

## VISUALISING SPATIAL DATA IN QGIS

### Learning objectives:

- To work with raster, vector and web basemaps within a GIS to visualise data.
- Create heatmap to visualise distribution of point data.
- Learn how to use the TimeManager plugin to view change over time.
- Learn how to create 3D visualisations in QGIS.

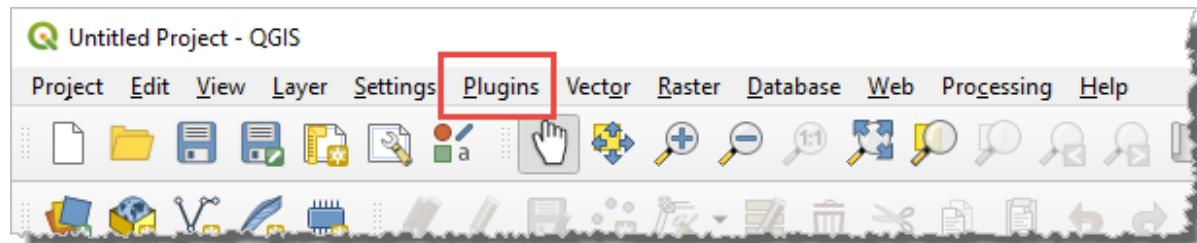
## CONTENTS

Visualising Spatial Data in QGIS .....	1
Setting up QGIS for the Workshop .....	2
Plugins: .....	2
Adding a Web Basemap:.....	2
Basic GIS Functions .....	4
Layers:.....	4
Zooming and Panning:.....	4
Practical 1 .....	5
Adding data from a CSV file .....	5
Styling the Points .....	6
Style by Attribute.....	7
Heatmap .....	9
Time Manager.....	13
Practical 2 .....	18
Vector Data.....	18
Visualising the results in 3D .....	21
Creating a 3D model of George Square .....	25

## SETTING UP QGIS FOR THE WORKSHOP

For the workshop today we need to add a few plugins and you should set the projection we will be working in. You will only ever need to add plugins to QGIS the first time you use it. Equally you can set a default map projection to match your most commonly used data.

### PLUGINS:

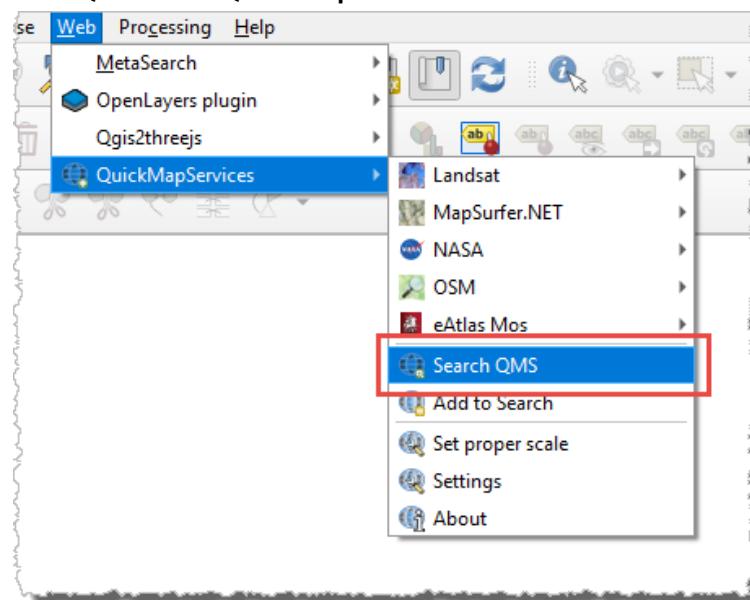


Click on the Plugins list at the top of the screen and go to Manage and Install Plugins. The ones we need today are **QGIS2threeJS**, **QuickMapServices** and **TimeManager**. We will also be using the **Heatmap** plugin but this is installed by default with QGIS.

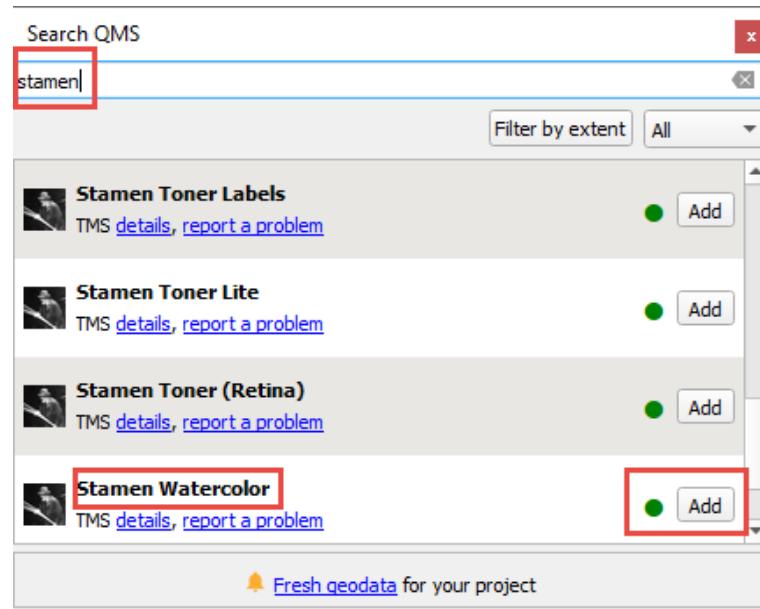
### ADDING A WEB BASEMAP:

The first dataset we are going to use is a global dataset so we need a global basemap to display it on. The **QuickMapServices** plugin will allow us to pipe one straight from the internet into the GIS.

- Click **Web** at the top of the screen
- Select the **Search QMS** from **QuickMapServices**

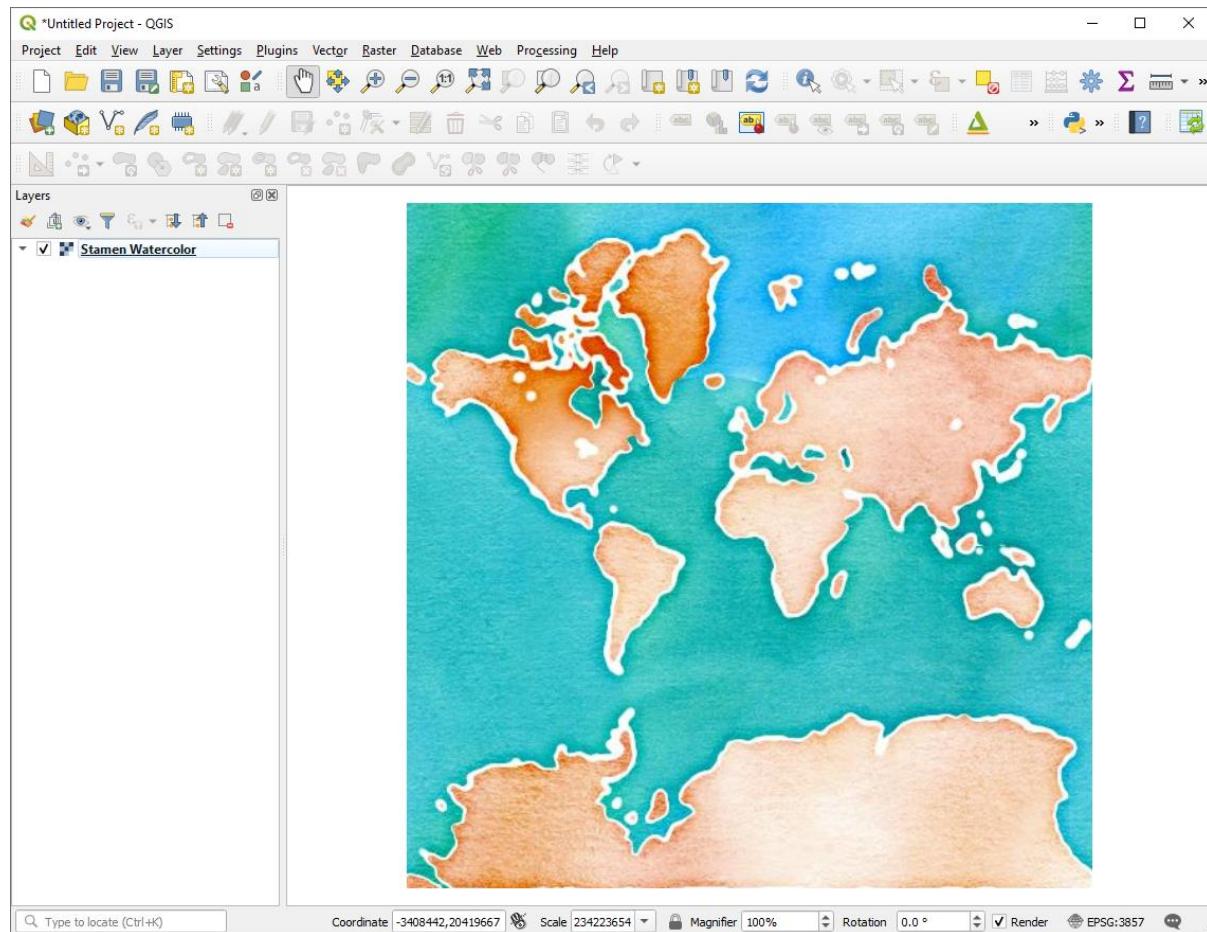


- Type “**stamen**” in the search box of the **Search QMS** window that has opened
- Click the **Add** button next to the **Stamen Watercolor** option



- The map should appear in the main window

You will now have a very nice looking world map, just right for arts and humanities data:



## BASIC GIS FUNCTIONS

### LAYERS:

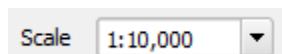
The table of contents on the left shows the names of the files you have added. The datasets you have added are now referred to as layers within the data frame. The check box allows you to show or hide the data in the map window.

### ZOOMING AND PANNING:

The main tools you will need are found in the tool bar above the map:



There is also the Scale drop down menu at the bottom of the map where you can pick from a list or manually type in the scale at which you want to view the data.



You can also use the **Scroll Wheel** on your mouse to zoom in and out on your current location.

- The button allows you to drag a box round features you are interested in to zoom in on them.
- The button changes your mouse pointer to a hand. This allows you to grab and pan the map.
- The buttons allow you go back and forward between map views you have already seen.
- Finally the button allows you to return to view where you can see all the data you have added to your map document.

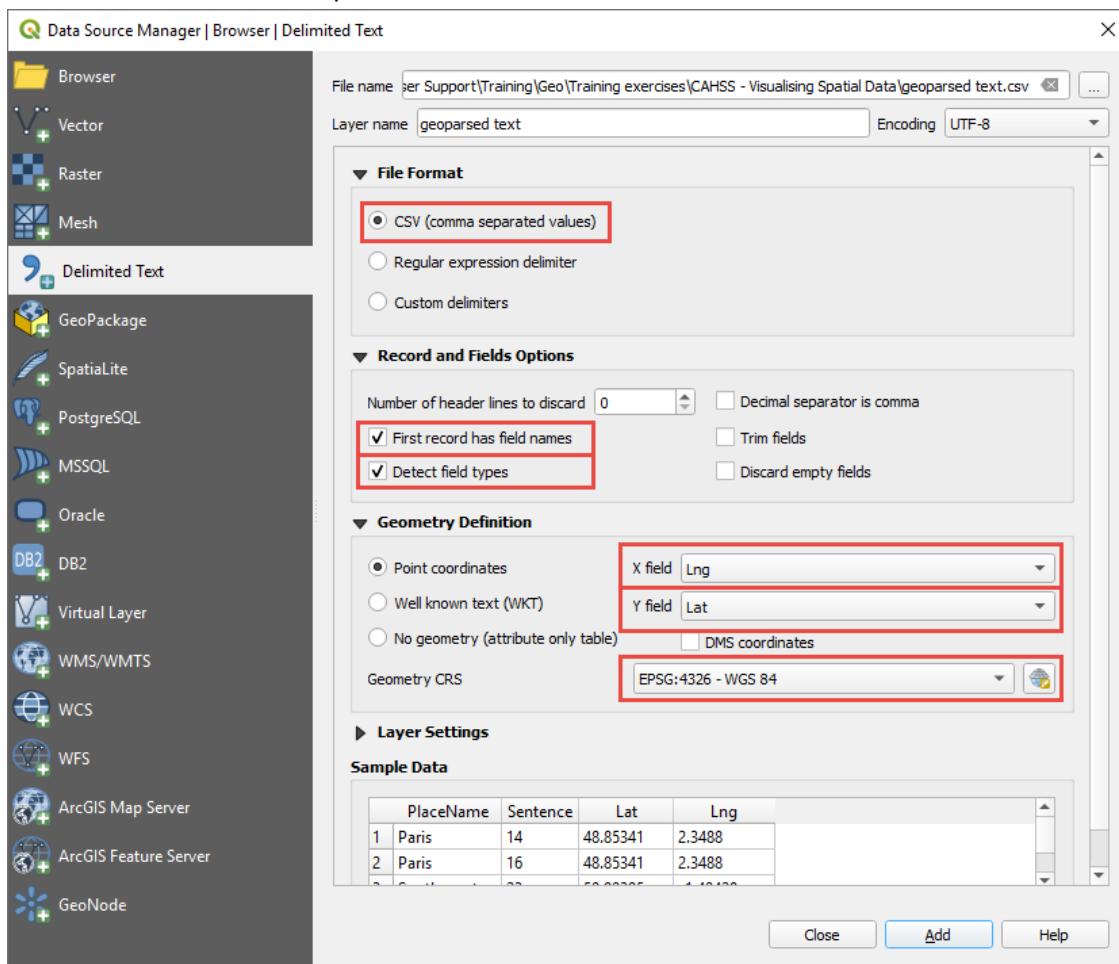
## PRACTICAL 1

### ADDING DATA FROM A CSV FILE

If you have created some data yourself then it is most likely going to be in this format or as a spreadsheet that you can save as a CSV. To add this data type to QGIS click on the **Open Data Source**

**Manager** button:

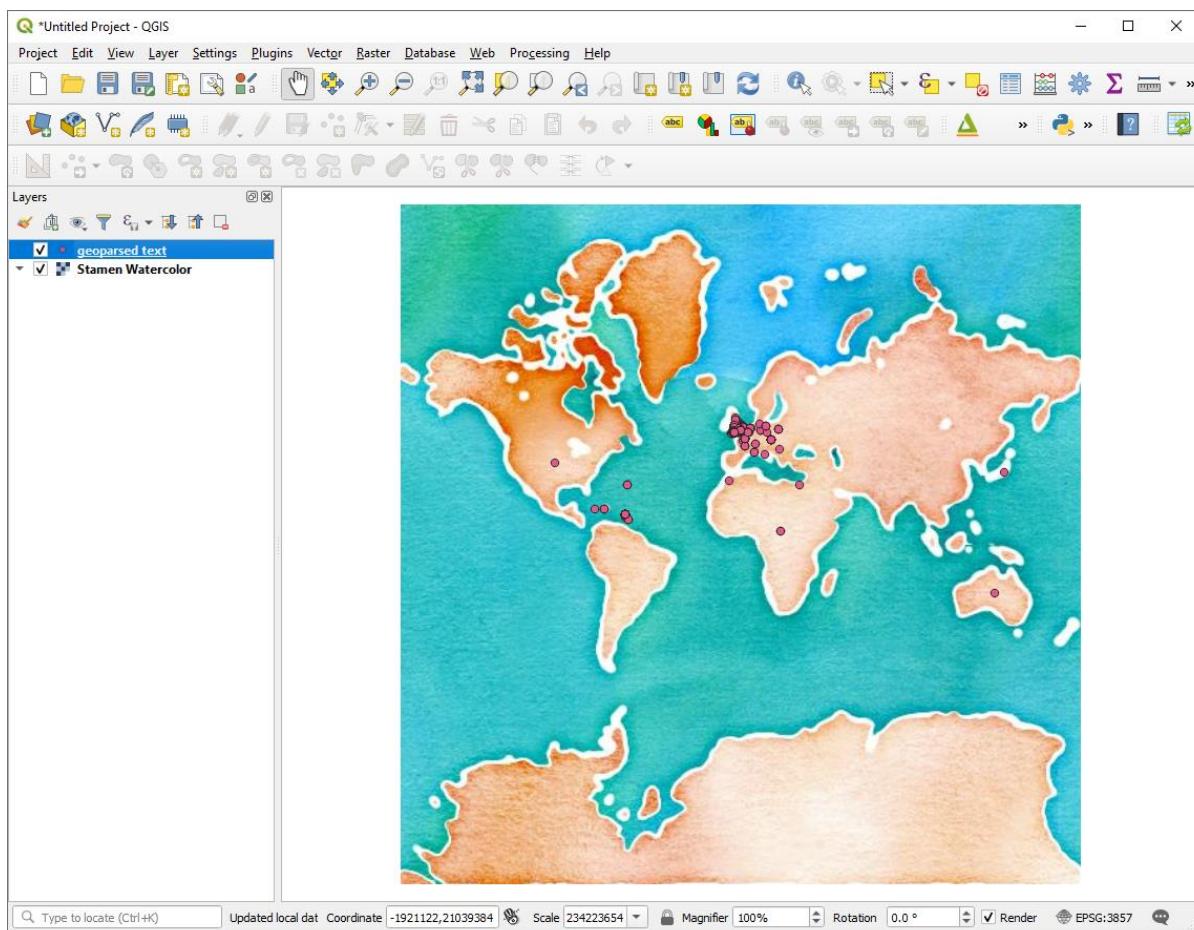
- Select the **Delimited Text** option from the left hand menu:



- Click the **Browse** button to navigate to the **geoparsed text.csv** file you should have downloaded
- Select **CSV** as the **File Format**
- Select **First record has field names**
- Select **Detect field types**
- Set the **X Field** to **Lng** and the **Y field** to **Lat**
- Select **EPSG: 4326 (or WGS 84)** as the **Geometry CRS**
- Click **OK**

**NOTE:** You can add csv files with no spatial information at all, just check the No Geometry option. These csv files can be joined to another dataset via a common attribute, such as an ID number, Postcode or place name.

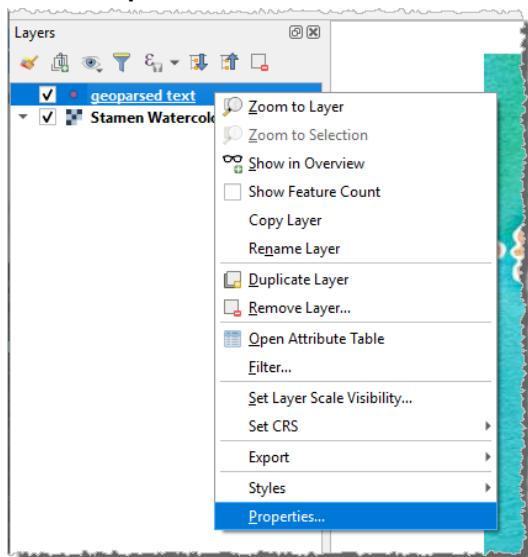
Your map should now look like the one below:



## STYLING THE POINTS

Now you have the points on the map you can make them more noticeable by changing their size, shape and colour.

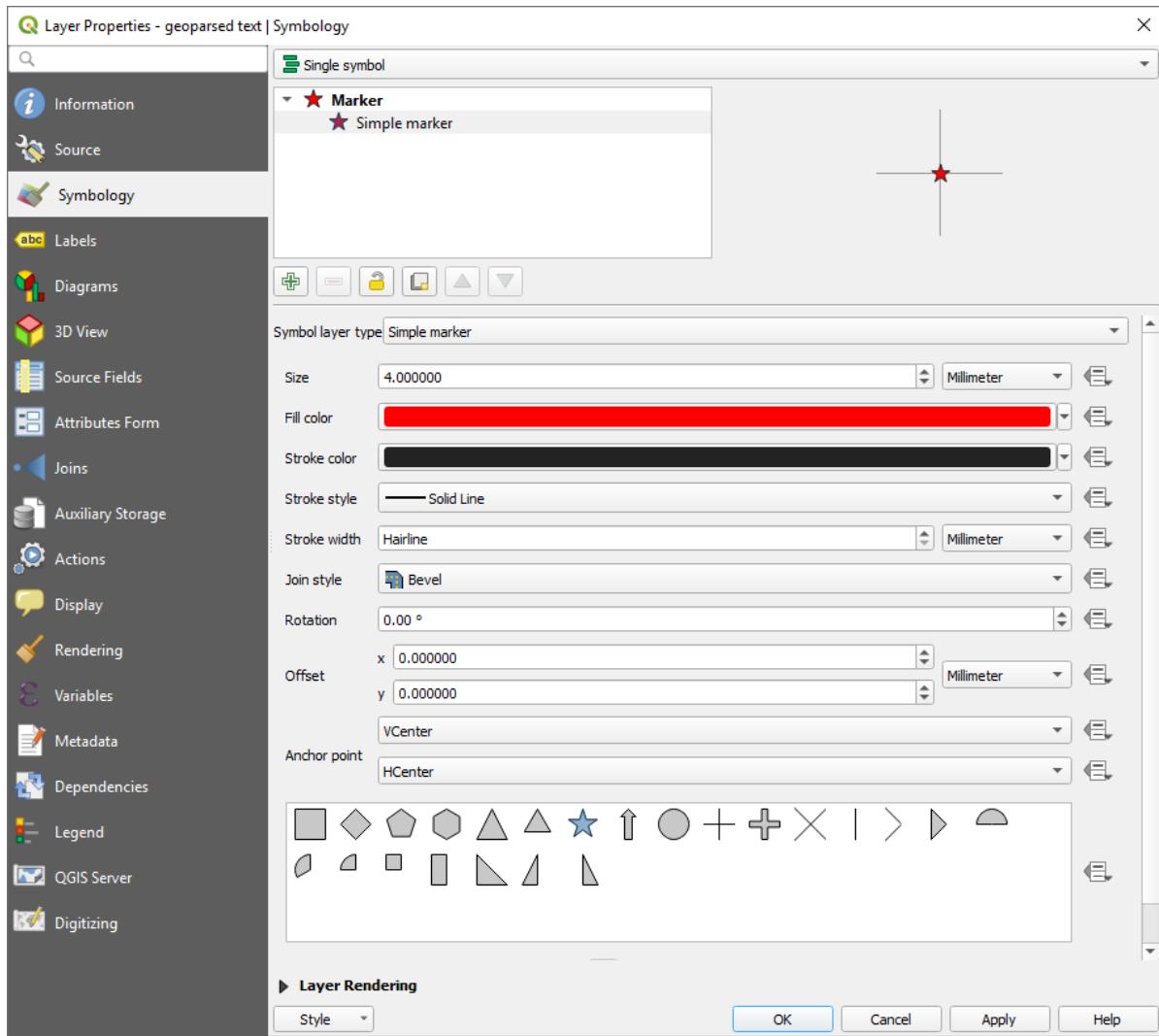
- Right Click on **geoparsed text** layer in the table of contents.
- Select **Properties**



- Select the **Symbology** tab on the left side of the pop-up window.

The symbology tab allows us to control all aspects of how the data is displayed.

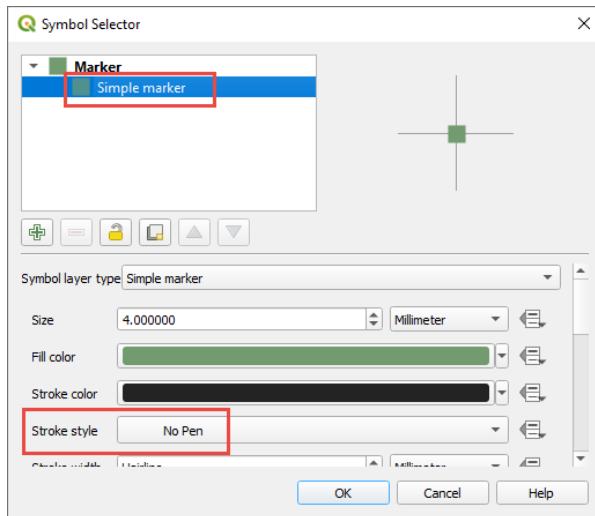
- The **Size** and **Color** can be changed easily
- Click on **Simple marker** to change the shape of the marker to one of your choice



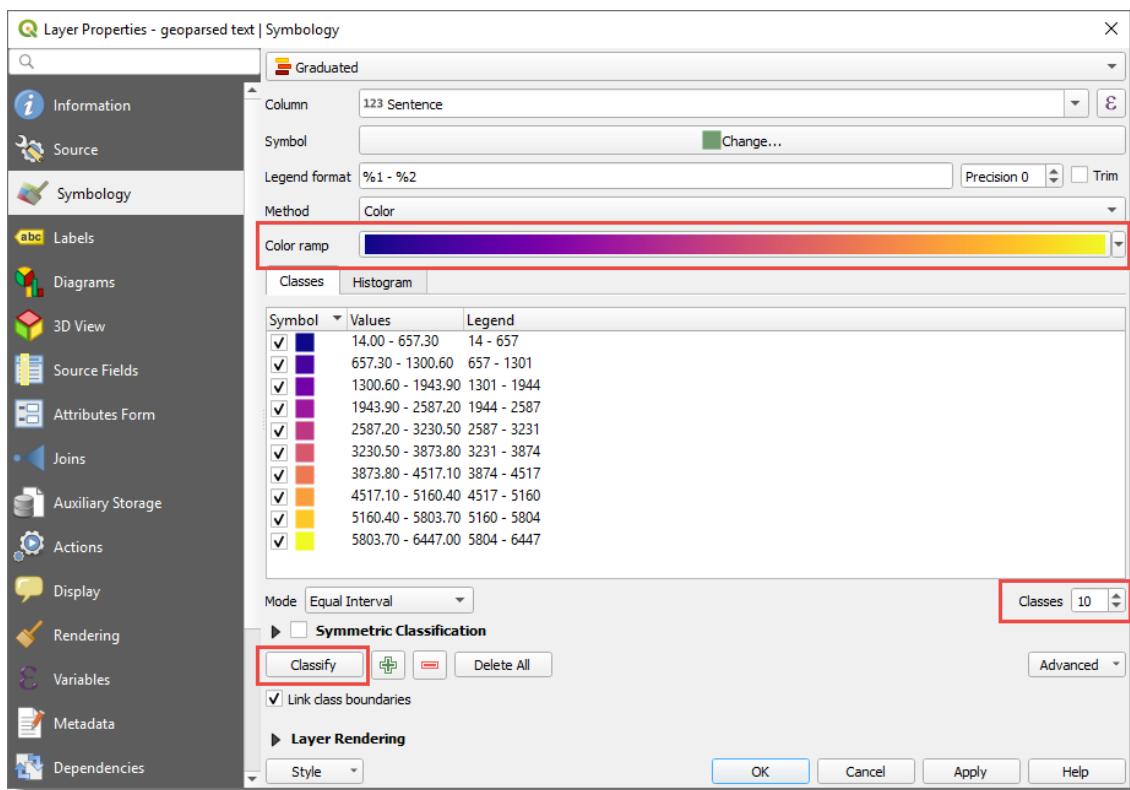
## STYLE BY ATTRIBUTE

It is possible to use the attributes of features, such as the line reference in our CSV, to apply different colours or sizes to the data.

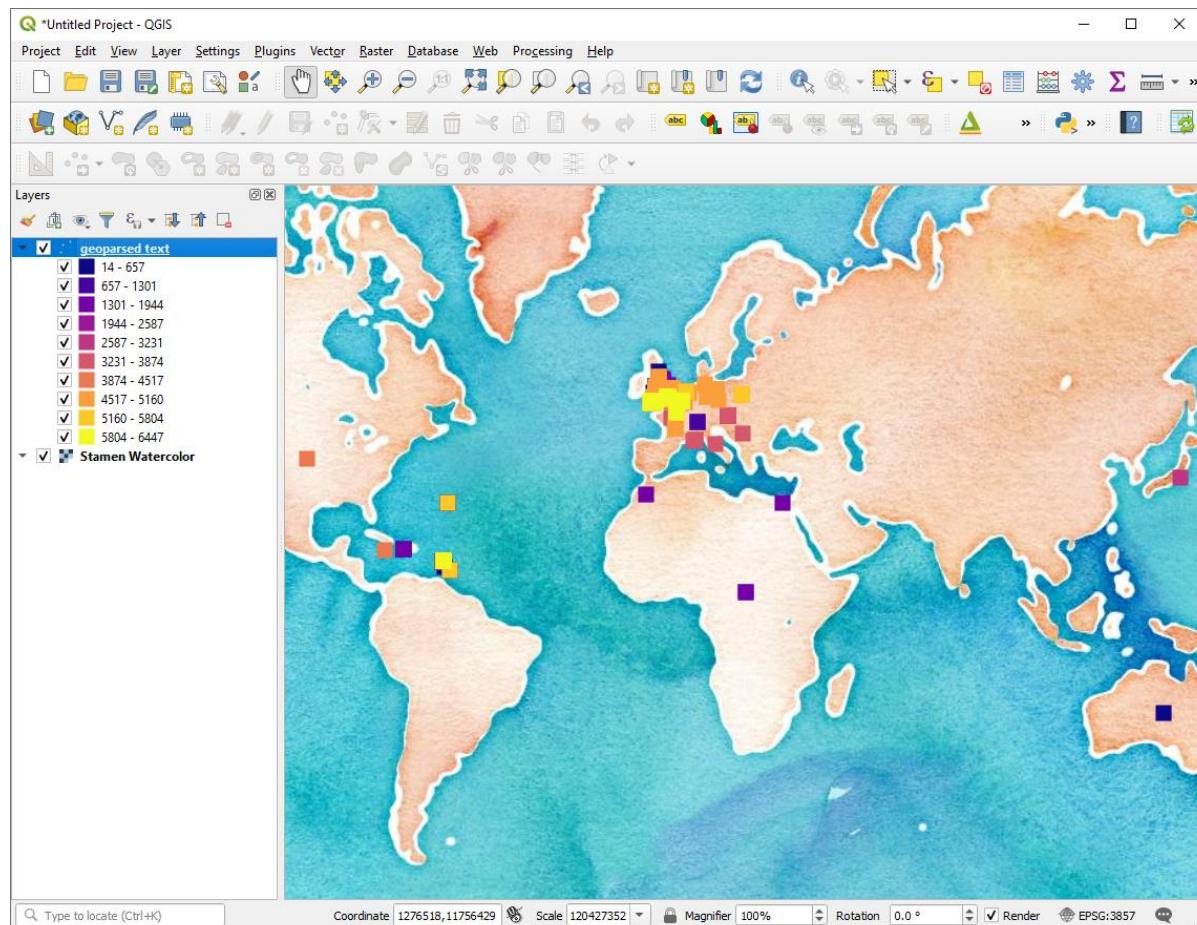
- Click the drop down menu next to where it says **Single Symbol**
- Select **Graduated**
- Change the **Column** to **Sentence**
- Change the symbol to a **4 point square**
  - Click on **Simple Marker** and change the **Stroke Style** to **No Pen**



- Click **OK** to go back to the Symbology tab and set the number of **Classes** to be 10
- Go to **Color Ramp** and choose a suitable color ramp, the **Plasma** one looks good
- Click **Classify** to get your **10** categories



Click **OK** to see your points on the map, blues indicate references near the start of the book, pinks near the middle and yellows near the end.



## HEATMAP

The point data we have overlaps a lot so we are not seeing early references hidden underneath the later ones. QGIS can create a heatmap with “hot” colour where there are a lot of points and “cool” colour where there are fewer.

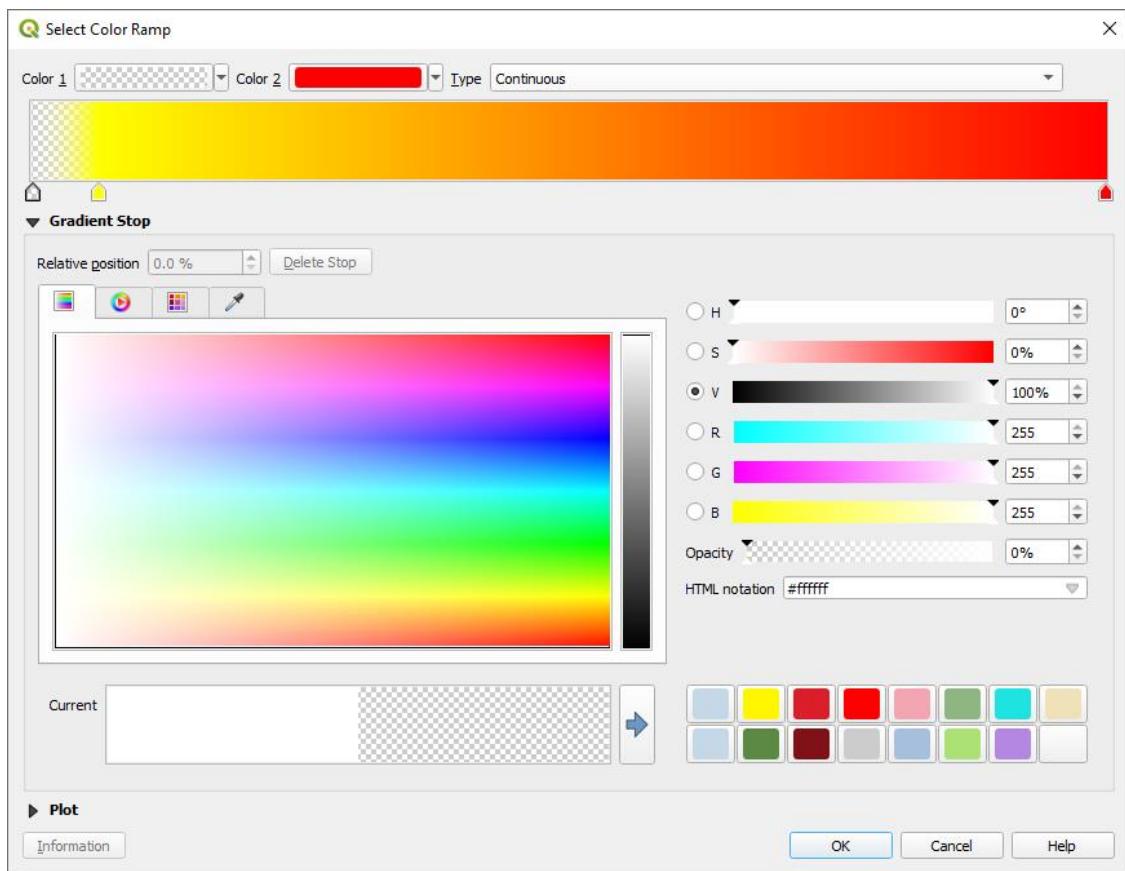
- Open the **Symbology** tab again by right clicking on **geoparsed text** in the table of contents and clicking on **Properties**.
- Change the top drop down from **Graduated** to **Heatmap**
- Change the colour ramp by selecting **Edit Color Ramp...** from the Color ramp drop down menu
- In the **Select Color Ramp** window set **Color 1** to be transparent and set **Color 2** to be red
  - Use the drop down arrow next to the colour swatch

At the moment the transparent colour is black, which will give a faded black halo around our heatmap points. To make it look better we should set the transparent colour to white.

- Click on the transparent (checkerboard pattern) swatch next to **Color 1**.
- In the **Select Ramp Color** window change the **HTML notation** value to **#ffffff**.
- Once you have selected a white colour click **OK**

We need the transparent colour to be white otherwise we will get dark halos around the “Hot” areas of the map. With the zero values being completely transparent we won’t be colouring the entire map, just the areas around where there are mentions in the book.

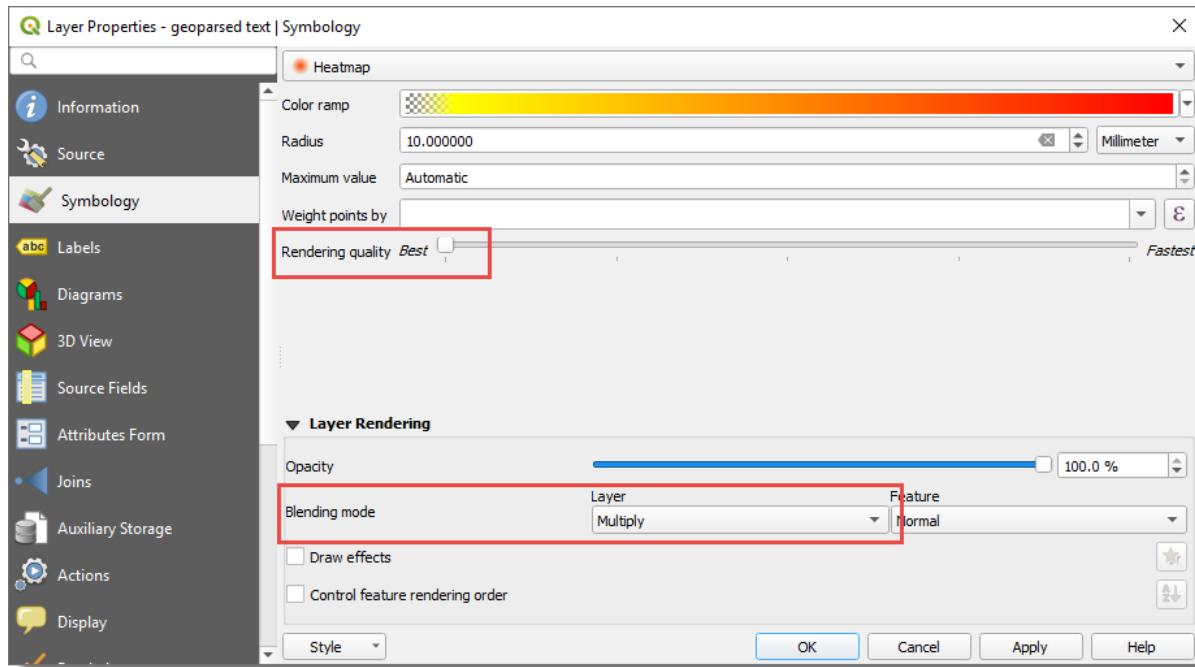
- Double click on the large color ramp swatch to add a new stop
- Click to select this new stop
- Change the **Relative position** to **5%**
- Choose **Yellow** as the colour
- Set the opacity to 100%
- The result should look like this:



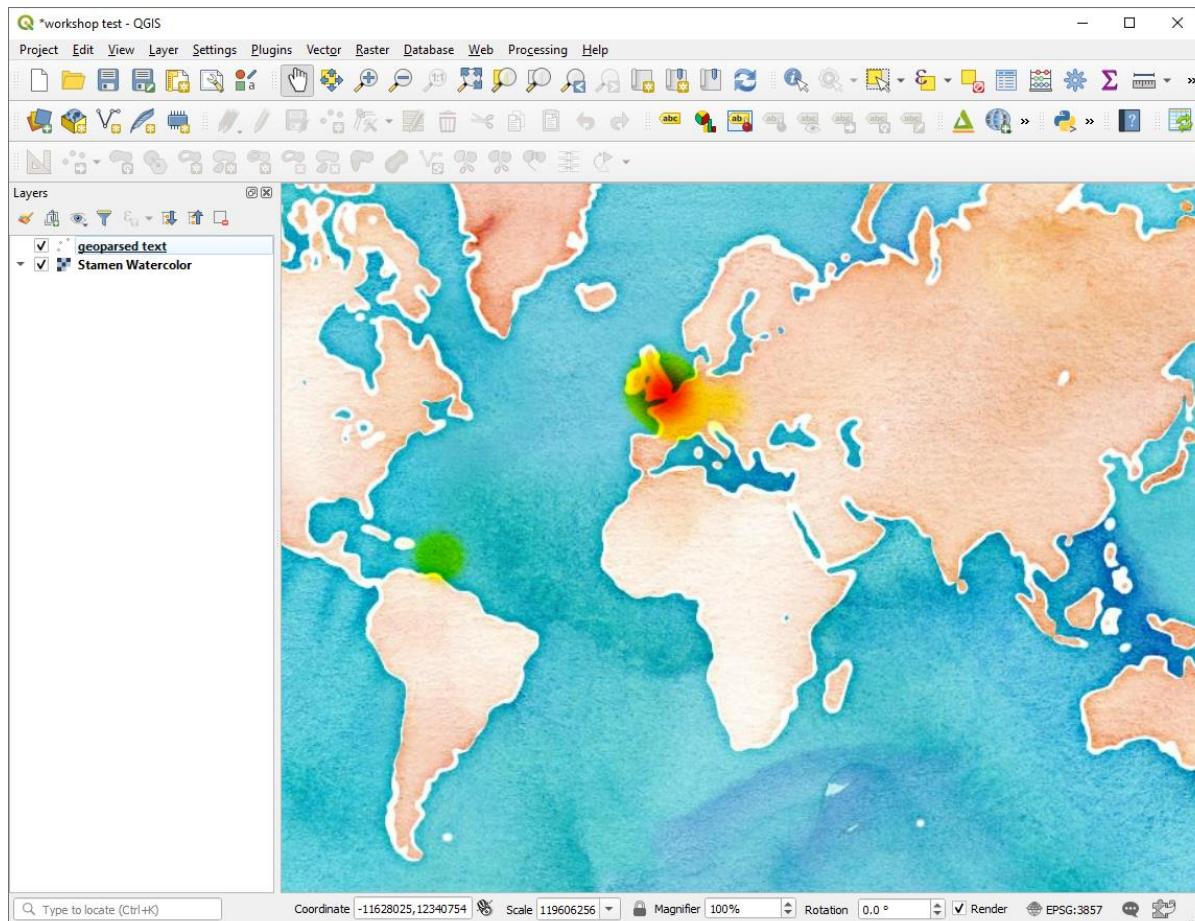
- Click **OK**
- Set the **Rendering quality** to **Best** by dragging the slider to the left.
- Set the **Layer blending mode** to **Multiply**

“**Multiply**” allows the backdrop map to show through the colours of the heat map

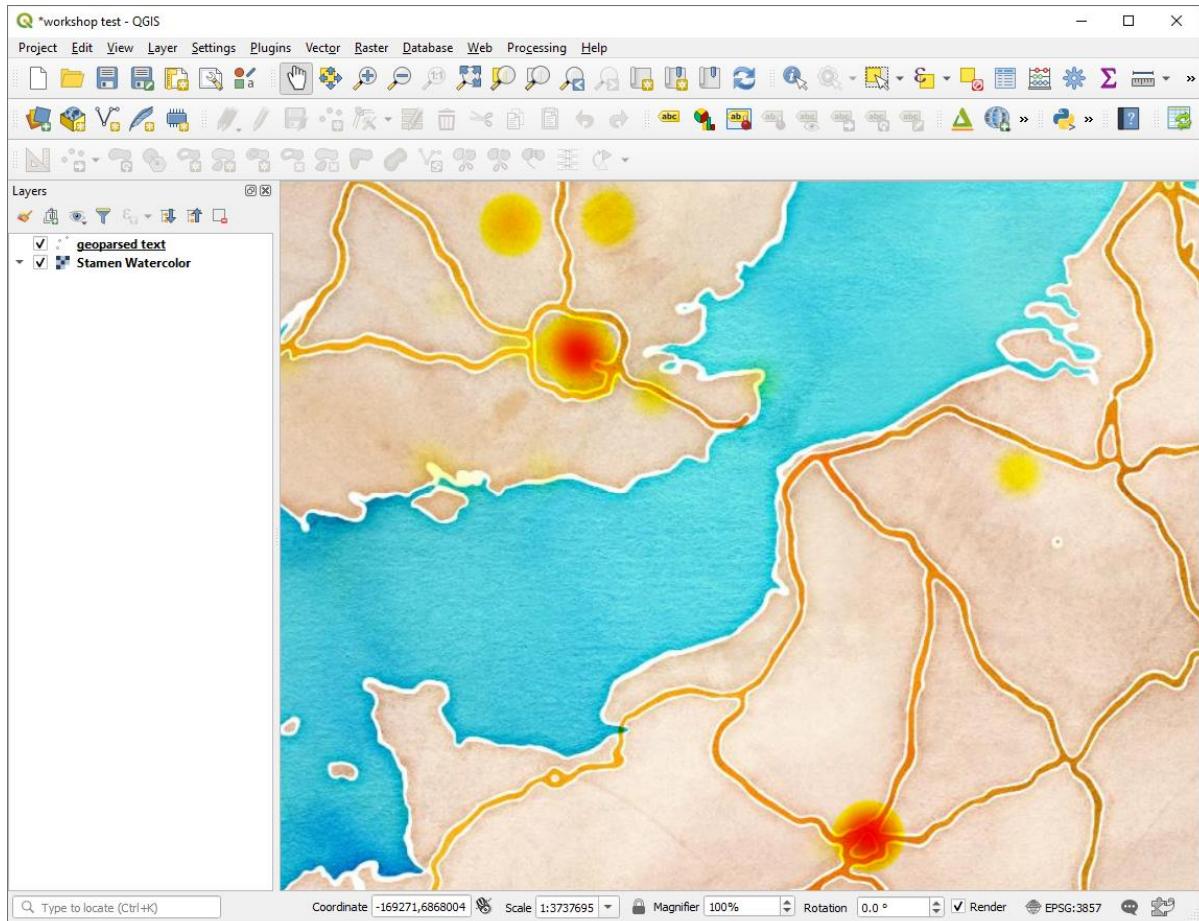
## Visualising Spatial Data in QGIS



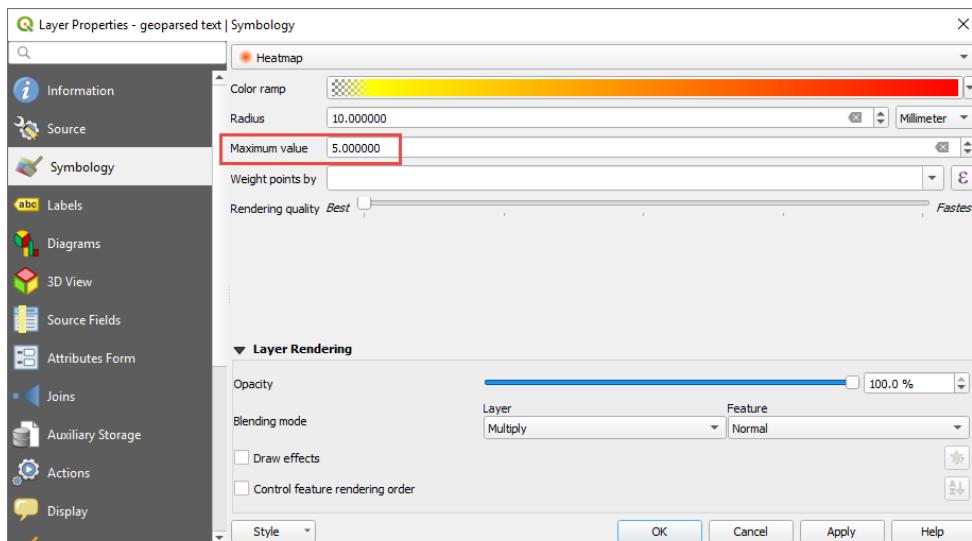
The results show a big hotspot covering London and Paris and a smaller one in the Caribbean:



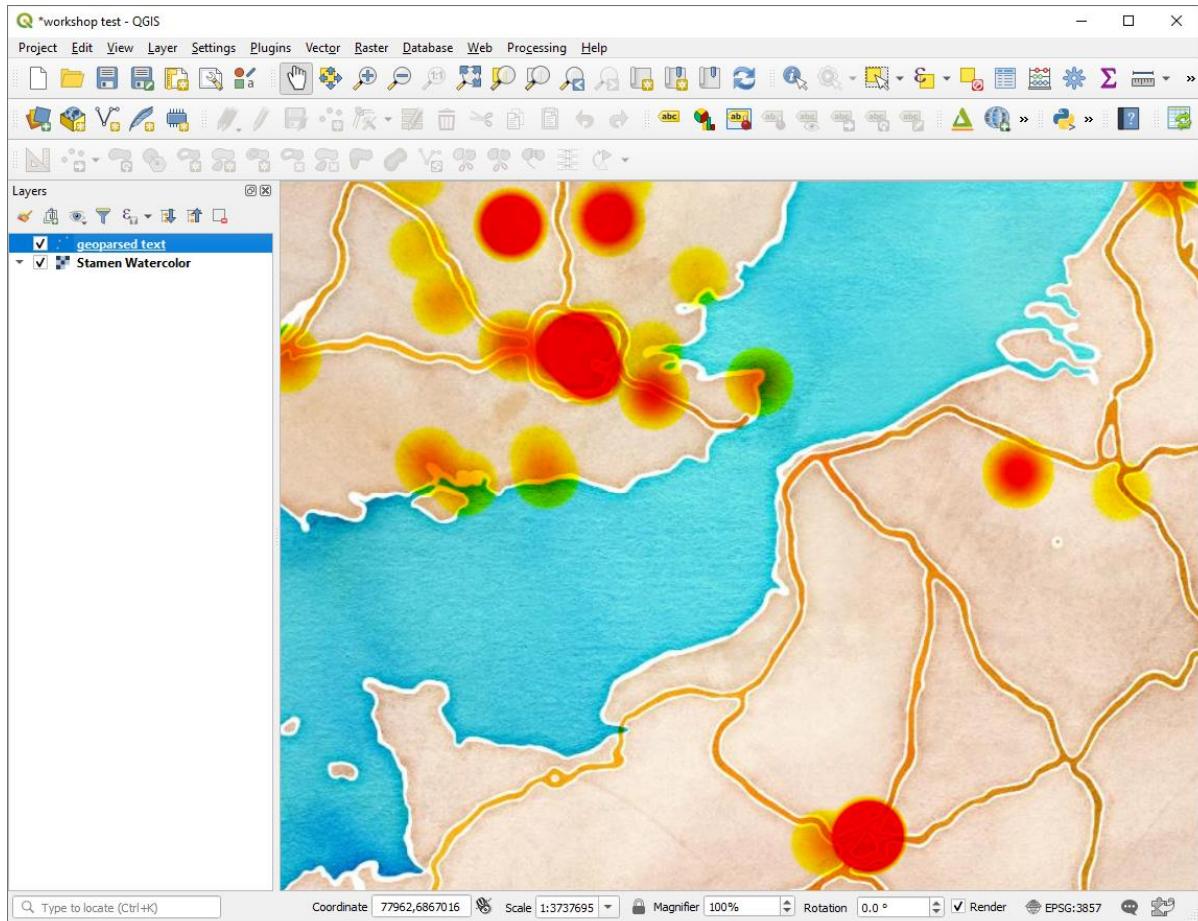
The hotspots adjust as you zoom in and out, here we have zoomed in to the London/Paris concentration:



The data is dominated by the big hotspots of London and Paris, which account for the majority of the points. To make the other locations in the dataset more visible you can change the style of the heatmap, adjusting the **Maximum value** from **Automatic** to **5** in the **Properties → Symbology** tab:



This gives a much clearer picture of the geographic spread of the book as it makes the heat map more sensitive to lower values. The results can be seen on the map overleaf:

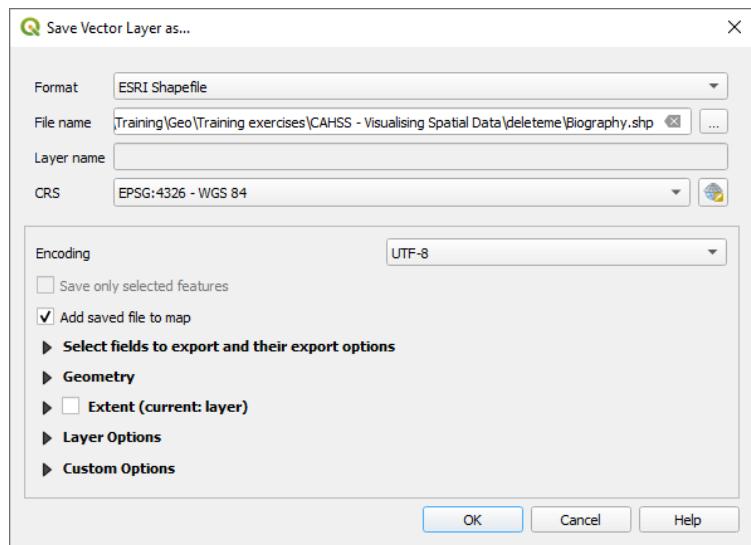


## TIME MANAGER

Earlier we coloured the markers on the map according to the sentence they appeared in but we can't do that as well as the heatmap. However we can use another plugin for QGIS called **TimeManager** to slice up the data based on the sentence to show how the locations change through the book much more clearly.

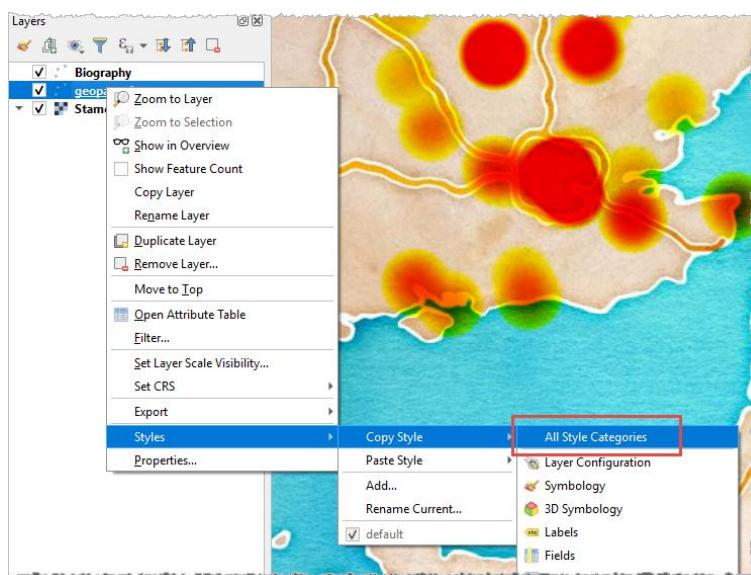
The **TimeManager** Plugin only works with spatial data formats like shapefiles, not the CSV we have used so far, so we will need to reformat the data. This is very easy in QGIS, simply right click on **geoparsed text** in the table of contents and select **Export → Save Features As...**

Browse to a location that is easy for you to access and call your new file **Biography**. The defaults of **Shapefile** as a format and **WGS 84** as a CRS are what we need.



The new dataset will be automatically added to the map and we will style it as a heatmap like we did before.

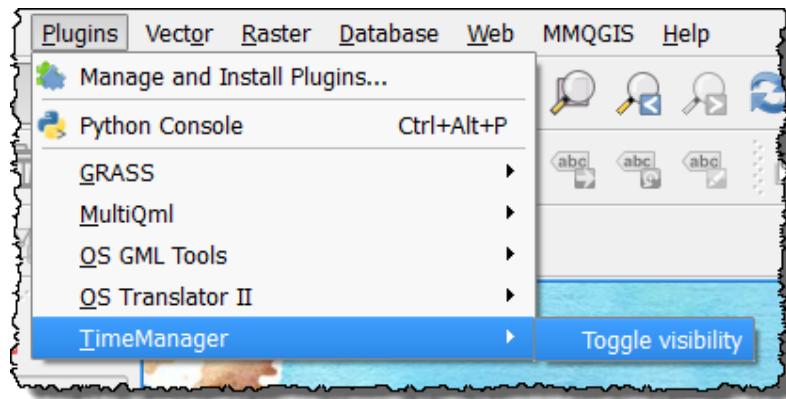
- Right click on the **geoparsed text** layer and go to **Styles → Copy Style → All Style Categories**



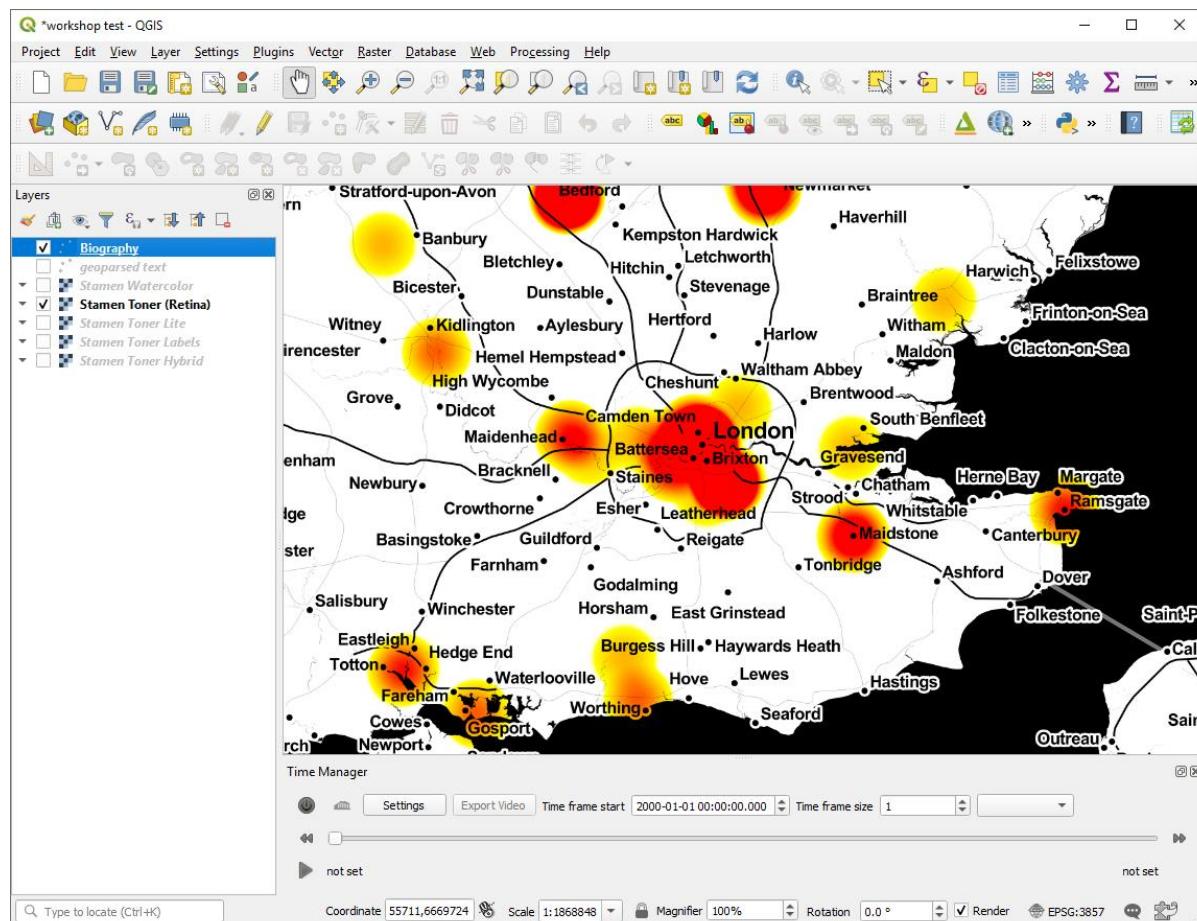
- Right click on the **Biography** layer and go to **Styles → Paste Style → All Style Categories**
- Open the **Symbology** tab on the **Biography Properties** window and set the **maximum** value to be **3**.

Your Biography should now have the Heatmap styling. It will also help to have a clearer backdrop map so you can change this to the Stamen Toner using **Quick Map Services** plugin.

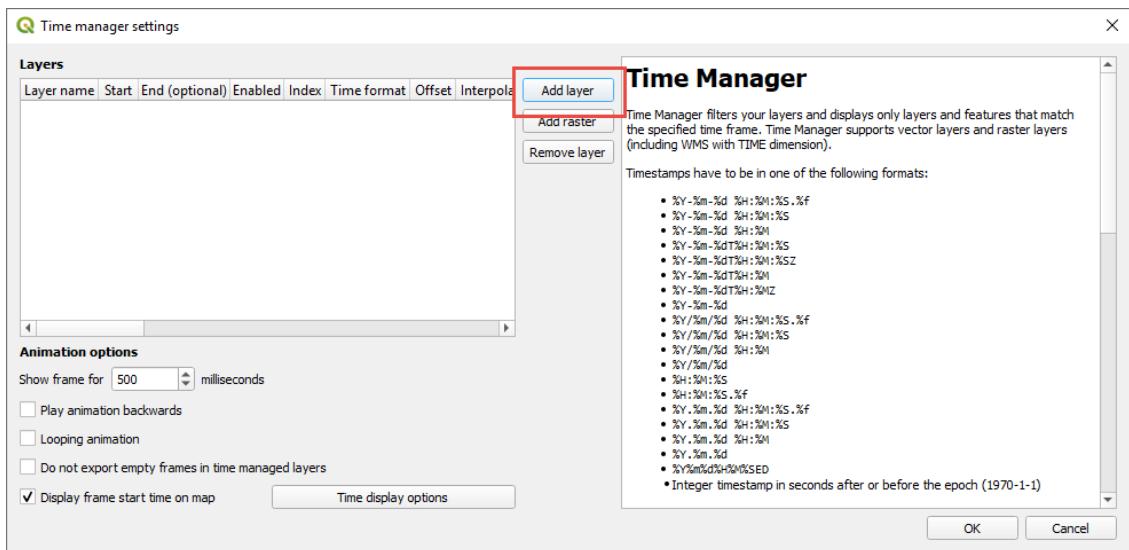
- Switch off the **Stamen Watercolor** and **geoparsed text** layers
- Add the **Stamen Toner (Retina)** backdrop map from the **Web → Quick Map Services → Search QMS** menu
- Zoom in to the London area
- Now we need to switch on the **Time Manager** plugin



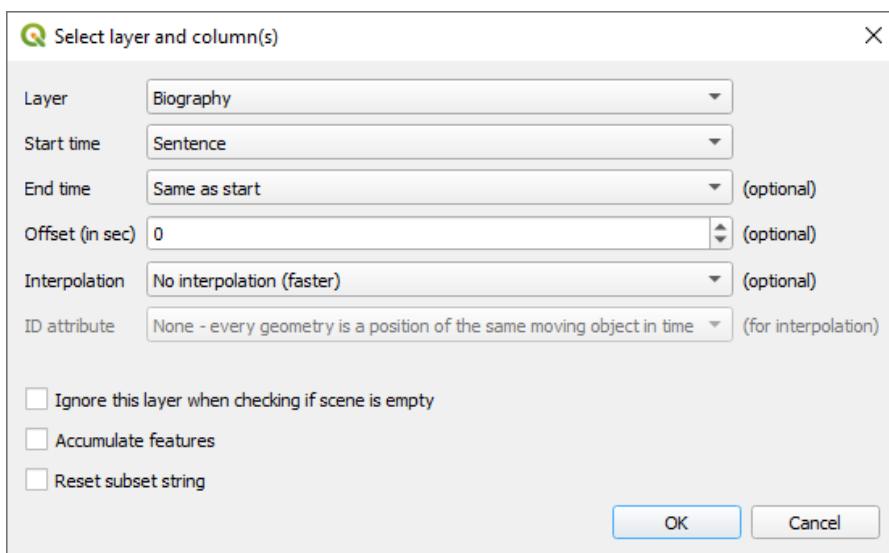
You should now see a set of controls at the bottom of the map:



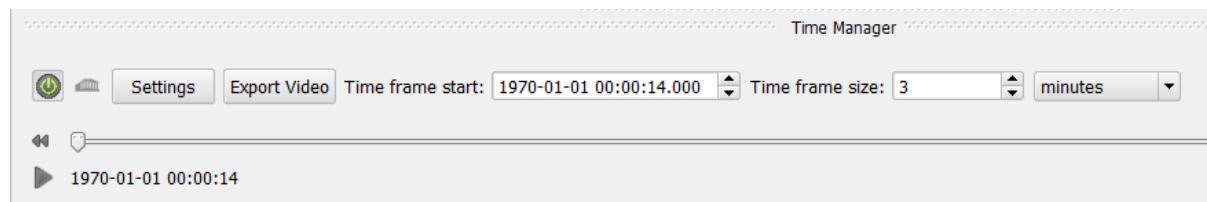
- Click on the **Settings** button in the **Time Manager** section beneath the map
- Click on the **Add layer** button



- Now add **Biography** as a layer like this:



We now need to set up TimeManager to slice the data; as we are using sentences and not actual time it will count each sentence as a second past midnight on the 1<sup>st</sup> of January 1970.



If we set the our time frame size to **3 minutes** then we are dividing up the book into chunks that are 180 sentences long, you can play around with this but bear in mind that the novel is over 6000 sentences long so you will need to group them otherwise it will take a very long time. Also as the book rarely has more than one place name in a sentence the maps would look very bare.

- Enable the **Time Manager** plugin using the power button:

- Click the **play** button  when you have made the settings to view the animation

The map sequence will play very slowly in QGIS, but if you click the **Export Video** button it will output a PNG file for each map. These can be stitched together very easily into a video in a range of different software: Windows Movie Maker, Blender etc. Linux and OSX users can output a video directly from QGIS.

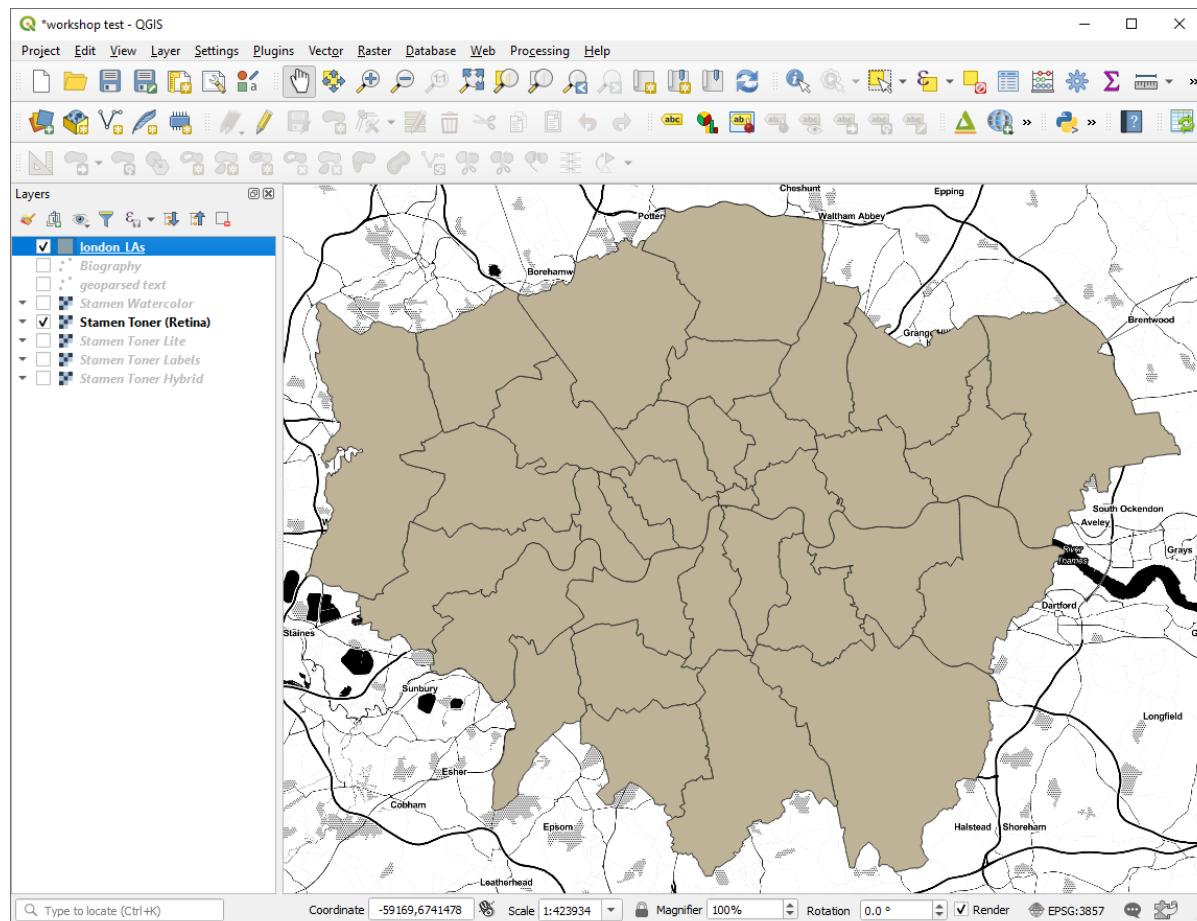
## PRACTICAL 2

### VECTOR DATA

We can now add in some vector data so we can do some analysis. Essentially the point data became vector data once we imported it but we have some vector polygons to add now representing the different local authorities for London. This data has the Index of Multiple Deprivation (IMD) scores for each area, these allow you to map the deprivation of London.



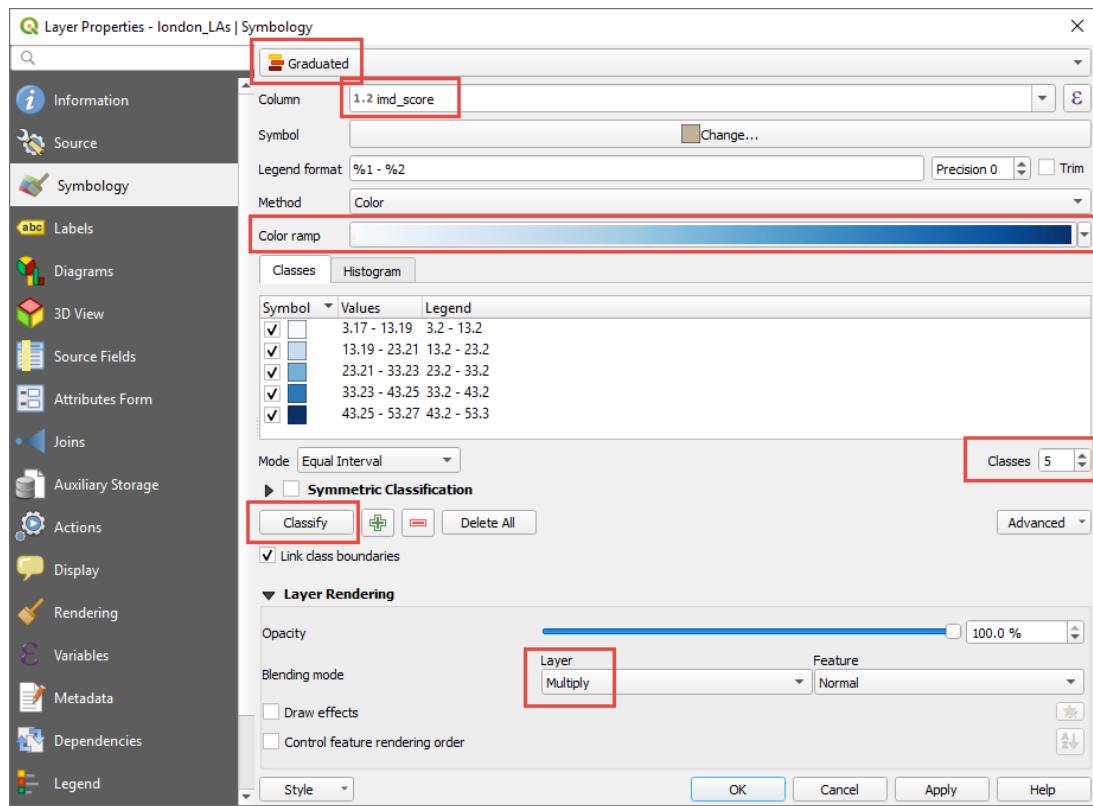
- Click on the **Open Data Source Manager** button:
- Select the **Vector** option from the left hand menu
- Click browse and navigate to the **London LAs.shp** file



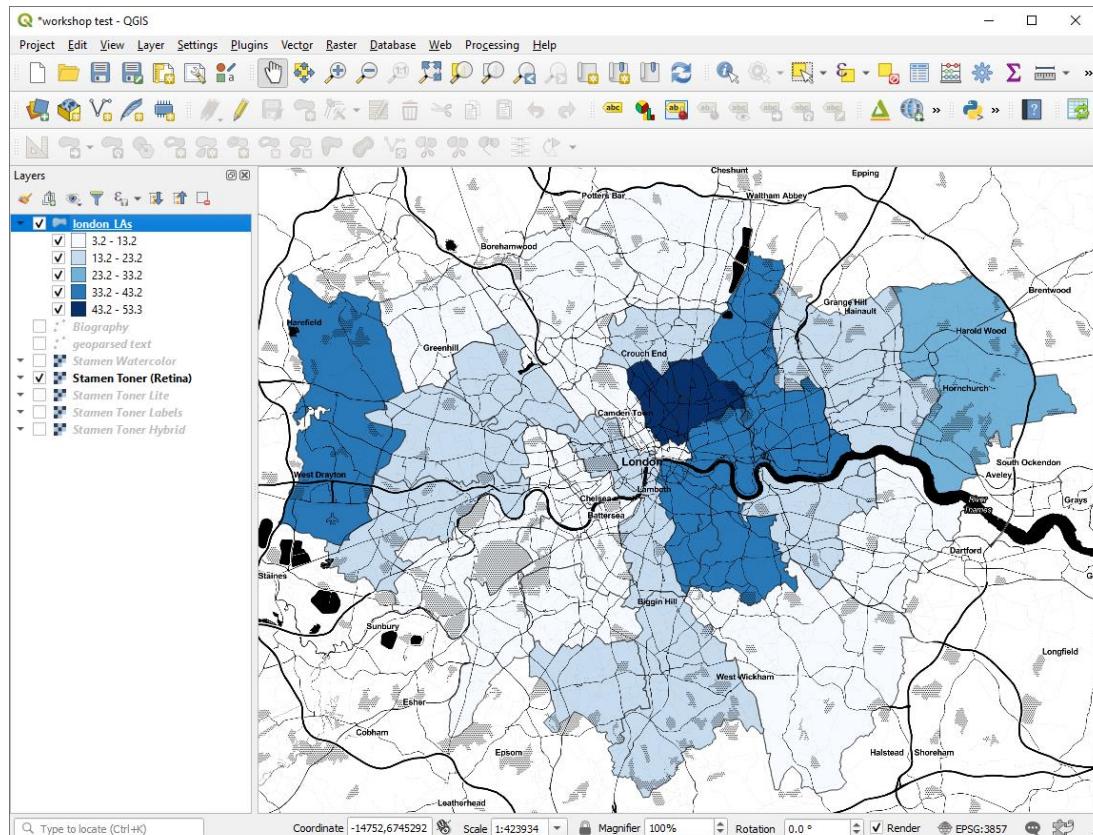
Have a go at setting the colours of the different Local Authorities by the attributes of the data.

- Open the **Symbology** tab from the **Properties** Menu
- Use the **Graduated** option
- Choose **imd\_score** as the column to style the data with
- Pick a **Color ramp** like **Blues**
- Choose **10 classes** and press the **Classify** button
- Set the layer blending mode to **Multiply** (**Layer Rendering → Blending mode**) so you can see the map data through the colours again

Your **Symbology** tab should look something like this:



...and your map should now look something like this:



Multiply works really well on the black and white Stamen Toner basemap producing clear colour and clear map detail.

## VISUALISING THE RESULTS IN 3D

To show you one final technique, we can use another QGIS plugin called Qgis2threejs. In this last part of the workshop we will show you how you can use 3D maps to show two different values at the same time. In this case we are going to show the deprivation score of an area and the number of times it was mentioned in the biography.

To save time we have produced a layer that has summarised local authorities' deprivation scores and has also added another value, a count of how many times each area was mentioned. We could use the outlines of the Local Authorities but these are very intricate and detailed and take a long time to process into 3D. We have created a layer of hexagons instead, and assigned each one an average value for the deprivation score it covers and a count of the number of points within its boundary.

First we need to set up the map to show the right information.

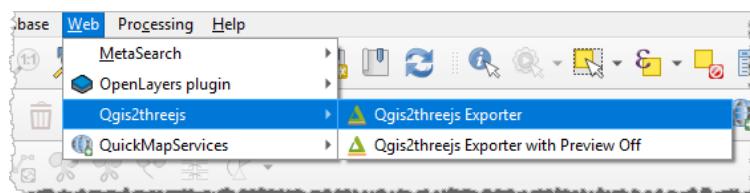
- Click on the **Open Data Source Manager** button: 
- Select the **Vector** option from the left hand menu
- Click browse and navigate to the **Hex Stats Count.shp** file

We can copy and paste the style from the London LAs layer as it uses the same Field name (column title).

- Right click on **London LAs** in the **layers panel** and select **Styles → Copy Style → All Style Categories**
- Right click on **Hex Stats Count** and select **Styles → Paste Style → All Style Categories**
- Switch off the **London LAs** layer so you should only have the **Hex Stats Count** and the **Stamen Toner** layers switched on.

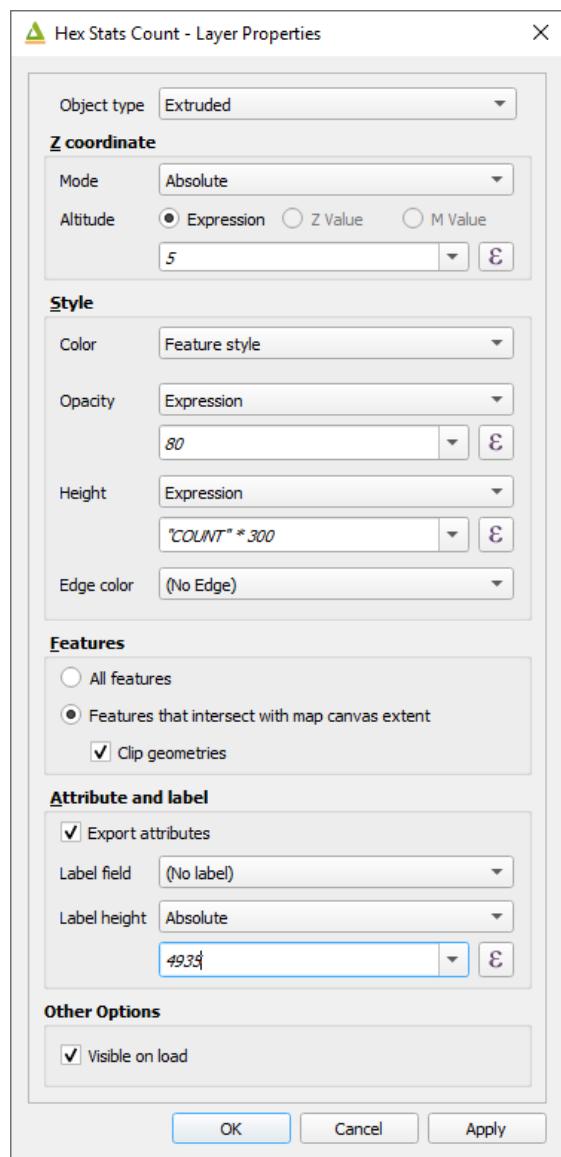


- Turn off all layers in the **Layers panel** apart from the **Stamen Toner** background map
- Open the **Qgis2threejs** plugin from the Web menu like this:

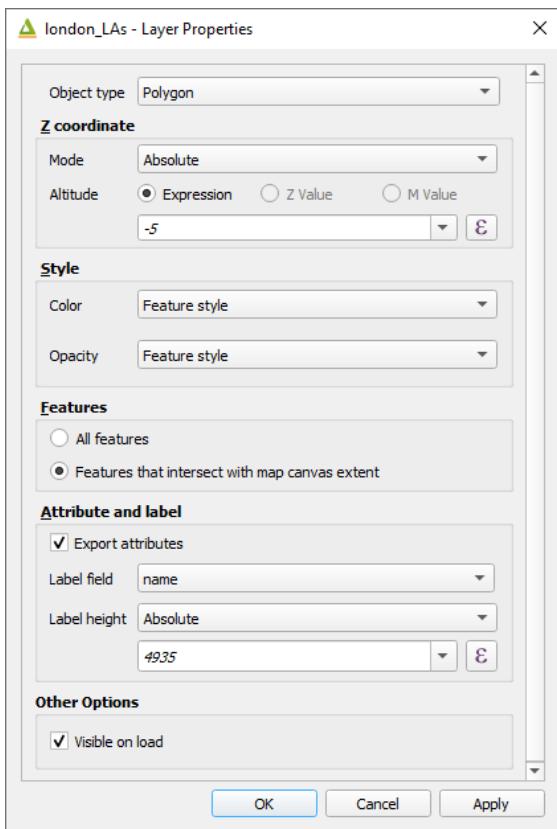


In the **Qgis2threejs** window make the following selections:

- Select the **DEM → Flat Plane** option
- In the **Polygon** section, check the box next to the **Hex Stats Count** and **London\_LAs** layers
- **Double click** on the **Hex Stats Count** entry to bring up the properties for this layer

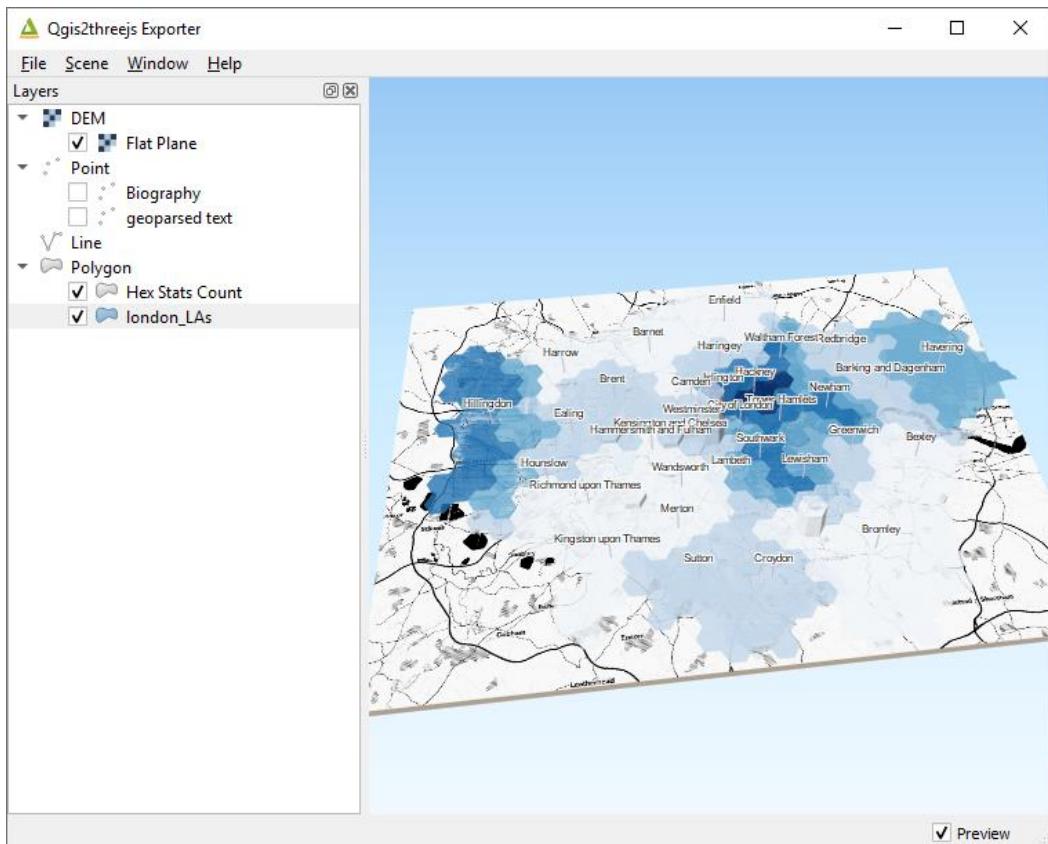


- For the **Z coordinate** set the **Altitude** to **5**
- For the **Style** set the following:
  - **Opacity** to **80**
  - **Height** to "**COUNT**" \* **300**
- For the **Attribute and label** section ensure **Export attributes** is enabled



- Double click on the **London\_LAs** entry to bring up the properties for this layer
- For the **Z coordinate** set the **Altitude** to **-5**
- For the **Attribute and label** section select **name** in the **Label field** drop down

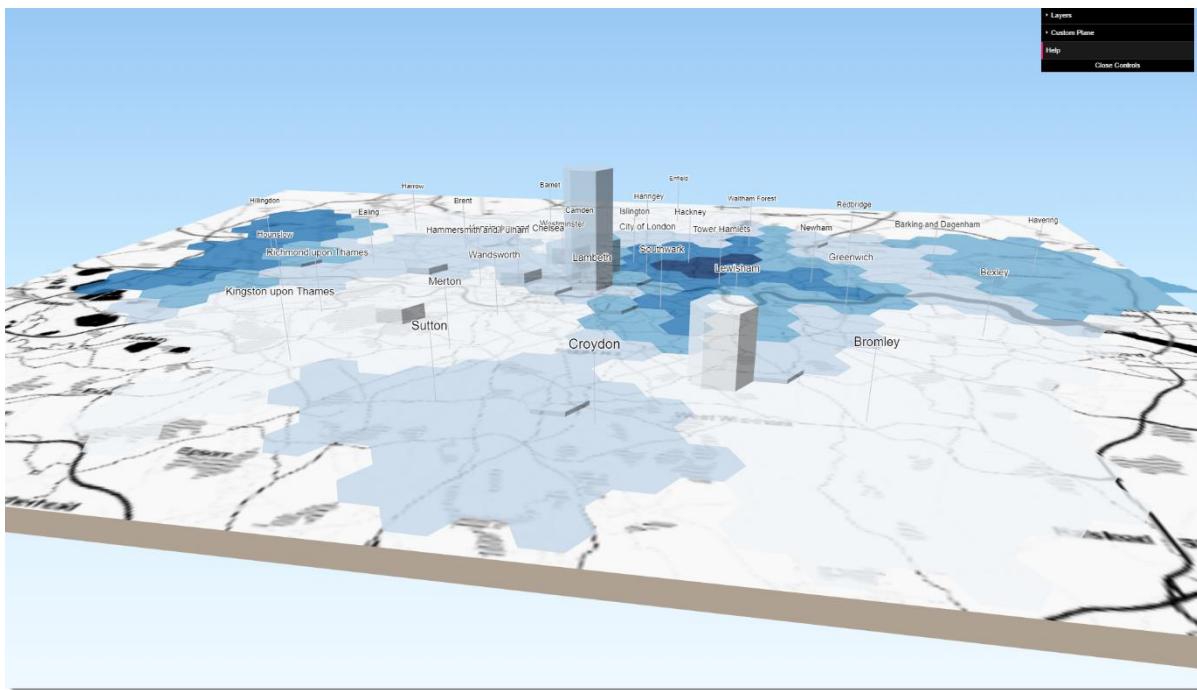
A small preview will be displayed in the panel on the right hand side which you can interact with:



To view the 3D scene full screen select **File → Export to Web...**

- Change the **Template** to **3D Viewer with dat-gui panel**
- In **General Settings** select **Enable the Viewer to Run Locally**
- Press the **Export** button

The result should look similar to the one shown below. You can pan and zoom around to explore the 3D scene.



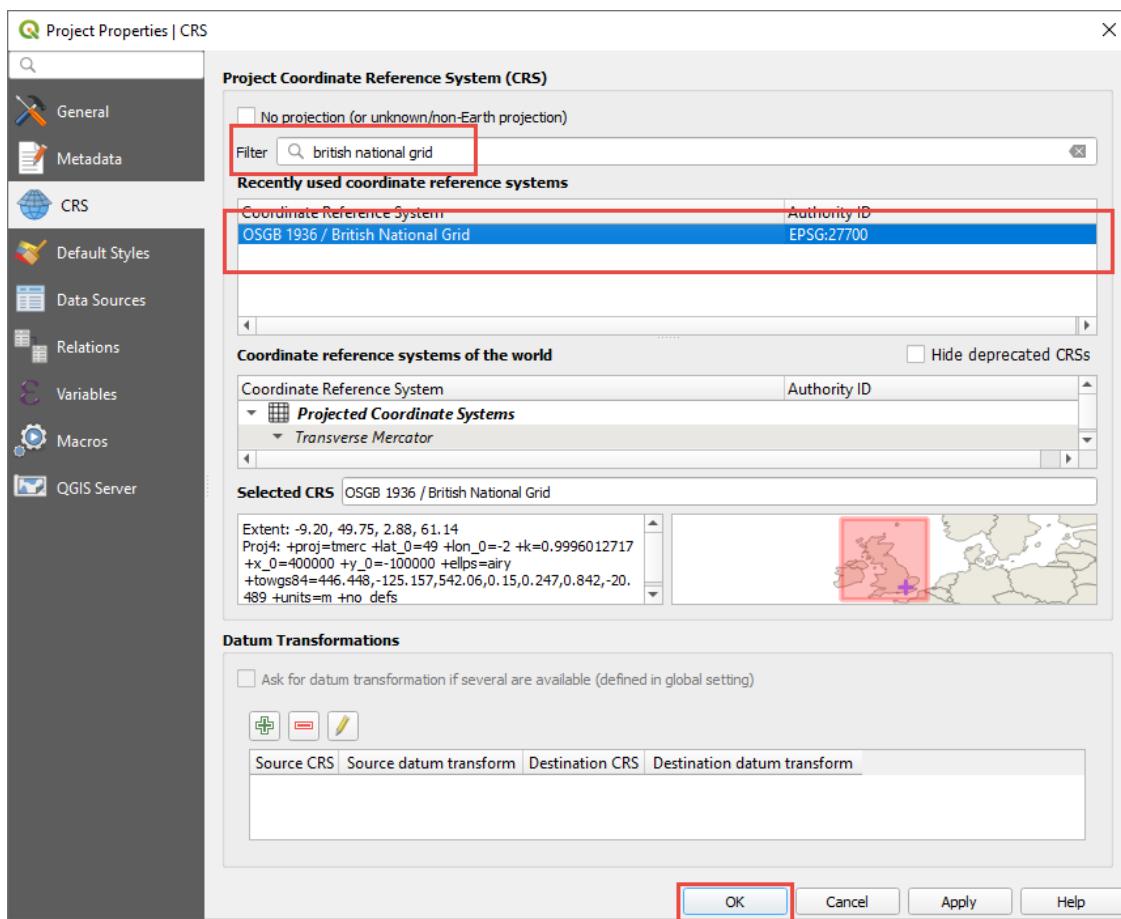
## CREATING A 3D MODEL OF GEORGE SQUARE

In this exercise we're going to create a realistic 3D model of the George Square area of Edinburgh using the following datasets downloaded from Digimap (<https://digimap.edina.ac.uk>):

- **OS Terrain 50** – this is a raster Digital Terrain Model (DTM) giving an accurate representation of the earth's surface.
- **Open Map Local (OML) Raster** – this is a raster backdrop map.
- **OpenStreetMap** – vector data including building outlines and tree locations

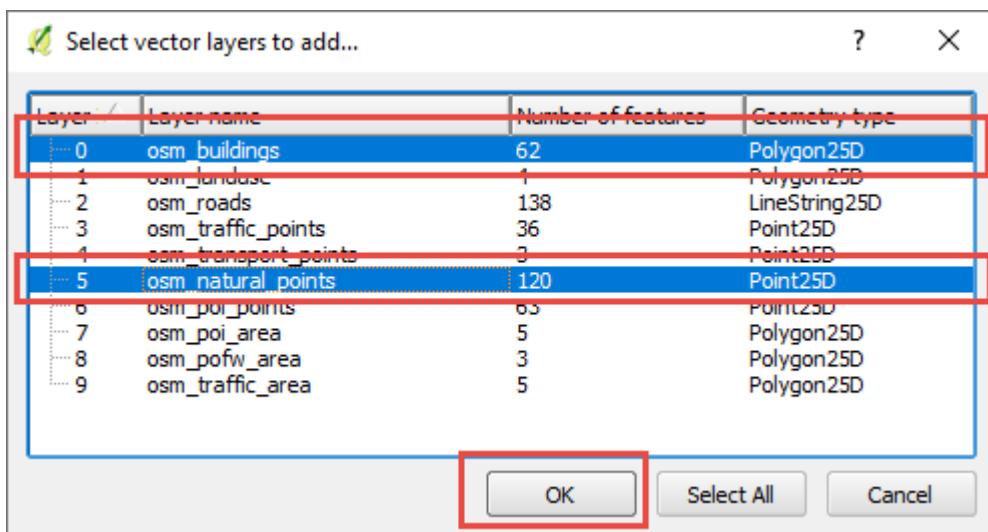
We will first add the datasets to a new project in QGIS, then we will create a 3D model using the data.

- Create a new project by pressing the **New** button: , you will be prompted to save your work if you haven't already done so
- Set the **Coordinate Reference System** to **British National Grid** on the **CRS tab** of the **Project Properties** window:

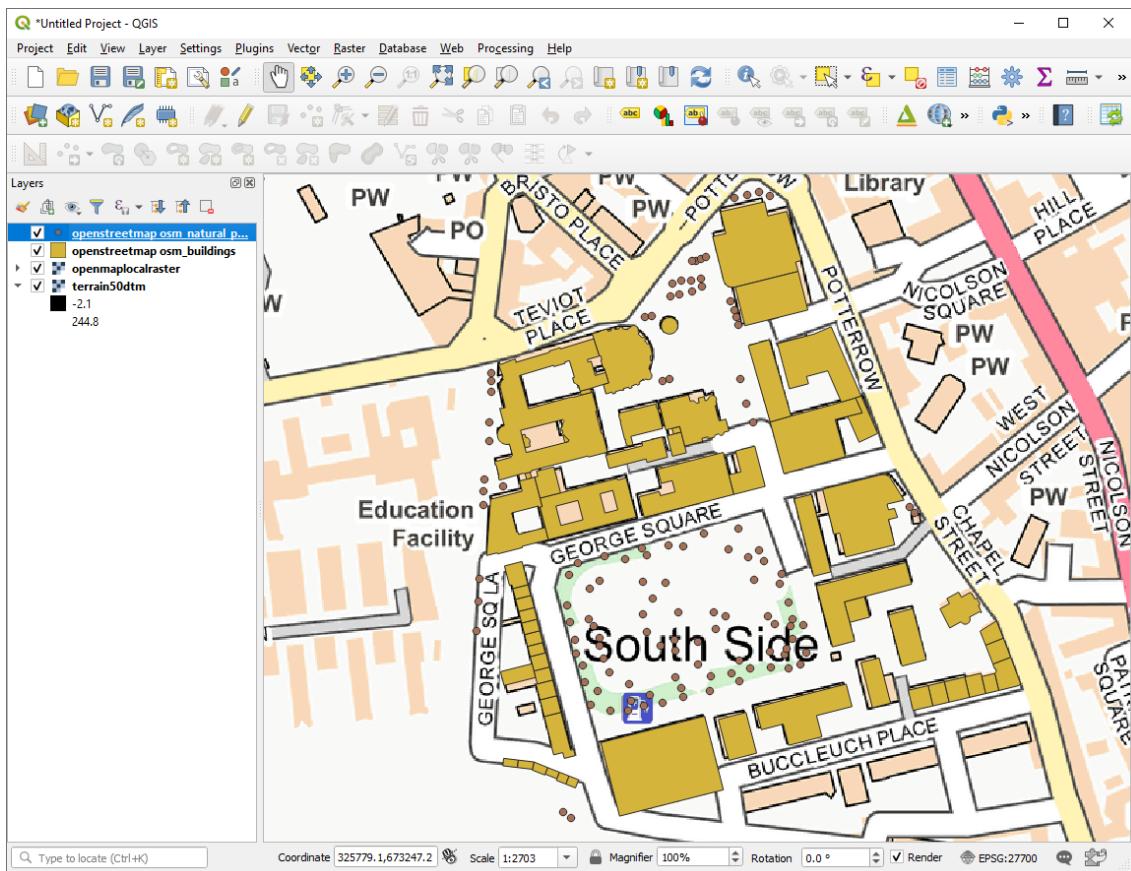


- Select **OSGB 1936/British National Grid** from the list and press **OK**
- Click on the **Open Data Source Manager** button: 
- Select the **Raster** option from the left hand menu

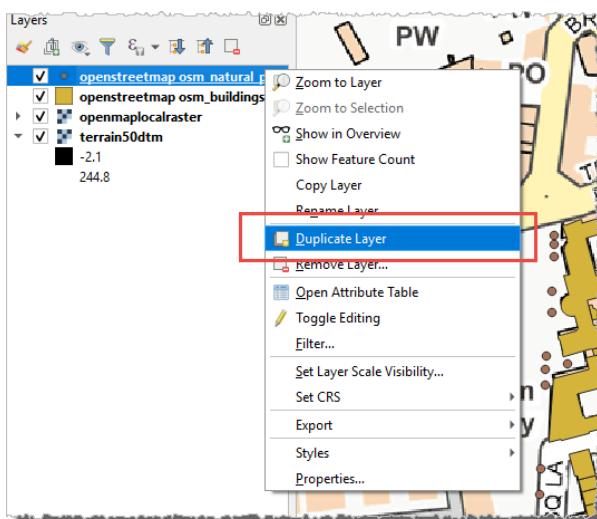
- Browse to the **george square** folder and select the files called **terrain50dtm.asc** and **openmaplocalraster.tif** by holding the Ctrl key down on your keyboard
- Press the **Add** button to add these layers to the map window
- With the **Data Source Manager** still open select the **Vector** option from the left hand menu
- Browse to the **george square** folder and select the file called **openstreetmap.gpkg**
- Press the **Open** button, then press the **Add** button on the **Data Source Manager** window
- You will be prompted to select the layers you wish to add:



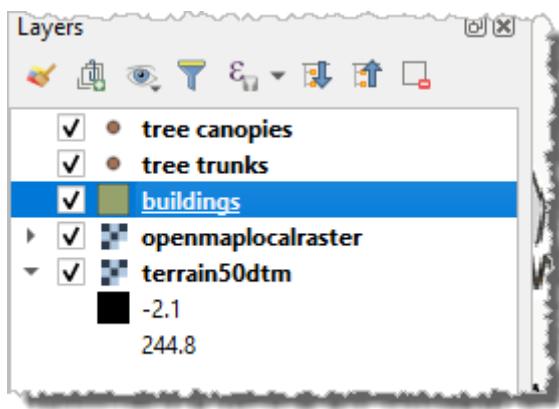
- Holding the Ctrl key down on your keyboard select the layers called **osm\_buildings** and **osm\_natural\_points** and press the **OK** button.
- Zoom in on the area around George Square, your map should look similar to the one below:



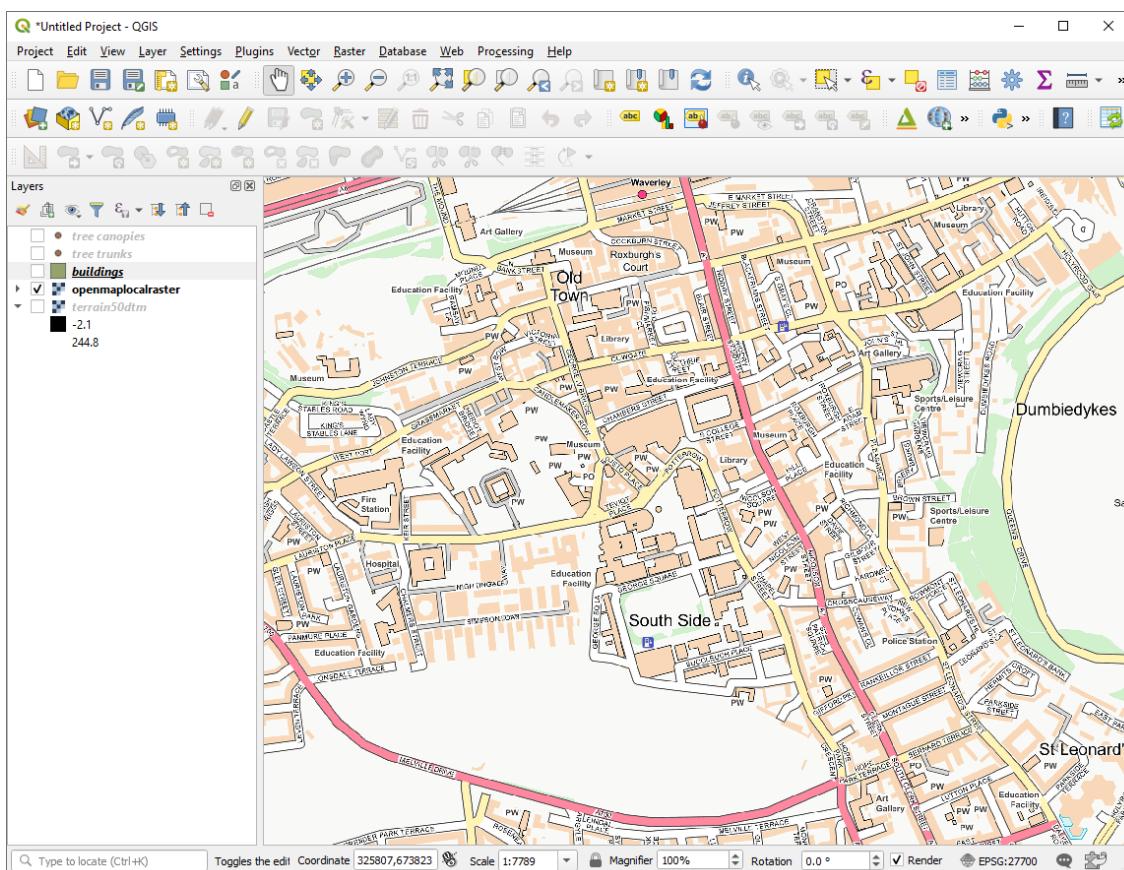
- Right click on the layer called **openstreetmap osm\_natural\_points** and select **duplicate**:



- Right click on the top point layer and select **Rename layer**, rename this layer to **tree canopies**
- Rename the second point layer to be **tree trunks**
- Rename the **openstreetmap os\_buildings** layer to **buildings**
- Your layers list should look similar to the one below, note you may need to reorder the layers by clicking and dragging them up/down to get them in the right order



- Now we will turn off all the layers apart from the **openmaplocalraster** layer and zoom in/out so that the map covers the area from Edinburgh Castle to Salisbury crags, as shown below:



- Open the Qgis2threejs plugin window by selecting **Web** → **Qgis2threejs** → **Qgis2threejs exporter** from the top menu
- In the **DEM** section ensure the **DEM Layer** is set to **terrain50dtm**:
- In the **Point** section, select the **tree canopies** and **tree trunks**
- In the **Polygon** section, select the **buildings**
- Double click** on the **tree canopies** item and set the following properties:
  - Object Type: **Sphere**
  - Z coordinate:

- Mode: **Relative to “terrain50dtm” layer**
    - Altitude: **10**
  - Style:
    - Color: **Expression** and select a **green** colour using the color picker
    - Radius: **5**
- Double click on the **tree trunks** item and set the following properties:
  - Object Type: **Cylinder**
  - Z coordinate:
    - Mode: **Relative to “terrain50dtm” layer**
    - Altitude: **0**
  - Style:
    - Color: **Expression** and select a **brown** colour using the color picker
    - Radius: **1**
    - Height: **10**
- Double click on the **buildings** item and set the following properties:
  - Object Type: **Extruded**
  - Z coordinate:
    - Mode: **Relative to “terrain50dtm” layer**
    - Altitude: **0**
  - Style:
    - Color: **Expression** and select a **light grey** colour using the color picker
    - Opacity: **Expression**, with a value of **80**
    - Height: **Expression**, with a value of **20**

To view the 3D scene full screen select **File → Export to Web...**

- Change the **Template** to **3D Viewer with dat-gui panel**
- In **General Settings** select **Enable the Viewer to Run Locally**
- Press the **Export** button

The result should look similar to the one shown below. You can pan and zoom around to explore the 3D scene.



**Tip:** if your 3D scene doesn't look quite right, close the browser window and go back and check the settings on the Qgis2threejs window in QGIS match those shown above. When ready, you can export again to regenerate the scene with the updated settings. You can re-export the scene as many times as you wish to see what effect changing the settings has.

You can use the controls in the panel on the right hand side to interact with the scene, try experimenting by changing the transparency of the buildings or turning features on/off.

**You have now completed the whole workshop!**

**Thank you for attending.**