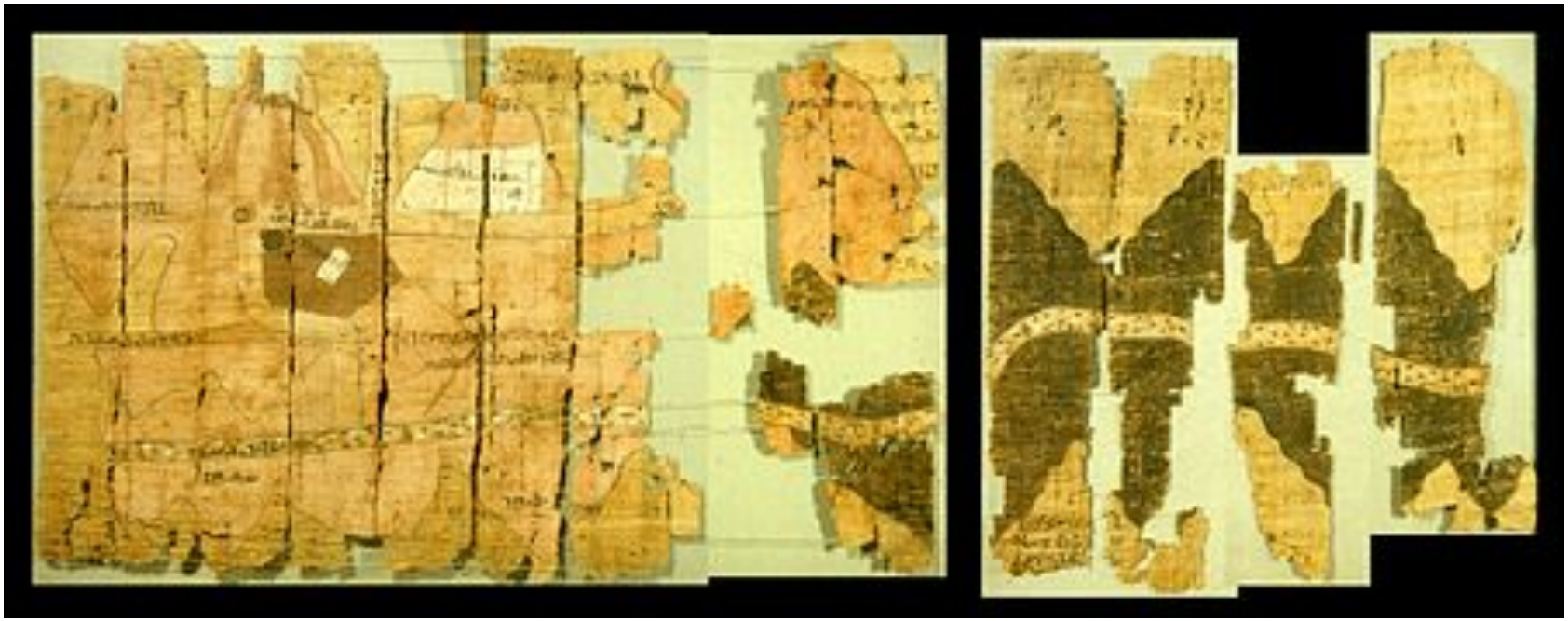
Maps

Data Visualization | Steven Bedrick & Jackie Wirz

Image from xkcd.com http://xkcd.com/503/

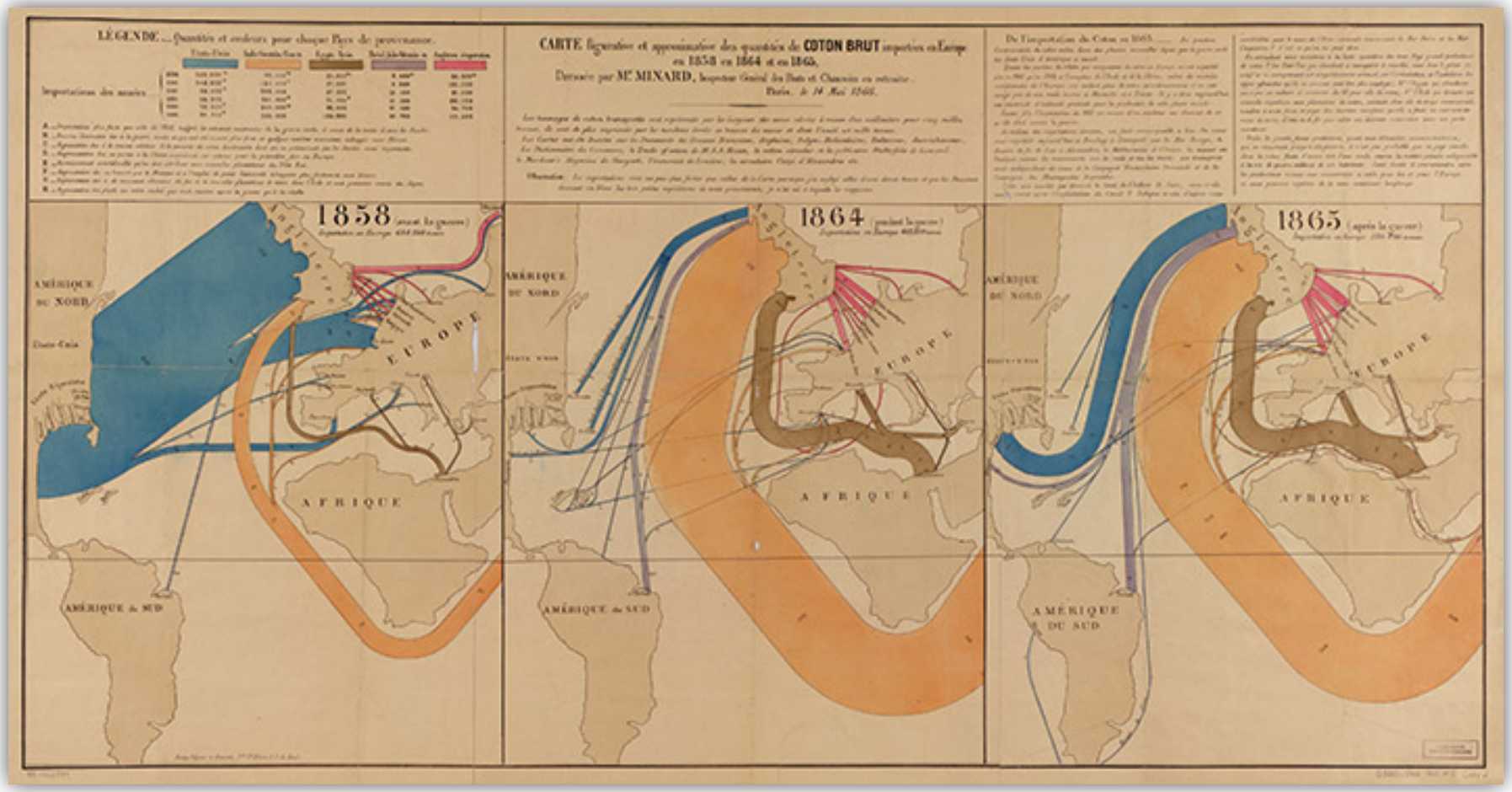


Turin Papyrus Map (~1160 BC): http://en.wikipedia.org/wiki/Turin_Papyrus_Map

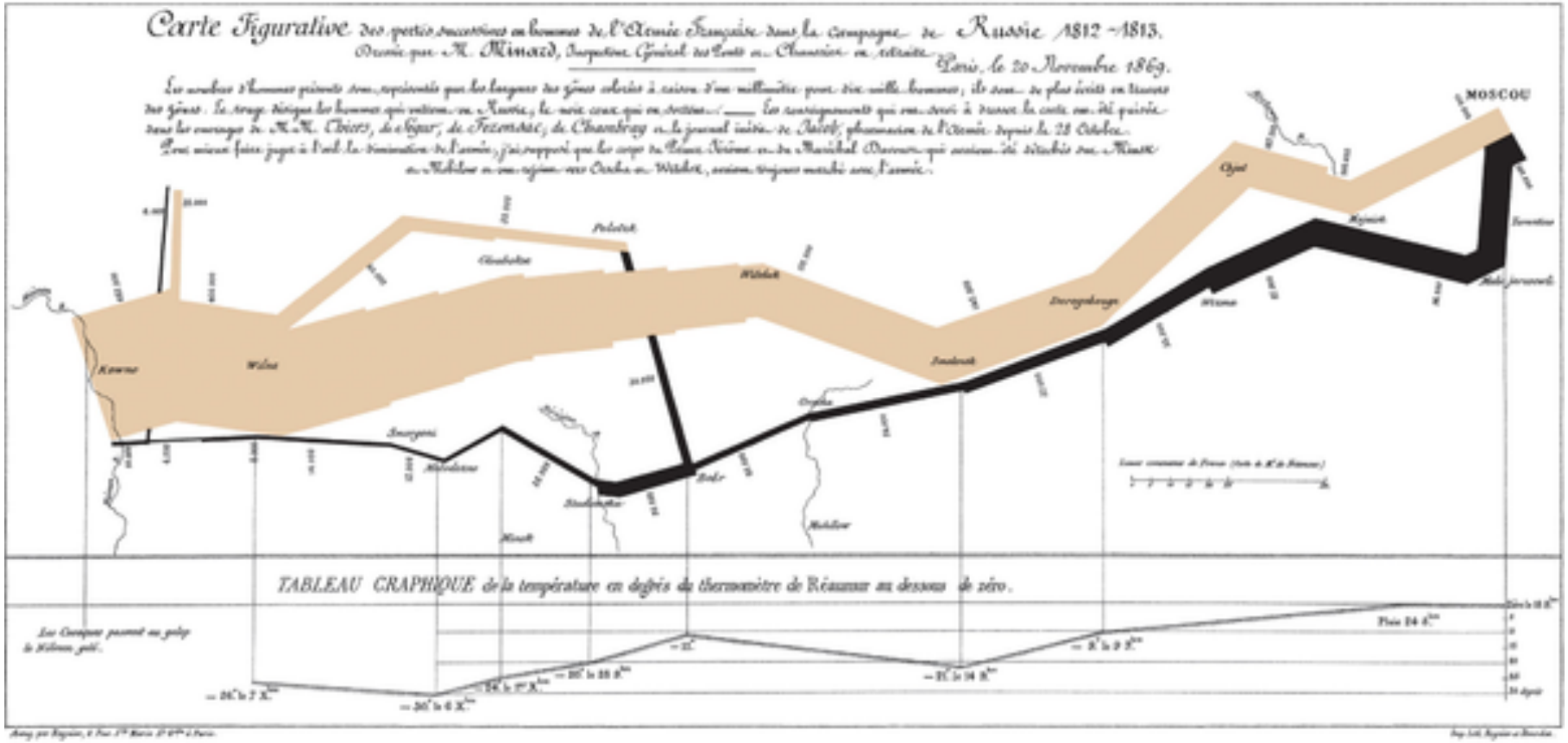
Babylonian World Map (original ~500 BC) -
http://en.wikipedia.org/wiki/Babylonian_Map_of_the_World

Ptolemy *Geography* (original ~150 AD) - The British Library Harley MS 7182, ff 58v-59.

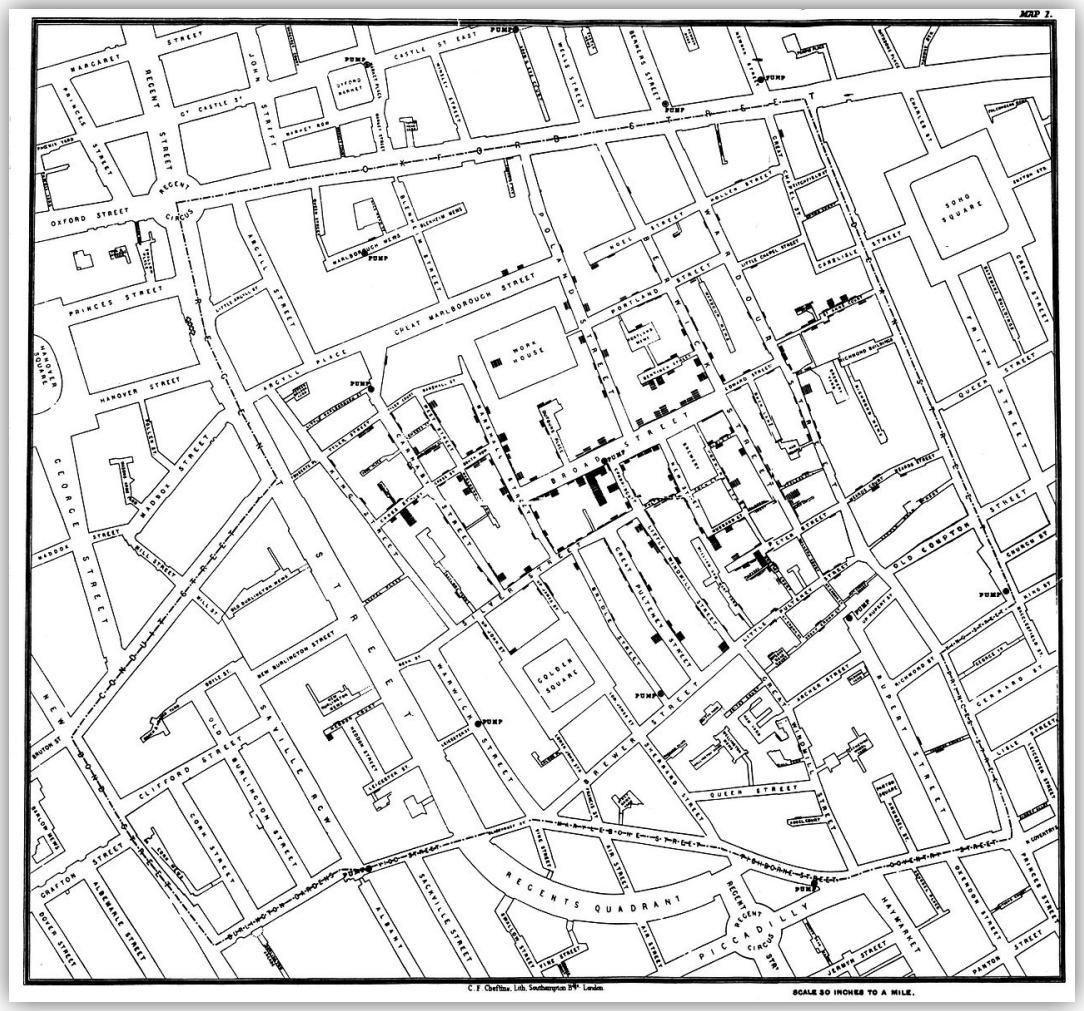
Herman Moll *A New Map of the Whole World* (1736). Image from Wikipedia.



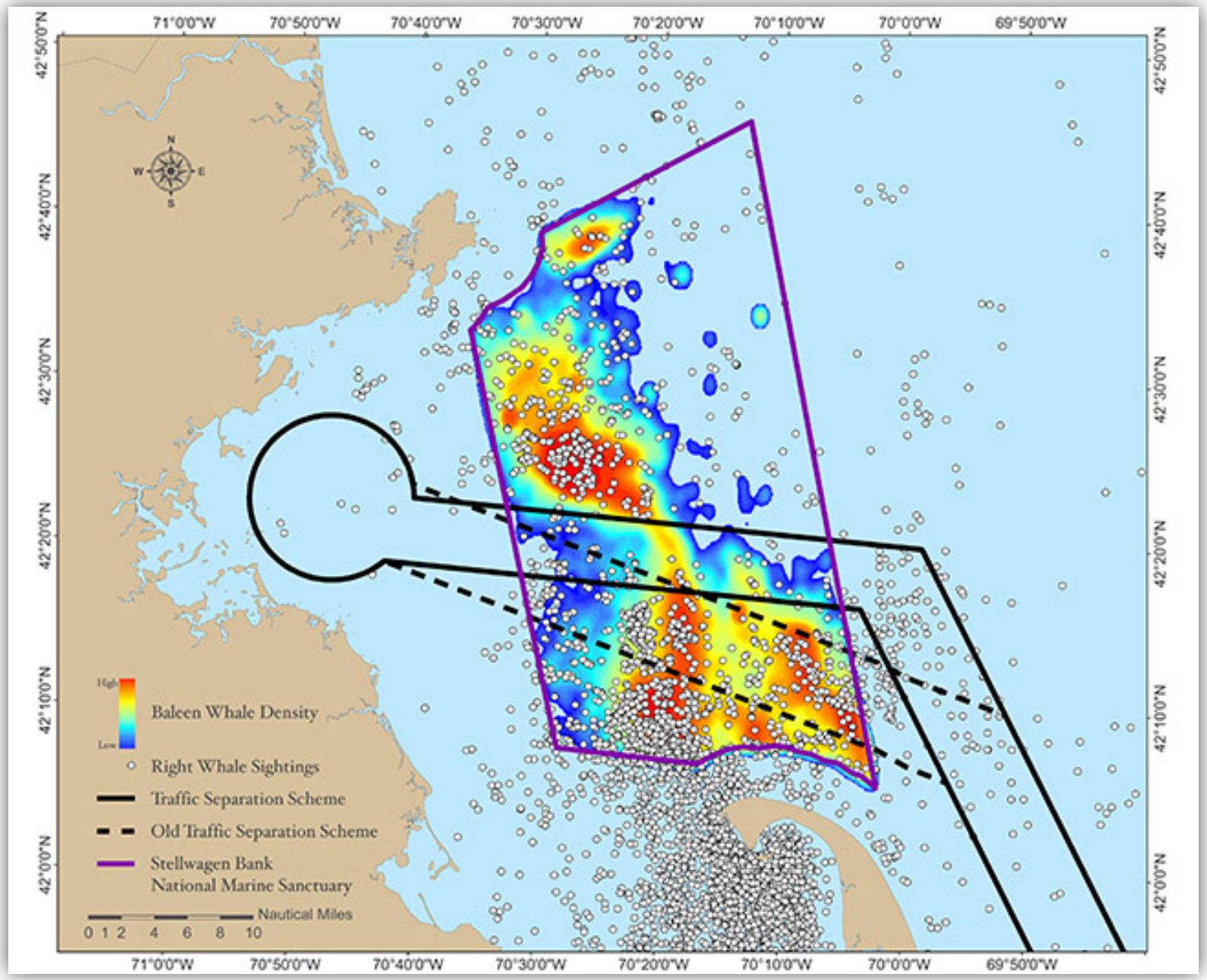
Charles Joseph Minard *Europe Raw Cotton Imports* (1866); Image from Scimaps.org



Charles Joseph Minard *map of Napoleon's disastrous Russian campaign of 1812* (1869)



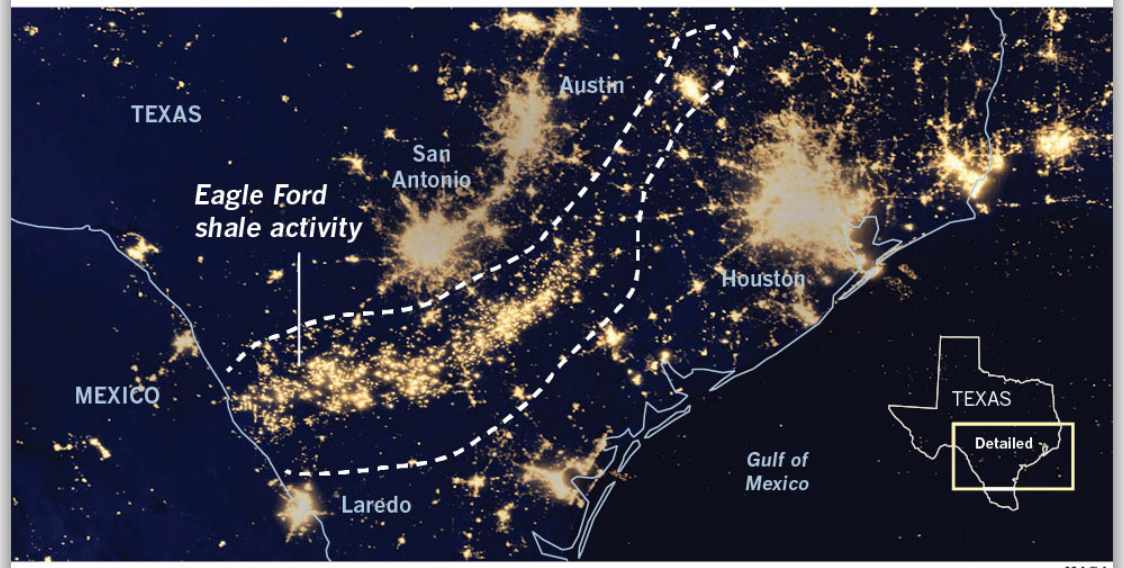
Cholera Cases in London, 1854, drawn by Charles Cheffins.
http://en.wikipedia.org/wiki/John_Snow_%28physician%29



Wiley, Thompson and Merrick: *Realigning the Boston Traffic Separation Scheme* (2006): http://scimaps.org/V.3

Texas oil boom is visible from space

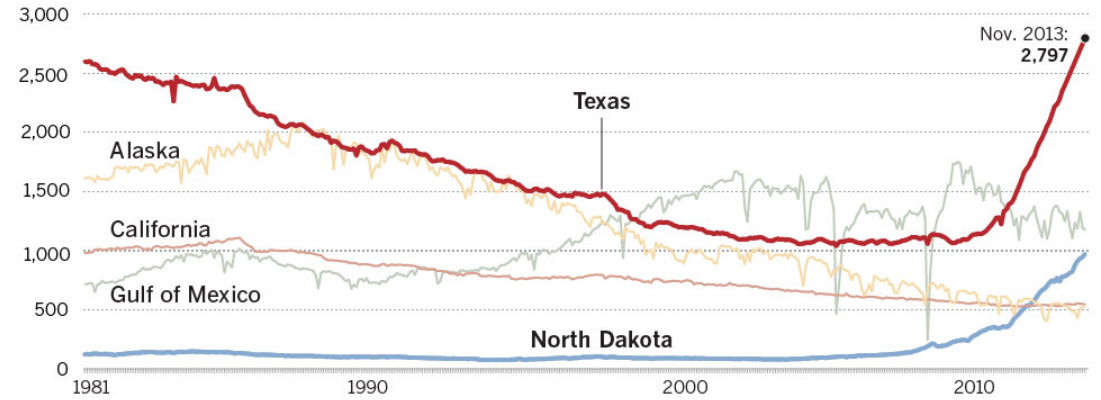
Lighting and natural gas flares from drilling on the 400-mile-long Eagle Ford shale formation can be seen from space in this image.



NASA

The new formation has helped make Texas the No. 1 oil-producing state in the nation.

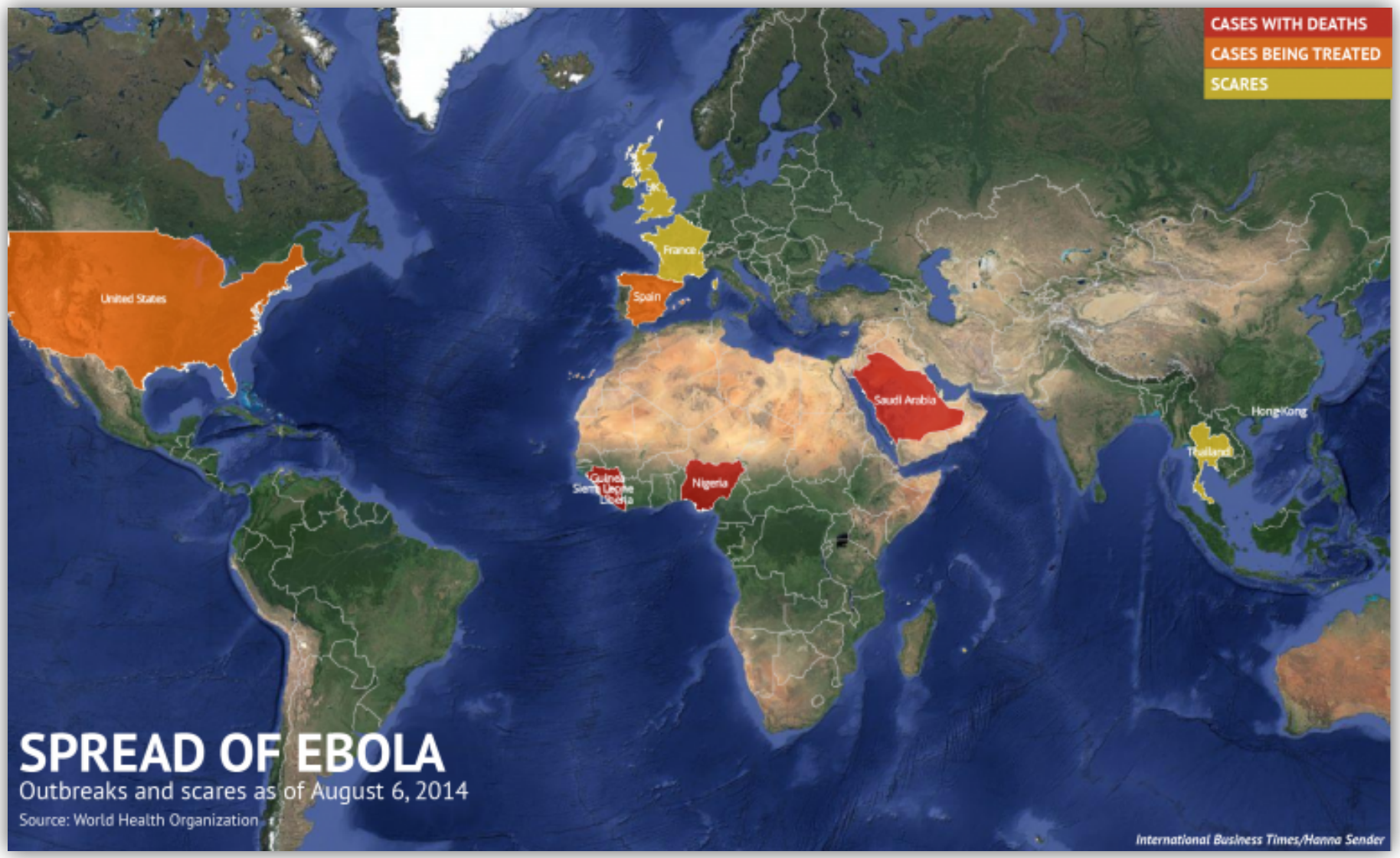
Oil production from different U.S. regions (in thousands of barrels per day)



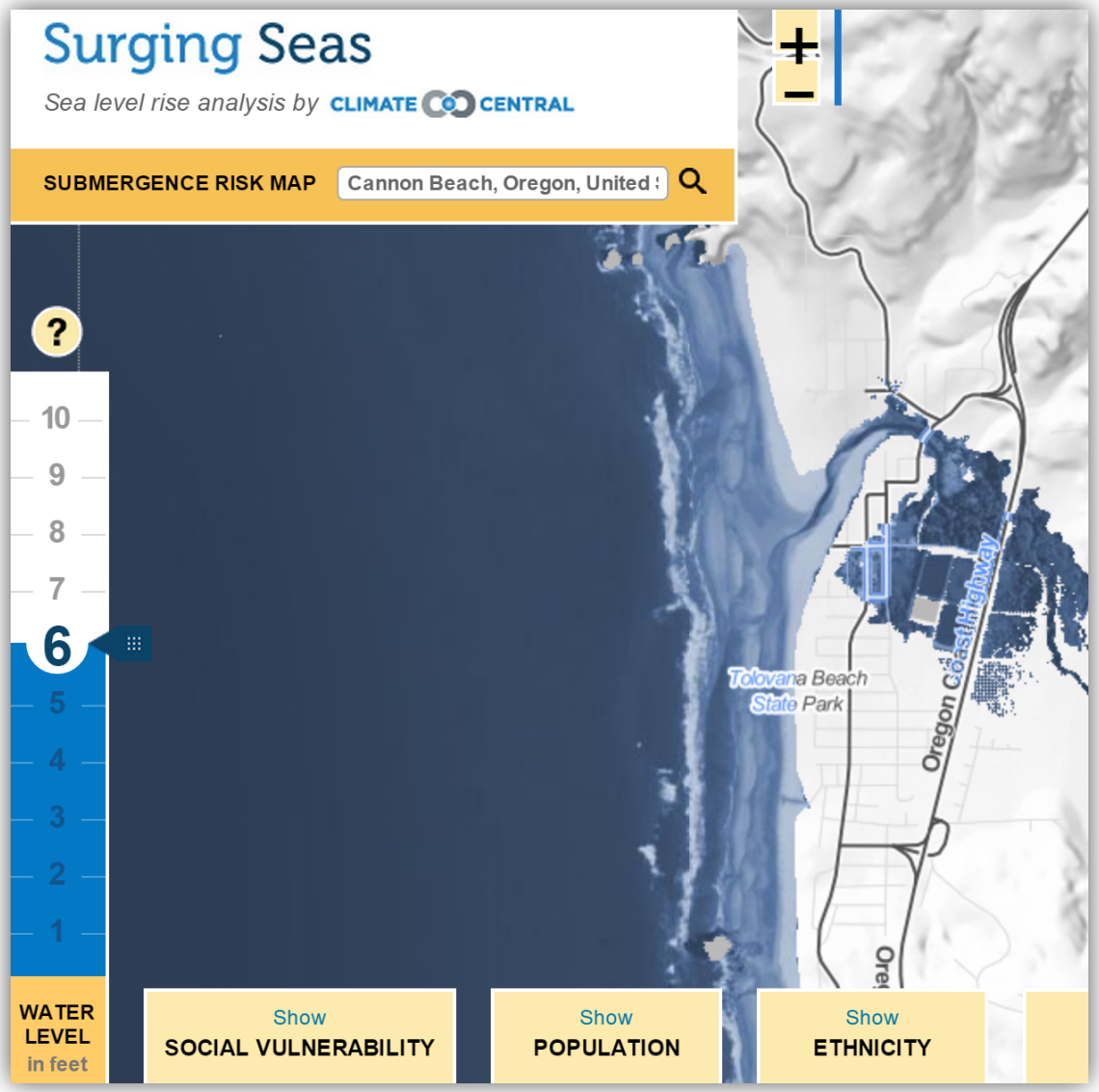
Source: Energy Information Administration

MATT MOODY Los Angeles Times

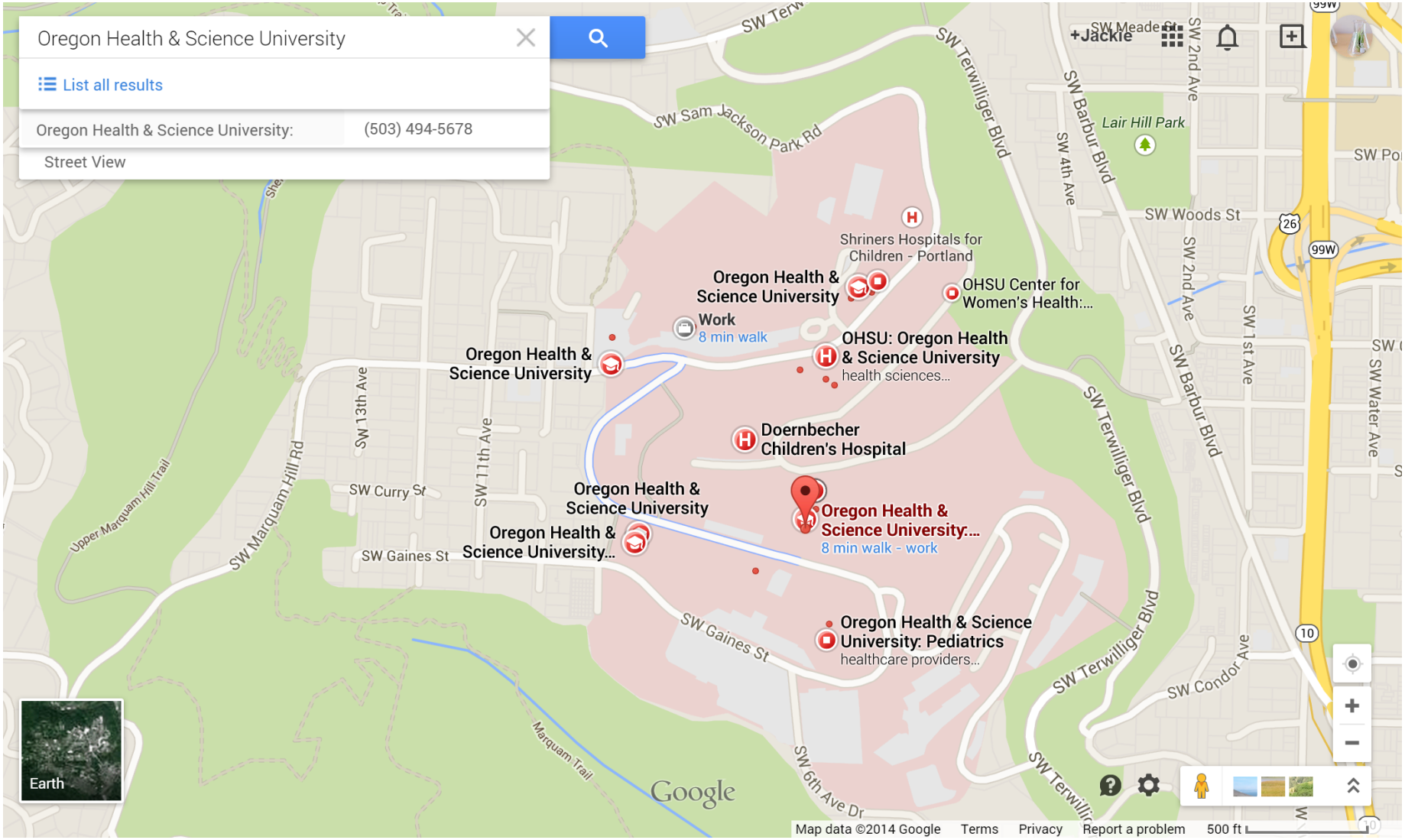
LA Times, 2014: http://latdevelopers.com/graphics/bag/texas-oil-boom/texas-oil-boom.jpg



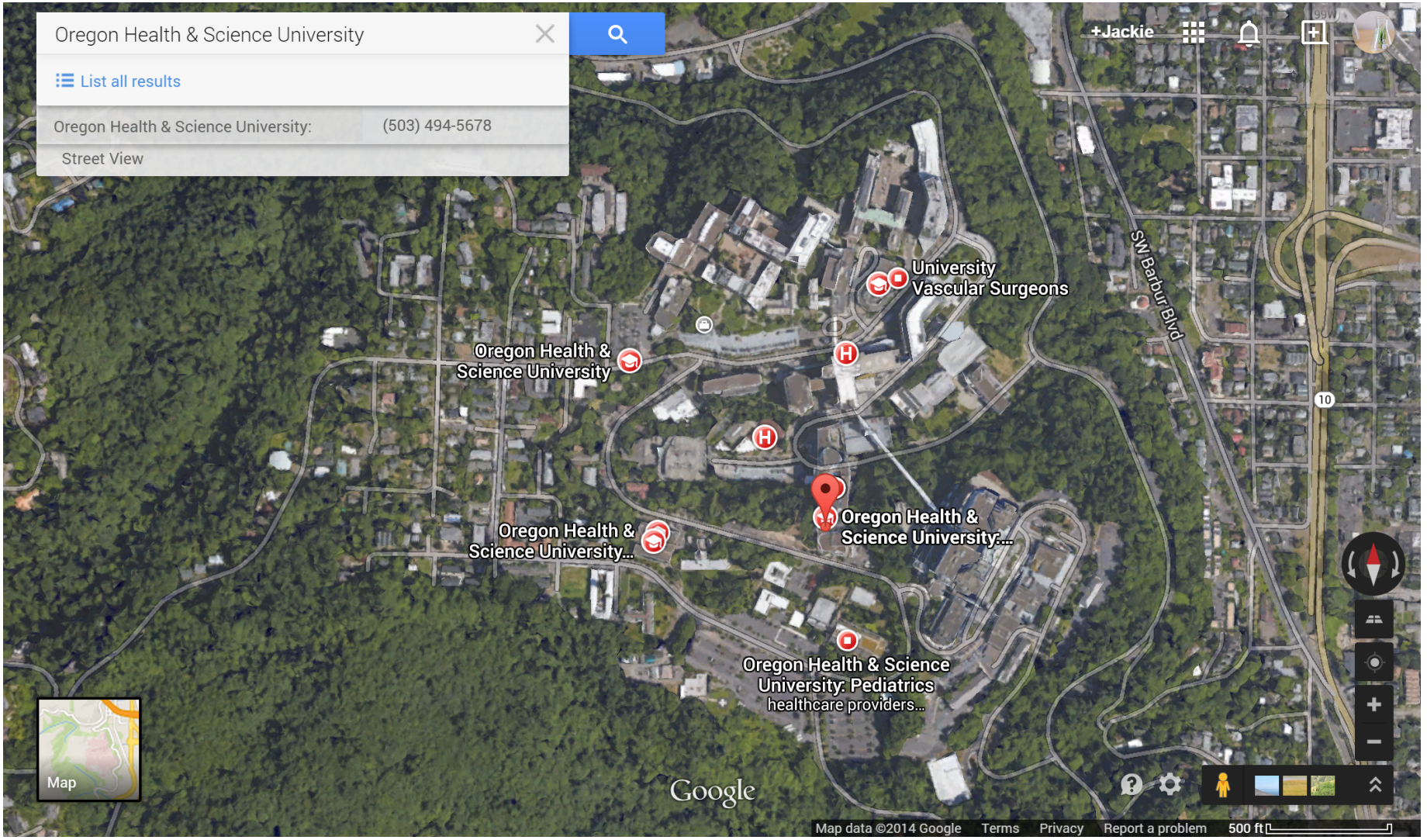
International Business Times/Hanna Sender *The Spread of Ebola* (2014)



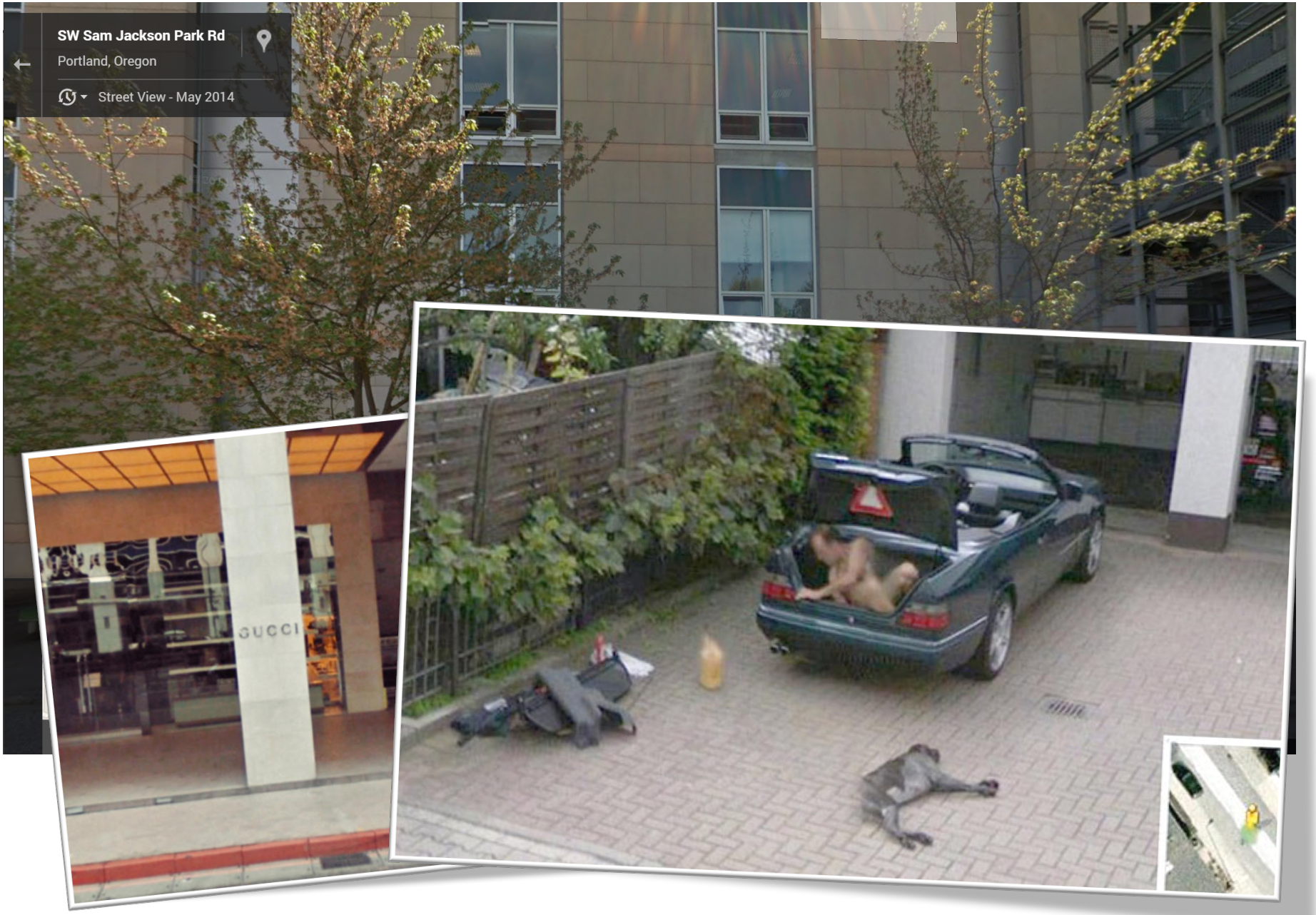
http://sealevel.climatecentral.org/


Oregon Health & Science University
List all results
Oregon Health & Science University: (503) 494-5678
Street View
+Jackie
SW Sam Jackson Park Rd
SW Terwilliger Blvd
SW Barbur Blvd
SW 4th Ave
SW 2nd Ave
Lair Hill Park
SW Woods St
26
99W
SW 1st Ave
SW Water Ave
Shriners Hospitals for Children - Portland
Oregon Health & Science University
OHSU Center for Women's Health:...
Work
8 min walk
Oregon Health & Science University
OHSU: Oregon Health & Science University
health sciences...
Doernbecher Children's Hospital
SW 13th Ave
SW 11th Ave
SW Marquam Hill Rd
Upper Marquam Hill Trail
SW Curry St
Oregon Health & Science University
Oregon Health & Science University...
Oregon Health & Science University:...
8 min walk - work
SW Gaines St
Oregon Health & Science University: Pediatrics
healthcare providers...
SW Condor Ave
10
Marquam Trail
SW 6th Ave Dr
Earth
Google
Map data ©2014 Google
Terms
Privacy
Report a problem
500 ft

Google Maps


Oregon Health & Science University
List all results
Oregon Health & Science University: (503) 494-5678
Street View
+Jackie
University Vascular Surgeons
Oregon Health & Science University
Oregon Health & Science University...
Oregon Health & Science University:...
Oregon Health & Science University: Pediatrics
healthcare providers...
SW Barbur Blvd
10
Map
Google
Map data ©2014 Google
Terms
Privacy
Report a problem
500 ft

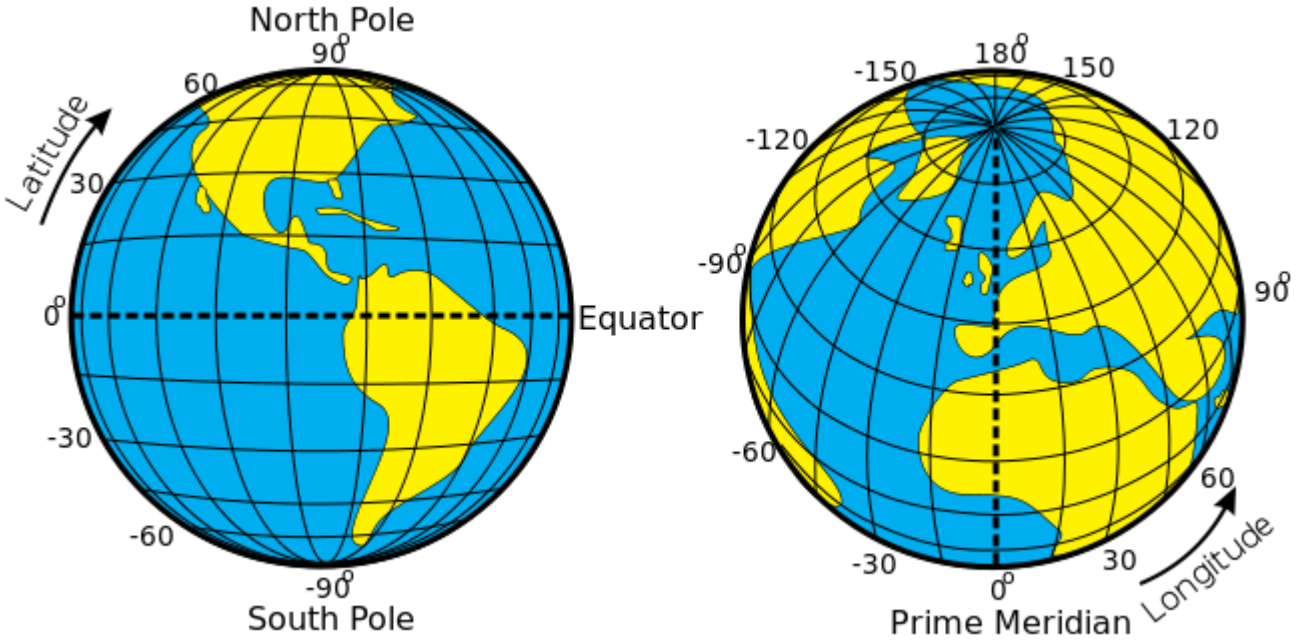
Google Maps


SW Sam Jackson Park Rd
Portland, Oregon
Street View - May 2014
GUCCI

Google Maps

Maps 101

Overview and terminology



DMS: – Degrees, minutes, and seconds
Latitude: 40°26'47"N – Longitude: 79°58'36"W

Decimal Degree: – Only degrees (real number)
Latitude: 40.446195 – Longitude: -79.948862

http://en.wikipedia.org/wiki/File:Latitude_and_Longitude_of_the_Earth.svg

3D Spheres do not flatten well…

http://www.herbalwater.com/herbs-and-ingredients/orange-peel.aspx

Distortion Happens:
Choose what you want to prioritize

- Distance between two points
- Direction between two points
- Shape of regions
- Area of regions
- Familiarity of projection…

http://www.herbalwater.com/herbs-and-ingredients/orange-peel.aspx

Slide from Jeffery Heer, University of Washington

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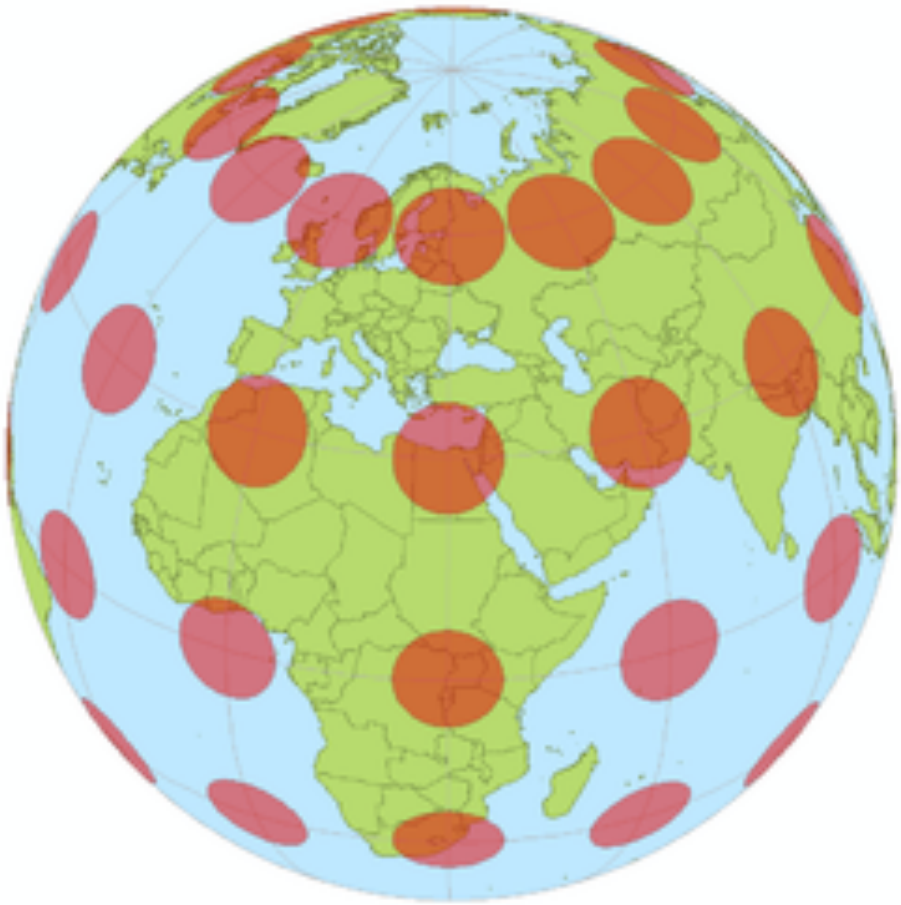
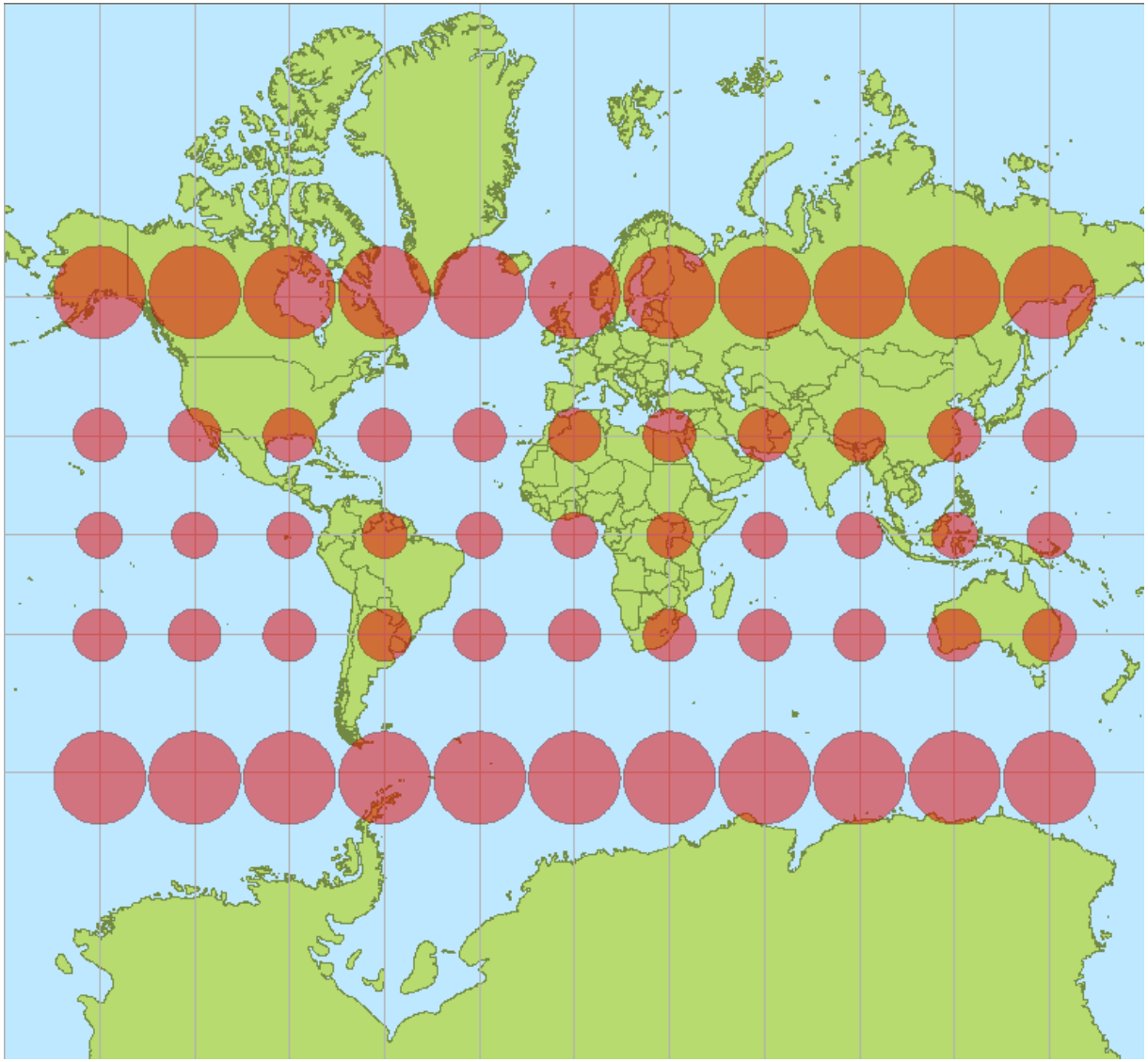
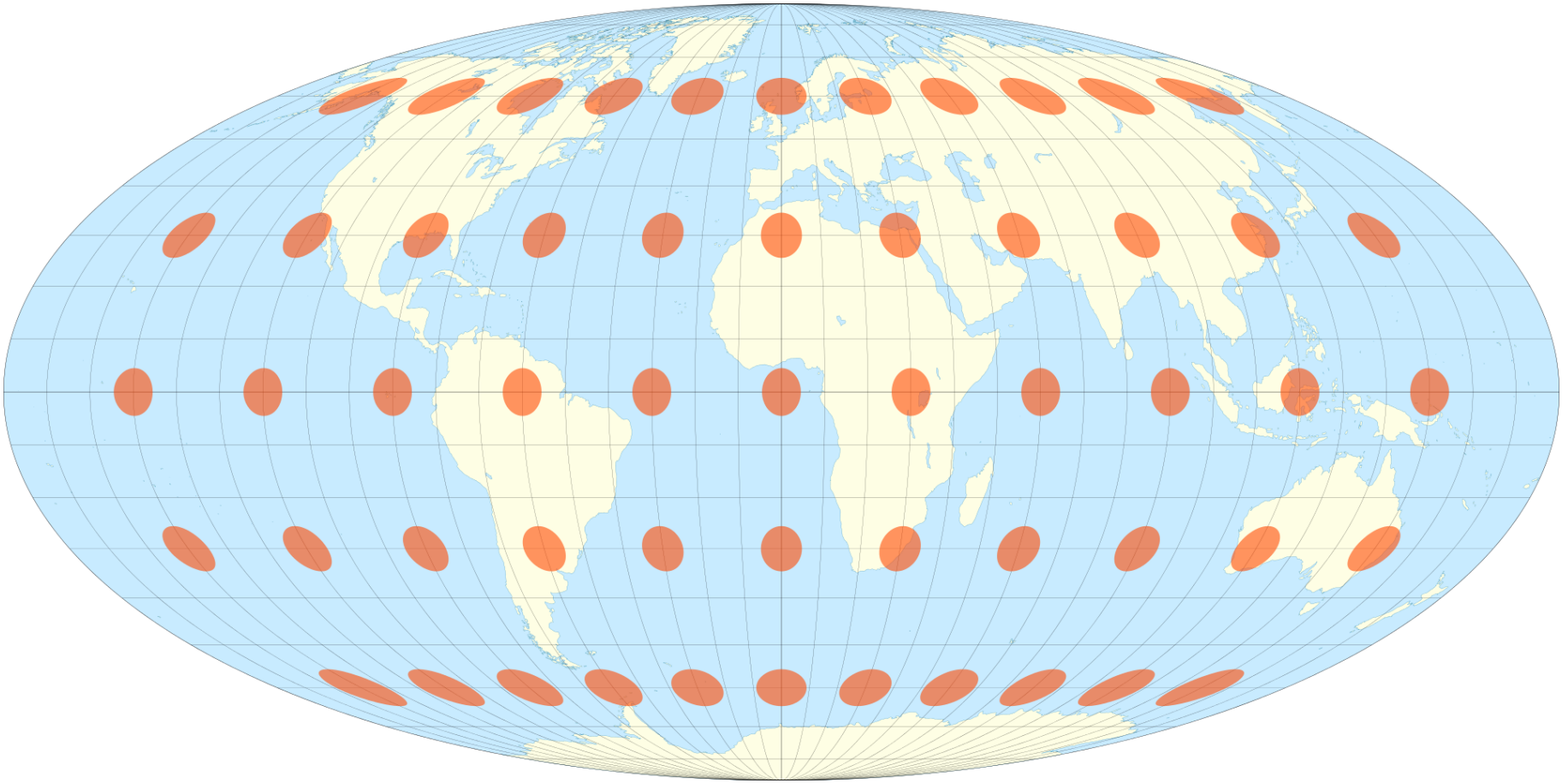


Tissot *Indicatrices*: http://en.wikipedia.org/wiki/Tissot%27s_indicatrix

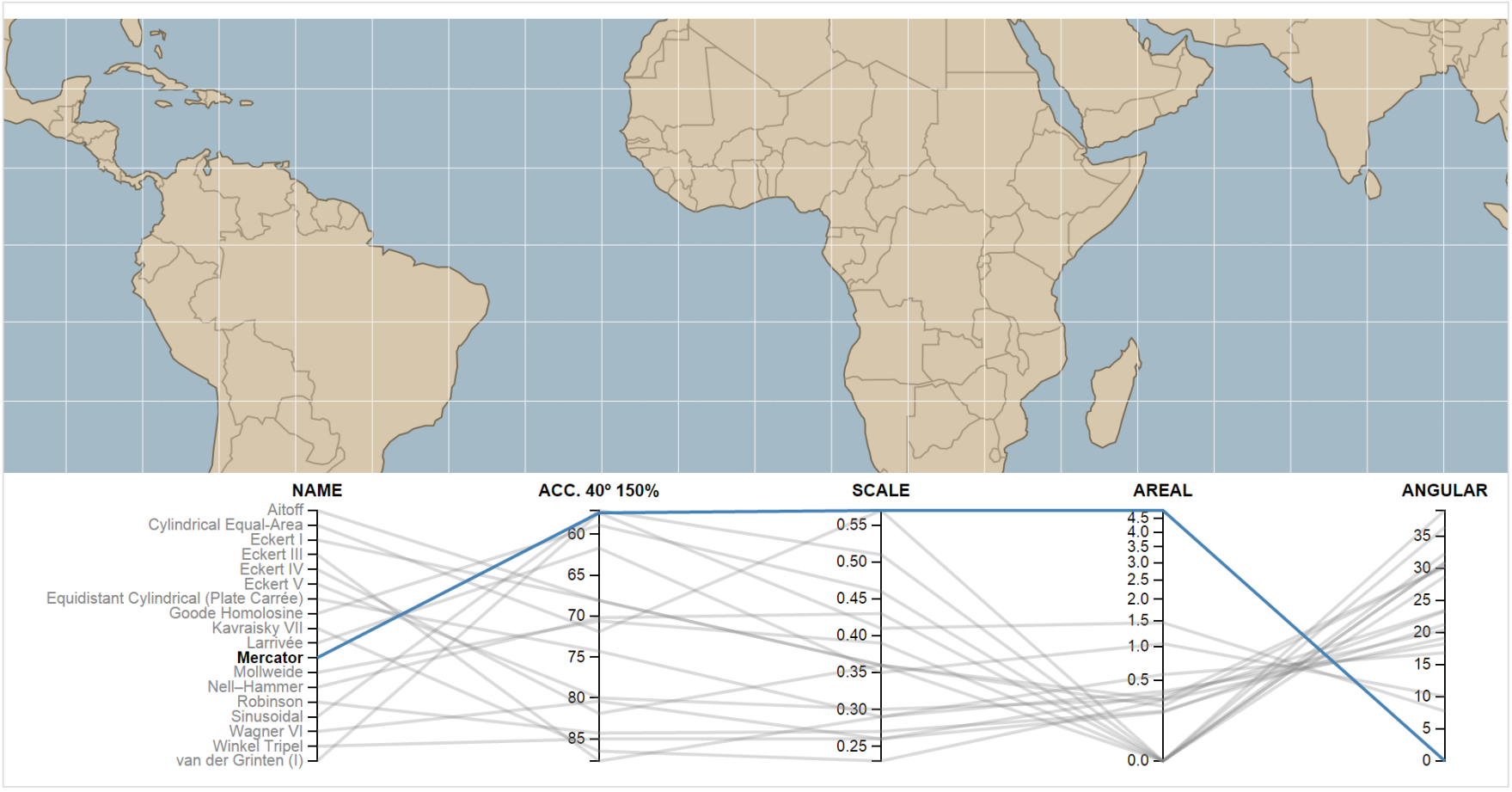


Tissot *Indicatrices*: http://en.wikipedia.org/wiki/Tissot%27s_indicatrix



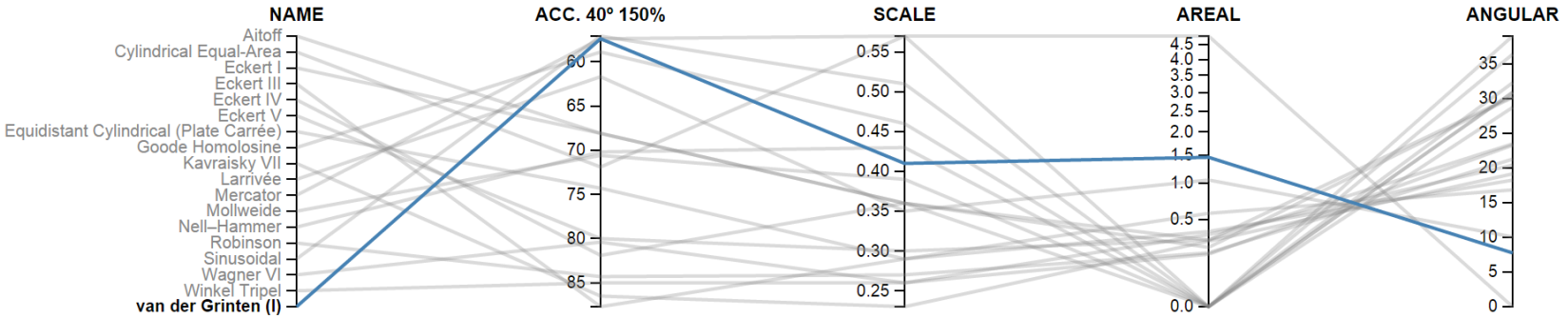
Tissot *Indicatrices*: http://en.wikipedia.org/wiki/Tissot%27s_indicatrix

Comparing Map Projections

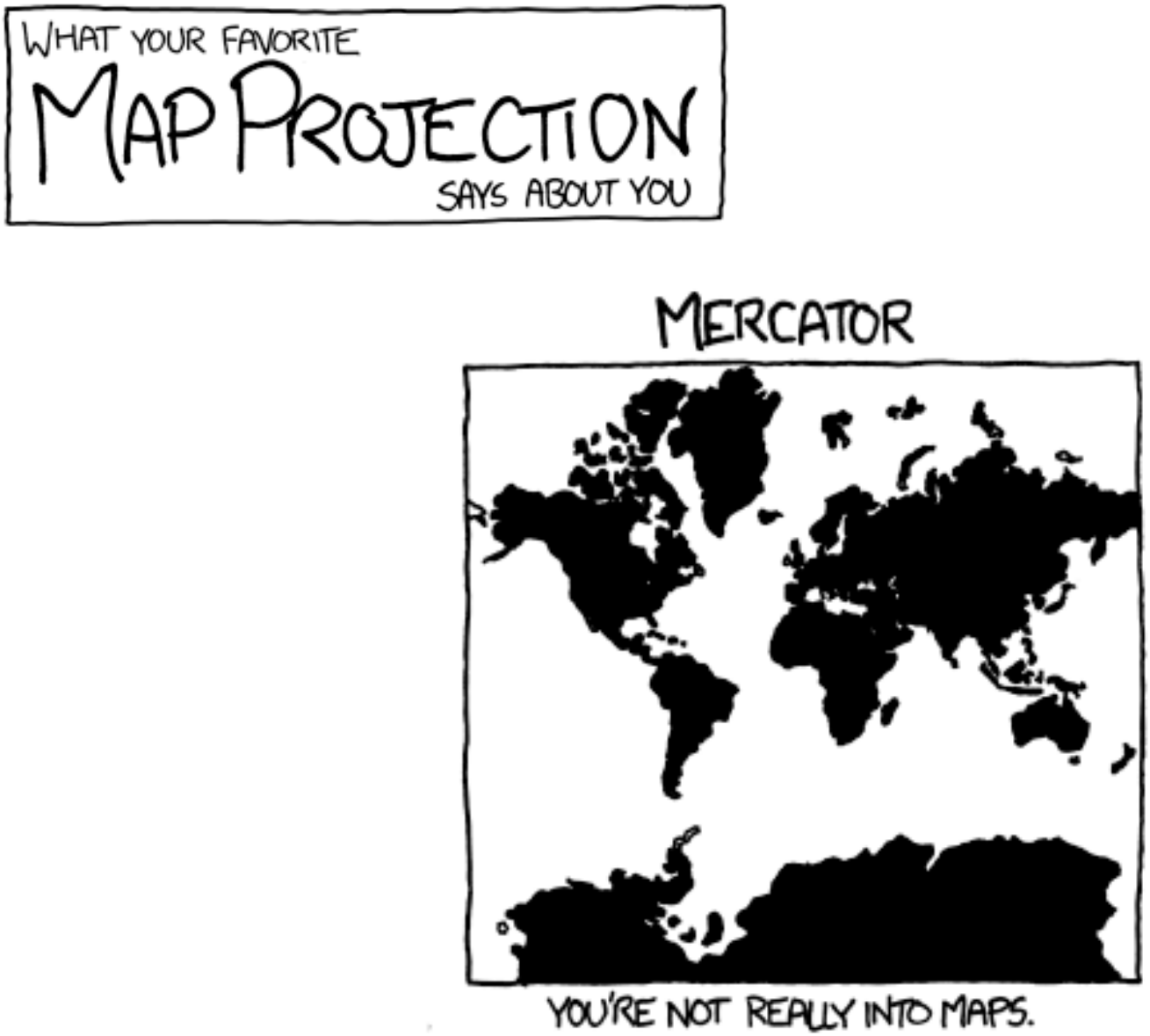


http://bl.ocks.org/syntagmatic/3711245

Comparing Map Projections



http://bl.ocks.org/syntagmatic/3711245



http://xkcd.com/977/

WHAT YOUR FAVORITE

MAP PROJECTION

SAYS ABOUT YOU

ROBINSON

YOU HAVE A COMFORTABLE PAIR OF RUNNING SHOES THAT YOU WEAR EVERYWHERE. YOU LIKE COFFEE AND ENJOY THE BEATLES. YOU THINK THE ROBINSON IS THE BEST-LOOKING PROJECTION, HANDS DOWN.

DYMAXION

YOU LIKE ISAAC ASIMOV, XML, AND SHOES WITH TOES. YOU THINK THE SEGWAY GOT A BAD RAP. YOU OWN 3D GOGGLES, WHICH YOU USE TO VIEW ROTATING MODELS OF BETTER 3D GOGGLES. YOU TYPE IN DVORAK.

http://xkcd.com/977/

WHAT YOUR FAVORITE

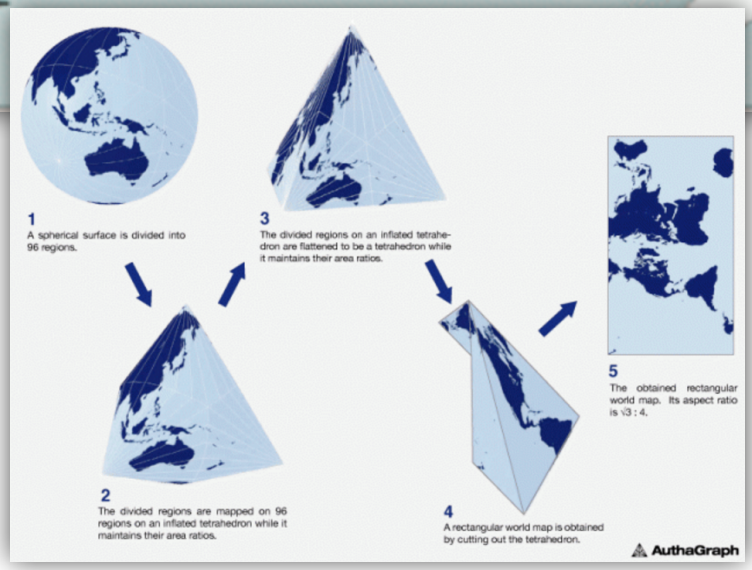
MAP PROJECTION

SAYS ABOUT YOU

PEIRCE QUINCUNCIAL

YOU THINK THAT WHEN WE LOOK AT A MAP, WHAT WE REALLY SEE IS OURSELVES. AFTER YOU FIRST SAW *INCEPTION*, YOU SAT SILENT IN THE THEATER FOR SIX HOURS. IT FREAKS YOU OUT TO REALIZE THAT EVERYONE AROUND YOU HAS A SKELETON INSIDE THEM. YOU *HAVE* REALLY LOOKED AT YOUR HANDS.

http://xkcd.com/977/



http://www.authagraph.com/category/projects/description/?lang=en

Maps Types

More than you'd think…

Physical Maps – Shows physical features (mountains, lakes)

Road Maps – Shows location and name of roads, other manmade features

Topographic Maps – Shows 3d topography in 2d map using contour lines

Thematic Maps – generally designed to depict a single theme (coropleth, proportional symbol, dot maps)

Other Maps – includes cartograms, flow maps, stylized

Thematic Maps

choropleth, proportional symbol, dot maps

Choropleth

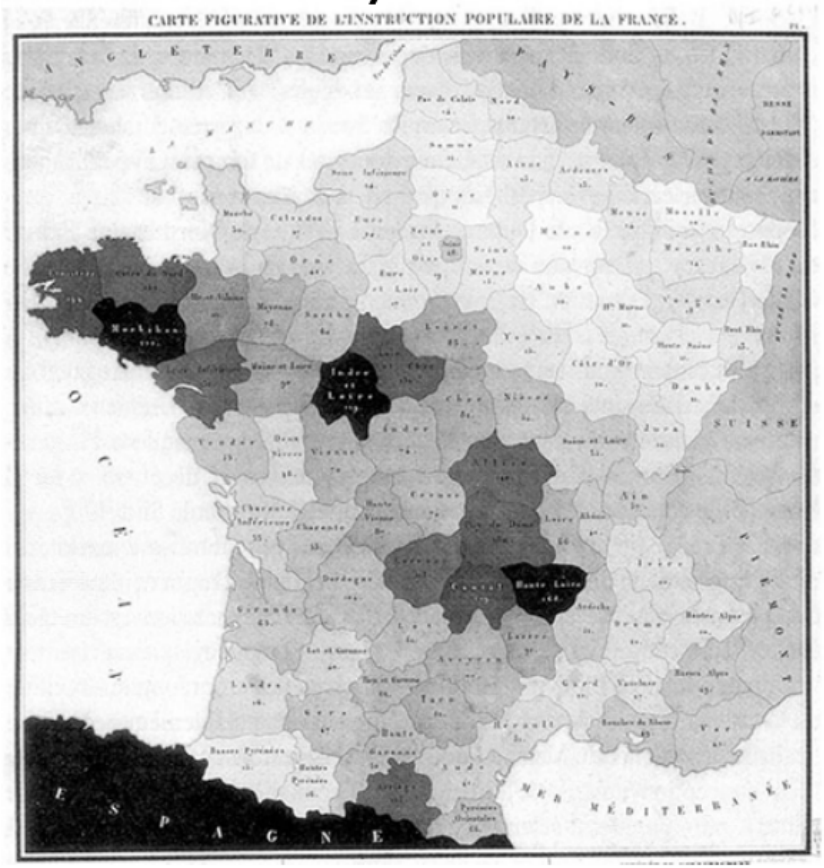
Uses color and intensity to indicate data values

- Use color *wisely*!

Data should be normalized

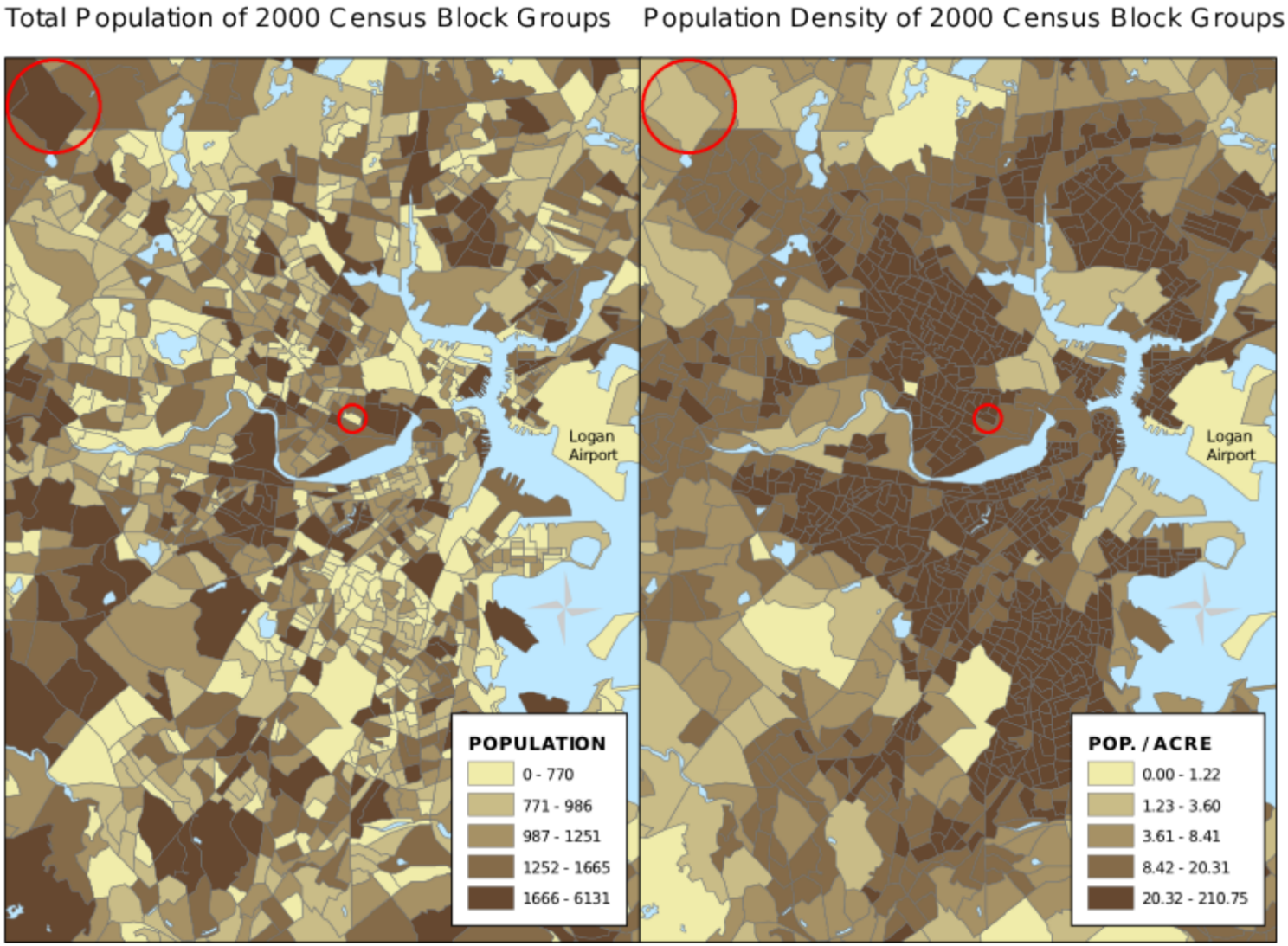
- Good: Percentages, ratios
- Bad: Counts, totals

Illiteracy in France

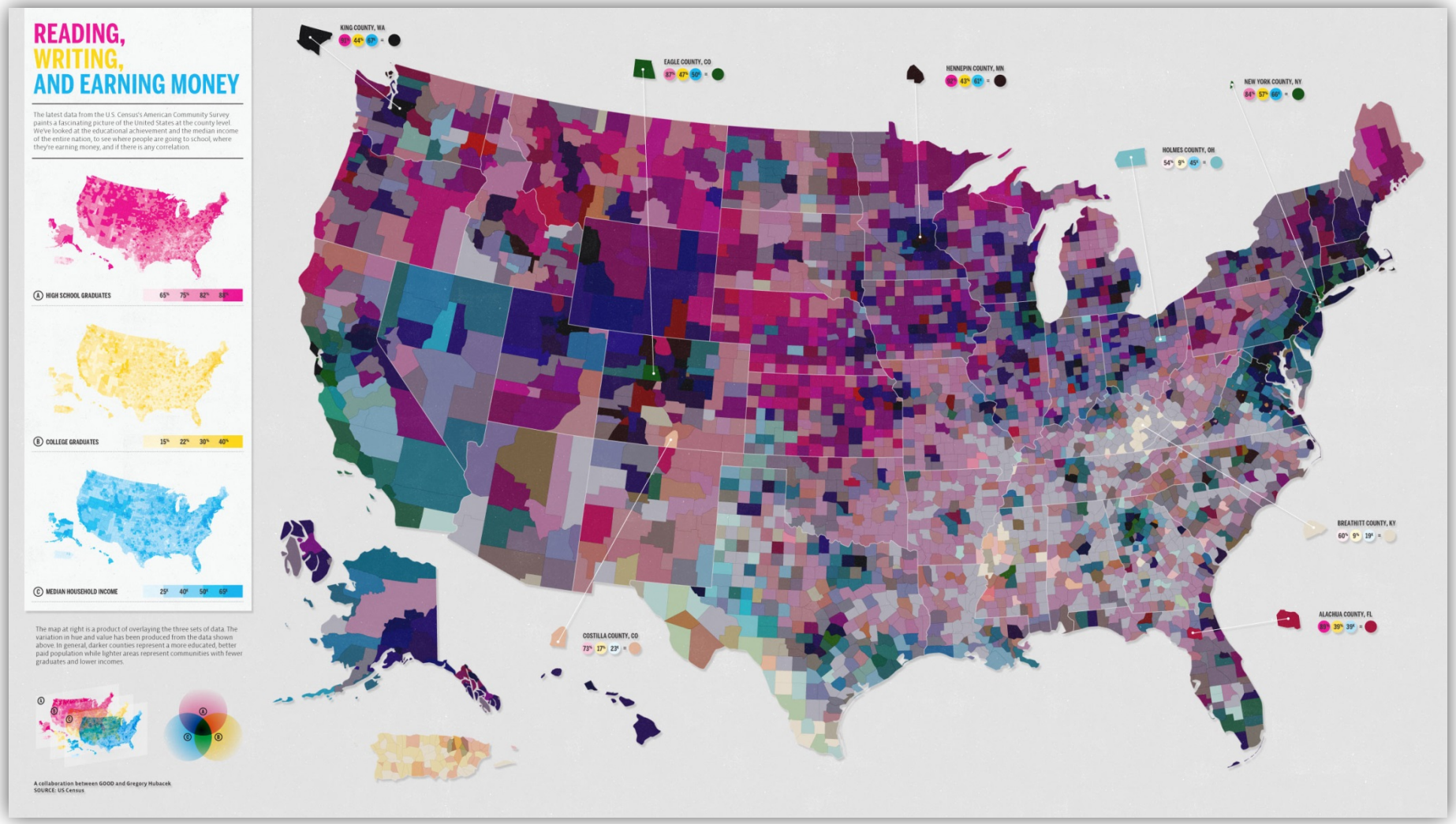


Charles Dupin, 1826

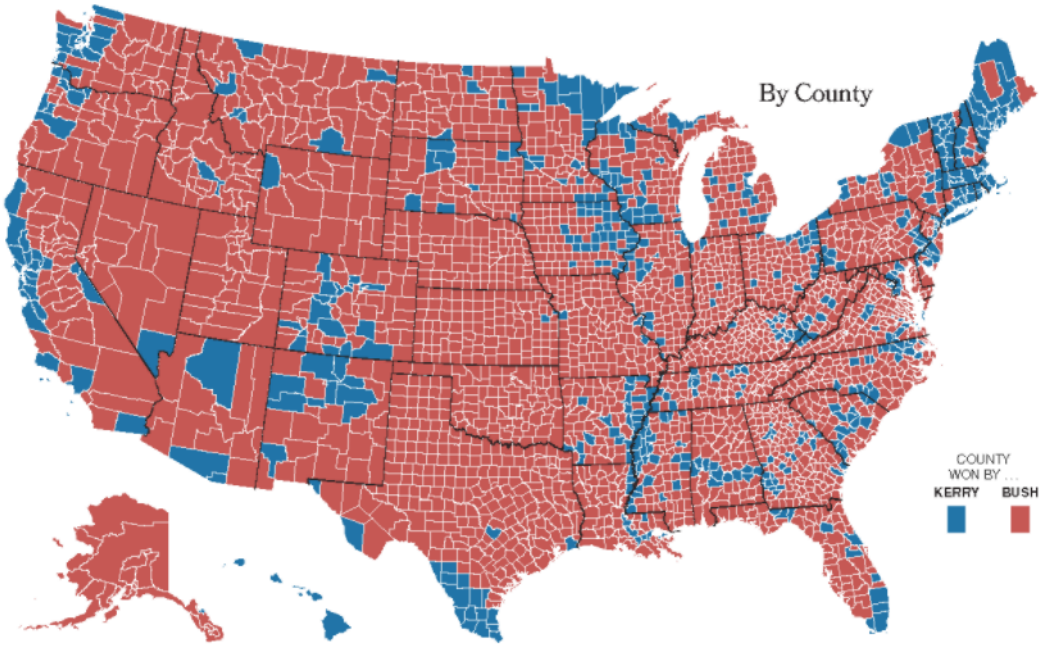
Slide modified from Hanspeter Pfister, Harvard

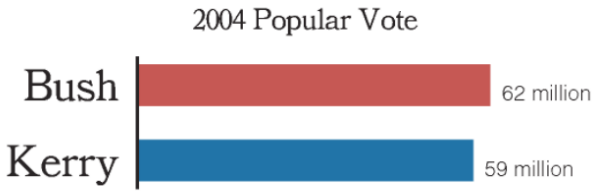


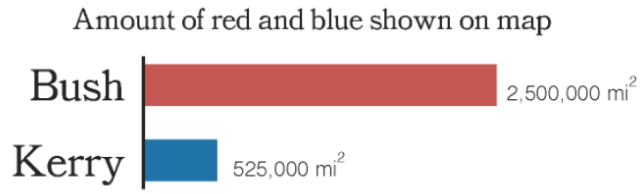
http://en.wikipedia.org/wiki/File:Choropleth-density.png



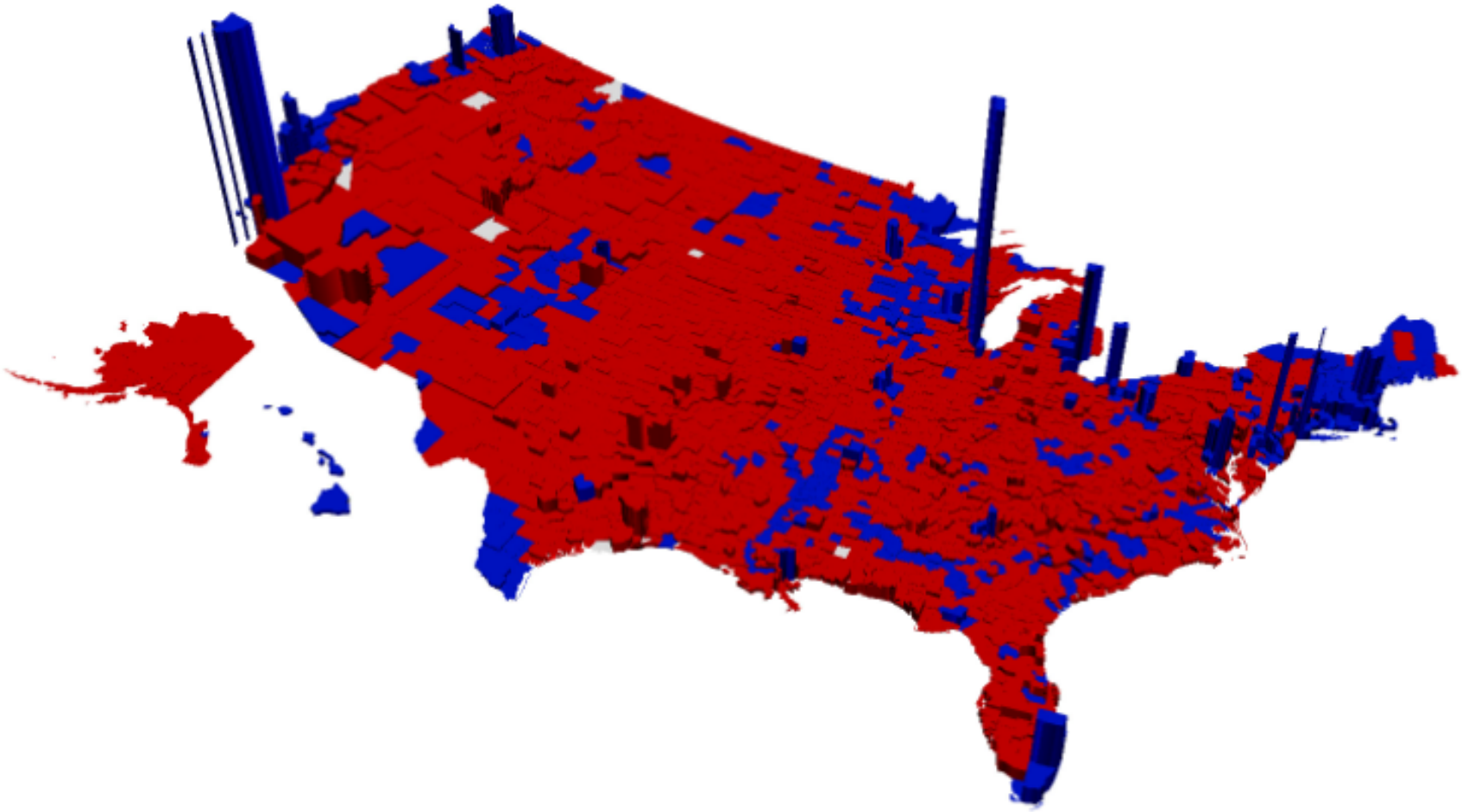
http://awesome.good.is/transparency/web/1101/census-data/flat.html



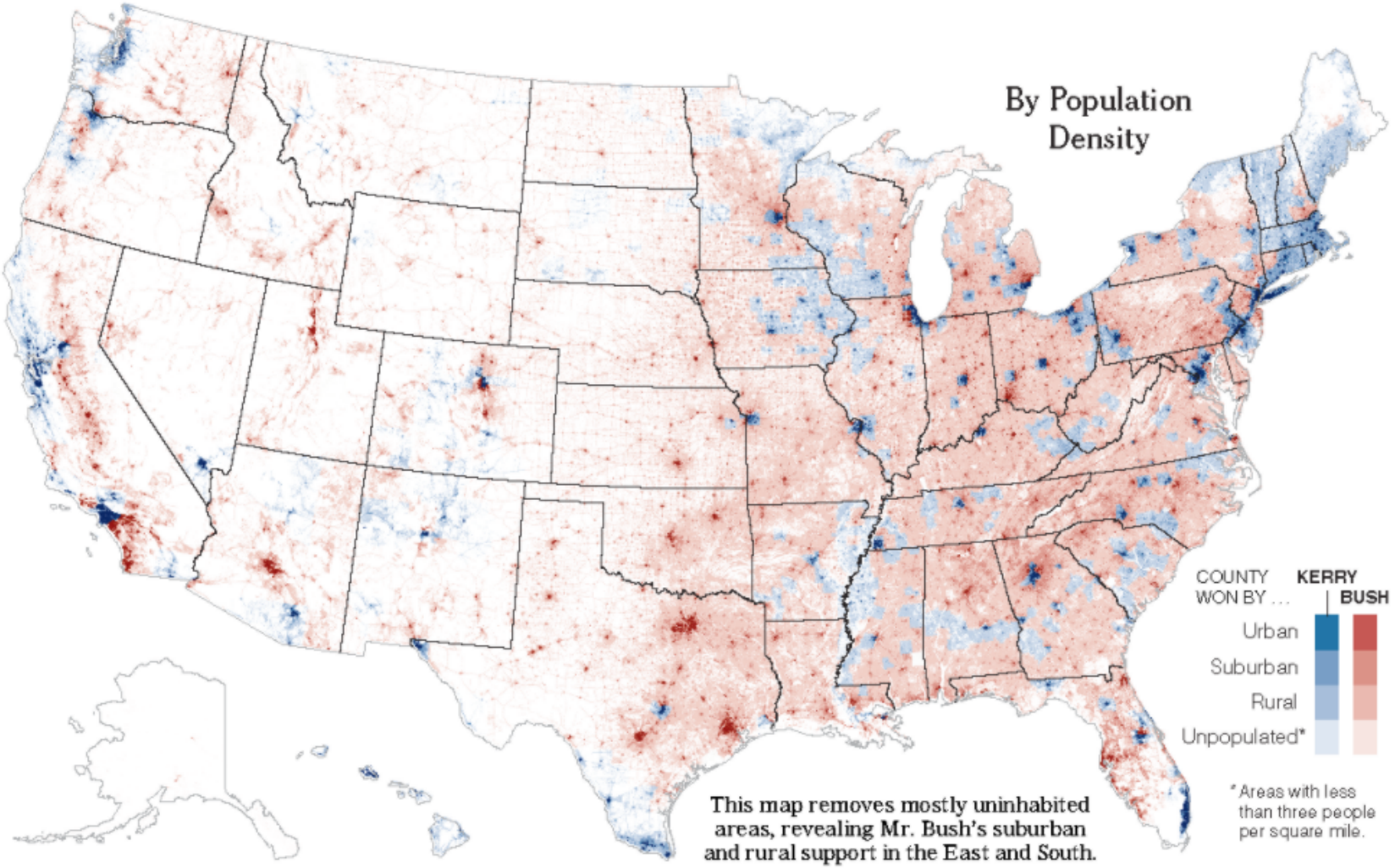




http://www.ericson.net/content/2011/10/when-maps-shouldnt-be-maps/#more-403



Slide modified from Hanspeter Pfister, Harvard



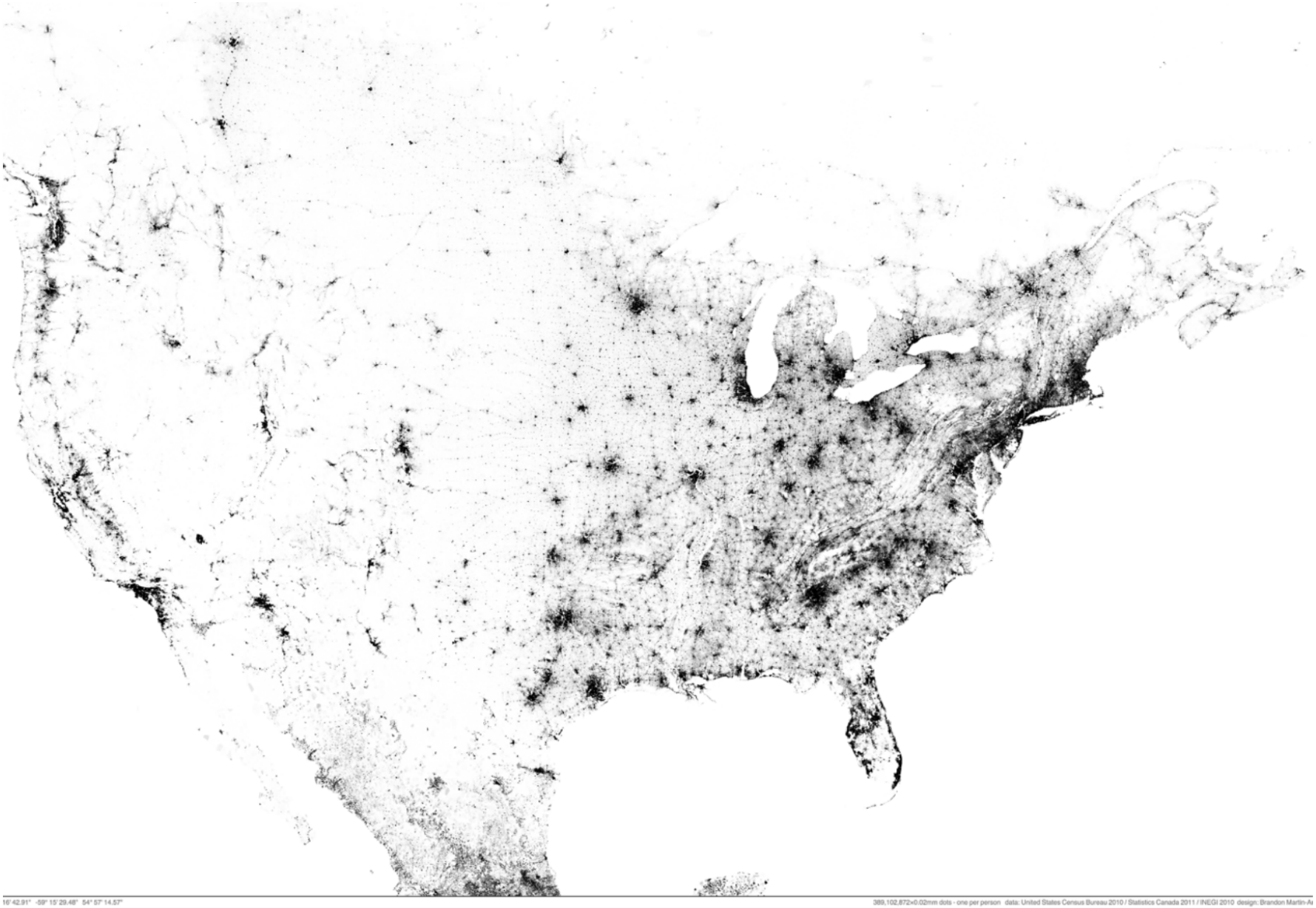
Slide modified from Hanspeter Pfister, Harvard

(Proportional) Symbol Maps

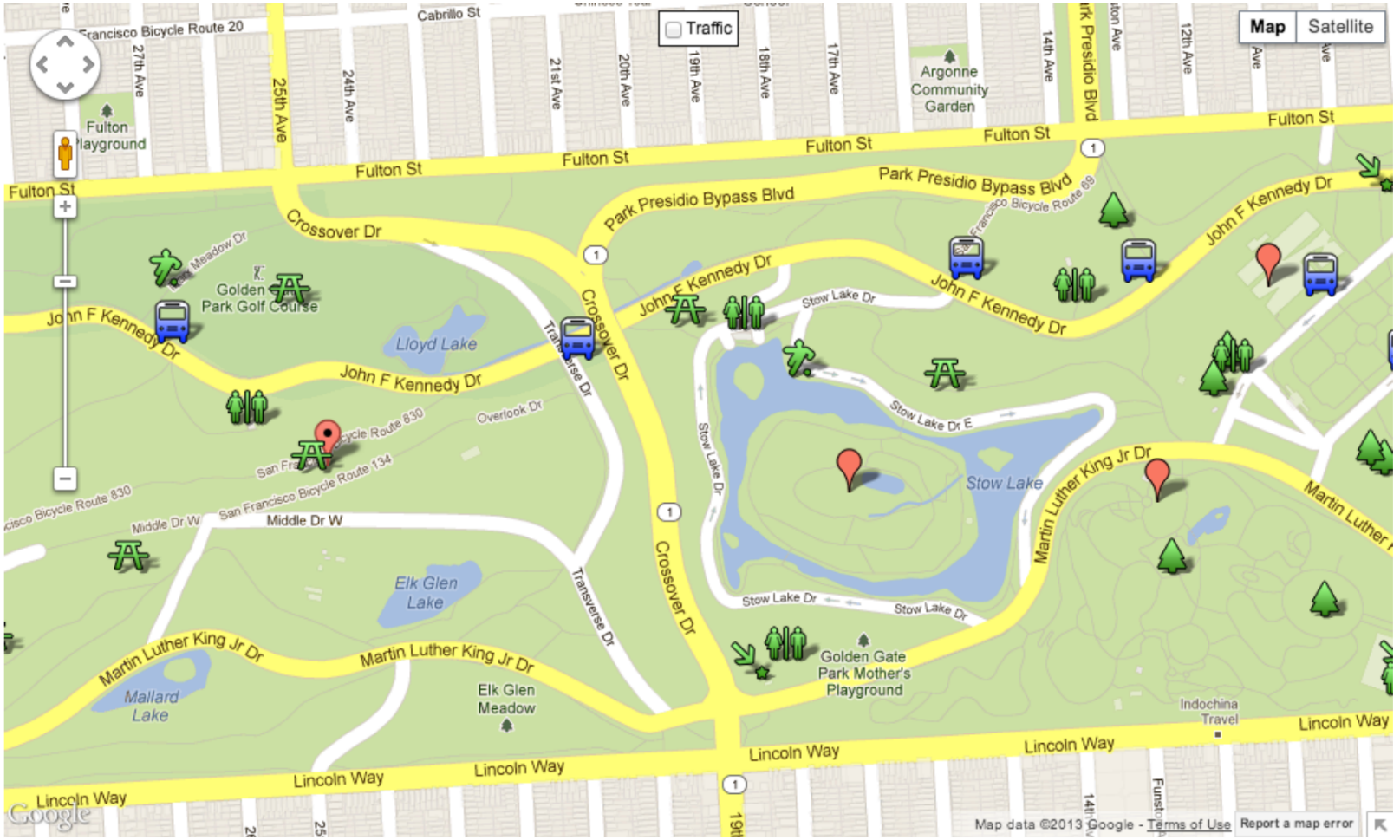
Use symbol size, color, or shape to code data in map overlays

Data sets be aggregated to points within an area

- e.g. Cities



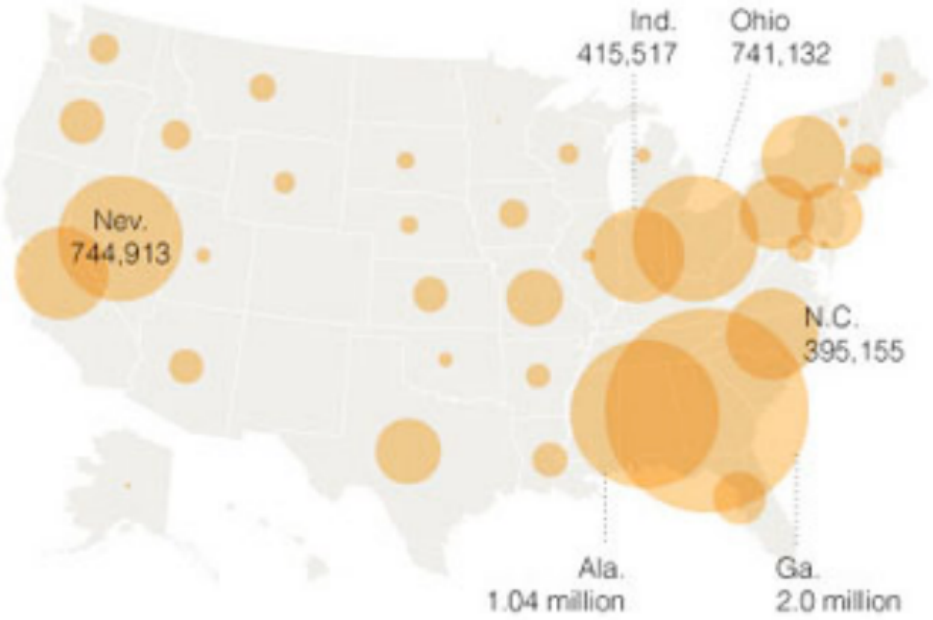
http://bmander.com/dotmap/index.html

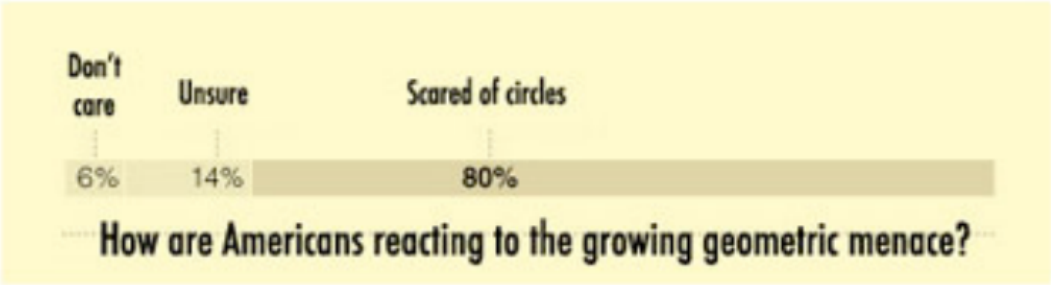


http://www.golden-gate-park.com/interactive-golden-gate-park-map.html

Killer circles threaten America

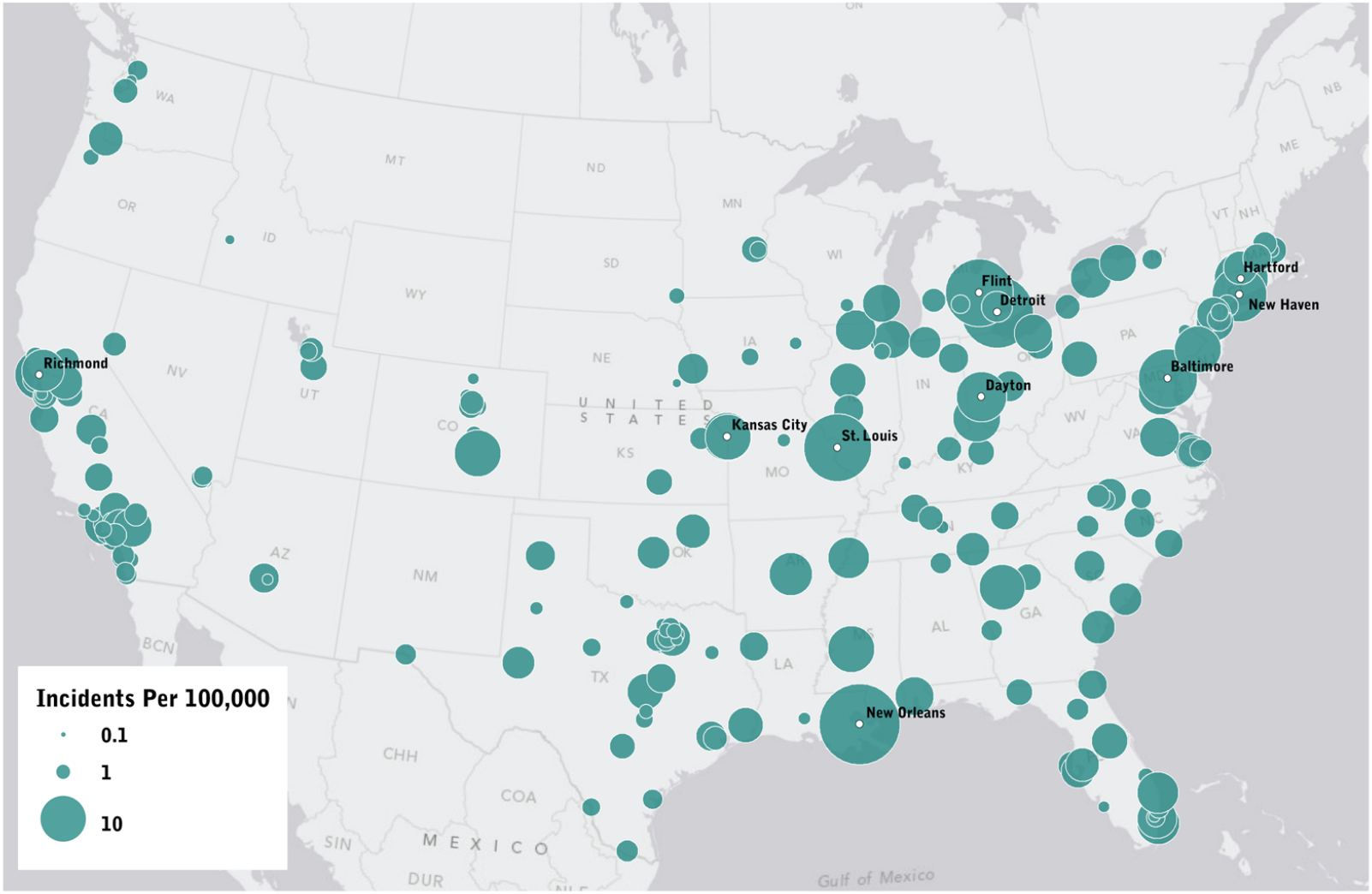
- No sides
- Area equal to πr^2
- Extremely round
- Often fatal
- North Dakota, New Mexico, Colorado remain circle-free



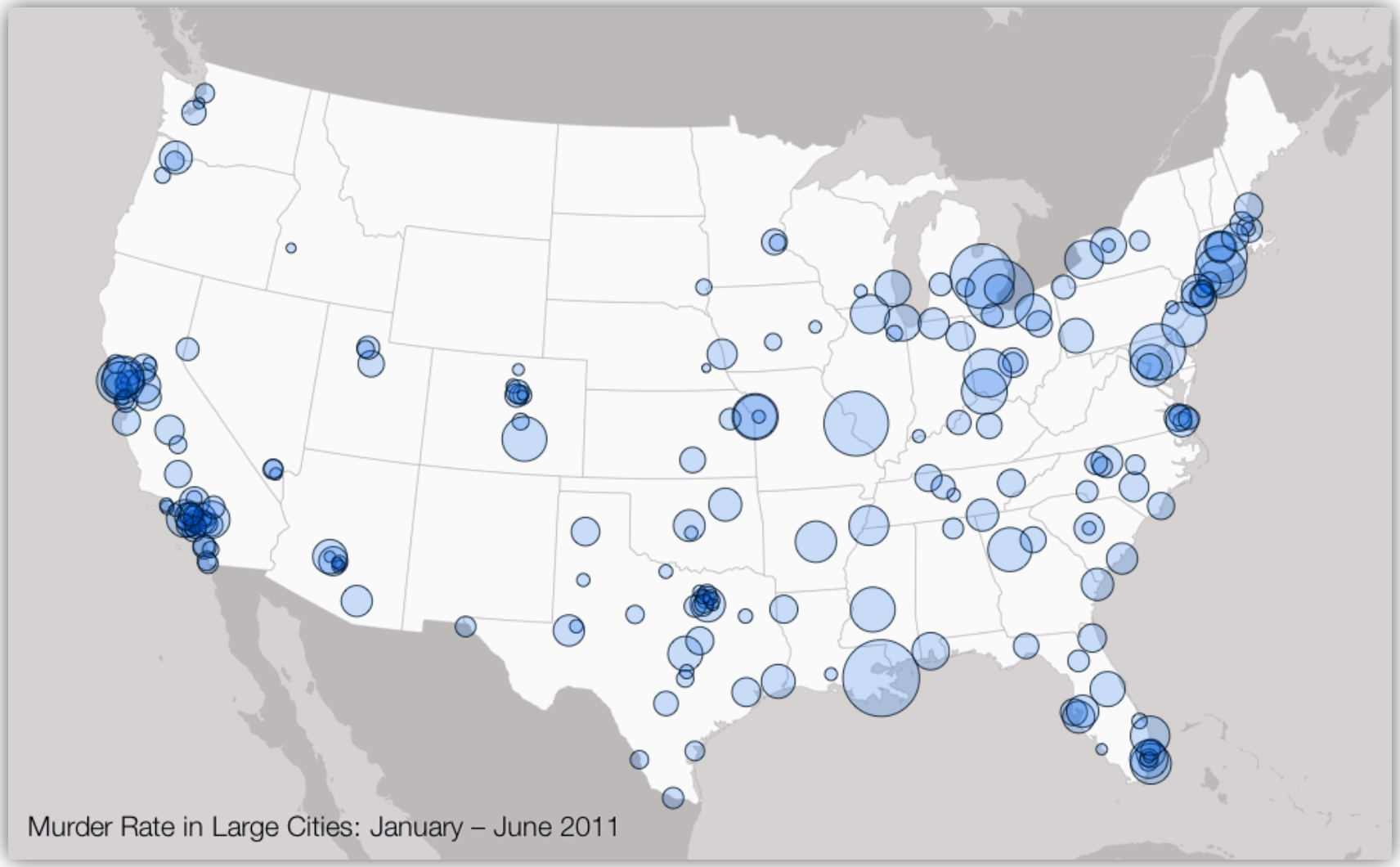


Slide modified from Hanspeter Pfister, Harvard

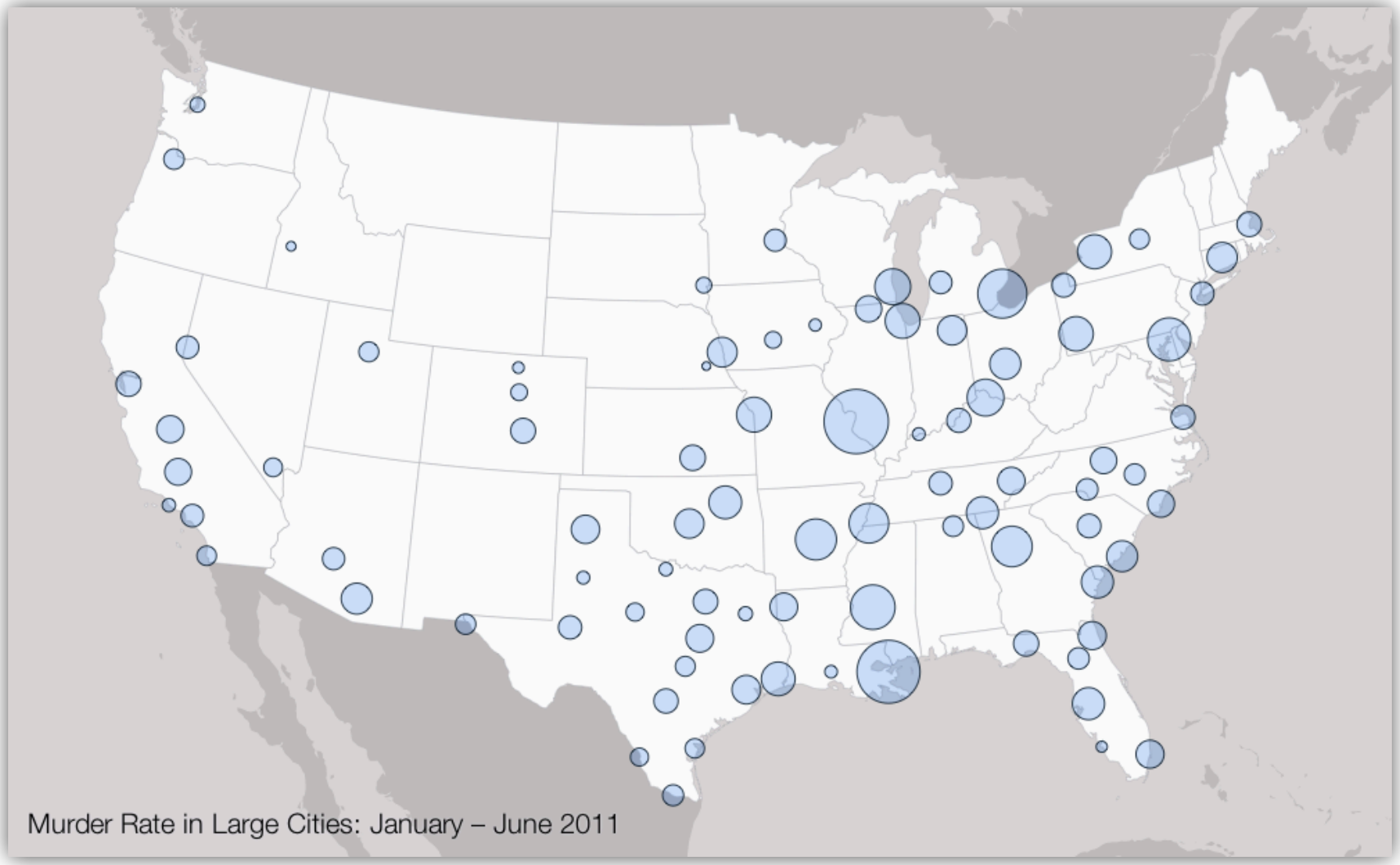
Murder Rate in Large Cities: January-June 2011



http://mattstil.es/images/murder.png



http://vis4.net/blog/wp-content/uploads/2011/12/murder-rate1.png



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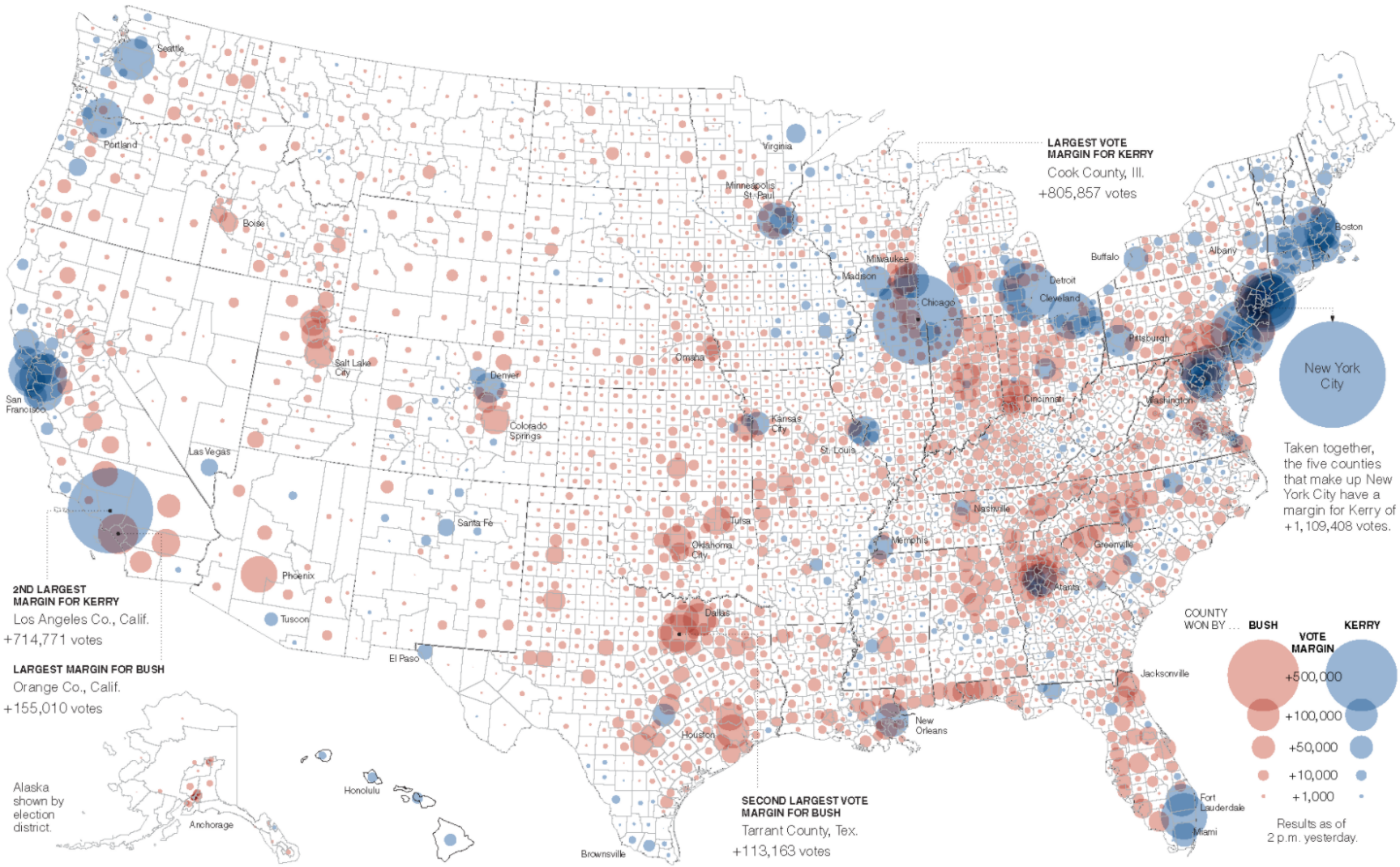
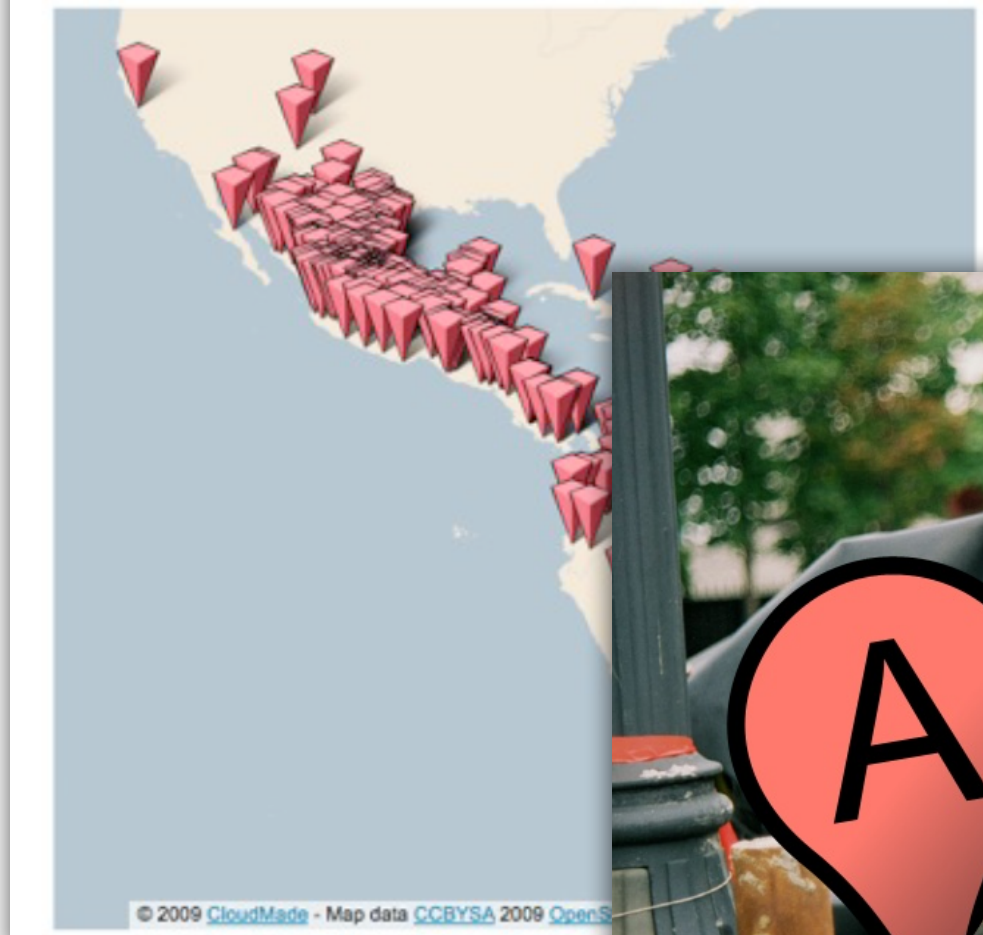
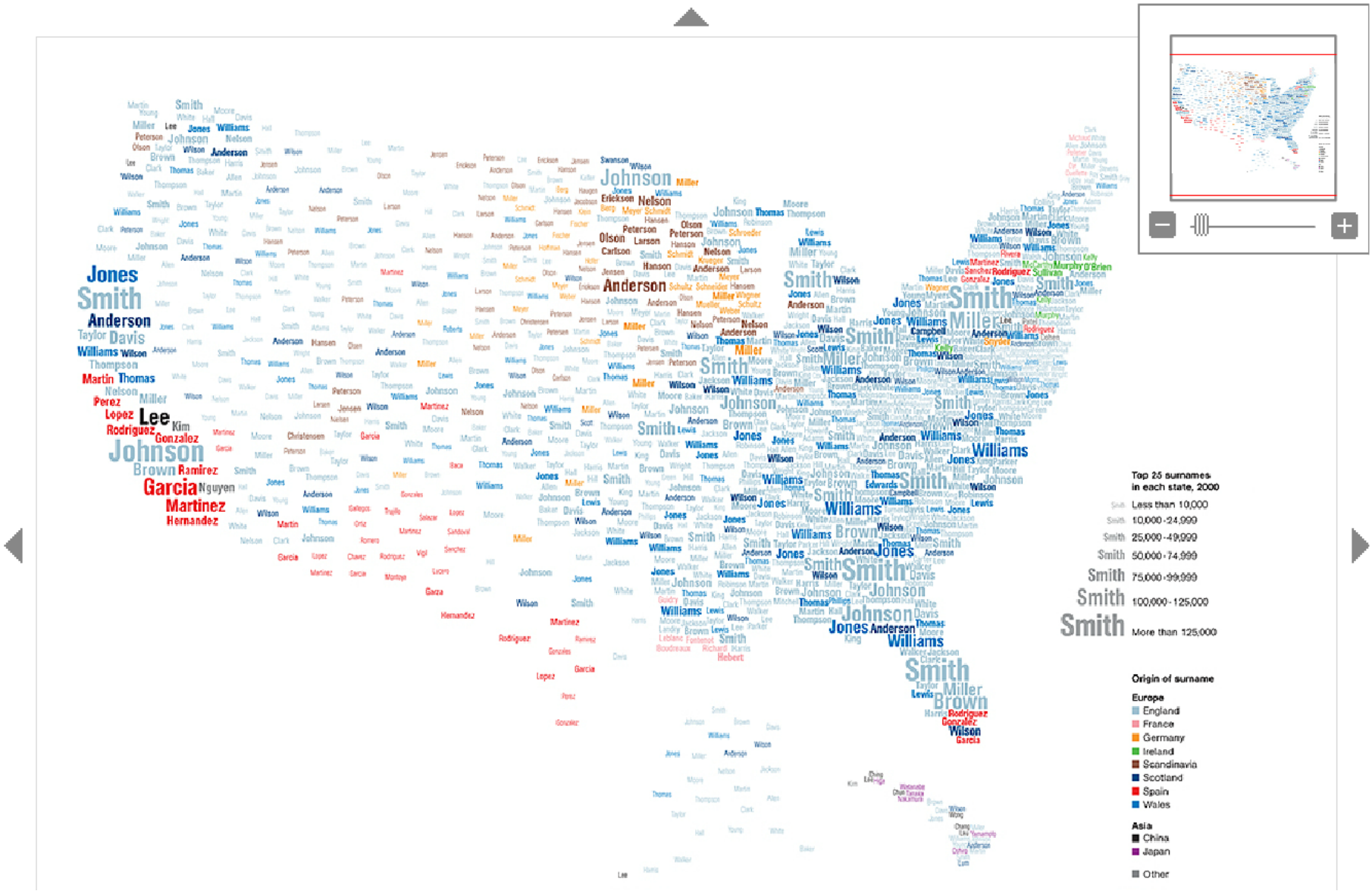


Slide from Matthew Erickson, NY Times

“Red Dot Fever”



Slide from Jeffery Heer, University of Washington; http://makingmaps.files.wordpress.com/2010/09/google-maps-risk.jpg



http://ngm.nationalgeographic.com/2011/02/geography/usa-surnames-interactive

Isopleth

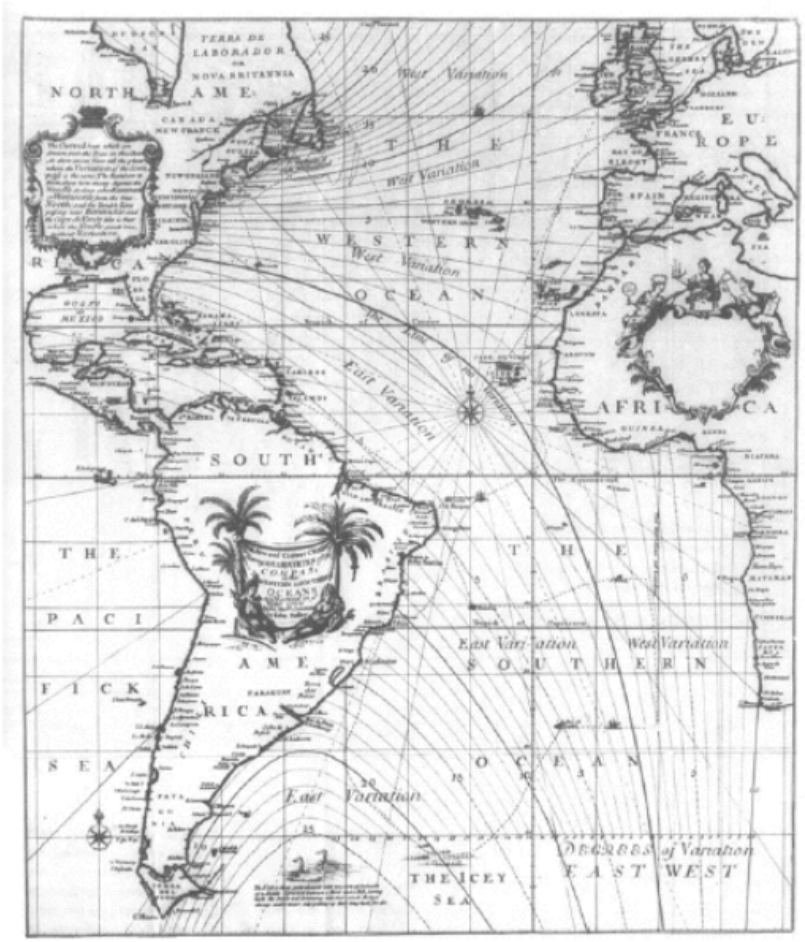
Color codes data according to values

Use contour lines to follow data at specific values

Use “heat maps” display gradient data

Data should be normalized and binned or smoothed

- Binning determines number & visual density of isopaths
- Smoothing involved with heat map

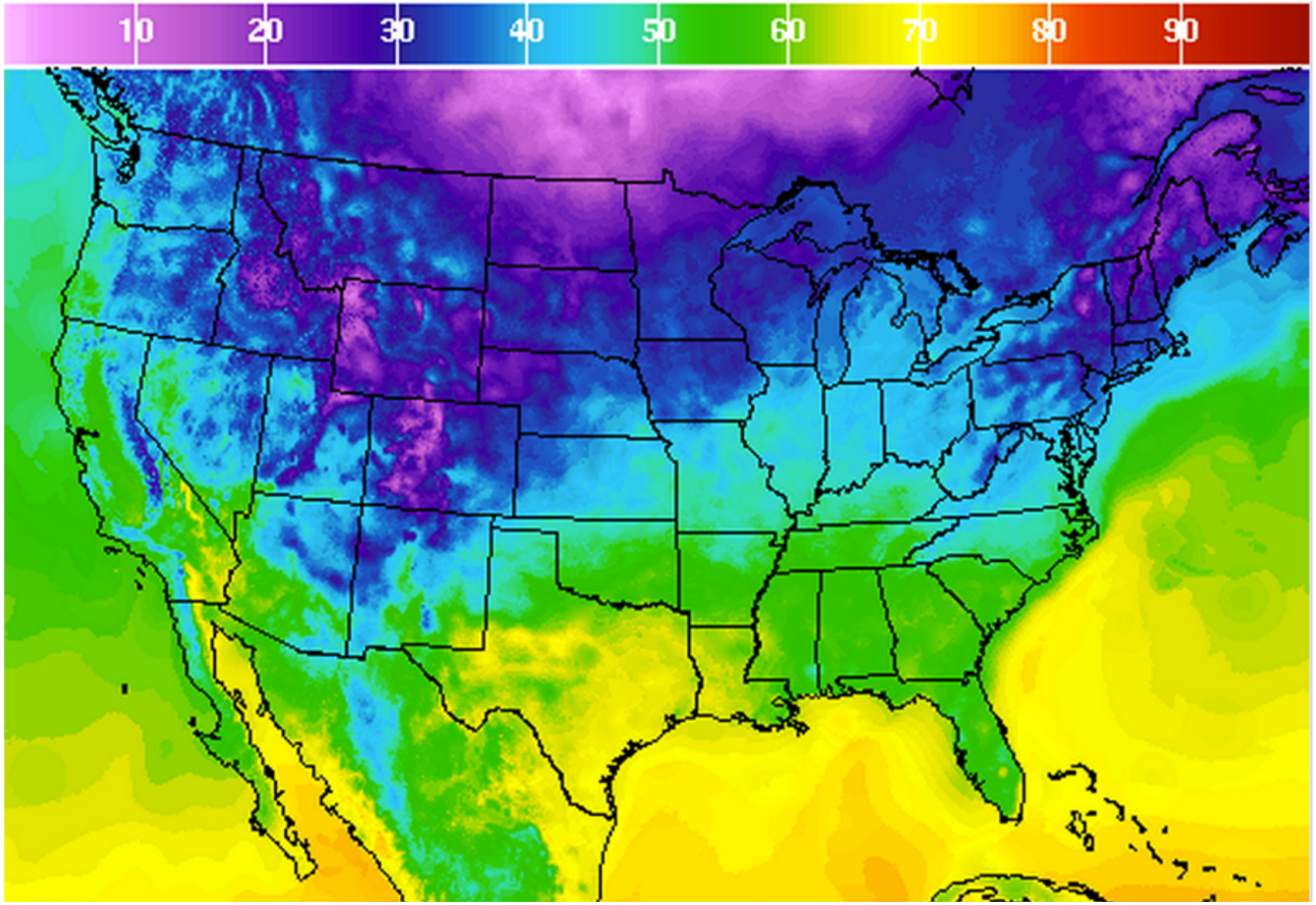


Lines of Equal Magnetic Declination
Edmond Halley, 1701

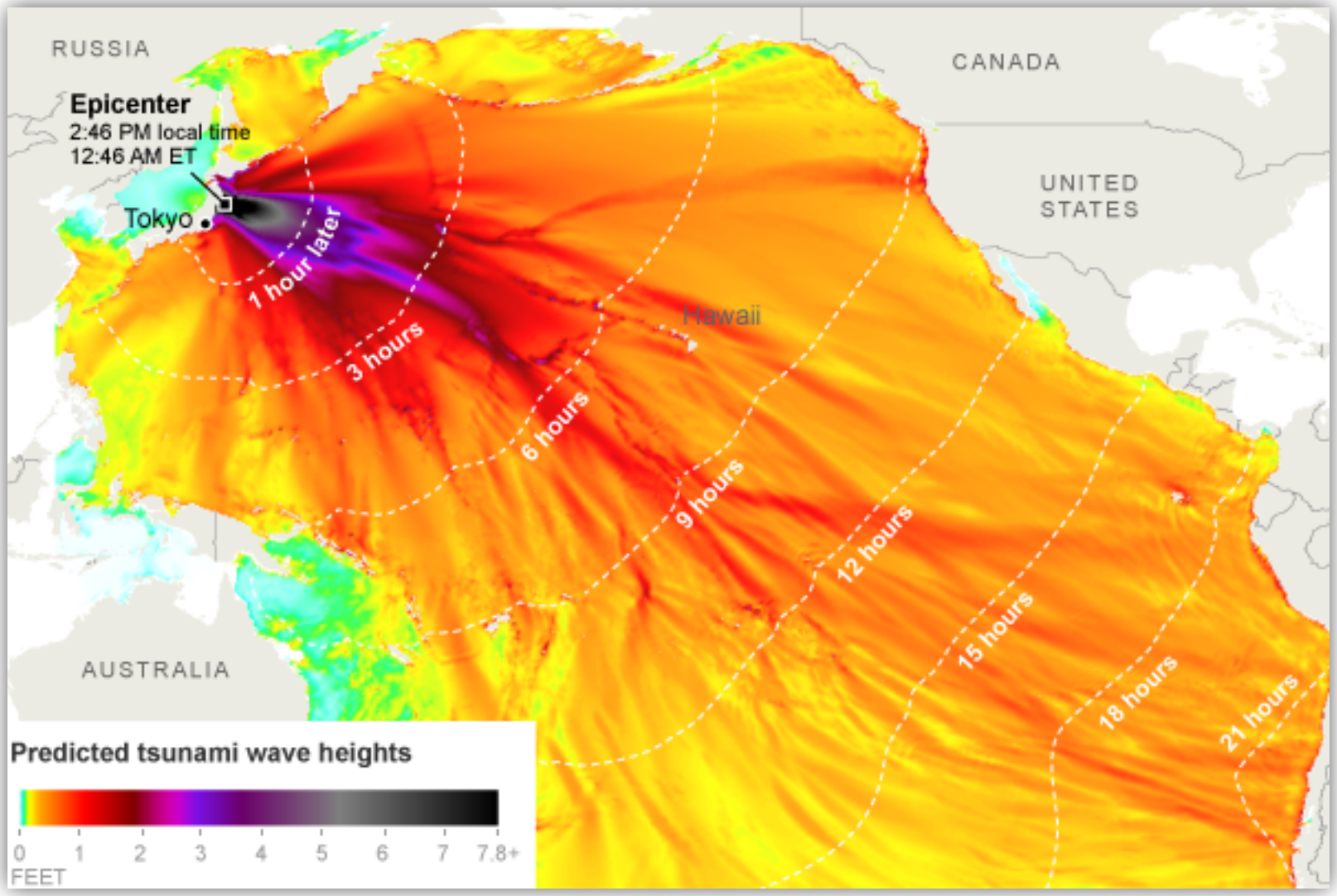
Slide modified from Hanspeter Pfister, Harvard

Wind Map, Edmond Halley, 1686

Slide modified from Hanspeter Pfister, Harvard



http://graphical.weather.gov/sectors



http://www.nytimes.com/interactive/2011/03/11/world/asia/maps-of-earthquake-and-tsunami-damage-in-japan.html?_r=0#panel/2

Cartogram

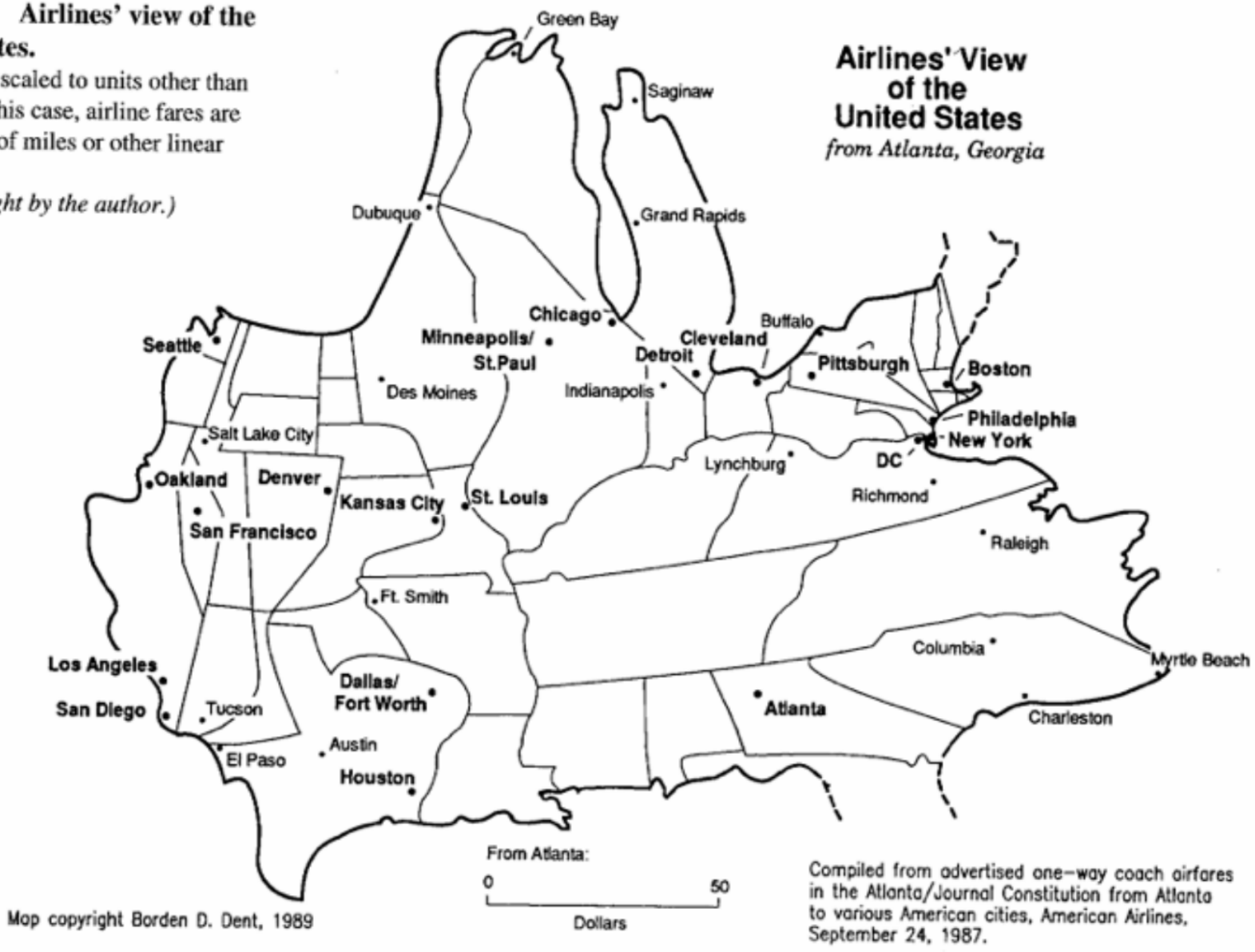
Use data attribute values to distort the area or shape of familiar maps

Only as useful as your target population is familiar with the baseline map!

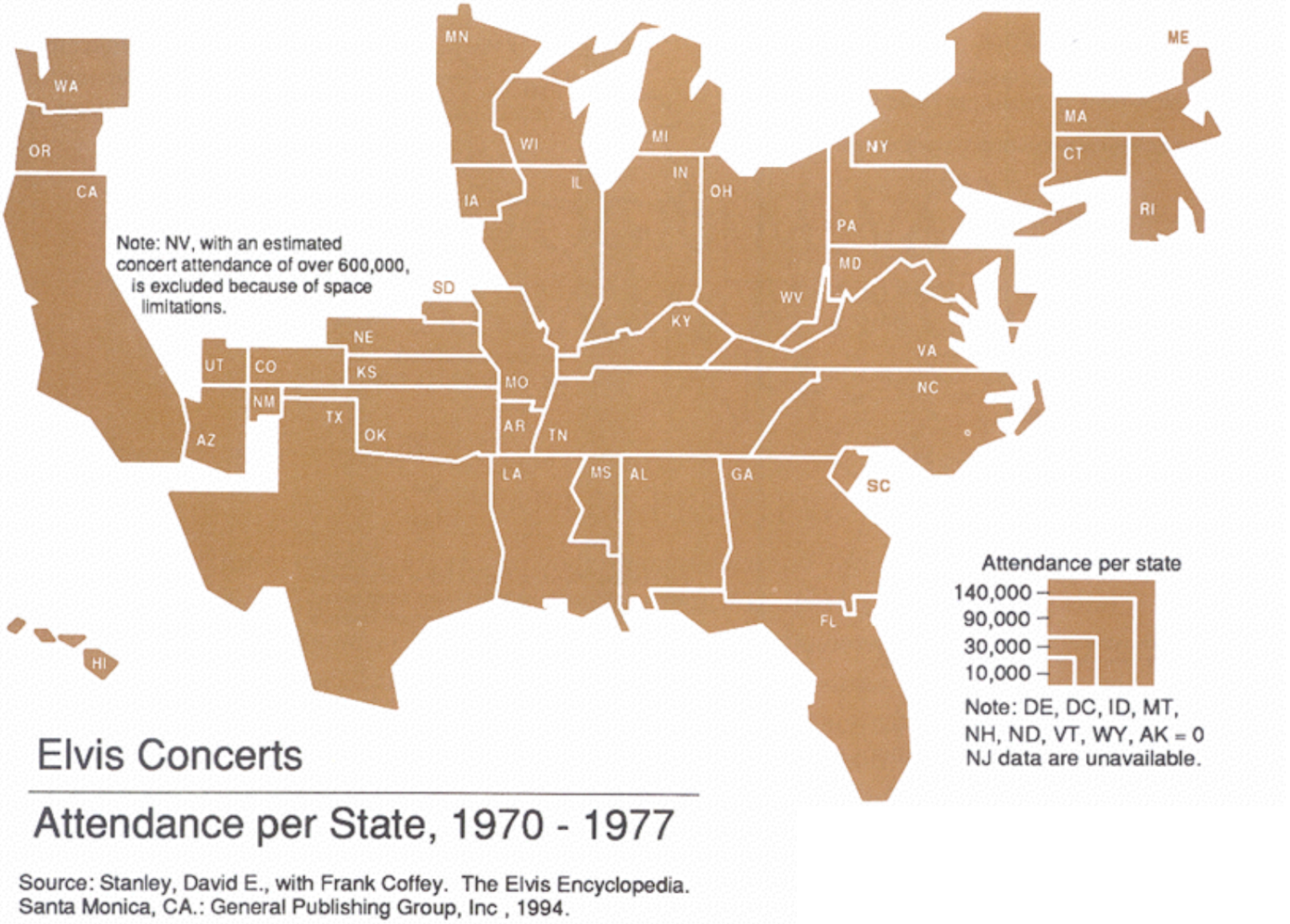
Can scale by:

- *Distance*
- Dorling Cartograms –*scaled shape;* does not maintain region shape
- *Area*

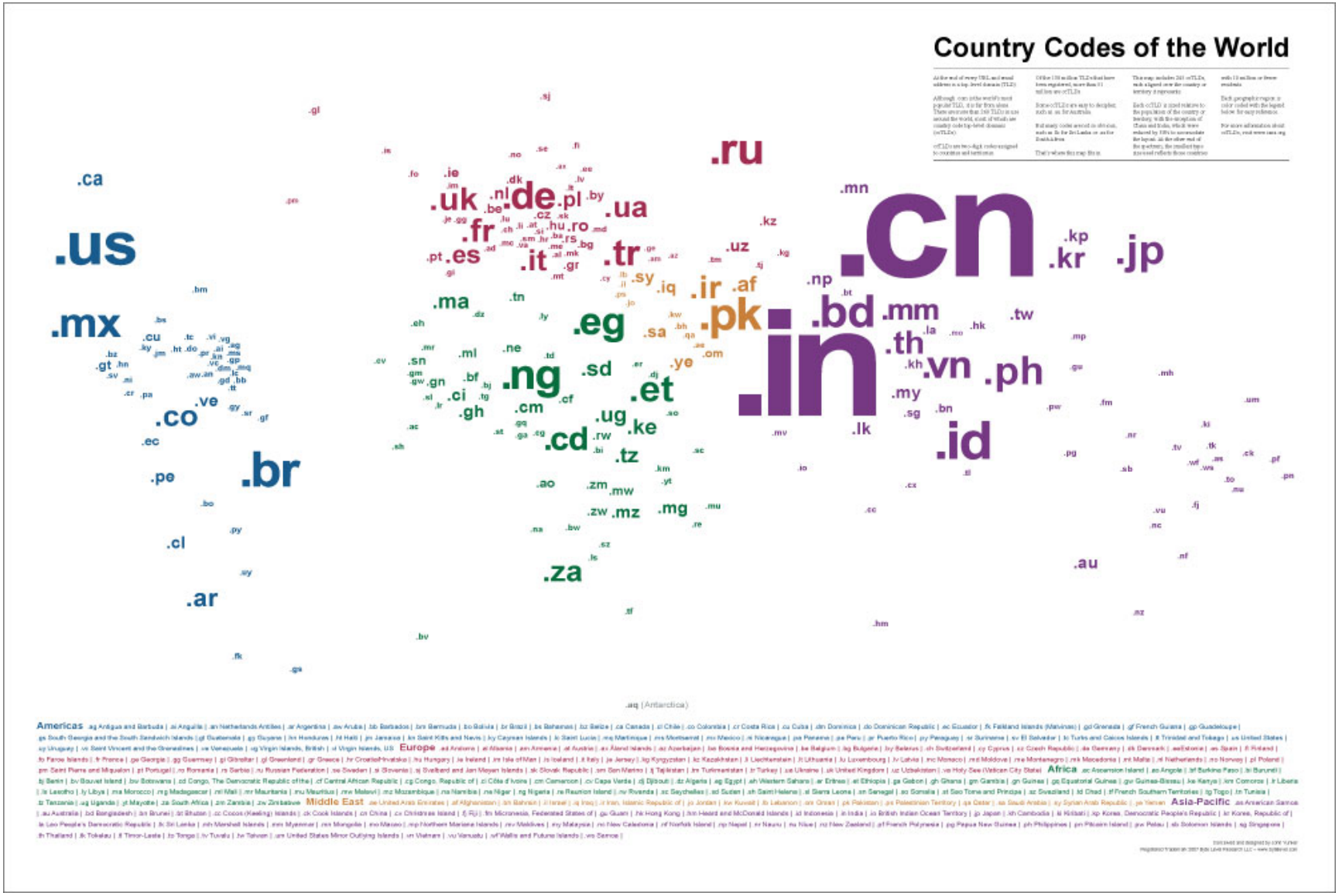
Figure 1.8 Airlines' view of the United States.
Maps can be scaled to units other than distance. In this case, airline fares are used instead of miles or other linear units.
(Map copyright by the author.)



Dent, "Cartography" Based on slide from Hanrahan



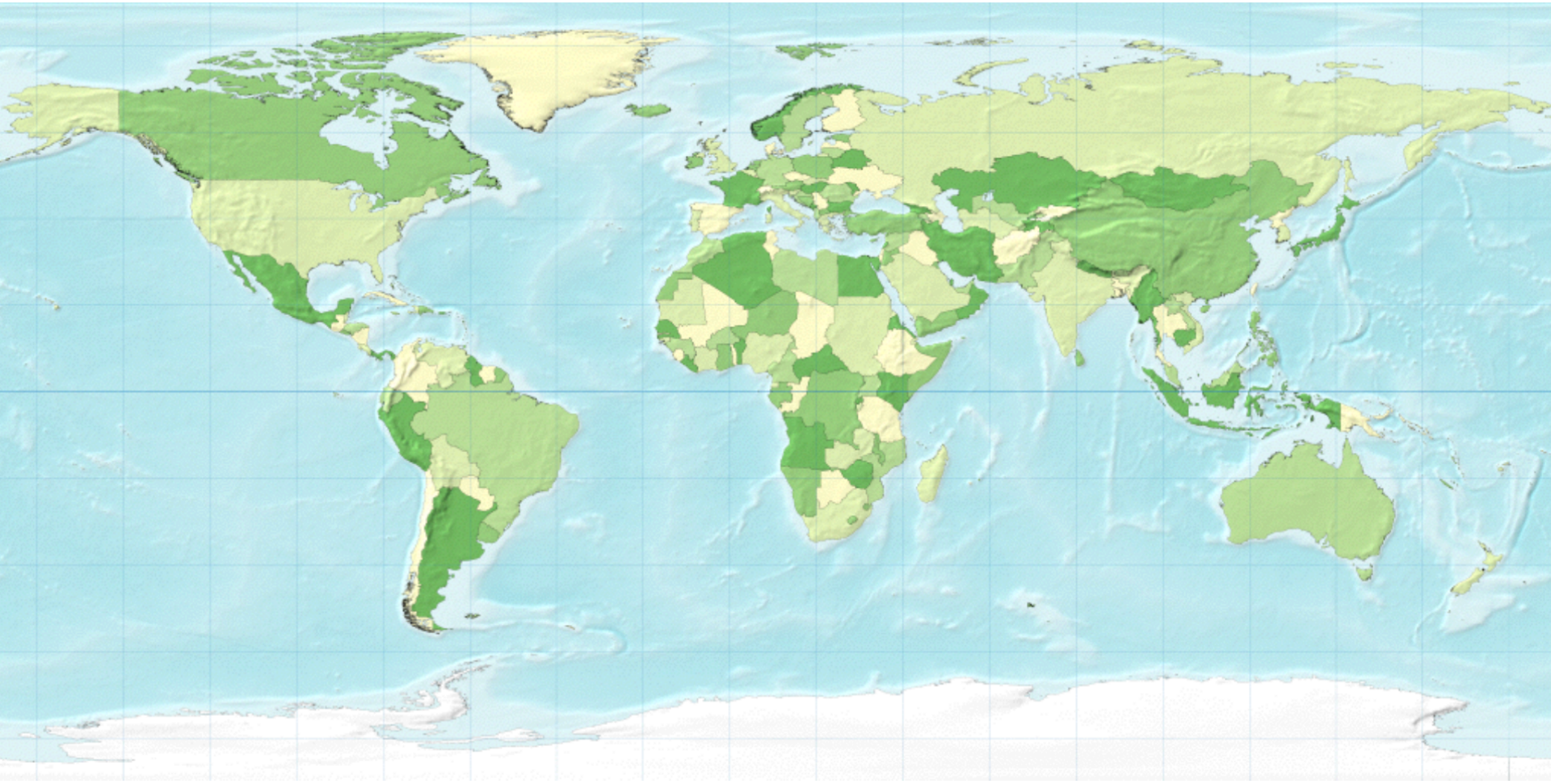
Dent and Turnbull, “Elvis Concerts” Based on slide from Hanrahan



http://www.bytelevel.com/map/ccTLD.html

The following slides depict “The World” using different cartogram data distortions.

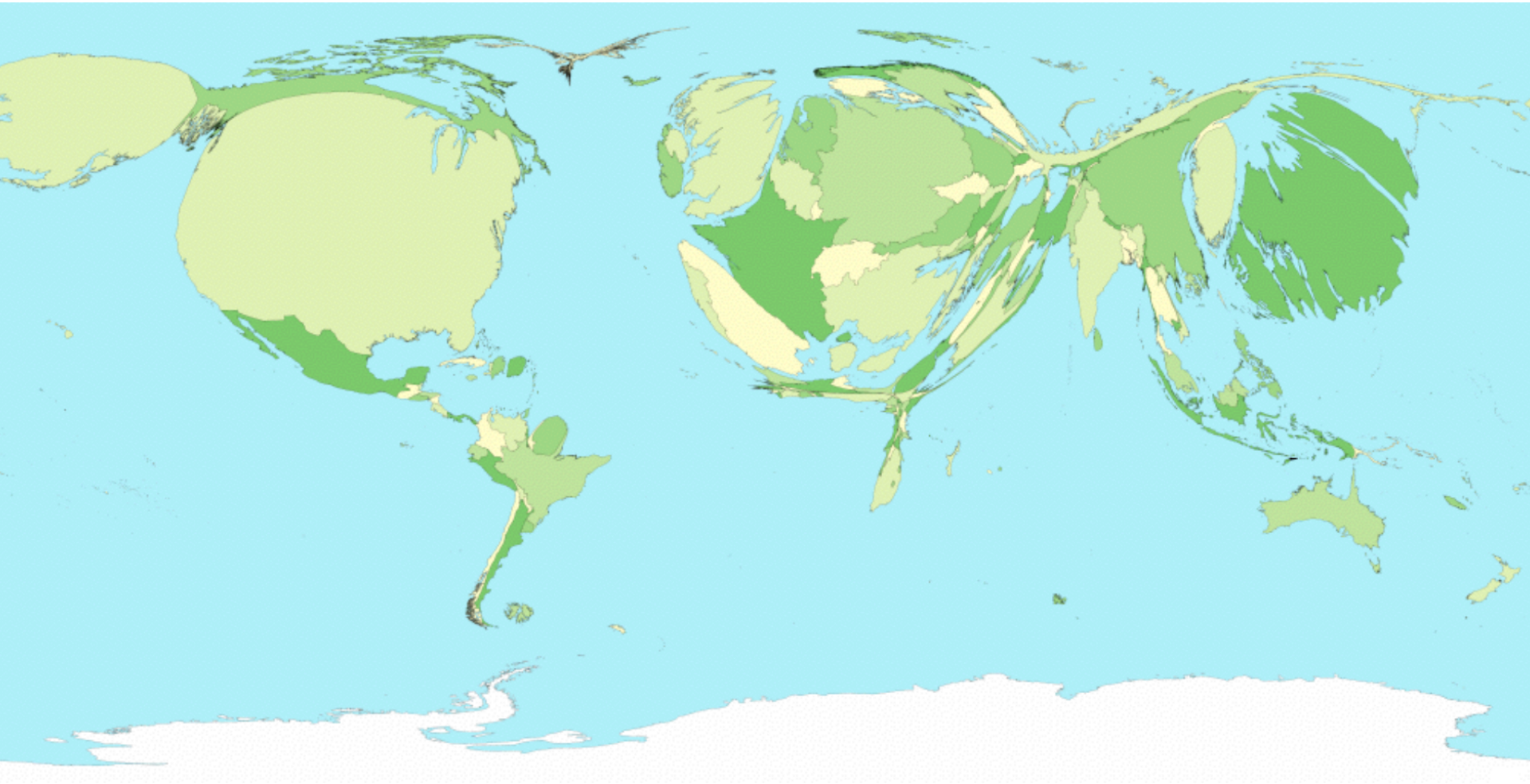
Images are originally from Mark Newman, University of Michigan.



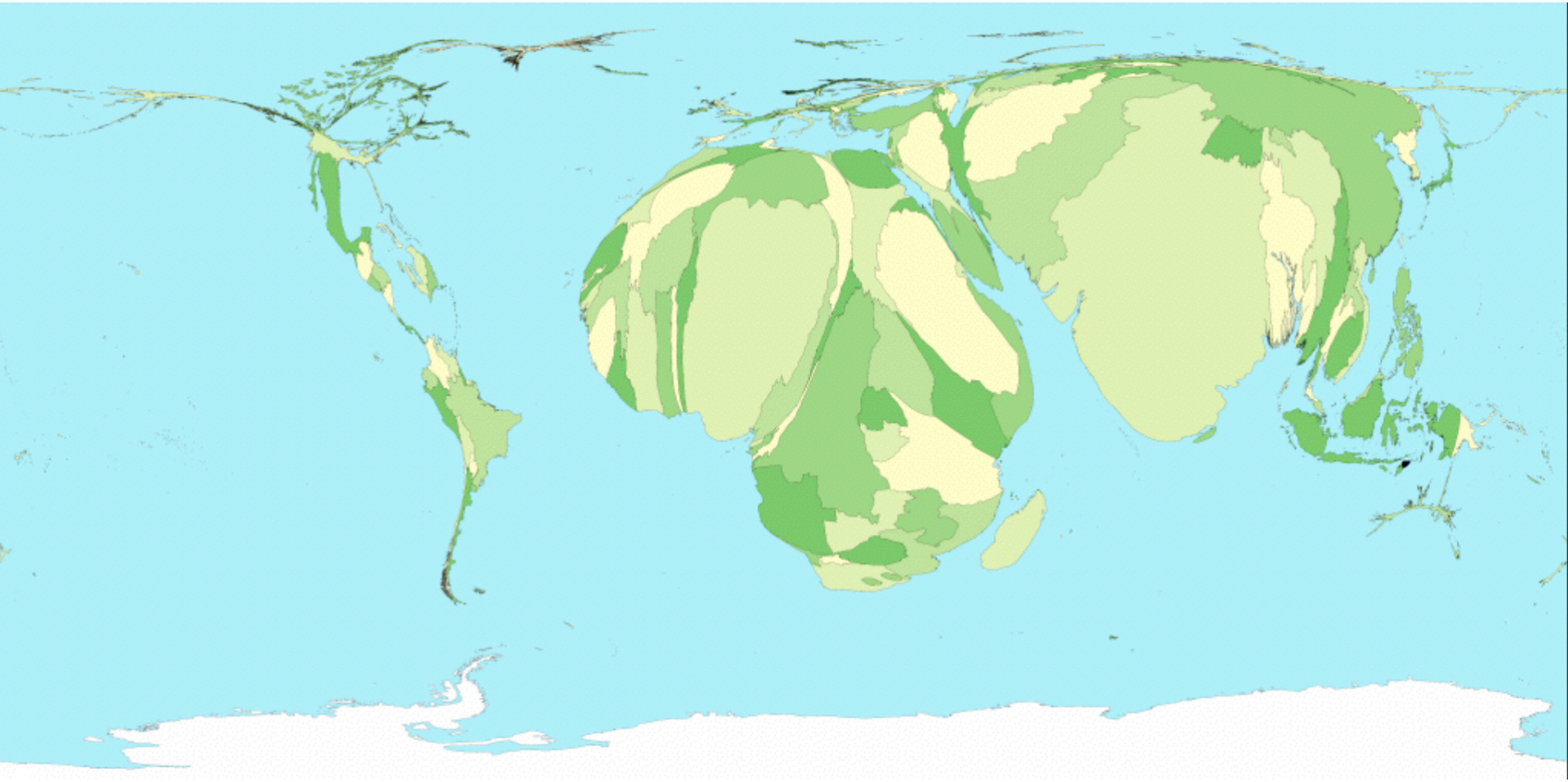
POPULATION


RUSSIA
CANADA
UNITED STATES
U.K.
GERMANY
UKRAINE
FRANCE
ITALY
TURKEY
IRAN
PAKISTAN
CHINA
INDIA
S. KOREA
JAPAN
MEXICO
EGYPT
NIGERIA
ETHIOPIA
BANGLADESH
MYANMAR
THAILAND
PHILIPPINES
COLOMBIA
PERU
BRAZIL
DR CONGO
INDONESIA
PACIFIC OCEAN
ATLANTIC OCEAN
SOUTH AFRICA
INDIAN OCEAN
AUSTRALIA
NEW ZEALAND
ARGENTINA
ANTARCTICA

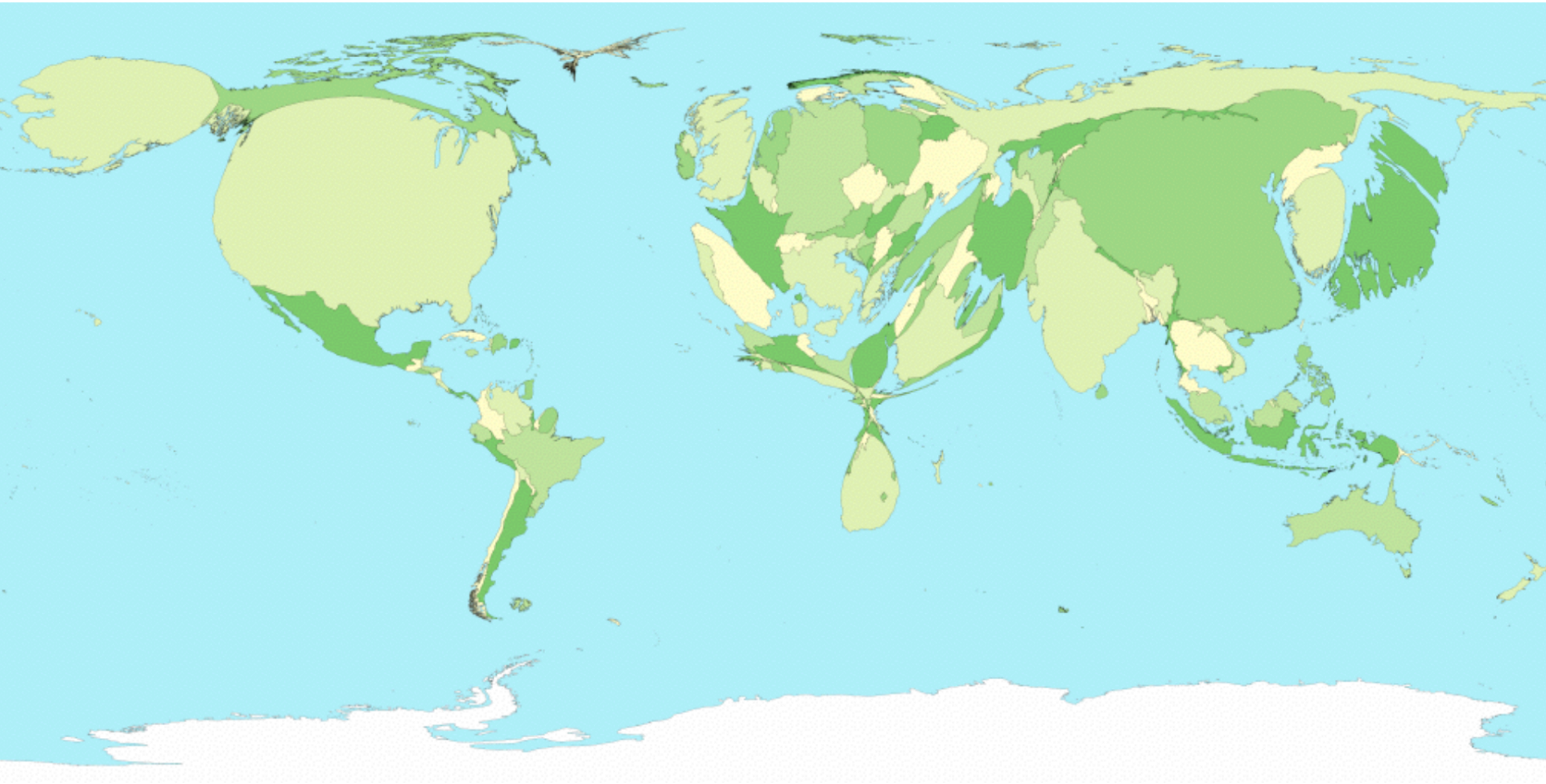
GDP



Child Mortality



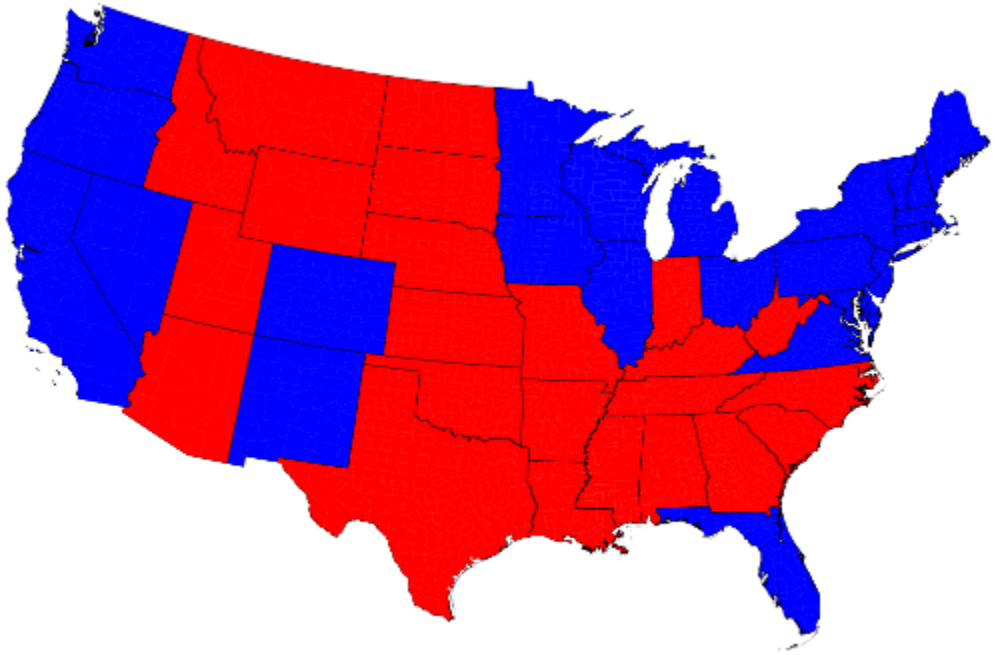
Greenhouse Gas Emissions



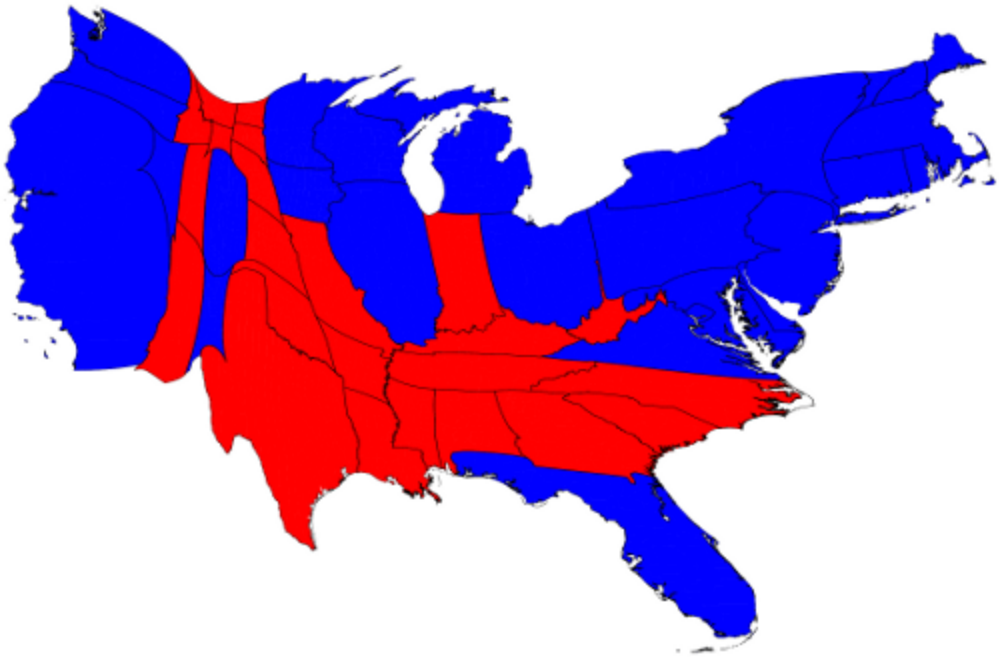
The following slides depict the 2012 Presidential Elections using different cartographical approaches.

Images are originally from Mark Newman, University of Michigan.

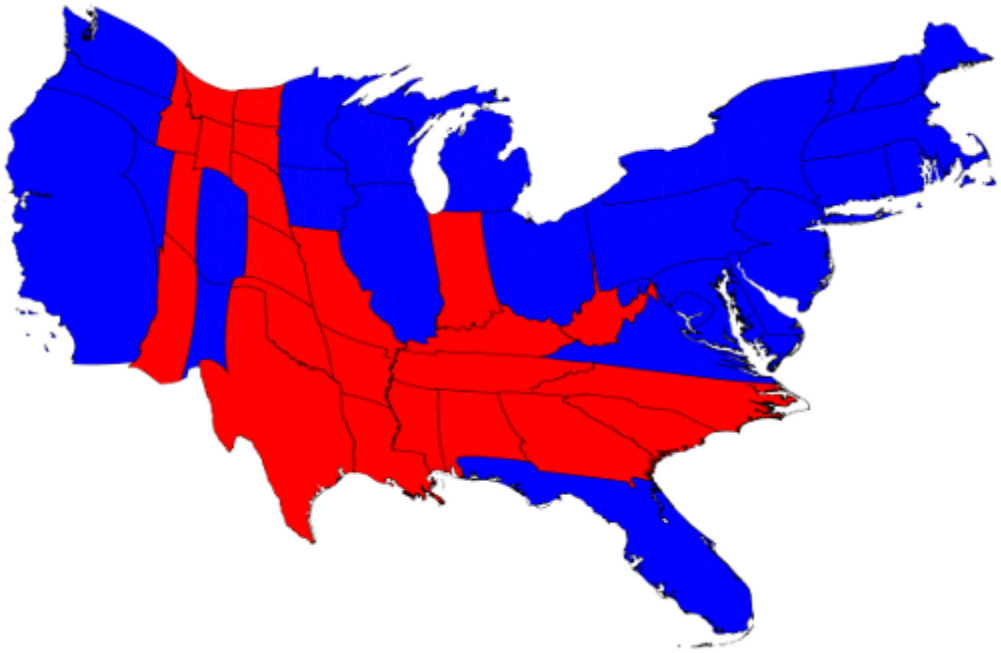
Election Results by State



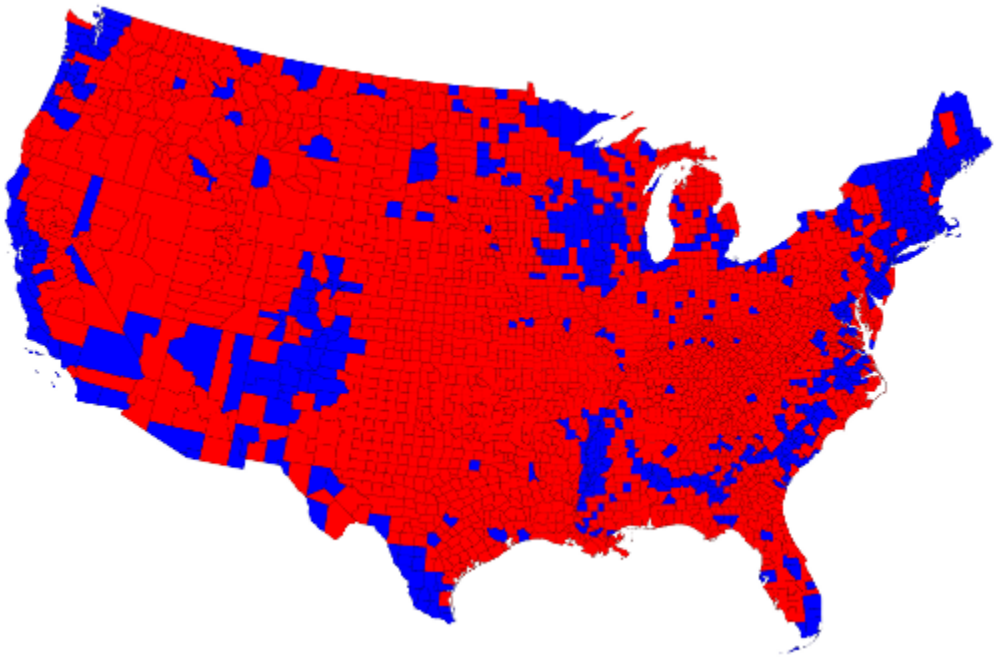
Election Results by Population of State



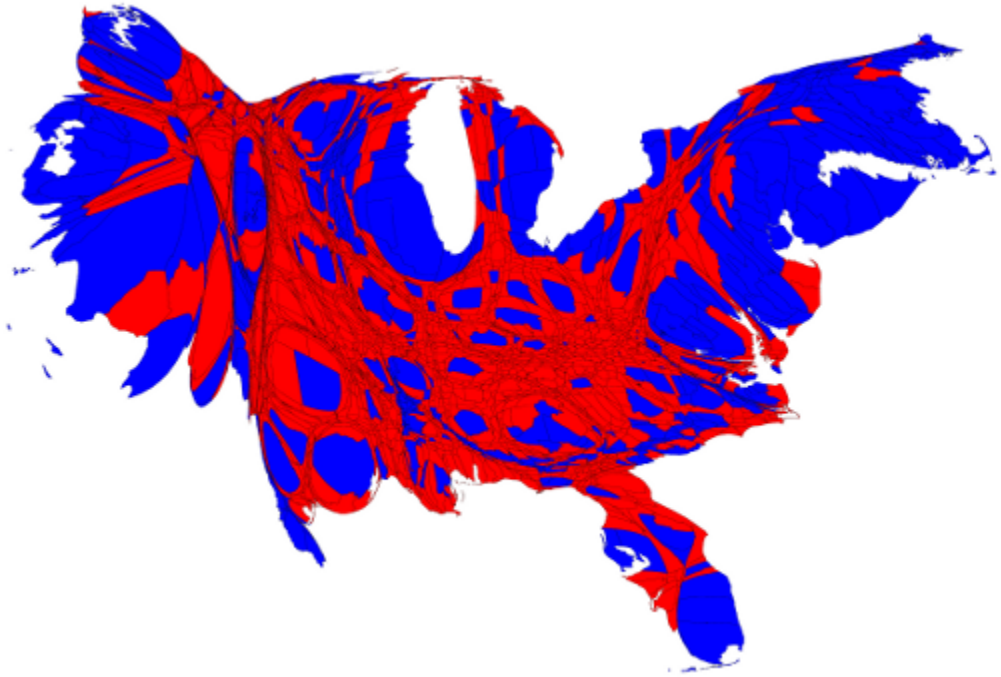
Election Results by Electoral College Votes



Election Results by County

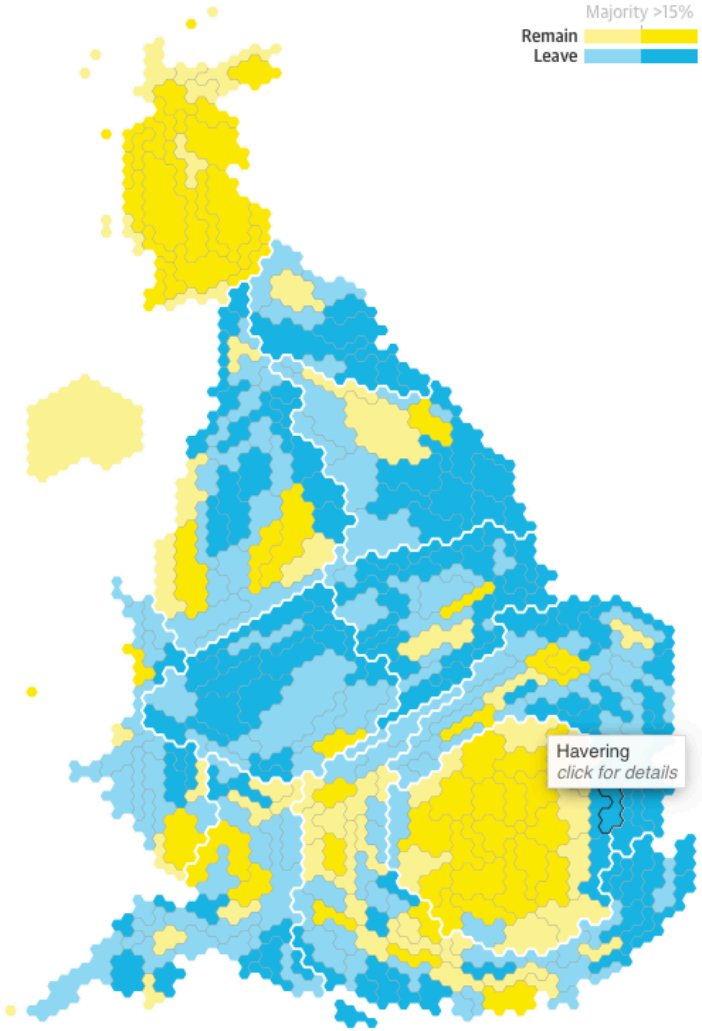


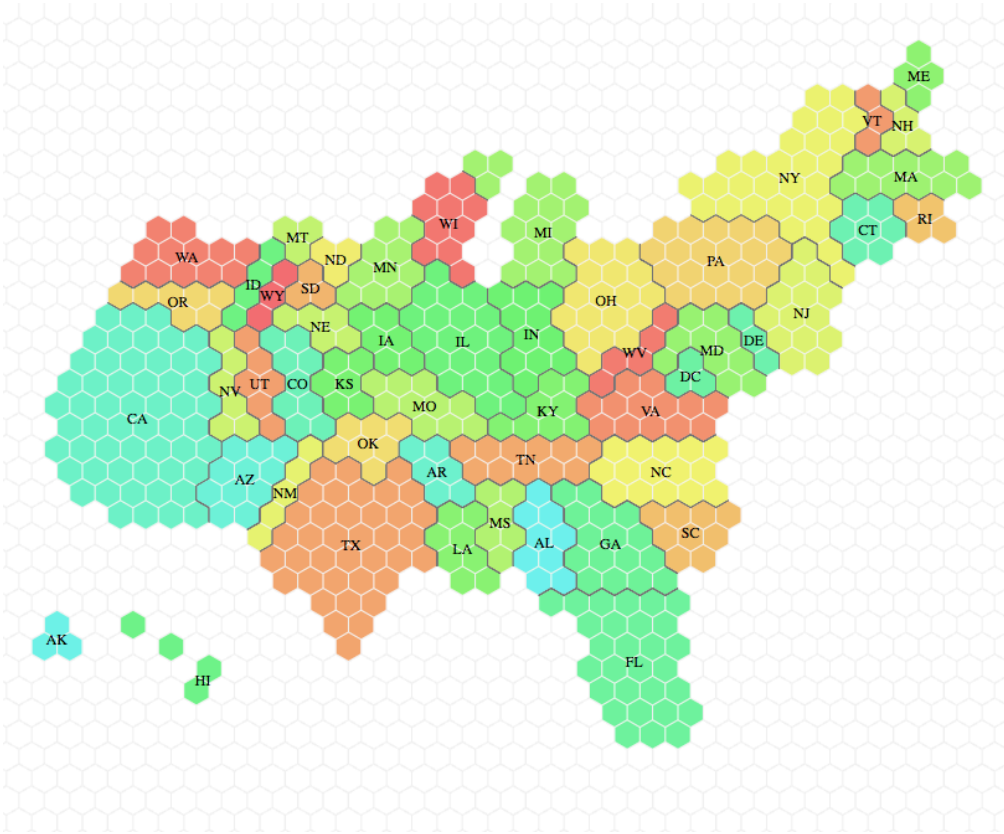
Election Results by County Population



Election Results by County Population with Gradient Binning

”Tilegrams” address some limitations of cartograms:





https://www.theguardian.com/politics/ng-interactive/2016/jun/23/eu-referendum-live-results-and-analysis

https://pitchinteractiveinc.github.io/tilegrams/

Flow Maps

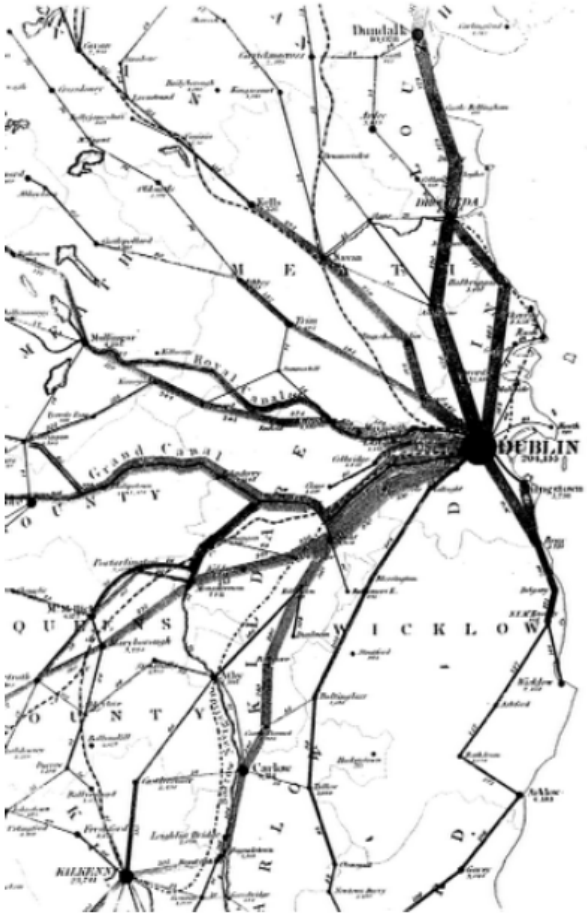
Reduce visual clutter by clustering edges

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

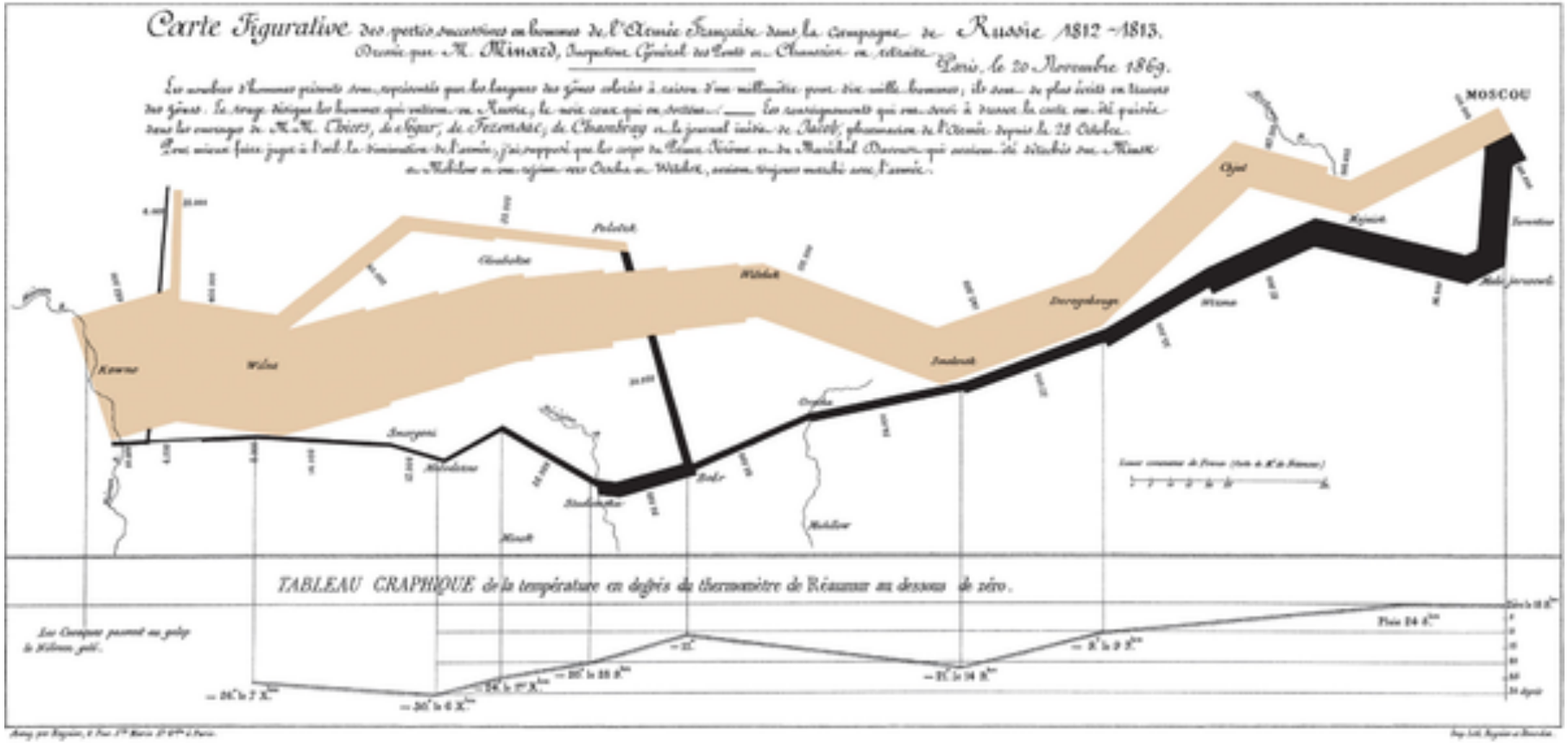
Limitations – Can get difficult to compare flows – Best flow maps are done by hand

Special types: Sankey Diagrams

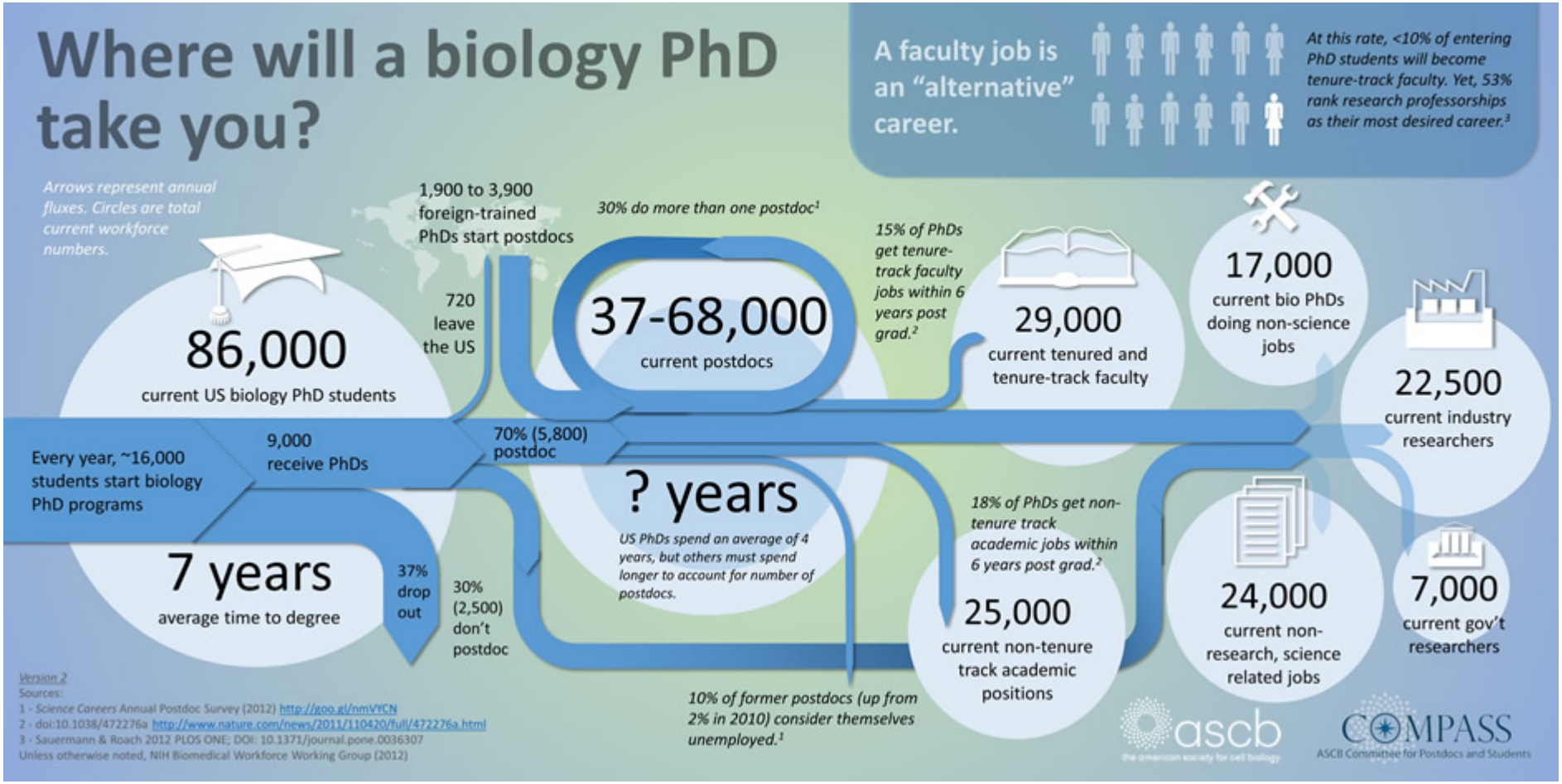


Transportation of Passengers
in Ireland
Henry Drury Harness, 1837

Slide modified from Hanspeter Pfister, Harvard



Charles Joseph Minard *map of Napoleon's disastrous Russian campaign of 1812* (1869)



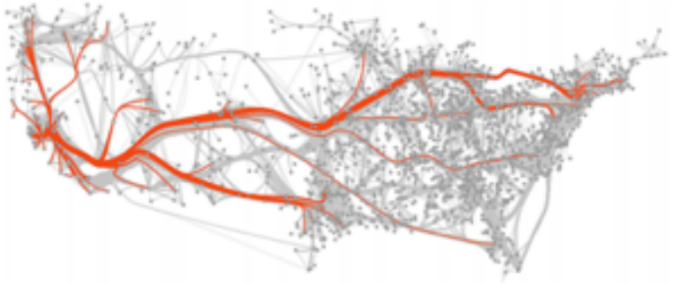
http://www.ascb.org/ascbpost/index.php/compass-points/item/285-where-will-a-biology-phd-take-you

Migration from California

Tobler 1987

Phan et al. 2005

Verbeek et al. 2011



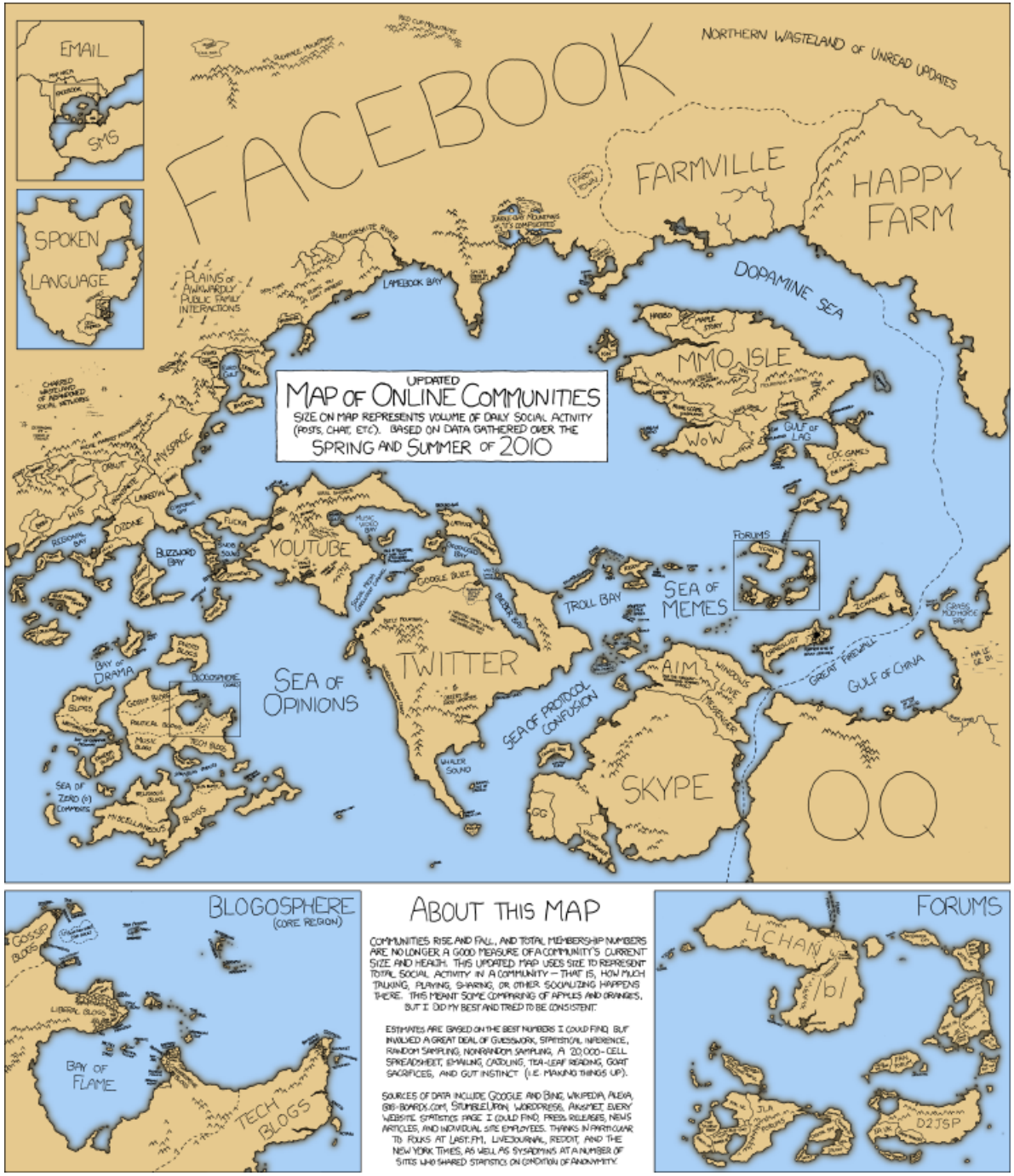
Cui et al. 2008

Holten & van Wijk 2009

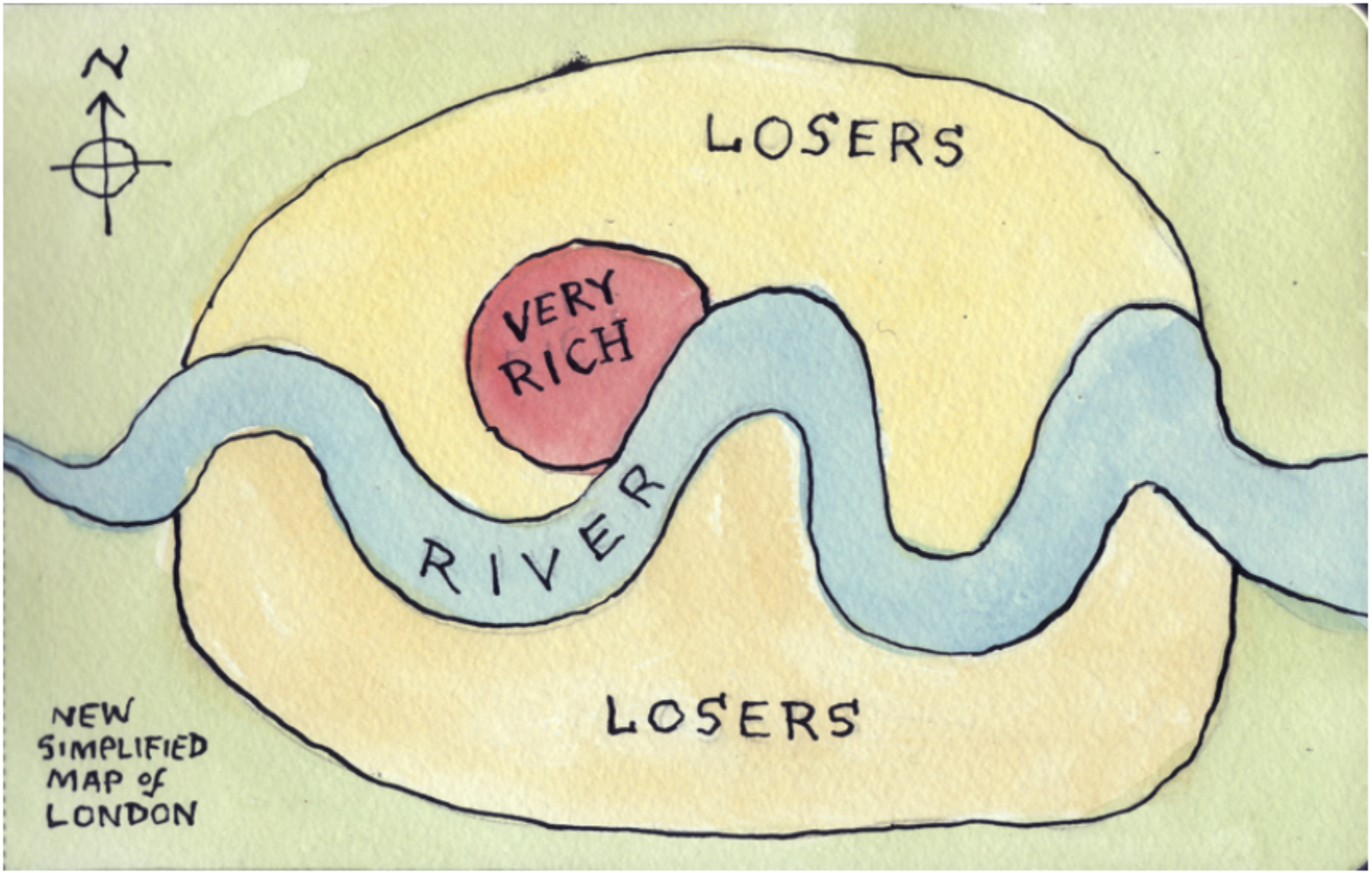
For Fun…,

Extra entertaining thematic maps

Generalizations… and gross generalizations


EMAIL
SMS
SPOKEN LANGUAGE
FACEBOOK
NORTHERN WASTELAND OF UNREAD UPDATES
FARMVILLE
HAPPY FARM
PLAINS OF AWKWARDLY PUBLIC FAMILY INTERACTIONS
LAMEBOOK BAY
DOPAMINE SEA
MMO ISLE
WoW
GULF OF LAG
COC GAMES
UPDATED
MAP OF ONLINE COMMUNITIES
SIZE ON MAP REPRESENTS VOLUME OF DAILY SOCIAL ACTIVITY (POSTS, CHAT, ETC). BASED ON DATA GATHERED OVER THE SPRING AND SUMMER OF 2010
MYSPACE
YOUTUBE
BUZZWORD BAY
FORUMS
SEA OF MEMES
TROLL BAY
BAY OF DRAMA
SEA OF OPINIONS
TWITTER
SEA OF PROTOCOL CONFUSION
AIM
GREAT FIREWALL
GULF OF CHINA
SKYPE
QQ
BLOGOSPHERE
(CORE REGION)
BAY OF FLAME
TECH BLOGS
ABOUT THIS MAP
COMMUNITIES RISE AND FALL, AND TOTAL MEMBERSHIP NUMBERS ARE NO LONGER A GOOD MEASURE OF A COMMUNITY'S CURRENT SIZE AND HEALTH. THIS UPDATED MAP USES SIZE TO REPRESENT TOTAL SOCIAL ACTIVITY IN A COMMUNITY — THAT IS, HOW MUCH TALKING, PLAYING, SHARING, OR OTHER SOCIALIZING HAPPENS THERE. THIS MEANT SOME COMPARING OF APPLES AND ORANGES, BUT I DID MY BEST AND TRIED TO BE CONSISTENT.
ESTIMATES ARE BASED ON THE BEST NUMBERS I COULD FIND, BUT INVOLVED A GREAT DEAL OF GUESSWORK, STATISTICAL INFERENCE, RANDOM SAMPLING, NONRANDOM SAMPLING, A 20,000-CELL SPREADSHEET, EMAILING, CATDLING, TEA-LEAF READING, GOAT SACRIFICES, AND GUT INSTINCT (I.E. MAKING THINGS UP).
SOURCES OF DATA INCLUDE GOOGLE AND BING, WIKIPEDIA, ALEXA, QUANTCAST, STUMBLEUPON, WORDPRESS, AKISMET, EVERY WEBSITE STATISTICS PAGE I COULD FIND, PRESS RELEASES, NEWS ARTICLES, AND INDIVIDUAL SITE EMPLOYEES. THANKS IN PARTICULAR TO FOLKS AT LAST.FM, LIVEJOURNAL, REDDIT, AND THE NEW YORK TIMES, AS WELL AS SYSADMINS AT A NUMBER OF SITES WHO SHARED STATISTICS ON CONDITION OF ANONYMITY.
FORUMS
4CHAN
/b/
D2JSP

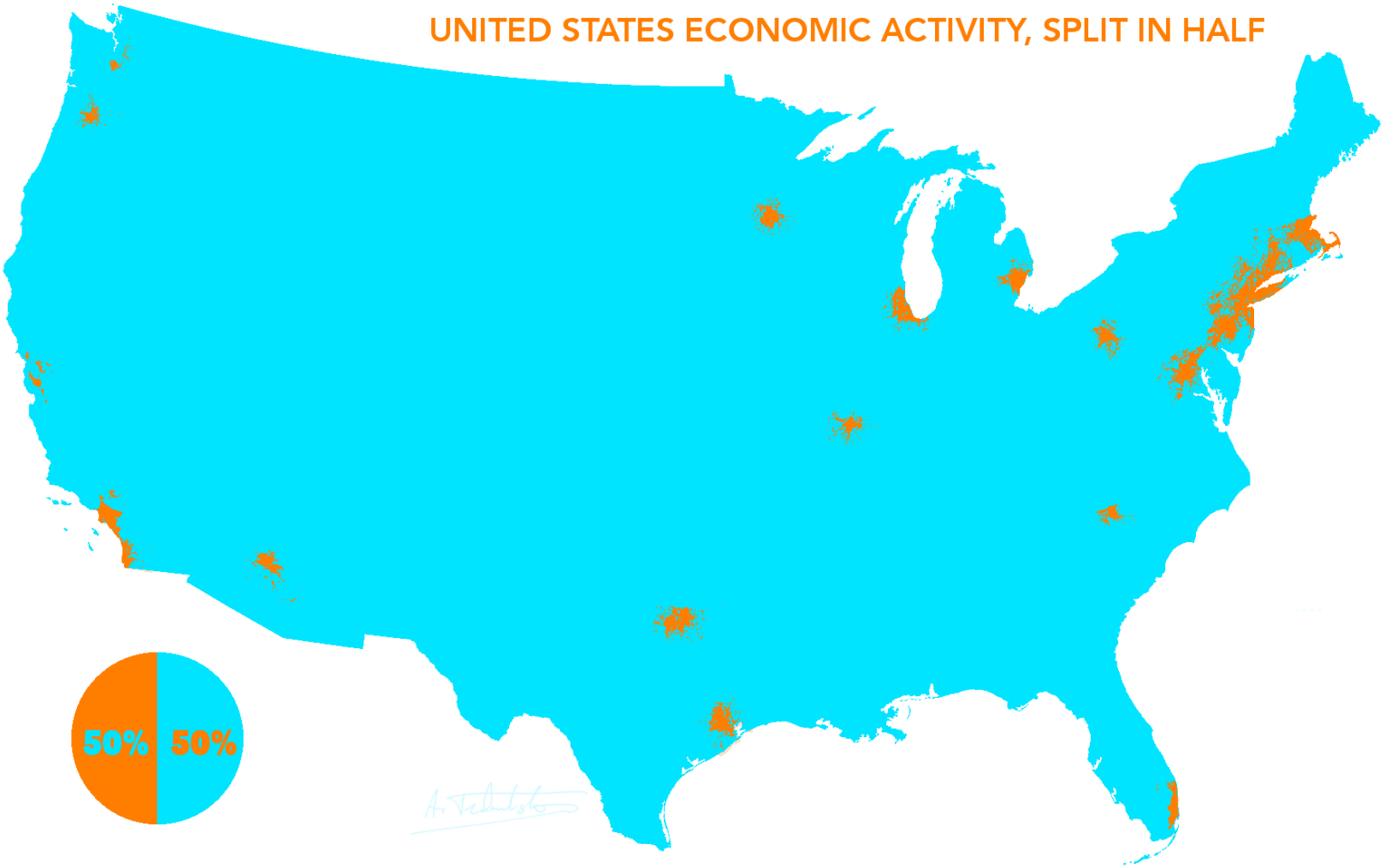
London Underground by Harry Beck (1933): http://en.wikipedia.org/wiki/Harry_Beck



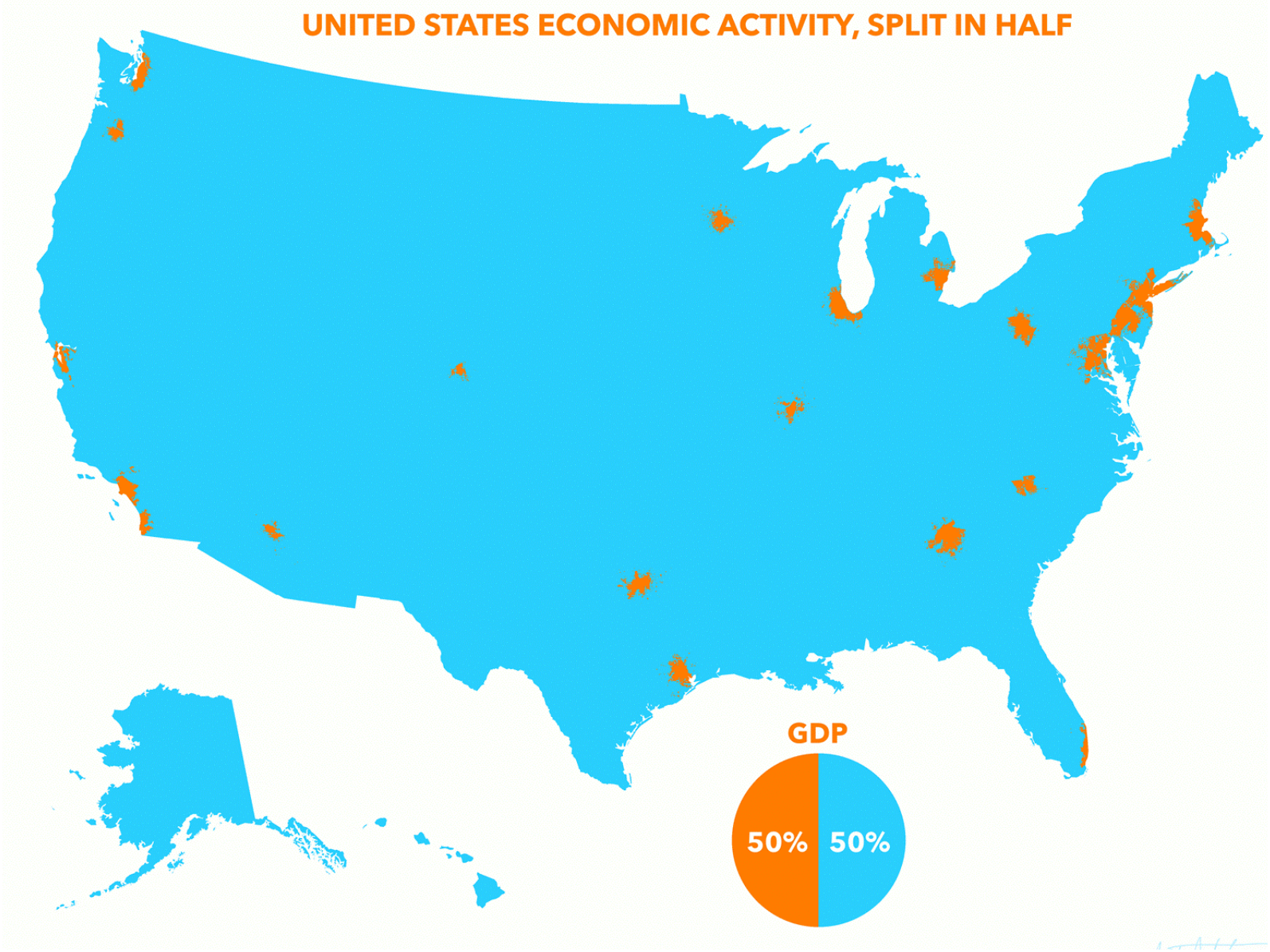
From Memory (was: Maps from Memory): http://www.flickr.com/groups/46079190@N00/

Some conversations

Is it good? Is it bad? Is it… something else?



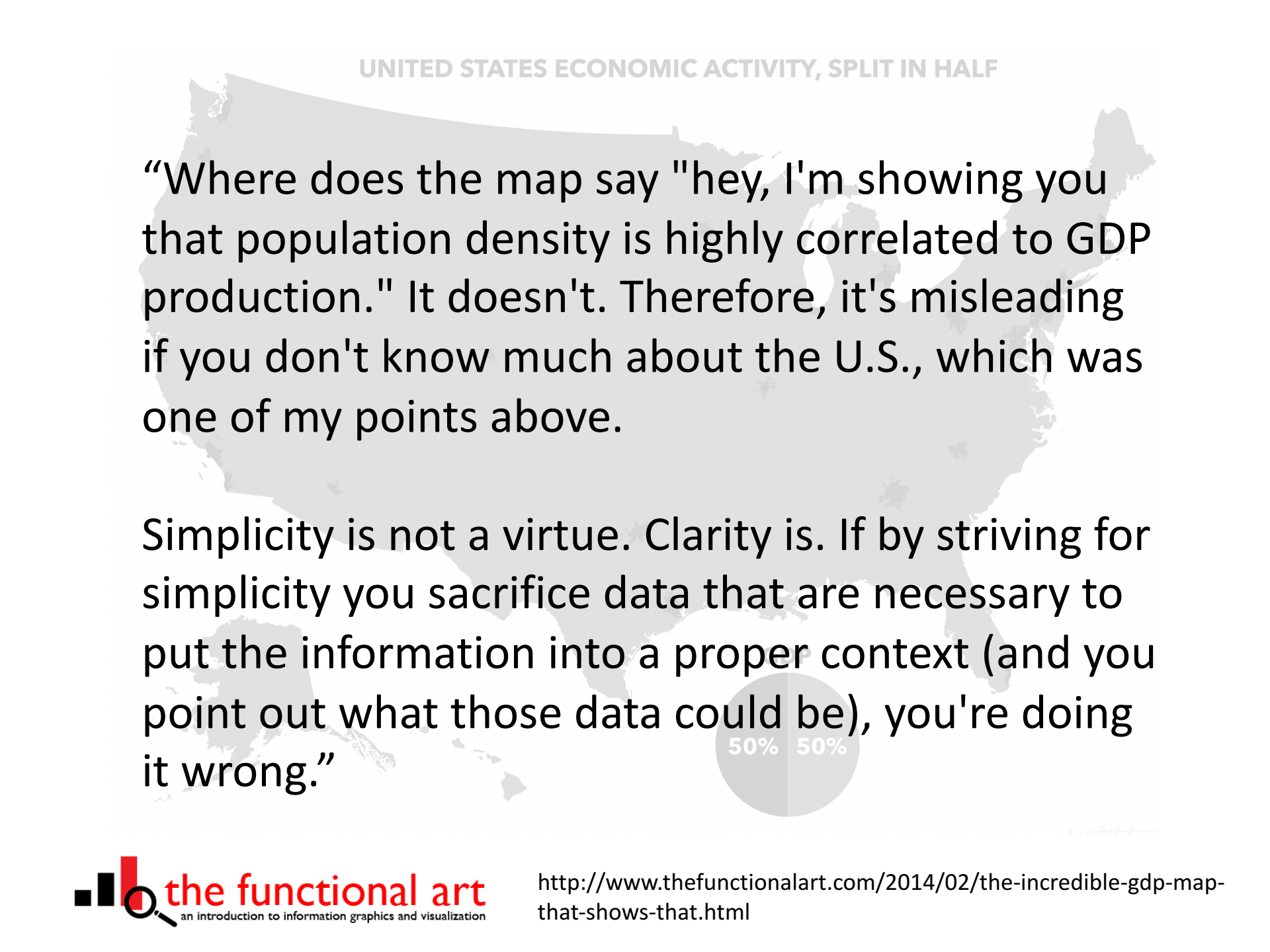
Data From: http://www.usmayors.org/metroeconomies/2013/201311-report.pdf
Image From: http://i.imgur.com/9slRTRJ.png (atrubetskoy)



Data From: http://www.usmayors.org/metroeconomies/2013/201311-report.pdf
Image From: http://i.imgur.com/9slRTRJ.png (atrubetskoy)

"The reason this is getting any attention at all is because it's a map. If it were a bar chart or similar, people would just ignore it. But no matter how simple or obvious your data, once it's shown on a map, people find it interesting."

http://www.reddit.com/r/MapPorn/comments/1y371s/us_gdp_split_in_half_oc_1770x1114/



"Where does the map say "hey, I'm showing you that population density is highly correlated to GDP production." It doesn't. Therefore, it's misleading if you don't know much about the U.S., which was one of my points above.

Simplicity is not a virtue. Clarity is. If by striving for simplicity you sacrifice data that are necessary to put the information into a proper context (and you point out what those data could be), you're doing it wrong."

the functional art
an introduction to information graphics and visualization

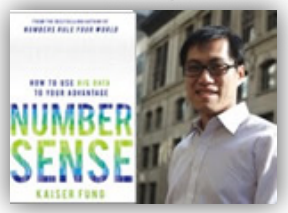
http://www.thefunctionalart.com/2014/02/the-incredible-gdp-map-that-shows-that.html

"The objective of visualization is not just to surprise, enlighten and reveal new things to all. If you can, wow, oh my god and the rest. But sometimes it just reinforces, maybe showing something we know but from a different angle. That's ok. It is still legitimate to serve 'just' that objective."

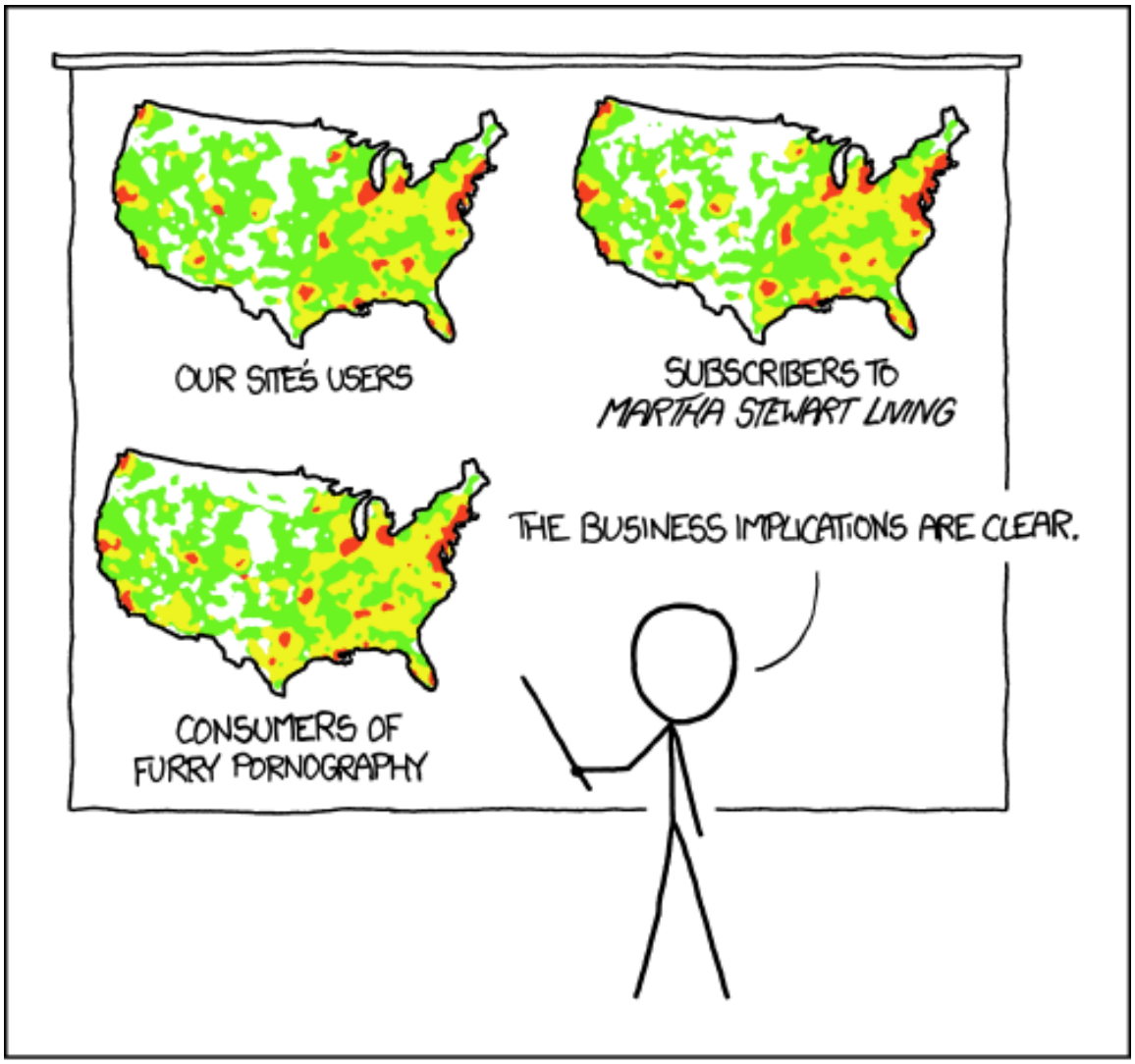
visualising data

http://www.visualisingdata.com/index.php/2014/02/defending-the-incredible-gdp-map/

UNITED STATES ECONOMIC ACTIVITY, SPLIT IN HALF



http://junkcharts.typepad.com/numbersruleyourworld/2014/02/numbersense-and-true-lies.html



PET PEEVE #208:

GEOGRAPHIC PROFILE MAPS WHICH ARE BASICALLY JUST POPULATION MAPS

Homework

Let’s get Political…

Who is going to win the election?

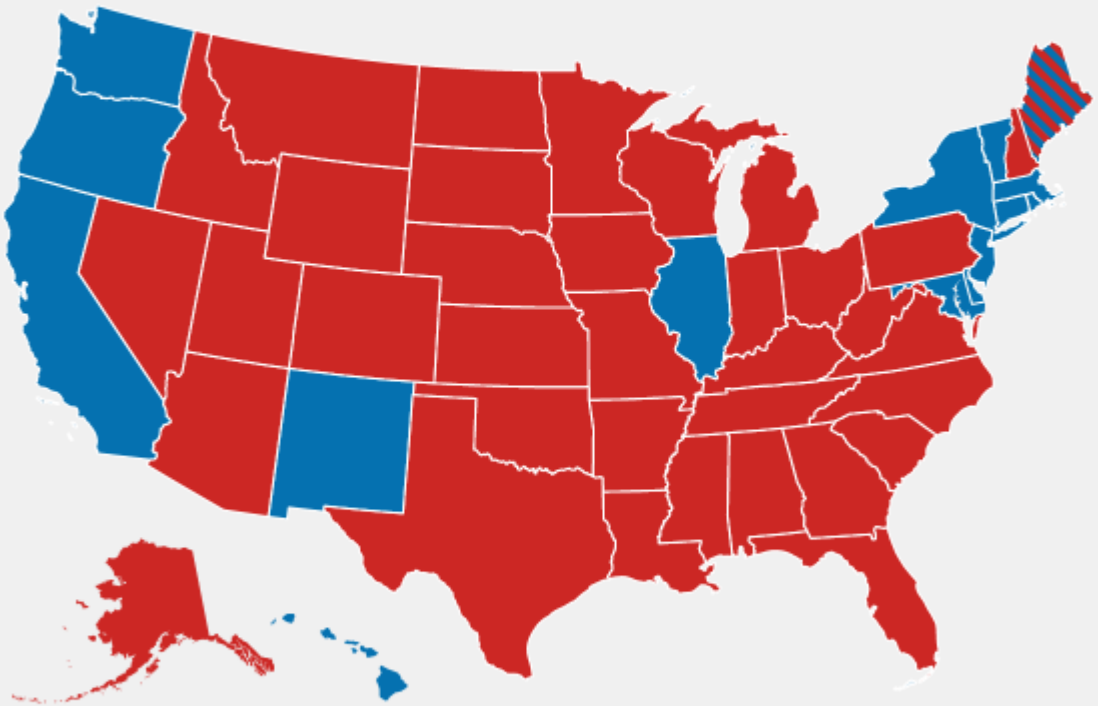
What 2016 would look like if just men voted

Based on the FiveThirtyEight polls-only forecast

188 Clinton

ELECTORAL VOTES NEEDED TO WIN

Trump 350



Nebraska's 5 electoral votes

STATEWIDE:

DISTRICTS:

Maine's 4 electoral votes

STATEWIDE:

DISTRICTS:

FIVETHIRTYEIGHT

Find a map that predicts the election…

Chose an interesting set of circumstances (e.g. if only Men voted); detail what those circumstances are. How was the data gathered, cleaned and filtered? Was the data manipulation ethically sound?

Discuss how the data was visualized. Did they use a choropleth map? Symbolic map? Was the representation ethically sound?

http://www.thefunctionalart.com/2014/02/the-incredible-gdp-map-that-shows-that.html

http://www.visualisingdata.com/index.php/2014/02/defending-the-incredible-gdp-map/

http://junkcharts.typepad.com/numbersruleyourworld/2014/02/numbersense-and-true-lies.html