

# THEMATIC MAPS

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# DEFINITION

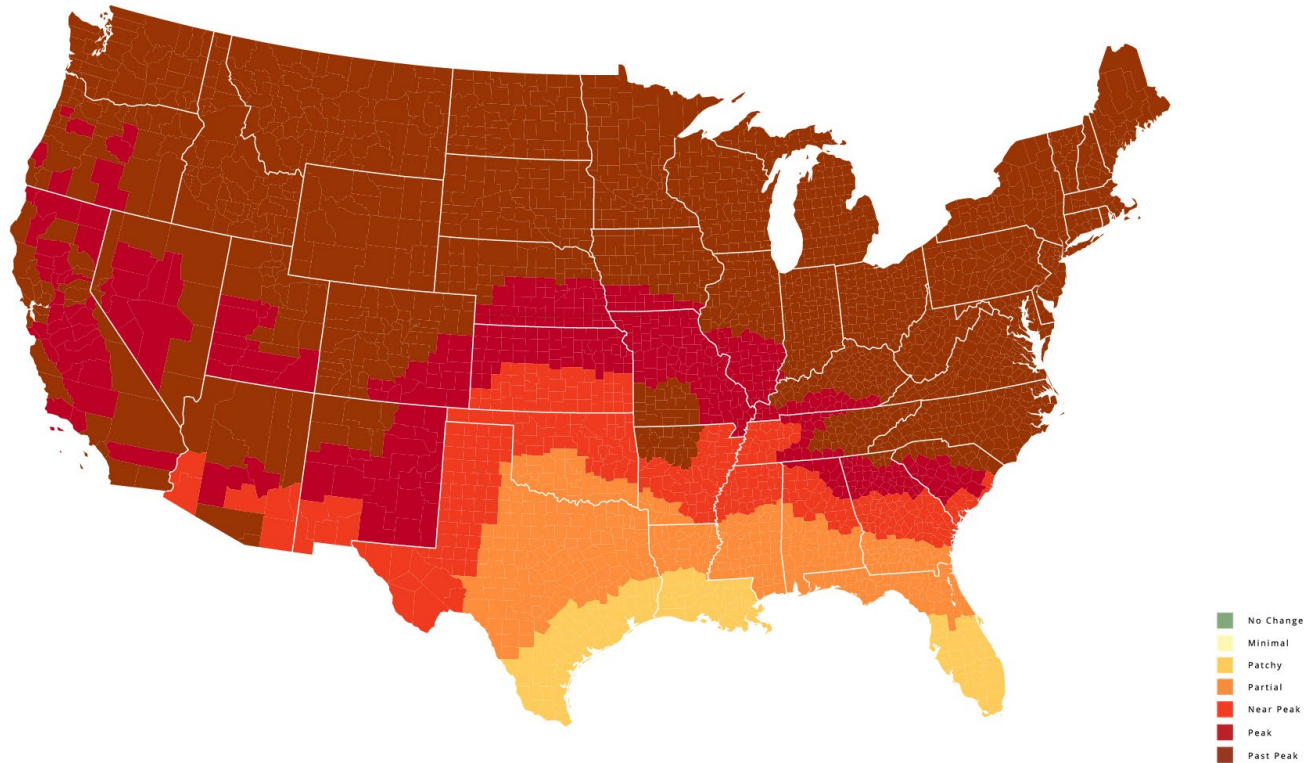
- A map designed to demonstrate particular features or concepts. In conventional use this term excludes topographic maps

– *Meynen 1973*

- Major Components
  - Geographic base
  - Thematic overlay
  - Ancillary elements (title, legend, etc)

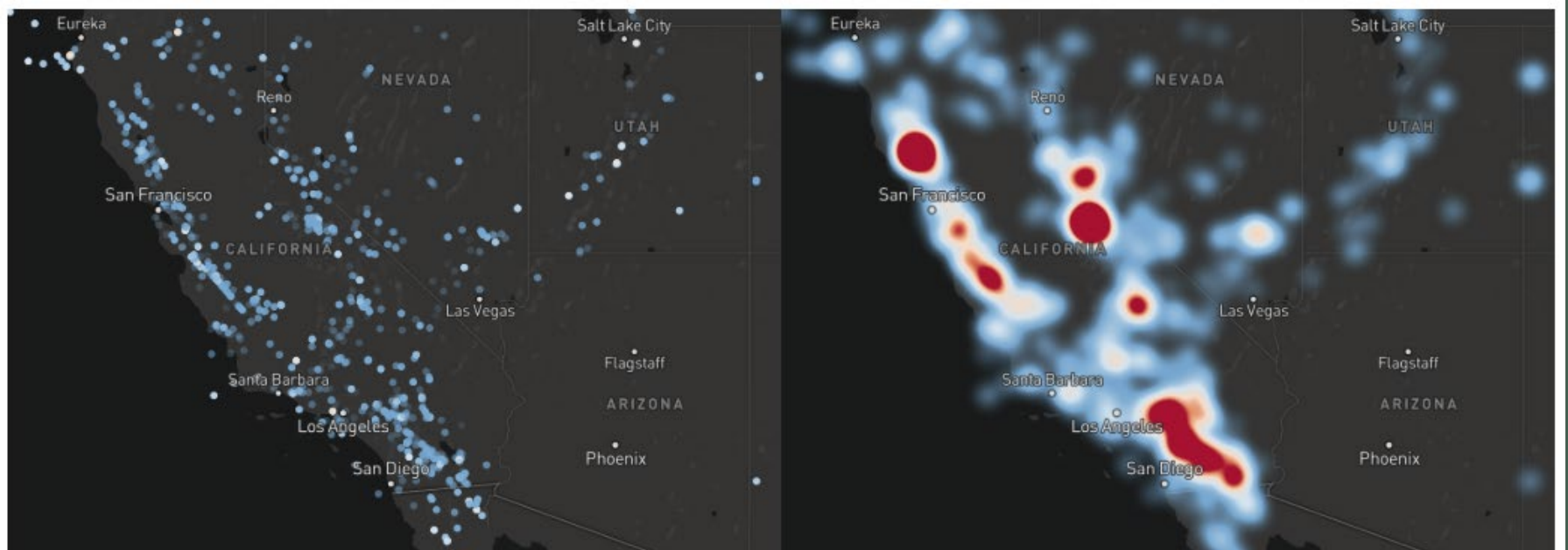
THE 2023

# Fall Foliage Prediction Map



<https://smokymountains.com/fall-foliage-map/>

# Heat Map



Circle (left) and heatmap (right) layers representing earthquakes in California

# COMMUNICATING MAP INFORMATION

- Define a clear purpose
- Level of data – detailed or generalize
- Display data
- Avoid distortion
- Make datasets coherent
- Encourage the viewers to compare different pieces of data
- Provide descriptions of datasets and statistics that support visualization

Edward Tufte's principles of graphical excellence.

# MAP DESIGN PROCESS



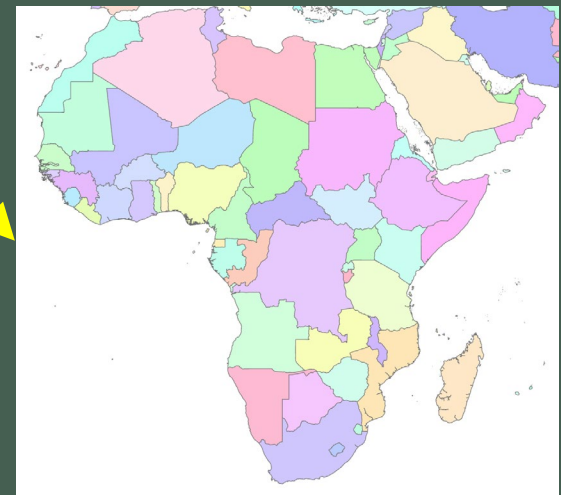
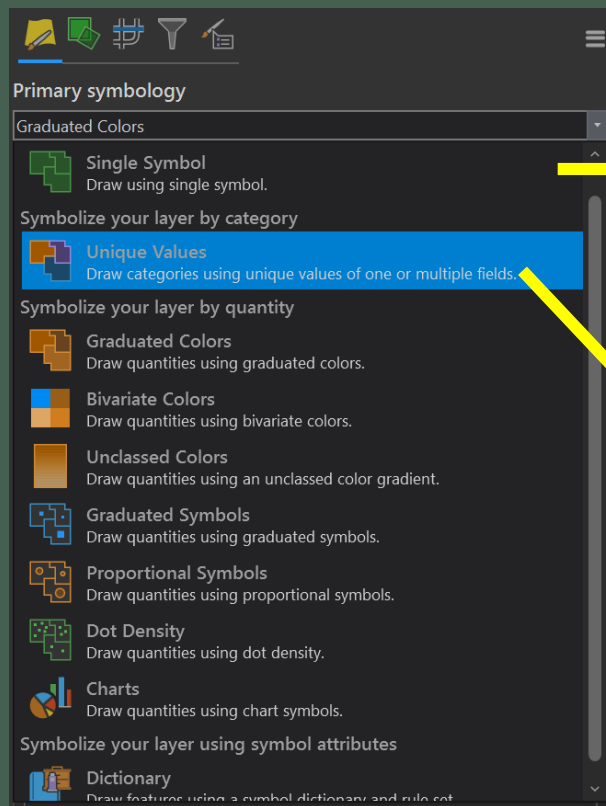
Slocum 1999

# DATA CHARACTERISTICS

- Location
  - Point, Line, and Area
- Form
  - Qualitative/Quantitative
    - Mine – Tons of Copper
    - River – Volume of Water
  - Discrete/Continuous
    - Temperature at your home vs. Temperature across the US
    - Elevation of the tower vs. Topographic surface
  - Total/Derived
    - Total Population vs. Population per square mile
    - Employment in Agriculture vs. Agriculture employment as a percentage of all employment.
- Time

# DISPLAYING QUALITATIVE VALUES

- Features & Categories





# DISPLAYING QUANTITATIVE VALUES

- Quantities & Charts

## Symbolize your layer by quantity



### Graduated Colors

Draw quantities using graduated colors.



### Bivariate Colors

Draw quantities using bivariate colors.



### Unclassed Colors

Draw quantities using an unclassed color gradient.



### Graduated Symbols

Draw quantities using graduated symbols.



### Proportional Symbols

Draw quantities using proportional symbols.



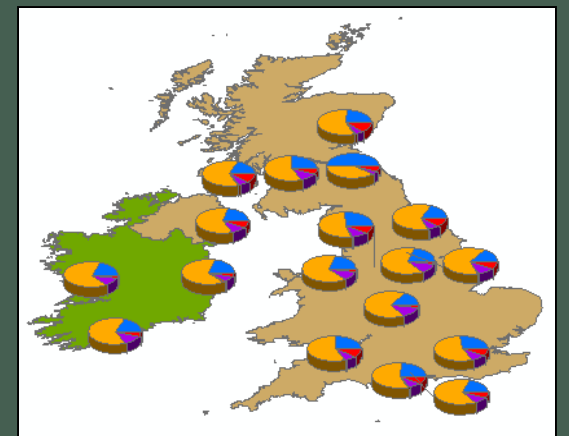
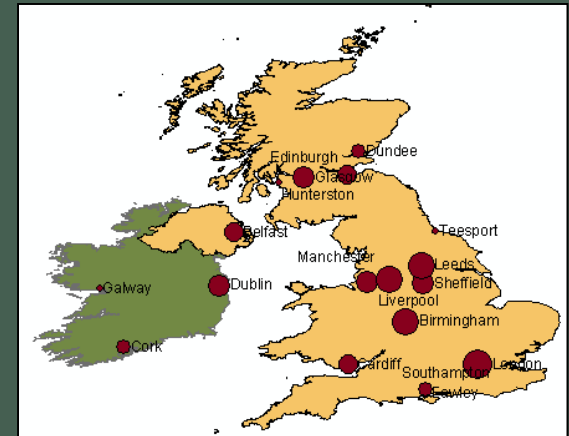
### Dot Density

Draw quantities using dot density.



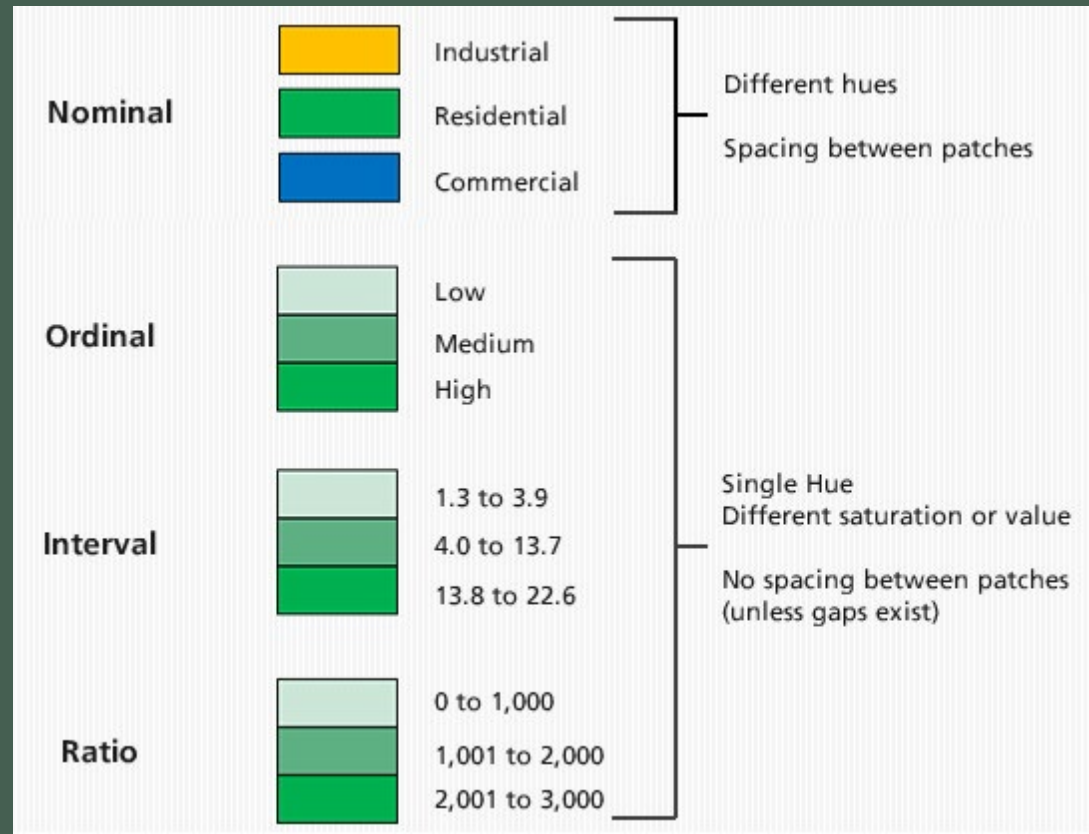
### Charts

Draw quantities using chart symbols.



# DATA MEASUREMENT

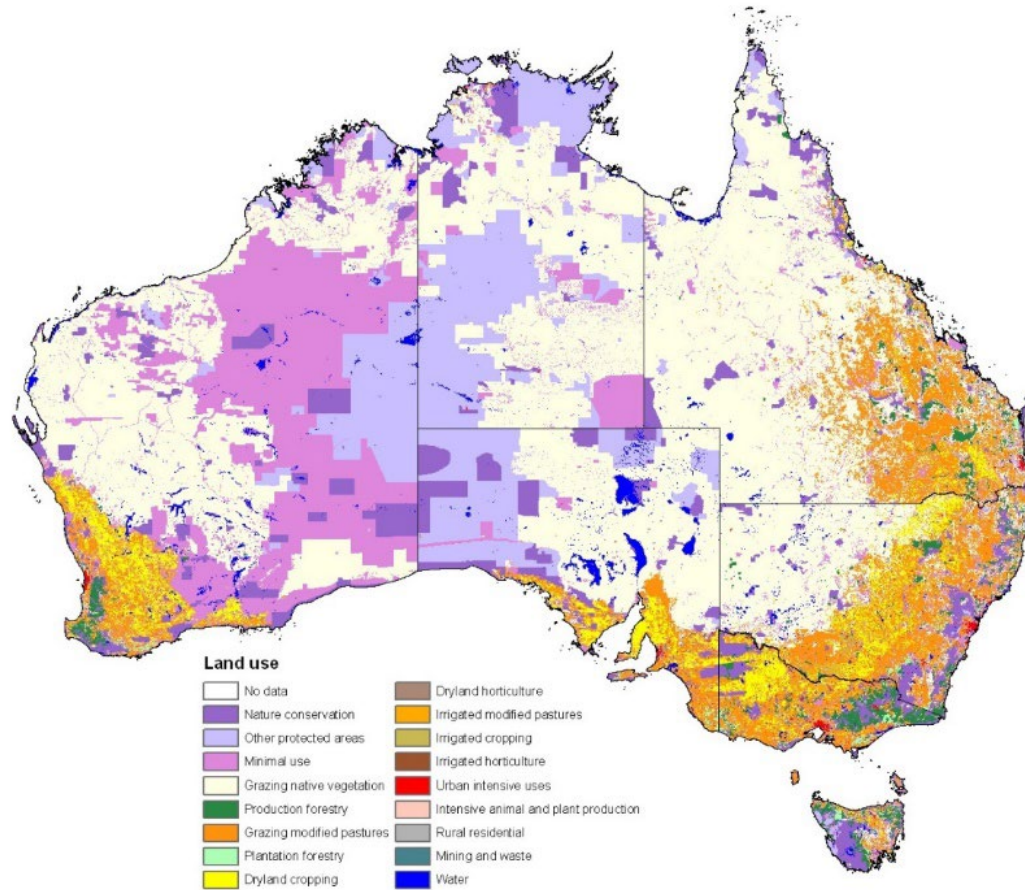
- Nominal
- Ordinal
- Interval
- Ratio



# THEMATIC MAPS

- Display the spatial pattern of a theme or attribute
- Types: Qualitative and Quantitative thematic Maps
- Thematic Mapping Techniques
  - Choropleth
  - Dot Density
  - Proportional Symbol
  - Flow
  - Isarithmic
  - Cartogram

# QUALITATIVE THEMATIC MAP

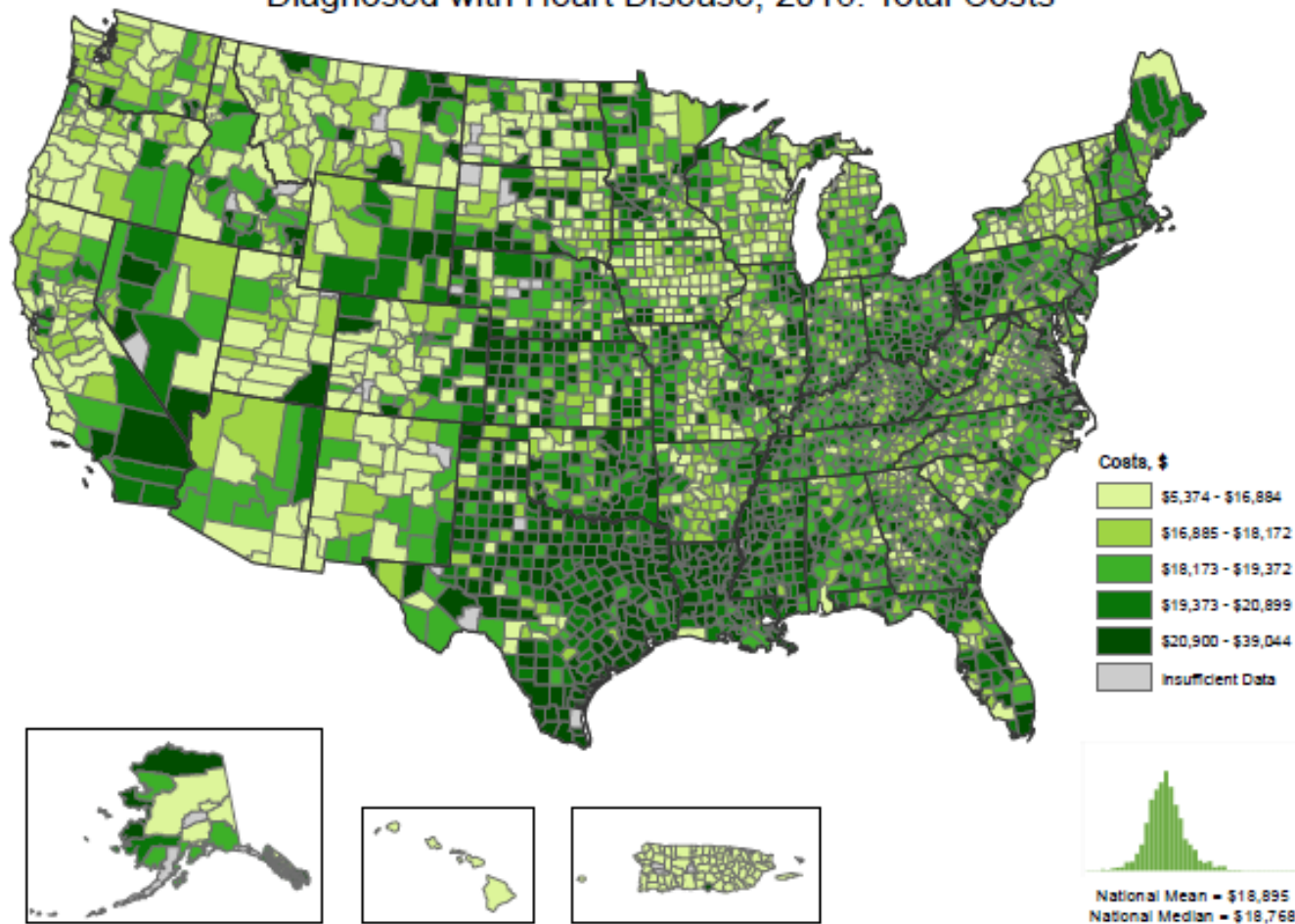


**Figure 2.** Land Use of Australia 2005-06, Version 4 (ABARE-BRS 2010)

According to this dataset, in 2005-06 the total area of land under primary production (livestock grazing, dryland and irrigated agriculture) was nearly 4.6 million square kilometres or 59% of the continent. The dominant land use is livestock grazing which makes up 56% (or 4.3 million square kilometres) of land uses.

# QUANTITATIVE THEMATIC MAP

Cost of Care per Capita for Medicare Beneficiaries\*  
Diagnosed with Heart Disease, 2016: Total Costs

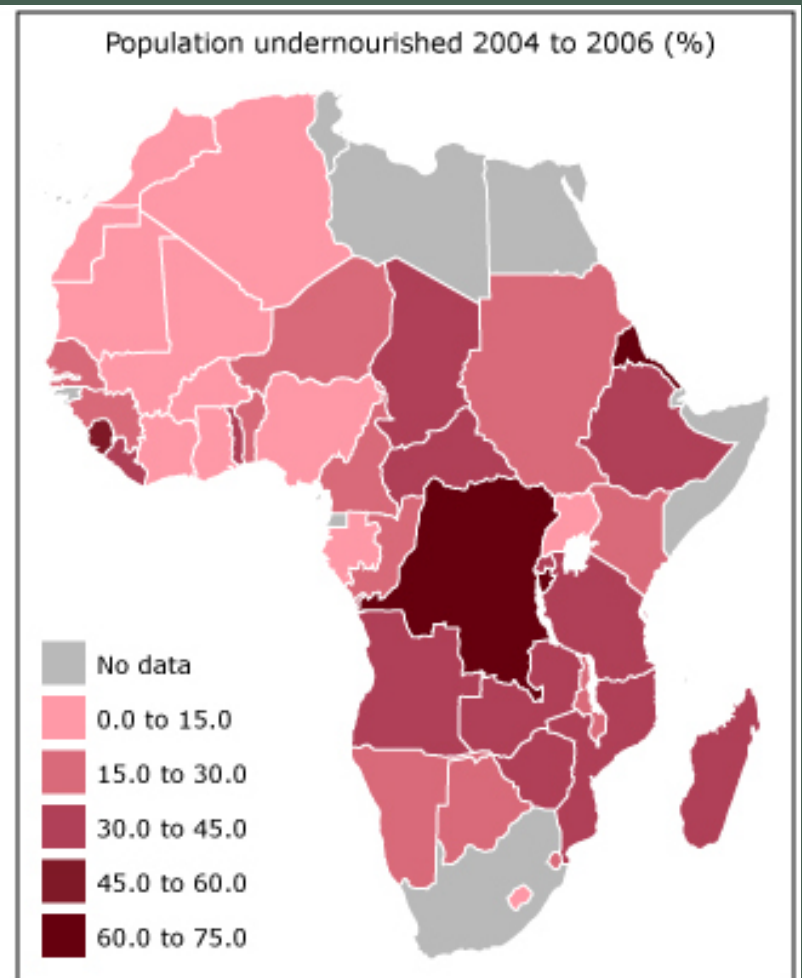
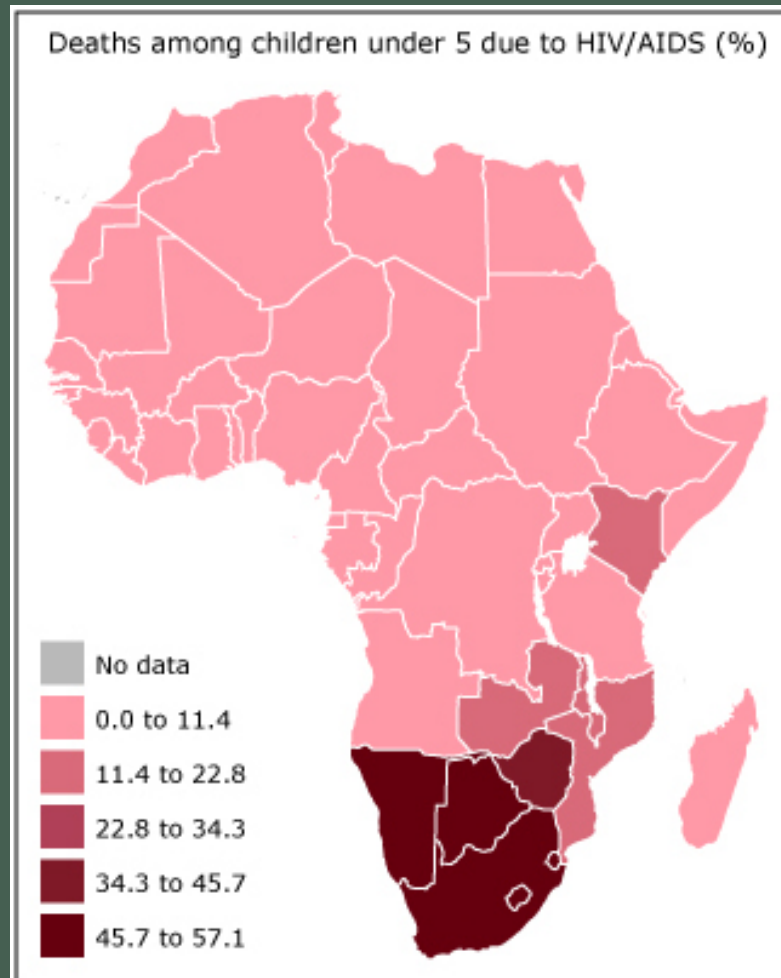


\*Enrolled in fee-for-service Medicare

# CHOROPLETH MAP

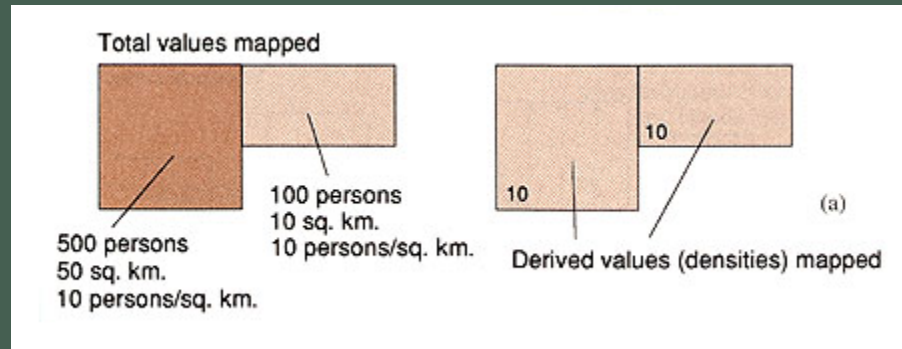
- Greek: Choro (place/area) plethein (to fill)
- Quantitative Mapping technique
- Data collected for enumeration units such as statistical or administrative areas
- Colored or shaded area can be used to represent magnitude

# CHOROPLETH MAP



# DATA APPROPRIATENESS

- When data occur or can be attributed to enumeration units
- Not suitable for continuous data
- Map scale should be chosen appropriately
- Data can be totals (rates) or derived values (ratios)
- Traditionally totals are not accepted



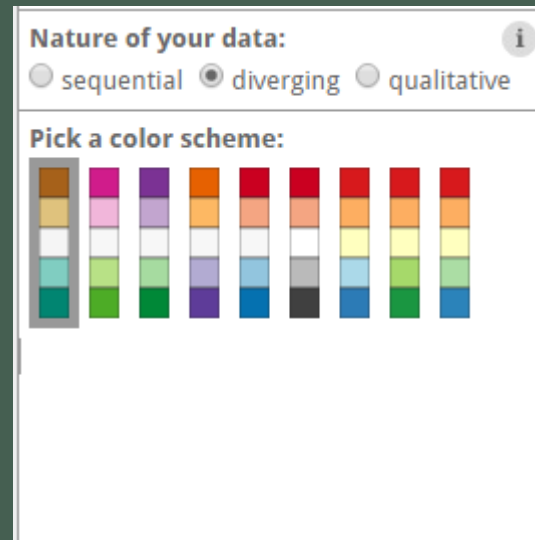
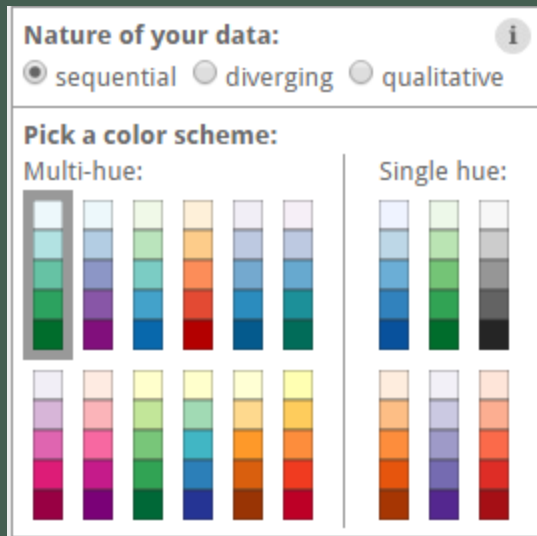


# SYMBOLIZATION AND LEGEND

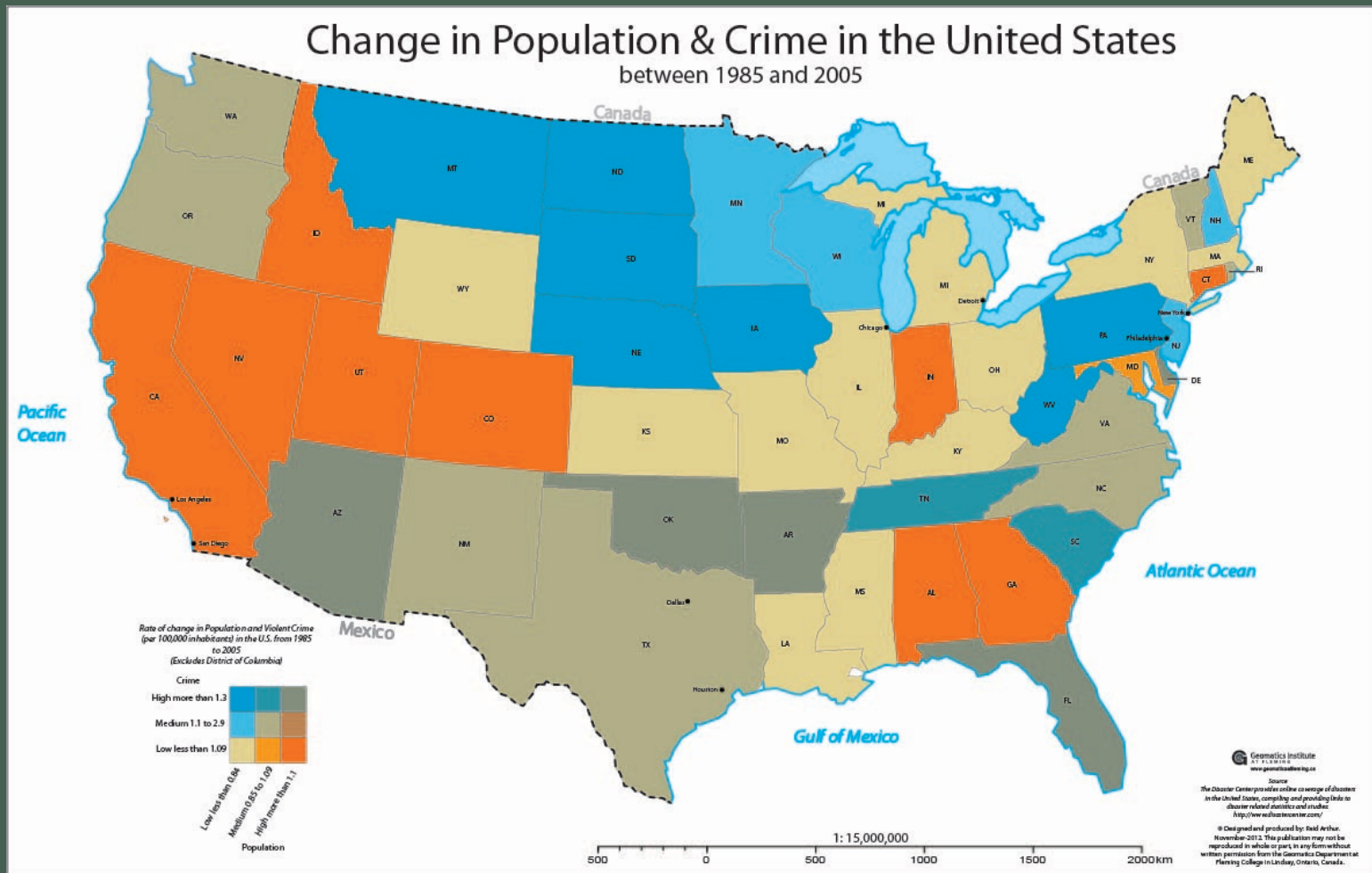
- Continuous Class Range
  - No gaps or overlaps
  - Used for map sequences
- Non Continuous Class Range
  - Reduces map reading errors and depicts better data ranges
  - Used for single maps

# SYMBOLIZATION AND LEGEND

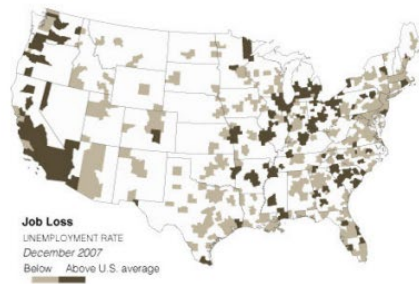
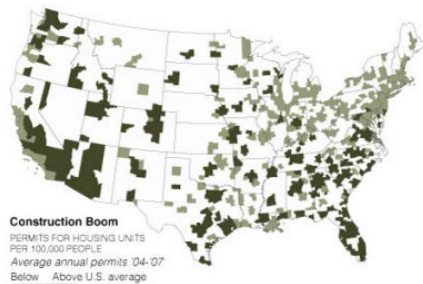
- Unipolar Choropleth – A map where data class has no natural dividing point (central value) represented using a sequential color scheme
- Bipolar Choropleth – A map where data class ranges diverge from a central value and are encoded using a divergent color scheme



# BIVARIATE CHOROPLETH

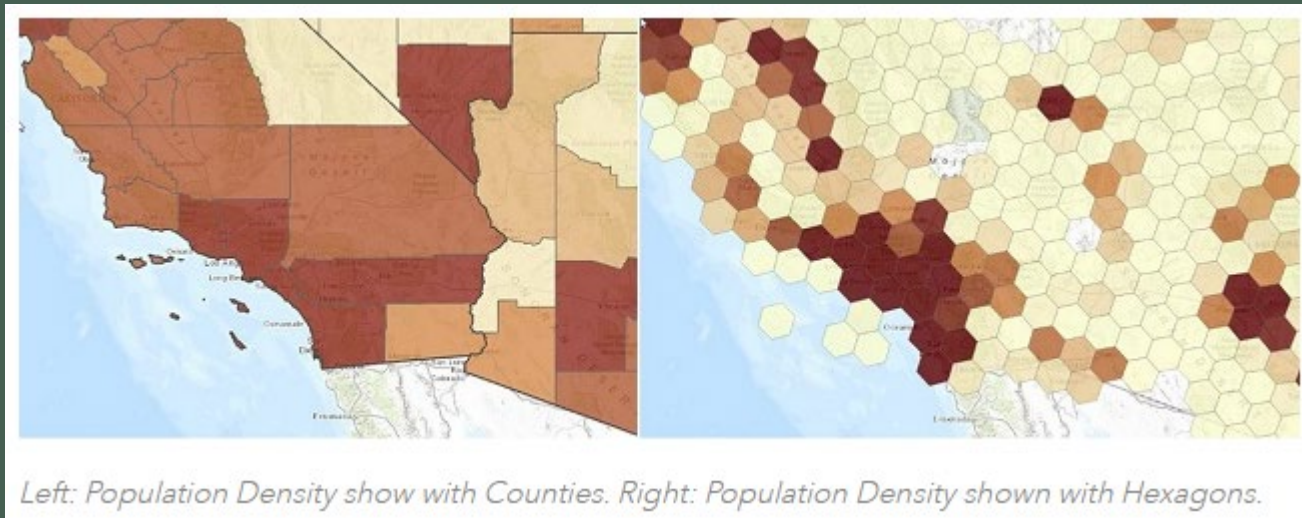


# 3D CHOROPLETH



Sources: First American CoreLogic; LoanPerformance; Bureau of Labor Statistics; Census Bureau

# MAPPING WITH HEXAGONS

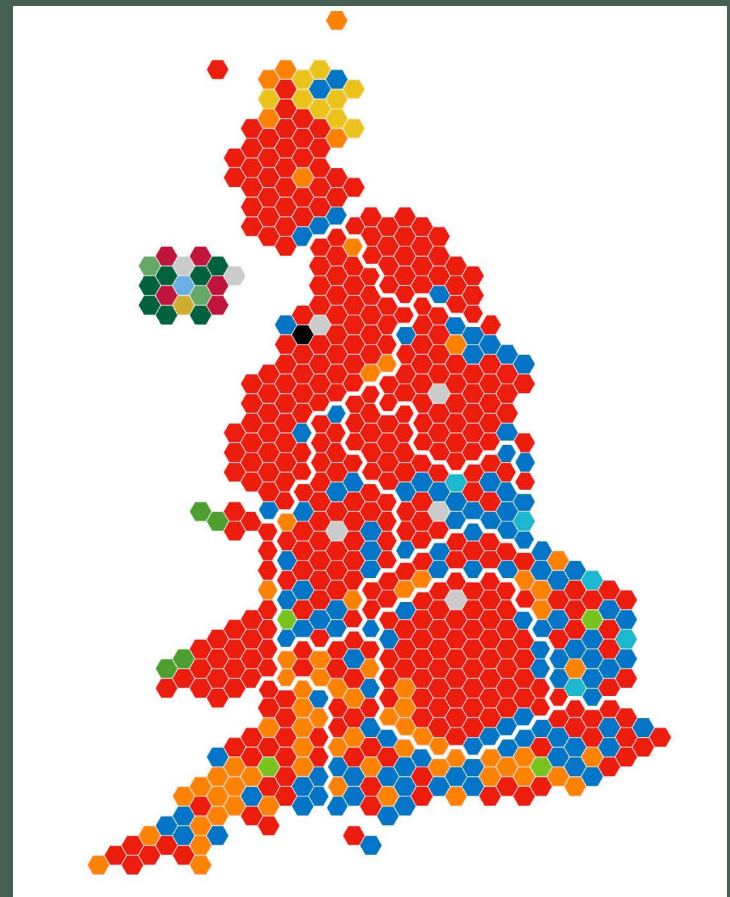
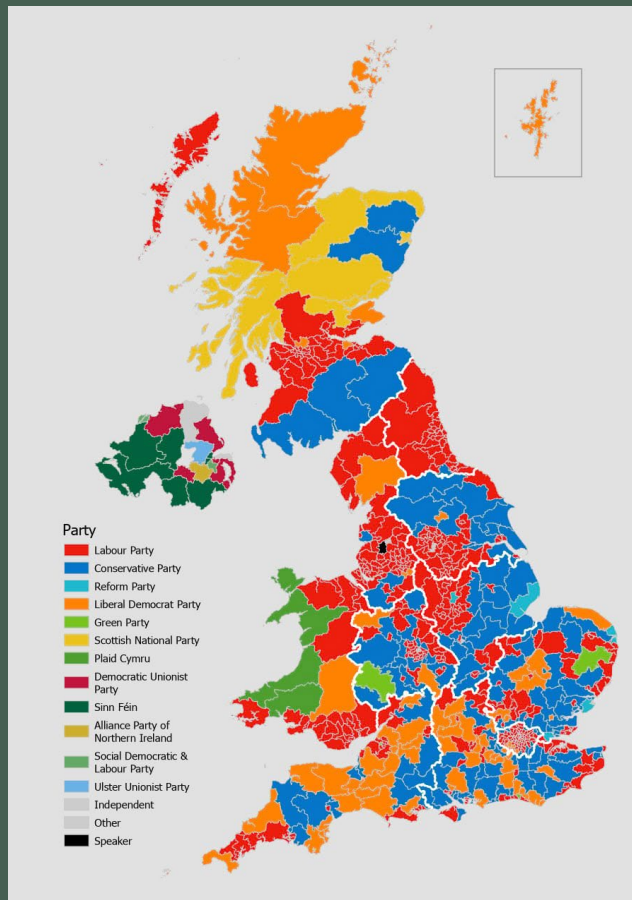


esri.com

<https://pro.arcgis.com/en/pro-app/latest/tool-reference/spatial-statistics/h-whyhexagons.htm>

# MAPPING WITH HEXAGONS

## 2024 UK Elections



# MAPPING WITH HEXAGONS

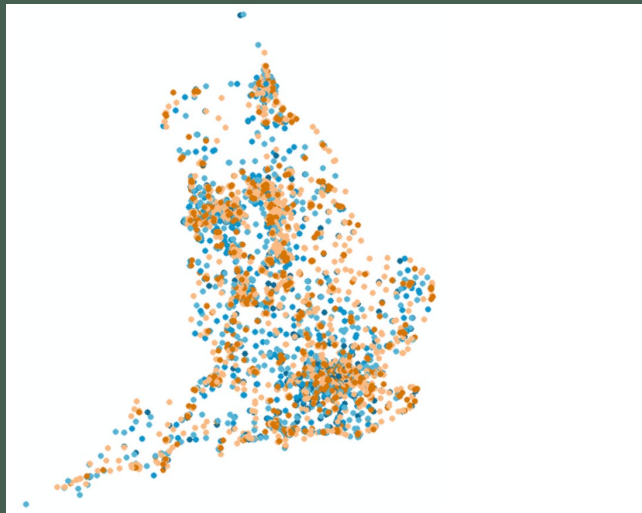


Figure 1: Mapping English Secondary School GCSE attainment levels as points.

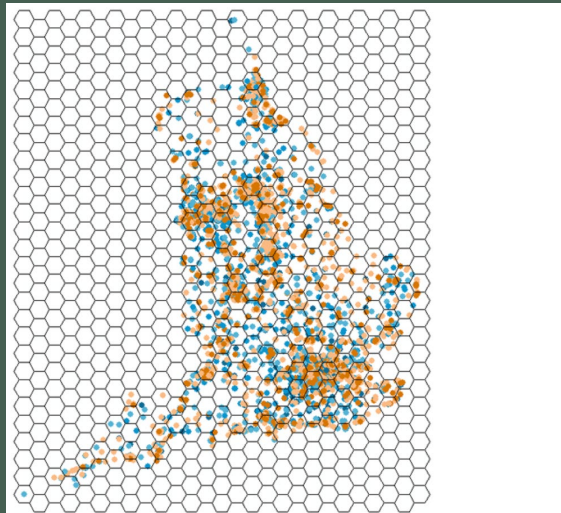


Figure 2: 40km resolution hexagonal polygon feature class at 1:4,632,845.



Figure 4a. Hexagonal data bins at 1:4,622,324.

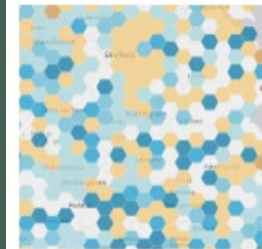


Figure 4b. Hexagonal data bins at 1:2,311,162.

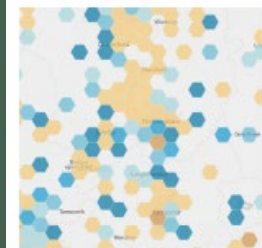


Figure 4c. Hexagonal data bins at 1:1,155,581.

# DOT DENSITY MAP

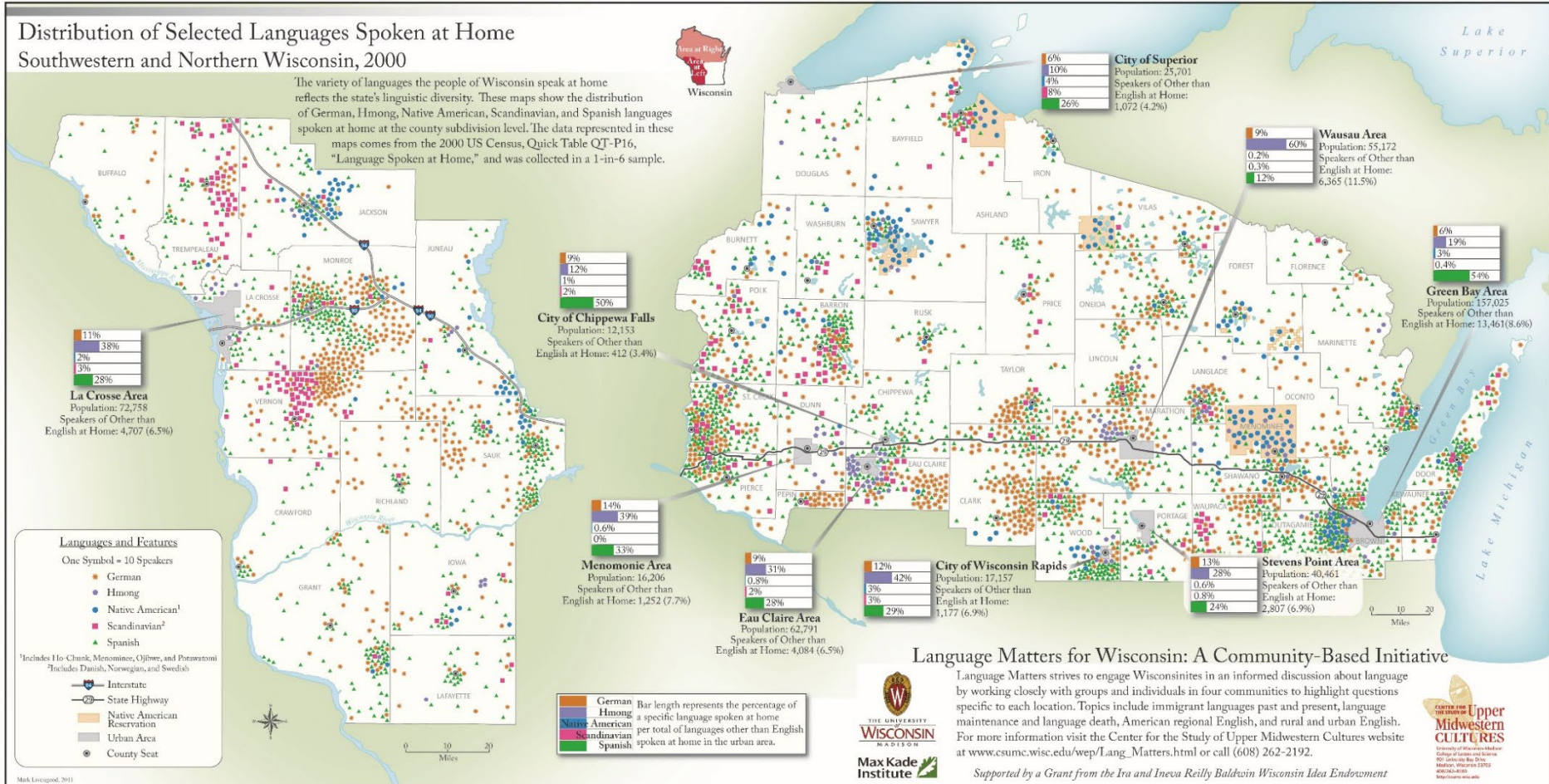
- Point symbol represents data
- A quantitative mapping technique
- Introduced as early as 1863
- Frequency of the symbols are proportional to the number of objects being represented
- Effective way to illustrate spatial density



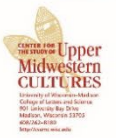
# DOT DENSITY MAP

## Distribution of Selected Languages Spoken at Home Southwestern and Northern Wisconsin, 2000

The variety of languages the people of Wisconsin speak at home reflects the state's linguistic diversity. These maps show the distribution of German, Hmong, Native American, Scandinavian, and Spanish languages spoken at home at the county subdivision level. The data represented in these maps comes from the 2000 US Census, Quick Table QT-P16, "Language Spoken at Home," and was collected in a 1-in-6 sample.



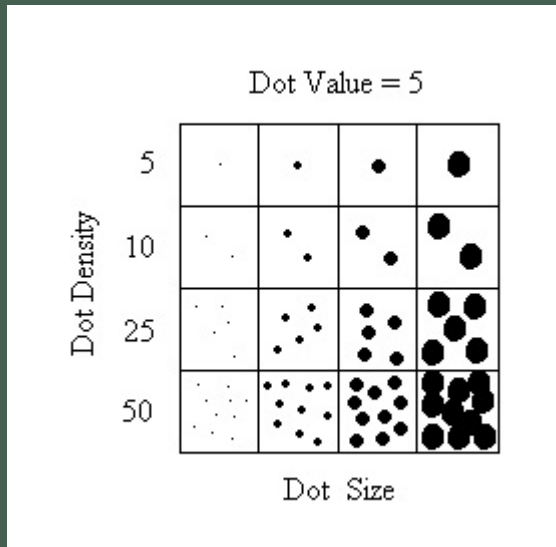
Mark Lovagood, 2011



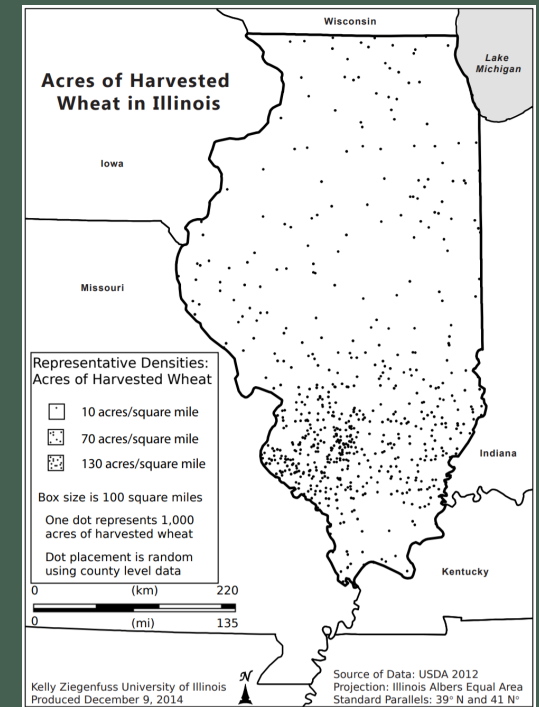
# DATA APPROPRIATENESS

- Totals or non derived values are used
  - Examples: agricultural production data, numbers of livestock, population totals, etc.
- Derived or ratio values are difficult to interpret
- Data sets with extremely small or large attribute ranges are inappropriate

# DOT VALUE, SIZE, AND PLACEMENT



<https://www.axismaps.com/guide/univariate/dot-density/>



[https://en.wikipedia.org/wiki/File:Acres\\_of\\_Harvested\\_Wheat\\_in\\_Illinois\\_in\\_2012.pdf](https://en.wikipedia.org/wiki/File:Acres_of_Harvested_Wheat_in_Illinois_in_2012.pdf)

# LEGEND

- Indicating the dot and its unit value
  - Traditional
    - Example: One dot represents 50,000 acres of cropland
- Legend with three squares
  - Representing different densities – low, medium, and high
- Indicating the dot placement with a statement, if they were placed randomly within an enumeration unit

## Representative Densities: Acres of Harvested Wheat



10 acres/square mile



70 acres/square mile



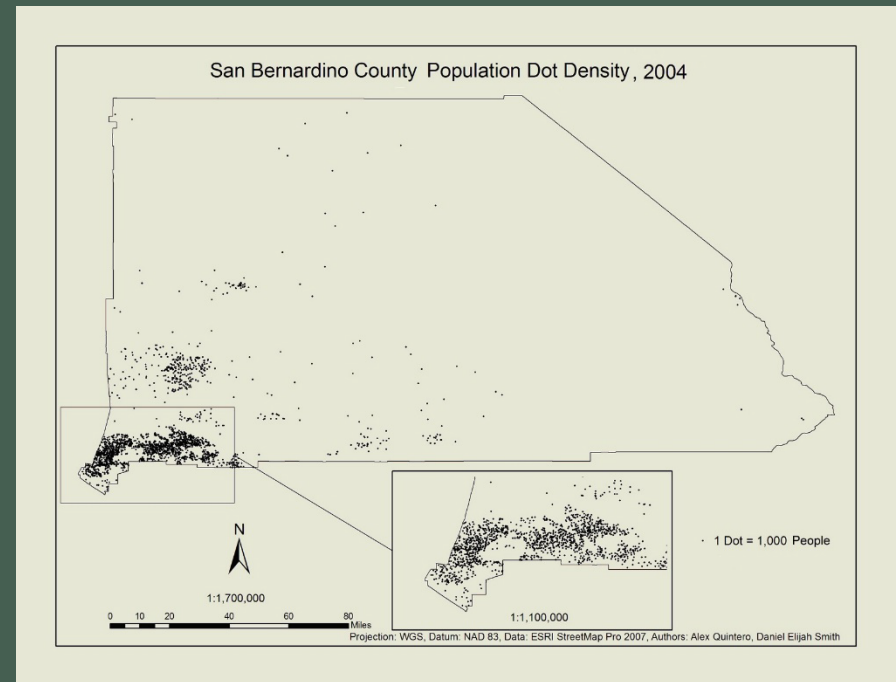
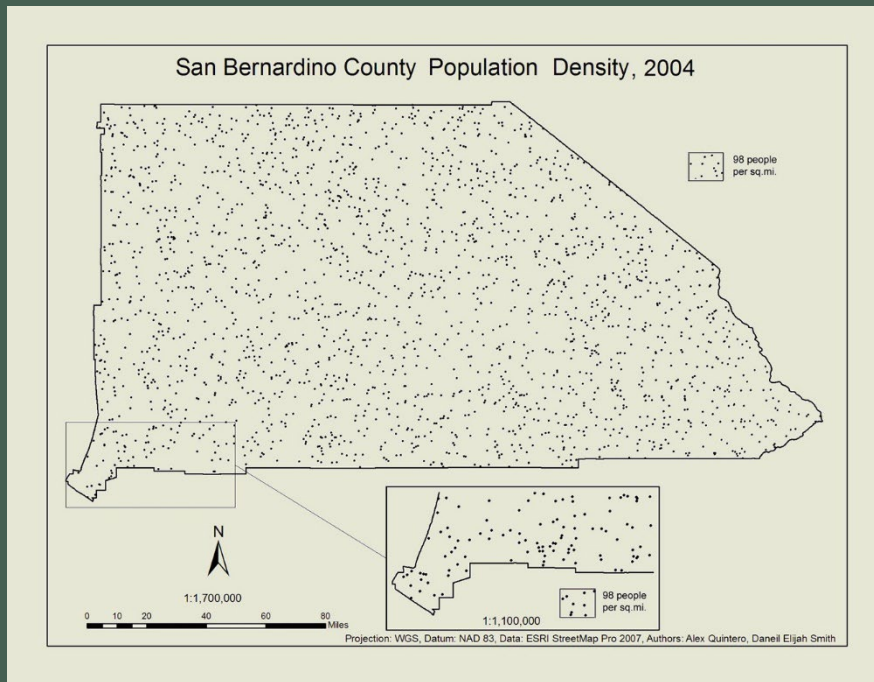
130 acres/square mile

Box size is 100 square miles

One dot represents 1,000 acres of harvested wheat

Dot placement is random using county level data

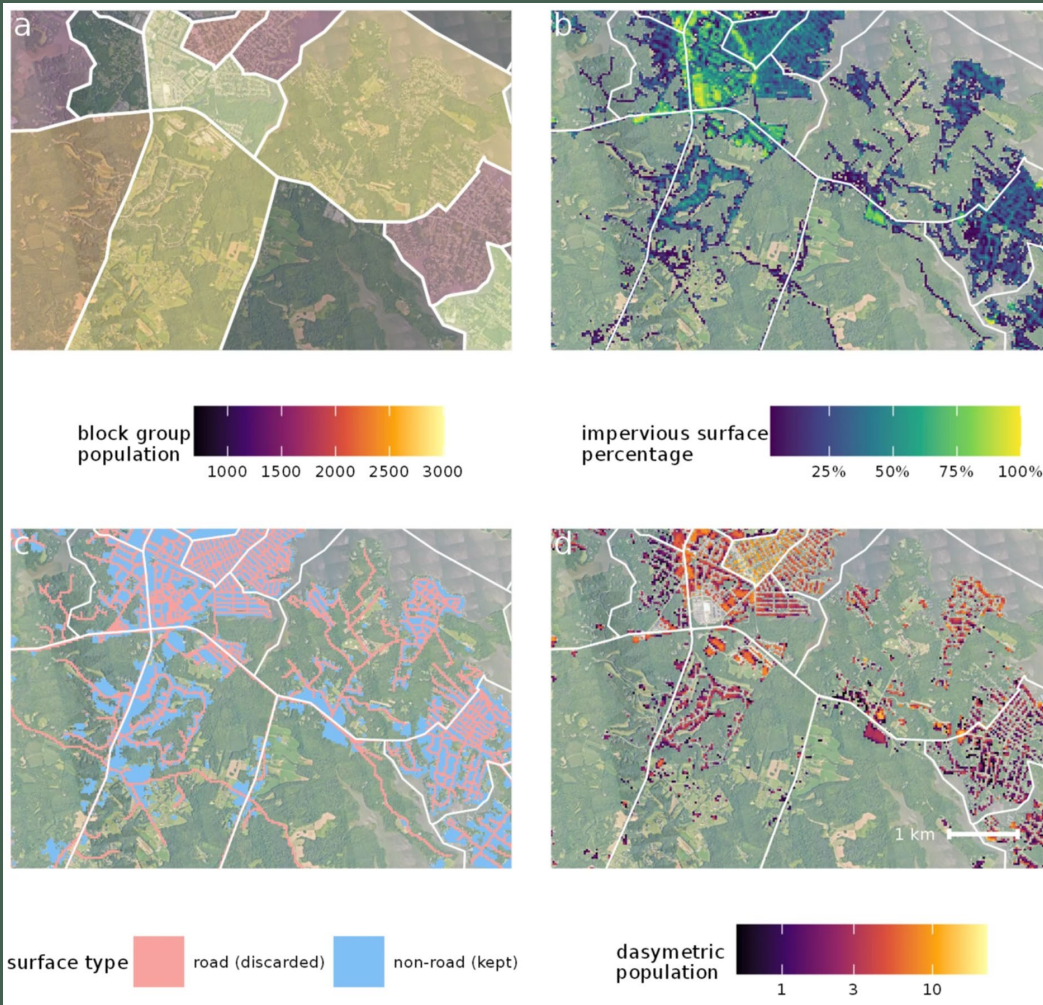
# MORE EXAMPLES



# DASYMETRIC MAP

- Refining a map (choropleth or dot-density) using additional geographical information.
- Boundaries are modified to conform to areas of homogeneity and are not restricted to administrative or statistical boundaries

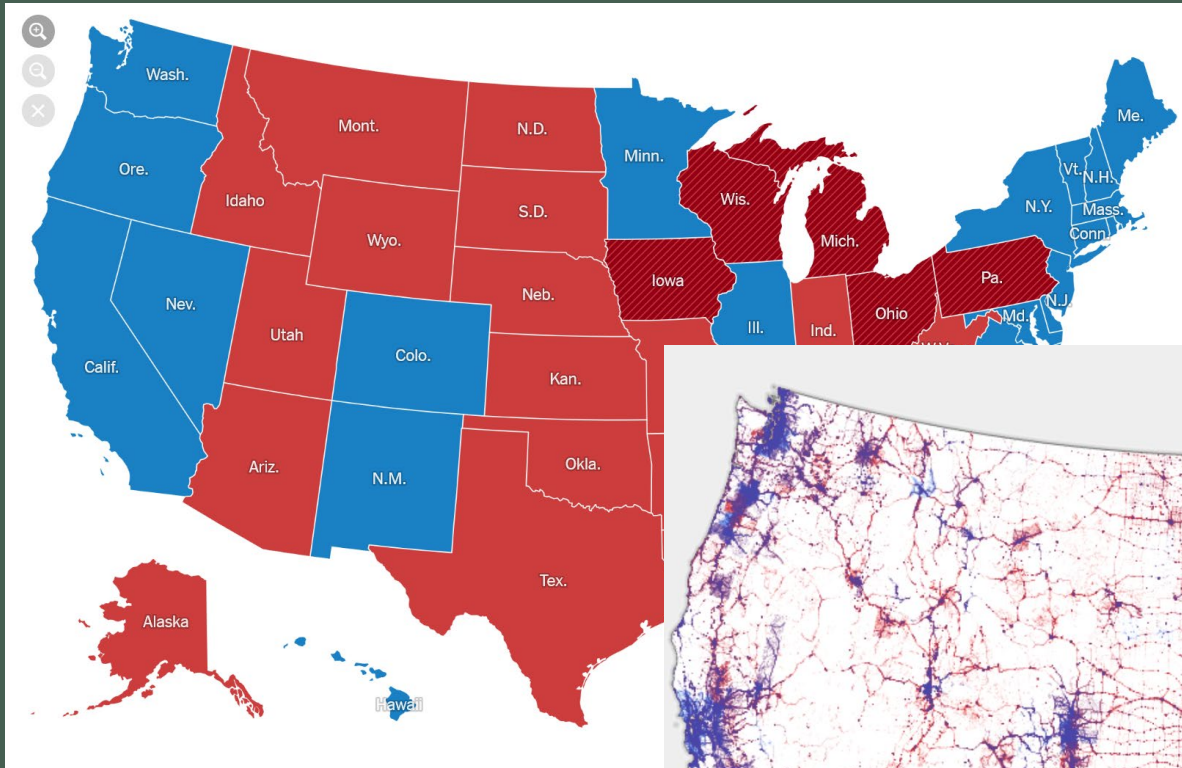
# DASYMETRIC MAP



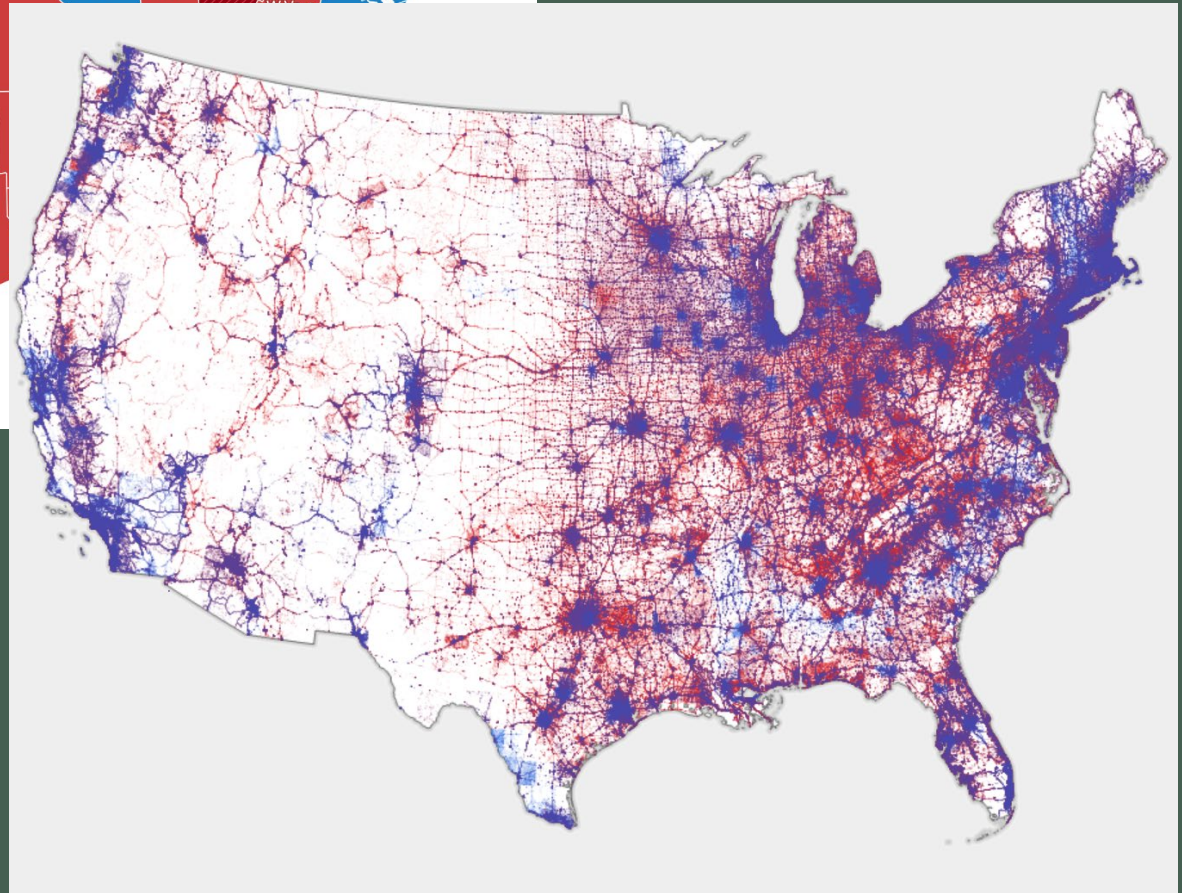
Elements of the dasymetric population mapping workflow. (a) Block group population estimates for south-central Anne Arundel County, Maryland (boundaries between block groups shown in white). (b) Impervious surface area (30 m) from the NLCD. (c) Impervious surface classification, showing roads and non-road areas. (d) The final population map, with population distributed across non-road impervious surface area and all Census blocks with zero population removed.

Swanwick, R.H., Read, O.D., Guinn, S.M. *et al.* Dasymetric population mapping based on US census data and 30-m gridded estimates of impervious surface. *Sci Data* 9, 523 (2022). <https://doi.org/10.1038/s41597-022-01603-z>

# 2016 US Presidential Election Results



<https://www.nytimes.com/elections/2016/results/president>



<https://carto.maps.arcgis.com/apps/webappviewer/index.html?id=8732c91ba7a14d818cd26b776250d2c3>



# PROPORTIONAL SYMBOL MAP



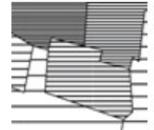
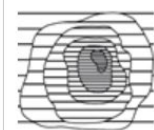




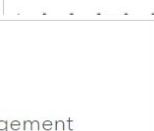

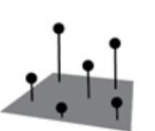


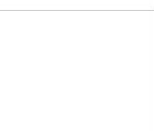
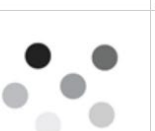
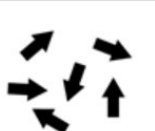







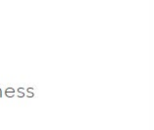

- Data is represented by 2D or 3D symbols
- Symbol size represents magnitude
- When data occur at points
- When data are aggregated at points within areas








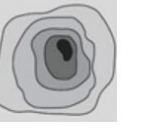




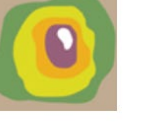



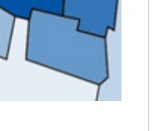




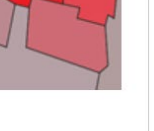
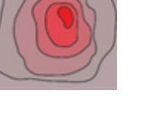

# PROPORTIONAL SYMBOLS

- Geometric or Pictographic Symbols
- Geometric: two-dimensional or three-dimensional
- 2D Symbols: Circle, Square, Triangle
  - Area is scale to represent magnitude difference
  - Easy to understand
- 3D Symbols: Sphere, Cube, Cylinder, etc.
  - Visually attractive but difficult to understand magnitude

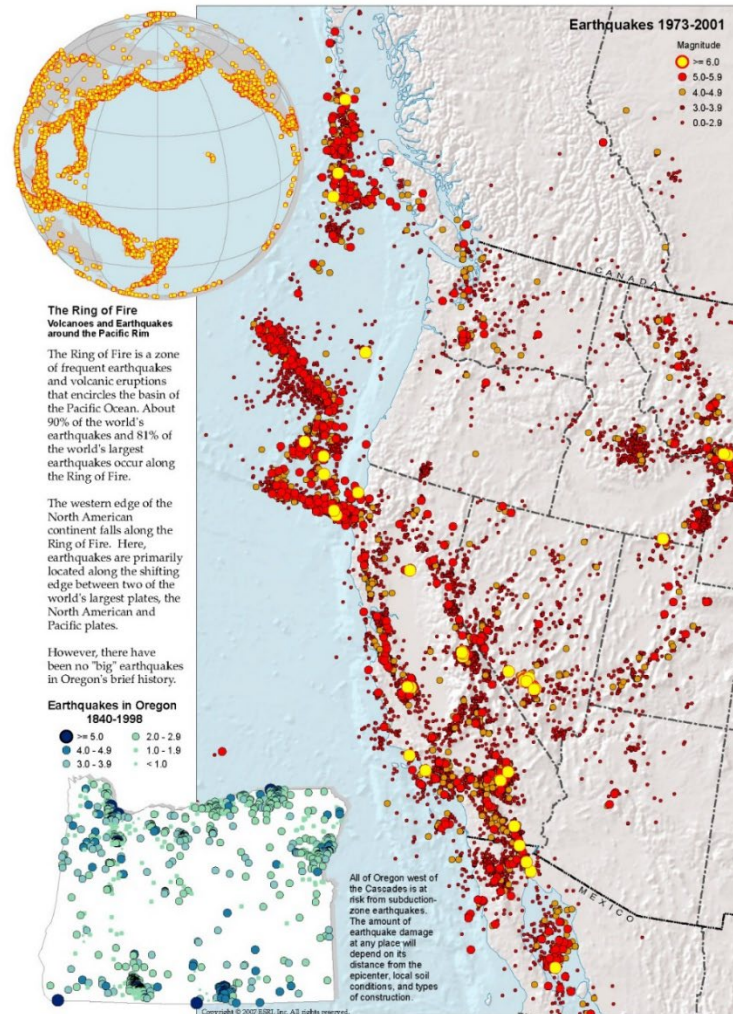


# Visual Variables

Visual variable	Point	Linear	Areal	2.5D	True 3D
Spacing					
Size					
Perspective height					
Orientation					
Shape					

Arrangement				Not recommended	
Value					
Hue					
Lightness					
Saturation					

# PROPORTIONAL SYMBOL MAP

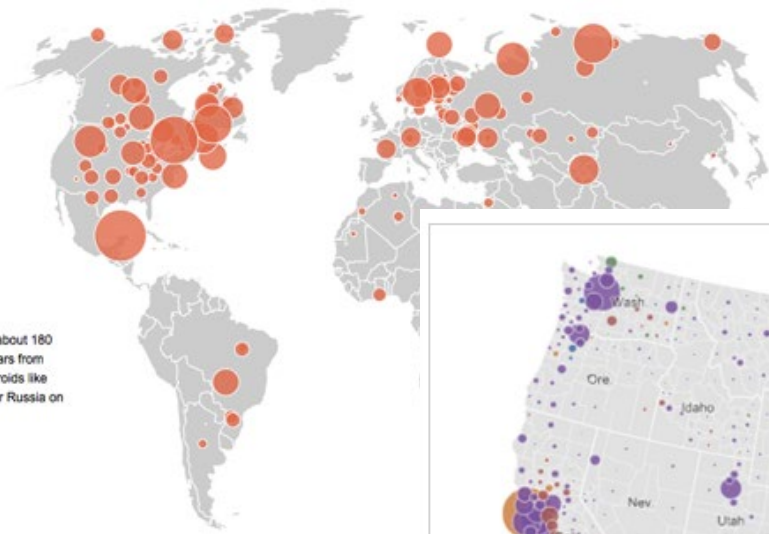


# PROPORTIONAL SYMBOL MAP

## Craters

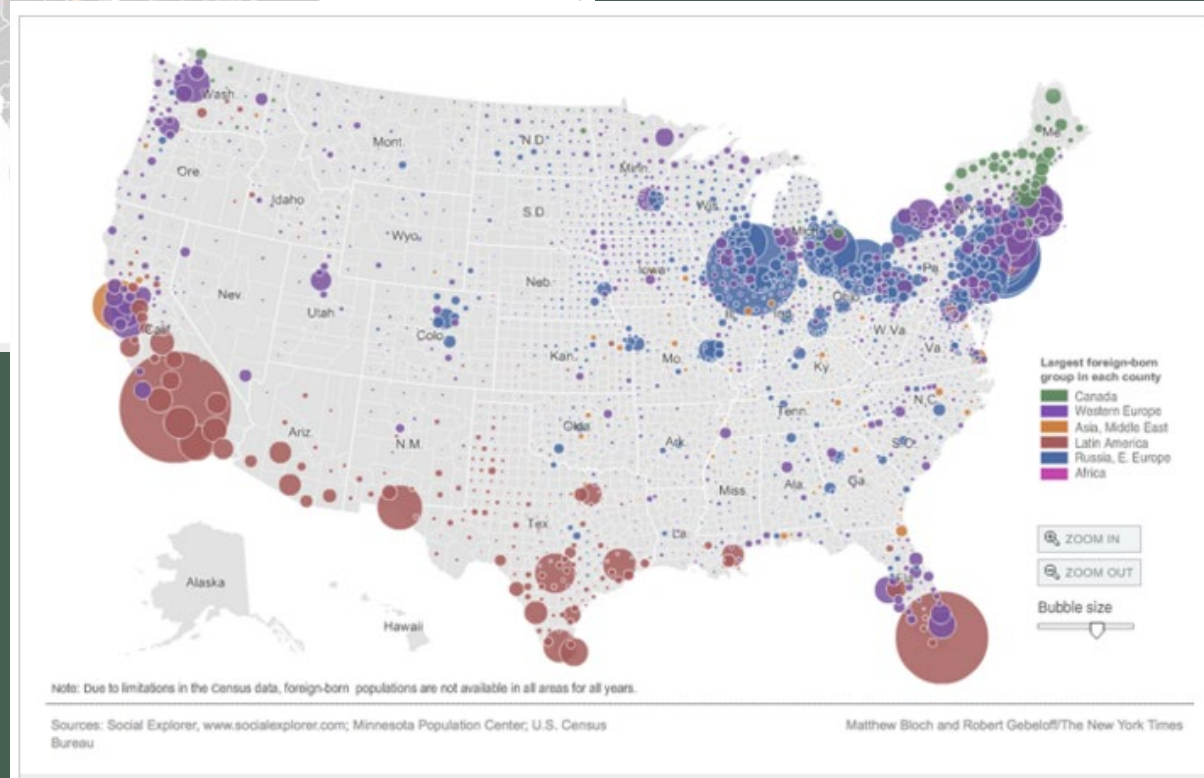
The earth is marked with about 180 named craters that are scars from previous run-ins with asteroids like the one that exploded over Russia on Friday.

Crater diameter



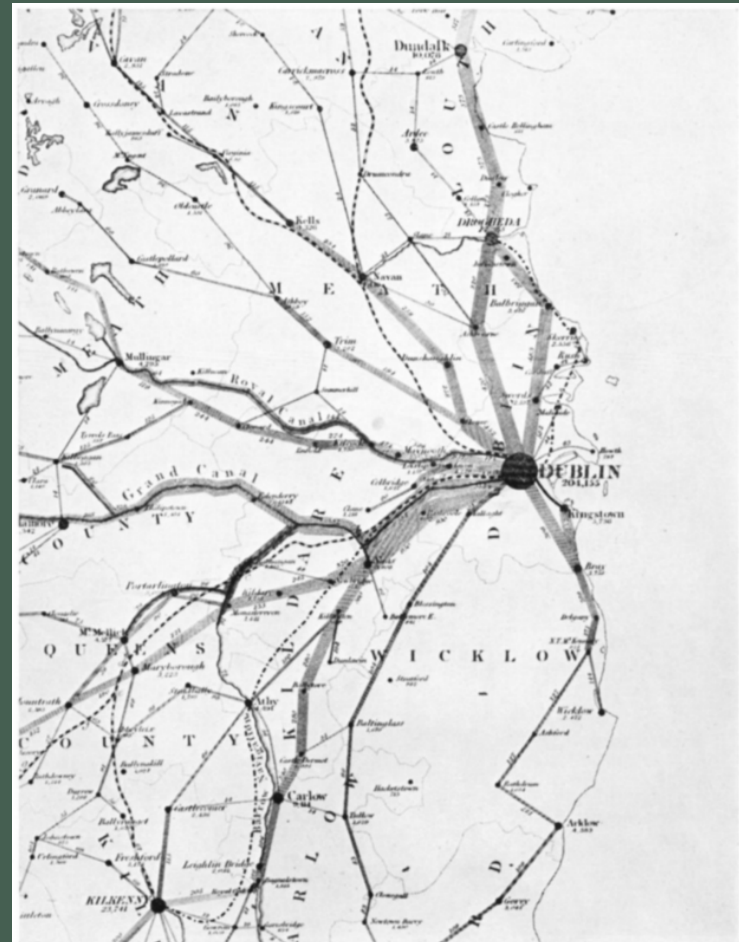
Credit: The Washington Post  
<https://www.e-education.psu.edu/geog486/node/1869>

Credit: The New York Times  
<https://www.e-education.psu.edu/geog486/node/1871>



# FLOW MAP

- Linear movement between places
- Data are represented by flow lines/ streamlines
- Flow mapping was introduced in 1837 by Henry Drury Harness



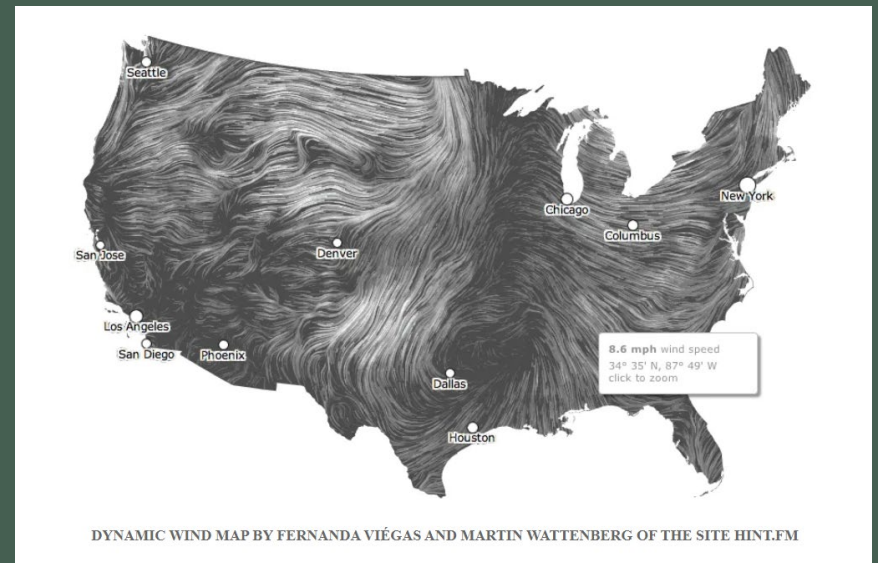
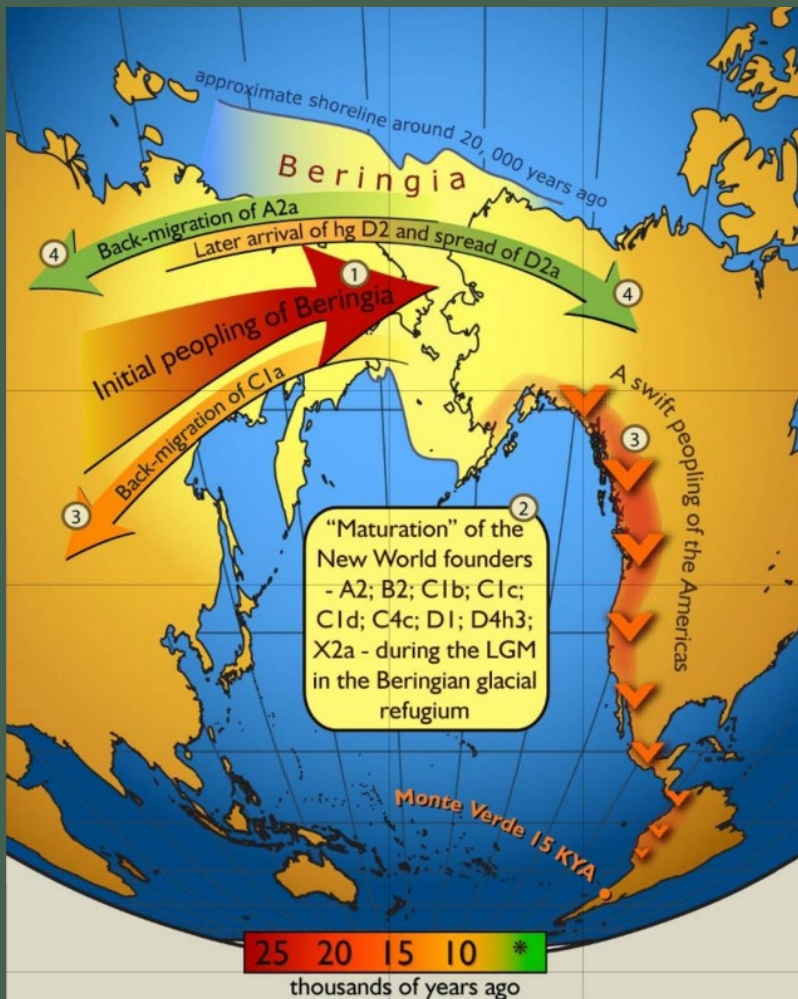
Arthur H. Robinson. "The 1837 Maps of Henry Drury Harness" *The Geographical Journal* Vol. 121, No. 4 (Dec., 1955), pp. 440-450

*Harness' Passenger Conveyance Map, 1837. Original, 1 inch to 10 miles: Brit. Mus.*

# FLOW MAP

- Qualitative – lines are typically not scaled.
- Quantitative – width of the flow lines connecting places are drawn in proportion to the quantity of movement represented.
- Data generalization are very common and depends on map scale.

# FLOW MAP

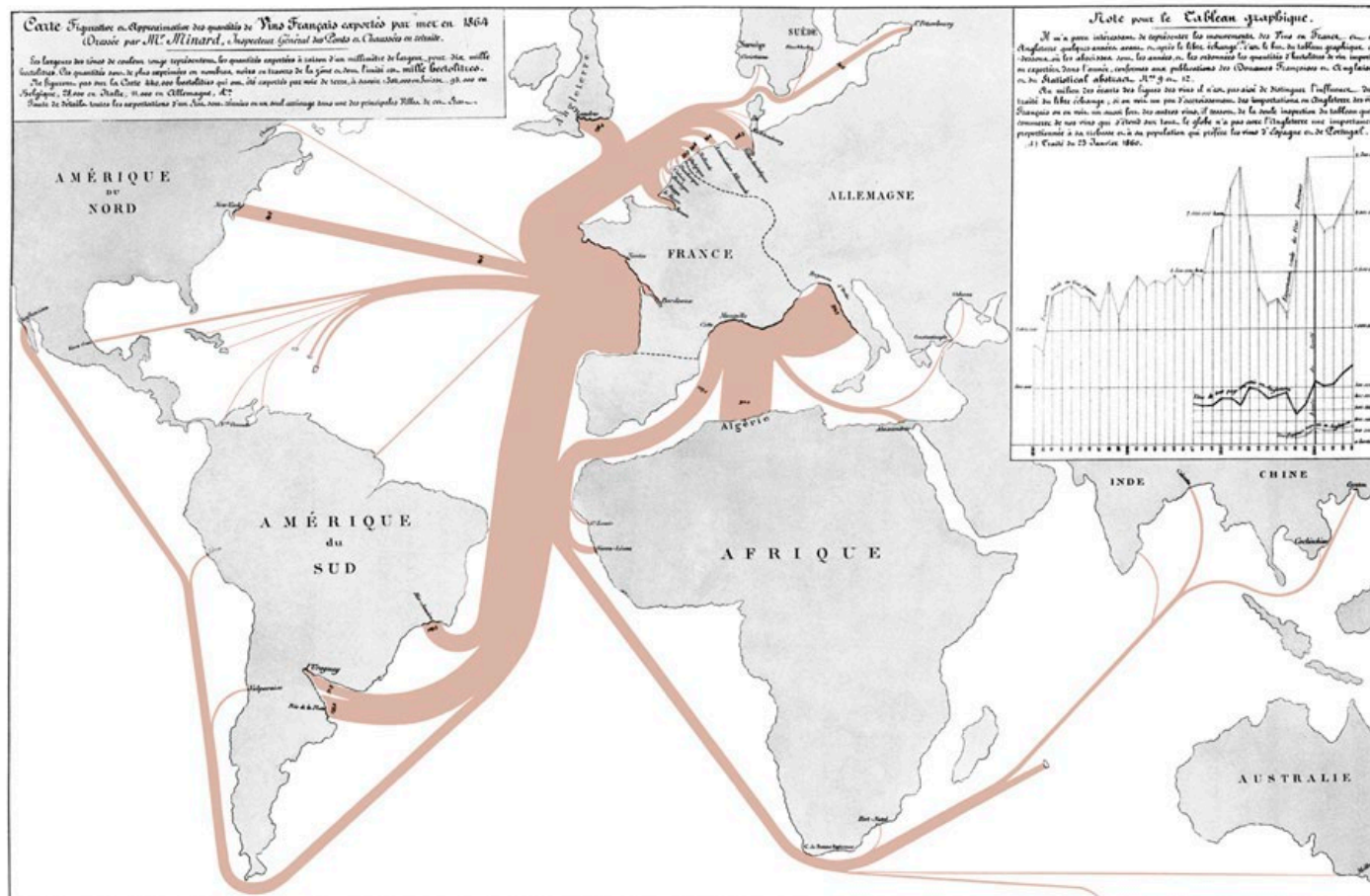


<http://hint.fm/wind/>

Flow Map, Map of gene flow in and out of Beringia By Erika Tamm et al.  
CC-BY-SA-3.0, via Wikimedia Commons



# FLOW MAP



Charles Joseph Minard, *Tableaux Graphiques et Cartes Figuratives de M. Minard*, 1845-1869, a portfolio of his work held by the Bibliothèque de l'École Nationale des Ponts et Chaussées, Paris.

Charles Joseph Minard's map of French wine exports for 1864.

# DATA APPROPRIATENESS

- Raw or Derived data can be used
  - Totals, Ratios, and Proportions
- Interval data should not be used as it will not ensure proportionality\*
- Weight, volume, value (\$), amount, and/or frequencies are the most common units used

# DIRECTED AND UNDIRECTED FLOWS

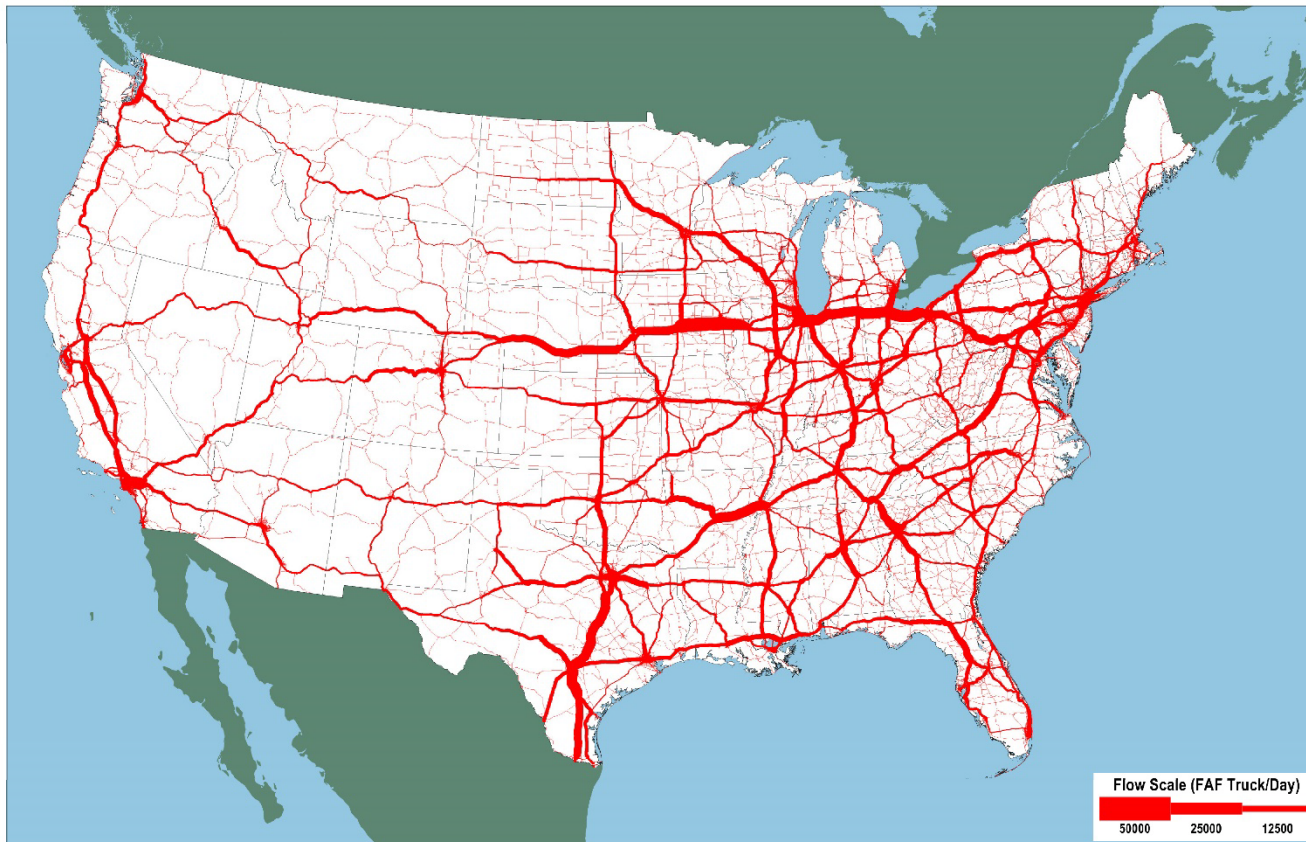
- Directed Flow Maps
  - Arrows are used to display the flow direction
- Undirected Flow Maps
  - Drawn without arrows, can imply movement in both directions
- Undirected flow maps are used:
  - When the data are aggregated for both directions
  - When it is impractical to portray both directions
  - Easy to generate in GIS and mapping software

# FLOW MAP TYPES

- Traffic Flow Maps
  - Actual routes and the magnitude of traffic are important.
  - Commonly found without directional symbols as most of the roads accommodate traffic in both directions.
- Origin-Destination Maps
  - Desire Line Maps (Davis 1974).
  - Typically illustrate social or economic interaction using a line/arc connecting points of origin and destination.
  - Used when exact routes cannot be displayed.

# TRAFFIC FLOW MAP

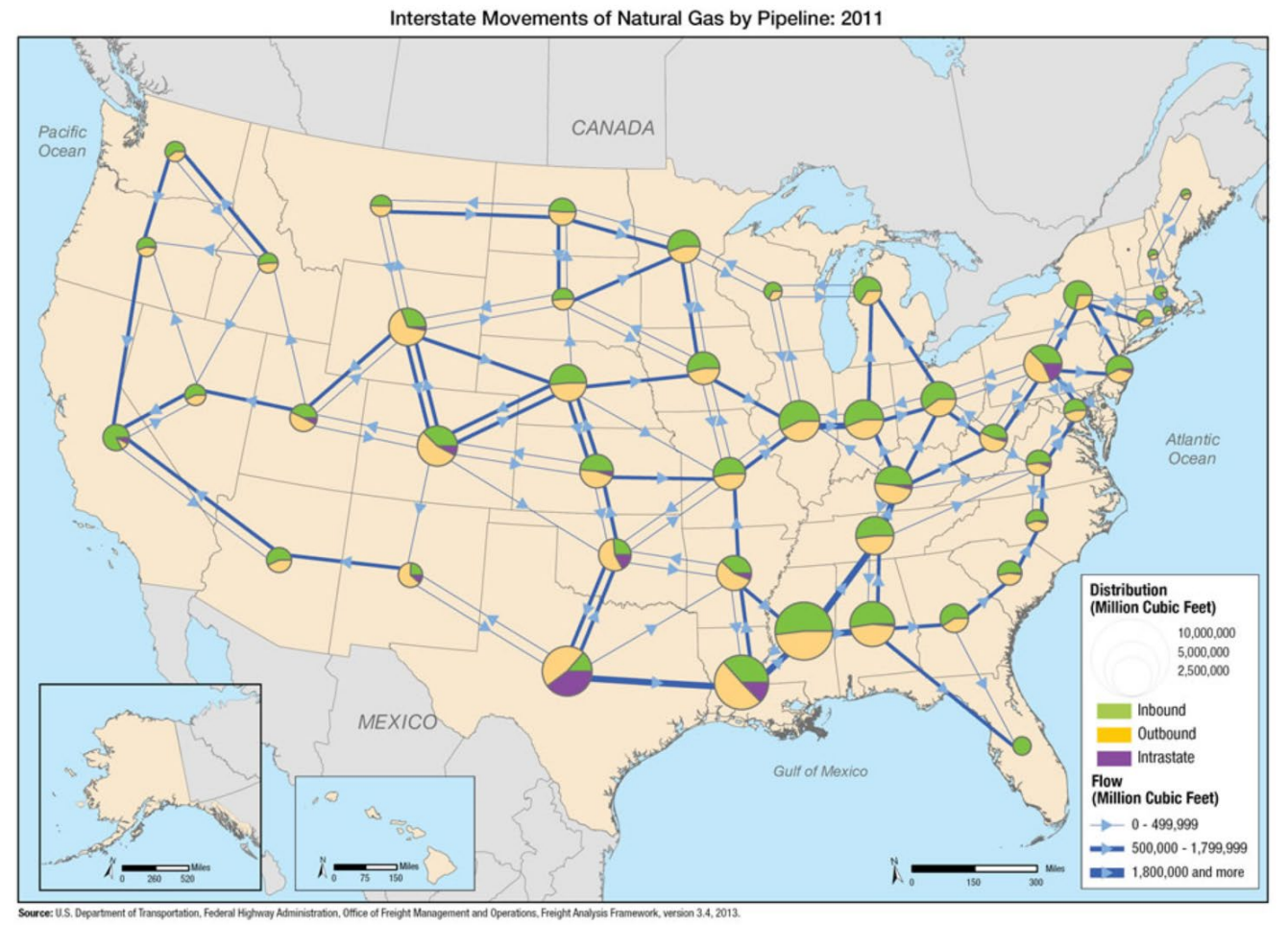
Average Daily Long-Haul Truck Traffic on the National Highway System: 2015



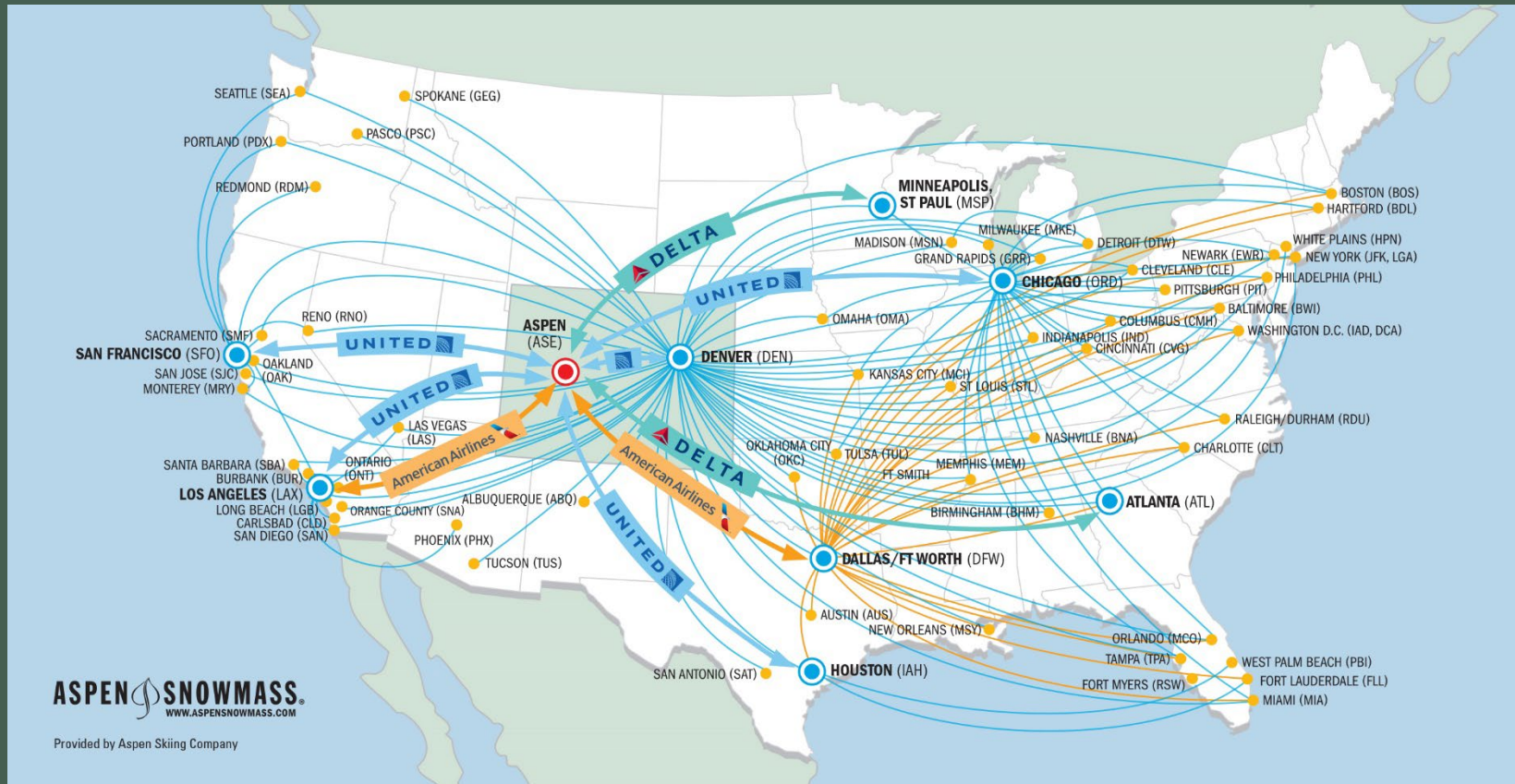
Note: Major flows include domestic and international freight moving by truck on highway segments with more than twenty five FAF trucks per day and between places typically more than fifty miles apart.

Source: U.S. Department of Transportation, Federal Highway Administration, Office of Freight Management and Operations, Freight Analysis Framework, version 4.3, 2017.

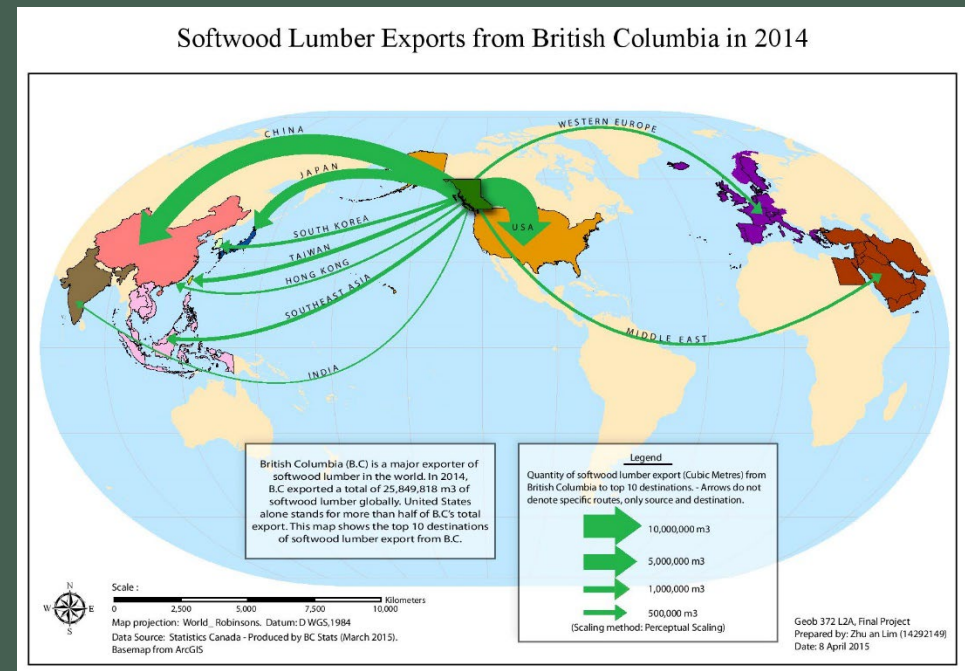
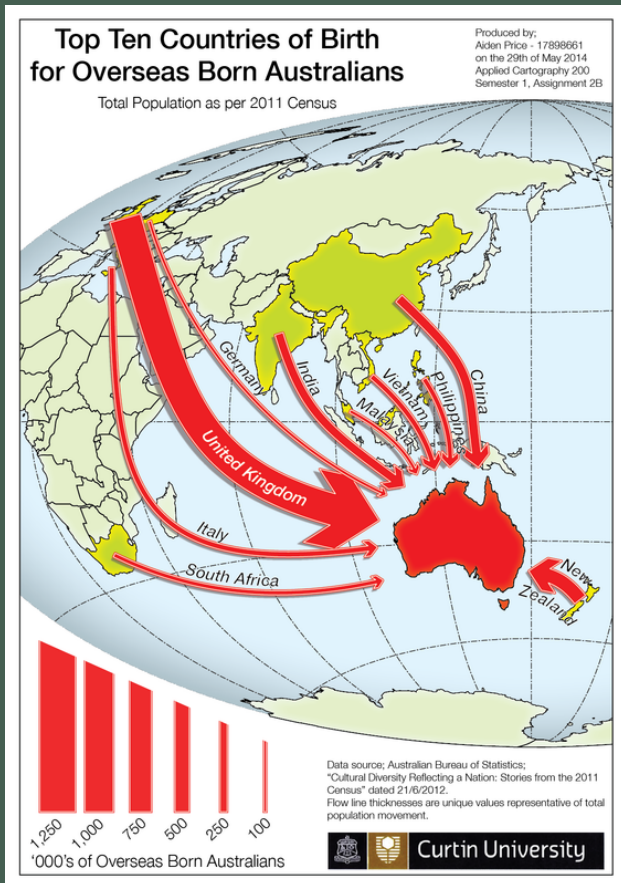
# TRAFFIC FLOW MAP



# ORIGIN-DESTINATION MAP



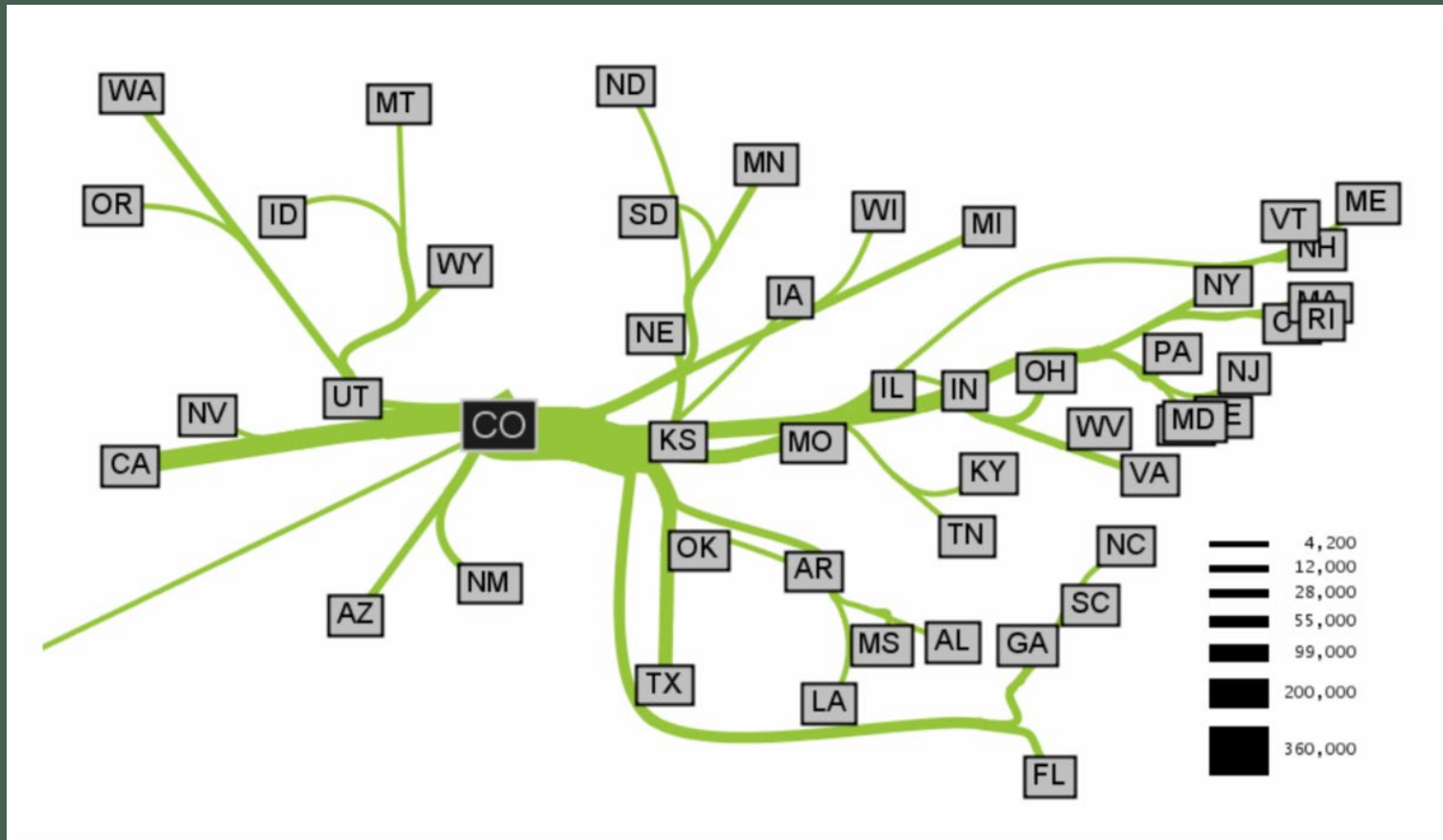
# MAP ORGANIZATION AND FIGURE-GROUND



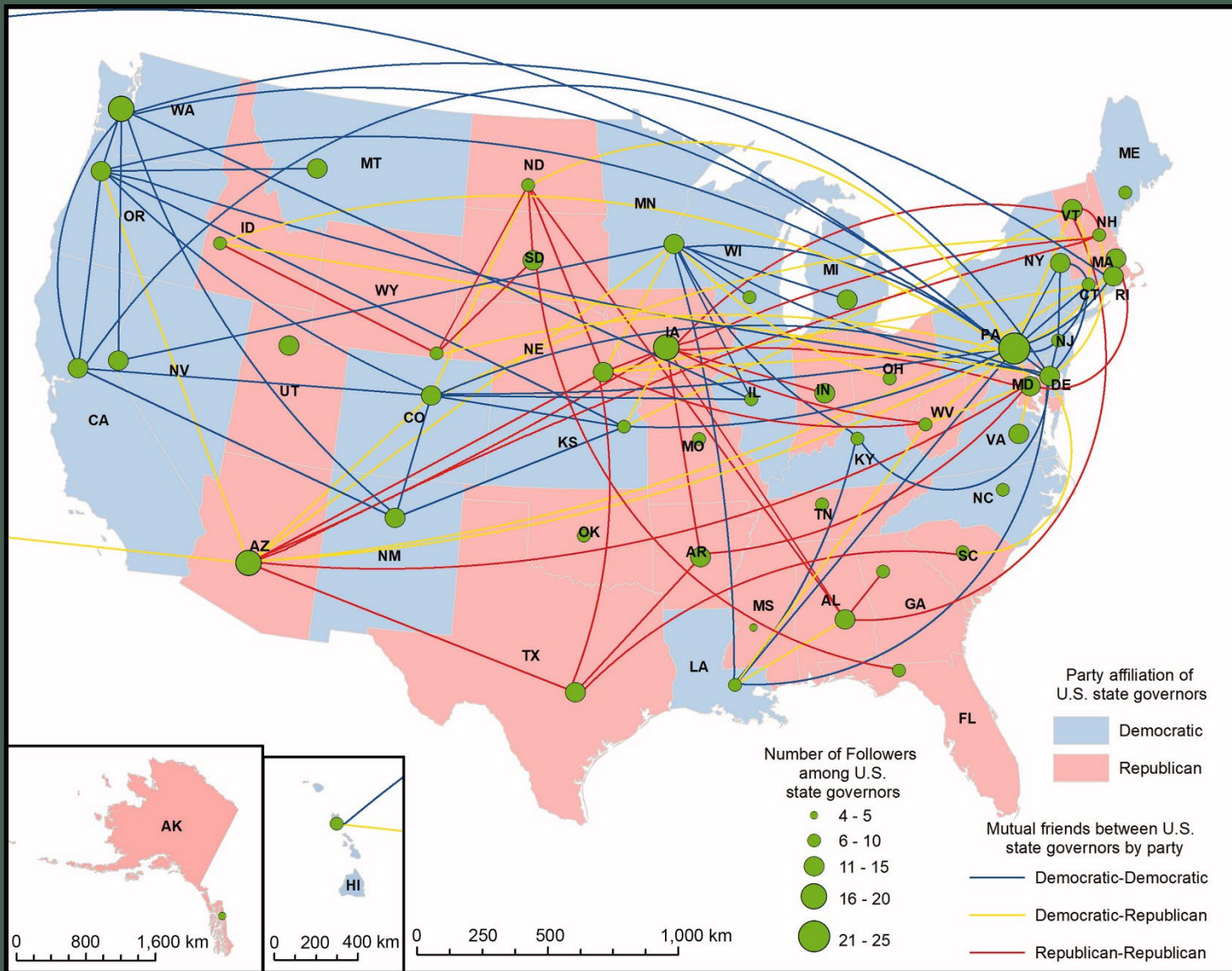
<https://blogs.ubc.ca/zhuanim/2015/12/03/proportional-symbol-flow-map/>



# FLOW MAPPING TECHNIQUES

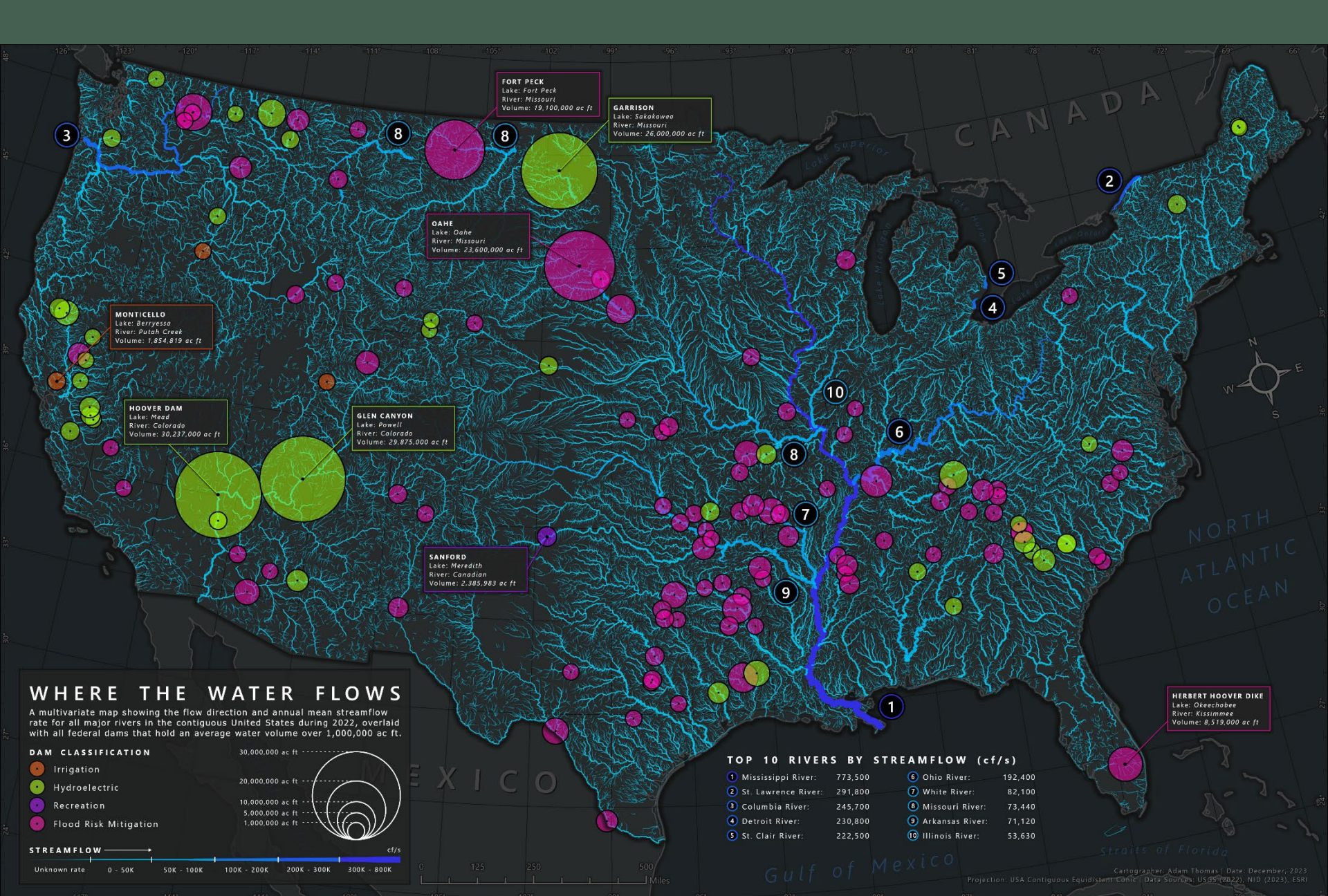


Outgoing migration map from Colorado for 1995-2000. Phan et al.



## Following connections among Twitter accounts of U.S. state governors as of 15 June 2020.

Xi Gong & Xinyue Ye (2021) Governors Fighting Crisis: Responses to the COVID-19 Pandemic across U.S. States on Twitter, *The Professional Geographer*, 73:4, 683-701. <https://doi.org/10.1080/00330124.2021.1895850>



Adam Thomas, Johns Hopkins University

<https://mapgallery.esri.com/submission-detail/65ab5f391843cf90681cf61d>

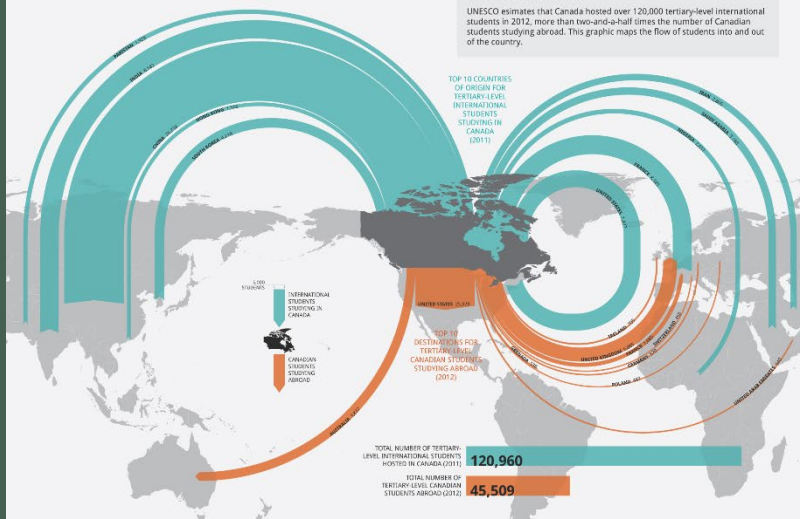
## STUDENTS ON THE MOVE

The benefits of cross-border education go beyond the fees that international students pay. It is increasingly a way for a country to project itself on the world stage. This graphic breaks down the flow of international students and where Canada fits in.

Designed by Cameron Tull

### THE PICTURE IN CANADA

UNESCO estimates that Canada hosted over 120,000 tertiary-level international students in 2012, more than two-and-a-half times the number of Canadian students studying abroad. This graphic maps the flow of students into and out of the country.



### THE TOP 10 DESTINATION COUNTRIES FOR ALL TERTIARY-LEVEL INTERNATIONAL STUDENTS IN 2012

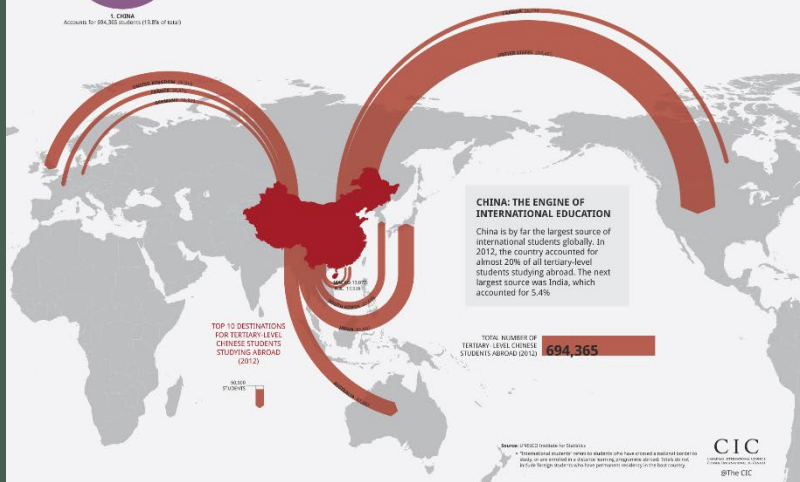


### THE TOP 10 SOURCE COUNTRIES FOR ALL TERTIARY-LEVEL INTERNATIONAL STUDENTS IN 2012



### CHINA: THE ENGINE OF INTERNATIONAL EDUCATION

China is by far the largest source of international students globally. In 2012, the country accounted for almost 29% of all tertiary-level students studying abroad. The next largest source was India, which accounted for 5.4%.

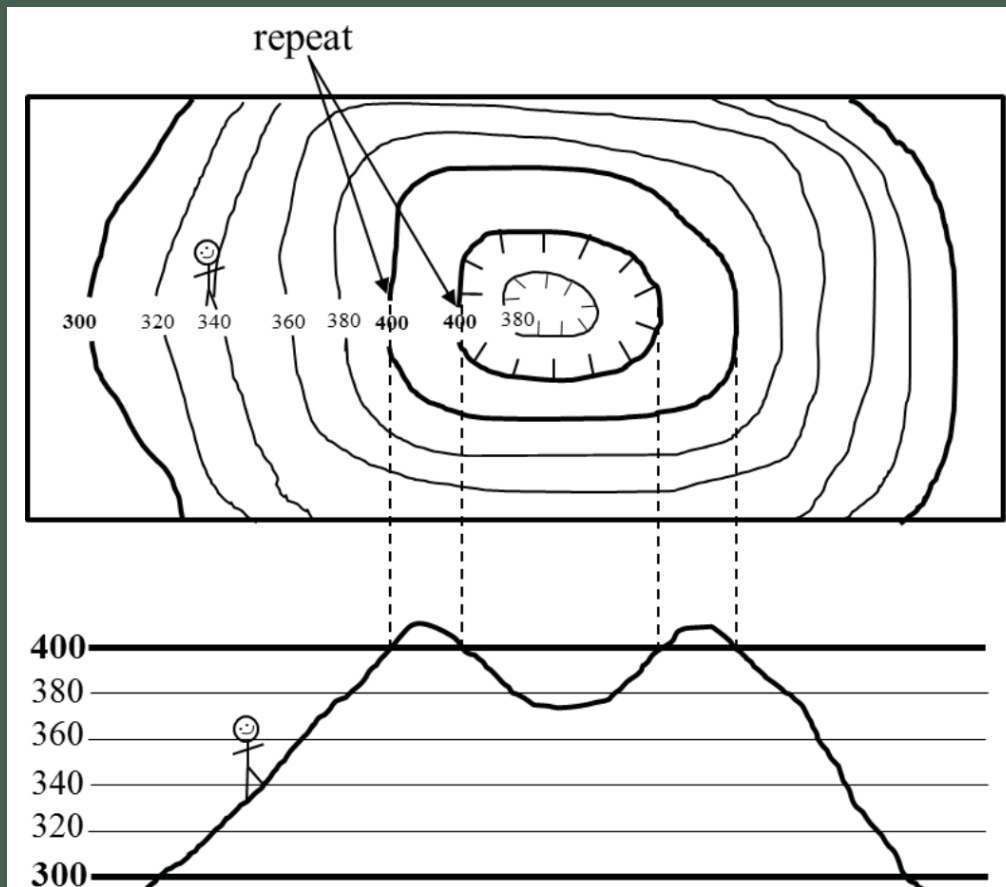


<http://sites.duke.edu/intellexchangeresources/the-burgeoning-business-of-international-education/>

# ISARITHMIC MAP

- A planimetric representation of the surface of a three-dimensional volume.
- Data should be continuous and not discrete.
- A quantitative mapping technique.
- Dates back to mid-sixteenth century.
- Created from a series of sampling points where data are measured and recorded.

# CONSTRUCTION OF ISARITHM



*Contours and hachured contours for a depression at the top of a hill illustrated on a topographic map and a corresponding topographic profile. Notice that the first hachured depression contour line elevation is a repeat of the closest non-hachured contour line elevation.*

Source: Karen Tefend (2017)  
CC BY-SA 3.0 [view source](#)

# MAP TYPES & DATA APPROPRIATENESS

## Isometric

- Data occurring at points
  - Totals
    - Ex: elevation, temperature
  - Derived – average, deviations, ratios
    - Ex: drought, mean temperature

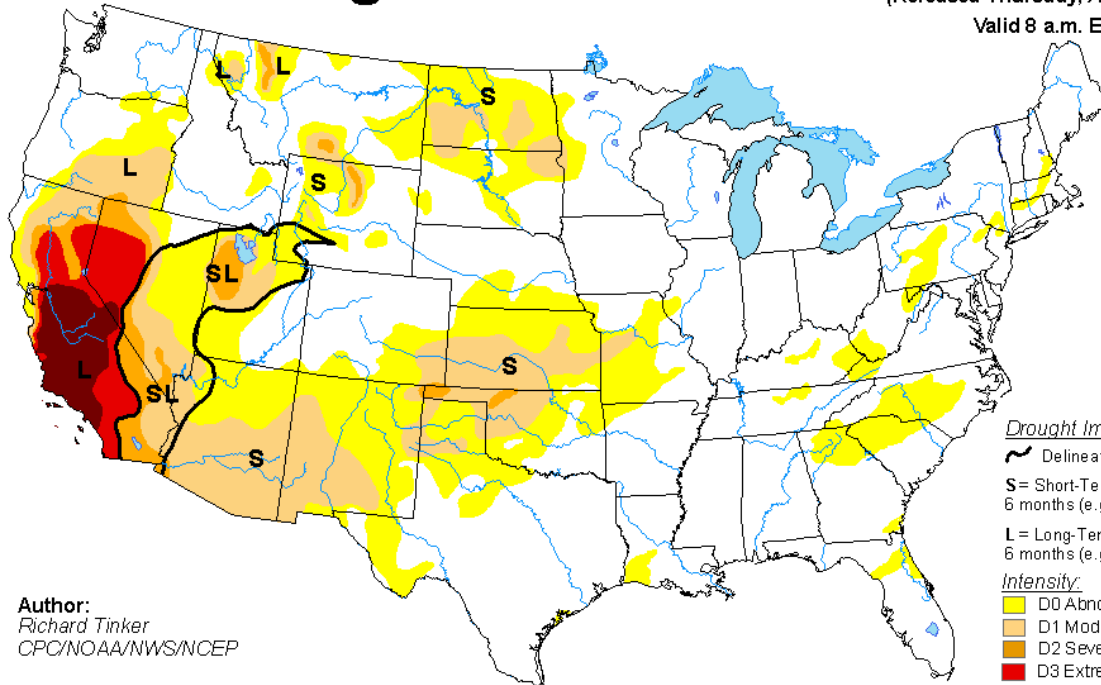
## Isoplethic

- Data occurring over geographical areas
  - Derived – ratios, proportions
    - Ex: population density, crop yield (bushels per acre)

# ISARITHMIC MAPS

## U.S. Drought Monitor

April 12, 2016  
 (Released Thursday, Apr. 14, 2016)  
 Valid 8 a.m. EDT



Drought Impact Types:

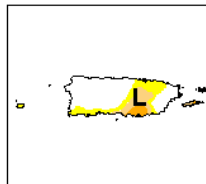
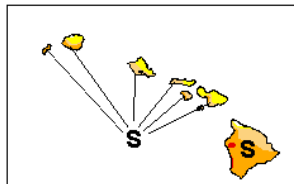
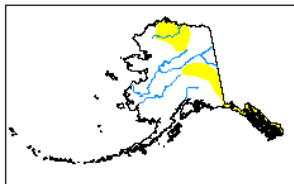
- ~ Delineates dominant impacts
- S = Short-Term, typically less than 6 months (e.g. agriculture, grasslands)
- L = Long-Term, typically greater than 6 months (e.g. hydrology, ecology)

Intensity:

- Yellow: D0 Abnormally Dry
- Light Orange: D1 Moderate Drought
- Orange: D2 Severe Drought
- Red-Orange: D3 Extreme Drought
- Dark Red: D4 Exceptional Drought

The Drought Monitor focuses on broad-scale conditions. Local conditions may vary. See accompanying text summary for forecast statements.

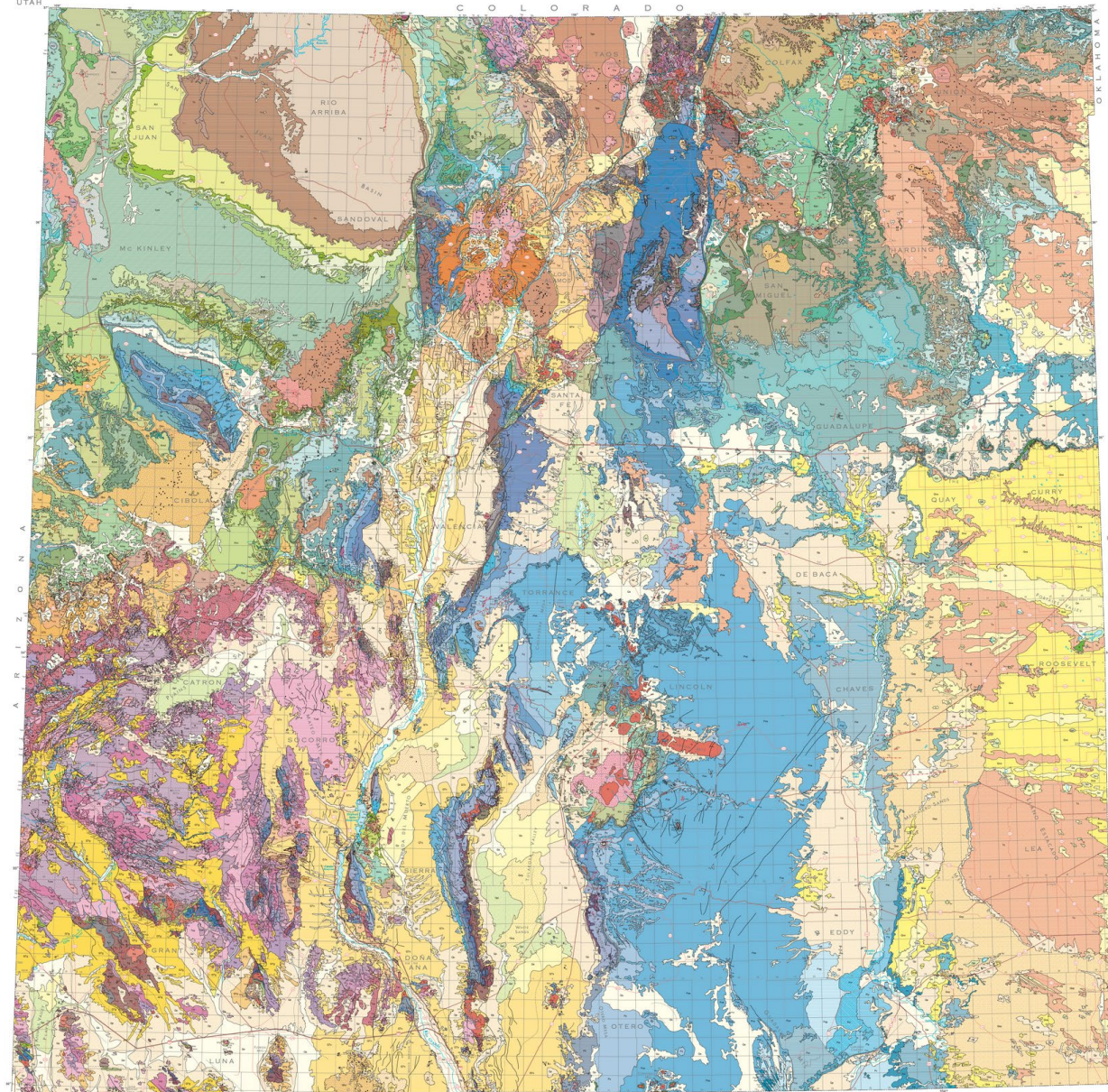
Author:  
 Richard Tinker  
 CPC/NOAA/NWS/NCEP



The data cutoff for Drought Monitor maps is each Tuesday at 8 a.m. EDT. The maps, which are based on analysis of the data, are released each Thursday at 8:30 a.m. Eastern Time.

<http://droughtmonitor.unl.edu/>





# Geologic Map of New Mexico

New Mexico Bureau of Geology and Mineral Resources  
*Celebrating 75 Years of Service*  
 A DIVISION OF NEW MEXICO INSTITUTE OF MINING AND TECHNOLOGY  
 Peter A. Scholle, State Geologist

2003



**USGS** PUBLISHED IN COOPERATION WITH THE U.S. GEOLOGICAL SURVEY

Scale: 1:500,000  
 0 10 20 30 40 50 Miles  
 0 10 20 30 40 50 Kilometers

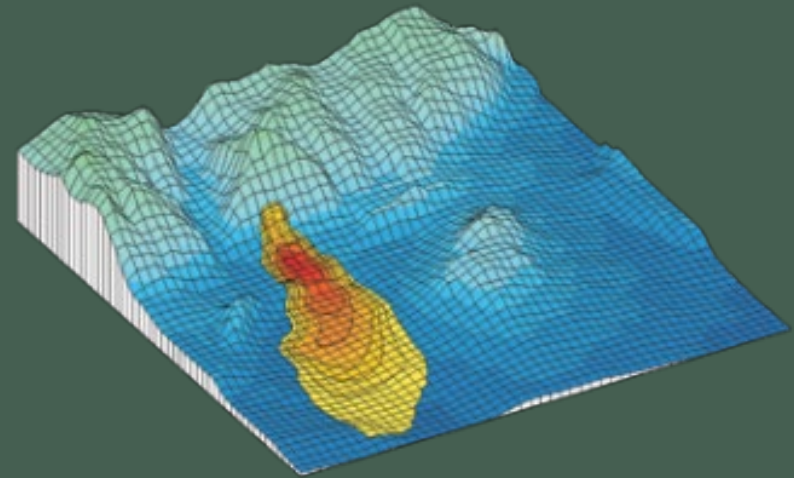
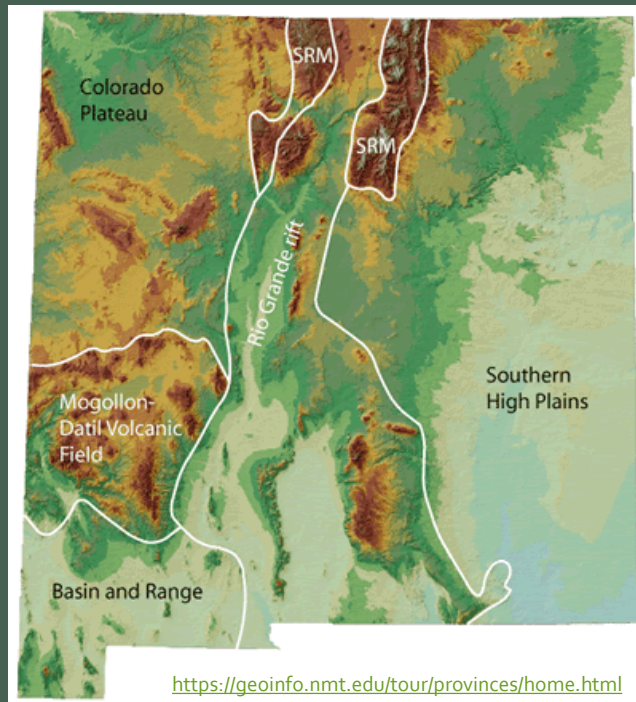
For sale by the New Mexico Bureau of Geology and Mineral Resources, 601 Leroy Place, Socorro, New Mexico 87801. (505) 656-3600. gdm@dmr.nm.gov

# INTERPOLATION

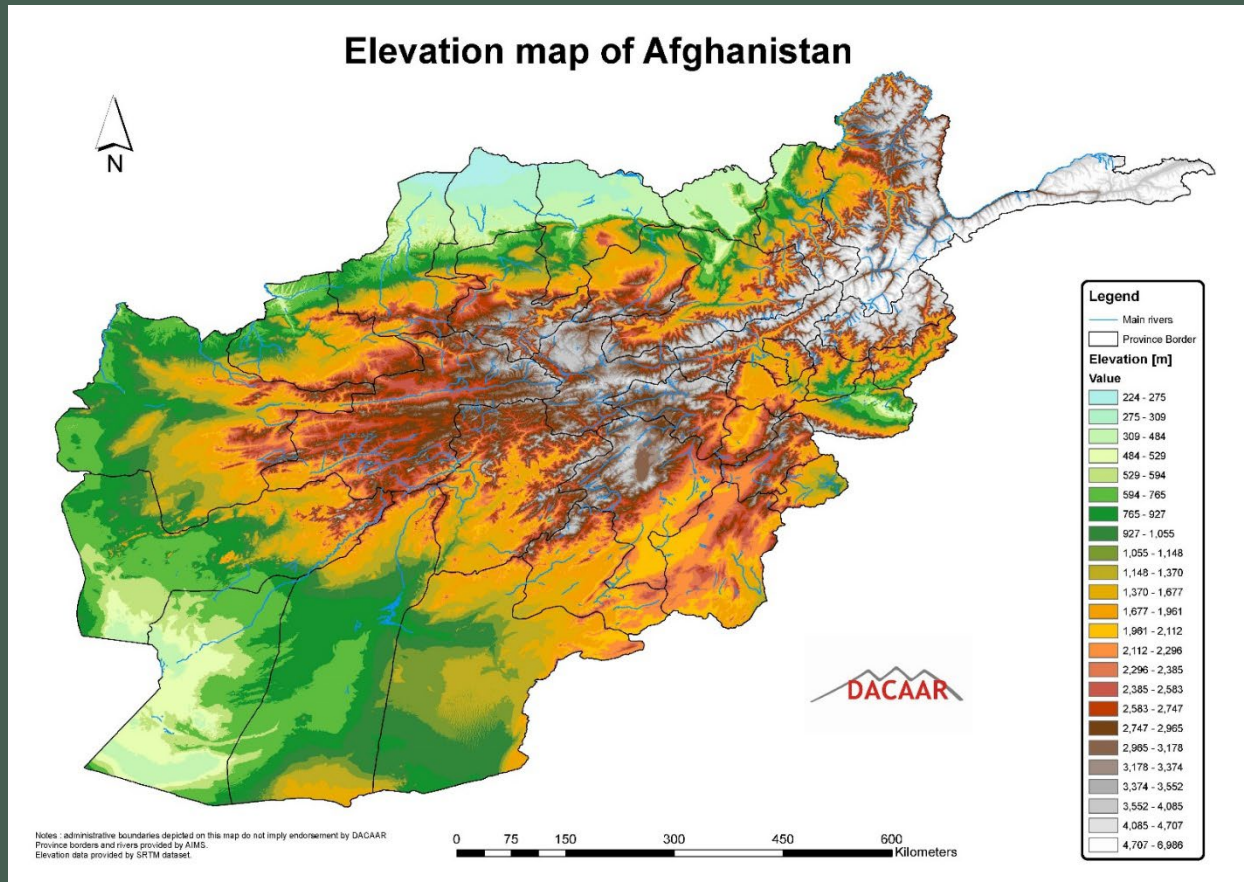
- Interpolation is necessary when data are not at grid intersections, or are irregular or sparse.
- Interpolation becomes extrapolation
  - When areas deficient of points are interpolated
  - When interpolation is carried outside the data area

# ISARITHMIC REPRESENTATIONS

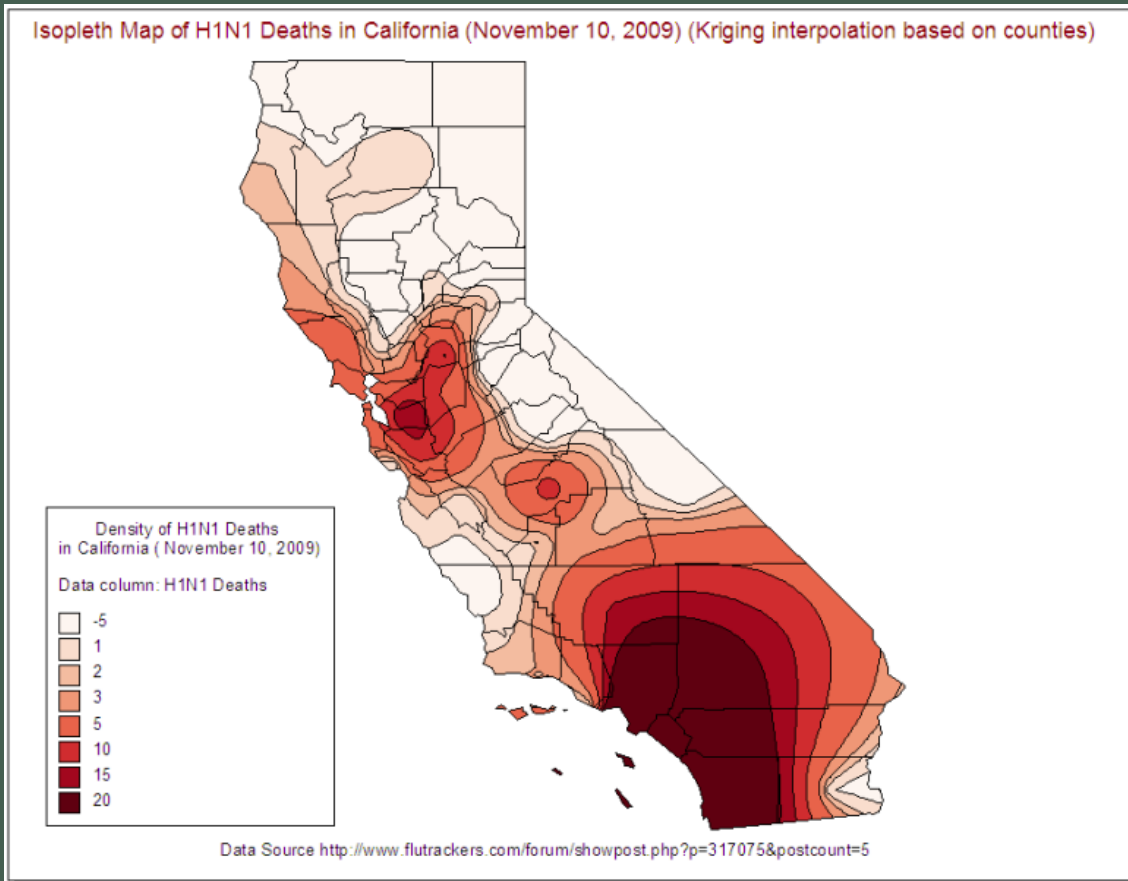
- Isarithmic maps can be difficult to interpret by a novice reader
- To assist the interpretation, other three-dimensional views such as shaded relief maps or Wireframe/Surface maps can be used



# ISARITHMIC MAPS



# ISOPLETH MAP



# CARTOGRAM

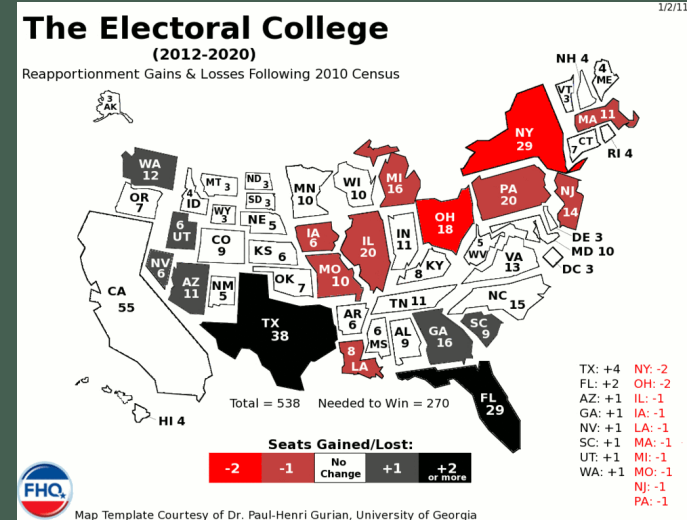
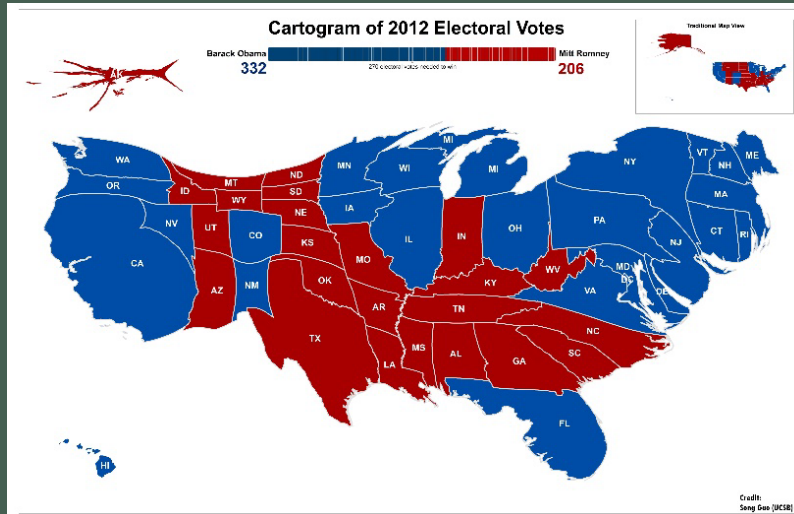
- Areas of the enumeration units are scaled to the data they represent
- Geographical relationships within the mapped space should be familiar to the readers
- Must preserve total shape of the study area

# CARTOGRAM

- Construction Approaches
  - Manual or automated
- Data
  - Raw or derived
  - Ratios
  - Not intervals – no classification of data
- Types
  - Rectangular – Erwin Raisz
  - Circle – Danny Dorling
  - Square – Demers

# CARTOGRAM

- Forms
  - Contiguous or noncontiguous
- Requirements
  - Preservation of shape and orientation

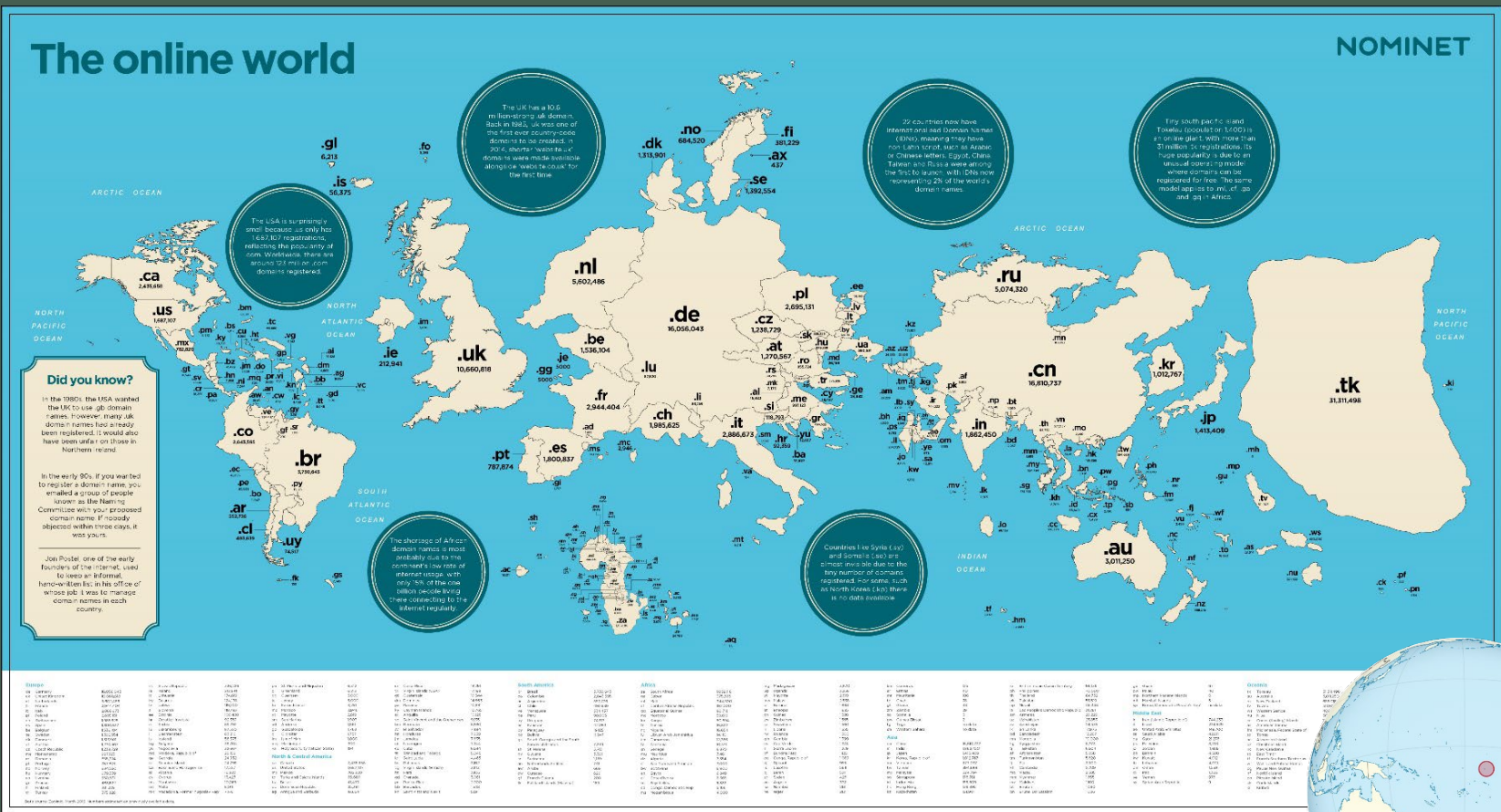




# CONTIGUOUS CARTOGRAMS

## The online world

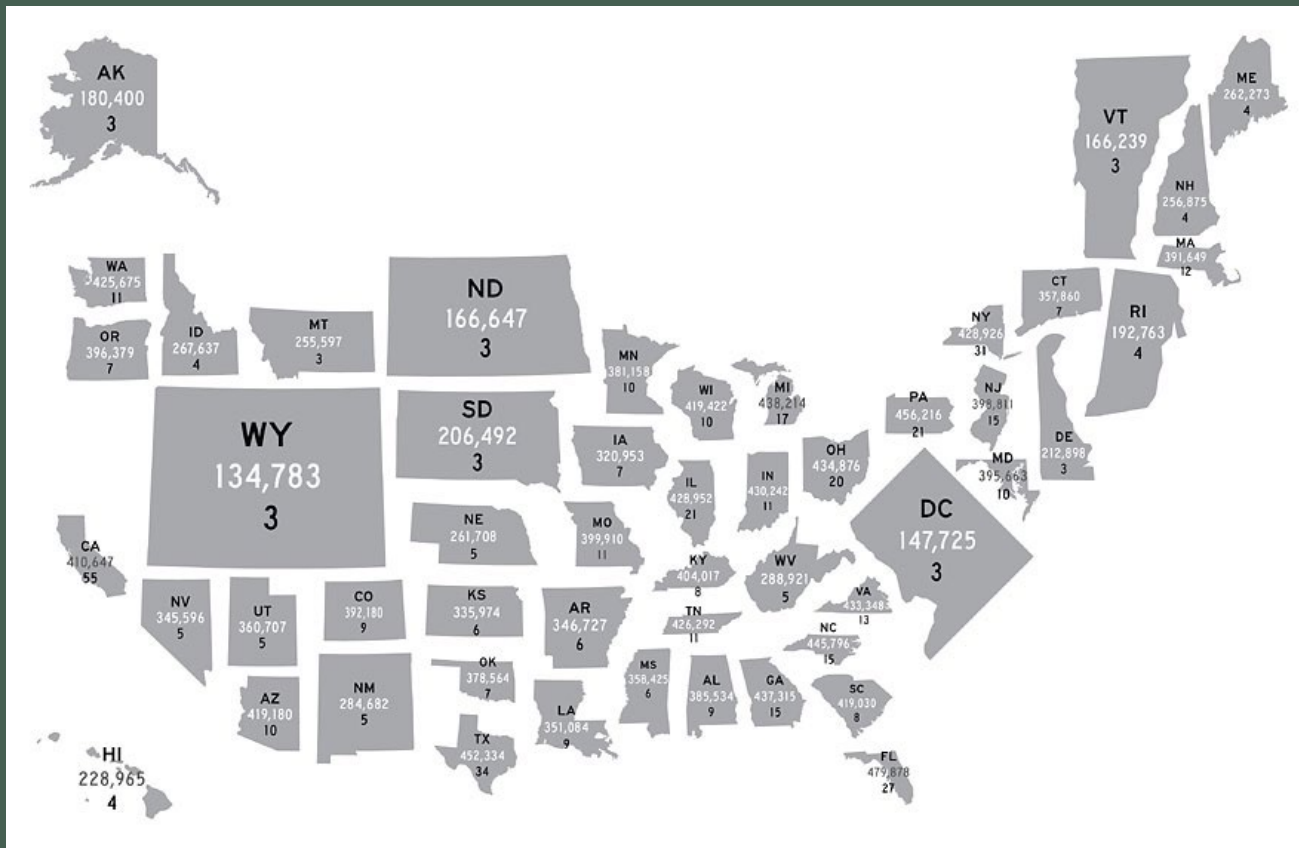
NOMINET



<https://www.nominet.uk/mapping-the-online-world/>

Country	Count	Country	Count	Country	Count	Country	Count	Country	Count
AD	1,000	FR	1,800,837	IT	2,886,673	RU	5,074,820	US	6,627,607
AE	1,000	GB	10,660,818	SE	1,392,554	UK	10,660,818	ZA	100,000
AF	1,000	DE	10,056,043	SI	1,000	US	6,627,607		
AG	1,000	DK	1,314,901	SK	1,000	US	6,627,607		
AI	1,000	FI	381,229	SM	1,000	US	6,627,607		
AL	1,000	IS	56,375	SN	1,000	US	6,627,607		
AM	1,000	IT	2,886,673	SR	1,000	US	6,627,607		
AN	1,000	JP	1,413,409	SV	1,000	US	6,627,607		
AO	1,000	KR	1,002,767	TD	1,000	US	6,627,607		
AR	1,000	LV	1,000	TH	1,000	US	6,627,607		
AS	1,000	LT	1,000	TL	1,000	US	6,627,607		
AT	1,000	LU	1,000	TM	1,000	US	6,627,607		
AU	3,071,250	LV	1,000	TO	1,000	US	6,627,607		
AW	1,000	LY	1,000	TR	1,000	US	6,627,607		
AX	1,000	MA	1,000	TT	1,000	US	6,627,607		
BA	1,000	MC	1,000	TU	1,000	US	6,627,607		
BB	1,000	MD	1,000	TV	1,000	US	6,627,607		
BD	1,000	ME	1,000	UZ	1,000	US	6,627,607		
BE	1,536,104	MG	1,000	VE	1,000	US	6,627,607		
BF	1,000	MH	1,000	VG	1,000	US	6,627,607		
BG	1,000	MI	1,000	VI	1,000	US	6,627,607		
BH	1,000	ML	1,000	VN	1,000	US	6,627,607		
BI	1,000	MM	1,000	WF	1,000	US	6,627,607		
BJ	1,000	MN	1,000	WS	1,000	US	6,627,607		
BK	1,000	MO	1,000	YU	1,000	US	6,627,607		
BL	1,000	MP	1,000	YU	1,000	US	6,627,607		
BM	1,000	MQ	1,000	YU	1,000	US	6,627,607		
BN	1,000	MR	1,000	YU	1,000	US	6,627,607		
BO	1,000	MS	1,000	YU	1,000	US	6,627,607		
BR	1,000	MT	1,000	YU	1,000	US	6,627,607		
BS	1,000	MU	1,000	YU	1,000	US	6,627,607		
BT	1,000	MV	1,000	YU	1,000	US	6,627,607		
BV	1,000	MW	1,000	YU	1,000	US	6,627,607		
BW	1,000	MY	1,000	YU	1,000	US	6,627,607		
BY	1,000	MZ	1,000	YU	1,000	US	6,627,607		
BZ	1,000	NA	1,000	YU	1,000	US	6,627,607		
CA	1,000	NC	1,000	YU	1,000	US	6,627,607		
CC	1,000	NE	1,000	YU	1,000	US	6,627,607		
CD	1,000	NG	1,000	YU	1,000	US	6,627,607		
CE	1,000	NI	1,000	YU	1,000	US	6,627,607		
CF	1,000	NL	5,602,486	YU	1,000	US	6,627,607		
CG	1,000	NO	664,530	YU	1,000	US	6,627,607		
CH	1,885,825	NP	1,000	YU	1,000	US	6,627,607		
CI	1,000	NZ	1,000	YU	1,000	US	6,627,607		
CK	1,000	OM	1,000	YU	1,000	US	6,627,607		
CL	1,000	ON	1,000	YU	1,000	US	6,627,607		
CM	1,000	OR	1,000	YU	1,000	US	6,627,607		
CN	10,810,737	OS	1,000	YU	1,000	US	6,627,607		
CO	1,000	OT	1,000	YU	1,000	US	6,627,607		
CR	1,000	OU	1,000	YU	1,000	US	6,627,607		
CU	1,000	OV	1,000	YU	1,000	US	6,627,607		
CV	1,000	OW	1,000	YU	1,000	US	6,627,607		
CW	1,000	OX	1,000	YU	1,000	US	6,627,607		
CX	1,000	OY	1,000	YU	1,000	US	6,627,607		
CY	1,000	OZ	1,000	YU	1,000	US	6,627,607		
CZ	1,270,567	PA	1,000	YU	1,000	US	6,627,607		
DE	10,056,043	PE	1,000	YU	1,000	US	6,627,607		
DK	1,314,901	PF	1,000	YU	1,000	US	6,627,607		
DM	1,000	PG	1,000	YU	1,000	US	6,627,607		
DO	1,000	PH	1,000	YU	1,000	US	6,627,607		
DZ	1,000	PK	1,000	YU	1,000	US	6,627,607		
EC	1,000	PL	2,695,181	YU	1,000	US	6,627,607		
EE	1,000	PM	1,000	YU	1,000	US	6,627,607		
EG	1,000	PN	1,000	YU	1,000	US	6,627,607		
EH	1,000	PR	1,000	YU	1,000	US	6,627,607		
ES	1,800,837	PS	1,000	YU	1,000	US	6,627,607		
ET	1,000	PT	787,874	YU	1,000	US	6,627,607		
FI	381,229	PY	1,000	YU	1,000	US	6,627,607		
FJ	1,000	QA	1,000	YU	1,000	US	6,627,607		
FK	1,000	RE	1,000	YU	1,000	US	6,627,607		
FM	1,000	RO	1,000	YU	1,000	US	6,627,607		
FO	1,000	RS	1,000	YU	1,000	US	6,627,607		
FR	1,800,837	RU	5,074,820	YU	1,000	US	6,627,607		
GA	1,000	SA	1,000	YU	1,000	US	6,627,607		
GB	10,660,818	SB	1,000	YU	1,000	US	6,627,607		
GD	1,000	SC	1,000	YU	1,000	US	6,627,607		
GE	1,000	SD	1,000	YU	1,000	US	6,627,607		
GF	1,000	SE	1,392,554	YU	1,000	US	6,627,607		
GG	1,000	SG	1,000	YU	1,000	US	6,627,607		
GH	1,000	SI	1,000	YU	1,000	US	6,627,607		
GI	1,000	SJ	1,000	YU	1,000	US	6,627,607		
GL	6,211	SK	1,000	YU	1,000	US	6,627,607		
GM	1,000	SL	1,000	YU	1,000	US	6,627,607		
GN	1,000	SM	1,000	YU	1,000	US	6,627,607		
GP	1,000	SN	1,000	YU	1,000	US	6,627,607		
GQ	1,000	SO	1,000	YU	1,000	US	6,627,607		
GR	1,000	SR	1,000	YU	1,000	US	6,627,607		
GS	1,000	SS	1,000	YU	1,000	US	6,627,607		
GT	1,000	ST	1,000	YU	1,000	US	6,627,607		
GU	1,000	SV	1,000	YU	1,000	US	6,627,607		
GW	1,000	TD	1,000	YU	1,000	US	6,627,607		
GY	1,000	TF	1,000	YU	1,000	US	6,627,607		
HA	1,000	TG	1,000	YU	1,000	US	6,627,607		
HC	1,000	TH	1,000	YU	1,000	US	6,627,607		
HD	1,000	TJ	1,000	YU	1,000	US	6,627,607		
HE	1,000	TK	1,000	YU	1,000	US	6,627,607		
HF	1,000	TL	1,000	YU	1,000	US	6,627,607		
HG	1,000	TM	1,000	YU	1,000	US	6,627,607		
HH	1,000	TN	1,000	YU	1,000	US	6,627,607		
HI	1,000	TO	1,000	YU	1,000	US	6,627,607		
HJ	1,000	TP	1,000	YU	1,000	US	6,627,607		
HK	1,000	TQ	1,000	YU	1,000	US	6,627,607		
HL	1,000	TR	1,000	YU	1,000	US	6,627,607		
HM	1,000	TT	1,000	YU	1,000	US	6,627,607		
HN	1,000	TU	1,000	YU	1,000	US	6,627,607		
HO	1,000	TV	1,000	YU	1,000	US	6,627,607		
HP	1,000	TW	1,000	YU	1,000	US	6,627,607		
HQ	1,000	TZ	1,000	YU	1,000	US	6,627,607		
HR	1,000	UA	1,000	YU	1,000	US	6,627,607		
HS	1,000	UG	1,000	YU	1,000	US	6,627,607		
HT	1,000	UJ	1,000	YU	1,000	US	6,627,607		
HU	1,000	UK	10,660,818	YU	1,000	US	6,627,607		
HV	1,000	UM	1,000	YU	1,000	US	6,627,607		
HW	1,000	UN	1,000	YU	1,000	US	6,627,607		
HX	1,000	UO	1,000	YU	1,000	US	6,627,607		
HY	1,000	UP	1,000	YU	1,000	US	6,627,607		
HZ	1,000	UQ	1,000	YU	1,000	US	6,627,607		
IA	1,000	UR	1,000	YU	1,000	US	6,627,607		
IB	1,000	US	6,627,607	YU	1,000	US	6,627,607		
IC	1,000	UY	1,000	YU	1,000	US	6,627,607		
ID	1,000	UZ	1,000	YU	1,000	US	6,627,607		
IE	1,000	VA	1,000	YU	1,000	US	6,627,607		
IF	1,000	VC	1,000	YU	1,000	US	6,627,607		
IG	1,000	VE	1,000	YU	1,000	US	6,627,607		
IH	1,000	VG	1,000	YU	1,000	US	6,627,607		
II	1,000	VI	1,000	YU	1,000	US	6,627,607		
IJ	1,000	VN	1,000	YU	1,000	US	6,627,607		
IK	1,000	VU	1,000	YU	1,000	US	6,627,607		
IL	1,000	WF	1,000	YU	1,000	US	6,627,607		
IM	1,000	WS	1,000	YU	1,000	US	6,627,607		
IN	1,882,450	YT	1,000	YU	1,000	US	6,627,607		
IO	1,000	ZA	100,000	YU	1,000	US	6,627,607		
IP	1,000	ZD	1,000	YU	1,000	US	6,627,607		
IQ	1,000	ZF	1,000	YU	1,000	US	6,627,607		
IR	1,000	ZG	1,000	YU	1,000	US	6,627,607		
IS	56,375	ZH	1,000	YU	1,000	US	6,627,607		
IT	2,886,673	ZI	1,000	YU	1,000	US	6,627,607		
IU	1,000	ZJ	1,000	YU	1,000	US	6,627,607		
IV	1,000	ZK	1,000	YU	1,000	US	6,627,607		
IW	1,000	ZL	1,000	YU	1,000	US			

# NONCONTIGUOUS CARTOGRAMS



This map shows each state re-sized in proportion to the relative influence of the individual voters who live there. The numbers indicate the total delegates to the Electoral College from each state, and how many eligible voters a single delegate from each state represents.

Source: The United States Election Project at George Mason University.

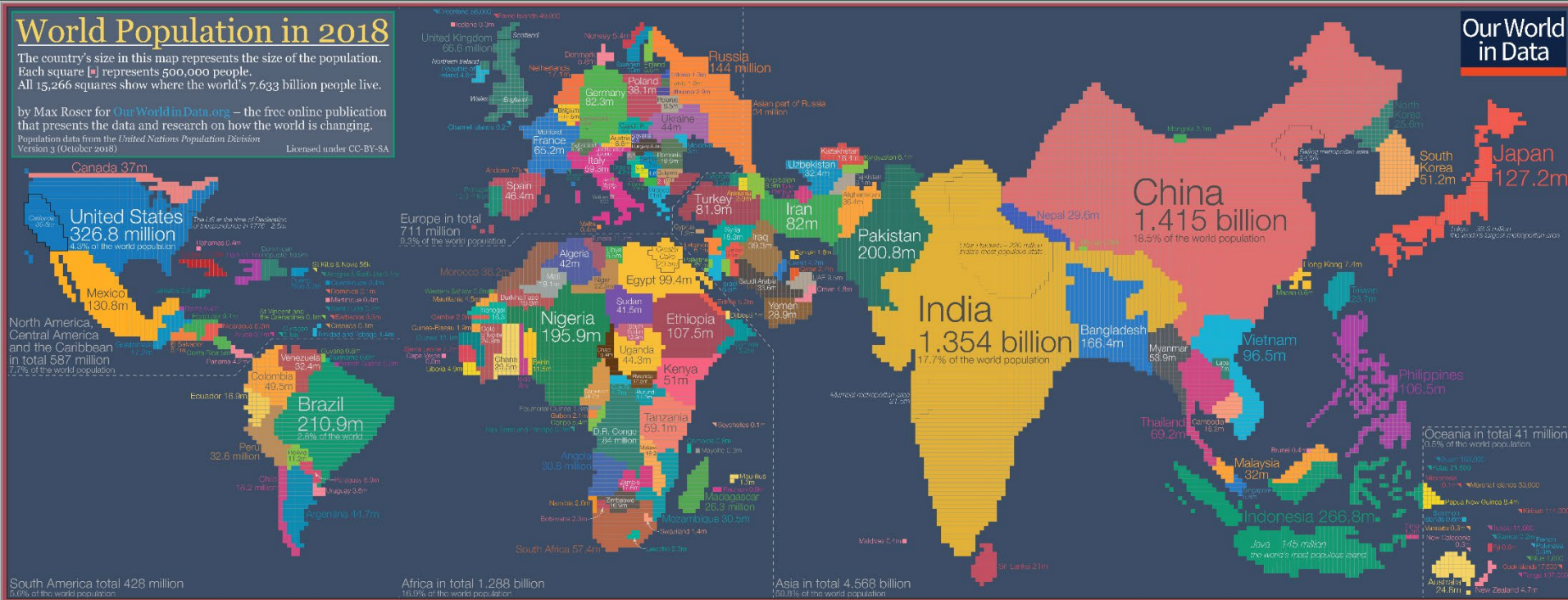
By SARAH K. COWAN, STEPHEN DOYLE and DREW HEFFRON



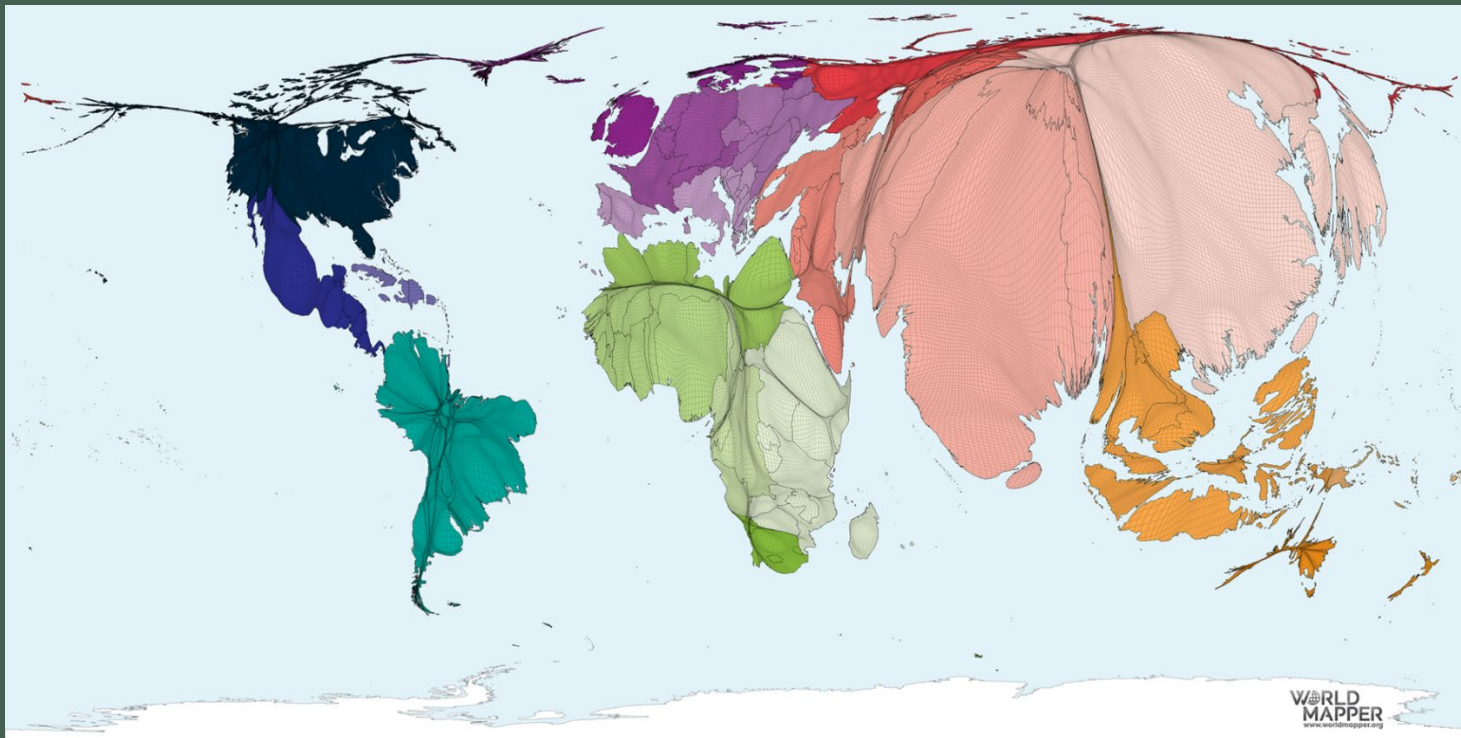
# EXAMPLES



# EXAMPLES

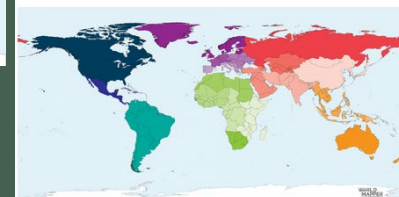


# EXAMPLES



## COLOUR KEY

- North America
- Central America
- Caribbean
- South America
- Northern Europe
- Central Europe
- Eastern Europe
- Southern Europe
- Southern Africa
- Northern Africa
- Western Africa
- Central Africa
- Eastern Africa
- Russia
- Central Asia
- Western Asia
- Southern Asia
- Eastern Asia
- Australasia
- Southeastern Asia
- Pacific Oceania



## REFERENCE MAP

## Population – Year 2000 from [World Mapper](#).

*Technical Notes:* This map shows the land surface resized by its population. Each transformed grid cell in the map is proportional to the total number of people living in that area.

*Data sources:* This map uses population estimates for the year 2020 based on data from the [Gridded Population of the World \(GPW\), v4](#) at 0.25 degree resolution, released by SEDAC (Socioeconomic Data and Applications Center) (accessed March 2018).

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