A background map showing a network of roads and paths. A central area is highlighted in yellow and orange, while a larger area to the right and bottom is highlighted in blue. The map is overlaid with a grid of light gray lines.

Spatial is Special

Intro to GIS for URB 670

Sarah Zhang

GIS/Map Librarian, SFU Library

2022 Spring

Learning objectives

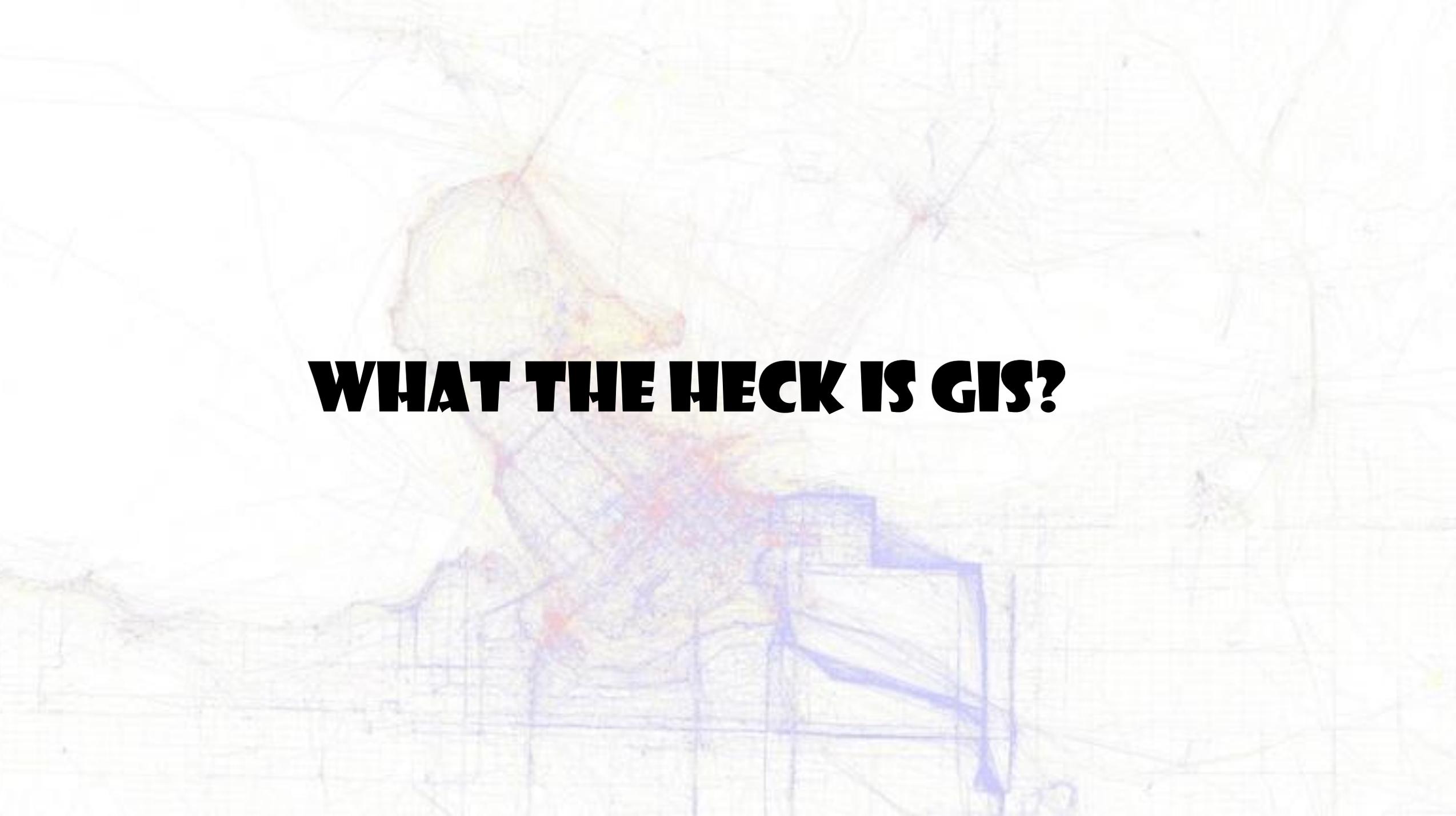
- Get a basic idea of what GIS is, and how it works (attribute table, visual representation, and analytical tools), basic data types.
- Get a basic idea of spatial analysis and spatial thinking.
- How to avoid making a misleading map.

Survey: how much GIS experience do you have?

Little to No

Advanced



The background is a map with a grid of roads. A large, irregularly shaped area in the center is highlighted in a semi-transparent blue color. This area appears to be a specific region or district within a larger urban or suburban layout. The text is overlaid on this map.

WHAT THE HECK IS GIS?

Example: traffic and driving queries

The screenshot displays a Google Maps interface with a cycling route highlighted in blue. The route starts at 'The University of British Columbia' and ends at 'Vancouver General Hospital'. The map shows the city of Vancouver, including areas like West Point Grey, Kitsilano, and Fairview. A sidebar on the left provides route details:

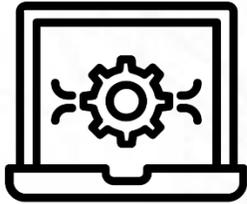
- Send directions to your phone
- via W 10th Ave/10th Avenue Bikeway: 37 min, 10.1 km
- via Seaside Bicycle Route: 42 min, 12.3 km (Note: This route has restricted usage or private roads.)

A vertical elevation profile on the left shows the route's altitude, ranging from 21 meters to 95 meters. The map interface includes a search bar at the top with the origin and destination, and various navigation icons.

Screenshot: maps.google.com

What is GIS?

Software?



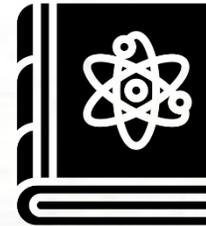
Created by remmachenasreddine
from Noun Project

hardware?



Created by Aficons
from Noun Project

science?

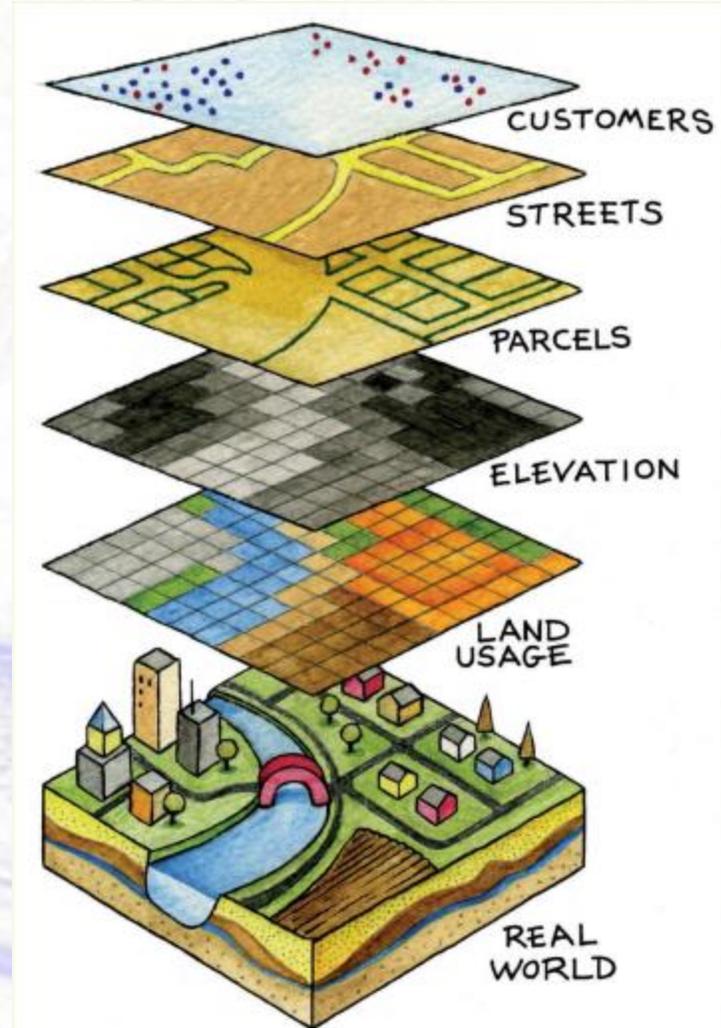


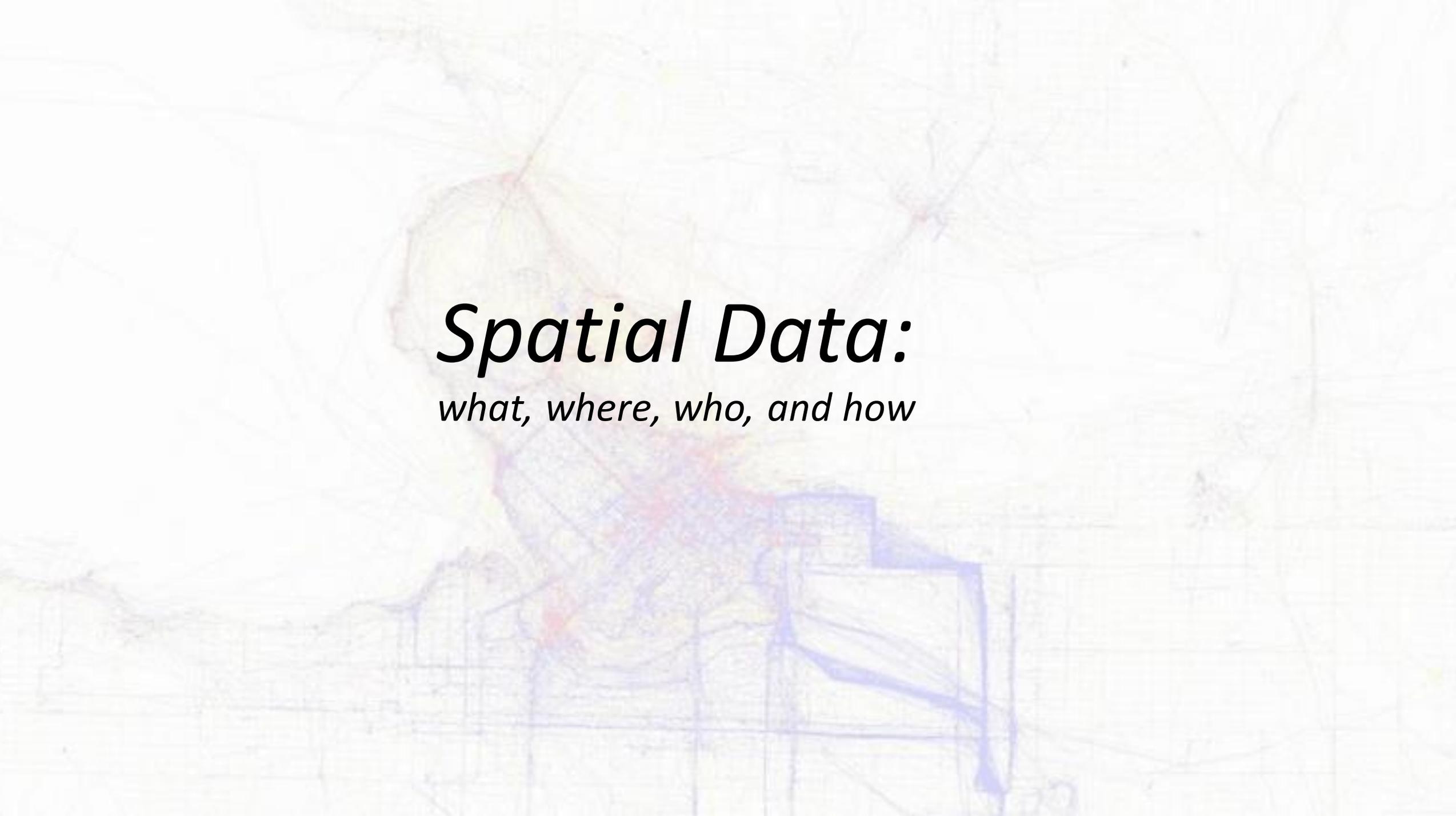
Created by Komkrit Noenpoempiut
from Noun Project

Answer: all of the above! And more!

What is GIS?

- A GIS allows us to **maintain, analyze, and share** a wealth of data and information (usually in **layers**).





Spatial Data:

what, where, who, and how

What is spatial data?

- Is this spatial data?

Table 1.2

ID	Type	Description
42	Patrol	Light-weight veh..
43	Intercept	Performance crui..
44	Ambulance	2-axel diesel truc..

What is spatial data?

- Geographic data represent spatial locations and non-spatial attributes measured at certain times.
- What questions can this data answer?

Table 1.3

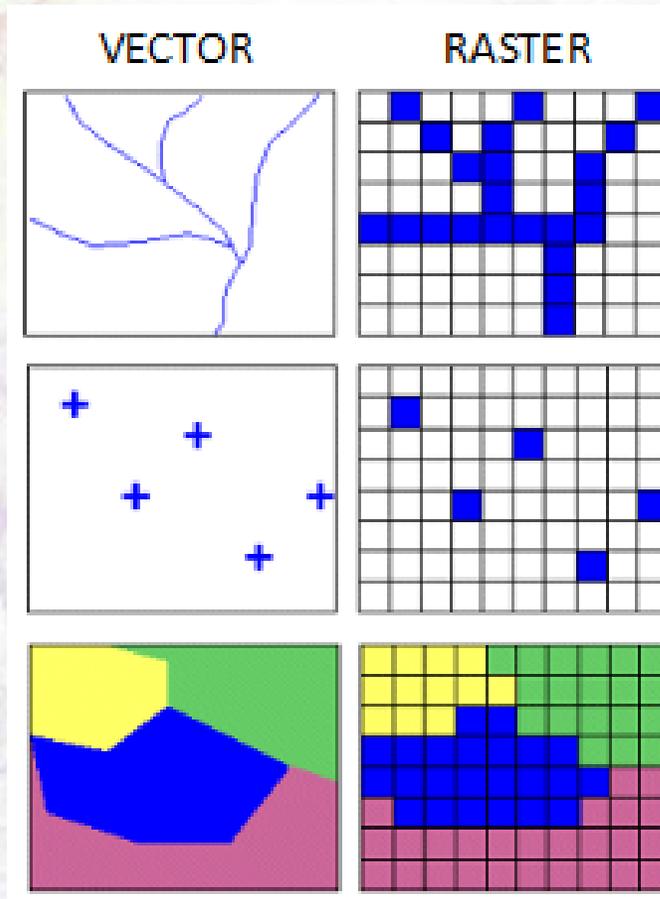
ID	Type	Description	Latitude	Longitude
42	Patrol	Light-weight veh..	40.776853	-77.87650
43	Intercept	Performance crui..	34.594421	-80.301819
44	Ambulance	2-axel diesel truc..	34.612899	-79.635086

Source: [Mapping our changing world](#). Penn State University Open Course

Two types of spatial data

VECTOR DATA

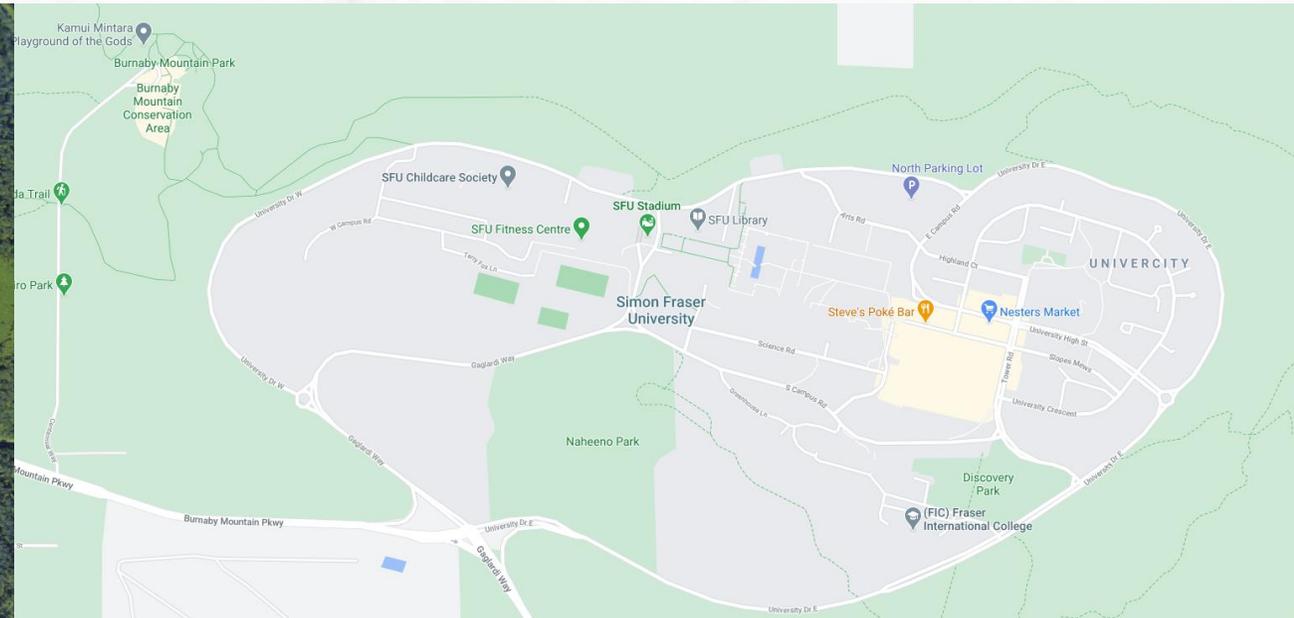
- Discrete shapes with crisp boundaries
- Database queries of shape attributes
- Points
- Lines
- Polygons



RASTER DATA

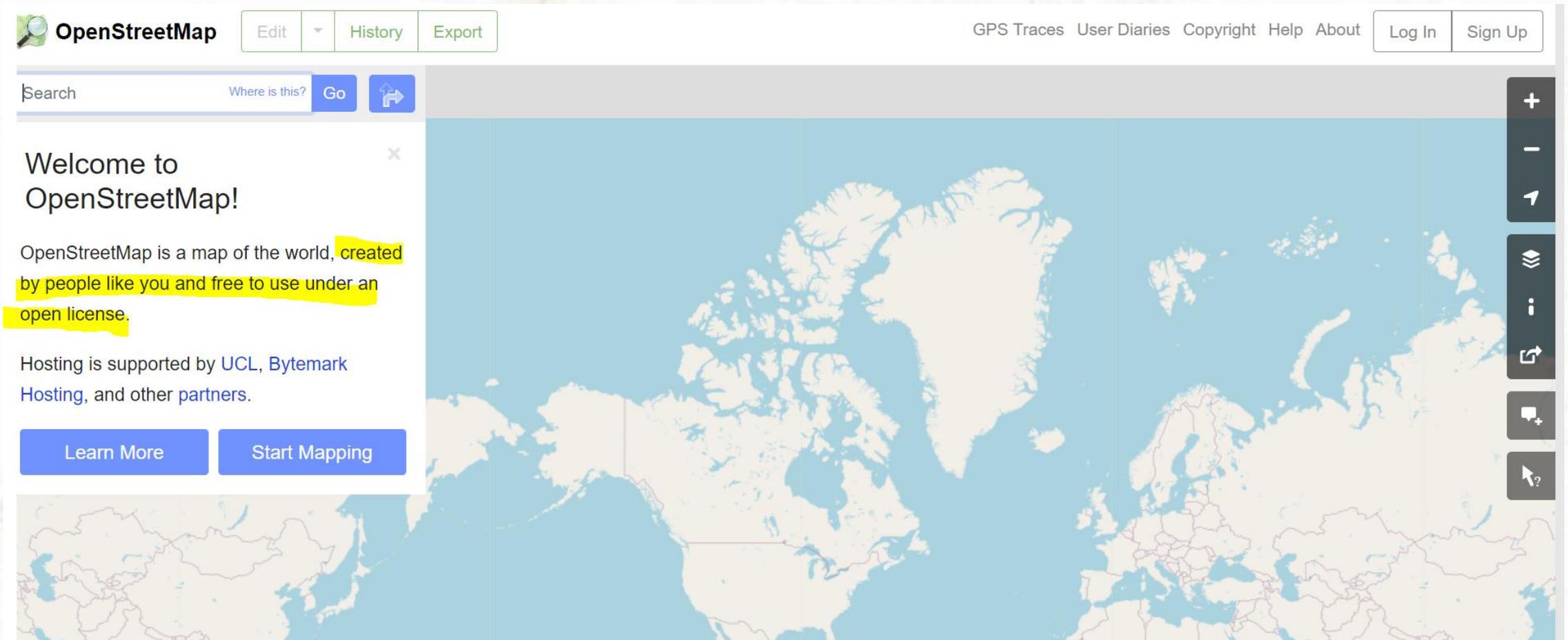
- Continuous surfaces with fuzzy boundaries
- Spatial modelling of continuous features
- Aerial photography
- Satellite imagery
- Digital elevation models (DEM)

Example:



Source: Google Maps

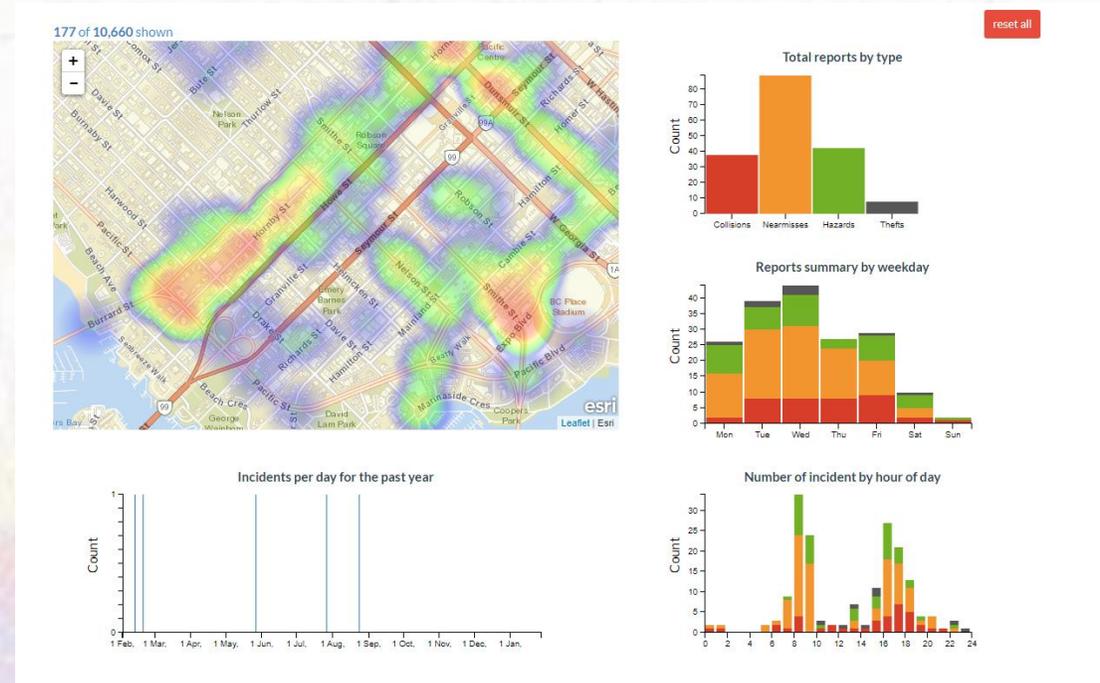
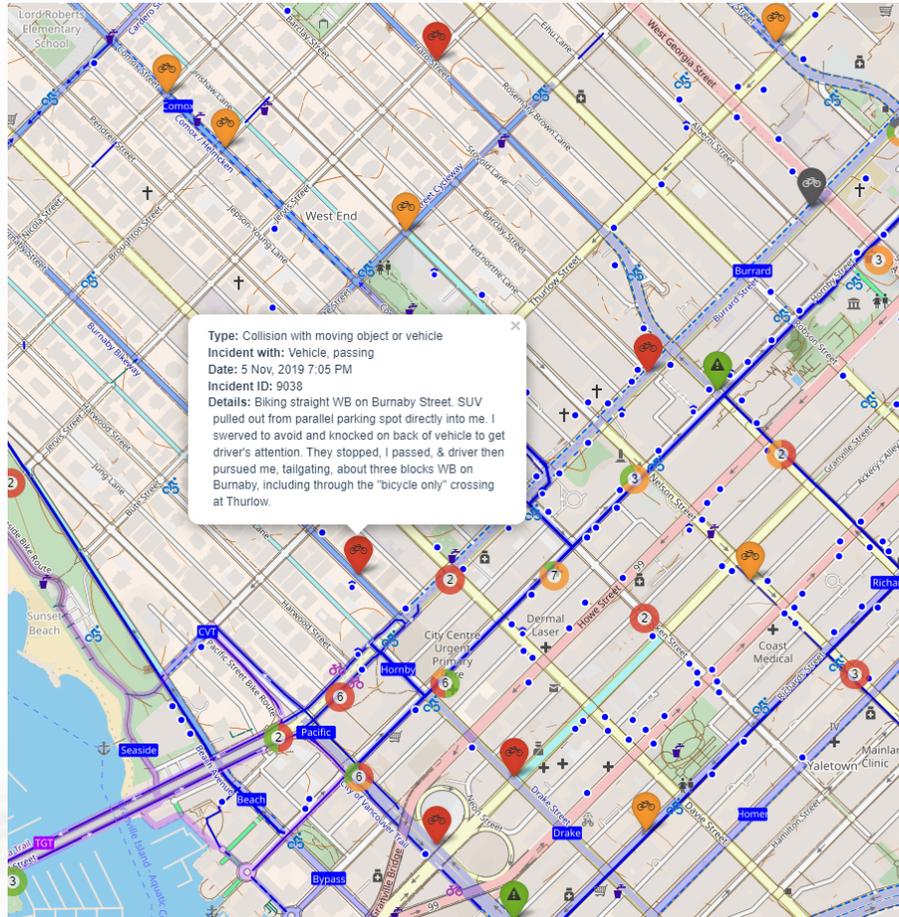
The rise of Volunteered Geographic information



The screenshot shows the OpenStreetMap website interface. At the top left is the OpenStreetMap logo. To its right are buttons for 'Edit', 'History', and 'Export'. Further right are links for 'GPS Traces', 'User Diaries', 'Copyright', 'Help', and 'About'. On the far right are 'Log In' and 'Sign Up' buttons. Below the logo is a search bar with the text 'Search' and 'Where is this?' followed by 'Go' and a share icon. A large white welcome message box is overlaid on the left side of the map. The message reads: 'Welcome to OpenStreetMap! OpenStreetMap is a map of the world, created by people like you and free to use under an open license. Hosting is supported by UCL, Bytemark Hosting, and other partners.' Below the text are two buttons: 'Learn More' and 'Start Mapping'. The background is a world map with a blue overlay on the Americas. On the right side of the map, there is a vertical toolbar with icons for zooming in (+), zooming out (-), home, full screen, and other map controls.

Openstreetmap.org

Compare this website: [BikeMaps.org](https://www.bikemaps.org)



And this article



Accident Analysis & Prevention
Volume 45, March 2012, Pages 164-172



Mapping commuter cycling risk in urban areas

Nikolaos Yiannakoulias ^a, Scott A. Bennet ^a, Darren M. Scott ^b

Show more

+ Add to Mendeley Share Cite

<https://doi.org/10.1016/j.aap.2011.12.002>

Get rights and content

Data source:

“A cyclist-motor vehicle collision database maintained by the City of Hamilton was used to obtain information on bicycle collisions involving motor vehicles. Minor collisions that did not involve police or other emergency services at the site of collision are not included.”

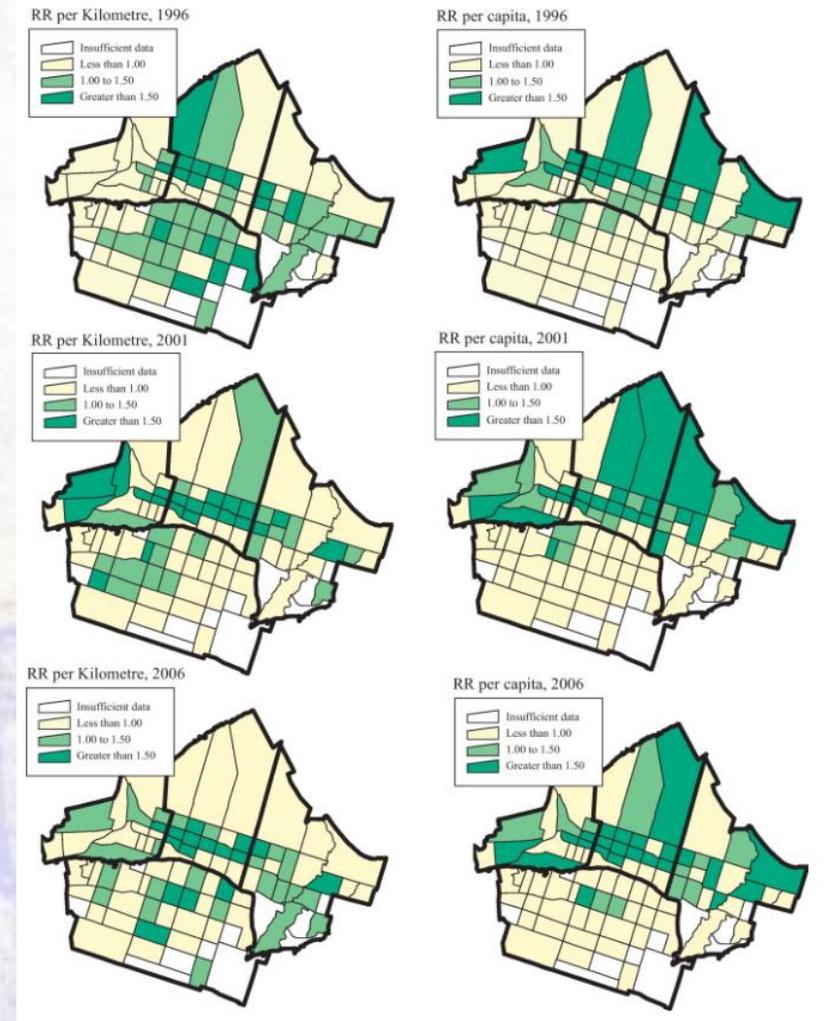


Figure: Maps of modelled relative risk per kilometre and per capita

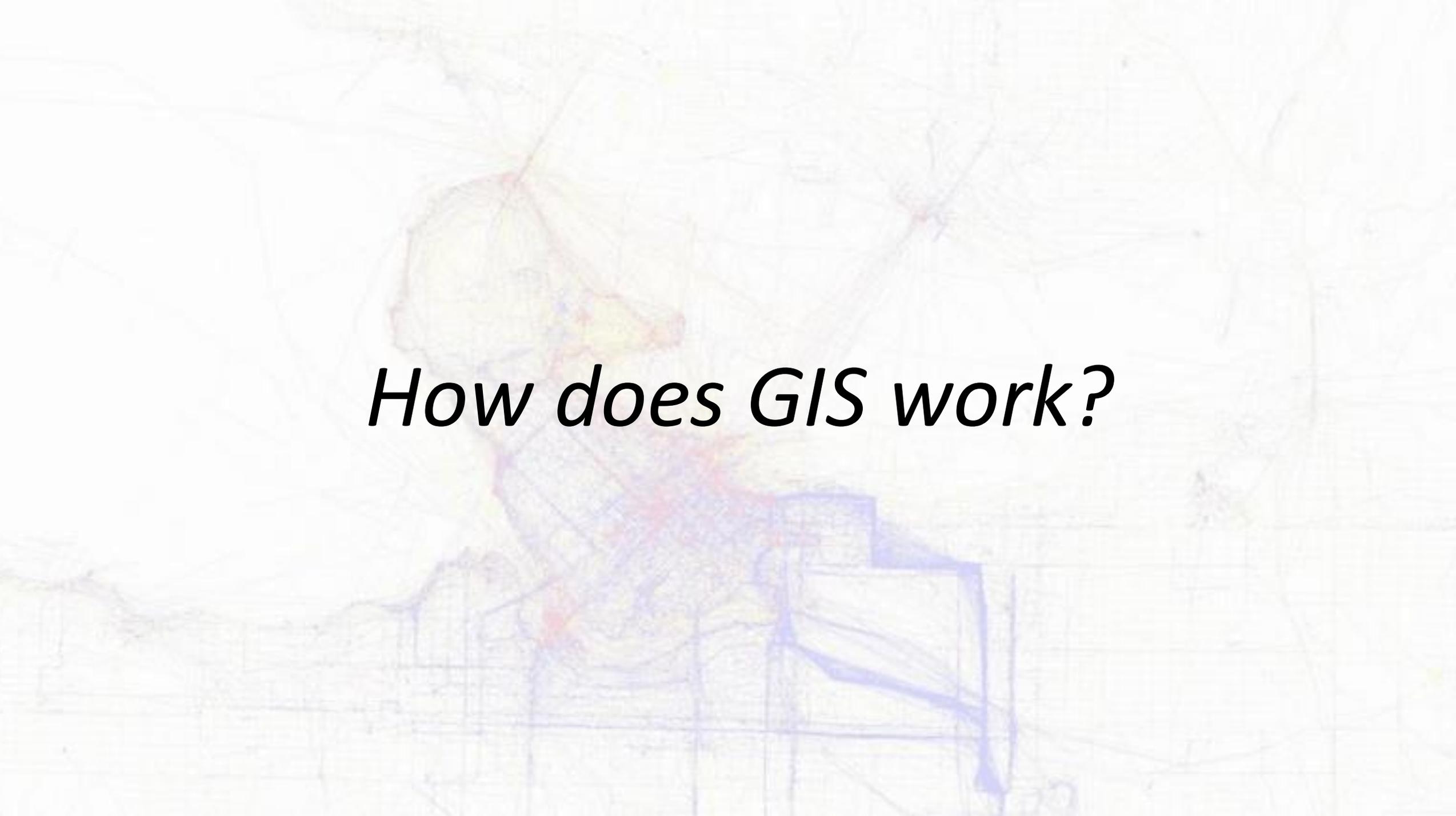
Where to find spatial data?

- Government open data portals, i.e. City of Vancouver Open Data Portal, Data BC, Vancouver Police Department Open Data, etc
- Library licensed data
- Spatial data search portals: FRDR

For more information, visit <https://www.lib.sfu.ca/find/other-materials/data-gis/gis/spatial-data>

Can I create spatial data myself? Yes!

- Desktop GIS software: create feature layers
- Create a csv file with coordinates for each point
- Use ArcGIS Collector, an app for mobile devices, for field data collection



How does GIS work?

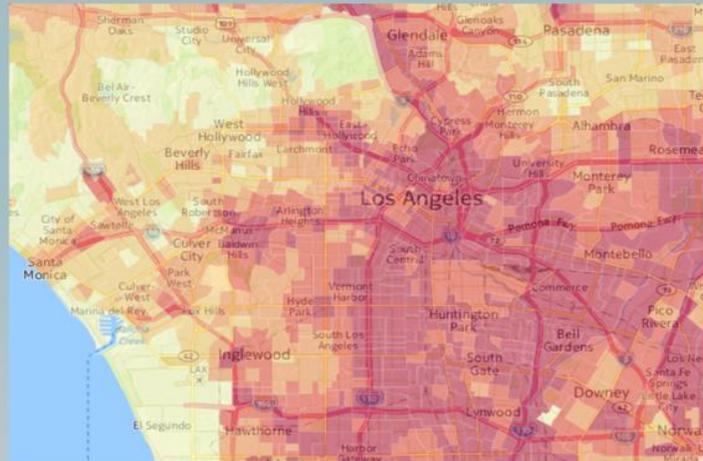
What does GIS allow you to do?

- Create geographic data.
- Manage it in a database.
- Analyze and find patterns.
- Visualize it on a map.

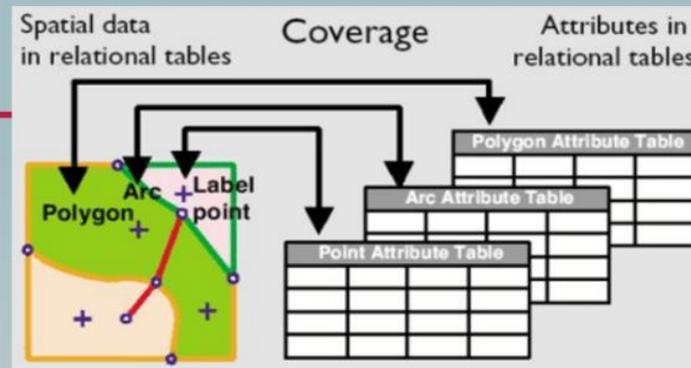


Source: GIS Geography. "What is Geographic Information System". Last modified February 27, 2021, <https://gisgeography.com/what-gis-geographic-information-systems/>

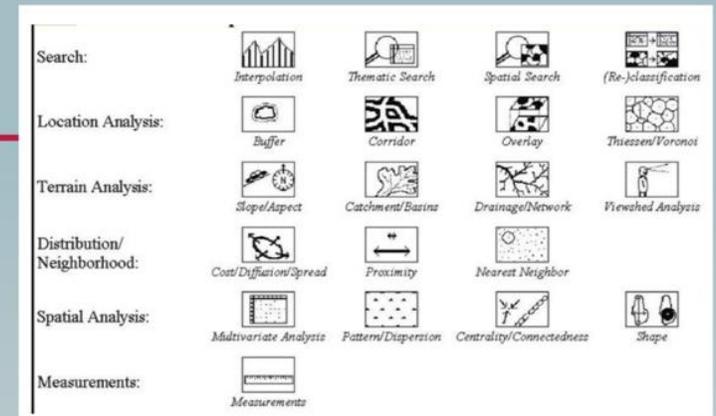
GIS Components



Visual representation



Relational database

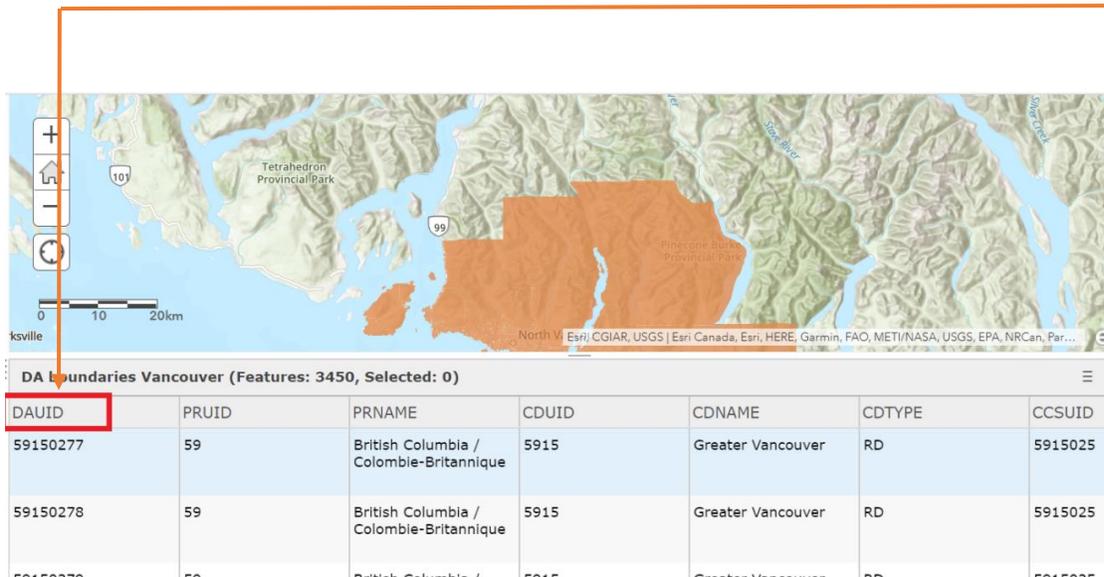


Spatial analysis tools

Attribute table

- Feature data is stored in the 'Attribute Table'.
- Attribute tables are made up of rows and columns that contain information relative to the different features in the file.
- Open the attribute tables of the data we imported to explore what each file is.

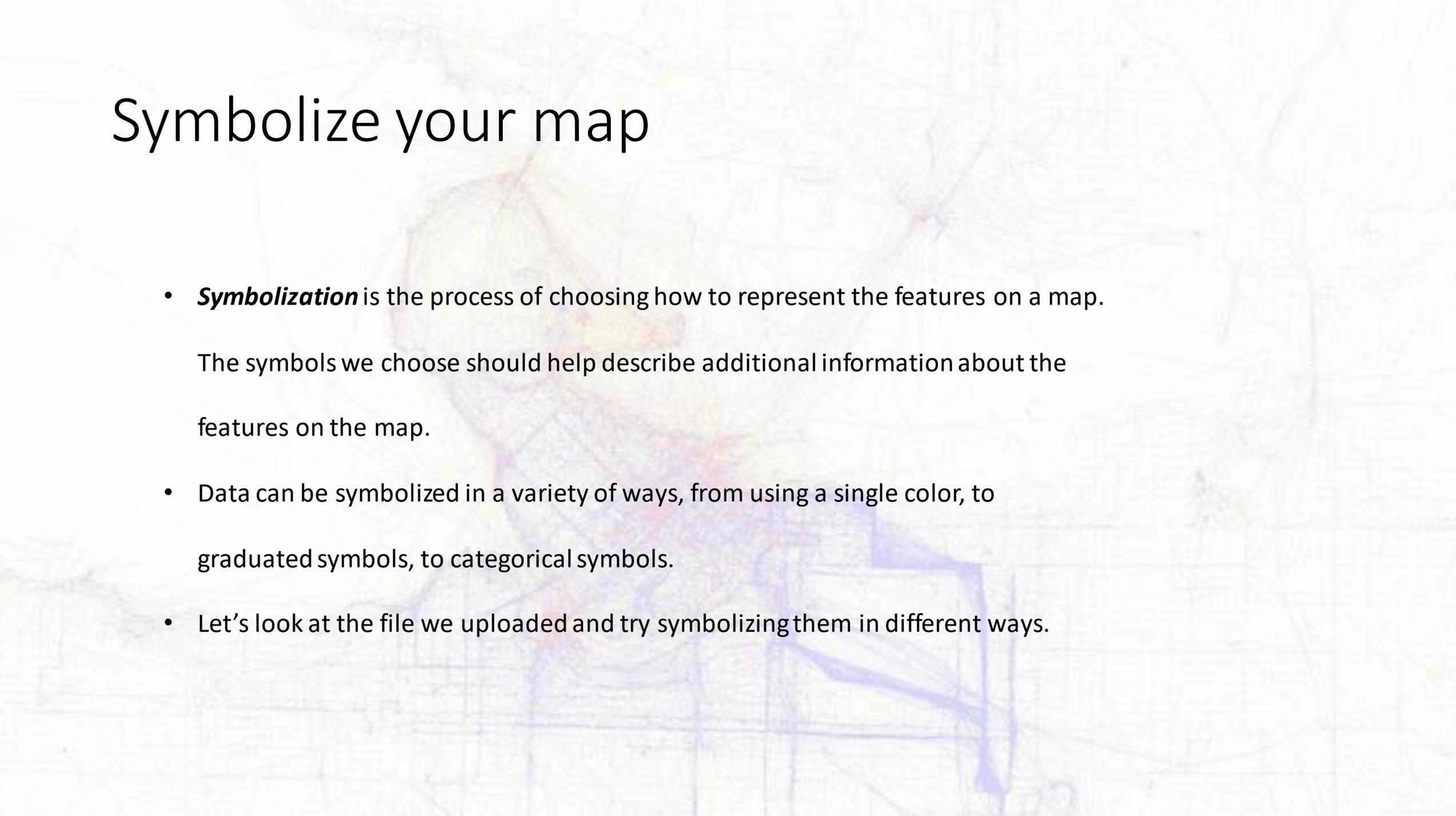
Attribute Join



A	B	C	D
DAUID	Total_pop	Visible_minority	
59150004	370	70	
59150005	500	55	
59150006	460	85	
59150007	515	50	
59150008	645	85	
59150009	405	65	
59150010	740	105	
59150012	455	170	
59150013	390	100	
59150014	1100	485	
59150015	530	105	
59150016	415	125	
59150017	285	75	
59150018	530	130	
59150019	495	30	
59150020	370	150	
59150021	285	0	
59150022	335	135	

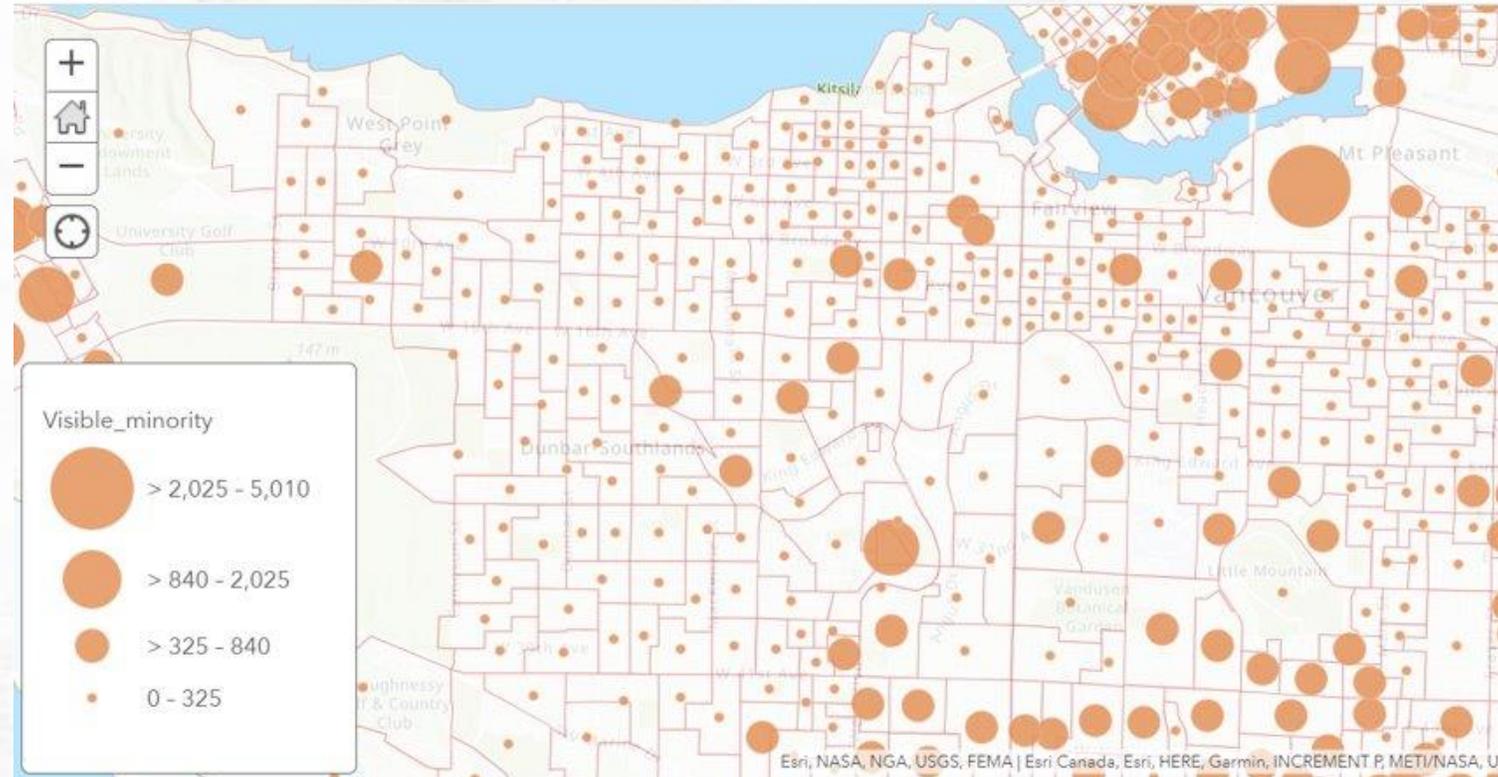
Attribute Join: you can join a table of data to a layer based on the value of a field that can be found in both tables.

Symbolize your map



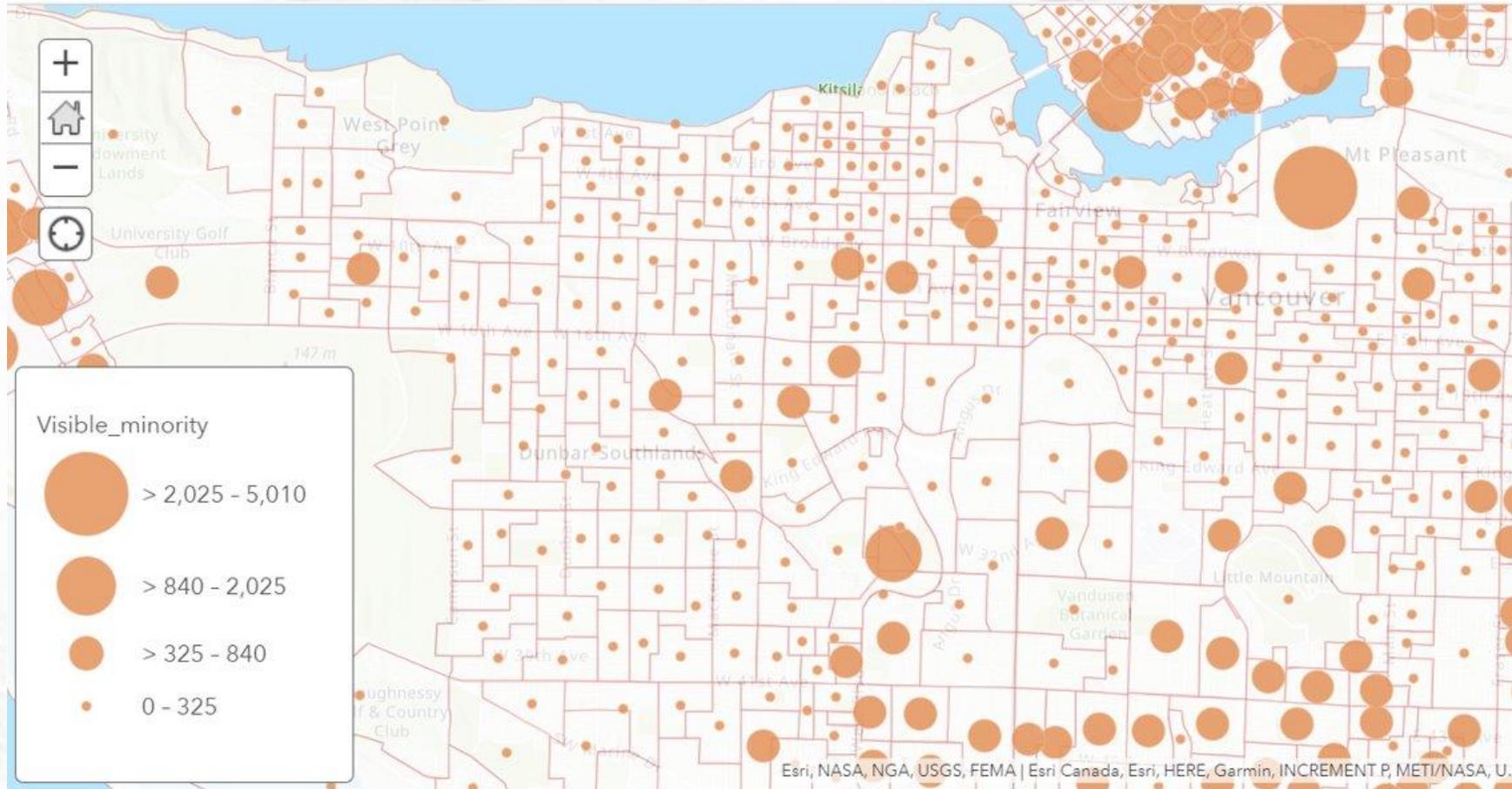
- **Symbolization** is the process of choosing how to represent the features on a map.
The symbols we choose should help describe additional information about the features on the map.
- Data can be symbolized in a variety of ways, from using a single color, to graduated symbols, to categorical symbols.
- Let's look at the file we uploaded and try symbolizing them in different ways.

Proportional symbol maps

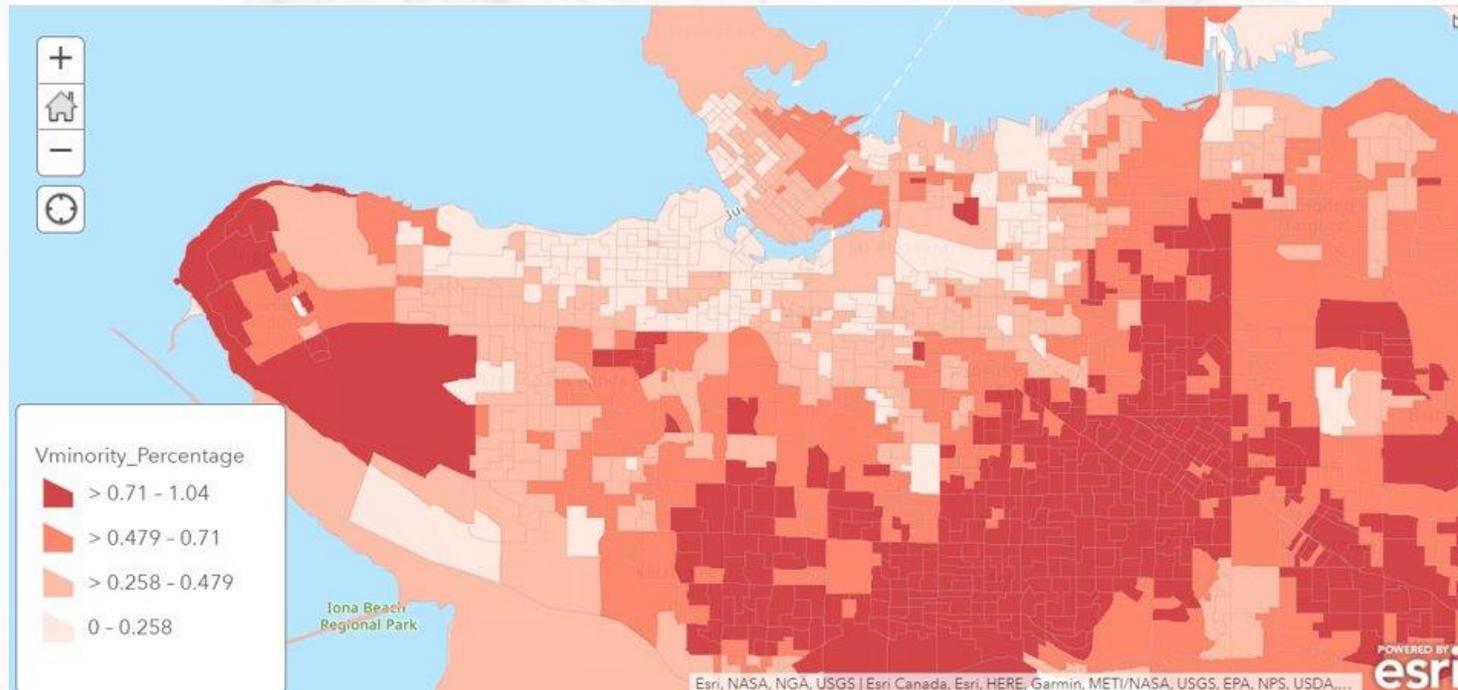


Symbols in which the graphic variable of size is used to depict data magnitude.

Wait a minute... is it right to map the number of visible minority people?



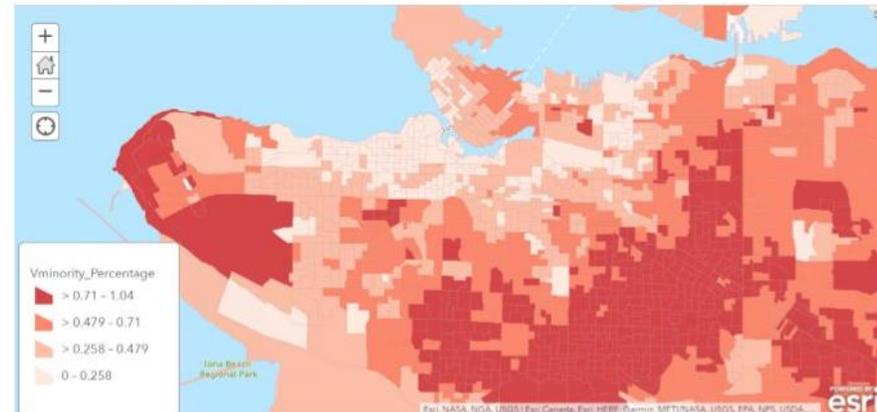
Choropleth maps



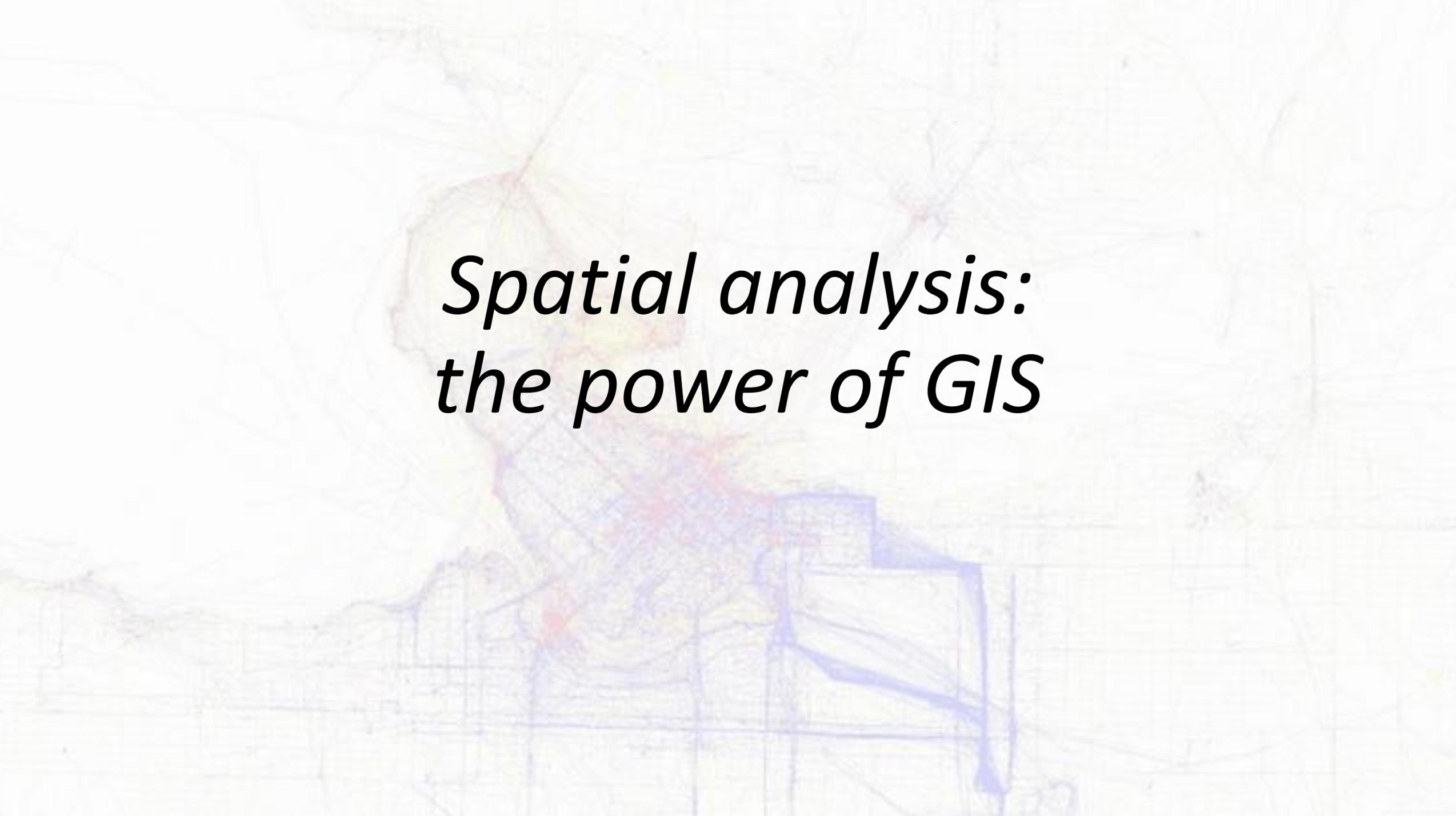
Choropleth maps represent quantitative data that is aggregated to areas.

Proportional symbol maps vs. Choropleth maps

- Graduated point symbols are best for displaying raw quantity: **amount/counts**
- Choropleth maps are best for displaying intensity, including **density/rate/percent**



A misleading choropleth map: an article "As Vancouver Shrinks, the Suburbs Swell" from the Tyee, Jan 20, 2022 <https://thetyee.ca/News/2022/01/20/Vancouver-Shrinks-Suburbs-Swell/>



*Spatial analysis:
the power of GIS*

Filtering and Querying Data

Query by Attribute

- Map features and their associated data can be retrieved via the query of attribute information within the data tables.
- Challenge: How do we find all the DAs that have the percentage of minority people greater than 50%?

Filtering and Querying Data

Query by Geography (Spatial Query)

Query by geography, also known as a “spatial query,” allows one to highlight particular features by examining their position relative to other features.

Challenge:

How do you find all the DAs within 5 km of Vancouver General Hospital (VGH)?

Steps:

1. create a csv file for Vancouver General Hospital with coordinates
2. upload it to AGOL and add it to your map viewer
3. create a 5km buffer for VGH
4. do an "intersect" analysis for two layers: DAs and the 5km buffer

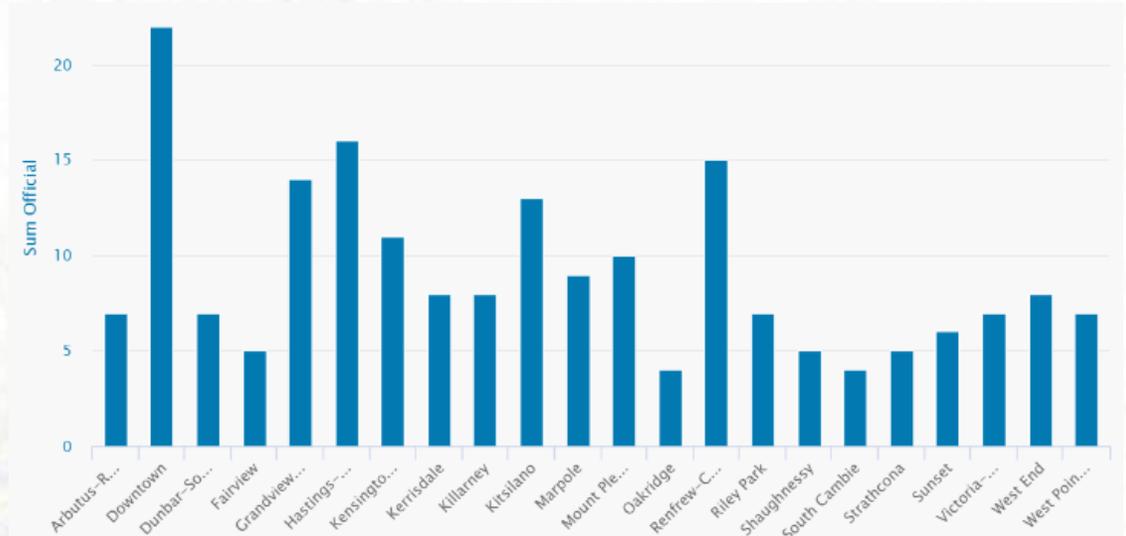
Fundamentals of spatial analysis

- GIS software packages use databases to store extensive attribute information for geospatial features within a map.
- The true usefulness of this information, however, is not realized until similarly powerful analytical tools are employed to access, process, and simplify the data.
- To accomplish this, GIS typically provides extensive tools for *searching, querying, describing, summarizing, and classifying* datasets. With these data exploration tools, even the most expansive datasets can be mined to provide users the ability to make *meaningful insights into* and statements about that information.

Source: “Data Characteristics and Visualization”, chapter 6 from the book [Geographic Information System Basics](#) (v. 1.0).

Thinking spatially

How many parks are in the city of Vancouver?

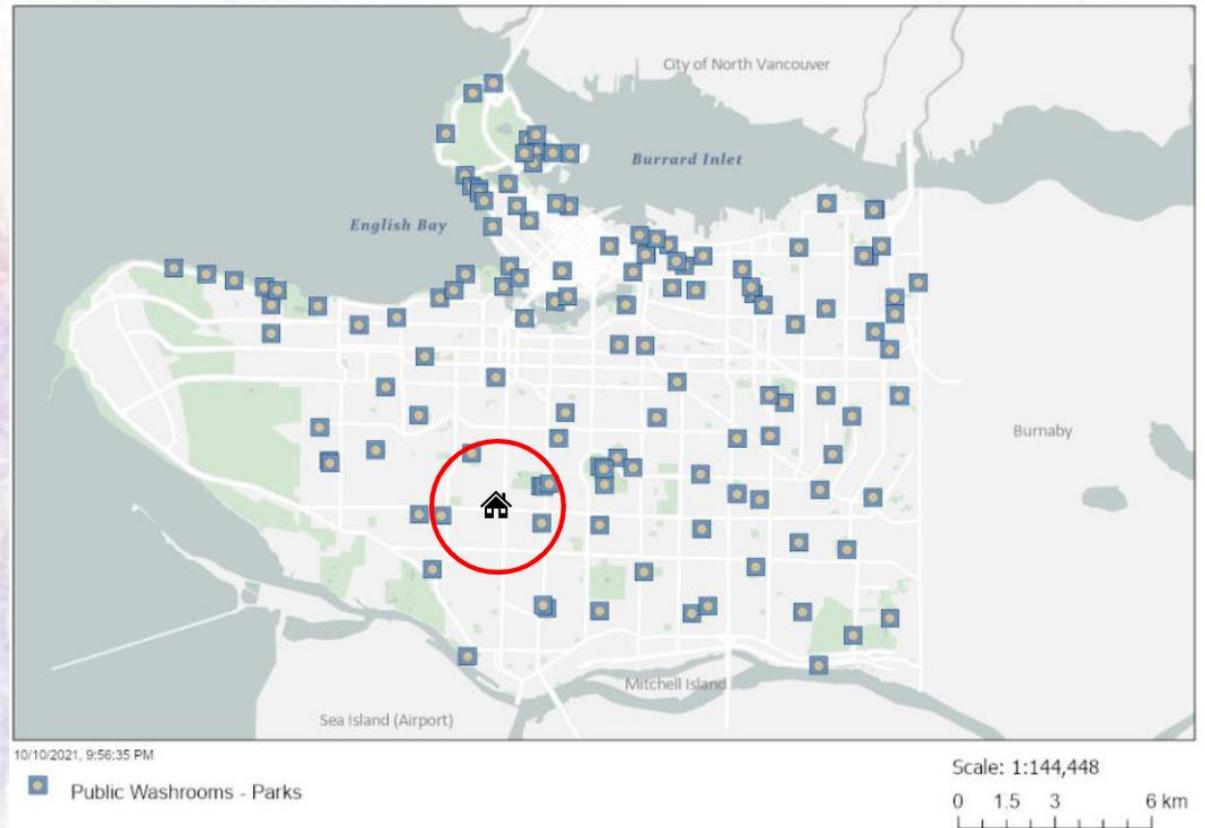


Name	Official	Advisories	SpecialFeatures	Facilities	Washrooms	NeighbourhoodName
Carnarvon Park	1	N	N	Y	Y	Arbutus-Ridge
Park Site on Quesnel Drive	0	N	N	N	N	Arbutus-Ridge
Ravine Park	1	N	N	N	N	Arbutus-Ridge
Park Site on Trafalgar Street	0	N	N	N	N	Arbutus-Ridge
Cardero Park	1	N	Y	N	N	West End
Harbour Green Park	1	N	Y	Y	Y	Downtown

Thinking spatially

"How many parks are within 3km of my home?"

This is a spatial question that can only be answered using location data and other information such as road network. These kinds of questions can be answered using GIS!



Thinking spatially

1. Where is it?

Locate places or objects

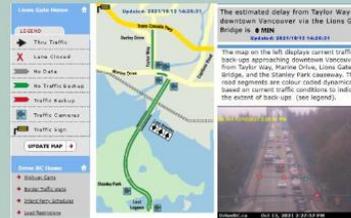
- Where is the nearest bus stop?



2. What is at?

Query conditions at a location or within an area

- What is the average traffic volume on the Lions Gate Bridge?

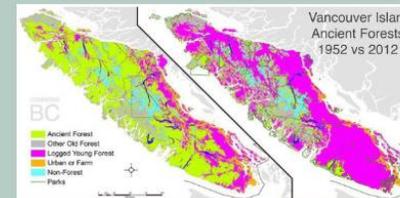


5 types of questions GIS can answer

3. What has changed?

Look at change over time

- Change in old growth forest coverage



4. What patterns/relationships exist?

Use analysis tools to uncover spatial patterns and relationships

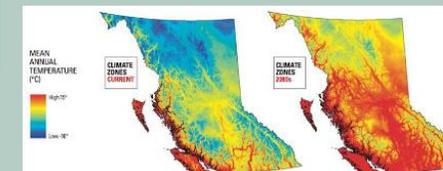
- Identify COVID-19 case hotspots

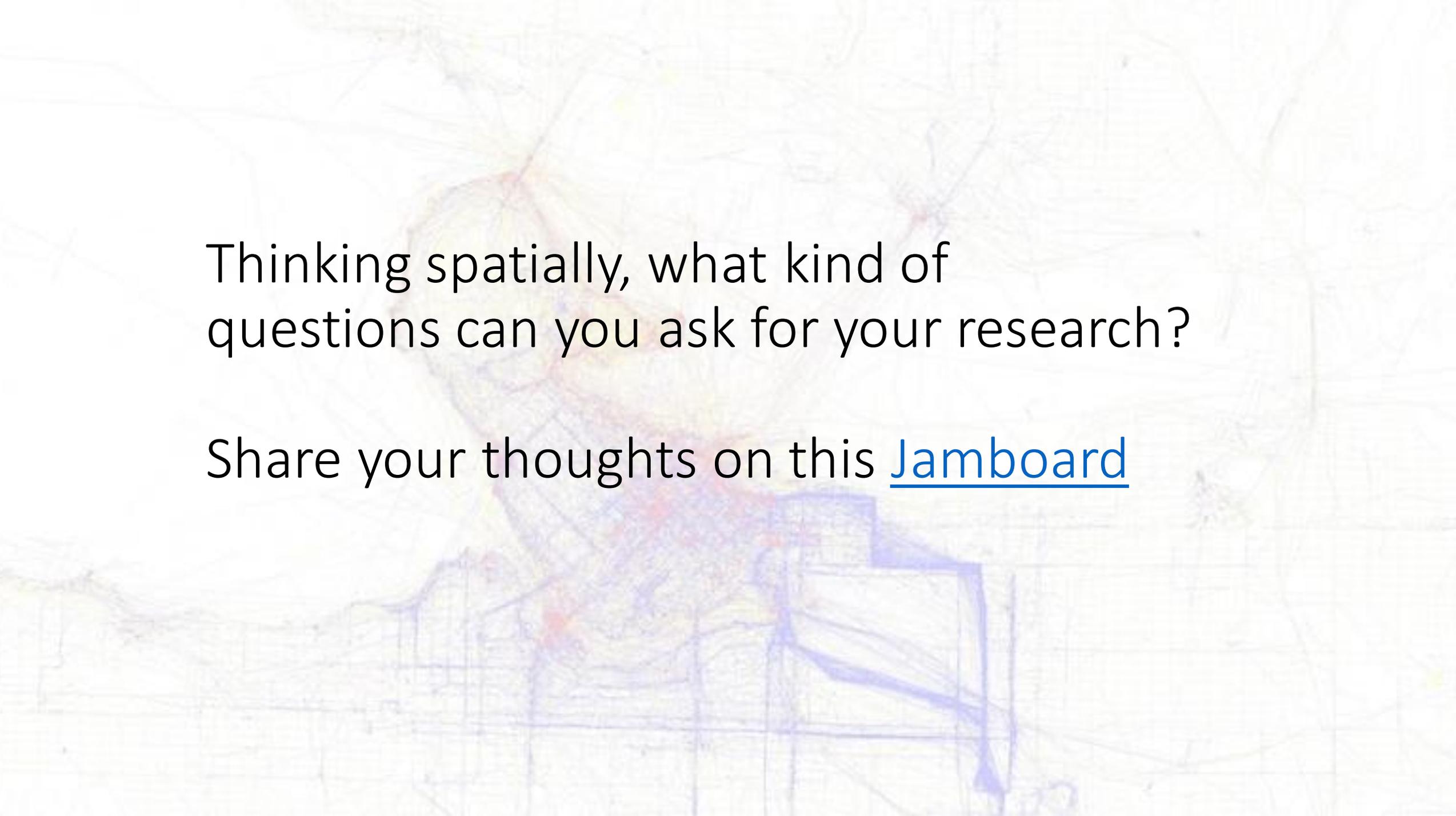


5. What if?

Use spatial relationships to build models

- Climate change modeling





Thinking spatially, what kind of questions can you ask for your research?

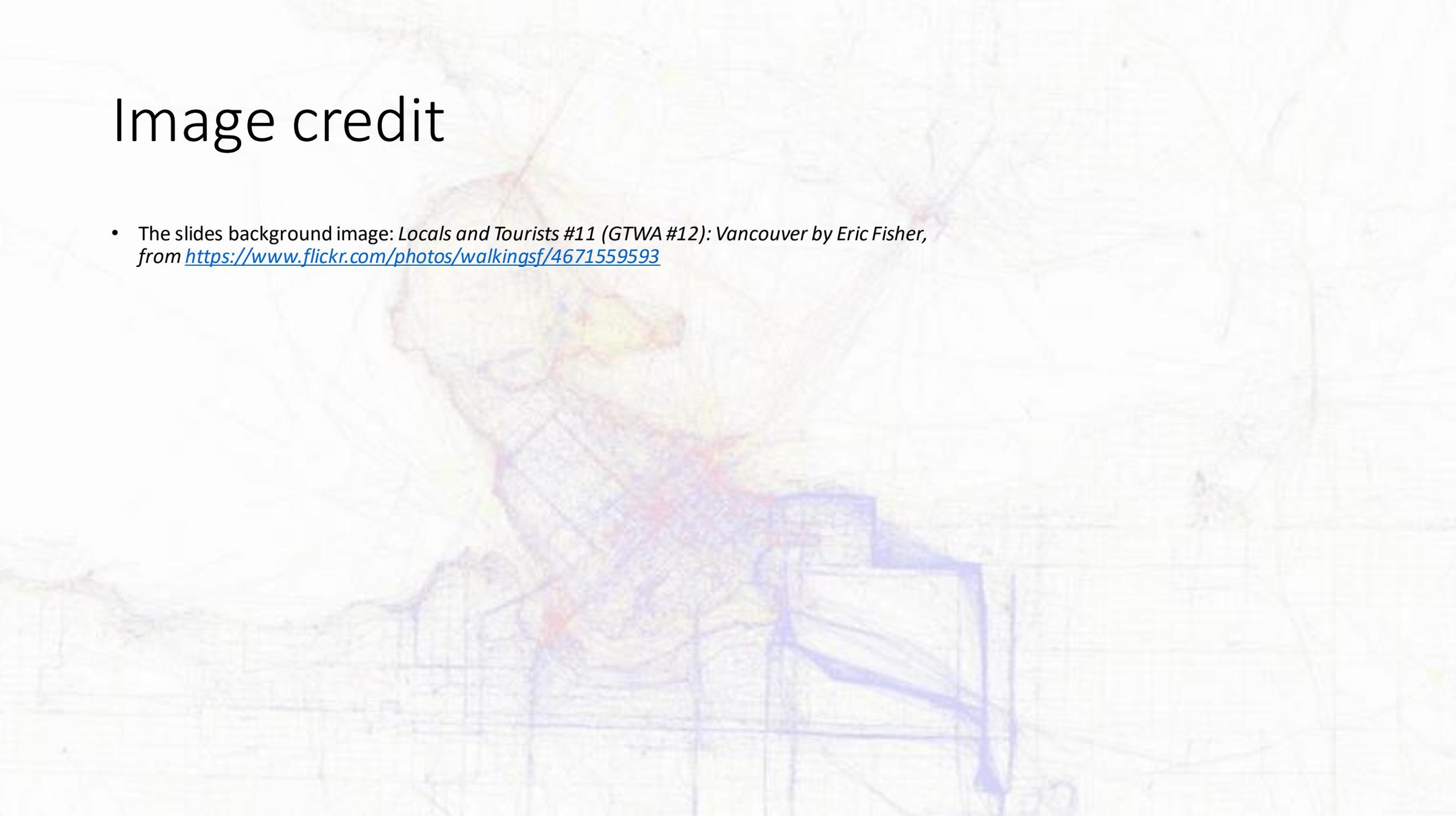
Share your thoughts on this [Jamboard](#)

We'd love to hear what you learned from this session. Please fill out the feedback form. Thank you!

<https://www.surveymonkey.ca/r/VKYR59T>

Image credit

- The slides background image: *Locals and Tourists #11 (GTWA #12): Vancouver* by Eric Fisher, from <https://www.flickr.com/photos/walkingsf/4671559593>



Recommended video: how to think like a geographer – this is entertaining I promise...

https://www.e-education.psu.edu/maps/l2_p1.html

Source: Maps and the Geospatial Revolution. Anthony C. Robinson, Department of Geography and John A. Dutton e-Education Institute, College of Earth and Mineral Sciences, The Pennsylvania State University

Suggested resources

In person GIS workshops by the Research Commons in February 2022

- [Introduction to Spatial Thinking and ArcGIS Pro](#)
- [Intro to QGIS and Map Making](#)

Getting started (GIS concepts like scale, data types, querying, map projection, simple analysis etc):

- [Getting started with GIS](#) 3- hour tutorial on Esri training, a free Esri account is required

In-depth training on GIS Desktop applications:

- [LinkedIn Learning](#)
 - ArcGIS Essential Training
 - Learning ArcGIS
 - Learning QGIS
 - ArcGIS Pro Essential Training
- [Esri Training](#): numerous tutorials on ArcGIS Desktop, ArcGIS Pro, ArcGIS Online, etc

GIS for problem solving (contextualizing GIS within real-world issues or scholarship):

- [Open Educational Resources](#) by Penn State University
 - Mapping our Changing World

Get in touch!

GIS Consultation Form:

<https://www.lib.sfu.ca/find/other-materials/data-gis/gis/help-consultations>

Or contact Sarah Zhang s_zhang@sfu.ca