Introduction to Maps

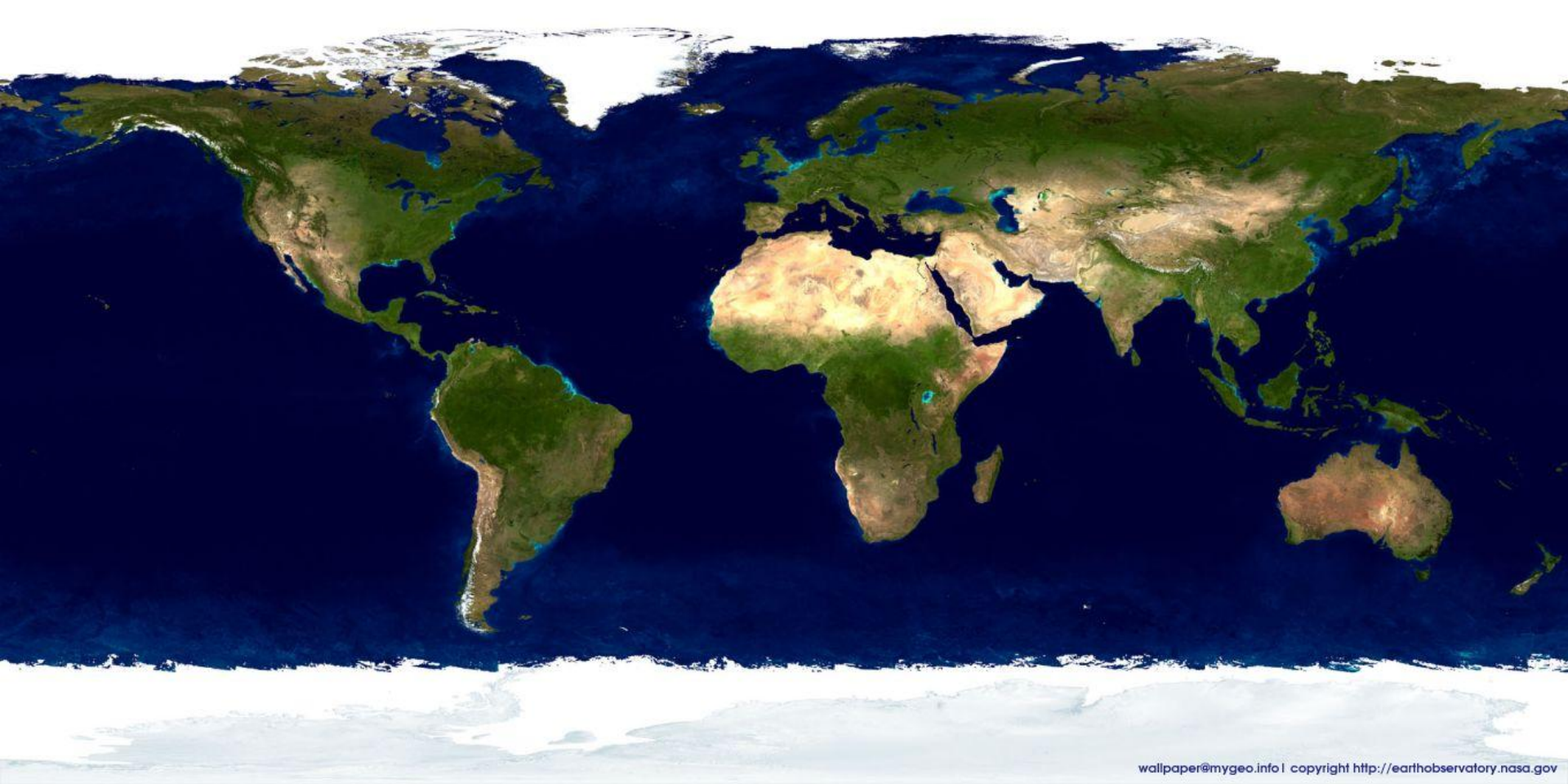
What is a map?

- A map is any concrete or abstract representation of the features that occur on or near the surface of the earth or other celestial bodies at a greatly reduced size.
- Any geographical image of the environment.
- A two-dimensional representation of the spatial distribution of selected phenomena

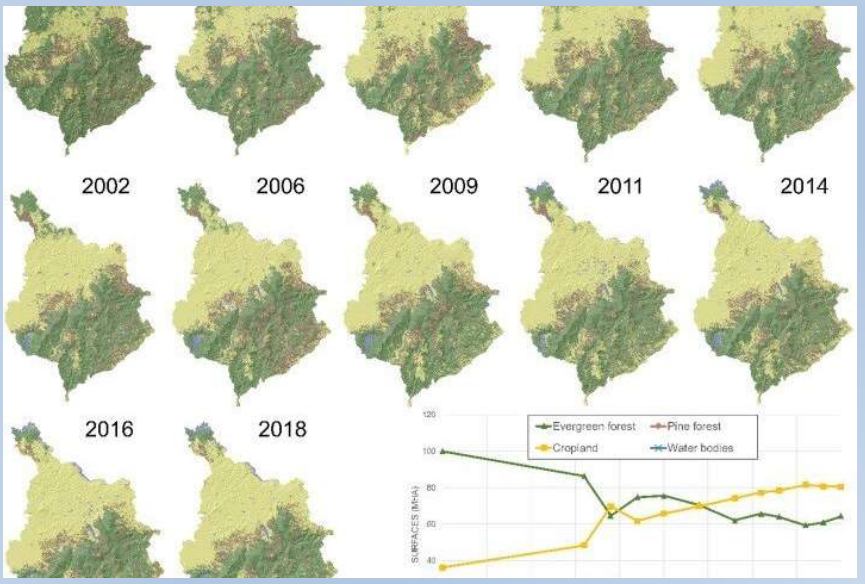
Why make maps?

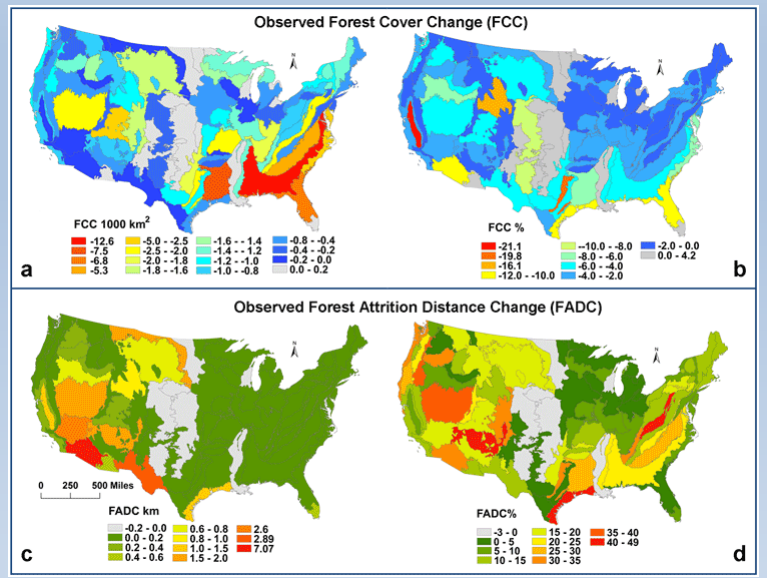
- To represent a larger area than we can see
- To show a phenomenon or process we can’t see with our eyes
- To present information concisely
- To show spatial relationships

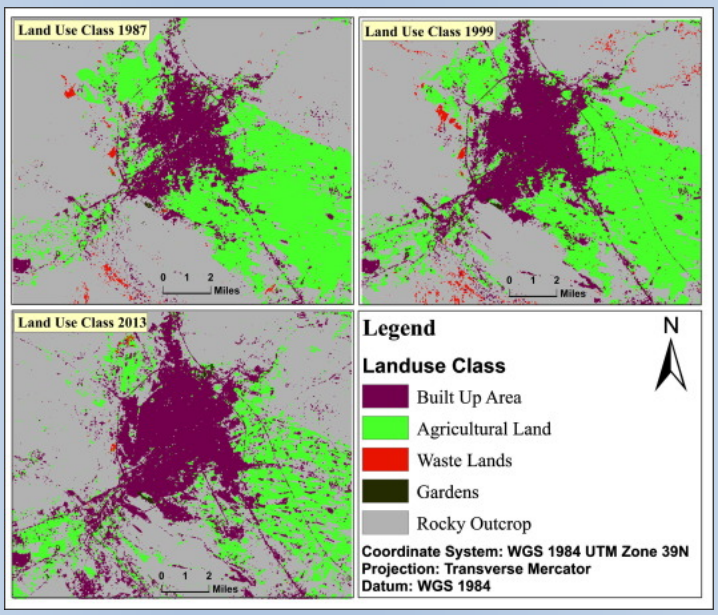
Represent a larger area

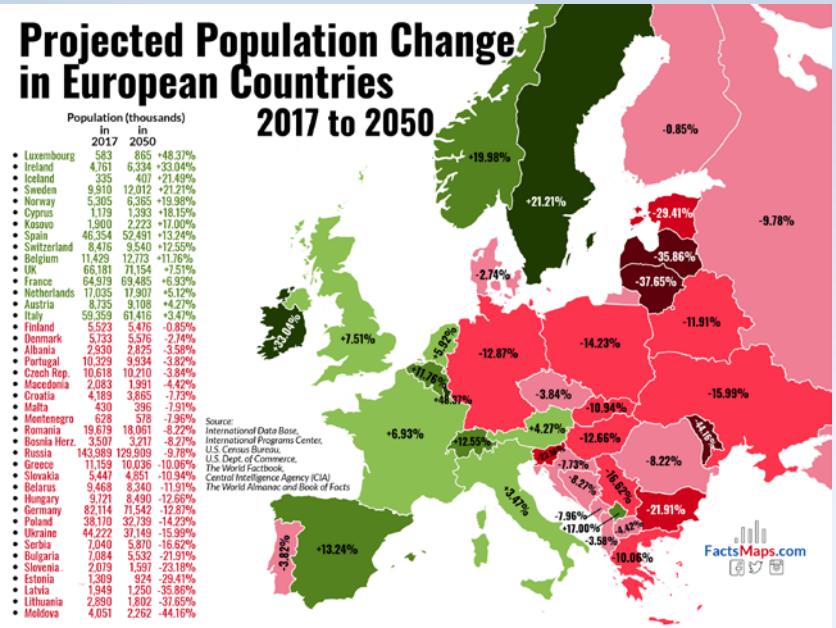


Show what we can't see

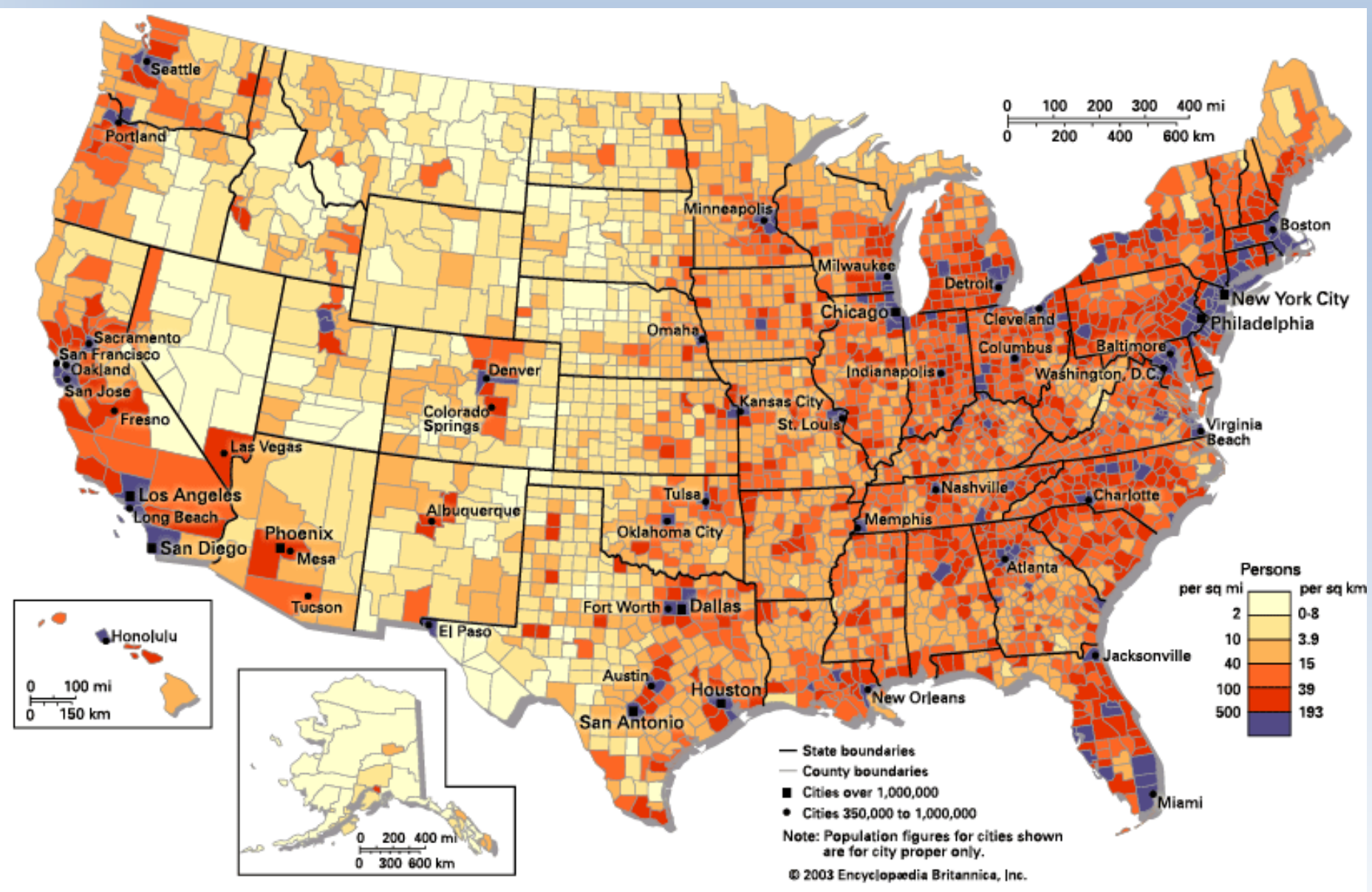




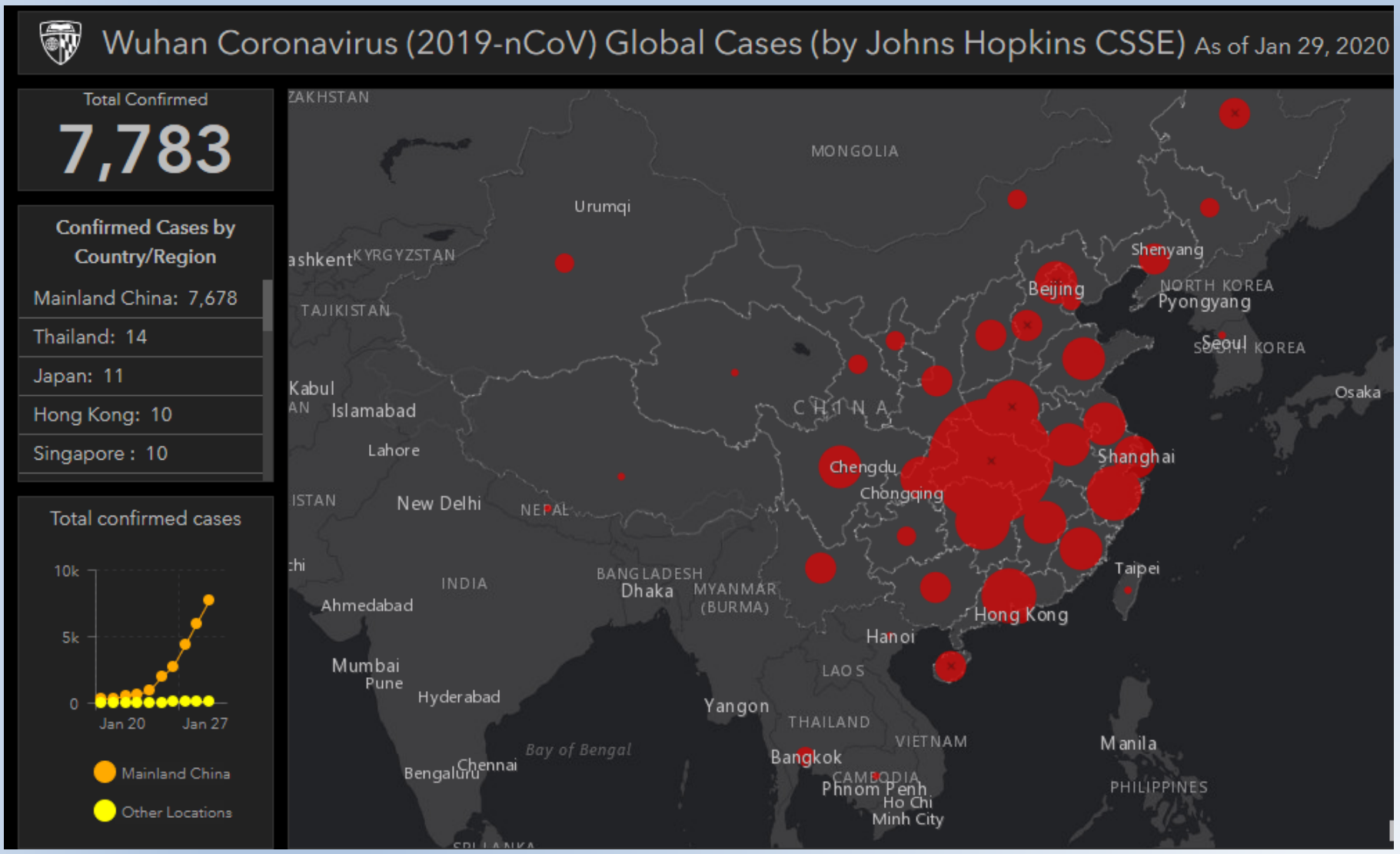




Present info concisely



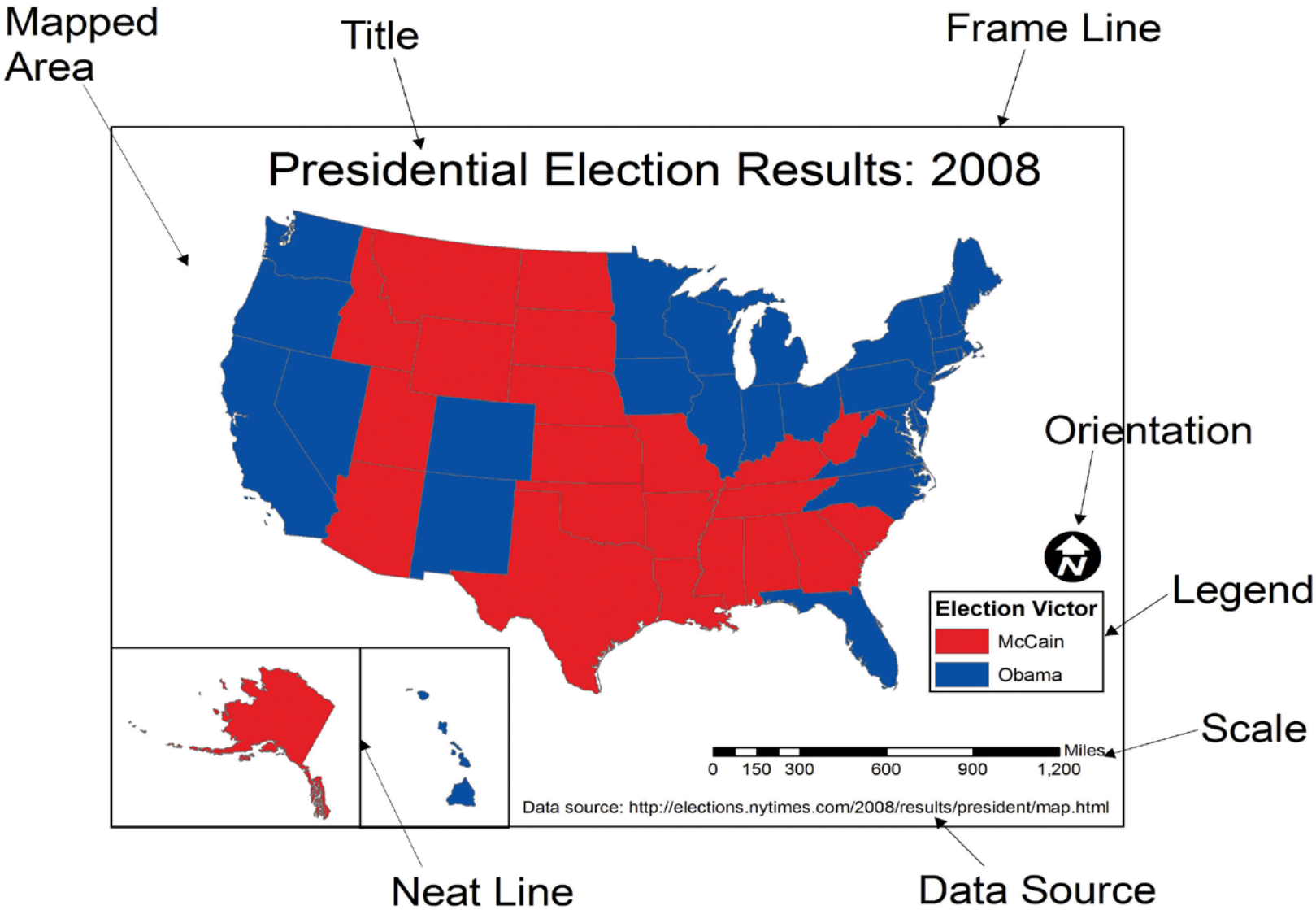
Show spatial relationships



How do we read maps?

- Maps are selective views of reality
- Size of the map relative to reality (scale)
- What’s on the map (symbolization)
- Shape of the map (projection)
- Checking map orientation (North Arrow)

Common Map Elements



Orientation

- Orientation is the way that the map is aligned relative to the earth's surface
- Typically (but not always) oriented with north at the top
- North is usually shown with a north arrow

Insets

- Insets are small additional maps included in the main map
  - Enlargement of the portion of the mapped area
  - Locator map, showing where the mapped region lies in relation to a larger, better known region
  - Areas that are related to the main map (e.g. Alaska, Hawaii, etc.)
  - Additional information
- Insets often include their own legend, scale, orientation, and other features as needed

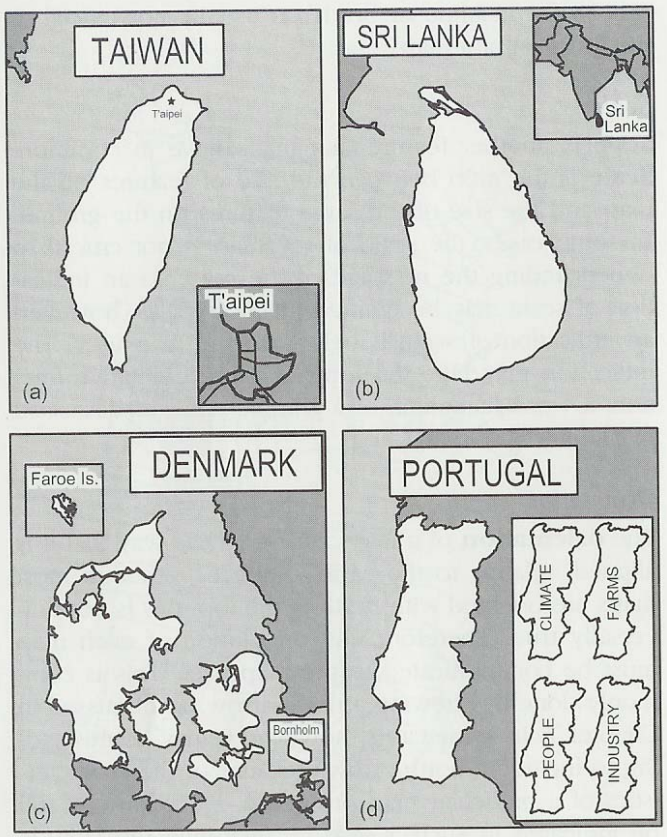


Figure 1.5 Types of insets. (*a*) Enlargement of important region. (*b*) Area locator. (*c*) Related areas. (*d*) Additional information.

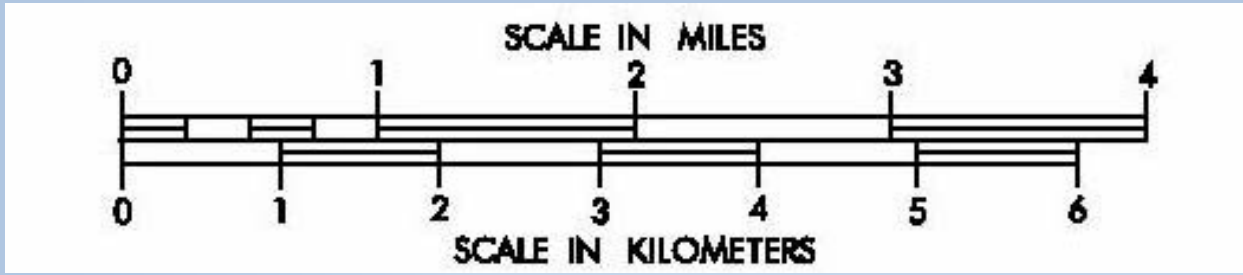
Map scale

- Scale is the ratio between the size of features on the map and the size of the same feature on the ground
- Scale is a fraction
- Larger area covered means larger denominator
- So a large-scale map covers a small area

- Scales can be…
  - Representative fraction: 1:24,000
  - Word statement: “One to twenty-four thousand”
  - Graphic scale

Map scale

- Ratio of the distance on the map to the distance on the ground
- Graphic:



- Stays the same when photocopied
- Might not be right for the whole map

Map scale

- Verbal:
  - » 1 inch equals 10 miles
- Easy to understand
- Can change if photocopied

Map scale

- Representative fraction or ratio:
  - » 1:24,000
- Units don’t matter
- Can change if photocopied


Waukegan
North Chicago
Mundelein
Lake
Michigan
Highland
Park
Buffalo
Grove
Wheeling
Northbrook
Mount
Prospect
Glenview
Wilmette
Skokie
Evanston
Elgin
Schaumburg
Des
Plaines
Niles
Bartlett
Itasca
Hanover
Park
Glendale
Heights
Elmhurst
St. Charles
Oak Park
Maywood
Chicago
Wheaton
Glen
Ellyn
Berwyn
Aurora
Downers
Grove
La Grange
Naperville
Oak Lawn
Bolingbrook
Orland
Park
Tinley
Park
Chicago
Heights
ILLINOIS
INDIANA
©2000 Maps.com
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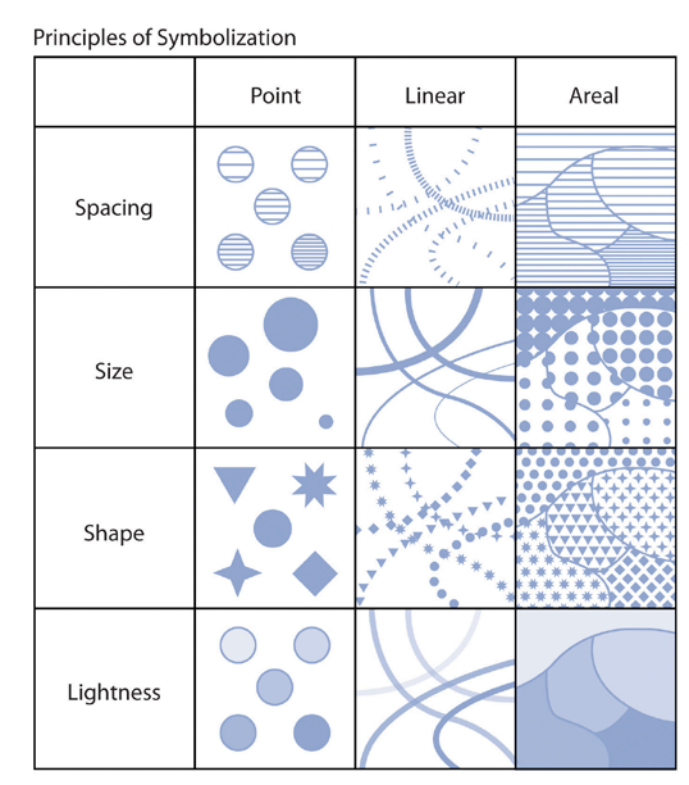
Erie St
River
North
Ontario St
Near
North
Grand Ave
Illinois St
Dearborn St
State St
Wabash Ave
Rush St
St. Clair St
Fairbanks Ct
Ohio St
McClurg Ct
Olive
Park
Navy Pier
Park
Navy
Pier
Hubbard St
Kinzie St
Water St
River
Esplanade
Park
N. Water St
Wacker Dr
Centennial
Fountain & Arc
S. Water St
Lake St
Randolph St
Field Blvd
Chicago
Washington Blvd
Madison St
Monroe St
Monroe Dr
Adams St
Sears
Tower
Jackson Blvd
Jackson Dr
De Paul
Univ.
Van Buren St
Lincoln
Statue
Grant
Park
Chicago
Harbor
Lake
Michigan
EISENHOWER EXPY
Congress Pkwy
Buckingham
Fountain
Harrison St
Balbo Dr
Polk St
8th St
9th St
South
Taylor St
Roosevelt Rd
Adler
Planetarium &
Astronomy Mus.
Solidarity Dr
Northerly
Island
Northerly
Island Park
McFetridge Dr
13th St
14th St
North Branch Chicago R.
South Branch Chicago R.
Chicago R.
N. Milwaukee Ave
Clinton St
Canal St
Wacker Dr
Franklin St
La Salle St
Wells St
Garland Ct
Michigan Ave
Clark St
Plymouth Ct
Columbus Dr
Lake Shore Dr
©2000 Maps.com
0
0.5 mi

Large-scale

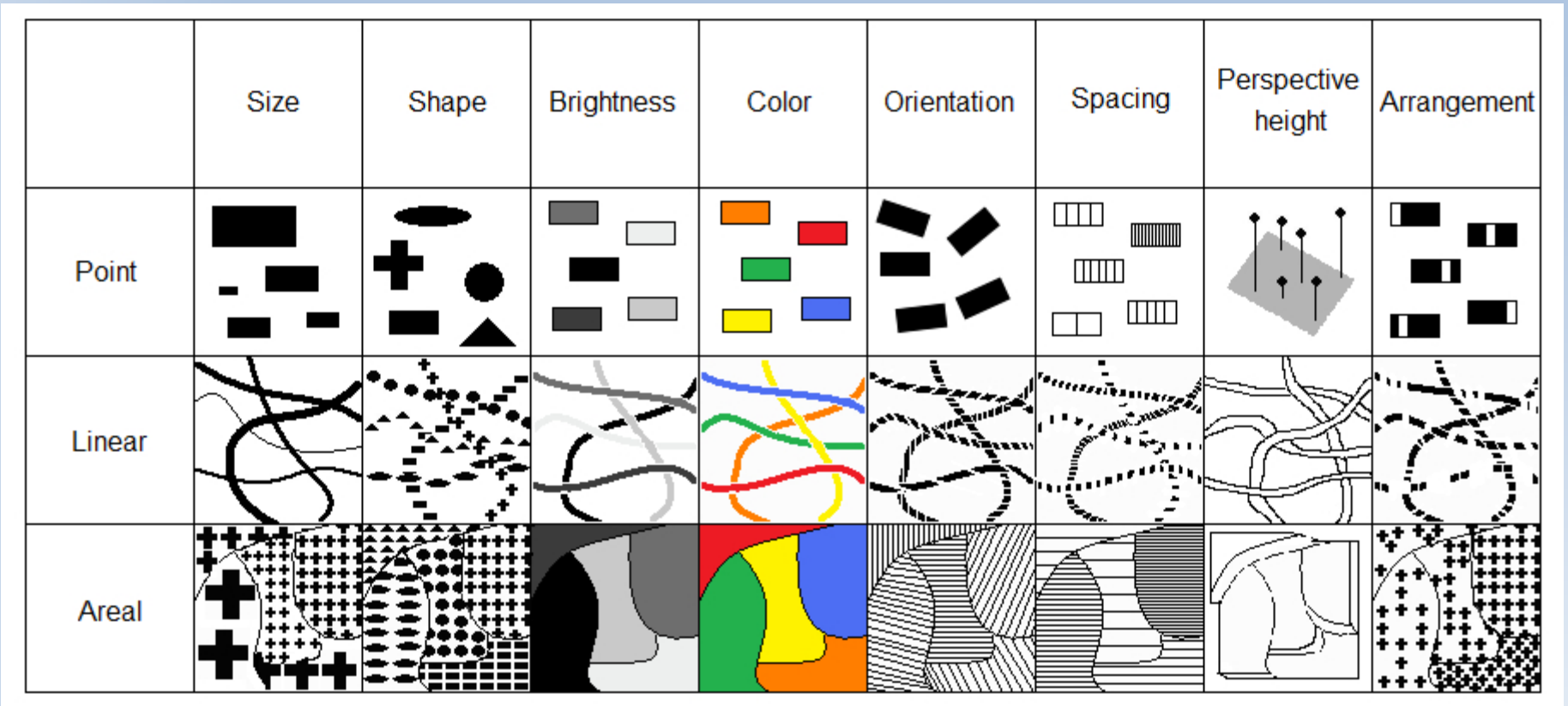
Small-scale

Map symbolization

- Symbols are a code instead of text
- Three kinds: point, line, area
- Consider shape, size, orientation, pattern, color, value

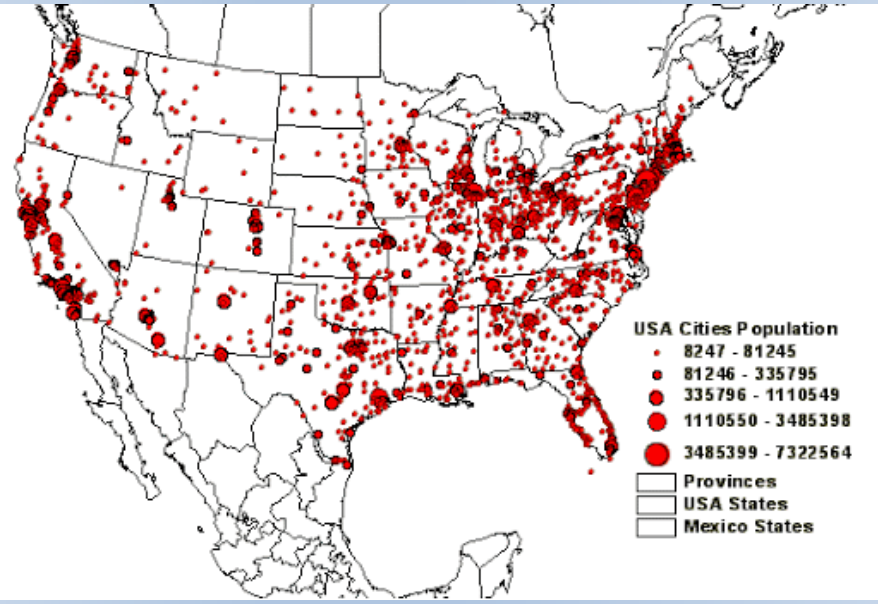


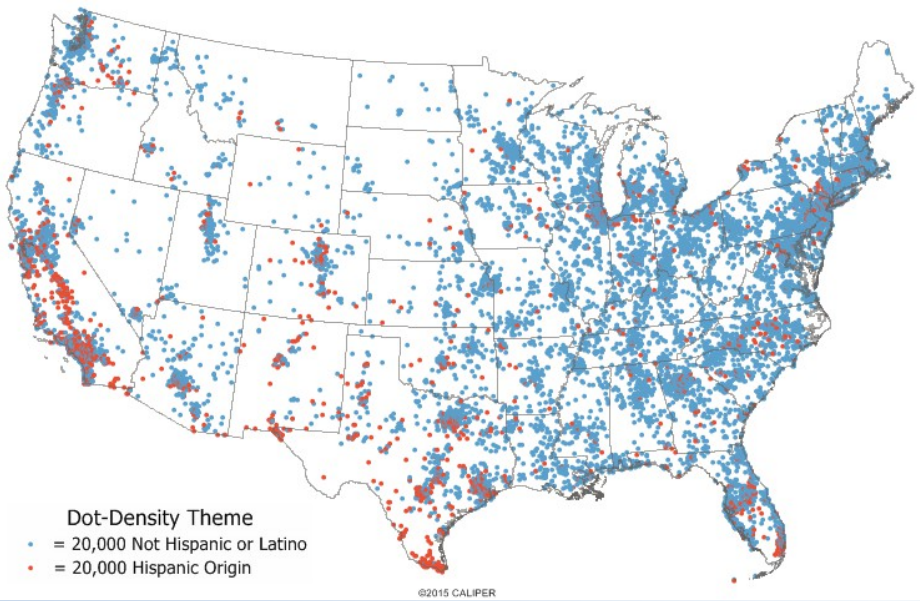
Visual Variables for Spatial Data



Point symbols

- Every symbol counts as one occurrence
- Qualitative points
  - Indicate location
  - Can also describe that location
- Quantitative points
  - Show a distribution
  - Indicate a value (graduated symbols)





Indicate location

Describe location

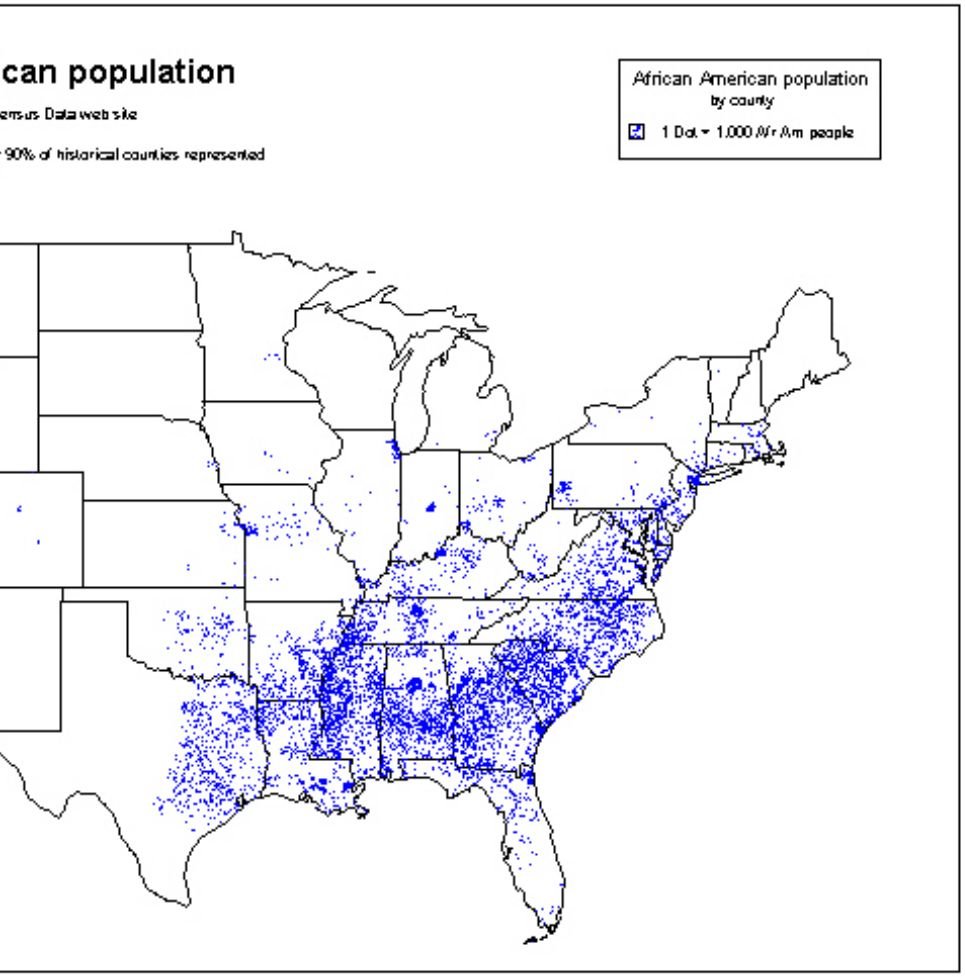
- Picnic area
- Toilets
- Camping
- Lookout point/views
- Wheelchair access
- Interpretation walk
- Swimming
- Parking/carpark
- Accommodation
- Water taxi
- Cafe/Food
- Launch service
- Hut
- Bus tour
- Shelter
- Visitor Centre
- Information
- Walkway
- Seals
- Wildlife

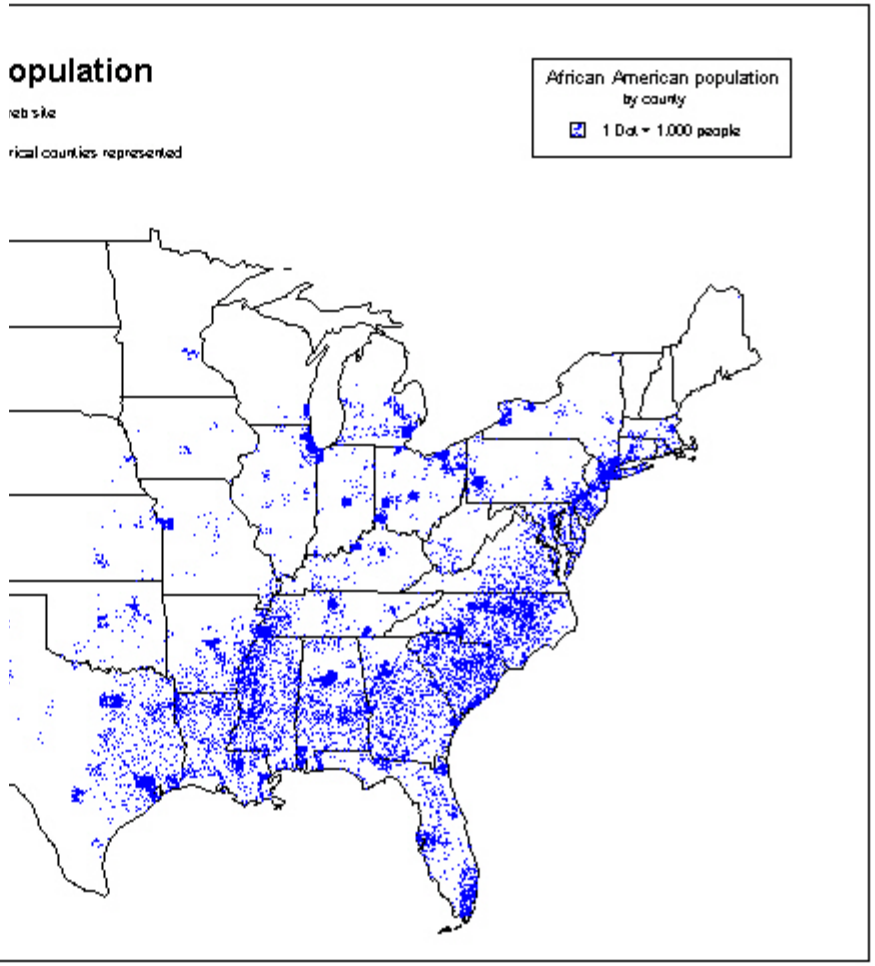
Path - Well marked and always benched * waterways bridged * few steep sections * boots not necessary * for all ages fitness levels * some suitable for disable visitors

Walking Track - Well marked and usually benched * boots not generally needed * most waterways bridged * for most fitness levels

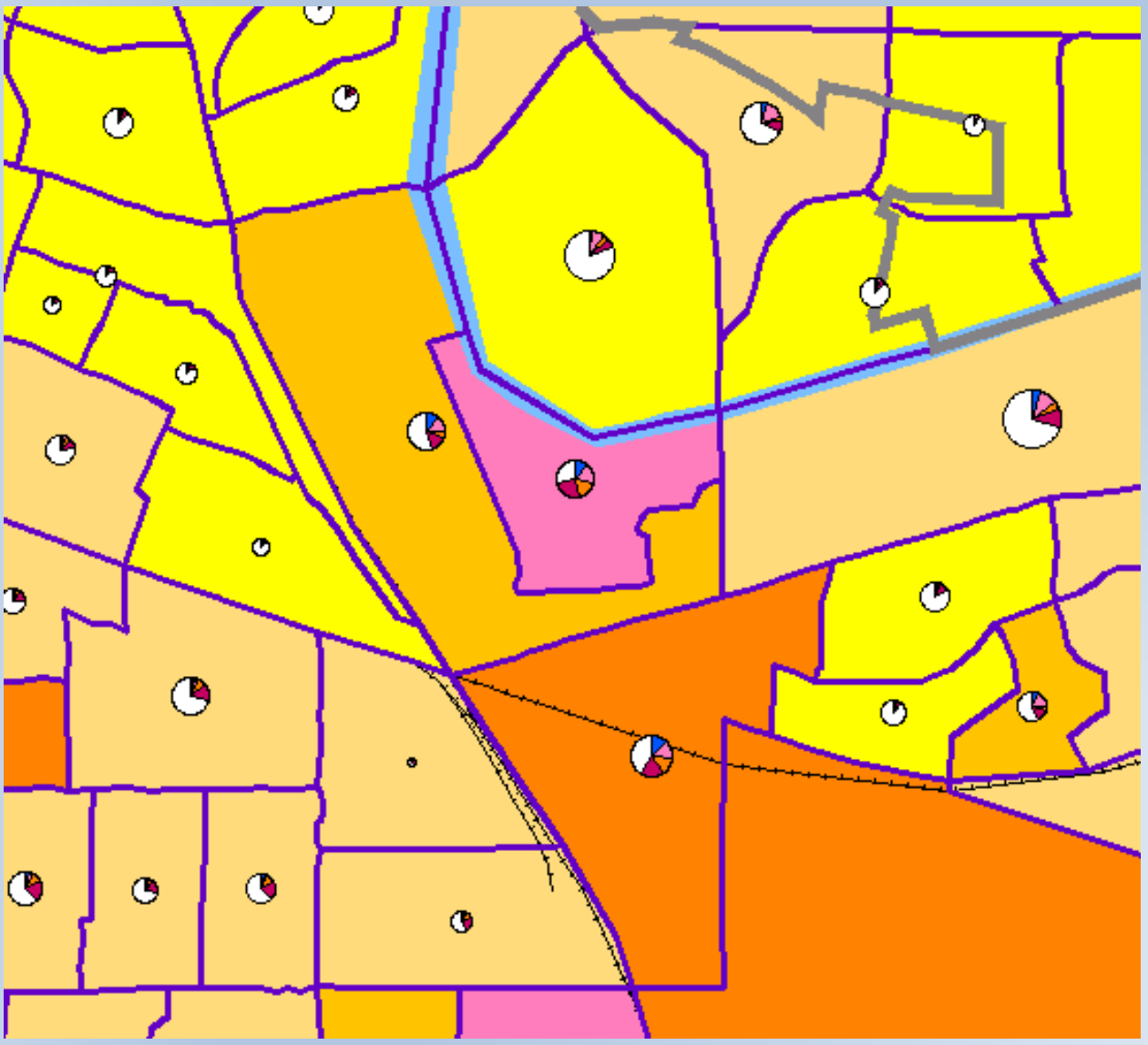
Tramping Track - Marked but not usually benched * may be steep and rough in places * some unbridged waterways * boots advisable * moderate fitness usually required

Show a distribution





Indicate a value



108th Congress Districts

Map Layers

- Block Group
- Water Area
- Census Place (2000)
- County (High)
- _Block Group
- _Congress District

%Minority

- 0.% to 5%
- 5% to 20%
- 20% to 40%
- 40% to 50%
- 50% to 60%
- 60% to 80%
- 80% to 100%

Pop by Race/Ethnicity

5,000
2,510
20

- Black
- AmIndian
- Asian
- Hawaiian
- Other Race
- AP_Hispanic Origin
- NH_White

0 .2 .4 .6

Miles

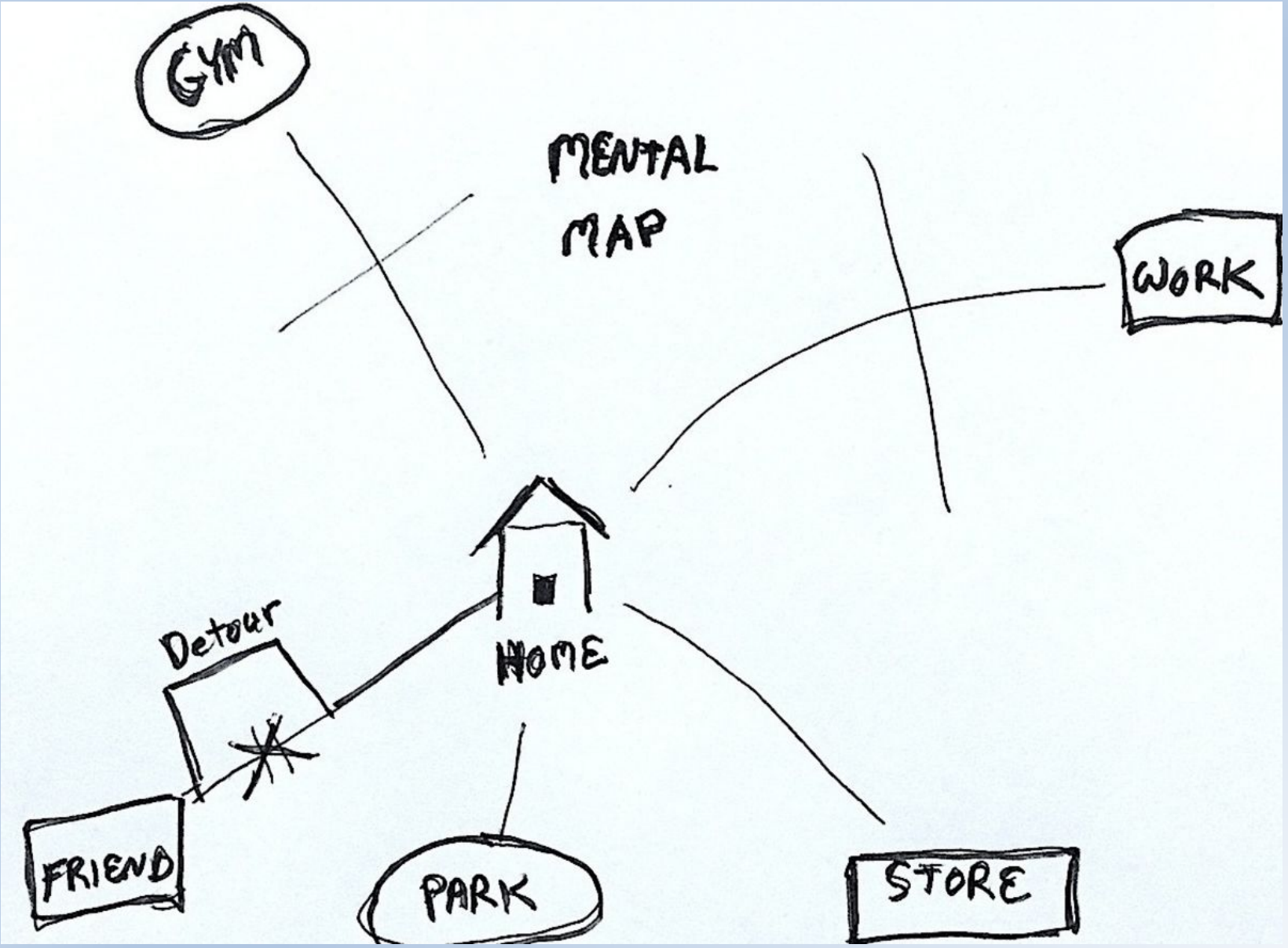
Maps can be real or virtual

- A real map (cartographic map) is any tangible map product that has a permanent form and that can be directly viewed (hard copy)
- Virtual maps do not physically exist, but can be converted into hard copy

Types of virtual maps

- Images that can be directly viewed but are not permanent (e.g. on a computer screen)
- Mental images (mental maps)
- Map data – information gathered by researchers or remote sensing that is stored in tabular form (but may be viewed as an image)

Mental Image

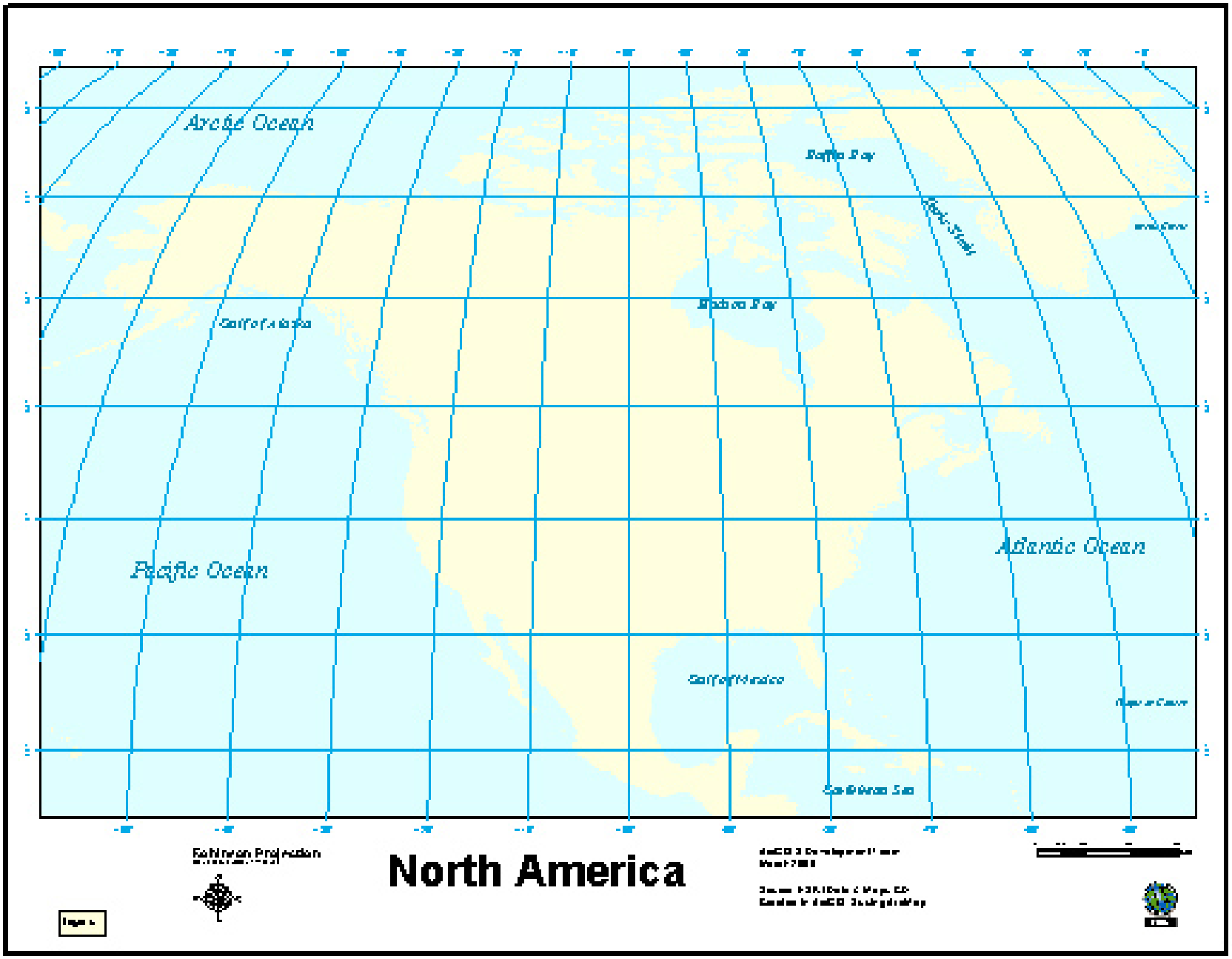


Map Categories

1) Planimetric Maps
2) Topographic Maps
3) Thematic Maps
4) Cartograms
5) Remotely sensed images

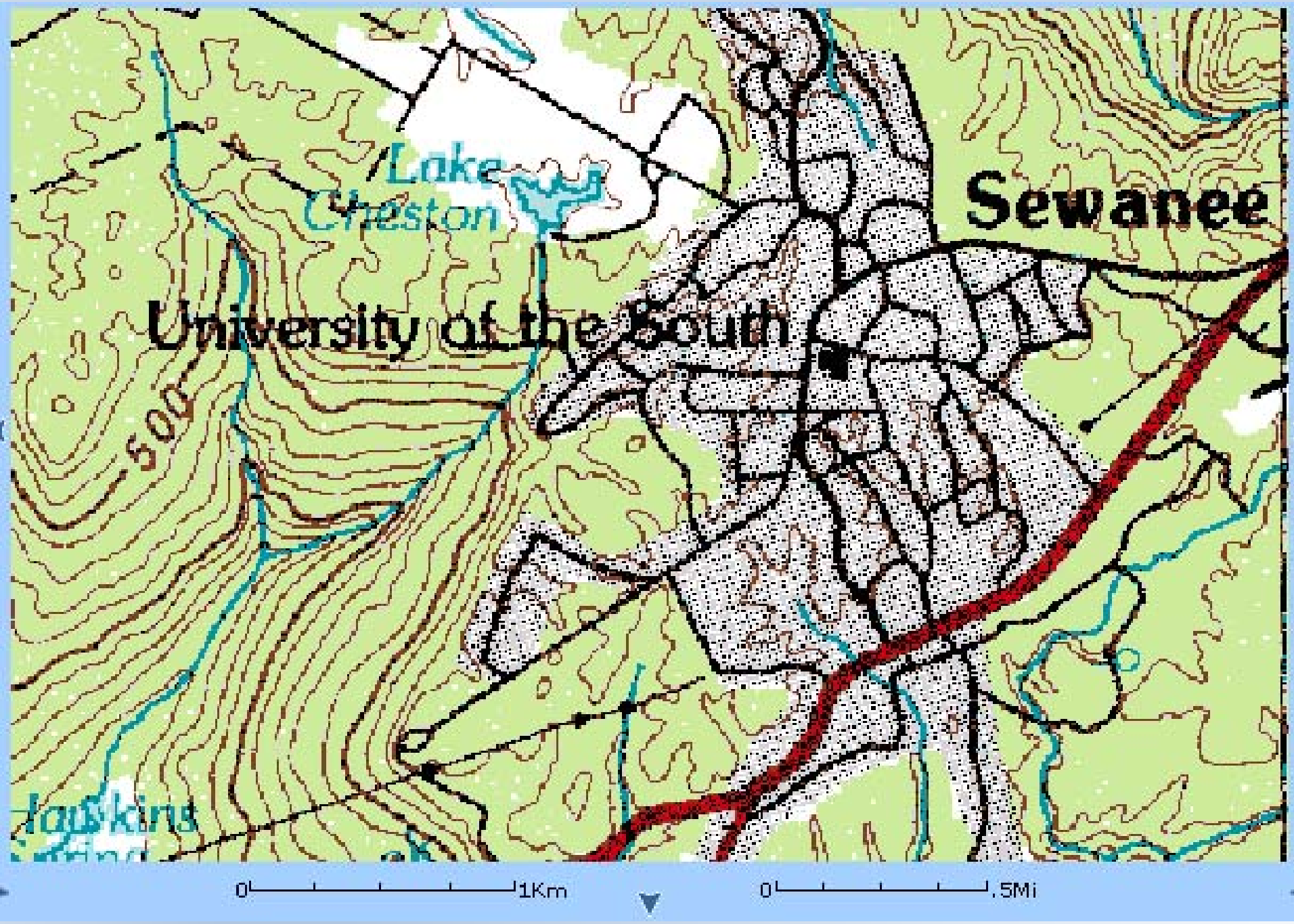
Planimetric Maps

- Planimetric maps do not show relief features (e.g. elevation)
- Planimetric base maps are used to provide the framework for thematic maps (which present information about some special subject)


Arctic Ocean
Baffin Bay
Hudson Bay
Gulf of Alaska
Pacific Ocean
Atlantic Ocean
Gulf of Mexico
Caribbean Sea
Eckert IV Projection
North America

Topographic Maps

- Maps that show shape and elevation of terrain are called topographic maps
  - Ex: Engineering maps, flood-prone area maps, landscape maps, etc.
- Maps that show water depth and the configuration of underwater topography are called bathymetric maps


Lake
Cheston
Sewanee
University of the South
500
0
1Km
0
.5Mi

Thematic Maps

- Show information about special topics superimposed on a base map
- Types of thematic maps include geologic, forestry, soil, land-use, slope, and historical

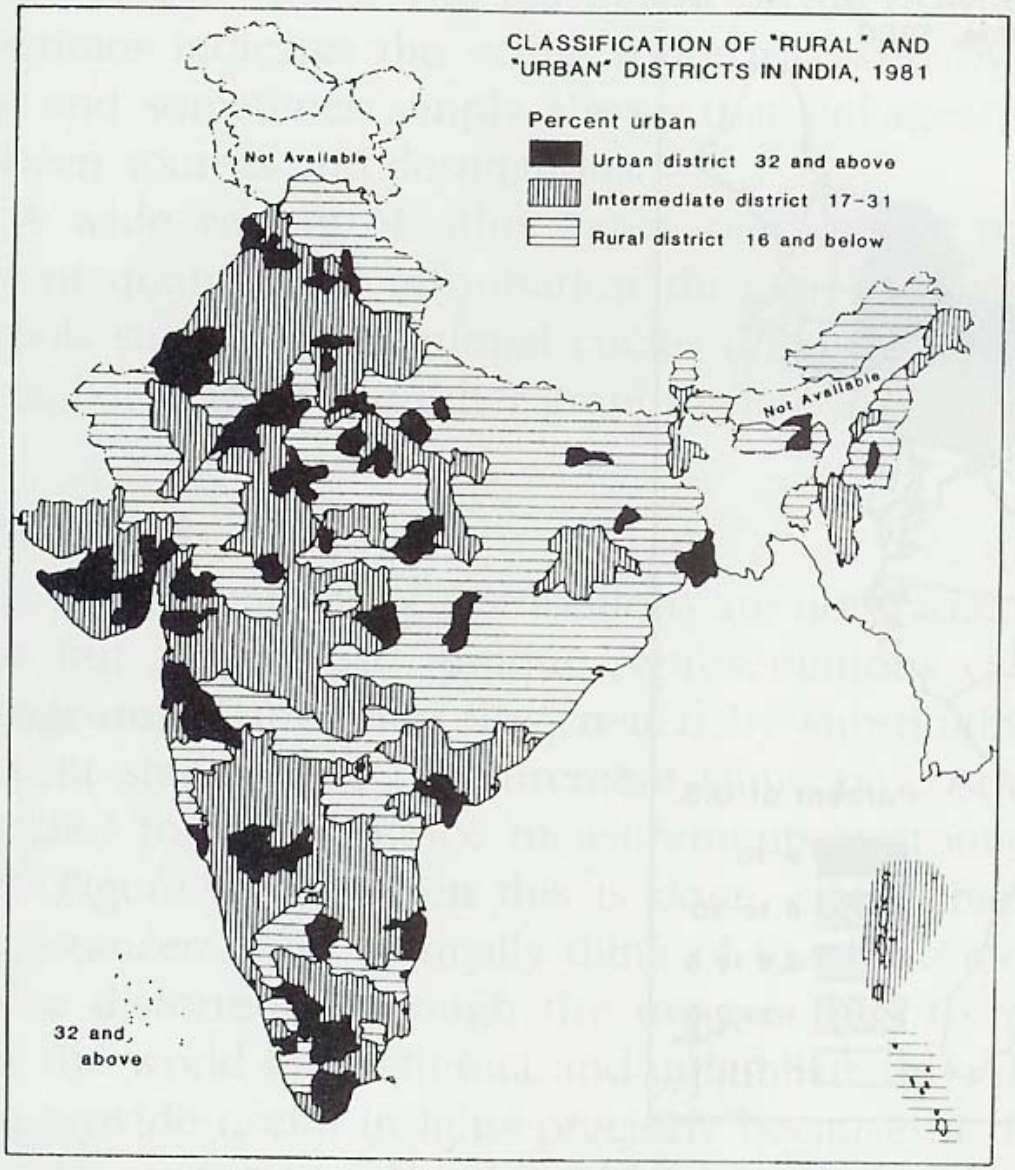


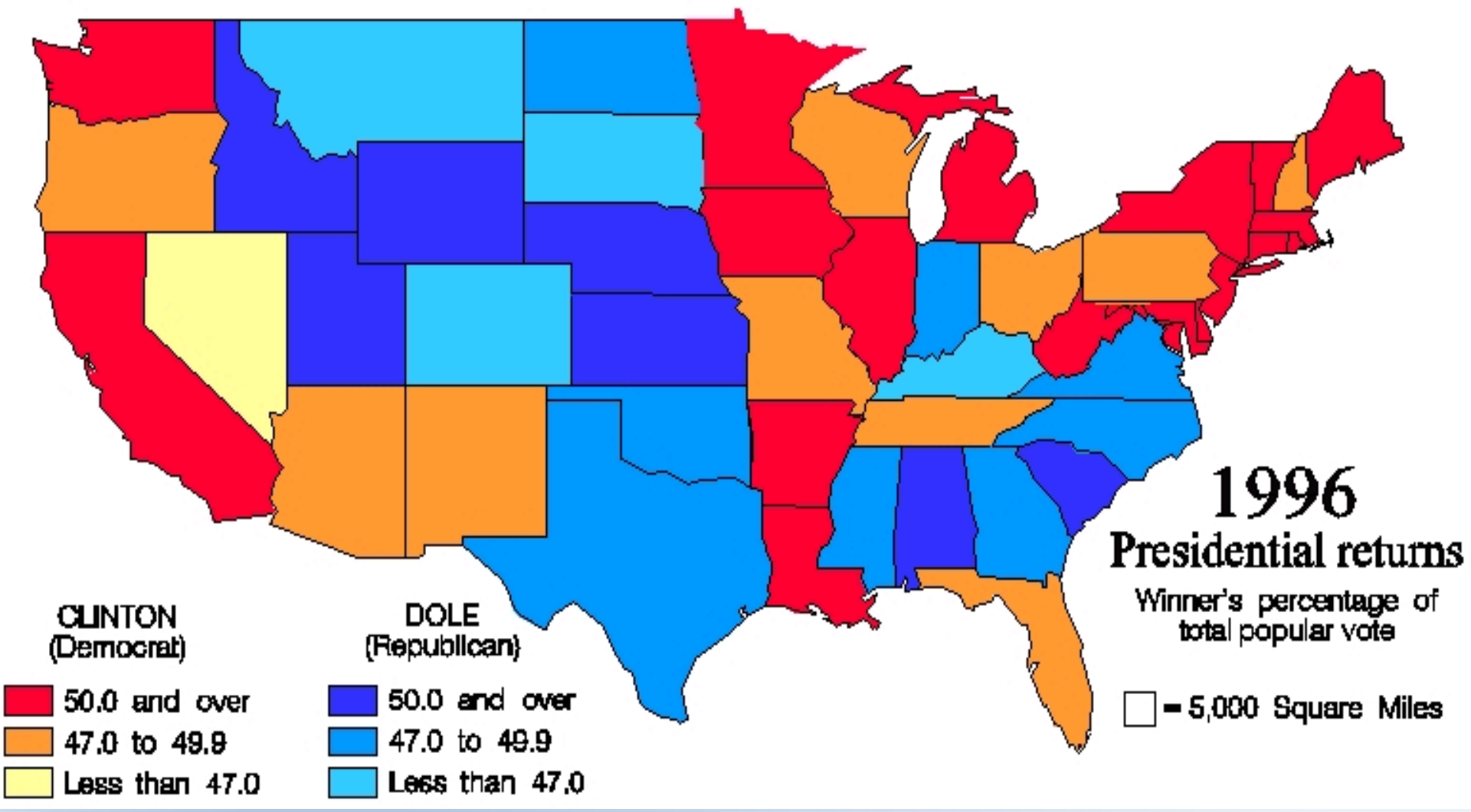
Figure 1.13 Example of a typical thematic map.

Source: From Ashok K. Dutt, Charles B. Monroe, and Ramesh Vakamundi, "Rural-Urban Correlates for Indian Urbanization," *The Geographical Review* 76, no. 2 (April 1986): 173–83. Reproduced by permission of The American Geographical Society.

Thematic Map Data

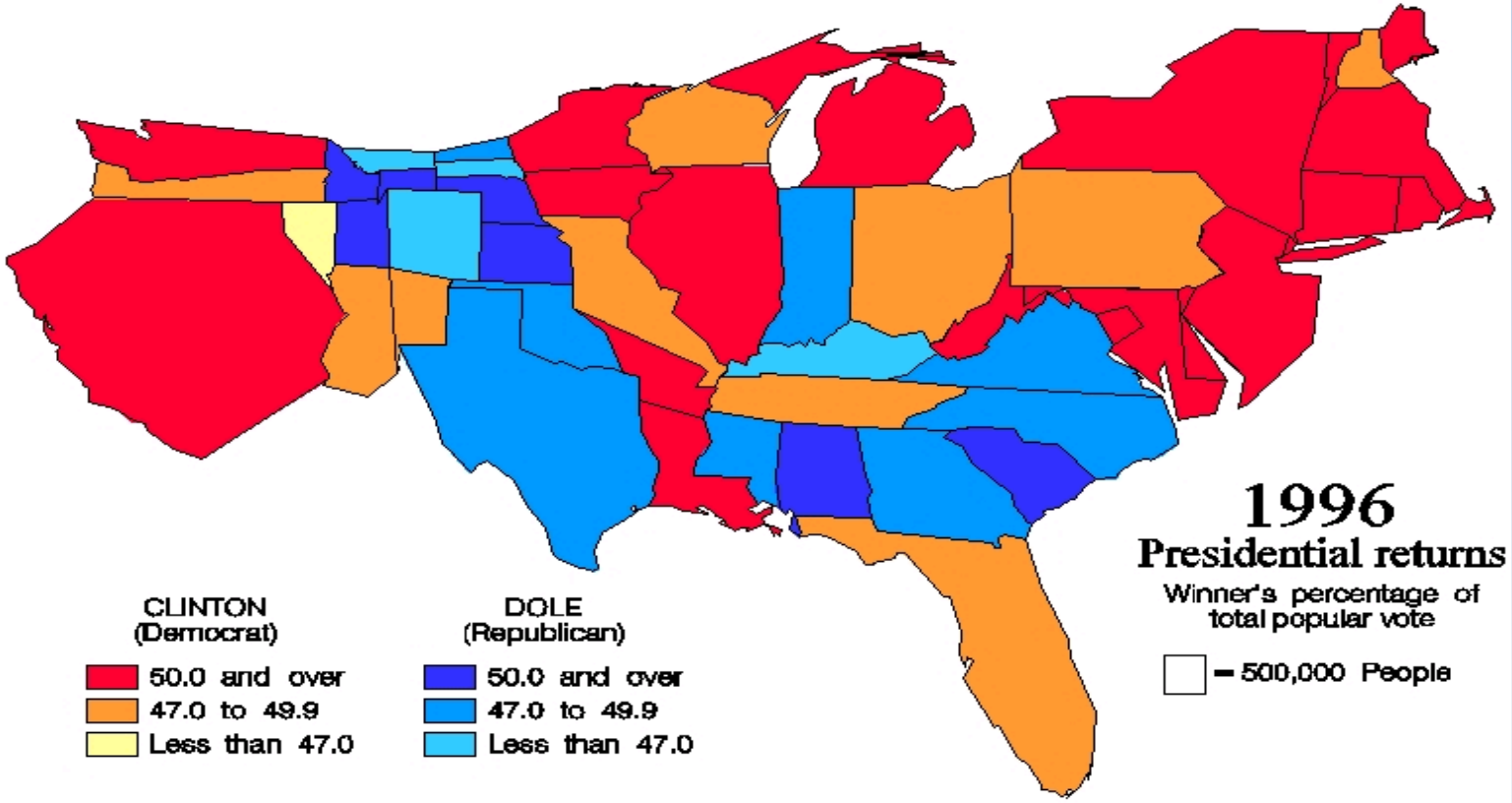
- Data may be represented by:
  - Dot-distribution maps
  - Choropleth maps
  - Isoline maps
  - Flow maps
  - Other symbols (e.g. proportional circles, bar graphs, etc.)

Thematic map example

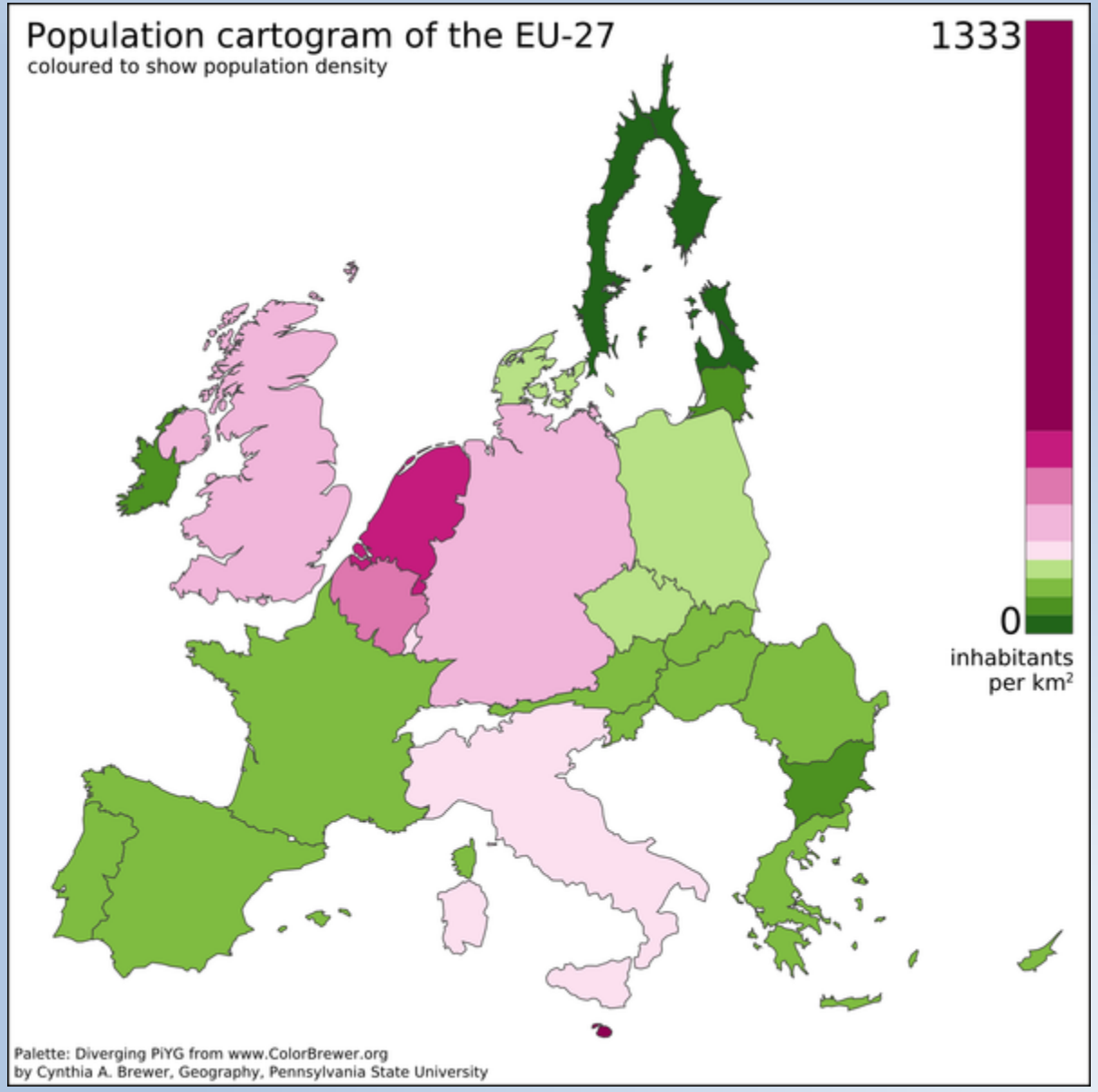


Cartograms

- Cartograms are created by substituting a different standard of measurement (time or cost, for example) for the distance measurements customarily used.
- This modifies size, shapes, and distances

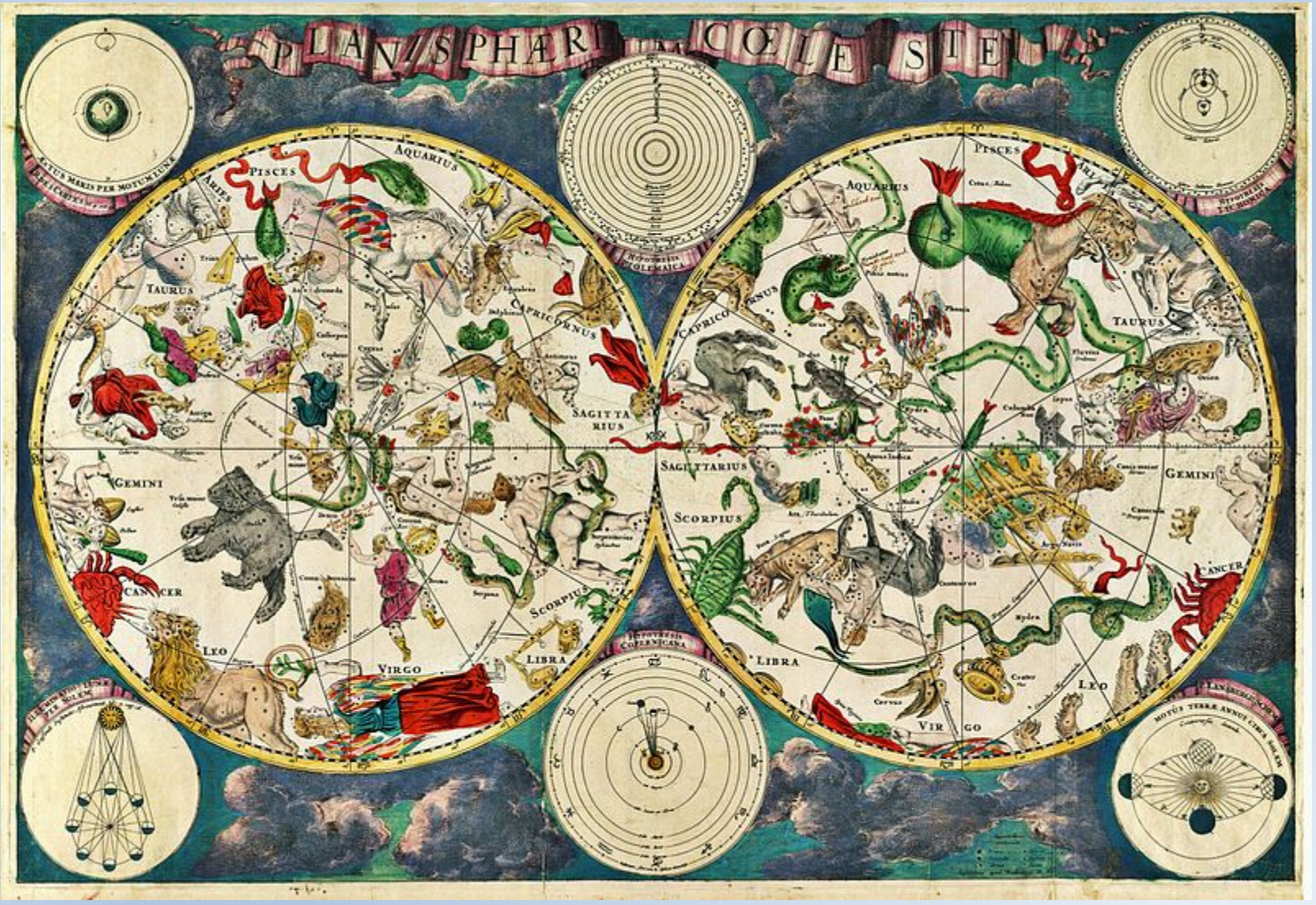


Cartograms Example



Remotely sensed images

- Will discuss in near future
- Major types are
  - Aerial photographs
  - Satellite images



A celestial map from the 17th century, by the cartographer [Frederik de Wit](#).

Data → Information

Data – numbers, text, symbols

- Sea surface temperature, soil type, population density

Information – differentiated from data

- implying some degree of selection, organization, and preparation for particular purpose, or
- data given some degree of interpretation

Geographic Information

(map, digital form)

- Information about places on Earth's surface

  Geographic versus *spatial*

  Geographic refers to Earth's surface and near surface

  Spatial refers to any space (more general)

- Knowledge about *where* something is
- Knowledge about *what* is at a given location

- Can be very detailed or very course
- Can be relatively static or change rapidly
- Can be very sparse or voluminous

TABLE 1–2 Selected types of geospatial data and their sources in the United States. Additional sources of geospatial data are provided in Chapter 3 and in the Appendix.

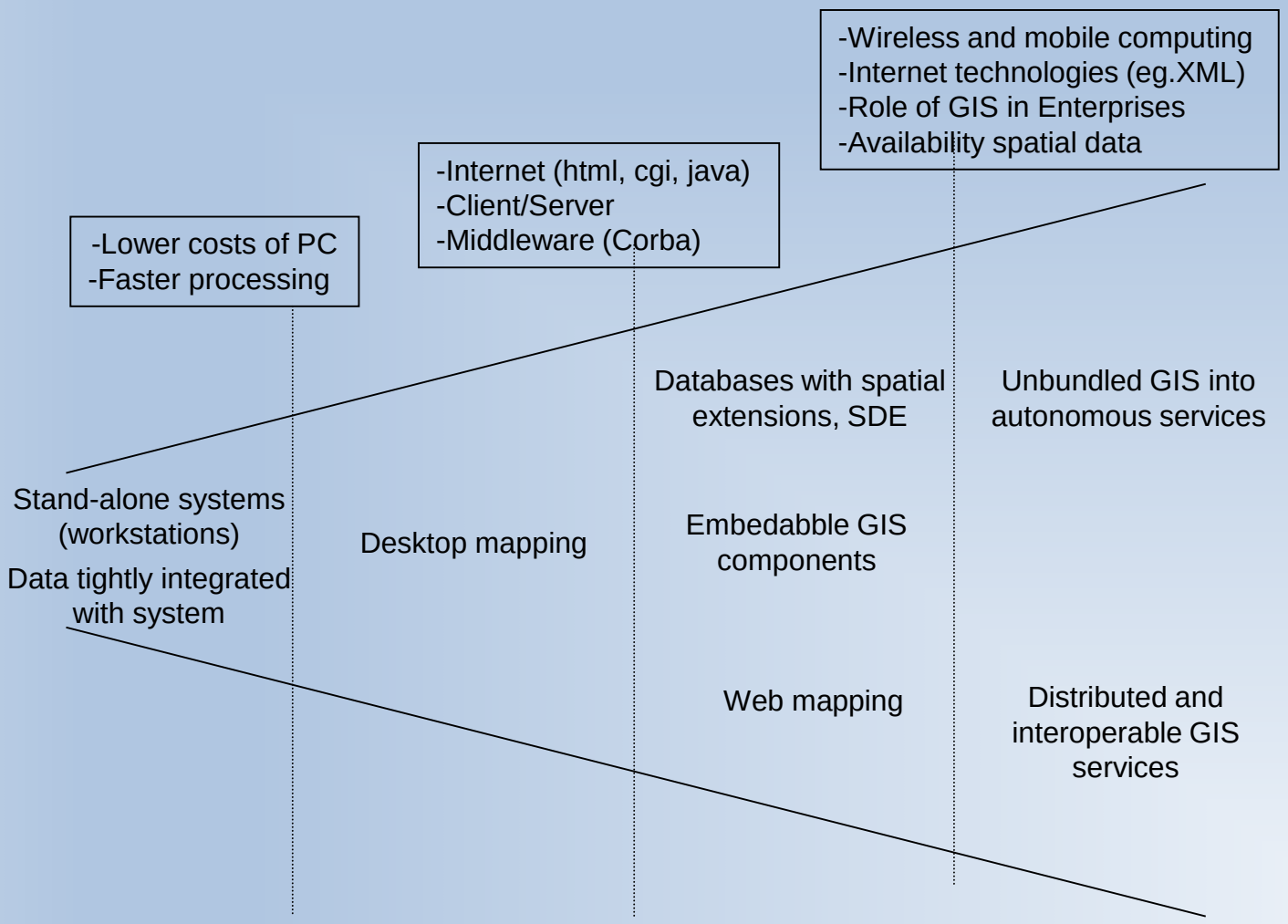
Geospatial Data	Representative Public Source	Representative Commercial Source
Cadastral		
Parcels	Tax Assessor	Surveying and photogrammetric engineering companies
Building footprints	Tax Assessor	
Demography		
Population density	U.S. Census Bureau	Demographic consulting firms
Socio-economic characteristics	U.S. Census Bureau	Demographic consulting firms
Remote Sensor Data		
Very high spatial resolution <0.25 m	U.S. Dept. of Agriculture	Photogrammetric engineering firms
High spatial resolution 1 to 5 m	U.S. Dept. of Agriculture	GeoEye, DigitalGlobe, SPOT
Moderate spatial resolution 5 to 100 m	NASA Landsat TM, ETM, ETM+	SPOT, RADARSAT
Low spatial resolution >100 m	NASA MODIS, NOAA AVHRR	SPOT
High spectral resolution > 30 bands	NASA MODIS, NASA HYPERION	HiVista Hymap, CASI
Light Detecting and Ranging (LiDAR)	U.S. Geological Survey	EarthData, Sanborn, Optech
Soils and Geology		
Soils	U.S. Natural Resources Cons. Service	Soils consulting firms
Geology	U.S. Geological Survey	Oil and gas companies
Topography/Bathymetry		
Digital elevation models	U.S. Geological Survey	Photogrammetric and lidargrammetric engineering companies
Digital bathymetric models	U.S. Geological Survey	
Transportation Network		
Road centerlines	U.S. Department of Transportation	Transportation and photogrammetric engineering consulting firms
As-built engineering drawings	U.S. Department of Transportation	
Urban Infrastructure		
Land Use/Land Cover	U.S. National Map Local, regional, state planning agencies	Planning and photogrammetric engineering consulting firms
Utilities		
Power, sewer, water, communication	U.S. Census Bureau	Utility and photogrammetric firms
Vegetation		
Agriculture	U.S. Dept. of Agriculture	Agriculture consulting firms
Forestry	U.S. and State Forest Service	Forestry consulting firms
Rangeland	U.S. Bureau of Reclamation	Rangeland consulting firms
Wetland	U.S. Fish & Wildlife Service	Wetland consulting firms
Water		
Drainage network	U.S. Geological Survey	Hydrology consulting firms
Discharge	U.S. Geological Survey	Hydrology consulting firms
Weather		
Current	U.S. NOAA Weather Service	Weather consulting firms

A typical GIS process

1. Understanding basic geographic concepts
   - Projections, datums, coordinate systems
   - Reading maps
2. Formulating a game plan
   - Planning the process
3. Acquiring data
   - Data storage formats
   - Data sources
   - Data challenges
4. Database manipulation
   - Attribute data
   - Database management
   - Computer database types
5. Analysis techniques
   - Spatial analysis
   - Models and modeling
     - Cartographic
     - Interpolation
     - Dynamic modelling
6. Presenting the results
   - Map creation and design

Start to think about your final project now

Evolution of GIS: From Stand-alone to Web Services



GIS Web Service Chain