Maps

DSC 106: Data Visualization

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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
Code: **lab6**

Final Project:
Explorable Explanation

Final Project (out now)

Create an **Explorable Explanation**: interactive article that explains something complex to the reader.

Must use one of the health datasets for the class.

Teams of 3-4 only.

Four submissions: proposal (Week 8), prototype (Week 9), video (Week 10), final submission (finals week).

Final Project Showcase: Thurs June 12th 11:30am-2:30pm.

What if I have a really cool dataset I want to visualize?

New this quarter: can propose a dataset to visualize (doesn't have to be health!)

Dataset must be publicly available and have at least 100 rows and 5 columns of data. **Cannot** be synthetic or simulated.

See Final Project page for details.

Maps

When to use a map?

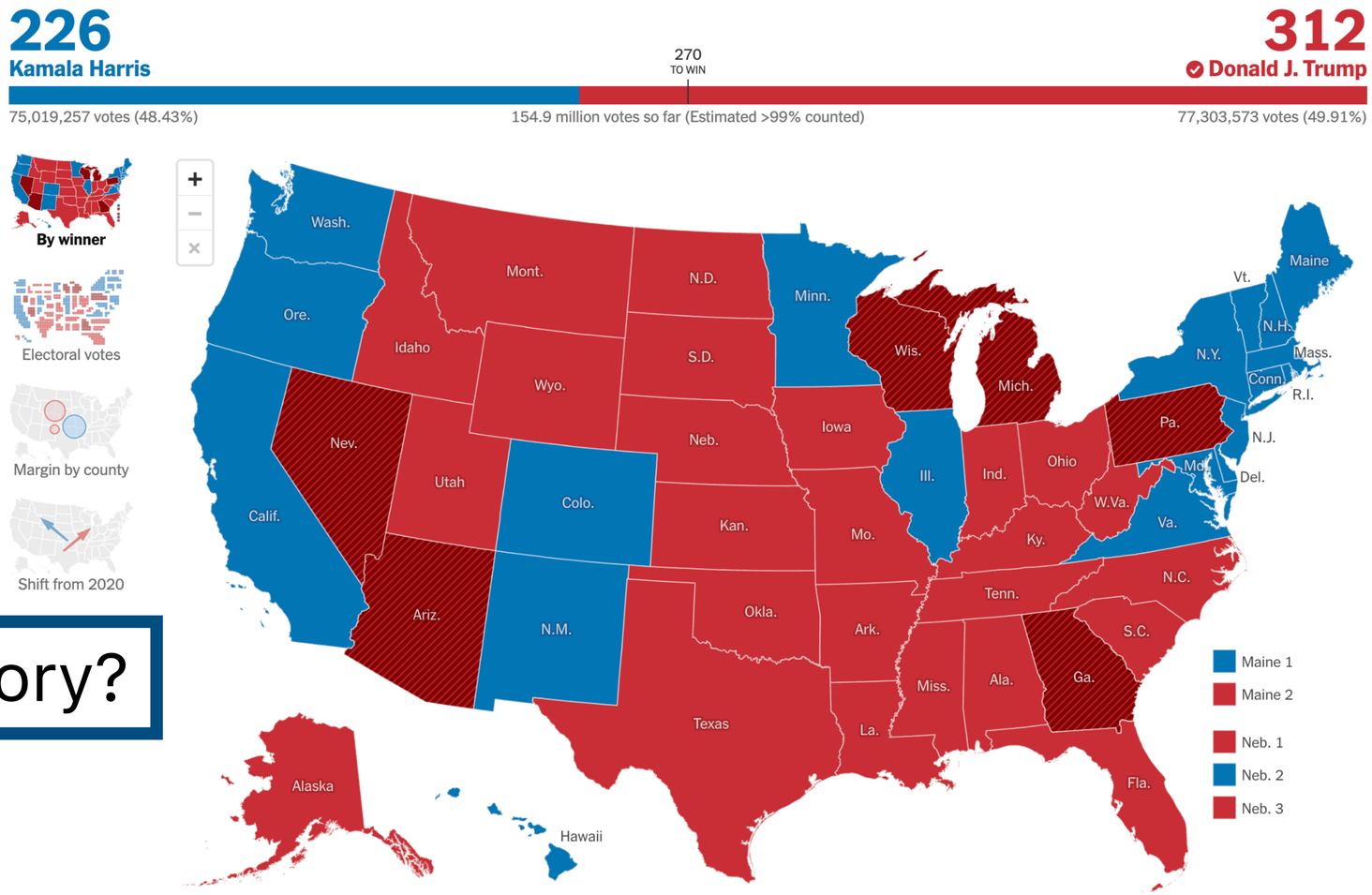
1. When data contains geographical attributes (e.g., latitude, longitude, city, state, country, etc.).
2. When you want to emphasize **geographic relationship**.

Geographic Relationships

✅ Who's winning my state?

❌ Is it a landslide?

❌ What are the paths to victory?



Geographic Relationships

✅ Who's winning my state?

✅ Is it a landslide?

❌ What are the paths to victory?

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

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

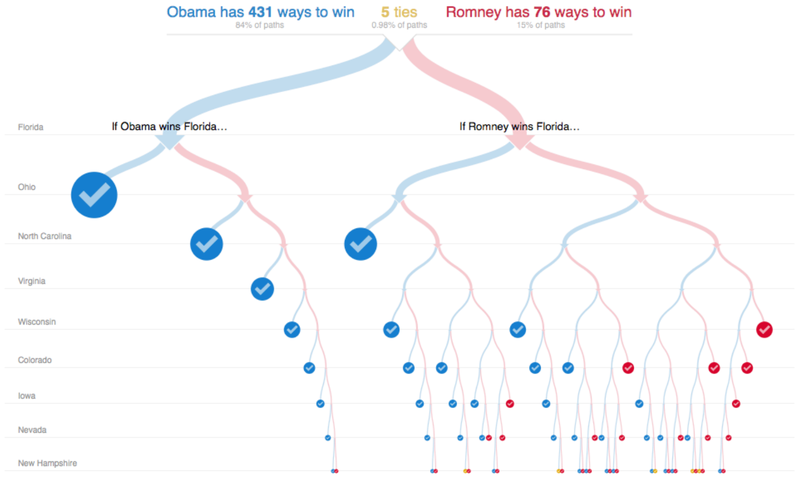
State	Margin	% In
Ariz.	R+6 ✓	100%
Ga.	R+2 ✓	100%
Mich.	R+1.4 ✓	100%
Nev.	R+3 ✓	100%
N.C.	R+3 ✓	100%
Pa.	R+1.7 ✓	100%
Wis.	R+0.86 ✓	100%

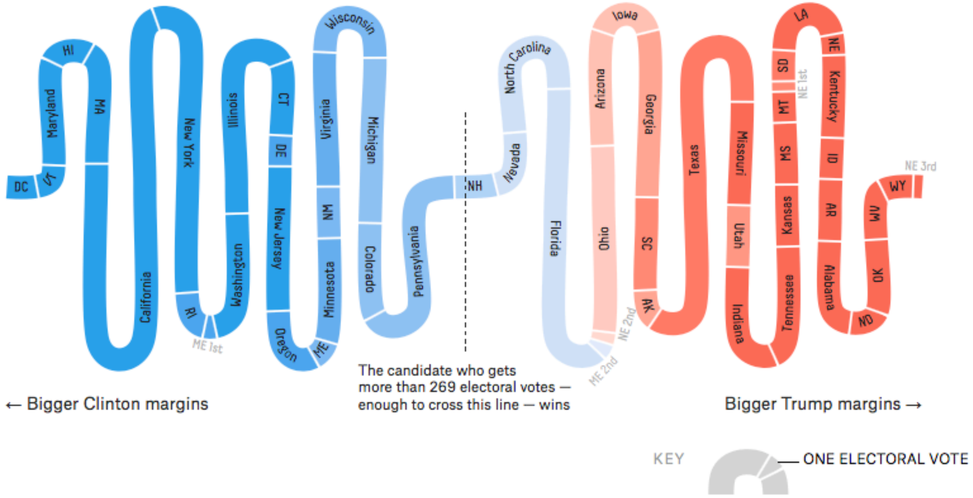
Trump expected to win narrowly

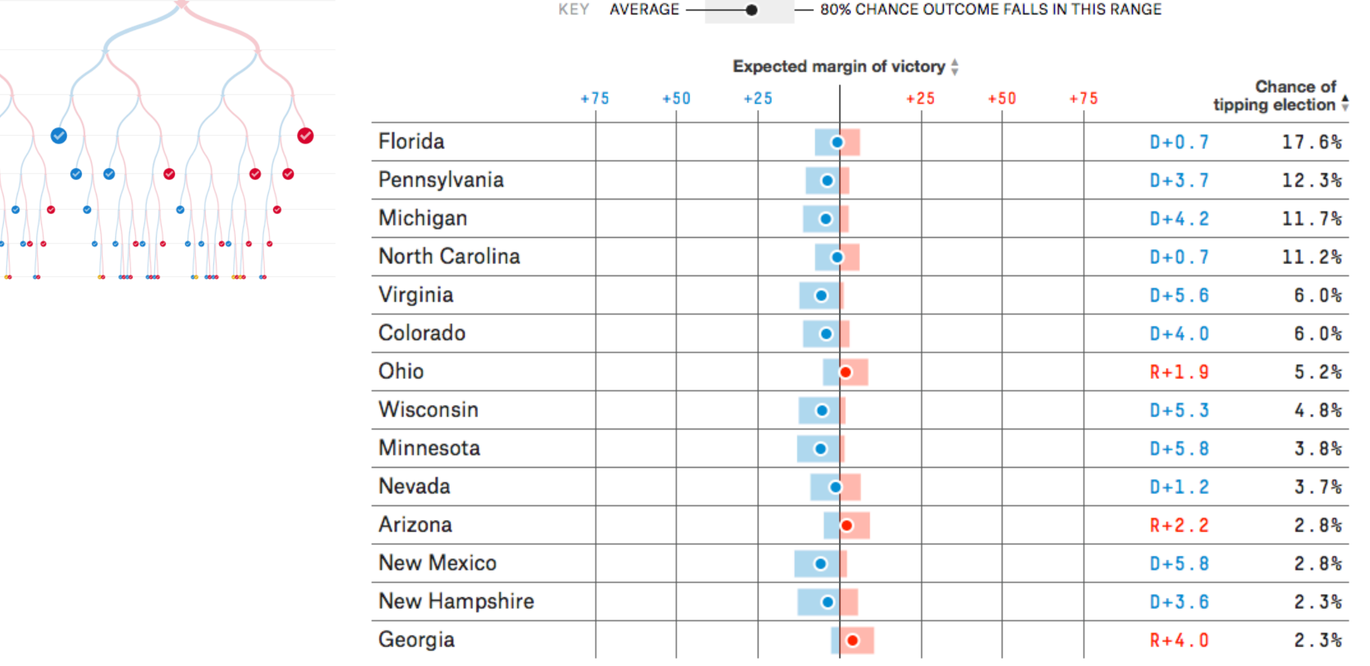
State	Margin	% In
Fla.	R+13 ✓	100%
Iowa	R+13 ✓	100%
Maine 2	R+10 ✓	100%
Texas	R+14 ✓	100%

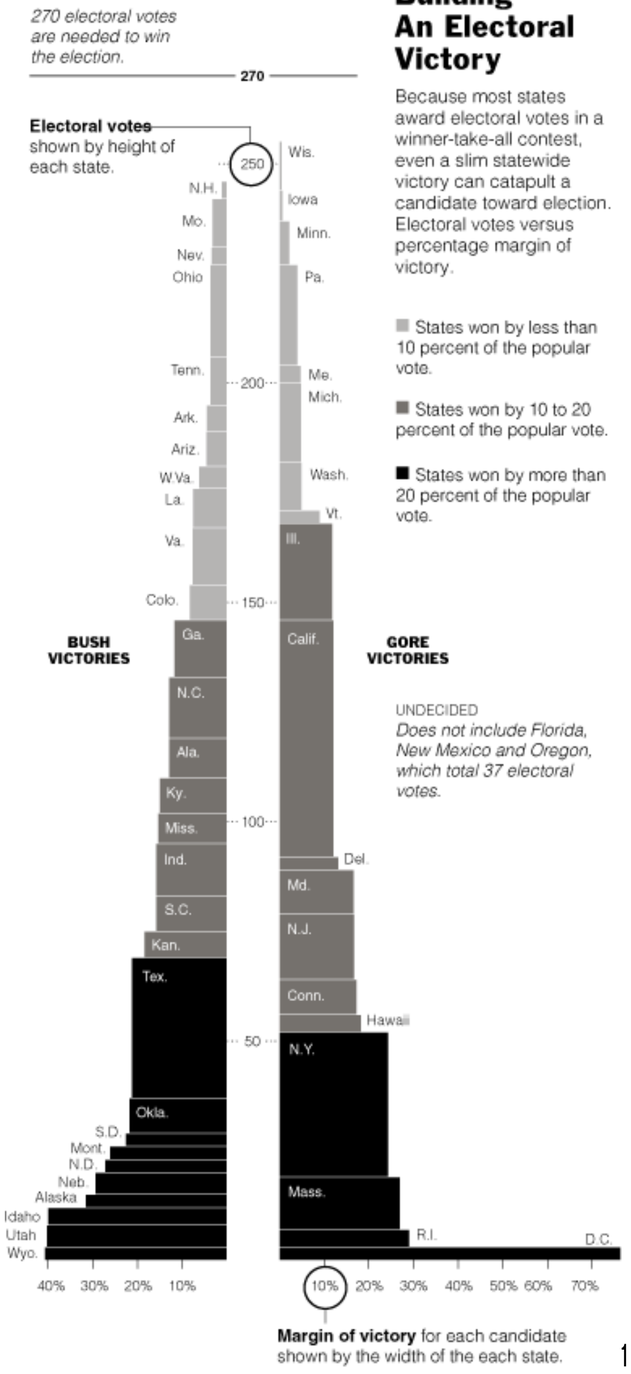
Trump expected to win easily

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%









Building An Electoral Victory

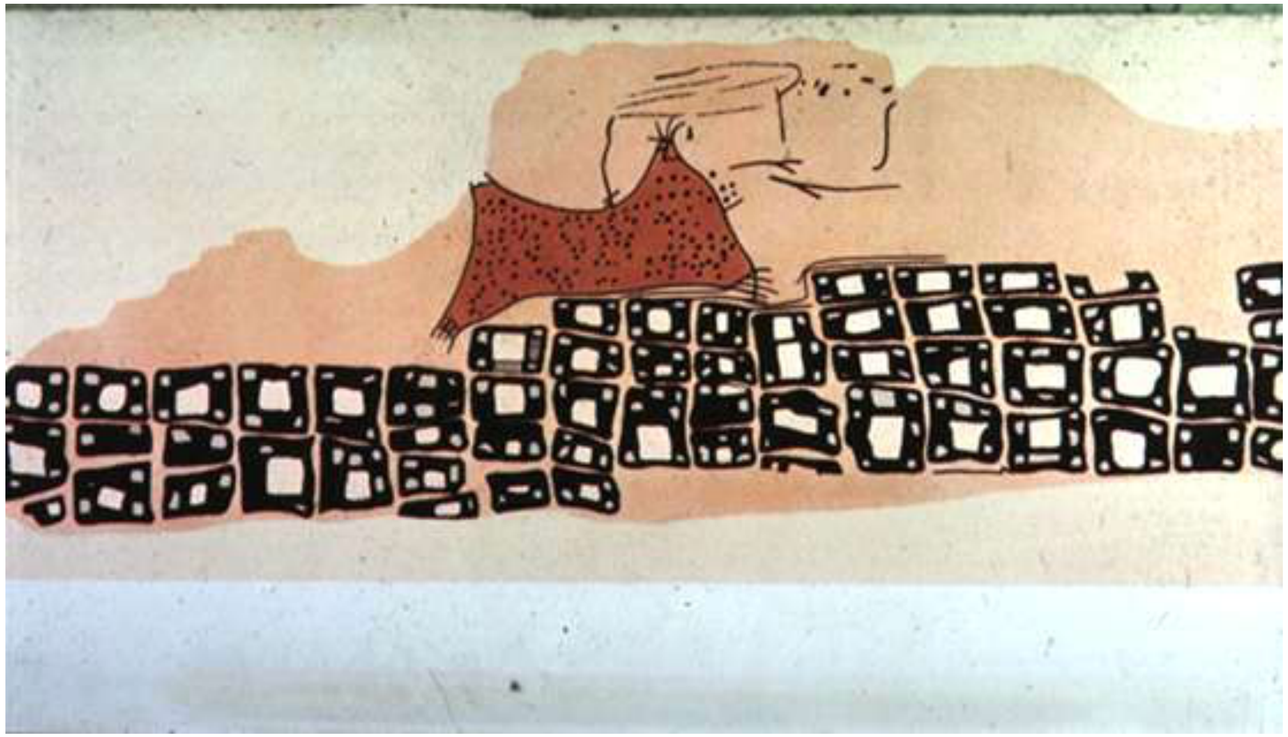
Because most states award electoral votes in a winner-take-all contest, even a slim statewide victory can catapult a candidate toward election. Electoral votes versus percentage margin of victory.

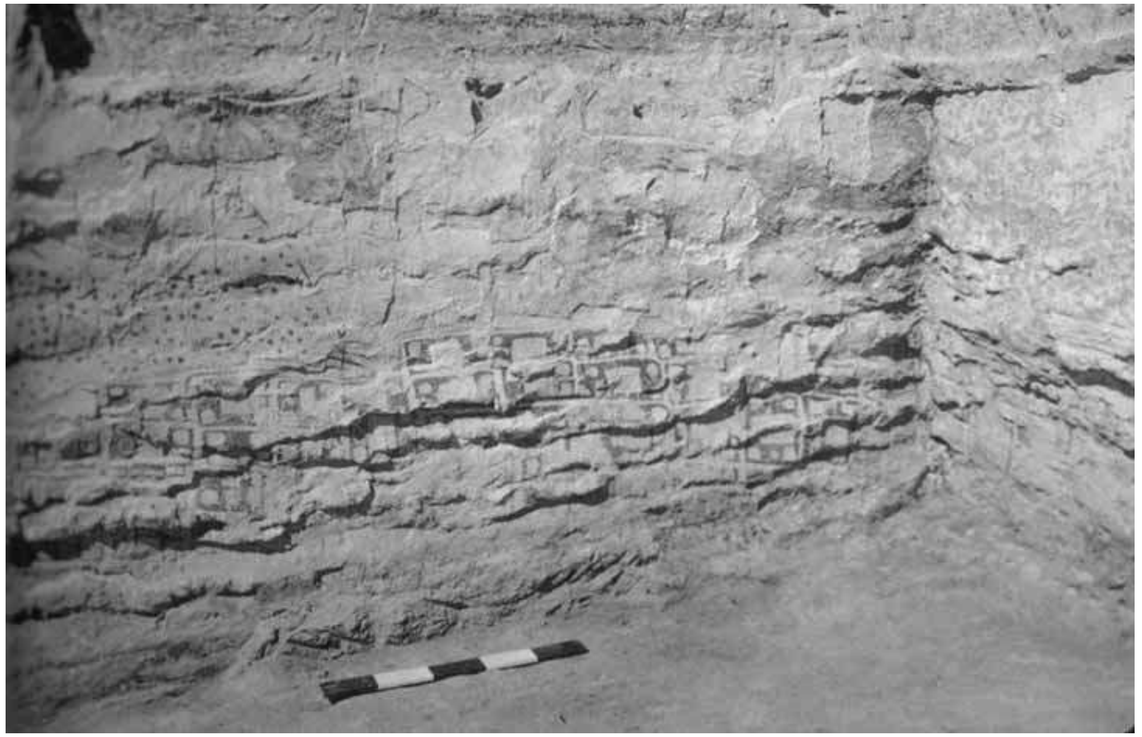
- States won by less than 10 percent of the popular vote.
- States won by 10 to 20 percent of the popular vote.
- States won by more than 20 percent of the popular vote.

UNDECIDED
Does not include Florida, New Mexico and Oregon, which total 37 electoral votes.

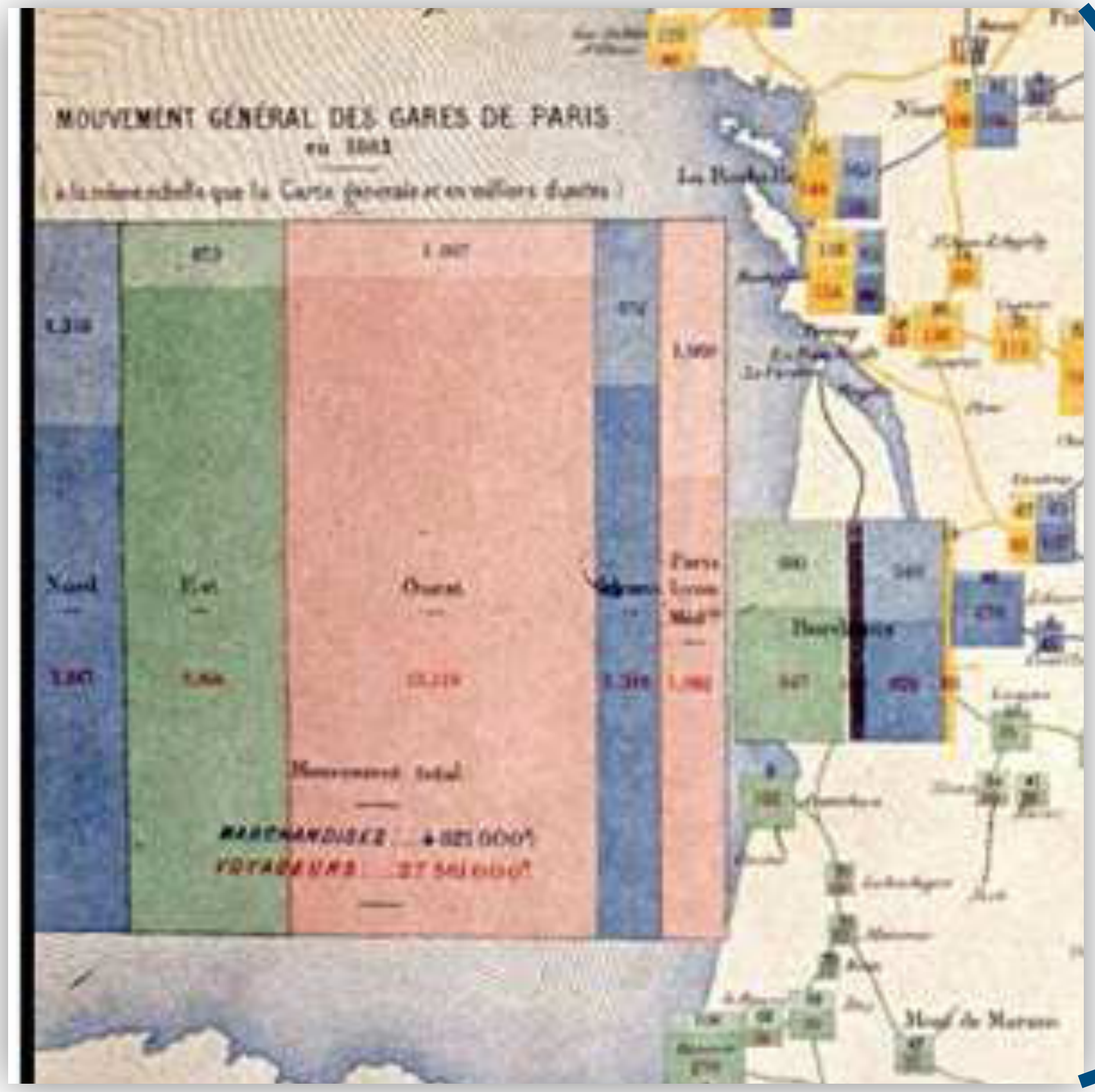
Cartography
(Map Making)

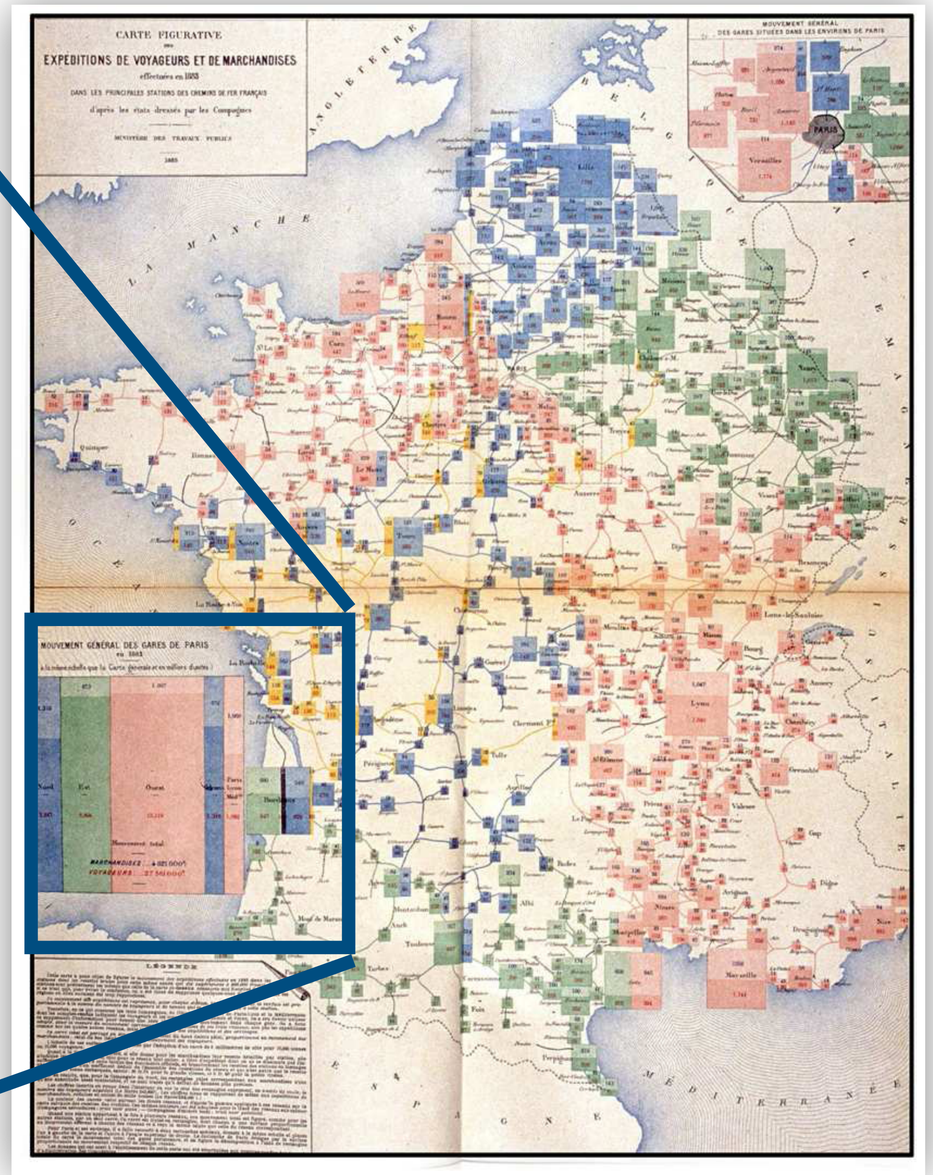
Oldest Known Map: Konya, Turkey (~6200 BC)



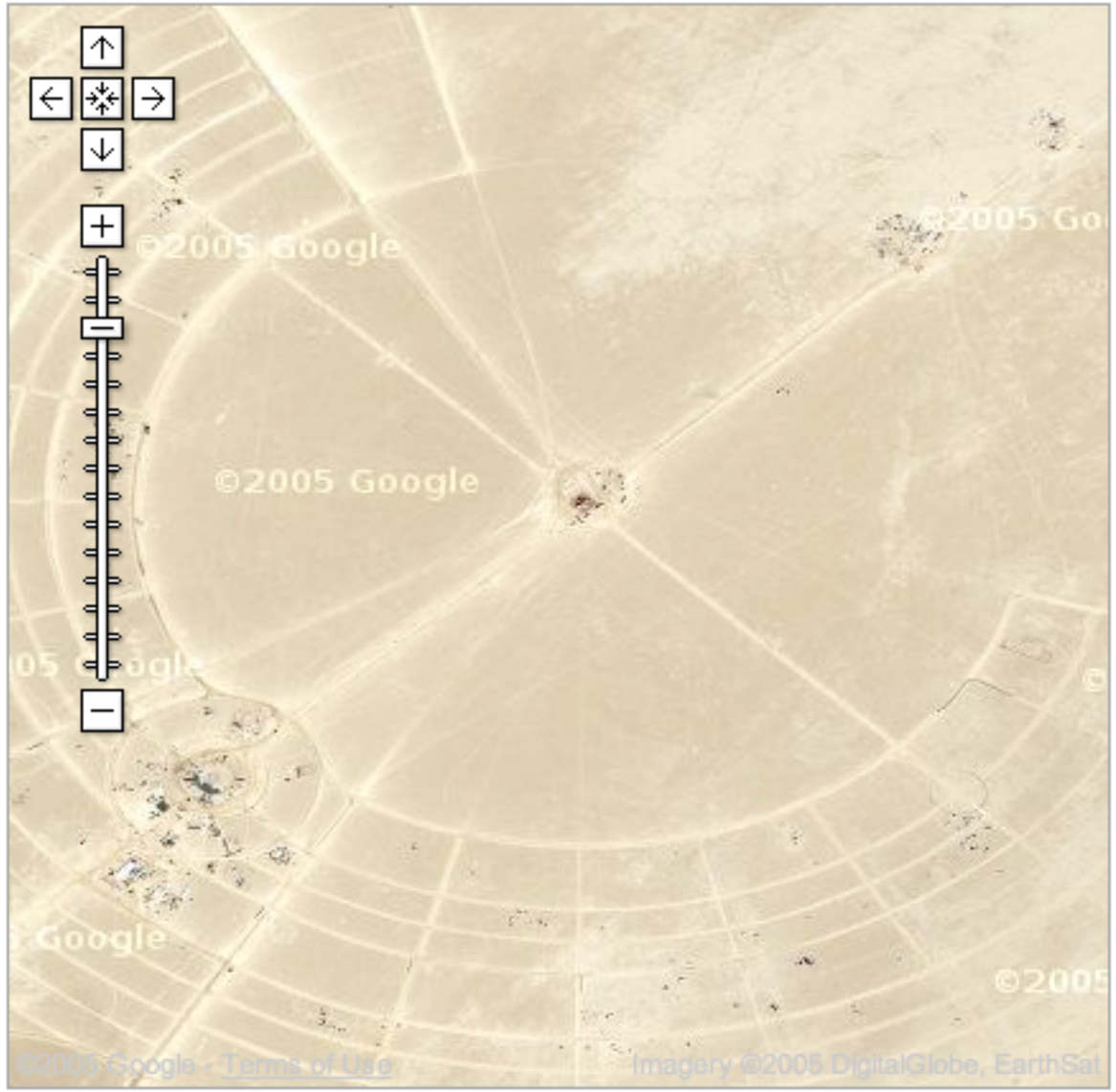


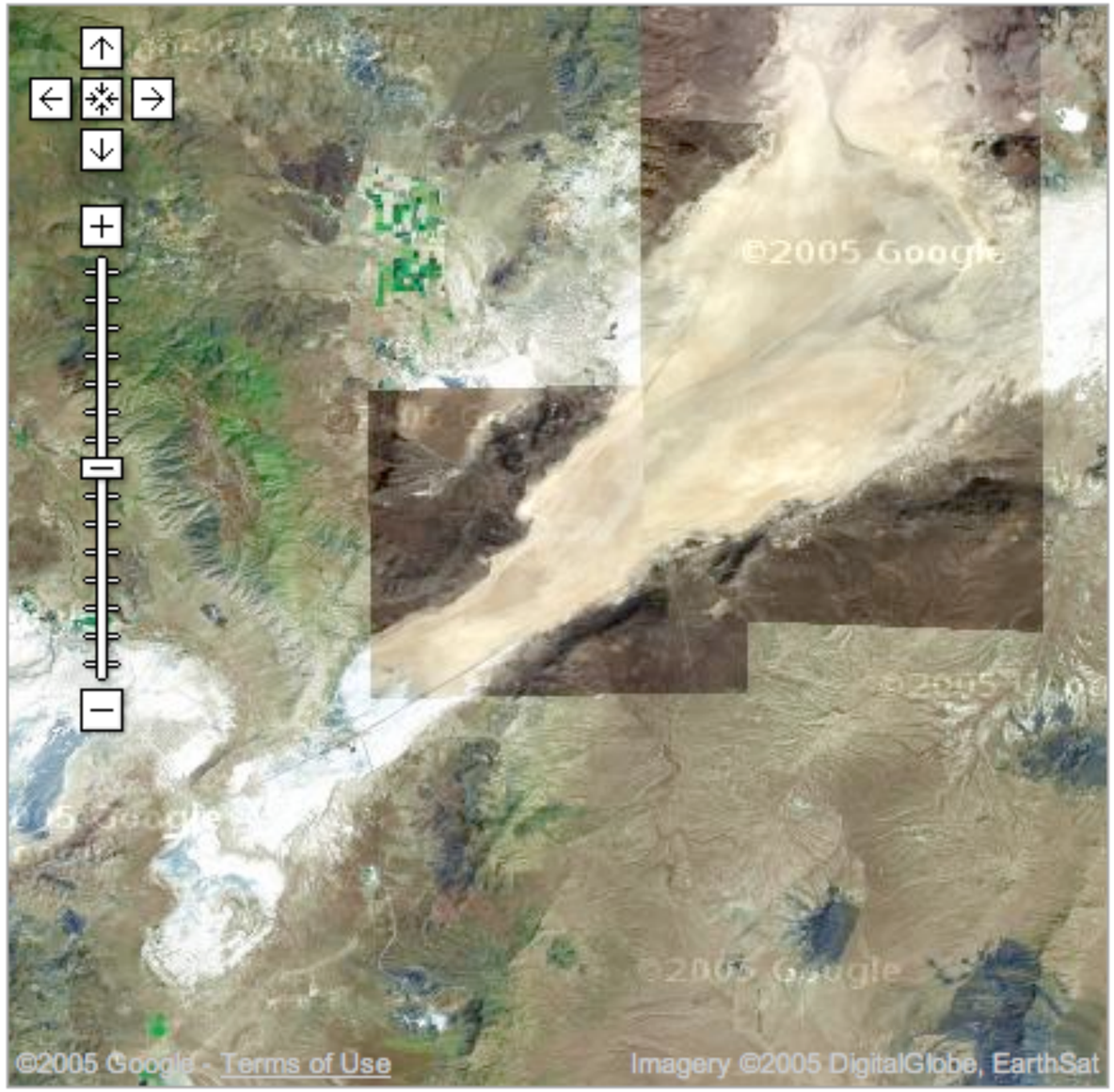
Rail Passengers and Freight from Paris 1884

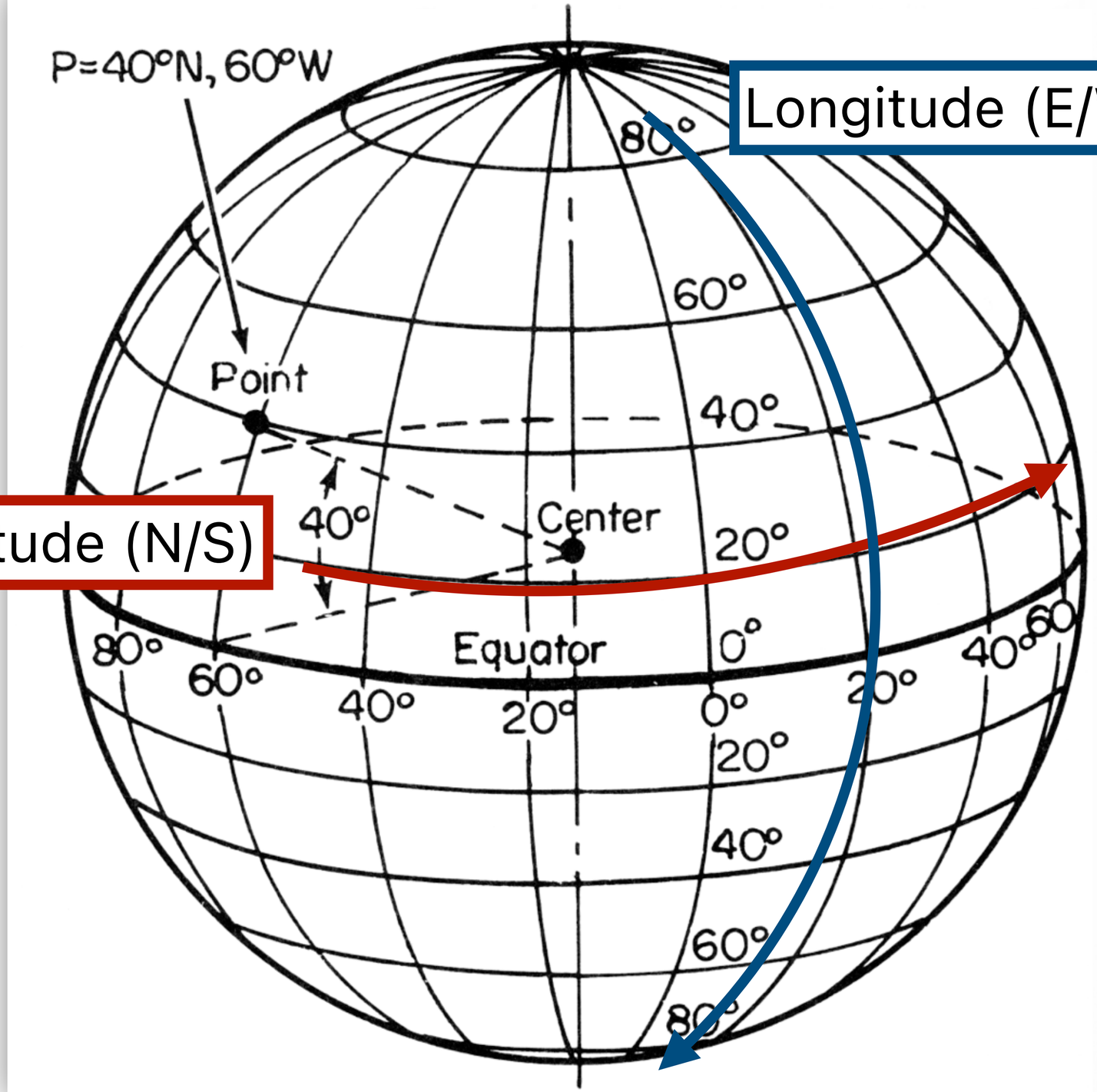




Google Maps, 2005







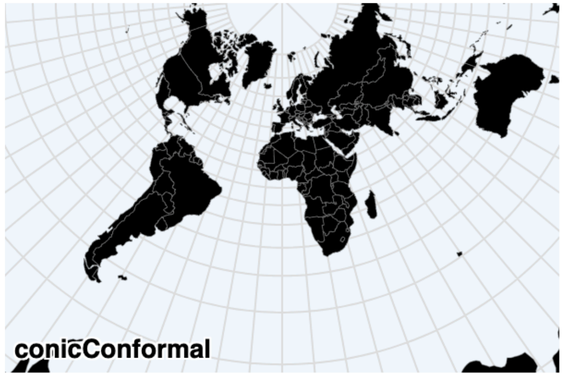
Longitude (E/W)

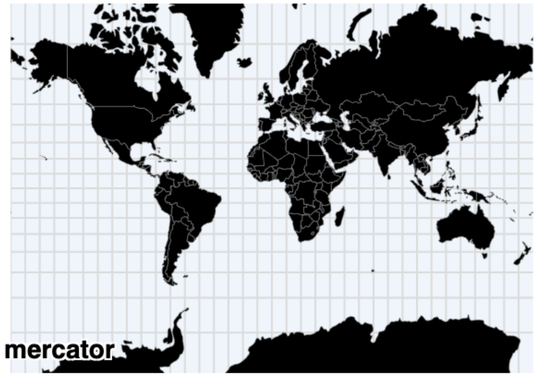
Latitude (N/S)

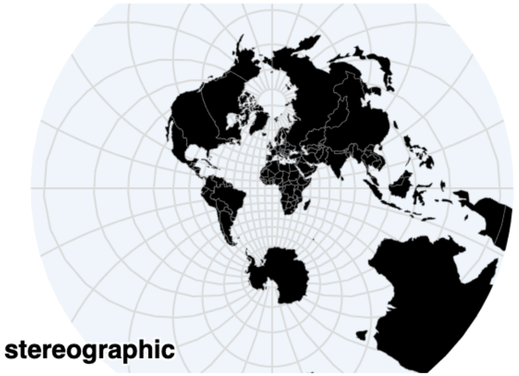
LONGitude lines are all long (some latitude lines are quite short!)

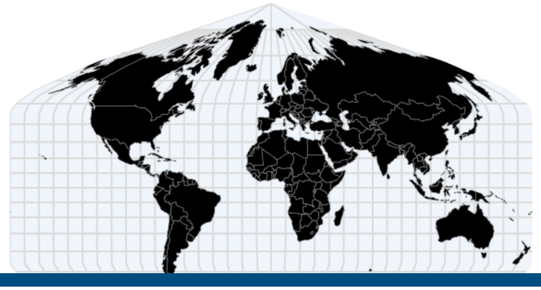

A sphere tears
when you flatten it

Exploring Projections





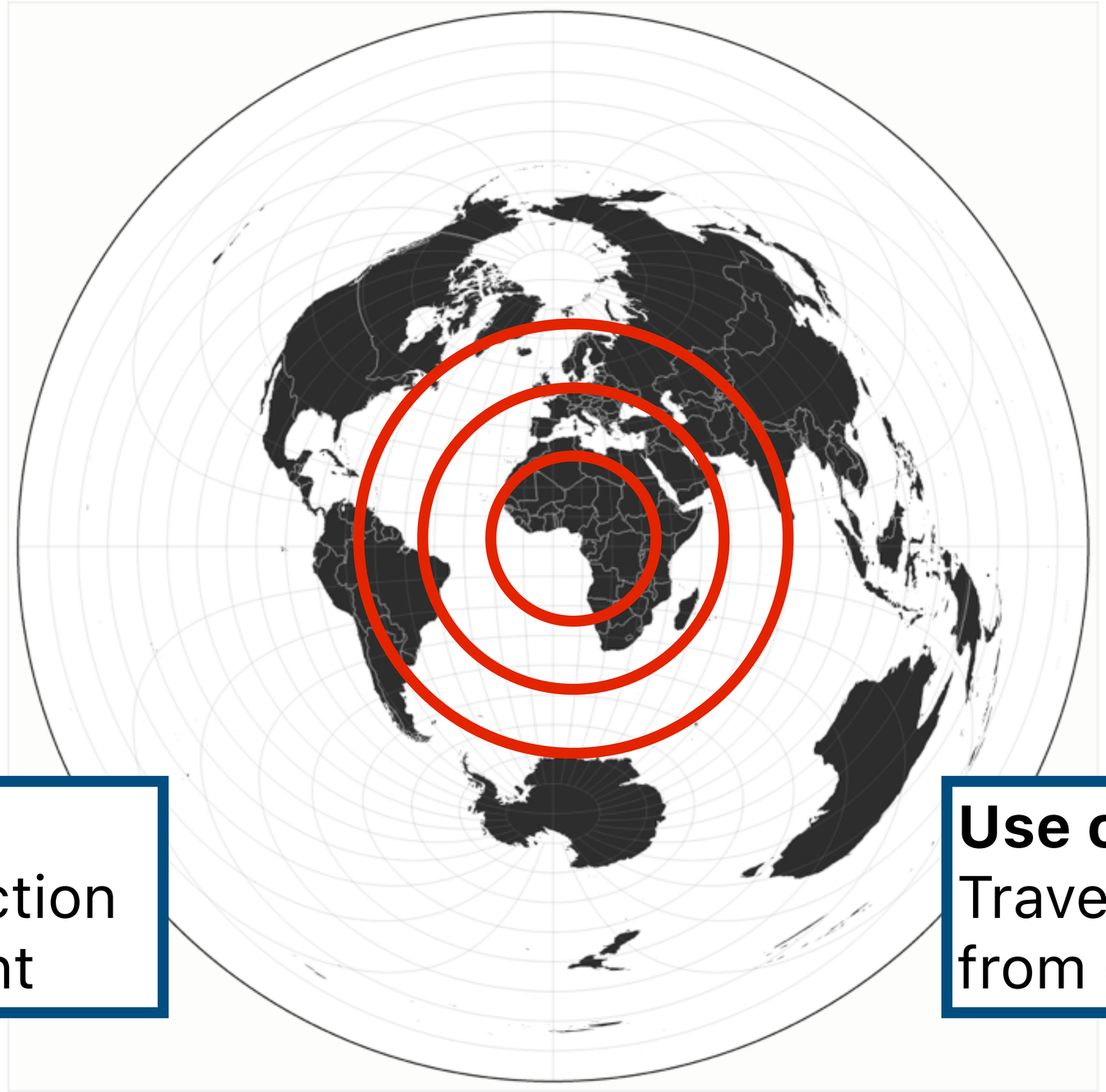




https://vega.github.io/vega/examples/projections/

Projections preserve some metrics, distort others

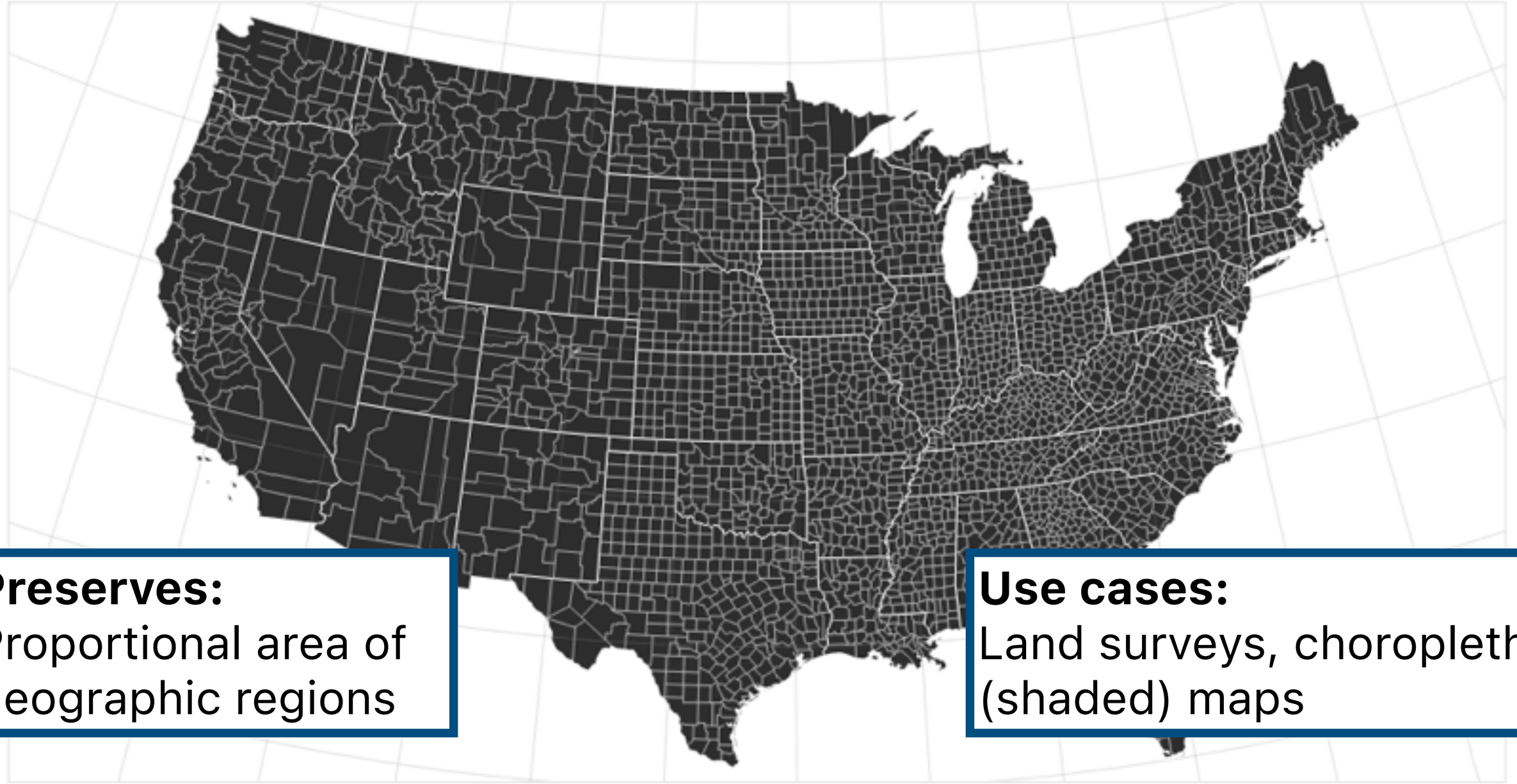
Azimuthal Equidistant



Preserves:
Distance & direction from center point

Use cases:
Travel / propagation from center point

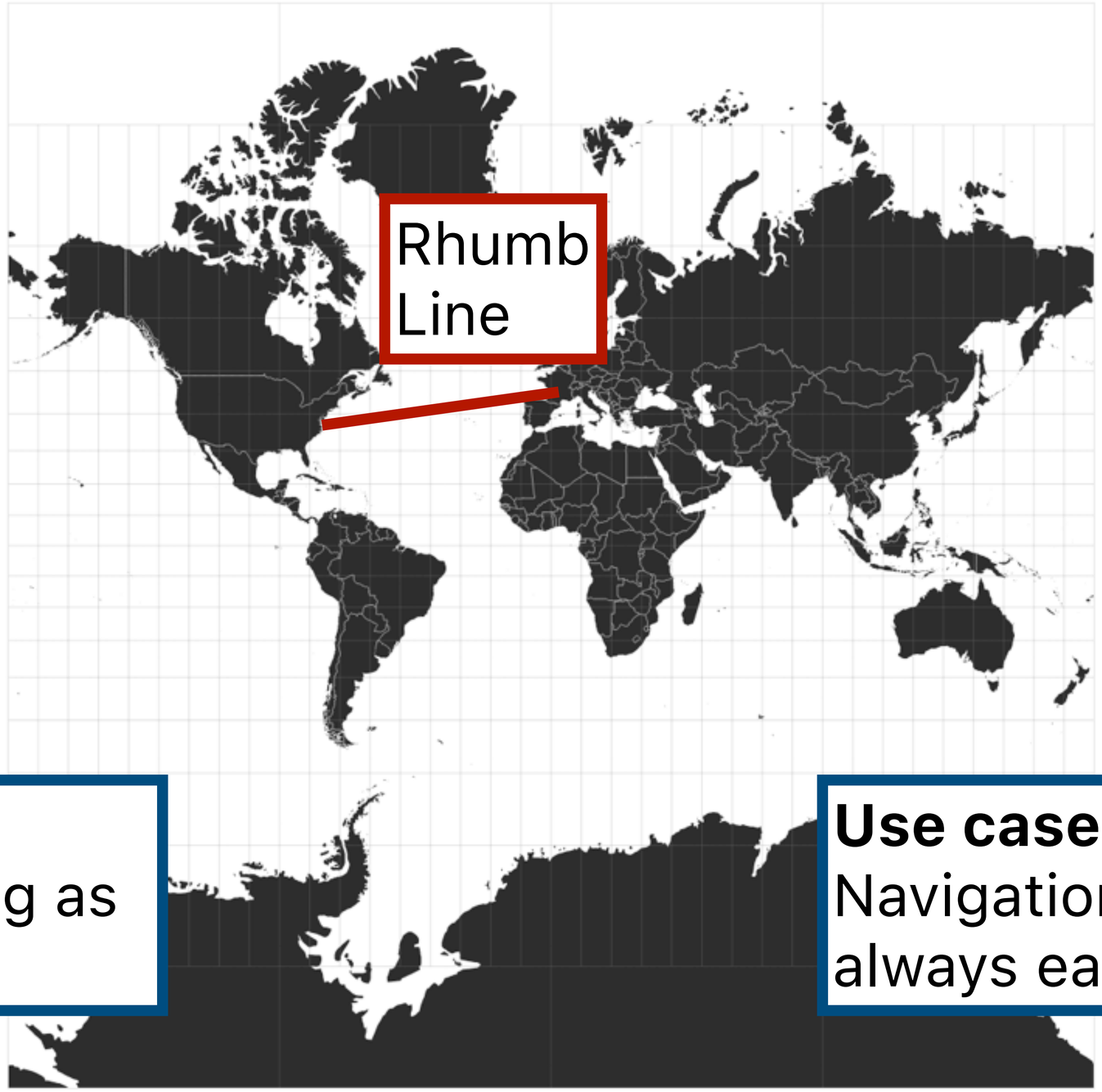
Albers Equal-Area Conic



Preserves:
Proportional area of geographic regions

Use cases:
Land surveys, choropleth (shaded) maps

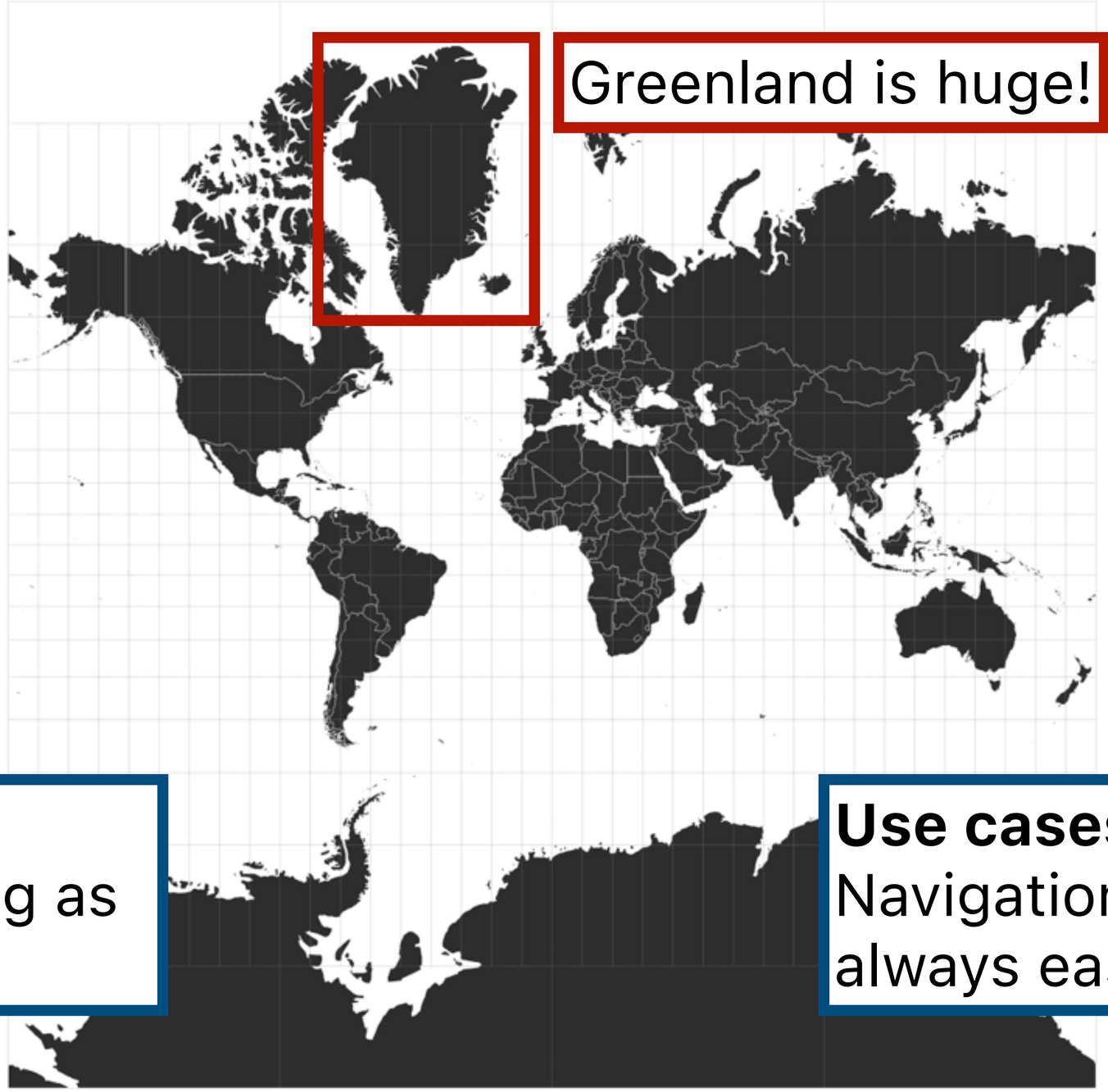
Spherical Mercator



Preserves:
Compass bearing as straight line

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

Spherical Mercator

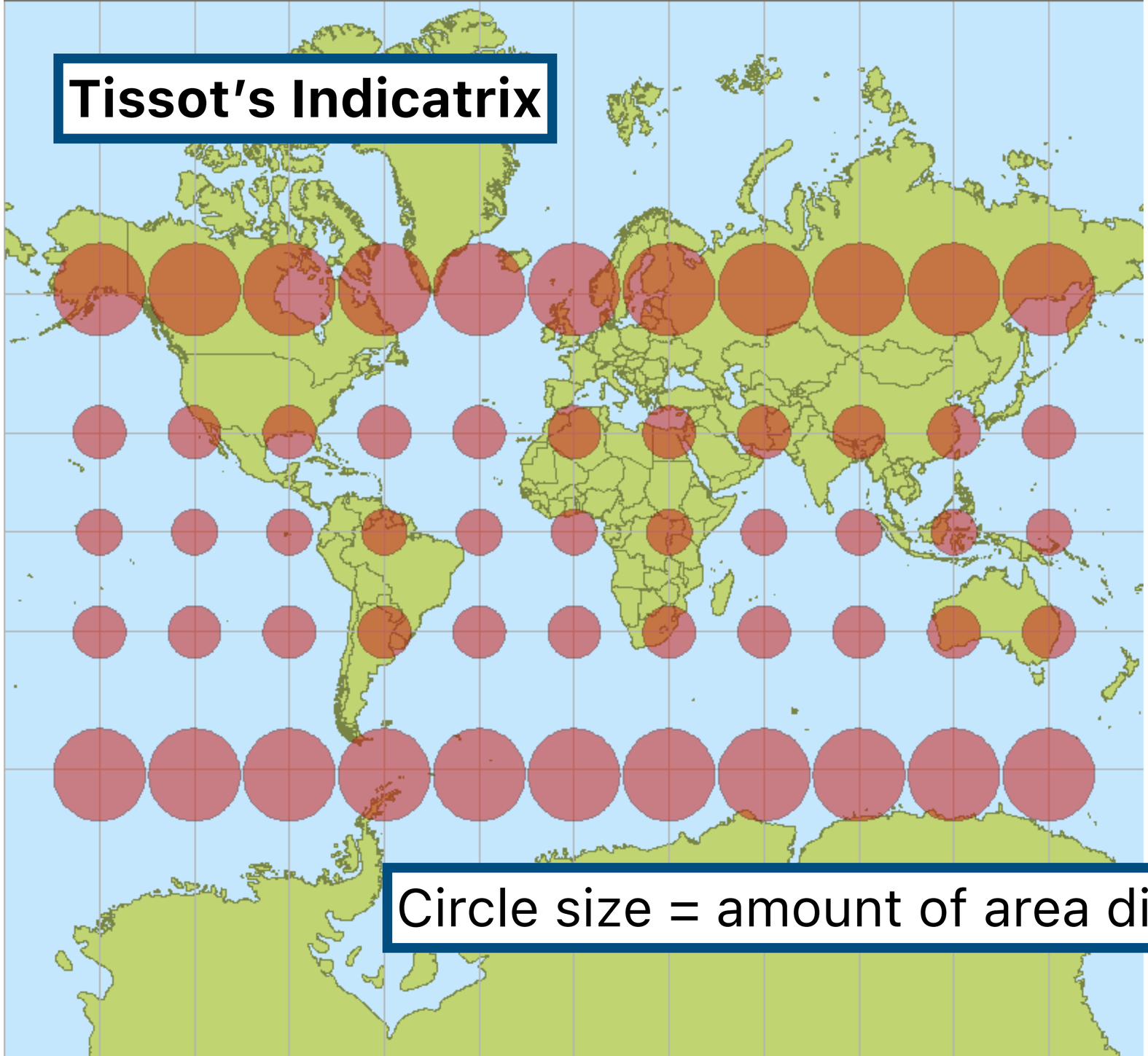


Greenland is huge!

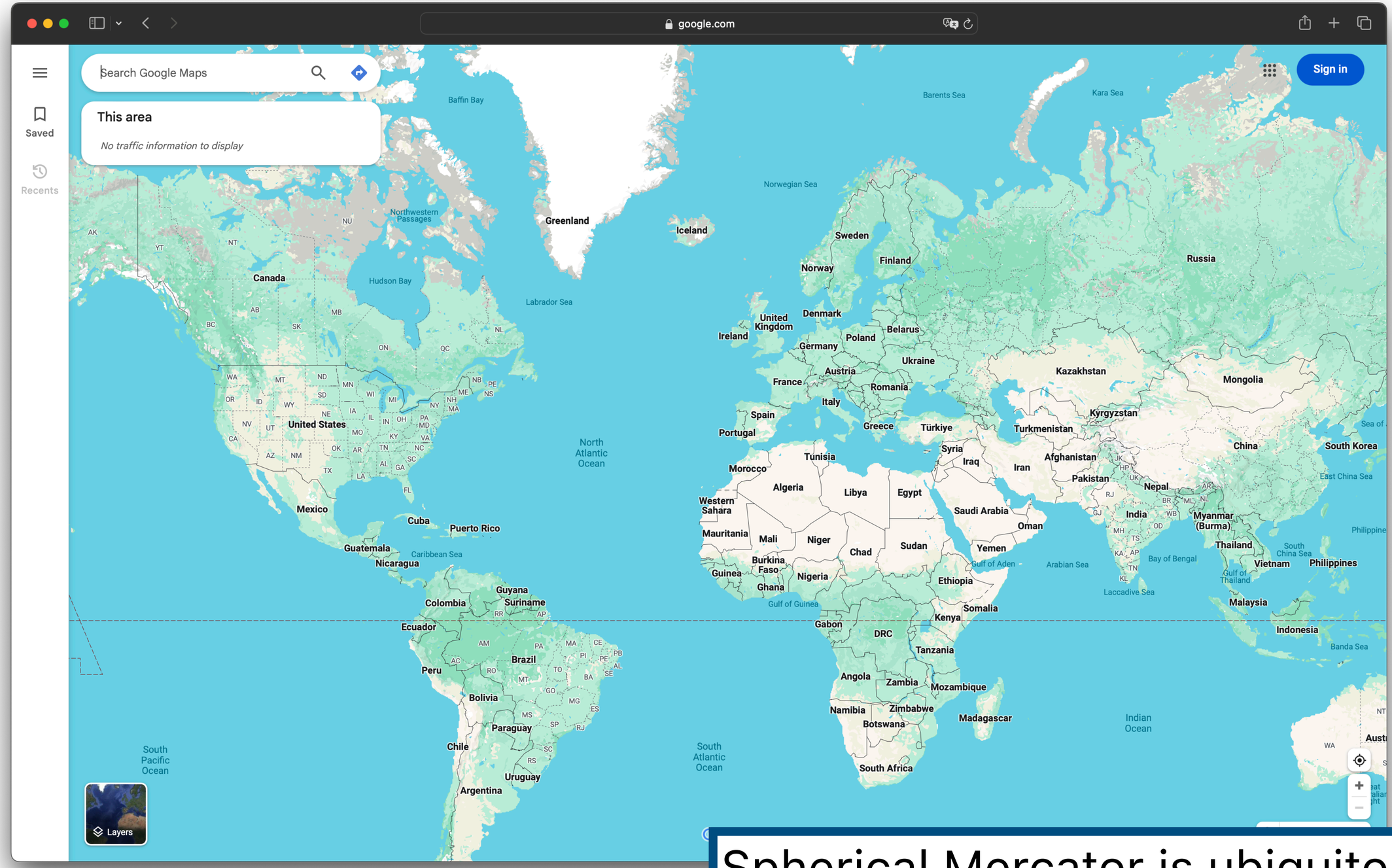
Preserves:
Compass bearing as straight line

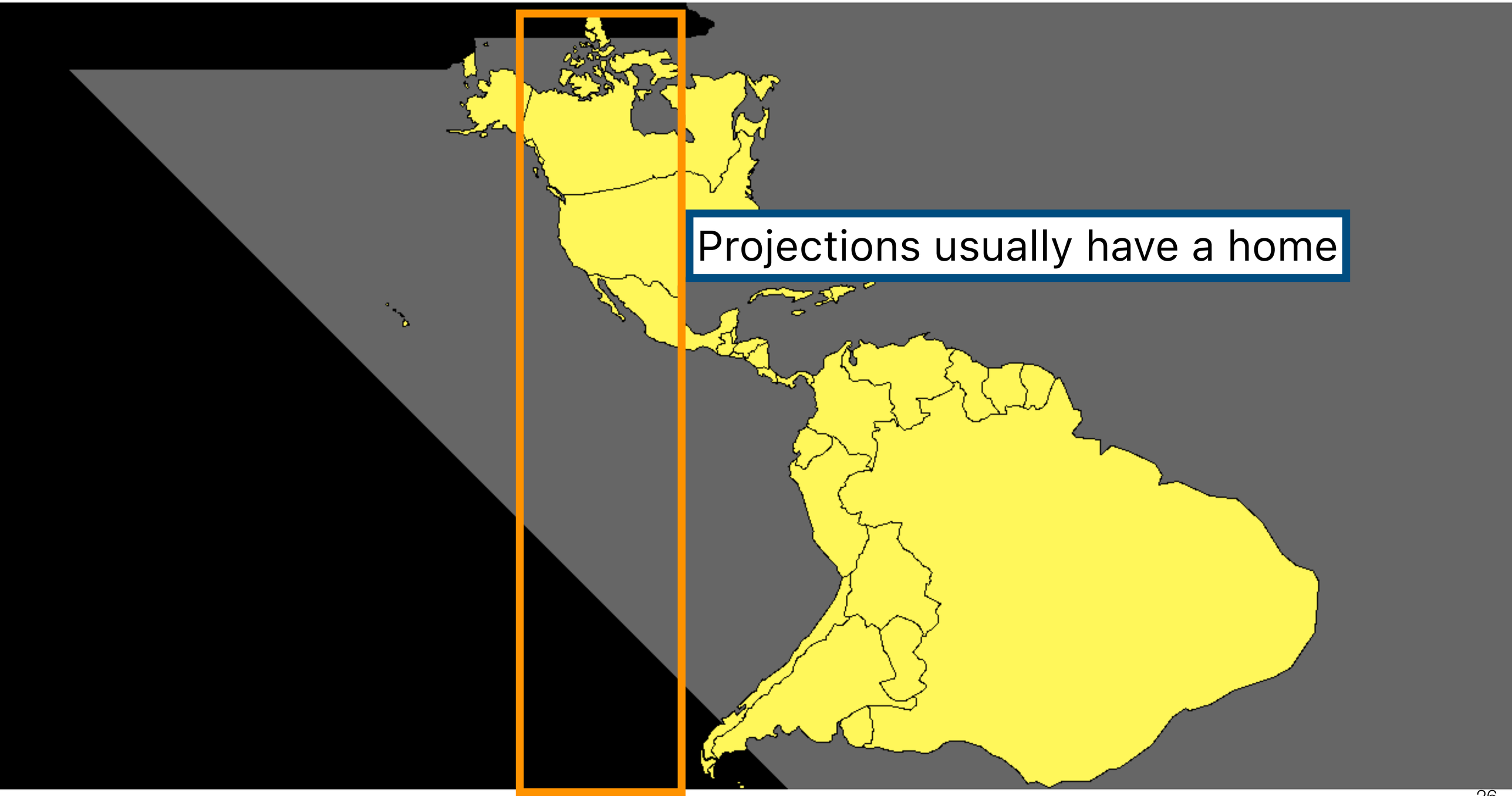
Use cases:
Navigation (left / right is always east / west)

Tissot’s Indicatrix



Circle size = amount of area distortion

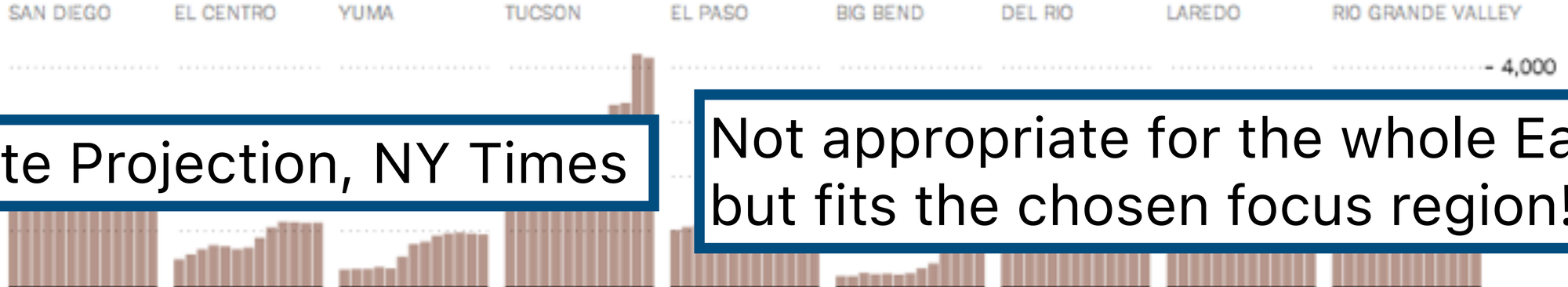

google.com
Search Google Maps
Sign in
This area
No traffic information to display
Saved
Recents
Layers
Baffin Bay
Barents Sea
Kara Sea
Greenland
Iceland
Norwegian Sea
Northwestern Passages
Hudson Bay
Labrador Sea
Canada
United States
Mexico
Cuba
Puerto Rico
Guatemala
Nicaragua
Caribbean Sea
Colombia
Guyana
Suriname
Ecuador
Peru
Brazil
Bolivia
Paraguay
Chile
Uruguay
Argentina
North Atlantic Ocean
South Atlantic Ocean
South Pacific Ocean
Sweden
Finland
Norway
Russia
Denmark
United Kingdom
Ireland
Belarus
Poland
Germany
Ukraine
Kazakhstan
Mongolia
France
Austria
Romania
Italy
Spain
Portugal
Greece
Türkiye
Turkmenistan
Kyrgyzstan
China
South Korea
Syria
Iraq
Iran
Afghanistan
Pakistan
Nepal
India
Myanmar (Burma)
Thailand
Vietnam
Philippines
Tunisia
Morocco
Algeria
Libya
Egypt
Western Sahara
Saudi Arabia
Oman
Yemen
Mauritania
Mali
Niger
Chad
Sudan
Burkina Faso
Guinea
Nigeria
Ghana
Gulf of Guinea
Ethiopia
Somalia
Kenya
Gabon
DRC
Tanzania
Angola
Zambia
Mozambique
Namibia
Zimbabwe
Botswana
Madagascar
South Africa
Gulf of Aden
Arabian Sea
Bay of Bengal
Laccadive Sea
Gulf of Thailand
Malaysia
Indonesia
Banda Sea
Indian Ocean
East China Sea
South China Sea
Philippine
Sea of
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

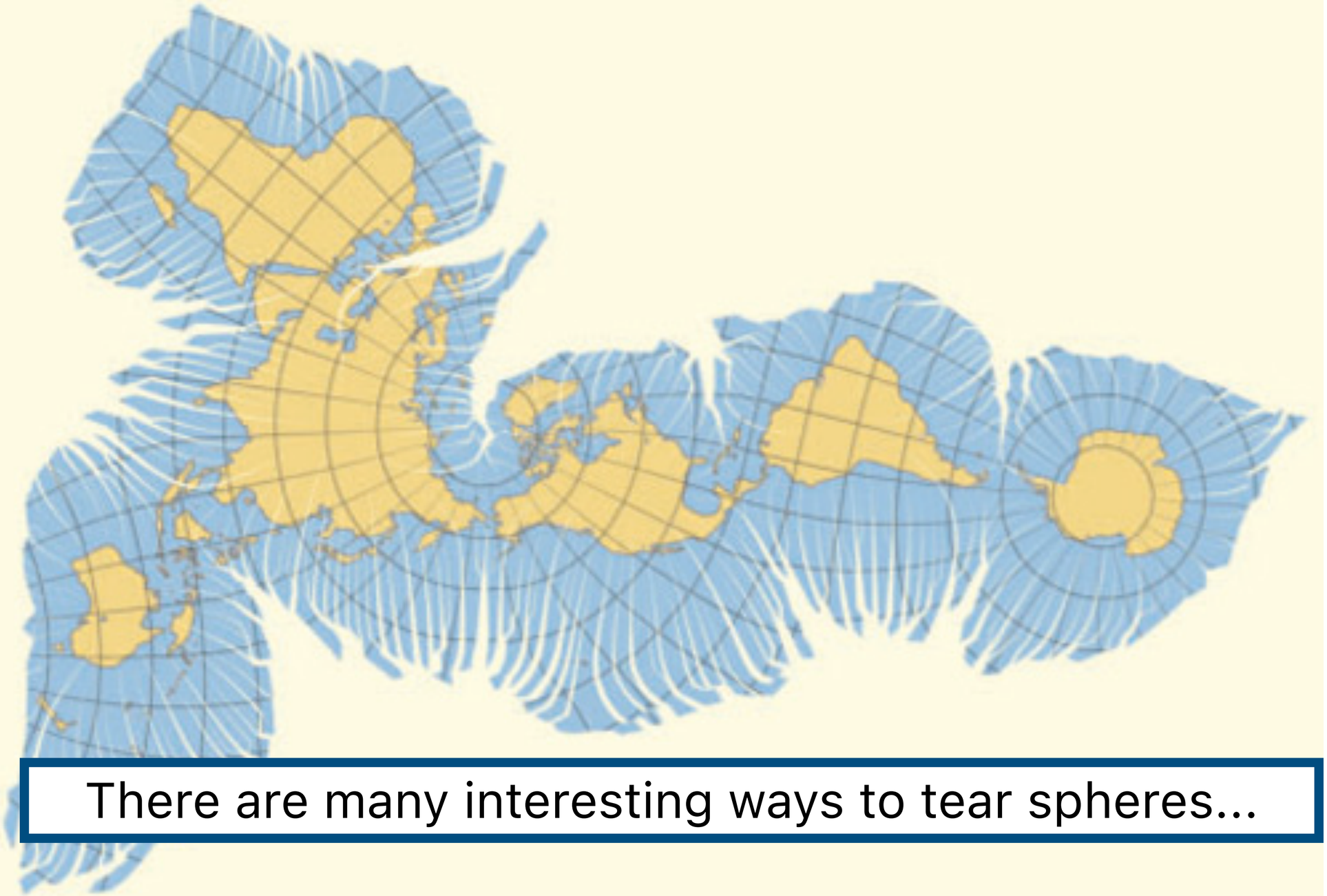
http://xkcd.com/977

MERCATOR

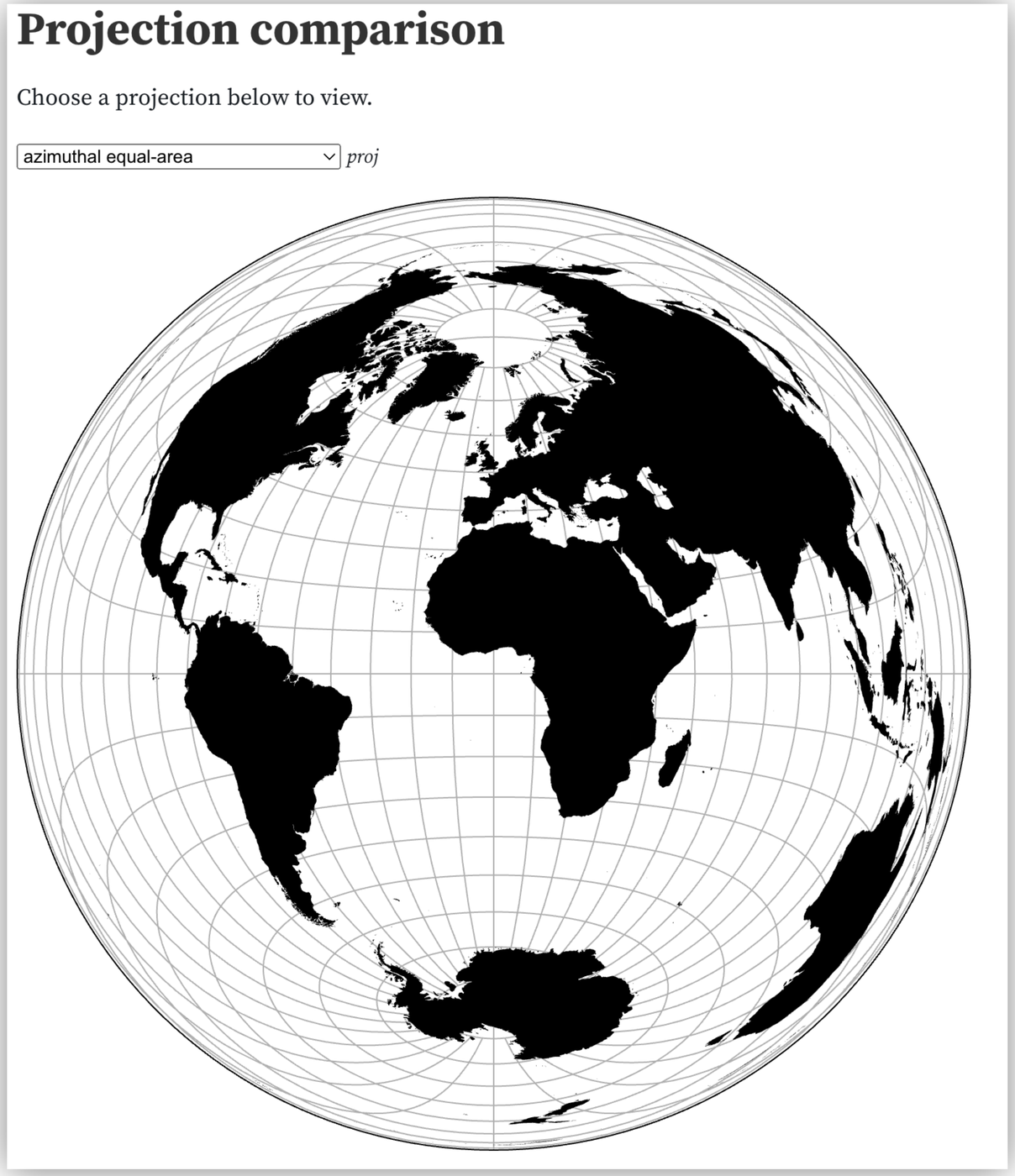
YOU'RE NOT REALLY INTO MAPS.

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...



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?

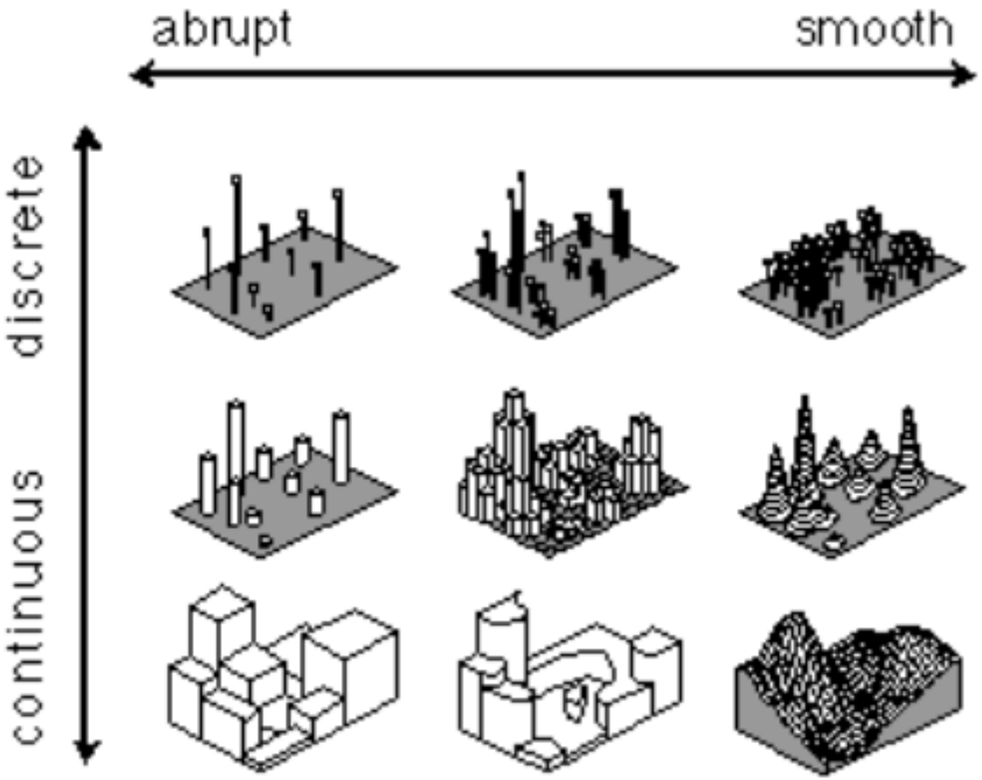


Fig. 8. Data models representing points in the continuity-abruptness phenomena space.

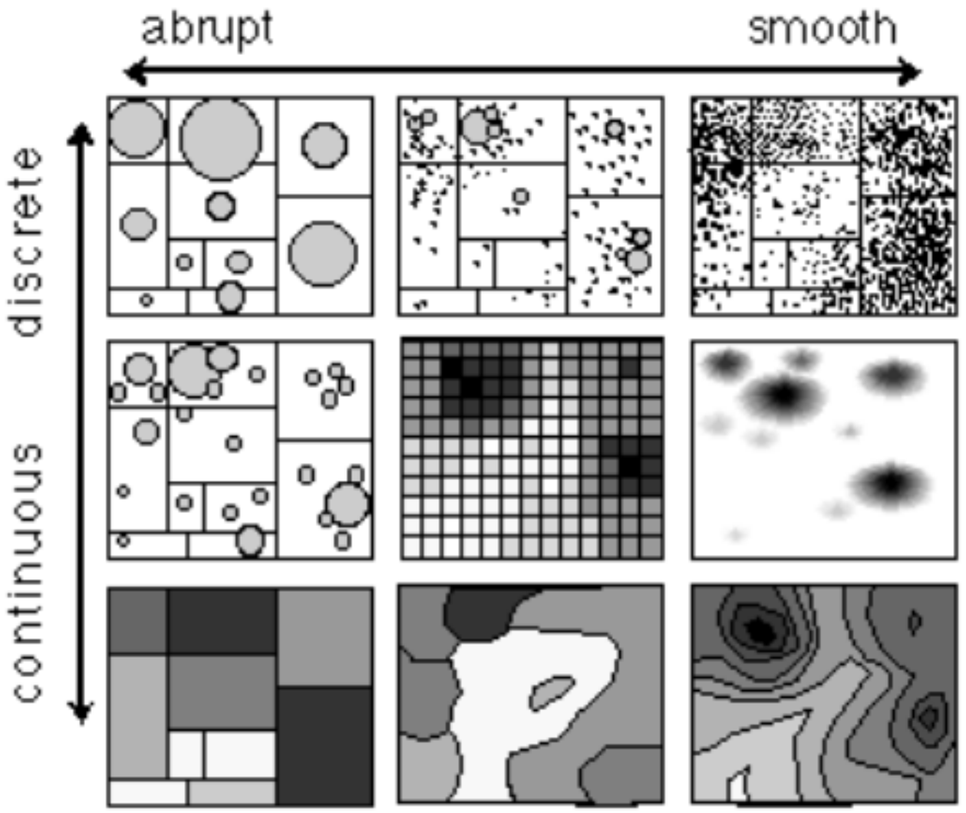
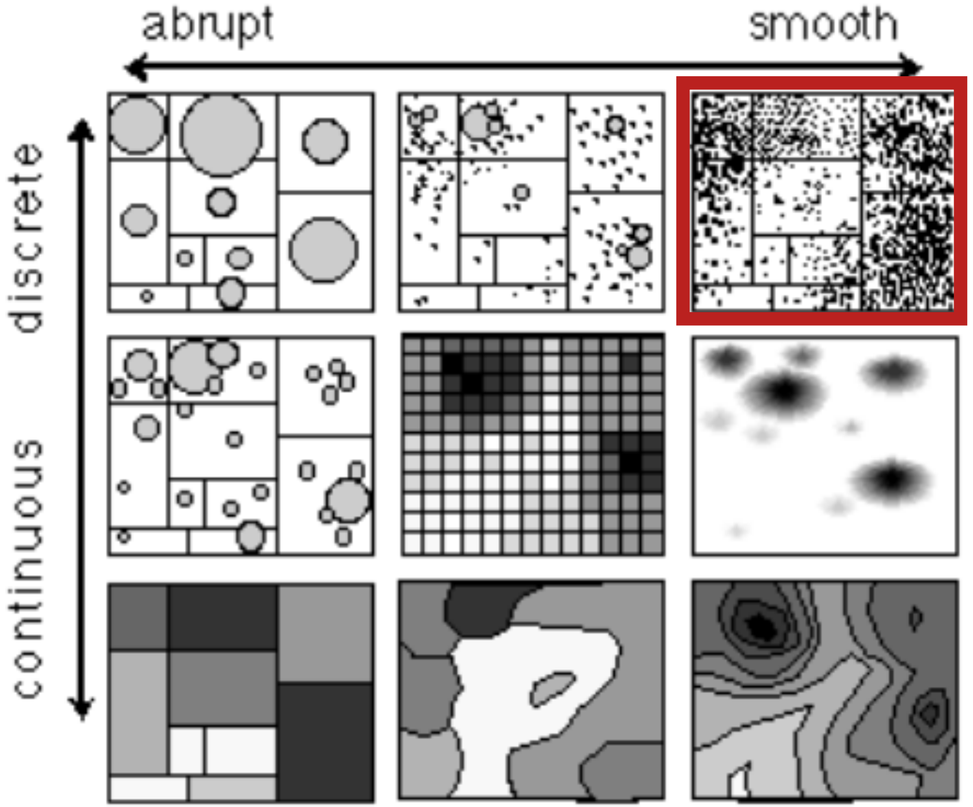


Fig. 9. Possible 2D translations of the 3D data models shown in figure 8.

[MacEachren. Visualizing Uncertain Information. 1992]

Dot Distribution Map



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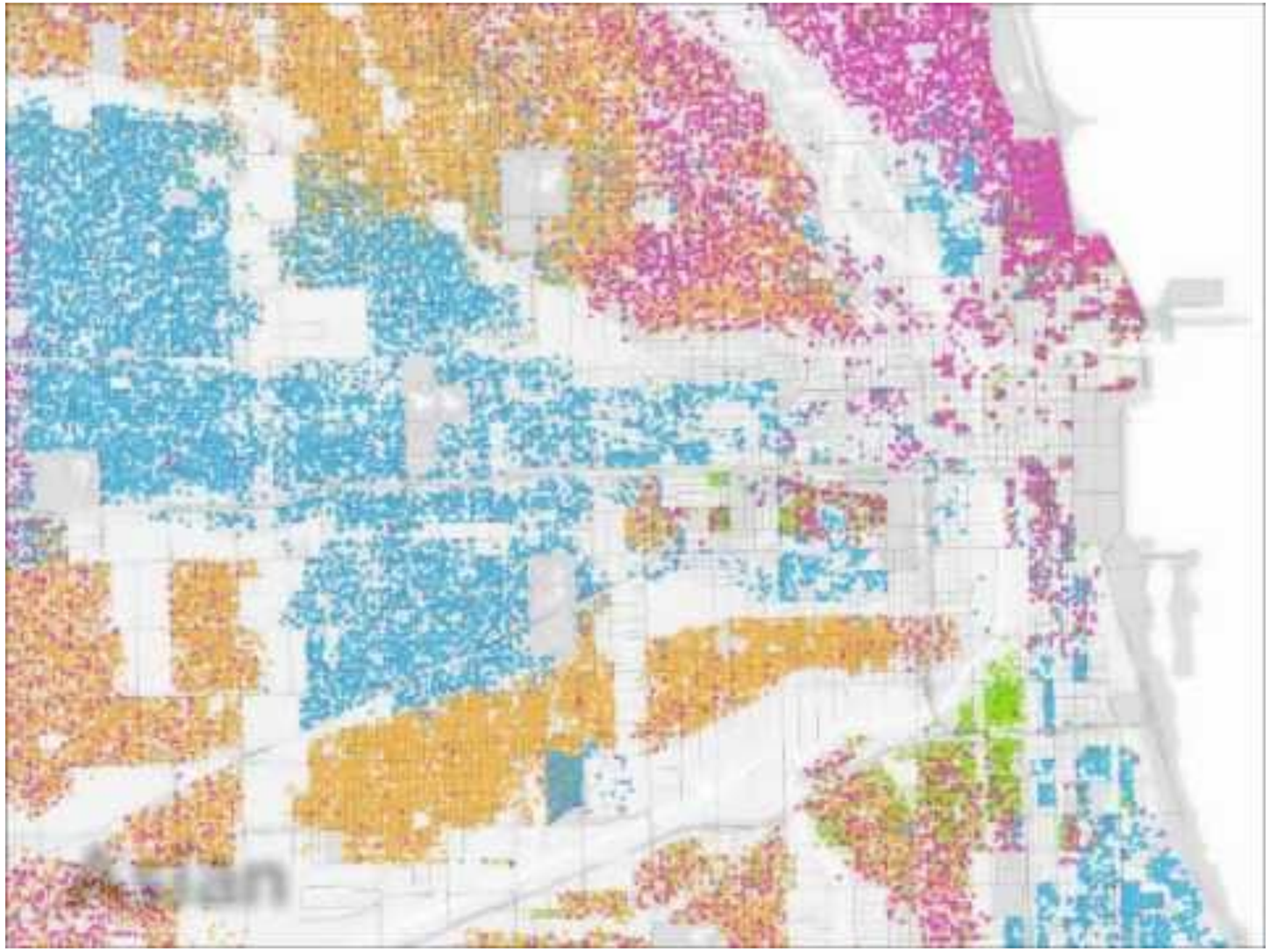
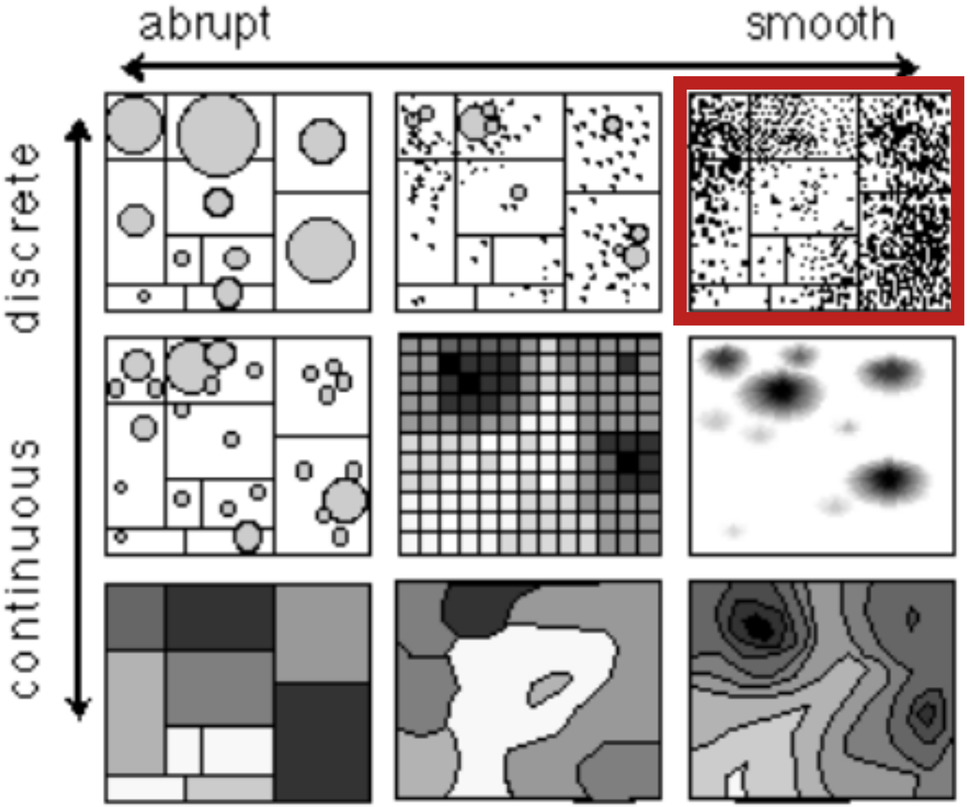


https://www.youtube.com/watch?v=8pRcdMVkA3k

Dot Distribution Map



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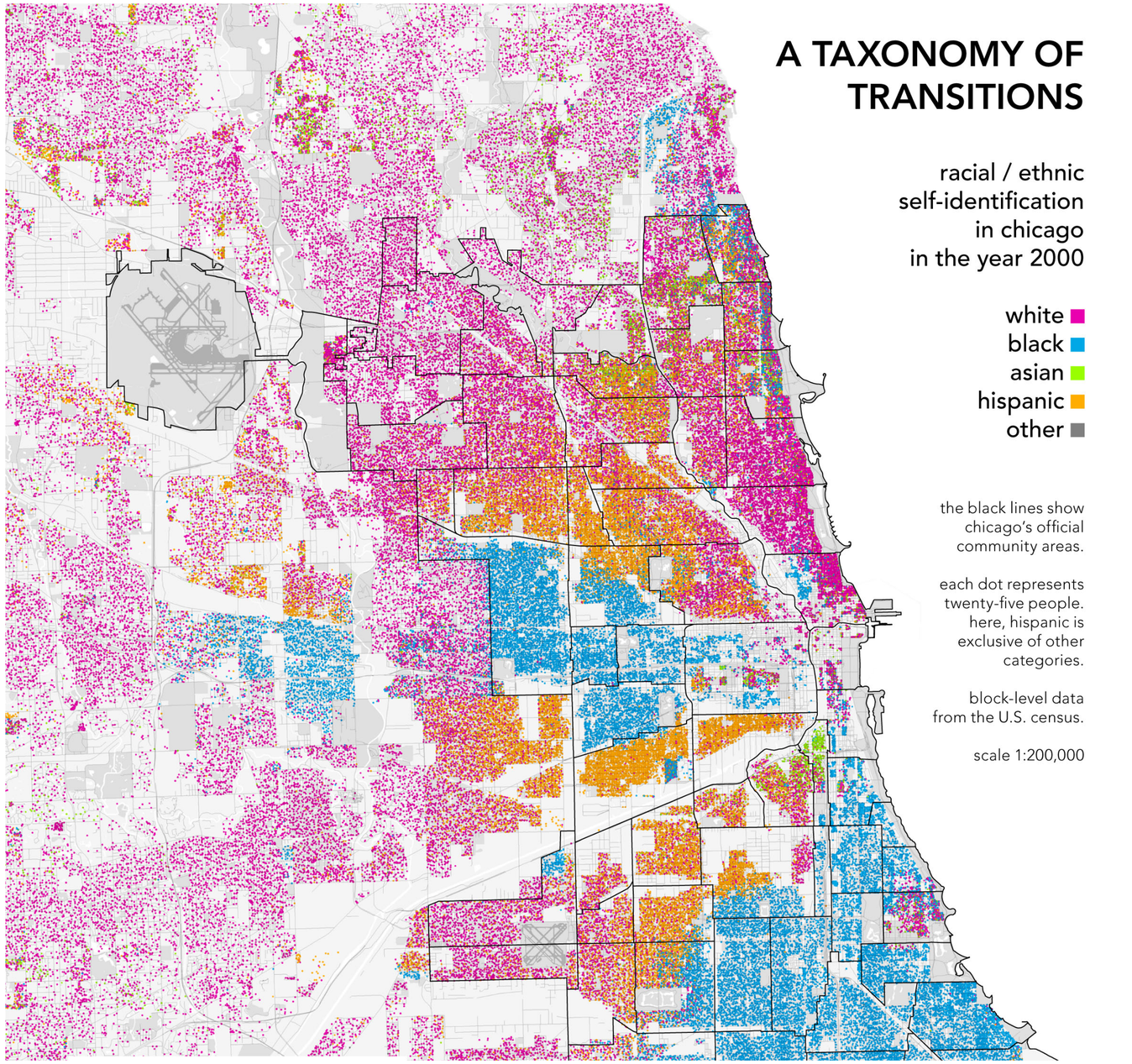

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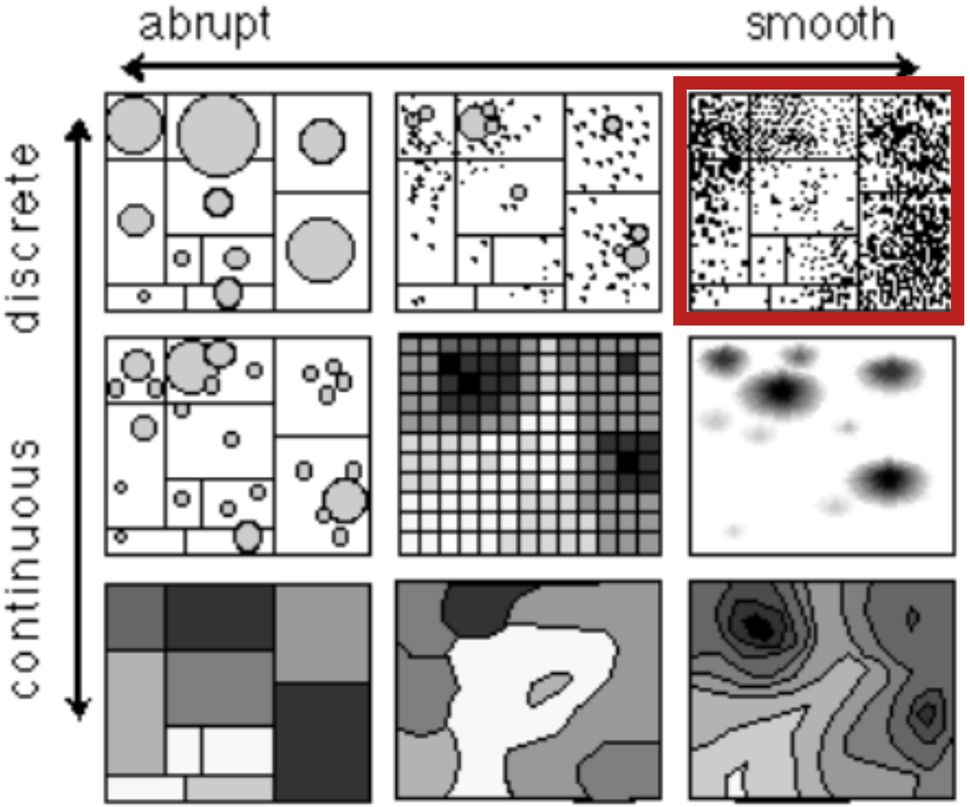

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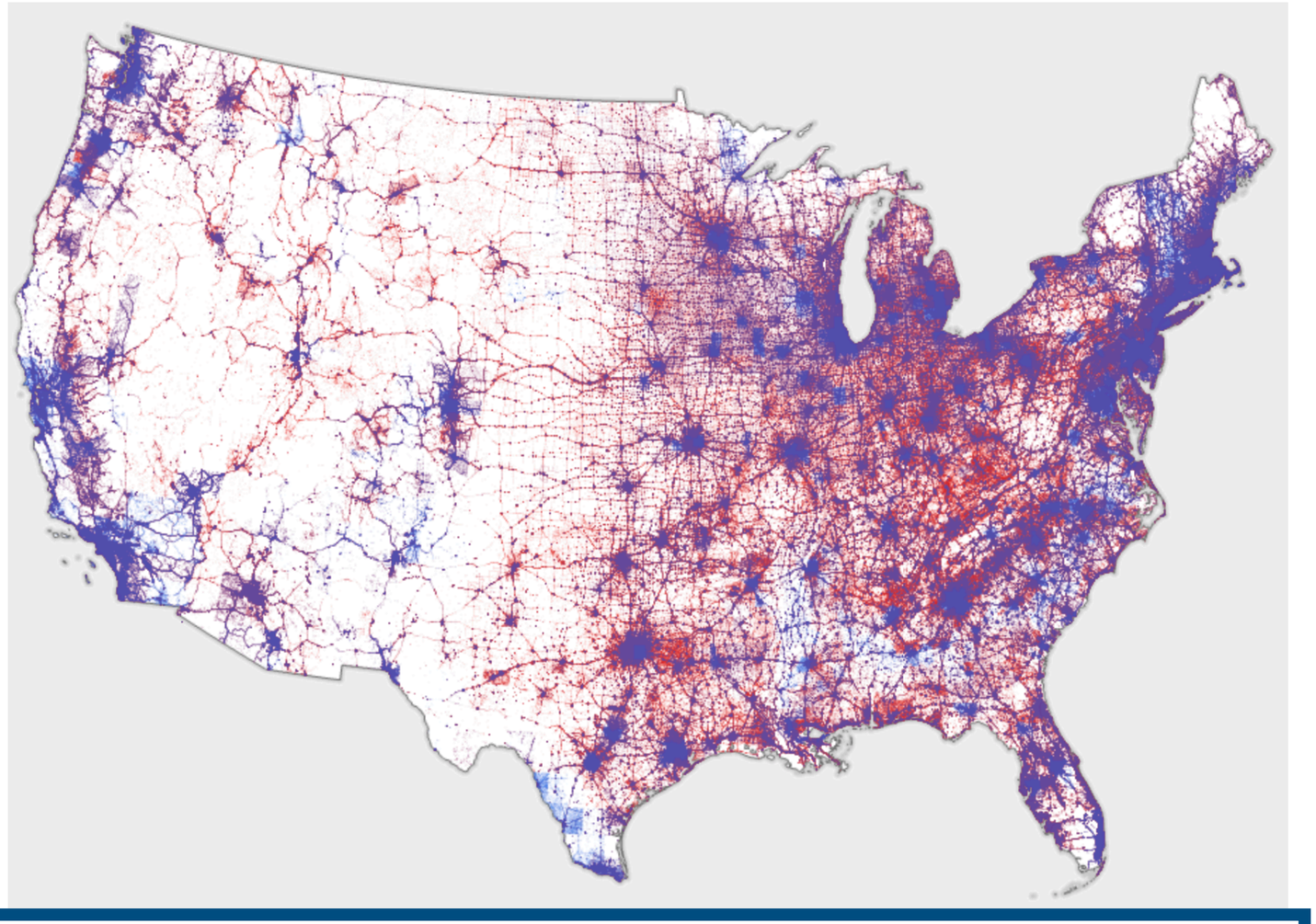
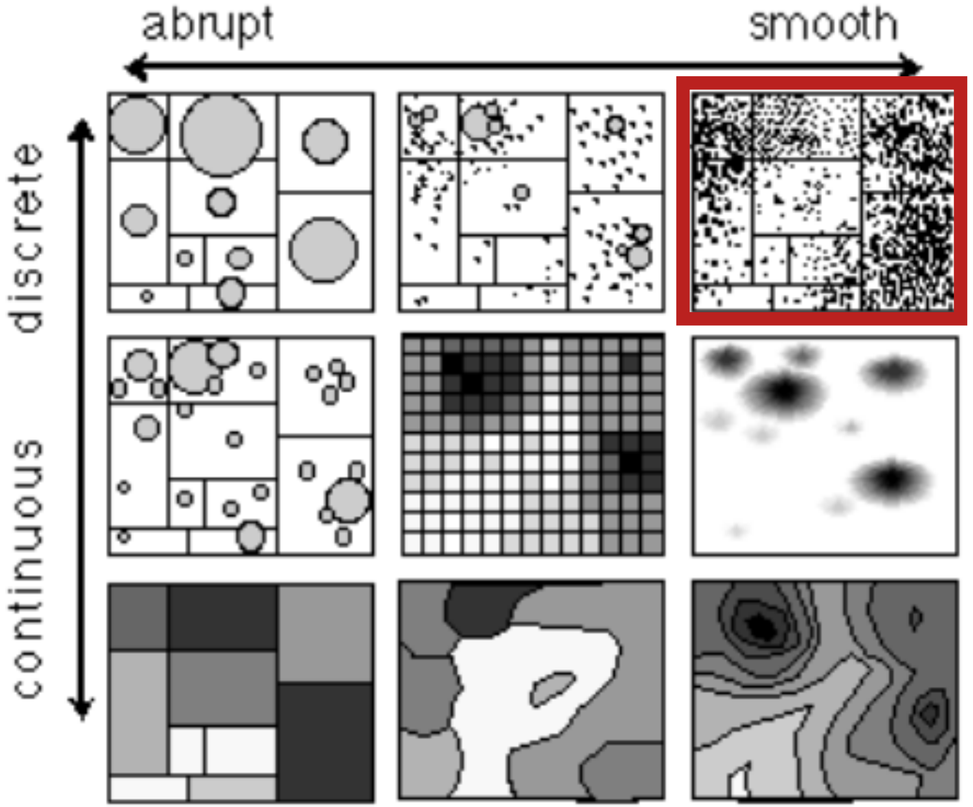


Votes cast in the 2016 Presidential Election

Dot Distribution Map



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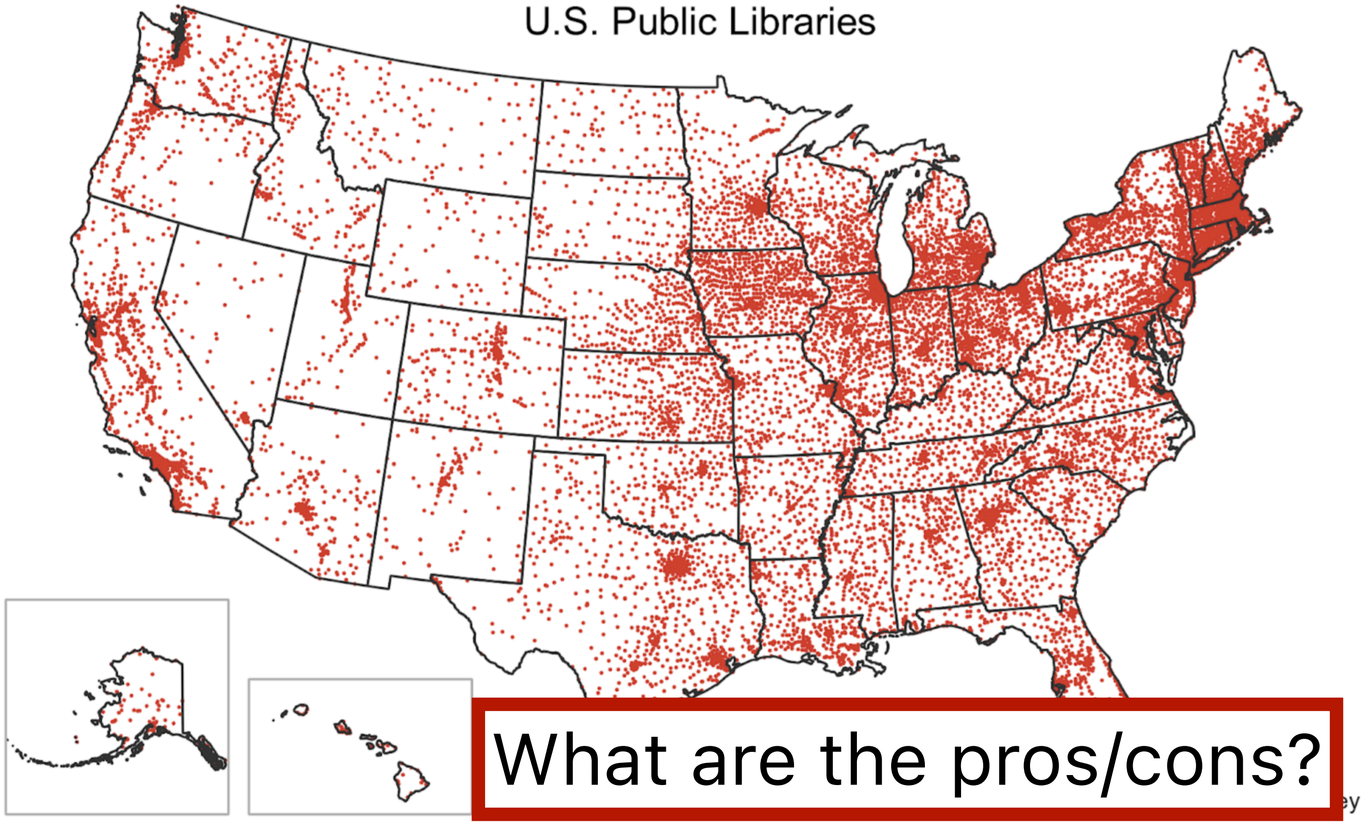
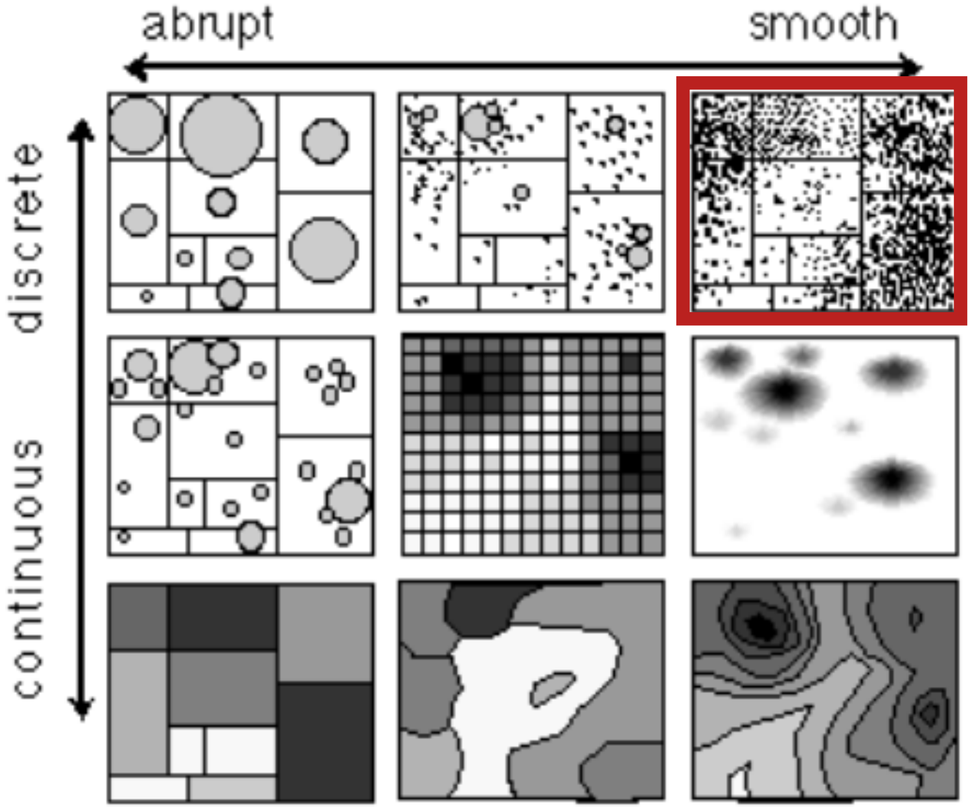


What are the pros/cons?

tryclassbuzz.com
Code: **dots**

Dot Distribution Map



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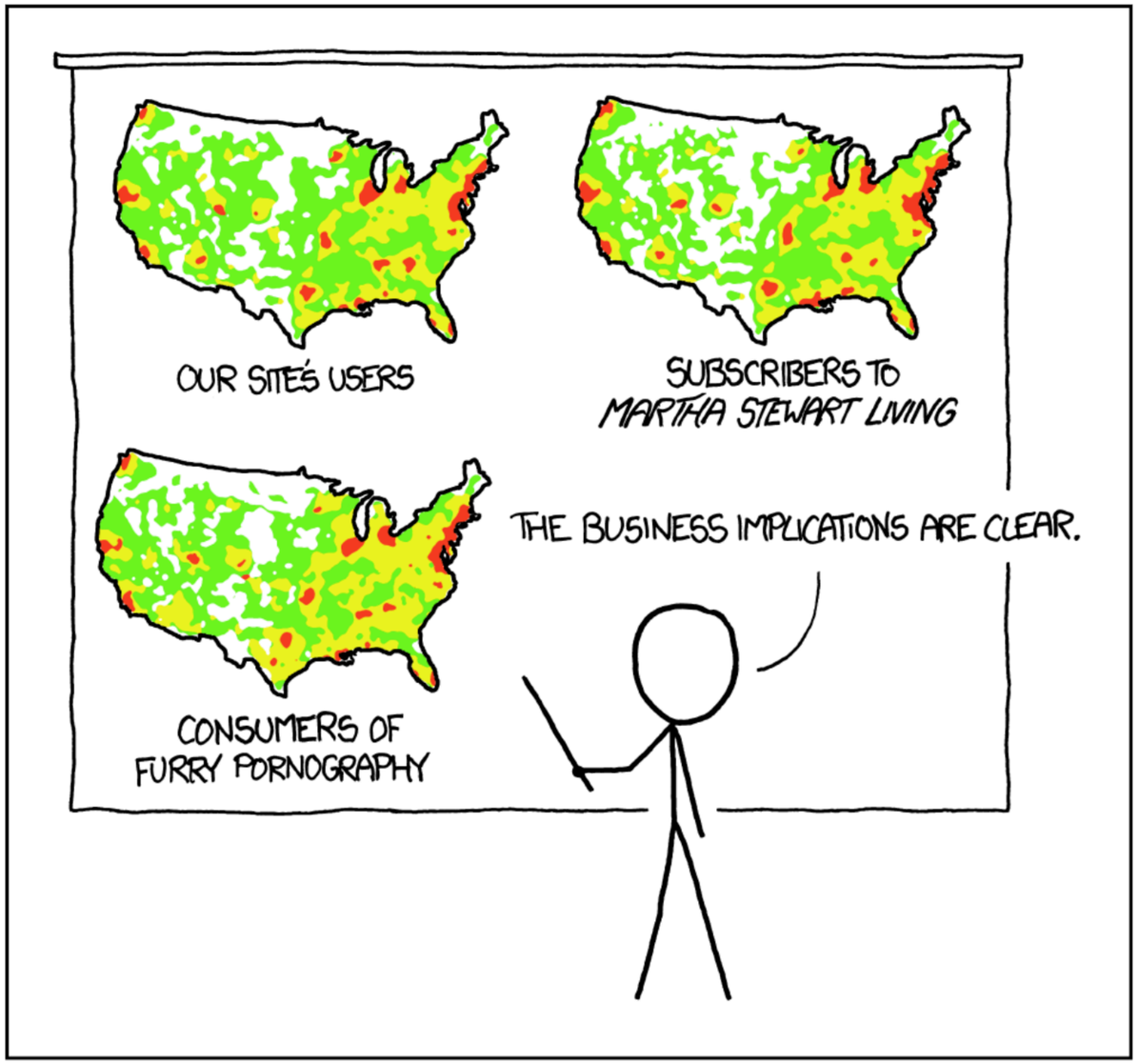
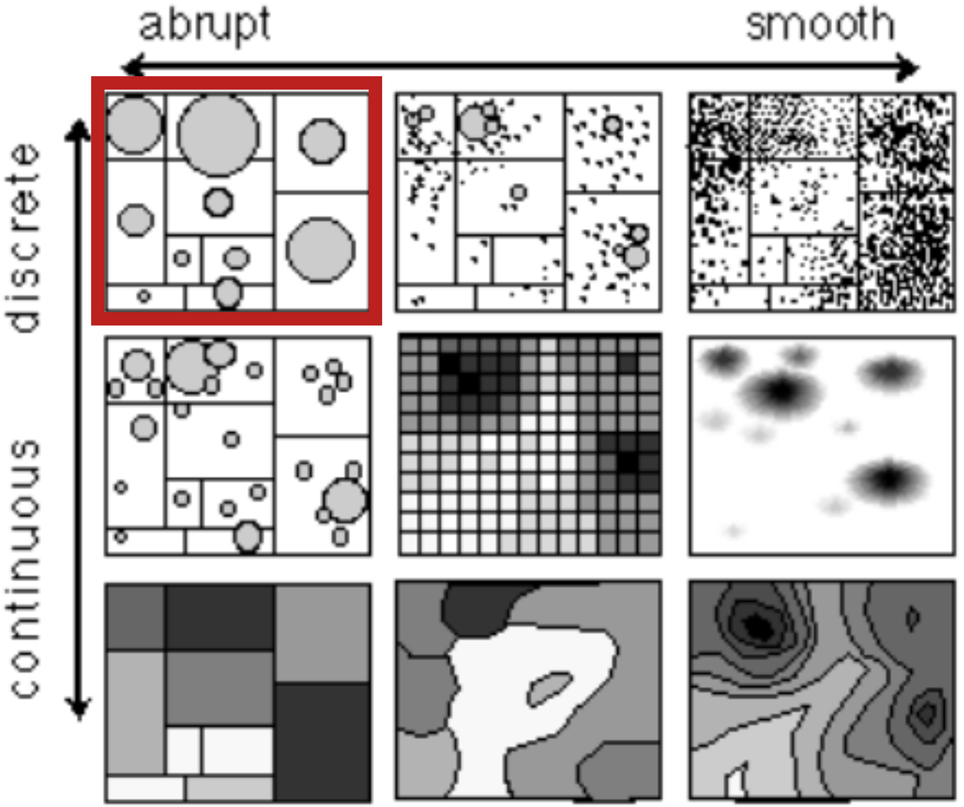


PET PEEVE #208:
GEOGRAPHIC PROFILE MAPS WHICH ARE BASICALLY JUST POPULATION MAPS

Proportional Symbol Map



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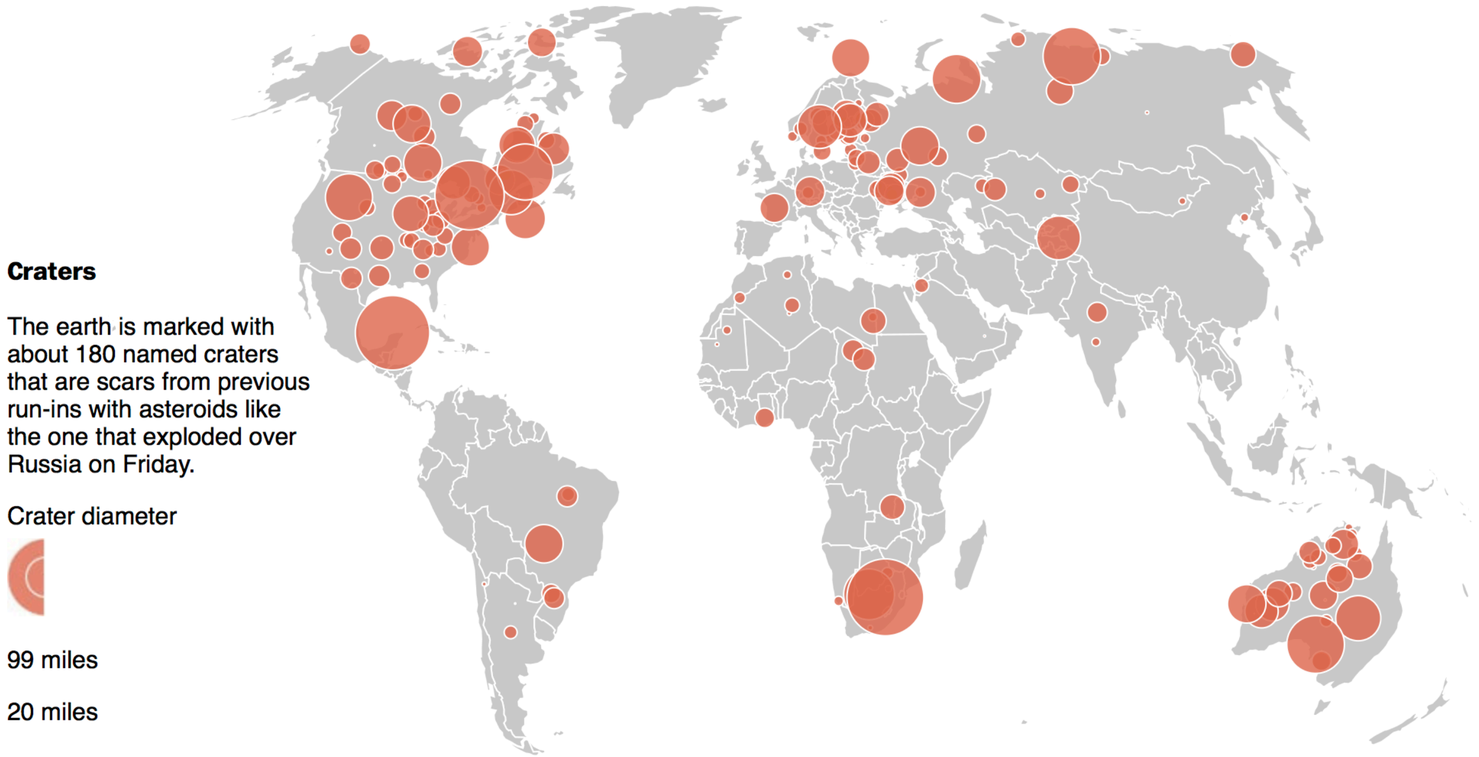


http://www.washingtonpost.com/wp-srv/special/world/russia-meteor/index.html

Proportional Symbol Map

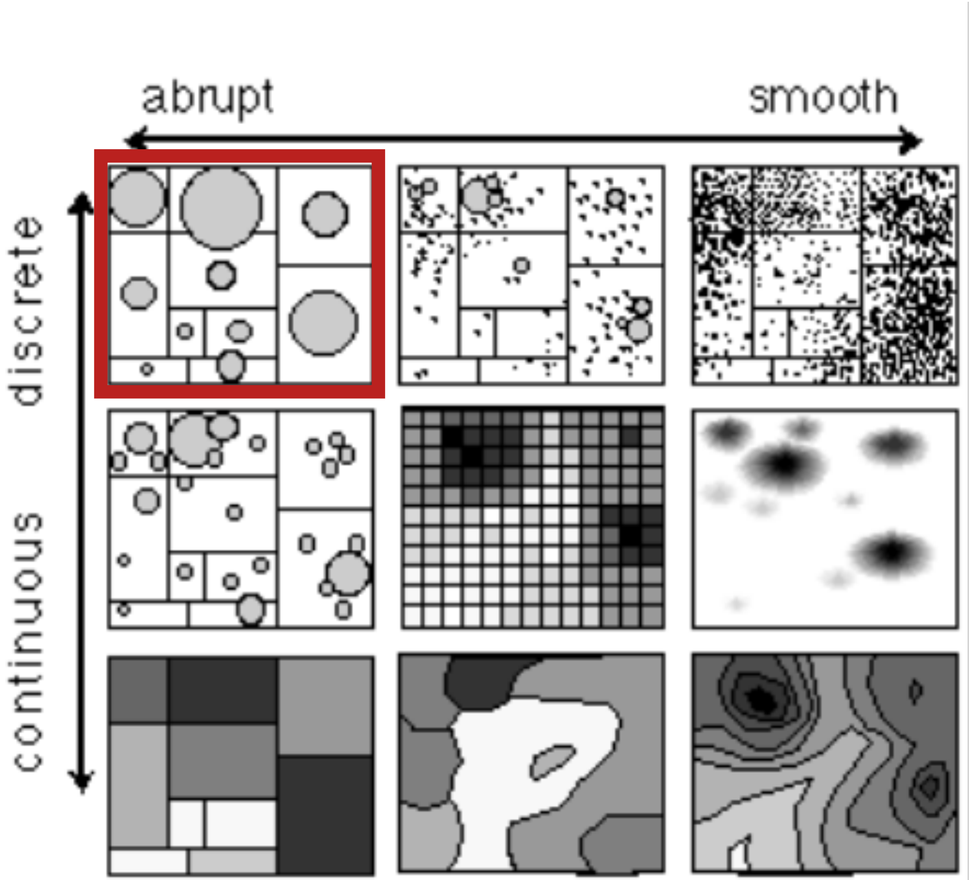
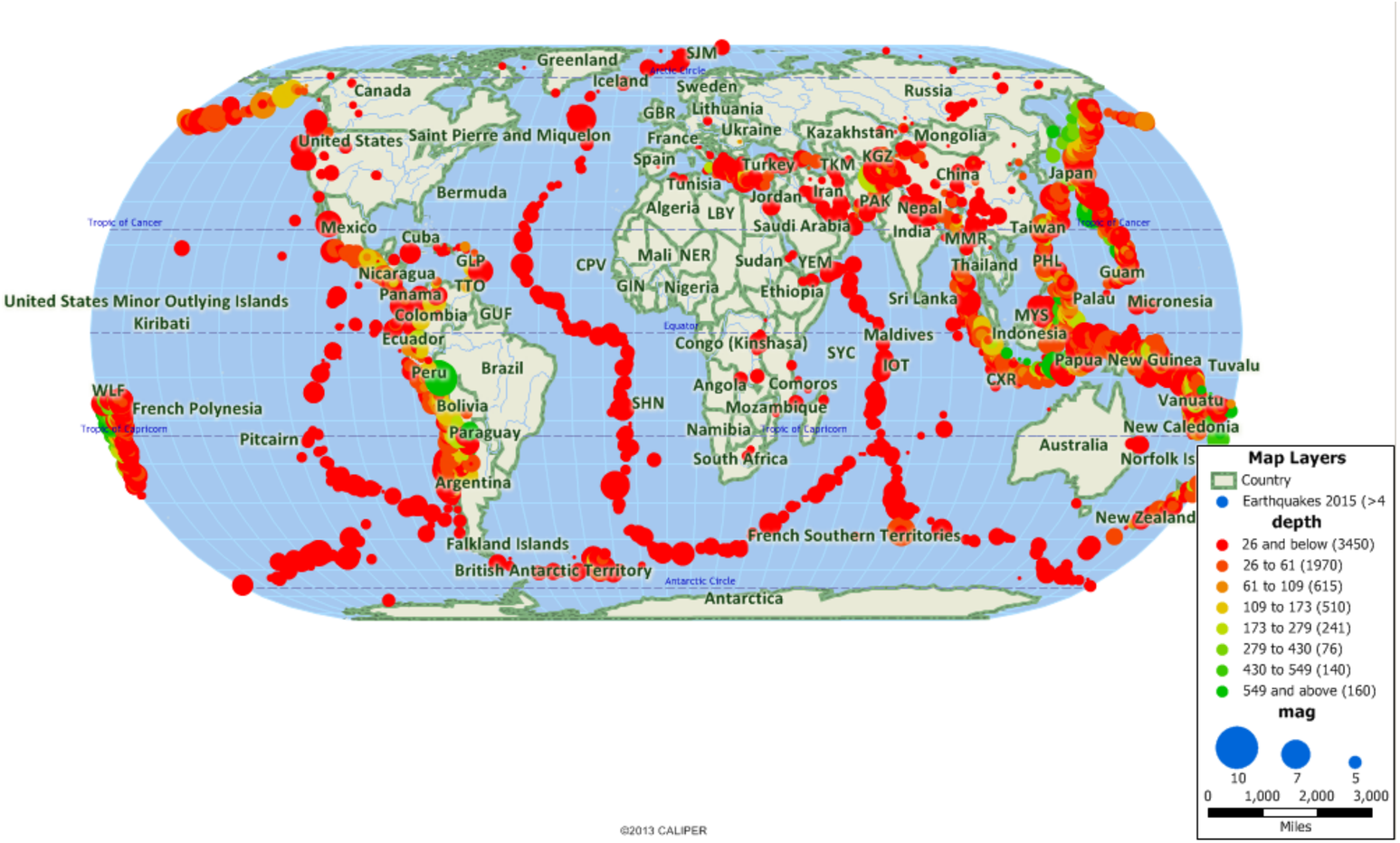
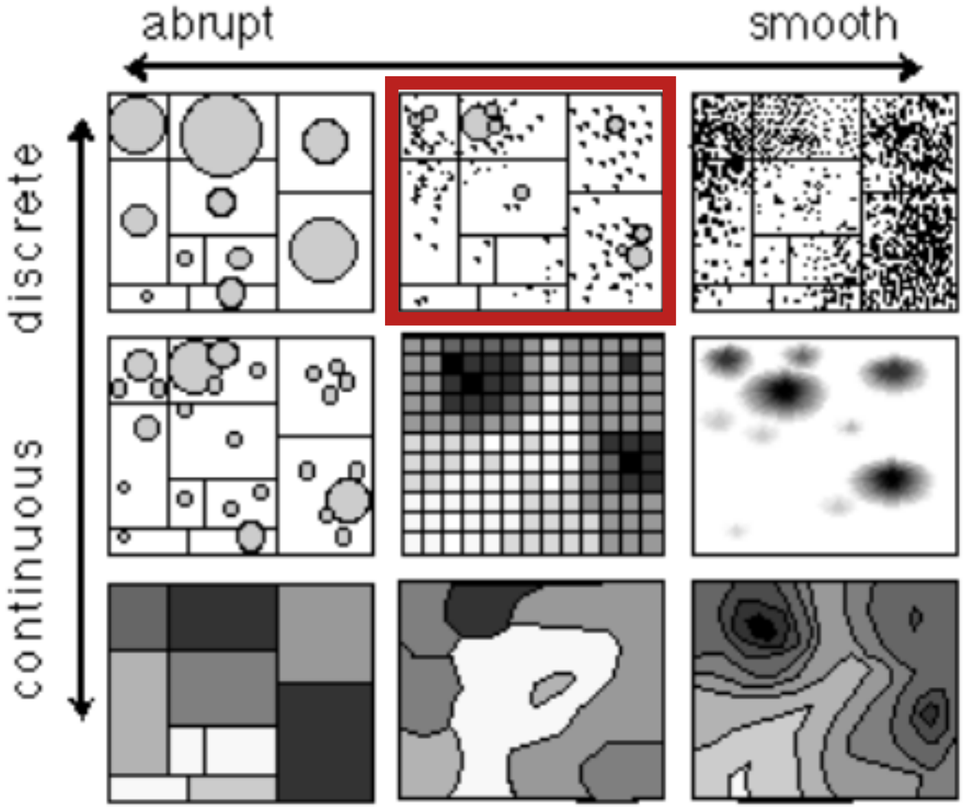


Fig. 9. Possible 2D translations of the 3D data models shown in figure 8.



Graduated Symbol Map



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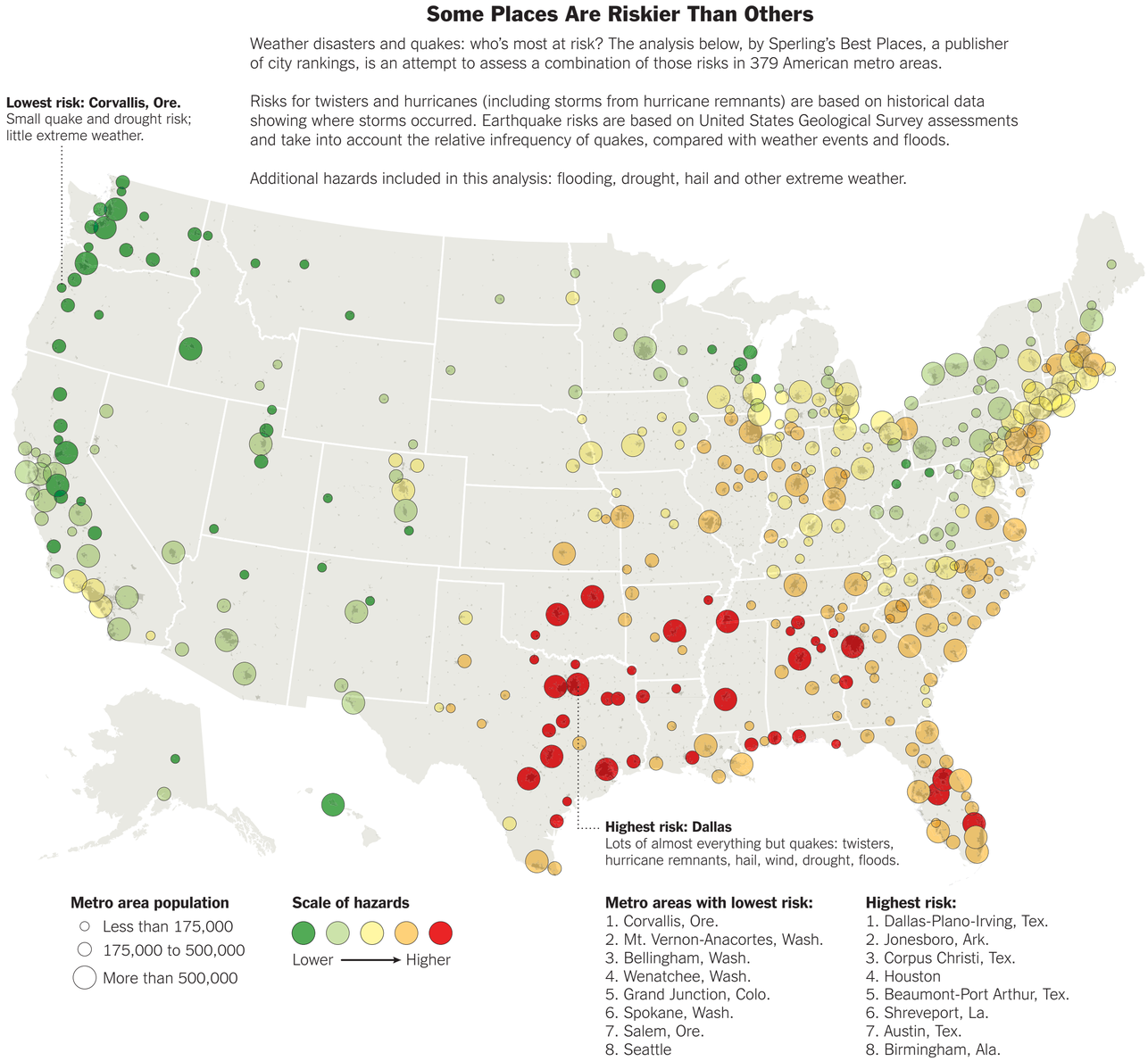
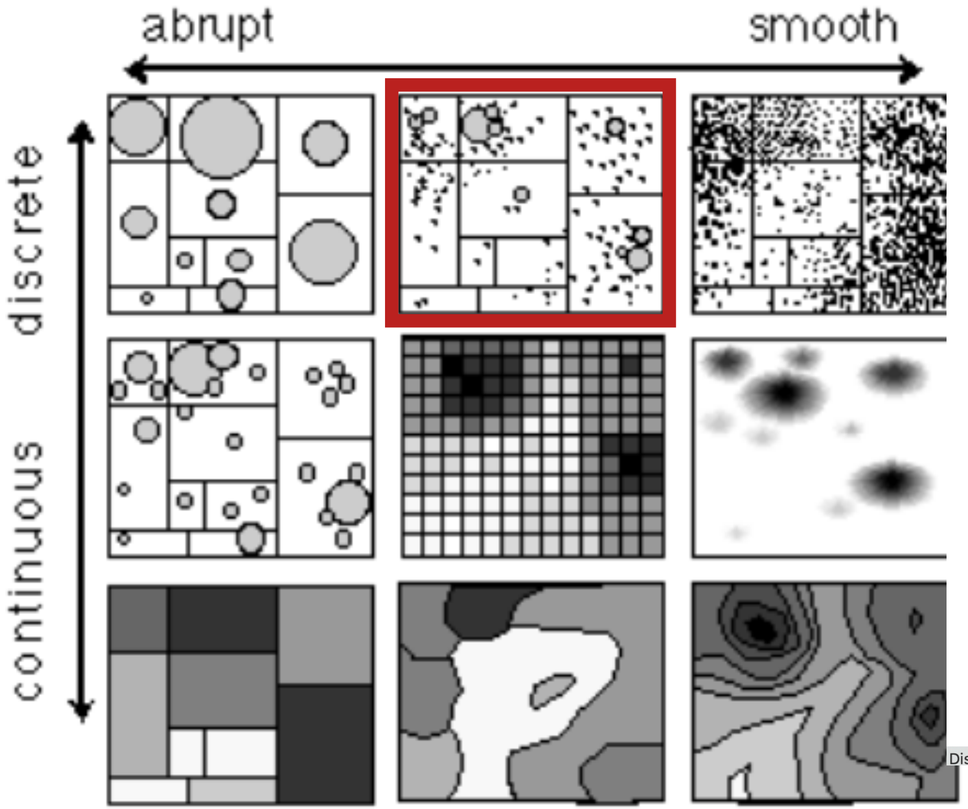


https://archive.nytimes.com/www.nytimes.com/interactive/2011/05/01/weekinreview/01safe.html?_r=0

Graduated Symbol Map



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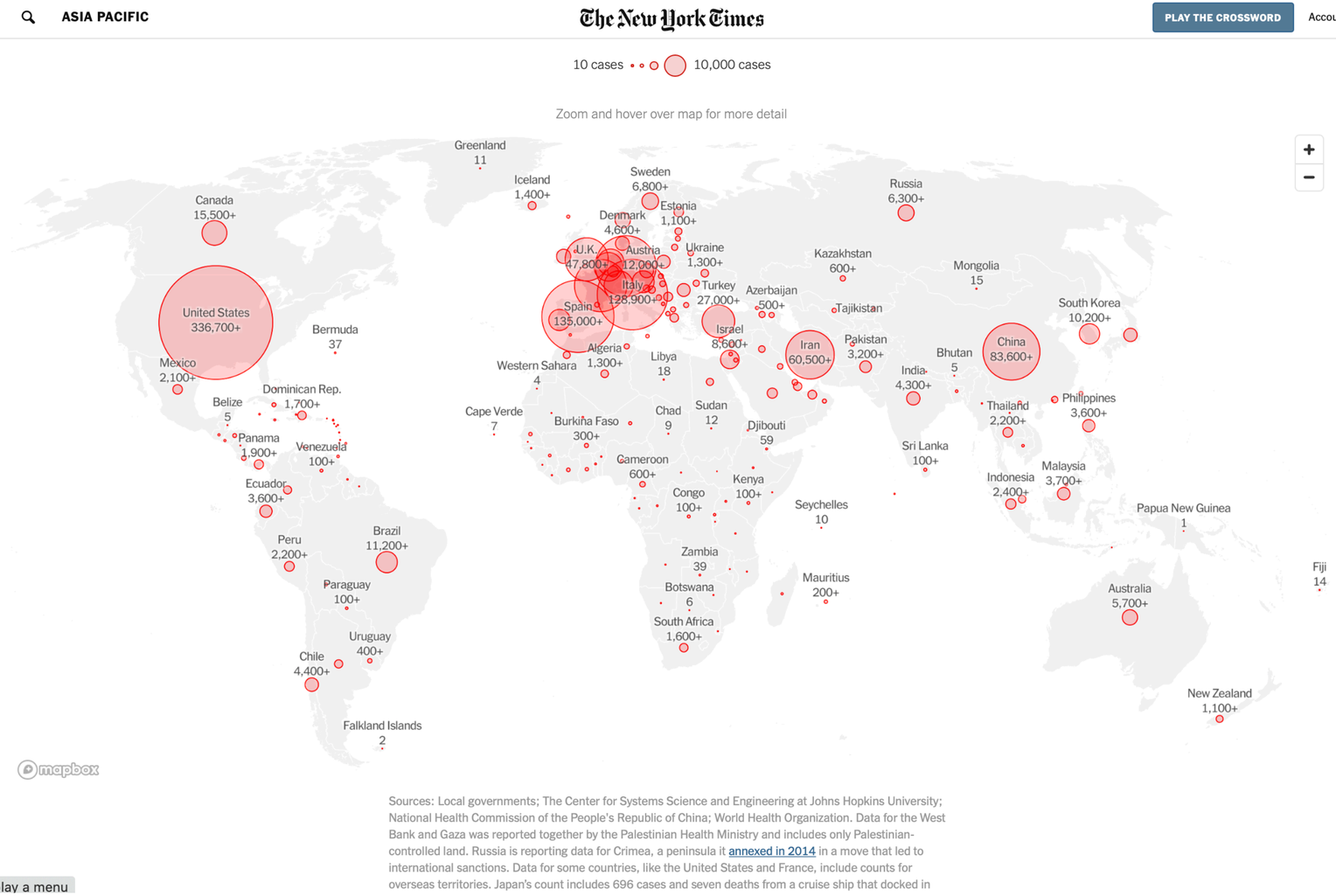
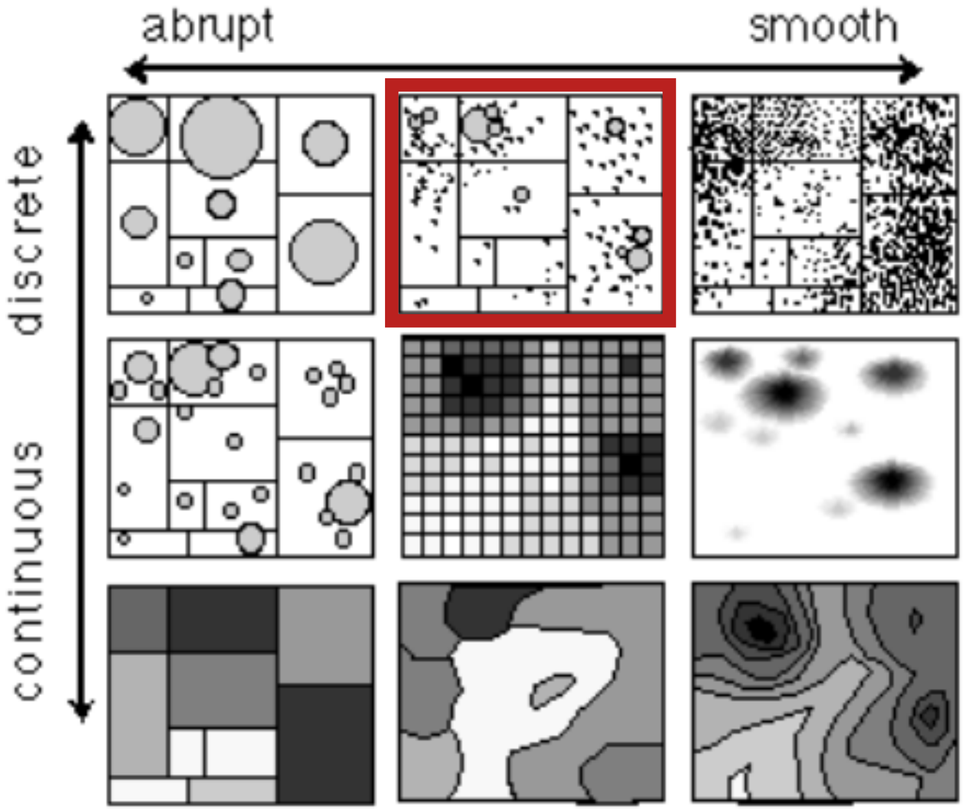


Display a menu

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

Graduated Symbol Map?



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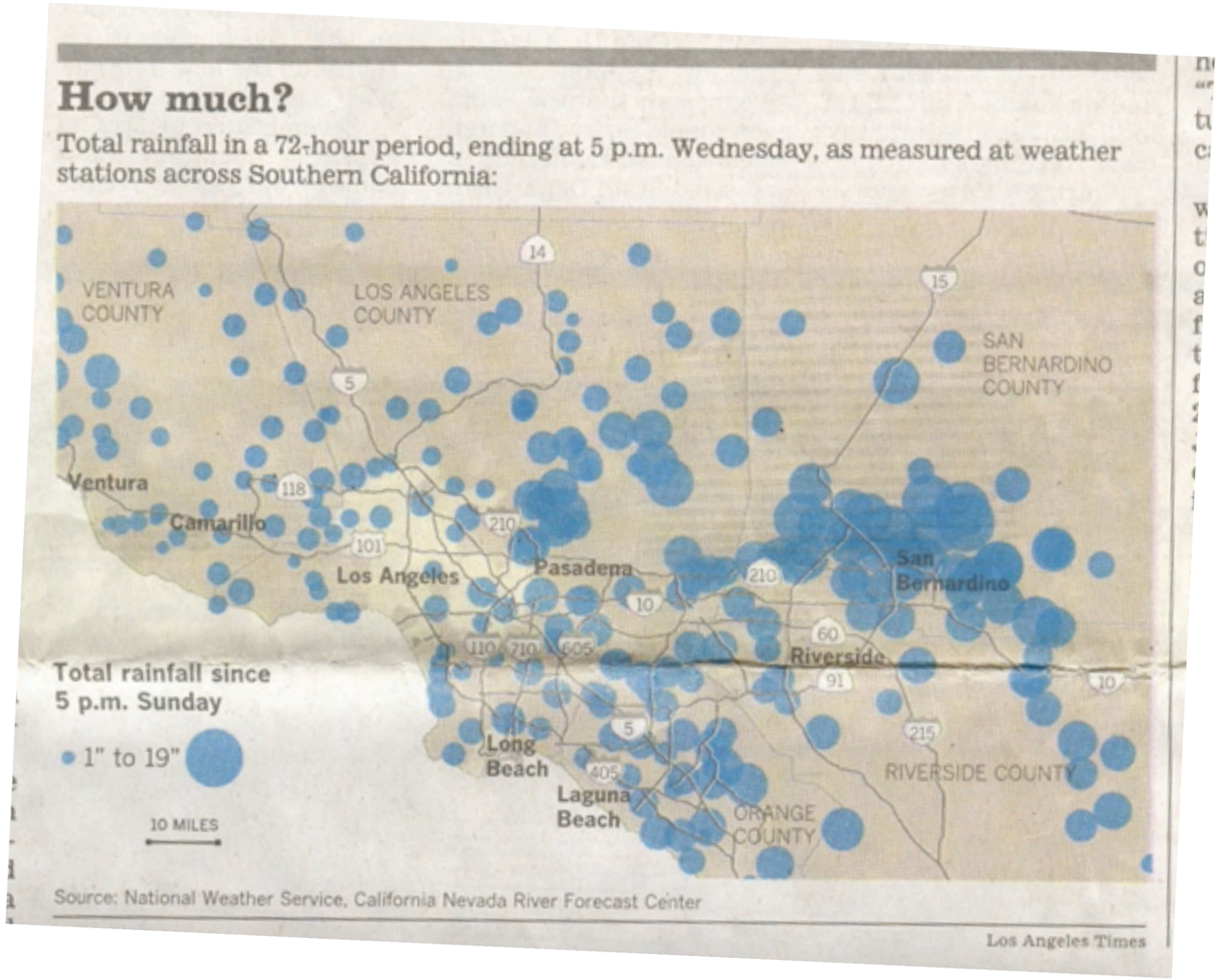
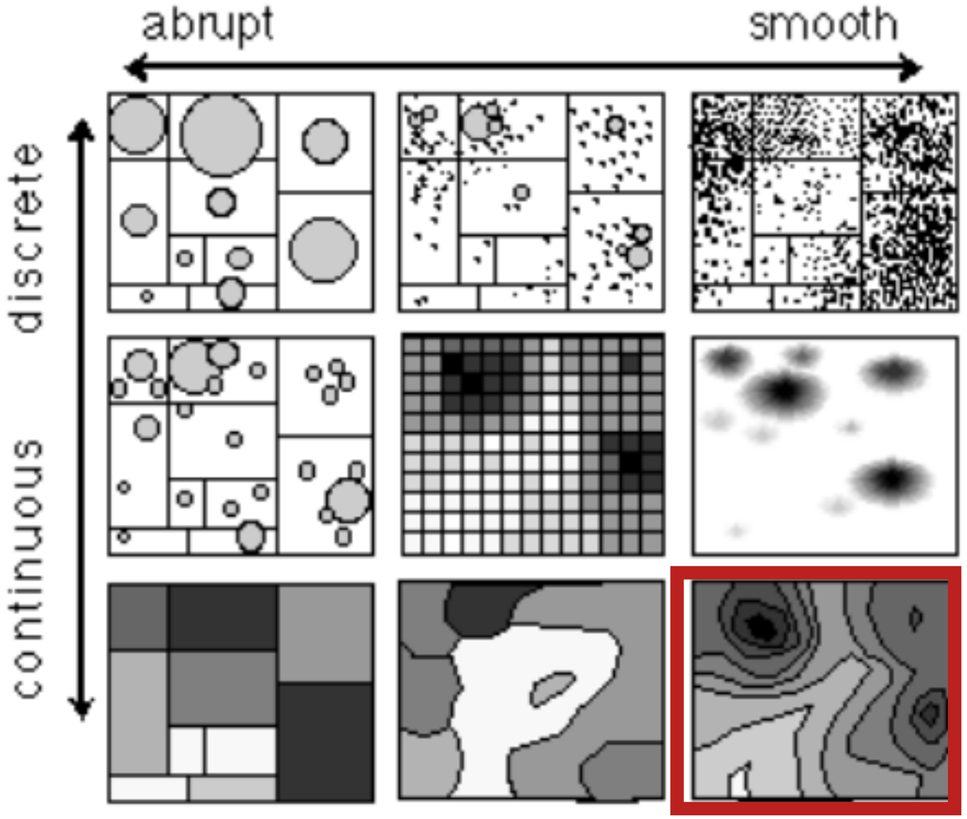


Isopleth / Heat Map



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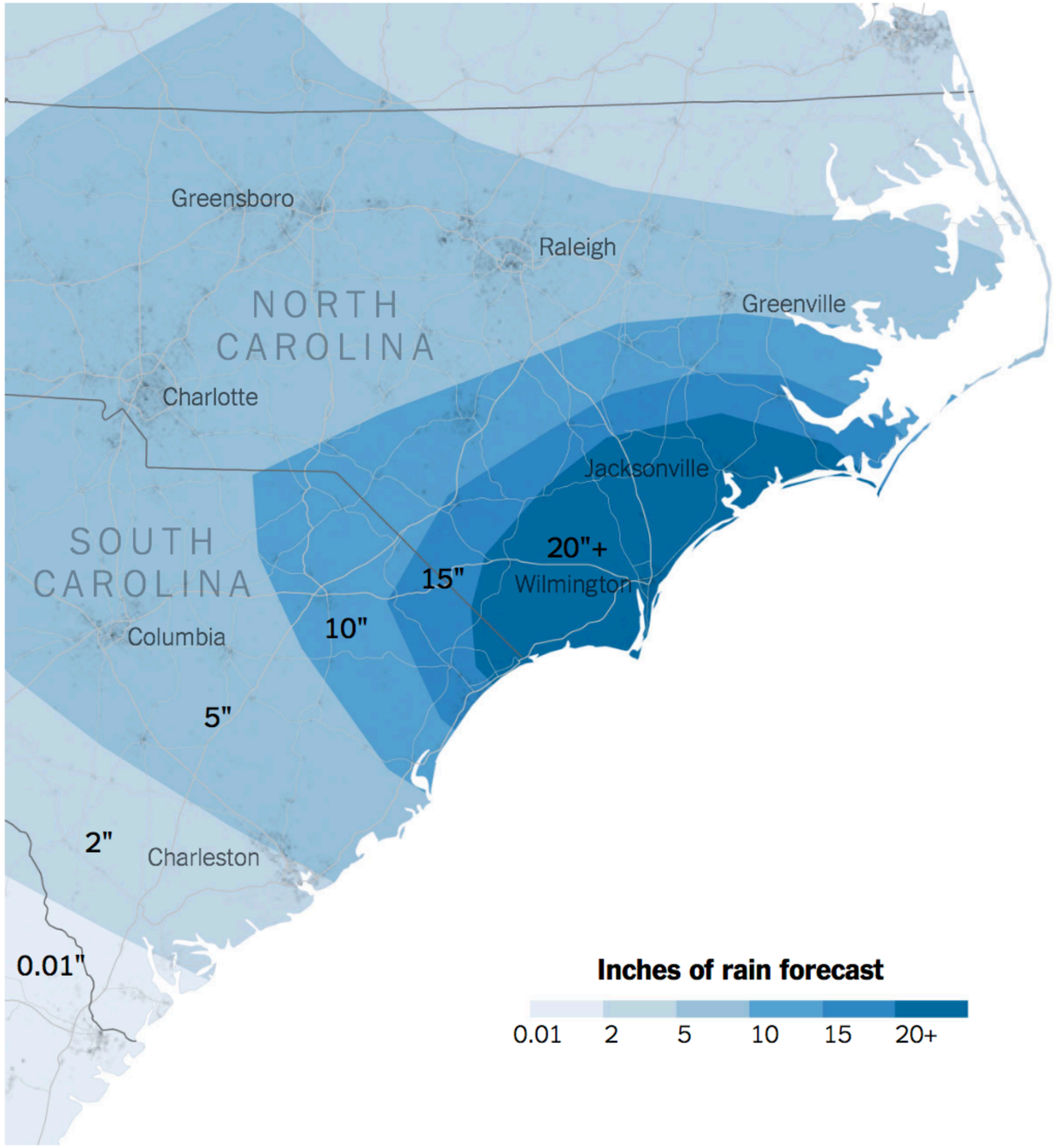
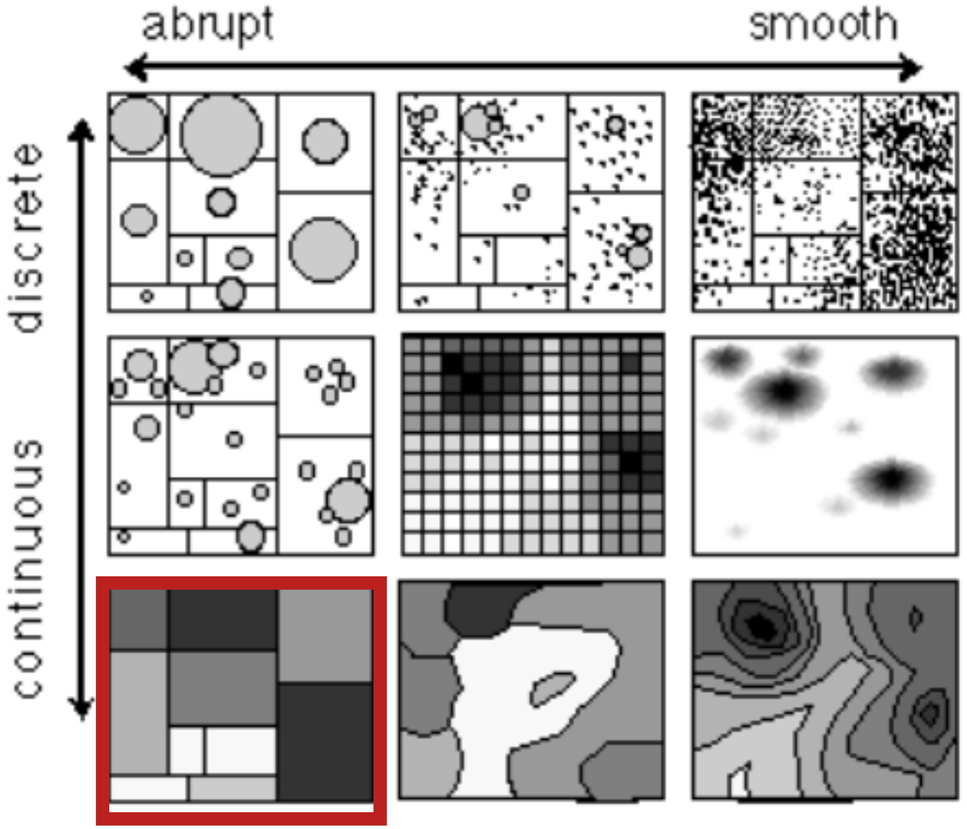


Source: National Weather Service

Choropleth



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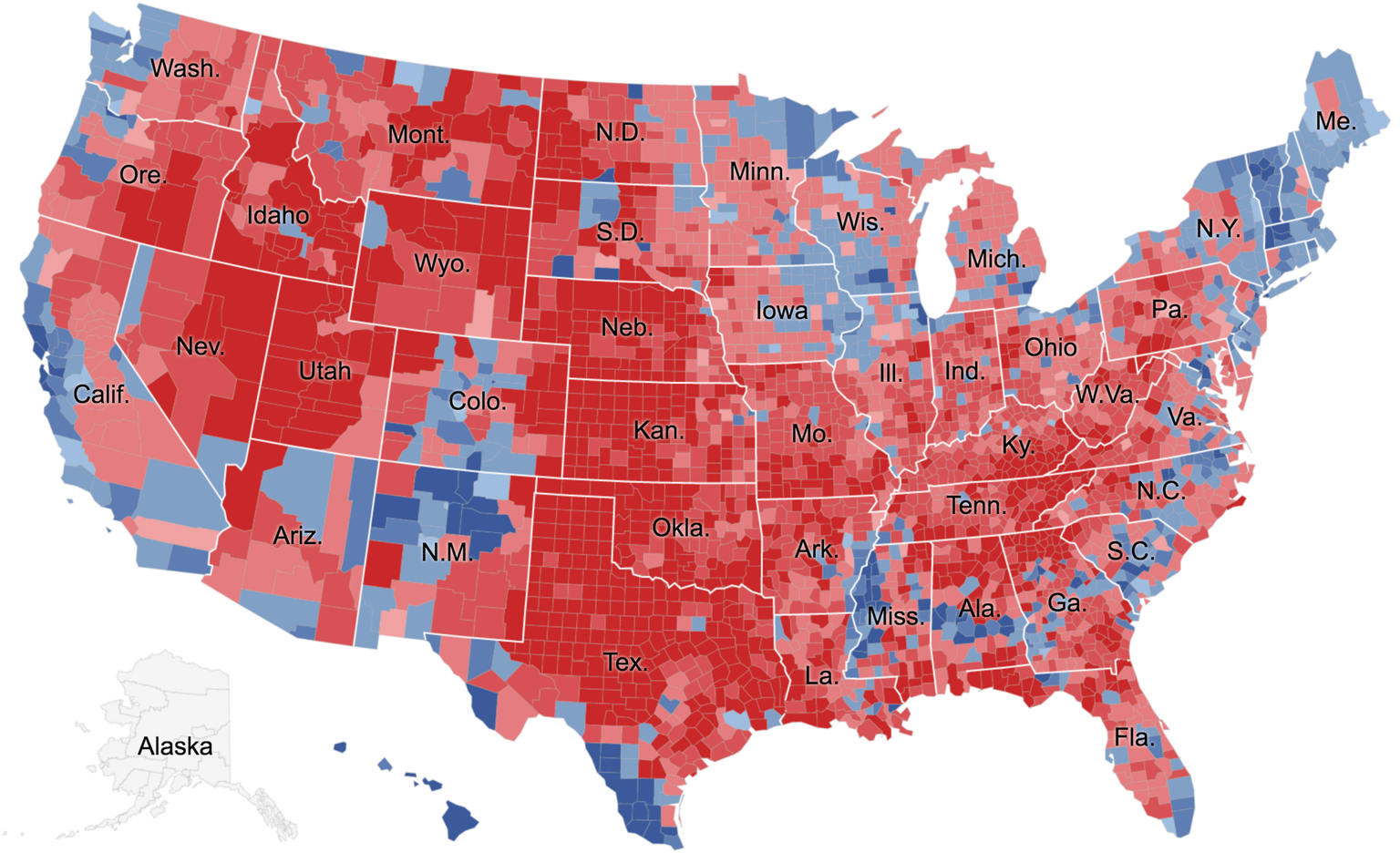
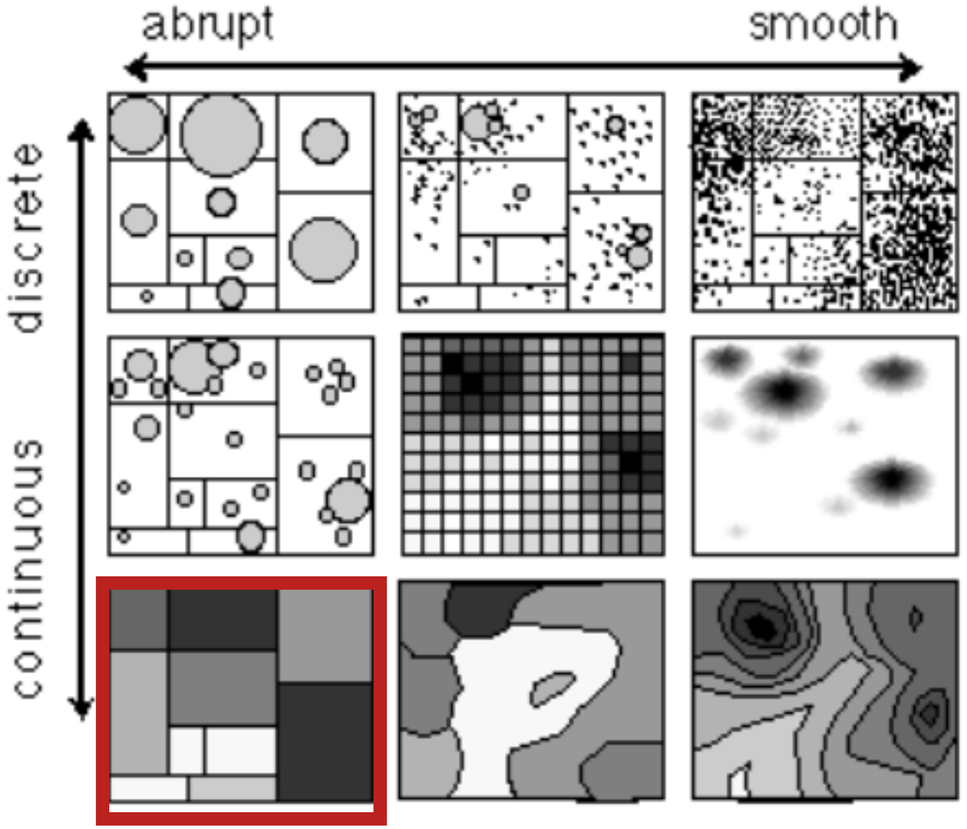


https://www.nytimes.com/interactive/2016/11/01/upshot/many-ways-to-map-election-results.html

Choropleth



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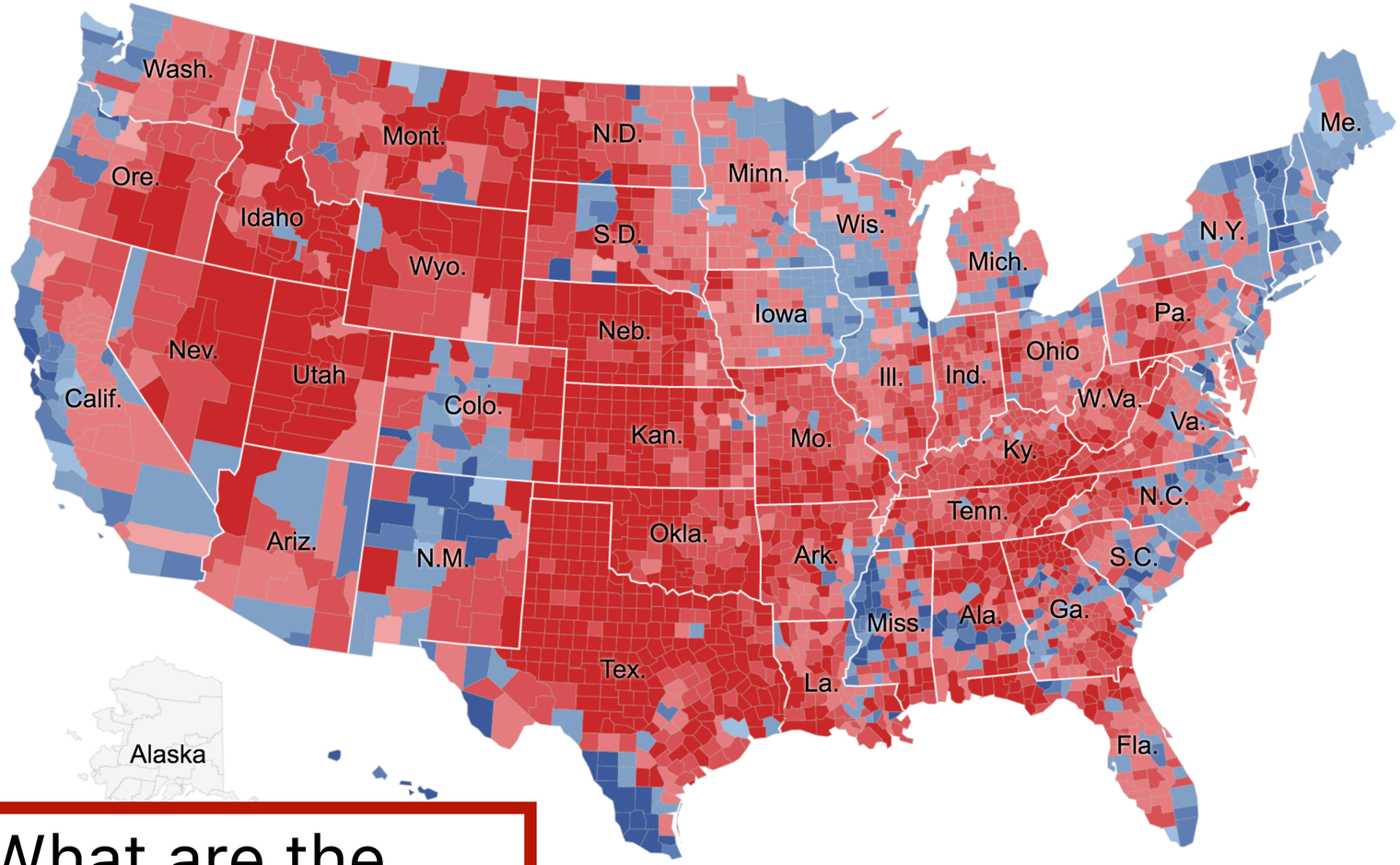
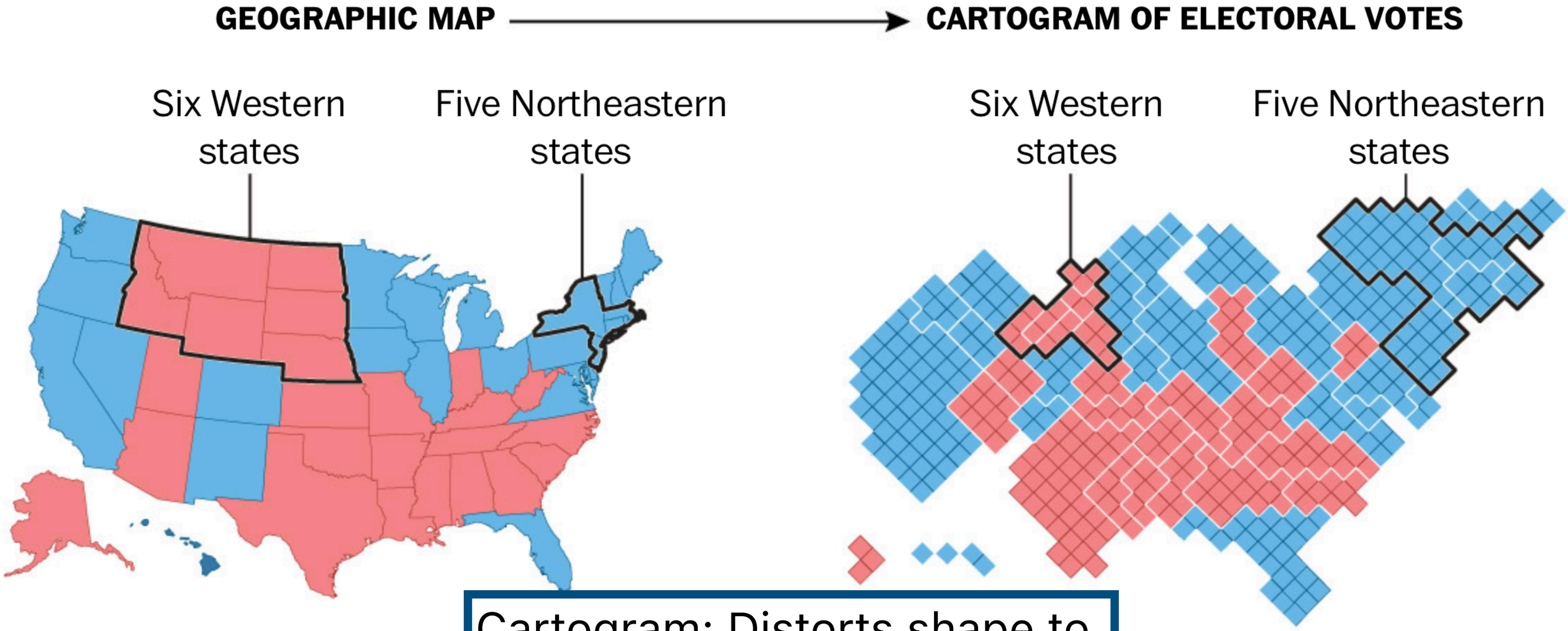


What are the pros/cons of this display?

tryclassbuzz.com
Code: **choro**

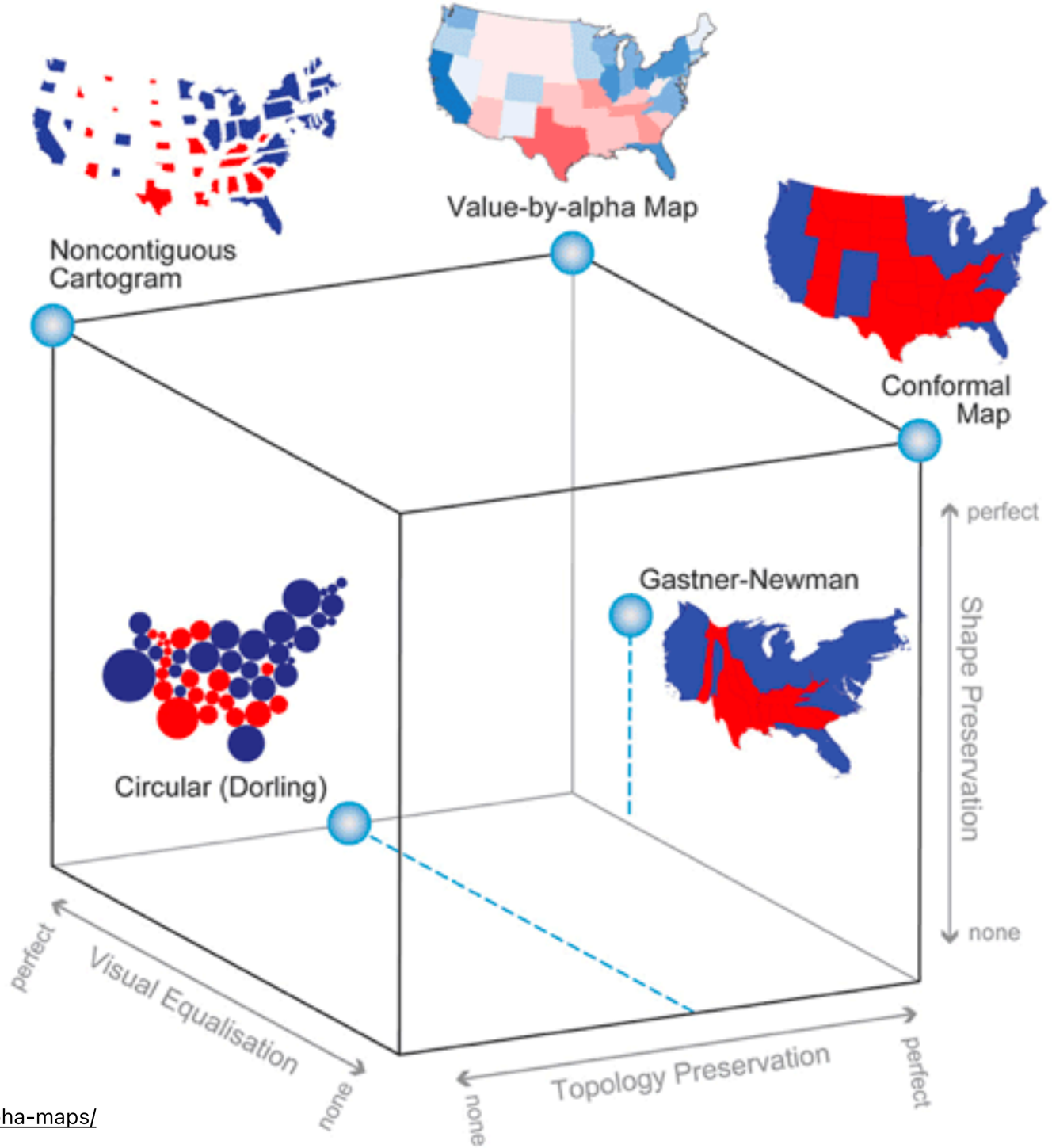
ion-results.html



Cartogram: Distorts shape to convey quantity

What are the pros/ cons of this display?

tryclassbuzz.com
Code: **carto**

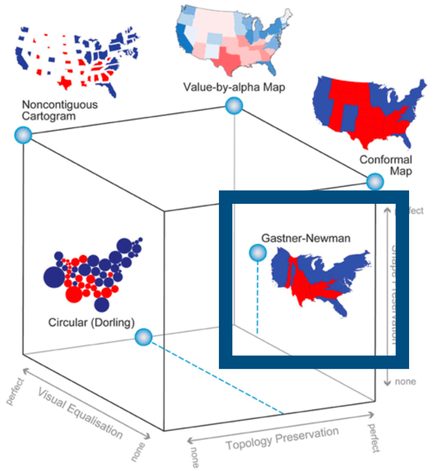


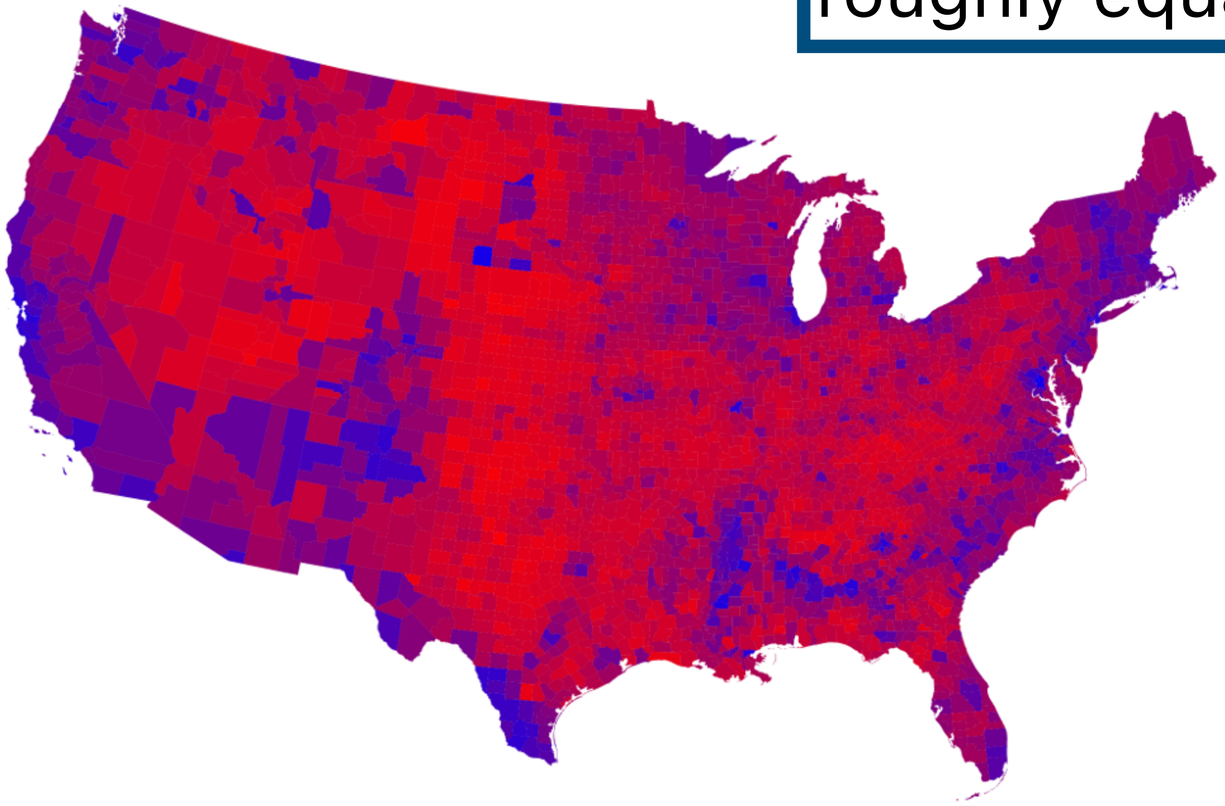
https://andywoodruff.com/blog/value-by-alpha-maps/

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

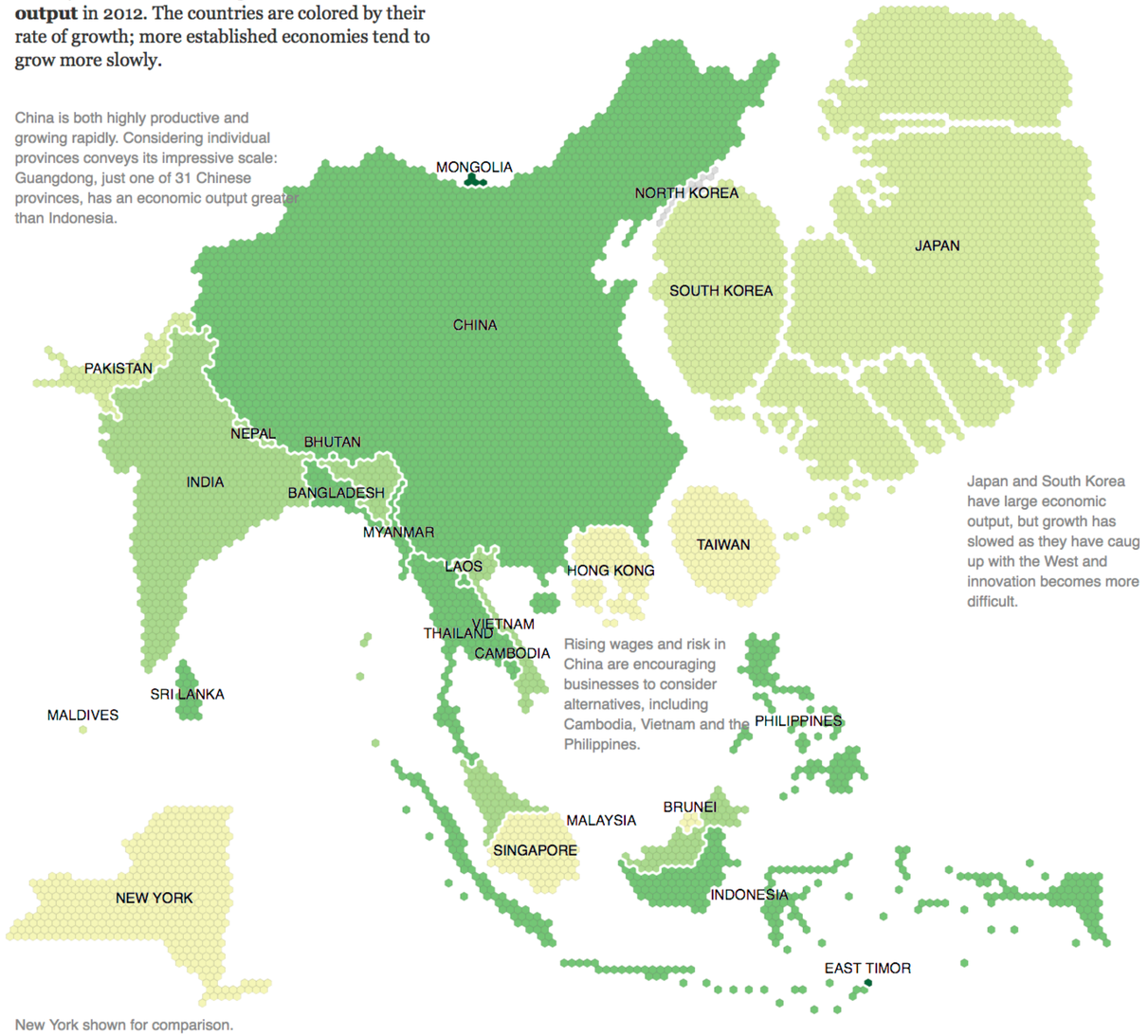
While China maintains its overwhelming dominance in manufacturing, multinational companies are looking for ways to limit their reliance on factories there. Related Article »

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.

Each hexagon represents $2.7 billion in G.D.P.

G.D.P. growth, 2011 to 2012: 2 4 6 8 +10%



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.

Japan and South Korea have large economic output, but growth has slowed as they have caug up with the West and innovation becomes more difficult.

Rising wages and risk in China are encouraging businesses to consider alternatives, including Cambodia, Vietnam and the Philippines.

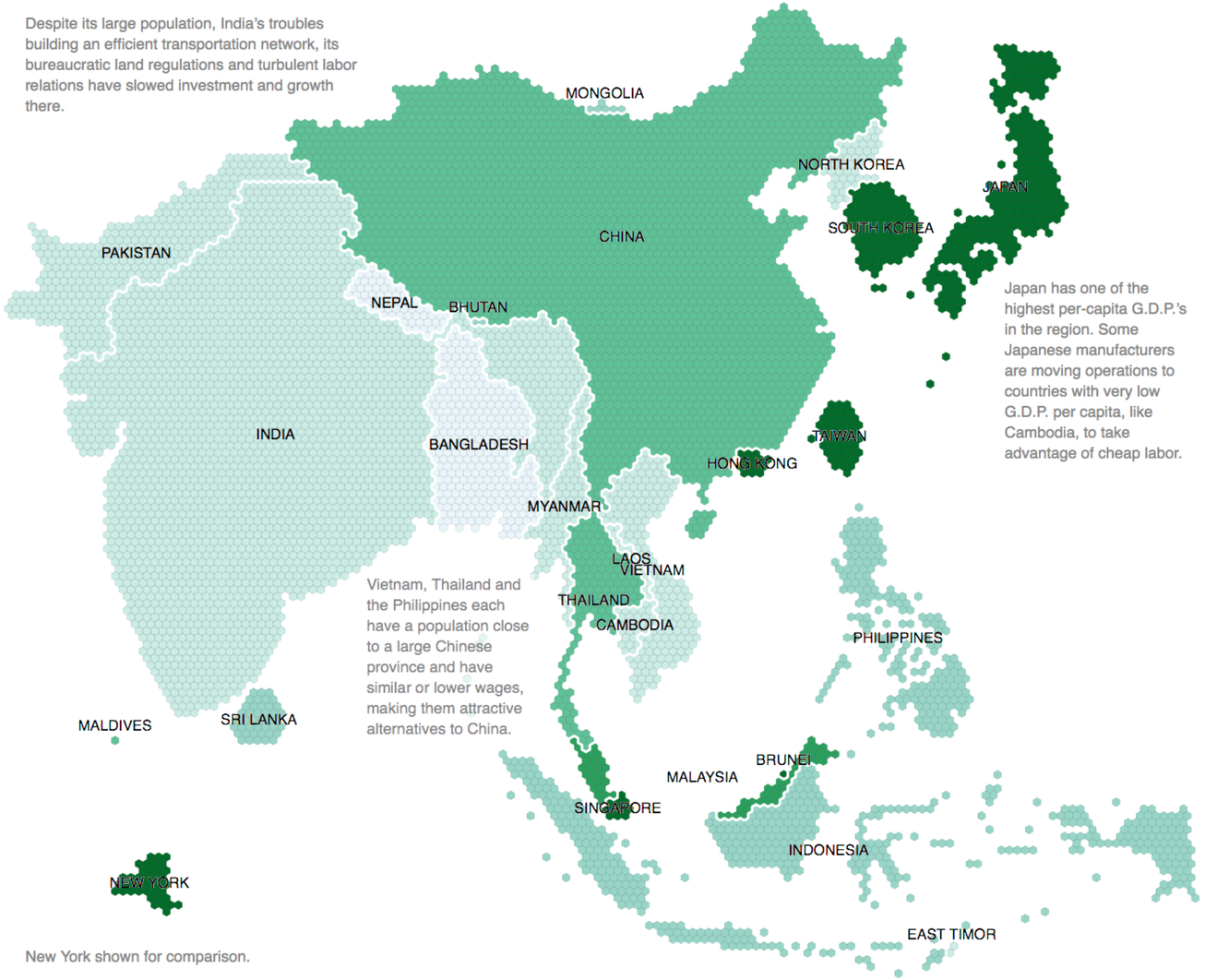
New York shown for comparison.

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.

Each hexagon represents 500,000 people

G.D.P. per capita, 2012: 1 2 5 10 $20K



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.

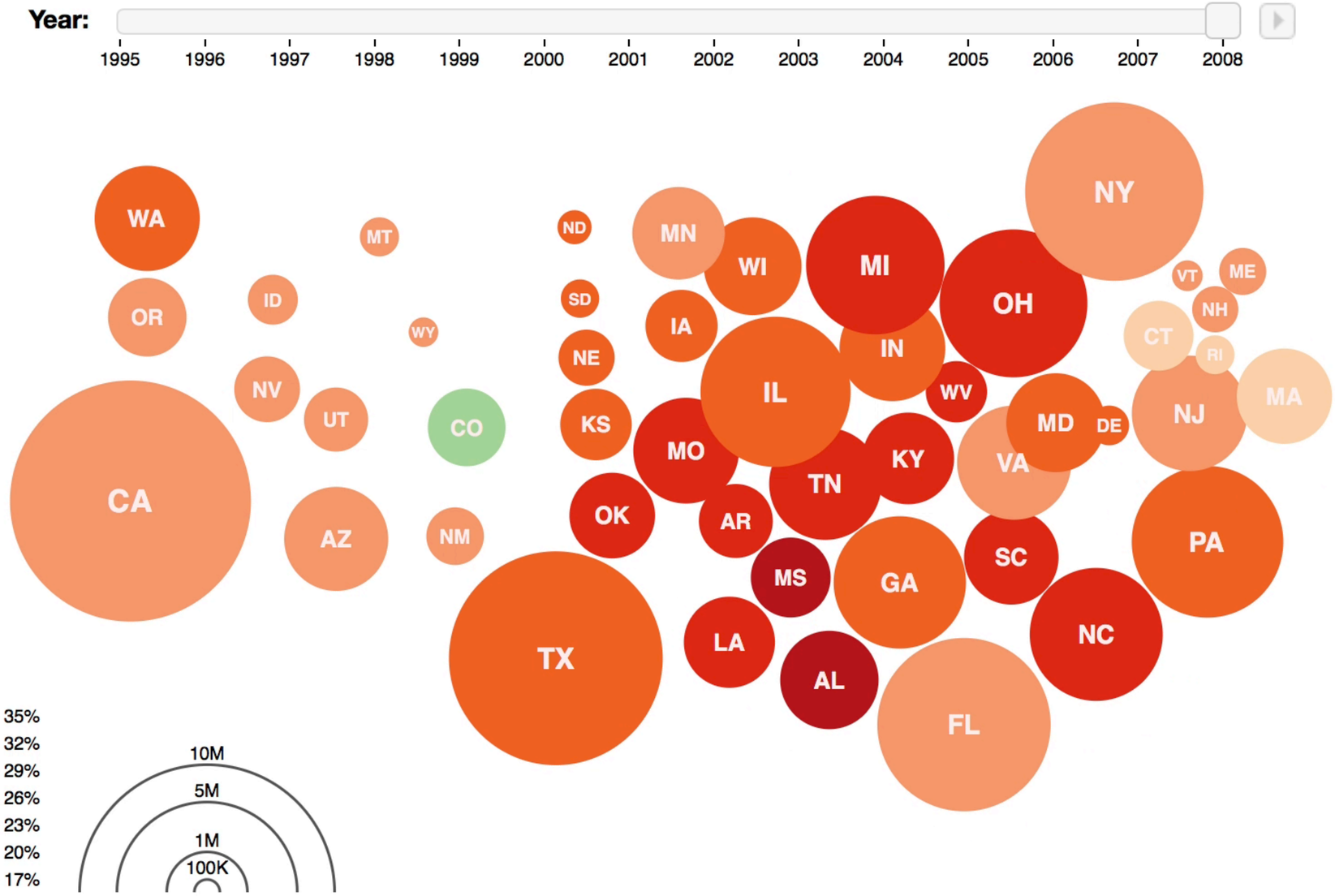
Japan has one of the highest per-capita G.D.P.'s in the region. Some Japanese manufacturers are moving operations to countries with very low G.D.P. per capita, like Cambodia, to take advantage of cheap labor.

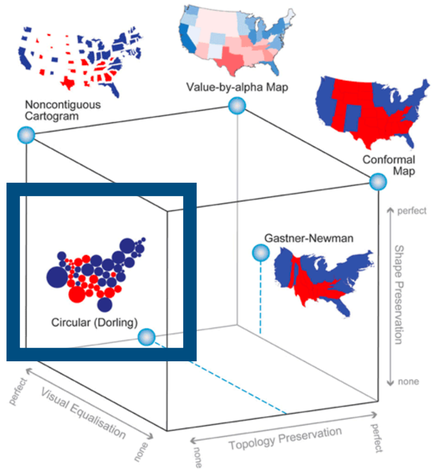
Vietnam, Thailand and the Philippines each have a population close to a large Chinese province and have similar or lower wages, making them attractive alternatives to China.

New York shown for comparison.

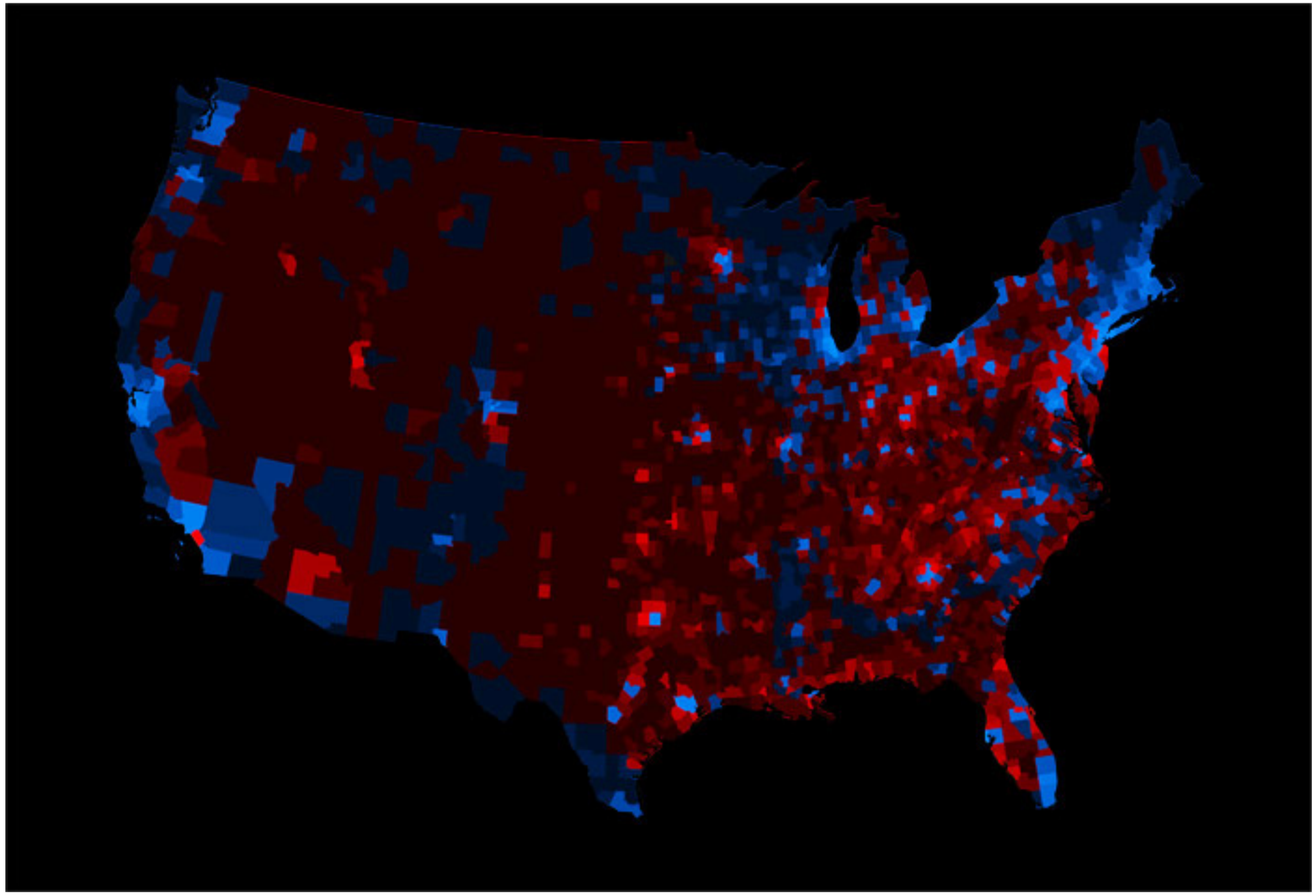
By MIKE BOSTOCK; Additional reporting by KEITH BRADSHER

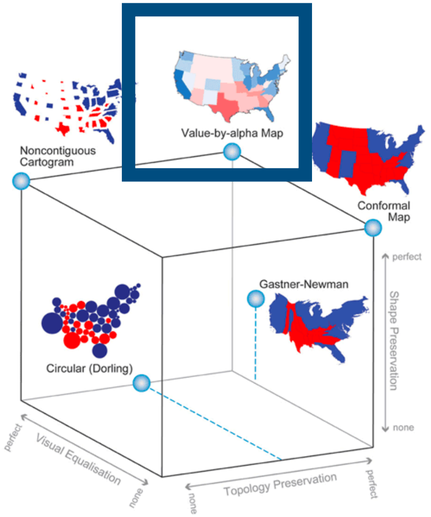
Dorling Cartograms





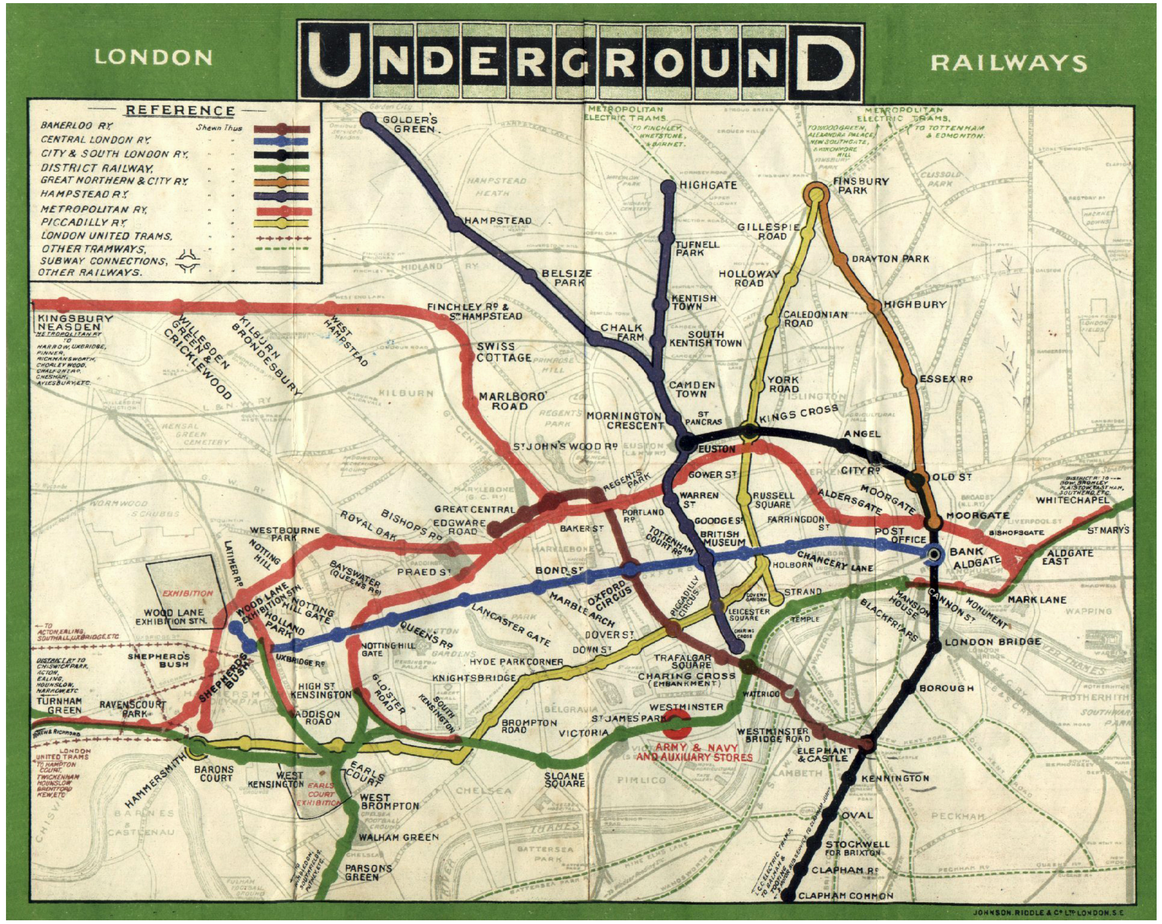
Value-By-Alpha





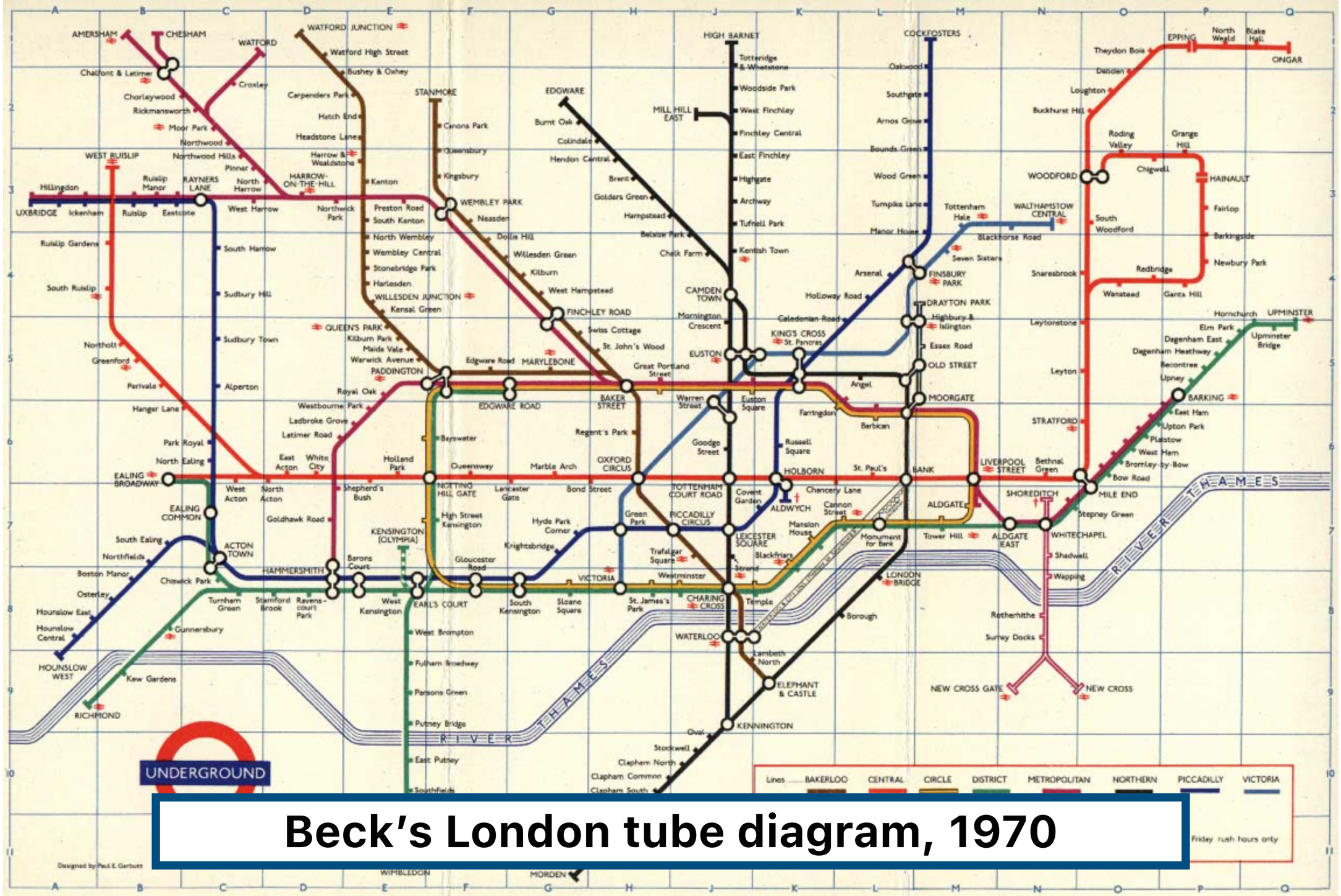
https://andywoodruff.com/blog/value-by-alpha-maps/

Route Maps

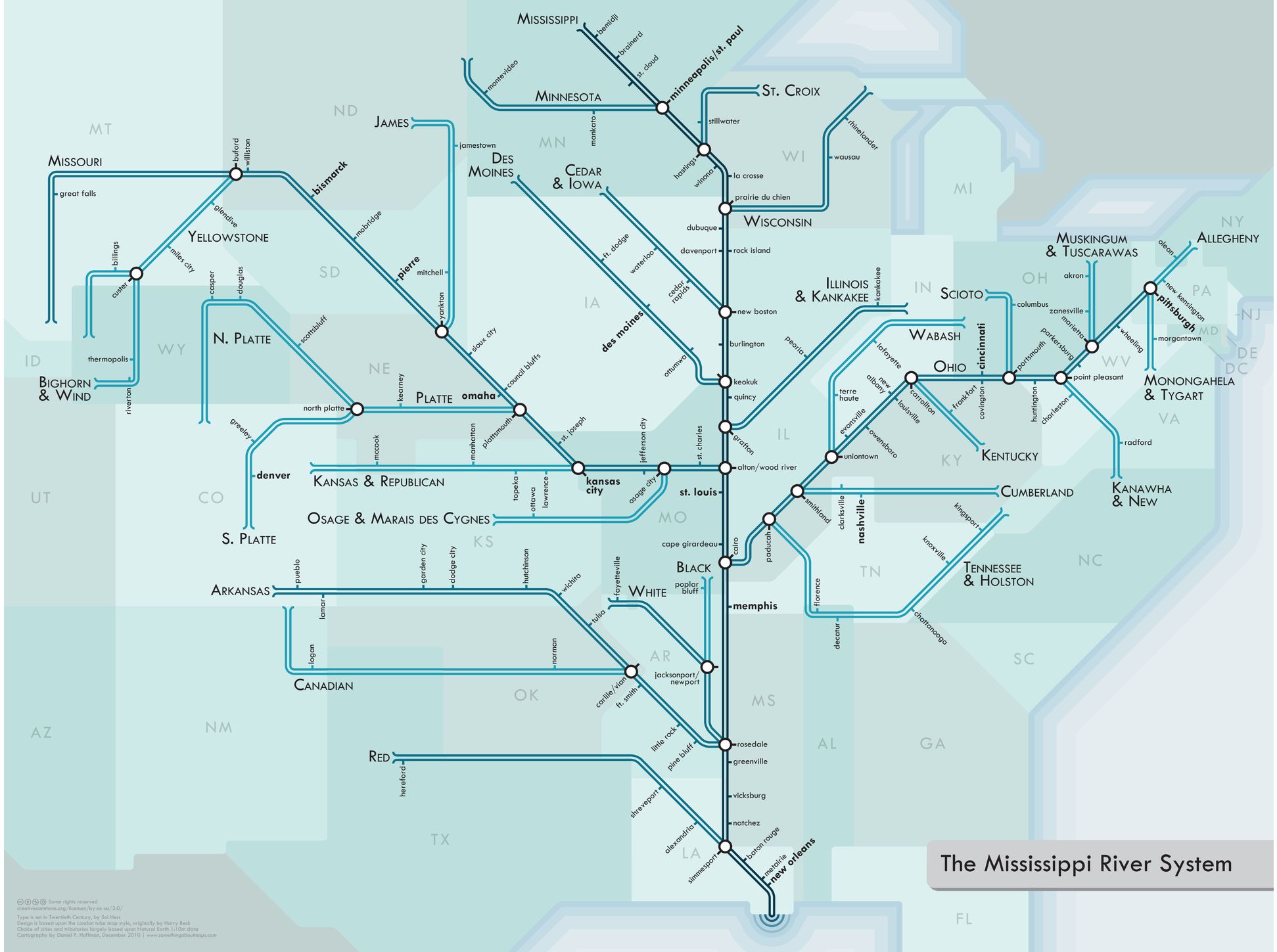


Geographic version of

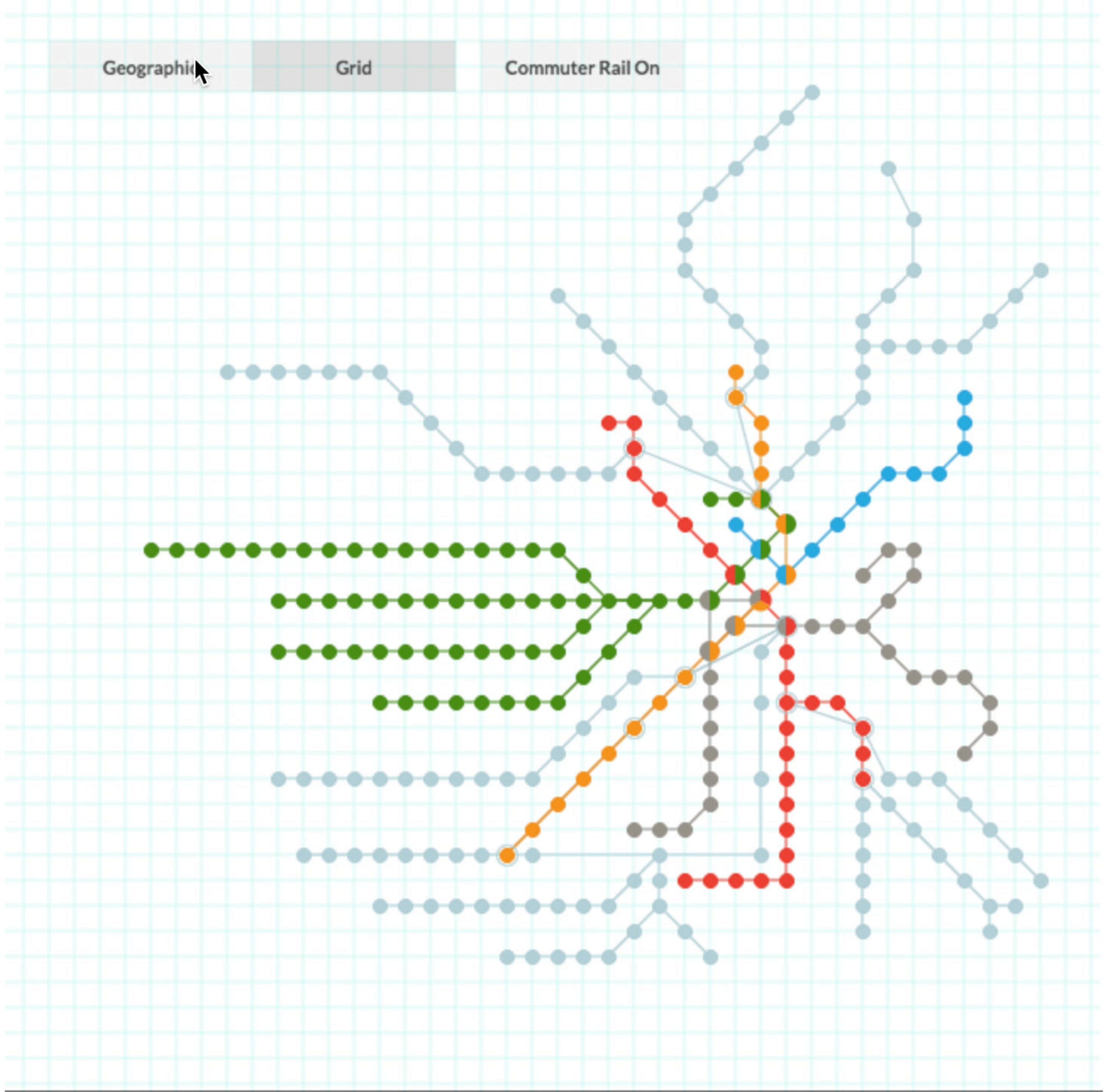
London Underground



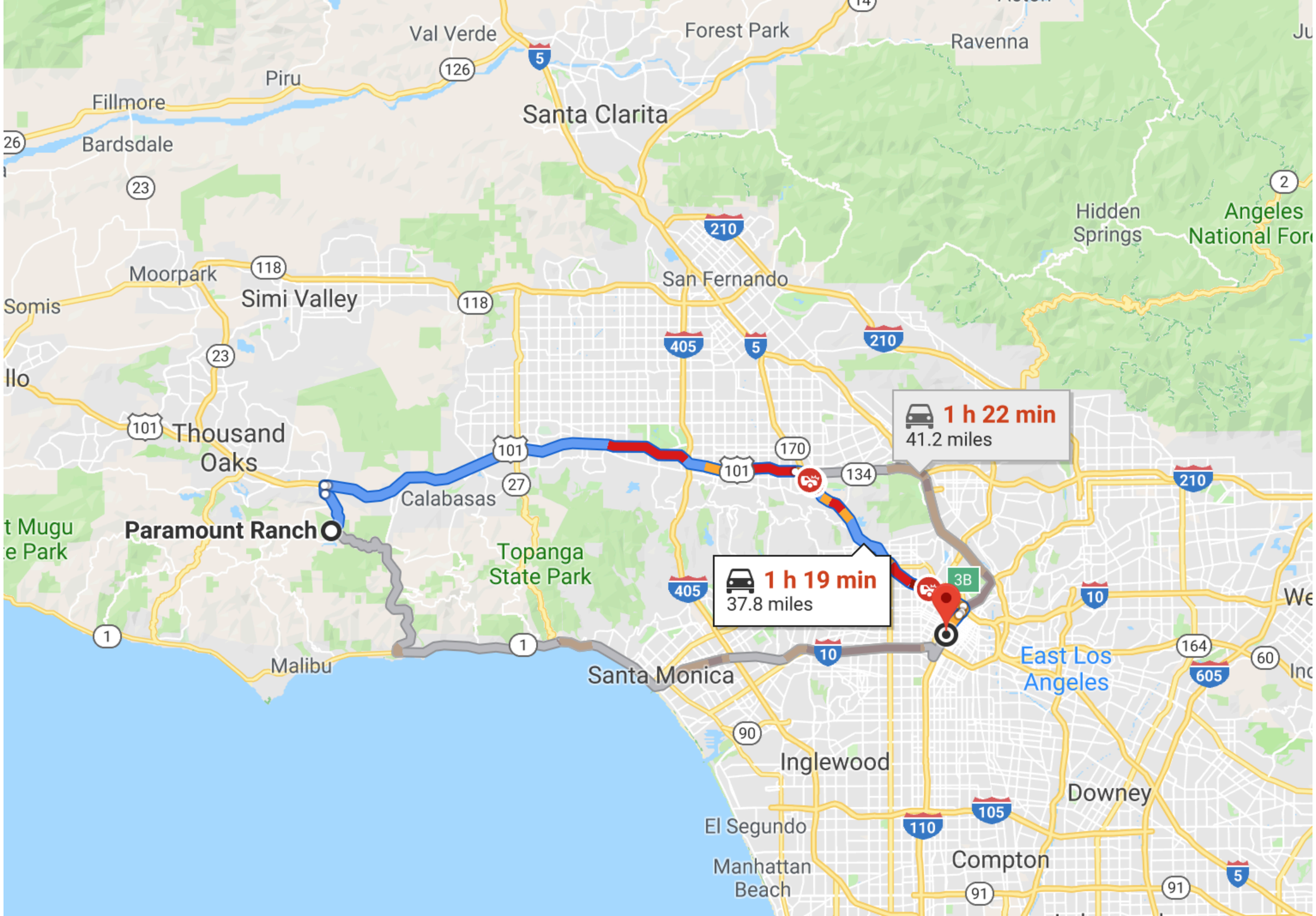
Beck's London tube diagram, 1970

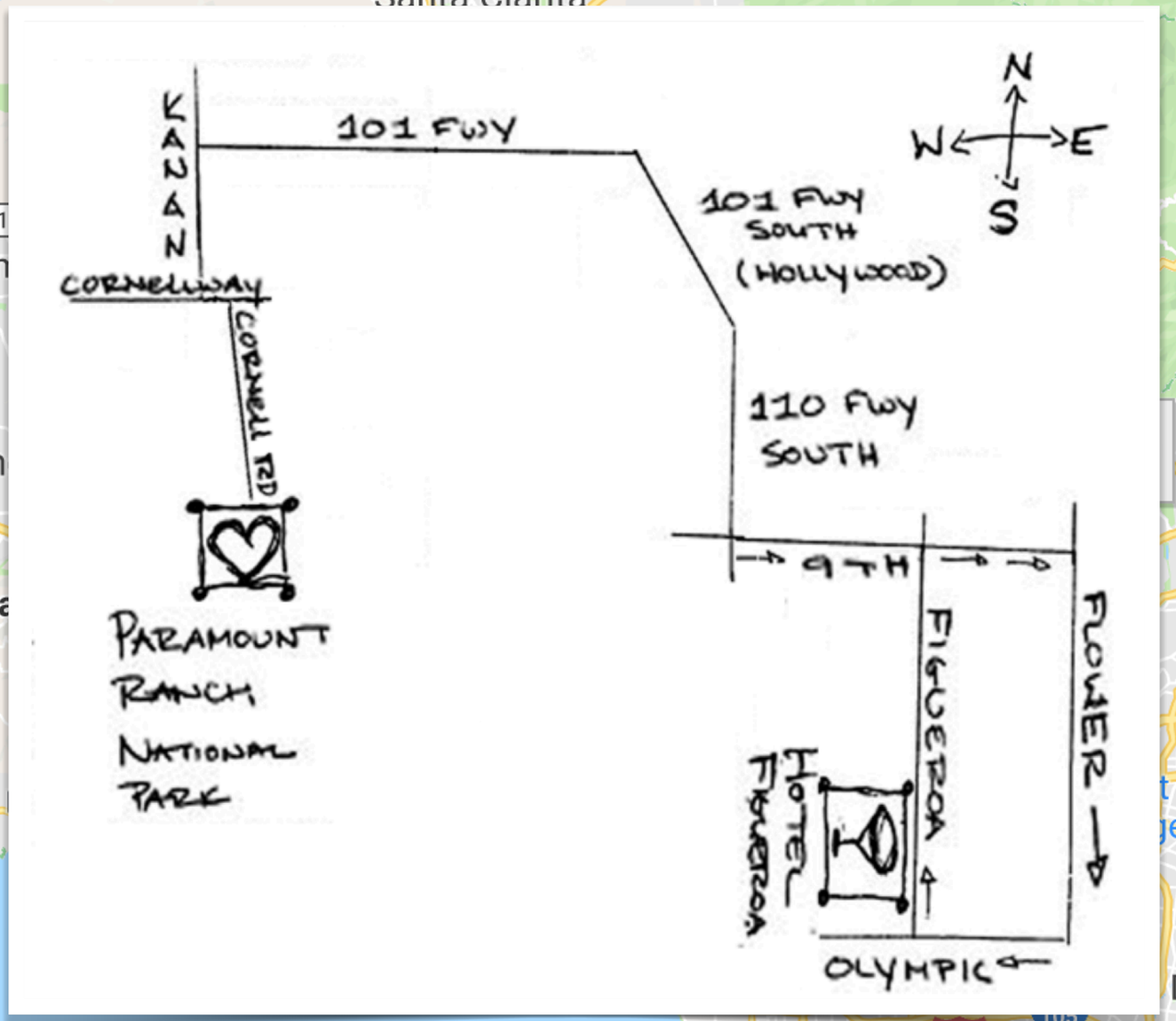


The Mississippi River System

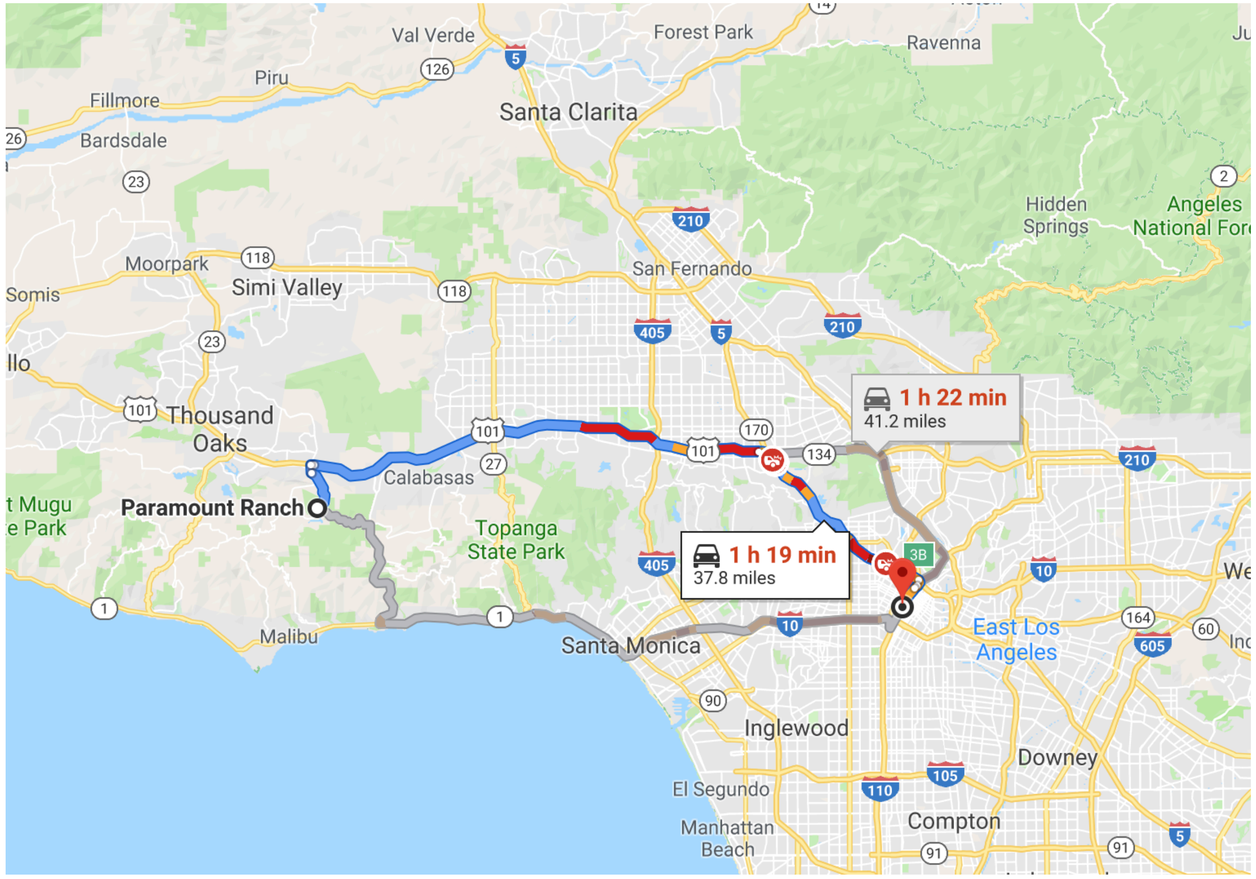


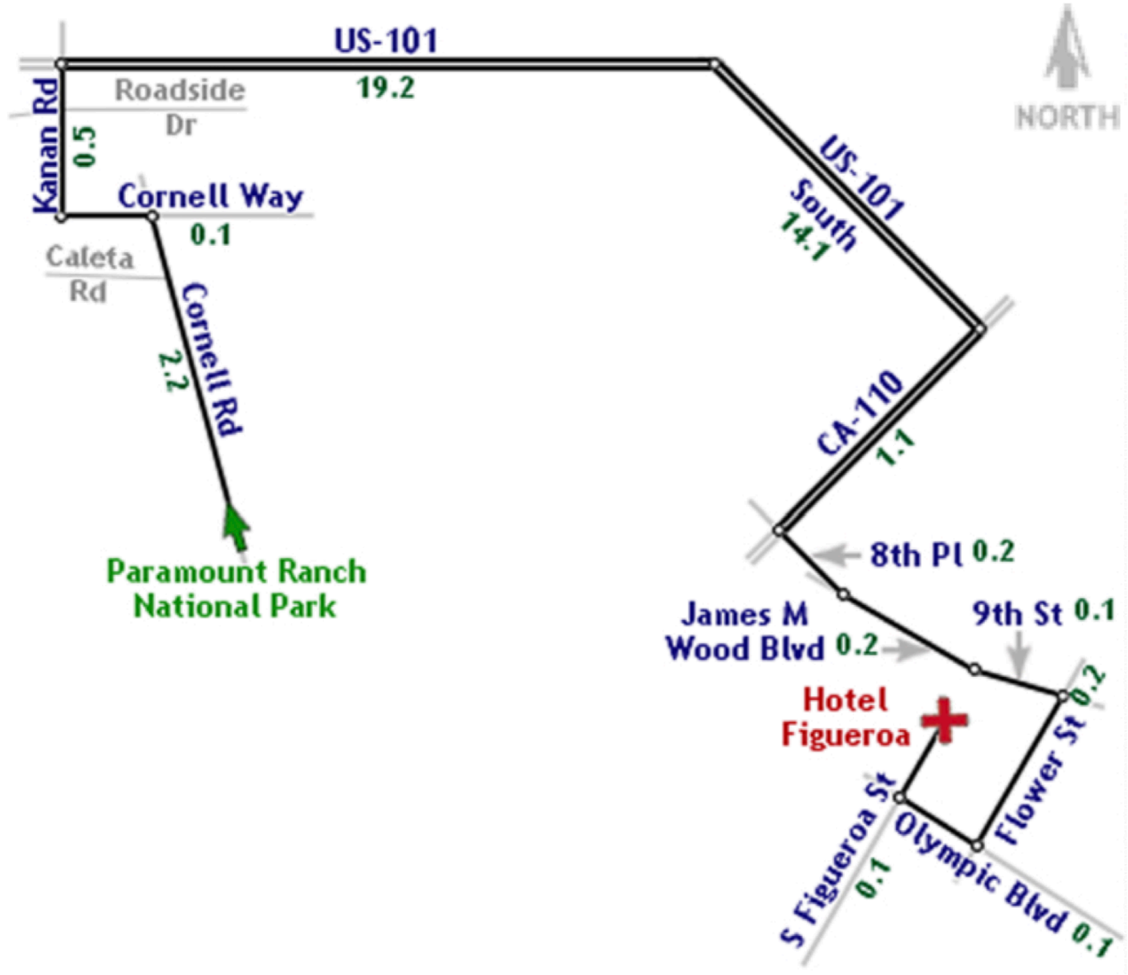
https://fathom.info/notebook/4756/


1 h 22 min
41.2 miles
1 h 19 min
37.8 miles
Paramount Ranch
Thousand Oaks
Simi Valley
Moorpark
Somis
Fillmore
Piru
Bardsdale
Val Verde
Santa Clarita
Forest Park
Ravenna
Hidden Springs
Angeles National For
San Fernando
Calabasas
Topanga State Park
Malibu
Santa Monica
East Los Angeles
Inglewood
Downey
El Segundo
Manhattan Beach
Compton
t Mugu e Park
3B


KANAN
101 FWY
CORNELL WAY
CORNELL RD
PARAMOUNT RANCH, NATIONAL PARK
101 FWY SOUTH (HOLLYWOOD)
110 FWY SOUTH
9TH
FIGUEROA
HOTEL FIGUEROA
FLOWER
OLYMPIC
N
W
E
S

Line Drive





Agrawala, Maneesh, and Chris Stolte. "Rendering effective route maps: Improving usability through generalization." SIGGRAPH 2001

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
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