# Chapter 10 – Cartography and map product

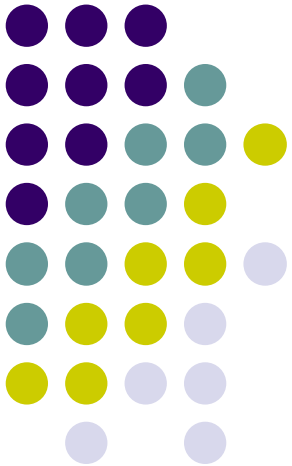
§ 1 Introduction

§ 2 Maps and cartography

§ 3 Principle of map design

§ 4 Map series

§ 5 Application

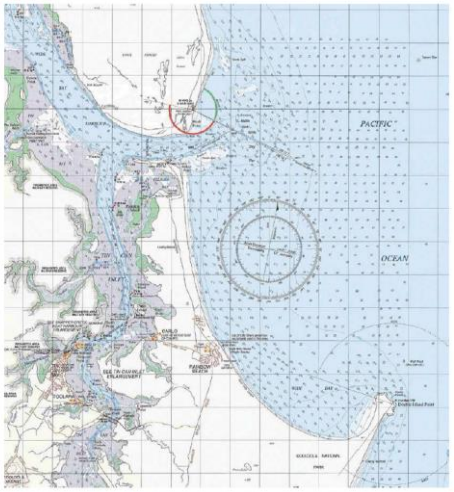


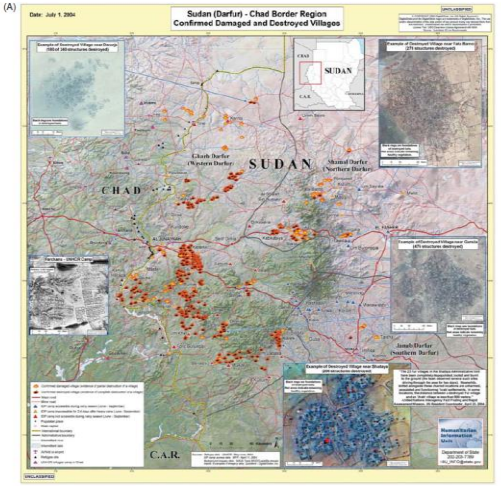
# Learning Objectives

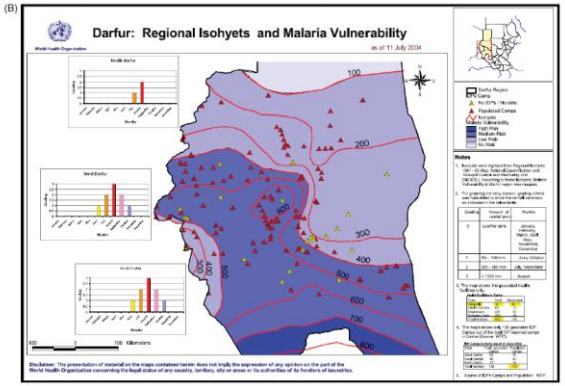
- After reading this chapter you will be able to:
  - The nature of maps and cartography
  - Key map design principles
  - Choices that are available to compose maps
  - The many types of map symbology
  - Concepts of map production flow-lines

# § 1 Introduction

- it is useful to distinguish between two types of GIS output:
  - formal maps, created according to well-established cartographic conventions, that are used as a reference or communication product
  - transitory map and map-like visualizations used simply to display, analyze, edit, and query geographic information
- Maps are important communication and decision support tool
- Both paper and digital maps have an important role to play in many economic, environmental, and social activities



# § 2 Maps and cartography

What's a map?

"***a representation, normally to scale and on a flat medium, of a selection of material or abstract features on , or in relation to, the surface of the earth*.**" (International Cartographic Association)

**A** *spatial model of the real world,* **but differentiated from it by:**

***abstraction, focus, simplification, symbolization***

***scale, projection, and purpose***

# § 2 Maps and cartography(cont.)

- Abstraction
  - Imaginary features (i.e. political boundaries) as well as physical features
  - Past, present, and future (archaeological sites, current, and planned roads) features
- Focus
  - Selection and classification of features in real world to include in the map
- Simplification
  - Simplification of complex features such as coastlines
  - Exaggeration of features that are too small to show at the scale of the map
- Symbolization
  - Use of symbols or graphic to represent classified objects (e.g. church)
- Scale
  - The ratio of distance on a map, to the equivalent distance on the earth's surface.
- Projection
  - Representing curved surface of the earth on a flat plane. Distortion is inevitable.
- Purpose
  - To describe, measure, communicate/persuade

# § 2 Maps and cartography(cont.)

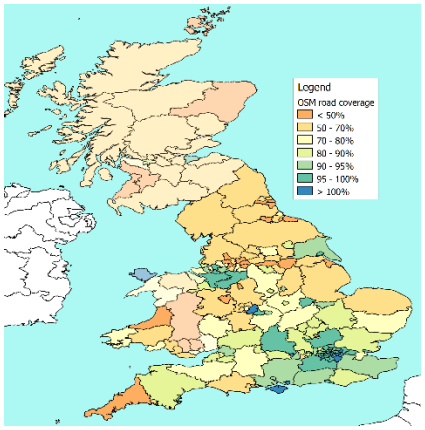
## Types of map

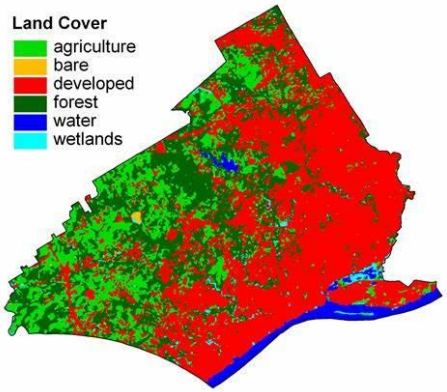
- Planimetric (e.g. municipal base map)
  - A map designed to portray the horizontal positions of features; vertical information is specifically ignored.
- Topographic (e.g. USGS 7.5 minute quads)
  - A map designed to portray features on the surface of the Earth, including relief (elevation), hydrography, and cultural features.
- Cadastral (e.g. municipal parcel map)
  - A map representing boundaries of land parcels, ownership, land use, valuation, and other related information.
- Image (e.g. LANDSAT image ‘map’)
  - A map representing a remotely sensed picture or reflection of all or part of the Earth's surface
  - may or may not be orthomorphically correct.
- Thematic (see next slide for types and examples)
  - A map used to visualize spatial relationships and patterns among information pertaining to some theme or concept (e.g. income)

# § 2 Maps and cartography(cont.)

## Types of thematic map

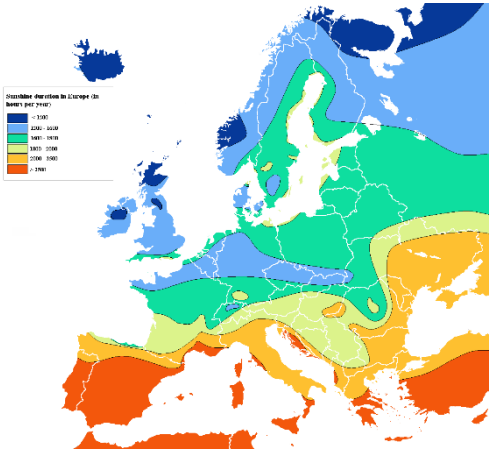
- Thematic Map: A map used to visualize spatial relationships and patterns among information pertaining to some theme or concept (e.g. income)
  - *Choropleth map*: uses zones or polygons to display information using shading, dot, density, or other techniques. e.g. population change
  - *Proximal (dasymetric) map*: shows zones of constant attributes, such as soil type or vegetation (similar to choropleth except that data determines boundary lines; no pre-defined polygons). e.g. zoning, soil map

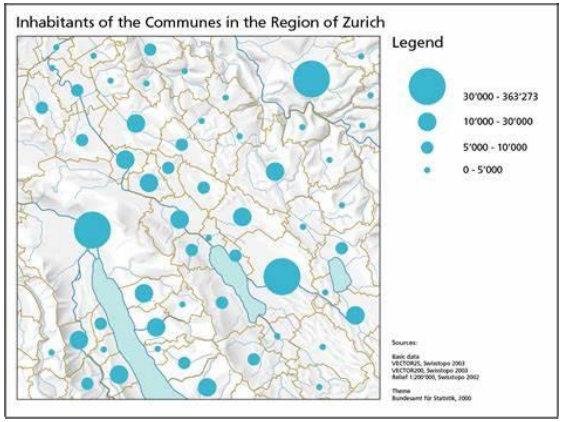


# § 2 Maps and cartography(cont.)

- *Isopleth map (contour or isarithmic)* : shows a continuous three dimensional surface such as elevation using lines connecting points of equal value (contours).
  - e.g. elevation, travel time contours from a point(s), land values, income
- *Point (dot) or symbol map*: shows information relating to specific points using marker symbols whose size and/or frequency relates to magnitude of phenomena
  - housing sales, code violations, crimes

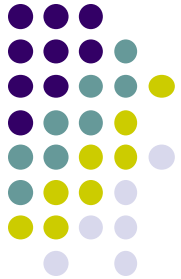




# § 2 Maps and cartography(cont.)

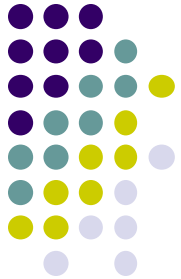
- A map is the final outcome of a series of GIS data processing steps beginning with data collection, editing and maintenance, through data management, analysis and concluding with a map
- Maps have four roles today:
  - *Data display* : provide useful ways of displaying information in a meaningful way
  - *Data stores*: can be very efficient, high density stores
  - *Spatial indexes*: can show the boundaries of areas (e.g. land use zones, soil or rock types) and identify each area with a label . A separate manual with corresponding entries may provide greater detail about each area
  - *Data analysis tool* : make or test hypotheses, such as the identification of cancer clusters; examine the relationship between two distributions using simple transparent overlays
- GIS is a flexible medium for the production of many types of maps

# § 3 Principles of map design



- gives the viewer the greatest number of ideas, in the shortest time, with the least ink, in the smallest place
  - maximize the data/ink ratio
  - erase non-data ink
  - erase redundant data-ink
  - revise and edit the graphic
    - it is difficult to get a good graphic first time around
  - mobilize every graphical element to show the data
  - maximize data density and the number of data entries shown, within reason
- if the nature of the data suggests the shape of the graphic, follow that suggestion - otherwise, move toward horizontal graphics about 50% wider than tall

# § 3 Principles of map design



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# § 3 Principles of map design(cont.)

- Map composition is the process of creating a map comprising several closely interrelated elements:
  - Map body
  - Inset/overview map
  - Title
  - Legend
  - Scale
  - Direction indicator
  - Map metadata

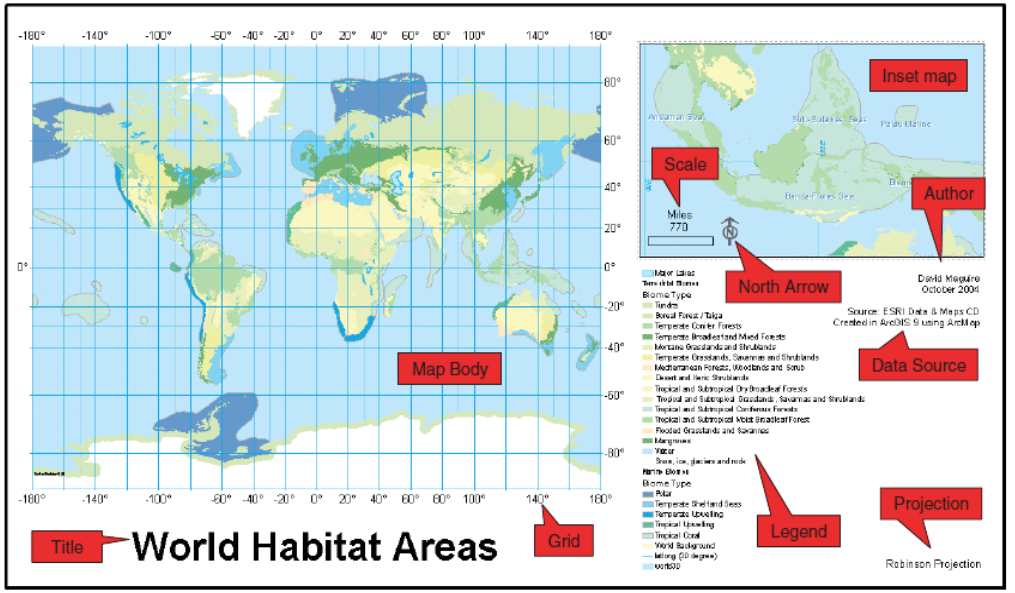



**Figure 12.8** The principal components of a map composition layout

# § 3 Principles of map design(cont.)

- The data to be displayed on a map must be classified and represented using graphic symbols that conform to well-defined and accepted conventions
- The choice of symbolization is critical to the usefulness of any map
- The process of mapping attributes frequently entails further problems of classification because many spatial attributes are inherently uncertain
  - Attribute representation and Transformation: retinal variables
  - Multivariate mapping

# § 3 Principles of map design(cont.)

- Retinal Variables

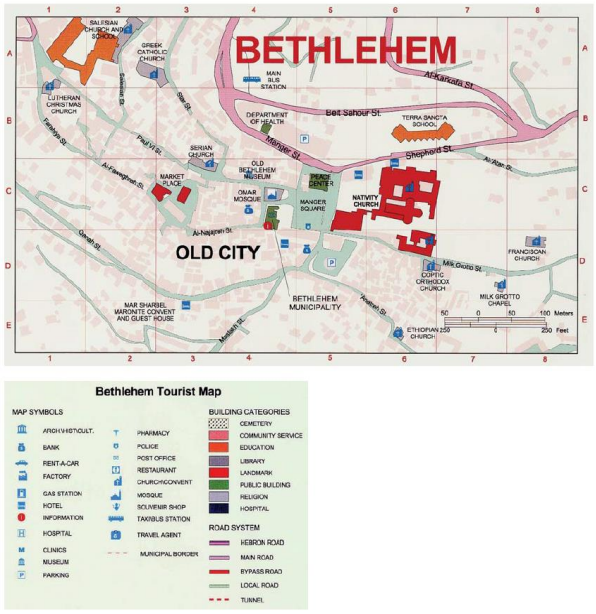



Figure 12.12 Use of hue (color) to discriminate between Bethlehem, Israel urban land-use categories, and of symbols to communicate location and other attribute information (Courtesy: ESRI)

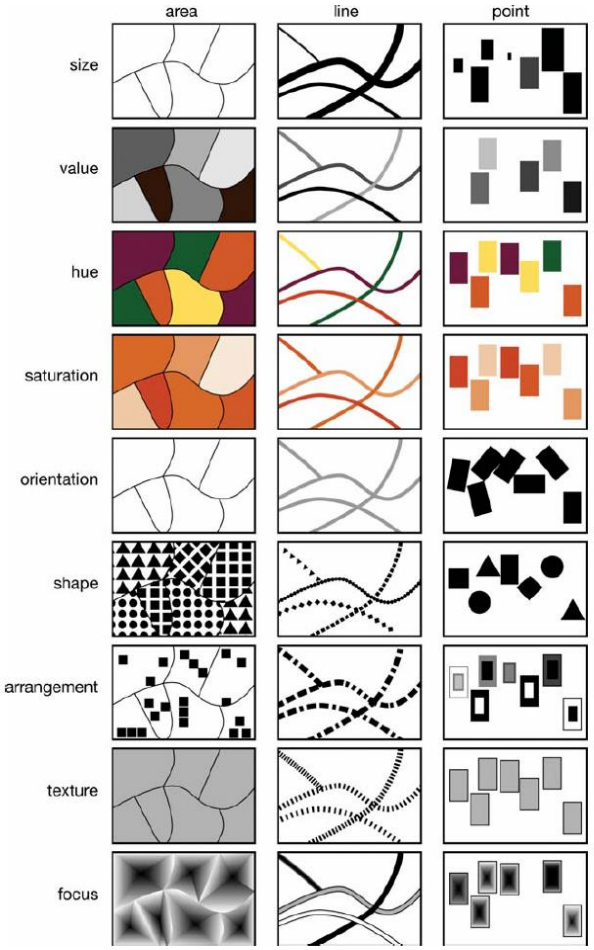
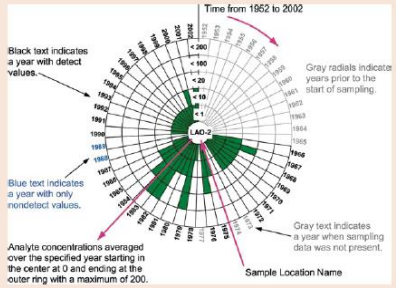



**Figure 12.9** Bertin's graphic primitives, extended from seven to ten variables (the variable location is not depicted). *Source*: MacEachren 1994, from *Visualization in Geographical Information Systems,* Hearnshaw H.M. and Unwin D.J. (eds), Plate B. (Reproduced by permission of John Wiley & Sons, Ltd.)

# § 3 Principles of map design(cont.)

- Multivariate maps show two or more variables for comparative purposes


**Figure 12.10** Incidence of Asian Bird Flu in Shanghai City. Pie size is proportional to the number of cases; red = duck, yellow = chicken, blue = goose



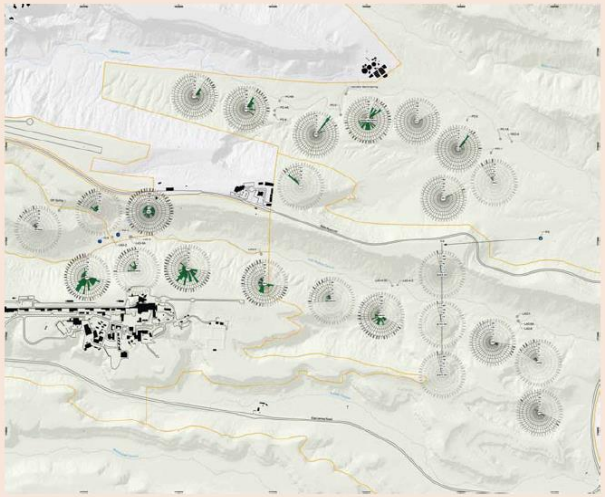



**Figure 12.15** Representing temporal data as clock diagrams on maps (Courtesy: ESRI)

# § 4 Map series

- Editing or copying a map composition to create similar maps of any combination of areas and data themes is relatively straightforward with a GIS
- GIS makes it much easier to create collections of maps with common characteristics from map templates

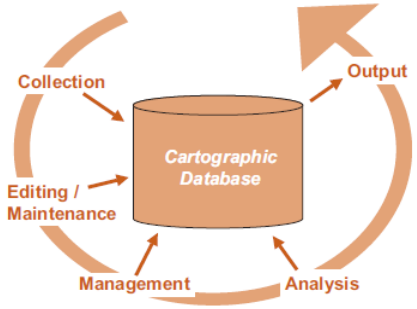



**Figure 12.4** GIS processing transformations needed to create a map

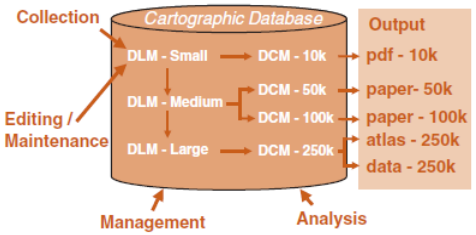



**Figure 12.18** Key components and information flows in a GIS map production system

# § 5 Application

- The relative importance of representing space and attributes will vary within and between different applications, as will the ability to broker improved measures of spatial distributions through integration of ancillary sources
  - Topographic map
  - AM/FM
  - ITS and auto-pilot
  - Military mapping
  - Social mapping

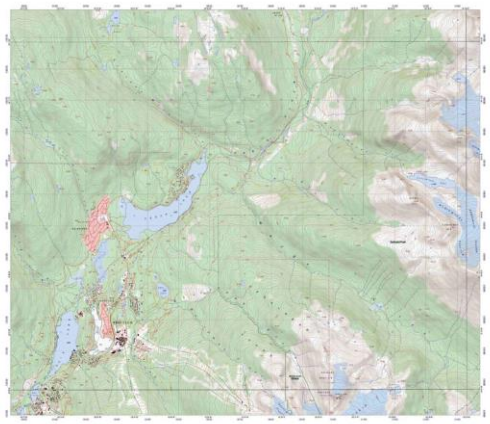


Figure 12.1 Terrestrial topographic map of Whistler, British Columbia, Canada. This is one of a collection of 7016 commercial maps at 1:20 000 scale covering the province (Courtesy: ESRI)

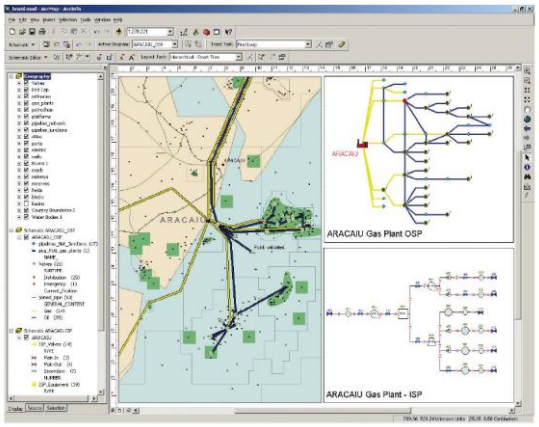



Figure 12.20 Schematic gas pipeline utility maps for Aracaiu, Brazil. Geographic view (left), Outside Plant schematic (top right), Inside Plant schematic (bottom right). Data courtesy of IHS-Energy/Tobin