Today’s Theme: transformations

From earth to map
- Start: Earth or part of the earth
- Next: Scale transformation
- Next: Projection transformation
- Next: Symbolization and representation
- Last: Reading and interpretation
- End: Mental “image” of earth or part of earth

The scale transformation
- Real world
- A representation of the world
Small scale and large scale

- In many fields, biology and ecology for example, “scale” is used as a more general term than in cartography
- Large scale = global, extensive
- Small scale = detailed, localized
- Usage is opposite in cartography
- My solution is never to say “scale”
- Use “map scale” or “cartographic scale”
- Use detailed or extensive scale
- Scale gives us a sense of how big

Map Scale

- Map scale is based on the representative fraction, the ratio of a distance on the map to the same distance on the ground
- Most maps fall between 1:1 million and 1:1000
- Digital and web maps are scale-less because maps can be enlarged and reduced and plotted at many scales other than that of the original data
- But in fact, all maps when displayed have a scale

Non-scientific Quiz #3

- If a globe is one meter around (circumference), what is its approximate scale?
  a. One inch to five feet
  b. 1:250 000
  C. 1:24 000
  d. 1: 1 million
  e. 1:40 million

- If a globe is one meter around (circumference), what is its scale?
  - One meter on the map corresponds to 40 million meters on the ground
  - RF = map distance / ground distance
  - RF = 1 meter / 40 000 000 meter
  - Globe scale is 1 to 40 million
  - Or 1:40 million or 1/40 million
Three ways of communicating scale

- The RF
  - As a ratio e.g. 1:200,000
  - As a fraction e.g. 1/200,000
  - Often abbreviated e.g. 1:24K
  - Beware of periods and commas

- Equivalent lengths
  - E.g. Inch to a mile
  - E.g. One inch to 2000 feet

- As a graphic

Advantages of a graphic scale

- Can be used for direct measurements on the map
- Is true at whatever enlargement or reduction you use on the map
- Can show different units, e.g. miles and kilometers
- BUT cannot account for scale differences on the map
- May be directionally biased
Universal plotting chart
Linear distance is a function of Latitude! Means distances N-S
Different from E-W and diagonals

But…..

A word on units

- English units standardized for mapping and surveying
- Inch-foot-yard-rod-chain-furlong-mile
- 12-3-16.5ft-66ft-10-8
- A mile is 5280 ft
- International Nautical mile
  = 6076.11549 ft = 1852 m
- Nautical mile (6080 ft.) =
  one minute of arc of a great circle

The “mile high” city

Remember Datums?

- Three markers on the steps of the Colorado State Capitol that identify this point.
- The first marker was installed in 1909 on the fifteenth step, but was stolen several times before a more permanent "ONE MILE ABOVE SEA LEVEL" marker was engraved in 1947.
- The second marker was placed in 1969 by Colorado State University engineering students on the eighteenth step, after resurveying the elevation.
- Third marker was placed in 2003, after surveyors using the new national vertical datum, determined that the thirteenth step was exactly at one-mile above sea level.
A note on areas

- 144 square inches = one square foot
- Note 10 square feet is not ten feet square
- 9 sq. ft. = 1 square yard
- 160 square rods = 10 sq. chains = 1 acre
- 640 acres = one square mile
- Baseball diamond around the bases = 90 feet square = 8100 sq. ft. = 752.49 square meters

Fortunately, we have the metric system

- 1000 mm = 1m
- 1000 m = 1 km
- 1000 mm x 1000 mm = 1 square meter (metre)
- 10 000 square meters = 1 hectare
- NOTE: 10 square meters is NOT 10 meters squared

The mantra

*The representative fraction is the map distance divided by the ground distance in the same units*

Burn in!

*The representative fraction is the map distance divided by the ground distance in the same units*
The formula

\[ RF = \frac{MD}{GD} \]

Only issue: different units feet, yards, miles; mm, m, km

Calculating scale from a map

Known distances, calculate scale

- Bridge to cemetery on map = 126 mm
- Bridge to cemetery on the ground = 3024 m
- \( RF = \frac{MD}{GD} = \frac{126}{3024000} \)
- \( RF = 1:24000 \)

Scale of a baseball earth

- Baseball circumference = 226 mm
- Earth circumference approx 40 million meters
- \( RF \text{ is: } 1:177 \text{ million} \)
Calculating ground distance from a map

Known scale, calculate distances

- Map distance = 300mm
- Map scale = 1:50 000
- RF = MD / GD so GD = MD / RF
- 1/RF is the denominator
- GD = 300 mm x 50 000 = 15 000m

The paper strip-to-graphic scale trick

Move the paper to the graphic scale
Read off distance
Trick works along roads

Examples

Bigger range

Zoom: New features at new scale
Some common map scales
Round numbers makes life easier

- 1:24 000
- 1:50 000
- 1:100 000
- 1:62 500
- 1:63 360
- 1:250 000
- 1:500 000
- 1:1M

The take-home

- The map scale transformation is the first, and changes data about the earth into a representation at a particular scale
- Don’t use the terms large and small scale
- Most maps are between 1:1000 and 1:400M
- RF = MD / GD
- The paper strip trick works
- Most maps are at standard scales, like 1:50 000
- Computer-based maps can be zoomed