

Geo Visualization

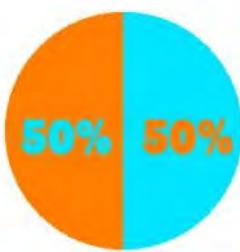
ID 413: Information Graphics and Data Visualization
Spring 2016

Venkatesh Rajamanickam (@venkatrajam)

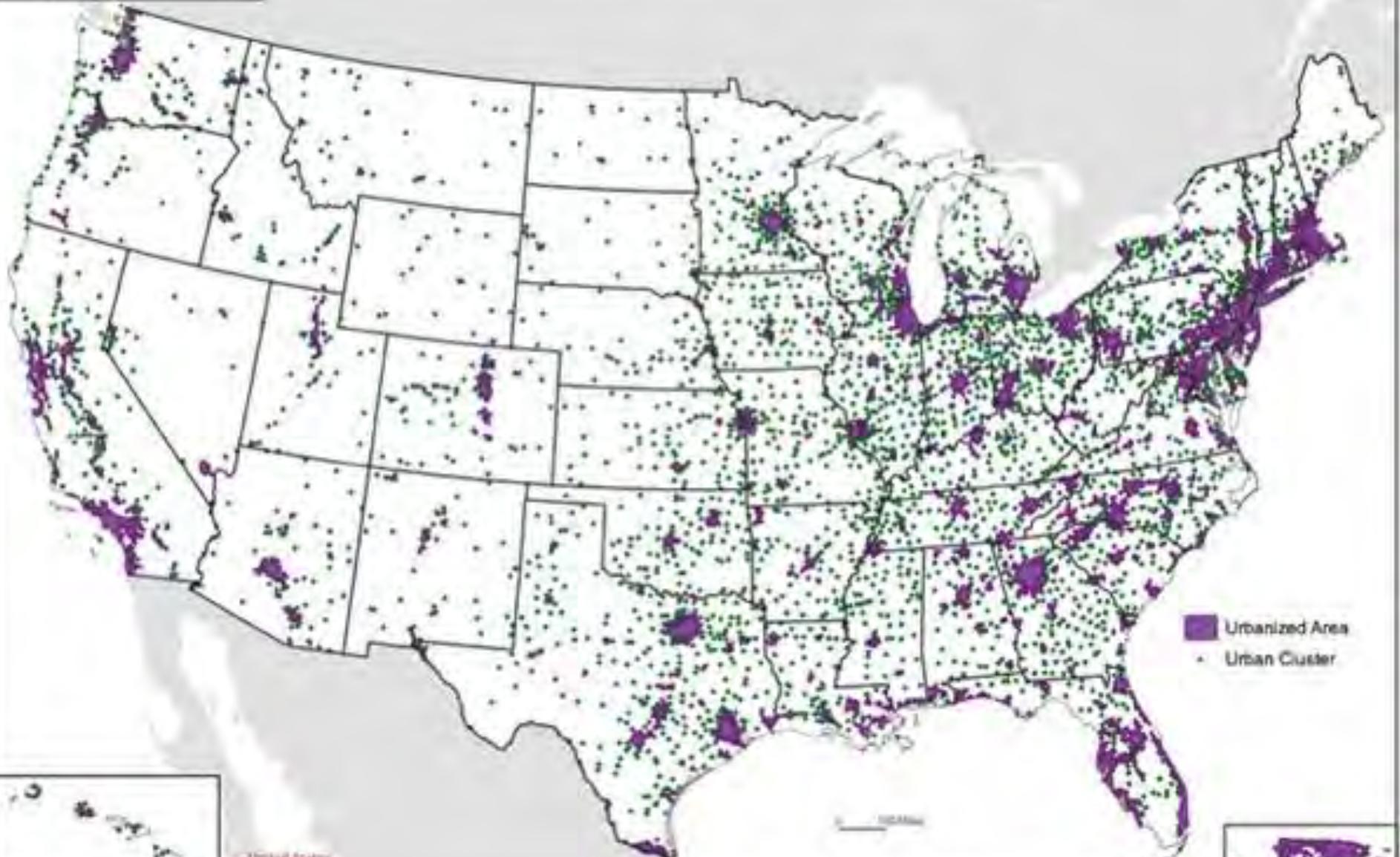
venkatra@iitb.ac.in

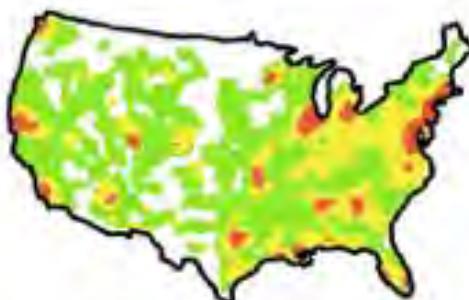
<http://info-design-lab.github.io/ID413-DataViz/>

UNITED STATES ECONOMIC ACTIVITY, SPLIT IN HALF

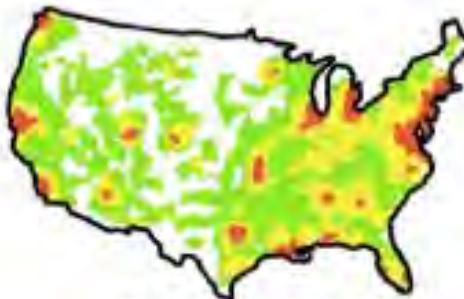


Urbanized Areas and Urban Clusters: 2010

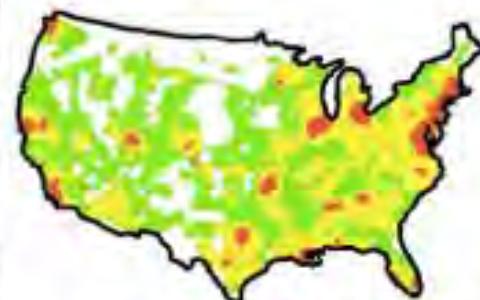




OUR SITE'S USERS



SUBSCRIBERS TO
MARTHA STEWART LIVING



CONSUMERS OF
FURRY PORNOGRAPHY

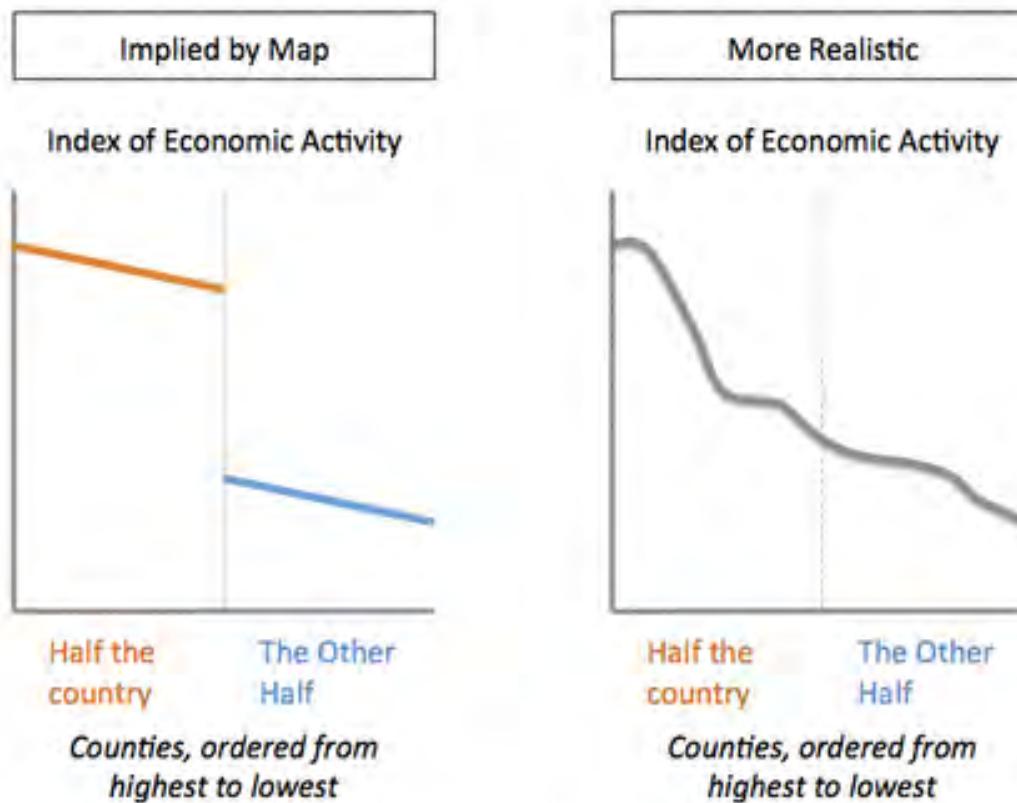
THE BUSINESS IMPLICATIONS ARE CLEAR.



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

The map does not make false claims but it leads readers to the conclusion that the orange areas are much more important than the blue region (equal economic activity but much smaller area). The first problem is that the types of economic activities are vastly different between those regions, and this significant factor is ignored.

The second problem is that the designer over-aggregated the data. All counties (or zip codes) are classified into two groups ("split in half") when in fact, the level of economic activity at the level of counties (or zip codes) is a gradient. Imagine plotting the economic activity index by county, ordered from the highest to the lowest. Do we see a dramatic drop-off after counting out half the counties (i.e., the pattern shown on the left chart below)? Or are we more likely to see the pattern shown on the right? If you see a distribution like the one shown on the right, would you summarize that with just two segments?

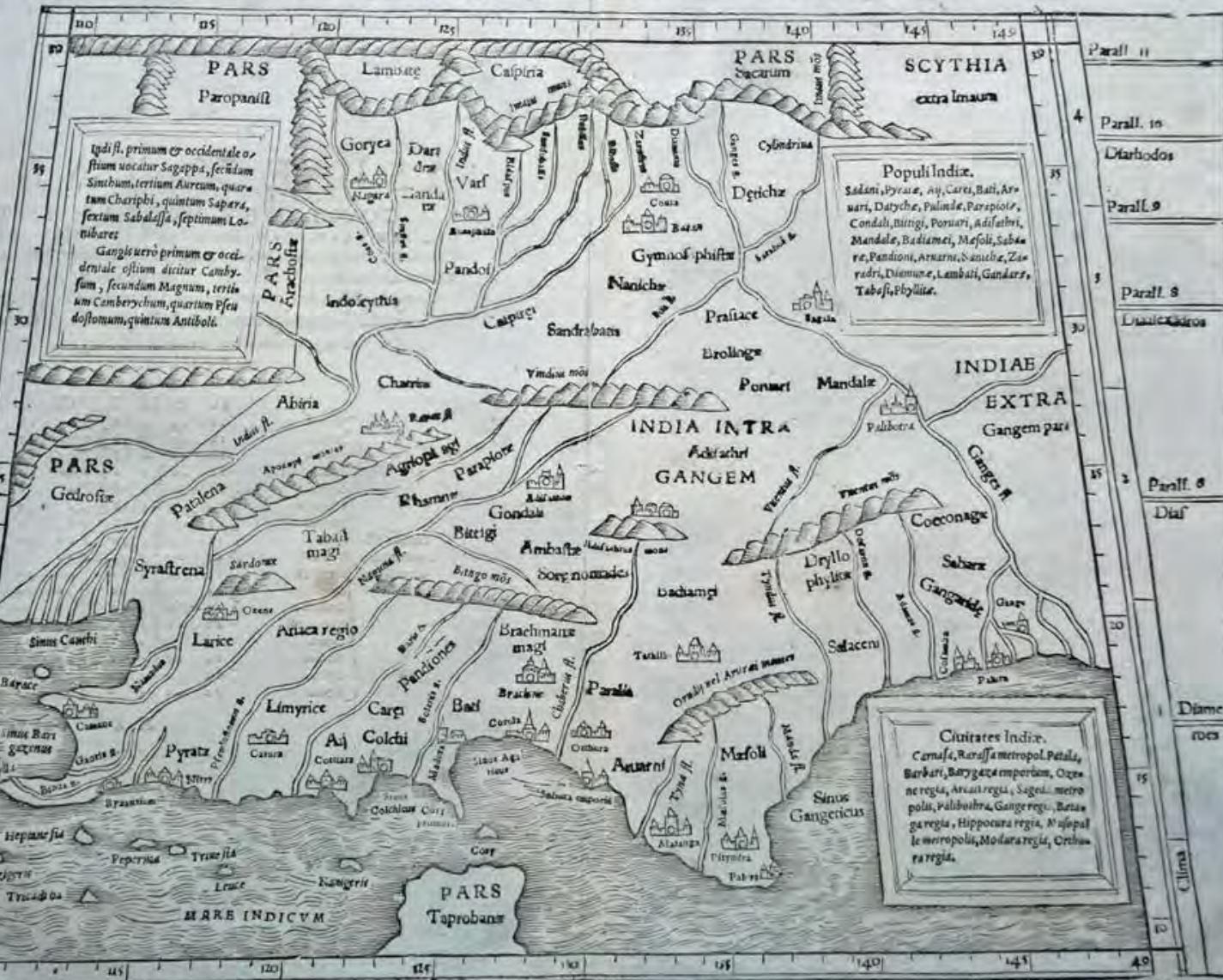


Cartography - Münster's Geographia (1552)

452

TABVLA INDIÆ X.

453



Cartography - Johannes van Keulen (1679)



Cartography - Daniël Stoopenaal (1702)



Cartography - S. Augustus Mitchell (1867)



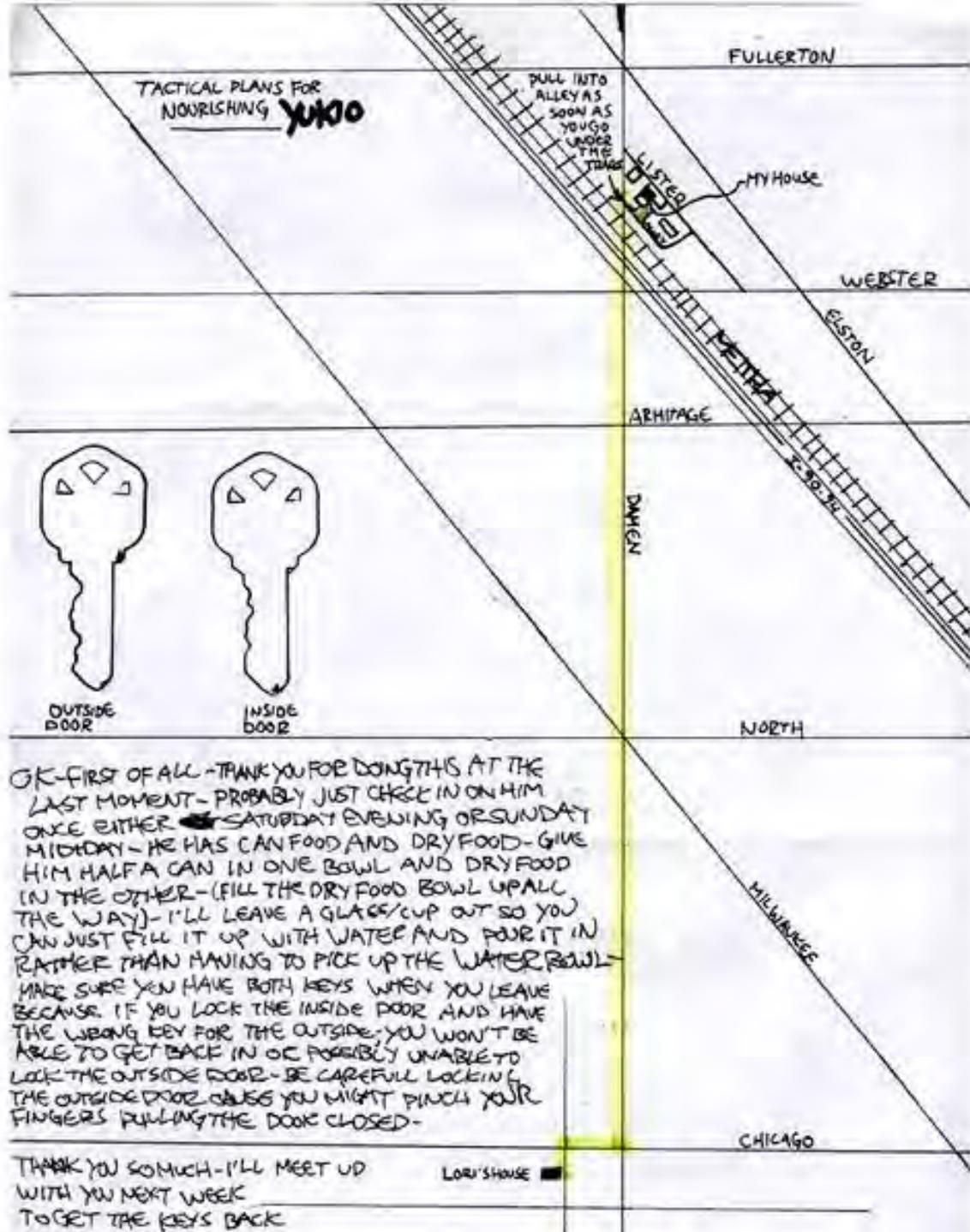
Cartography – 20th Century physical



Cartography – 20th Century political



Mental Cities



Mental Cities

Mental map exercises

- Where am I in the city?
- From here to there
- What's around here?
- Where I went and what I did

Mental Cities

What's so interesting about these maps?

Taking note of people's intuitive strategies – as landscape architects might use shortcuts taken by users or as park planners might in some cities after the snow.



Mental Cities

- Individually tailored “Made for an audience of one”
- In a moment, ephemeral

Mental Cities

Directions

- Steps
- Intermediate goals
- Progressive disclosure

Mental Cities

Efficient

- Edited, only necessary information
- Shorthand notation to accompany verbal description

Mental Cities

Rotate and distort

- Orientation eg. seaside maps
- Geography
- Geometry eg. 'rectilinear correction'
- Scale
- Detail, 'granularity'

Mental Cities

Supportive

- Annotated
- Error detection, "If you reach the toll road, you've gone too far"

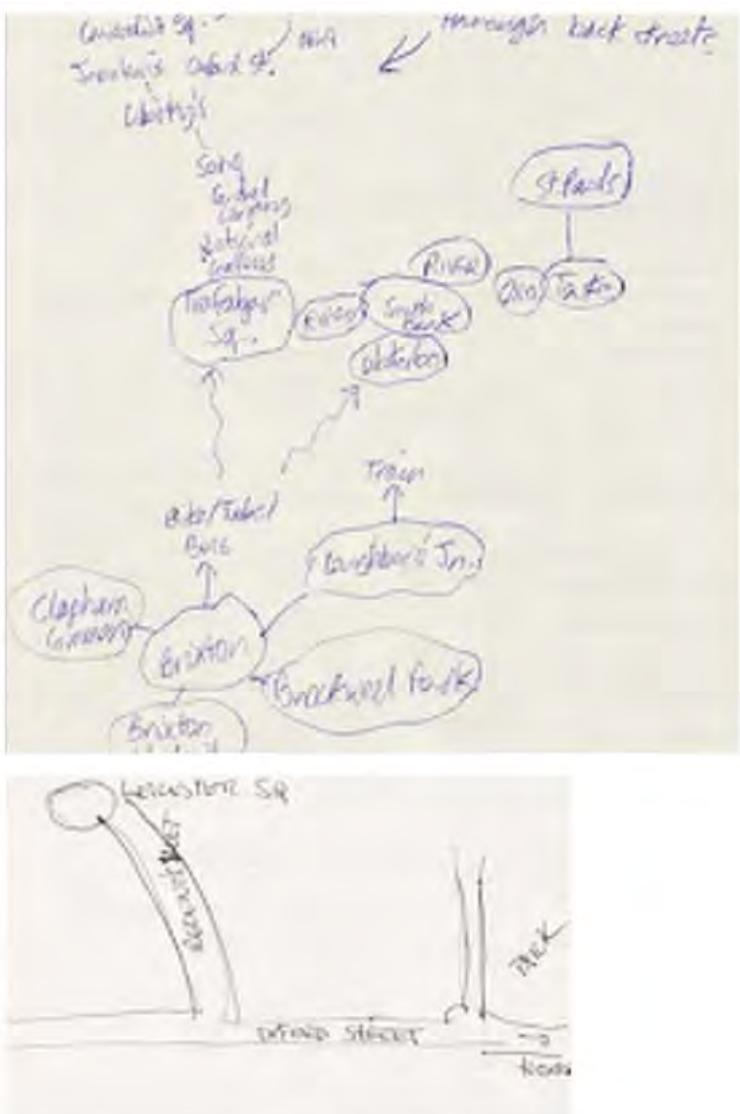
Mental Cities

High Seat 4

ASCENT FROM ASHNESS BRIDGE
1500 feet of ascent : 2 miles (4½ from Keswick)

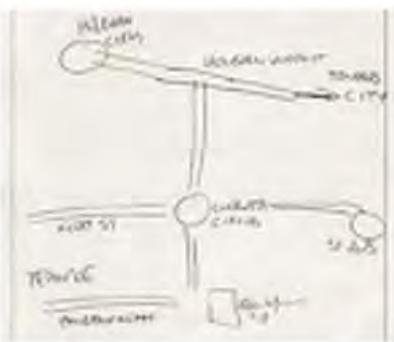
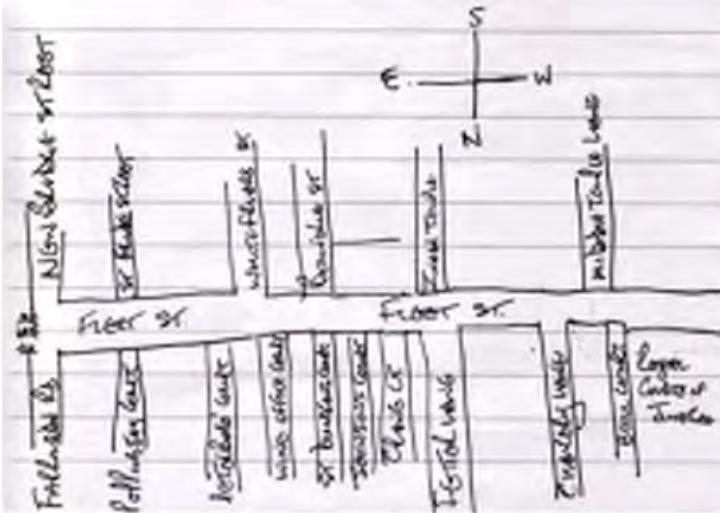


Mental Cities



Linear

This mental map demonstrates the importance of backbone walking routes. Broad and reasonably straight, Fleet Street provides the perfect spine from which roads jut off to the north and south. Names are in the right order, but not geographically. The level of detail and familiarity with the street names suggests that the person responsible has worked in this area for some years.



Stick and ball

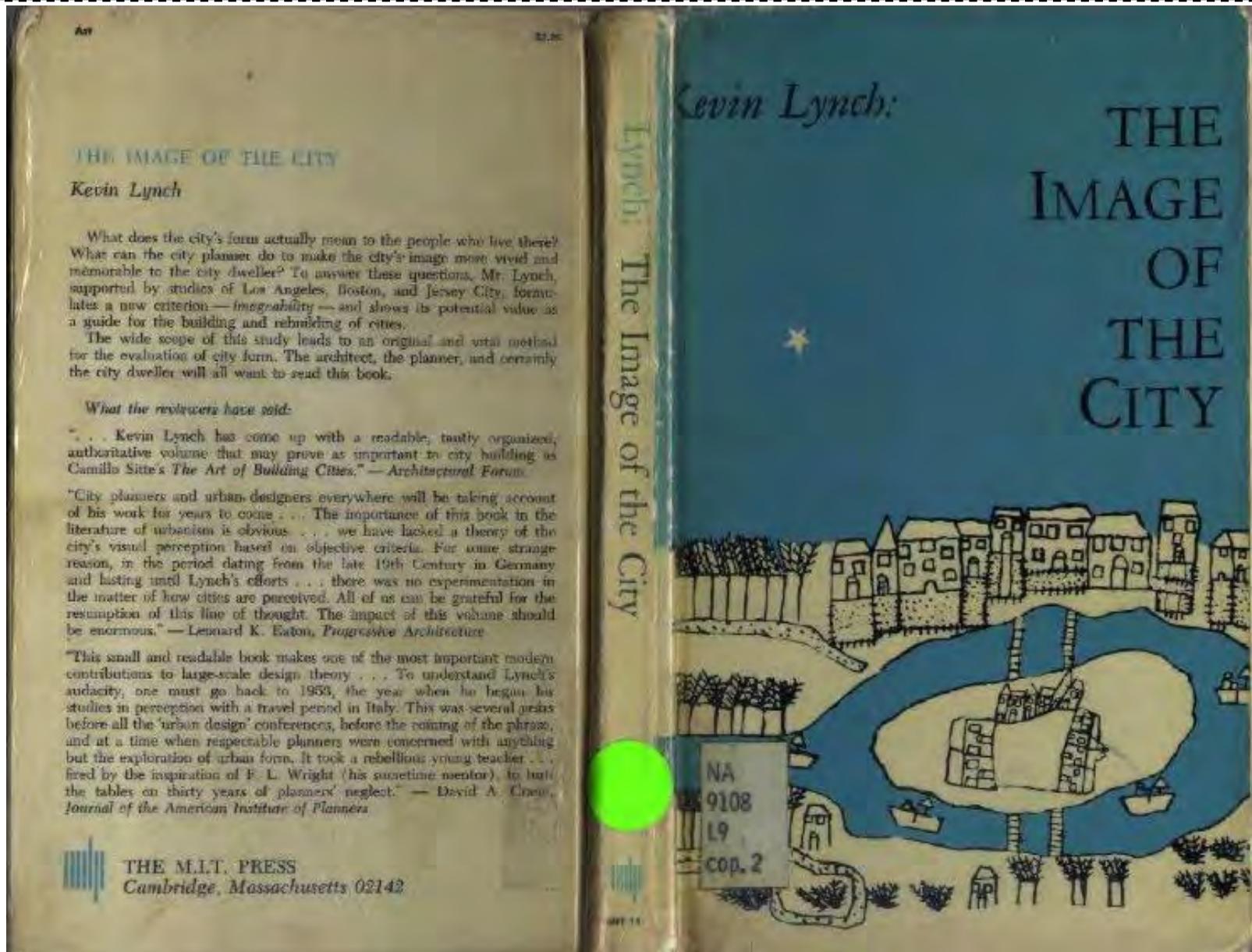
This map is defined by destinations (drawn as circles and named) rather than the routes (drawn as parallel lines and left unnamed). It is probably influenced by the Tube map, and emphasises the arrival rather than the journey.



Human A-Z

Possibly the work of a professional. The level of detail is exceptional, with accomplished draftsmanship and a thorough understanding of geographical relationships. Note the number of important landmarks (to the author!)

The Image of the City – Kevin Lynch



The Image of the City – Kevin Lynch

Mental maps used by Lynch to isolate distinct features of a city and deduce their impact on public experience

The Image of the City – Kevin Lynch

Imageability, or legibility, of a place

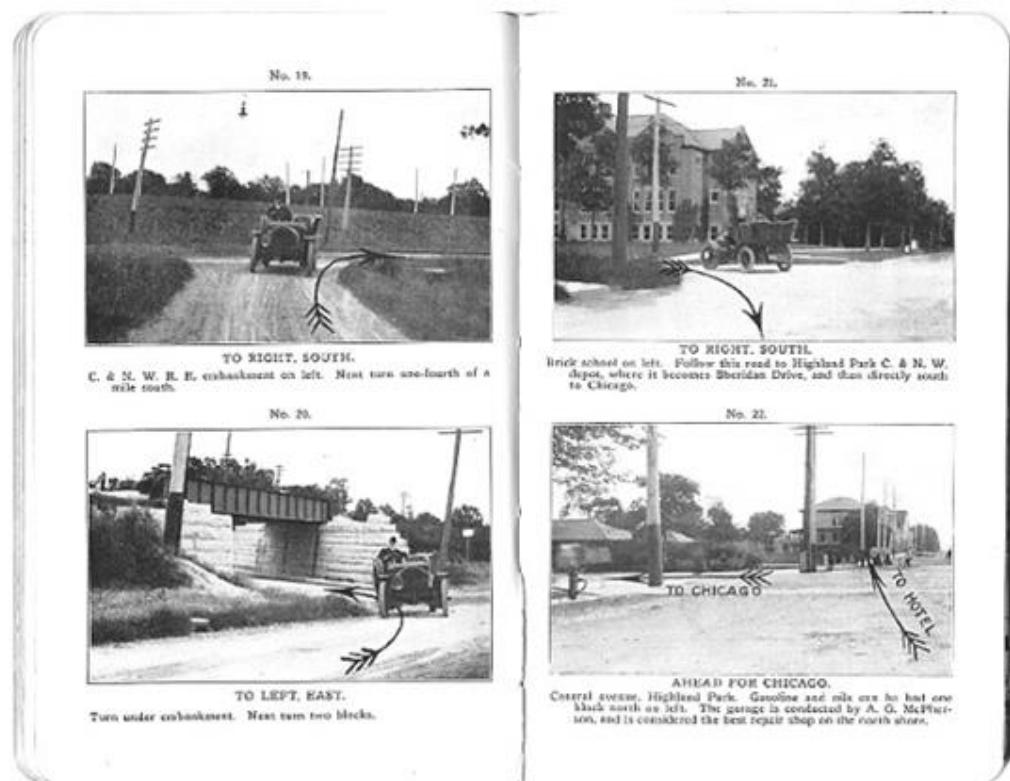
Five elements

1. Paths – routes
2. Edges – other lines eg. shoreline
3. Districts – realms
4. Nodes – foci, centres
5. Landmarks – architectural, natural

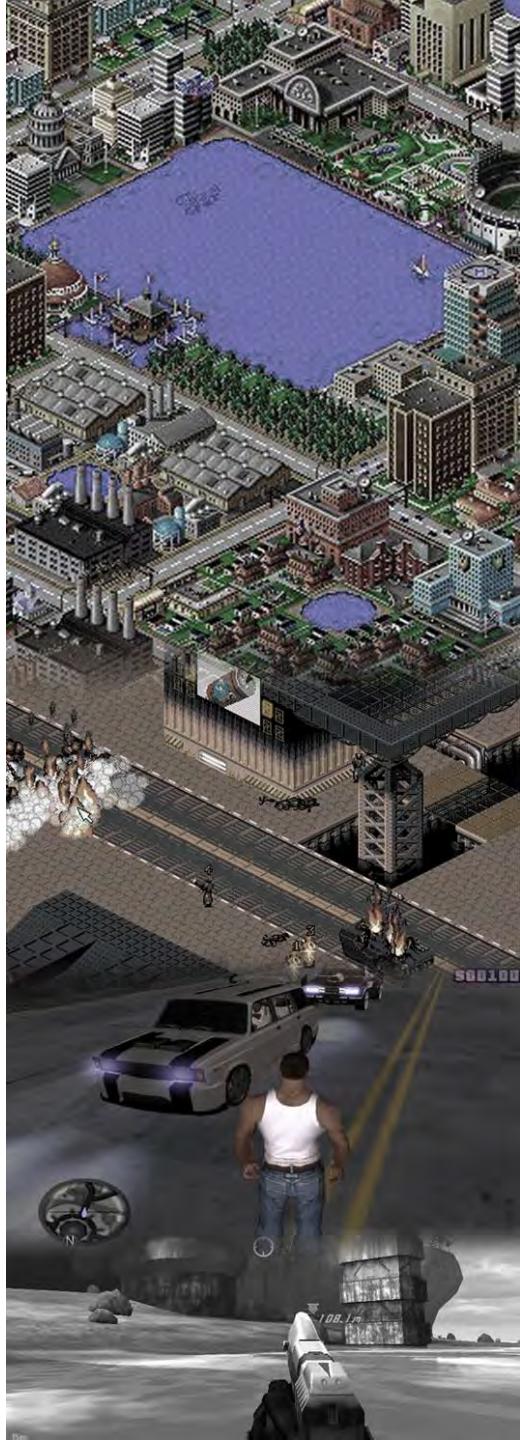
Locate / Describe

Mapping – systematically locating things
A map – representation of this

J.W.Jones
Jones-Live Map (1909)



Andrew McNally II
Photo-Auto Guide (c. 1907)



Locate / Describe

"A shift in perception is reflected in changing methods of mapping. Our knowledge of the world allows us to see it in different ways, and this manifests itself in new [graphic] representations."

Emmet Connolly
Web developer, Google
blog.thoughtwax.com

Rendering Effective Route Maps: Improving Usability Through Generalization

Maneesh Agrawala Chris Stolte
Stanford University*

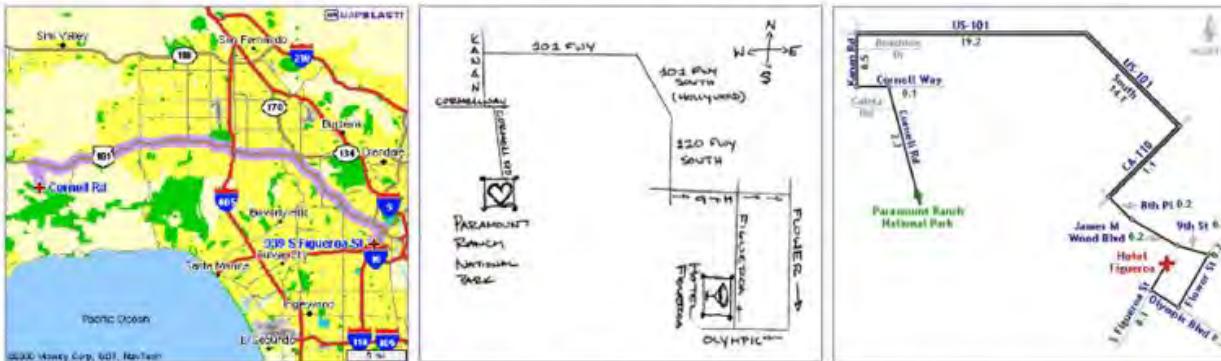


Figure 1: Three route maps for the same route rendered by (left) a standard computer-mapping system, (middle) a person, and (right) LineDrive, our route map rendering system. The standard computer-generated map is difficult to use because its large, constant scale factor causes the short roads to vanish and because it is cluttered with extraneous details such as city names, parks, and roads that are far away from the route. Both the handdrawn map and the LineDrive map exaggerate the lengths of the short roads to ensure their visibility while maintaining a simple, clean design that emphasizes the most essential information for following the route. Note that the handdrawn map was created without seeing either the standard computer-generated map or the LineDrive map.

(Handdrawn map courtesy of Mia Trachinger.)

Abstract

Route maps, which depict a path from one location to another, have emerged as one of the most popular applications on the Web. Current computer-generated route maps, however, are often very difficult to use. In this paper we present a set of cartographic generalization techniques specifically designed to improve the usability of route maps. Our generalization techniques are based both on cognitive psychology research studying how route maps are used and on an analysis of the generalizations commonly found in handdrawn route maps. We describe algorithmic implementations of these generalization techniques within LineDrive, a real-time system for automatically designing and rendering route maps. Feedback from over 2200 users indicates that almost all believe LineDrive maps are preferable to using standard computer-generated route maps alone.

Keywords: Information Visualization, Non-Realistic Rendering, WWW Applications, Human Factors

1 Introduction

Route maps, which depict a path from one location to another, are one of the most common forms of graphic communication. Al-

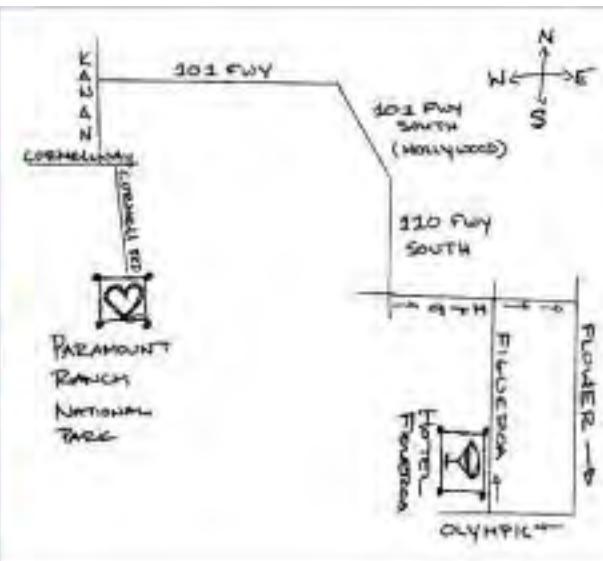
though route maps are often used to follow a path, they are also used to plan a path, to understand the context of a path, and to remember a path. The clarity of the map and to emphasize the most important information [16, 21]. This type of generalization, performed either consciously or sub-consciously, is prevalent both in quickly sketched maps and in professionally designed route maps that appear in print advertisements, invitations, and subway schedules [25, 13].

Recently, route maps in the form of driving directions have become widely available through the Web. In contrast to hand-designed route maps, these computer-generated route maps are often more precise and contain more information. Yet these maps are more difficult to use. The main shortcoming of current systems for automatically generating route maps is that they do not distinguish between essential and extraneous information, and as a result, cannot apply the generalizations used in hand-designed maps to emphasize the information needed to follow the route.

Figure 1 shows several problems arising from the lack of differentiation between necessary and unnecessary information. The primary problem is that current computer-mapping systems maintain a constant scale factor for the entire map. For many routes, the lengths of roads can vary over several orders of magnitude, from tens of feet within a neighborhood to hundreds of miles along a highway. When a constant scale factor is used for these routes, it forces the shorter roads to shrink to a point and essentially vanish.

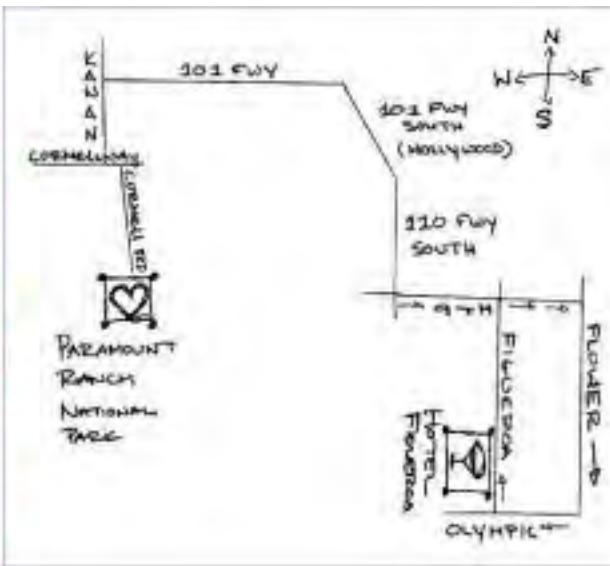
LineDrive

- cartographic generalization techniques specifically designed to improve the usability of route maps
- The generalization techniques are based both on cognitive psychology research studying how route maps are used and on an analysis of the generalizations commonly found in handdrawn route maps
- They describe algorithmic implementations of these generalization techniques within LineDrive, a real-time system for automatically designing and rendering route maps



LineDrive

- straighten wiggly lines
- snap turns to right angles
- expand regions with turns
- contract long straight roads
- label carefully
- maintain overall orientation



Map Projections



Gall-Peters Projection



UsefulClips

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391

707,276

 Add to

 Share

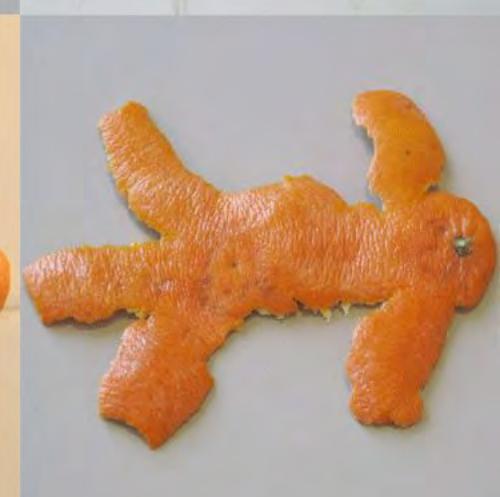
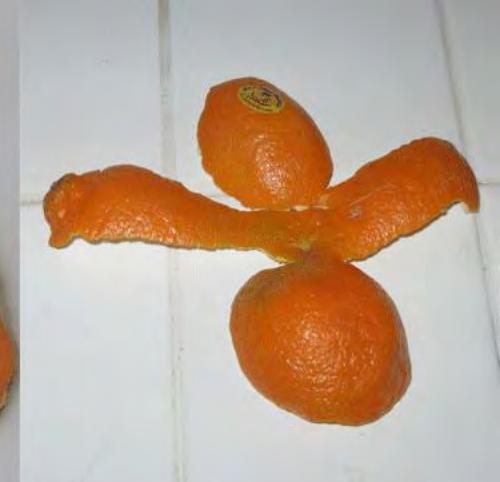
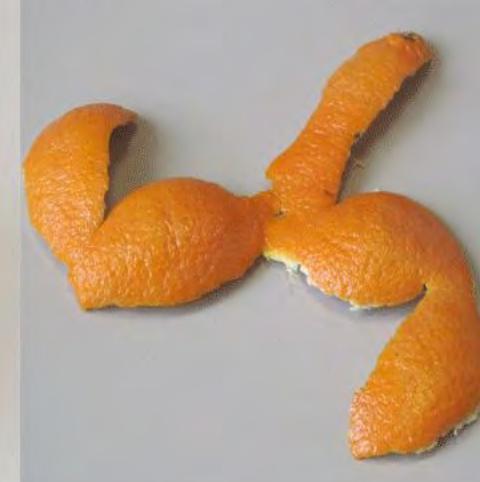
More

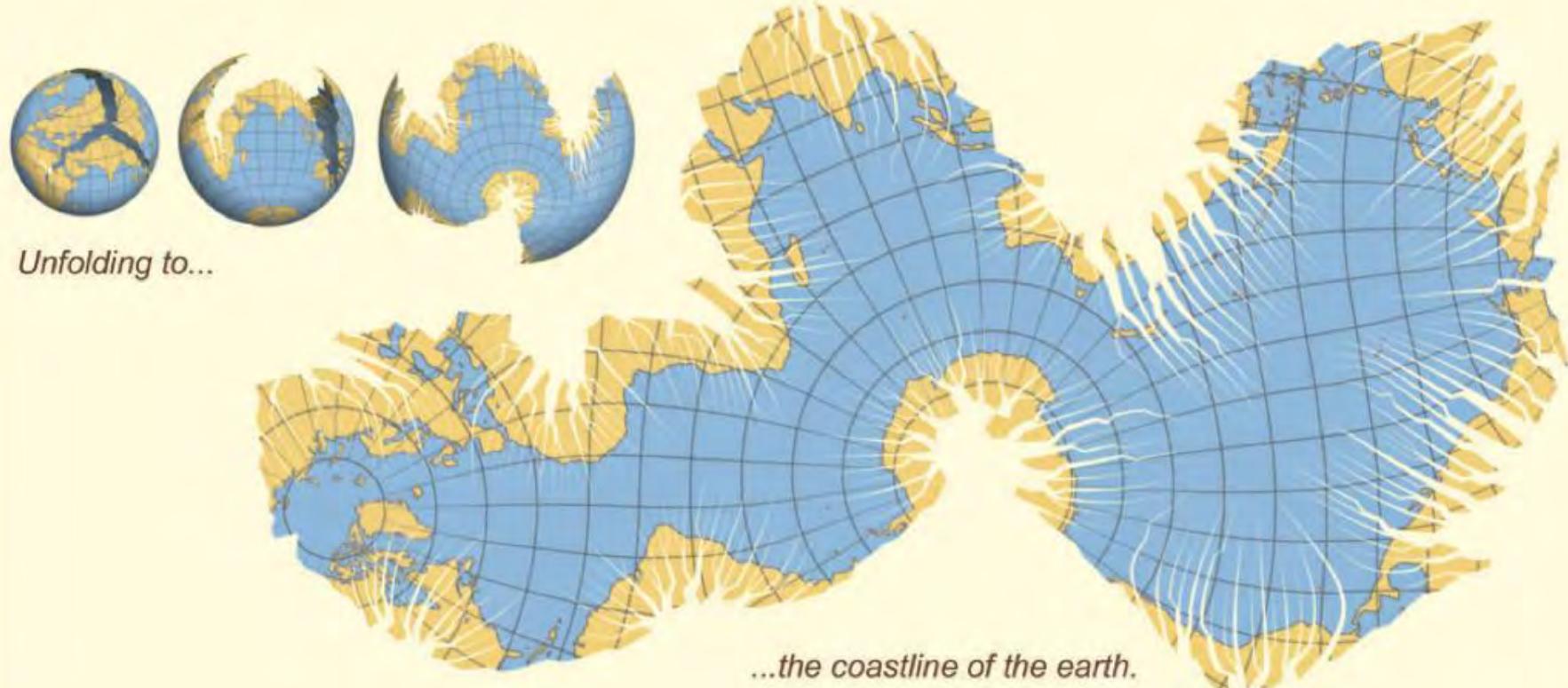
 2,831

 106



A sphere tears
when you
flatten it





Unfolding to...

...the coastline of the earth.

Many ways to tear it
van Wijk 2008

WHAT YOUR FAVORITE

MAP PROJECTION

SAYS ABOUT YOU

MERCATOR



YOU'RE NOT REALLY INTO MAPS.

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.

VAN DER GRIJNEN



YOU'RE NOT A COMPLICATED PERSON. YOU LOVE THE MERCATOR PROJECTION; YOU JUST WISH IT WEREN'T SQUARE. THE EARTH'S NOT A SQUARE, IT'S A CIRCLE. YOU LIKE CIRCLES. TODAY IS GONNA BE A GOOD DAY!

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.

WINKEL-TRIPEL



NATIONAL GEOGRAPHIC ADOPTED THE WINKEL-TRIPEL IN 1998, BUT YOU'VE BEEN A WT FAN SINCE LONG BEFORE "NAT GEO" SHOWED UP. YOU'RE WORRIED IT'S GETTING PLAYED OUT, AND ARE THINKING OF SWITCHING TO THE KAVRAYSKIY. YOU ONCE LEFT A PARTY IN DISGUST WHEN A GUEST SHOWED UP WEARING SHOES WITH TOES. YOUR FAVORITE MUSICAL GENRE IS "POST-".

HOBO-DYER



YOU WANT TO AVOID CULTURAL IMPERIALISM, BUT YOU'VE HEARD BAD THINGS ABOUT GALL-PETERS. YOU'RE CONFLICT-AVERSE AND BUY ORGANIC. YOU USE A RECENTLY-INVENTED SET OF GENDER-NEUTRAL PRONOUNS AND THINK THAT WHAT THE WORLD NEEDS IS A REVOLUTION IN CONSCIOUSNESS.

GOODE HOMOLOSONE



THEY SAY MAPPING THE EARTH ON A 2D SURFACE IS LIKE FLATTENING AN ORANGE PEEL, WHICH SEEMS EASY ENOUGH TO YOU. YOU LIKE EASY SOLUTIONS. YOU THINK WE WOULDN'T HAVE SO MANY PROBLEMS IF WE'D JUST ELECT NORMAL PEOPLE TO CONGRESS INSTEAD OF POLITICIANS. YOU THINK AIRLINES SHOULD JUST BUY FOOD FROM THE RESTAURANTS NEAR THE GATES AND SERVE THAT ON BOARD. YOU CHANGE YOUR CAR'S OIL, BUT SECRETLY WONDER IF YOU REALLY NEED TO.

PLATE CARRÉE (EQUIRECTANGULAR)



YOU THINK THIS ONE IS FINE. YOU LIKE HOW X AND Y MAP TO LATITUDE AND LONGITUDE. THE OTHER PROJECTIONS OVERCOMPLICATE THINGS. YOU WANT ME TO STOP ASKING ABOUT MAPS SO YOU CAN ENJOY DINNER.

NEEDS IS A REVOLUTION IN CONSCIOUSNESS.

A GLOBE!



YES, YOU'RE VERY CLEVER.

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.

WATERMAN BUTTERFLY



REALLY? YOU KNOW THE WATERMAN? HAVE YOU SEEN THE 1909 CAHILL MAP IT'S BASED— ... YOU HAVE A FRAMED REPRODUCTION AT HOME?! WHOA. ... LISTEN, FORGET THESE QUESTIONS. ARE YOU DOING ANYTHING TONIGHT?

GALL-PETERS



I HATE YOU.

Map Projections

Projections Types

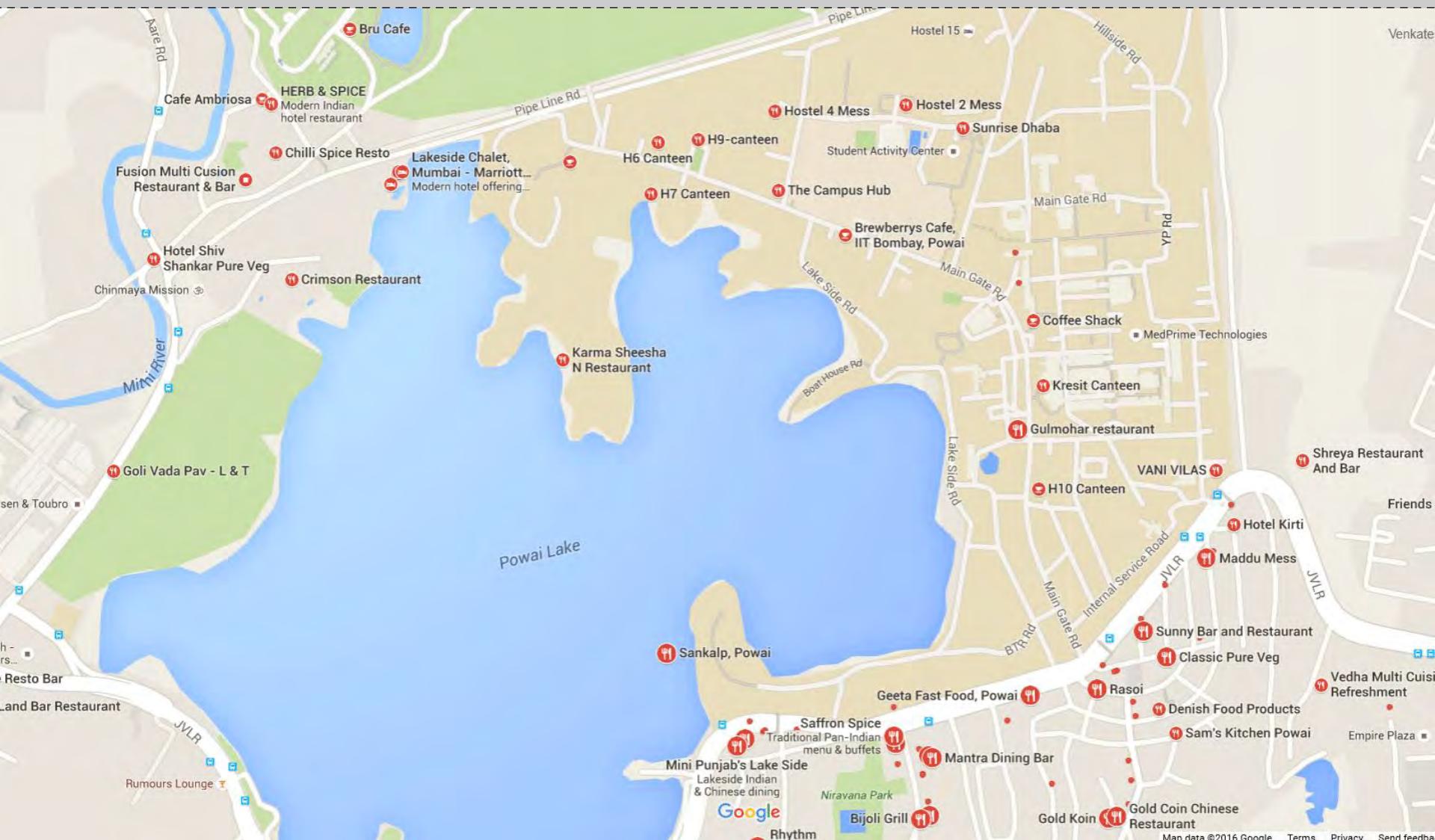
- Azimuthal: Preserves direction from a central point
- Authalic: Preserves area
- Conformal: Preserves angles / local shapes
- Others? Combinations?

Encoding data on the Maps

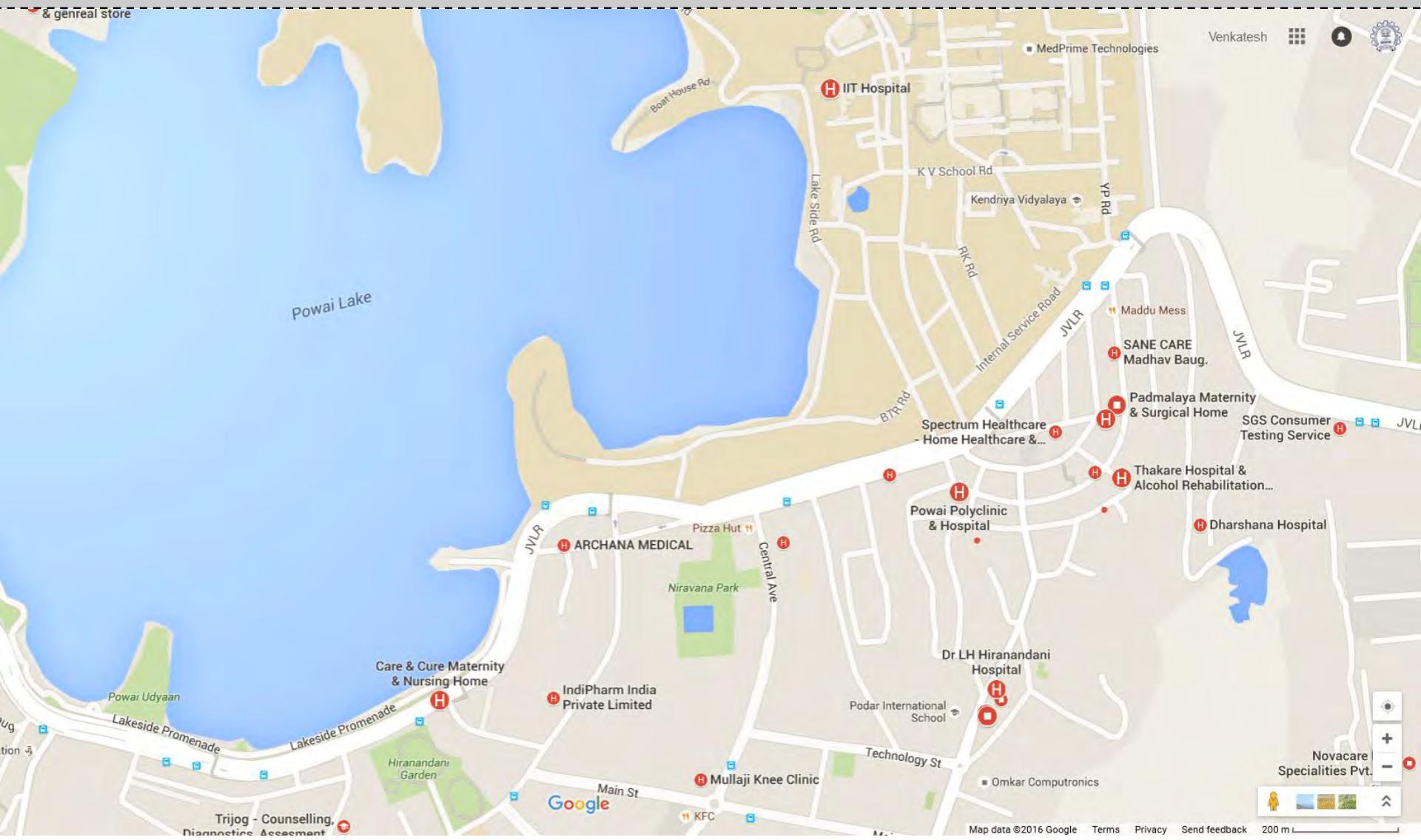
Representing Spatial Position vs. Spatial Relationships

- Glyphs and Landmarks (discrete)
- Heatmaps / Isocurves (continuous)
- Choropleths
- Cartograms
- Flow Maps
- Thematic Maps

Glyphs and Landmarks



Glyphs and Landmarks



Glyphs and Landmarks

Data as Points

data: ordered/
quantitative

encoding: size

The New York Times | ASIA

Map of the Damage From the Japanese Earthquake

An interactive map and photographs of places in Japan that were damaged by the March 11 earthquake
tsunami | UPDATED MARCH 15, 2011 7:20 PM ET



The Japanese Ministry of Internal Affairs and Communications is keeping a running tally of the deaths and destruction caused by the earthquake and tsunami. While the tally is not yet complete, it already shows a stretch of devastation that reaches more than 400 miles along the coast. The data shown are as of 6:30 a.m. local time on March 16.

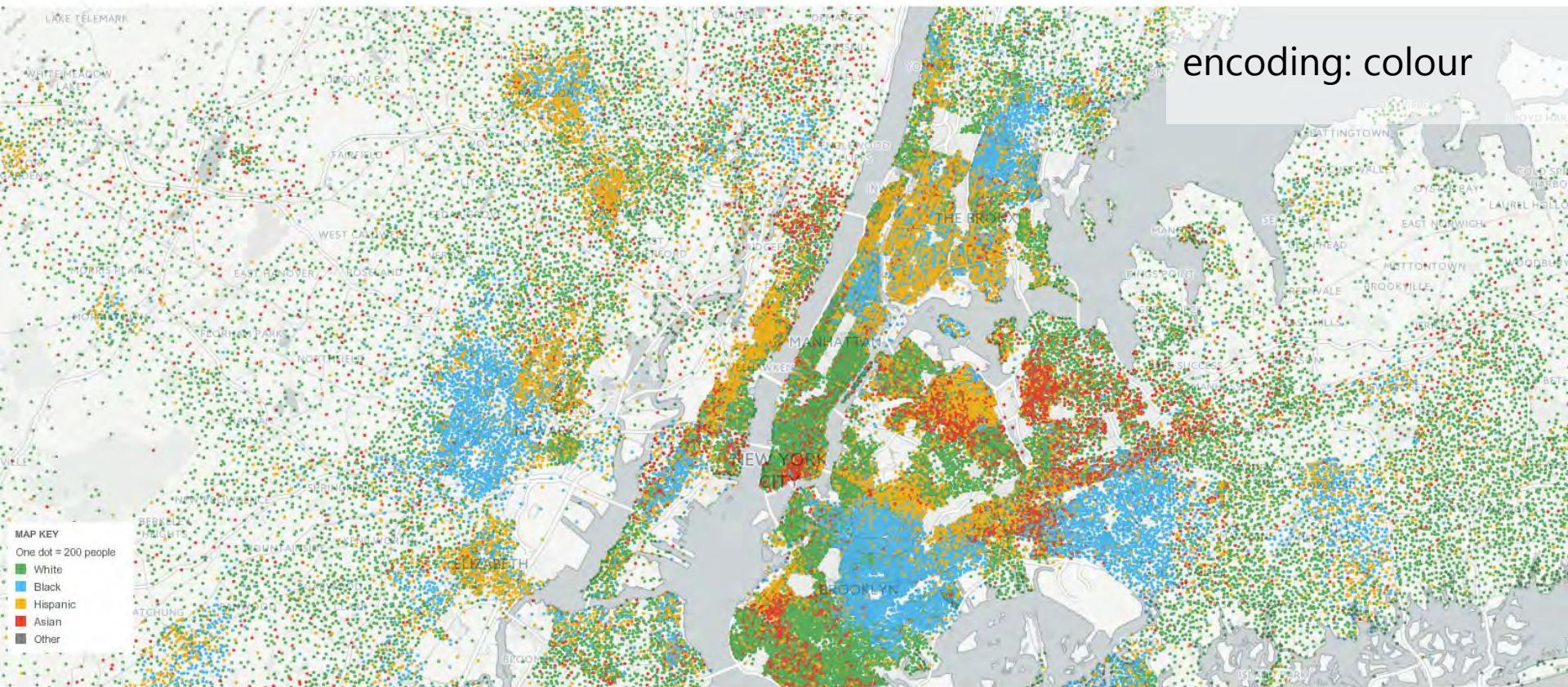
Glyphs and Landmarks

The New York Times

Mapping America: Every City, Every Block

Browse local data from the Census Bureau's American Community Survey, based on samples from 2005 to 2009. Because these figures are based on 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



Data as Points

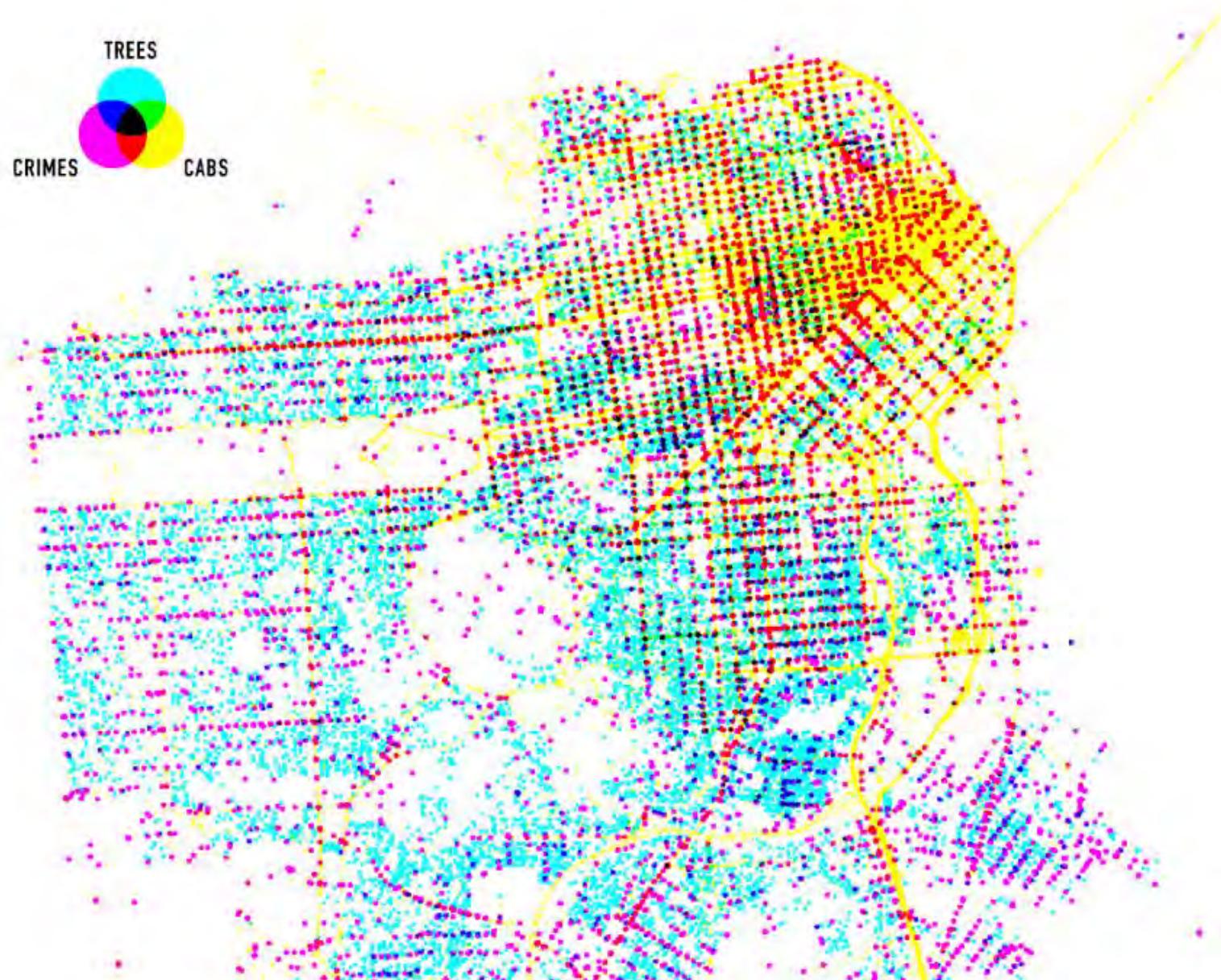
Find something interesting? Share

data: categorical

encoding: colour

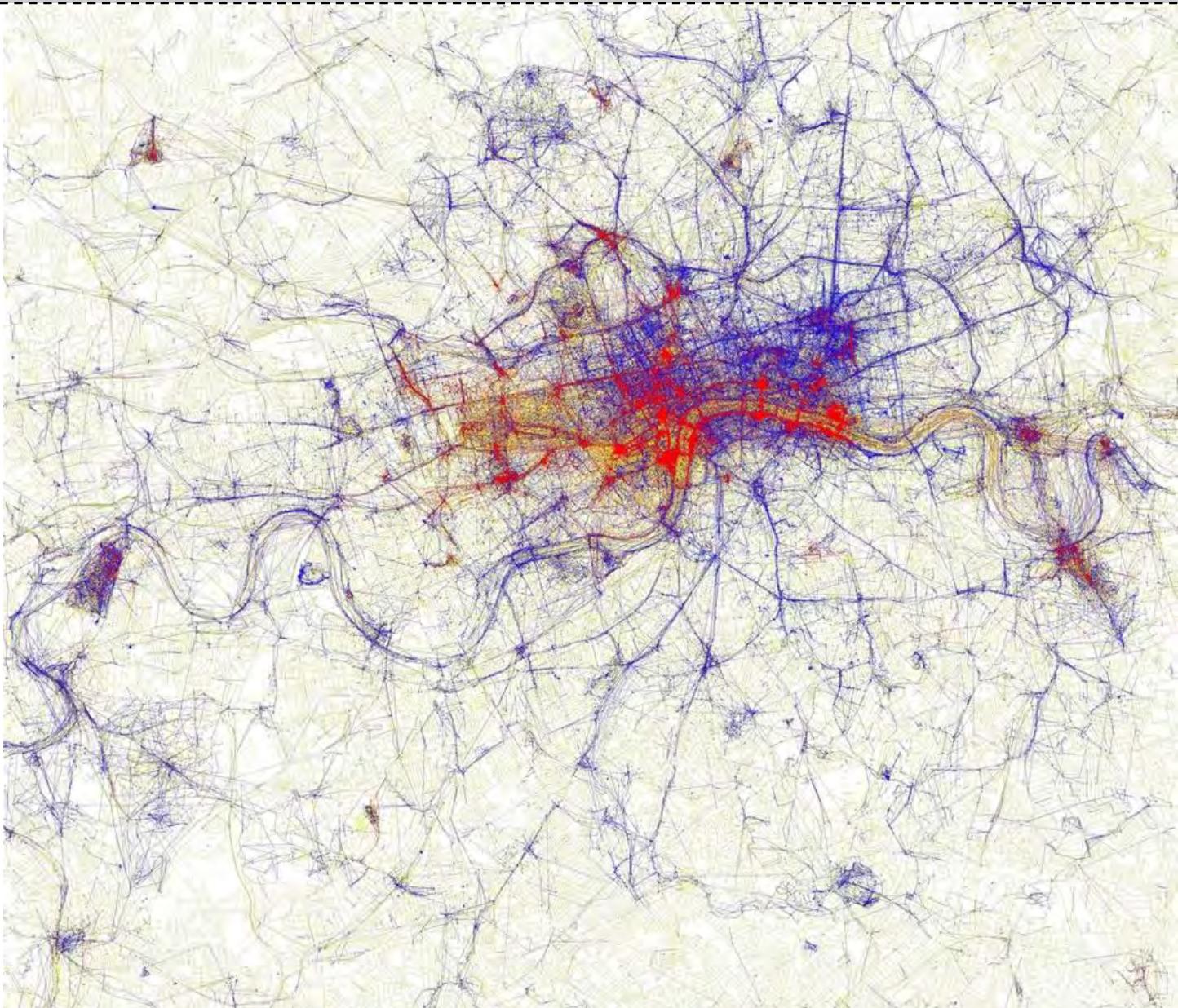
Note: Dots are county. Dollar a

Glyphs and Landmarks



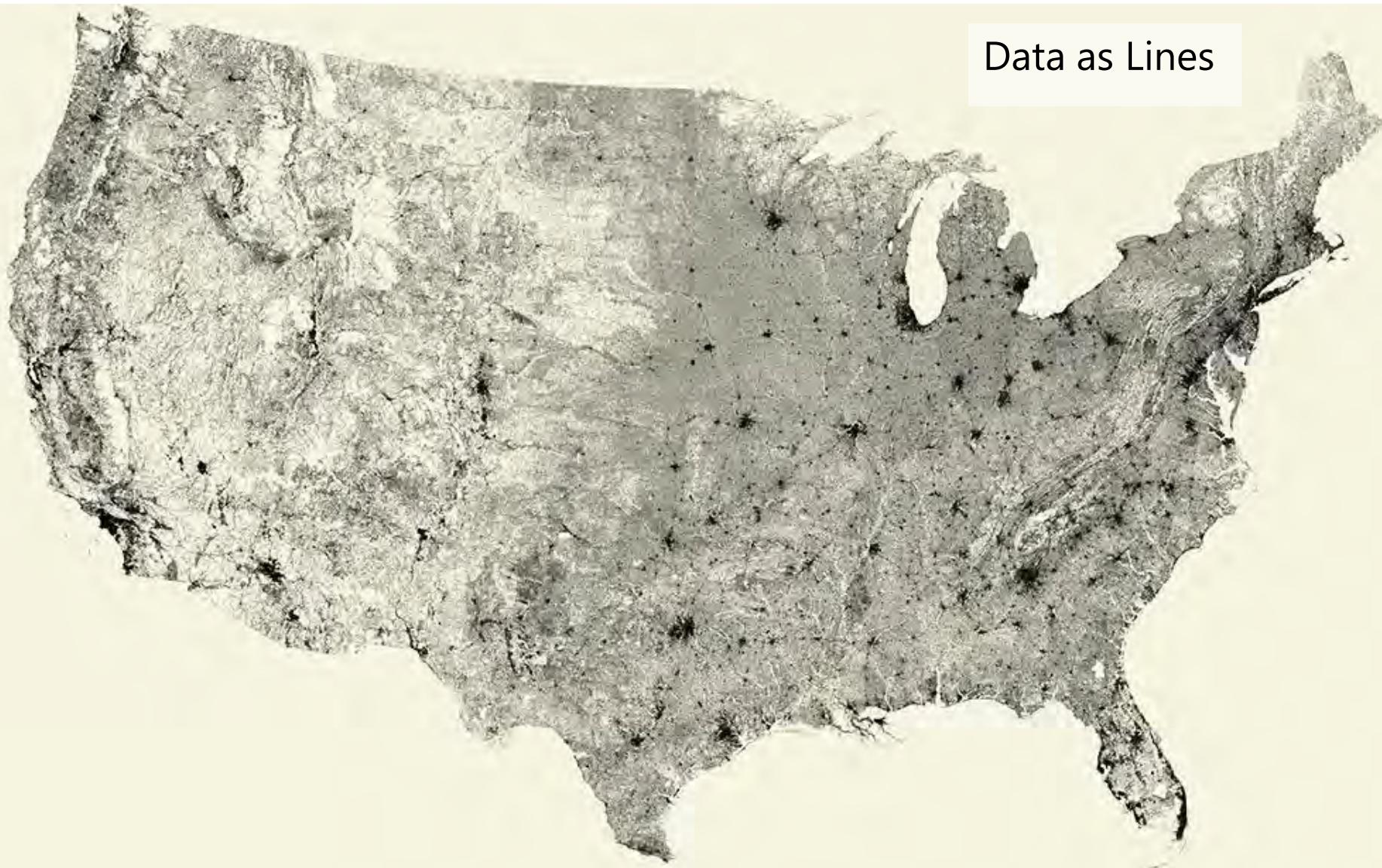
Glyphs and Landmarks

Data as Points



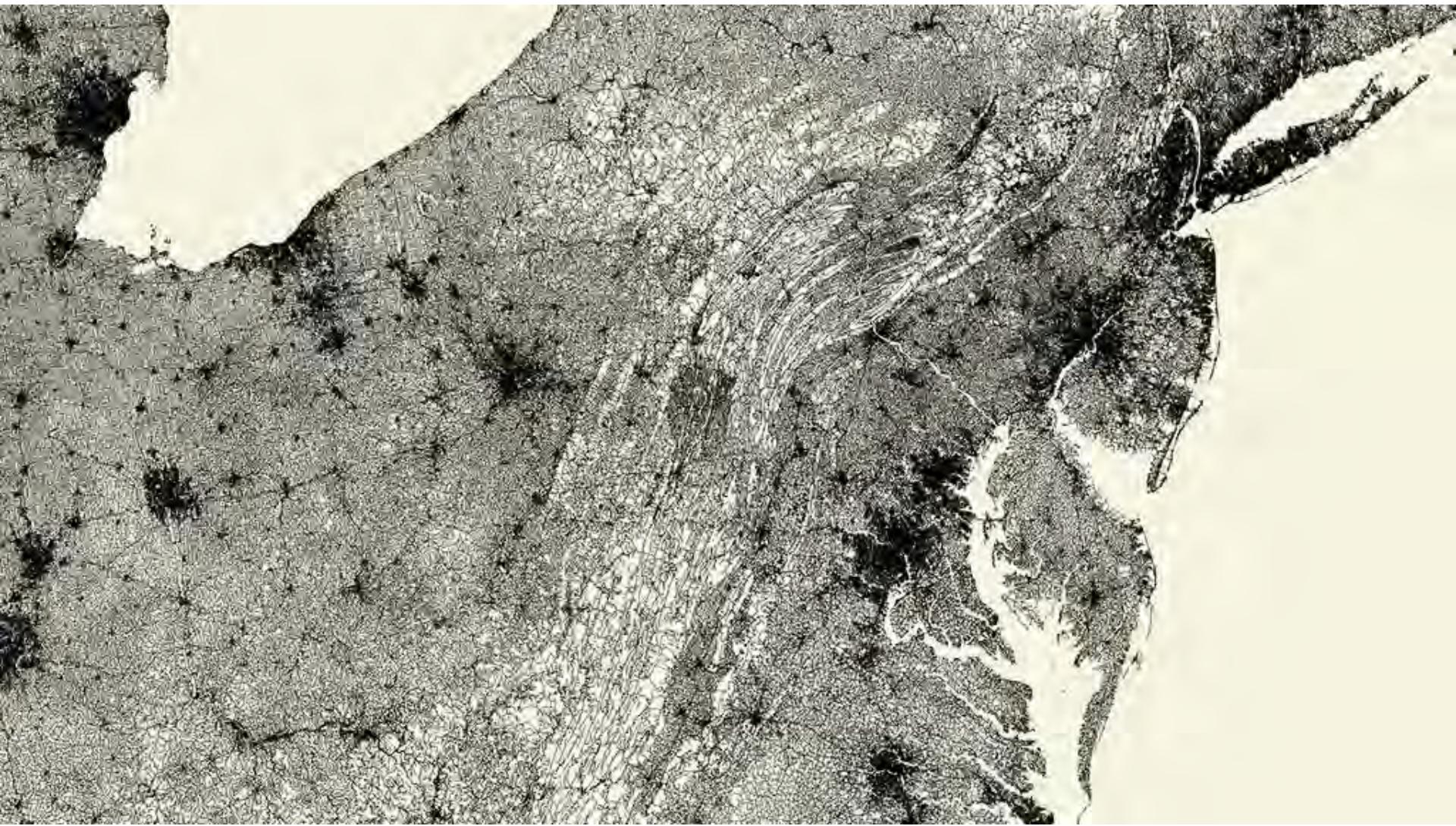
Glyphs and Landmarks

Data as Lines



Glyphs and Landmarks

Data as Lines



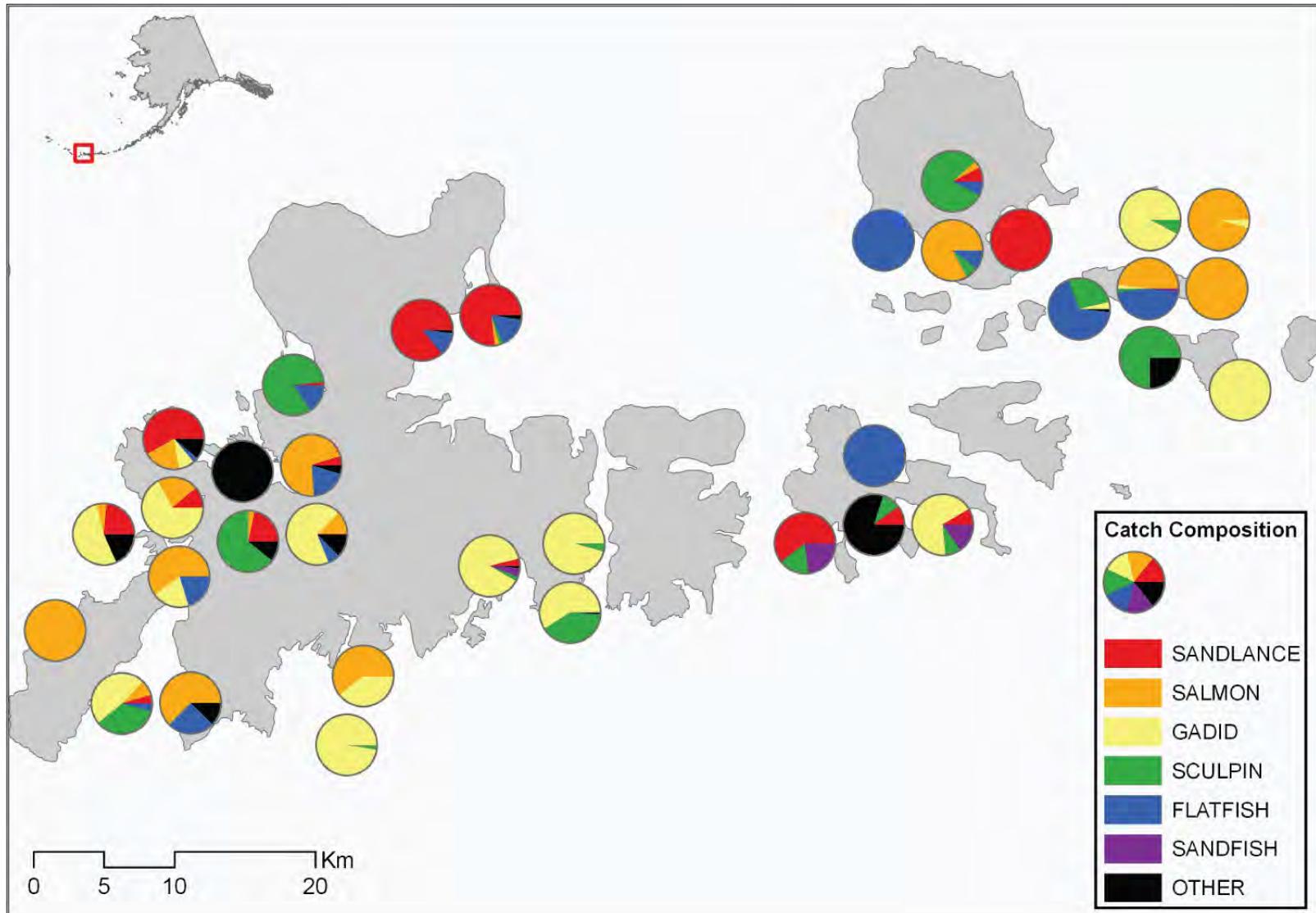
Glyphs and Landmarks

Data as Lines



Glyphs and Landmarks

Data as Charts



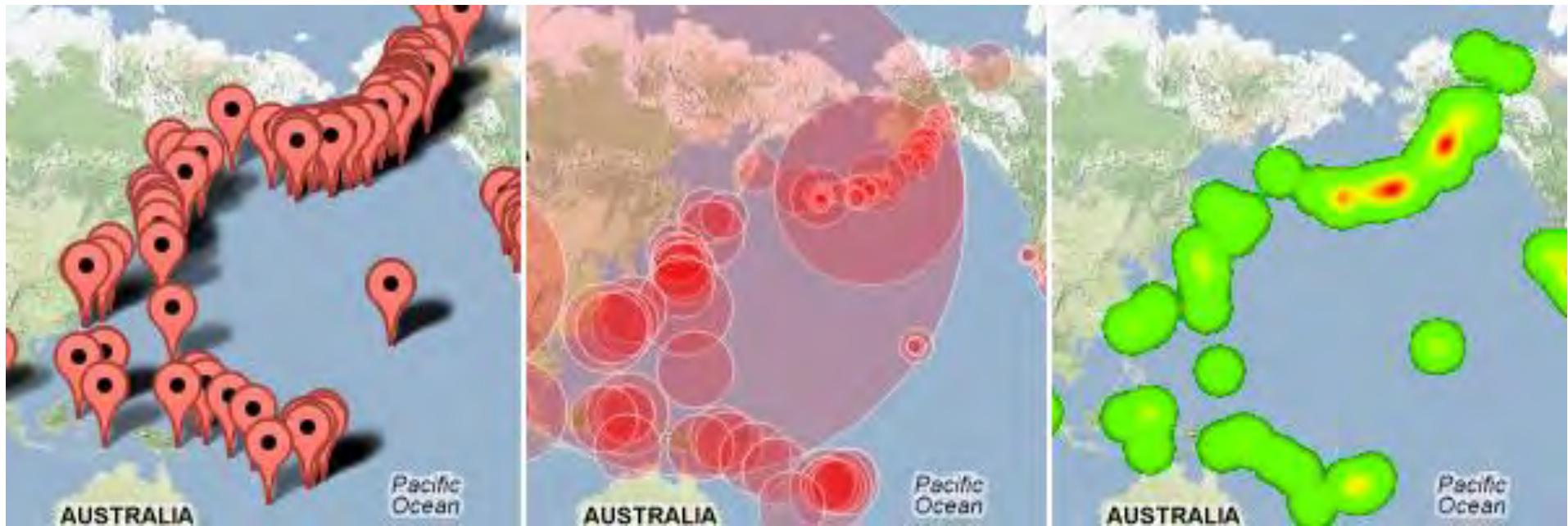
Glyphs and Landmarks



Data as Time

Glyphs and Landmarks

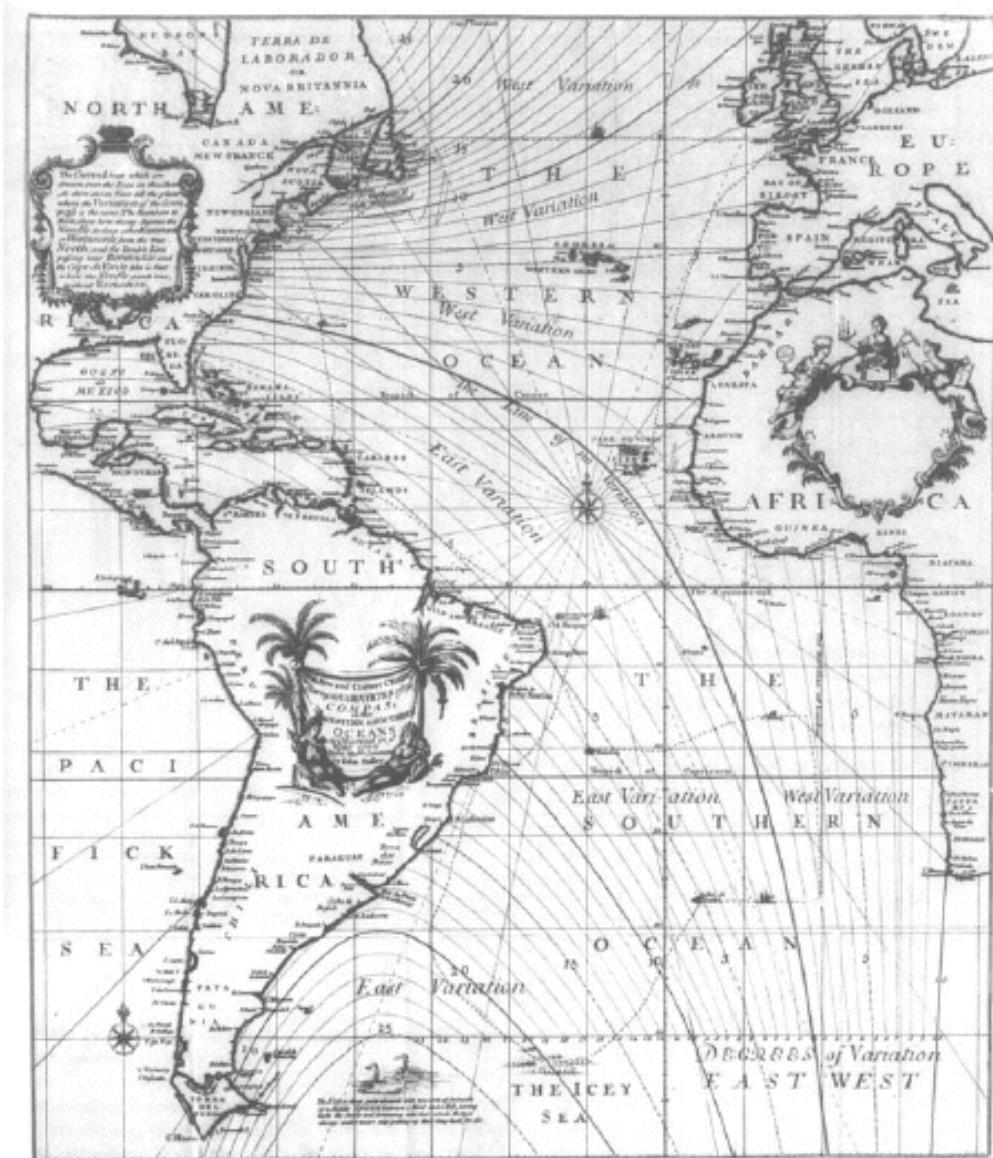
Mapping Earthquake



Encoding continuous data on the Maps

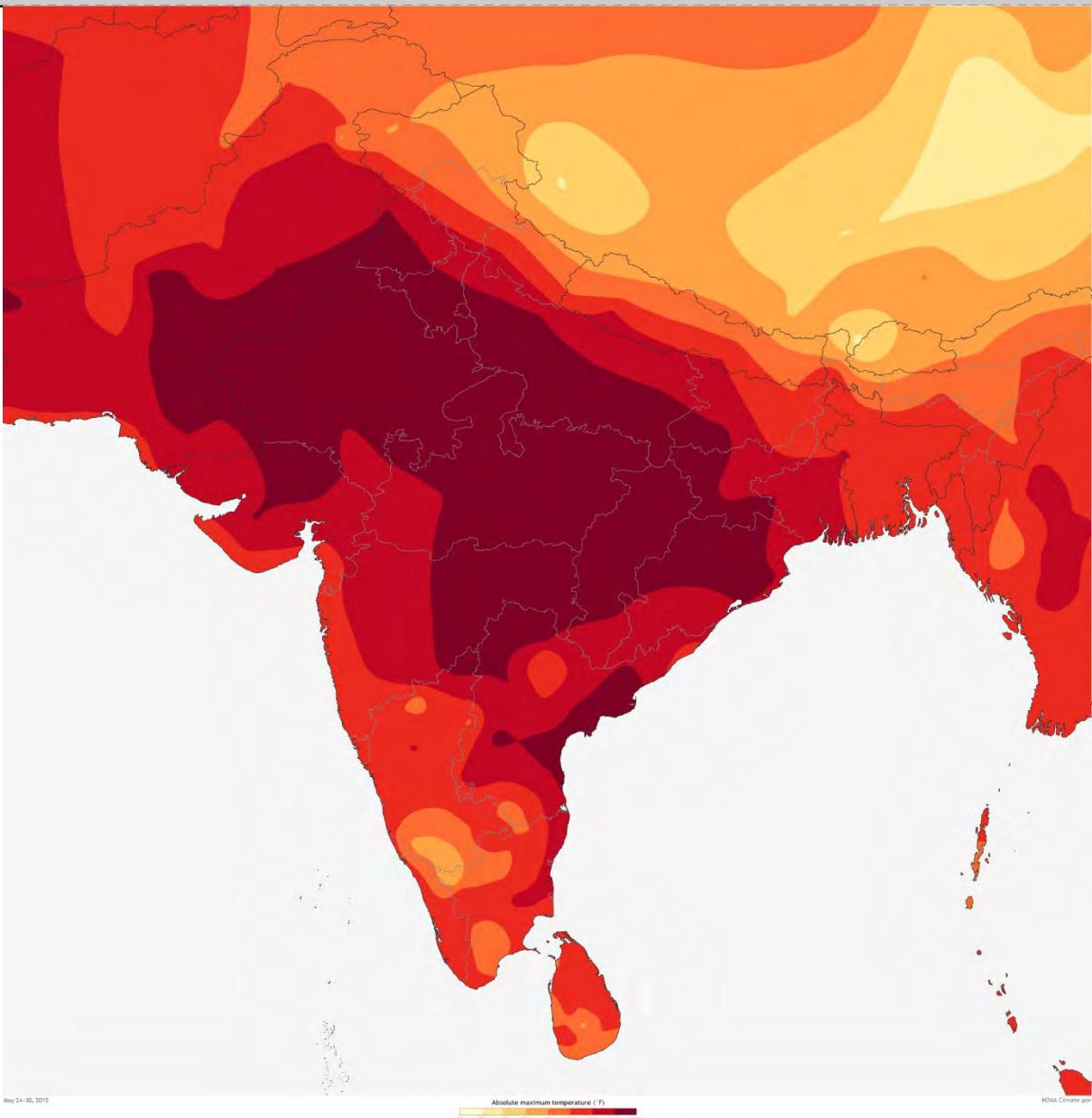
Isopleth

- Map which overlays continuous data using a third encoding channel
- e.g. lines of equal magnetic declination
(first ever contour map by Edmond Halley, 1701)

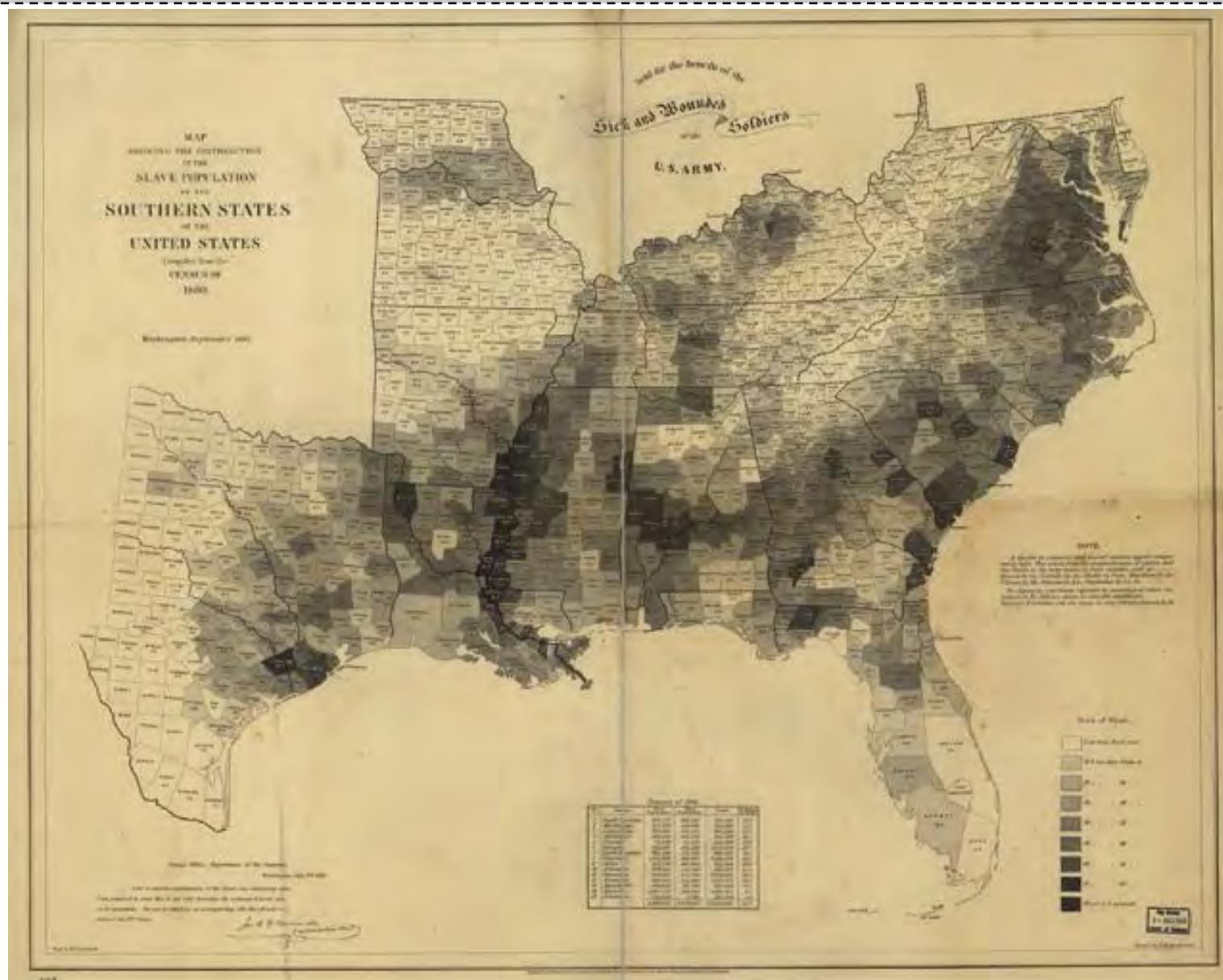


Encoding continuous data on the Maps

India Heat Wave:
week of May 24-30,
2015

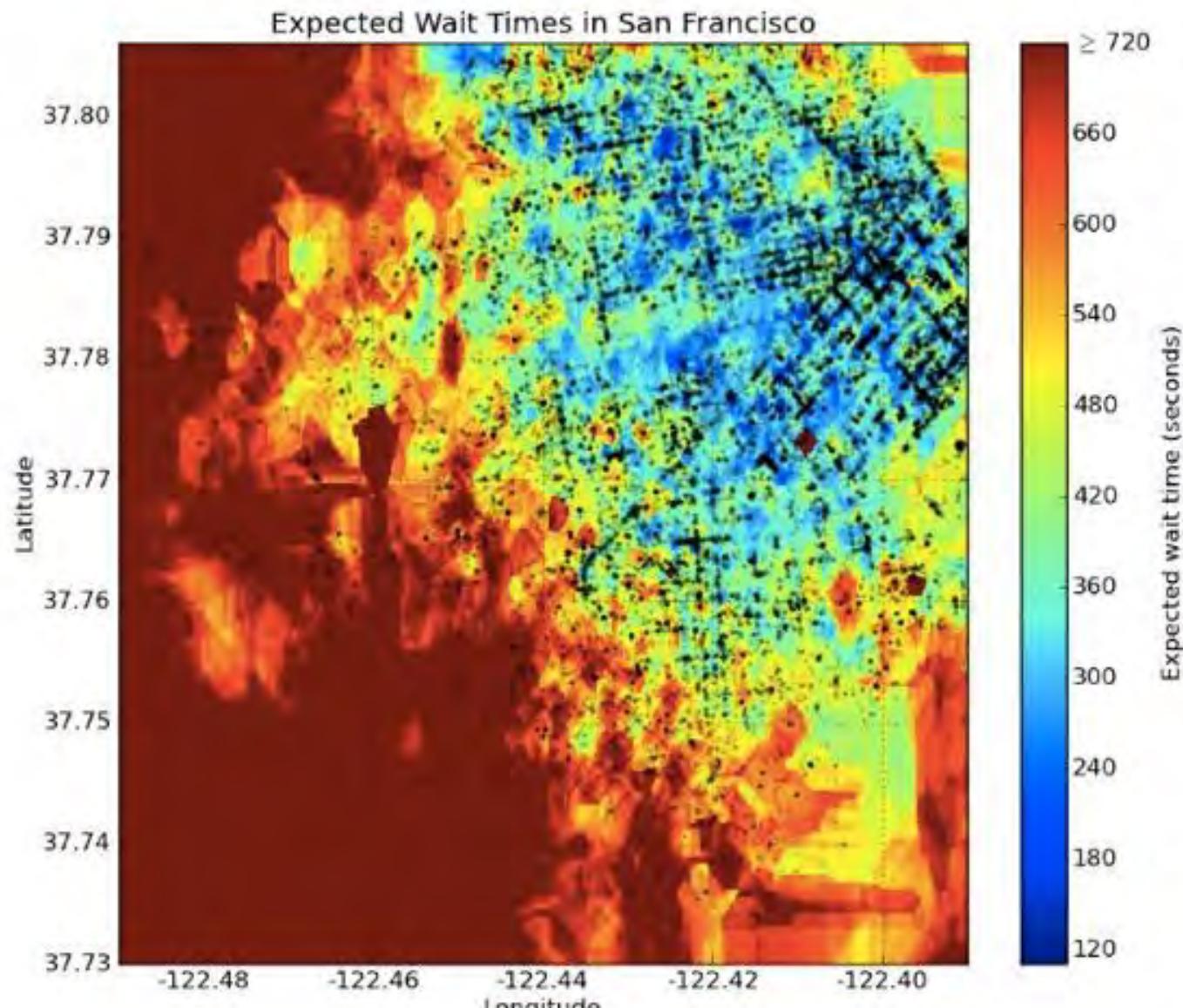


Encoding continuous data on the Maps



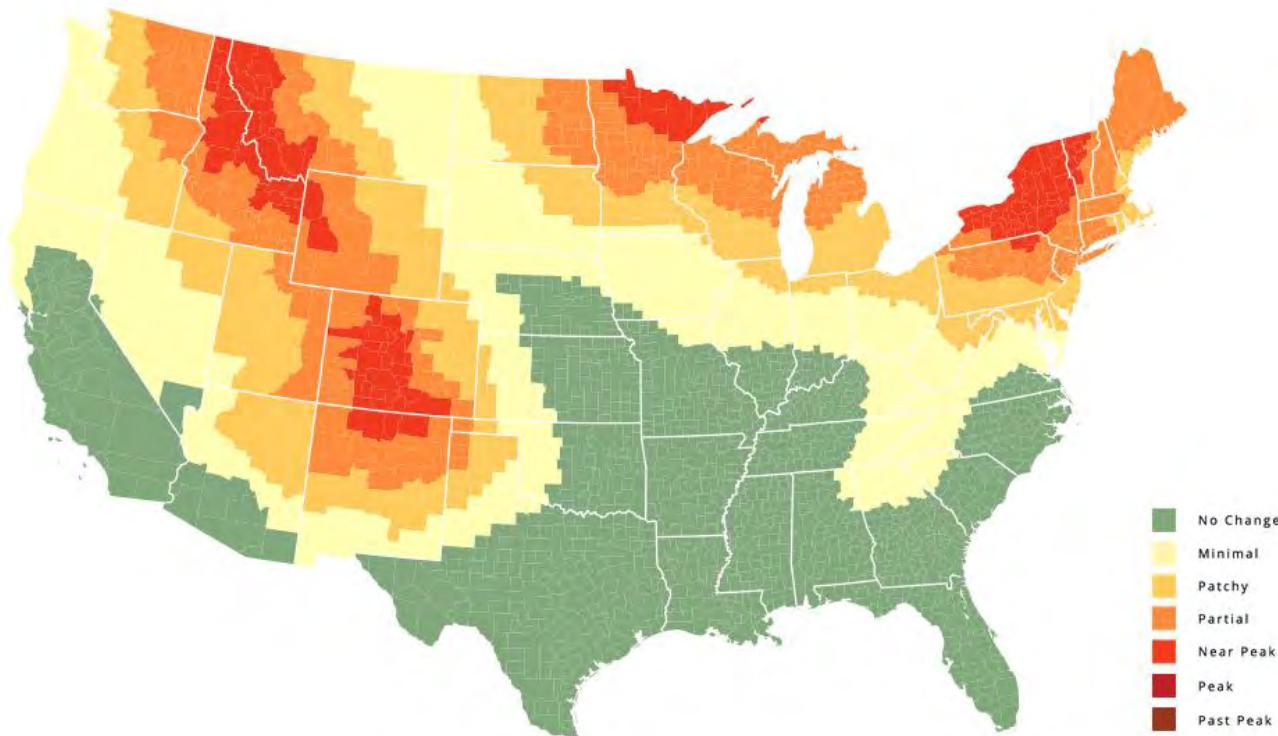
Encoding continuous data on the Maps

Uber wait times,
SF



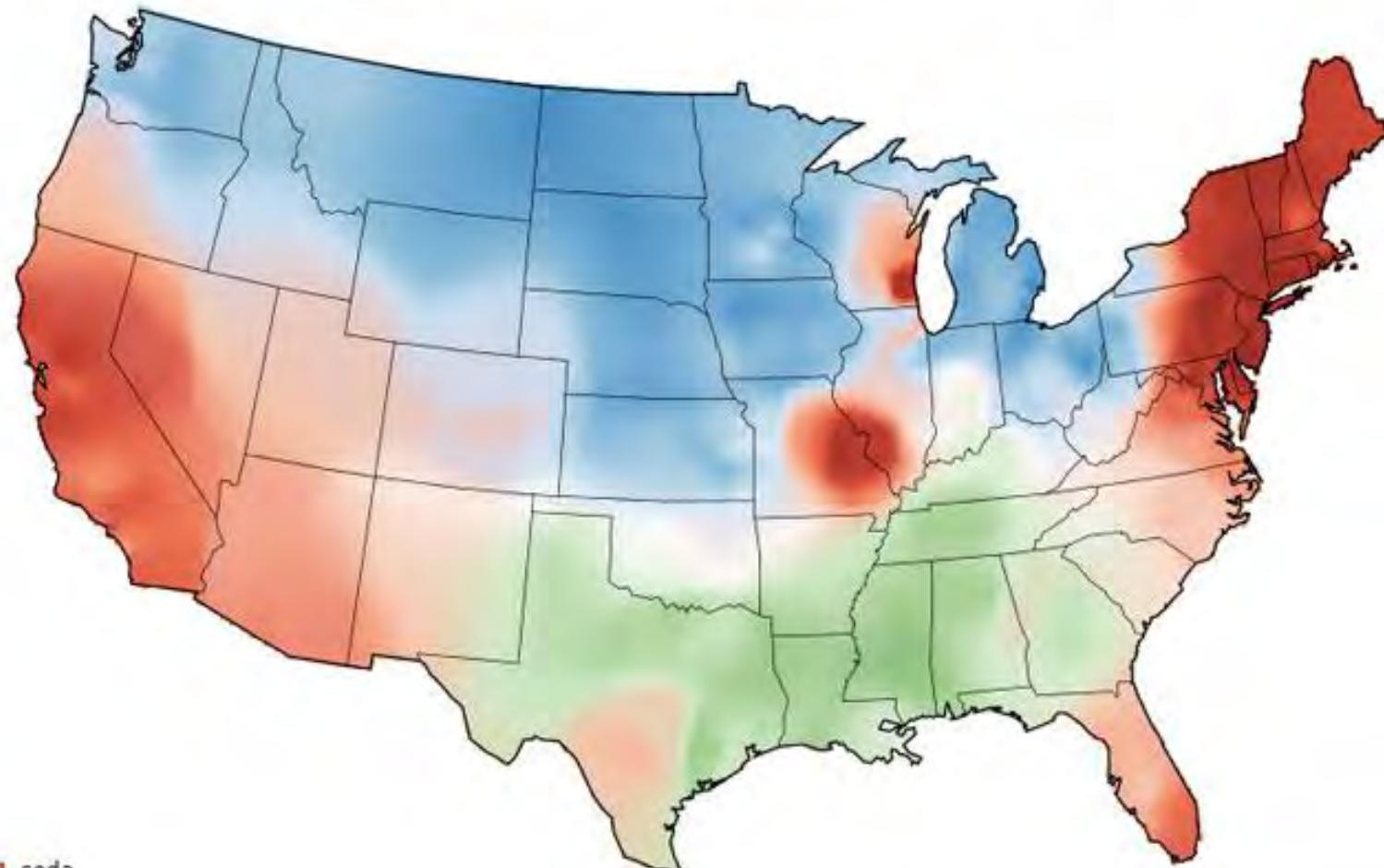
Encoding continuous data on the Maps

THE
Fall Foliage Prediction Map
2015 EDITION



Encoding continuous data on the Maps

What is your generic term for a sweetened carbonated beverage?

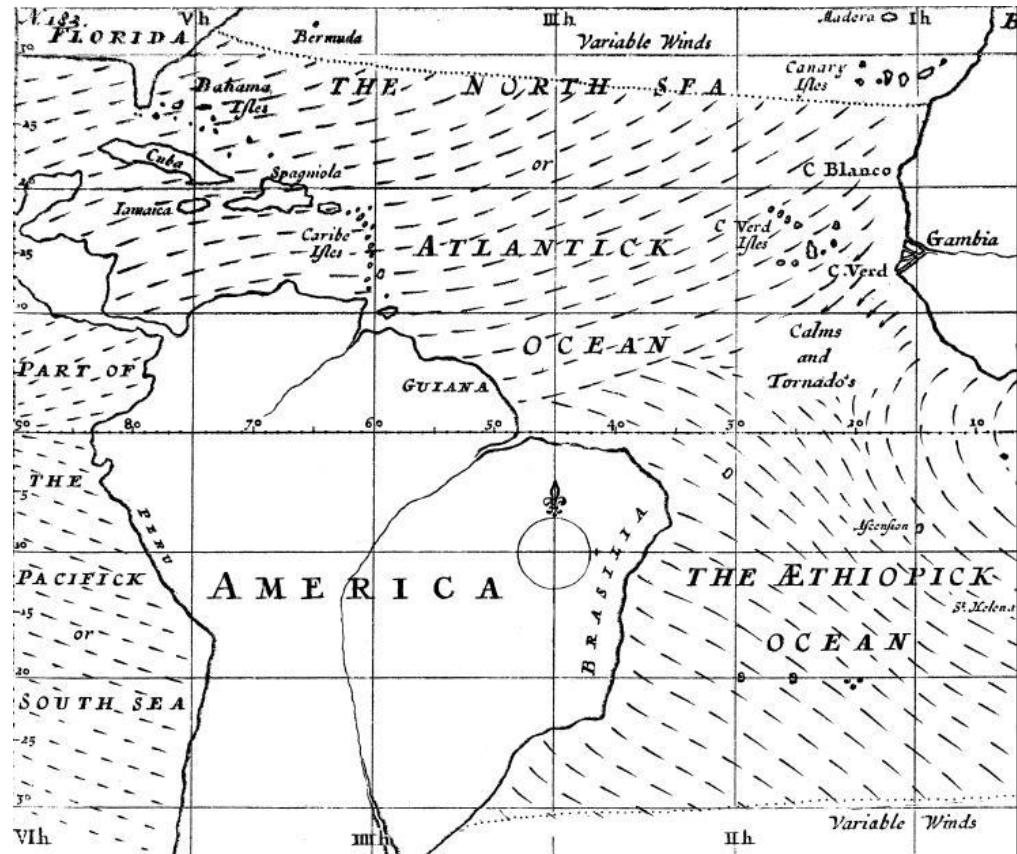


- soda
- pop
- coke
- soft drink

Encoding continuous data on the Maps

Isocurves

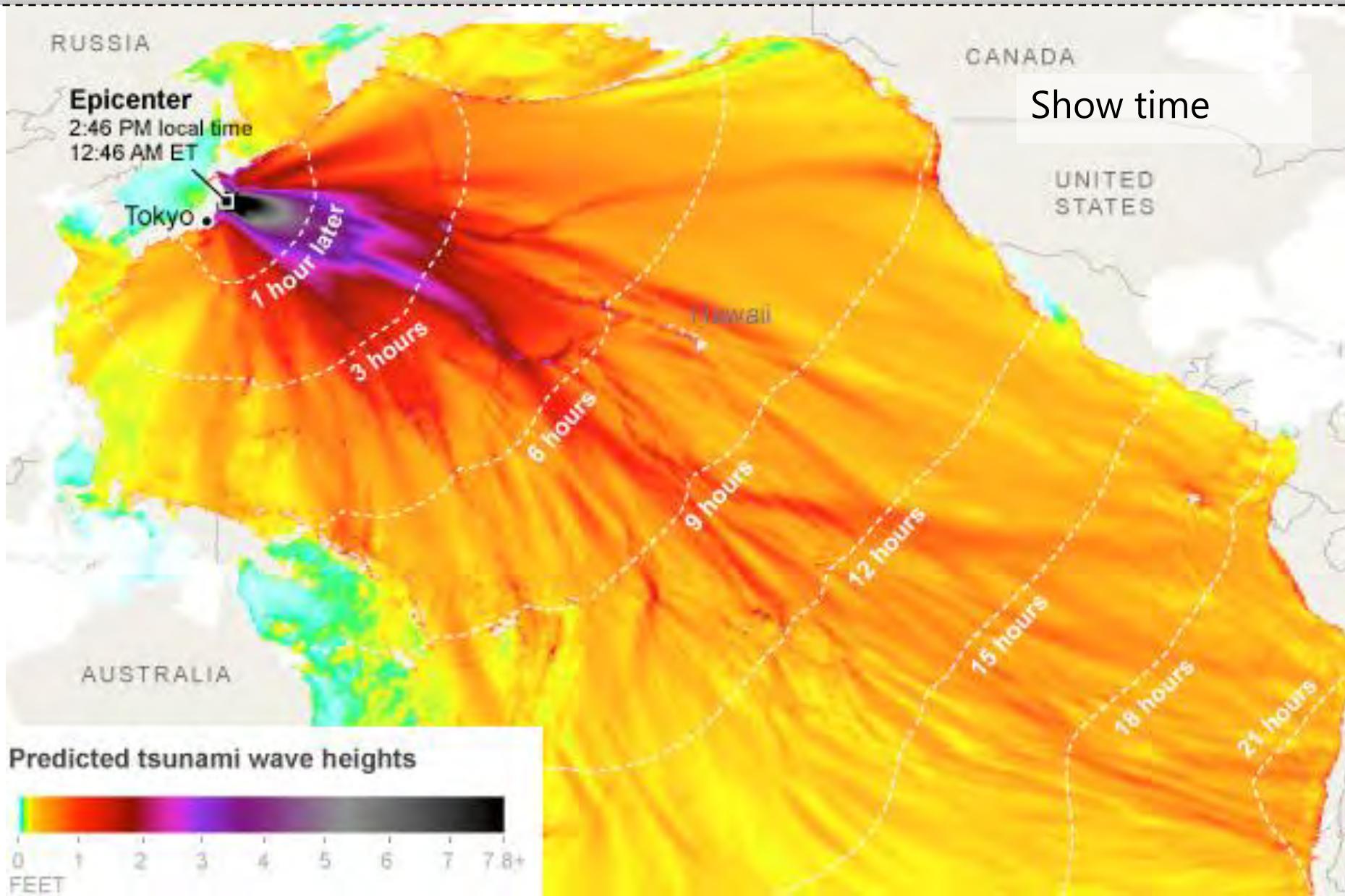
- Map which uses curves to encode direction data
- e.g. wind maps
(first isocurve, Edmond Halley, 1686)



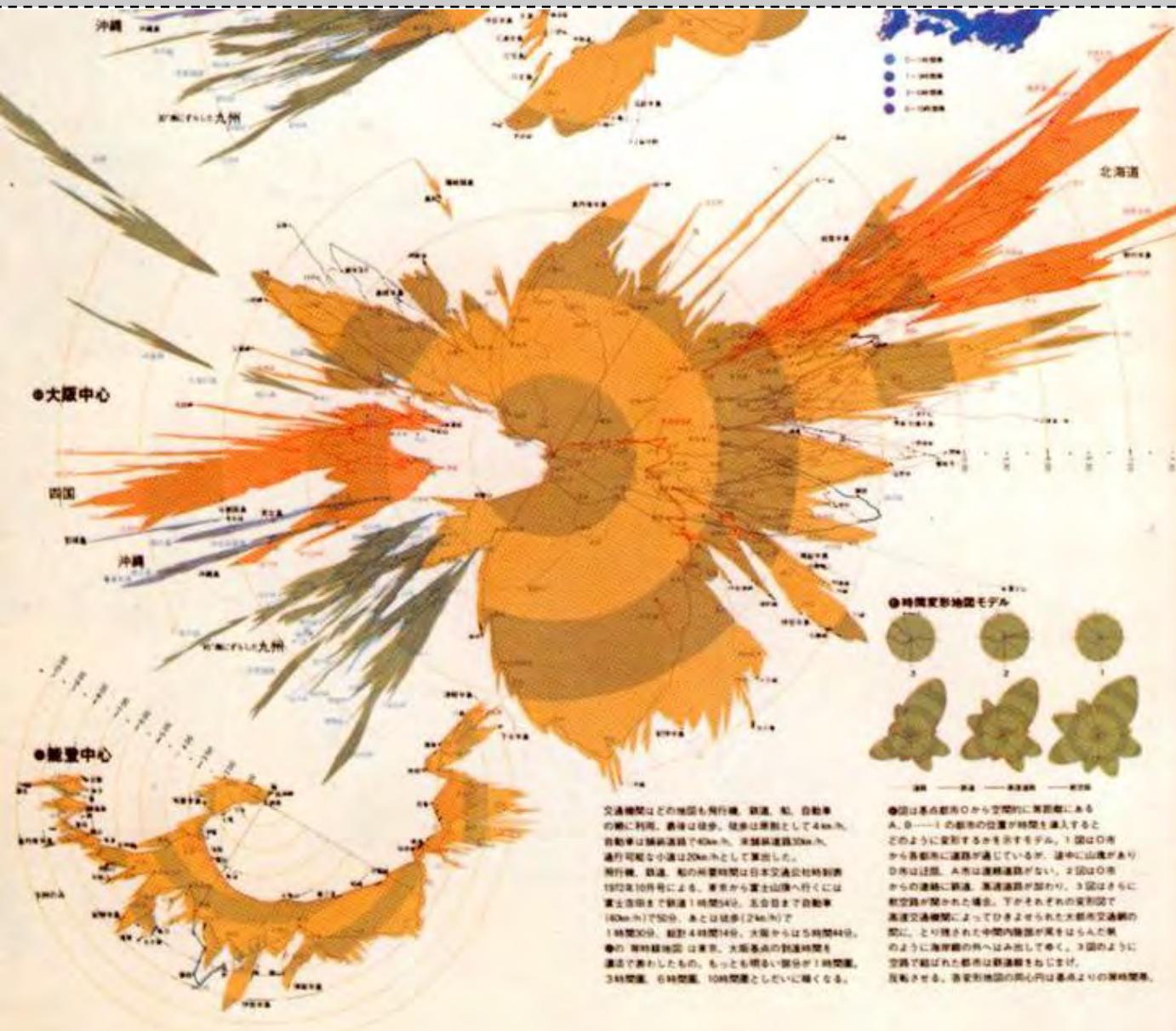
Show topology



Encoding continuous data on the Maps



Encoding continuous data on the Maps

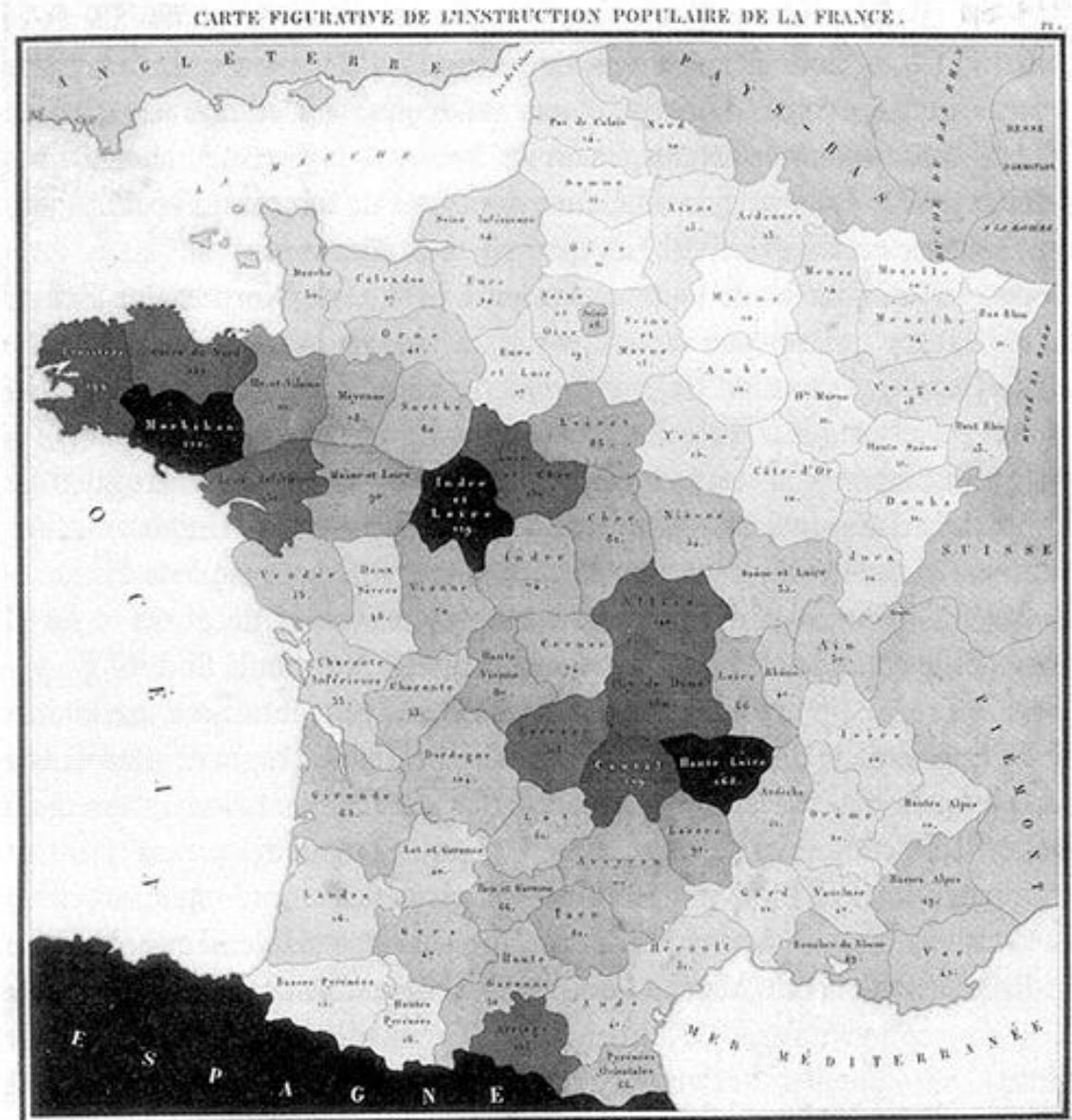


Show time

Encoding continuous data on the Maps

Choropleths

- Map in which areas are shaded, coloured, or patterned relative to a data attribute value
- e.g. Illiteracy in France (first choropleth map, Charles Dupin, 1826)



Encoding continuous data on the Maps

Show contrast

Map 1.1

Borders matter

HDI in United States and Mexican border localities, 2000

HDI, 2000

- 0.636 – 0.700
- 0.701 – 0.765
- 0.766 – 0.830
- 0.831 – 0.895
- 0.896 – 0.950

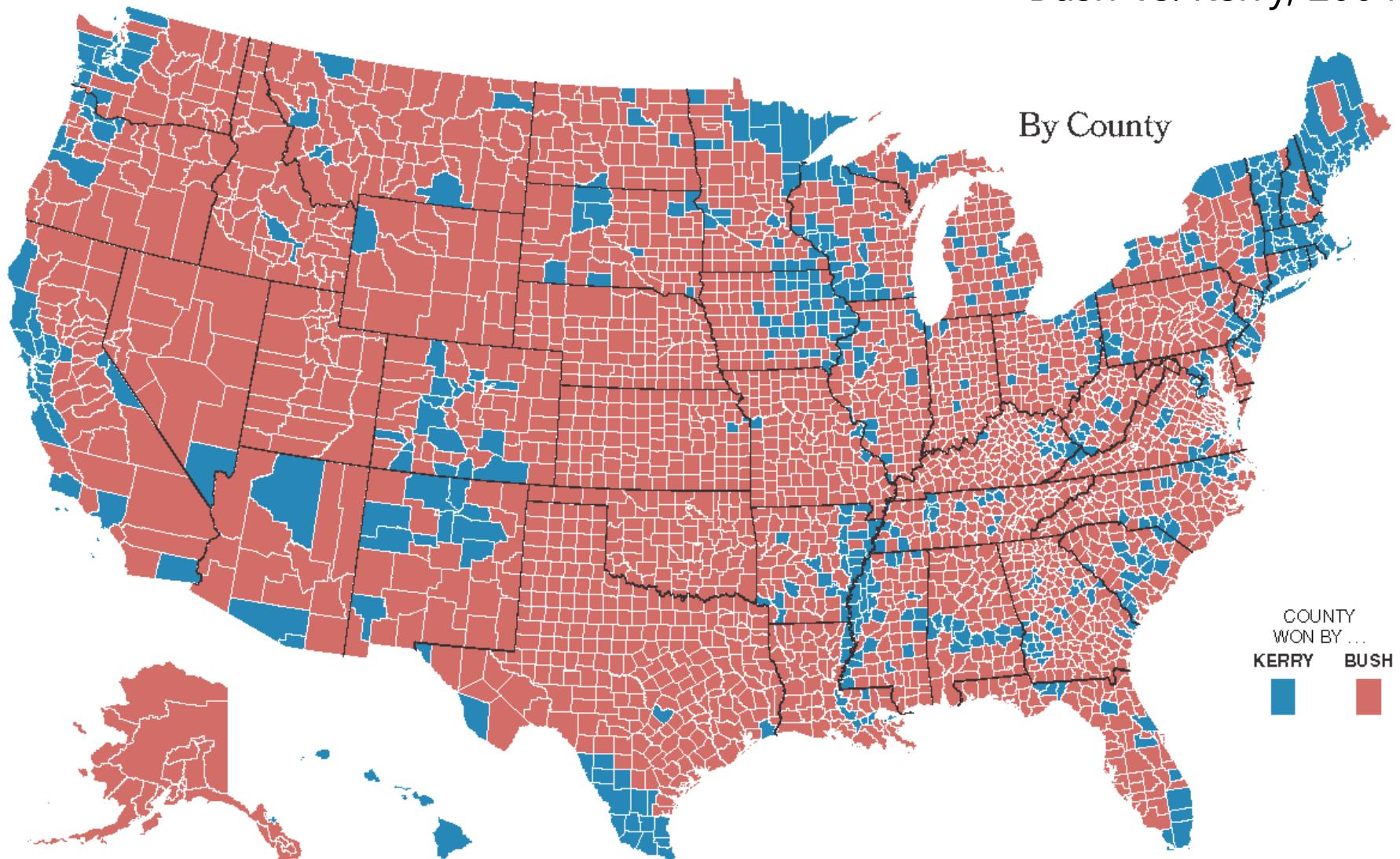
Mexicali: HDI = 0.757

Starr: HDI = 0.766

Source: Anderson and Gerber (2007a).

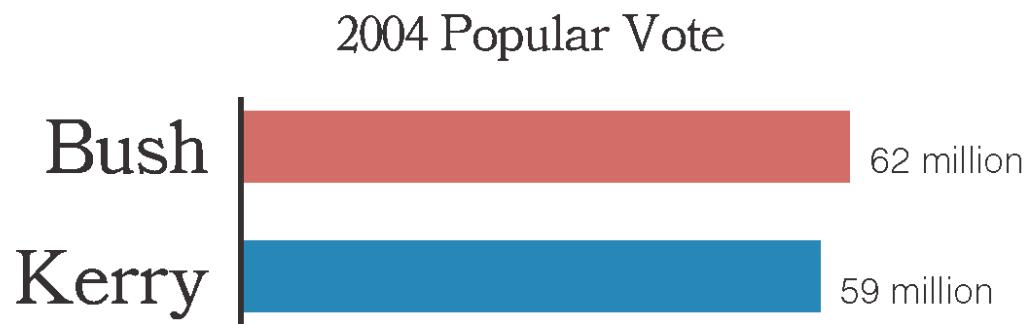
Encoding continuous data on the Maps

Bush Vs. Kerry, 2004



Encoding continuous data on the Maps

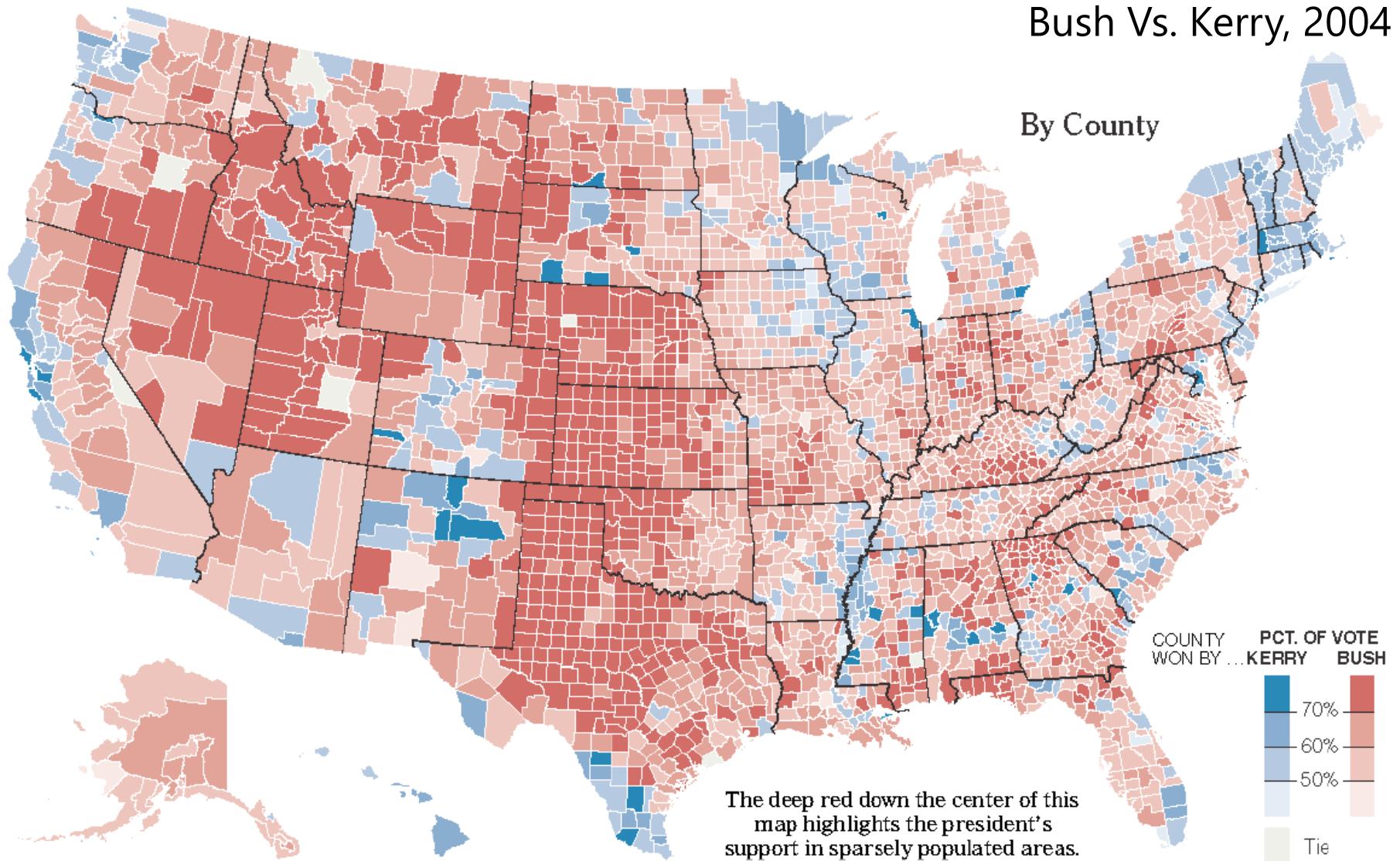
Bush Vs. Kerry, 2004



Amount of red and blue shown on map

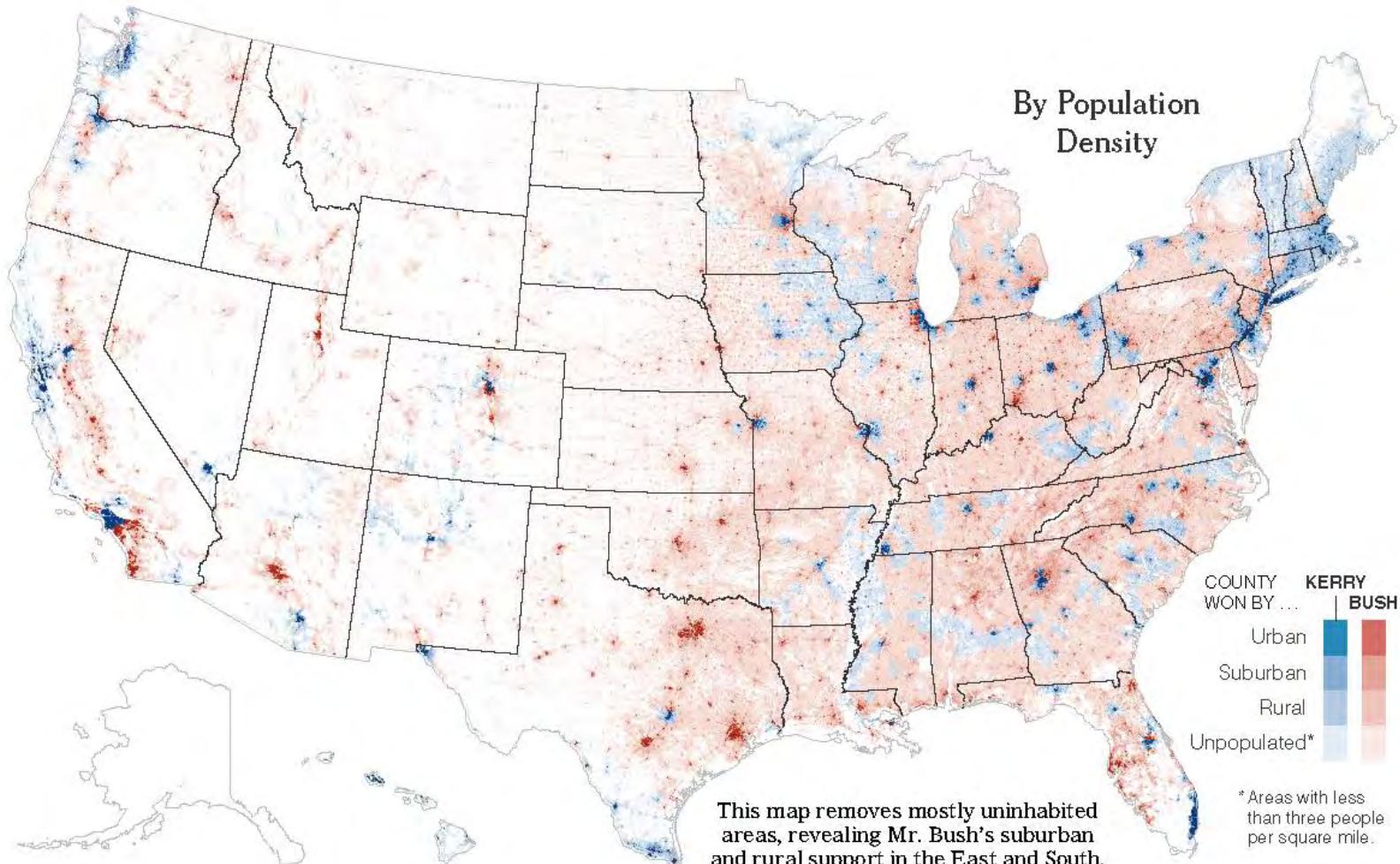


Encoding continuous data on the Maps



Encoding continuous data on the Maps

Bush Vs. Kerry, 2004



Encoding continuous data on the Maps

Cartograms

- Map in which areas are scaled and distorted relative to a data attribute value
- e.g. Land Area
(first cartogram, Emile Levasseur, 1868)

STATISTIQUE FIGURATIVE

SUPERFICIE

1 millimètre carré représente
955 kilomètres carrés



Encoding continuous data on the Maps

SOURCES, CREDITS AND FEEDBACK

2006 ELECTION GUIDE

SENATE RACES

HOUSE RACES

GOVERNORS' RACES

RACE PROFILES

New York Times ratings

198

16

17

24

180

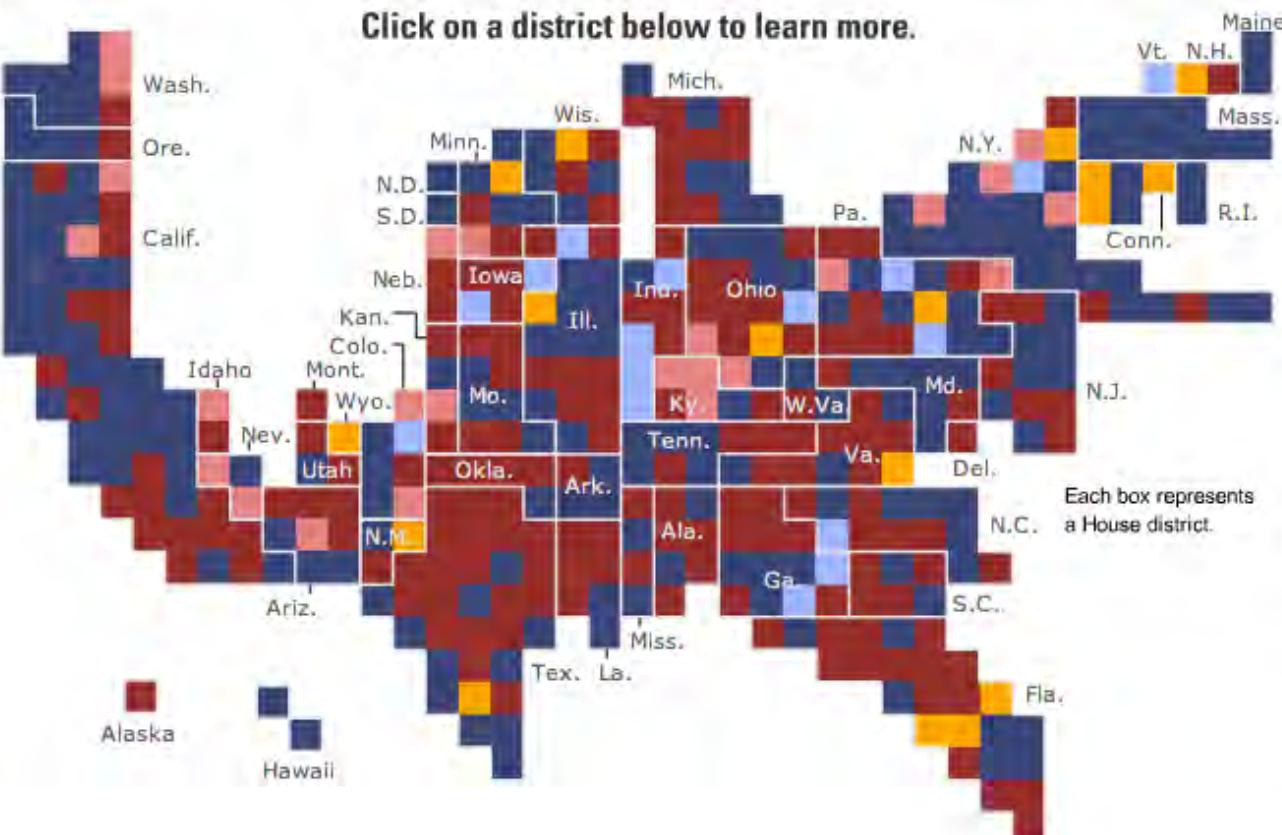
Safe Dem. Leaning Dem.

Toss up

Leaning Rep.

Safe Rep.

Click on a district below to learn more.



ANALYZE RACES

CREATE OUTCOMES

Shade the map using the pulldown...

New York Times ratings

...then show only certain states

New York Times ratings ②

- | | | | | | | |
|-------------|--------------------------|------|--------------------------|---------|--------------------------|---------|
| Democrat: | <input type="checkbox"/> | Safe | <input type="checkbox"/> | Leaning | <input type="checkbox"/> | Toss Up |
| Republican: | <input type="checkbox"/> | Safe | <input type="checkbox"/> | Leaning | <input type="checkbox"/> | |

Current Rep. Dem. Rep.

Margin in 2004 House race

- | | | | | | | |
|-------------|--------------------------|------|--------------------------|--------|--------------------------|------|
| Democrat: | <input type="checkbox"/> | >50% | <input type="checkbox"/> | 25-50% | <input type="checkbox"/> | <25% |
| Republican: | <input type="checkbox"/> | >50% | <input type="checkbox"/> | 25-50% | <input type="checkbox"/> | <25% |

Votes for president Kerry Gore
 Bush Bush

Appearances by big fundraisers ⑦

- | | |
|---|---------------------------------------|
| <input type="checkbox"/> George W. Bush | <input type="checkbox"/> Bill Clinton |
|---|---------------------------------------|

Races to watch ⑦

Open races

Switch districts ⑦

Urbanization

- | | | | |
|--------------------------------|-----------------------------------|--------------------------------|--------------------------------|
| <input type="checkbox"/> Urban | <input type="checkbox"/> Suburban | <input type="checkbox"/> Rural | <input type="checkbox"/> Mixed |
|--------------------------------|-----------------------------------|--------------------------------|--------------------------------|

Race/Ethnicity

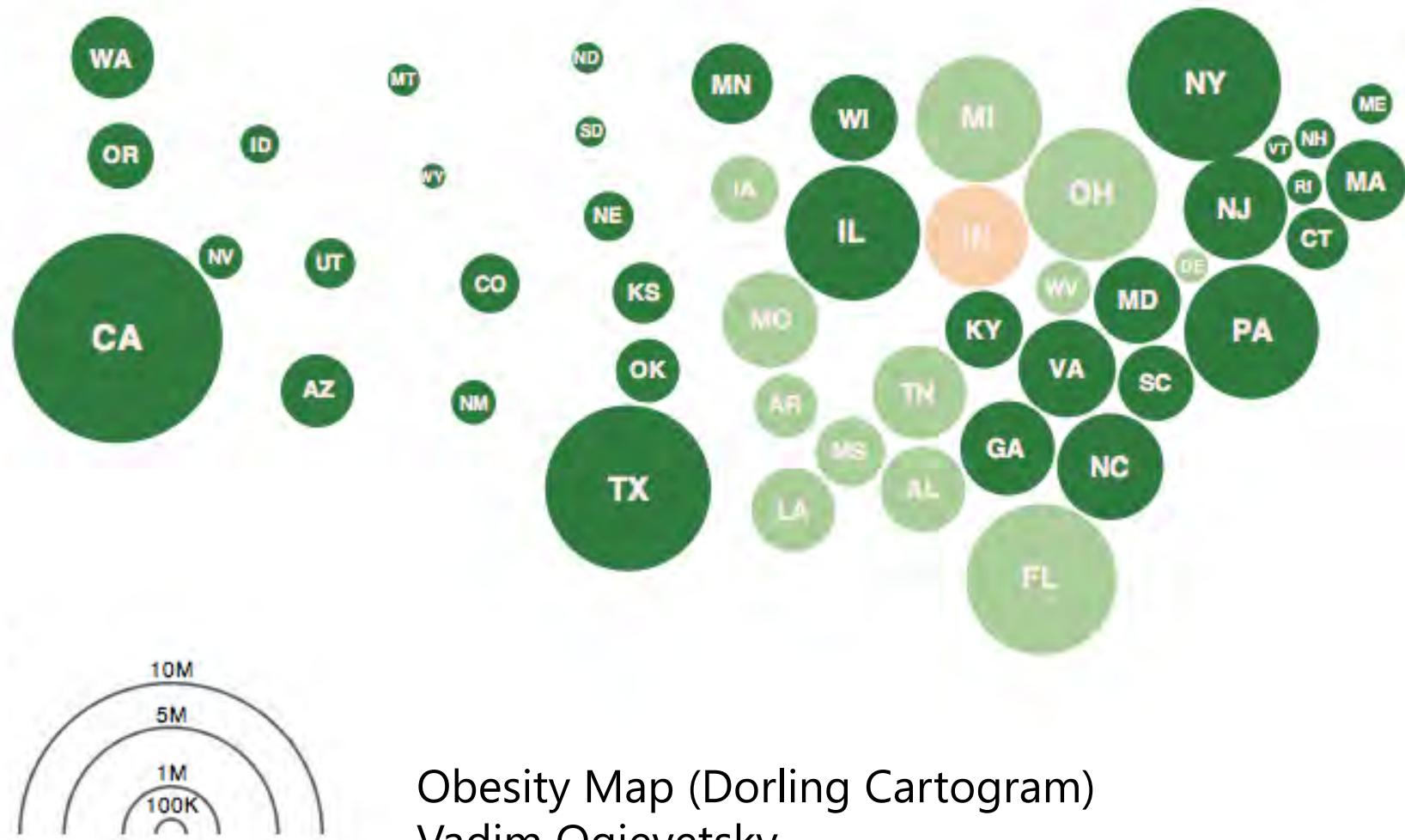
- | | | |
|--------------------------------|--------------------------------|-----------------------------------|
| <input type="checkbox"/> White | <input type="checkbox"/> Black | <input type="checkbox"/> Hispanic |
|--------------------------------|--------------------------------|-----------------------------------|

Median income

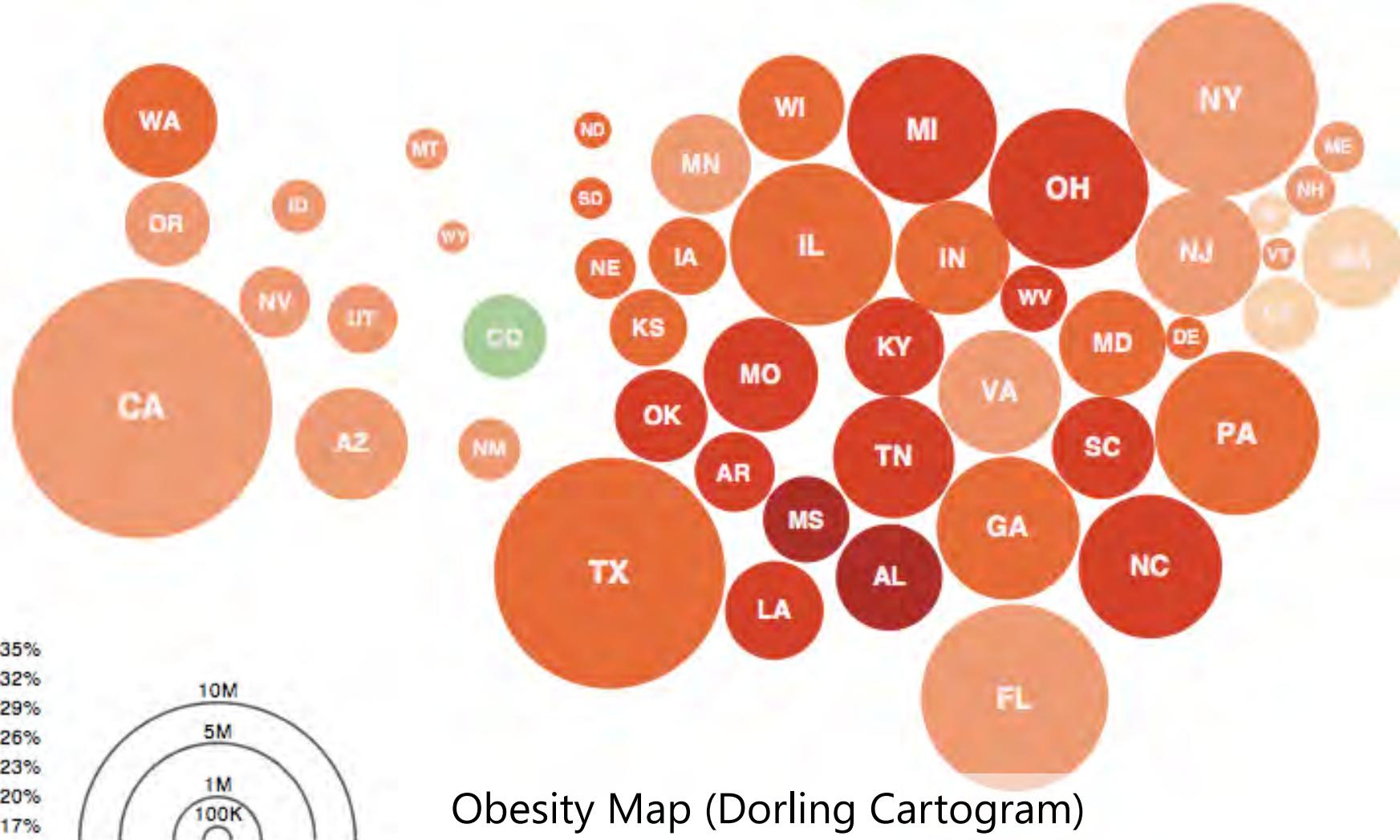
- | | | |
|---------------------------------|-----------------------------------|---------------------------------|
| <input type="checkbox"/> <\$30K | <input type="checkbox"/> \$30-50K | <input type="checkbox"/> >\$50K |
|---------------------------------|-----------------------------------|---------------------------------|

RESET

Encoding continuous data on the Maps



Encoding continuous data on the Maps



Economic Output

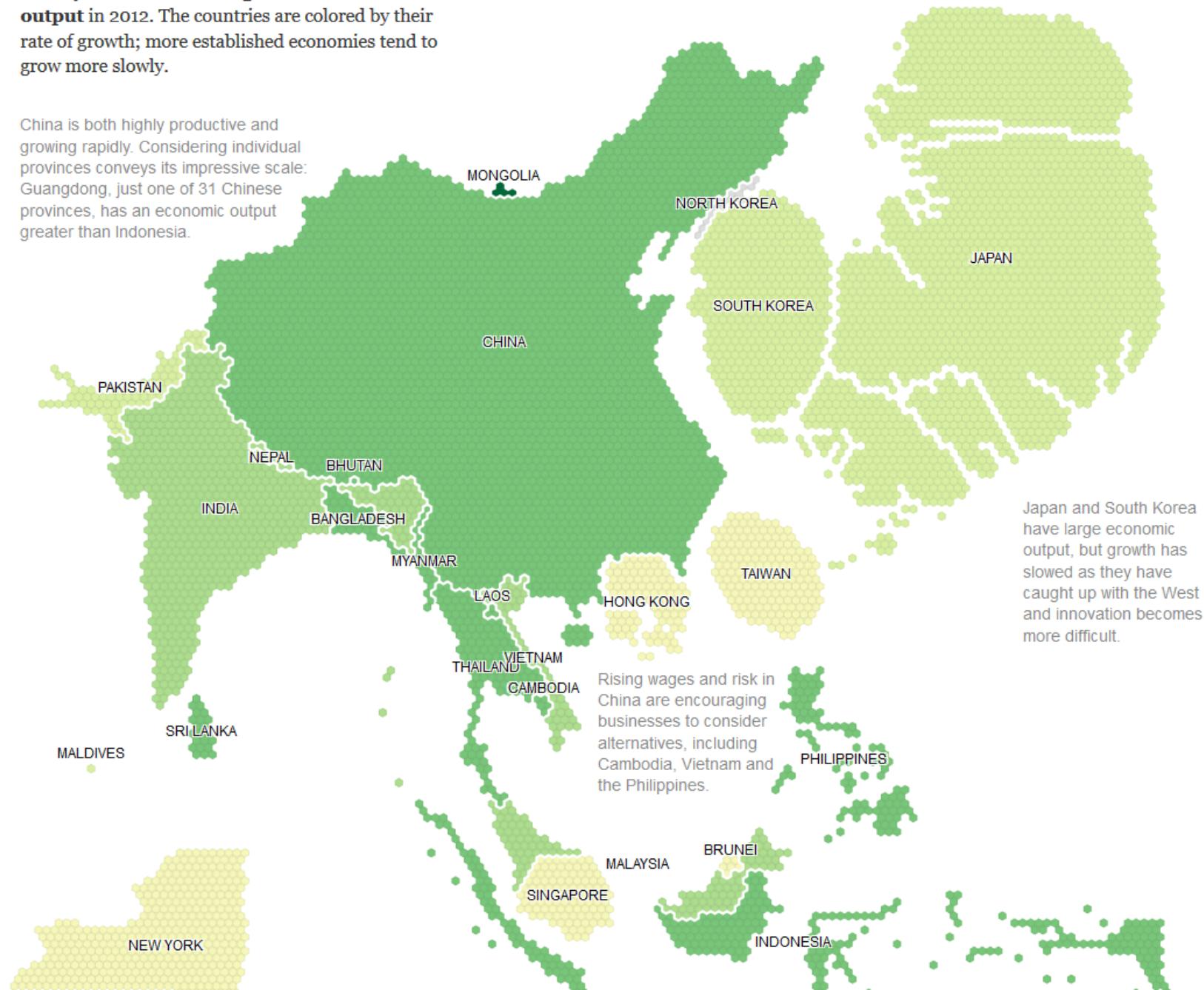
In this map, geography is distorted so that each country is sized according to its economic output in 2012. The countries are colored by their rate of growth; more established economies tend to grow more slowly.

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%



Population

Sizing by population instead gives an estimate of a country's economic potential, at least for labor-based manufacturing. The color here shows the economic output per capita: a measure of how effectively that potential has been realized, and a proxy for labor cost.

Each hexagon represents
500,000 people

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

Despite its large population, India's troubles building an efficient transportation network, its bureaucratic land regulations and turbulent labor relations have slowed investment and growth there.

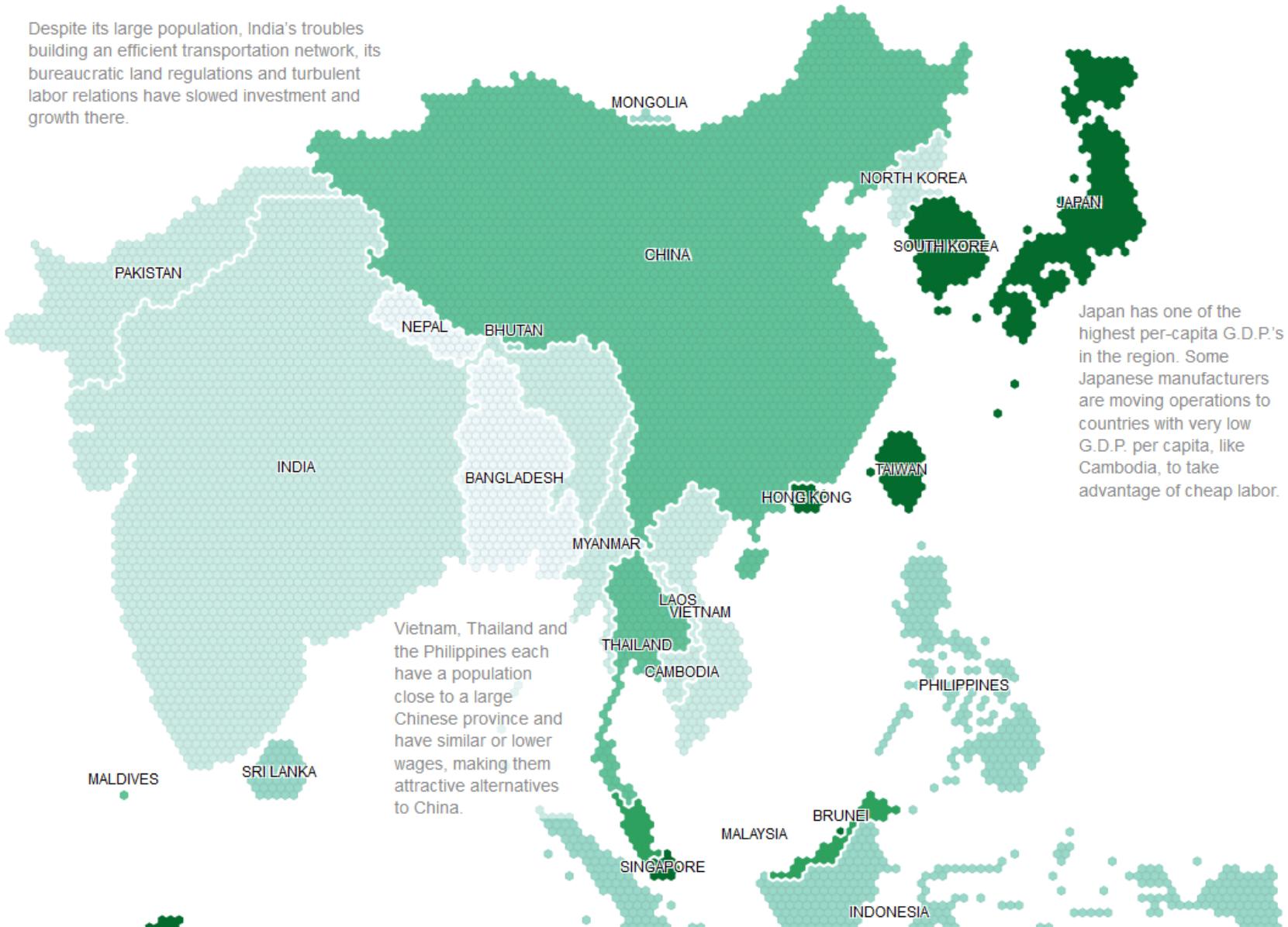
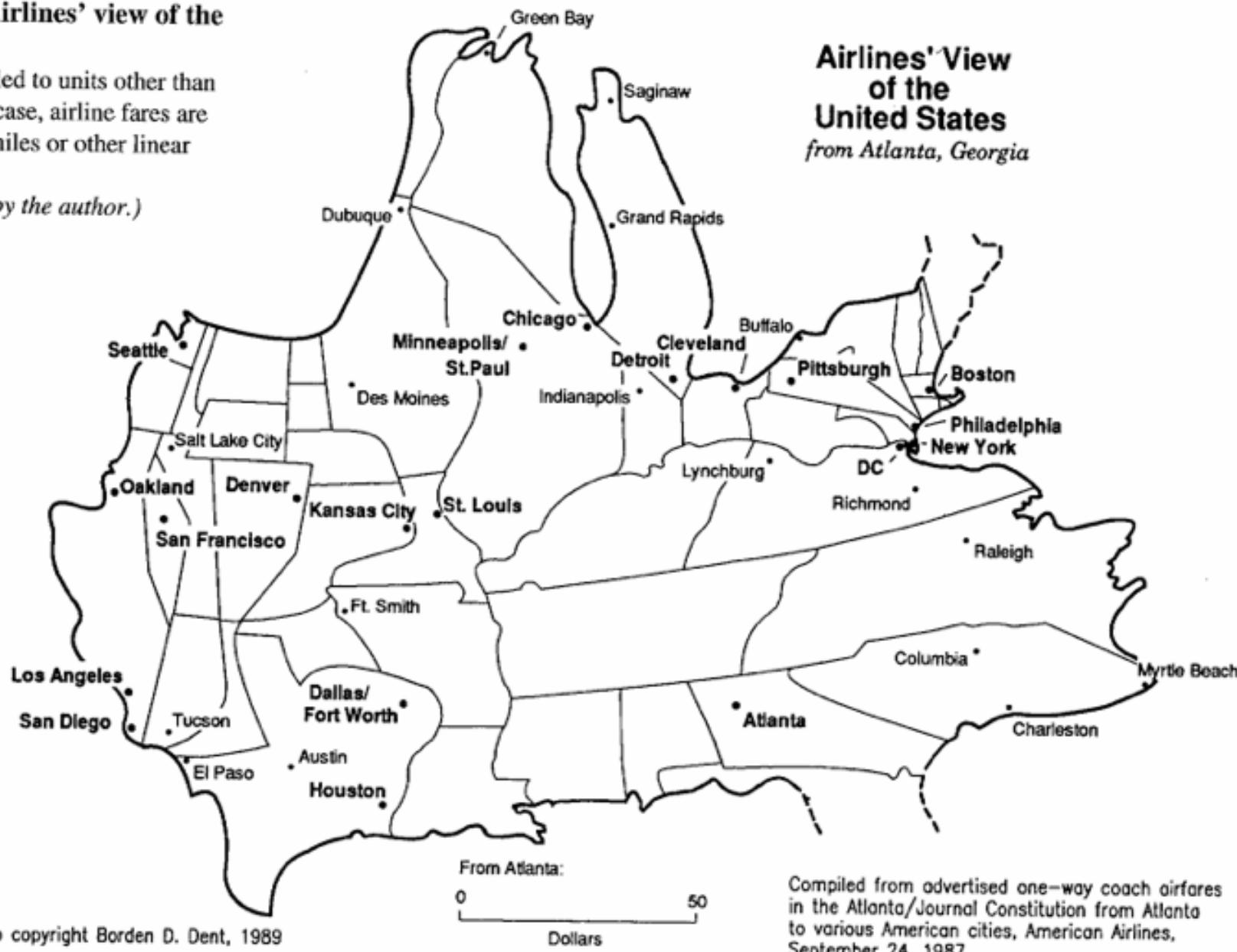
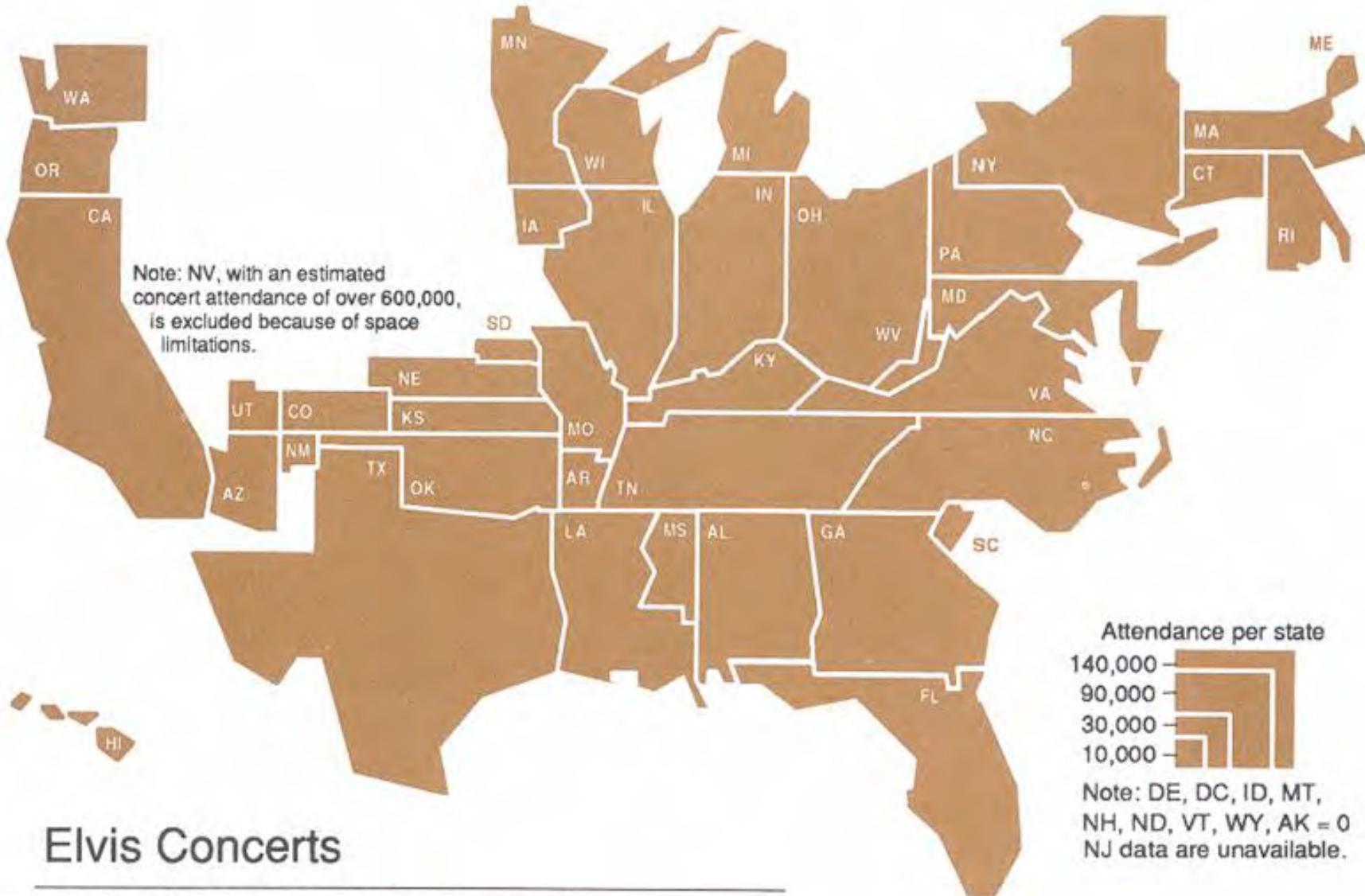


Figure 1.8 Airlines' view of the United States.

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.)





Elvis Concerts

Attendance per State, 1970 - 1977

Source: Stanley, David E., with Frank Coffey. *The Elvis Encyclopedia*. Santa Monica, CA.: General Publishing Group, Inc , 1994.

© 1995 Andrew Dent and Linda Turnbull

What Your Global Neighbors Are Buying

How people spend their discretionary income – the cash that goes to clothing, electronics, recreation, household goods, alcohol – depends a lot on where they live. People in Greece spend almost 13 times more money on clothing as they do on electronics. People living in Japan spend more on recreation than they do on clothing, electronics and household goods combined. Americans spend a lot of money on everything.

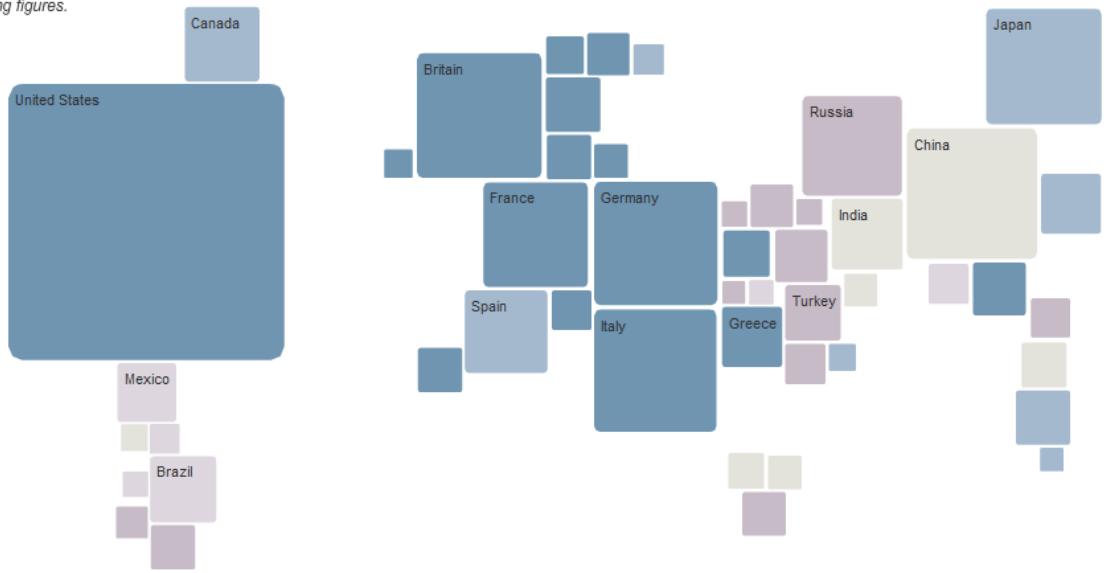
Related Article

CLOTHING & FOOTWEAR ELECTRONICS ALCOHOL & TOBACCO HOUSEHOLD GOODS RECREATION

Boxes represent selected countries and are scaled according to total spending in 2007.



Roll over countries to see spending figures.

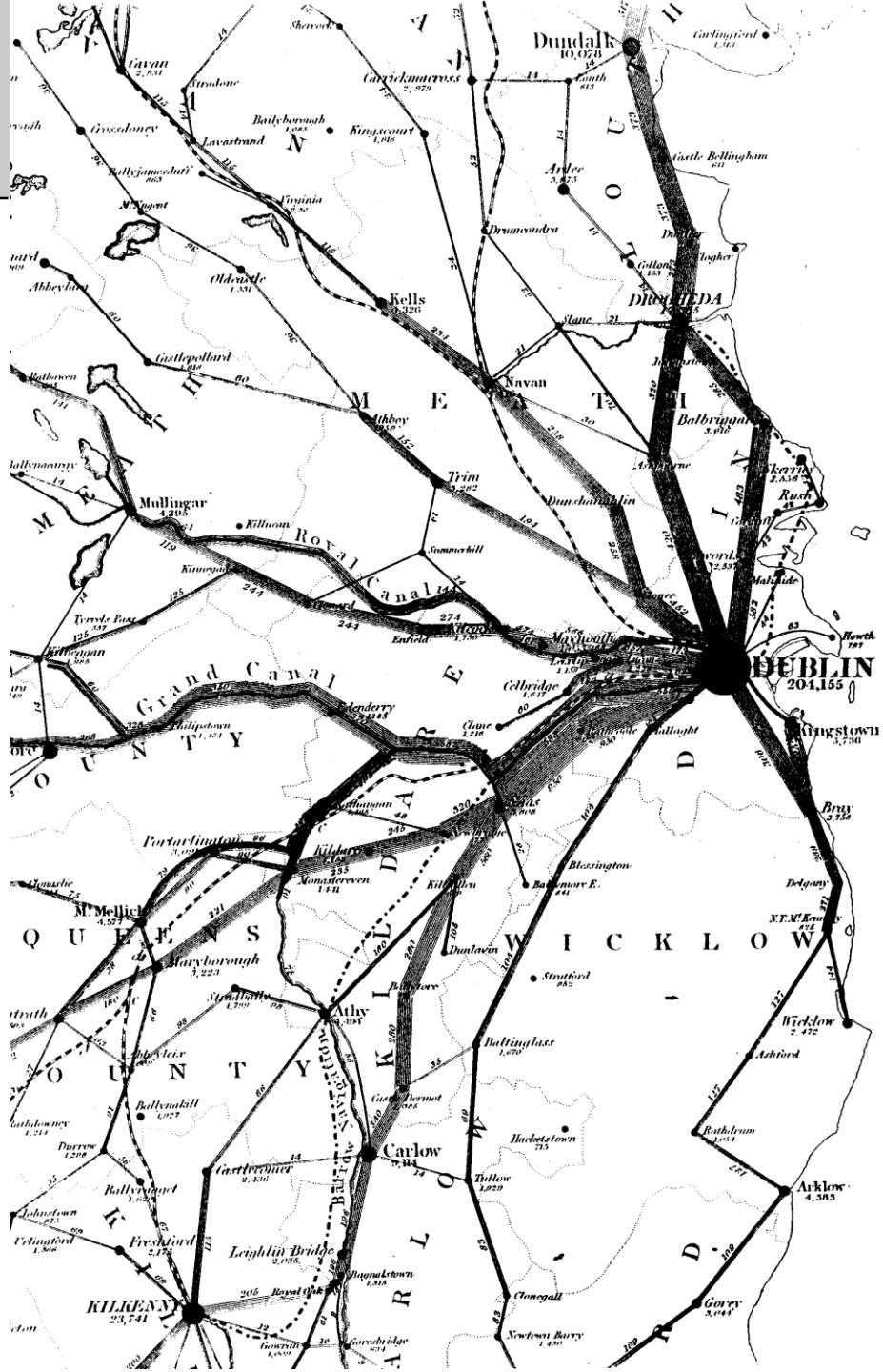


Includes new clothing and footwear as well as cleaning and repair. Excludes sports-related footwear.

Encoding continuous data

Flow maps

- Transportation of passengers in Ireland 1837 print by Henry Drury Harness
- Map shows transportation by means of shaded lines, widths proportional to amount (passengers)



Encoding continuous data – Flow Maps

Carte Figurative des pertes successives en hommes de l'Armée Française dans la campagne de Russie 1812-1813.
Dessiné par A. Minard, Ingénieur Général des Ponts et Chaussées en retraite. Paris, le 20 Novembre 1869.

Les nombres d'hommes perdus sont représentés par les largures des zones colorées à raison d'un millimètre pour six mille hommes; ils sont le plus évidents sur les zones. Le rouge désigne les hommes qui meurent en Russie, le noir ceux qui en sortent. — Les renseignements qui me sont venus à propos la cause ont été pris sur les ouvrages de M. N. Chotet, de Nogat, de Ferondeac, de Chambray et le journal militaire de Paris, pharmacien de l'Armée depuis le 28 Octobre.

Je vous prie faire juge à l'ordre la diminution de l'armée, j'ai supposé que les corps de l'Armée Noyale et du Marshal Davout, qui suivirent l'Armée de Napoléon au-delà de l'Oural, avaient disparu avec l'armée.

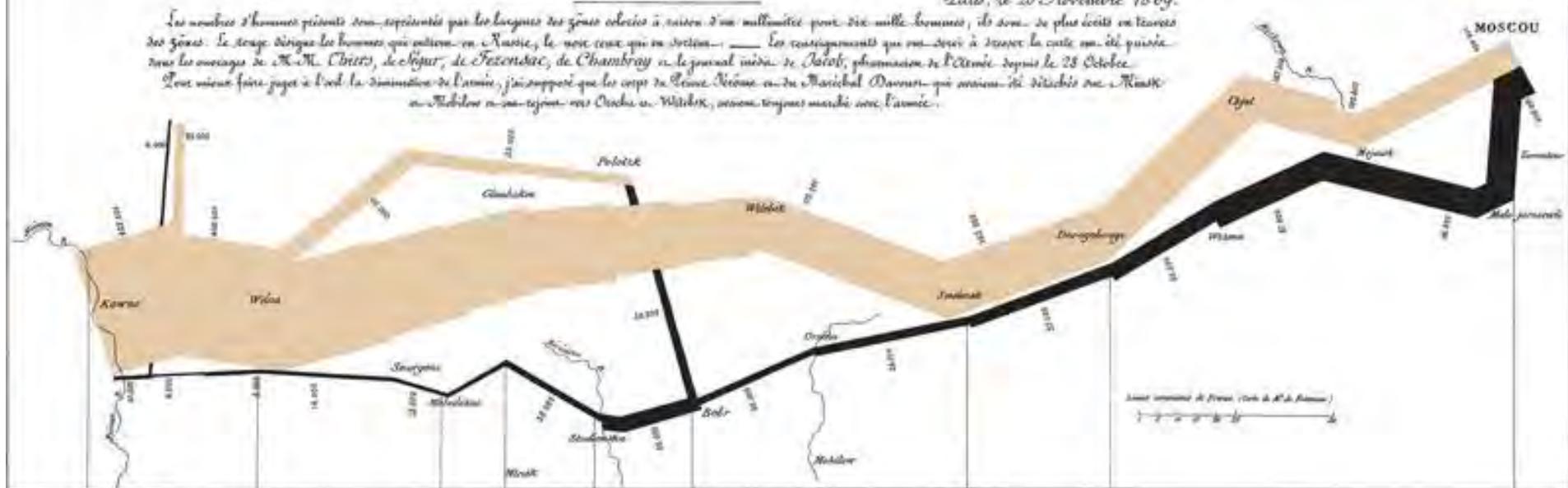
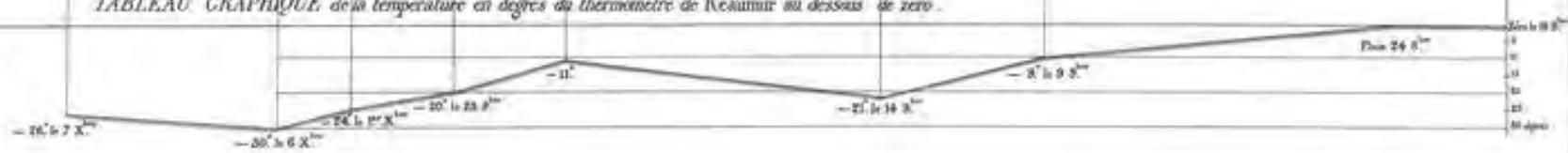


TABLEAU GRAPHIQUE de la température en degrés du thermomètre de Réaumur au dessus de zéro.

Les Champs passent au gelé
le 16ème, gelé.



CARTE figurative et approximative de la Houille Anglaise exportée en 1854 dressée par M^{INARD}. Assemblage Général des Ports et Chemins de fer.

Les tonnages exportés dans les principaux Ports de Géôle sont extraits du Mineral statistics at St Robert Hall pour l'anné 1854 (page 19 et 20) sur simple Géôle. Indication des distances entre les ports et les villes de destination.

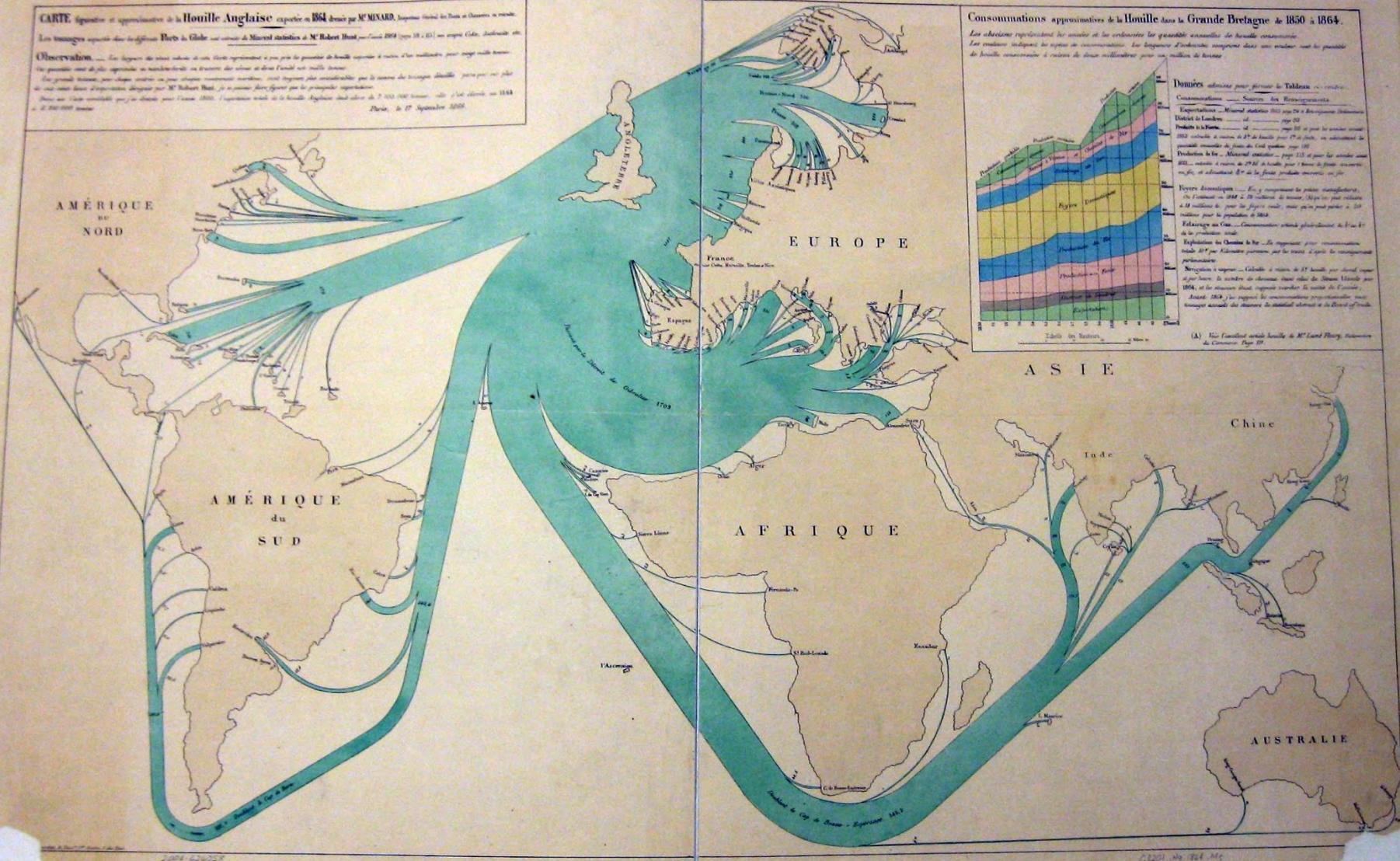
Observation. — Les départs des bateaux volontaires sont tirés par les quantités de houille exportées à moins d'un millionne pour chaque ville.

Les distances sont de plus approchées au bord de la carte, mais l'exactitude n'est pas assurée.

Les grande distances, pour chaque ville, ou pour chaque communauté commerciale, sont toujours plus considérables que le centre des terrains éloignés, par ce que ces derniers sont d'autant plus importants que le port de la houille anglaise dans celles-ci est élevé, au 1854.

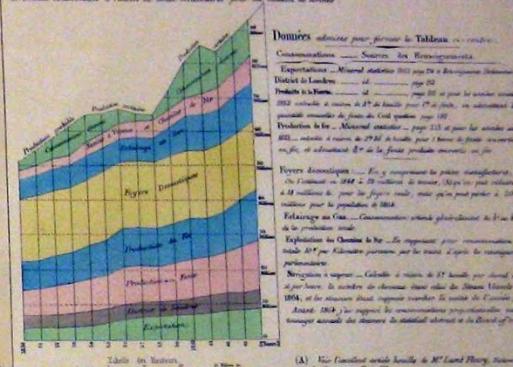
Dans une note remise par le décret pour l'année 1855, l'importance totale de la houille anglaise était alors de 7.000.000 tonnes, soit d'environ un million de tonnes.

Paris, le 17 Septembre 1855.



Consommations approximatives de la Houille dans la Grande Bretagne de 1850 à 1854.

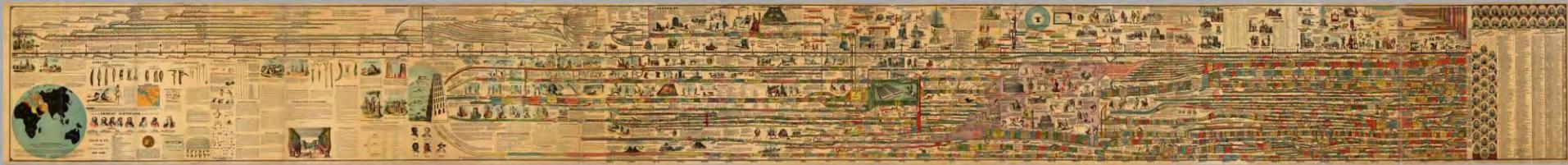
Les abscisses représentent les années et les ordonnées les quantités annuelles de houille consommée.
Les couleurs indiquent les types de consommation. Les tonnages d'exportation engrangés dans nos écluses sont les quantités de houille consommée à moins de deux milliardines pour un million de tonnes.



(A) Voir Considérations sur la Houille de M^{INARD} Paris, Séminaire du Commerce, page 12.

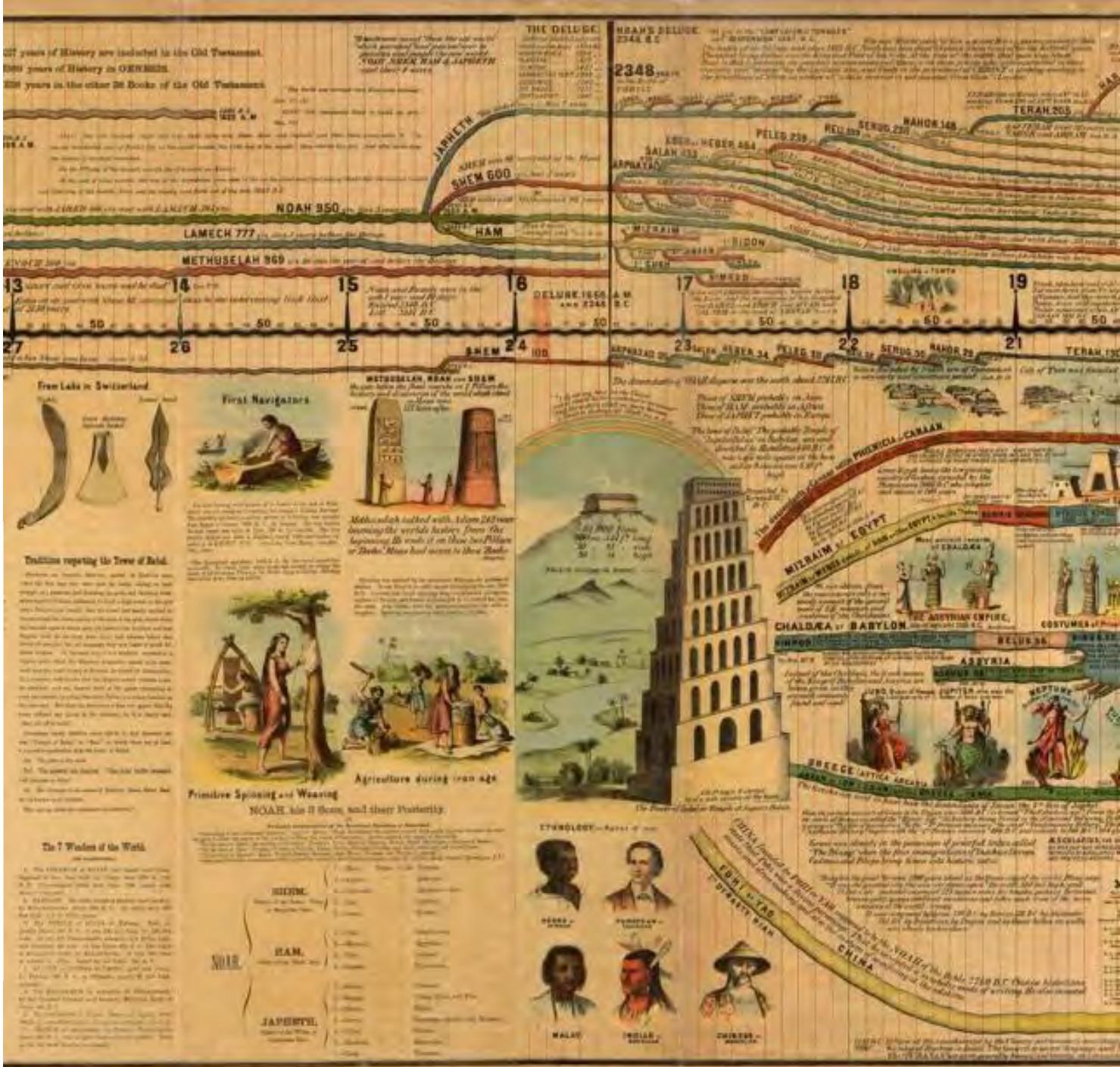
CB201 Inv 744 MS

Encoding continuous data – Flow Maps



- A huge and impressive twenty three foot long chart showing 5,885 years of history, from 4004 B.C.. to 1881 A.D.
- First issued in 1871, Adams put out several editions in many formats.
- Rosenberg and Grafton in "Cartographies of Time" say that as a timeline, Adams Synchronological Chart "was nineteenth-century America's surpassing achievement in complexity and synthetic power."

Adams Synchronological Chart (detail)



Encoding continuous data – Flow Maps

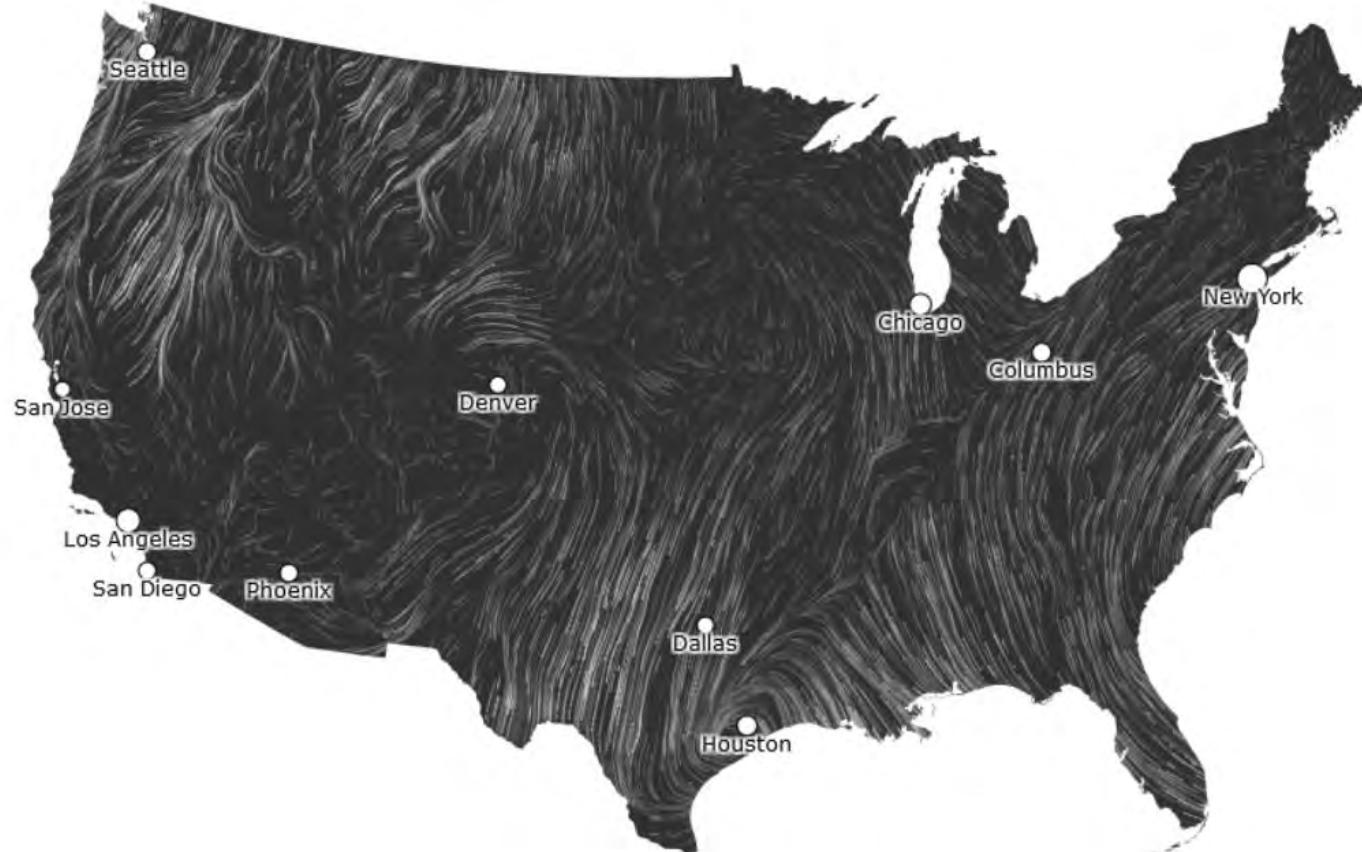
wind map

March 10, 2016

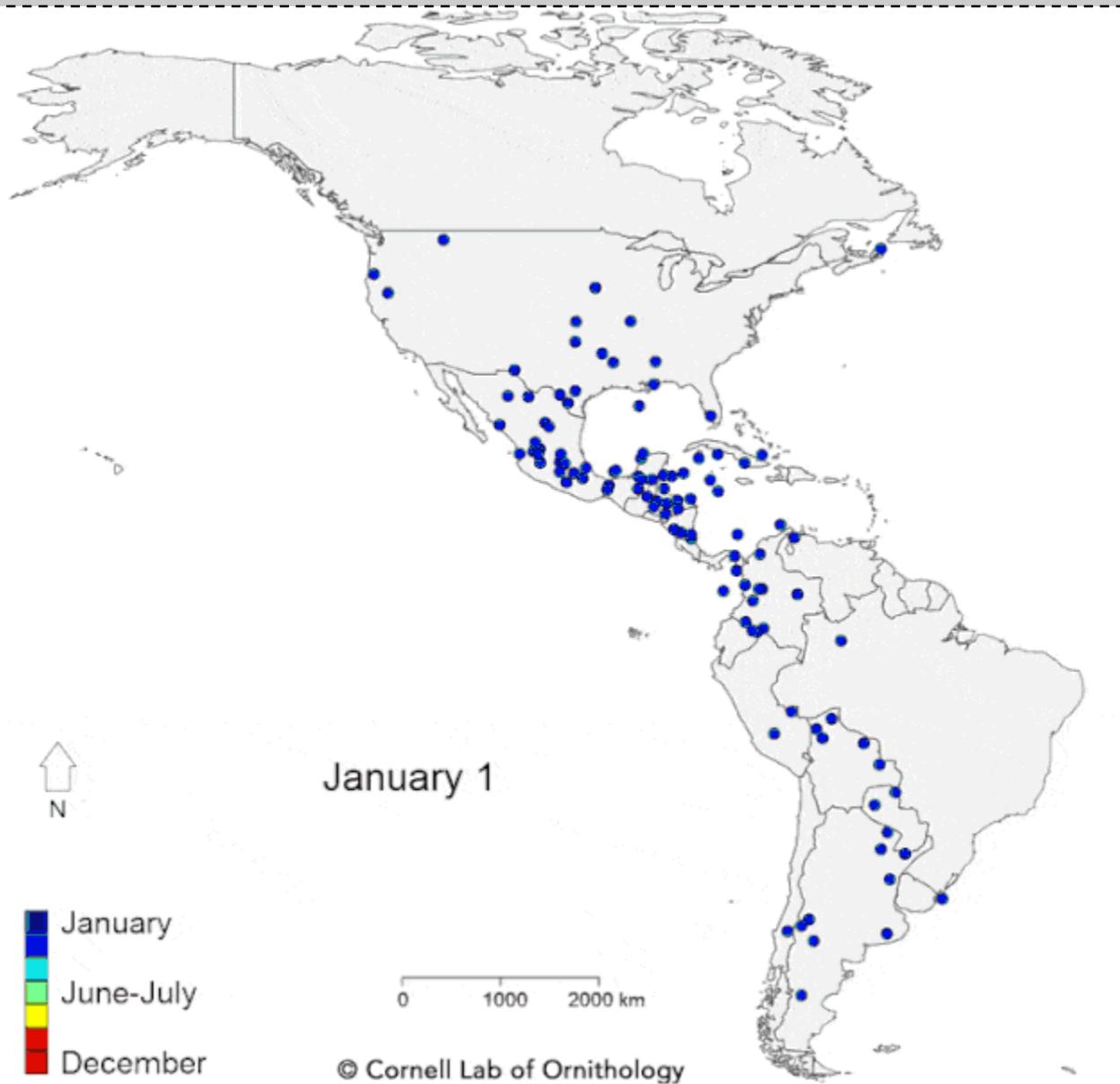
11:35 am EST

(time of forecast download)

top speed: 46.2 mph
average: 9.9 mph



Encoding continuous data – Flow Maps



Encoding continuous data – Flow Maps

How Obama Won Re-election

Whites Were Outvoted

Women

Hispanics

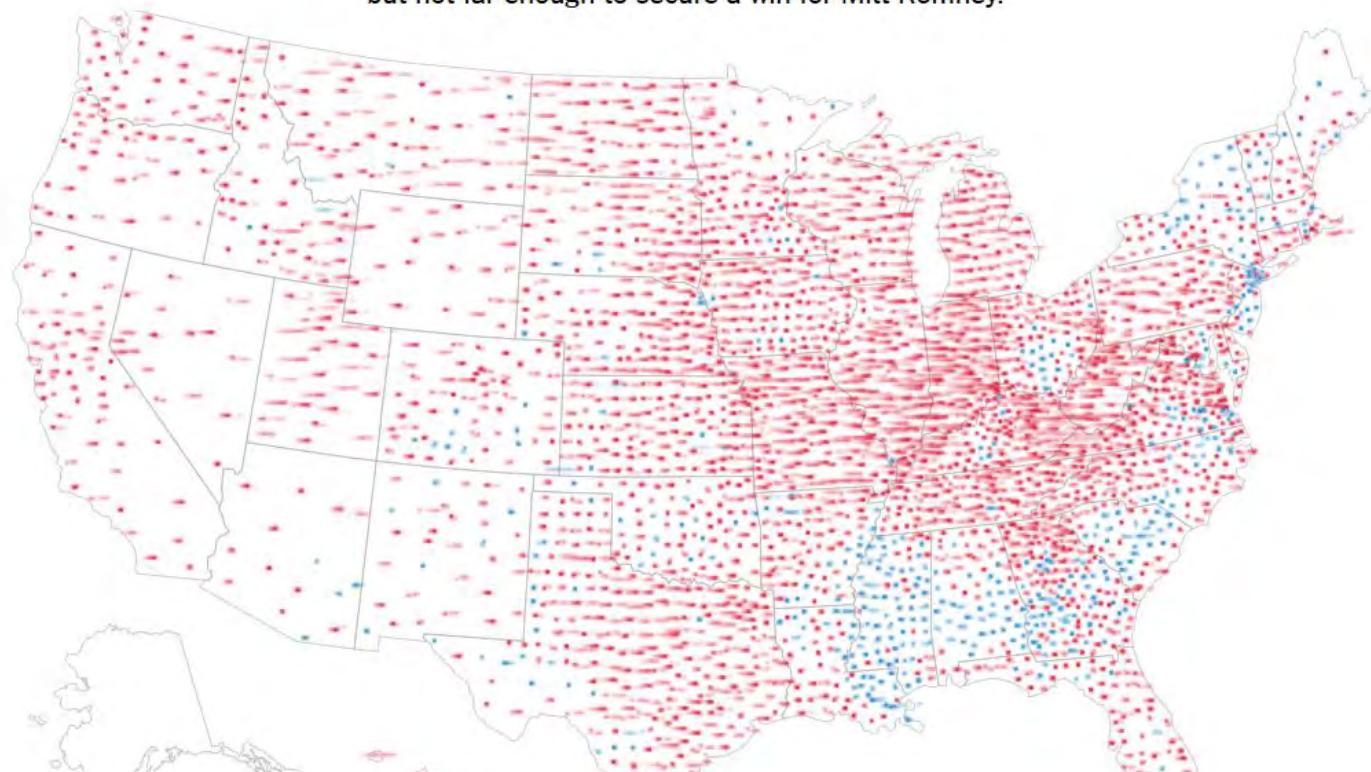
Youth

Romney's Shift Wasn't Enough

2008

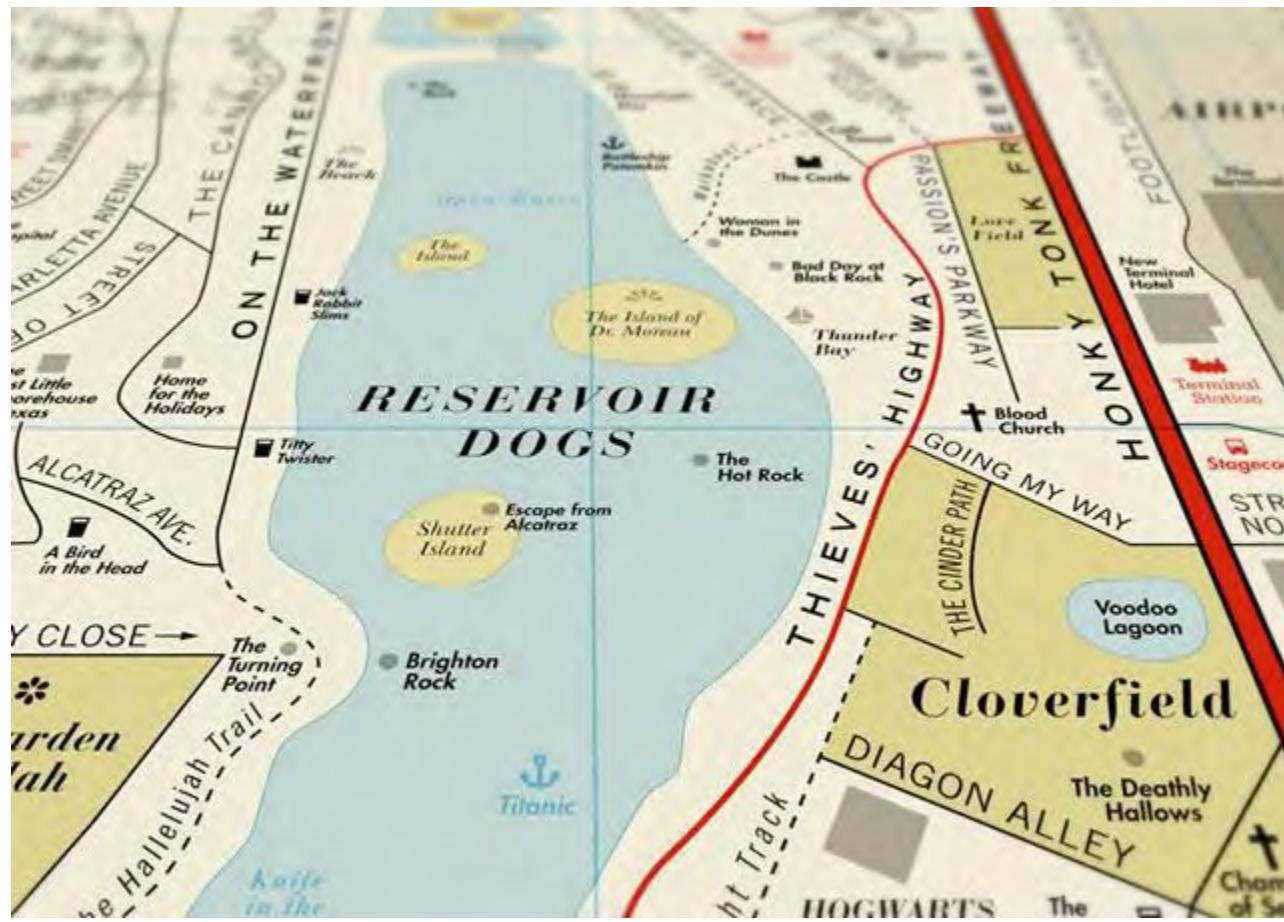
2012

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



Thematic Maps

- Information representation that uses a map metaphor
 - Might not encode any data



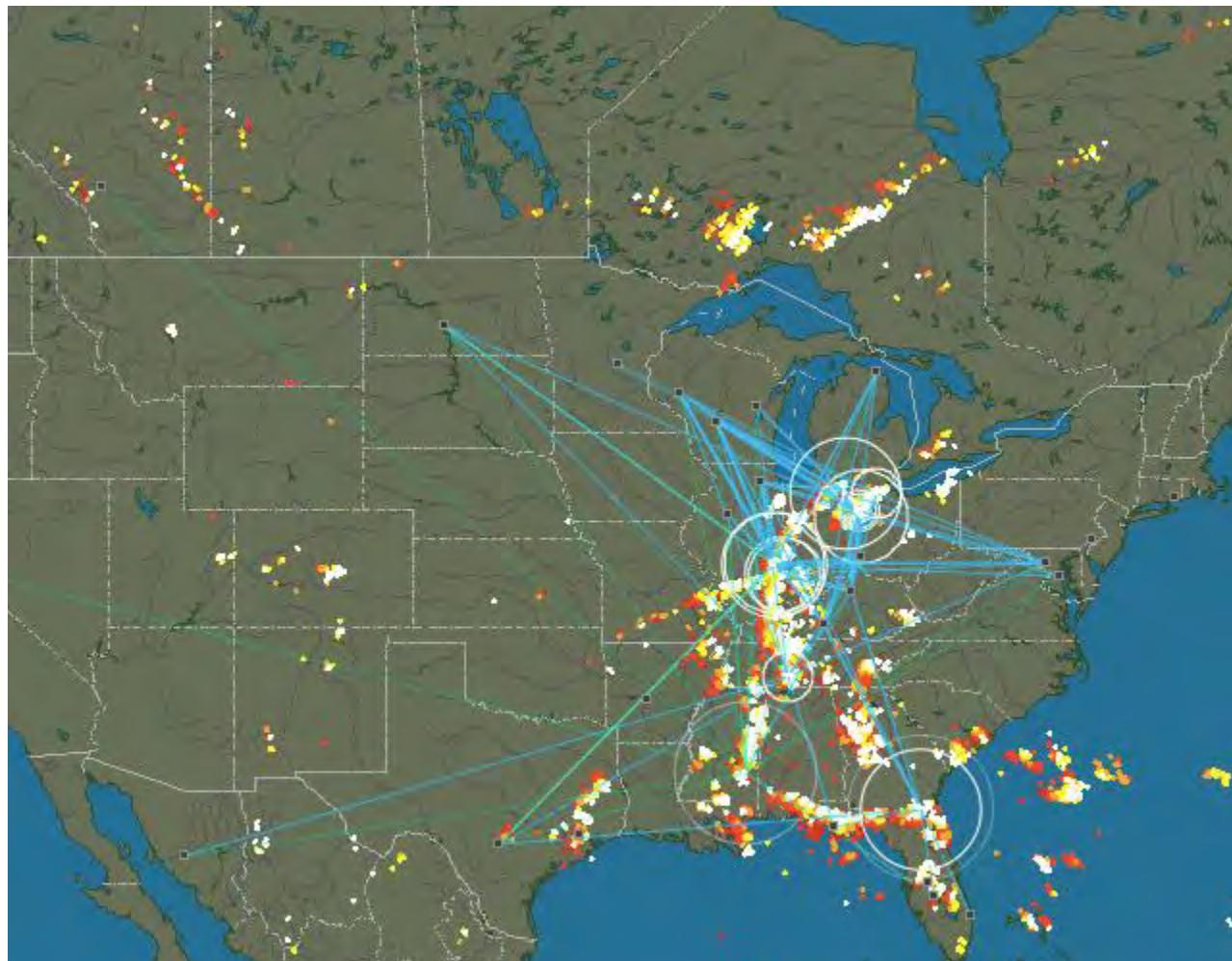
Desire map of the world

- This map was compiled using Google's autocomplete results for "how much does a * cost" for every country in the world



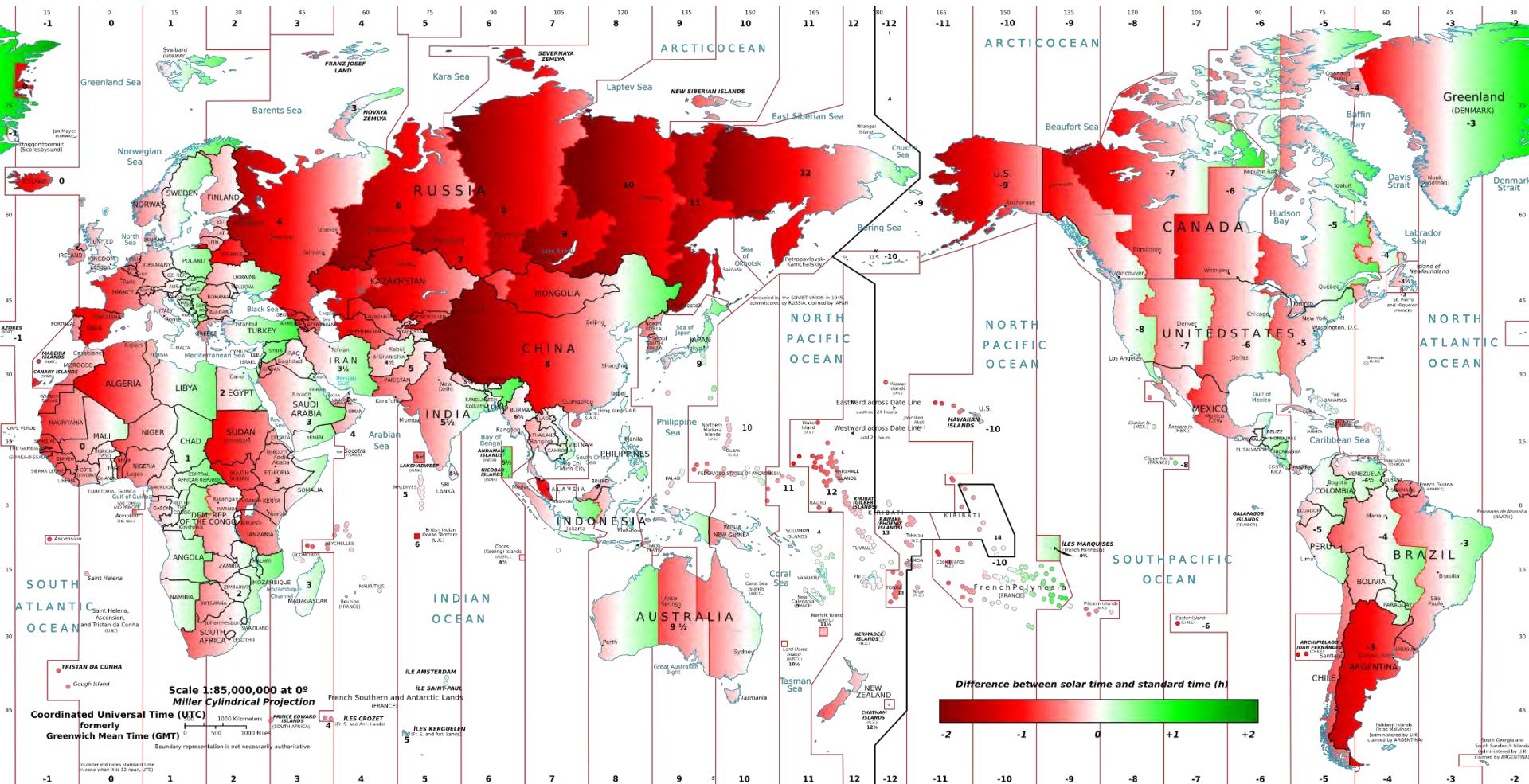
Realtime map of lightning strikes

- The detection system is volunteer community effort. Anyone who wants to can buy a detection kit (for around 200 Euro) and hook it up to the Internet to provide strike data



Realtime map of lightning strikes

- Stefano Maggiolo made a map of how much the time zones of the world vary from solar time. The darker the colour, the more the deviation



Realtime satellite map

- Skybox's constellation of micro-satellites is putting out the world's first commercial, high-resolution, HD video of Earth from space. Here you can see Mapbox Streets paired with this video from SkySat-1





Grass
Grasslands of America



