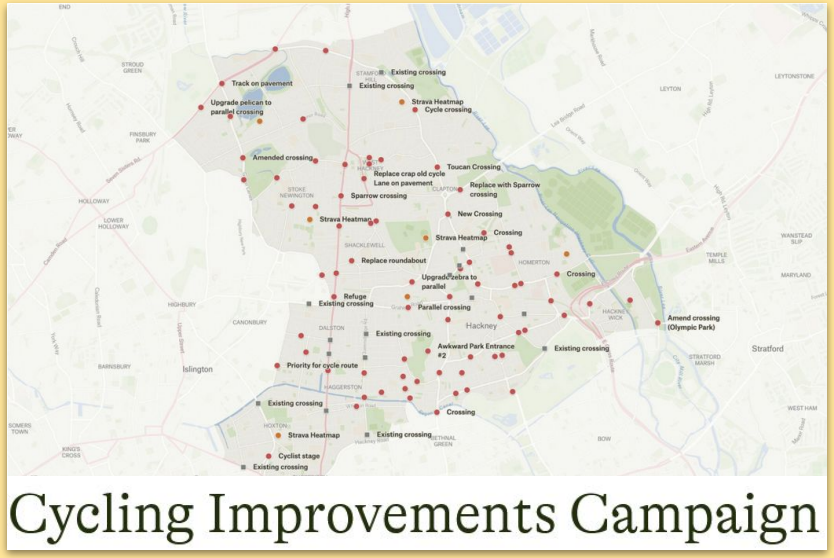
Visualizing Spatial Data

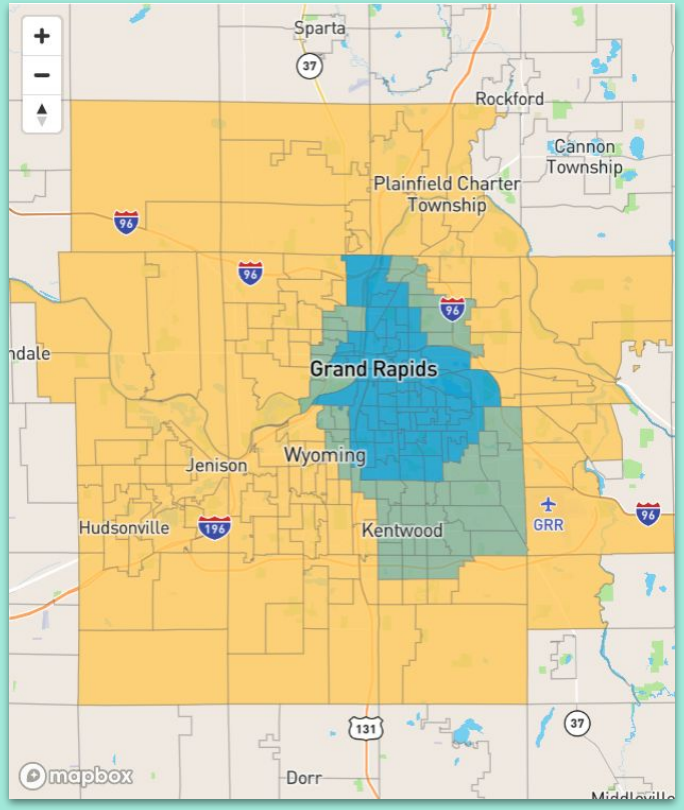
Spatial Analysis Lab (SAL) & SDS/CS 235
Fall 2024

Outline

- What's a map?
- Spatial data
- Parts of a map
- Visual hierarchy & visual balance

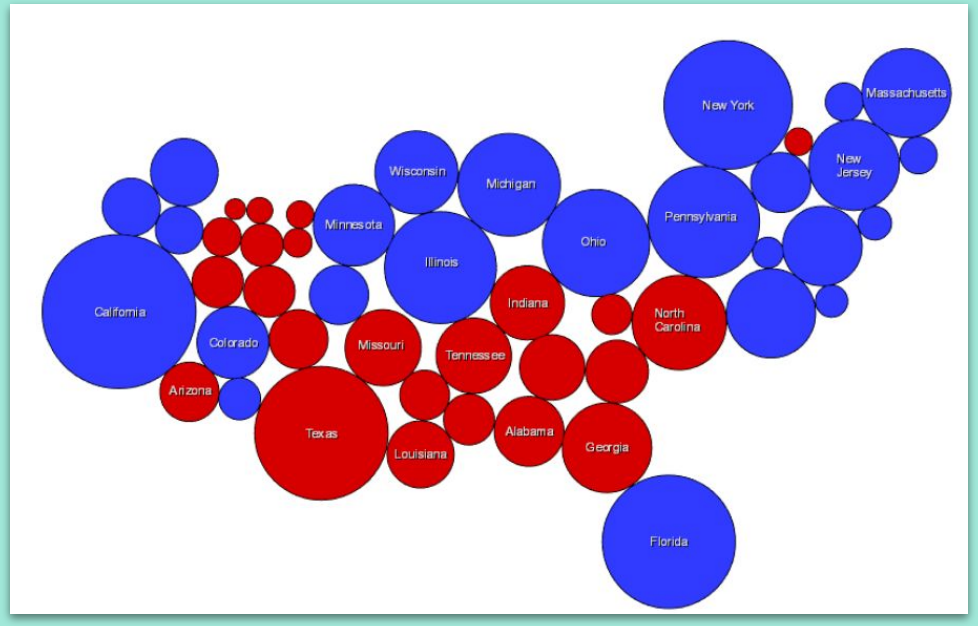


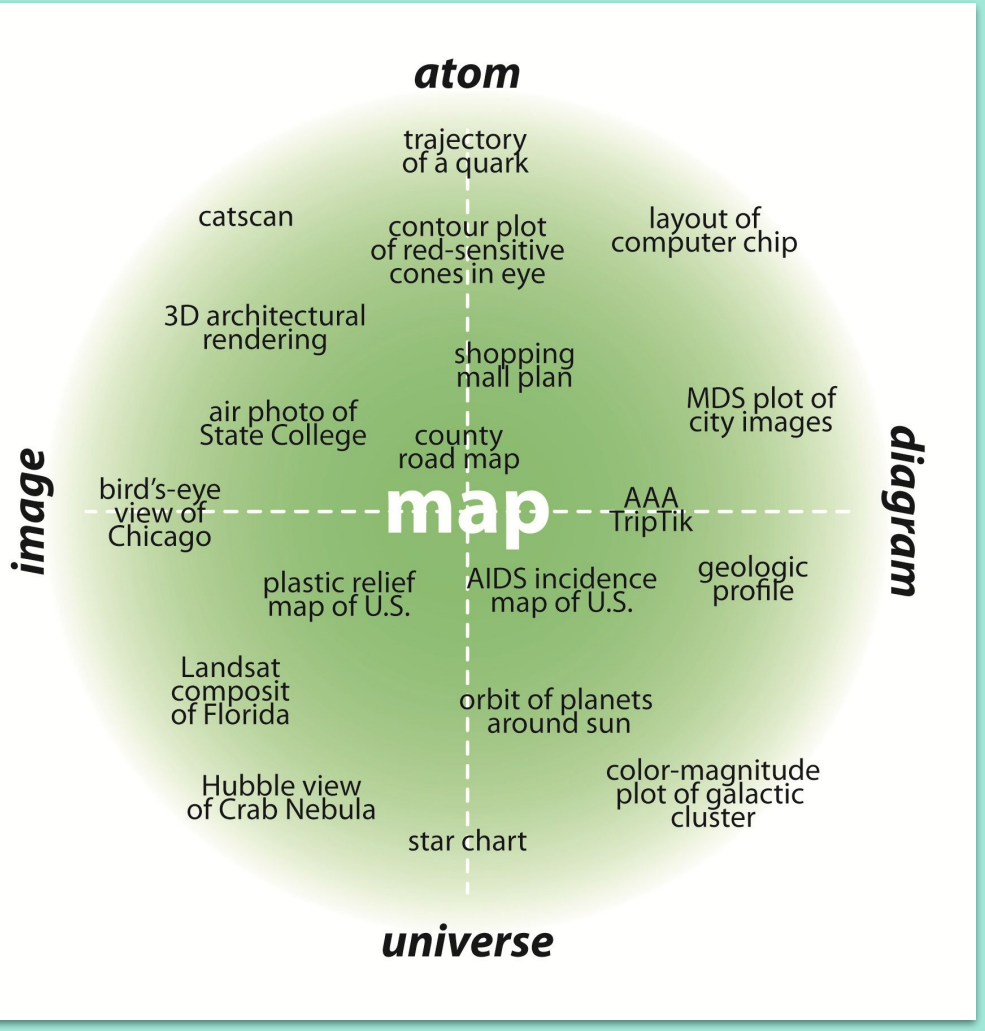
What's a map?


Sparta
37
Rockford
Cannon Township
Plainfield Charter Township
96
Grand Rapids
Wyoming
Jenison
Hudsonville
196
Kentwood
GRR
131
Dorr
mapbox

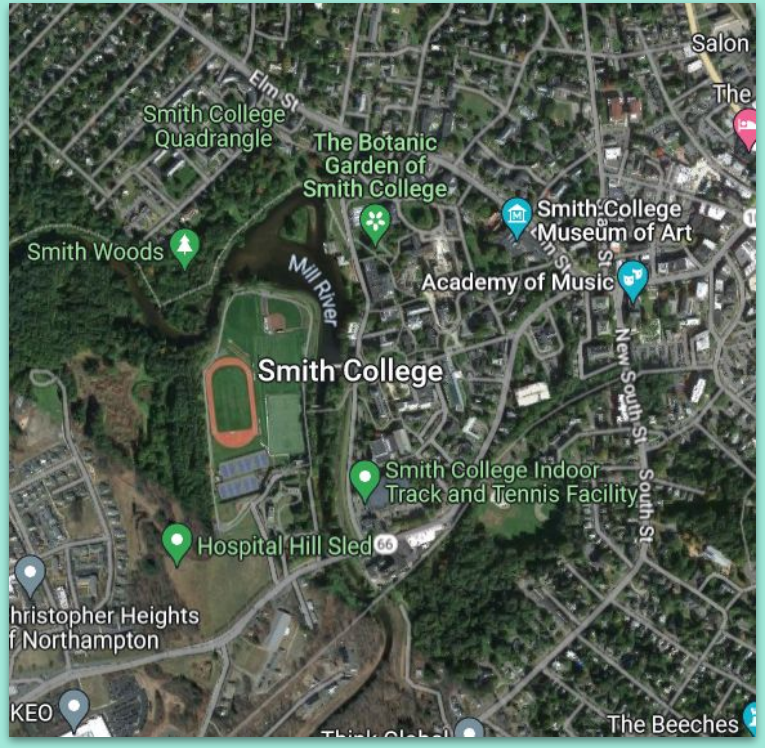

LATIN
AMERICA

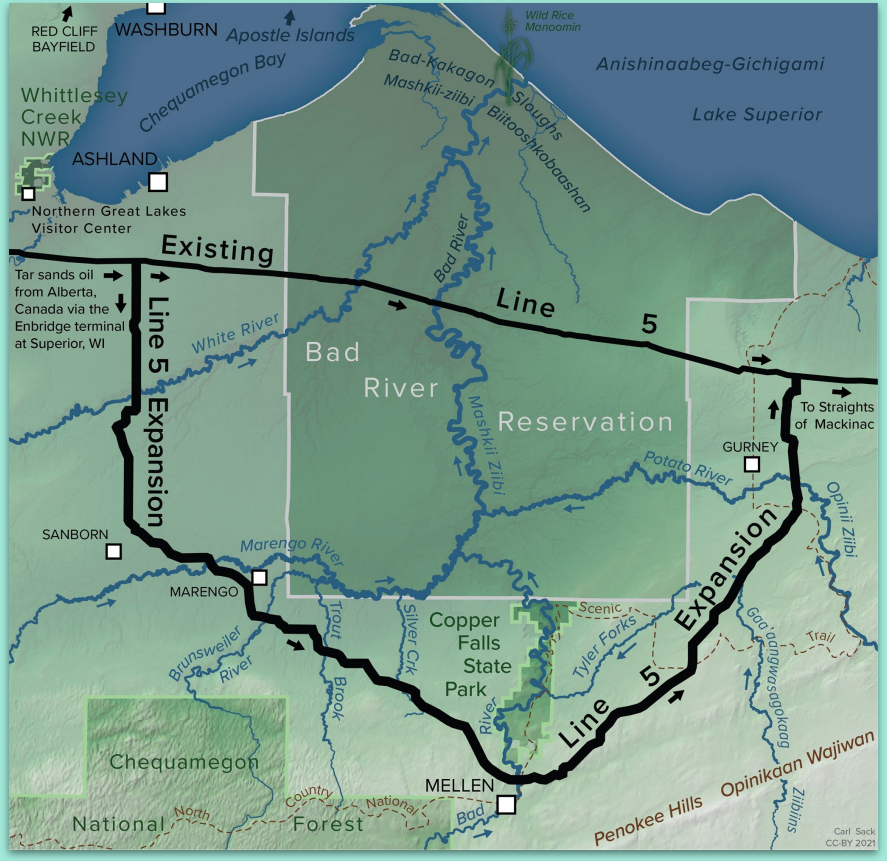

The Places We've BEEN!
Pop-Pop & Me
I remember you here.
Madison
"Hush Little Baby" One of the MANY dolls you gave me.
candy during car rides
"How many miles can you make ONE PIECE last?" (when it ran out, there was always more!)
Here you waved goodbye.
I watched the flag fold and knew you lived in my heart.
Stuart
Florida oranges for Christmas!
Lottery tickets at the mall. You offerred to let me pick the numbers, but the decision was too big!
The Yardley Country Club: Place of BRUNCH!
"Hello, Chelsea!"
State College
New York Stock Exchange
"SINCE THE STOCK MARKET IS UP YOU GET A TOY!"
New York City
Yardley
Mercer County
you played my FAVORITE game with me, when I was 5
Pop Pop's HOUSE!
Ewing
THE ATOMIC SUNDAE!
Trenton
Pumpkin Candy!
the one dessert I really wish I ordered!
Cherry Hill
We rode the mall train five times in a row!
Voorhees
"RACE ME, POP-POP!"
Where you were
1944 WWII
ENGLAND
London


New York
Massachusetts
New Jersey
Wisconsin
Michigan
Minnesota
Ohio
Pennsylvania
Illinois
California
Indiana
North Carolina
Colorado
Missouri
Tennessee
Arizona
Texas
Alabama
Georgia
Louisiana
Florida

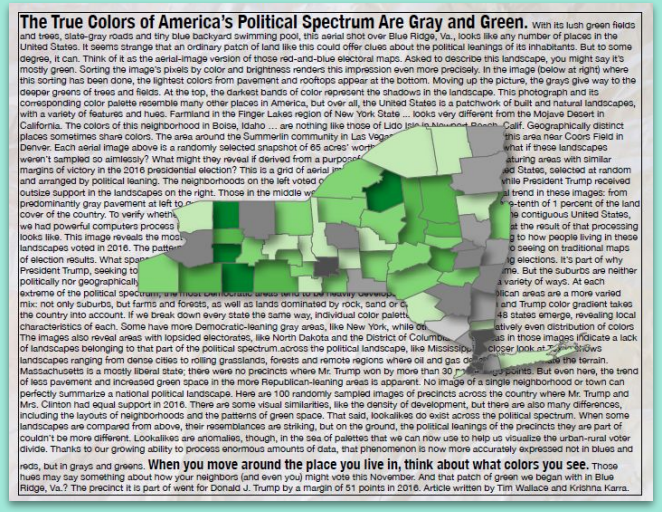

atom
trajectory of a quark
catscan
contour plot of red-sensitive cones in eye
layout of computer chip
3D architectural rendering
shopping mall plan
MDS plot of city images
air photo of State College
county road map
image
map
diagram
bird's-eye view of Chicago
AAA TripTik
plastic relief map of U.S.
AIDS incidence map of U.S.
geologic profile
Landsat composit of Florida
orbit of planets around sun
color-magnitude plot of galactic cluster
Hubble view of Crab Nebula
star chart
universe

Reference maps

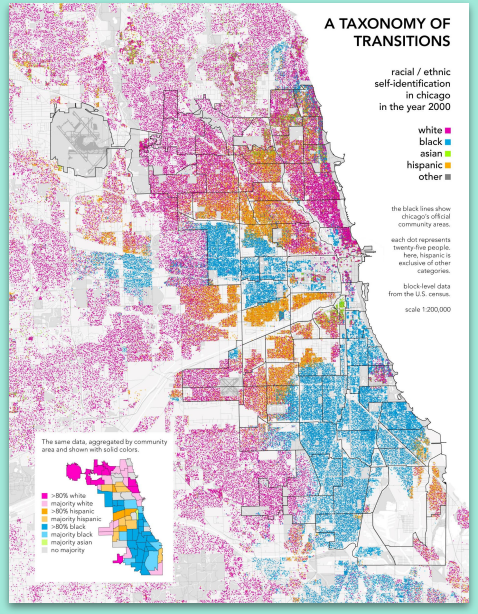


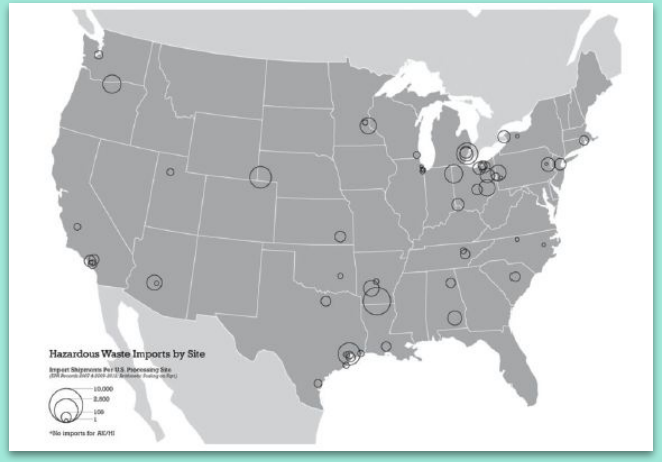


Thematic (data) maps



The True Colors of America's Political Spectrum Are Gray and Green. With its lush green fields and trees, slate-gray roads and tiny blue backyard swimming pool, this aerial shot over Blue Ridge, Va., looks like any number of places in the United States. It seems strange that an ordinary patch of land like this could offer clues about the political leanings of its inhabitants. But to some degree, it can. Think of it as the aerial-image version of those red-and-blue electoral maps. Asked to describe this landscape, you might say it's mostly green. Sorting the image's pixels by color and brightness renders this impression even more precisely. In the image (below at right) where this sorting has been done, the lightest colors from pavement and rooftops appear at the bottom. Moving up the picture, the grays give way to the deeper greens of trees and fields. At the top, the darkest bands of color represent the shadows in the landscape. This photograph and its corresponding color palette resemble many other places in America, but over all, the United States is a patchwork of built and natural landscapes, with a variety of features and hues. Farmland in the Finger Lakes region of New York State ... looks very different from the Mojave Desert in California. The colors of this neighborhood in Boise, Idaho ... are nothing like those of Lido Isle in Newport Beach, Calif. Geographically distinct places sometimes share colors. The area around the Summerlin community in Las Vegas ... this area near Coors Field in Denver. Each aerial image above is a randomly selected snapshot of 65 acres' worth ... what if these landscapes weren't sampled so aimlessly? What might they reveal if derived from a purposef ... aturing areas with similar margins of victory in the 2016 presidential election? This is a grid of aerial ... d States, selected at random and arranged by political leaning. The neighborhoods on the left voted ... while President Trump received outsize support in the landscapes on the right. Those in the middle w ... l trend in these images: from predominantly gray pavement at left to ... e-tenth of 1 percent of the land cover of the country. To verify whether ... e contiguous United States, we had powerful computers process ... t the result of that processing looks like. This image reveals the most ... g to how people living in these landscapes voted in 2016. The patter ... o seeing on traditional maps of election results. What span ... g elections. It's part of why President Trump, seeking to ... me. But the suburbs are neither politically nor geographically ... a variety of ways. At each extreme of the political spectrum, ... itican areas are a more varied mix: not only suburbs, but farms and forests, as well as lands dominated by rock, sand or ... and Trump color gradient takes the country into account. If we break down every state the same way, individual color palett ... 48 states emerge, revealing local characteristics of each. Some have more Democratic-leaning gray areas, like New York, while ot ... atively even distribution of colors The images also reveal areas with lopsided electorates, like North Dakota and the District of Columbi ... as in those images indicate a lack of landscapes belonging to that part of the political spectrum across the political landscape, like Mississip ... closer look at ... shows landscapes ranging from dense cities to rolling grasslands, forests and remote regions where oil and gas d ... the terrain. Massachusetts is a mostly liberal state; there were no precincts where Mr. Trump won by more than 30 p ... points. But even here, the trend of less pavement and increased green space in the more Republican-leaning areas is apparent. No image of a single neighborhood or town can perfectly summarize a national political landscape. Here are 100 randomly sampled images of precincts across the country where Mr. Trump and Mrs. Clinton had equal support in 2016. There are some visual similarities, like the density of development, but there are also many differences, including the layouts of neighborhoods and the patterns of green space. That said, lookalikes do exist across the political spectrum. When some landscapes are compared from above, their resemblances are striking, but on the ground, the political leanings of the precincts they are part of couldn't be more different. Lookalikes are anomalies, though, in the sea of palettes that we can now use to help us visualize the urban-rural voter divide. Thanks to our growing ability to process enormous amounts of data, that phenomenon is now more accurately expressed not in blues and reds, but in grays and greens. **When you move around the place you live in, think about what colors you see.** Those hues may say something about how your neighbors (and even you) might vote this November. And that patch of green we began with in Blue Ridge, Va.? The precinct it is part of went for Donald J. Trump by a margin of 51 points in 2016. Article written by Tim Wallace and Krishna Karra.

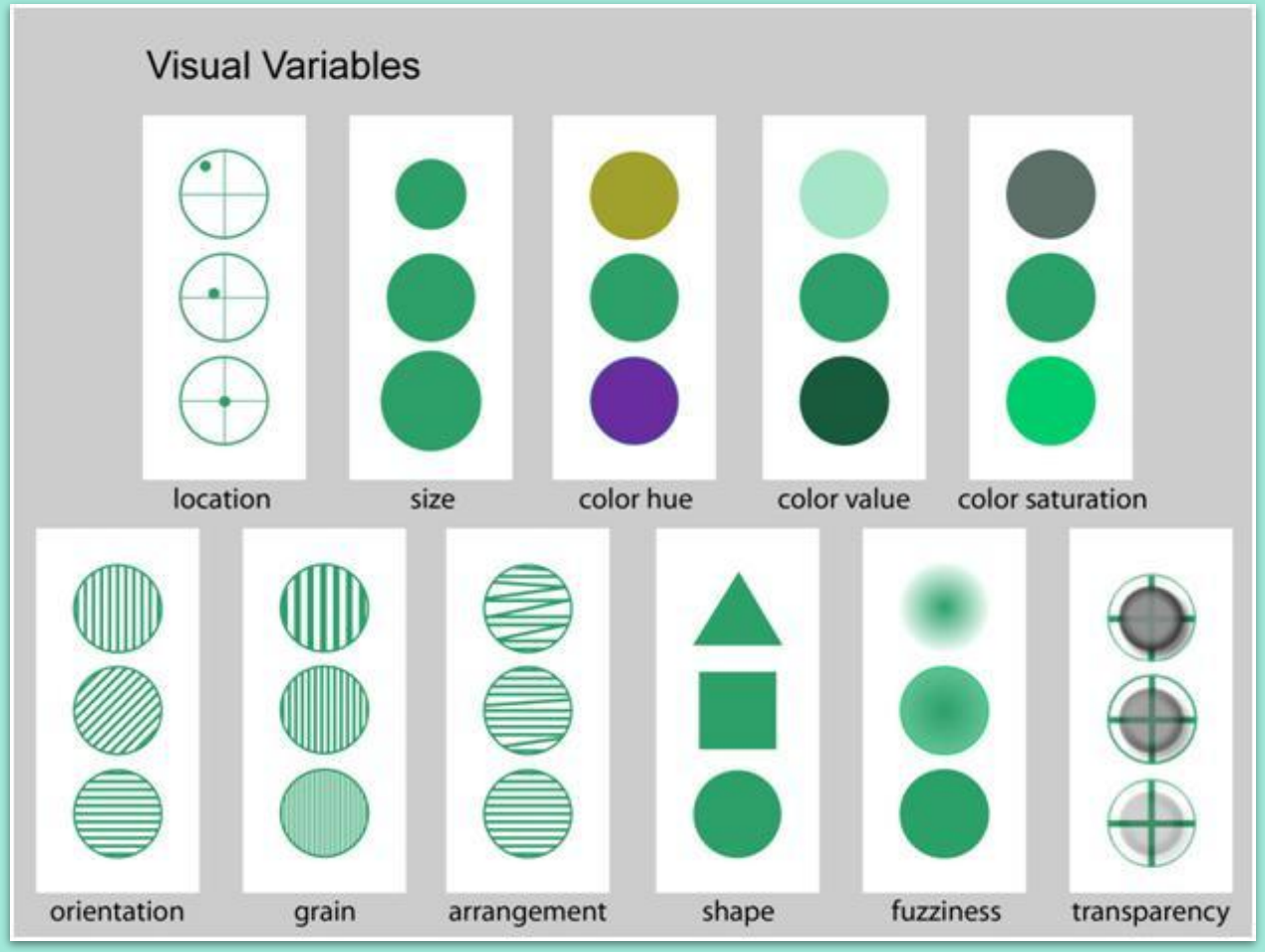




Choropleth

Dot density

Proportional symbol

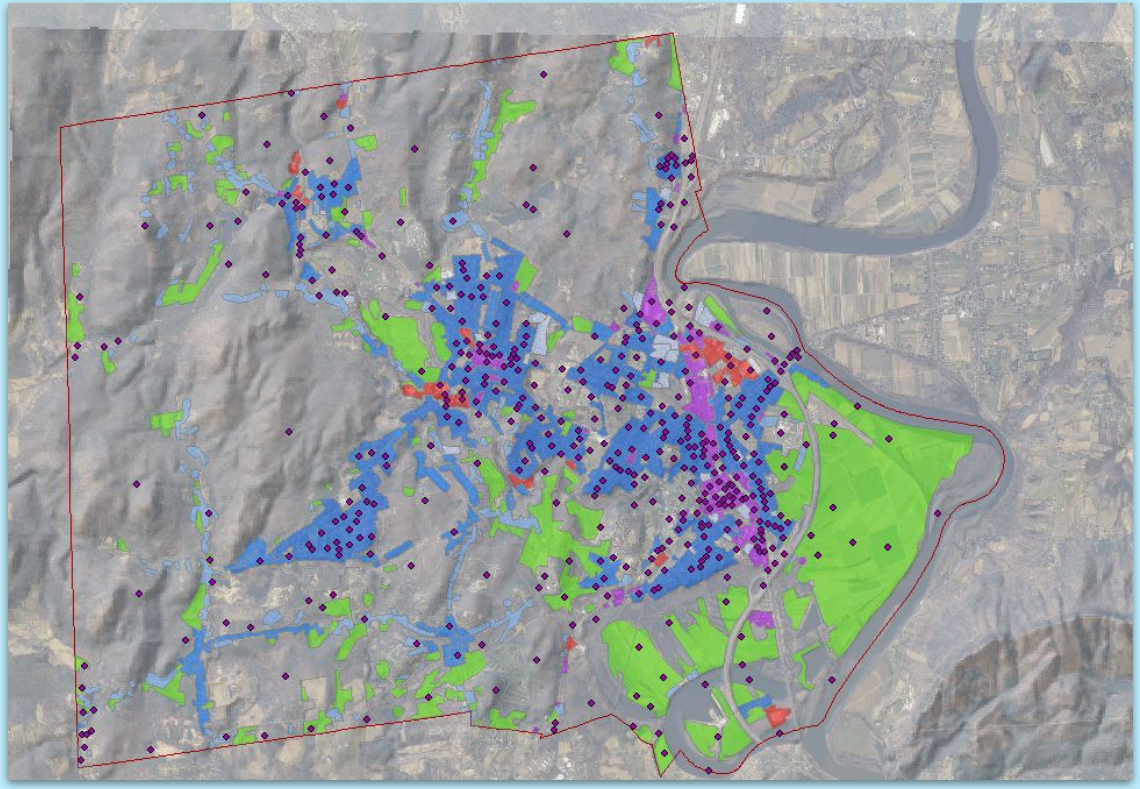


AKA visual channels or visual dimensions

Spatial data

Location and attribute information

X: Longitude
Y: Latitude
Z: Elevation

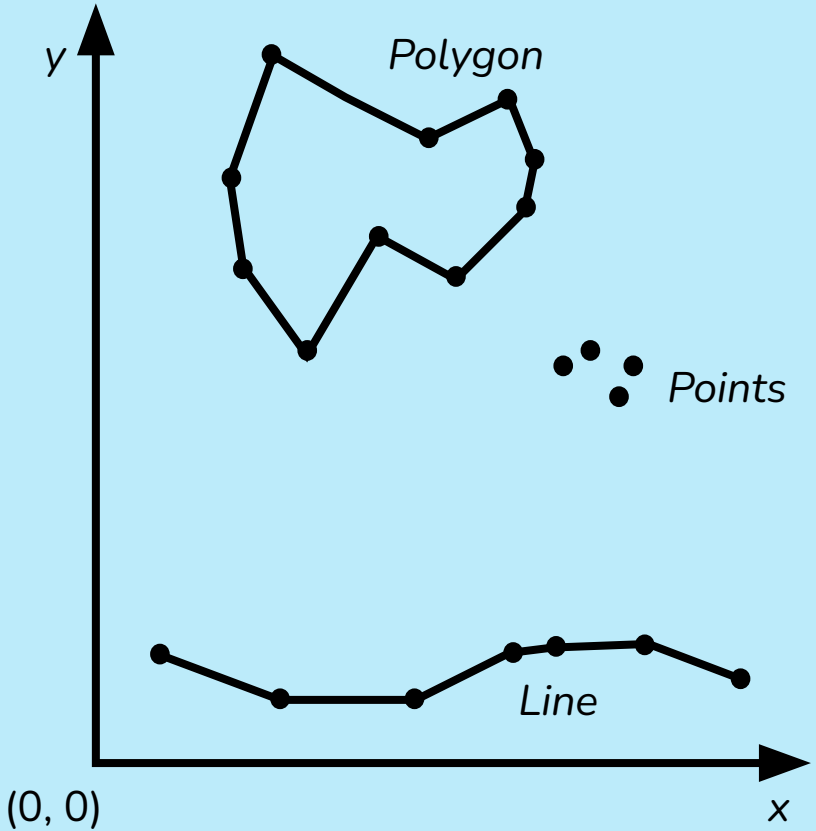


Vector

Points
Lines
Polygons

Discrete data

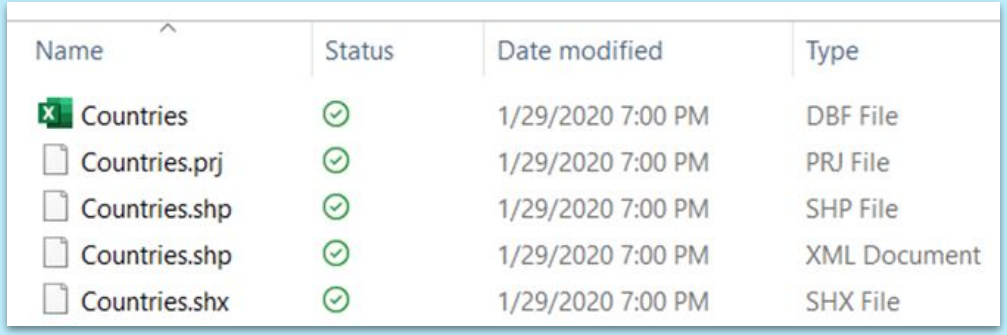
Contain geography and attributes



The major GIS file format: Shapefiles

Technically multiple files:

- .shp: stores geometry
- .shx: index file
- .dbf: database file (stores attribute data)
- .prj: projection file
- .xml: stores metadata
- ...and more



Name	Status	Date modified	Type
Countries	✓	1/29/2020 7:00 PM	DBF File
Countries.prj	✓	1/29/2020 7:00 PM	PRJ File
Countries.shp	✓	1/29/2020 7:00 PM	SHP File
Countries.shp	✓	1/29/2020 7:00 PM	XML Document
Countries.shx	✓	1/29/2020 7:00 PM	SHX File

Don’t delete pieces!

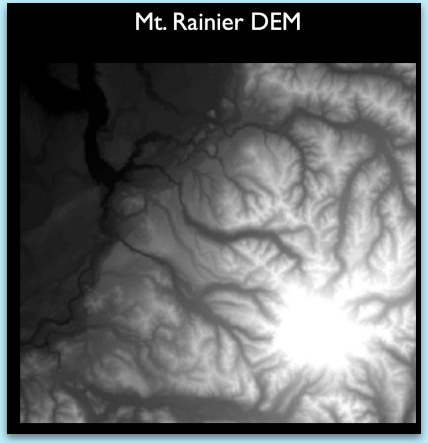
Raster

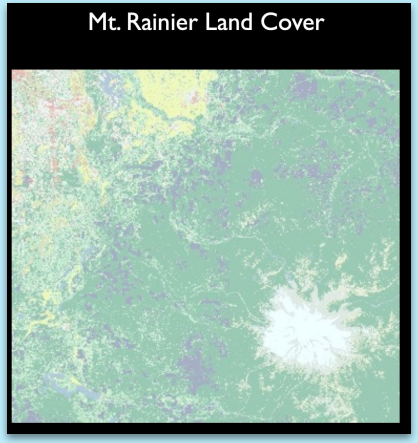
Grids
Continuous data

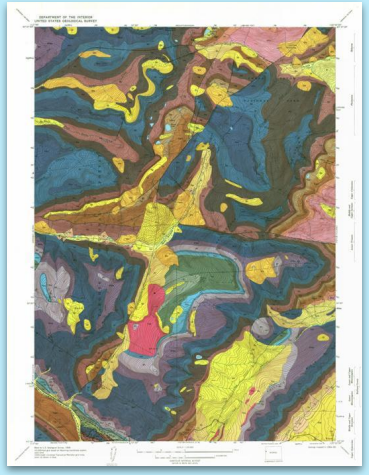
Consider:

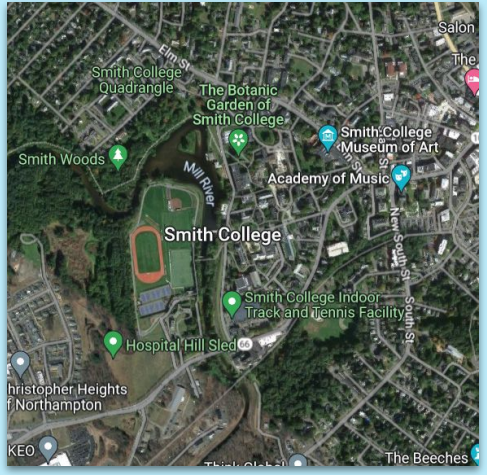
- Resolution
- Cell values

Caution: large files

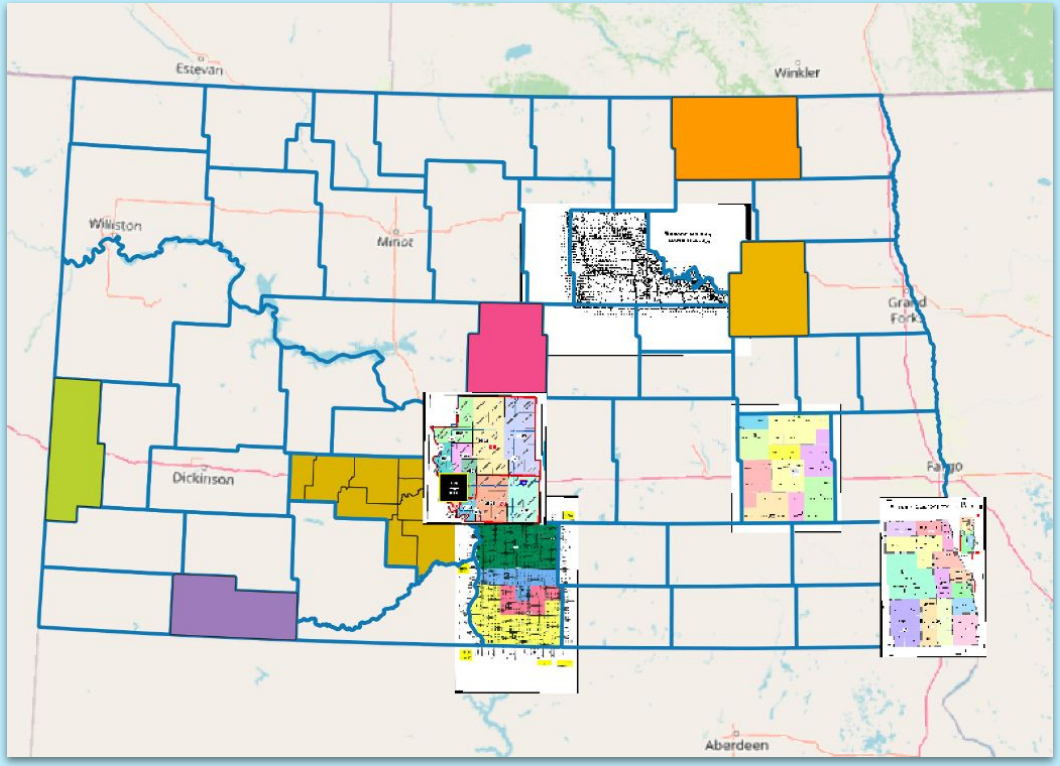








Raster to vector

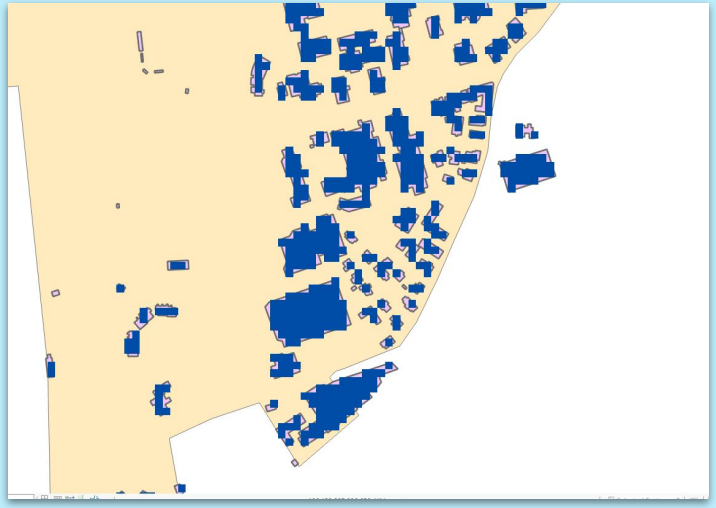


North Dakota voting precincts

Steps:

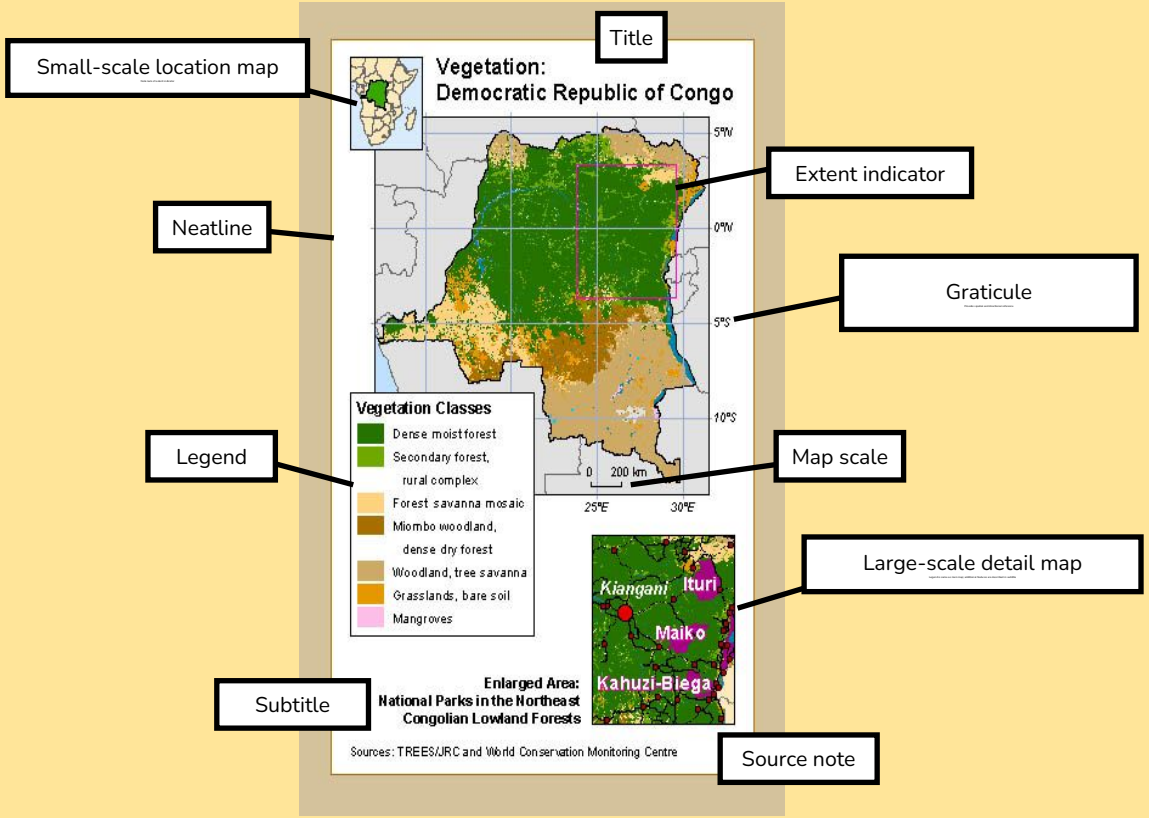
- Scan at high resolution
- Georeference
- Vectorize

Vector to raster



Northampton buildings

- Conversion tool with appropriate cell size

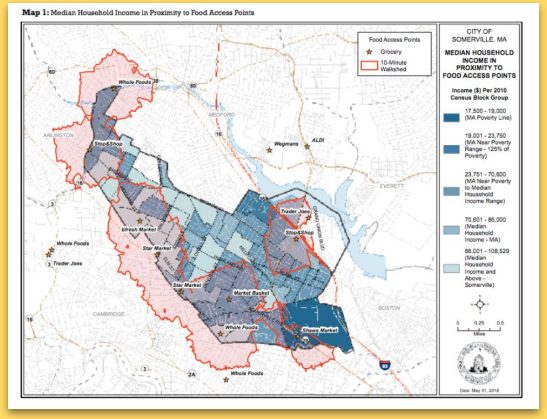


Cynthia Brewer: http://www.personal.psu.edu/cab38

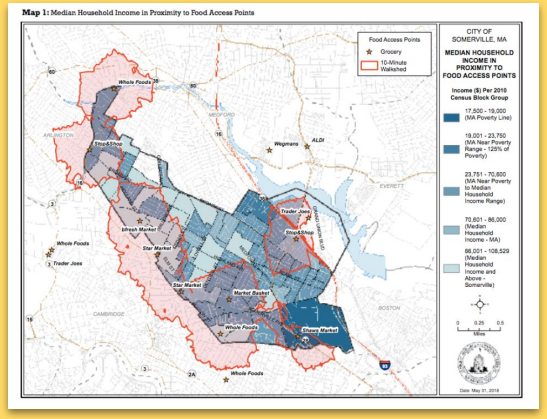
What are the parts of a map?

Parts of a map

- **Map frame:** area dedicated to the map (including symbols and labels)
- **Title:** name of the map
- **Inset:** smaller map that supplements the main map/argument
- **Neatline:** graphic container for all elements



- **Scale indicator:** an indicator of cartographic scale
- **Orientation indicator:** an indicator of bearing (e.g., North Arrow or Graticule)
- **Legend/Key:** description of symbols included in the map
- **Metadata:** information about the map and information therein
    - Information sources
    - Information quality
    - Projection information
    - Creator
    - Date of creation



Visual hierarchy
&
Visual balance

Visual hierarchy

Visual representation of the relative importance of map components (symbols, labels, peripherals)

- Consider intellectual hierarchy
- Generate figure-ground
- Use negative space and cultural norms
- Establish graphic contrast between different kinds of map features
- Establish graphic similarity between features of the same type

Visual Hierarchy

PROMINENT MAP SYMBOLS

HIGHLIGHTED LAND

HIGHLIGHTED WATER

TITLE

GRAPH

LEGEND

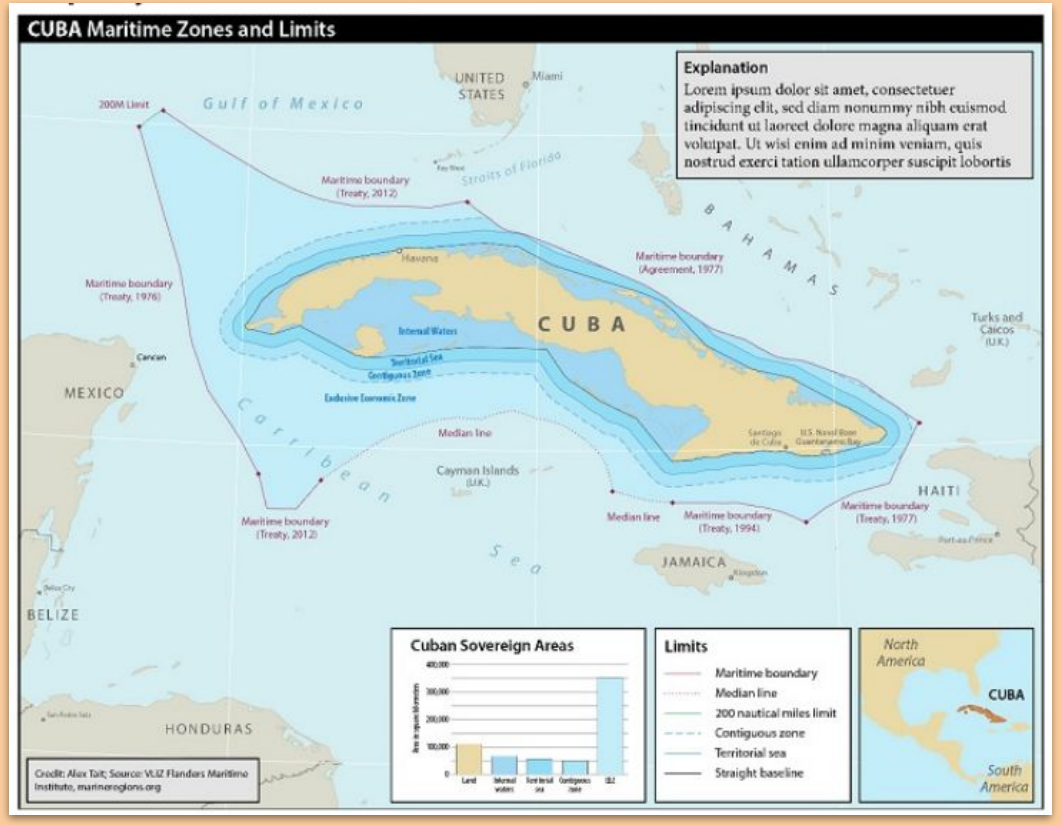
INSET MAP

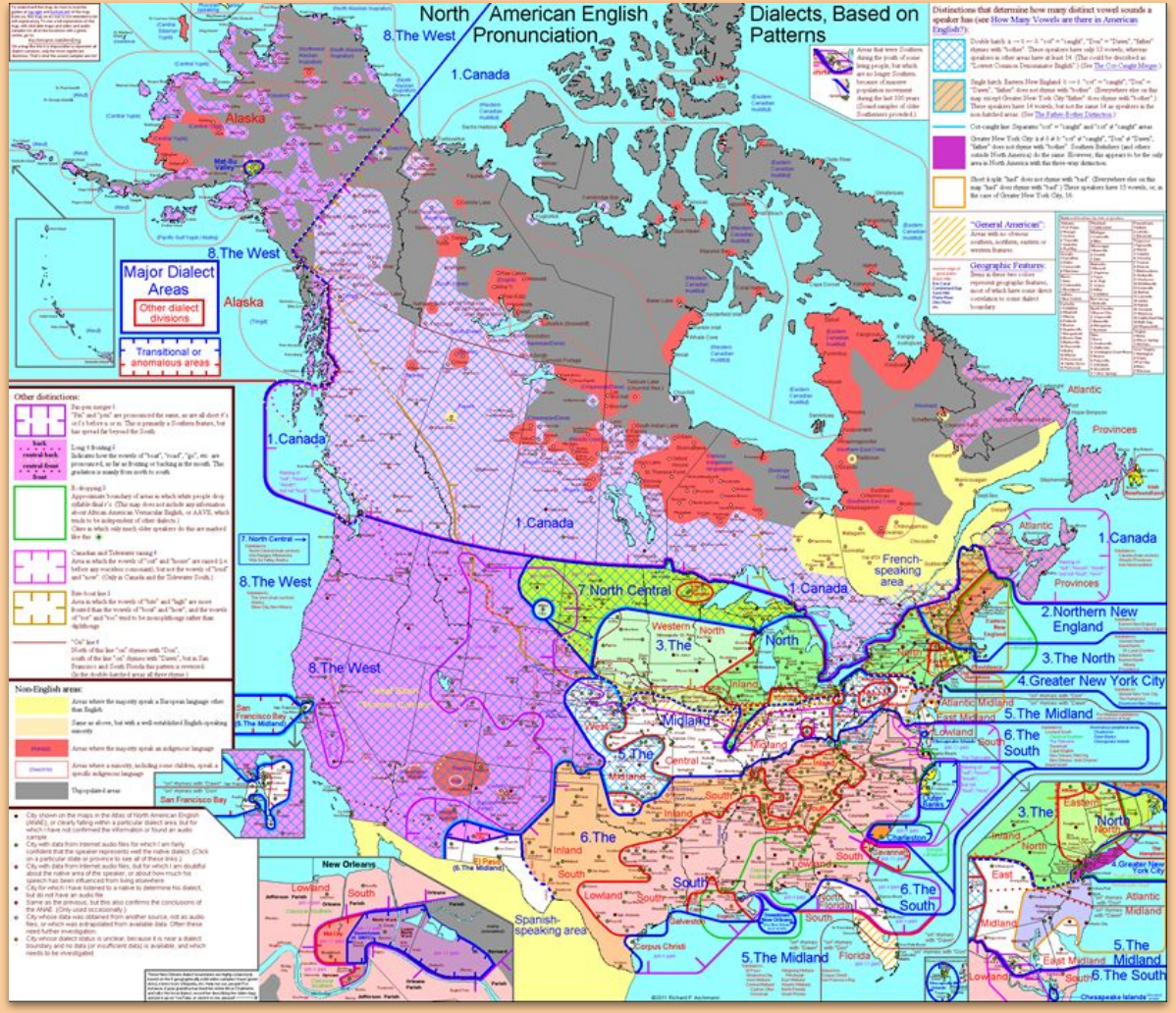
EXLANATORY TEXT

CREDIT

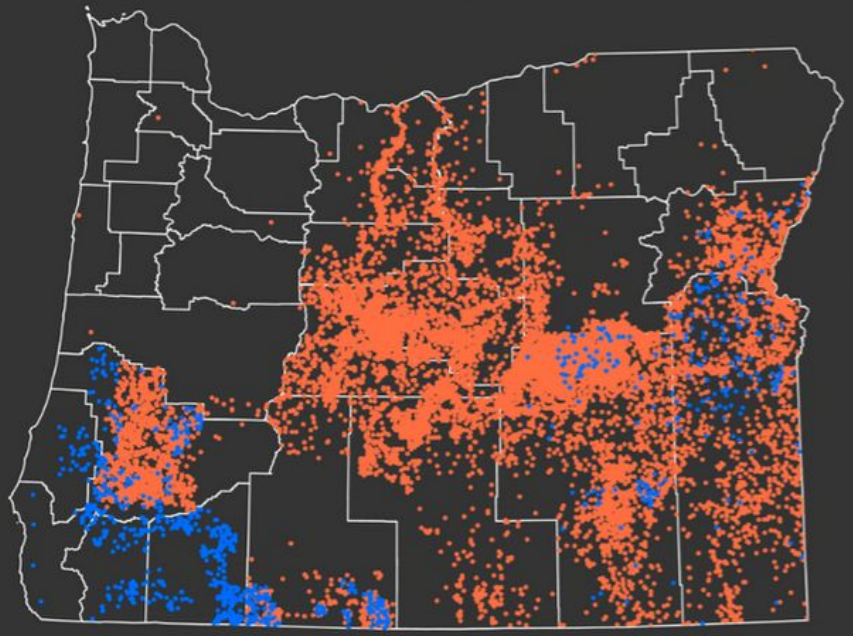
BASEMAP LAND

BASEMAP WATER




North American English Pronunciation Dialects, Based on Patterns
Major Dialect Areas
Other dialect divisions
Transitional or anomalous areas
Alaska
8.The West
1.Canada
7.North Central
2.Northern New England
3.The North
4.Greater New York City
5.The Midland
6.The South
French-speaking area
Spanish-speaking area
Atlantic Provinces
Other distinctions:
Non-English areas:
Distinctions that determine how many distinct vowel sounds a speaker has (see How Many Vowels are there in American English?):
"General American":
Geographic Features:

Wildfire Sources and Firefighting Water Sources



Legend

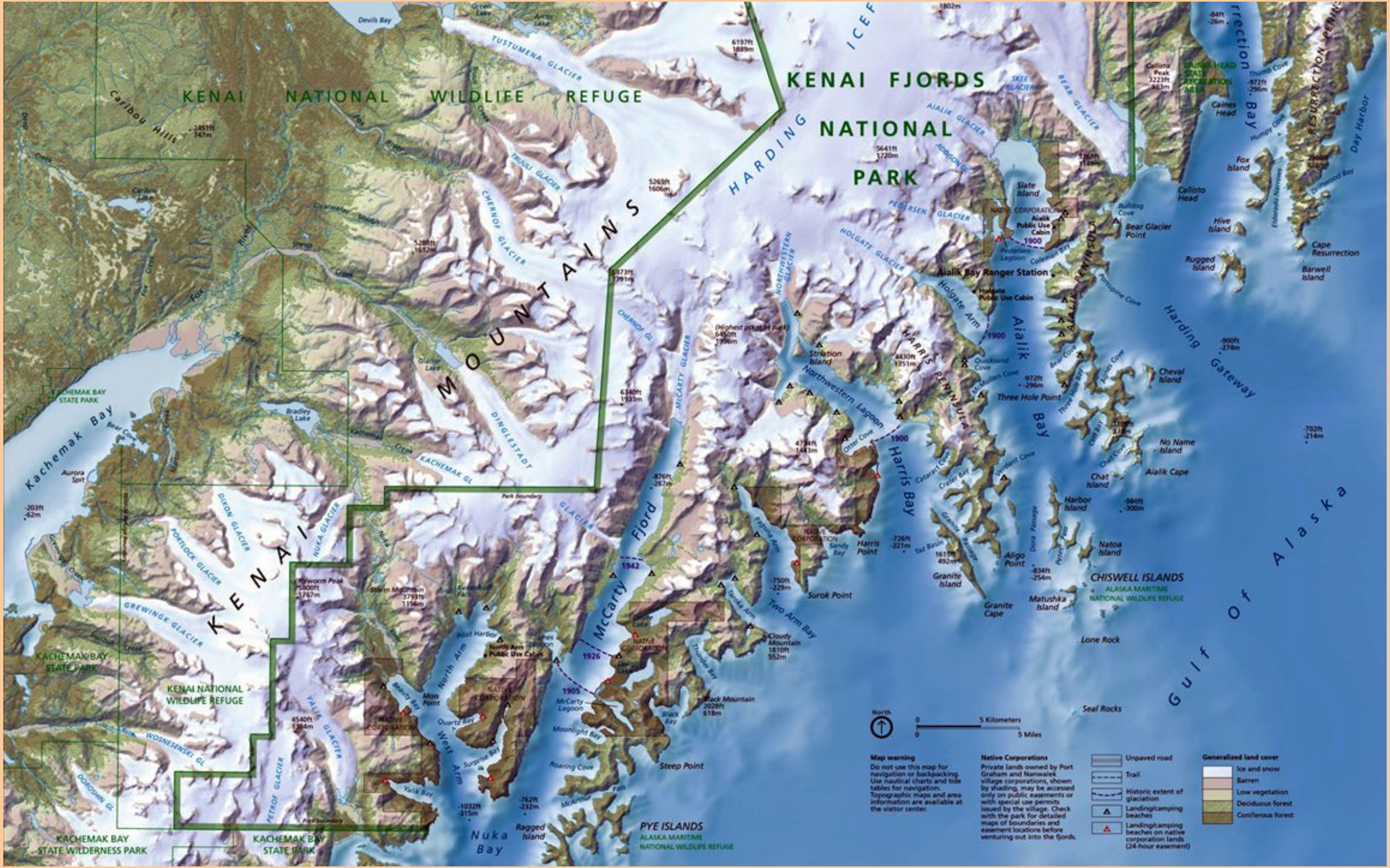
- BLM water source
- BLM fire origin point

*Dot size enlarged for clarity

0 50 Miles

Kelby Beyer

Sources: United States Census Bureau, OpenStreetMap, Esri, Bureau of Land Management Geospatial Business Platform


KENAI NATIONAL WILDLIFE REFUGE
KENAI FJORDS NATIONAL PARK
HARDING ICEFIELD
KENAI MOUNTAINS
Devils Bay
Tustumena Glacier
Caribou Hills
Chernof Glacier
Truuli Glacier
Dinglestadt Glacier
Kachemak Gl
McCarty Glacier
Northwestern Glacier
Holgate Glacier
Pedersen Glacier
Aialik Glacier
Bear Glacier
Skilak Glacier
Dixon Glacier
Portlock Glacier
Grewingk Glacier
Nuka Glacier
Yalik Glacier
Petrof Glacier
Wosnesenski Gl
Doroshin Gl
Kachemak Bay
KACHEMAK BAY STATE PARK
KENAI NATIONAL WILDLIFE REFUGE
KACHEMAK BAY STATE WILDERNESS PARK
Bradley Lake
Aurora Spit
Bear Cove
Park boundary
Aialik Bay Ranger Station
Aialik Bay
Holgate Arm
Harris Bay
Northwestern Lagoon
Harris Peninsula
Aialik Peninsula
Three Hole Point
Aialik Cape
McCarty Fjord
Two Arm Bay
Surok Point
Harris Point
Granite Island
Granite Cape
Aligo Point
Matushka Island
CHISWELL ISLANDS
ALASKA MARITIME NATIONAL WILDLIFE REFUGE
Natoa Island
Harbor Island
Chat Island
No Name Island
Cheval Island
Harding Gateway
Lone Rock
Seal Rocks
Gulf of Alaska
Resurrection Bay
RESURRECTION PENINSULA
Callisto Head
Caines Head
Fox Island
Hive Island
Rugged Island
Cape Resurrection
Barwell Island
Bear Glacier Point
Day Harbor
Thumb Cove
Humpy Cove
Cloudy Mountain 1810ft 552m
Black Mountain 2028ft 618m
Steep Point
PYE ISLANDS
ALASKA MARITIME NATIONAL WILDLIFE REFUGE
Nuka Bay
Ragged Island
West Arm
North Arm
Beauty Bay
Quartz Bay
Surprise Bay
Yalik Bay
Moonlight Bay
McCarty Lagoon
Roaring Cove
Pilot Harbor
Storm Mountain 3793ft 1156m
Rywoorm Peak 5800ft 1767m
NATIVE CORPORATION
1900
1905
1926
1942
(Highest point in park) 6450ft 1966m
North
0 5 Kilometers
0 5 Miles
Map warning
Do not use this map for navigation or backpacking. Use nautical charts and tide tables for navigation. Topographic maps and area information are available at the visitor center.
Native Corporations
Private lands owned by Port Graham and Nanwalek village corporations, shown by shading, may be accessed only on public easements or with special use permits issued by the village. Check with the park for detailed maps of boundaries and easement locations before venturing out into the fjords.
Unpaved road
Trail
Historic extent of glaciation
Landing/camping beaches
Landing/camping beaches on native corporation lands (24-hour easement)
Generalized land cover
Ice and snow
Barren
Low vegetation
Deciduous forest
Coniferous forest

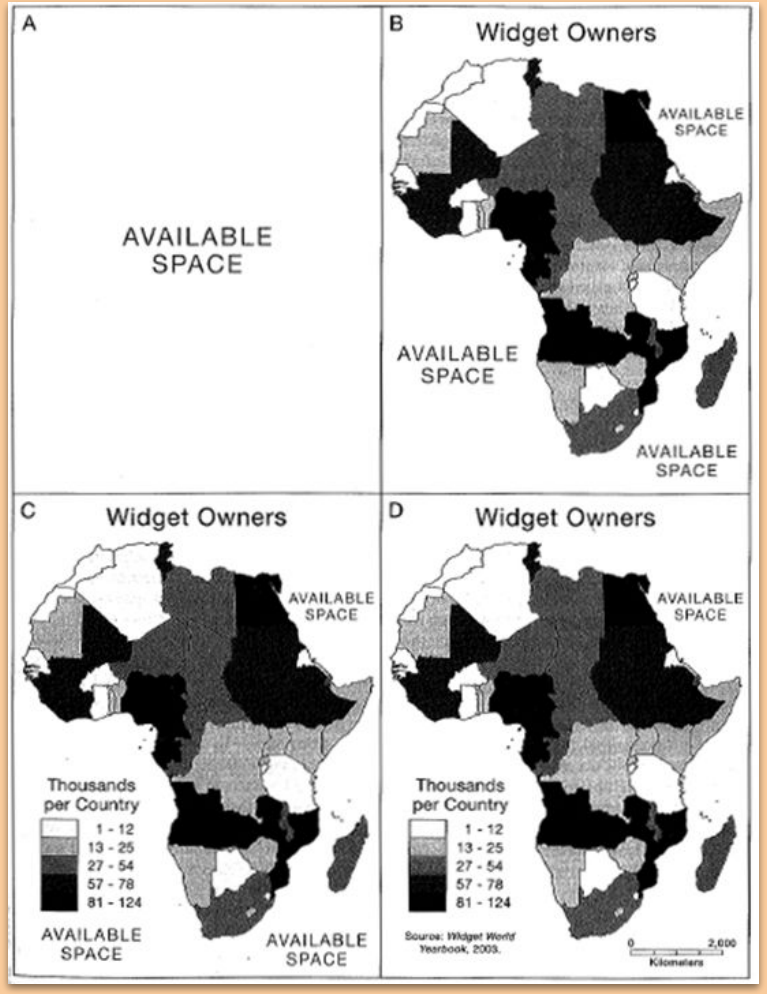
Visual balance

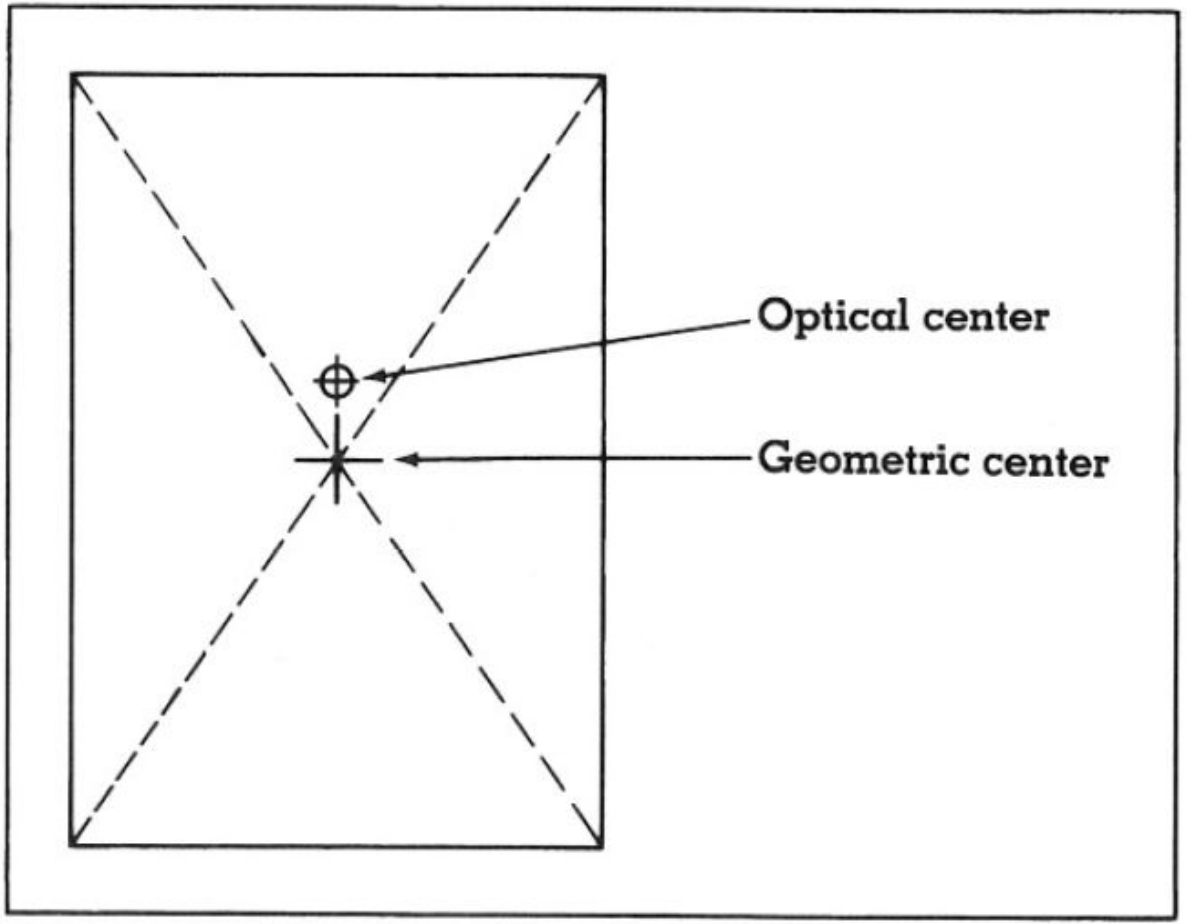
How?

- Layout of map elements
- Use of negative space

Why?

- Produce visual harmony, dissonance, or other reactions
- Reinforce visual hierarchy




Optical center
Geometric center

Ordering your map data

Point *over*
Line *over*
Polygon *over*
Raster

Land *over*
Graticule *over*
Water

Intro to AGOL

Overall interface

Adding data

Save

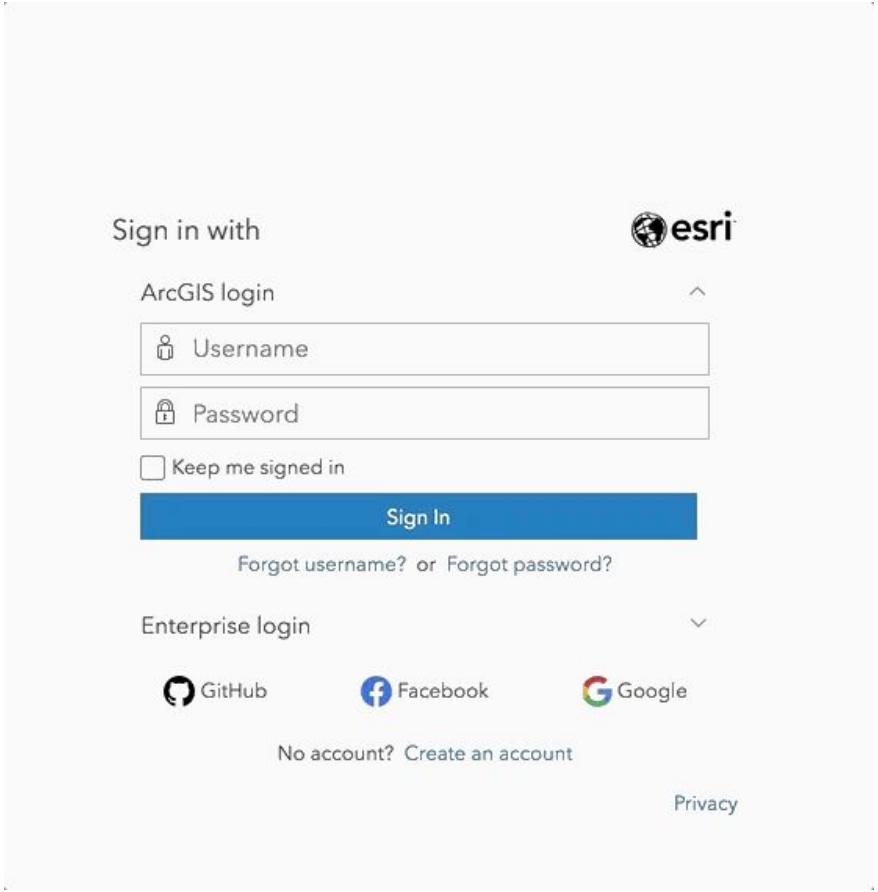
Look at attribute tables

Properties (Symbolize)

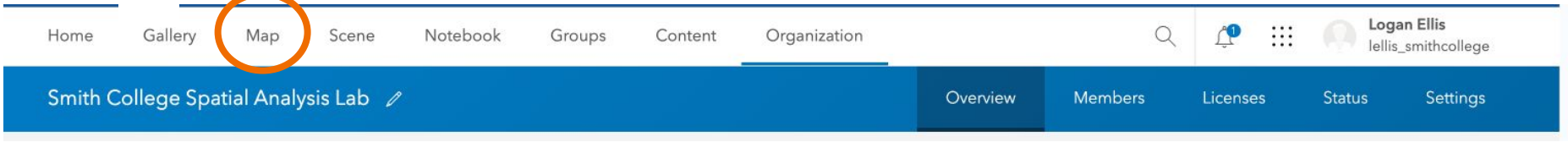
Analysis

Intro to AGOL

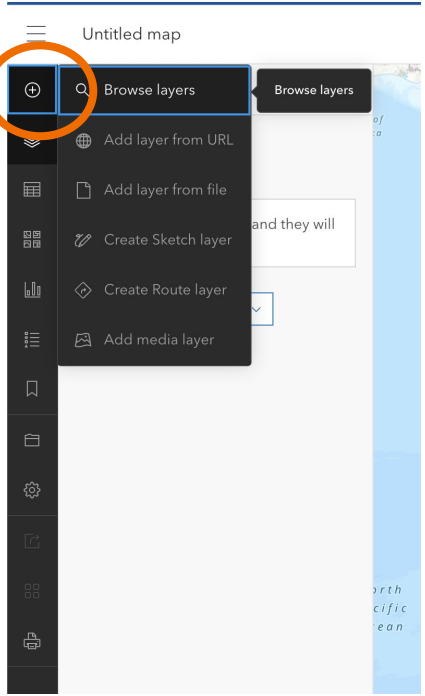
- Go to : arcgis.com
- And click “Sign In”
- Expand “Your ArcGIS organization’s URL” and type: smithcollege
- Click Continue
- Click on the blue button at the top that says “Smith College”
- Sign in with your Smith Credentials



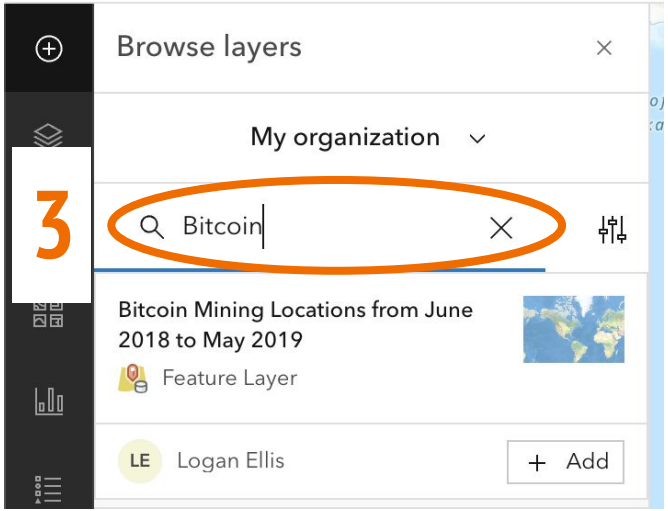
1

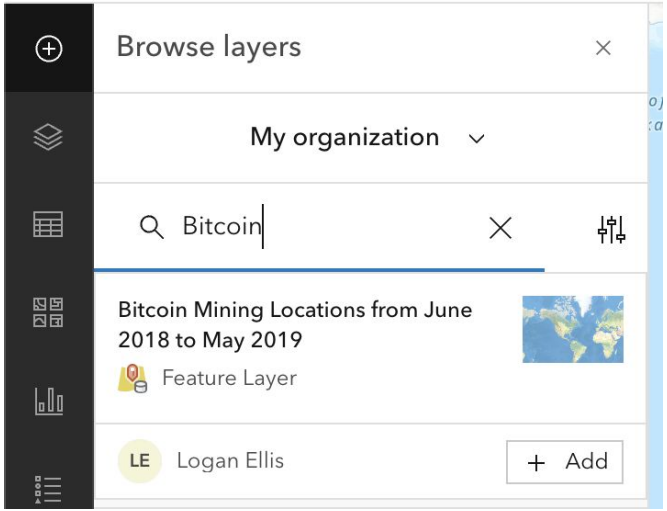

Home
Gallery
Map
Scene
Notebook
Groups
Content
Organization
Logan Ellis
lellis_smithcollege
Smith College Spatial Analysis Lab
Overview
Members
Licenses
Status
Settings

2


Untitled map
Browse layers
Browse layers
Add layer from URL
Add layer from file
Create Sketch layer
Create Route layer
Add media layer

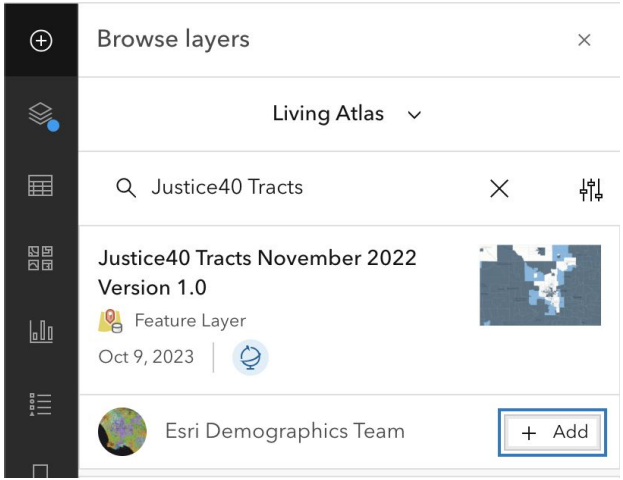
3

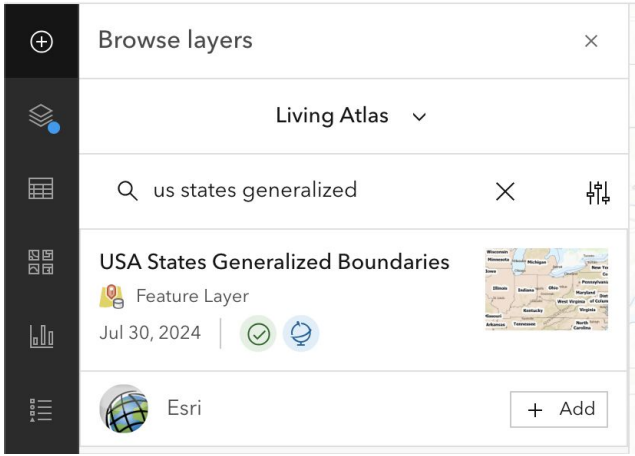

Browse layers
My organization
Bitcoin
Bitcoin Mining Locations from June 2018 to May 2019
Feature Layer
LE
Logan Ellis
+ Add

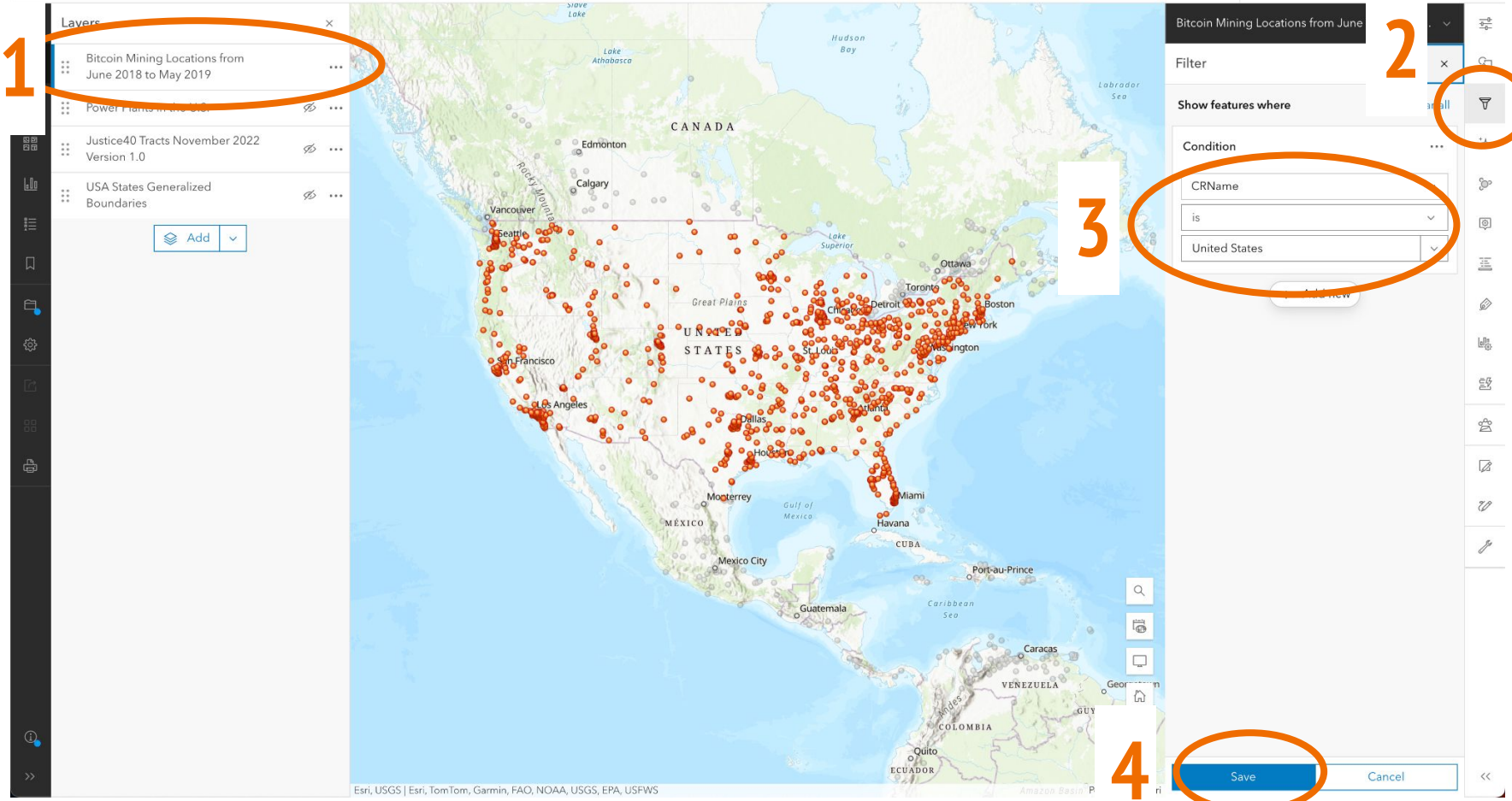


Add these four data layers

a. Bitcoin Mining Locations (via My Organization)
b. Power plants in the US (via Living Atlas)
c. Demographic data: Justice40 Tracts November 2022 Version 1.0 (via Living Atlas)
d. US States generalized boundaries or United States State Boundaries (via Living Atlas)



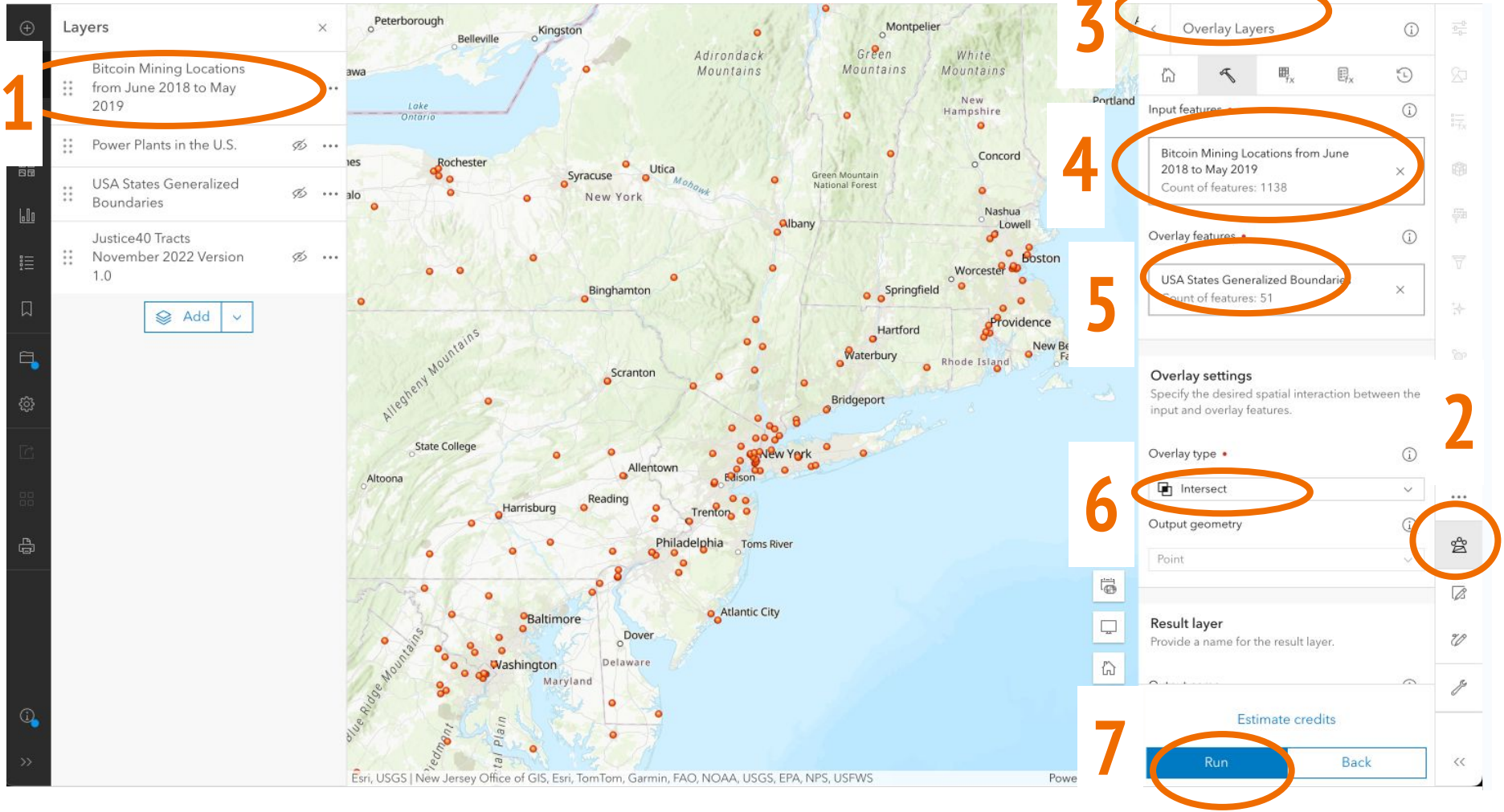


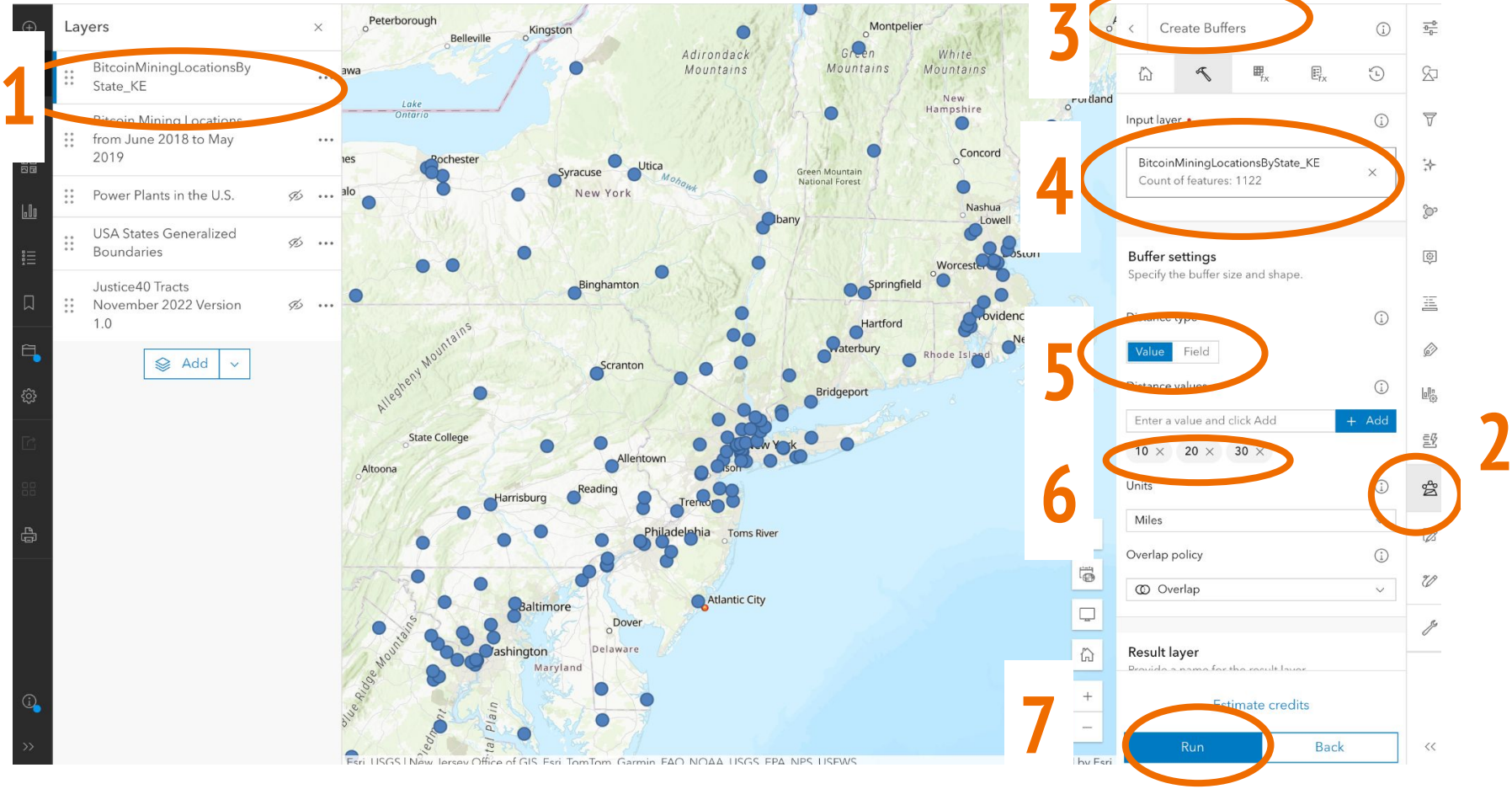

1
Layers
Bitcoin Mining Locations from June 2018 to May 2019
Justice40 Tracts November 2022 Version 1.0
USA States Generalized Boundaries
Add
2
Bitcoin Mining Locations from June
Filter
Show features where
Condition
CRName
is
United States
3
4
Save
Cancel
CANADA
UNITED STATES
MÉXICO
CUBA
COLOMBIA
VENEZUELA
ECUADOR
Edmonton
Calgary
Vancouver
Seattle
San Francisco
Los Angeles
Dallas
Houston
Chicago
Detroit
Toronto
Ottawa
Boston
New York
Washington
St. Louis
Atlanta
Miami
Havana
Mexico City
Monterrey
Guatemala
Port-au-Prince
Caracas
Quito
Great Plains
Rocky Mountains
Hudson Bay
Lake Athabasca
Lake Superior
Gulf of Mexico
Caribbean Sea
Labrador Sea
Esri, USGS | Esri, TomTom, Garmin, FAO, NOAA, USGS, EPA, USFWS

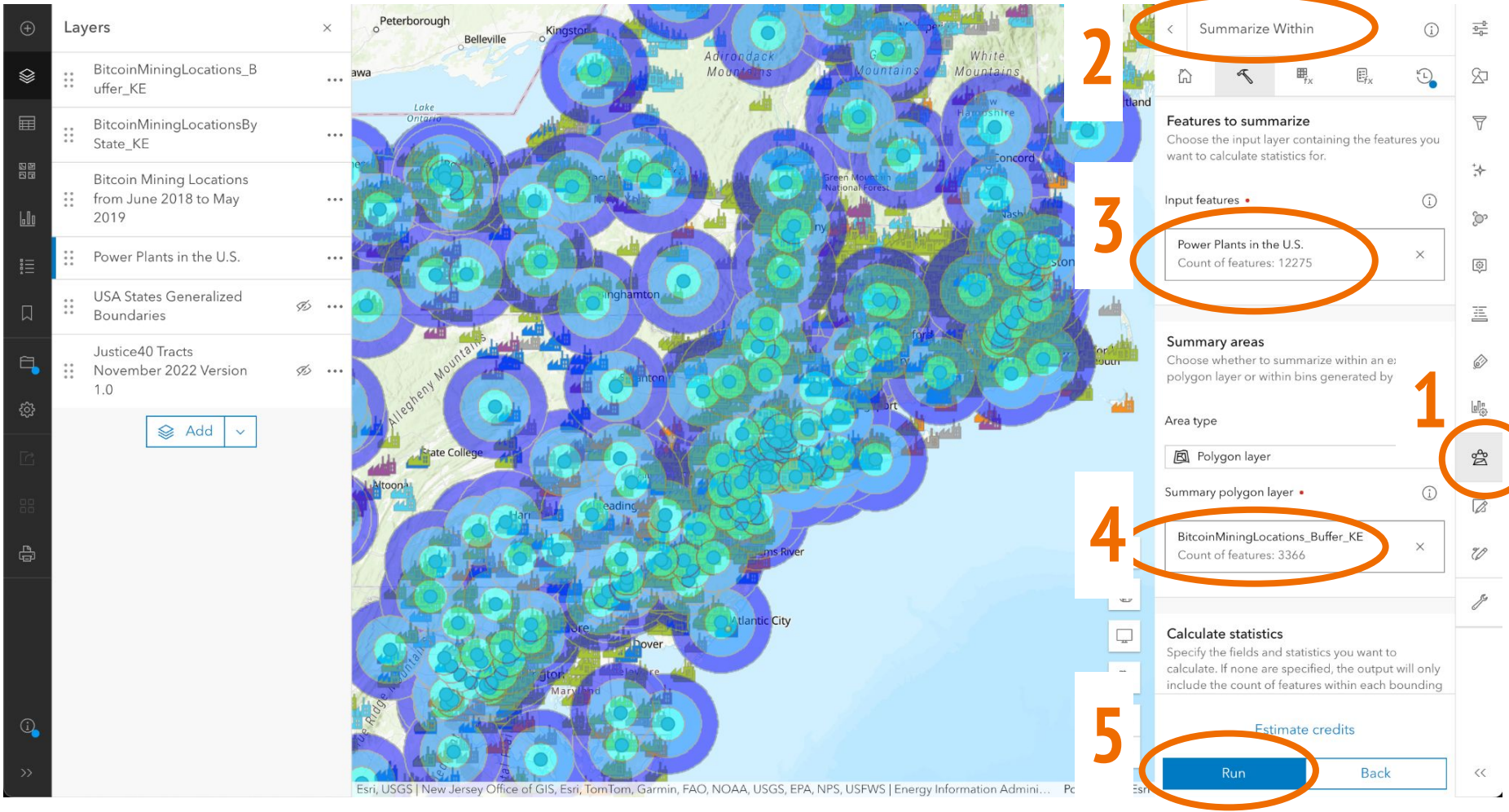
What patterns do you notice in the distribution of bitcoin mining locations across the U.S.?

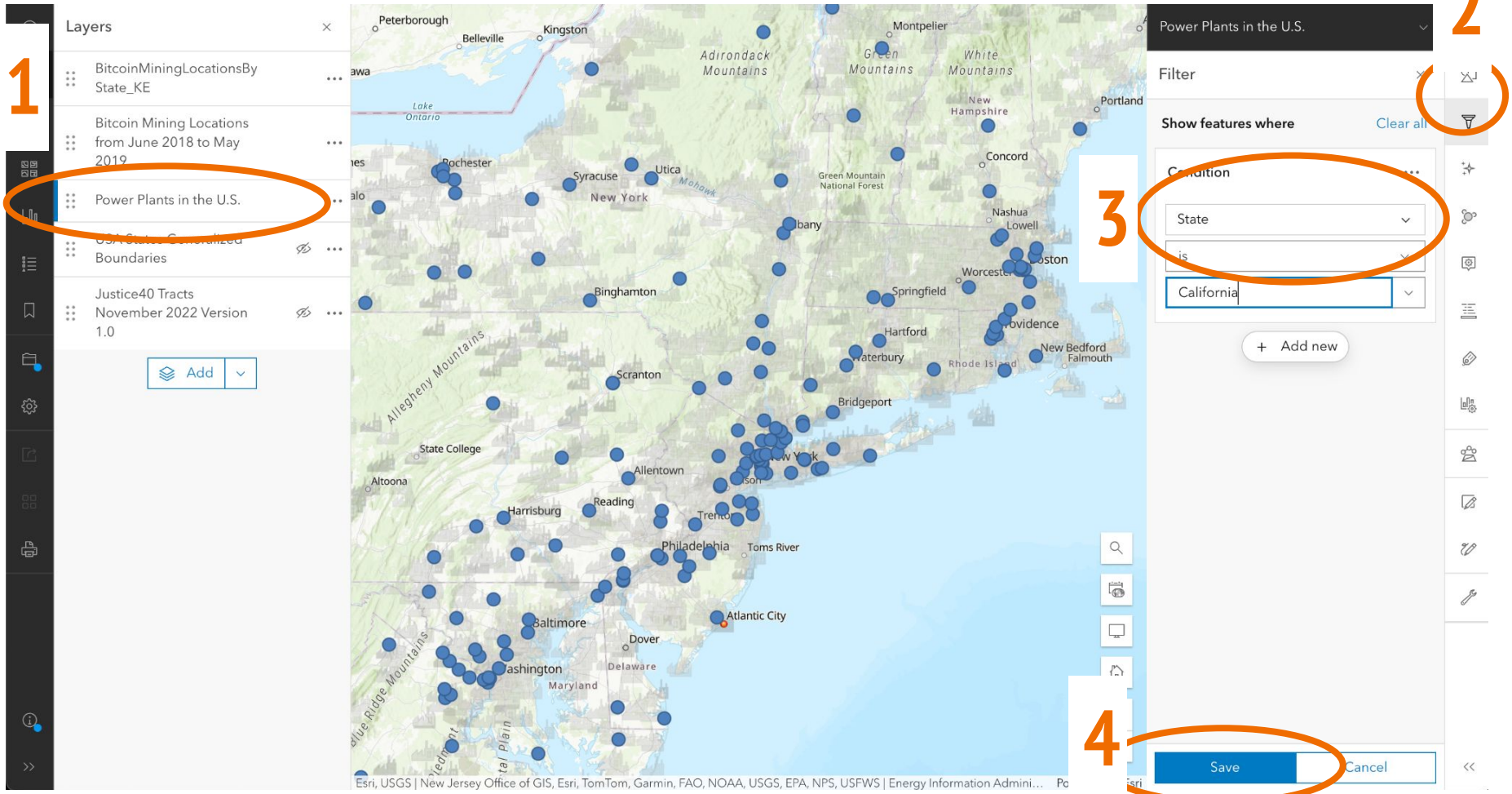
Are there certain regions or states where bitcoin mining is more concentrated?

What factors might contribute to this spatial distribution?


Layers
Bitcoin Mining Locations from June 2018 to May 2019
Power Plants in the U.S.
USA States Generalized Boundaries
Justice40 Tracts November 2022 Version 1.0
Add
1
Overlay Layers
3
Input features
Bitcoin Mining Locations from June 2018 to May 2019
Count of features: 1138
4
Overlay features
USA States Generalized Boundaries
Count of features: 51
5
Overlay settings
Specify the desired spatial interaction between the input and overlay features.
2
Overlay type
Intersect
6
Output geometry
Point
Result layer
Provide a name for the result layer.
Estimate credits
7
Run
Back
Esri, USGS | New Jersey Office of GIS, Esri, TomTom, Garmin, FAO, NOAA, USGS, EPA, NPS, USFWS


Layers
BitcoinMiningLocationsBy State_KE
Bitcoin Mining Locations from June 2018 to May 2019
Power Plants in the U.S.
USA States Generalized Boundaries
Justice40 Tracts November 2022 Version 1.0
Add
1
Create Buffers
3
Input layer
BitcoinMiningLocationsByState_KE
Count of features: 1122
4
Buffer settings
Specify the buffer size and shape.
Value
Field
5
Enter a value and click Add
Add
10
20
30
6
Units
Miles
Overlap policy
Overlap
2
Result layer
Estimate credits
Run
Back
7
Peterborough
Belleville
Kingston
Montpelier
Adirondack Mountains
Green Mountains
White Mountains
Lake Ontario
New Hampshire
Portland
Rochester
Syracuse
Utica
Mohawk
New York
Green Mountain National Forest
Concord
Nashua
Lowell
Albany
Worcester
Springfield
Binghamton
Hartford
Waterbury
Rhode Island
Scranton
Allegheny Mountains
Bridgeport
State College
Altoona
Allentown
Harrisburg
Reading
Trenton
Philadelphia
Toms River
Atlantic City
Baltimore
Dover
Delaware
Maryland
Blue Ridge Mountains
Piedmont
Coastal Plain
Esri, USGS | New Jersey Office of GIS, Esri, TomTom, Garmin, FAO, NOAA, USGS, EPA, NPS, USFWS
by Esri


Layers
BitcoinMiningLocations_Buffer_KE
BitcoinMiningLocationsByState_KE
Bitcoin Mining Locations from June 2018 to May 2019
Power Plants in the U.S.
USA States Generalized Boundaries
Justice40 Tracts November 2022 Version 1.0
Add
Peterborough
Belleville
Kingston
Adirondack Mountains
White Mountains
Lake Ontario
Concord
Binghamton
Allegheny Mountains
State College
Atlantic City
Dover
Esri, USGS | New Jersey Office of GIS, Esri, TomTom, Garmin, FAO, NOAA, USGS, EPA, NPS, USFWS | Energy Information Admini...
2
Summarize Within
Features to summarize
Choose the input layer containing the features you want to calculate statistics for.
3
Input features
Power Plants in the U.S.
Count of features: 12275
Summary areas
Choose whether to summarize within an e: polygon layer or within bins generated by
1
Area type
Polygon layer
4
Summary polygon layer
BitcoinMiningLocations_Buffer_KE
Count of features: 3366
Calculate statistics
Specify the fields and statistics you want to calculate. If none are specified, the output will only include the count of features within each bounding
5
Estimate credits
Run
Back


1
Layers
BitcoinMiningLocationsBy State_KE
Bitcoin Mining Locations from June 2018 to May 2019
Power Plants in the U.S.
Boundaries
Justice40 Tracts November 2022 Version 1.0
Add
2
Power Plants in the U.S.
Filter
Show features where
Clear all
State
is
California
Add new
3
4
Save
Cancel
Peterborough
Belleville
Kingston
Montpelier
Adirondack Mountains
Green Mountains
White Mountains
Lake Ontario
Portland
New Hampshire
Concord
Rochester
Syracuse
Utica
Mohawk
New York
Green Mountain National Forest
Nashua
Lowell
Albany
Boston
Worcester
Springfield
Binghamton
Providence
Hartford
Waterbury
Rhode Island
New Bedford
Falmouth
Allegheny Mountains
Scranton
Bridgeport
State College
Altoona
Allentown
Harrisburg
Reading
Trenton
Philadelphia
Toms River
Atlantic City
Baltimore
Dover
Delaware
Maryland
Washington
Blue Ridge Mountains
Piedmont
Coastal Plain
Esri, USGS | New Jersey Office of GIS, Esri, TomTom, Garmin, FAO, NOAA, USGS, EPA, NPS, USFWS | Energy Information Admini…

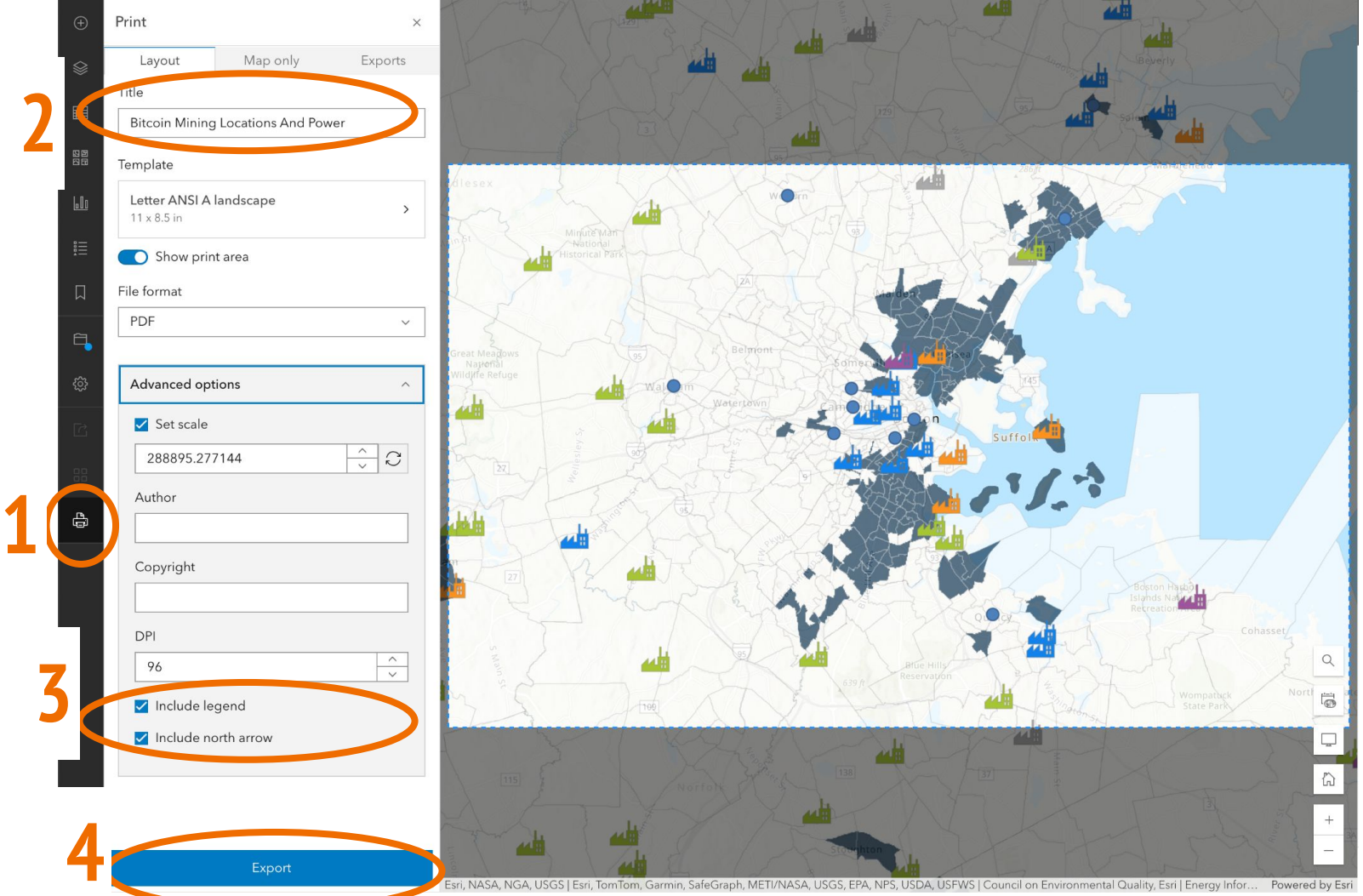
How many power plants fall within the 10-mile, 20-mile, and 30-mile buffers around bitcoin mining locations?

Are there regions where mining sites are consistently close to power plants?

Why might bitcoin mining operations choose to locate near power plants?

How do the bitcoin mining locations and power plant buffers intersect with Justice40 tracts?

Are there clusters of mining locations near disadvantaged communities? If so, what are the potential implications?


Print
Layout
Map only
Exports
2
Title
Bitcoin Mining Locations And Power
Template
Letter ANSI A landscape
11 x 8.5 in
Show print area
File format
PDF
Advanced options
Set scale
288895.277144
1
Author
Copyright
DPI
96
3
Include legend
Include north arrow
4
Export
Esri, NASA, NGA, USGS | Esri, TomTom, Garmin, SafeGraph, METI/NASA, USGS, EPA, NPS, USDA, USFWS | Council on Environmental Quality, Esri | Energy Infor…
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