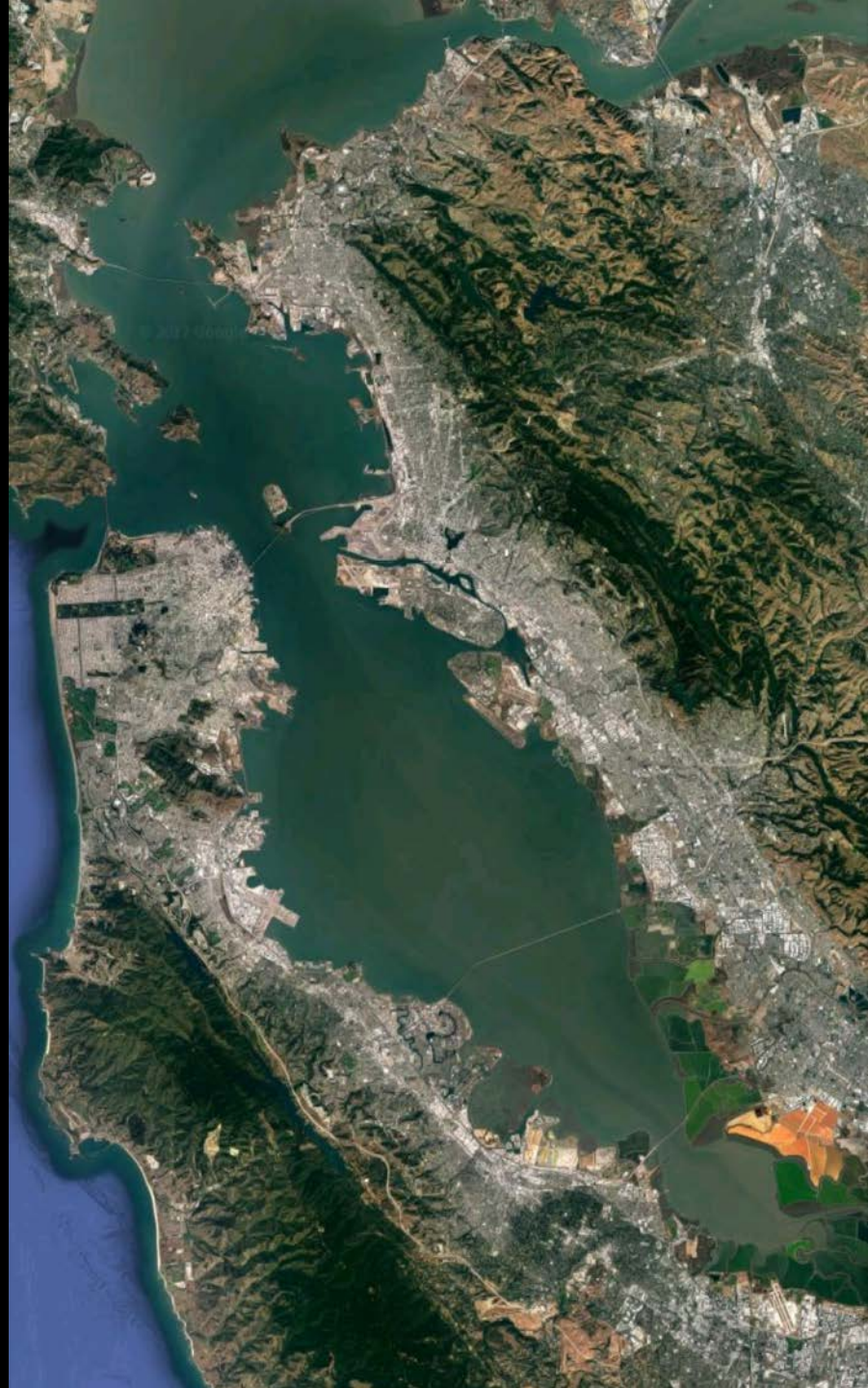
Spatial Data & GIS Fundamentals

CP101, Summer 2020

Department of City + Regional Planning, UC Berkeley

Chester Harvey

It’s hard to study cities without maps



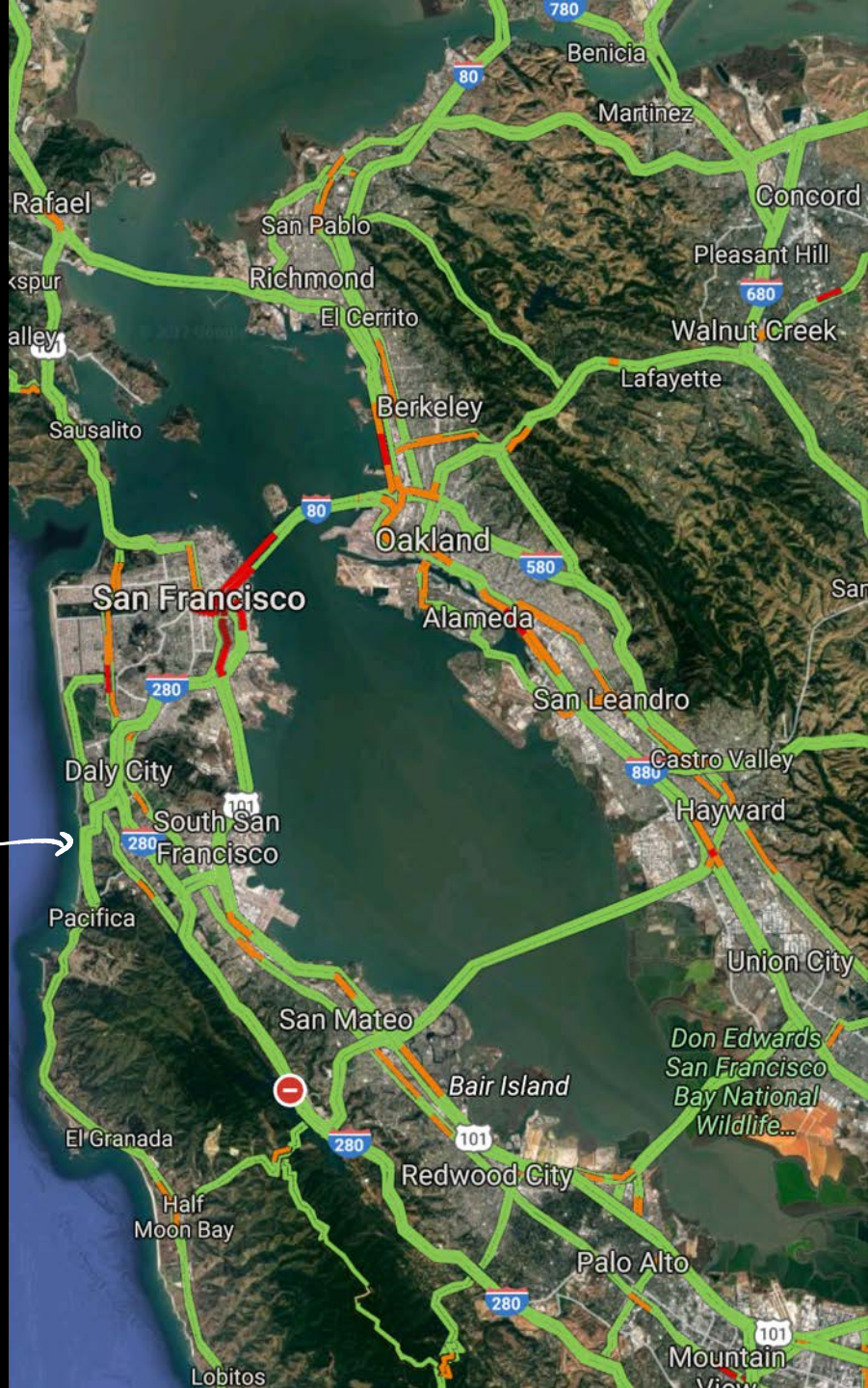
Google, 2017

Maps are places to visualize and compare spatial data

SPACE

MAPS → Visualize BY OVERLAY

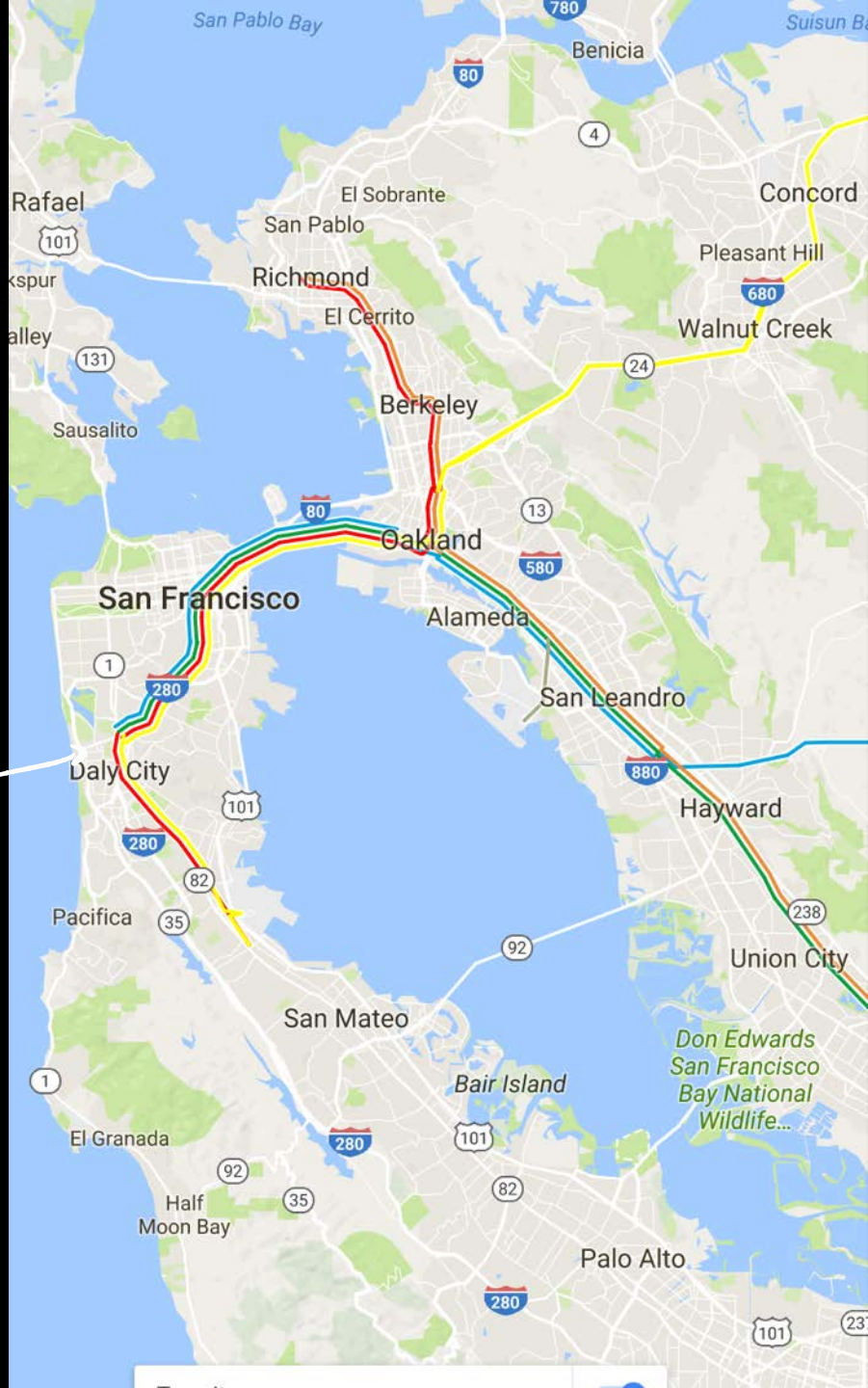
↳ UNDERSTAND CHARACTERISTIC OVERLAY.



Google, 2017

Maps are places to visualize and "compare spatial data"

DIFFERENT BART LINE
→ ABSTRACTING EACH LINE.

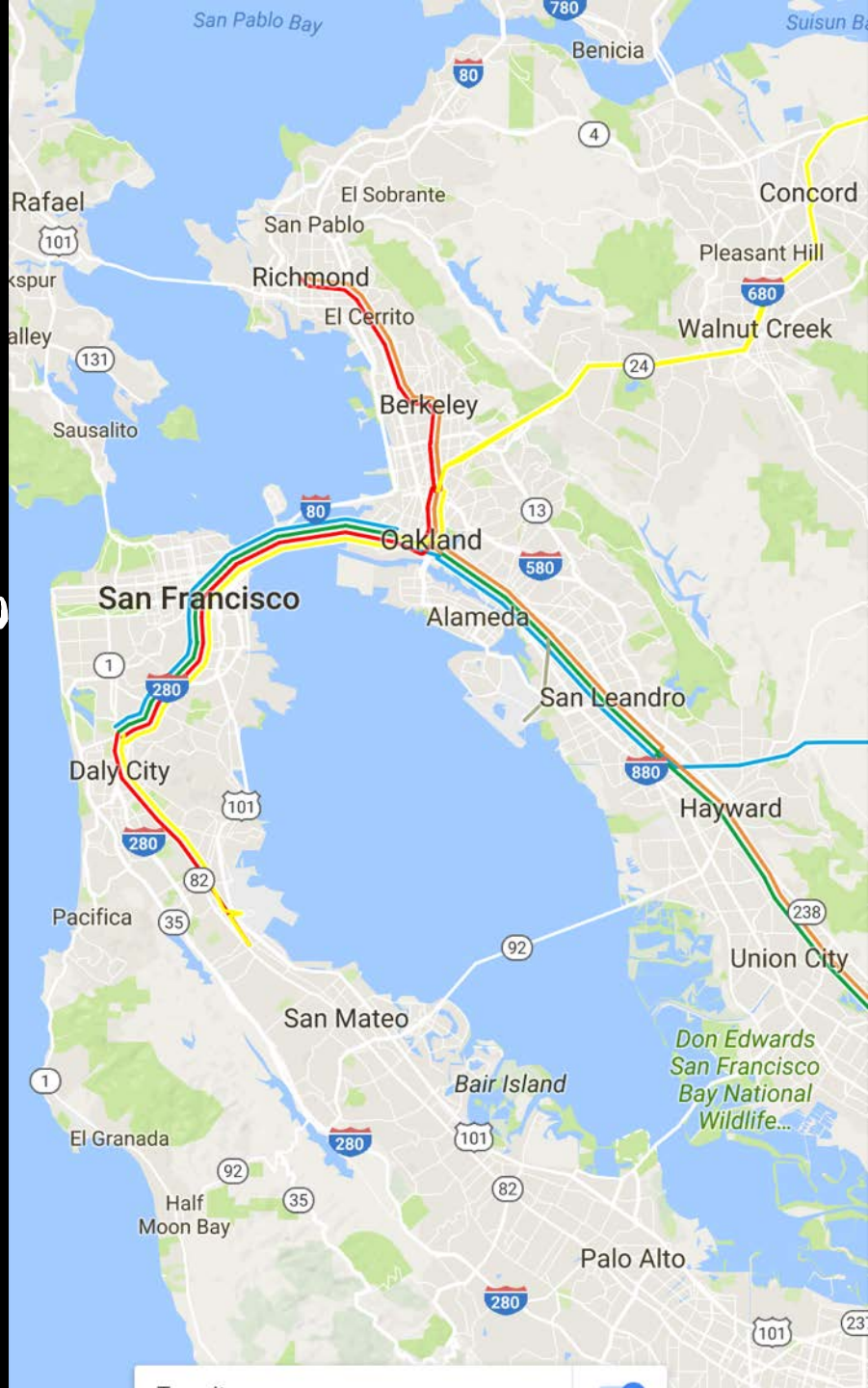


Google, 2017

What goes into a map?

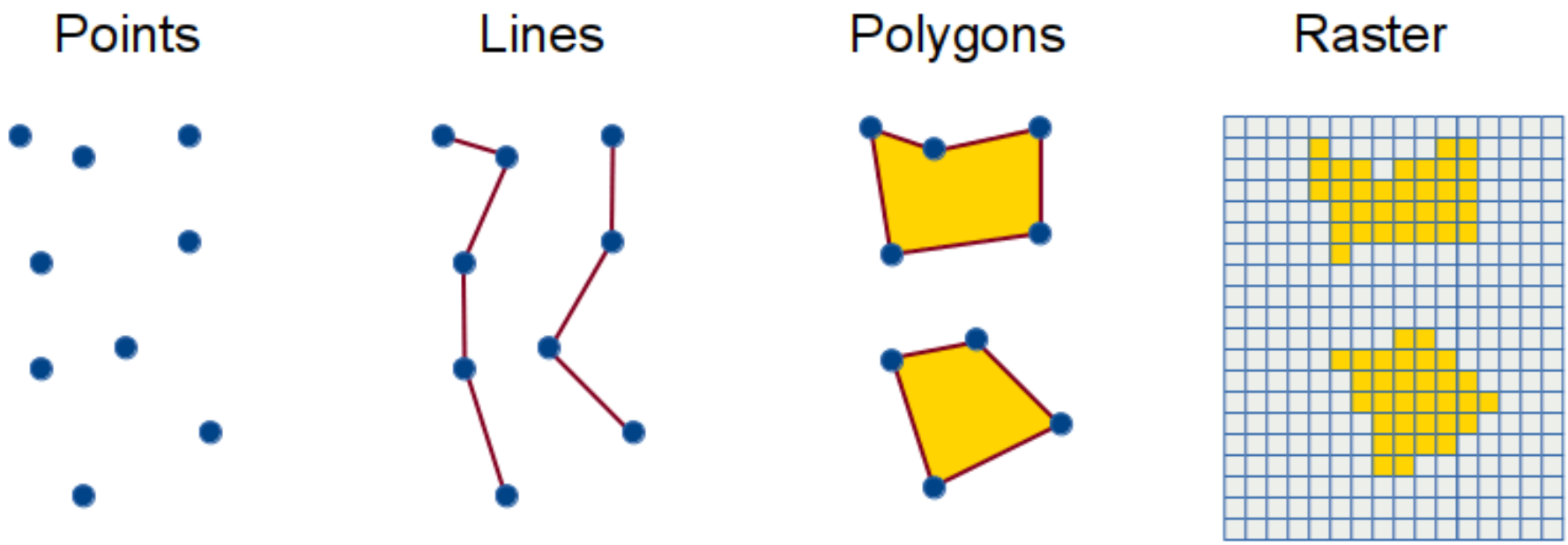
- Data
  - Structure
  - Generalization
- Analysis
- Cartography
  - Projection
  - Graphic Design

FOCUS ON TOPIC (WHAT'S IMPORTANT)



Google, 2017

Spatial Data Fundamentals



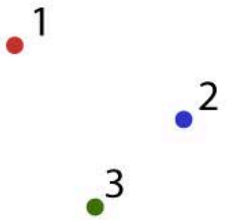
VECTOR DATA
(ORDER OF COORDINATES)

http://michaelminn.net/tutorials/gis-data/

RASTER DATA
(DEFINE LOCATION ON GRID)

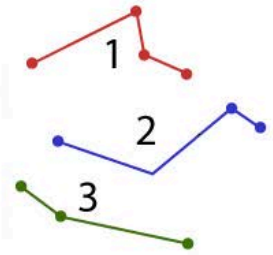
Vector Data

Point →

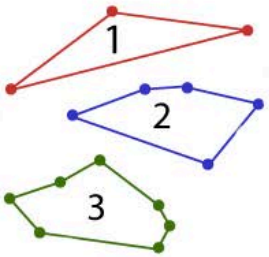


ID	Plot Size	Type	VegClass
1	40	Vegetation	Conifer
2	20	Vegetation	Deciduous
3	40	Vegetation	Conifer

List of coordinate



ID	Type	Status	Maintenance
1	Road	Open	Year Round
2	Dirt Trail	Open	Summer
3	Road	Closed	Year Round



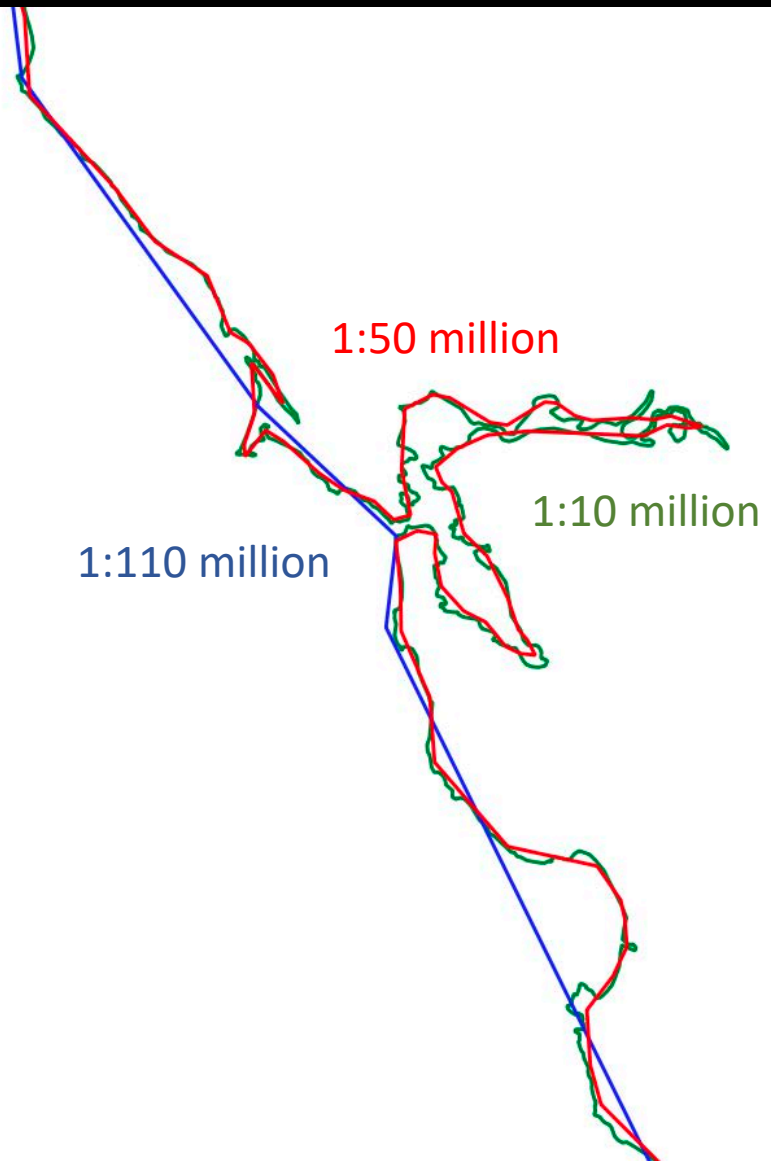
ID	Type	Class	Status
1	Herbaceous	Grassland	Protected
2	Herbaceous	Pasture	Open
3	Herbaceous / Woody	Grassland	Protected

Adapted from https://www.earthdatascience.org/workshops/gis-open-source-python/intro-vector-data-python/t

Vector Data

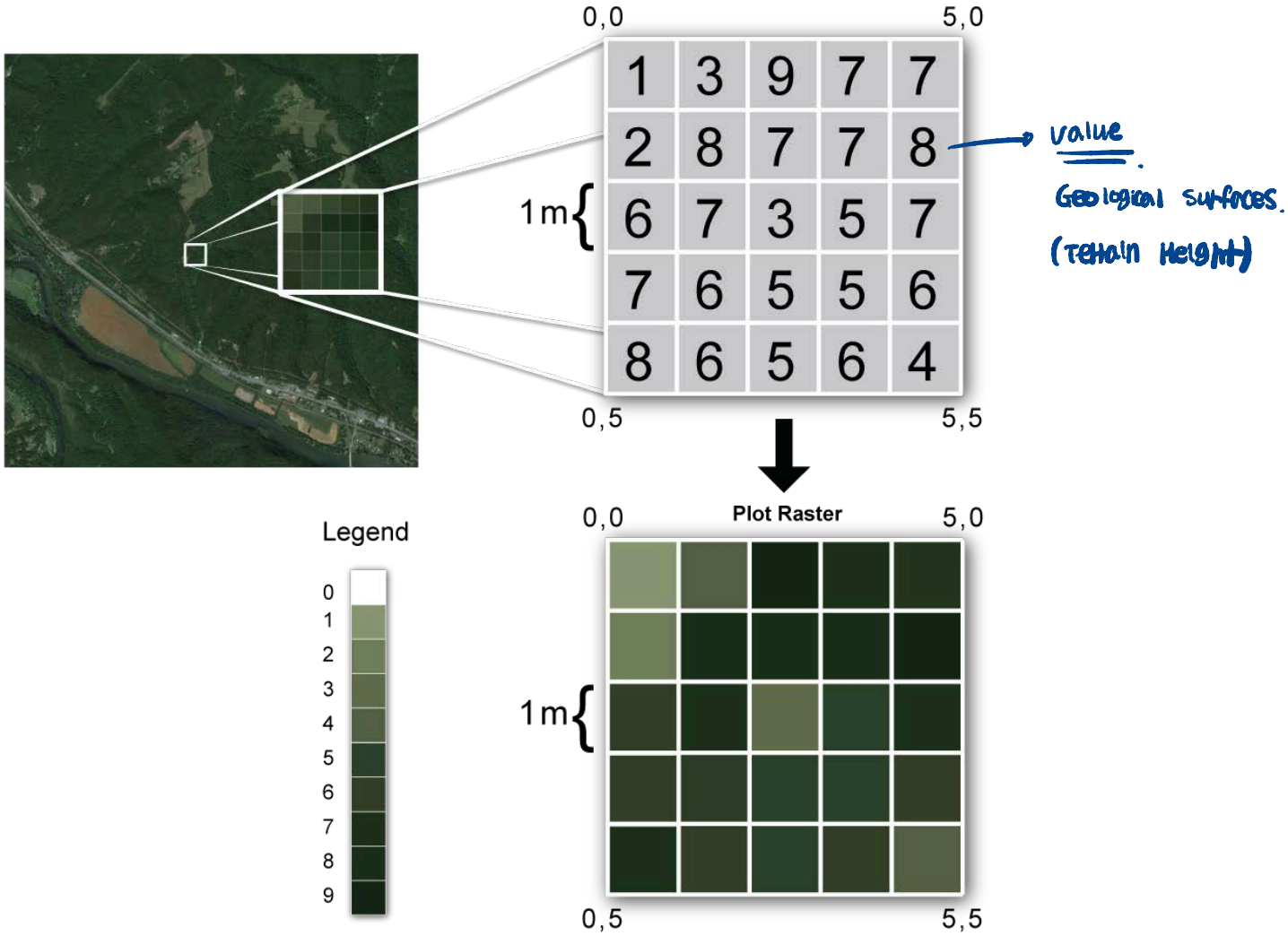
Scale/Generalization

Fidelity



https://www.naturalearthdata.com/downloads/

Raster Data



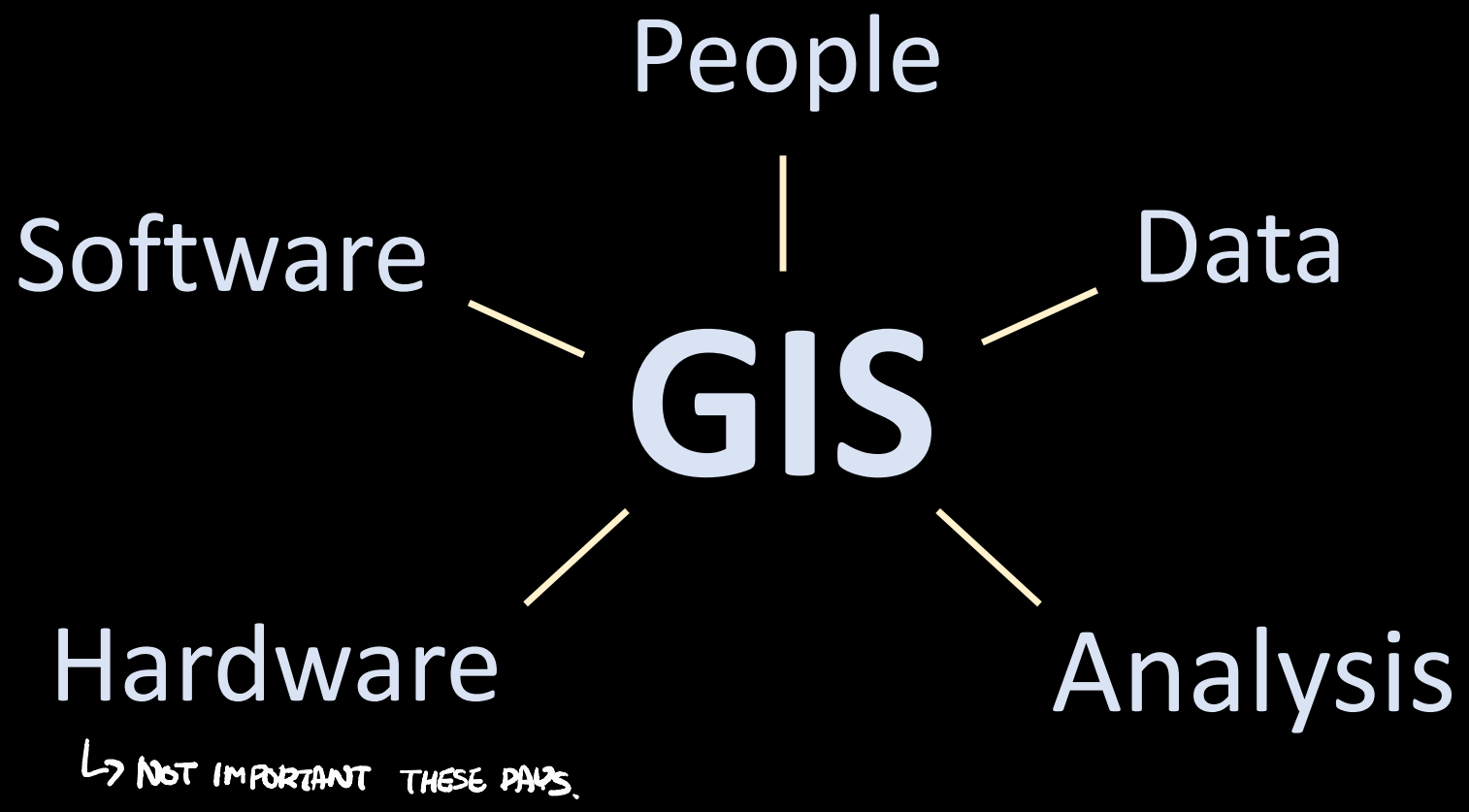
https://datacarpentry.org/organization-geospatial/01-intro-raster-data/

Raster Data

a. Landsat ETM+ b. ATLAS c. QuickBird

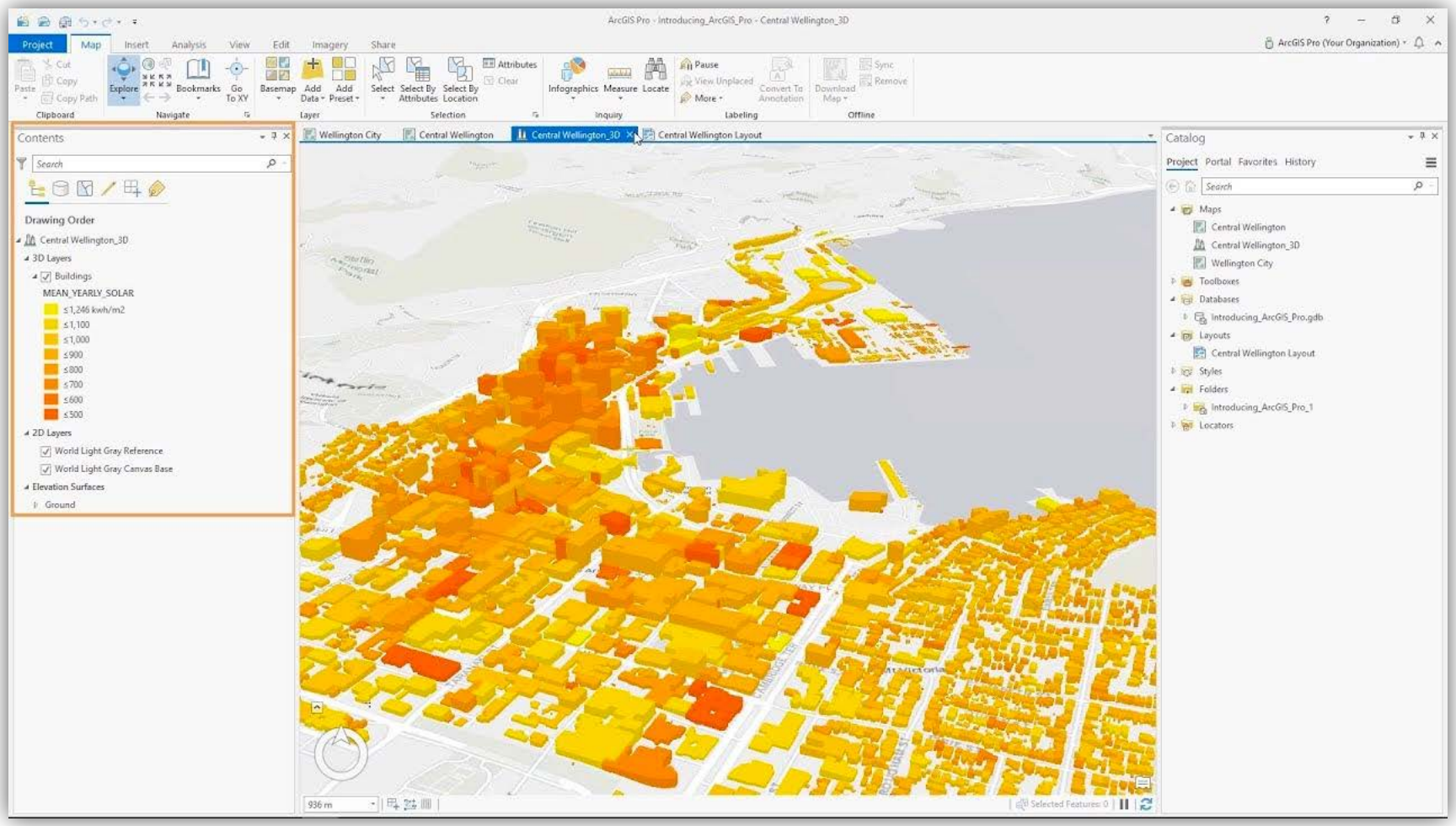
https://weather.msfc.nasa.gov/land/ncrst/mcfig2.jpg

GIS: Geographic Information System



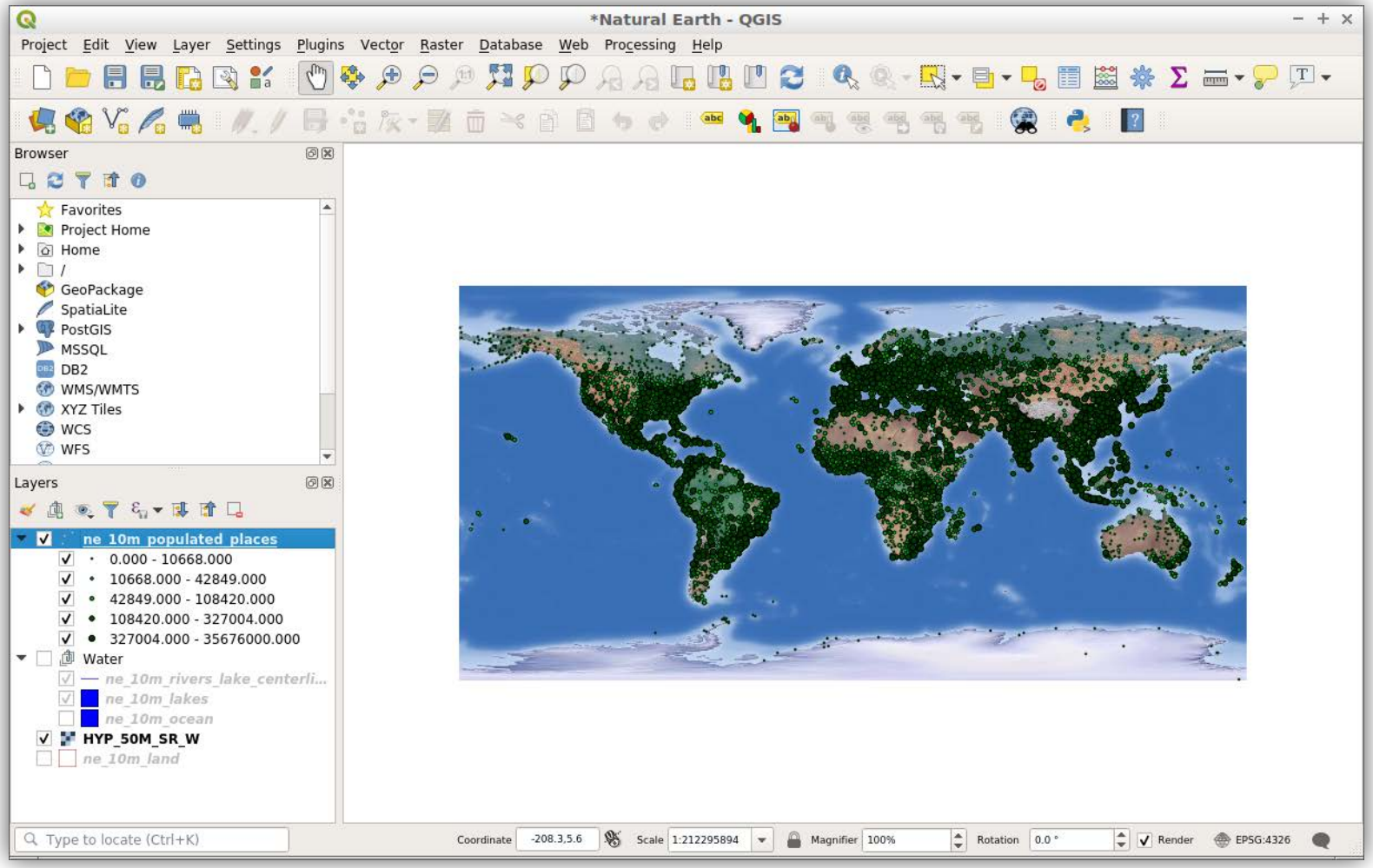
GIS Software

ESRI ArcGIS Pro



GIS Software

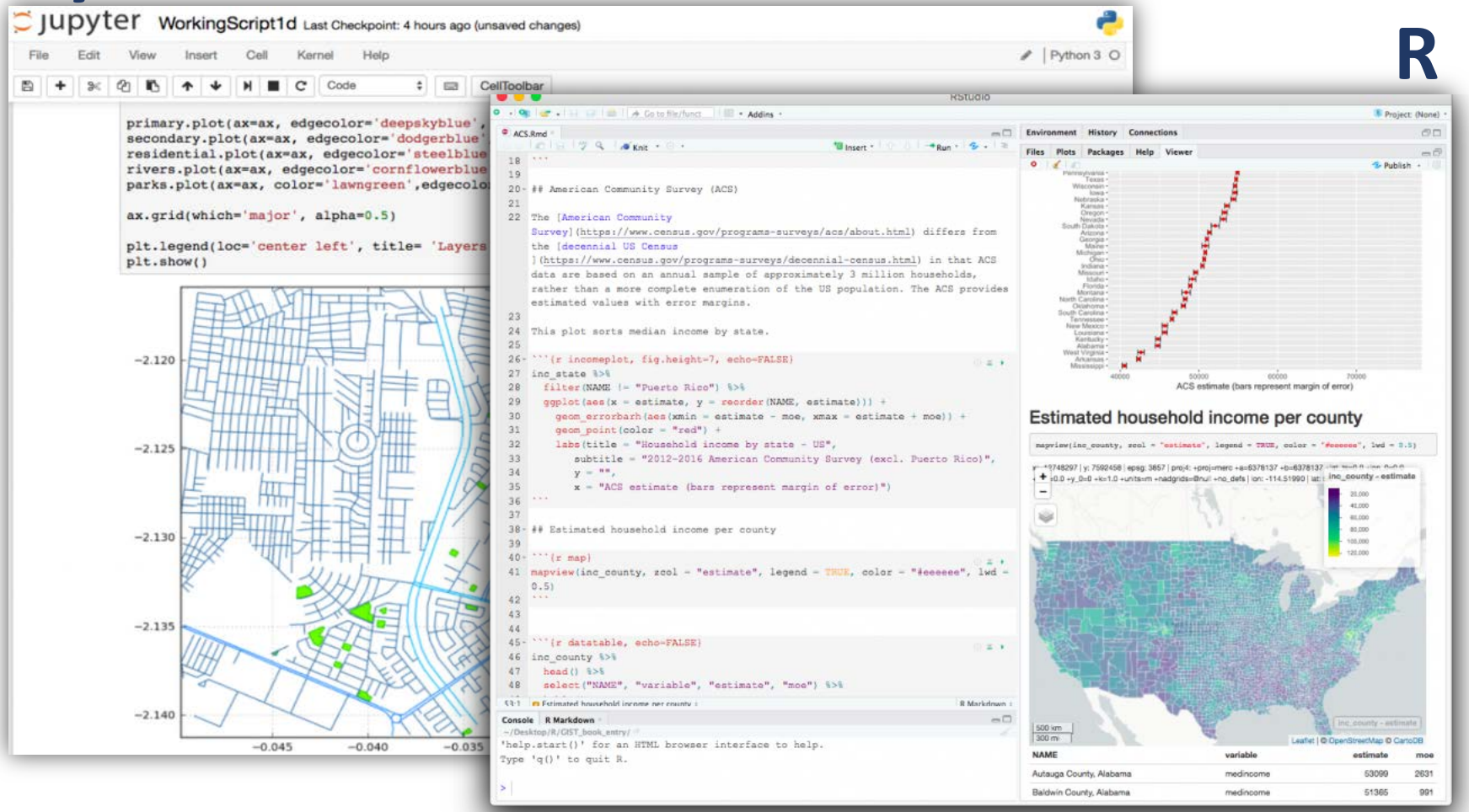
QGIS



GIS Software

Python

R



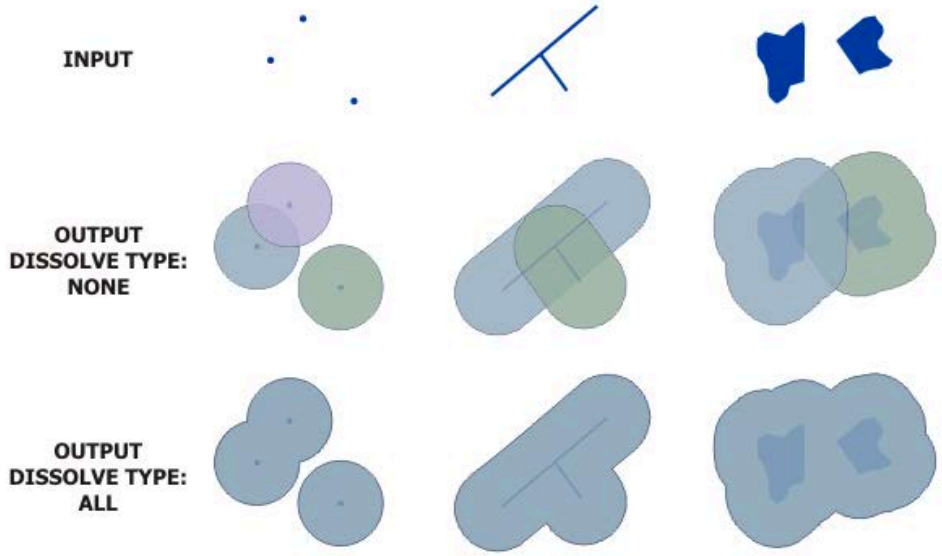
GIS Software

Web Applications & Services

ArcGIS Online

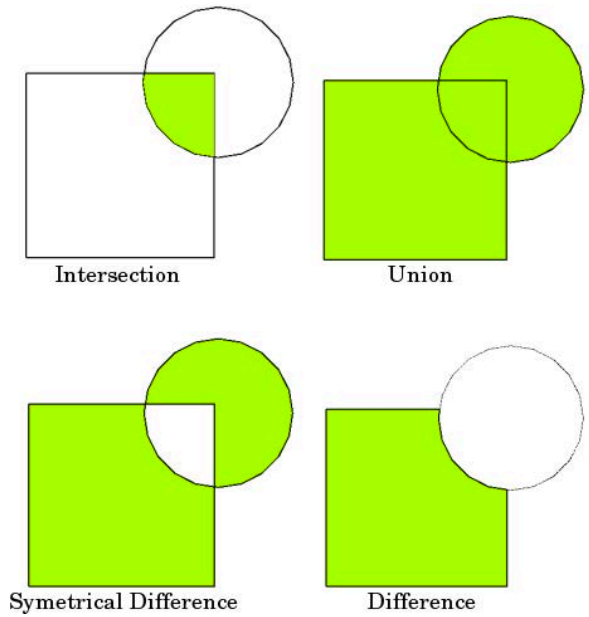
Analysis

Buffer



https://desktop.arcgis.com/en/arcmap/10.3/tools/analysis-toolbox/GUID-267CF0D1-DB92-456F-A8FE-F819981F5467-web.png

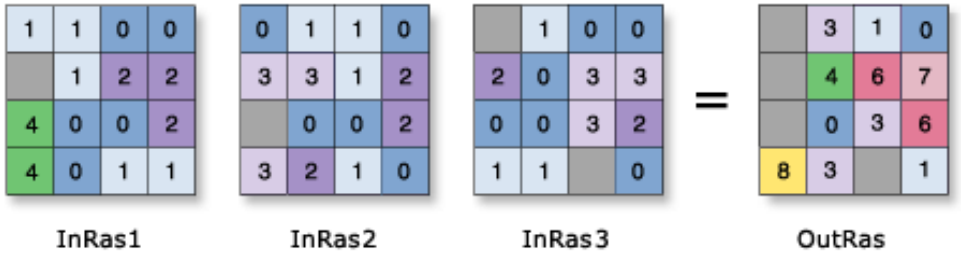
Overlay
(geometric query)



https://docs.qgis.org/2.8/en/_images/overlay_operations.png

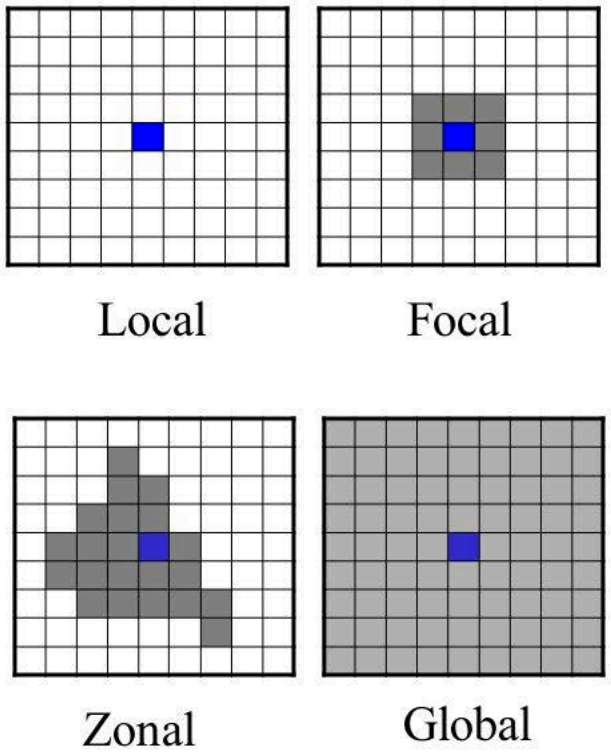
Analysis

Raster Algebra



https://desktop.arcgis.com/en/arcmap/10.3/tools/spatial-analyst-toolbox/GUID-D8BD897C-B7A2-46A5-93DC-121409FF4C0D-web.png

Operating Scope

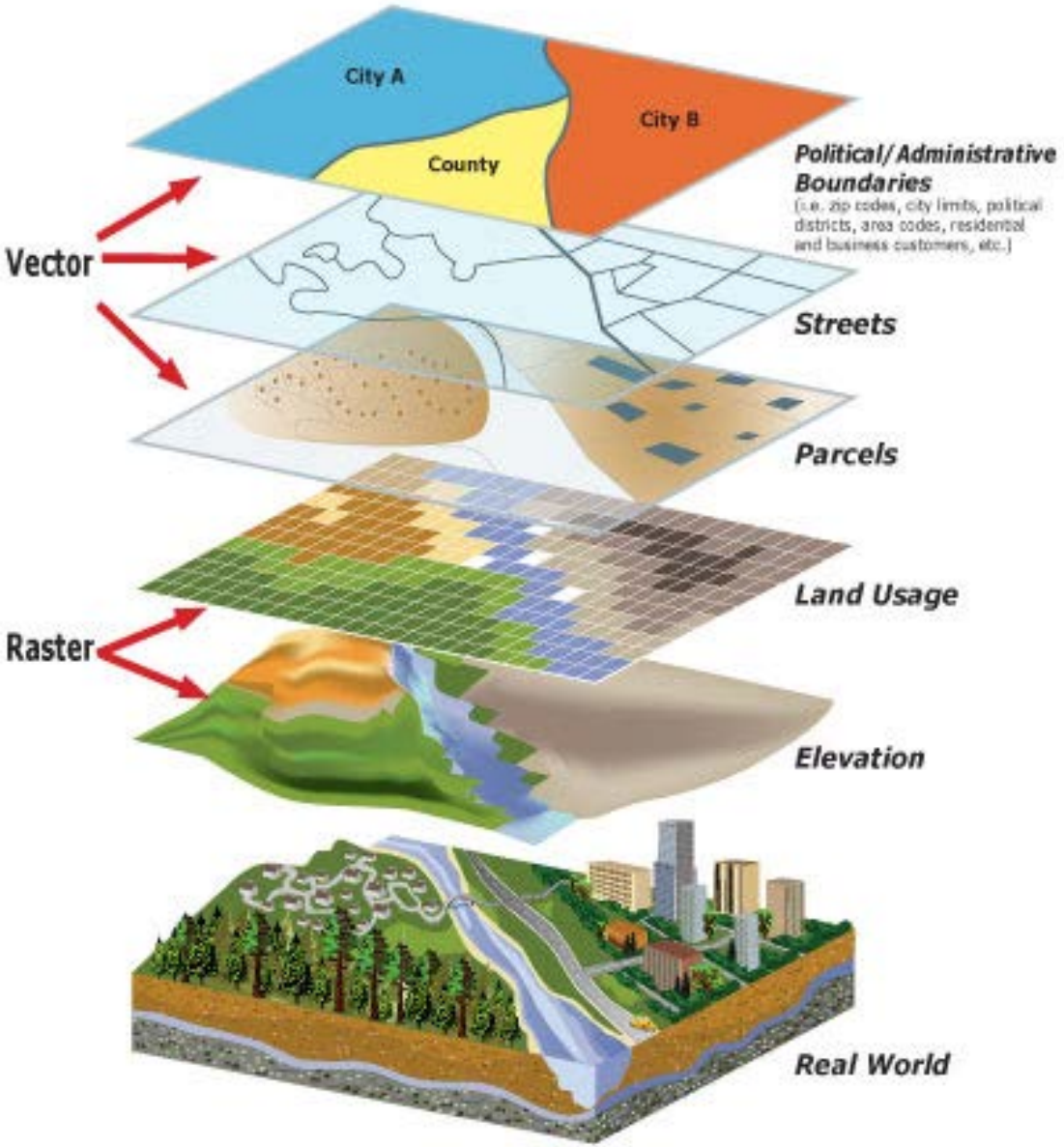


https://slideplayer.com/slide/5822638/19/images/4/Map+Algebra+Operations.jpg

What sorts of

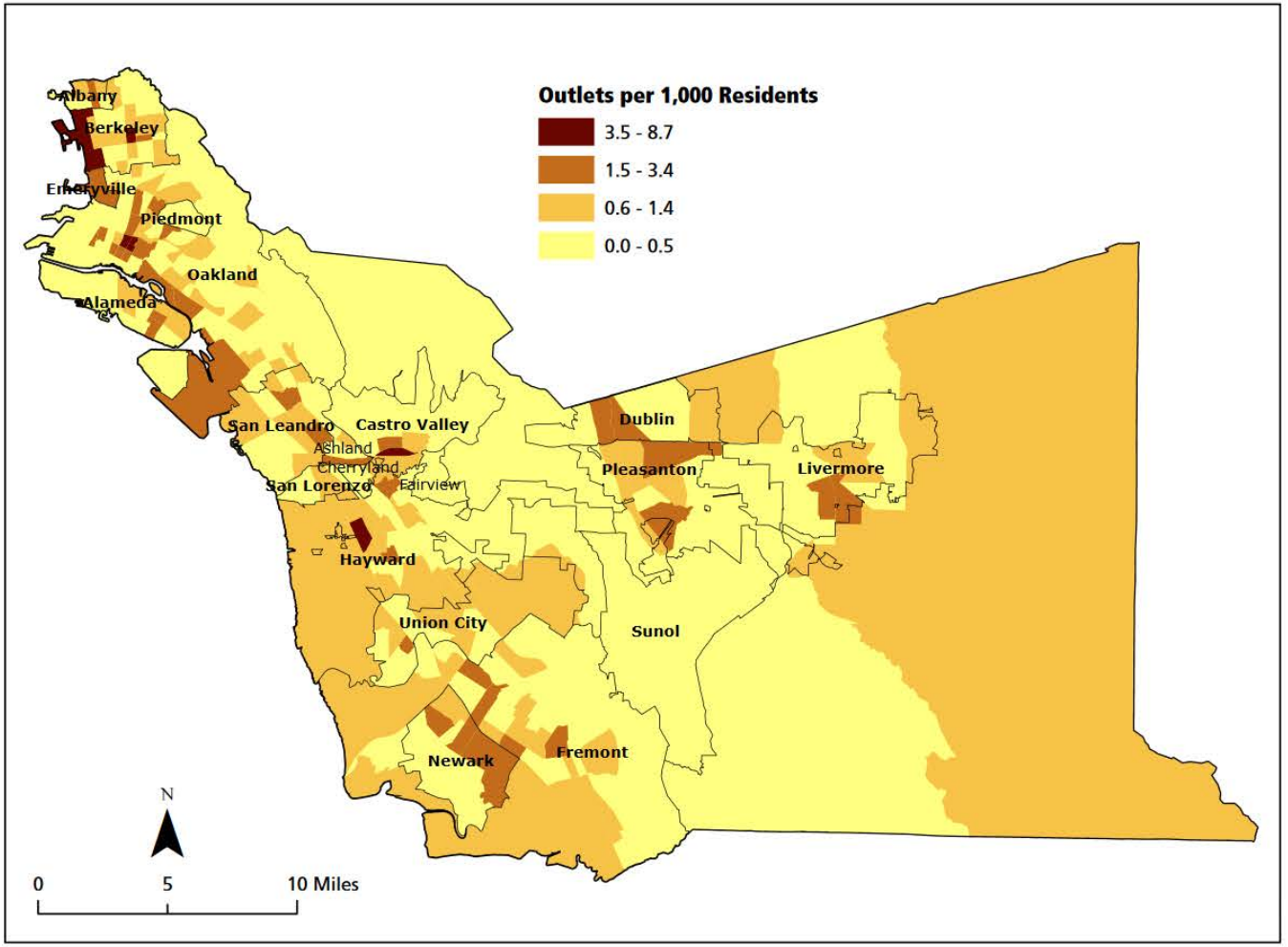
questions

can we ask with these data and tools?



How do you think this analysis was done?

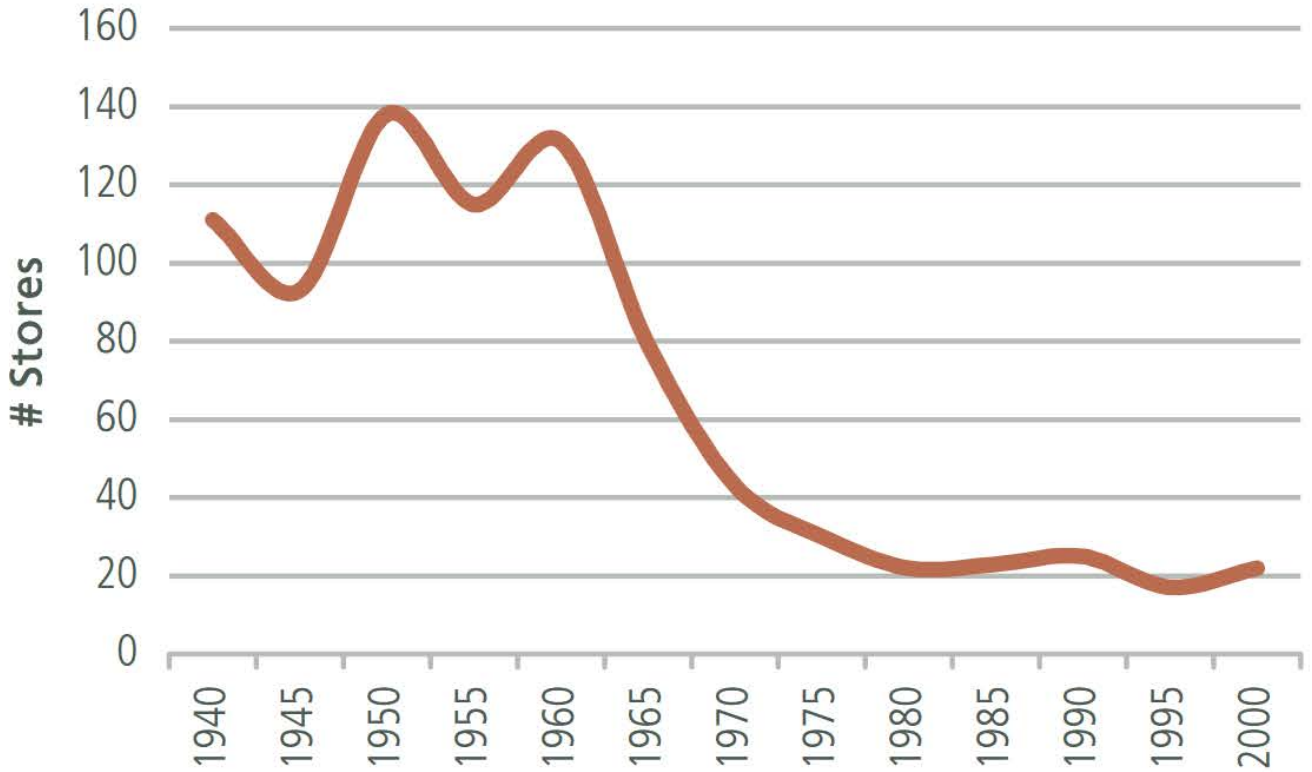
Map 9: Fast Food and Convenience Store Density, Alameda County



Source: California Center for Public Health Advocacy, with data from ESRI/InfoUSA 2005.

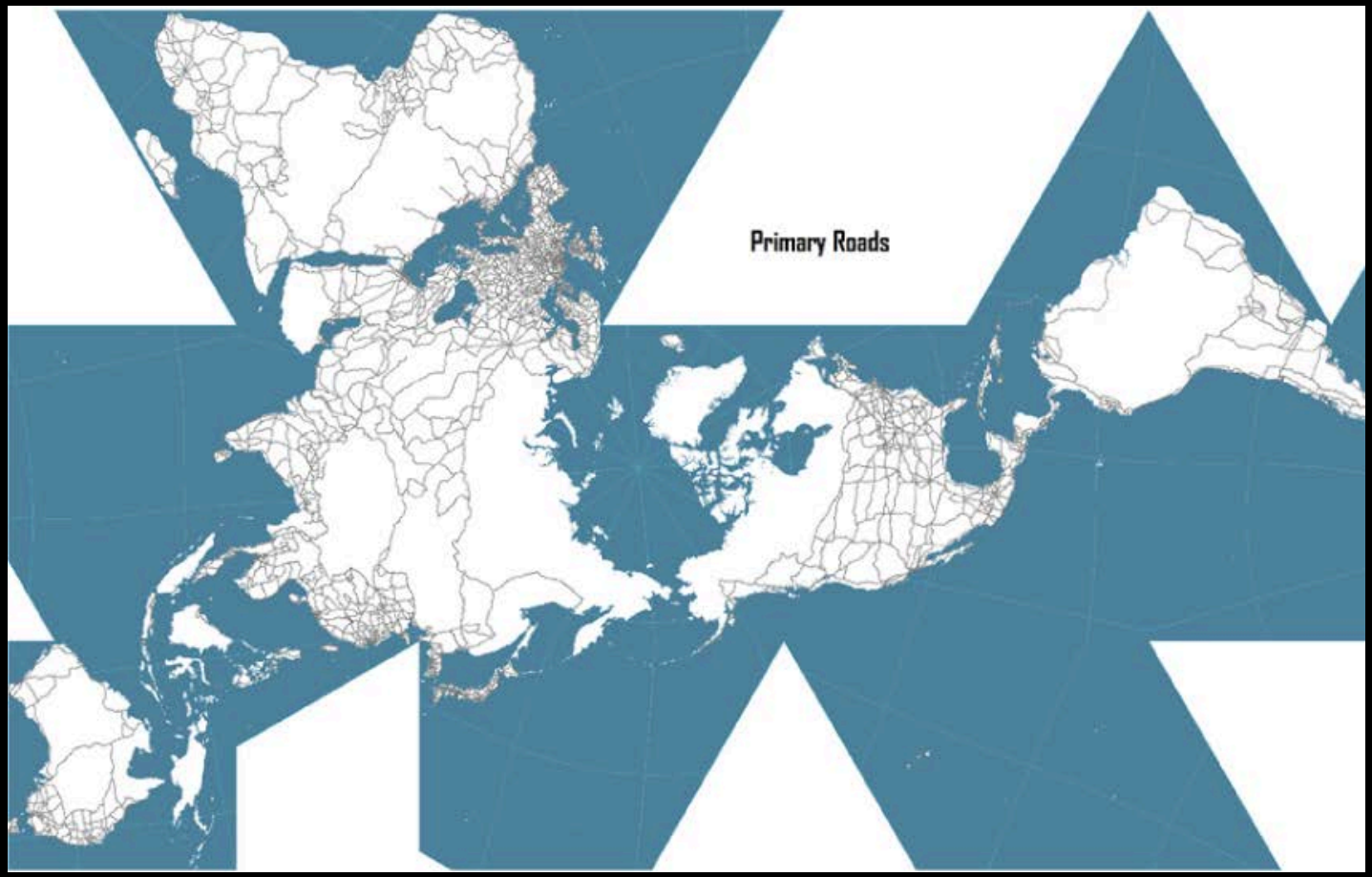
Spatial analyses can have non-spatial outputs

Figure 47: Number of Food Stores, West Oakland



Source: Fuller A, 2006.

Cartography = Representation of Spatial Data

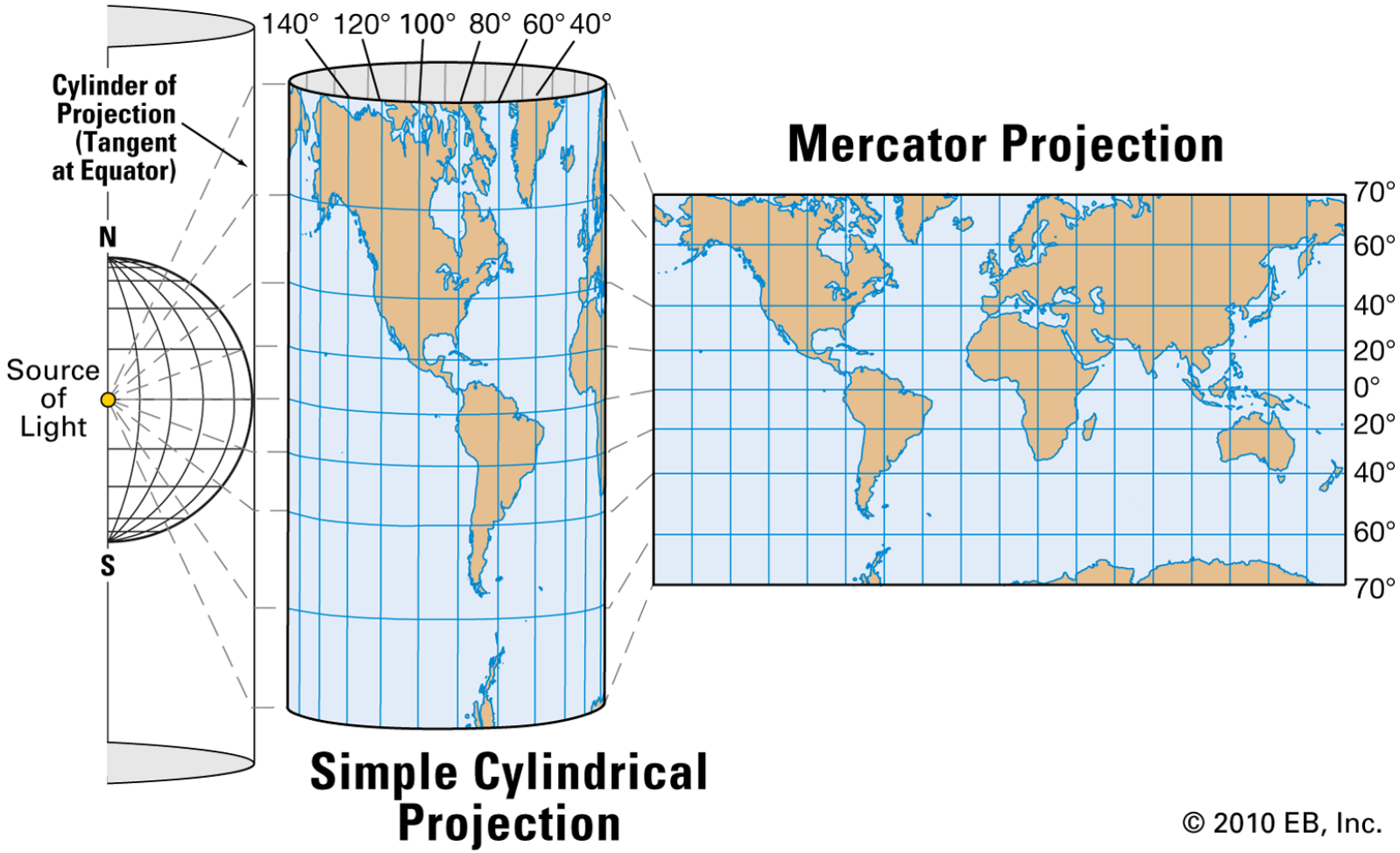


Dymaxion Projection, by Buckminster Fuller

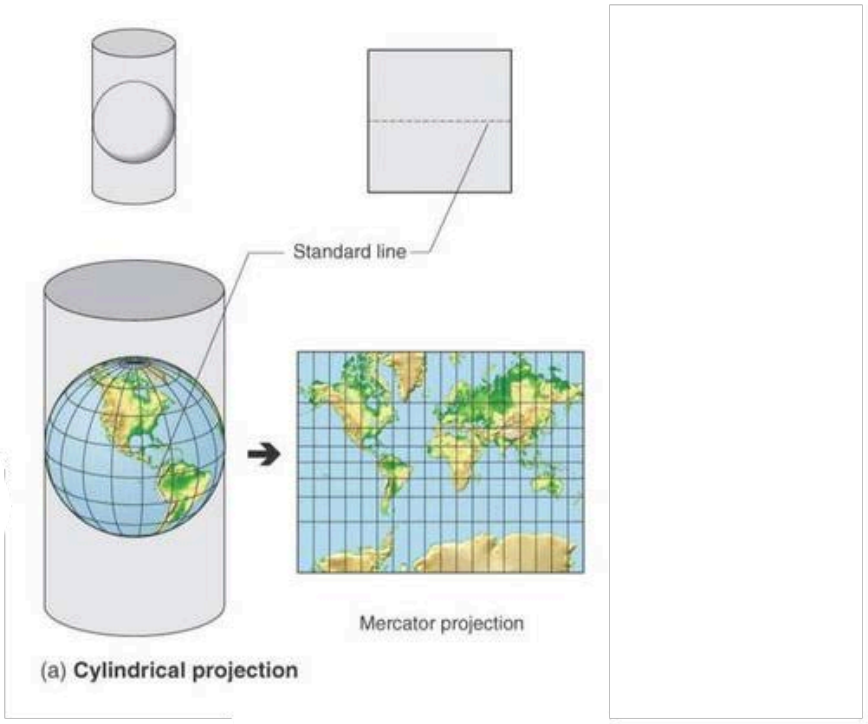
Projection

https://s3t.waypointgeographic.com/wp-content/uploads/2019/03/21161150/WP21002.jpg.webp

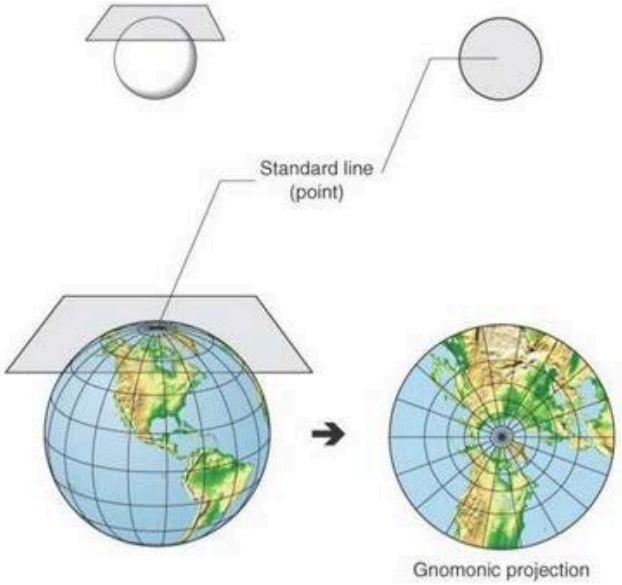
Projection



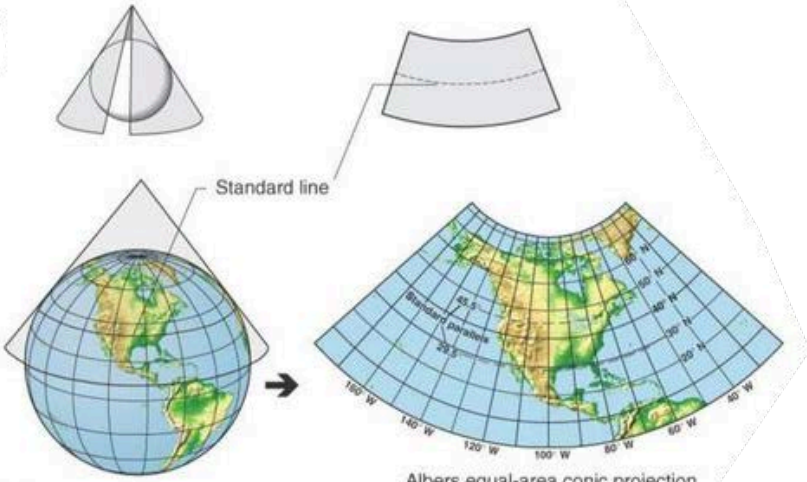
https://cdn.britannica.com/55/109155-050-2886F564/transformation-Mercator-navigation-projection.jpg



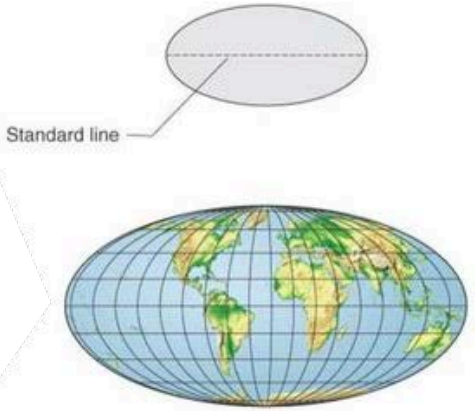
(a) **Cylindrical projection**



(b) **Planar projection**



(c) **Conic projection**

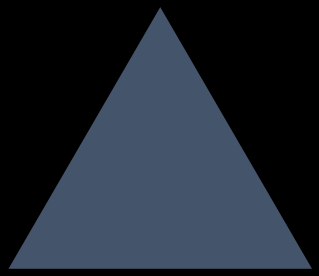


(d) **Oval projection**

Projection Compromise

(choose 1 or 2)

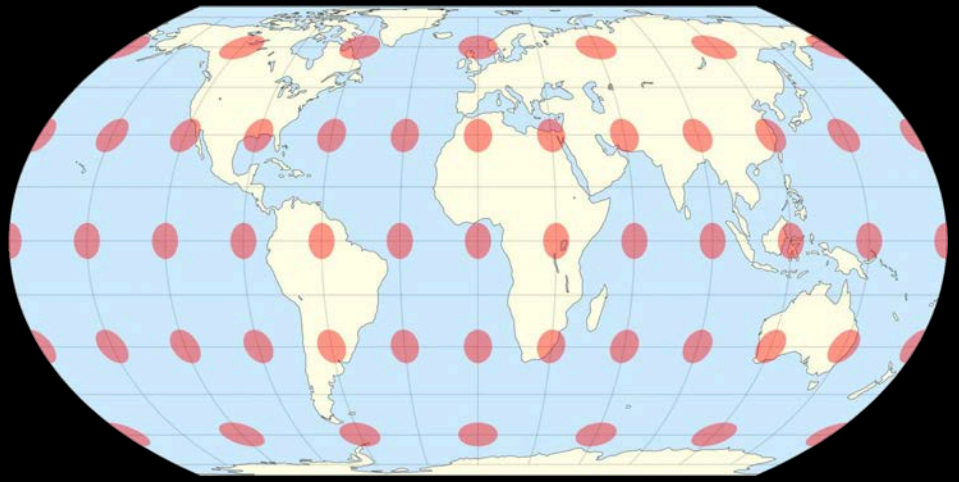
Area



Shape **Distance**

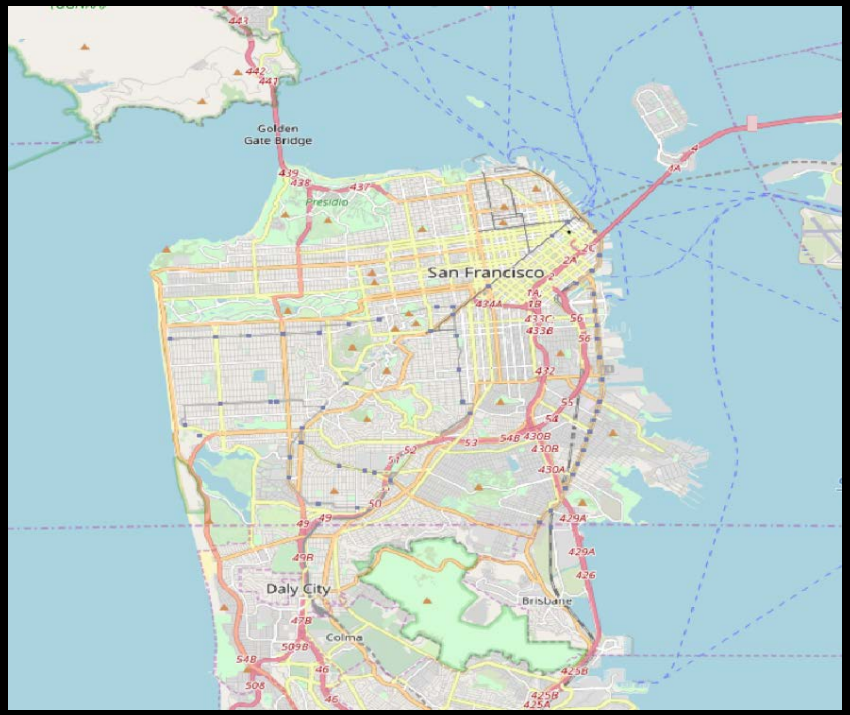
Mercator

Equal Earth

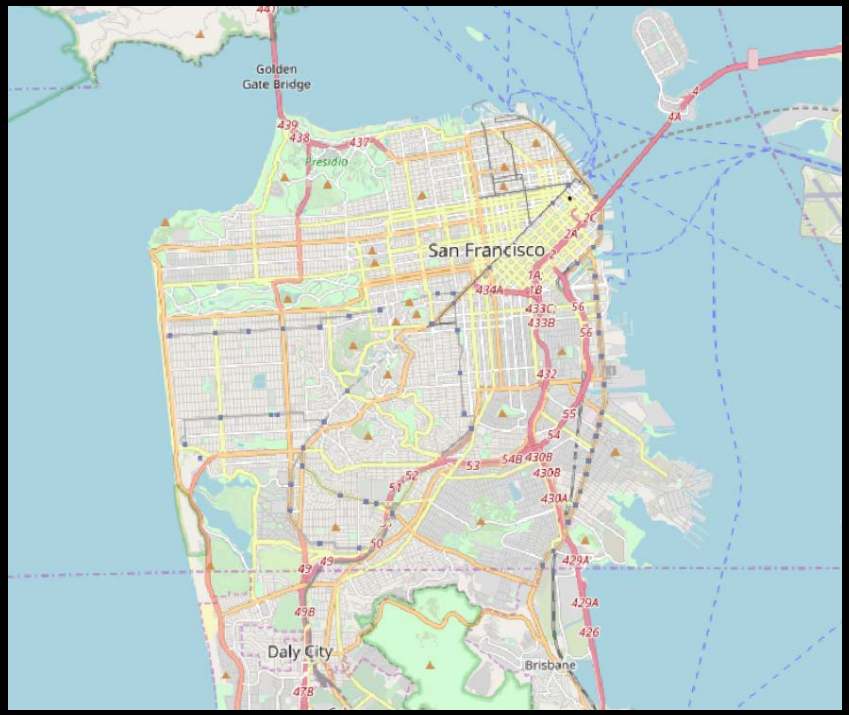


Other Projections

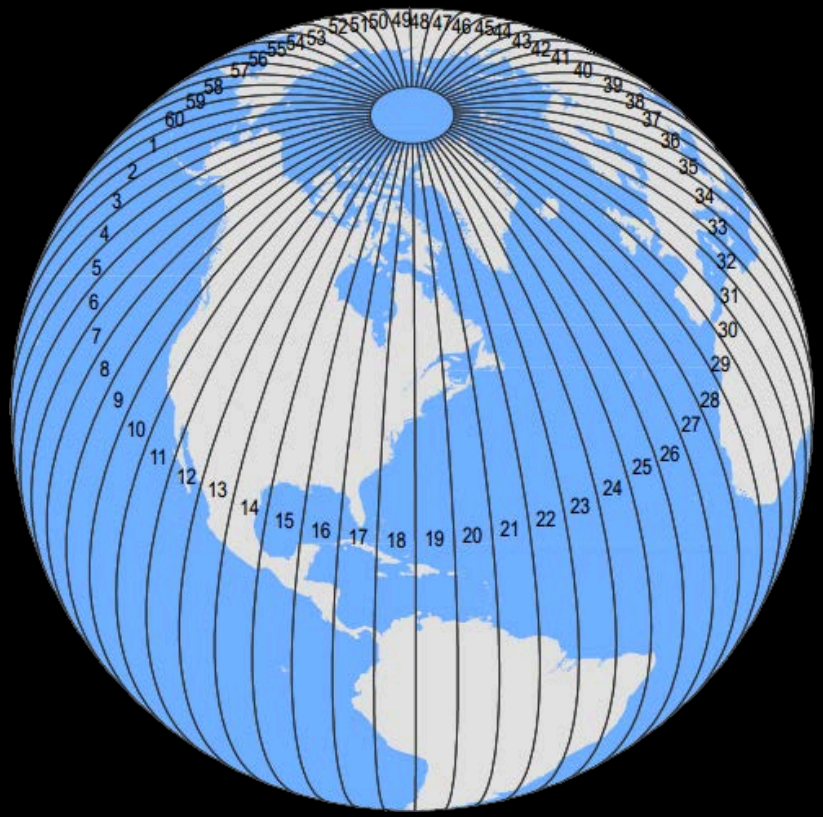
Latitude, Longitude (WGS84)



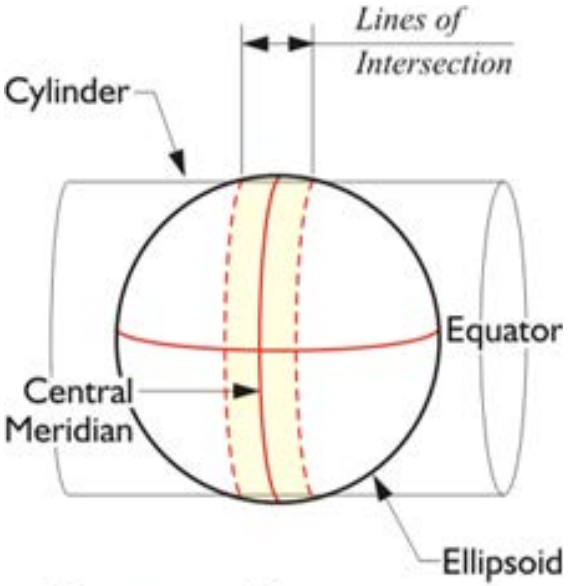
Meters (UTM10N)



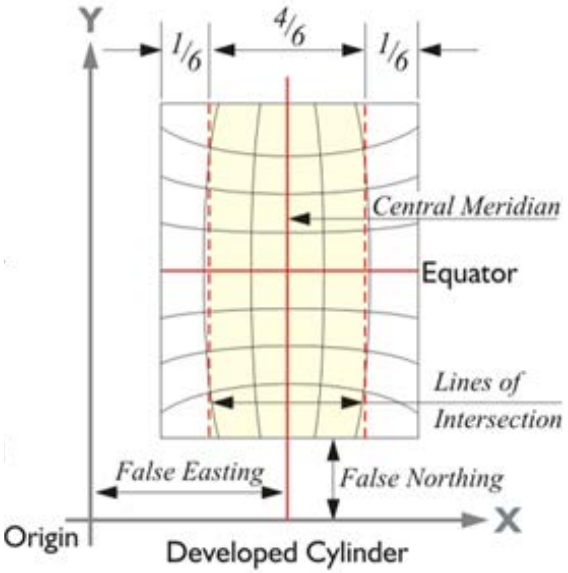
UTM Zones



https://gisgeography.com/wp-content/uploads/2016/05/UTM-Zones-Globe-2.png



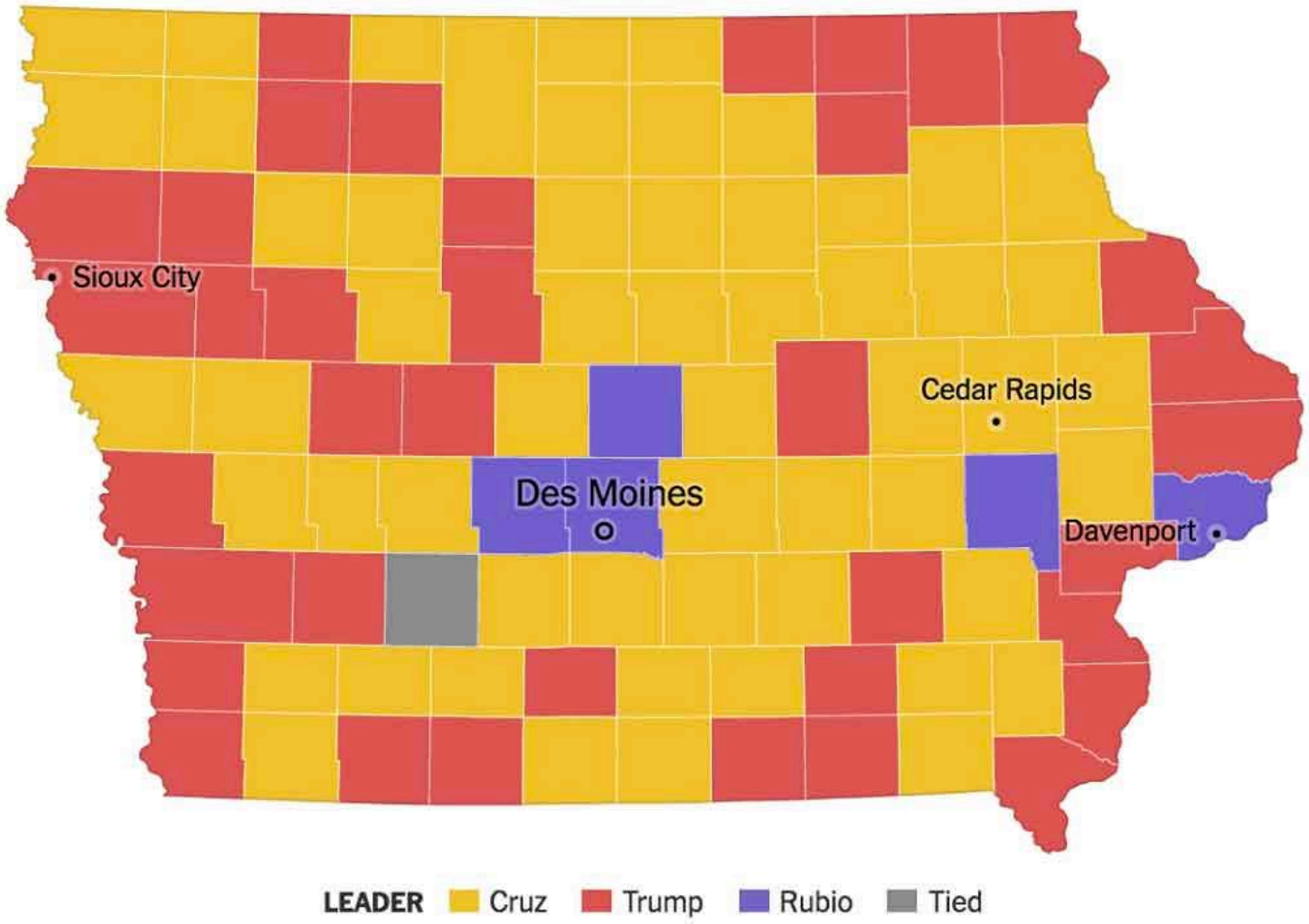
Transverse Mercator Projection



https://www.e-education.psu.edu/geog862/sites/www.e-education.psu.edu.geog862/files/images/Lesson06/Projection%20Design2.png

State Plane Coordinate Systems

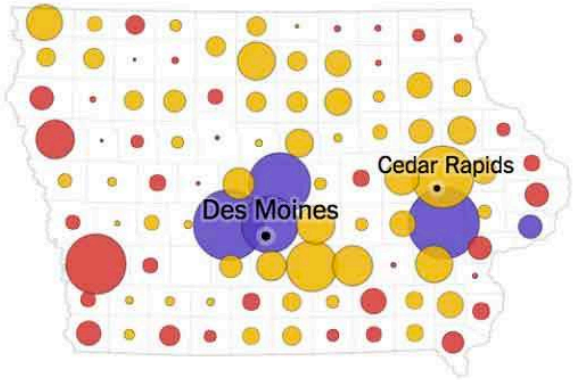
Symbology Matters



https://uxmag.com/articles/winning-the-primary-election

How Republicans Voted

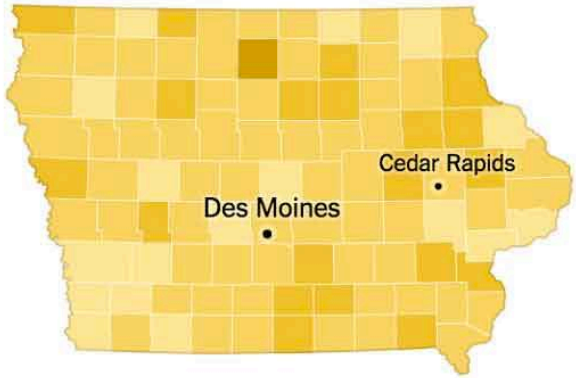
Size of lead



LEADER Cruz Trump Rubio

Circle size is proportional to the size of a candidate's lead.

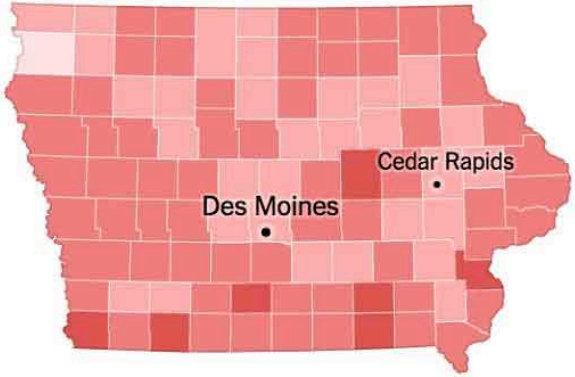
Cruz



CRUZ'S VOTE SHARE

15 25 35 45%

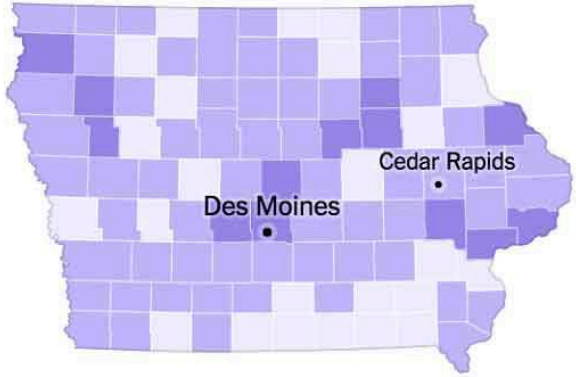
Trump



TRUMP'S VOTE SHARE

15 25 35 45%

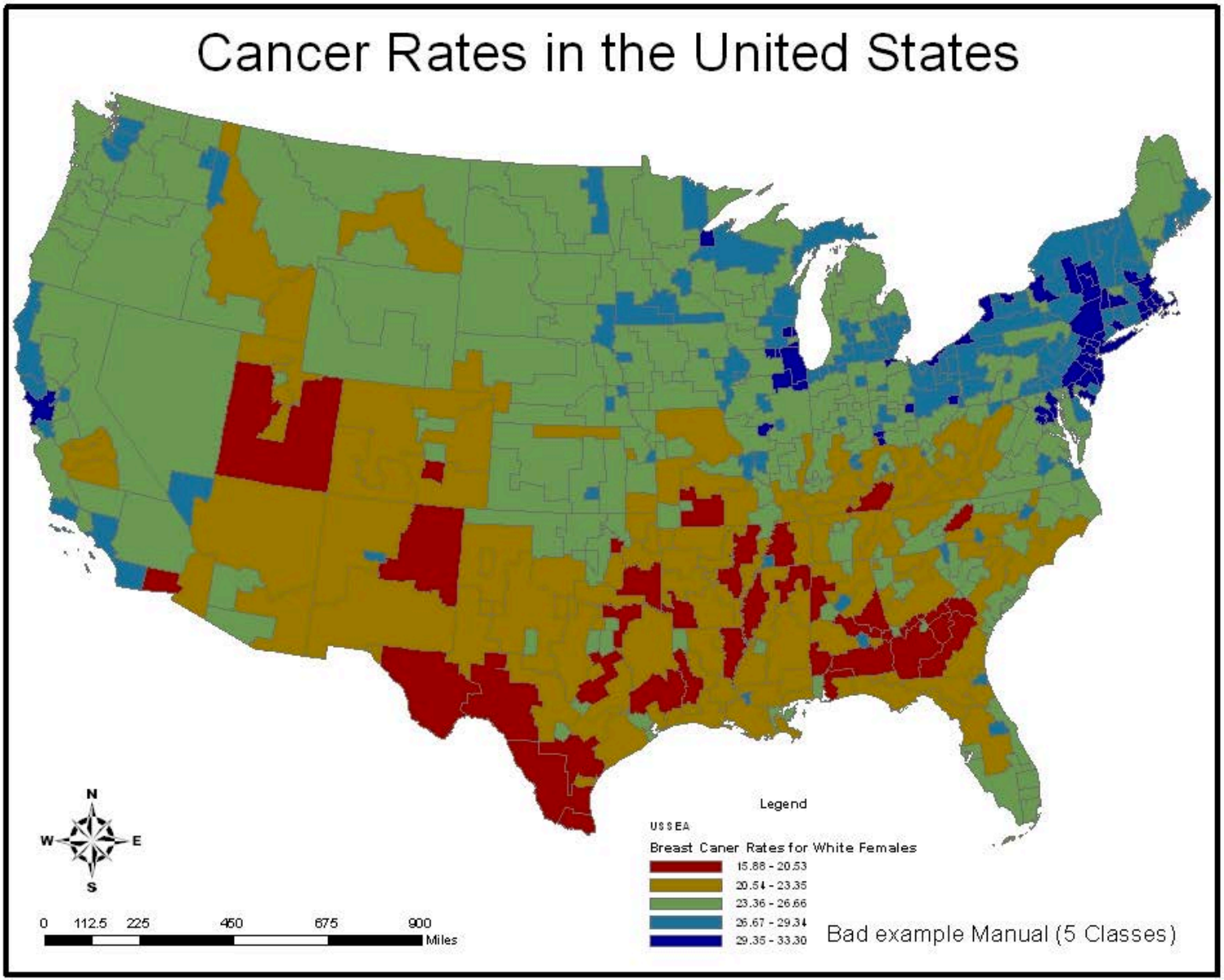
Rubio



RUBIO'S VOTE SHARE

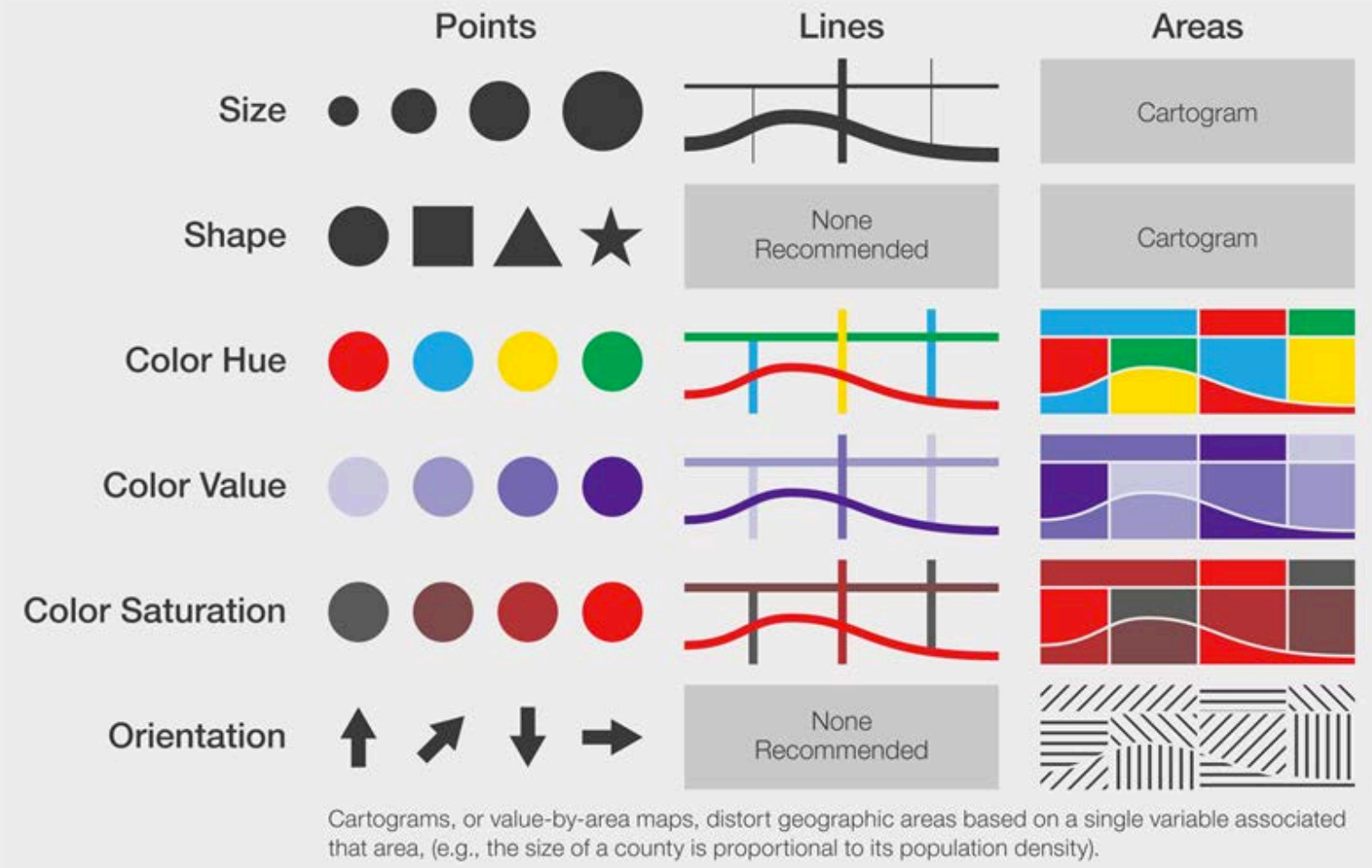
15 25 35 45%

What's Bad About This Map?



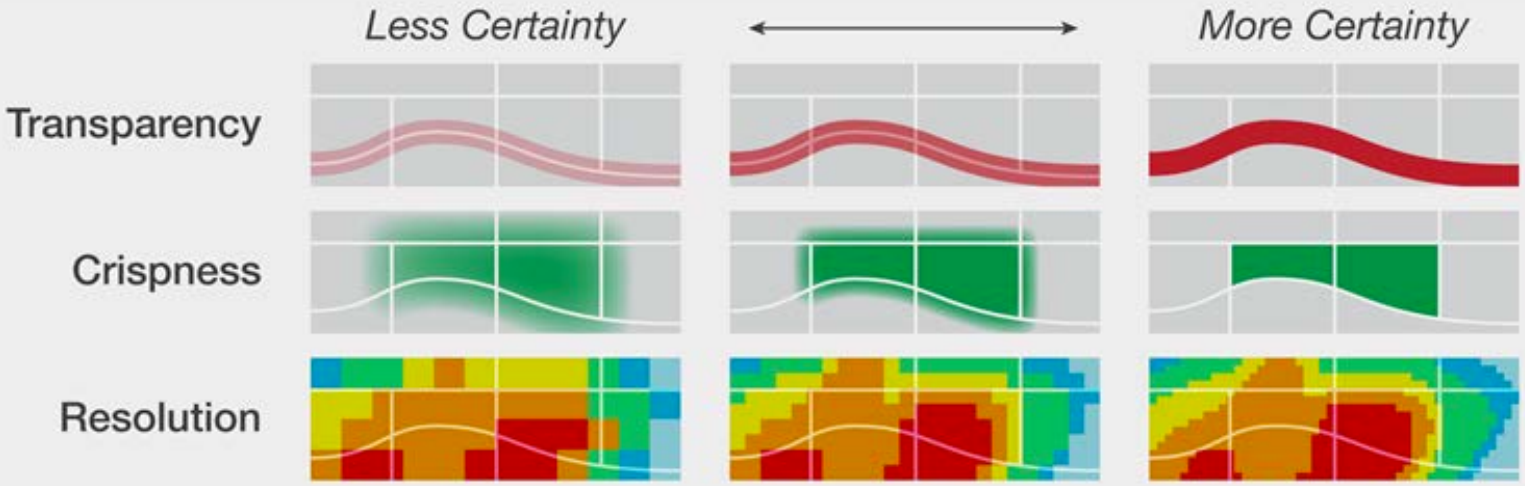
https://msu.edu/~dougl126/lab4.html

Visual Variables



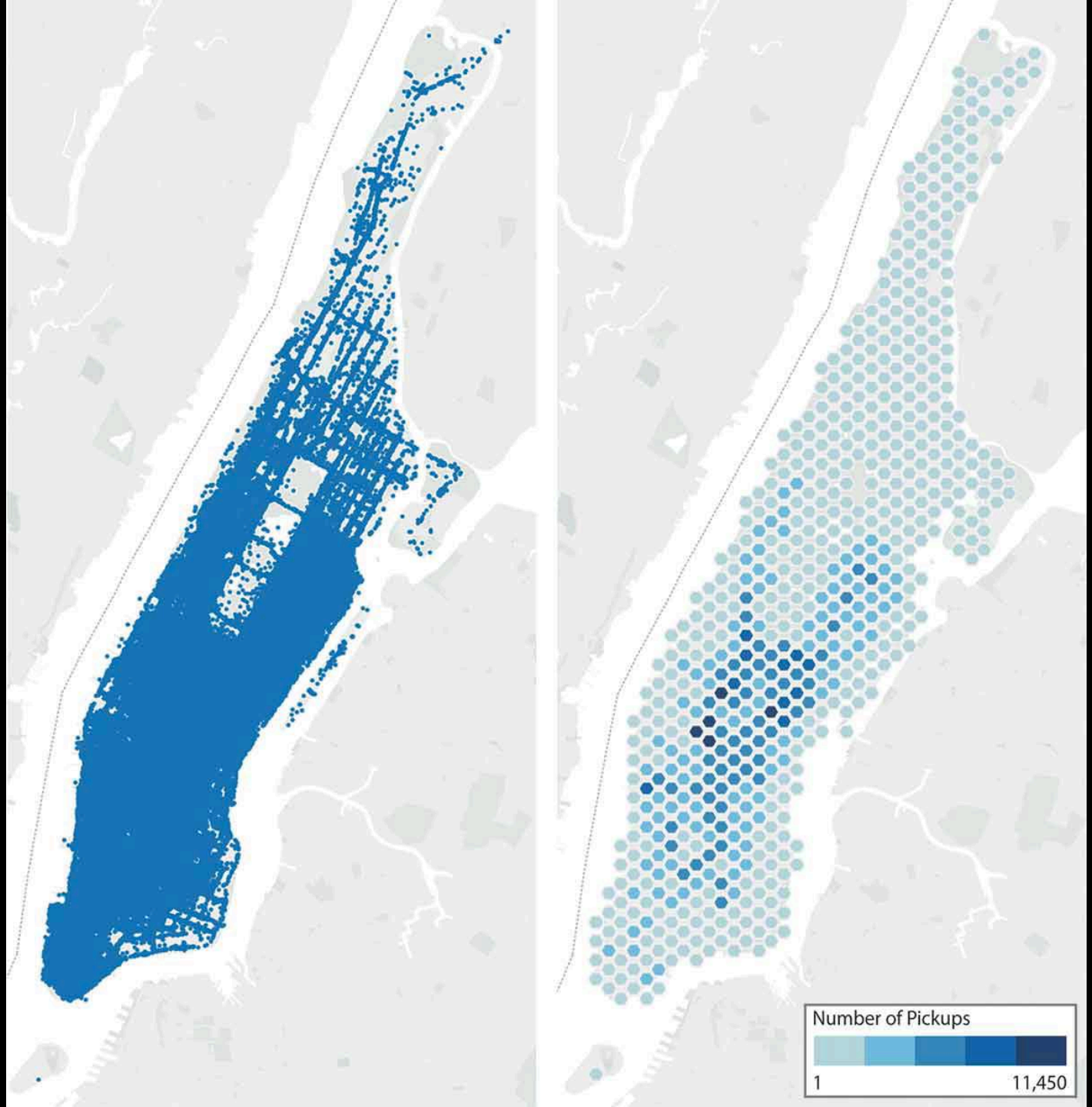
https://gistbok.ucgis.org/bok-topics/symbolization-and-visual-variables

Visual Variables



https://gistbok.ucgis.org/bok-topics/symbolization-and-visual-variables

Binning



Battersby, S. E., Strebe, D. D., & Finn, M. P. (2017). Shapes on a plane: Evaluating the impact of projection distortion on spatial binning. *Cartography and Geographic Information Science*, *44*(5), 410-421.

From Home to Work

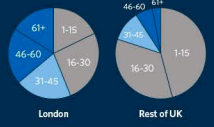
High-paying jobs draw workers from far, far away

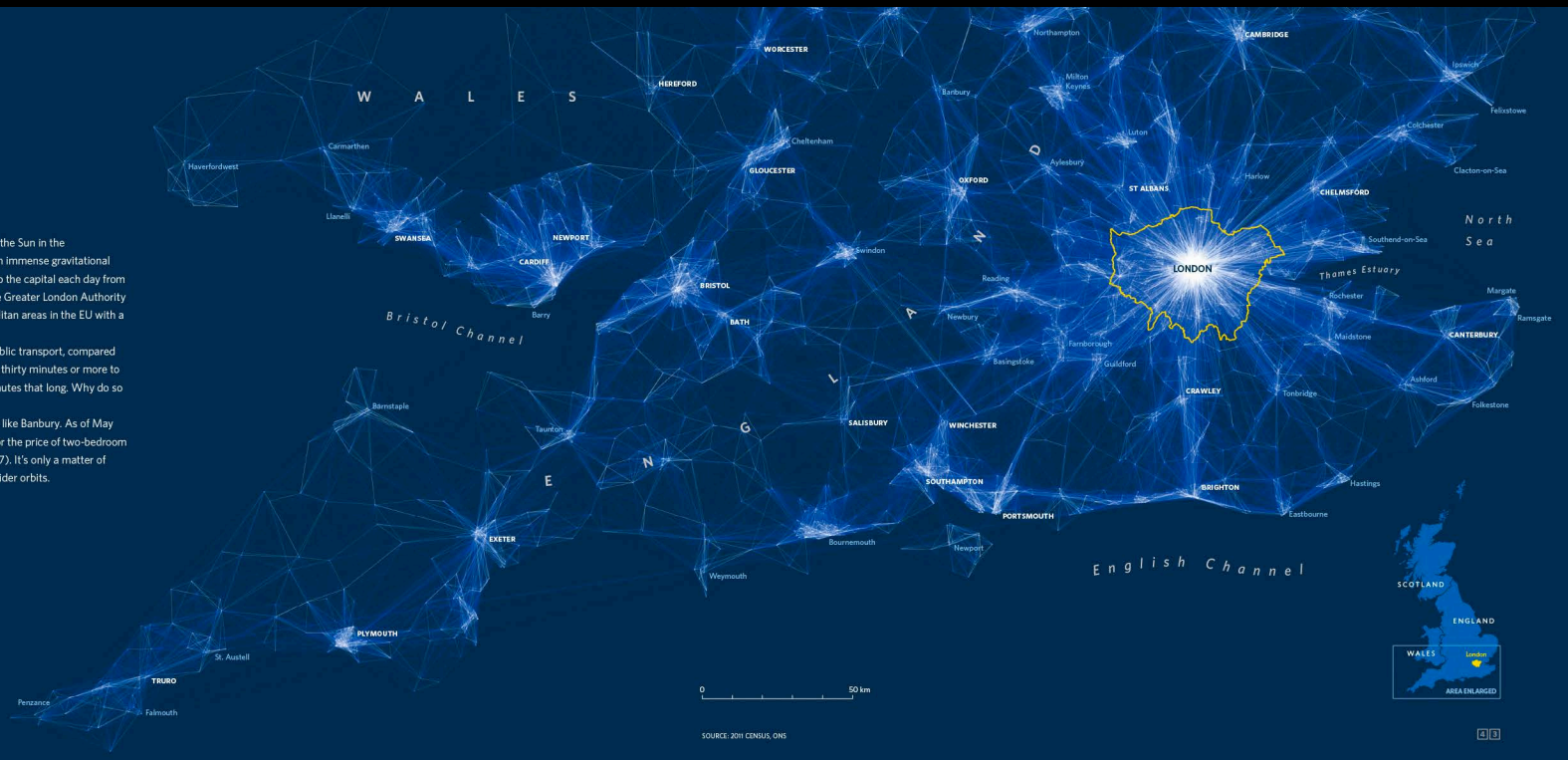
In this depiction of daily commutes, London shines like the Sun in the constellation of Southern England. Like all stars, it has an immense gravitational pull. Whether by car, train or tube, thousands travel into the capital each day from all directions. Including this 'commuter belt' beyond the Greater London Authority boundary makes the capital one of the largest metropolitan areas in the EU with a population of more than 13 million.

Half of London's workforce make their journey by public transport, compared with only 9% in the rest of the country. Still, most need thirty minutes or more to get to work. Elsewhere in the UK, only 20% have commutes that long. Why do so many live so far away?

For one, London salaries go further in satellite towns like Banbury. As of May 2014, a five-bedroom converted barn there was going for the price of two-bedroom flats along the Underground's Central Line (see pp. 66–7). It's only a matter of time before faster trains propel commuters into even wider orbits.

Commuting times in minutes by region of workplace
October–December 2009





SOURCE: 2011 CENSUS, ONS

http://theinformationcapital.com/project/from-home-to-work/

From Home to Work

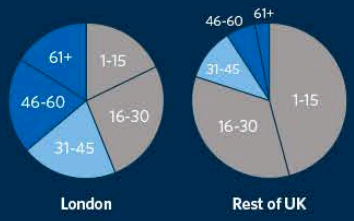
High-paying jobs draw workers from far, far away

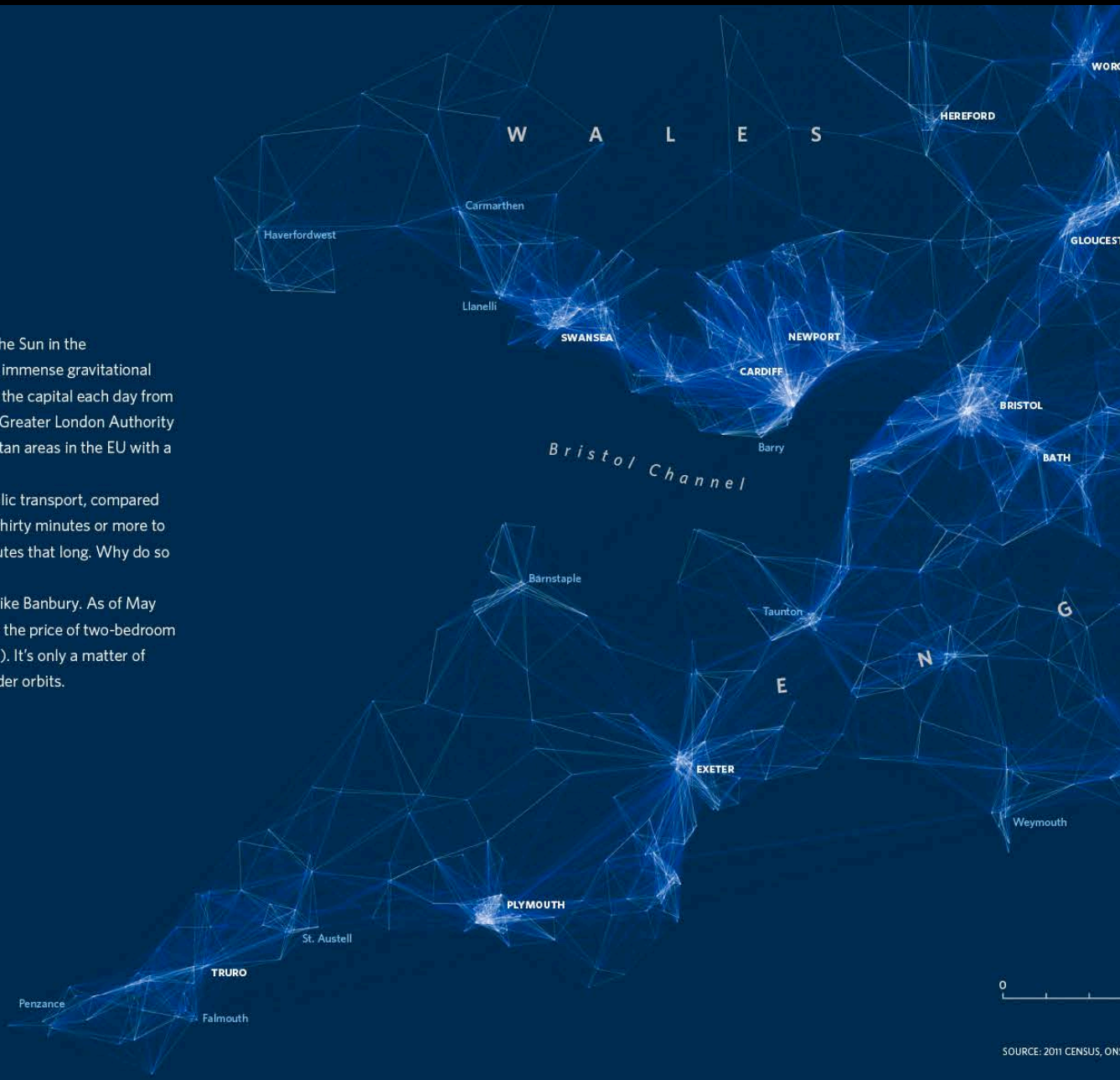
In this depiction of daily commutes, London shines like the Sun in the constellation of Southern England. Like all stars, it has an immense gravitational pull. Whether by car, train or tube, thousands travel into the capital each day from all directions. Including this 'commuter belt' beyond the Greater London Authority boundary makes the capital one of the largest metropolitan areas in the EU with a population of more than 13 million.

Half of London's workforce make their journey by public transport, compared with only 9% in the rest of the country. Still, most need thirty minutes or more to get to work. Elsewhere in the UK, only 20% have commutes that long. Why do so many live so far away?

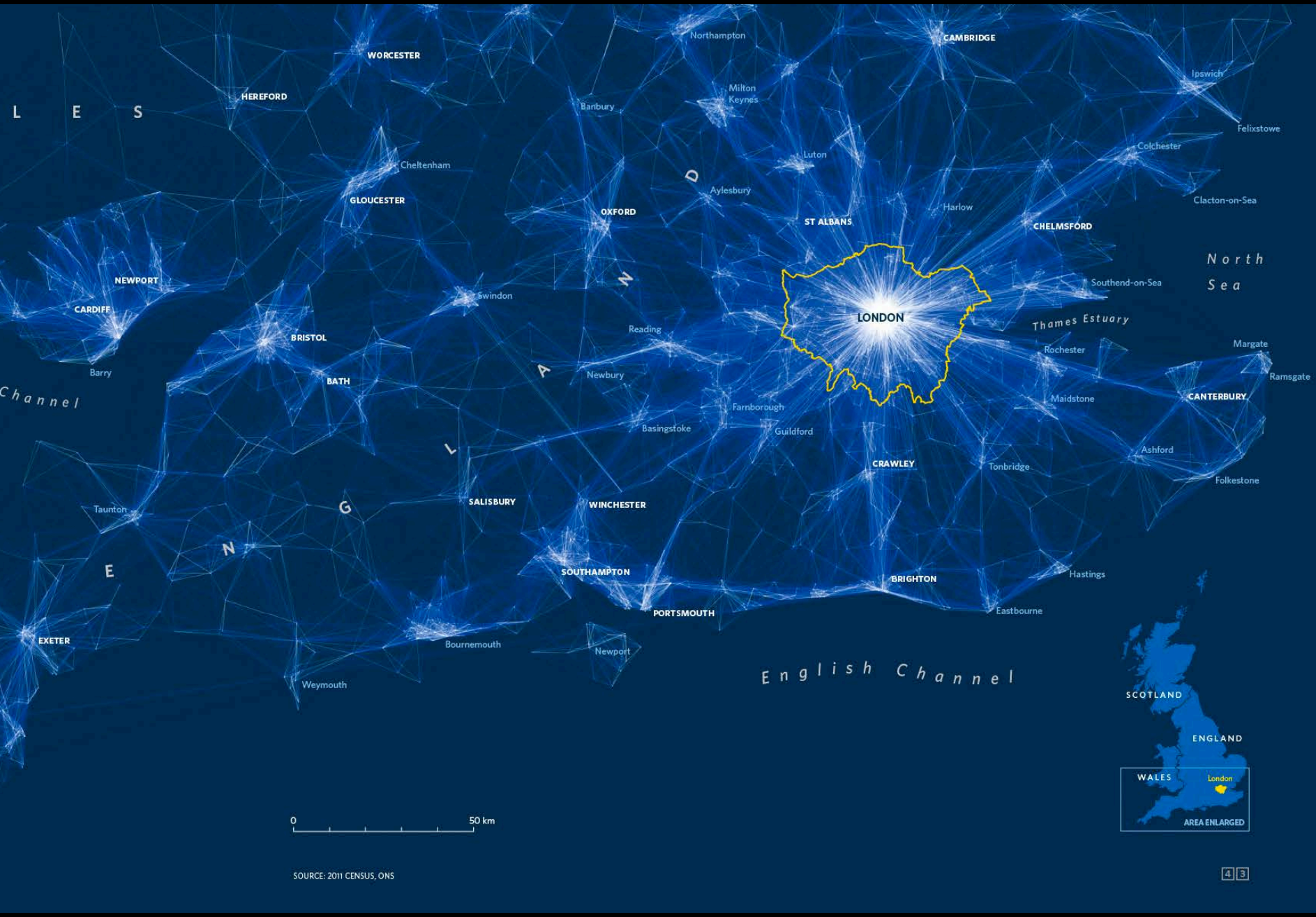
For one, London salaries go further in satellite towns like Banbury. As of May 2014, a five-bedroom converted barn there was going for the price of two-bedroom flats along the Underground's Central Line (see pp. 66–7). It's only a matter of time before faster trains propel commuters into even wider orbits.

Commuting times in minutes by region of workplace
October–December 2009





http://theinformationcapital.com/project/from-home-to-work/



http://theinformationcapital.com/project/from-home-to-work/