

Lecture : Maps Visualization- II

Putting data on maps

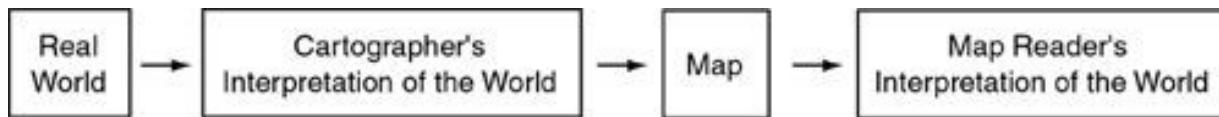
DATA ANALYSIS & VISUALIZATION
FALL 2021

Dr. Muhammad Faisal Cheema
FAST-NU

GOALS FOR TODAY

- Learn what elements visually encode data in maps.
- Learn about different map types, and how they relate to tasks.
- How to integrate/map non-spatial attributes (e.g. population, life expectancy, etc.) on maps

Tasks & Users



Make sure the map representation, data encodings, data plotted, and dimensionality reduction is appropriate for the viewers and their tasks.

Types of Maps (in Cartography)

THREE BROAD CATEGORIES OF MAPS:

REFERENCE MAPS

A map that plots several types of spatial data without specific emphasis on one type over another.

THEMATIC MAPS

A map with a specific theme or focus. Typically display attributes of features that vary spatially in a qualitative (e.g., precipitation) or nominal way (e.g. categories of land cover).

SPECIAL-PURPOSE MAPS

Typically thematic maps but are task/user specific (i.e., used like reference maps but for specific tasks or specific types of data).

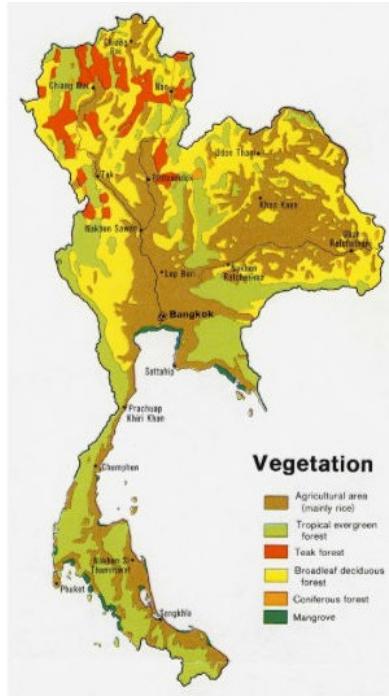
Types of Maps (in Cartography)

THREE BROAD CATEGORIES OF MAPS:

REFERENCE MAPS



THEMATIC MAPS



SPECIAL-PURPOSE MAPS



<https://uuuue-education.psuedu.edu/geoq486/node/1848>

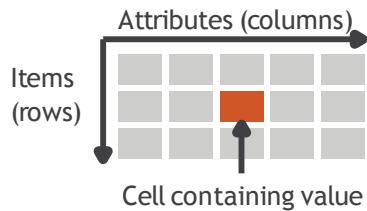
Mapping

(putting data on maps)

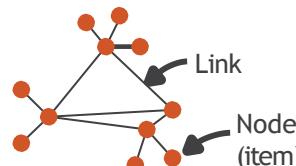


→ Dataset Types

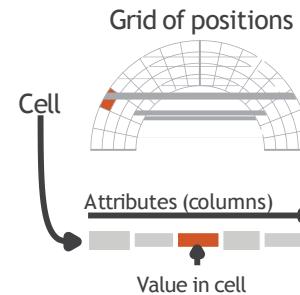
→ Tables



→ Networks



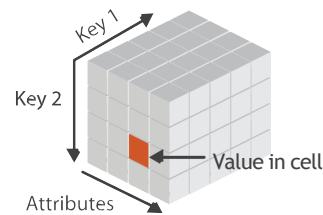
→ Fields (Continuous)



→ Geometry (Spatial)



→ Multidimensional Table



→ Trees



Arrange Spatial Data

→ Use Given

→ Geometry

→ *Geographic*

→ *Other Derived*



Types of Mappings

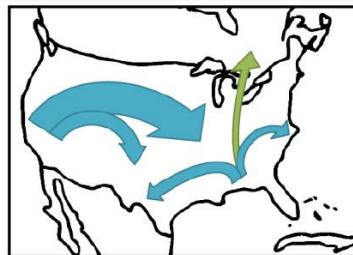
Map

Geographic Map



Geographic Map

Flow Map

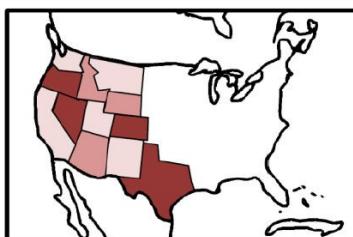


Statistical Map

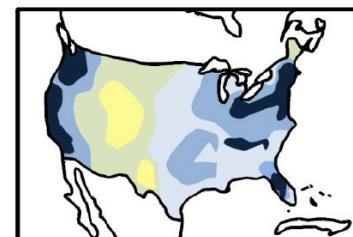
Street Map



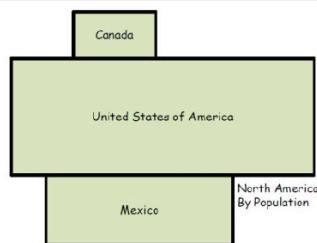
Choropleth Map



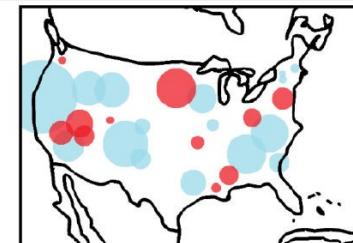
Contour Map (Isopleth)



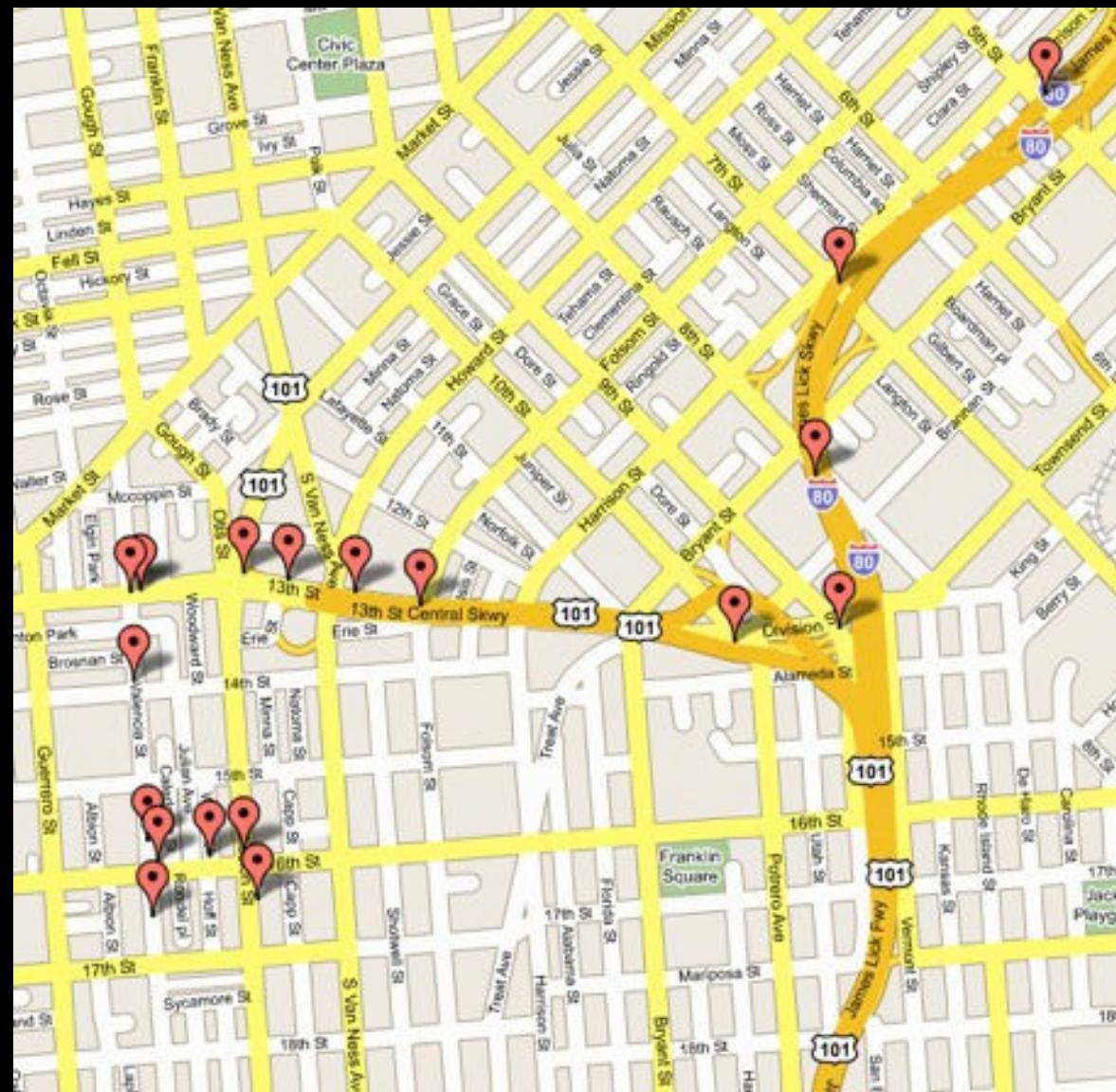
Distorted Map (Cartogram)



Statistical Plot Map



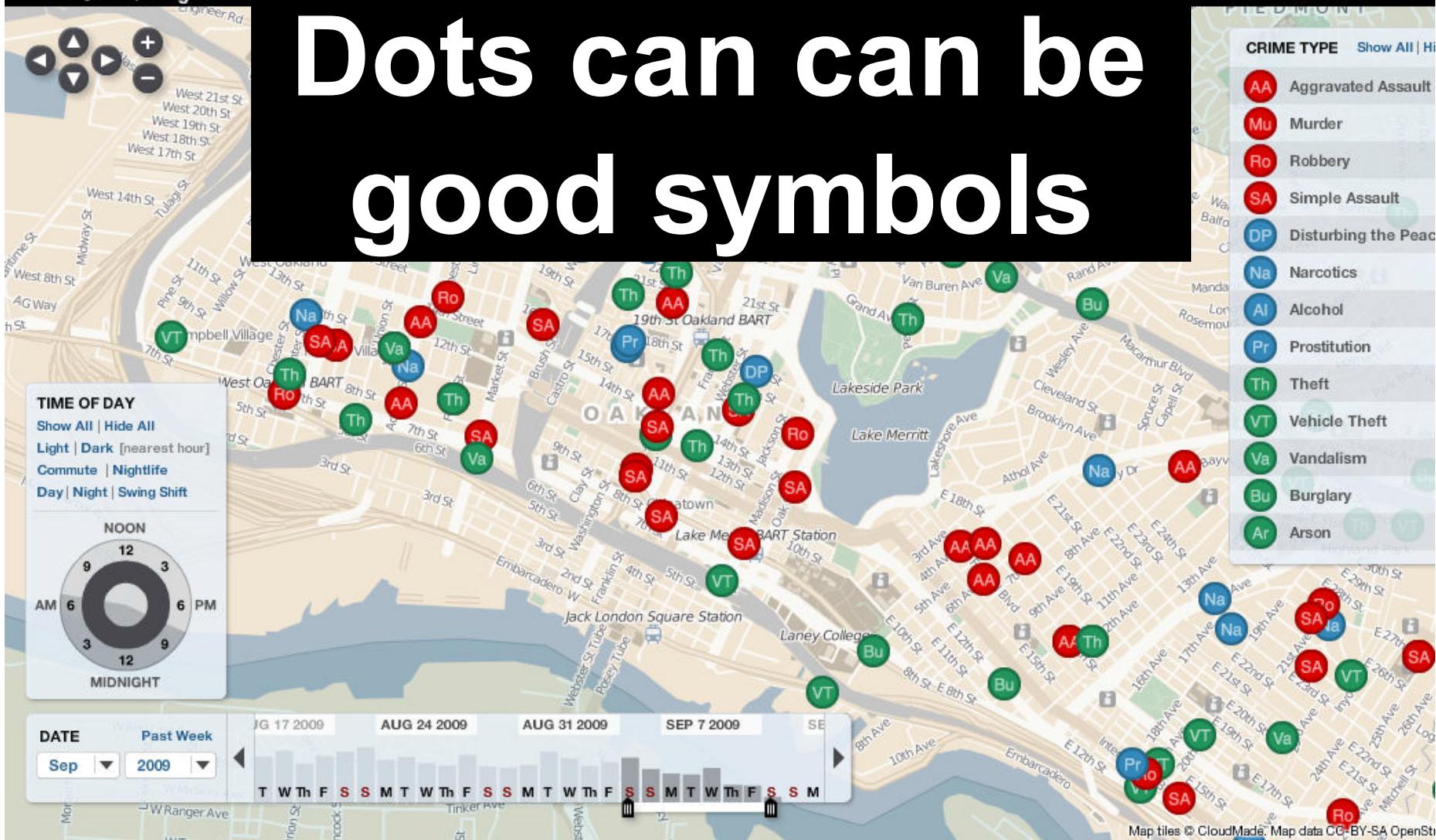
Symbol Maps

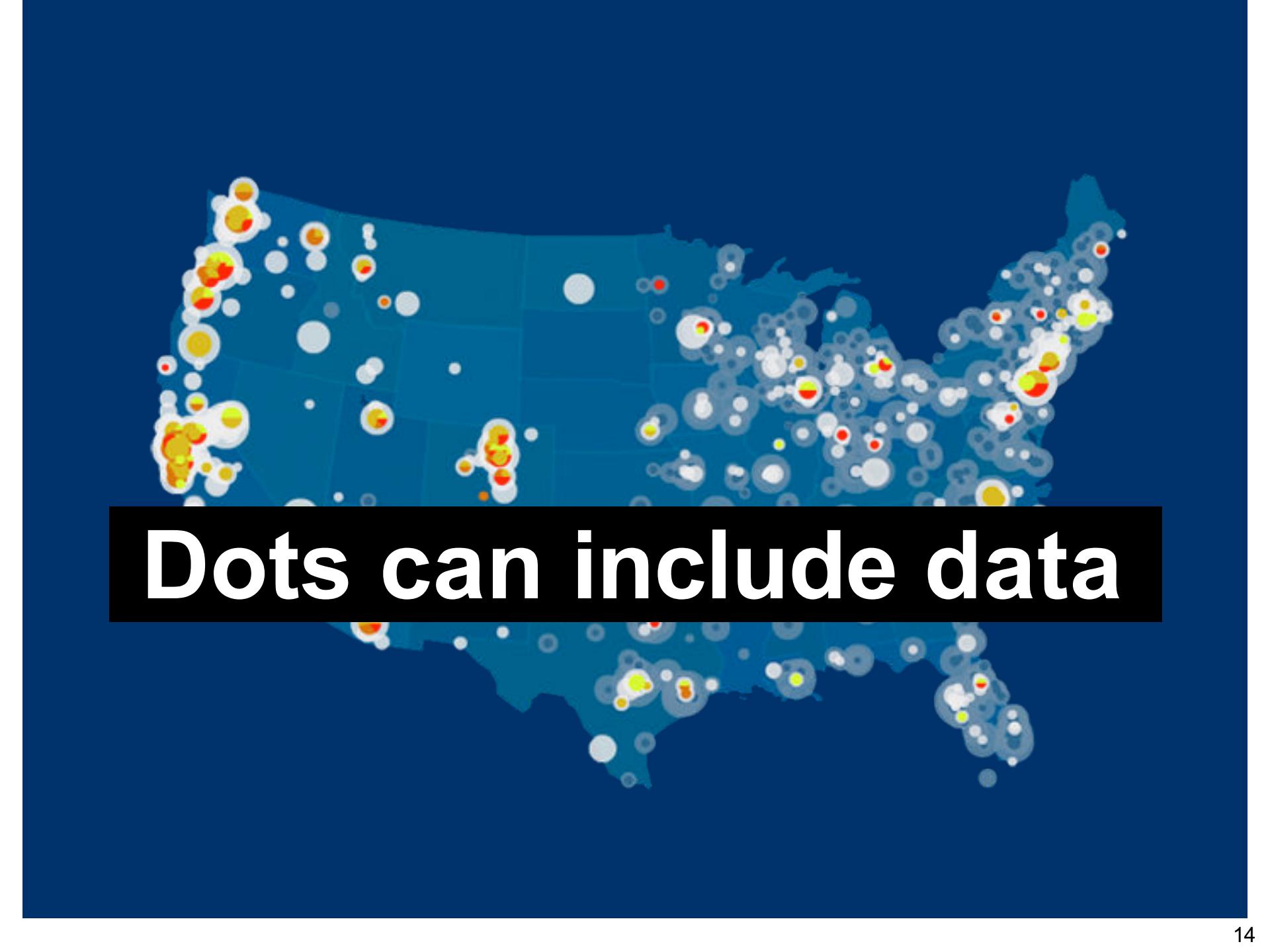


Dots can be symbols



Dots can be good symbols





Dots can include data

The New York Times

Mapping America: Every City, Every Block

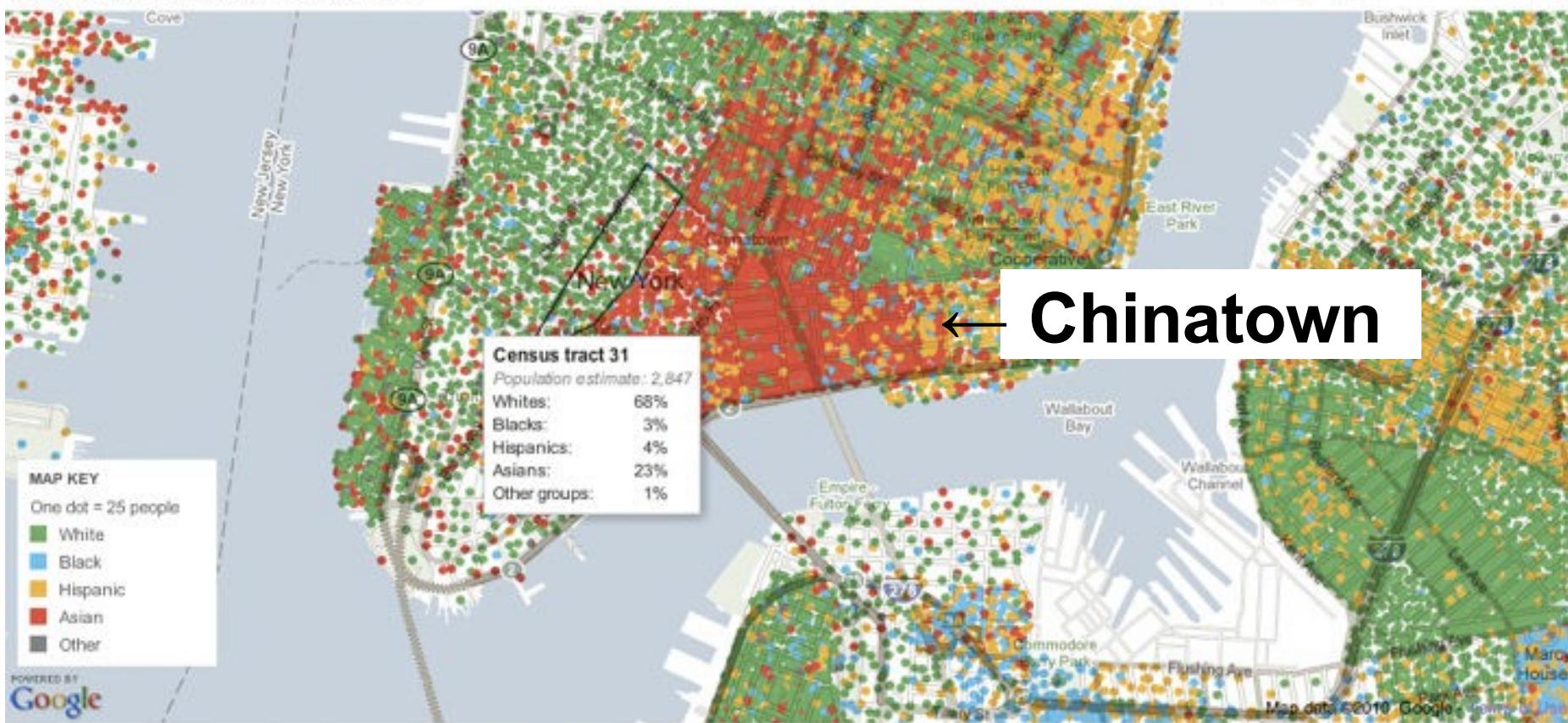
Find something interesting? Share this view on [Twitter](#) or [Facebook](#)

Browse local data from the Census Bureau's American Community Survey, based on samples from 2005 to 2009. Because these figures are based on [View Readers Maps \(49\)](#) samples, they are subject to a margin of error, particularly in places with a low population, and are best regarded as estimates.

Distribution of racial and ethnic groups

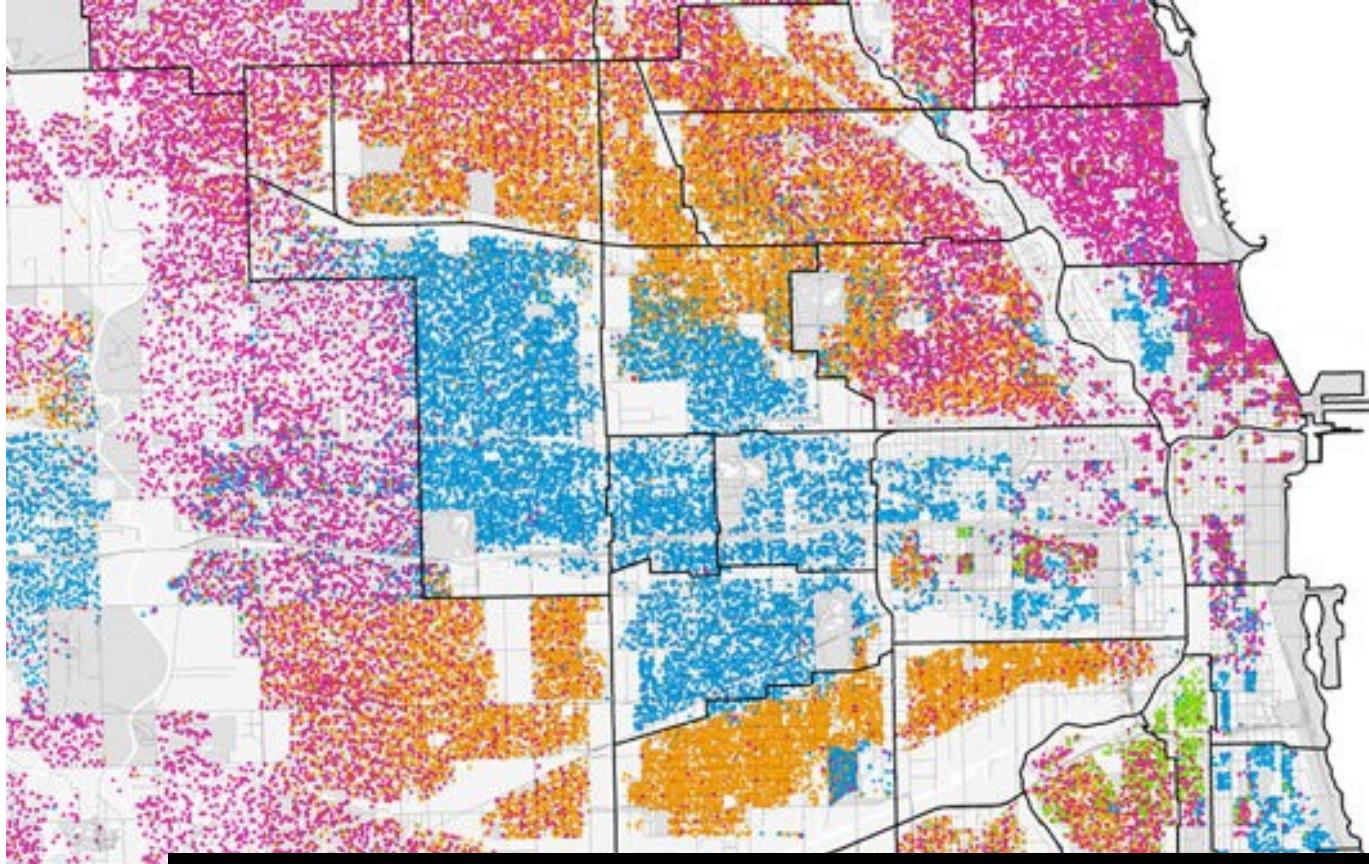
[View More Maps](#)

Address, ZIP code or city

[Go](#)

By MATTHEW BLOCH, SHAN CARTER and ALAN McLEAN | Source: 2005-9 American Community Survey, Census Bureau; socialexplorer.com

Note: Dots are evenly distributed across each Census tract or county. Dollar amounts are adjusted for inflation.



the black lines show
chicago's official
community areas.

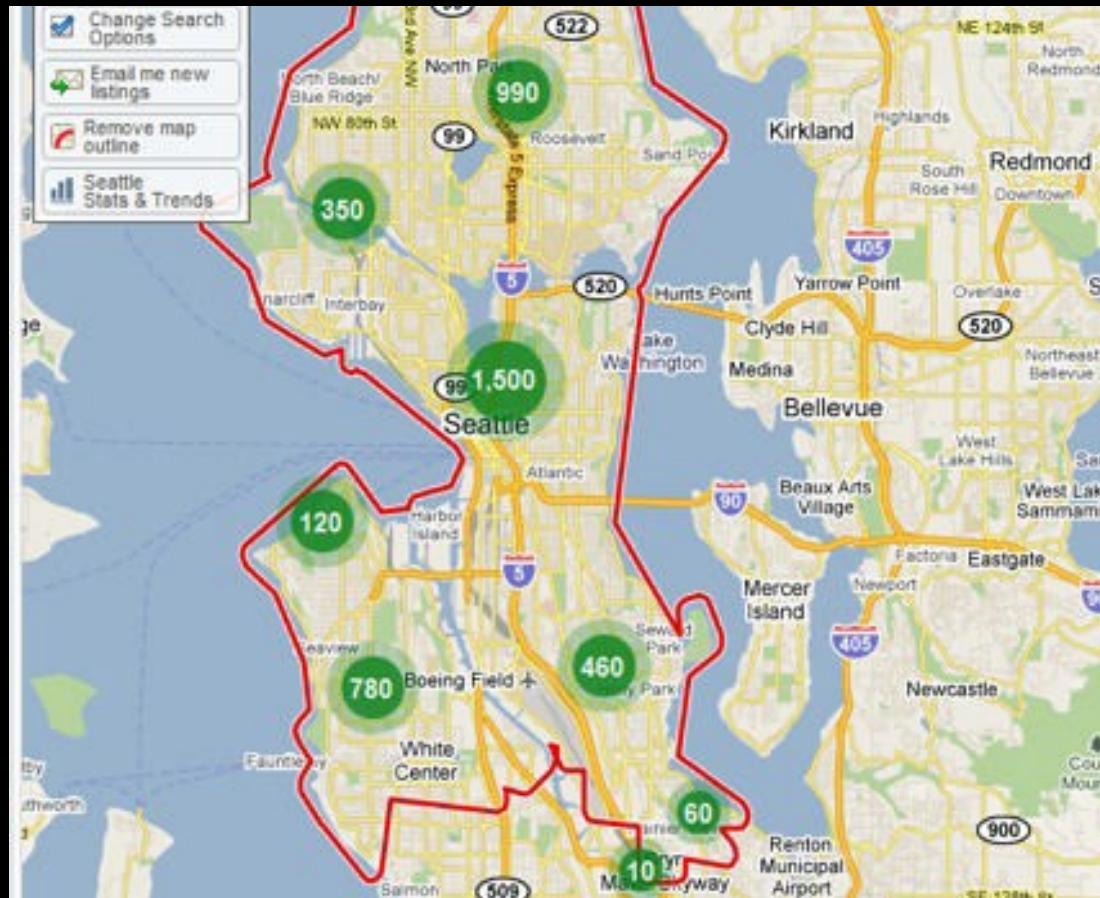
each dot represents
twenty-five people.
here, hispanic is
exclusive of other
categories.

block-level data
from the U.S. census.

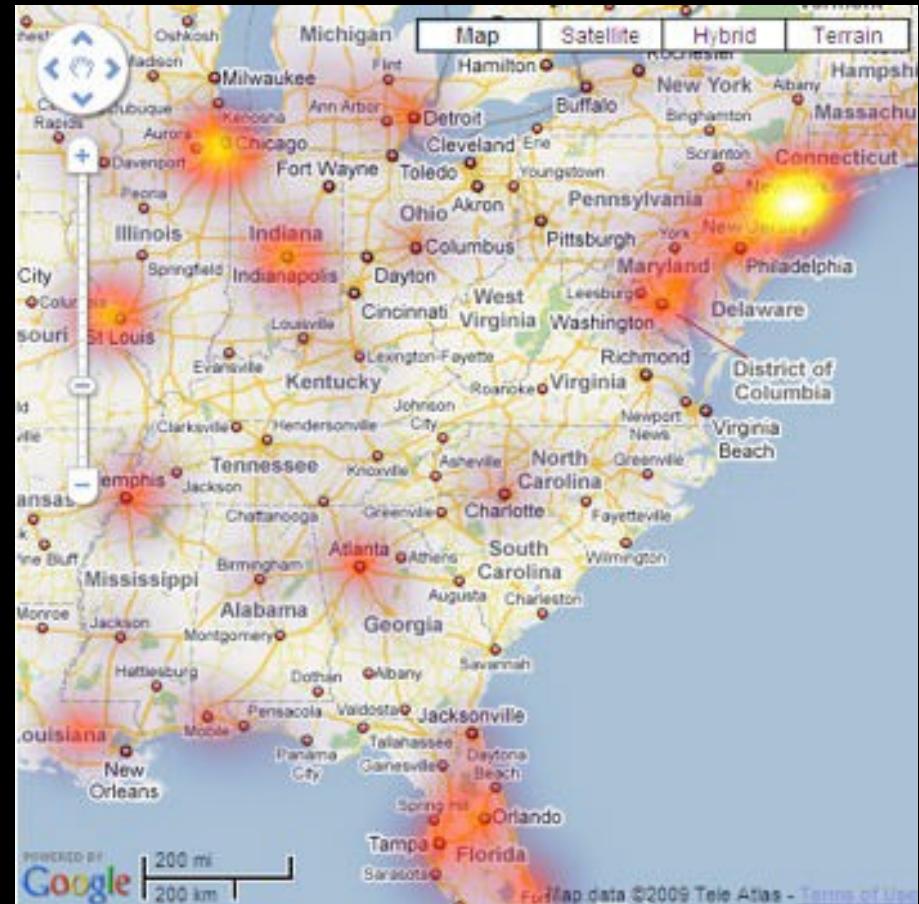
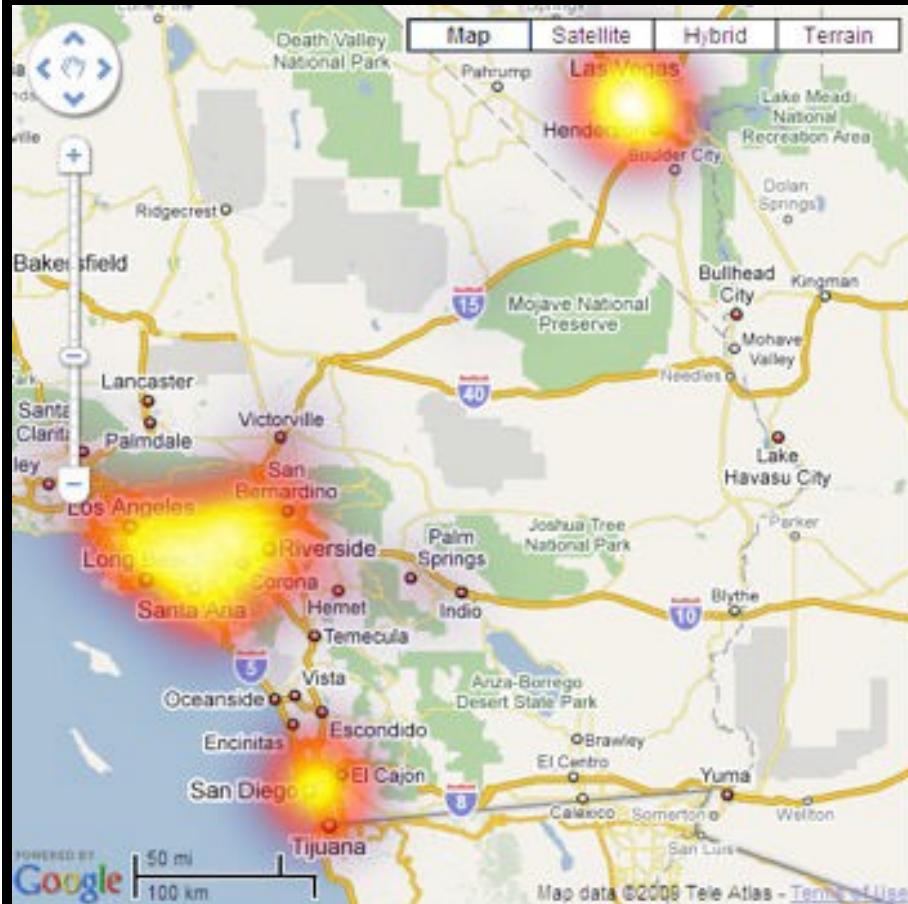
scale 1:200,000

This map is counting
many small things

Clustering, grouping



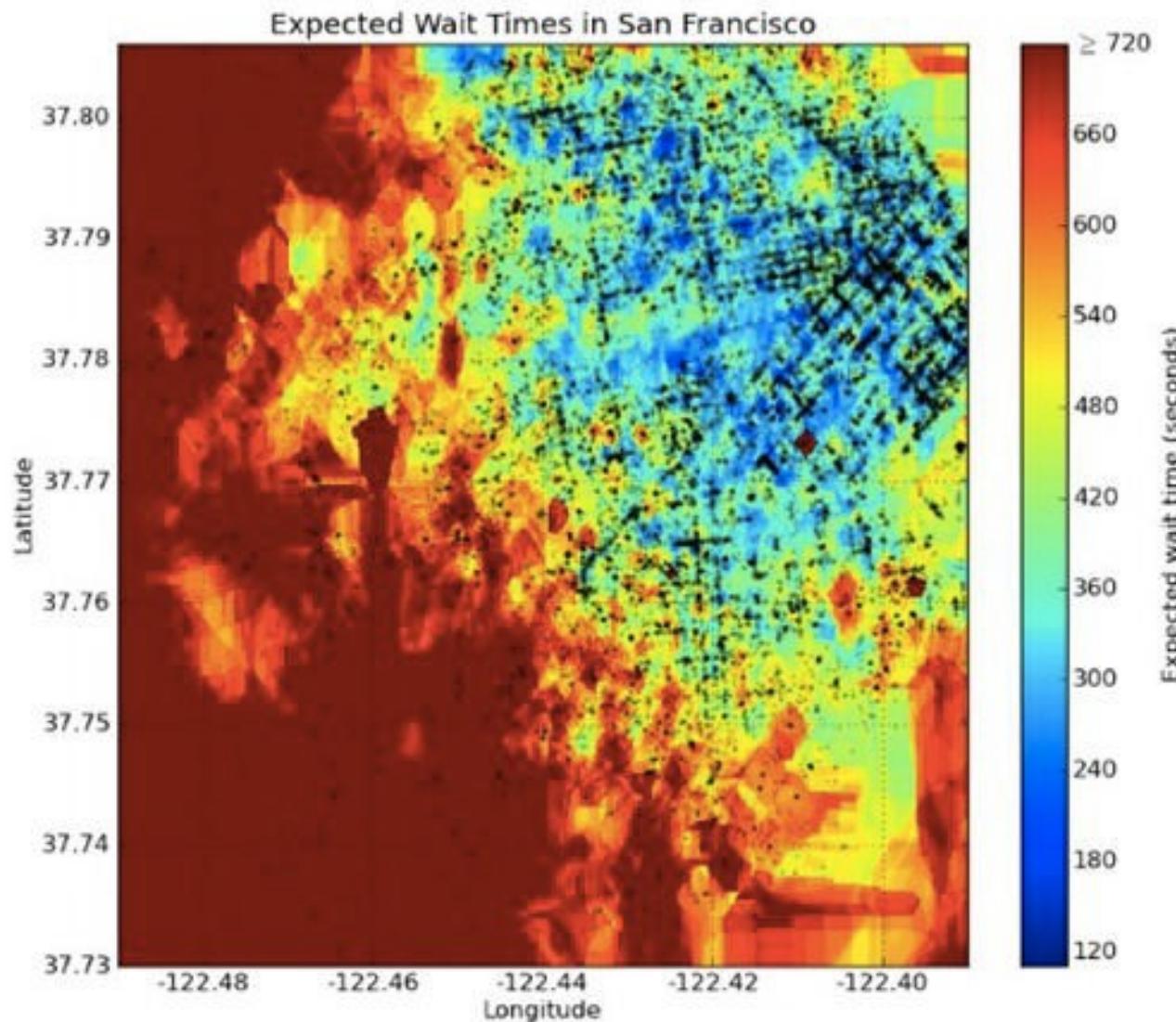
Continuous Data



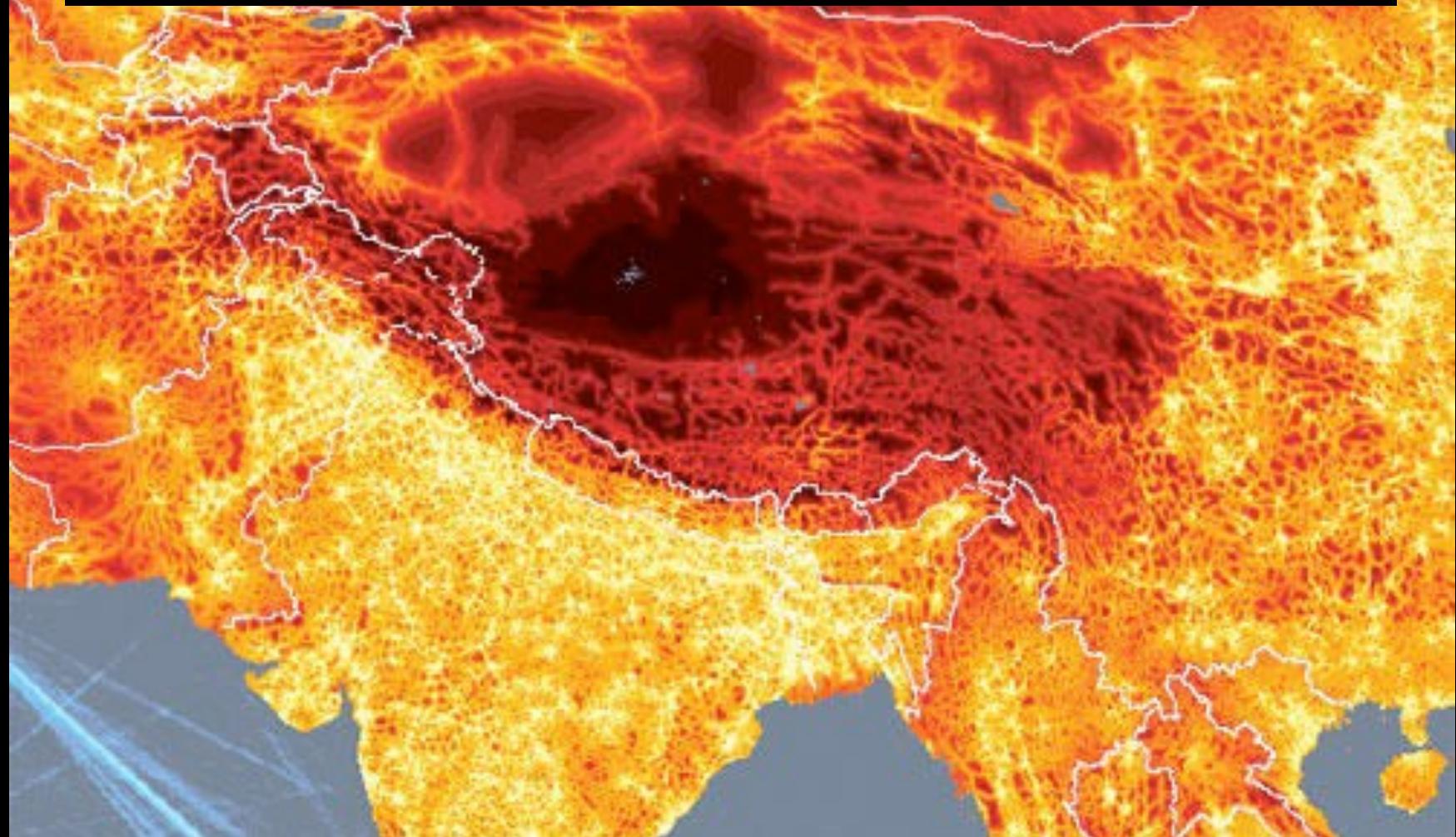
Don't hide the context

Uber Wait Times, 2011

<http://sta.mn/6x27>

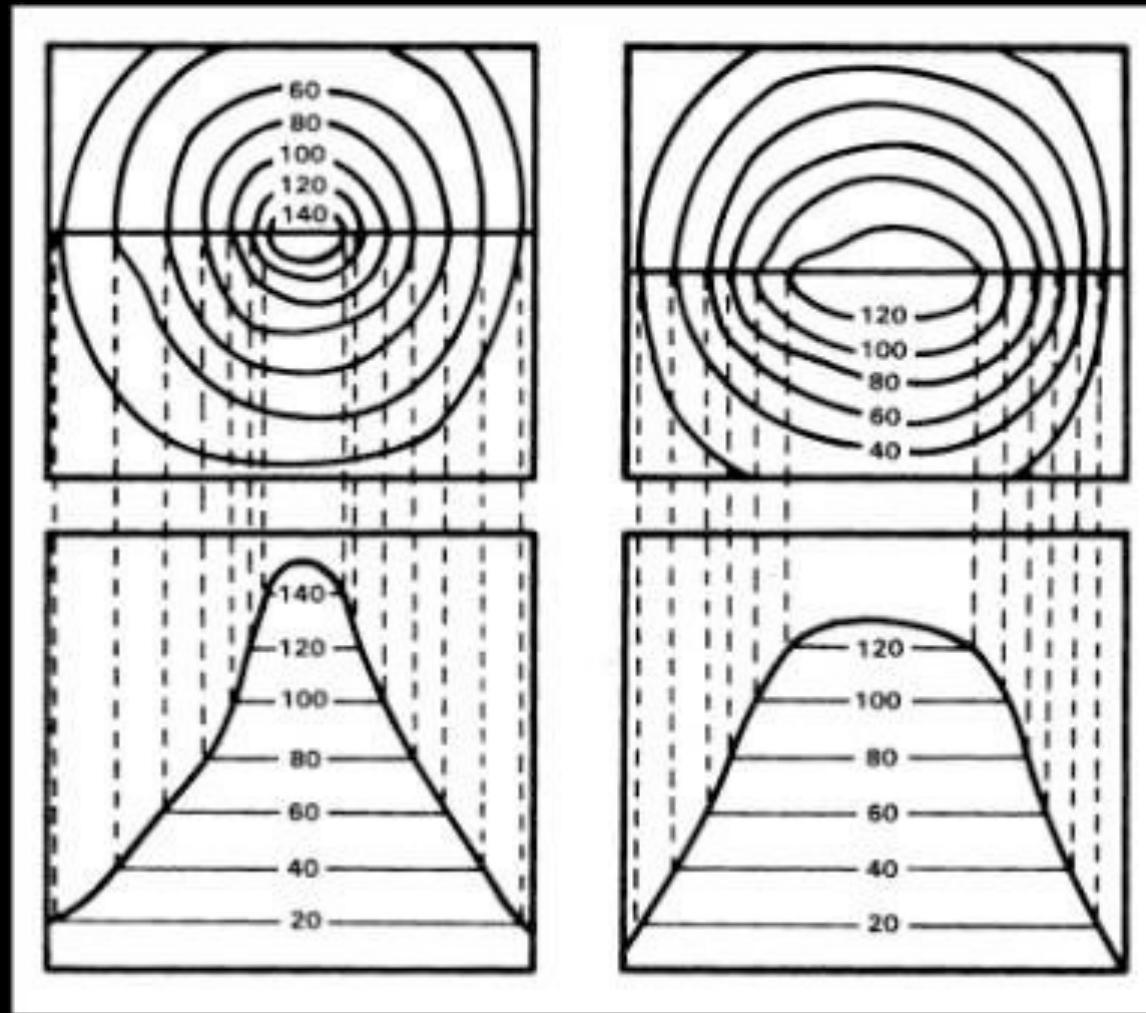


Try smooth gradations



How to show elevation information

Meaningful buckets





“Iso” means “same”

Isolines for elevation

Break data into buckets *(and plot as elevations)*



Flow Maps

Minard 1869: Napoleon's march

Carte Figurative des pertes successives en hommes de l'Armée Française dans la Campagne de Russie 1812-1813.

Conçue par A. Minard, Ingénieur Général des Ponts et Chaussées en retraite. Paris, le 20 Novembre 1869.

Les nombres d'hommes peuvent être représentés par la largeur des zones colorées à cause d'une millimétrie pour une mille horizontale; ils sont le plus évidé en fin des zones. Le rouge désigne les hommes qui sortent en Russie; le noir ceux qui en rentrent. — Les renseignements qui ont servi à dresser la carte ont été pris dans les ouvrages de M. Chiat, de Léger, de Tocqueville, de Chambry et le Journal intime de Jaccot, pharmacien de l'Armée depuis le 22 Octobre.

Le moins faire peut à l'ordre de l'exactitude de l'œuvre, j'ai supposé que les corps de l'armée Napoléon et du Maréchal Davout qui avaient été détachés sur l'Amblève et l'Ourthe avec Oudiné et Wrede, avaient toujours marché avec l'armée.

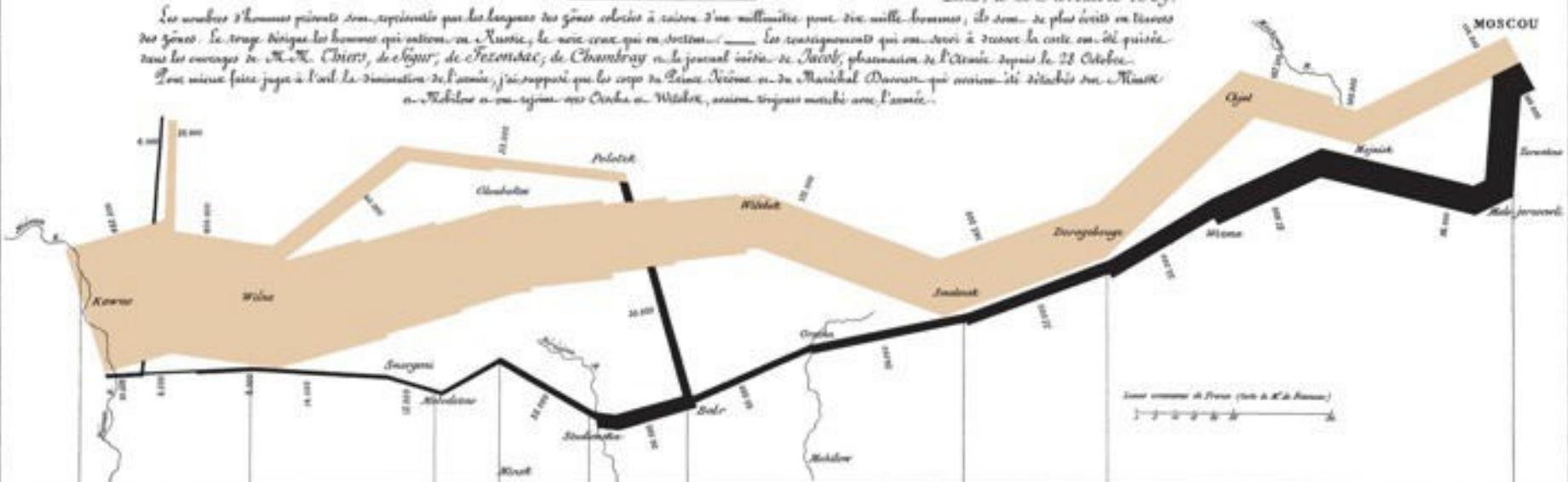
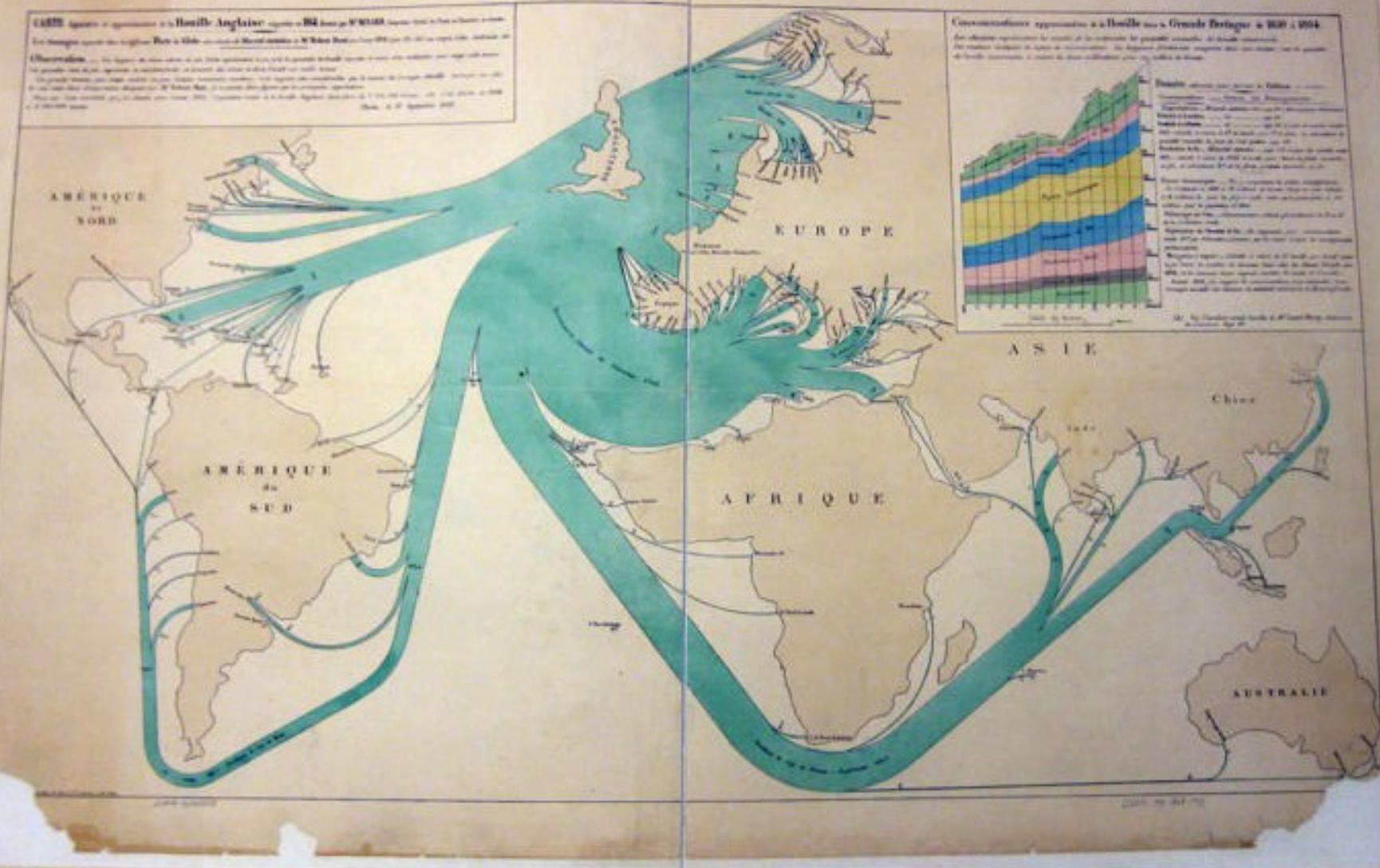


TABLEAU CRAPHIQUE de la température en degrés du thermomètre de Réaumur au dessous de zéro.

Les Champs peuvent au gelé
la violence gèle.

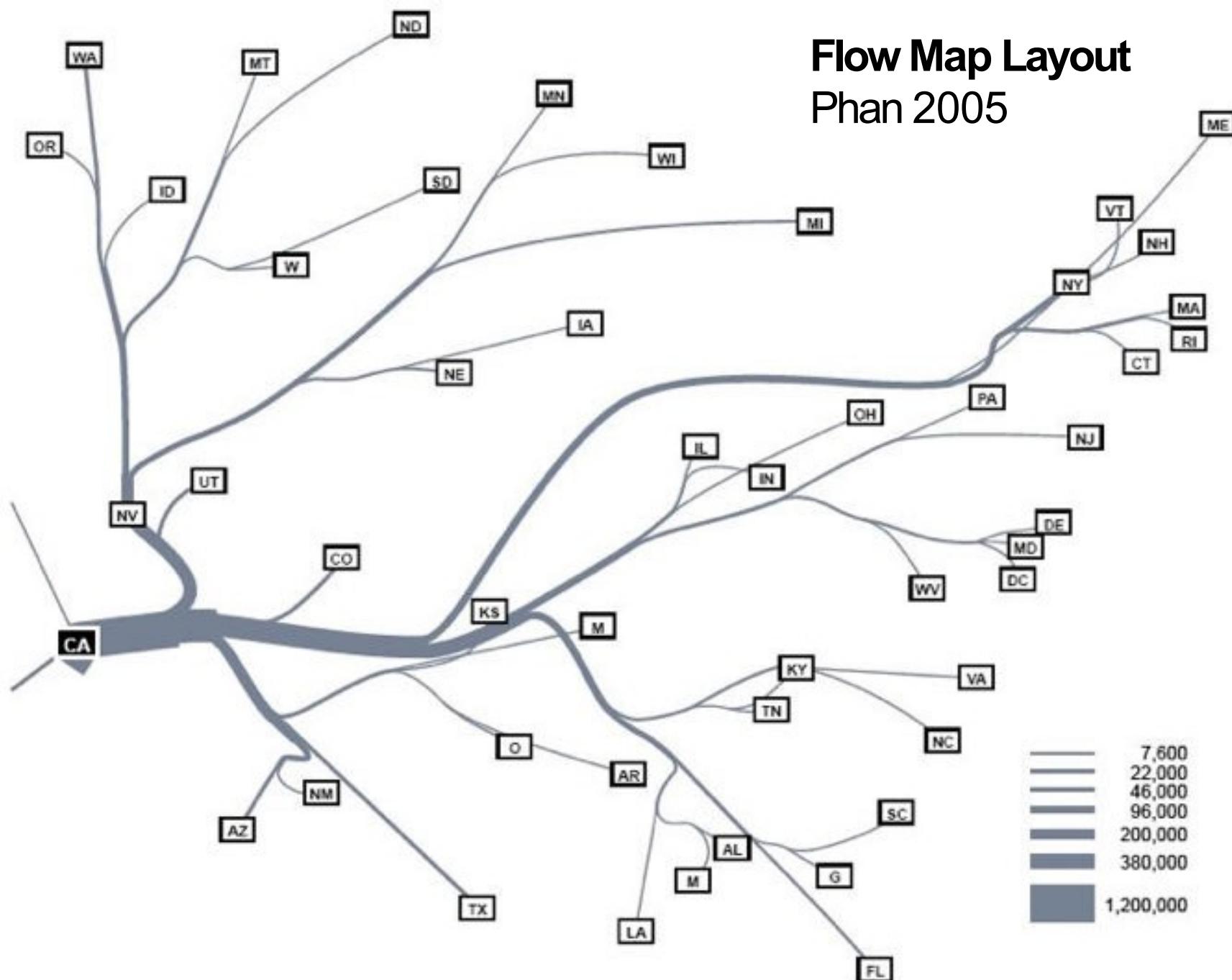




1864 British Coal Exports, Charles Minard

Flow Map Layout

Phan 2005

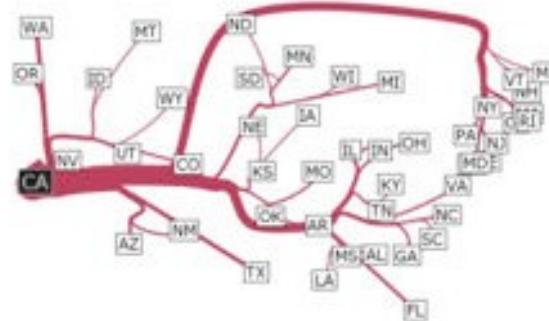


Migration from California, 1995-2000

Tobler 1987



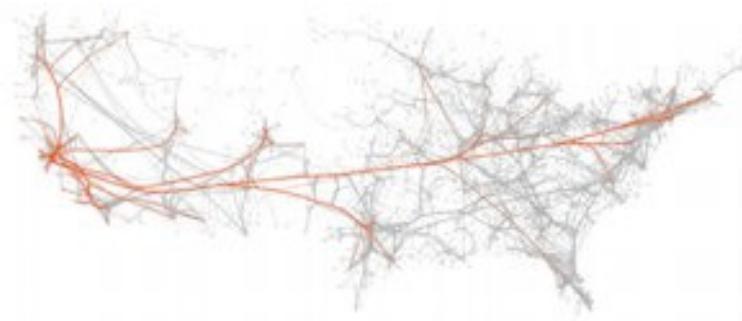
Phan et al. 2005



Verbeek et al. 2011



Cui et al. 2008



Holten & van Wijk 2009

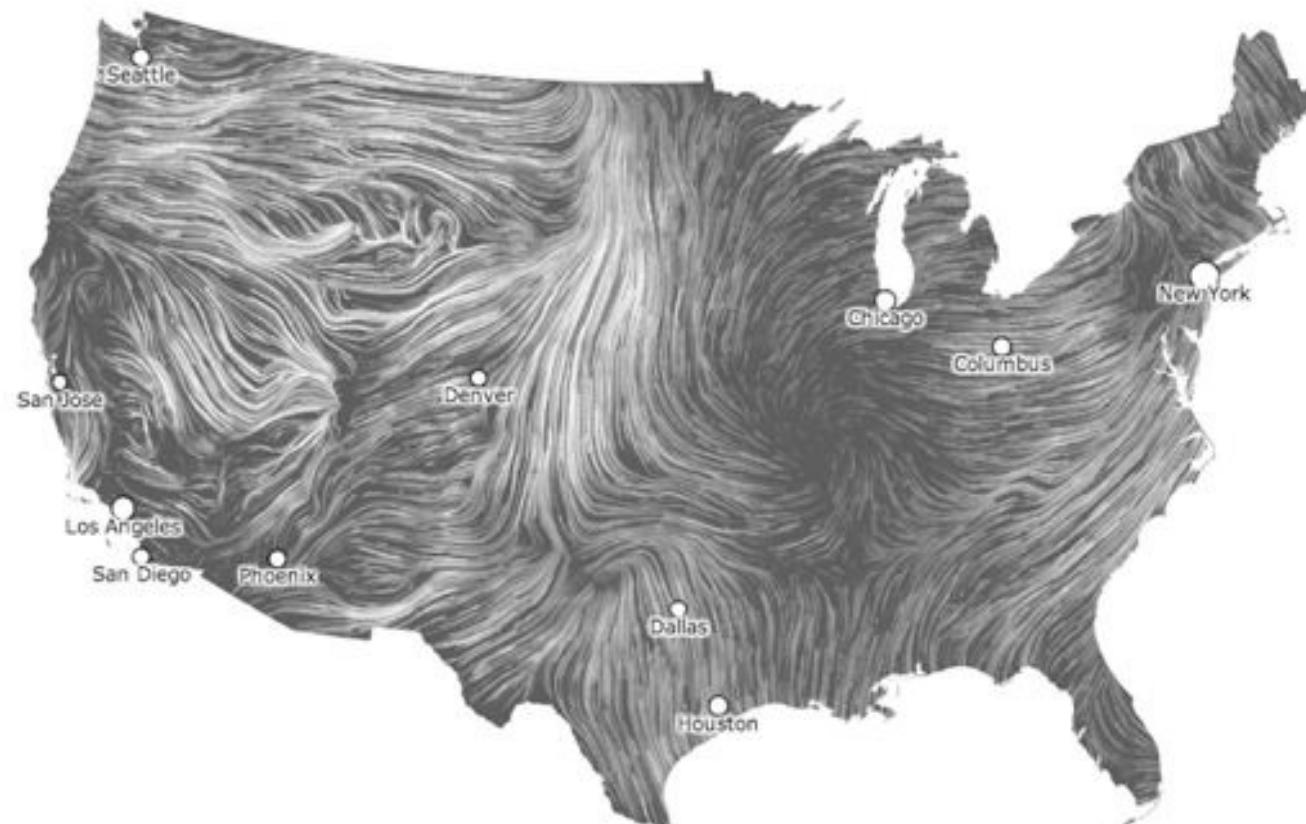
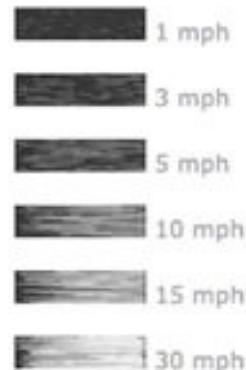
wind map

February 19, 2014

11:55 am EST

(time of forecast download)

top speed: 35.3 mph
average: 11.6 mph



Romney's Shift Wasn't Enough

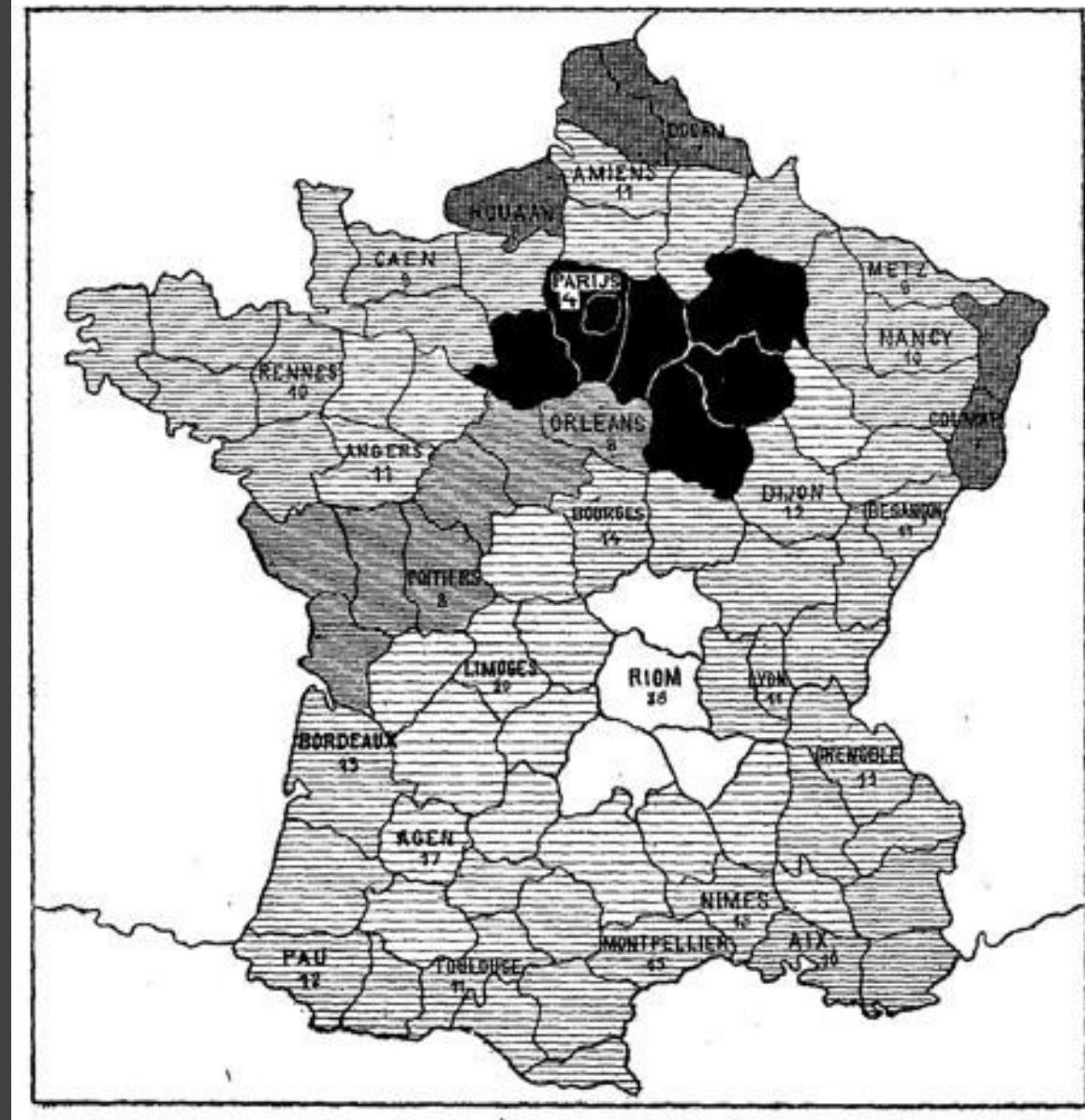
2008

2012

Most of the nation shifted to the right in Tuesday's vote,
but not far enough to secure a win for Mitt Romney.

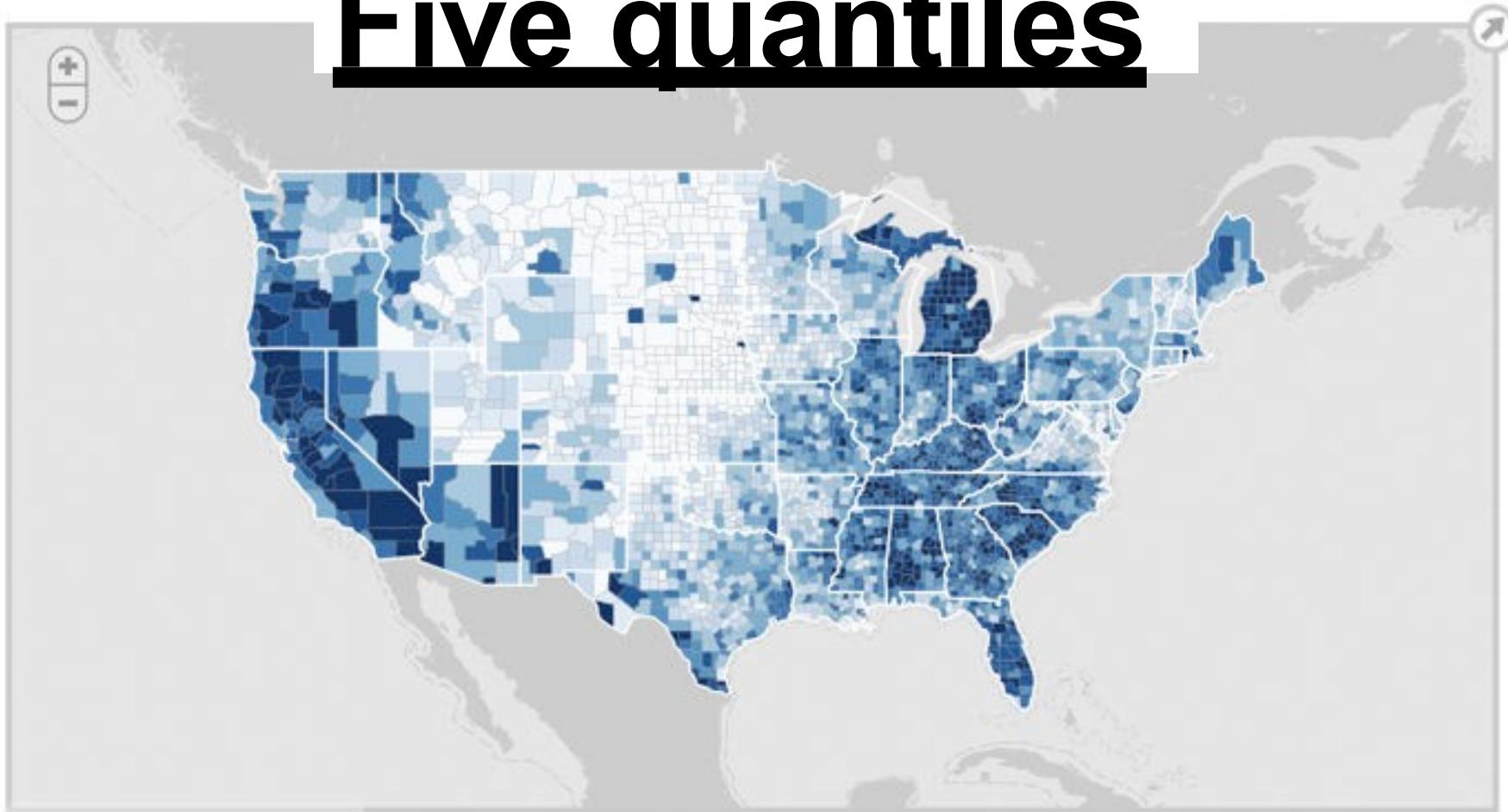


Choropleths



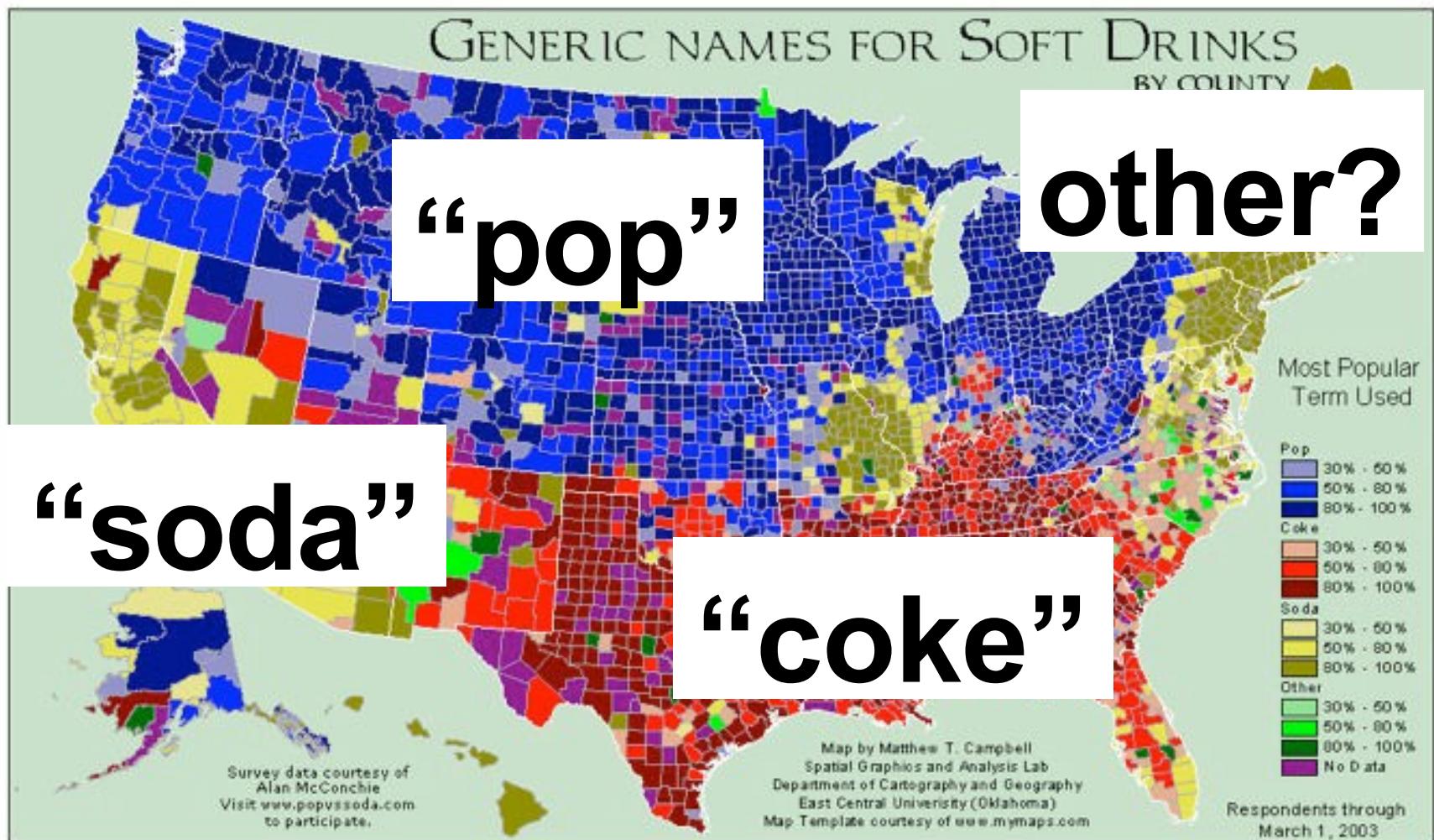
1826(?) Illiteracy in France, Pierre Charles Dupin

Five quantiles



Poly**maps** is a project from
SimpleGeo and Stamen.

Unemployment



READING, WRITING, AND EARNING MONEY

The maps below illustrate 21 measures of American Community Survey poverty by county across all 3,142 counties in the United States. All the County Data is available at sta.mn/pjr and the measures can be ranked on any measure or any county map by clicking the "rank" button when viewing the reading, writing, and earning money county map.



© 2010 RAND CORPORATION



© 2010 RAND CORPORATION



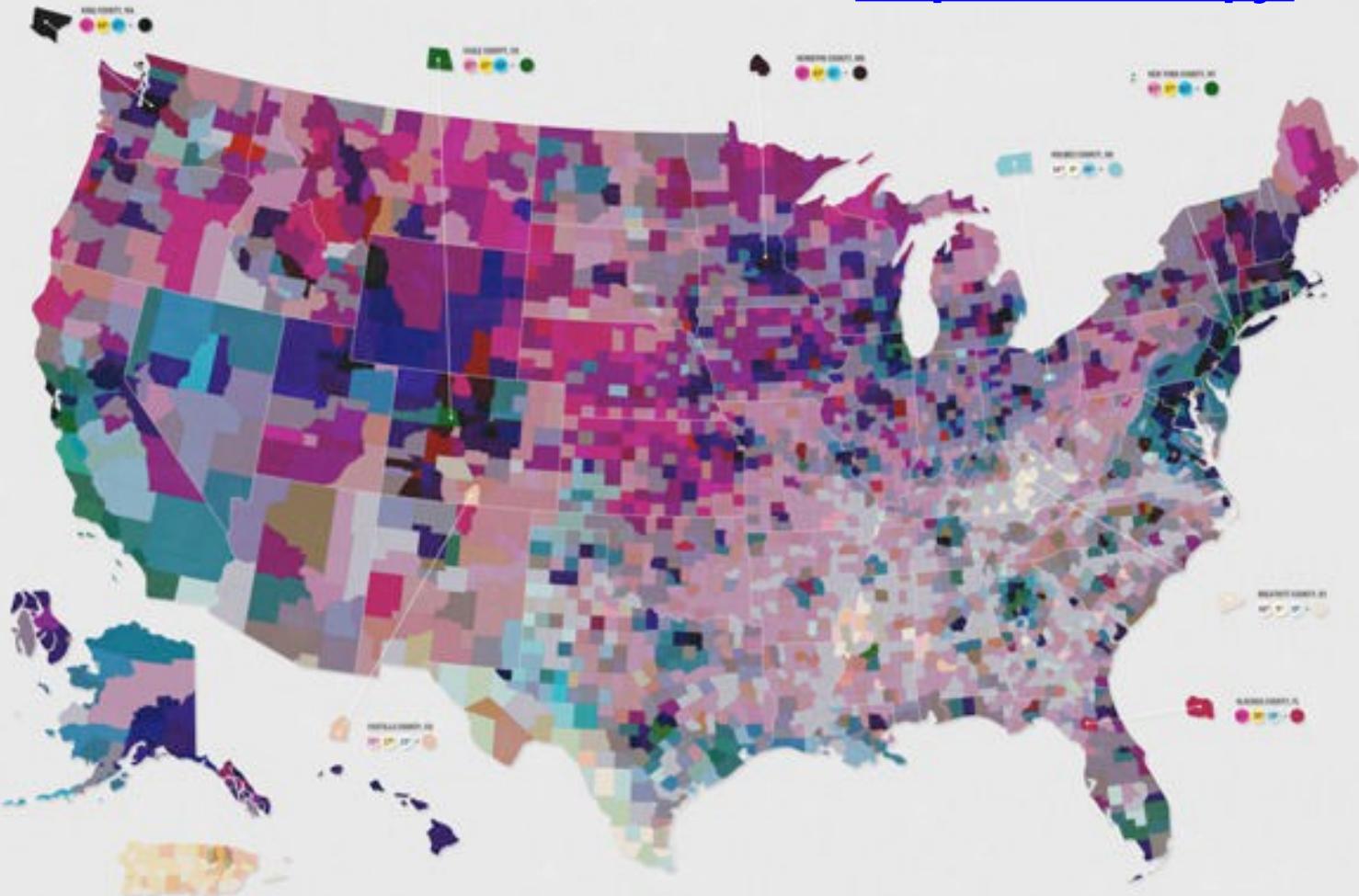
© 2010 RAND CORPORATION

This map is right is a choropleth showing the median income. The darker the color, the higher the median income. In general, median income increases from west to east across the United States. Median income is often used as an indicator of economic well-being and living standards.

The map is right is a choropleth showing the median income. The darker the color, the higher the median income. In general, median income increases from west to east across the United States. Median income is often used as an indicator of economic well-being and living standards.



© 2010 RAND CORPORATION



Choose colors well

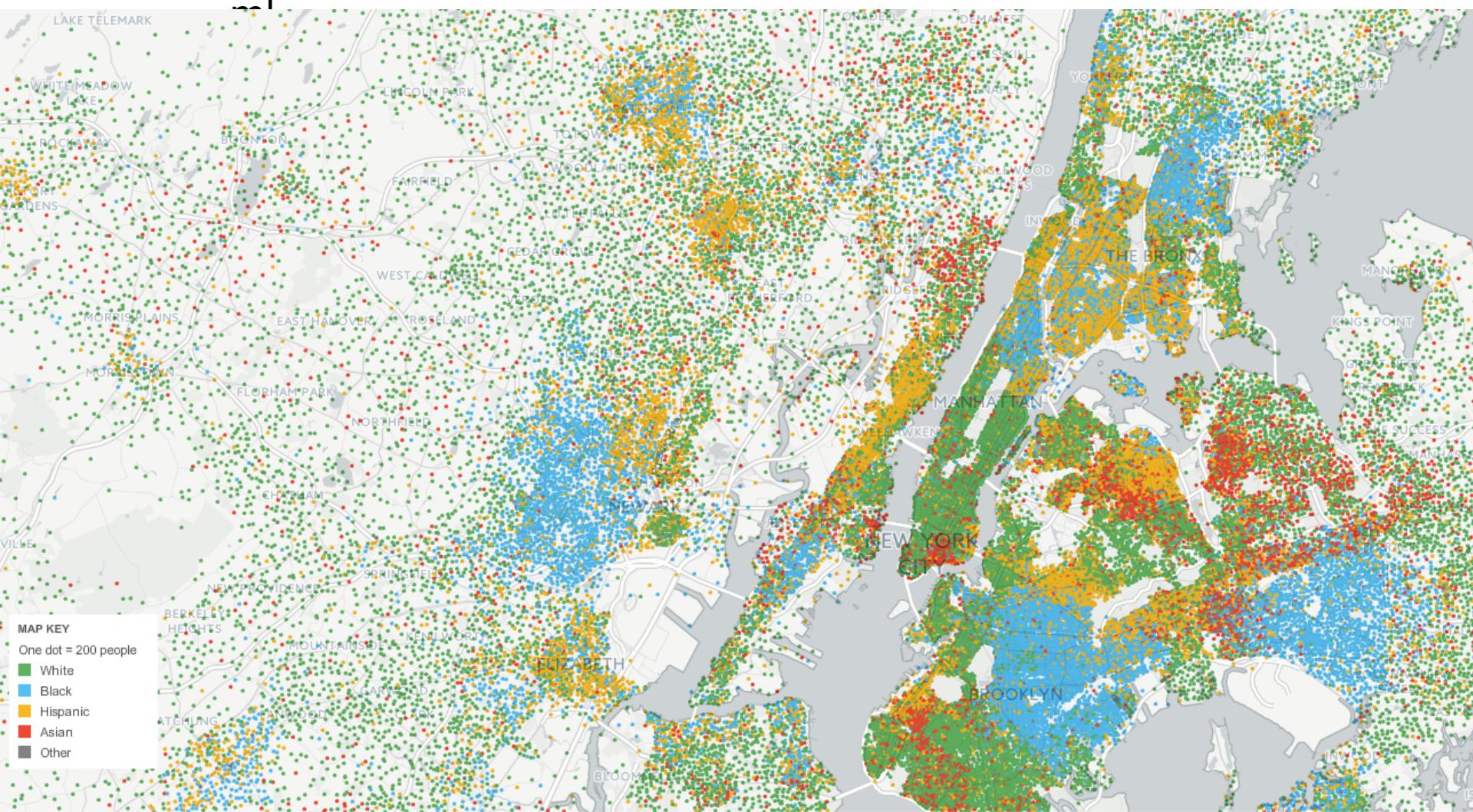


Focus on the foreground

Problems with mapping
(large/multivariate) data on
maps

Mapping America – Census Data 2010

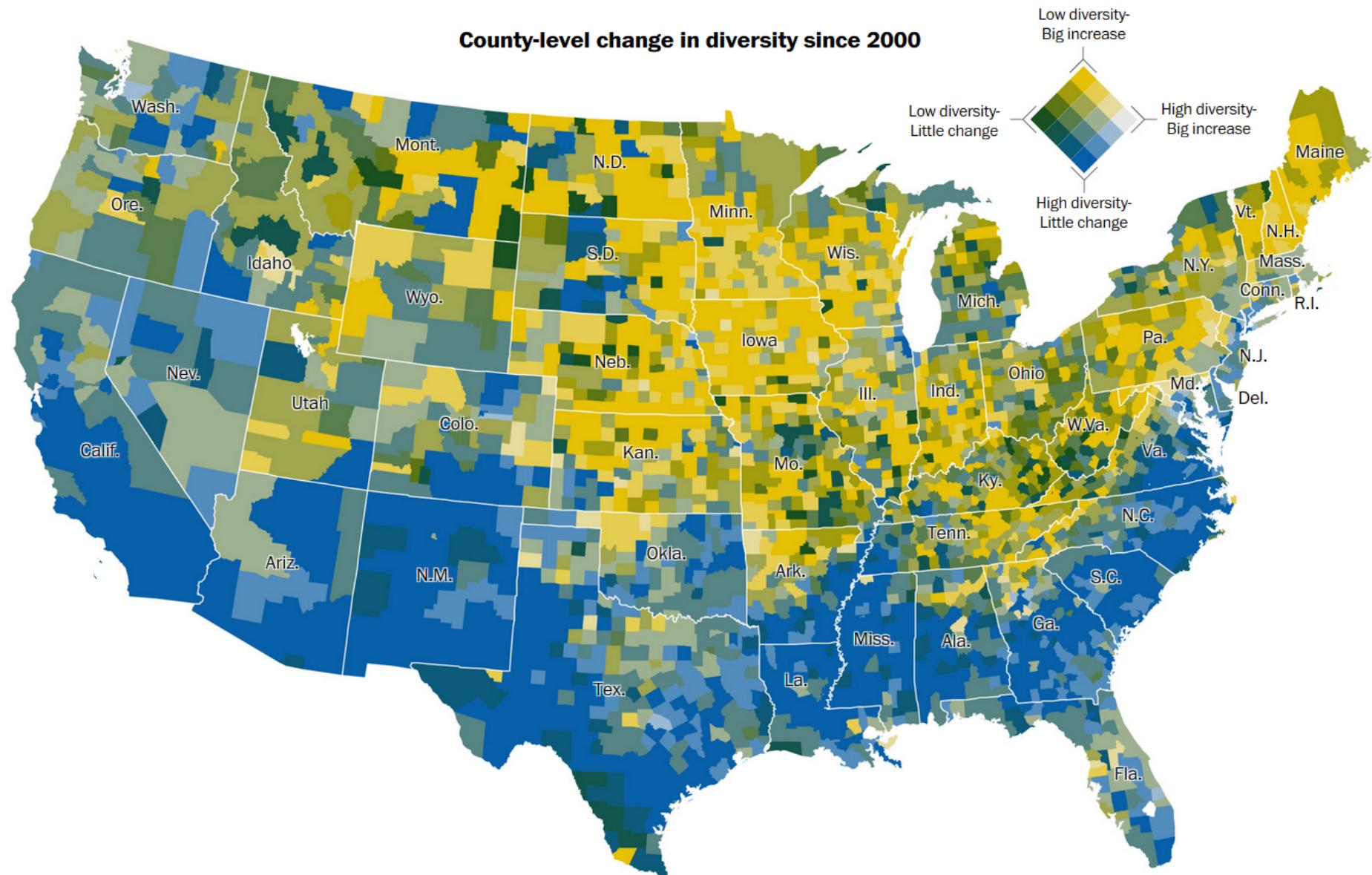
- <http://www.nytimes.com/projects/census/2010/explorer.html>



© Anselm Spoerri

US – Diversity

- <https://www.washingtonpost.com/graphics/national/how-diverse-is-america/>



Possible Solutions

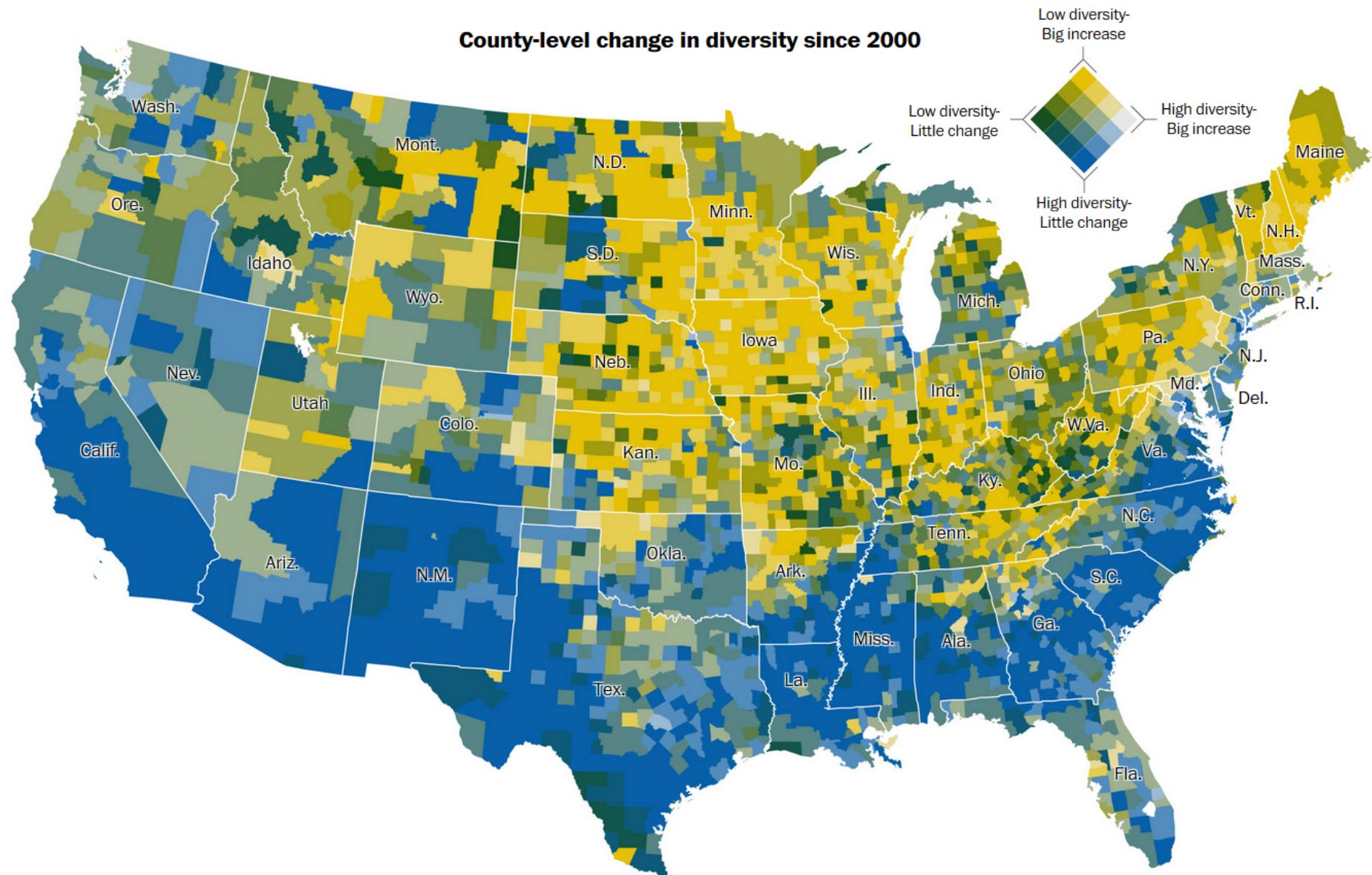
- Filtering
- Alter map shapes ?
- Do not use maps !

4
5

Solution 1: Filtering...

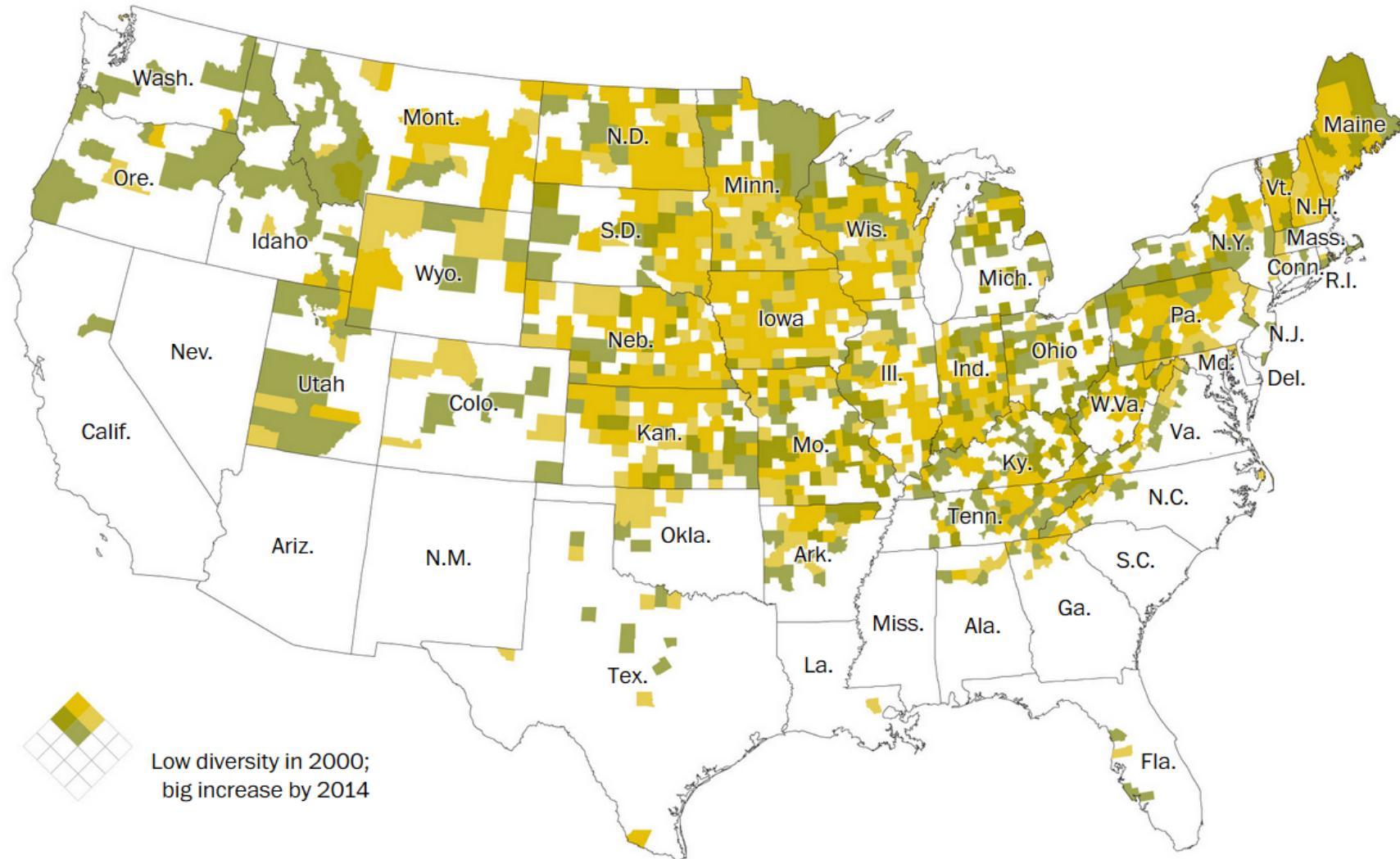
US – Diversity

- <https://www.washingtonpost.com/graphics/national/how-diverse-is-america/>



US – Diversity

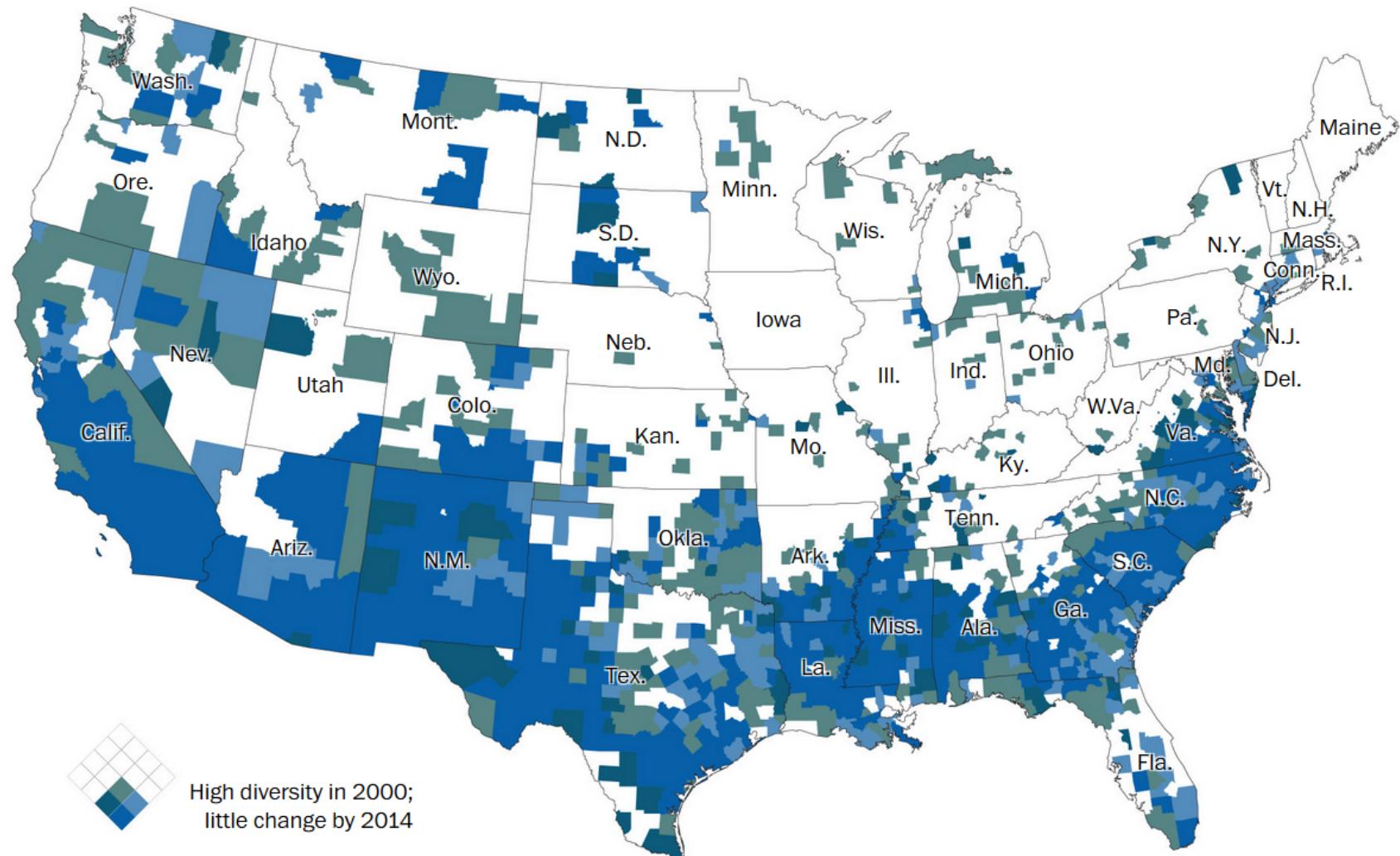
- <https://www.washingtonpost.com/graphics/national/how-diverse-is-america/>
Not diverse, but changing fast



US – Diversity

- <https://www.washingtonpost.com/graphics/national/how-diverse-is-america/>

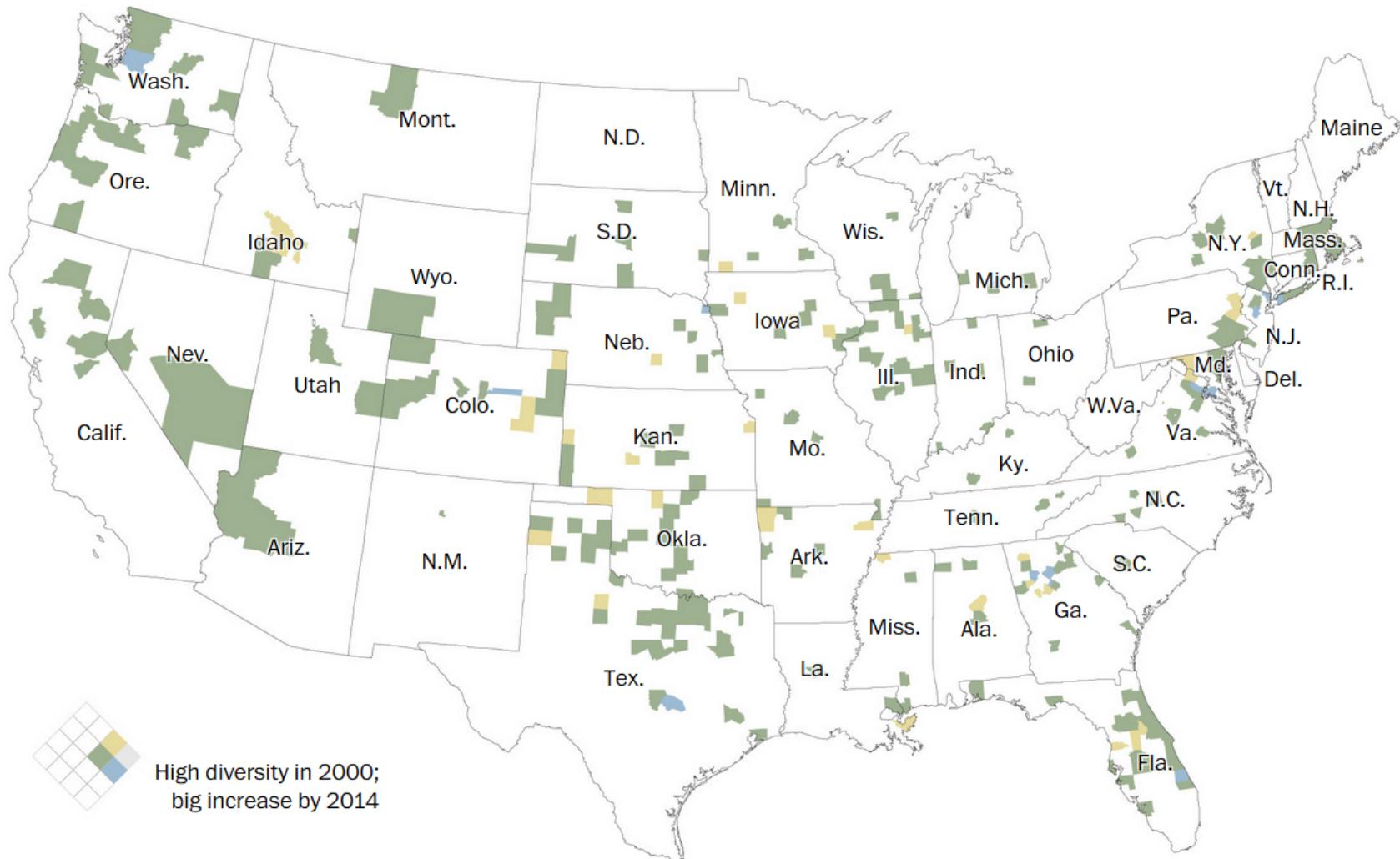
Already very diverse



US – Diversity

- <https://www.washingtonpost.com/graphics/national/how-diverse-is-america/>

Diverse and getting more so

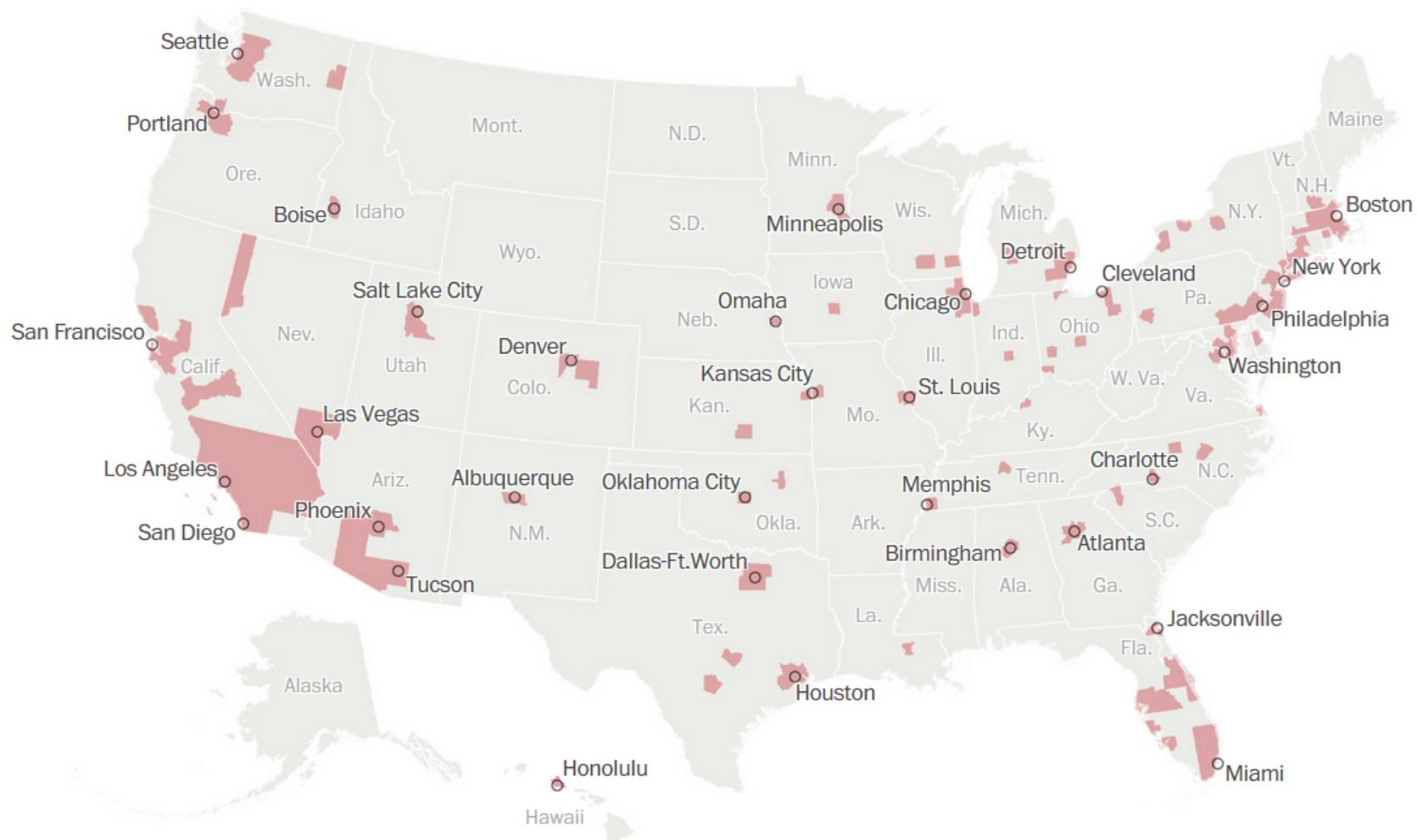


Solution 2:
Alter map shapes
Cartograms

How Intensity / Choropleth Maps Can Distort Data

- <https://www.washingtonpost.com/graphics/politics/2016-election/how-election-maps-lie/>

In 2012, about the same number of votes were cast in ● **these 160 counties** as were cast in the ○ **rest of the country**. But, your run-of-the-mill election map won't show you that.



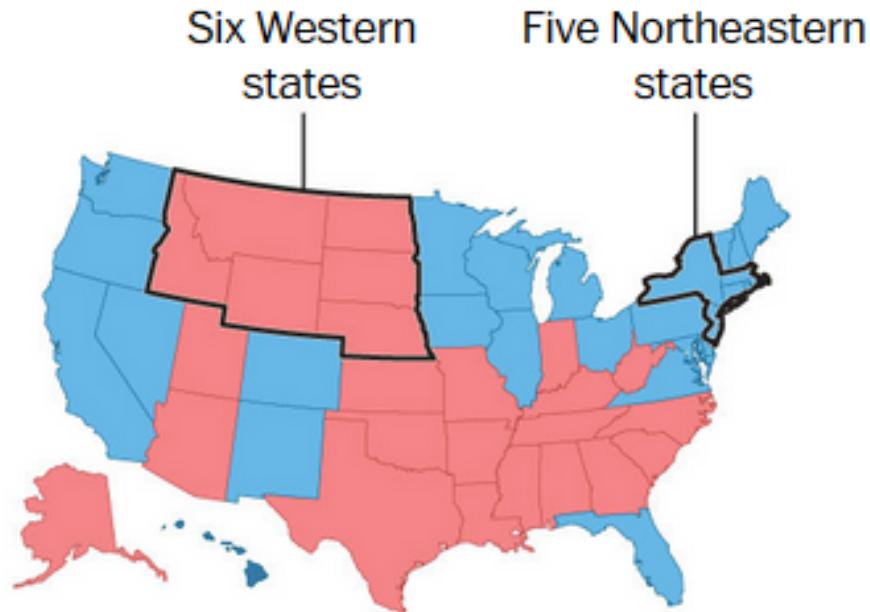
How Intensity / Choropleth Maps Can Distort Data



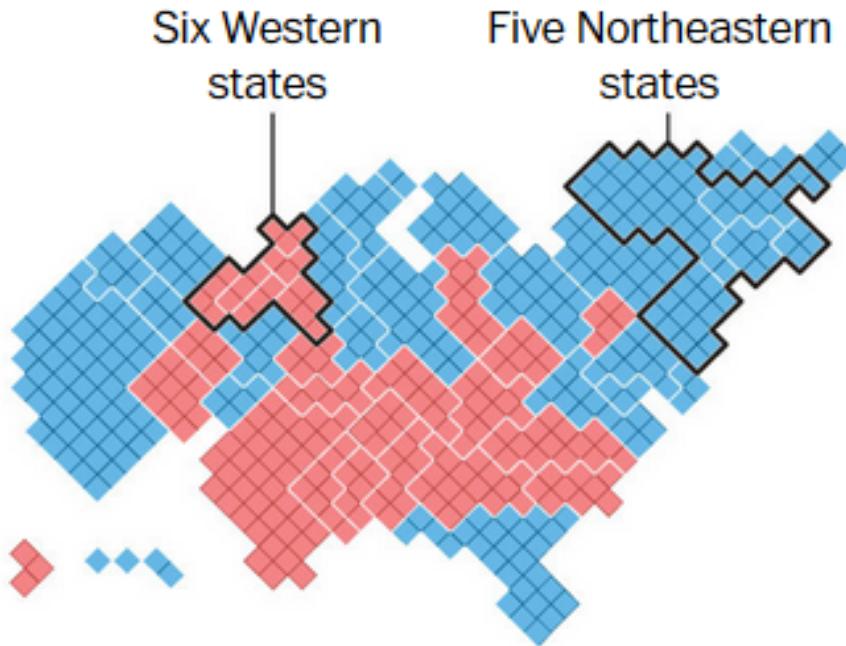
The votes cast in these seven states total just 250,000 more votes than in New Jersey.

Mapping Data to Cartogram

GEOGRAPHIC MAP



CARTOGRAM OF ELECTORAL VOTES



Cartogram – Electoral Votes 2016



Hillary Clinton

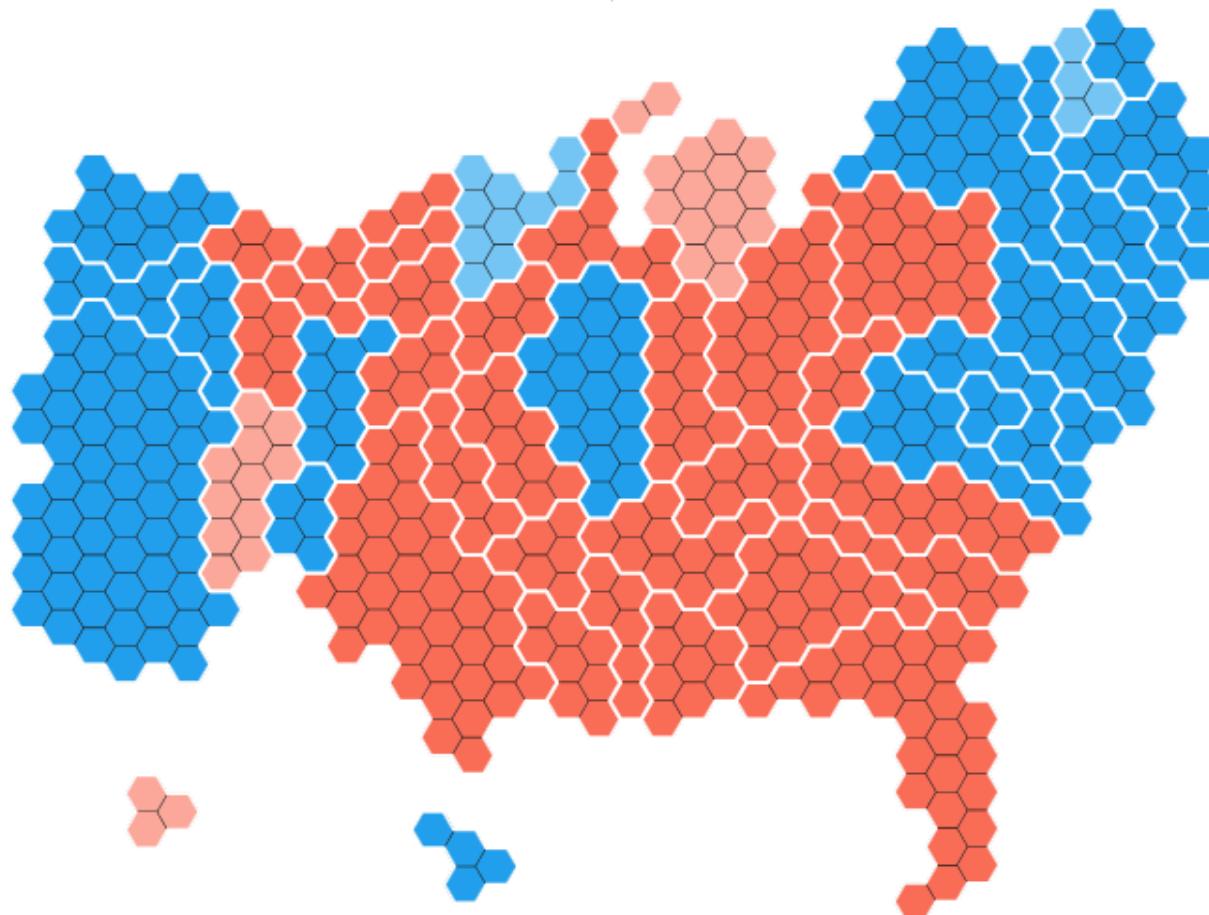
218



Donald Trump

276

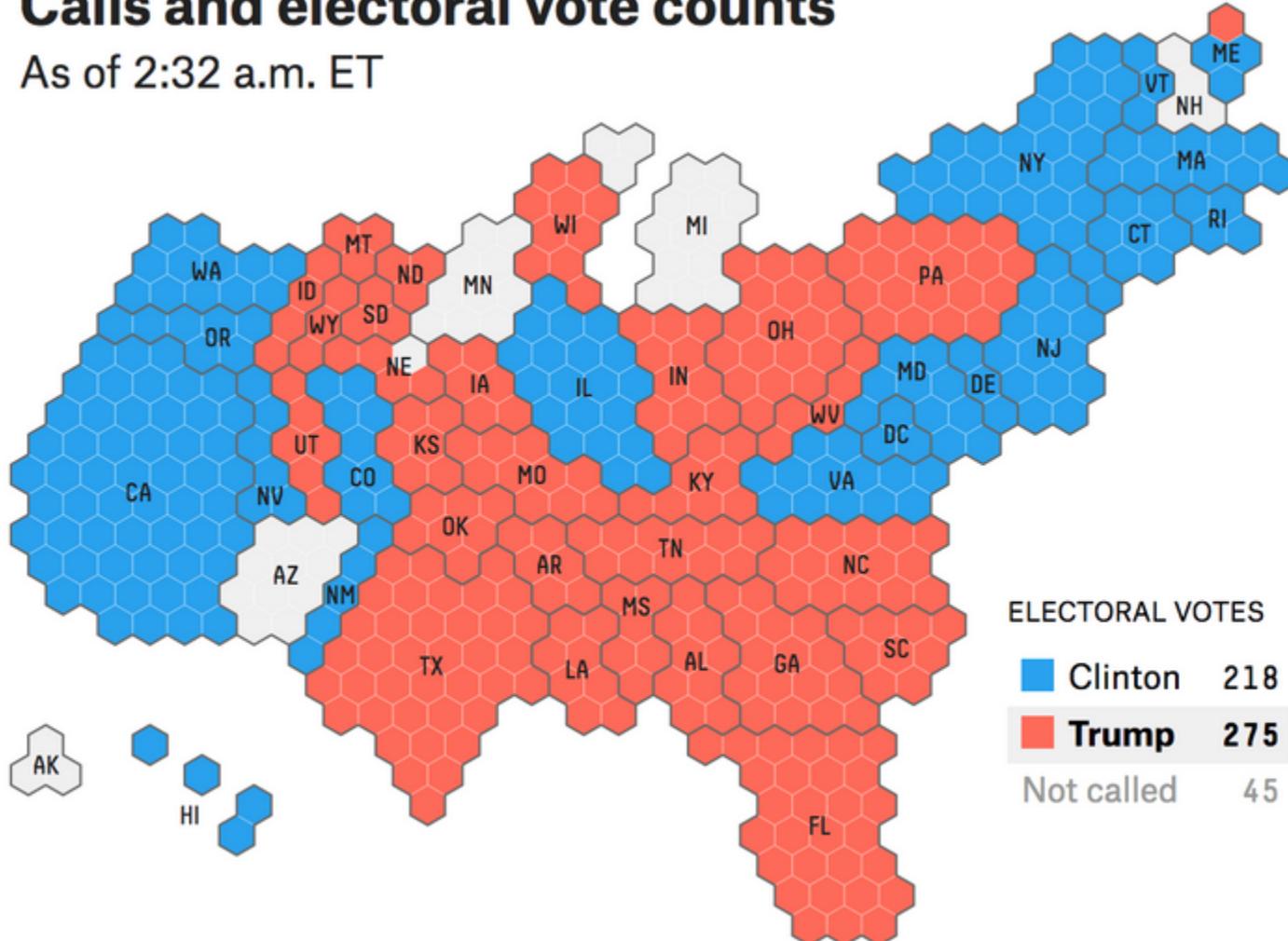
270 für Mehrheit



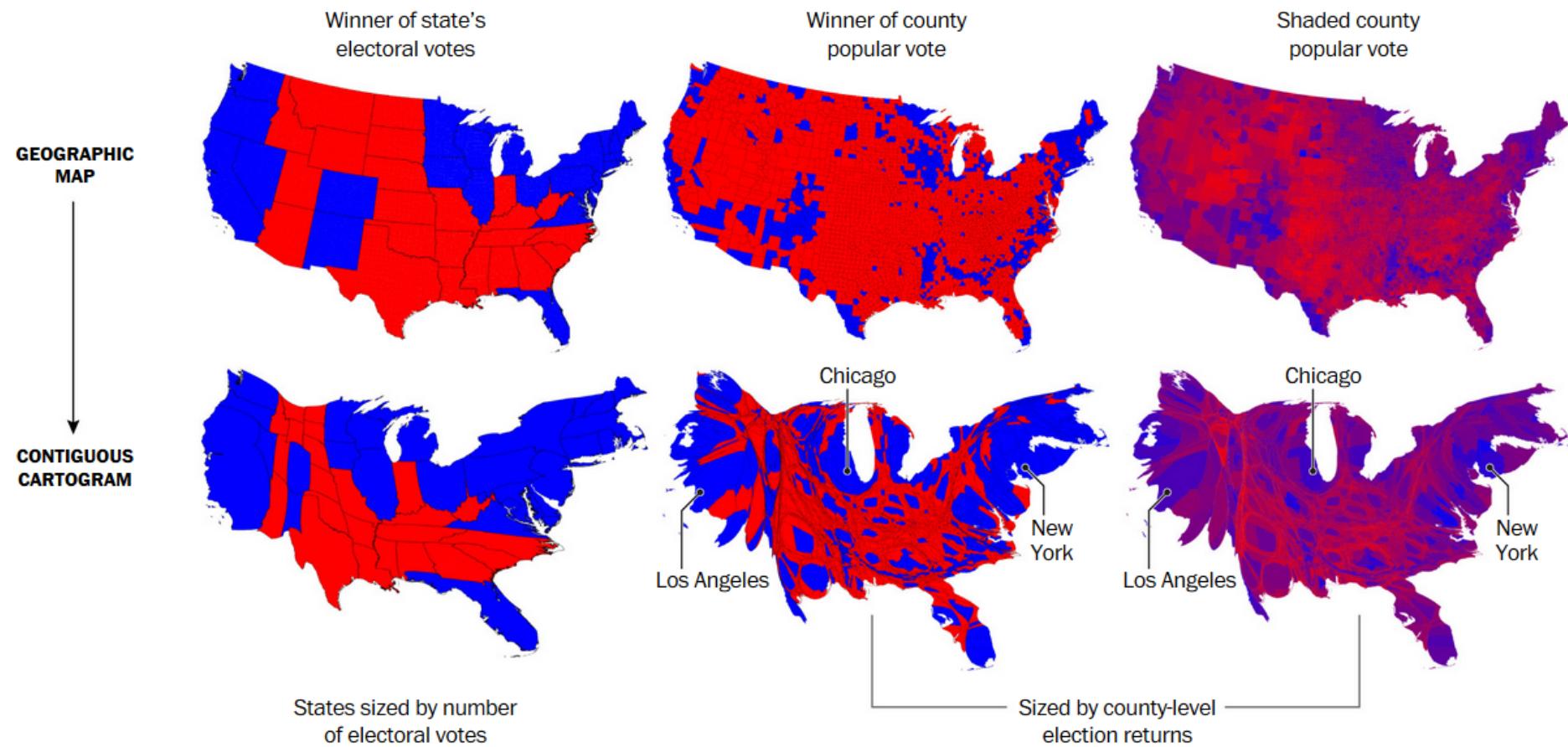
Cartogram – Electoral Votes 2016

Calls and electoral vote counts

As of 2:32 a.m. ET



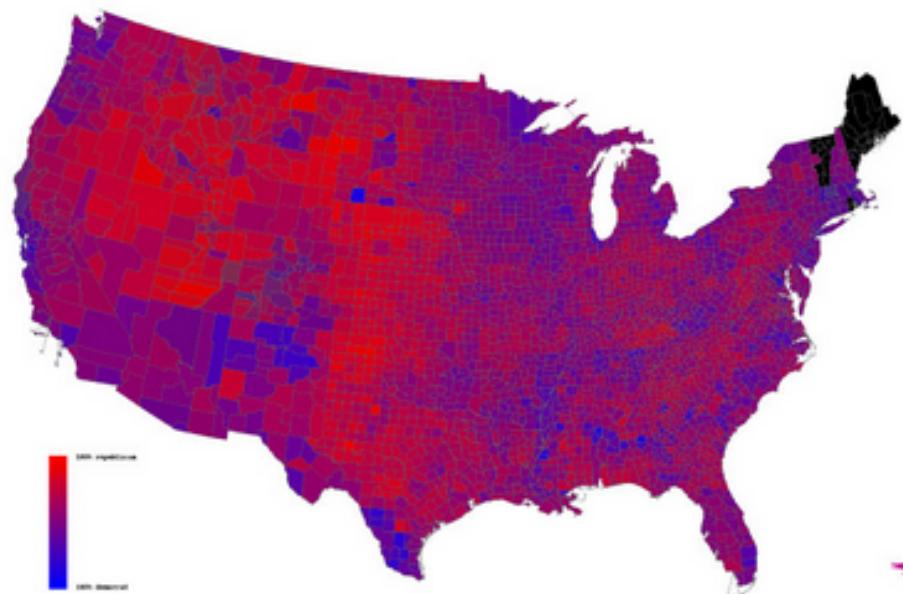
US Elections 2000 – Voting and Population



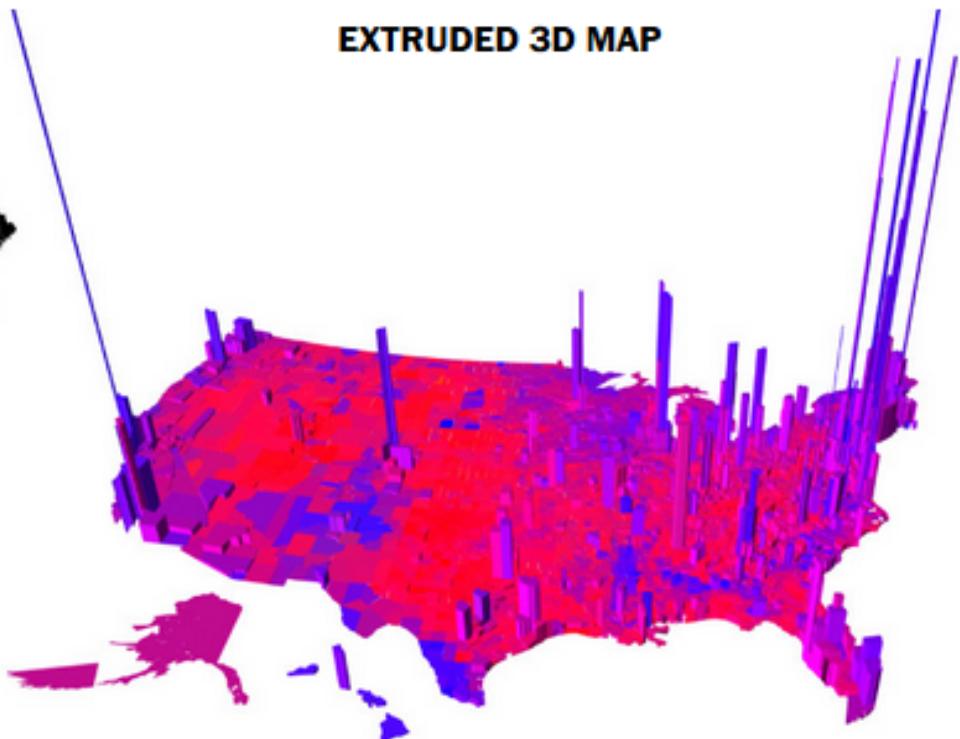
Maps courtesy of Mark Newman

US Elections 2000 – Voting and Population

'PURPLE AMERICA' FROM 2000 ELECTION



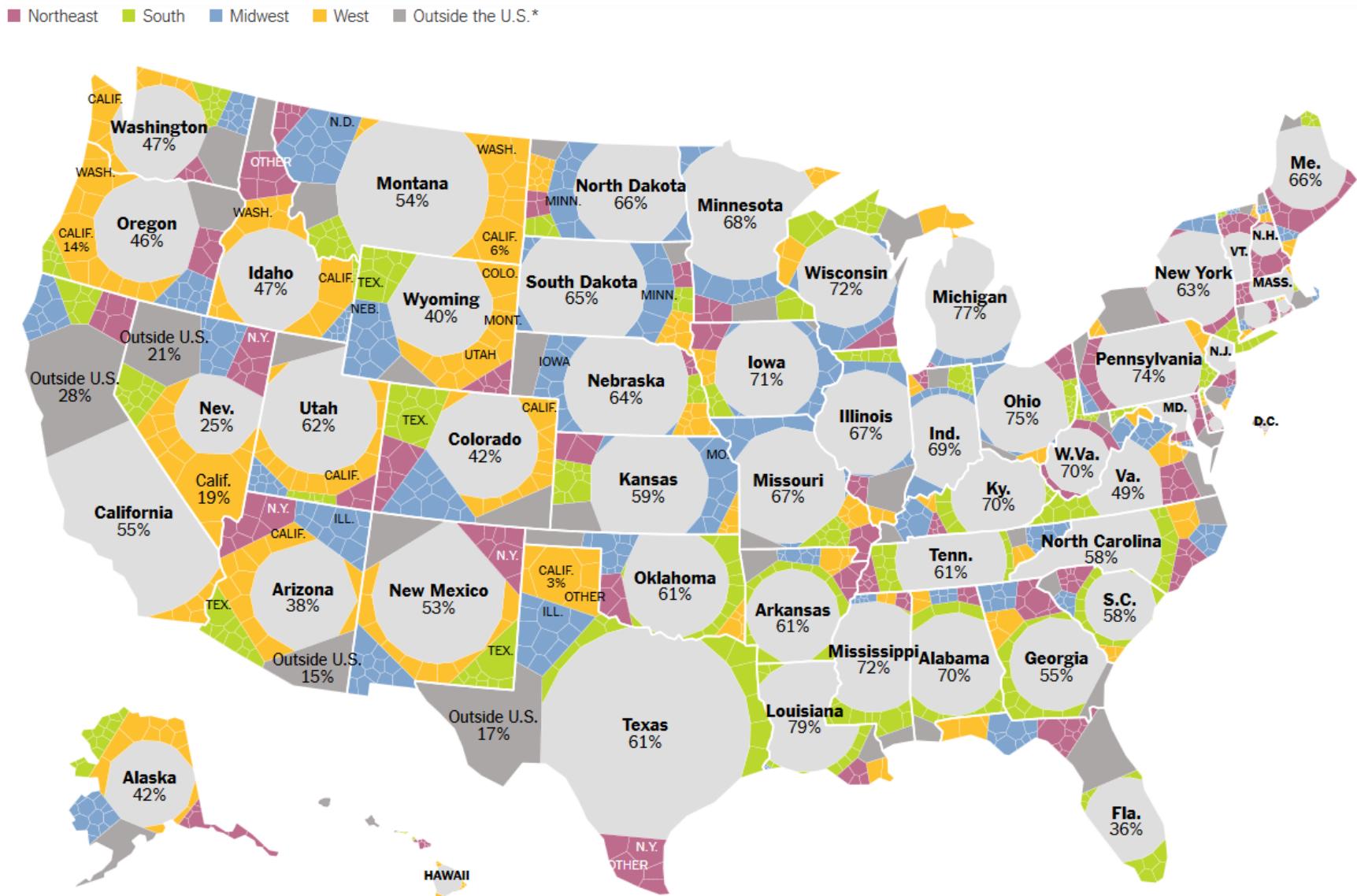
EXTRUDED 3D MAP



Maps courtesy of Robert J. Vanderbei

Mapping Migration in the United States

- <http://www.nytimes.com/2014/08/16/upshot/mapping-migration-in-the-united-states-since-1900.html>



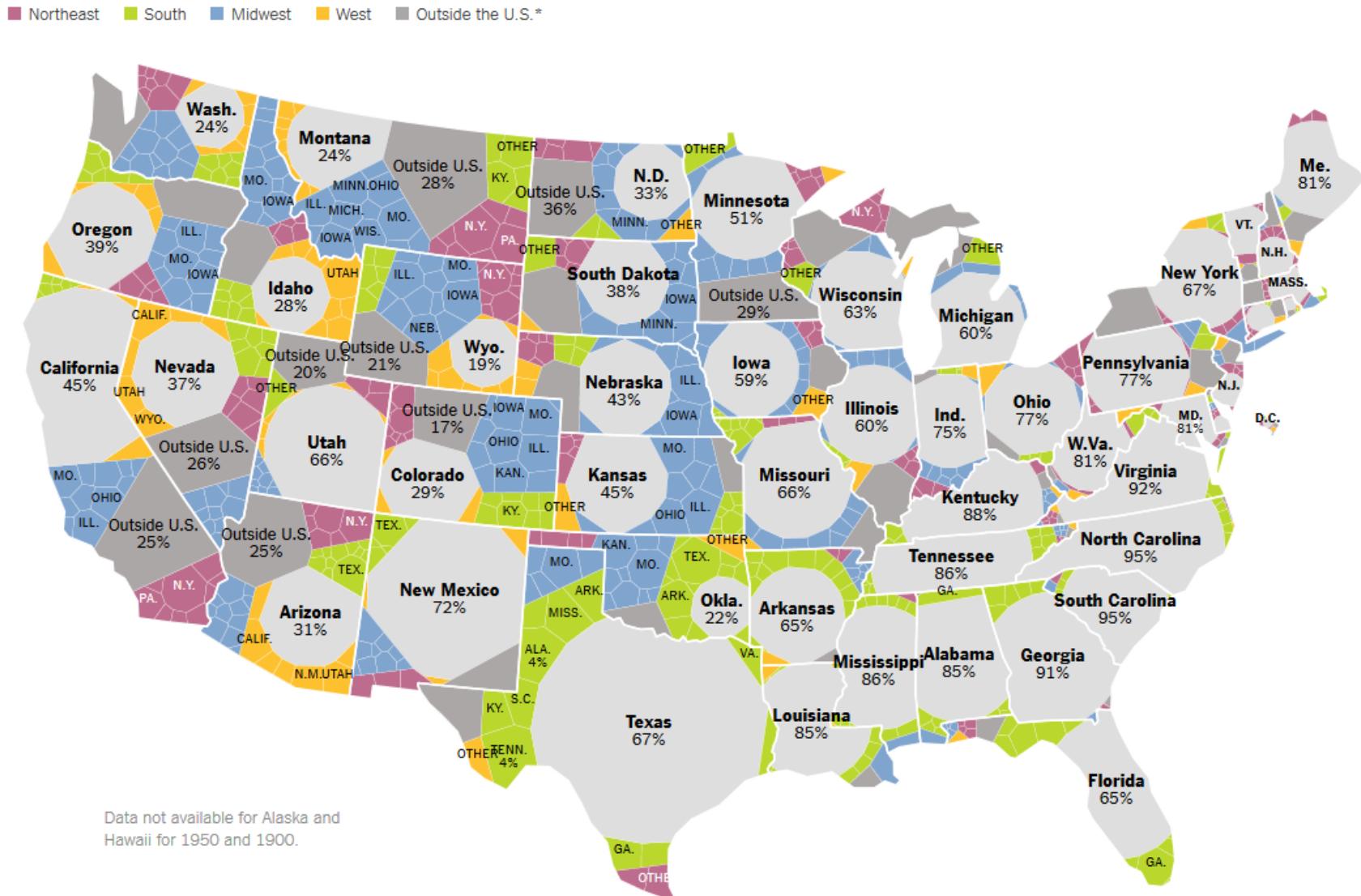
Mapping Migration in the United States

Where people who lived in each state in 1900 were born

Each shape represents where the people living in a state were born. Within a state, larger shapes mean a group makes up a larger share of the population.

SELECT A YEAR

1900 | 1950 | 2012



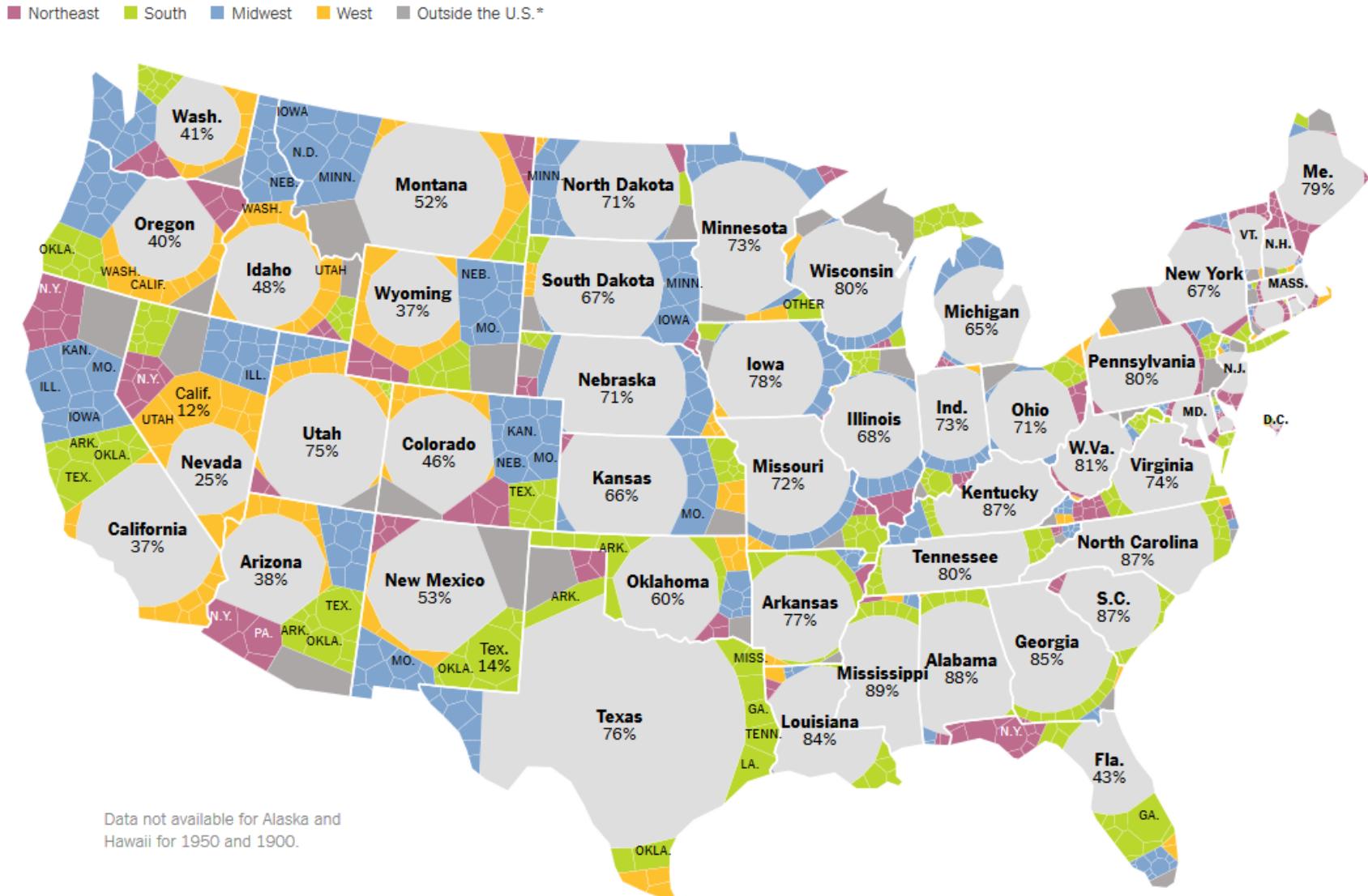
Mapping Migration in the United States

Where people who lived in each state in 1950 were born

Each shape represents where the people living in a state were born. Within a state, larger shapes mean a group makes up a larger share of the population.

[SELECT A YEAR](#)

1900 | **1950** | 2012



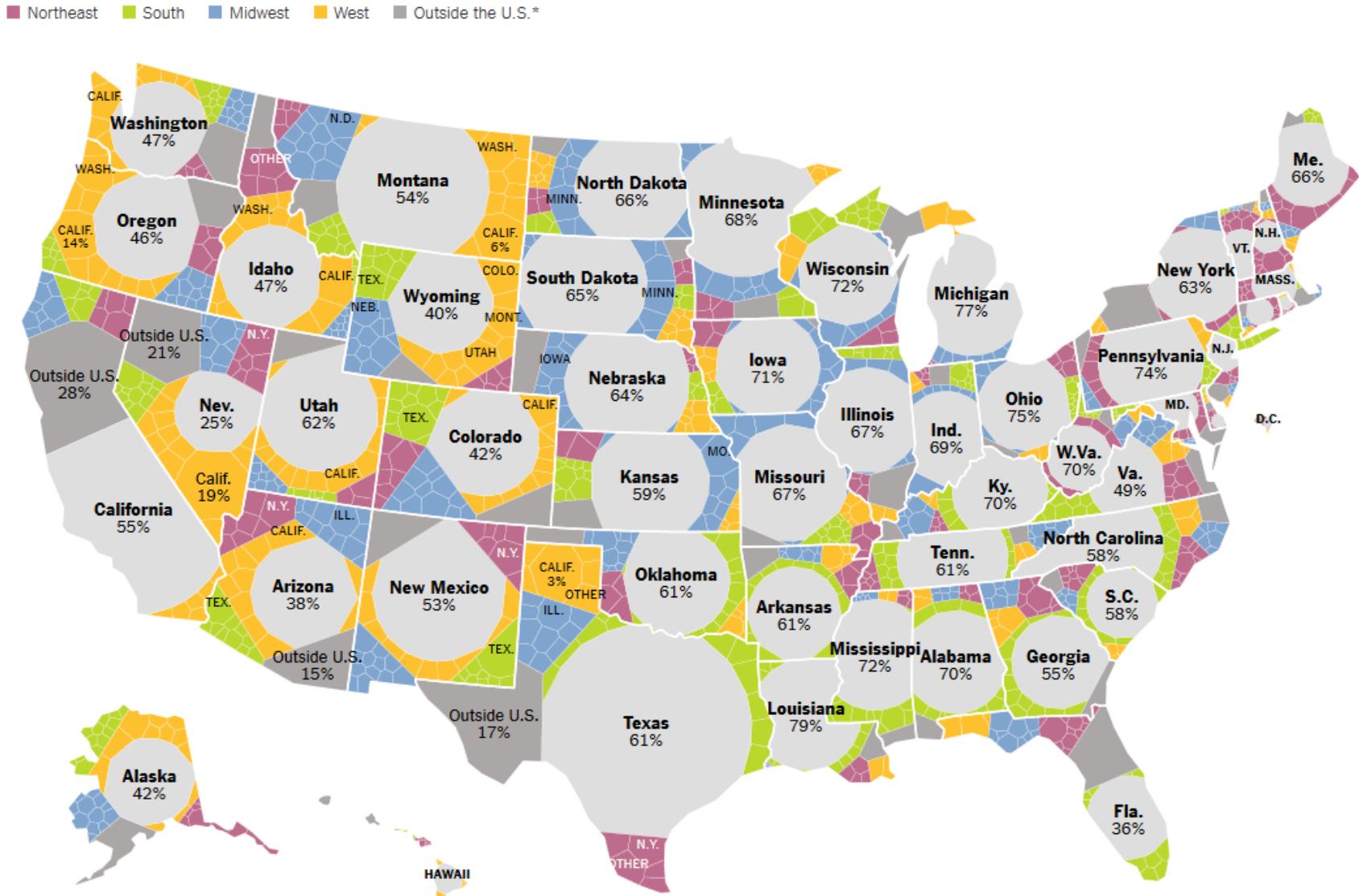
Mapping Migration in the United States

Where people who lived in each state in 2012 were born

Each shape represents where the people living in a state were born. Within a state, larger shapes mean a group makes up a larger share of the population.

SELECT A YEAR

1900 | 1950 | **2012**



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.

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

G.D.P. growth, 2011 to 2012

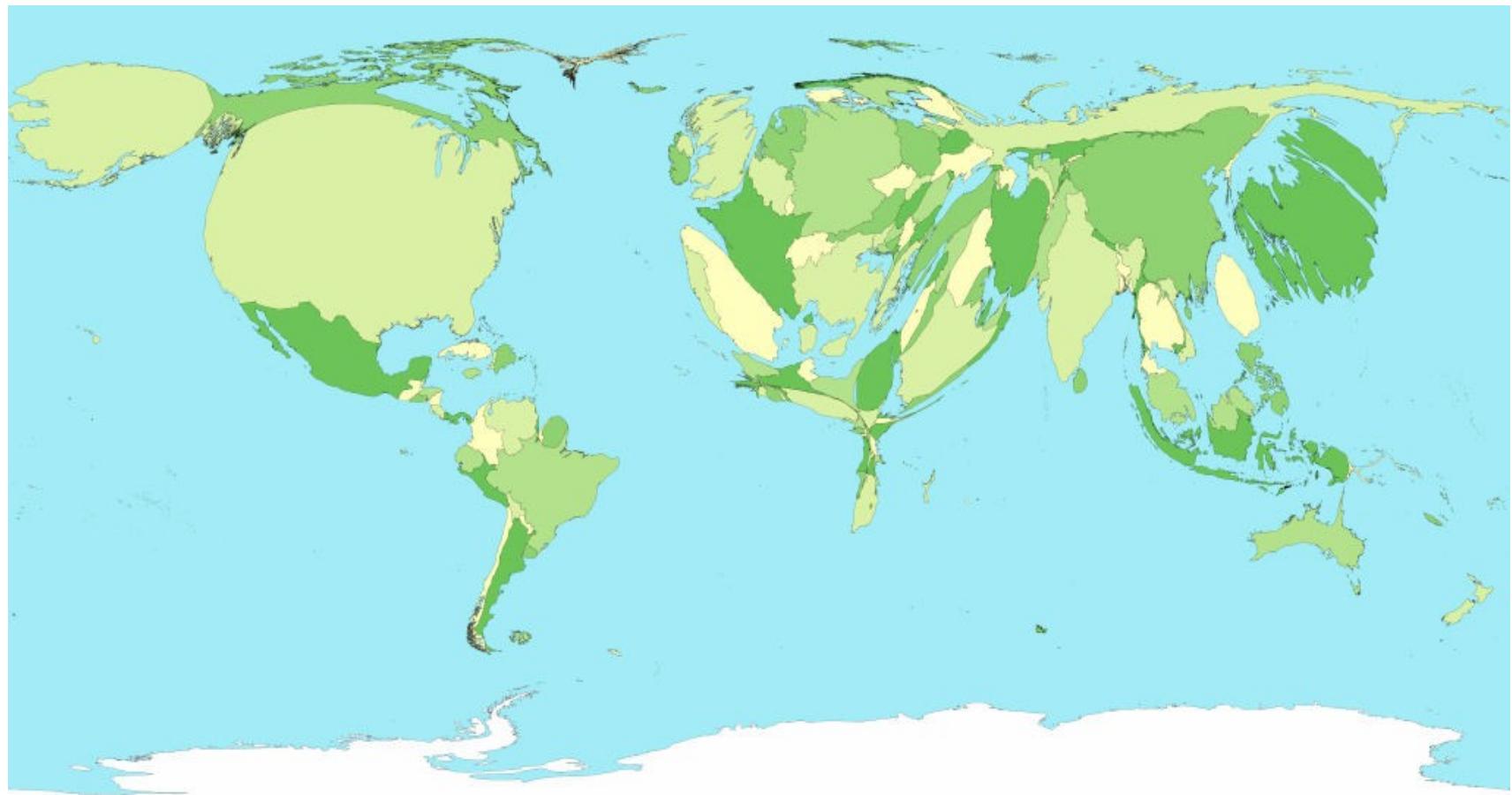
2% 4% 6% 8% +10%

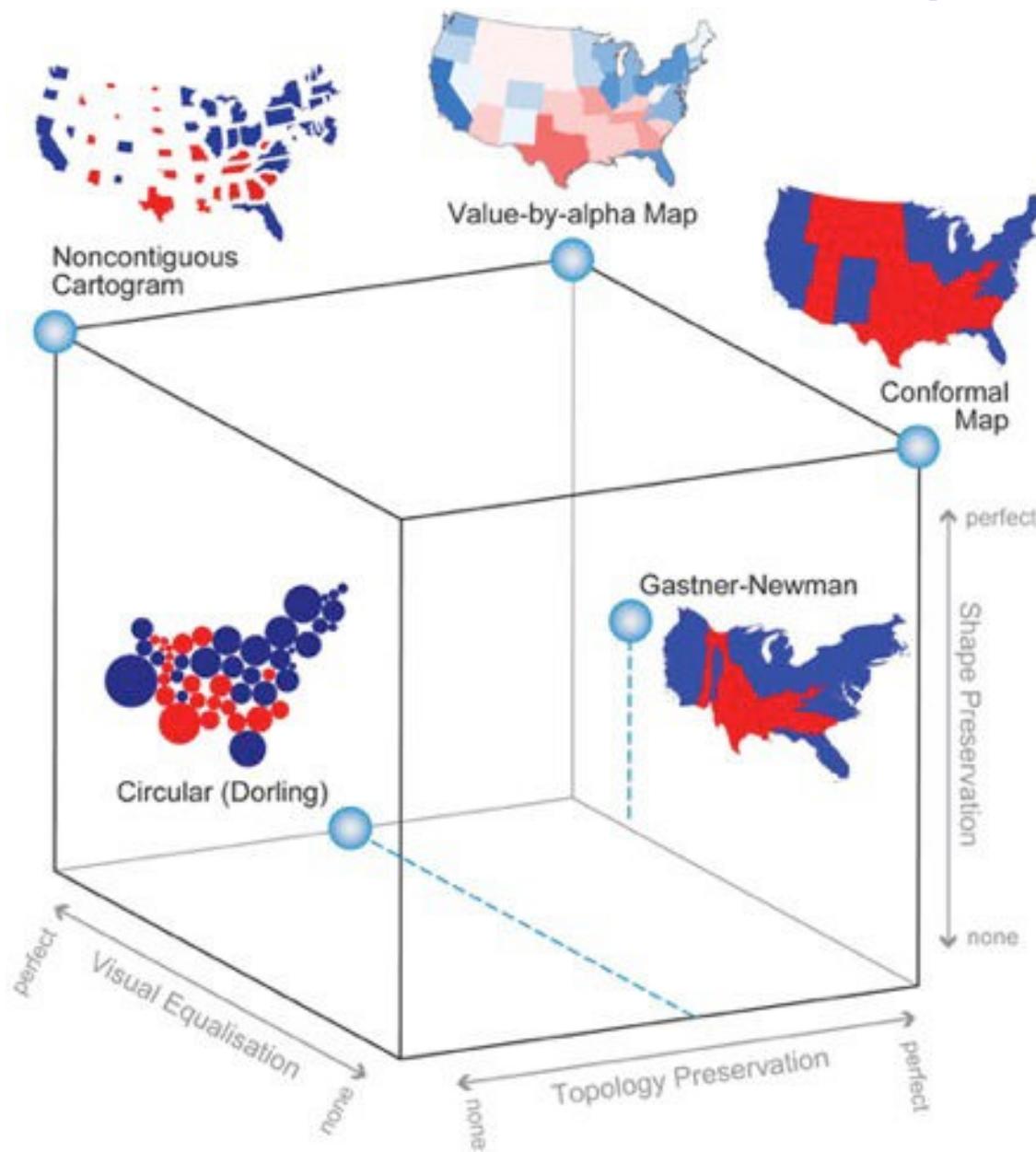


Another example: World Population Cartogram

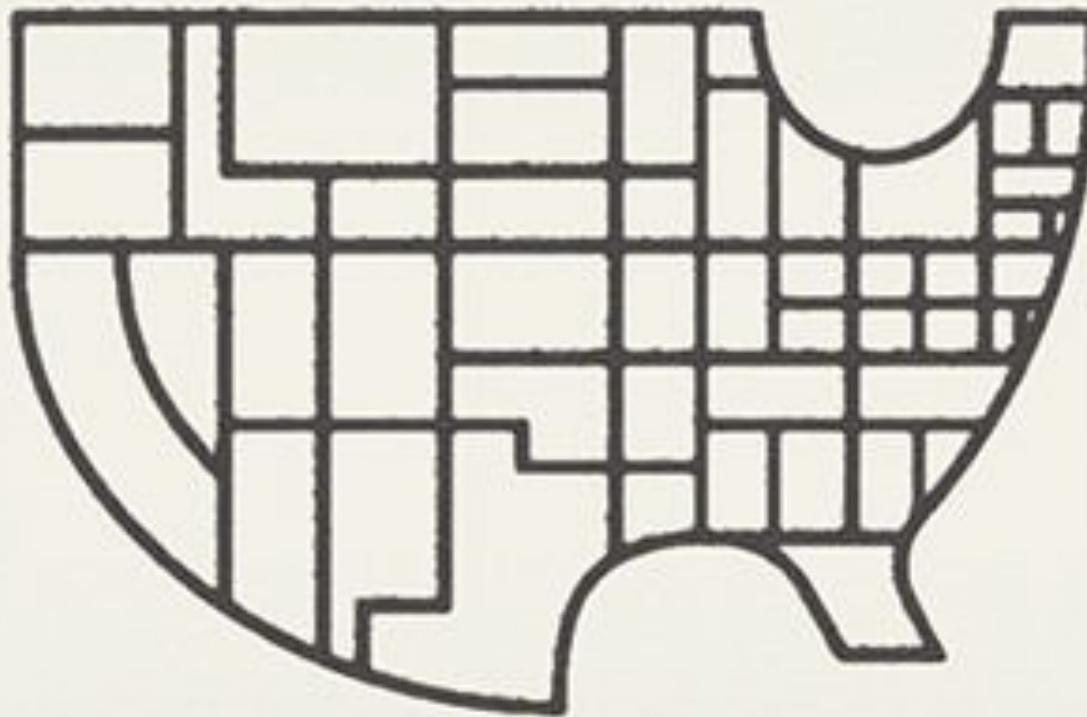


Another example: World Energy Consumption





Major distortions can stay recognizable

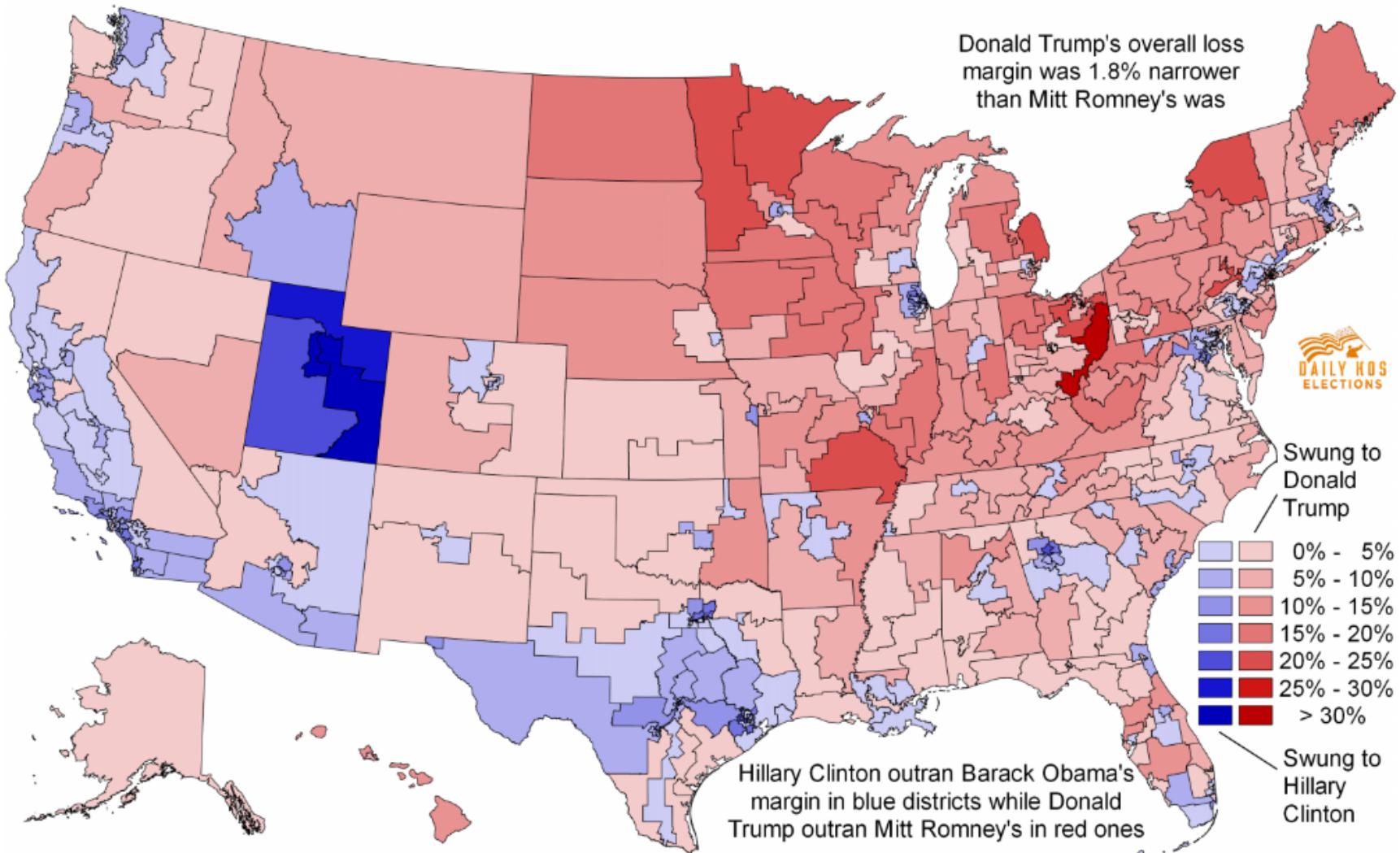


Solution 3:
Do not use maps at all ???

US Presidential Election – Shift from 2012 to 2016

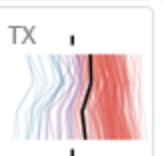
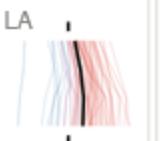
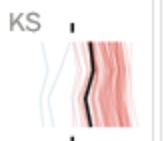
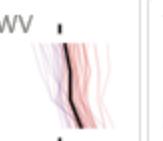
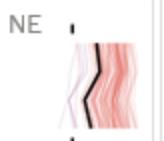
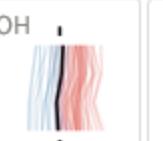
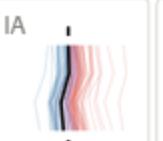
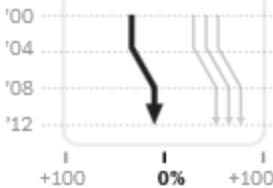
- <https://www.washingtonpost.com/news/the-fix/wp/2017/02/03/how-donald-trump-totally-re-drew-the-political-map>

2016 Presidential Election Margin by Congressional District vs. 2012



◀ DEM. ▶ REP.

State Counties

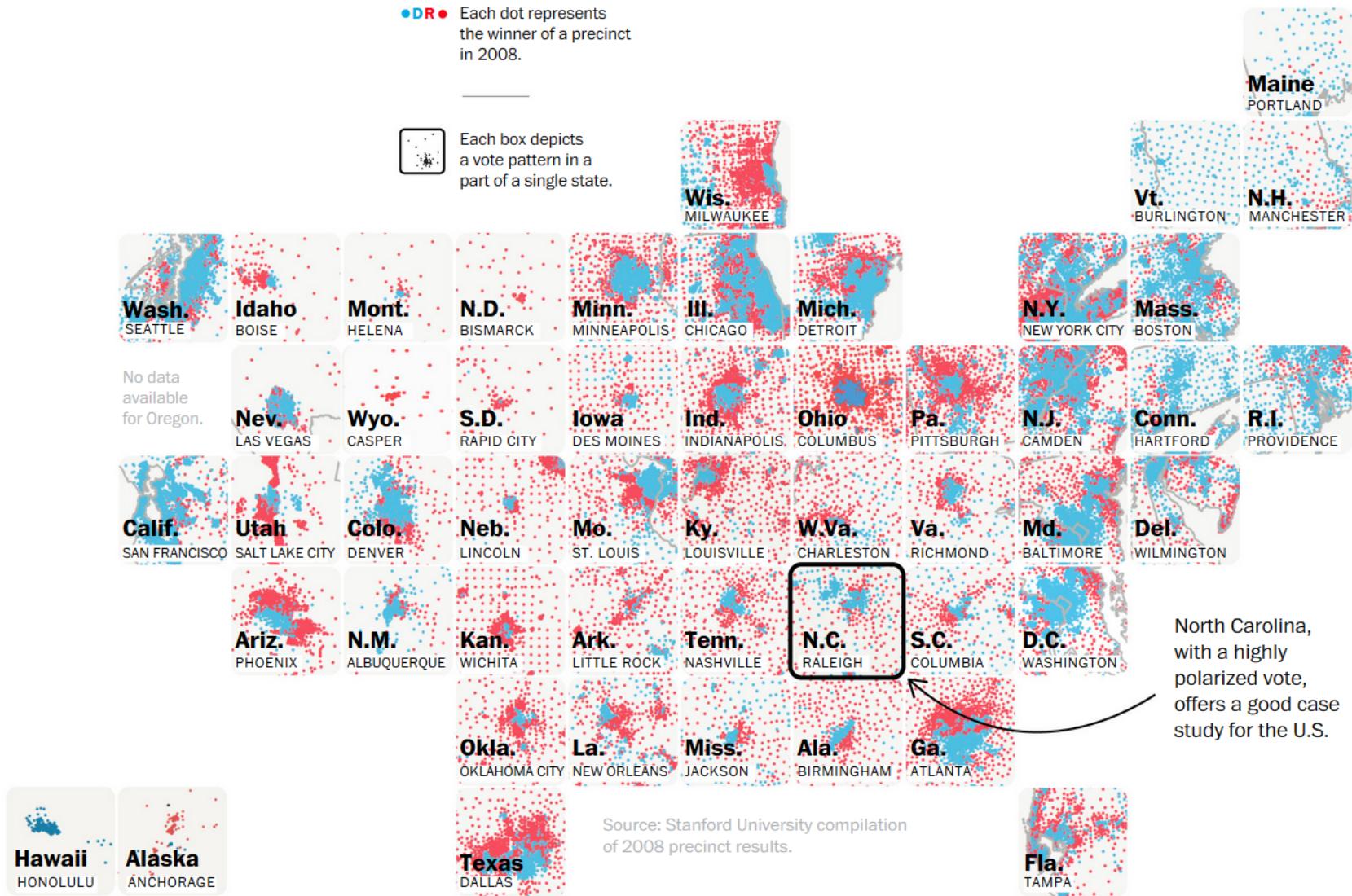


Political Polarization in America

- <https://www.washingtonpost.com/graphics/politics/2016-election/nc-precincts/>

● DR ● Each dot represents the winner of a precinct in 2008.

Each box depicts a vote pattern in a part of a single state.



Generalization

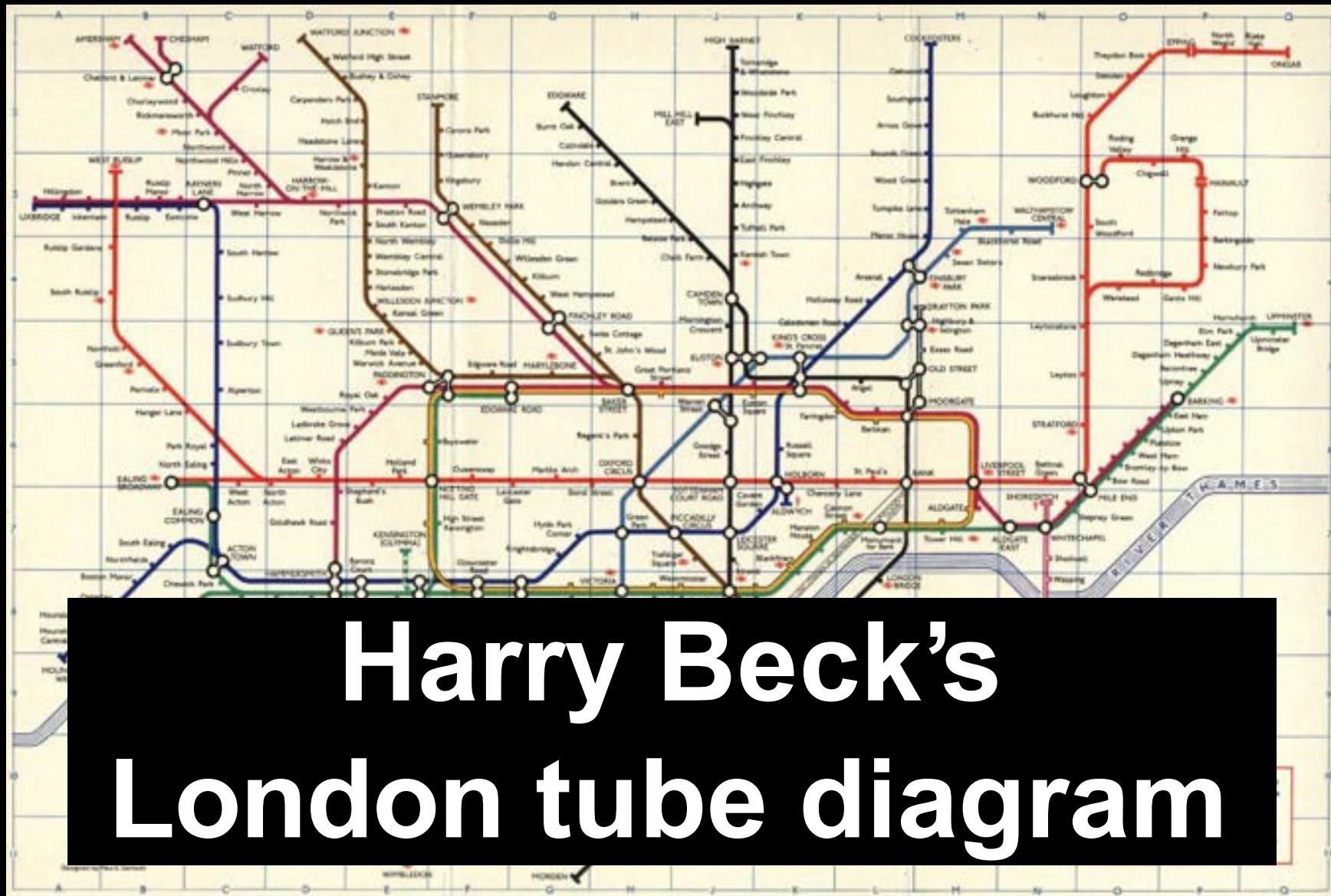
CHIFFRE APPROXIMATIF DE LA HOUILLE ANGLAISE exportée en 1864 dans les VÉNDEURS. Source: Annuaire des Mines de France 1865.

Les chiffres approximatifs sont basés sur les dernières statistiques de l'Office du Commerce et de l'Industrie. Les chiffres exacts sont ceux qui ont été déclarés par les compagnies ou les sociétés de transport, mais ces derniers sont souvent incomplets ou mal renseignés. Les chiffres approximatifs sont donc probablement plus précis que les chiffres exacts.

Observation: Les chiffres approximatifs sont basés sur les dernières statistiques de l'Office du Commerce et de l'Industrie. Les chiffres exacts sont ceux qui ont été déclarés par les compagnies ou les sociétés de transport, mais ces derniers sont souvent incomplets ou mal renseignés. Les chiffres approximatifs sont donc probablement plus précis que les chiffres exacts.

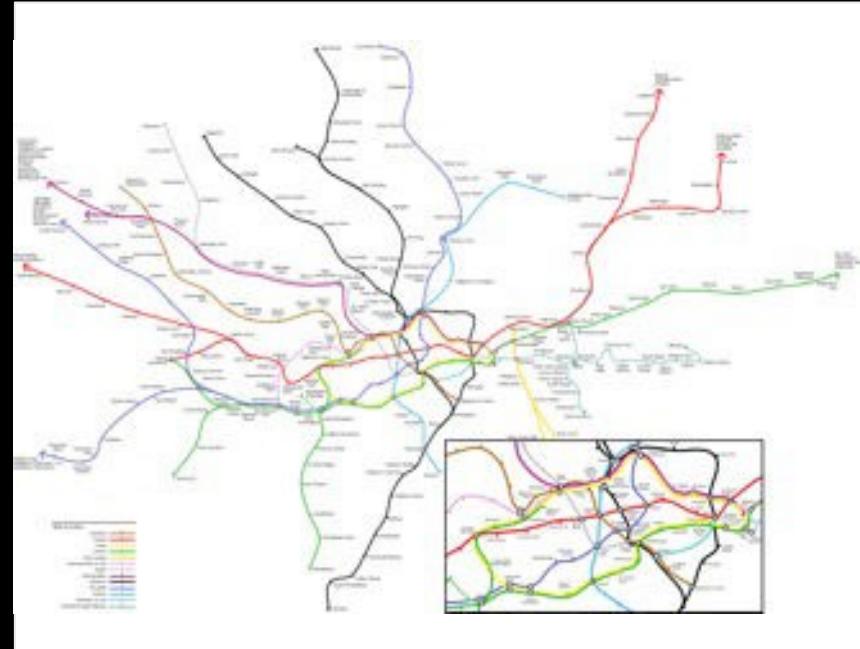


1864 British Coal Exports, Charles Minard





London Underground [Beck 33]



Geographic version of map

Principle: Straighten lines to emphasize stop sequence
Technique used to emphasize/de-emphasize information



Scale

Scale is an idea imported from print



$1:1,000,000$
scale mapping

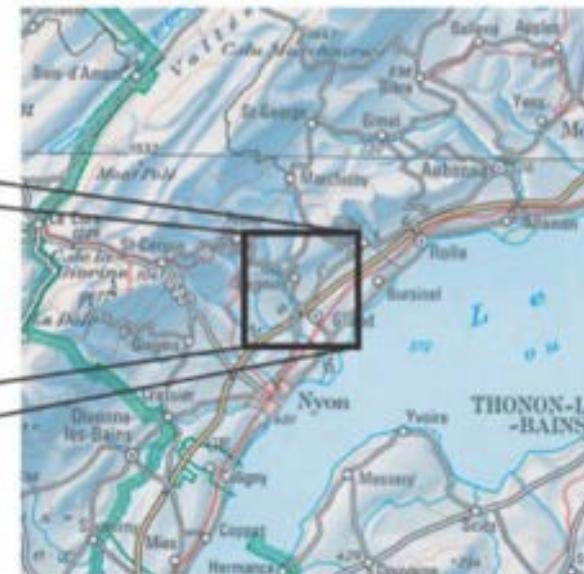
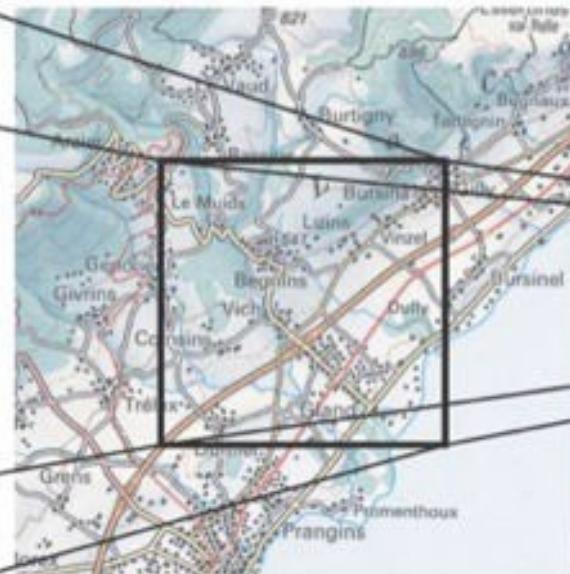
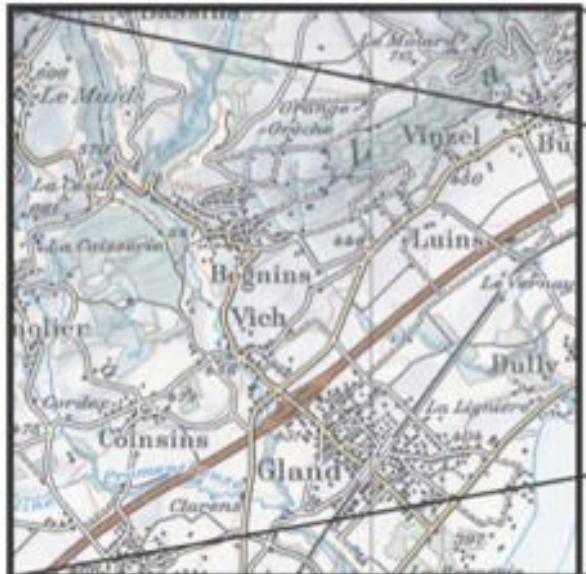
$1:625,000$
scale mapping

$1:250,000$
scale mapping

$1:50,000$
scale mapping

$1:25,000$
scale mapping

$1:10,000$
scale mapping



Choose the right content at different scales





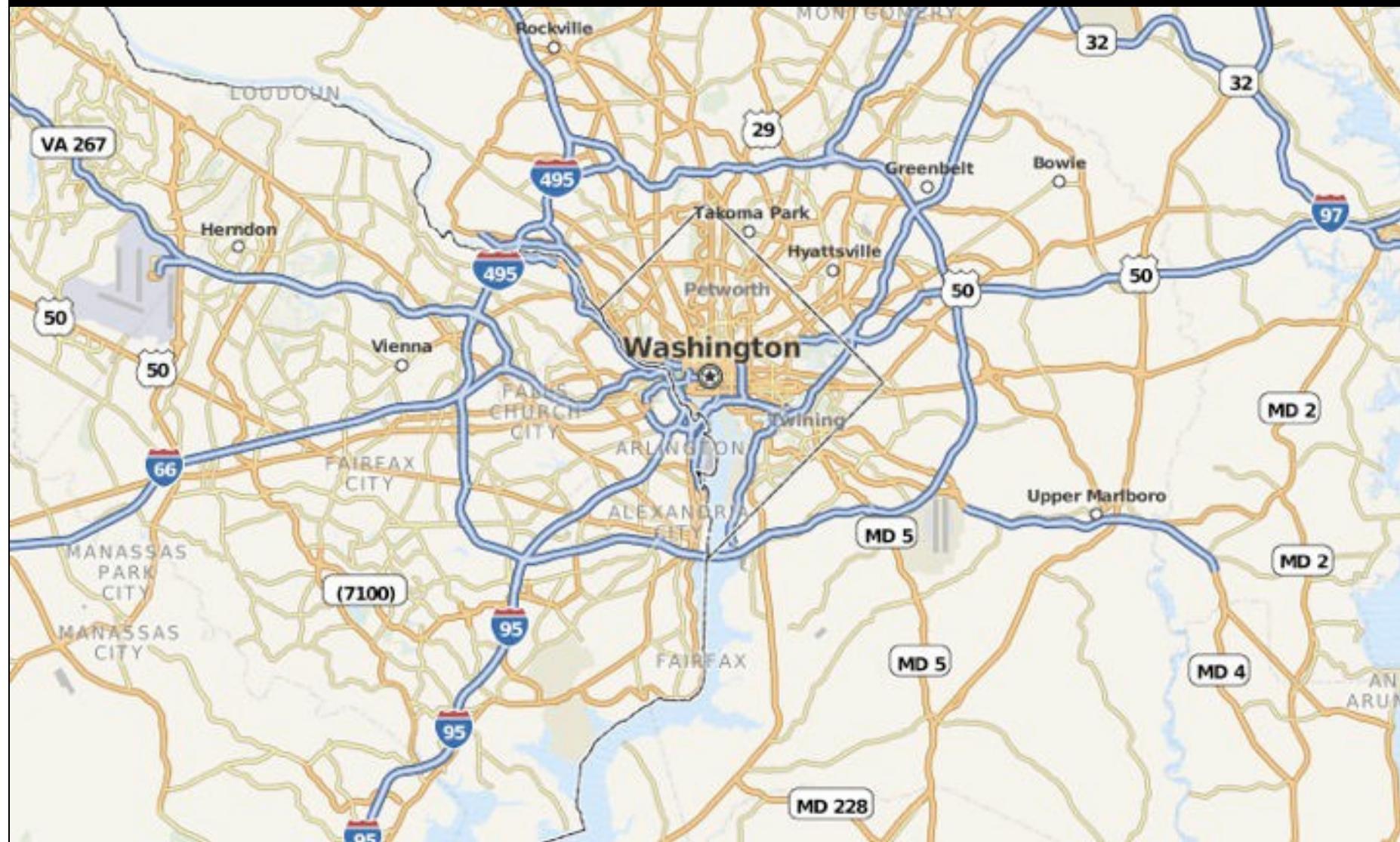
Four maps, same area

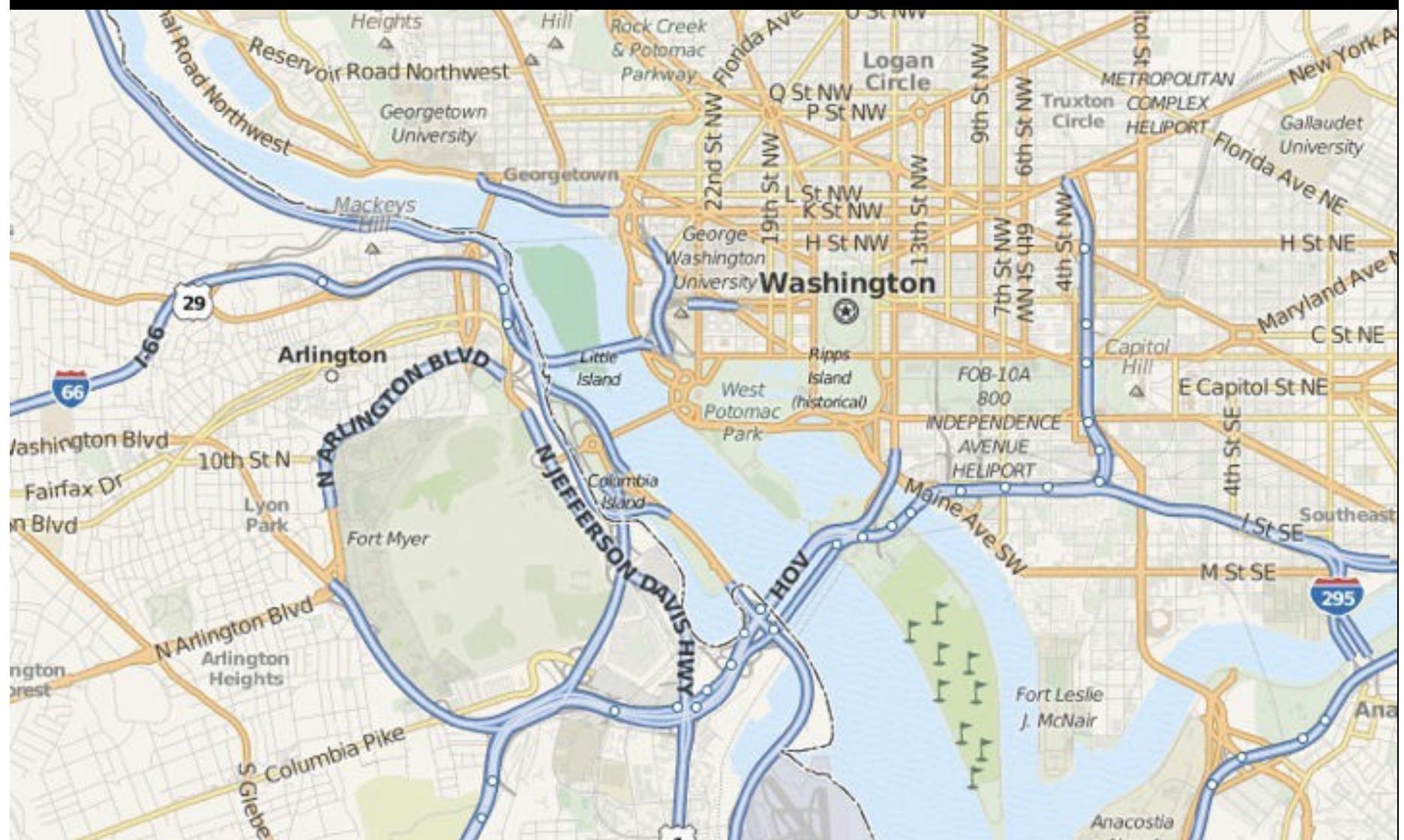


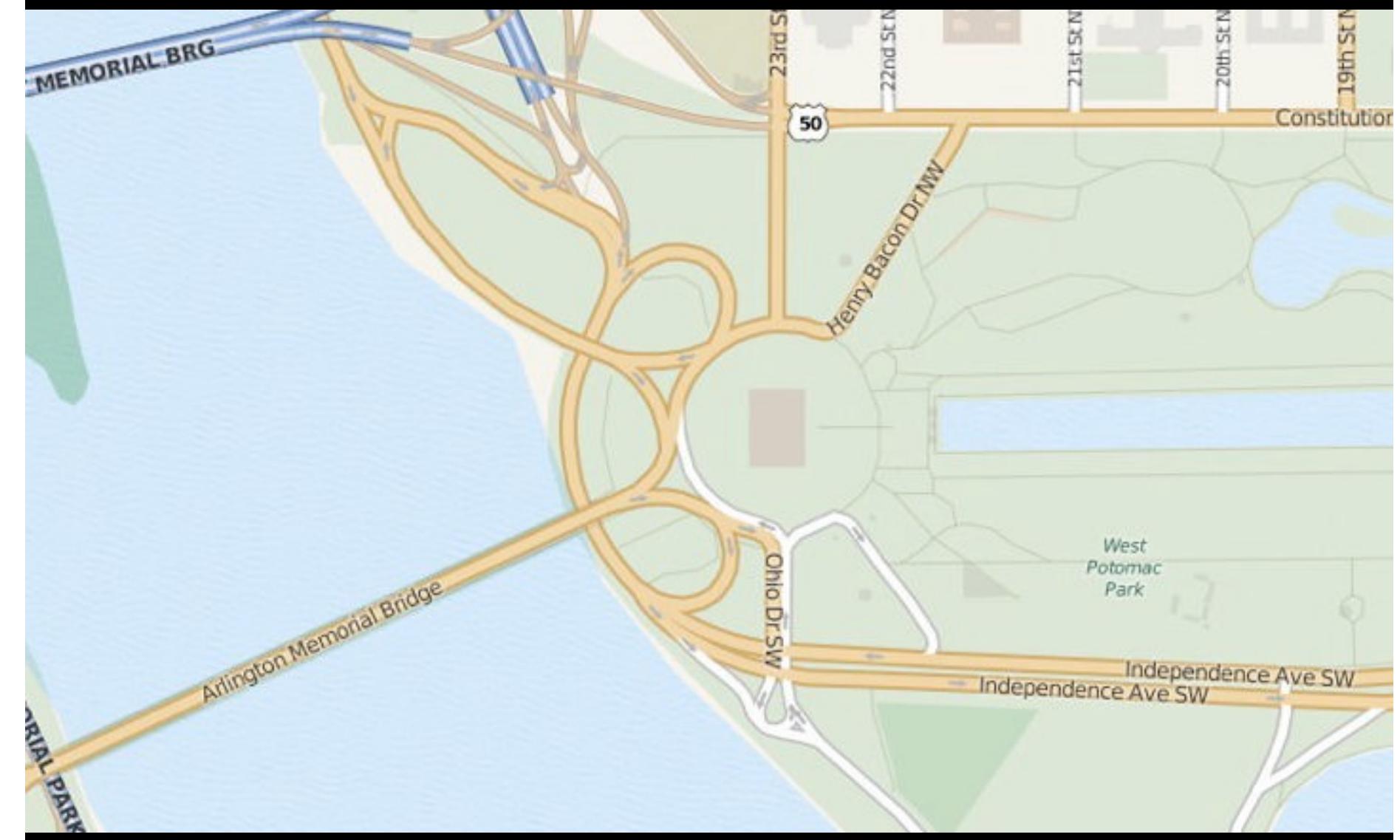
What shows at different scales?





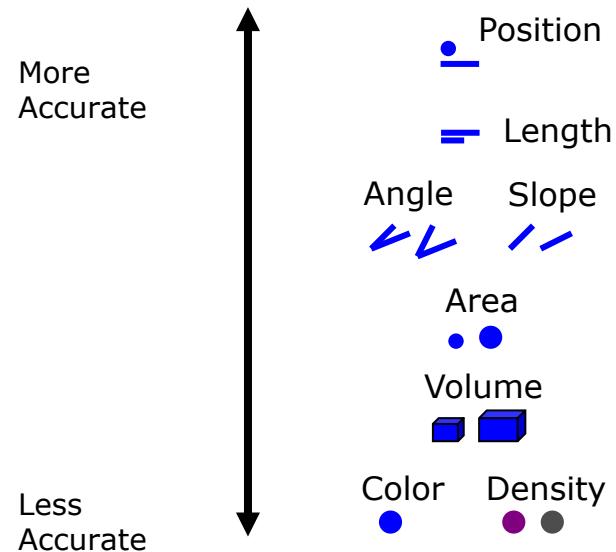




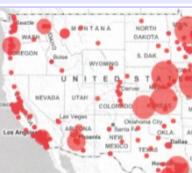
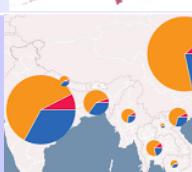


Tips

How can we visualize data in a map?



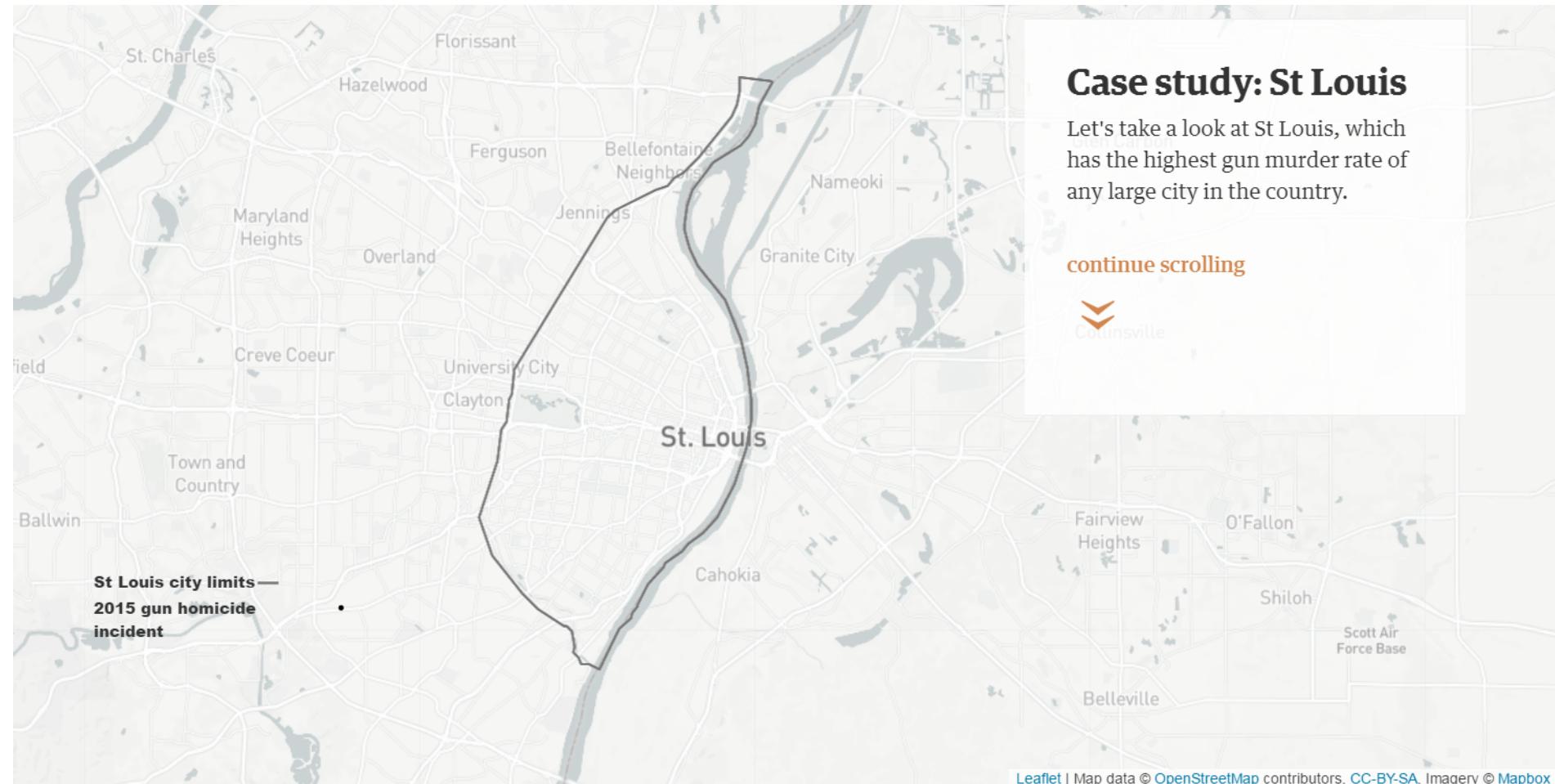
Map – Visual DataStory

Display Type	Visual Encoding	Variables	Story Narrative	
Map Path		Location Shape	Location Path 3	Distance Proximity
Map Dots		Location Color Density / Texture	Location Numerical data for location variable 3	Proximity Clustering Similarity
Map Size		Location Size Color	Location Numerical data for location variable 3	Compare values Proximity
Map Area Choropleth		Location Color Saturation Motion	Location Numerical data for location variable 3+	Proximity Clustering Similarity
Map Size & Pie Chart		Location Size Angle	Location Numerical data for location variable 4	Compare totals & values Proximity

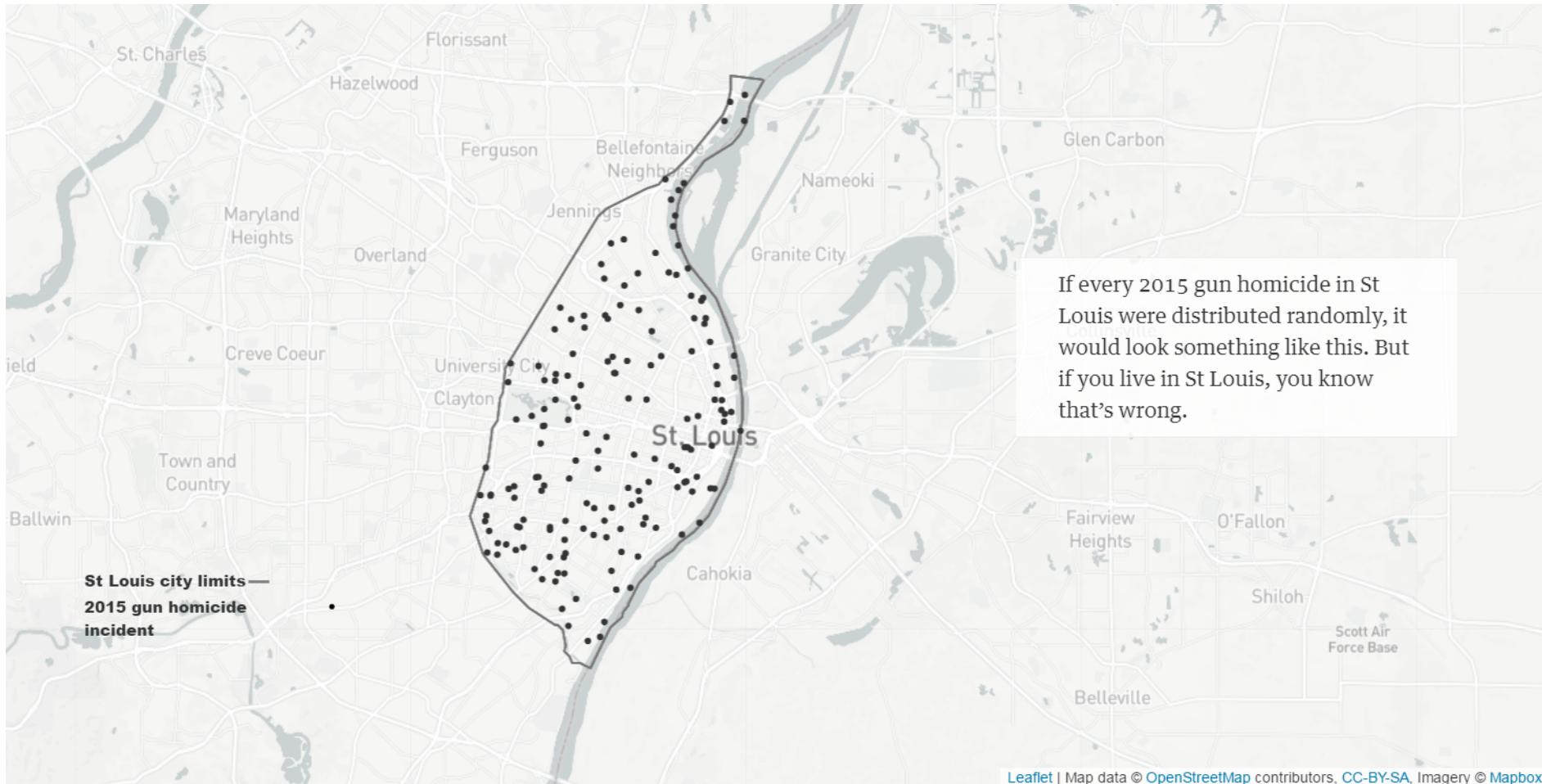
An example

(Use of multiple map visualization
techniques in visual analysis)

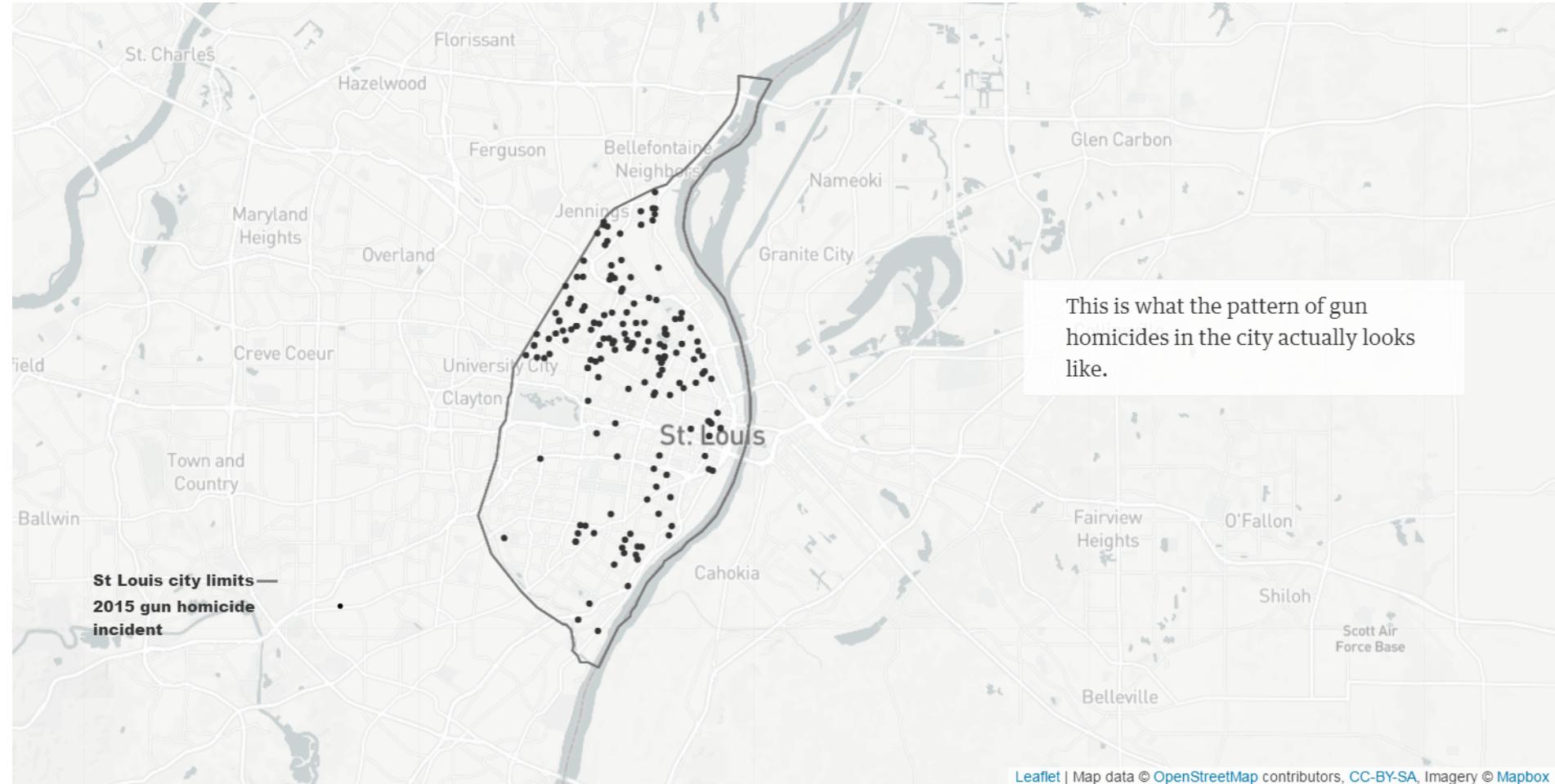
Guardian – Gun Violence in USA



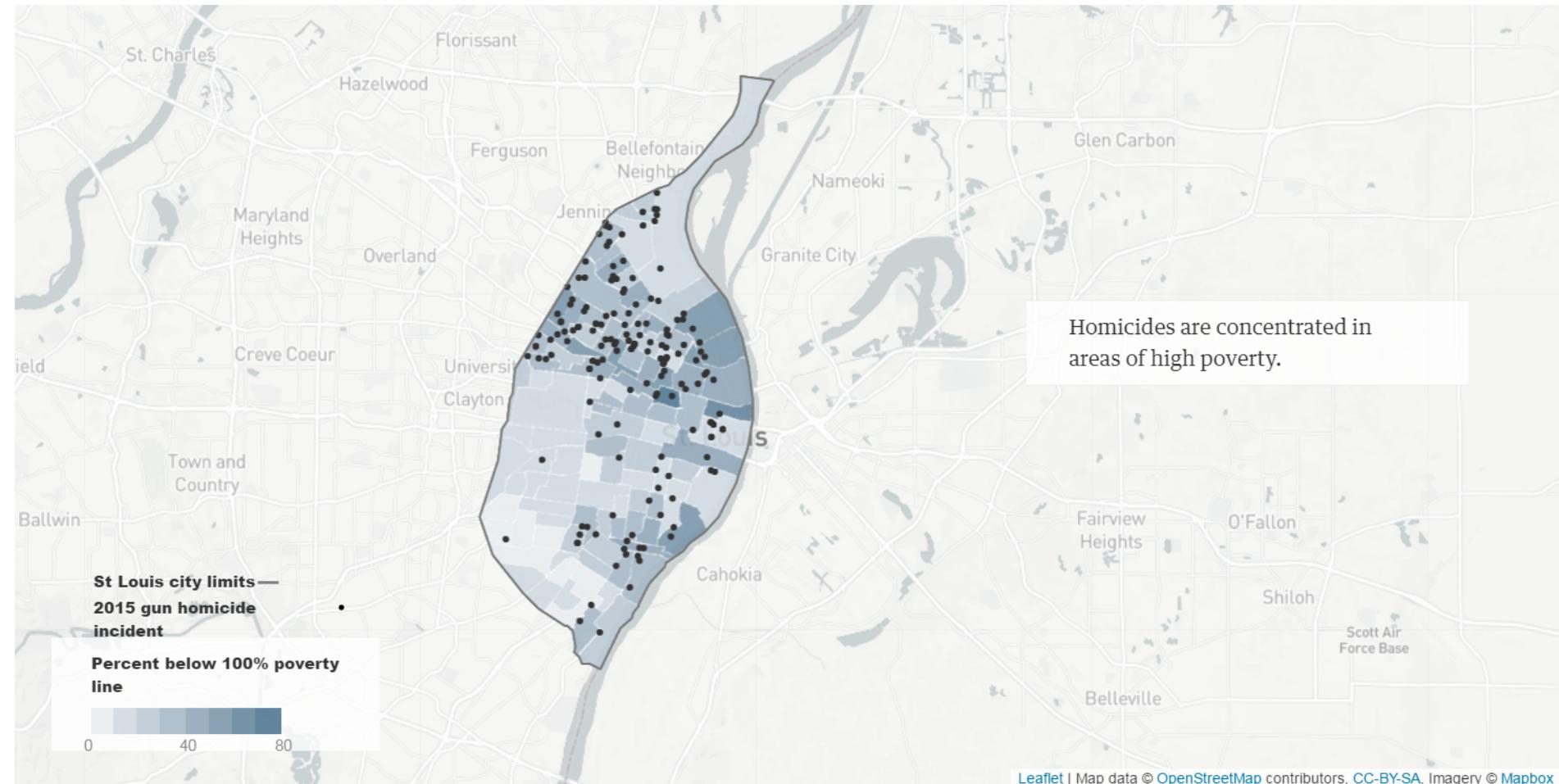
Guardian – Gun Violence in USA



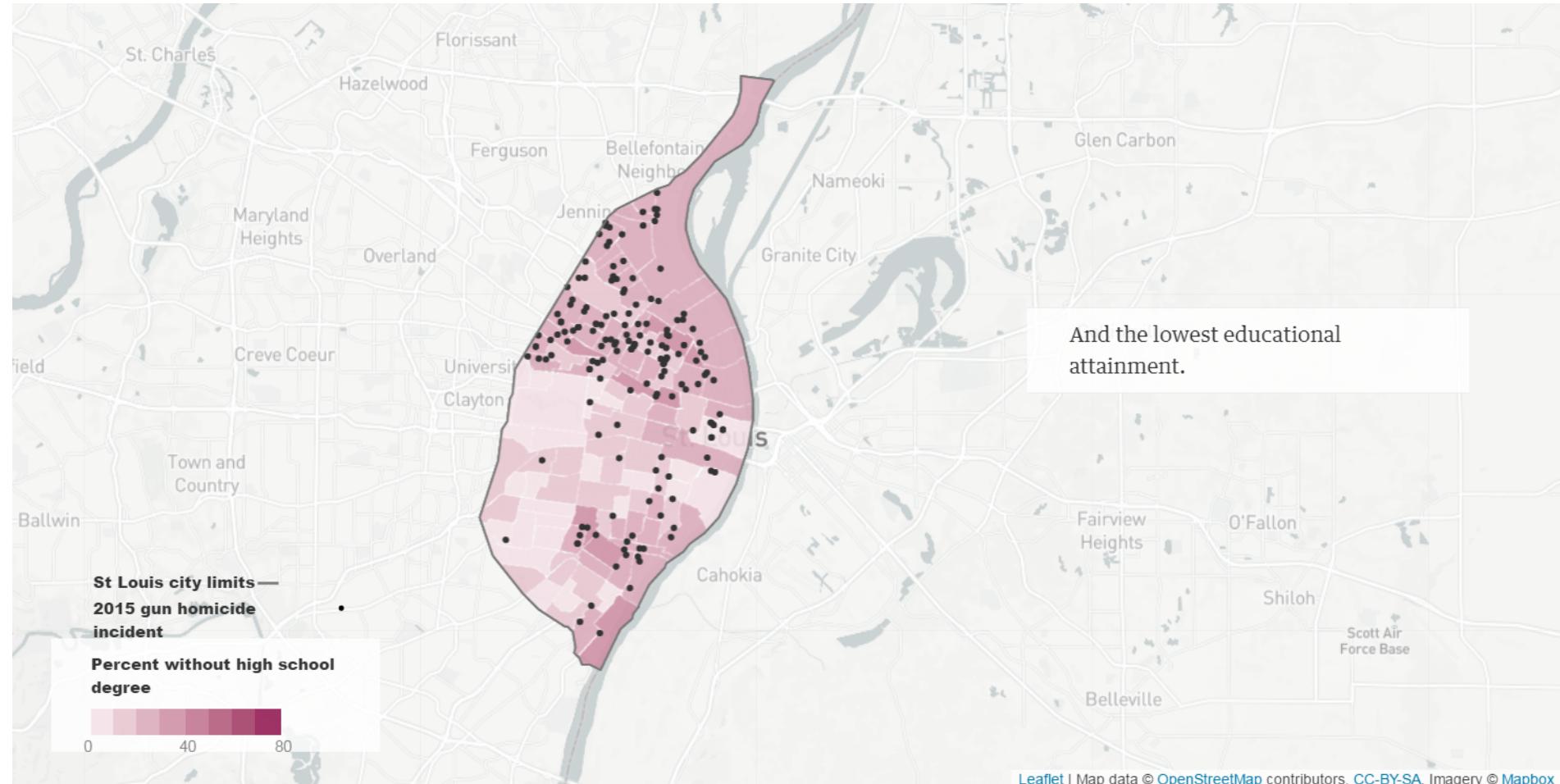
Guardian – Gun Violence in USA



Guardian – Gun Violence in USA



Guardian – Gun Violence in USA



Guardian – Gun Violence in USA

