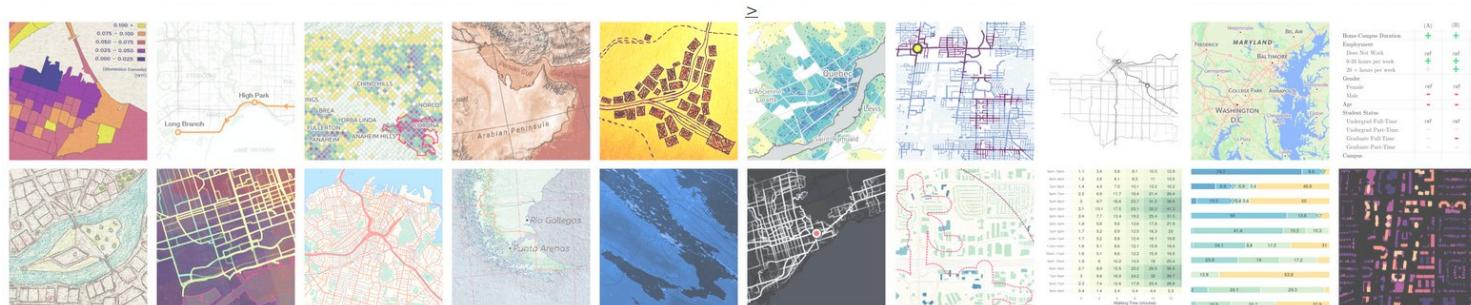


Maps & Geospatial Data Visualization

Jeff Allen, PhD - School of Cities, University of Toronto

Workshop Slides & Data: <https://github.com/schoolofcities/utif-workshops-2025>
 (Click 'Code', then 'Download ZIP')





Introductions! :)

Goals

- Learn theory and good practice for visualizing geospatial data
- Apply these in QGIS learning how to make a variety of types of maps
- Thinking about how this knowledge and skills can be applied to your own project

Agenda

Today

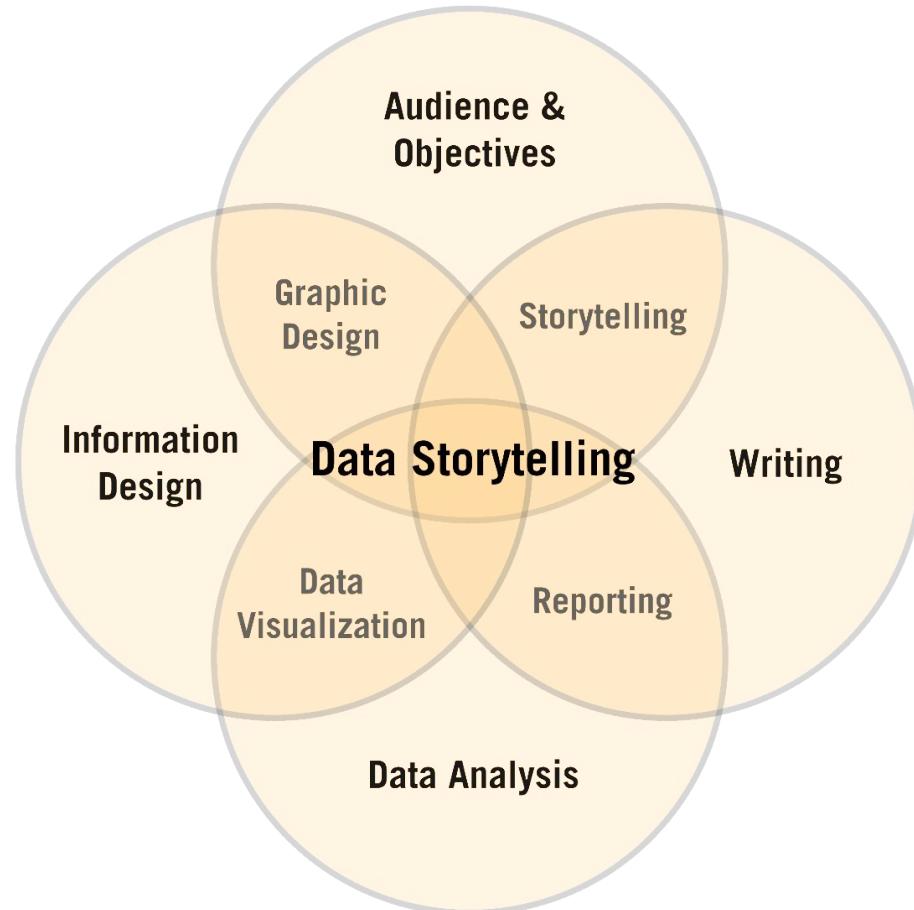
- Mix of short presentations and discussion on the why and how of visualizing spatial data
- Several tutorials about creating a variety of different types of maps

Tomorrow morning

- Any overflow from today
- Create one or more maps using your own data and present back to group for feedback/discussion

Why Visualize Your Data?

- Data Analysis
- Communicate
- Tell Stories
- Advocacy



Why Visualize?

Data Analysis

x	y
55.3846	97.1795
51.5385	96.0256
46.1538	94.4872
42.8205	91.4103
40.7692	88.3333
38.7179	84.8718
35.6410	79.8718
33.0769	77.5641
28.9744	74.4872
26.1538	71.4103
23.0769	66.4103
22.3077	61.7949
22.3077	57.1795
23.3333	52.9487
25.8974	51.0256
29.4872	51.0256
32.8205	51.0256
35.3846	51.4103
40.2564	51.4103
44.1026	52.9487
46.6667	54.1026
50.0000	55.2564
53.0769	55.6410



X Mean: 54.26

Y Mean: 47.83

X SD : 16.76

Y SD : 26.93

Corr. : -0.06

Why Visualize?

Data Analysis

e.g. The Datasaurus:

x	y
55.3846	97.1795
51.5385	96.0256
46.1538	94.4872
42.8205	91.4103
40.7692	88.3333
38.7179	84.8718
35.6410	79.8718
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28.9744	74.4872
26.1538	71.4103
23.0769	66.4103
22.3077	61.7949
22.3077	57.1795
23.3333	52.9487
25.8974	51.0256
29.4872	51.0256
32.8205	51.0256
35.3846	51.4103
40.2564	51.4103
44.1026	52.9487
46.6667	54.1026
50.0000	55.2564
53.0769	55.6410



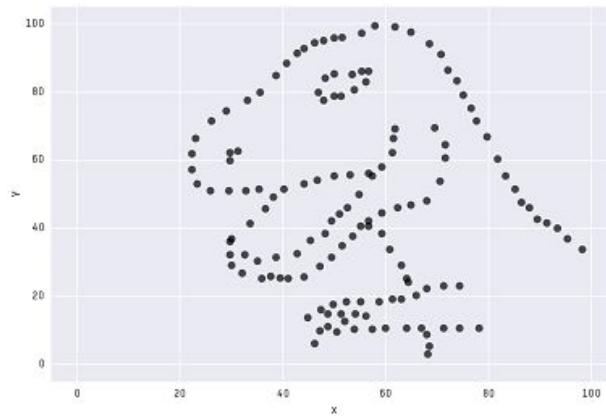
X Mean: 54.26

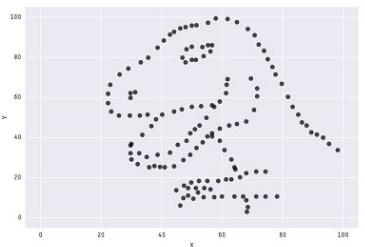
Y Mean: 47.83

X SD : 16.76

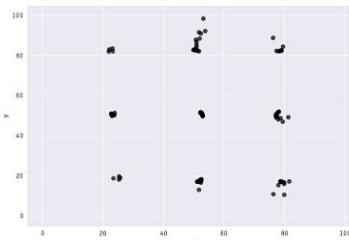
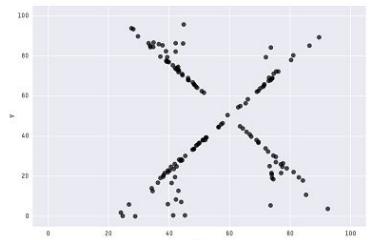
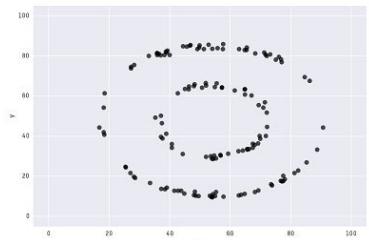
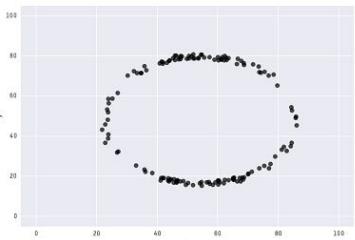
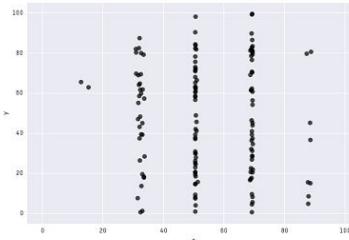
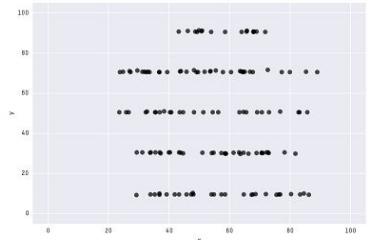
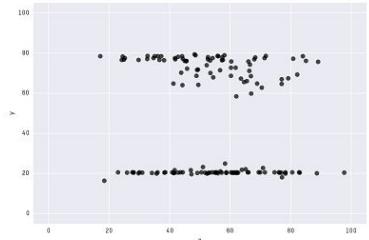
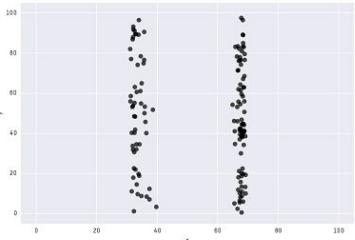
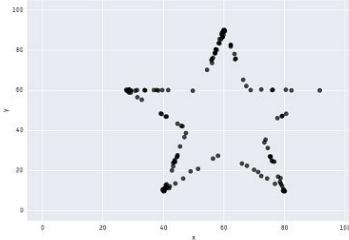
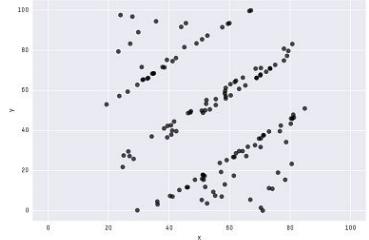
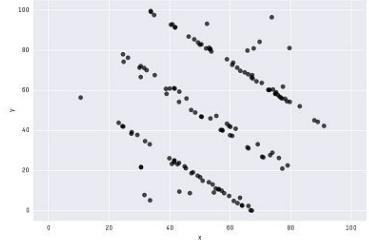
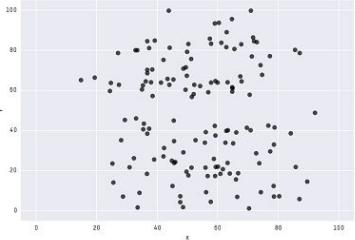
Y SD : 26.93

Corr. : -0.06





X Mean: 54.26
Y Mean: 47.83
X SD : 16.76
Y SD : 26.93
Corr. : -0.06

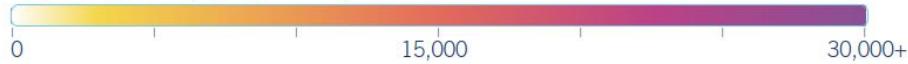


Why Visualize?

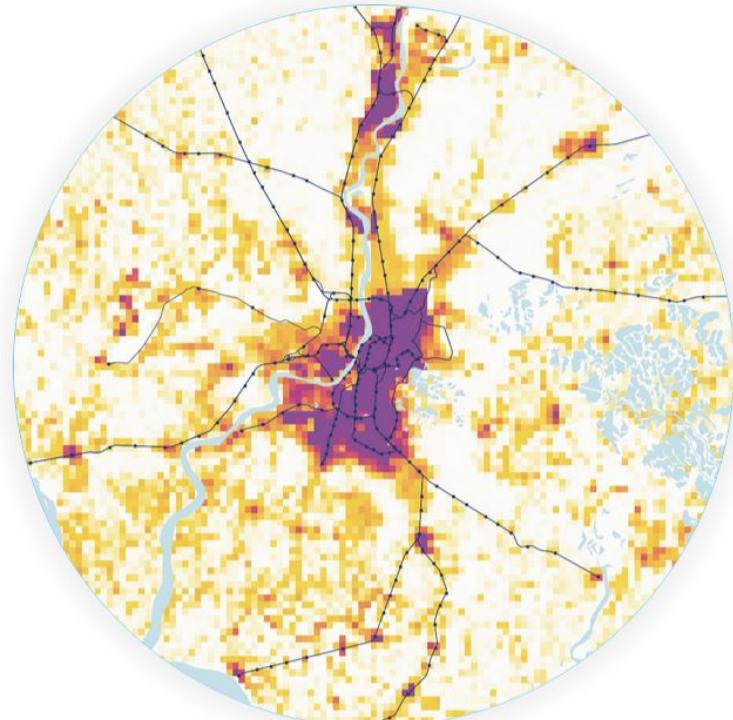
Data Analysis

Rail transit line and station —●—

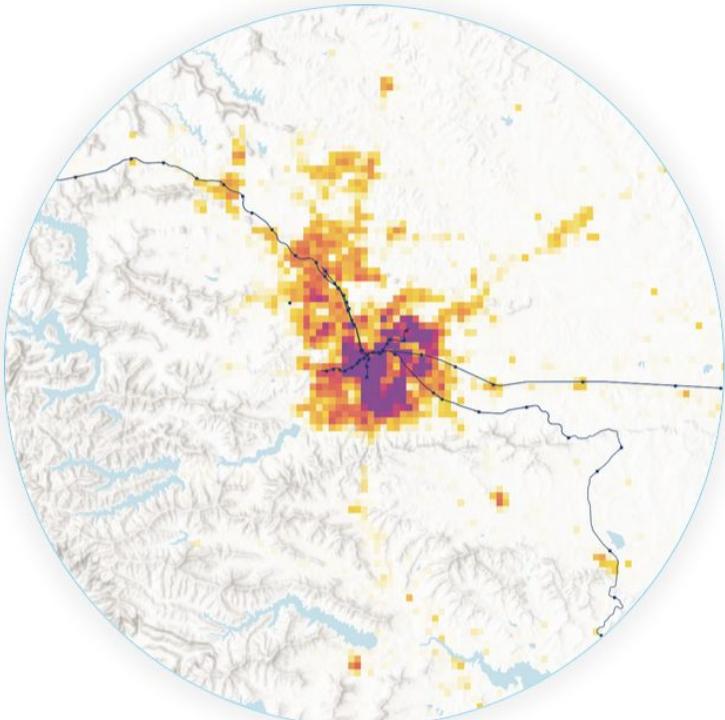
Population density (people / km²)



Kolkata



Pune



Urban Activity Atlas

Julia Greenberg, Aniket Kali, Jeff Allen, Karen Chapple

Use this tool to explore human activity levels in the 300 largest metropolitan regions in the US and Canada.

Toronto, ON

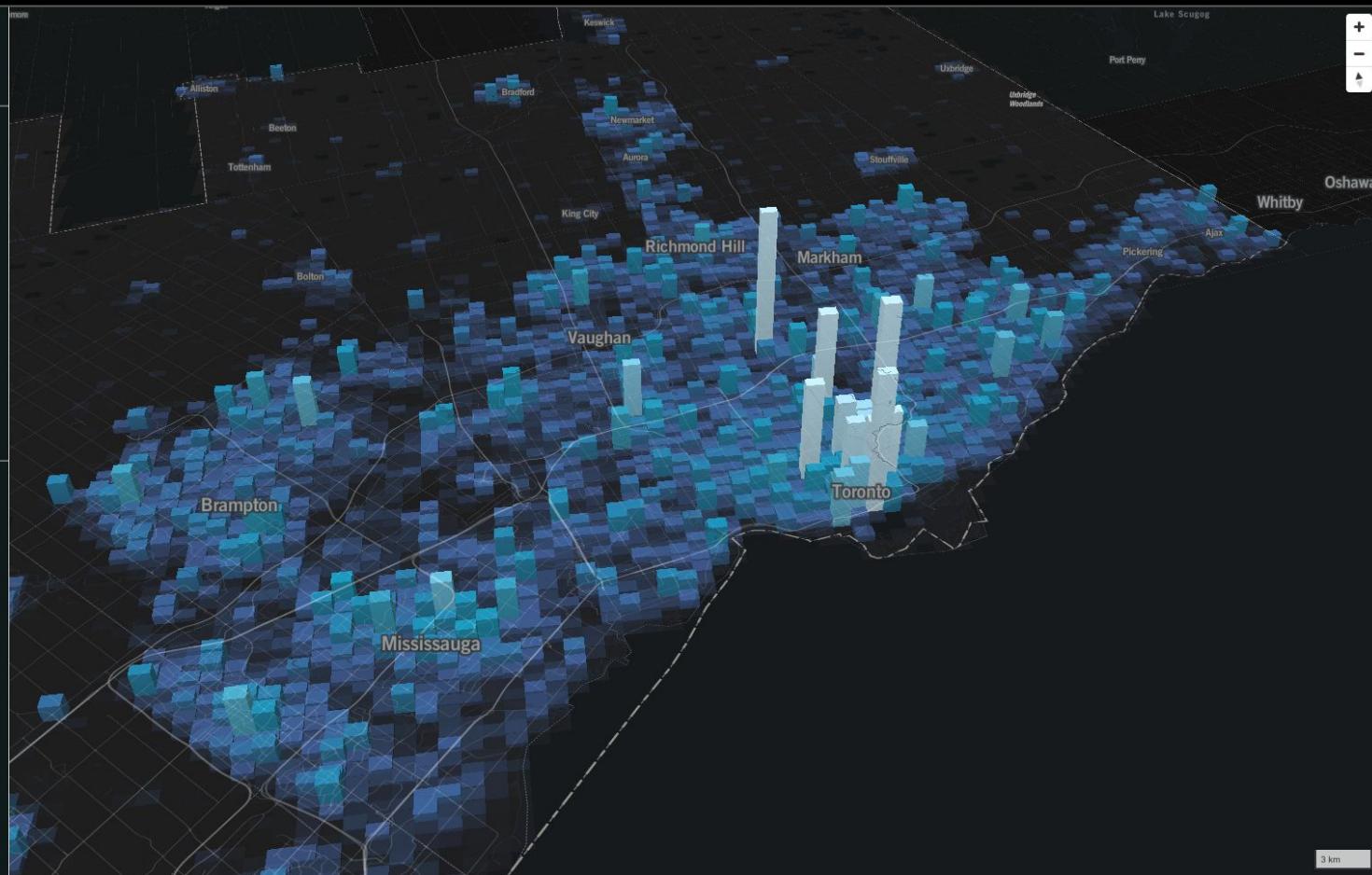
The colour of the grid pertains to how many people stopped or visited for the year-long period between April 1, 2023 and March 31, 2024.

Data presented are normalized by the total activity in each metropolitan region.

Activity Level:

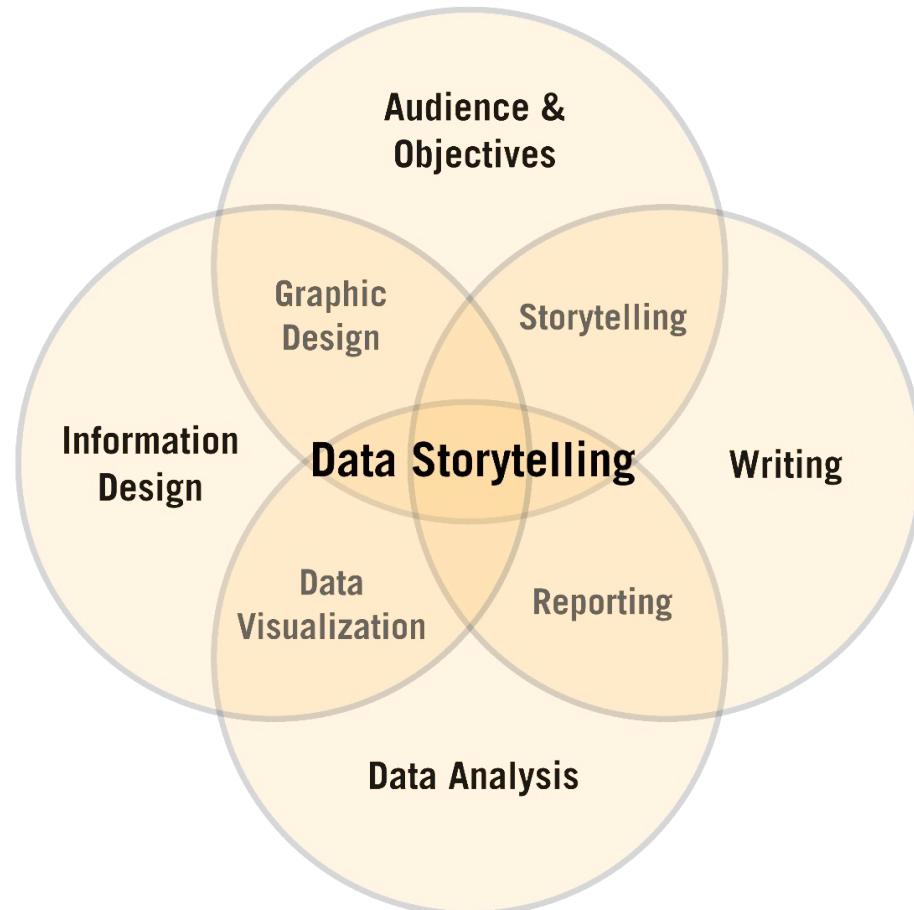


The activity data on the map is derived from a sample of mobile phone data via Spectus. Other reference data on the map are from OpenStreetMap via Protomaps. Check out our [Github](#) for more information about the data and methods.



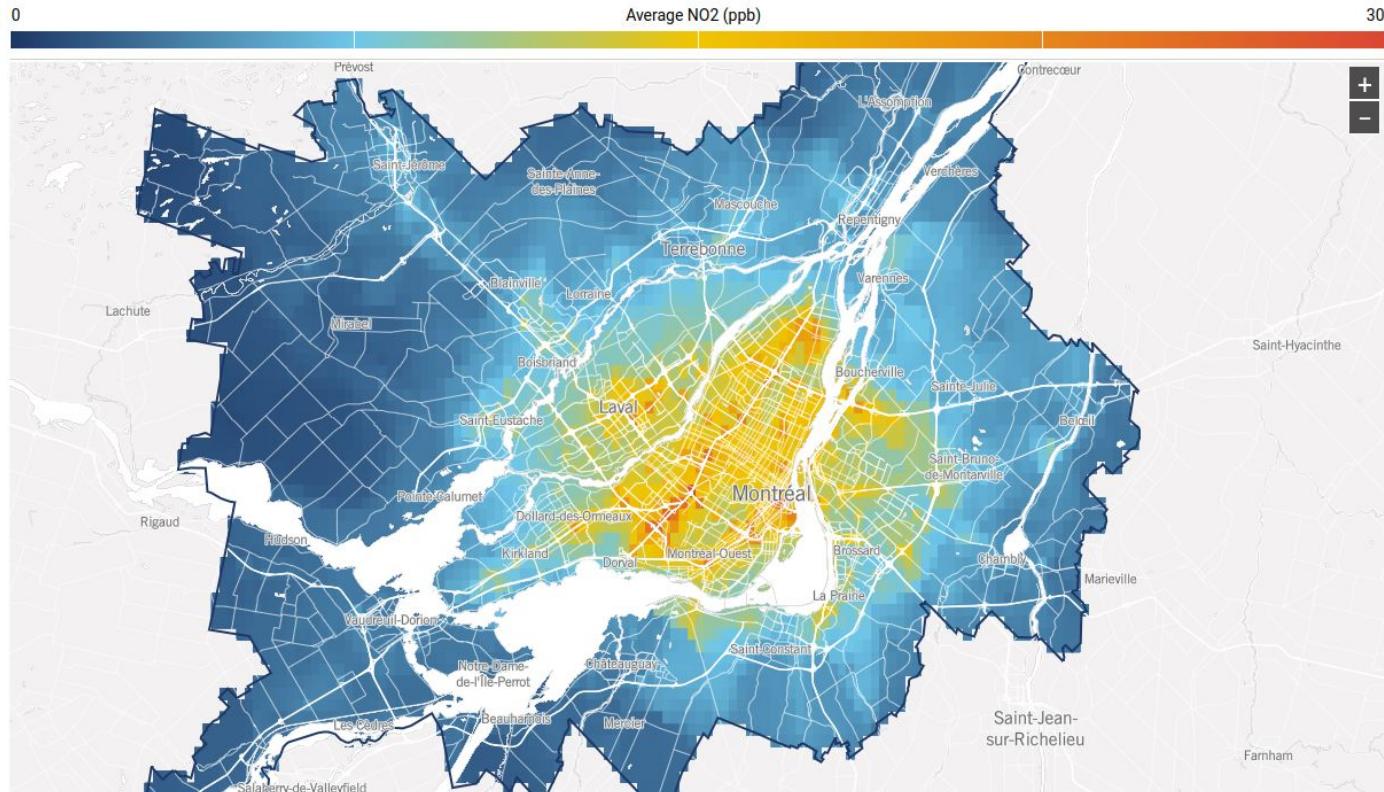
Why Visualize Your Data?

- Data Analysis
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- Advocacy



Why Visualize?

- Communicate
 - Tell Stories
 - Advocacy



Why Visualize?

- Communicate
- Tell Stories
- Advocacy

Total lives saved by reducing air pollution

Summed for 31 Census Metropolitan Areas (CMAs) in Canada

Lives saved by reducing air pollutant levels to air quality standard targets

930

Lives saved with a 10% reduction + capping at the ambient air quality standards

2,145

Lives saved with a 25% reduction + capping at the ambient air quality standards

3,953

Lives saved with a 50% reduction + capping at the ambient air quality standards

6,545

Select Air Pollutants

PM2.5 and NO₂

Select Sex

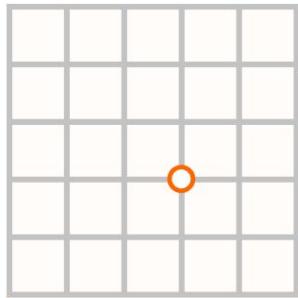
All

Spatial Data

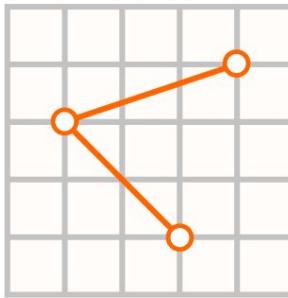
City	Country	Latitude	Longitude
Athens	Greece	37.967	23.717
Paris	France	48.857	2.351
St. Louis	United States	38.627	-90.198
London	England	51.507	-0.123
Stockholm	Sweden	59.329	18.068
Antwerp	Belgium	51.217	4.400
Amsterdam	Netherlands	52.367	4.900
Los Angeles	United States	34.050	-118.250
Berlin	Germany	52.517	13.383
Helsinki	Finland	60.171	24.938
Melbourne	Australia	-37.814	144.963
Rome	Italy	41.900	12.500
Tokyo	Japan	35.683	139.683
Mexico City	Mexico	19.433	-99.133
Munich	West Germany	48.133	11.567
Montreal	Canada	45.502	-73.567
Moscow	USSR	55.750	37.615
Seoul	South Korea	37.567	126.967



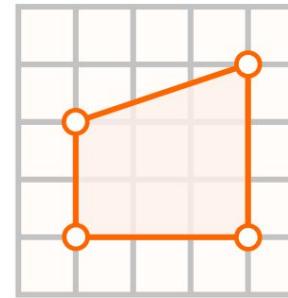
Spatial Data



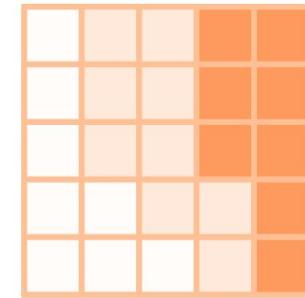
Point



Line



Polygon



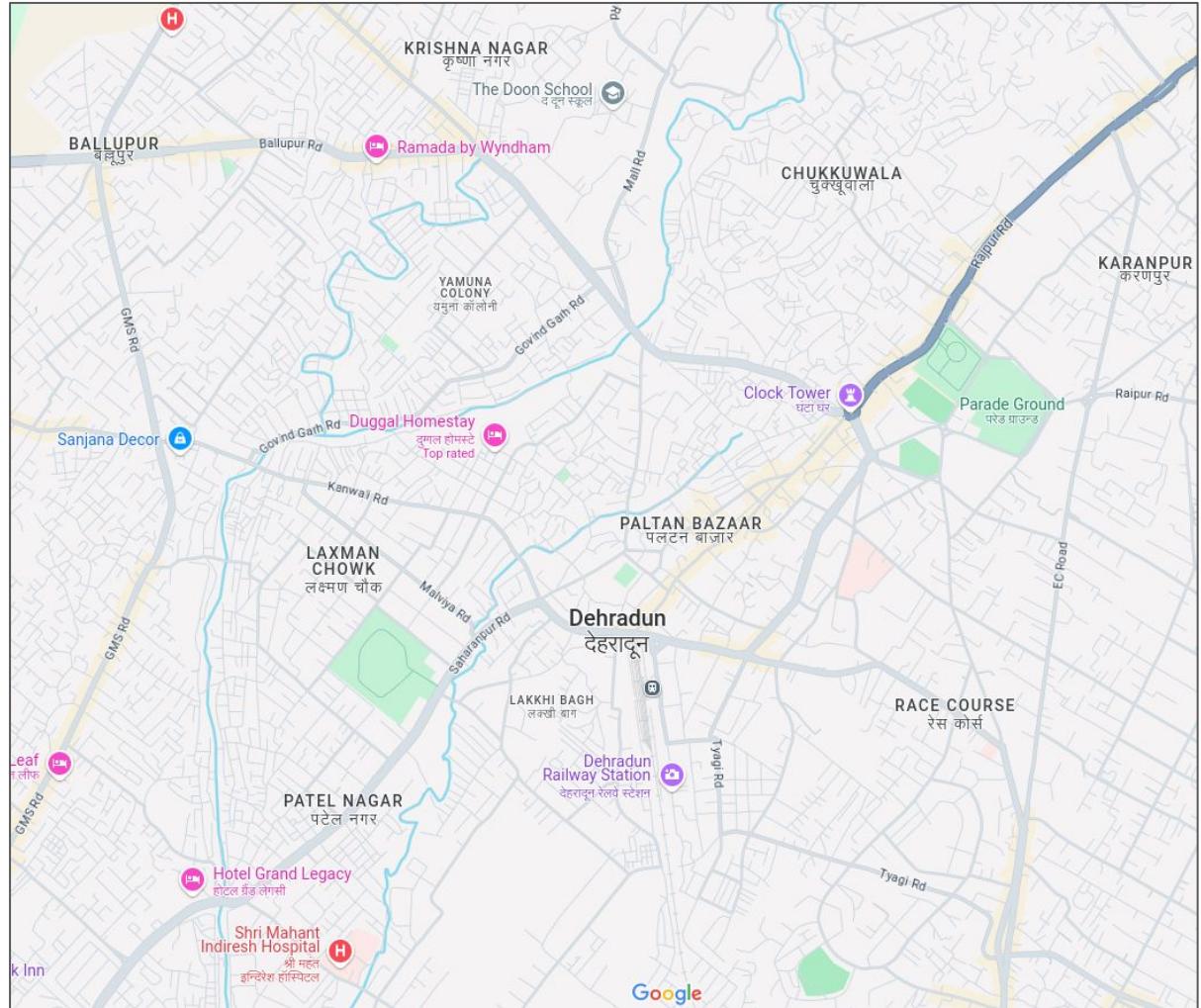
Raster

Vector



Spatial data are abstractions of reality

Creating maps/viz is a process of selecting and generalizing and visualizing spatial data



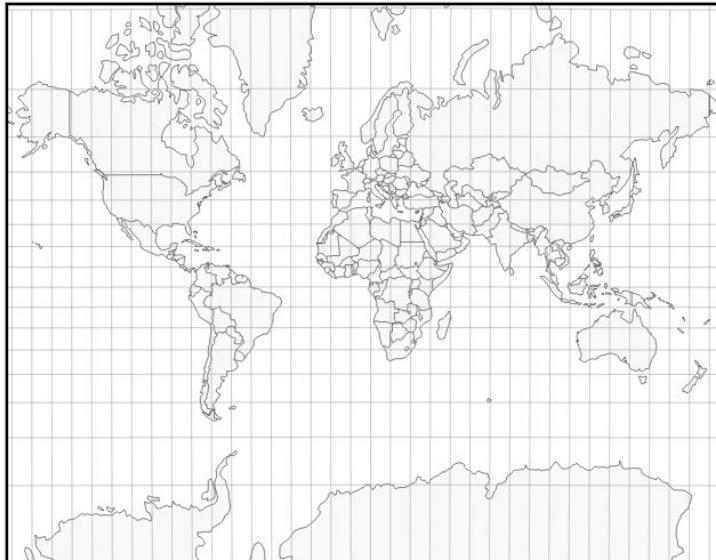
Spatial Data Formats

- GeoJSON →
 - GeoPackage
 - CSV
 - Shapefile
 - Many many more
-
- GDAL/OGR is a great tool for converting between formats: <https://gdal.org>

```
{  
  "type": "Feature",  
  "geometry": {  
    "type": "Point",  
    "coordinates": [125.6, 10.1]  
  },  
  "properties": {  
    "name": "Dinagat Islands"  
  }  
}
```

Map Projections

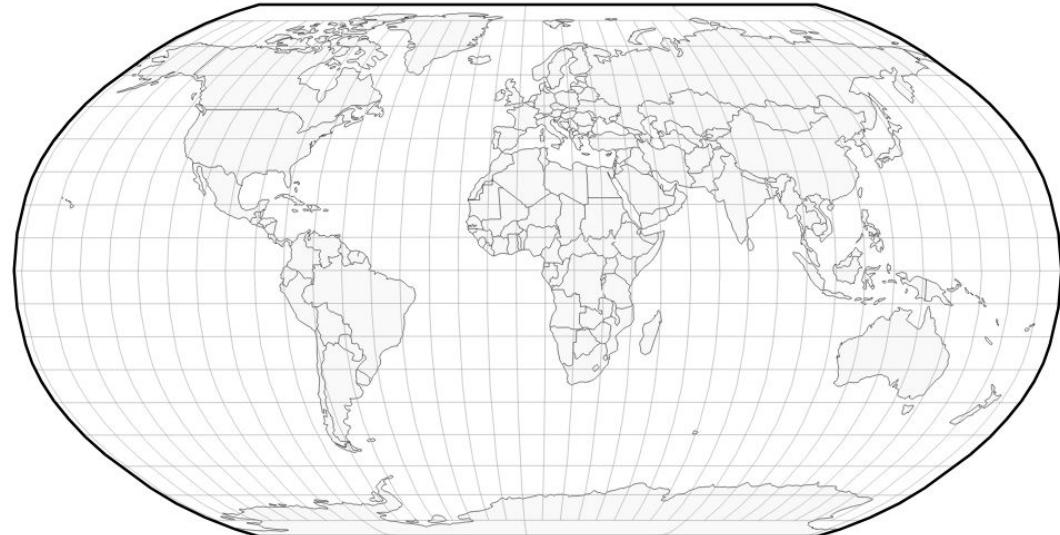
- Presenting the globe on a flat surface



Mercator



Pause



Robinson



Pause

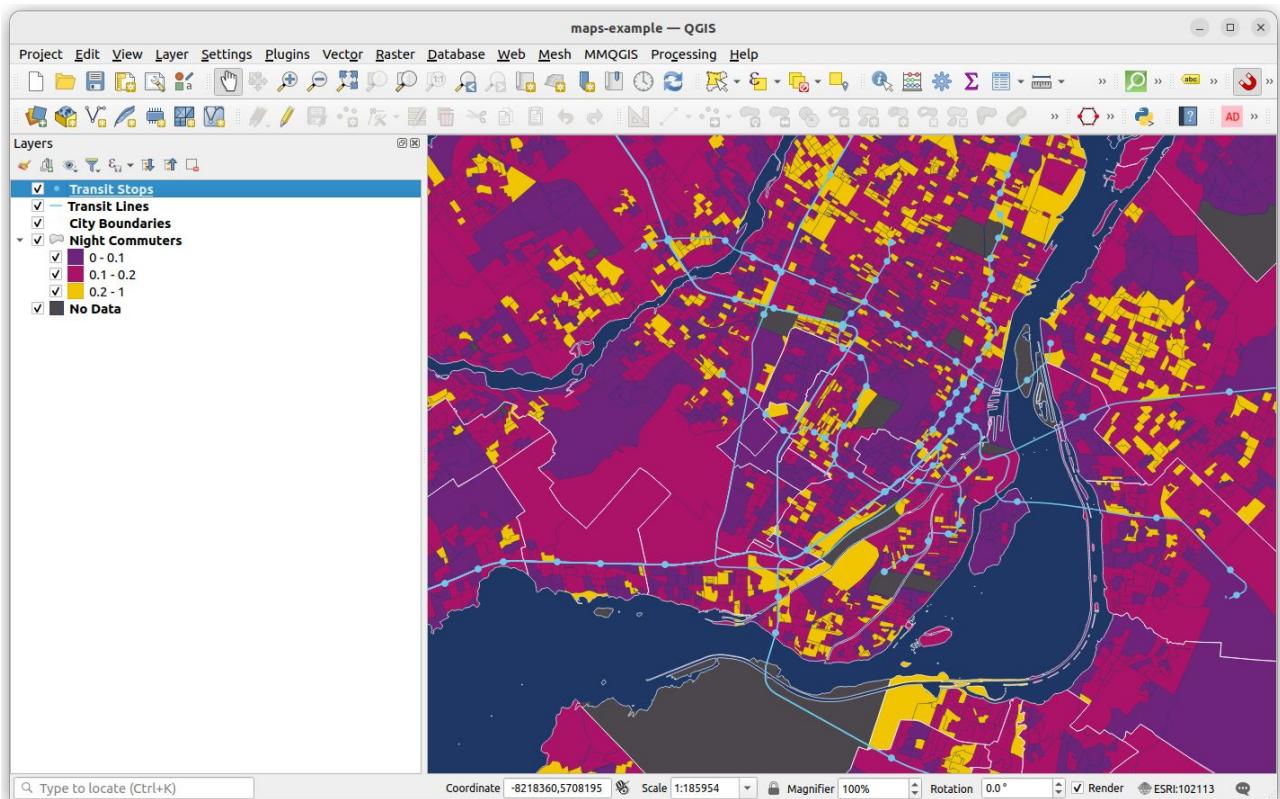
GIS (Geographic Information Systems)

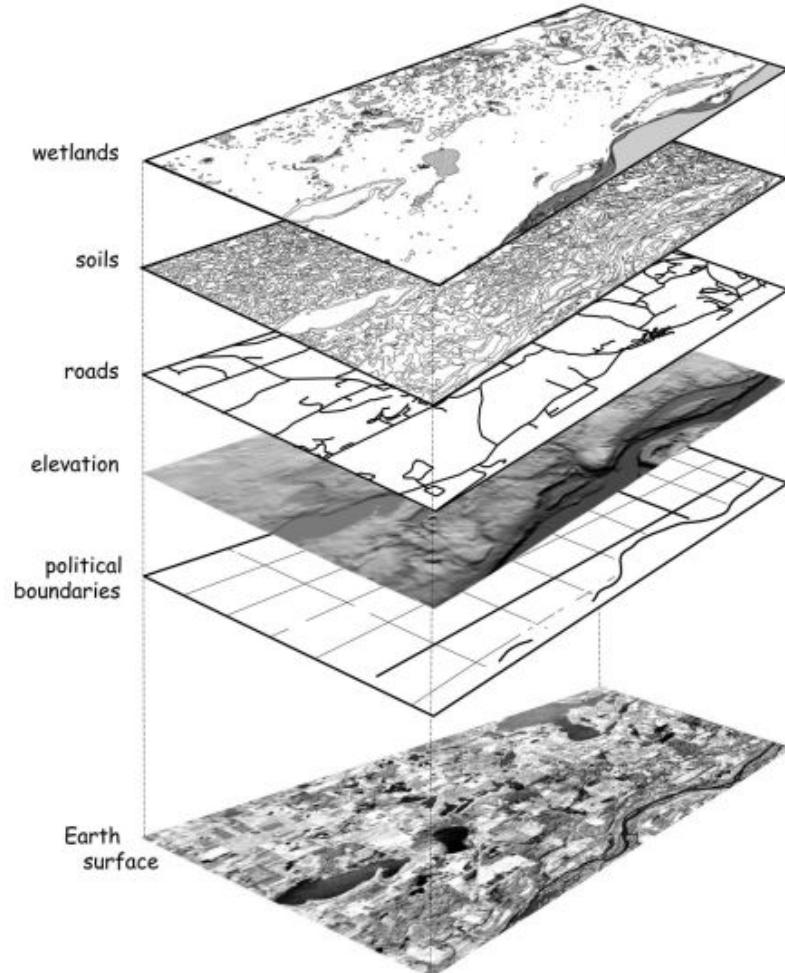
- Tools for managing, analyzing, processing, and **visualizing** spatial data

e.g. QGIS, ArcGIS

Other Options:

Python, R, SQL, JavaScript, etc.





Sources of Spatial Data

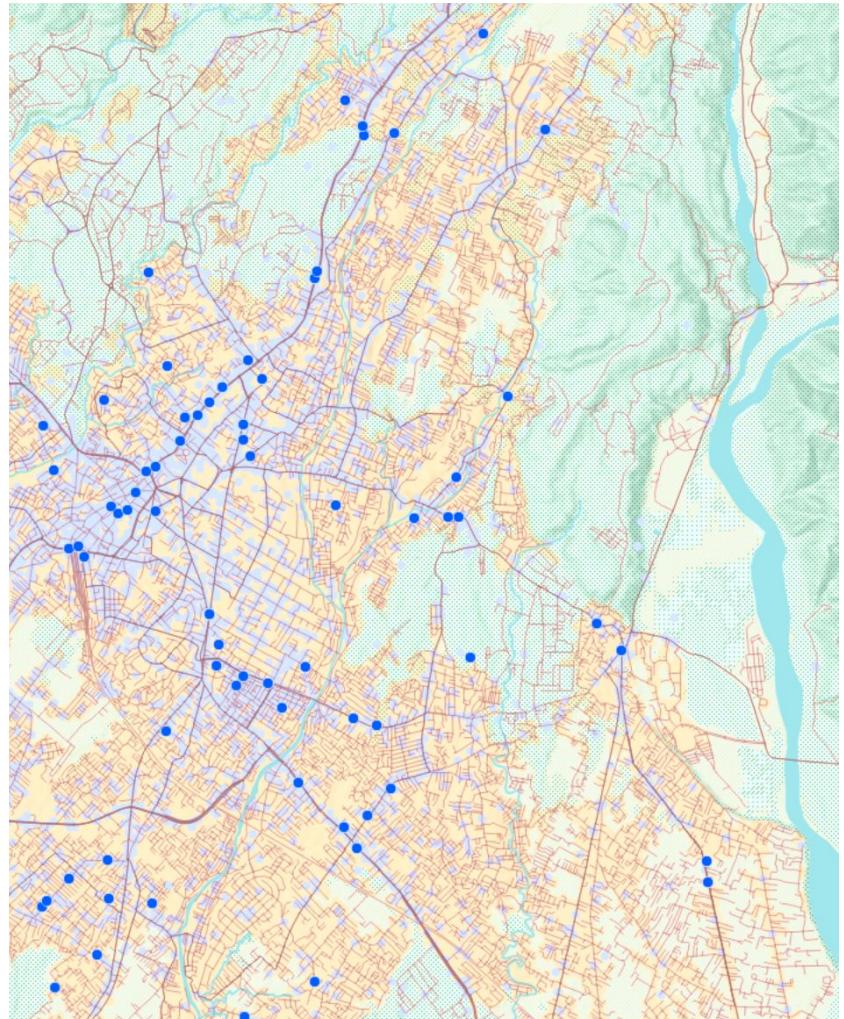
- Government / Administrative (e.g. national census, municipal data)
- Crowdsourced Data (e.g. OpenStreetMap)
- Academic Research Data
- Nonprofits / Community Organizations / Open Source
- Private Companies

OpenStreetMap (OSM)

- Crowd-sourced map data across the globe
- “Wikipedia” of map data
- <https://www.openstreetmap.org>
- Download data from
<https://overpass-turbo.eu/>

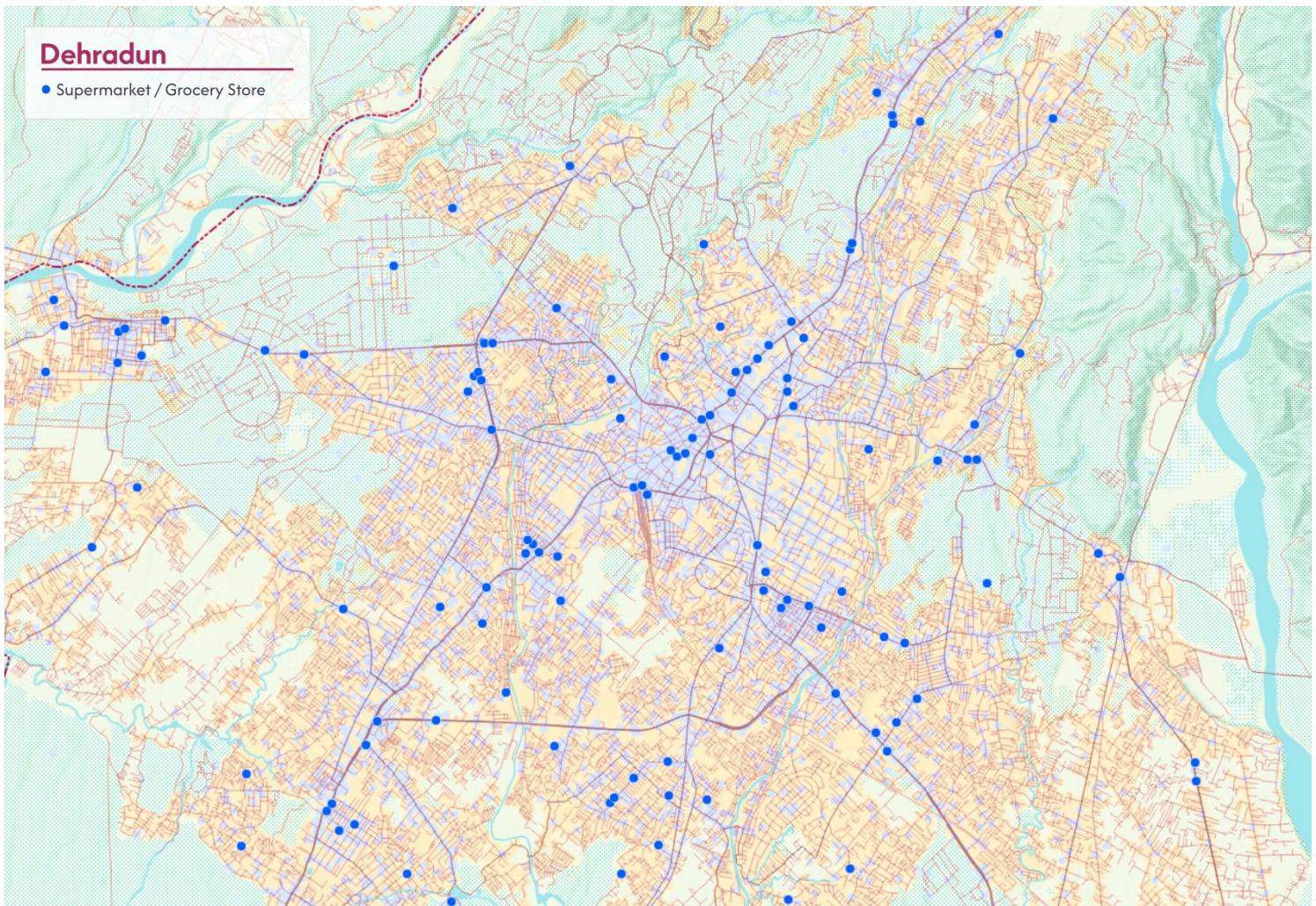
Overture Maps

- Tidy, standardized, map data across the globe
- Derived from OSM data + other sources
- <https://overturemaps.org/>



Dehradun

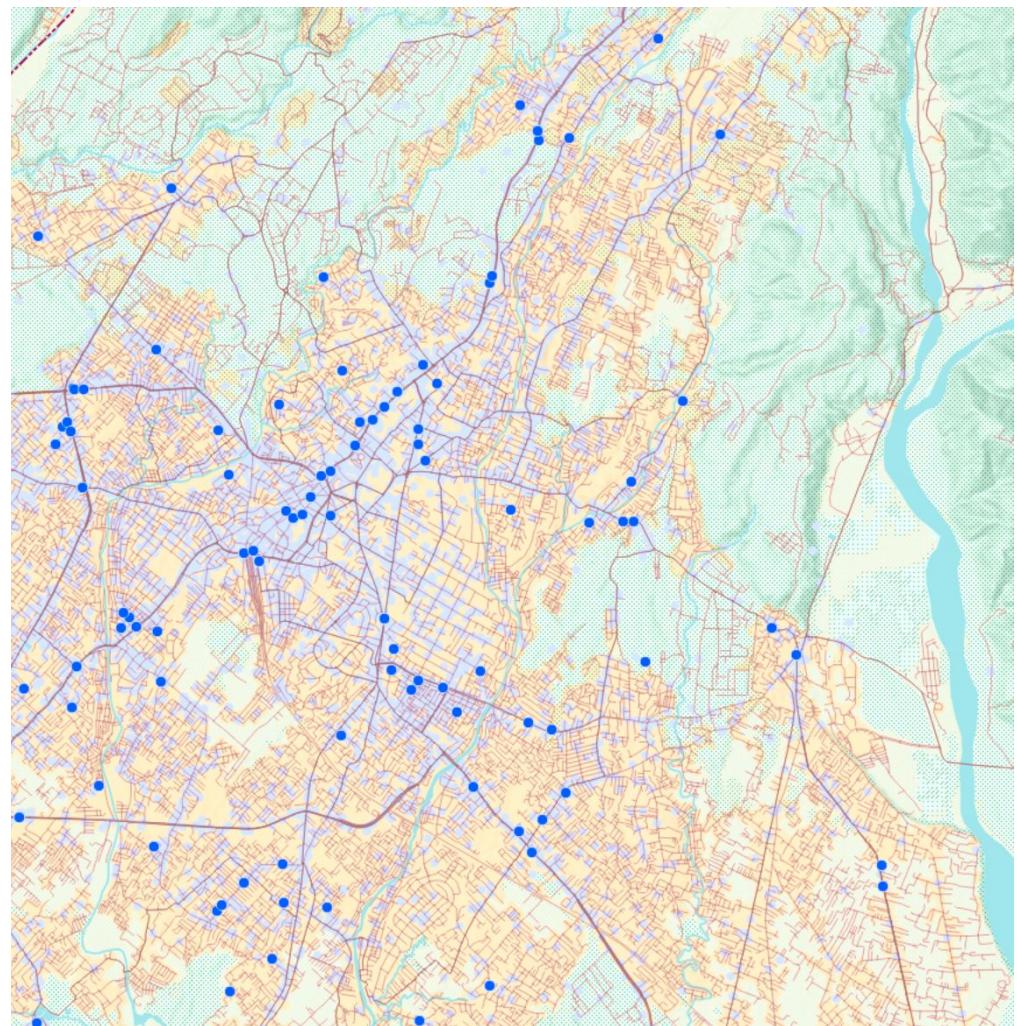
• Supermarket / Grocery Store



Map 1 - Reference Map

Objective:

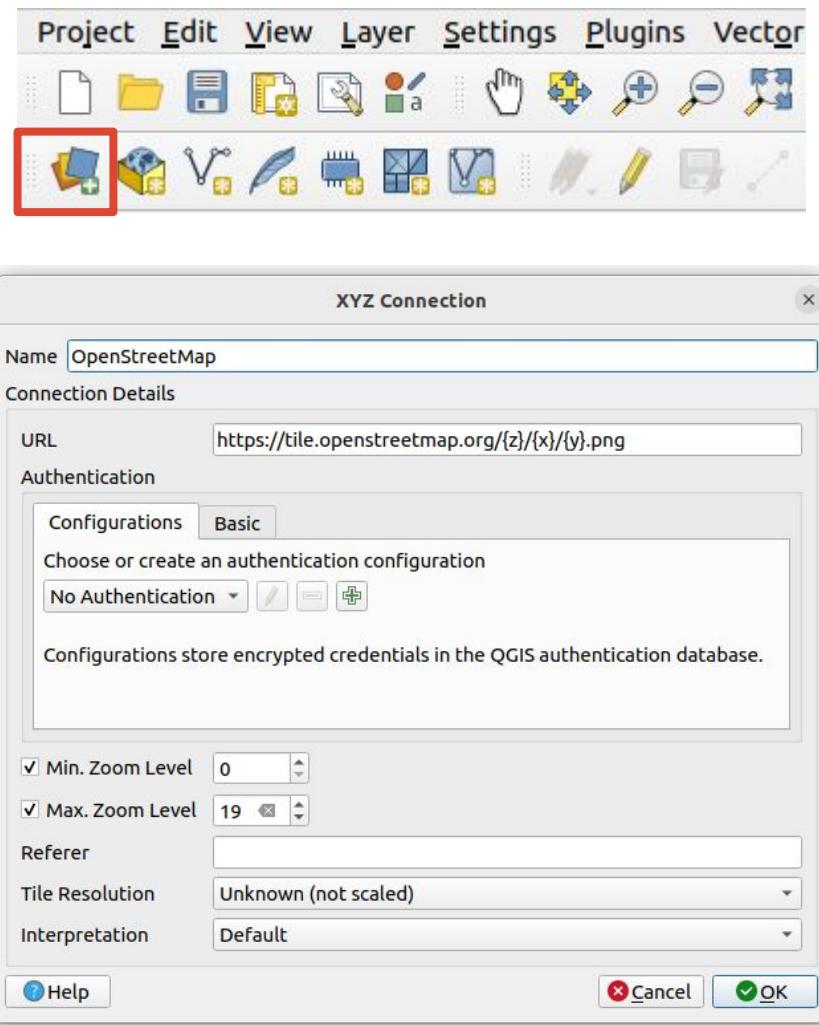
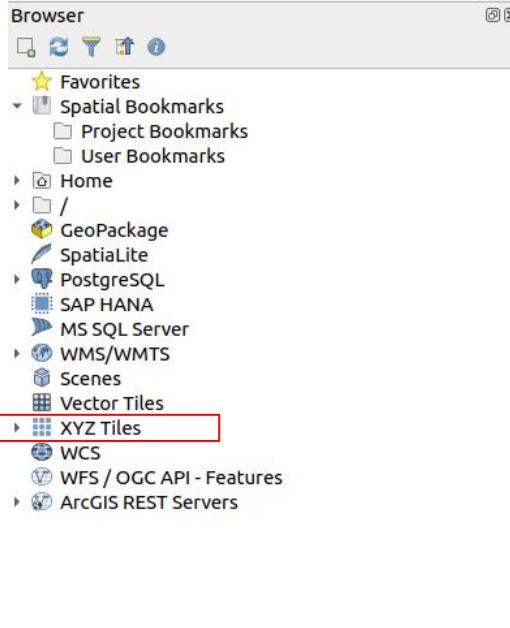
Load in raster base-map
data overlaid with Overture
Maps vector data to create
a map similar to this ..



Map 1 - Reference Map

Add OpenStreetMap raster base map

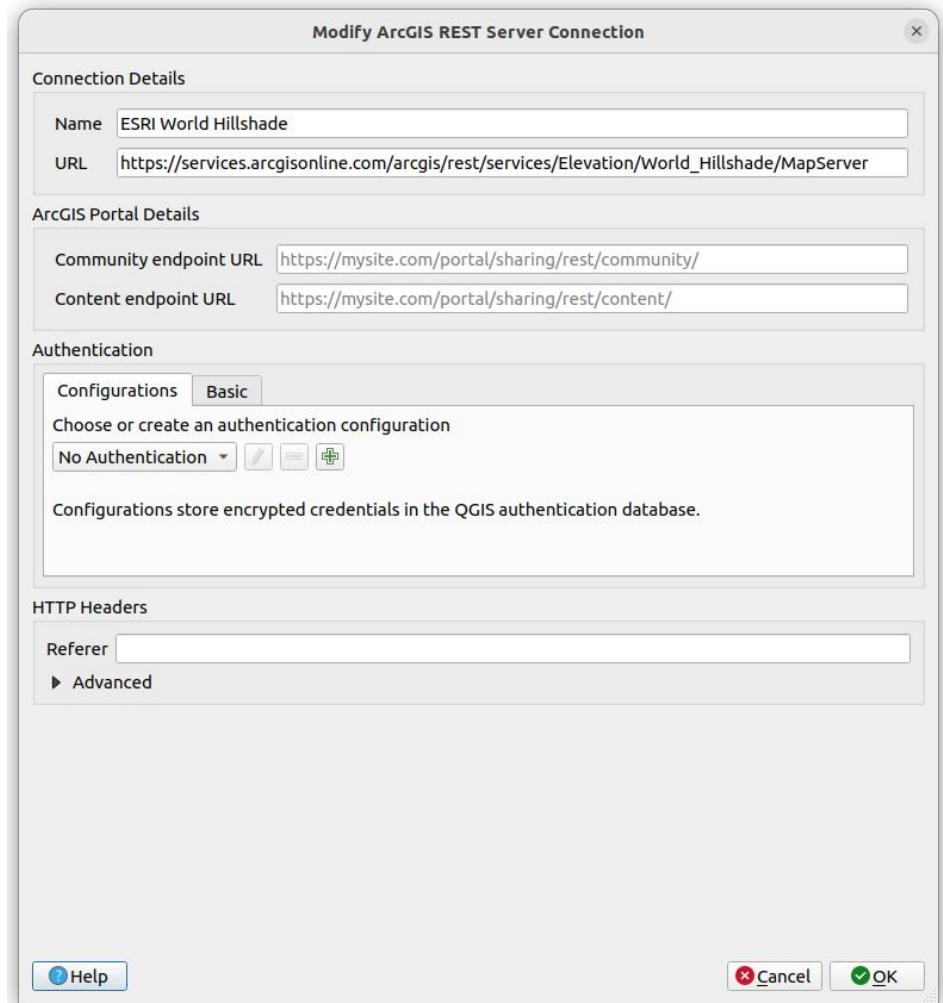
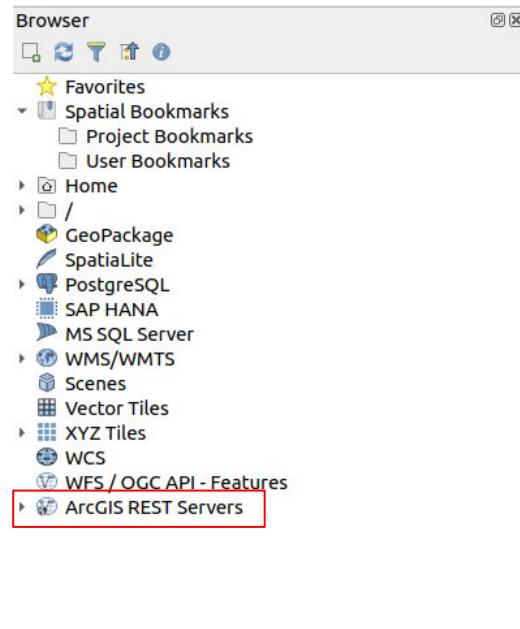
<https://tile.openstreetmap.org/{z}/{x}/{y}.png>



Map 1 - Reference Map

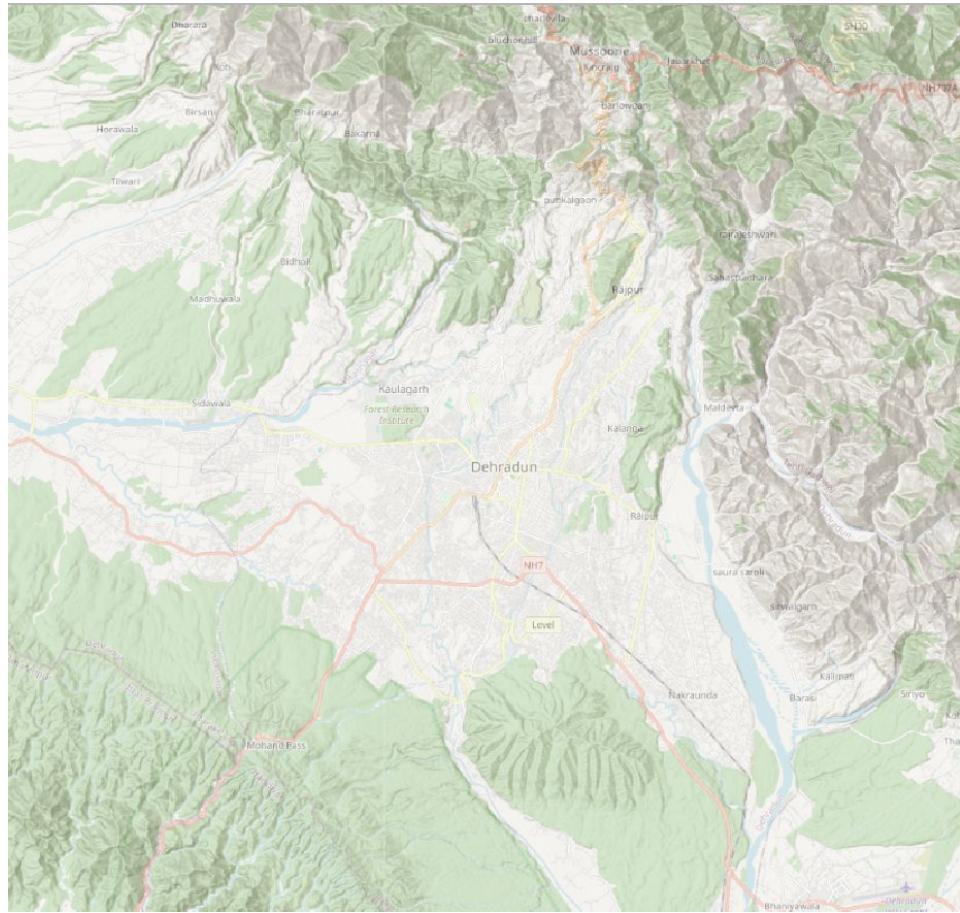
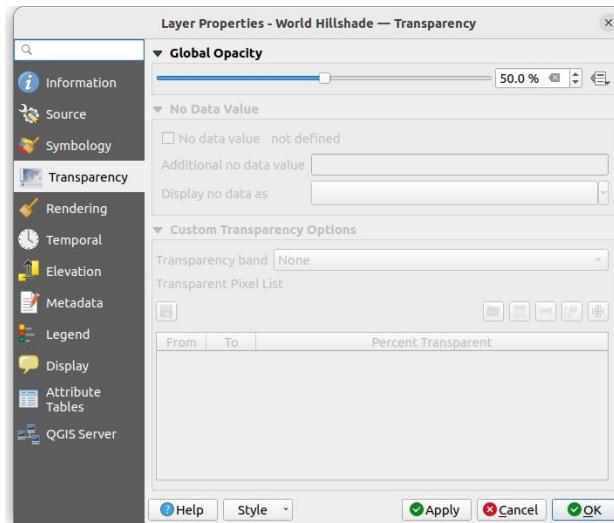
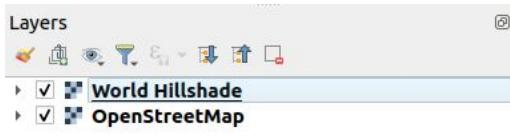
Add ESRI Hillshade Raster

https://services.arcgisonline.com/arcgis/rest/services/Elevation/World_Hillshade/MapServer

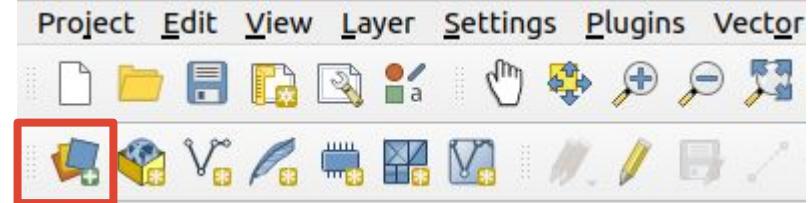


Map 1 - Reference Map

Play with order of “Layers” panel and transparency-opacity



Map 1 - Reference Map



Add in vector data

Layer	Type	File Name
Admin Boundary	Polygon	“REGION-NAME.geojson”
Transport	Lines	“overture-transport.gpkg”
Water	Polygons / Lines	“overture-water.gpkg”
Land Cover	Polygons	“overture-landcover.gpkg”
Places	Points	“overture-places.gpkg”

The image shows the QGIS layers panel on the right side of the interface. It lists several layers: 'overture-places', 'overture-transport' (which is currently selected), 'DEHRADUN', 'overture-water', 'overture-water', 'World Hillshade', and 'OpenStreetMap'. Each layer has a checkbox next to its name.

Map 1 - Reference Map

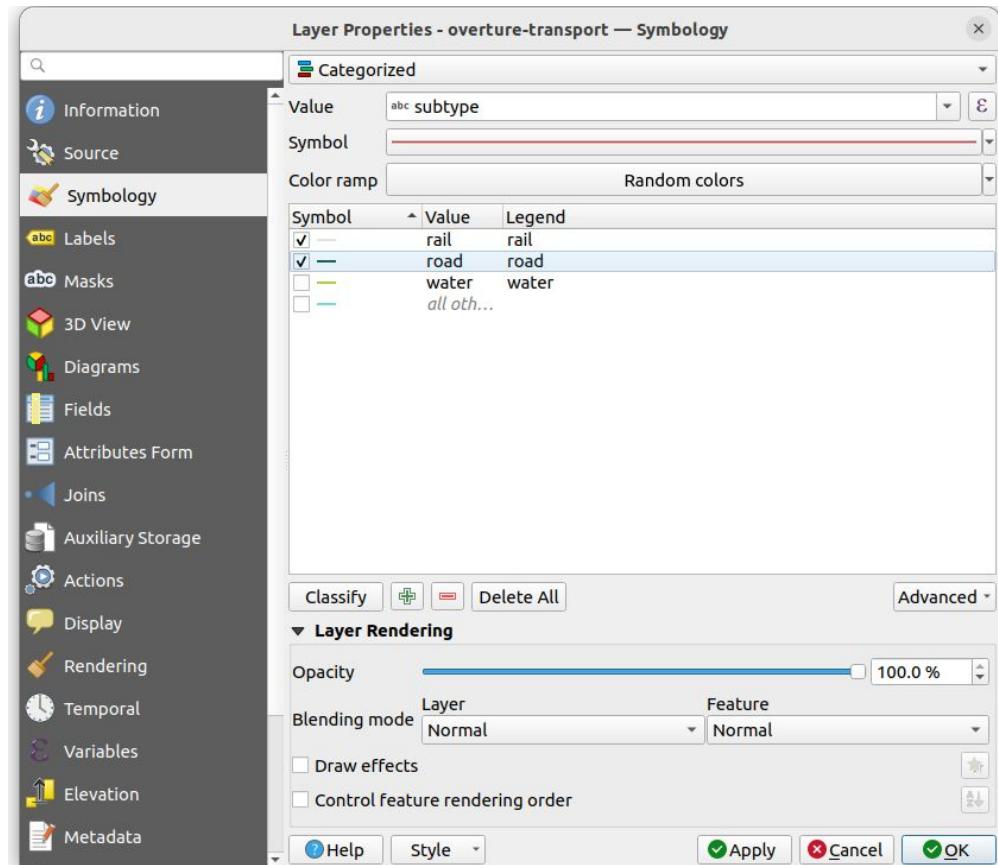
To change the styling of a layer...

Right click the layer ->

Properties ->

Symbology

Try “Single Symbol” and “Categorized”



Map 1 - Reference Map

Try filtering a data layer

Right click the layer ->

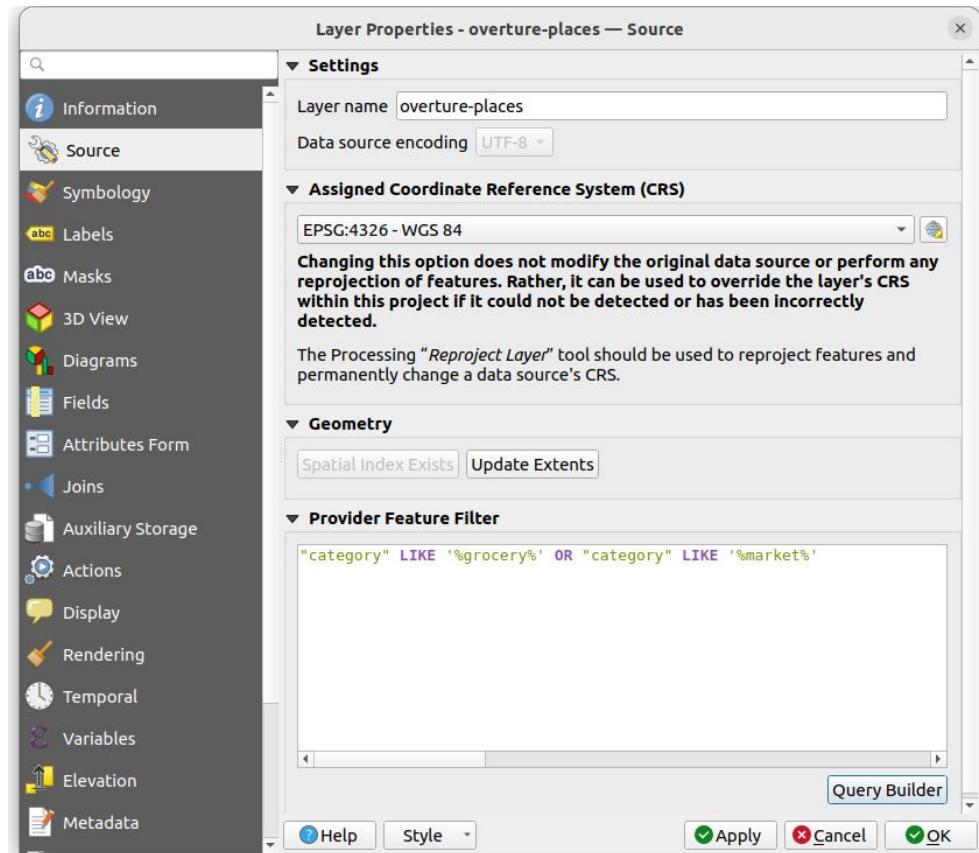
Properties ->

Sources ->

Provide Feature Filter

Uses SQL formatted queries

For example, I am trying to filter for grocery stores and supermarkets

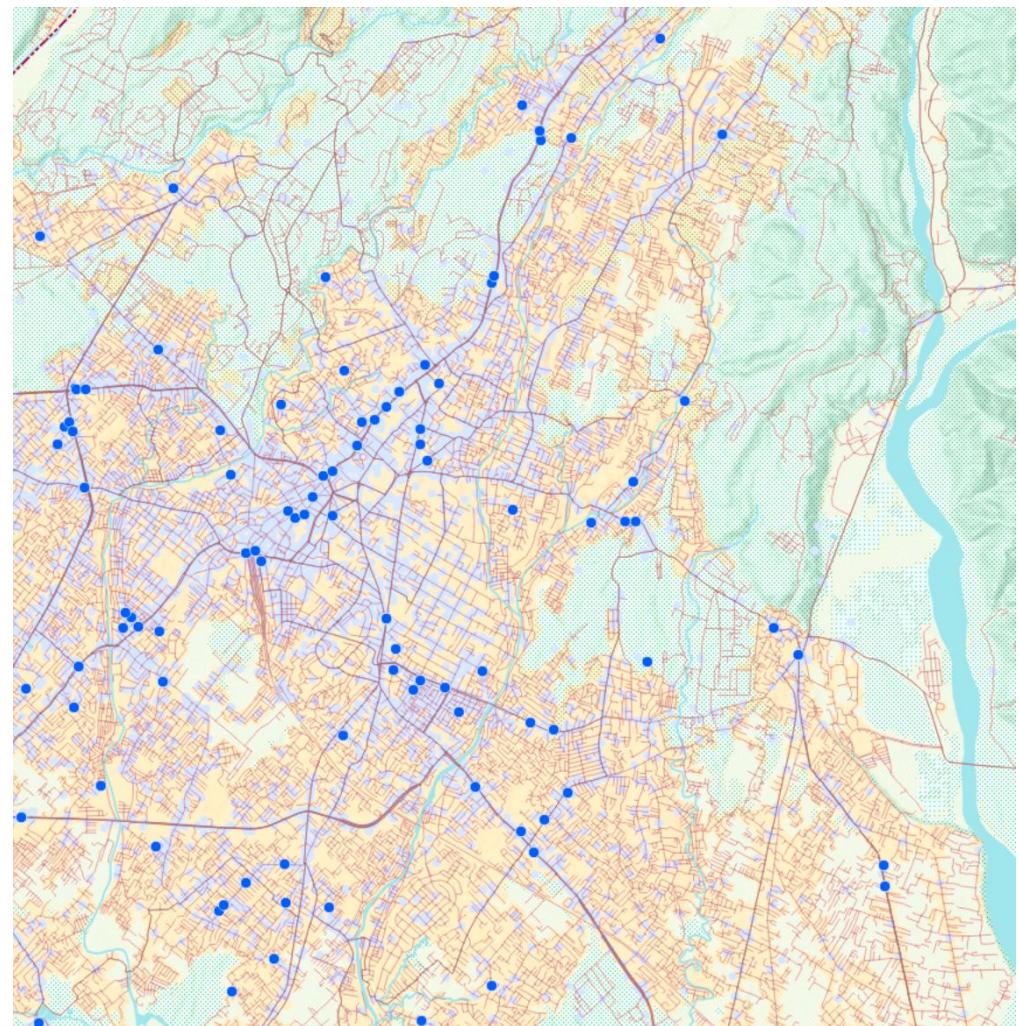


Map 1 - Reference Map

Tinker with layer order and symbology until finding something that you like!

Think about...

- how colours contrast to each other
- what layers are important for geographic reference
- which layers you want to be more prominent than others
- the zoom level and location of the map



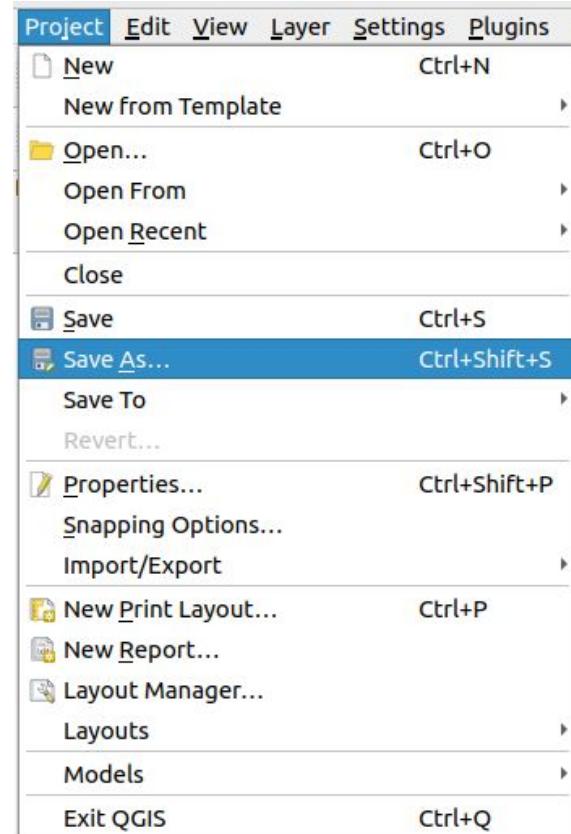
Map 1 - Reference Map

Saving your project

.qgis files save symbology, filters, layer orders, etc.

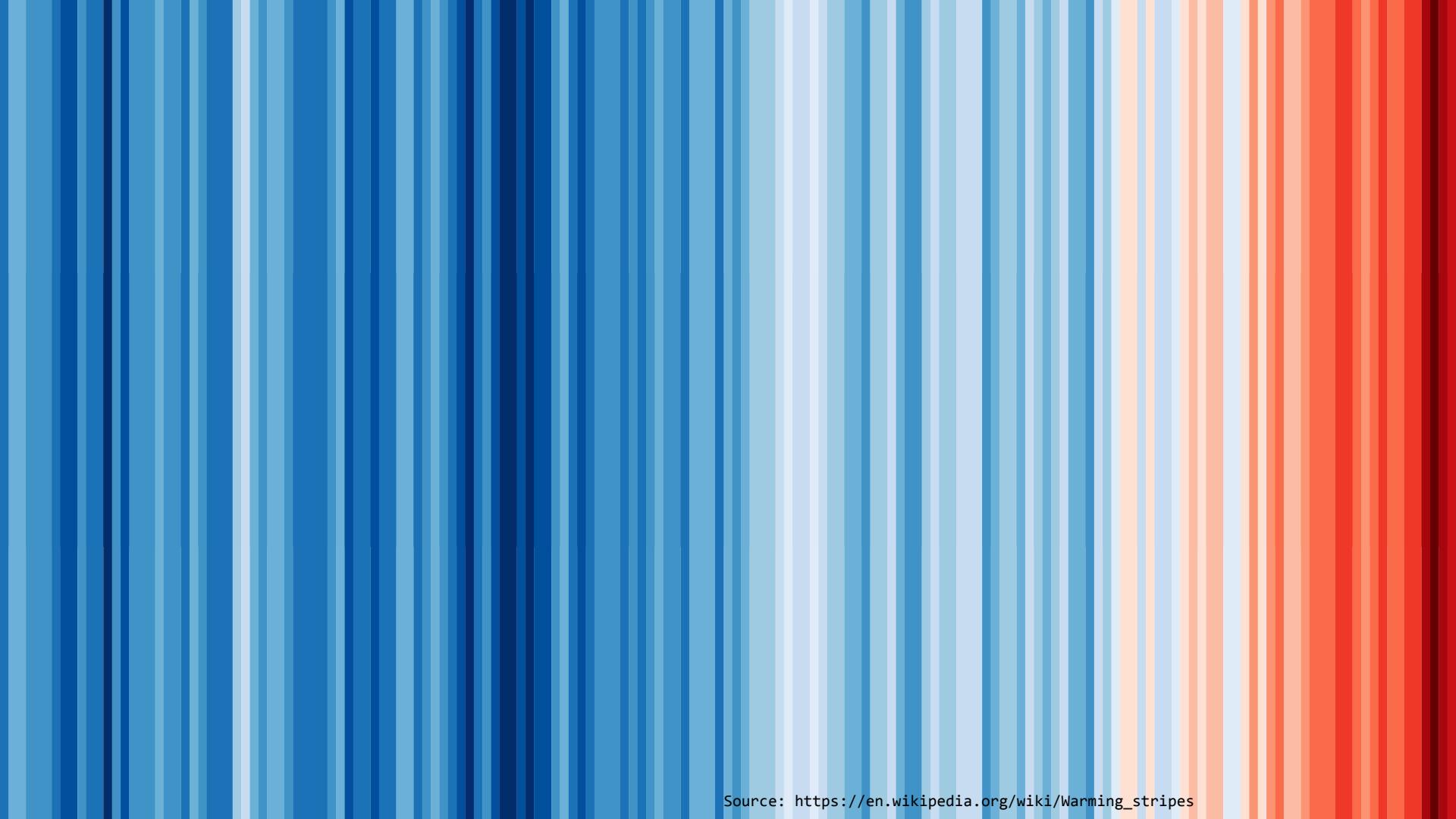
.qgis files DO NOT save data, just paths/links to where data are located

If you share your project, you'll need to also share any local datasets

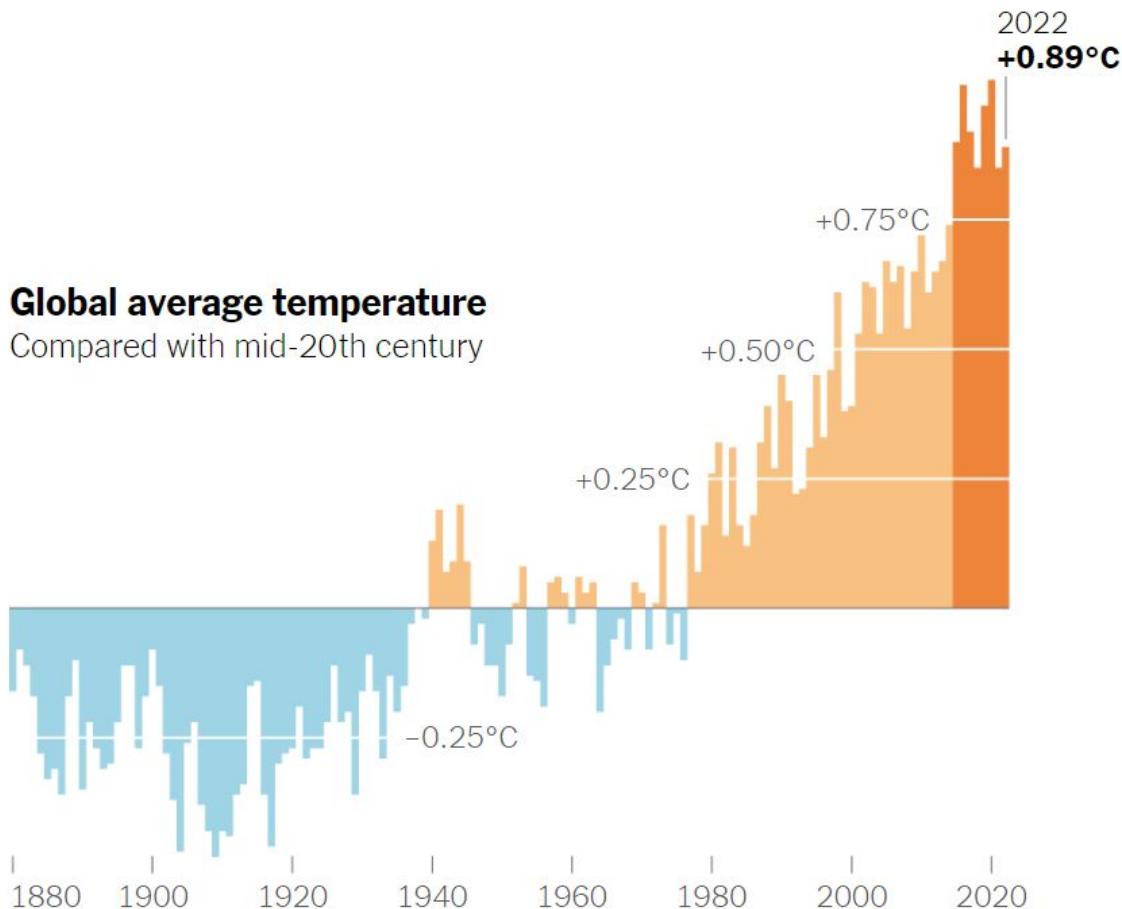


How to get help?

- Official documentation
- Stackoverflow
- Chatbots / AI



Source: https://en.wikipedia.org/wiki/Warming_stripes

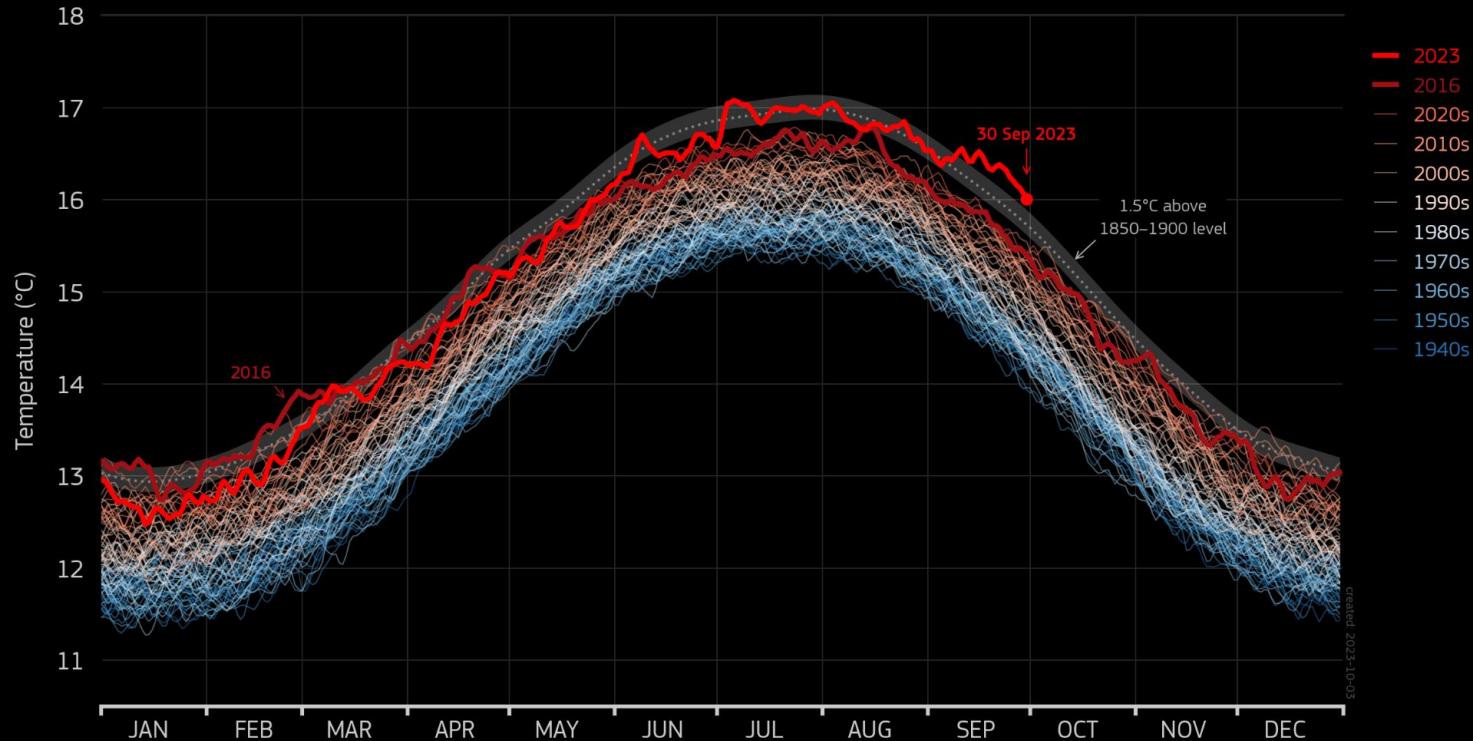


Source: NASA Goddard Institute for Space Studies

Source: <https://www.nytimes.com/2023/01/26/learning/whats-going-on-in-this-graph-feb-1-2023.html>

DAILY SURFACE AIR TEMPERATURE

Data: ERA5 1940–2023 • Credit: C3S/ECMWF



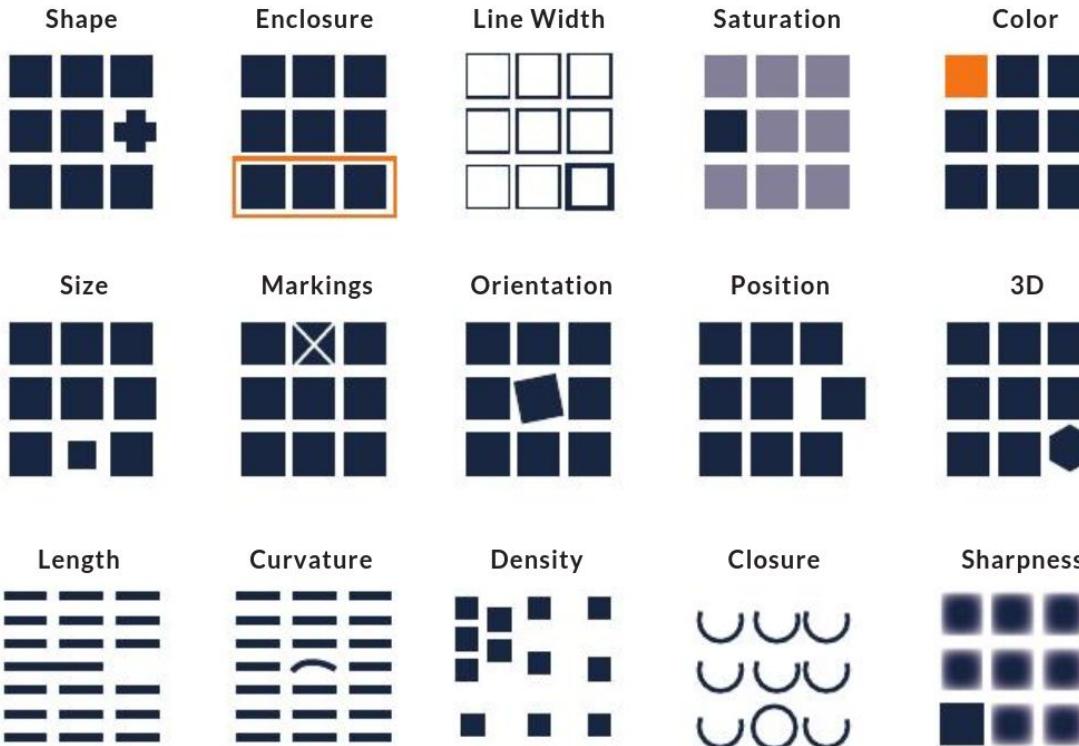
PROGRAMME OF
THE EUROPEAN UNION



IMPLEMENTED BY
ECMWF

Visual Variables

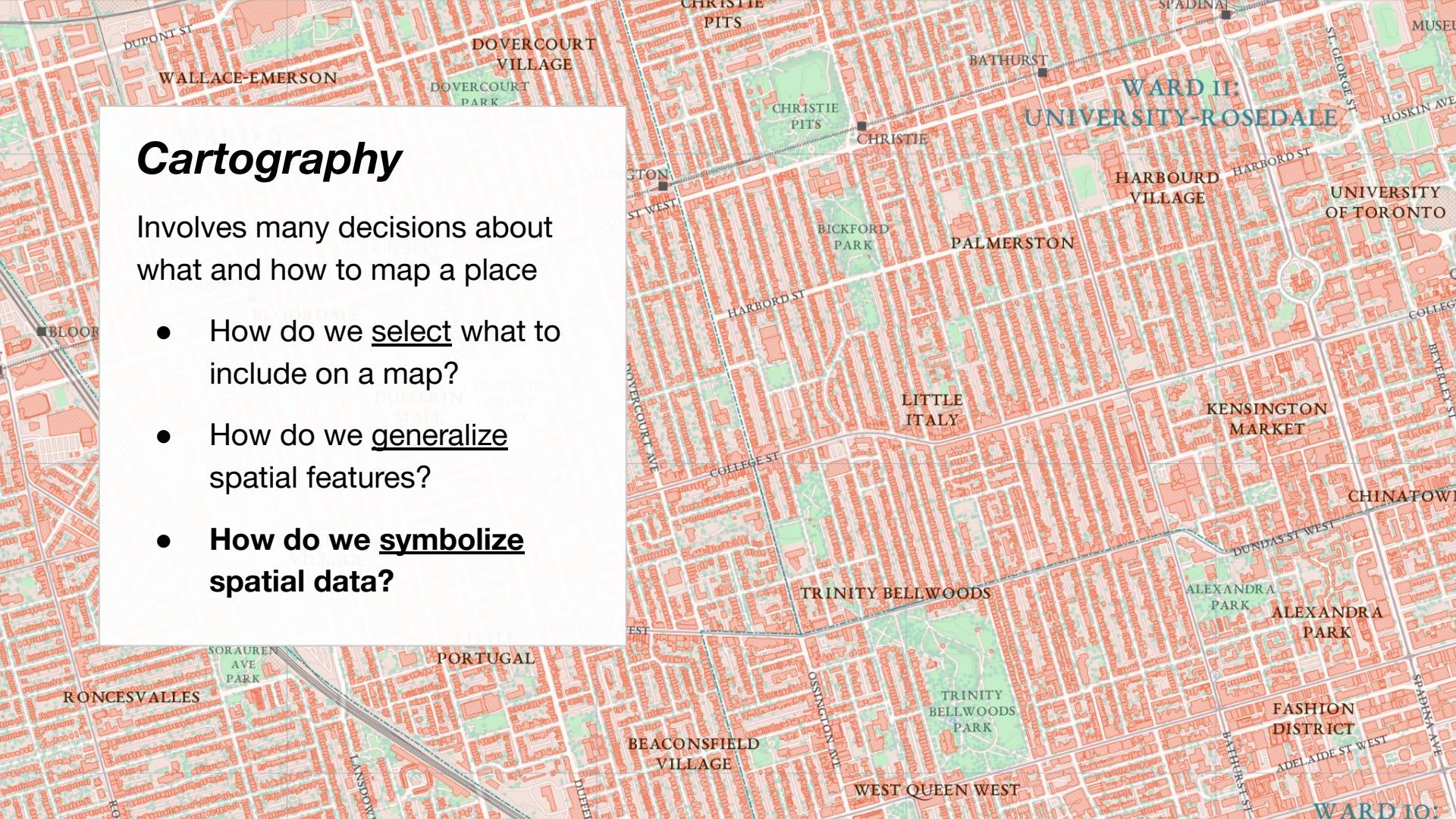
The elemental components of maps and charts



Cartography

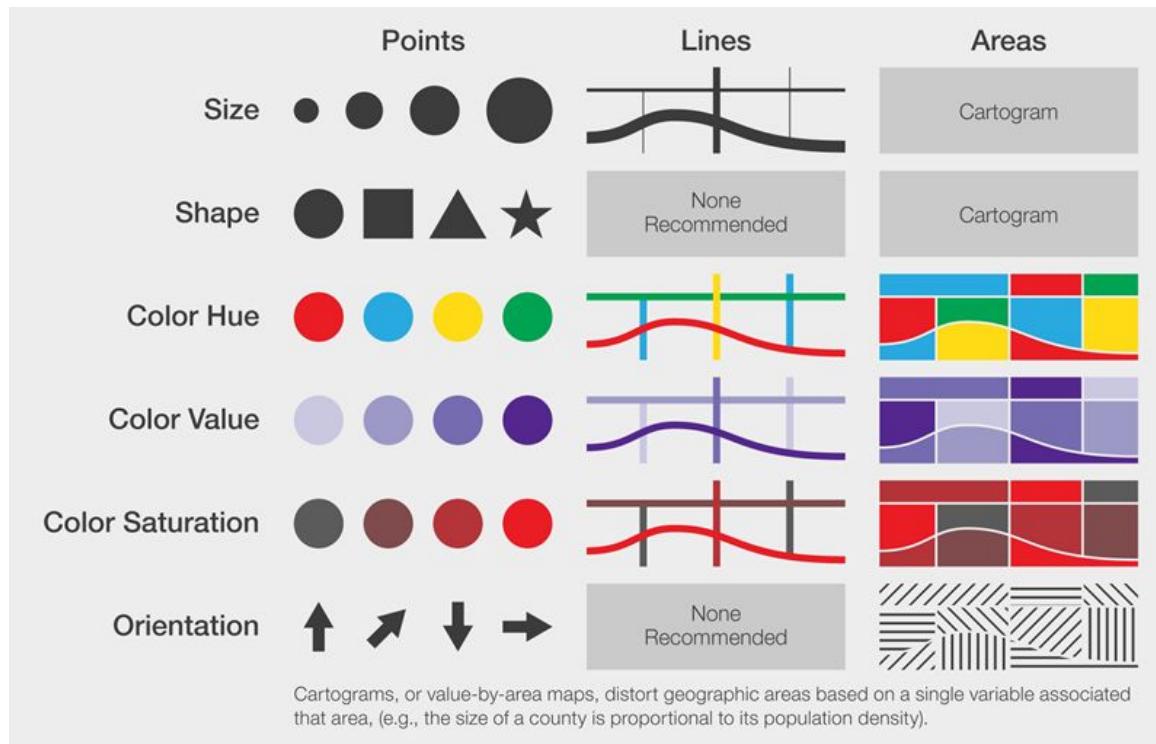
Involves many decisions about what and how to map a place

- How do we select what to include on a map?
- How do we generalize spatial features?
- How do we symbolize spatial data?



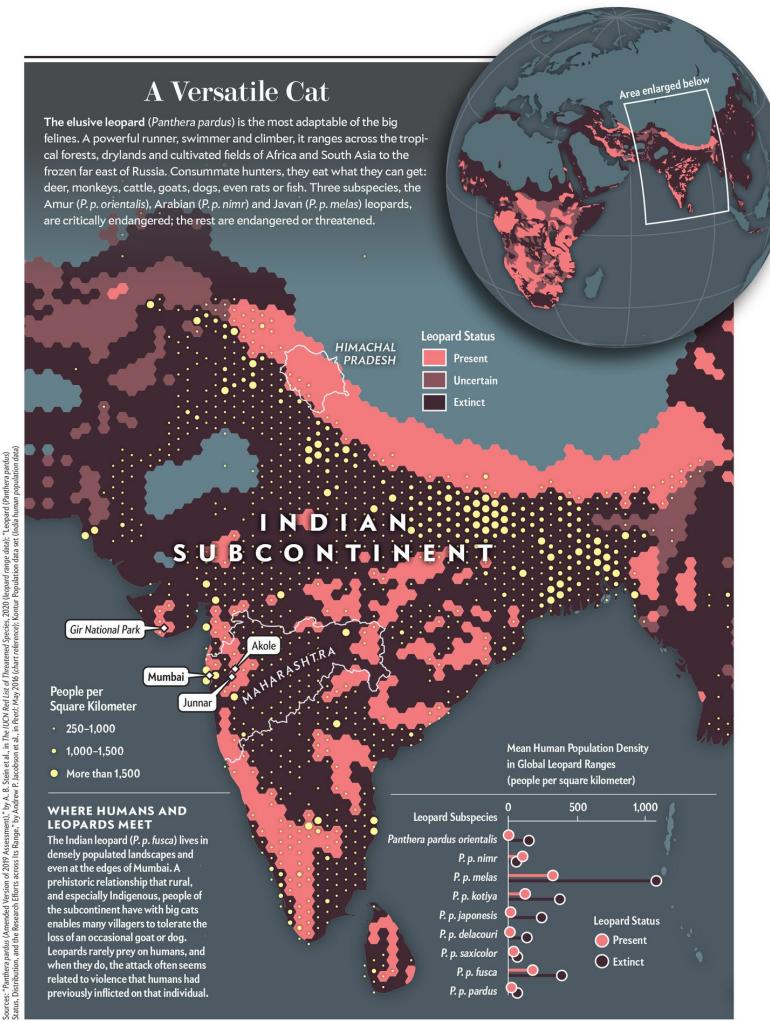
Visual Variables

The elemental components of maps and charts



Thematic Maps

- A type of map that portrays the geographic pattern of a particular subject matter in a geographic area



Data-Driven Styling

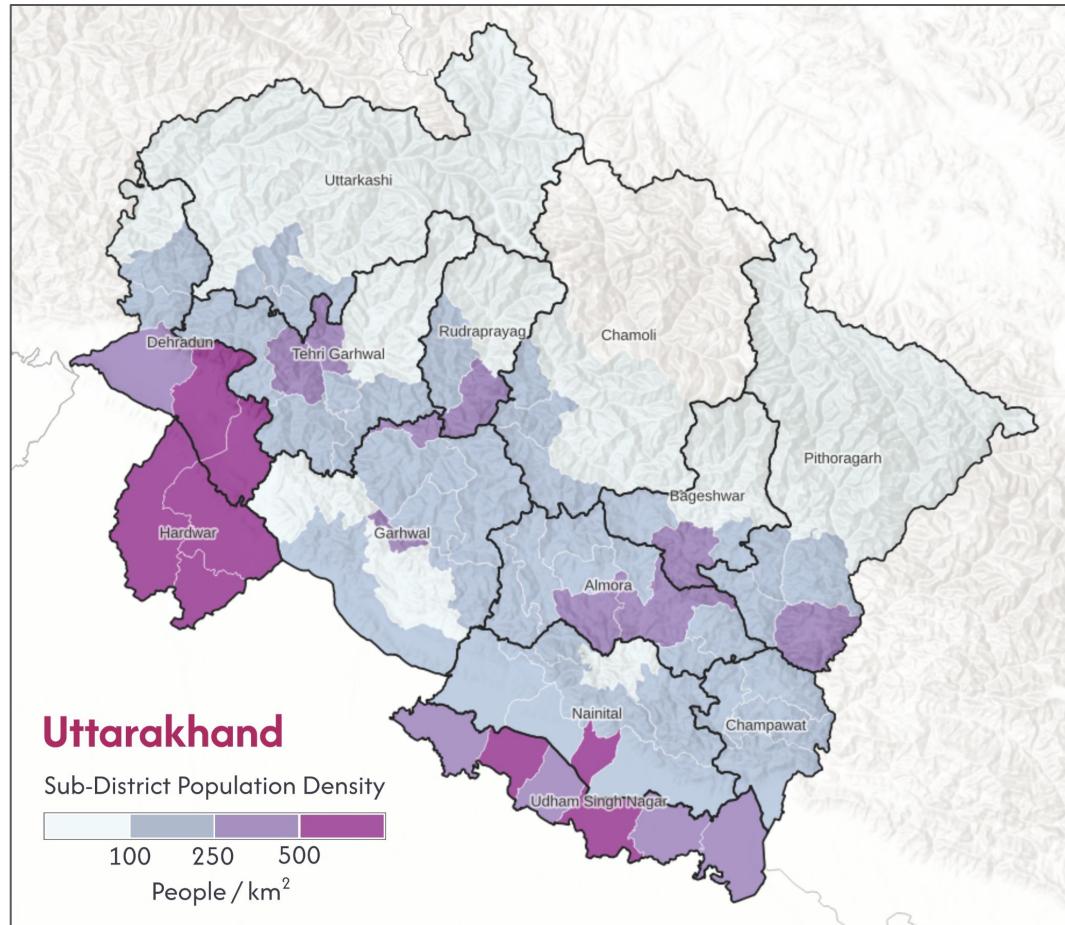
- Styling features on a map based on quantitative or categorical data

e.g. **Choropleth map**

- Polygons are coloured based on numeric data

Choro = area/region

Pleth = multitude

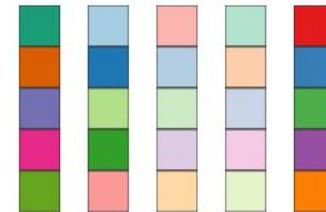


Source: Census of India 2011

Data-Driven Styling

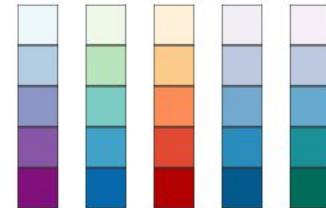
Categorical

- Non-numeric data



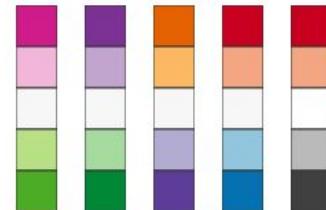
Sequential

- Numeric or ordinal data from low-to-high



Divergent

- Numeric or ordinal data centred on a value (e.g. 0, an average)



Data-Driven Styling:

Ordinal / Rank Data

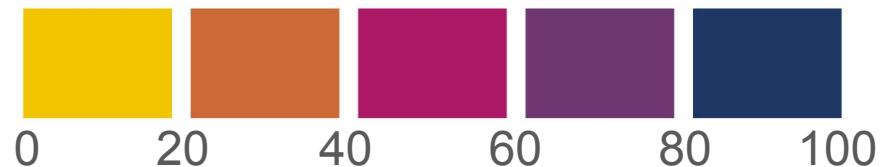


Numeric Data

Representing Continuously

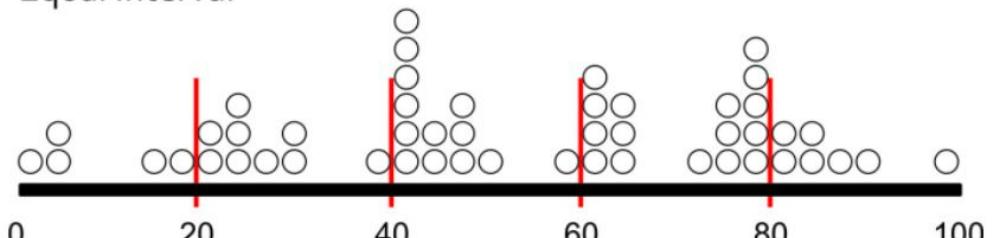


Represented As Groups

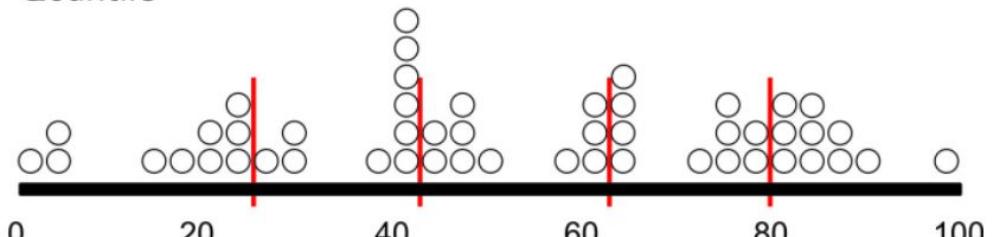


Grouping Numeric Data

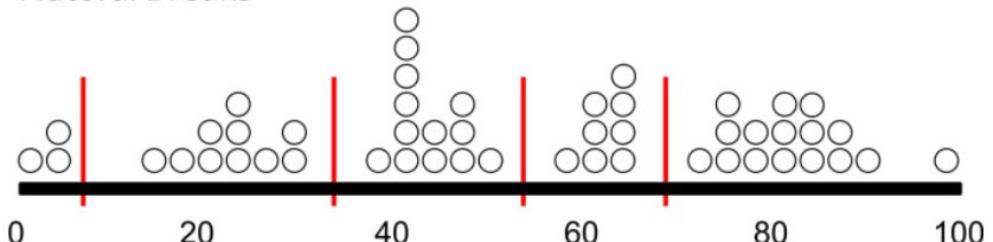
Equal Interval



Quantile



Natural Breaks

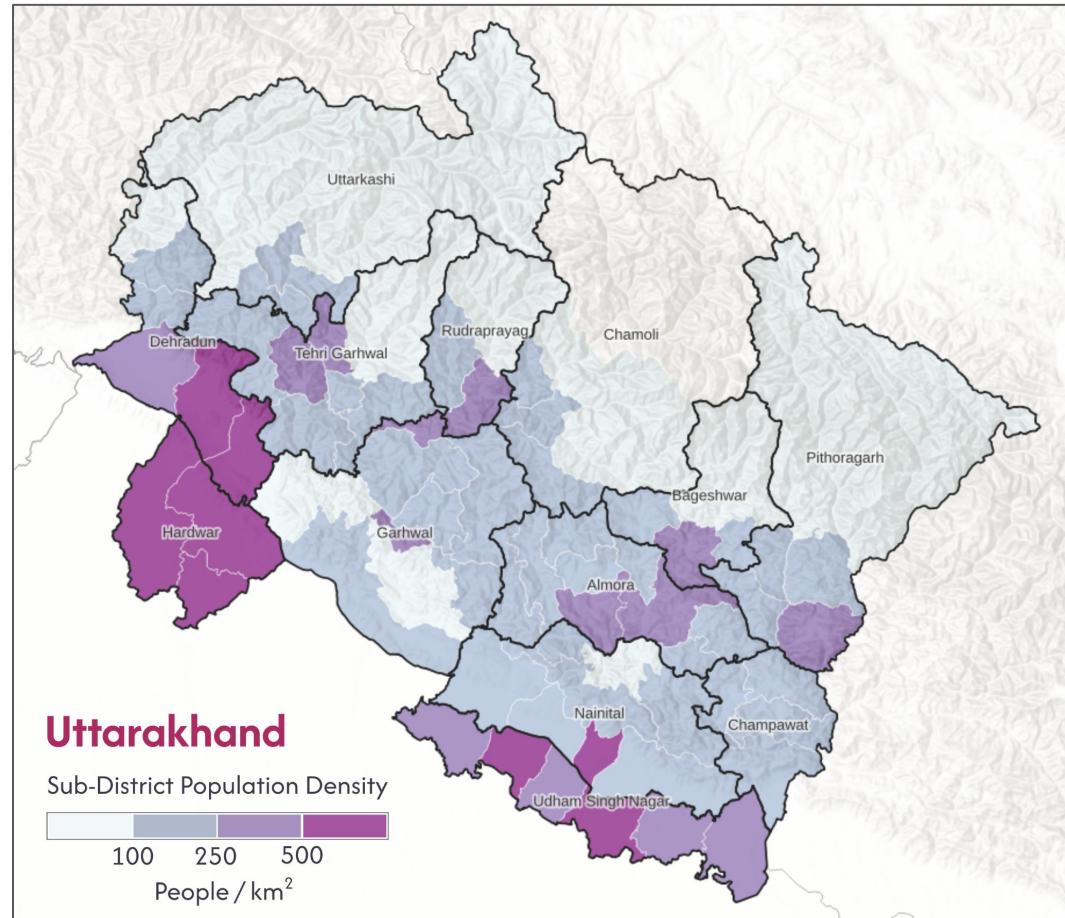


Map 2 - Choropleth Map

Objective:

Create a choropleth map of population density for an Indian State

<https://censusindia.gov.in/censuswebsite/data/population-finder>



Source: Census of India 2011

Map 2 - Choropleth Map

Data Preparation Steps:

- Load into QGIS the vector data in the ‘national-data’ folder
 - Filter the sub-district data by just one State
 - Open the population data spreadsheet and filter by
 - “State”
 - “Level”
 - “TRU”
 - Save the filtered data as a .csv
 - Load this .csv into QGIS

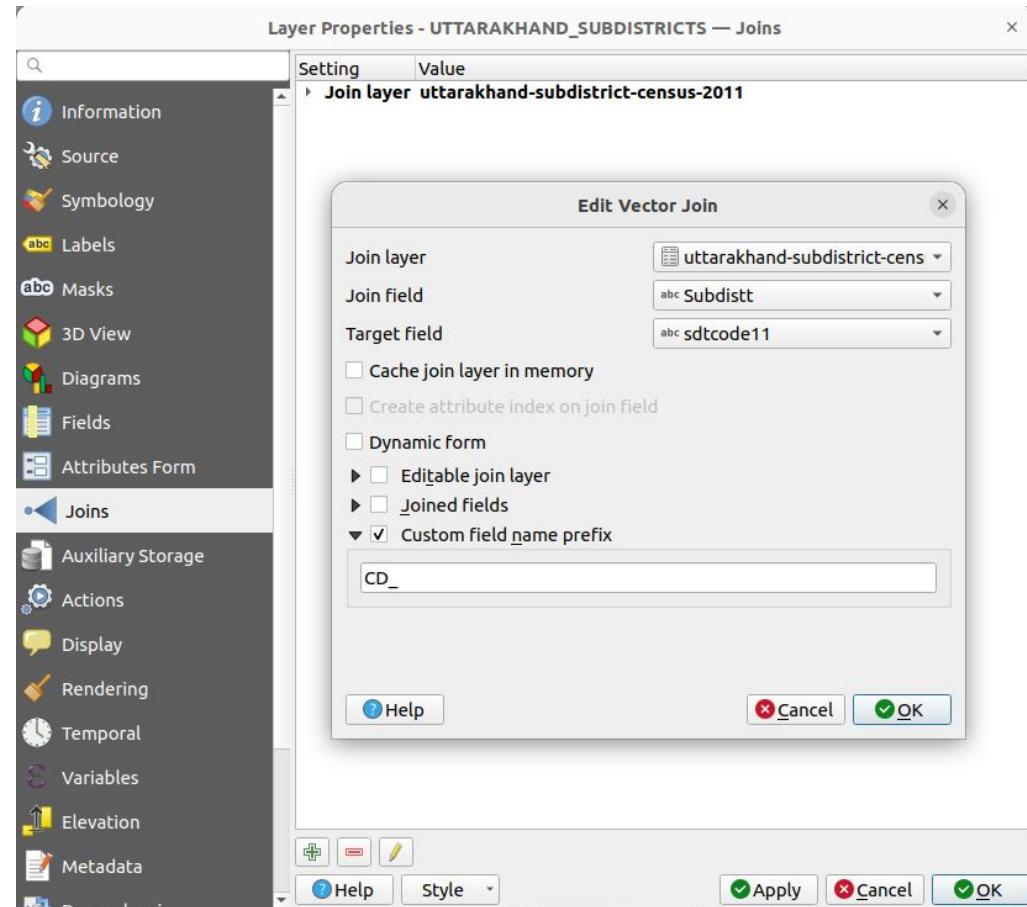
1	State	District	Subdistrict	Town/Villages	Ward	EB	Level	Name	TRU	No_HH	TOT_P
1019	05	056	00278	000000	0000	00000000	SUR-1	TRIET_Pauria	Total	6521	33792
1022	05	056	00279	000000	0000	00000000	SUR-1	TRIET_Pauria	Total	7473	40491
1025	05	056	00280	000000	0000	00000000	SUR-1	TRIET_Pauria	Total	13612	70564
1028	05	056	00281	000000	0000	00000000	SUR-1	TRIET_Pauria	Total	12493	60283
1031	05	056	00282	000000	0000	00000000	SUR-1	TRIET_Pauria	Total	9974	49900
1034	05	056	00283	000000	0000	00000000	SUR-1	TRIET_Pauria	Total	17529	75056
1040	05	057	00284	000000	0000	00000000	SUR-1	TRIET_Pauria	Total	12358	48202
1043	05	057	00285	000000	0000	00000000	SUR-1	TRIET_Pauria	Total	22242	99982
1046	05	057	00286	000000	0000	00000000	SUR-1	TRIET_Pauria	Total	8244	35890
1049	05	057	00287	000000	0000	00000000	SUR-1	TRIET_Pauria	Total	13204	56005
1052	05	057	00288	000000	0000	00000000	SUR-1	TRIET_Pauria	Total	19739	89114
1055	05	057	00289	000000	0000	00000000	SUR-1	TRIET_Pauria	Total	13177	62412
1061	05	058	00290	000000	0000	00000000	SUR-1	TRIET_Pauria	Total	18524	87024
1064	05	058	00291	000000	0000	00000000	SUR-1	TRIET_Pauria	Total	21497	91859
1067	05	058	00292	000000	0000	00000000	SUR-1	TRIET_Pauria	Total	13521	63402
1073	05	059	00293	000000	0000	00000000	SUR-1	TRIET_Pauria	Total	25127	120775
1076	05	059	00294	000000	0000	00000000	SUR-1	TRIET_Pauria	Total	22310	94441
1079	05	059	00295	000000	0000	00000000	SUR-1	TRIET_Pauria	Total	14773	73592
1082	05	059	00296	000000	0000	00000000	SUR-1	TRIET_Pauria	Total	7955	32753
1085	05	059	00297	000000	0000	00000000	SUR-1	TRIET_Pauria	Total	26919	117607
1088	05	059	00298	000000	0000	00000000	SUR-1	TRIET_Pauria	Total	12409	74083
1091	05	059	00299	000000	0000	00000000	SUR-1	TRIET_Pauria	Total	23221	105680
1097	05	060	00300	000000	0000	00000000	SUR-1	TRIET_Pauria	Total	6158	49607
1100	05	060	00301	000000	0000	00000000	SUR-1	TRIET_Pauria	Total	4715	33926
1103	05	060	00302	000000	0000	00000000	SUR-1	TRIET_Pauria	Total	6421	47329
1106	05	060	00303	000000	0000	00000000	SUR-1	TRIET_Pauria	Total	62160	317482
1109	05	060	00304	000000	0000	00000000	SUB-DISTRICT	Dehradun	Total	213030	988007
1112	05	060	00305	000000	0000	00000000	SUB-DISTRICT	Rishikesh	Total	54517	260343
1118	05	061	00306	000000	0000	00000000	SUB-DISTRICT	Srinagar	Total	12828	53689
1121	05	061	00307	000000	0000	00000000	SUB-DISTRICT	Pauri	Total	34134	135718
1124	05	061	00308	000000	0000	00000000	SUB-DISTRICT	THALISAIN	Total	19679	92286
1127	05	061	00309	000000	0000	00000000	SUB-DISTRICT	Dhoomakot	Total	9600	39230
1129	05	061	00310	000000	0000	00000000	SUB-DISTRICT	Lamayoon	Total	18900	77624

Map 2 - Choropleth Map

Joining Data

“Join” (i.e. link) the tabular data to the spatial boundaries

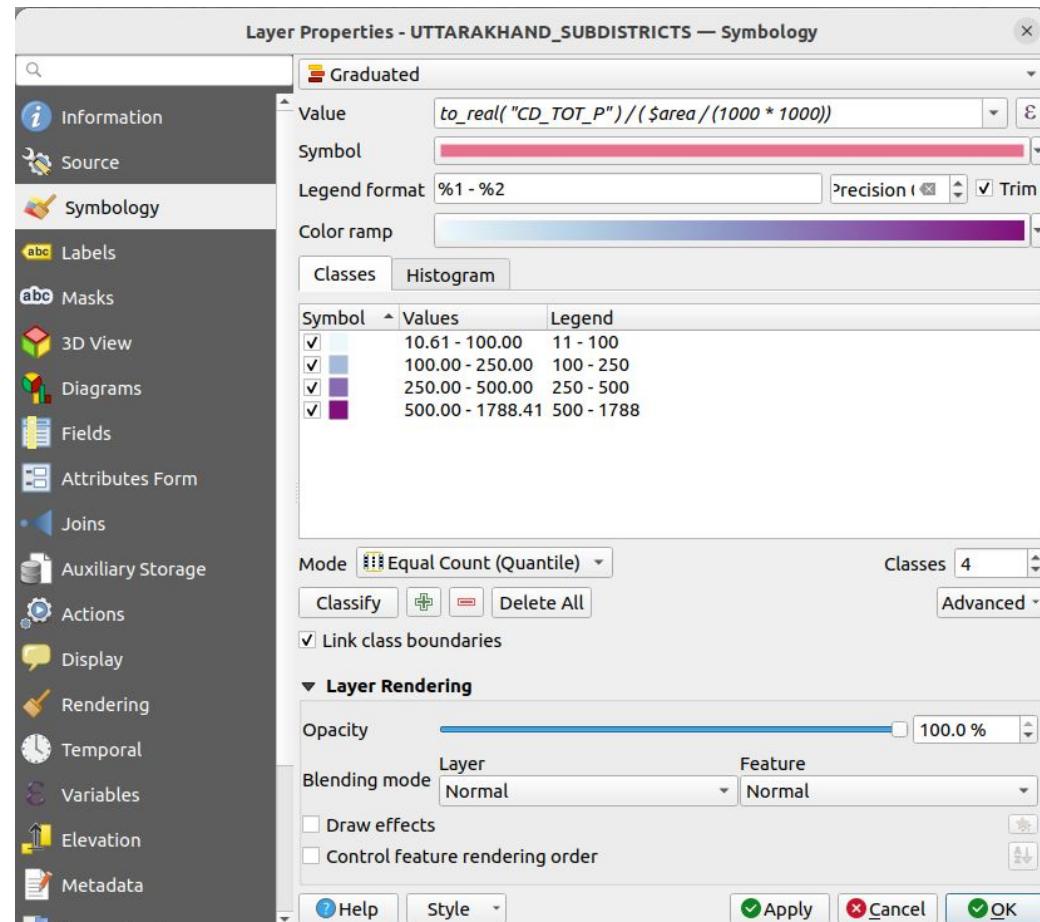
- Right click on the boundary layer
- Go to “Properties”
- Go to “Joins”
- Hit the + to create a new join, linking the two datasets



Map 2 - Choropleth Map

Create the choropleth layer

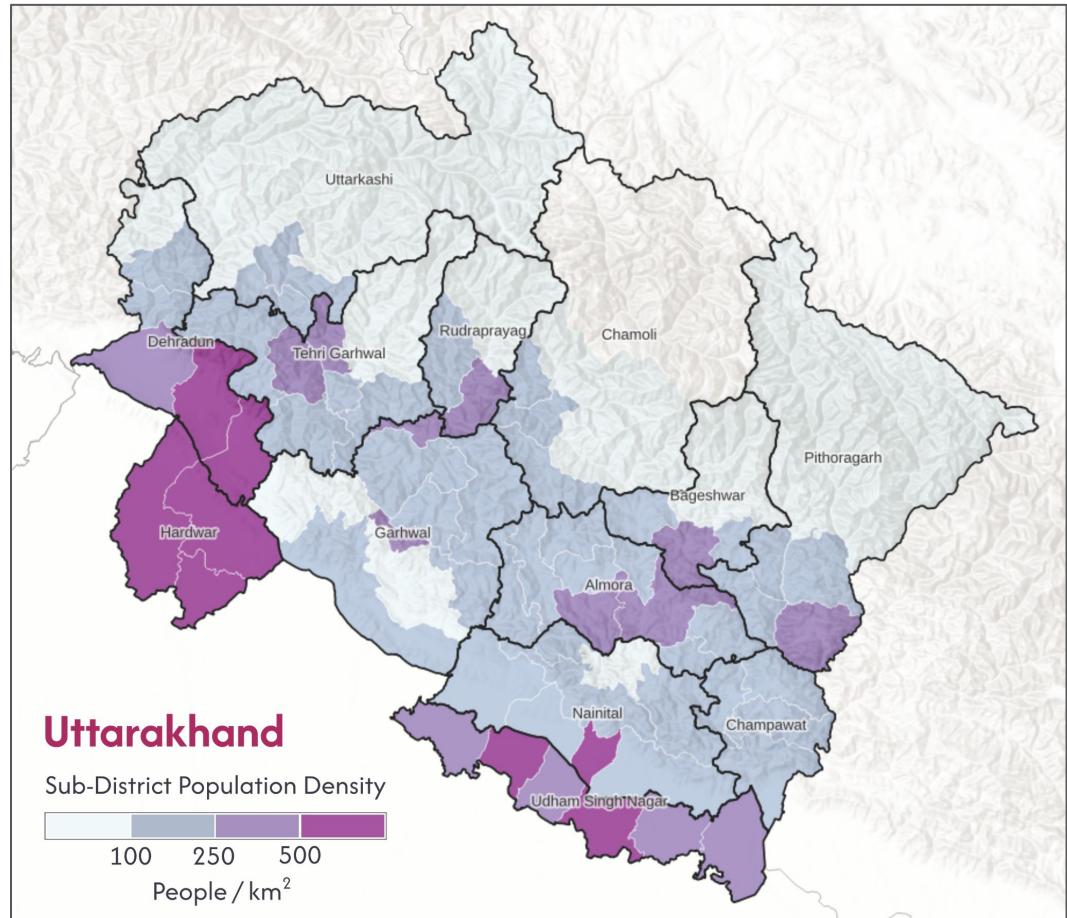
- Right click the layer
- Go to “Properties”
- Go to “Symbology”
- Select “Graduated”
- Input the formula for population density
 - (1000 * 1000 is to convert from m² to km²)
 - (“to_real” converts from a string to a number)
- Play with the “Color ramp” and “Mode” and “Classes” options



Map 2 - Choropleth Map

Extra!

- Add in other reference data such as ...
 - Place labels
 - Terrain
 - Admin boundaries
 - Transport routes
 - Other data!



Source: Census of India 2011

Map 3 - Raster Choropleth Map

Objective:

Visualize air pollution in India (PM2.5) via colouring raster data

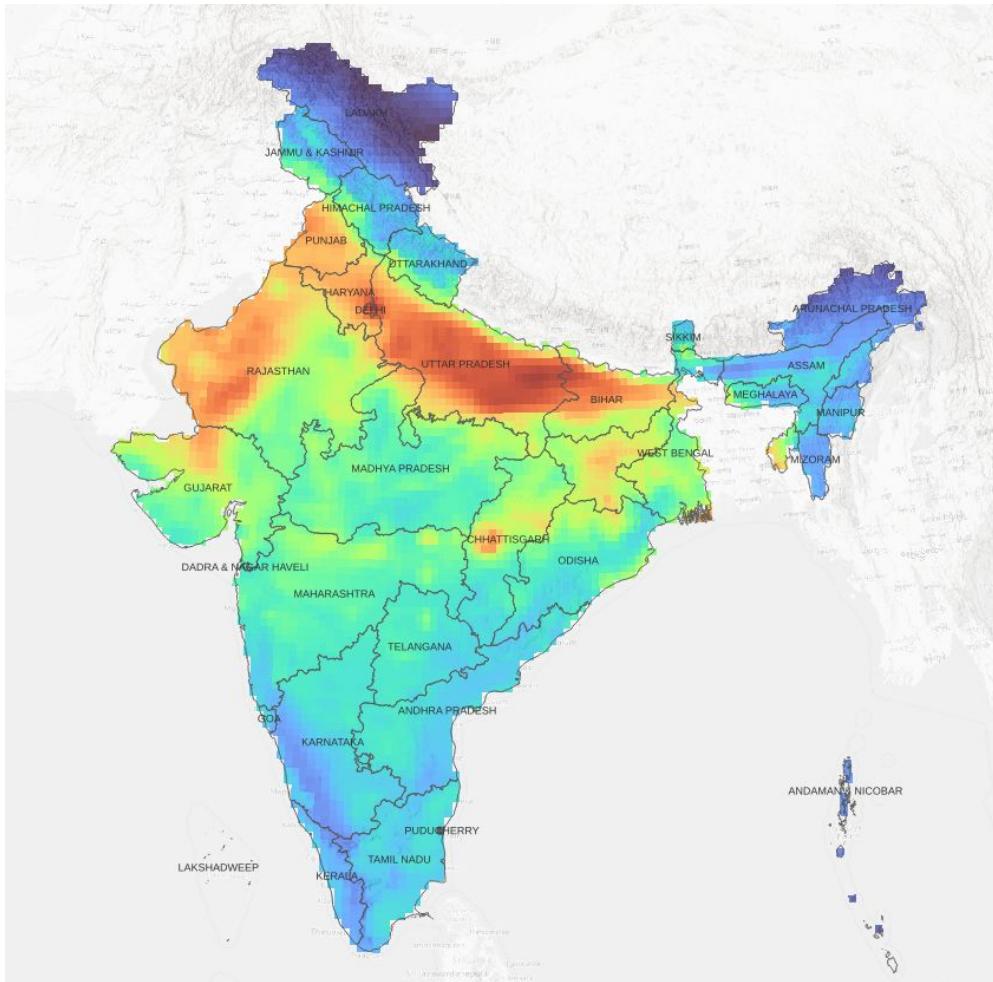
Test different colour and classification options and layering on reference data

Data source:

<https://sites.wustl.edu/acag/datasets/surface-pm2-5/>

Reference data:

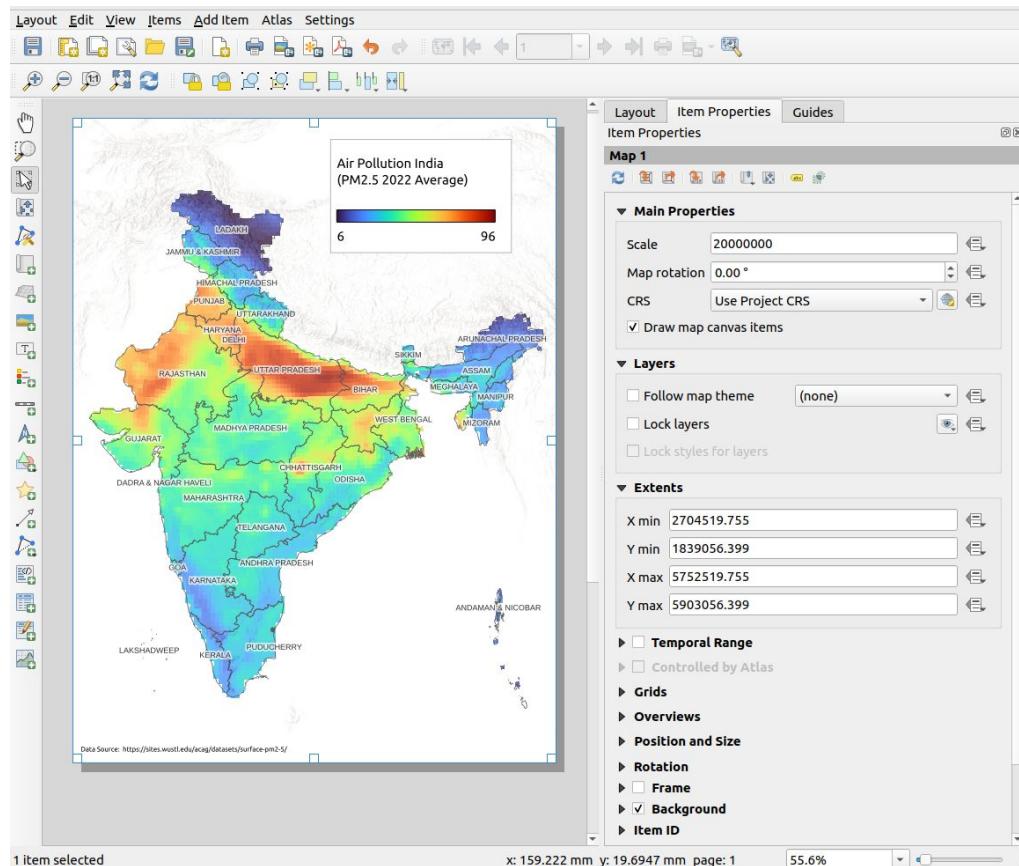
<https://www.naturalearthdata.com/>



Map 3 - Raster Choropleth Map

Exporting Maps:

Create a ‘print layout’ - a rectangular space for exporting a map alongside other elements (text, legend)



Spatial Data Processing

Geocoding

- Converting addresses to coordinates

Spatial Selections

- Querying data based on spatial relationships

Geometry Creation

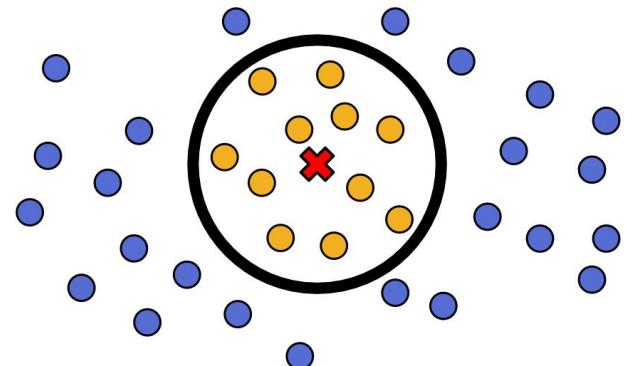
- Create new dataset from the geometry of other dataset(s)
(e.g. buffers, centroids)

Joins

- Joining tabular data
- Joining data based on spatial relationships

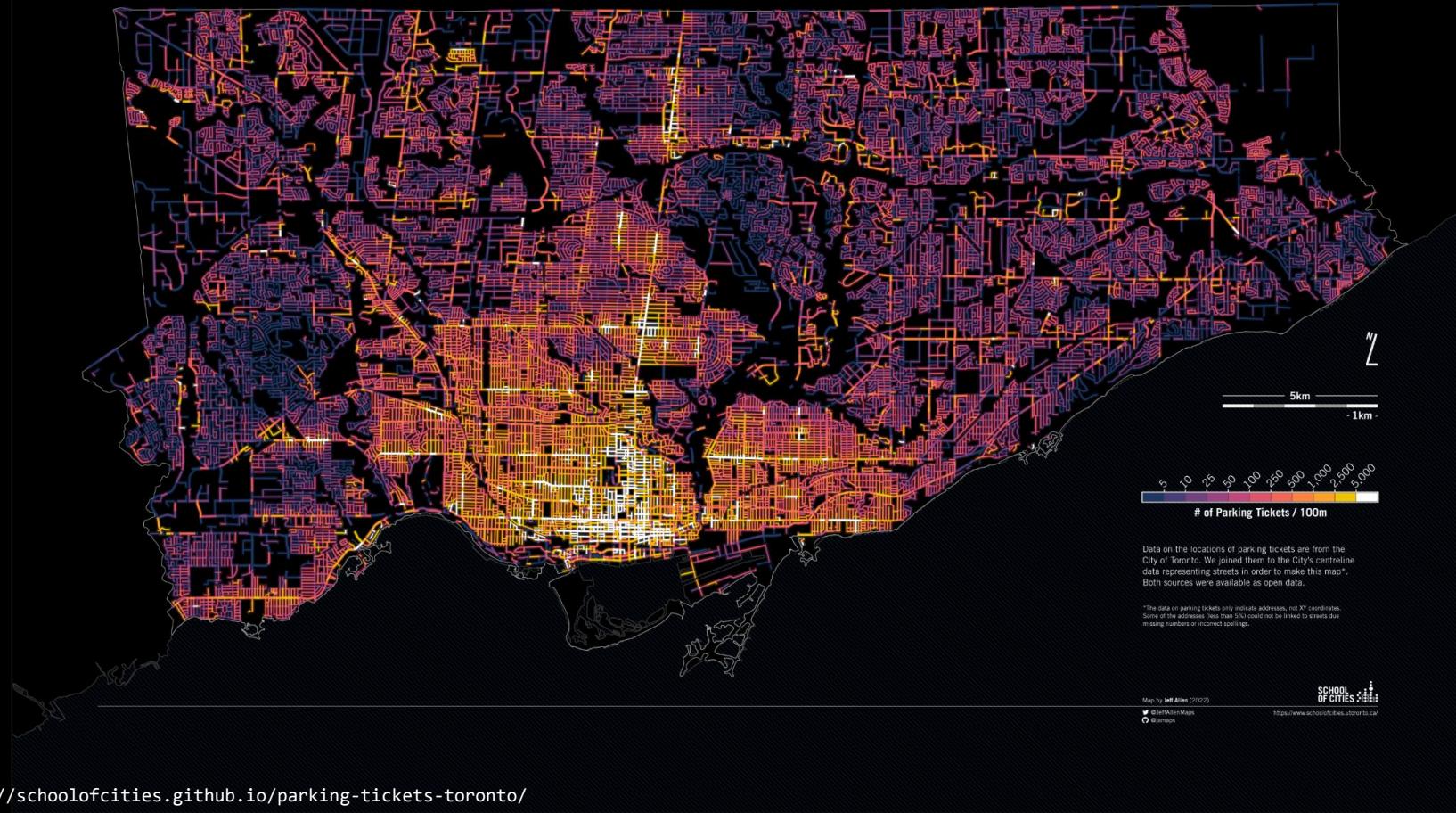
Interpolation

- Estimating data values at unknown locations from values at other known locations



Parking Tickets in Toronto

Over 22.8 million parking tickets were issued in the City of Toronto in the decade spanning 2011 to 2020, representing over 1 billion dollars in fines. This map shows the location of almost* all of these parking tickets.





Every Bike Share Trip in
Toronto in June 2024

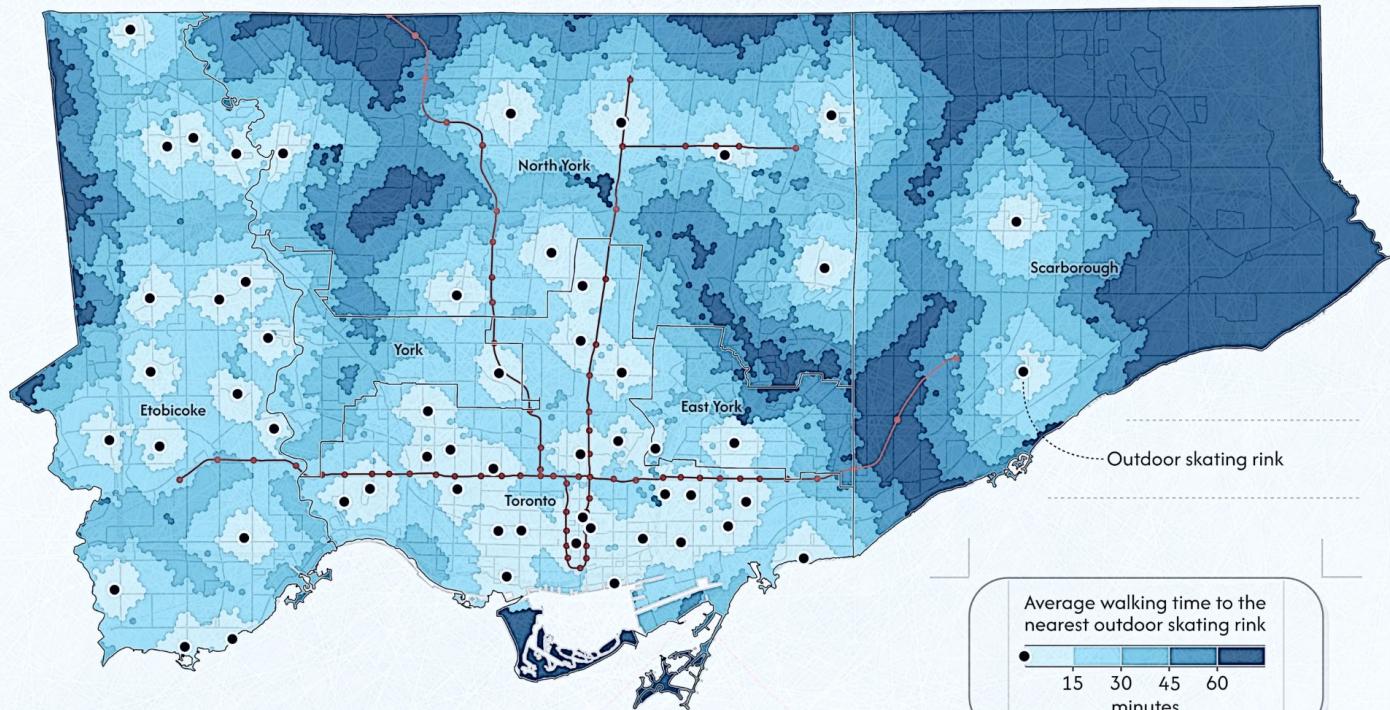
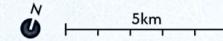
762,580 Total Trips

By Jeff Allen, School of Cities

Data Sources: Bike Share Toronto, OpenStreetMap

Hex Maps / Isochrones

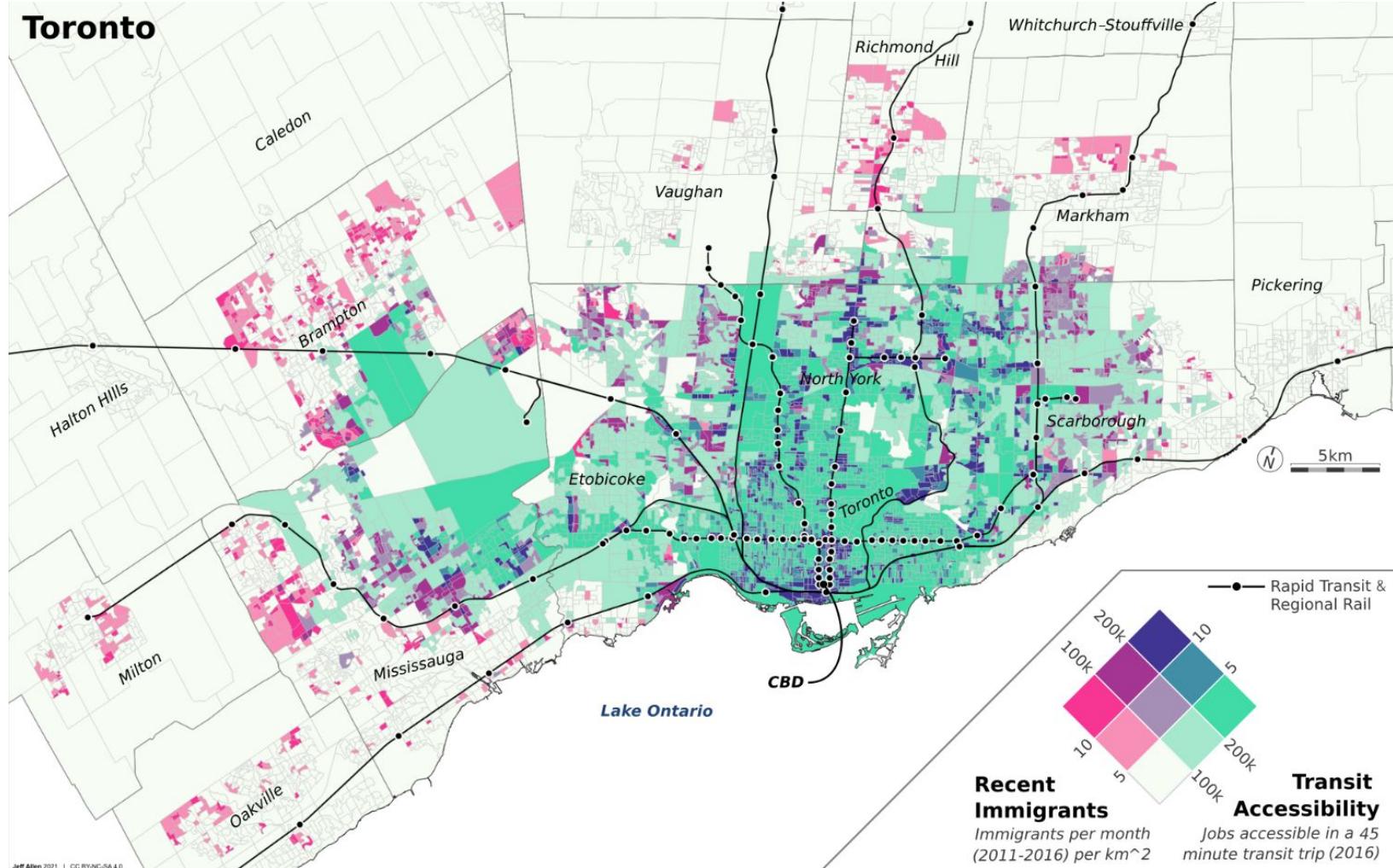
Proximity to outdoor skating rinks in Toronto



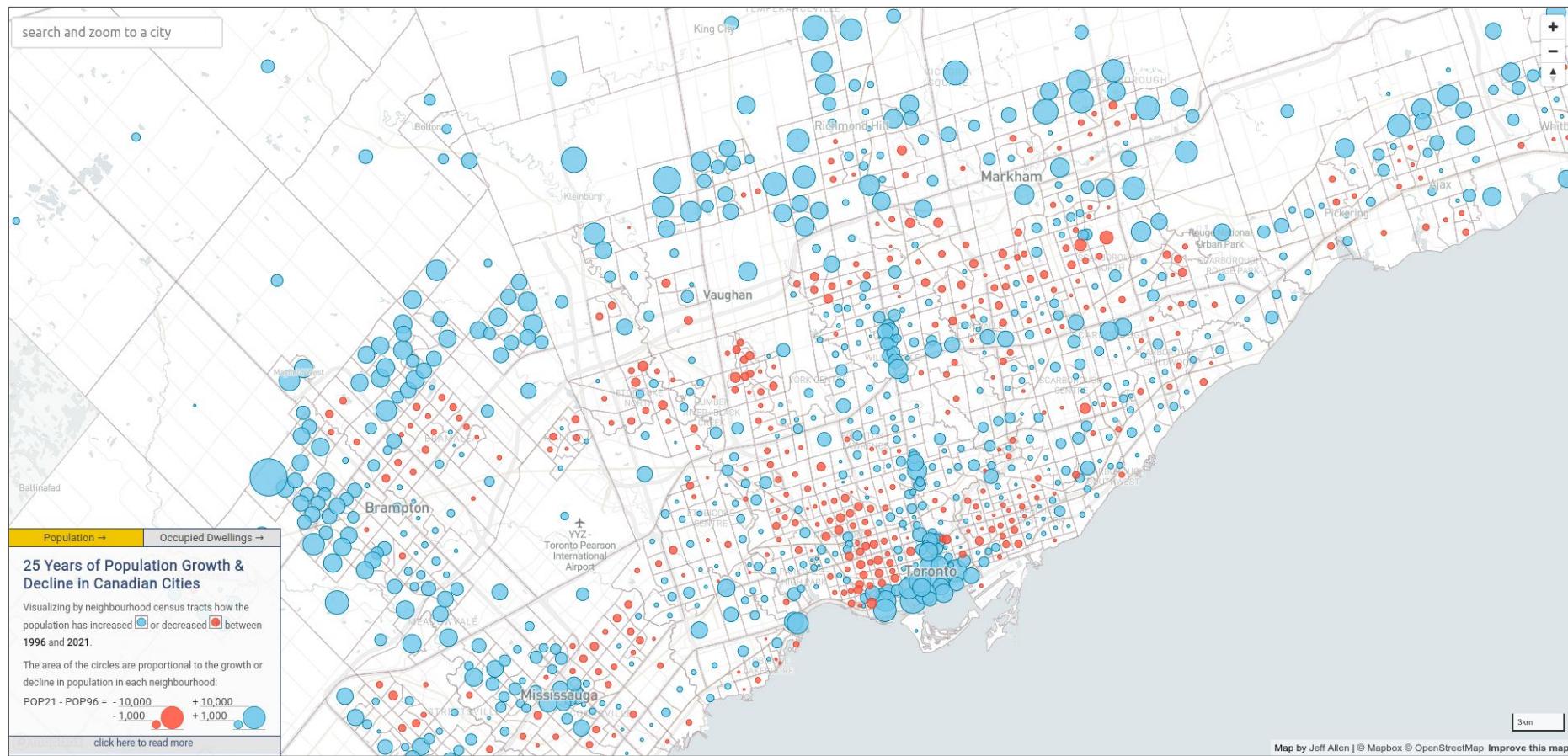
Map by Jeff Allen and Teresa Lau, School of Cities, University of Toronto

Data Sources: City of Toronto, OpenStreetMap

Toronto

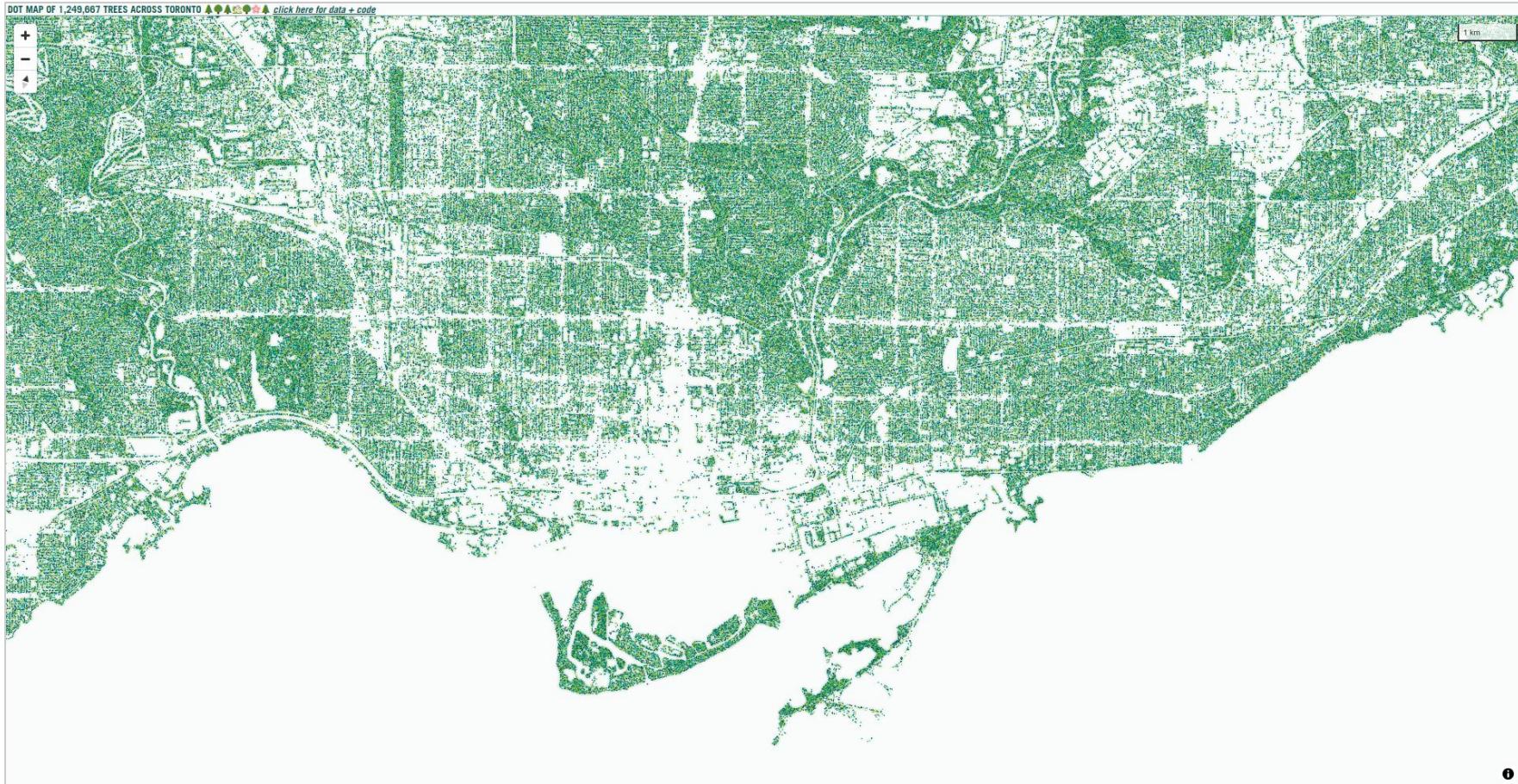


Proportional Symbol Map (e.g. colour and size of circle represents population growth or decline)



<https://schoolofcities.github.io/urban-growth-canada/1996-to-2021>

Dot Map (1 dot = 1 tree)



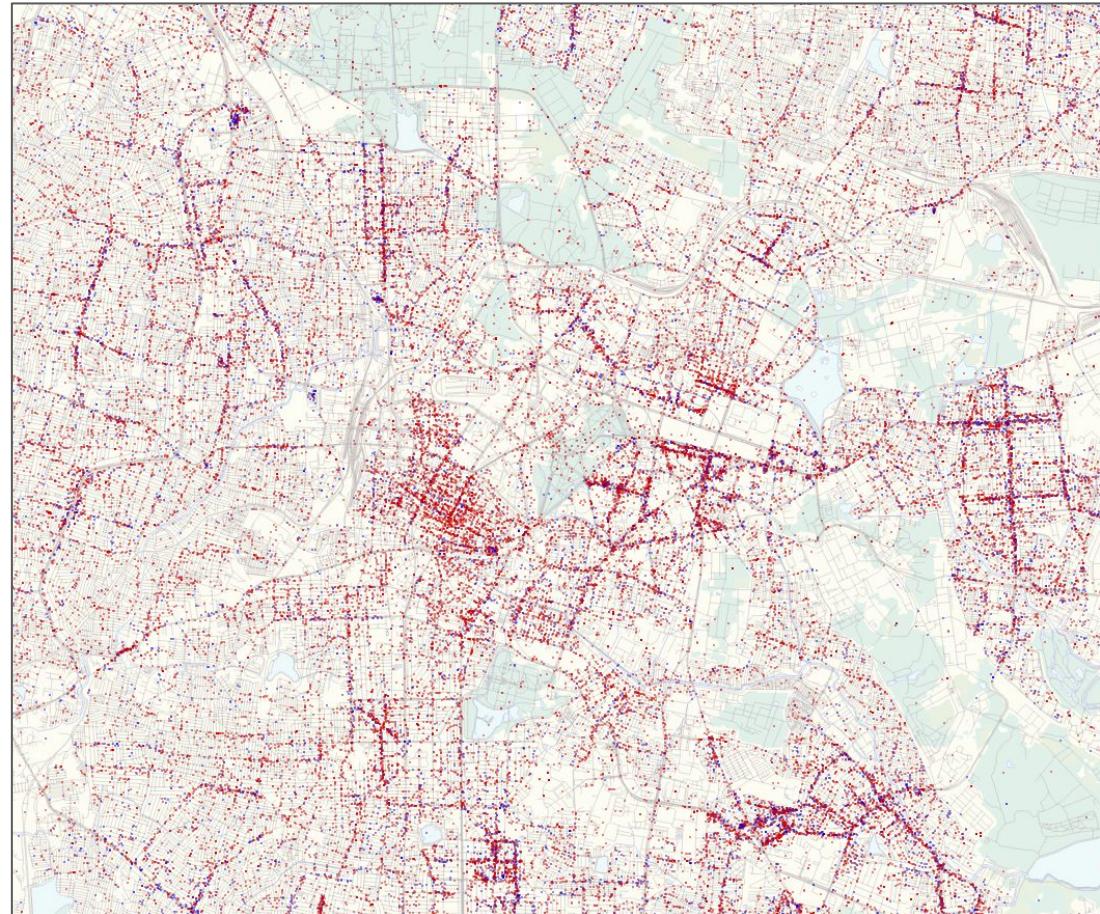
Map 4 - Dot Map

Objective:

Create a dot map showing density of 'Places'

Represents each POI as a very small point, but when many are on the map, it highlights patterns

One way to visualize large datasets

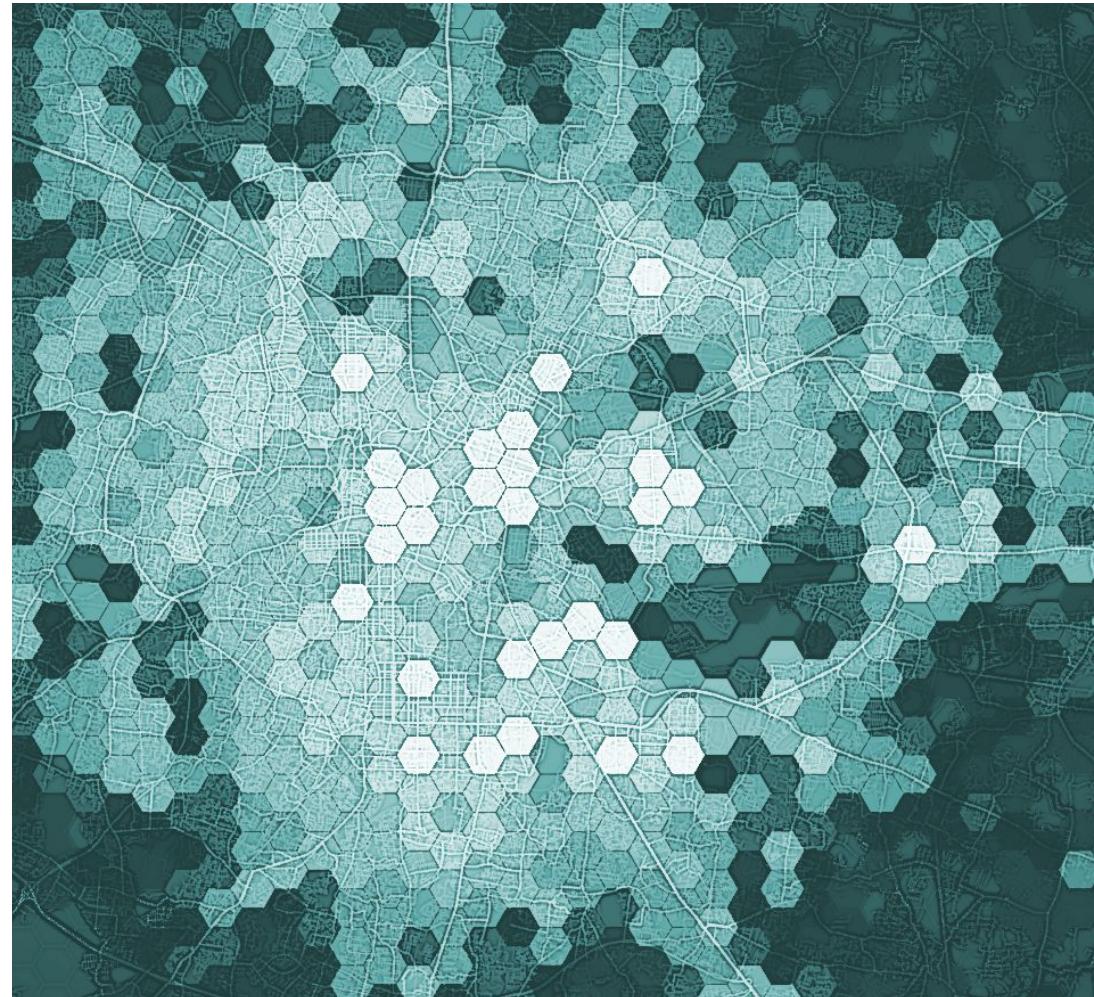


Map 5 - Hex Map

Objective:

Aggregate the ‘Places’ data to hexagon polygons and then colour by the number of POI per hexagon

This is another way to aggregate and visualize large datasets



Map 5 - Hex Map

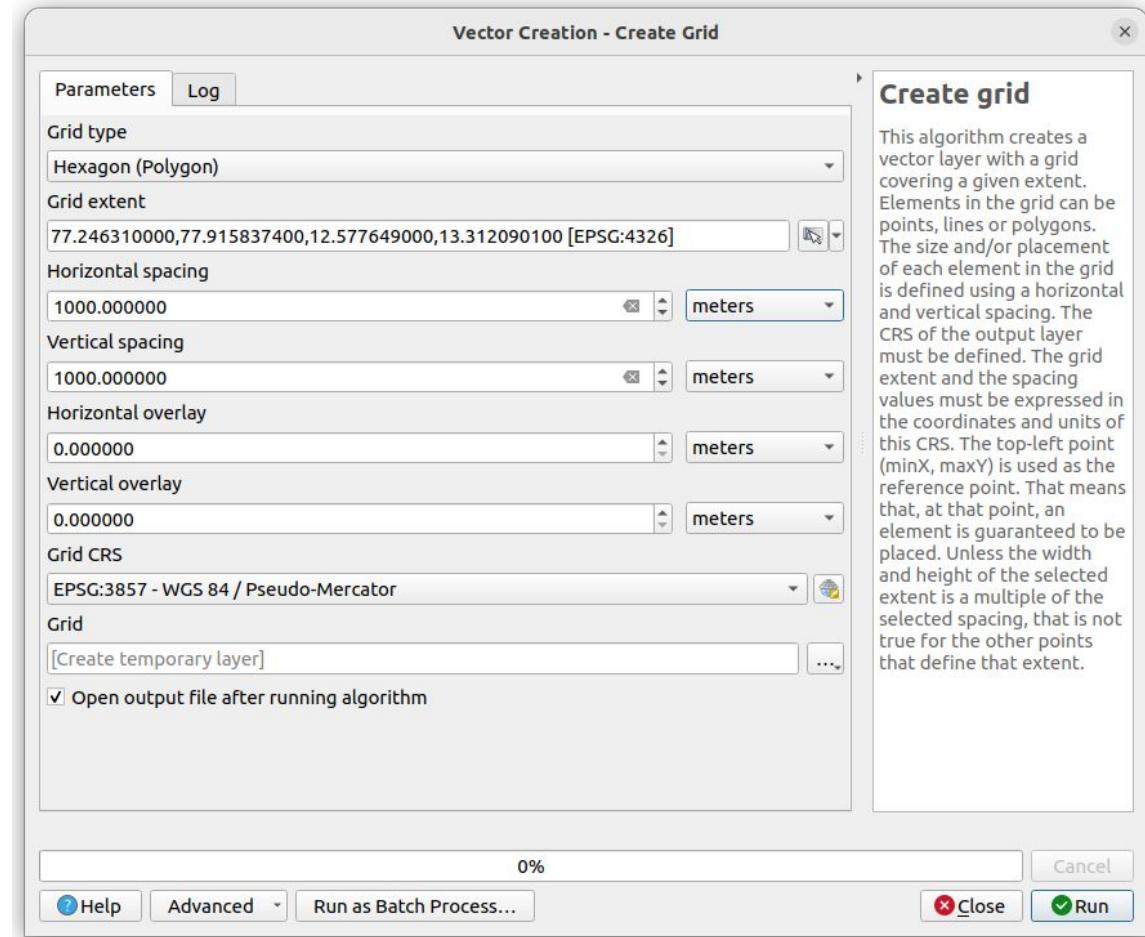
Step 1:

Create a hexagon grid

- Vector →
- Research Tools →
- Create Grid

Make sure units are in metres or kilometres

Can use extents of the 'Places' layer



Map 5 - Hex Map

Step 2:

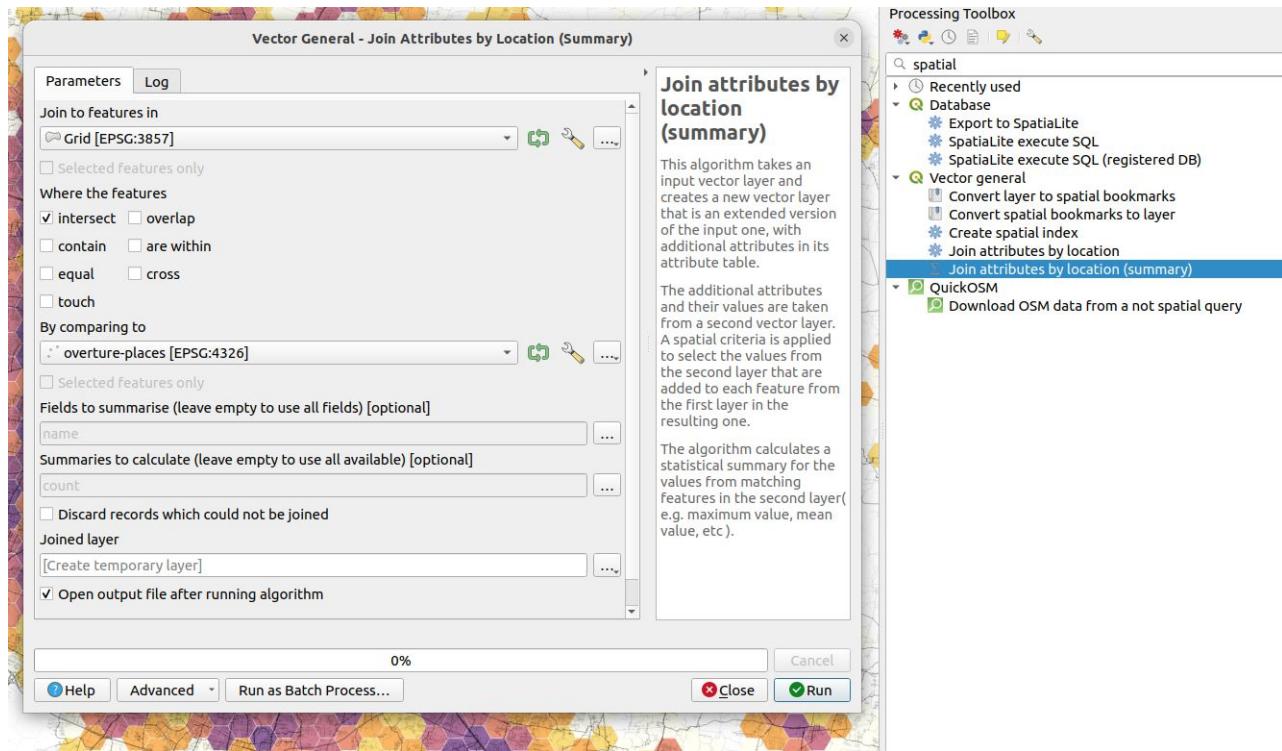
Count the number of
“Places” points in each
hexagon

Processing →

Toolbox →

Join attributes by location
(summary)

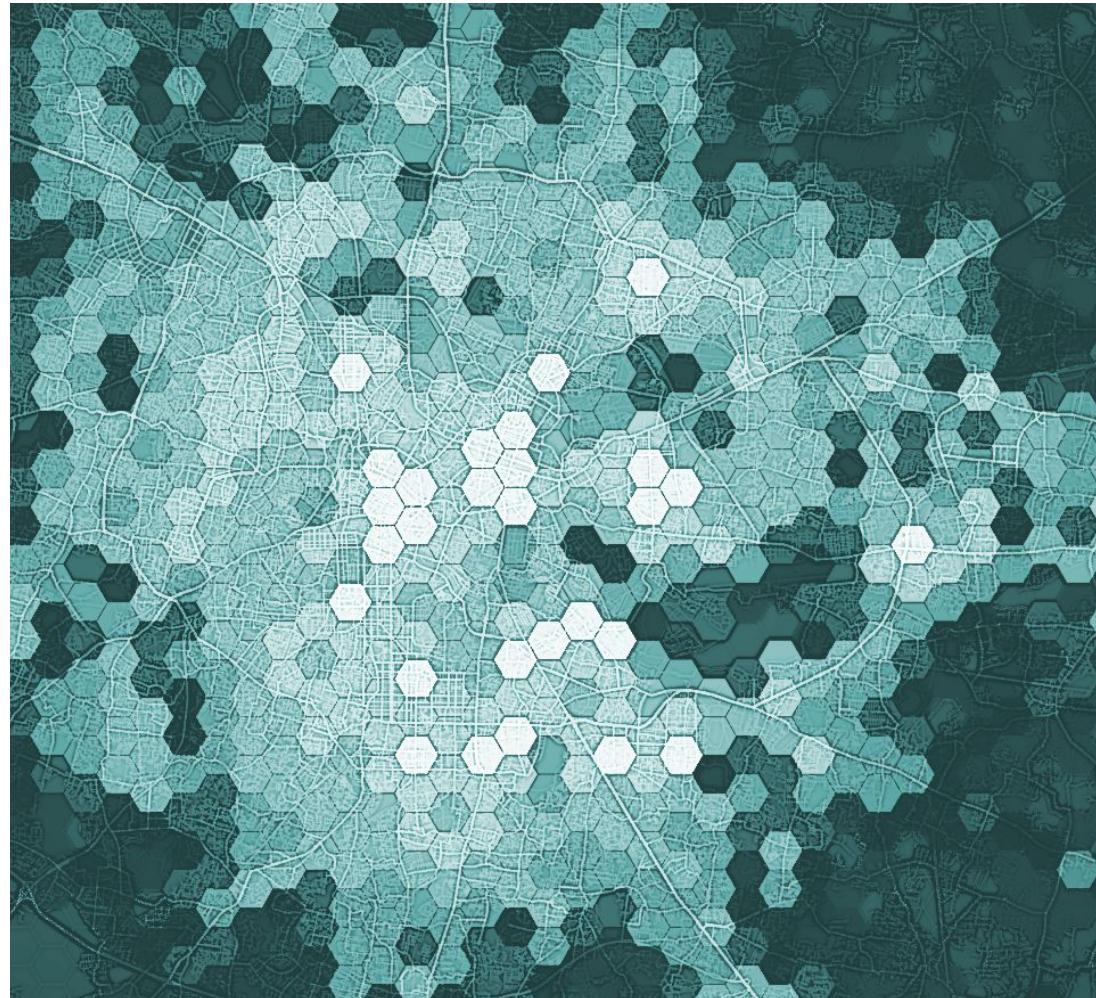
Make sure to specify
“count”



Map 5 - Hex Map

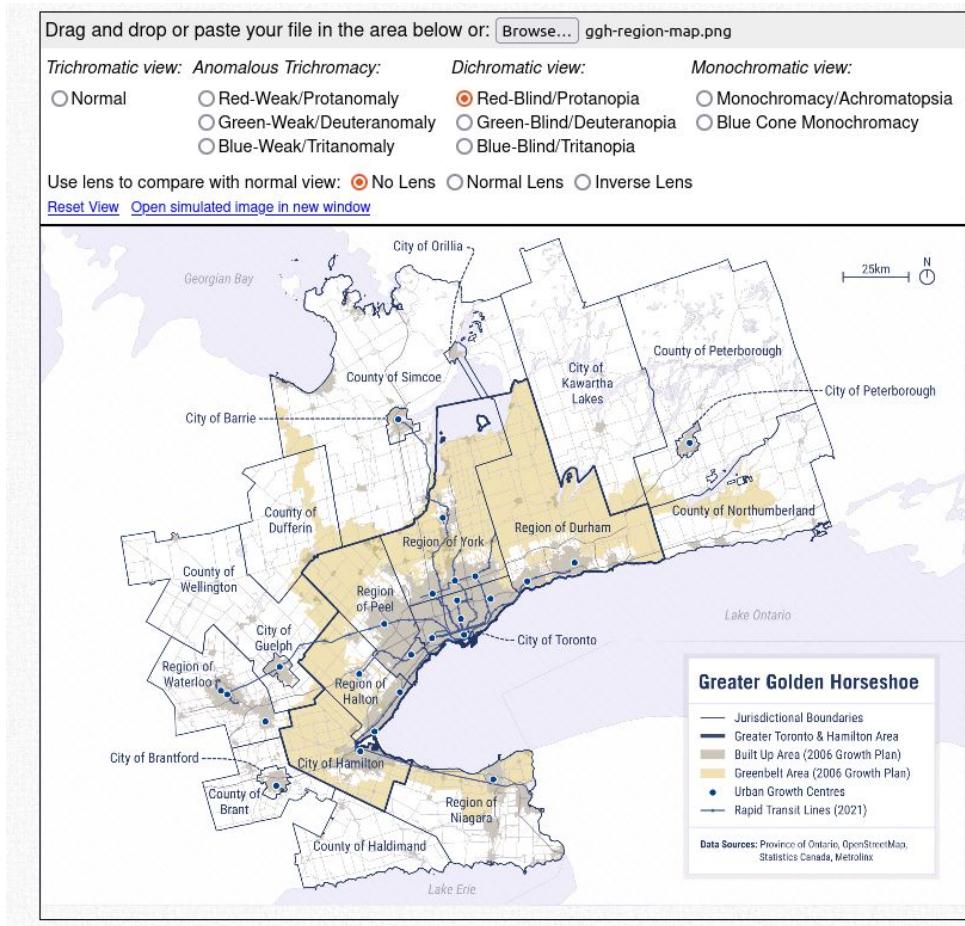
Step 3:

Visualize like a choropleth map!



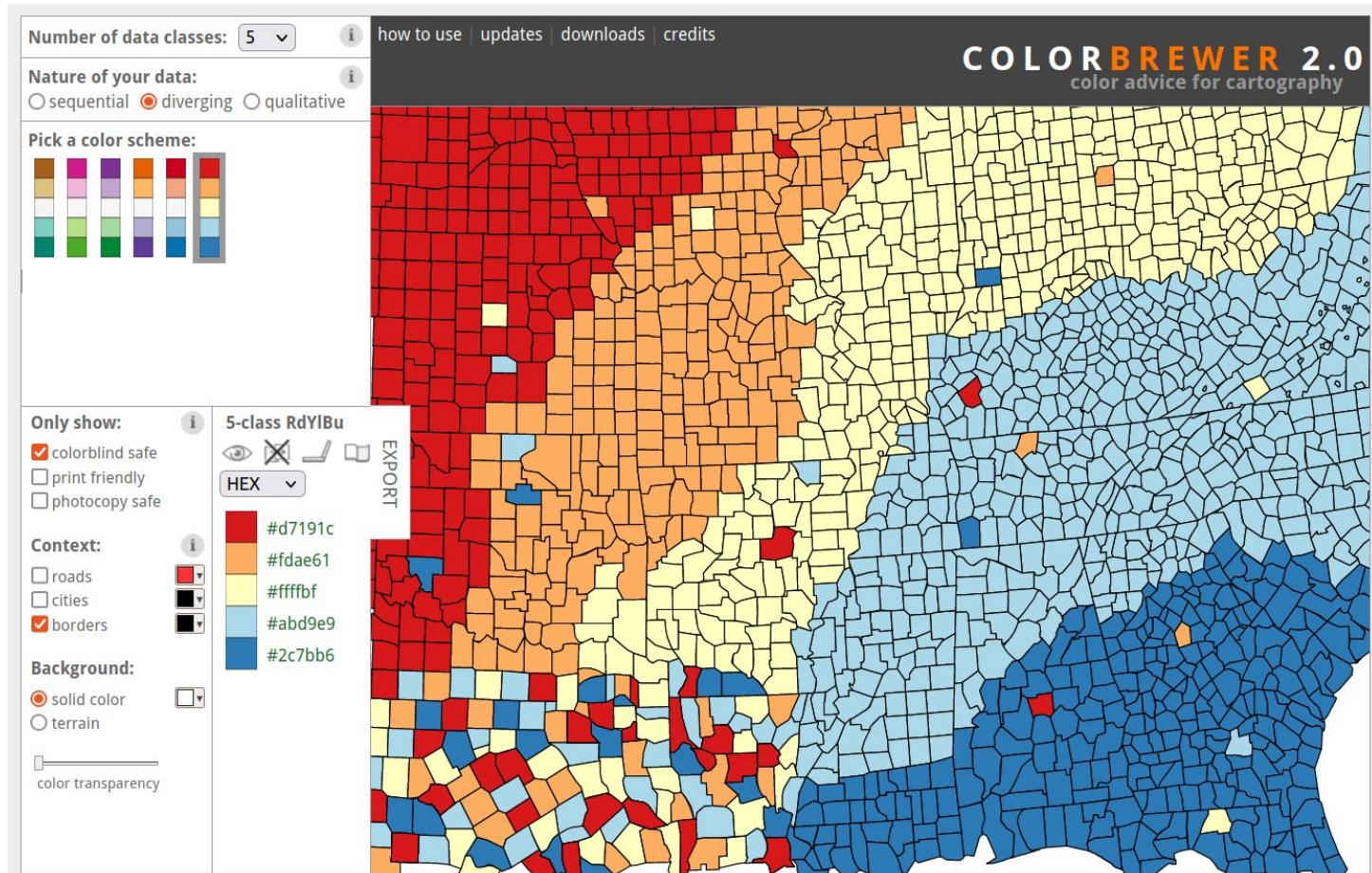
Accessibility

e.g. designing graphics for people who are colour blind



Accessibility

e.g. designing maps for people who are colour blind



Accessibility

Contrast checking...

Difference in perceived
"luminance" or
brightness between
two colours

Can you read me?

Can you read me?

Can you read me?

Contrast Checker

[Home](#) > [Resources](#) > Contrast Checker

Foreground Color

#0000FF



Lightness



Background Color

#FFFFFF



Lightness



Contrast Ratio

8.59:1

[permalink](#)

Normal Text

WCAG AA:

Pass

WCAG AAA:

Pass

The five boxing wizards jump quickly.

Large Text

WCAG AA:

Pass

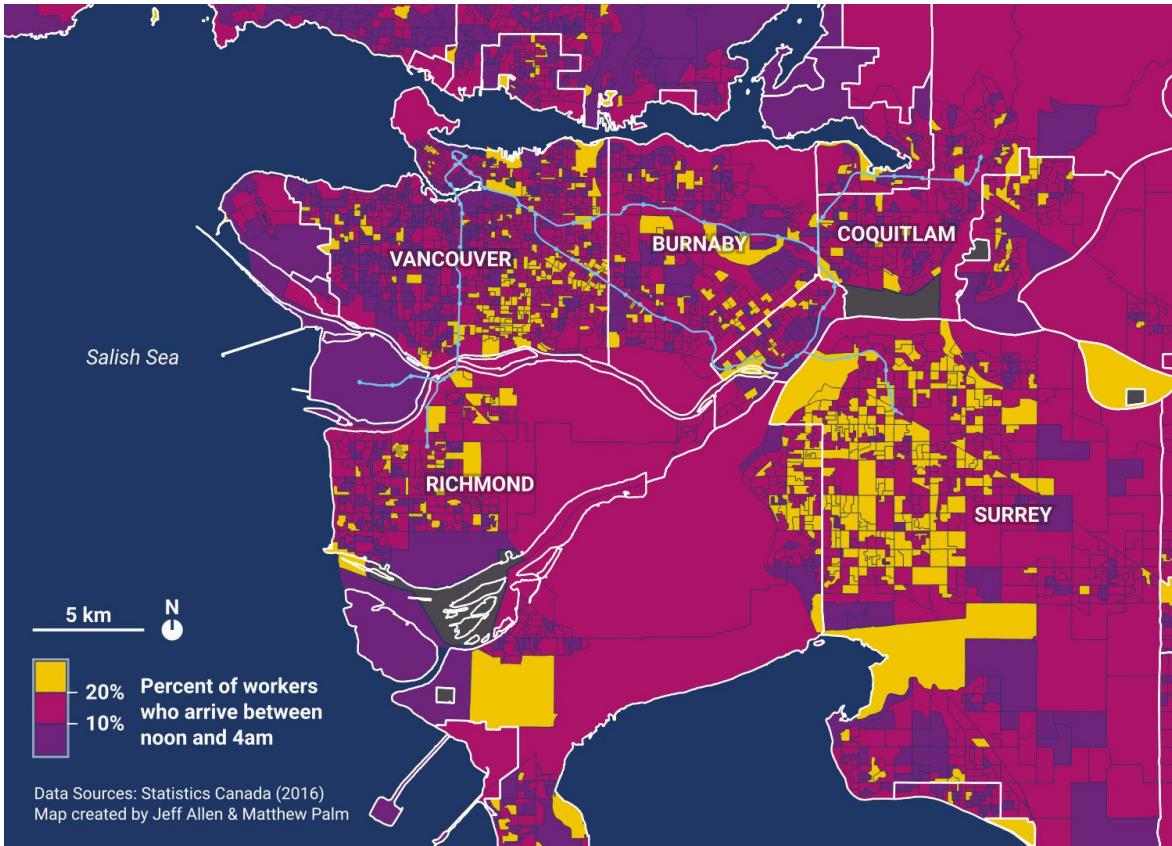
WCAG AAA:

Pass

The five boxing wizards jump quickly.

Accessibility

- Colours, Fonts, etc.
- Language
- Screens
- Data Transfer
- Open Source



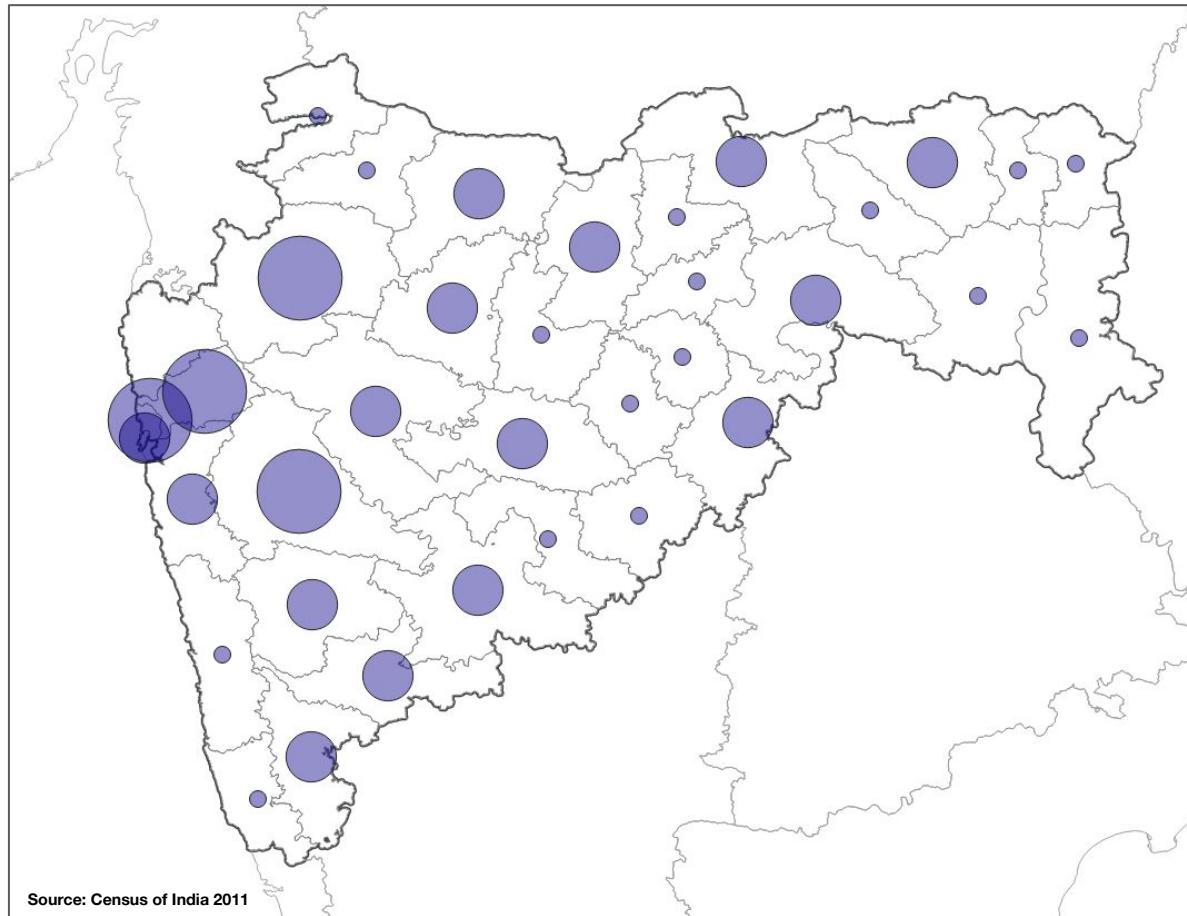
Map 6 - Proportional Symbol Map

Objective:

Create a proportional symbol map of an Indian State

Steps:

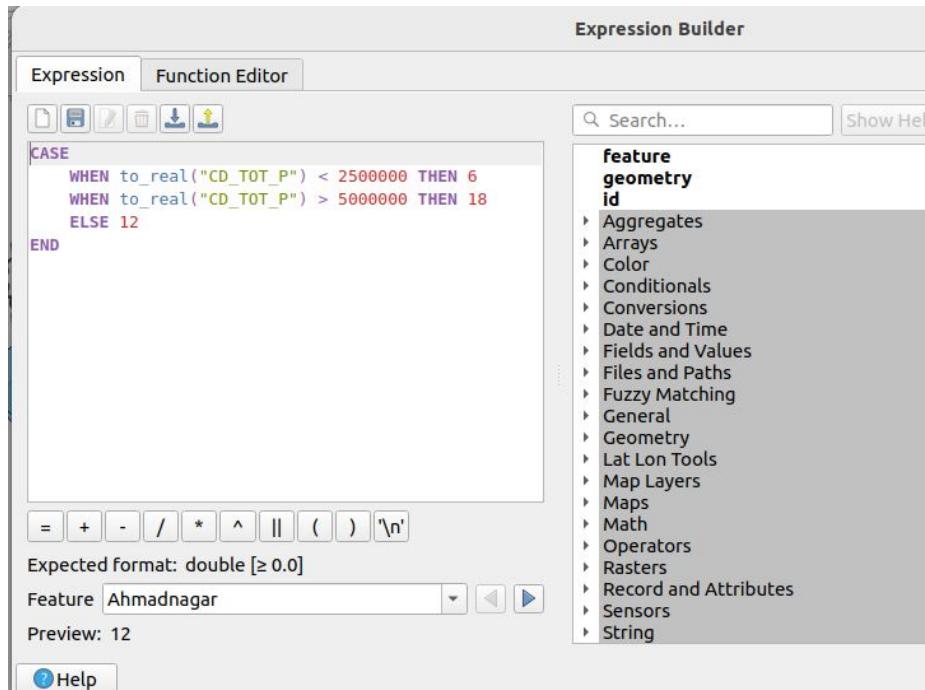
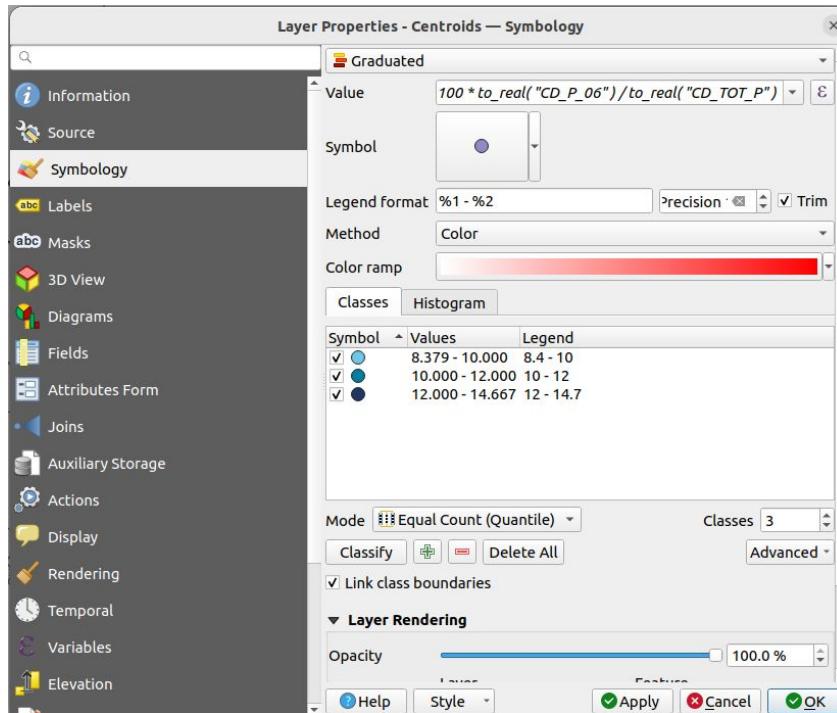
- Join in census data similar to how we did early for choropleth maps
- Create “Centroids” of the joined layer
 - Vector →
 - Geometry →
 - Centroids →
- Visualize these points by “Graduated” and “Size”



Map 6 - Proportional Symbol Map

Bonus!

Visualize both by size and colour



Map 6 - Proportional Symbol Map

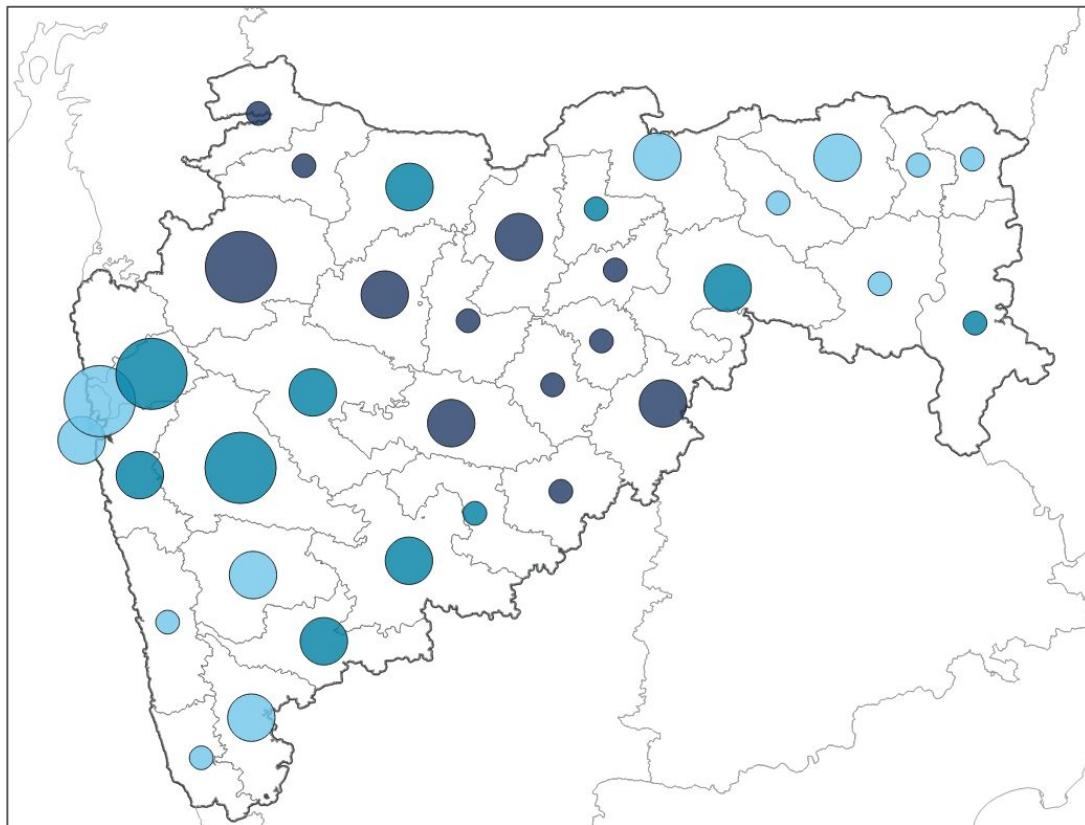
Bi-variate symbols

Visualize both both by size and colour

Size = population

Colour = % of population aged 0 to 6

This is a type of **bi-variate** map,
visualizing two variables of a dataset



Source: Census of India 2011

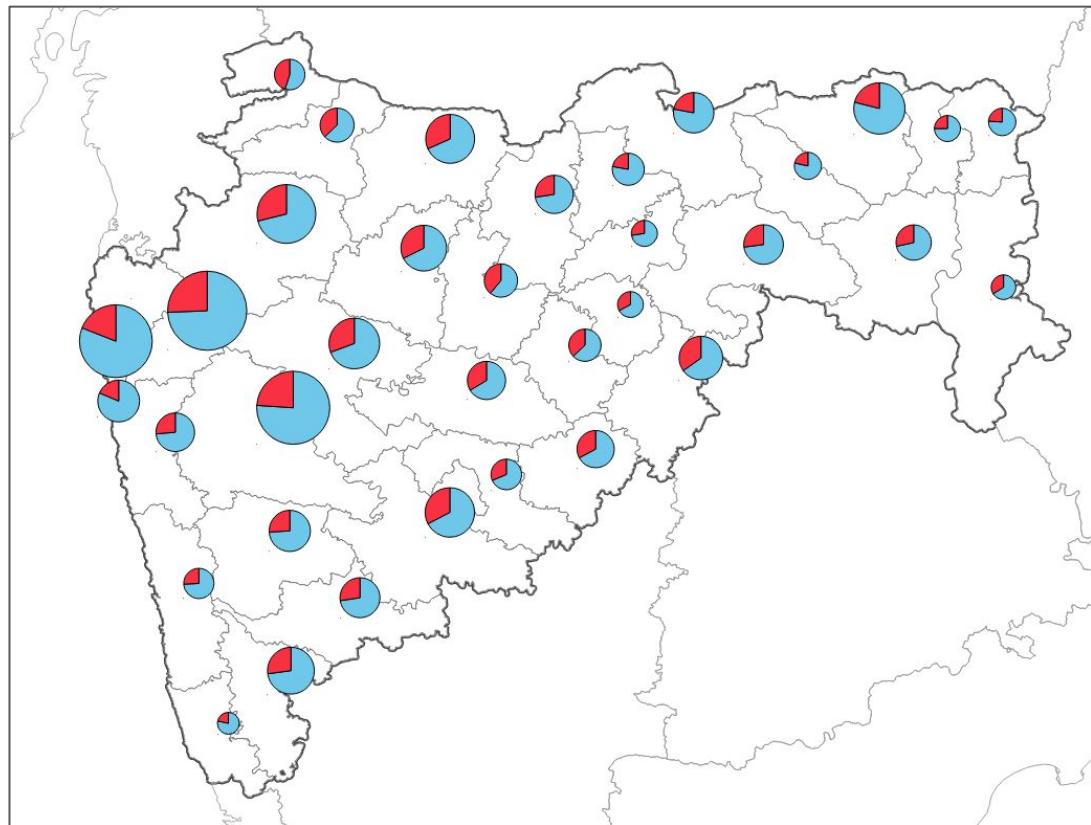
Map 6 - Proportional Symbol Map

Multivariate symbols

Creating diagram symbols

- Properties →
- Diagrams →
- Pie Chart →
- Select two variables that combine to the total population

e.g. these charts are sized by population and show % literacy



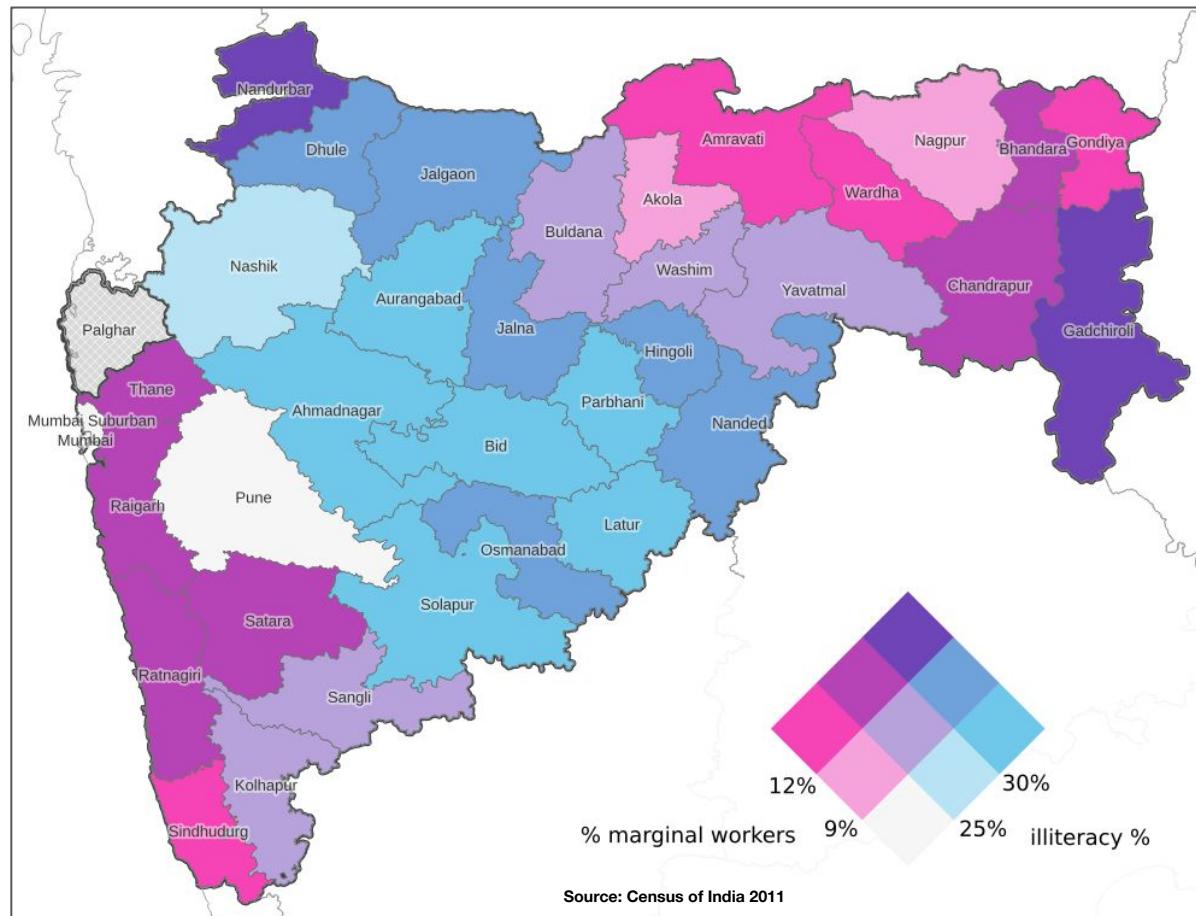
Source: Census of India 2011

Map 7 - Bi-variate Choropleth Map

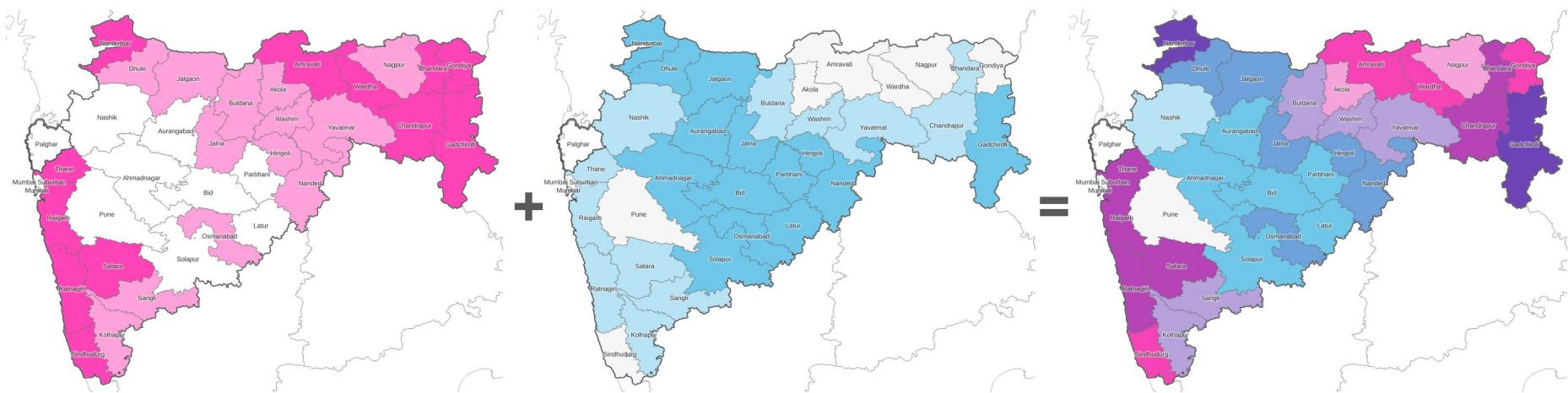
Objective:

Create a bivariate choropleth map

A combination of two choropleth maps of the same regions overlaid onto each other, blending colours together



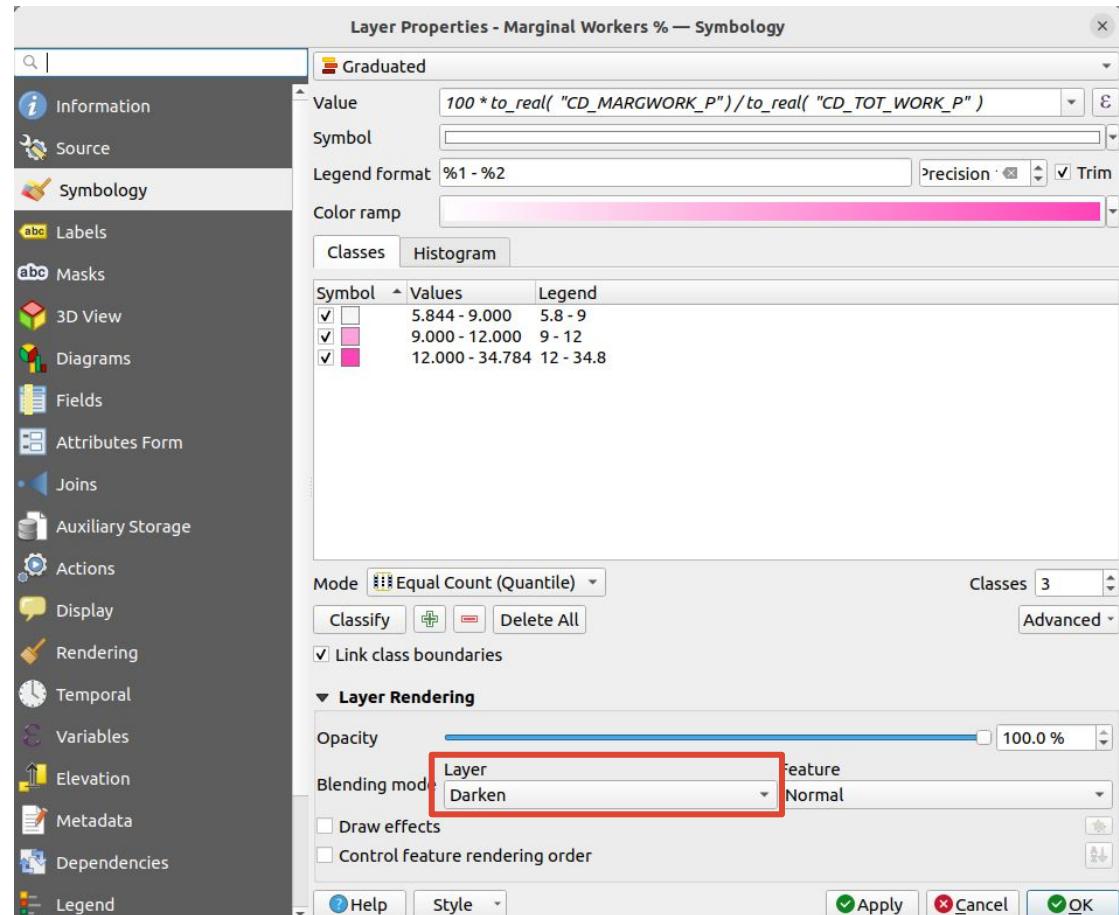
Map 7 - Bi-variate Choropleth Map



Map 7 - Bi-variate Choropleth Map

Steps:

- Create two layers, one for each variable
- Style both as graduated, into 3 classes
- For the layer on top, set the blending mode to “darken”
- May need to tinker with colours

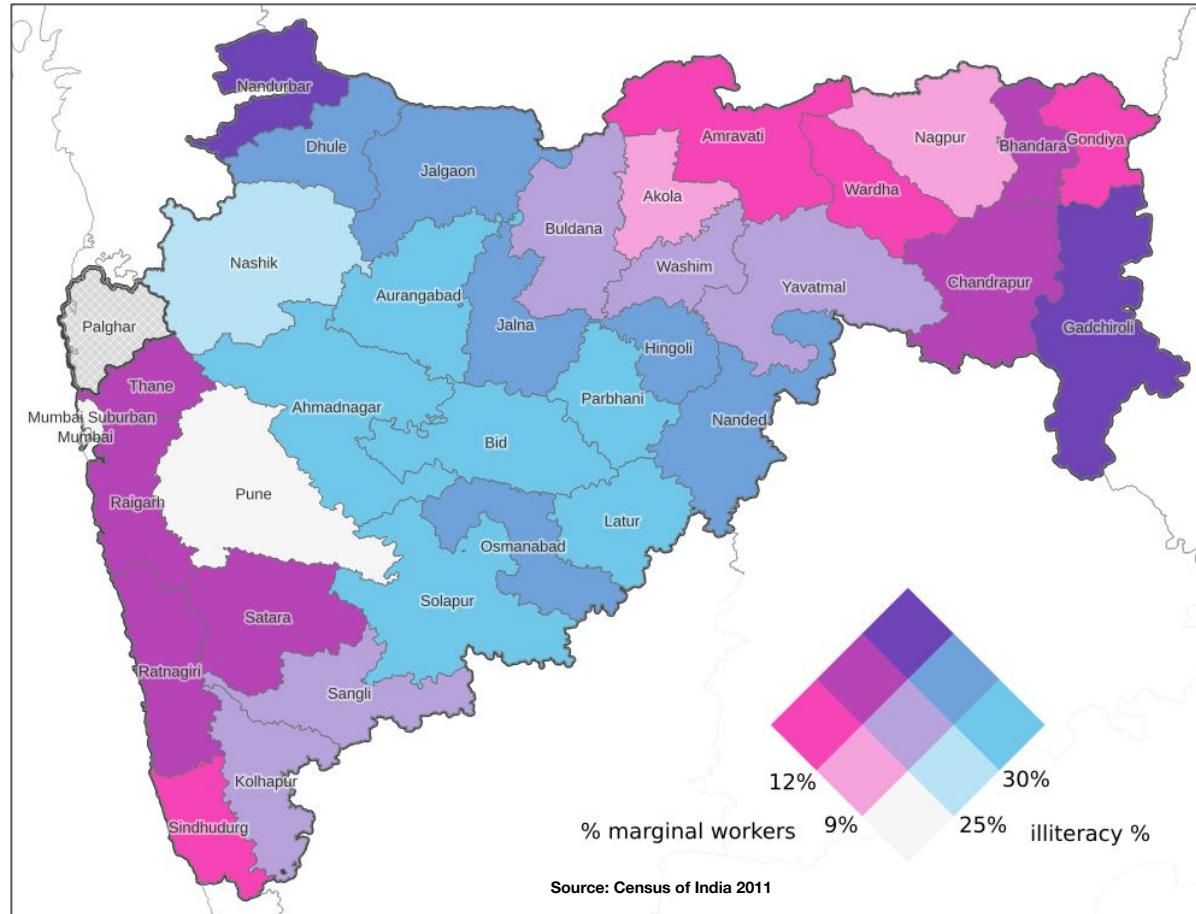


Creating Nicer Layouts

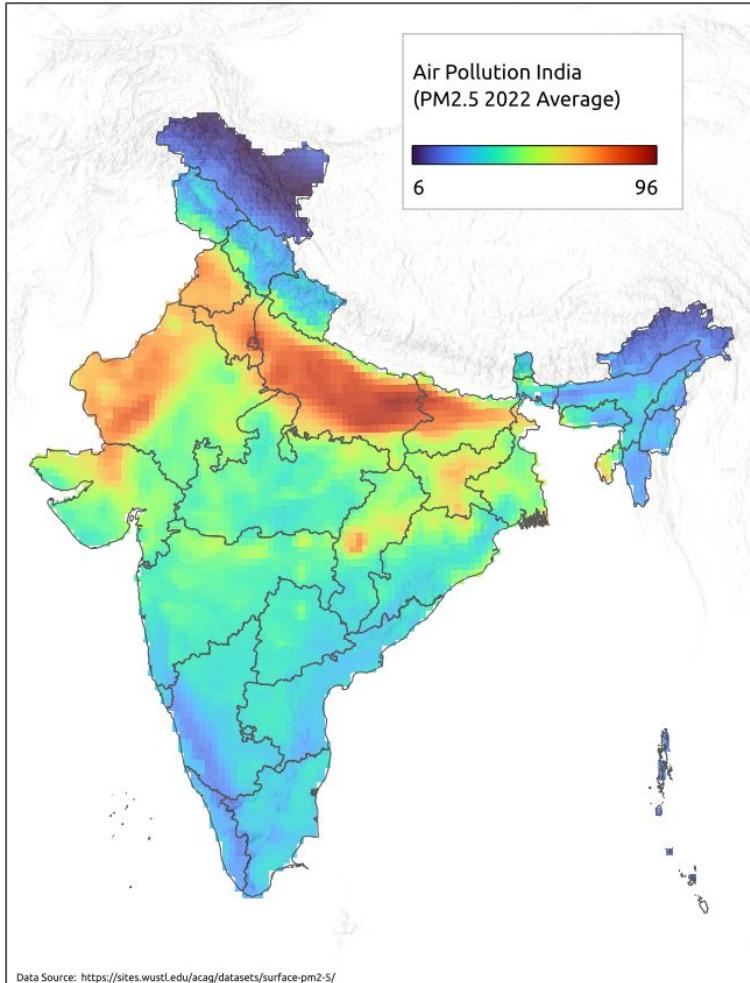
QGIS is limited in customizing layout elements

- Legends
- Annotations
- Labels
- North arrows
- Borders
- Etc.

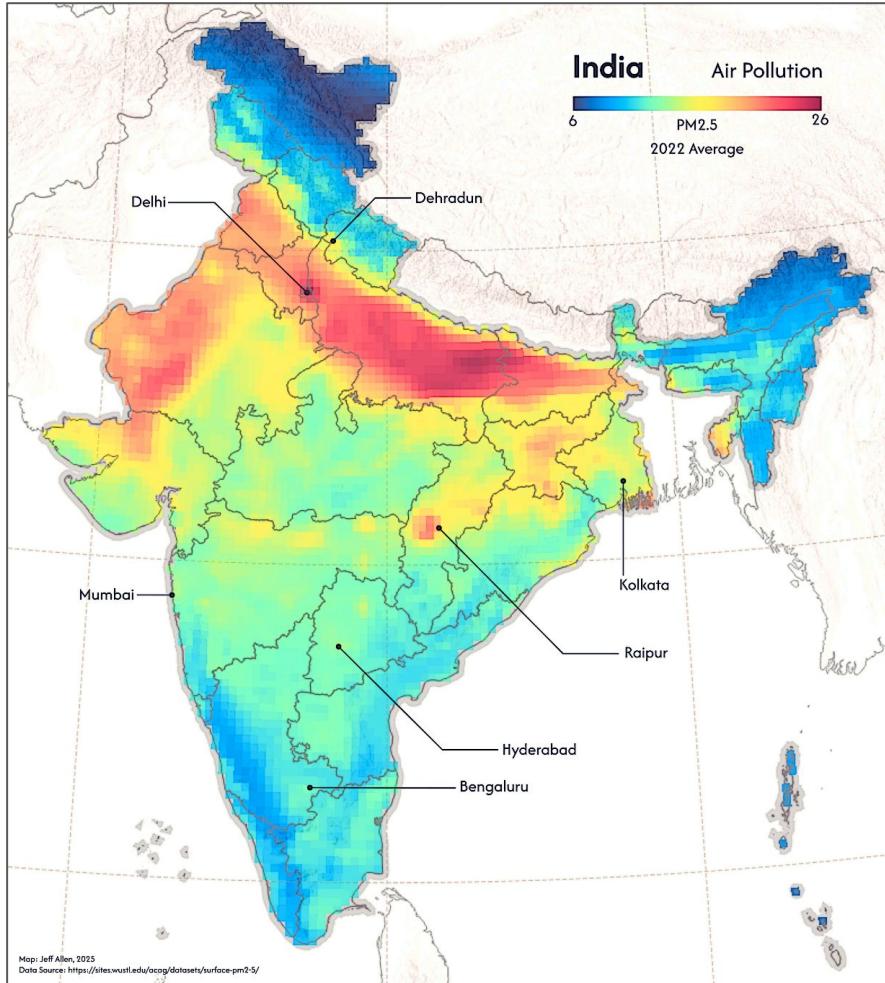
e.g. could not easily create the bi-variate legend in QGIS - so I exported the map image, then created the legend in the graphic design software **Inkscape**



QGIS (~5 minute layout)



QGIS + Inkscape (~30 minute layout)



Consider Context / Setting

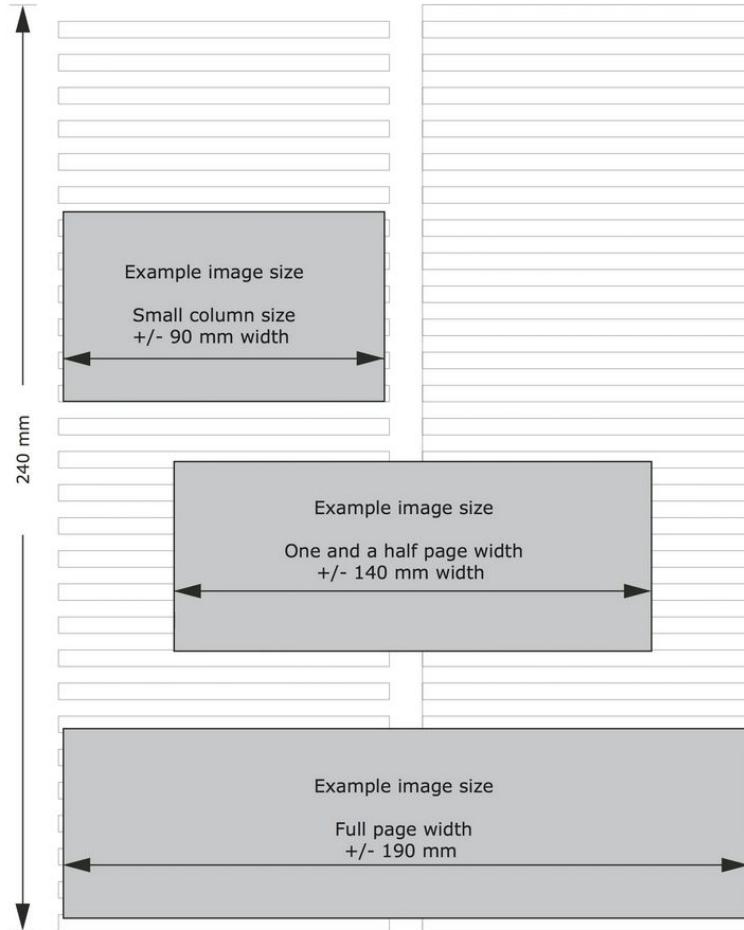
Web & Mobile Viewing

Social Media

Presentation Slides

In a PDF/Word Document

In an Online Article



Design Guidelines

Trade Gothic

A B C D E F G H I J K L M N O P Q R S T U V W X Y Z
a b c d e f g h i j k l m n o p q r s t u v w x y z
1 2 3 4 5 6 7 8 9 ! @ # \$ % &

The acceptable replacement for Trade Gothic, which is available on most computer operating systems, is **Arial**.

Bembo

A B C D E F G H I J K L M N O P Q R S T U V W X Y Z
a b c d e f g h i j k l m n o p q r s t u v w x y z
1 2 3 4 5 6 7 8 9 0 ! @ # \$ % &

The acceptable replacement for Bembo, which is available on most computer operating systems, is **Times New Roman**.

Primary



U of T Blue Pantone 655

CMYK 100/79/12/59
RGB 30/55/101
HEX #1E3765

Secondary



Pantone 633

CMYK 98/6/10/29
RGB 0/127/163
HEX #007FA3



Pantone 2613

CMYK 74/99/5/11
RGB 109/36/122
HEX #6D247A



Pantone Warm Red

CMYK 0/83/80/0
RGB 220/70/51
HEX #DC4633



Pantone 2985

CMYK 60/0/3/0
RGB 111/199/234
HEX #6FC7EA



Pantone 3285

CMYK 98/0/59/0
RGB 0/161/137
HEX #00A189



Pantone 227

CMYK 7/100/10/21
RGB 171/19/104
HEX #AB1368



Pantone 7722

CMYK 89/0/45/72
RGB 13/83/77
HEX #0D534D



Pantone 7406

CMYK 0/20/100/2
RGB 241/197/0
HEX #F1C500

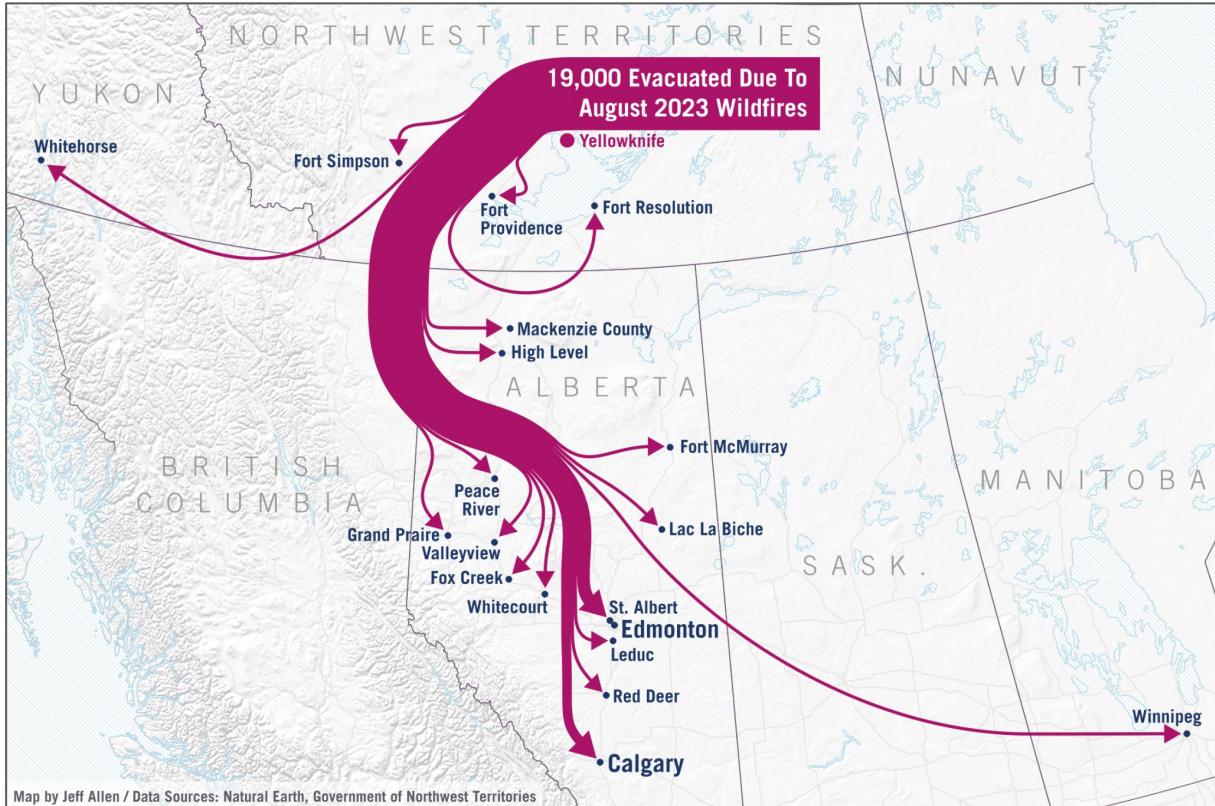


Pantone 376

CMYK 54/0/100/0
RGB 141/191/46
HEX #8DBF2E

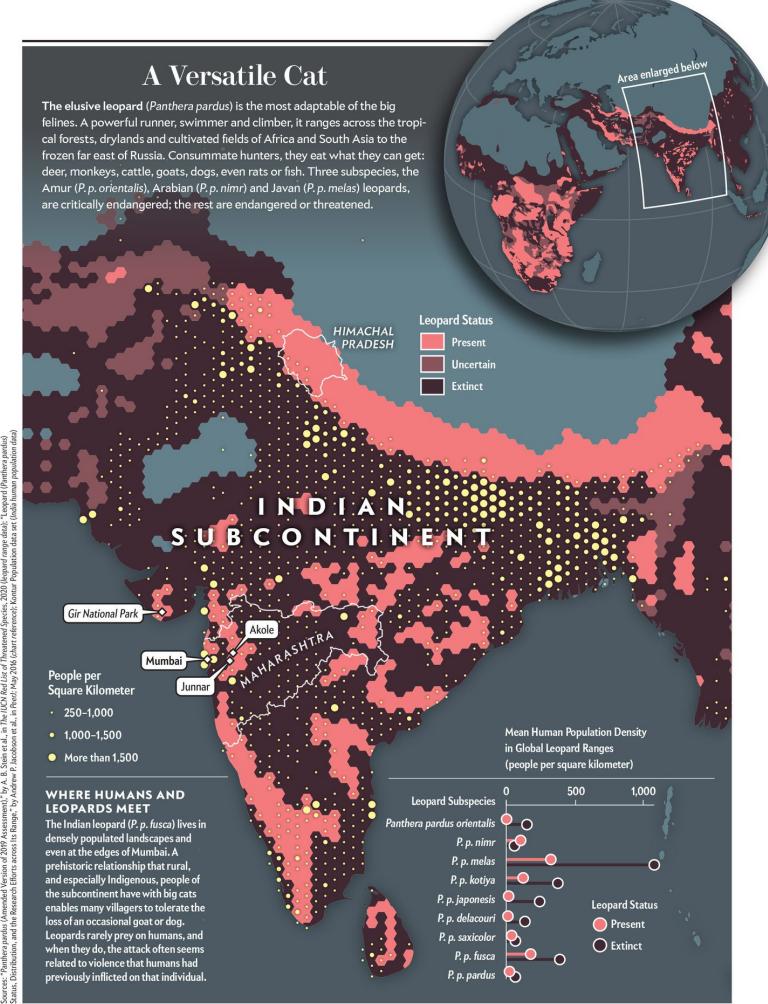
Visual Design

- Hierarchy
- Balance
- Harmony



Visual Design

- Hierarchy
- Balance
- Harmony





Source: National Geographic

List of other tools we use ..

- Processing / analyzing / visualizing data
 - Python, R, SQL
- Graphic design / layouts
 - Inkscape, GIMP
- Web development
 - HTML, CSS, Javascript, Svelte
- Web-based maps/viz
 - D3, MapLibre, PMtiles
- Hosting / project management
 - GitHub

The screenshot shows the GitHub organization page for 'School of Cities, University of Toronto'. The page includes a repository overview, a list of popular repositories, and sections for discussions and people.

Popular repositories:

- historical-aerial-imagery-toronto (Public)
- gentle-density (Public)
- mapping-workshops-2023 (Public)
- parking-tickets-toronto (Public)
- downtown-recovery (Public)
- bike-share-toronto (Public)

Repositories:

- gentle-density (Public)
- air-pollution-and-premature-mortality (Public)
- access-programs (Private)
- yellowknife (Public)
- bike-share-toronto (Public)
- non-profit-real-estate (Public)
- venture-capital-canada (Public)

People: Shows a grid of user icons.

Top languages: Svelte, Jupyter Notebook, CSS, HTML, Python.

Remainder of workshop

In small groups (1-3 participants), select one or more datasets (can be one from your own research or organization, or data provided earlier in this workshop) and to create one or more maps telling a specific story around that dataset

Short (~5 minute) presentations sharing what you've found and created to the group.



Thank you! :)

Email: jeff.allen@utoronto.ca

School of Cities Website: schoolofcities.ca

Personal Website: jamaps.github.io

GitHub: [@jamaps](https://github.com/jamaps)

