

Maps

DSC 106: Data Visualization

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UC San Diego

Announcements

Lab 6 out, due Friday.

Project 2 peer feedback due Friday.

Project 3 due next week Tuesday.

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 doesn't need to be complicated. More importantly: how does your interaction help user explore interesting pieces of data?

**How much time did you spend
on Lab 5?**

tryclassbuzz.com
Code: **lab5**

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?

226
Kamala Harris

75,019,257 votes (48.43%)

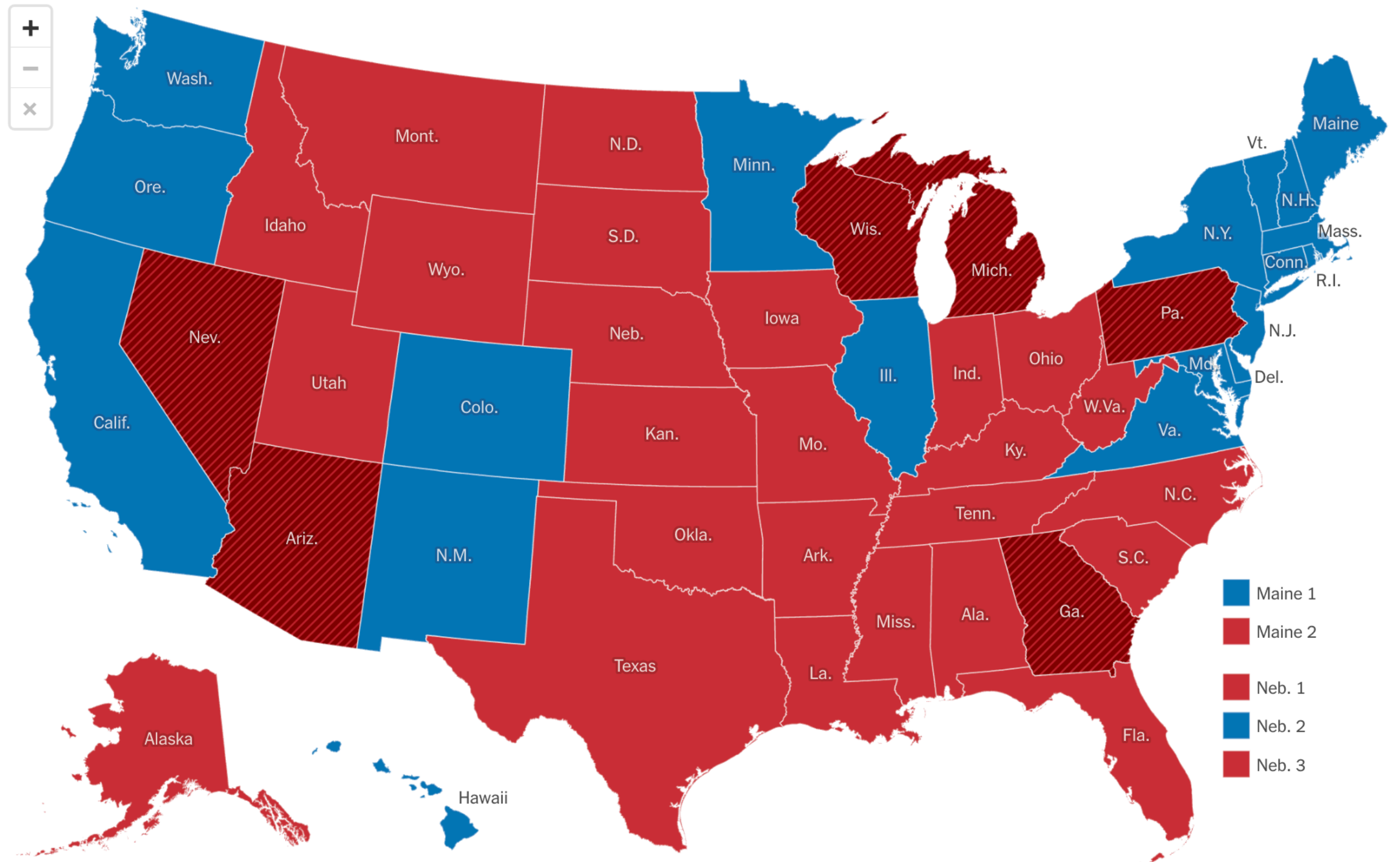
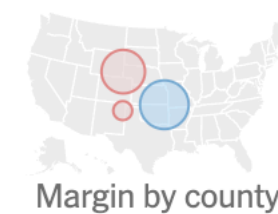
270
TO WIN

154.9 million votes so far (Estimated >99% counted)

312

✓ Donald J. Trump

77,303,573 votes (49.91%)



Geographic Relationships

Results by state

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

Harris expected to win easily

State	Margin	% In
Calif.	D+20 ✓	100%
Colo.	D+11 ✓	100%
Conn.	D+15 ✓	100%
Del.	D+15 ✓	100%
Hawaii	D+23 ✓	100%
Ill.	D+11 ✓	100%
Maine 1	D+22 ✓	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%

Harris expected to win narrowly

State	Margin	% In
Maine	D+7 ✓	100%
Minn.	D+4 ✓	100%
Neb. 2	D+5 ✓	100%
N.H.	D+3 ✓	100%
N.M.	D+6 ✓	100%
Va.	D+6 ✓	100%

Most competitive states

State	Margin	% In
Ariz.	R+6 ✓	100%
Ga.	R+2 ✓	100%
Mich.	R+1.4 ✓	100%
Nev.	R+3 ✓	100%
N.C.	R+3 ✓	100%
Pa.	R+1.7 ✓	100%
Wis.	R+0.86 ✓	100%

Trump expected to win narrowly

State	Margin	% In
Fla.	R+13 ✓	100%
Iowa	R+13 ✓	100%
Maine 2	R+10 ✓	100%
Texas	R+14 ✓	100%

Trump expected to win easily

State	Margin	% In
Ala.	R+31 ✓	100%
Alaska	R+13 ✓	100%
Ark.	R+31 ✓	100%
Idaho	R+37 ✓	100%
Ind.	R+19 ✓	100%
Kan.	R+16 ✓	100%
Ky.	R+31 ✓	100%
La.	R+22 ✓	100%
Miss.	R+23 ✓	100%
Mo.	R+18 ✓	100%
Mont.	R+20 ✓	100%
Neb.	R+21 ✓	100%
Neb. 1	R+13 ✓	100%
Neb. 3	R+54 ✓	100%
N.D.	R+37 ✓	100%
Ohio	R+11 ✓	100%
Okla.	R+34 ✓	100%
S.C.	R+18 ✓	100%
S.D.	R+29 ✓	100%
Tenn.	R+30 ✓	100%
Utah	R+22 ✓	100%
W.Va.	R+42 ✓	100%
Wyo.	R+46 ✓	100%

Dem. Win Flip Rep. Win Flip

✓ Who's winning my state?

✓ Is it a landslide?

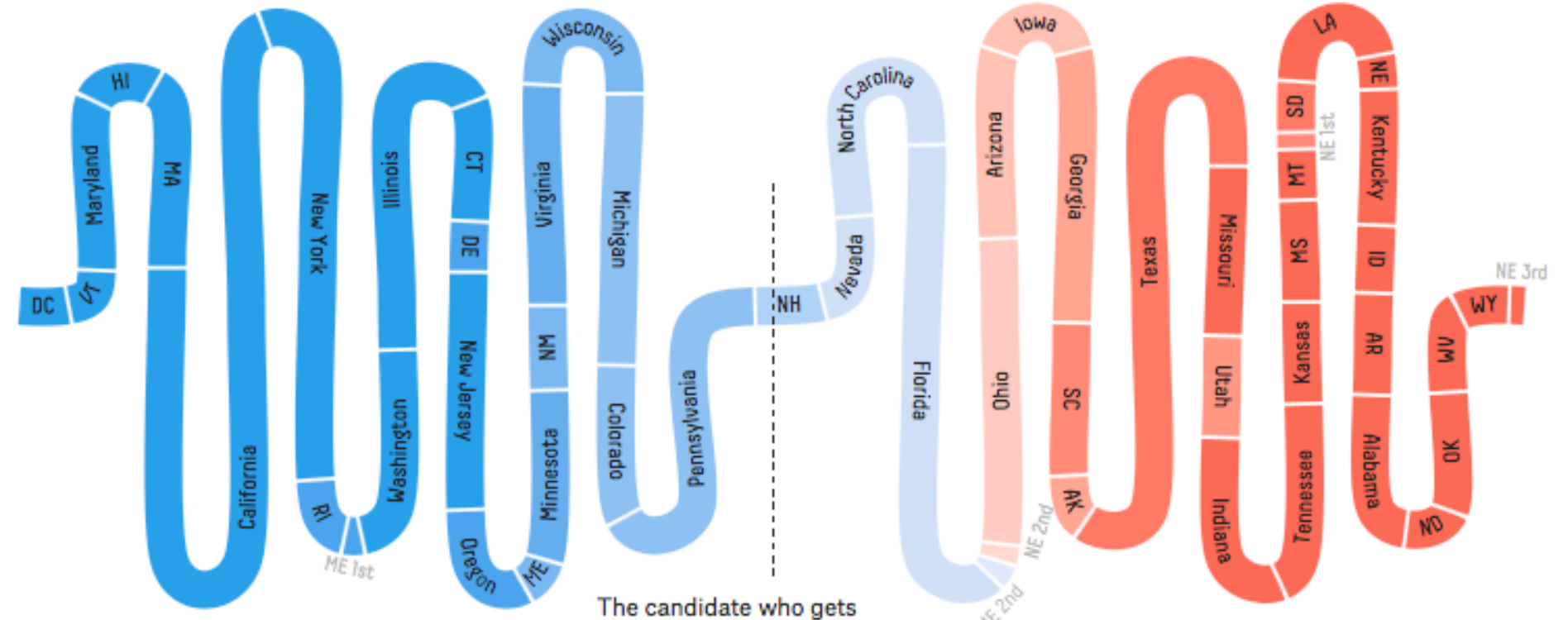
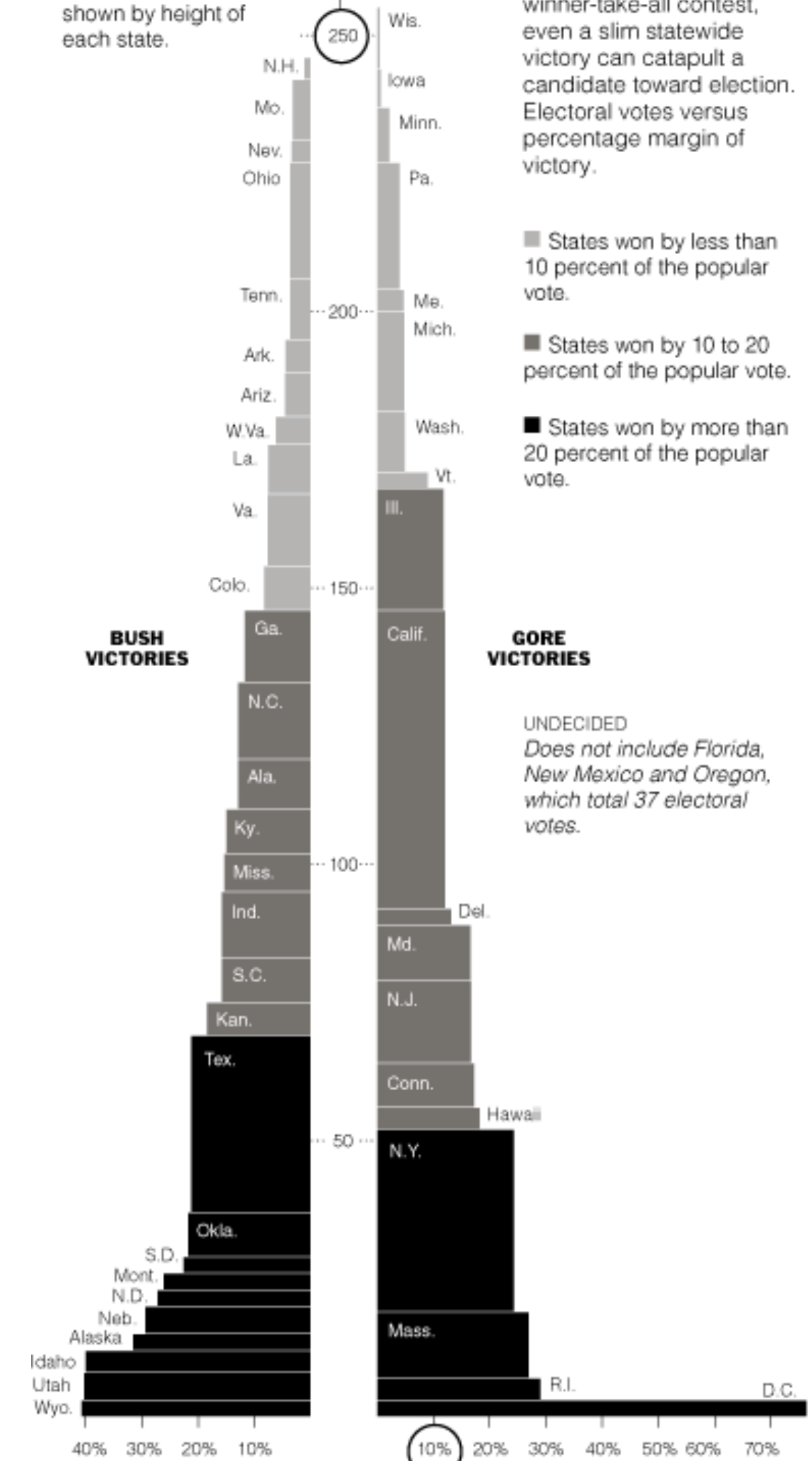
✗ What are the paths to victory?

Building An Electoral Victory

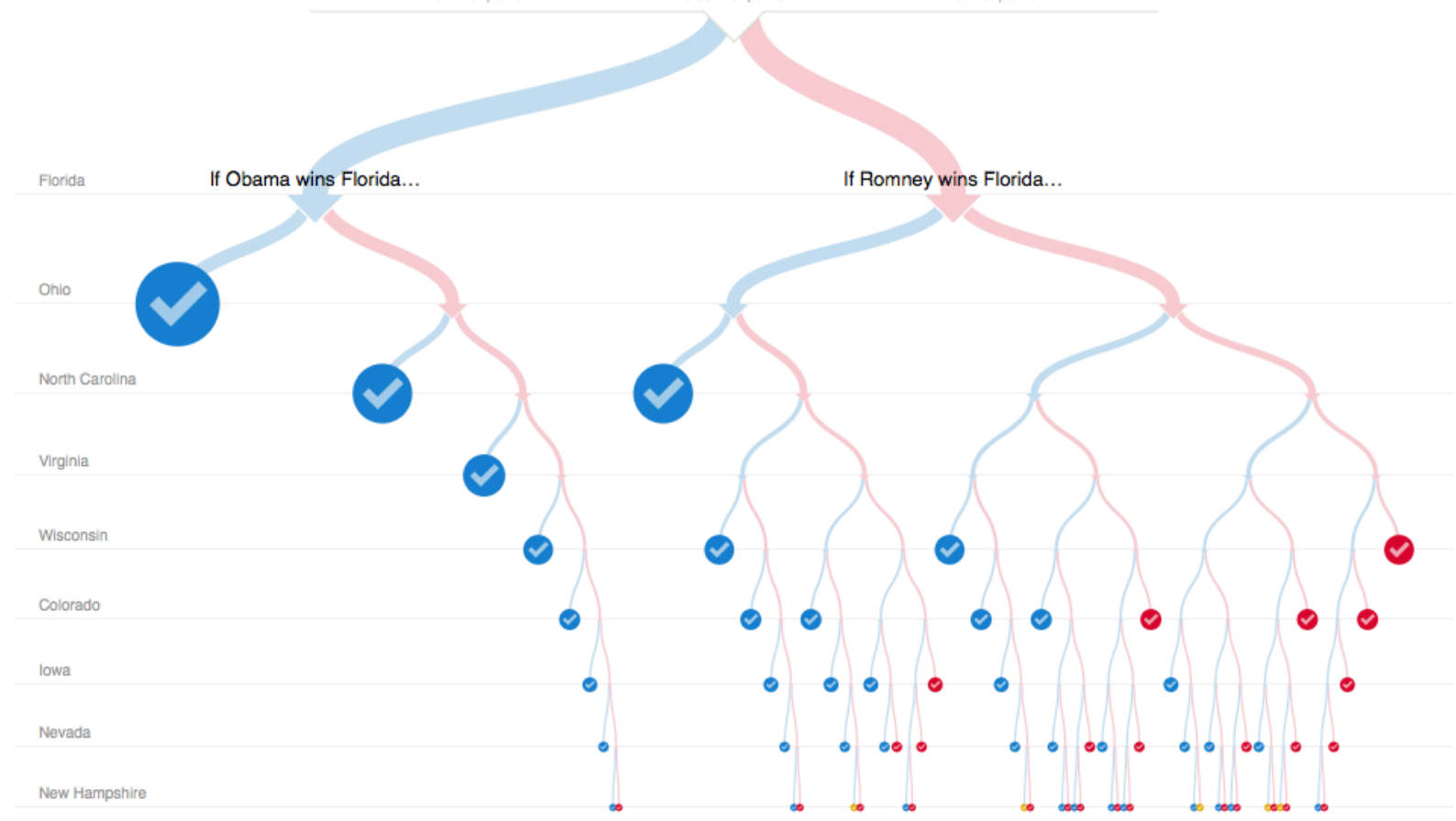
270 electoral votes are needed to win the election.

Because most states award electoral votes in a winner-take-all contest, even a slim statewide victory can catapult a candidate toward election. Electoral votes versus percentage margin of victory.

Electoral votes shown by height of each state.



Obama has 431 ways to win (64% of paths) 5 ties (0.98% of paths) Romney has 76 ways to win (15% of paths)



KEY AVERAGE 80% CHANCE OUTCOME FALLS IN THIS RANGE

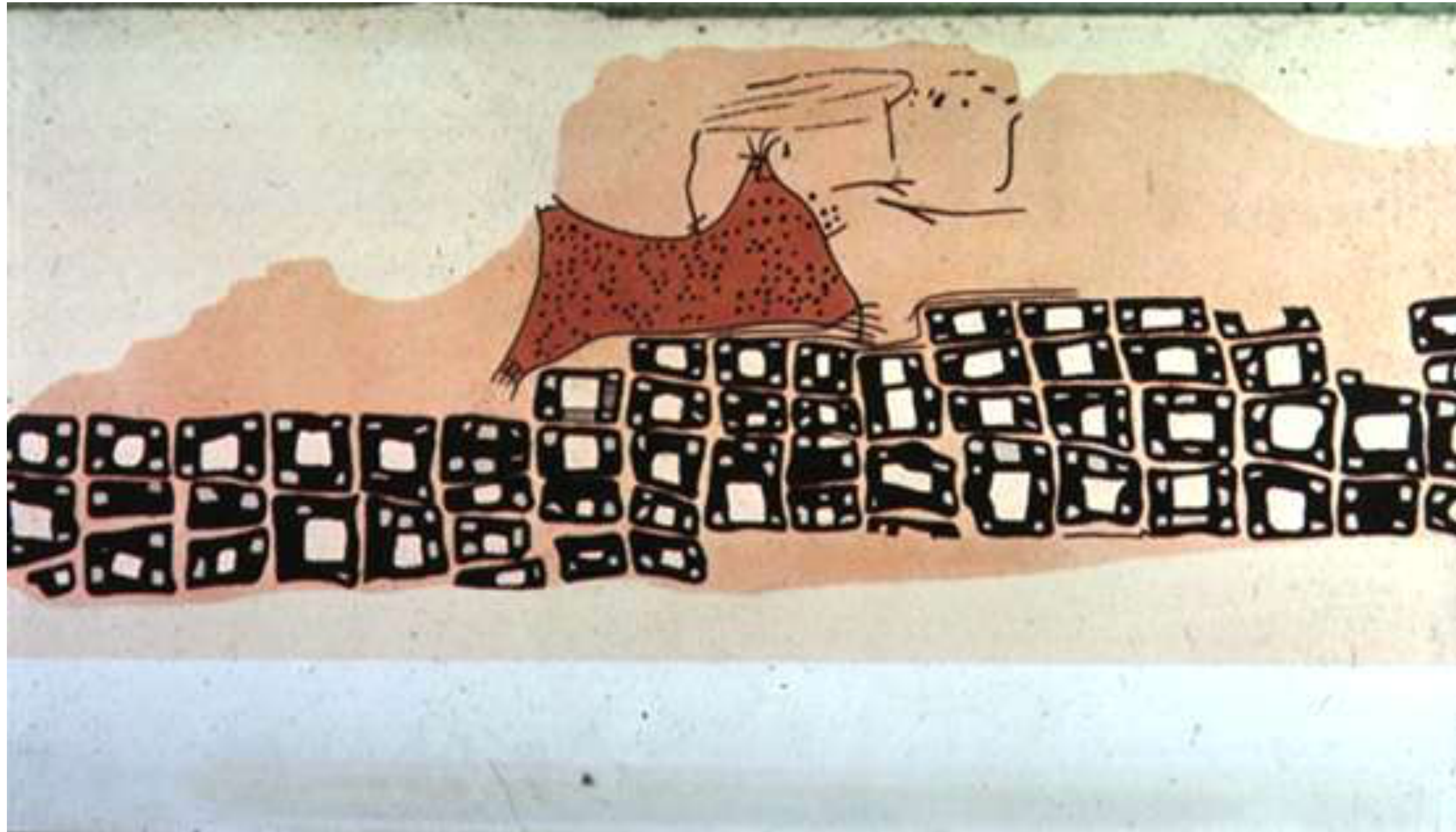
	Expected margin of victory						Chance of tipping election
	+75	+50	+25	+25	+50	+75	
Florida							D+0.7 17.6%
Pennsylvania							D+3.7 12.3%
Michigan							D+4.2 11.7%
North Carolina							D+0.7 11.2%
Virginia							D+5.6 6.0%
Colorado							D+4.0 6.0%
Ohio							R+1.9 5.2%
Wisconsin							D+5.3 4.8%
Minnesota							D+5.8 3.8%
Nevada							D+1.2 3.7%
Arizona							R+2.2 2.8%
New Mexico							D+5.8 2.8%
New Hampshire							D+3.6 2.3%
Georgia							R+4.0 2.3%

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

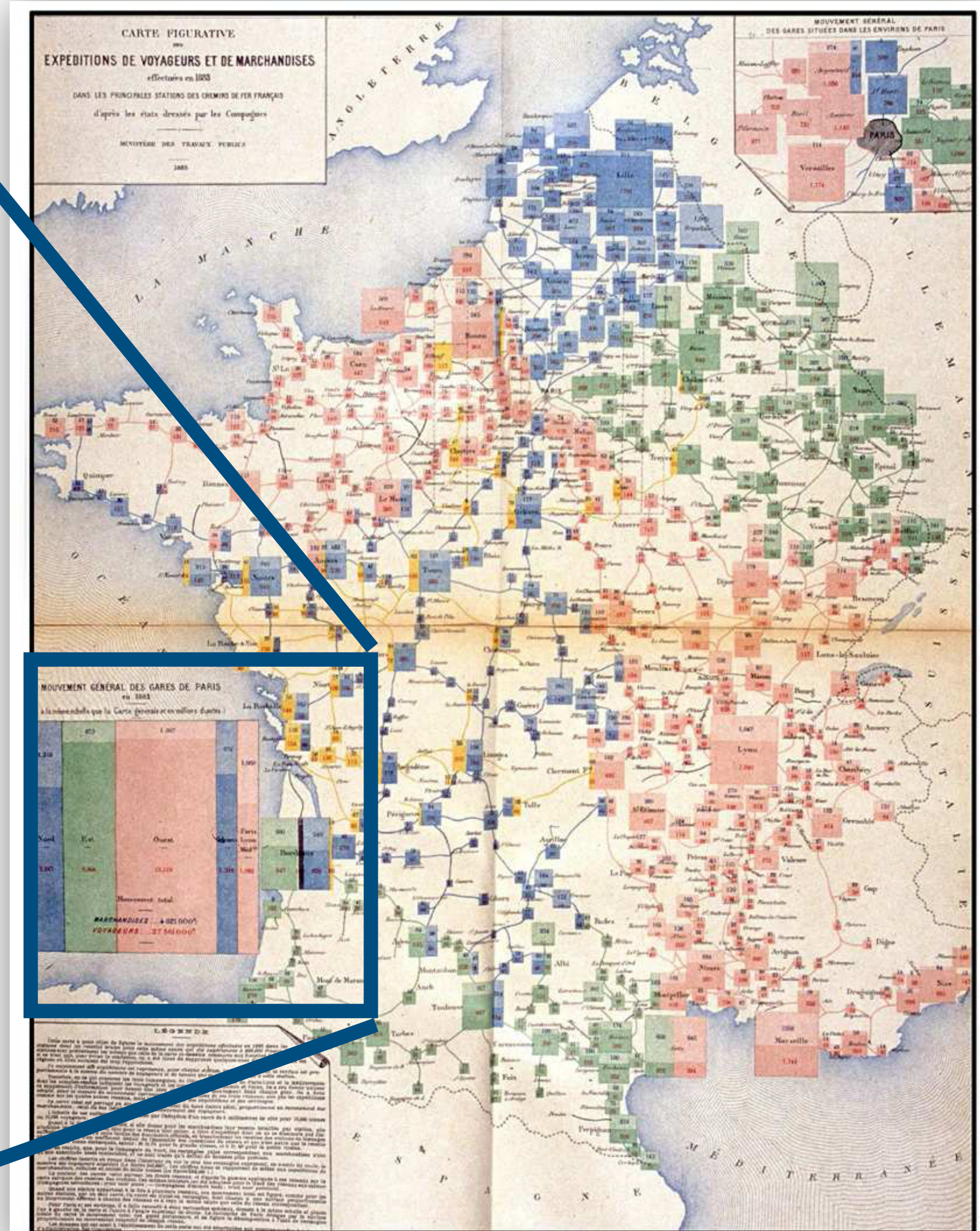
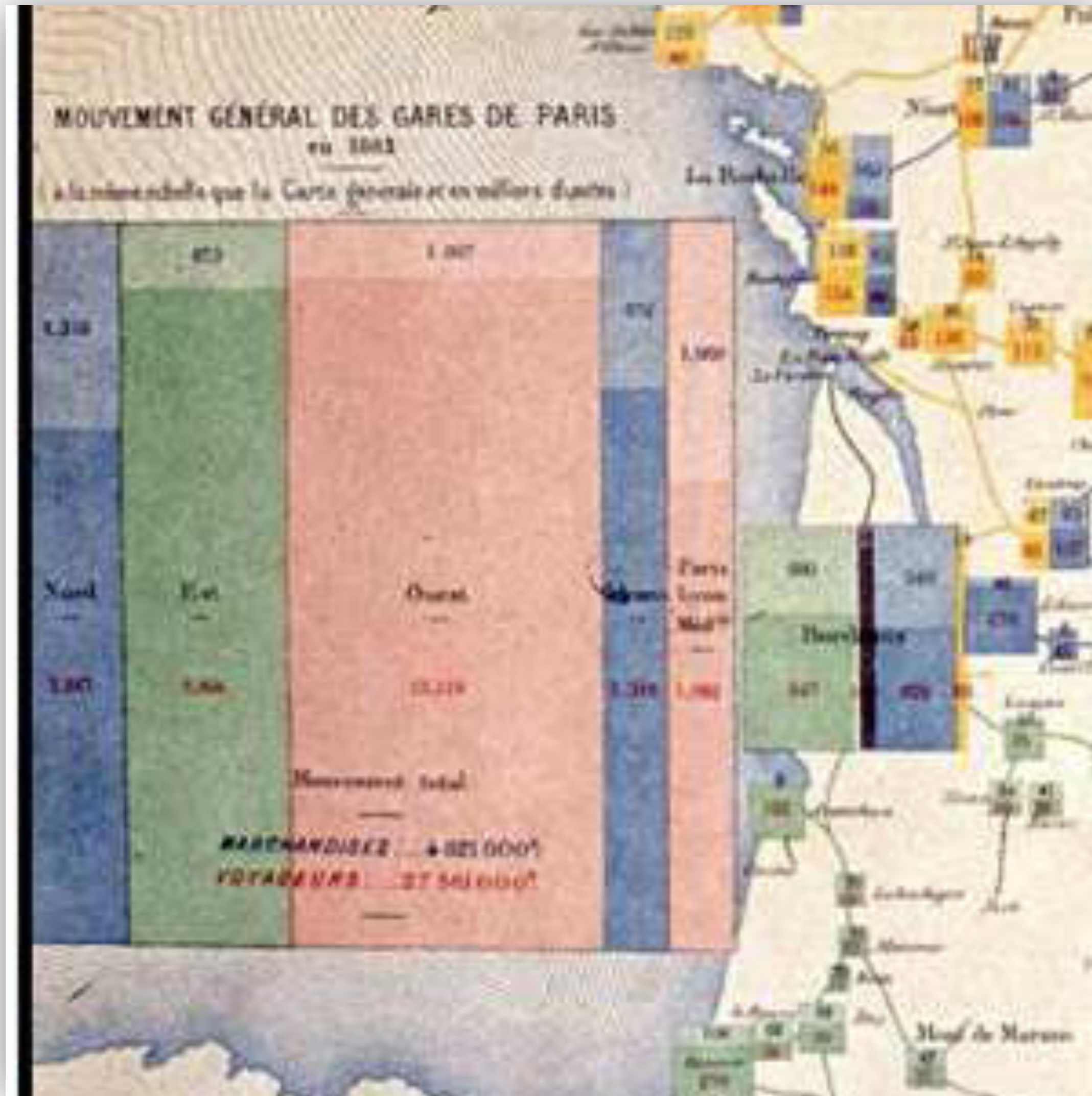
Cartography

(Map Making)

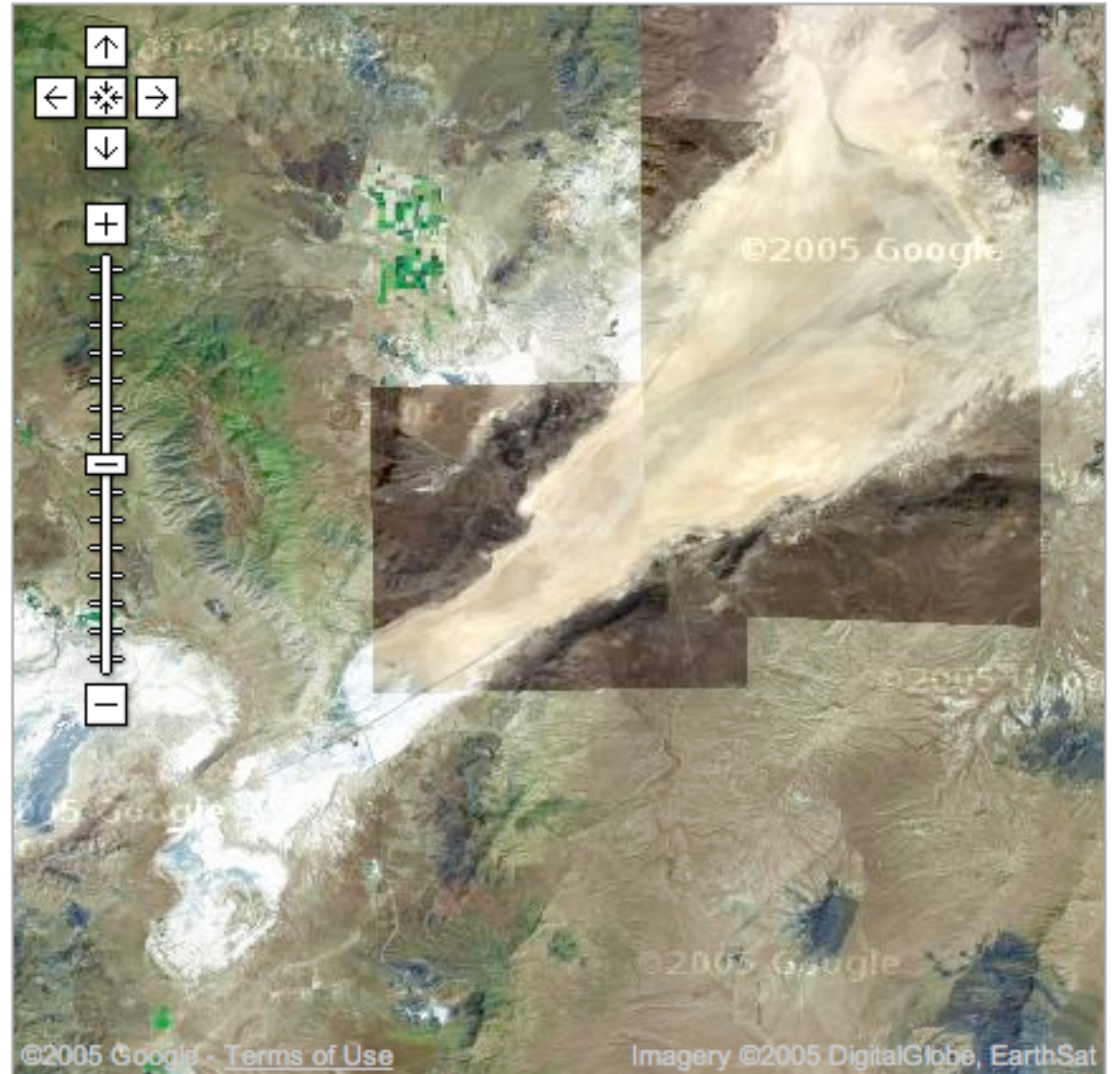
Oldest Known Map: Konya, Turkey (~6200 BC)



Rail Passengers and Freight from Paris 1884



Google Maps, 2005

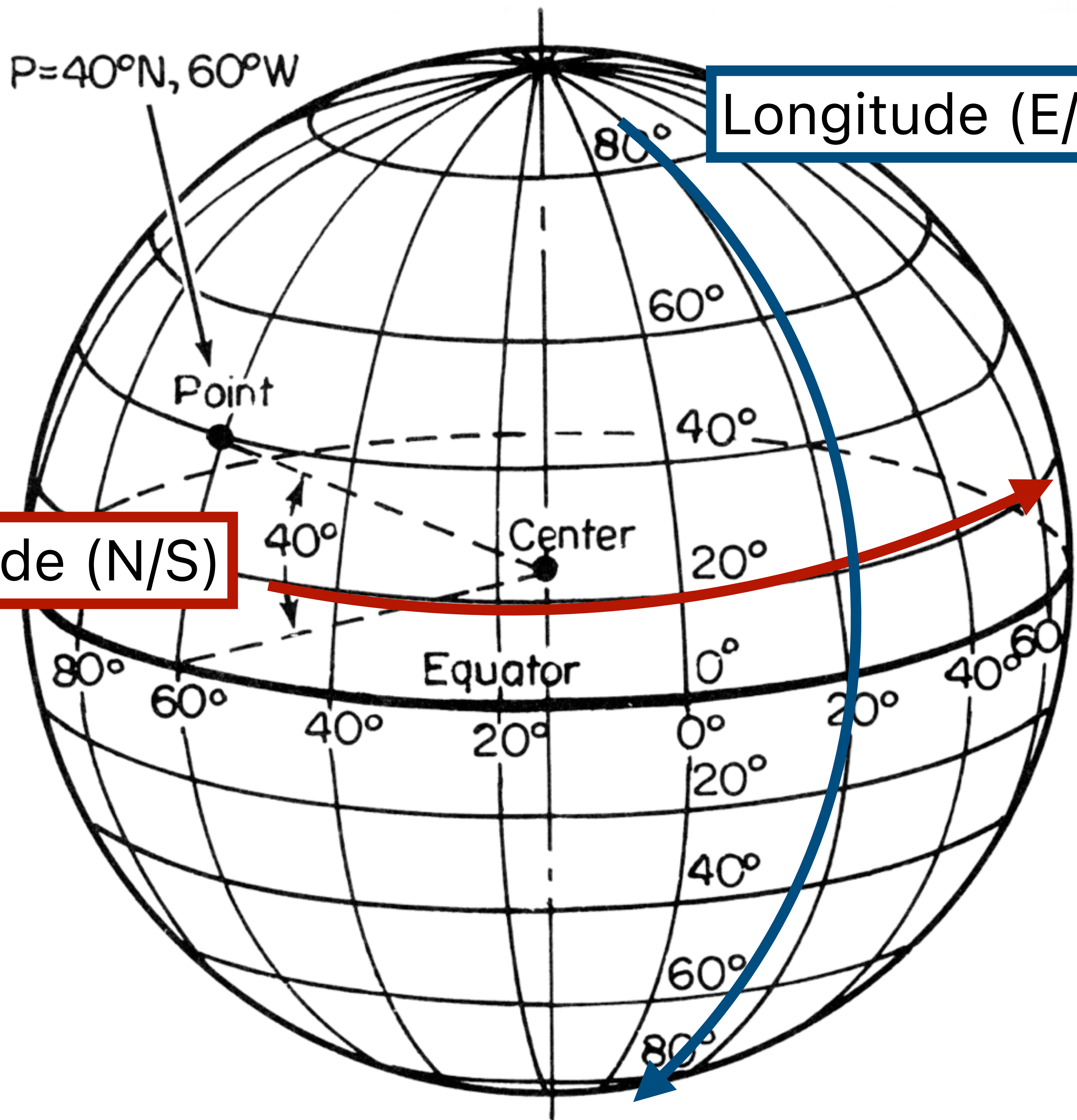


P=40°N, 60°W

Longitude (E/W)

Latitude (N/S)

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





A sphere tears
when you flatten it

Exploring Projections



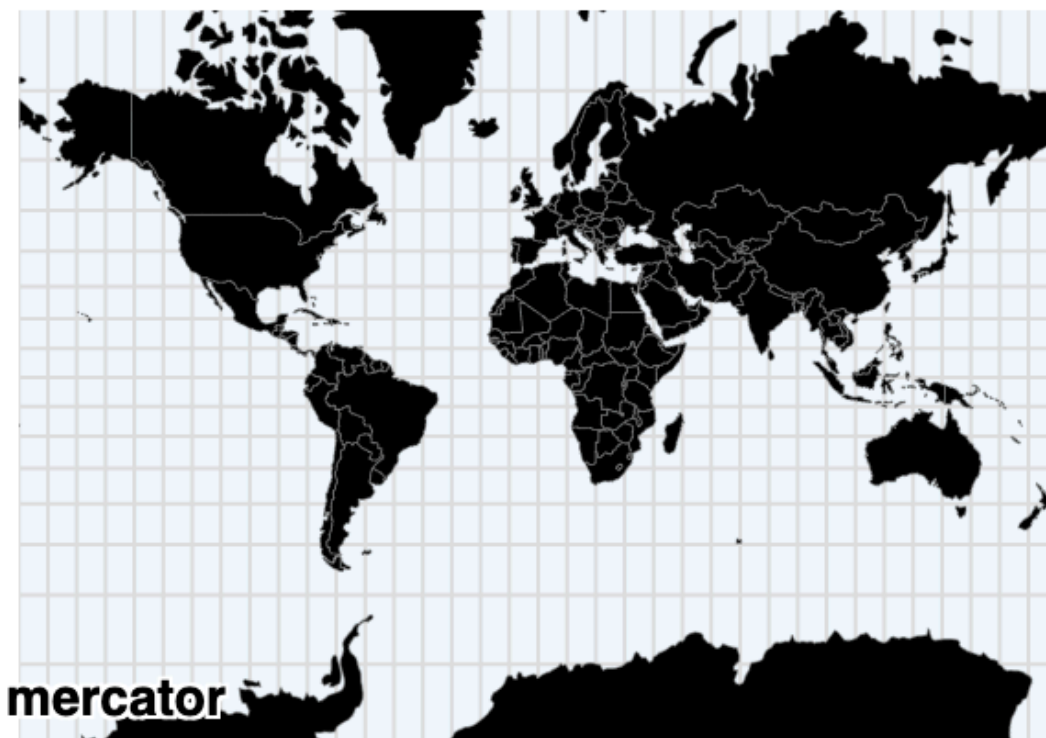
azimuthalEquidistant



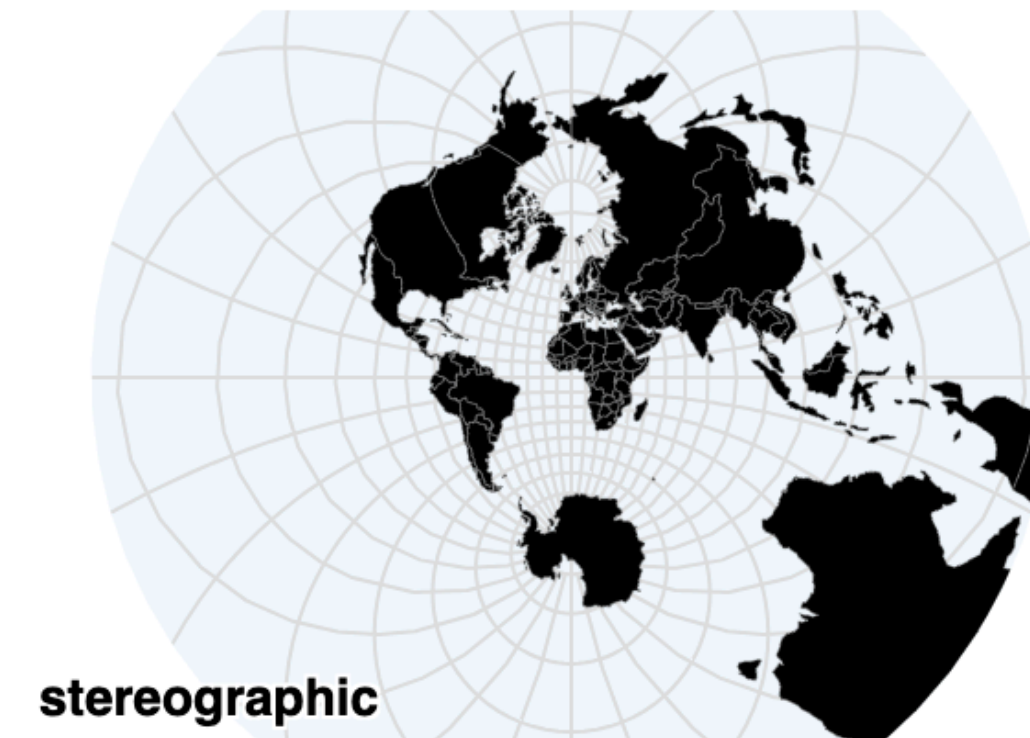
conicConformal



gnomonic



mercator



stereographic



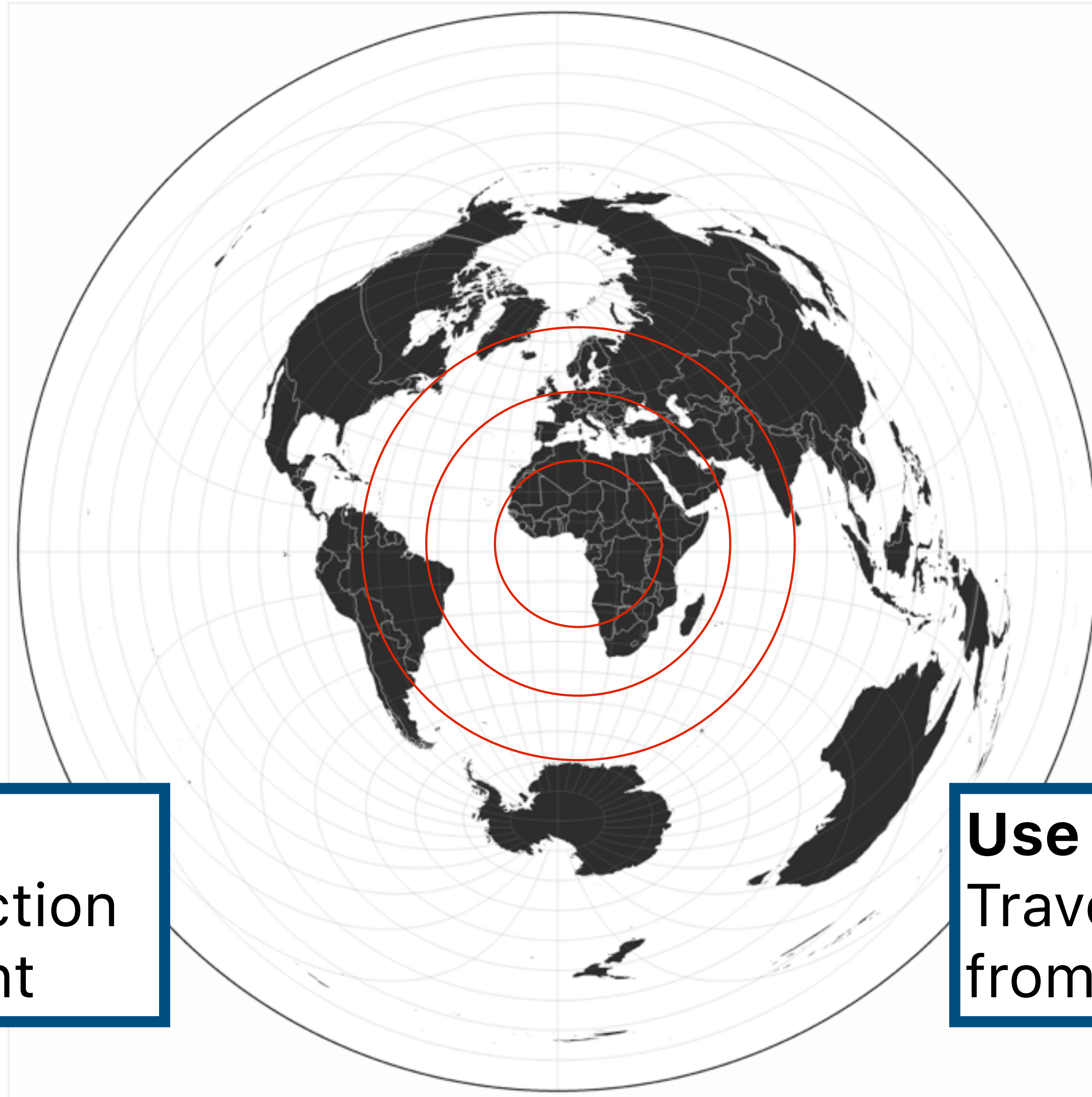
airy



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

**Projections preserve some
metrics, distort others**

Azimuthal Equidistant



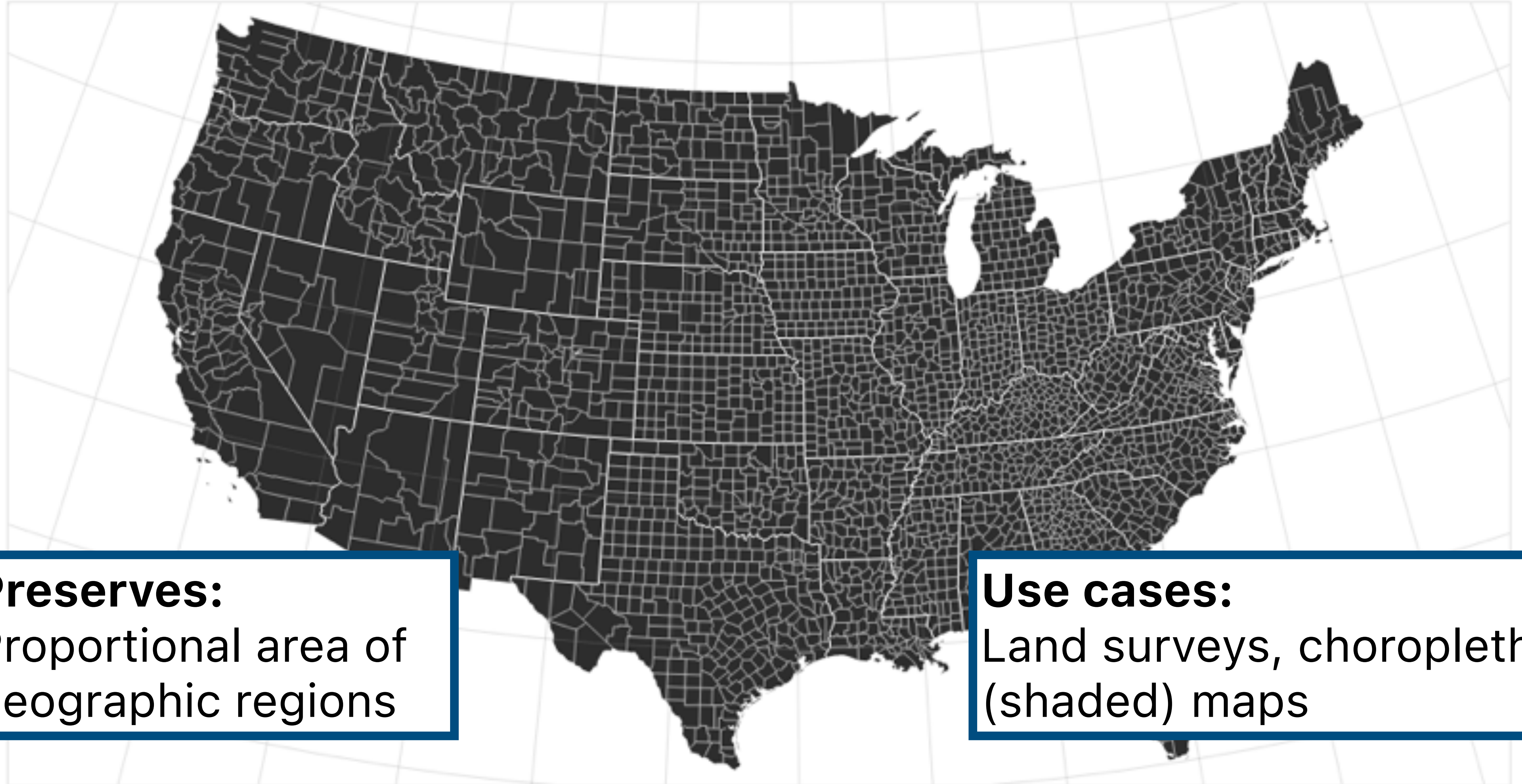
Preserves:

Distance & direction
from center point

Use cases:

Travel / propagation
from center point

Albers Equal-Area Conic



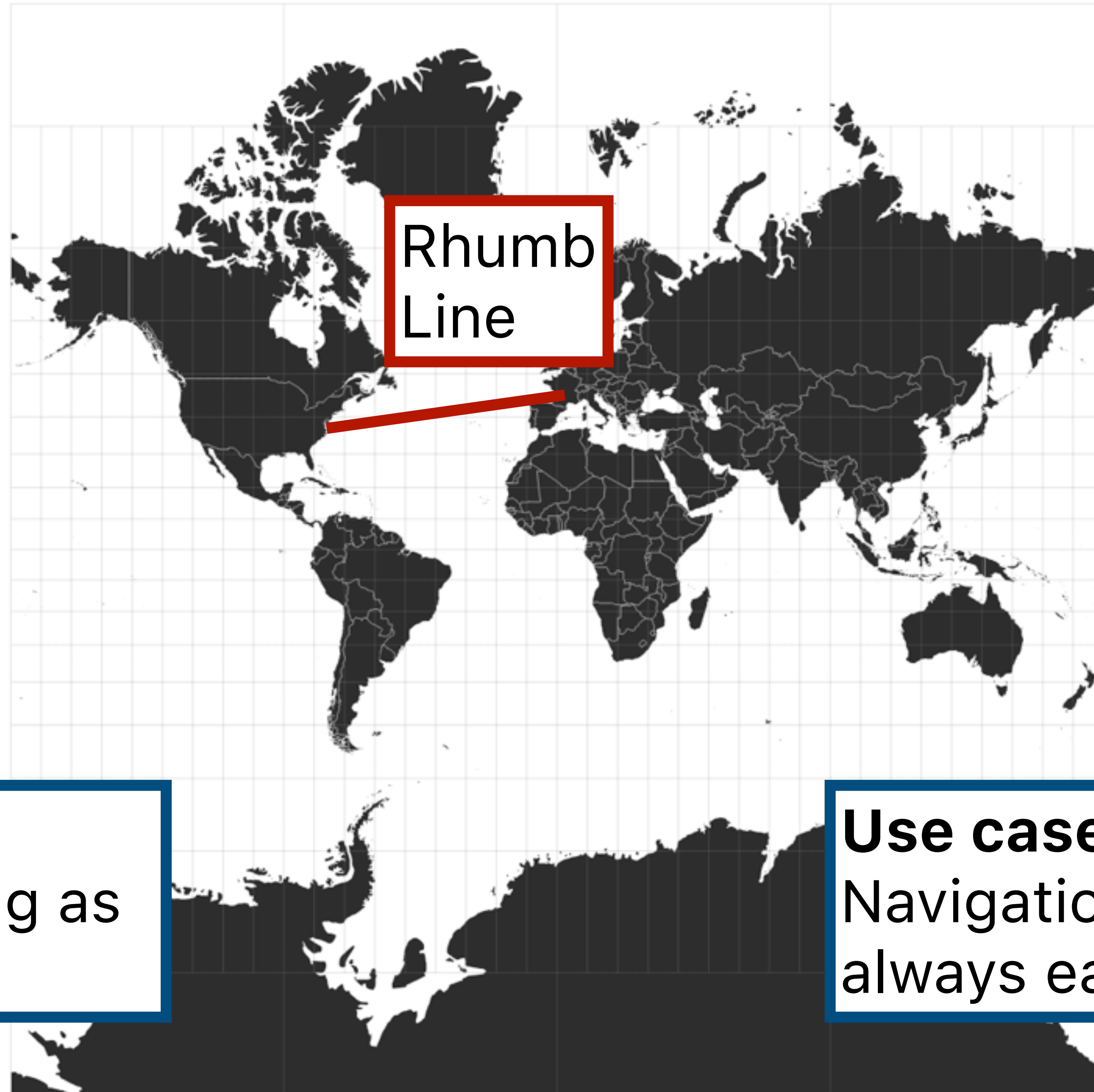
Preserves:

Proportional area of geographic regions

Use cases:

Land surveys, choropleth (shaded) maps

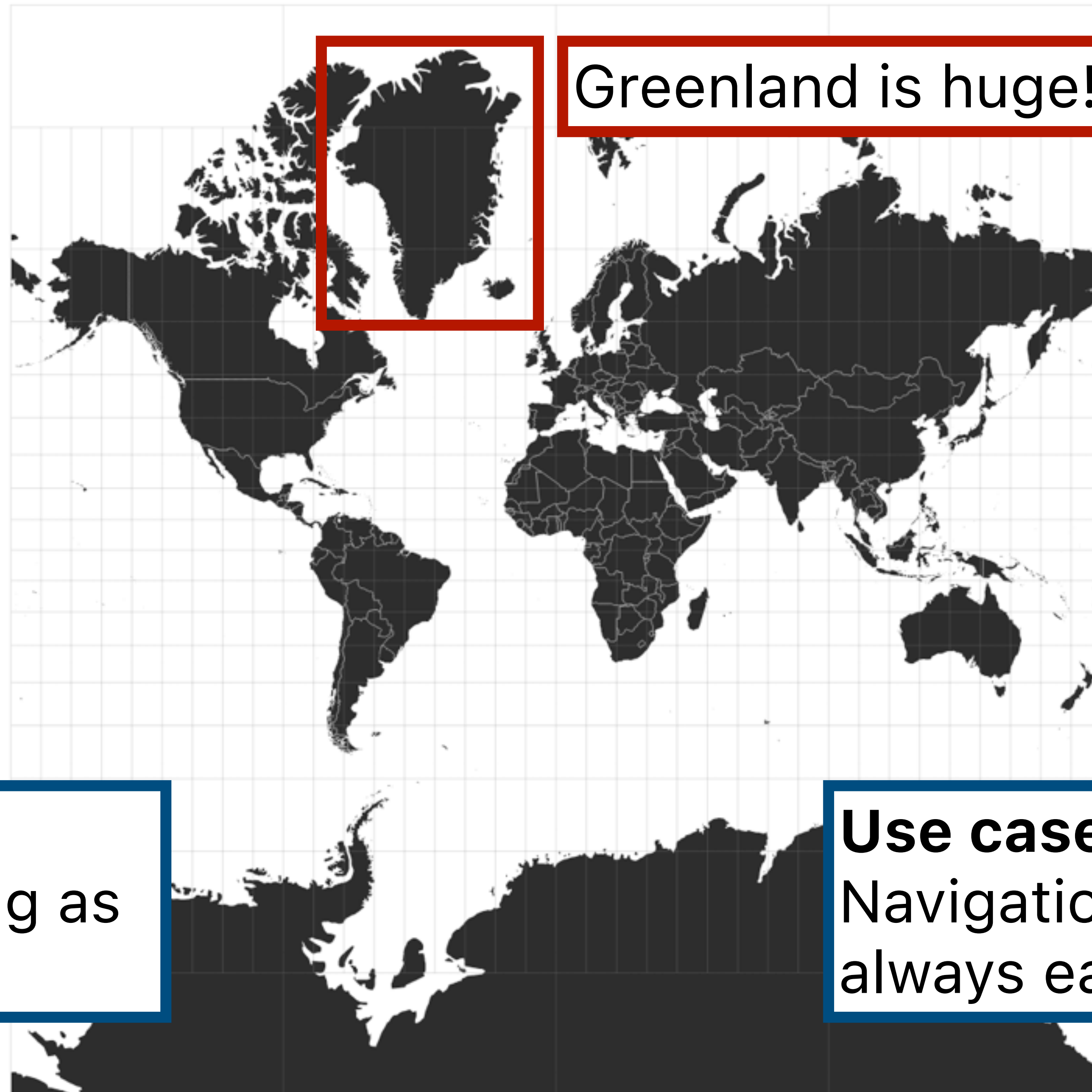
Spherical Mercator



Preserves:
Compass bearing as
straight line

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

Spherical Mercator



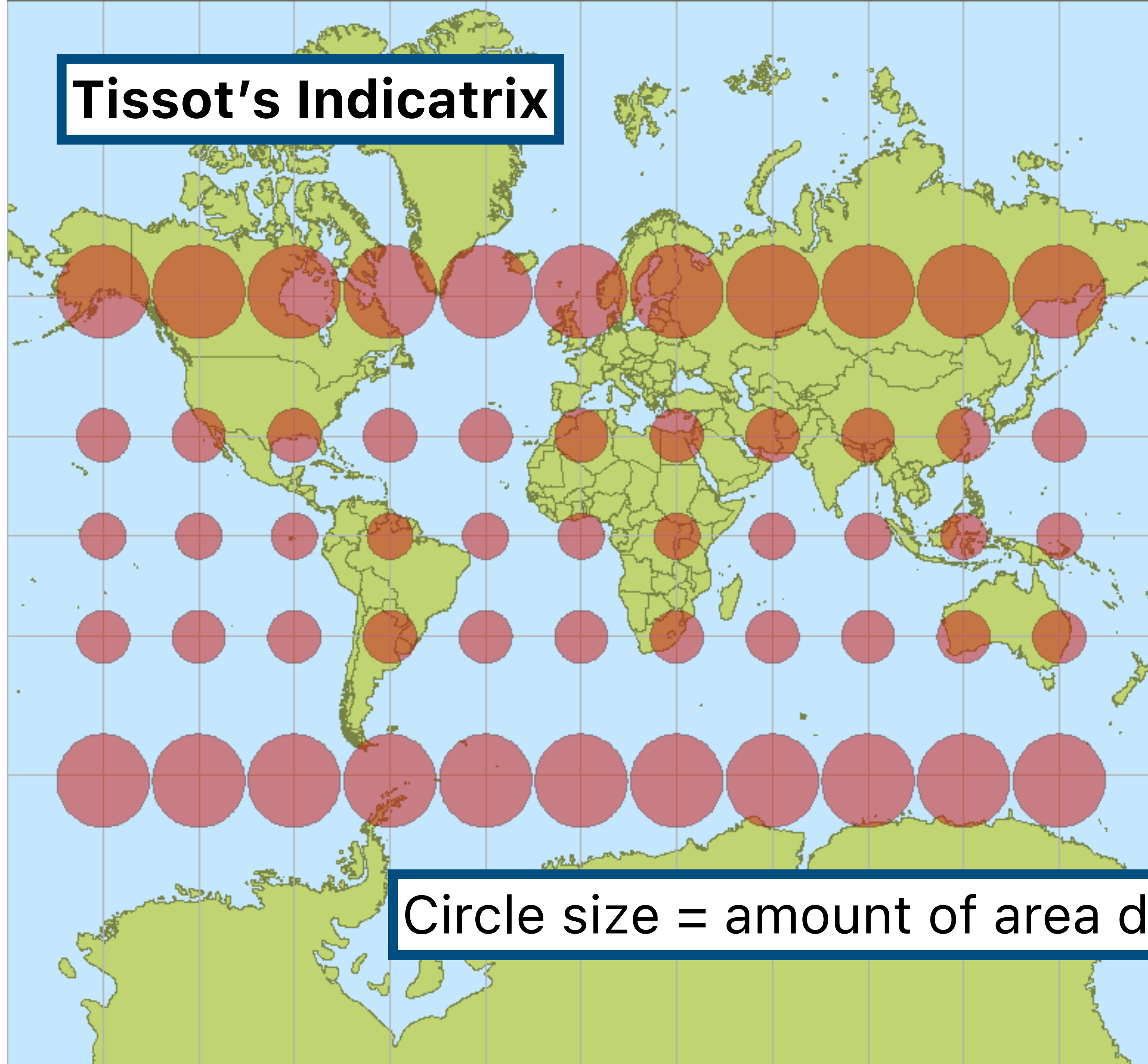
Preserves:

Compass bearing as straight line

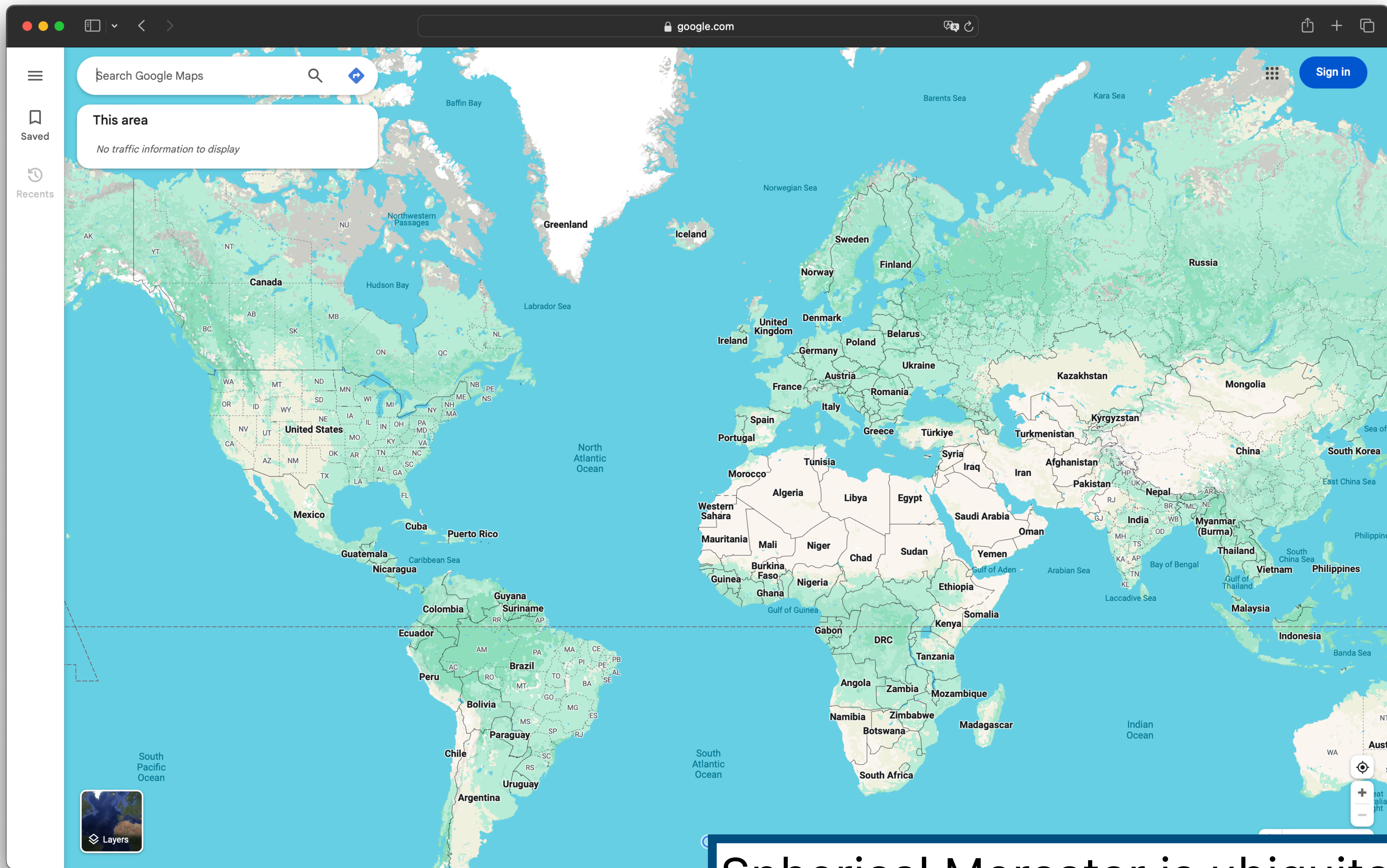
Use cases:

Navigation (left / right is always east / west)

Tissot's Indicatrix



Circle size = amount of area distortion



Spherical Mercator is ubiquitous on web

A map of the Americas, including North and South America, is shown in yellow against a grey background. A blue-bordered text box is overlaid on the map, containing the text "Projections usually have a home". A vertical orange-bordered rectangle highlights a portion of the western United States and northern Mexico. The text box is positioned over the eastern United States and northern South America.

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

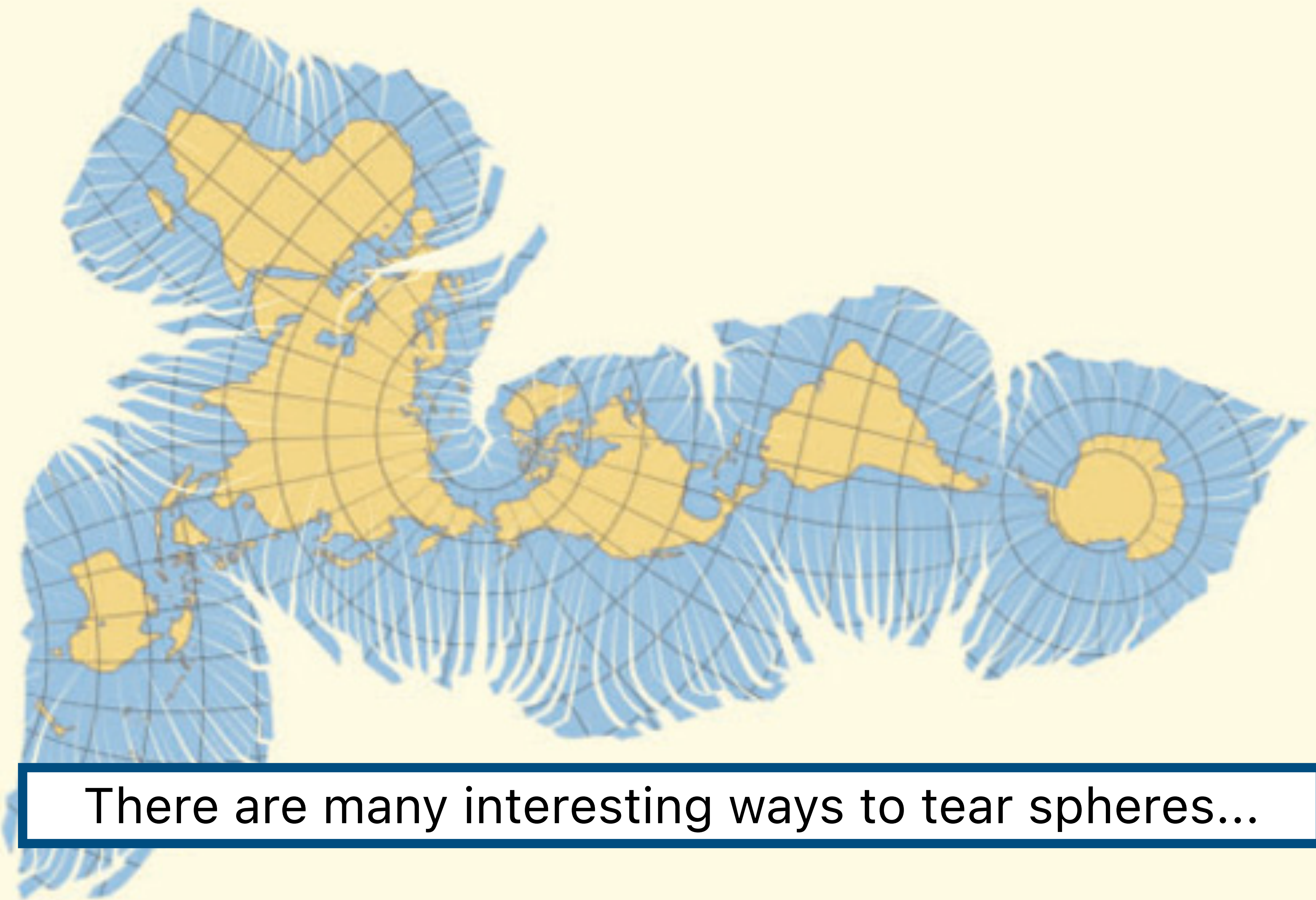


YOU'RE NOT REALLY INTO MAPS.

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!

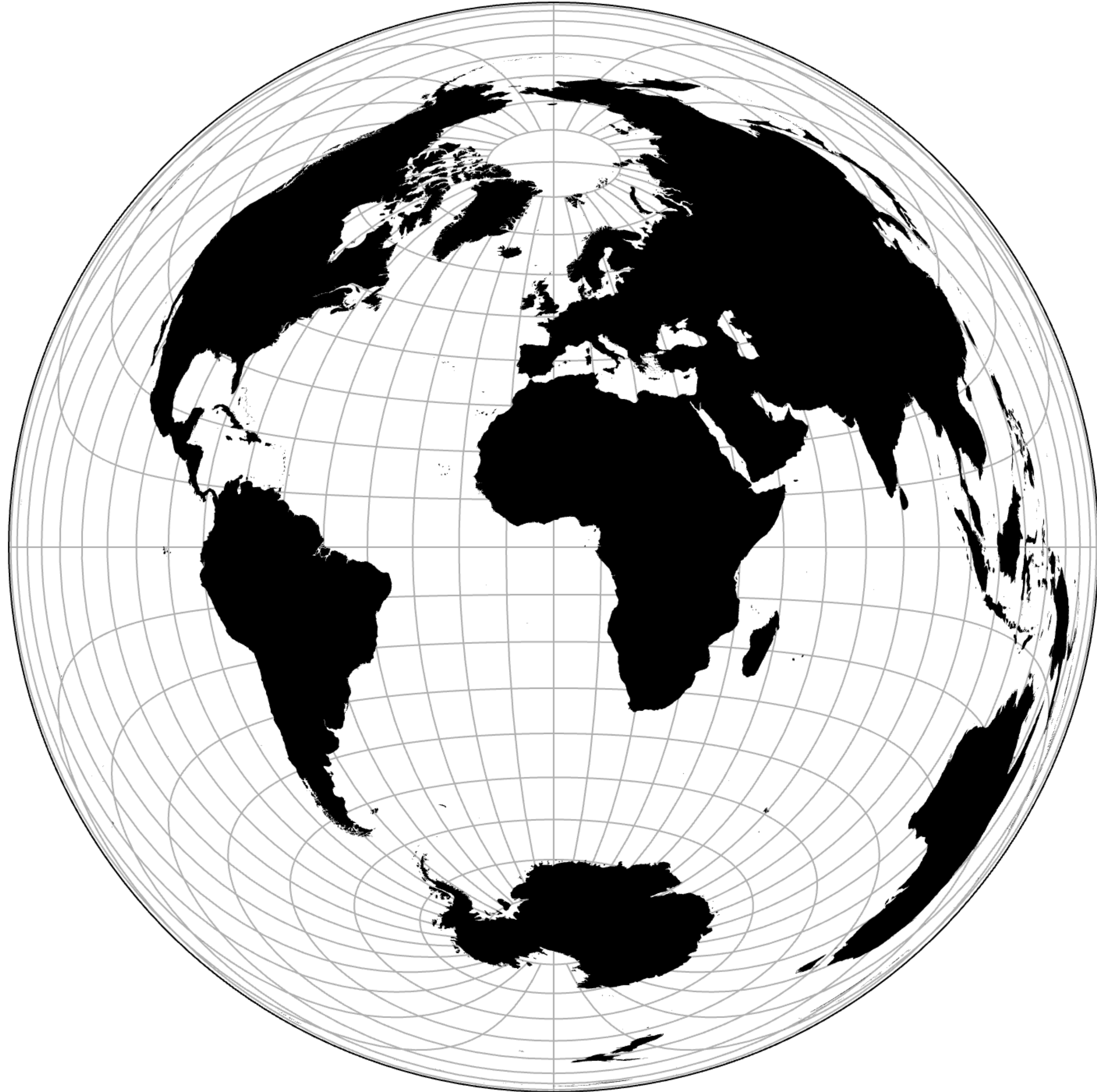


There are many interesting ways to tear spheres...

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?

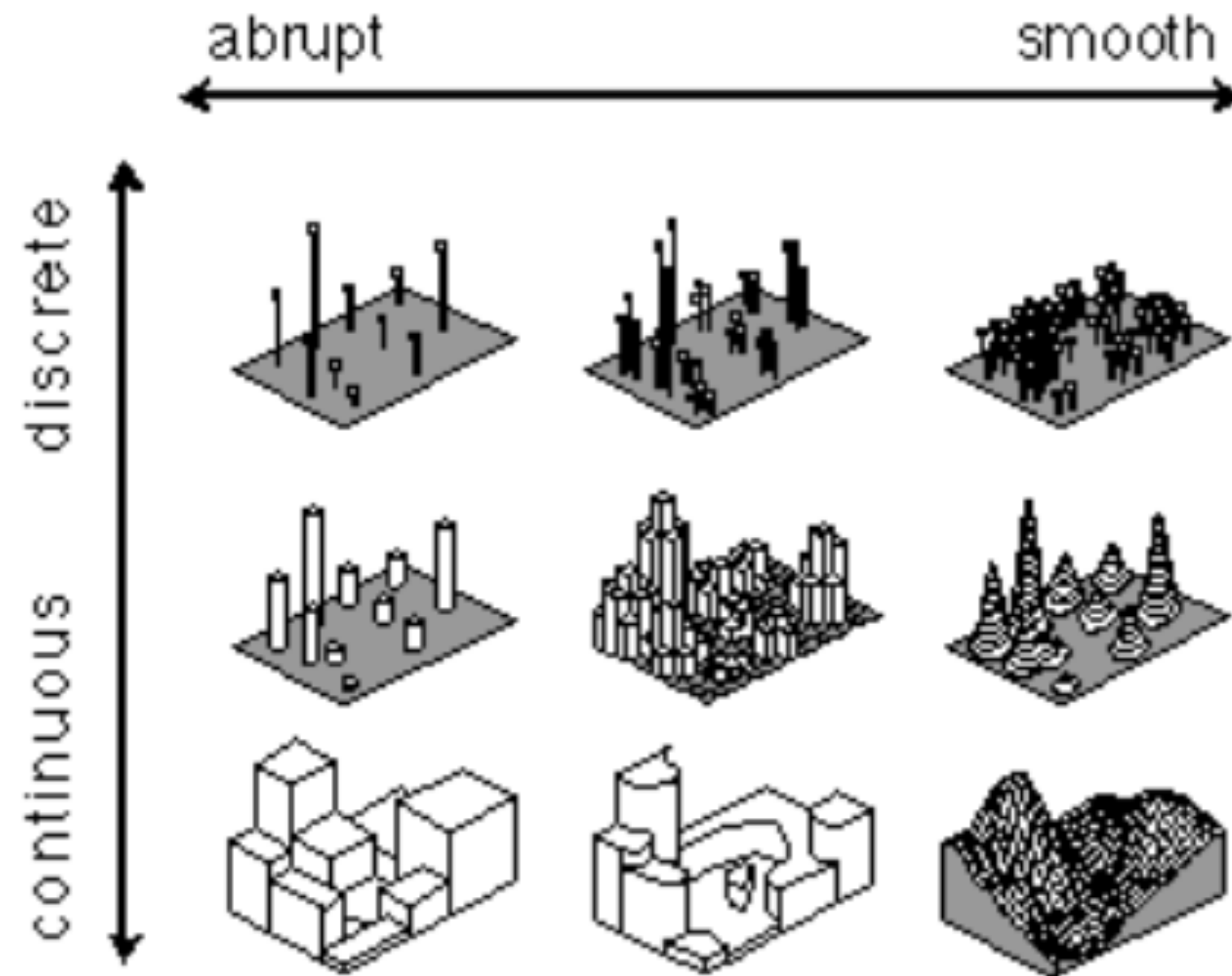


Fig. 8. Data models representing points in the continuity-abruptness phenomena space.

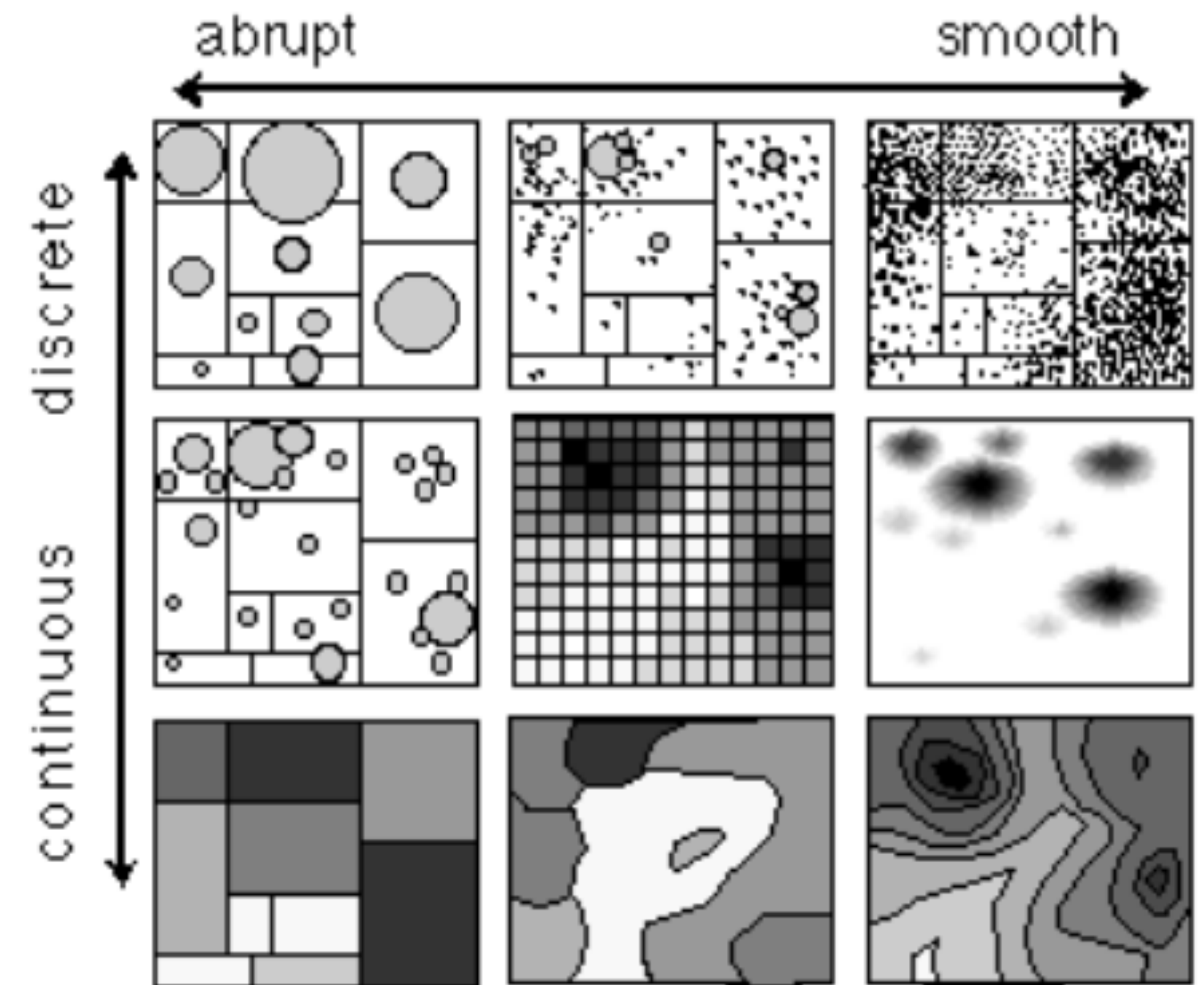


Fig. 9. Possible 2D translations of the 3D data models shown in figure 8.

Dot Distribution Map

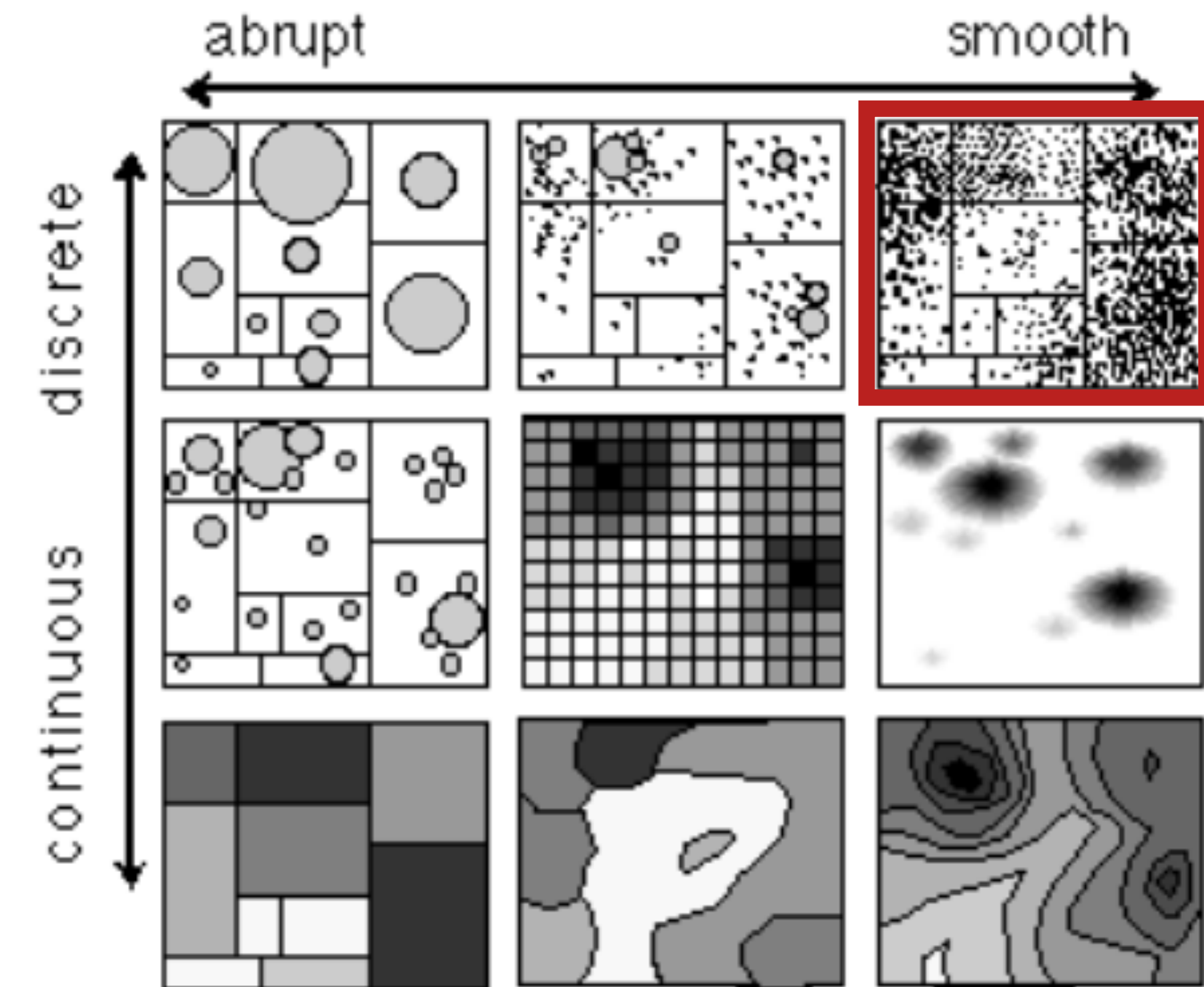


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<https://www.youtube.com/watch?v=8pRcdMVkA3k>

Dot Distribution Map

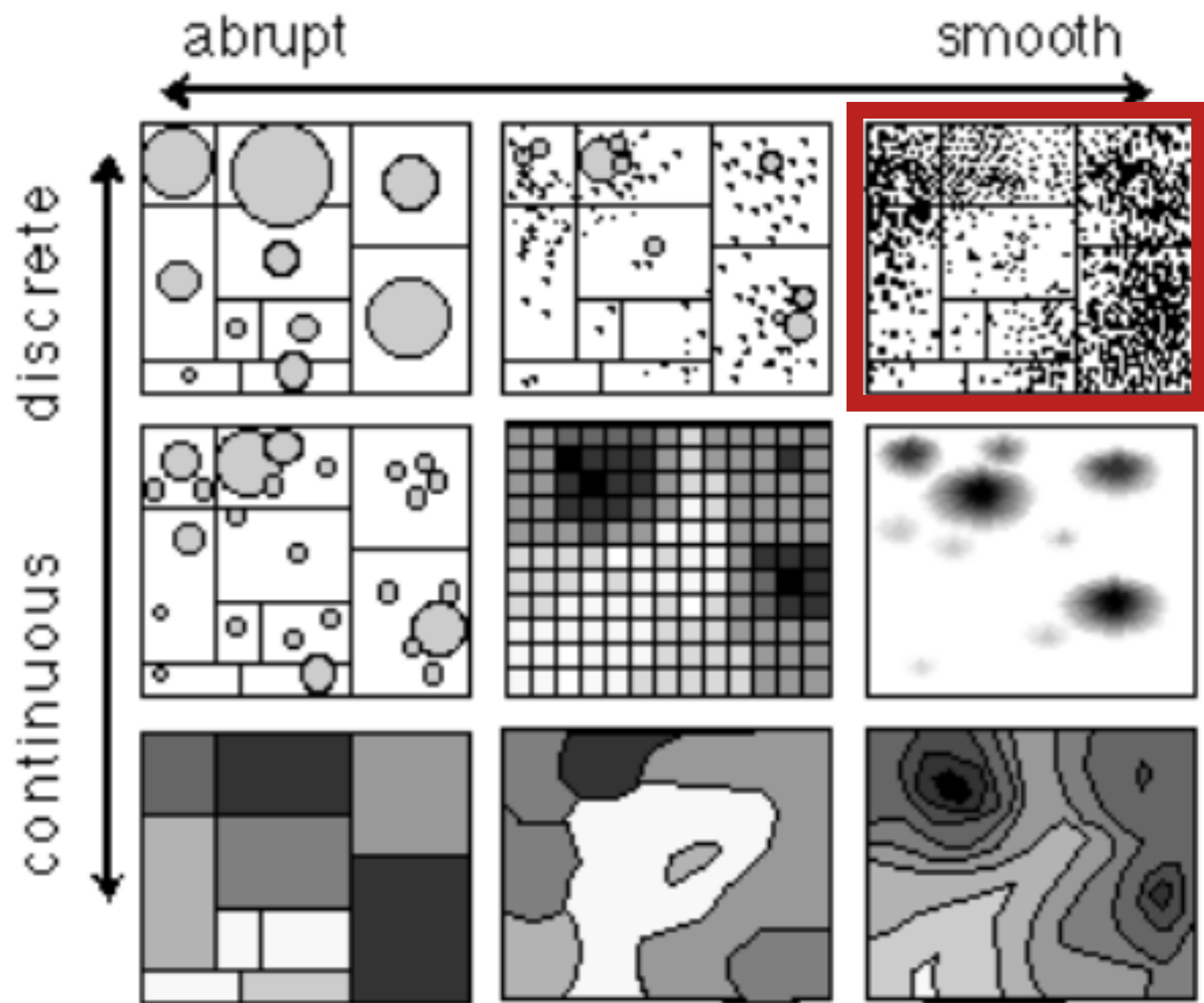
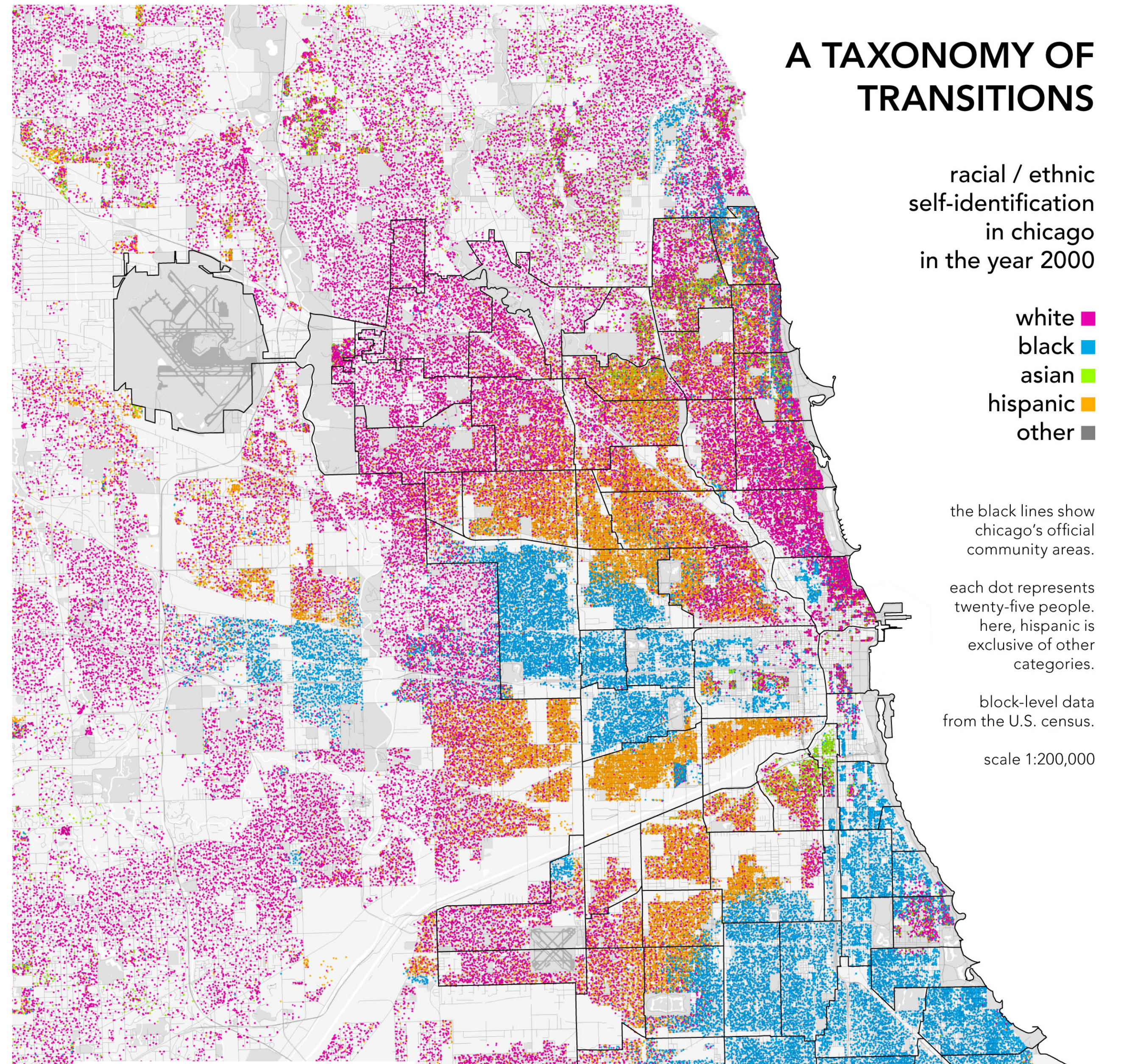


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Dot Distribution Map

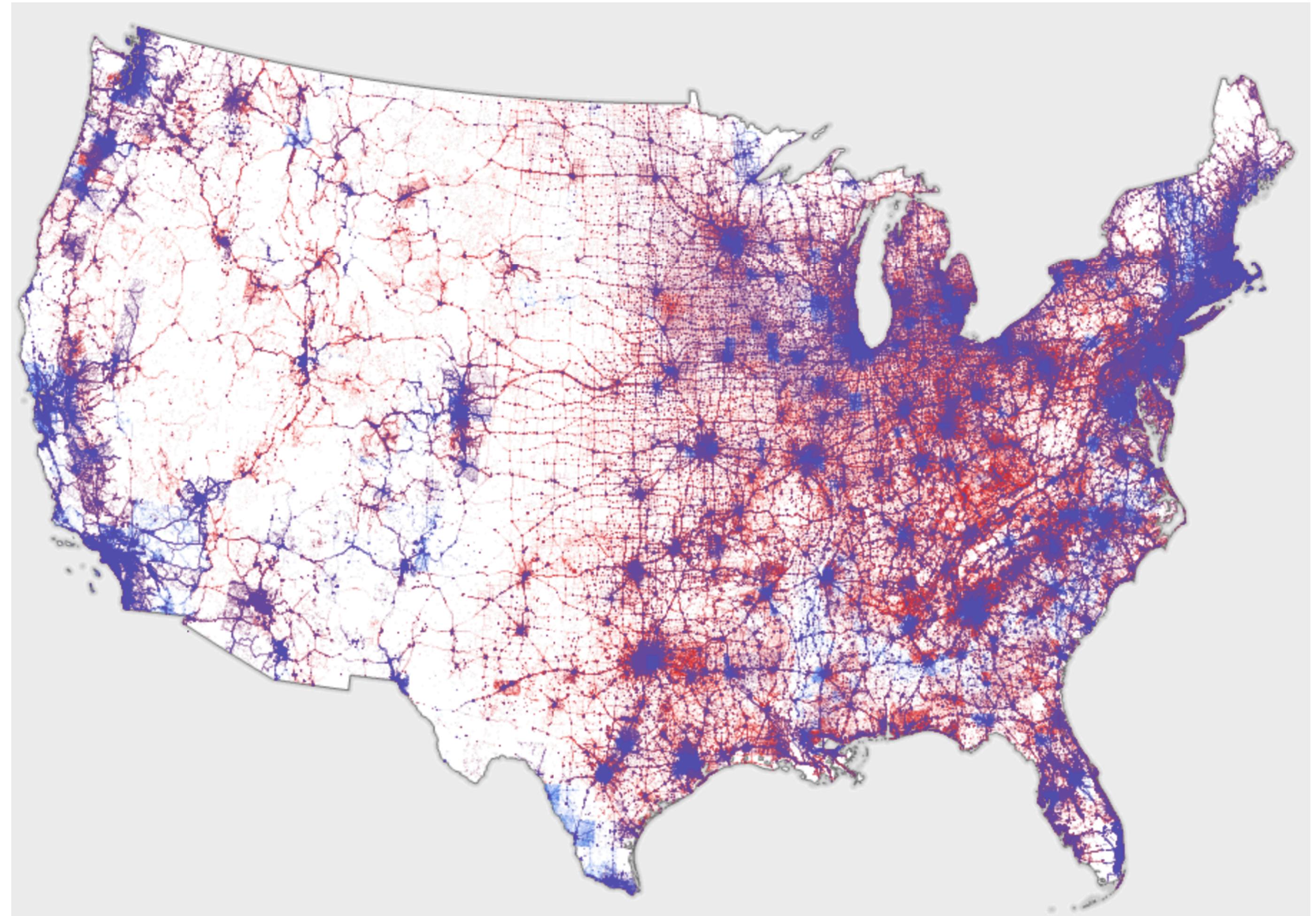
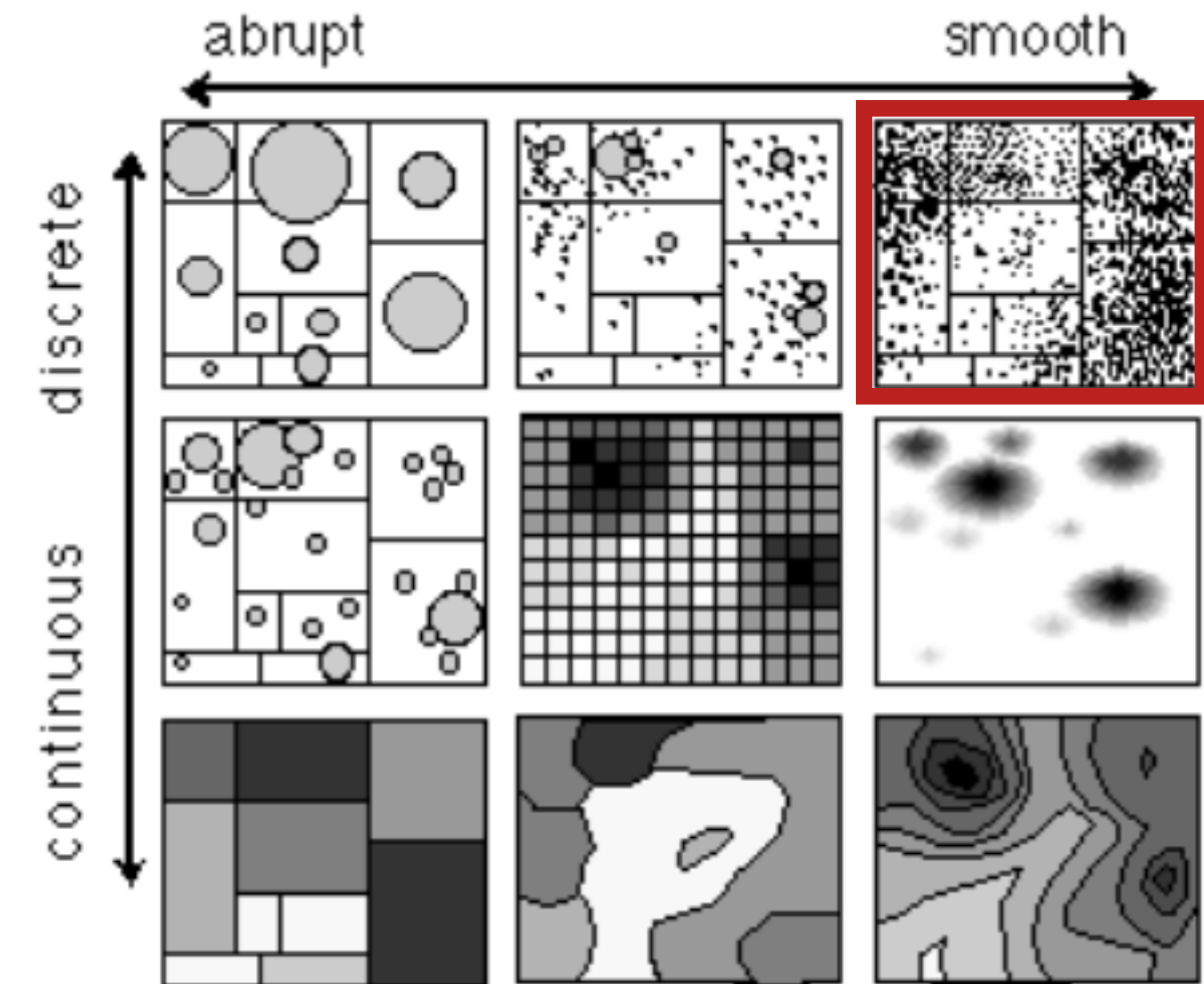


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Votes cast in the 2016 Presidential Election

Dot Distribution Map

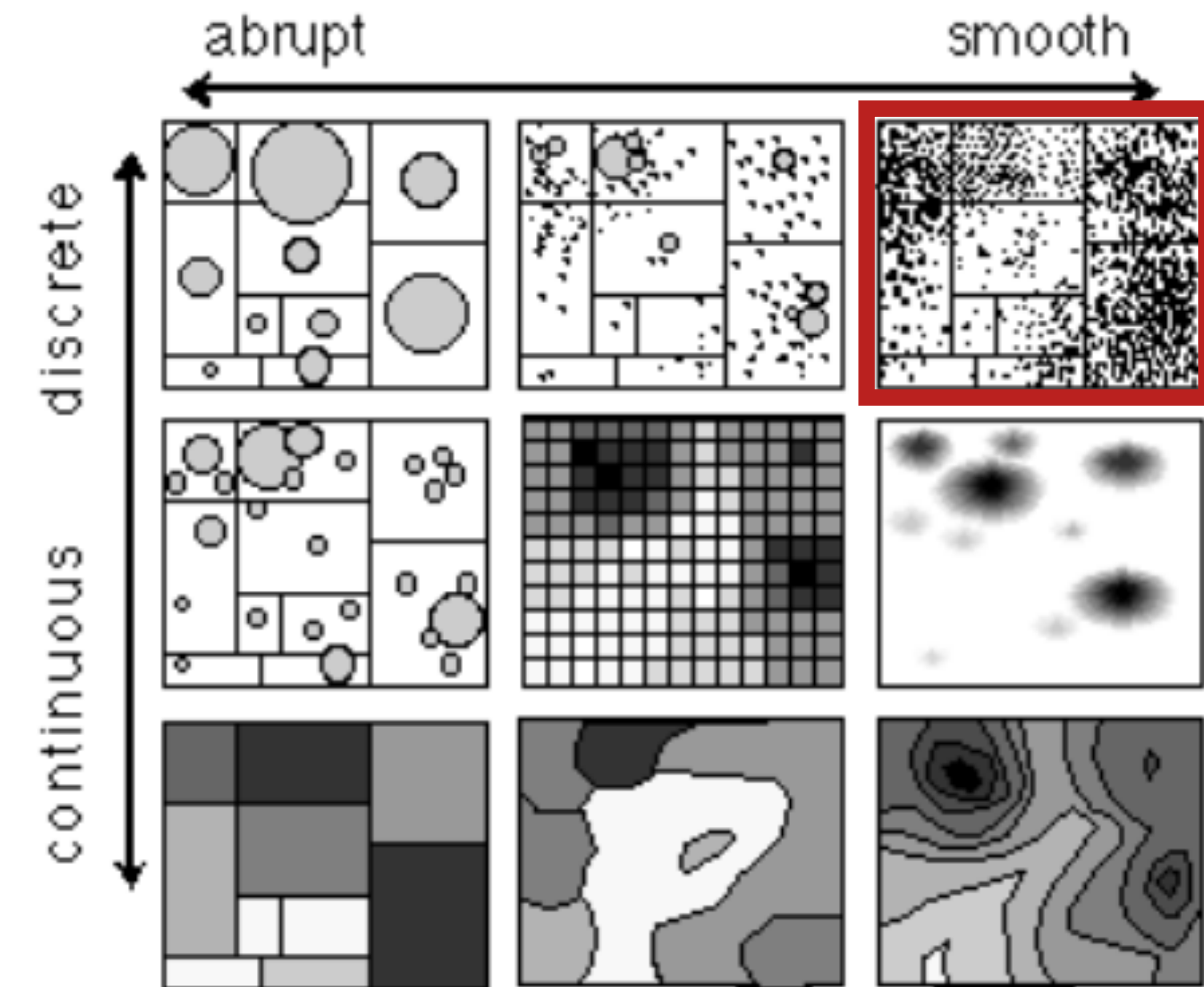
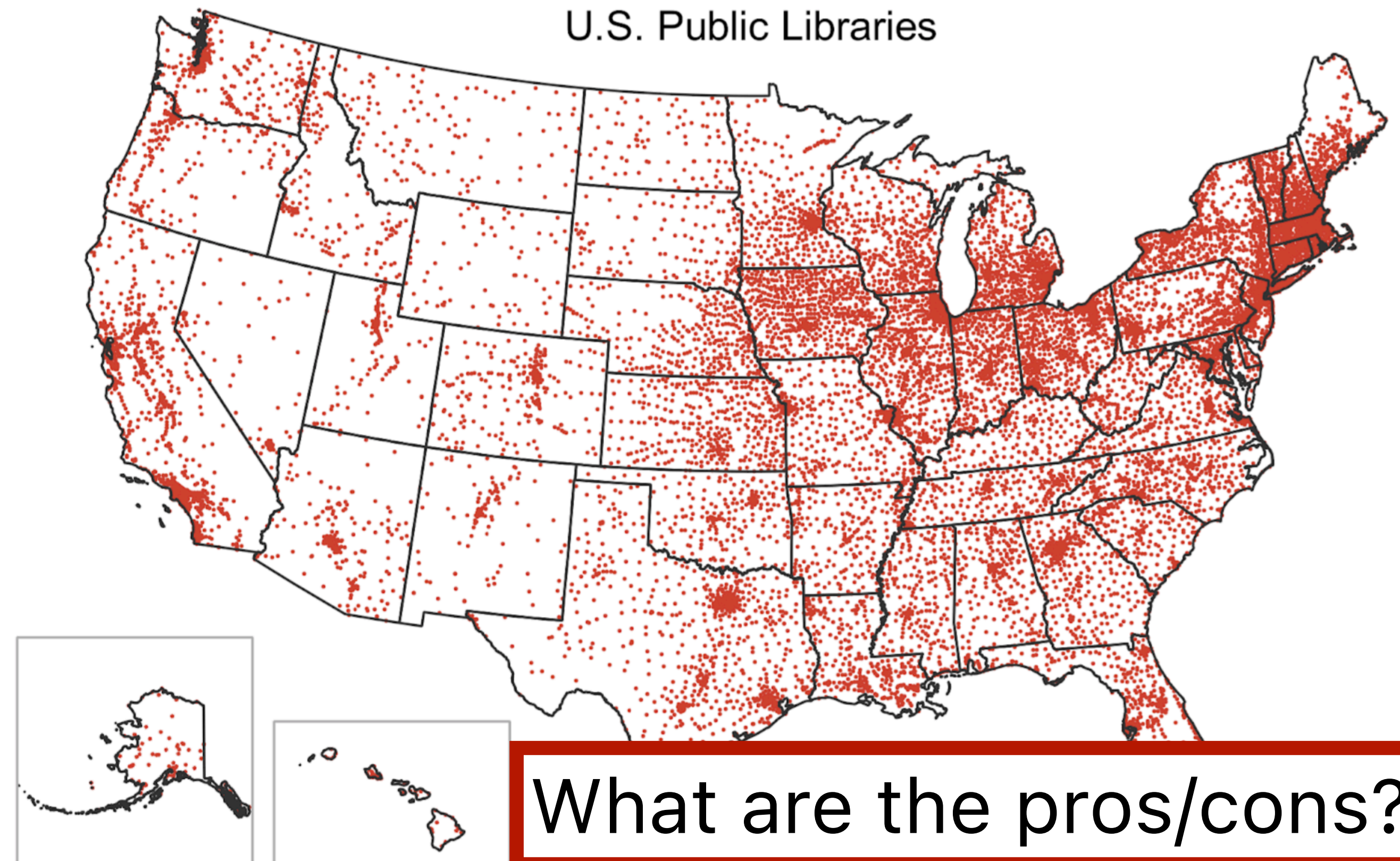


Fig. 9. Possible 2D translations of the 3D data models shown in figure 8.



What are the pros/cons?

tryclassbuzz.com
Code: **dots**

Dot Distribution Map

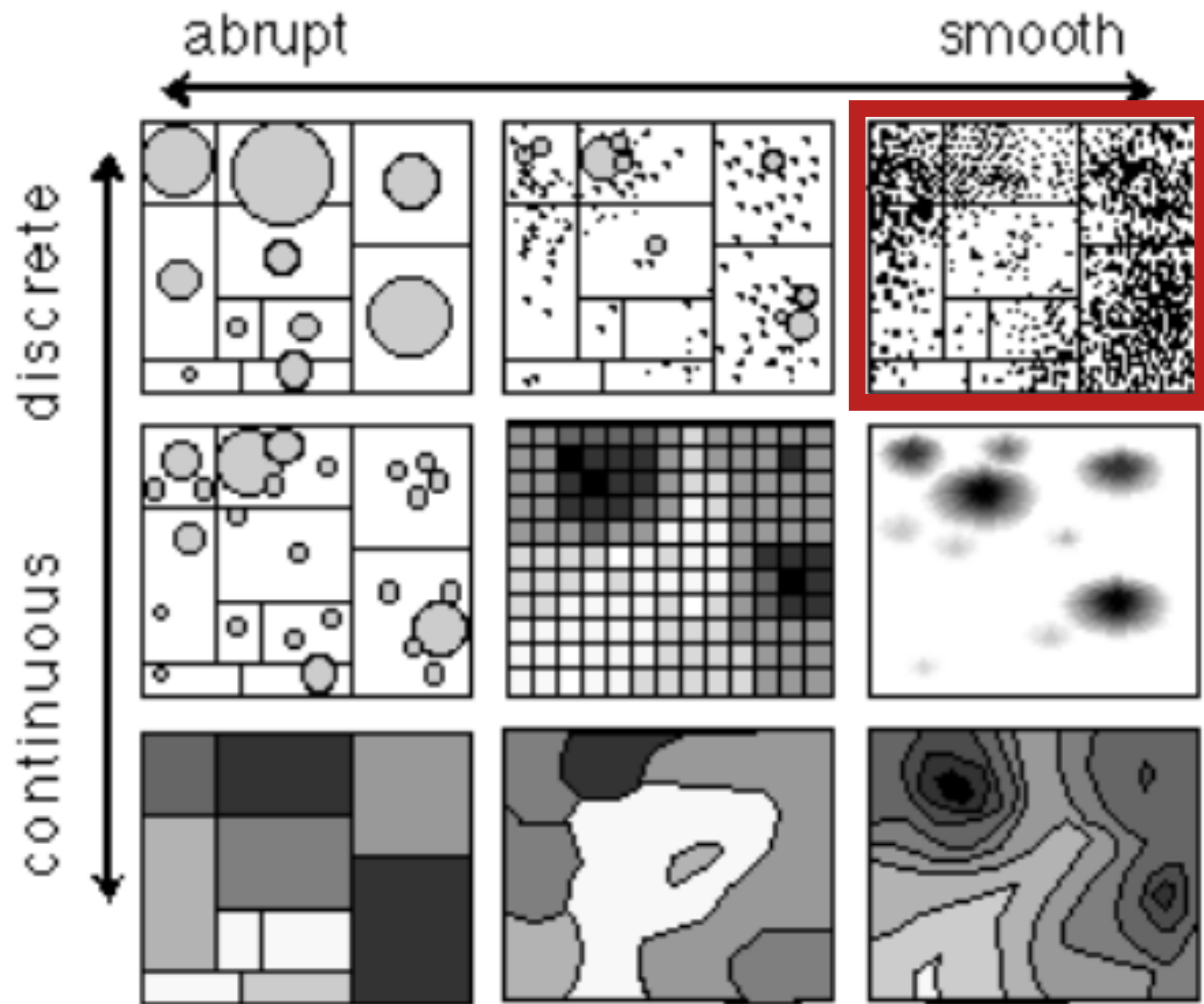
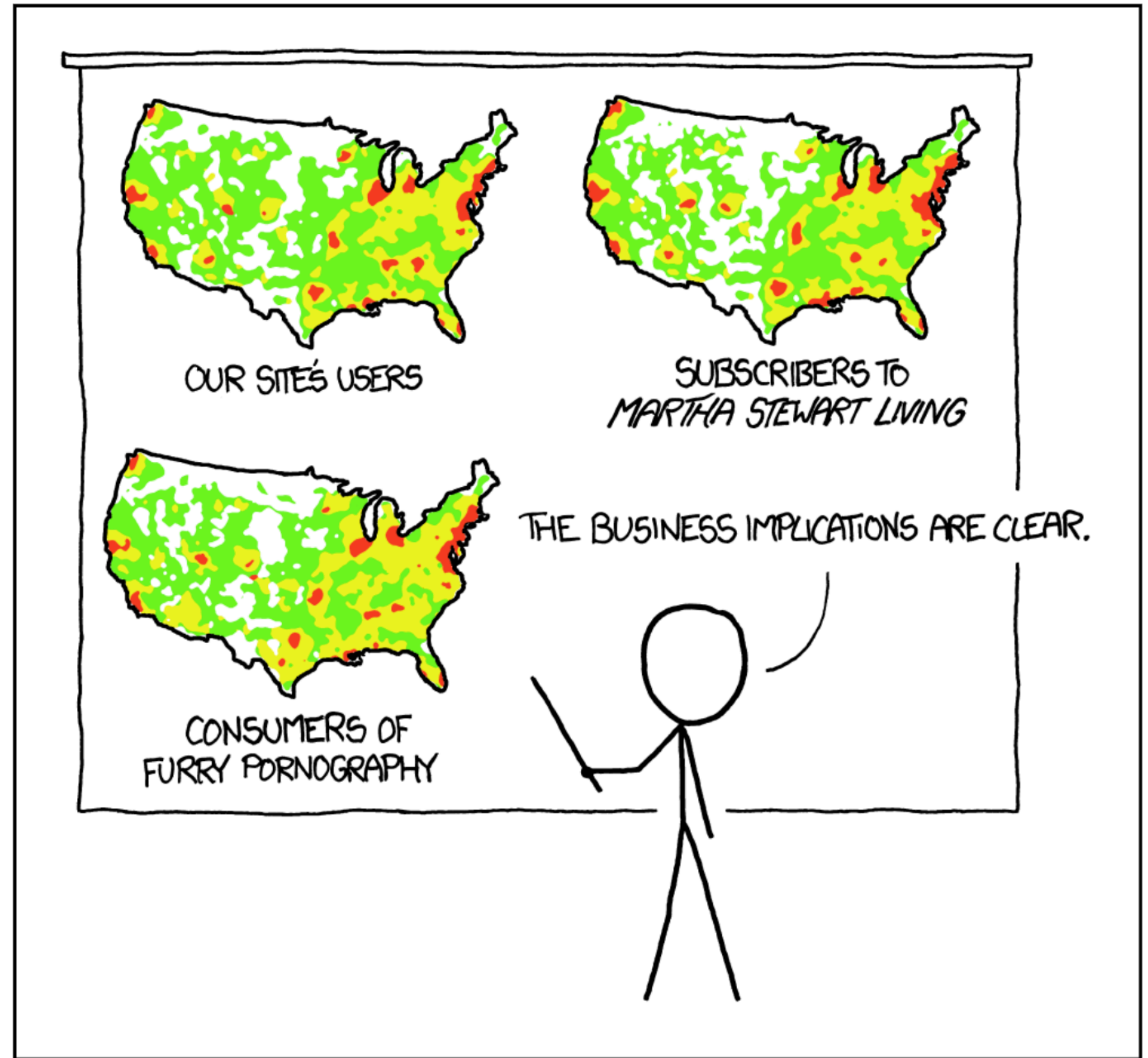
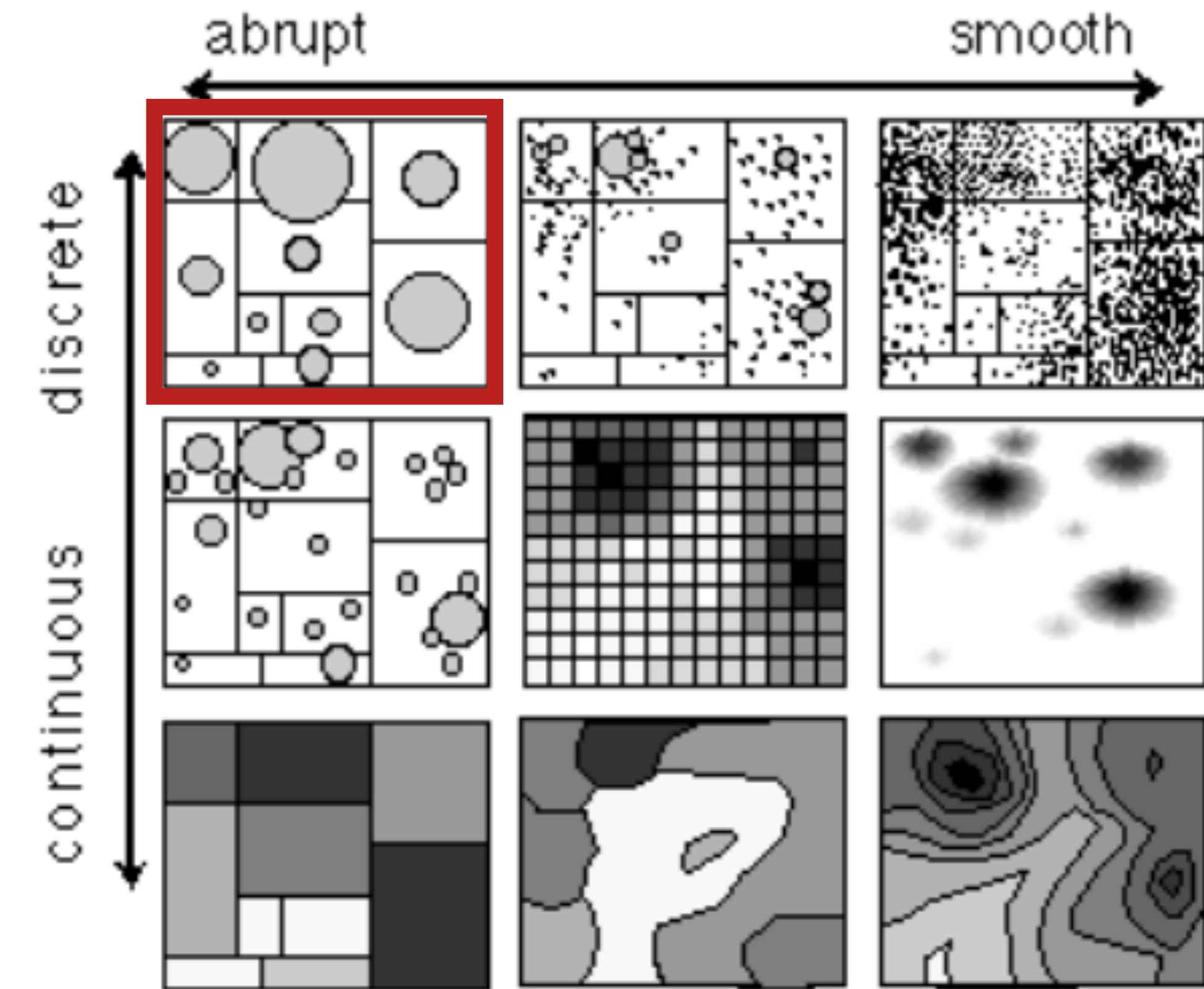


Fig. 9. Possible 2D translations of the 3D data models shown in figure 8.



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

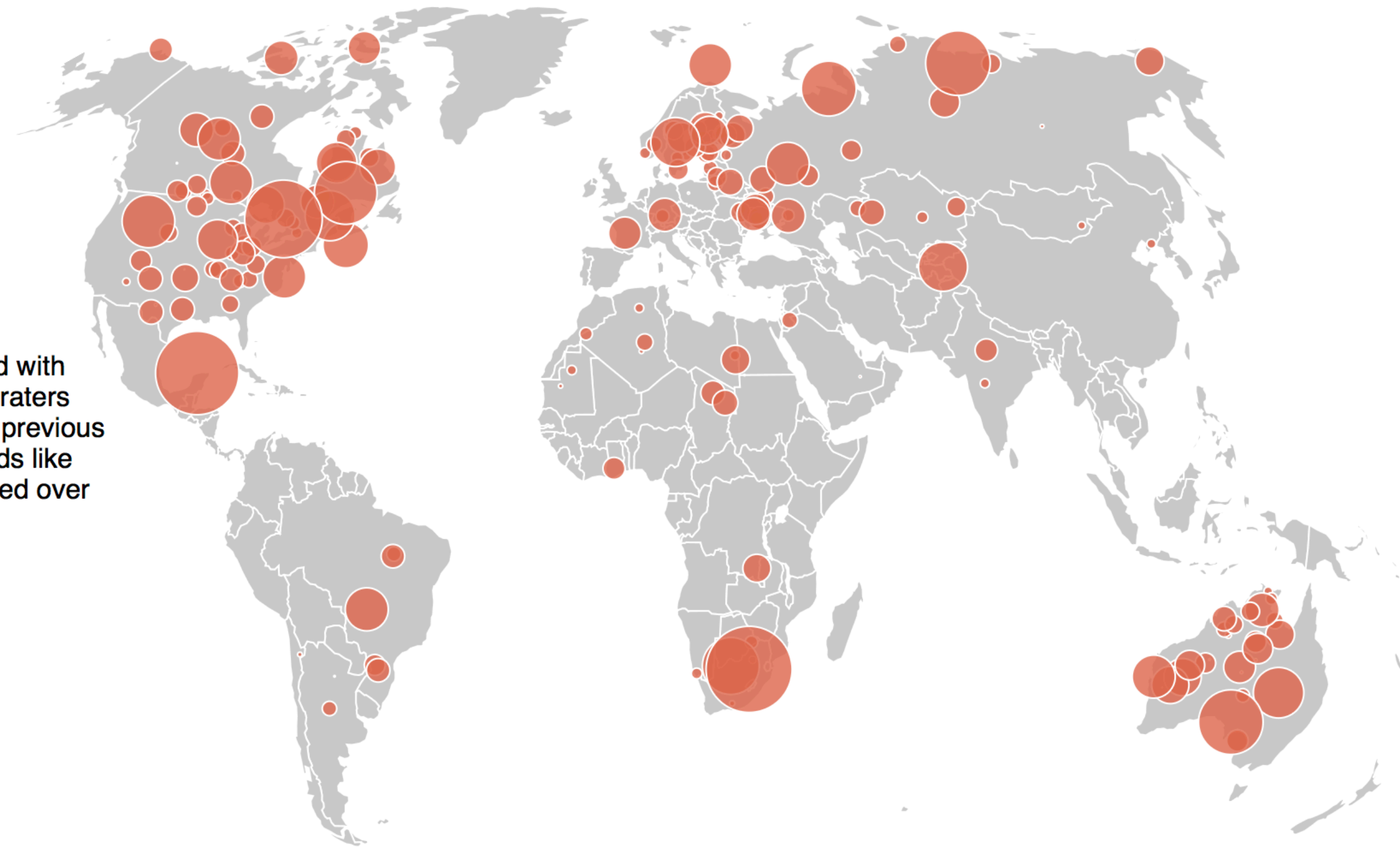


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<http://www.washingtonpost.com/wp-srv/special/world/russia-meteor/index.html>

Proportional Symbol Map

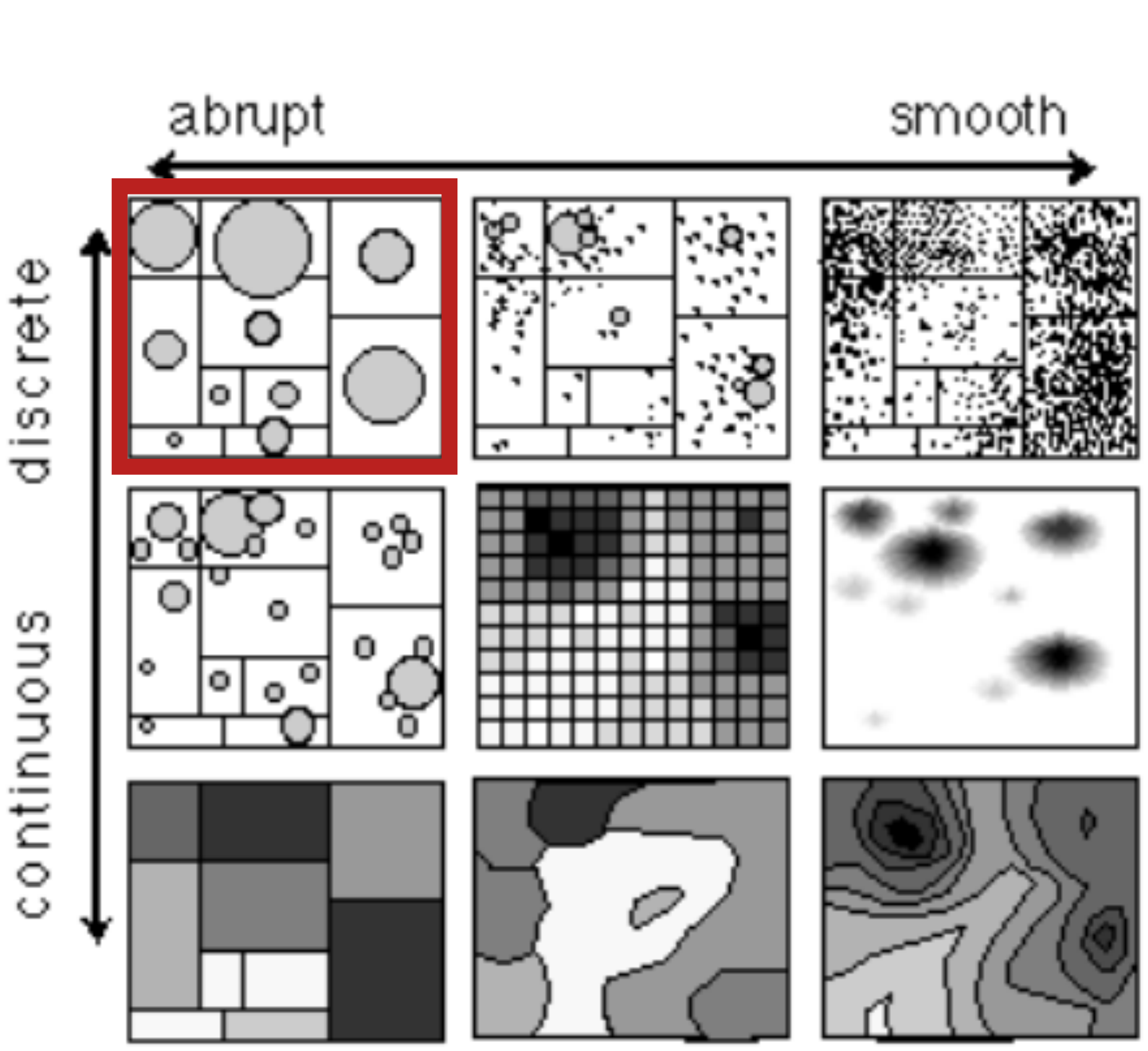
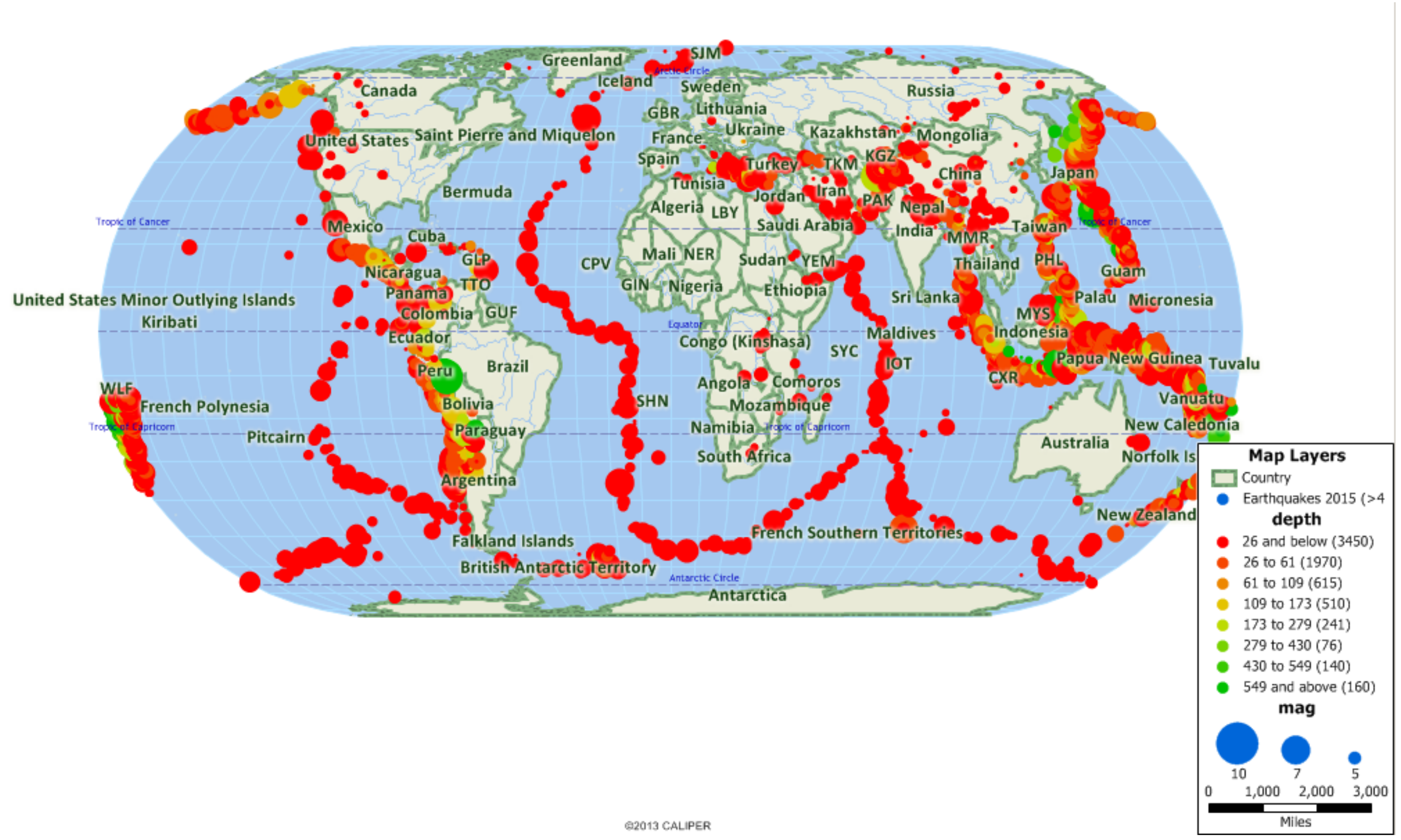


Fig. 9. Possible 2D translations of the 3D data models shown in figure 8.



©2013 CALIPER

Graduated Symbol Map

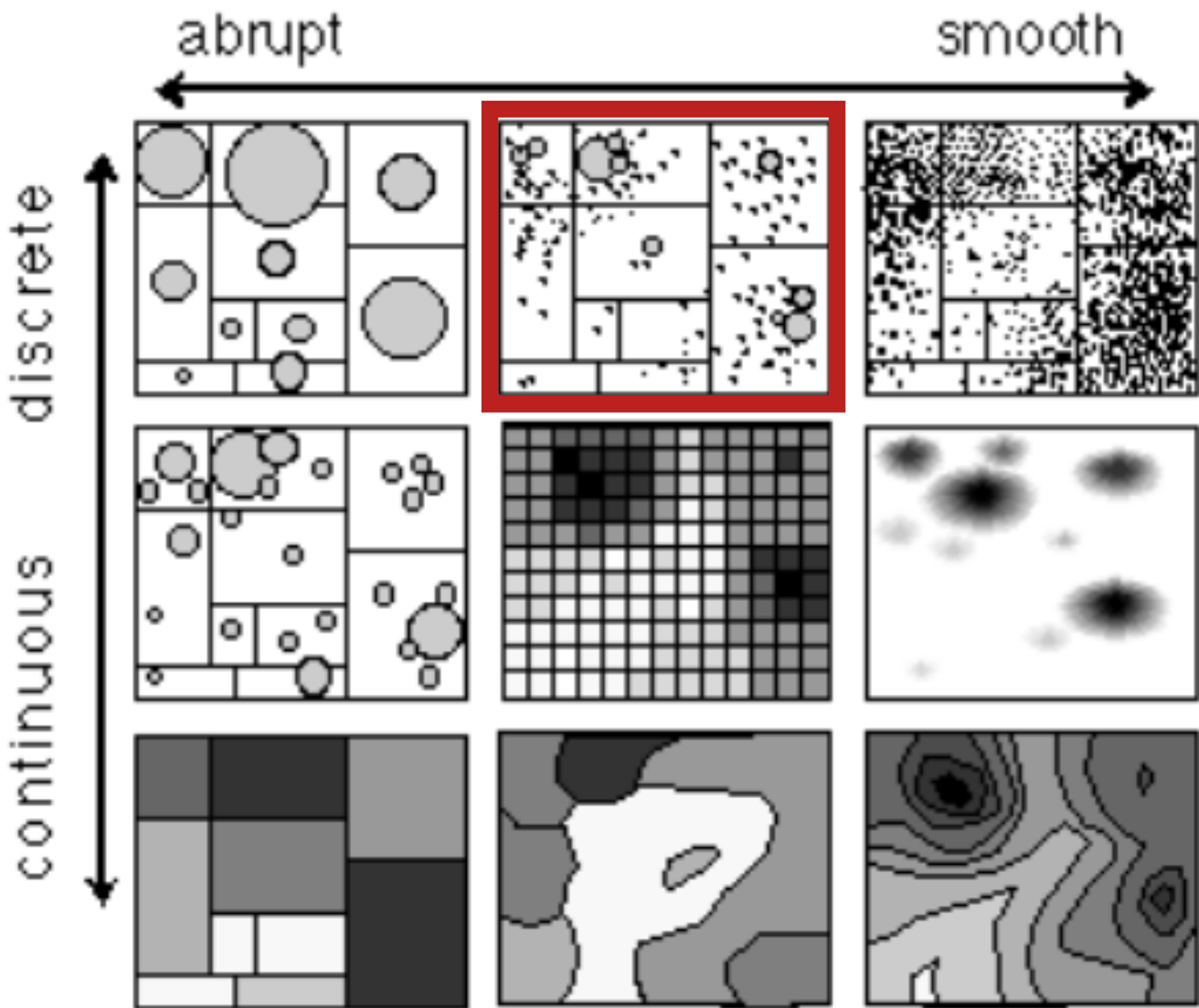


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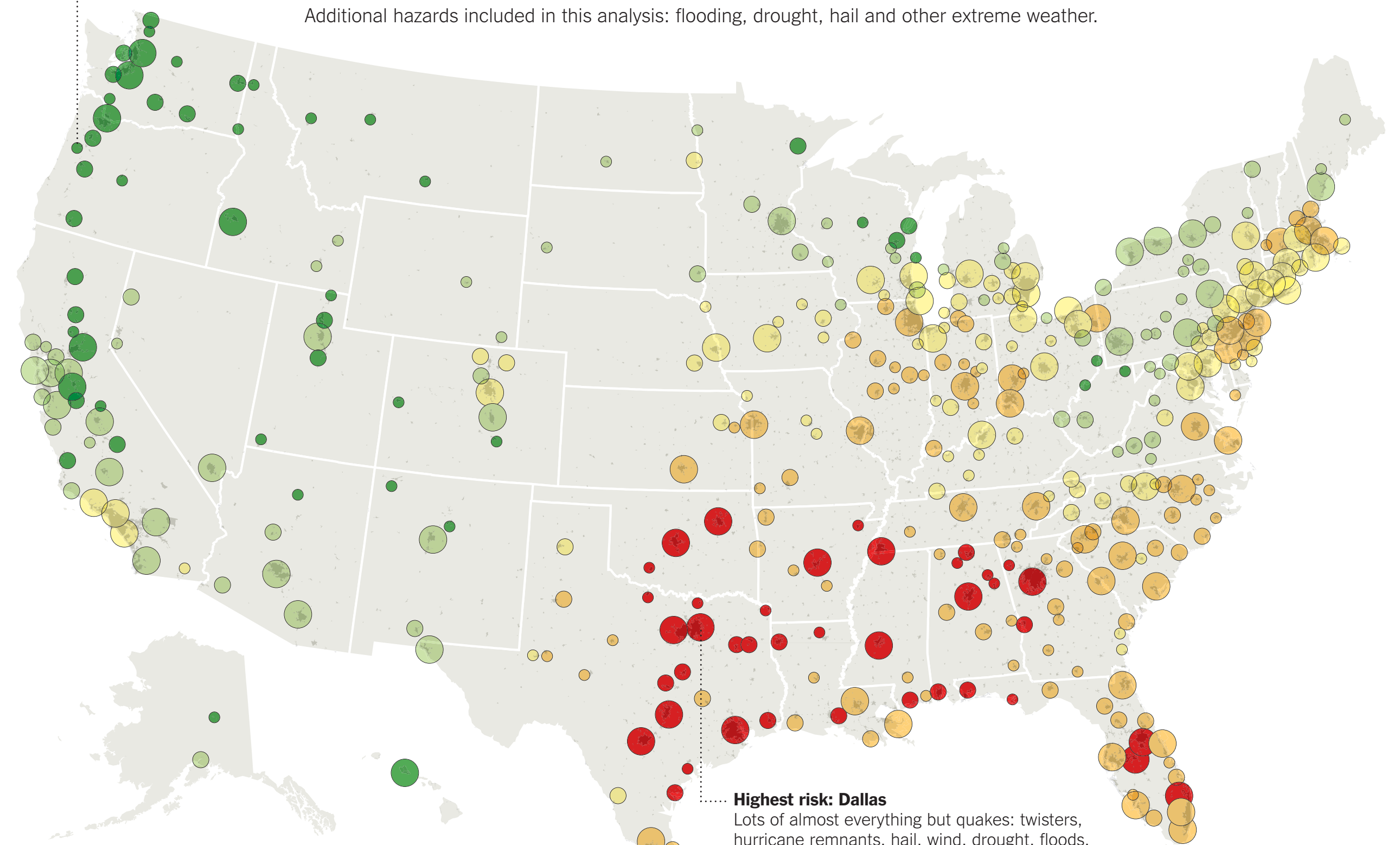
Some Places Are Riskier Than Others

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.

Lowest risk: Corvallis, Ore.
Small quake and drought risk;
little extreme weather.



Highest risk: Dallas
Lots of almost everything but quakes: twisters,
hurricane remnants, hail, wind, drought, floods.

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

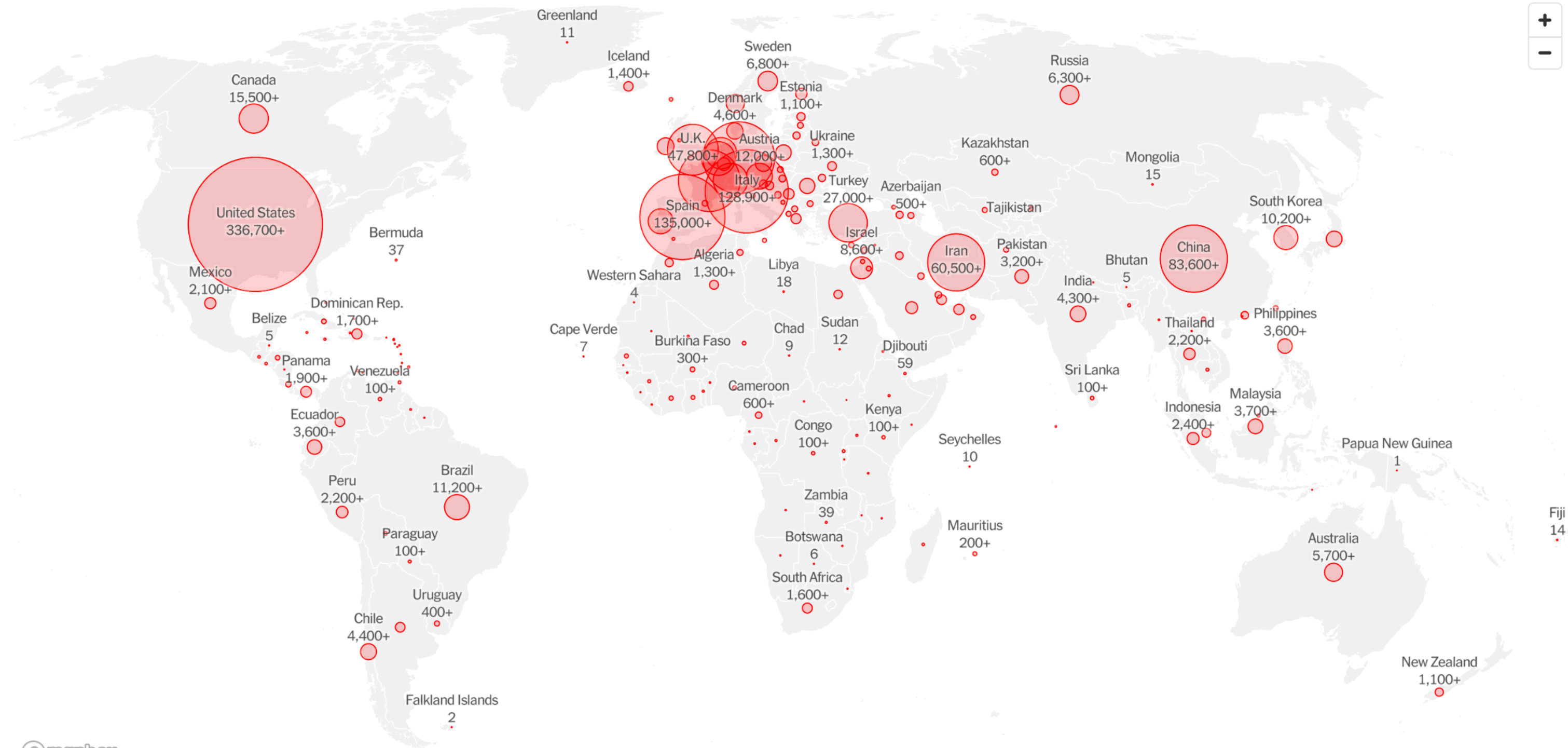
The New York Times

PLAY THE CROSSWORD

Account

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

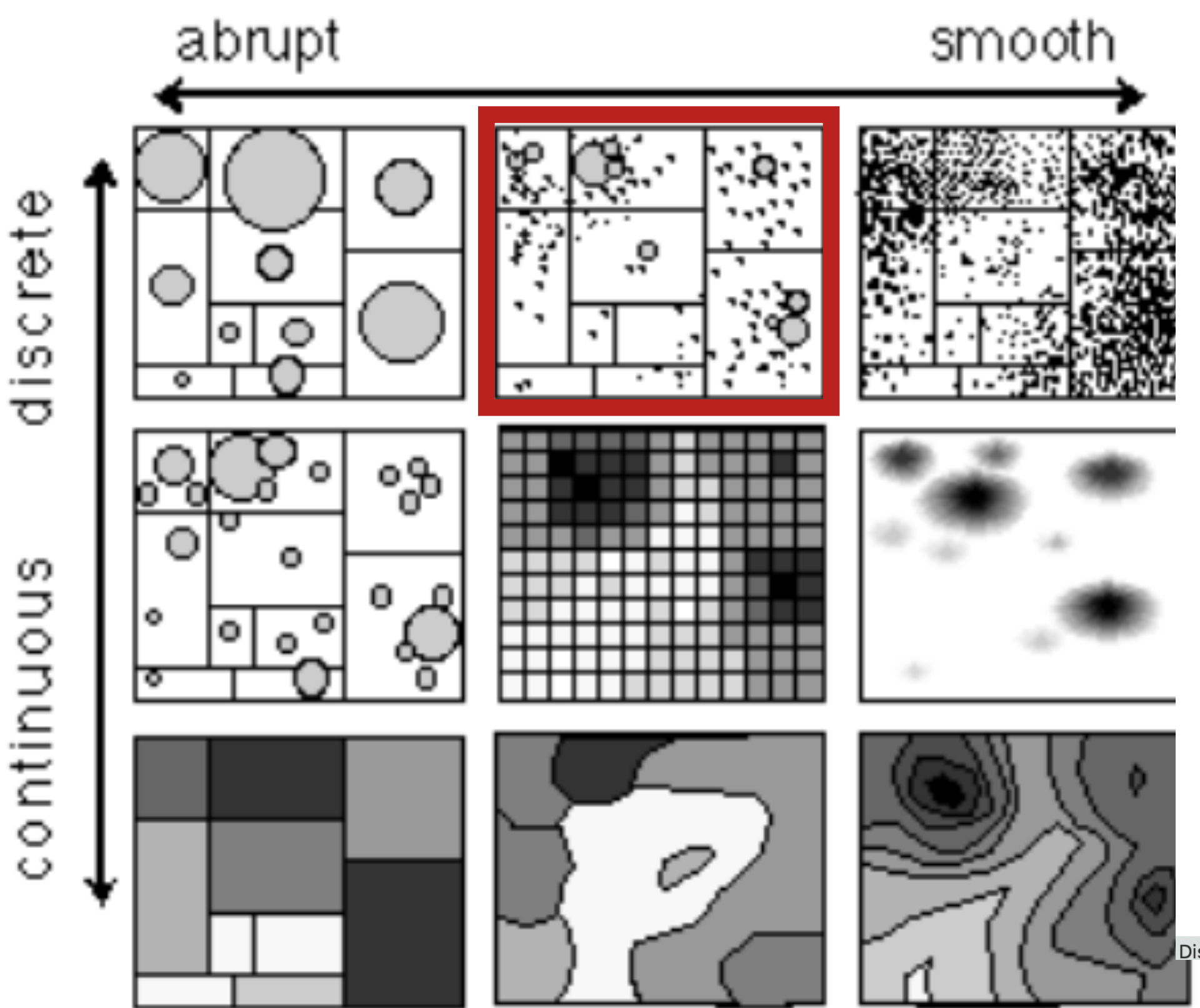


Fig. 9. Possible 2D translations of the 3D data models shown in figure 8.

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

Graduated Symbol Map?

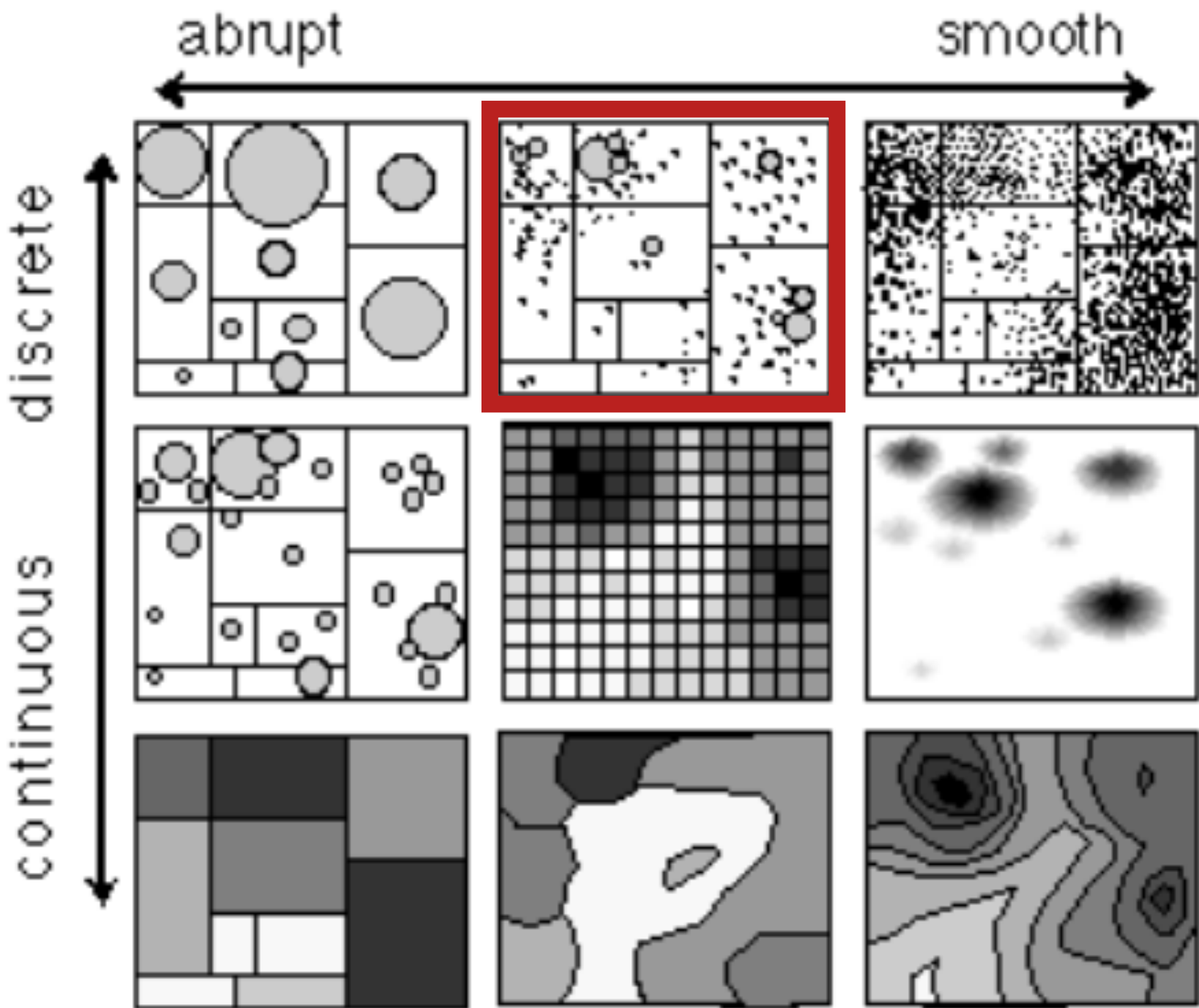
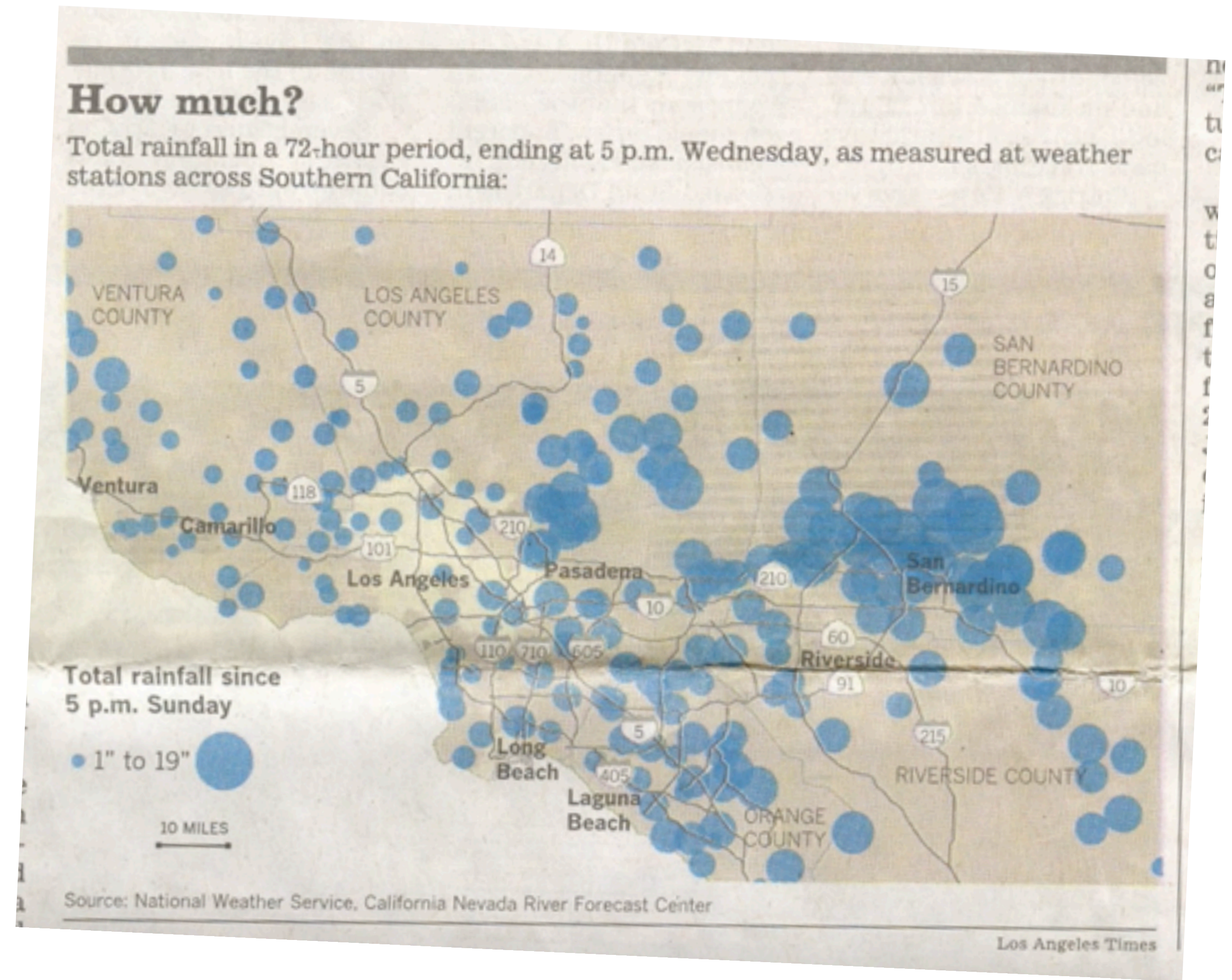


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Isopleth / Heat Map

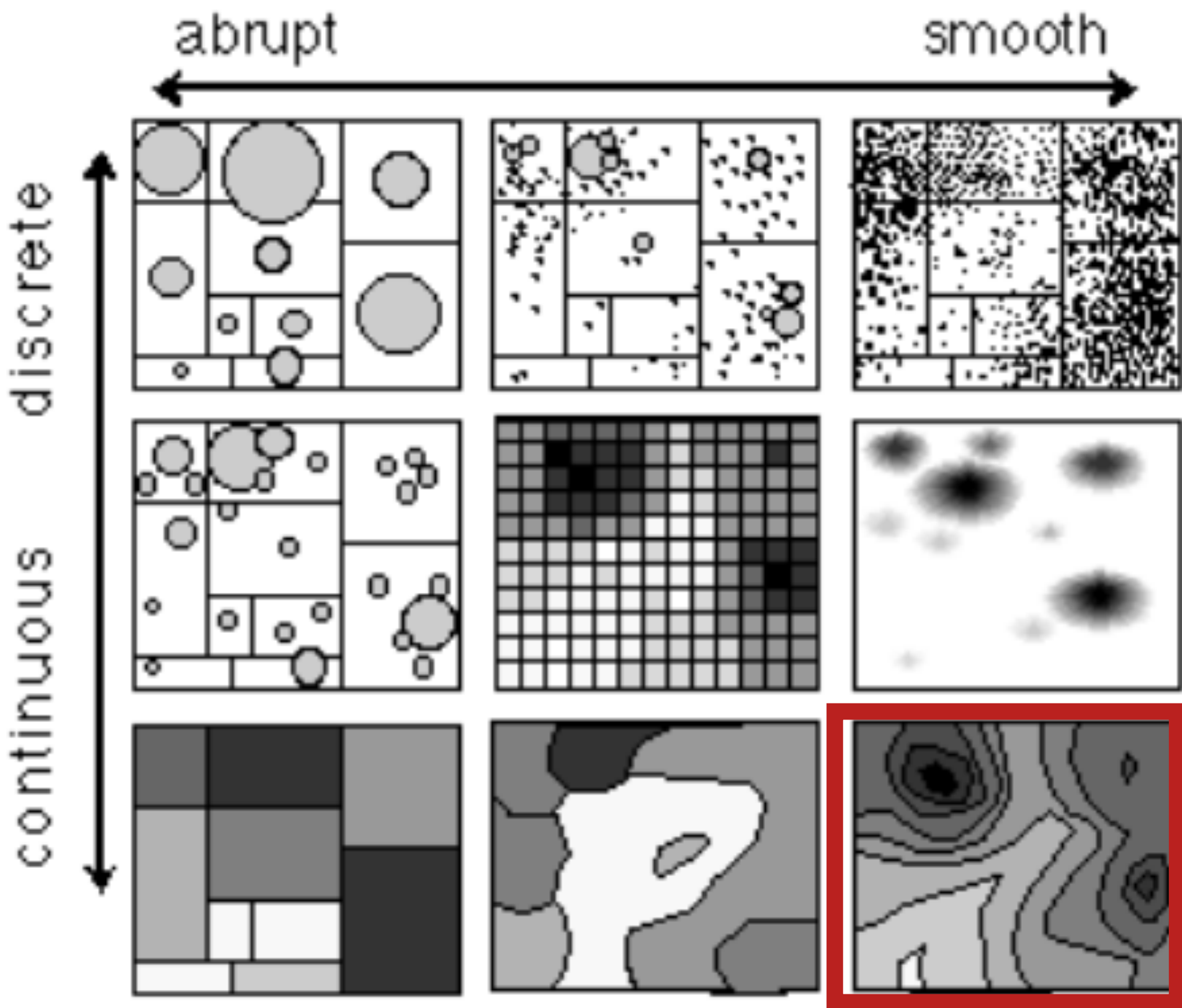
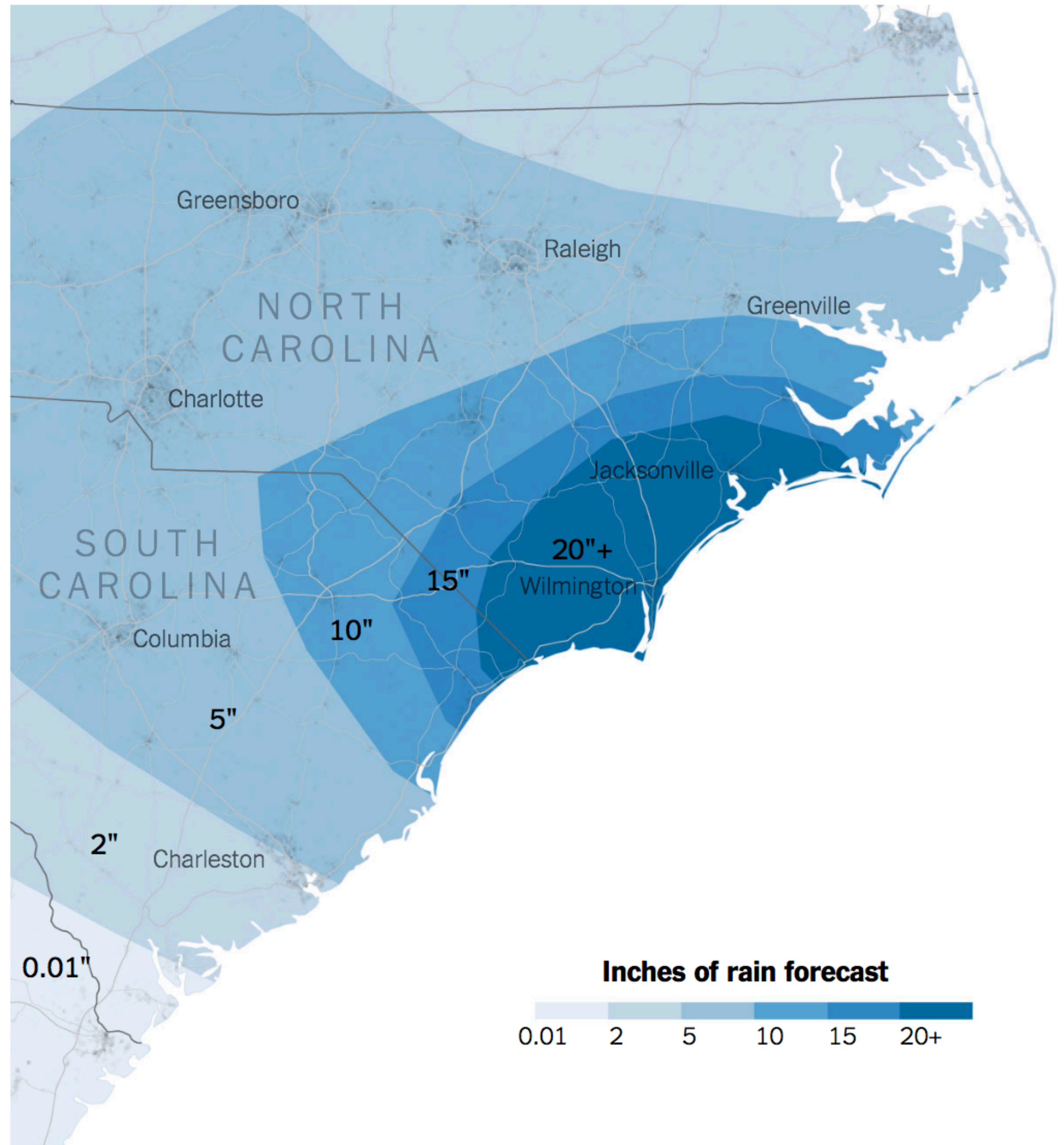
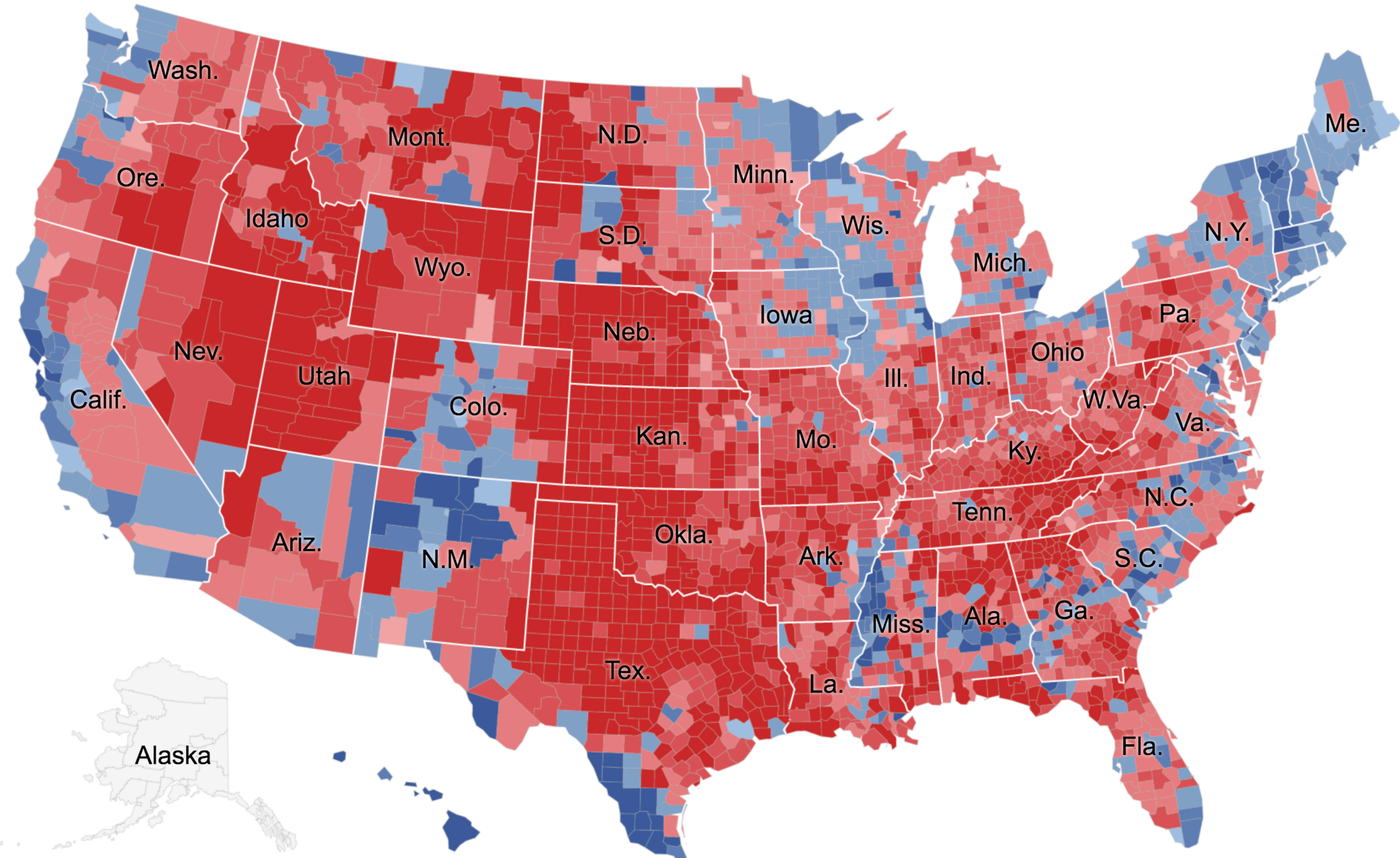
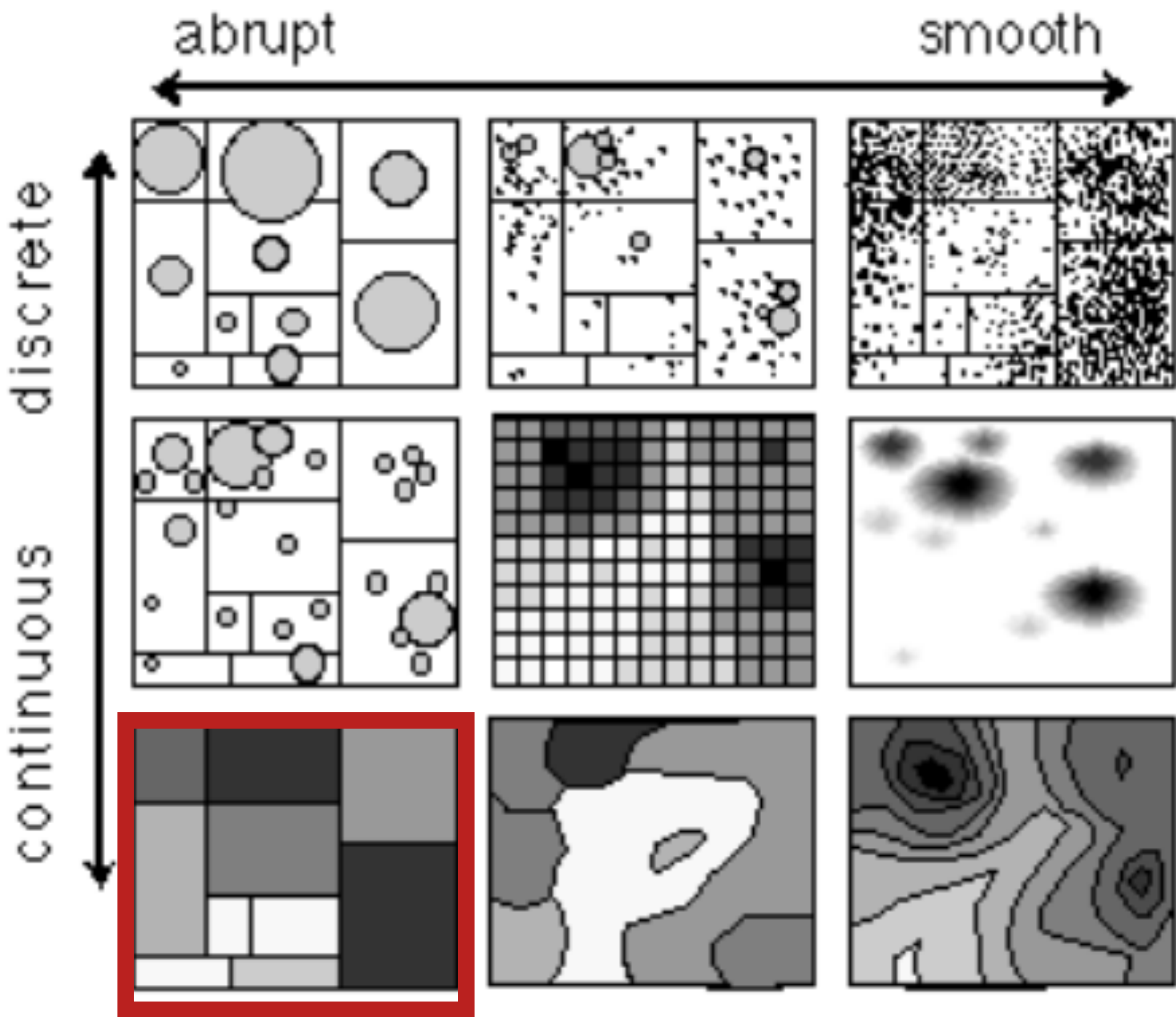


Fig. 9. Possible 2D translations of the 3D data models shown in figure 8.



Source: National Weather Service

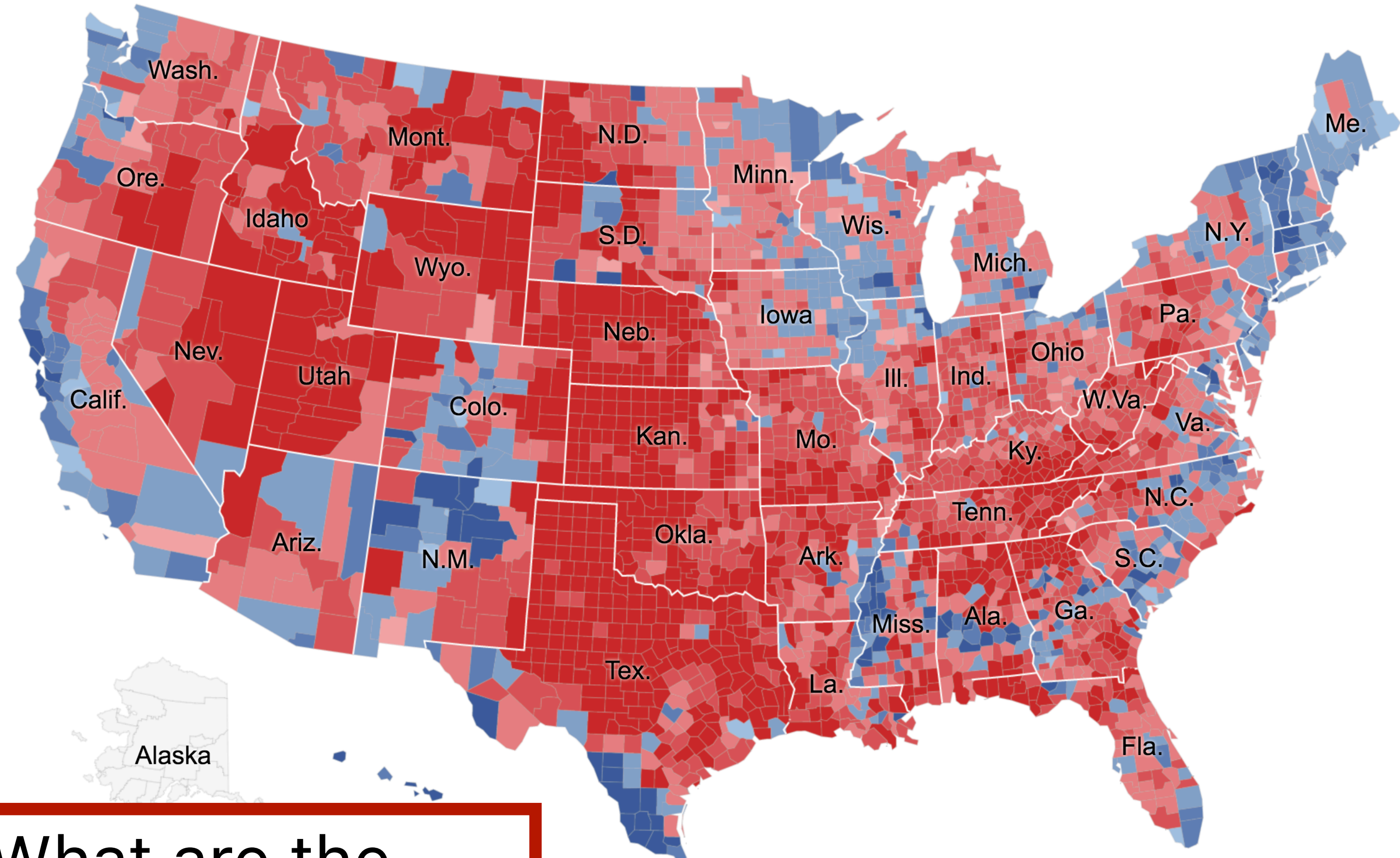
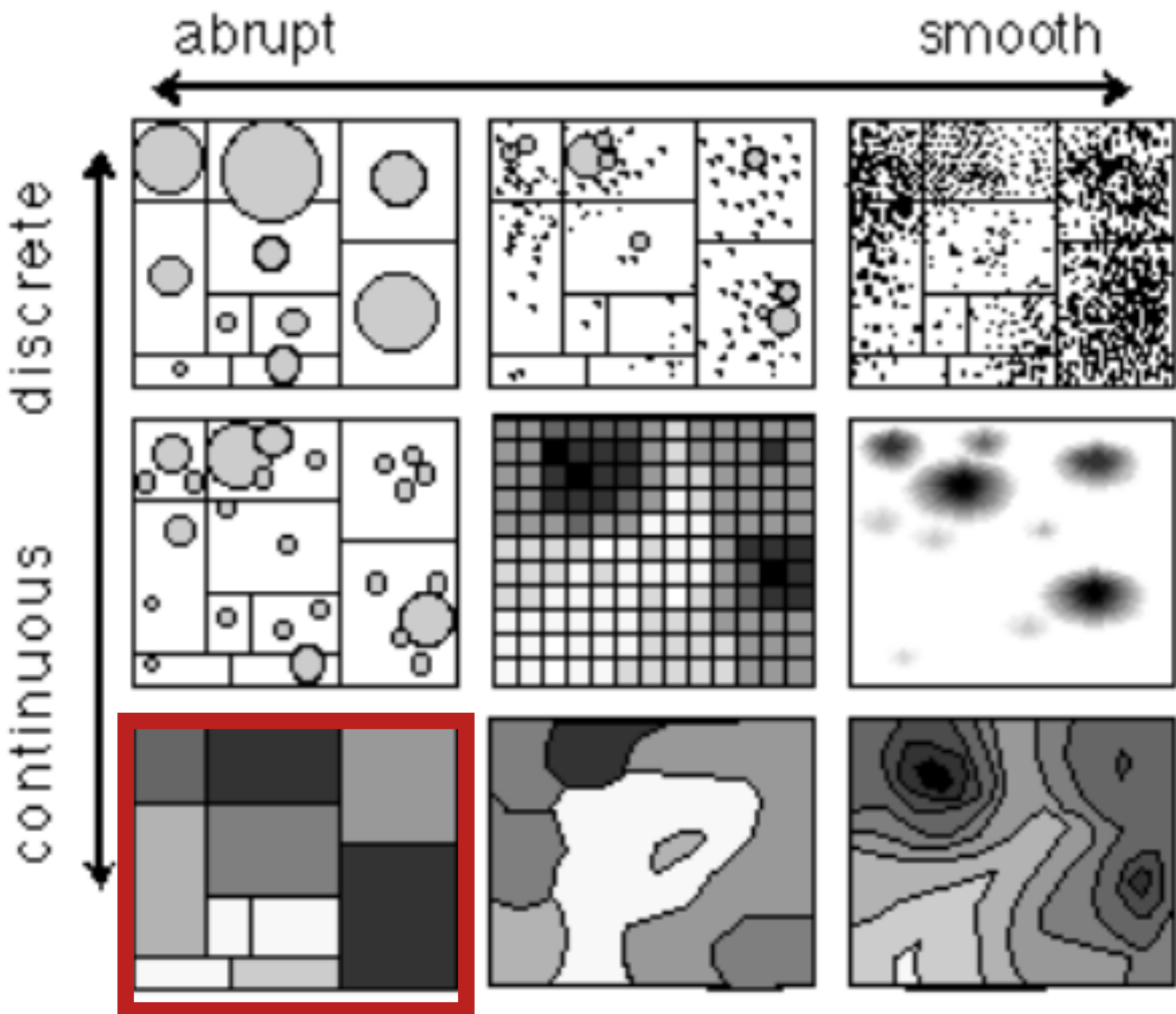
Choropleth



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

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

Choropleth



What are the pros/cons of this display?

tryclassbuzz.com
Code: **choro**

ion-results.html

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

GEOGRAPHIC MAP



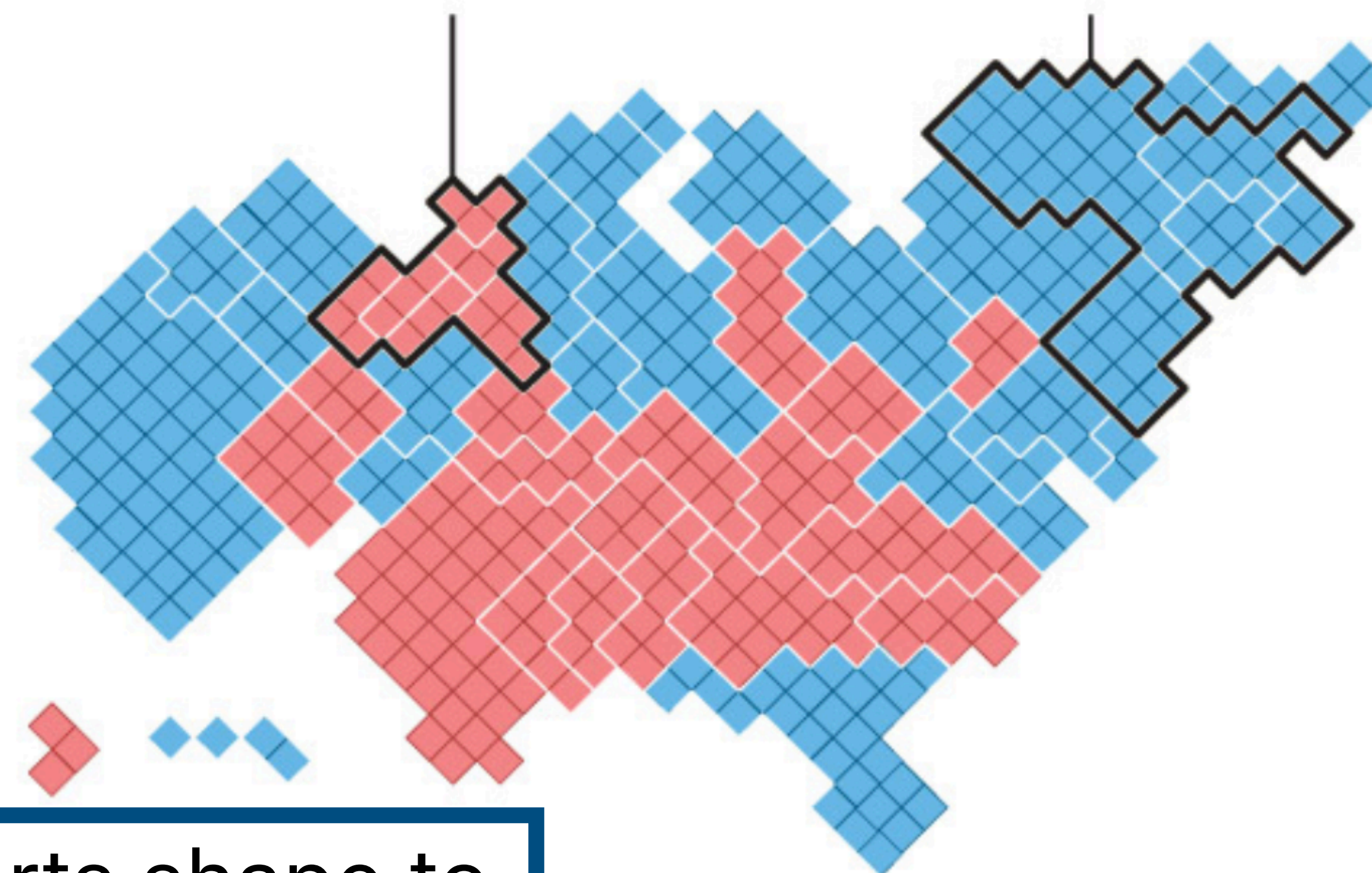
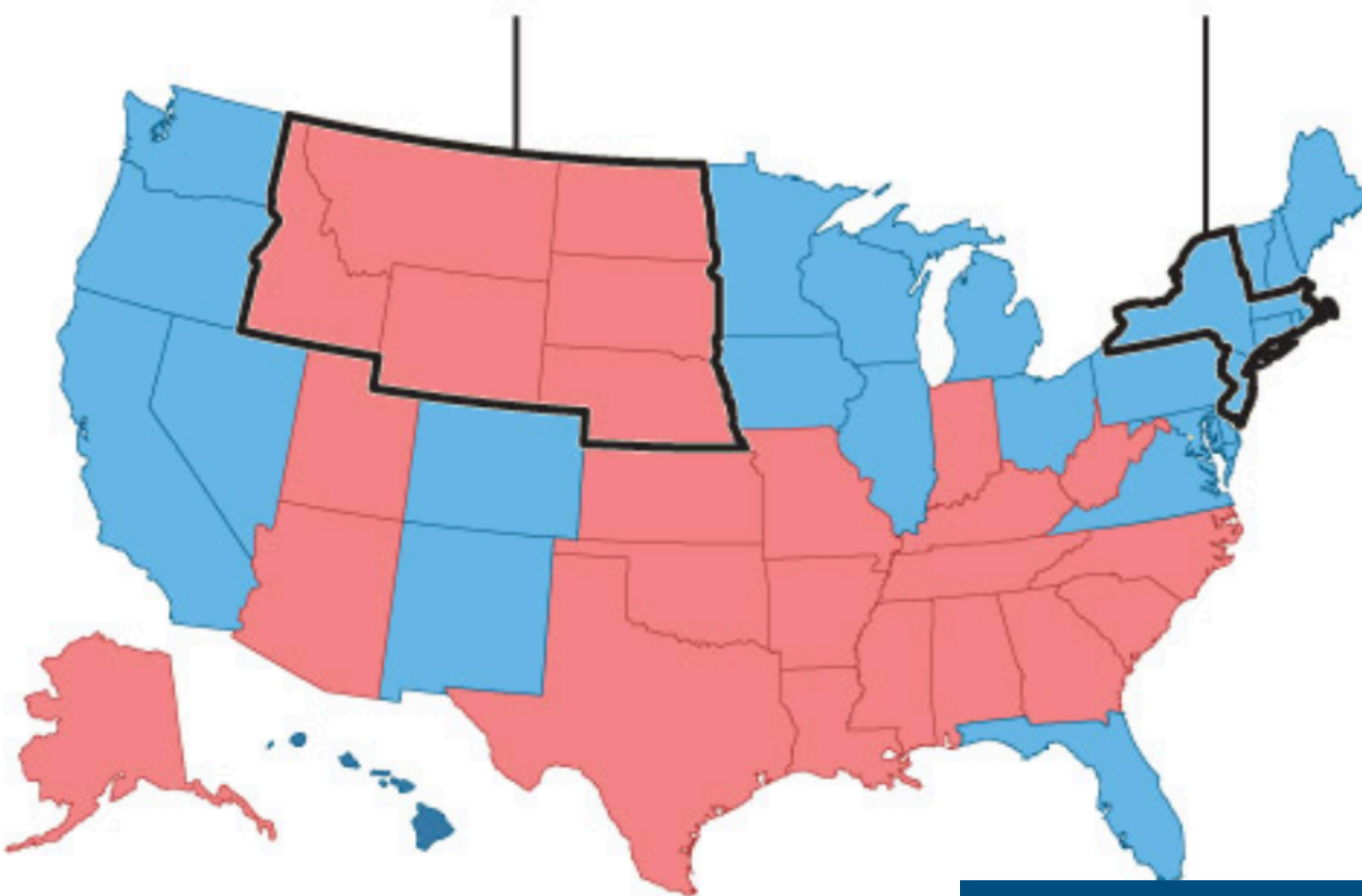
CARTOGRAM OF ELECTORAL VOTES

Six Western
states

Five Northeastern
states

Six Western
states

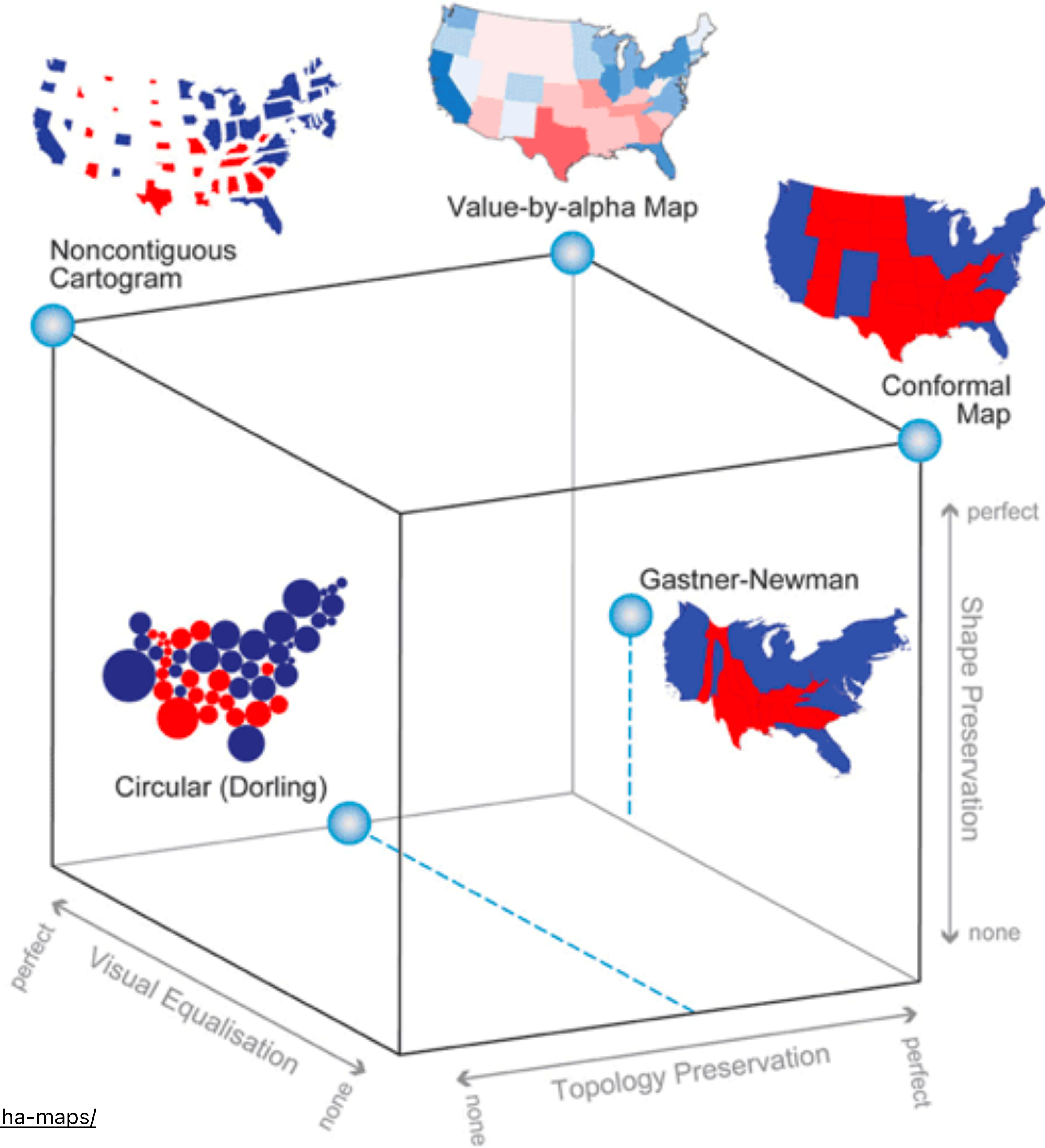
Five Northeastern
states



Cartogram: Distorts shape to convey quantity

What are the pros/cons of this display?

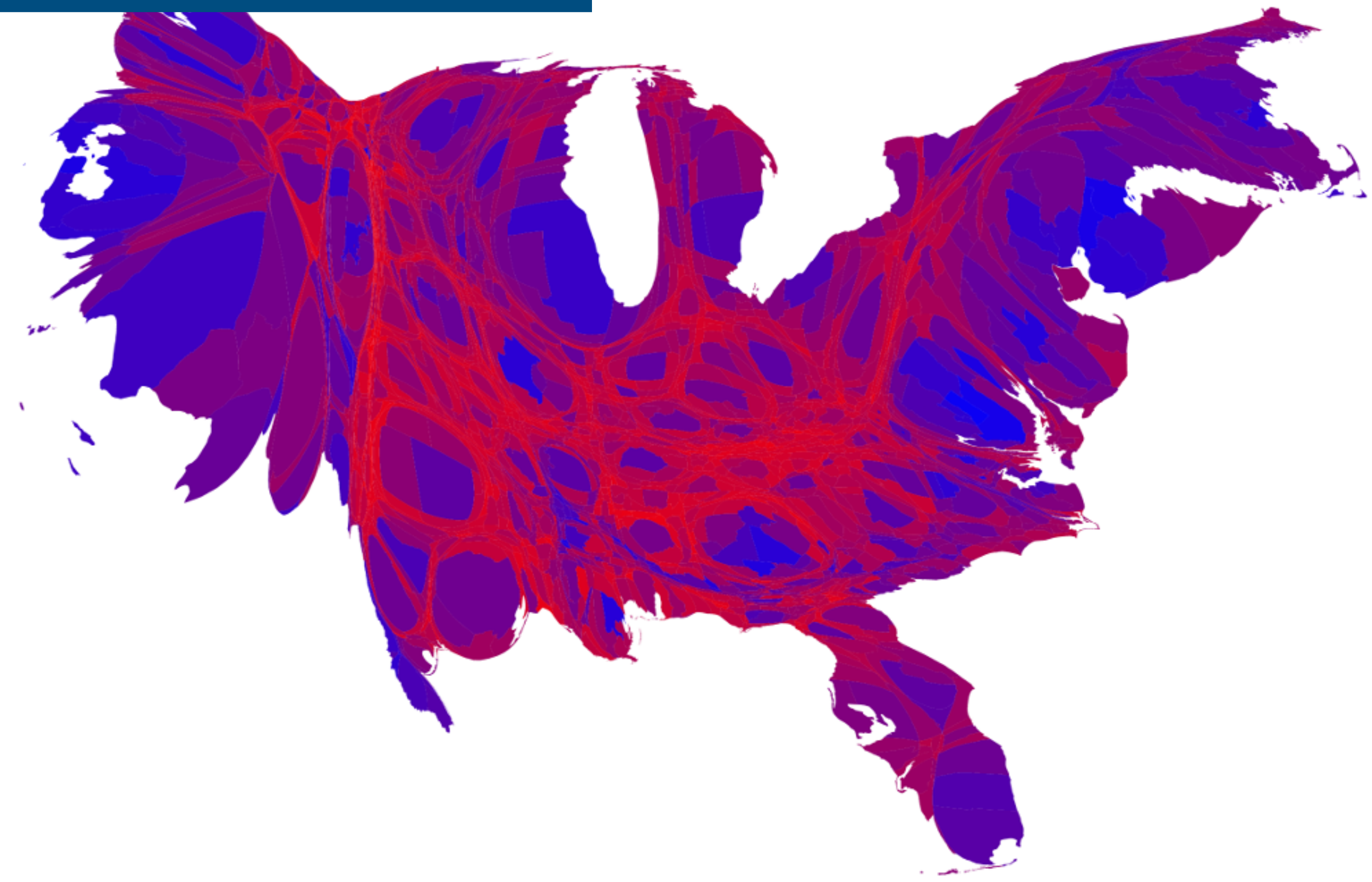
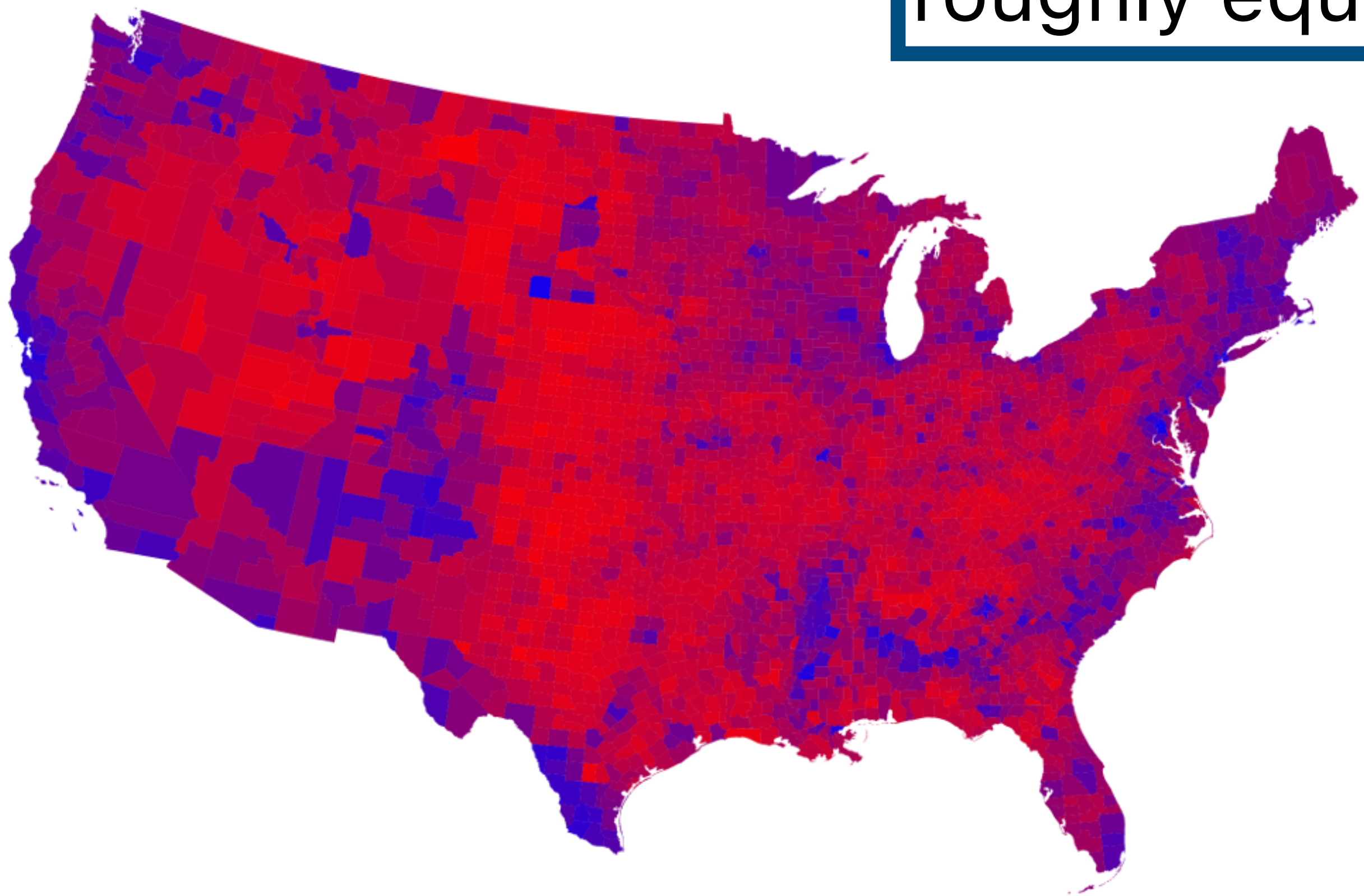
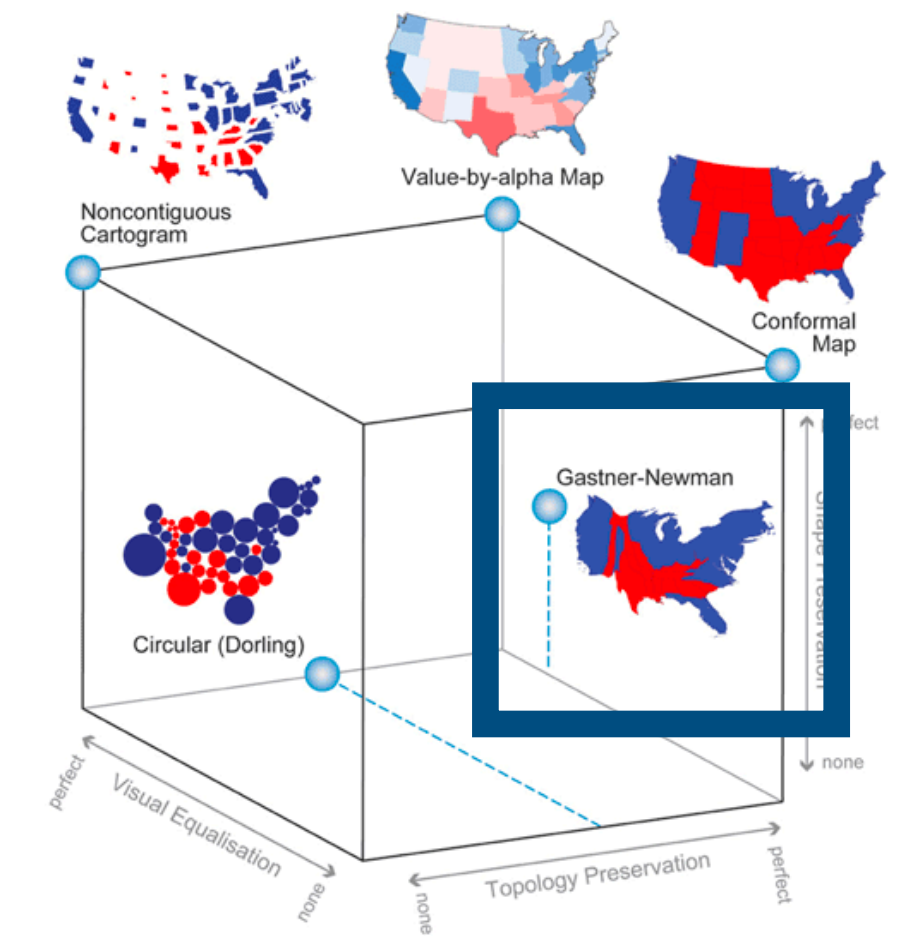
tryclassbuzz.com
Code: **carto**



Gaster-Newman

Physical diffusion model.

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



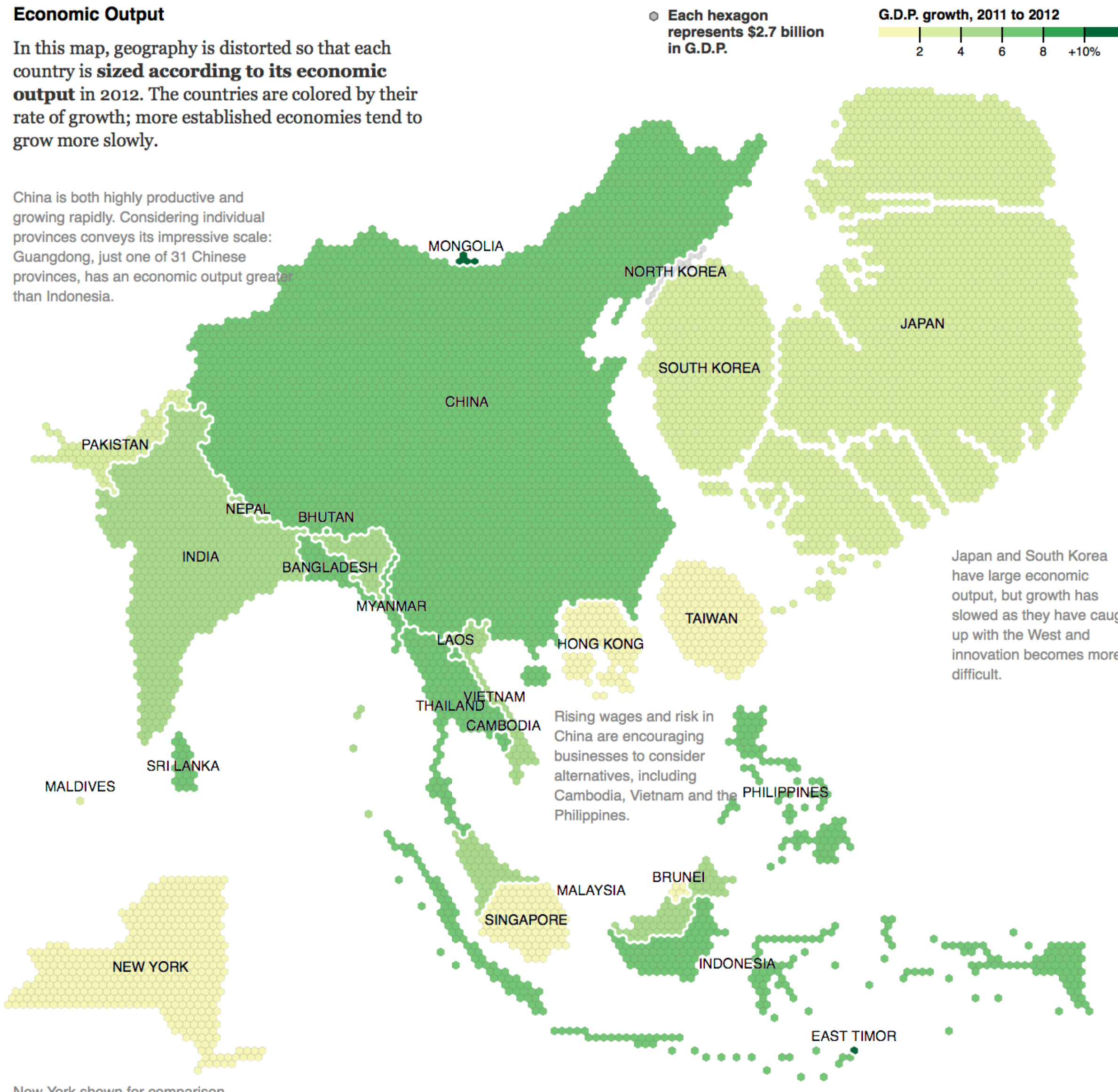
China Still Dominates, but Some Manufacturers Look Elsewhere

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.

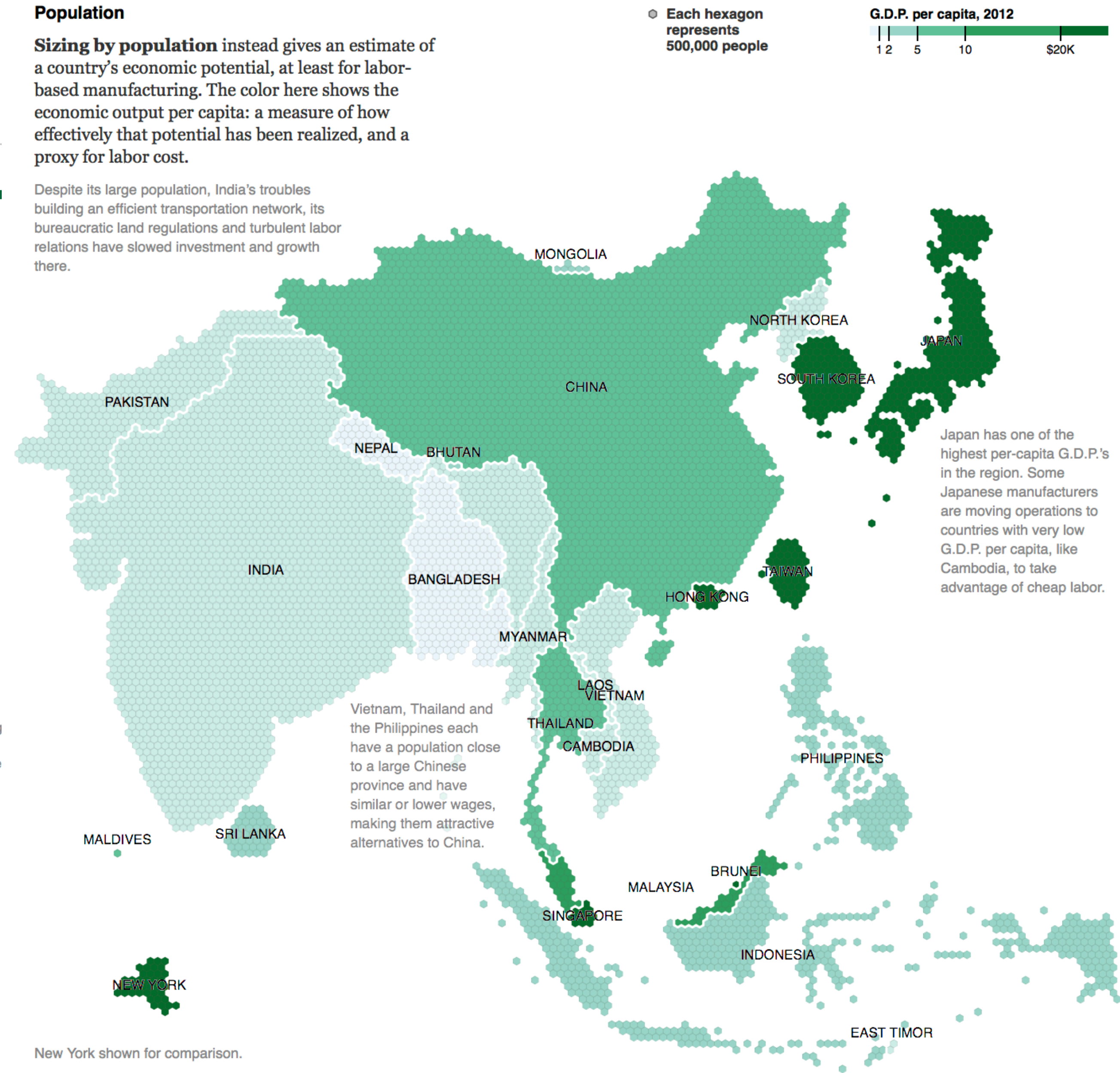
China is both highly productive and growing rapidly. Considering individual provinces conveys its impressive scale: Guangdong, just one of 31 Chinese provinces, has an economic output greater than Indonesia.



Population

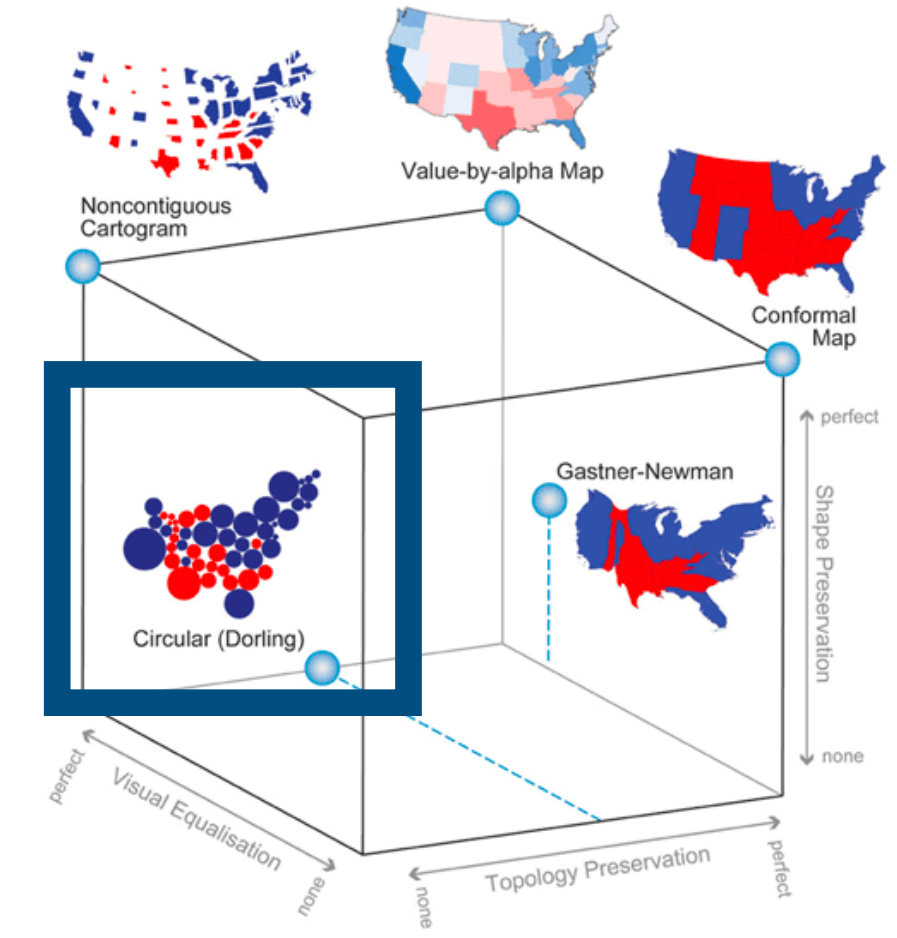
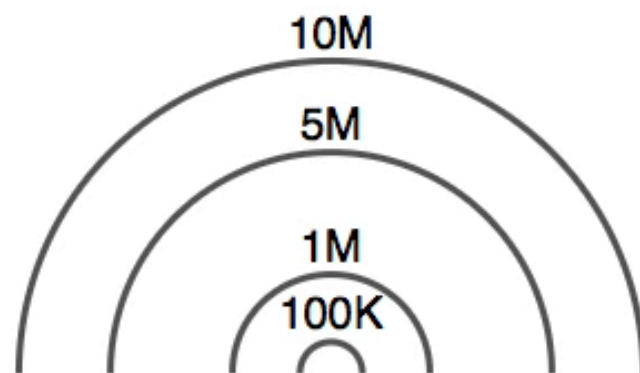
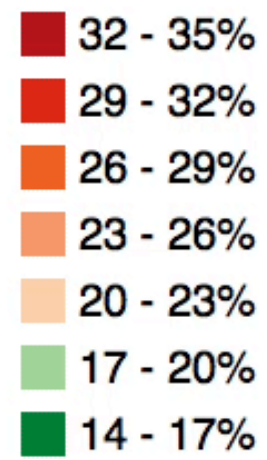
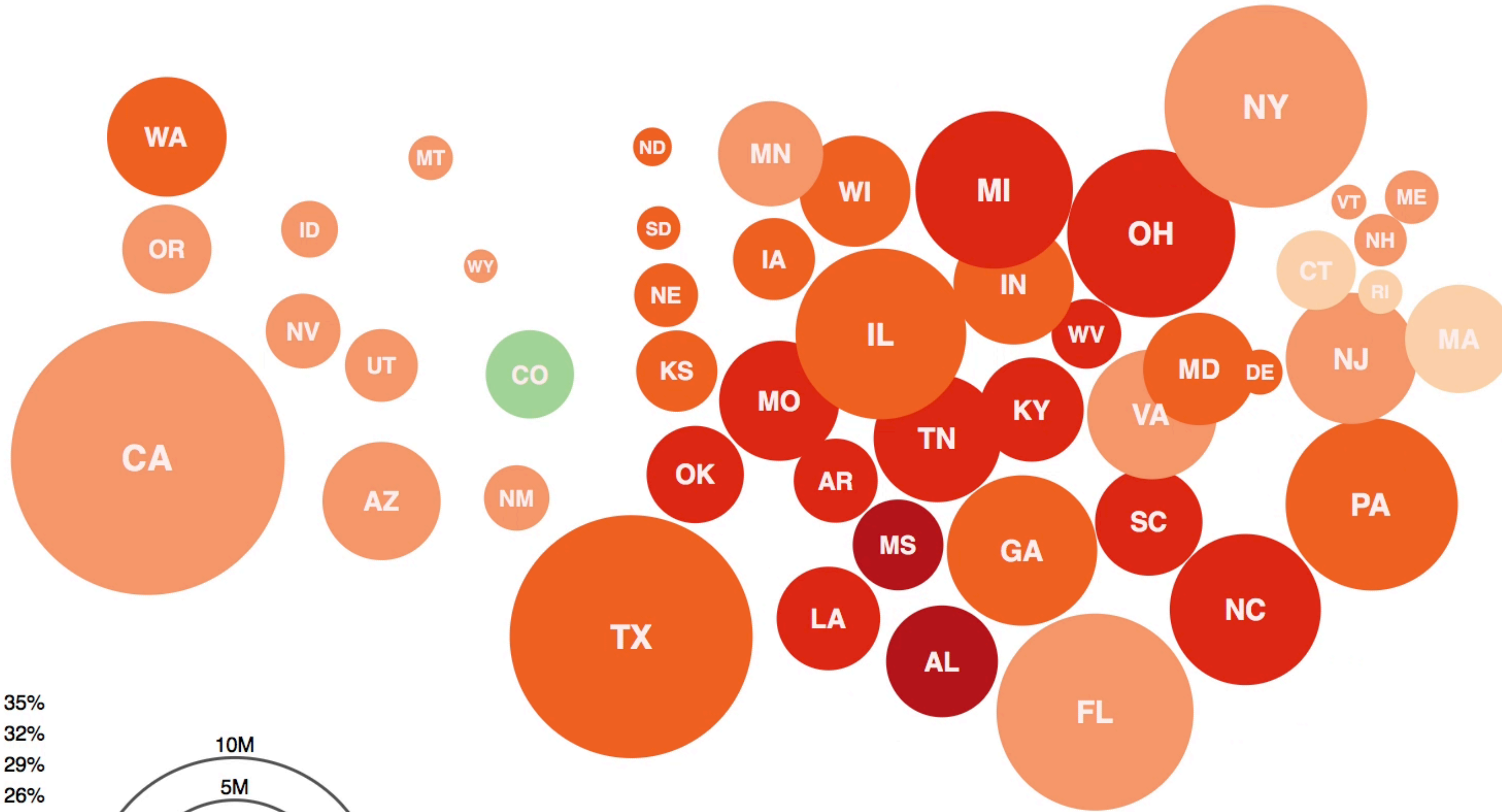
Sizing by population instead gives an estimate of a country's economic potential, at least for labor-based manufacturing. The color here shows the economic output per capita: a measure of how effectively that potential has been realized, and a proxy for labor cost.

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.

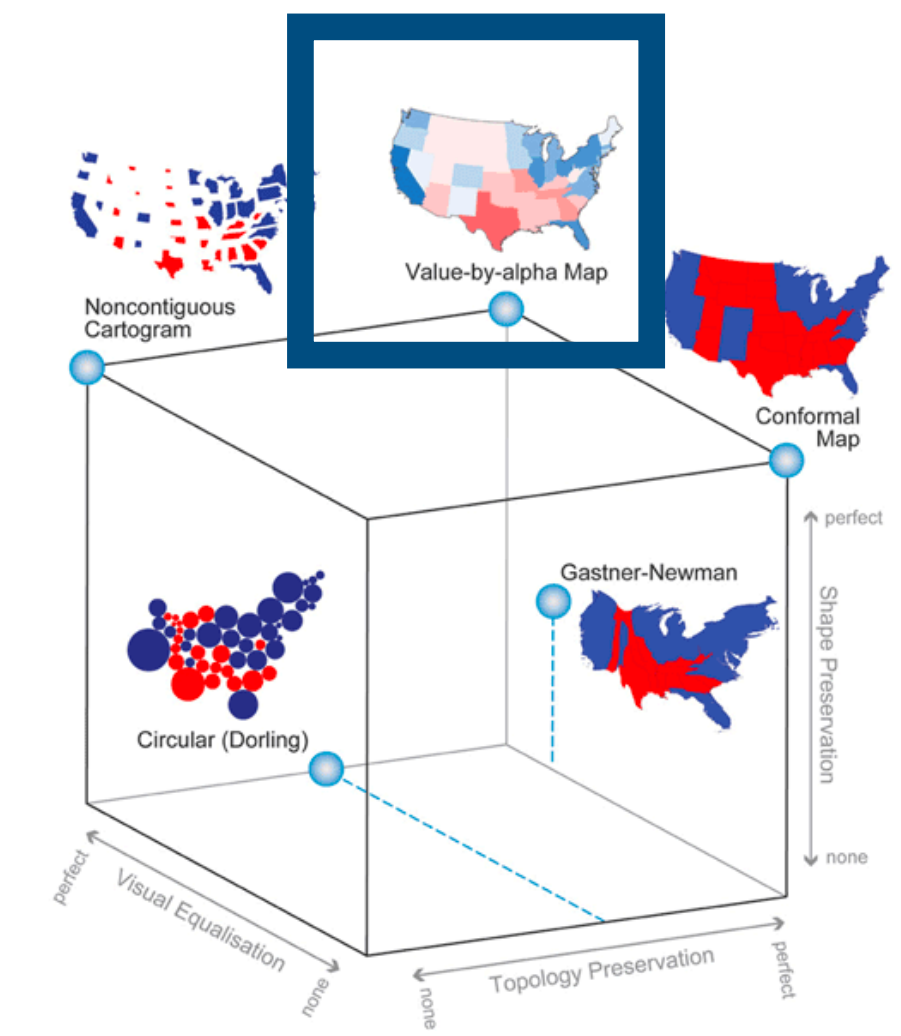
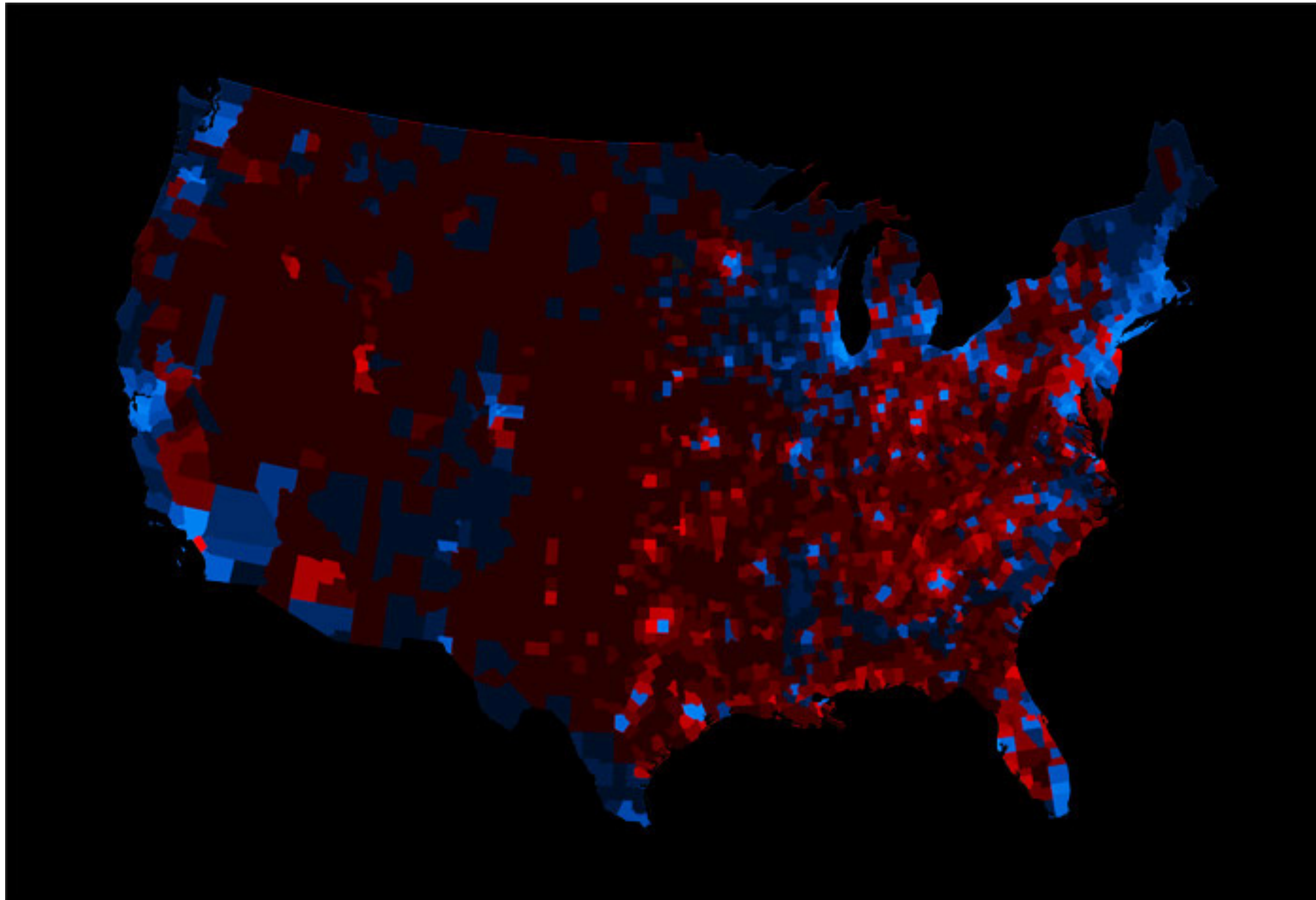


By MIKE BOSTOCK; Additional reporting by KEITH BRADSHER

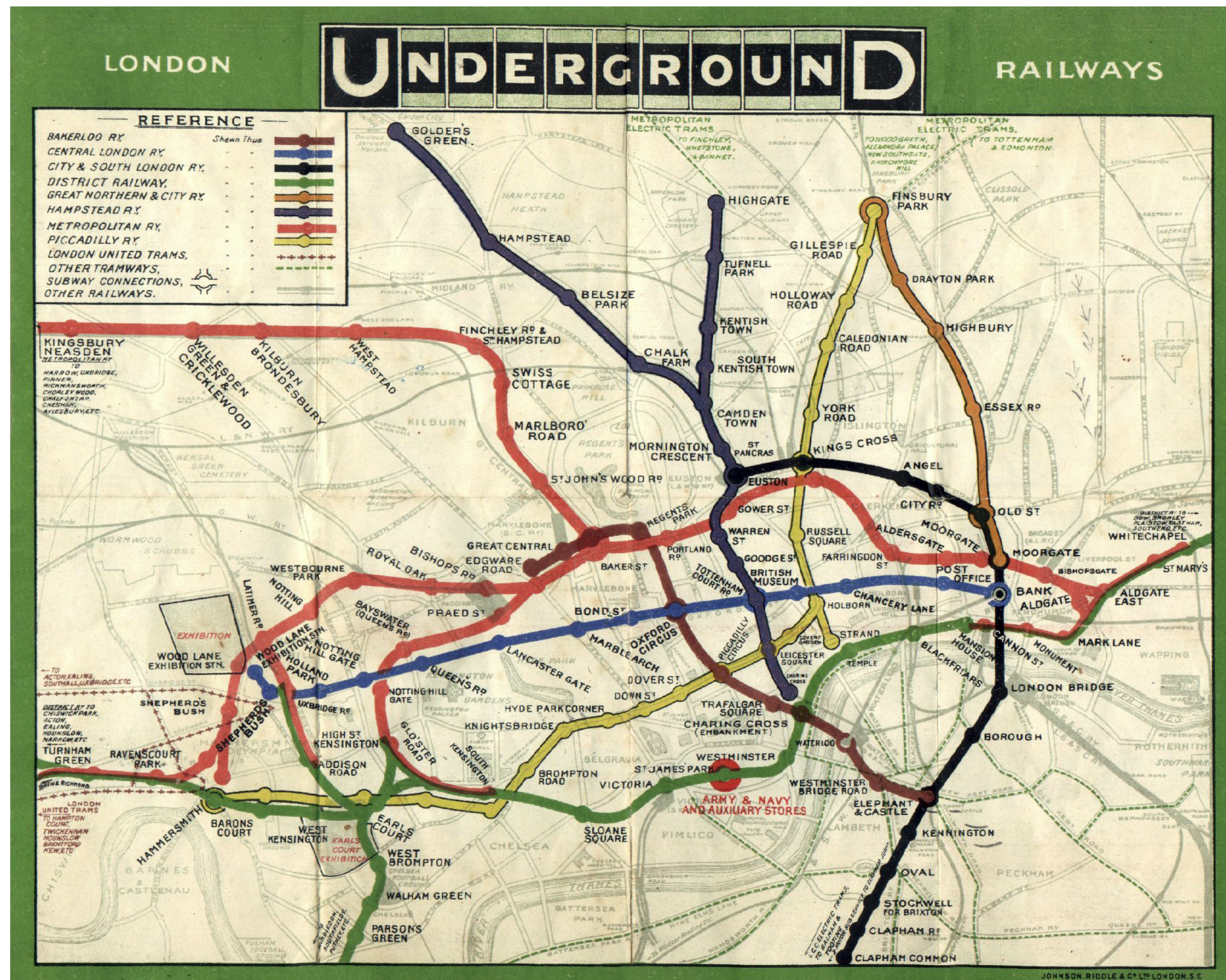
Dorling Cartograms



Value-By-Alpha



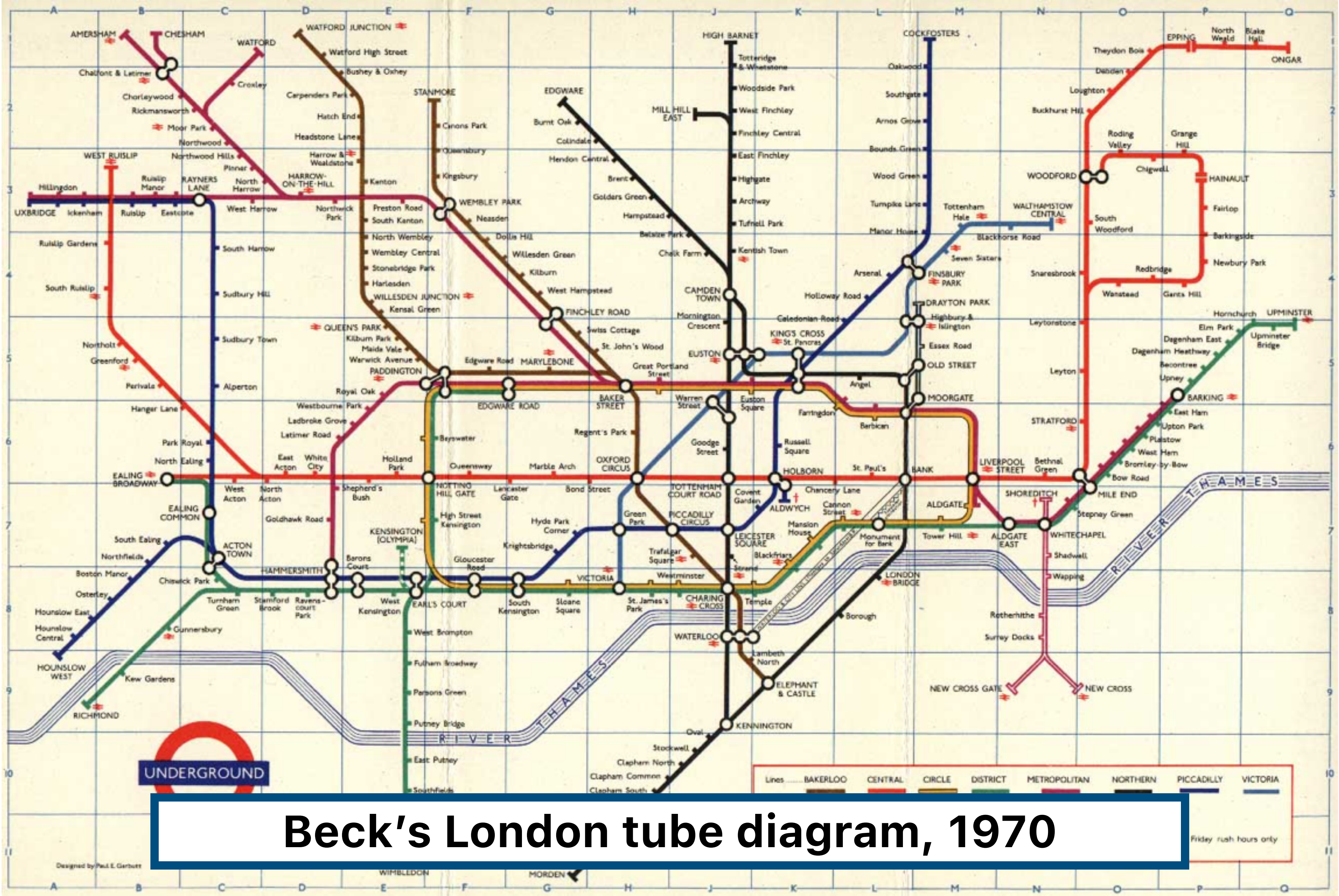
Route Maps



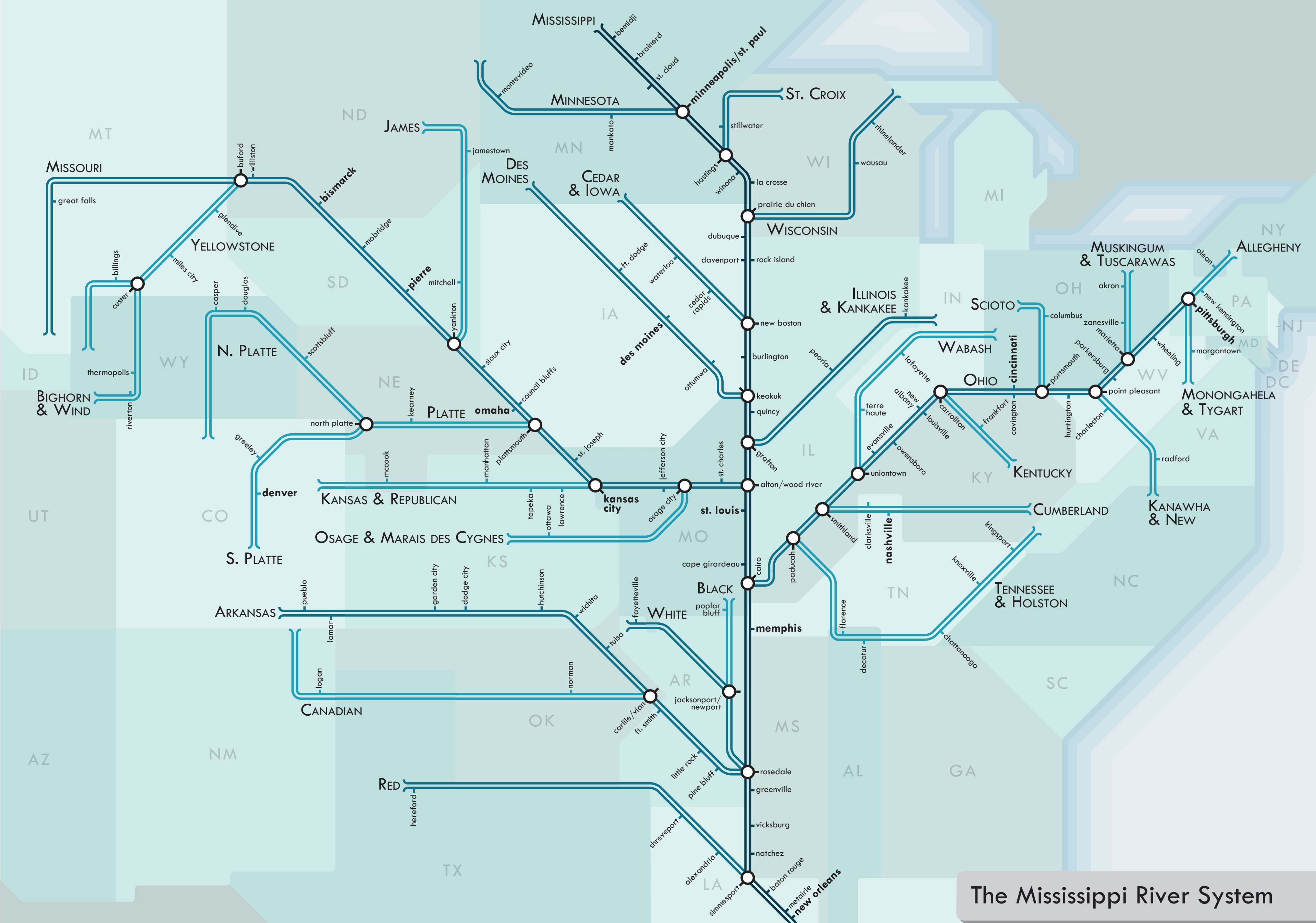
Geographic version of



London Underground



Beck's London tube diagram, 1970



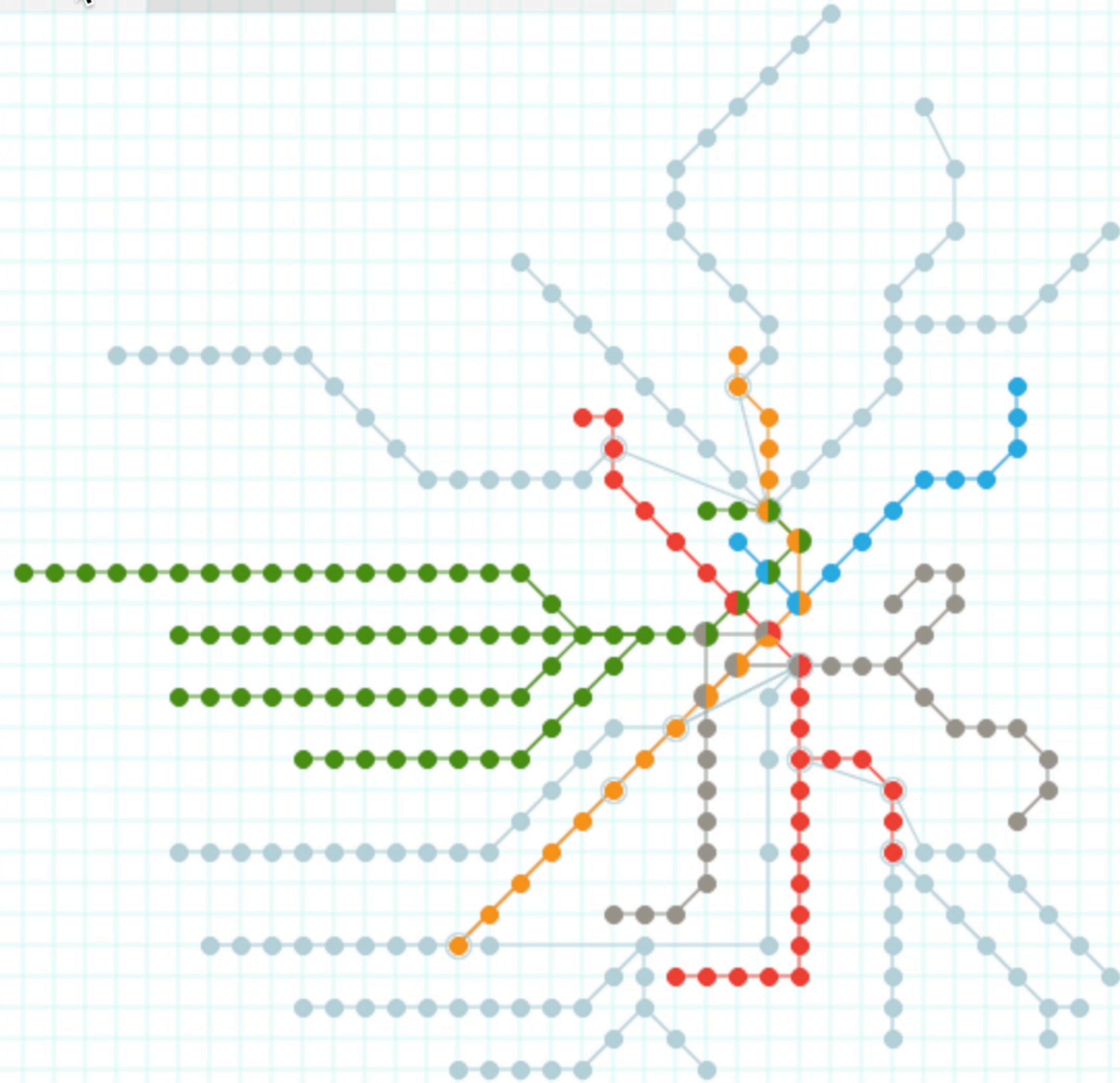
The Mississippi River System

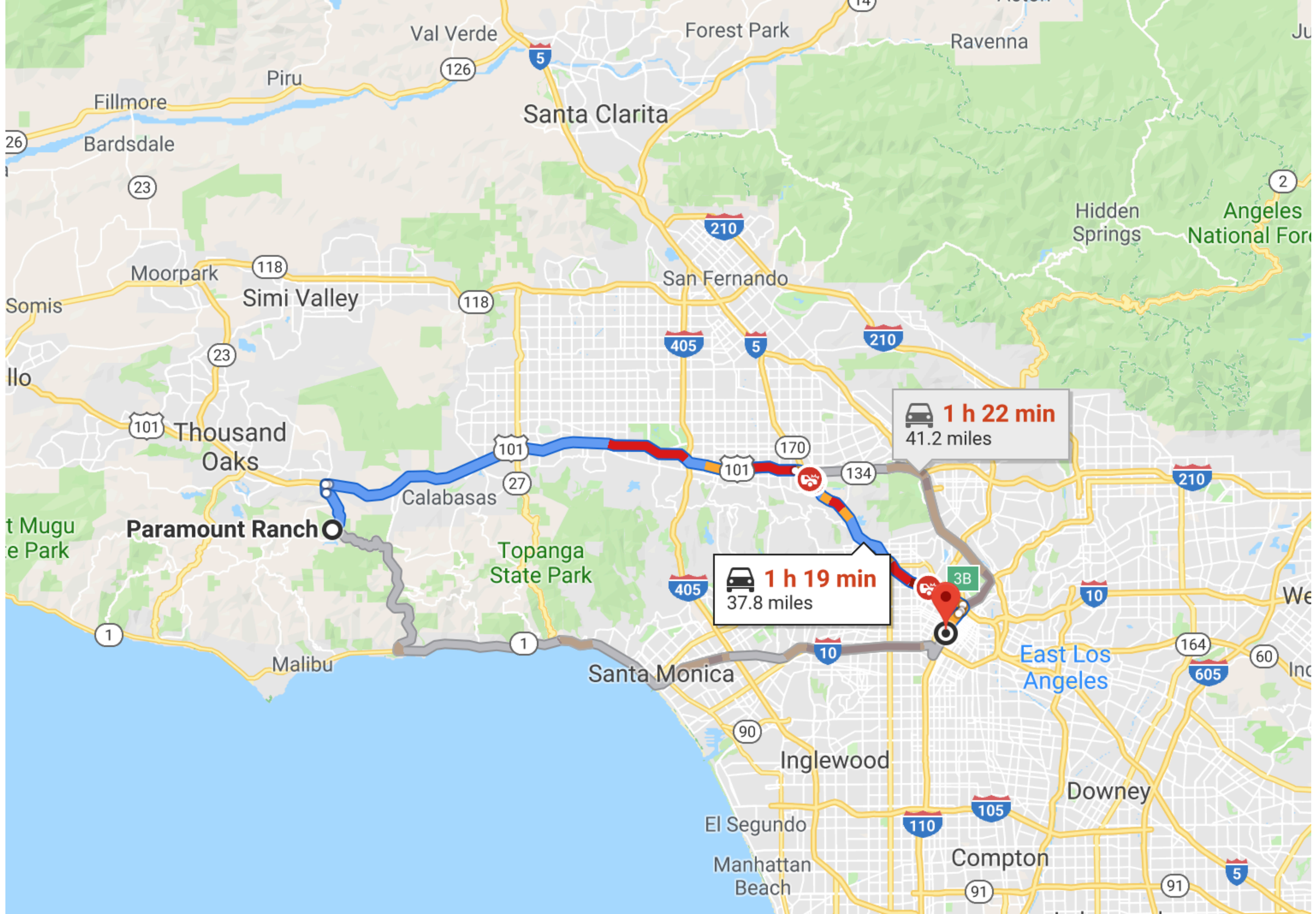
© 2010 Some rights reserved
 creativecommons.org/licenses/by-nc-sa/3.0/
 Type is set in Twentieth Century, by Sol Hess
 Design is based upon the London tube map style, originally by Harry Beck
 Choice of cities and tributaries largely based upon Natural Earth 1:10m data
 Cartography by Daniel P. Huffman, December 2010 | www.somethingaboutmaps.com

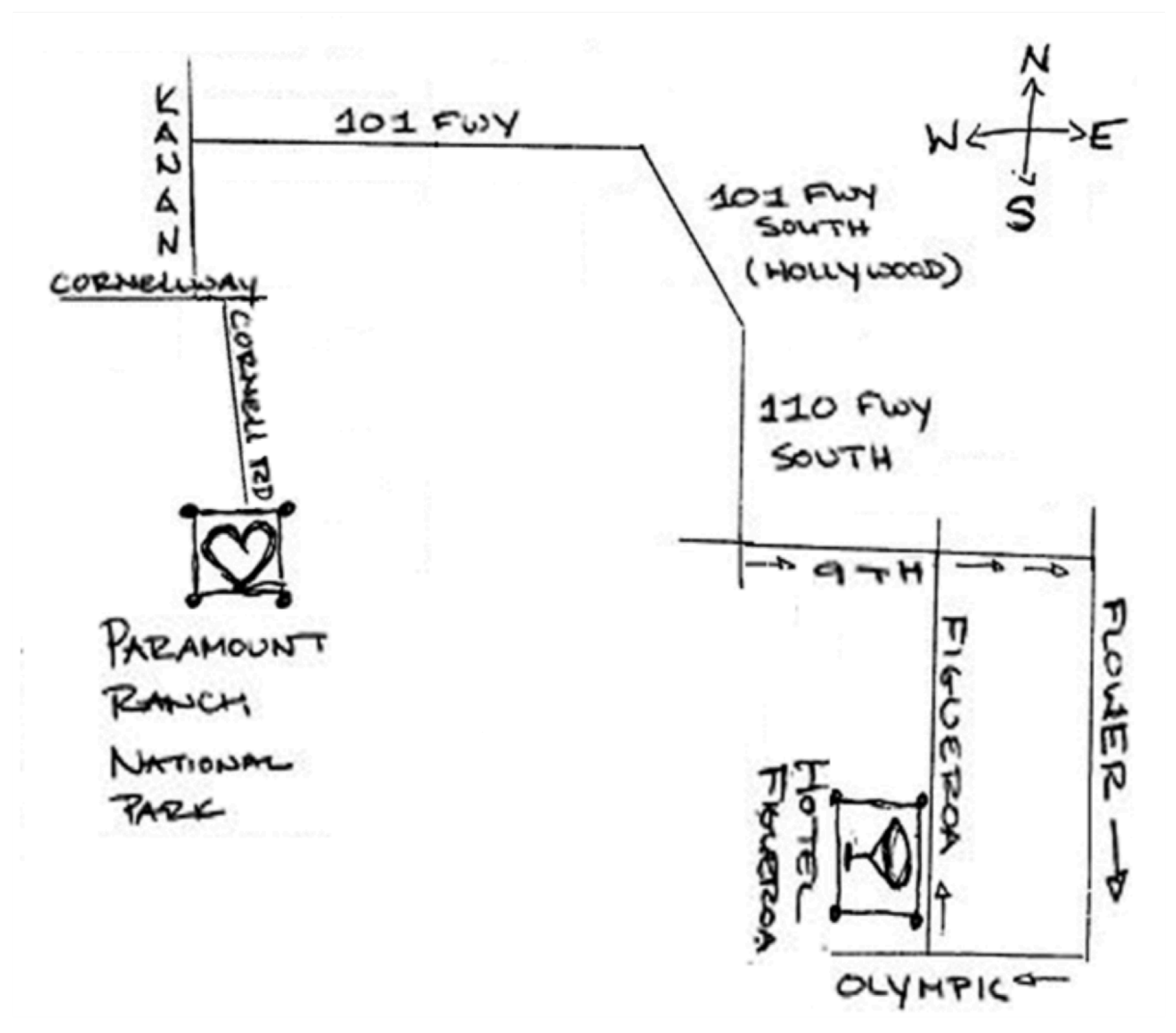
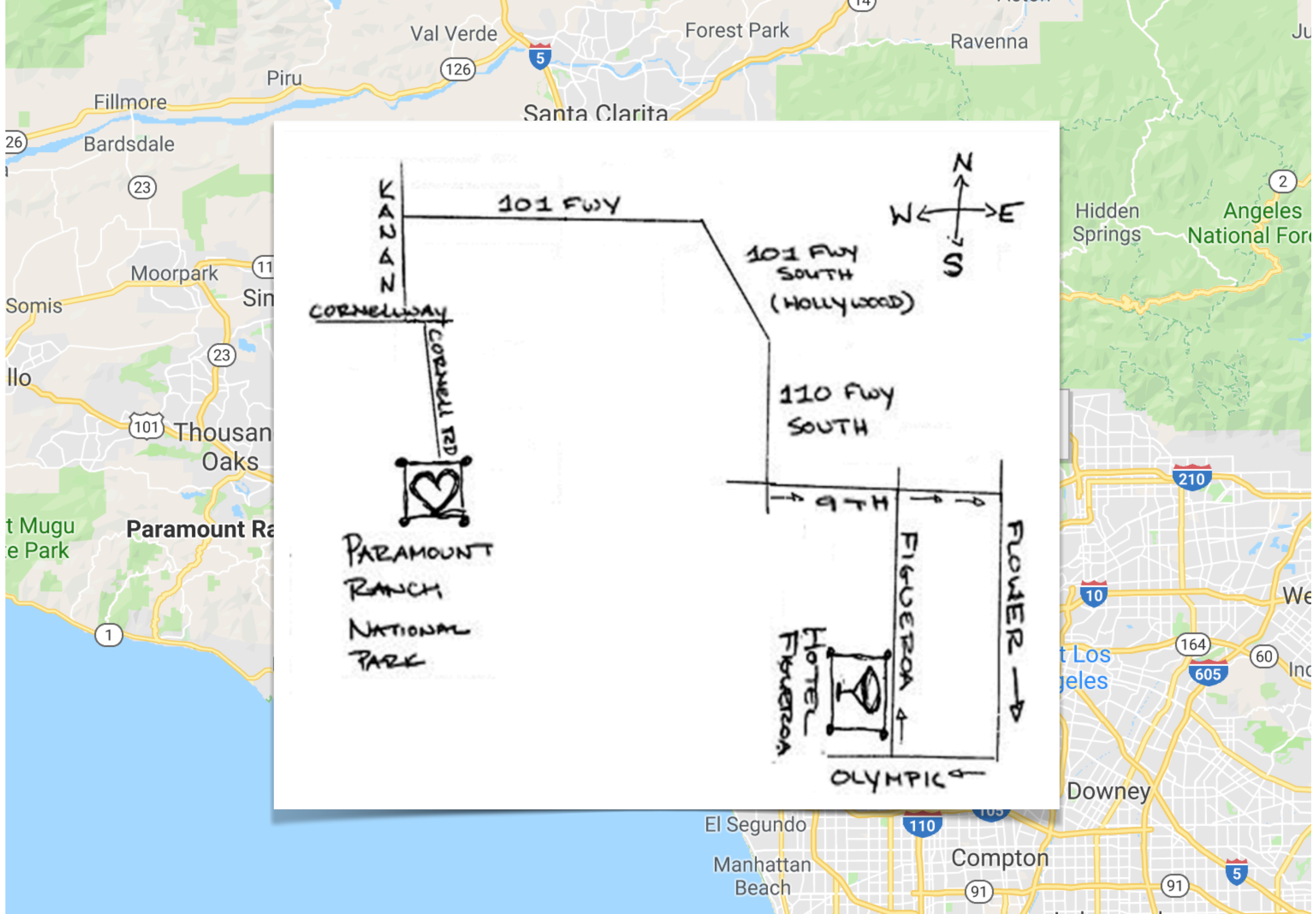
Geographi

Grid

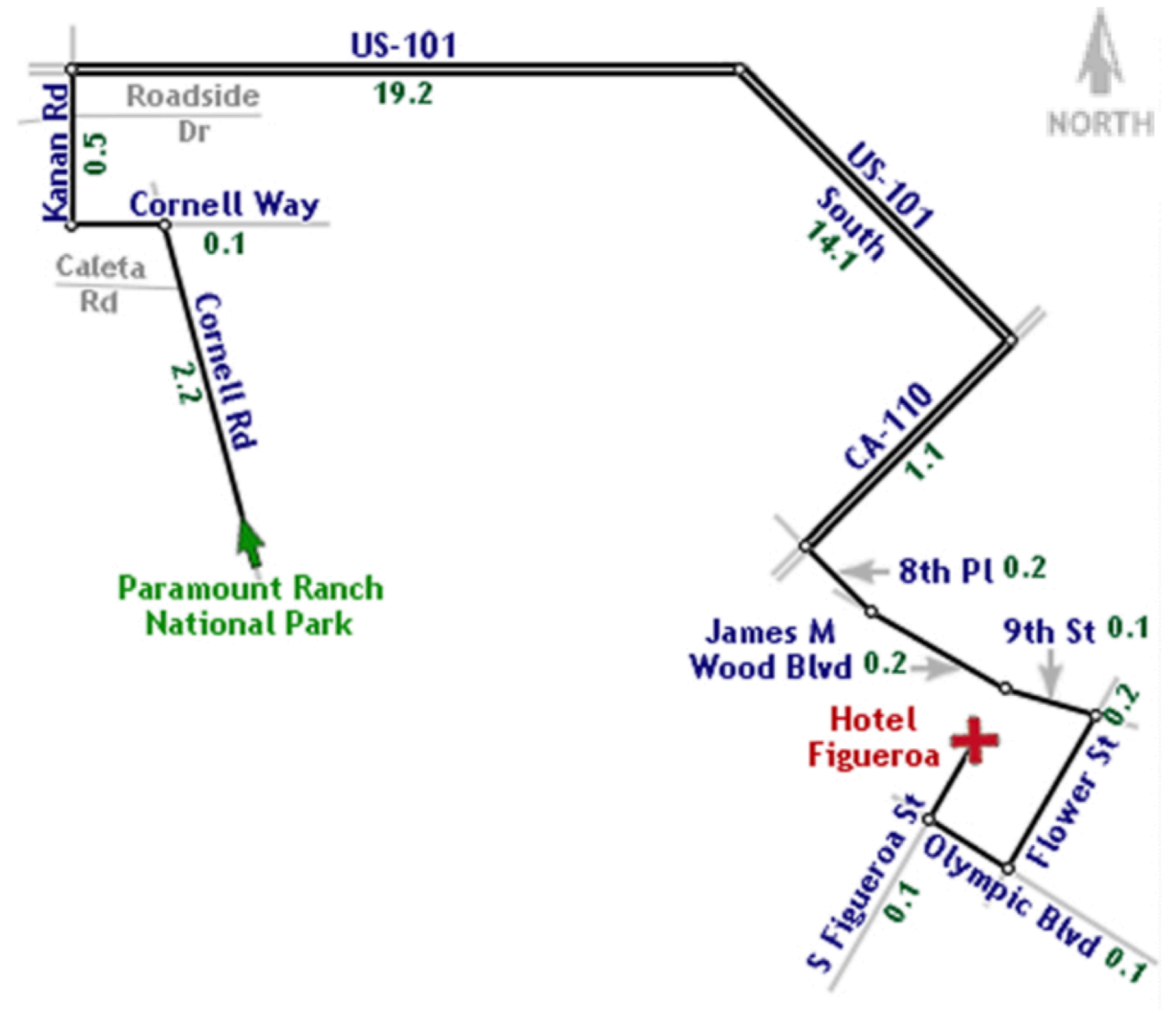
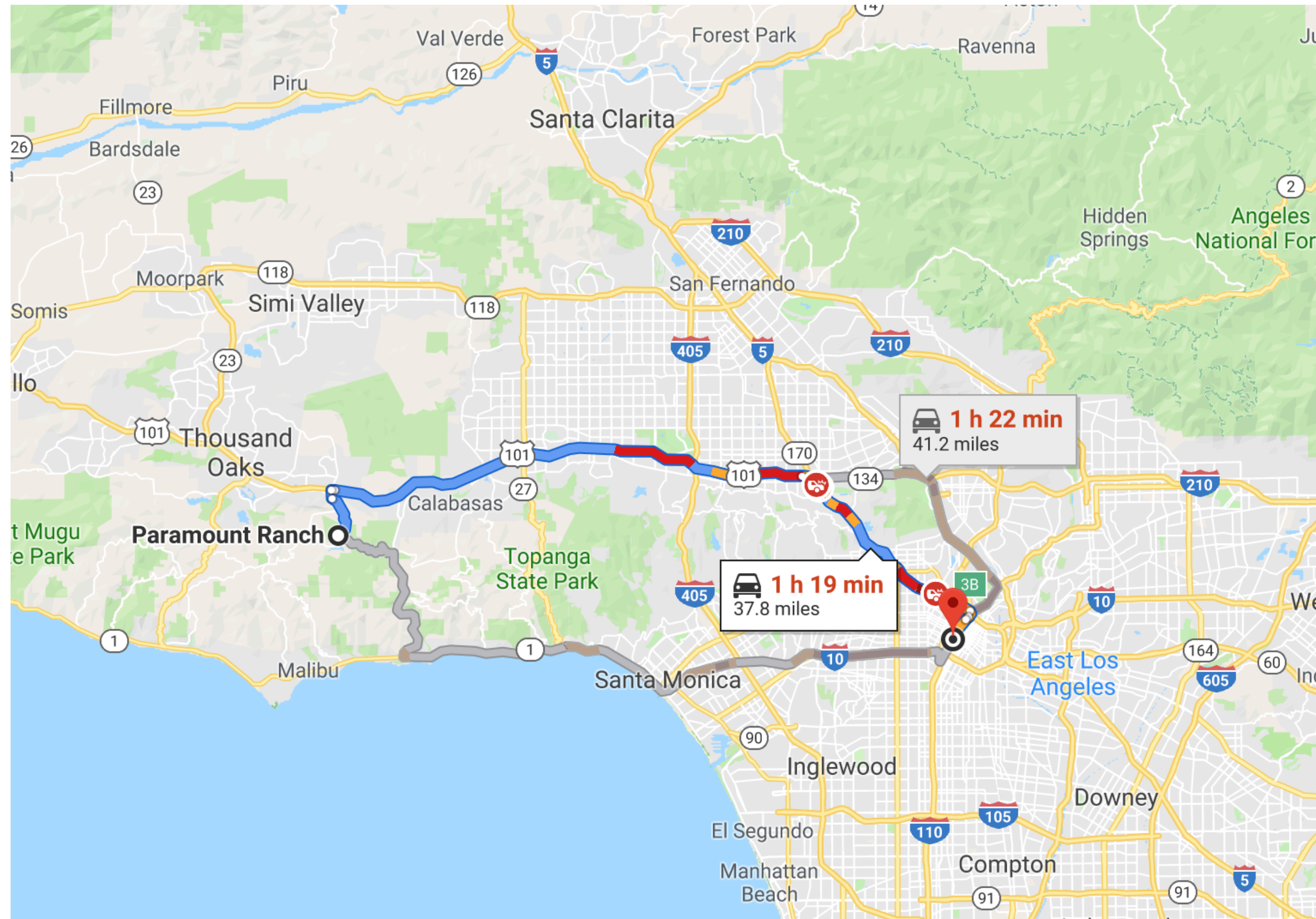
Commuter Rail On







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

Data Resources

Natural Earth Data: naturalearthdata.com

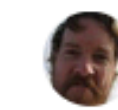
OpenStreetMap: openstreetmap.org

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

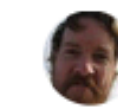
A tour of d3-geo's new command-line interface.

[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

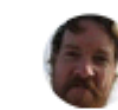
A tour of d3-geo's new command-line interface.

[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