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: Monday June 9th 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?

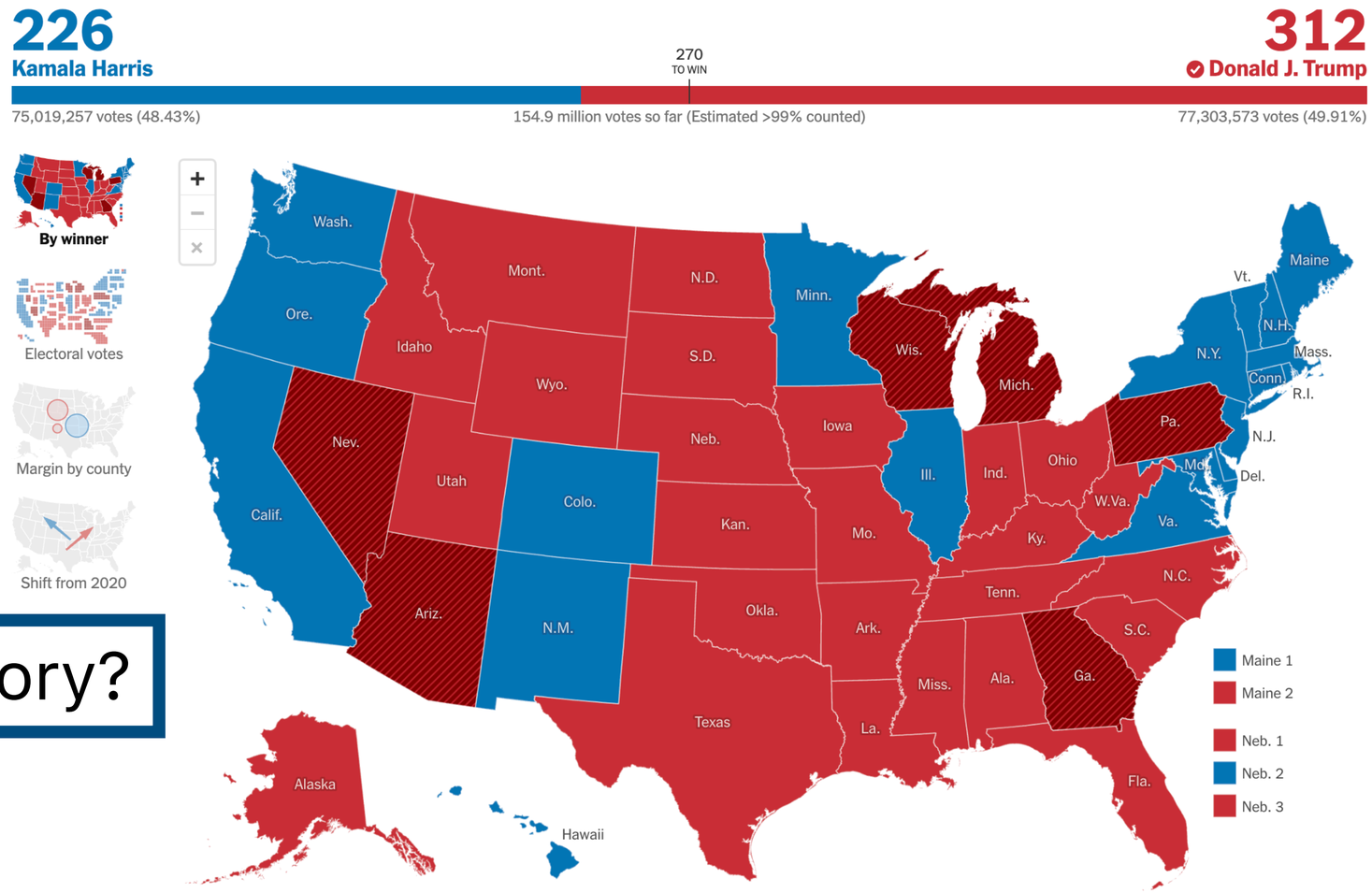
1. When data contains geographical attributes (e.g., latitude, longitude, city, state, country, etc.).
2. When you want to emphasize **geographic relationship**.

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

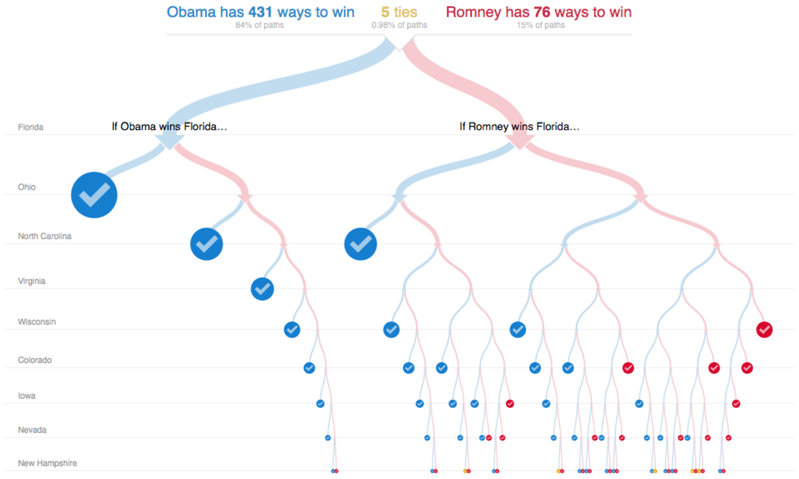
State	Margin	% In
Ariz.	R+6 ✓	100%
Ga.	R+2 ✓	100%
Mich.	R+1.4 ✓	100%
Nev.	R+3 ✓	100%
N.C.	R+3 ✓	100%
Pa.	R+1.7 ✓	100%
Wis.	R+0.86 ✓	100%

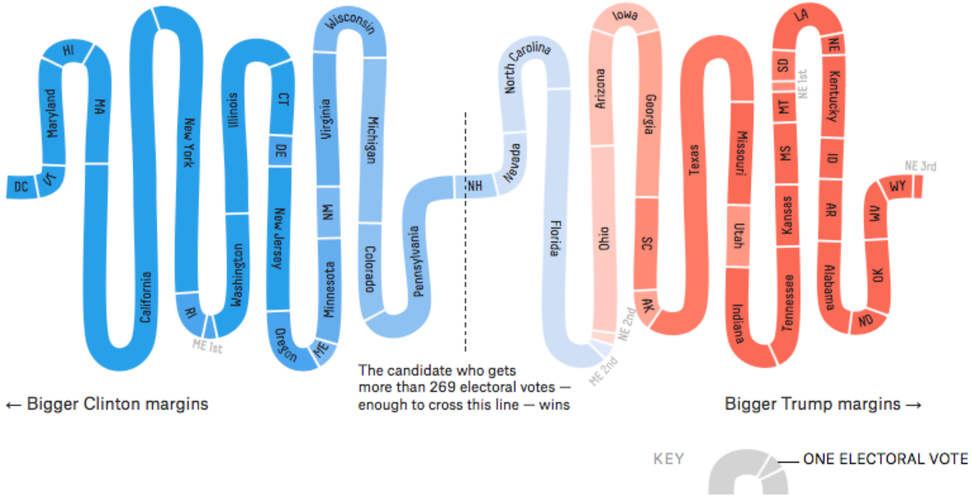
Trump expected to win narrowly

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

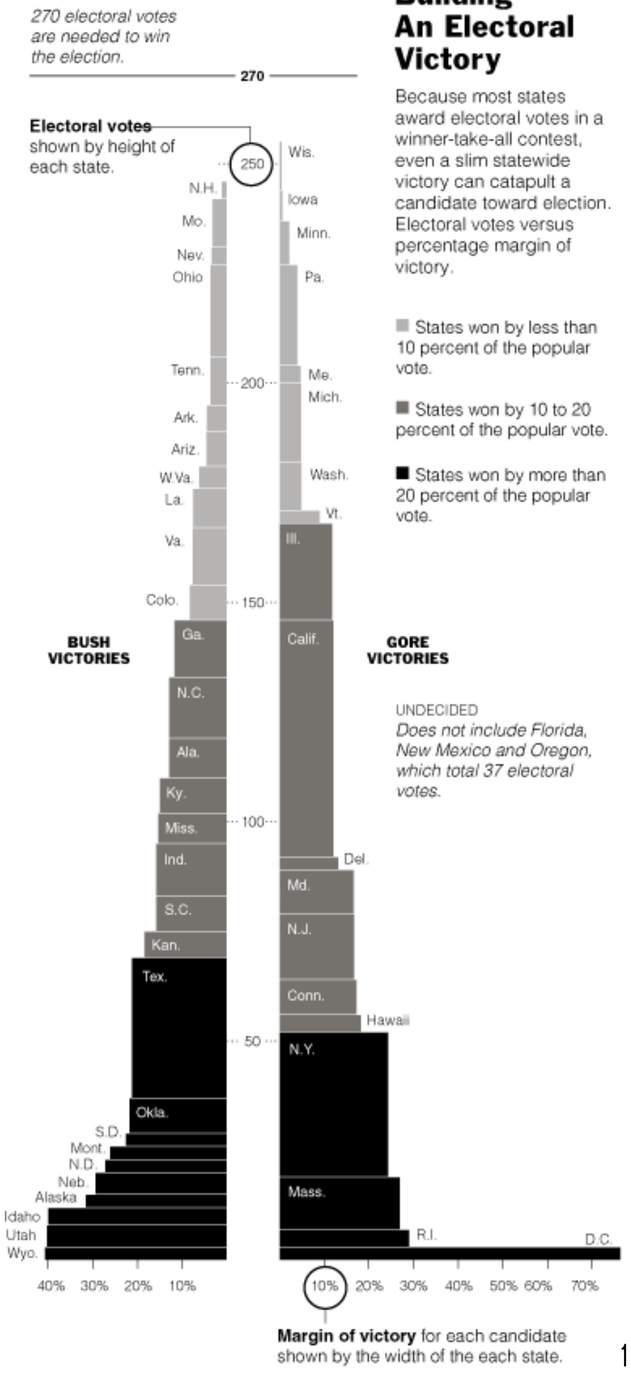
State	Margin	% In
Ala.	R+31 ✓	100%
Alaska	R+13 ✓	100%
Ark.	R+31 ✓	100%
Idaho	R+37 ✓	100%
Ind.	R+19 ✓	100%
Kan.	R+16 ✓	100%
Ky.	R+31 ✓	100%
La.	R+22 ✓	100%
Miss.	R+23 ✓	100%
Mo.	R+18 ✓	100%
Mont.	R+20 ✓	100%
Neb.	R+21 ✓	100%
Neb. 1	R+13 ✓	100%
Neb. 3	R+54 ✓	100%
N.D.	R+37 ✓	100%
Ohio	R+11 ✓	100%
Okla.	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%





KEY AVERAGE — 80% CHANCE OUTCOME FALLS IN THIS RANGE

	Expected margin of victory (+75 +50 +25	+25 +50 +75)	Chance of tipping election
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%



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.

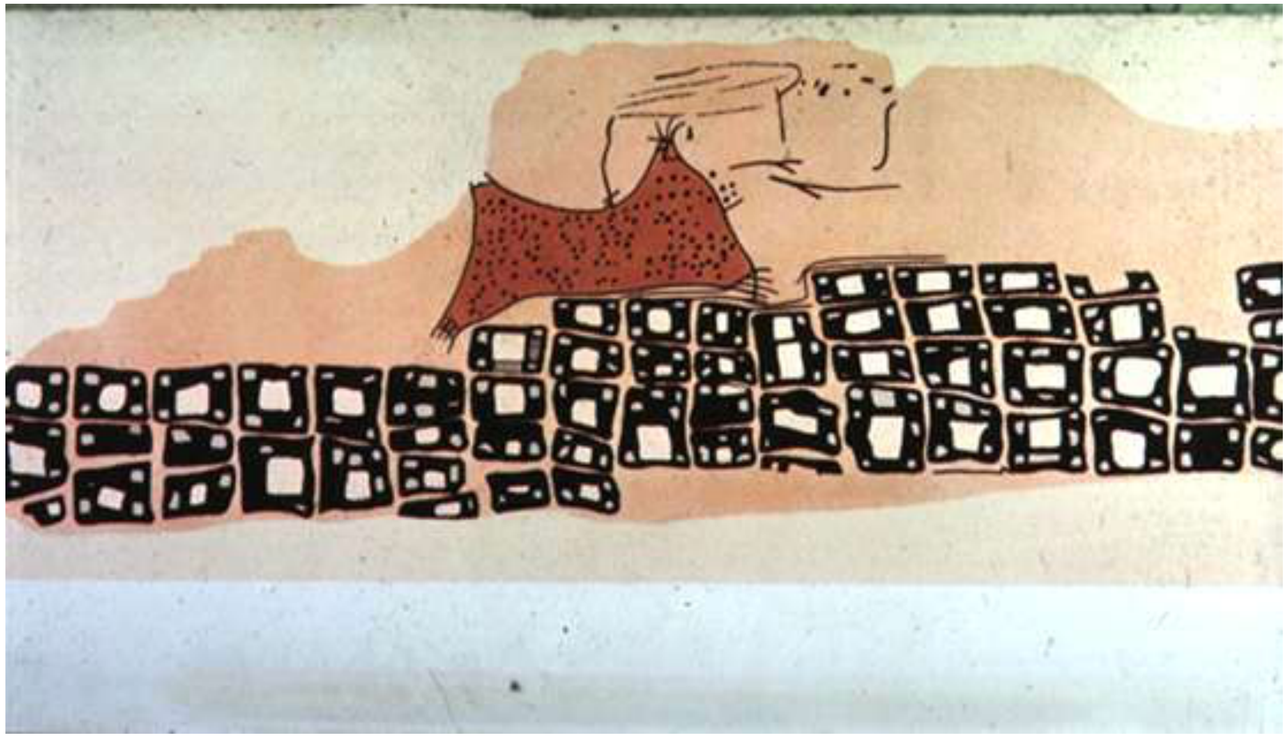
- States won by less than 10 percent of the popular vote.
- States won by 10 to 20 percent of the popular vote.
- States won by more than 20 percent of the popular vote.

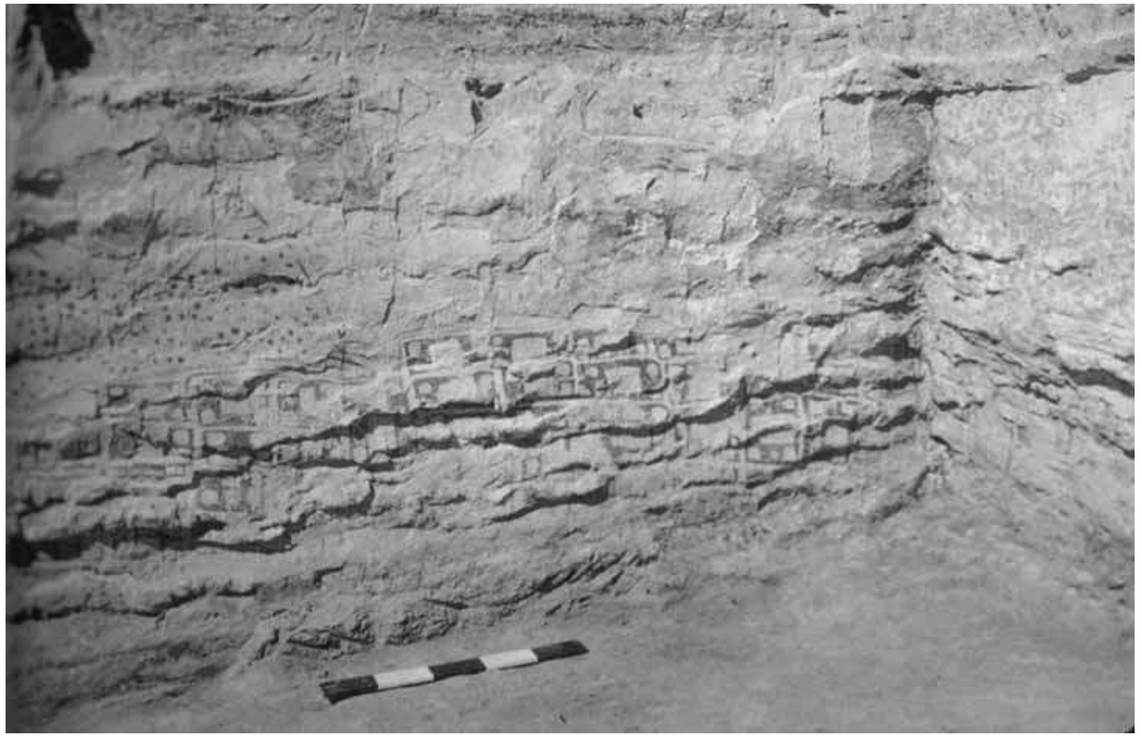
UNDECIDED
Does not include Florida, New Mexico and Oregon, which total 37 electoral votes.

Cartography

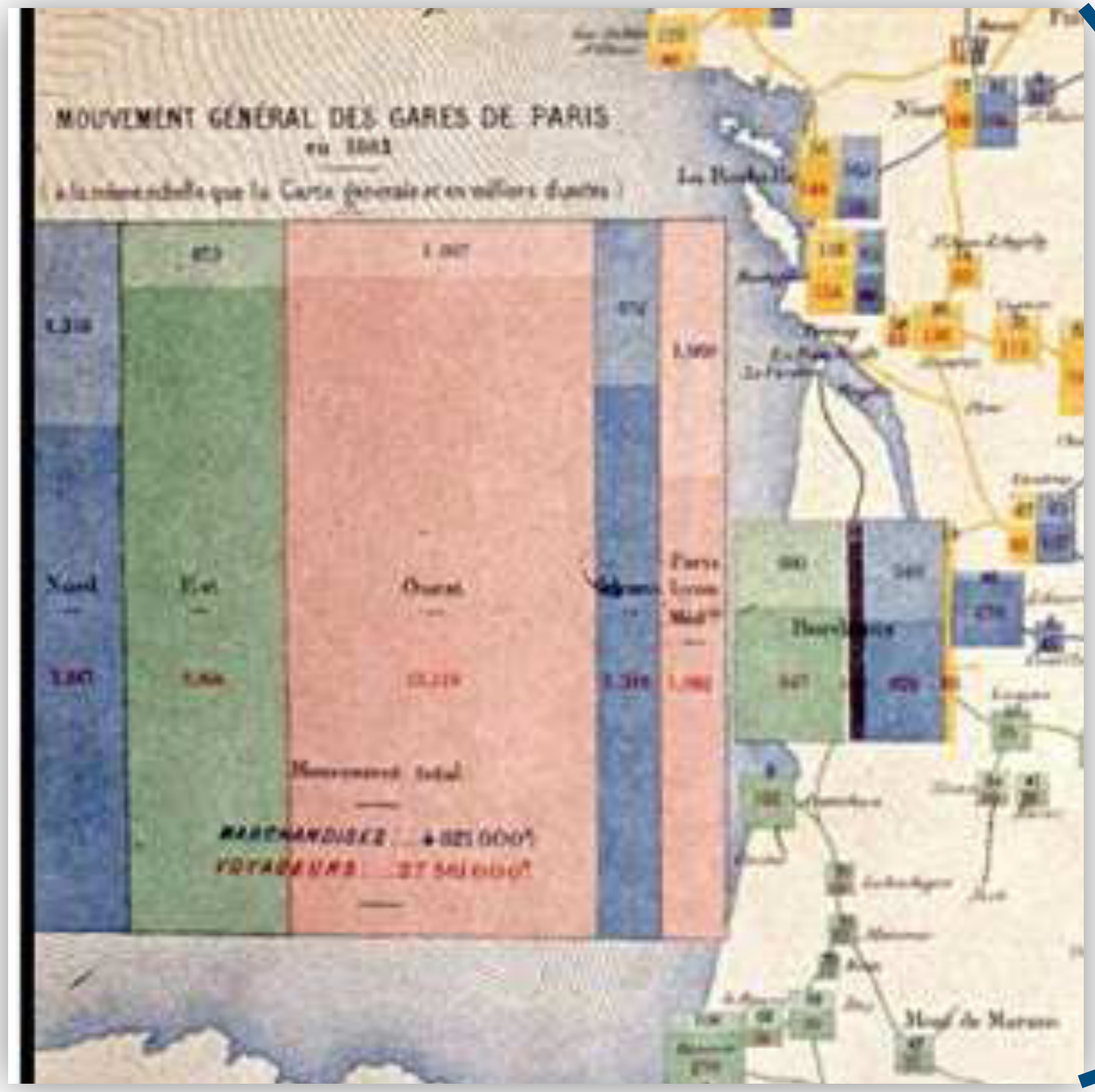
(Map Making)

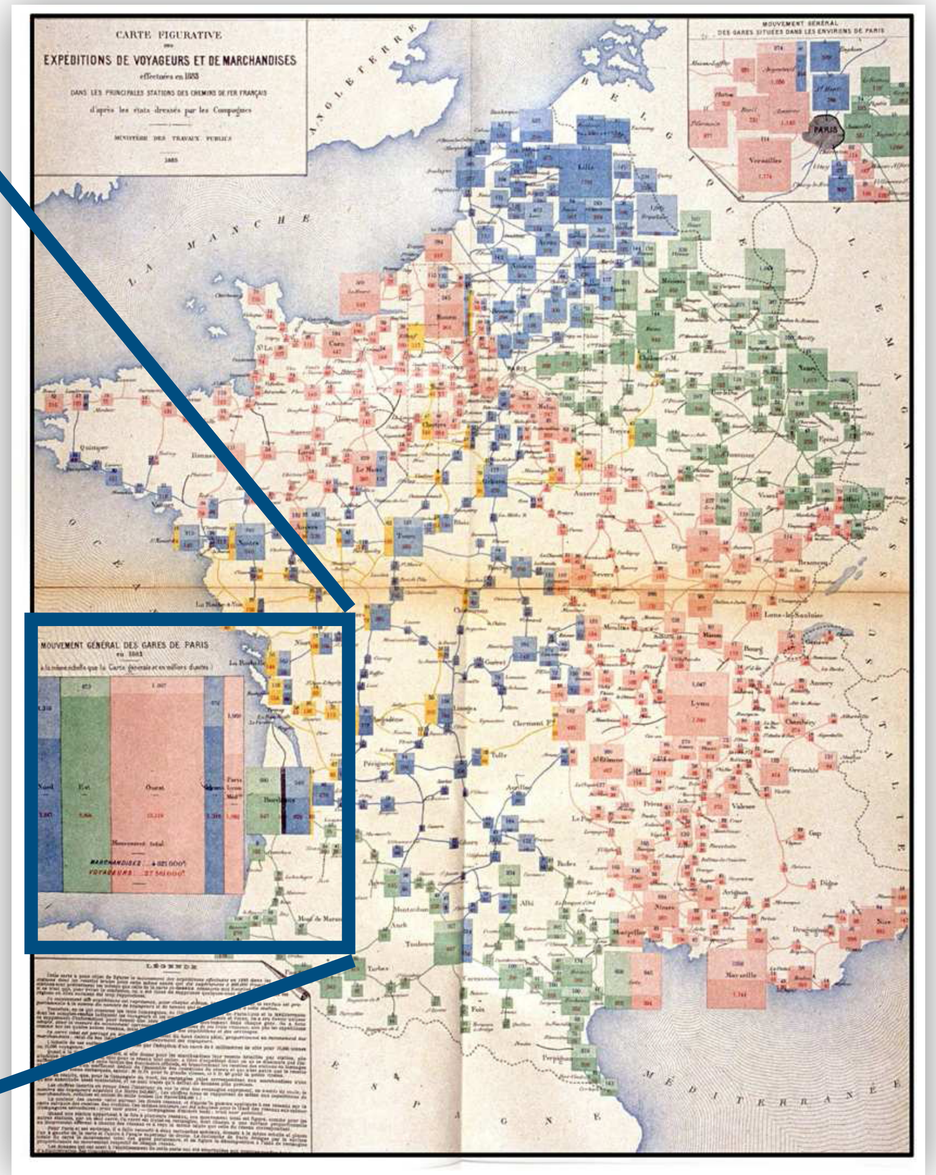
Oldest Known Map: Konya, Turkey (~6200 BC)



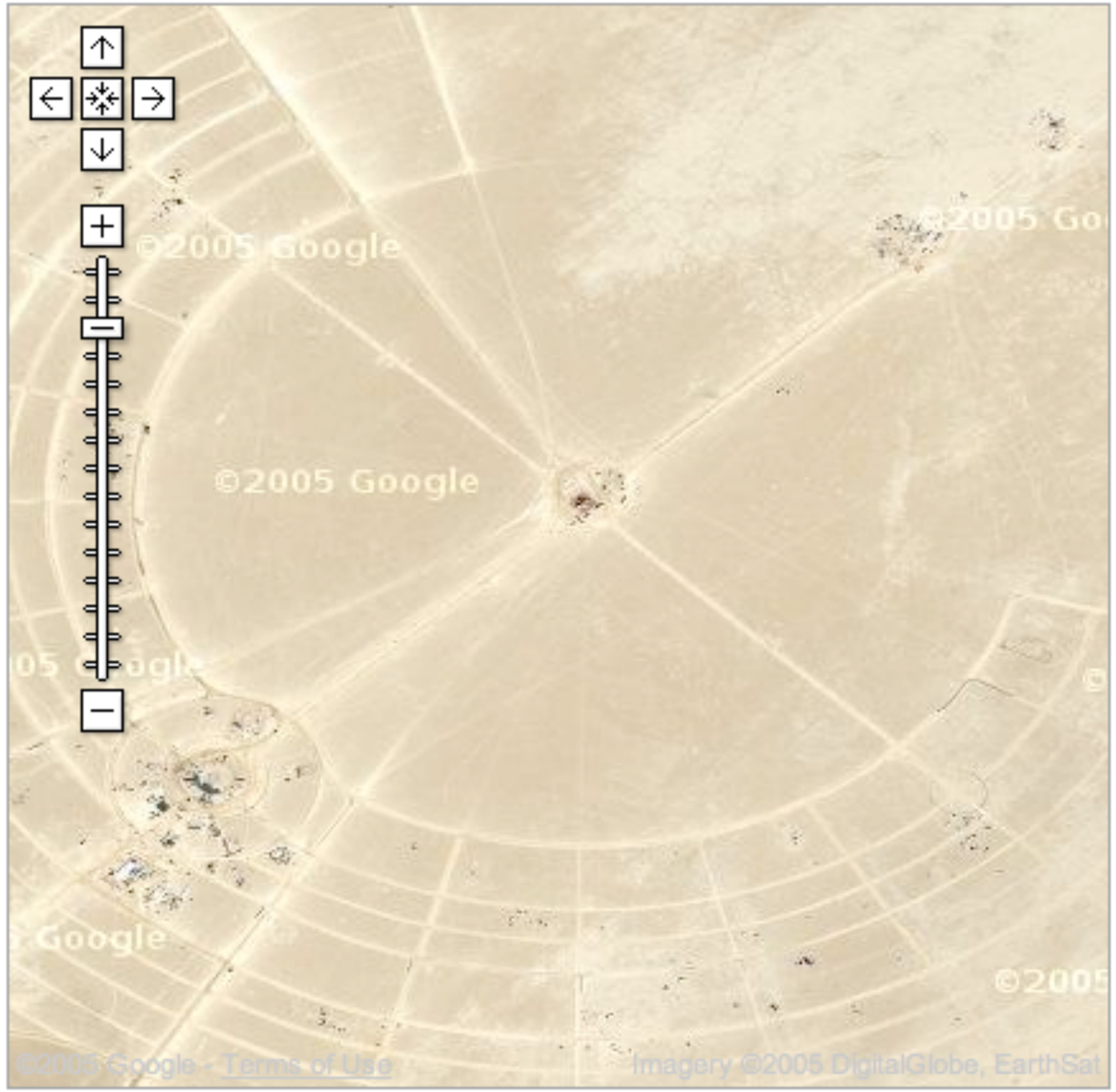


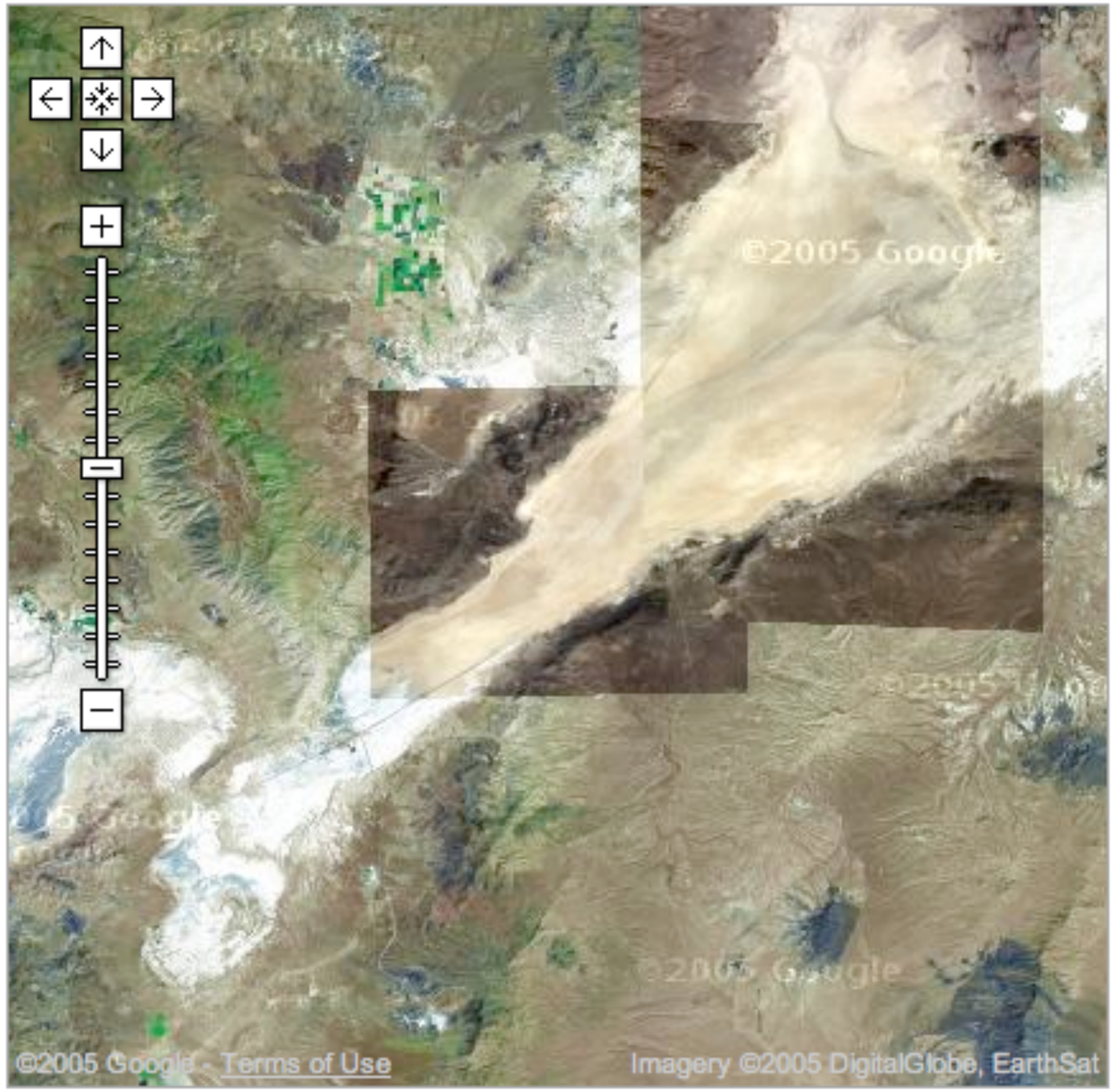
Rail Passengers and Freight from Paris 1884

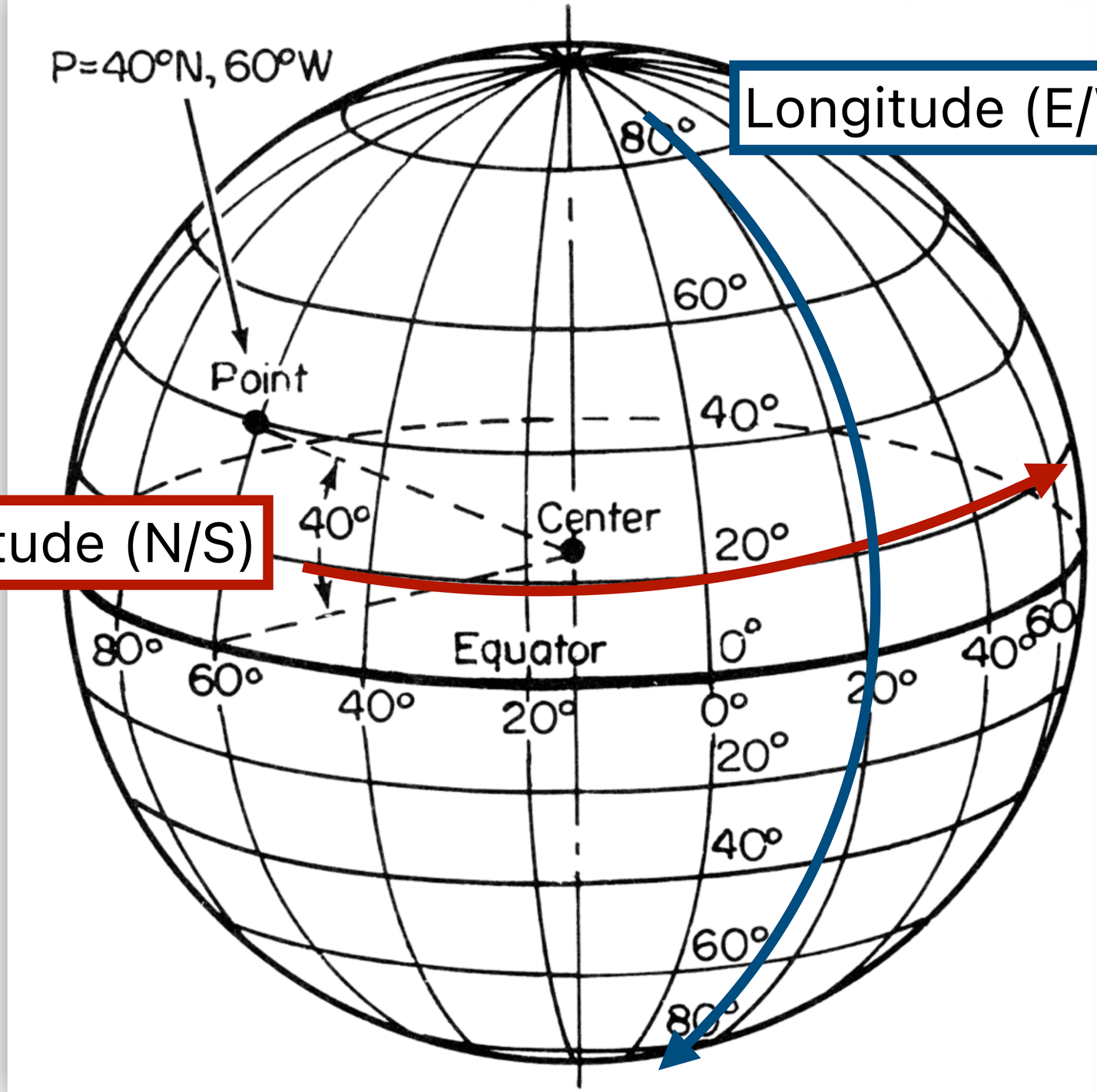




Google Maps, 2005







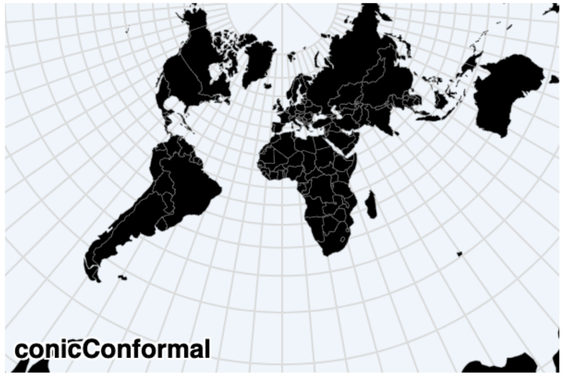
Longitude (E/W)

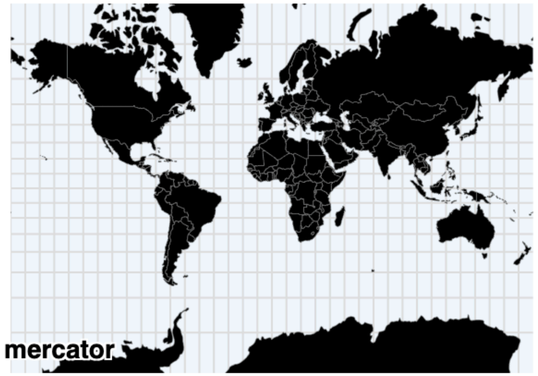
Latitude (N/S)

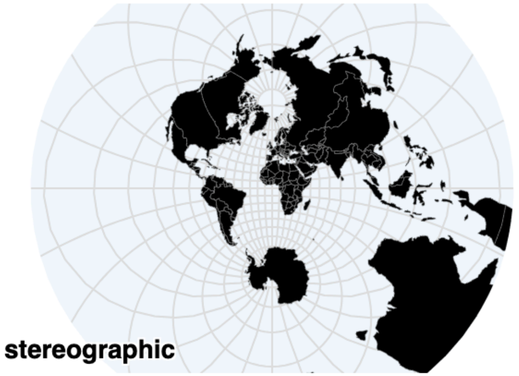
LONGitude lines are all long (some latitude lines are quite short!)

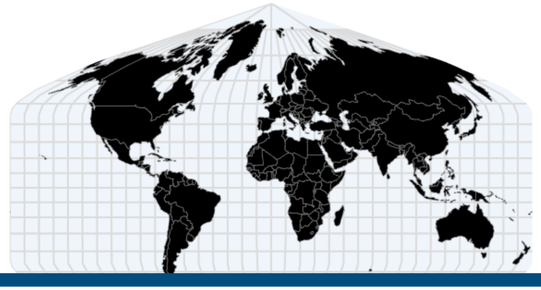
A sphere tears
when you flatten it

Exploring Projections





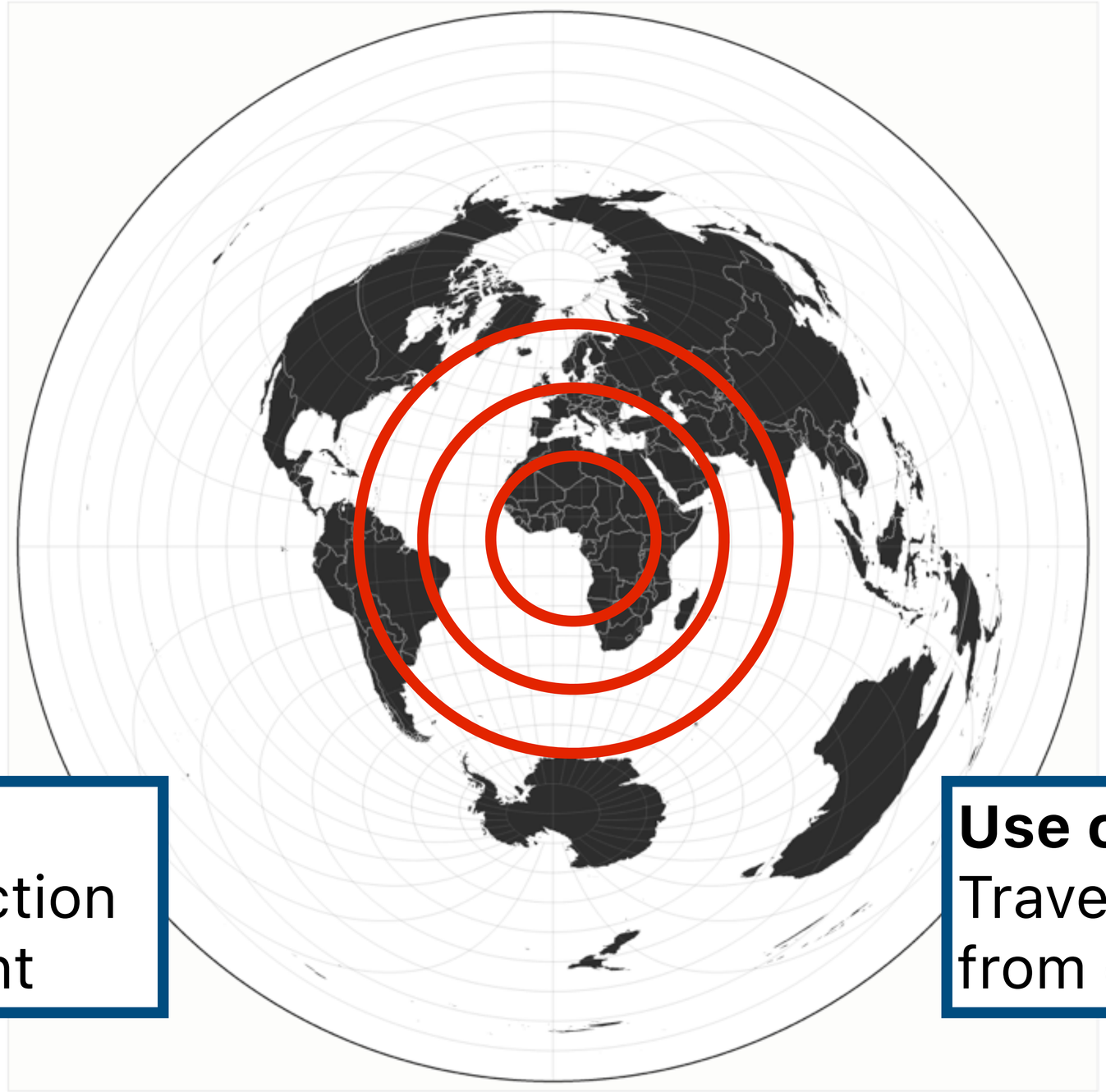




https://vega.github.io/vega/examples/projections/

Projections preserve some metrics, distort others

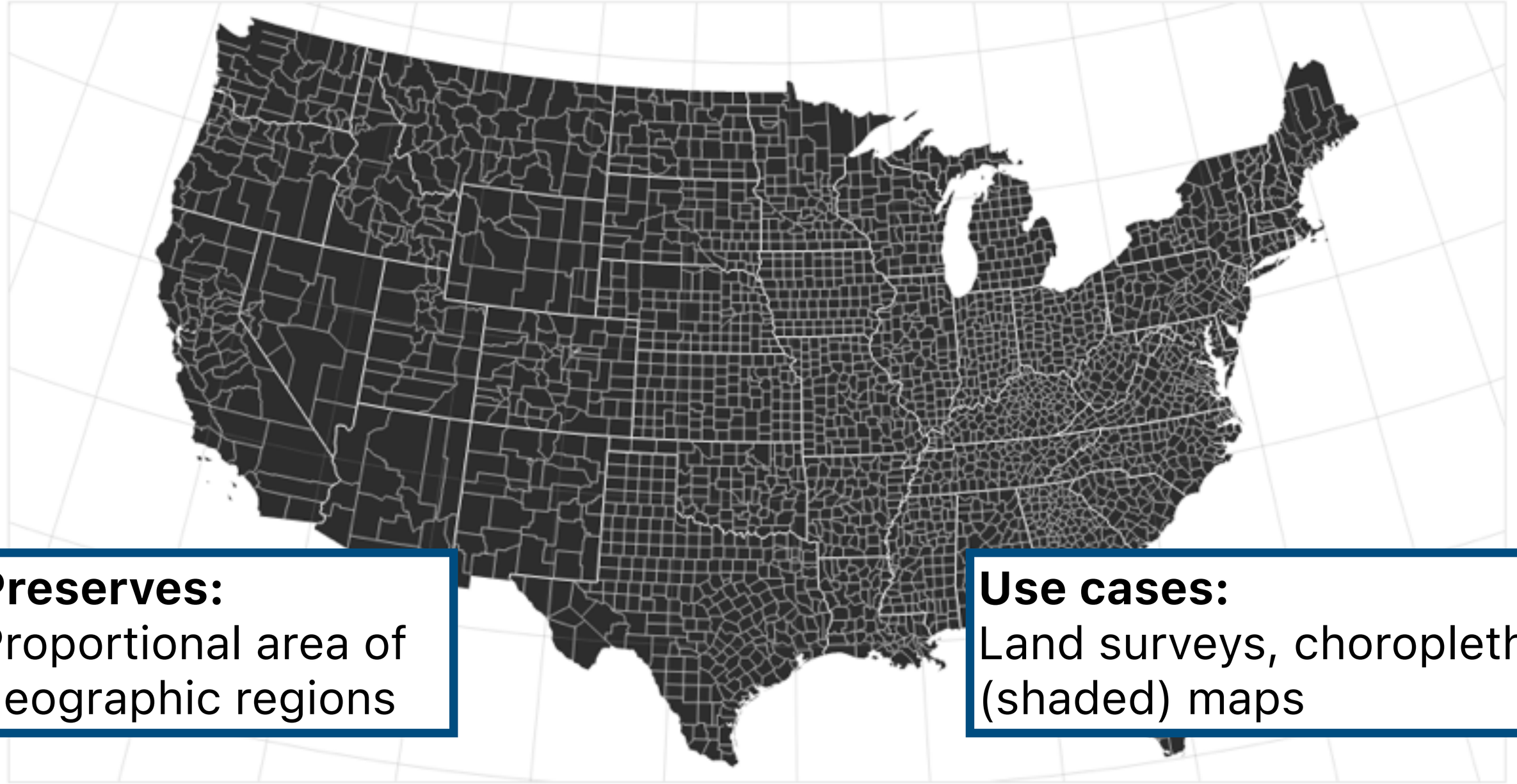
Azimuthal Equidistant



Preserves:
Distance & direction from center point

Use cases:
Travel / propagation from center point

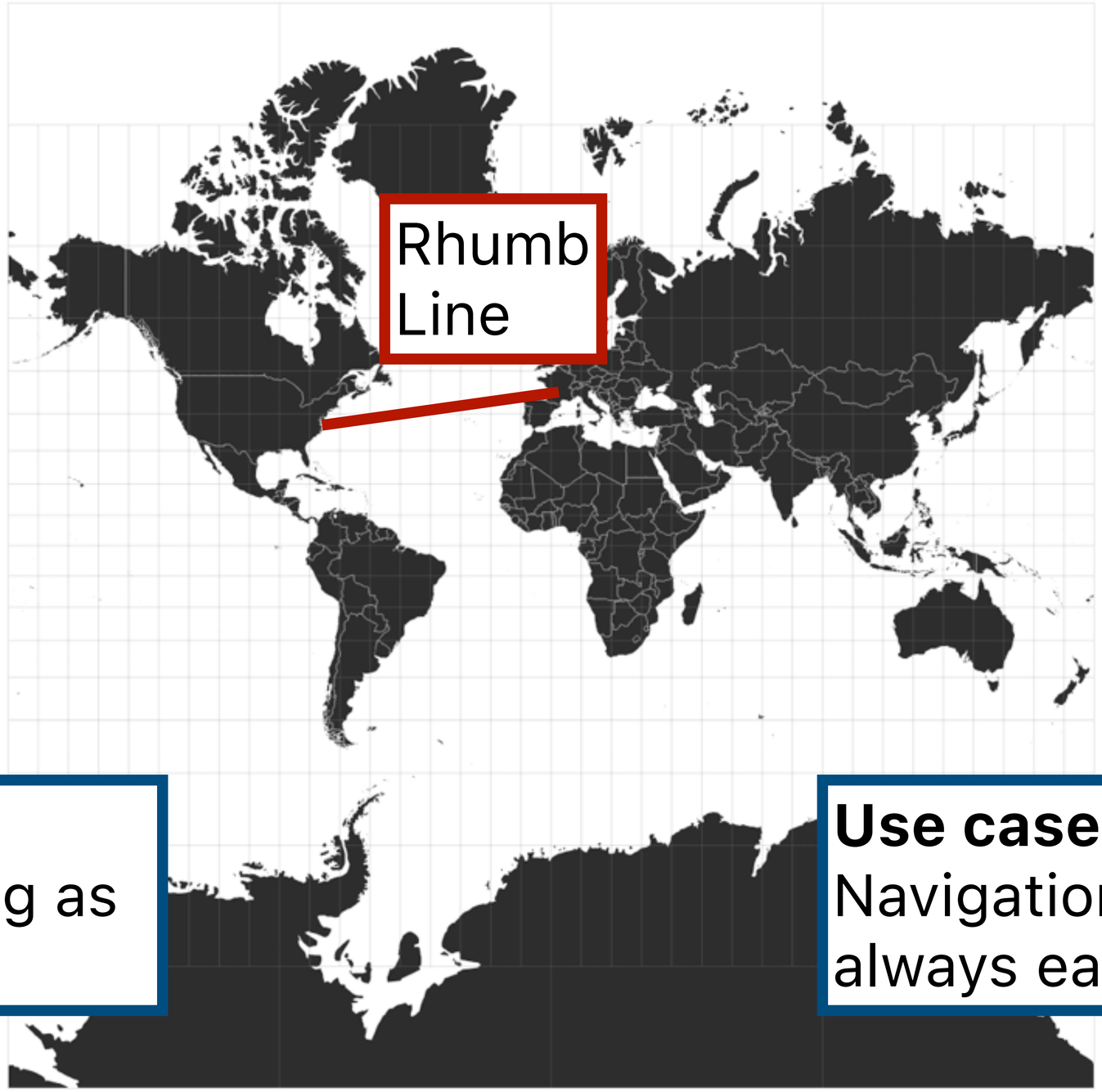
Albers Equal-Area Conic



Preserves:
Proportional area of geographic regions

Use cases:
Land surveys, choropleth (shaded) maps

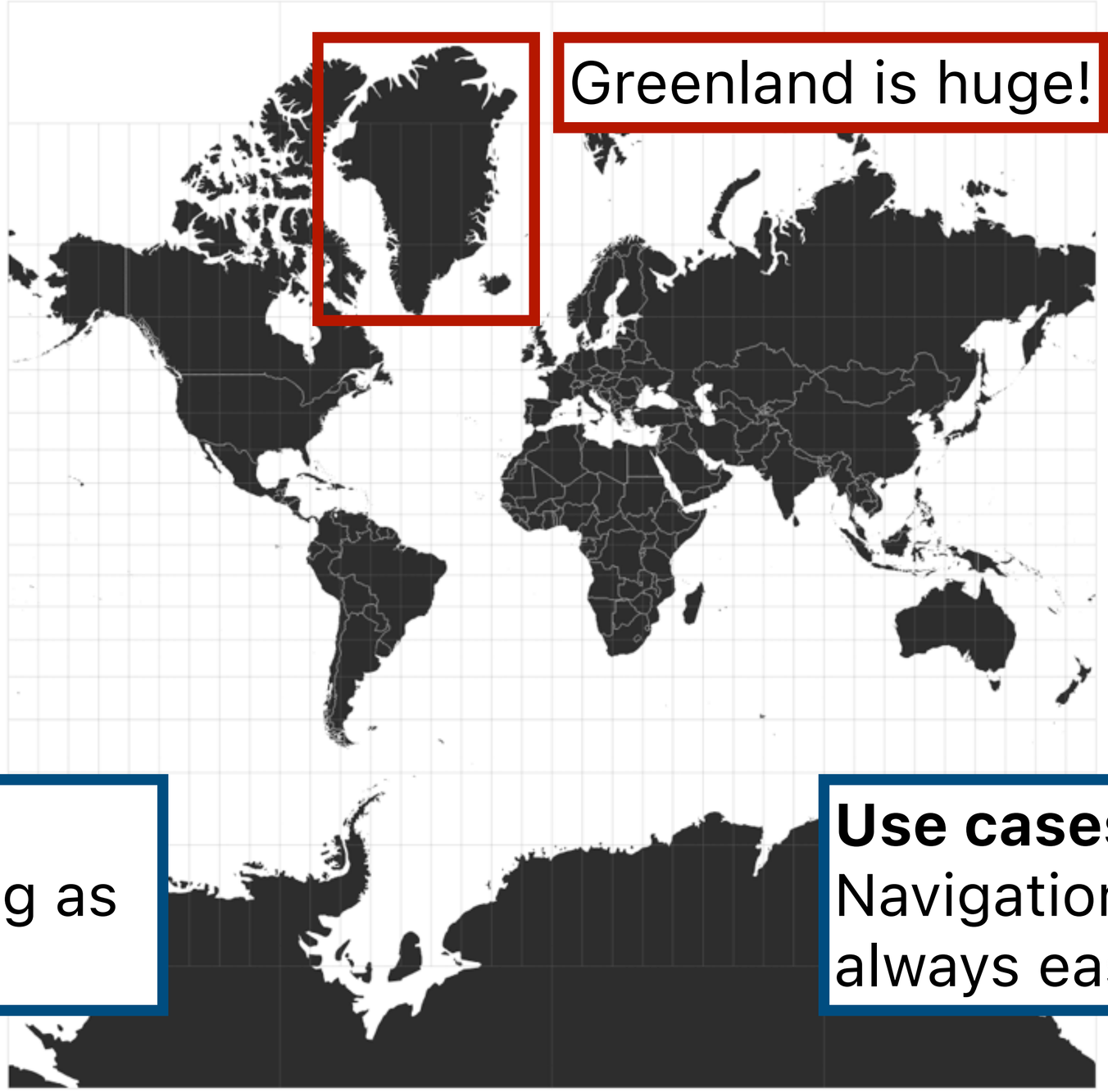
Spherical Mercator



Preserves:
Compass bearing as straight line

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

Spherical Mercator

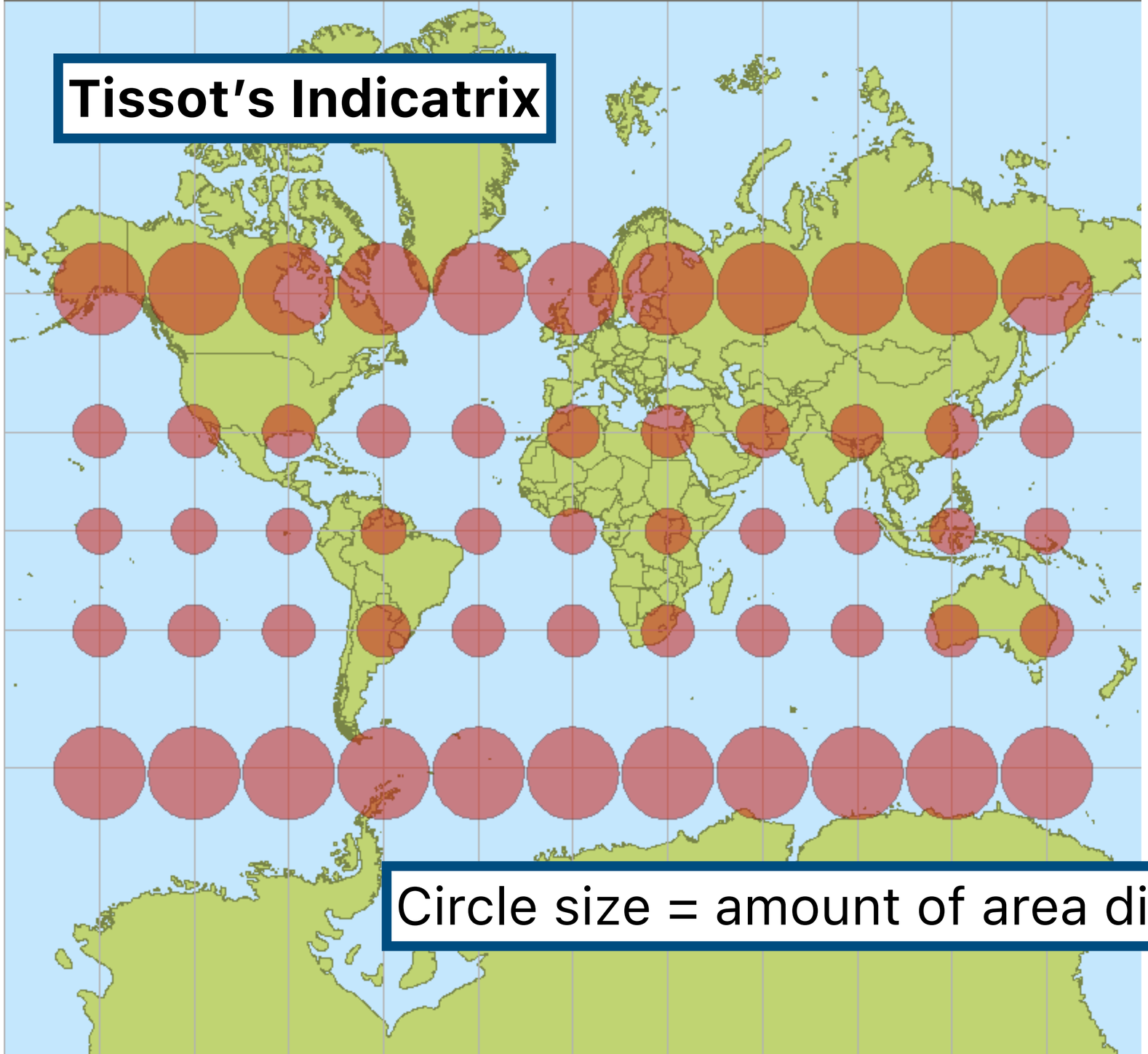


Greenland is huge!

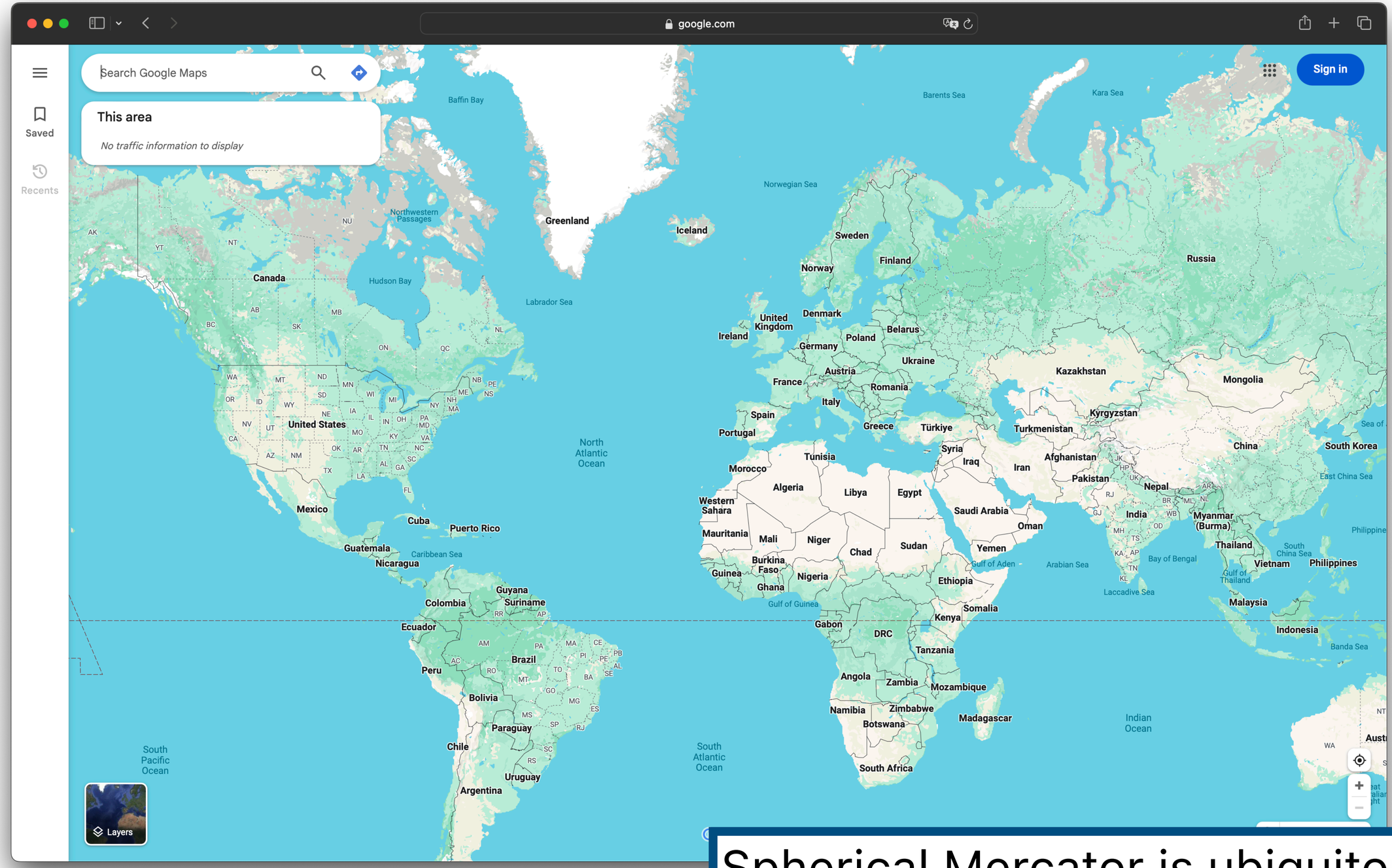
Preserves:
Compass bearing as straight line

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

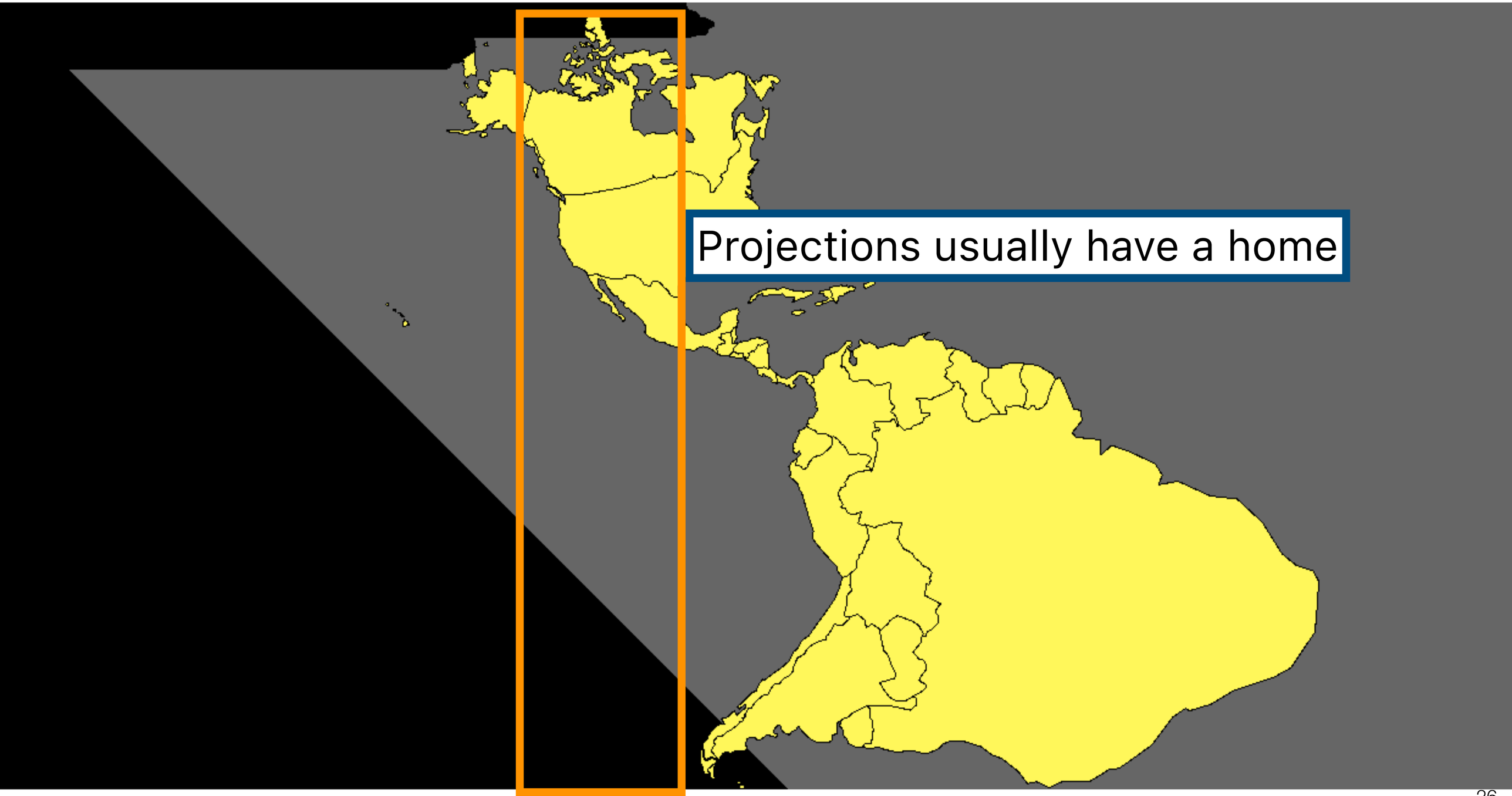
Tissot’s Indicatrix



Circle size = amount of area distortion



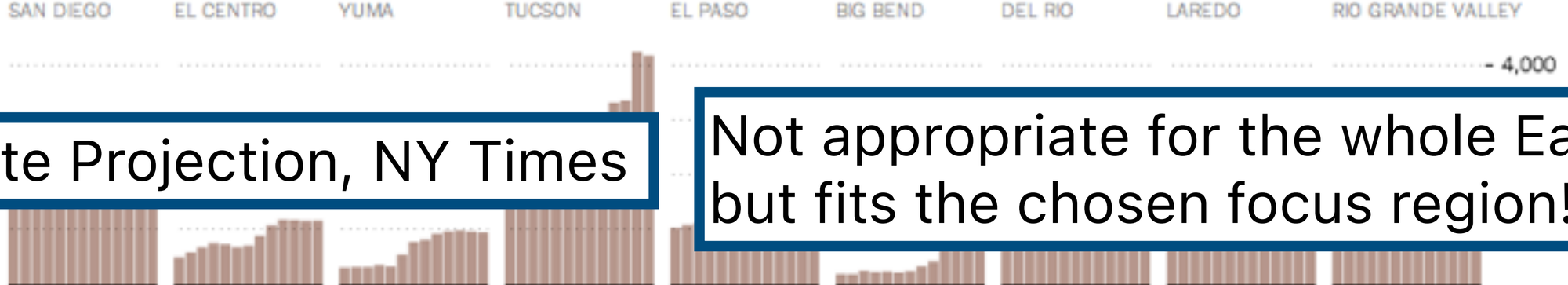
Spherical Mercator is ubiquitous on web


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

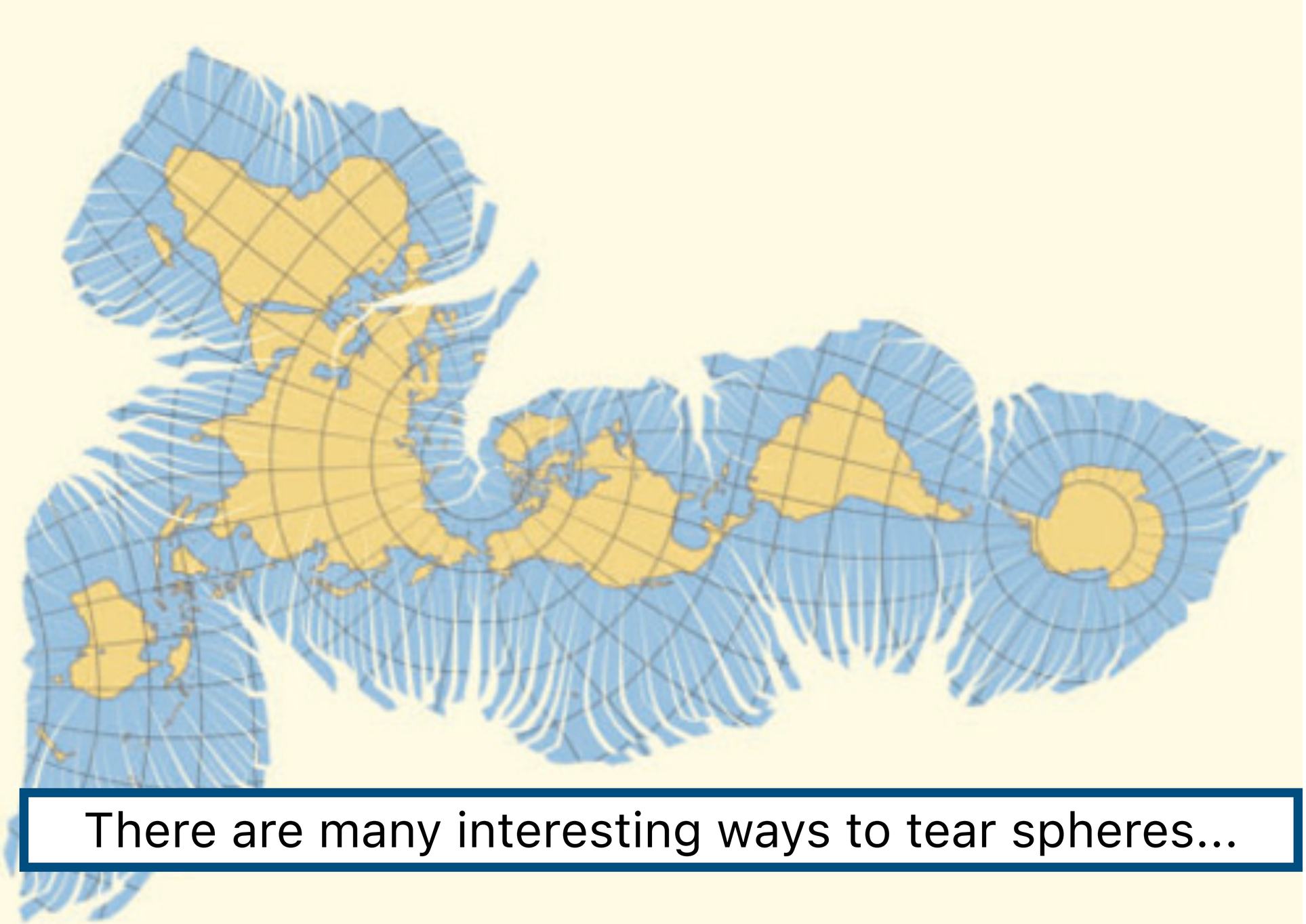
http://xkcd.com/977

MERCATOR

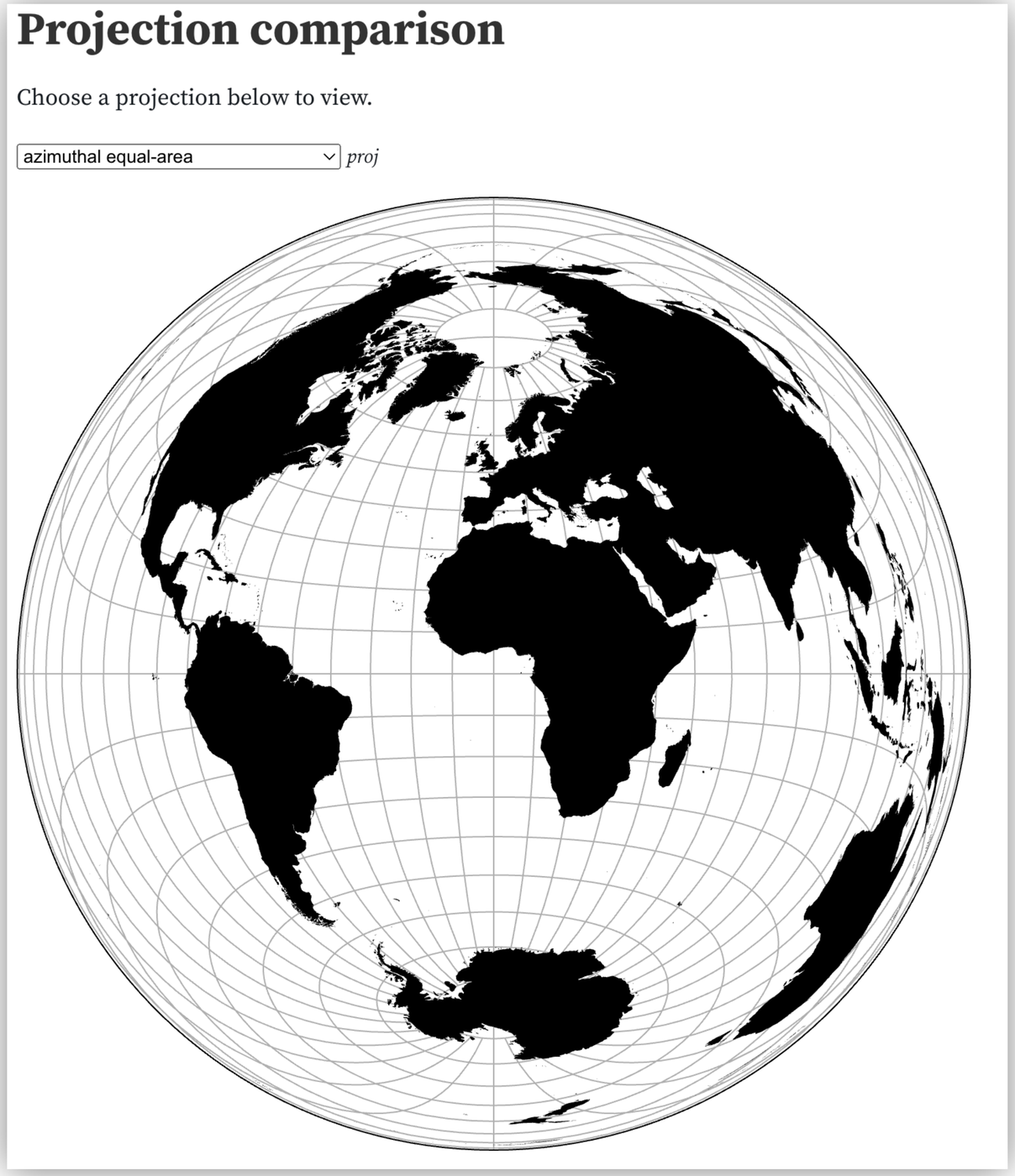
YOU'RE NOT REALLY INTO MAPS.

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?

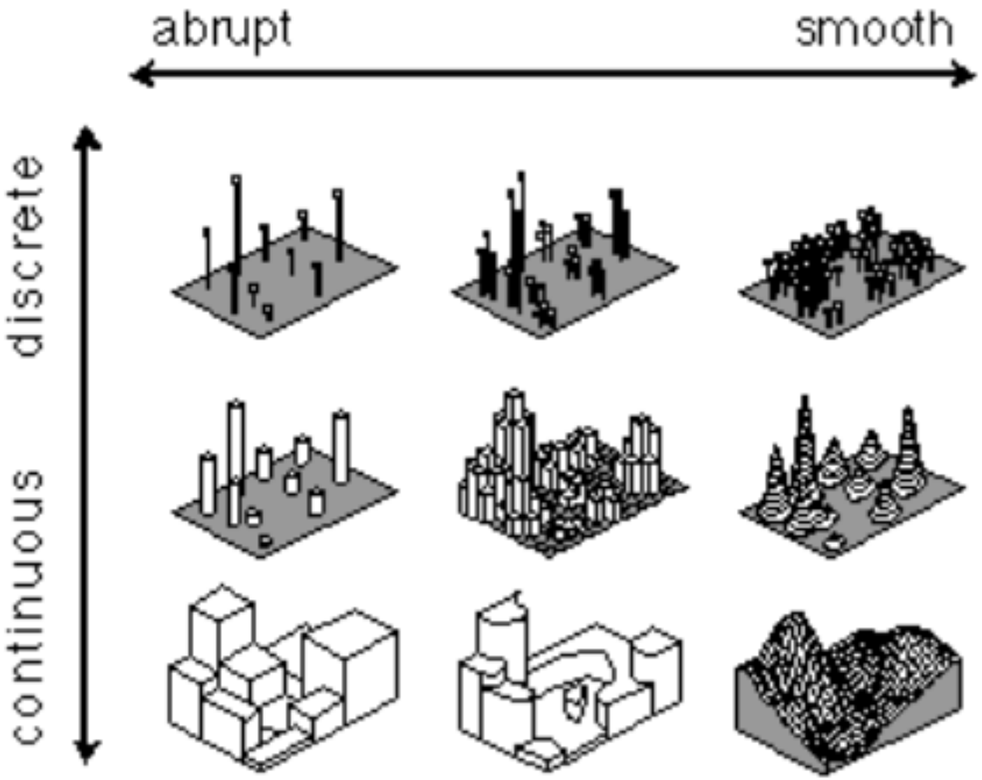


Fig. 8. Data models representing points in the continuity-abruptness phenomena space.

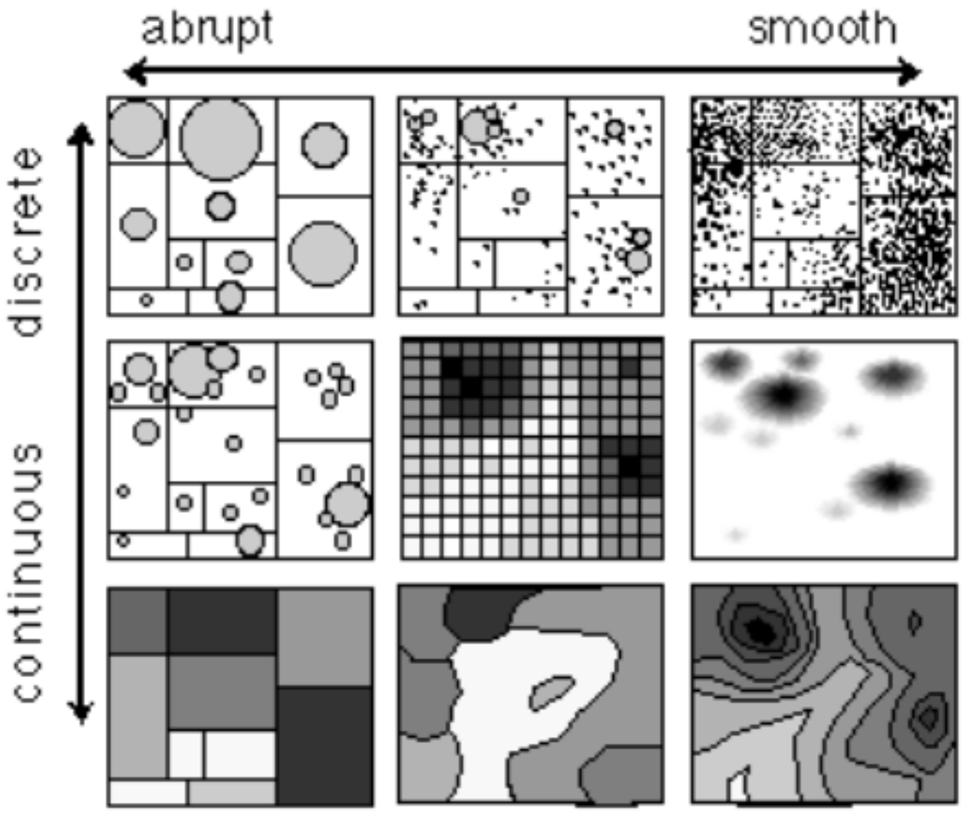
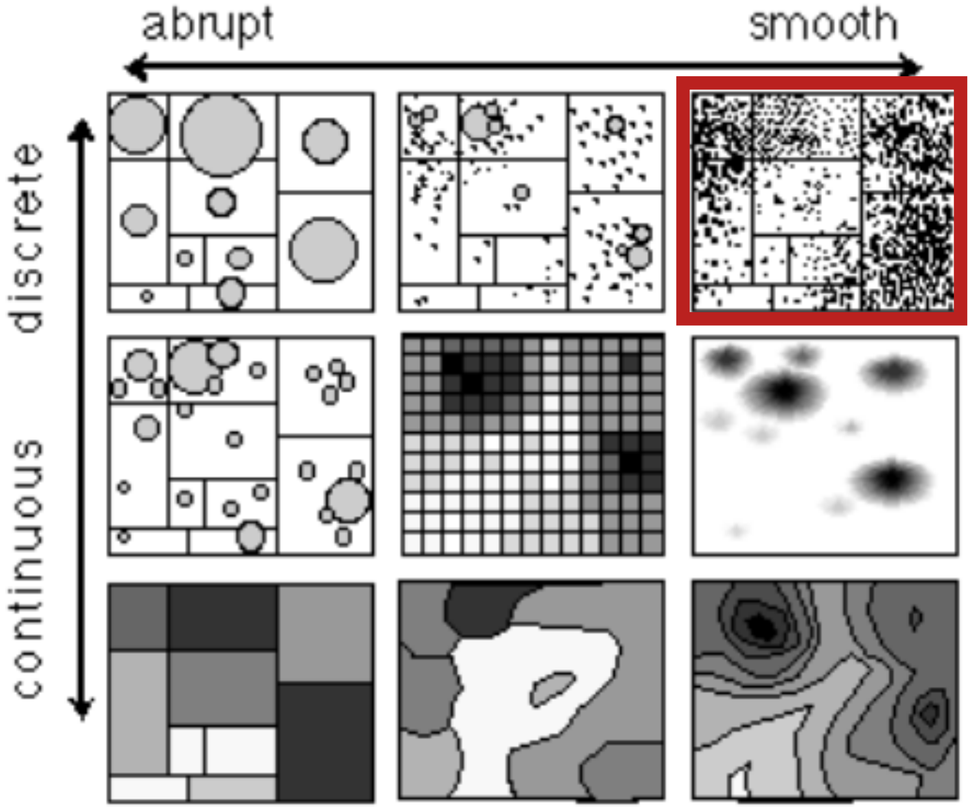


Fig. 9. Possible 2D translations of the 3D data models shown in figure 8.

[MacEachren. Visualizing Uncertain Information. 1992]

Dot Distribution Map



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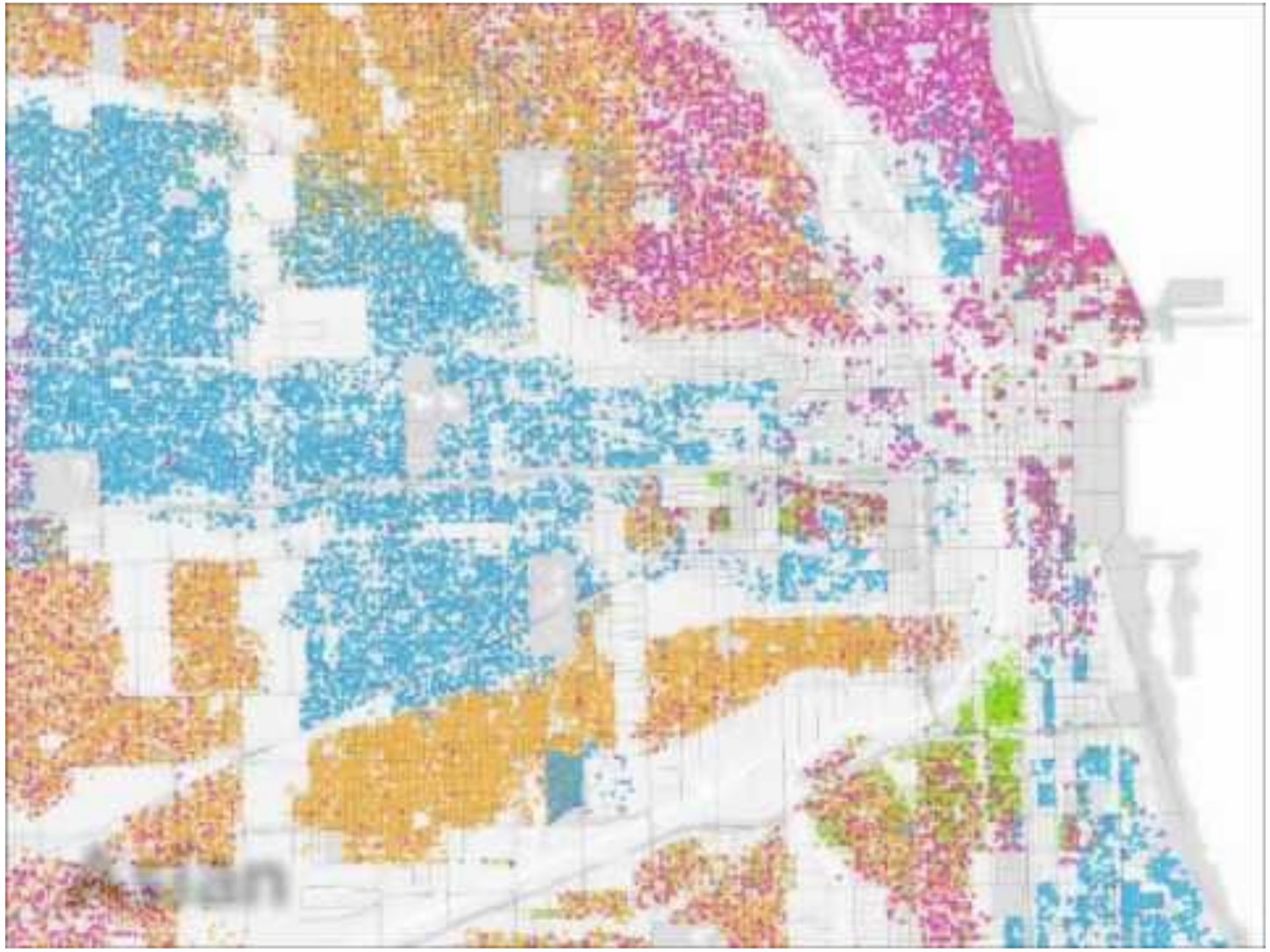

https://www.youtube.com/watch?v=8pRcdMVkA3k

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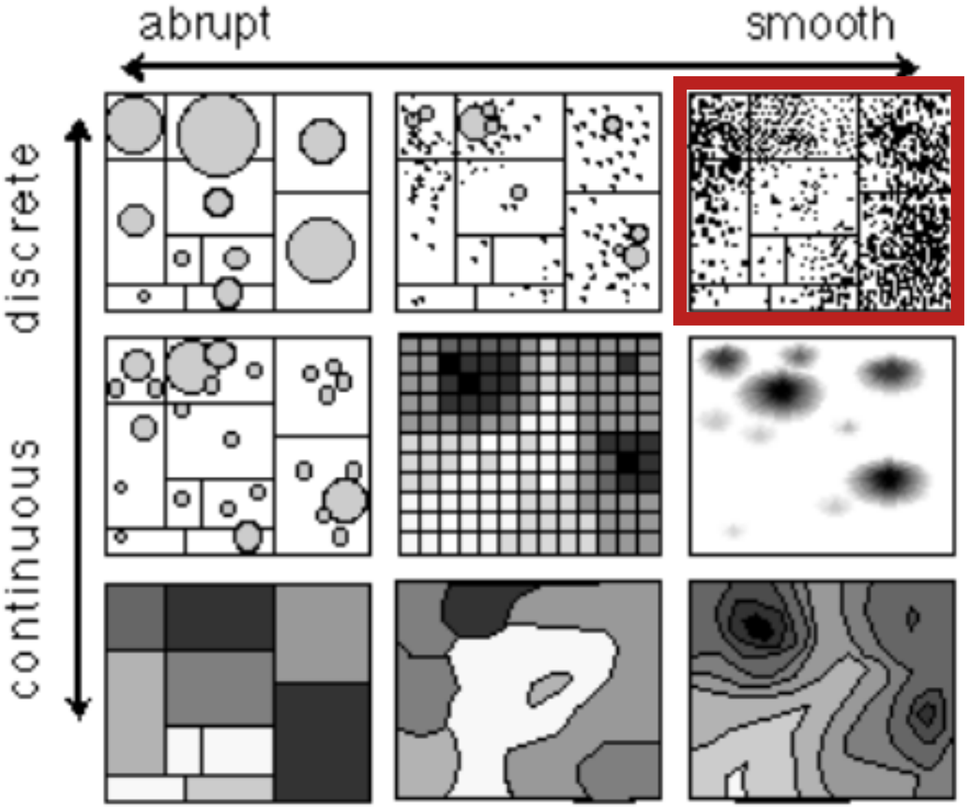

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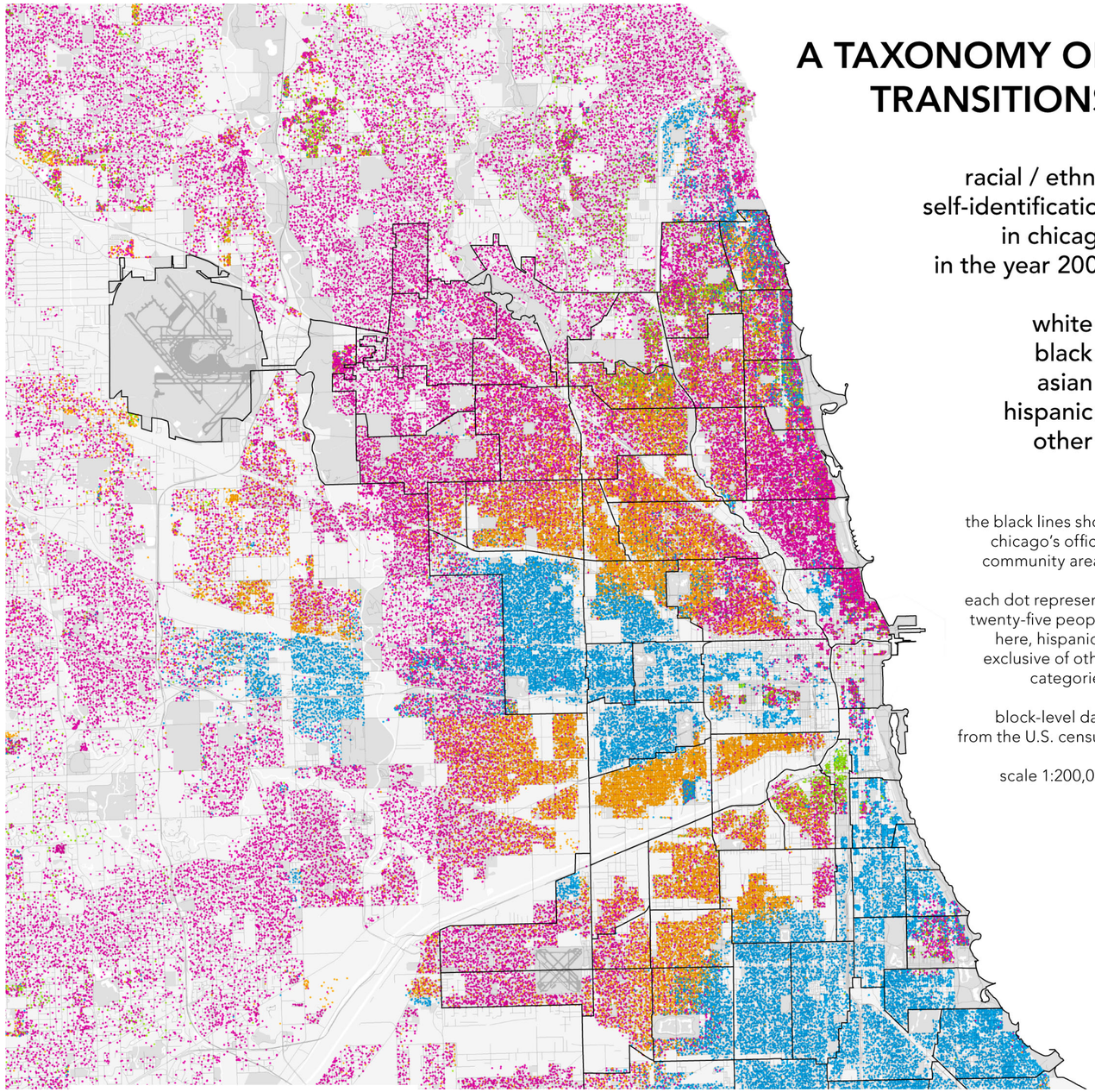

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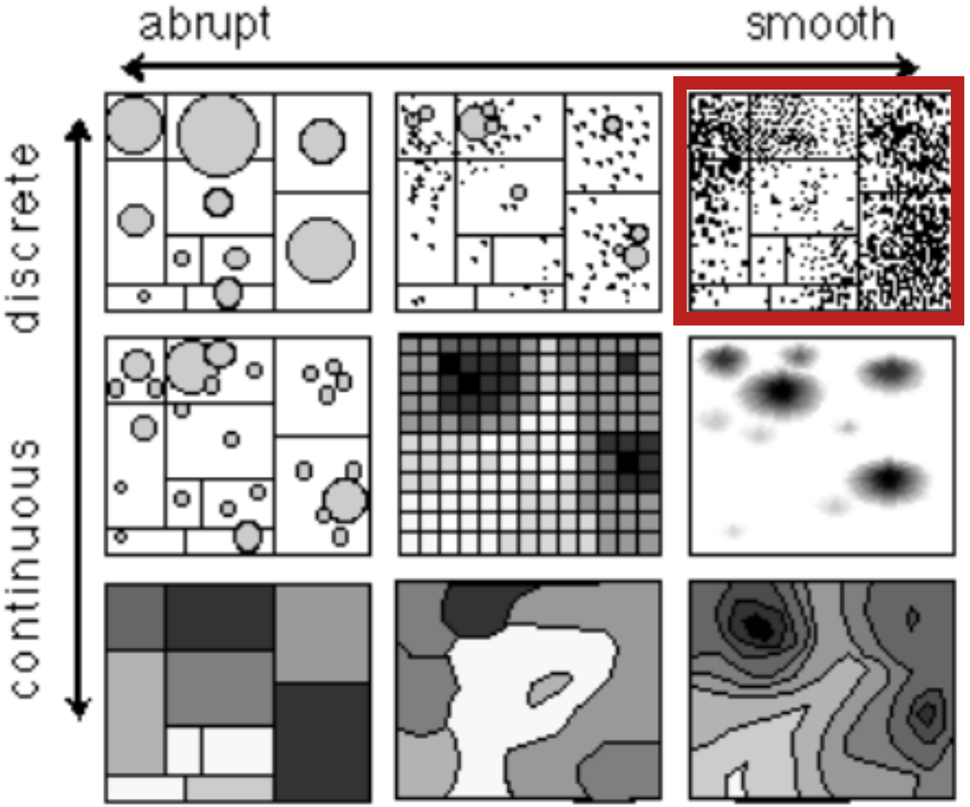

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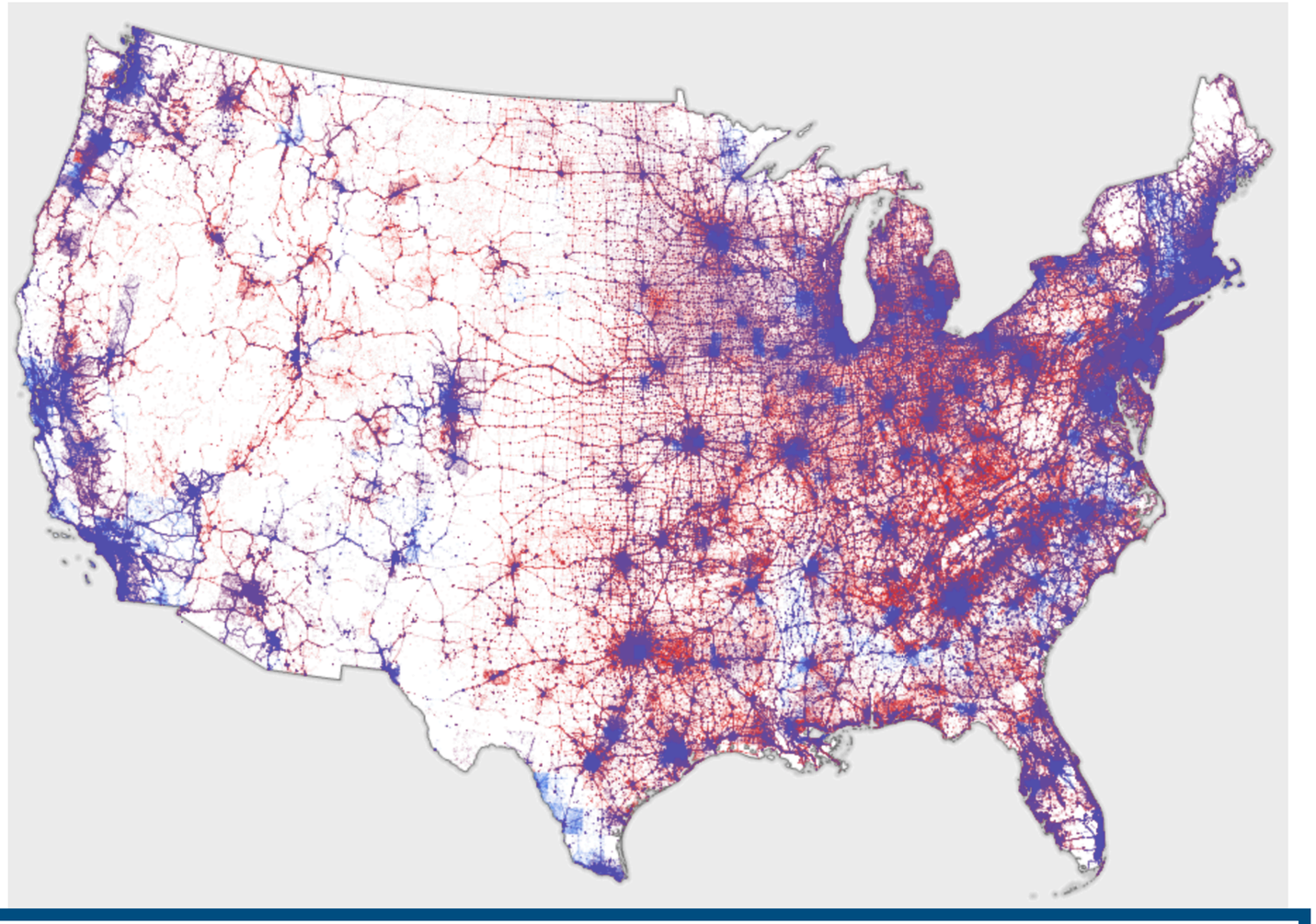
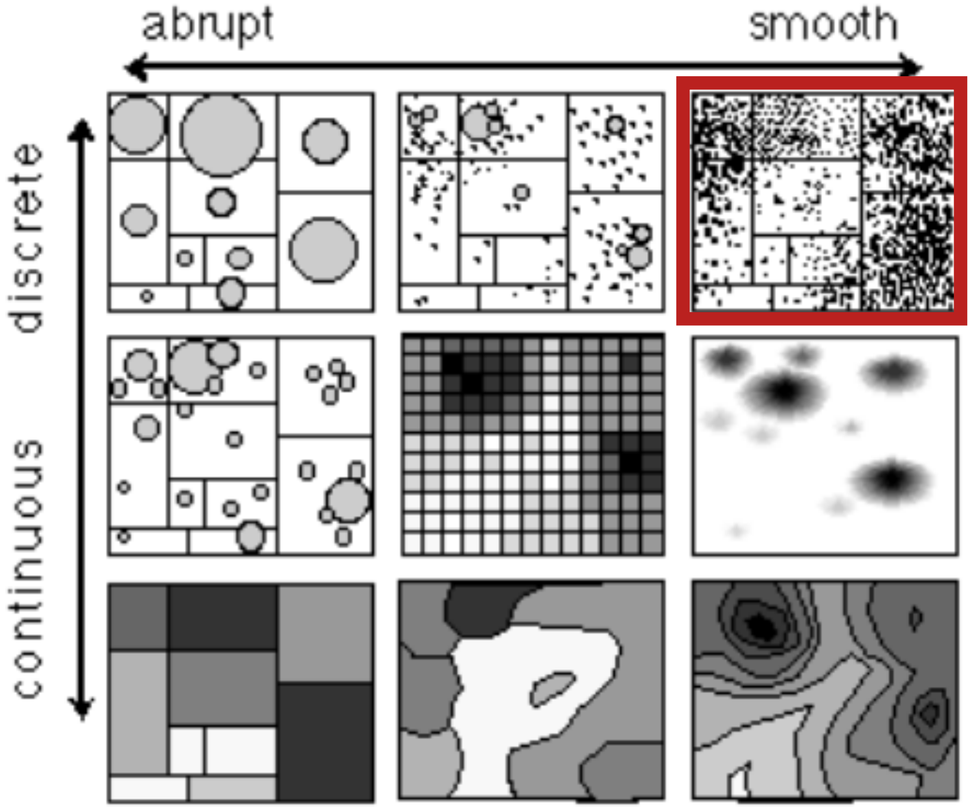


Votes cast in the 2016 Presidential Election

Dot Distribution Map



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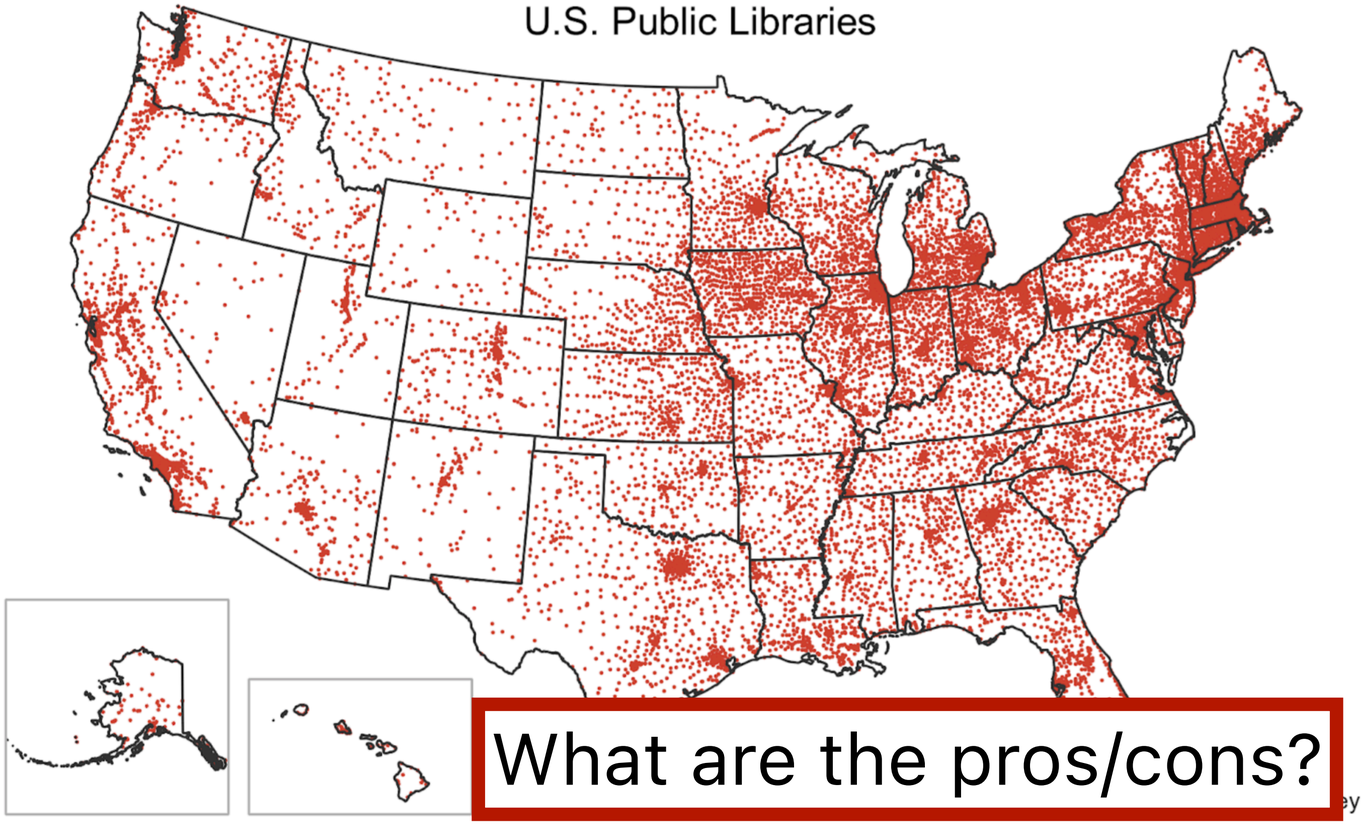
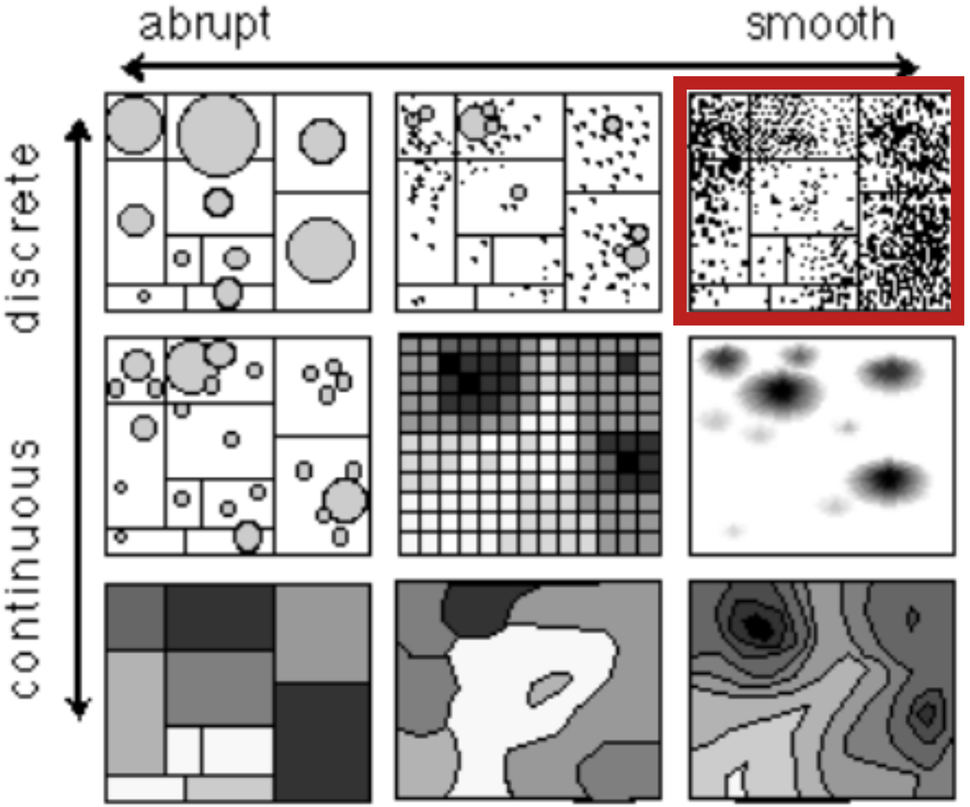


What are the pros/cons?

tryclassbuzz.com
Code: **dots**

Dot Distribution Map



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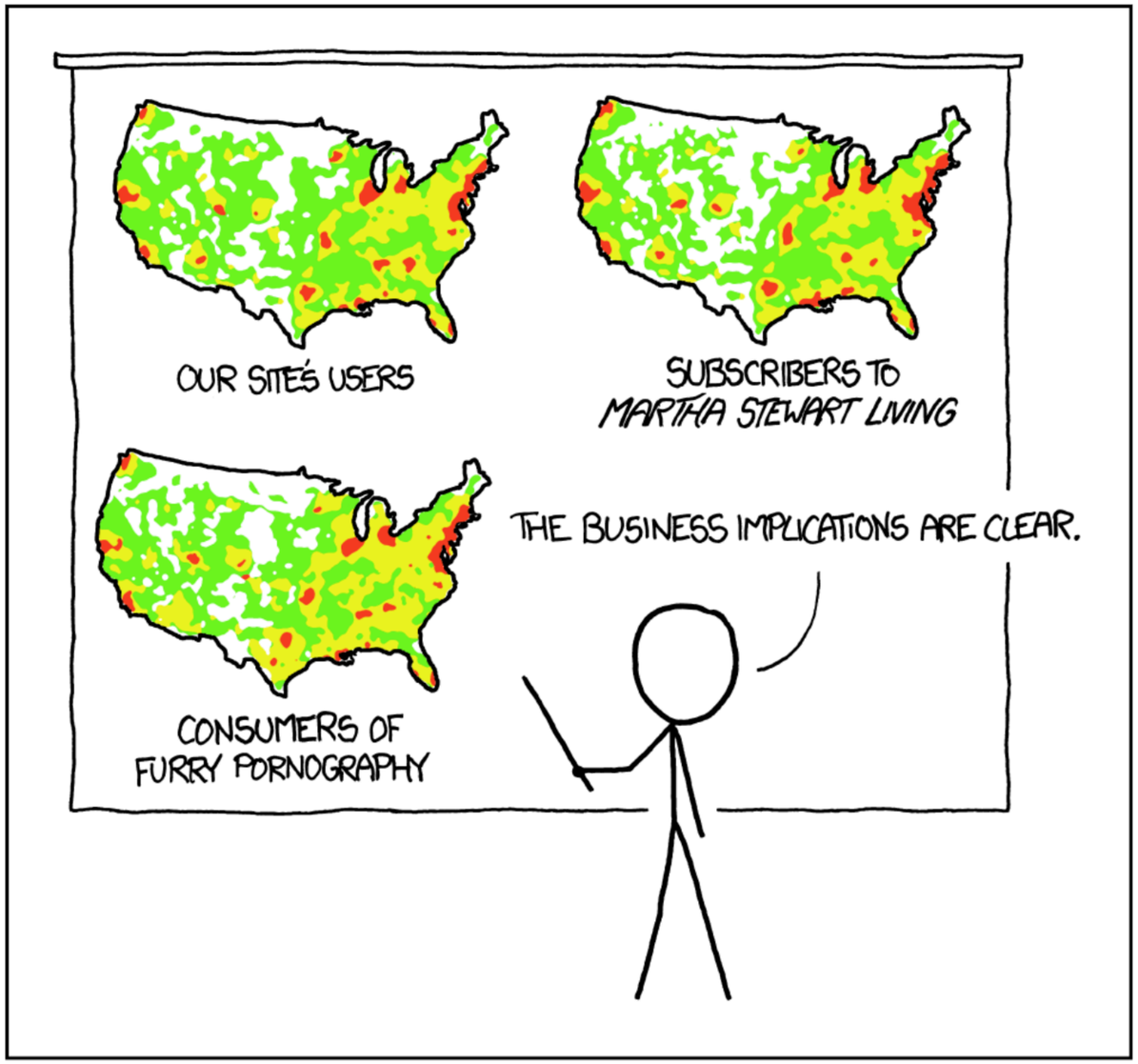
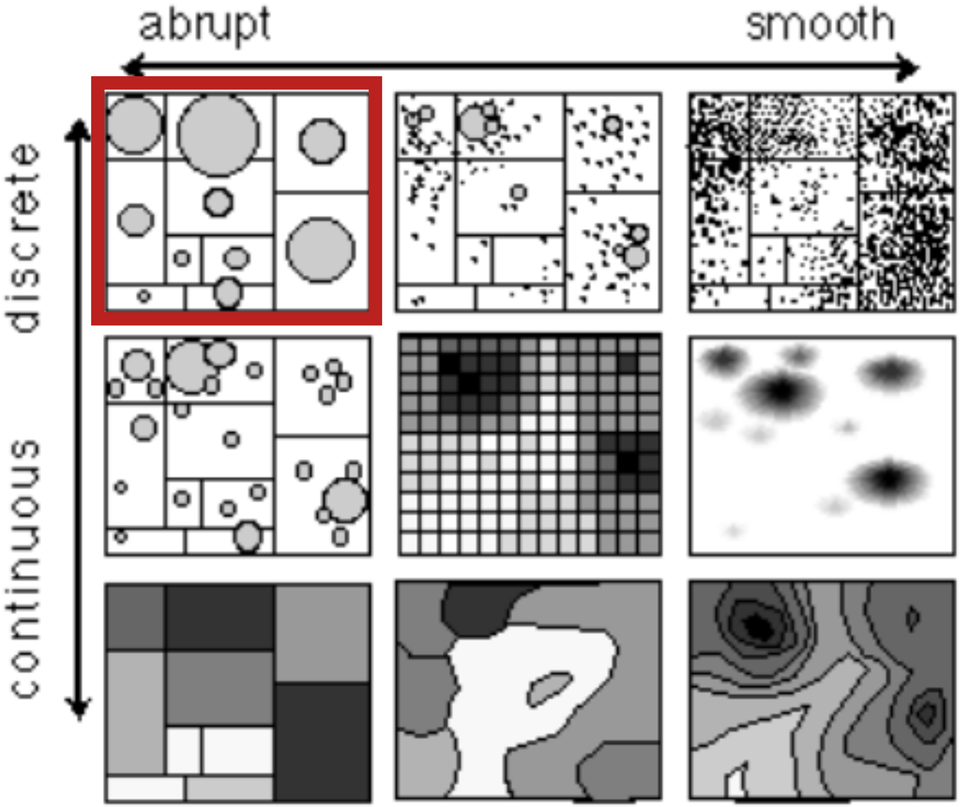


PET PEEVE #208:
GEOGRAPHIC PROFILE MAPS WHICH ARE BASICALLY JUST POPULATION MAPS

Proportional Symbol Map



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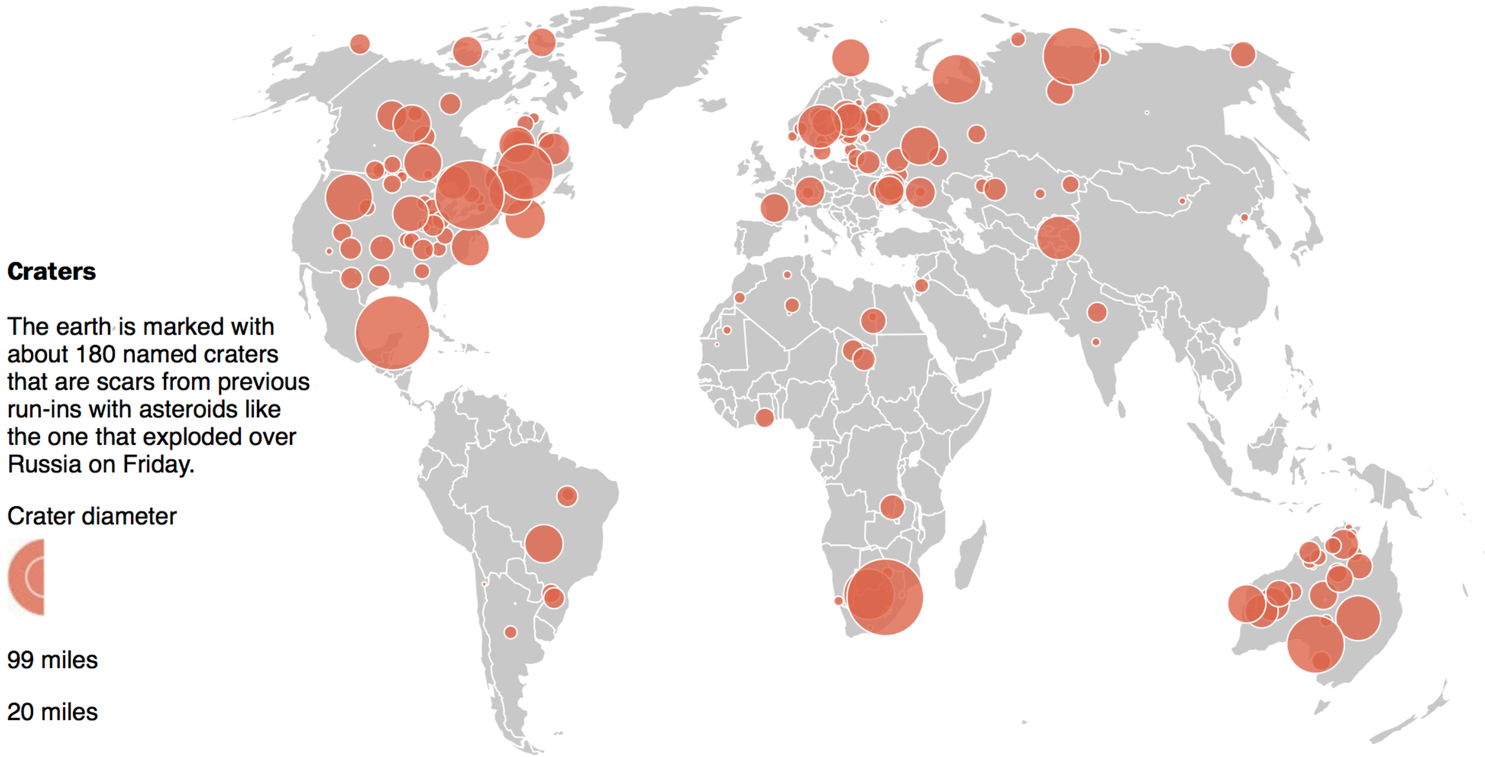


http://www.washingtonpost.com/wp-srv/special/world/russia-meteor/index.html

Proportional Symbol Map

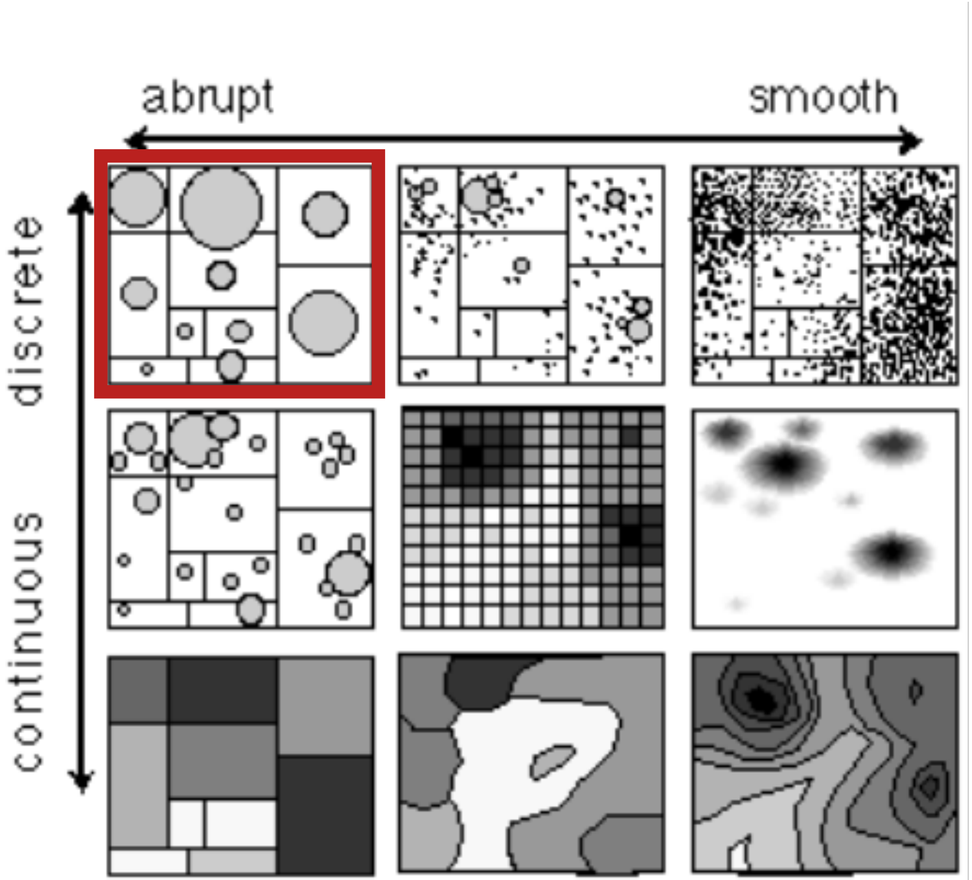
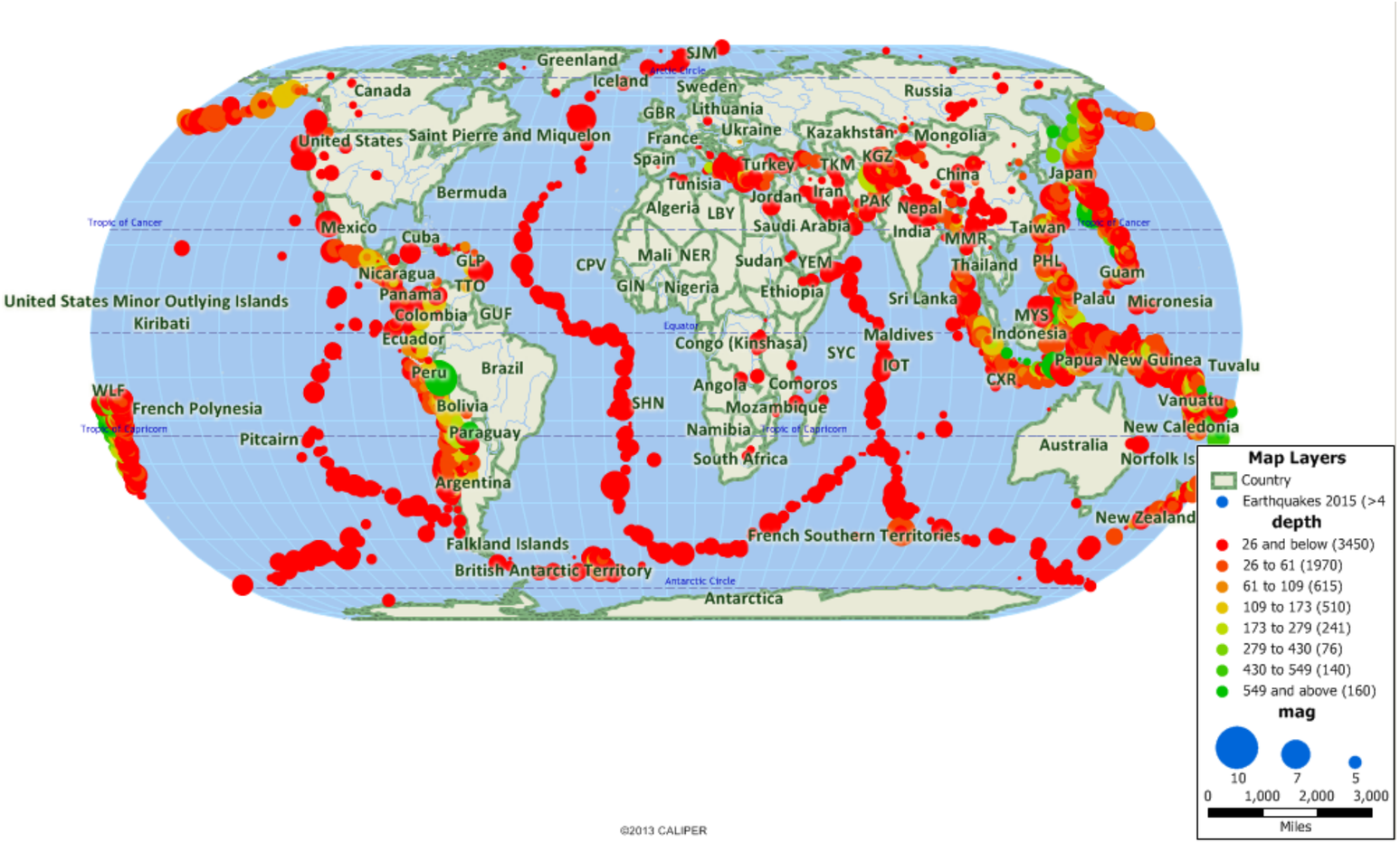
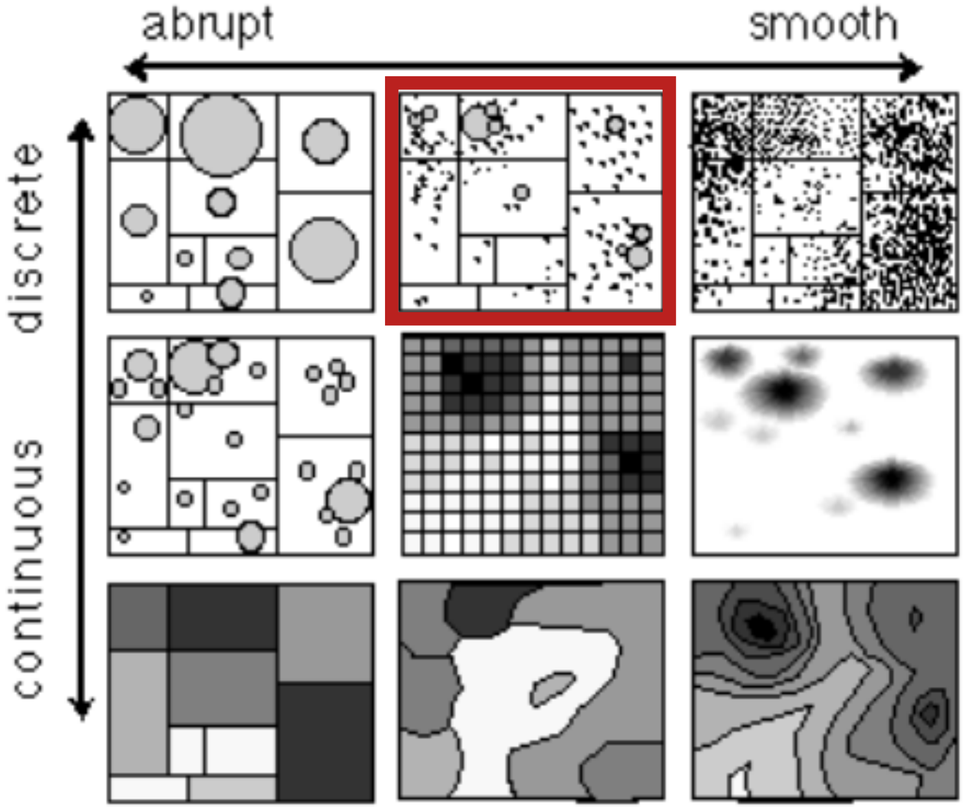


Fig. 9. Possible 2D translations of the 3D data models shown in figure 8.



Graduated Symbol Map



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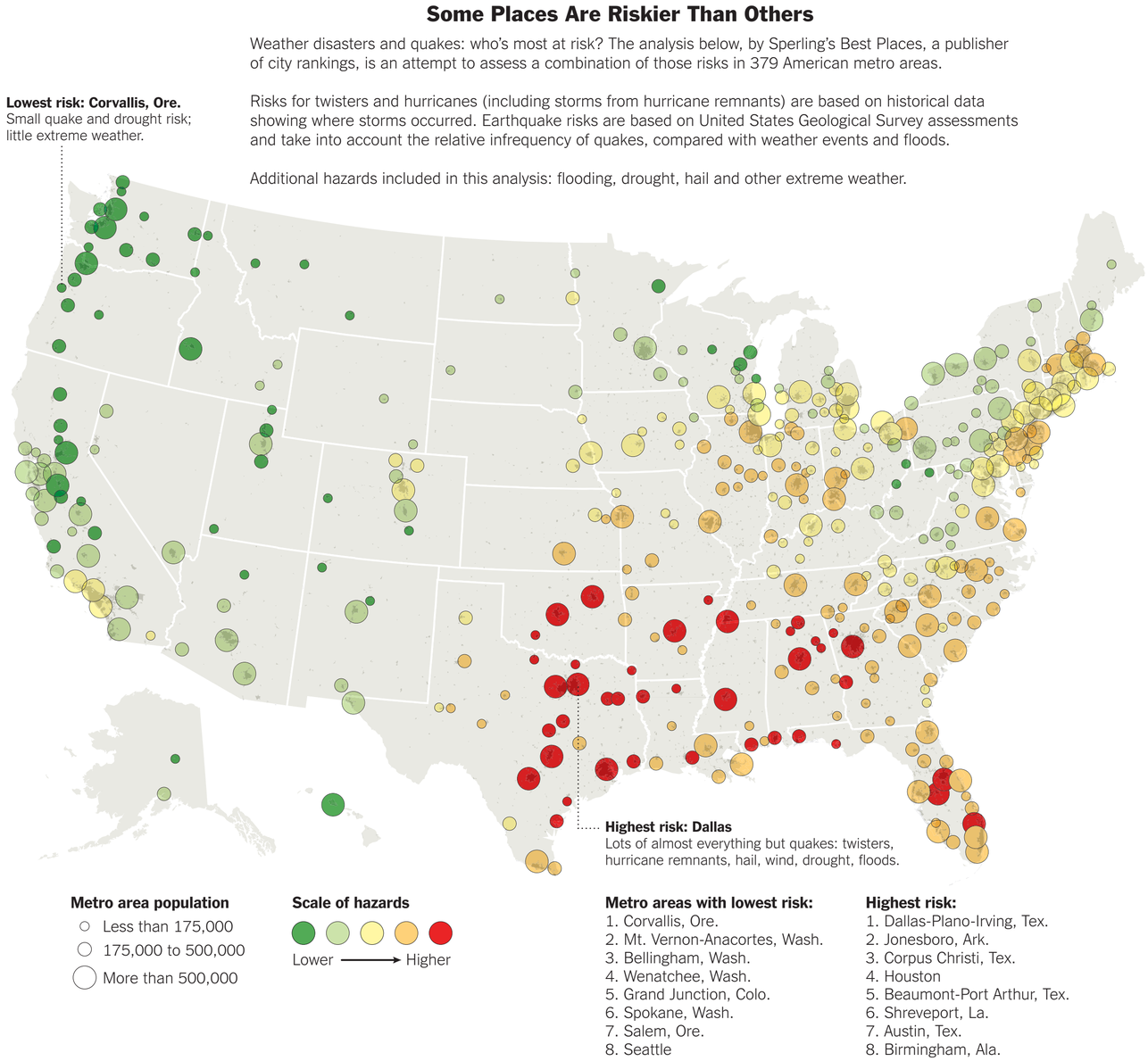
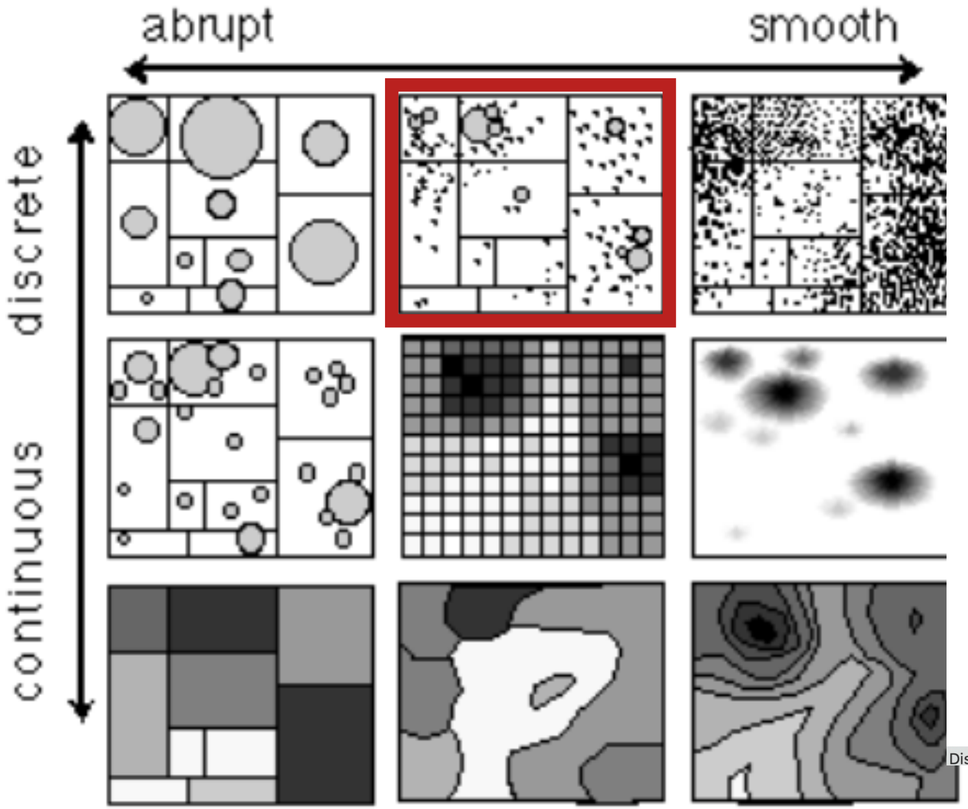


https://archive.nytimes.com/www.nytimes.com/interactive/2011/05/01/weekinreview/01safe.html?_r=0

Graduated Symbol Map



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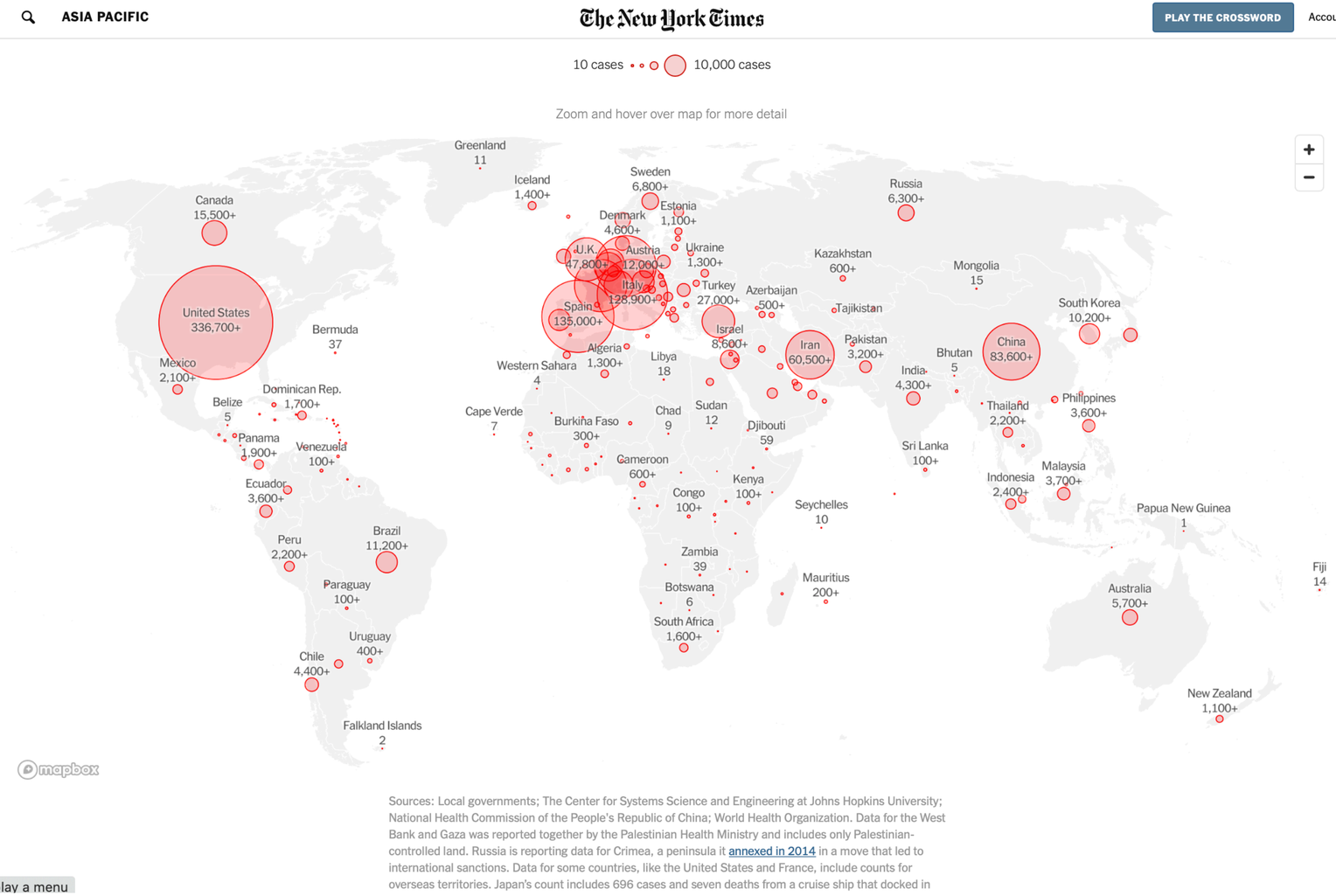
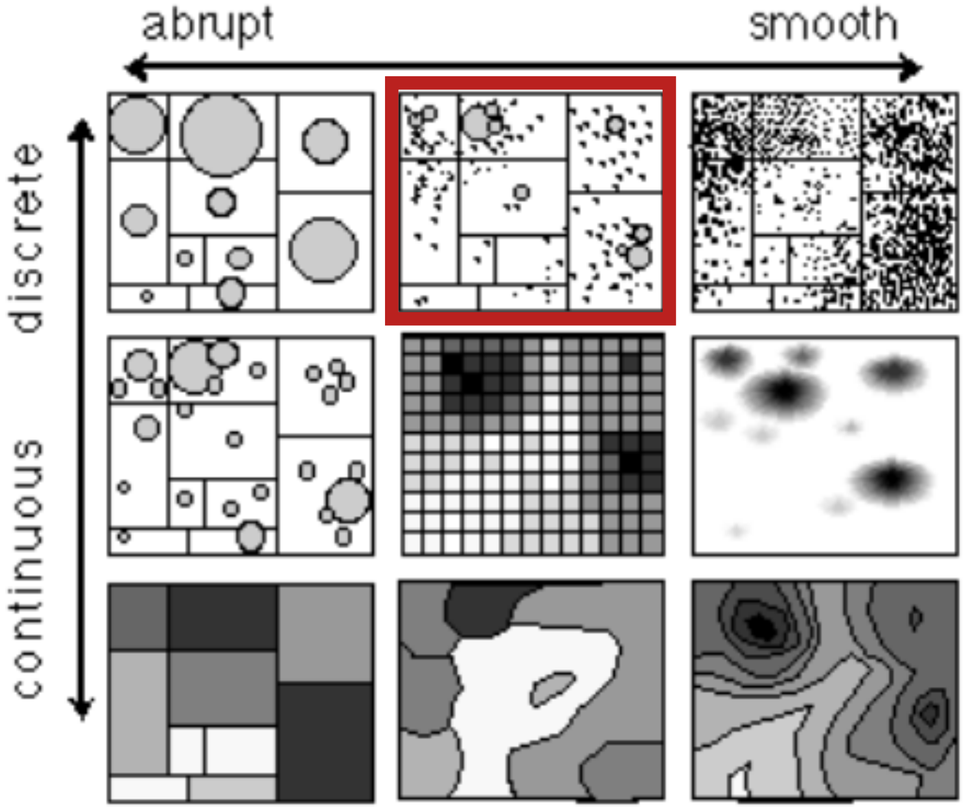


https://www.nytimes.com/interactive/2021/world/covid-cases.html

Graduated Symbol Map?



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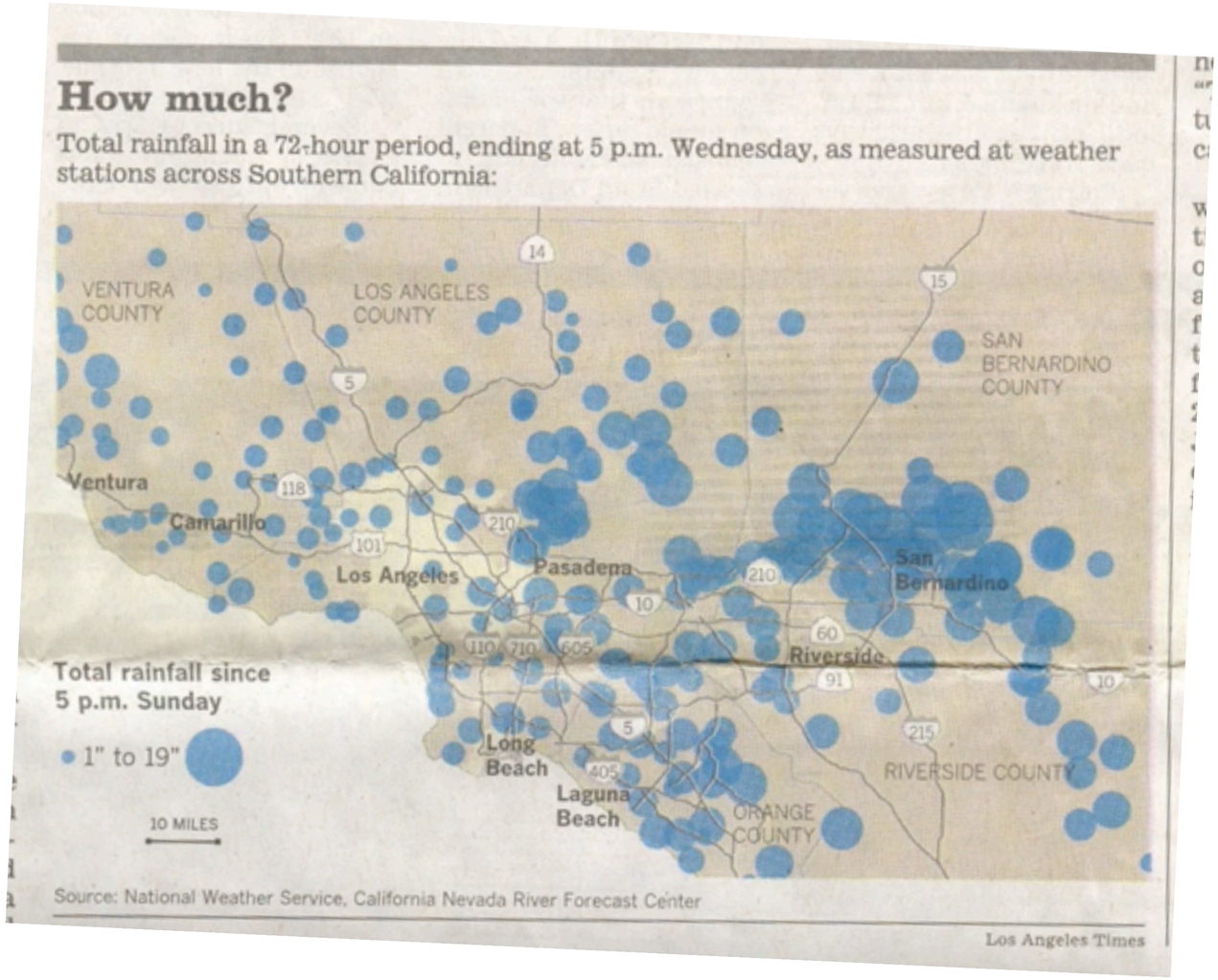
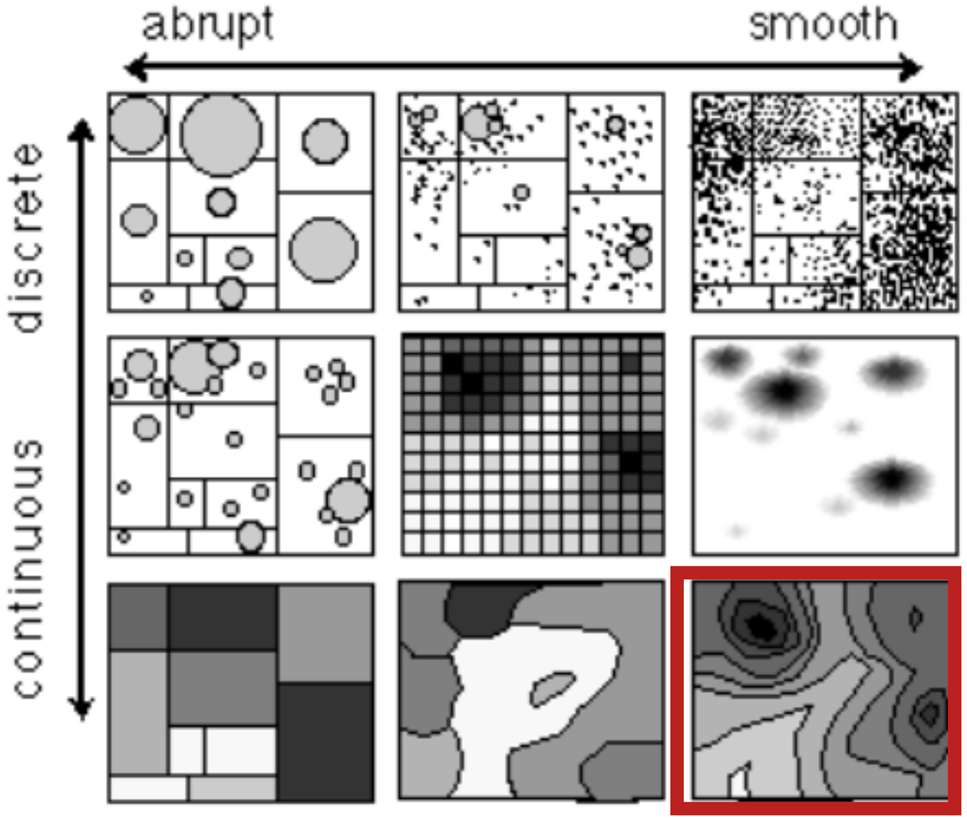


Isopleth / Heat Map



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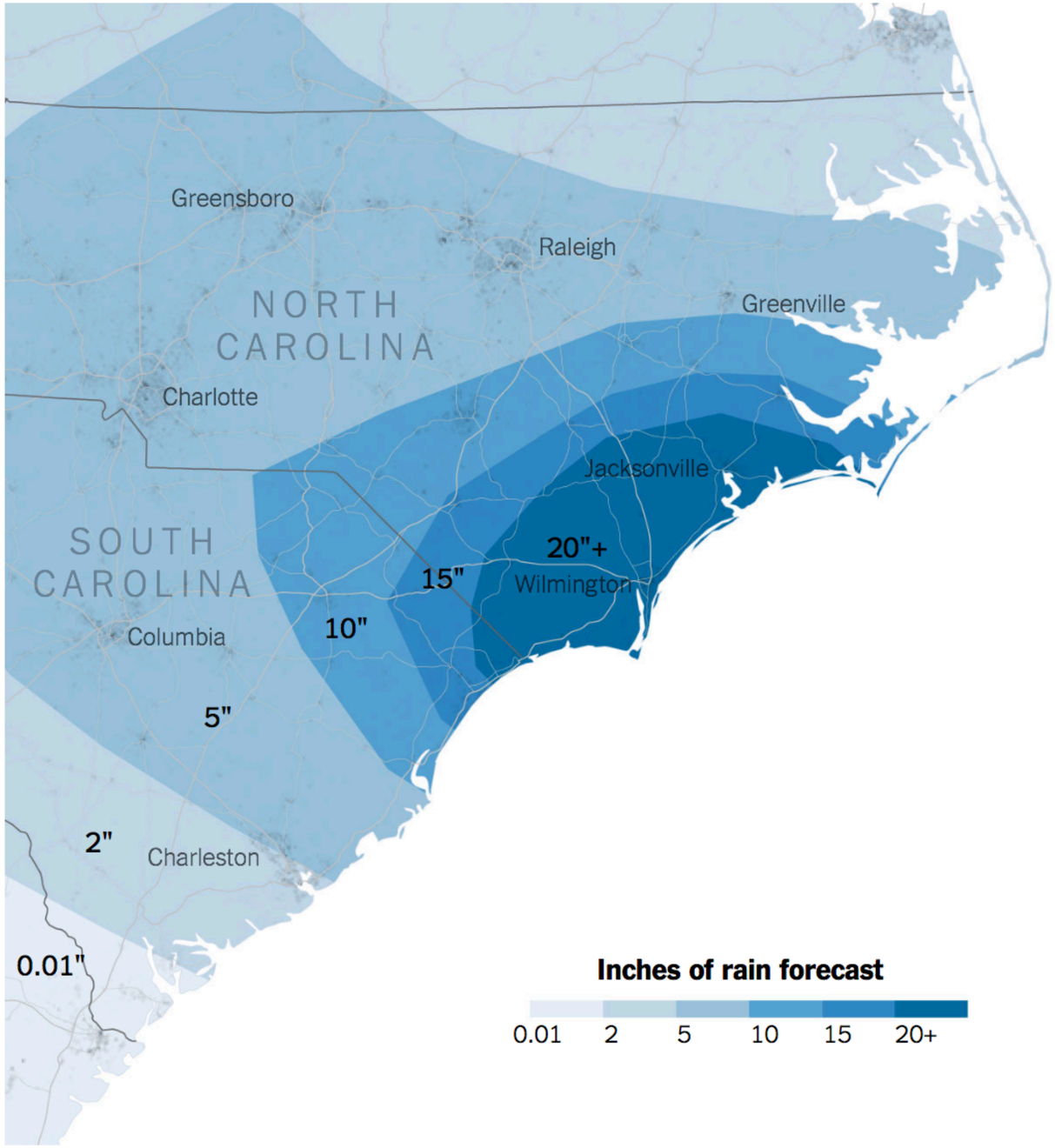
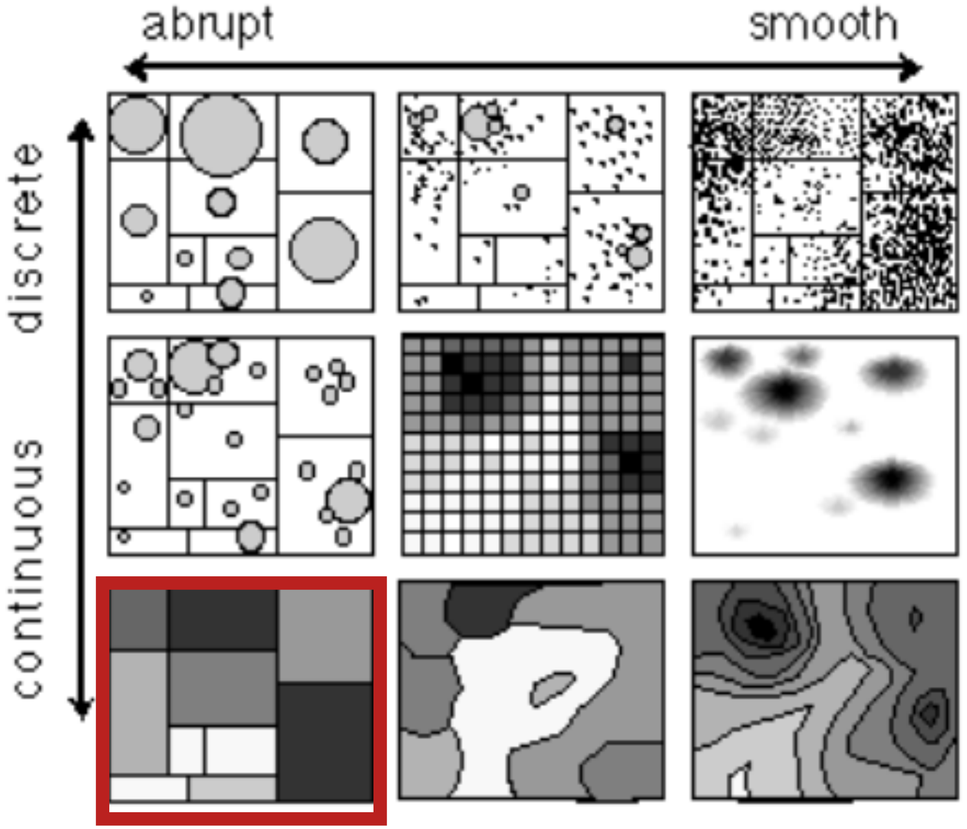


Source: National Weather Service

Choropleth



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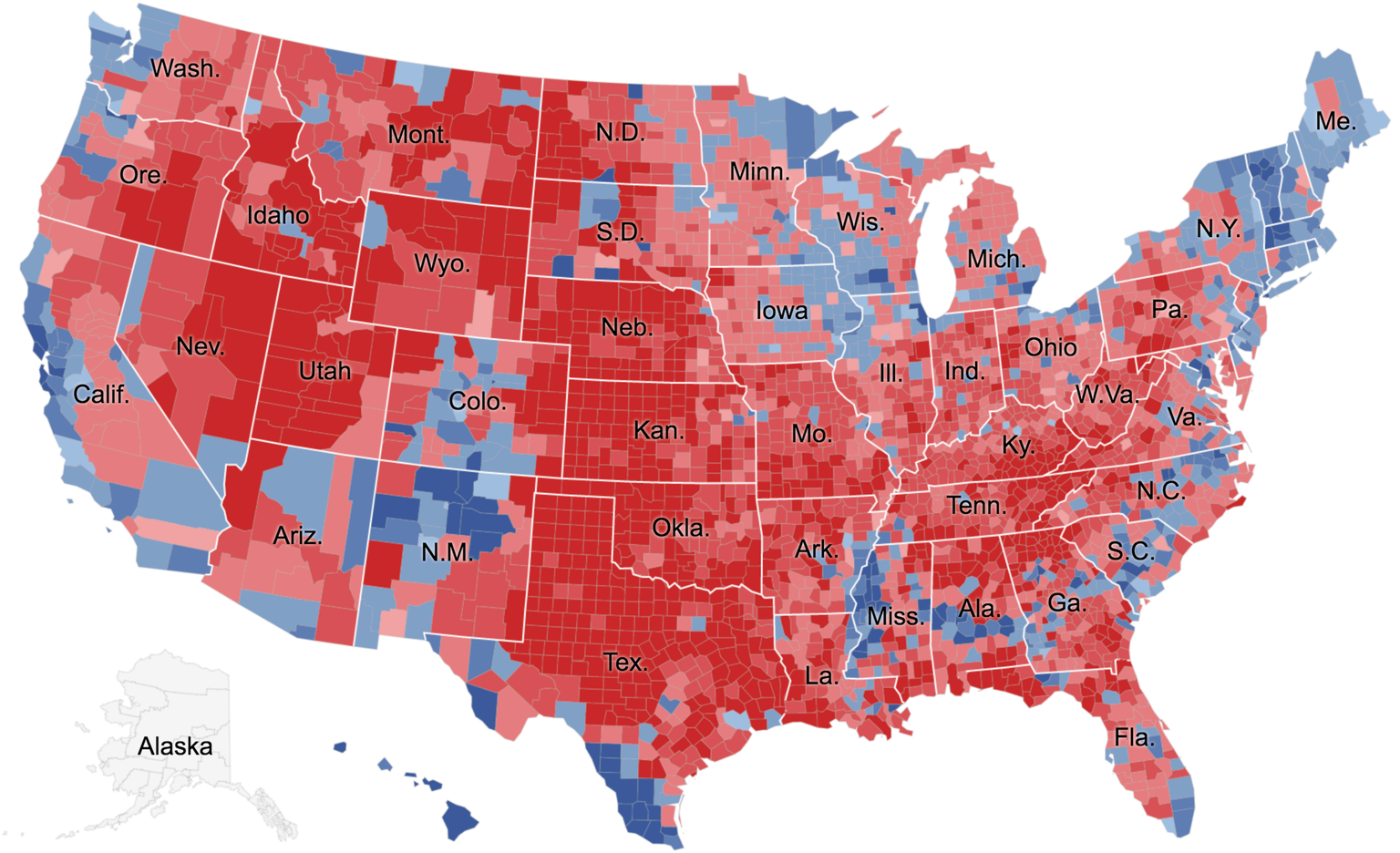
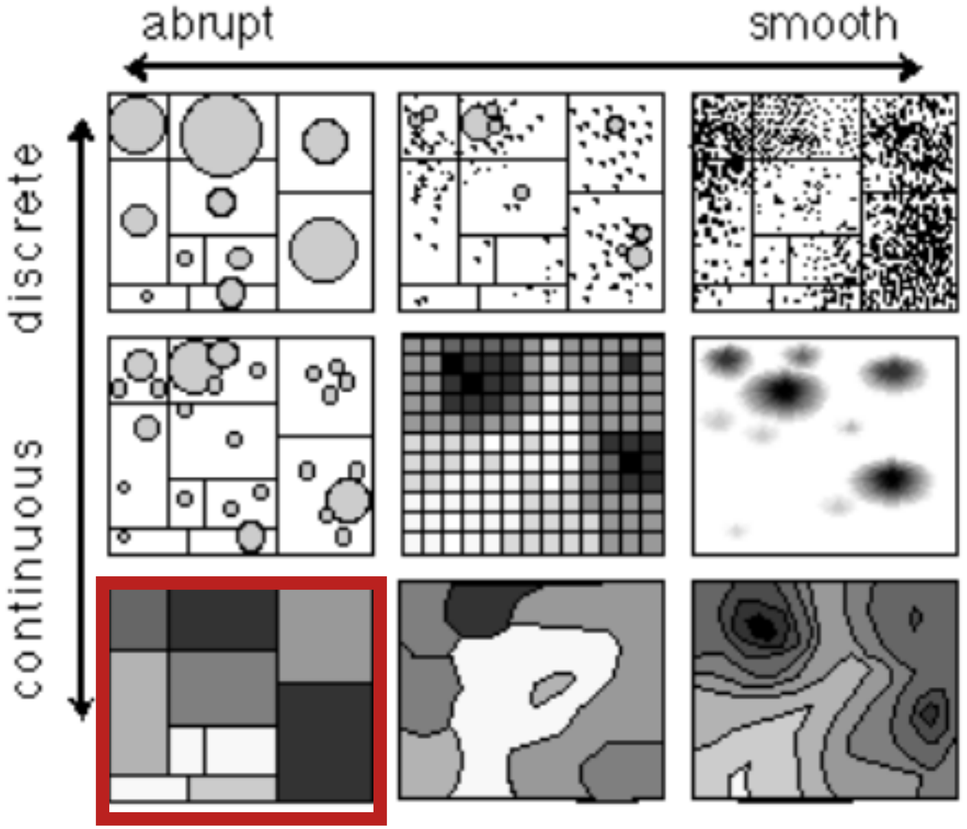


https://www.nytimes.com/interactive/2016/11/01/upshot/many-ways-to-map-election-results.html

Choropleth



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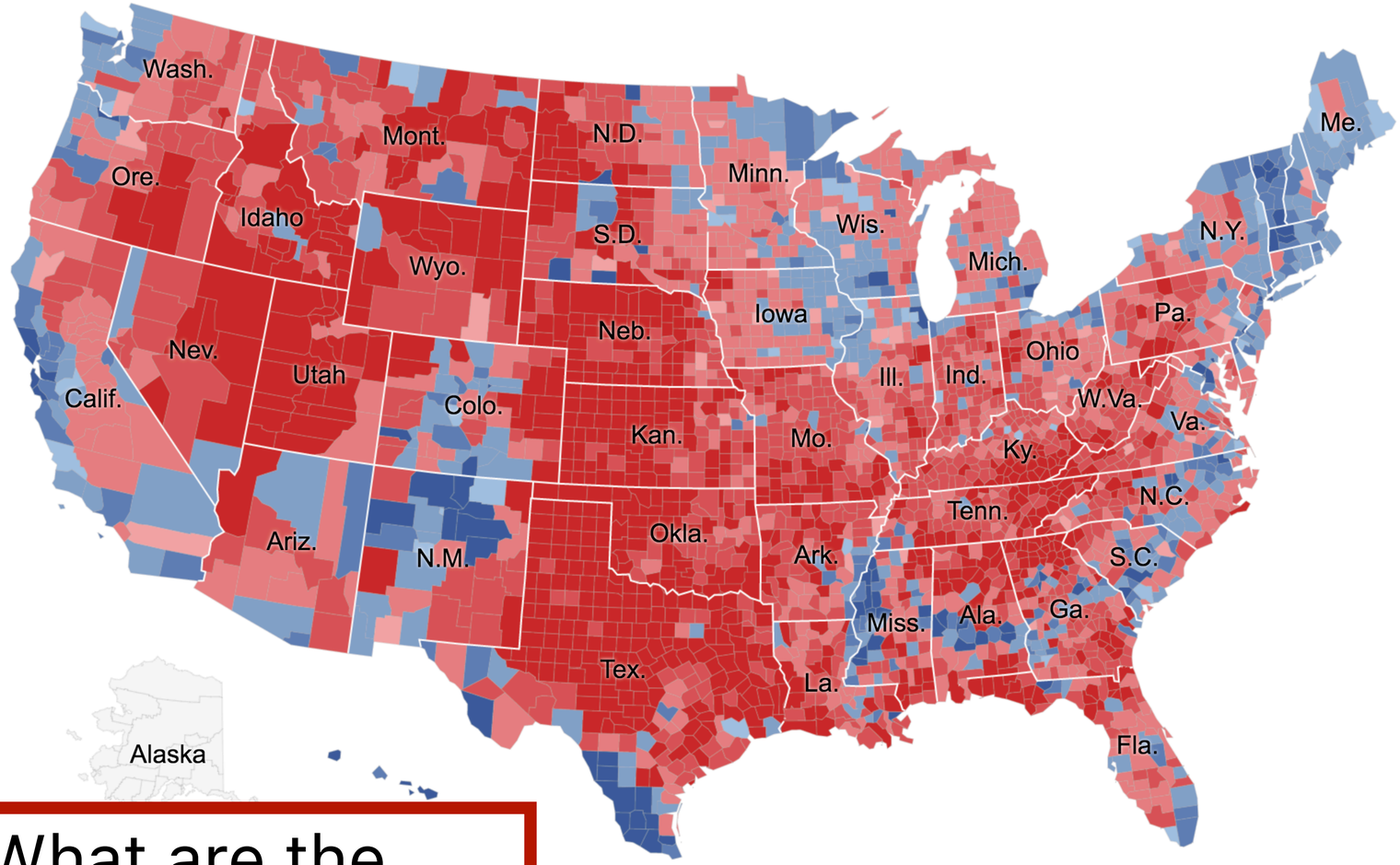
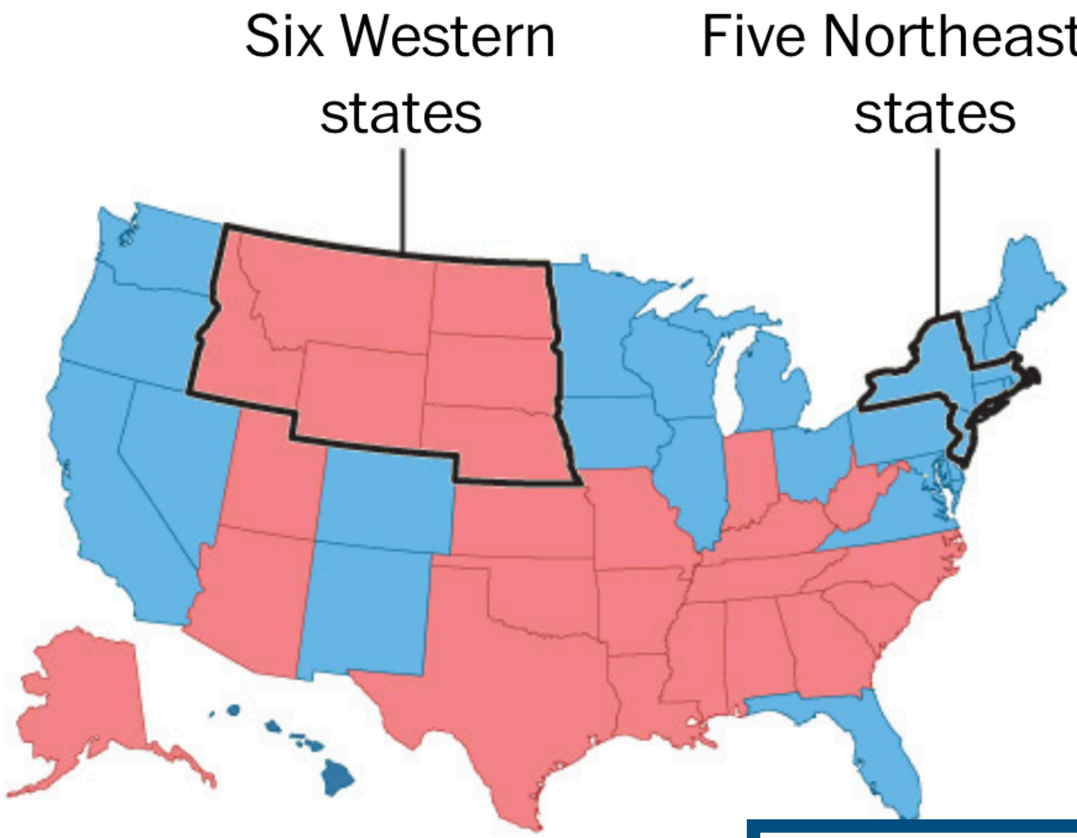


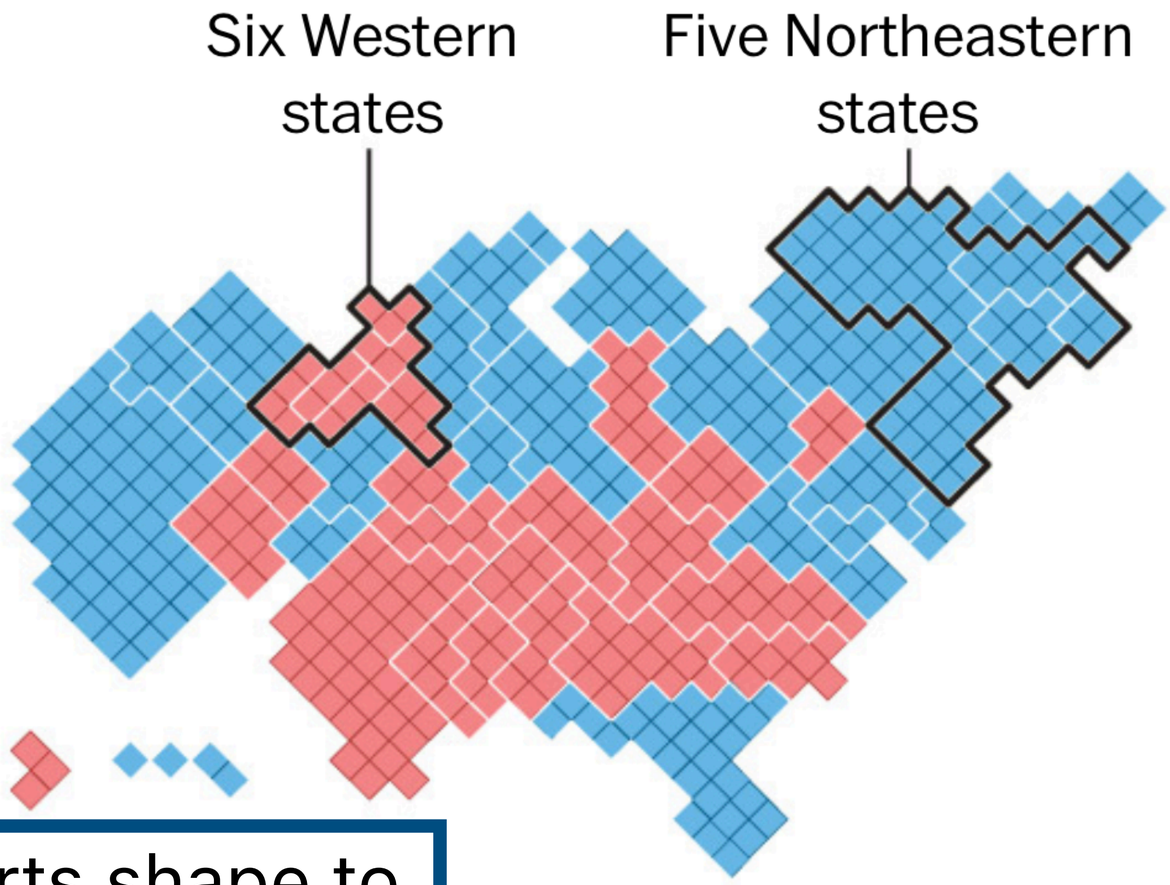
What are the pros/cons of this display?

tryclassbuzz.com
Code: **choro**

ion-results.html

GEOGRAPHIC MAP → **CARTOGRAM OF ELECTORAL VOTES**

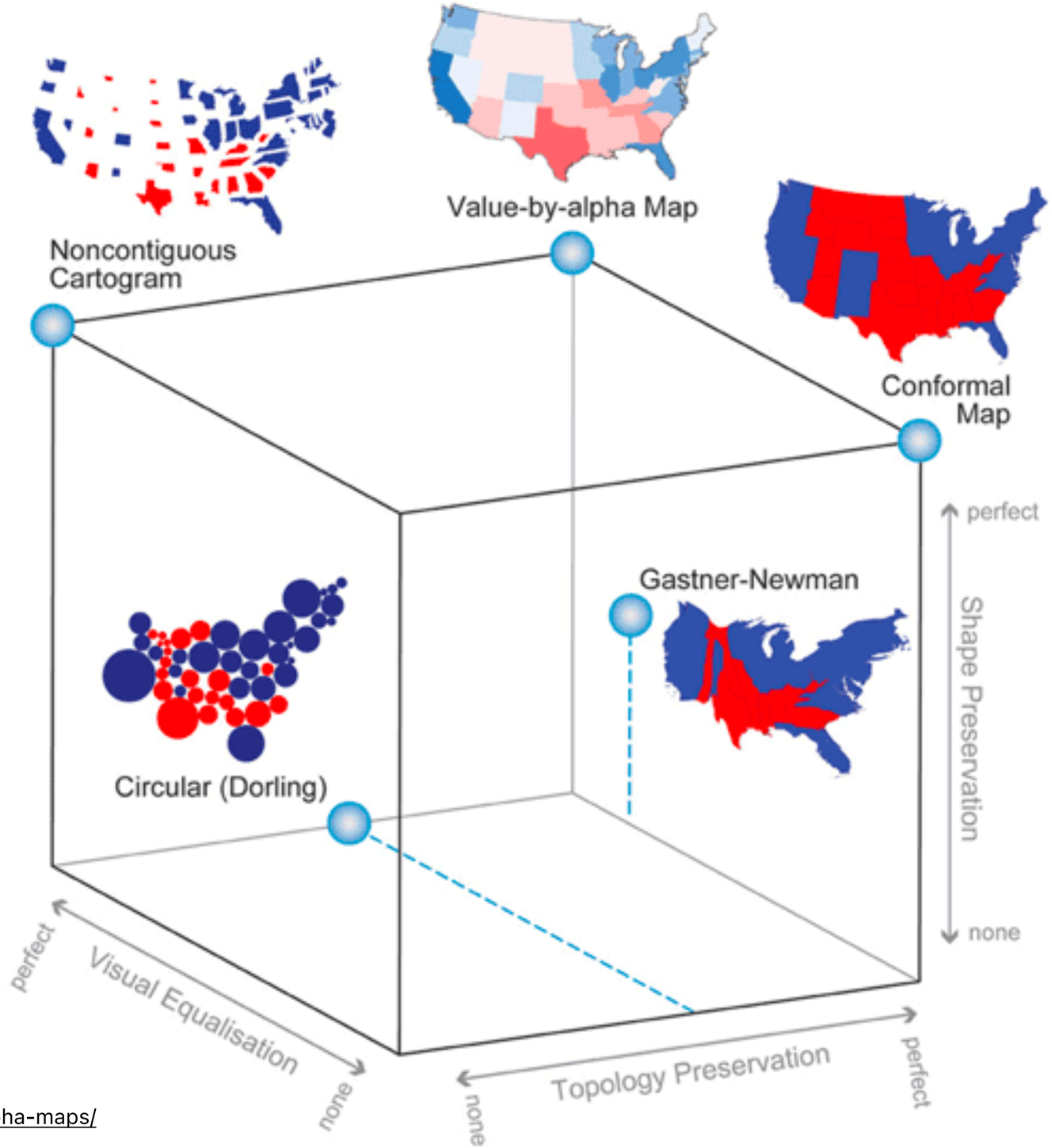




Cartogram: Distorts shape to convey quantity

What are the pros/ cons of this display?

tryclassbuzz.com
Code: **carto**

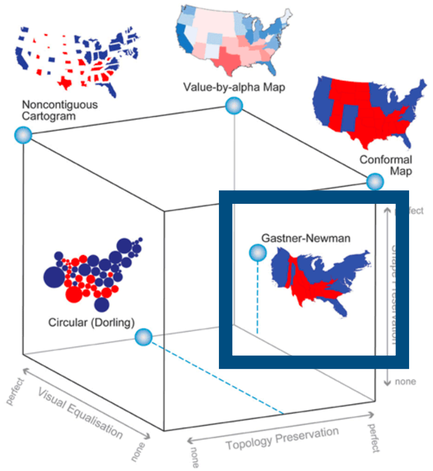


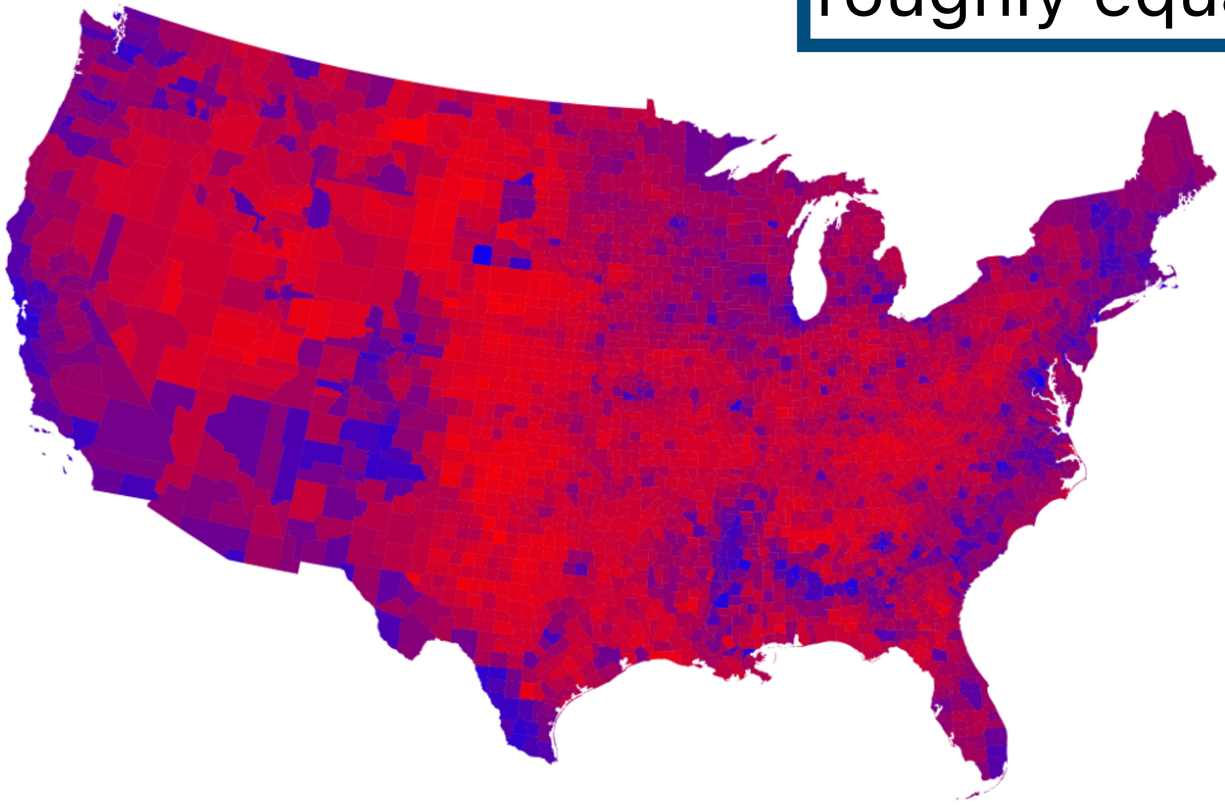
https://andywoodruff.com/blog/value-by-alpha-maps/

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

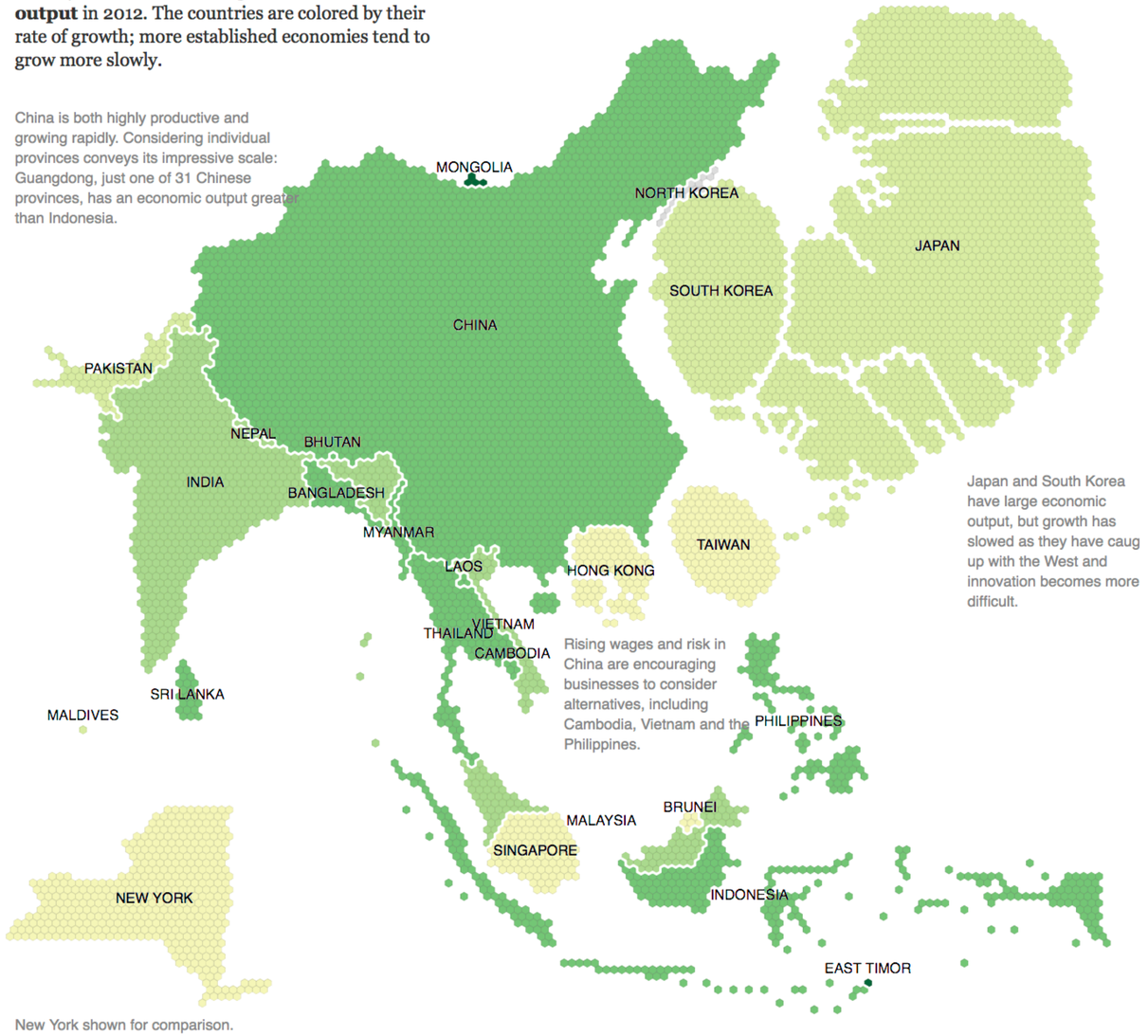
While China maintains its overwhelming dominance in manufacturing, multinational companies are looking for ways to limit their reliance on factories there. Related Article »

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.

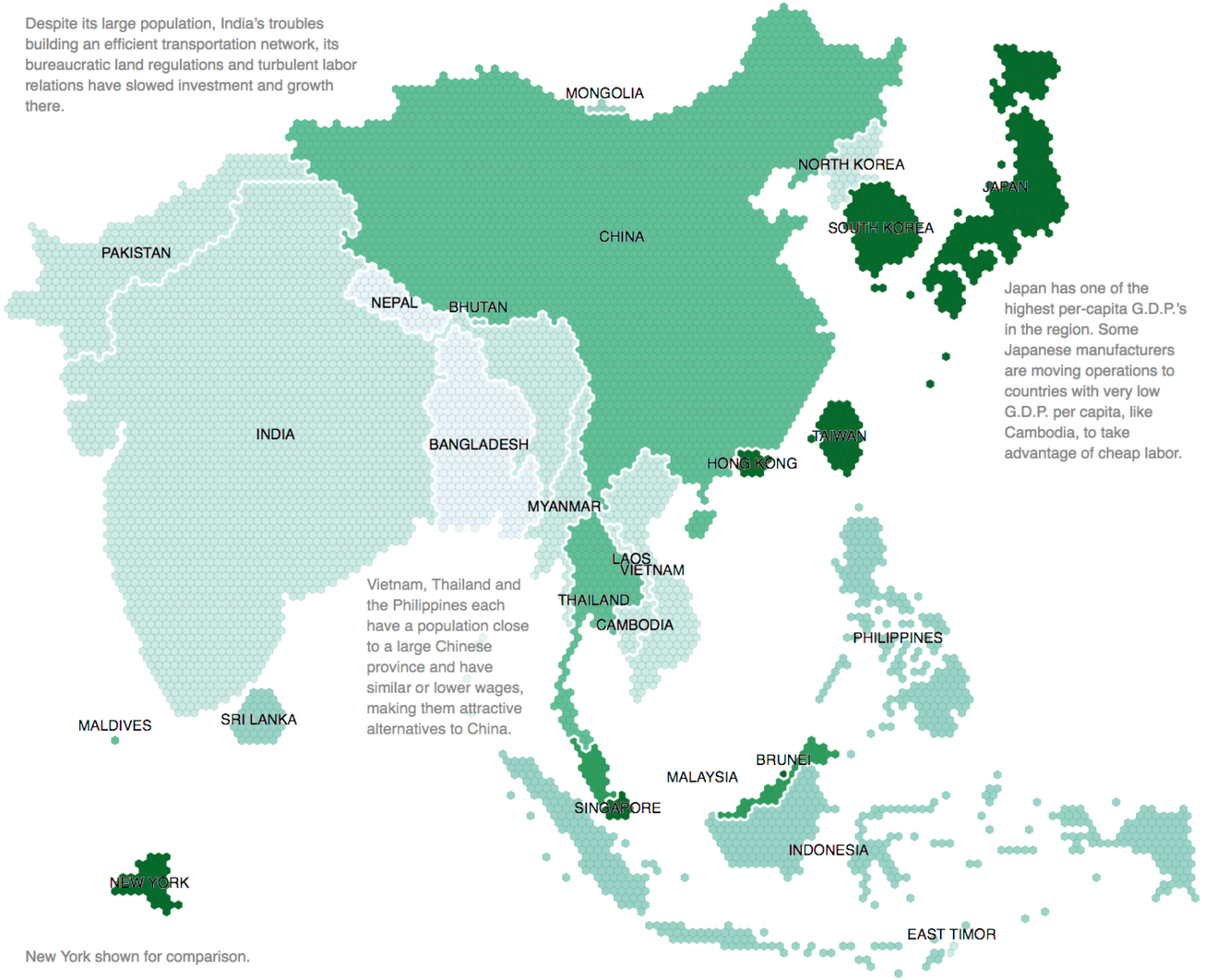
New York shown for comparison.

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.

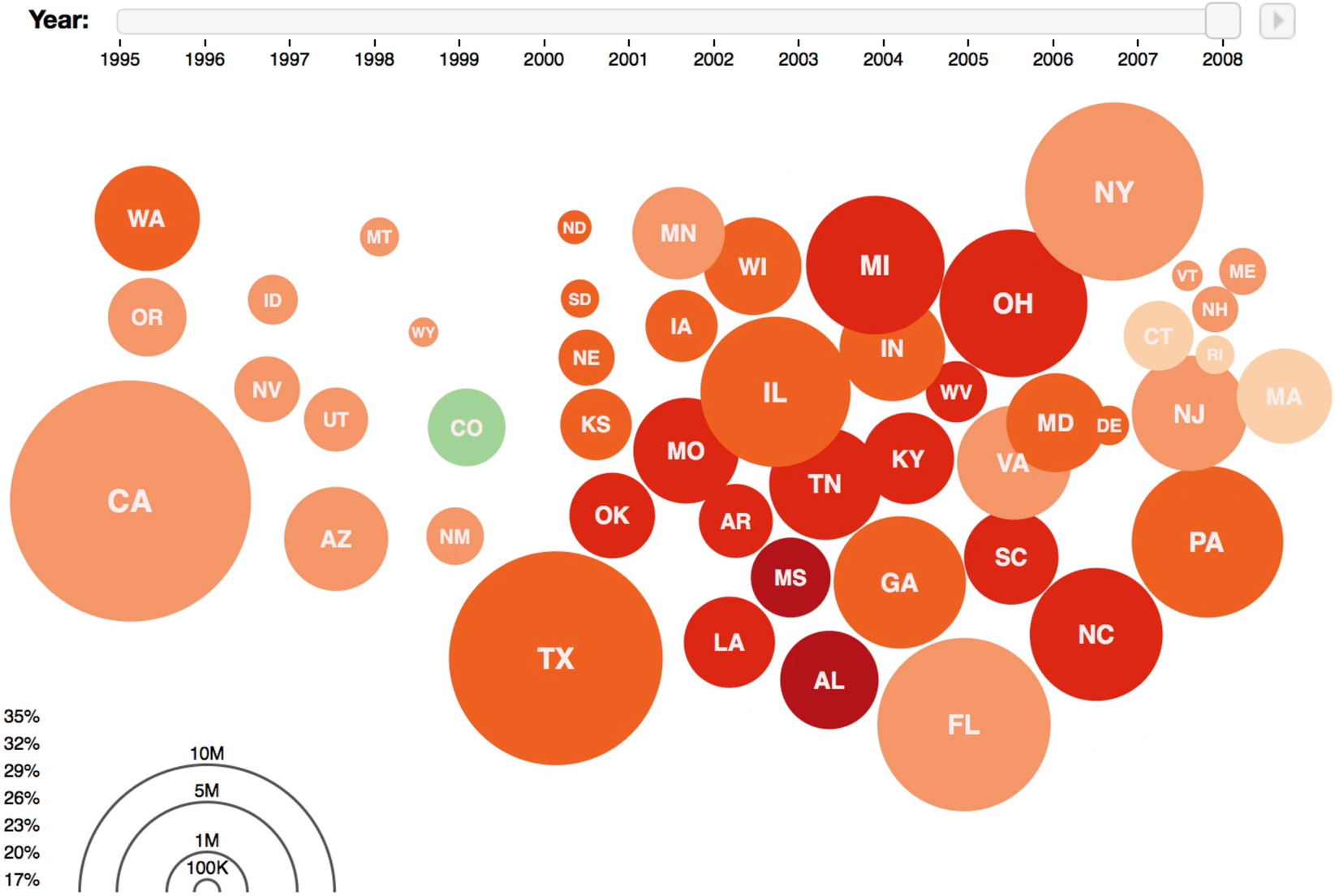
Japan has one of the highest per-capita G.D.P.'s in the region. Some Japanese manufacturers are moving operations to countries with very low G.D.P. per capita, like Cambodia, to take advantage of cheap labor.

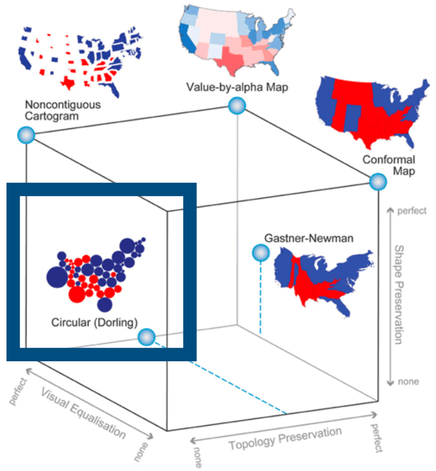
Vietnam, Thailand and the Philippines each have a population close to a large Chinese province and have similar or lower wages, making them attractive alternatives to China.

New York shown for comparison.

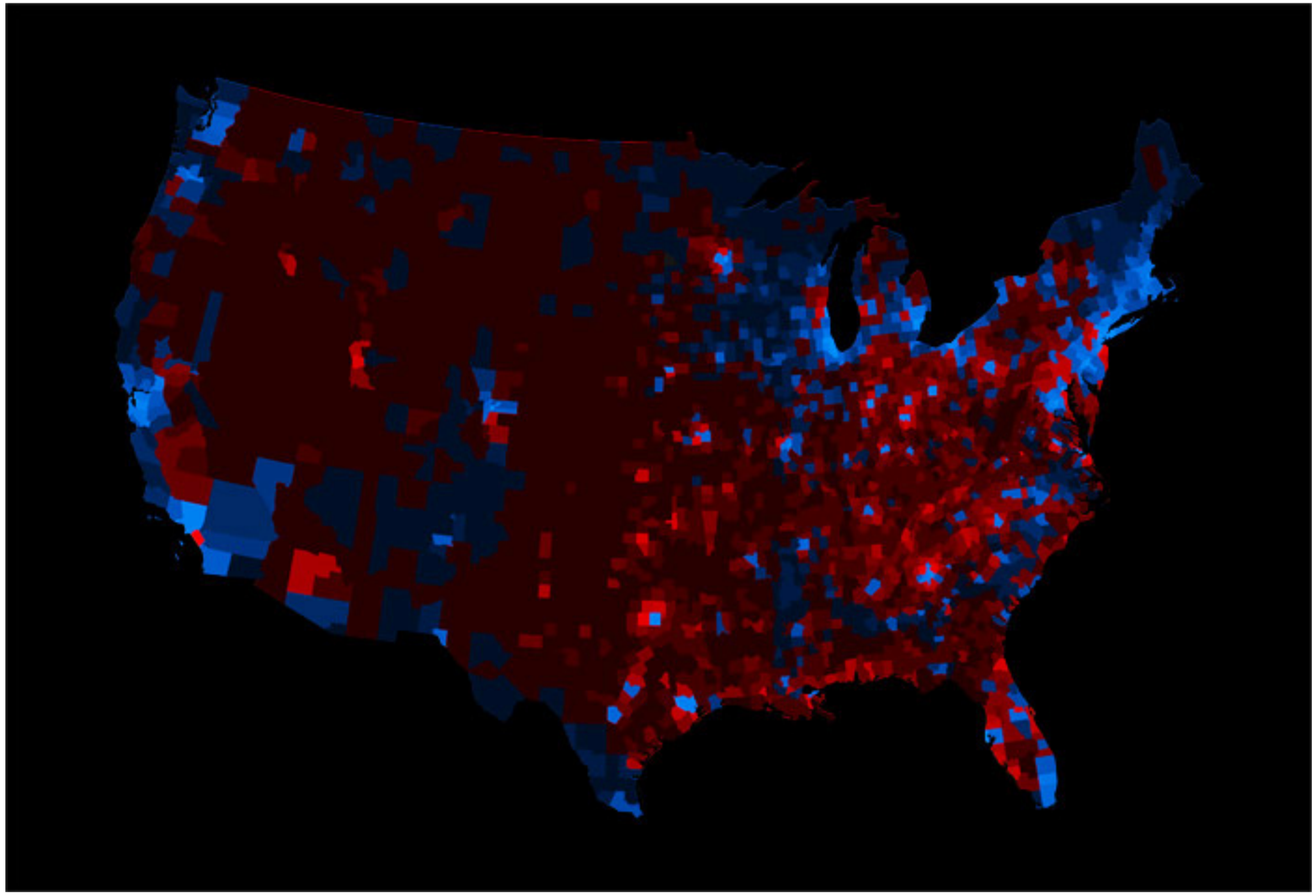
By MIKE BOSTOCK; Additional reporting by KEITH BRADSHER

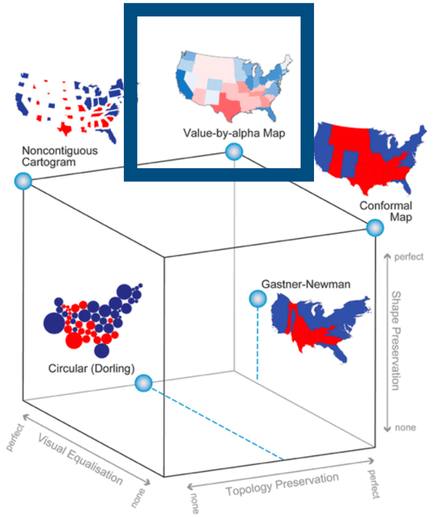
Dorling Cartograms





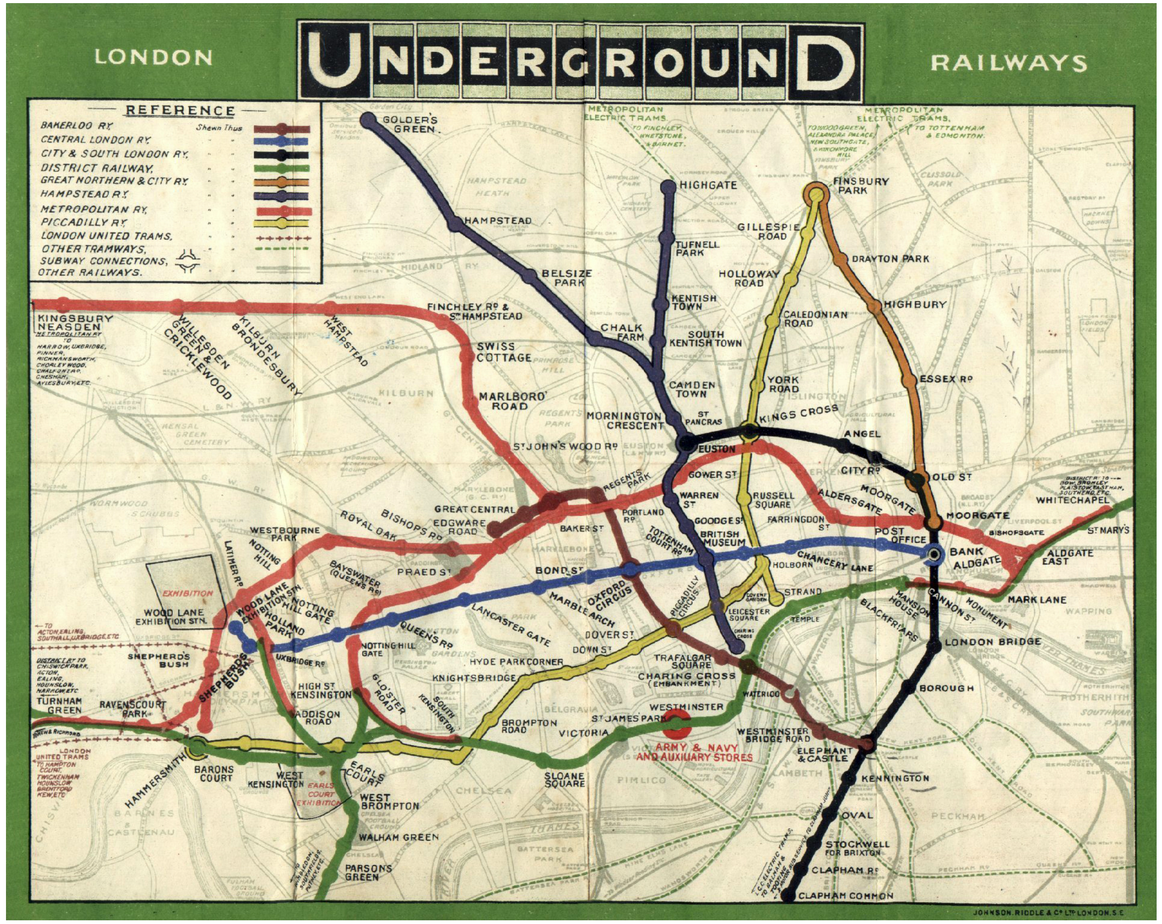
Value-By-Alpha





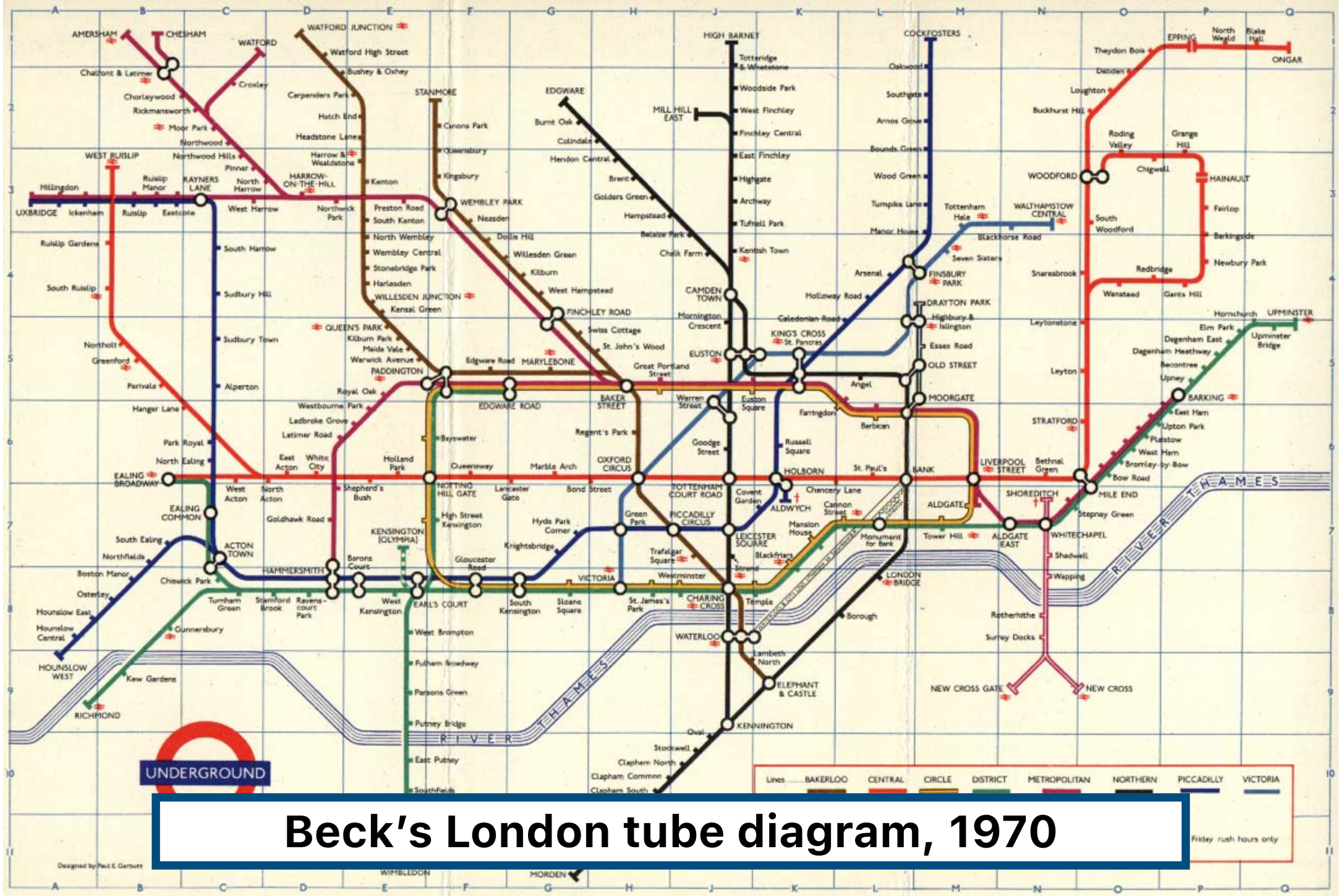
https://andywoodruff.com/blog/value-by-alpha-maps/

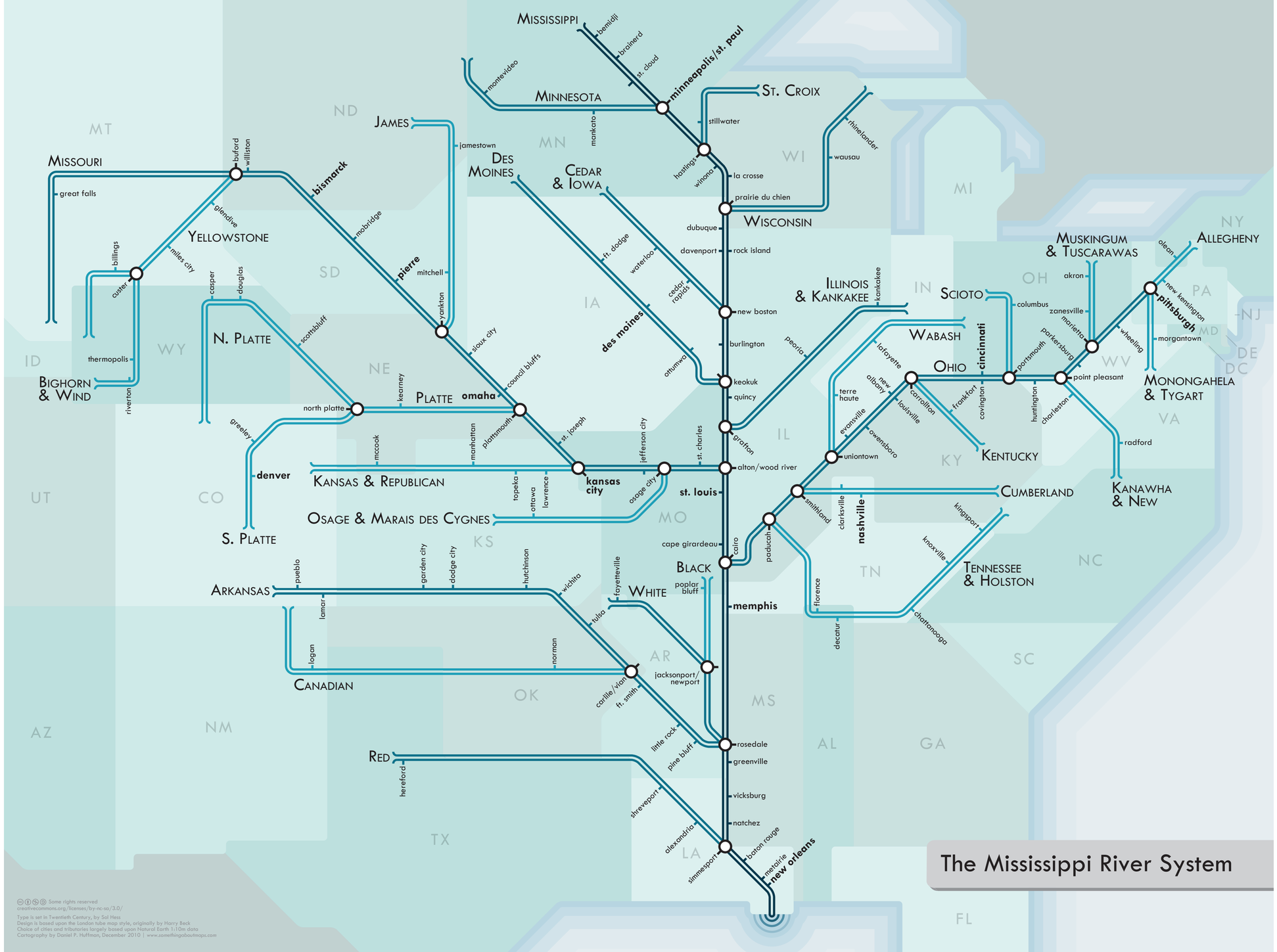
Route Maps



Geographic version of

London Underground


Beck's London tube diagram, 1970
UNDERGROUND
Designed by Paul E. Garbutt
Lines BAKERLOO CENTRAL CIRCLE DISTRICT METROPOLITAN NORTHERN PICCADILLY VICTORIA
Friday rush hours only
RIVER THAMES
AMERSHAM
CHESHAM
WATFORD
WATFORD JUNCTION
HIGH BARNET
COCKFOSTERS
EPPING
ONGAR
UXBRIDGE
HARROW-ON-THE-HILL
STANMORE
EDGWARE
MILL HILL EAST
WOODFORD
HAINAULT
WEST RUISLIP
RAYNERS LANE
WEMBLEY PARK
FINCHLEY ROAD
CAMDEN TOWN
EUSTON
KING'S CROSS St. Pancras
FINSBURY PARK
DRAYTON PARK
OLD STREET
MOORGATE
QUEEN'S PARK
PADDINGTON
EDGWARE ROAD
MARYLEBONE
BAKER STREET
OXFORD CIRCUS
HOLBORN
BANK
LIVERPOOL STREET
ALDGATE
ALDWYCH
TOTTENHAM COURT ROAD
PICCADILLY CIRCUS
LEICESTER SQUARE
CHARING CROSS
WATERLOO
VICTORIA
SLOANE SQUARE
SOUTH KENSINGTON
GLOUCESTER ROAD
EARL'S COURT
KENSINGTON (OLYMPIA)
HAMMERSMITH
ACTON TOWN
EALING BROADWAY
EALING COMMON
NORTH EALING
PARK ROYAL
HANGER LANE
PERIVALE
GREENFORD
NORTHOLT
RUISLIP GARDENS
SOUTH RUISLIP
RUISLIP
RUISLIP MANOR
EASTCOTE
ICKENHAM
HILLINGDON
NORTHWOOD
NORTHWOOD HILLS
PINNER
MOOR PARK
CHORLEYWOOD
RICKMANSWORTH
CHALFONT & LATIMER
CROXLEY
WATFORD HIGH STREET
BUSHEY & OXHEY
CARPENDERS PARK
HATCH END
HEADSTONE LANE
HARROW & WEALDSTONE
KENTON
NORTH HARROW
WEST HARROW
SOUTH HARROW
SUDBURY HILL
SUDBURY TOWN
ALPERTON
NORTHWICK PARK
PRESTON ROAD
SOUTH KENTON
NORTH WEMBLEY
WEMBLEY CENTRAL
STONEBRIDGE PARK
HARLESDEN
WILLESDEN JUNCTION
KENSAL GREEN
KILBURN PARK
MAIDA VALE
WARWICK AVENUE
ROYAL OAK
WESTBOURNE PARK
LADBROKE GROVE
LATIMER ROAD
WHITE CITY
EAST ACTON
WEST ACTON
NORTH ACTON
GOLDHAWK ROAD
SHEPHERD'S BUSH
HOLLAND PARK
NOTTING HILL GATE
LANCASTER GATE
BAYSWATER
QUEENSWAY
MARBLE ARCH
BOND STREET
REGENT'S PARK
GREEN PARK
HYDE PARK CORNER
KNIGHTSBRIDGE
BARONS COURT
WEST KENSINGTON
TURNHAM GREEN
STAMFORD BROOK
RAVENSCOURT PARK
CHISWICK PARK
SOUTH EALING
NORTHFIELDS
BOSTON MANOR
OSTERLEY
HOUNSLOW EAST
HOUNSLOW CENTRAL
HOUNSLOW WEST
GUNNERSBURY
KEW GARDENS
RICHMOND
WEST BROMPTON
FULHAM BROADWAY
PARSONS GREEN
PUTNEY BRIDGE
EAST PUTNEY
SOUTHFIELDS
WIMBLEDON
MORDEN
BURNT OAK
COLINDALE
HENDON CENTRAL
BRENT
GOLDERS GREEN
HAMPSTEAD
BELSIZE PARK
CHALK FARM
KENTISH TOWN
TOTTERIDGE & WHETSTONE
WOODSIDE PARK
WEST FINCHLEY
FINCHLEY CENTRAL
EAST FINCHLEY
HIGHGATE
ARCHWAY
TUFNELL PARK
WILLESDEN GREEN
DOLLIS HILL
NEASDEN
KILBURN
WEST HAMPSTEAD
SWISS COTTAGE
ST. JOHN'S WOOD
MORNINGTON CRESCENT
GREAT PORTLAND STREET
WARREN STREET
GOODGE STREET
EUSTON SQUARE
FARRINGDON
BARBICAN
ANGEL
CALEDONIAN ROAD
HOLLOWAY ROAD
ARSENAL
OAKWOOD
SOUTHGATE
ARNOS GROVE
BOUNDS GREEN
WOOD GREEN
TURNPIKE LANE
MANOR HOUSE
TOTTENHAM HALE
BLACKHORSE ROAD
SEVEN SISTERS
ESSEX ROAD
HIGHBURY & ISLINGTON
RUSSELL SQUARE
HOLBORN
ST. PAUL'S
CHANCERY LANE
COVENT GARDEN
CANNON STREET
MANSION HOUSE
MONUMENT FOR BANK
TOWER HILL
ALDGATE EAST
SHOREDITCH
WHITECHAPEL
MILE END
STEPNEY GREEN
BETHNAL GREEN
BOW ROAD
BROMLEY-BY-BOW
WEST HAM
PLAISTOW
UPTON PARK
EAST HAM
BECONTREE
DAGENHAM HEATHWAY
DAGENHAM EAST
ELM PARK
HORNCHURCH
UPMINSTER
UPMINSTER BRIDGE
BARKING
UPNEY
LEYTON
LEYTONSTONE
SNARESBROOK
SOUTH WOODFORD
BUCKHURST HILL
LOUGHTON
DEBDEN
THEYDON BOIS
RODING VALLEY
CHIGWELL
GRANGE HILL
FAIRLOP
BARKINGSIDE
NEWBURY PARK
GANTS HILL
REDBRIDGE
WANSTEAD
NORTH WEALD
BLAKE HALL
WALTHAMSTOW CENTRAL
STRATFORD
LONDON BRIDGE
BOROUGH
TEMPLE
BLACKFRIARS
TRAFALGAR SQUARE
STRAND
WESTMINSTER
ST. JAMES'S PARK
LAMBETH NORTH
ELEPHANT & CASTLE
KENNINGTON
OVAL
STOCKWELL
CLAPHAM NORTH
CLAPHAM COMMON
CLAPHAM SOUTH
ROTHERHITHE
SURREY DOCKS
NEW CROSS GATE
NEW CROSS
SHADWELL
WAPPING



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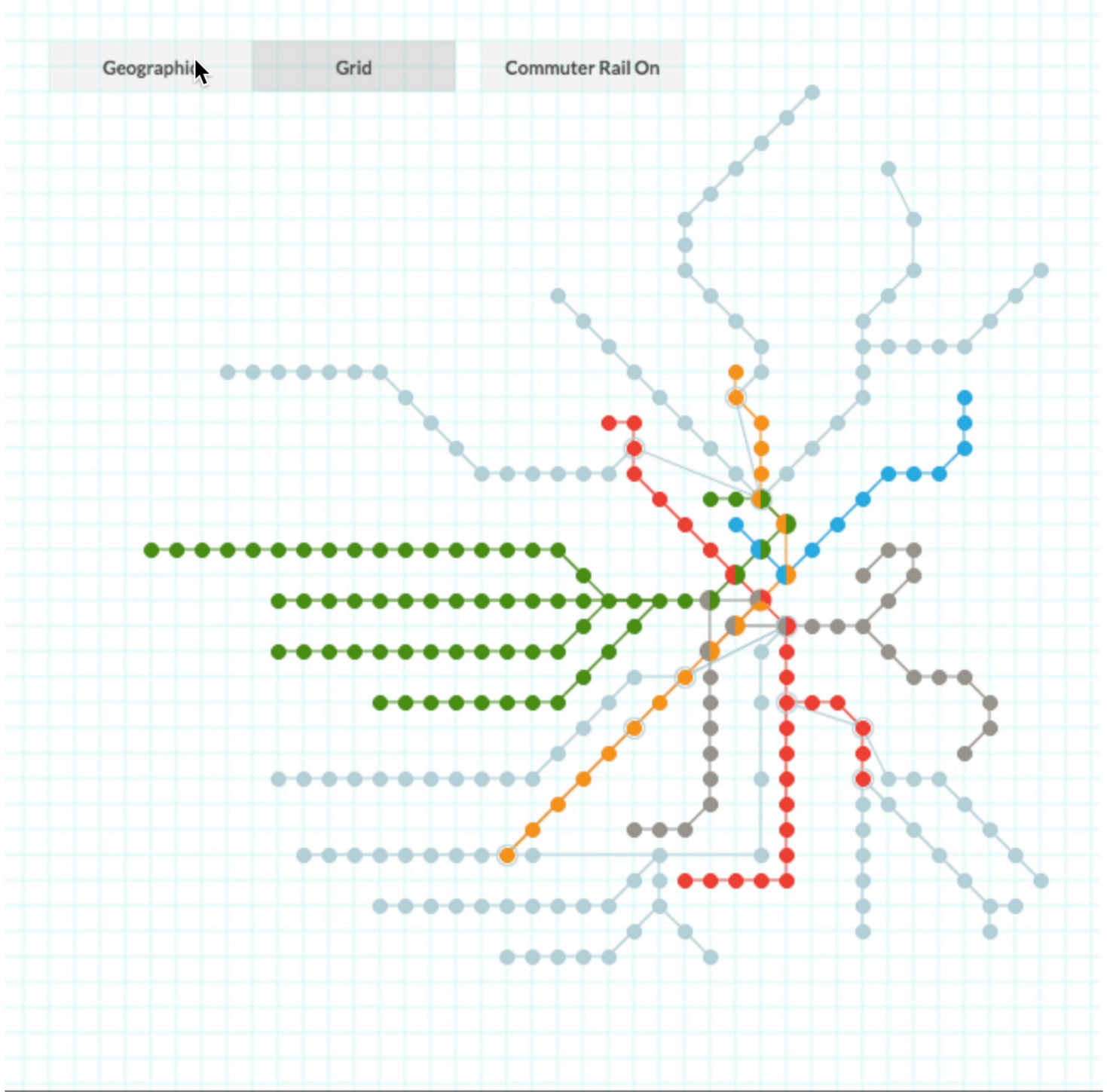
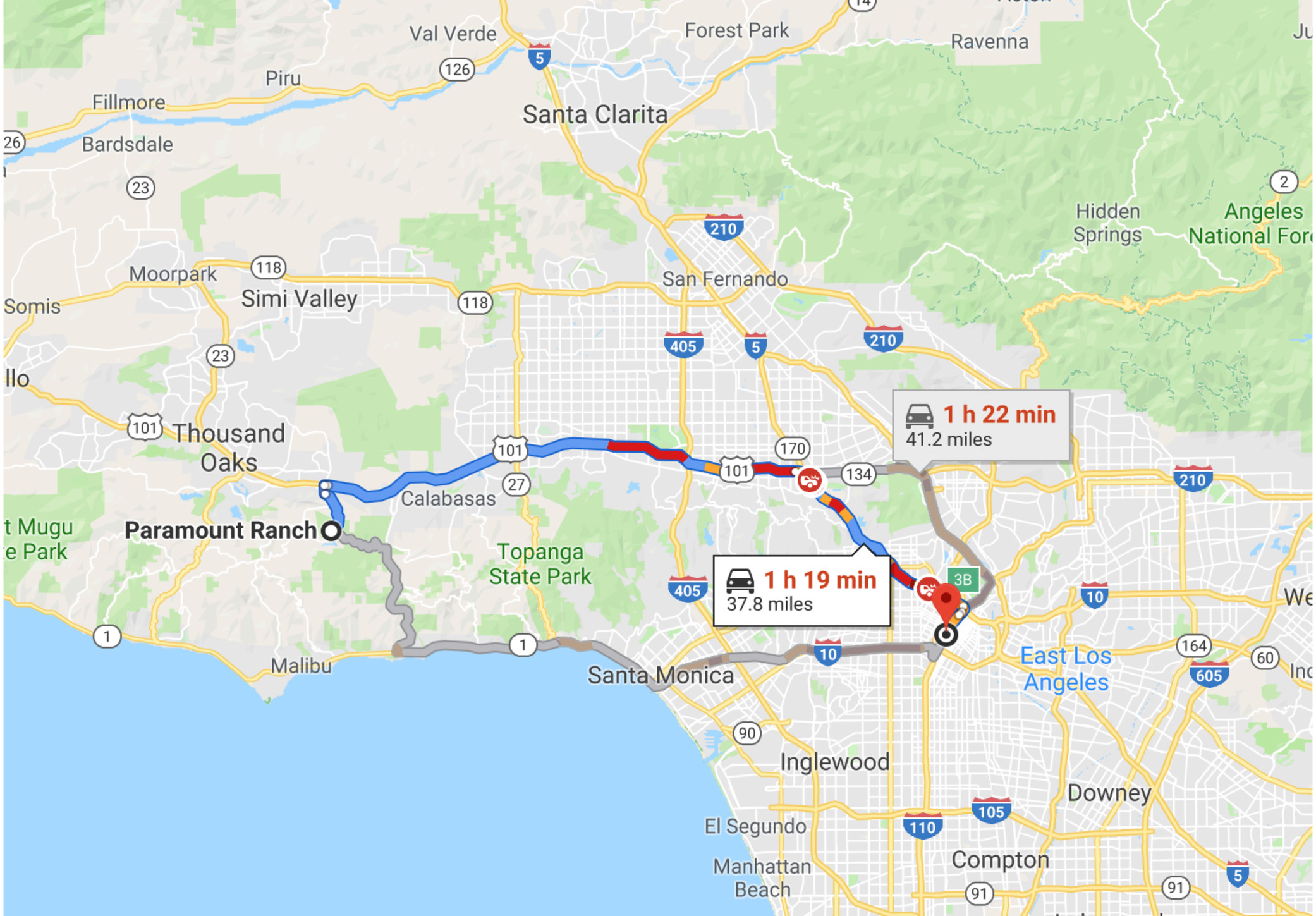
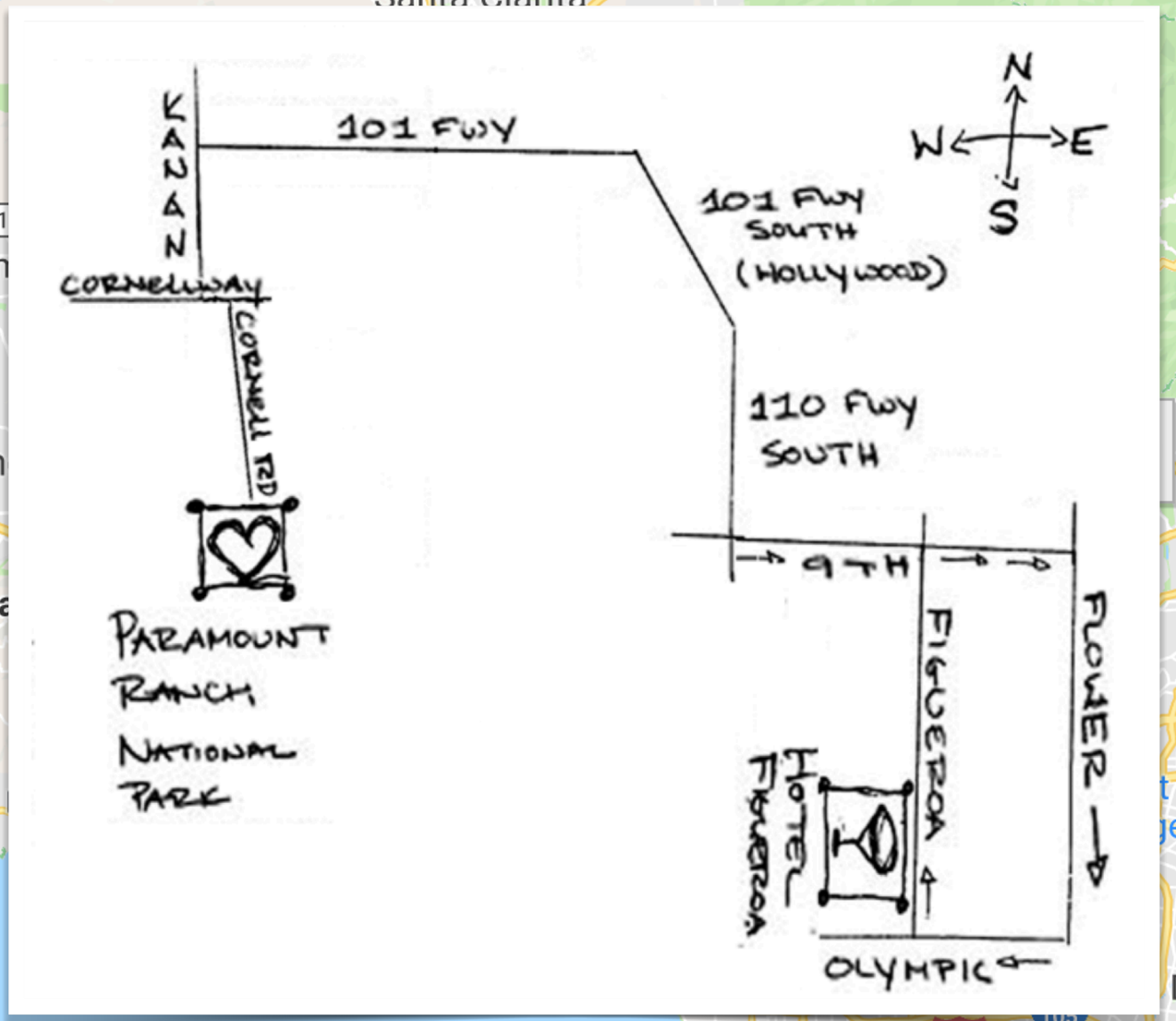
Type is set in Twentieth Century, by Sol Hess
Design is based upon the London tube map style, originally by Harry Beck
Choice of cities and tributaries largely based upon Natural Earth 1:10m data
Cartography by Daniel P. Huffman, December 2010 | www.somethingaboutmaps.com

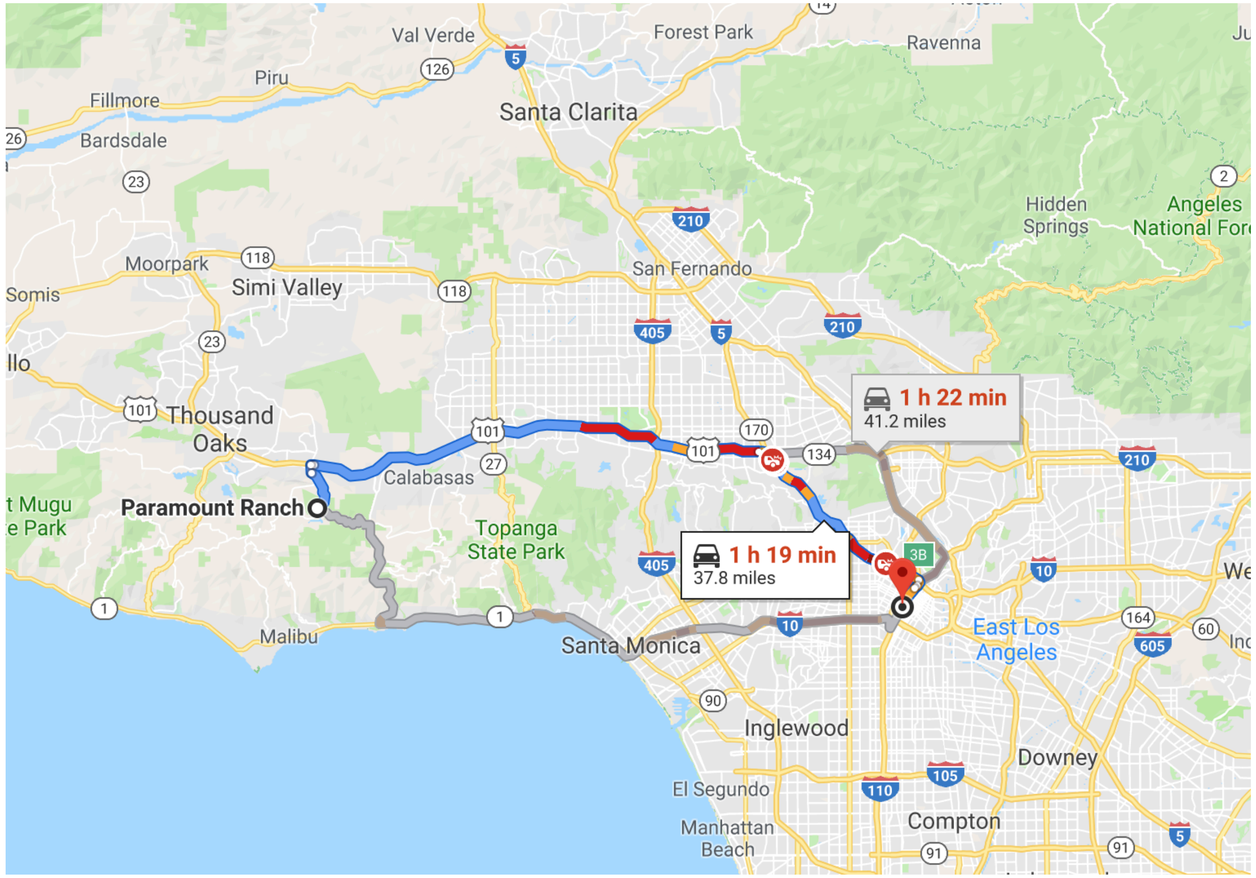


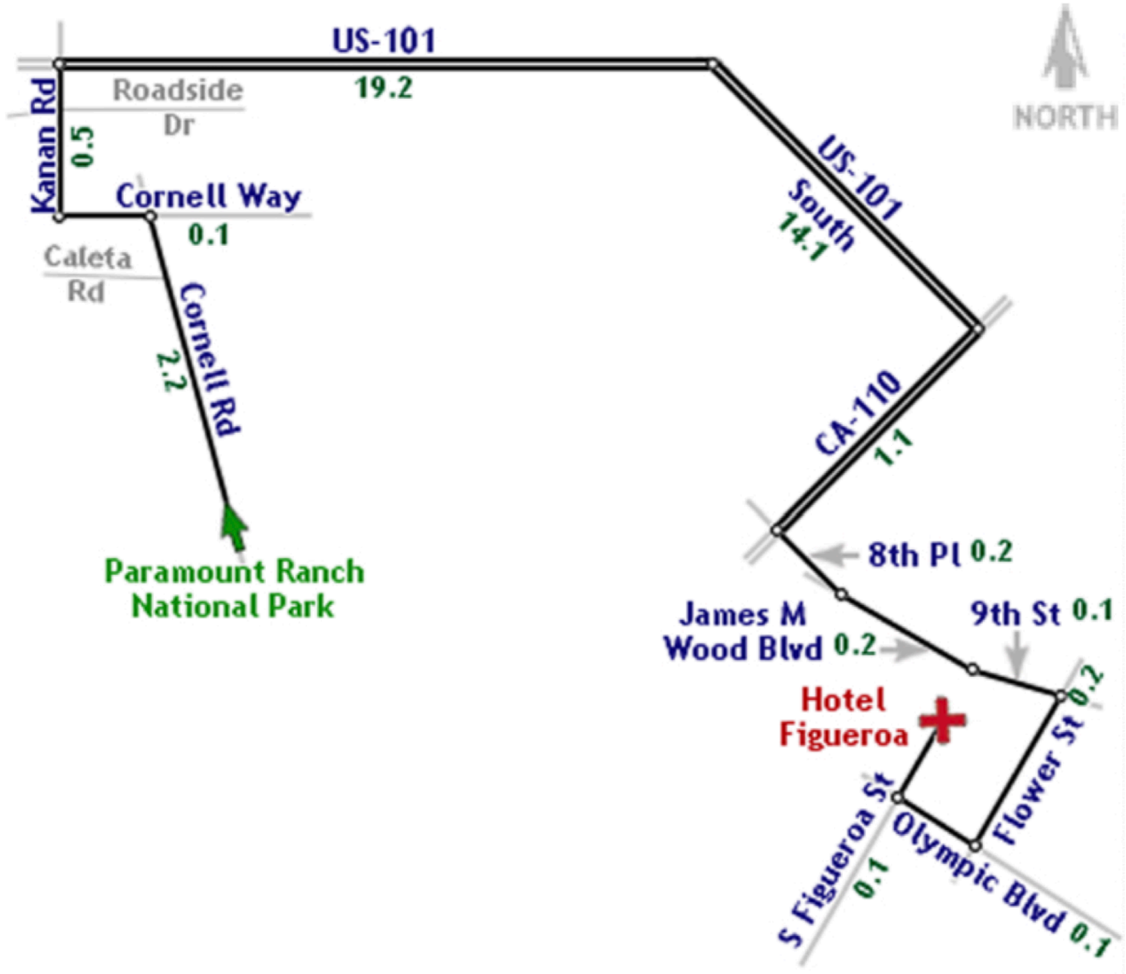
https://fathom.info/notebook/4756/


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


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

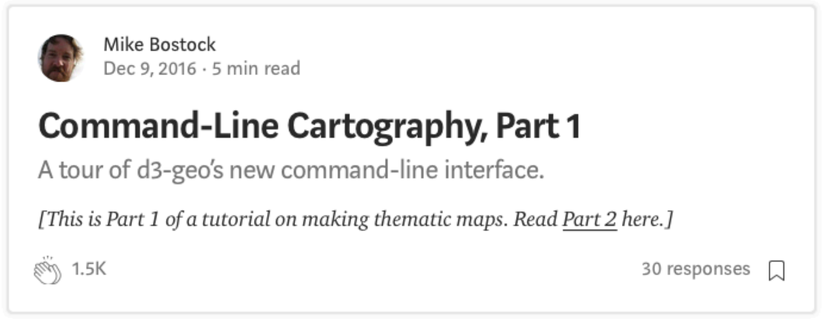
Tooling for Maps

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