

# Maps

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**DSC 106: Data Visualization**

Sam Lau

UC San Diego

# Announcements

Lab 7 out, due Friday.

Final Project out, proposals (and teams) due Tuesday.

## FAQs:

- 1. What happens if I can't find a final project team by Proposal Deadline?** We will not take your submission!
- 2. Do I need to enter in a credit card to use Mapbox in Lab 7?**  
No, use your UCSD email and you should get an API key for free.

**How much time did you spend on Lab  
6? (And how do you feel about your D3  
knowledge now?)**

[tryclassbuzz.com](http://tryclassbuzz.com)  
**Code: lab6**

# Maps

# When to use a map?

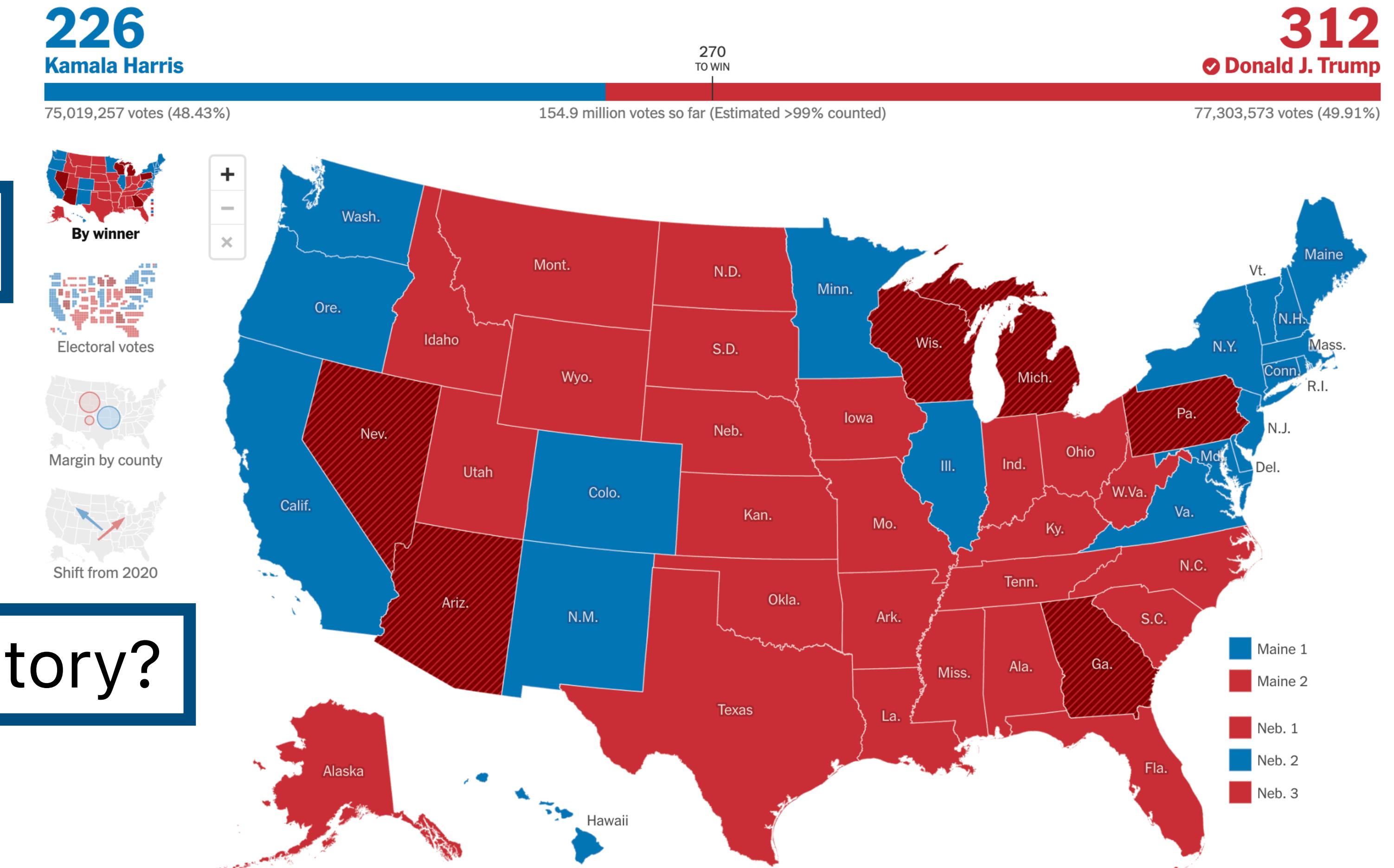
1. When data contains geographical attributes (e.g., latitude, longitude, city, state, country, etc.).
2. When you want to emphasize **geographic relationship**.

# Geographic Relationships

# Who's winning my state?

# Is it a landslide?

# What are the paths to victory?



# Geographic Relationships

## Results by state

Below are the latest results for each state, grouped according to pre-election ratings by the [Cook Political Report](#).

Dem. Win Flip Rep. Win Flip

Harris expected to win easily			Harris expected to win narrowly			Most competitive states			Trump expected to win narrowly			Trump expected to win easily			
State	Margin	% In	State	Margin	% In	State	Margin	% In	State	Margin	% In	State	Margin	% In	
Calif.	D+20	✓	100%	Maine	D+7	✓	100%	Ariz.	R+6	✓	100%	Fla.	R+13	✓	100%
Colo.	D+11	✓	100%	Minn.	D+4	✓	100%	Ga.	R+2	✓	100%	Iowa	R+13	✓	100%
Conn.	D+15	✓	100%	Neb. 2	D+5	✓	100%	Mich.	R+1.4	✓	100%	Maine 2	R+10	✓	100%
Del.	D+15	✓	100%	N.H.	D+3	✓	100%	Nev.	R+3	✓	100%	Texas	R+14	✓	100%
Hawaii	D+23	✓	100%	N.M.	D+6	✓	100%	N.C.	R+3	✓	100%				
Ill.	D+11	✓	100%	Va.	D+6	✓	100%	Pa.	R+1.7	✓	100%				
Maine 1	D+22	✓	100%					Wis.	R+0.86	✓	100%				
Md.	D+29	✓	100%												
Mass.	D+25	✓	100%												
N.J.	D+6	✓	100%												
N.Y.	D+13	✓	100%												
Ore.	D+14	✓	100%												
R.I.	D+14	✓	100%												
	D+32	✓	100%												
	D+18	✓	100%												
	D+86	✓	100%												

 Who's winning my state?

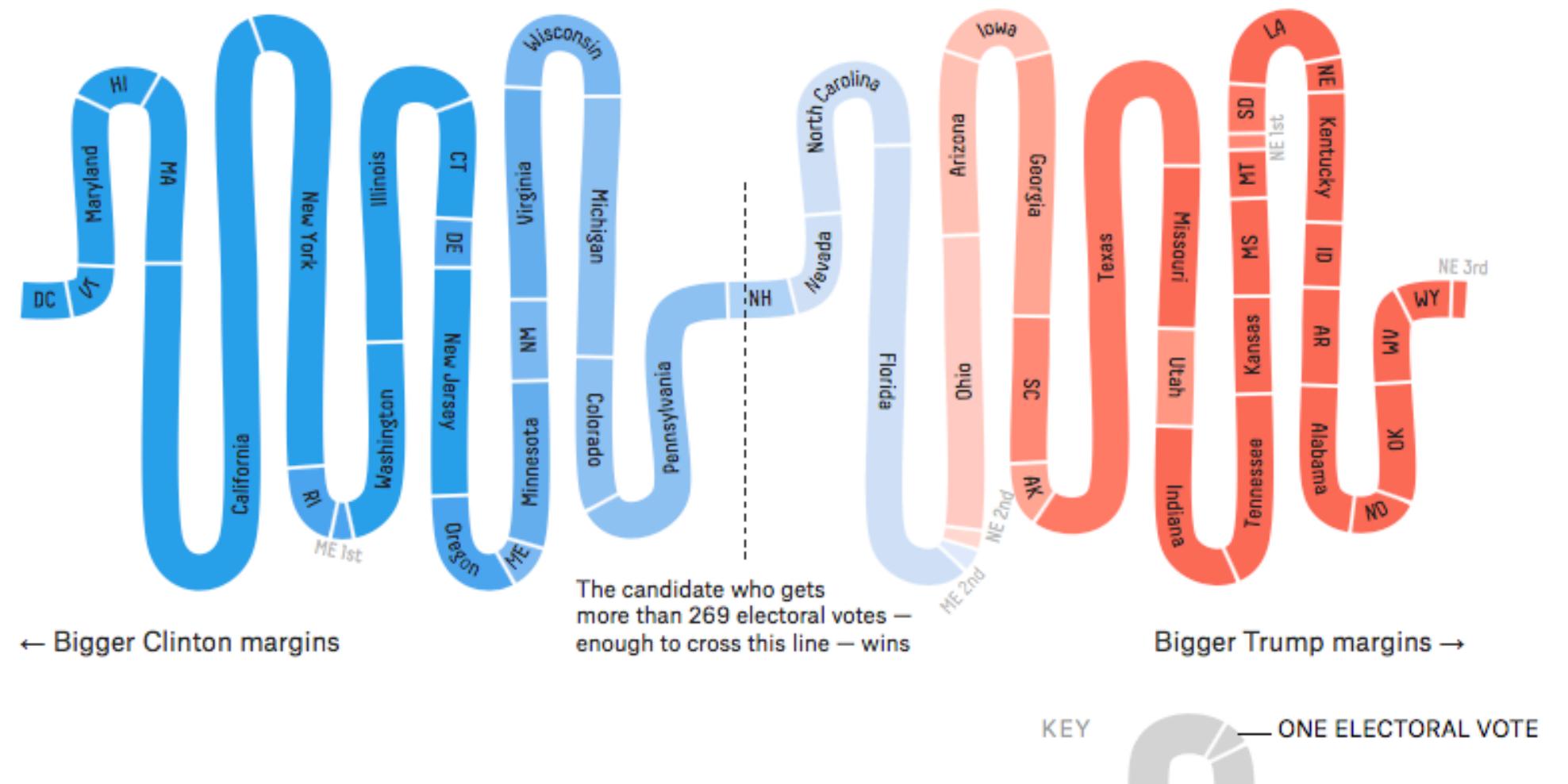
 Is it a landslide?

 What are the paths to victory?

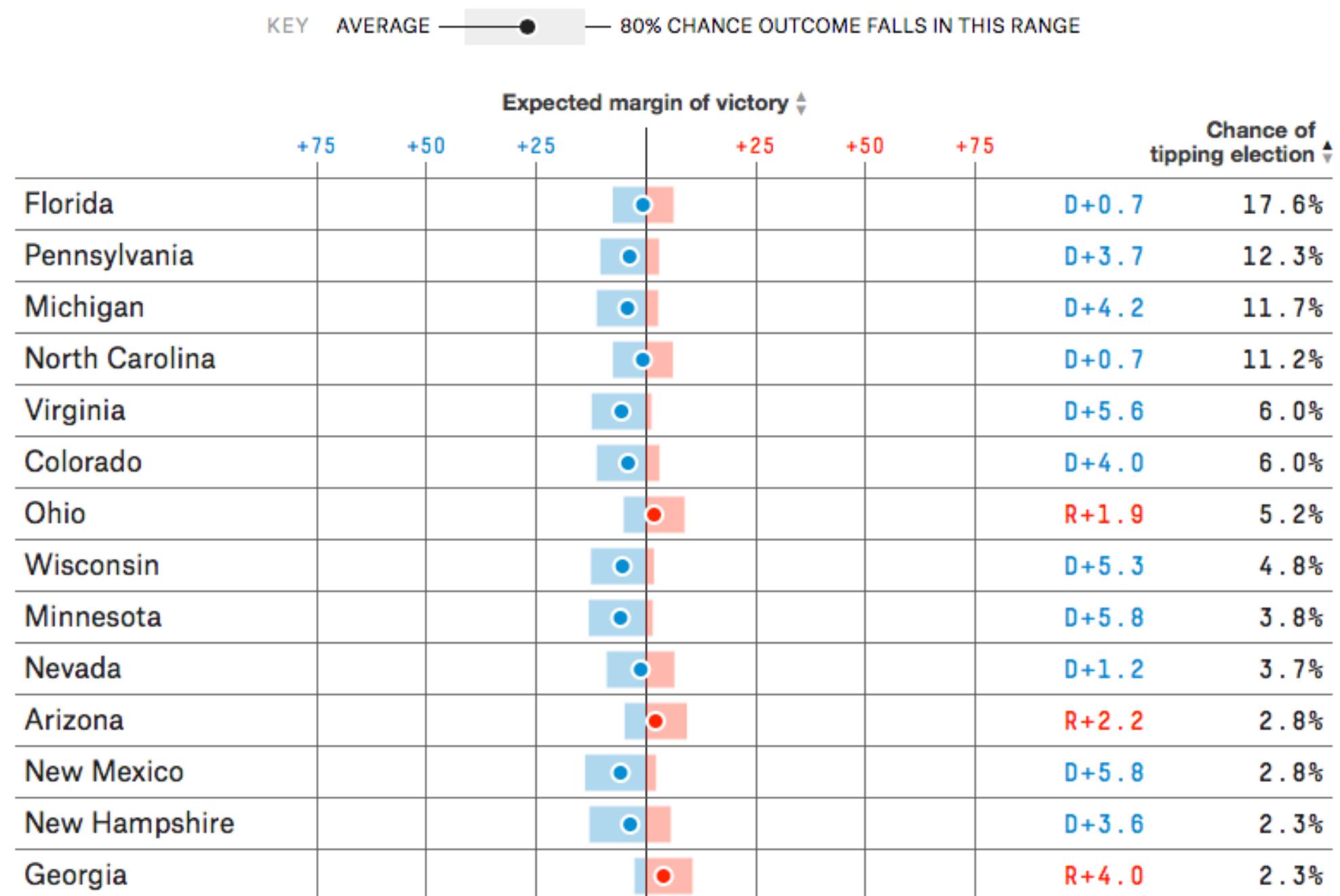
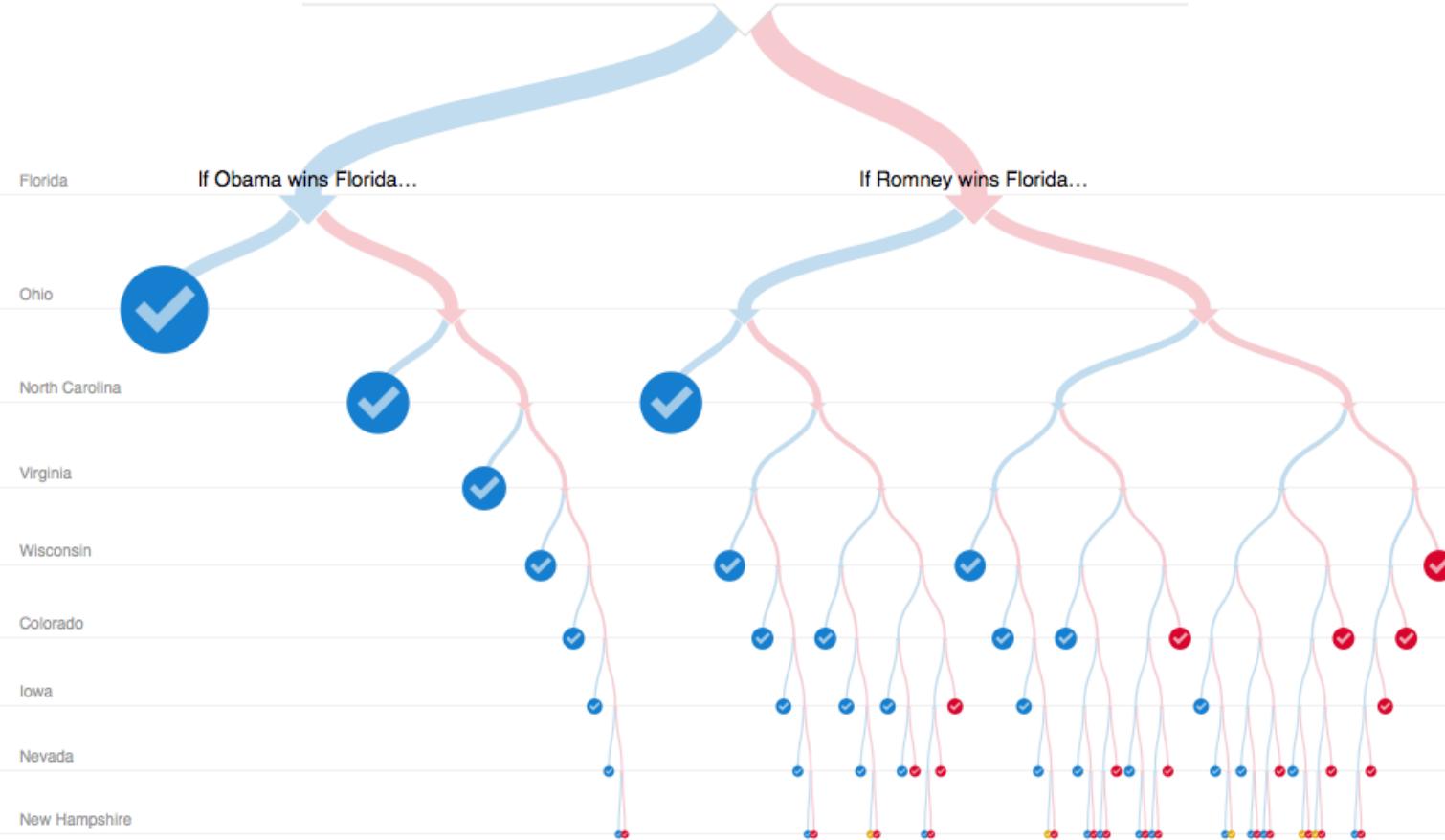
# Building An Electoral Victory

270 electoral votes are needed to win the election.

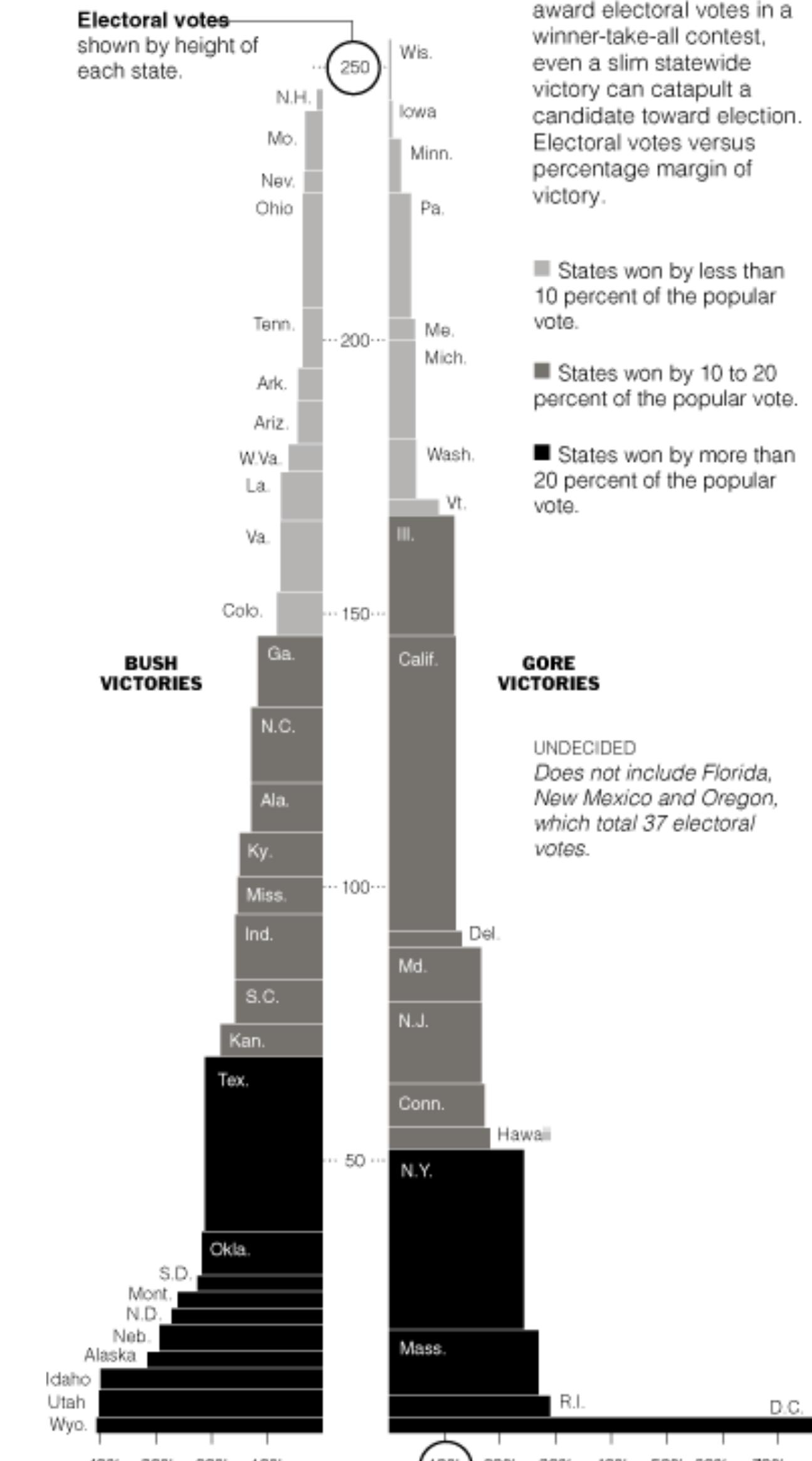
270



Obama has 431 ways to win  
64% of paths      Romney has 76 ways to win  
0.98% of paths



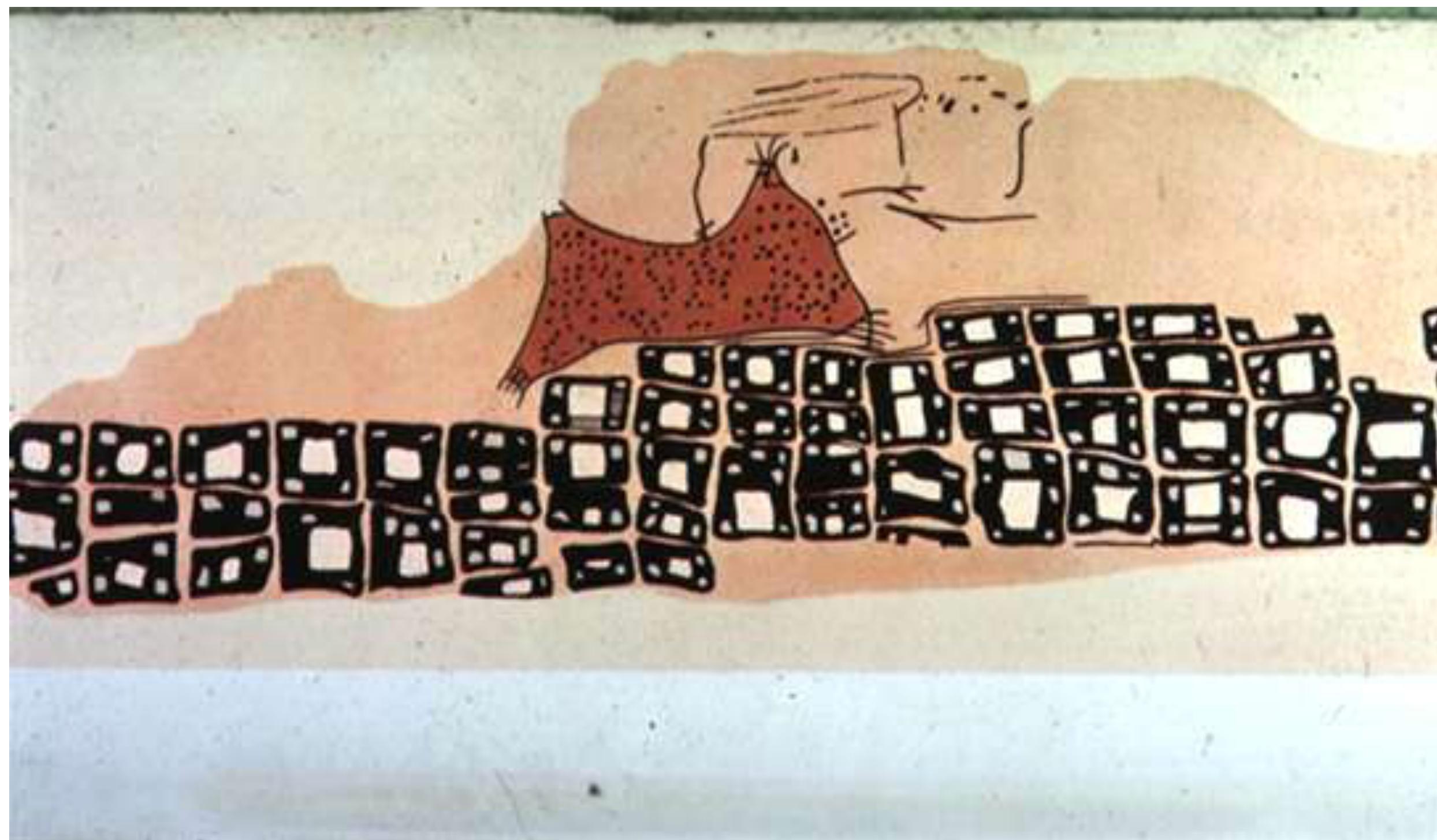
Electoral votes shown by height of each state.



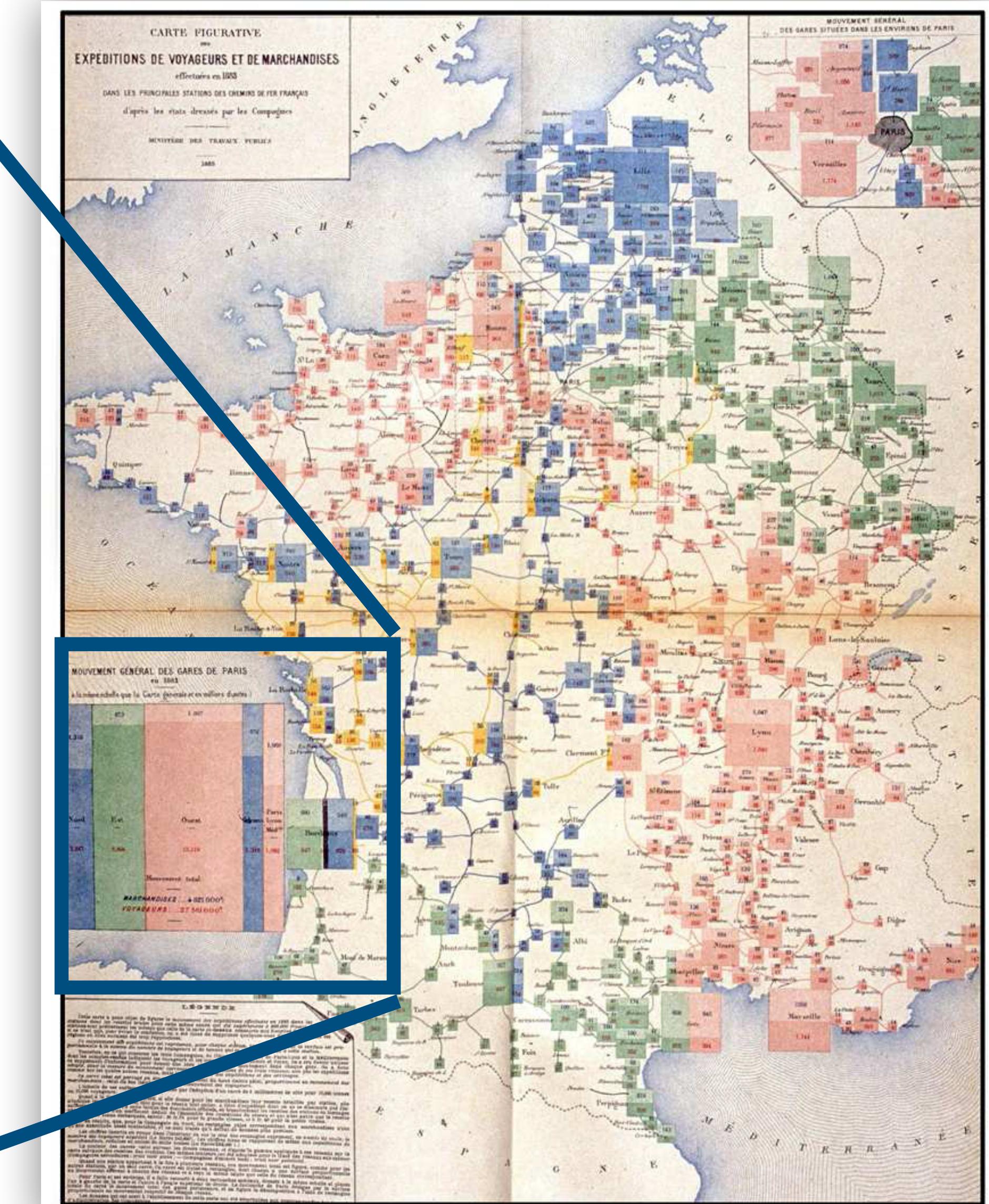
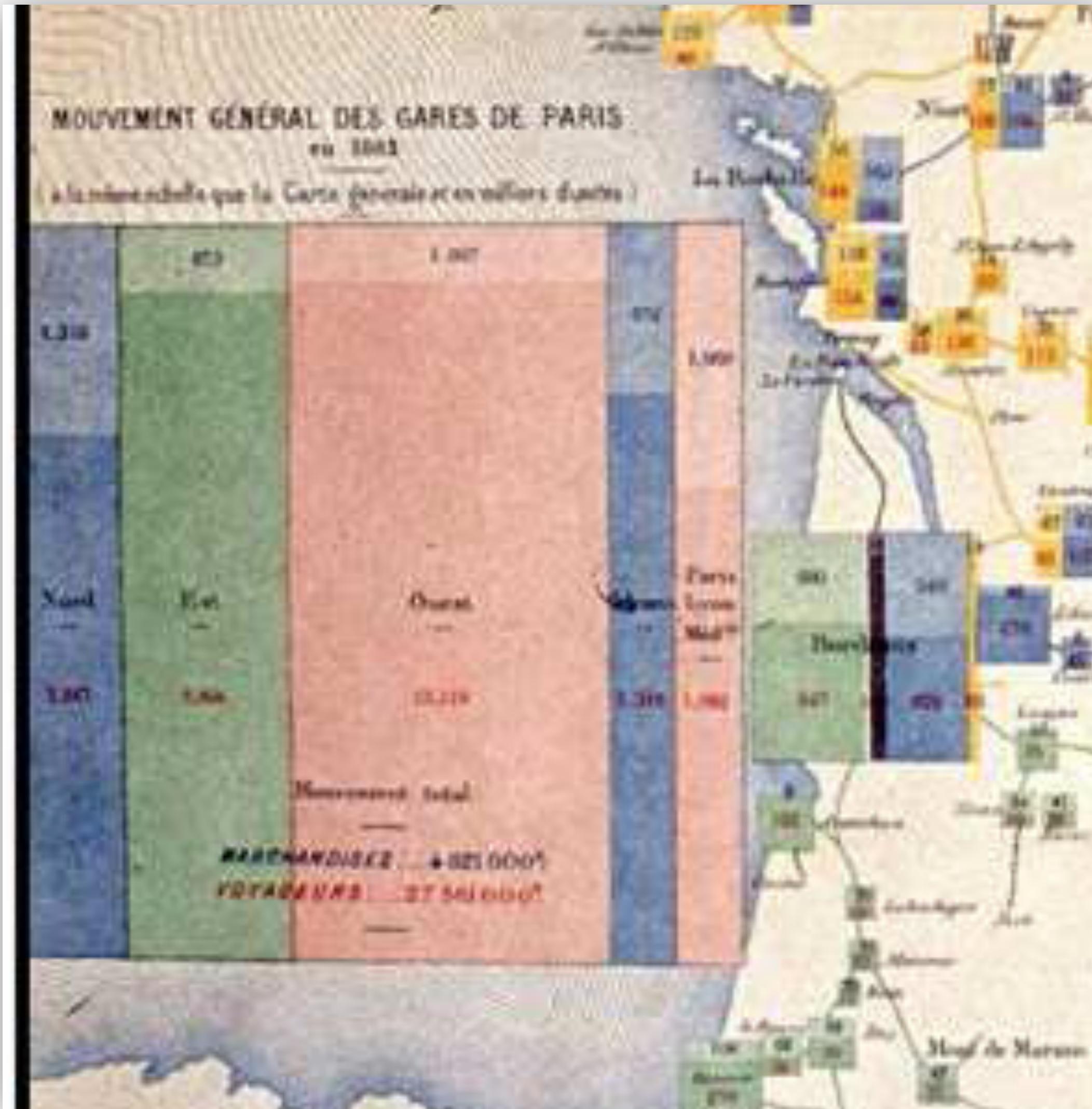
# **Cartography**

## **(Map Making)**

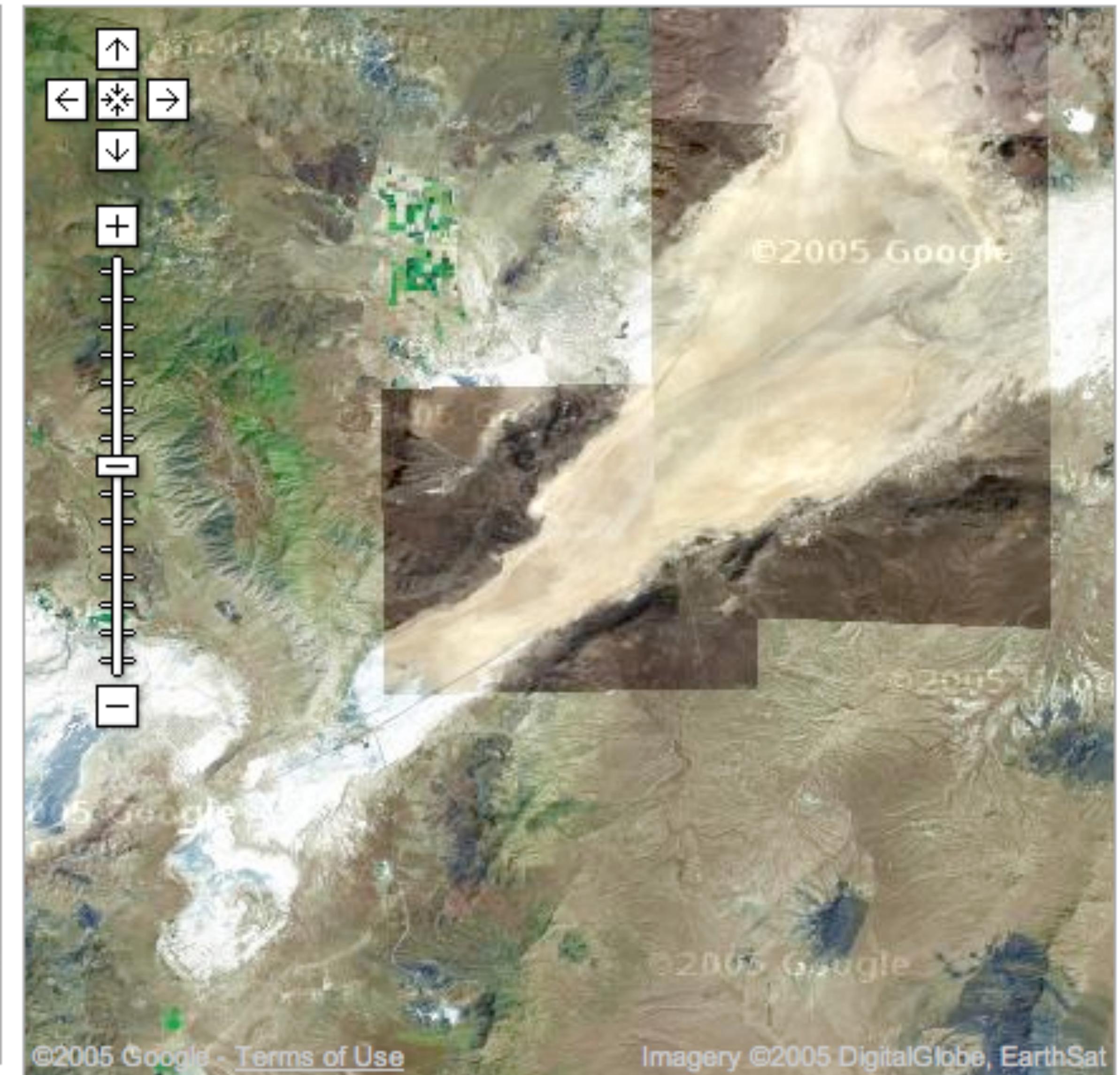
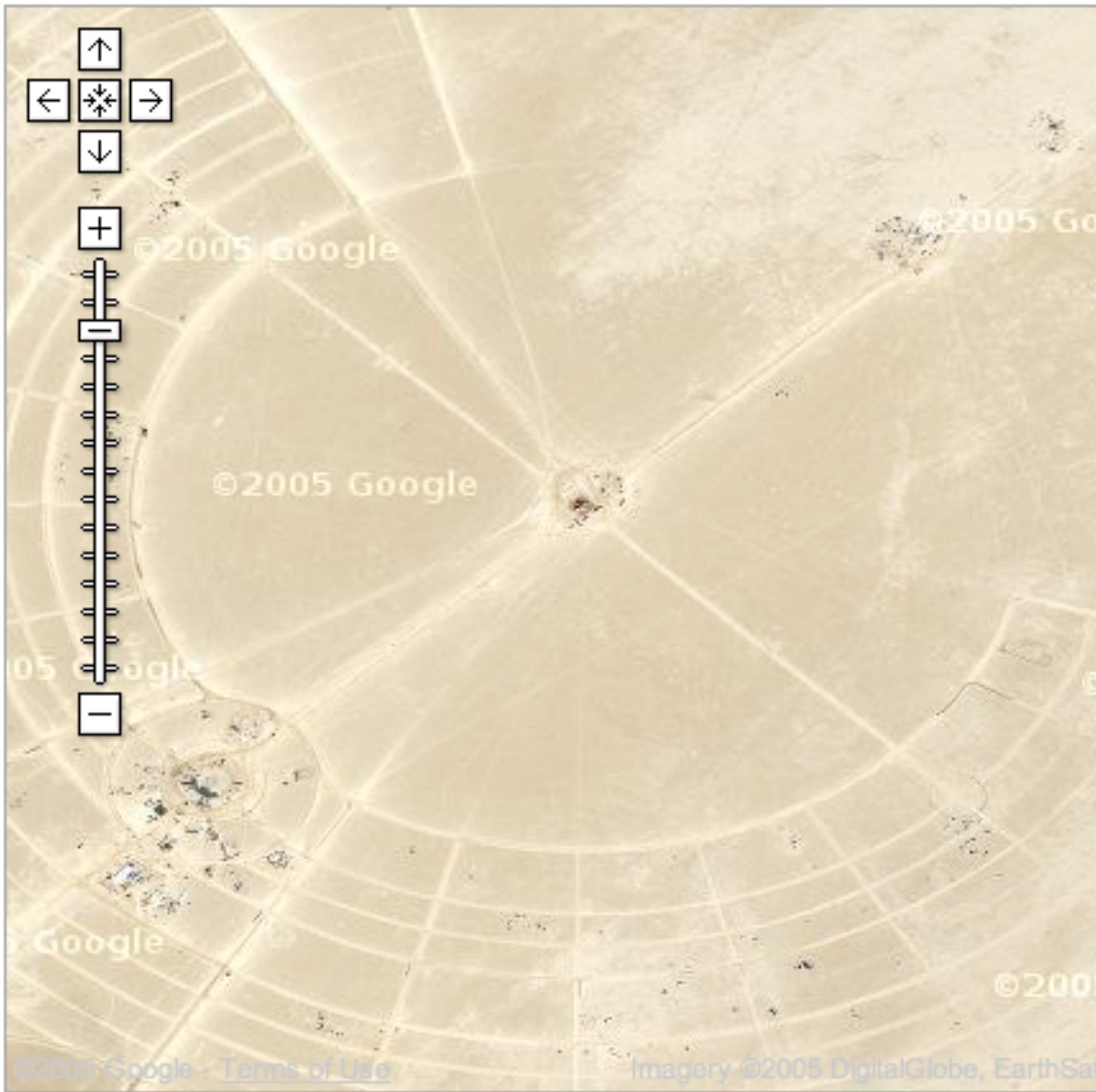
# Oldest Known Map: Konya, Turkey (~6200 BC)

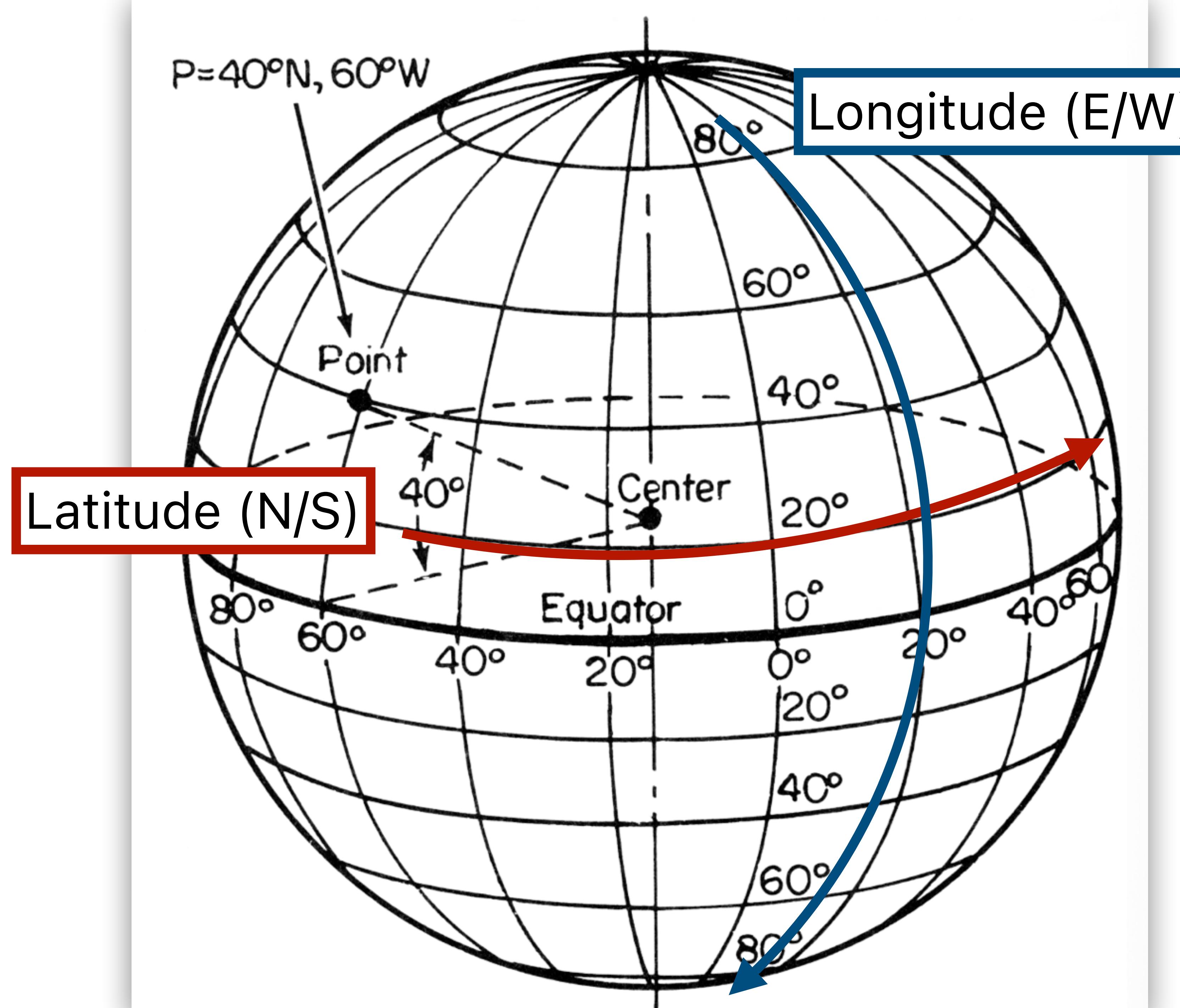


# Rail Passengers and Freight from Paris 1884



# Google Maps, 2005



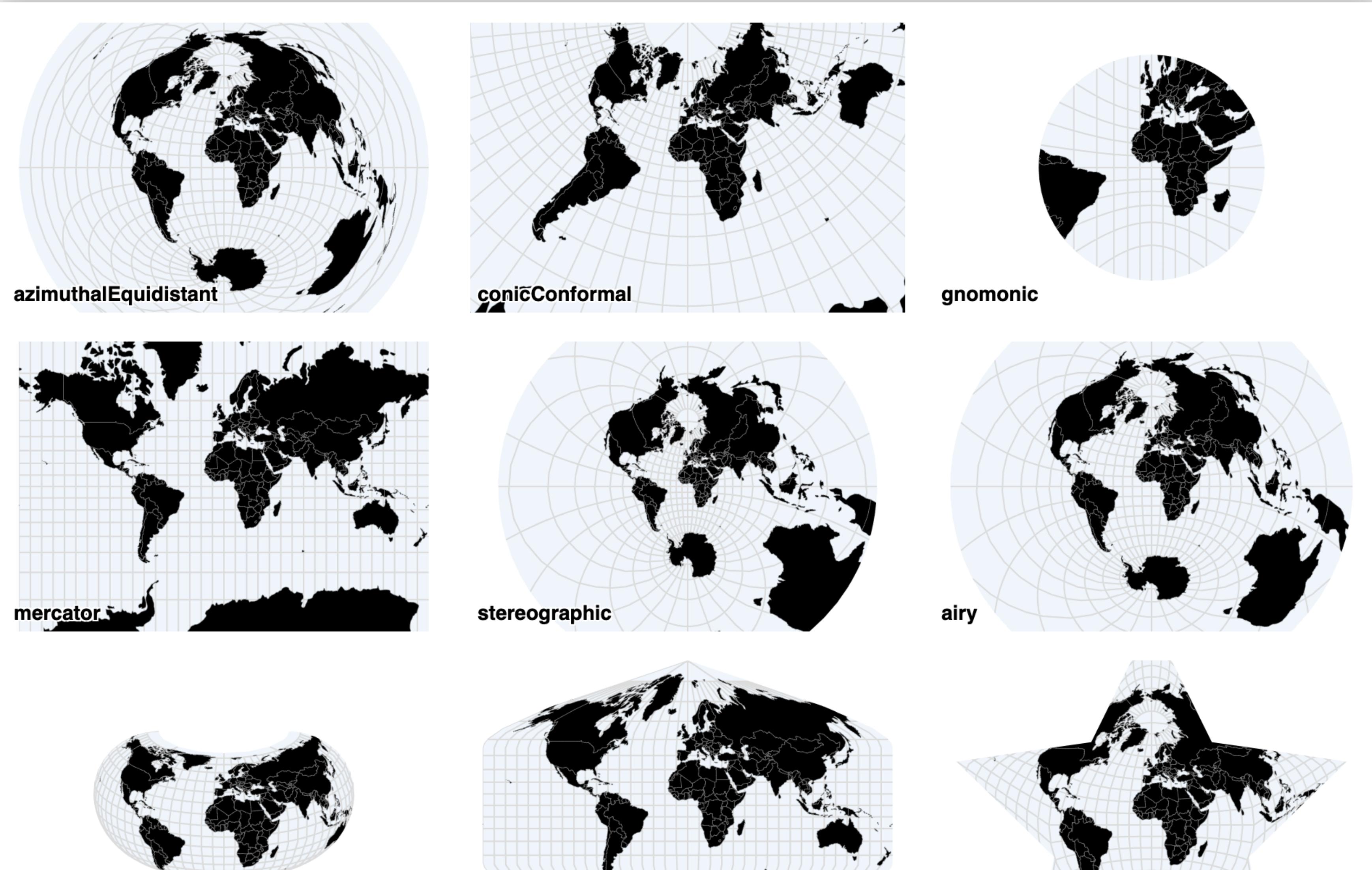


LONGitude lines are  
all long (some latitude  
lines are quite short!)



A sphere tears  
when you flatten it

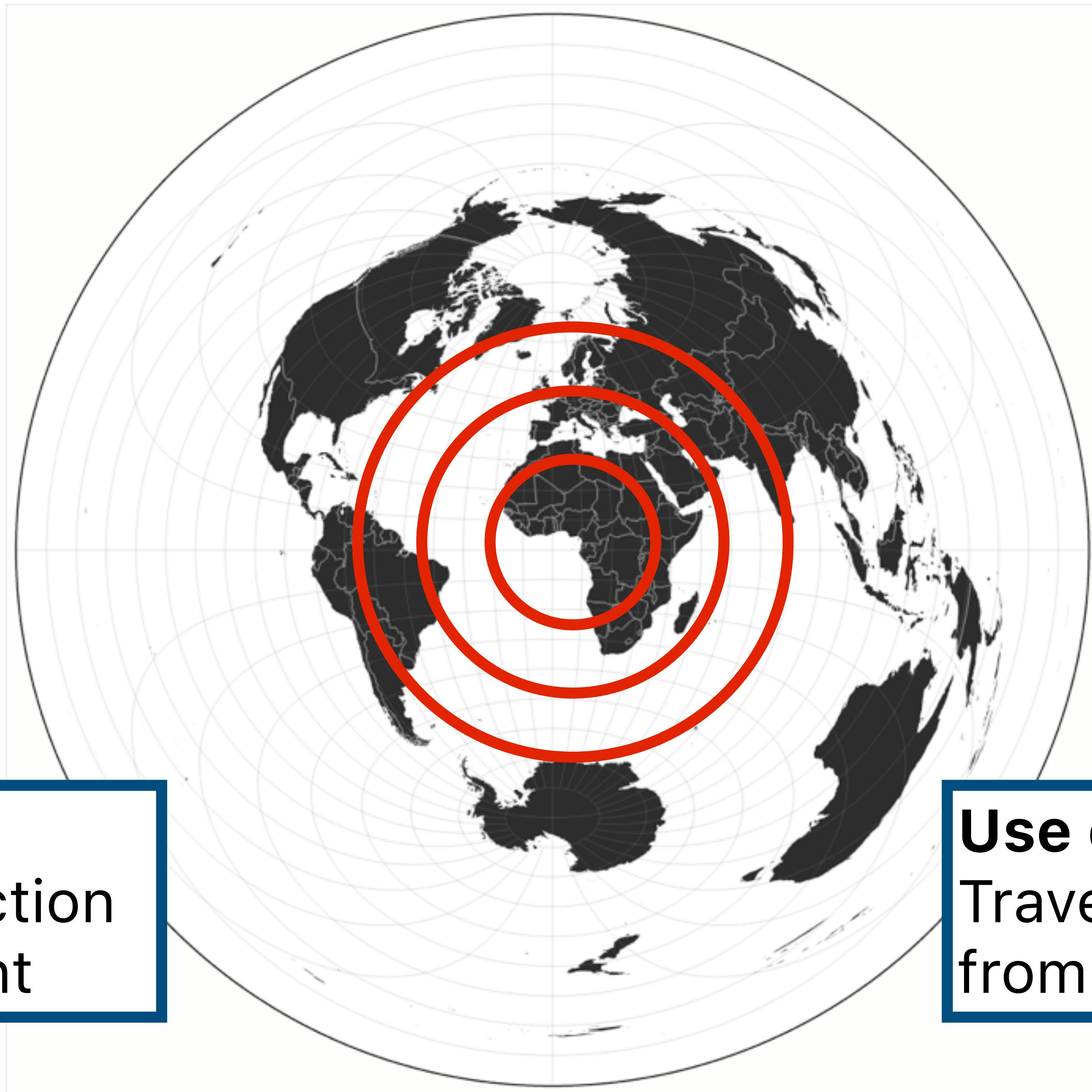
# Exploring Projections



<https://vega.github.io/vega/examples/projections/>

**Projections preserve some  
metrics, distort others**

# Azimuthal Equidistant



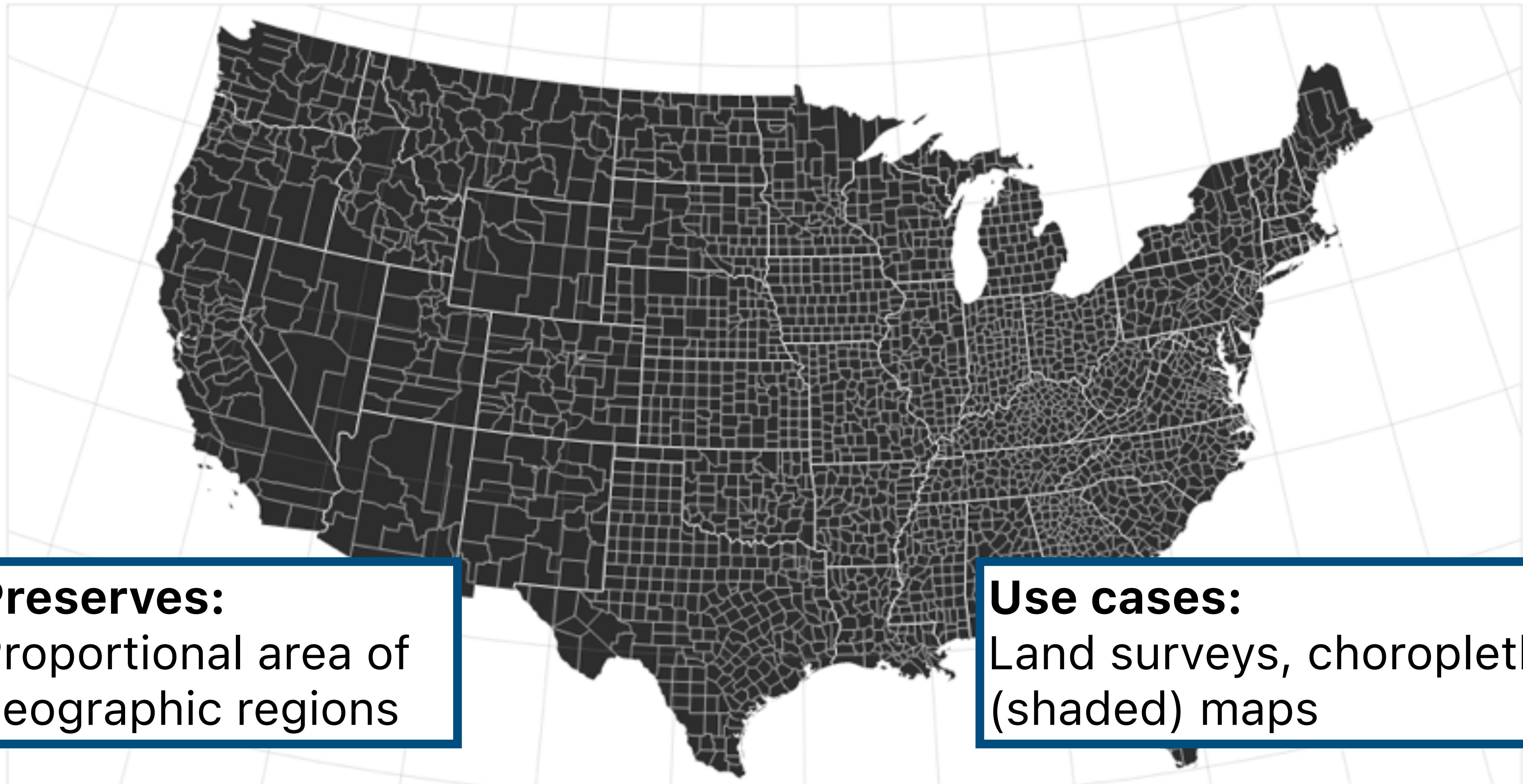
**Preserves:**

Distance & direction  
from center point

**Use cases:**

Travel / propagation  
from center point

# Albers Equal-Area Conic



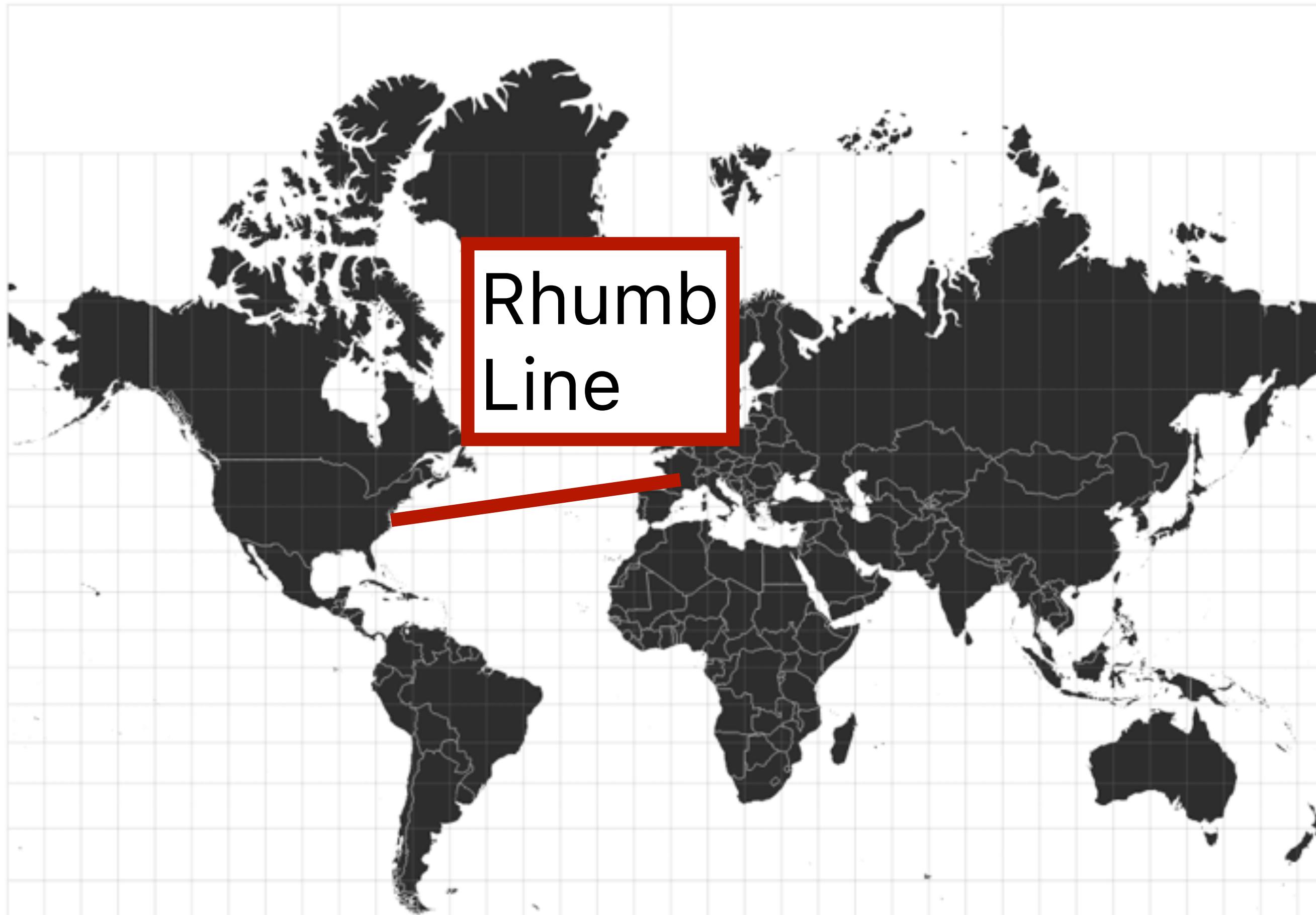
**Preserves:**

Proportional area of  
geographic regions

**Use cases:**

Land surveys, choropleth  
(shaded) maps

# Spherical Mercator



**Preserves:**  
Compass bearing as  
straight line

**Use cases:**  
Navigation (left / right is  
always east / west)



# Spherical Mercator

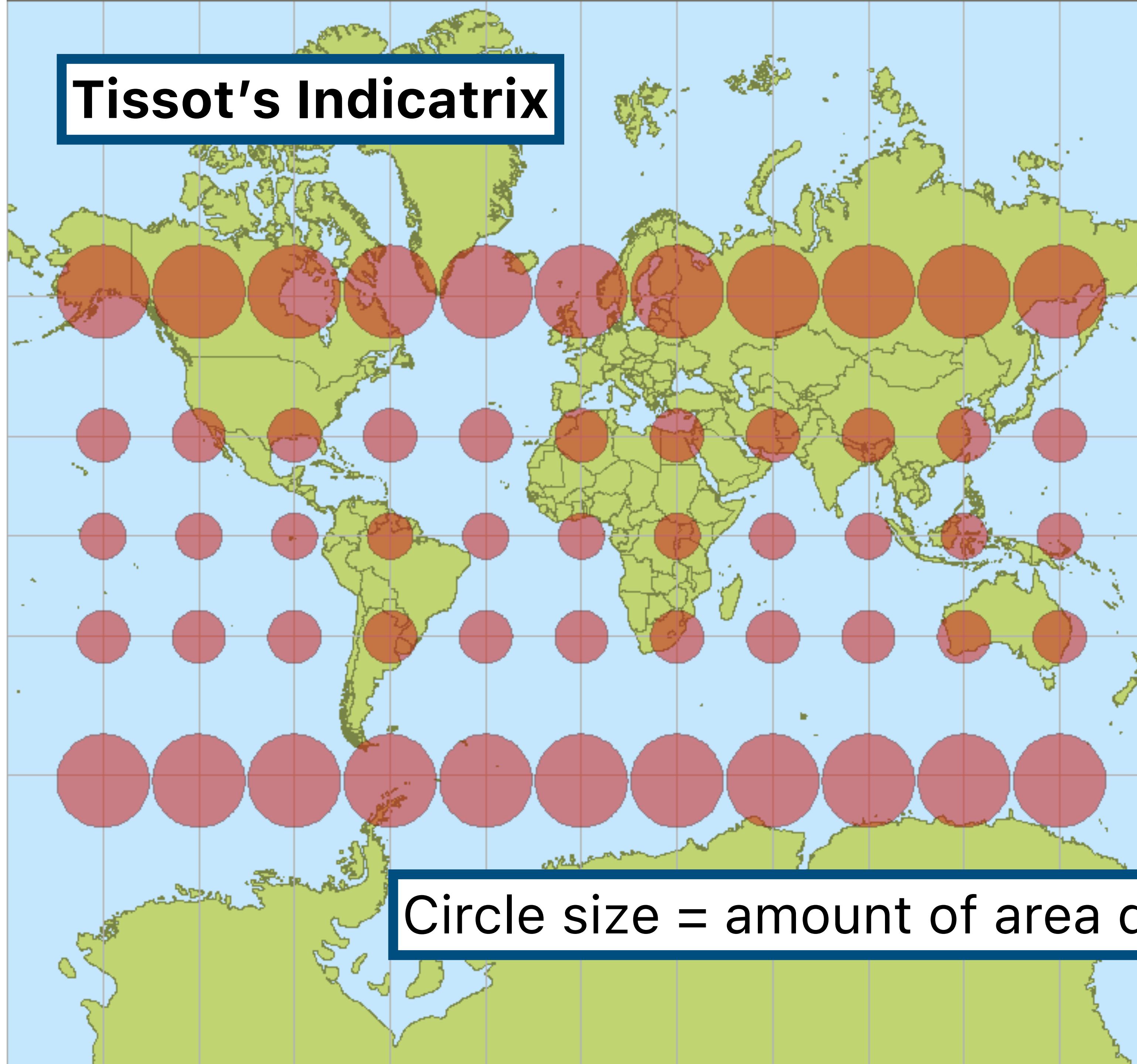


**Preserves:**  
Compass bearing as  
straight line

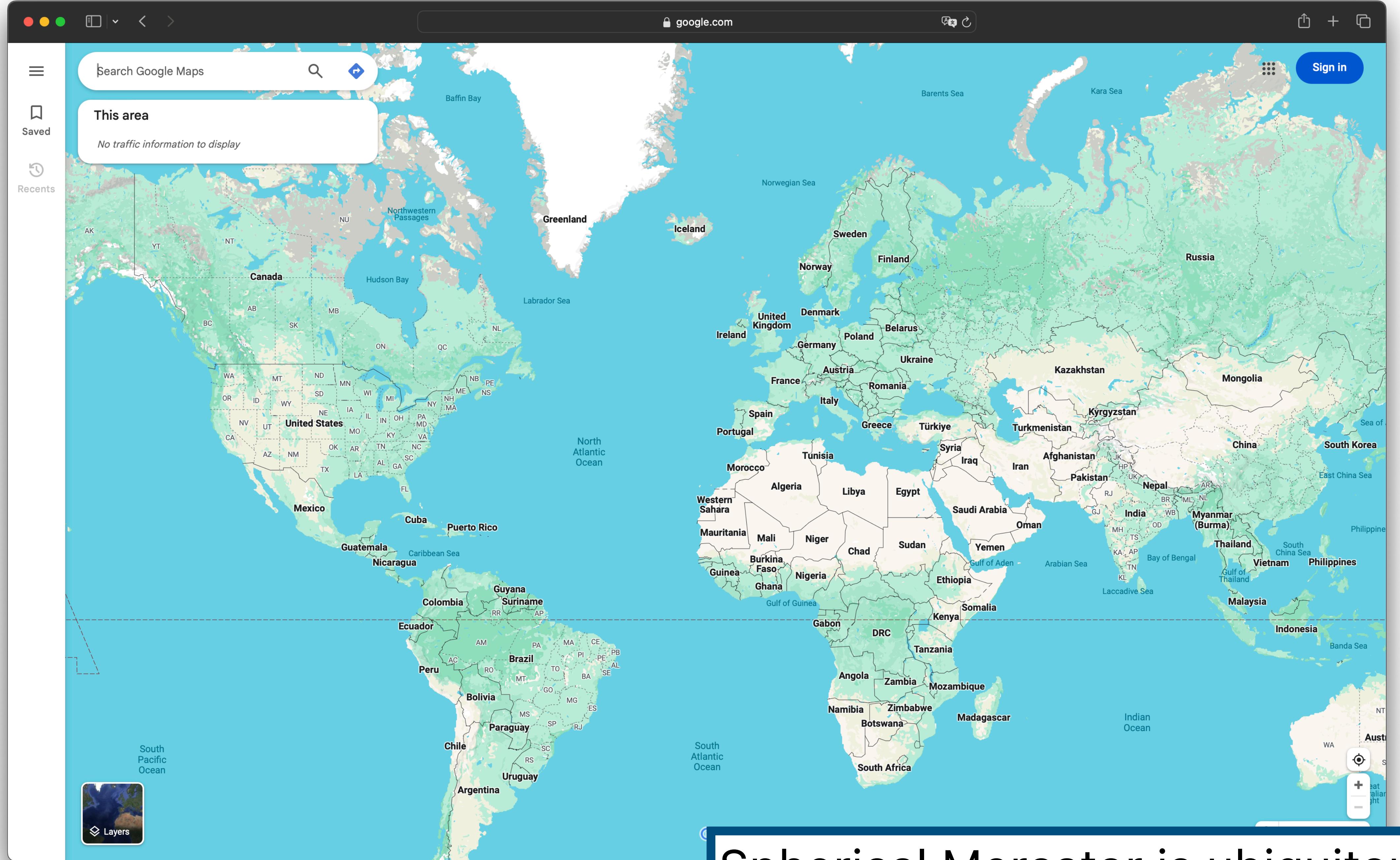


**Use cases:**  
Navigation (left / right is  
always east / west)

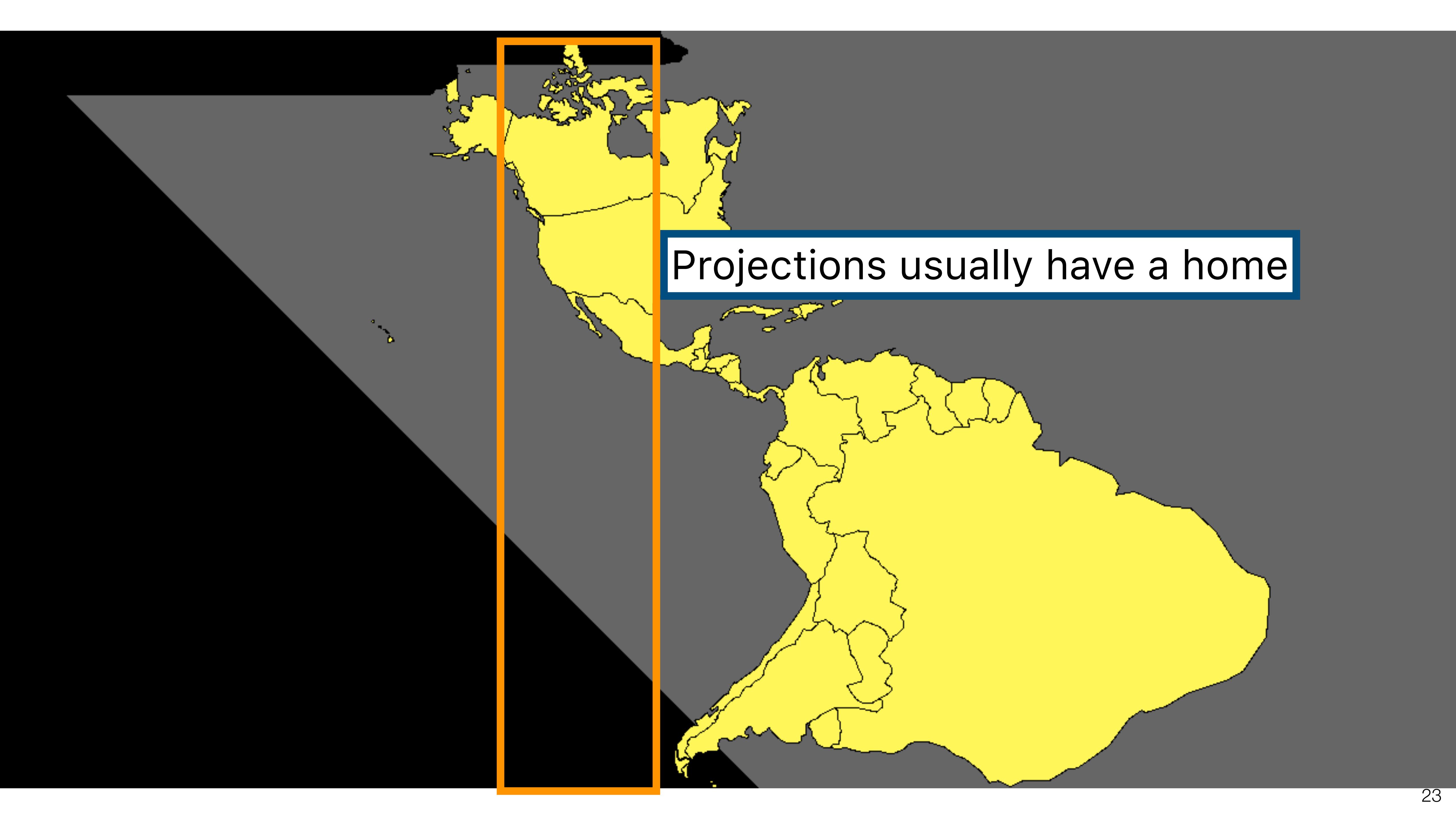
## Tissot's Indicatrix



Circle size = amount of area distortion



Spherical Mercator is ubiquitous on web



Projections usually have a home

# Increased Border Enforcement, With Varying Results



**There are now more agents along the 1,954 mile-long border than ever before...**

Border agents per sector.



Satellite Projection, NY Times

Not appropriate for the whole Earth,  
but fits the chosen focus region!

WHAT YOUR FAVORITE  
**MAP PROJECTION**  
SAYS ABOUT YOU

<http://xkcd.com/977>

MERCATOR



YOU'RE NOT REALLY INTO MAPS.

VAN DER GRINTEN



YOU'RE NOT A COMPLICATED PERSON. YOU LOVE THE MERCATOR PROJECTION; YOU JUST WISH IT WEREN'T SQUARE. THE EARTH'S NOT A SQUARE, IT'S A CIRCLE. YOU LIKE CIRCLES. TODAY IS GONNA BE A GOOD DAY!

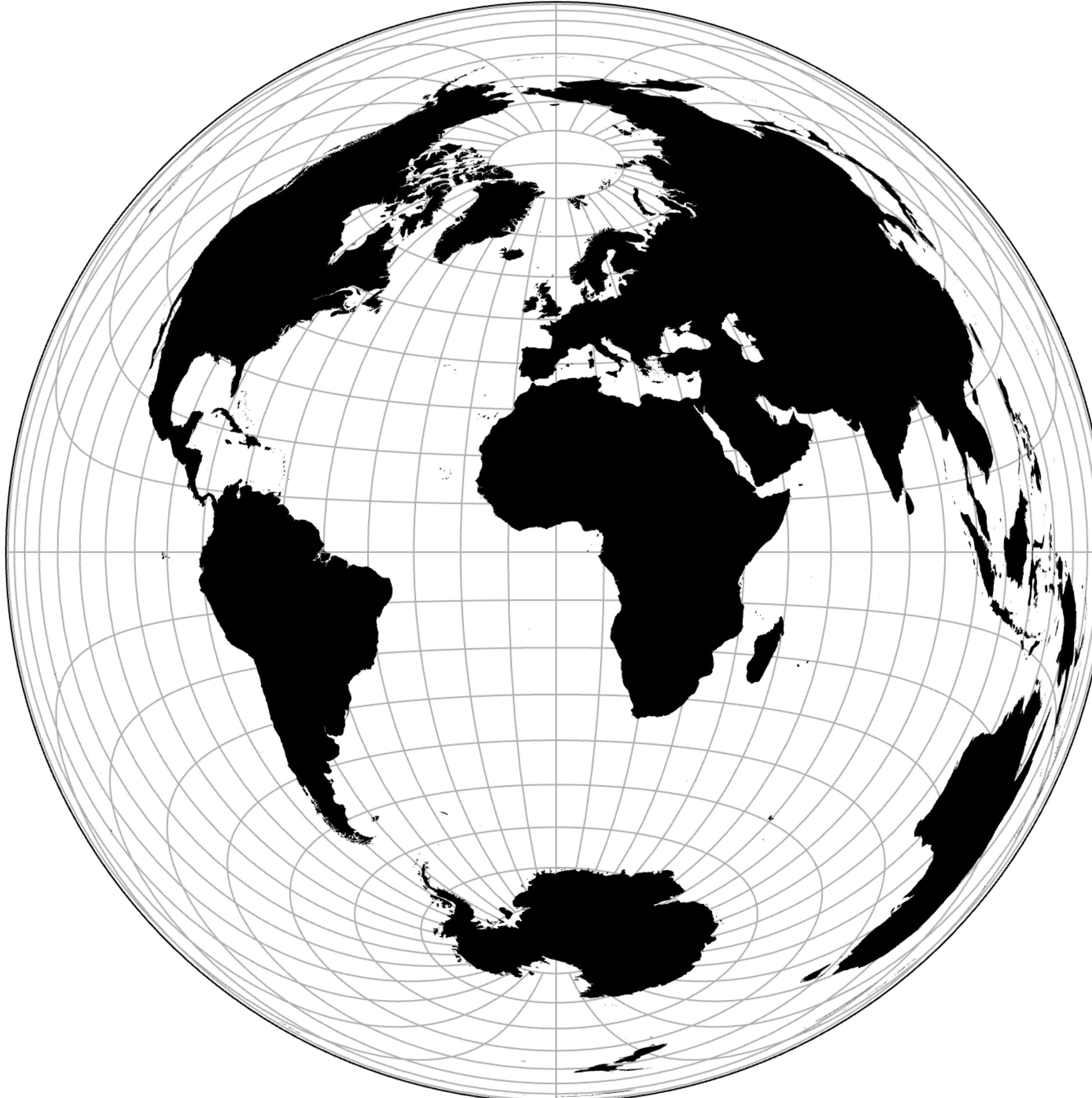


There are many interesting ways to tear spheres...

# Projection comparison

Choose a projection below to view.

azimuthal equal-area  proj



<https://bit.ly/d3-proj>

Respond with this format:

projection:

pros:

cons:

<tryclassbuzz.com>

Code: **proj**

# Mapping (Visualizing Geospatial Data)

# How does the data change?

Where  
does the  
data  
occur?

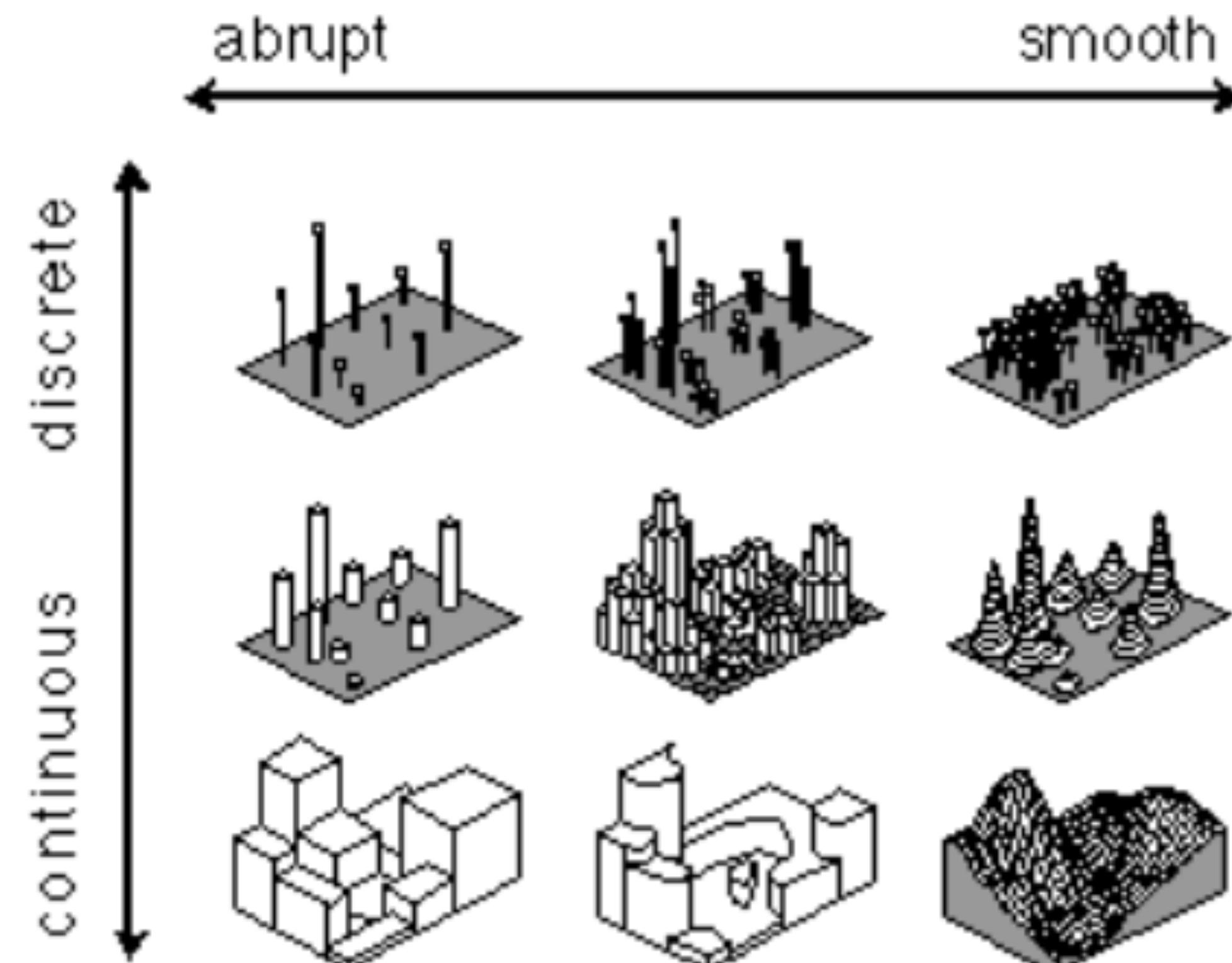


Fig. 8. Data models representing points in the continuity-abruptness phenomena space.

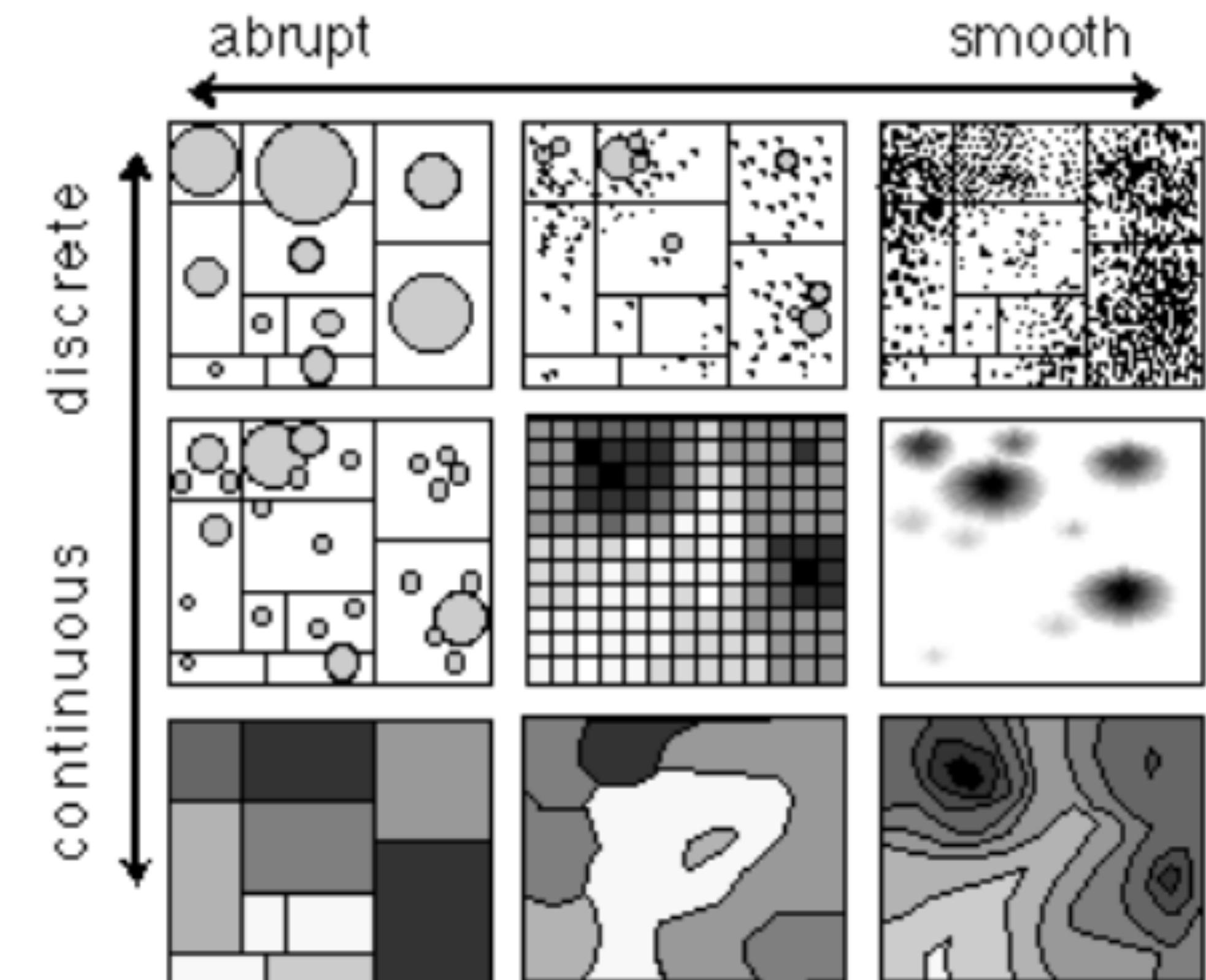


Fig. 9. Possible 2D translations of the 3D data models shown in figure 8.

# Dot Distribution Map

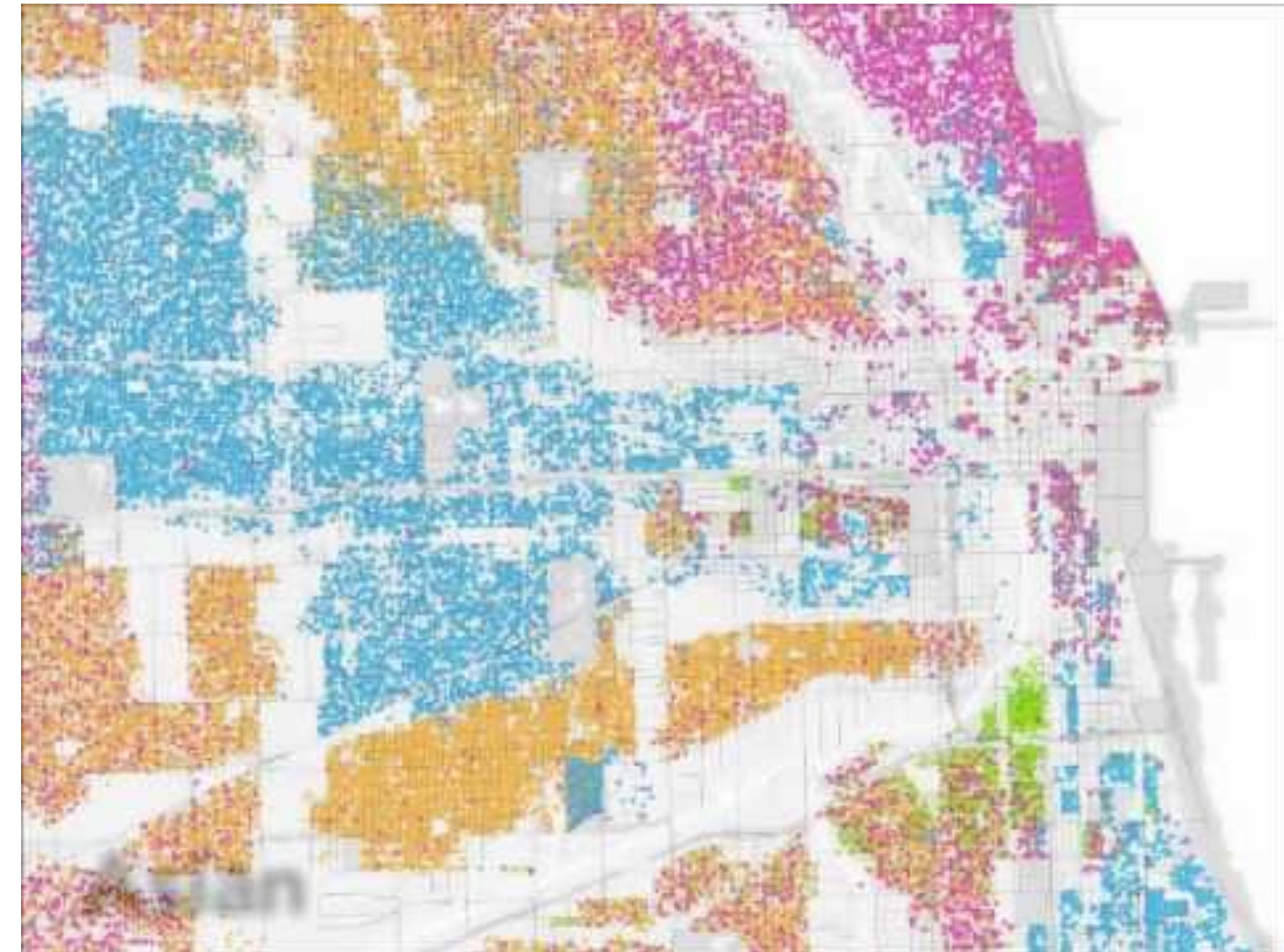
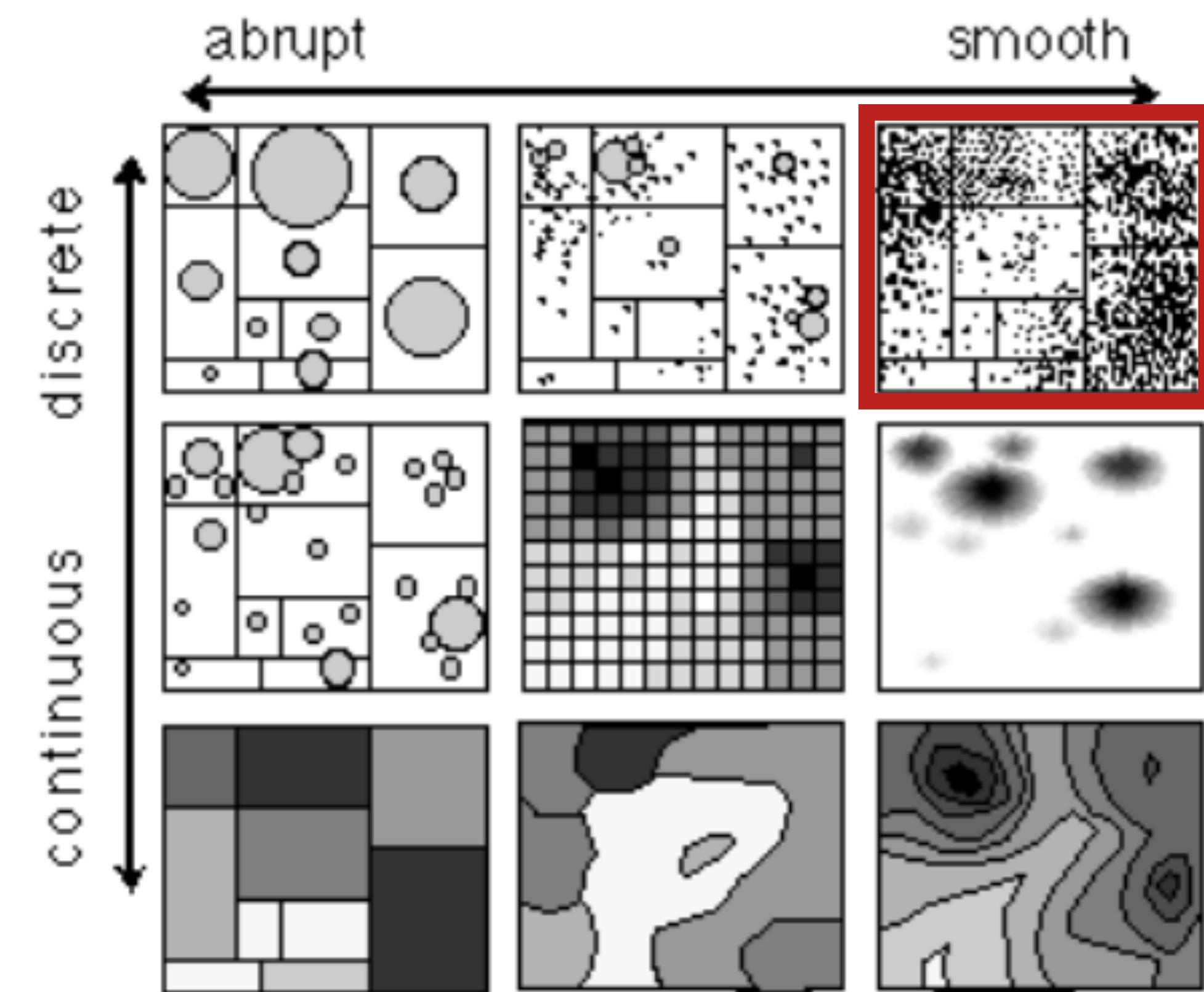


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<https://www.youtube.com/watch?v=8pRcdMVkA3k>

# Dot Distribution Map

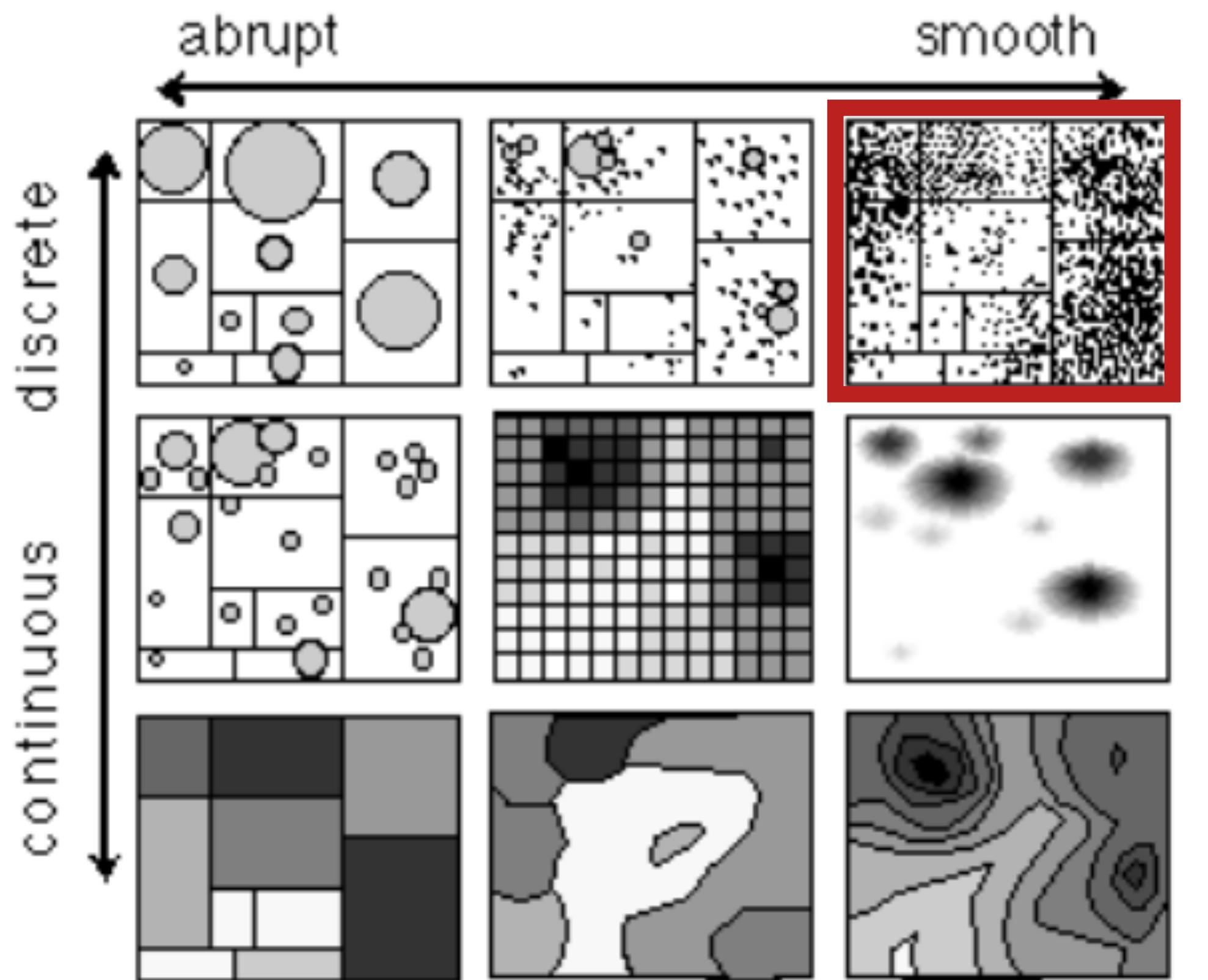
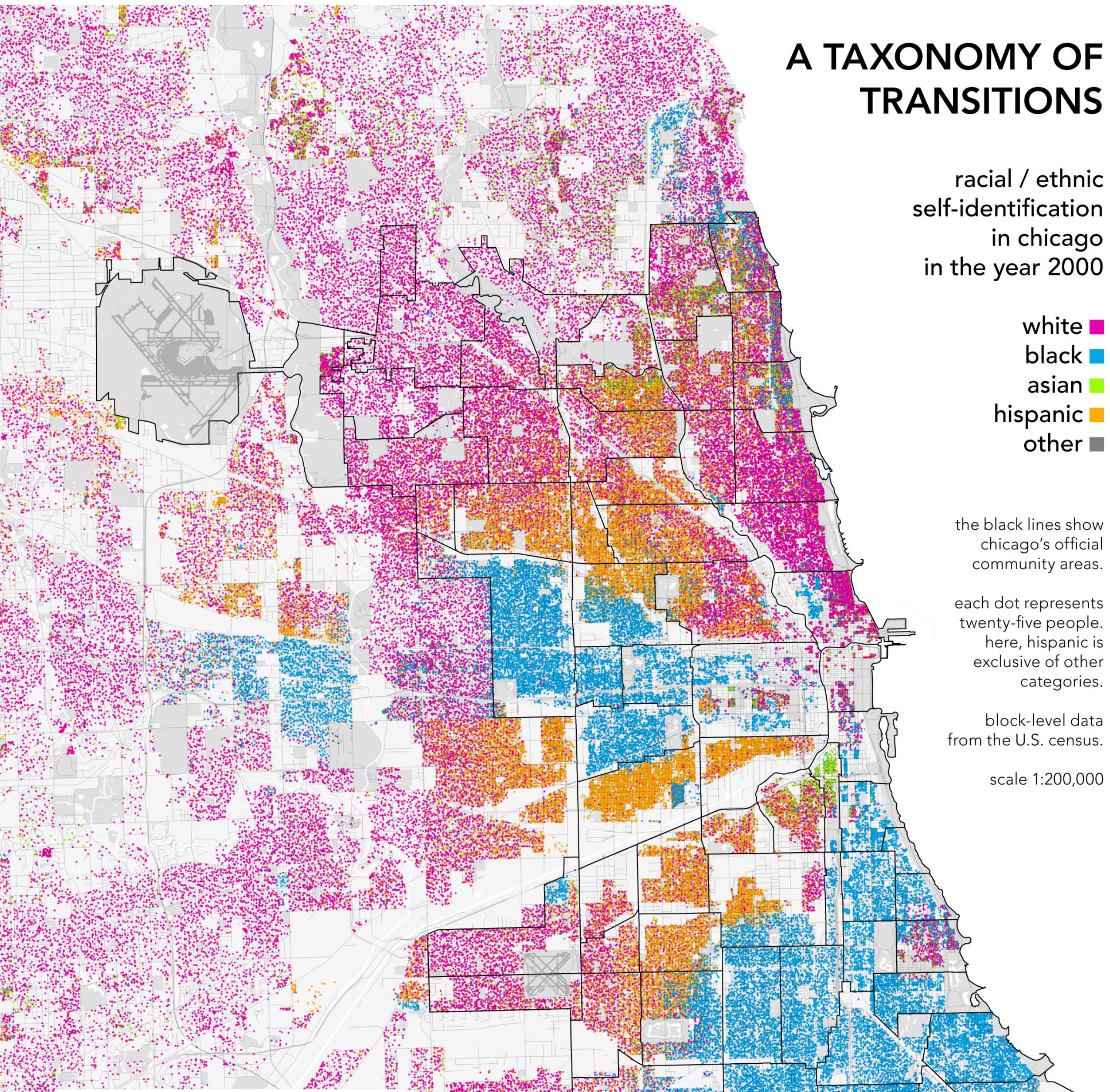


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A TAXONOMY OF TRANSITIONS

# Dot Distribution Map

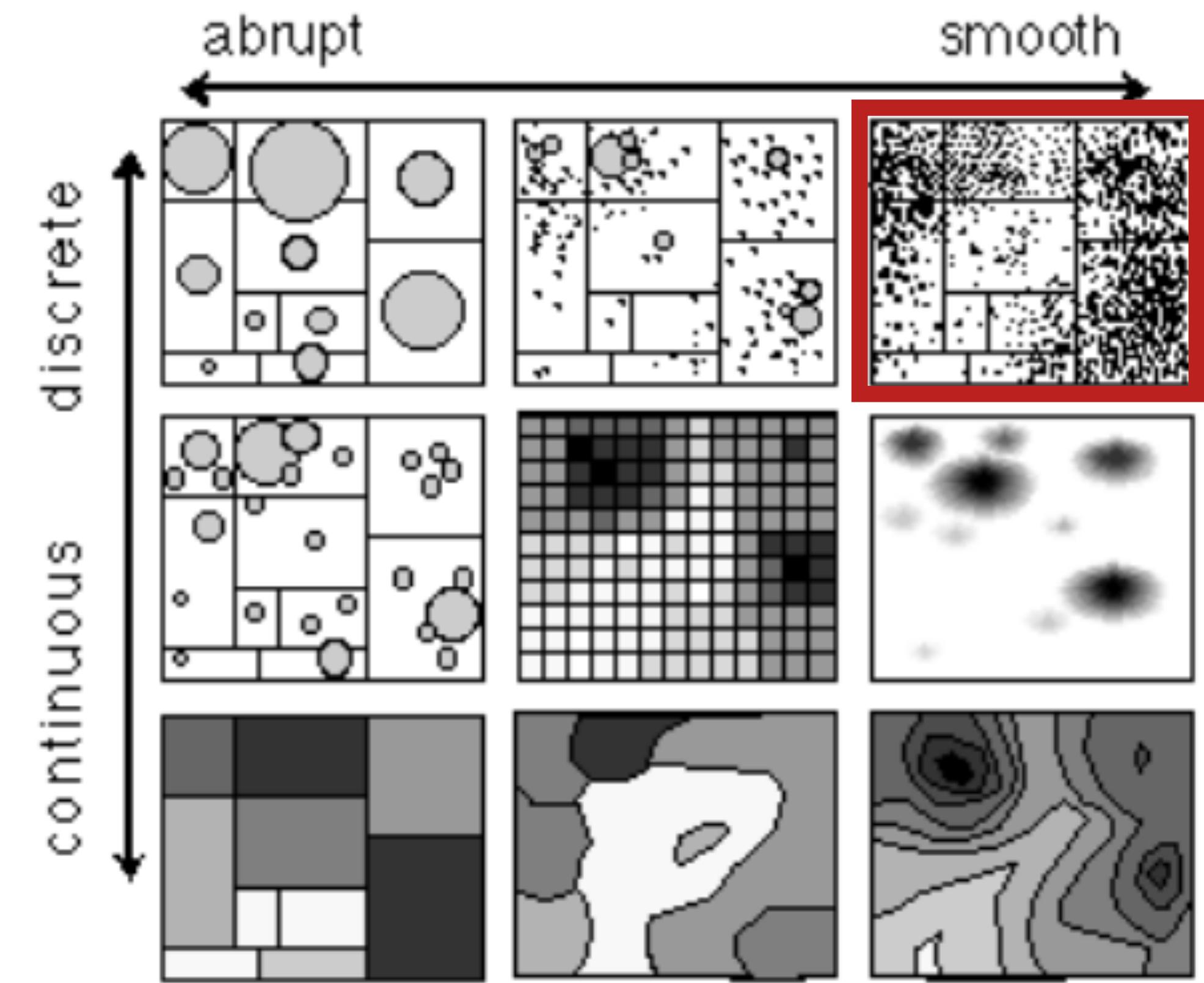
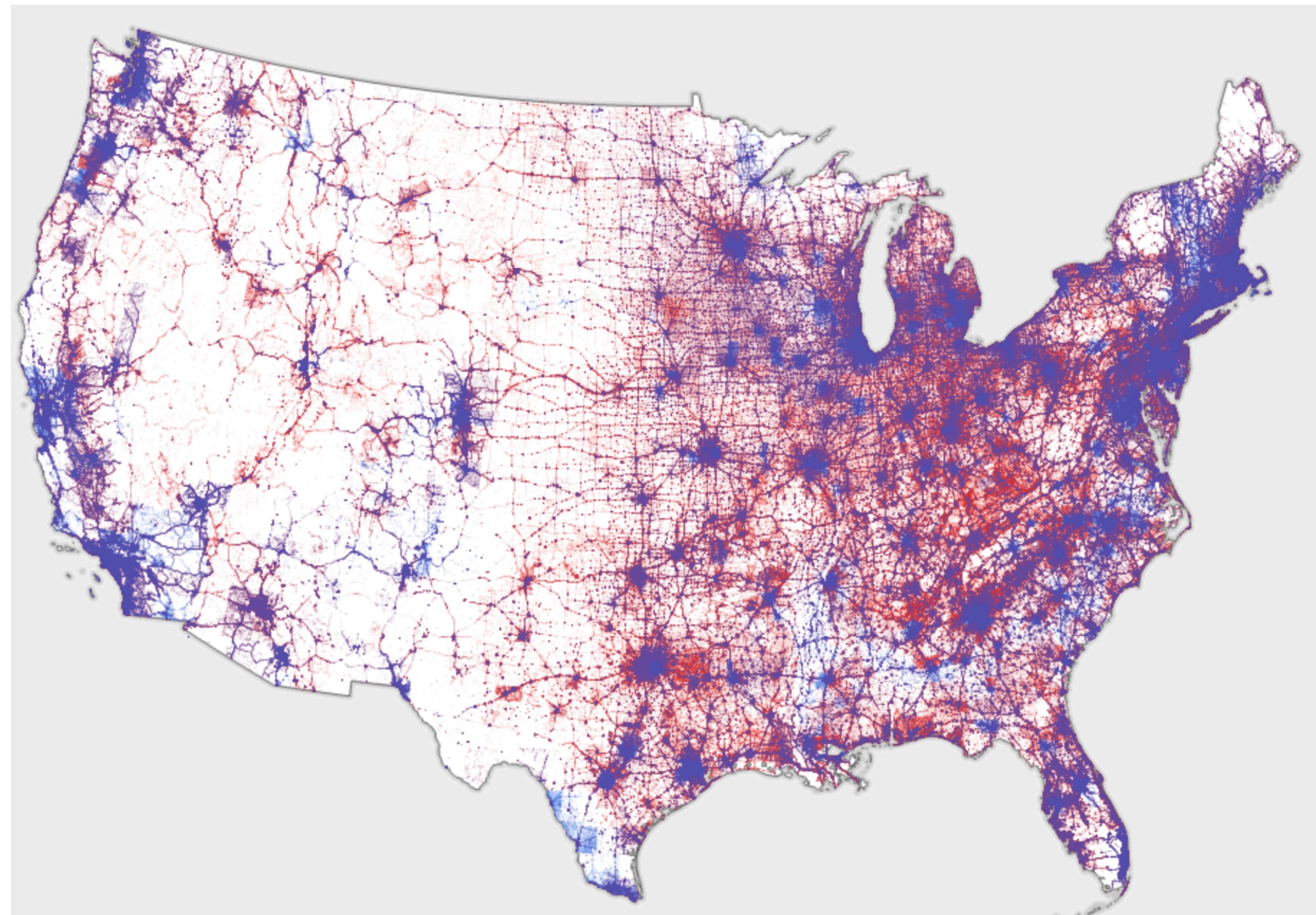


Fig. 9. Possible 2D translations of the 3D data models shown in figure 8.



Votes cast in the 2016 Presidential Election

# Dot Distribution Map

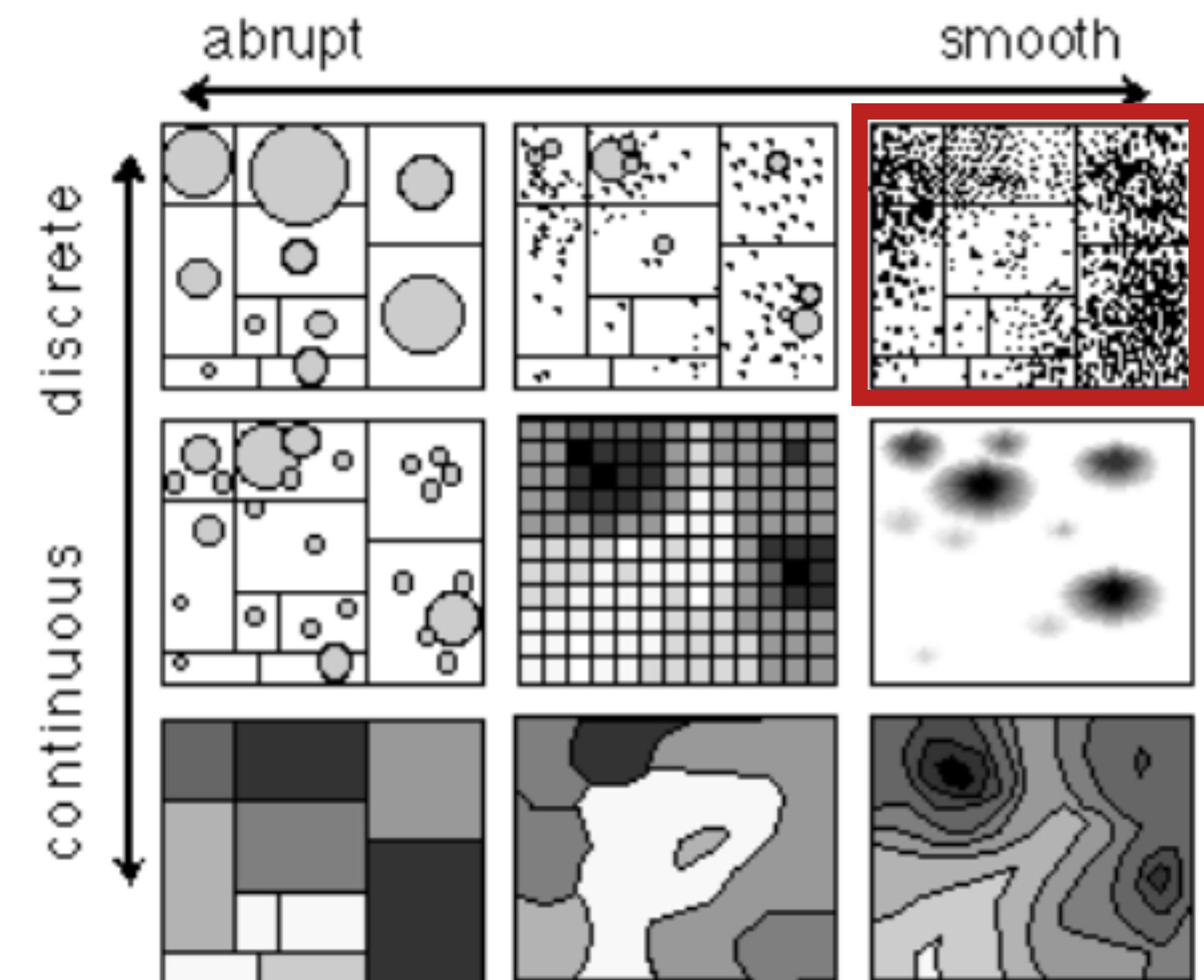
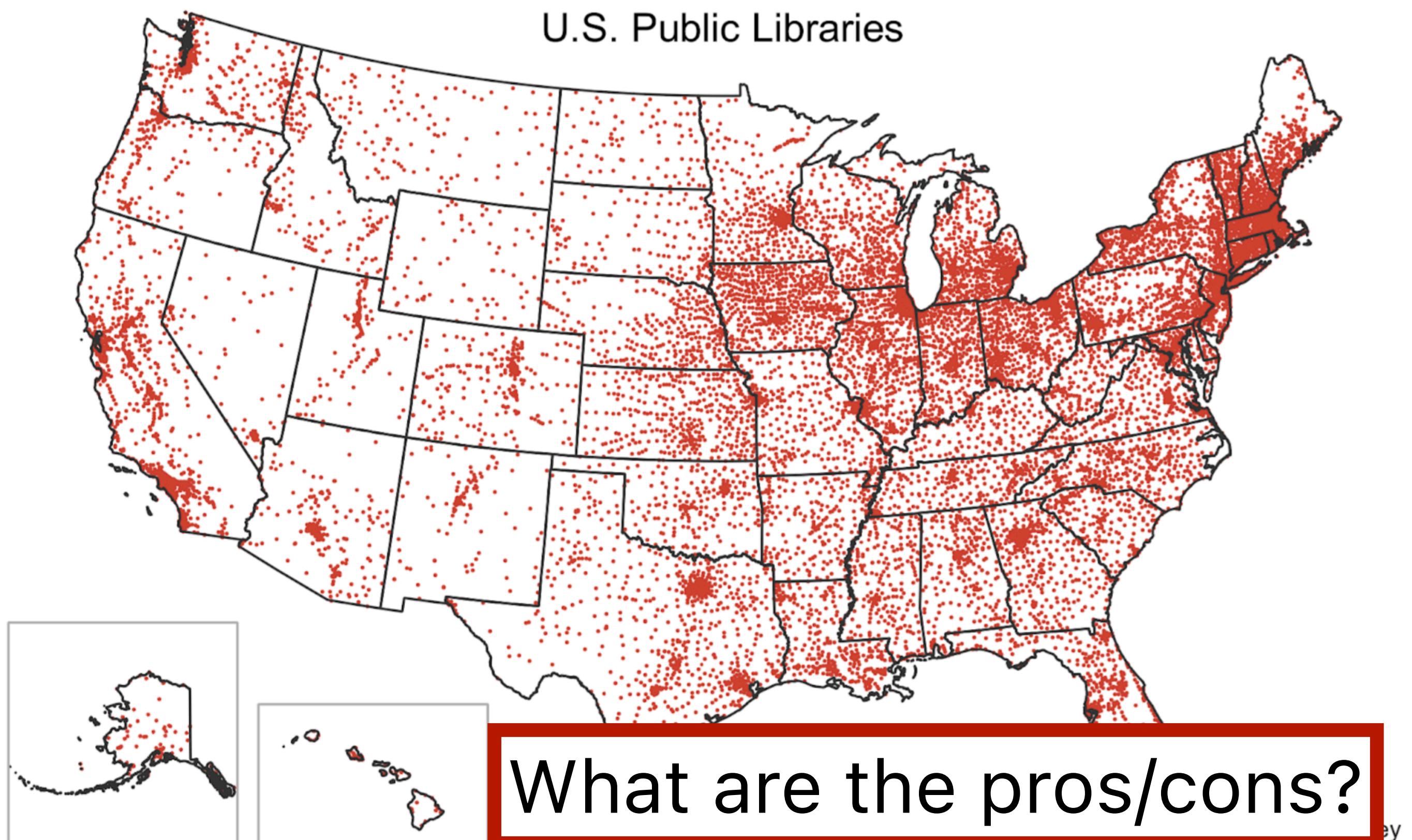


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What are the pros/cons?

[tryclassbuzz.com](http://tryclassbuzz.com)  
Code: **dots**

# Dot Distribution Map

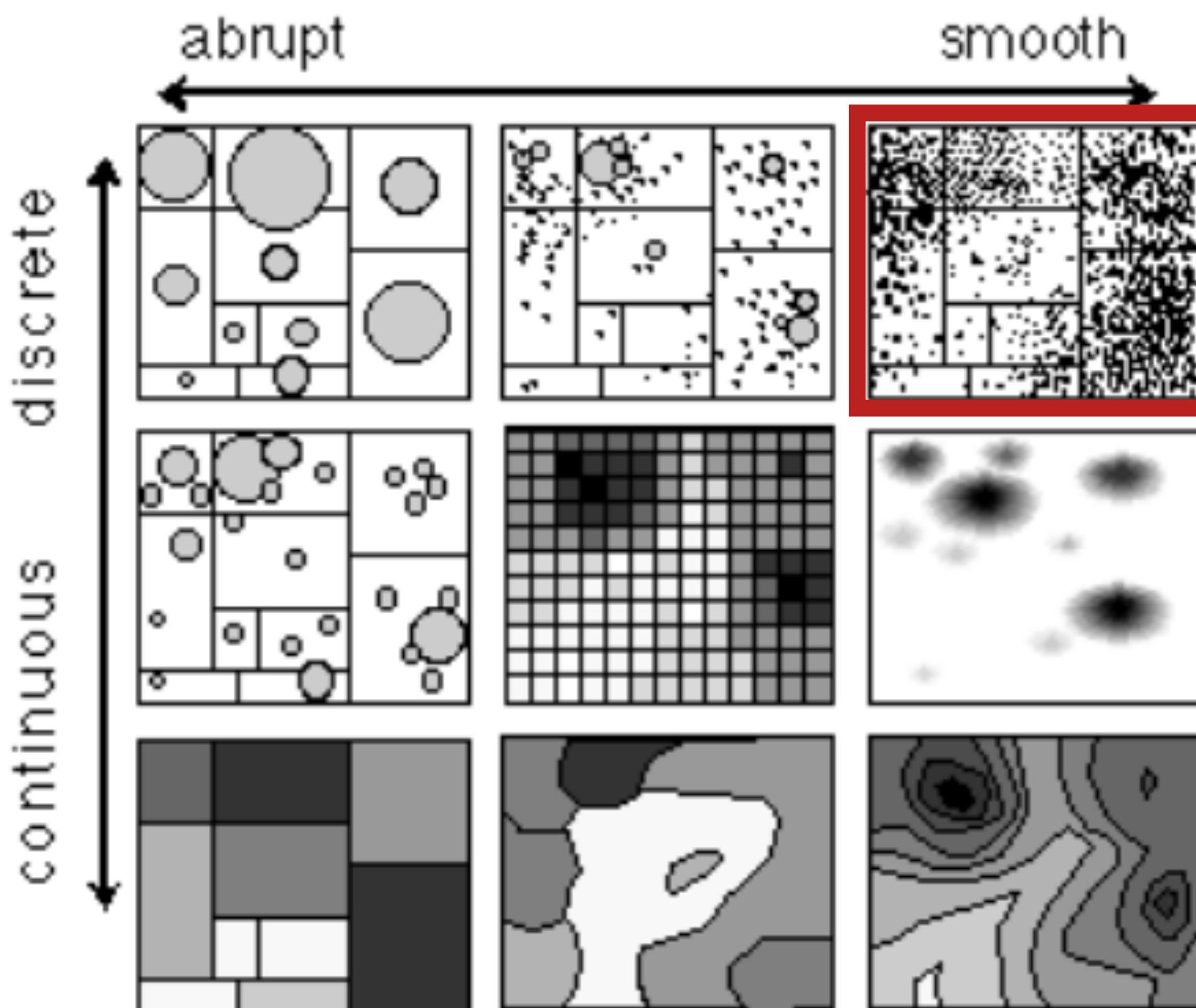
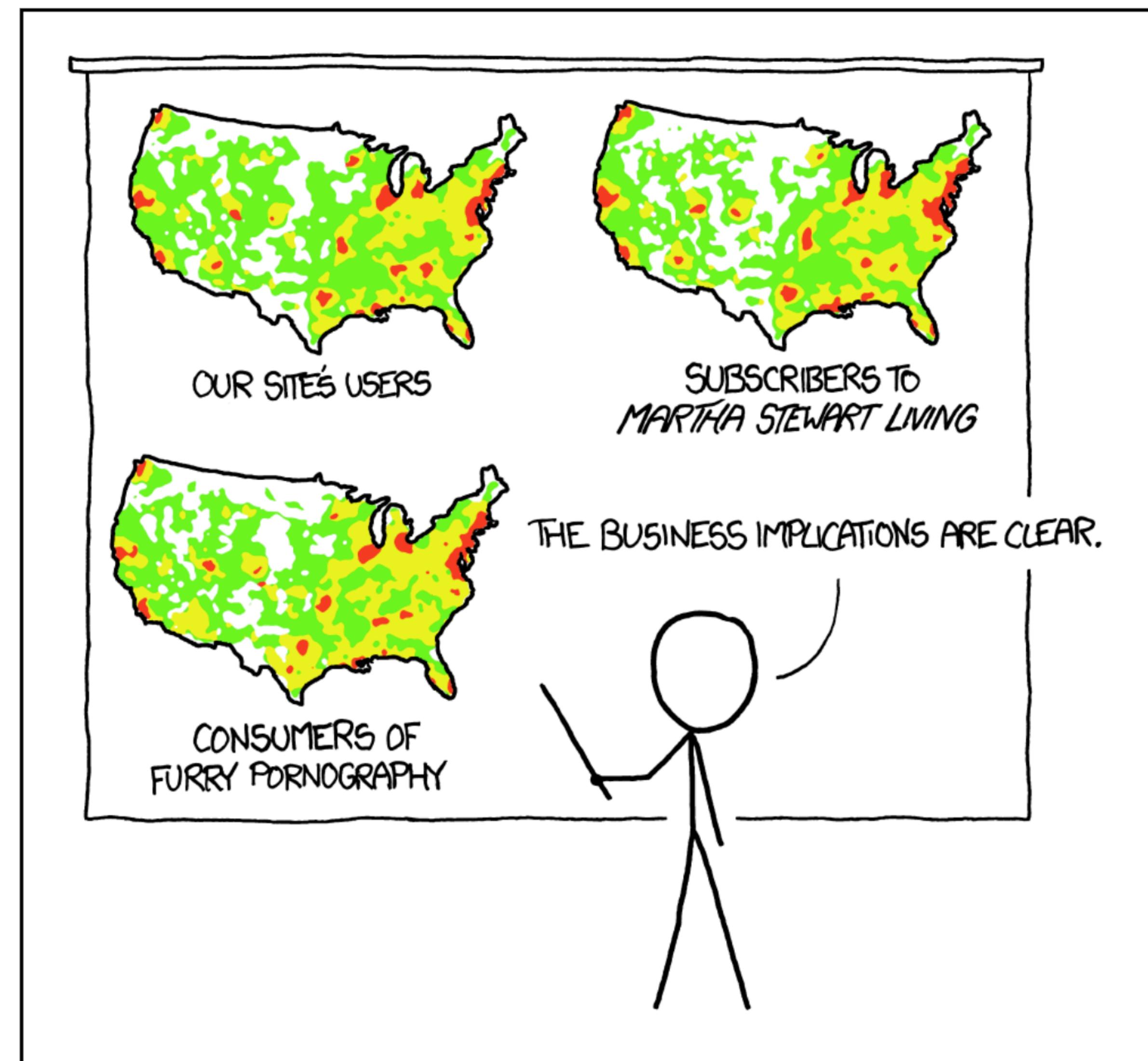
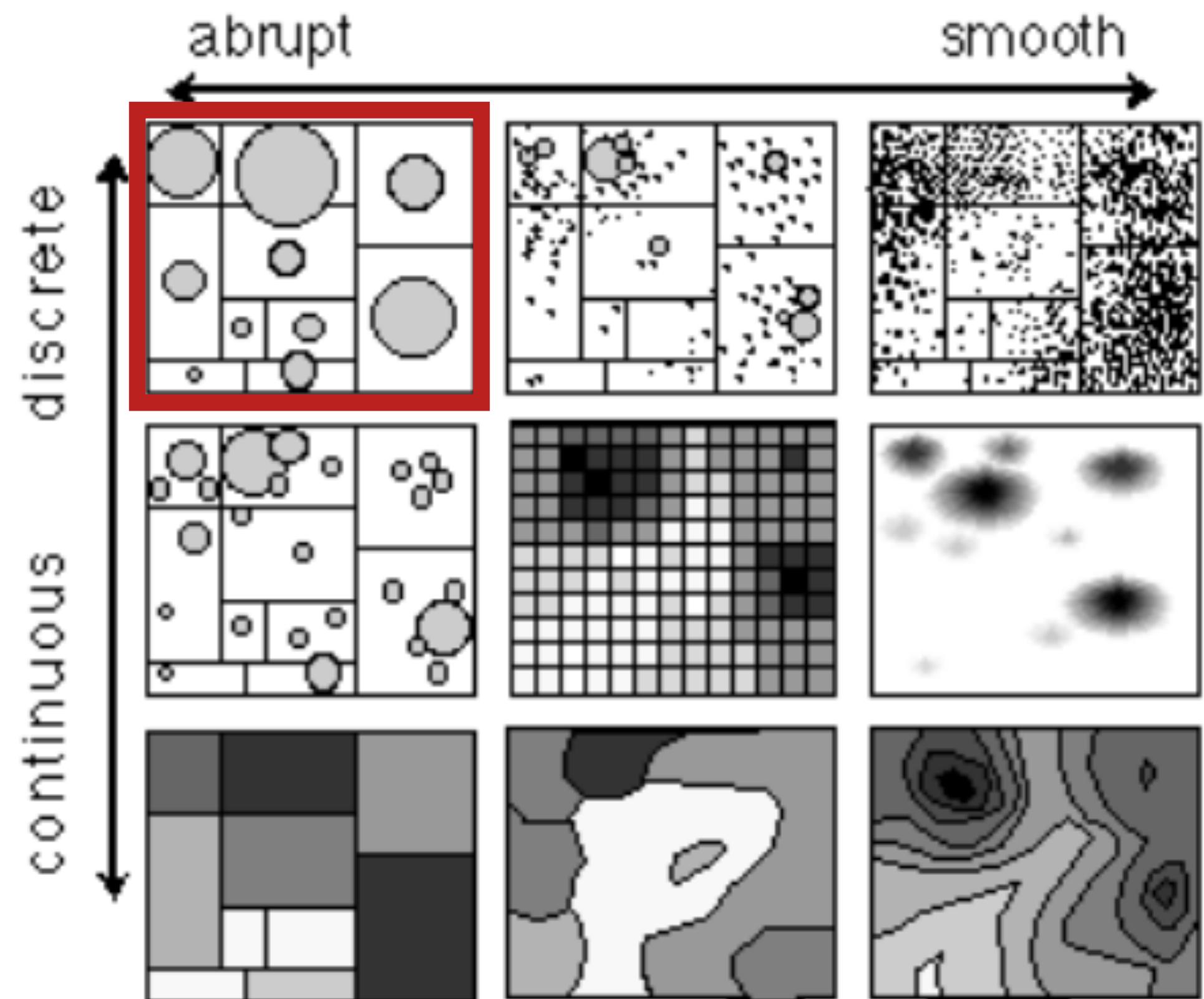


Fig. 9. Possible 2D translations of the 3D data models shown in figure 8.



PET PEEVE #208:  
GEOGRAPHIC PROFILE MAPS WHICH ARE  
BASICALLY JUST POPULATION MAPS

# Proportional Symbol Map



## Craters

The earth is marked with about 180 named craters that are scars from previous run-ins with asteroids like the one that exploded over Russia on Friday.

### Crater diameter



99 miles

20 miles

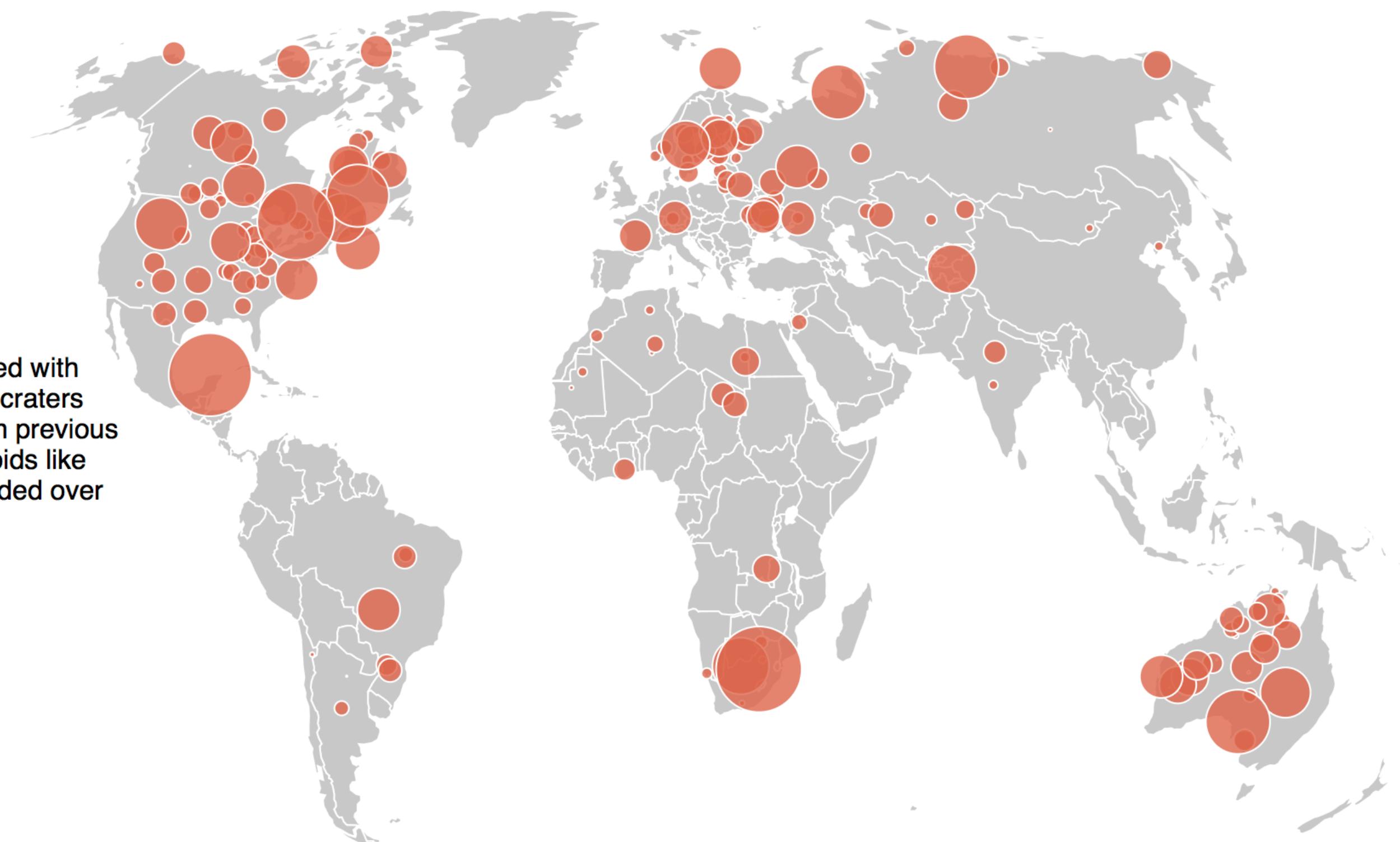


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<http://www.washingtonpost.com/wp-srv/special/world/russia-meteor/index.html>

# Proportional Symbol Map

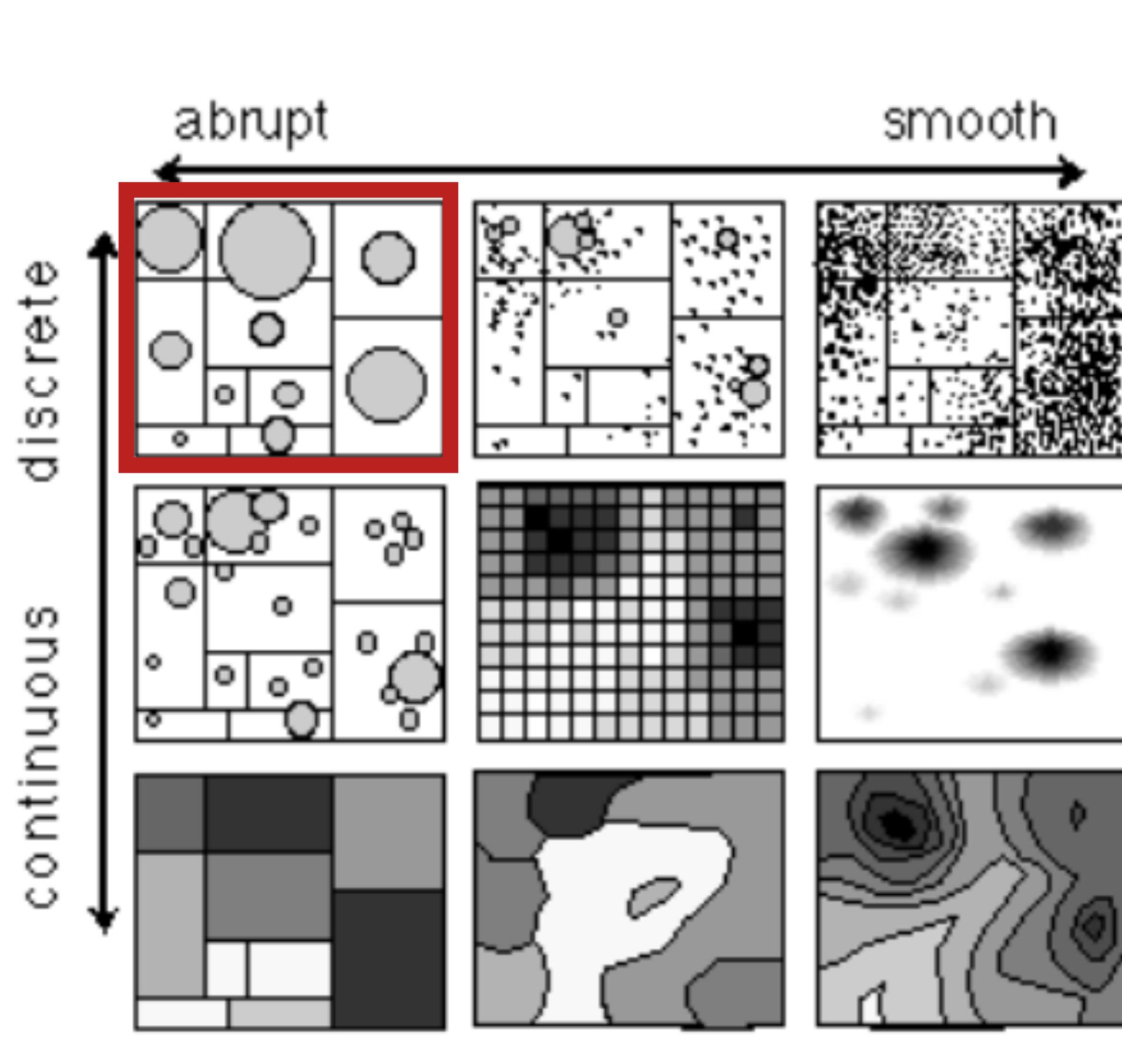
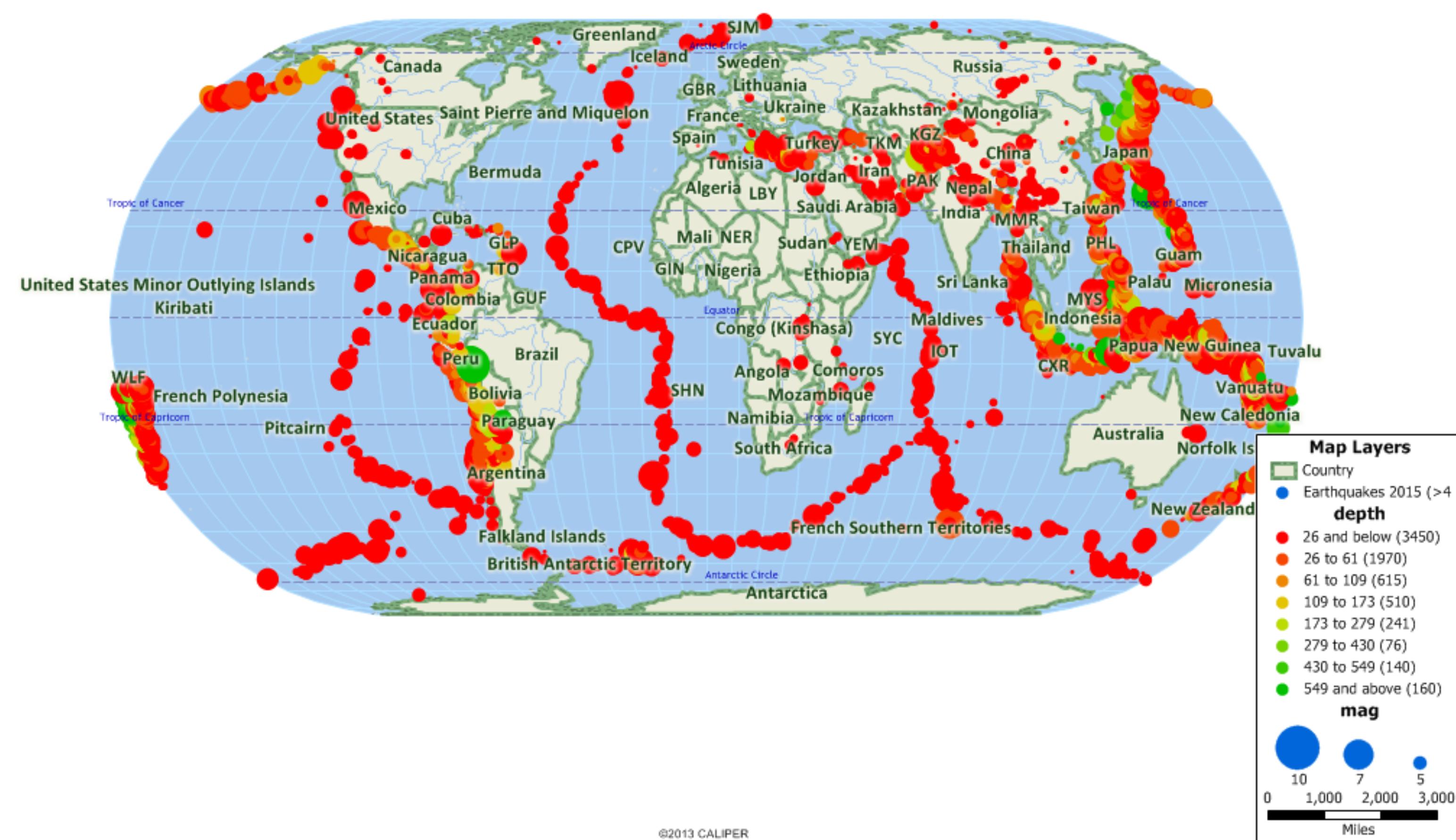


Fig. 9. Possible 2D translations of the 3D data models shown in figure 8.



# Graduated Symbol Map

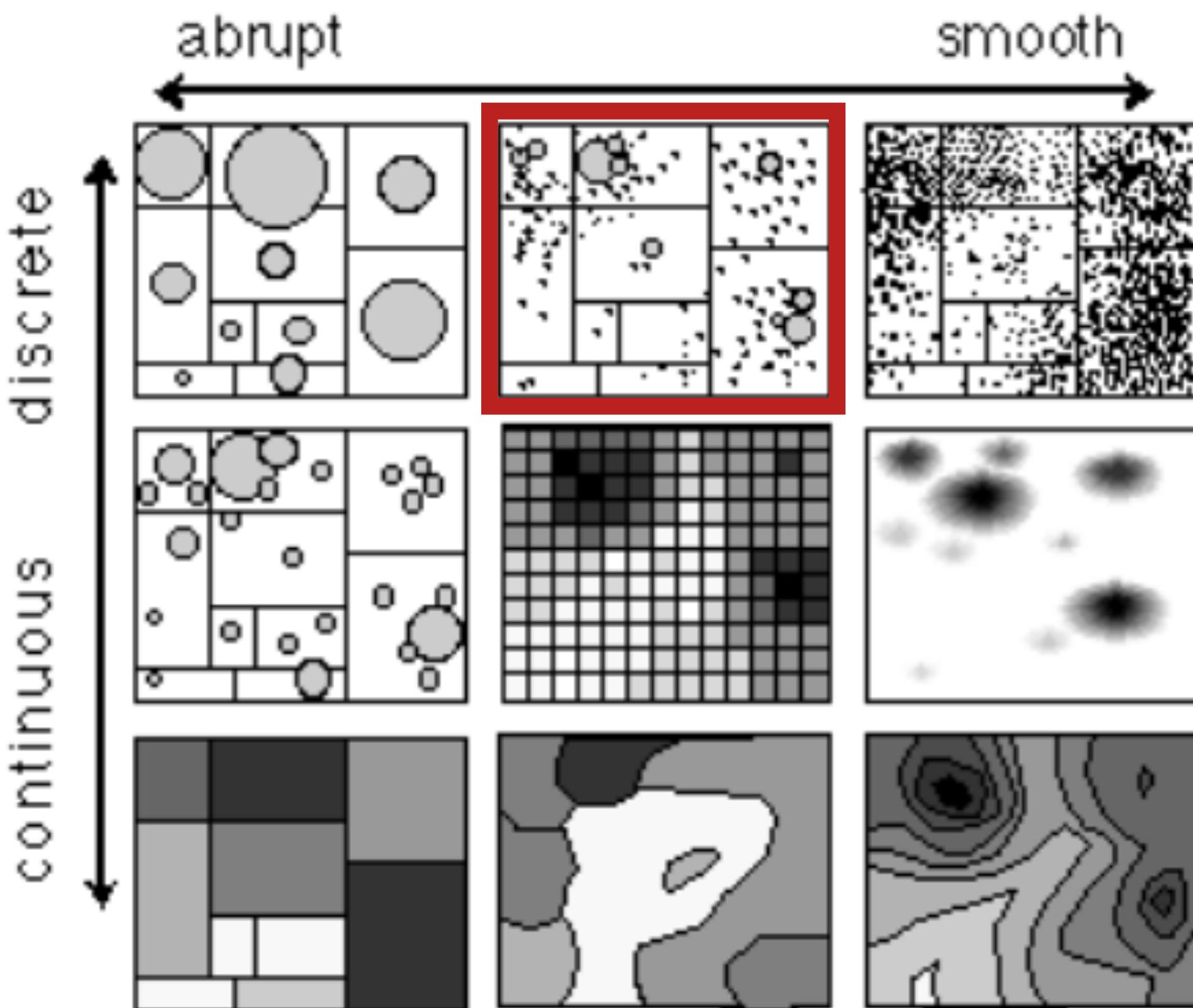


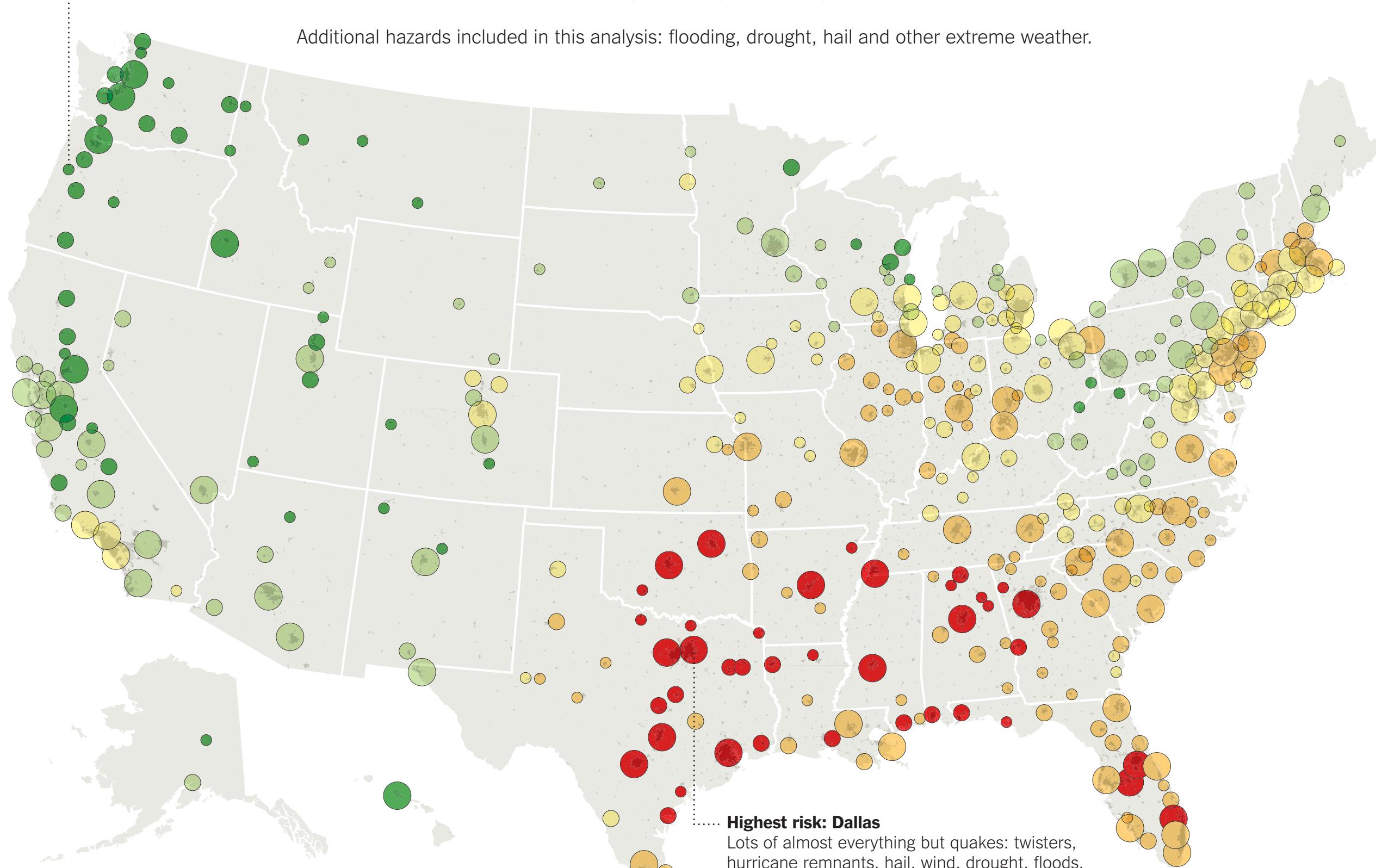
Fig. 9. Possible 2D translations of the 3D data models shown in figure 8.

## Some Places Are Riskier Than Others

Weather disasters and quakes: who's most at risk? The analysis below, by Sperling's Best Places, a publisher of city rankings, is an attempt to assess a combination of those risks in 379 American metro areas.

Risks for twisters and hurricanes (including storms from hurricane remnants) are based on historical data showing where storms occurred. Earthquake risks are based on United States Geological Survey assessments and take into account the relative infrequency of quakes, compared with weather events and floods.

Additional hazards included in this analysis: flooding, drought, hail and other extreme weather.



### Metro area population

- Less than 175,000
- 175,000 to 500,000
- More than 500,000

### Scale of hazards

- Lower → Higher

### Metro areas with lowest risk:

1. Corvallis, Ore.
2. Mt. Vernon-Anacortes, Wash.
3. Bellingham, Wash.
4. Wenatchee, Wash.
5. Grand Junction, Colo.
6. Spokane, Wash.
7. Salem, Ore.
8. Seattle

### Highest risk:

1. Dallas-Plano-Irving, Tex.
2. Jonesboro, Ark.
3. Corpus Christi, Tex.
4. Houston
5. Beaumont-Port Arthur, Tex.
6. Shreveport, La.
7. Austin, Tex.
8. Birmingham, Ala.

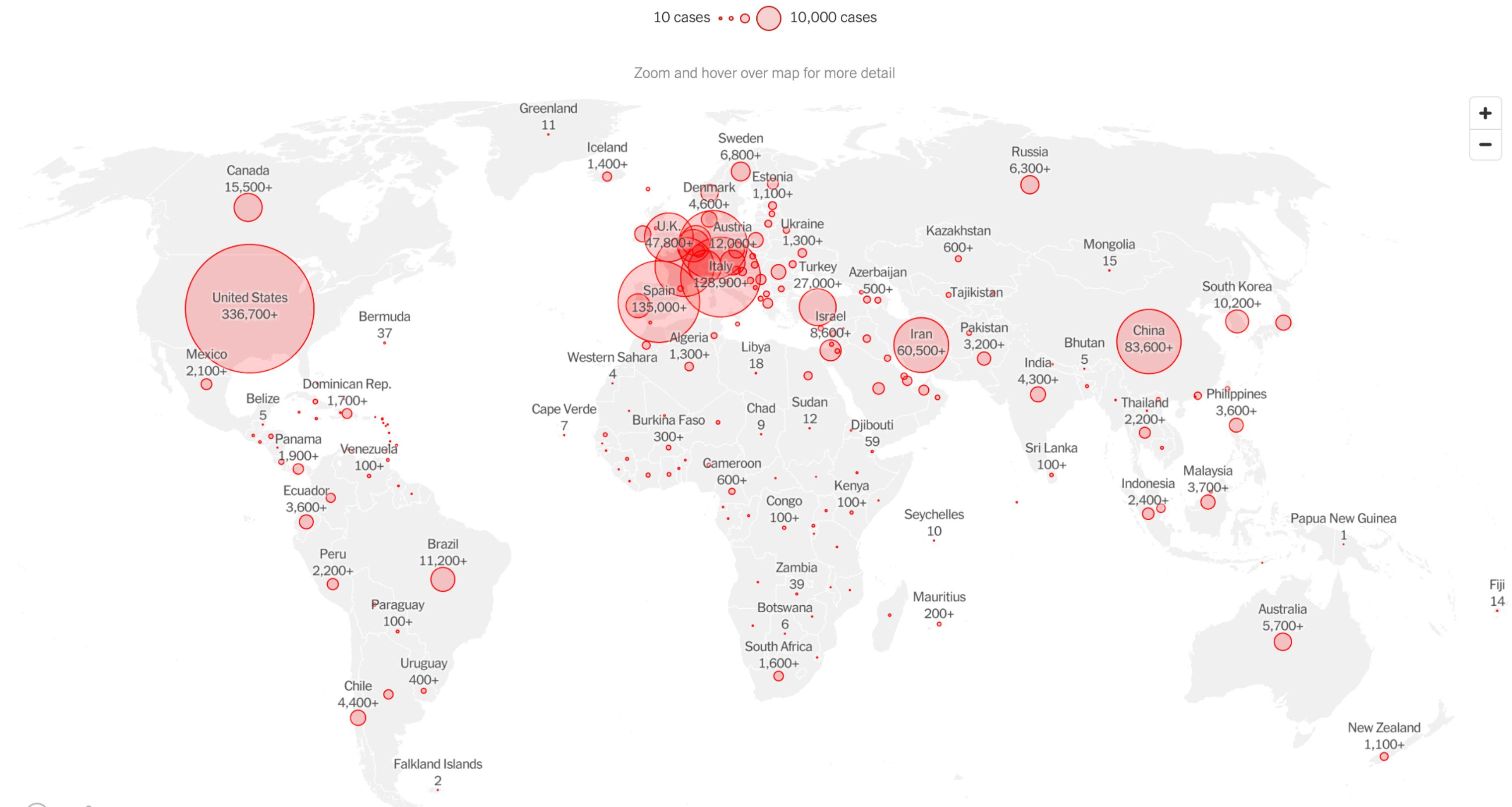
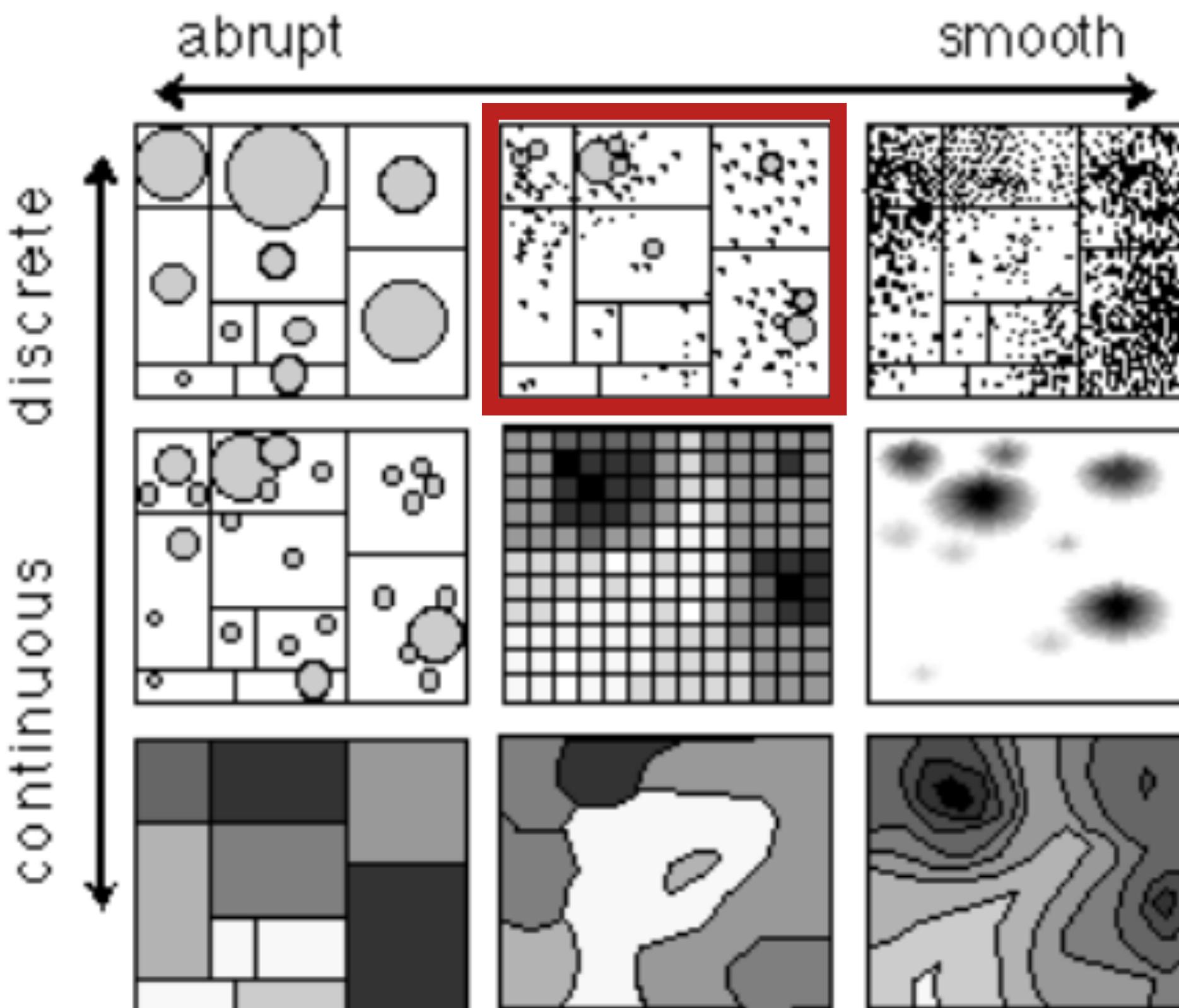
# Graduated Symbol Map

ASIA PACIFIC

The New York Times

PLAY THE CROSSWORD

Account



Sources: Local governments; The Center for Systems Science and Engineering at Johns Hopkins University; National Health Commission of the People's Republic of China; World Health Organization. Data for the West Bank and Gaza was reported together by the Palestinian Health Ministry and includes only Palestinian-controlled land. Russia is reporting data for Crimea, a peninsula it annexed in 2014 in a move that led to international sanctions. Data for some countries, like the United States and France, include counts for overseas territories. Japan's count includes 696 cases and seven deaths from a cruise ship that docked in

Fig. 9. Possible 2D translations of the 3D data models shown in figure 8.

<https://www.nytimes.com/interactive/2021/world/covid-cases.html>

# Graduated Symbol Map?

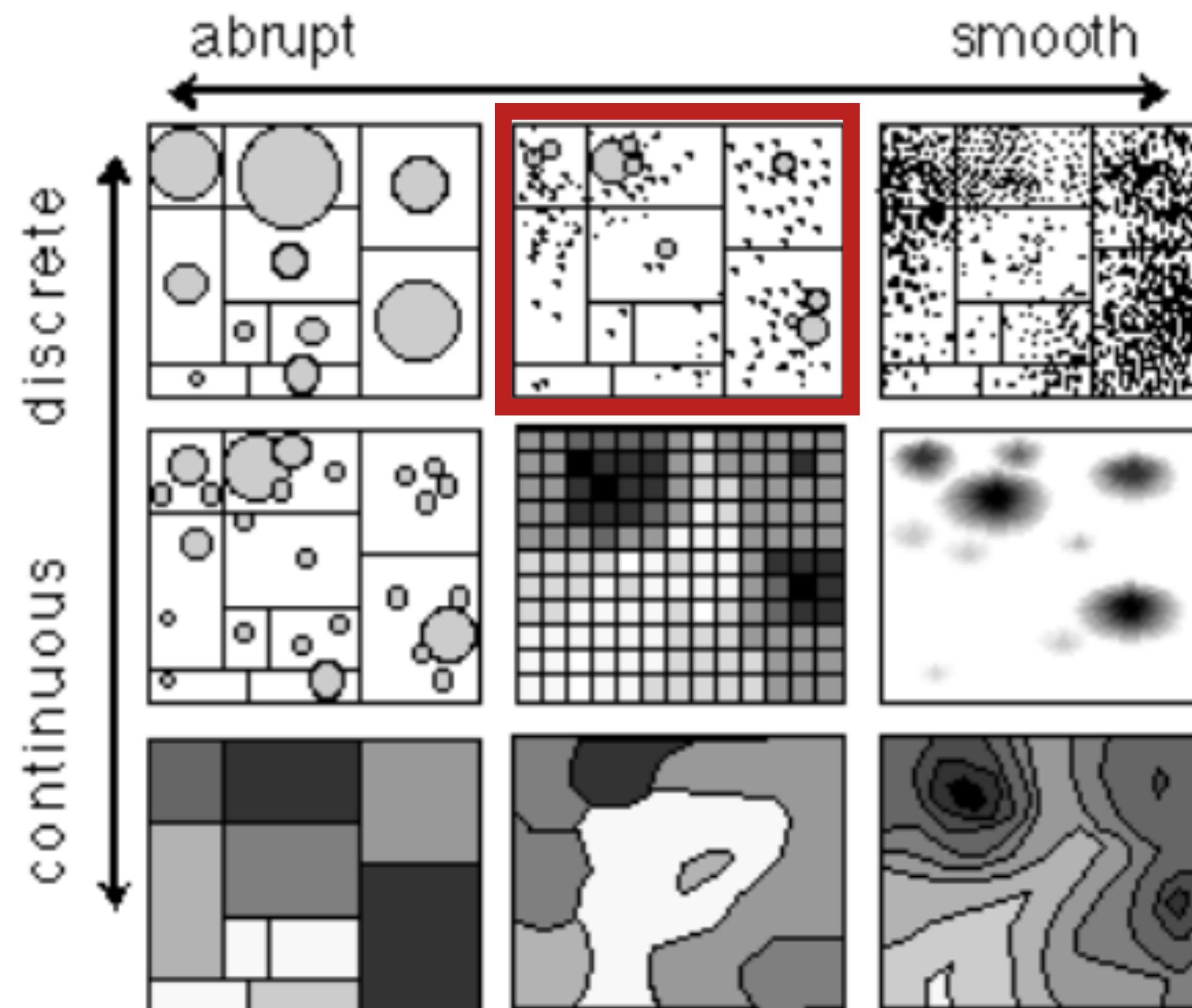
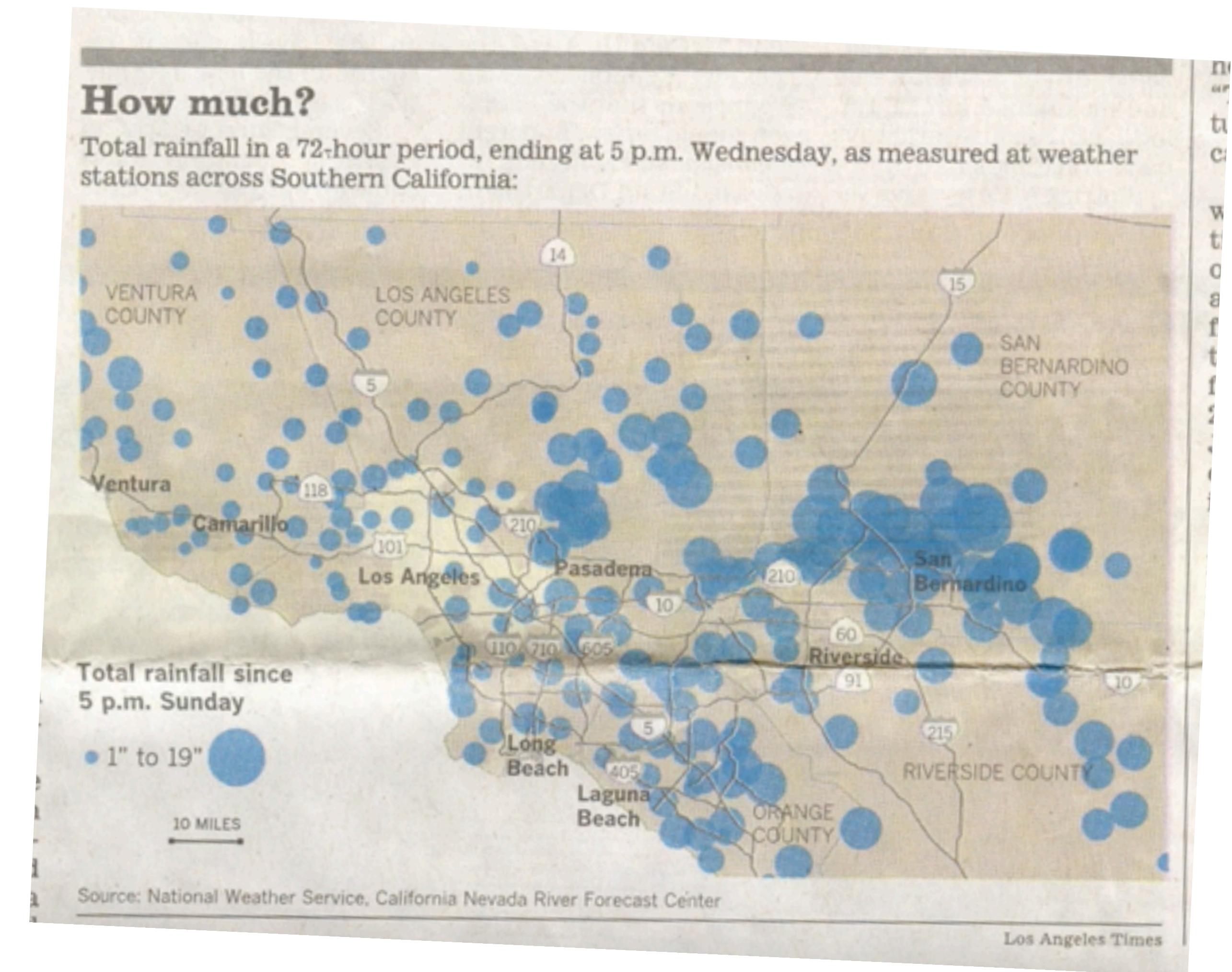


Fig. 9. Possible 2D translations of the 3D data models shown in figure 8.



# Isopleth / Heat Map

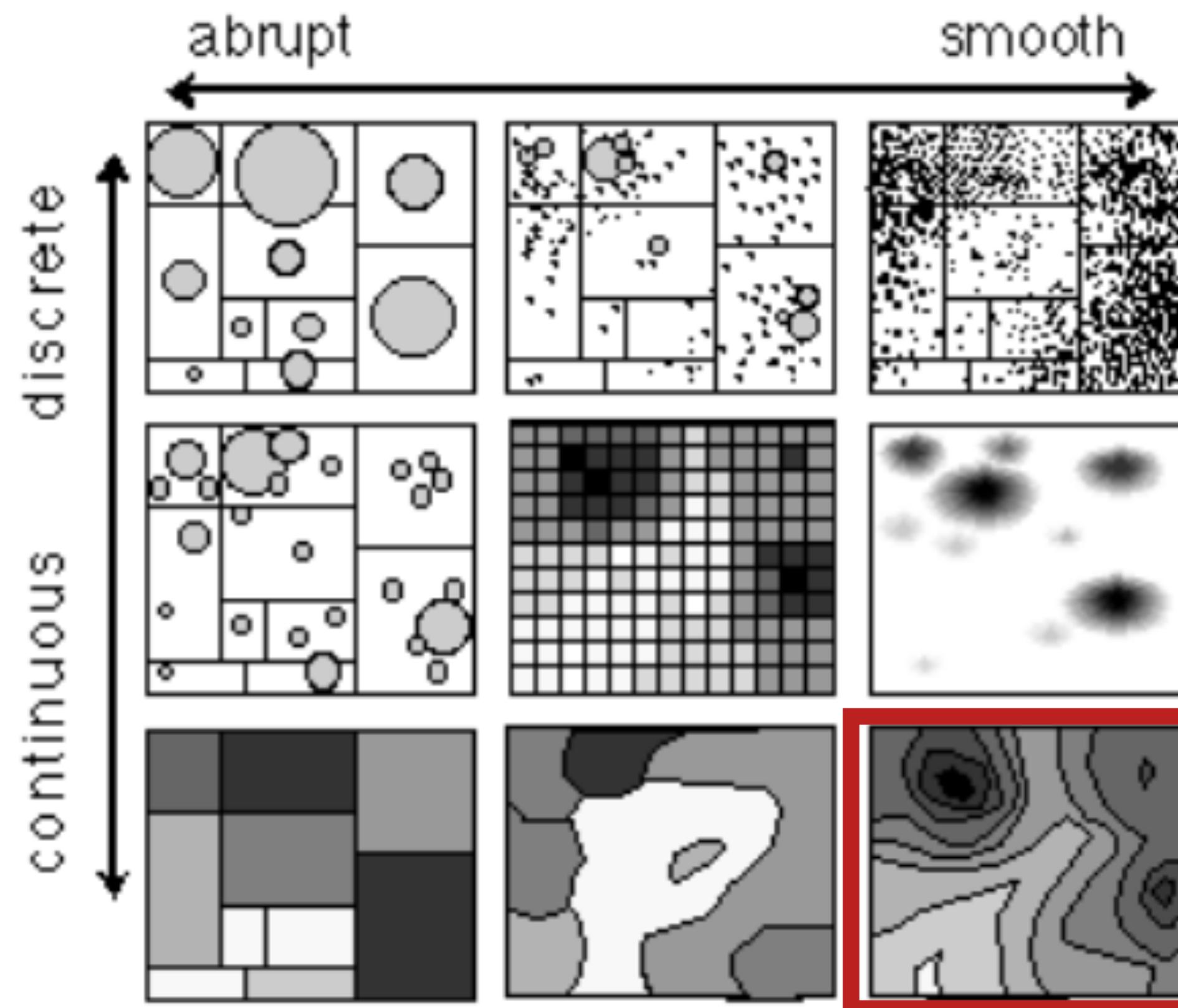
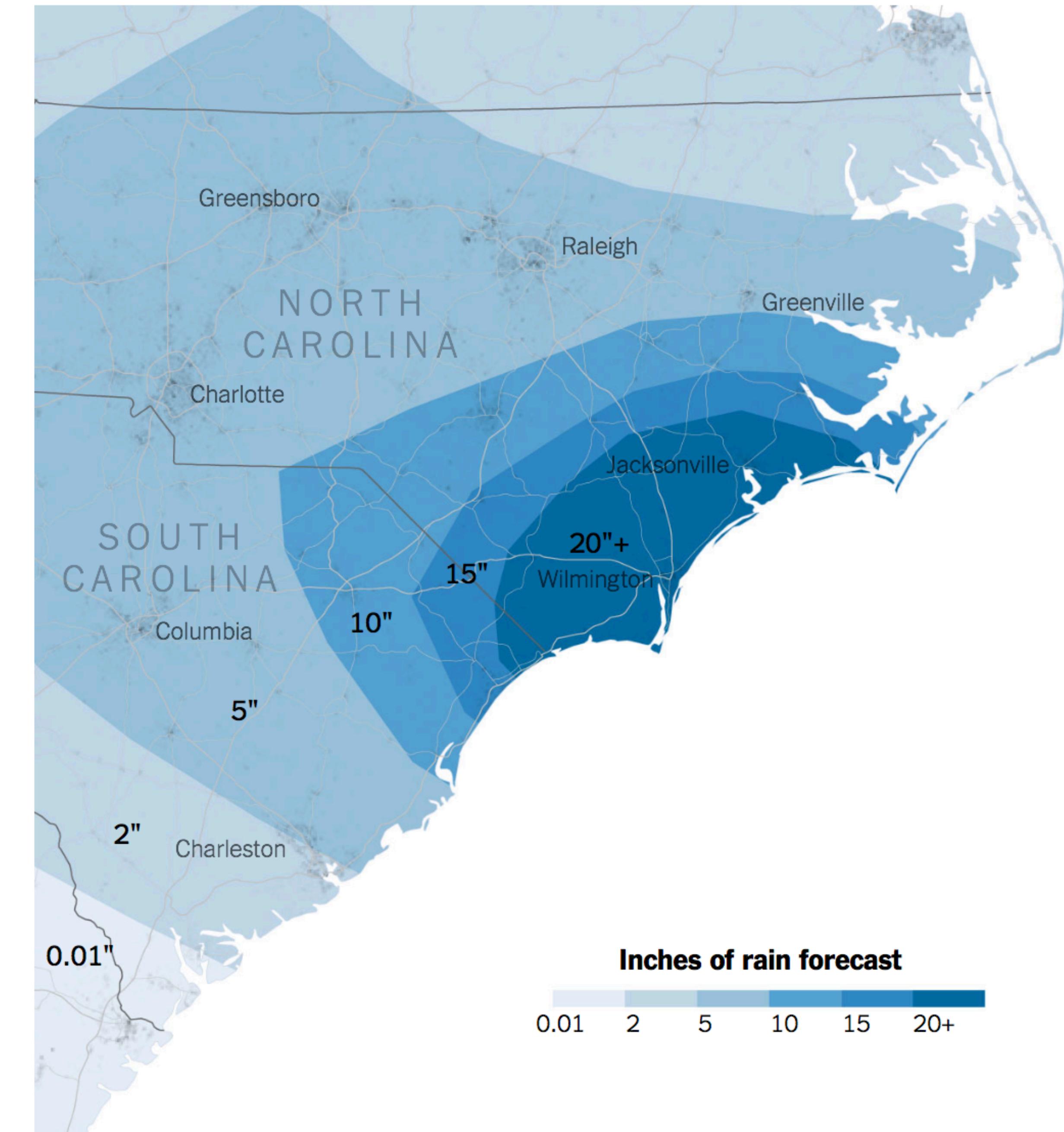


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Source: National Weather Service

# Choropleth

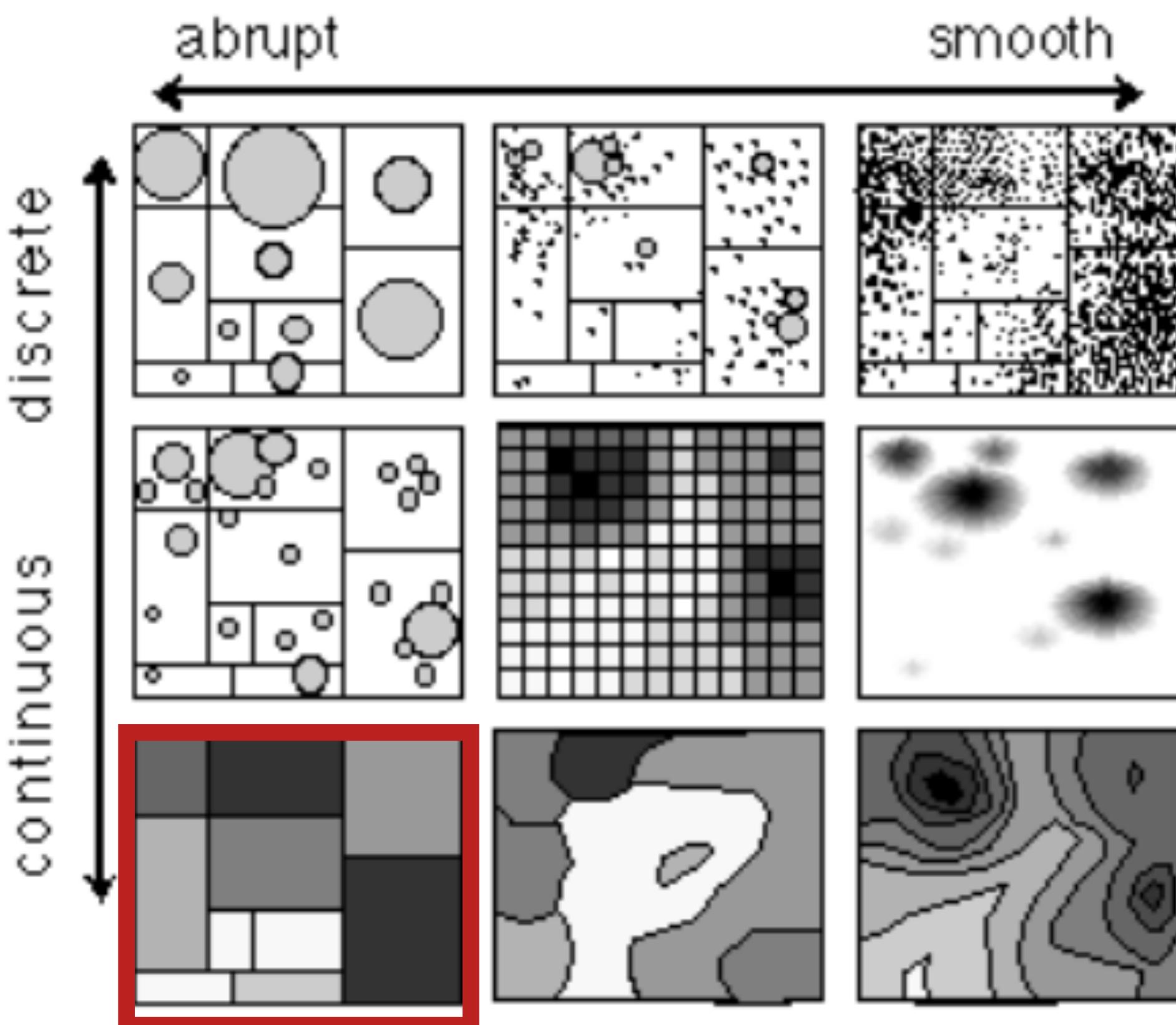
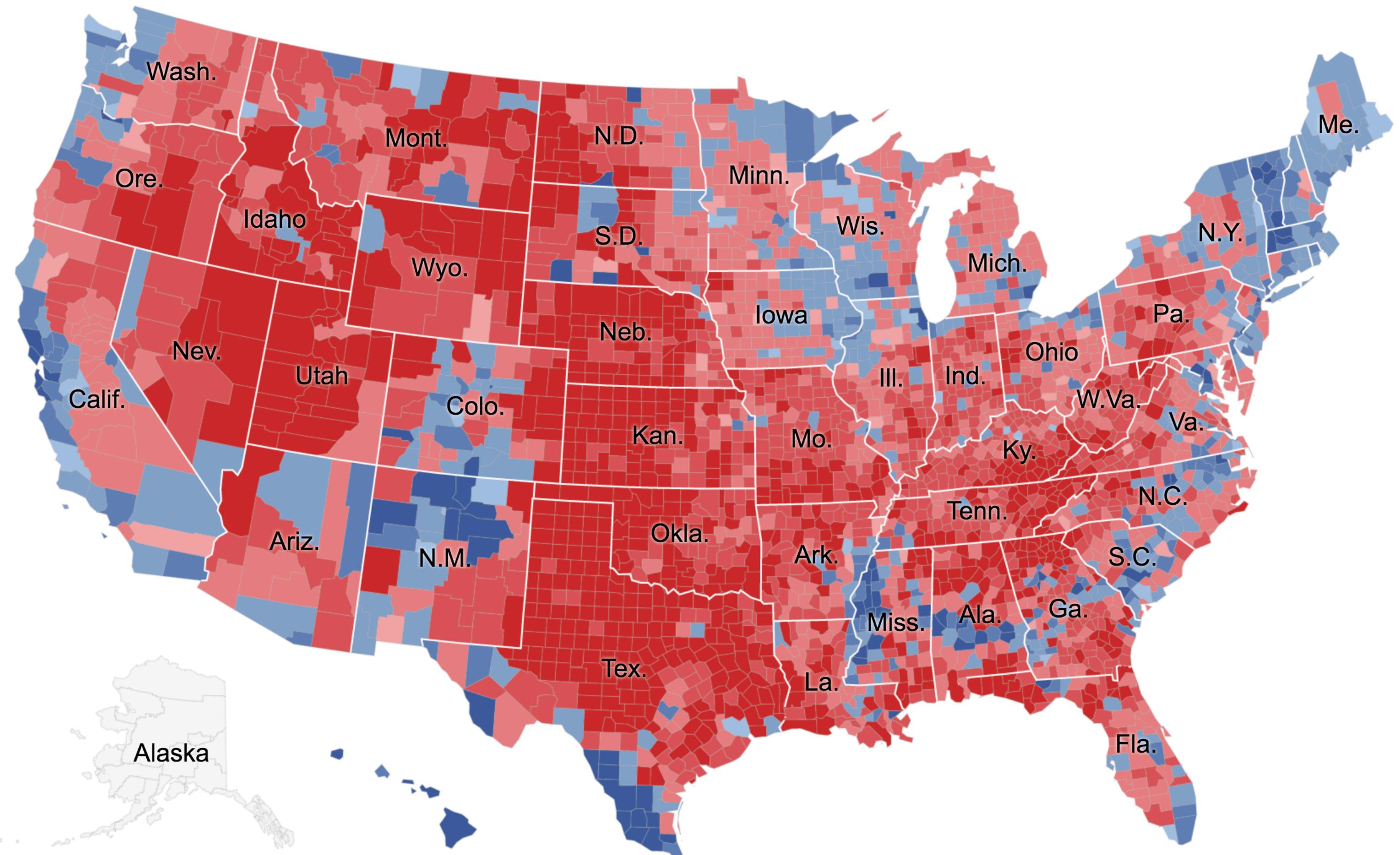


Fig. 9. Possible 2D translations of the 3D data models shown in figure 8.



<https://www.nytimes.com/interactive/2016/11/01/upshot/many-ways-to-map-election-results.html>

# Choropleth

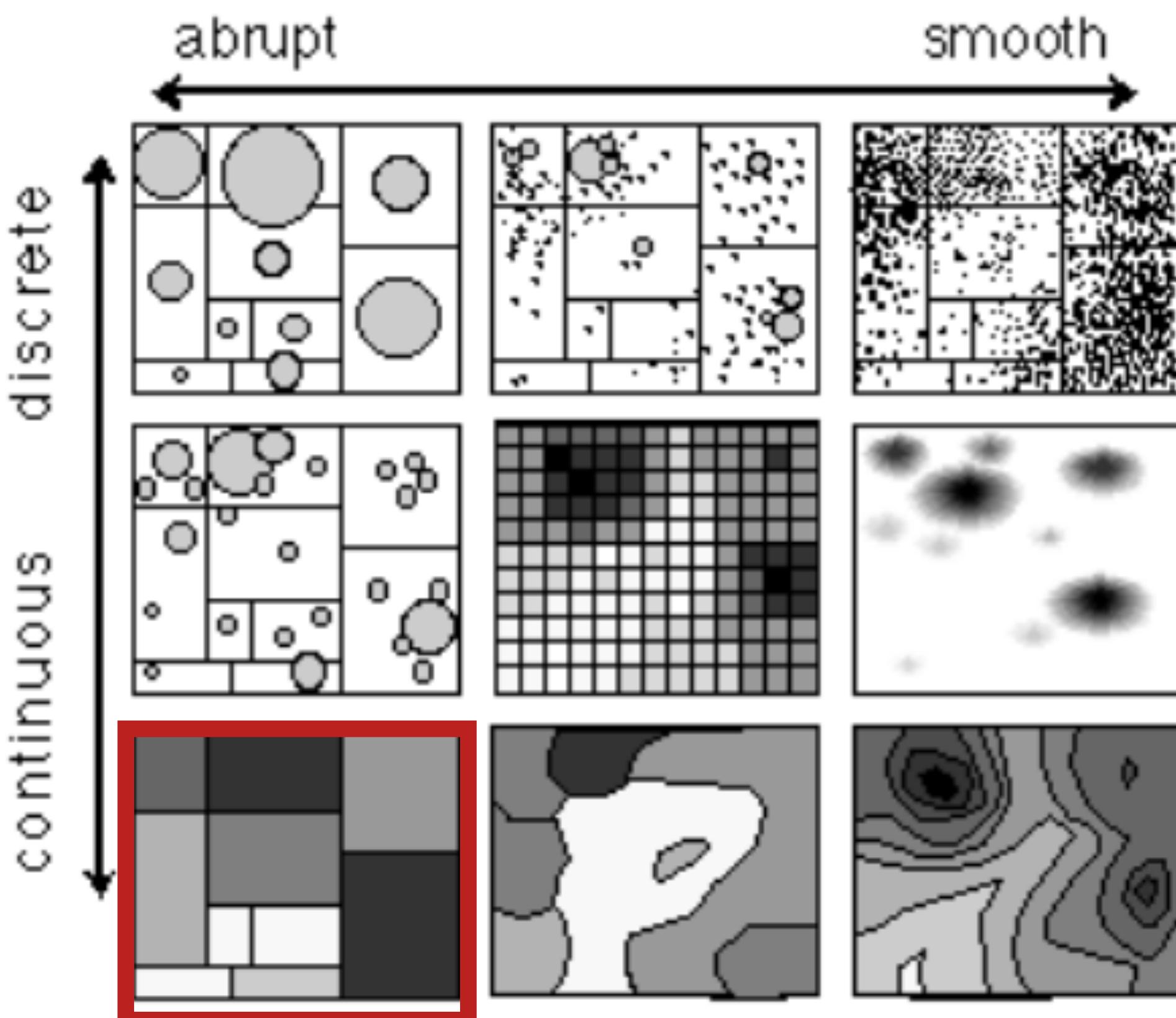
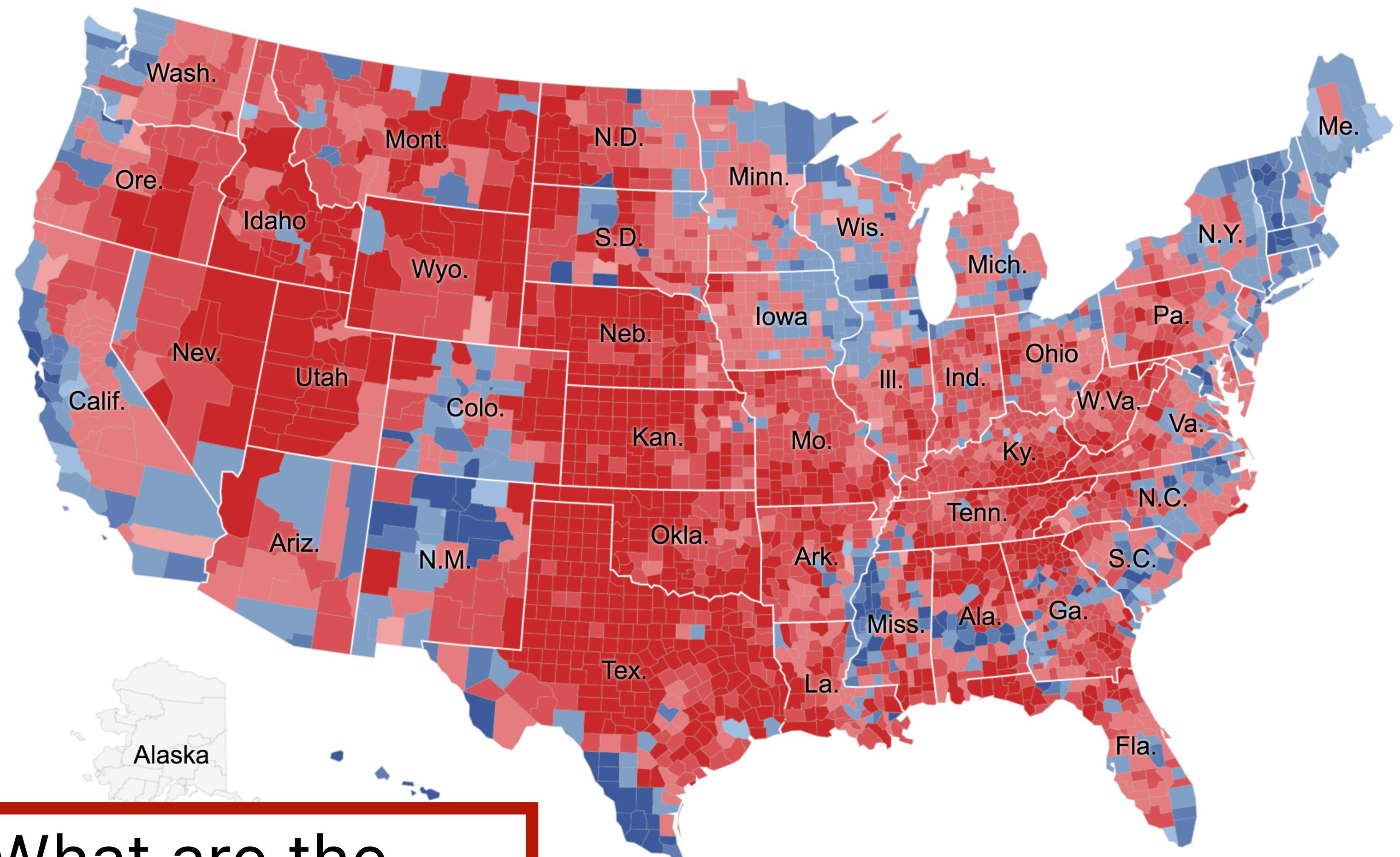


Fig. 9. Possible 2D translations of the 3D data models shown in figure 8.

What are the pros/cons of this display?

[tryclassbuzz.com](http://tryclassbuzz.com)  
Code: **choro**



ion-results.html

## GEOGRAPHIC MAP

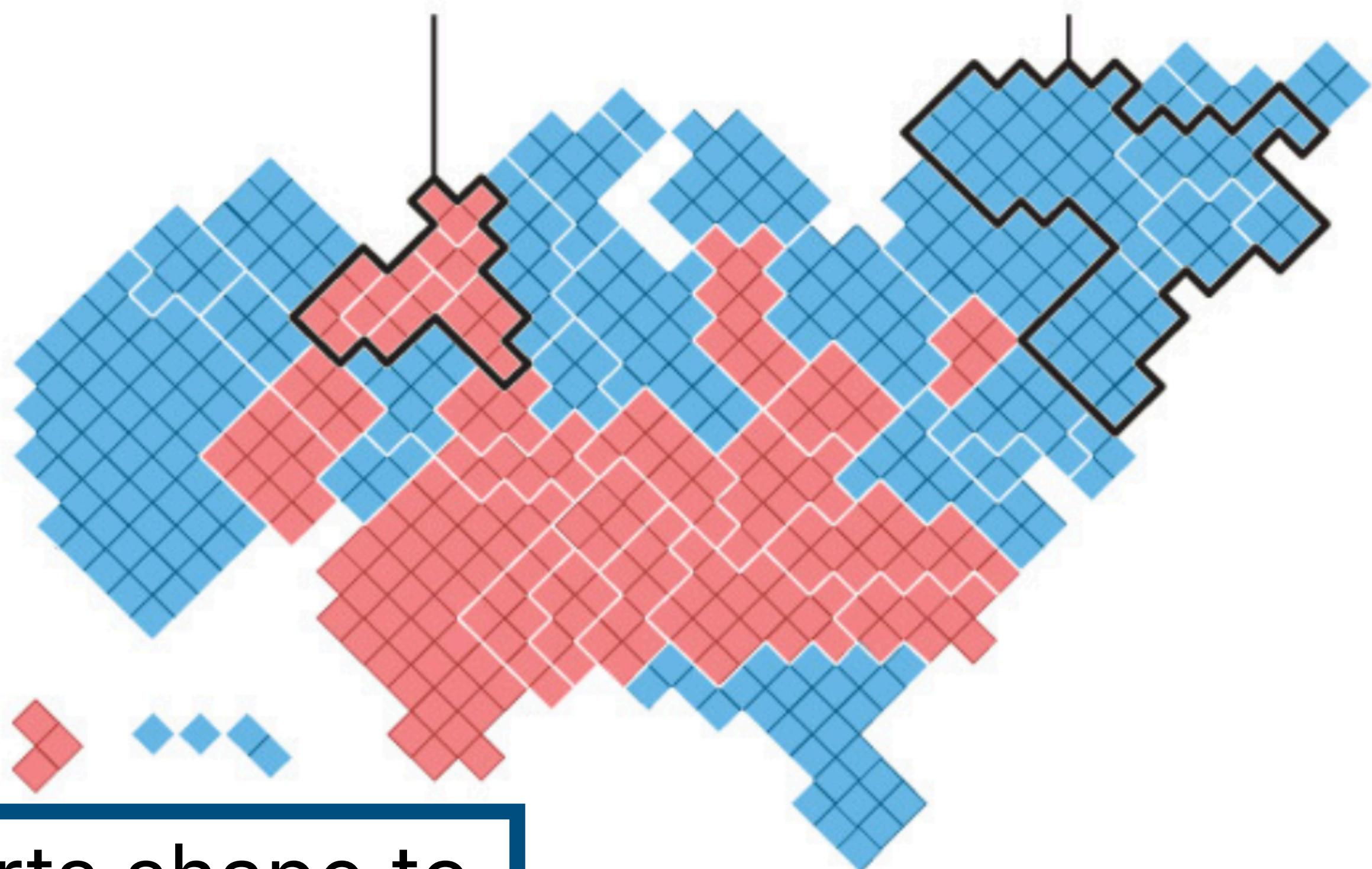
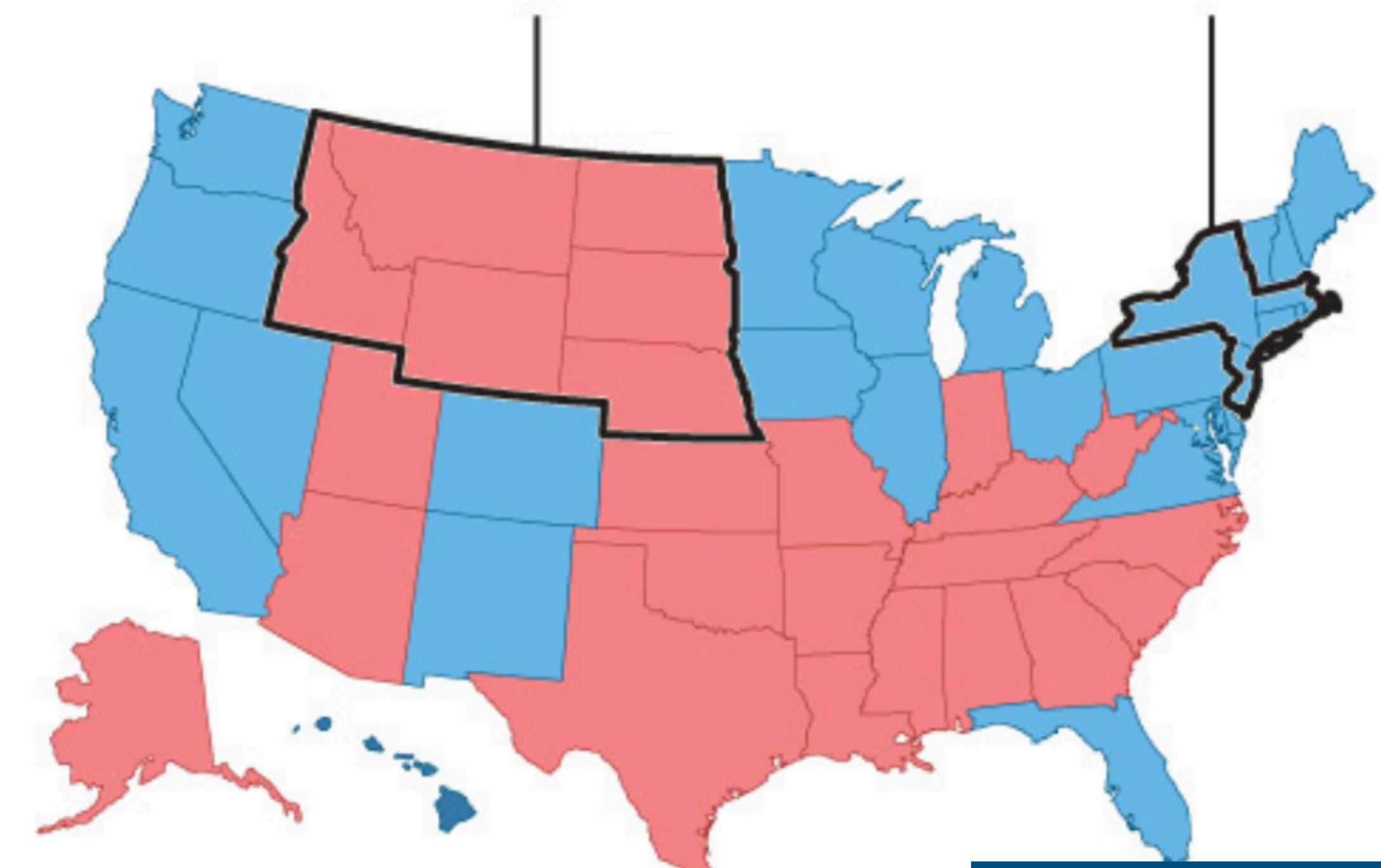
## CARTOGRAM OF ELECTORAL VOTES

Six Western states

Five Northeastern states

Six Western states

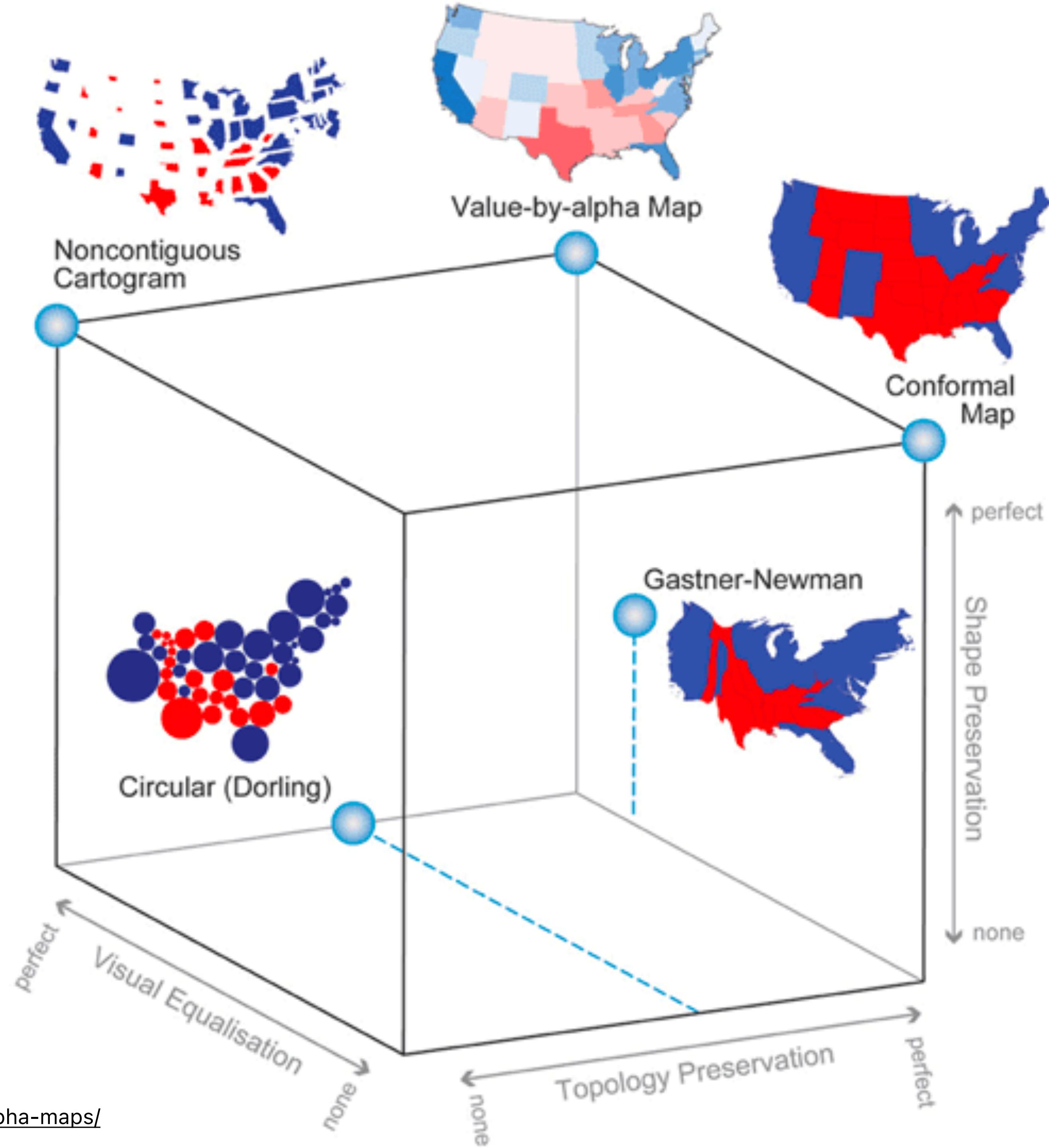
Five Northeastern states



Cartogram: Distorts shape to convey quantity

What are the pros/cons of this display?

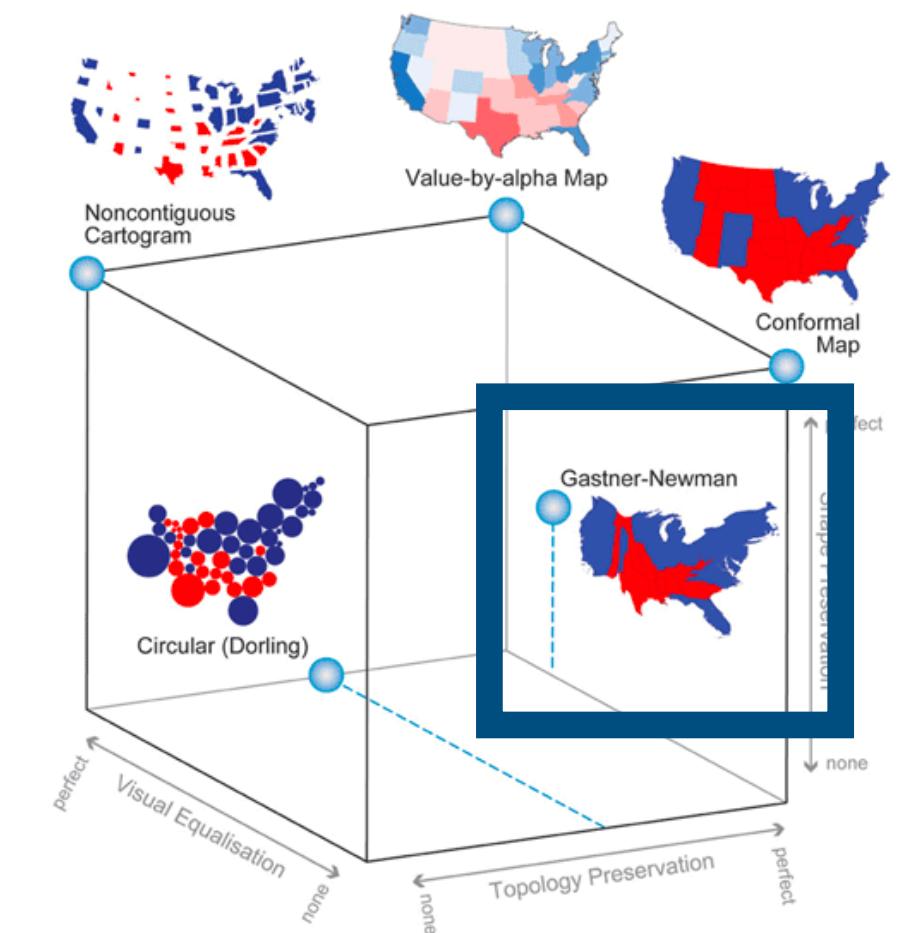
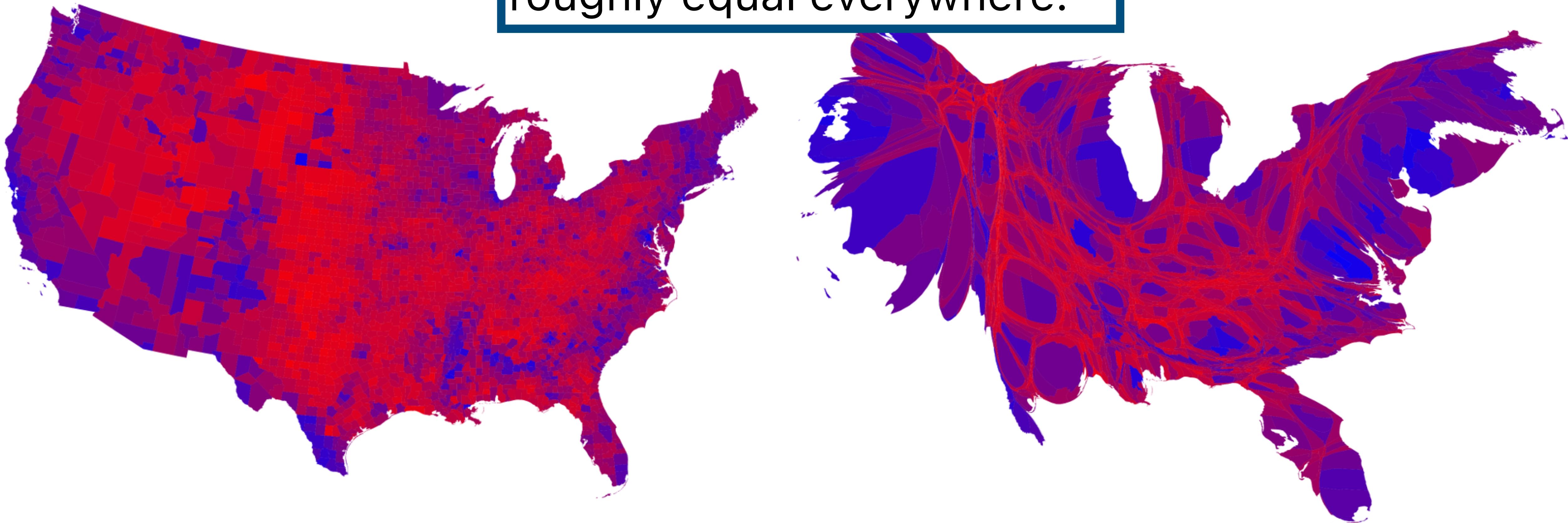
[tryclassbuzz.com](http://tryclassbuzz.com)  
Code: **carto**



# Gaster-Newman

## Physical diffusion model.

Population "flows" from high-density areas to low-density areas until density is roughly equal everywhere.



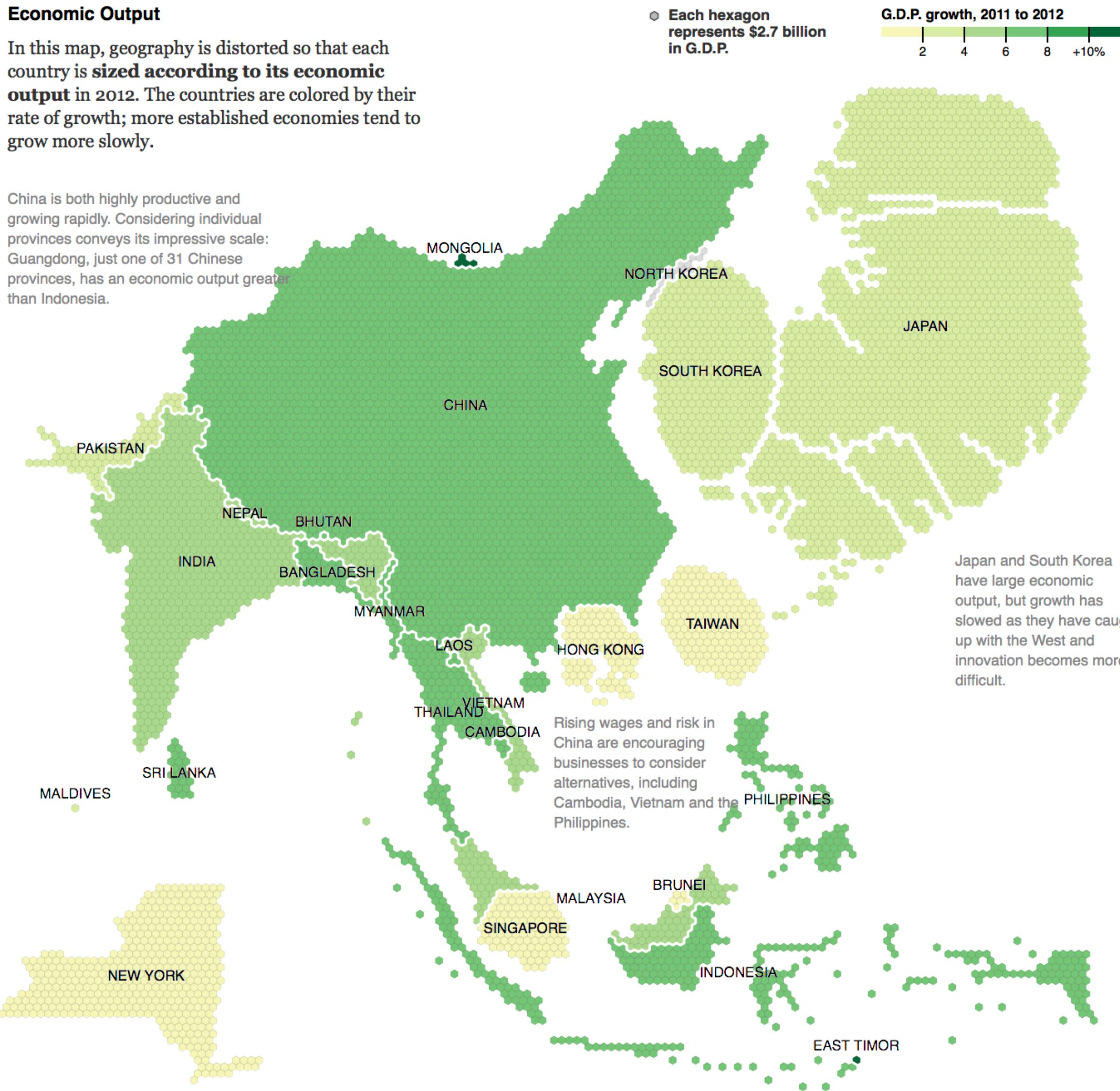
# China Still Dominates, but Some Manufacturers Look Elsewhere

While China maintains its overwhelming dominance in manufacturing, multinational companies are looking for ways to limit their reliance on factories there. [Related Article »](#)

## Economic Output

In this map, geography is distorted so that each country is **sized according to its economic output** in 2012. The countries are colored by their rate of growth; more established economies tend to grow more slowly.

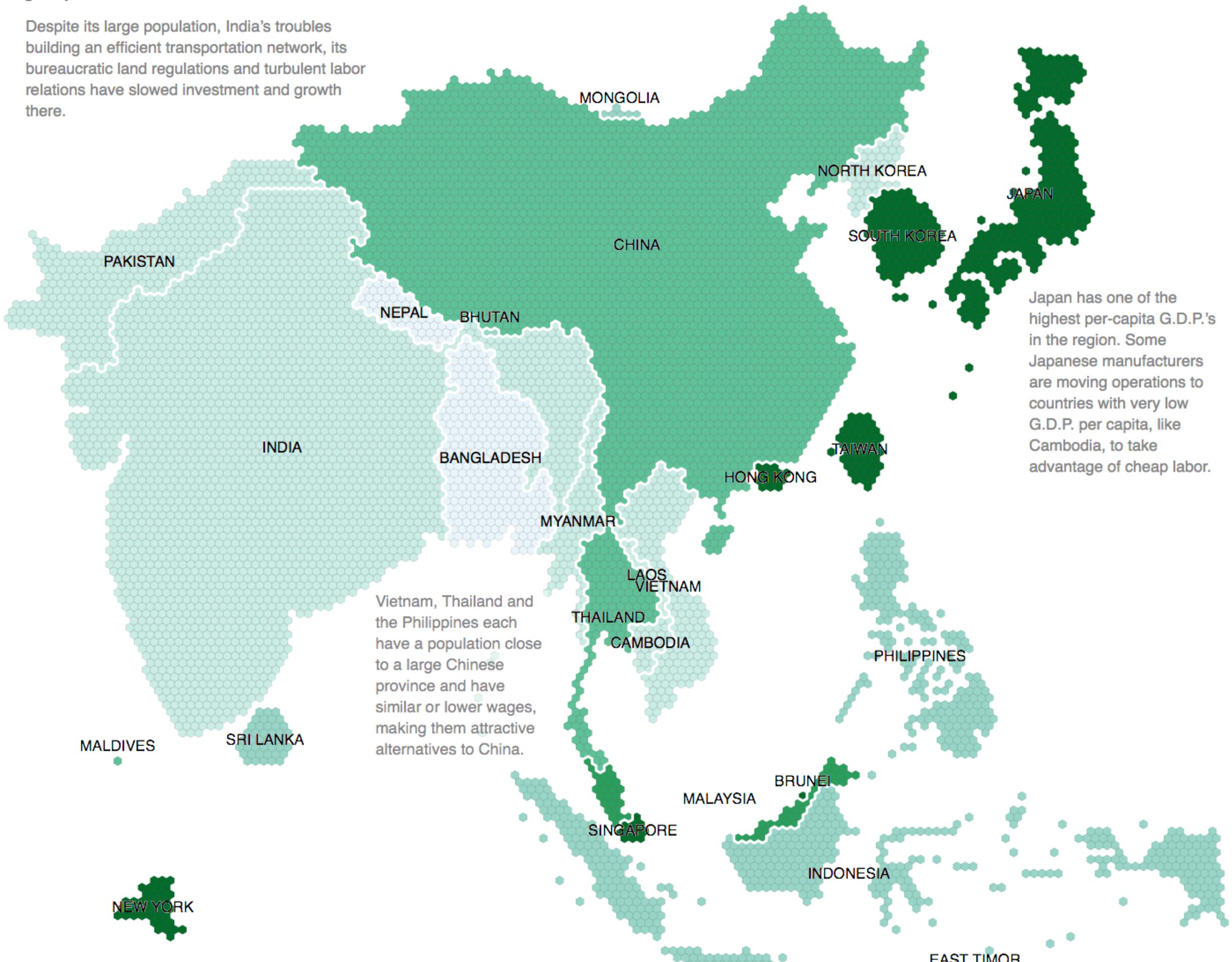
China is both highly productive and growing rapidly. Considering individual provinces conveys its impressive scale: Guangdong, just one of 31 Chinese provinces, has an economic output greater than Indonesia.



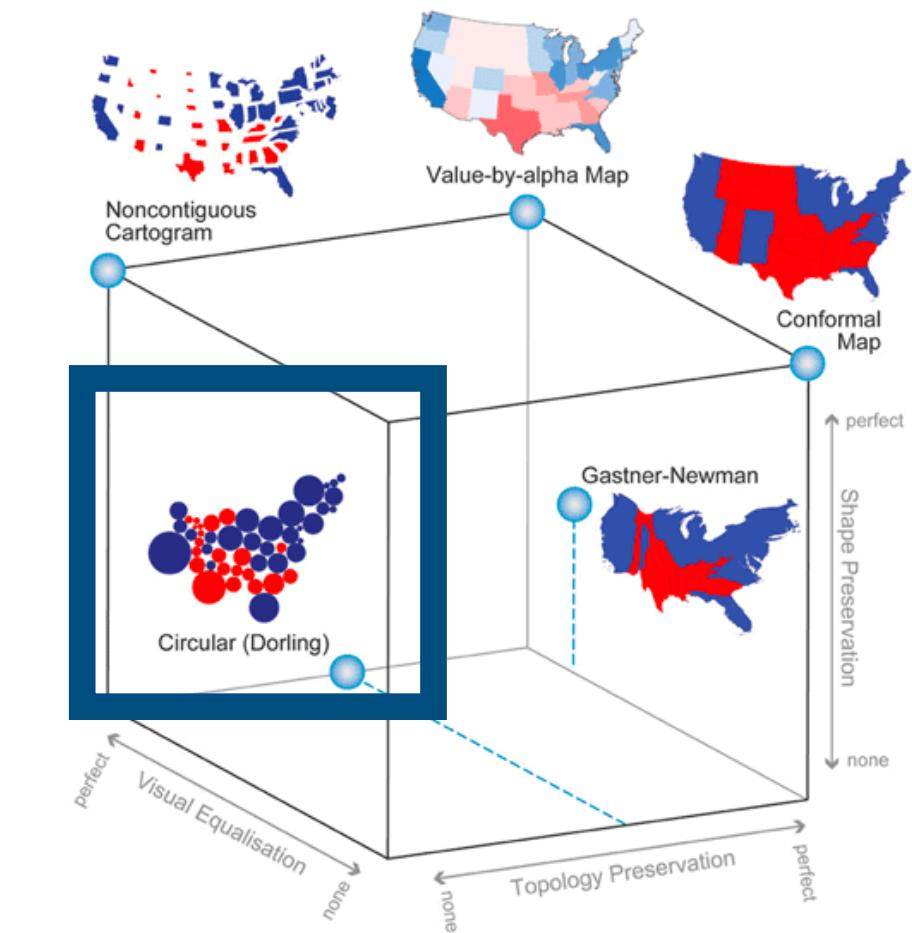
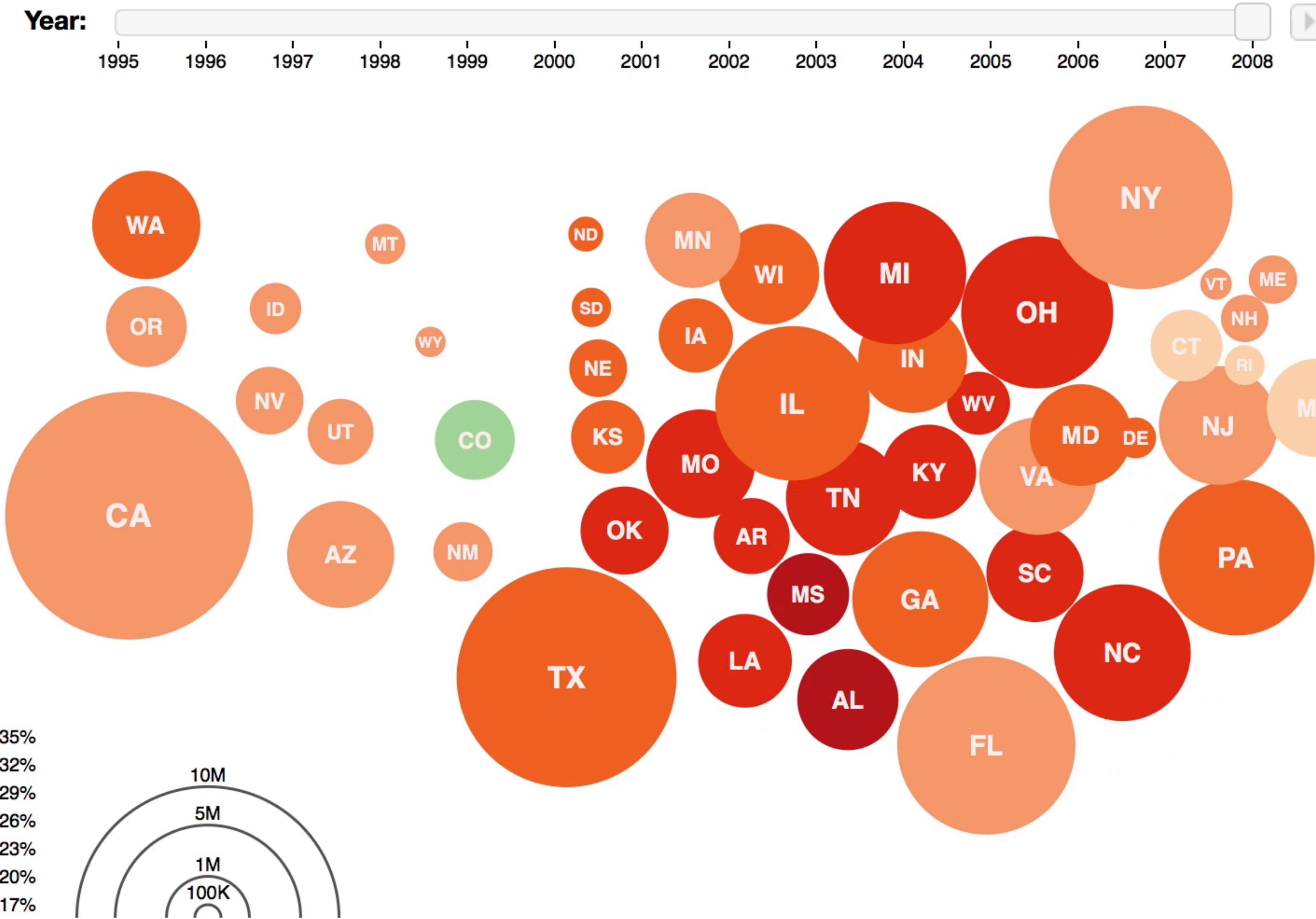
## Population

**Sizing by population** instead gives an estimate of a country's economic potential, at least for labor-based manufacturing. The color here shows the economic output per capita: a measure of how effectively that potential has been realized, and a proxy for labor cost.

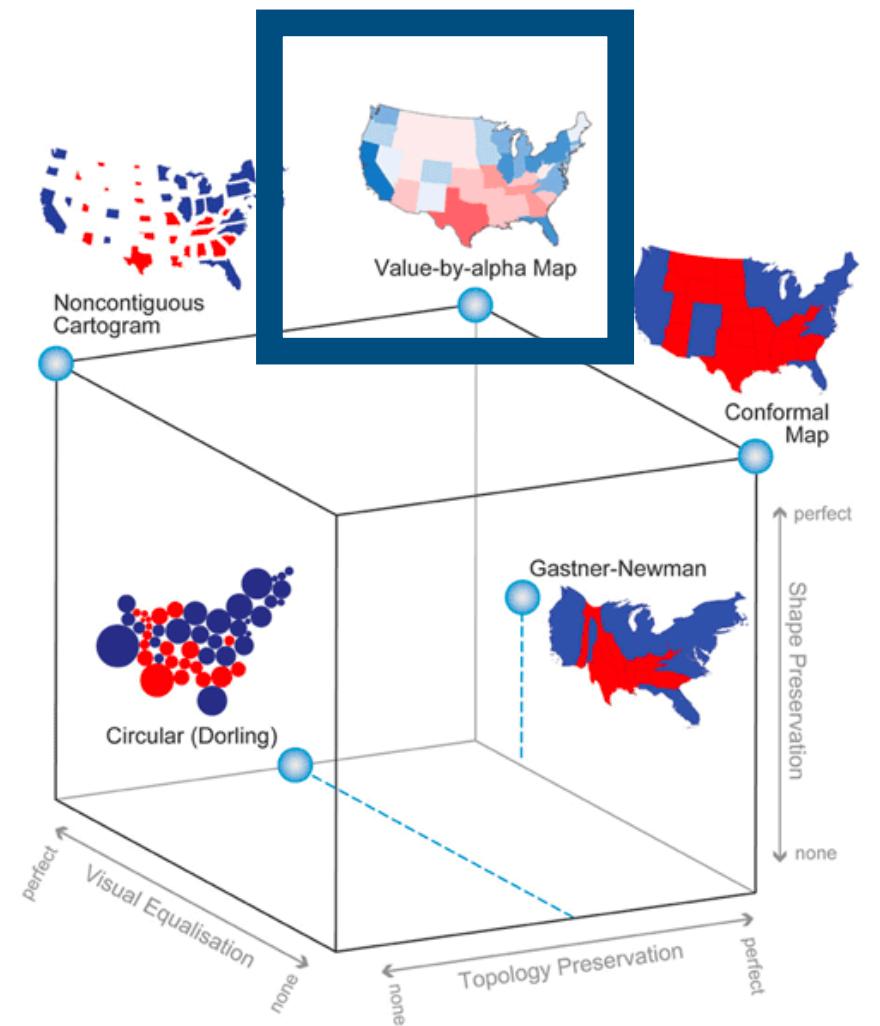
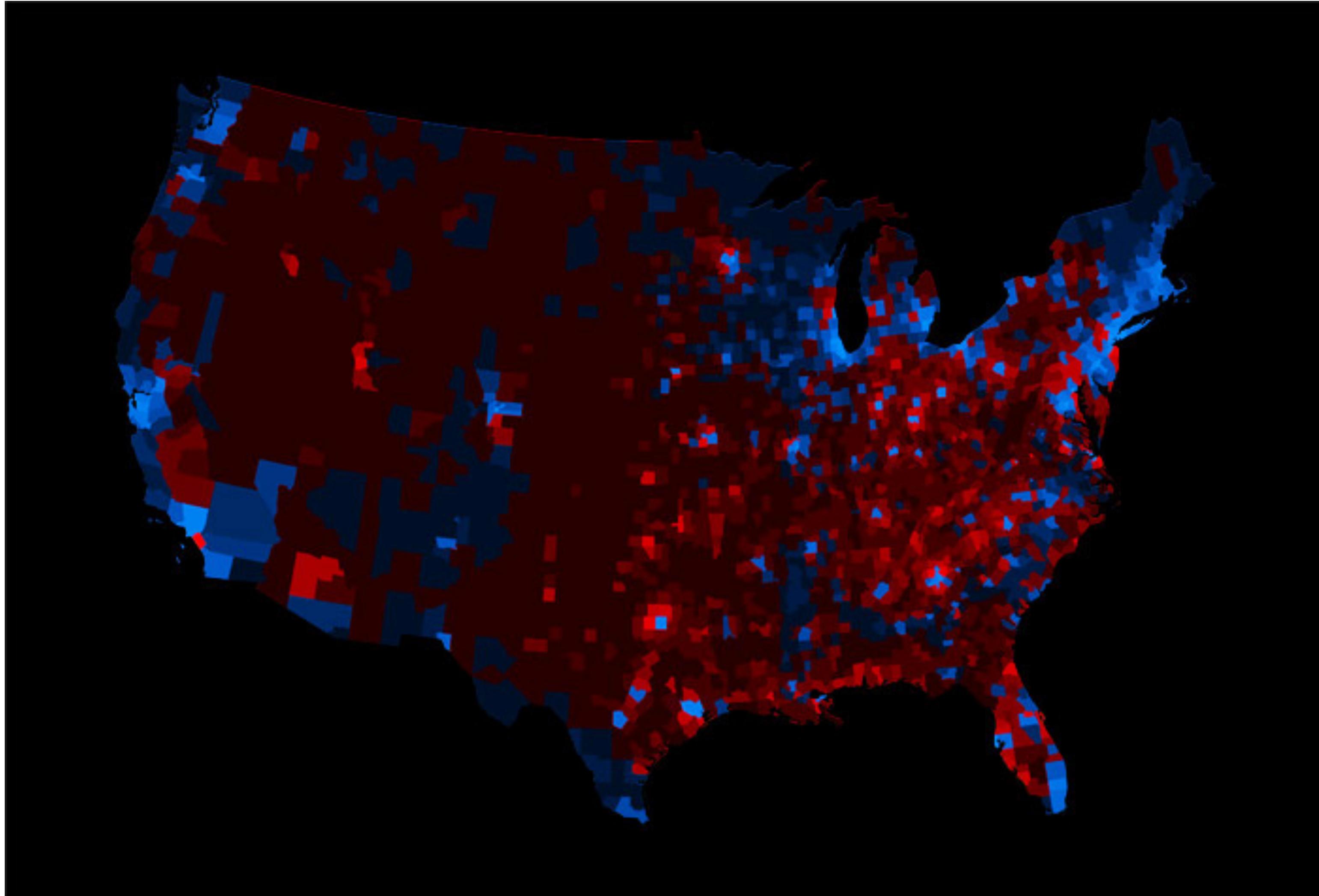
Despite its large population, India's troubles building an efficient transportation network, its bureaucratic land regulations and turbulent labor relations have slowed investment and growth there.



# Dorling Cartograms

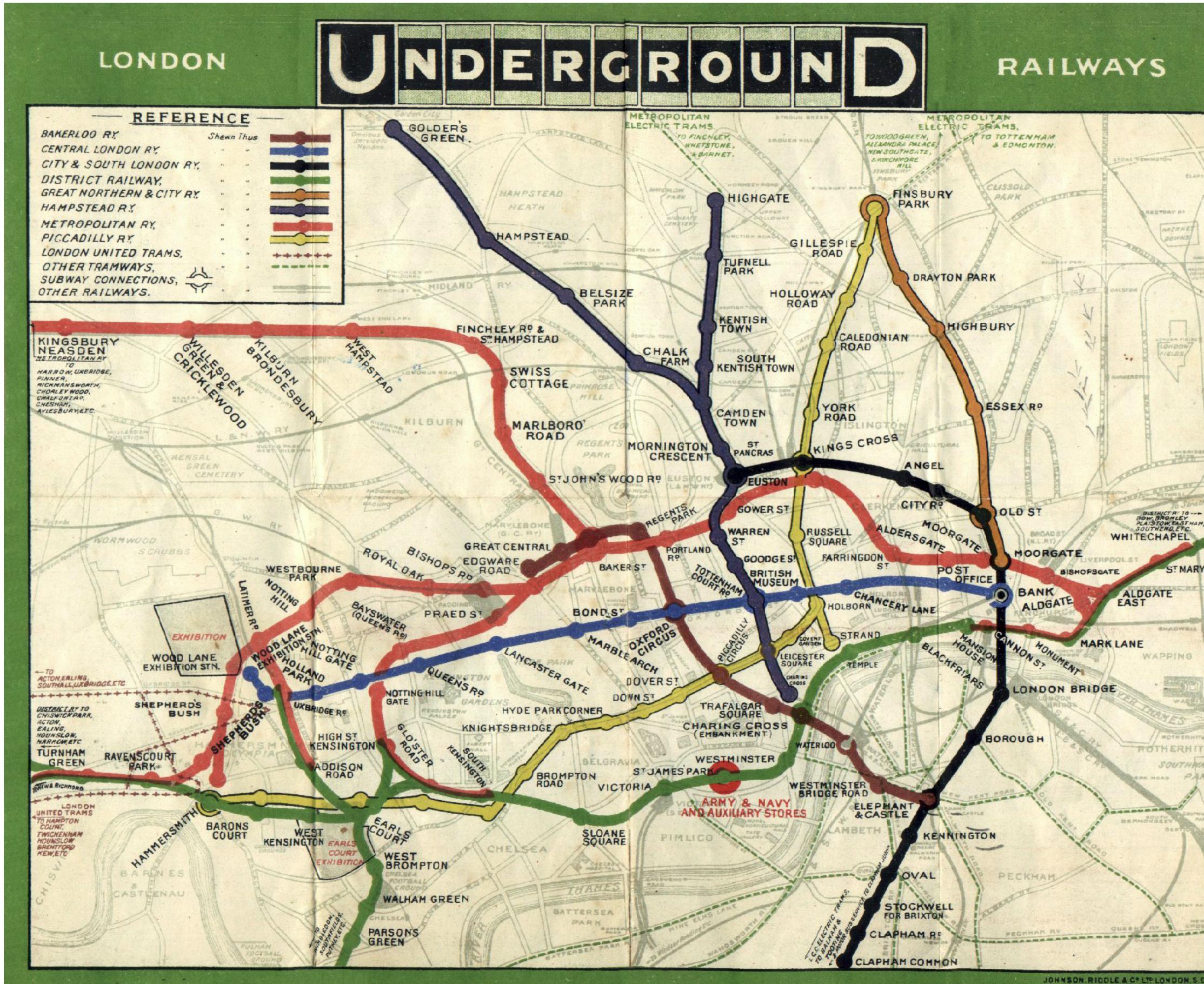


# Value-By-Alpha



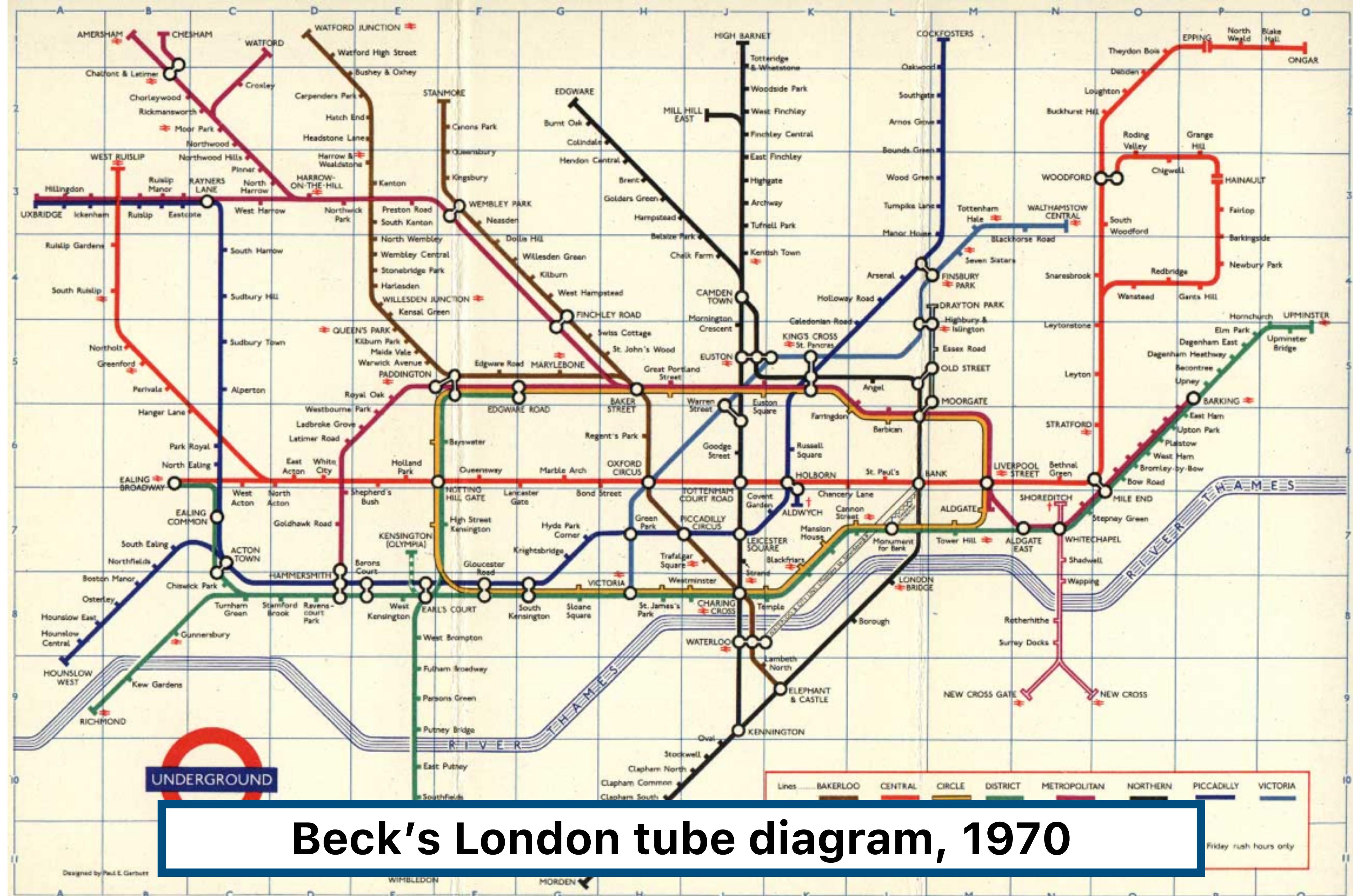
<https://andywoodruff.com/blog/value-by-alpha-maps/>

# Route Maps

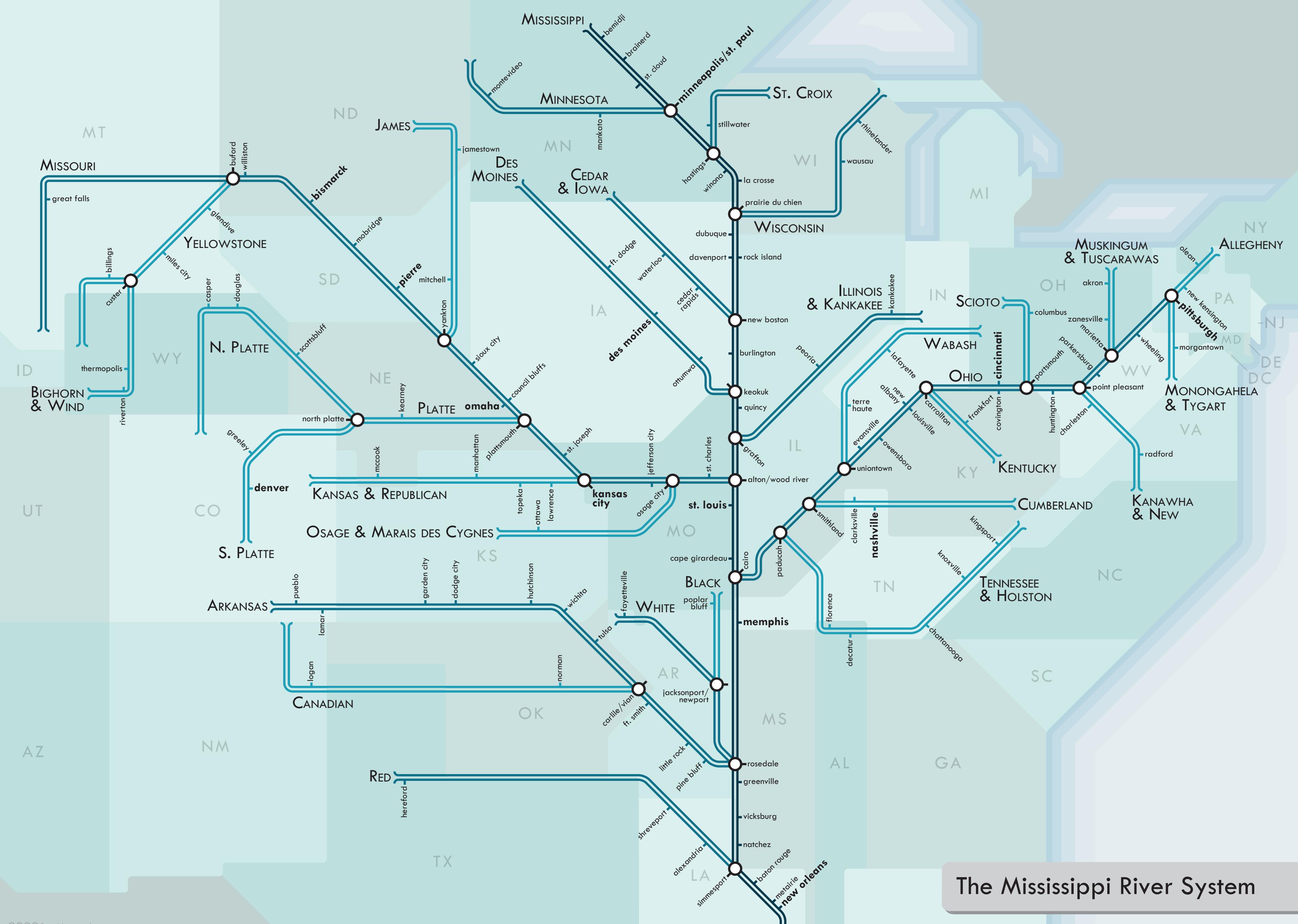


Geographic version of

London Underground



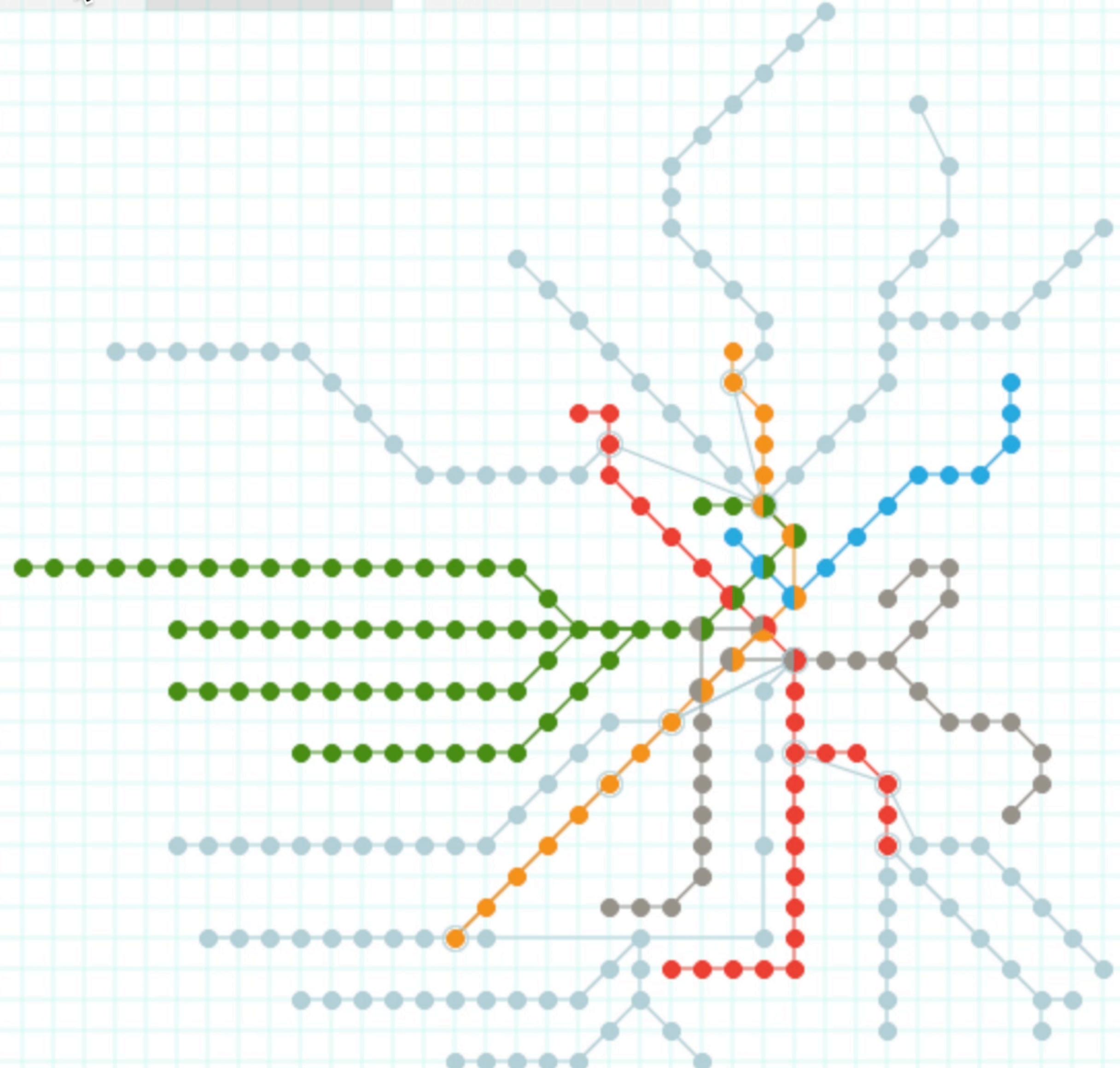
Beck's London tube diagram, 1970

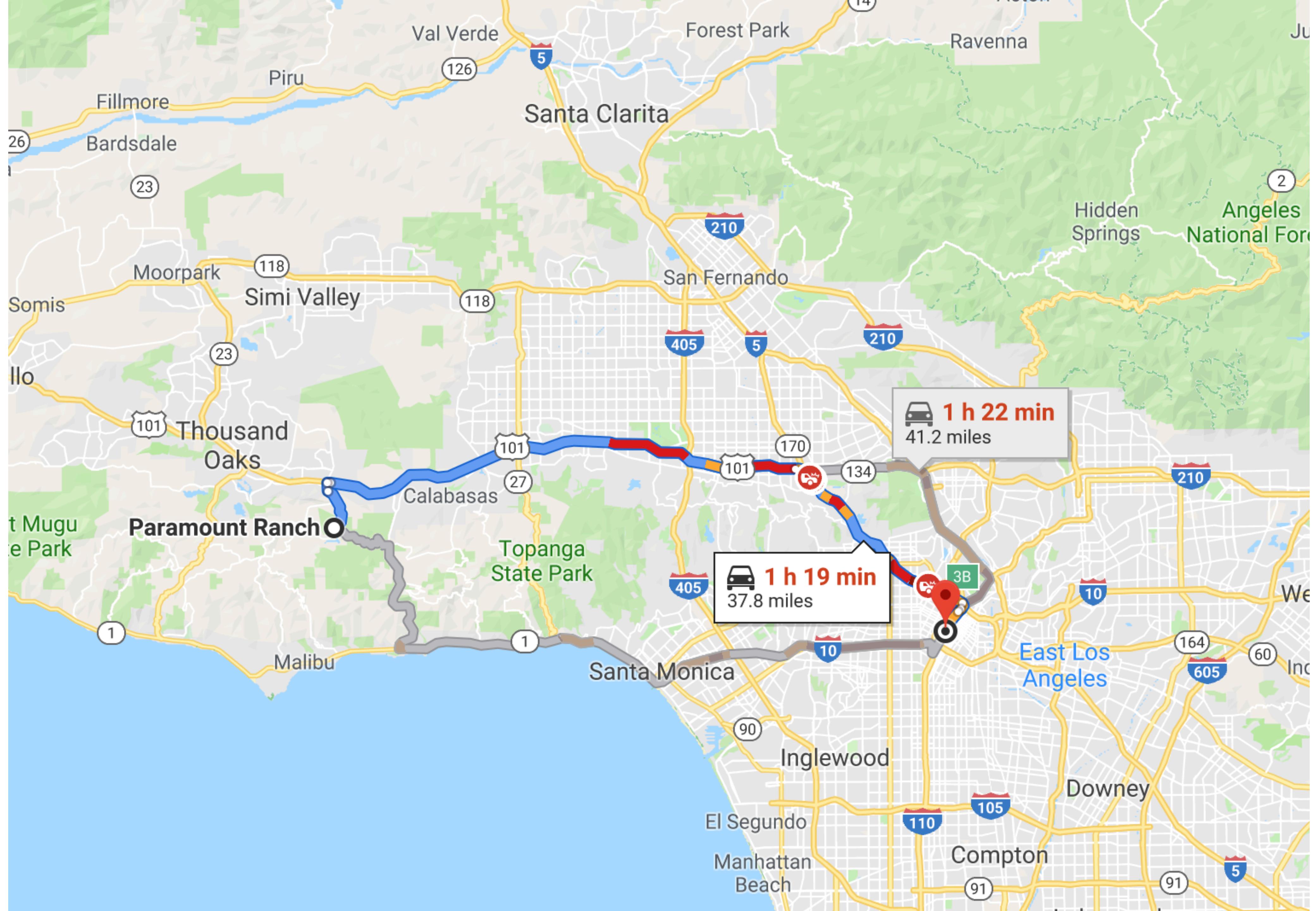


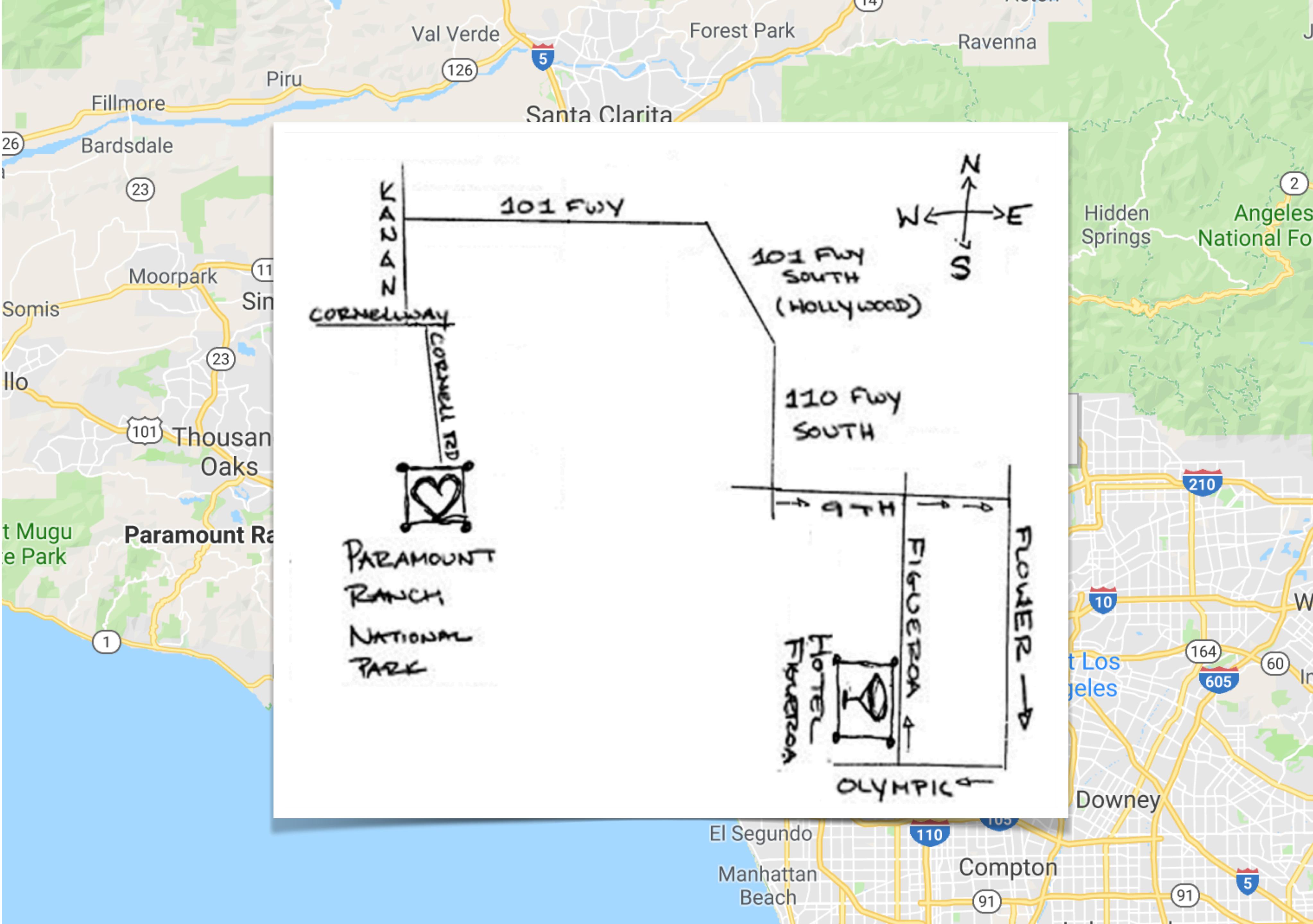
Geographic

Grid

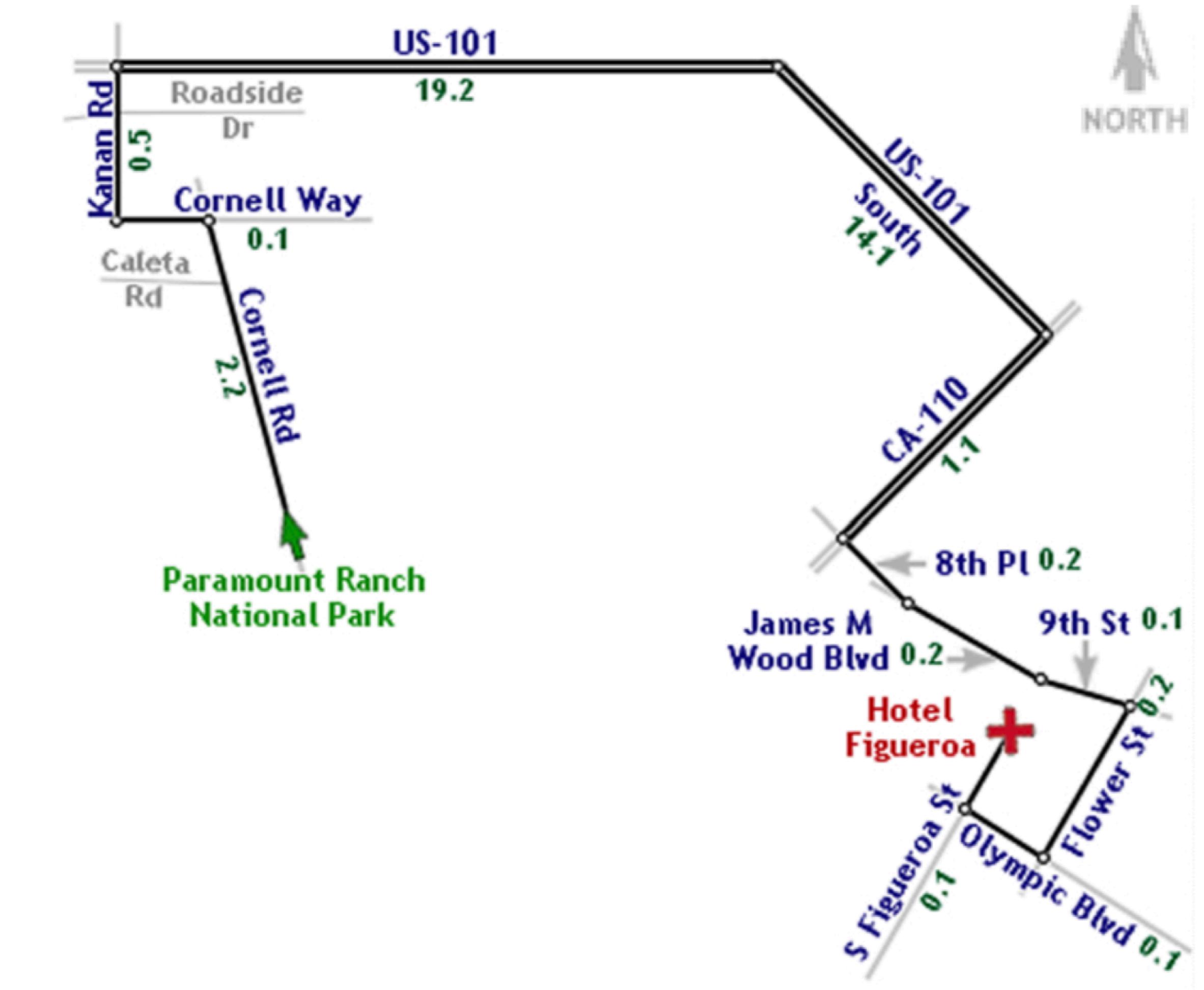
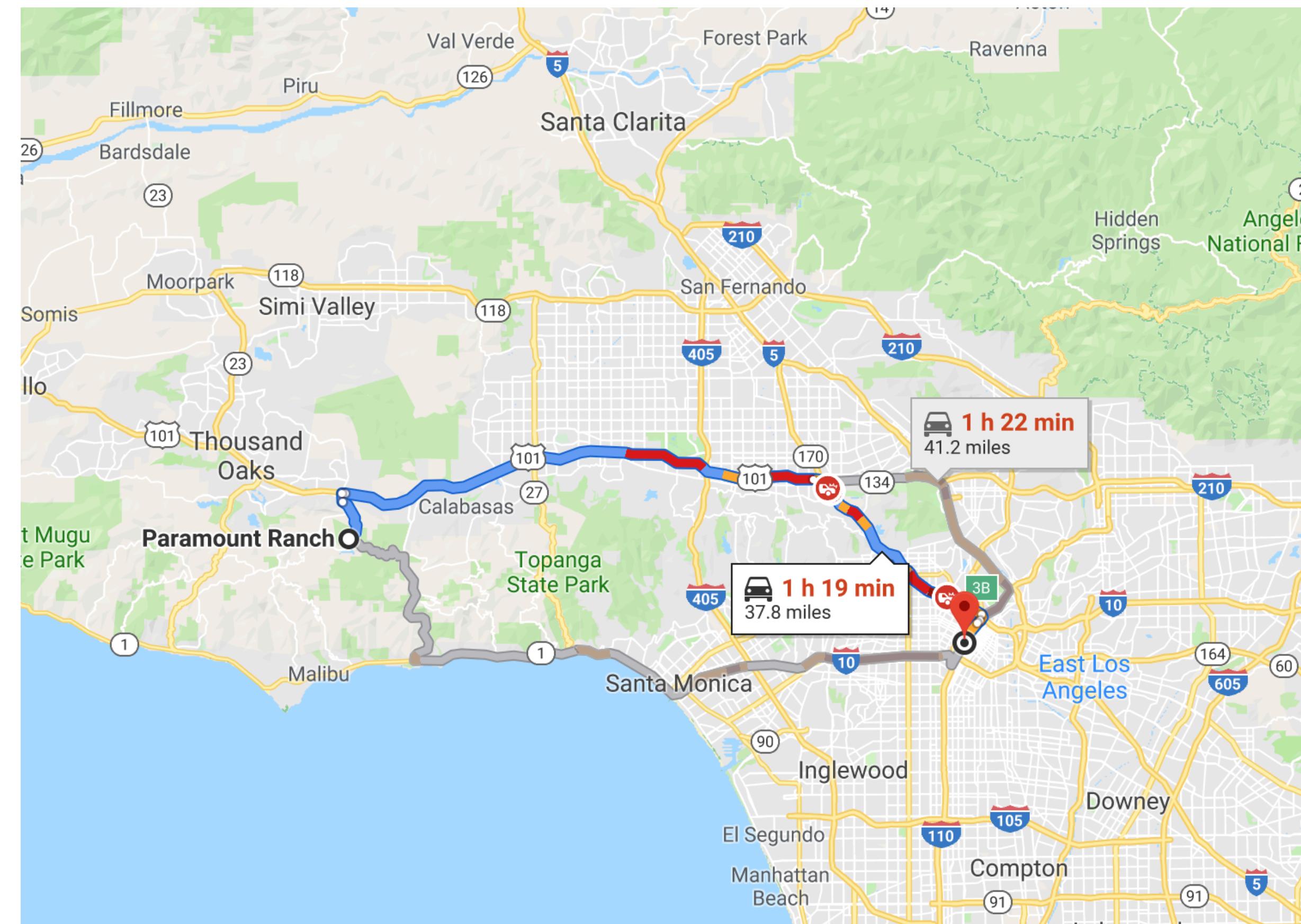
Commuter Rail On







# Line Drive



# Tooling for Maps

## Web Tools

D3: Projections, paths, graticules

GeoJSON: JSON format for geo data.

TopoJSON: Topology → compressed GeoJSON.

Leaflet: open-source, customizable map tile system.

Mapbox: commercial map tile system

Which you will use for Lab 7!

## Data Resources

Natural Earth Data: [naturalearthdata.com](http://naturalearthdata.com)

OpenStreetMap: [openstreetmap.org](http://openstreetmap.org)

U.S. Government: [nationalatlas.gov](http://nationalatlas.gov), [usgs.gov](http://usgs.gov)

## Tutorials

Command Line Cartography, by Mike Bostock

<https://medium.com/@mbostock/command-line-cartography-part-1-897aa8f8ca2c>



Mike Bostock  
Jan 23, 2017 · 5 min read

## Command-Line Cartography, Part 4

A tour of d3-geo's new command-line interface.

[This is Part 4 of a tutorial on making thematic maps from the command line using d3-geo, TopoJSON and ndjson-cli. Read Part 3 here.]

450

5 responses



Mike Bostock  
Dec 12, 2016 · 5 min read

## Command-Line Cartography, Part 3

A tour of d3-geo's new command-line interface.

[This is Part 3 of a tutorial on making thematic maps from the command line using d3-geo, TopoJSON and ndjson-cli. Read Part 2 and Part 4 here.]



Mike Bostock  
Dec 10, 2016 · 6 min read

## Command-Line Cartography, Part 2

A tour of d3-geo's new command-line interface.

[This is Part 2 of a tutorial on making thematic maps from the command line using d3-geo, TopoJSON and ndjson-cli. Read Part 1 or Part 3 here.]

365

15 responses



Mike Bostock  
Dec 9, 2016 · 5 min read

## Command-Line Cartography, Part 1

A tour of d3-geo's new command-line interface.

[This is Part 1 of a tutorial on making thematic maps. Read Part 2 here.]

1.5K

30 responses