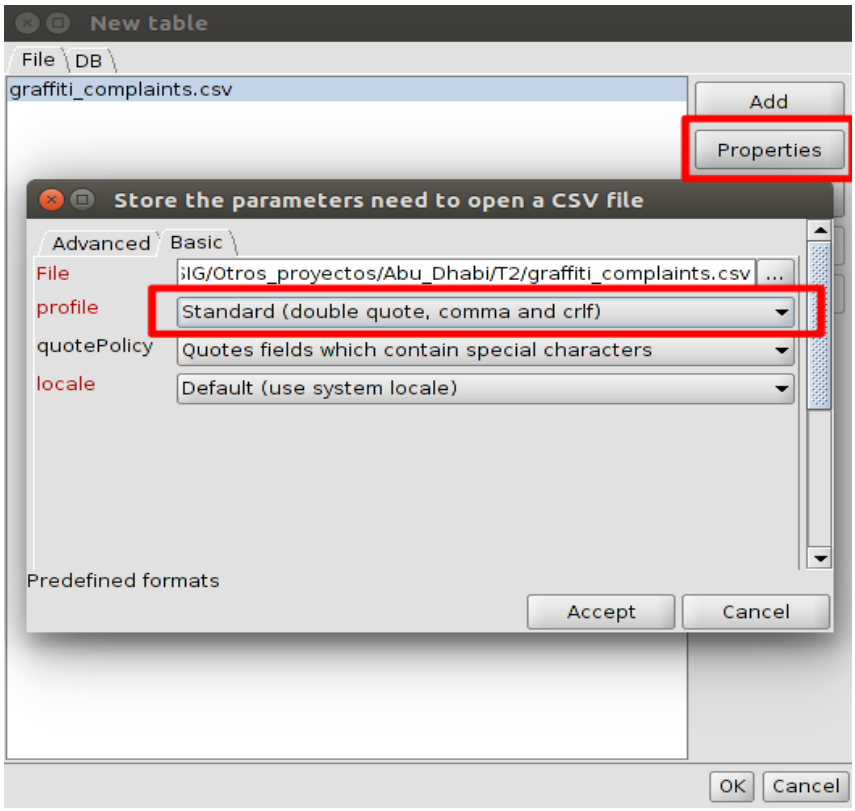


Figure 46: Selecting field separators in a CSV file

Then, at the “Advanced” tab, we have to uncheck the “automaticTypesDetection” option, and fill the “fieldtypes” box in with this text:

type:string,address:string,city:string,lat:double,lon:double

At that way we are indicating the field types in order to load them correctly in gvSIG. As we have 5 columns at the table, we indicate the name of every field and its type.

NOTE: From gvSIG 2.4 it is planned to include a tool to load tables in an easy way, like in the spreadsheets (Excel, LibreOffice...).

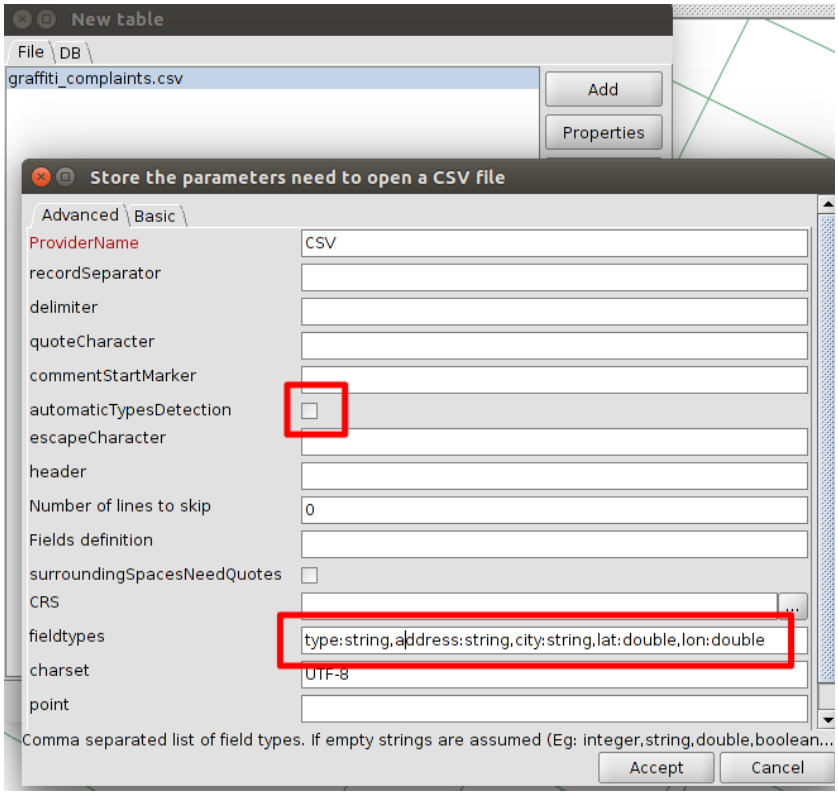


Figure 47: "Advanced" tab configuration

After that we Accept it, and the table will be loaded in gvSIG, with the 5 fields, and their new names.

We can see that Latitude and Longitude fields have only 3 decimals. We can show 10 decimals changing the Table properties. For that we will access to the "Table->Properties" menu, and at the "Pattern" column of the "lat" and "lon" fields we change it. Now we can see:

#,##0.000

and we will add 7 "zeros". It will remain:

#,##0.0000000000

(after editing the pattern, we have to press "Enter" for it to have effect).

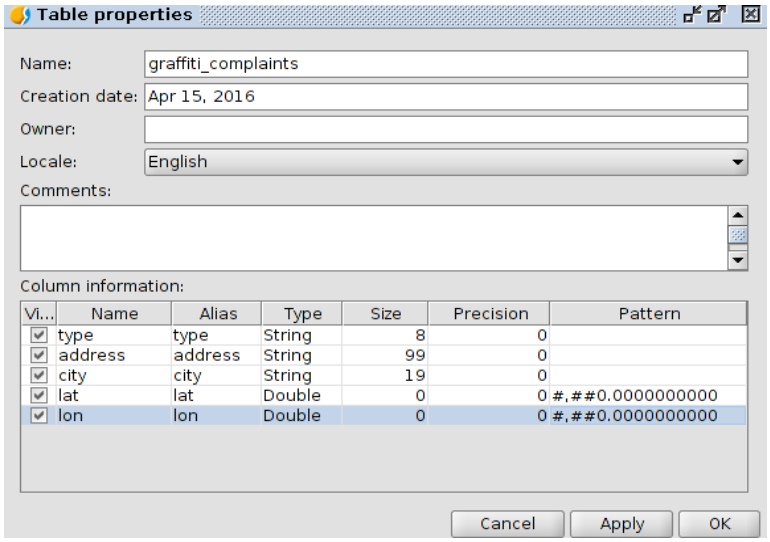


Figure 48. Changing pattern of fields in an attribute table

And now we see the fields with more decimals:

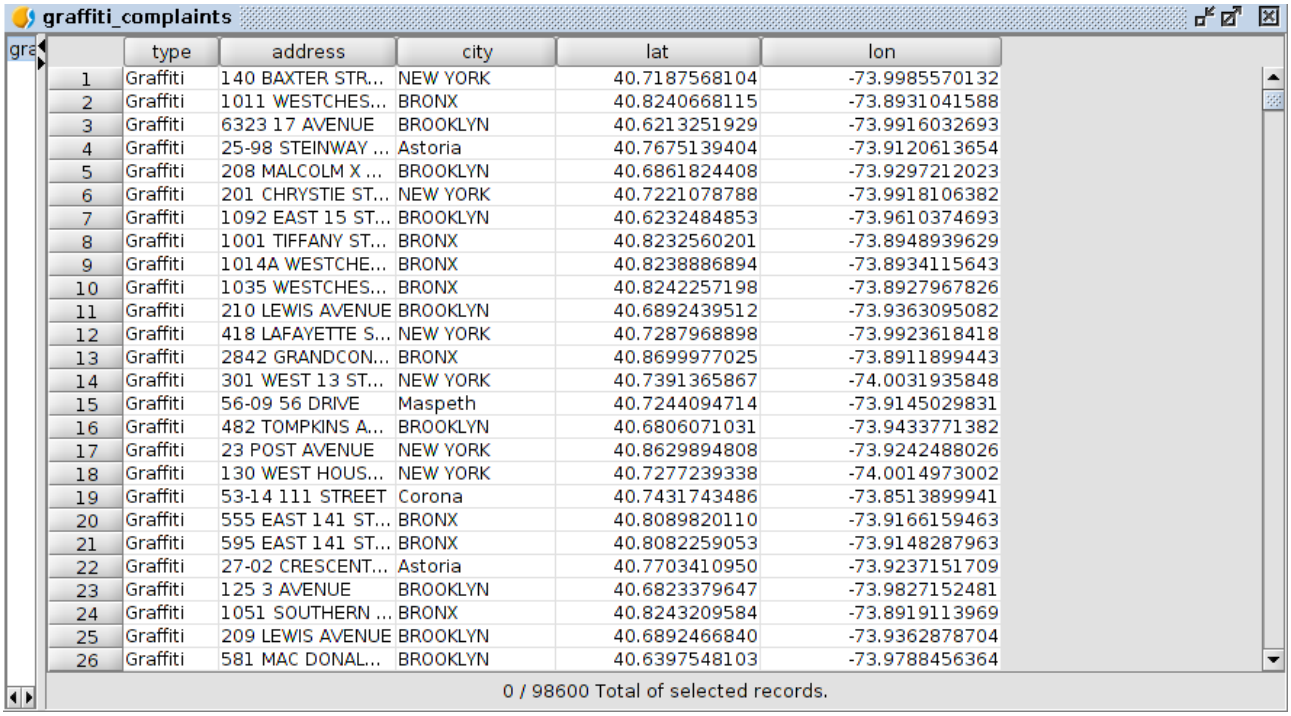


Figure 49. Attribute table with new pattern

The next step would be to create a point layer from the attribute table. It can be done with “Create event layer” tool when there are two fields with the coordinates.

But they are in EPSG 4326 CRS, so we will have to load them in a View in that reference system. For that, we will open the “Untitled-1” View, that was in that CRS.

Now we are going to add an Event layer, from the previous attribute table. We will go to the “View->Add event layer” menu (or ). At the first window we will select the “graffiti

complaints” table, and we press “Next”. Then we select the “lon” field for X coordinates and “lat” field for Y coordinates, and we change projection to EPSG 4326. Then we press “Next”. At the last window we keep the “Load the transformation output as a layer” option, and we select the “Untitled-1” View at the list.

The event layer is loaded at the “Untitled-1” View, but it is a virtual layer (it is a csv file, a text file). The way to have a point layer in gvSIG would be to export it to a new layer.

For that, we have to put the layer active, clicking on it at the ToC. And then we go to the “Layer->Export to” menu.

At the new window we will select “Shape format”, then we press “Next, and we will access to the “...” button in order to select the folder where the file will be saved, and the file name. We can name it “graffiti_complaints_4326.shp” (because it is its CRS). Then we press “Next”, and “All records” option, and we finally press “Export”. We indicate that we want to add that layer to the View, and we close the Window.

A new layer is added to the View, and now it is a SHP file, that is in EPSG 4326.

Now we want to have that layer on the other View (Untitled), in EPSG 26918, so we have to reproject it on the fly, and finally export the layer to a new SHP to have it in the new reference system. For that, we go to Show->Project manager, and at the Project manager we click on the “View” document, and we open the View “Untitled”.

Now we are going to add the new point layer, so we open the “View->Add layer” menu, and at the “File” tab we click on “Add” button. We select the “graffiti_complaints_4326.shp” file, but in this case, at the “Add layer” window we have to indicate that that layer is in another reference system. For that we press “Properties”, and at the Properties window we access to the CRS option.

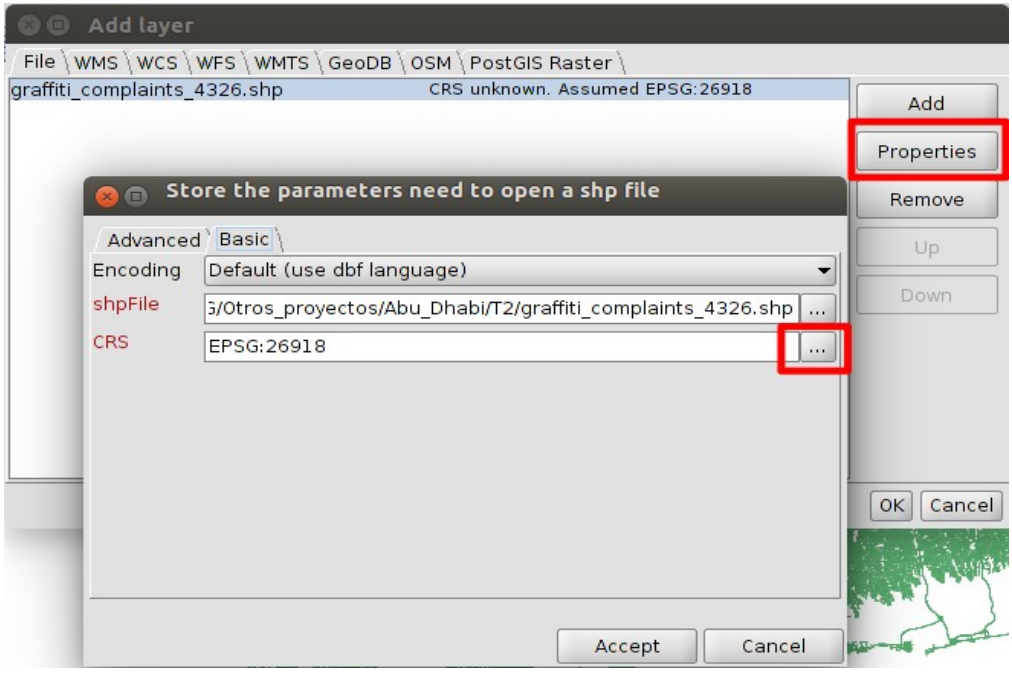


Figure 50. Changing reference system of a new layer

At the new window, we select the EPSG 4326 at the “Recent” Type, and press “Finish”. We will see now the “reprojected on the fly” text at the CRS properties.

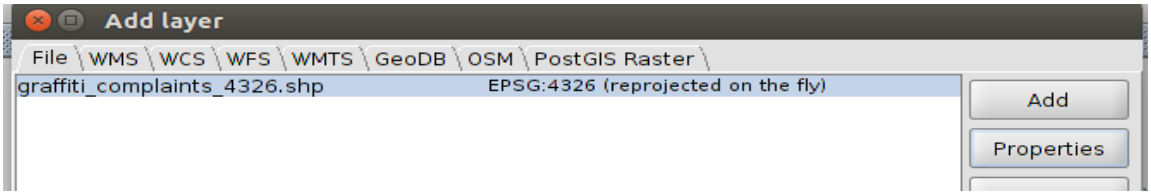


Figure 51. Reference system of the layer to be added

We finally accept the “Add layer” window and the Complaints layer will be reprojected on the fly at the View.

As the layer is reprojected on the fly, and we want to do analysis (geoprocesses...), we need to have the layer at the View CRS physicality. For that, we will export the reprojected layer (on the fly) to a new layer. Firstly we have to put the layer active, clicking on it at the ToC. And then we go to the “Layer->Export to” menu.

At the new window we will select “Shape format”, then we press “Next, and we will access to the “...” button in order to select the folder where the file will be saved, and the file name. We can name it “graffiti_complaints_26918.shp” (because it will be its new CRS). Then we press “Next”, and “All records” option, and we finally press “Export”. We indicate that we want to add that layer to the View, and we close the Window.

A new layer is added to the View, and its CRS is the same than the View.

We can delete the old layer from the View, clicking on “graffiti_complaints_4326.shp”, and with the secondary button a contextual menu is open, where we select “Delete layer”.

Exercise 19: Geoprocessing with gvSIG

At this point, after loading the cartography at the View, we are going to analyze if the situation of the skateparks have a relationship with the graffiti complaints.

We can use several geoprocesses for that.

For example, one way to check if there's a relationship is to create hot maps (density maps), where an image is create and pixel value is different when the density of points is higher.

At the current View, we are going to keep visible only the “complaints” and “skateparks” layers.

We can consider that skaters work in an area of 1,5 kilometers from the parks (it's an estimated area, but it will help to see if it affects. So we are to use the buffer geoprocess to create polygons the radio of which is 1500 meters from the skateparks.

Firstly we will open the Toolbox  (or from “Tools->Geoprocessing->Toolbox” menu). The geoprocessing manager will be opened.

Now we are going to open the “Buffer” geoprocess, inside “gvSIG Geoprocesses->Vector layer tools”. A new window is opened. We will select “Skateparks_26918.shp” as input layer, we mark the second option where distance for buffer is fixed (not by a field), and we write “1500”. We also select “Dissolve entities” because if there are a skatepark close to other one we want an only polygon.

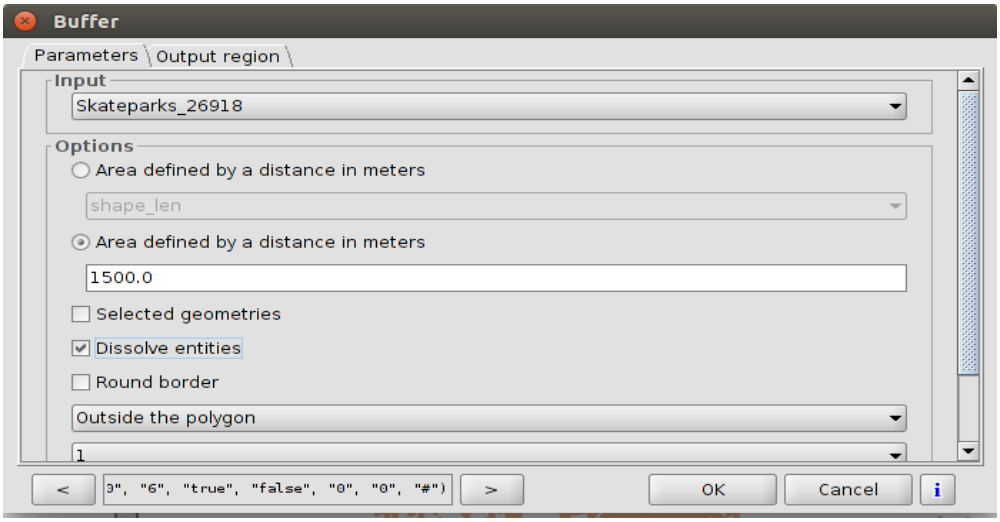


Figure 52. Buffer configuration

At the bottom of that window, in the “Outputs” option we access to the “...” button and we select the folder where it will be saved, and we call the file “buffer.shp”. At the end we accept it and the buffer is created, and the new layer added to the view.

Question 9:
How many polygons have been created?

We are going to change its symbology, double-clicking on the rectangle with the color at the ToC. We will remove the fill, and increase the thickness of the line.

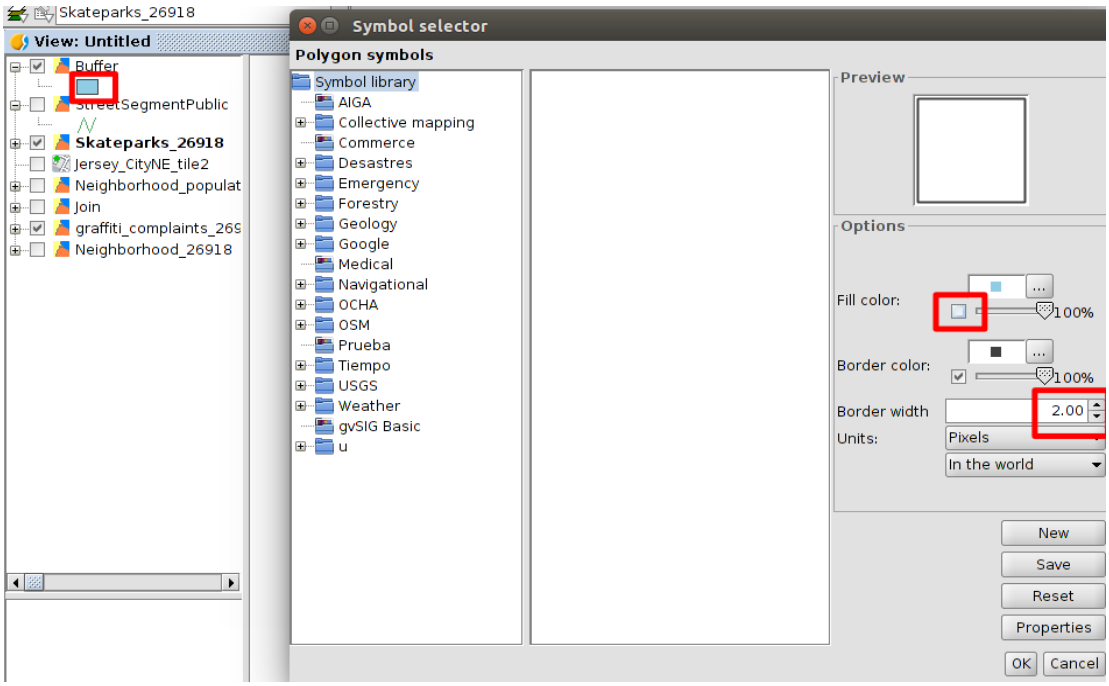


Figure 53. Changing symbology to a shapefile

Now we will use “Density (kernel)” geoprocess in order to get a density map, where areas with a high density of points (complaints) will have different colors.

We need a field at the attribute table with the weight to calculate the density. In our case the weight will be the same, so it will be the same value. We are going to put the graffiti_complaints_26918 layer active and start editing. Then we open its attribute table, and we access to “Table->Add column” menu. We will add a field called “Weight”, and this settings: “type“: Integer, “Size“: 1, and “Default value“: 1. At this way all the registers are filled in with “1”.

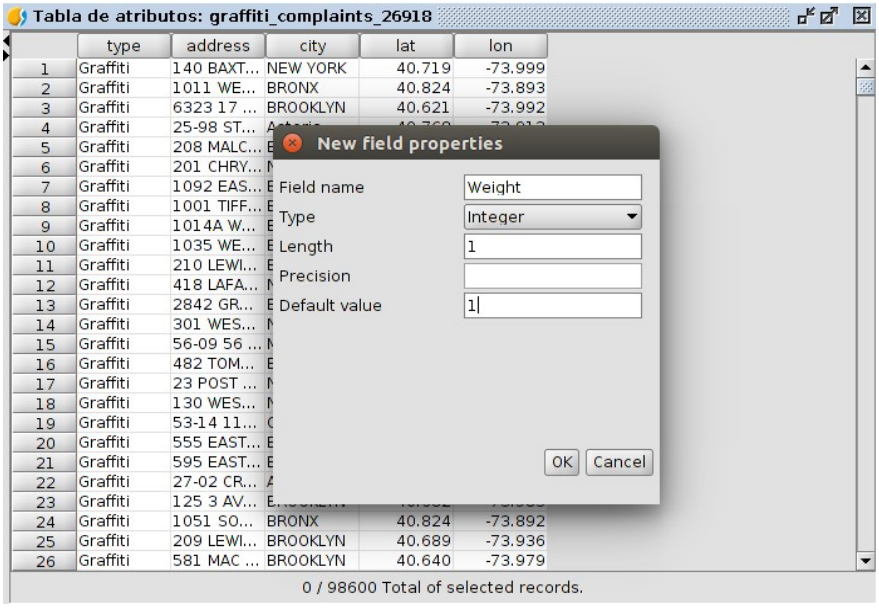


Figure 54. Creating a new field on the table

Now we finish editing and we will have the new field.

And now we can start with the geoprocess. For that we open the Toolbox again, and we open Sextante geoprocesses, and “Rasterization and interpolation” option. We open “Density (kernel)”.

At the geoprocess we will select “graffiti_complaints_26918” file for input layer. The field will be “Weight”, and “Search radius” will be “100”.

For output layer we access to “...” button and we select the folder. We can call the file “Density”. It will be a raster file.

At the “Output region” tab we will select:

- Use extent from layer: graffiti_complaints_26918

And cell size will be 20.

After accepting, the process will start, and it will take several minutes, depending on the computer.

We'll see an image, with several areas in different colors. We can apply a Color table in order to see it easily.

For that, we put the new layer active, and with secondary button of the mouse we access to “Color table”. Then we have to mark “Activate color table”, and we can select one of the color tables with a scale (from light color to dark one), for example “Deep Azure (256)”. Then we change the “Alpha” value of the first register to 0. At this way pixels with no value will be transparent.

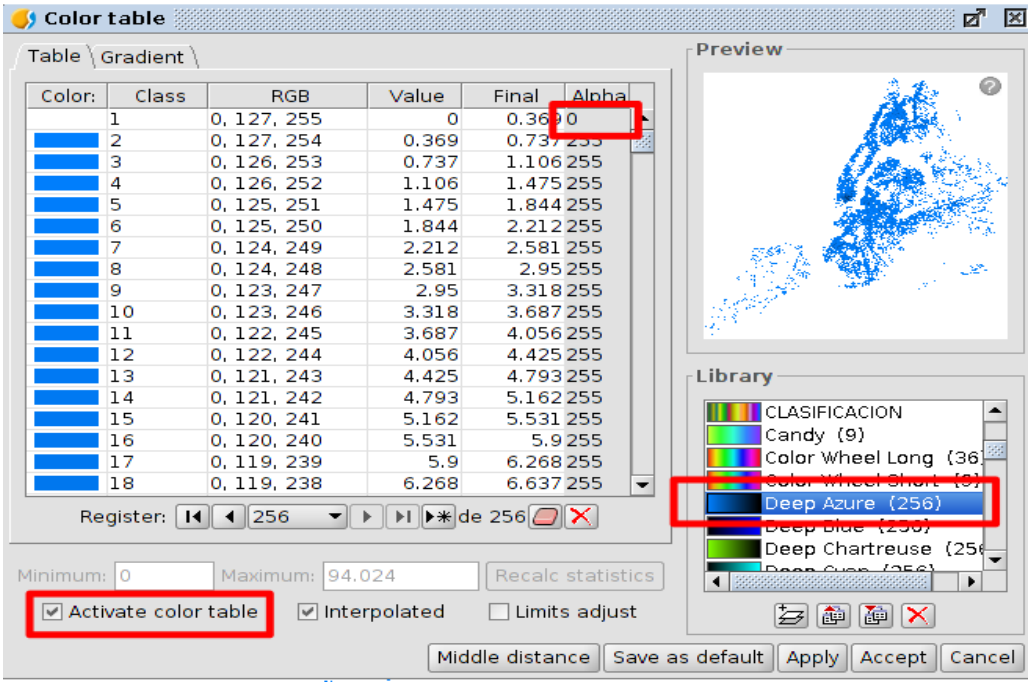


Figure 55. Applying a color table to a raster file

After applying and accepting we will be the image, where the dark blue areas will be the

areas with more graffiti complaints.

If we put the Buffer layer active and with secondary button of the mouse we select “Bring to front”.

At this way we can see the skateparks and the areas with high number of complaints.

Conclusions

To analyze the skatepark location in New York city in relation with complaints about requests on graffiti cleaning, some geoprocesses have been applied.

For this analysis, a density method has been used to get the areas where there are more graffiti complaints. It has been a first method. The situation of the skateparks has been taken into account too, calculating an estimated distance from them where the skaters can move.

Seeing the results we can interpret that only in one of the areas where there are some skateparks can have a direct relationship with the number of complaints. That area is one of the most populated areas in New York, where there's a high density of population, so it can be related too.

At the other locations of skateparks the density of graffiti complaints is not as much high as in the other case, so in general we can't deduce that they are related directly.

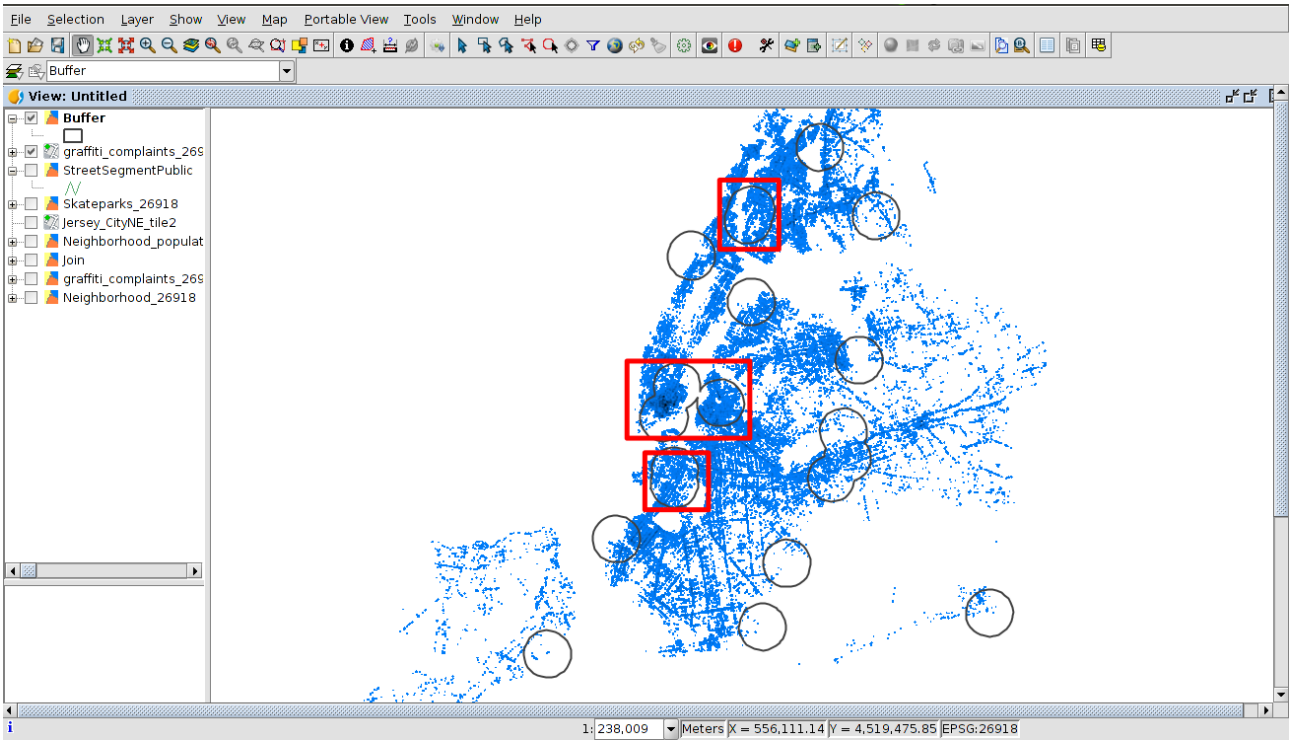


Figure 56. Results of the analysis

We can see in red color the areas where skateparks can be related to graffiti complaints, but at the other ones it's not very noteworthy.

Answers

Warning: *These values are for August 2016. Data can be uploaded at the website, so they can change a little bit.*

Question 1:
After ordering neighborhood field, look for the value "Manhattanville" and select it. Which is the area of that neighborhood (the value of the "shape_area" field)? Take into account that the three last numbers are the decimal ones.

10647077,452

Question 2:
After applying symbology and adding labels, and zooming to the specified point, which is the neighborhood under that point?

Kew Gardens Hills

Question 3:
After ordering neighborhood field, look for the value "Erasmus" and select it. How many population does it have?

31392

Question 4:
After ordering neighborhood field again, look for the value "Hollis" and select it. How much density does it have?

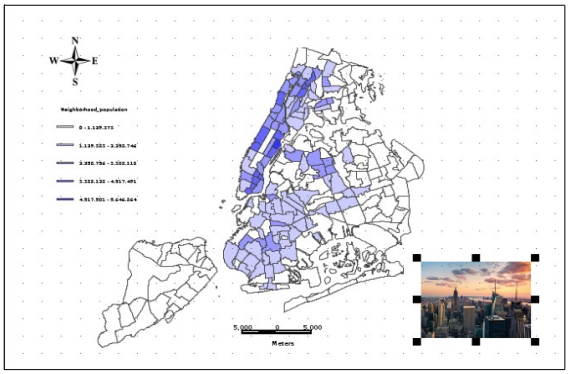
906467

Question 5:
What's the media of the population density in New York?

1496.6845418722953

Question 6:
Create a PDF file with the map of densities in New York neighborhoods.

It can be like this one:



Question 7:
How many neighborhoods have big skateparks (the records that have been selected)?

8 neighborhoods

Question 8:
Which is the country with “postal” = “DZ”?

Algerie

Question 9:
How many polygons have been created?

14 polygons