Making Maps With GIS

Getting Started with GIS
Chapter 8

What is a map?

“A graphic depiction of all or part of a geographic realm in which the real-world features have been replaced by symbols in their correct spatial location at a reduced scale.”

The cartographer’s paradox

- Complete accuracy & completeness
  - Position
  - Attribute
  - Timely
  - Scientific rigor
- Effective communication
- Easy to read and interpret (intuitive)
- Hard to misread (fault tolerant)
Producer’s Responsibility

Map function in GIS
- Storage
- Temporary communication
- Intermediate check of data
- Final report
- Use in the field
- To be effective, must be correctly designed and constructed

The Parts of a Map: Map Elements

The medium is the message
- Paper
- Film
- Mylar
- Monitor
- Projection
- Broadcast TV
- Internet
THE DISPLAY IS PART OF THE SYMBOLIZATION
Human vision: Acuity, focus, FOV, stereo

Cartographic Elements
- Medium
- Figure
- Ground
- Reference information

Cartographic Elements (2)
- Border and “collar”
- Neatline
- Insets
  - Scale up
  - Scale down
- Metadata e.g. index
- Off-map references

Cartographic Elements (3)
- Page coordinates
- Ground elements
- Graticule/Grid
- North arrow
**Cartographic Elements (4)**
- Figure
- Point/Line/Area symbols
- Text
- Place Names
- Title

**Cartographic Elements (5)**
- Reference Information
- Scale
- Projection(s)
- Sources (2)
- Credits
- Legend
- Reliability

**Map “impact”**
- Distribution of Employment by State 2010
- USA: Employment Distribution 2010
- U.S. Employment: 2010 Distribution
- America at Work
- Where the Jobs are Today
- America’s Great Recession

**Text: Selection and Placement**

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*Figure 7.3 Some cartographic label placement conventions: Point, right and above preferred with no overlap. Lines: Following the direction of the line, normal if a straight. Text should read up on the left of the map and down on the right. Areas: On a gently curved line following the shape of the figure and upright.*
Choosing Elements

- Map research
- Map compilation
- Selection
- Placement
- Layout
- Tools in GIS not ideal: Usually default layouts

Choosing a Map Type

- Cartographers have designed hundreds of map types: methods of cartographic representation
- Not all GISs allow all types
- Most have a set of basic types
- Depends heavily on the dimension of the data to be shown in the map figure

Choosing the Wrong Type

- Fairly common GIS error
- Due to lack of knowledge about cartographic options
- Can still have perfect symbolization
- Possibility of misinformation
- Definite reduction in communication effectiveness

Map Types: Point Data

- Reference
- Topographic
- Dot
- Picture Symbol
- Graduated Symbol
Graduated Symbol Map

Map Types: Line Data
- Network
- Flow
- Isopleth
- Reference

Origin of Flow Maps


Minard, C. 1869. Napoleon’s retreat from Moscow.

Flow Maps
Symbolizing flows

Flow Map: Truck traffic

Map Types: Area Data
- Choropleth
- Area qualitative
- Stepped surface
- Hypsometric
- Dasymetric
- Cartogram
- Reference

Choropleth
Continuous/Unclassed Choropleth

Area Qualitative Map

Stepped Statistical Surface

Hypsometric map
Map Types: Volume Data
- [Isopleth, Stepped Surface, Hypsometric]
- Gridded fishnet
- Realistic perspective
- Hill-shaded
- Image map
Map Types: Time

- Multiple views
- Animation
  - Moving map
  - Fly thru
  - Fly by

Cartographic Animations

[SOM Animation](http://www.ncgia.ucsb.edu/projects/gig/v2/About/abImages/apps/sb_growth.gif)

[Spatialization: SOM](http://www.aaronkoblin.com/work/faa/us.html)

Spatialization: SOM

[SOM Visualization](http://www.aaronkoblin.com/work/faa/us.html)

Word Cloud: Wordle

[Wordle](http://www.aaronkoblin.com/work/faa/us.html)
Choosing Types

- Check the data
  - Continuous
  - Discrete
- Accuracy & Precision
- Reliability
- Dimension (Point, Line, Area, Volume)
- Scale of Measurement (Nominal etc.)
- GIS capability
- May need to supplement GIS software

Data Scaling (Stevens)

- Nominal (Name of a place)
- Ordinal (Small, med., large town)
- Interval (Arbitrary zero e.g. Sea Level)
- Ratio (Absolute zero e.g. dollars, densities)

Example: Choropleth Mapping

- Data should be AREA (e.g. States)
- Data should not suffer from area effect.
- Population?
- Per capita Income?
- Elevation? Temperature?
- Boundaries unambiguous.
- Areas non-overlapping.
Classification

- Equal Interval
- Natural groups
- N-tiles
- Equal or unequal?
- Logarithmic? Linear? Discontinuous?
- How many classes?
- Non-overlapping, distinctive groups.

The Need for Design

- To appear professional and avoid errors, GIS maps should reflect cartographic knowledge about map design
- A map has a visual grammar or structure that must be understood and used if the best map design is desired
- Cartographic convention (e.g. forests should be green)

Symbolization Errors with a GIS
Map Design

- A GIS map is designed in a process called the design loop
- Good map design requires that map elements be placed in a balanced arrangement within the neat line
- Remember the human vision properties

Eye tracking research

The Design Loop

- Create map layout as macro
- Draw on screen (proof plot)
- Look
- Edit macro
- Repeat until happy
- Make final plot

Graphic Editors
Graphic Editor Software

- Vector
  - Adobe Illustrator
  - CorelDraw
  - Freehand
  - Inkscape
- Raster
  - Photoshop
  - CorelPhotoPaint
  - GIMP 2.0

Third Party Design Software

Map Design (2)

Visual balance is affected by:

- the "weight" of the symbols
- the visual hierarchy of the symbols and elements
- the location of the elements with respect to each other and the visual center of the map

Visual center

- Landscape
- Portrait
Eye expects (1) balance and (2) alignment

Color is a complex visual variable and in a GIS is specified by RGB or HSI (CMYK 4-color) values.
- Red, Green, Blue are additive primaries
- Magenta, Cyan and Yellow are subtractive primaries
- May support transparency layer
- Saturation and Intensity map better onto values than hue
- Figure/ground relationship critical
Color printing composites

Cyan
Magenta
Yellow

GE Transparency/Opacity

Dimensions of Color

Simultaneous Contrast
Simultaneous Contrast Illusion

Color Primaries

Subtractive color

Additive color

Design Assistance: ColorBrewer

Text placement

Santa Barbara

Path right

Path Down
Scale and Generalization

- Smaller scale means fewer features
- Smaller scale means smoother features
- Smaller scale means combining features
- Smaller scale means displacing features
- Often scales are mixed or over-generalized

Multivariate data

Small multiples

Mixing Symbols
Map Design and GIS

- When a GIS map is the result of a complex analytical or modeling process, good design is essential for understanding.
- The map is what distinguishes GIS as a different approach to the management of information.
- So extra care should be taken to improve the final maps that a GIS generates in a GIS task.

Visual analytics:
the science of analytic reasoning, facilitated by interactive visual interfaces.