

Maps

DSC 106: Data Visualization

Jared Wilber

UC San Diego

Announcements

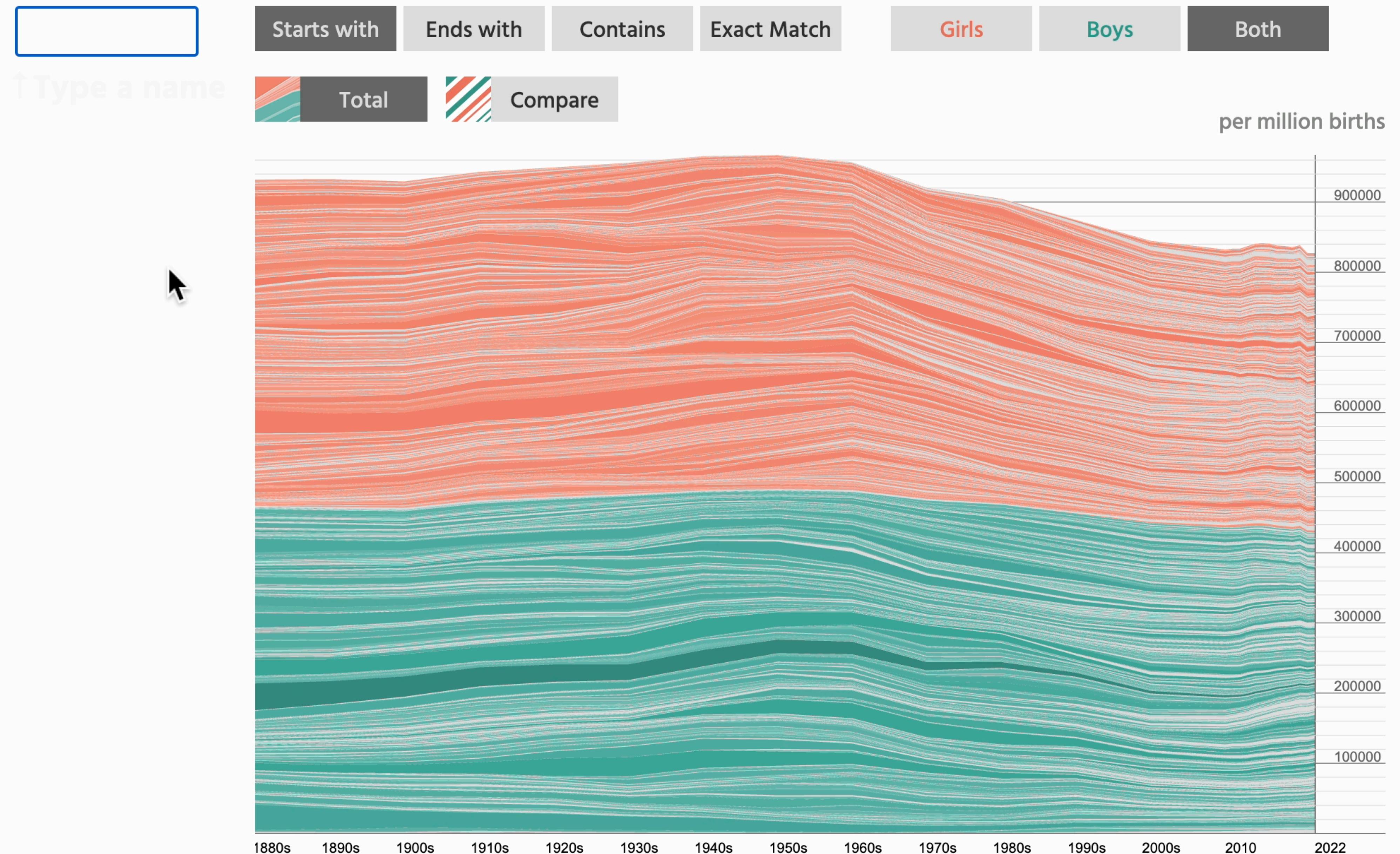
Lab 5 out, due Friday.

Project 2 peer feedback due Friday.

Project 3 out, due on 2/16.

FAQs:

1. Help, I don't understand D3?? Start by understanding basic examples: scatter plot, line plot, bar plot.
2. How complicated does my Project 3 need to be? Interaction can be basic. More importantly: how does your interaction help user explore interesting pieces of data?



<https://namerology.com/baby-name-grapher/>

sam

Sam M

Sam F

Samuel M

Samantha F

Samara F

Sammy M

Samson M

Samir M

Samira F

Sammie M

Samiyah F

Samiya F

Sami M

Sammie F

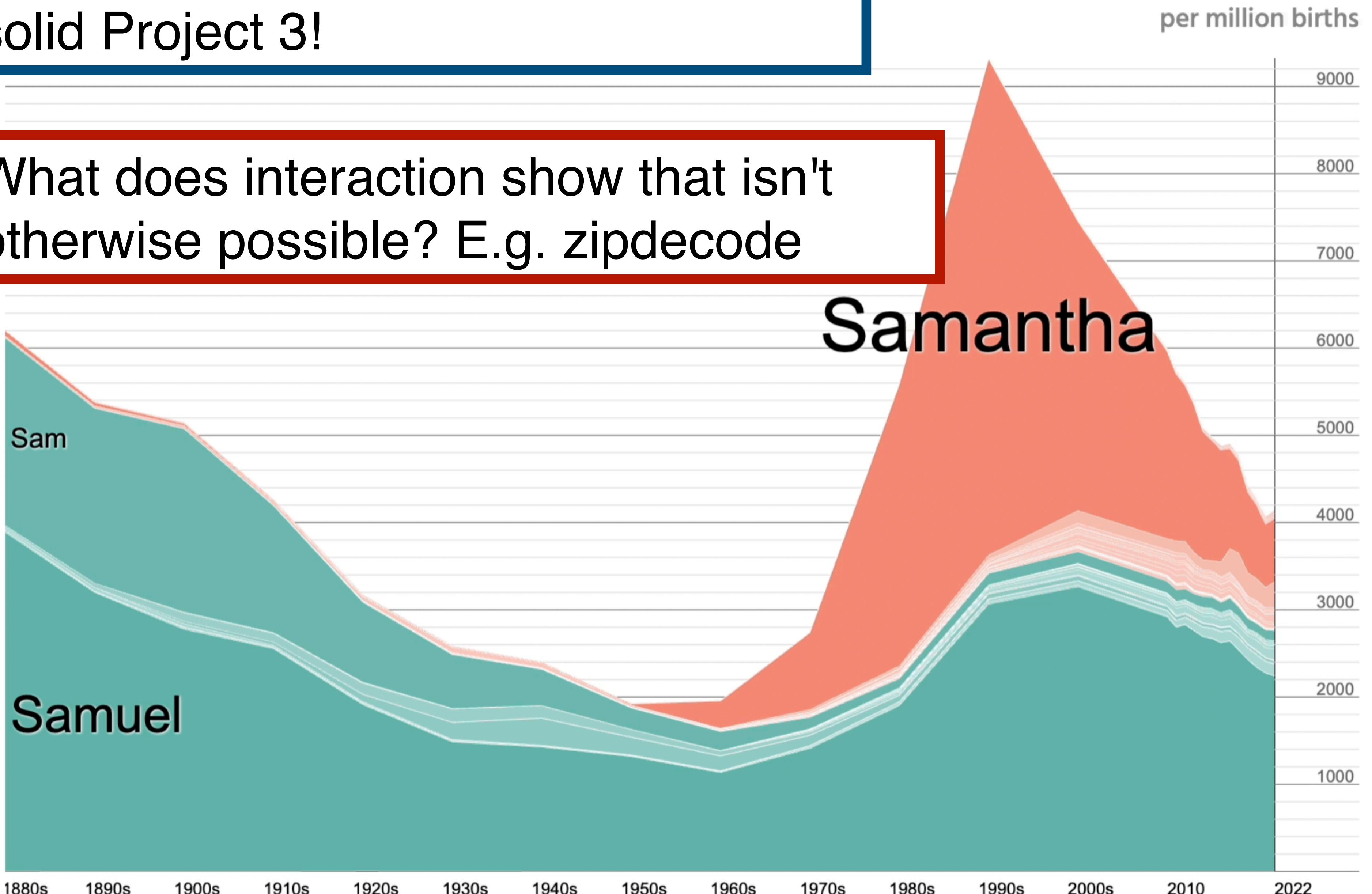
Samaya F

And 24 more...

If you just implemented the upper left textbox interaction, that would be a solid Project 3!

Boys

Both



Example: Horizontal Bar Chart

<https://observablehq.com/@d3/vertical-bar-chart/2>

Observable gotchas

Creates all elements in d3

```
// Append a rect for each letter.  
svg.append("g")  
  .attr("fill", "steelblue")  
  .selectAll()  
  .data(alphabet)  
  .join("rect")  
    .attr("x", x(0))  
    .attr("y", (d) => y(d.letter))  
    .attr("width", (d) => x(d.frequency) - x(0))  
    .attr("height", y.bandwidth());
```

Equivalent code in svelte

```
<g fill="steelblue">  
  {#each data as d, i}  
    <rect  
      key={i}  
      x={x(0)}  
      y={y(d.letter)}  
      width={x(d.frequency) - x(0)}  
      height={y.bandwidth()}  
    />  
  {/each}  
</g>
```

Observable gotchas

Input elements use Observable-specific code

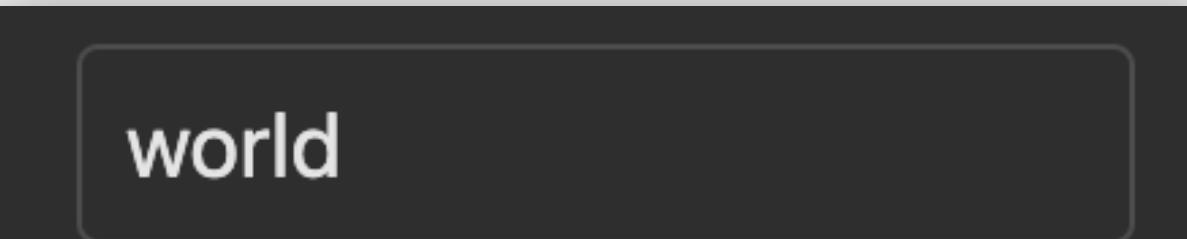
Basis

64.96



```
viewof basis = Inputs.range(d3.extent(aapl, d => d.Close), {label: "Basis",  
value: aapl[0].Close, step: 0.01, format: x => x.toFixed(2)})
```

Svelte: Use standard HTML
form inputs with svelte
bindings

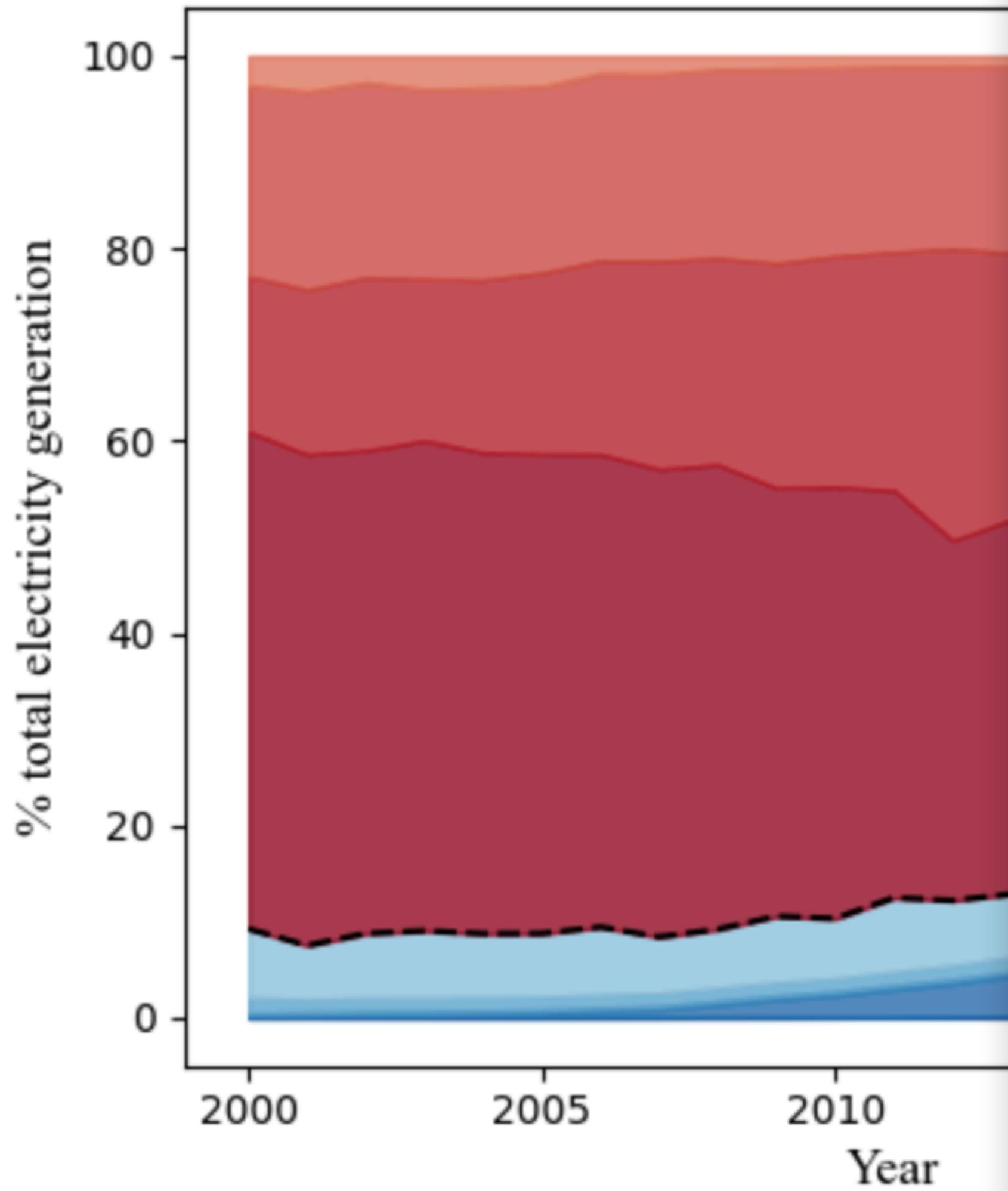


Hello world!

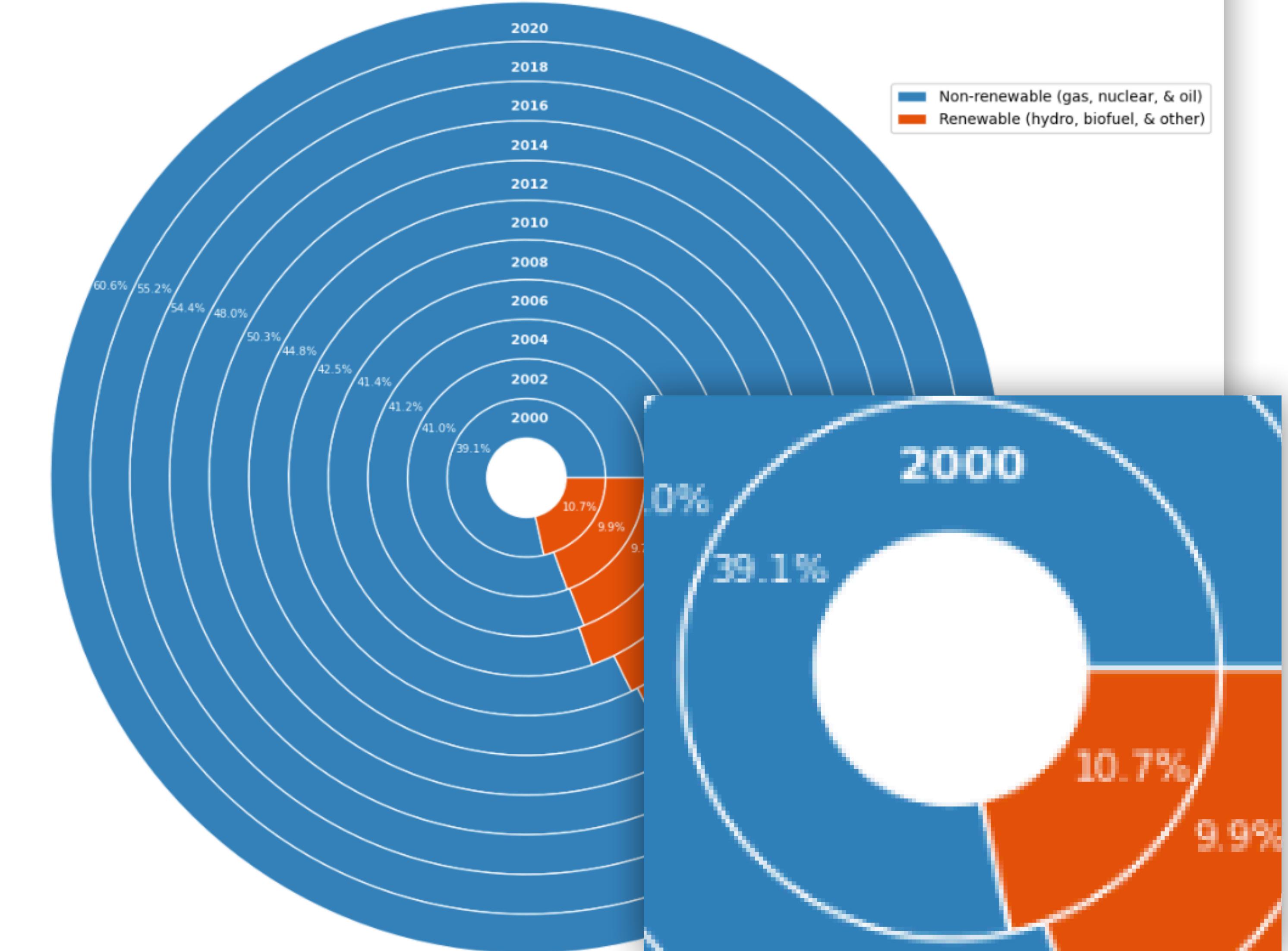
```
<script>  
  let name = 'world';  
</script>  
  
<input bind:value={name} />  
  
<h1>Hello {name}!</h1>
```

Neat Project 2 Submissions!

Has the proportion of total electricity in the US generated by renewable sources increased during the 21st century?



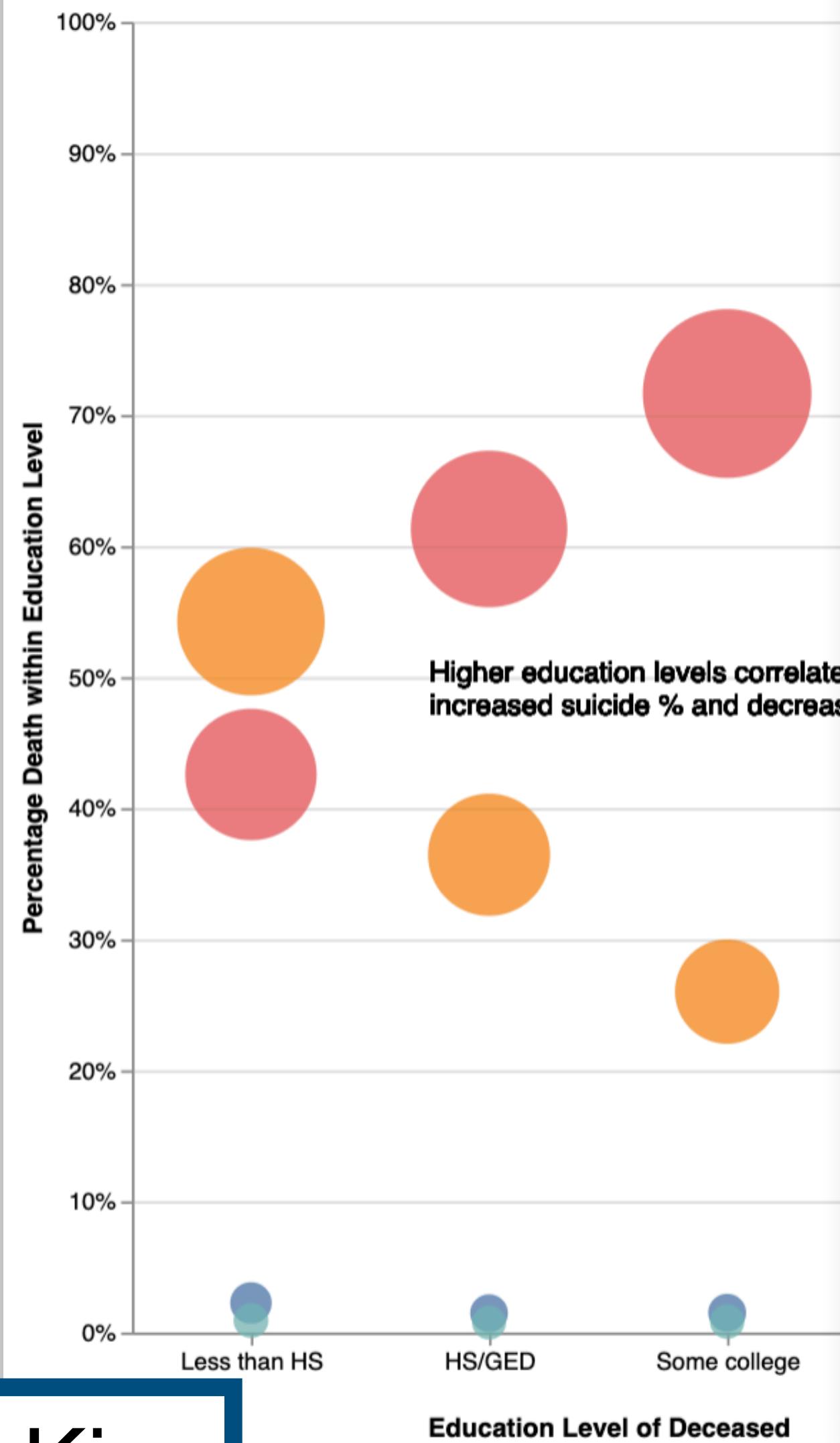
Has the proportion of total electricity in the US generated by renewable sources increased during the 21st century?



Saathvik Dirisala

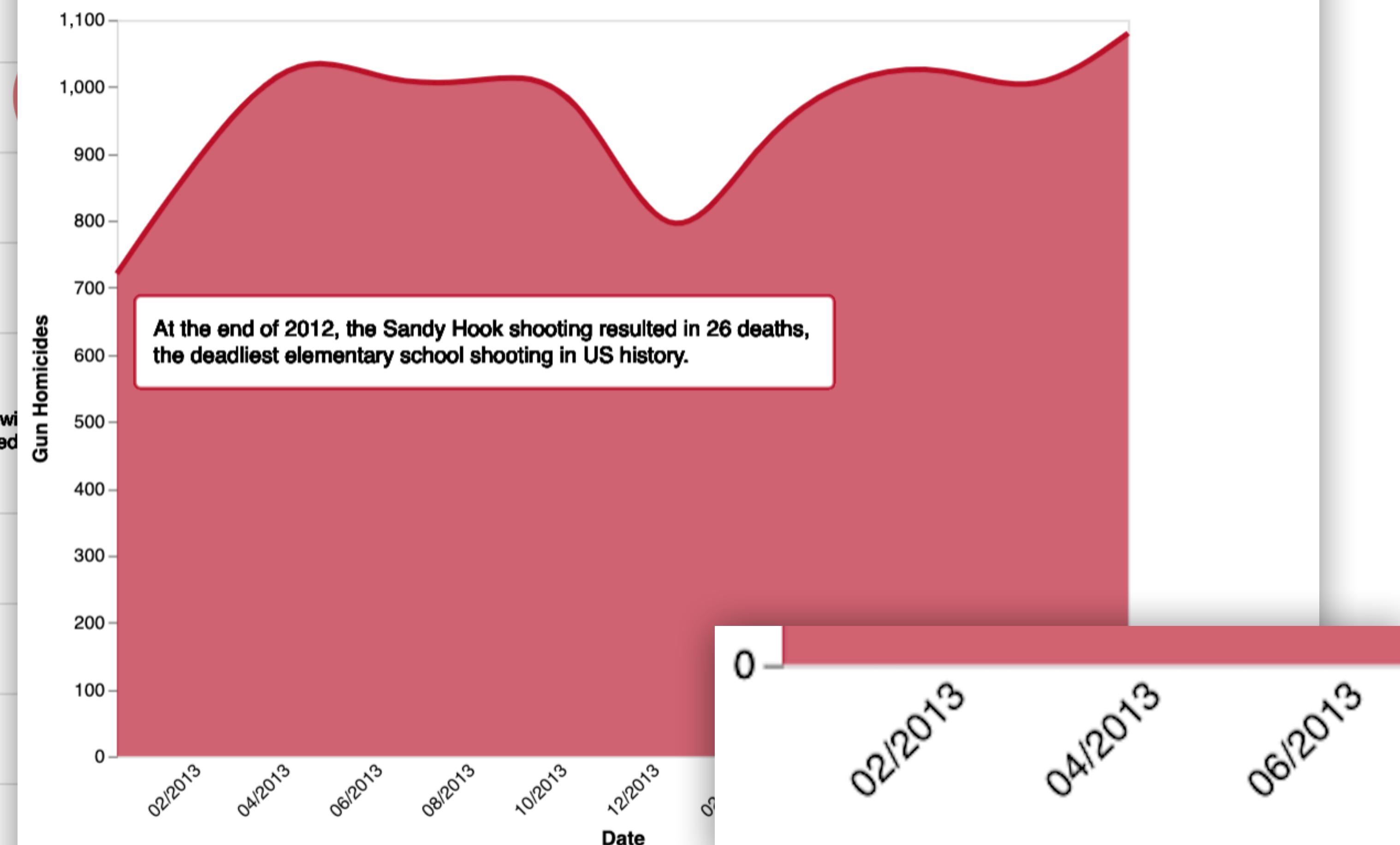
Lessons in Loss: Understanding Reasons for Gun Mortalities

Are there notable differences in the distribution of gun death causes?
How does gun fatalities vary across different educational background?



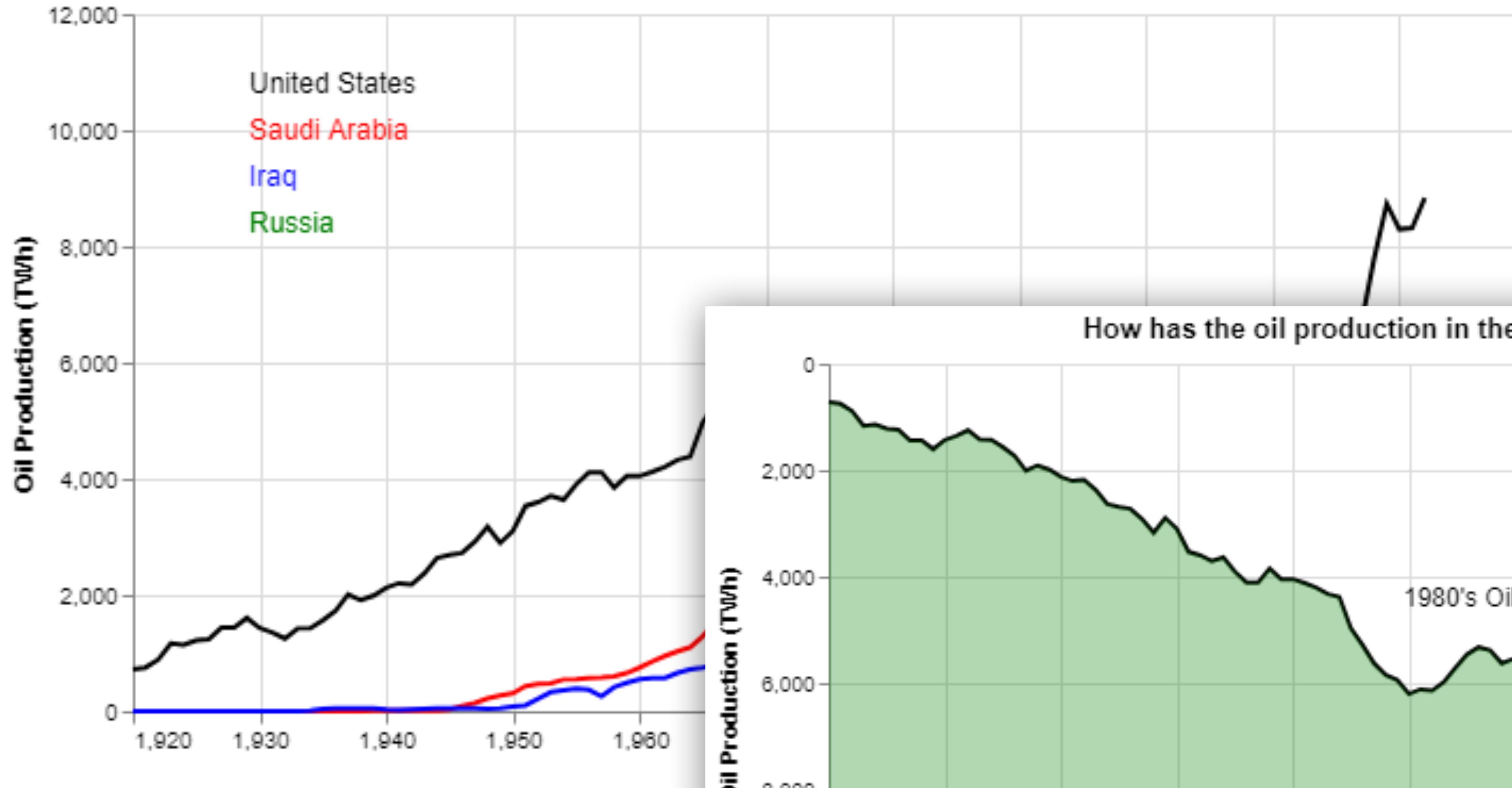
"Deadly Publicity" Rising Trend in US gun homicides after Sandy Hook Elementary School Shooting

"Did the heightened media attention on Sandy Hook correlate with an observed increase in gun homicides in the US?"
The Sandy Hook shooting was one of the deadliest American shooting homicides, publicizing gun violence on a new scale.
Has its notoriety triggered more gun homicides since?



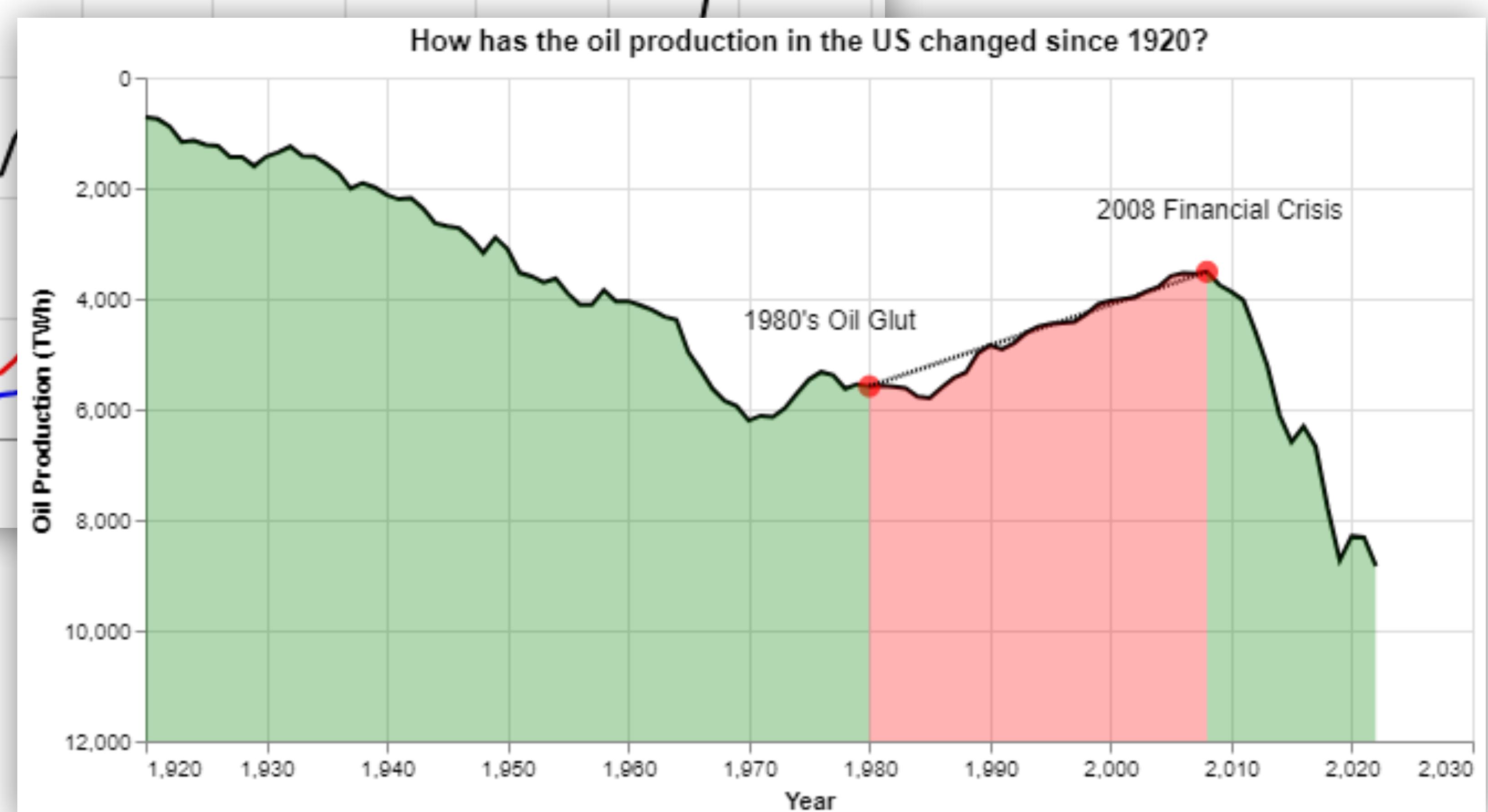
Data scraped from the CDC by Masood Ahmed – "Gun Deaths in America" (2012-2014)

How has the oil production in the US changed compared to other major oil producers?

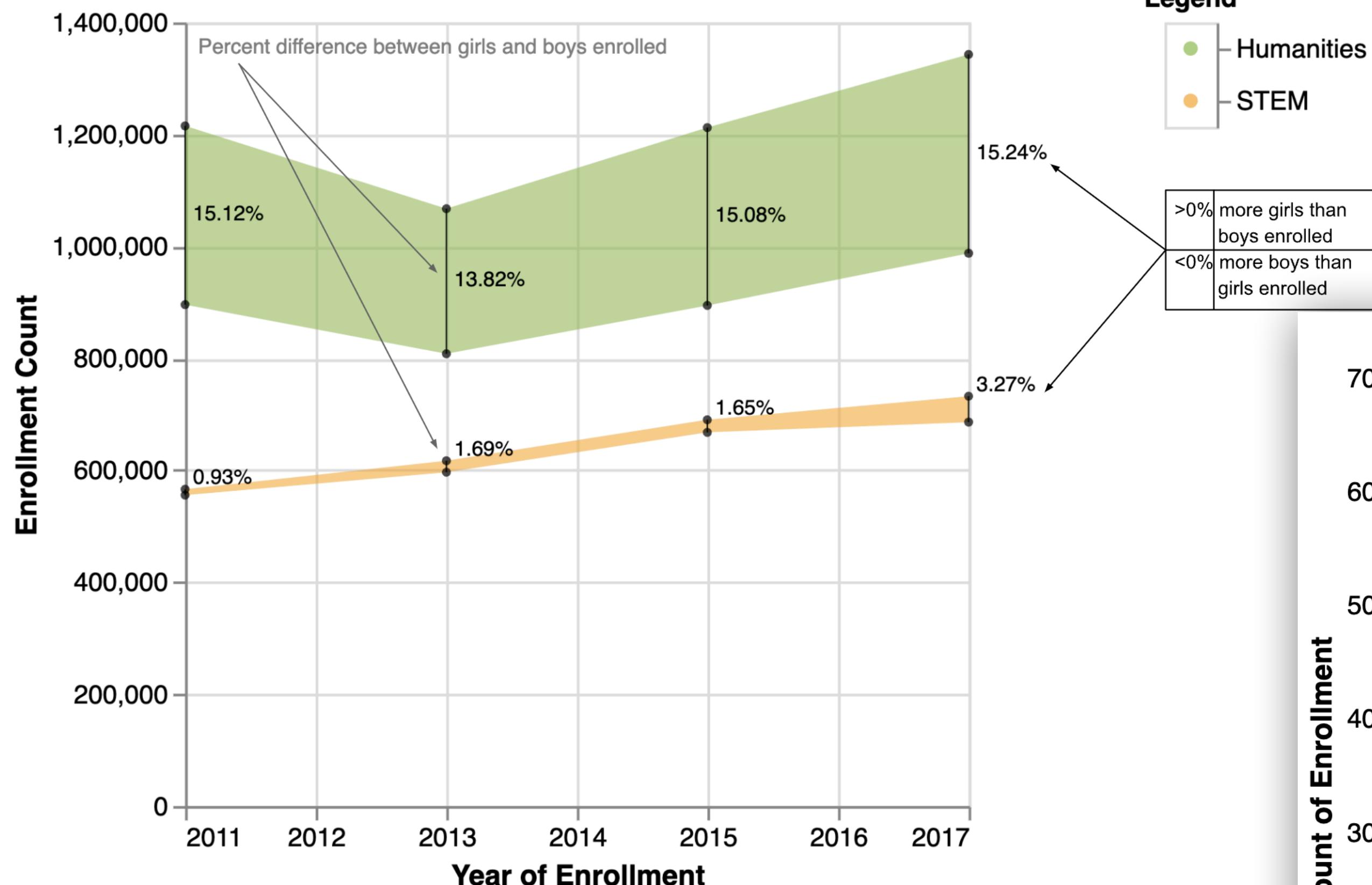


Haakon K. Garfjell

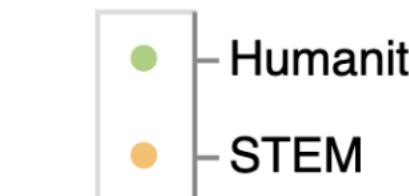
How has the oil production in the US changed since 1920?



Gender Gap in Enrollment in AP STEM vs. Humanities Courses

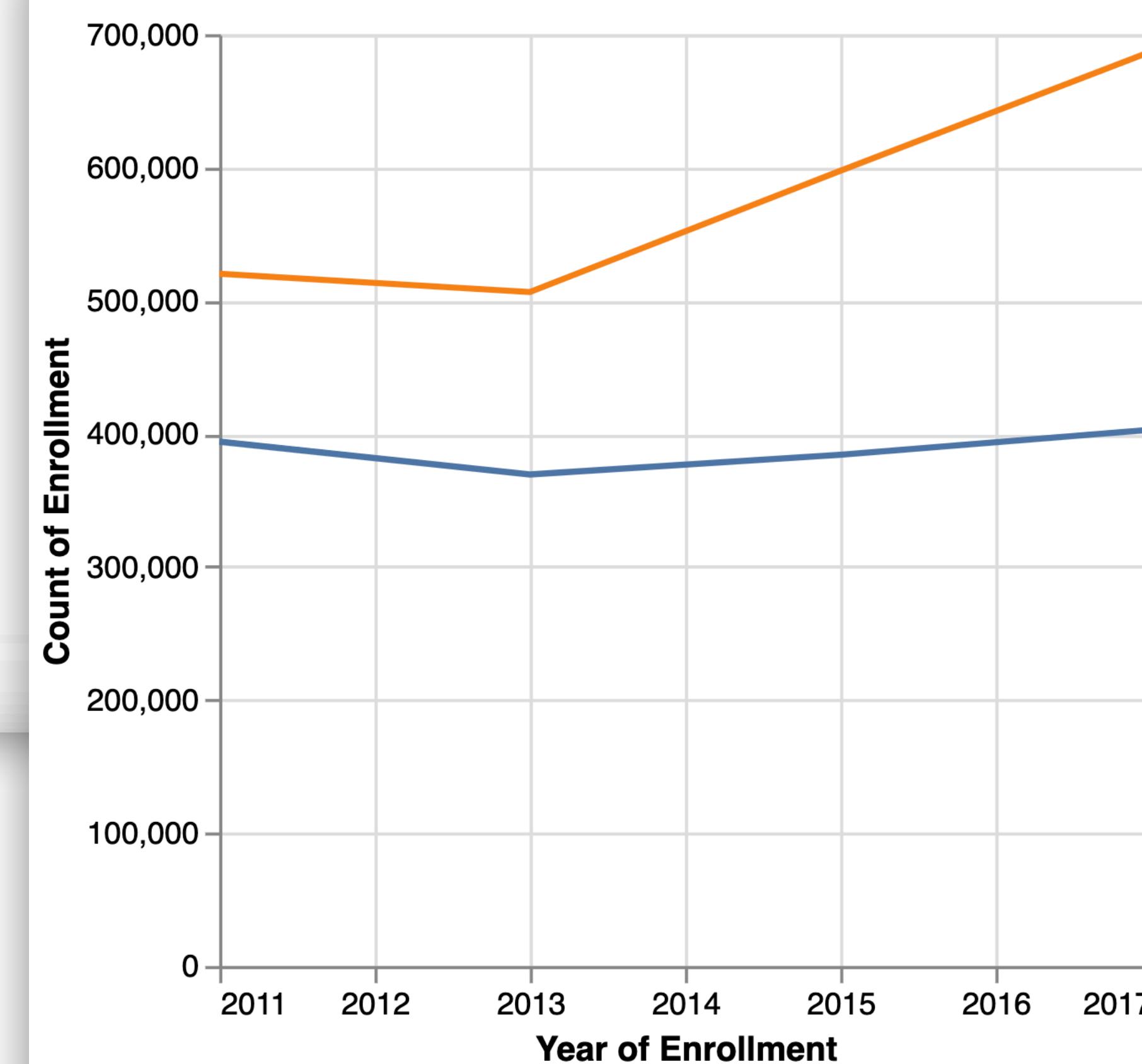


Legend

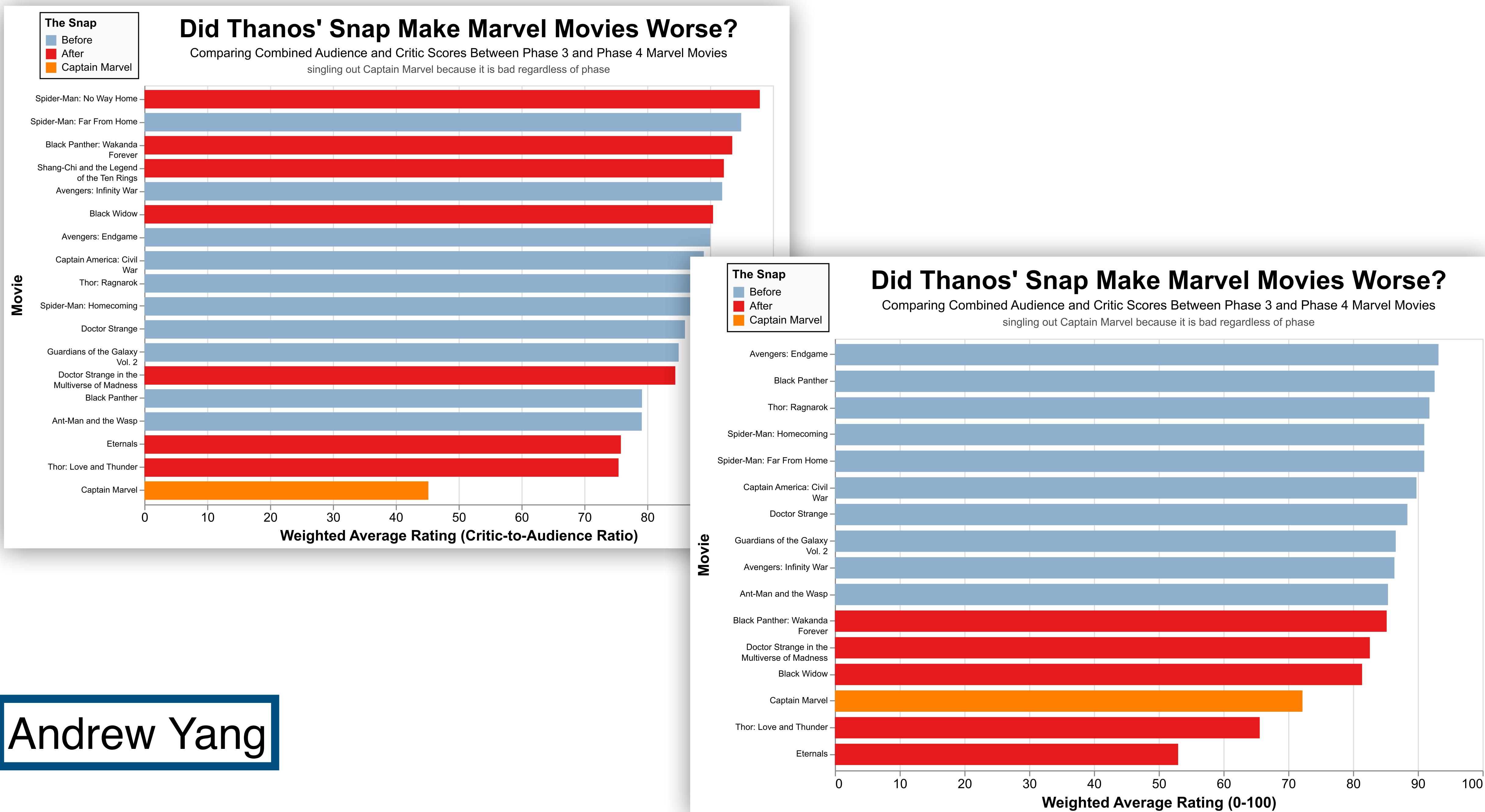


>0%	more girls than boys enrolled
<0%	more boys than girls enrolled

Minorities Dominate Enrollment in AP Courses

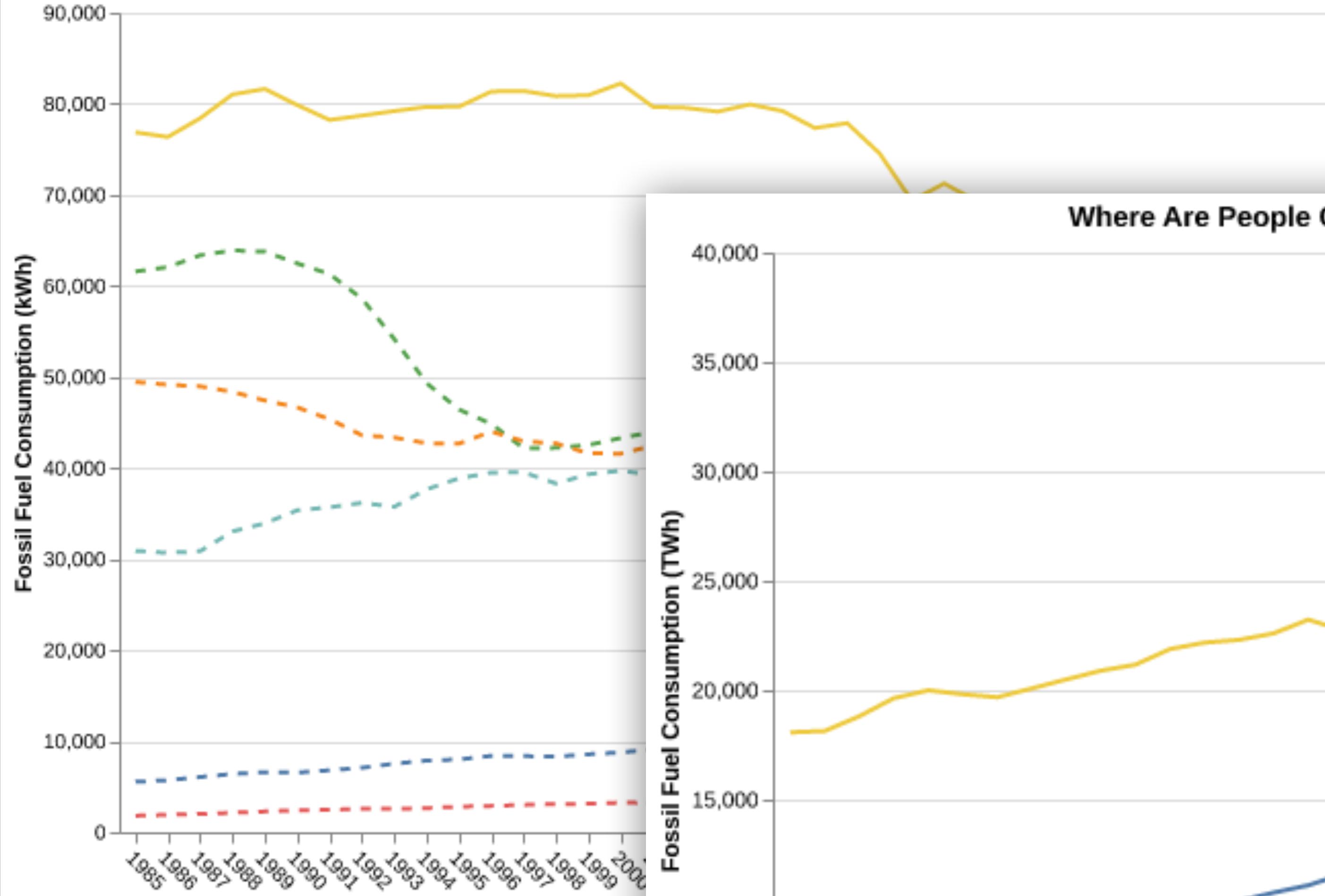


Anastasiya Markova

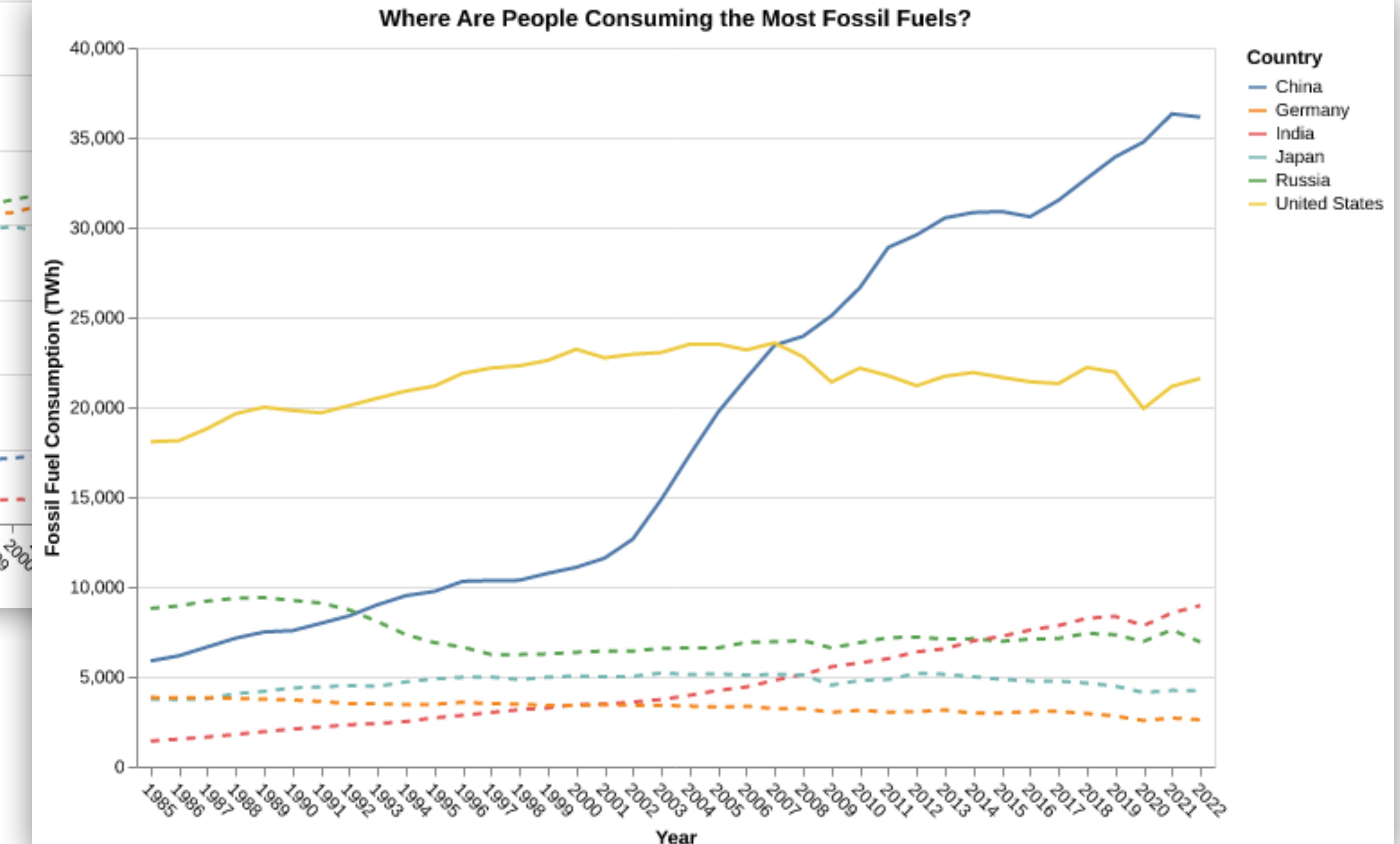


Andrew Yang

Where Are People Consuming the Most Fossil Fuels?



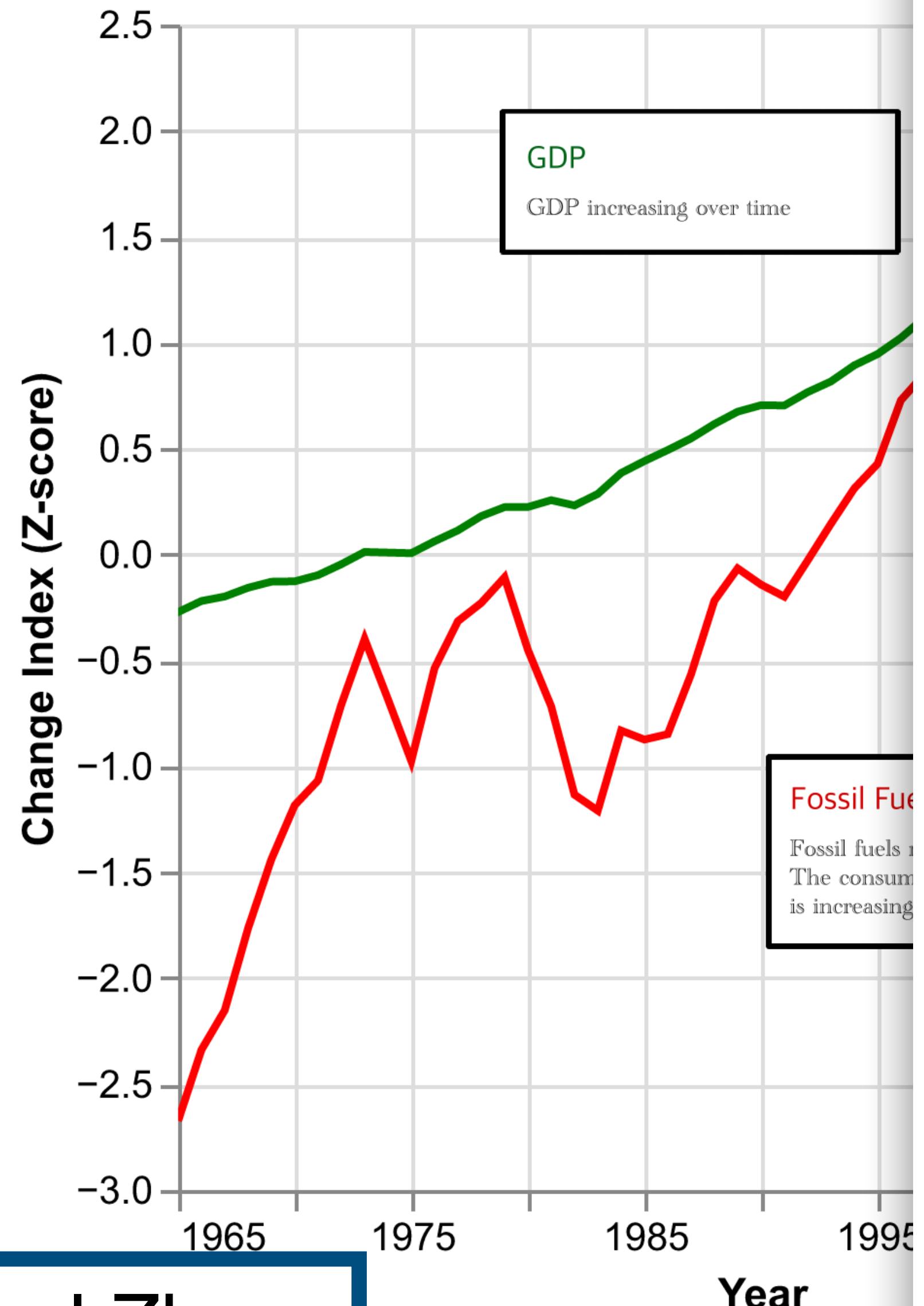
Where Are People Consuming the Most Fossil Fuels?



Maya Que

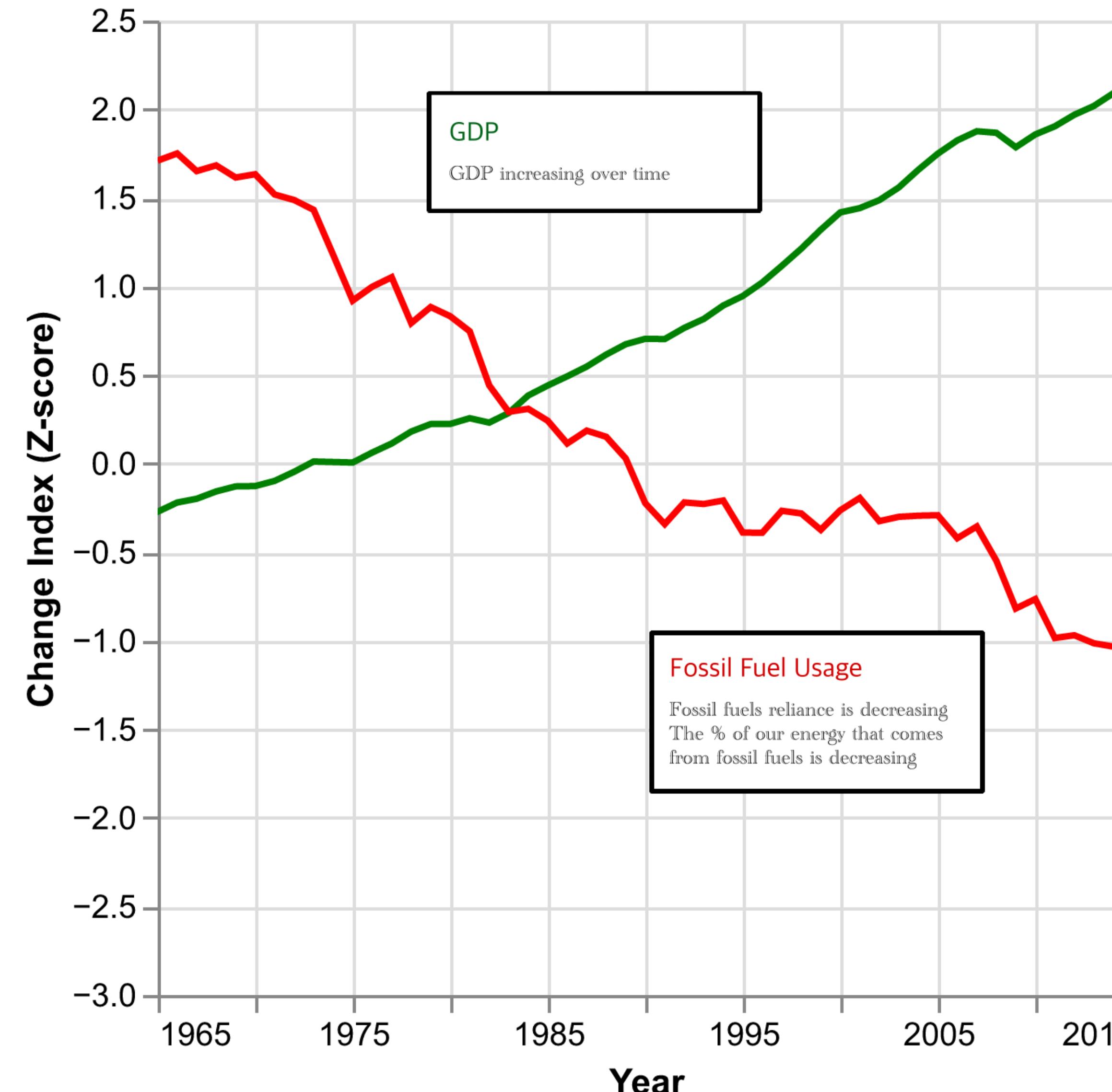
THE ECONOMY NEEDS FOSSIL FUELS

How are US GDP & Fossil Fuel Usage Related?



THE ECONOMY DOESN'T NEED FOSSIL FUELS

How are US GDP & Fossil Fuel Usage Related?

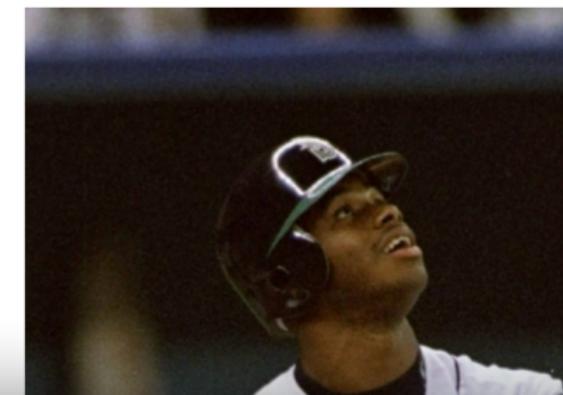
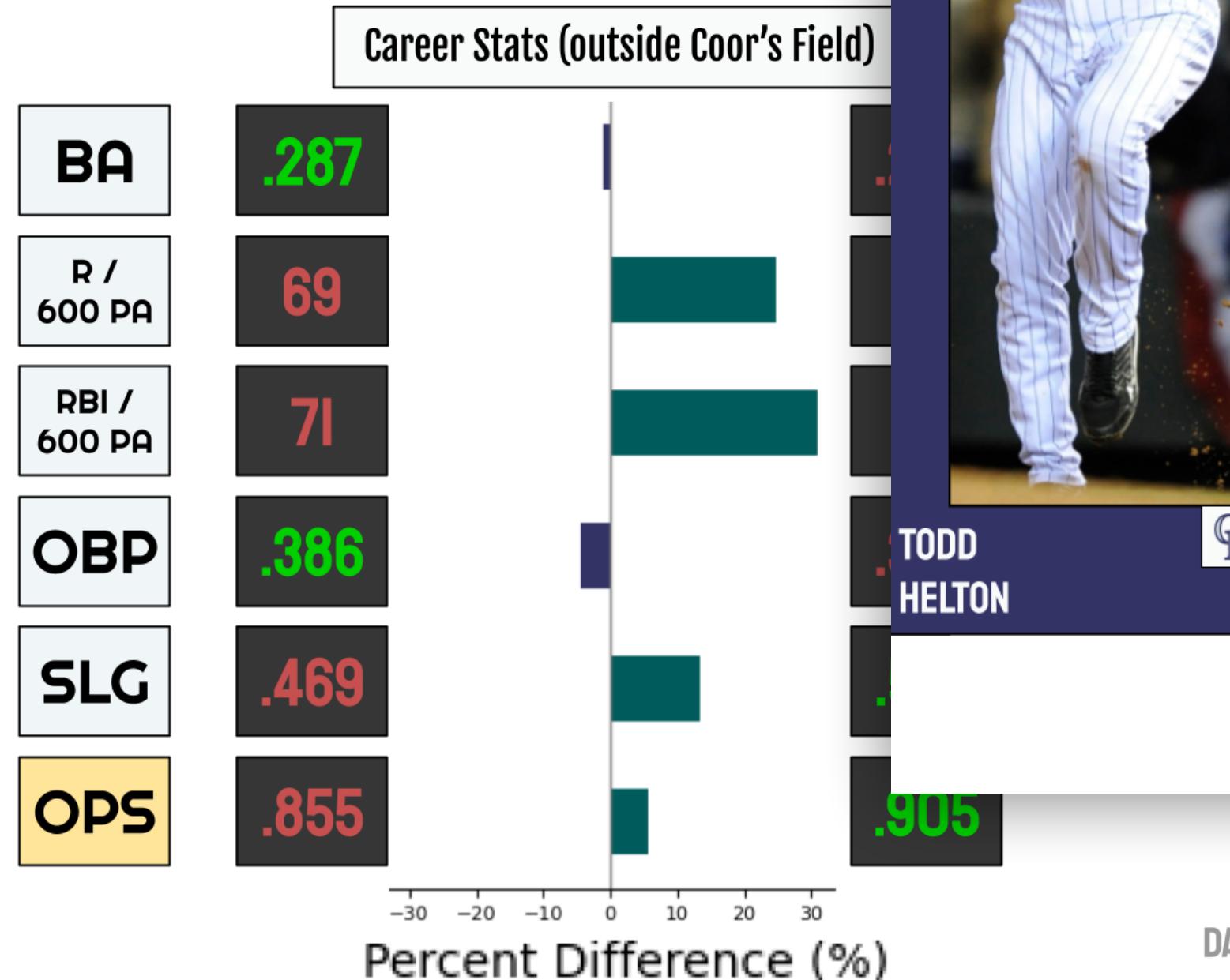
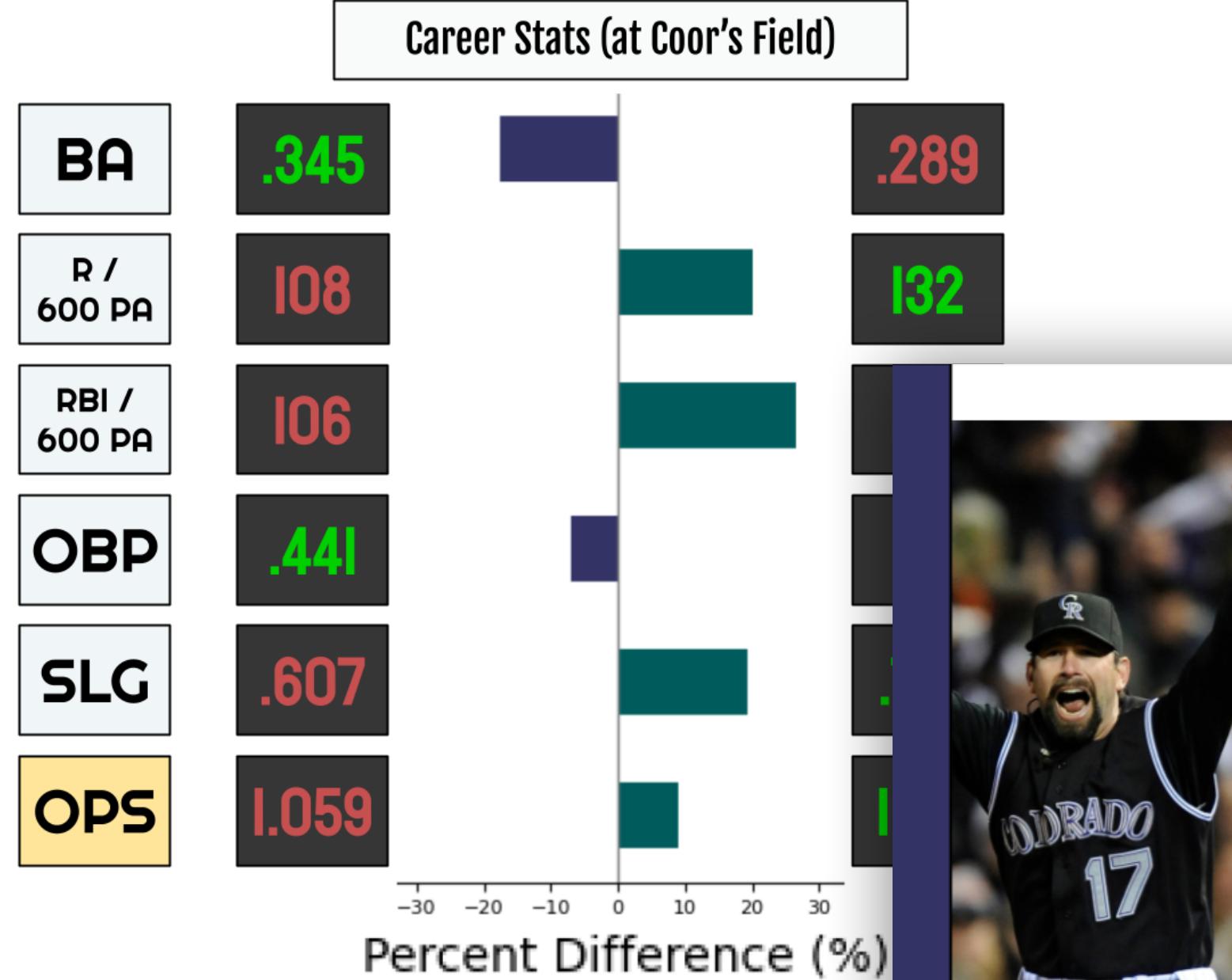


TODD HELTON VS KEN GRIFFEY JR:

WHO'S THE GREATEST LEFTY OF THE GENERATION?



TODD
HELTON

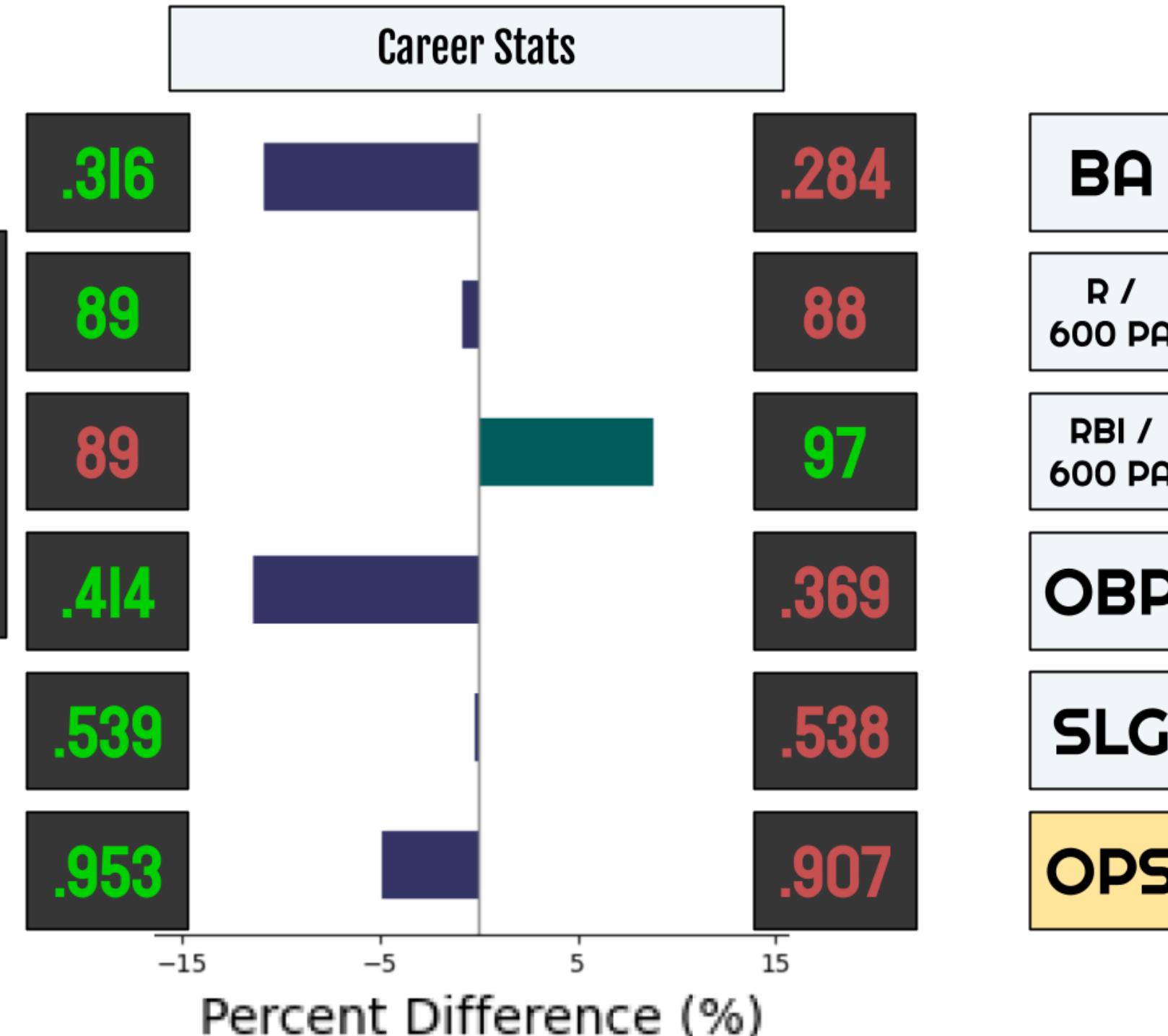


DATA FROM BASEBALLREFERENCE.COM

Justin Chou

TODD HELTON:
GREATEST LEFTY OF THE GENERATION?

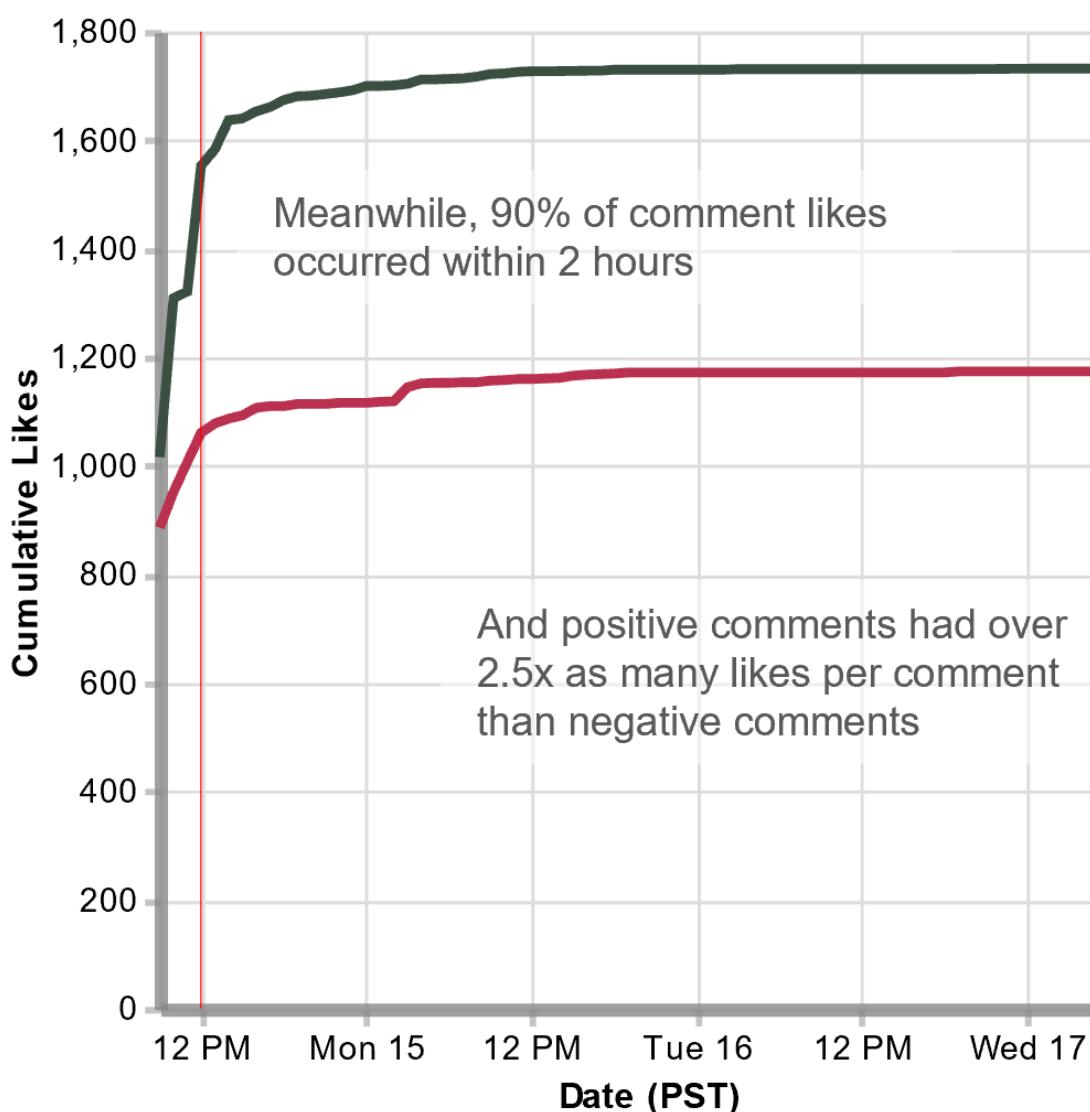
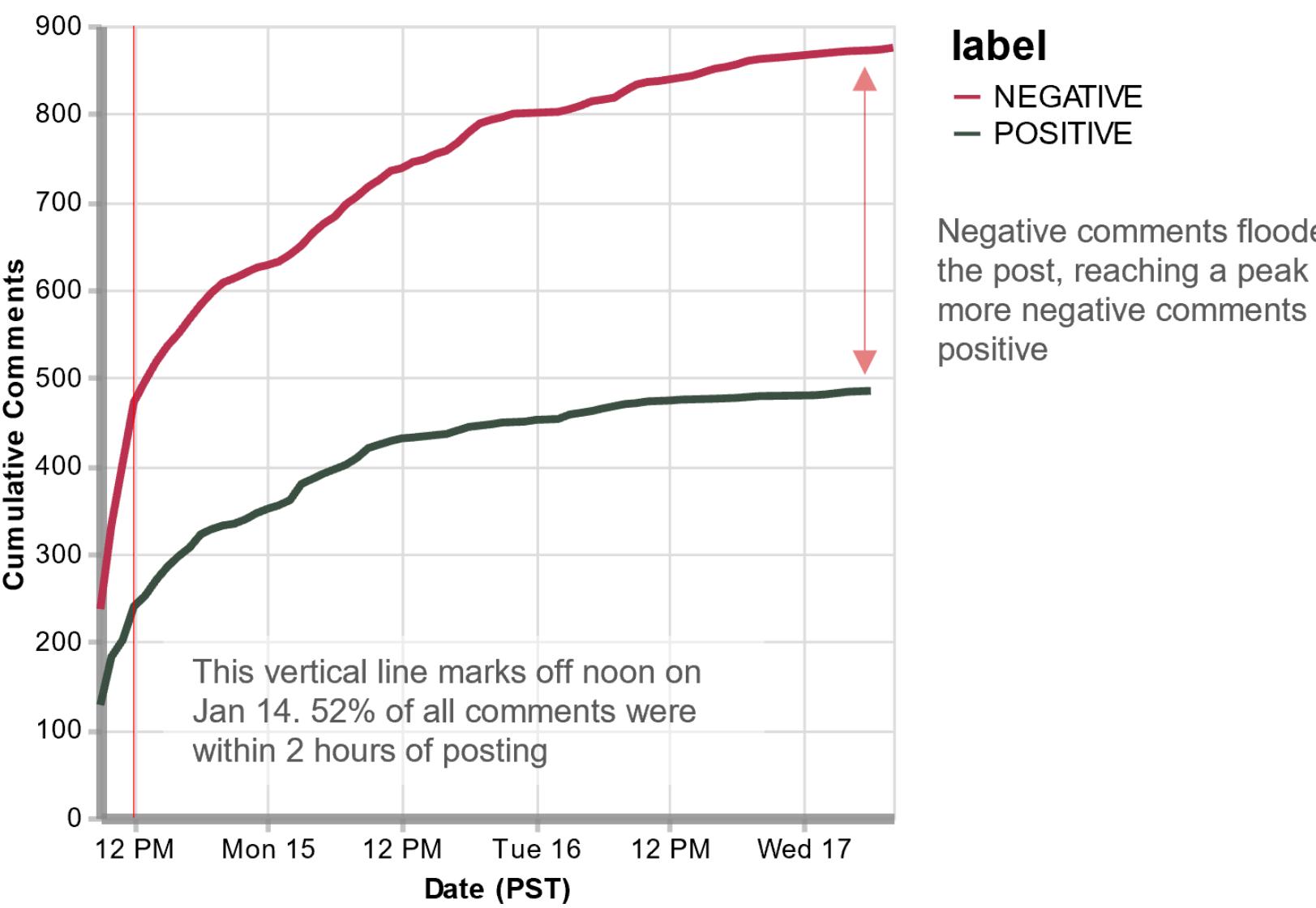
TODD HELTON WINS
5 OF 6 MAJOR
CATEGORIES,
INCLUDING OPS,
ACROSS THEIR
CAREERS



DATA FROM BASEBALLREFERENCE.COM

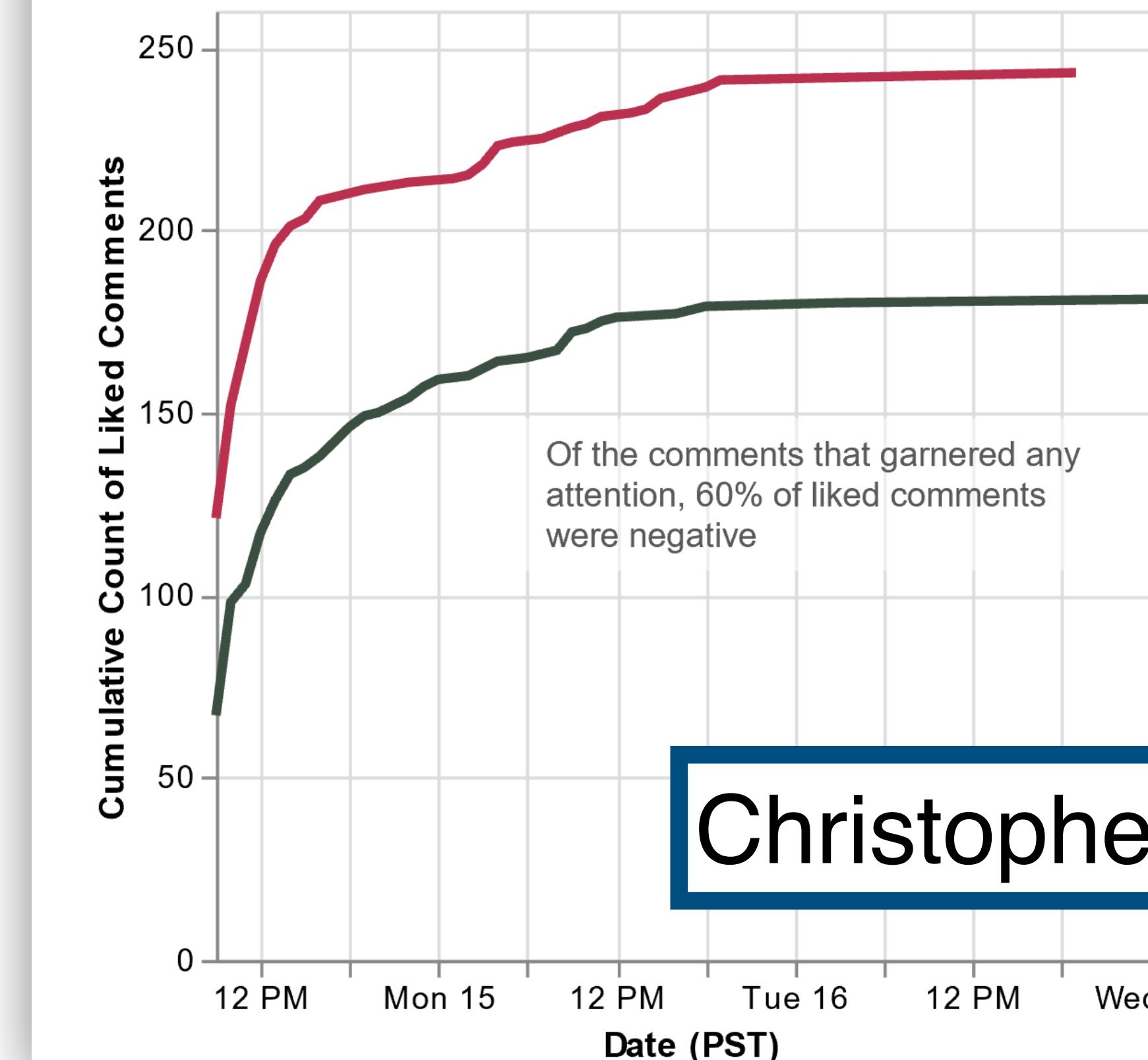
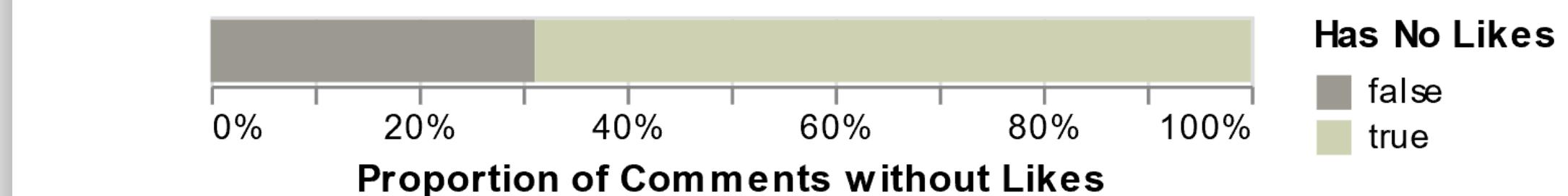
Digital Engagement in Politics: Diving into a Facebook Comment Section

Early January, President Biden announced he created 14 million new jobs while in office. 1,360 Facebook comments on the POTUS Facebook post were analyzed with Hugging Face sentiment analysis



No One Likes Biden: Diving into a Facebook comment section

Early January, President Biden announced he created 14 million new jobs while in office. 1,360 Facebook comments on the POTUS Facebook post were analyzed with Hugging Face sentiment analysis. Most comments weren't liked. Let's look at what was.



Christopher Lum

Maps

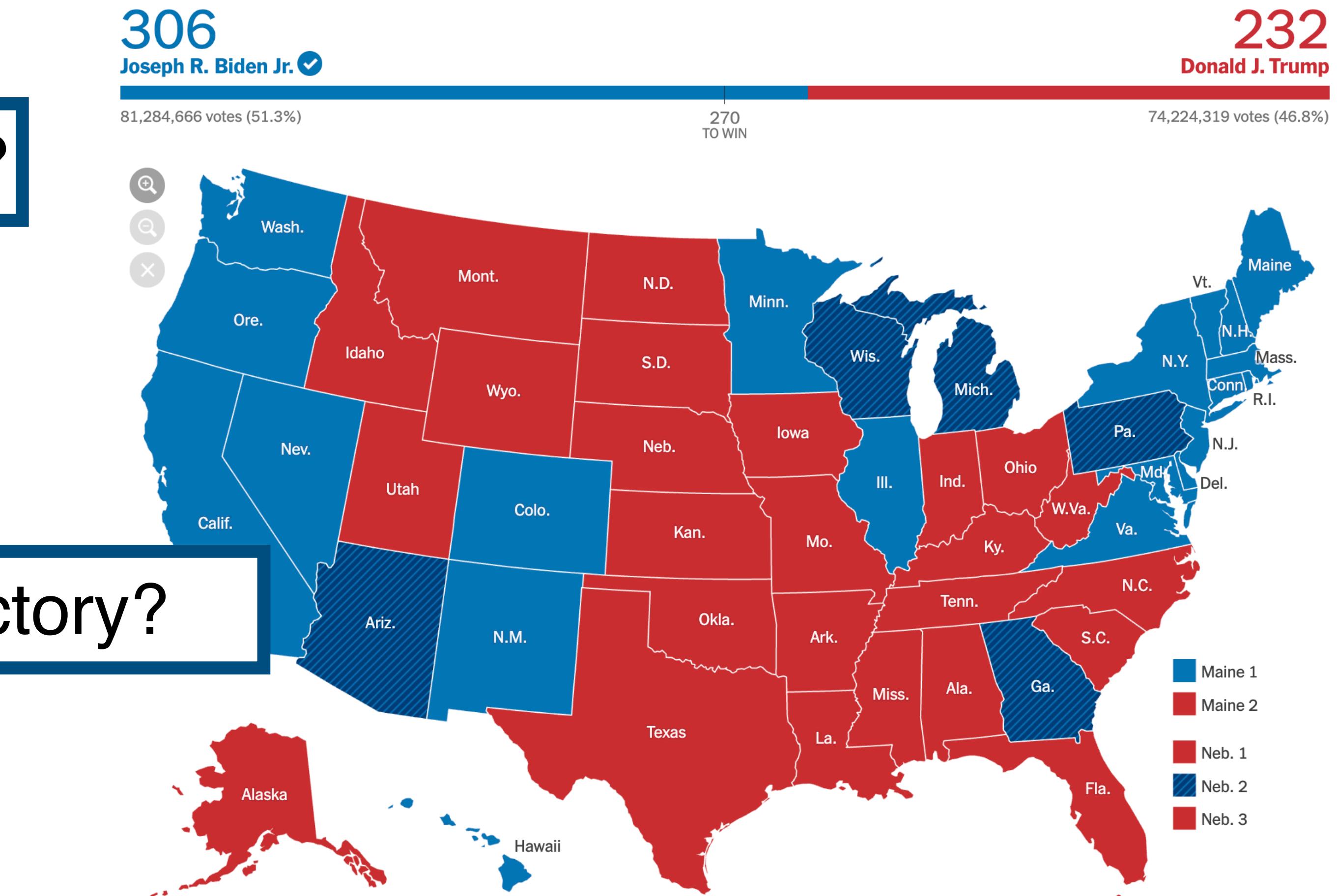
When to use a map?

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

Geographic Relationships

Presidential Election Results: Biden Wins

Joseph R. Biden Jr. was elected the 46th president of the United States. Mr. Biden defeated President Trump after winning Pennsylvania, which put his total of Electoral College votes above the 270 he needed to clinch the presidency.



Geographic Relationships

 Who's winning my state?

 Is it a landslide?

 What are the paths to victory?

Show results for: All Districts



Democrats expected to win easily

District	Dem.	Rep.	% Rpt.
Ala. 7	72%	28%	100%
Ariz. 4	67%	28%	100%
Calif. 1	63%	31%	100%
Calif. 5	72%	25%	100%
Calif. 6	66%	30%	100%
Calif. 7	68%	32%	100%
Calif. 8	80%	15%	100%
Calif. 9	84%	11%	100%
Calif. 10	59%	38%	100%
Calif. 12	76%	22%	100%
Calif. 13	72%	28%	100%
Calif. 14	69%	28%	100%
Calif. 15	68%	32%	100%

Democrats expected to win narrowly

District	Dem.	Rep.	% Rpt.
Ark. 4	58%	40%	100%
Calif. 18	58%	42%	100%
Calif. 20	52%	48%	100%
Calif. 47	53%	39%	100%
Colo. 7	53%	42%	100%
Conn. 4	53%	47%	100%
Conn. 5	54%	46%	100%
Del. 1	57%	41%	100%
Ga. 12	57%	43%	100%
Iowa 1	50%	48%	100%
Iowa 2	51%	46%	100%
Iowa 3	51%	47%	100%
Ill. 8	48%	48%	100%
Ill. 10	49%	51%	100%
Ky. 3	55%	44%	100%
La. 2	65%	33%	100%
Mass. 4	54%	43%	100%
Me. 1	57%	43%	100%
Me. 2	55%	45%	100%
Mich. 9	50%	47%	100%
Mich. 15	57%	40%	100%
Minn. 1	49%	44%	100%
Mo. 4	45%	50%	100%
N.C. 2	49%	49%	100%
N.C. 7	54%	46%	100%

Tossup seats

District	Dem.	Rep.	% Rpt.
Ala. 2	49%	51%	100%
Ariz. 5	43%	52%	100%
Ariz. 7	50%	44%	100%
Ariz. 8	49%	47%	100%
Calif. 11	48%	47%	100%
Colo. 3	46%	50%	100%
Fla. 22	46%	54%	100%
Fla. 25	43%	52%	100%
Ga. 2	51%	49%	100%
Ga. 8	47%	53%	100%
Hawaii 1	53%	47%	100%
Idaho 1	41%	51%	100%
Ill. 14	45%	51%	100%
Ill. 17	43%	53%	100%
Ind. 2	48%	47%	100%
Ind. 9	42%	52%	100%
Ky. 6	50%	50%	100%
Mass. 10	47%	42%	100%
Mich. 7	45%	50%	100%
Miss. 4	47%	52%	100%
N.C. 8	53%	44%	100%
N.D. 1	45%	55%	100%
N.H. 2	47%	48%	100%
N.J. 3	47%	50%	100%
Nev. 3	47%	48%	100%

Republicans expected to win narrowly

District	Dem.	Rep.	% Rpt.
Ark. 1	44%	52%	100%
Ariz. 1	44%	50%	100%
Ariz. 3	41%	52%	100%
Calif. 3	43%	50%	100%
Colo. 4	41%	52%	100%
Ala. 5	42%	58%	100%
Ala. 6	Unc.		
Ark. 2	38%	58%	100%
Ark. 3	28%	72%	100%
Ariz. 2	31%	65%	100%
Ariz. 6	29%	66%	100%
Calif. 2	43%	57%	100%
Calif. 4	31%	61%	100%
Calif. 19	35%	65%	100%
Calif. 21	Unc.		
Calif. 22	Unc.		
Calif. 24	40%	60%	100%
Calif. 25	38%	62%	100%
Calif. 26	37%	54%	100%
Calif. 40	33%	67%	100%
Calif. 41	37%	63%	100%
Calif. 42	32%	62%	100%
Calif. 44	44%	56%	100%
Calif. 45	42%	51%	100%
Calif. 46	38%	62%	100%
Calif. 48	36%	60%	100%

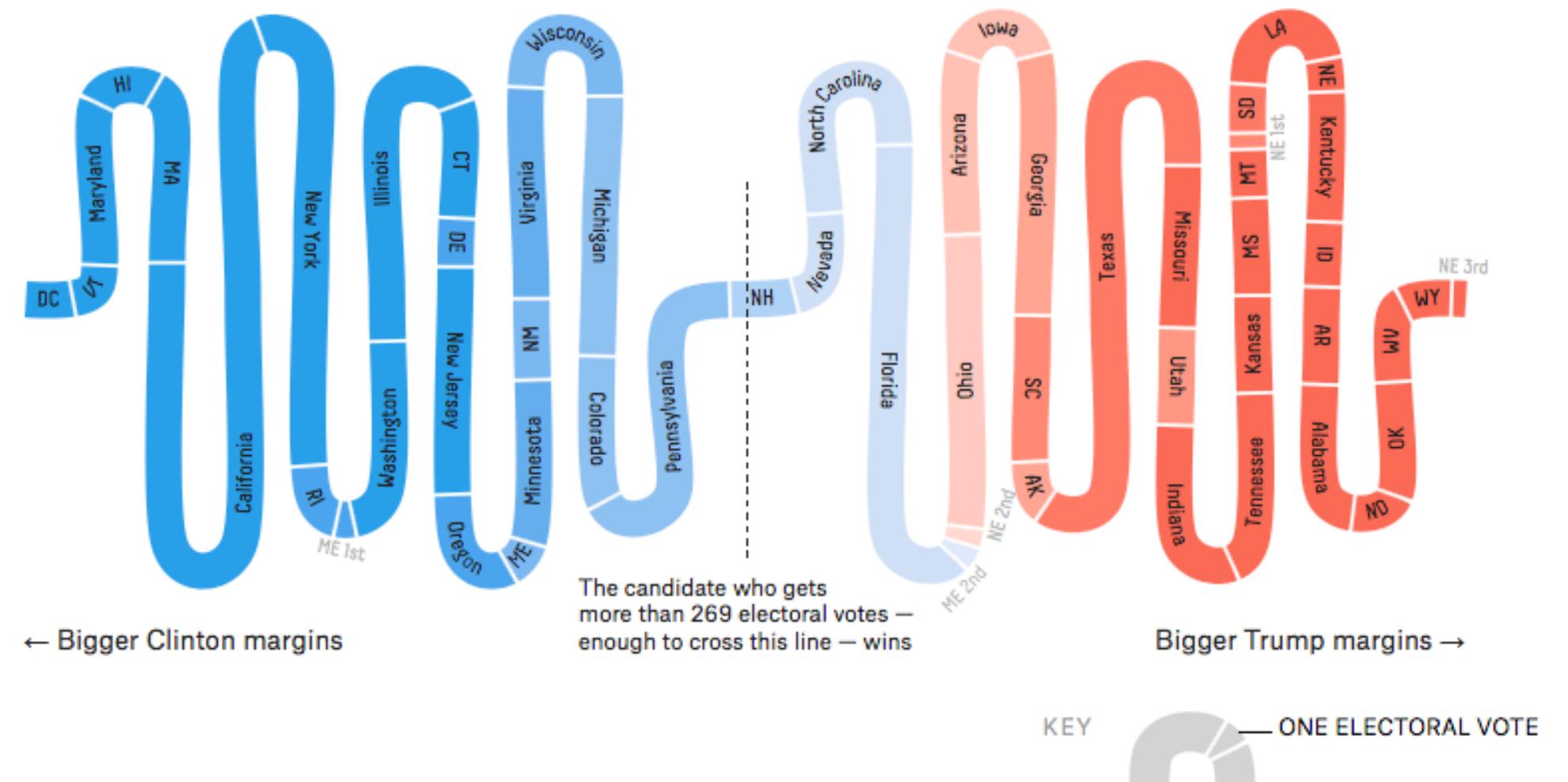
Republicans expected to win easily

District	Dem.	Rep.	% Rpt.
Alaska 1	31%	69%	100%
Ala. 1		83%	100%
Ala. 3	41%	59%	100%
Ala. 4		Unc.	
Ala. 5	42%	58%	100%
Ala. 6		Unc.	
Ark. 2	38%	58%	100%
Ark. 3	28%	72%	100%
Ariz. 2	31%	65%	100%
Ariz. 6	29%	66%	100%
Calif. 2	43%	57%	100%
Calif. 4	31%	61%	100%
Calif. 19	35%	65%	100%
Calif. 21	Unc.		
Calif. 22	Unc.		
Calif. 24	40%	60%	100%
Calif. 25	38%	62%	100%
Calif. 26	37%	54%	100%
Calif. 40	33%	67%	100%
Calif. 41	37%	63%	100%
Calif. 42	32%	62%	100%
Calif. 44	44%	56%	100%
Calif. 45	42%	51%	100%
Calif. 46	38%	62%	100%
Calif. 48	36%	60%	100%

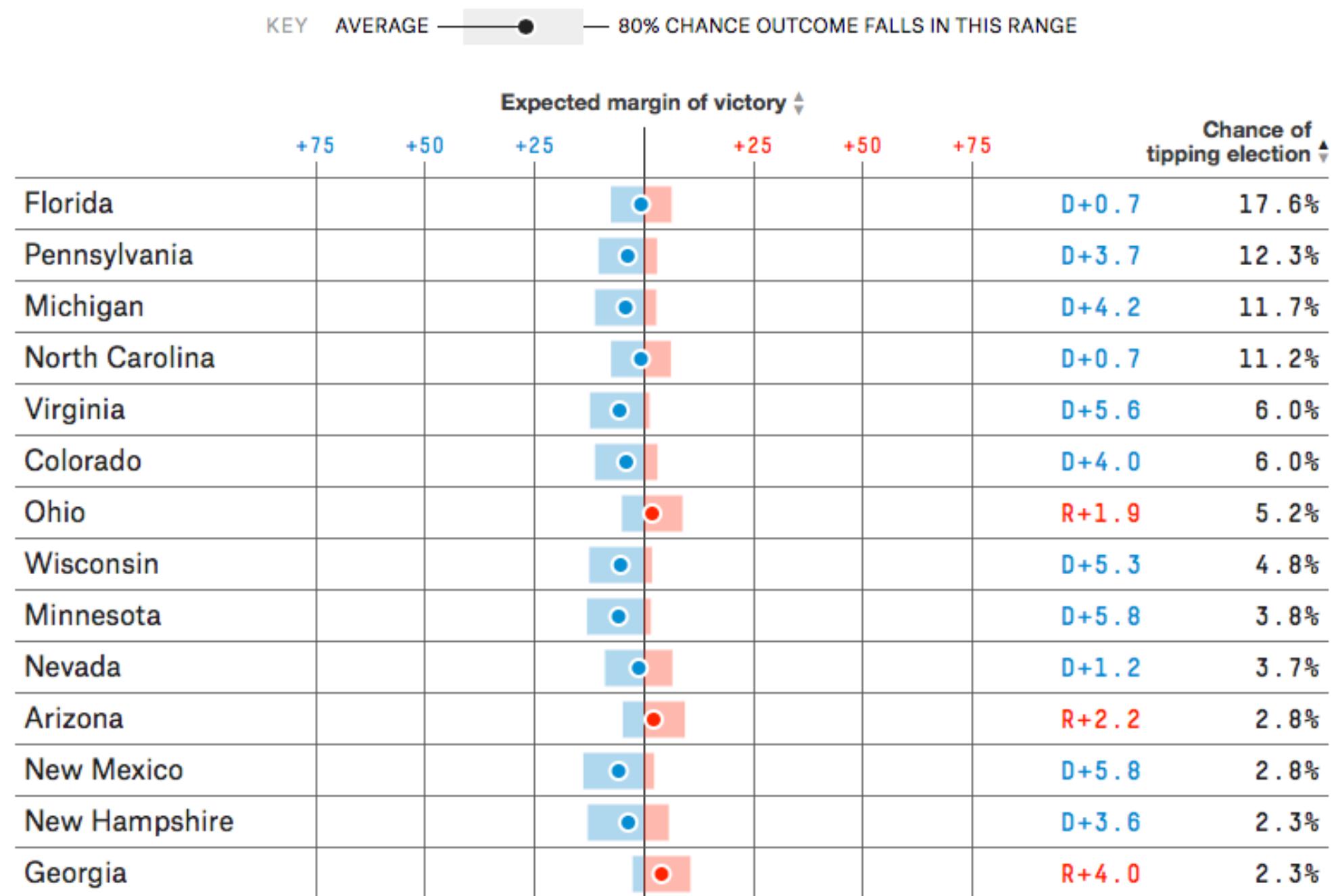
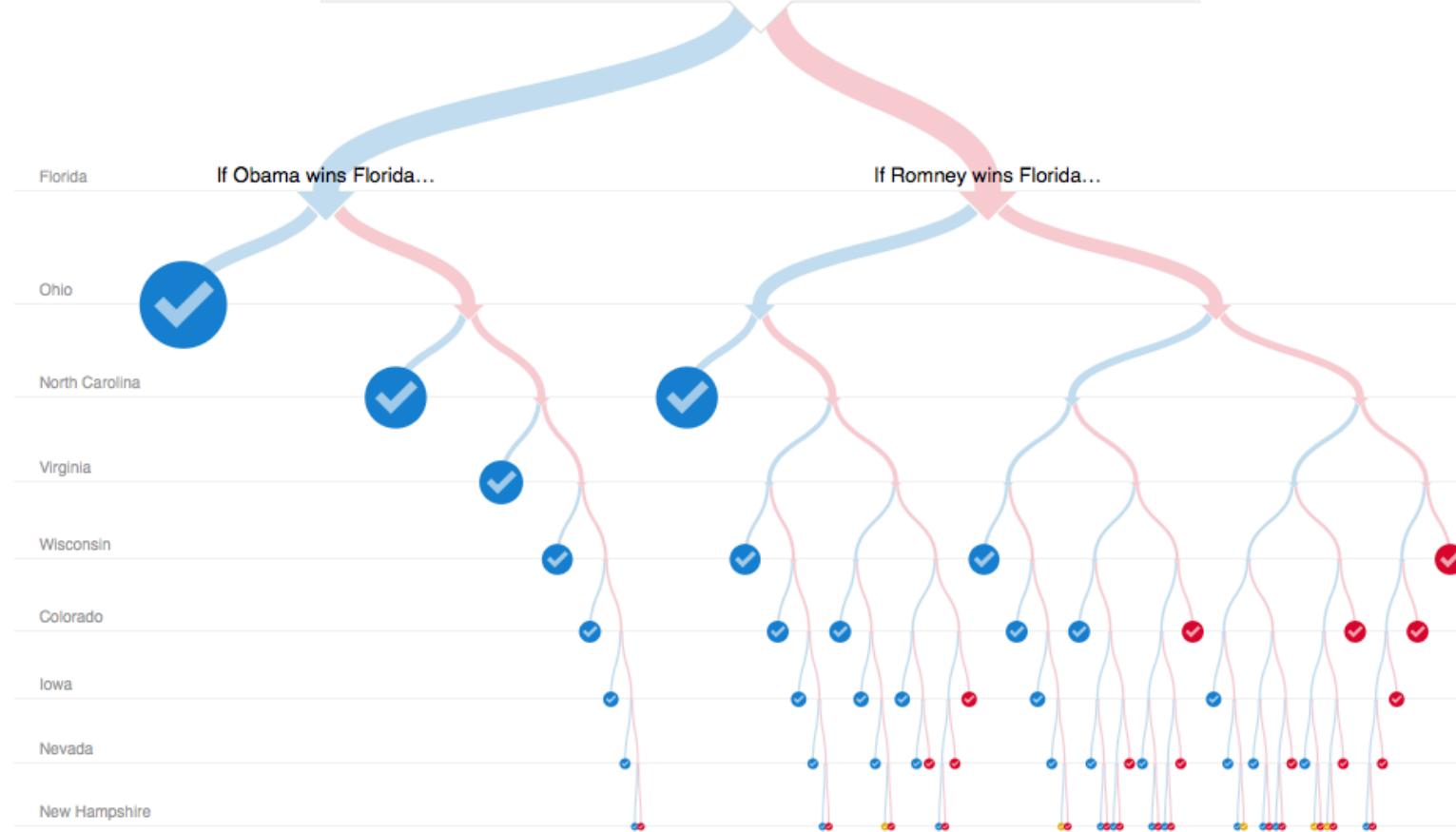
Building An Electoral Victory

270 electoral votes are needed to win the election.

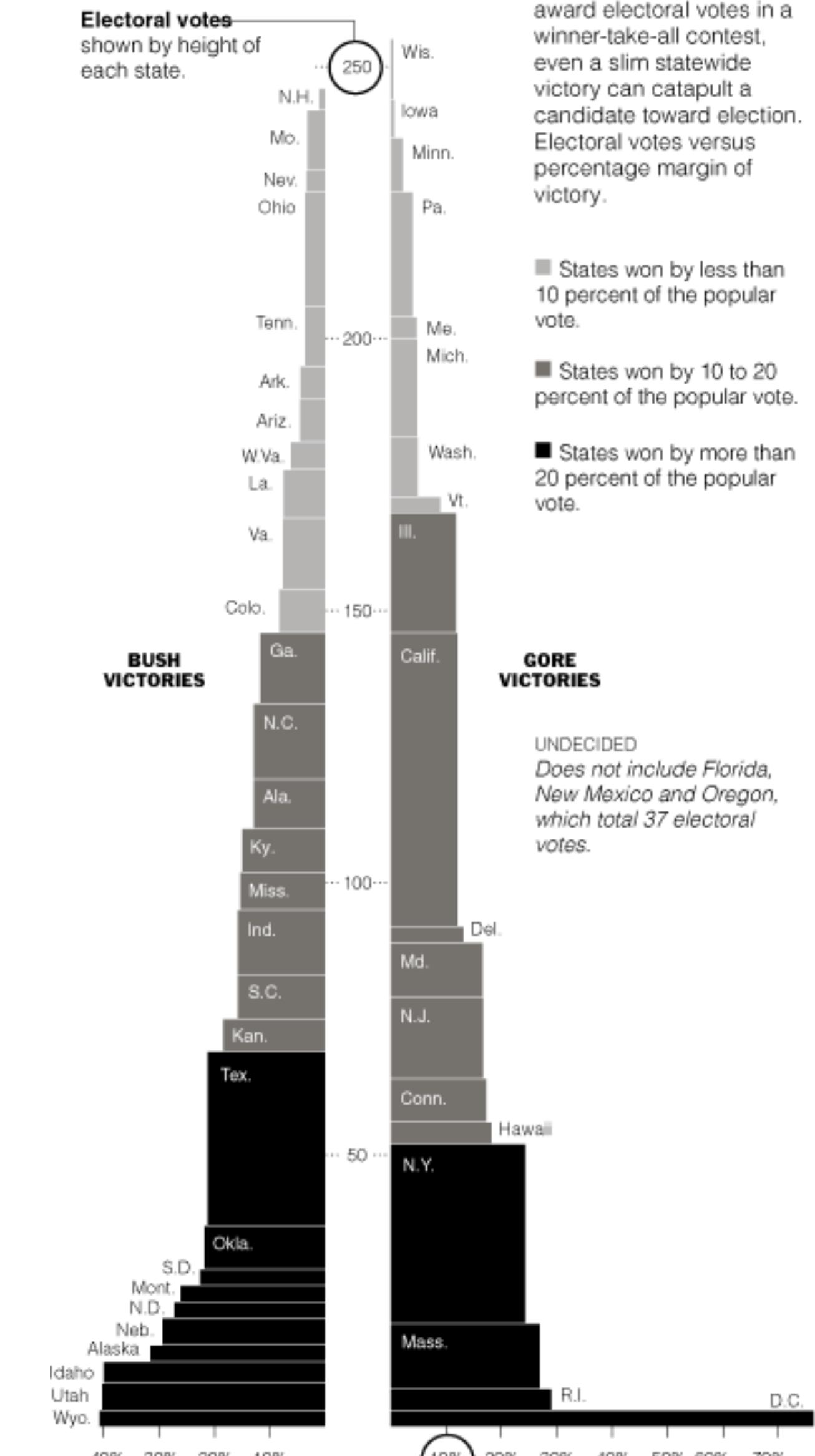
270



Obama has 431 ways to win
64% of paths Romney has 76 ways to win
0.98% of paths 15% of paths



Electoral votes shown by height of each state.

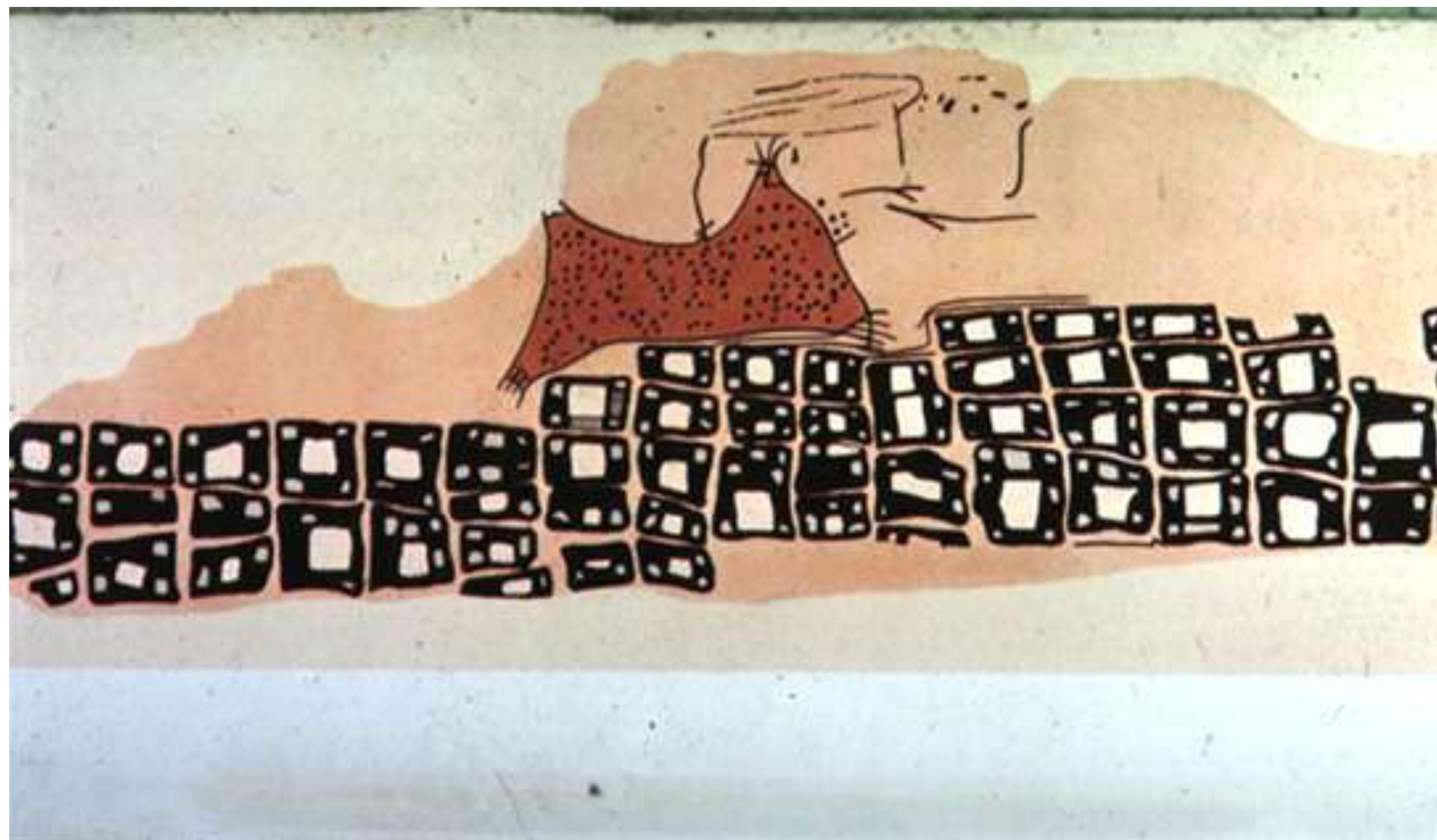


Margin of victory for each candidate shown by the width of each state.

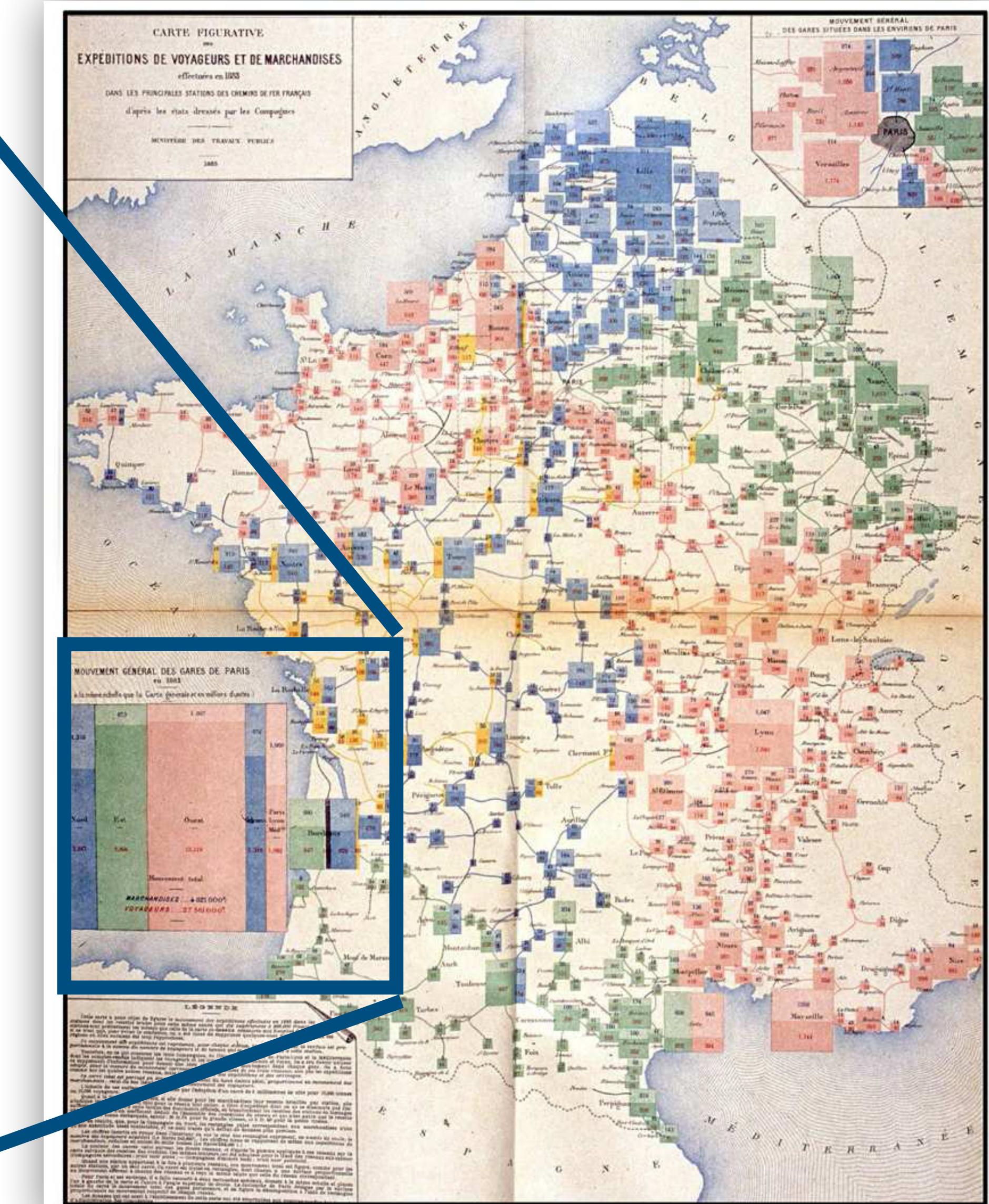
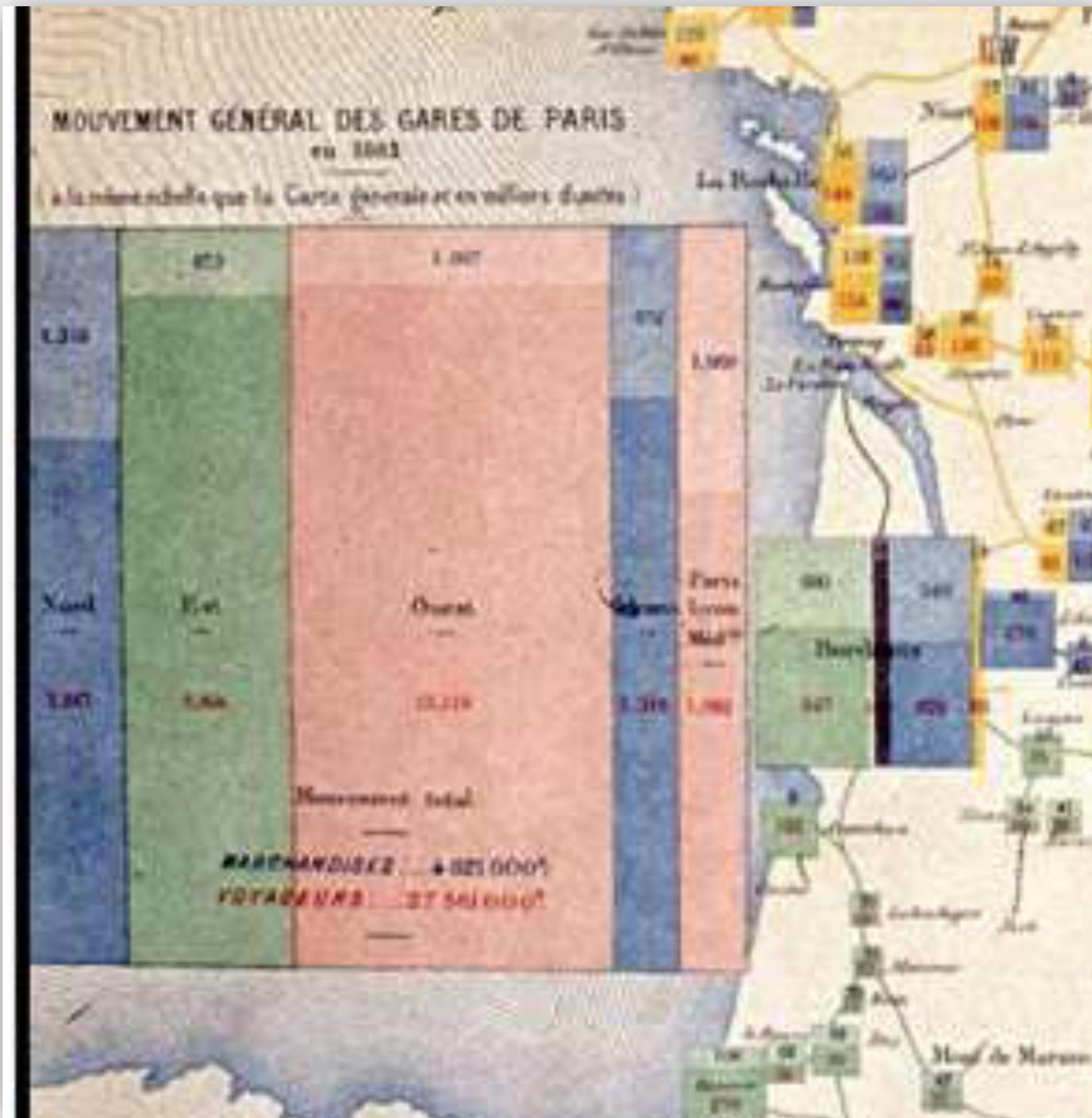
Cartography

(Map Making)

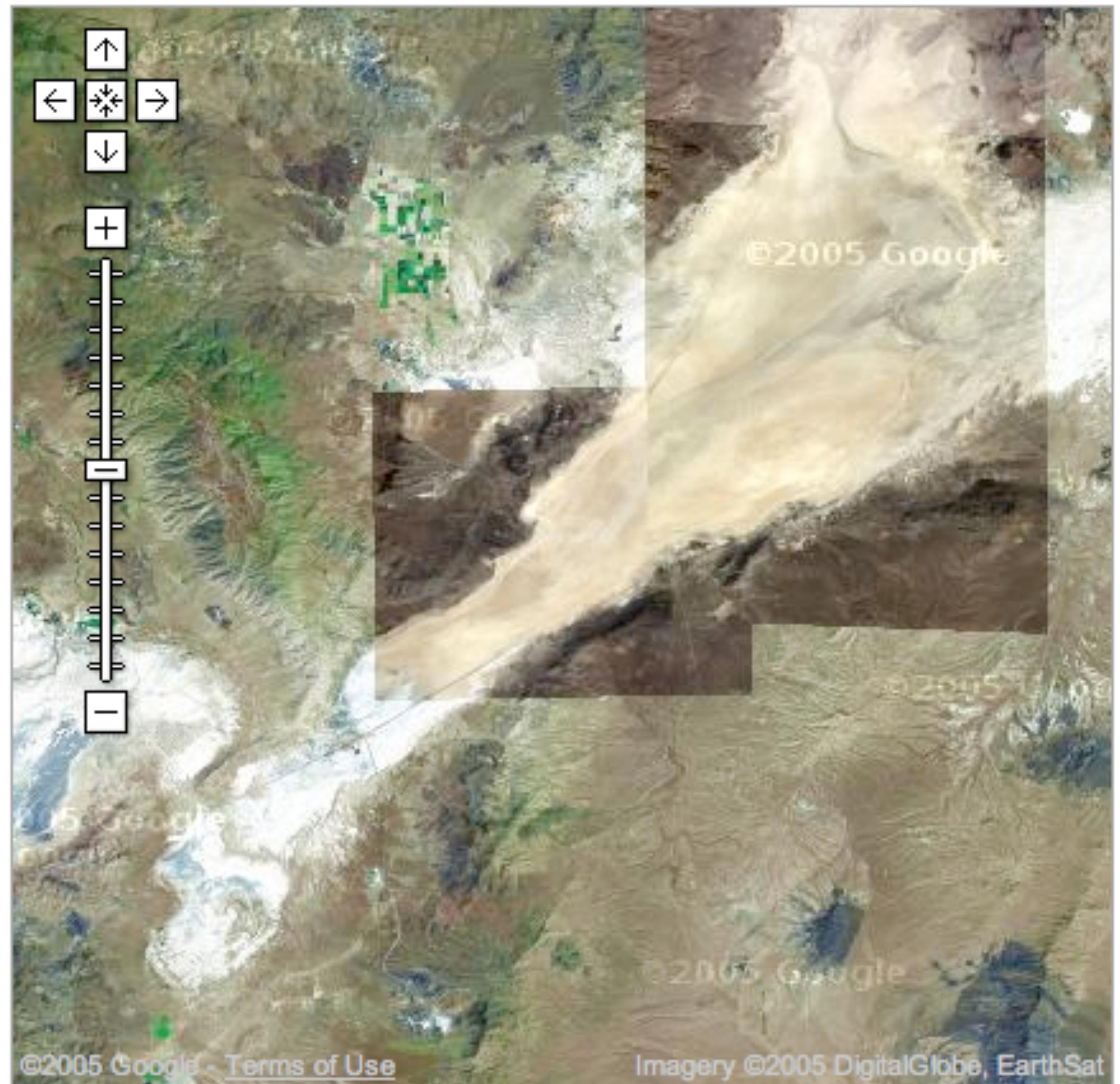
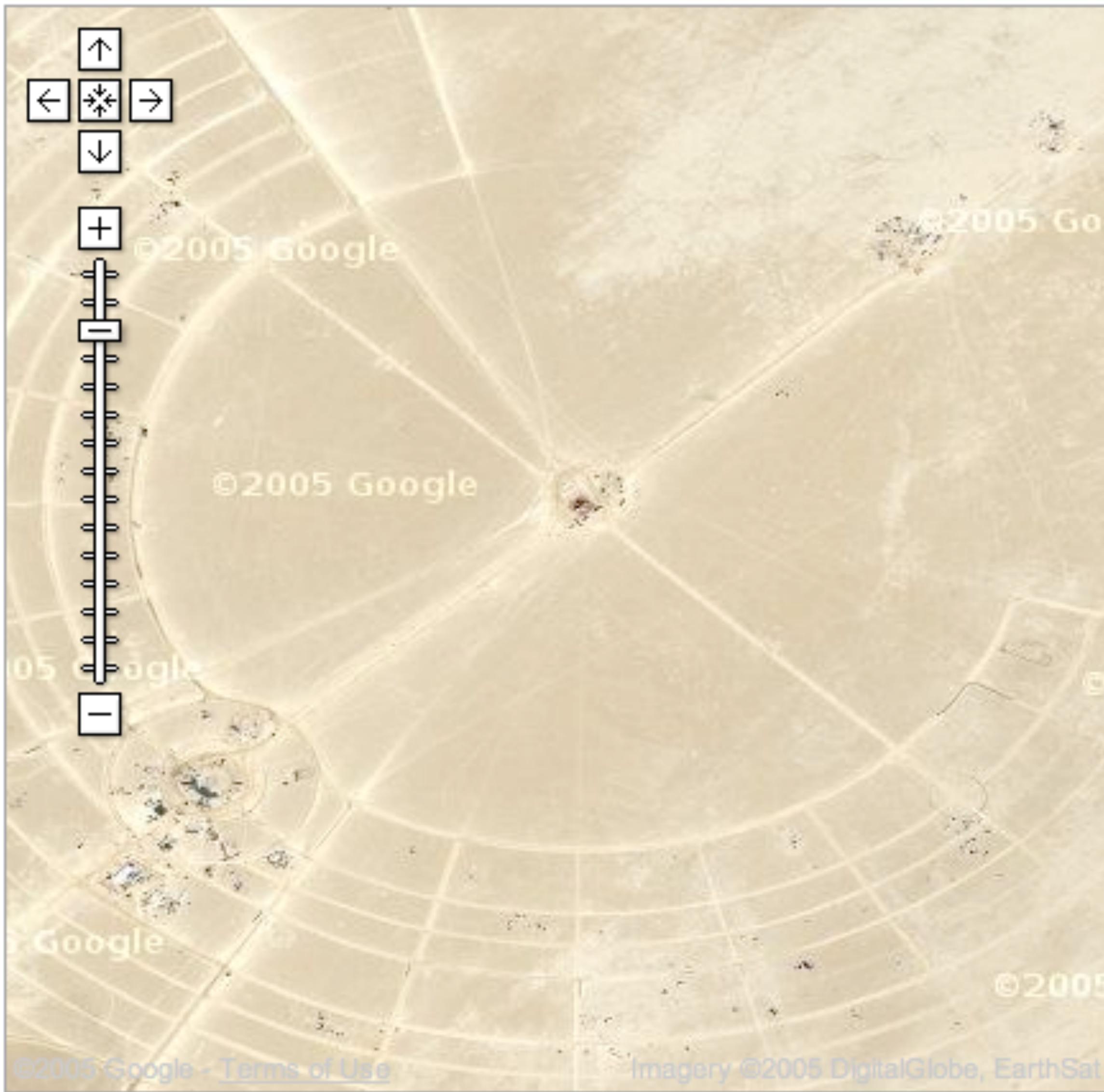
Oldest Known Map: Konya, Turkey (~6200 BC)

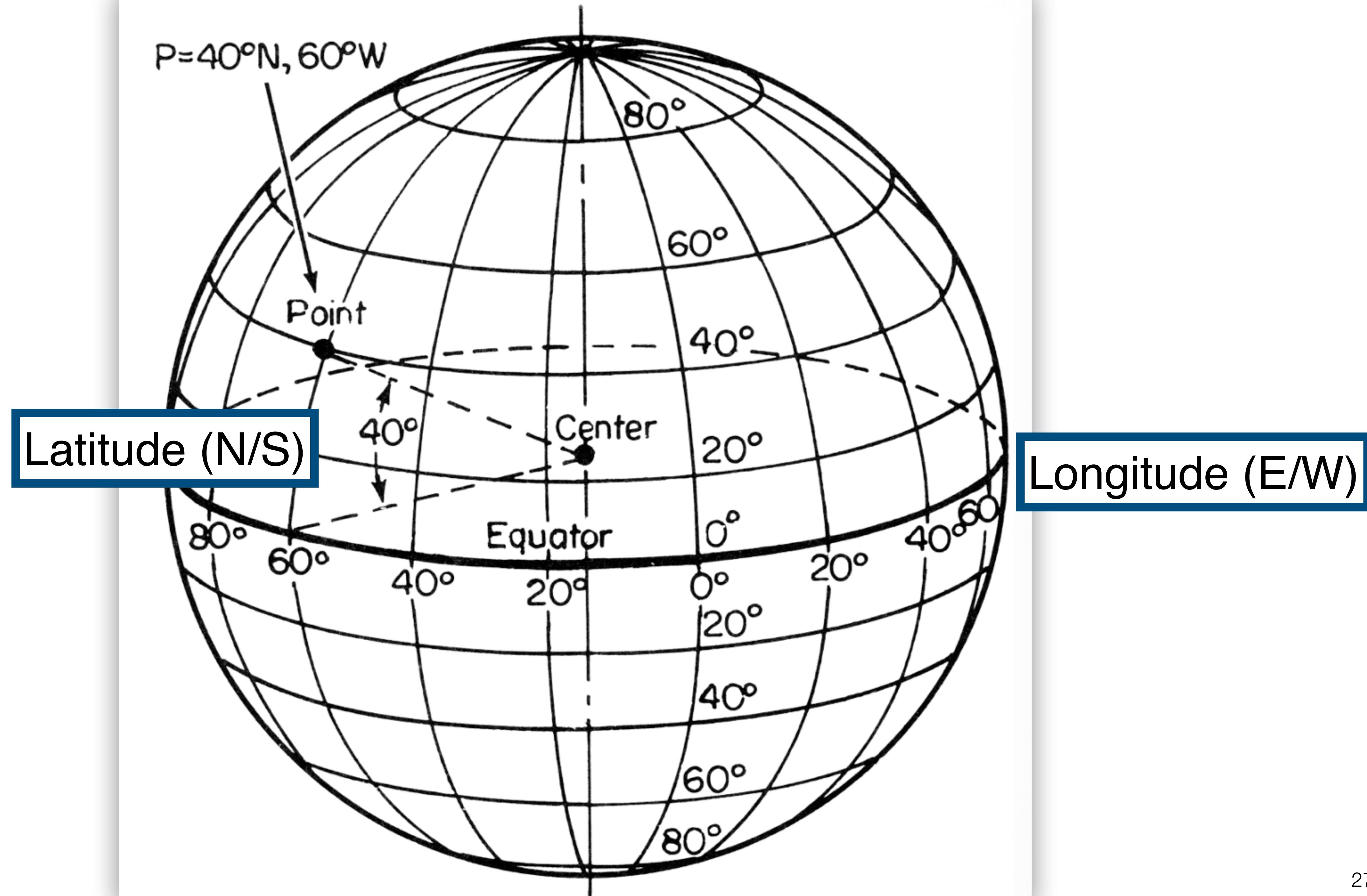


Rail Passengers and Freight from Paris 1884



Google Maps, 2005

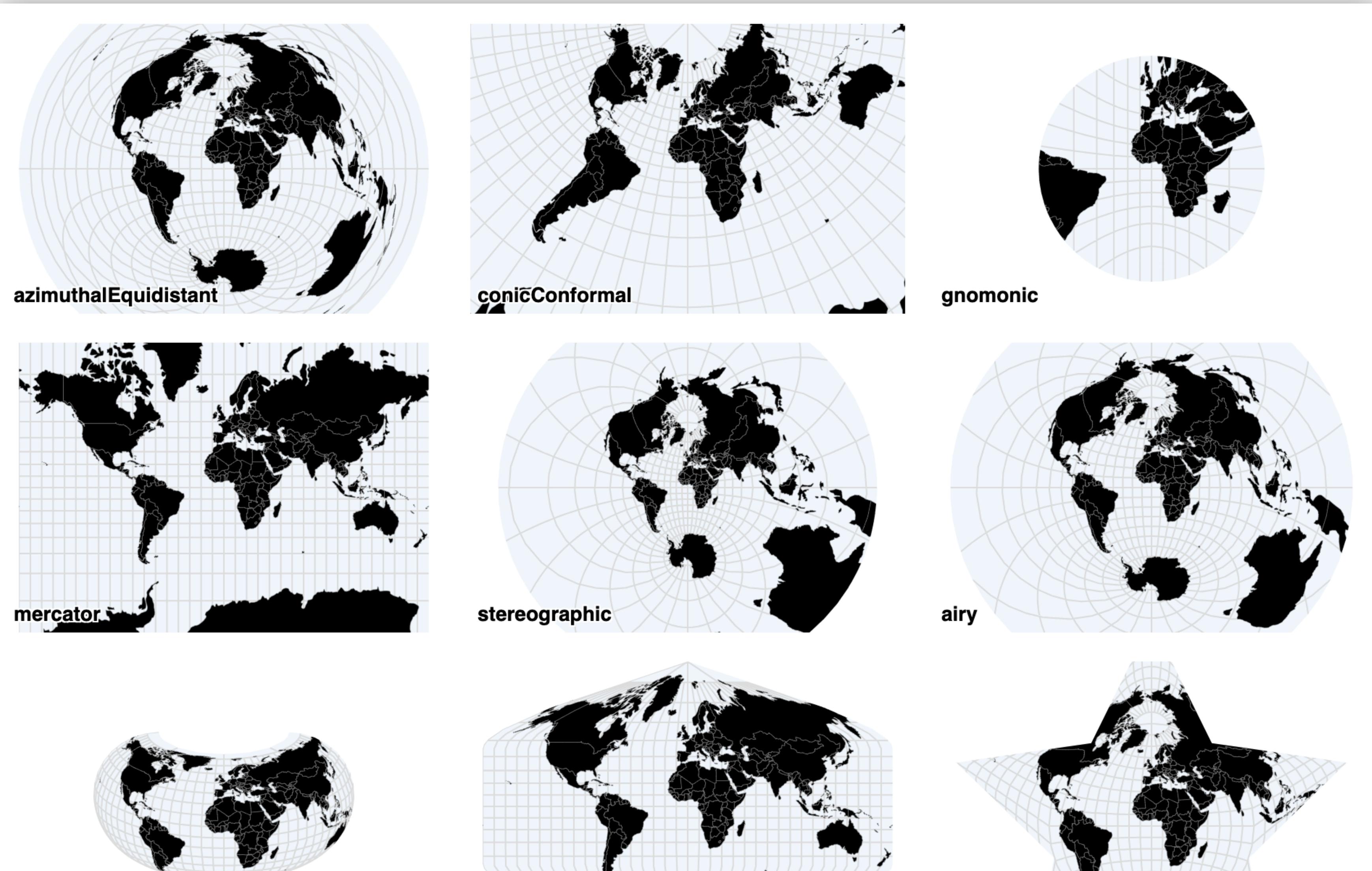






A sphere tears
when you flatten it

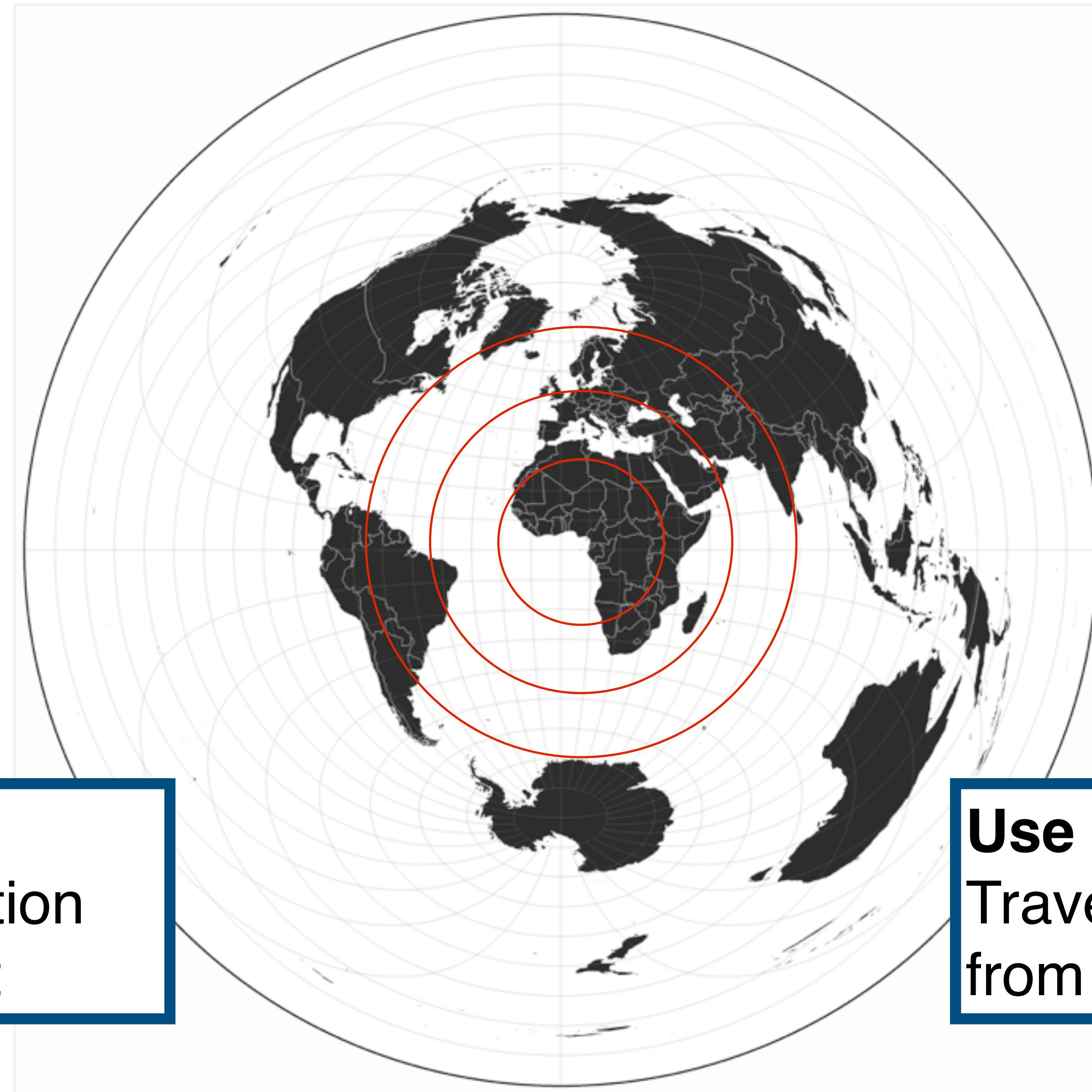
Exploring Projections



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

**Projections preserve some
metrics, distort others**

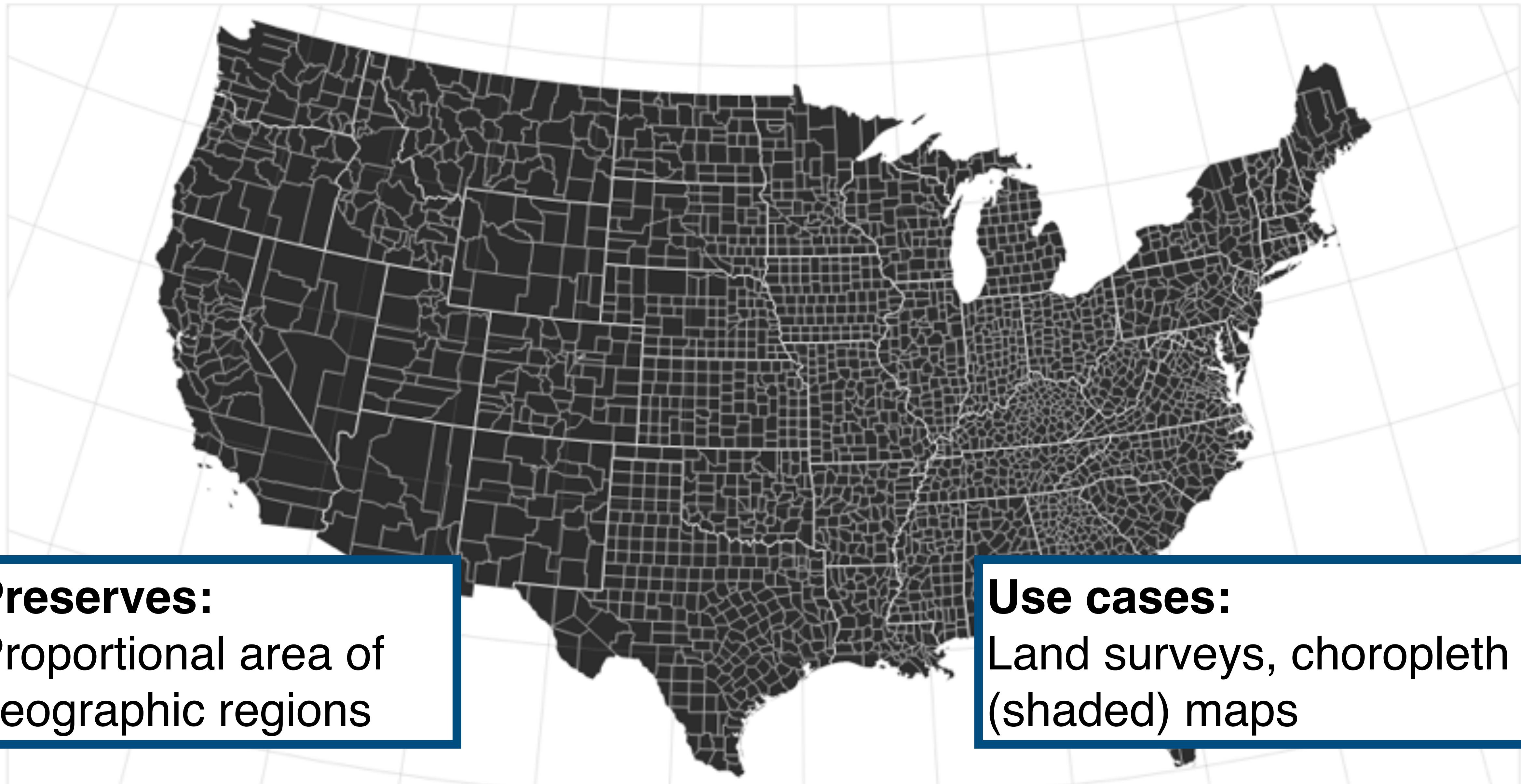
Azimuthal Equidistant



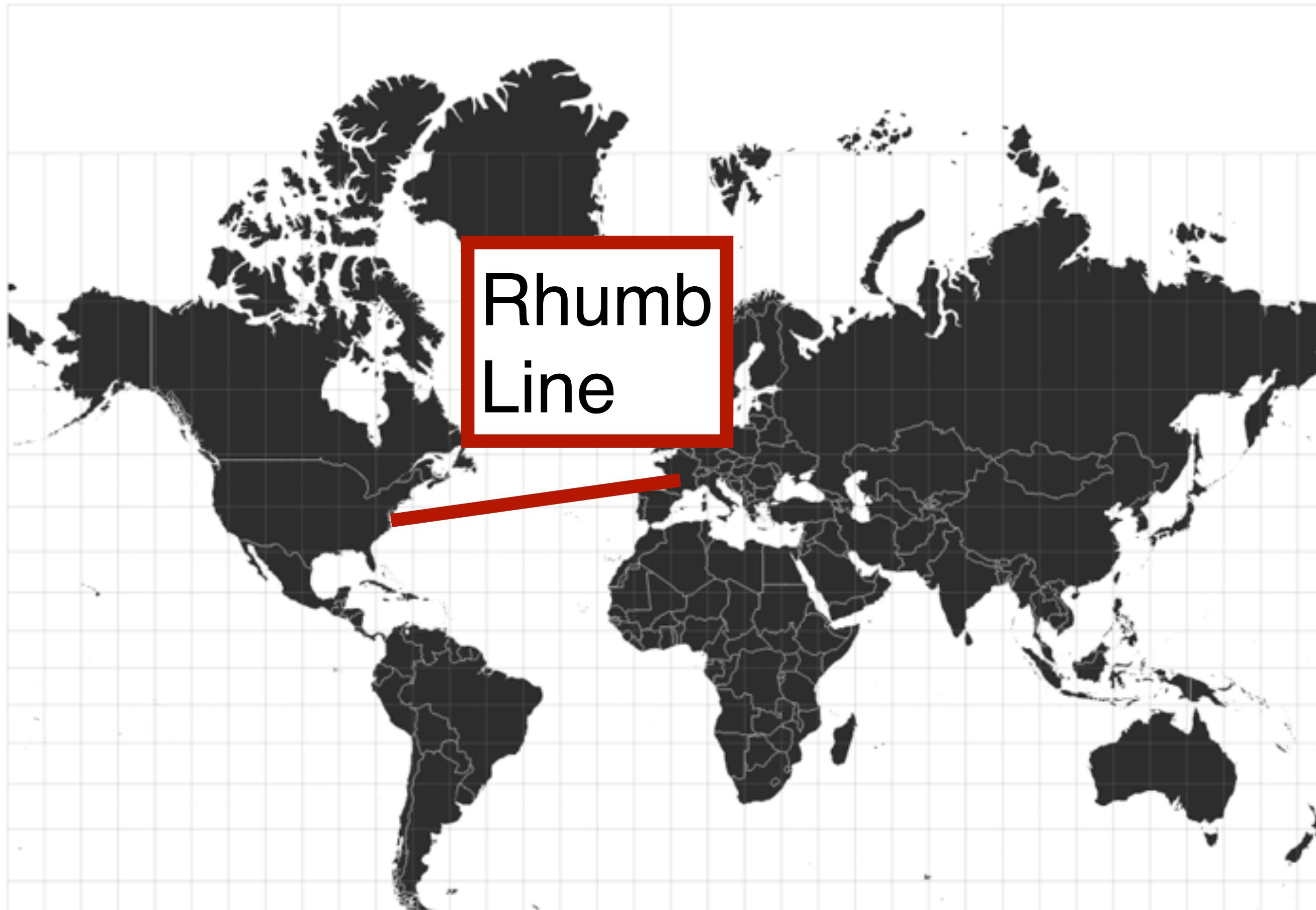
Preserves:
Distance & direction
from center point

Use cases:
Travel / propagation
from center point

Albers Equal-Area Conic



Spherical Mercator



Preserves:

Compass bearing as straight line

Use cases:

Navigation (left / right is always east / west)

Spherical Mercator

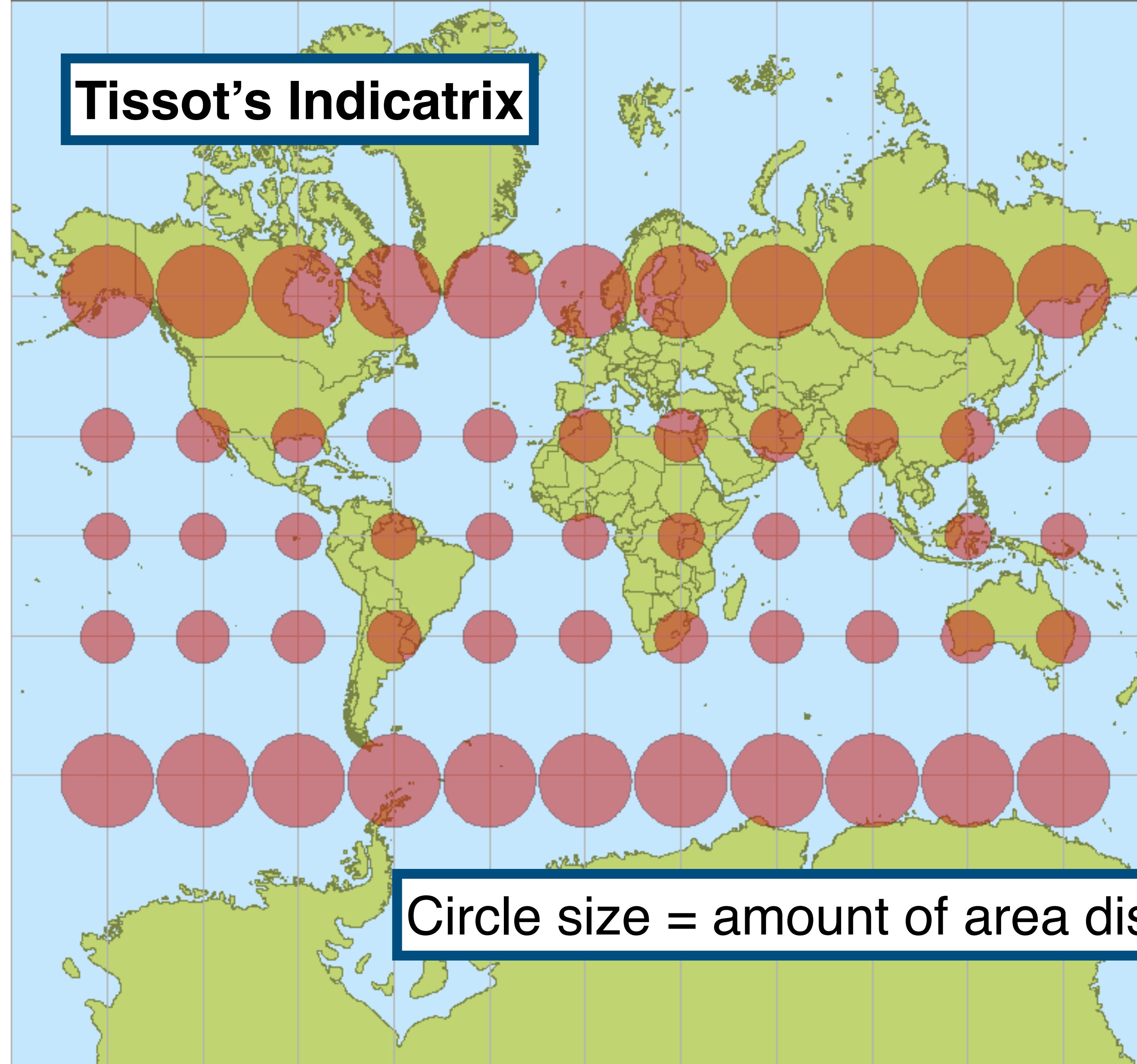


Preserves:
Compass bearing as
straight line

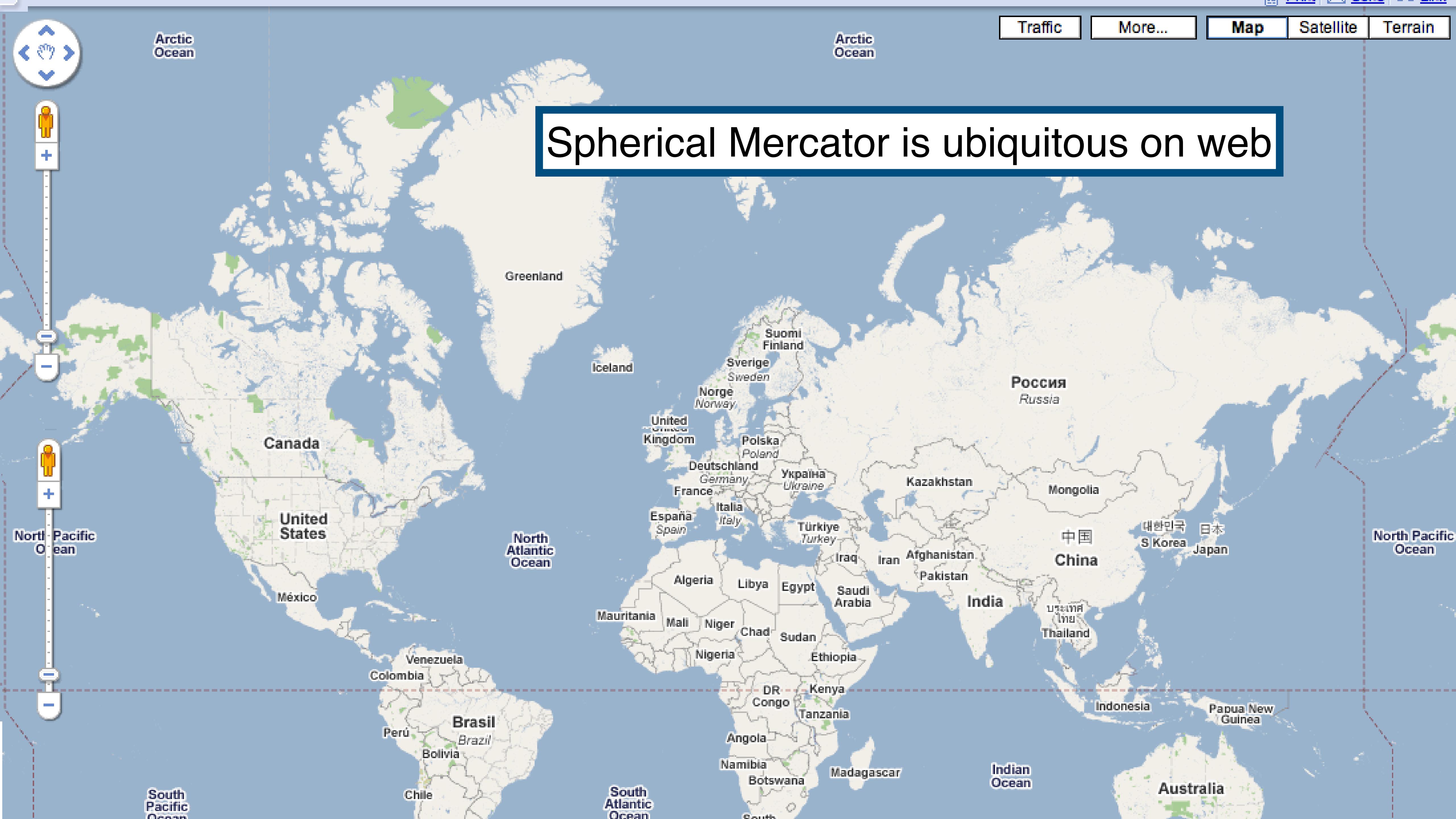


Use cases:
Navigation (left / right is
always east / west)

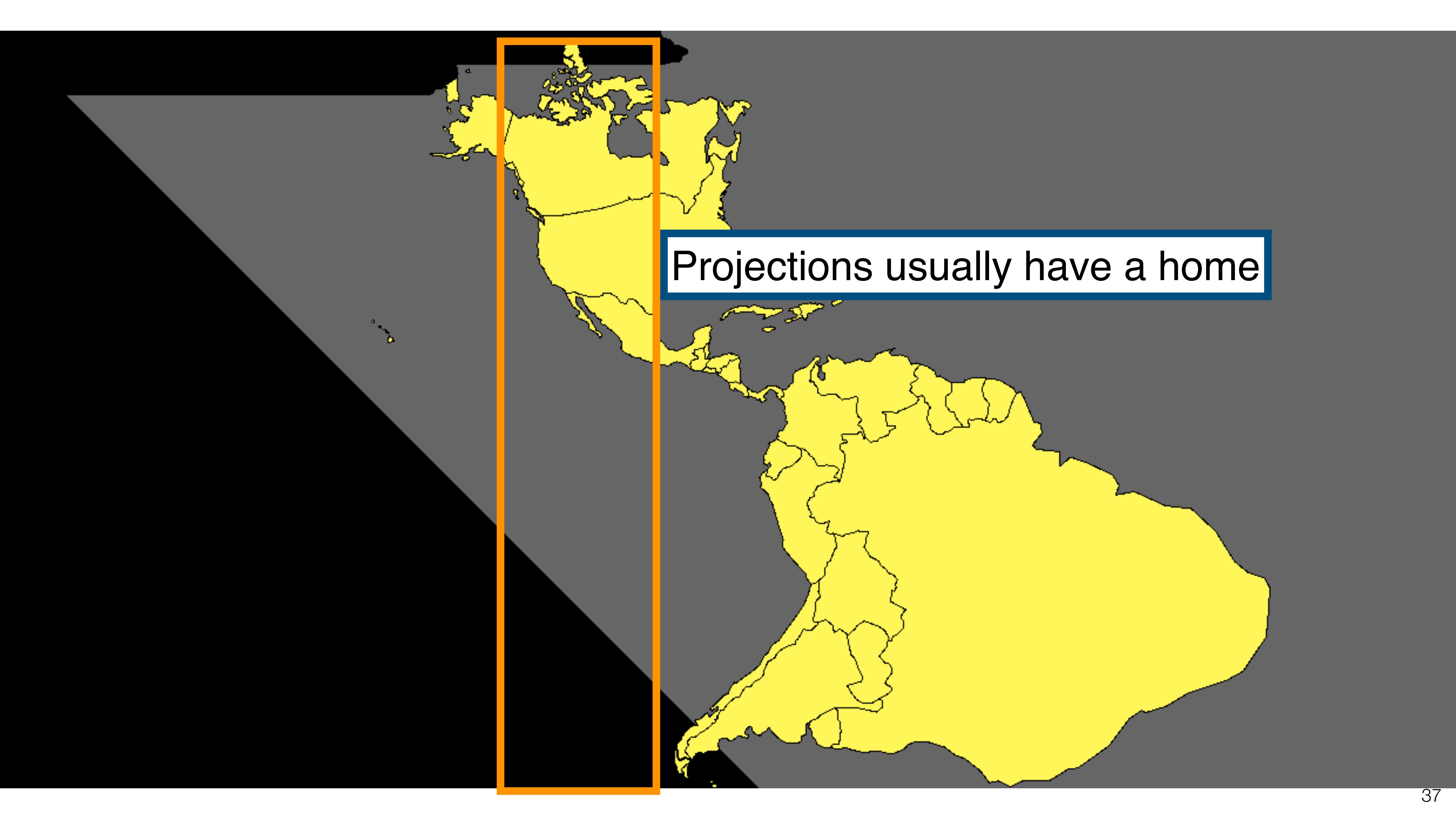
Tissot's Indicatrix



Circle size = amount of area distortion

[Traffic](#)[More...](#)[Map](#)[Satellite](#)[Terrain](#)Arctic
OceanArctic
Ocean

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>

VAN DER GRINTEN

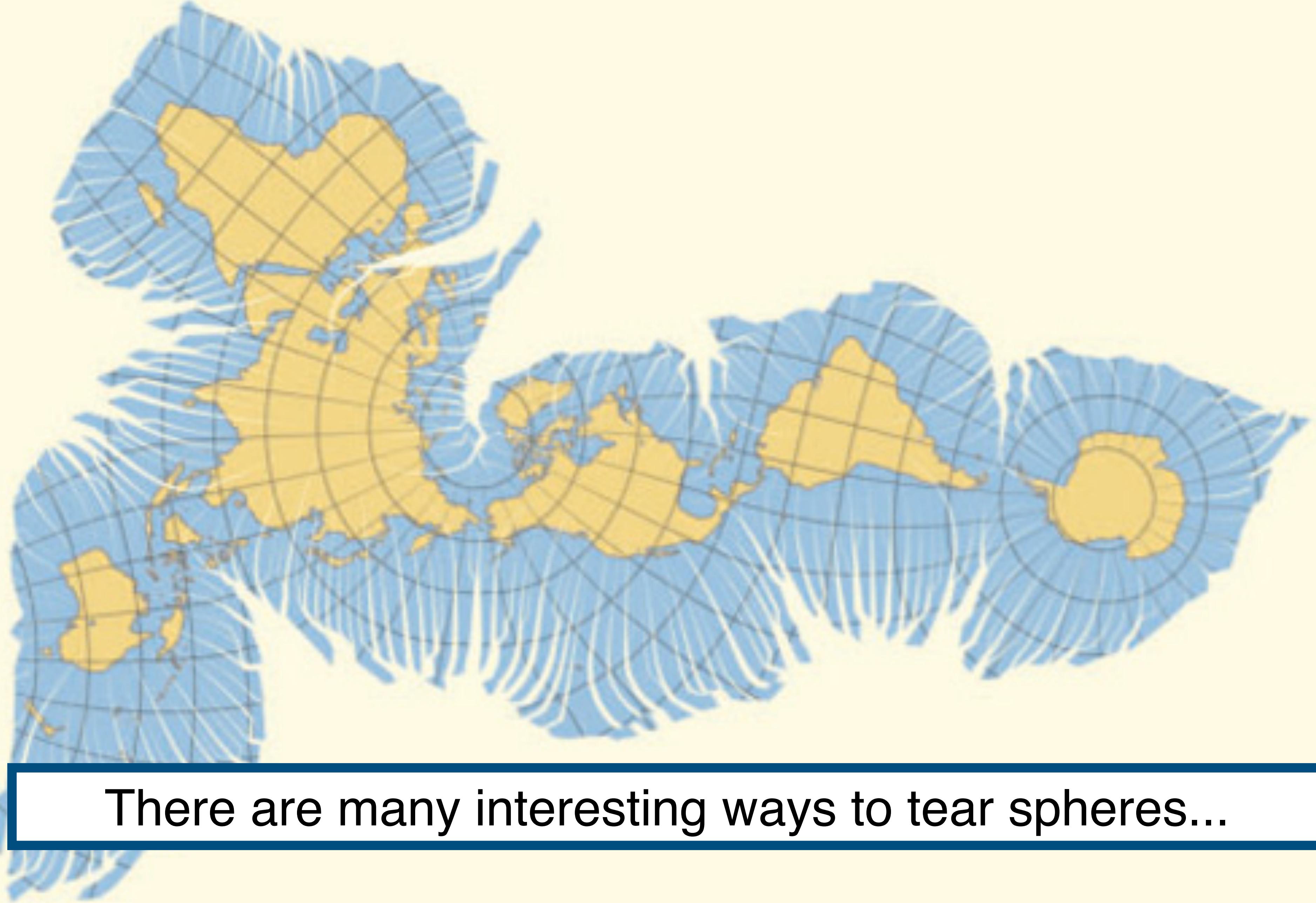
MERCATOR



YOU'RE NOT REALLY INTO MAPS.

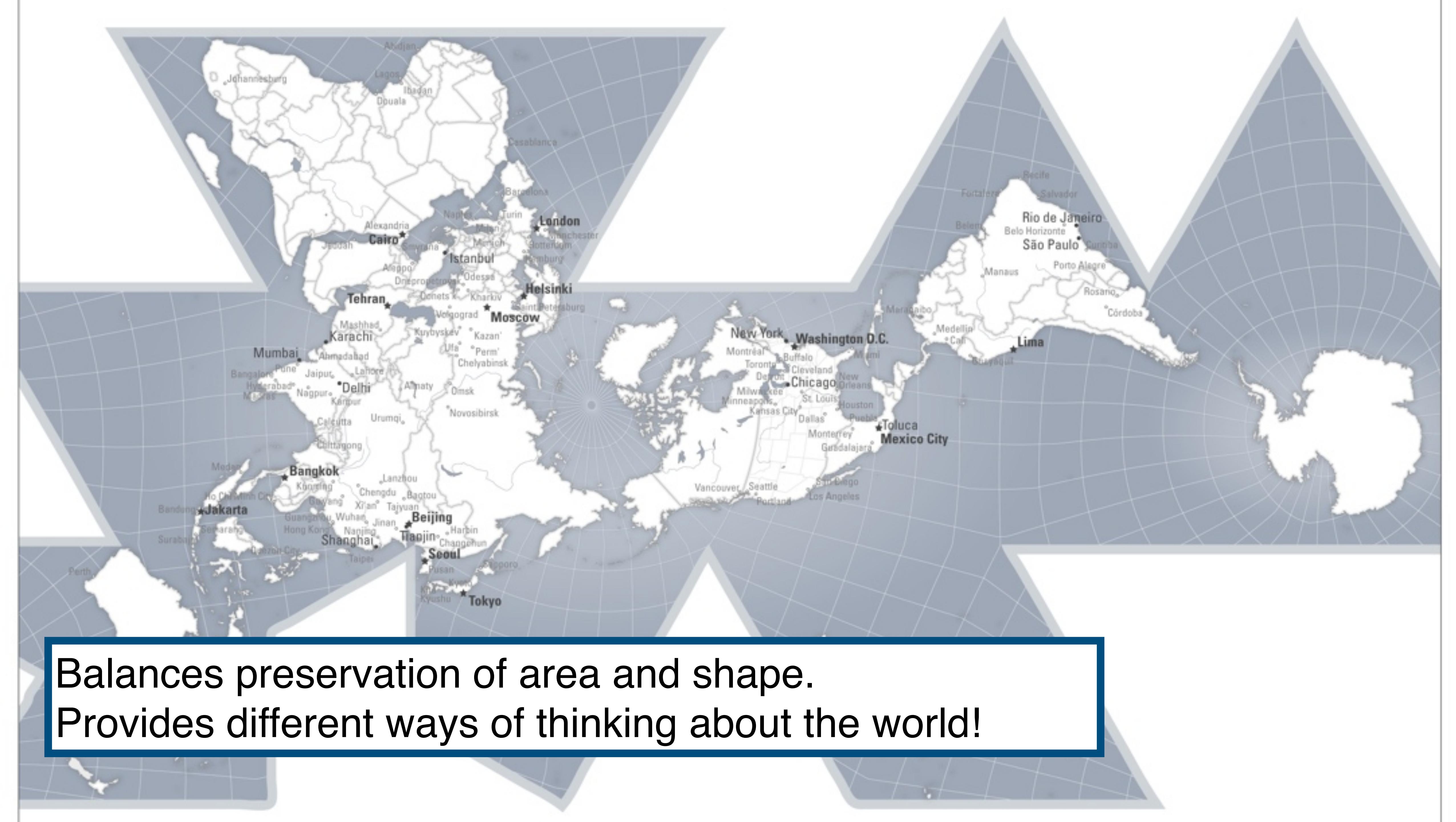


YOU'RE NOT A COMPLICATED PERSON. YOU LOVE THE MERCATOR PROJECTION; YOU JUST WISH IT WEREN'T SQUARE. THE EARTH'S NOT A SQUARE, IT'S A CIRCLE. YOU LIKE CIRCLES. TODAY IS GONNA BE A GOOD DAY!

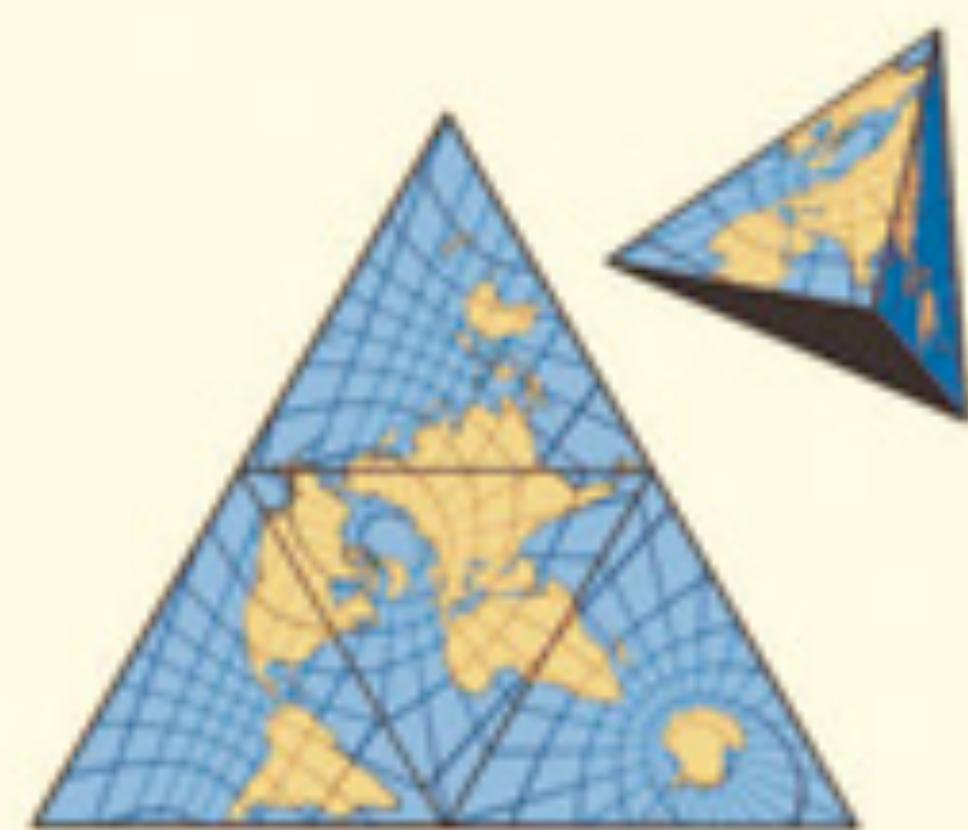


There are many interesting ways to tear spheres...

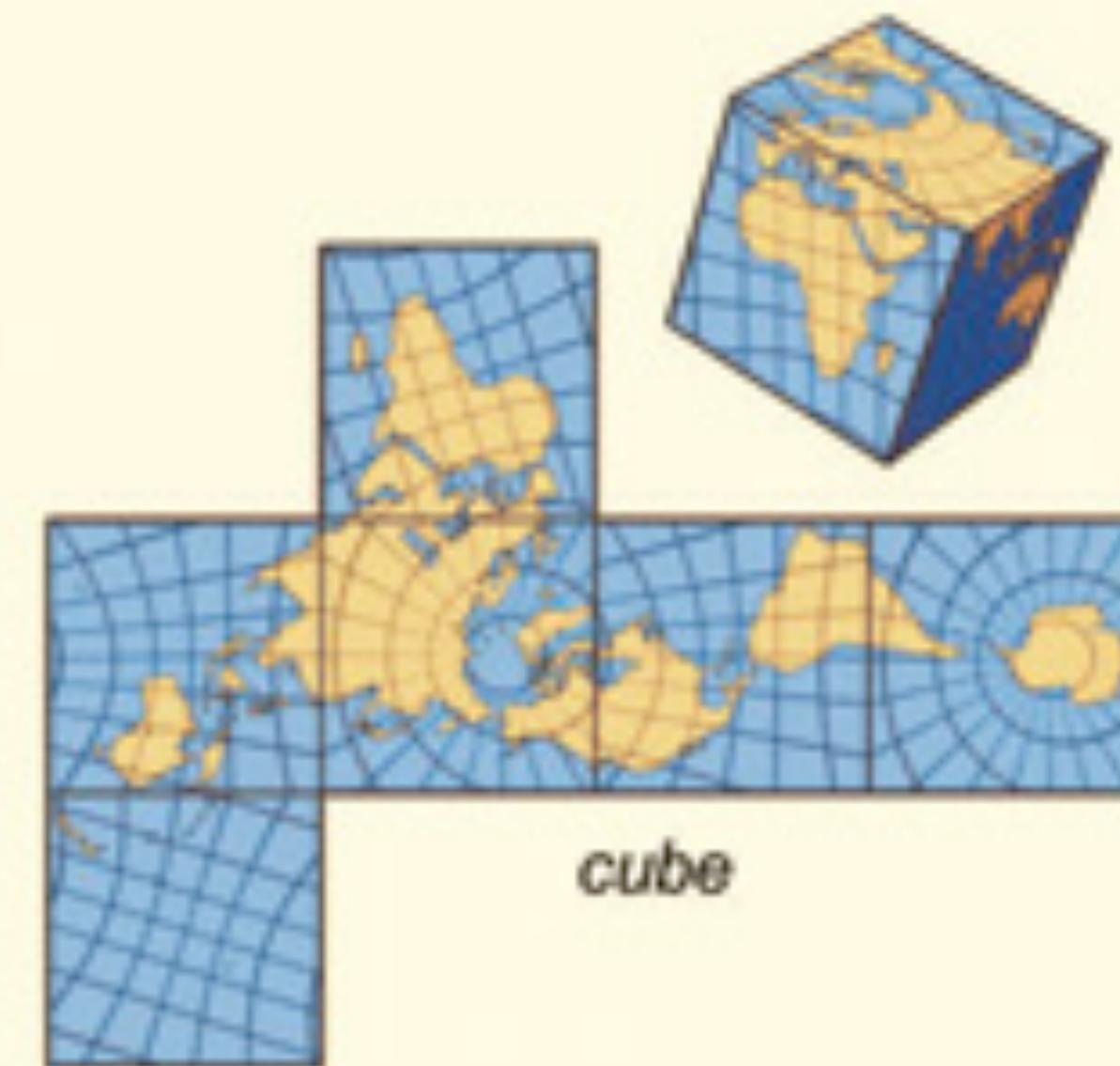




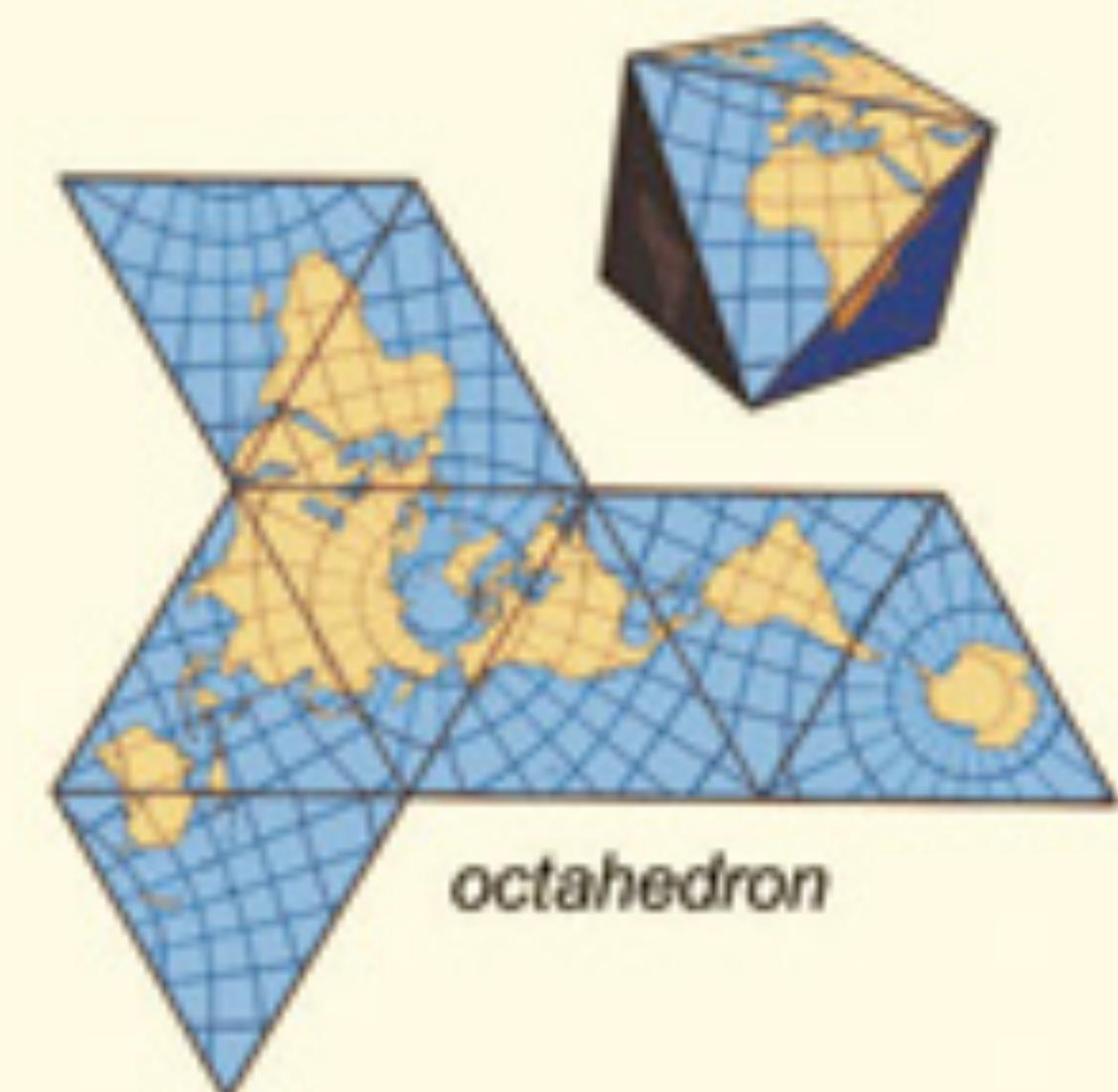
Balances preservation of area and shape.
Provides different ways of thinking about the world!



tetrahedron



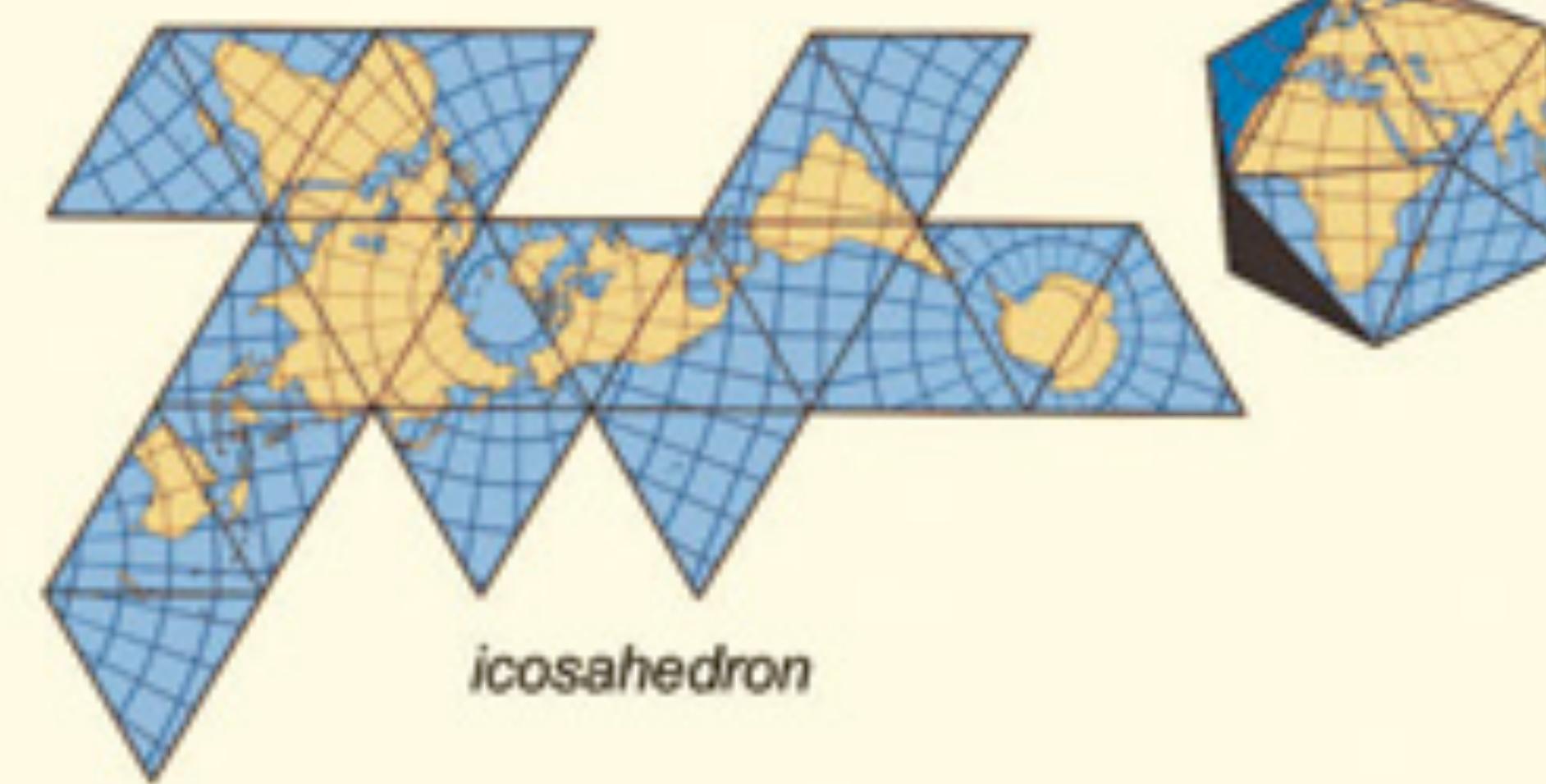
cube



octahedron



dodecahedron



icosahedron



ADAPTIVE COMPOSITE MAP PROJECTIONS

Idea: switch between projections by location and zoom level

Mapping

(Visualizing Geospatial Data)

How does the data change?

Where
does the
data
occur?

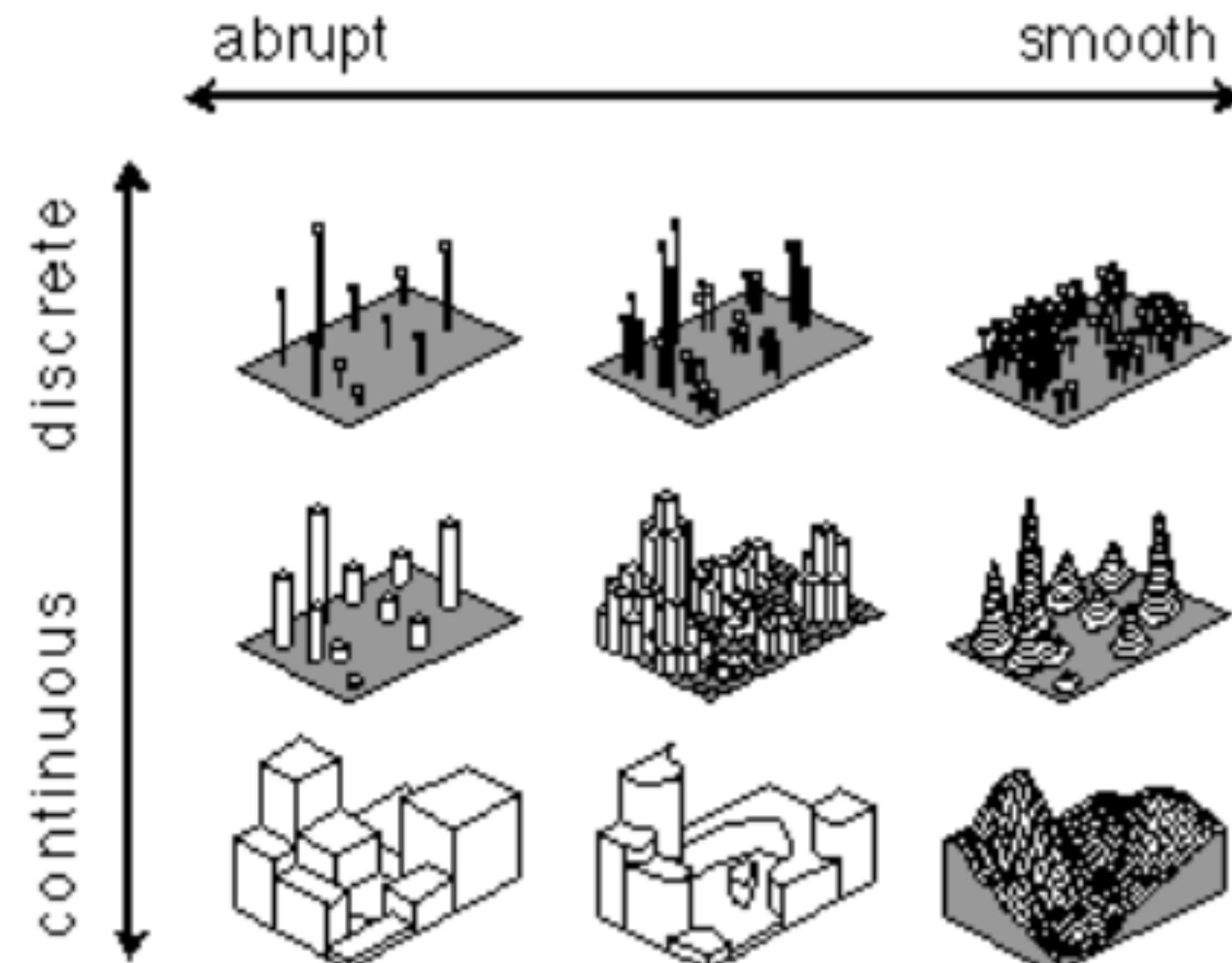


Fig. 8. Data models representing points in the continuity-abruptness phenomena space.

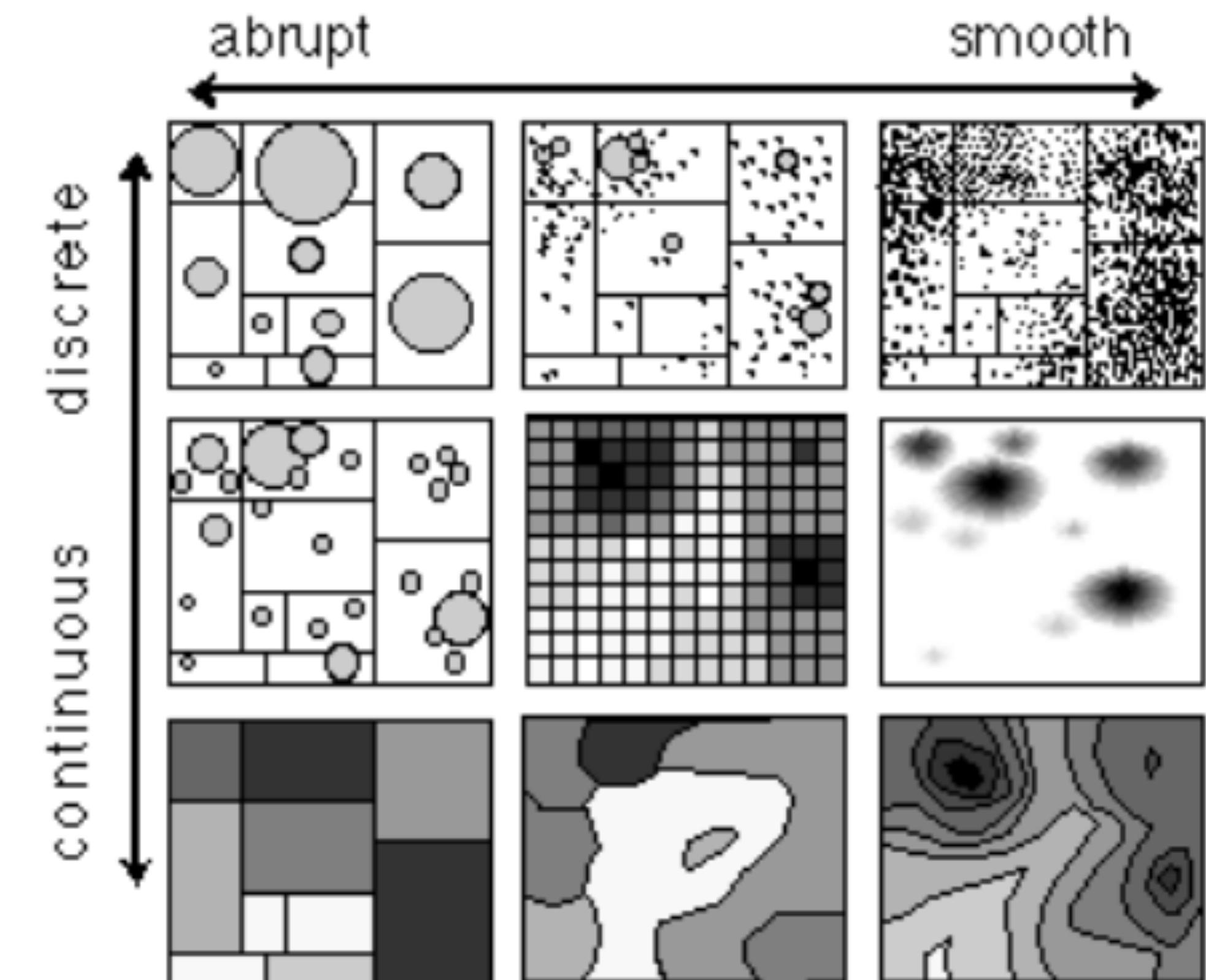


Fig. 9. Possible 2D translations of the 3D data models shown in figure 8.

Dot Distribution Map

A TAXONOMY OF TRANSITIONS

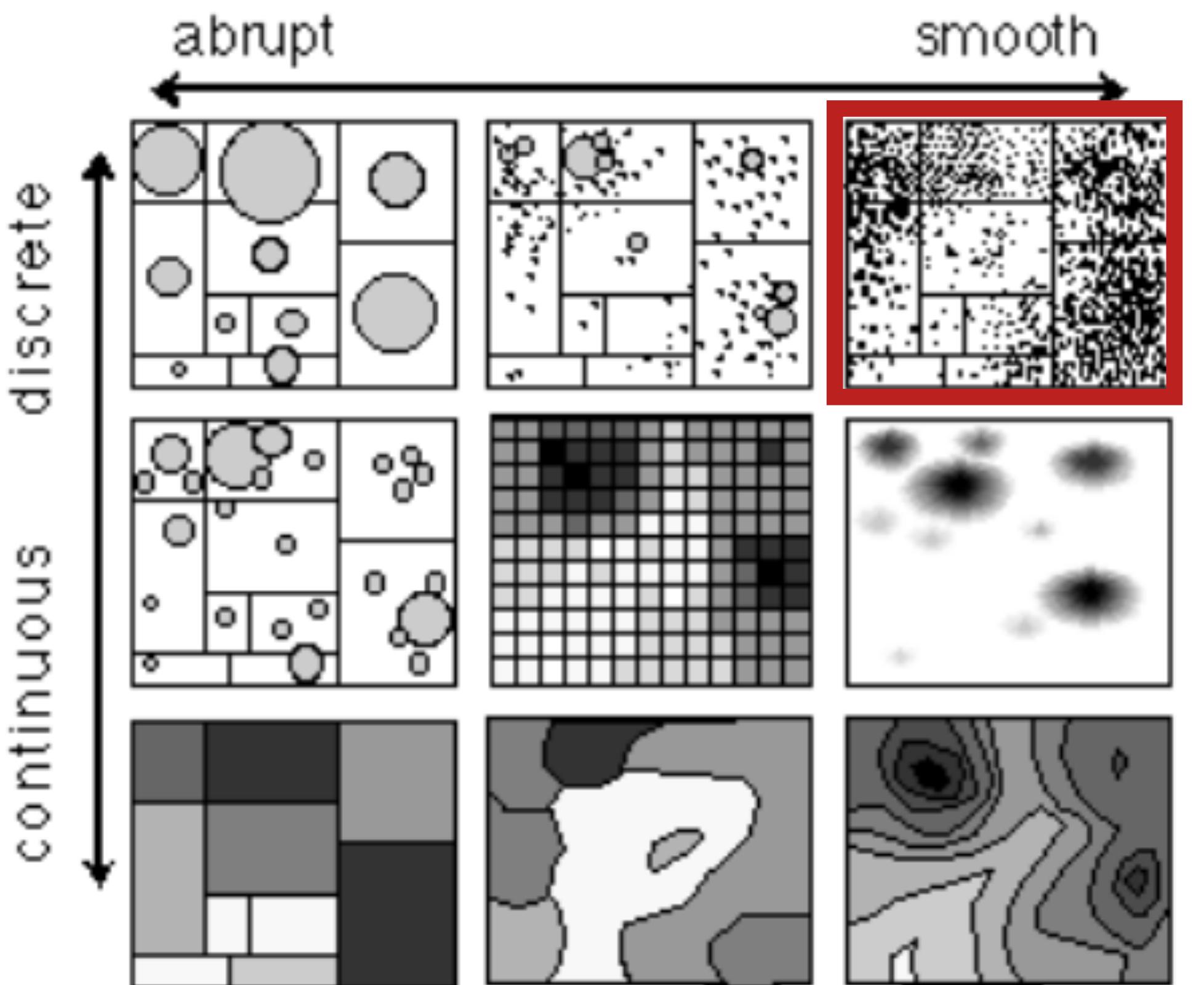
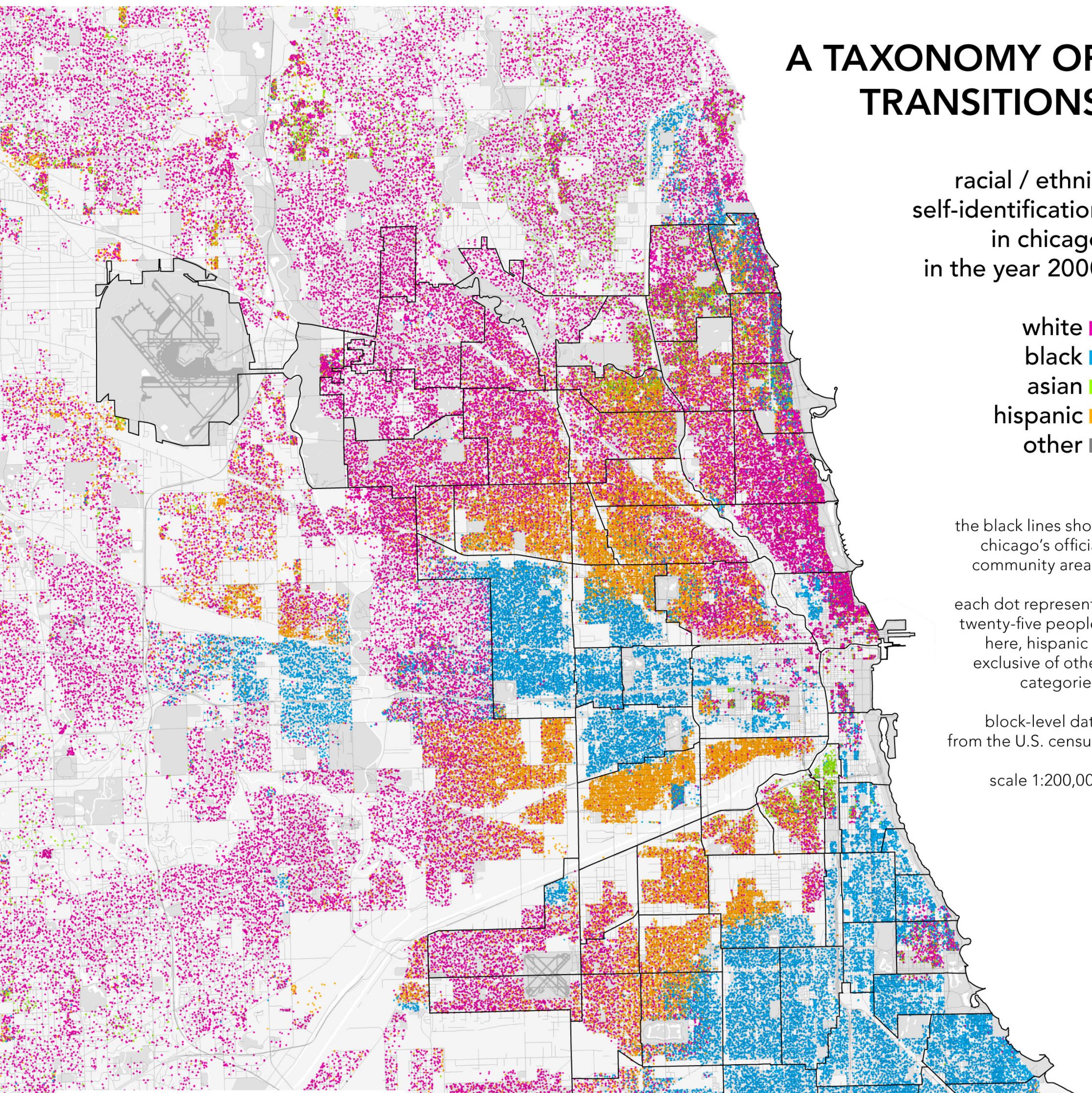


Fig. 9. Possible 2D translations of the 3D data models shown in figure 8.



Dot Distribution Map

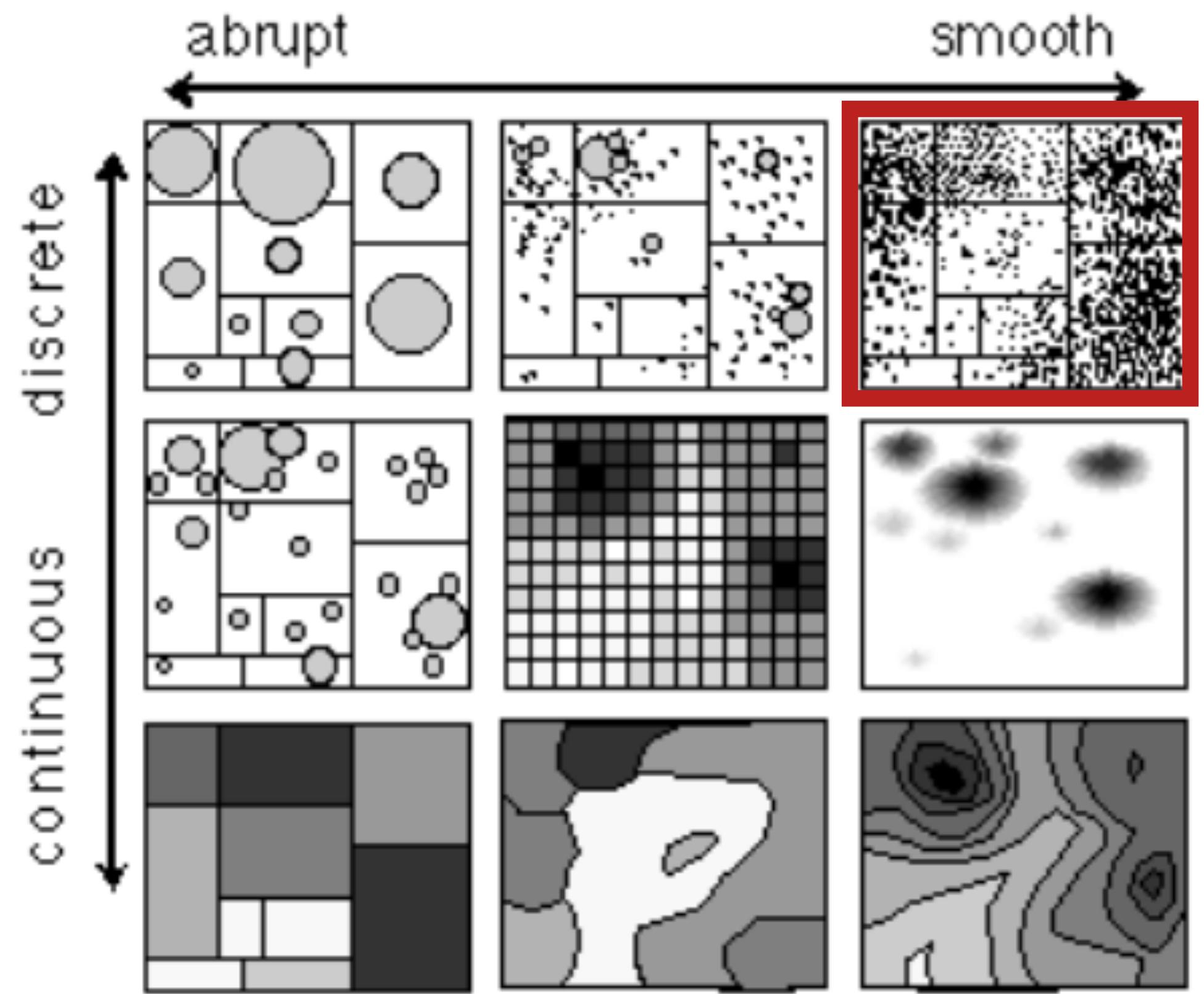
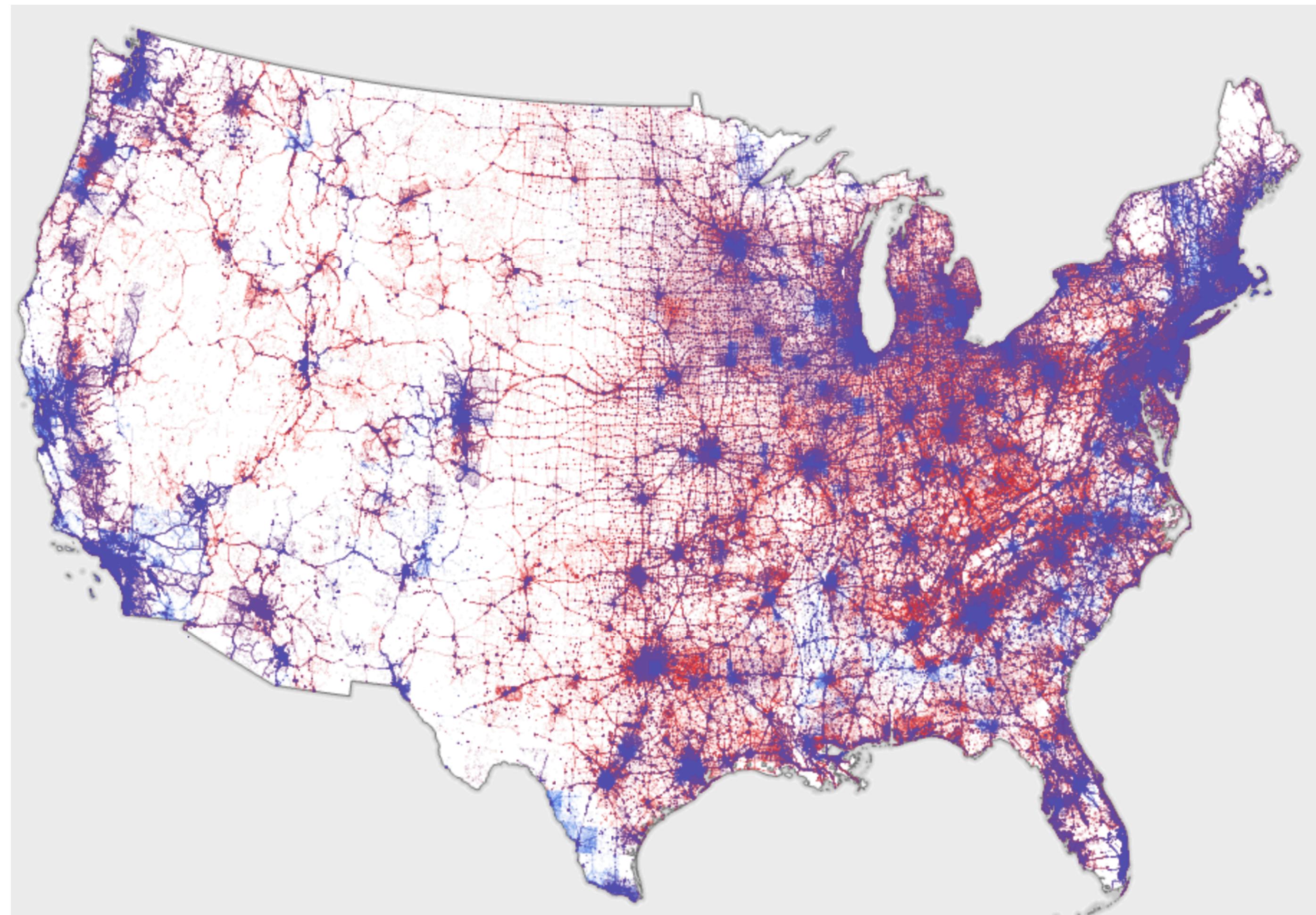


Fig. 9. Possible 2D translations of the 3D data models shown in figure 8.



Votes cast in the 2016 Presidential Election

Dot Distribution Map

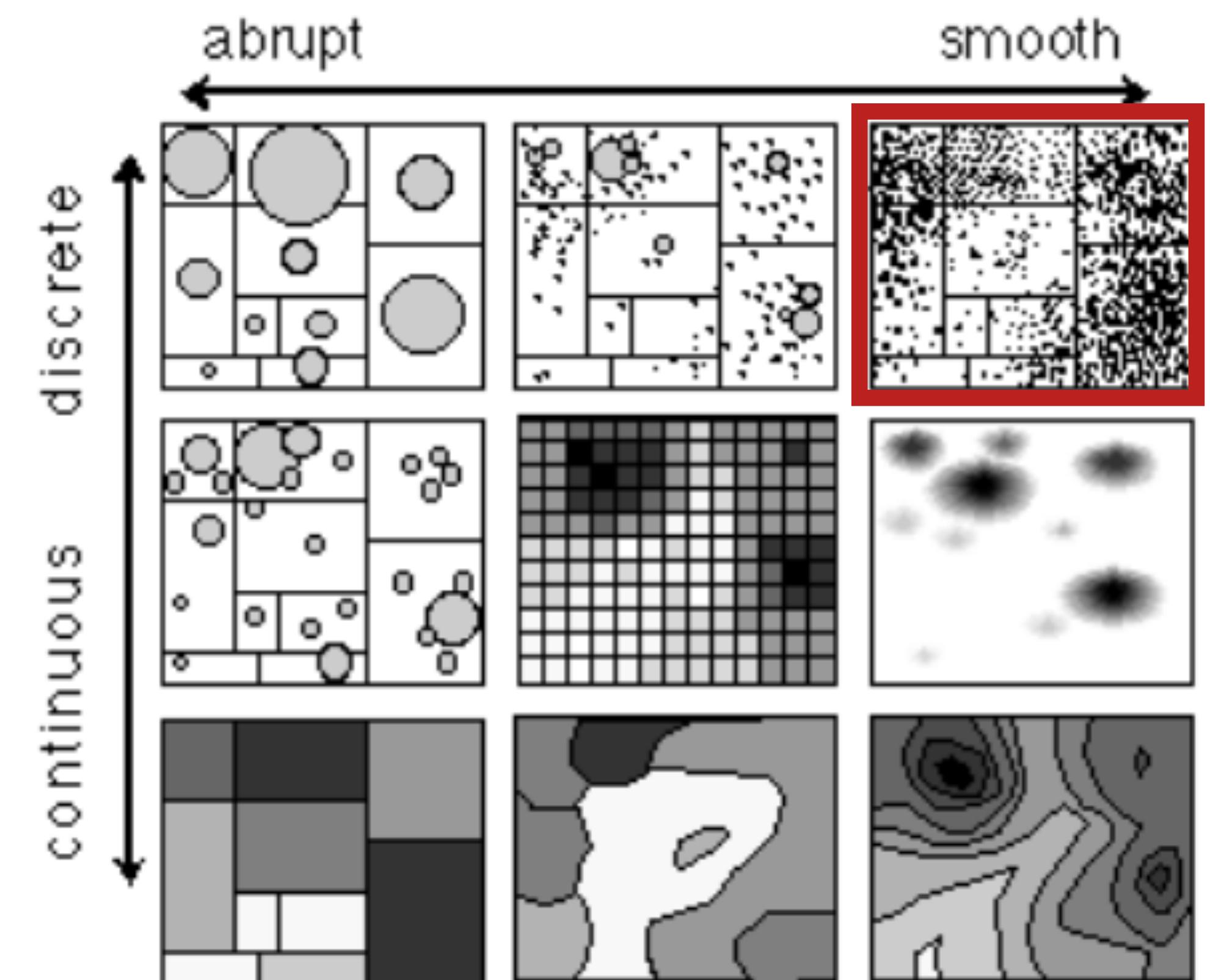
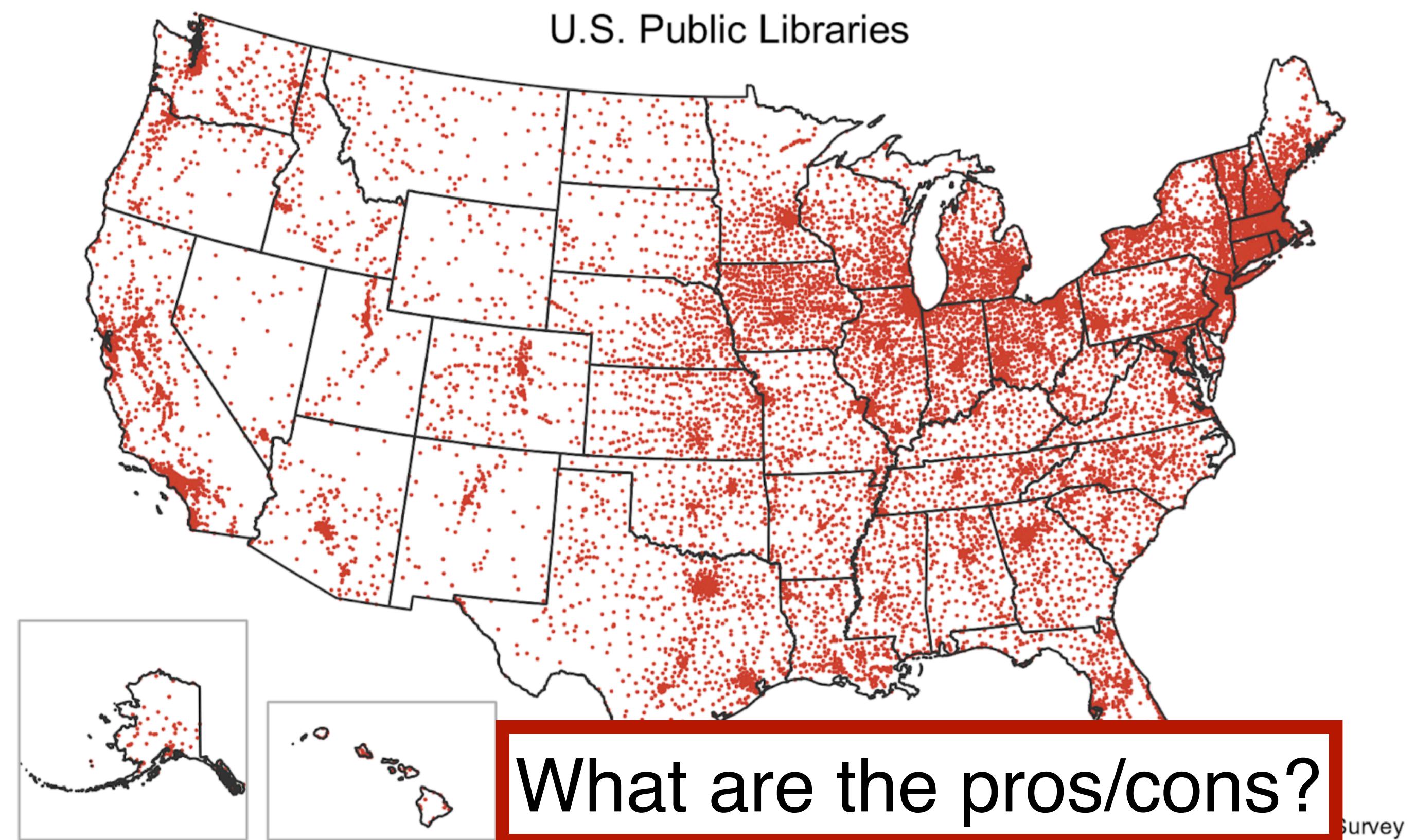


Fig. 9. Possible 2D translations of the 3D data models shown in figure 8.



Dot Distribution Map

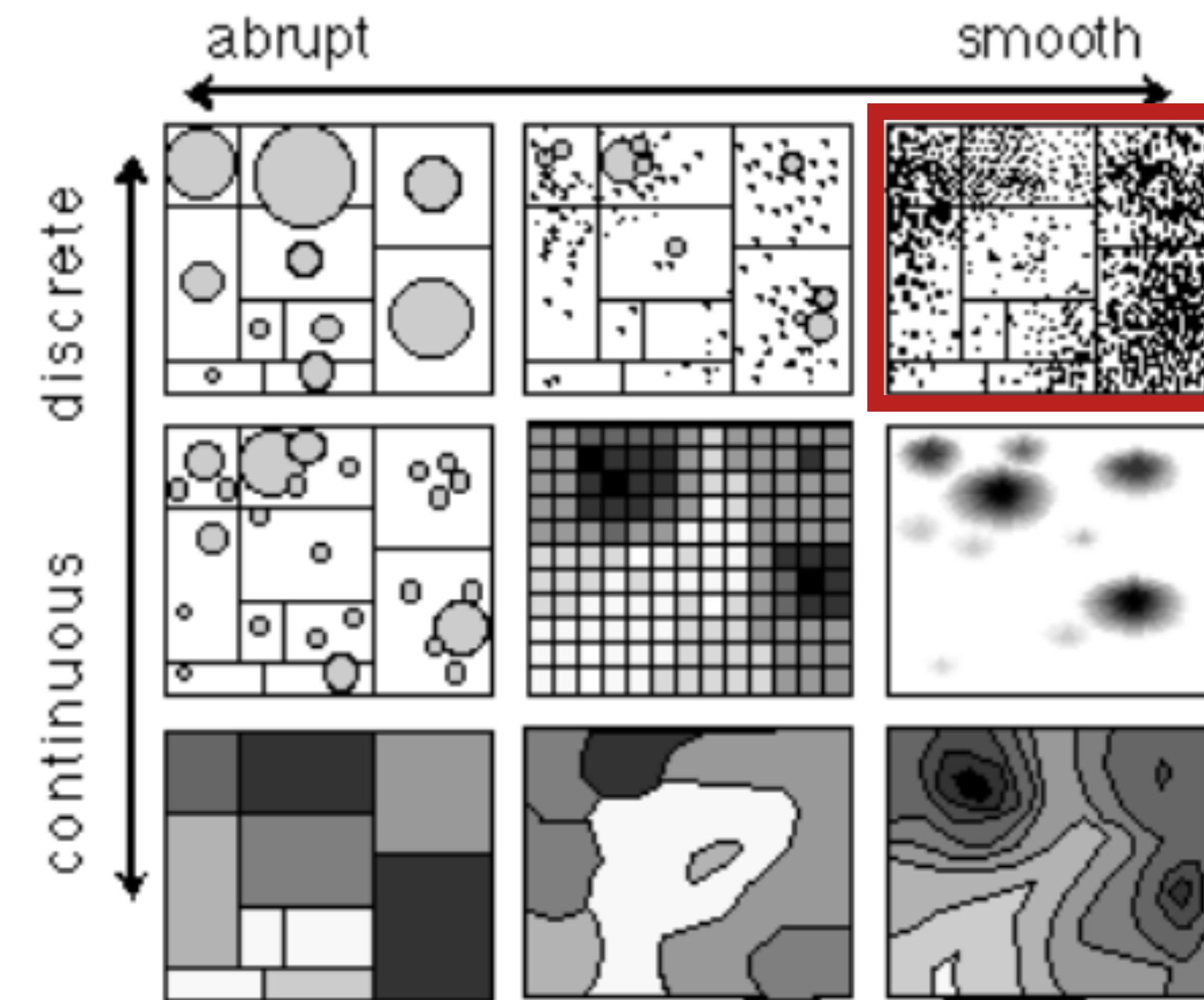
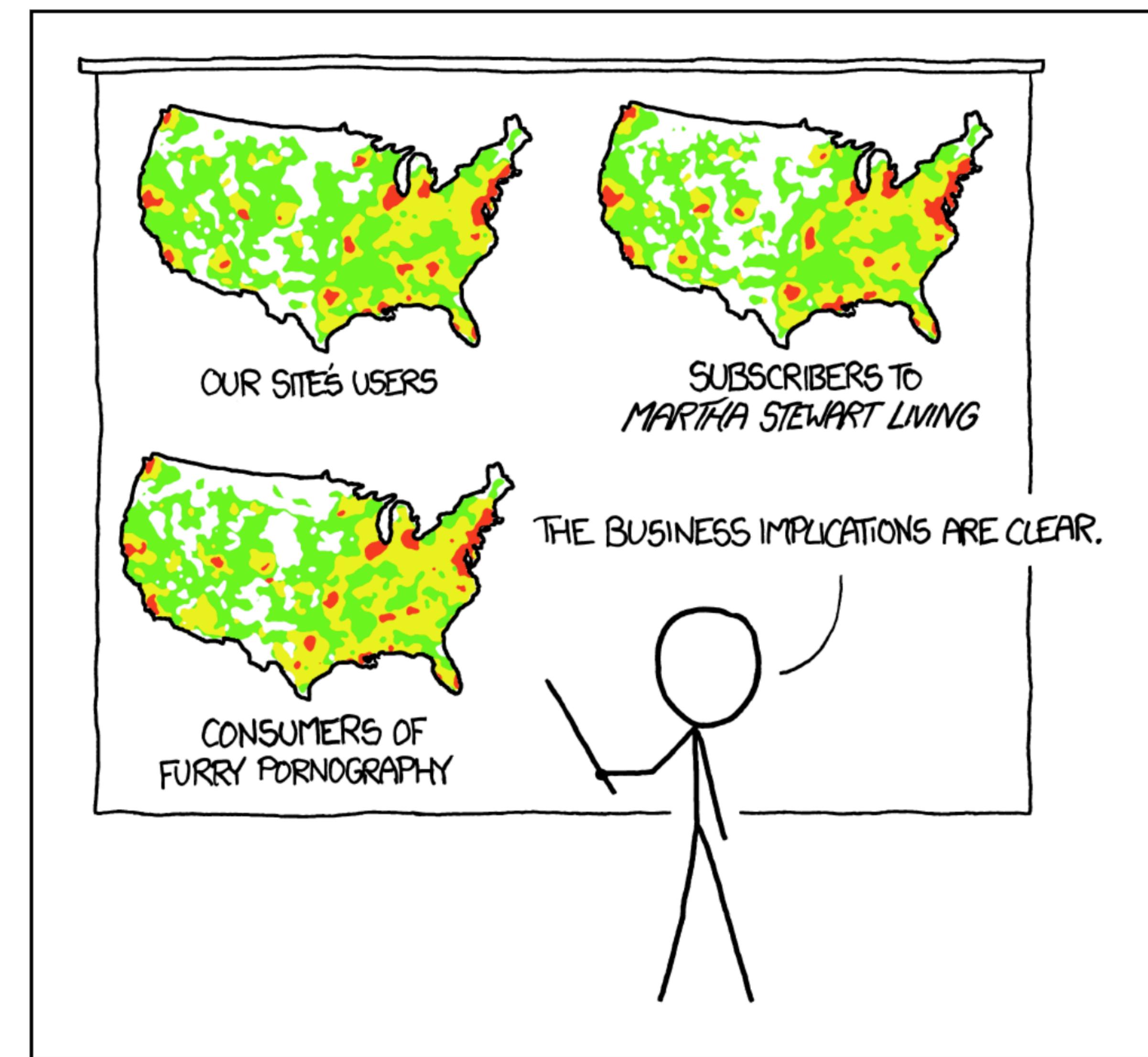
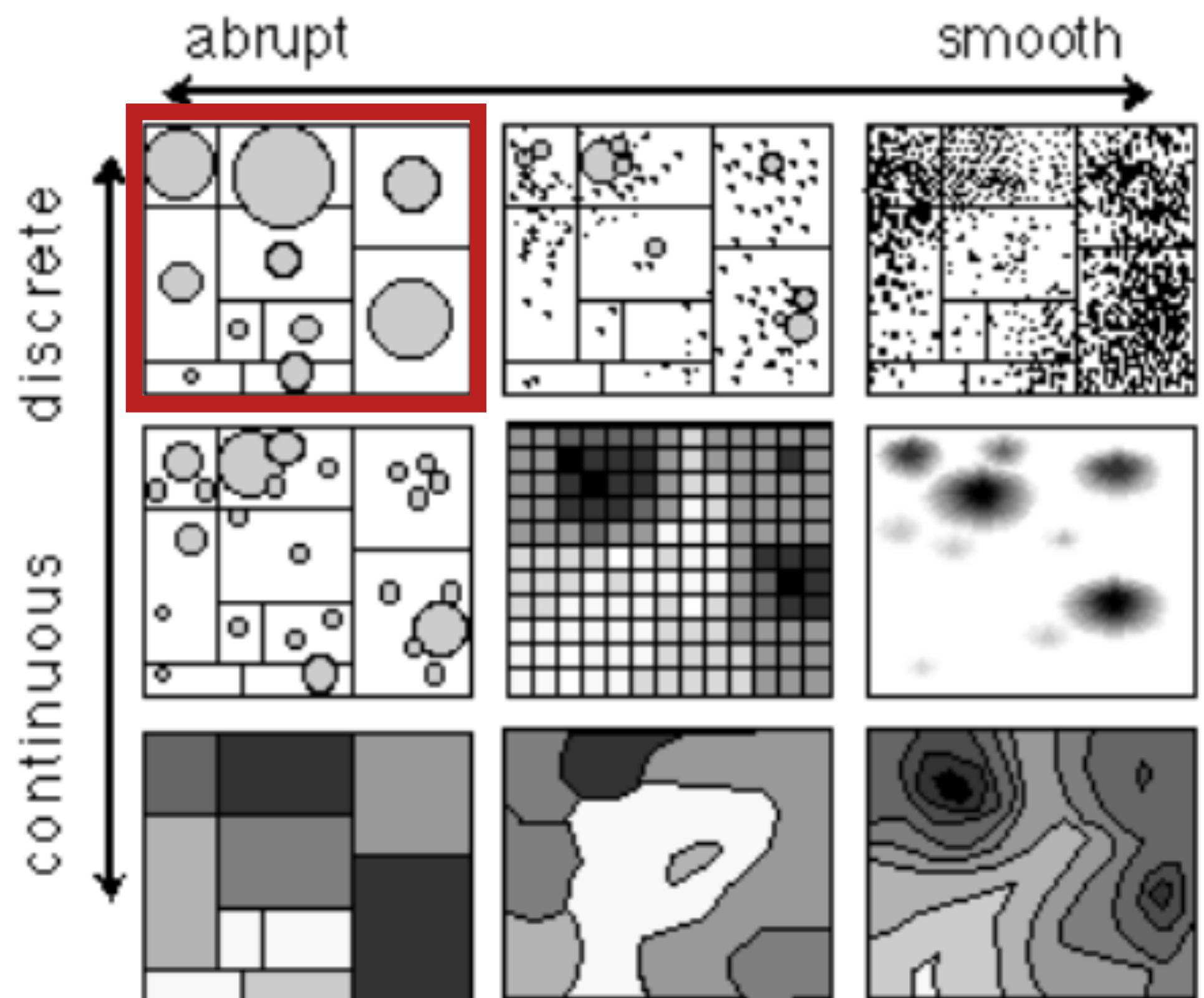


Fig. 9. Possible 2D translations of the 3D data models shown in figure 8.



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

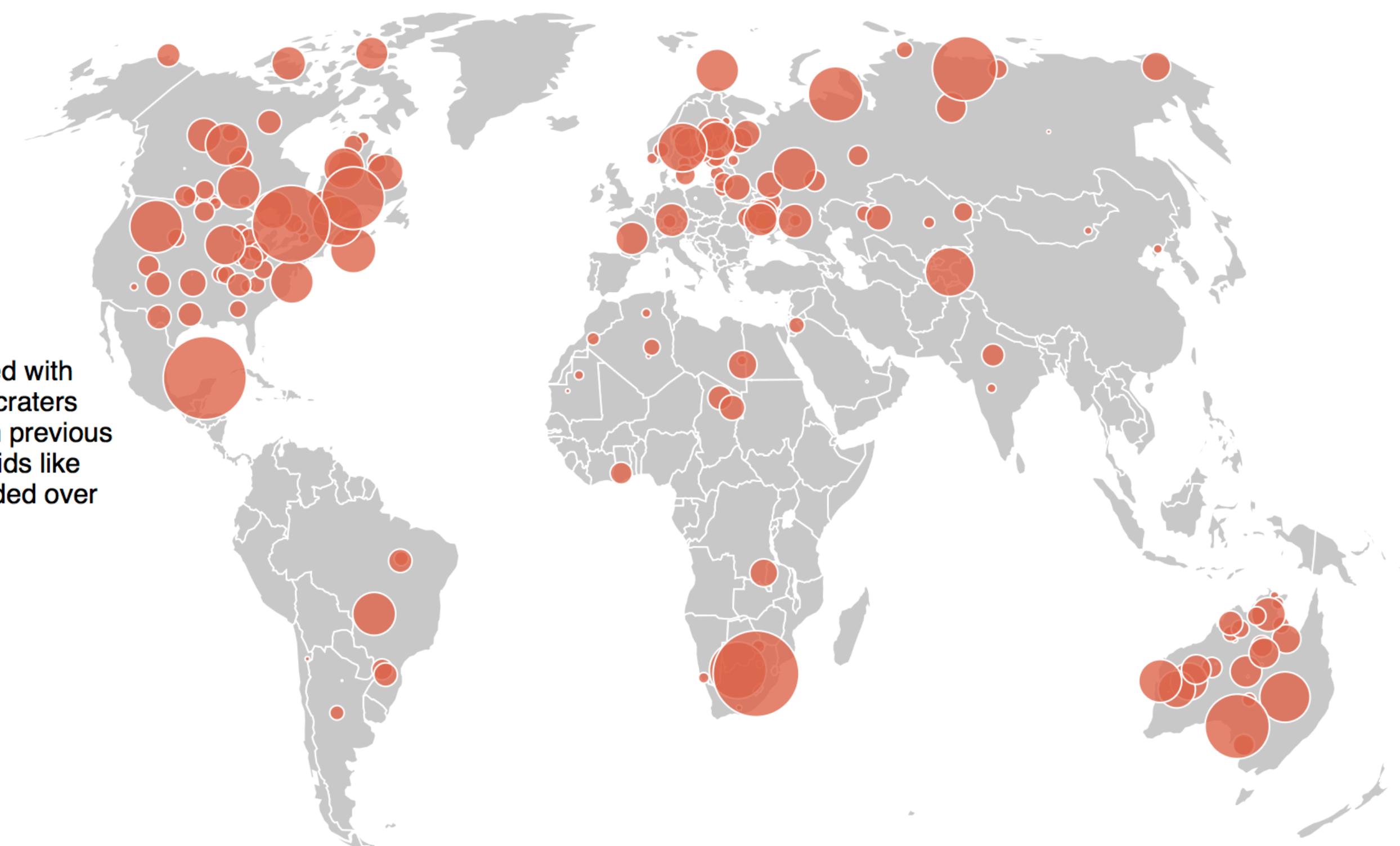


Fig. 9. Possible 2D translations of the 3D data models shown in figure 8.

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

Proportional Symbol Map

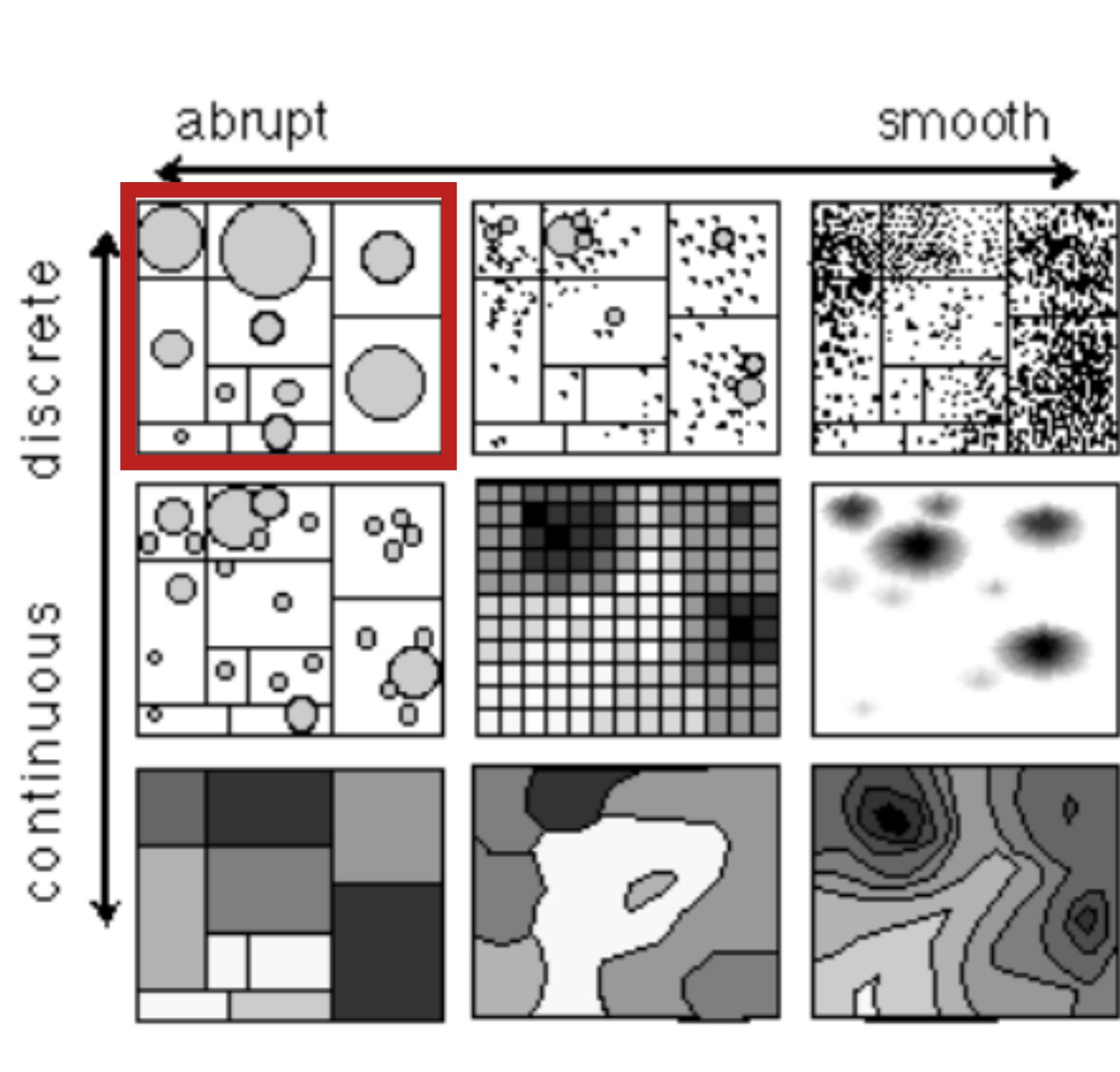
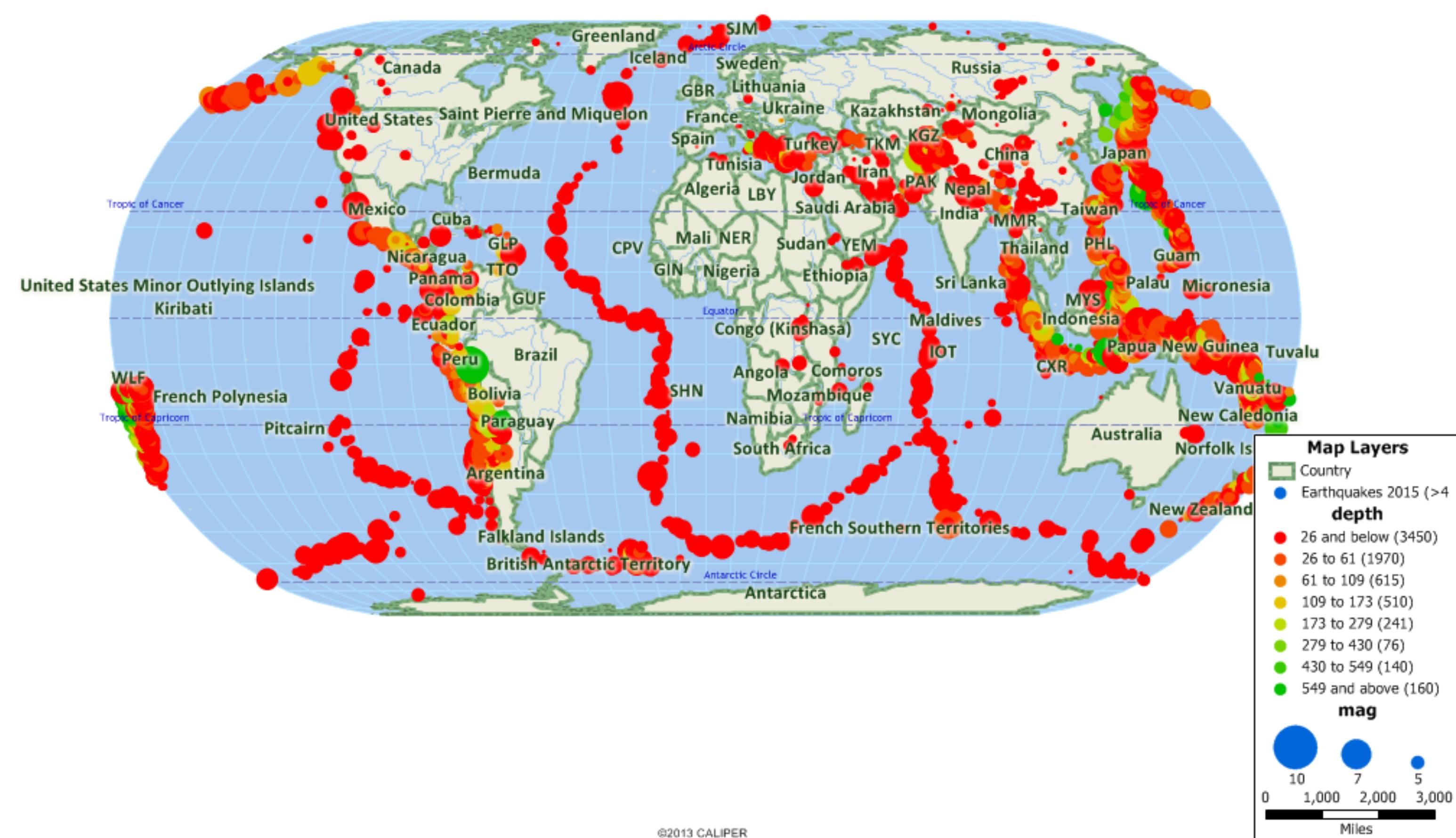


Fig. 9. Possible 2D translations of the 3D data models shown in figure 8.



Graduated Symbol Map

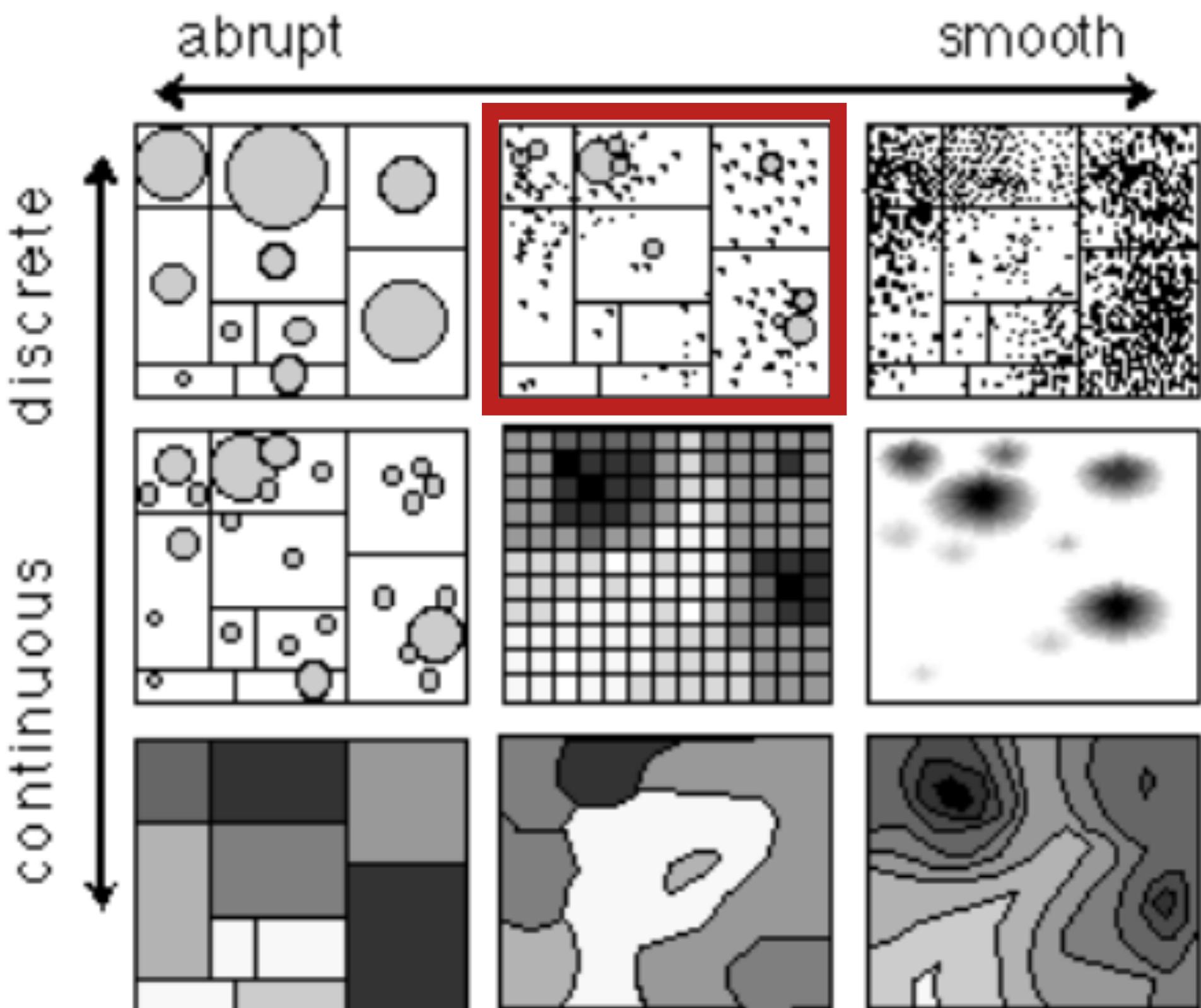


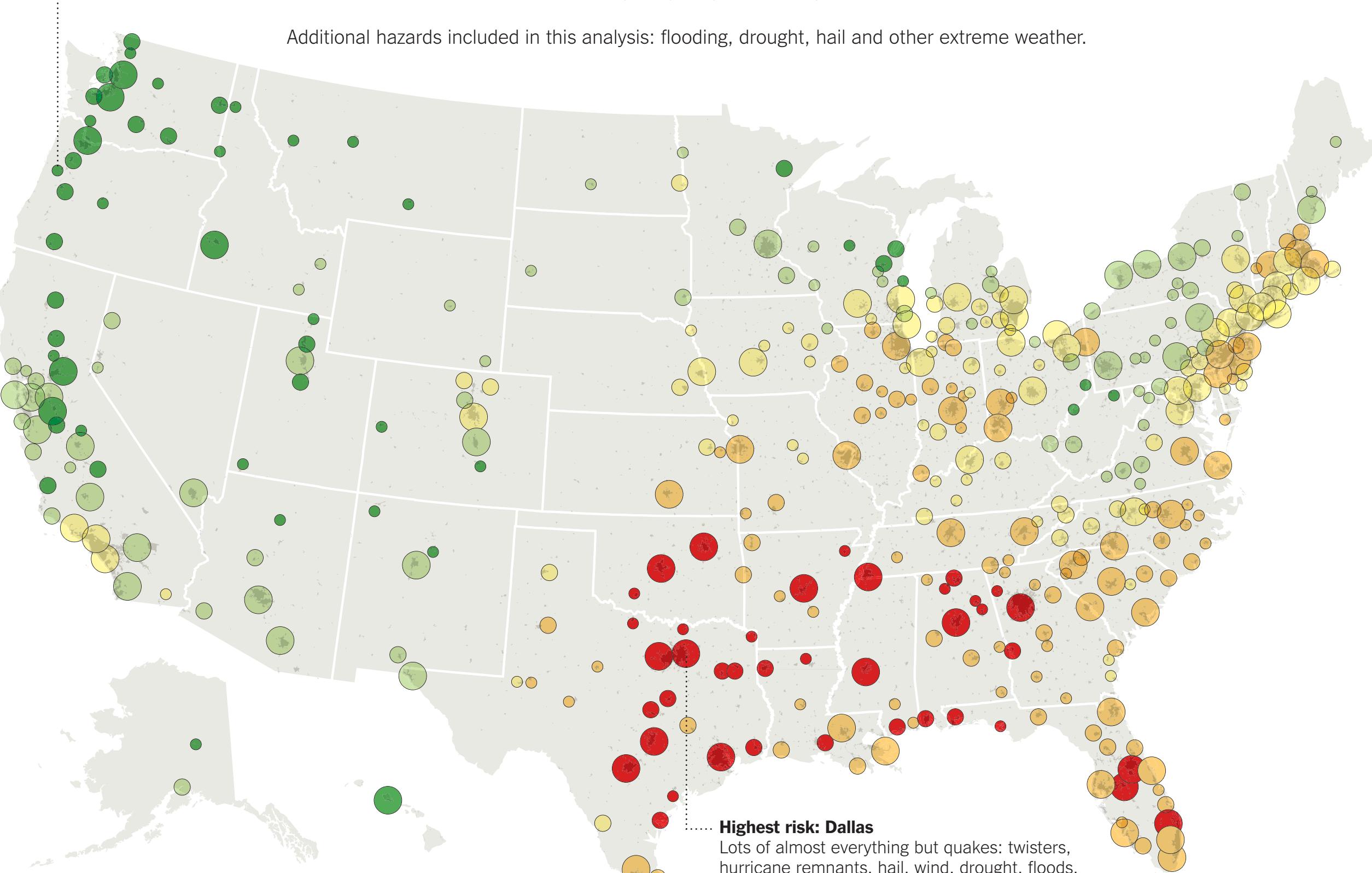
Fig. 9. Possible 2D translations of the 3D data models shown in figure 8.

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

≡ Q ASIA PACIFIC

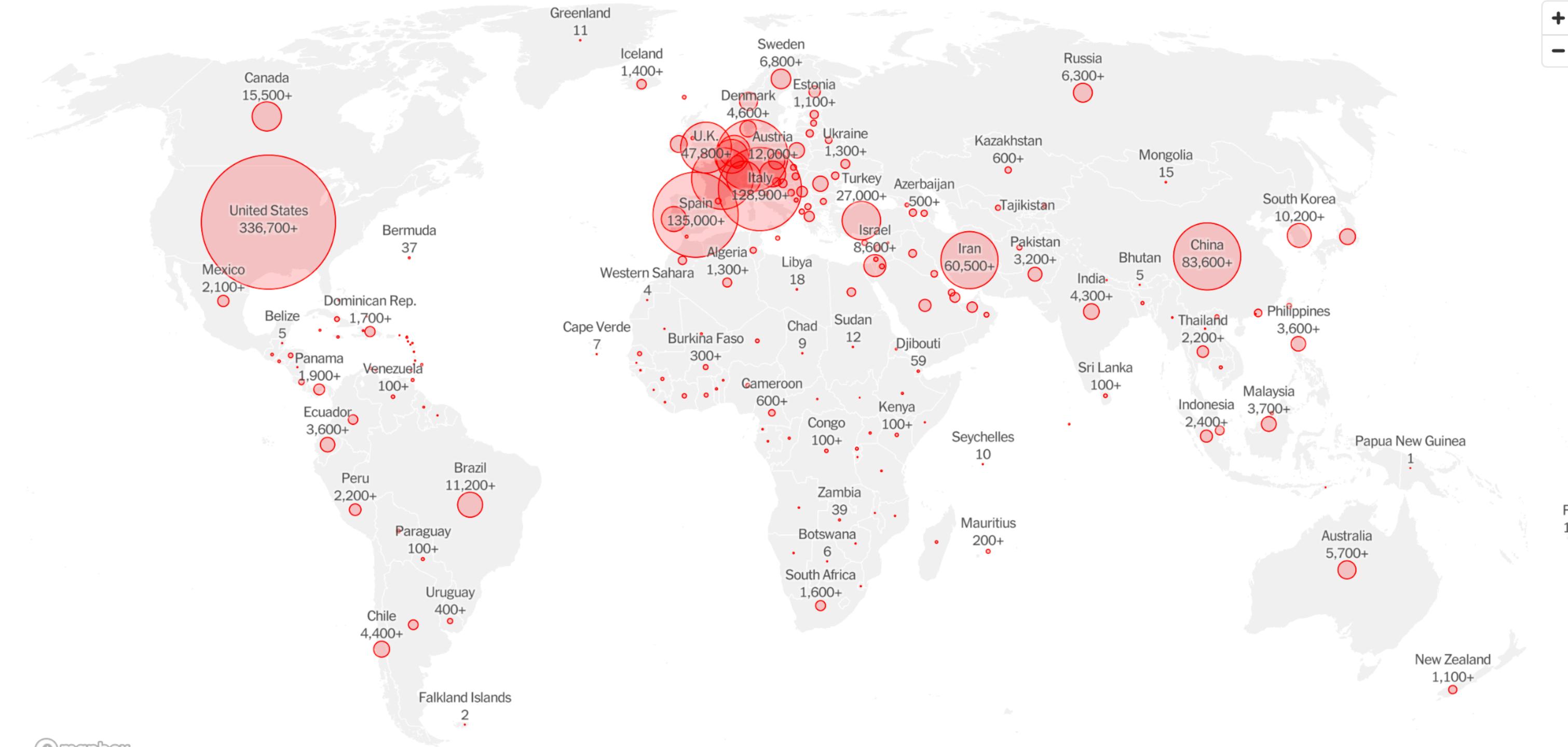
The New York Times

PLAY THE CROSSWORD

Account

10 cases ••• 10,000 cases

Zoom and hover over map for more detail



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

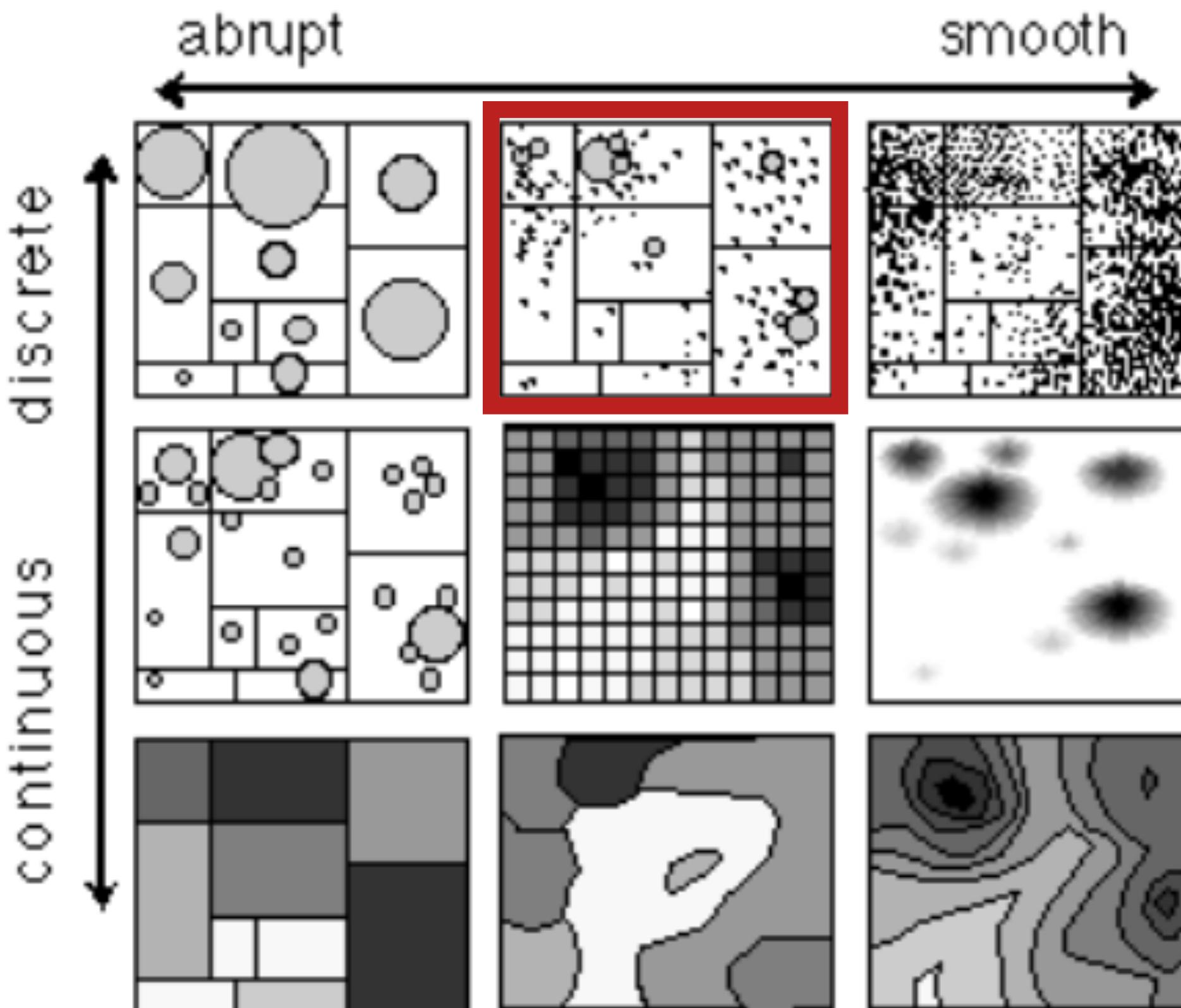


Fig. 9. Possible 2D translations of the 3D data models shown in figure 8.

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

Graduated Symbol Map?

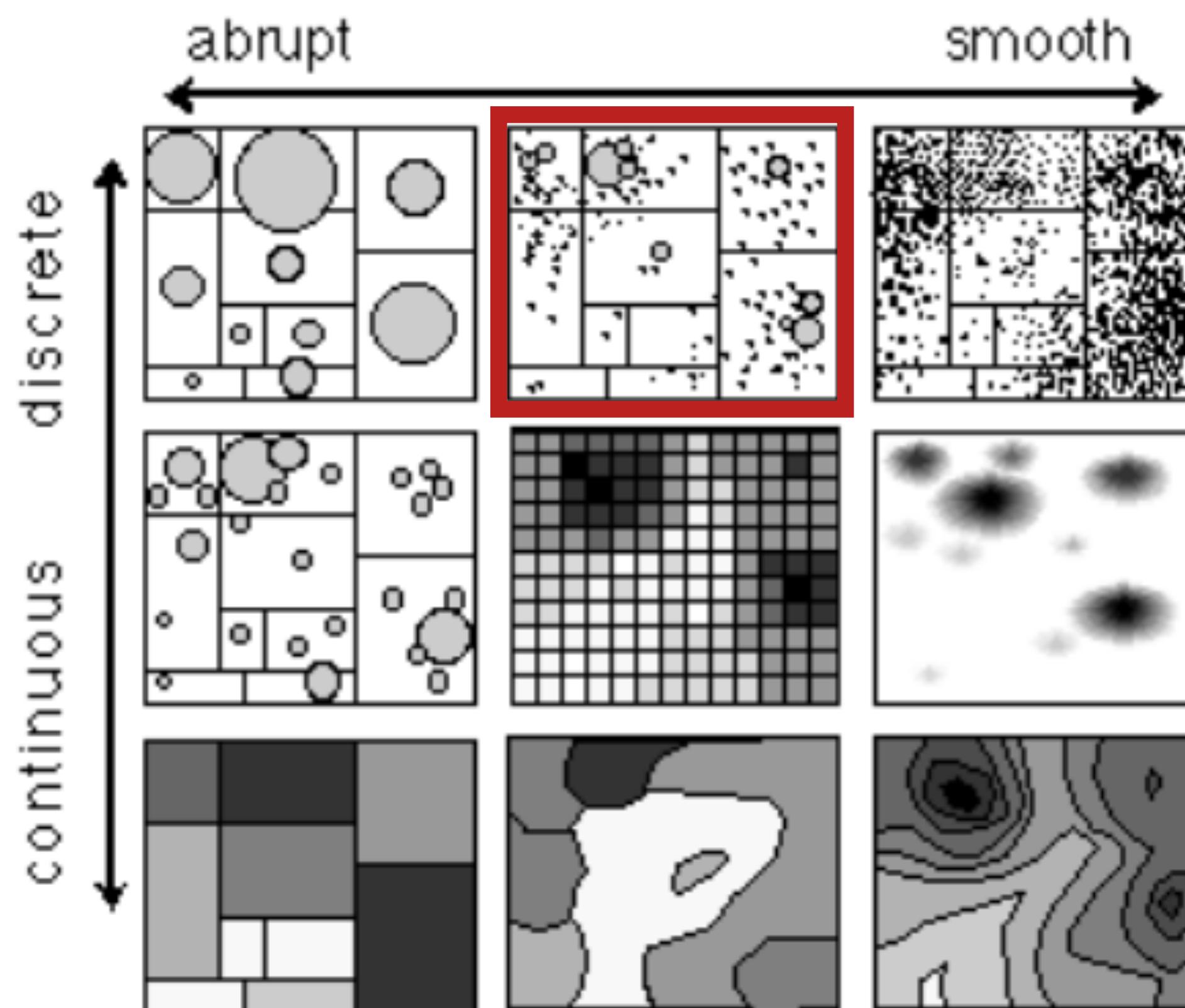
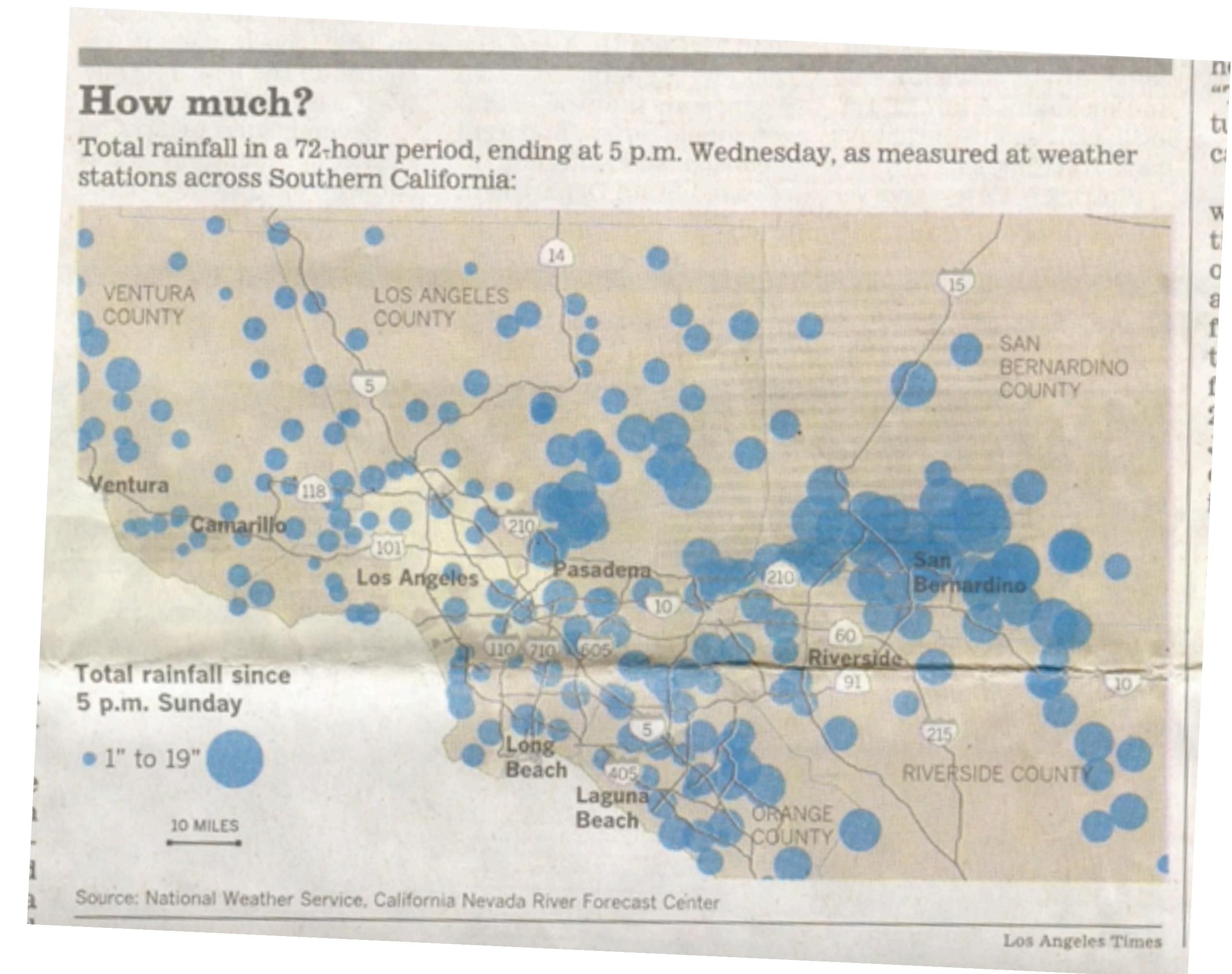


Fig. 9. Possible 2D translations of the 3D data models shown in figure 8.



Isopleth / Heat Map

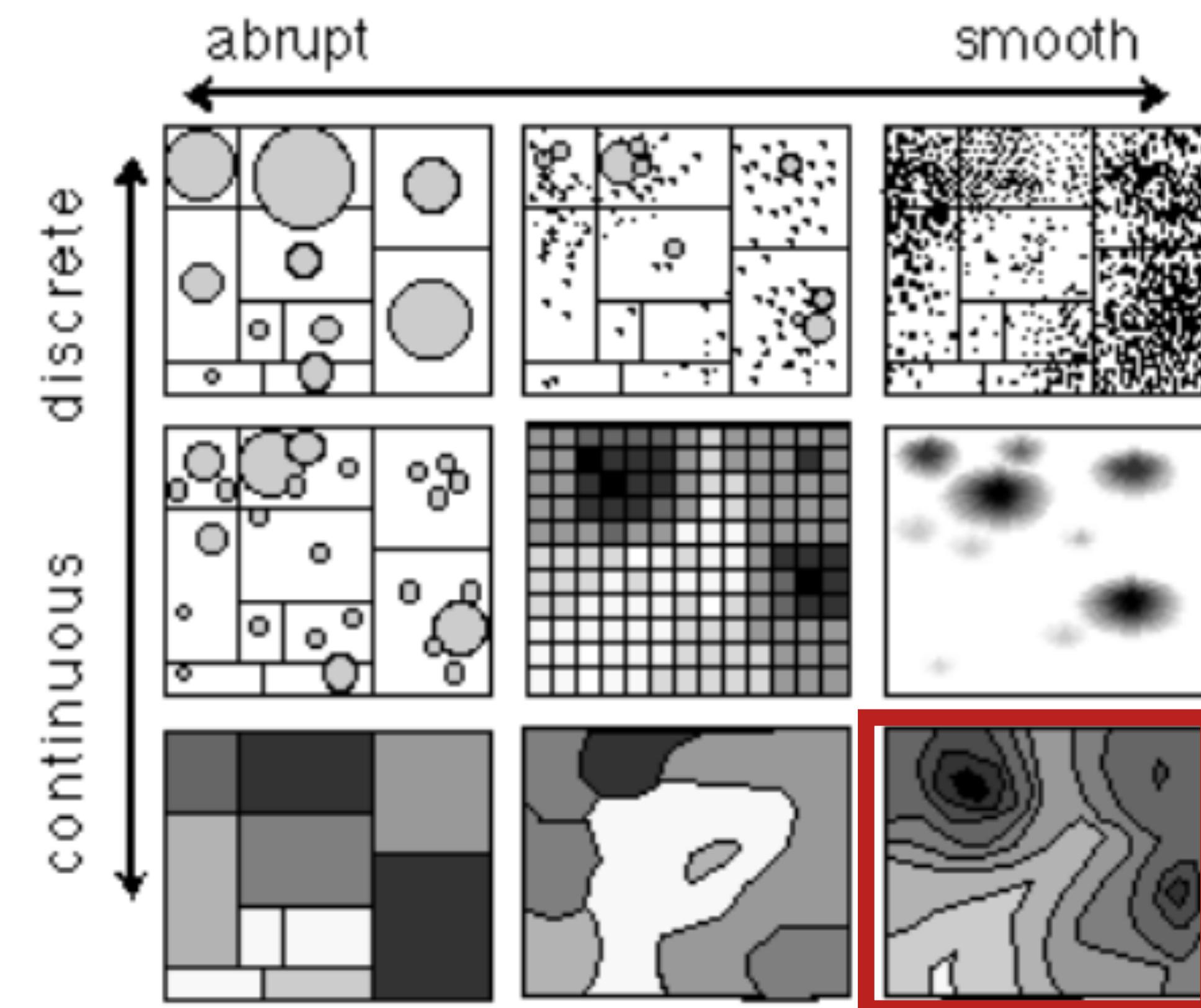
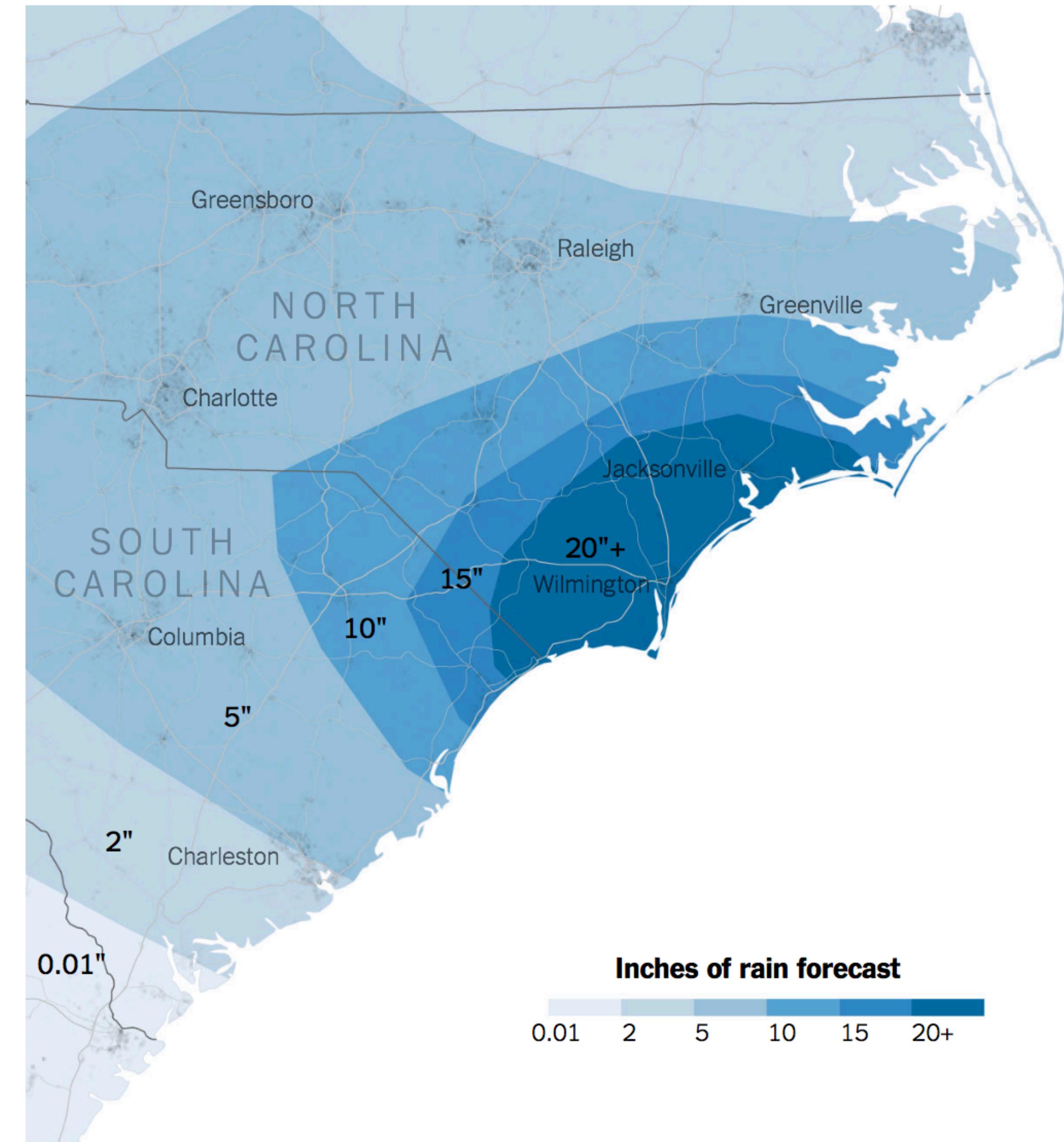


Fig. 9. Possible 2D translations of the 3D data models shown in figure 8.



Source: National Weather Service

Choropleth

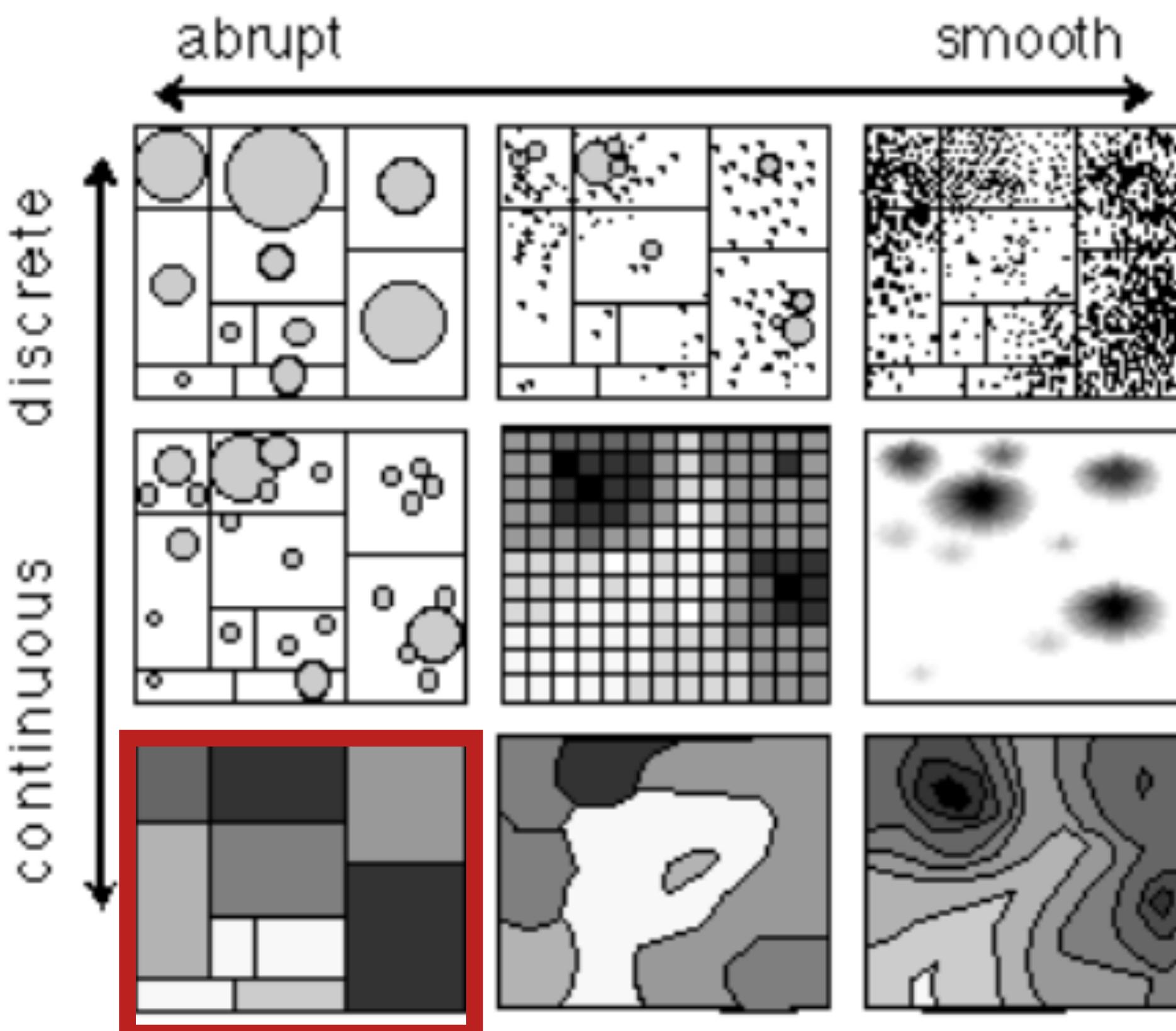
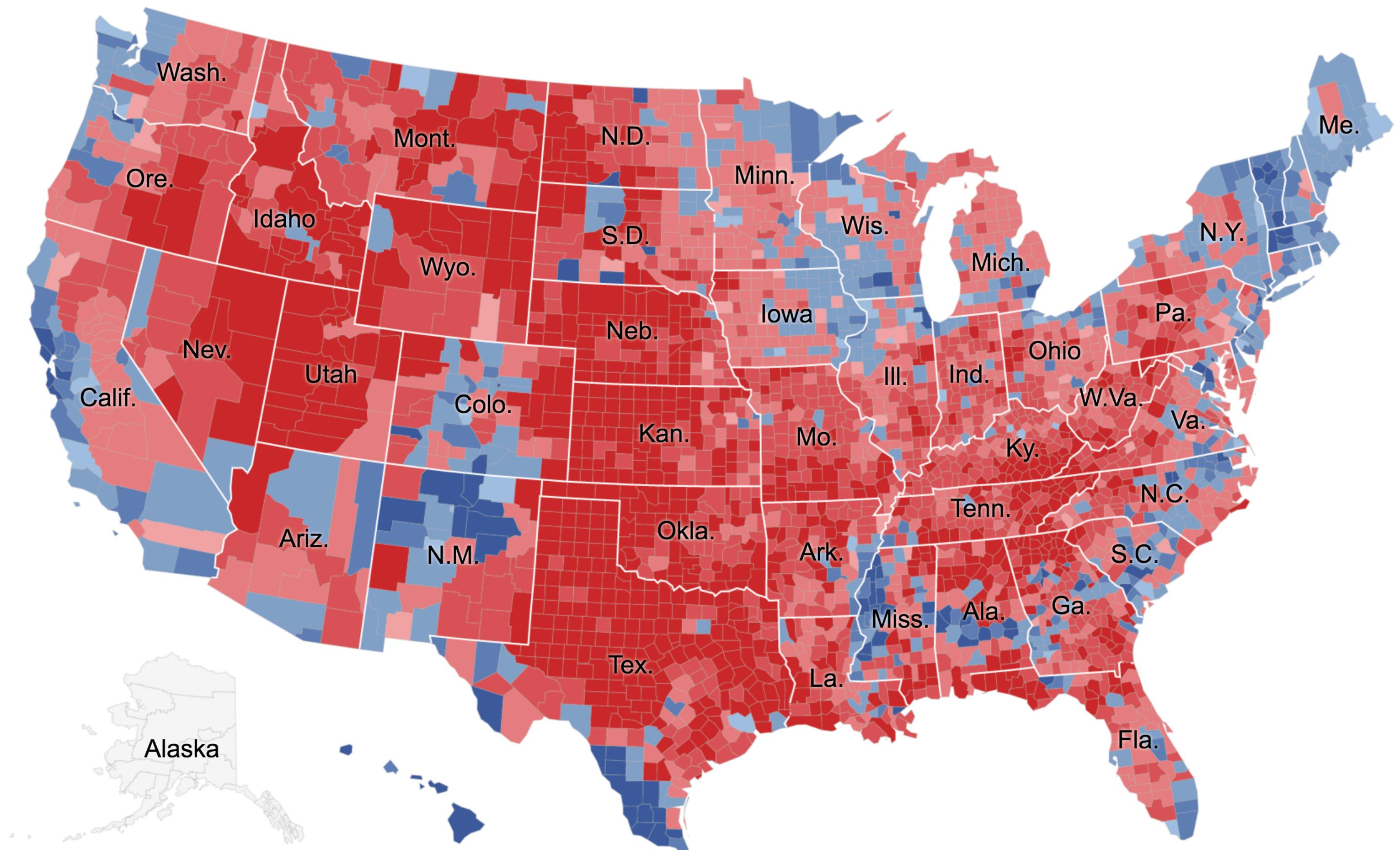


Fig. 9. Possible 2D translations of the 3D data models shown in figure 8.



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

Choropleth

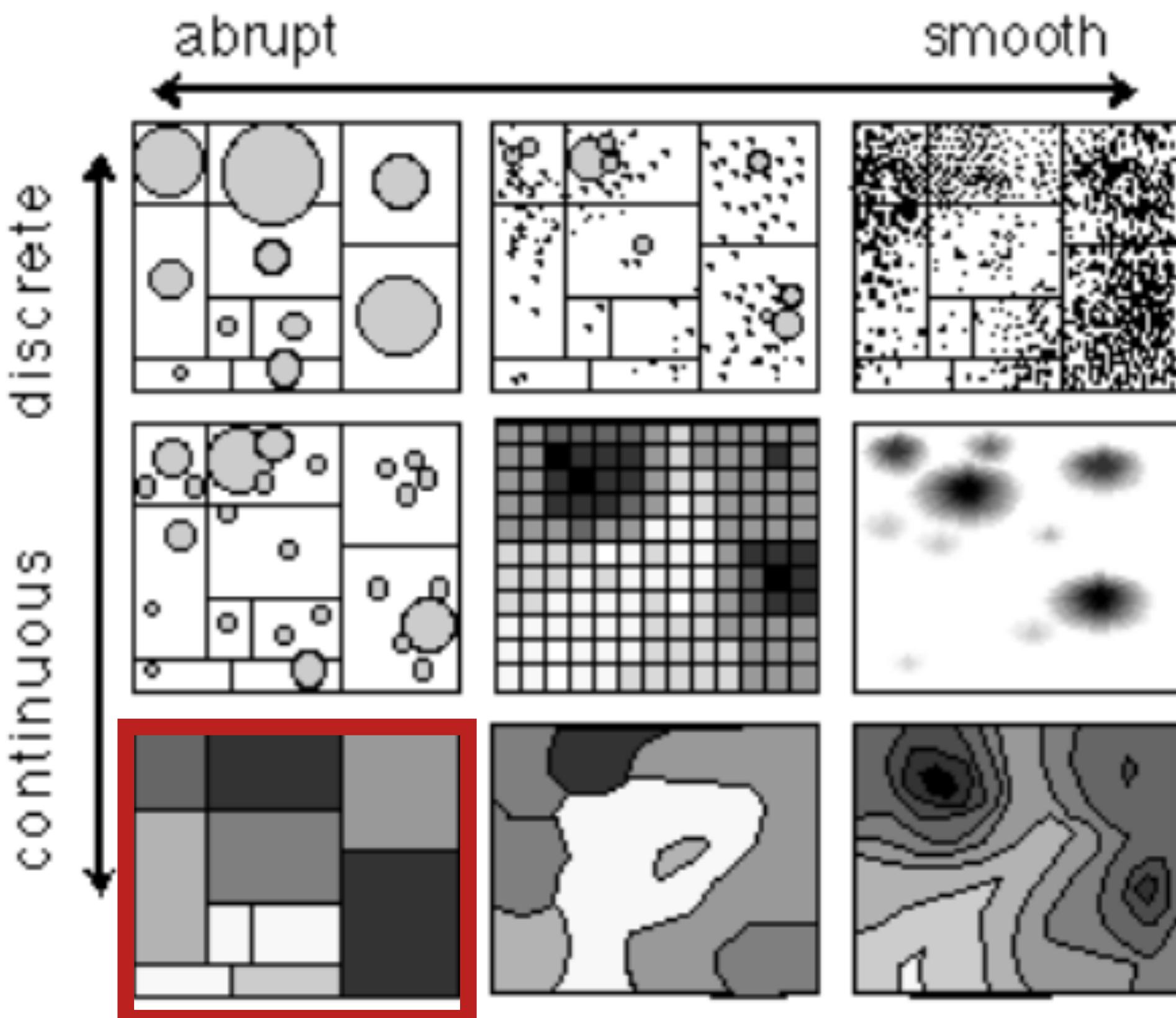
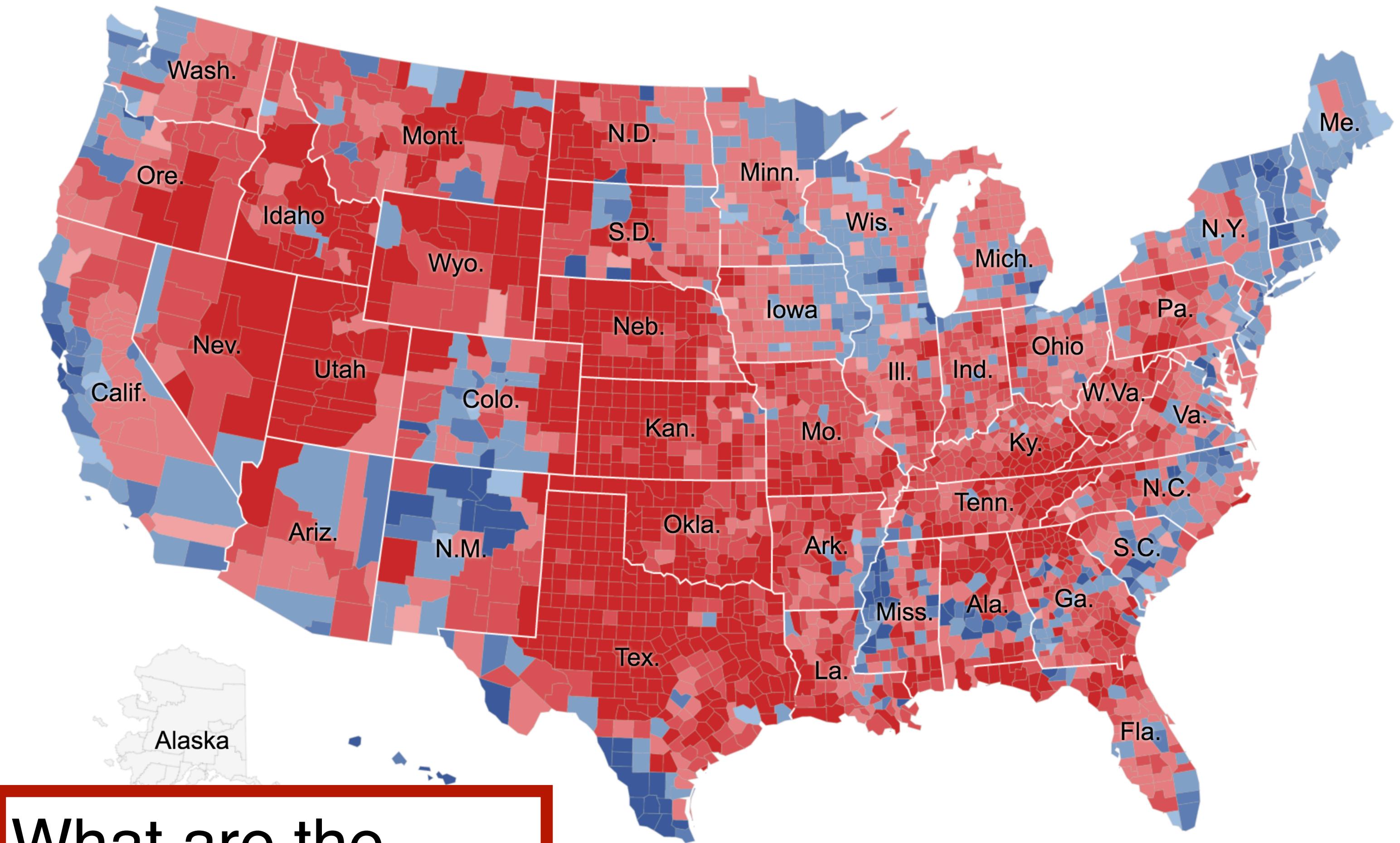


Fig. 9. Possible 2D translations of the 3D data models shown in figure 8.

What are the pros/cons of this display?



<http://2016/11/01/upshot/many-ways-to-map-election-results.html>

GEOGRAPHIC MAP

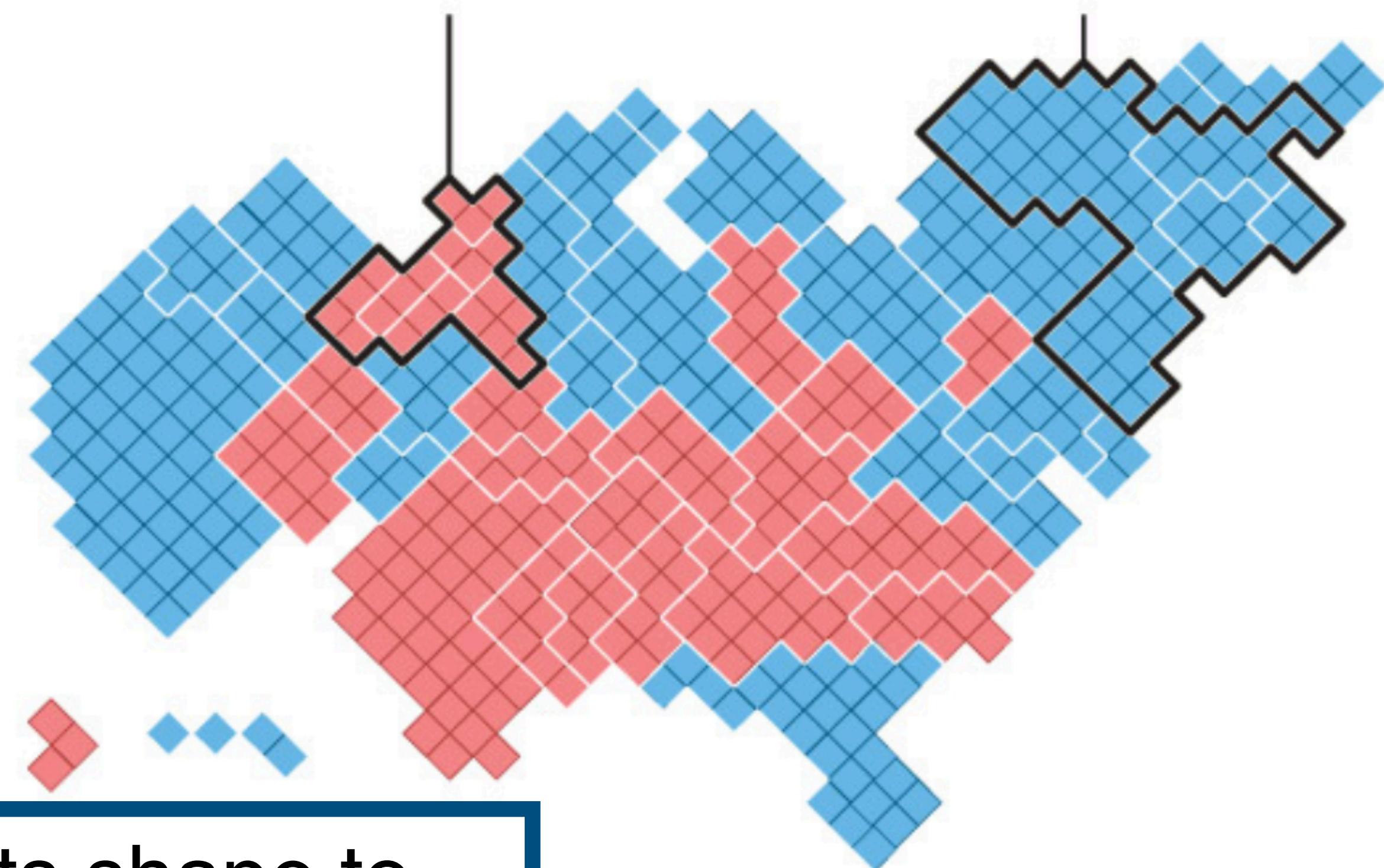
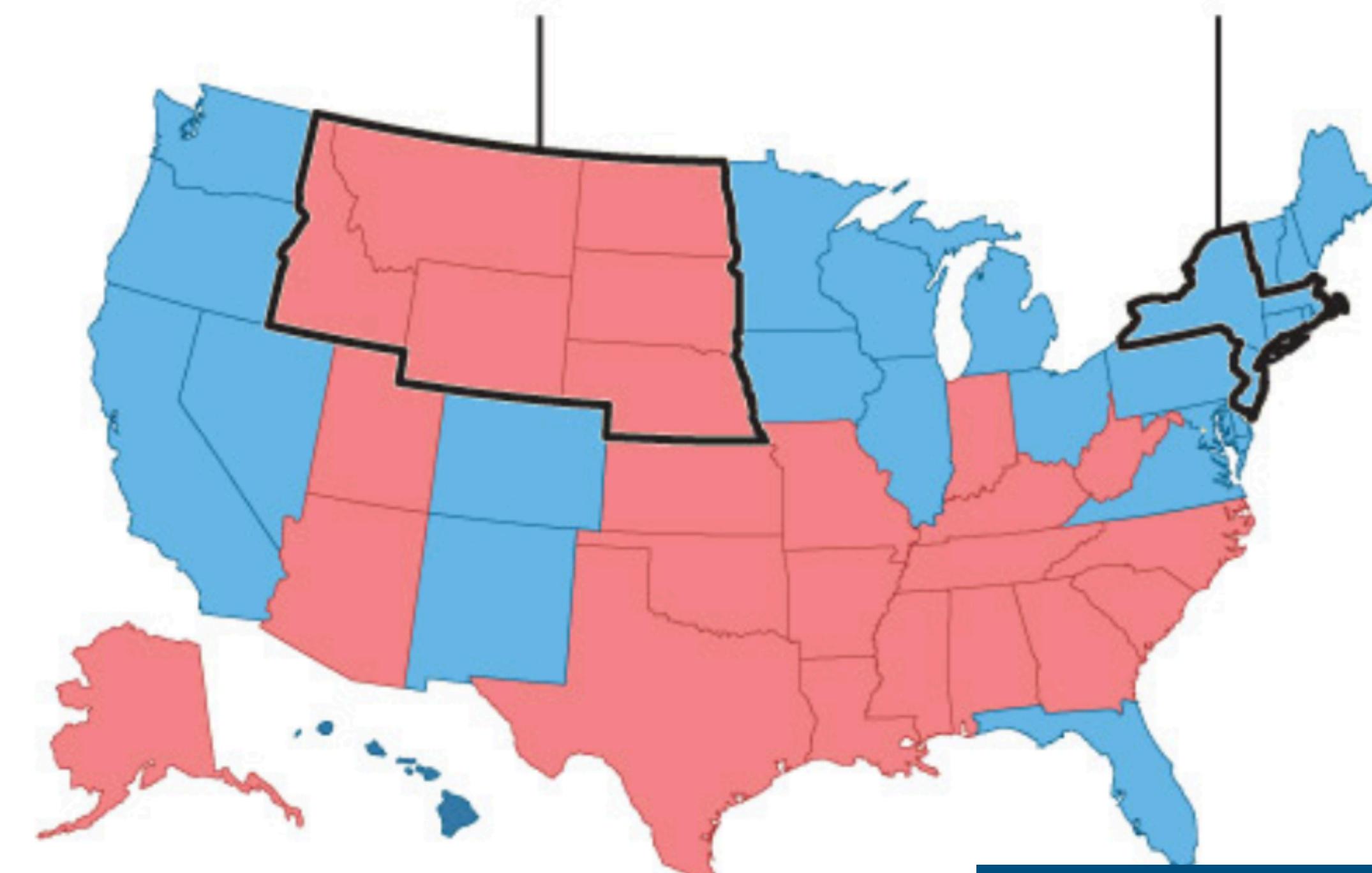
CARTOGRAM OF ELECTORAL VOTES

Six Western states

Five Northeastern states

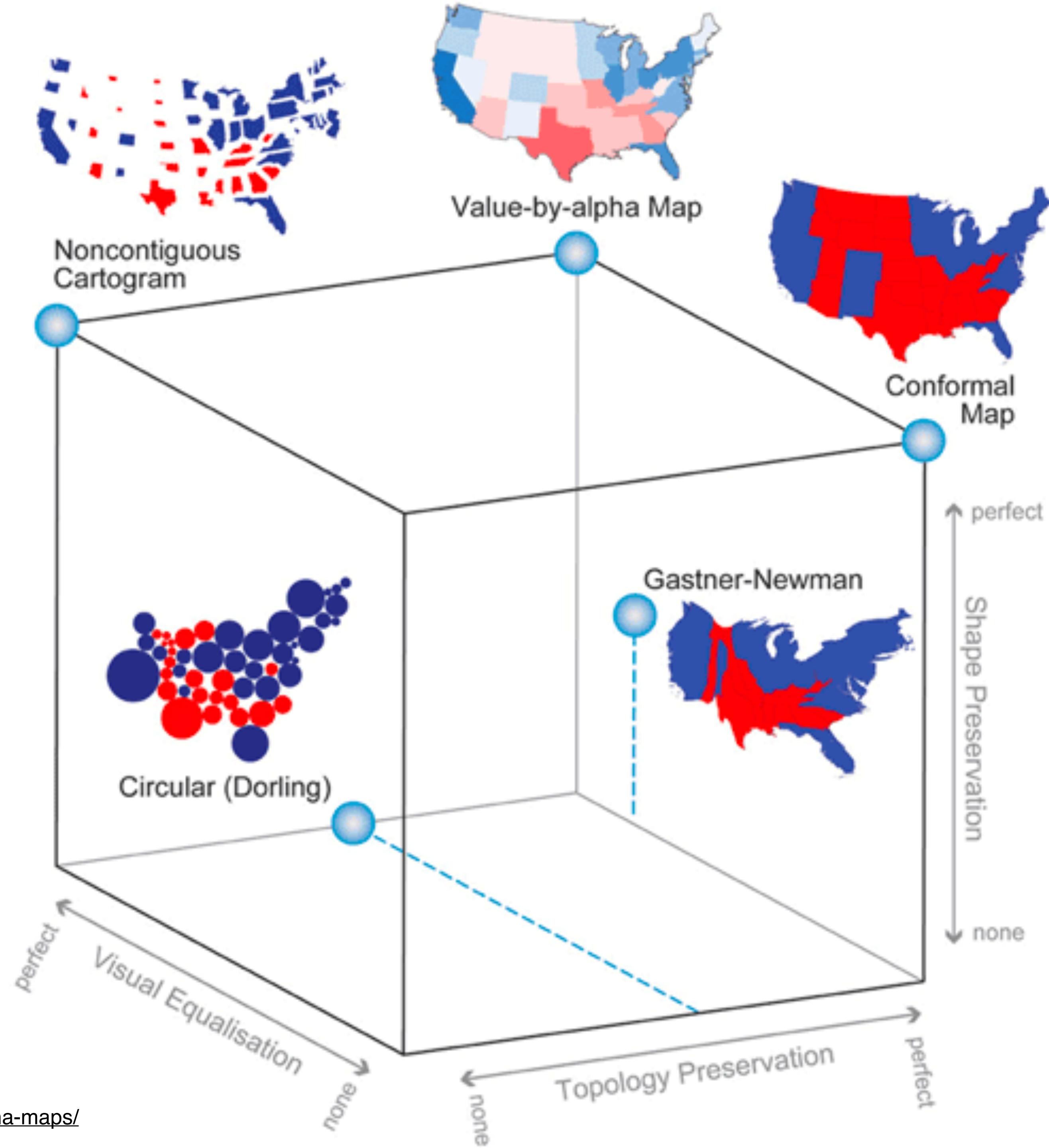
Six Western states

Five Northeastern states



Cartogram: Distorts shape to convey quantity

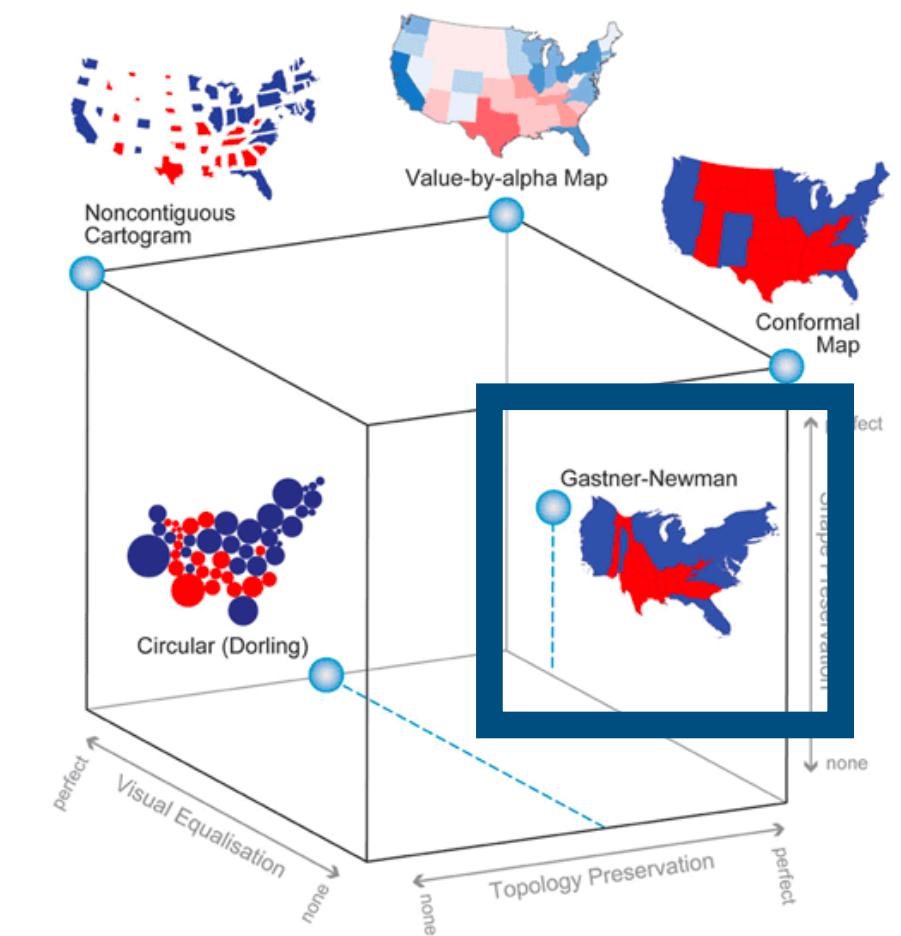
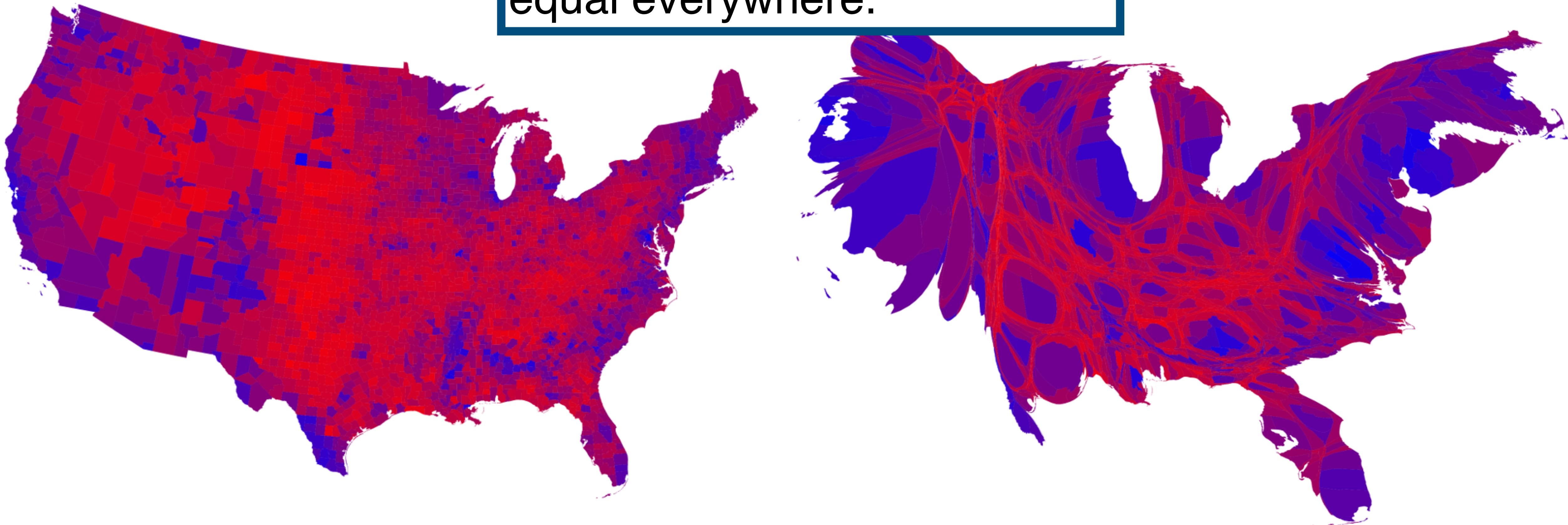
What are the pros/cons of this display?



Gaster-Newman

Physical diffusion model.

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



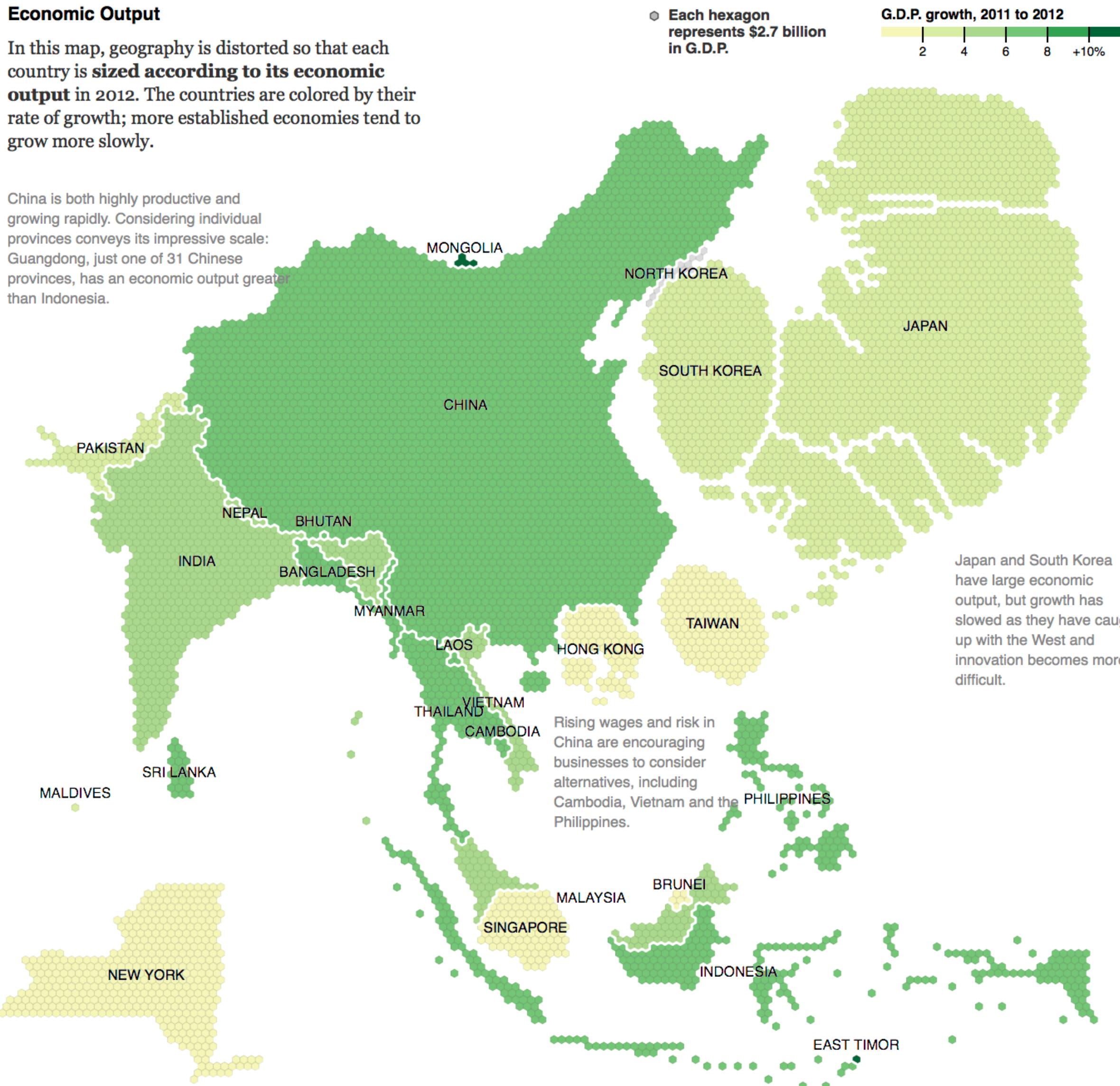
China Still Dominates, but Some Manufacturers Look Elsewhere

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.

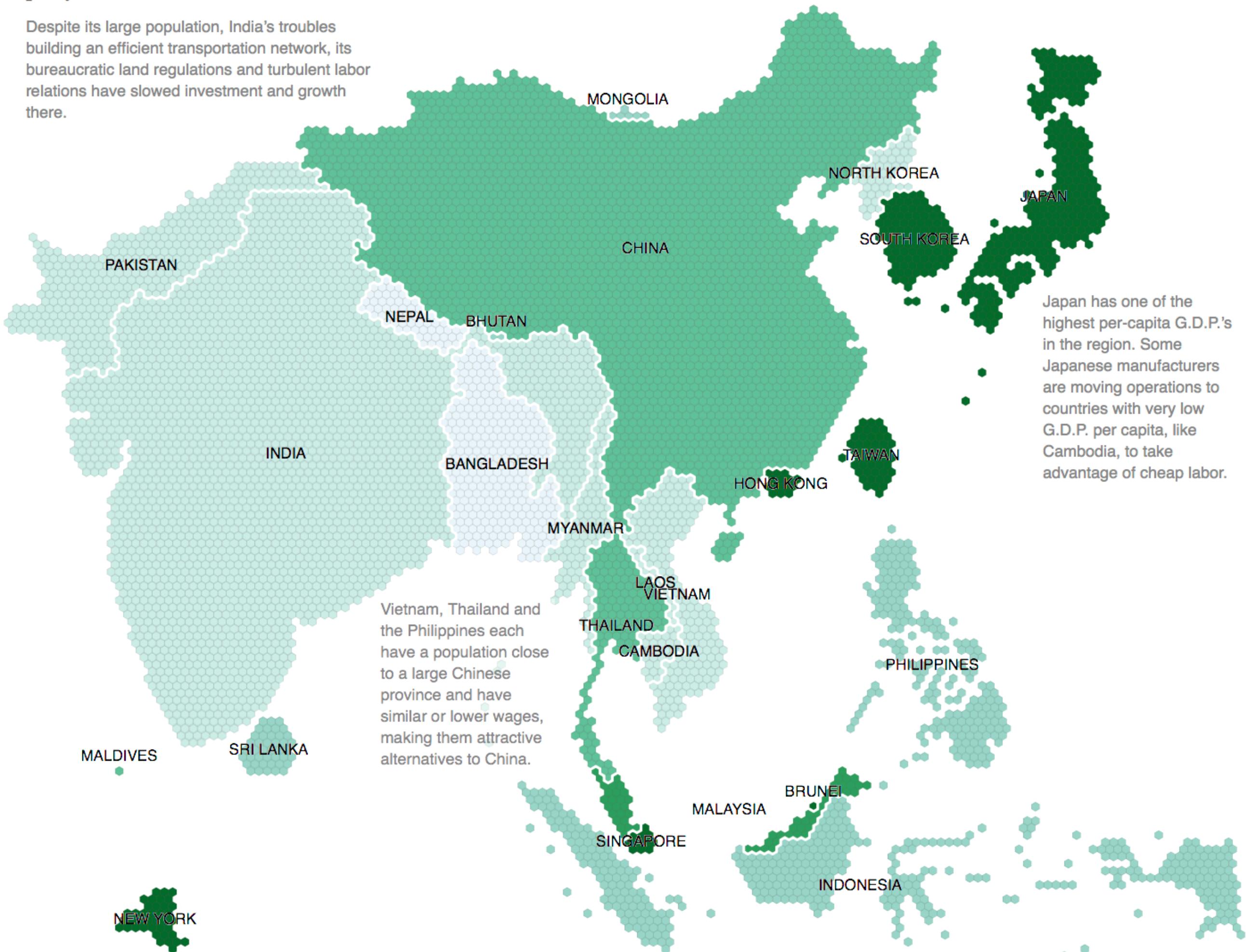
China is both highly productive and growing rapidly. Considering individual provinces conveys its impressive scale: Guangdong, just one of 31 Chinese provinces, has an economic output greater than Indonesia.



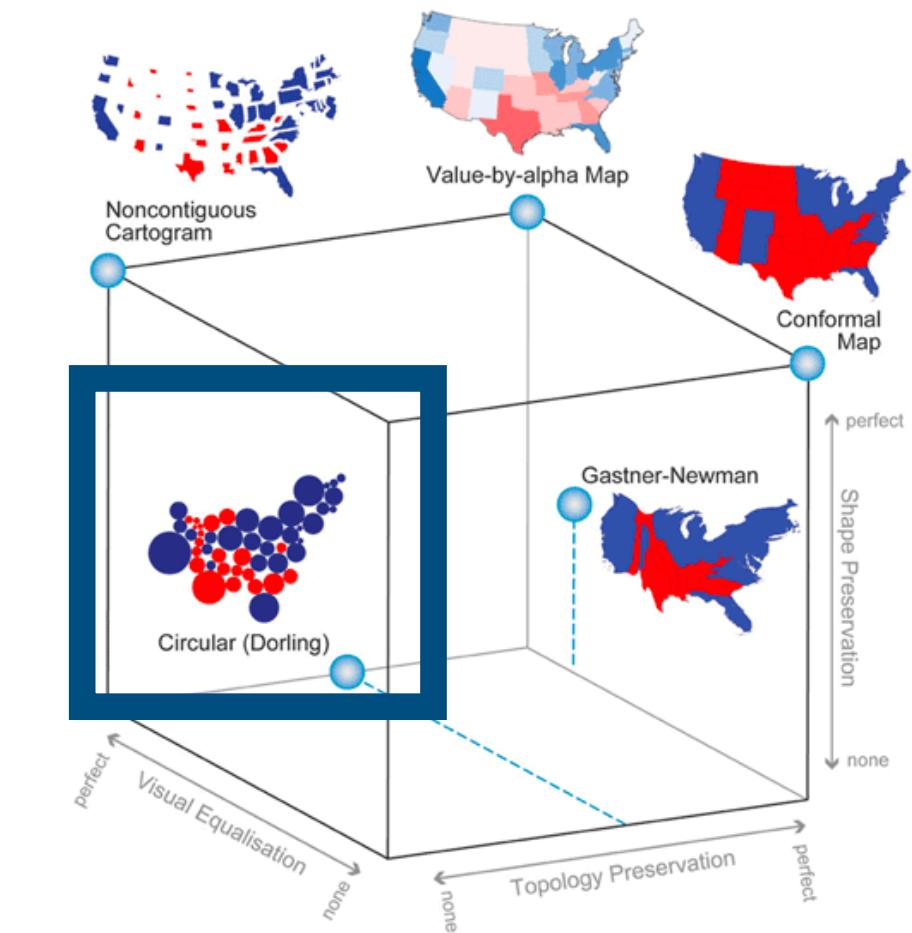
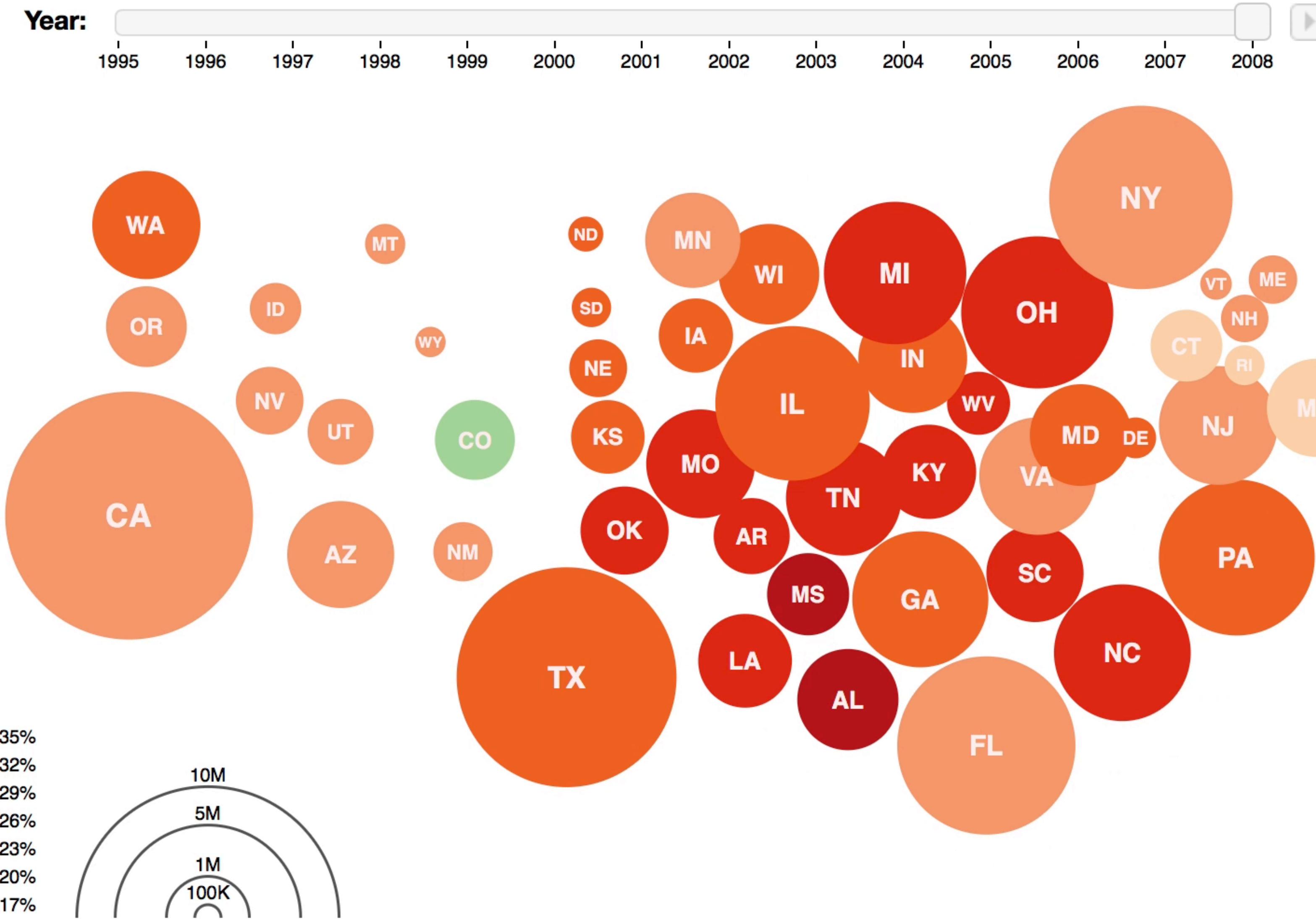
Population

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.

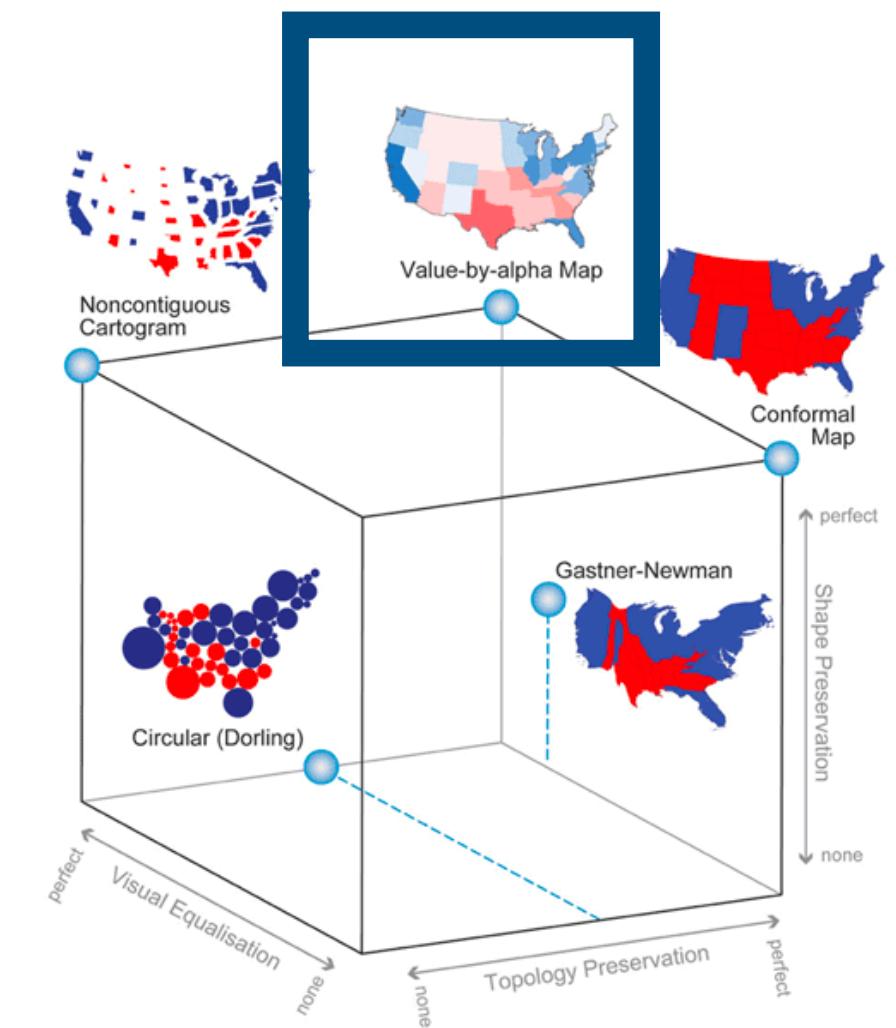
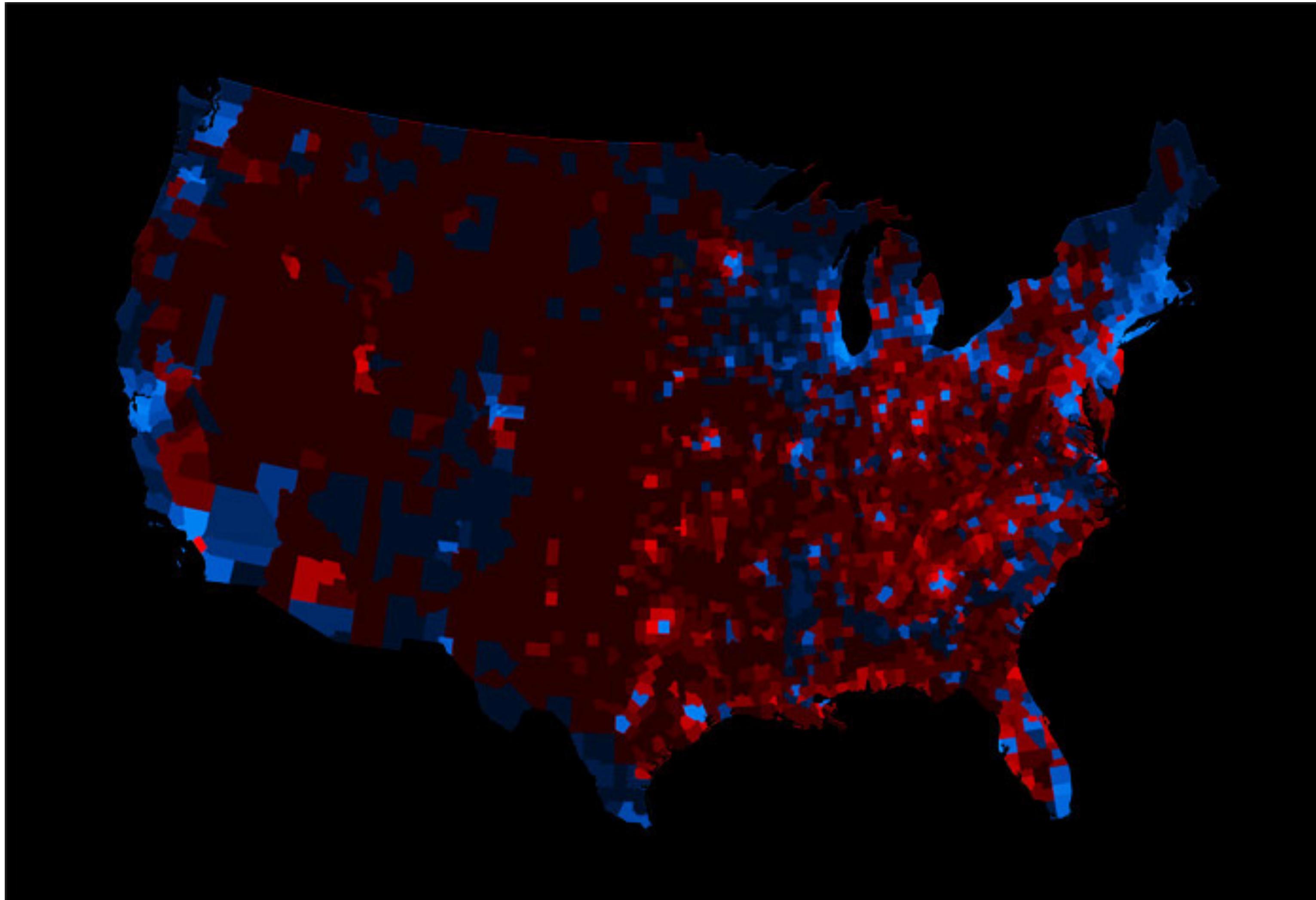
Despite its large population, India's troubles building an efficient transportation network, its bureaucratic land regulations and turbulent labor relations have slowed investment and growth there.



Dorling Cartograms

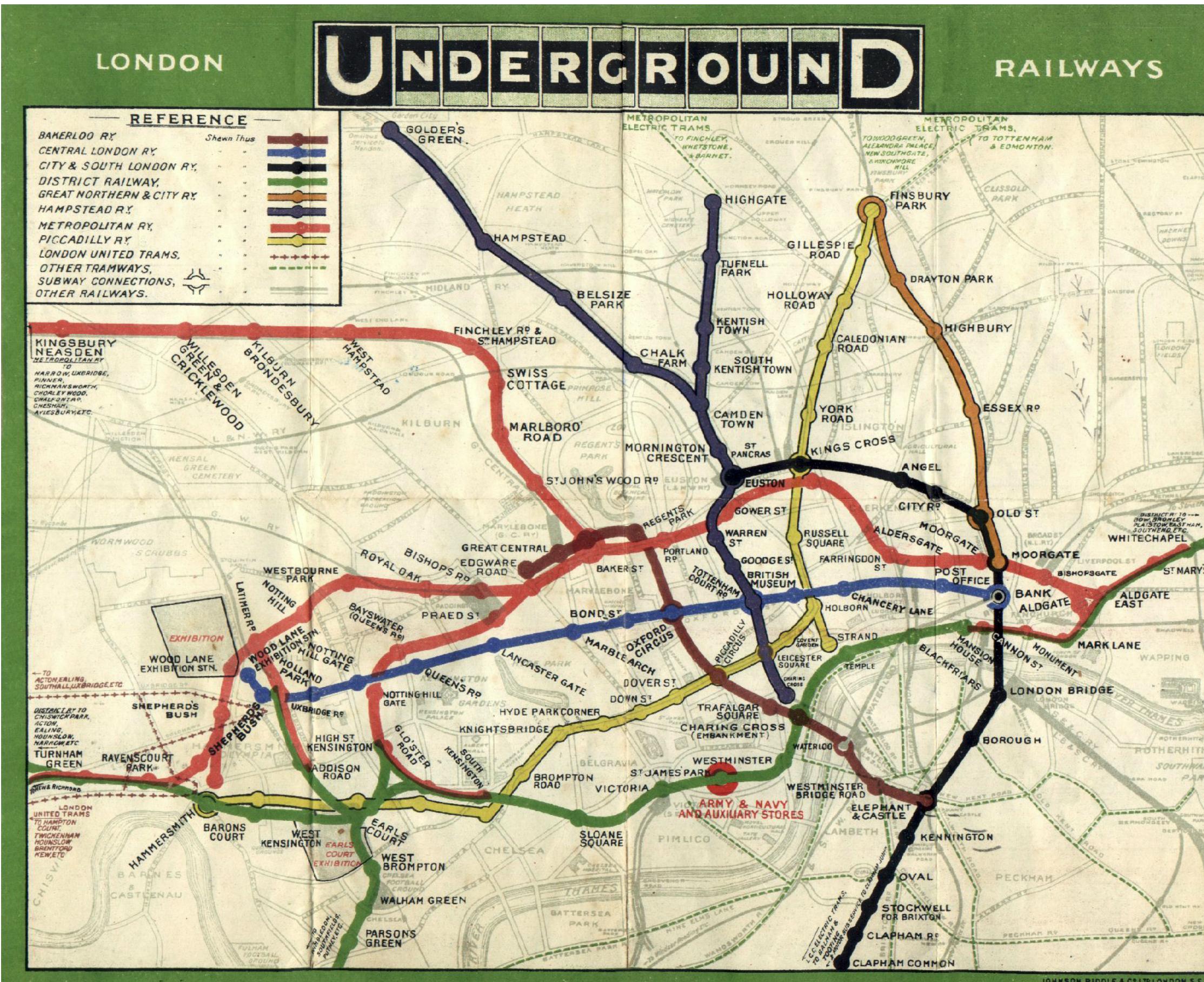


Value-By-Alpha



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

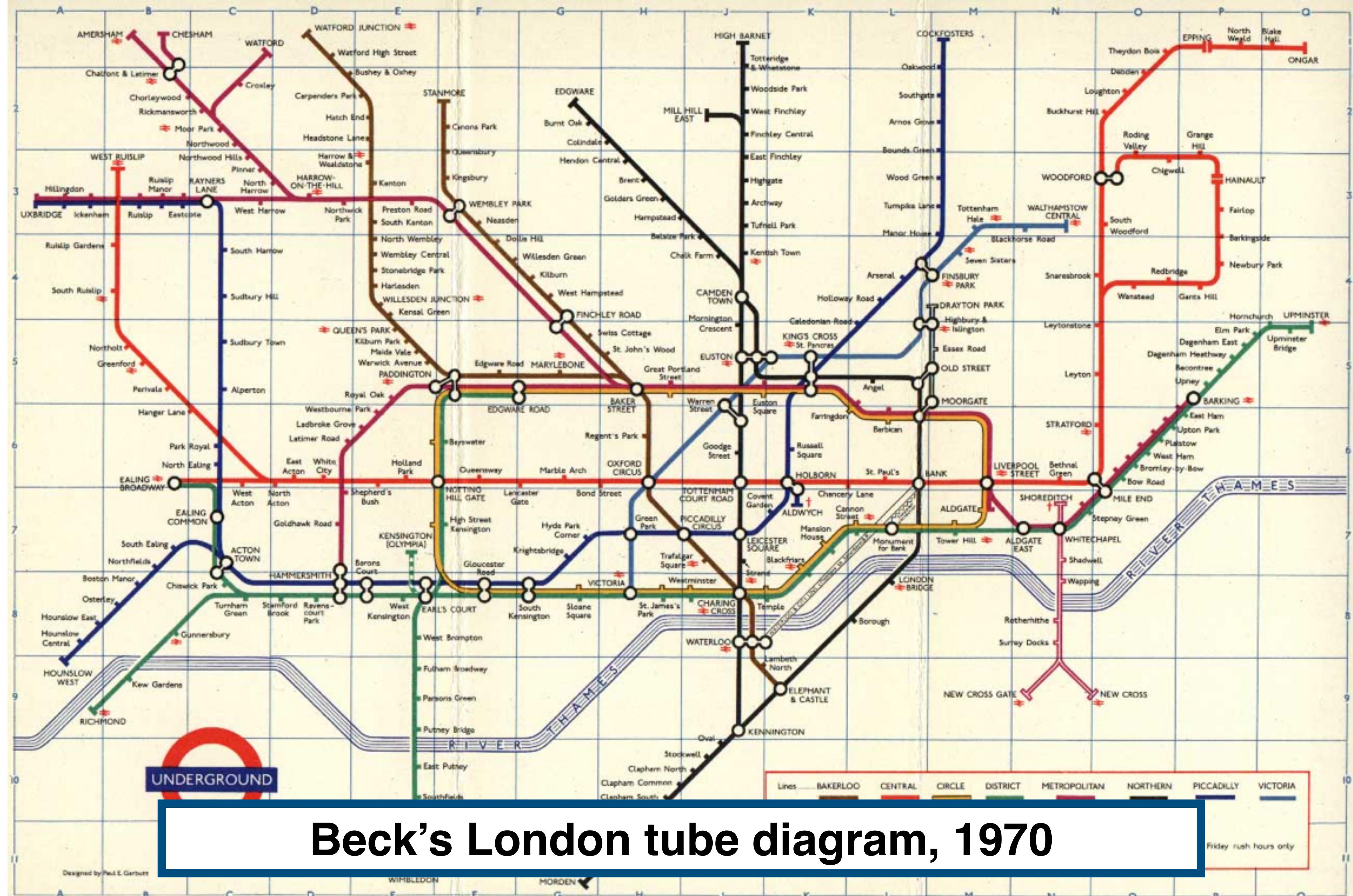
Route Maps



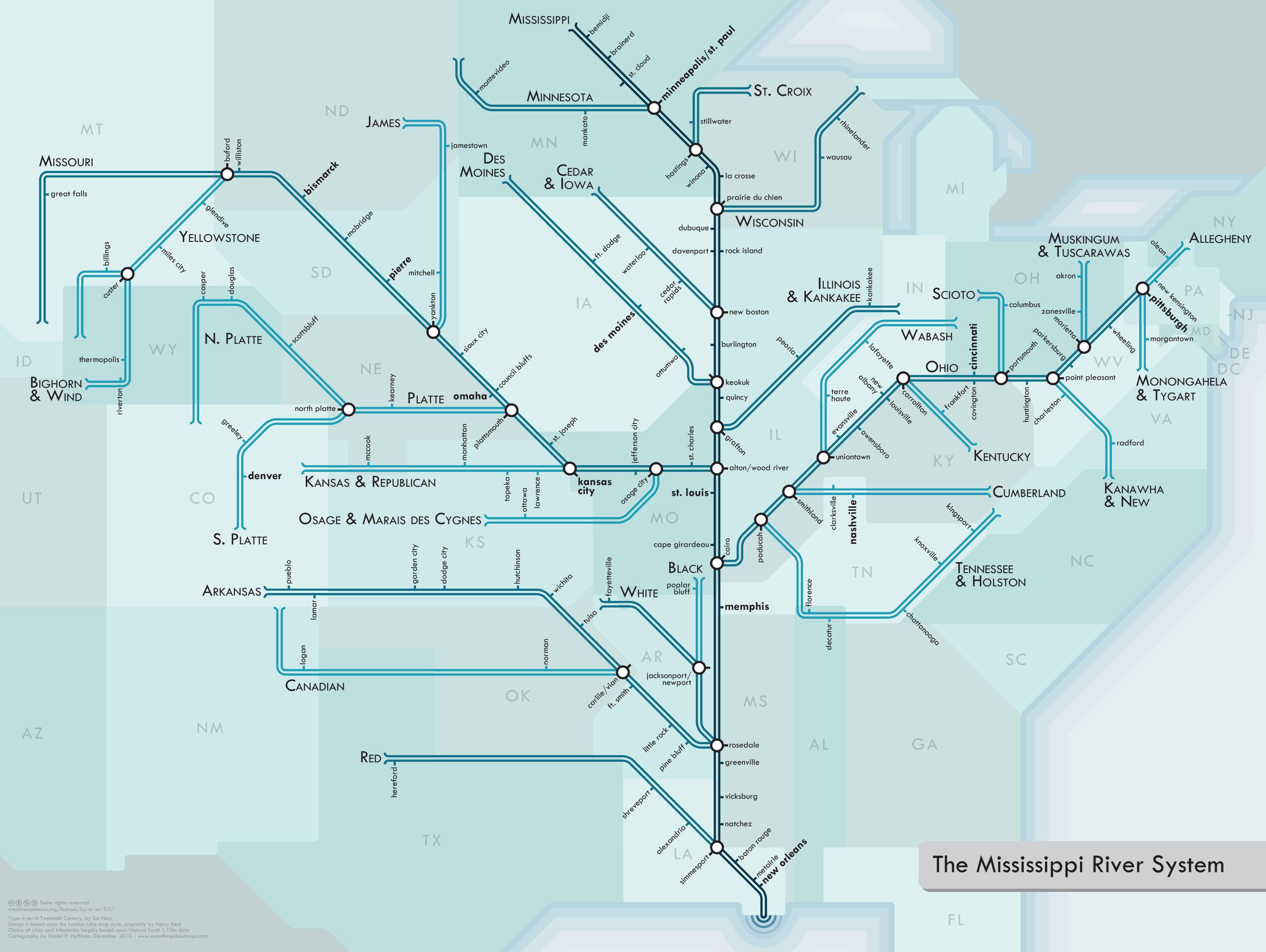
Geographic version of



London Underground



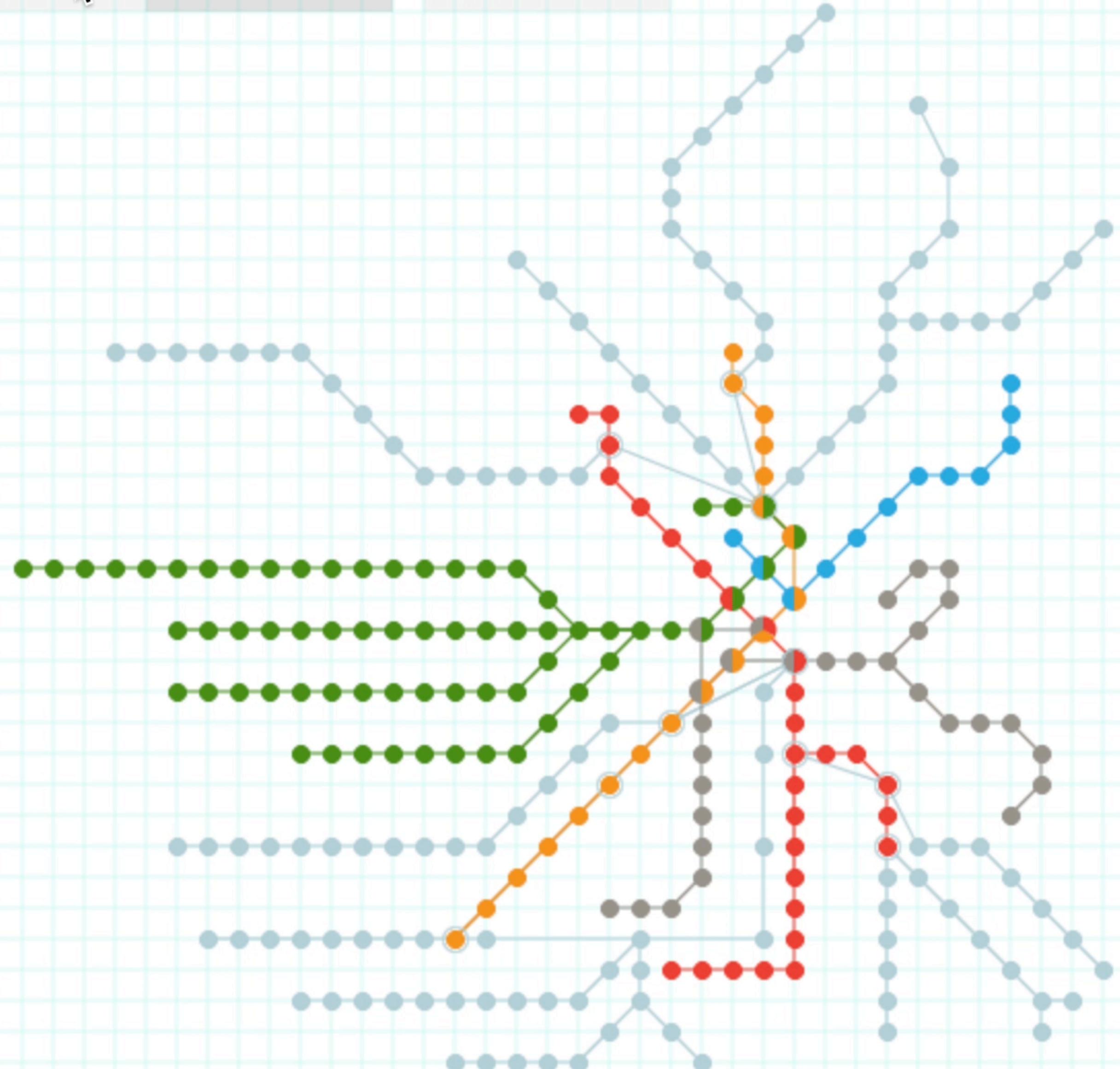
Beck's London tube diagram, 1970

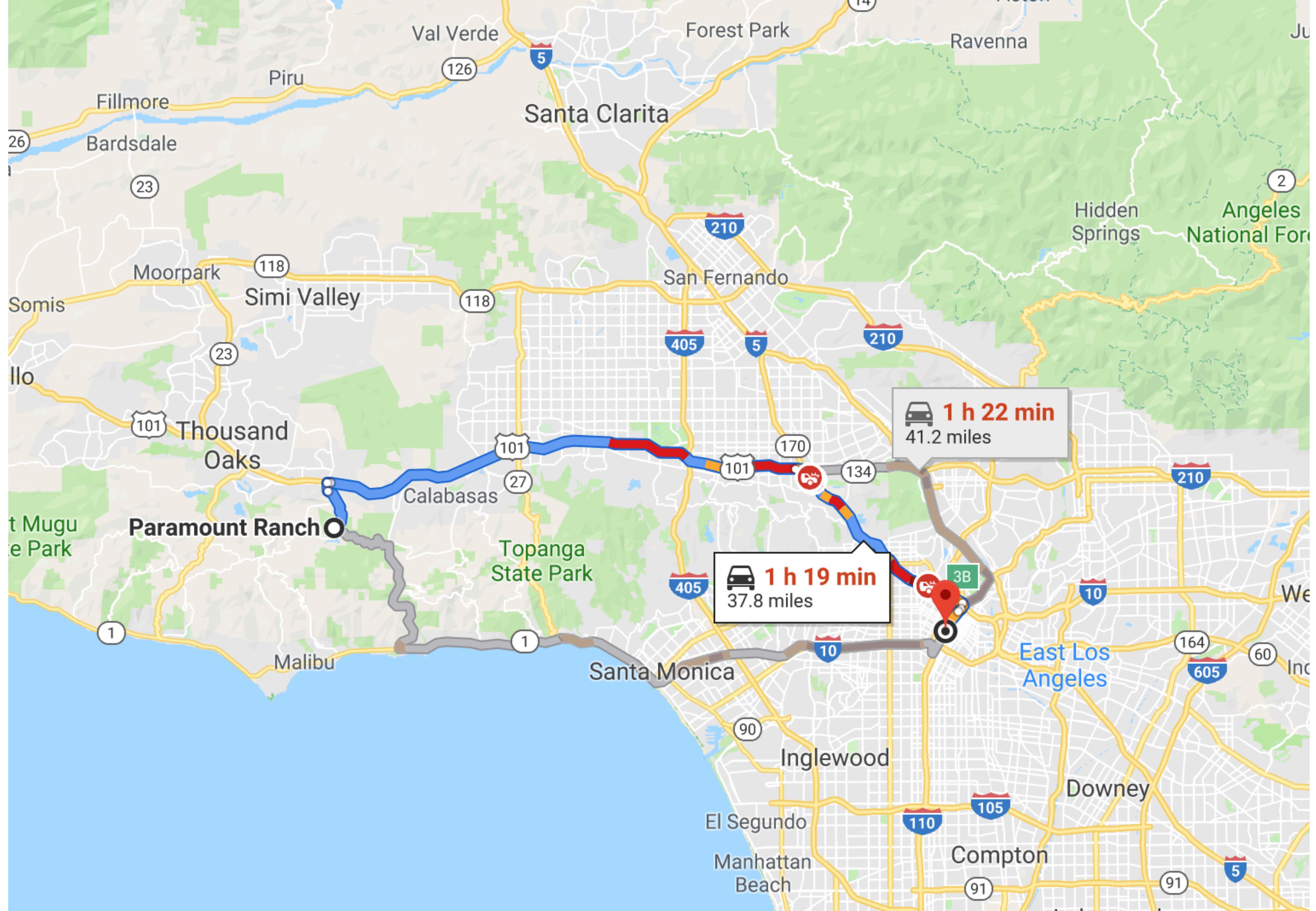


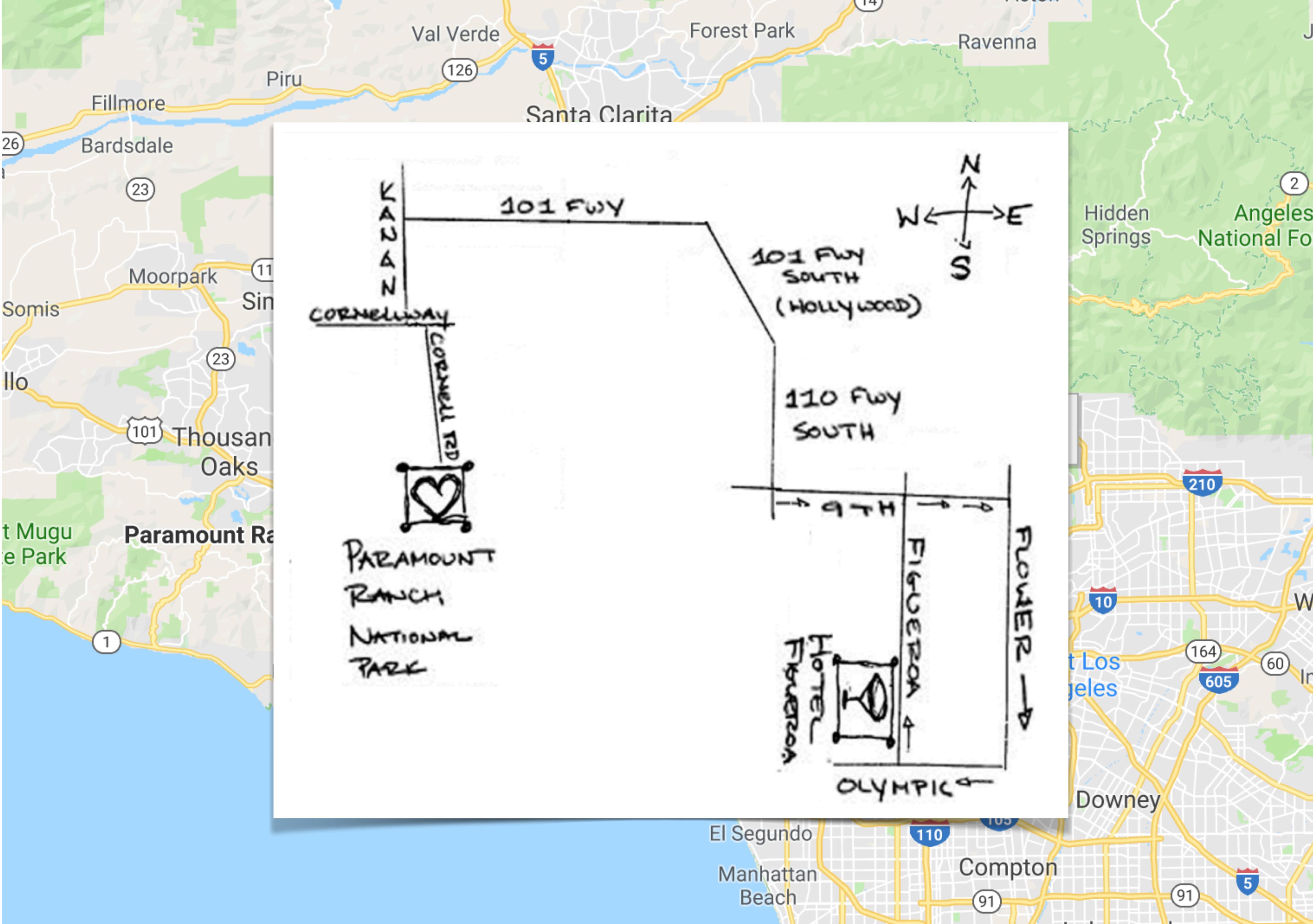
Geographic

Grid

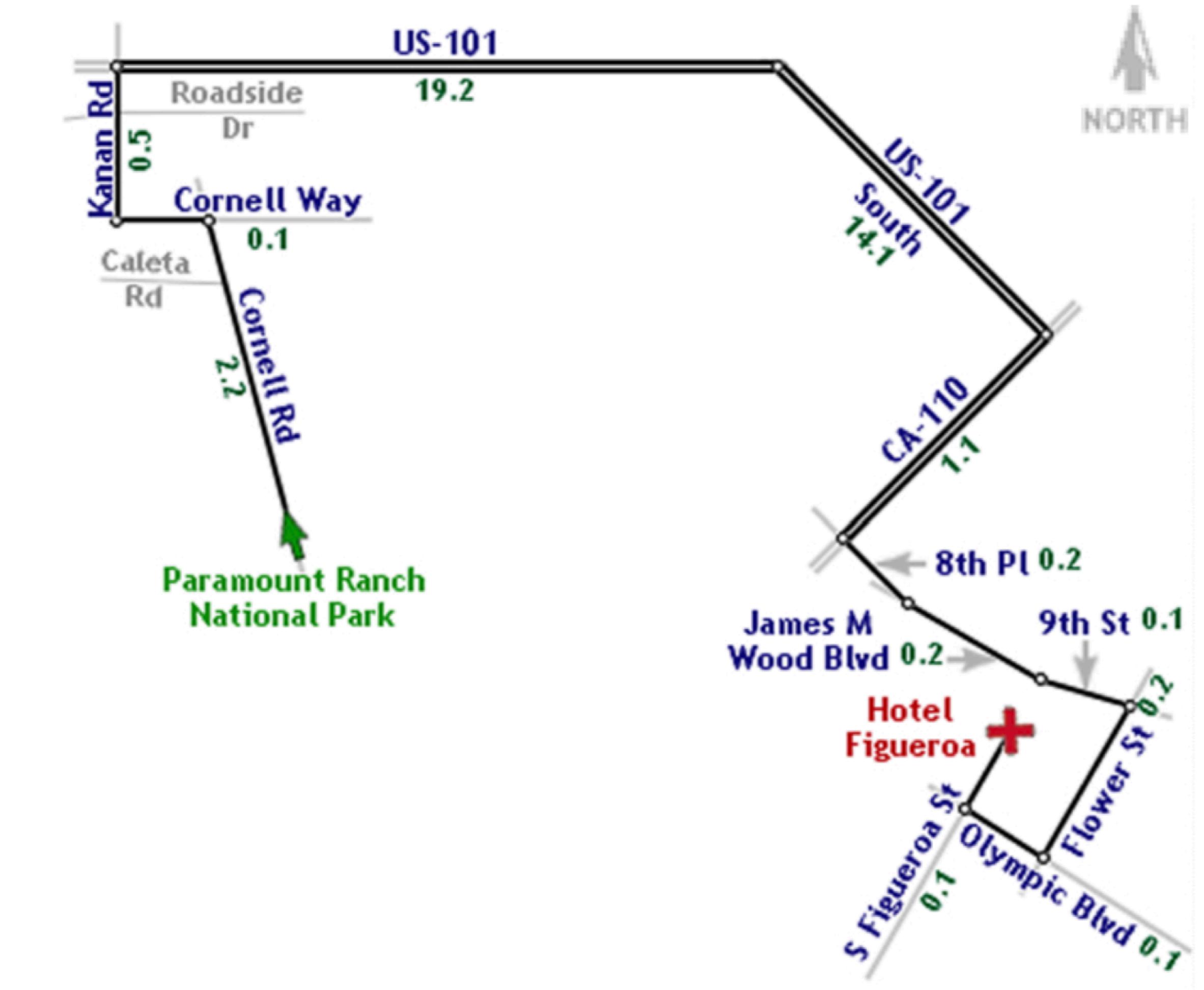
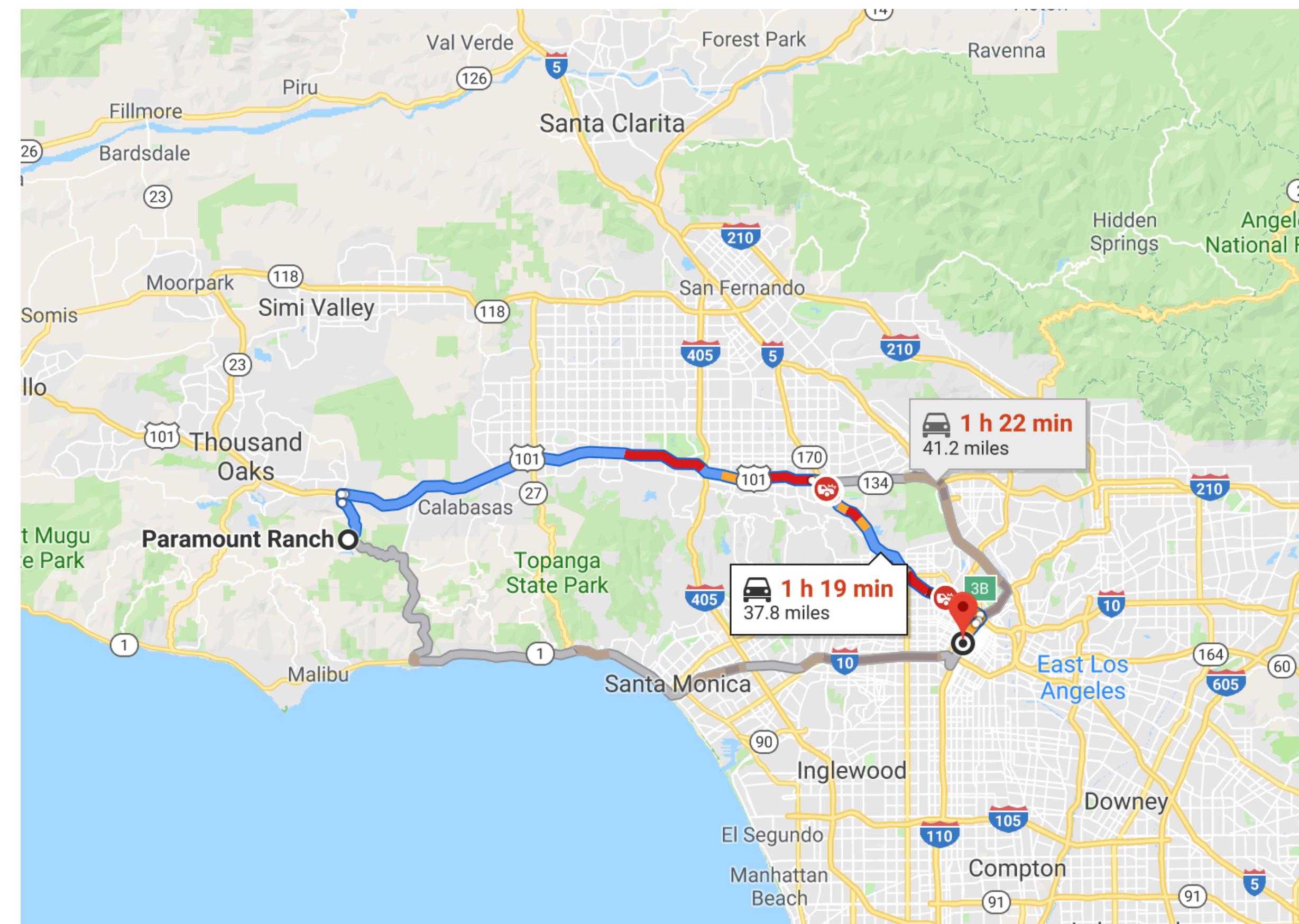
Commuter Rail On







Line Drive



Tooling for Maps

Web Tools

D3/Vega/Vega-Lite: 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

Data Resources

Natural Earth Data: naturalearthdata.com

OpenStreetMap: openstreetmap.org

U.S. Government: nationalatlas.gov, usgs.gov

Tutorials

Command Line Cartography, by Mike Bostock

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

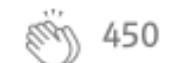


Mike Bostock
Jan 23, 2017 · 5 min read

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](#).]



359

10 responses

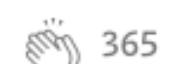


Mike Bostock
Dec 10, 2016 · 6 min read

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

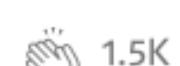


Mike Bostock
Dec 9, 2016 · 5 min read

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