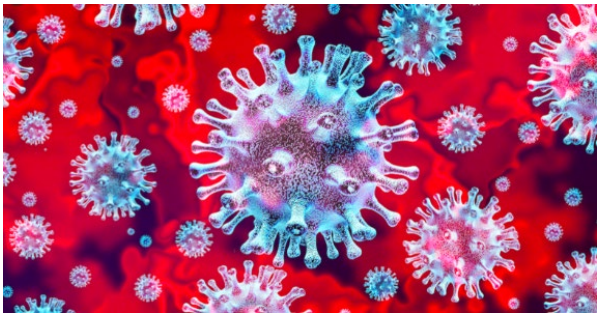
Mapping COVID-19

by David Crowther



In 2020 the **Coronavirus Epidemic** spread across the world and affected the lives of everyone we knew. I have always been acutely aware of how Geospatial Tools and Analysis techniques can aid better decision making and the targeting of resources, through my experience training ***Crime Analysts*** and ***Healthcare Professionals***, and again we have found this to be true when looking to tackle this worldwide epidemic. While we know it's easy to ***'Lie with Maps!'*** and produce multiple different visualisations from the same source data, by applying different algorithms, the correct application of 'Geospatial' is now more important than ever. We need to better understand incident patterns, identify and help vulnerable people and provide support for our finite emergency and healthcare resources.

This blog doesn't cover all the data available or explore all Geospatial tools that can be used, but it aims to give you an idea for a starting point to gather COVID-19 datasets and how that data can be visualised spatially within both desktop and web mapping applications. This blog was inspired through watching the YouTube video content by the **AMDGS**, which I would highly recommend you follow as it has lots of useful content around GIS.

AMDGS
Data & Geospatial

In this Cadline blog we will explore the following tasks:

- **Downloading** COVID-19 Data, importing into and Viewing in **QGIS**
- Uploading to **PostGIS** and Publishing via **GeoServer**
- Creating a **Web Mapping Application**

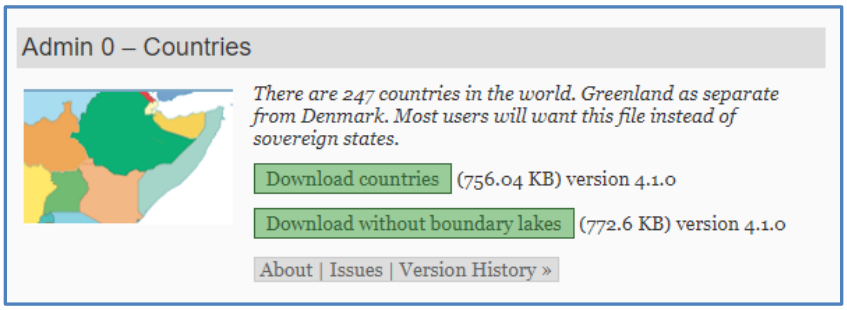
1 – Downloading the Data

So that we can map global COVID-19 data, we firstly need a **world mapping layer**. AMDGS recommend visiting the **Natural Earth** website which has a repository of Large, Medium and Small-scale world mapping data.

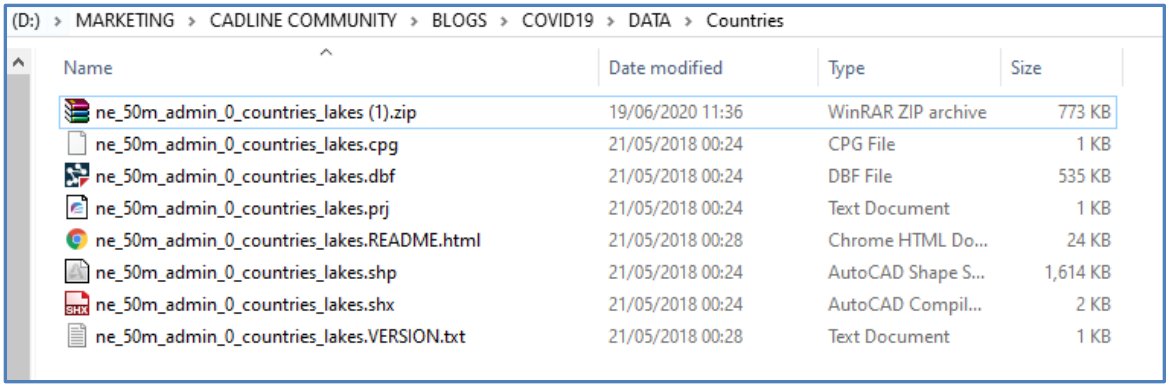
https://www.naturalearthdata.com/

From the **DOWNLOAD** page, choose the **Medium Scale** – **Cultural** data as this provides access to the Country specific spatial datasets.

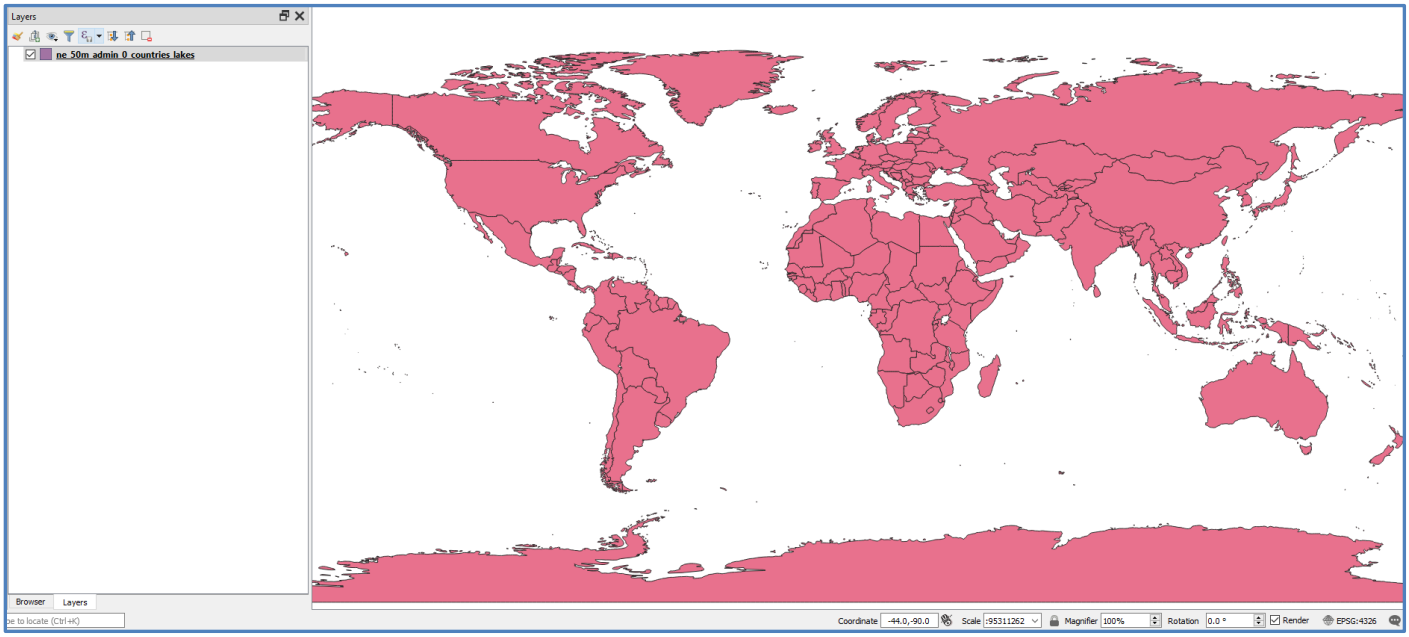
From the Medium Scale Cultural data, choose to **Download** the **Admin Countries – without boundary lakes.**



Once the **zip file** has downloaded, extract it onto your computer and save in a folder of your choice.



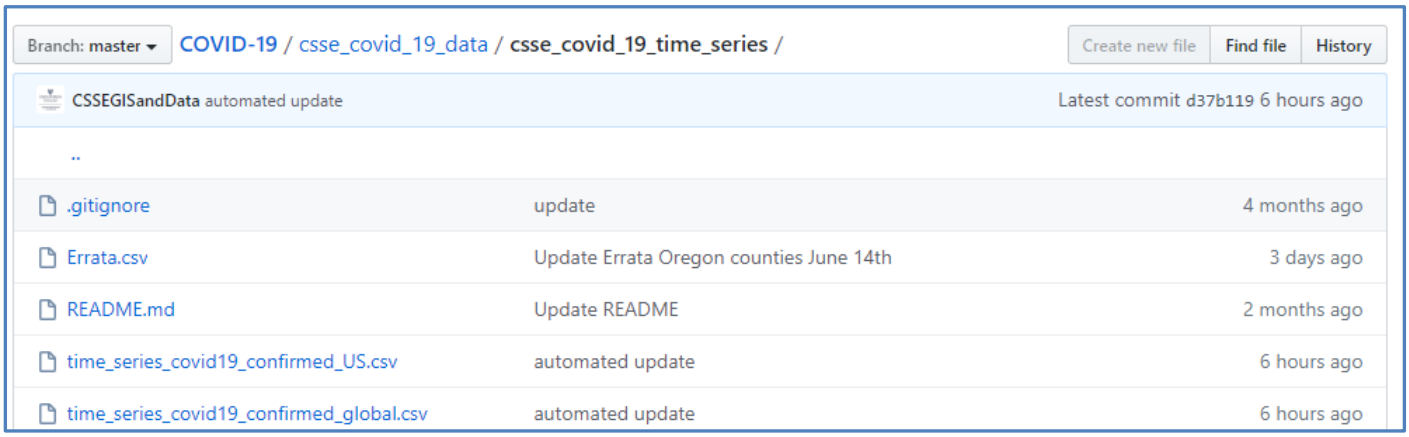
To view the country layer in QGIS ensure that your **Map Projection** is set to **4326** and then drag and drop the layer into the map.



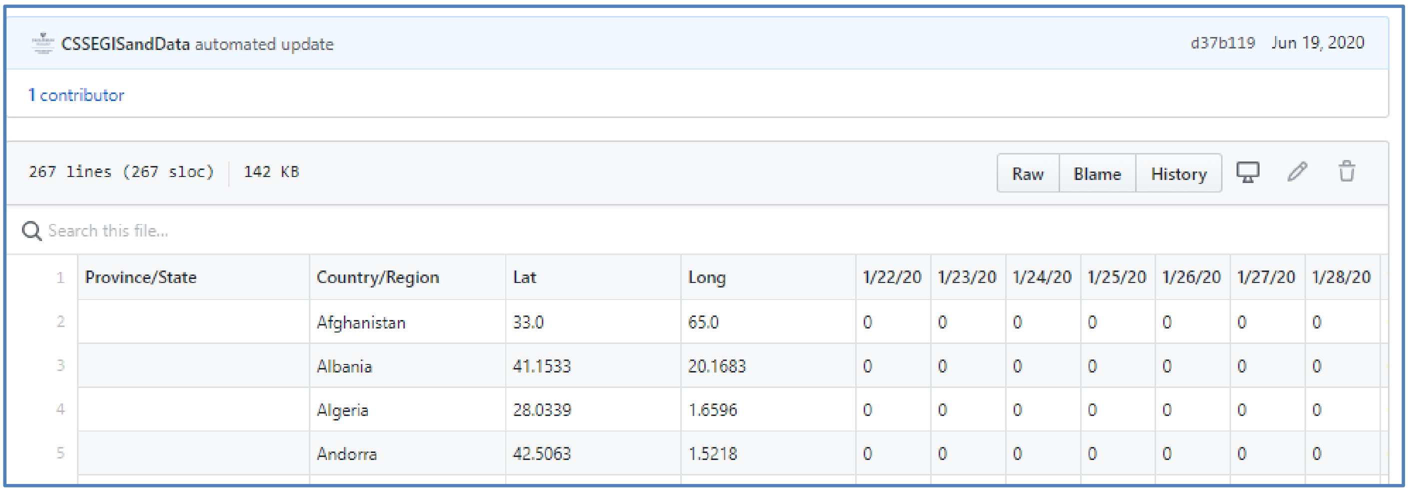
There are multiple sources for obtaining **COVID-19 datasets**, however we would recommend the **GitHub** Data Repository by the Center for Systems Science and Engineering (CSSE) at **Johns Hopkins University.**

https://github.com/CSSEGISandData/COVID-19

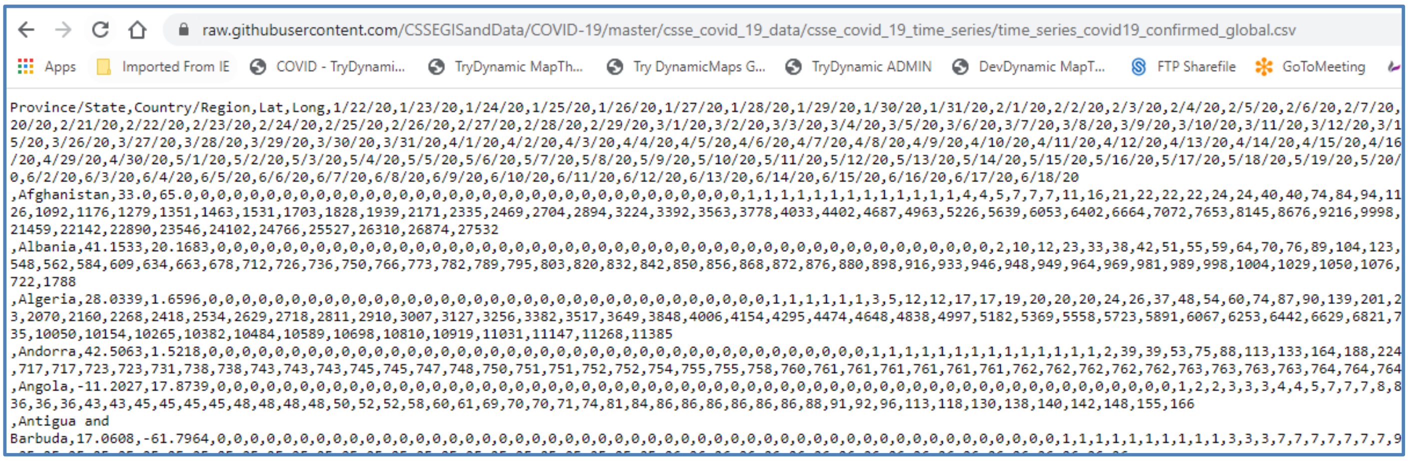
To download the data choose the **CSSE-COVID19_data** folder and then choose the **CSSE-COVID19_timeseries** folder and choose to download the confirmed **global cases CSV** file.



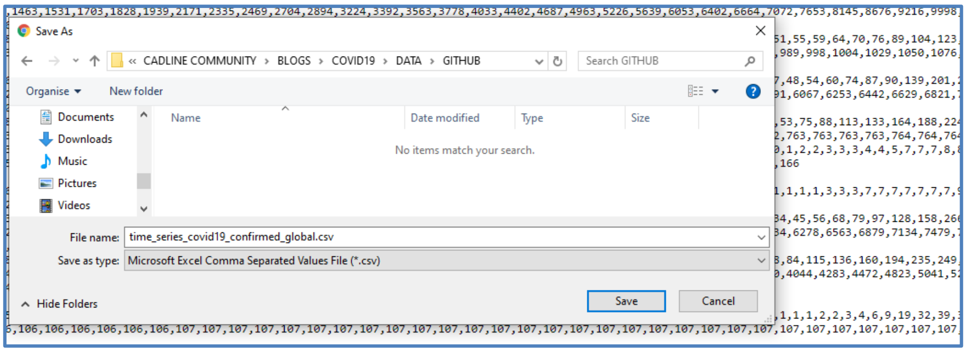
The data will be shown in **Table format.**



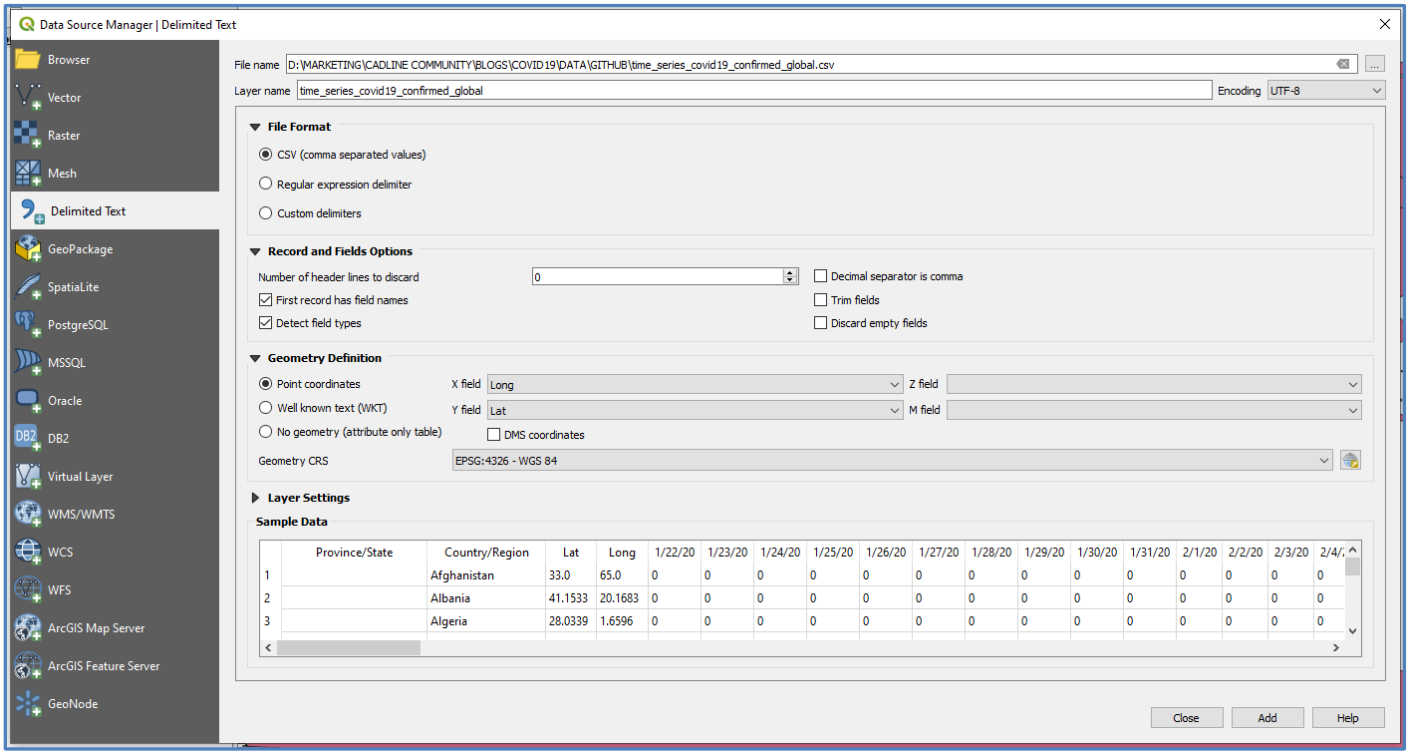
To download these records, change to show the data as **Raw**…

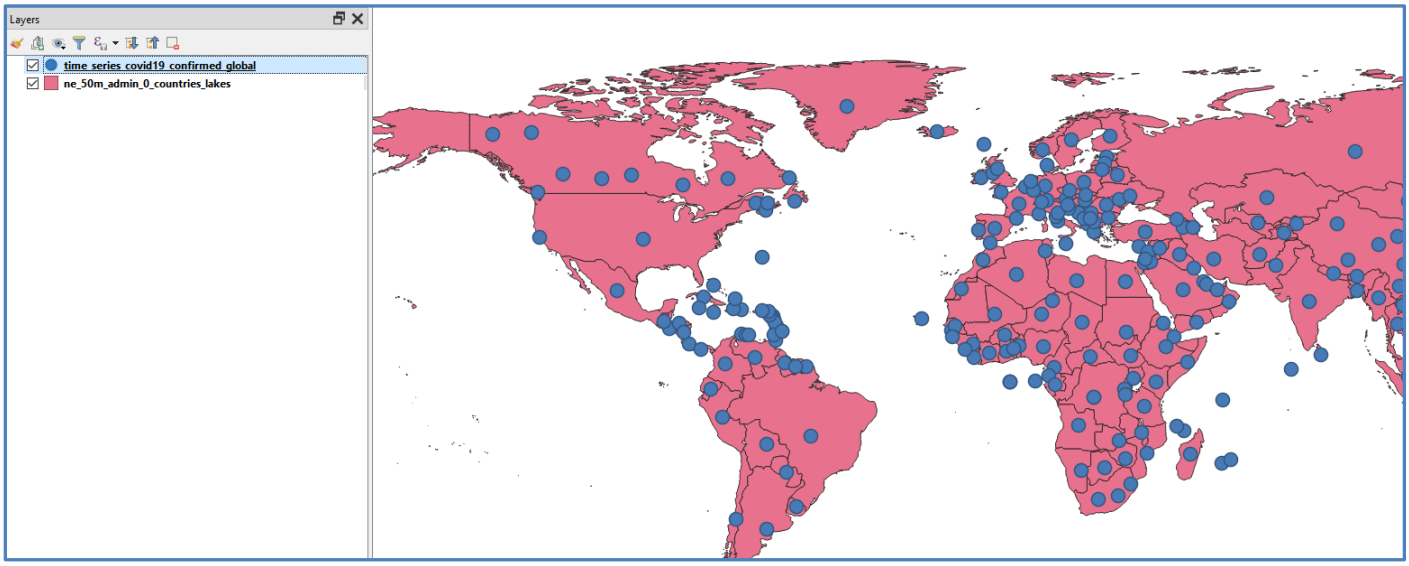


… and then **right click** in the page and **save as a CSV file.**



The CSV file has **Longitude** and **Latitude** values so using the **Open Delimited** files in QGIS we can import this data and plot the Countries as **Points.**





In previous mini blogs I have also explored the resources available via the **ESRI Living Atlas**, these include basemapping options and COVID-19 country datasets.

Follow the full details in this mini blog to get the best out of the ESRI Living Atlas:

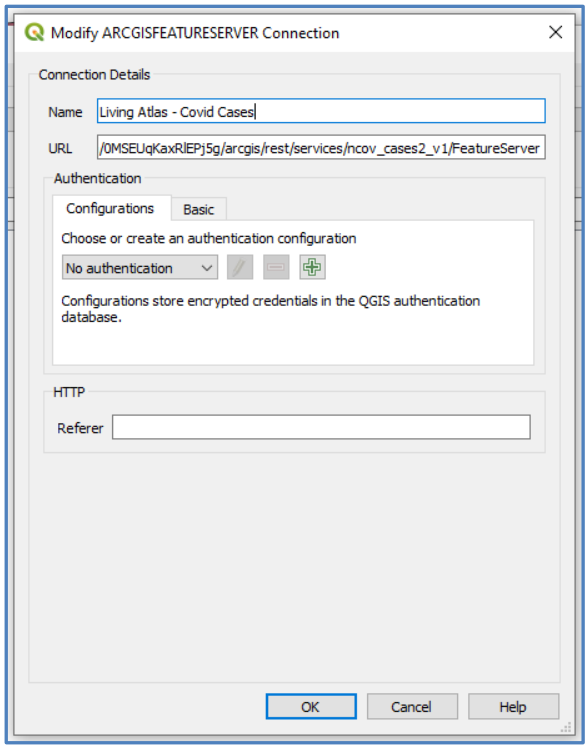
QGIS – Viewing COVID-19 Data:

https://www.cadlinecommunity.co.uk/hc/en-us/articles/360009767777-QGIS-Viewing-COVID-19-Data

In summary, the ESRI Living Atlas can provide you with **ArcGIS Feature Server Layers** which can then be opened in QGIS to provide spatial data layers related to COVID-19. A small search in the ESRI Living Atlas found this Feature Server Layer:

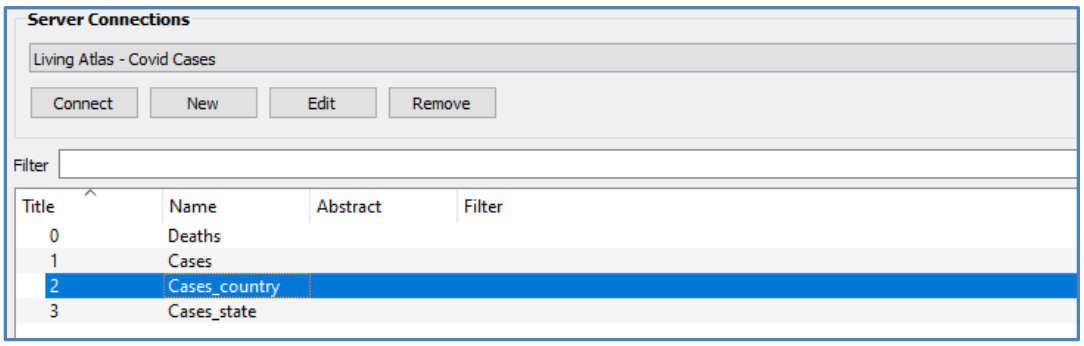
https://services1.arcgis.com/0MSEUqKaxRlEPj5g/arcgis/rest/services/ncov_cases2_v1/FeatureServer

This can be added to QGIS using the **Data Source Connection** where you simply choose to create a **New Connection** and copy in the provided **URL.**

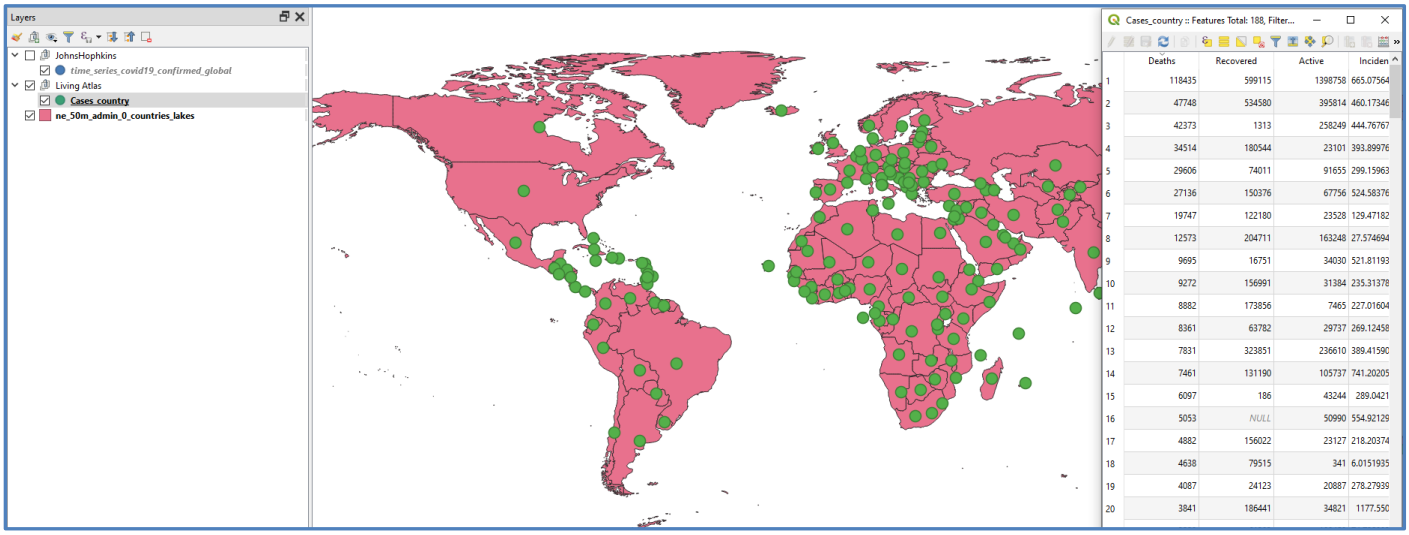


By connecting to this ArcGIS Feature Server Layer you can then add more COVID-19 data to the QGIS map.

For example, adding **Cases per Country**:



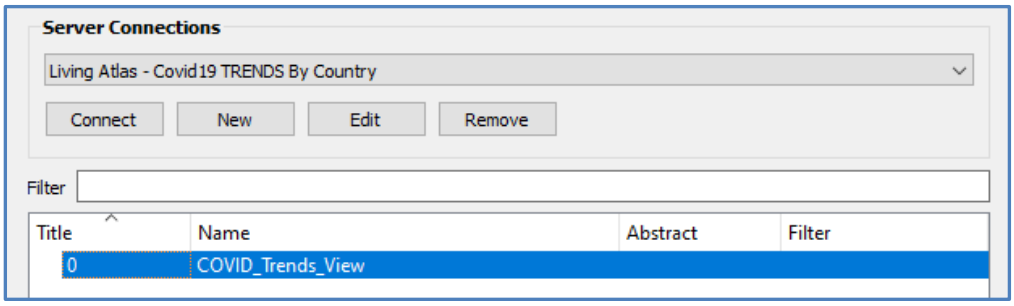
We now have a second source of COVID-19 data, this time with **Death, Recovered, Total Incident Rates** etc. Similar to the Johns Hopkins data downloaded earlier from GitHub, this data is Point Incidents, but by using this ArcGIS Feature Server Layer we already have the points **geolocated!**



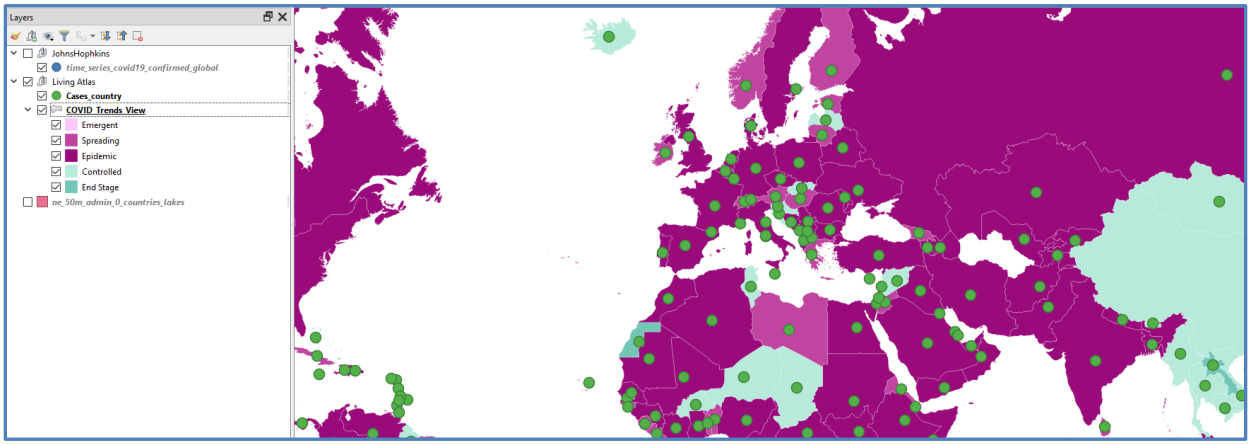
Another search in the ESRI Living Atlas found this **Country Polygon Layer**, detailing **COVID-10 Trends:**

https://services1.arcgis.com/0MSEUqKaxRlEPj5g/arcgis/rest/services/ncov_cases2_v1/FeatureServer

Adding this second ArcGIS Feature layer provided another version of the World Countries, but this time each Country already had the COVID-19 related attributes attached, saving any need to join Point data to the Country polygons.



Because this data source is from an ArcGIS Online Feature Server Layer, the data is **live**, it includes the **spatial geometry** and has already been **thematically styled** based on the Data Owners chosen attributes, in this case **'COVID-19Trends'**.



Follow the AMDGS YouTube video if you wish to see how you can now map the Johns Hopkins University data within QGIS, creating **Graduated Point Thematics** and **Death Rates per Countries**.

For more tips on how to spatially analyse healthcare related datasets here is a Cadline Blog with lots of **QGIS tips and tricks**:

https://www.cadlinecommunity.co.uk/hc/en-us/articles/360007617137-Open-Source-GIS-Mapping-Health-Care-Data

2 – PostGIS and GeoServer

Having downloaded our COVID-19 datasets and undertaken some analysis and thematic mapping options in QGIS, the next step is to look at other **Open Source** geospatial tools to better **store** and then **present** that data across the web.

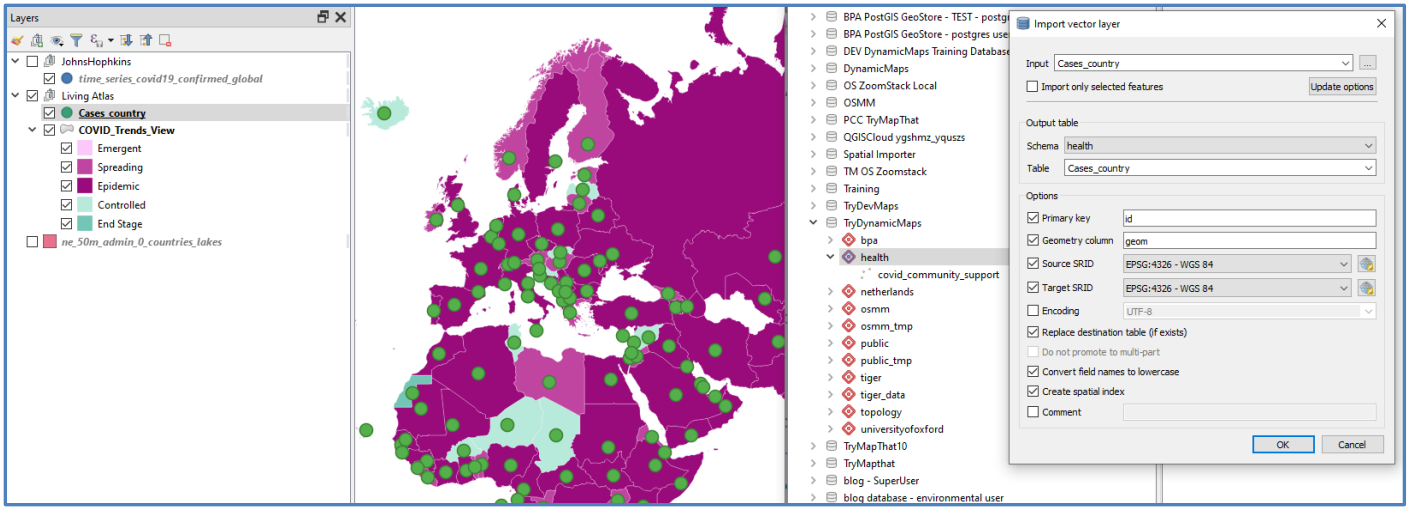
Cadline's Geospatial Team are listed as a Provider of Support for Open Source Geospatial tools for the **OSGeo Community.**

OSGeo
Your Open Source Compass

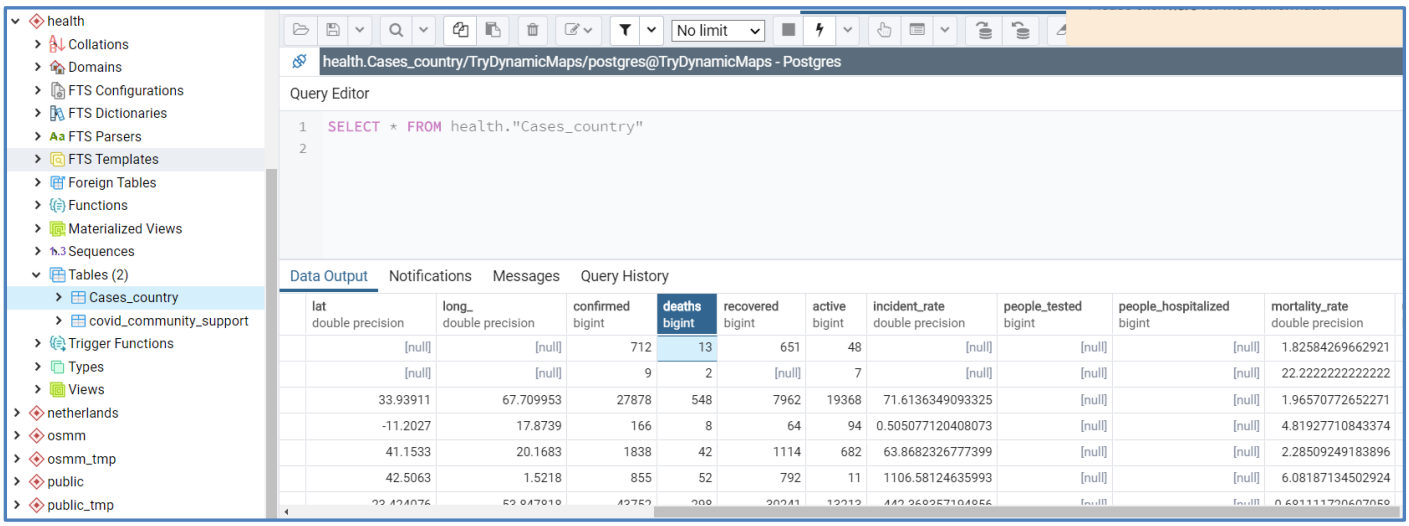
As part of that we deliver an **Introduction to GeoServer** Training course and an **Integrated Open Source GIS** Course, which includes working with PostGIS.

We recommend to all our GIS Users that both **GeoServer** and **PostGIS** will provide the right tools for them to store, manage and publish their spatial datasets and this definitely makes sense for our COVID-19 files.

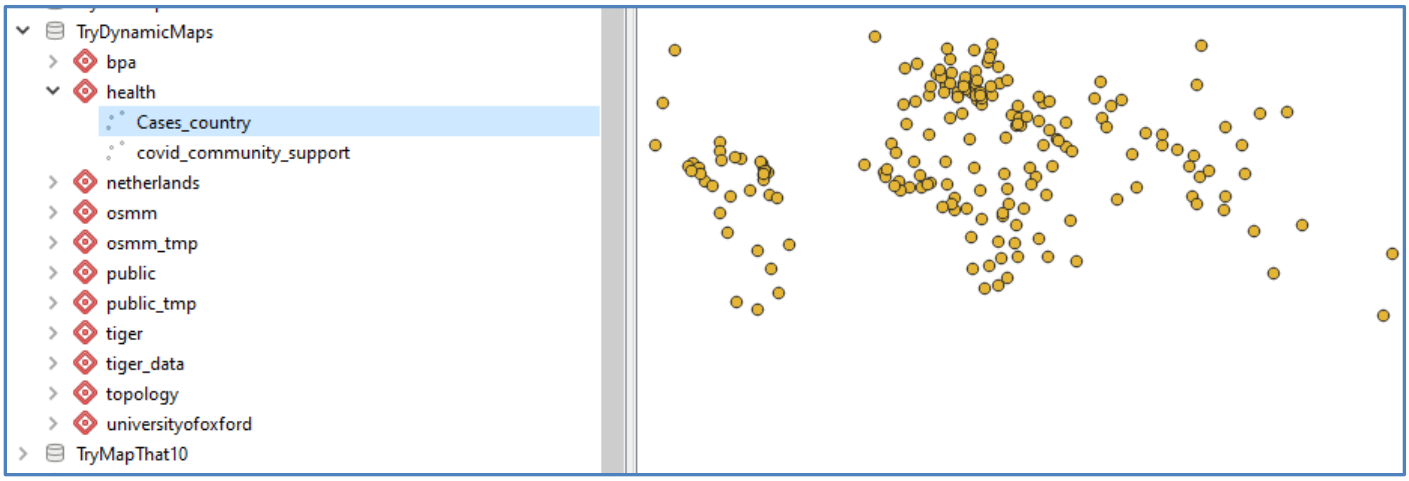
Using the integrated **Database Tool** within **QGIS**, we are able to very easily **upload** the COVID-19 spatial datasets into a **PostGIS** Spatial Database.



Once uploaded the COVID-19 datasets can be viewed in the PostGIS database using **PGAdmin**…

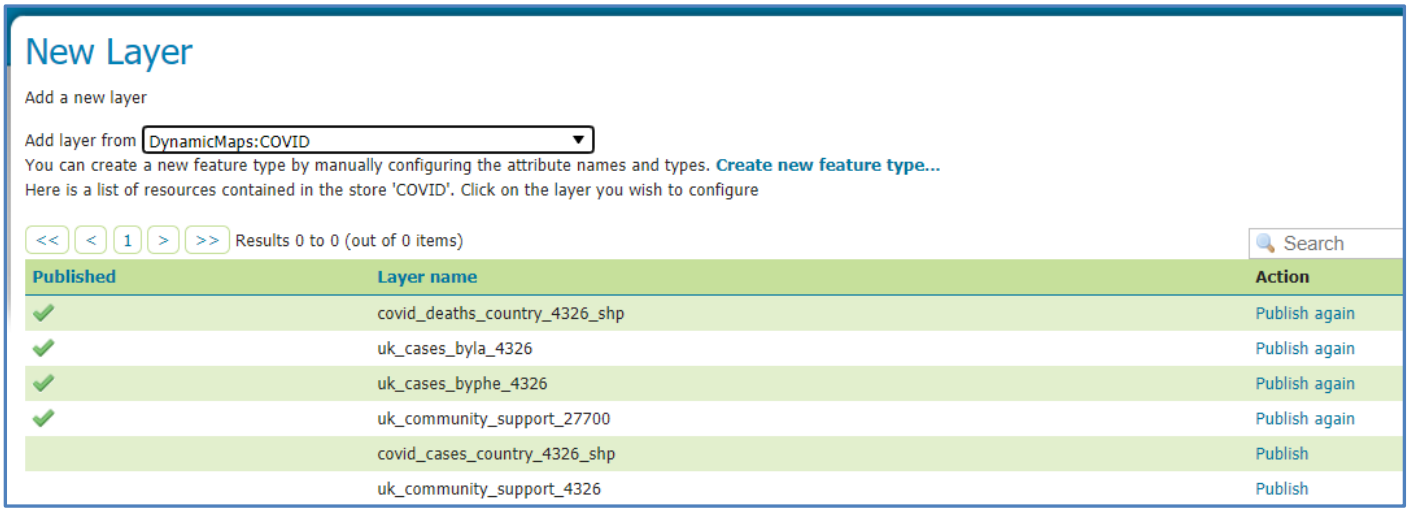


…and also opened into QGIS directly from the PostGIS database. This ensures that all Users are sharing the same **LIVE** datasets from **One Source of Truth**.

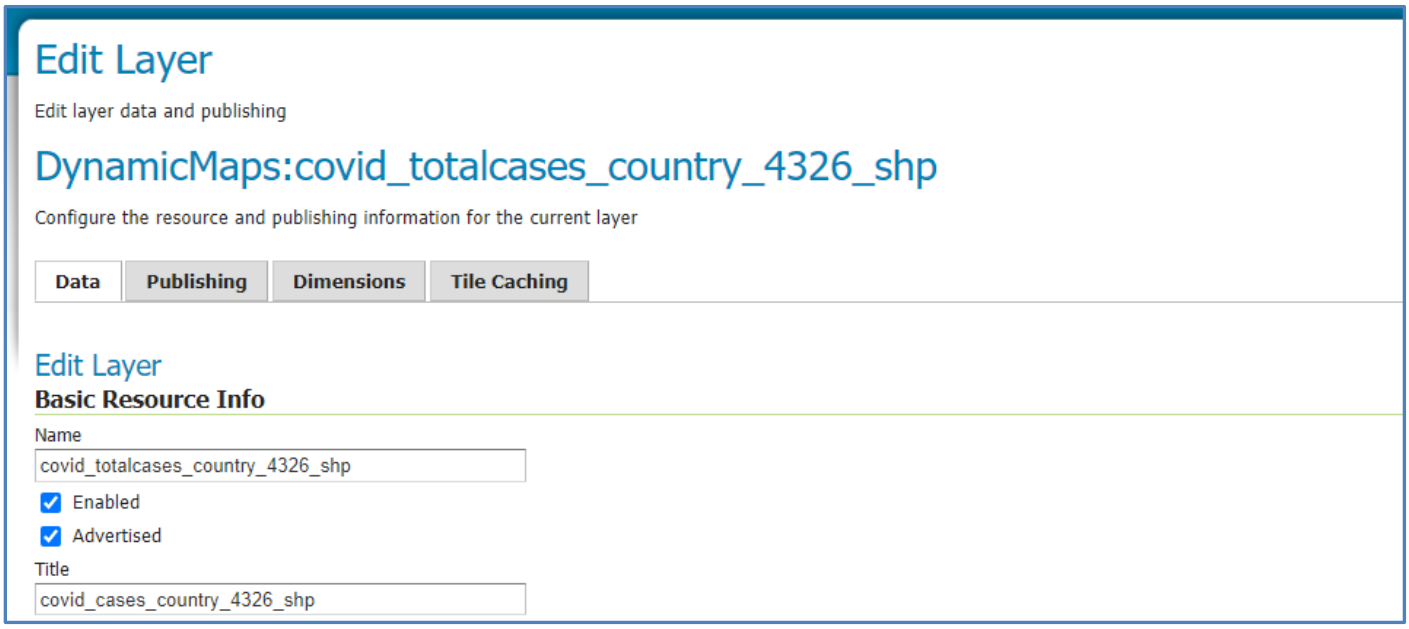


In addition, now we have uploaded the spatial data into a PostGIS Database, it's very easy to publish that data as **Web Map Services** (WMS) via **GeoServer.**

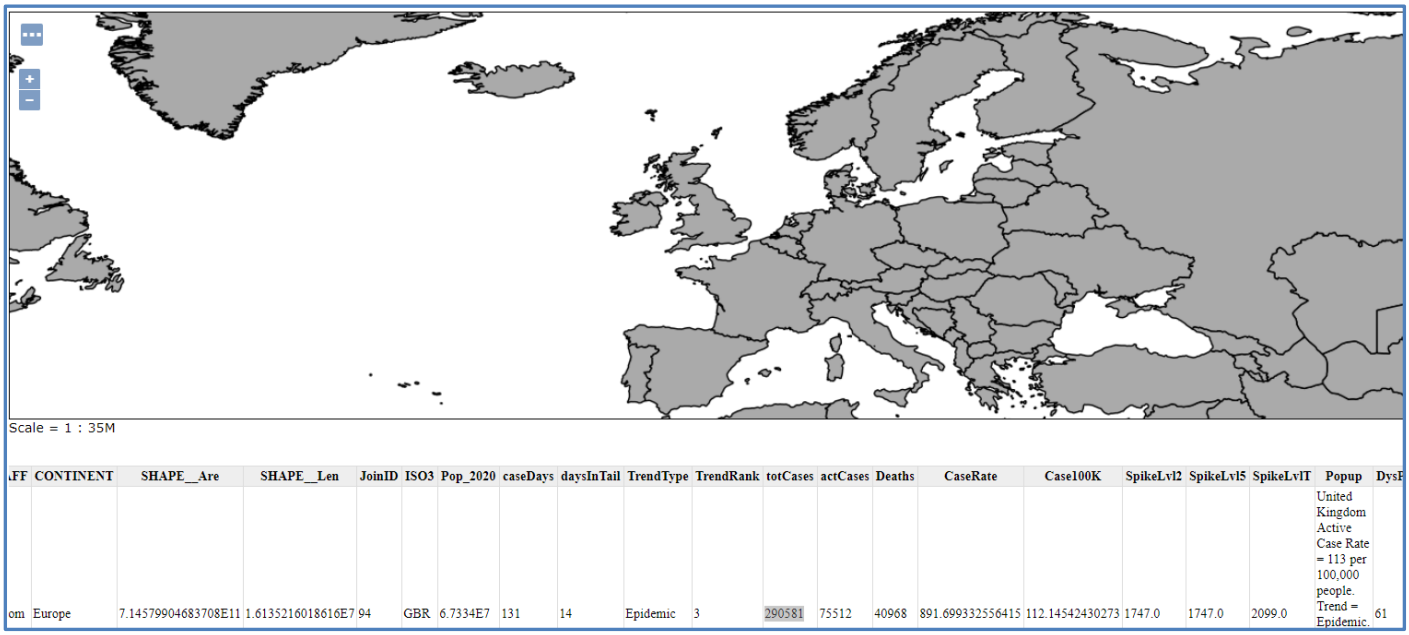
To do this I created a new Data Store to connect GeoServer to our PostGIS Database to then **Publish** any of the newly uploaded COVID-19 datasets.



Using the **Publish** option we can then create a **New WMS Layer** e.g. using the ArcGIS Online **COVID-19 Trends Table** we can create a WMS showing a **Count of Total Cases** for each world Country.



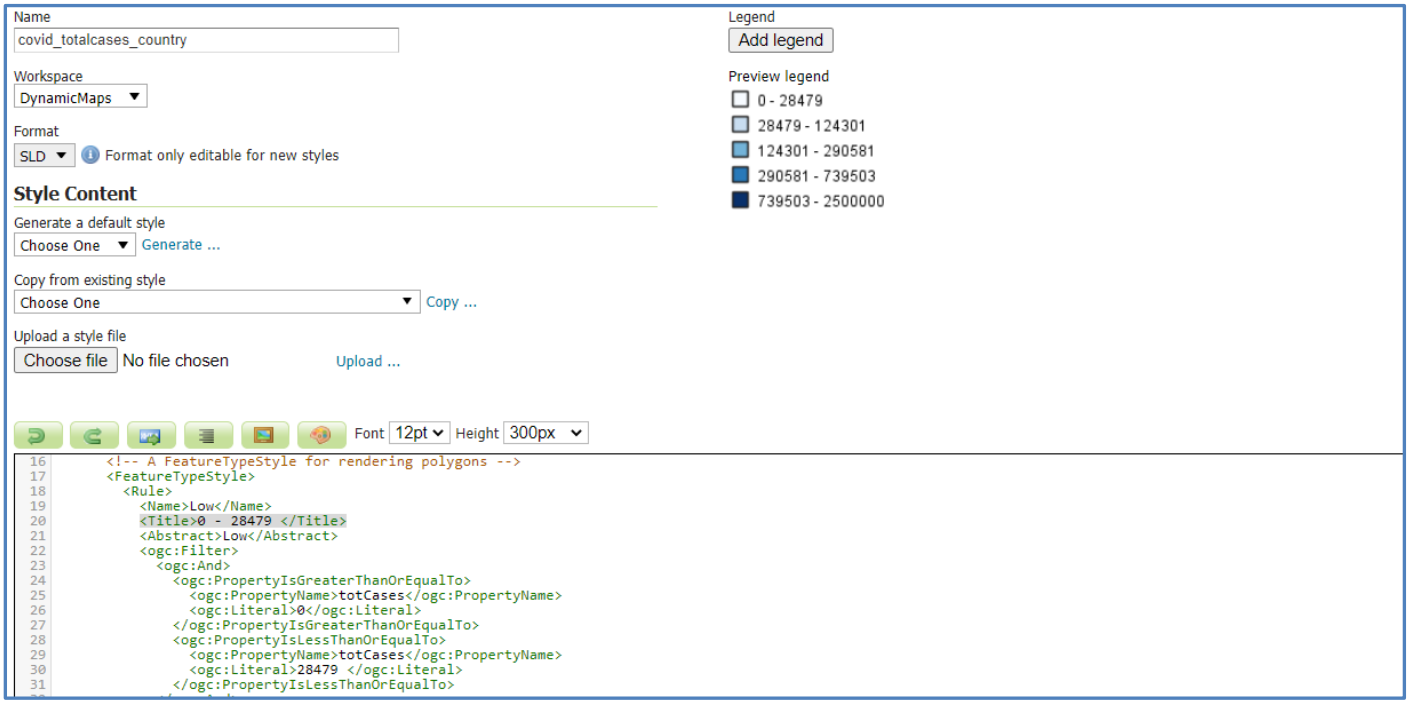
By default the COVID-19 Total Cases Layer will be shown as **Grey Polygons**……



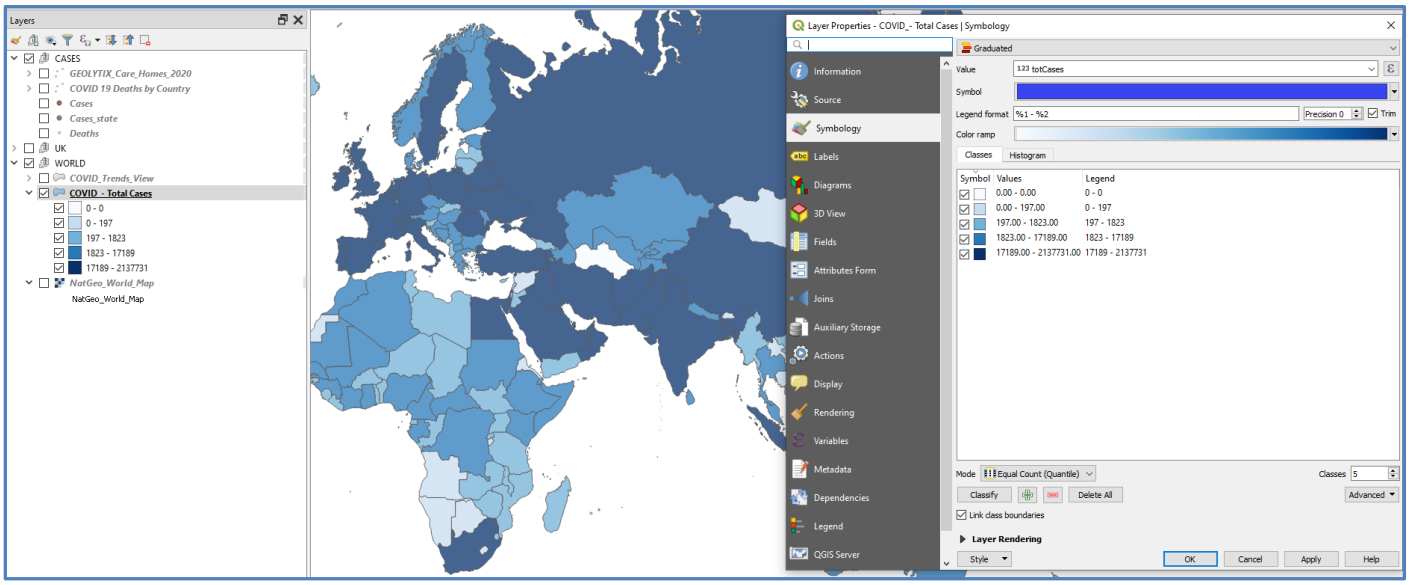
...FF	CONTINENT	SHAPE__Are	SHAPE__Len	JoinID	ISO3	Pop_2020	caseDays	daysInTail	TrendType	TrendRank	totCases	actCases	Deaths	CaseRate	Case100K	SpikeLvl2	SpikeLvl5	SpikeLvlT	Popup	DysF
om	Europe	7.14579904683708E11	1.6135216018616E7	94	GBR	6.7334E7	131	14	Epidemic	3	290581	75512	40968	891.699332556415	112.14542430273	1747.0	1747.0	2099.0	United Kingdom Active Case Rate = 113 per 100,000 people. Trend = Epidemic.	61

…. but using the power of **Style Layer Descriptors** (SLDs) we can style the data in GeoServer to better meet our needs.

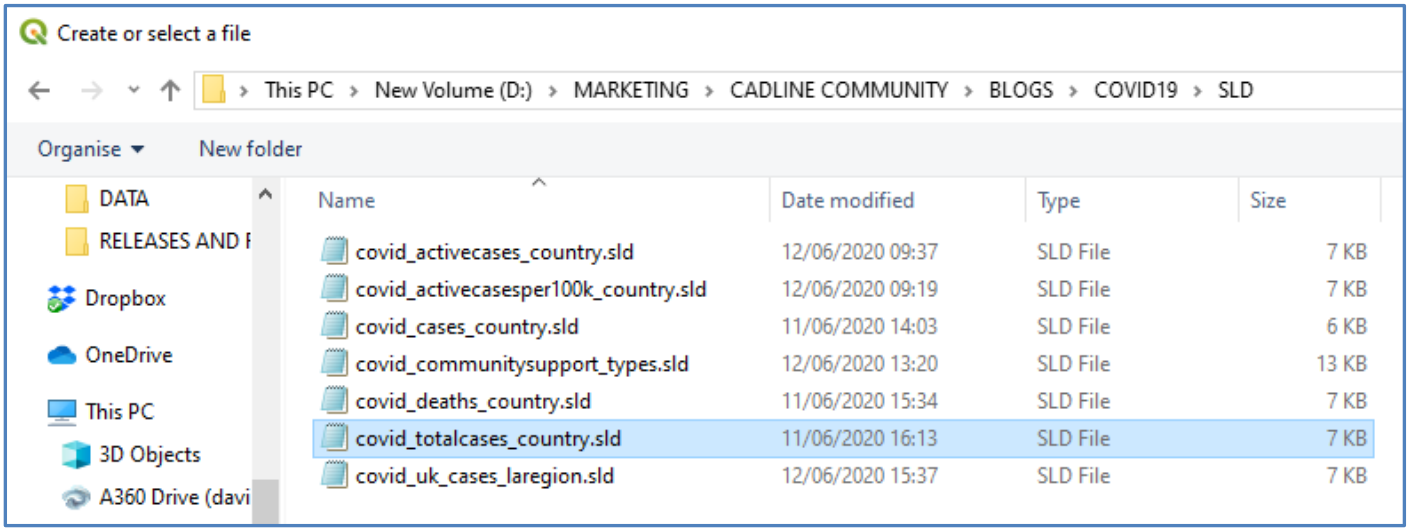
The SLD shown below uses a **Rule Based** xml to create **5 Thematic Categories** where the Total Cases are coloured based on the Range of Values each Country falls within.



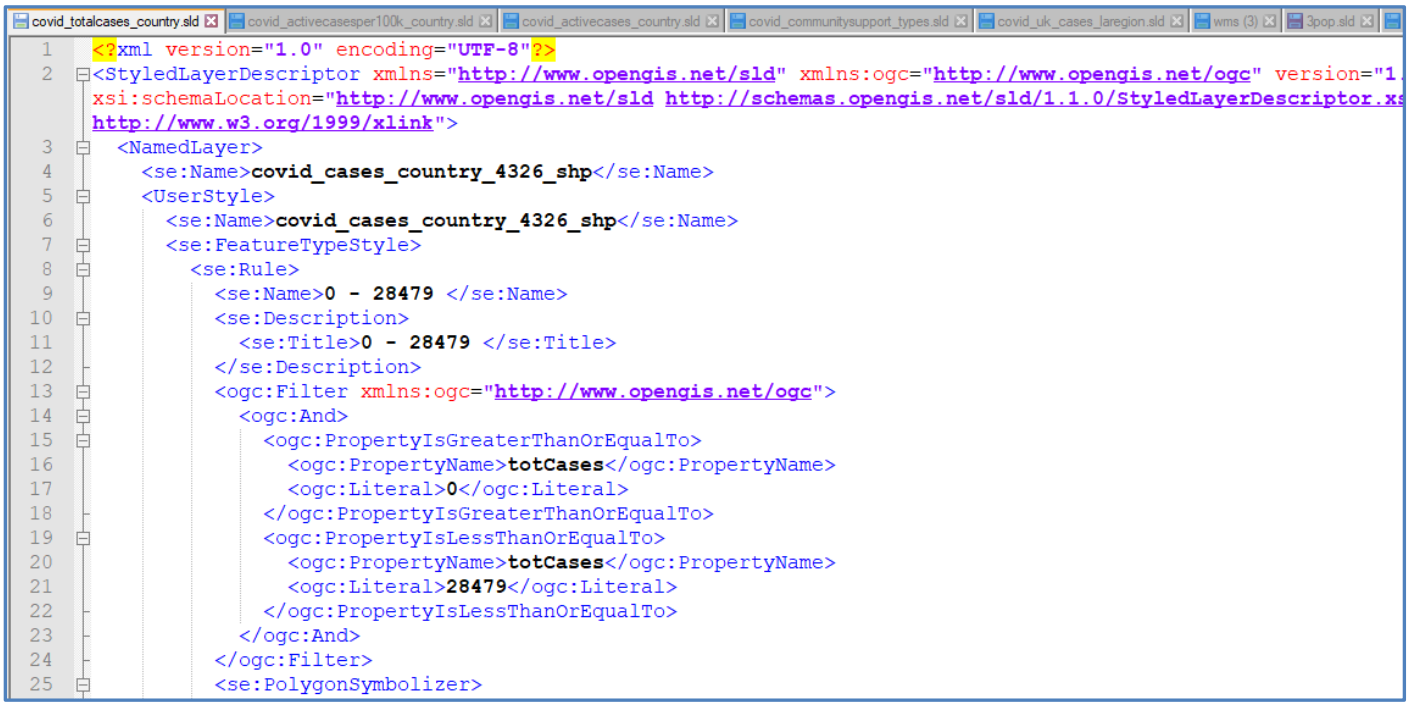
Tip – creating SLDs can be time consuming and can rely on some prior knowledge of XML. However, if you first create the **Thematic Styling in QGIS** e.g. Mapping the Country's by **Total Case**s, the style is applied to each Country in the QGIS layer.



Then in the QGIS **Layer Properties** you can choose the **Style > Save Style** and save the Thematic as an **SLD.**



If you now open the SLD in **Notepad++** you can see that the XML has been auto created, with the 5 Thematic Ranges that QGIS used to classify the data.

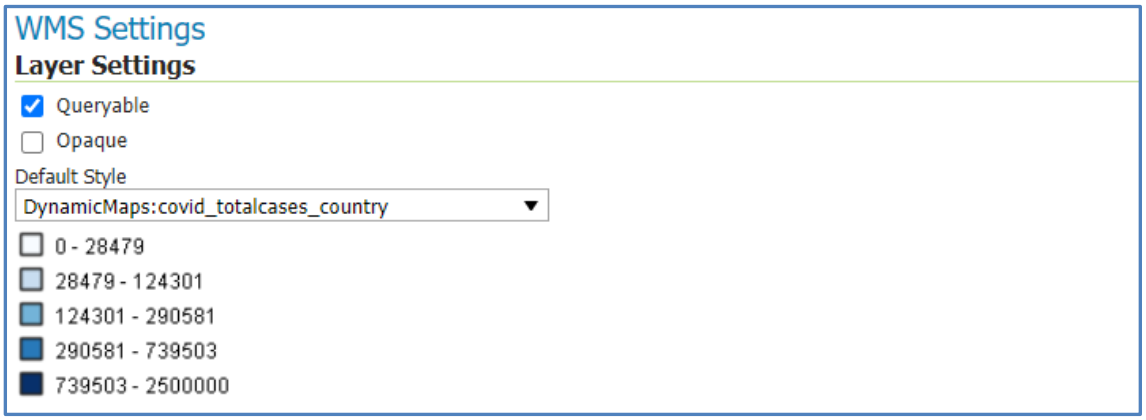


```
<?xml version="1.0" encoding="UTF-8"?>
<StyledLayerDescriptor xmlns="http://www.opengis.net/sld" xmlns:ogc="http://www.opengis.net/ogc" version="1.
xsi:schemaLocation="http://www.opengis.net/sld http://schemas.opengis.net/sld/1.1.0/StyledLayerDescriptor.xs
http://www.w3.org/1999/xlink">
  <NamedLayer>
    <se:Name>covid_cases_country_4326_shp</se:Name>
    <UserStyle>
      <se:Name>covid_cases_country_4326_shp</se:Name>
      <se:FeatureTypeStyle>
        <se:Rule>
          <se:Name>0 - 28479 </se:Name>
          <se:Description>
            <se:Title>0 - 28479 </se:Title>
          </se:Description>
          <ogc:Filter xmlns:ogc="http://www.opengis.net/ogc">
            <ogc:And>
              <ogc:PropertyIsGreaterThanOrEqualTo>
                <ogc:PropertyName>totCases</ogc:PropertyName>
                <ogc:Literal>0</ogc:Literal>
              </ogc:PropertyIsGreaterThanOrEqualTo>
              <ogc:PropertyIsLessThanOrEqualTo>
                <ogc:PropertyName>totCases</ogc:PropertyName>
                <ogc:Literal>28479</ogc:Literal>
              </ogc:PropertyIsLessThanOrEqualTo>
            </ogc:And>
          </ogc:Filter>
          <se:PolygonSymbolizer>
```

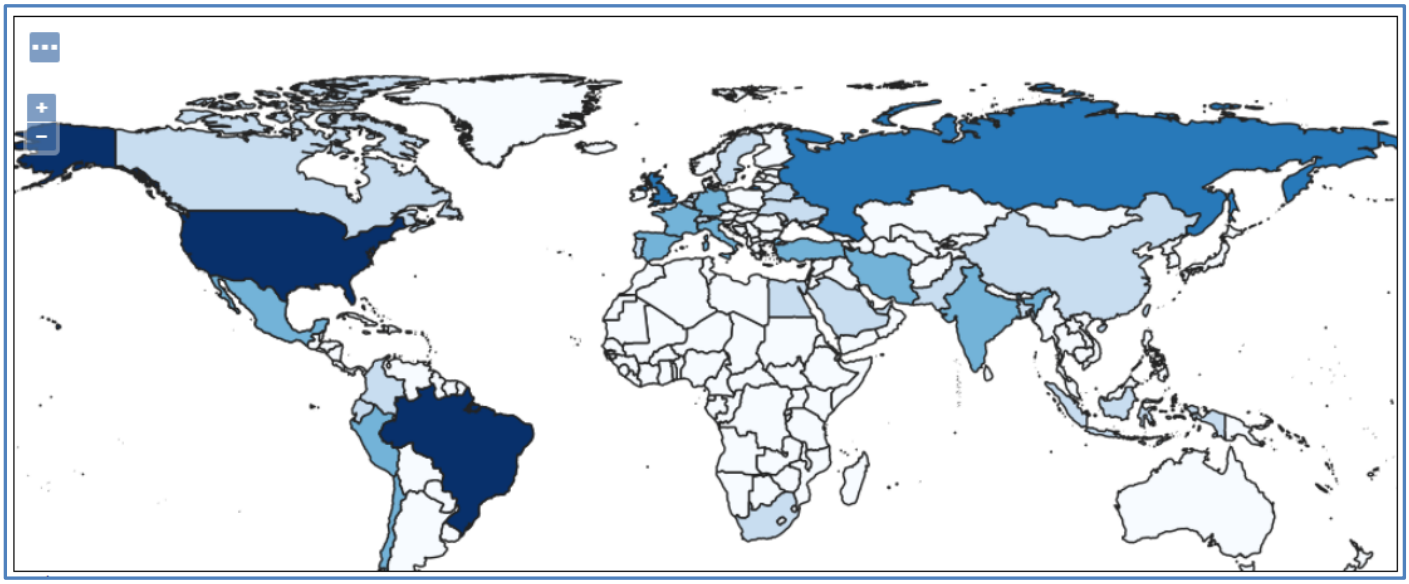
Tip – Unfortunately you can't simply copy the SLD file into GeoServer as it has **tags** that GeoServer will not like, however here is a **FAQ** in Cadline Community to help you replace those Tags:

https://www.cadlinecommunity.co.uk/hc/en-us/articles/115004680145-GeoServer-SLD-Using-GeoServer-Explorer

Once the SLD has been created in GeoServer you can now apply the **Style** to the **COVID-19 WMS Layer** in the layers **Publishing** Tab.

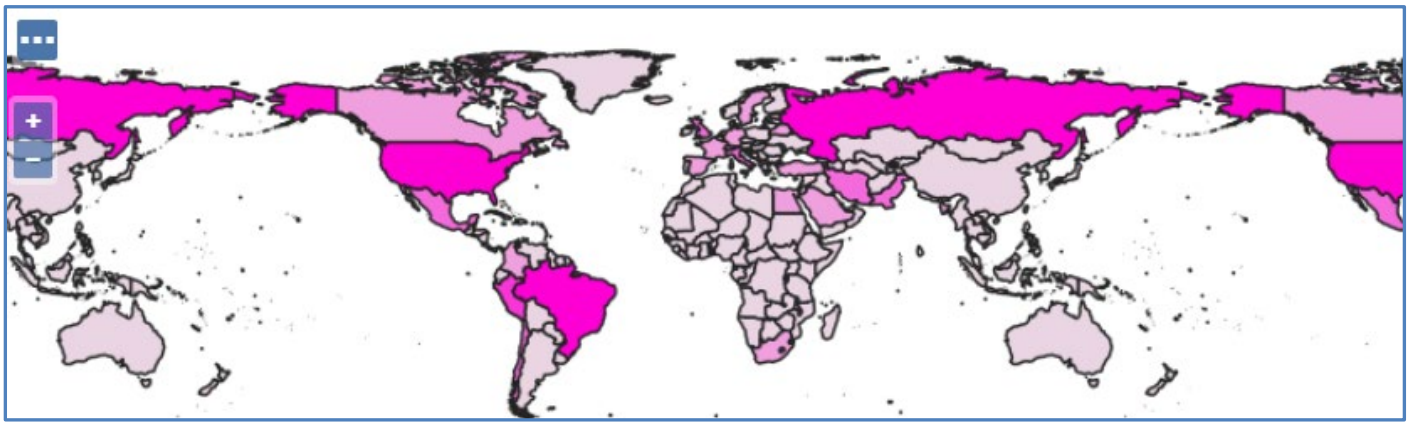


Now when previewed in **OpenLayers,** the WMS uses the Styled SLD to apply a Thematic Range to show **High and Low COVID-19 Total Cases**.



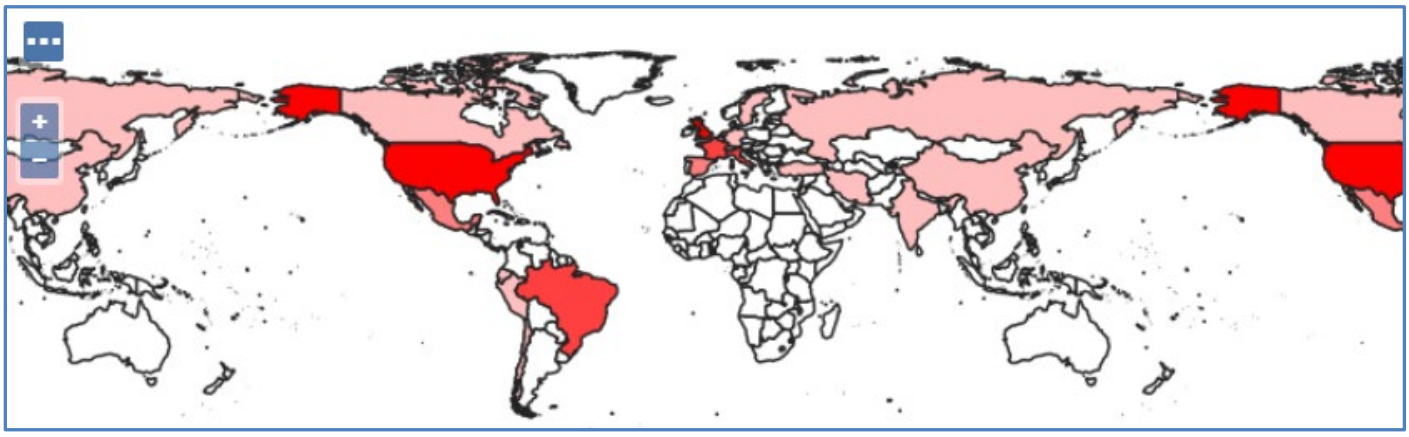
By simply republishing the same PostGIS Table – COVID-19 Countries – and applying different Style Files to each Layer, we can easily create **multiple WMS** layers from the same data source. For example, COVID-19 Country Maps showing; **Active Cases**, **Active Cases per 100K** and **Total Deaths.**

Active Cases:



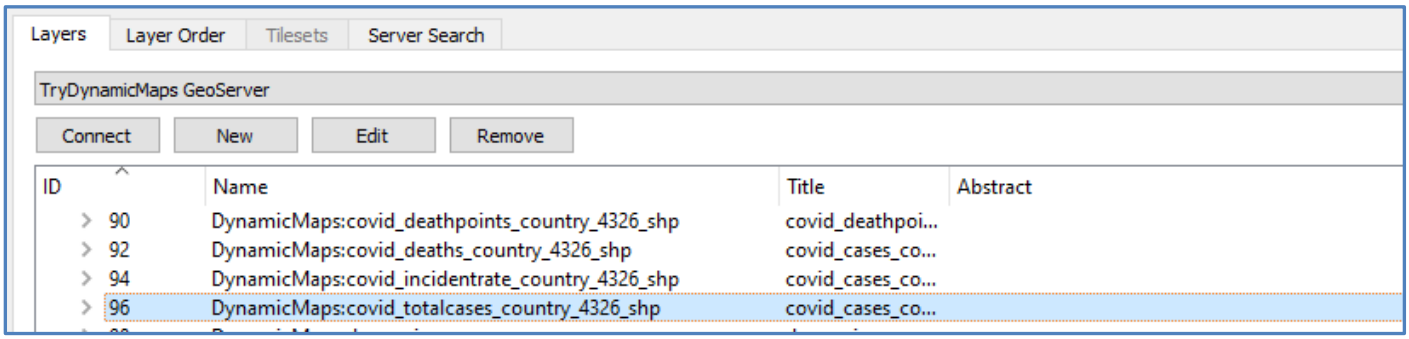
Active Cases per 100K Population:

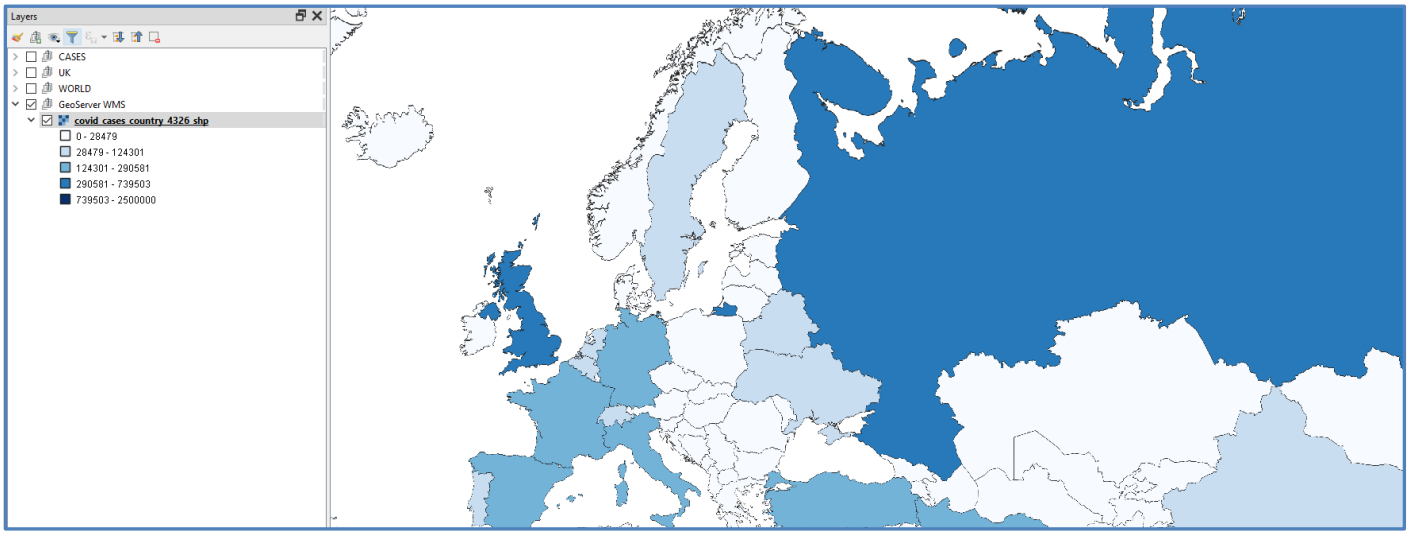
Total Deaths:



3 – Web Mapping

Now that we have a number of **Web Map Service** (WMS) Layers, we can consume those within both **desktop GIS** (e.g. QGIS) using the WMS Data Connection:



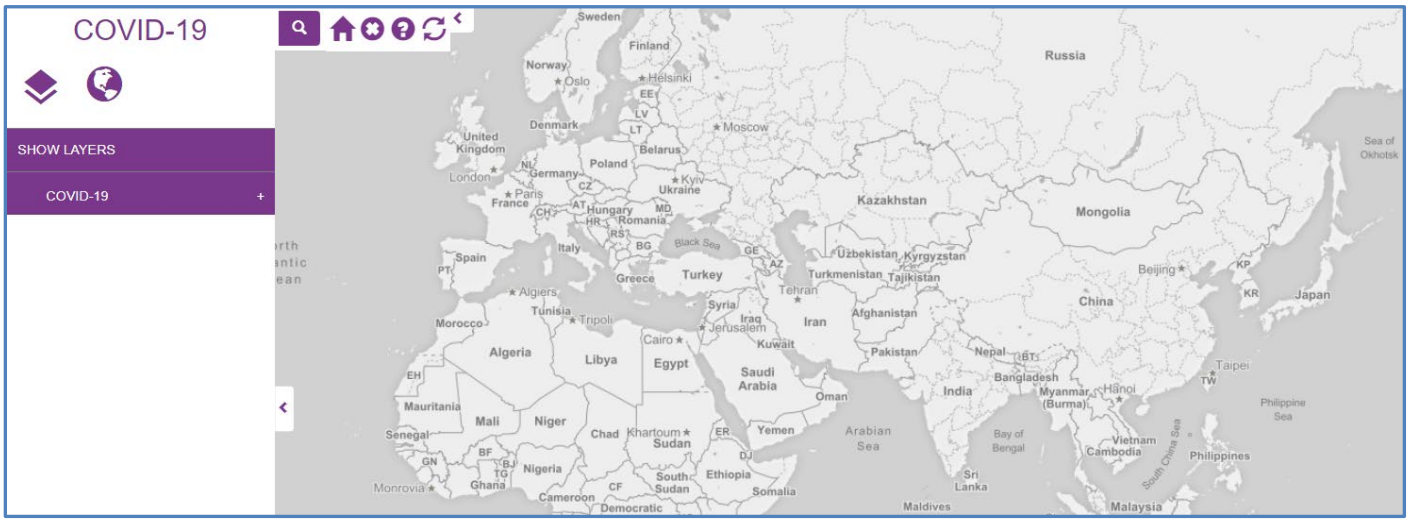


These WMS Layers can also be consumed within a **Web Mapping Application**. In this case we will utilise the **DynamicMaps webGIS – MapThat.**

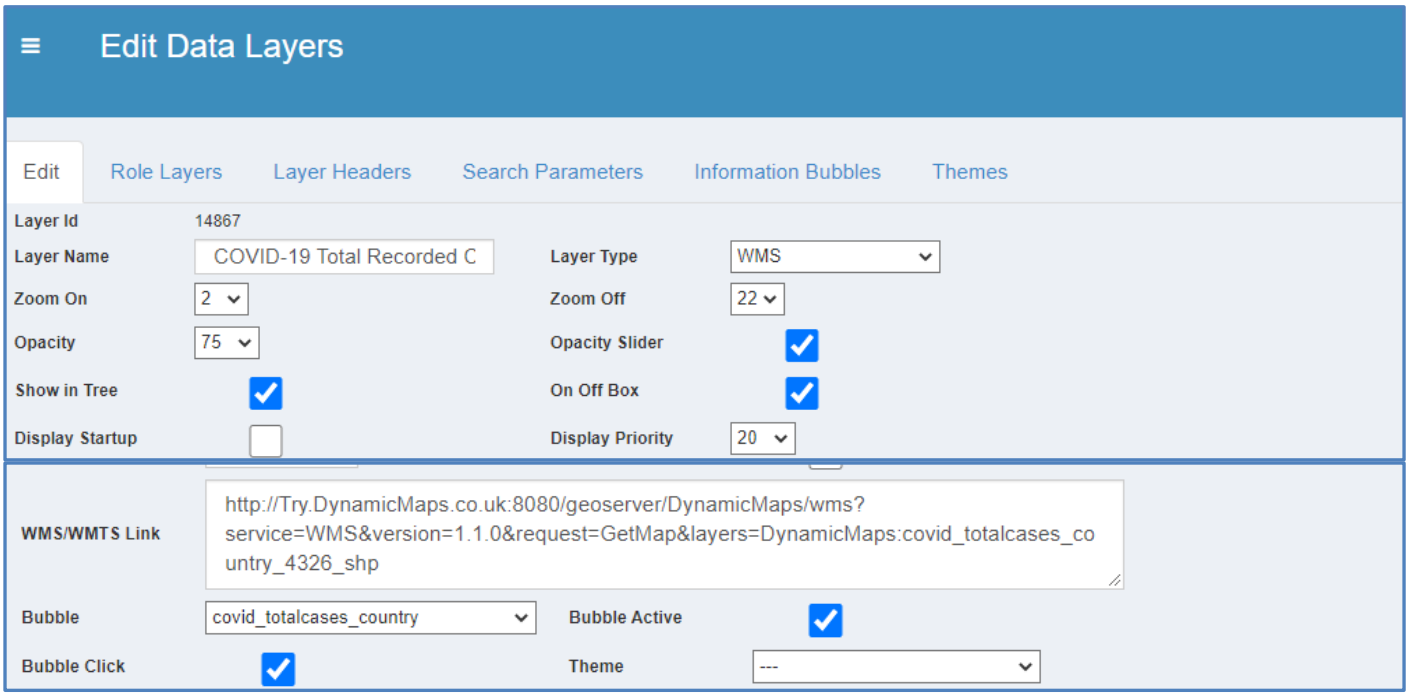
By simply **Copying** an existing **MapThat Project** and then making some small config changes:

- Changing the Start X&Y and Zoom Level..setting the Max Extents to the World
- Choosing a new SKIN Colour
- Assigning Basemaps for the World
- …. and creating a new COVID-19 Tree

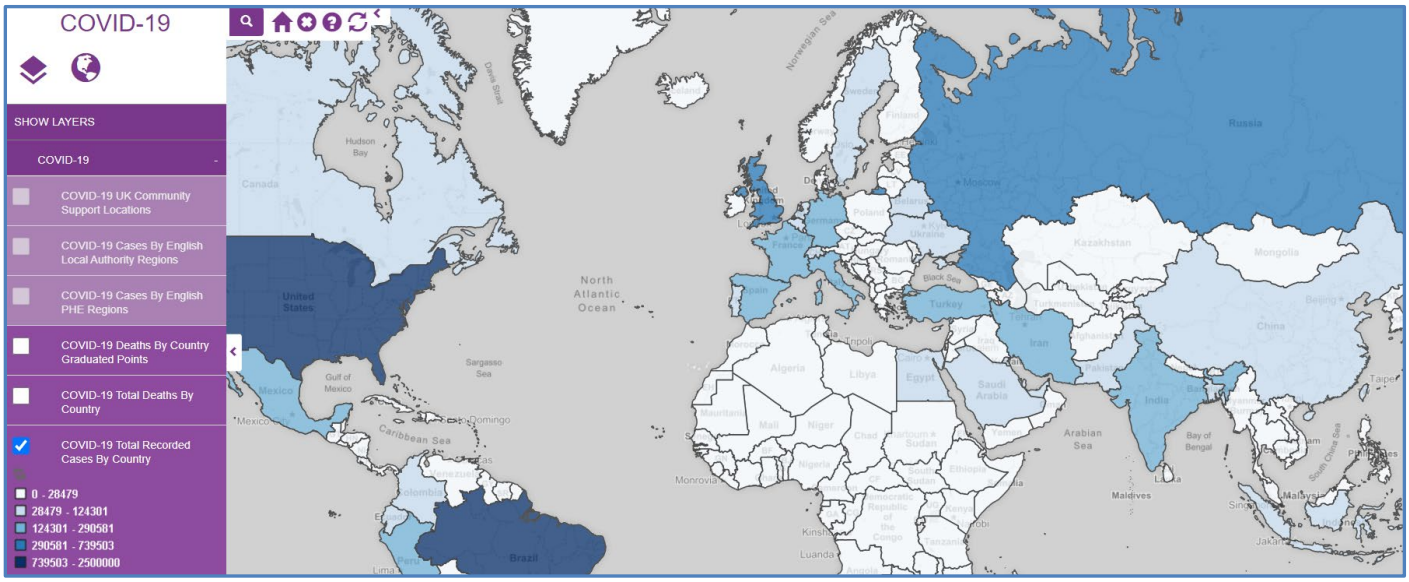
Within minutes we have new Web Mapping Project ready to add our COVID-19 WMS layers into.



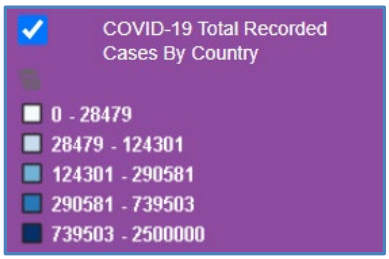
Using the online **MapThat Admin Forms**, it is now very simple to Create a **new MapThat Layer** and point to the **GeoServer WMS** as the Source for the Layer.



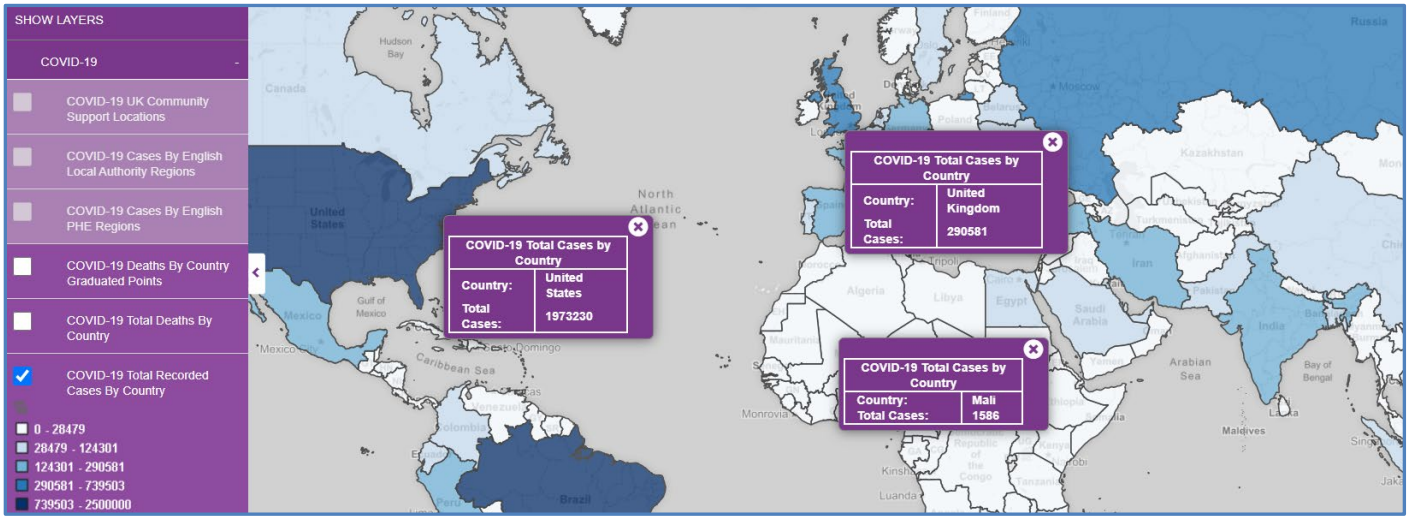
When added to the new COVID-19 MapThat Project we can now visualise the **Country Wide Total COVID-19 Cases**.



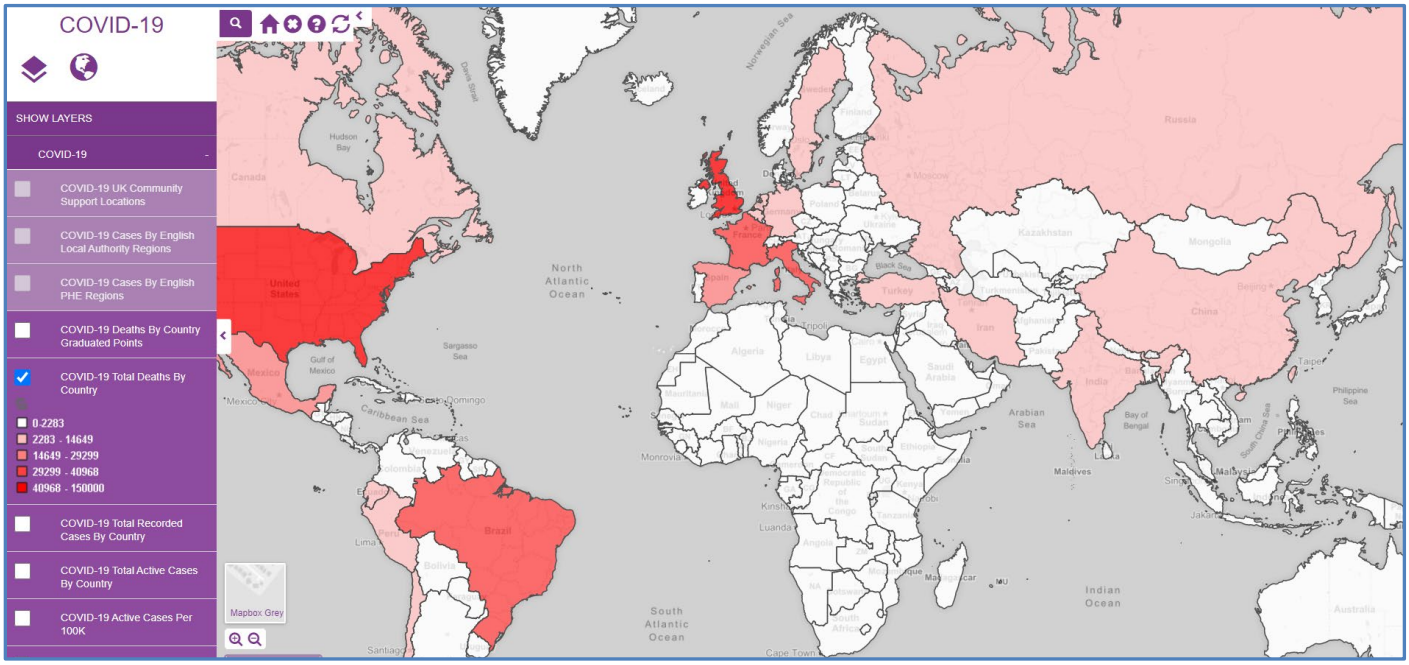
MapThat can render any **Legend** that is associated to the source WMS.



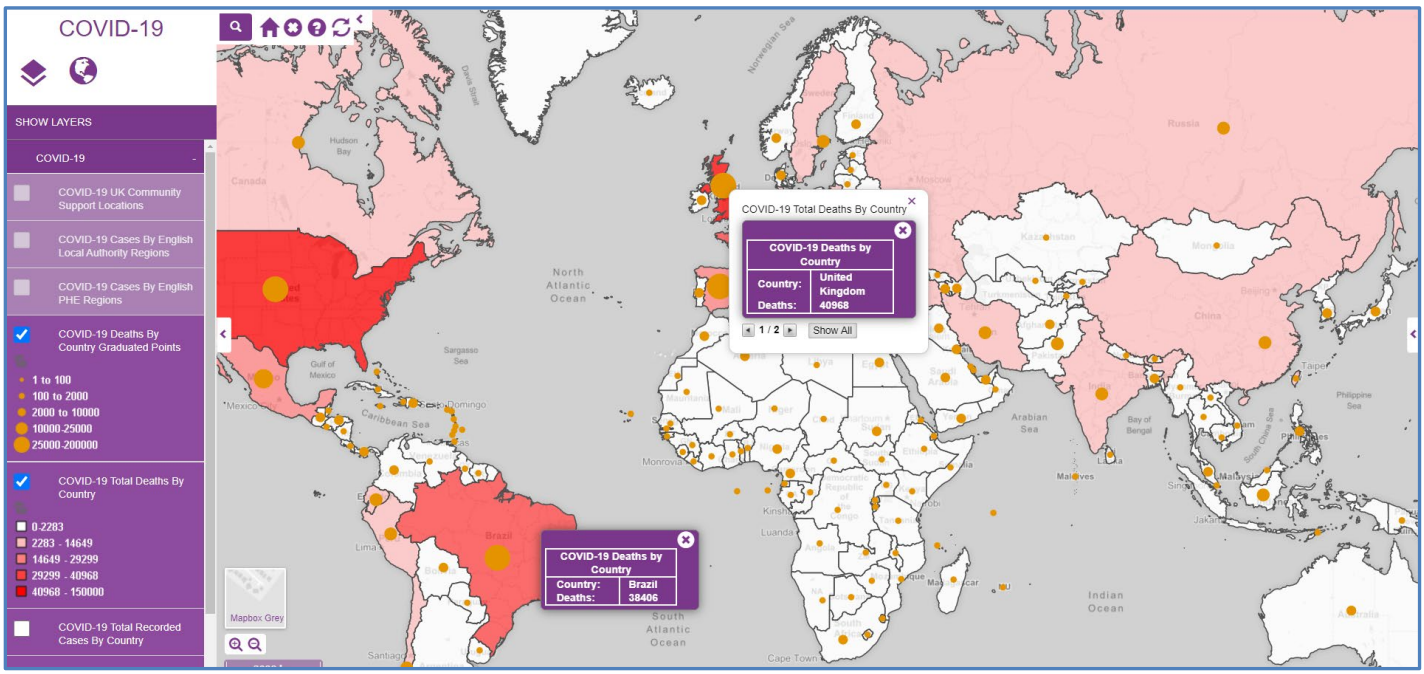
Using the **GetCapabilities** command we can also show **Information Bubbles** for the **attributes** of the source data, so Users can interrogate the map.



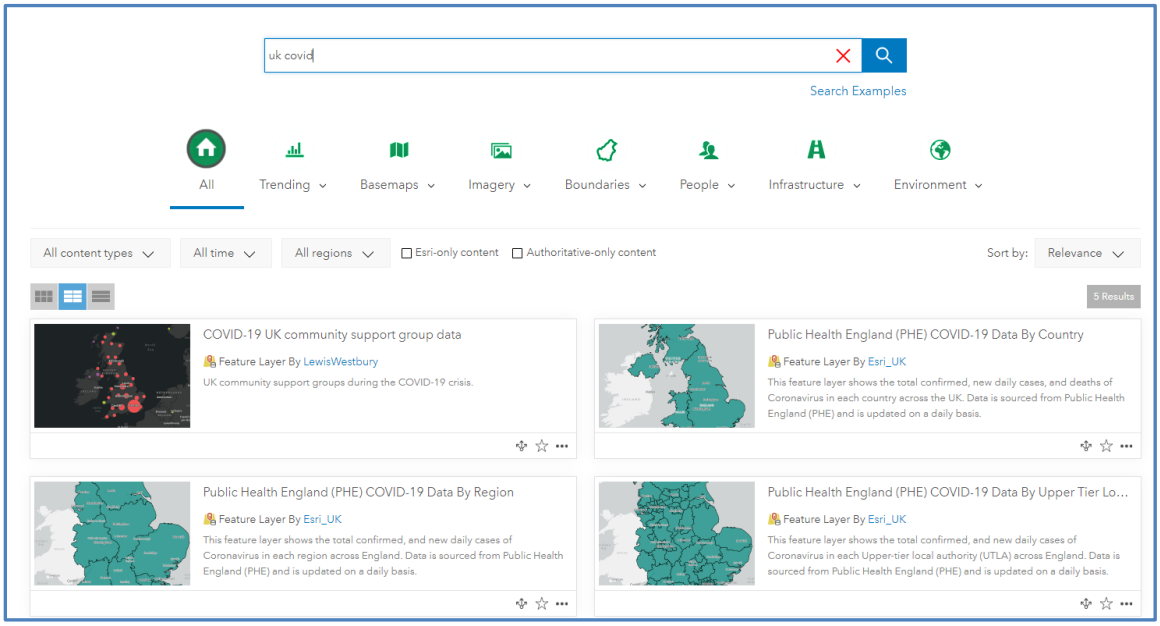
Using the **Clone Layer** tool in the MapThat Admin Forms, it then took 30 more minutes to create all the COVID-19 WMS Layers – Active Cases, Active Cases per 100K, Total Deaths, Trends….



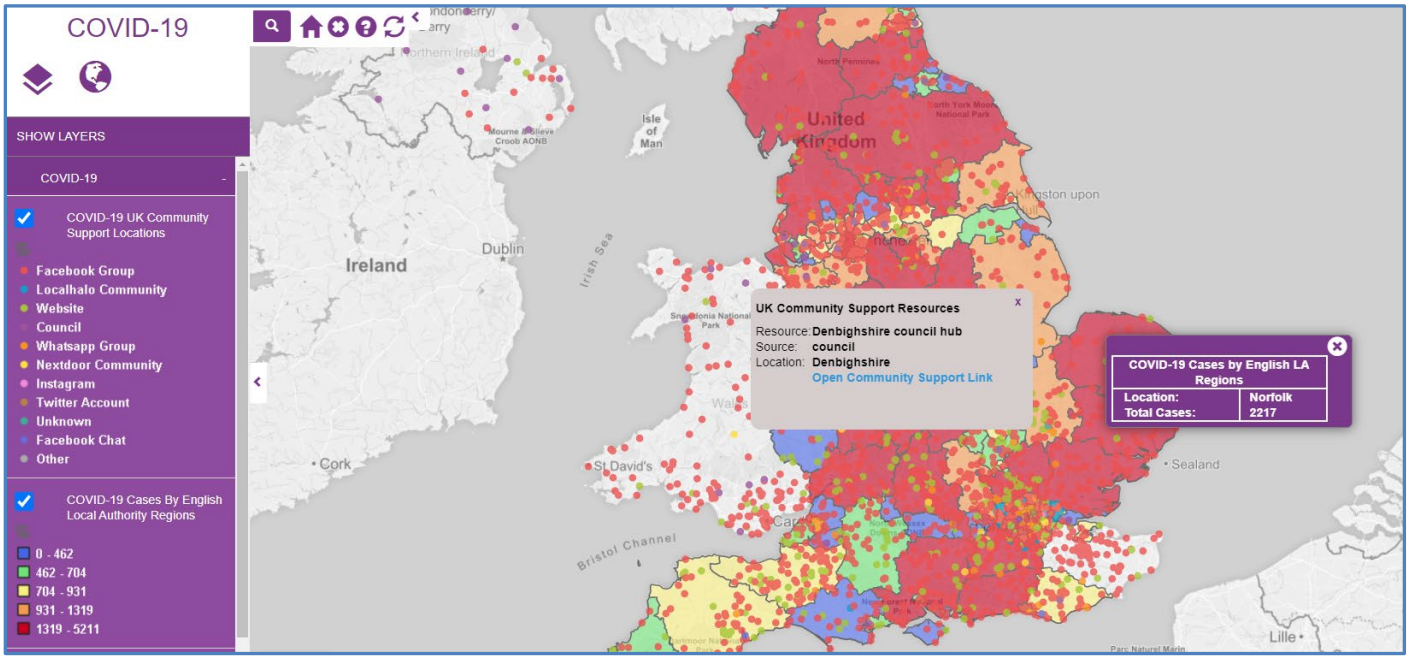
As well as using a new **Graduated Point Thematic** GeoServer WMS Layer, showing small through to large Points based on Total Death Rates.



With a little extra work, I was also able to source some **UK specific COVID-19** datasets from the ESRI Living Atlas:



.. and then download the data into QGIS, upload to my PostGIS database and Publish via GeoServer as Styled WMS layers to view in MapThat!



We now have a lightweight and very fast MapThat Project, which consumes fast rendering WMS Layers and benefits from great styling options as well as allowing Users to interrogate the attributes within these COVID-19 datasets.

Why don't you try the MapThat COVID-19 Web Map from this link – [COVID-19 MapThat] – and view the different COVID-19 Incident Layers to spot trends and identify those areas that are most affected.