

Spatial Layout: Arrange Spatial Data (Map)



How?

Encode

- Arrange
- Express
- Separate



- Order
- Align



- Use



- Map from **categorical** and ordered attributes
- Color
 - Hue
 - Saturation
 - Luminance
- Size, Angle, Curvature, ...



- Shape
 - +
 -
 -
 - ▲

- Motion
 - Direction, Rate, Frequency, ...



What?

Why?

How?

Manipulate

- Change



- Select



- Navigate



Facet

- Juxtapose



- Partition



- Superimpose



Reduce

- Filter



- Aggregate



- Embed





When do we need geographic visualization?

- (1) The data contains geographical attributes
 - City, location, altitude, longitude
- (2) Visualizing spatial relationships is an important task
 - A dataset may contain geographical information and yet creating a geographical visualization may not be relevant.



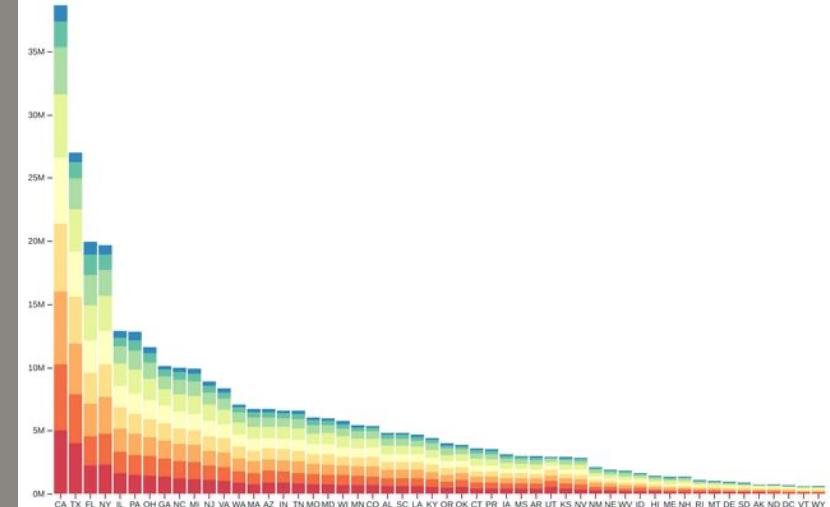
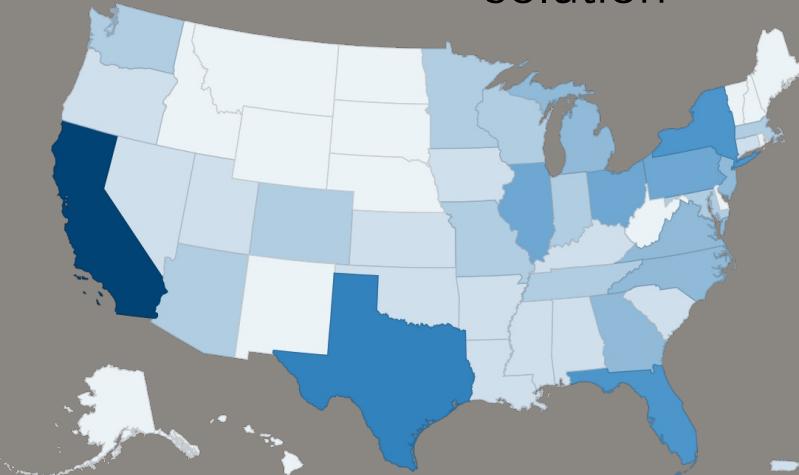
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When do we need geographic visualization?

Key question?

- Does the given spatial position matter for my task?
 - A geo map is not always the best or only solution





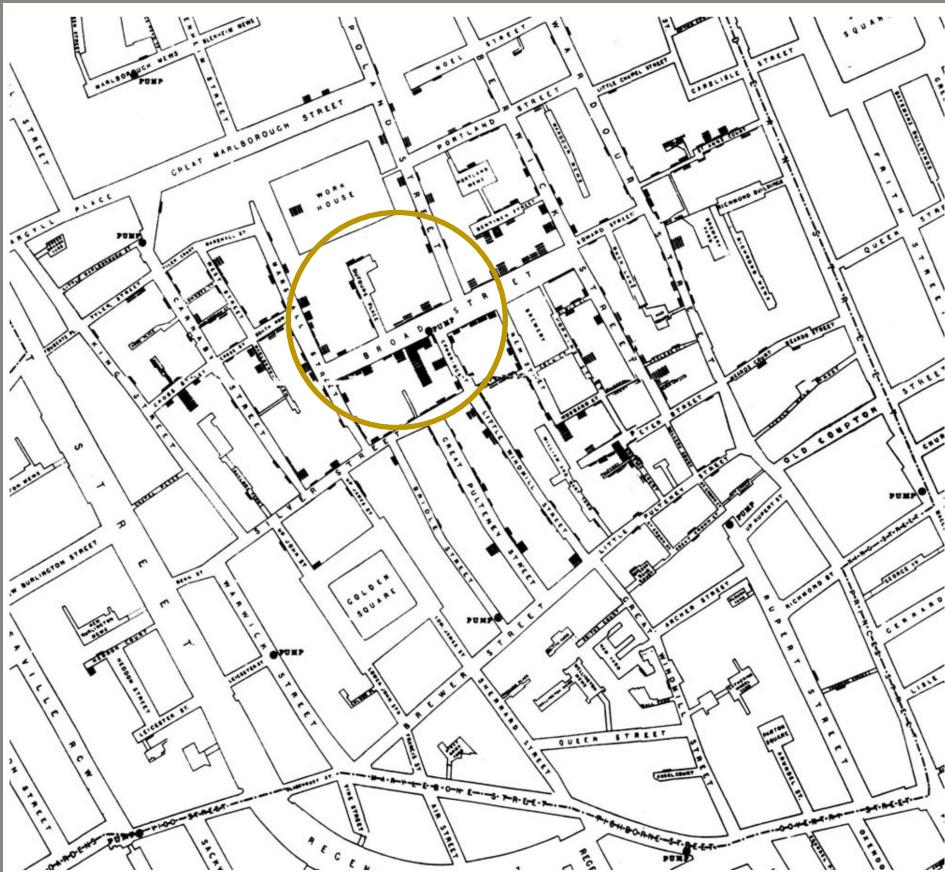
When do we need geographic visualization?

- ➊ There is an advantage of maps over other representations
 - Familiarity
 - People know where something on a map is
 - Map act as an index from spatial to semantic information and vice versa
 - Visually encode given spatial geometry as marks using 2D position channel



John Snow's Cholera Map

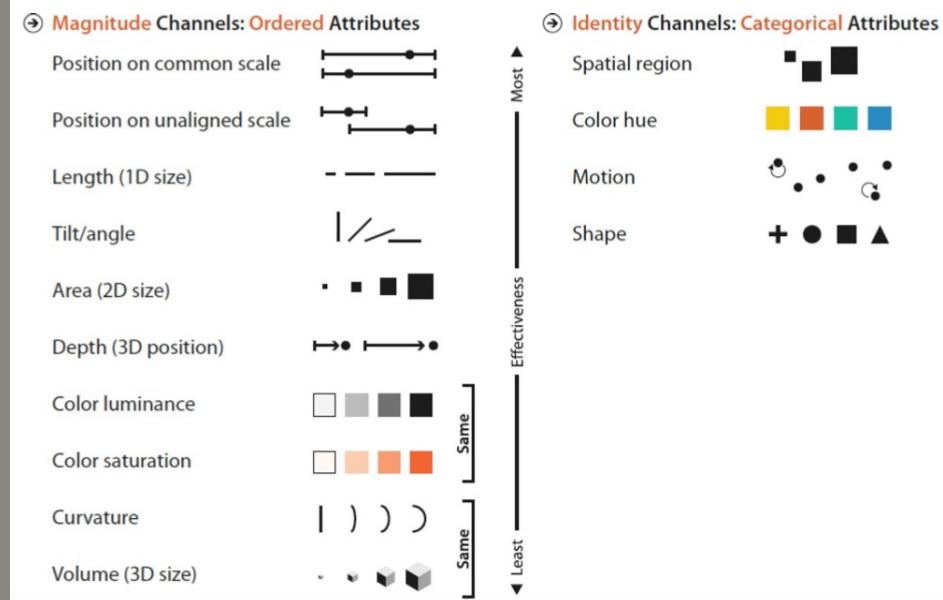
- London, 1854
 - Cholera outbreak was a mystery
- Snow mapped deaths as bars on a geo map
- Cases clustered around a water pump
- One part of a detailed statistical analysis

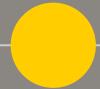




Geographic Map

- ◉ Interlocking marks
 - Shape
 - Area (size)
 - Position
- ◉ Cannot use to encode other attributes



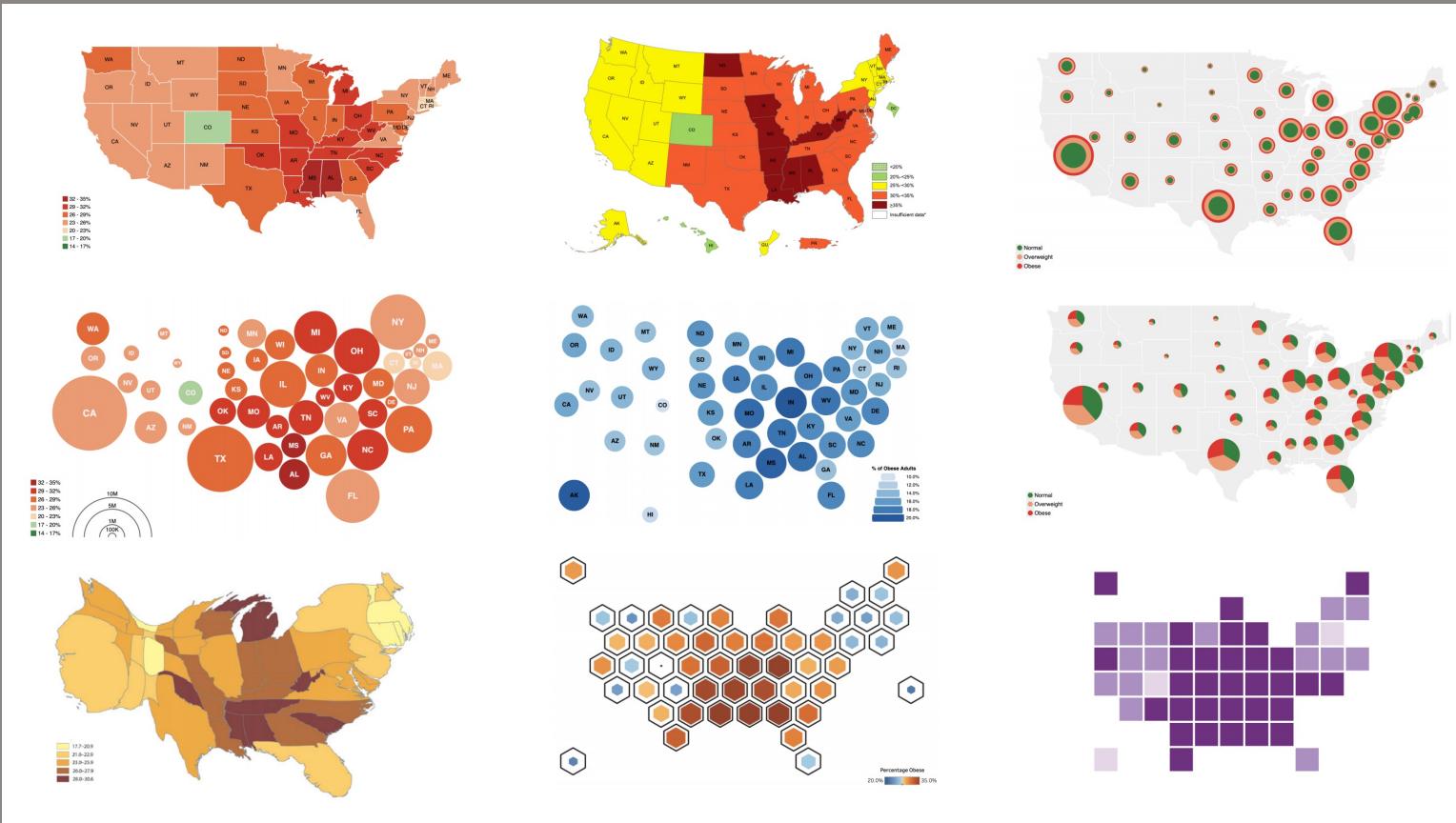


Idioms of Map Visualization

- Show spatial variability of attribute
 - Combine map with tabular data
 - Data: attributes that associate with regions (province, countries, 2D lat/lon)

- Major idioms
 - Choropleth map
 - Symbol map
 - Cartograms map
 - Dot density map

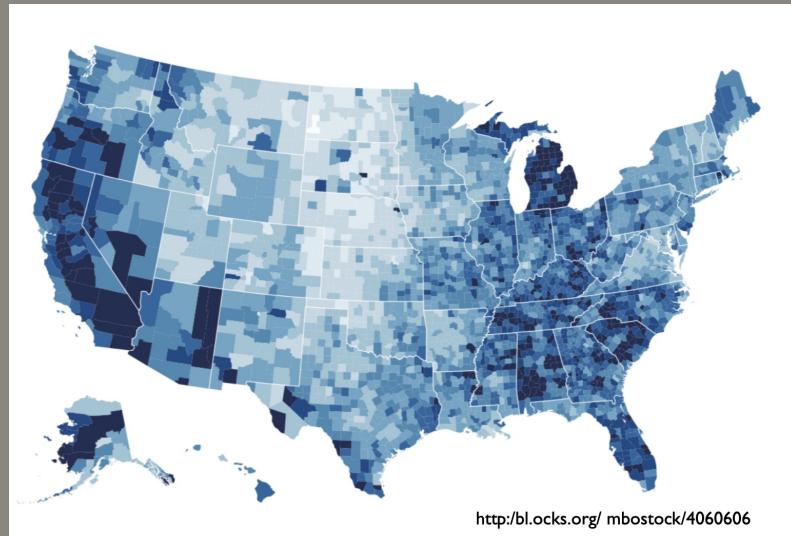
Examples of Geographic Vis





Choropleth Map

- Proposed by Charles Dupin in 1826
- Use when the central task is understanding spatial relationships
- Data
 - Geographic geometry
 - 1 quantitative attribute per “region”
- Encoding
 - Region: boundary (shape/size/position)
 - Color: sequential color map





Choropleth Map: Pros and Cons

○ Procs:

- Easy to understand (no learning curve)
- Much of the geo data is reported by enumeration unit

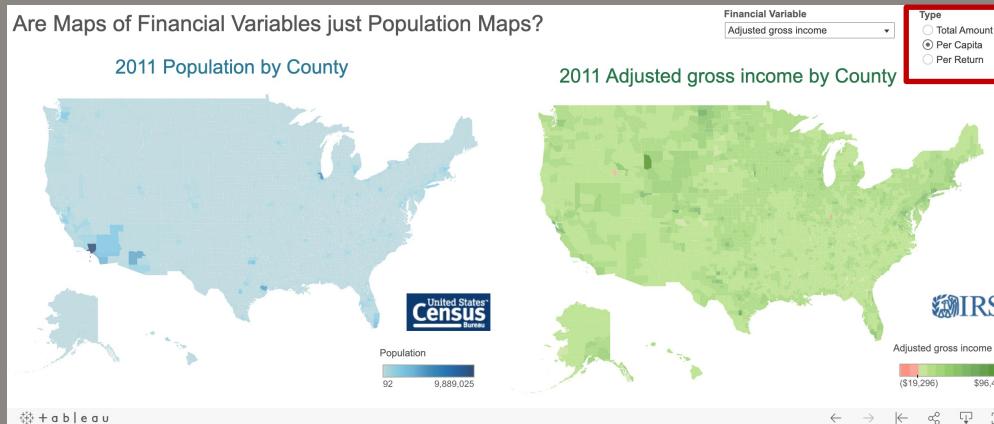
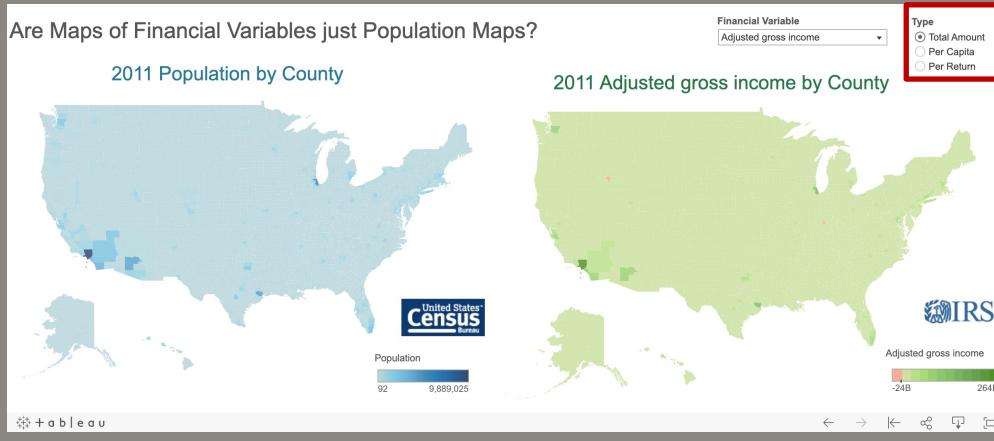
○ Cons:

- The most effective visual channel (location) used for geographic location (shape, area and position)
 - Not easy to show multiple attributes
- Large area is easier to attract people's attention
- Choropleths are often not suitable for showing total values.



Population Map Trickiness

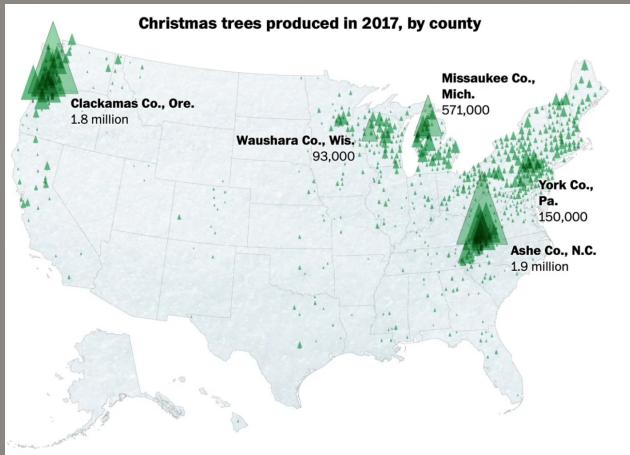
- If you directly map absolute value of an attribute to color, the result is often the same as the population map
 - <https://public.tableau.com/profile/ben.jones#!/vizhome/PopVsFin/PopVsFin>
- Example: google (website) visitor, milk consumption, New York times subscriber





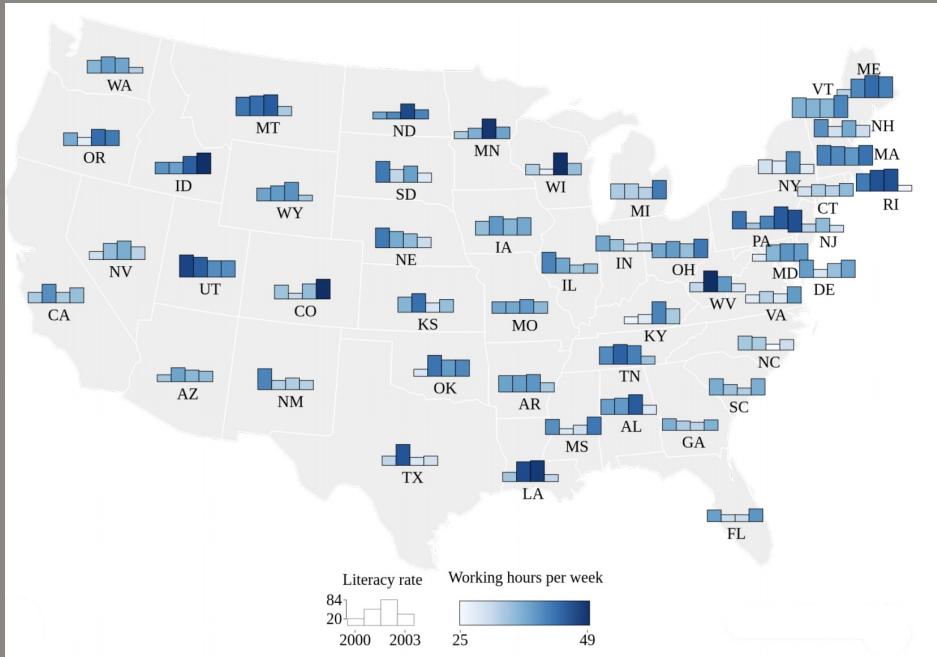
Symbol Map

- A symbol (ex: circle) is used to represent data
- Keep original spatial map in the background
- Use “size channel” to represent the attribute
- Encode multiple attributes of a region
- Often a good alternative to choropleth map

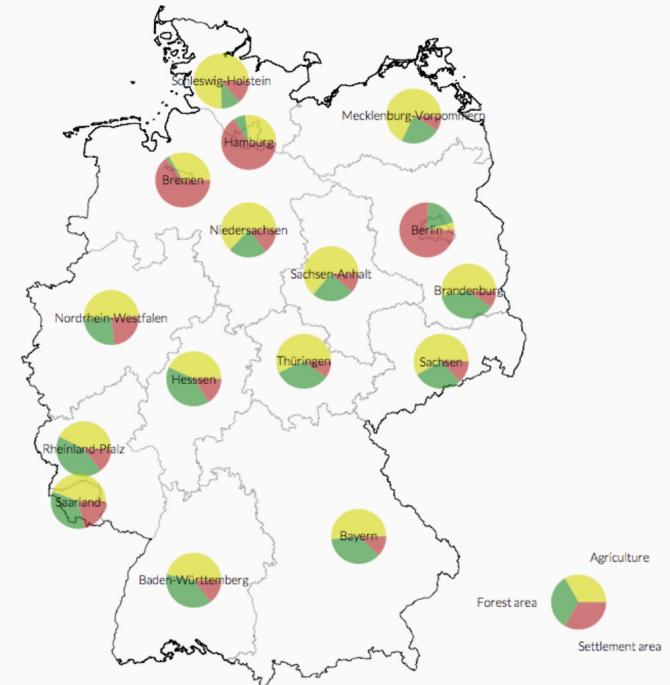




Symbol Map with Glyphs



Shares of agricultural, forest and settlement area





Symbol Map: Pros and Cons

○ Procs:

- Somewhat intuitive to read and understand
- Mitigate problems with region size vs data salience
 - Marks: symbol size follows attribute value
 - Glyphs: symbol size can be uniform

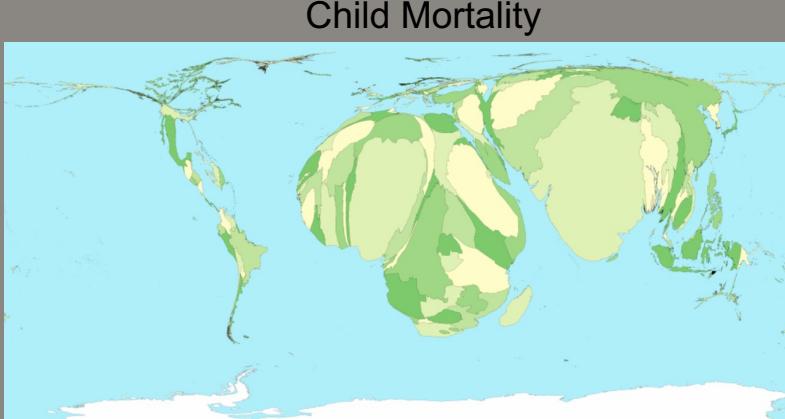
○ Cons:

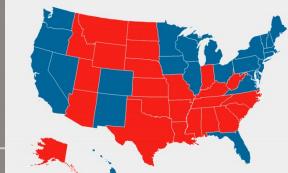
- Possible occlusion / overlap
- If a complex glyph is used, it may require explanation/training



(Contiguous) Cartograms

- Cartograms distort the shape of geographic region so that the area directly encodes a data variable
 - D3: <https://www.d3-graph-gallery.com/cartogram>
- Goal of the algorithm
 - Target size (your data value)
 - Shape as close to the original as possible
 - Maintaining the constraints of relative position and contiguous boundaries with their neighbors

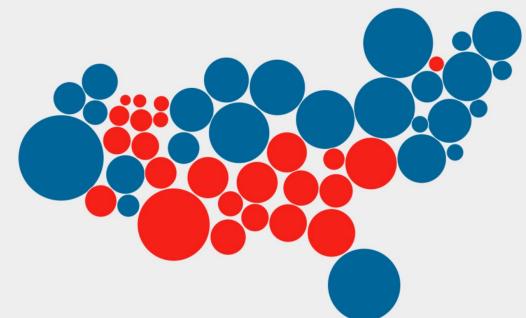




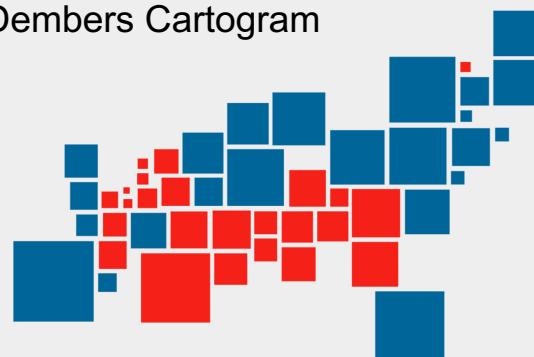
Dorling/Dembers of Cartogram

- Sized circles/rects represent quantity of interest per geographic region
- Geometric shapes in place of geographic area

Dorling Cartogram



Dembers Cartogram



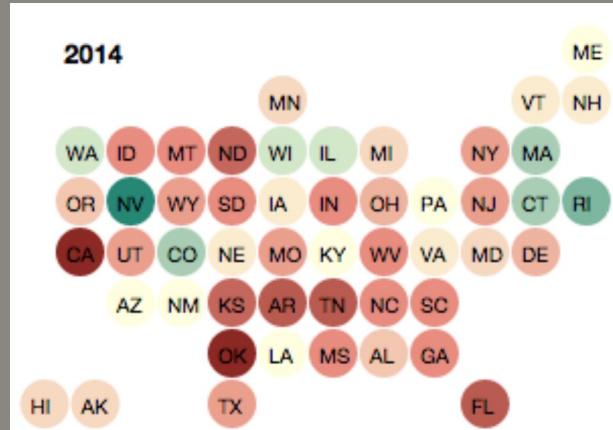
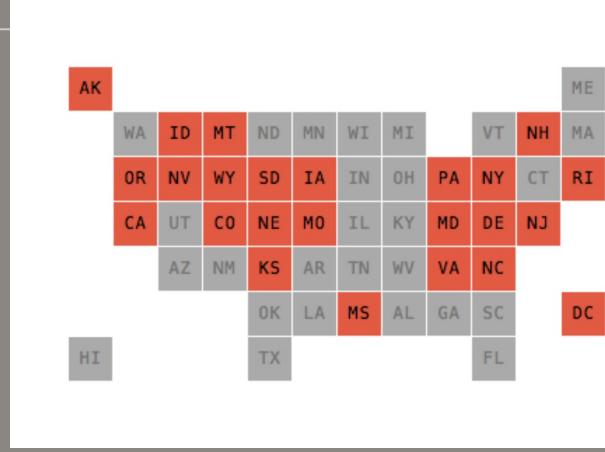


(Grid) Cartogram



Grid cartogram

- Uniform-sized shapes arranged in grid
- Maintain approximate spatial position and arrangement



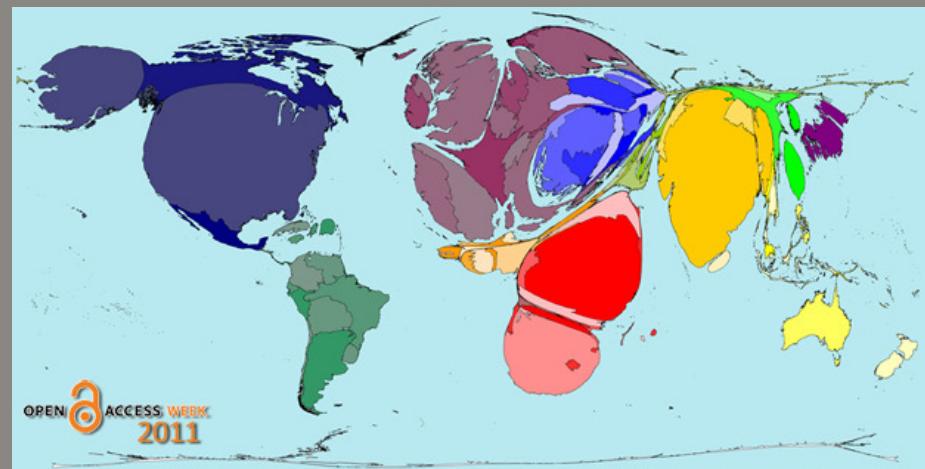
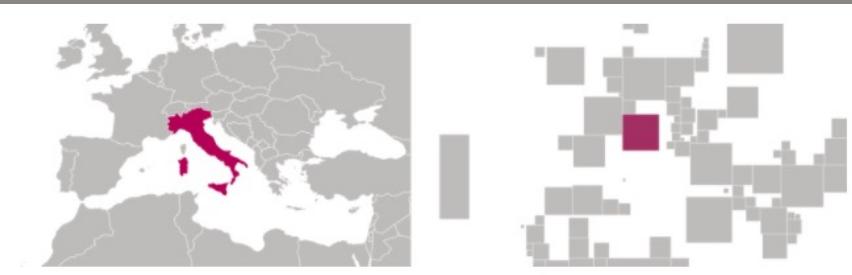


S06-02



Problem of Cartogram

- Most of visualization based on map
 - “Lock shape, area and position channels”
- Cartogram unlocks some of the above visual channels however, we usually use position and shape to recognize a country/region



Date Source: SPARC

www.viewsoftheworld.net

Map created by Benjamin D. Hennig, University of Sheffield



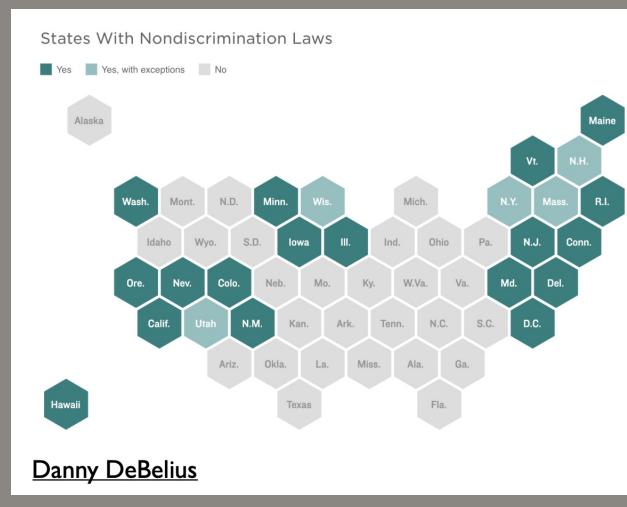
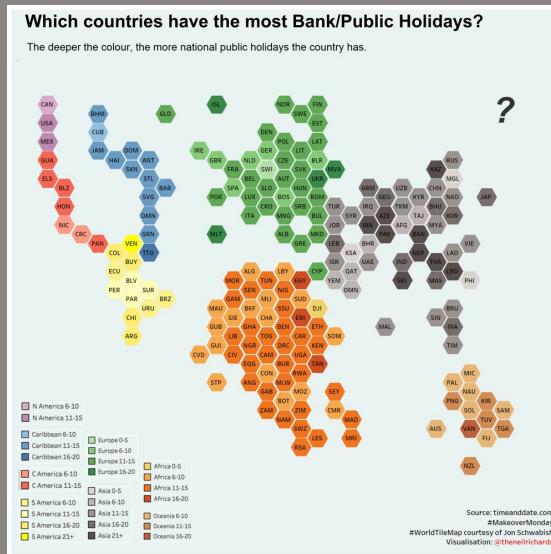
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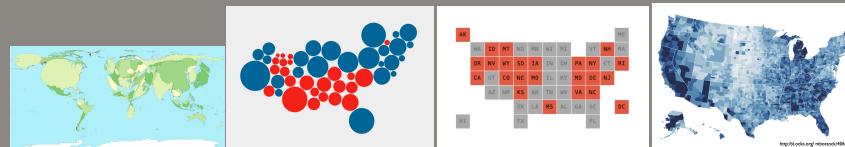


Grid Cartogram:

Resolution matters:
It is important to find a
“proper” resolution and users
still can recognize regions



Summary of Cartograms



	Continuous cartogram	Dorling cartogram	Grid cartogram	Geographic map
Easy to recognize by position?	● ●	●	●	● ● ●
Easy to recognize by size?	✗	✗	✗	● ● ●
Easy to recognize by shape?	●	✗	✗	● ● ●
Easy to compare shape size?	● ●	● ● ●	✗	✗

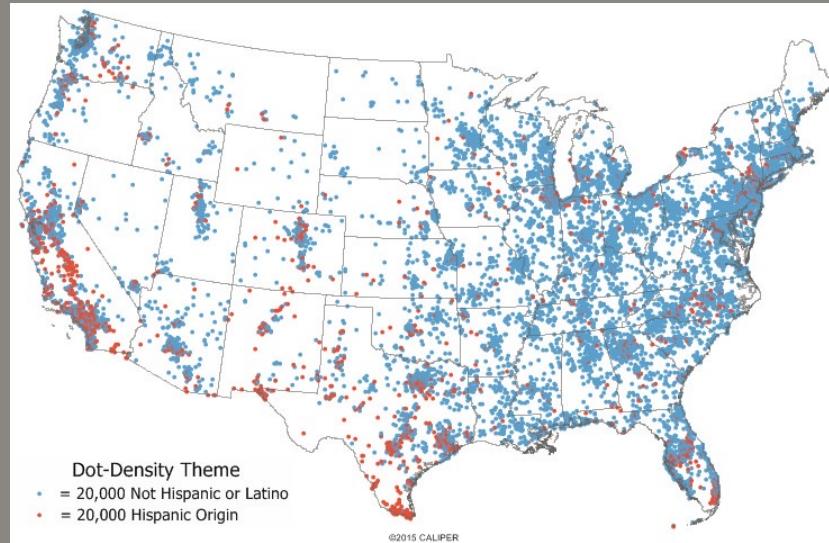
<https://blog.datawrapper.de/cartograms/>



Dot Density Map

- Visualize “distribution” over the map
- One symbol represents
 - one object or a constant number of objects
 - Allows use of color channel
- Goal: see spatial patterns, clusters

Two distributions on this map for distribution comparison





Dot Density Map: Pros and Cons

● Pros

- Straightforward to understand
- Avoid choropleth non-uniform region size problem

● Cons

- Challenge: population map trickiness (same as choropleth map)
- Difficult to extract quantities
- Performance disadvantage: rendering a lot of points could be slow



Map Projection Problem

- Map global to 2D plane
 - No perfect projection
- Mercator Projection is popular, but it's not accurate
 - Direction is accurate. Area is not.
- We will discuss projection again in D3 tutorial

