LINZ
Wellington, New Zealand

September 2012

Statistical Mapping

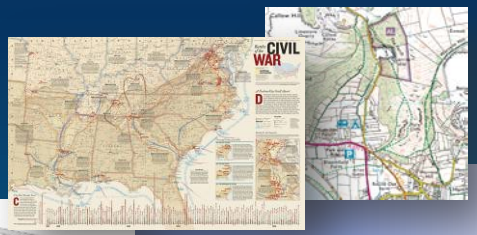
Aileen Buckley

Esri, Redlands, California, USA

Purpose and audience

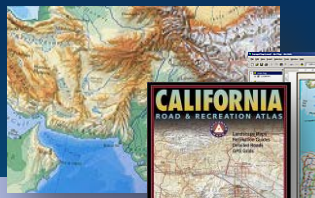
Purpose and audience

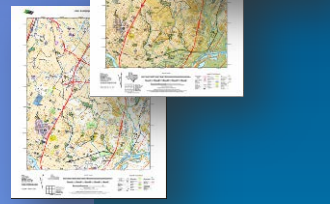
Number and types of features on maps



Special Use Maps

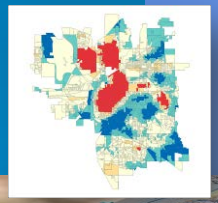
- Trail Map
- Campus Map

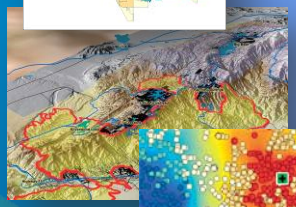


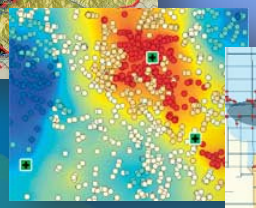


Reference Maps

- Topo Map
- Atlas Reference Map

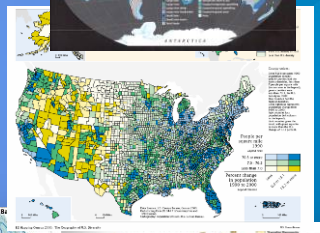


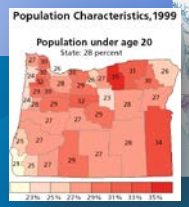


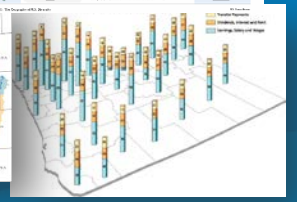


Analysis Results

- Suitability Map
- Crime Hot Spots





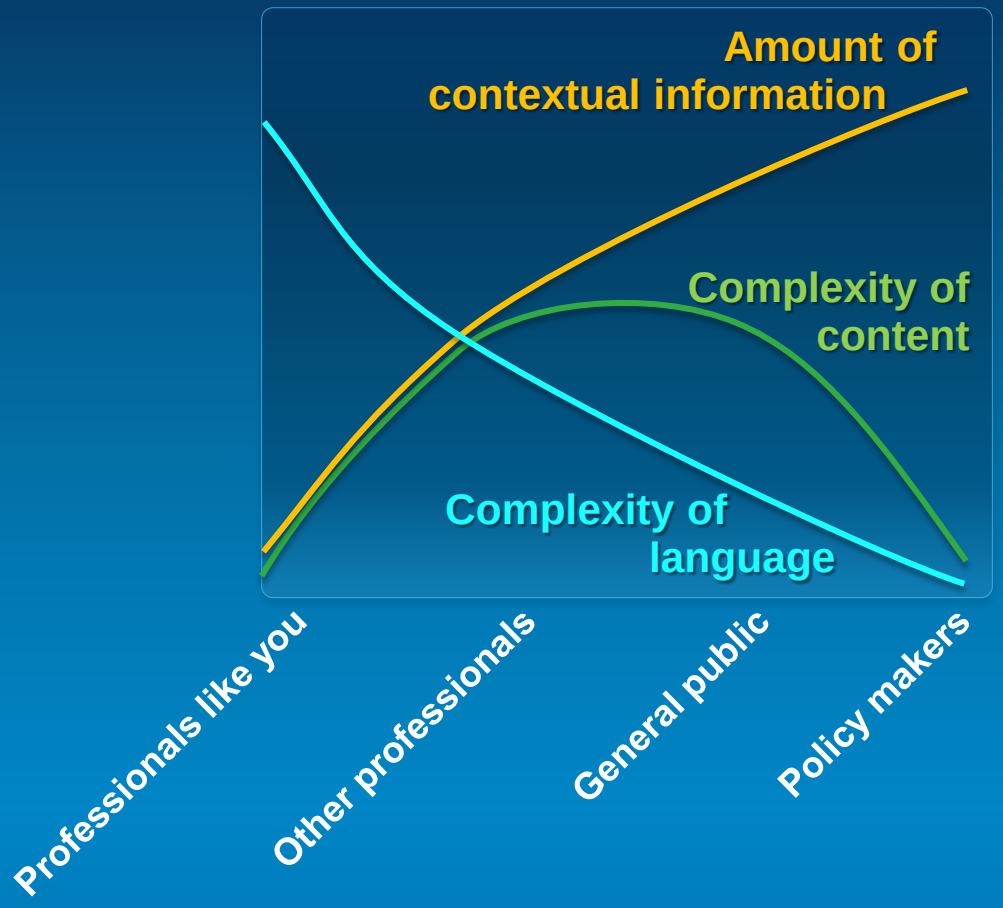


Thematic Maps

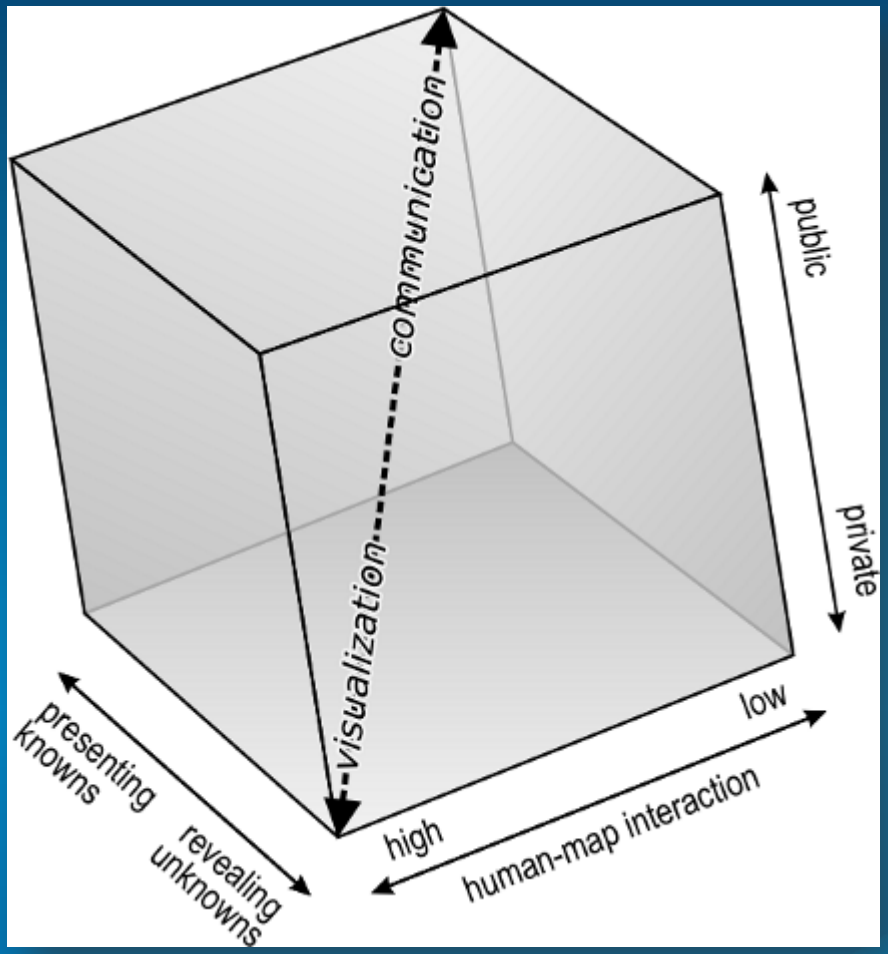
- Census Data
- Atlas Thematic Map

Internal > external audience

Audience


Amount of contextual information
Complexity of content
Complexity of language
Professionals like you
Other professionals
General public
Policy makers

Cartography Cubed (Cartography^3)



Nature of the phenomena

- Topographic
  - Land form > hydrography > land cover / land use > human features
- Environmental
  - Physical phenomena and processes, e.g., hydrography
- Network
  - Connectivity, flow, e.g., traffic
- Navigation
  - Networks, orientation, route finding features, e.g., aeronautical charts

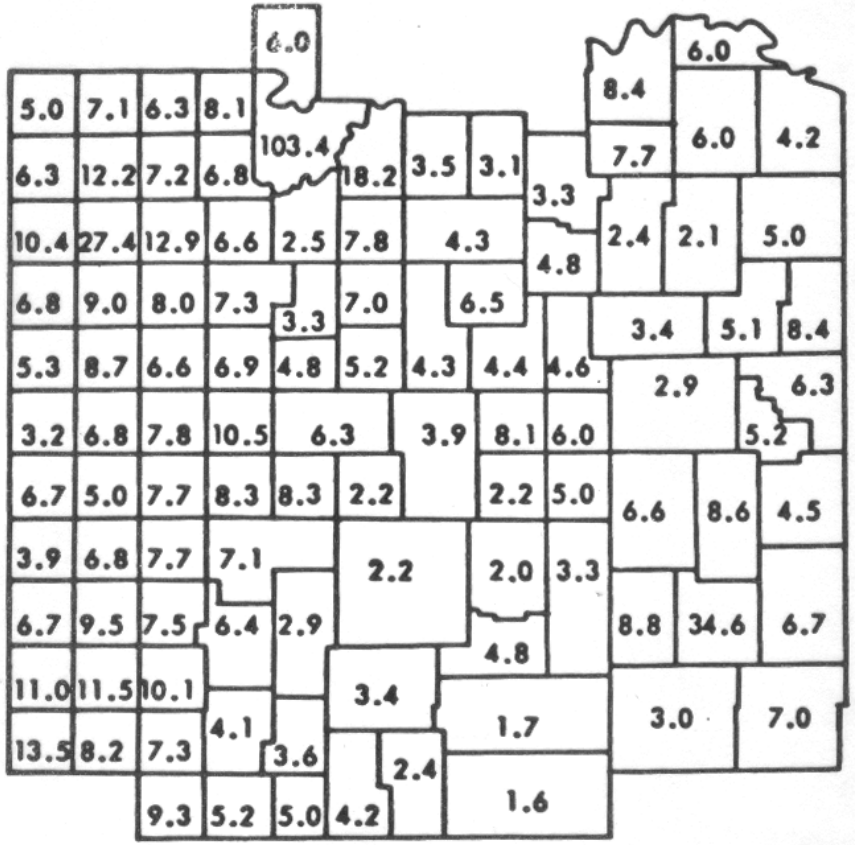
- Demographic
  - Statistics, sampling, enumeration areas

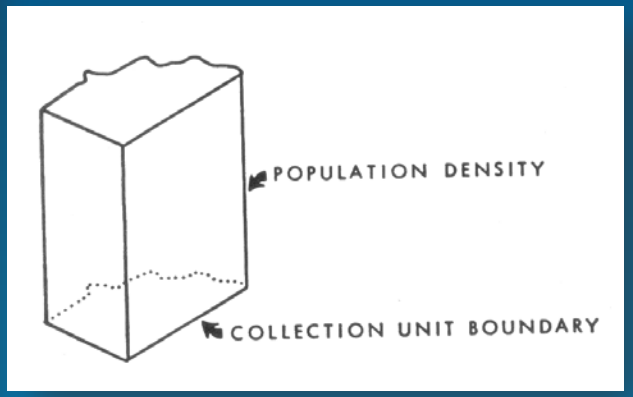
Data

Data

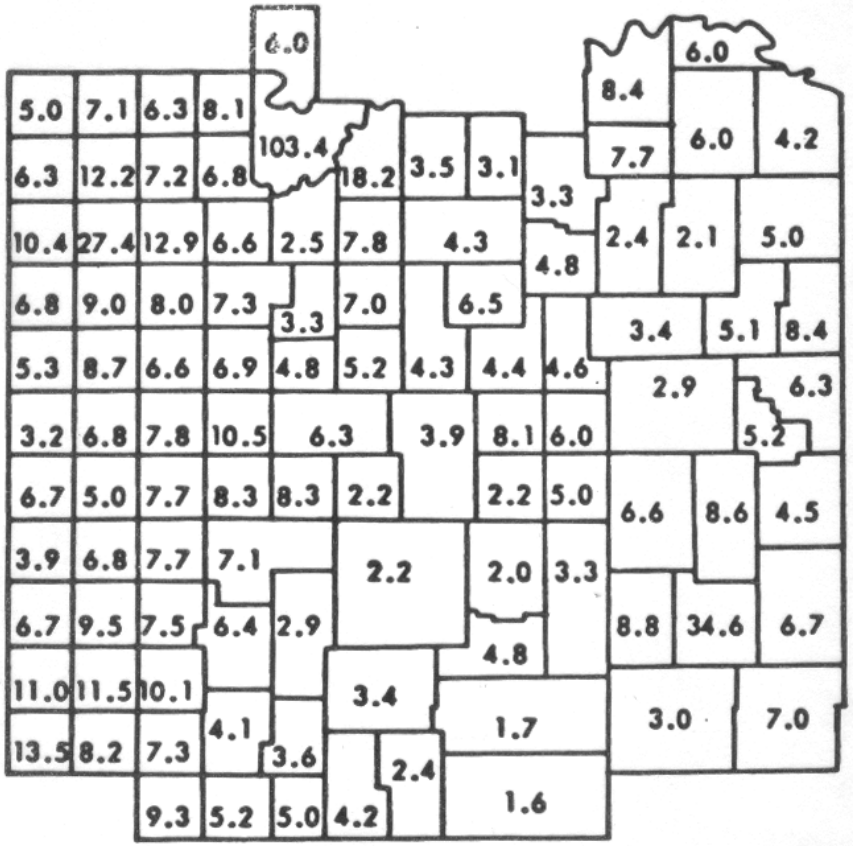
- Characteristics
  - Spatially discrete / continuous
  - Qualitative / quantitative
  - Point, line, polygon, surface, volume
  - Temporal
- Special characteristics
  - Important values (mean, threshold, etc.)
  - Zero values
  - Missing data or unknown values
  - Uncertainty

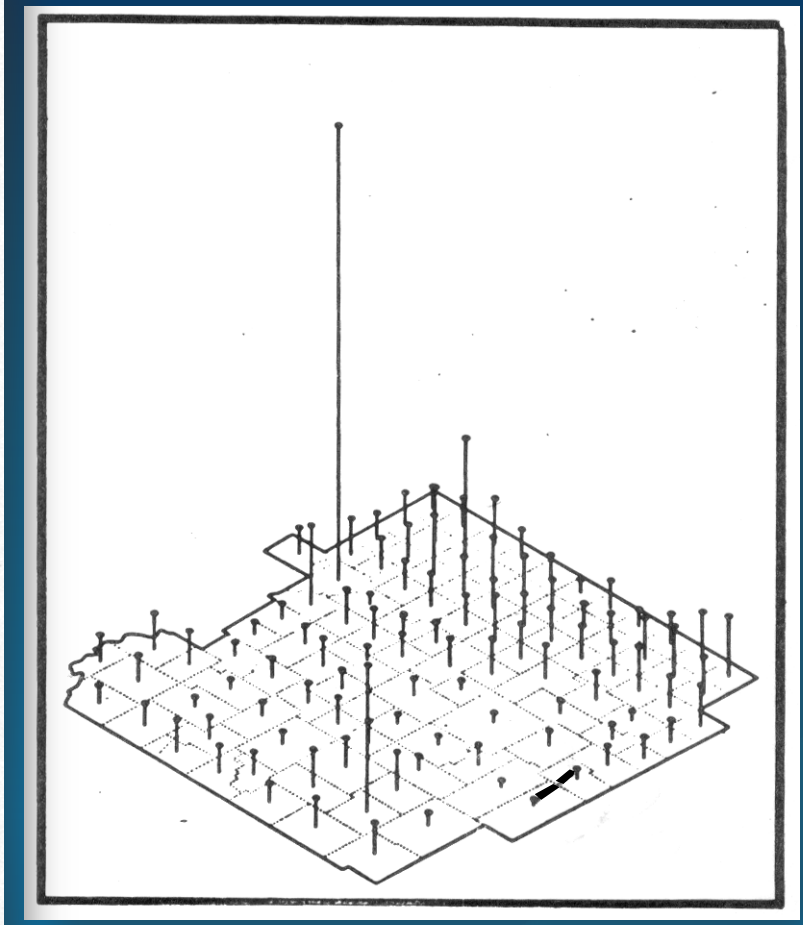
Original Data



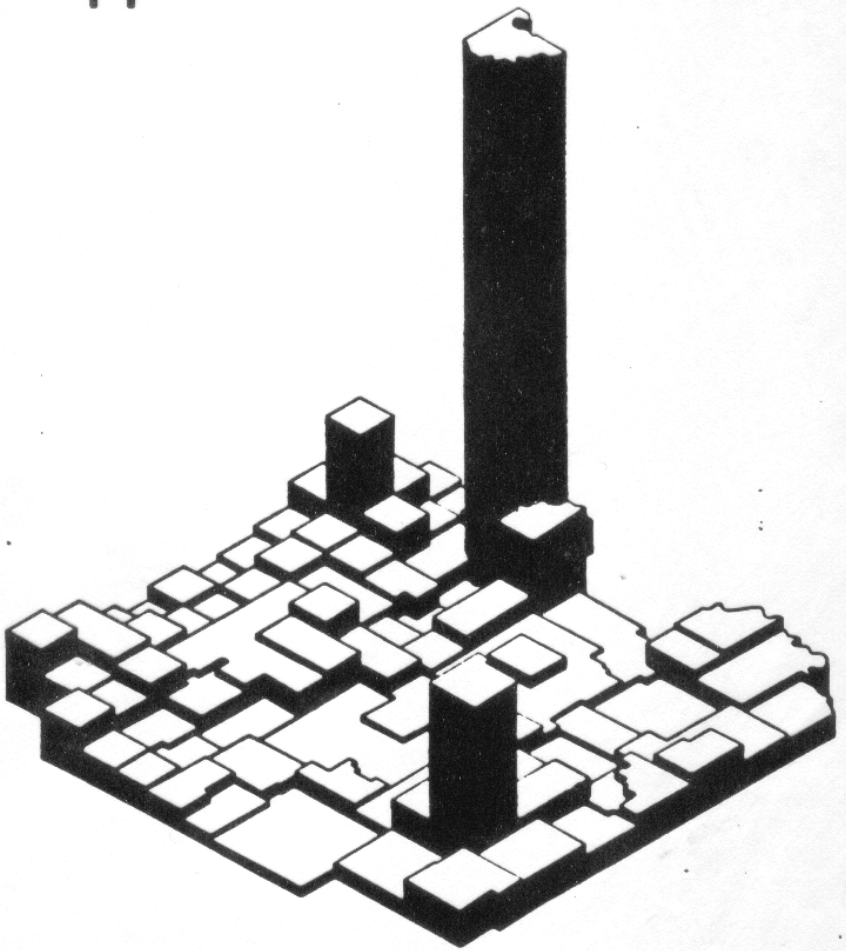


Original Data

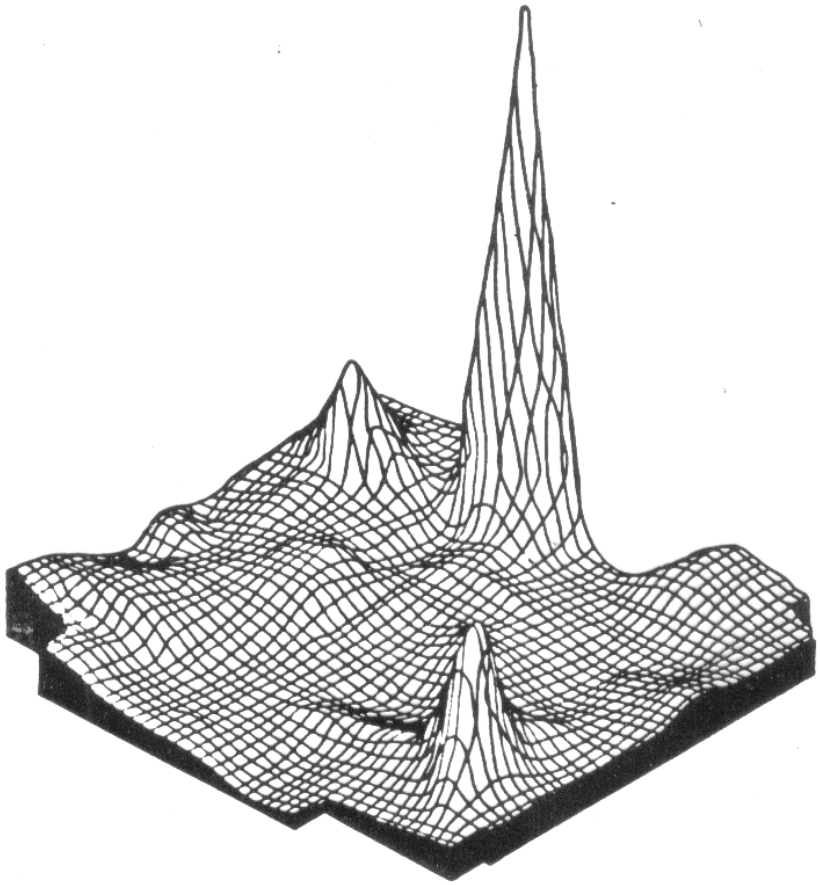


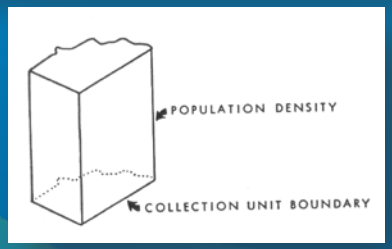


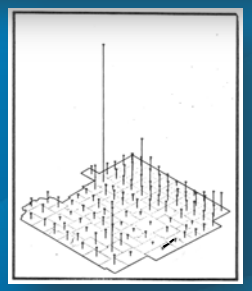
Stepped Statistical Surface



Smoothed Statistical Surface





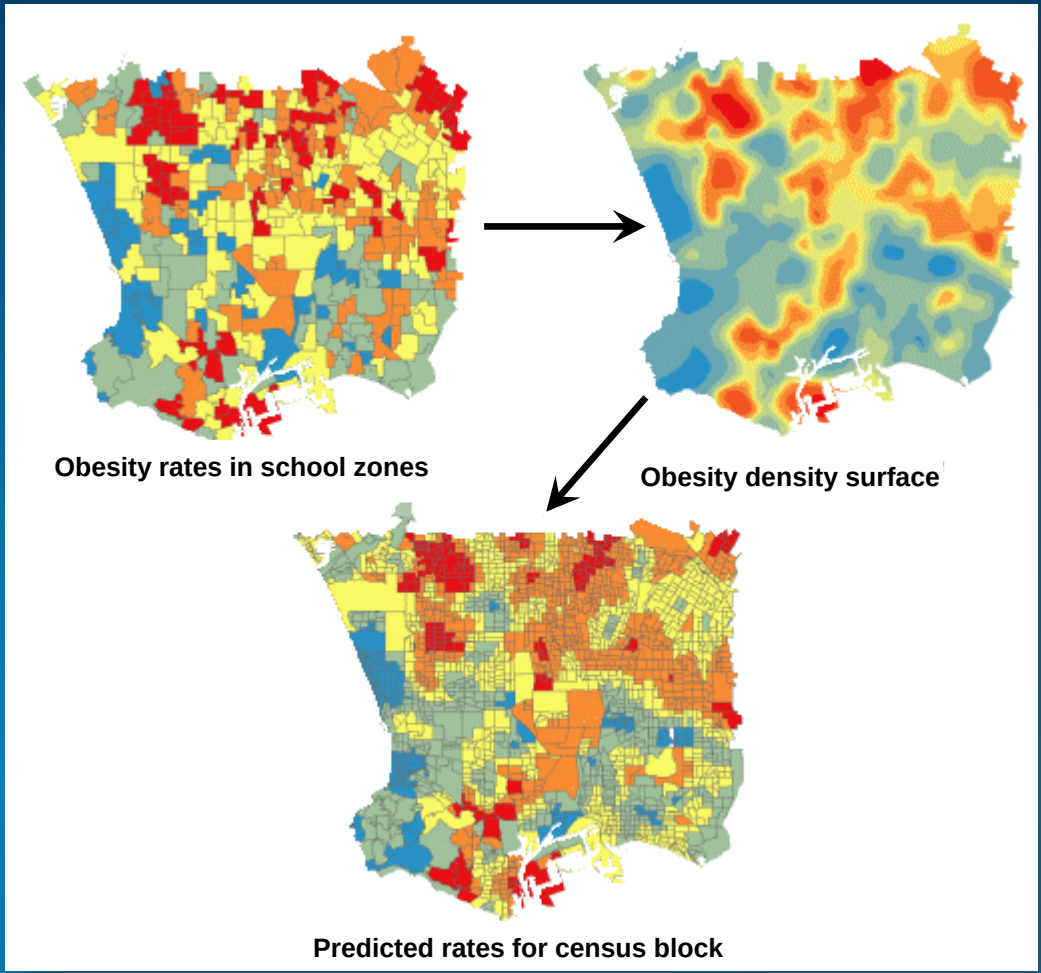


Data

- Characteristics
  - Spatially discrete / continuous
  - Qualitative / quantitative
  - Point, line, polygon, surface, volume
  - Temporal
- Special characteristics
  - Important values (mean, threshold, etc.)
  - Zero values
  - Missing data or unknown values
  - Uncertainty

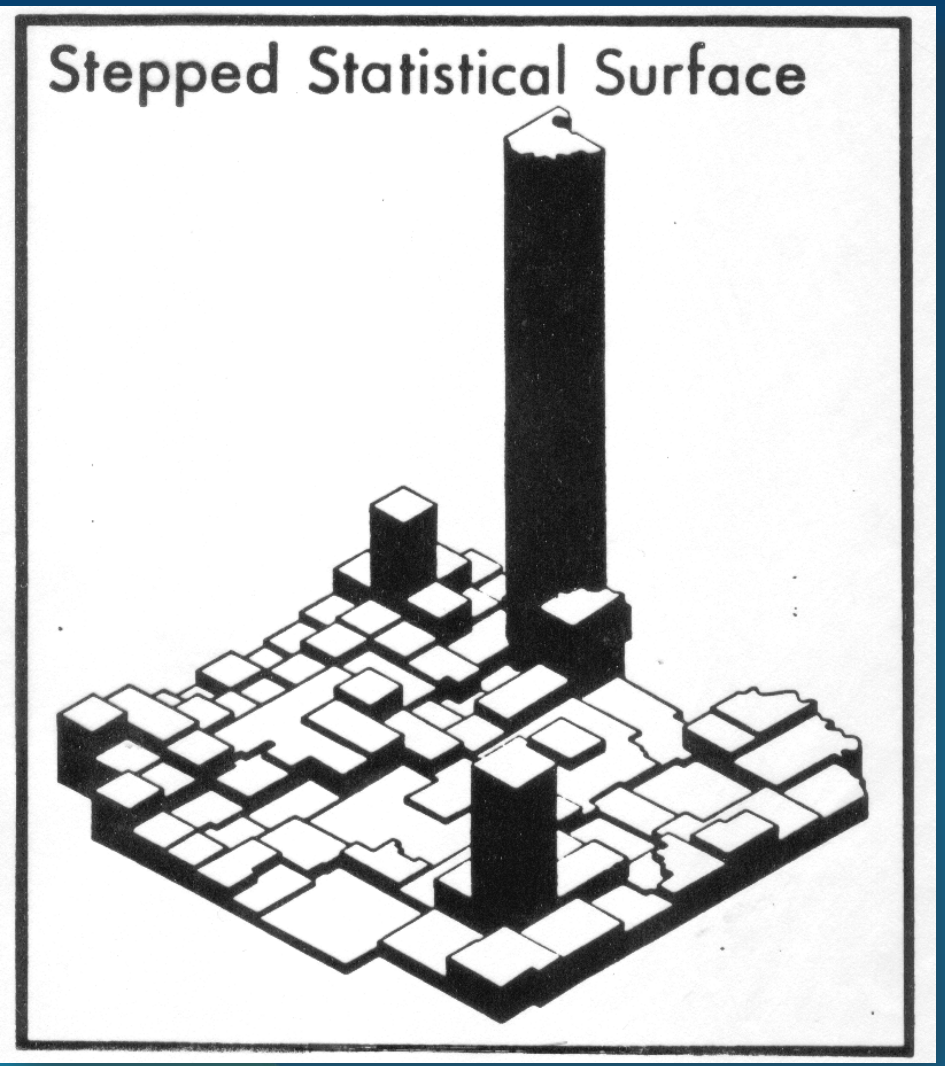
Switching between numeration areas

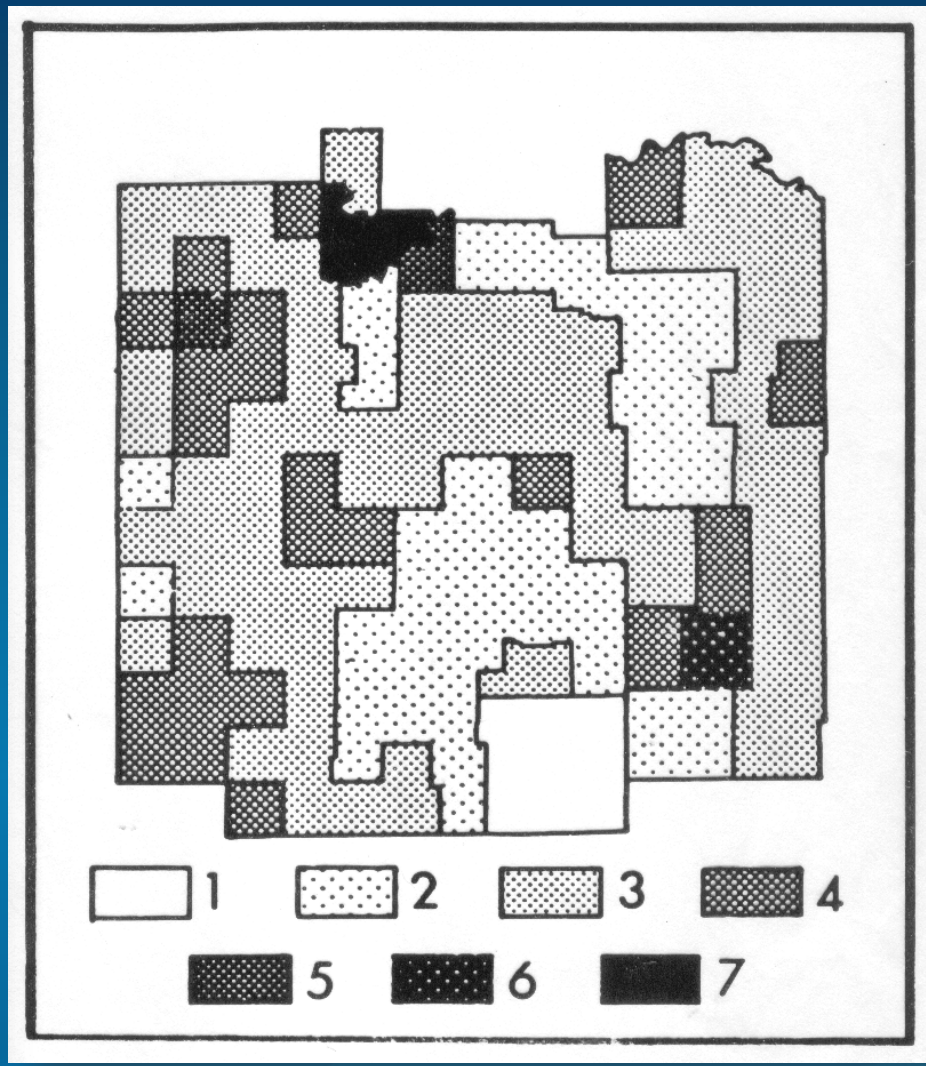
- Areal interpolation
  - Reaggregation of data from one set of polygons to another set of polygons
- A geostatistical interpolation technique that extends kriging theory to data averaged or aggregated over polygons



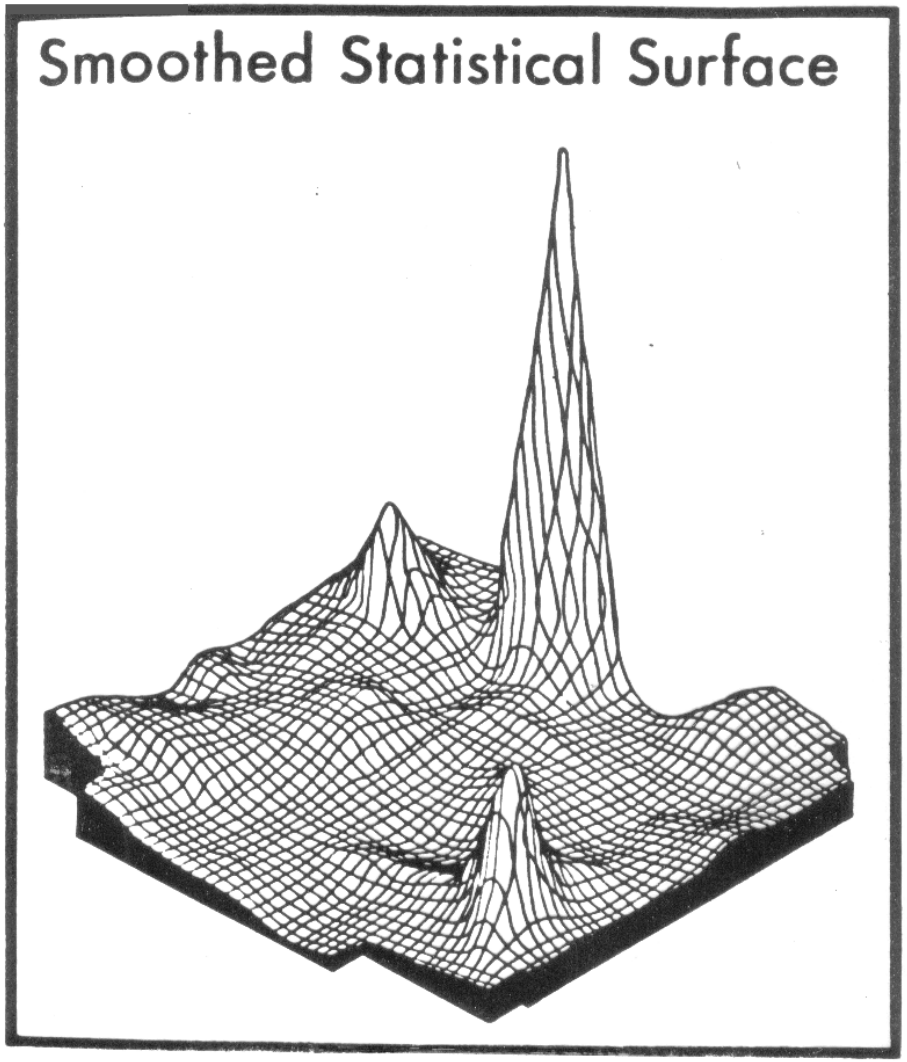
Classing data

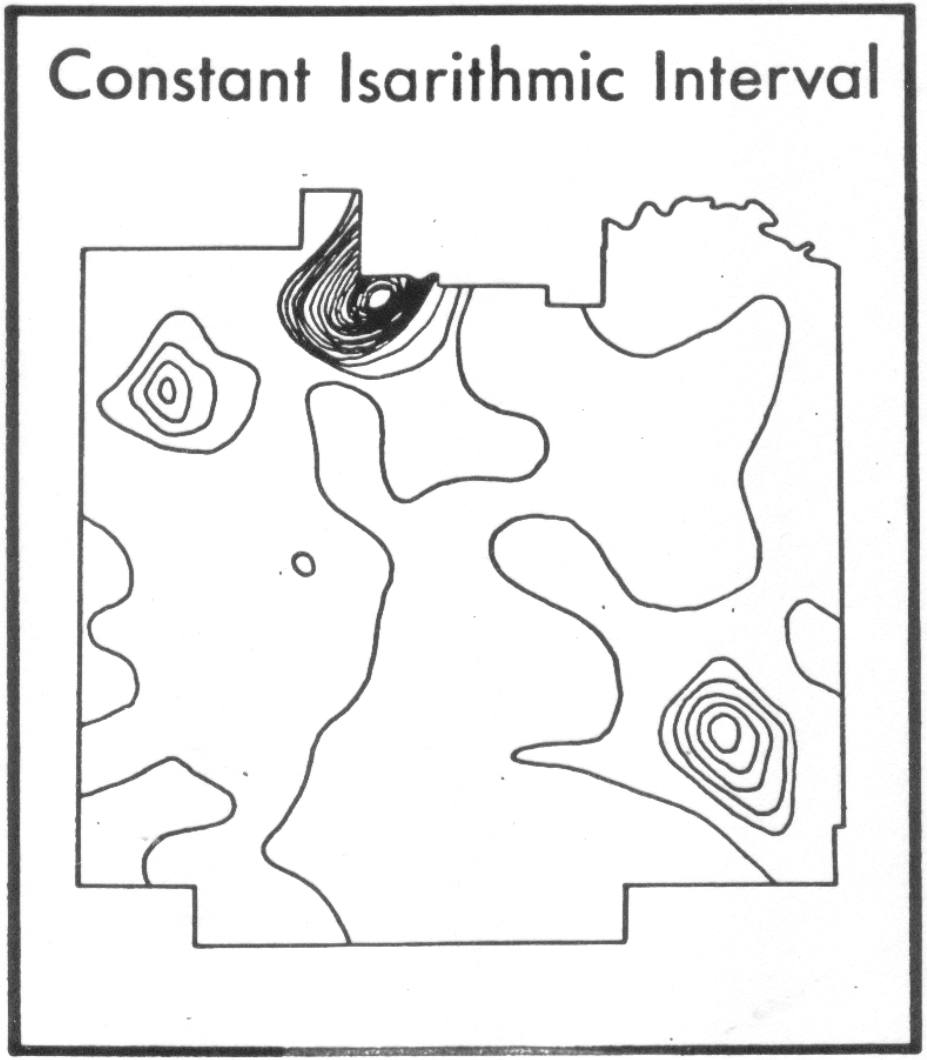
Classing data





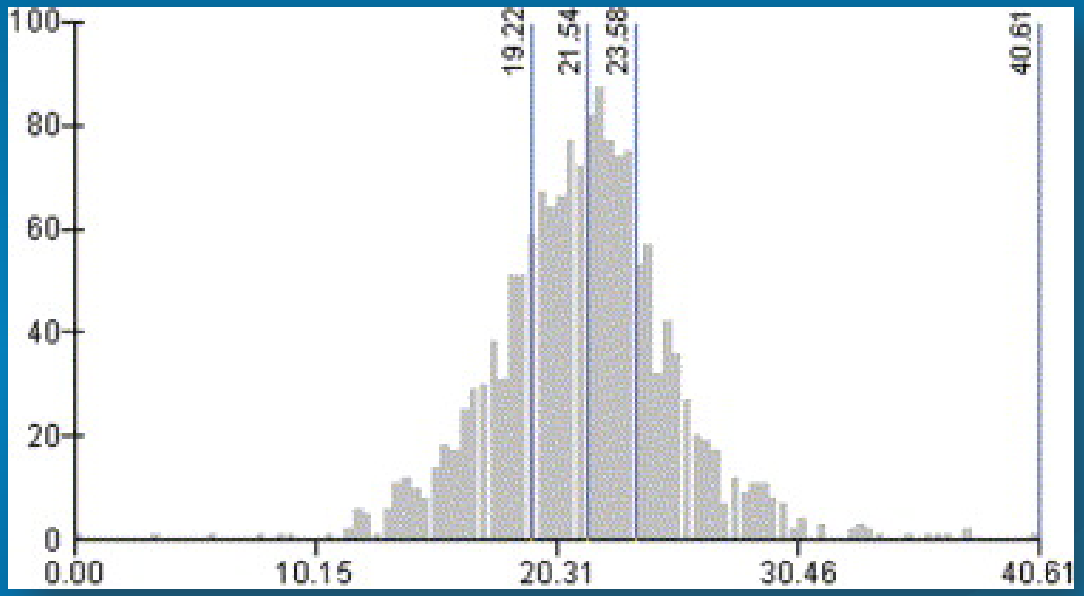
Classing data





Classing data

- Look at the histogram
- Start with a standard classification (usually natural breaks)
- Adjust breaks to improve the map based on knowledge of the data and the audience

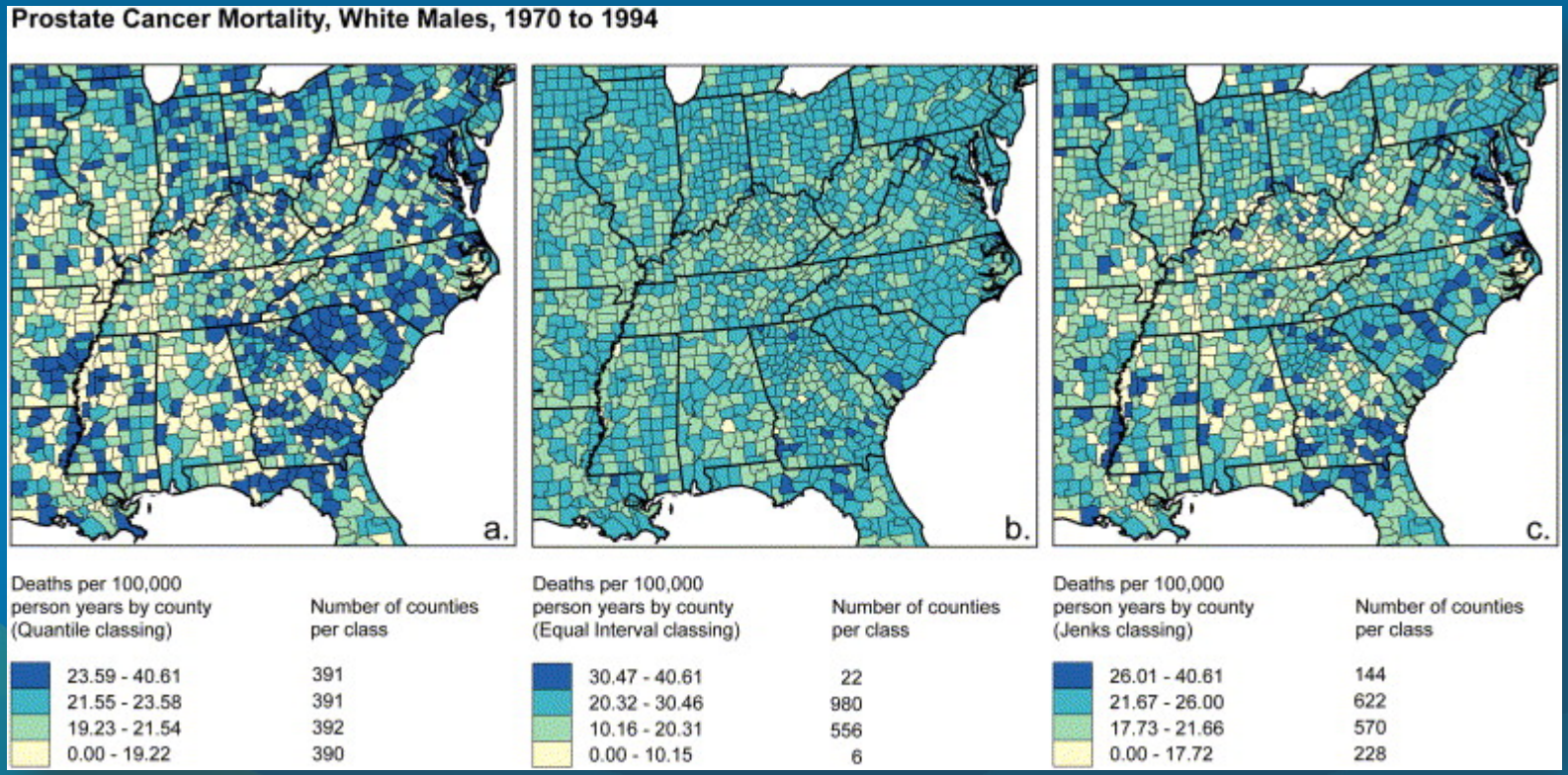


Classification schemes

- **Quantiles** - the same number of enumeration units assigned to each class; variation in calculated values produced by different types of standardization may be usefully seen as ranked values
- **Equal intervals** - breaks the data range into equal segments for predictable and equal class ranges
- **Natural breaks** - minimizes variation within classes and maximize variation between classes; enumeration units that share a color are statistically more similar to each other than to units in other color classes
- **Standard deviations** - shows you how much a feature's attribute value varies from the mean; class breaks are created with equal value ranges that are a proportion of the standard deviation, usually at intervals of 1, ½, ⅓, or ¼ standard deviations

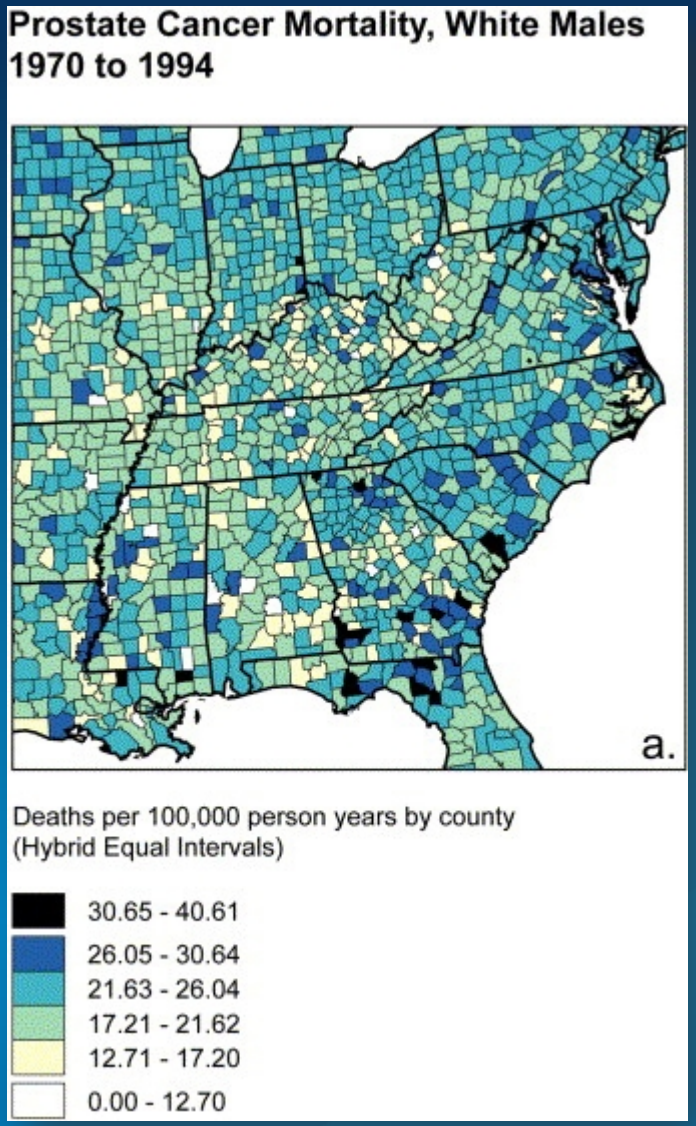
Classification schemes

- Three classifications of the same data set showing different patterns resulting from different classing methods
  - (a) quantile
  - (b) equal interval
  - (c) natural breaks
- The number of counties in each class is shown to the right of each legend



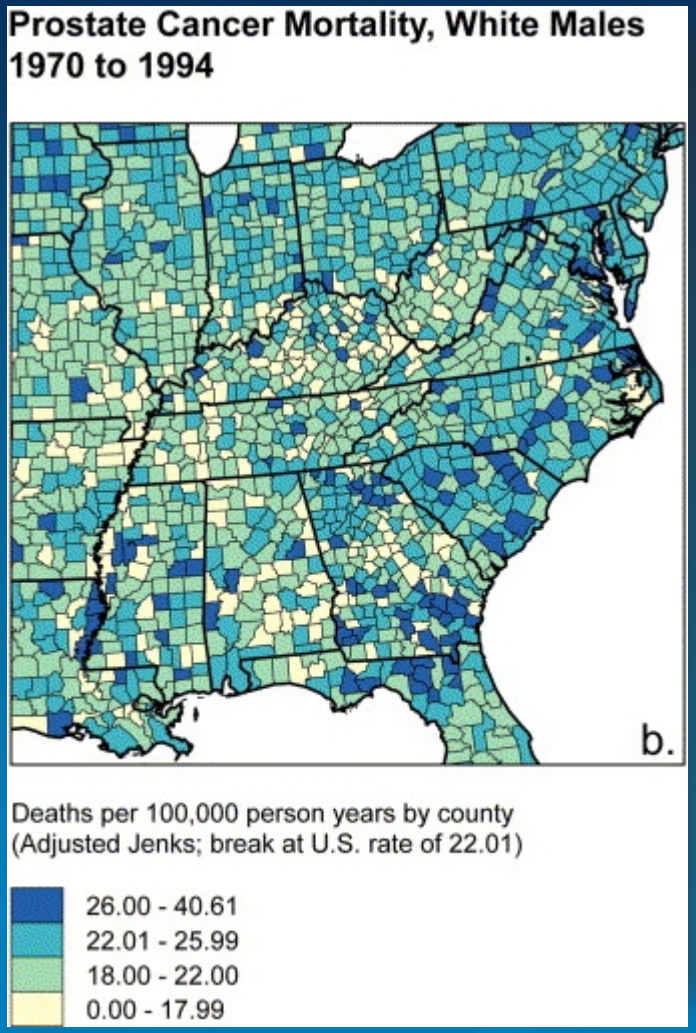
Adjusting classes

- A useful adjustment is to group extreme outliers into their own class and then class the rest of the data range using a standard method
- Ex - High and low extreme values grouped into separate classes with the remaining range classed using equal intervals
- When there are many zero values in a data set, it works well to separate them into their own class and then class the remainder of the data set



Adjusting classes

- Apply natural breaks for good statistical breaks
- Then adjust classes to include the national rate
- Round data values to assist map reading by a general audience

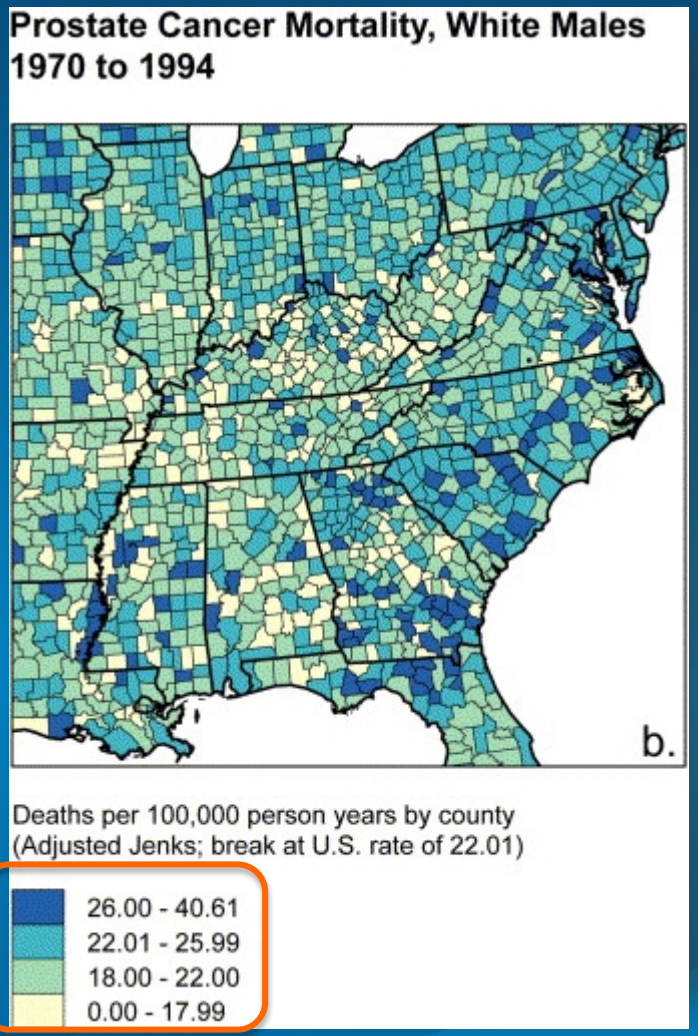


Number of classes

- The more classes used, the less changeable the map pattern will be with different classing methods and adjustments
- There are diminishing returns with increasing numbers of classes, and it becomes difficult to assign colors that readers can tell apart with too many classes
- **Seven classes** is often the most you will want to use on a statistical map with classed values
- An optimal number of classes can be found by examining diminishing reductions in variance with increasing numbers of classes

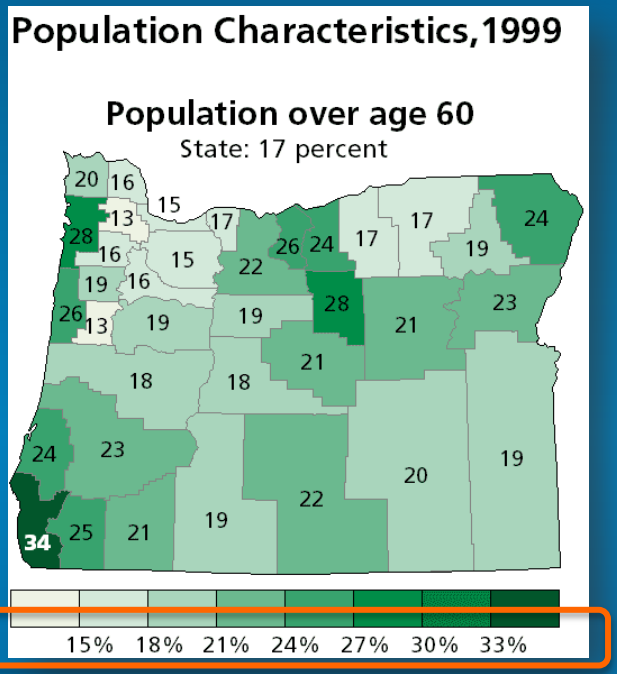
Things to note

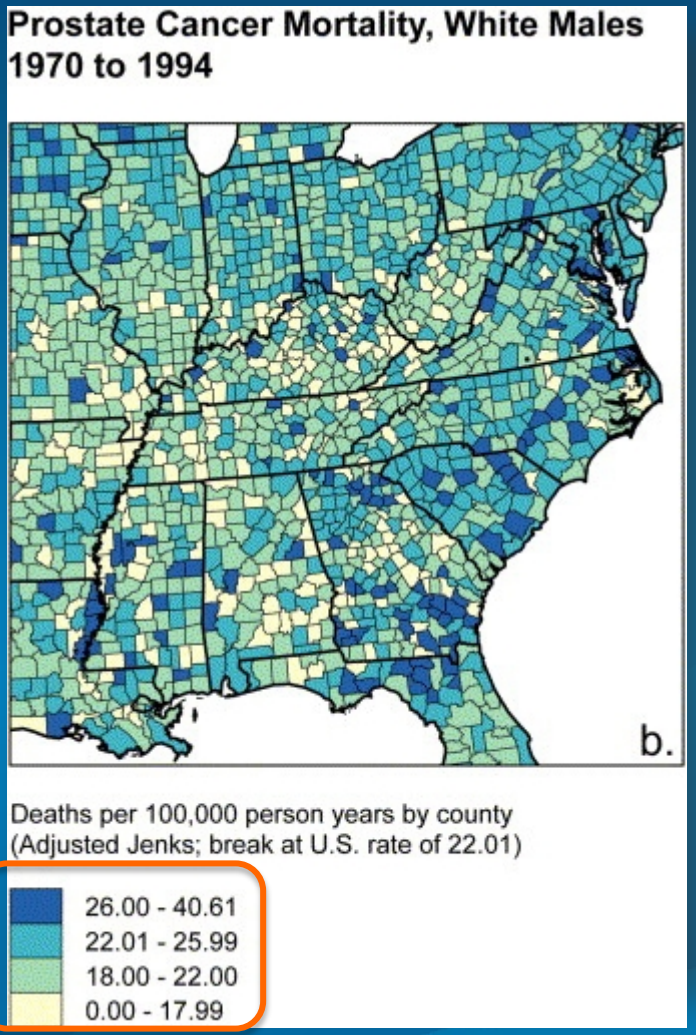
- A value can only belong to one class
  - 1-9, 10-19, 20-29, etc…



Things to note

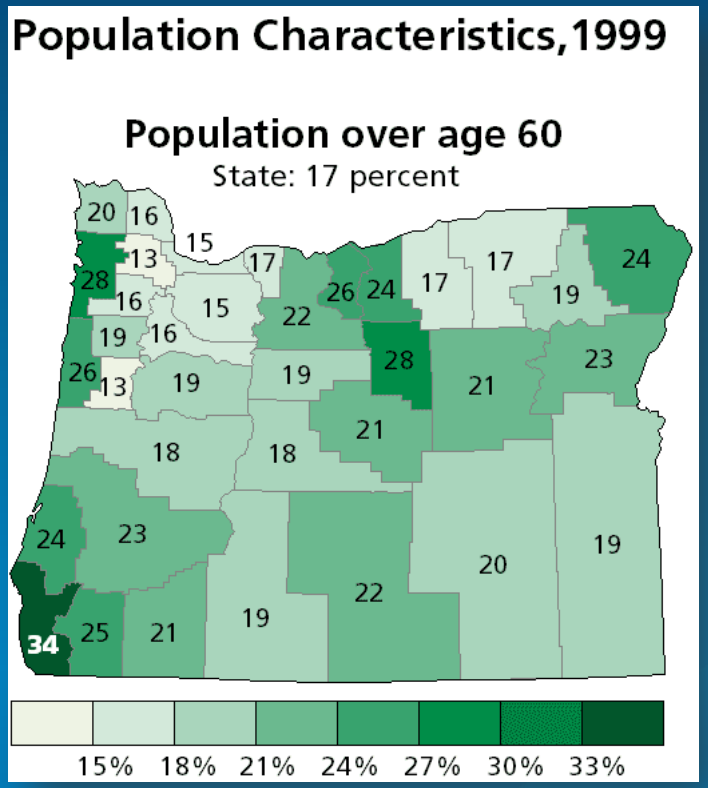
- A value can only belong to one class
  - 1-9, 10-19, 20-29, etc…
  - Label breaks instead



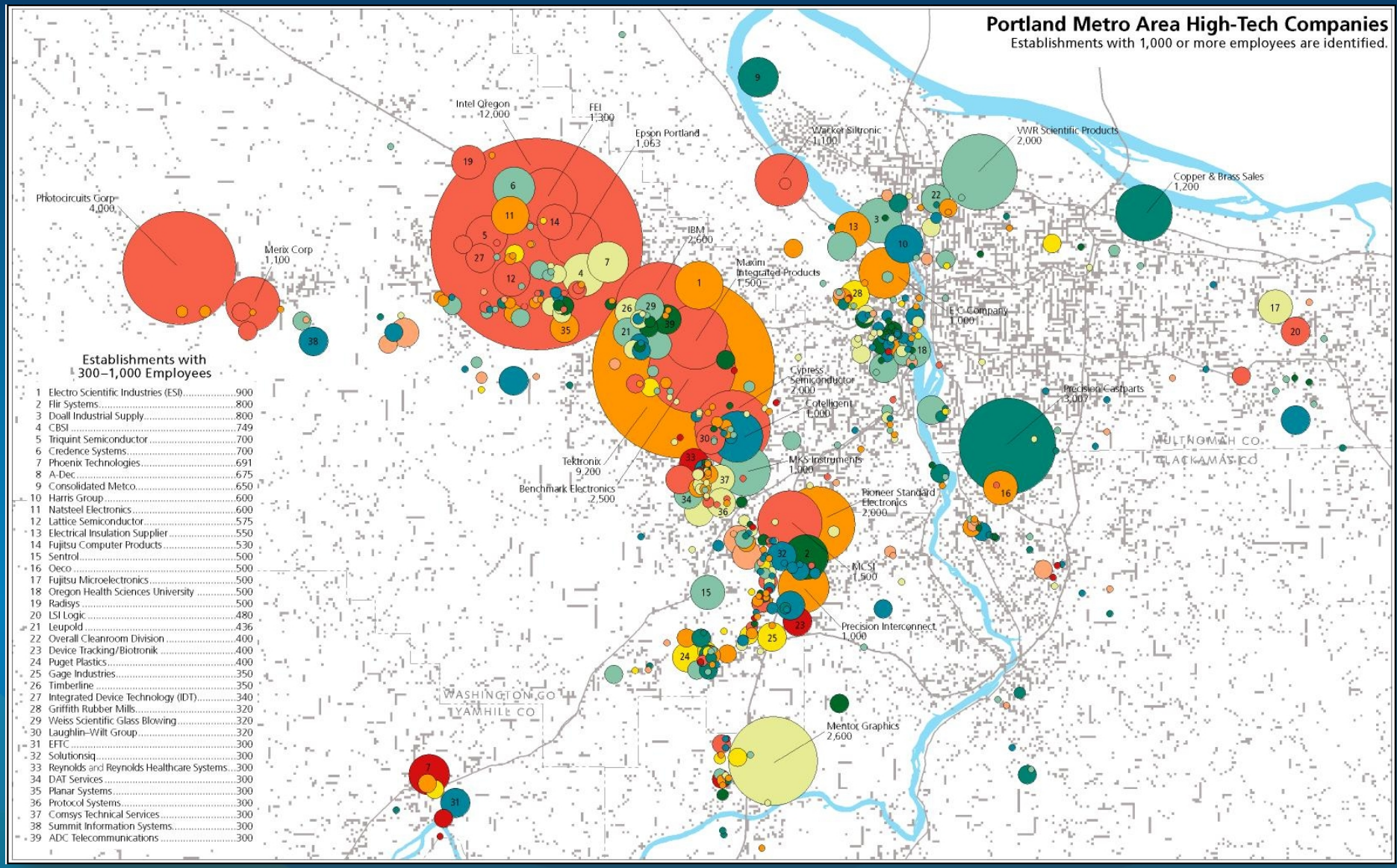


Things to note

- A value can only belong to one class
  - 1-9, 10-19, 20-29, etc…
  - Label breaks instead
- Possibly add labels
  - Adds immediate understanding
  - Could change visual impression

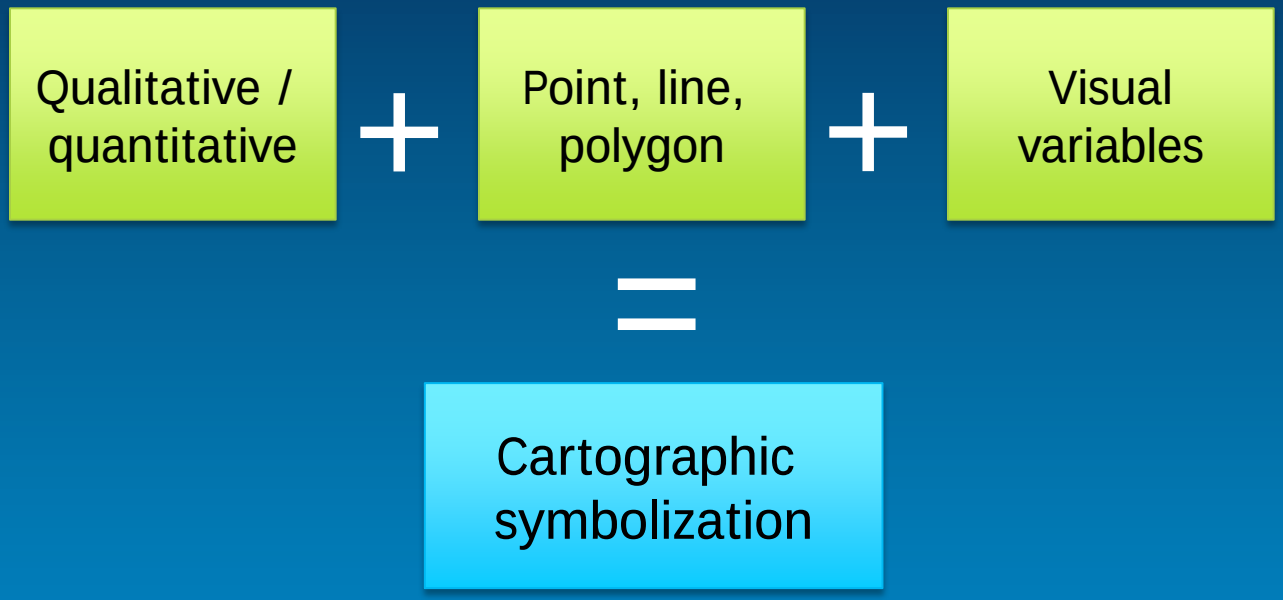


Labeling features with values

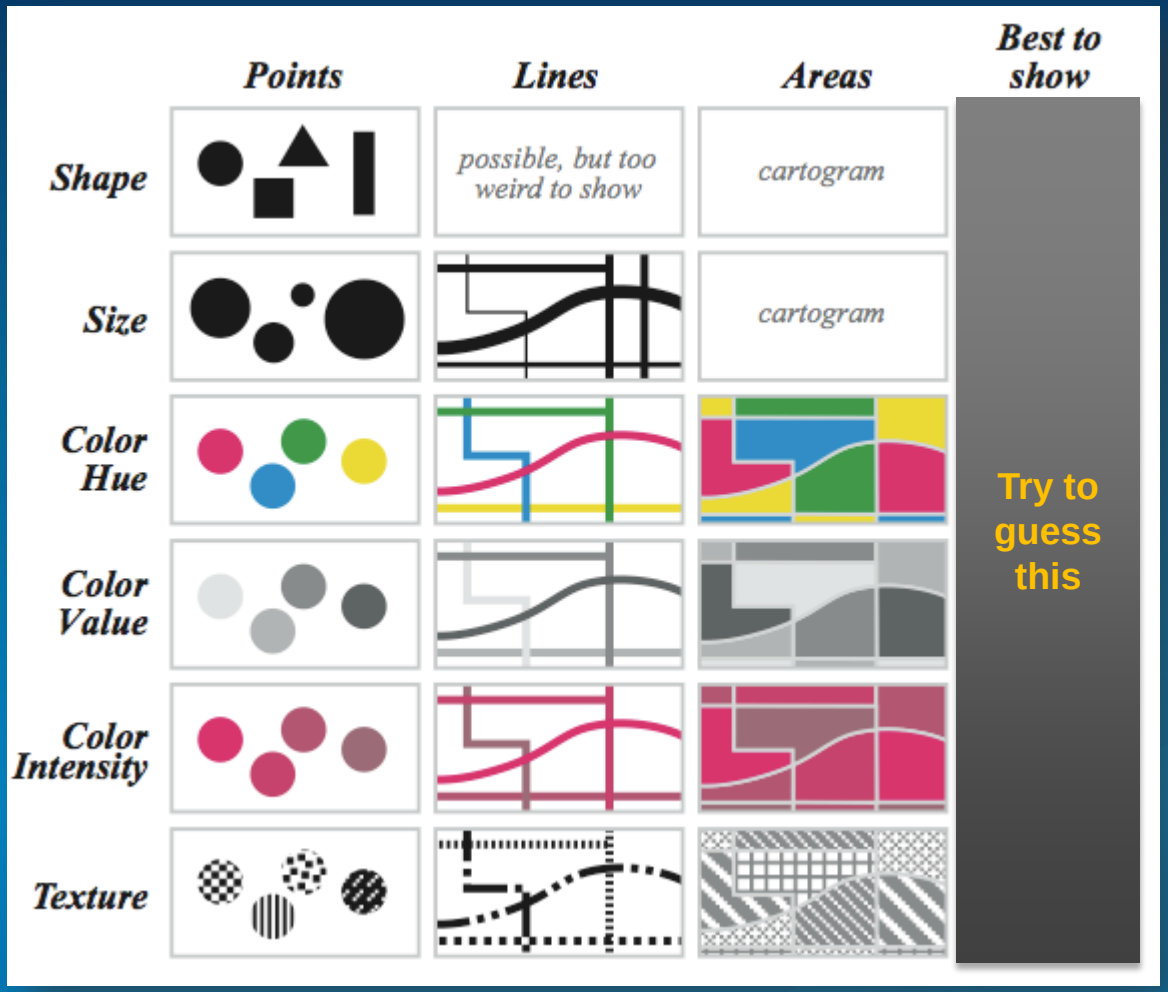


Cartographic symbolization

Cartographic symbolization

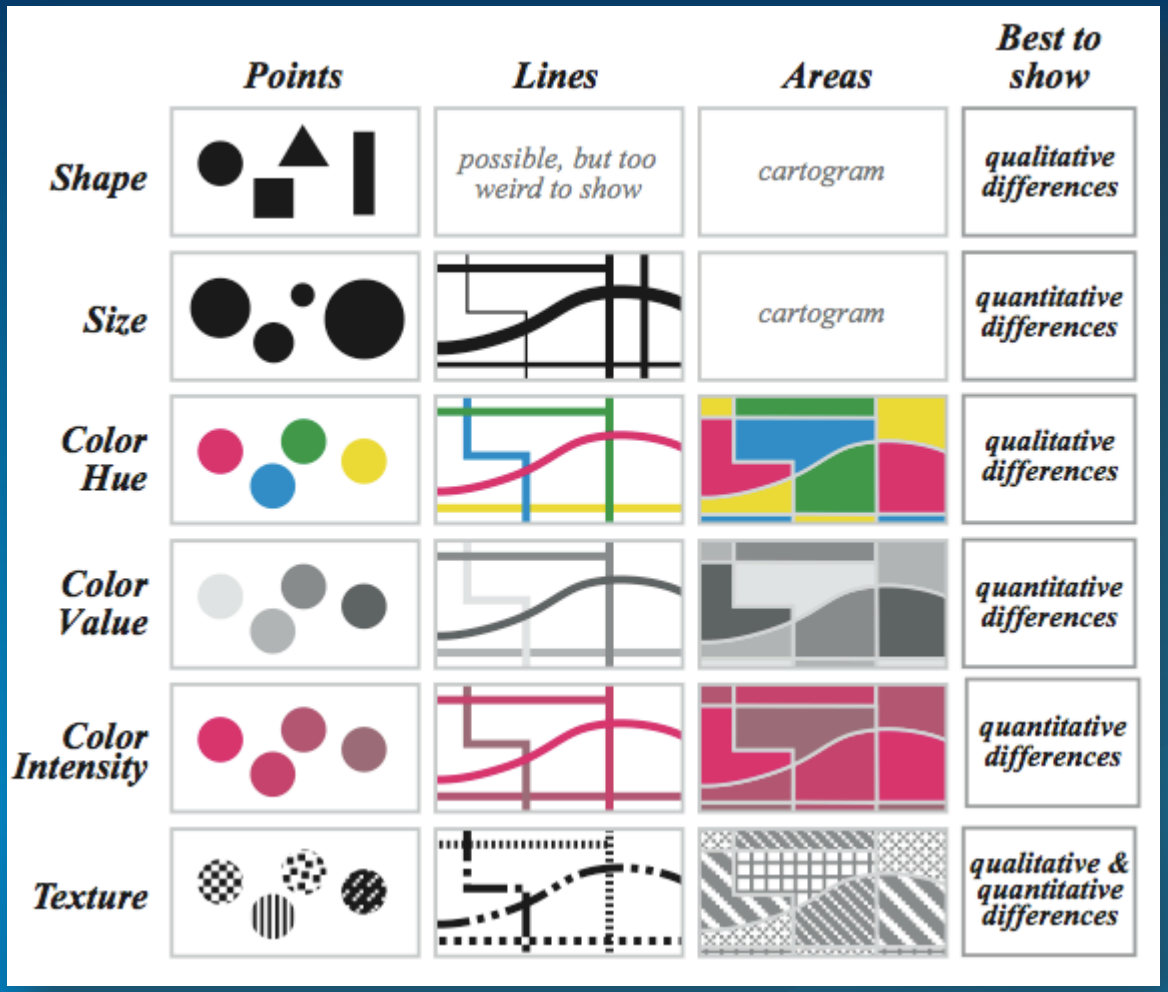


Visual variables



Visual variables

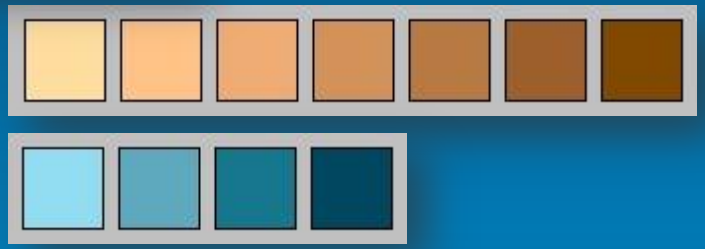
- **Qualitative**
  - Shape
  - Color hue
- **Quantitative**
  - Size
  - Color value
  - Color intensity
  - Texture



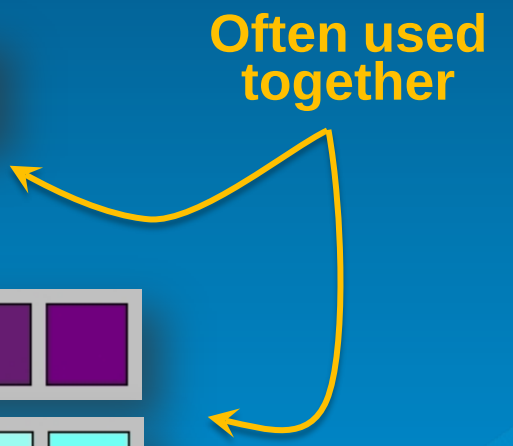
Color variables

- Hue

- Value / lightness

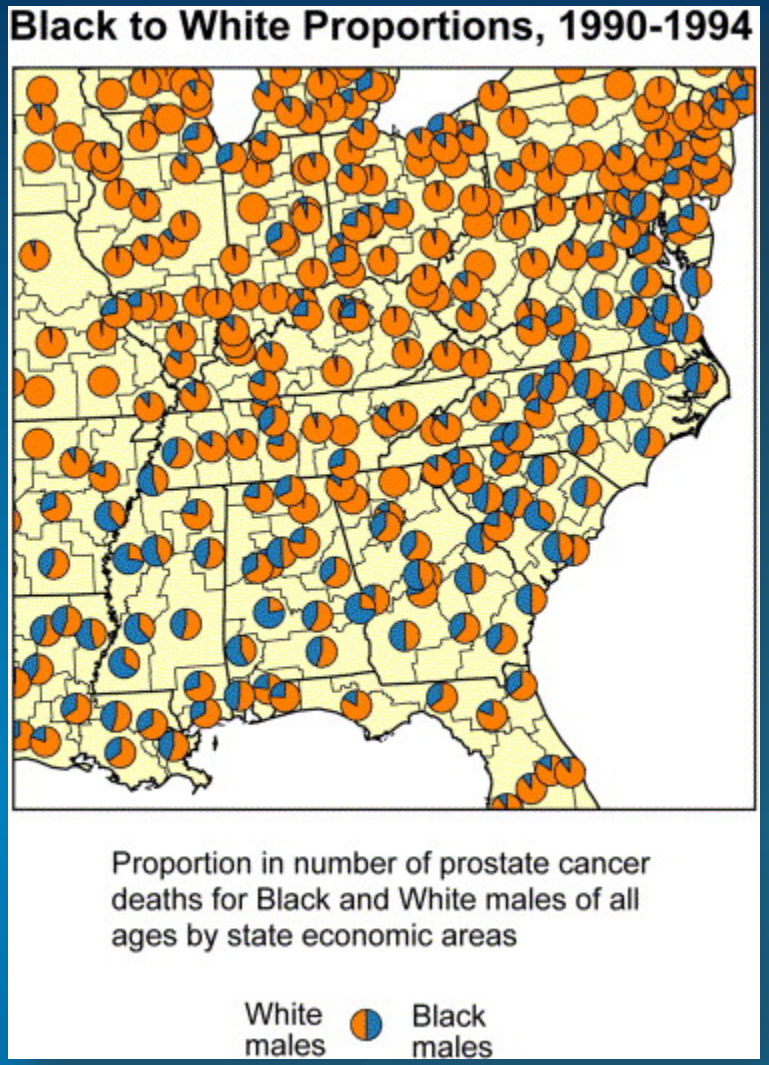


- Intensity / saturation / chroma



Qualitative data

- Color hue symbolizes categorical difference in counts for two race groups
- Pie chart symbols are scaled to a constant size and show relative proportions of mortality for two populations: black and white males

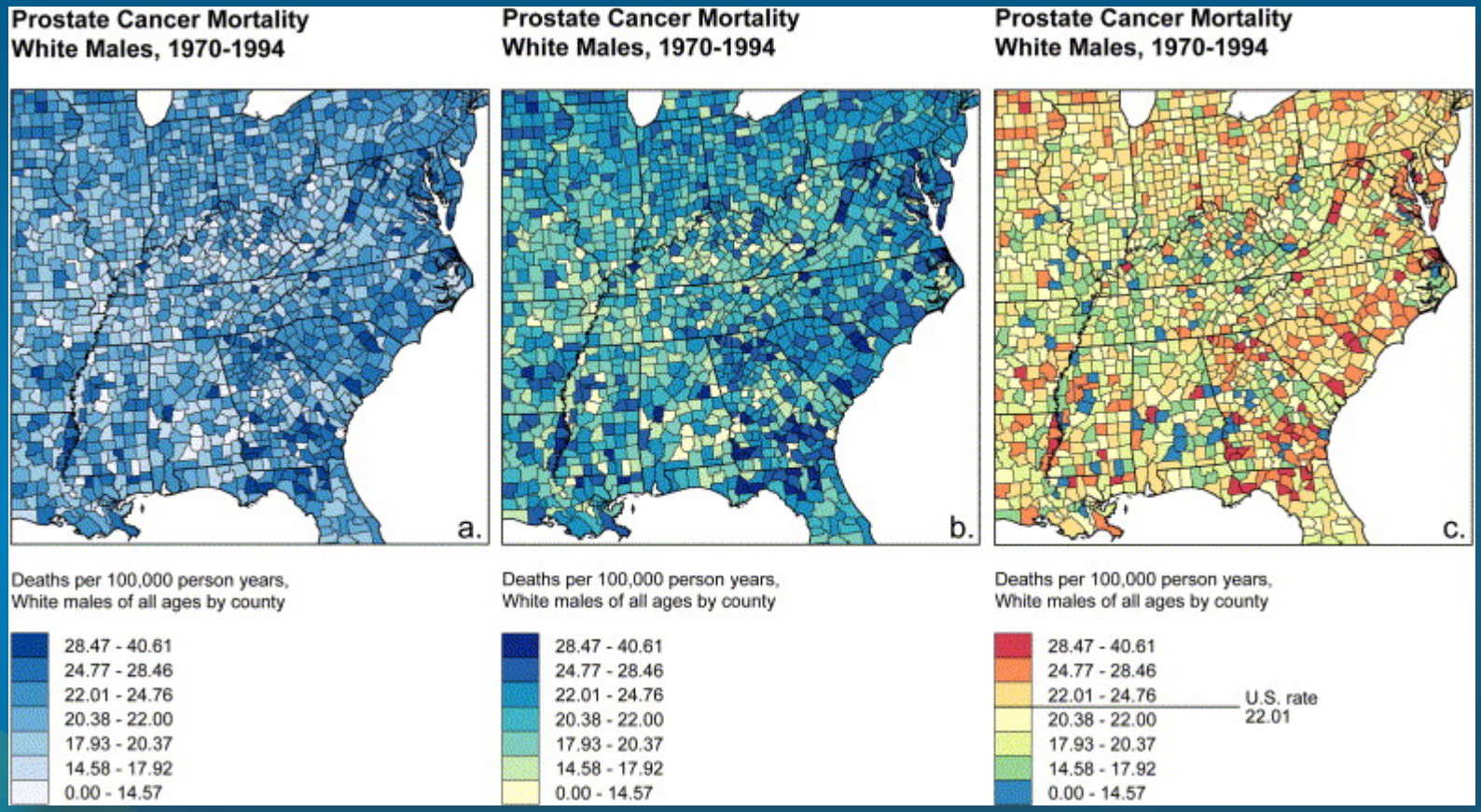


Color schemes

a. **Sequential**, single hue scheme (blue)

b. **Sequential** scheme with hue transition (yellow-green-blue)

c. Spectral scheme used as a **diverging** scheme with the lightest colors marking the overall U.S. rate (blue-green-yellow-orange-red)

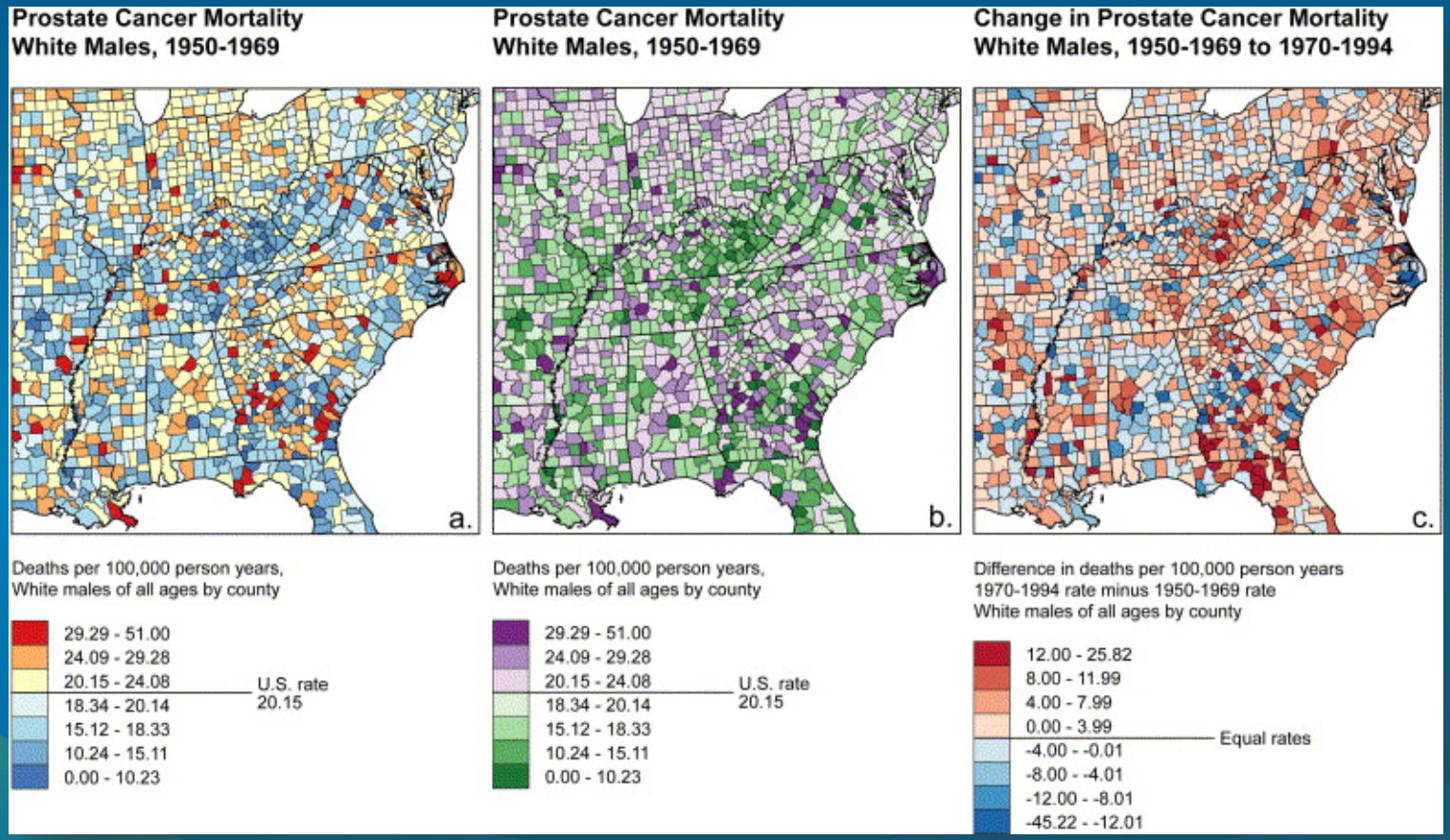


Diverging color schemes

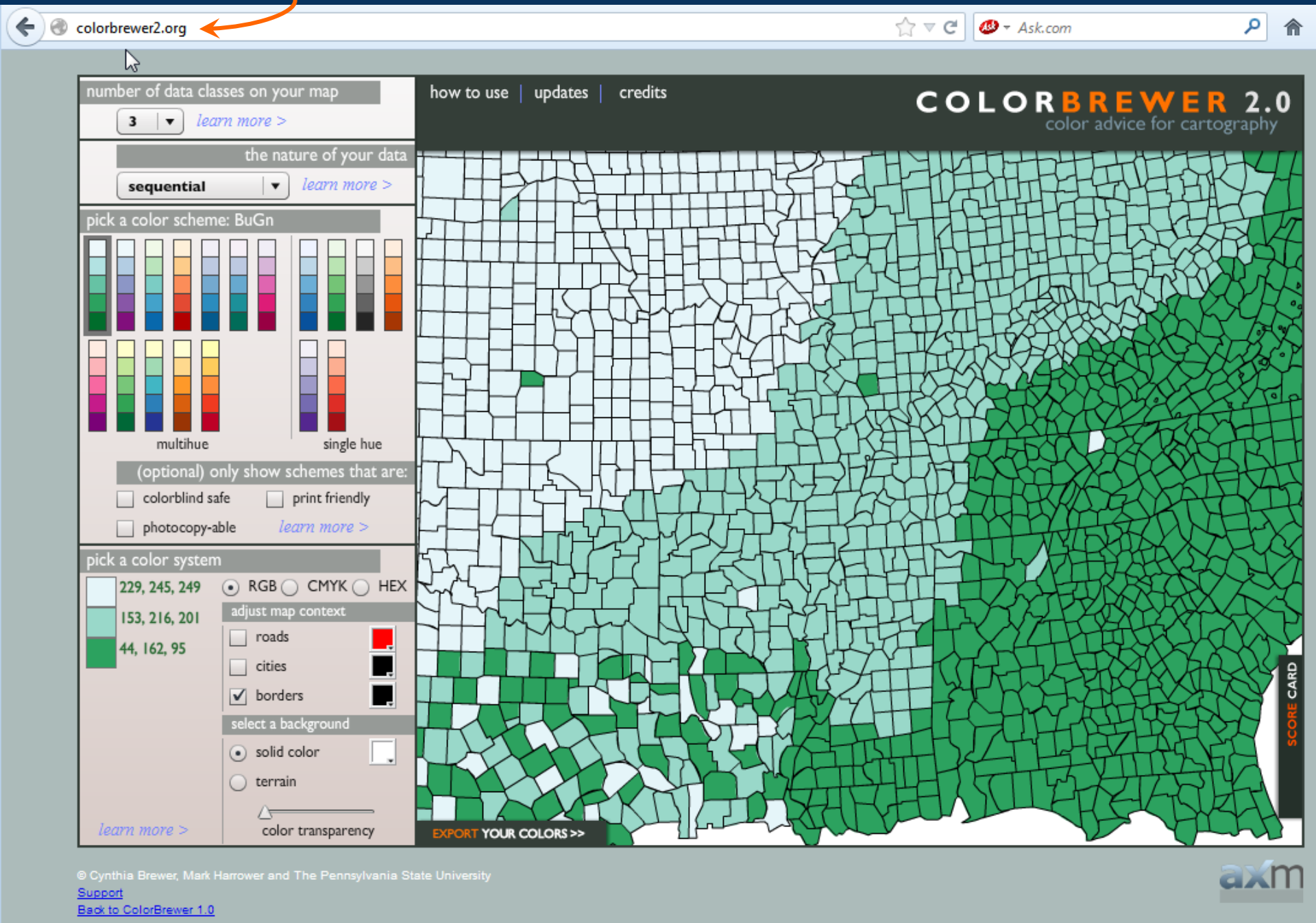
a. Spectral scheme modified to accommodate color blind map readers by skipping green hues (using blue and red)

b. Two hues (green and purple) diverging from a central light class at the U.S. rate

c. Change in rates between two time periods with diverging reds (increasing rates) and blues (decreasing)

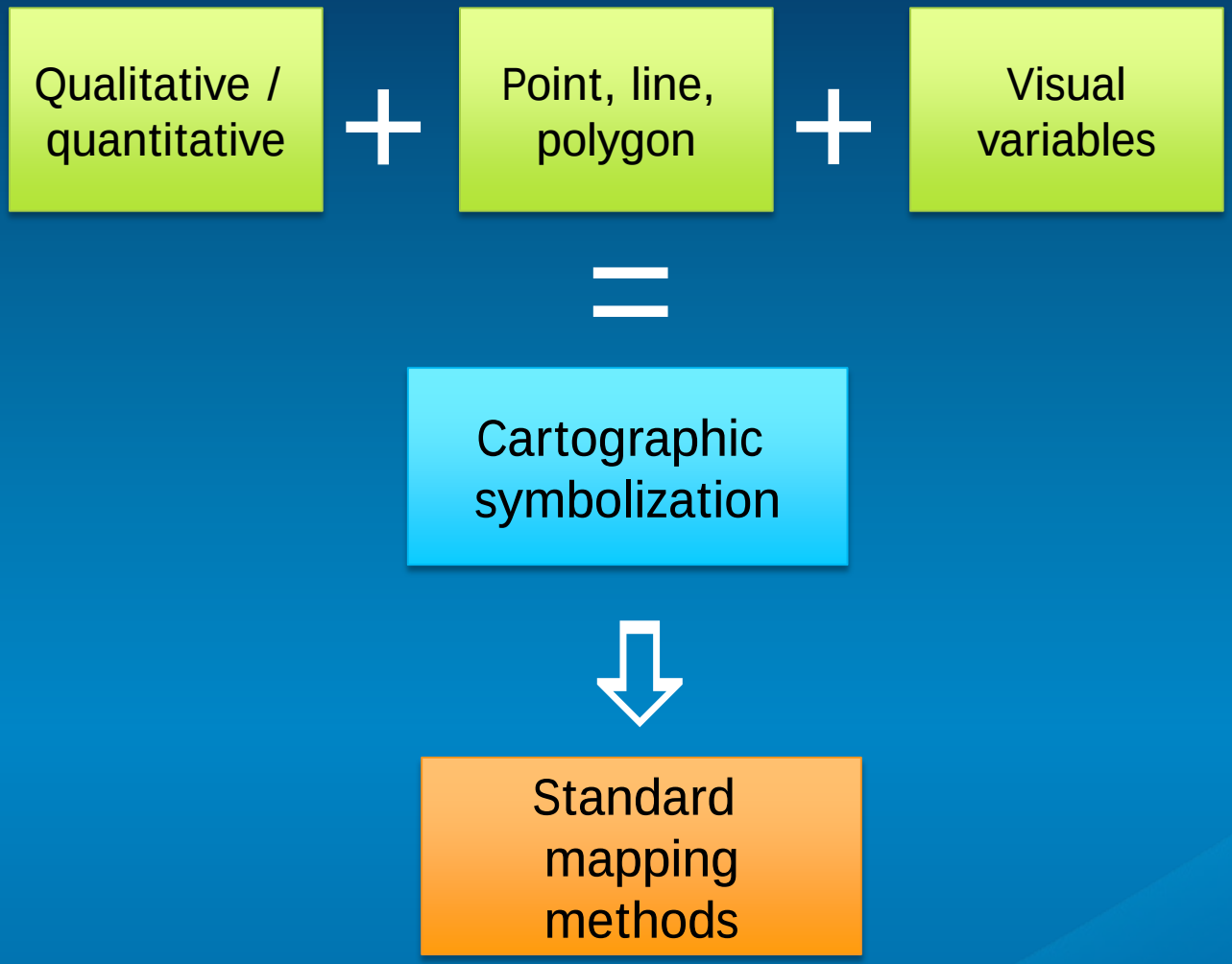


Colorbrewer.org



Mapping methods

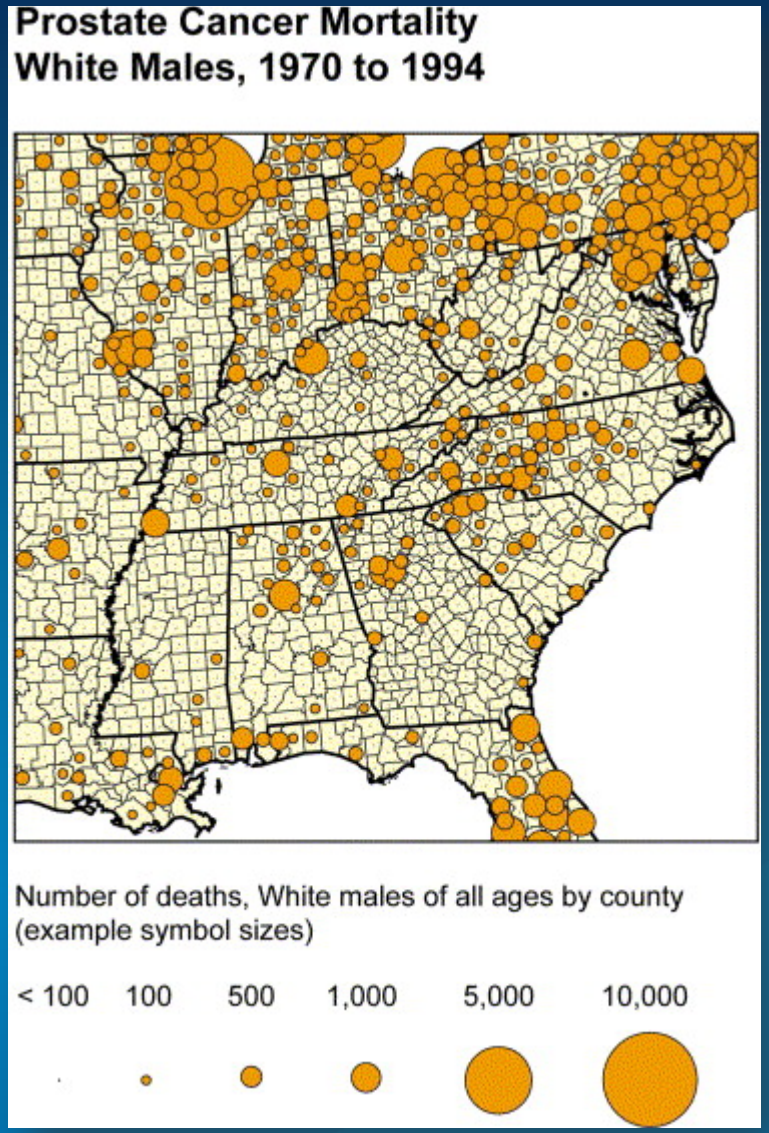
Mapping methods



Proportional symbols

- Point + size

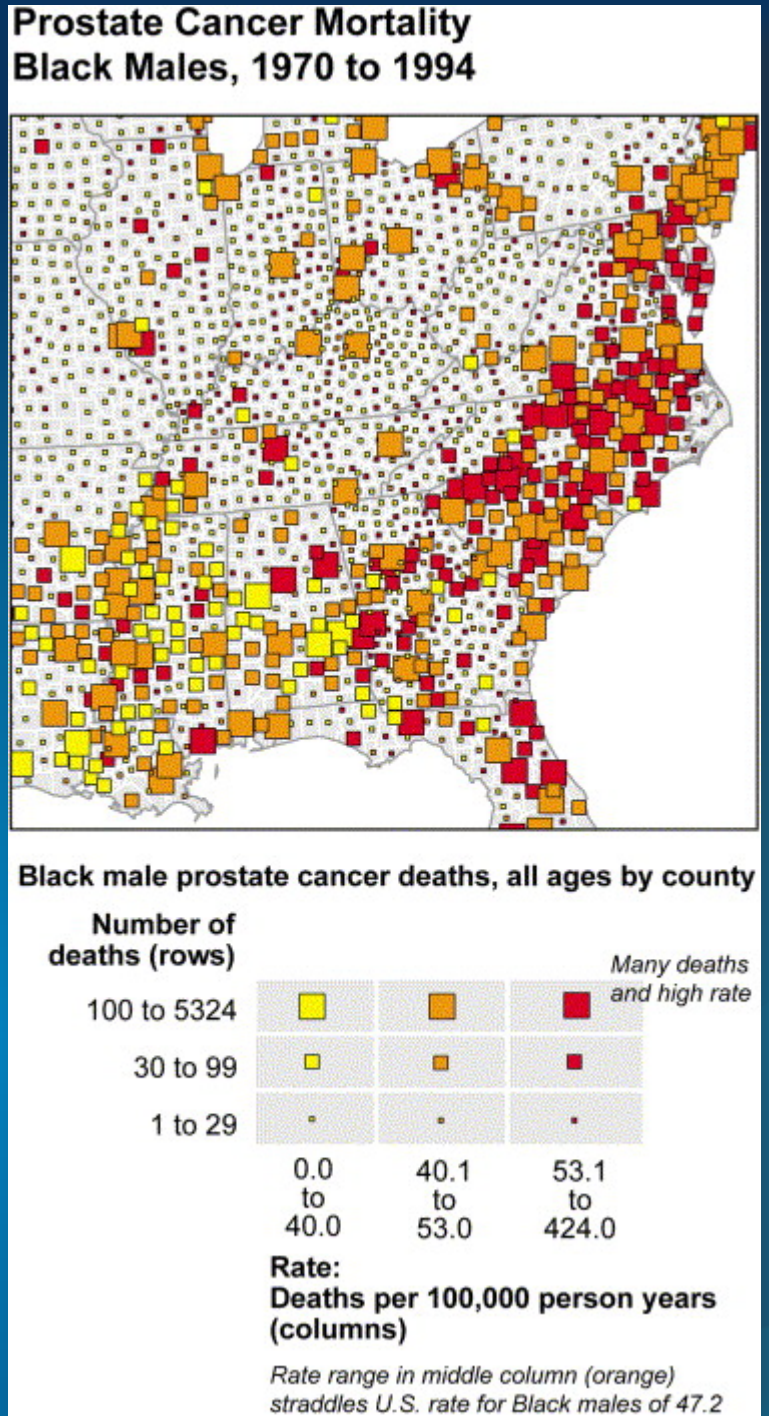
- Each map symbol is scaled to an individual county value
- Legend shows example symbol sizes and data values they represent



Graduated symbols

- Point + size

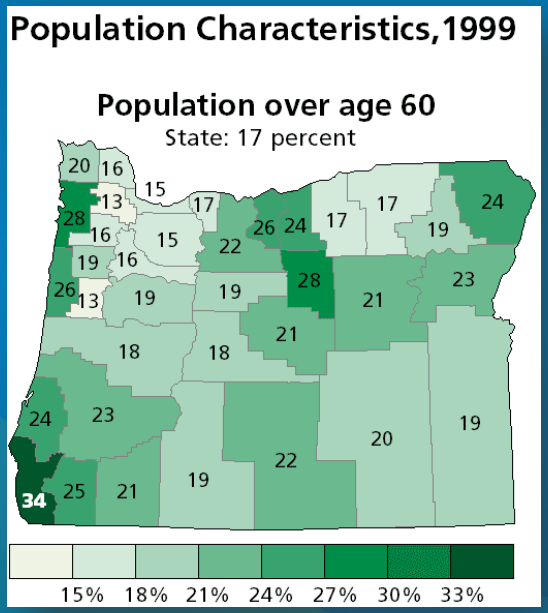
- Each map symbol is grouped into a class
- Legend shows symbol sizes and data values they represent
- On this map, size is used for the count variable (rows; larger symbols for more deaths)
- We'll talk about how this map is also bivariate in a minute

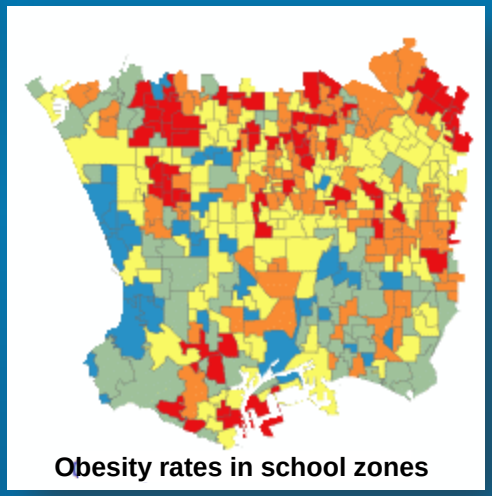


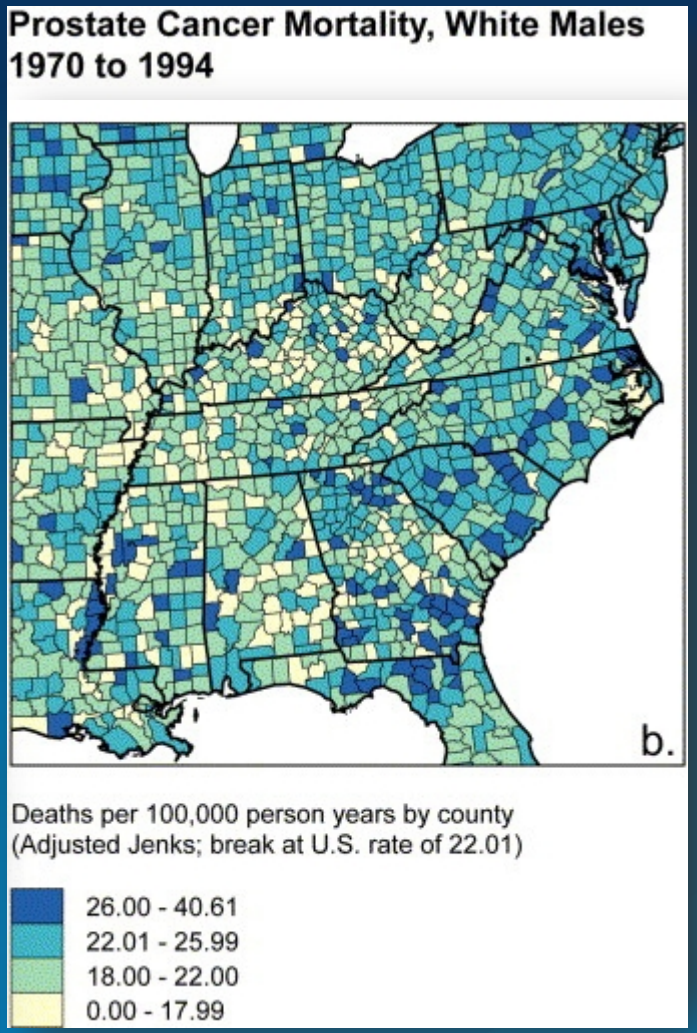
Choropleth

- Area + lightness

- Choro = area + pleth = value
- Because the method assumes homogeneity within areas, you **must** normalize the data

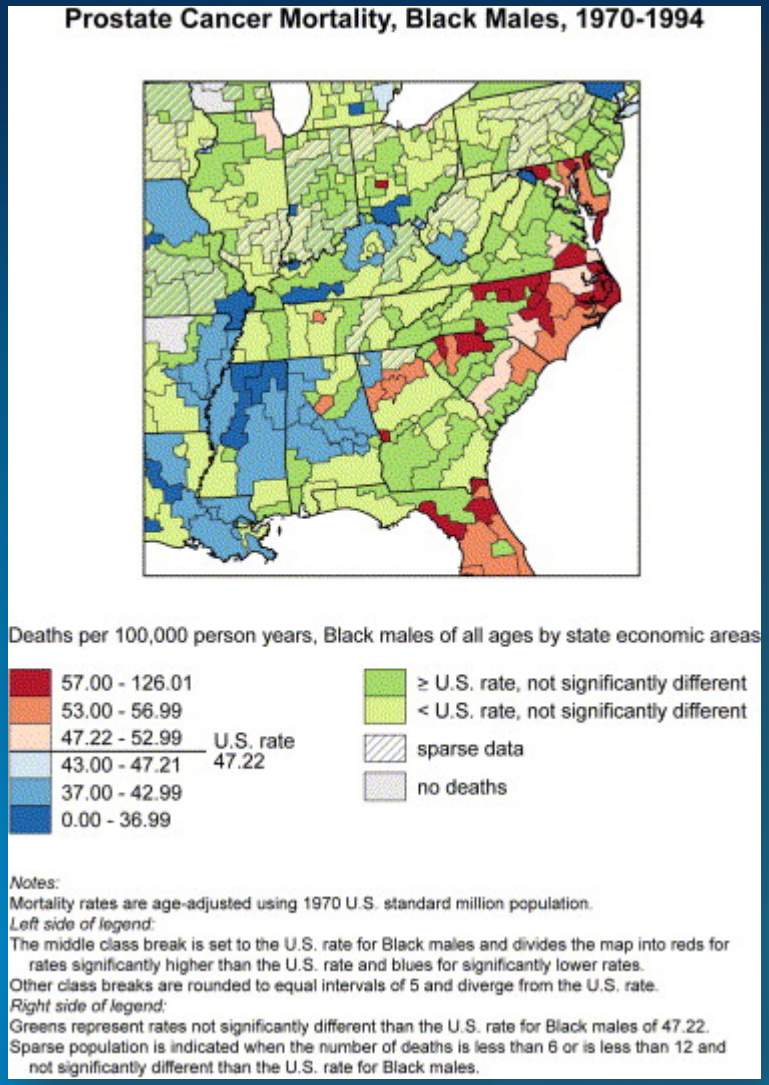



Obesity rates in school zones



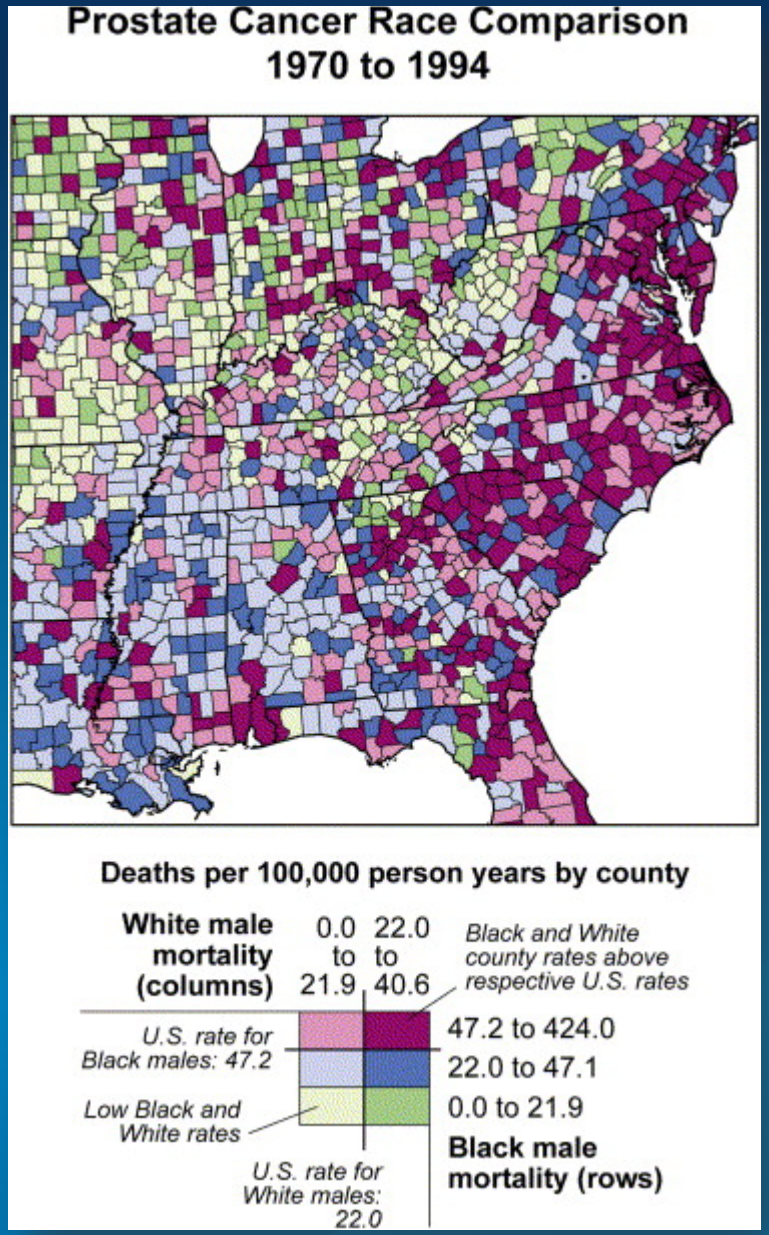
Special classes

- Zero deaths are separated to a class
- Significance and sparse data symbols are overlayed on a diverging choropleth representation
  - *Note - This map also shows more complete wording for a thematic map, with general information in the map title, and specific information about the calculation and data mapped in the legend title and note*



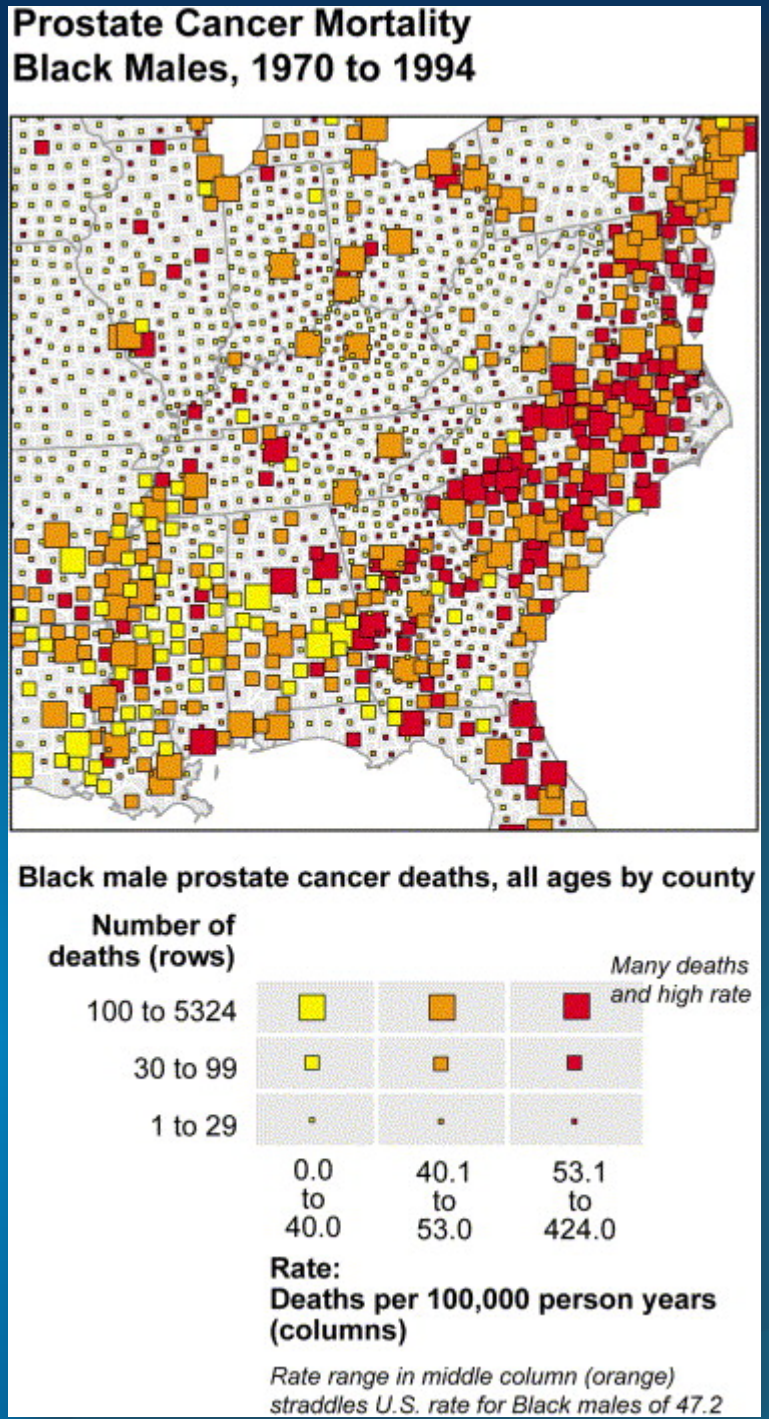
Bivariate choropleth

- A bivariate choropleth map offers a visual combination of two variables, making visible their covariation
- Breaks between classes for white male death rates separate columns
- Breaks for black male death rates separate rows
- Overall U.S. rates for black and white groups are used as class breaks for both races



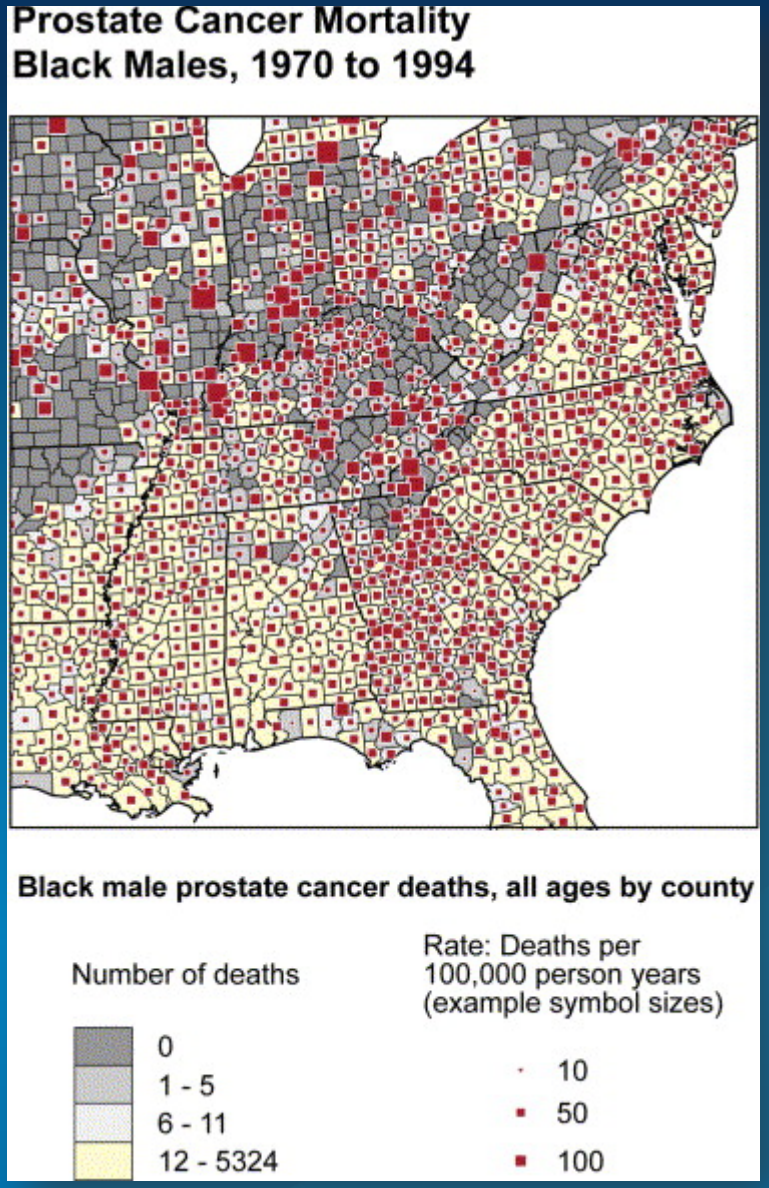
Bivariate map

- A bivariate map showing both number of deaths and death rates
- As we saw, size is used for the count variable (rows; small to large)
- Hue and lightness are used for the rate data (columns; light yellow to dark red)
- The combination of small size and color reduces the visual prominence of counties with few deaths and thus less reliable rates



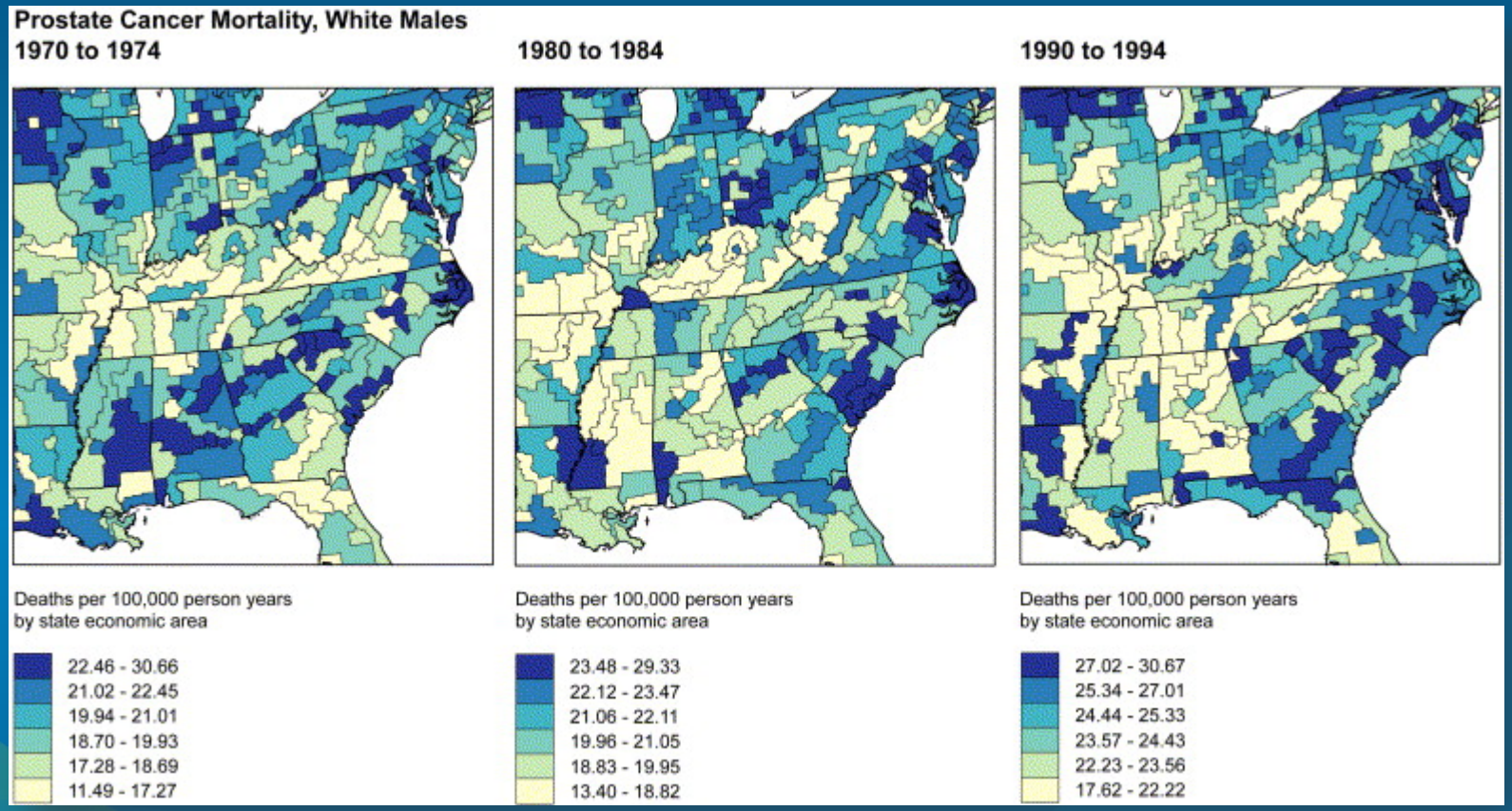
Bivariate map

- Proportional point symbols for rates overlay choropleth symbols for number of deaths
- Counts of zero, <6, and <12 are used to indicate sparse populations and suggest caution in judging rates (especially extreme rates) in these counties



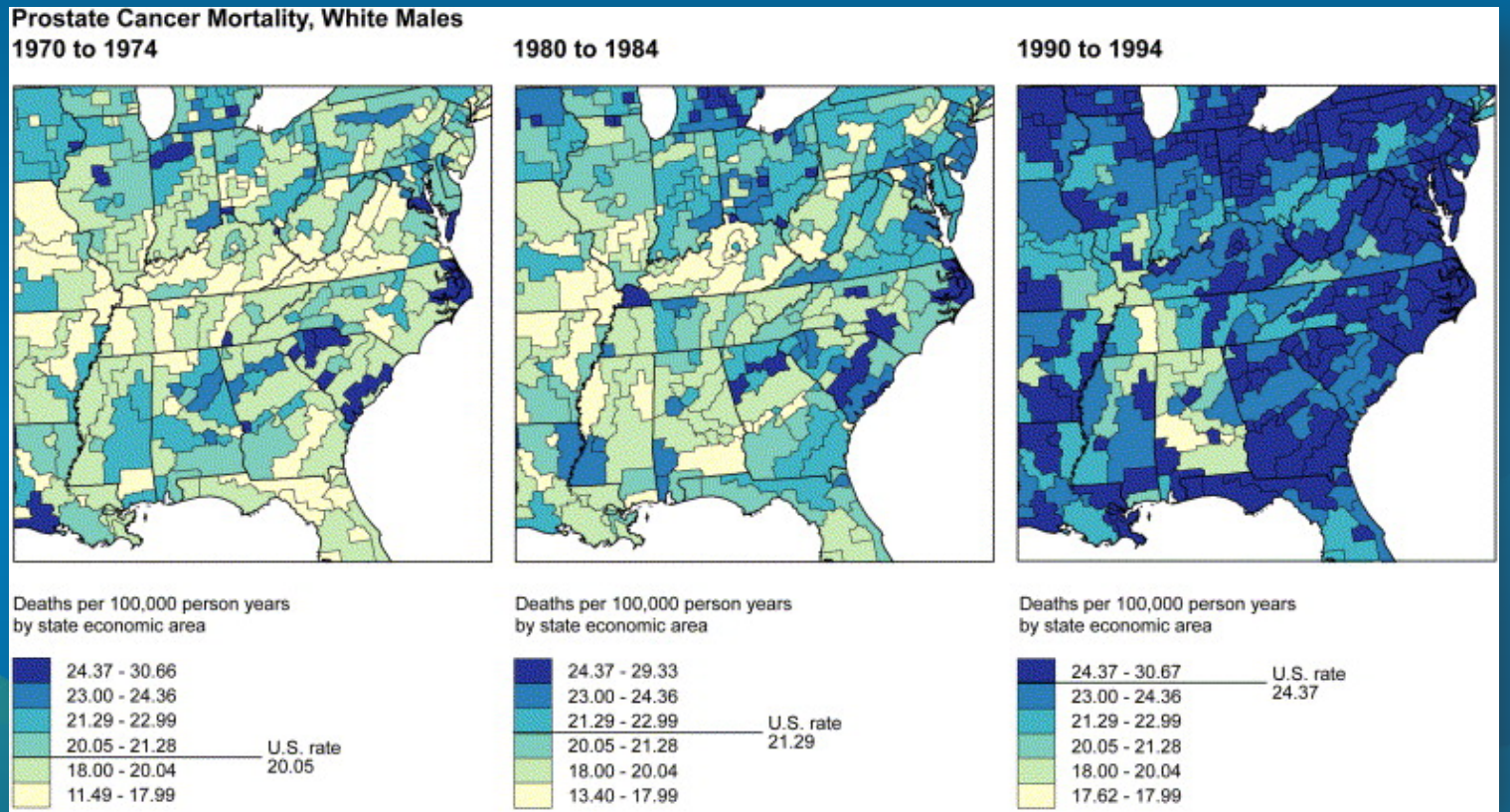
Map series - quantiles

- Each map classed separately using quantile classing
- The maps are a time series



Map series – same class breaks

- The same map series with all maps sharing the same set of classes to aid map comparison within the time series
- Class breaks based on the U.S. rate for each time period are included on all maps
- The U.S. rate for the 5-year period mapped is highlighted in each maps' legend



Politics

During the nineteenth century Oregon politics were fairly stable: Republicans were the majority party, but the Democrats were active and modestly successful. During this time of strong regional influence in American politics, Oregon resembled most other northern (or Union) states. Through the first third of the twentieth century Oregon became solidly Republican. From 1900 to 1928, Oregon voted for the Republican candidate for President in six of seven elections; in U.S. Senate elections, Grand Old Party (GOP) candidates prevailed eight of 11 times.

Economic reverses during the Great Depression of the 1930s made class rather than region the focus of political divisions. In Oregon and the nation, the New Deal made the Democrats much more competitive. This revival is reflected in the voter registration figures below, showing a rapid increase among the Democrats from 1930 to 1936. The 1932 and 1936 maps show the broad pattern of Franklin Roosevelt's first two victories—again reflecting national trends. But by the post-war years, Oregon trended back toward the Republican side, with state victories by Republican presidential candidates in 1948, 1952 and 1956. During this period, the Oregon congressional delegation also largely reverted to its GOP roots.

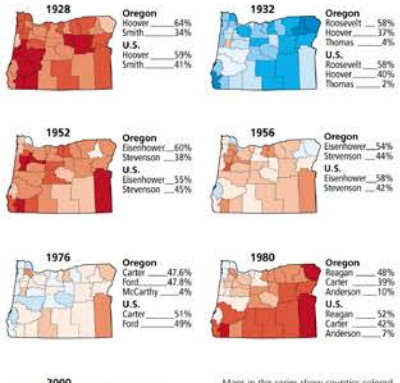
But by the mid-1950s, increasing urbanization and effective organizing by liberal political activists helped the Democrats. From that period to the late 1970s, Democrats expanded their urban and labor core (with significant support among registered voters in rural Oregon) to become the majority party in the state.

But the political wheel turned again starting roughly in 1980, as Ronald Reagan easily carried Oregon and the nation. The GOP captured control of the state House of Representatives in 1990 and the state Senate in 1994. But through the 1990s, with rare exceptions, the Republicans were unable to win most statewide contests. For example, since 1986 three Democratic governors have been elected to four successive terms.

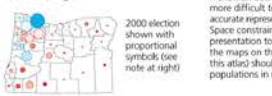
There is now strong urban–rural political regionalism in Oregon, clearly seen in the maps for presidential elections since 1988. Both Portland and Multnomah County are heavily Democratic, as are the university-influenced cities of Eugene and Corvallis and a number of coastal counties which are home to intense ongoing labor–management conflicts. Rural counties in Eastern and southern Oregon—including some in northeast Oregon that were once solidly Democratic—have shifted decisively to the GOP. Thus the urban Democratic preference is almost balanced by the rural tilt toward to the Republicans.

Since about 1980, many more voters have either declined to affiliate with a major party or registered with a minor party. Two important sources for these voters are (1) rural blue collar workers, formerly Democrats, who have been alienated by the influence of urban environmentalists on the party, and (2) moderate suburbanites, particularly women, alienated from the Republican party by the influence of religious conservatives.

Presidental Elections 1928–2000

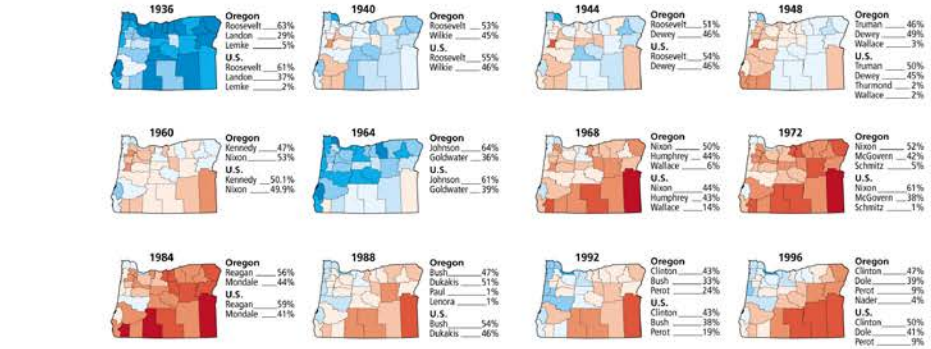


Bush is listed first despite placing second in the popular vote, since he prevailed in the Electoral College.



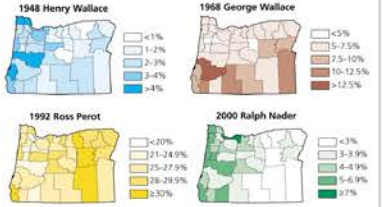
Colors indicate percentages of the two-party vote. Listed percentages reflect the total vote, and include third-party candidates receiving over 1 percent of votes cast.

Maps in this series show counties colored according to the division of the two-party vote in each. The 2000 presidential election is also presented in a second map, colored in the same way, but showing counties as circles proportional in size to the number of votes cast. This second presentation corrects for disparities in geographic size—a useful adjustment since it is votes, not square miles, that count in elections. Proportional circles make individual counties and their color classes more difficult to identify, but gives a more accurate representation of the statewide vote. Space constraints limit this "double map" presentation to this single example, but all the maps on these pages (and elsewhere in this atlas) should be interpreted with county populations in mind. See pages 26–27.



Minor Presidental Candidates

Progressive Party candidate Henry Wallace ran to Truman's political left, drawing less than 2 percent nationally but more than 3 percent in Oregon. George Wallace's 1968 state's rights and segregationist campaign generally won less than 10 percent of the vote outside the South, but surpassed that in four southern Oregon counties. Oregon gave Ross Perot one of his best showings, particularly in Eastern Oregon. Dissatisfaction with the major parties was again a factor in Nader's strong performance in Oregon, but Nader's principal appeal was to environmentalists.

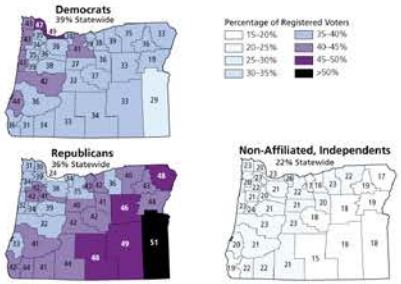


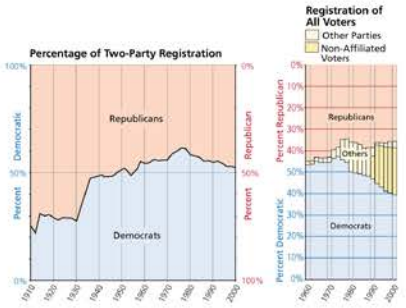
State Ballot Measures

One of the first states to adopt a ballot measure initiative process (1902), Oregon initiatives can qualify with fewer signatures than initiatives in most other states permitting the process. In the late 1980s, courts ruled that paid petition circulators could not be prohibited, and the use of initiatives expanded greatly. Measure 5 in 1990 reflected a widespread Western tax revolt which began in 1978 with California's Proposition 13. Measure 5's passage cut property taxes nearly in half, requiring greater state reliance on income taxes for funding. A decade later, the passage of Measure 7 required compensation to property owners for land use planning and zoning restrictions (later struck down by the courts). Measure 18 in 1994 restricting hunting clearly reflected the state's urban–rural split. The same divide is apparent in the approval of Measure 67 (1998), authorizing the use of marijuana for medical purposes, and the defeat of Measure 9 (2000), which proposed to deny legal protection to homosexuals.

Ballot measure maps show majority "yes" vote percentages in green, and majority "no" vote percentages in brown.

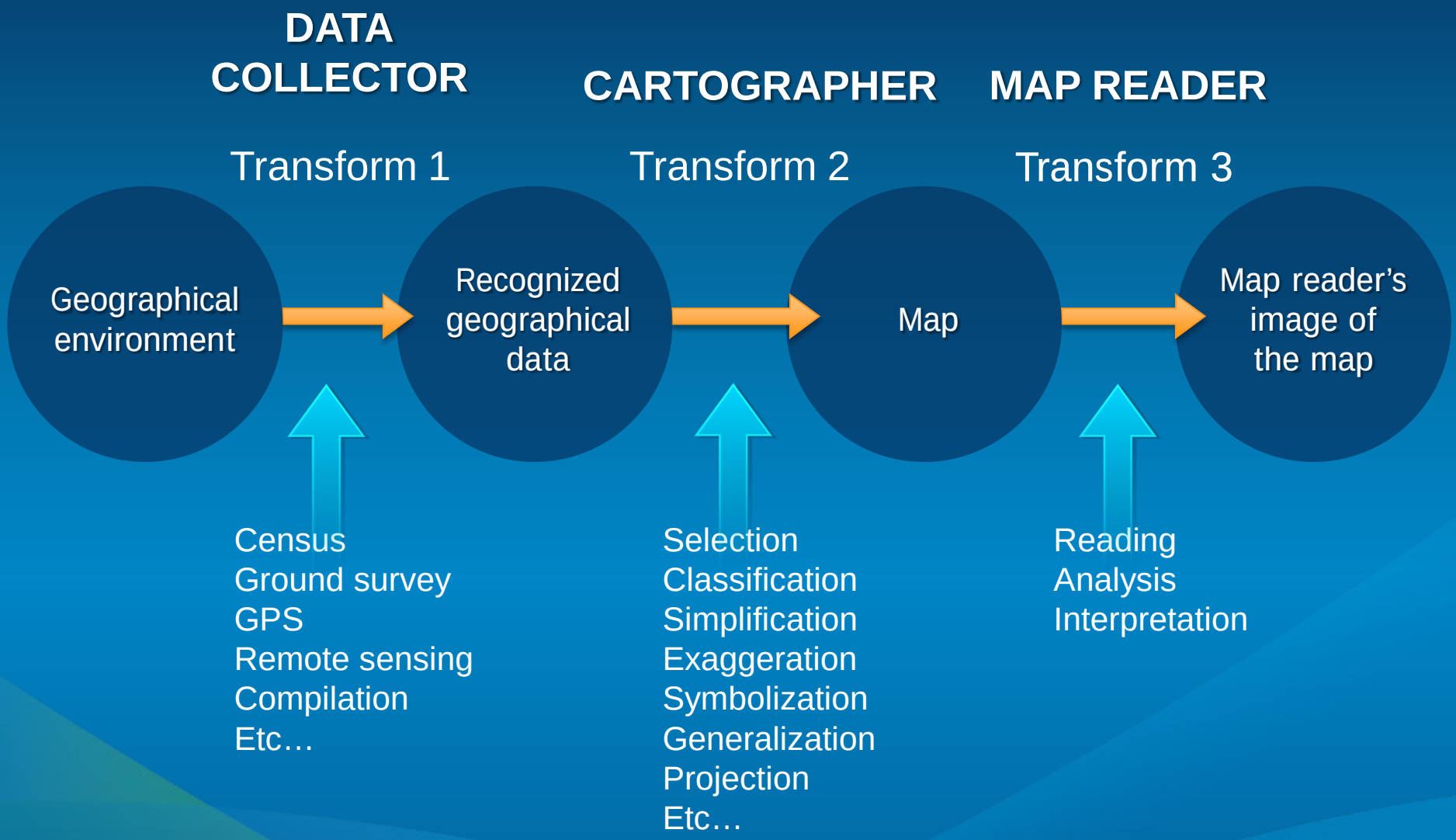
Voter Registration 2000





Transformational view of cartography

Information transformation



Basic characteristics of maps

- All maps are concerned with two primary elements
  - Locations and attributes
- All maps are reductions of reality
  - Scale
- All maps are abstractions of reality
  - Generalization and its components
- All maps are transformations of space
  - Map projections and coordinate systems
- All maps use signs and symbolism
  - Cartographic symbolization

Basic characteristics of maps

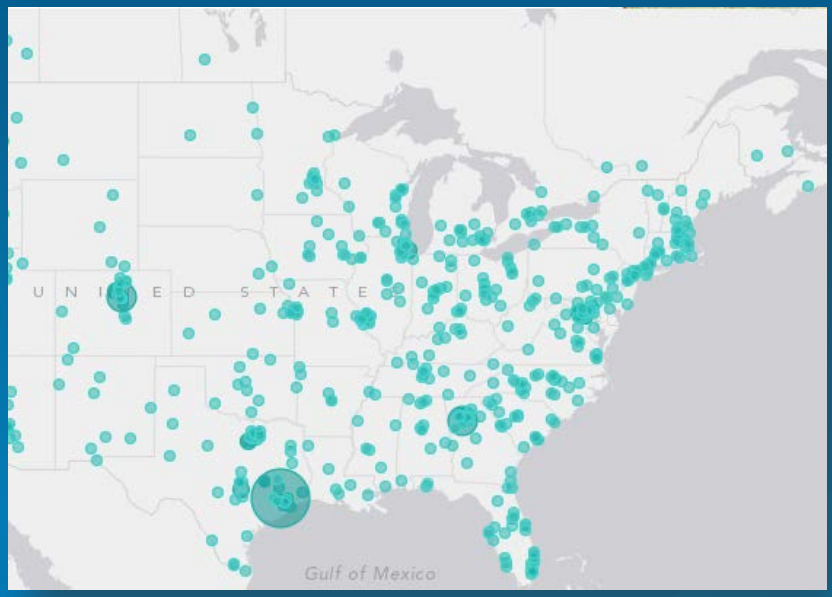
- All maps are concerned with two primary elements
  - Locations and attributes
- All maps are reductions of reality
  - Scale
- All maps are abstractions of reality
  - Generalization and its components
- All maps are transformations of space
  - Map projections and coordinate systems -
- All maps use signs and symbolism
  - Cartographic symbolization

Basemaps and overlays

Basemap – reference information to provide geographic context

Overlay – mapped statistical data

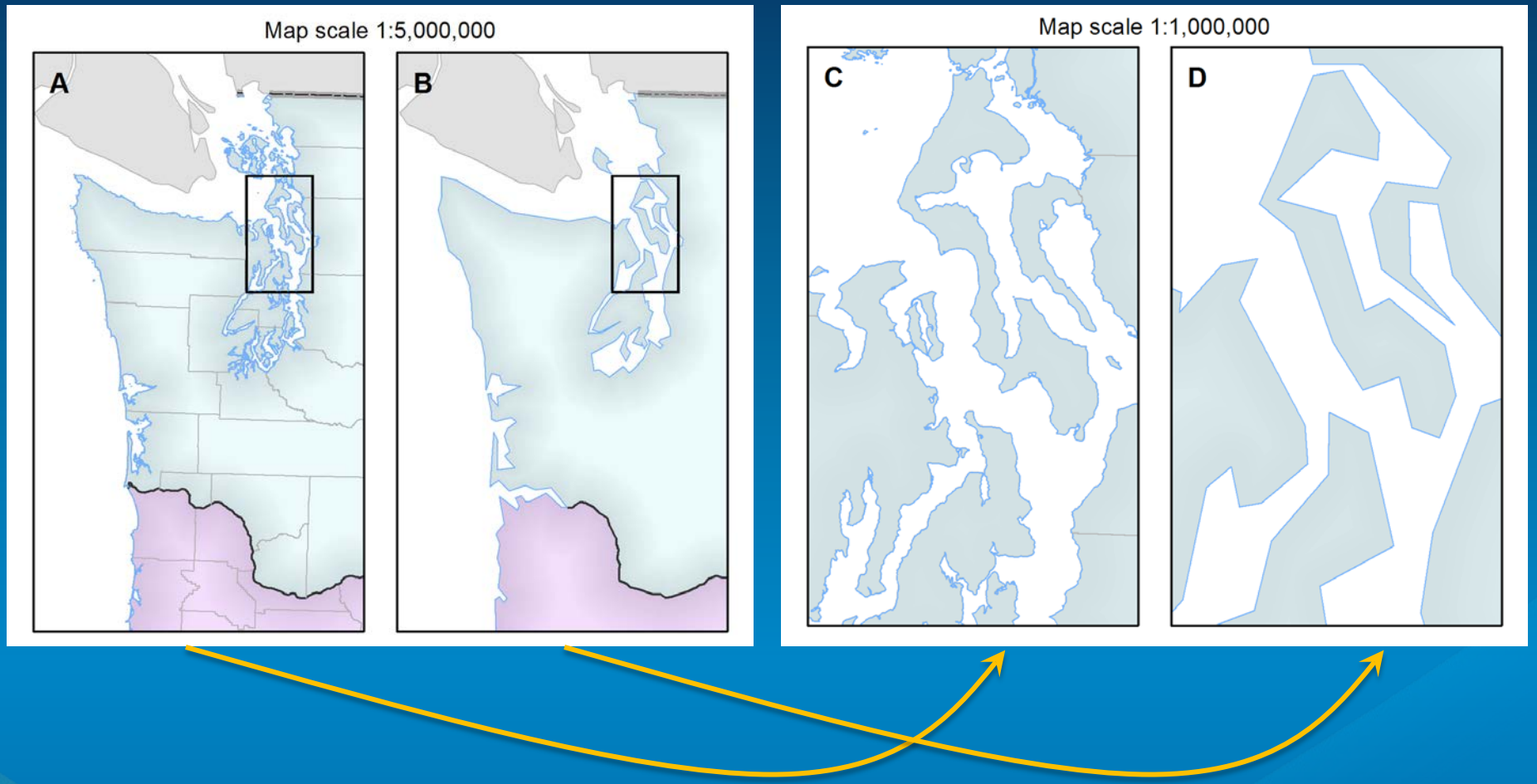
Administrative boundaries
Hydrography
Transportation
Land cover
Associated labels



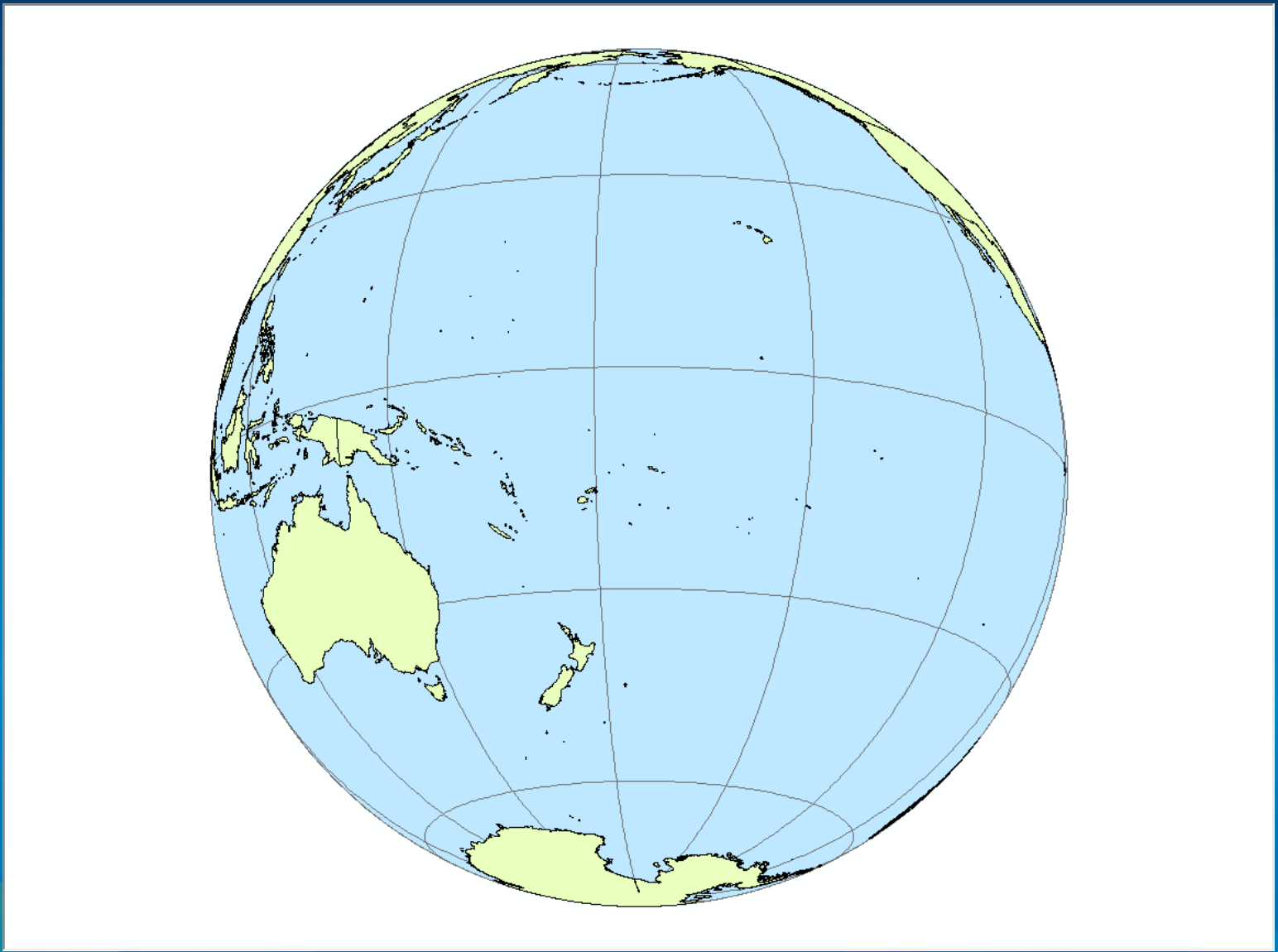
Administrative boundaries
Associated labels

Generalization

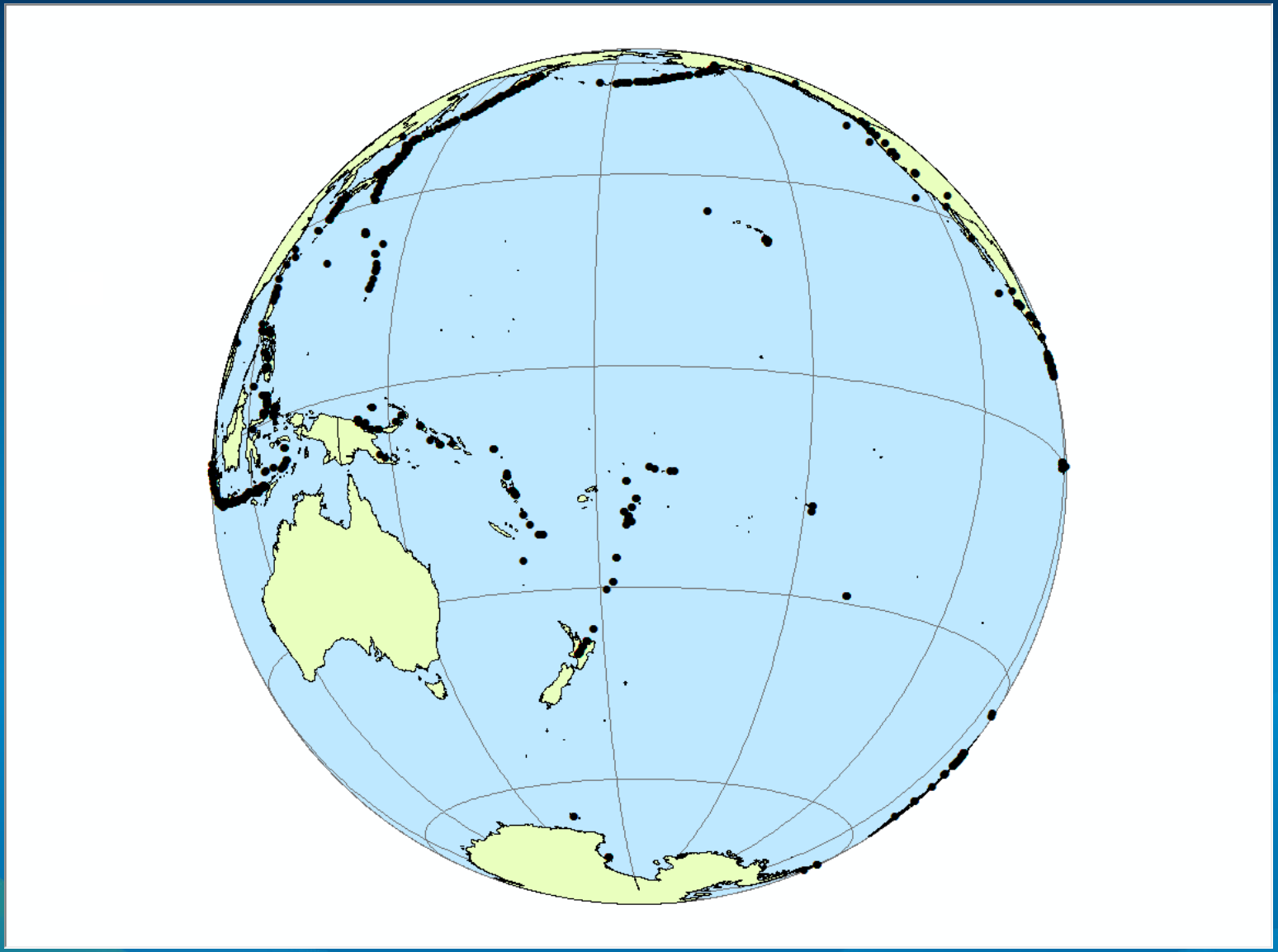
Generalization



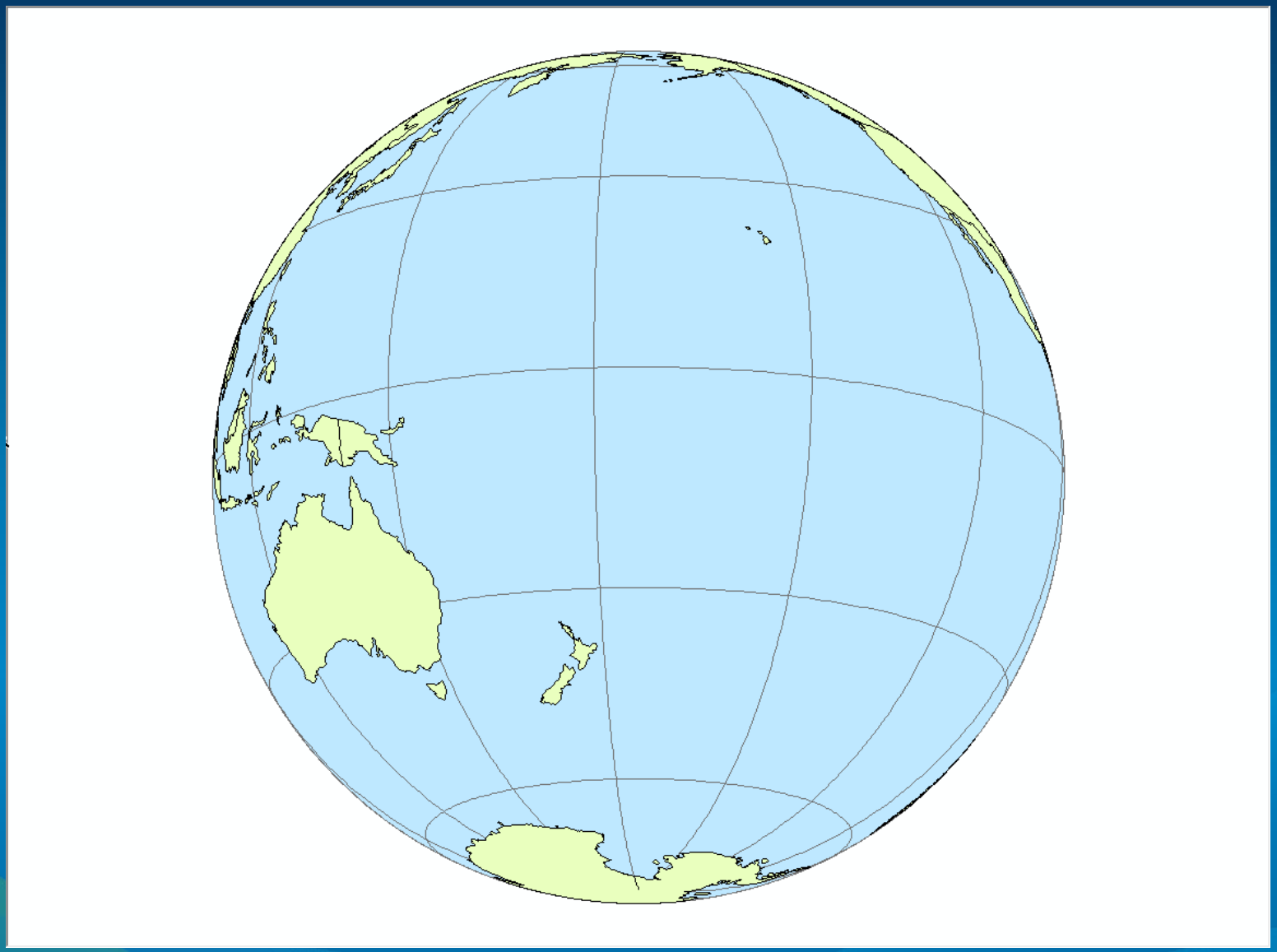
Detailed country boundary data



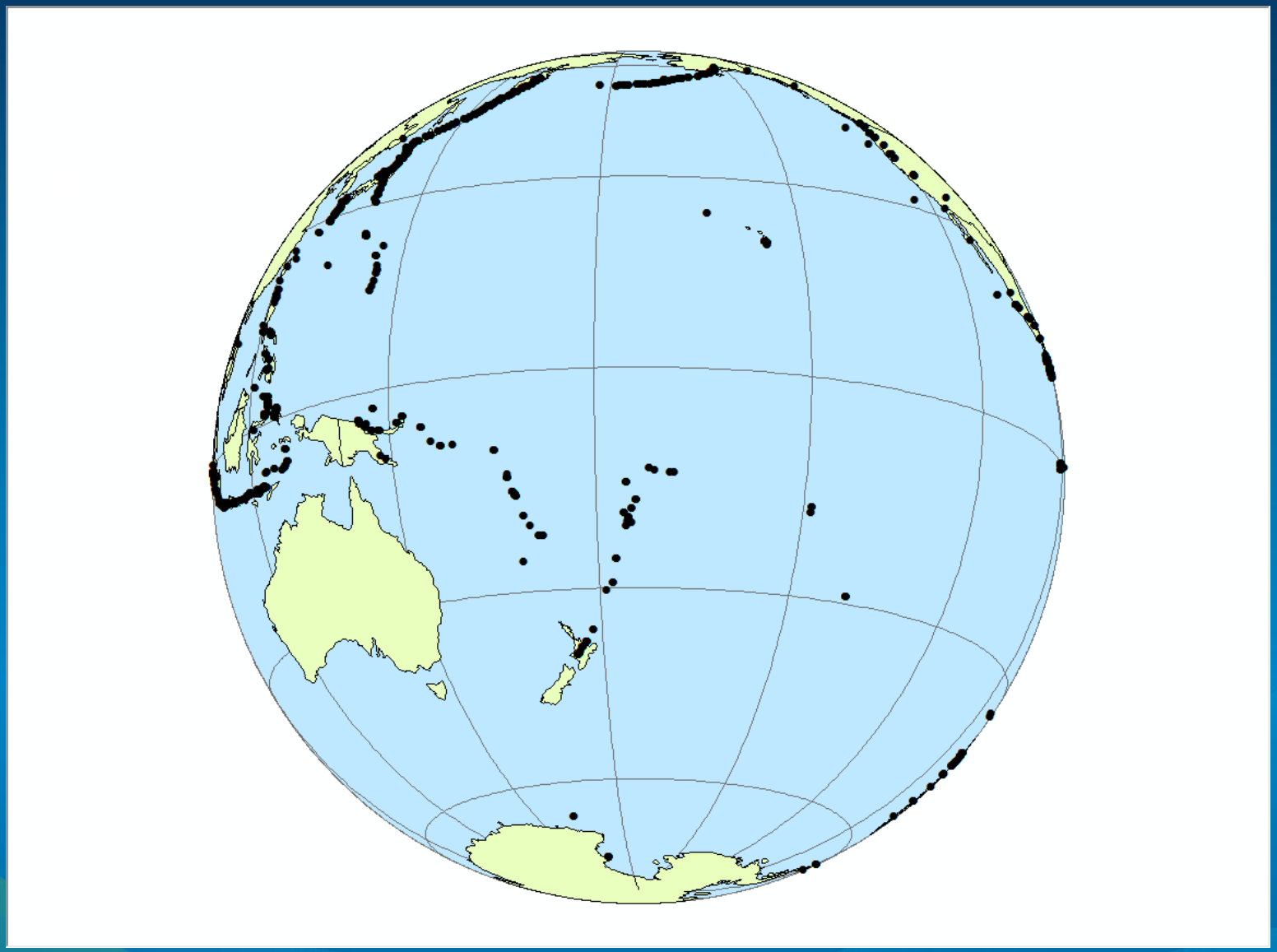
Detailed country boundary data + volcanic eruptions



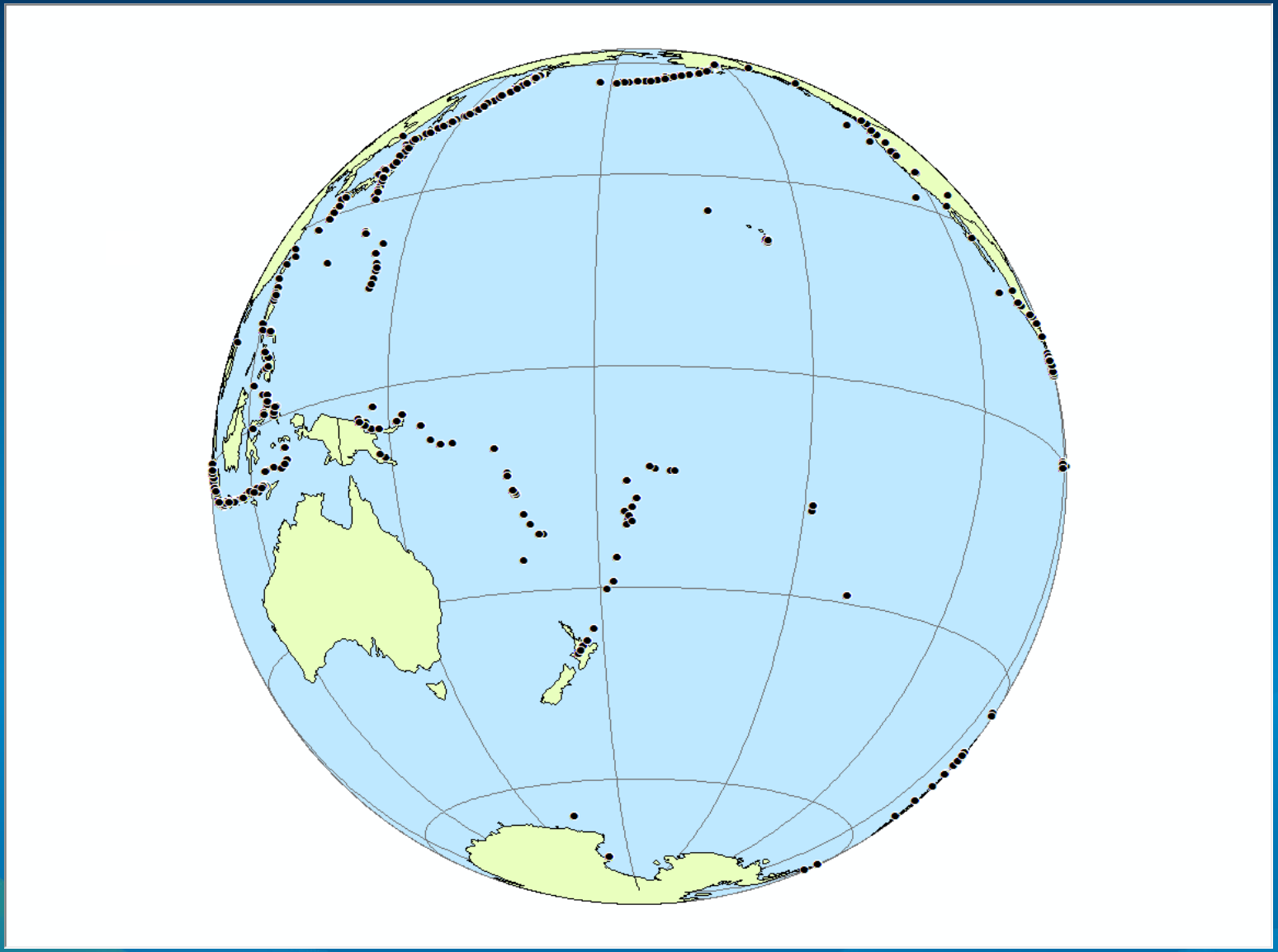
Generalized country boundary data



Generalized country boundary data + volcanic eruptions



Volcanoes + cased point symbols

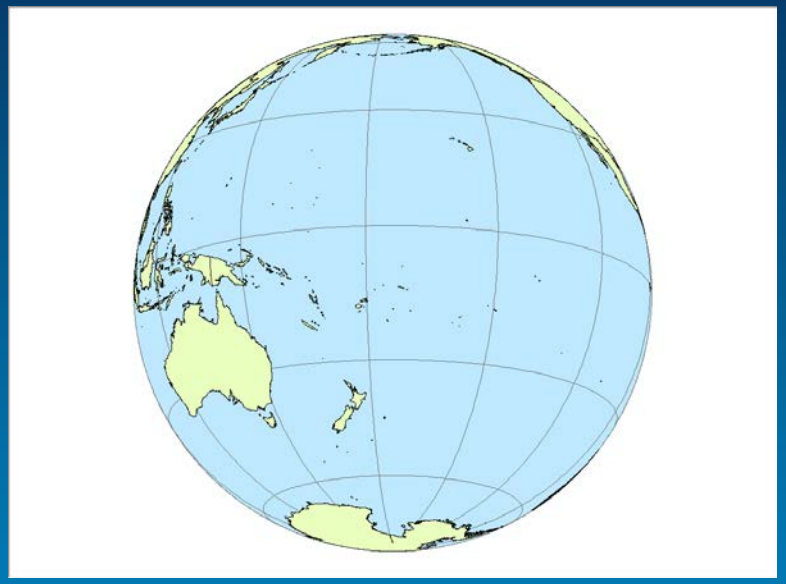


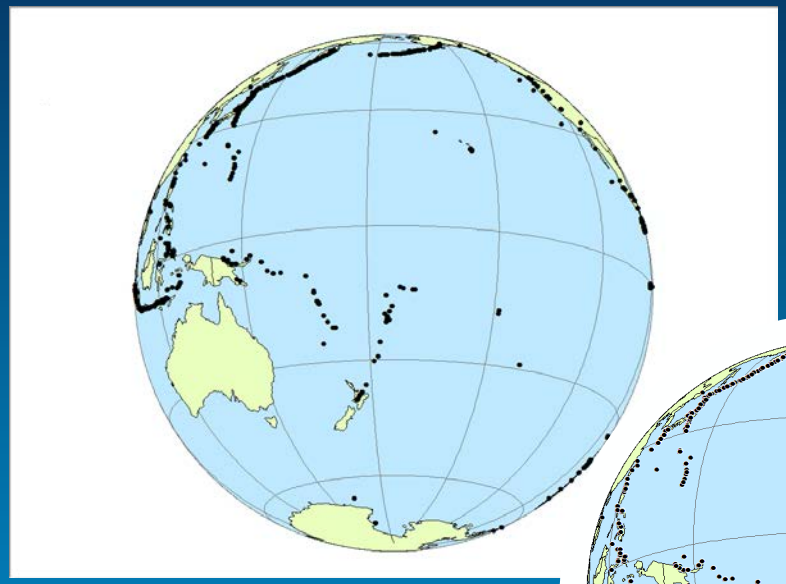
Comparisons

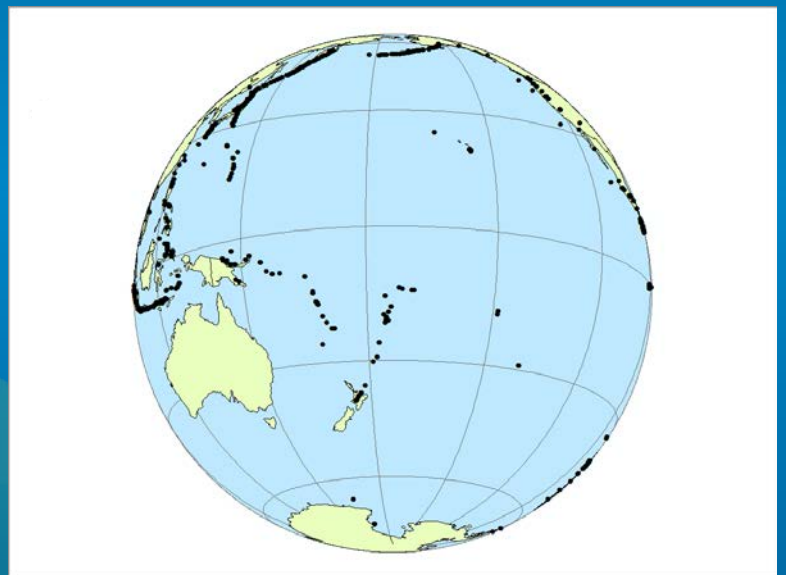
Detailed

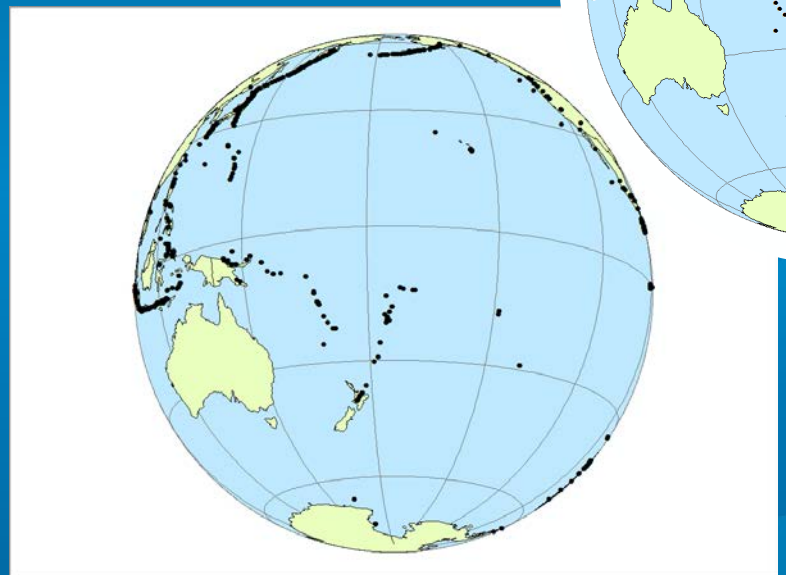
Generalized

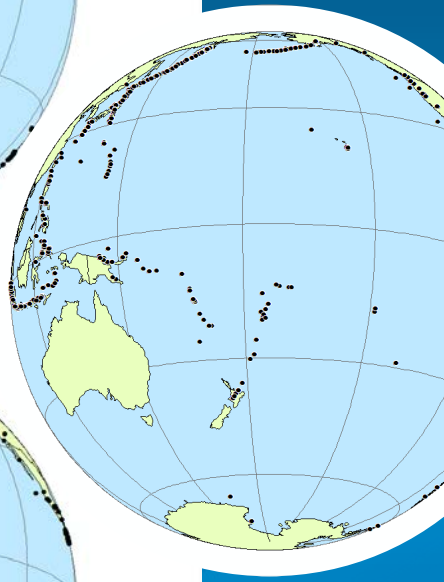
Cased symbols







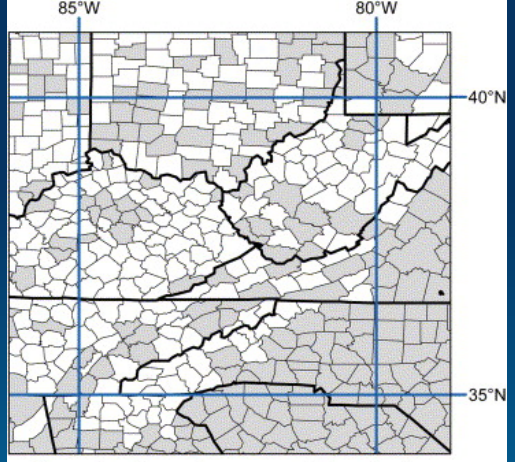




Map projection

Map projection

- (a) No projection is set so latitude and longitude remain in the square-grid default arrangement
- (b) Albers equal area projection for the U.S.
- (c) Albers modified by adjusting the central meridian to the center of the mapped area to position north as up
  - *Note - The gray-filled counties had more than five prostate cancer deaths for black males, 1970–1994*

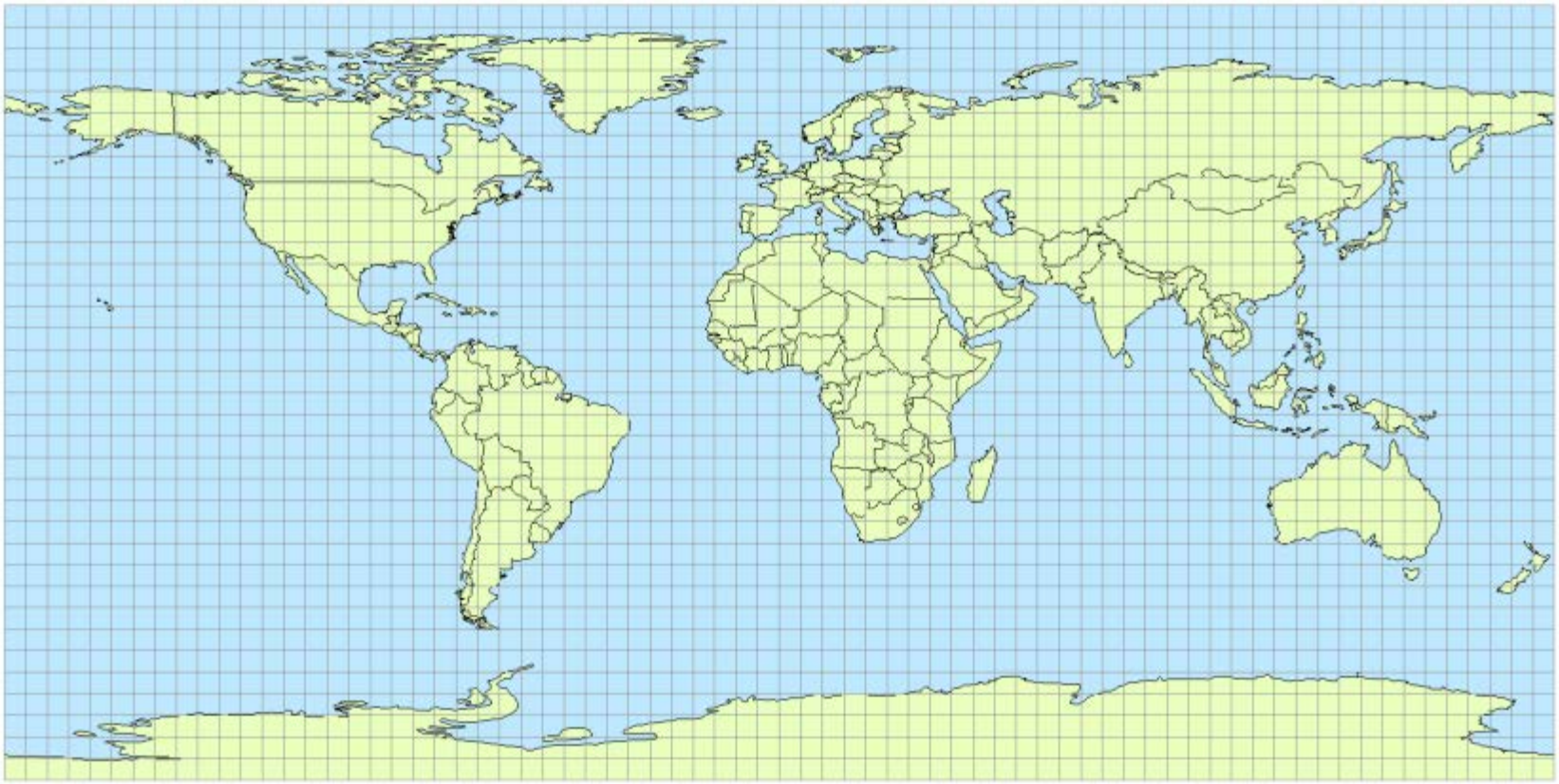


a. No projection set, square-grid graticule

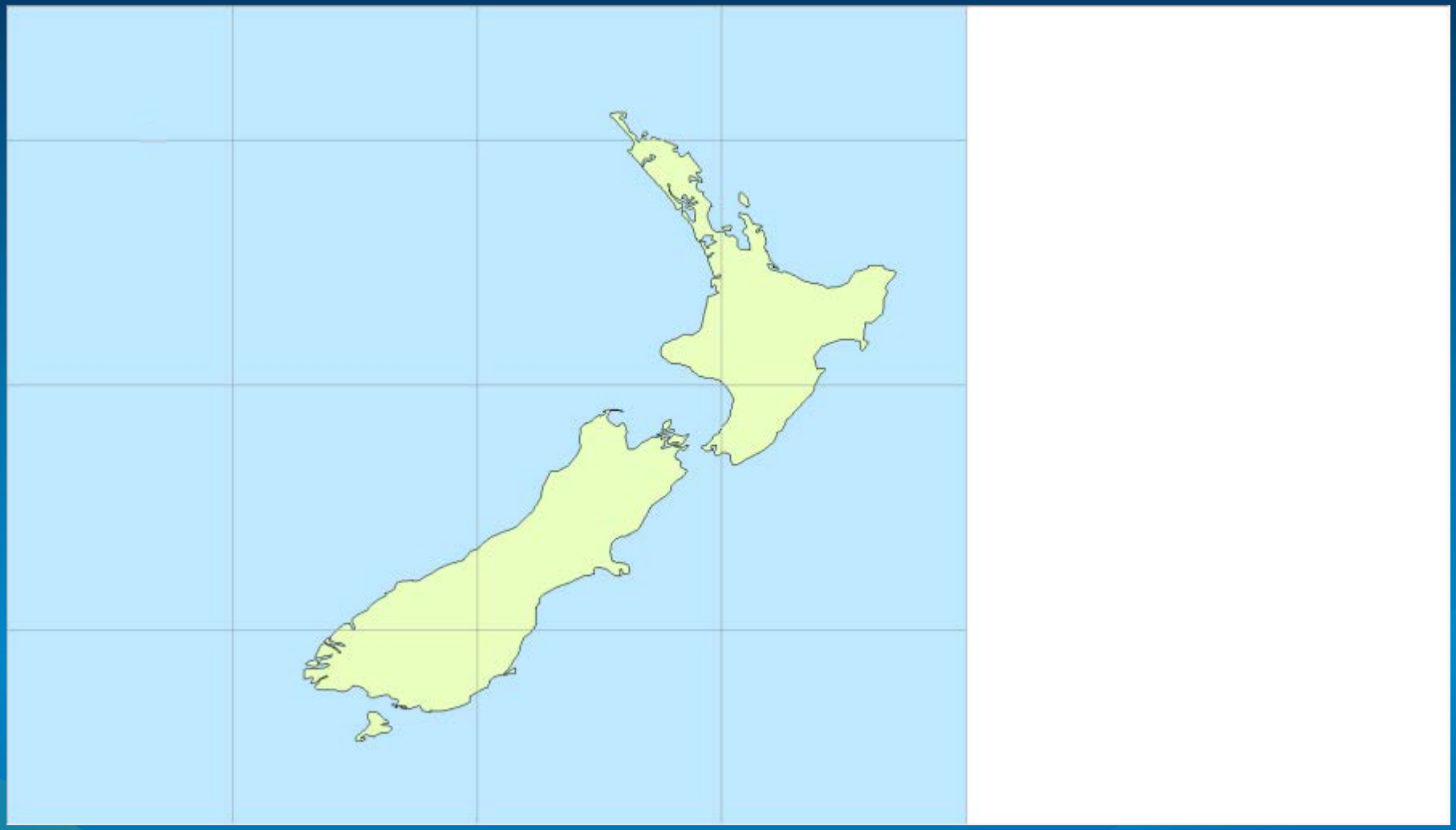
b. Albers Equal Area projection for U.S.

c. Albers with central meridian adjusted

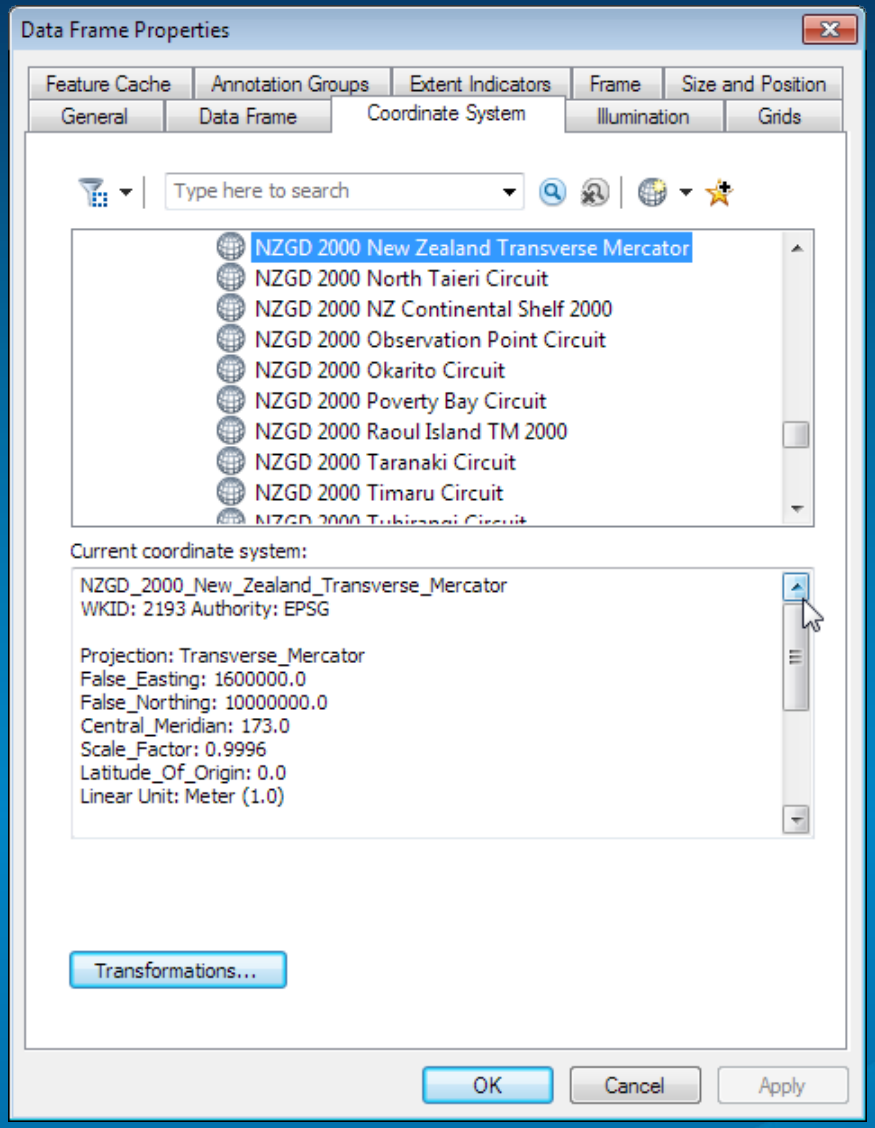
WGS84 (Geographic)



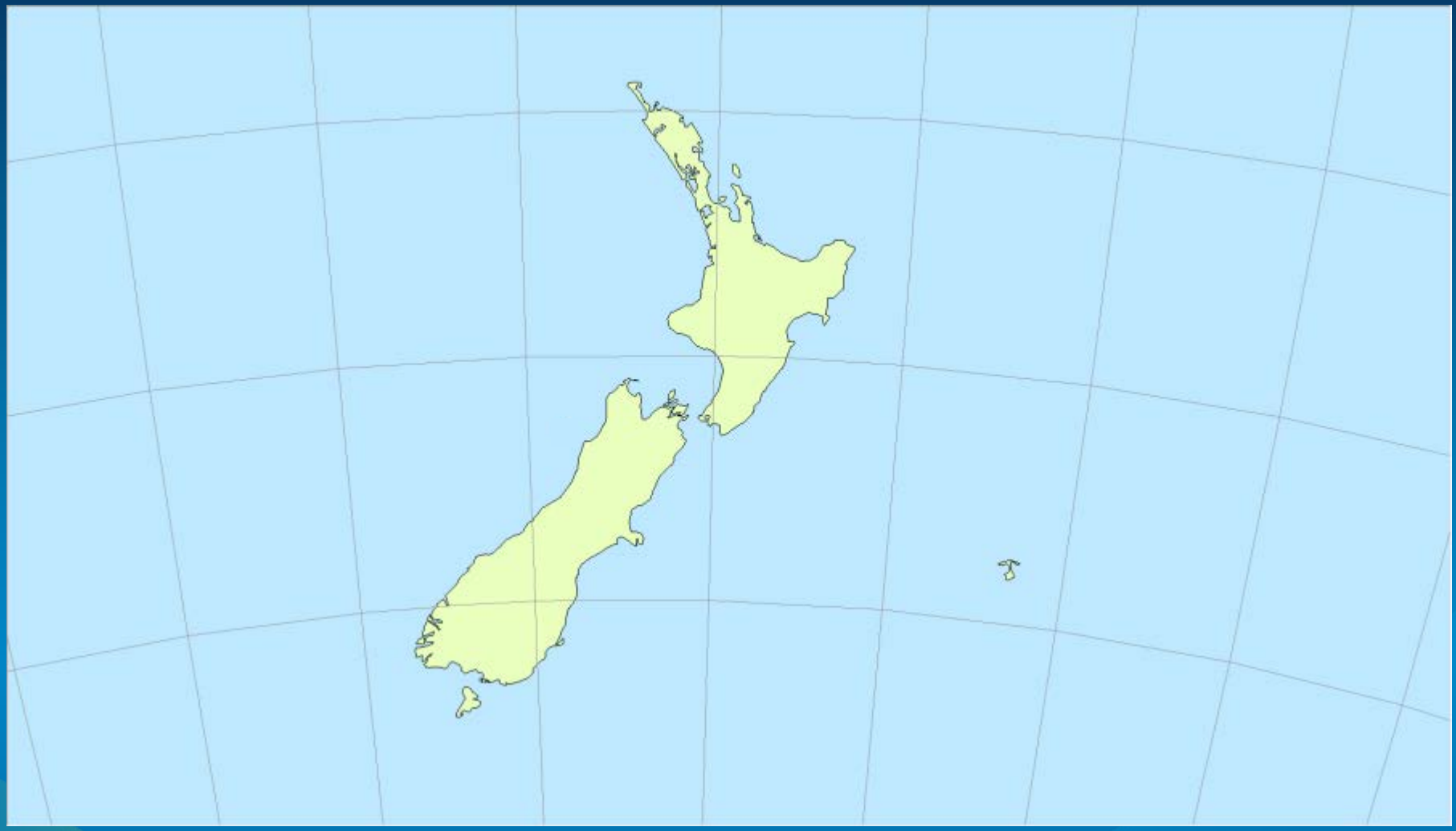
New Zealand – WGS84



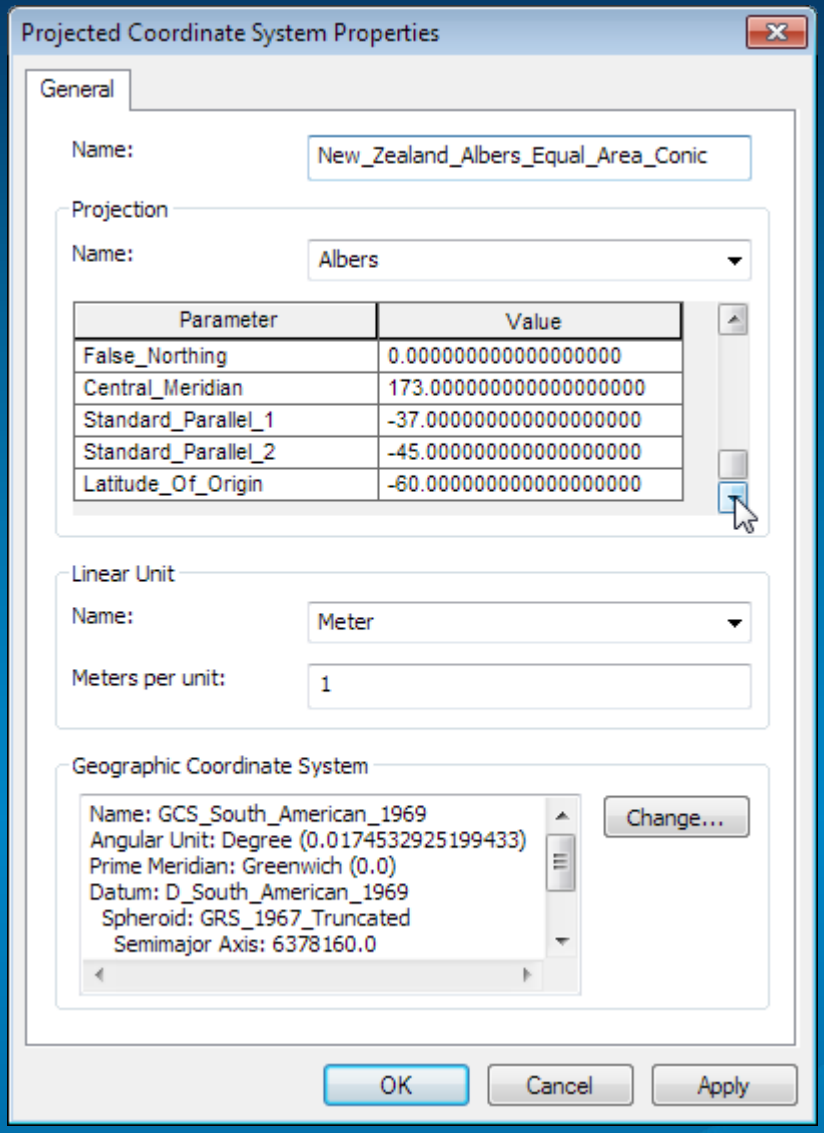
New Zealand Transverse Mercator



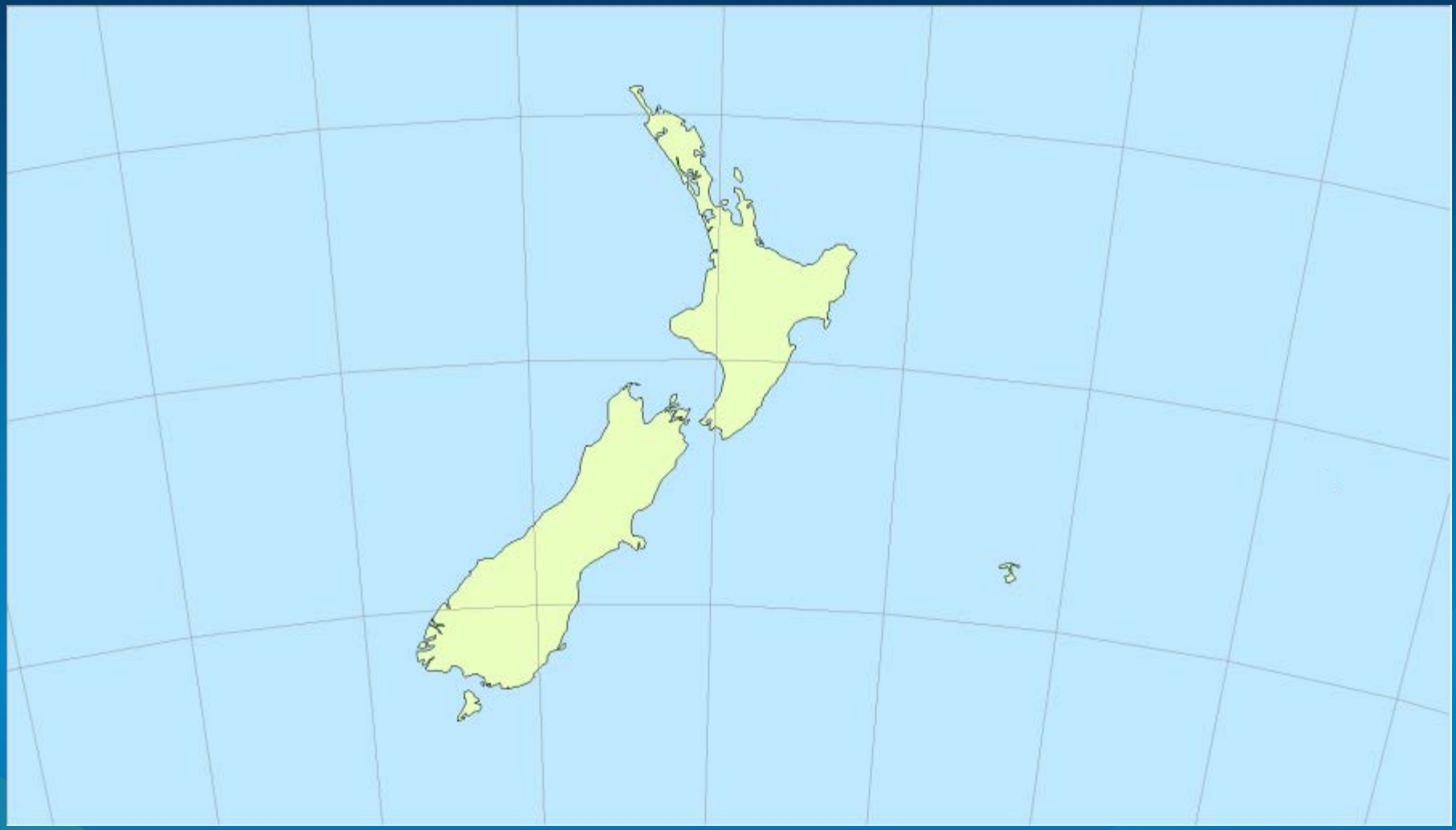
New Zealand Transverse Mercator



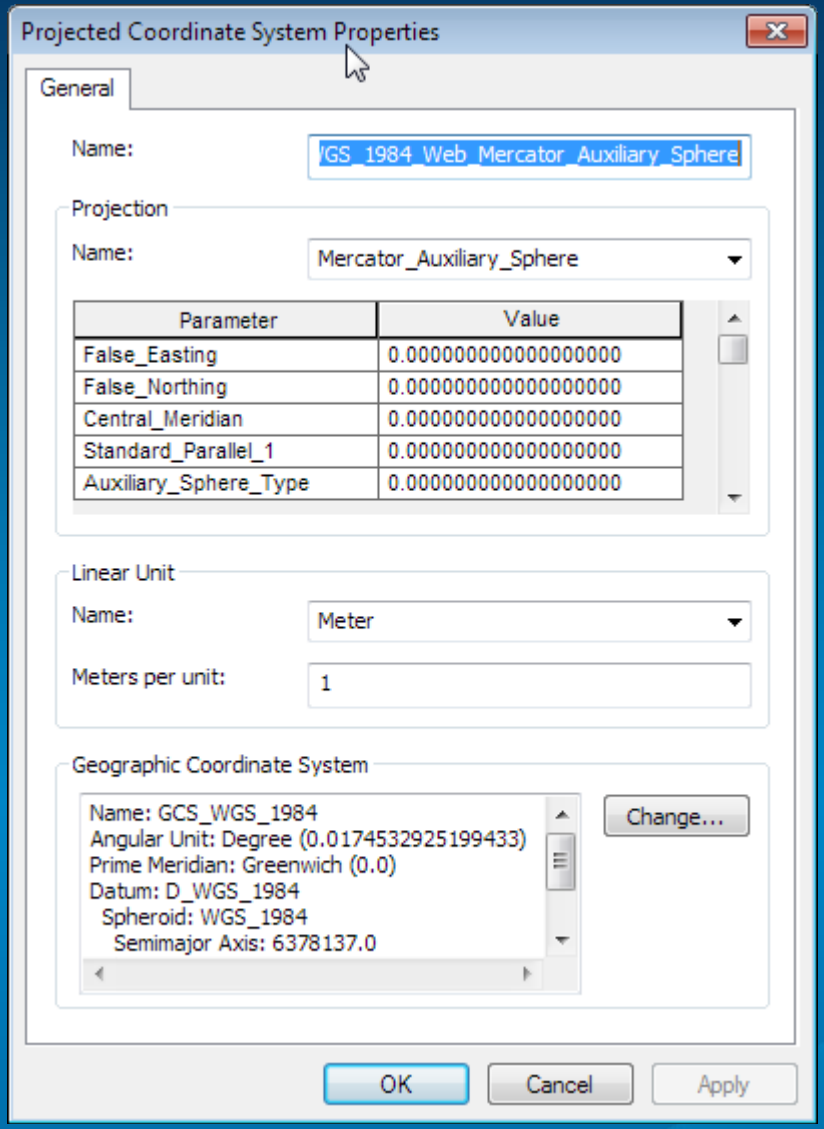
New Zealand – Albers equal area



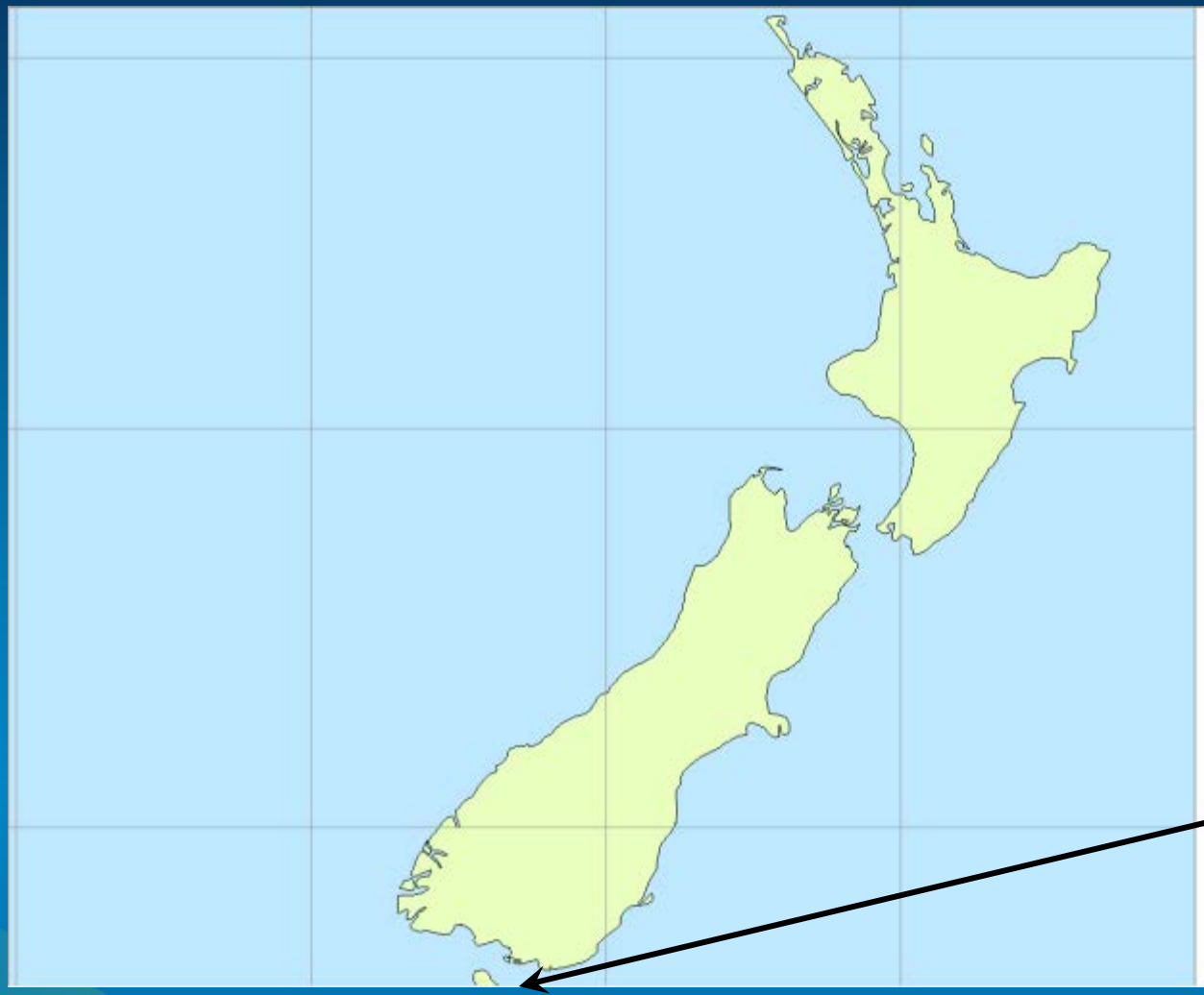
New Zealand – Albers equal area



New Zealand – Web Mercator (web maps)

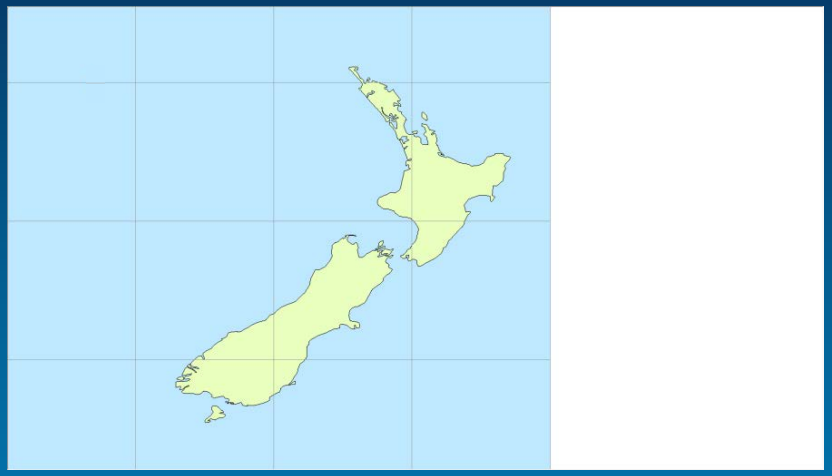


New Zealand – Web Mercator

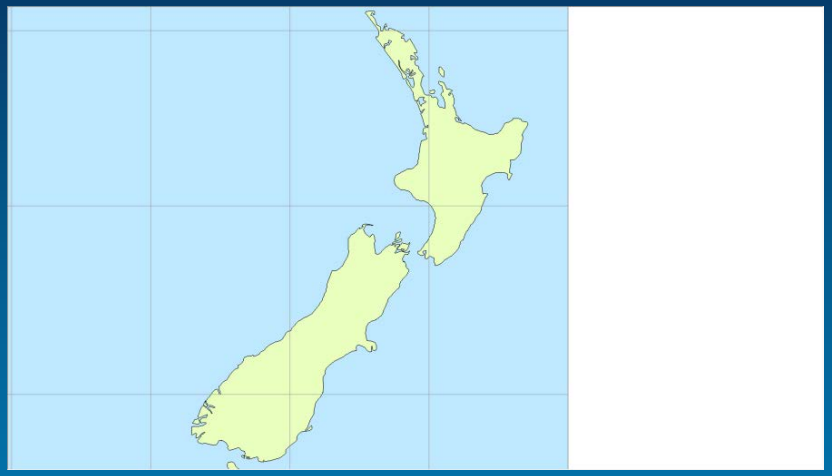


So distorted in shape that it does not even fit in the window anymore

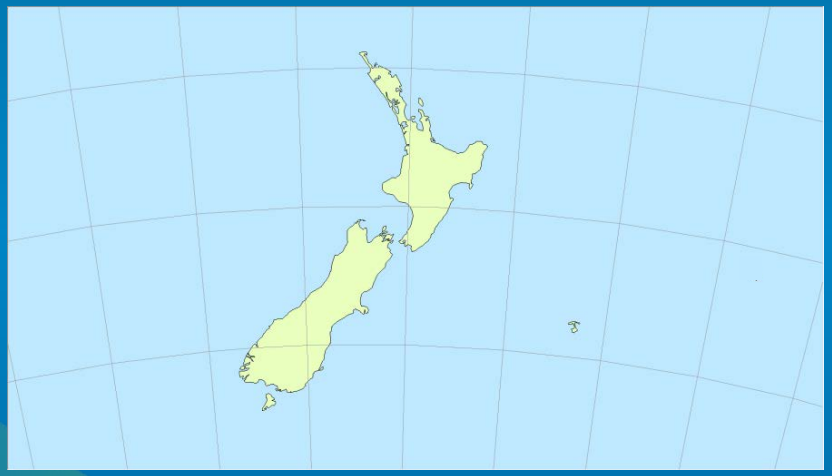
New Zealand projections



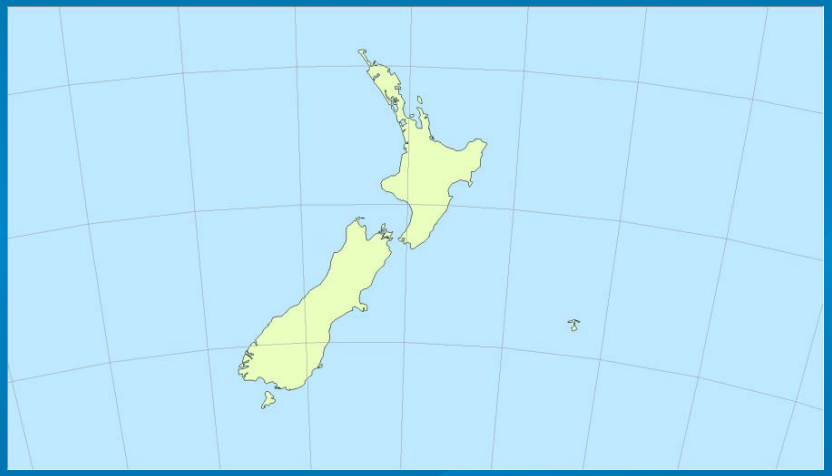
WGS84



Web Mercator

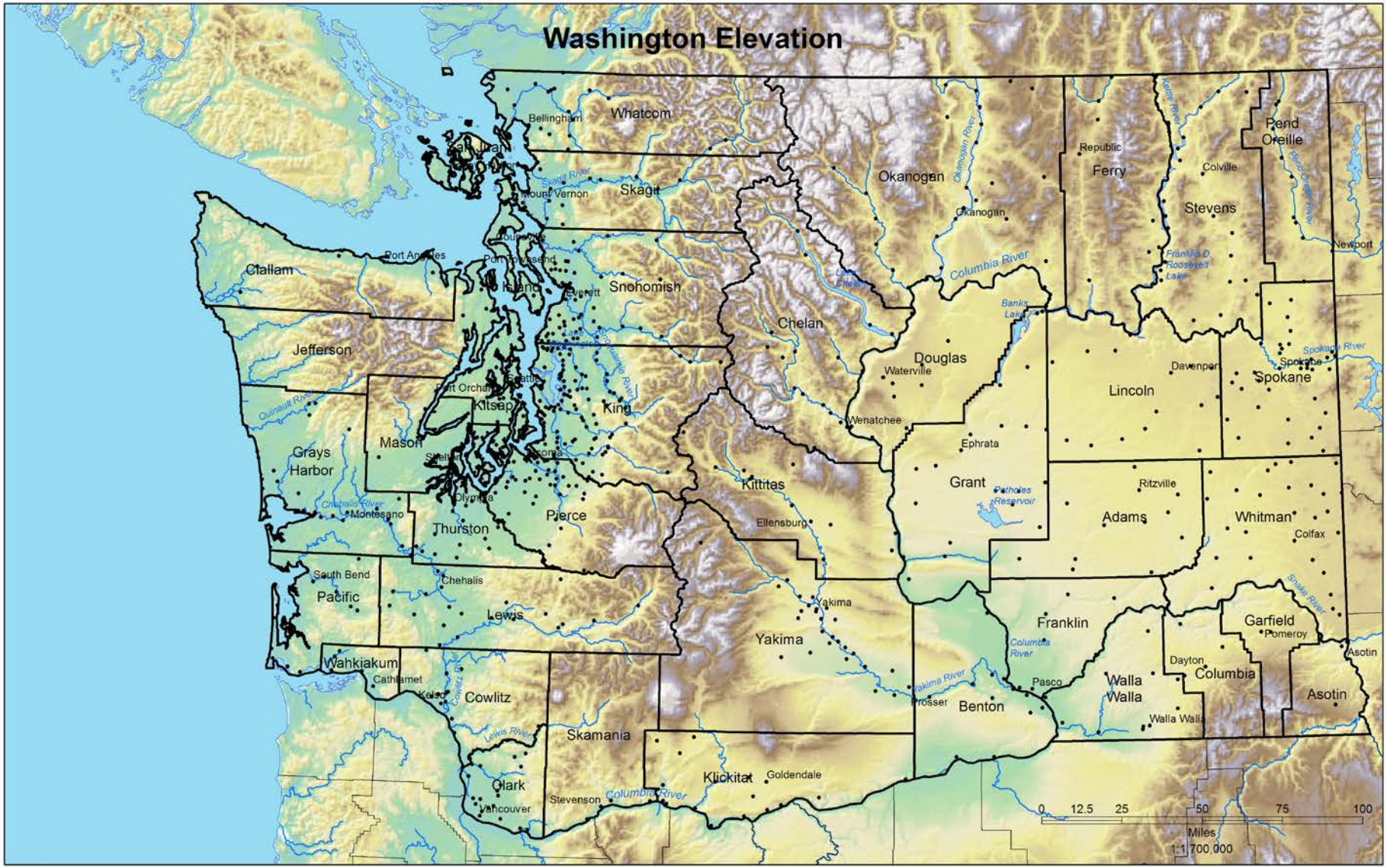


New Zealand Transverse Mercator



New Zealand Albers equal area

Map compilation

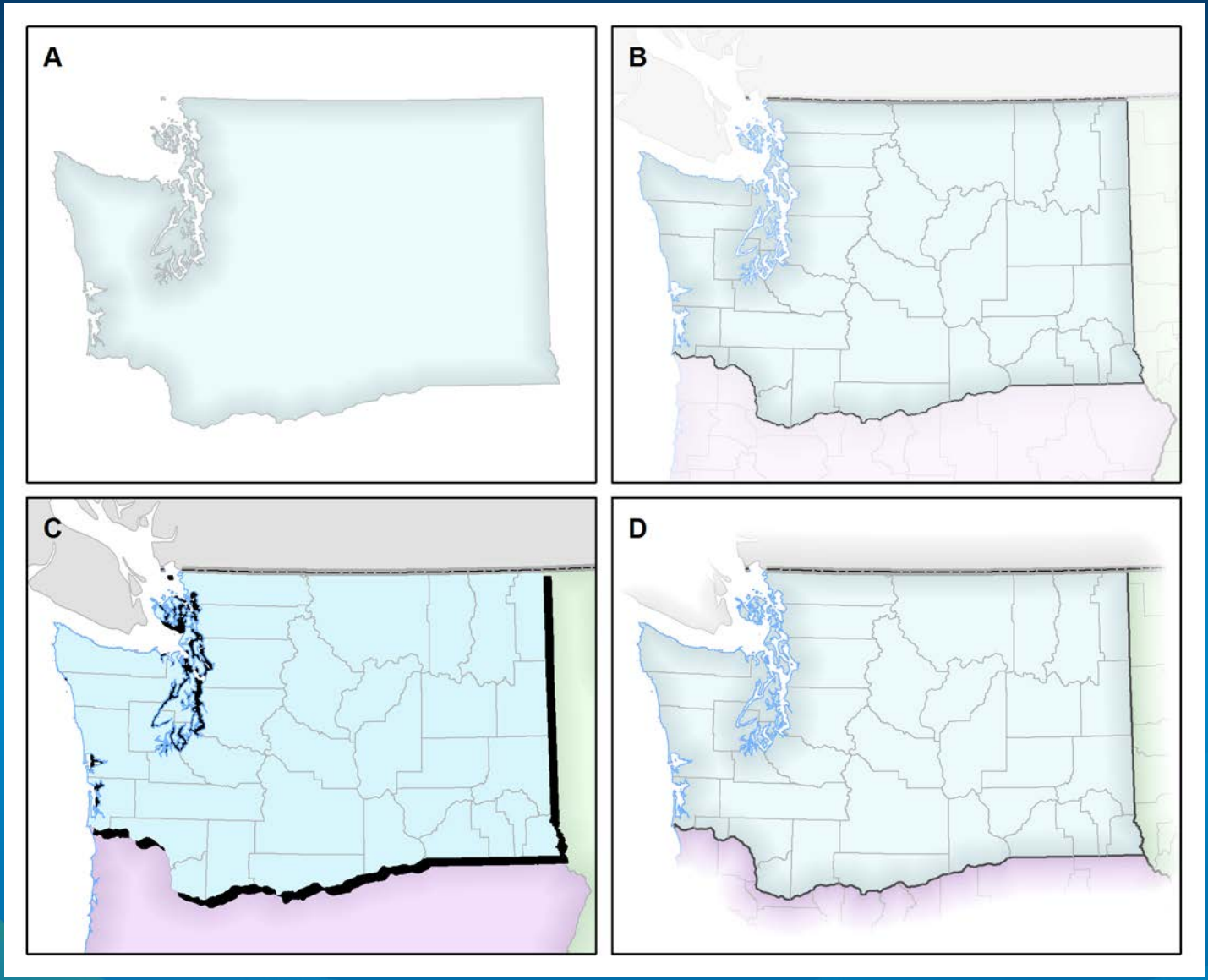

Washington Elevation
Whatcom
Bellingham
Skagit
Mount Vernon
Okanogan
Okanogan River
Republic
Ferry
Pend Oreille
Colville
Stevens
Newport
Columbia River
Franklin D Roosevelt Lake
Lake Chelan
Banks Lake
Port Angeles
Port Townsend
Clallam
Snohomish
Everett
Chelan
Jefferson
Douglas
Waterville
Wenatchee
Lincoln
Davenport
Spokane
Spokane River
Quinault River
Port Orchard
Seattle
Kitsap
King
Columbia River
Grays Harbor
Mason
Shelton
Ephrata
Grant
Potholes Reservoir
Ritzville
Kittitas
Chehalis River
Olympia
Montesano
Pierce
Ellensburg
Adams
Whitman
Colfax
Thurston
South Bend
Chehalis
Pacific
Yakima
Franklin
Garfield
Pomeroy
Snake River
Lewis
Columbia River
Wahkiakum
Cathlamet
Kelso
Cowlitz River
Cowlitz
Yakima River
Dayton
Columbia
Asotin
Pasco
Walla Walla
Prosser
Benton
Lewis River
Skamania
Klickitat
Goldendale
Clark
Vancouver
Stevenson
Columbia River
0 12.5 25 50 75 100
Miles
1:1,700,000


WASHINGTON ELEVATION
BRITISH COLUMBIA
PACIFIC OCEAN
IDAHO
OREGON
Strait of Juan de Fuca
OLYMPIC MOUNTAINS
CASCADE RANGE
COLUMBIA BASIN
WHATCOM
SAN JUAN
SKAGIT
ISLAND
SNOHOMISH
CLALLAM
JEFFERSON
KITSAP
KING
MASON
GRAYS HARBOR
THURSTON
PIERCE
PACIFIC
LEWIS
WAHKIAKUM
COWLITZ
SKAMANIA
CLARK
KLICKITAT
YAKIMA
KITTITAS
CHELAN
OKANOGAN
DOUGLAS
GRANT
BENTON
FRANKLIN
ADAMS
LINCOLN
FERRY
STEVENS
PEND OREILLE
SPOKANE
WHITMAN
GARFIELD
COLUMBIA
WALLA WALLA
ASOTIN
Bellingham
Friday Harbor
Mount Vernon
Coupeville
Port Angeles
Port Townsend
Everett
Seattle
Port Orchard
Shelton
Tacoma
Montesano
South Bend
Chehalis
Cathlamet
Kelso
Vancouver
Stevenson
Goldendale
Yakima
Ellensburg
Wenatchee
Waterville
Ephrata
Okanogan
Republic
Colville
Newport
Spokane
Davenport
Ritzville
Colfax
Pomeroy
Dayton
Asotin
Walla Walla
Pasco
Prosser
Columbia River
Snake River
Yakima River
Spokane River
Skagit River
Okanogan River
Kettle River
Lake Chelan
Banks Lake
Potholes Reservoir
Franklin D. Roosevelt Lake
Lake Washington
Chehalis River
Cowlitz River
Lewis River
Quinault River
Okanagan Range
Kettle River Range
Wenatchee Mountains
Saddle Mountains
Umtanum Ridge
Rattlesnake Mountains
0
14,000
Feet
0 12.5 25 50 75 100
Miles
1:1,700,000
ESRI MAPPING CENTER TEAM, ©2009

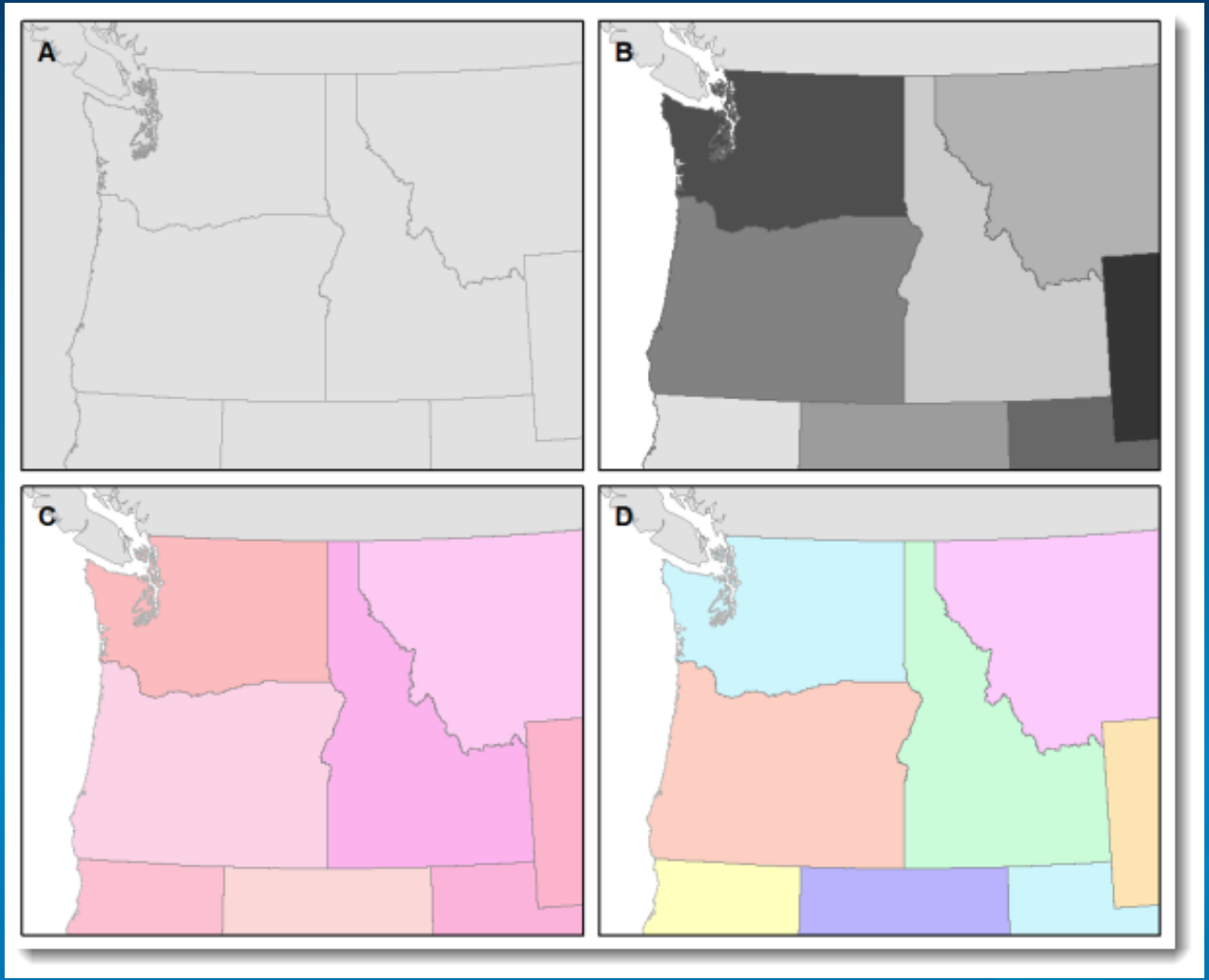
Five basic cartographic principles

- Figure-ground
- Contrast
- Legibility
- Visual hierarchy
- Balance

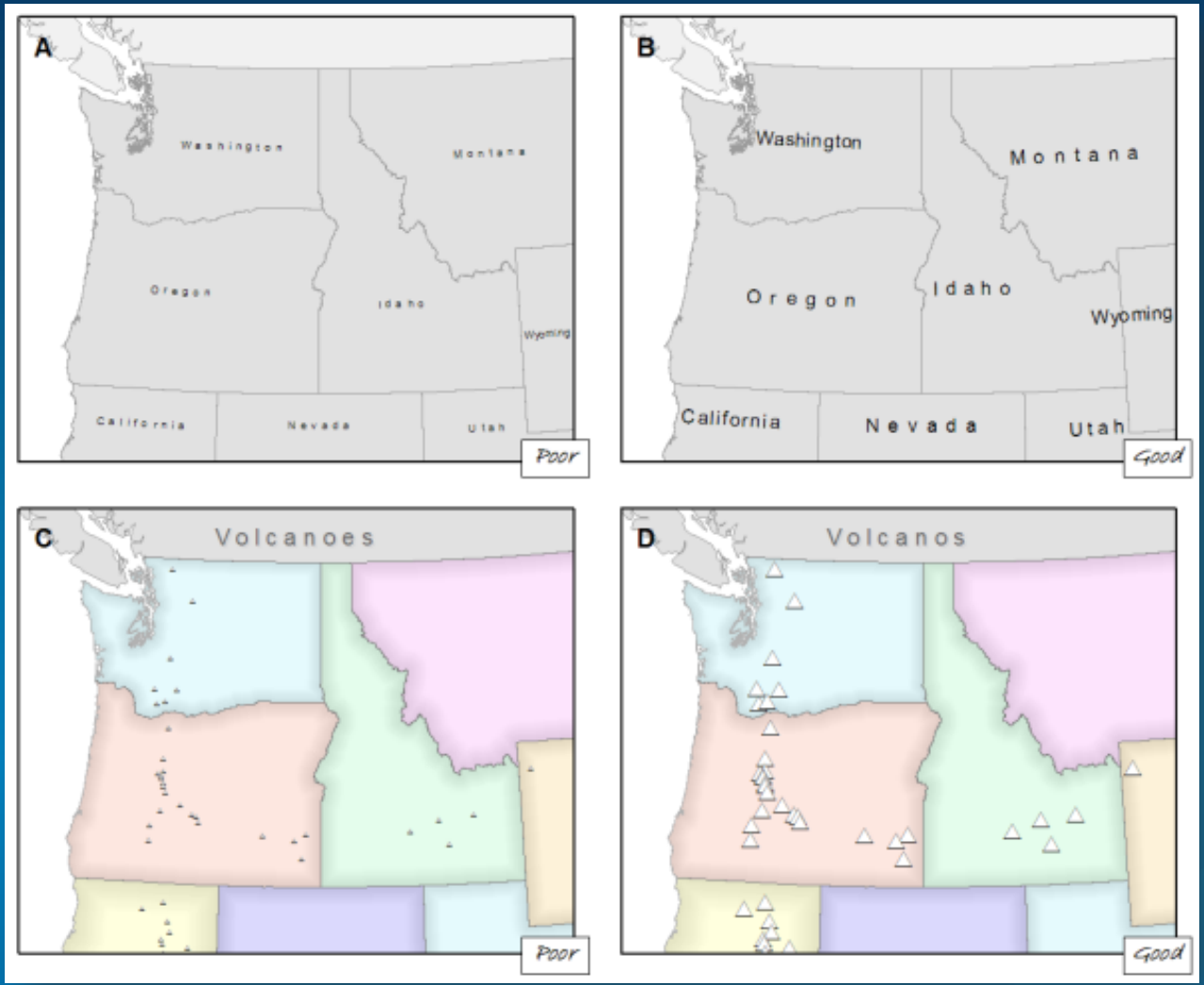
Figure-ground



Contrast

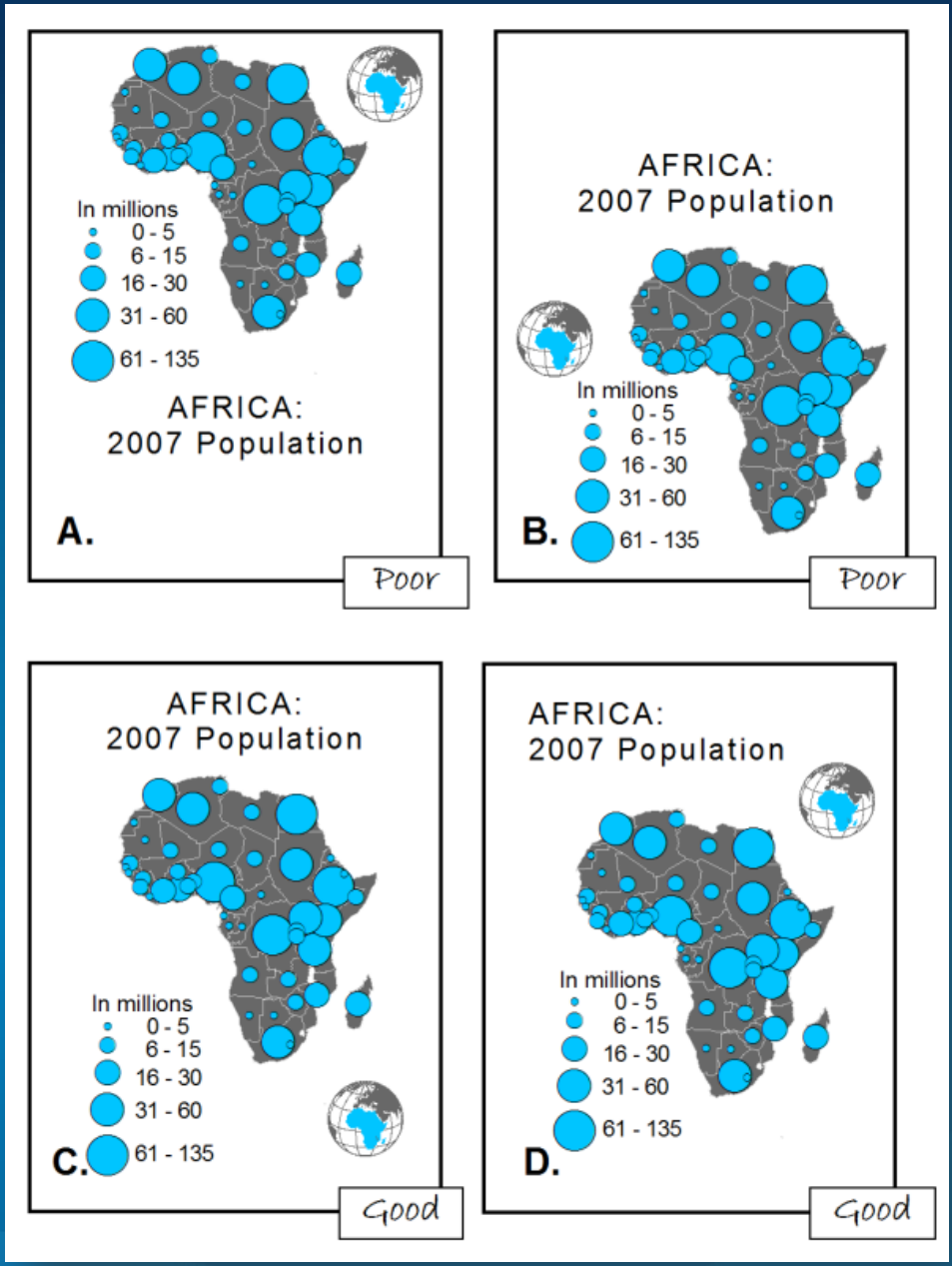


Legibility


A
Washington
Montana
Oregon
Idaho
Wyoming
California
Nevada
Utah
Poor
B
Washington
Montana
Oregon
Idaho
Wyoming
California
Nevada
Utah
Good
C
Volcanoes
Poor
D
Volcanos
Good

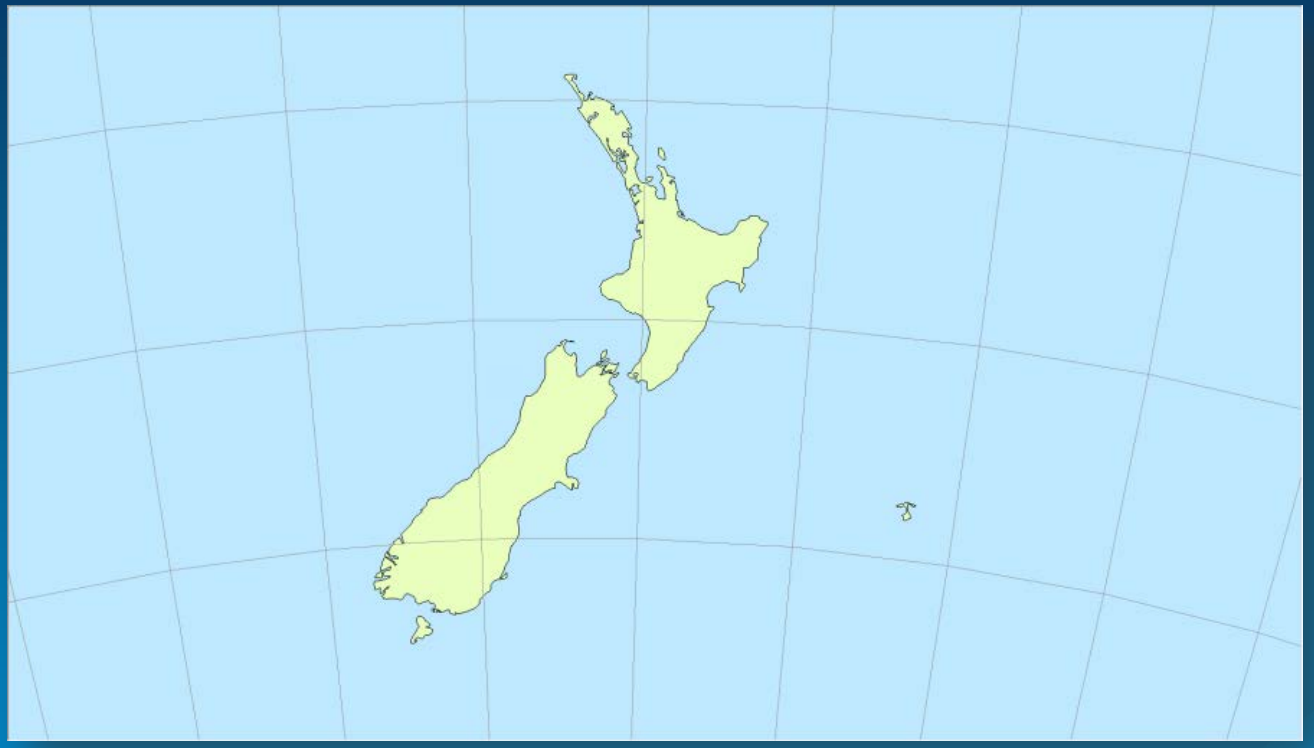
Visual hierarchy

Balance

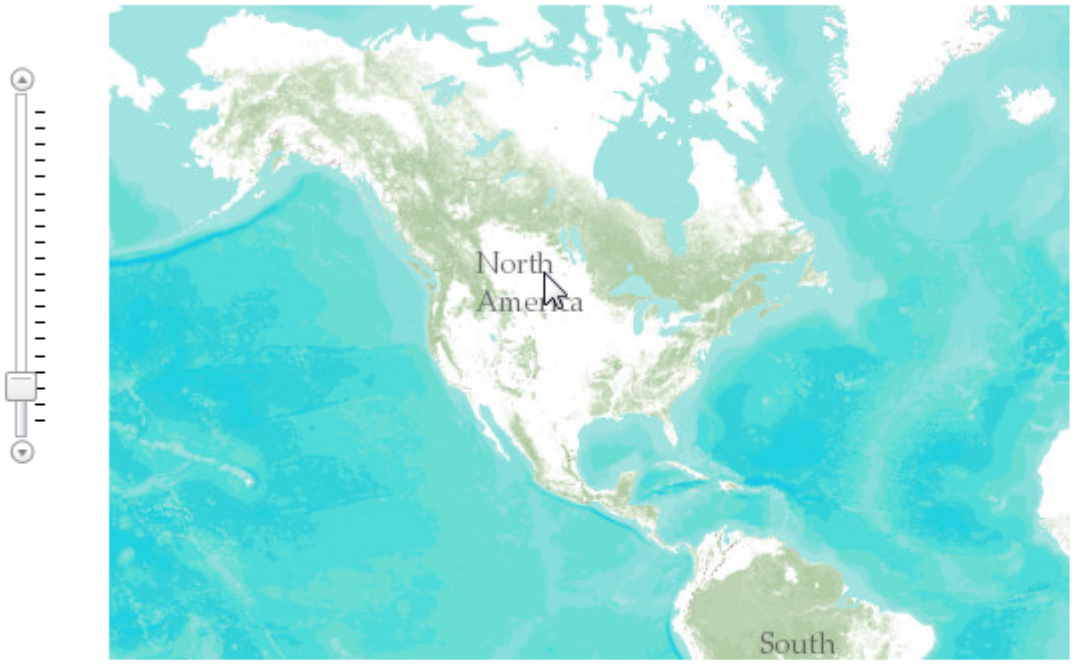

In millions
0 - 5
6 - 15
16 - 30
31 - 60
61 - 135
AFRICA:
2007 Population
A.
Poor
AFRICA:
2007 Population
In millions
0 - 5
6 - 15
16 - 30
31 - 60
61 - 135
B.
Poor
AFRICA:
2007 Population
In millions
0 - 5
6 - 15
16 - 30
31 - 60
61 - 135
C.
Good
AFRICA:
2007 Population
In millions
0 - 5
6 - 15
16 - 30
31 - 60
61 - 135
D.
Good

Marginalia

- Title
- North arrow
- Scale bar
- Inset maps

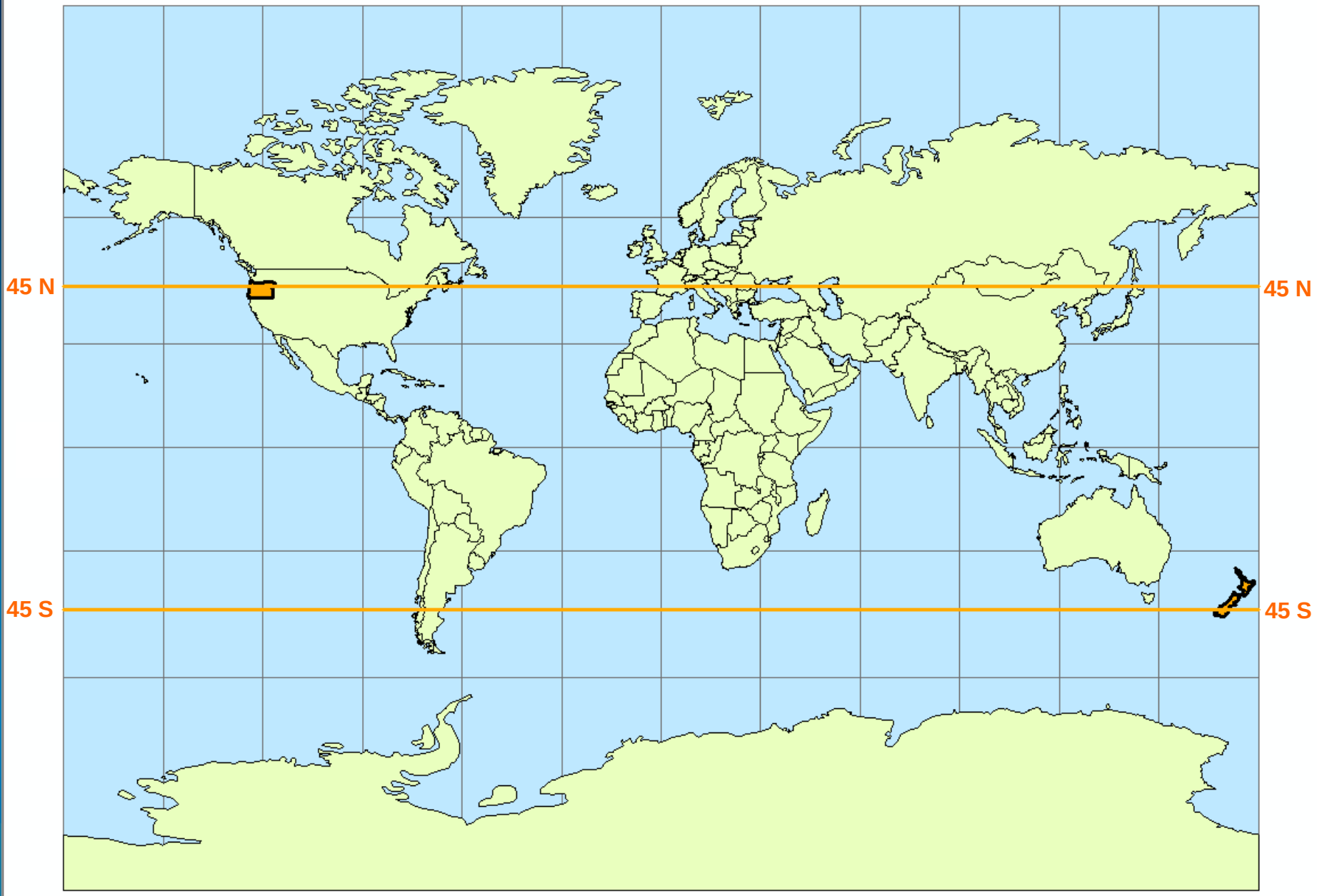


Draw polyline | Draw polygon | Deactivate drawing | Clear graphics



Results

This sample shows the differences in linear and areal measurements performed in Web Mercator, State Plane, and UTM. *The State Plane and UTM values are appropriate for northwestern Oregon only.* If you want to use this sample code in a different geographic location, you need to modify the well-known IDs (WKIDs) for StatePlane and UTM. Click here to view a list of WKIDs for projected coordinate systems.


45 N
45 S
45 N
45 S

Draw polyline | Draw polygon | Deactivate drawing | Clear graphics

Results

This sample shows the differences in linear and areal measurements performed in Web Mercator, State Plane, and UTM. *The State Plane and UTM values are appropriate for northwestern Oregon only.* If you want to use this sample code in a different geographic location, you need to modify the well-known IDs (WKIDs) for StatePlane and UTM. Click here to view a list of WKIDs for projected coordinate systems.

Draw polyline | Draw polygon | Deactivate drawing | Clear graphics

Results

Web Mercator (WKID:102100)
Length:790704 meters

State Plane Oregon North(WKID:32126)
Length:562401 meters

UTM Zone 10 (WKID:32610)
Length:562698 meters

This sample shows the differences in linear and areal measurements performed in Web Mercator, State Plane, and UTM. *The State Plane and UTM values are appropriate for northwestern Oregon only.* If you want to use this sample code in a different geographic location, you need to modify the well-known IDs (WKIDs) for StatePlane and UTM. Click here to view a list of WKIDs for projected coordinate systems.

Draw polyline | Draw polygon | Deactivate drawing | Clear graphics

Results

Web Mercator (WKID:102100)
Area:22100618925 square meters
Length:811722 meters

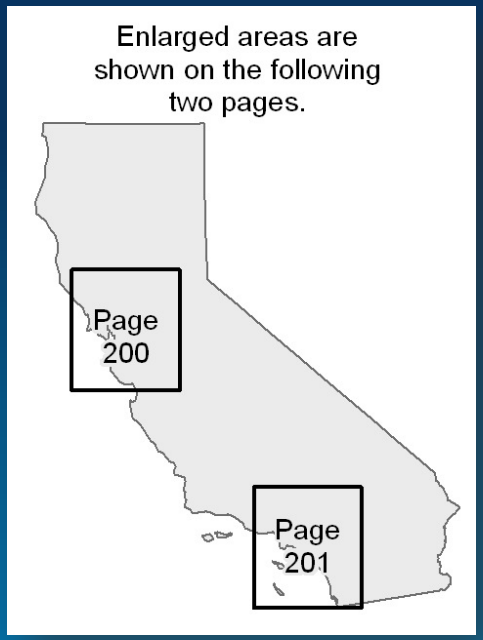
State Plane Oregon North (WKID:32126)
Area:11095389707 square meters
Length:575021 meters

UTM Zone 10 (WKID:32610)
Area:11088020179 square meters
Length:574821 meters

This sample shows the differences in linear and areal measurements performed in Web Mercator, State Plane, and UTM. *The State Plane and UTM values are appropriate for northwestern Oregon only.* If you want to use this sample code in a different geographic location, you need to modify the well-known IDs (WKIDs) for StatePlane and UTM. Click here to view a list of WKIDs for projected coordinate systems.

Inset maps


Area Shown
at Left

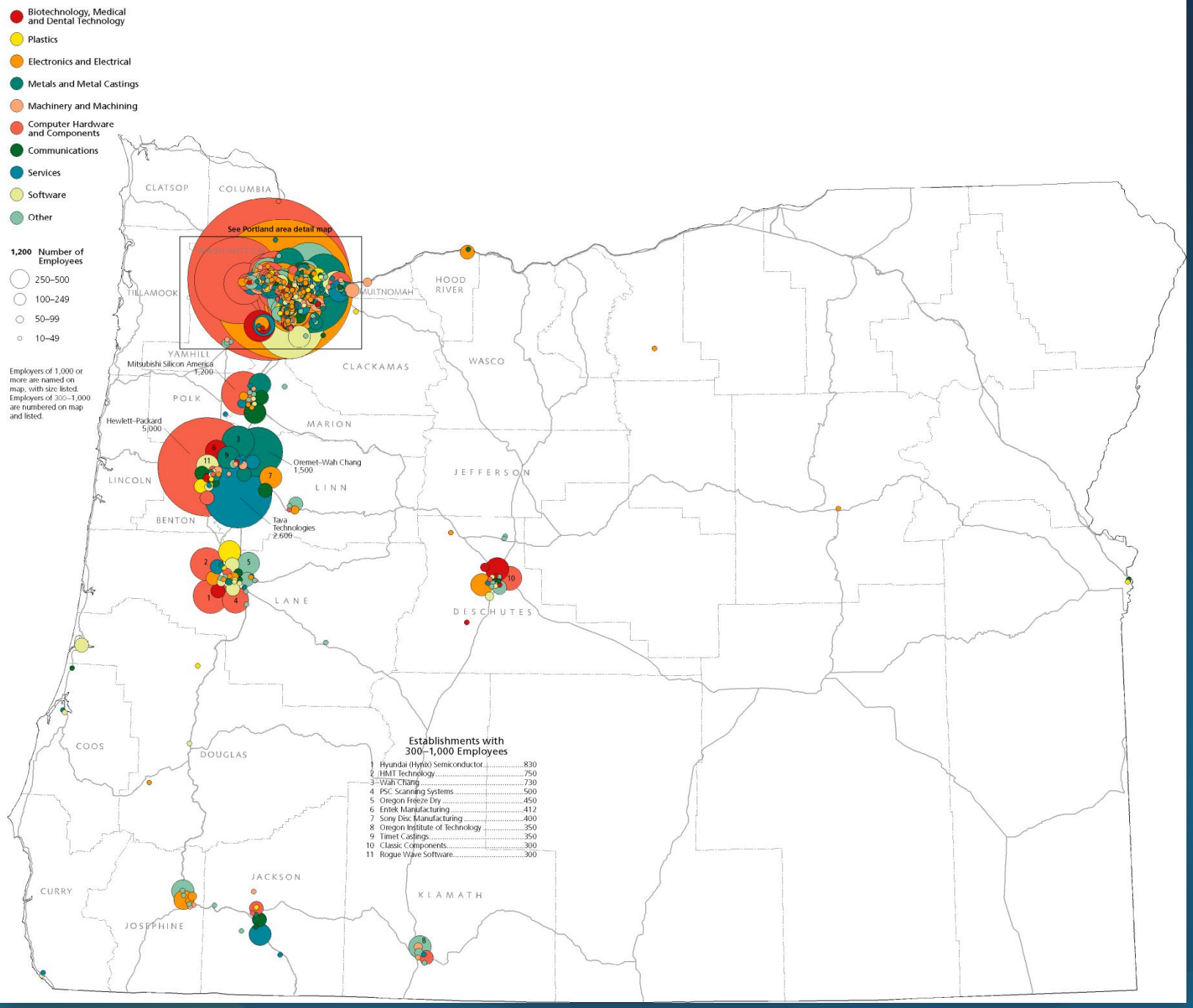

Enlarged areas are
shown on the following
two pages.
Page
200
Page
201


See enlargements below

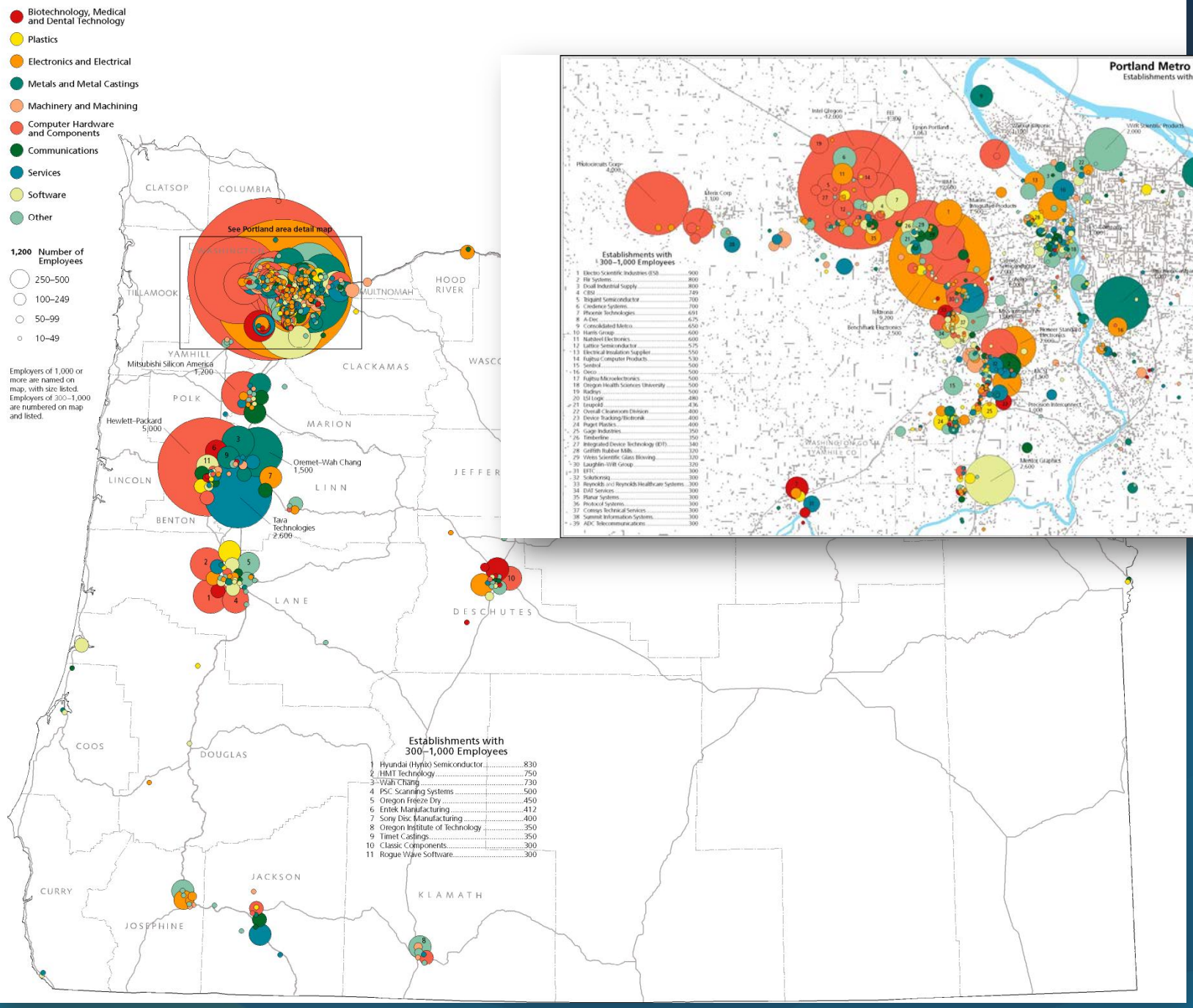

See also Reference Map
Pages 250-251


See Los Angeles area detail map at right

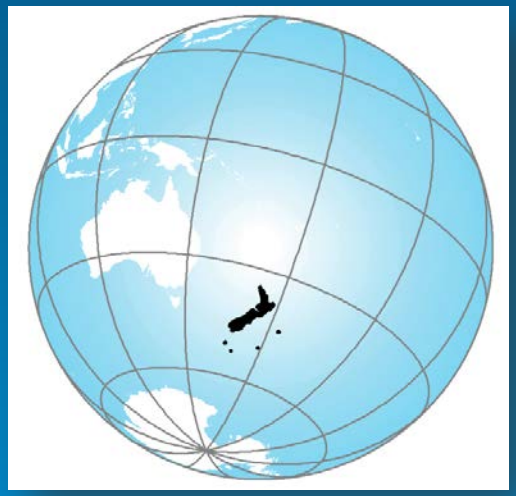
High-Tech Companies, 2000



High-Tech Companies, 2000



Locator maps



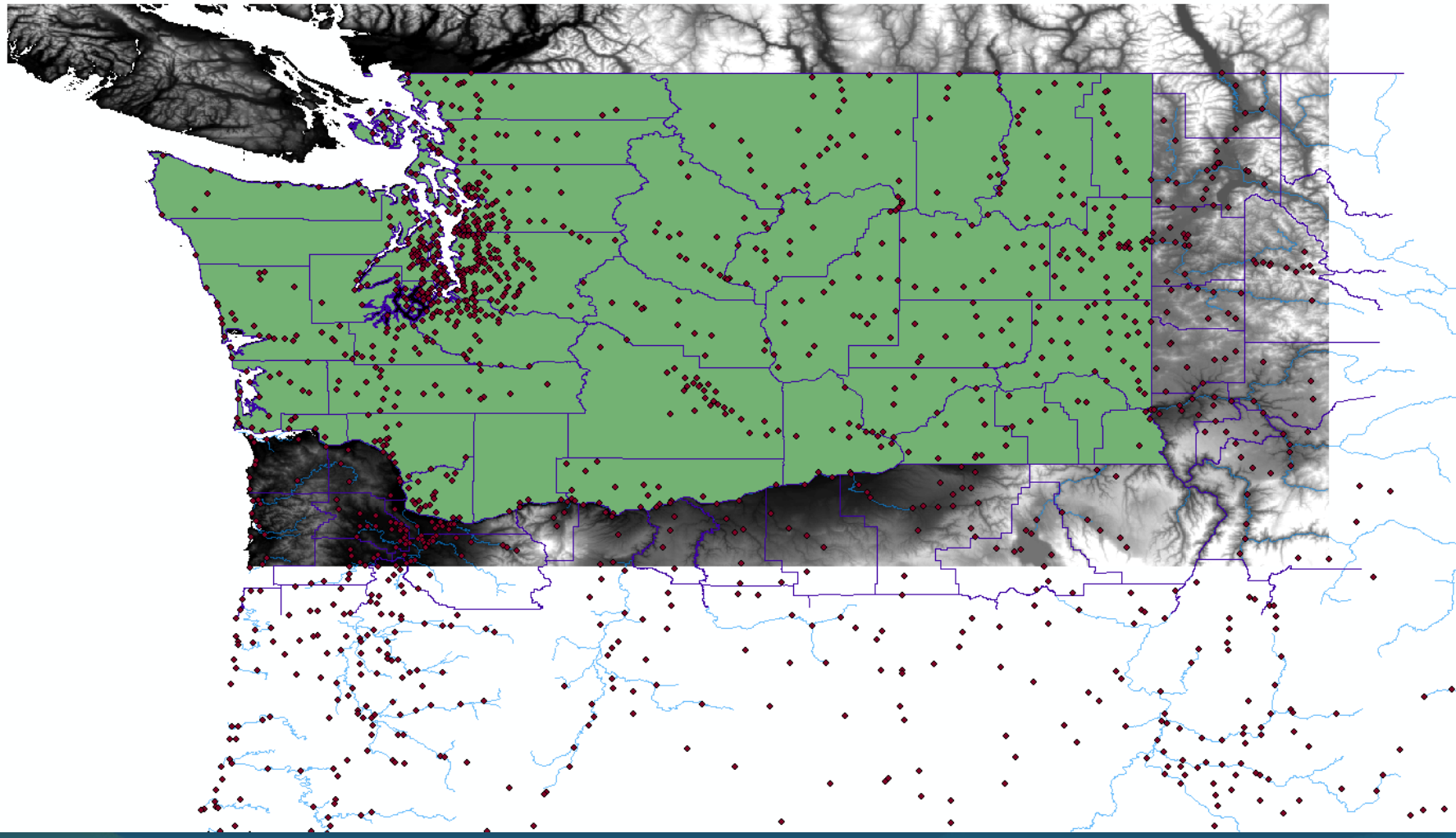
Emphasize location relative to southwestern Pacific Ocean

Emphasize location relative to Australia

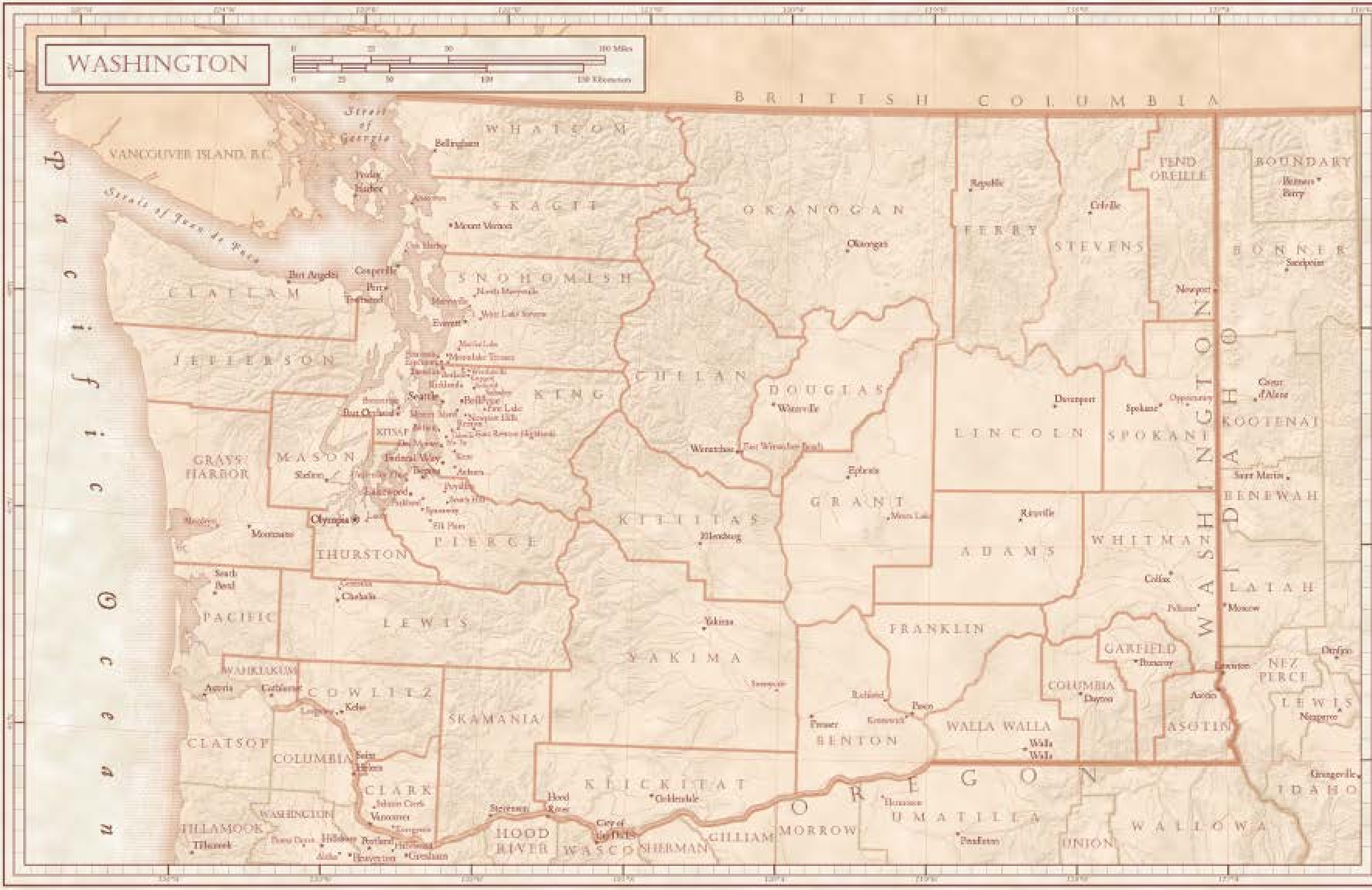
Emphasize location relative to Antarctica

Affective objective

- The “affect” of the map
- The “look and feel” of the map
- Aesthetic appeal
- Get peoples’ attention, then keep it




WASHINGTON ELEVATION
Pacific Ocean
WHATCOM
SAN JUAN
SKAGIT
OKANOGAN
FERRY
STEVENS
PEND OREILLE
CLALLAM
ISLAND
SNOHOMISH
CHELAN
DOUGLAS
LINCOLN
SPOKANE
JEFFERSON
KITSAP
KING
MASON
GRAYS HARBOR
KITTITAS
GRANT
ADAMS
WHITMAN
THURSTON
PIERCE
LEWIS
PACIFIC
YAKIMA
FRANKLIN
GARFIELD
WAHKIAKUM
COWLITZ
SKAMANIA
BENTON
WALLA WALLA
COLUMBIA
ASOTIN
CLARK
KLICKITAT
Bellingham
Port Angeles
Port Townsend
Everett
Seattle
Tacoma
Olympia
Shelton
Aberdeen
Hoquiam
Montesano
South Bend
Chehalis
Centralia
Castle Rock
Kelso
Longview
Vancouver
Mount Vernon
Coupeville
Friday Harbor
Mount Baker
Mount Rainier
Mount Adams
Mount St. Helens
Goldendale
Stevenson
Waterville
Wenatchee
Ephrata
Ellensburg
Yakima
Othello
Pasco
Kennewick
Prosser
Walla Walla
Dayton
Pomeroy
Colfax
Ritzville
Davenport
Spokane
Newport
Republic
Colville
Okanogan
Chief Joseph Dam
Grand Coulee Dam
Franklin D. Roosevelt Lake
Lake Chelan
Lake Wenatchee
Lake Washington
Puget Sound
Columbia River
Snake River
Yakima River
Grays Harbor
Willapa Bay
Scale 1:1,700,000
Lambert Conformal Conic Projection
Data from Esri Data and Maps DVD
Esri Mapping Center Team © 2010


WASHINGTON
BRITISH COLUMBIA
OREGON
IDAHO
WASHINGTON
Pacific Ocean
VANCOUVER ISLAND, B.C.
Strait of Georgia
Strait of Juan de Fuca
WHATCOM
SKAGIT
SNOHOMISH
OKANOGAN
FERRY
STEVENS
PEND OREILLE
BOUNDARY
BONNER
CLALLAM
JEFFERSON
KING
CHELAN
DOUGLAS
LINCOLN
SPOKANE
KOOTENAI
GRAYS HARBOR
MASON
KITSAP
THURSTON
PIERCE
KITTITAS
GRANT
ADAMS
WHITMAN
BENEWAH
LATAH
PACIFIC
LEWIS
YAKIMA
FRANKLIN
GARFIELD
NEZ PERCE
WAHKIAKUM
COWLITZ
SKAMANIA
COLUMBIA
WALLA WALLA
ASOTIN
BENTON
CLATSOP
COLUMBIA
CLARK
KLICKITAT
TILLAMOOK
WASHINGTON
HOOD RIVER
WASCO
SHERMAN
GILLIAM
MORROW
UMATILLA
UNION
WALLOWA
LEWIS
Bellingham
Mount Vernon
Port Angeles
Everett
Seattle
Tacoma
Olympia
Ellensburg
Wenatchee
Yakima
Spokane
Walla Walla
Vancouver
Portland

Additional topics

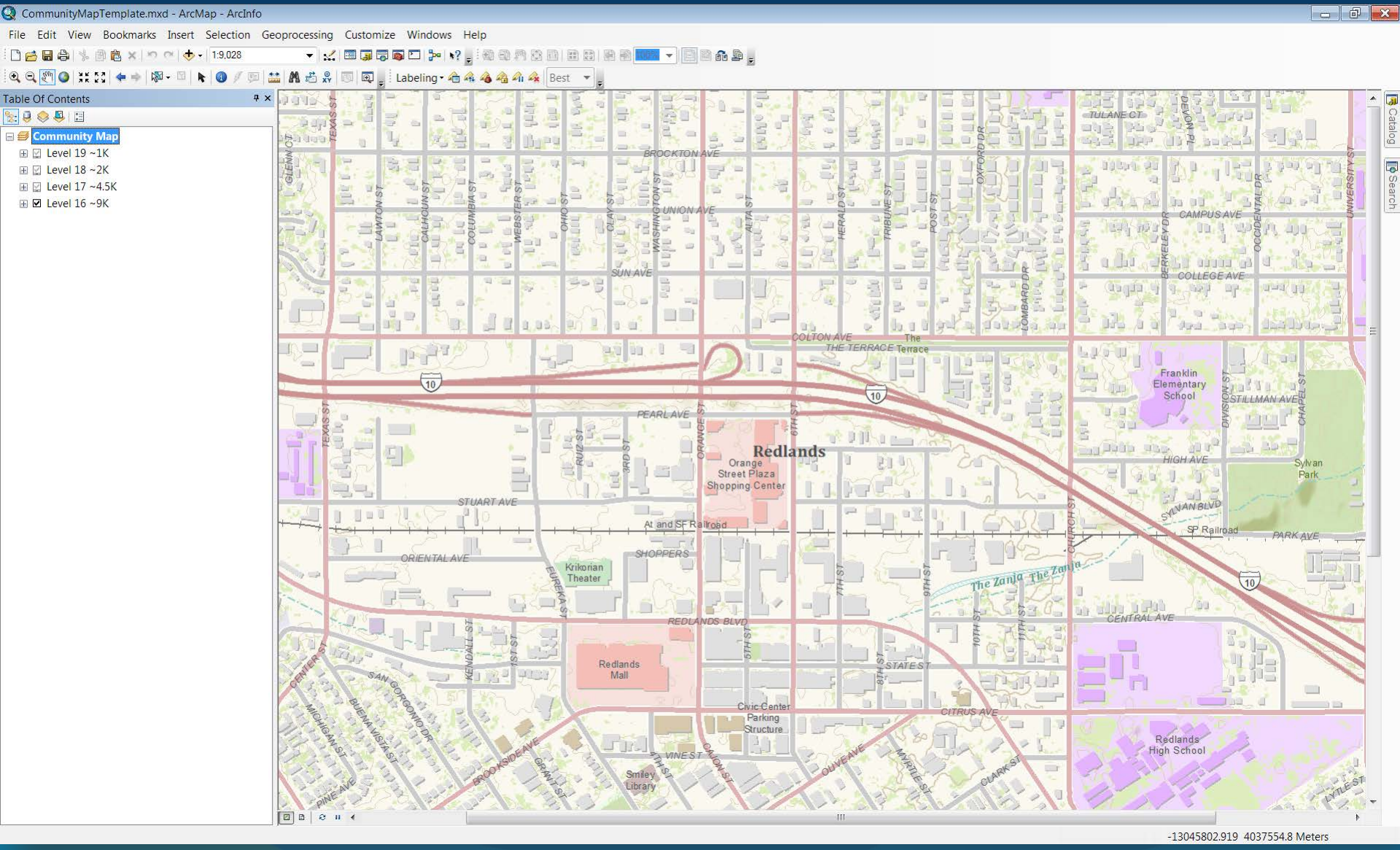
- Legends
- Map series
- Multivariate maps
- Spatio-temporal maps
- Other mapping methods
- Web maps

5 minute warning

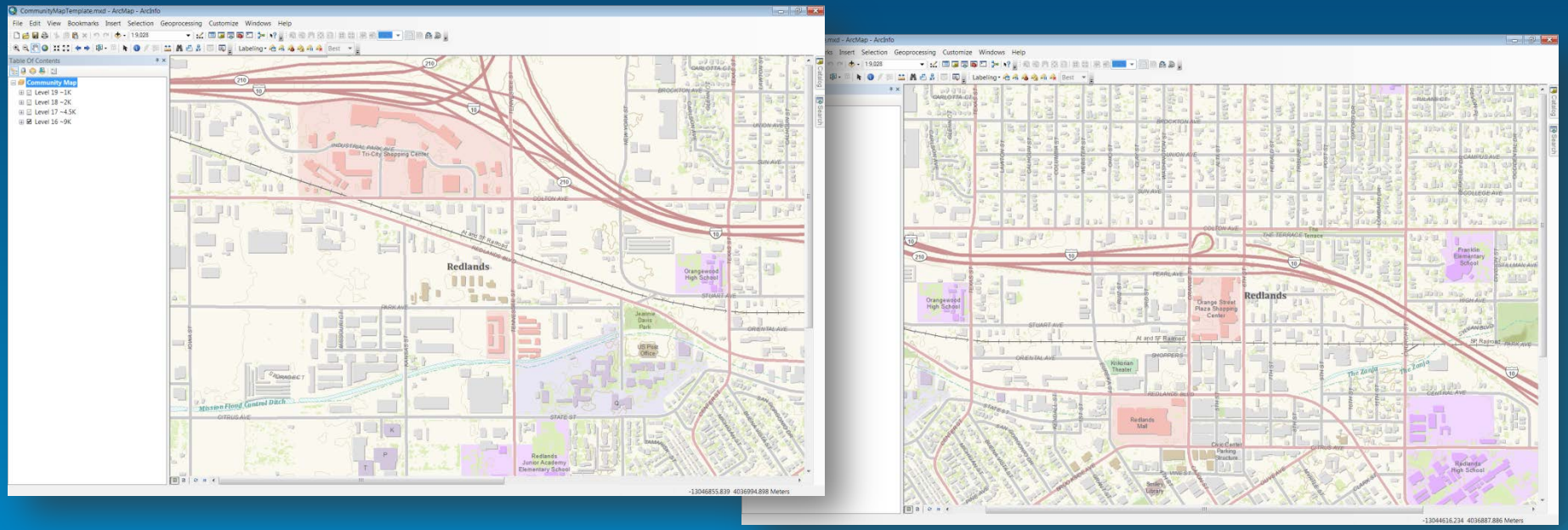
Design and technical considerations

- “What size will it be?”
- “What geographic extent will I show?”
- “What map scale will that make it?”
- “What map projection will I use?”
- “Will it be in color?”
- “What will the print resolution be?”

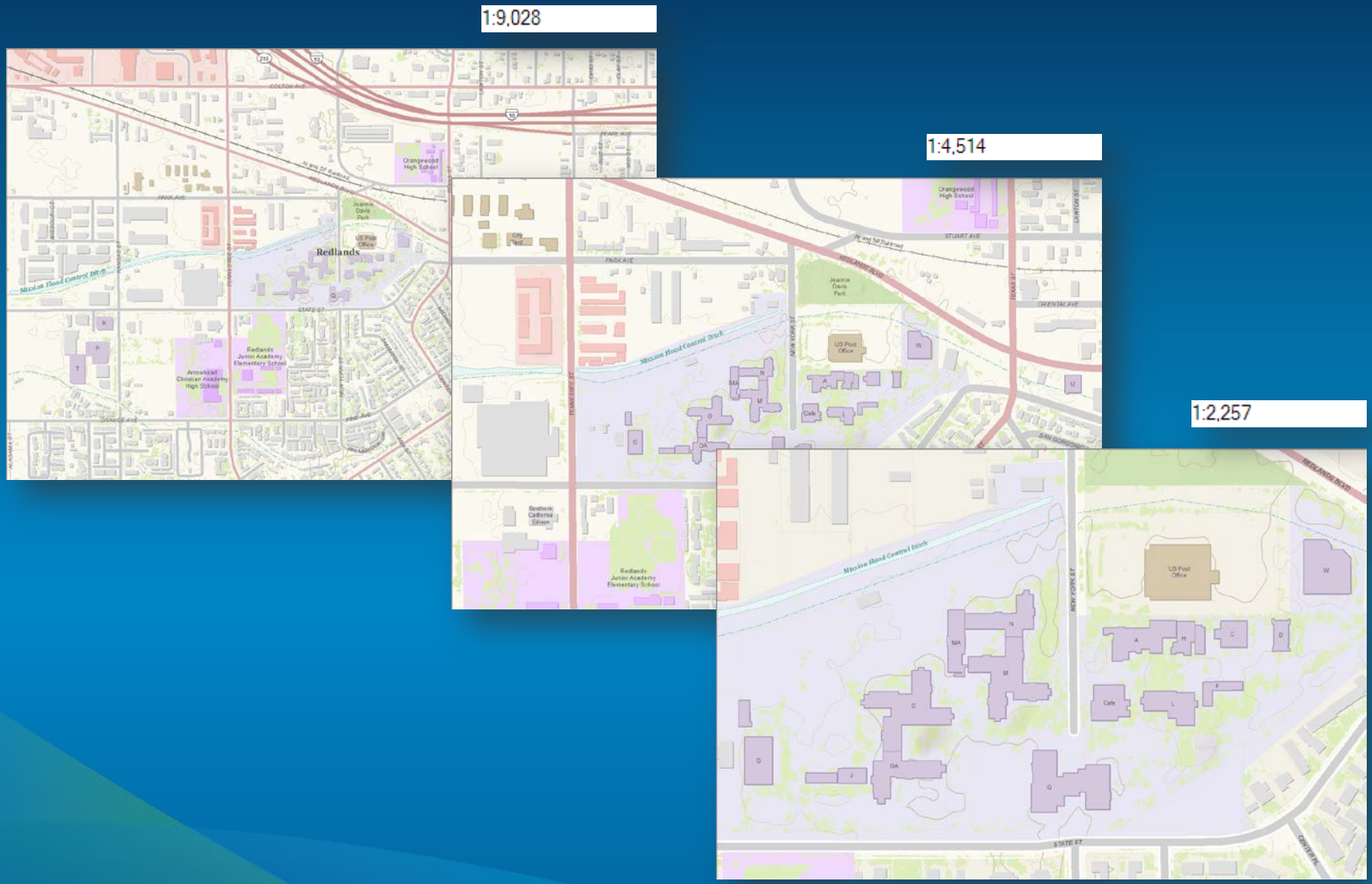
What size will it be? *17” – 19” monitor*



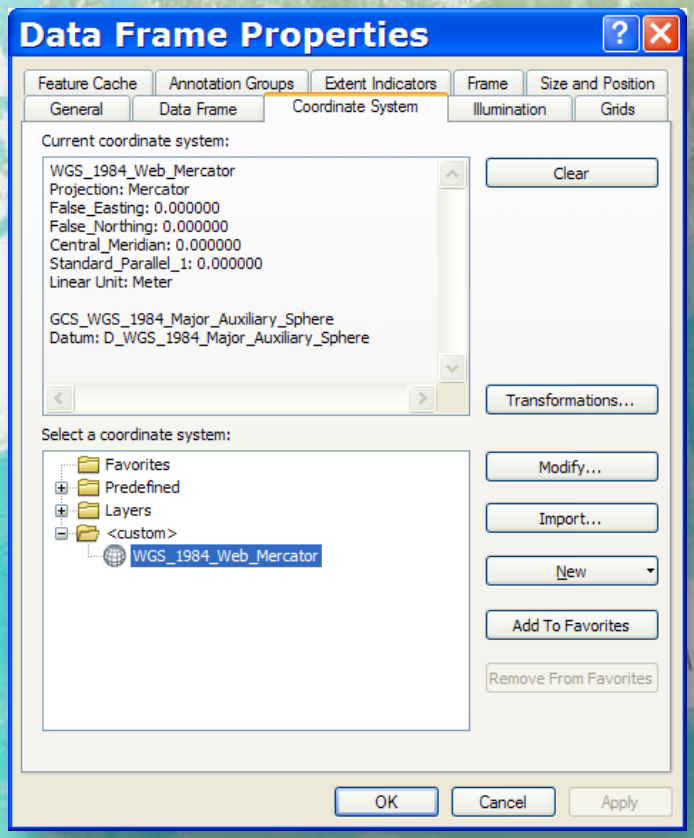
What geographic extent? *Larger than the screen*



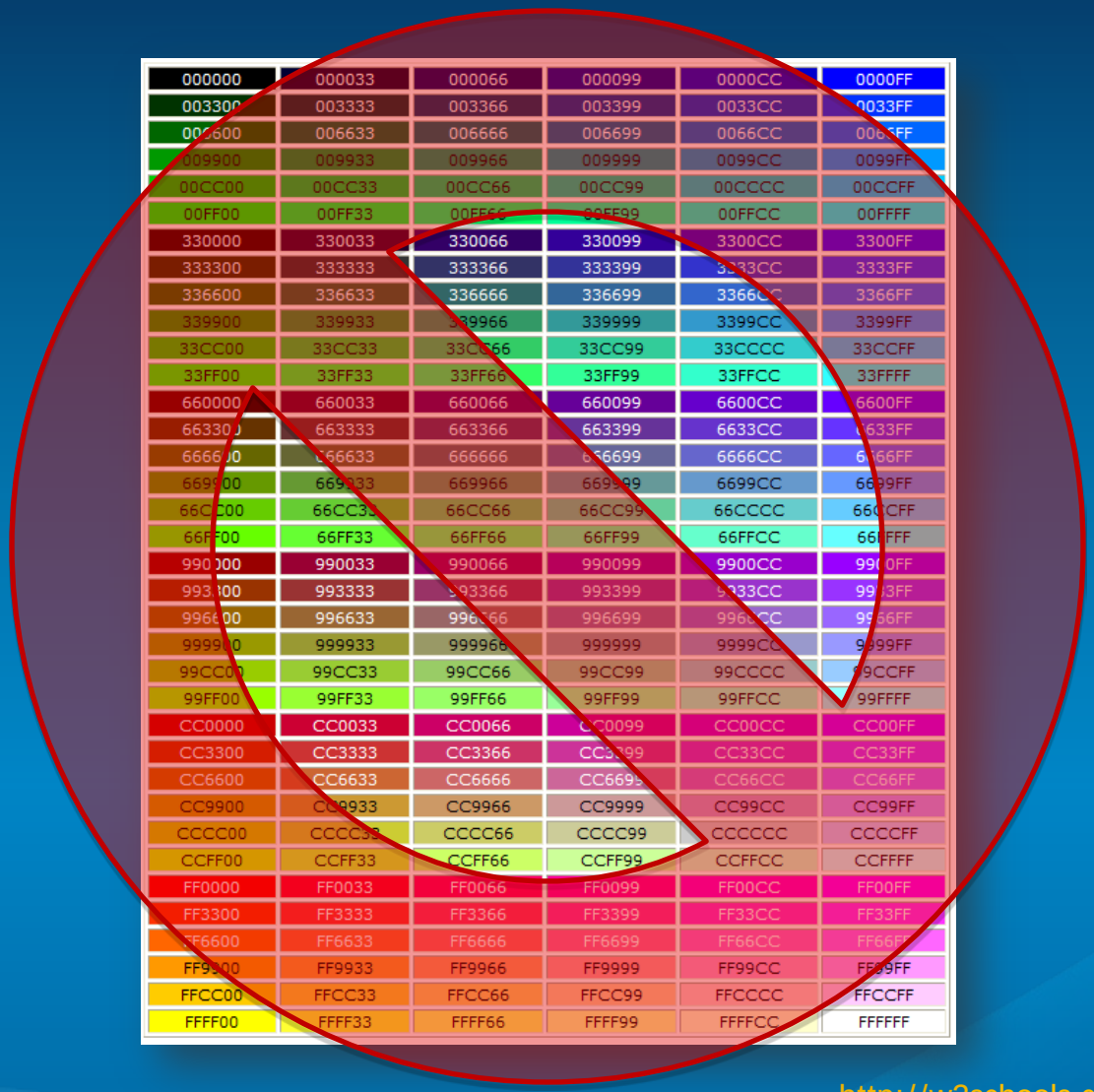
What map scale? *Multiple map scales*



What map projection? *Web Mercator???*

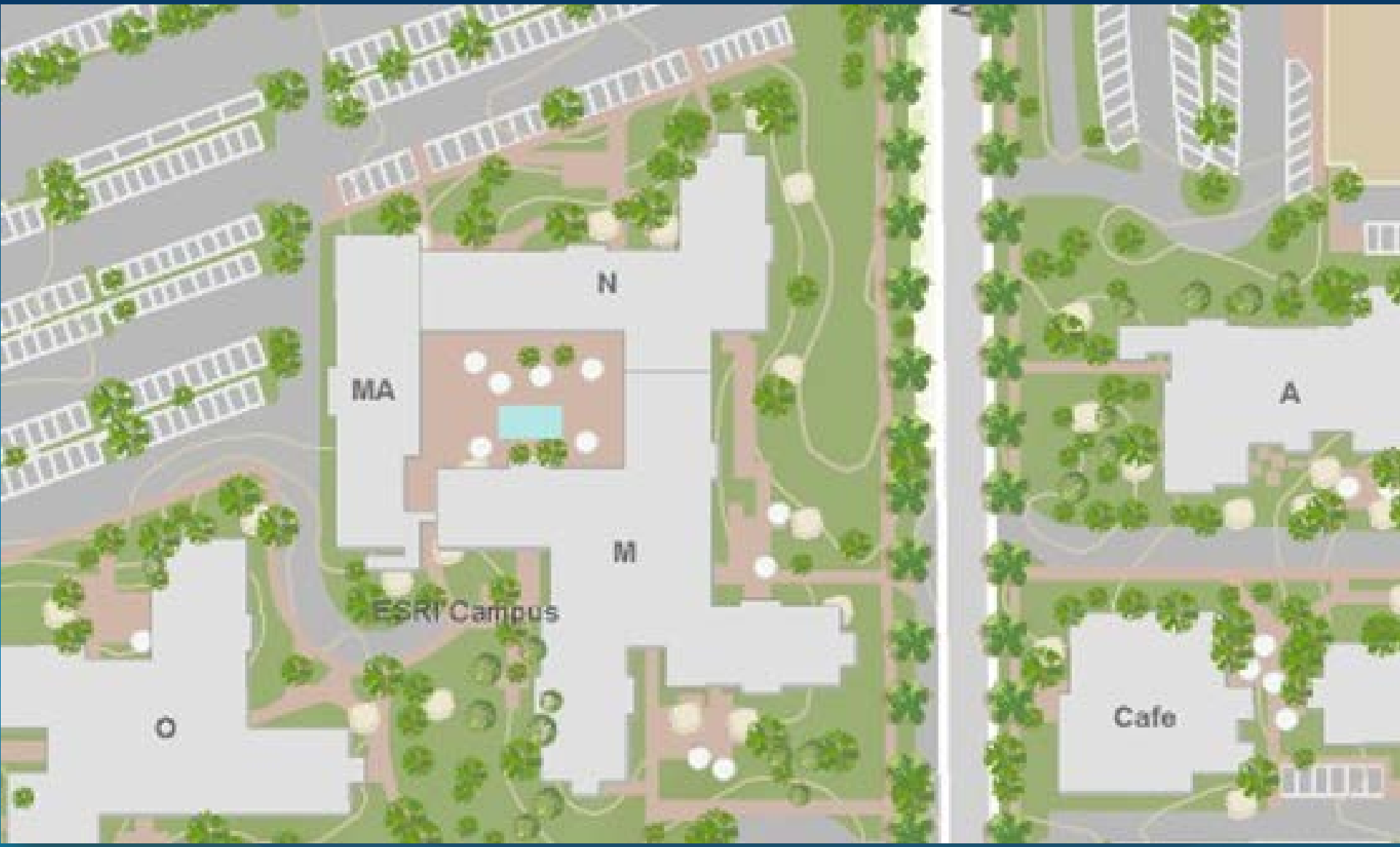


Will it be in color? *Yes*



http://w3schools.com/html/html_colors.asp

What will the resolution be? *96 dpi*



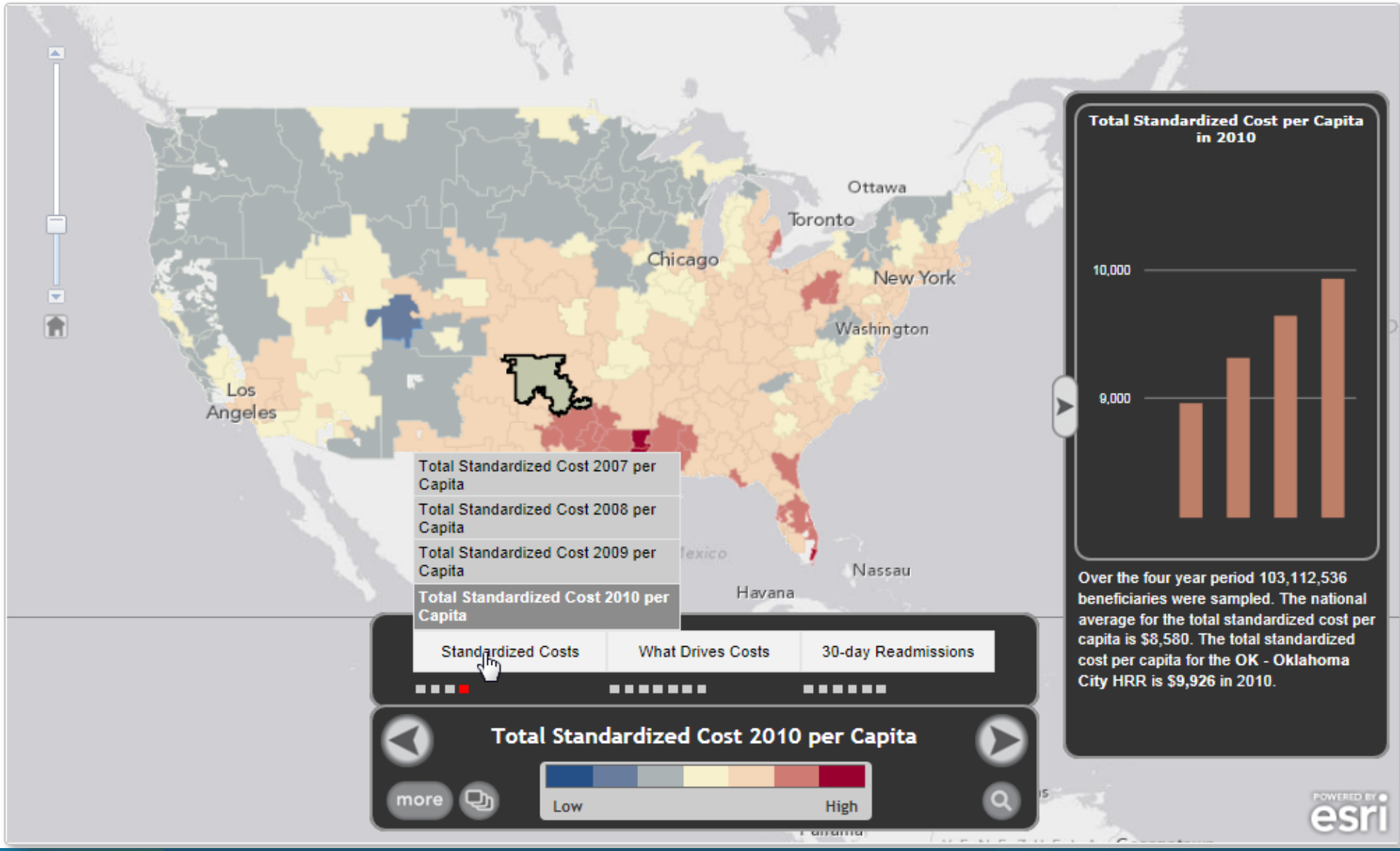
2 minute warning

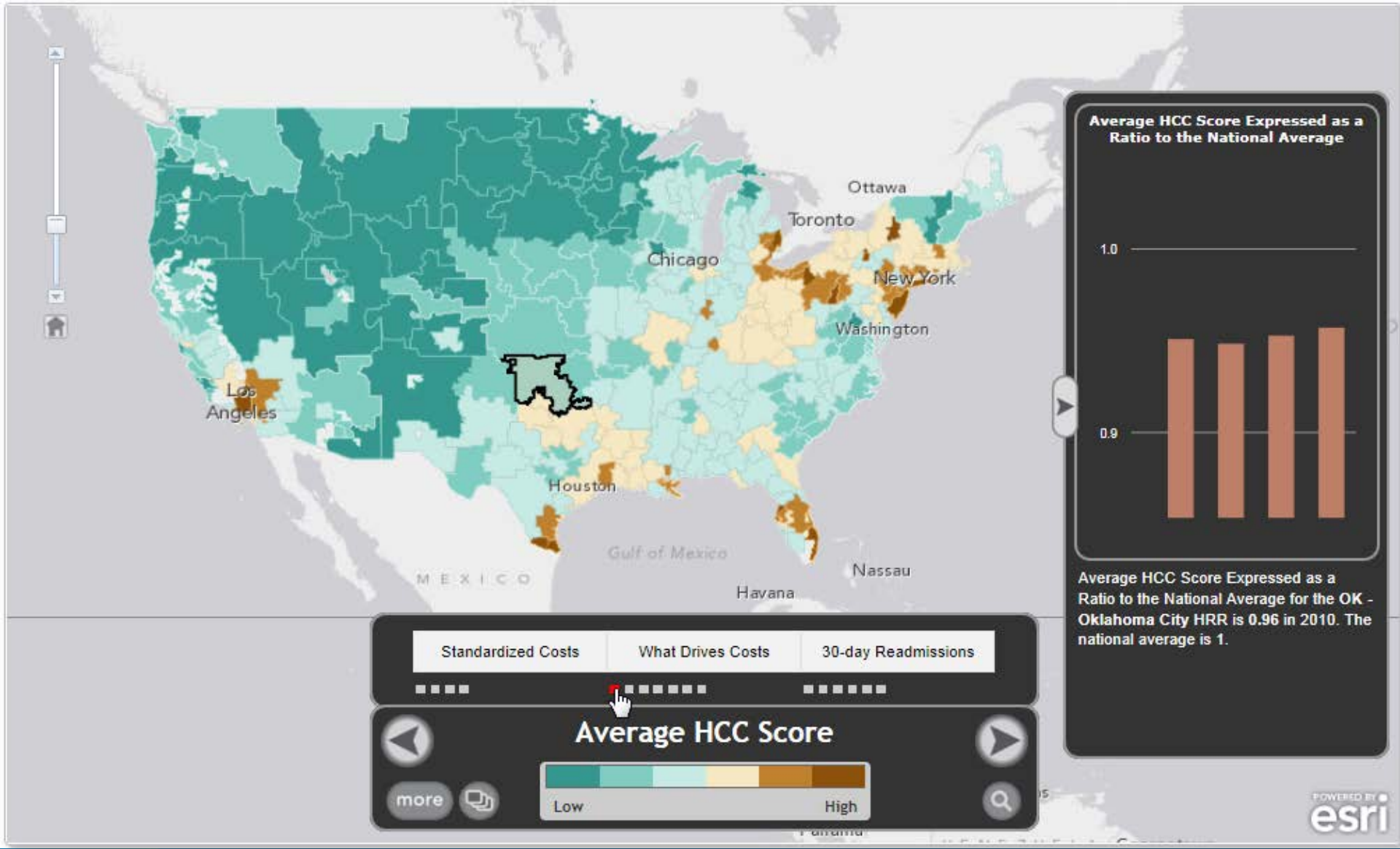
Design and technical considerations

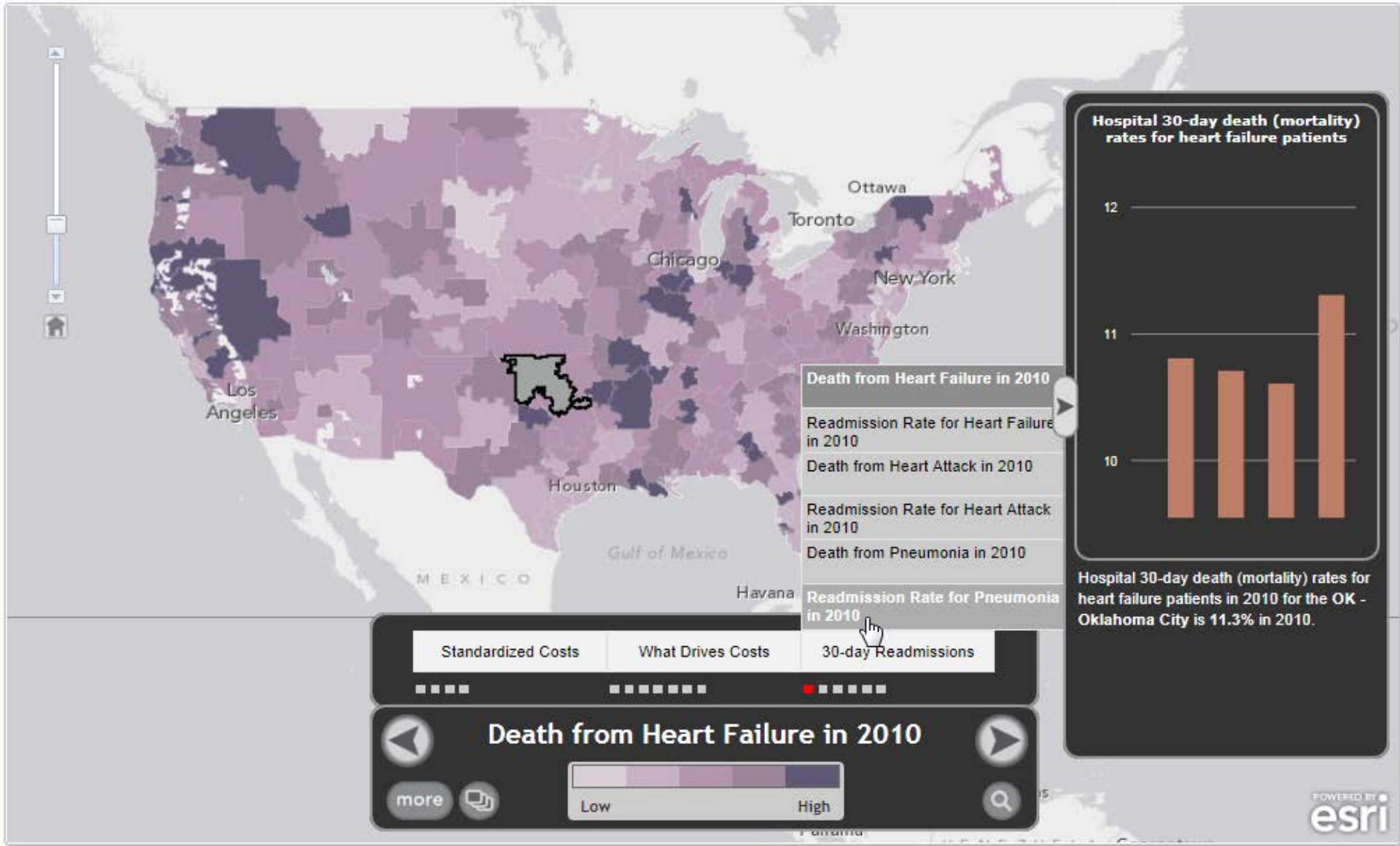
- “What size will it be?”
- “What geographic extent will I show?”
- “What map scale will that make it?”
- “What map projection will I use?”
- “Will it be in color?”
- “What will the print resolution be?”

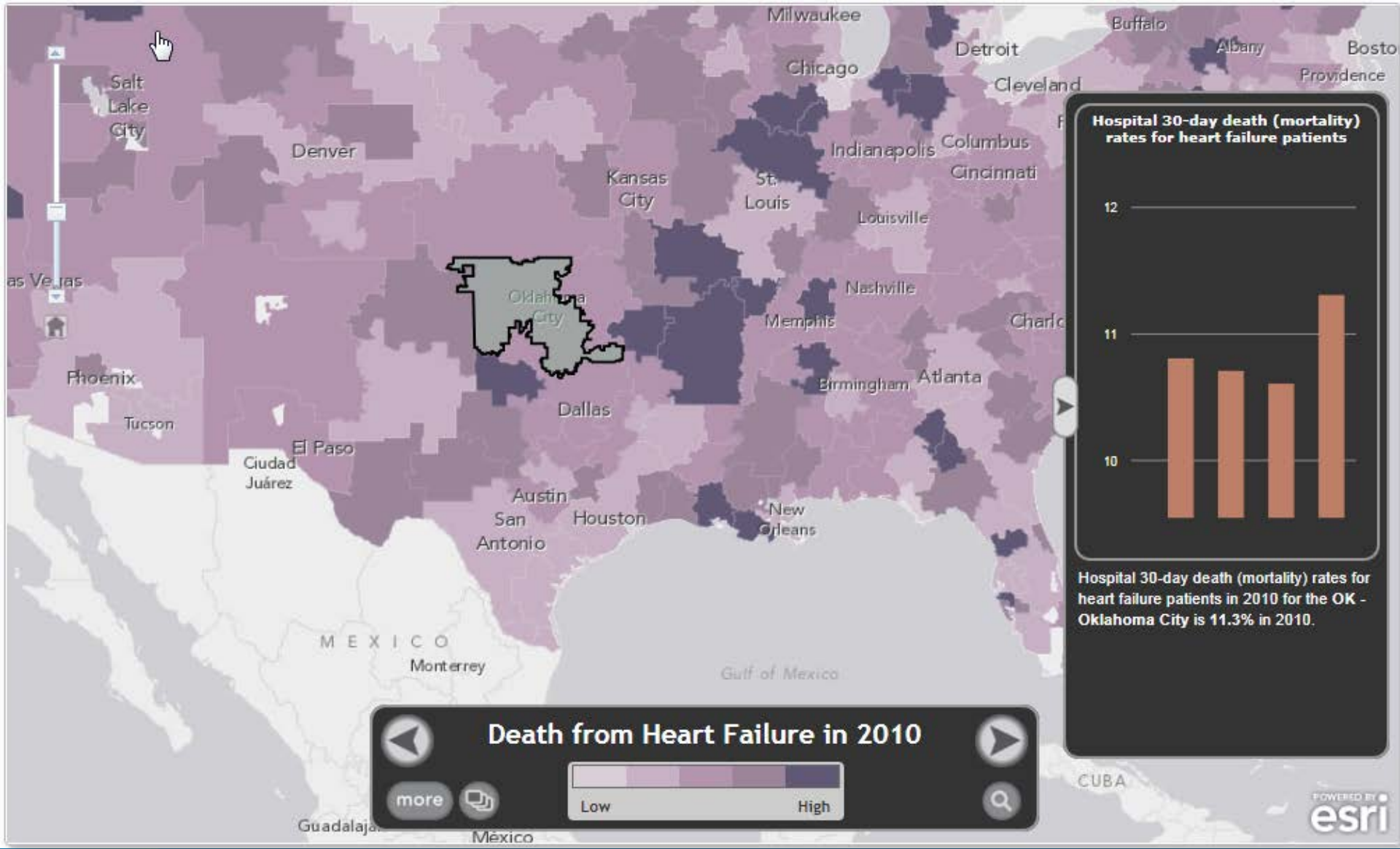
- “How will readers interact with the map?”

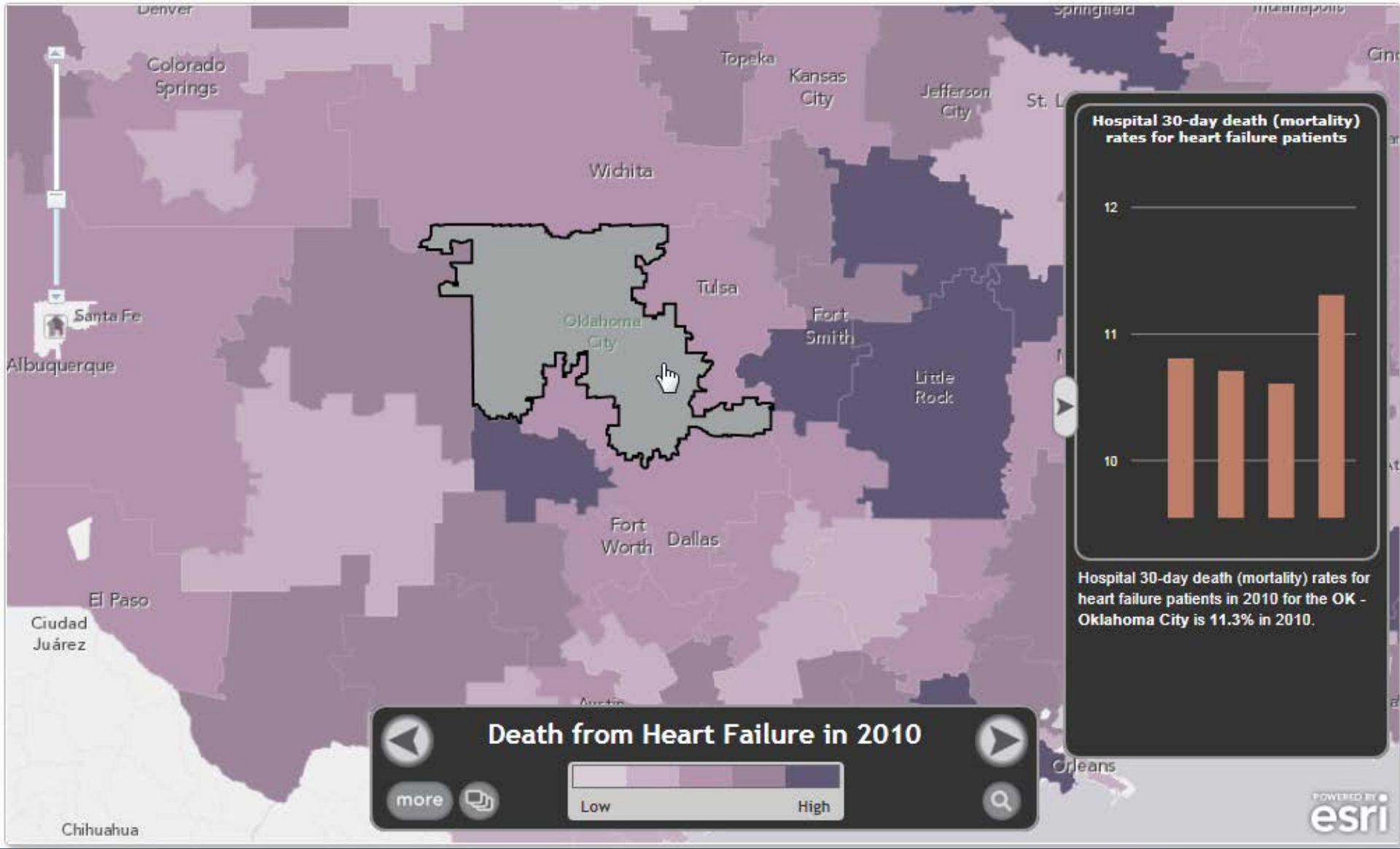
- “How to I publish the map?”

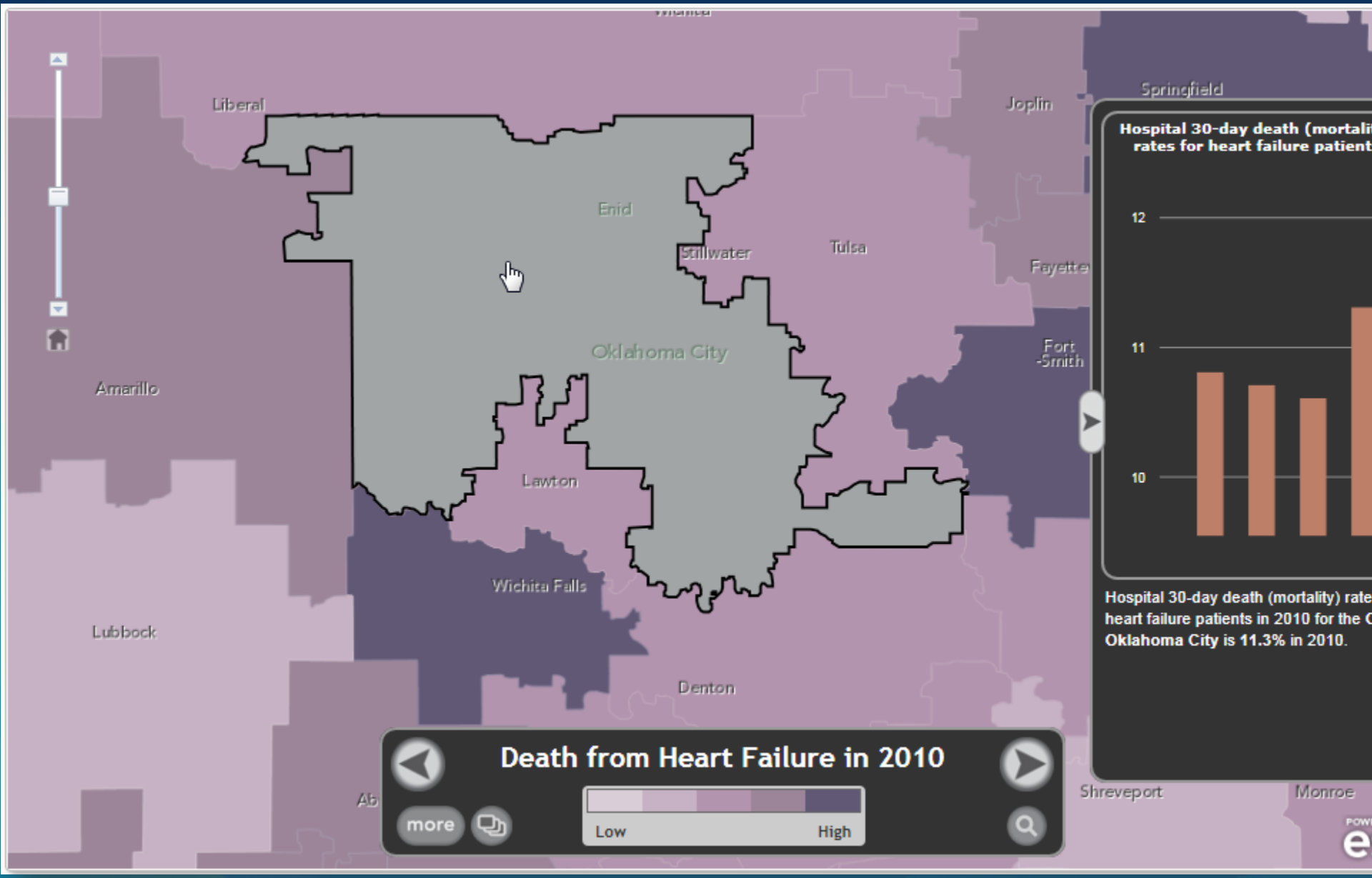

Ottawa
Toronto
Chicago
New York
Washington
Los Angeles
Nassau
Havana
Total Standardized Cost per Capita in 2010
10,000
9,000
Over the four year period 103,112,536 beneficiaries were sampled. The national average for the total standardized cost per capita is $8,580. The total standardized cost per capita for the OK - Oklahoma City HRR is $9,926 in 2010.
Total Standardized Cost 2007 per Capita
Total Standardized Cost 2008 per Capita
Total Standardized Cost 2009 per Capita
Total Standardized Cost 2010 per Capita
Standardized Costs
What Drives Costs
30-day Readmissions
Total Standardized Cost 2010 per Capita
Low
High
more
POWERED BY esri


Ottawa
Toronto
Chicago
New York
Washington
Los Angeles
Houston
Gulf of Mexico
MEXICO
Nassau
Havana
Average HCC Score Expressed as a Ratio to the National Average
1.0
0.9
Average HCC Score Expressed as a Ratio to the National Average for the OK - Oklahoma City HRR is 0.96 in 2010. The national average is 1.
Standardized Costs
What Drives Costs
30-day Readmissions
Average HCC Score
more
Low
High
esri


Hospital 30-day death (mortality) rates for heart failure patients
12
11
10
Ottawa
Toronto
Chicago
New York
Washington
Los Angeles
Houston
Gulf of Mexico
MEXICO
Havana
Death from Heart Failure in 2010
Readmission Rate for Heart Failure in 2010
Death from Heart Attack in 2010
Readmission Rate for Heart Attack in 2010
Death from Pneumonia in 2010
Readmission Rate for Pneumonia in 2010
Hospital 30-day death (mortality) rates for heart failure patients in 2010 for the OK - Oklahoma City is 11.3% in 2010.
Standardized Costs
What Drives Costs
30-day Readmissions
Death from Heart Failure in 2010
more
Low
High
esri


Milwaukee
Buffalo
Detroit
Albany
Chicago
Cleveland
Providence
Salt Lake City
Denver
Indianapolis
Columbus
Cincinnati
Kansas City
St. Louis
Louisville
Nashville
Memphis
Phoenix
Birmingham
Atlanta
Dallas
Tucson
El Paso
Ciudad Juárez
Austin
San Antonio
Houston
New Orleans
MEXICO
Monterrey
Gulf of Mexico
CUBA
Guadalajara
México
Hospital 30-day death (mortality) rates for heart failure patients
12
11
10
Hospital 30-day death (mortality) rates for heart failure patients in 2010 for the OK - Oklahoma City is 11.3% in 2010.
Death from Heart Failure in 2010
more
Low
High
esri


Denver
Colorado Springs
Topeka
Kansas City
Jefferson City
Wichita
Tulsa
Oklahoma City
Fort Smith
Little Rock
Santa Fe
Albuquerque
Fort Worth
Dallas
El Paso
Ciudad Juárez
Chihuahua
Orleans
Hospital 30-day death (mortality) rates for heart failure patients
12
11
10
Hospital 30-day death (mortality) rates for heart failure patients in 2010 for the OK - Oklahoma City is 11.3% in 2010.
Death from Heart Failure in 2010
more
Low
High
esri


Liberal
Springfield
Joplin
Enid
Stillwater
Tulsa
Fayette
Oklahoma City
Fort
-Smith
Amarillo
Lawton
Wichita Falls
Lubbock
Denton
Shreveport
Monroe
Hospital 30-day death (mortali
rates for heart failure patient
12
11
10
Hospital 30-day death (mortality) rate
heart failure patients in 2010 for the C
Oklahoma City is 11.3% in 2010.
Death from Heart Failure in 2010
more
Low
High

To learn more…

- Mapping Resource Center – esriurl.com/mapping
- Mapping blog – esriurl.com/mapping > Blog
- Mapping Center – mappingcenter.esri.com

- ArcUser magazine (online and print)
- ArcWatch online monthly newsletter

References (in order of appearance)

- Skipping stone image – http://en.wikipedia.org/wiki/Stone_skipping
- "Cartography Cubed" - MacEachren, A. M. and Kraak, M.-J. 1997. Exploratory cartographic visualization: Advancing the agenda. *Computers & Geosciences* 23(4): 335-343
- Statistical surfaces - Jenks, G. F. (1963), Generalization in Statistical Mapping. *Annals of the Association of American Geographers*, 53: 15–26
- Areal interpolation - ArcGIS Online Help, http://resources.arcgis.com/en/help/main/10.1/index.html#//0031000000q8000000
- Statistical maps - Brewer, C. 2006. Basic Mapping Principles for Visualizing Cancer Data Using Geographic Information Systems (GIS). *American Journal of Preventive Medicine,* 30(2): s25-S36, http://www.ajpmonline.org/article/S0749-3797%2805%2900358-2/fulltext#section2
- Visual variables - Bertin, Jacques. 2010. *Semiology of Graphics: Diagrams, Networks, Maps*. Redlands, CA: Esri Press, 124 pages, http://makingmaps.net/2008/02/13/map-symbols-showing-multivariate-data-with-texture/
- Color variables – Brewer, Cynthia A. 2005. *Designing Better Maps: A Guide for GIS Users*. Redlands, CA: Esri Press, 202 pages
- ColorBrewer 2.0 - http://colorbrewer2.org/
- Oregon maps – Loy, W. G, Allan S, Buckley A. R., Meacham, J. E. 2001. *Atlas of Oregon*, 2nd ed., Eugene, OR: University of Oregon Press, 301 pages
- Web Mercator measuring tool – http://serverx.esri.com/javascript_examples/compare_measurements.htm
- Online atlas maps - http://serverx.esri.com/javascript_examples/compare_measurements.htm

Thank you!

abuckley@esri.com