



UNIVERSITY OF  
SAN FRANCISCO

---

CHANGE THE WORLD FROM HERE

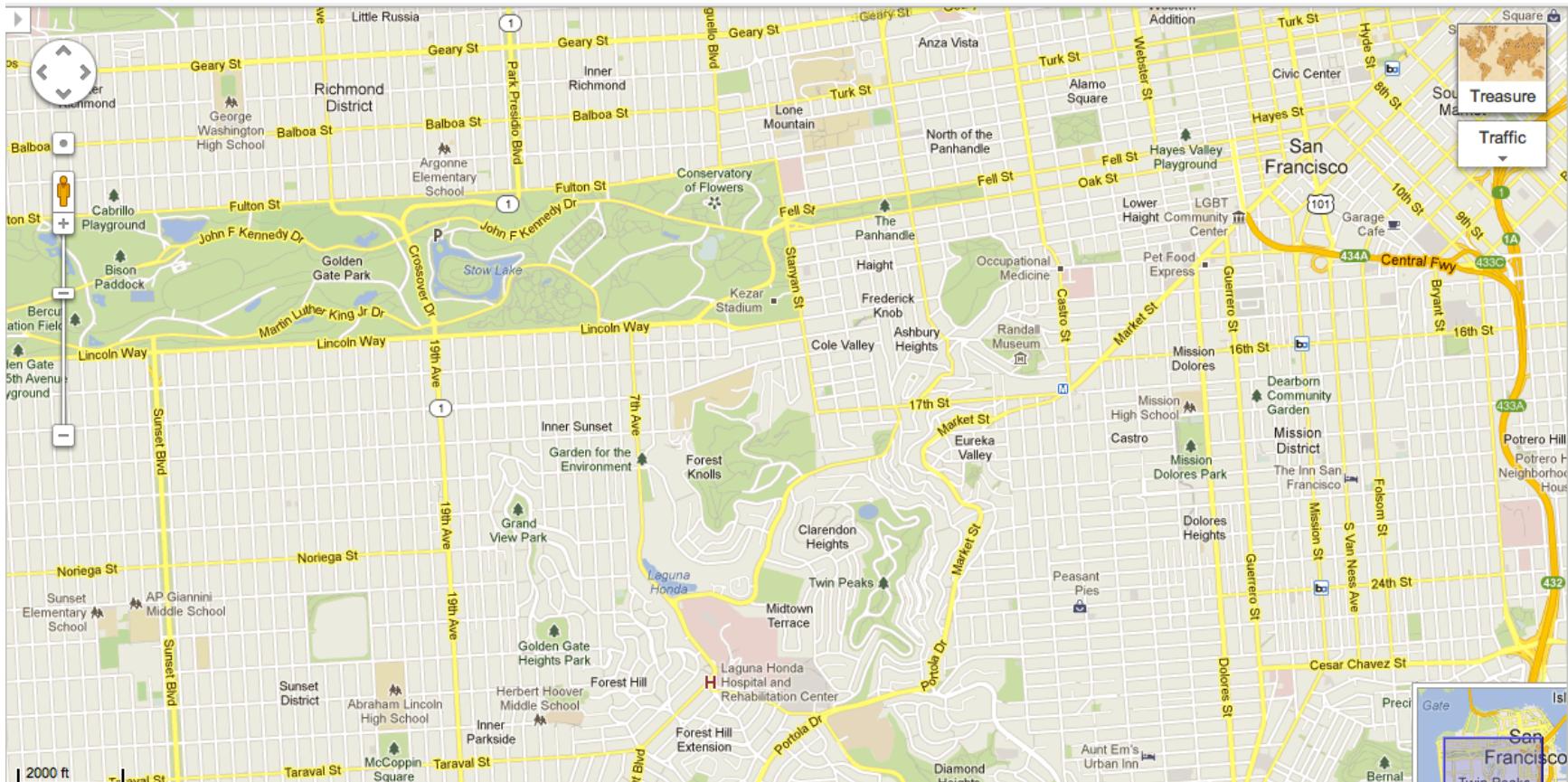
# Geographic Visualization



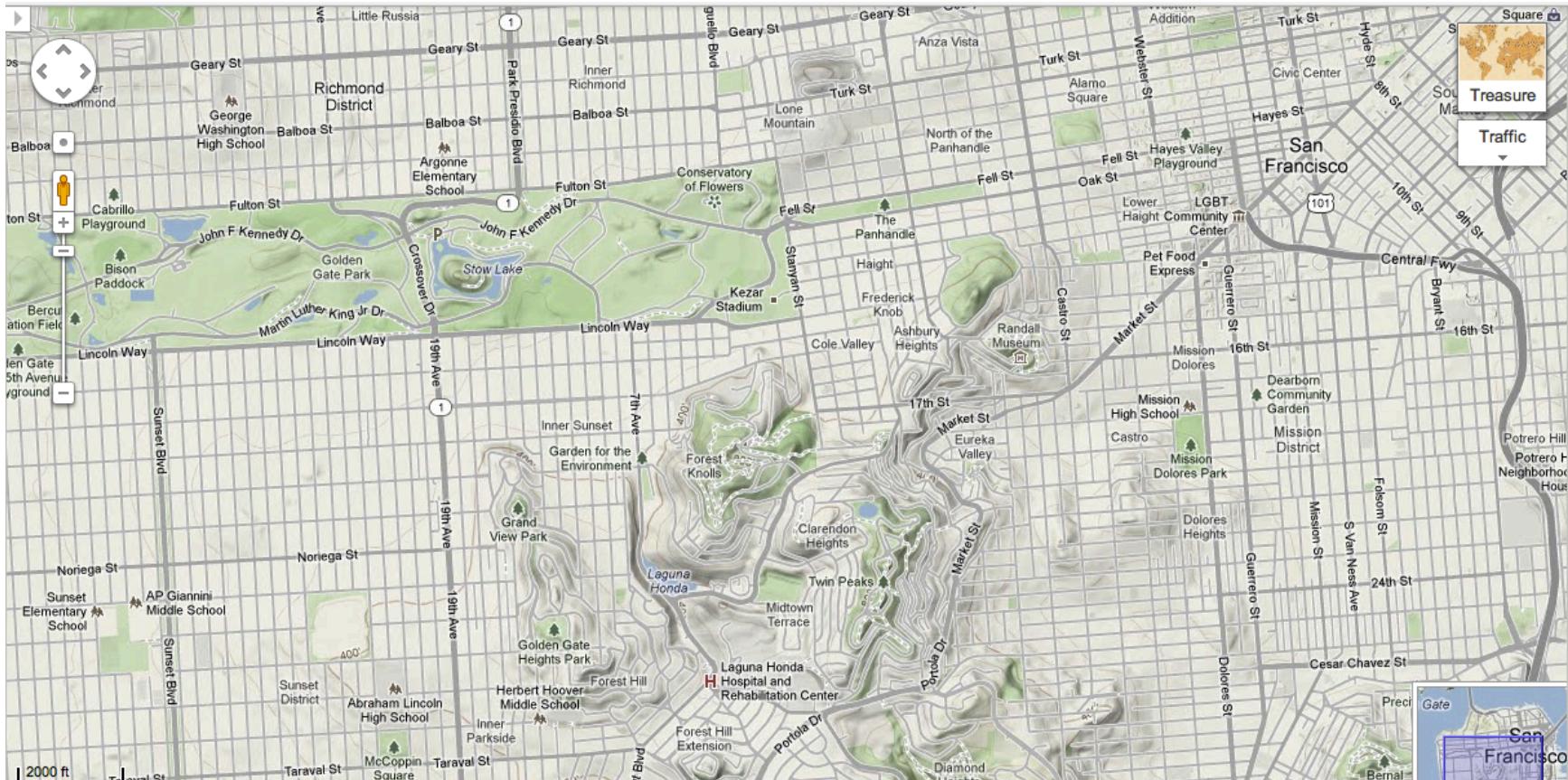
# MAP TYPES

# Map Types

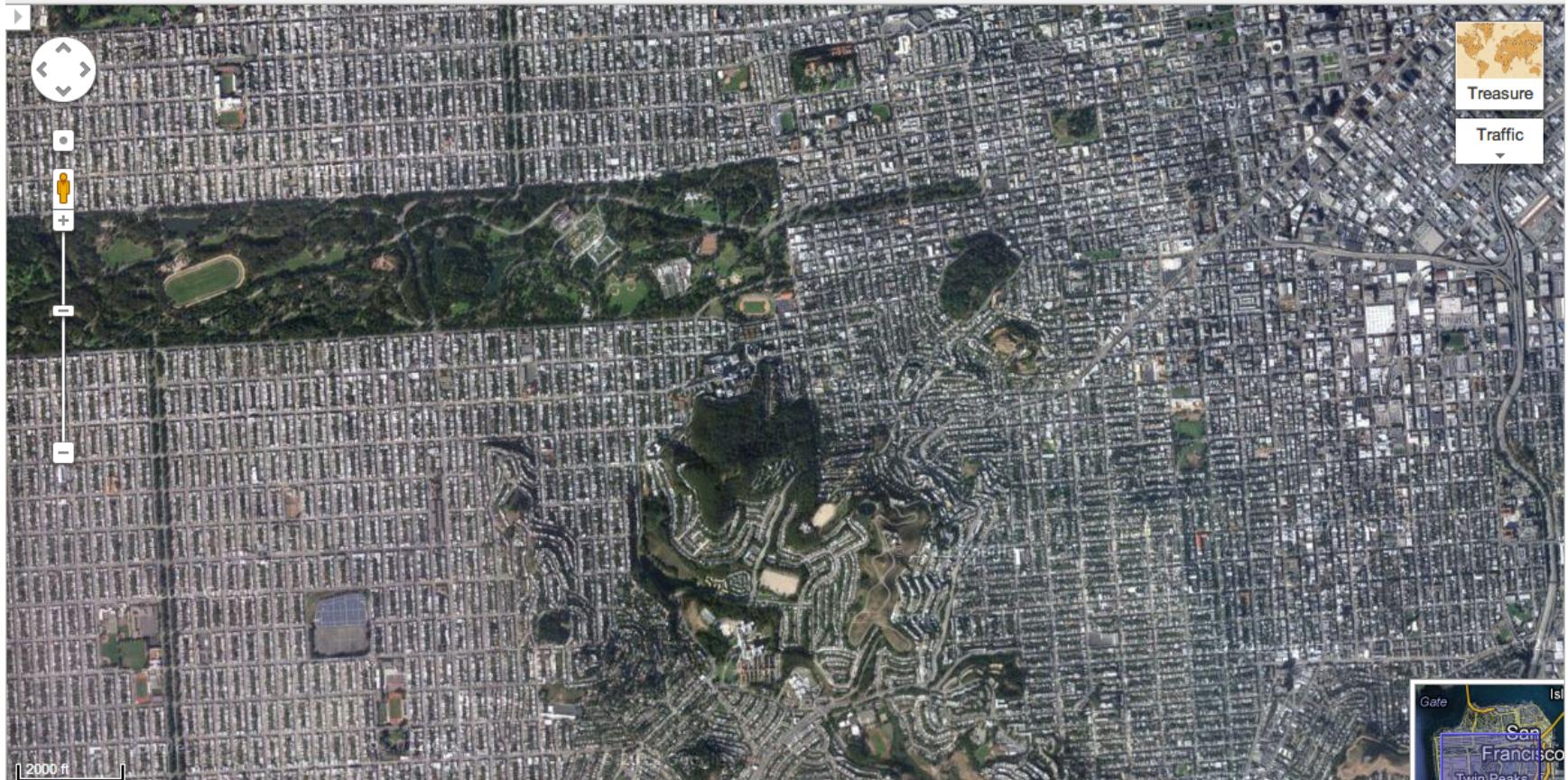
- Physical Maps
  - Shows physical features (mountains, lakes)
- Road Maps
  - Shows road location and names, man-made features
- Topographic Maps
  - Shows 3d topography in 2d often using contour lines



<http://maps.google.com/?ll=37.7577,-122.4376&spn=0.164489,0.283241&t=m&z=12>



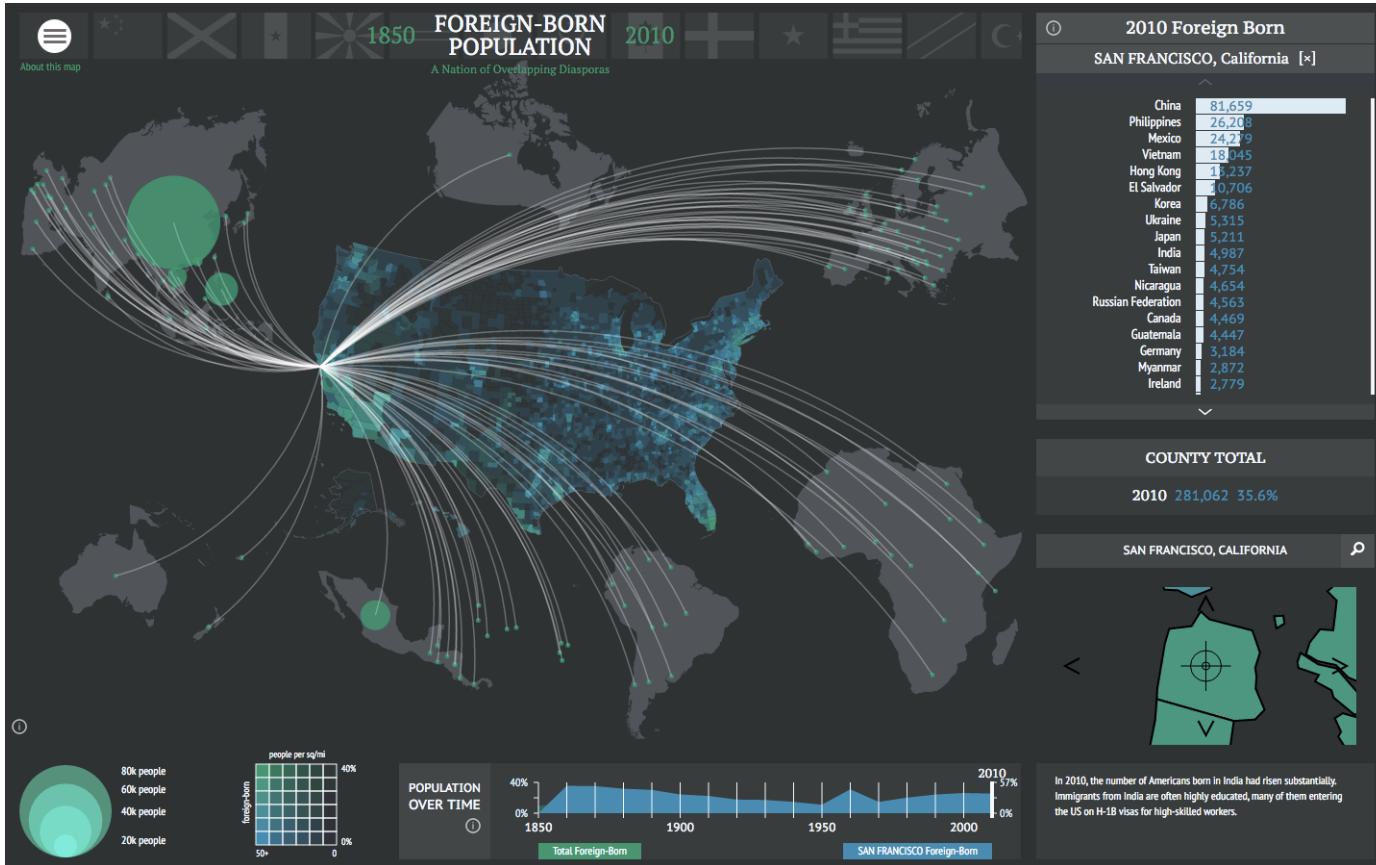
<http://maps.google.com/?ll=37.7577,-122.4376&spn=0.164489,0.283241&t=m&z=12>



<http://maps.google.com/?ll=37.7577,-122.4376&spn=0.164489,0.283241&t=m&z=12>

# Map Types

- Thematic Maps
  - Maps for a specific purpose, usually displays a single data attribute in a geographic context
  - Includes choropleth, symbol, dot maps
- Other Maps
  - May distort geography slightly
  - Includes cartograms, transit maps, flow maps

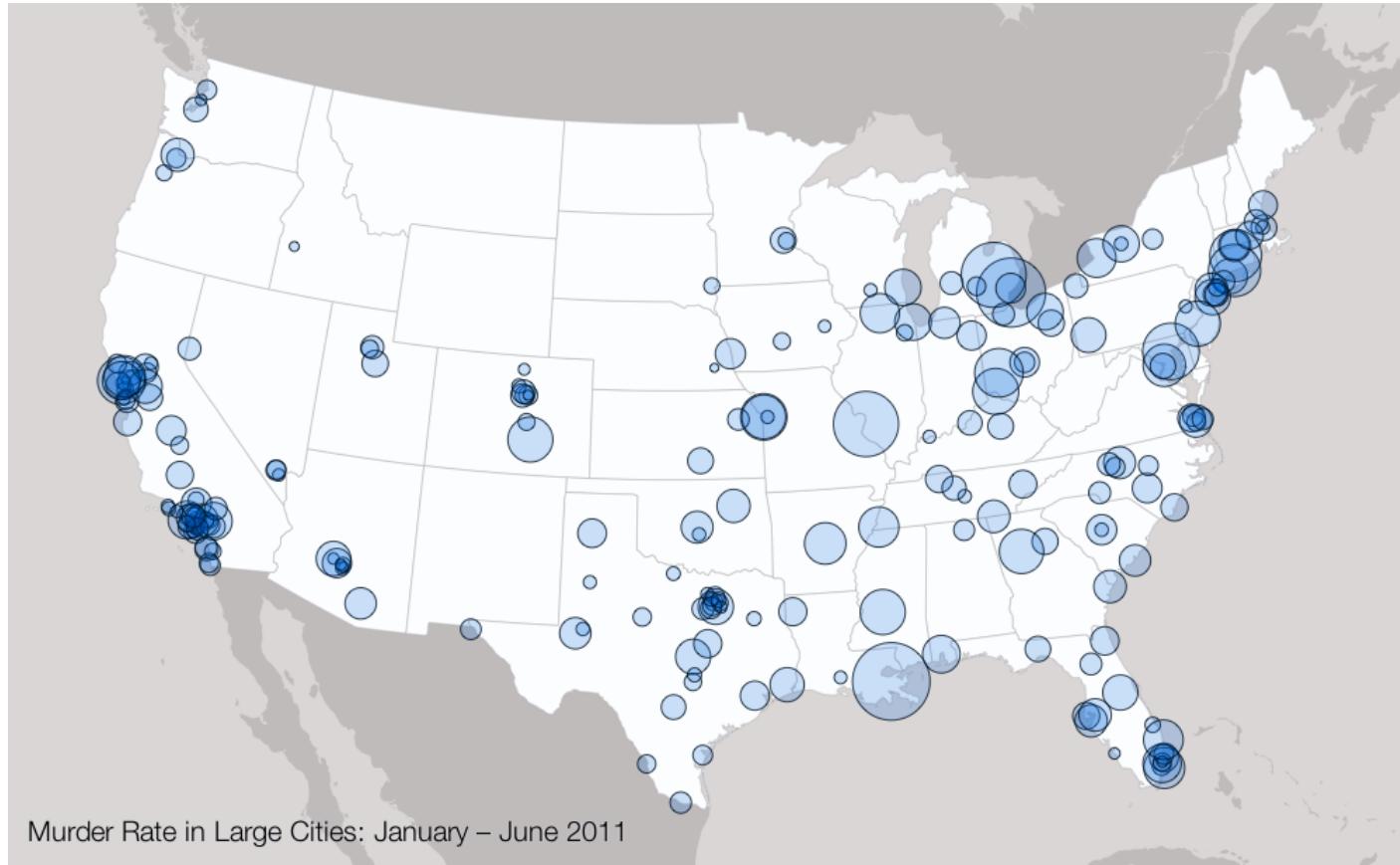


<http://dsl.richmond.edu/panorama/foreignborn/#decade=2010&county=G0600750>

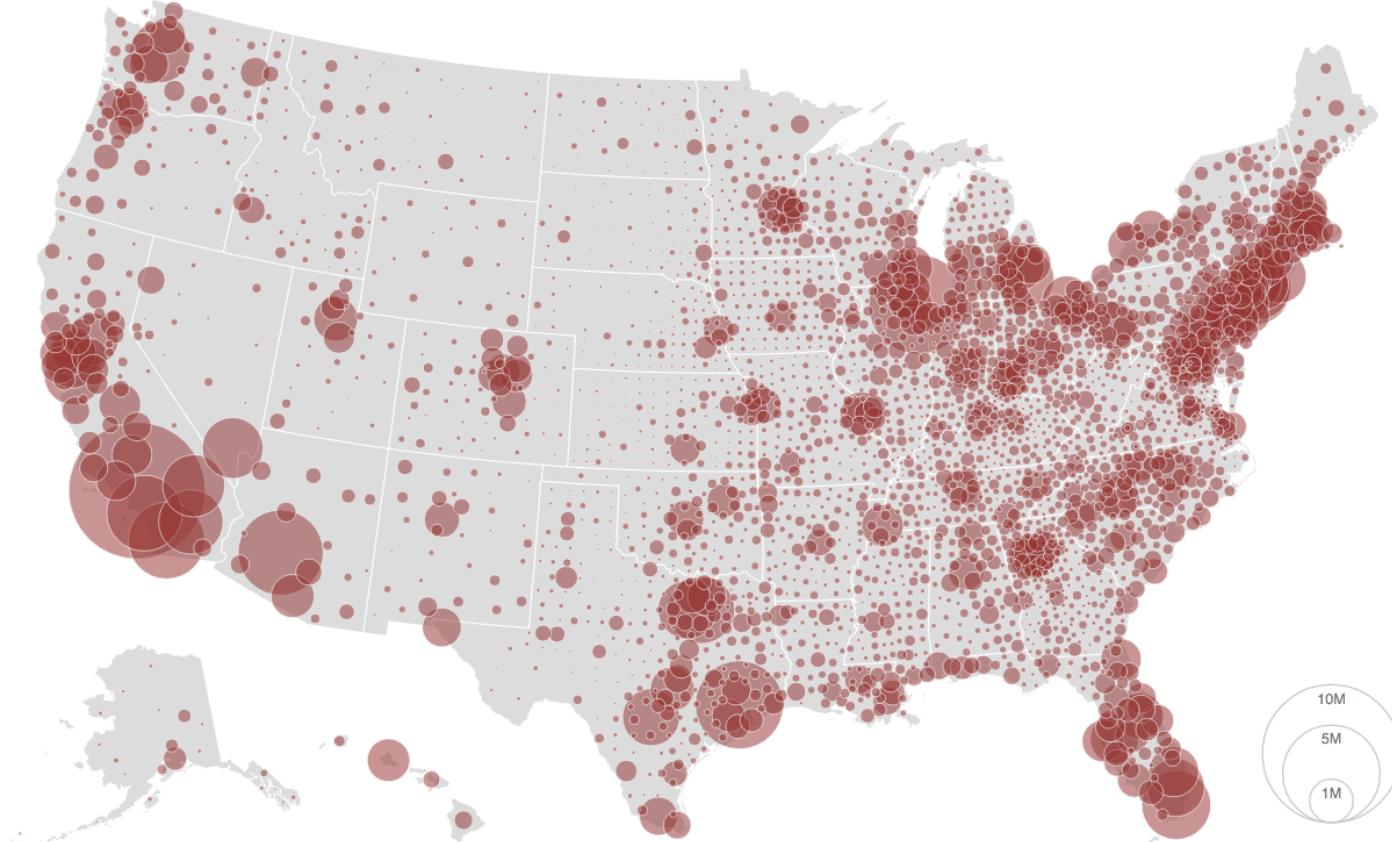
# SYMBOL MAPS

# Symbol Maps

- Encoding
  - Location, color, size, and type of symbol
- Location
  - Specific latitude and longitude
  - Regional (randomly placed within the region)
- Types
  - Proportional symbol maps
  - Dot maps (approximately one dot per pixel)



<http://vis4.net/blog/posts/clean-your-symbol-maps/>



<https://bostocks.org/mike/bubble-map/>

All occupations

Business and technical professions

Health, education and service professions

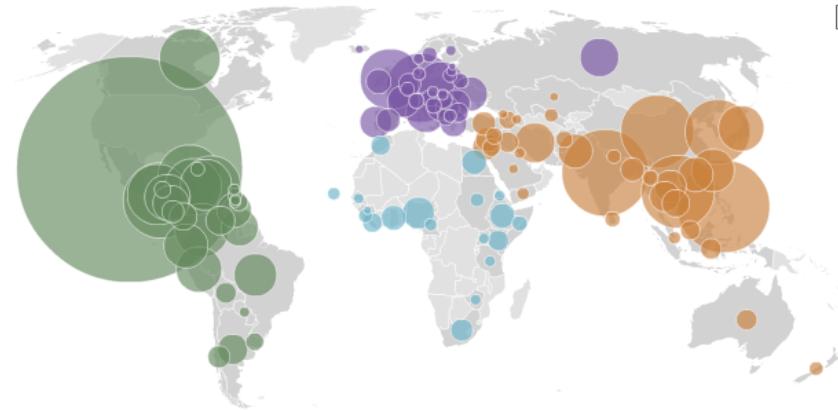
Hospitality, maintenance and personal services

Construction, manufacturing and other labor

## All foreign-born workers

Number of workers: 17,553,000

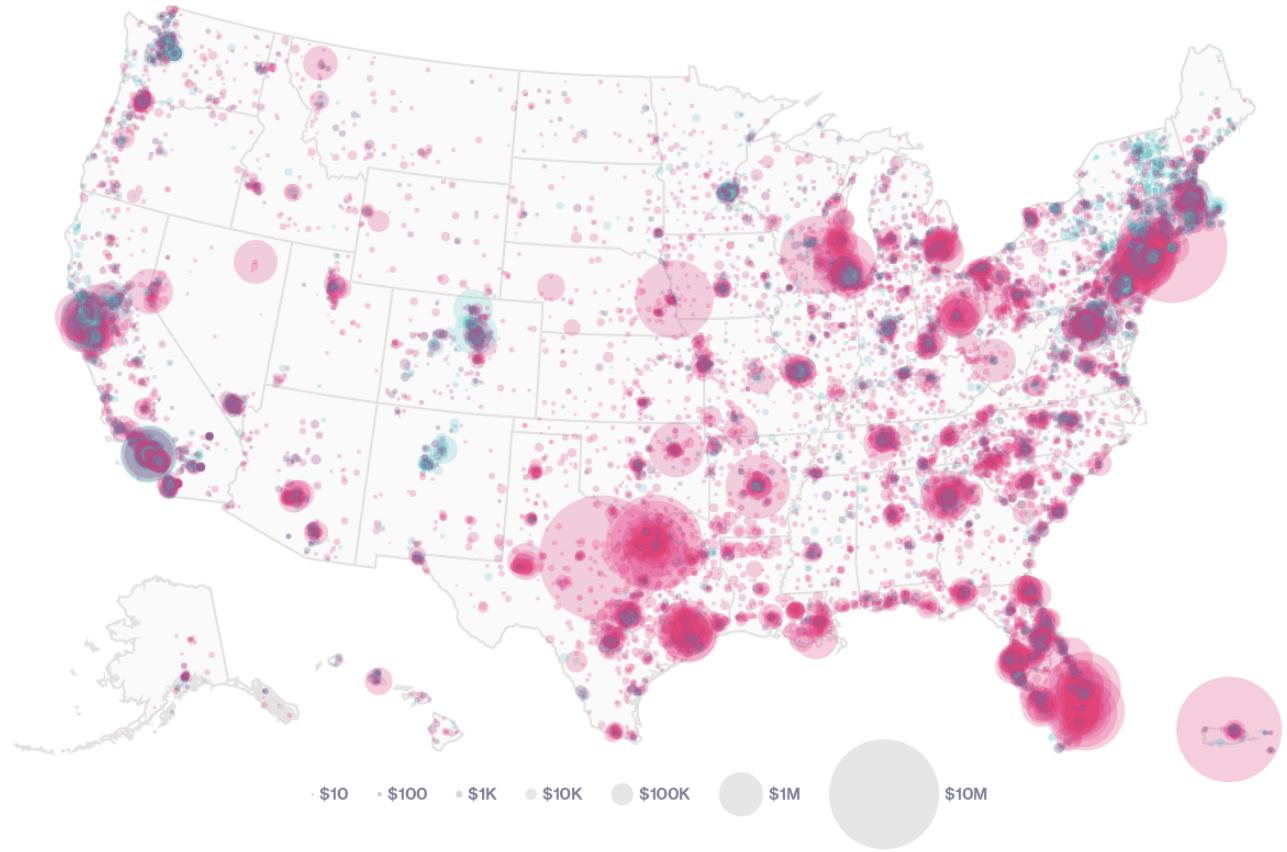
As a percentage of all U.S. workers in this category: 17%



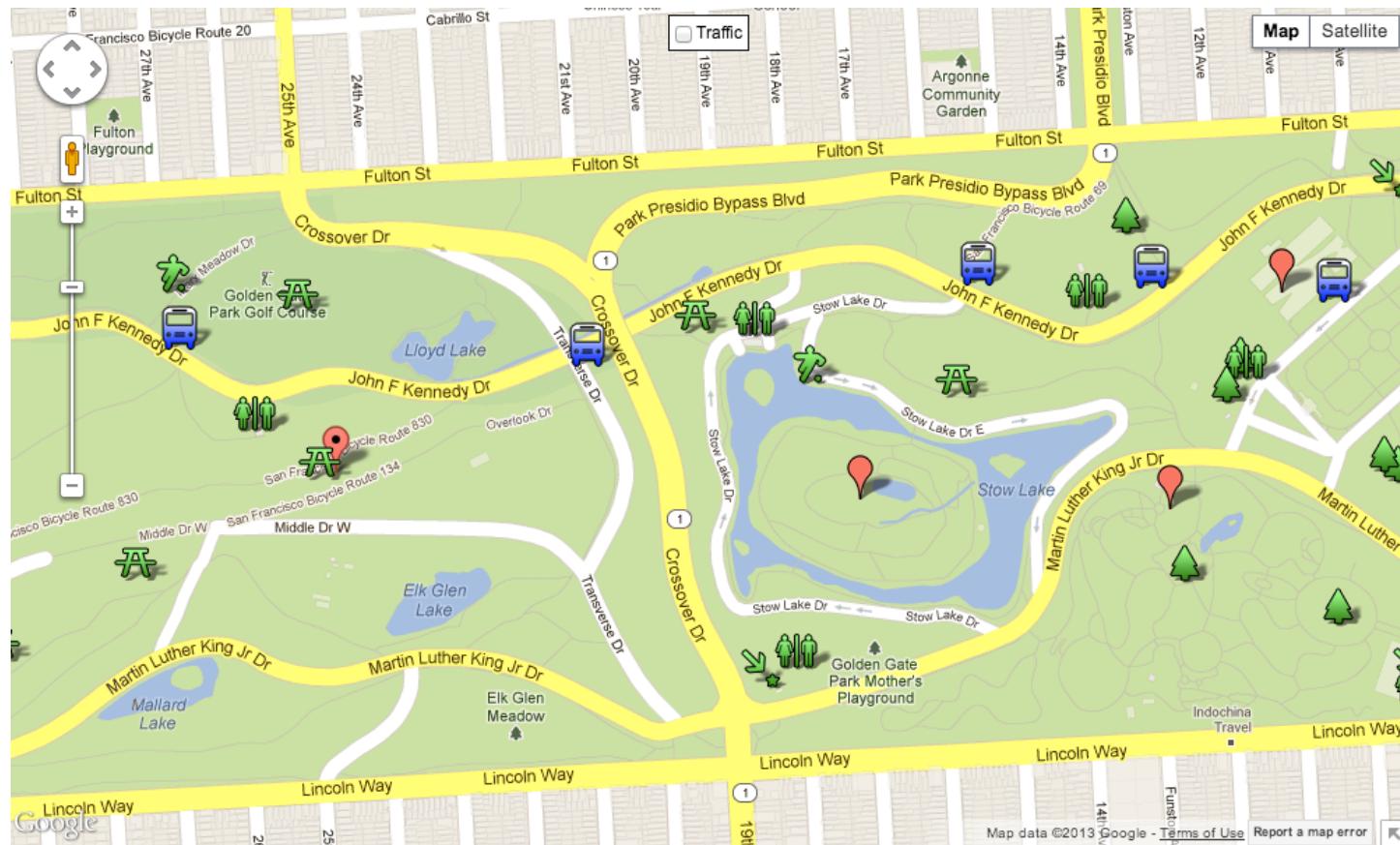
Map shows countries with more than 500 workers for the selected occupation.

Top ten	Number of workers (+/- Margin of error)	
1. Mexico	5,286,400	+/- 1%
2. Philippines	848,800	+/- 2%
3. India	746,200	+/- 2%
4. China	653,000	+/- 2%
5. El Salvador	580,100	+/- 2%
6. Vietnam	526,000	+/- 2%
7. Germany	476,100	+/- 2%
8. South Korea	408,400	+/- 2%
9. Cuba	399,300	+/- 2%
10. Canada	364,900	+/- 2%

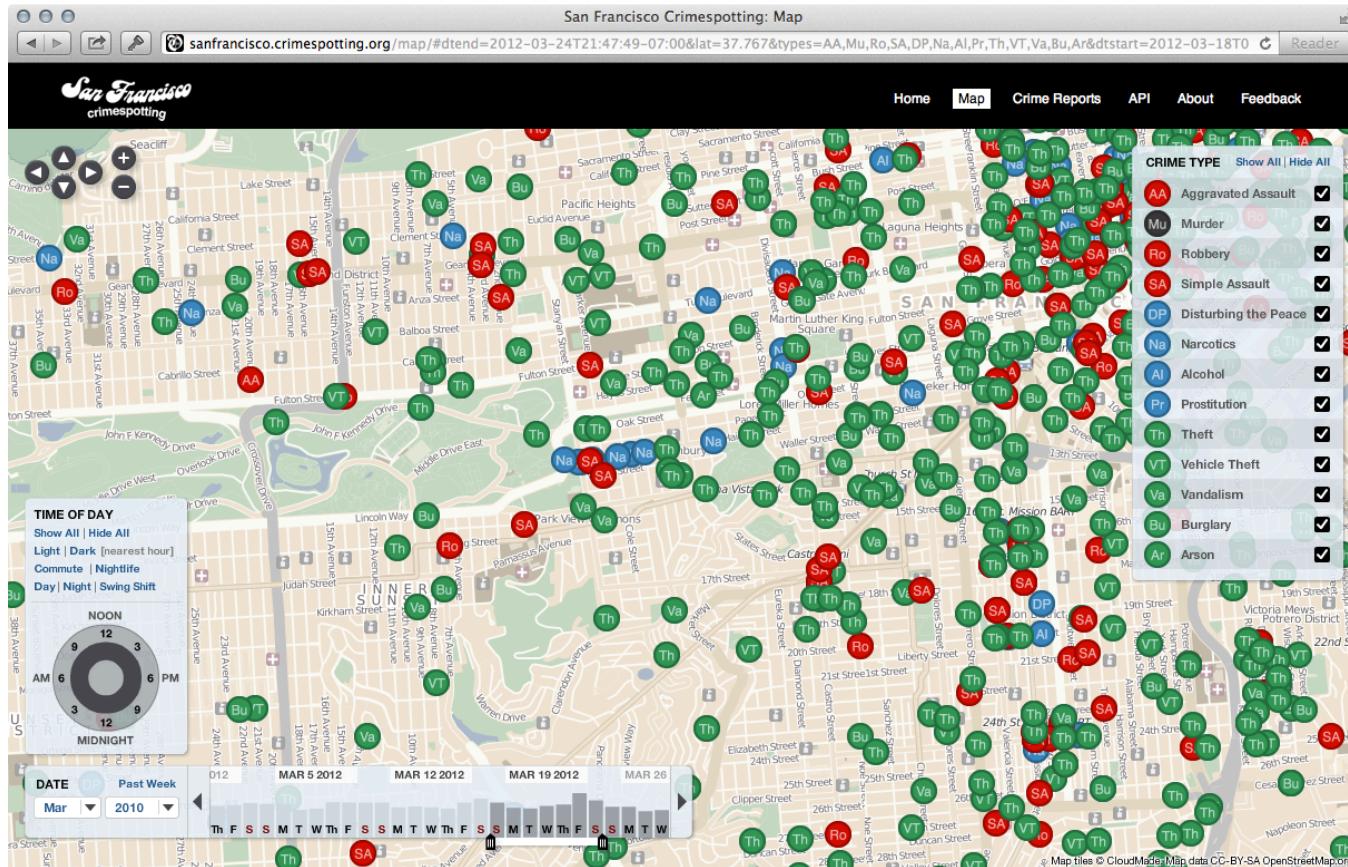
<http://www.nytimes.com/interactive/2009/04/07/us/20090407-immigration-occupation.html>



<http://www.bloomberg.com/politics/graphics/2015-presidential-money-map/>

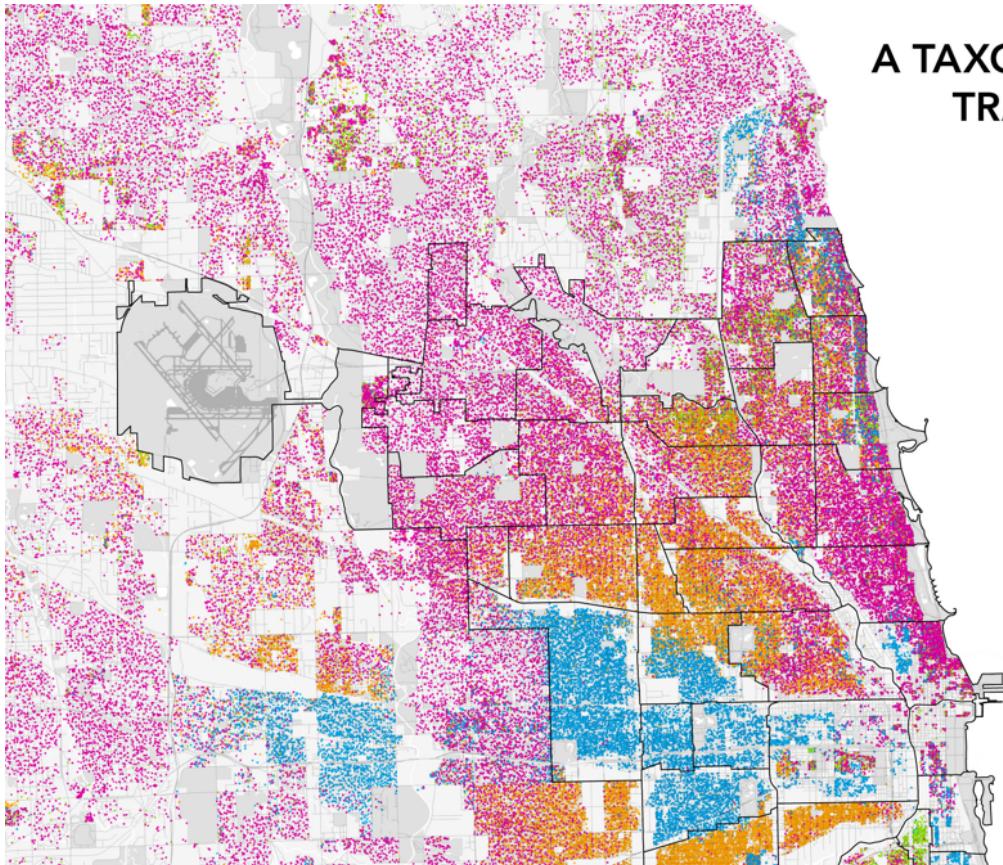


<http://www.golden-gate-park.com/interactive-golden-gate-park-map.html>



<http://sanfrancisco.crimespotting.org> (Warning: Flash required)





## A TAXONOMY OF TRANSITIONS

racial / ethnic  
self-identification  
in chicago  
in the year 2000

- white ■
- black ■
- asian ■
- hispanic ■
- other ■

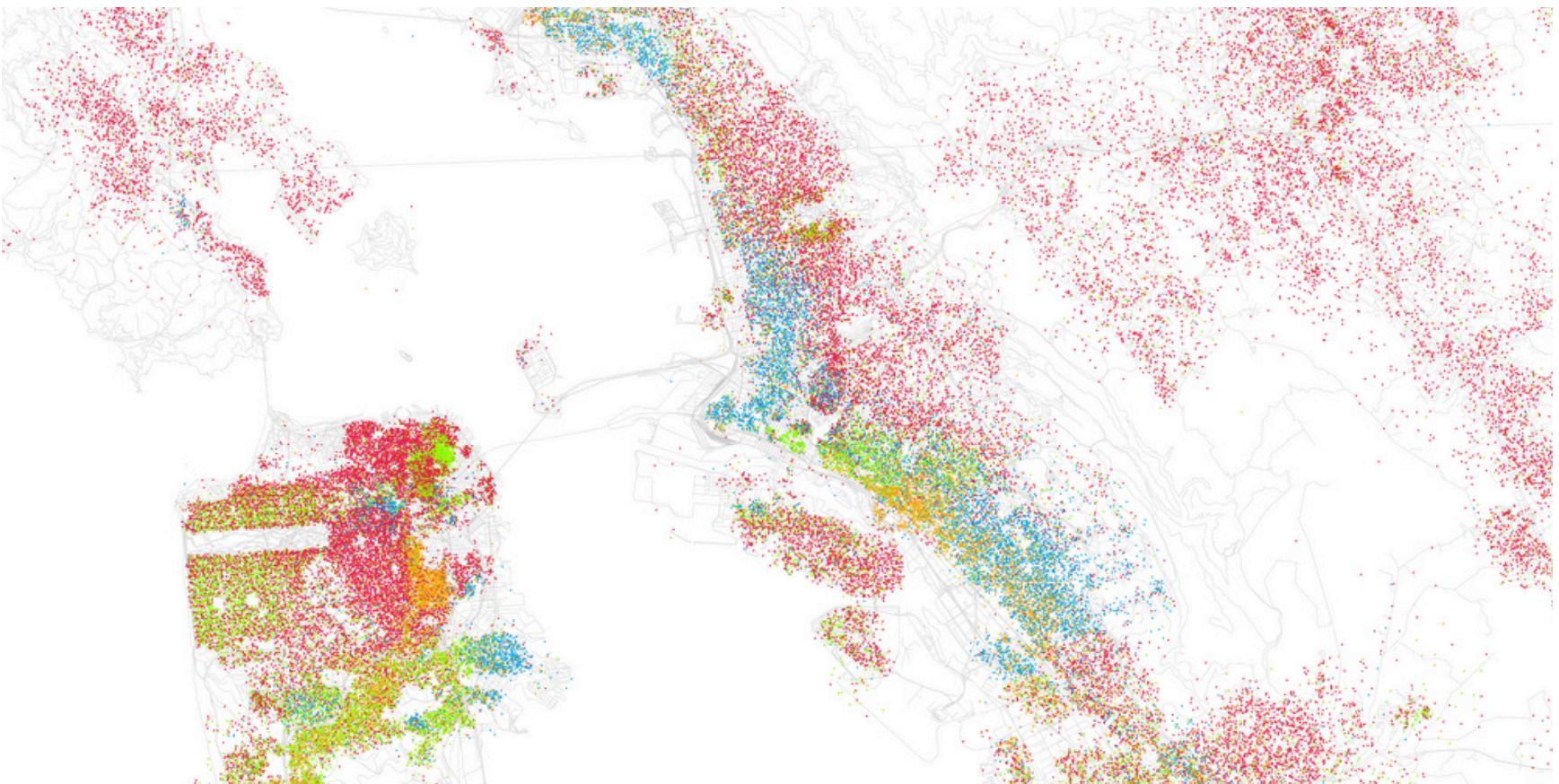
the black lines show  
chicago's official  
community areas.

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

<http://www.radicalcartography.net/index.html?chicagodots>



<http://www.flickr.com/photos/walkingsf/sets/72157624812674967/with/4981417821/> (SF)



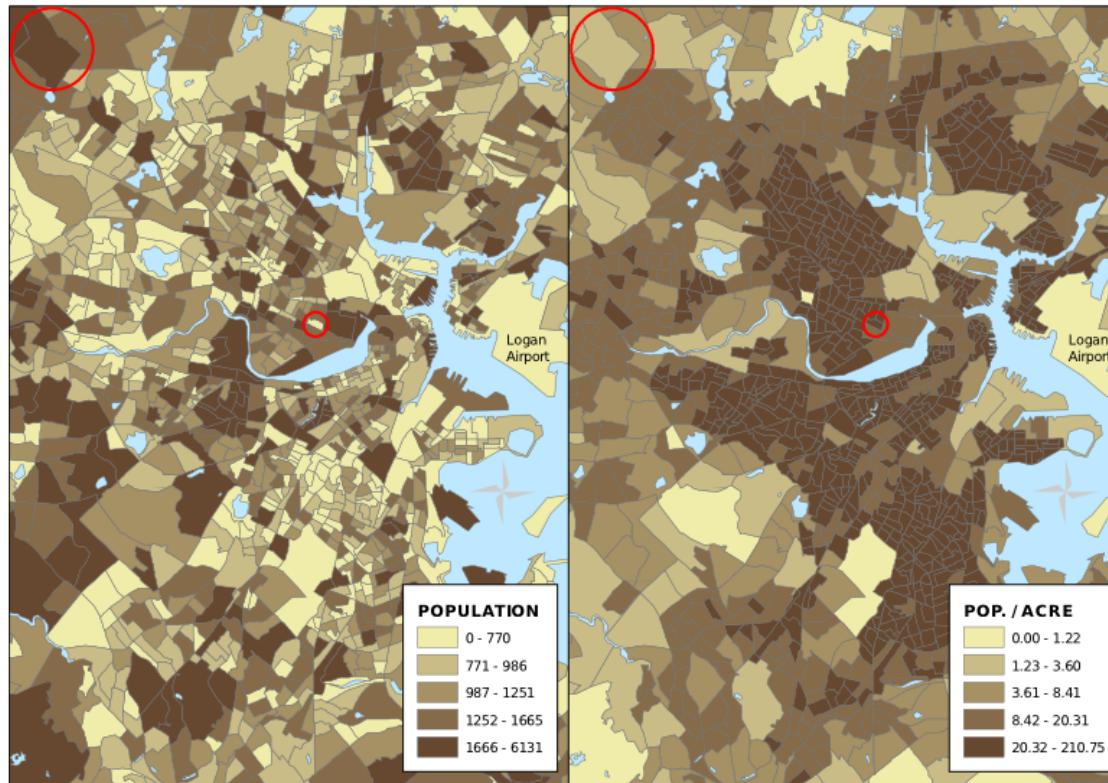
<https://demographics.virginia.edu/DotMap/index.html>

# CHOROPLETH MAPS

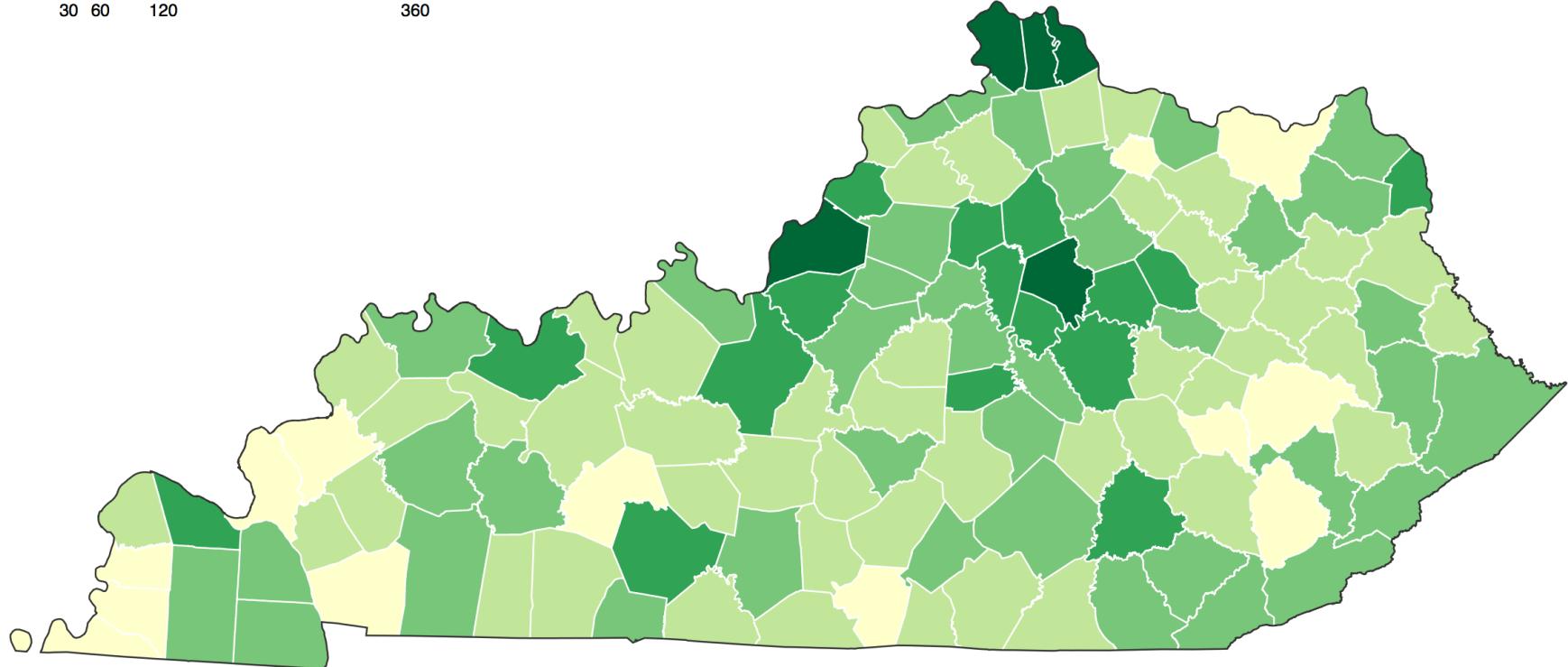
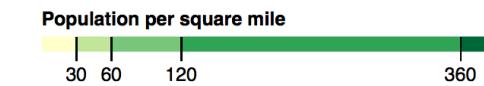
# Choropleth Maps

- Uses color and intensity to indicate data values
- Data should be normalized
  - Good: Percentages, ratios
  - Bad: Counts, totals
- Must use color wisely
  - Multiple colors, not using intensity
  - Multiple colors, using intensity
  - Monotone, only using intensity

Total Population of 2000 Census Block Groups    Population Density of 2000 Census Block Groups



<http://en.wikipedia.org/wiki/File:Choropleth-density.png>



<http://bl.ocks.org/mbostock/5144735>

# Immigration Explorer

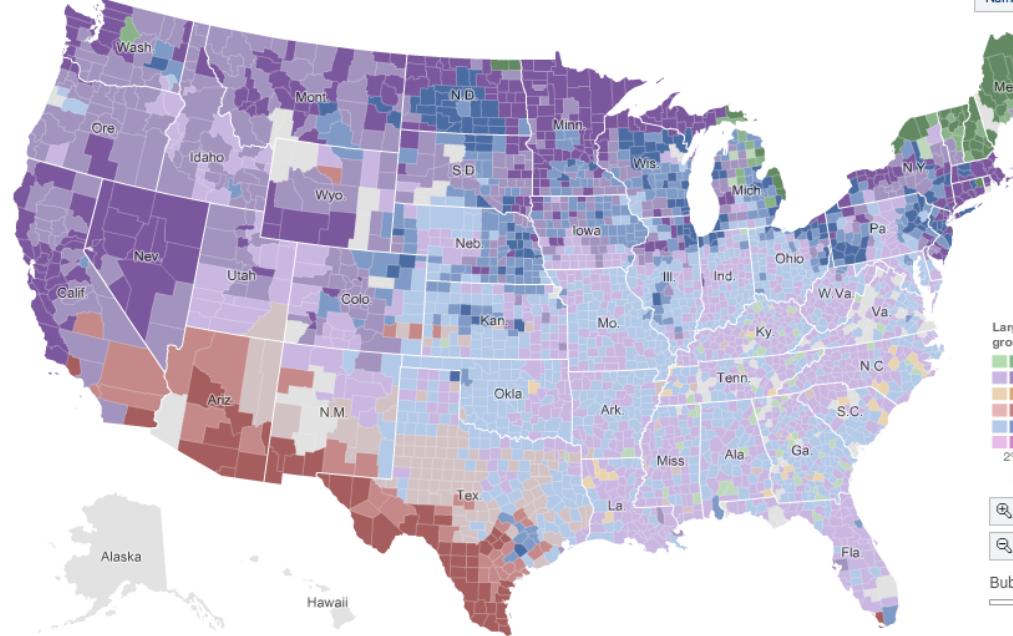
Select a foreign-born group to see how they settled across the United States.

All Countries | ▾

1880 '90 1900 '10 1920 '30 1940 '50 1960 '70 1980 '90 2000

SHOW Percent of population

Number of residents

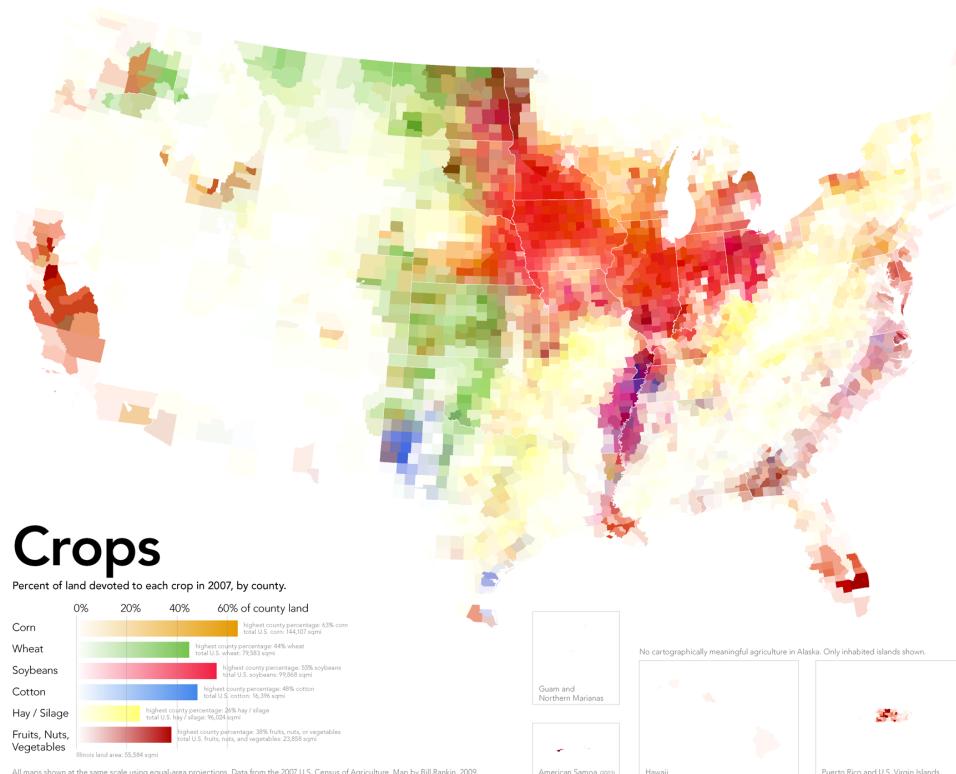


Note: Due to limitations in the Census data, foreign-born populations are not available in all areas for all years.

Sources: Social Explorer, [www.socialexplorer.com](http://www.socialexplorer.com); Minnesota Population Center; U.S. Census Bureau

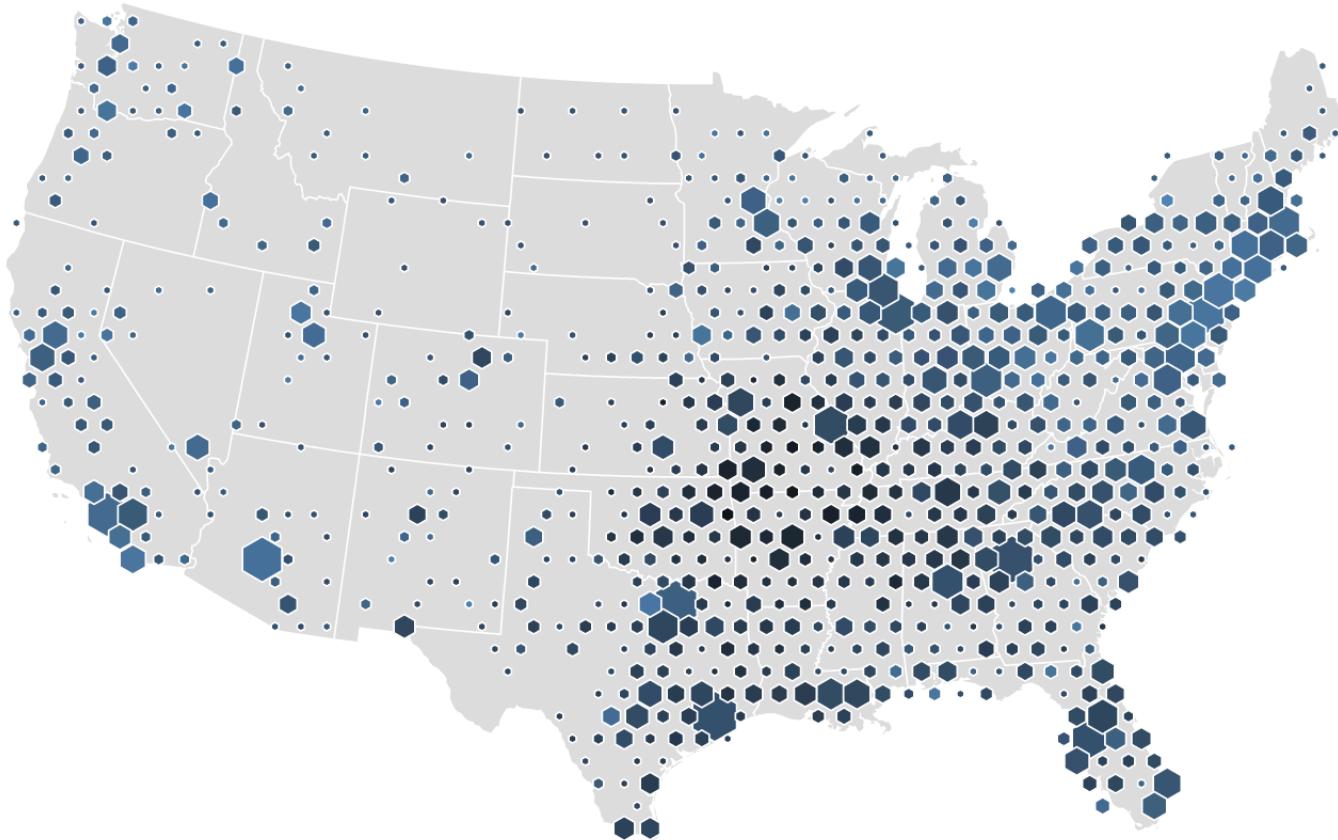
Matthew Bloch and Robert Gebeloff/The New York Times

<http://www.nytimes.com/interactive/2009/03/10/us/20090310-immigration-explorer.html>



<http://www.radicalcartography.net/index.html?crops>

# BINNING AND DENSITY



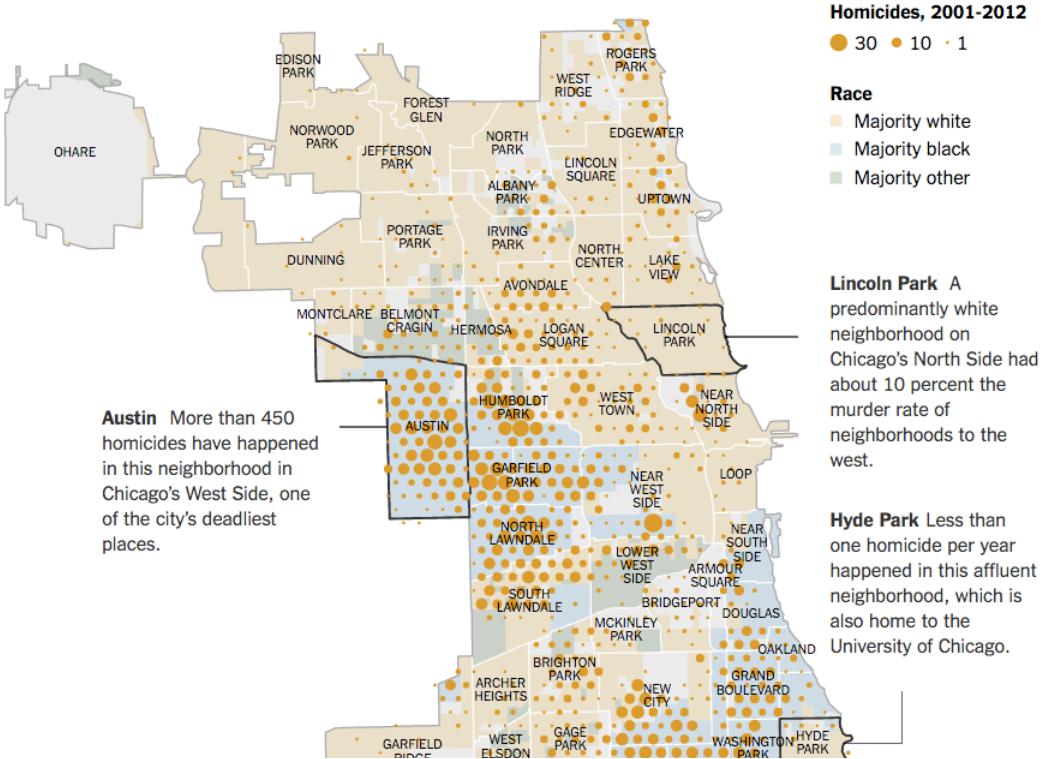
<http://bl.ocks.org/mbostock/4330486>

# A Chicago Divided by Killings

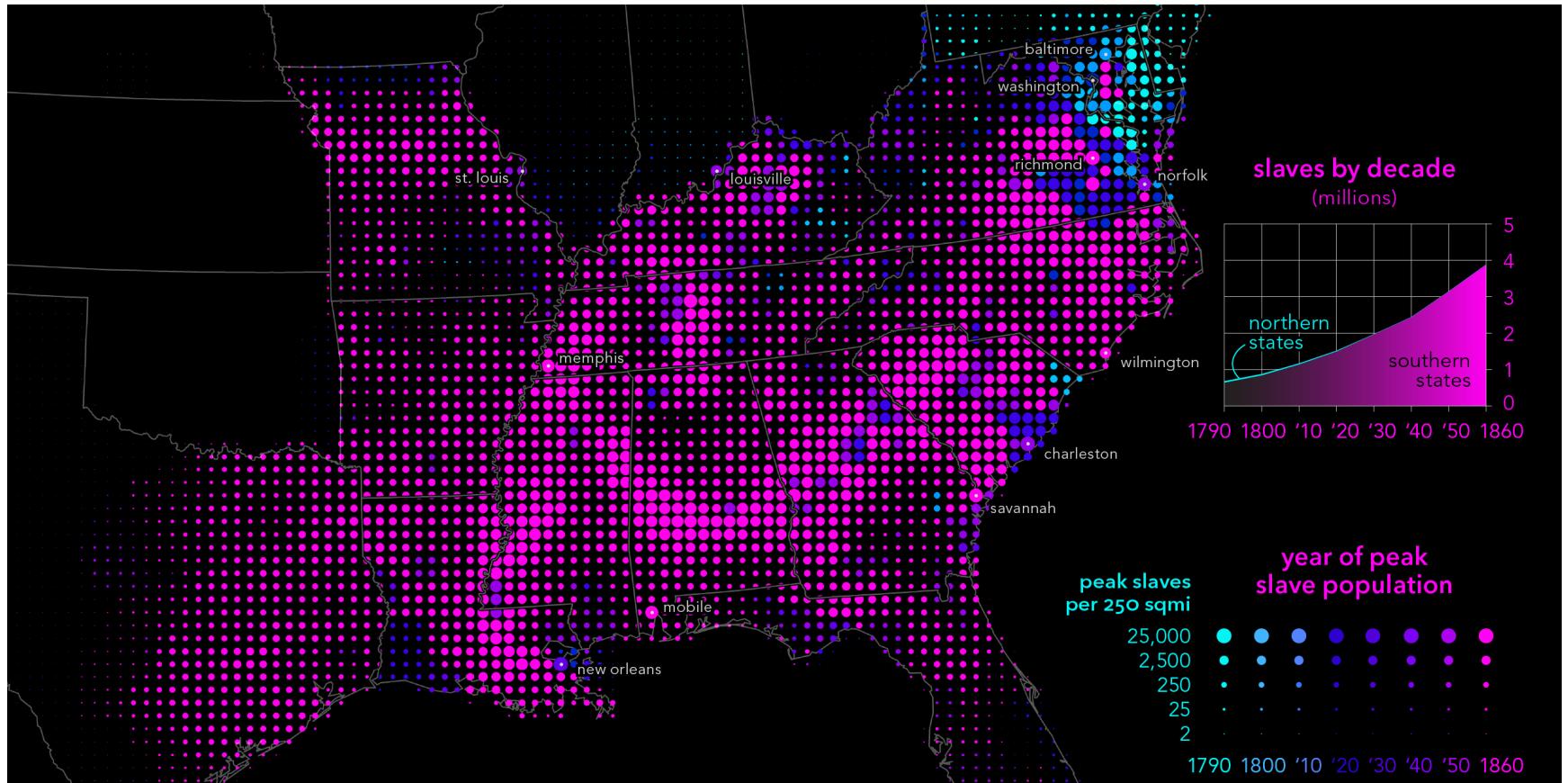
[Related Article »](#)

A New York Times analysis of homicides and census data in Chicago compared areas near murders to those that were not. Residents living near homicides in the last 12 years were much more likely to be black, earn less money and lack a college degree.

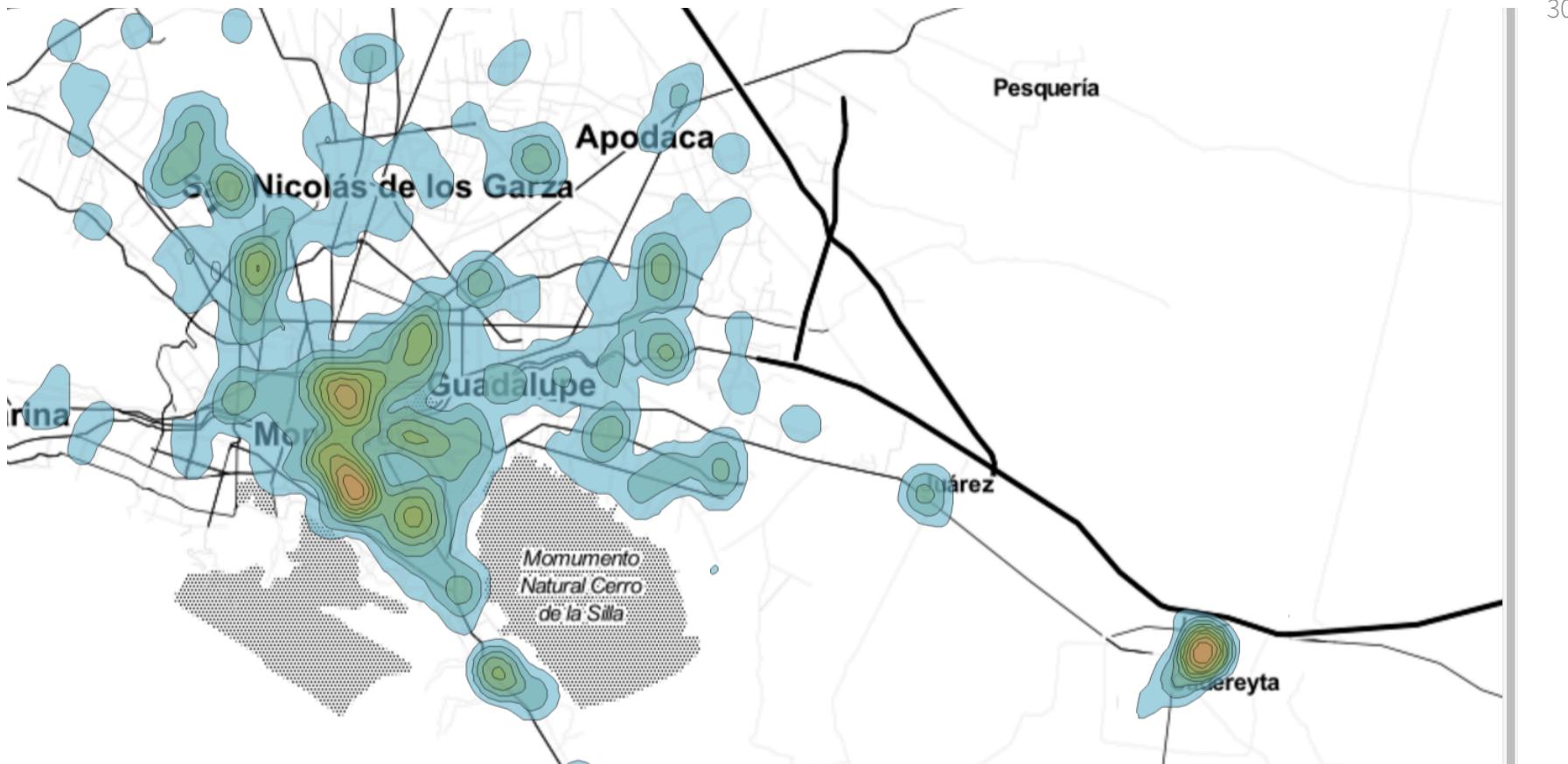
	NEAR HOMICIDES	NOT NEAR HOMICIDES
<b>Population</b>	1.3 mil.	1.4 mil.
<b>Income</b>	\$38,318	\$61,175
<b>No high school</b>	27%	15%
<b>High school</b>	28%	20%
<b>Bachelor's +</b>	19%	43%
<b>Pct. white</b>	24%	61%
<b>Pct. black</b>	55%	14%
<b>Pct. Asian</b>	3%	8%



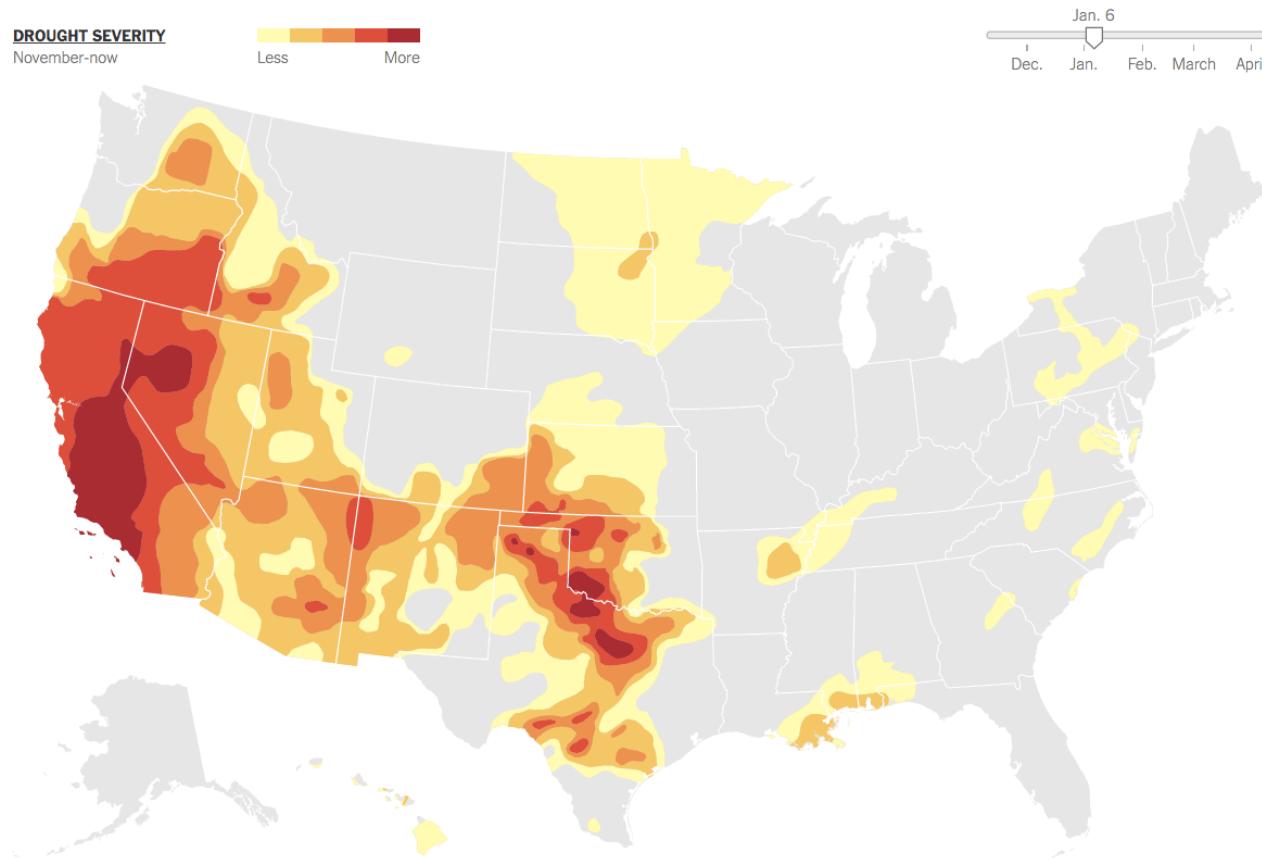
<http://www.nytimes.com/interactive/2013/01/02/us/chicago-killings.html>



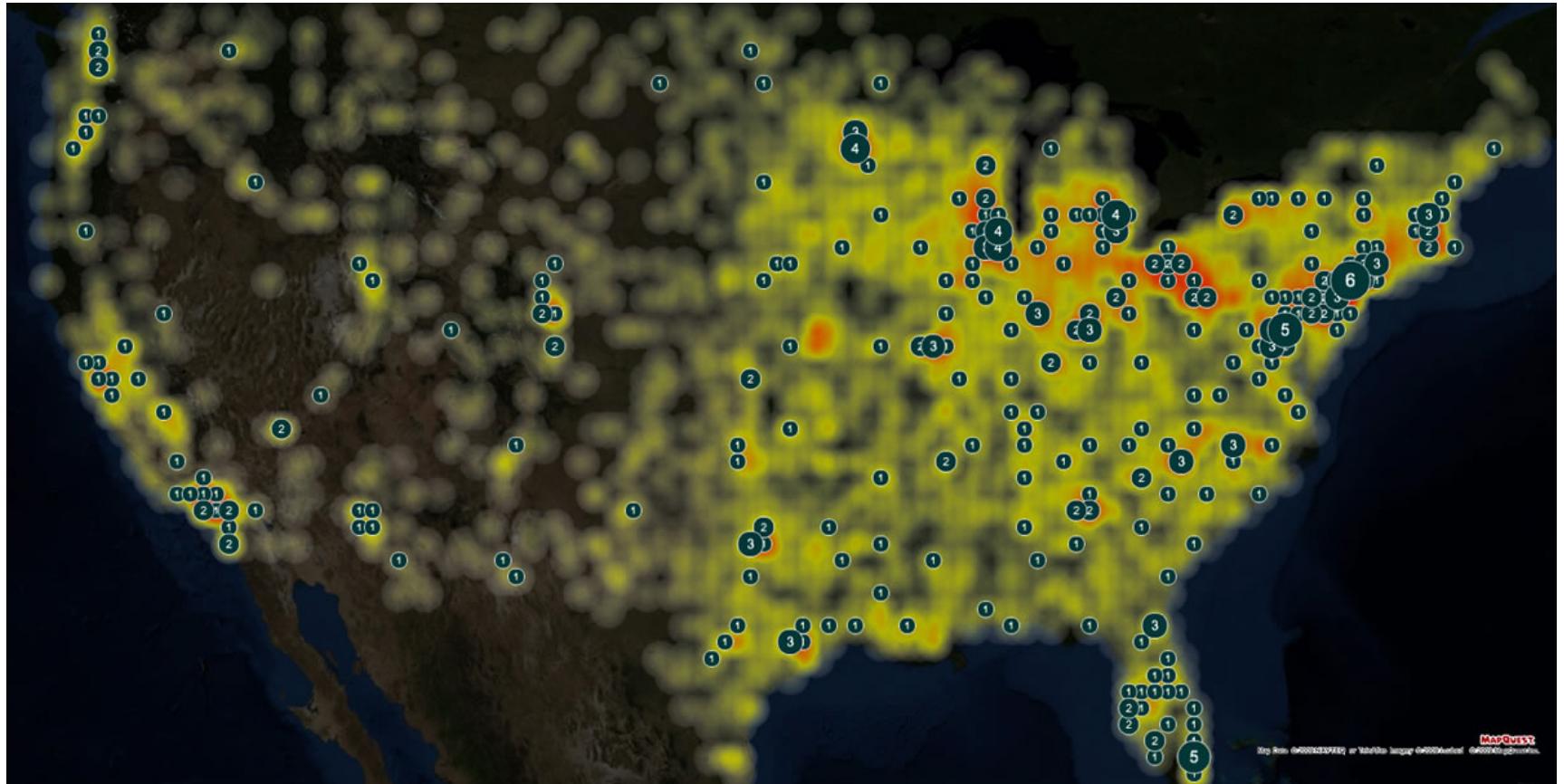
<https://pudding.cool/2017/01/shape-of-slavery/>



<http://bl.ocks.org/diegovalle/5166482>

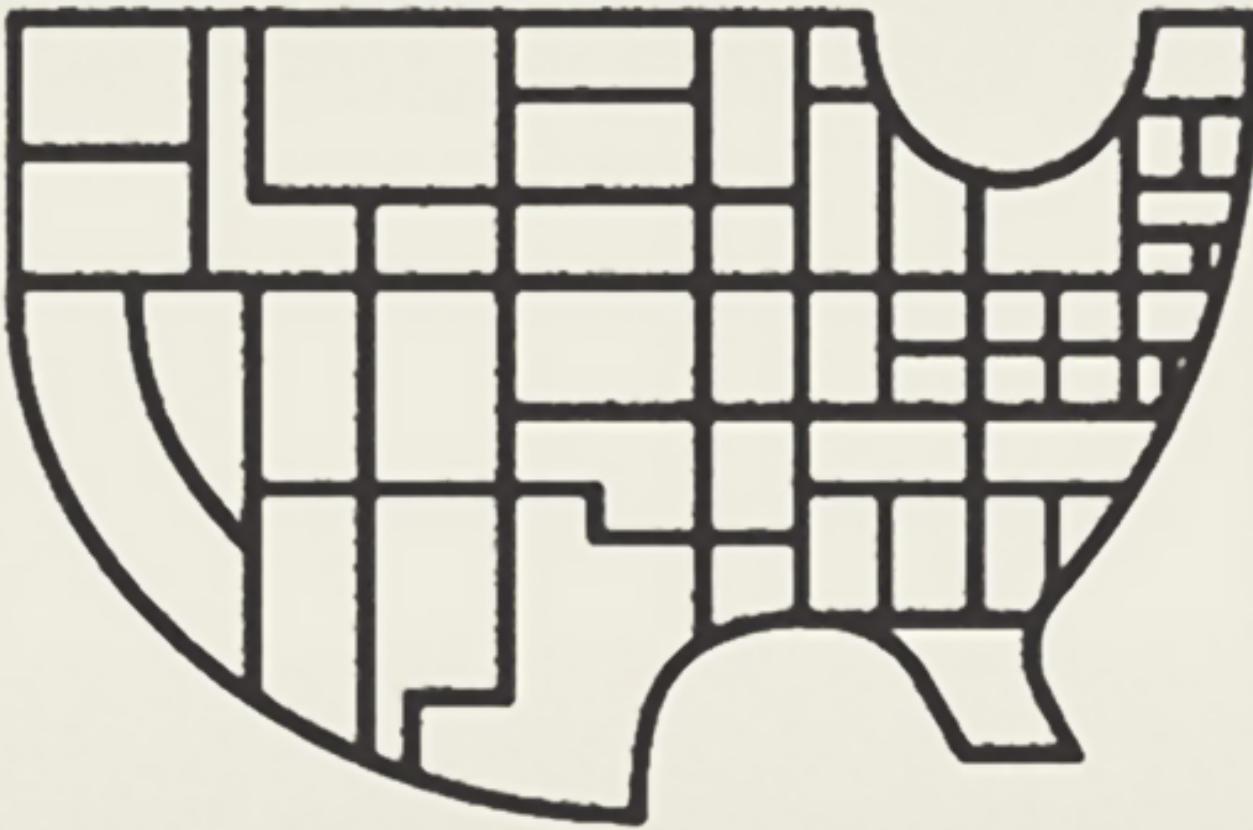


<http://www.nytimes.com/interactive/2014/upshot/mapping-the-spread-of-drought-across-the-us.html>



<http://blog.spatialkey.com/2009/10/mapping-saturn-and-gm-dealerships-service-is-still-nearby/>

# CARTOGRAMS



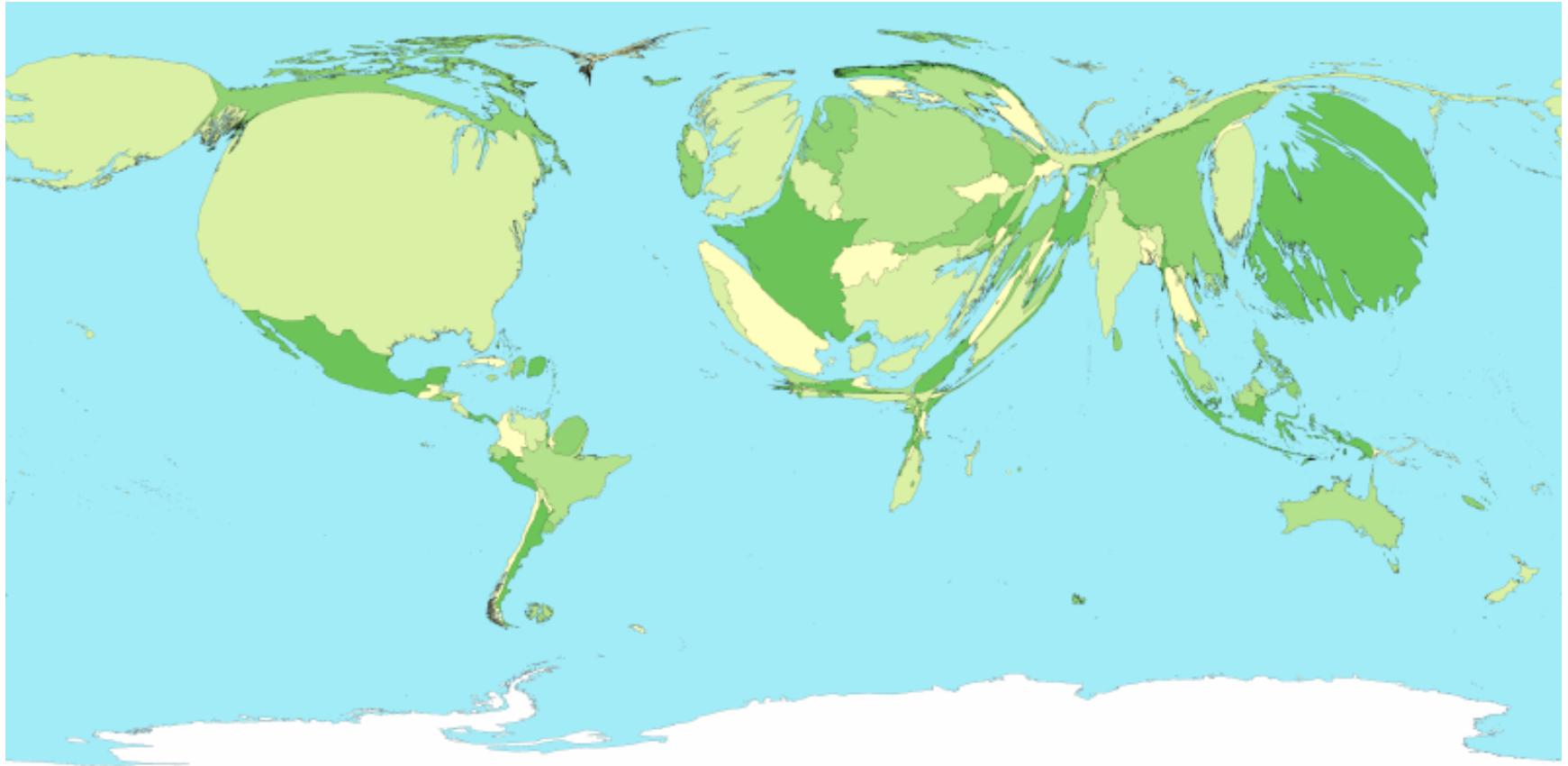
<http://drbl.in/xxR>

# Cartograms

- Area Cartograms
  - Scale area proportional to data value
  - Regions remain contiguous
- Non-Contiguous Cartograms
  - Scale area proportional to data value
  - Regions become non-contiguous
- Dorling Cartograms
  - Replace region with scaled shape
  - Does not maintain region shape or topology



<http://www-personal.umich.edu/~mejn/cartograms/>



<http://www-personal.umich.edu/~mejn/cartograms/>



## A New Way To Look At The World



### Aging Population

#### THIS MAP SHOWS

Countries resized relative to:  
People Aged 60 or Older  
(number of persons)

#### WORLD TOTAL

759.1 million

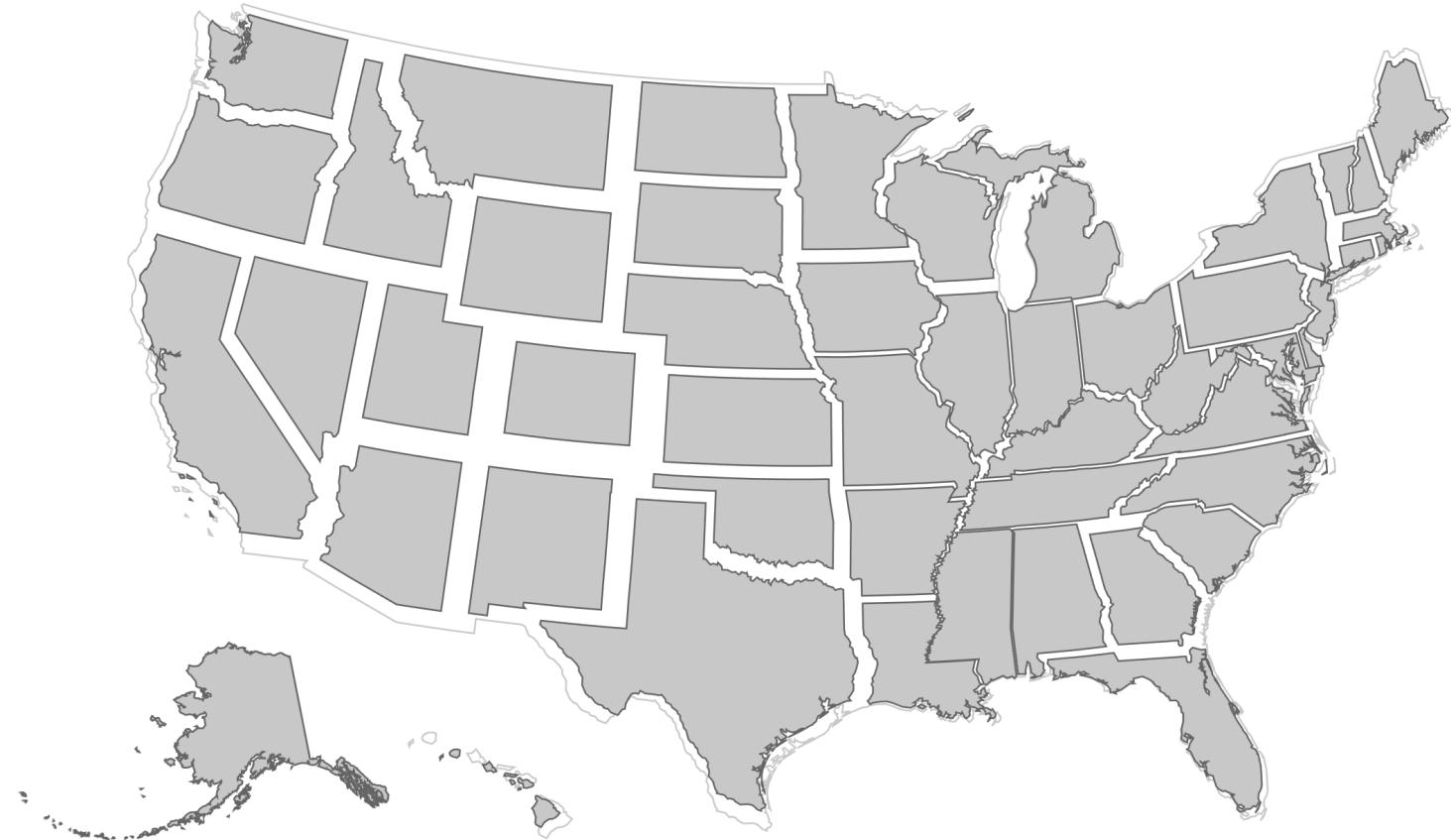
Data © UN Population Division

#### RANKING

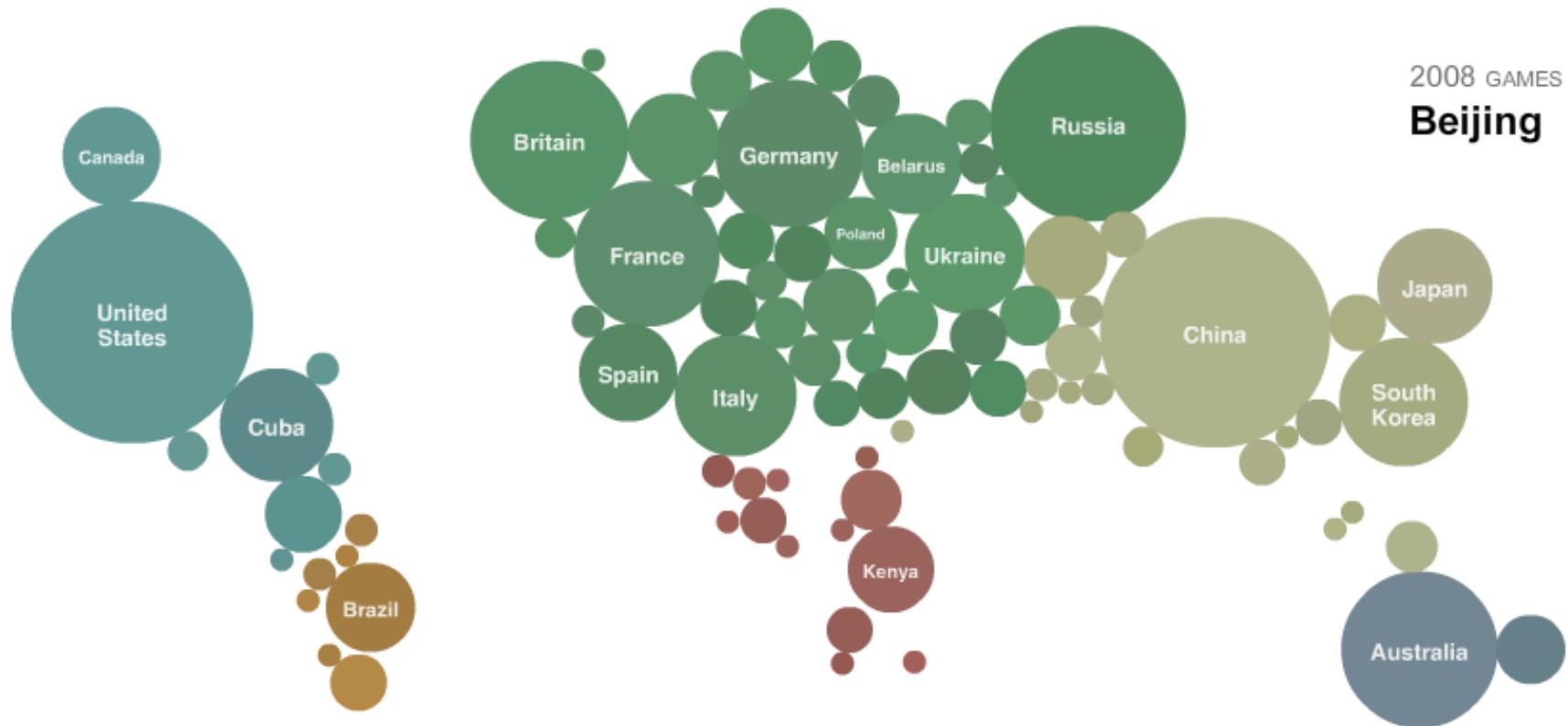
China	166.5 million
India	91.7 million
United States	57.8 million
Japan	38.7 million
Russian Federation	25.4 million
Germany	21.3 million
Indonesia	20.8 million
Brazil	19.8 million

**show.mappingworlds.com**

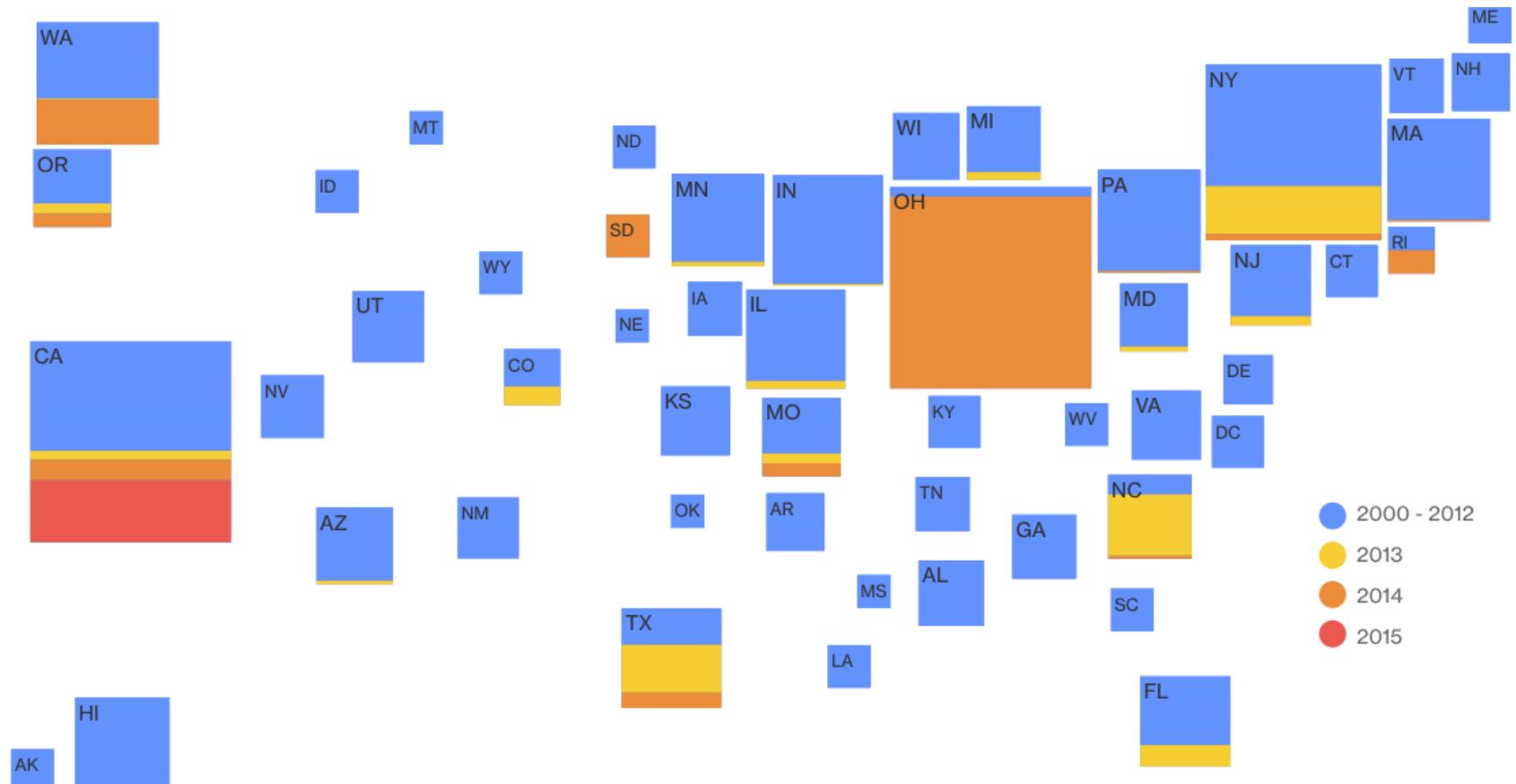
<http://show.mappingworlds.com/world/?subject=POPULATIONAGING>



<https://bl.ocks.org/mbostock/4055908>

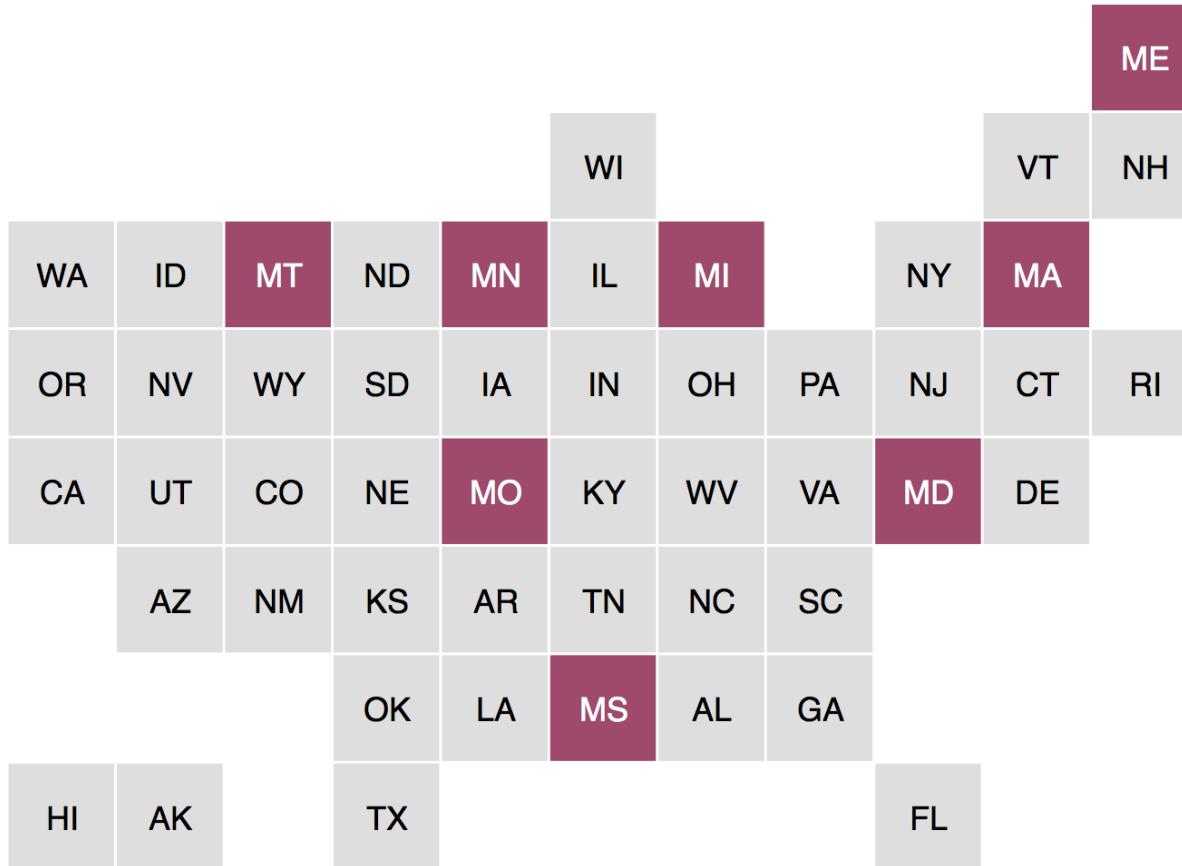


[http://www.nytimes.com/interactive/2008/08/04/sports/olympics/20080804\\_MEDALCOUNT\\_MAP.html](http://www.nytimes.com/interactive/2008/08/04/sports/olympics/20080804_MEDALCOUNT_MAP.html)

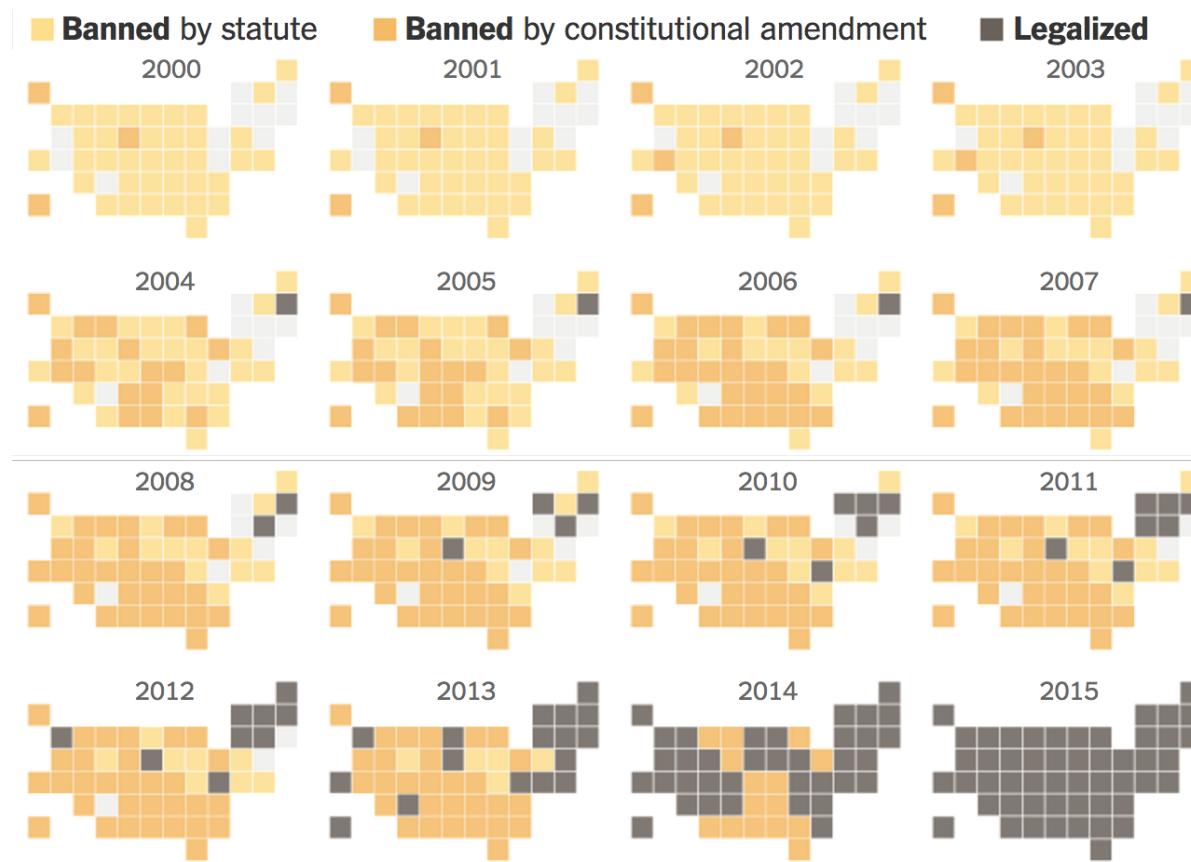


<http://www.bloomberg.com/graphics/2015-measles-outbreaks/>

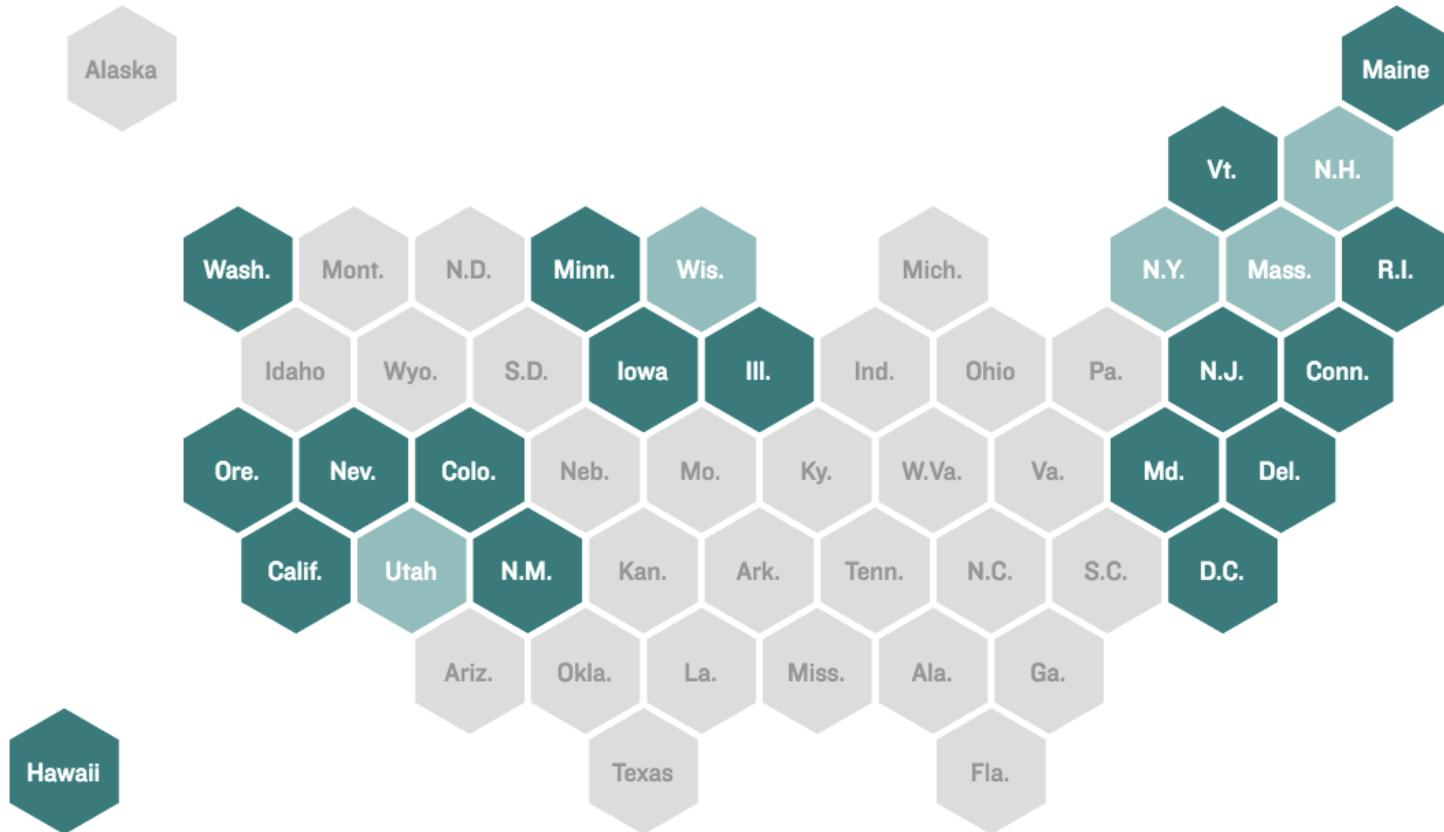
# OTHER MAP TYPES



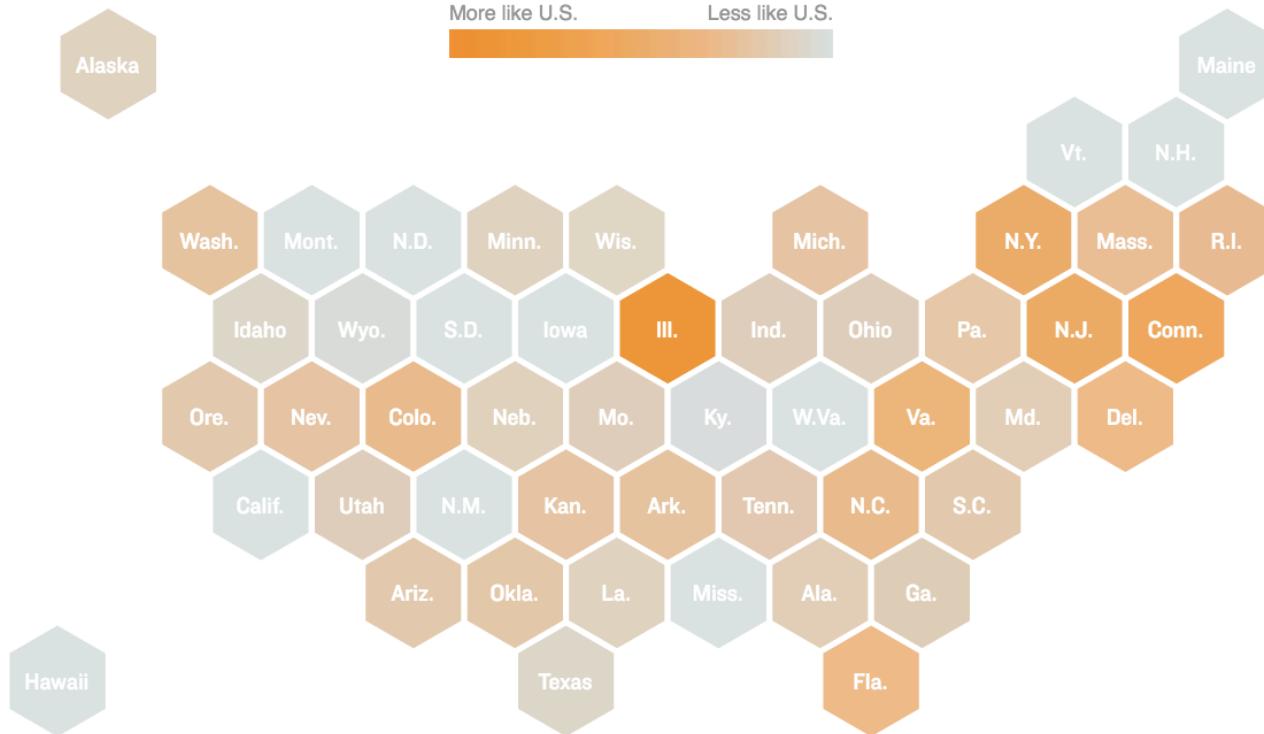
<http://bl.ocks.org/mbostock/29cc3cc4078091fd2115>



<http://www.nytimes.com/interactive/2015/03/04/us/gay-marriage-state-by-state.html>



<http://blog.apps.npr.org/2015/05/11/hex-tile-maps.html>



Source: [U.S. Census Bureau 2010-2014 estimates](#)

Credit: Katie Park and Asma Khalid/NPR

<http://www.npr.org/2016/01/29/464250335/the-perfect-state-index-if-iowa-n-h-are-too-white-to-go-first-then-who>

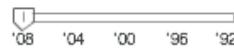
# ELECTION RESULTS 2008

<http://elections.nytimes.com/2008/results/president/map.html>  
<http://www-personal.umich.edu/~mejn/election/2008/>

State winners
County bubbles
County leaders
Voting shifts

ZOOM IN

Year



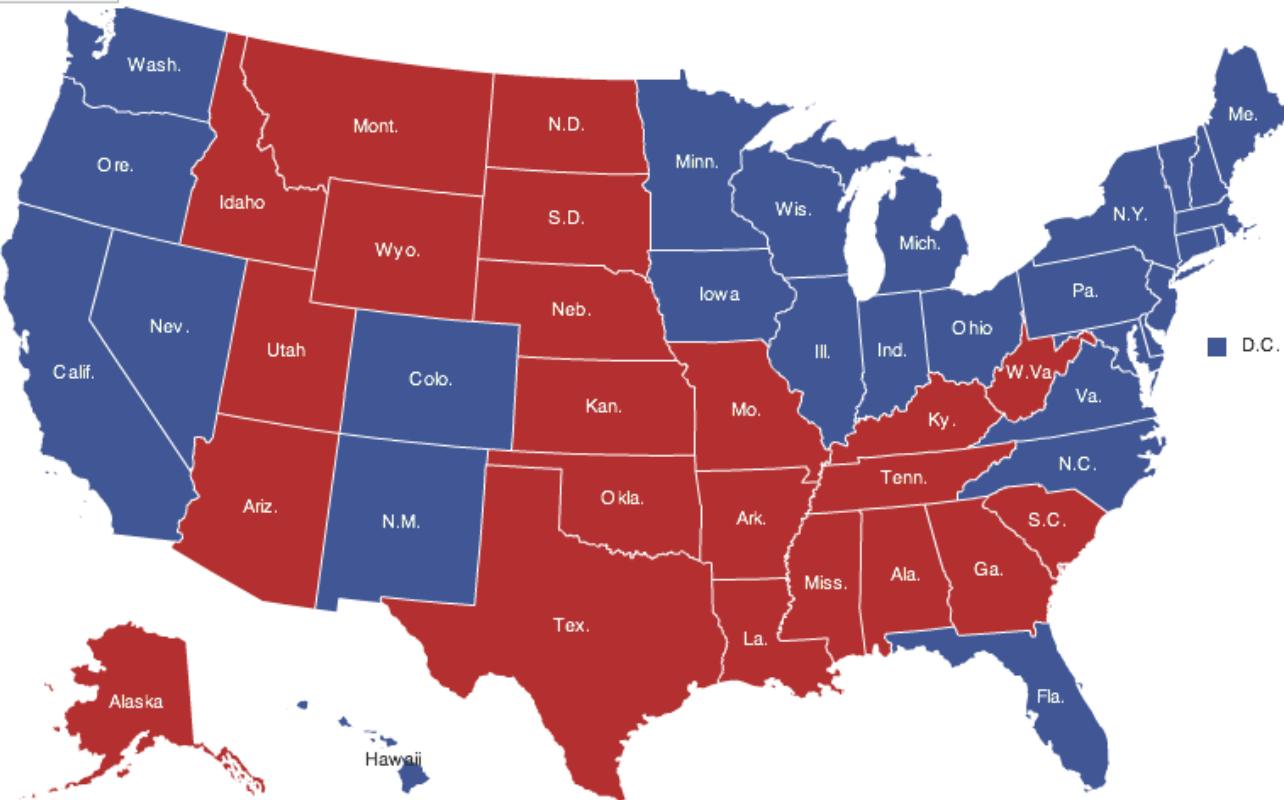
### Map key

#### DEMOCRATS

■ Lead ■ Win

#### REPUBLICANS

■ Lead ■ Win

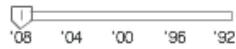


Choropleth Map

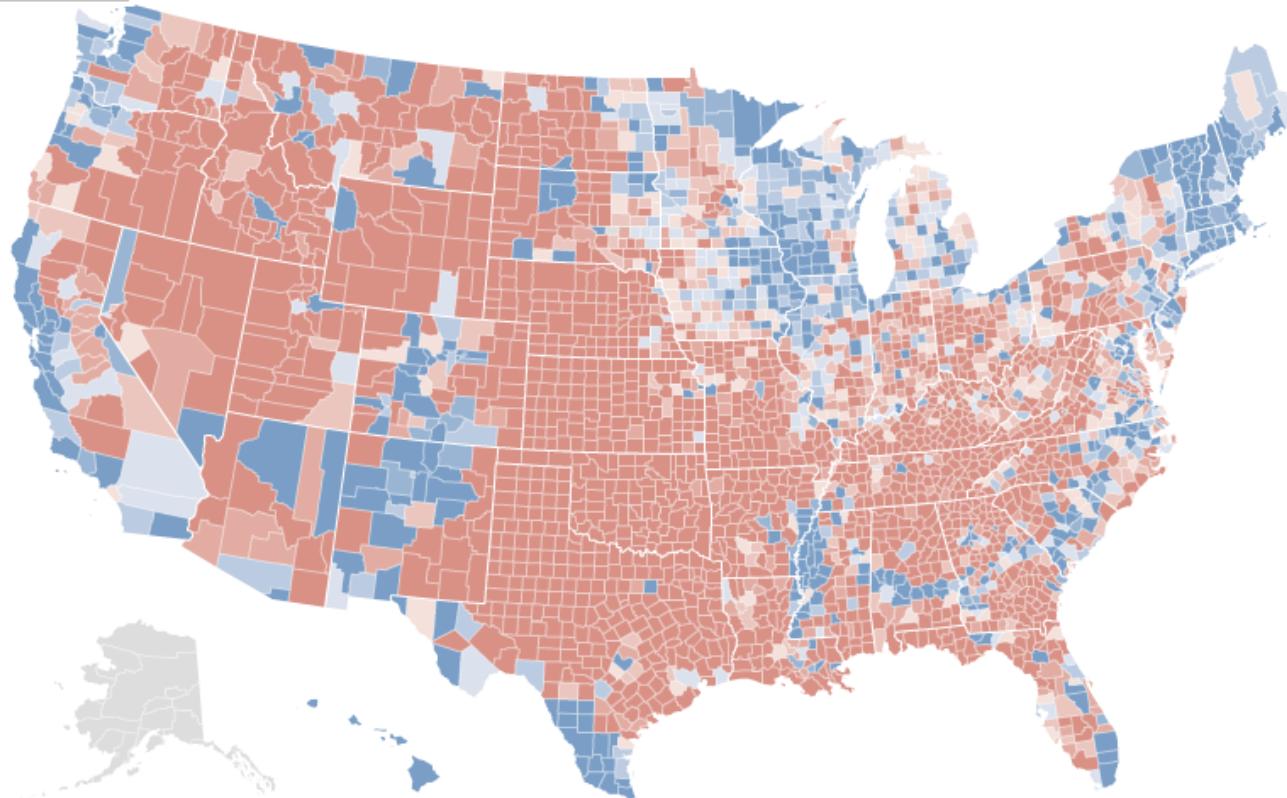
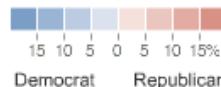
- [State winners](#)
- [County bubbles](#)
- [County leaders](#)
- [Voting shifts](#)

 ZOOM IN

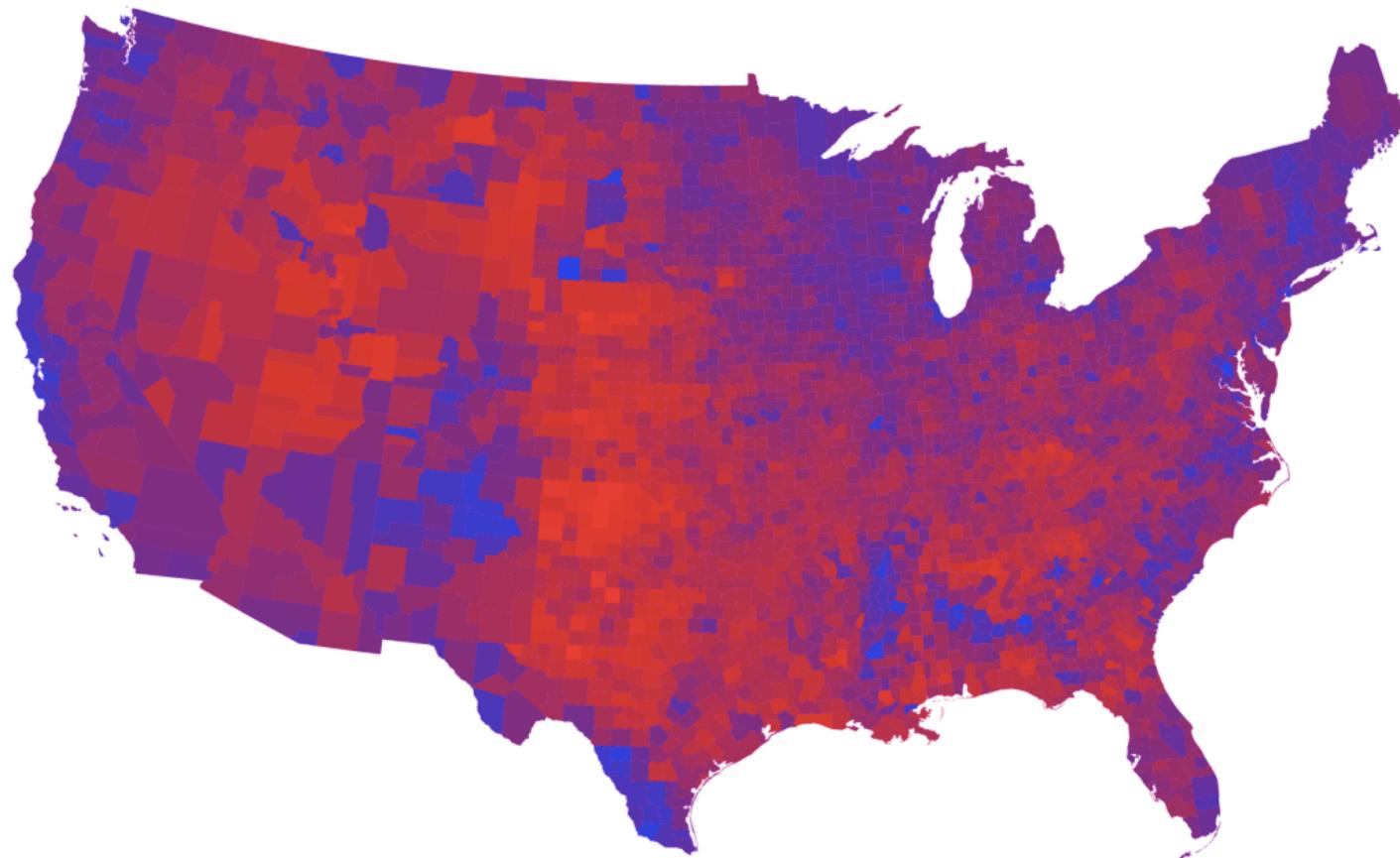
Year



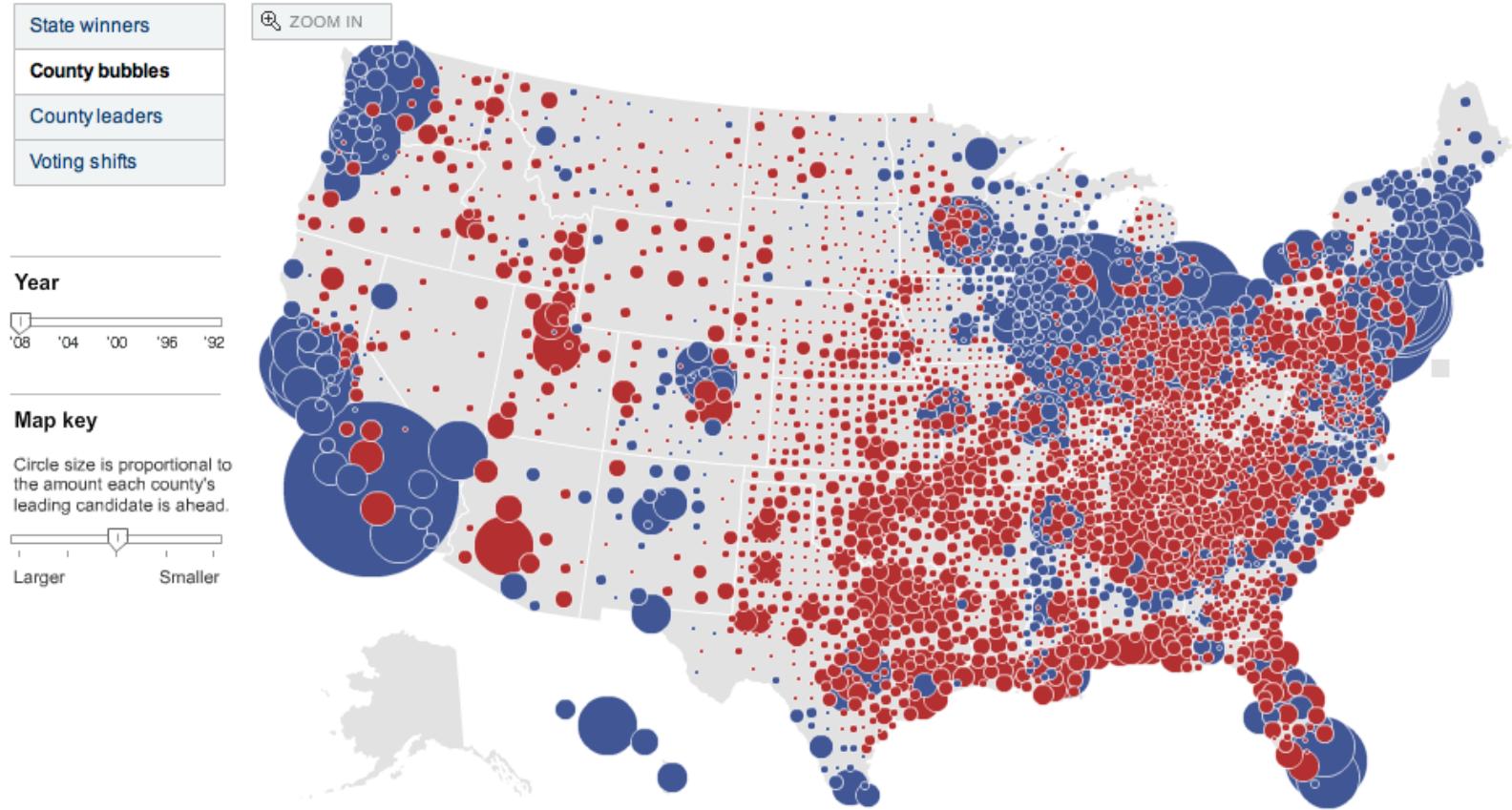
Map key



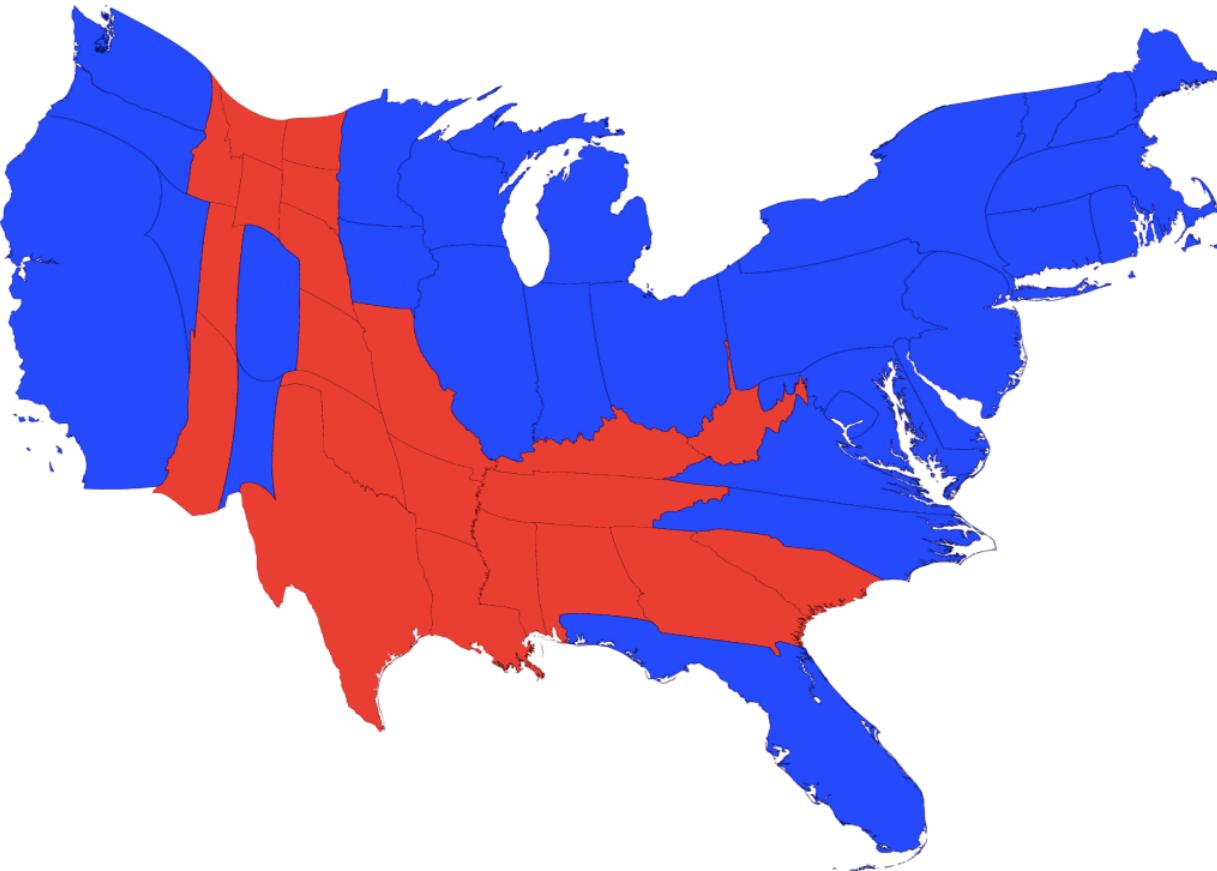
Choropleth Map



<http://www-personal.umich.edu/~mejn/election/2008/>



Proportional Symbol Map



<http://www-personal.umich.edu/~mejn/election/2008/>

# The Electoral Map: Key States

By ADAM NAGOUREY, JEFF ZELENY AND SHAN CARTER  
November 4, 2008

- E-MAIL
- SHARE
- FEEDBACK



**Obama 291**

**163 McCain**

196 Solid Obama

95 Leaning Obama

84 Tossup

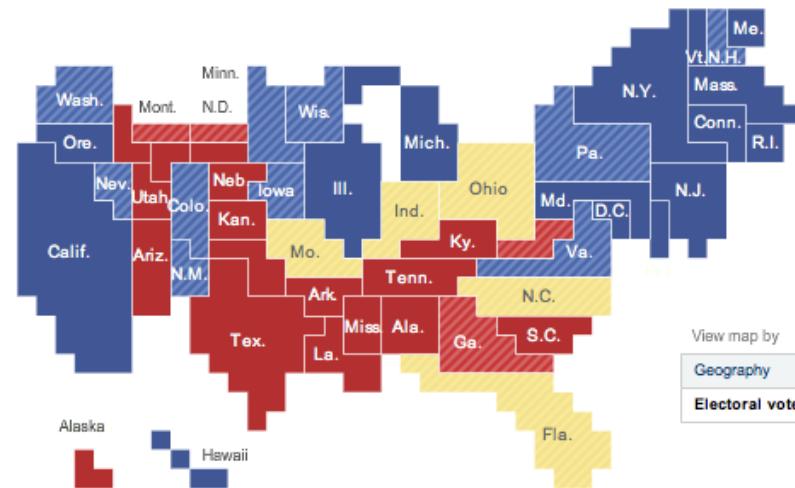
26

137 Solid McCain

270 electoral votes needed to win

**The colors show the latest breakdown by The New York Times of which states are considered to be in play in the presidential election. This is a snap-shot in time; it is not a prediction of how the race is going to turn out Nov. 4. Ratings are based on a variety of factors, including polling, previous elections results and the political landscape in the state.**

**Click on a state for more information.**



Dorling Cartogram

# TRANSIT MAPS

Schematic/Diagrammatic Map, Tube Map

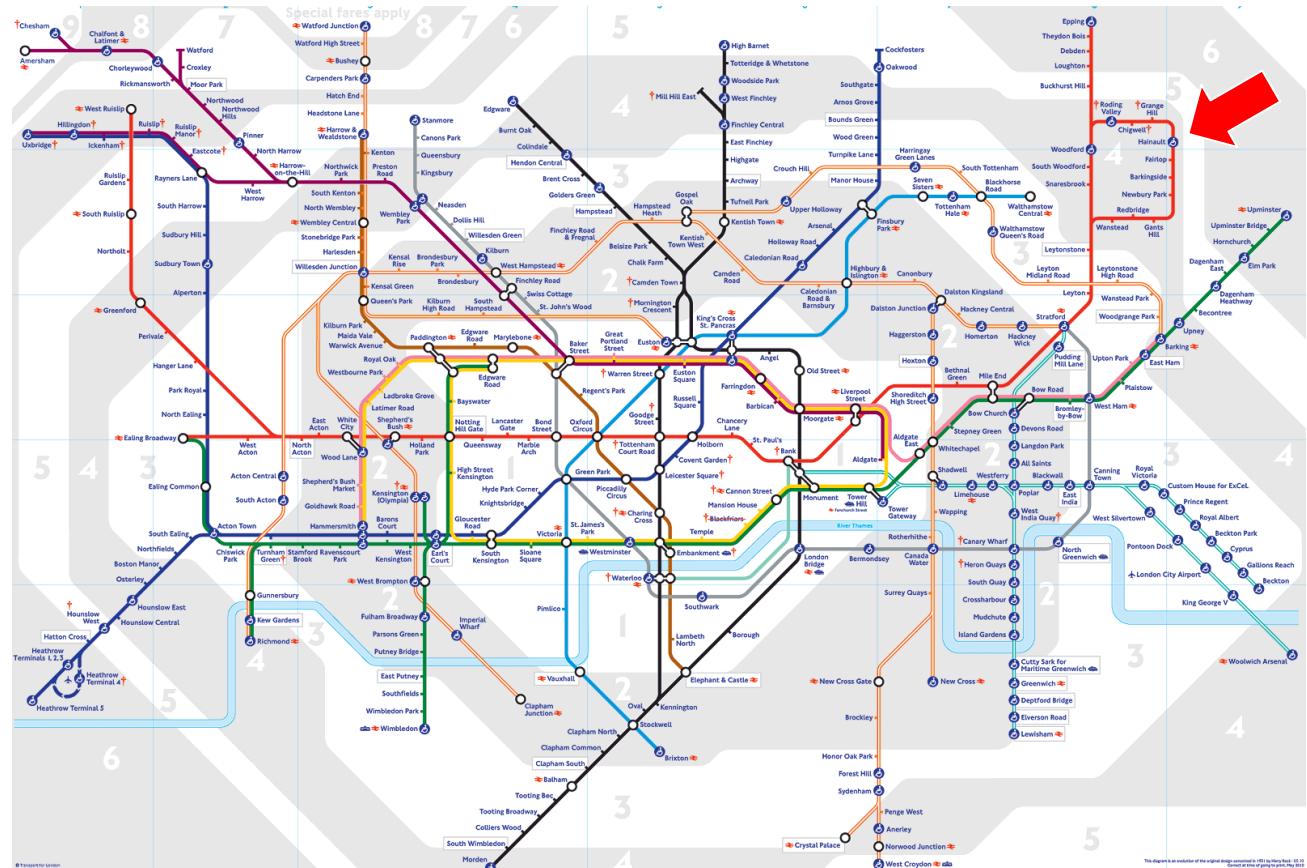
# Schematic Diagrams

- Diagram
  - Graphic design that **explains** rather than represents\*
- Schematic Diagram
  - Elements are abstracted and simplified
  - Realistic elements not necessarily included
  - Unrealistic elements sometimes introduced
- Examples
  - Circuit diagrams, transit maps

\* <http://www.merriam-webster.com/dictionary/diagram>

# Transit Map

- Try to preserve direction and order of stops
  - Distance less important, stops usually equally spaced for readability
- Simply as much as possible actual routes
  - Do not trace actual route taken by subway
- Use straight lines, and 45° angles
- Use color to indicate different transit lines

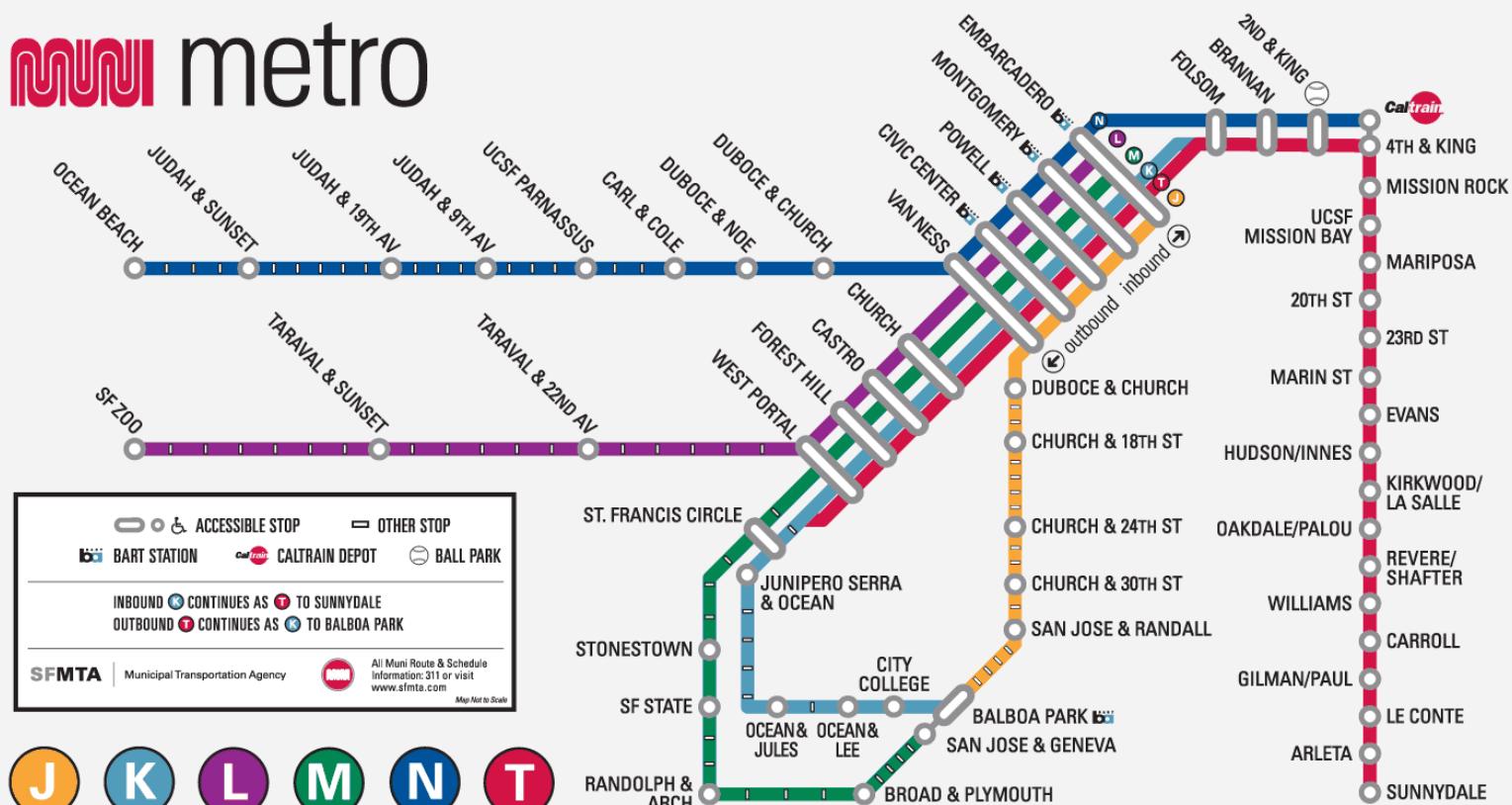


[http://www.bbc.co.uk/london/travel/downloads/tube\\_map.html](http://www.bbc.co.uk/london/travel/downloads/tube_map.html)





# MUNI metro

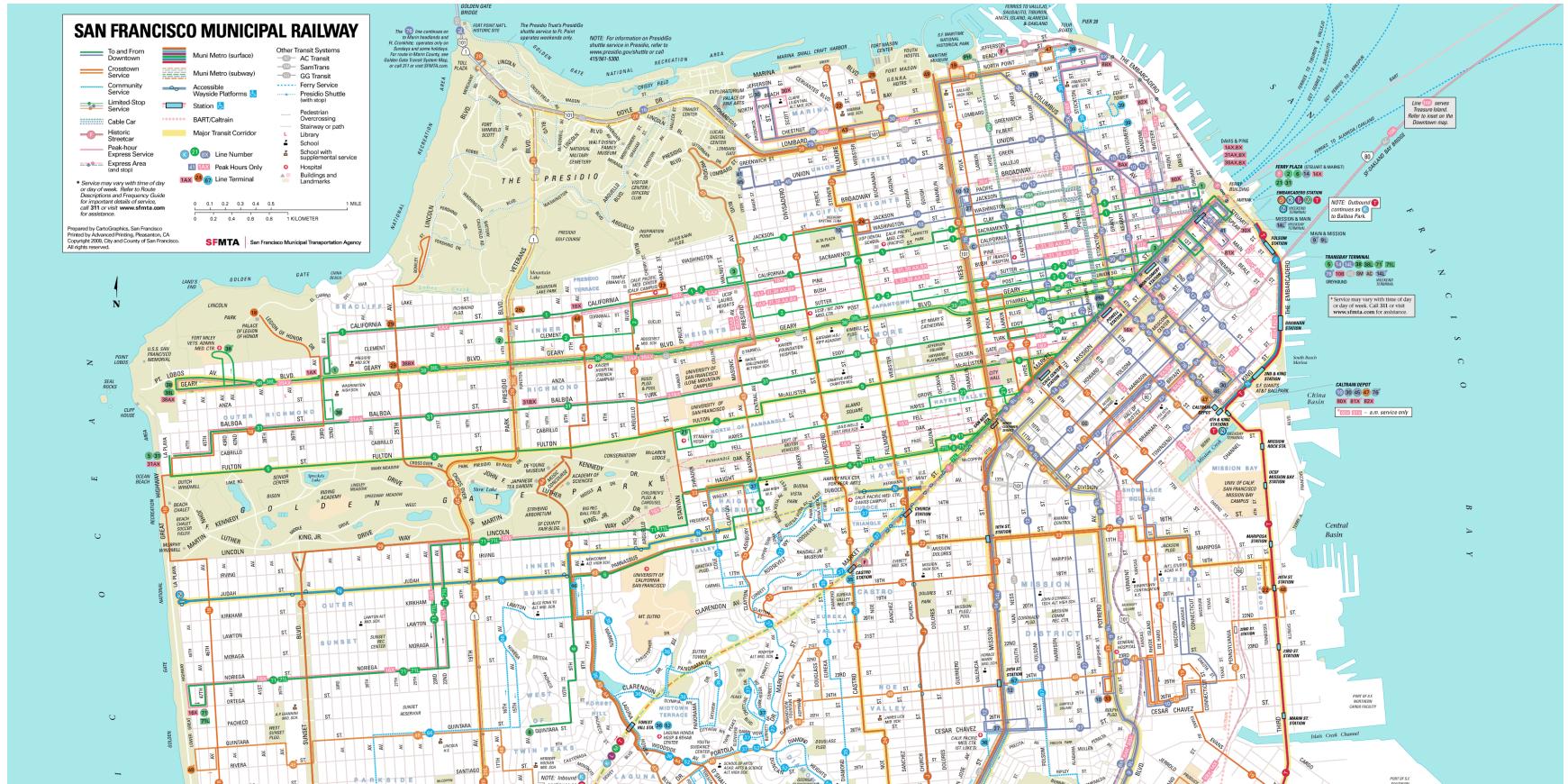


<http://www.sfmta.com/cms/mmaps/official.htm>



<http://www.bart.gov/schedules/bystation.aspx>





<http://www.sfmta.com/cms/mmaps/official.htm>



# FLOW MAPS

# Flow Maps

- Encoding
  - Edge between two locations indicates flow between those locations
  - Width of edge proportional to flow
  - Usually wider end of edge is source of flow
- Limitations
  - Can get difficult to compare flows
  - Best flow maps are done by hand

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

Dessiné par M. Minard, Inspecteur Général des Ponts et Chaussées en retraite à Paris, le 20 Novembre 1869.

Les nombres d'hommes présents sont représentés par les largeurs des zones colorées à raison d'un millimètre pour dix mille hommes; ils sont de plus écrits en travers des zones. Le rouge désigne les hommes qui entrent en Russie, le noir ceux qui en sortent. — Les renseignements qui ont servi à dresser la carte ont été puisés dans les ouvrages de M. M. Chiers, de Léger, de Fezensac, de Chambray et le journal médical de Jacob, pharmacien de l'Armée depuis le 28 Octobre.

Pour mieux faire juger à l'œil la diminution de l'armée, j'ai supposé que les corps du Prince Napoléon et du Maréchal Davout qui avaient été détachés sur Minsk et Malibow et se rejoignaient vers Orscha et Witebsk, avaient toujours marché avec l'armée.

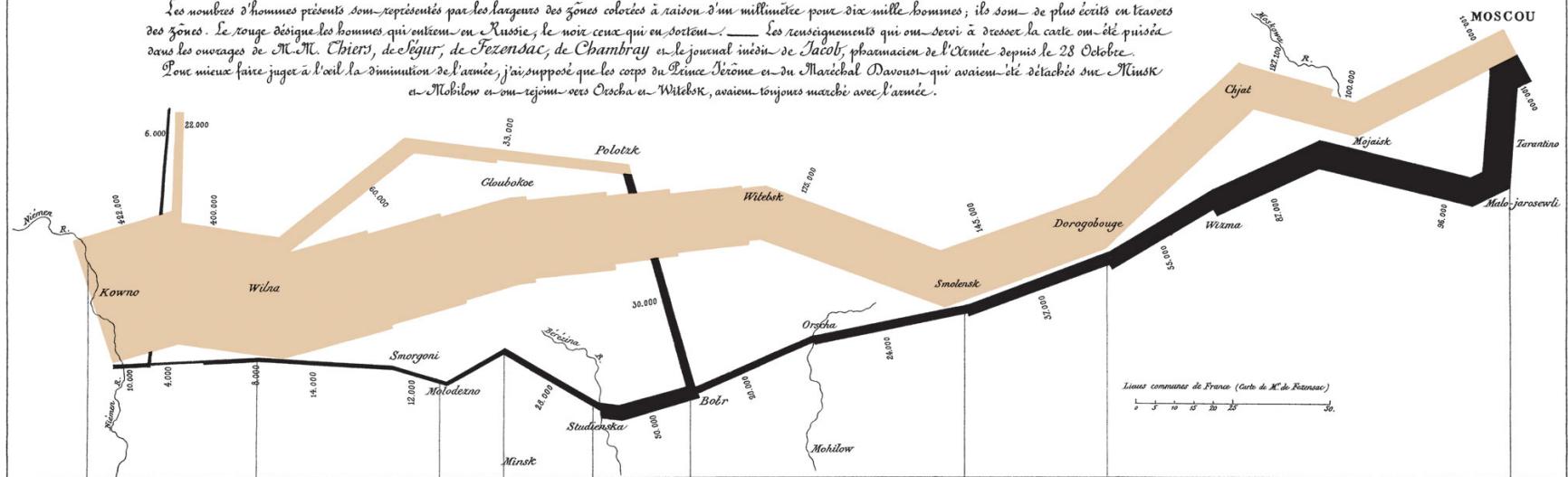
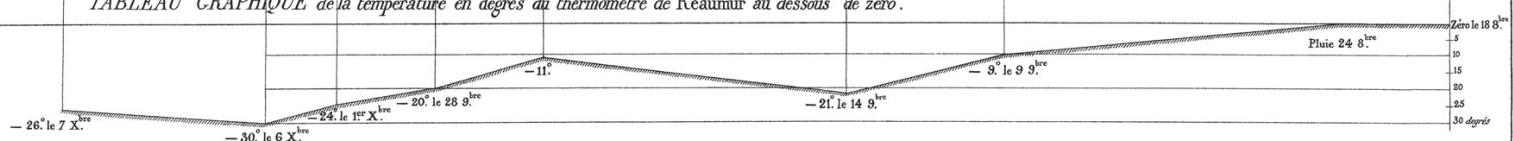


TABLEAU GRAPHIQUE de la température en degrés du thermomètre de Réaumur au dessous de zéro.

Les cosaques passent au galop  
le Niémen gelé.

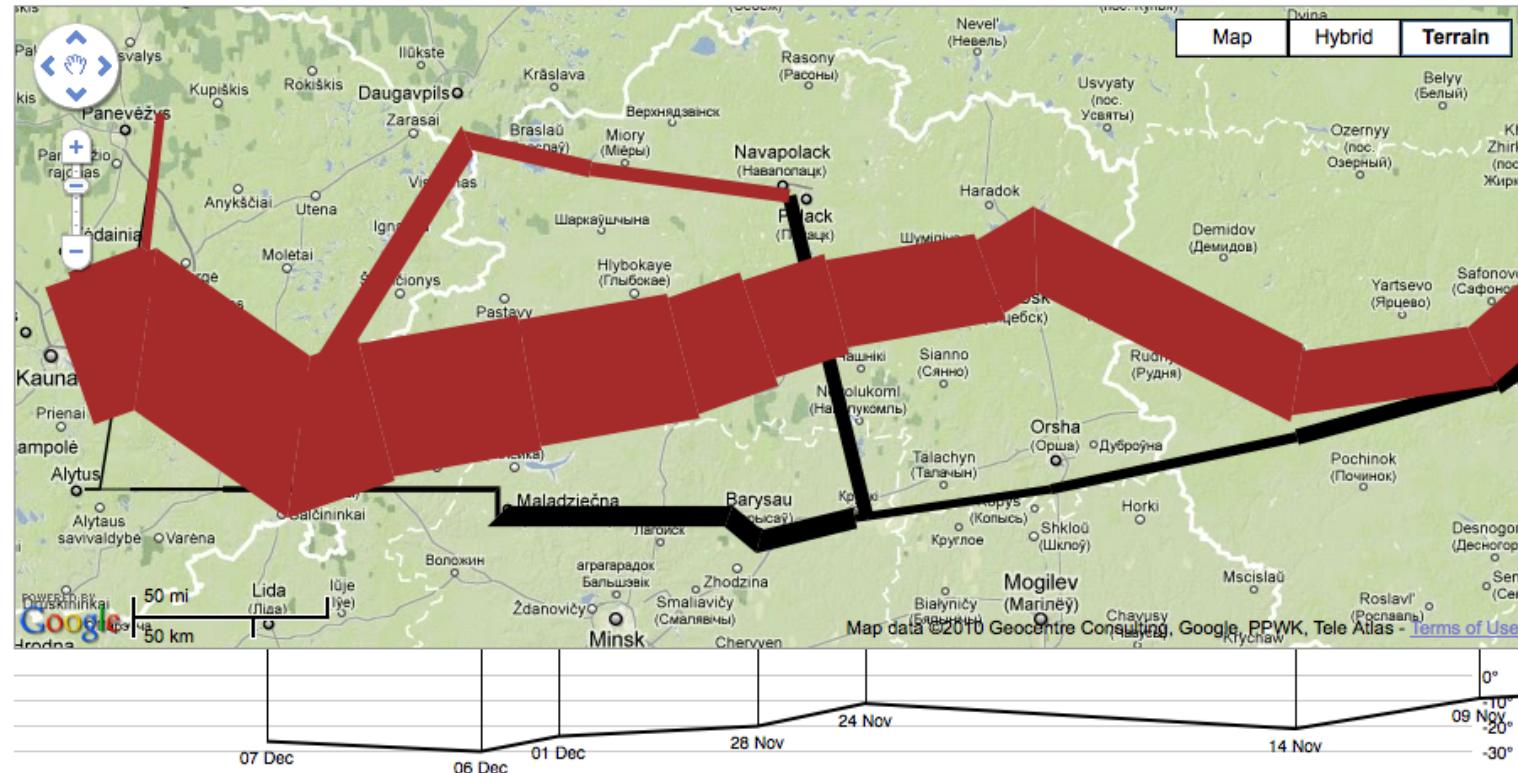


Autog. par Regnier, 8. Pas. S<sup>e</sup> Marie 3<sup>e</sup> G<sup>e</sup> à Paris.

Imp. Loh. Regnier et Duvordet.

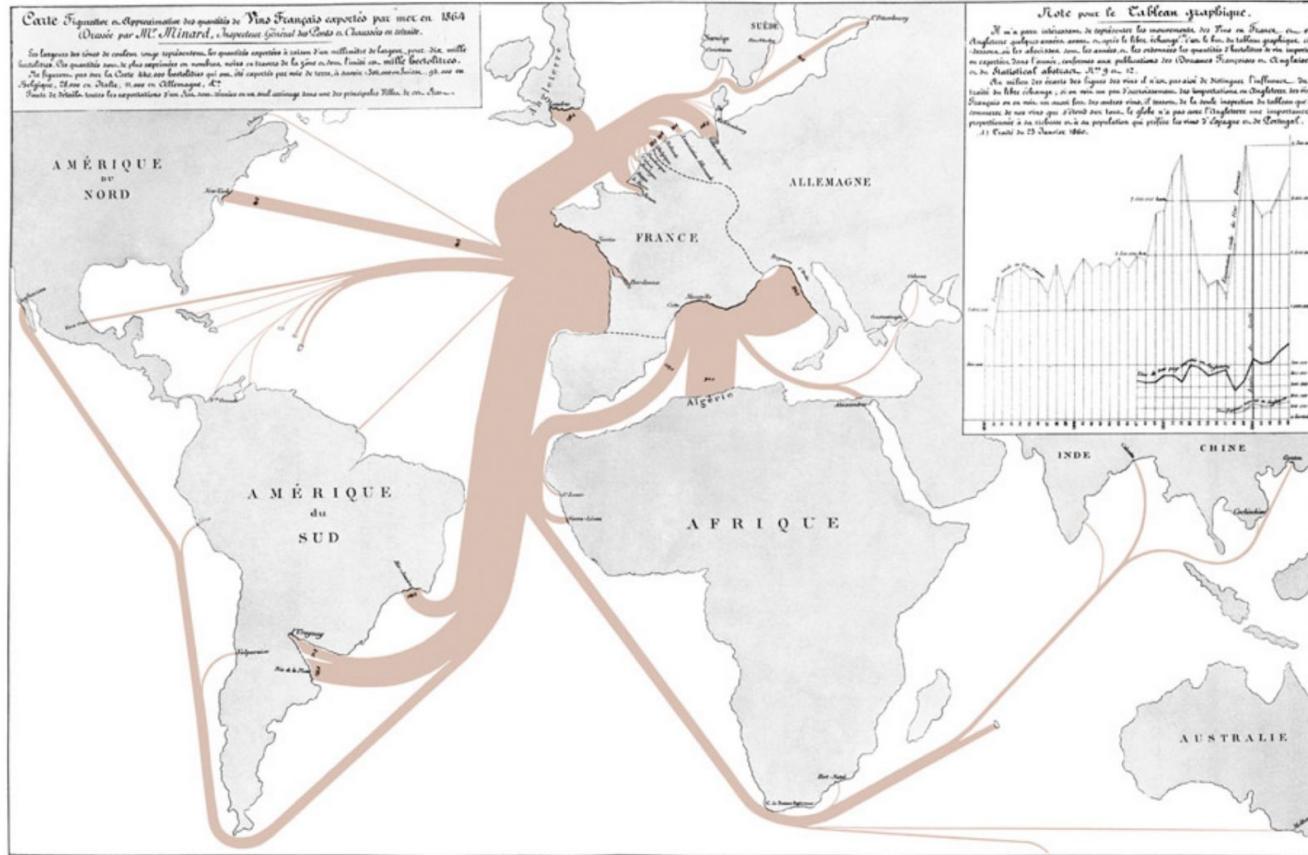
<http://en.wikipedia.org/wiki/File:Minard.png>

# Minard's Napoleon



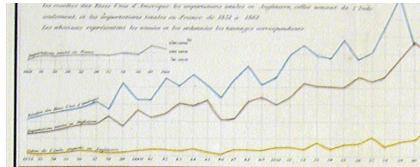
<http://vis.stanford.edu/protovis/ex/napoleon.html>





<http://lifeingreytones.blogspot.com/2009/04/literature-review-post-1.html>





La consommation d'Europe croissante pour des fibres de matières premières, nécessitait une disponibilité et un approvisionnement pour ces années aux îles Britanniques. Celle-ci fut alors la source principale et surtout assez prompte à se déverser par ces routes. Mais avec la guerre civile américaine, cet équilibre fut considérablement dérangé par l'abolition des esclaves. En effet l'Angleterre fut le seul à maintenir ses relations commerciales avec l'Amérique du Sud. Et donc plus que la moitié des sept millions prévus l'Angleterre proposait à ce moment-là une compétence dans ce qu'elle emploie naturellement.

Revenons à nos théories économiques alors que la France a importé en 1865 160 000 tonnes de coton dans les îles Britanniques. Mais il faut tenir compte que l'Angleterre contrebalance les importations de coton par des exportations de charbon et d'industries d'Europe contre leurs homologues à très peu de centaines d'années. C'est donc dans le sens de l'équilibre que l'Angleterre importe 160 000 tonnes dans les îles Britanniques et que la France a également importé 160 000 tonnes dans les îles Britanniques. Mais il faut tenir compte de ce que c'est à l'abordage ce qui est arrivé au cours des dernières années.

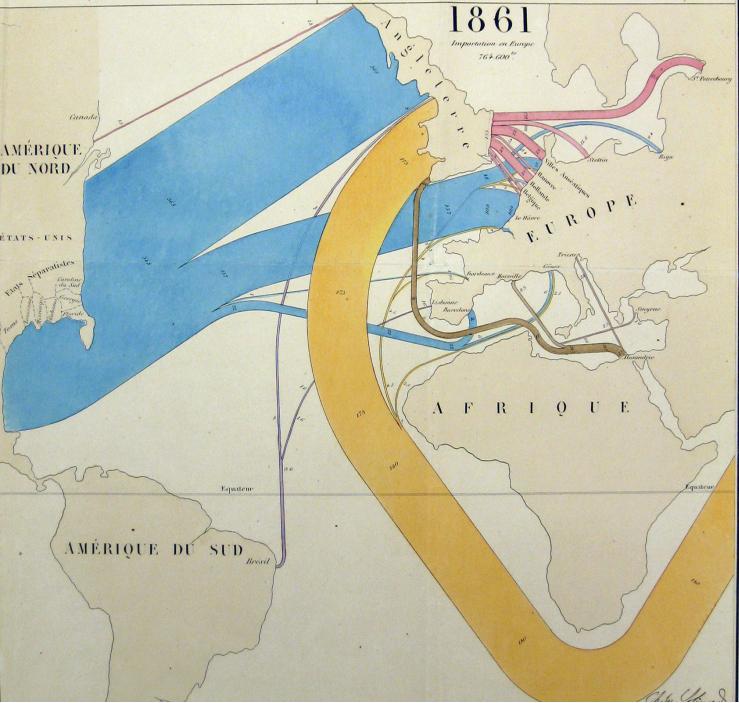
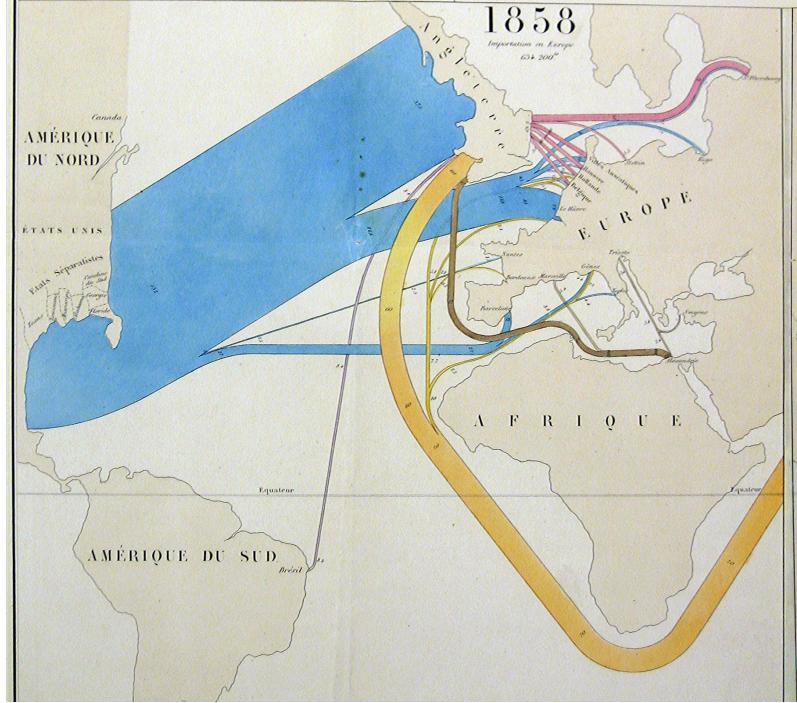
Il faut alors faire attention à ce que lorsque nous parlons d'importations d'Europe contre leurs homologues nous devons nous reporter à ce que c'est à l'abordage ce qui est arrivé au cours des dernières années.

Les importations en Inde, en France qui ferment les portes commerciales de l'Europe

sur l'importation à Europe. Les deux, fait intéressant que l'Angleterre qui redemande une division de votes pour l'Inde et réclame dans cette année "Mawat", cette dernière devra faire plus qu'en 1858 ce qu'elle a rendu à l'Europe périodique. Mais ce qui était nécessaire à son équilibre, c'est de faire que l'Angleterre puisse faire des dons entre les deux îles Britanniques. Mais il faut également faire des dons de bonsnes franchises. Mais il faut également faire des dons de bonsnes franchises. Mais il faut également faire des dons de bonsnes franchises. Mais il faut également faire des dons de bonsnes franchises. Mais il faut également faire des dons de bonsnes franchises. Mais il faut également faire des dons de bonsnes franchises. Mais il faut également faire des dons de bonsnes franchises.

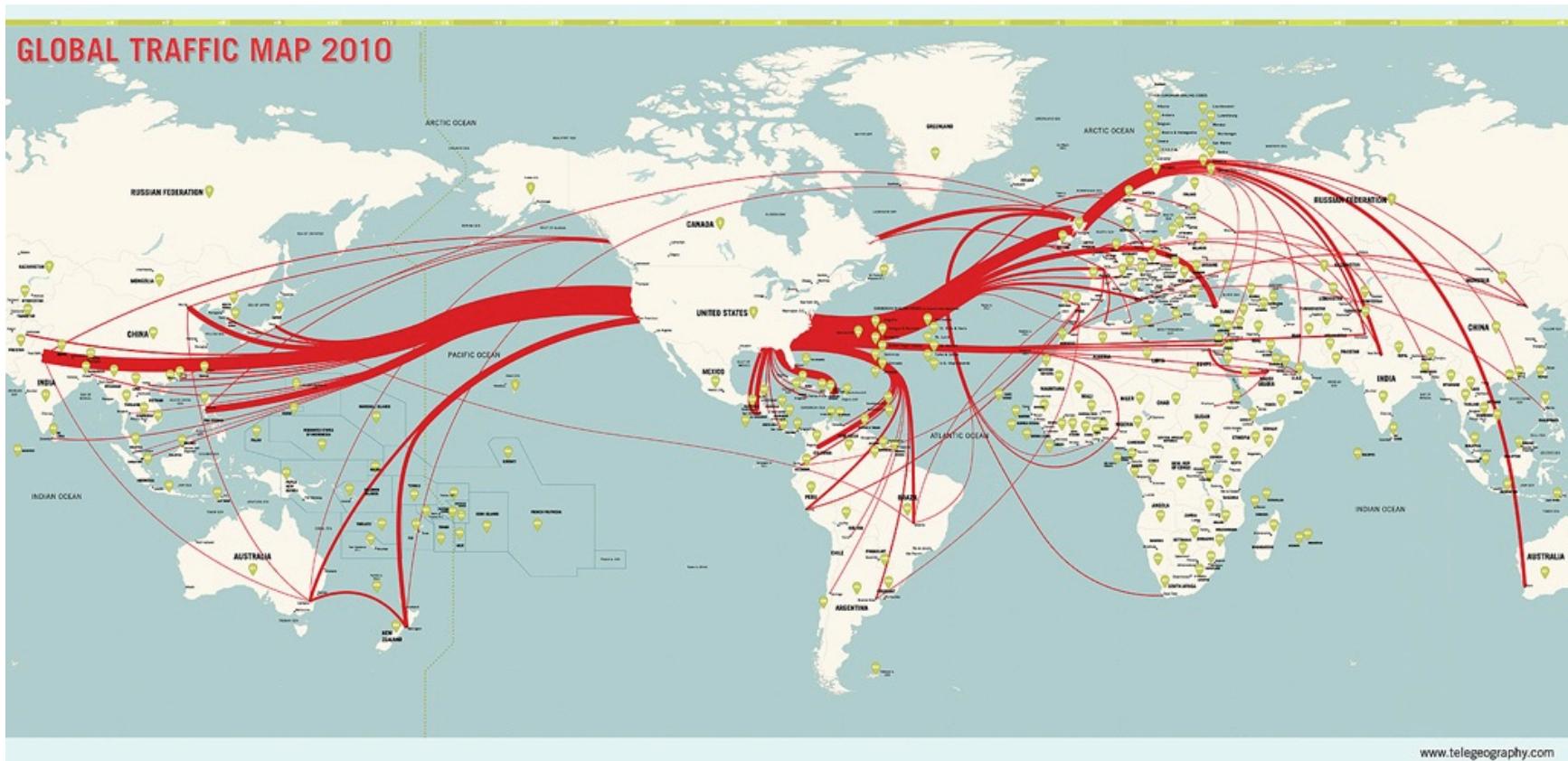
#### Note explicative

Les cartes de voies marines sont représentées par la largeur des voies marines et certaines d'entre elles sont également colorées pour faciliter leur lecture. Les distances sont exprimées par les nombres écrits en termes de milles et de lieues et non de tonnes.

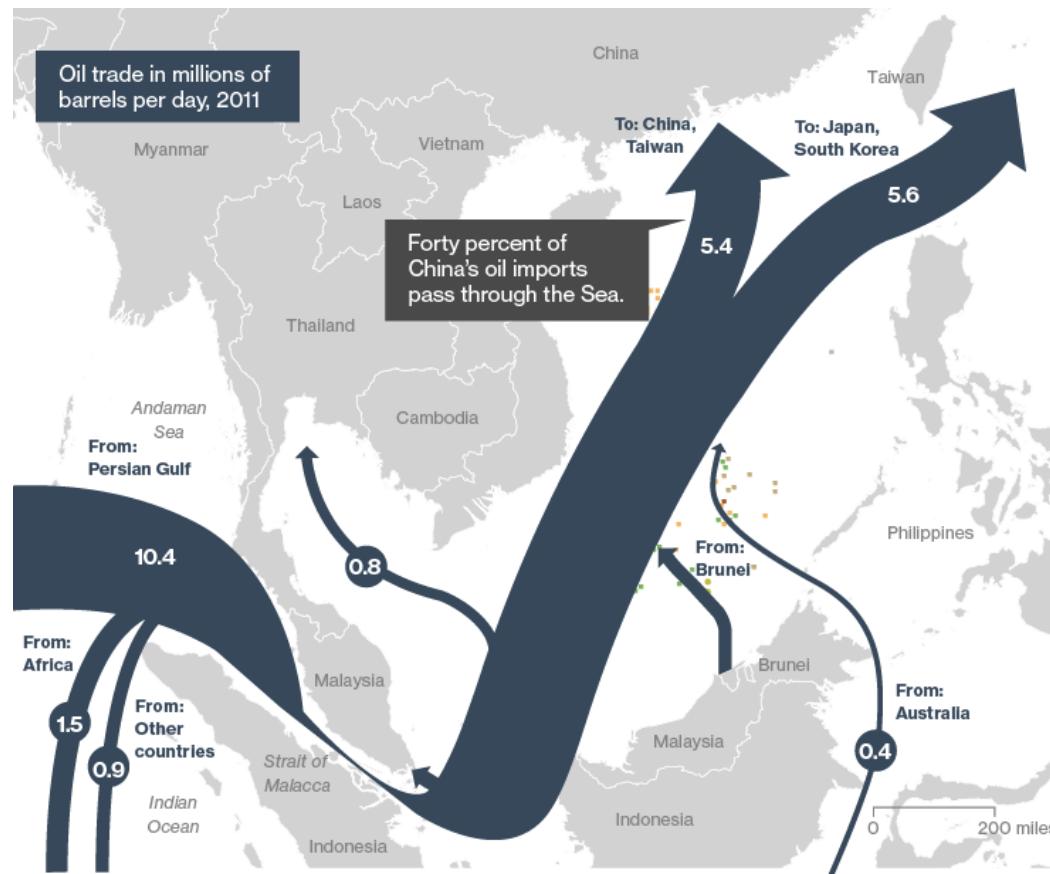


<http://cartographia.wordpress.com/2008/06/30/mondays-with-minard-cotton-and-wool-comparisons/>

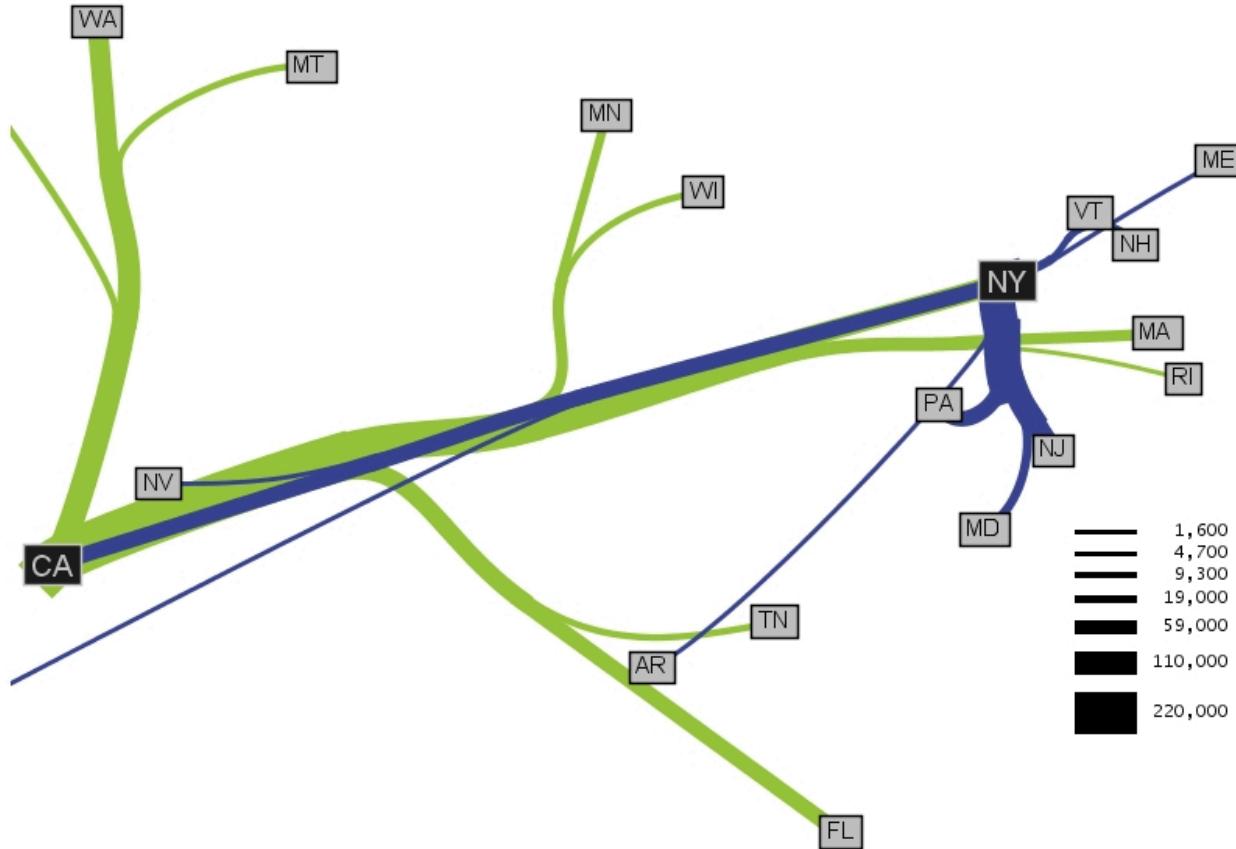




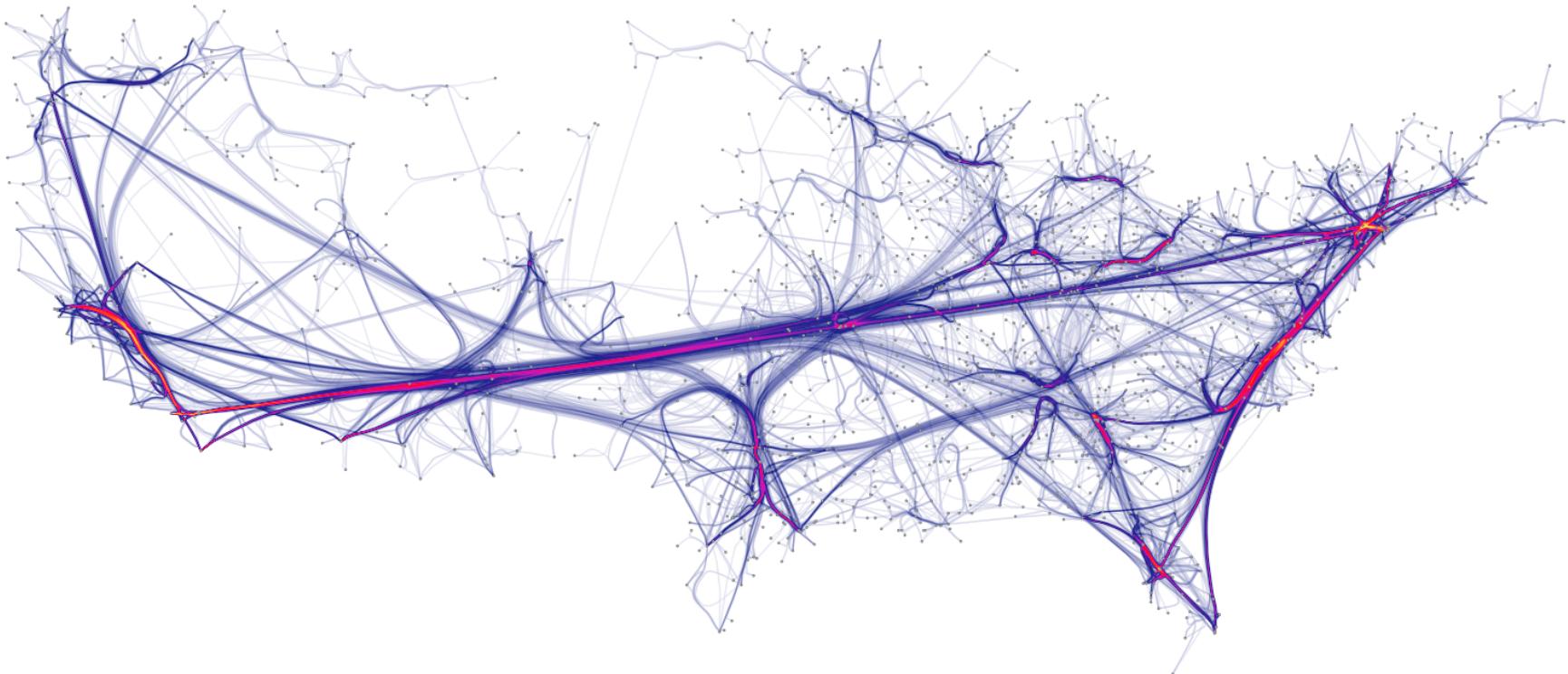
[http://www.telegeography.com/product-info/map\\_traffic/index.php](http://www.telegeography.com/product-info/map_traffic/index.php)



<http://www.bloomberg.com/news/articles/2015-11-12/china-argues-light-makes-right-with-new-south-china-sea-beacons>



[http://graphics.stanford.edu/papers/flow\\_map\\_layout/](http://graphics.stanford.edu/papers/flow_map_layout/)

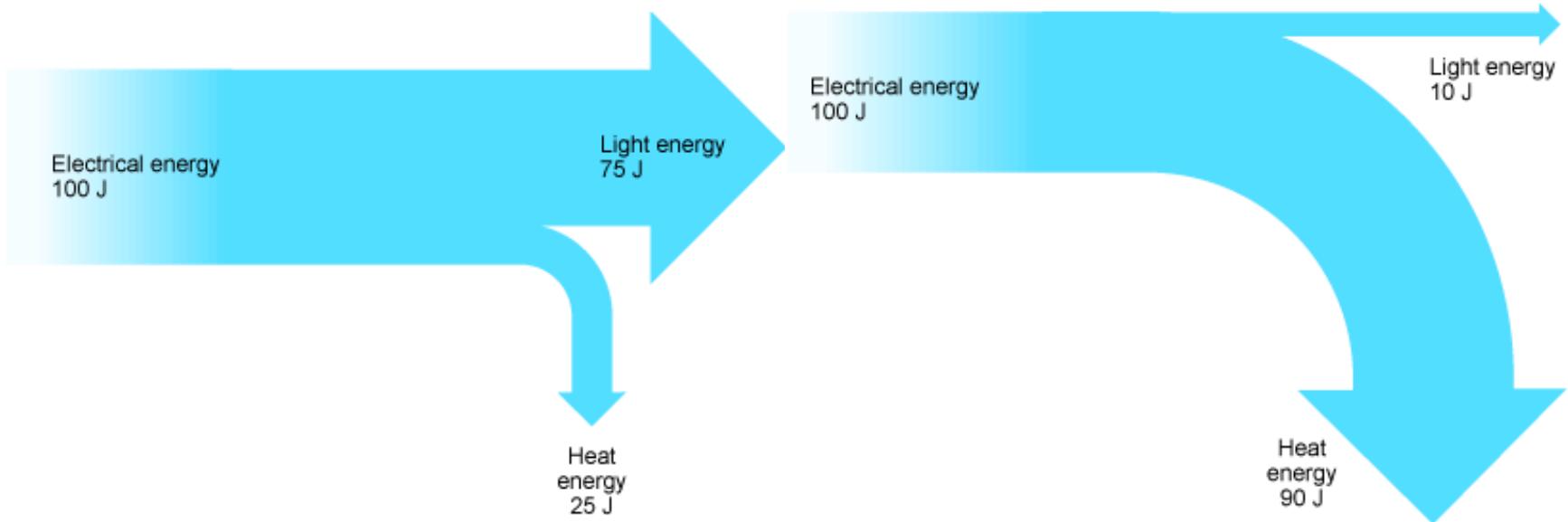


<http://www.win.tue.nl/~dholten/>

# SANKEY DIAGRAMS

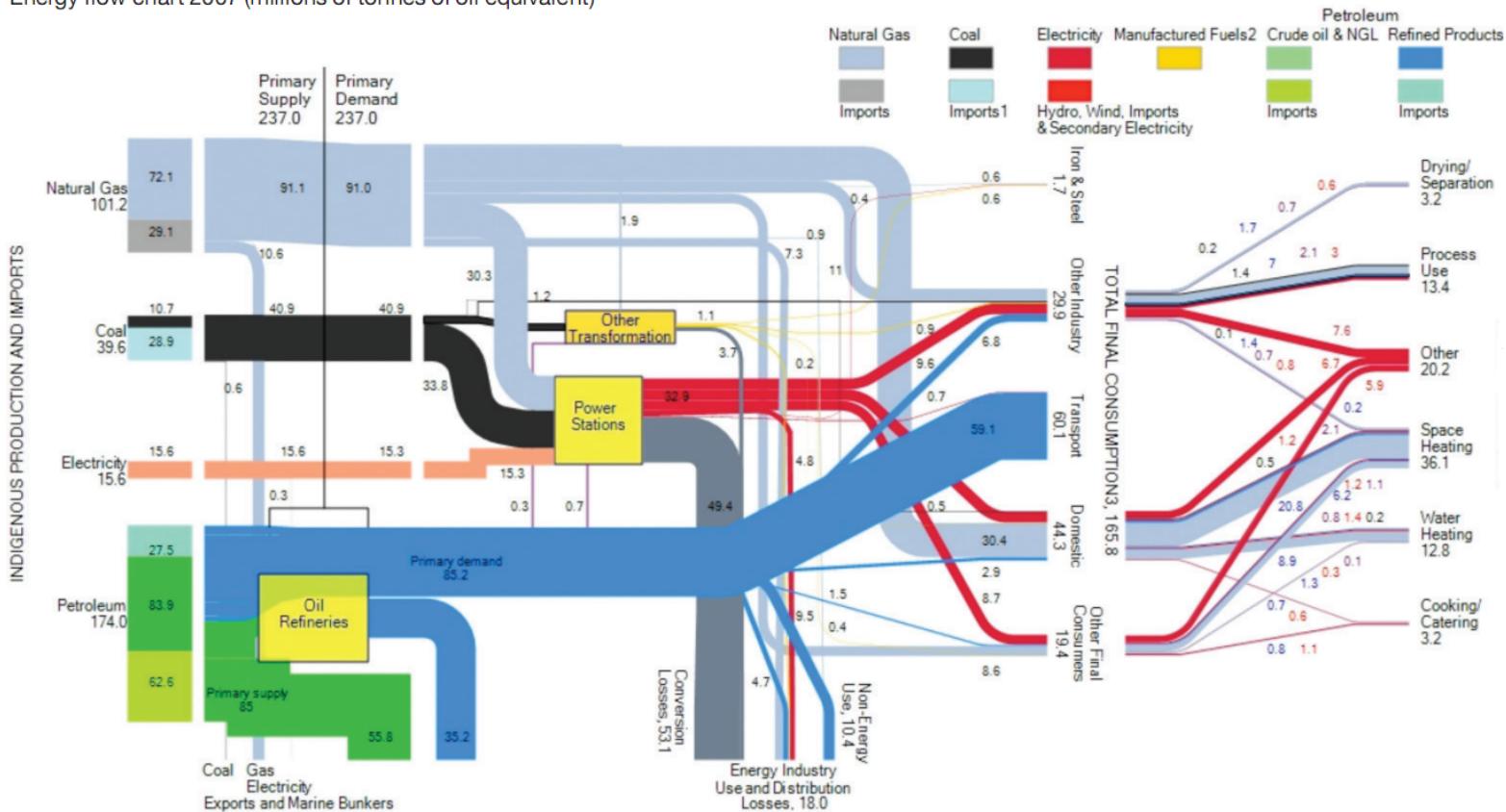
# Sankey Diagrams

- A type of flow map, applied to non-geospatial data
- Width of line indicates amount of flow
- Arrows (optional) indicate direction of flow
- Must apply a simple node layout
  - Usually nodes on left or right
  - Flow travels from left nodes to right nodes
  - No flow between nodes on same side

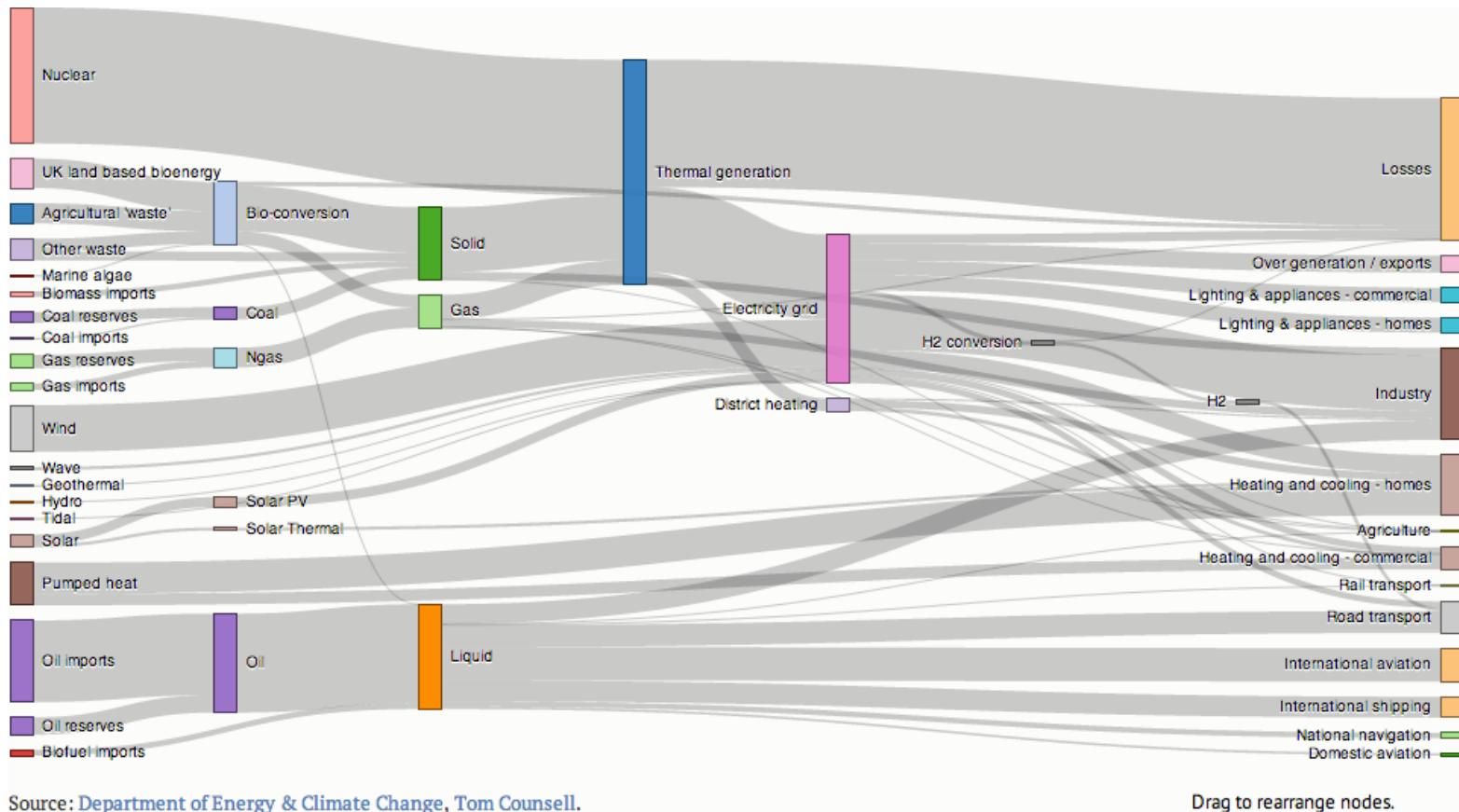


[http://www.bbc.co.uk/schools/gcsebitesize/science/aqa\\_pre\\_2011/energy/heatrev6.shtml](http://www.bbc.co.uk/schools/gcsebitesize/science/aqa_pre_2011/energy/heatrev6.shtml)

Energy flow chart 2007 (millions of tonnes of oil equivalent)



<http://www.sankey-diagrams.com/uk-2050-energy-flow-sankey-diagram/>



Source: Department of Energy & Climate Change, Tom Counsell.

Drag to rearrange nodes.

<http://bost.ocks.org/mike/sankey/>

# RESOURCES

# D3 Examples

- Proportional Symbol Map (no legend): <http://bl.ocks.org/mbostock/4342045>
- County Bubbles (with circle legend): <http://bl.ocks.org/mbostock/9943478>
- Unemployment Choropleth (no legend): <http://bl.ocks.org/mbostock/5925375>
- Kentucky Choropleth (with color legend): <http://bl.ocks.org/mbostock/5144735>
- Non-Contiguous Cartogram: <http://bl.ocks.org/mbostock/4055908>
- Hexbin Map: <http://bl.ocks.org/mbostock/4330486>
- Heatmap: <http://bl.ocks.org/mbostock/6264239>

# D3 Examples (Other)

- Zoom to Bounding Box II

<http://bl.ocks.org/mbostock/9656675>

- TopoJSON Files

<http://bl.ocks.org/mbostock/4090846>

- U.S. States TopoJSON Demo

<http://bl.ocks.org/mbostock/4090848>



---

CHANGE THE WORLD FROM HERE