Geog 1000 - Lecture 29

Mapping and GIS Continued

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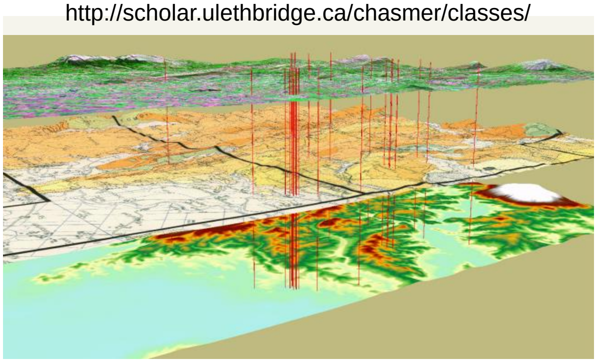
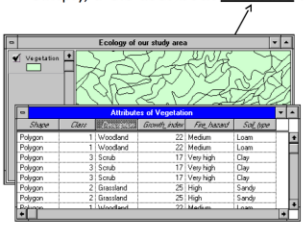


Today's Lecture (Pgs 13-25, 28-29)

1. Hand back Assignment 3
2. Review of Dr. Peddle's lecture last week
3. More on Geographic Information Systems

What is a GIS?

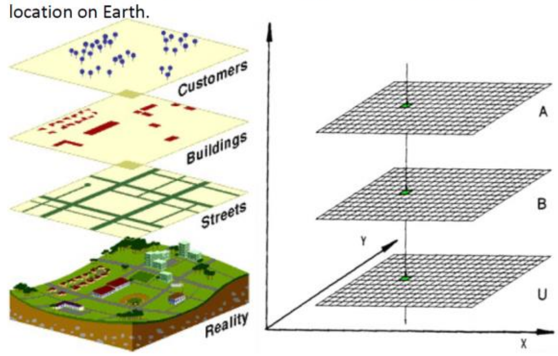
- Simply, a GIS uses both database and data processing tools.



...more completely: hardware and software integration with data, management, analysis, and mapping

The Basic Format of Data Layers:

Data layers are made up of spatial attributes, each being tied to a location on Earth.



GIS Needs…

And all data layers have spatial attributes (information) that can be accessed, questioned, or mapped.

Monitoring Wells

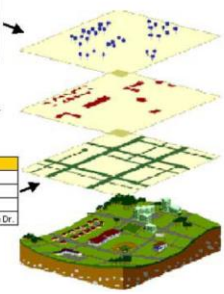
Well ID	Date Sampled	Concentration
C-6A	5/8/94	300
C-8A	5/8/94	20
C-13A	5/8/94	120
C-17A	5/8/94	560

Industries

Facility	Address
Acme	3029 Convington Dr.
Fox	742 West Lake St.
TPC	90 Aspen Dr.

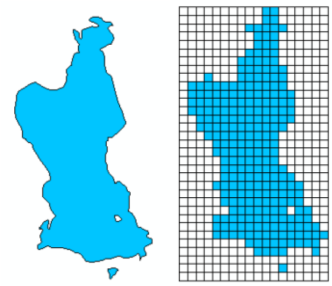
Population

Family Name	Occupants	Addresss
Blake	6	79 Circuit St
Hernandez	2	148 Plain St.
Joy	4	18 Webster St.
Smith	5	4321 Tecumseh Dr.



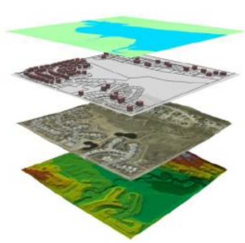
What kind of data can be used?

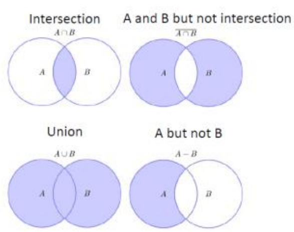
Most often converted to vector or raster:



Some Broad Categories of GIS Analysis

"Map overlays" Using Boolean logic to answer questions:

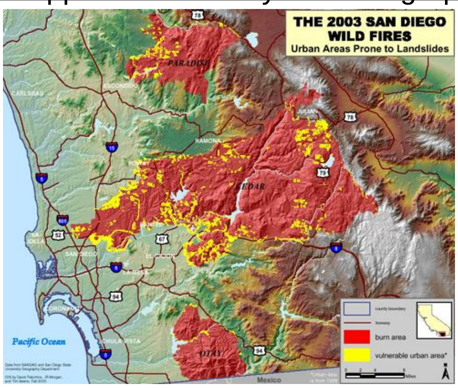




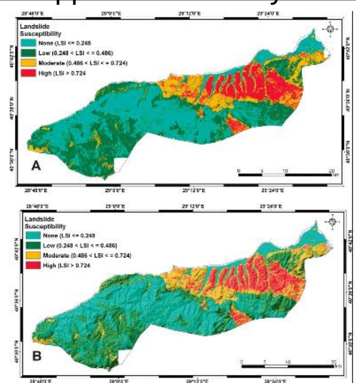
For Example: A = Forest; B = Proposed urban development:
Query: Show areas where urban development is proposed in a forested area
Query: Show areas where forest will remain natural

GIS Applications in Physical Geography

GIS Applications in Physical Geography



GIS Applications in Physical Geography



And many others!!

GIS → Built on Coordinate Systems

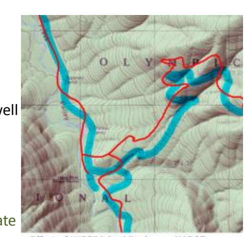
GIS → Useful because it brings together spatial data:

- many types, many sources

Relationships between datasets:

1. Depends on spatial *frame of reference* as well as data.
2. Coordinate systems don't need to be the same

BUT Need to know how coordinate systems relate to each other.



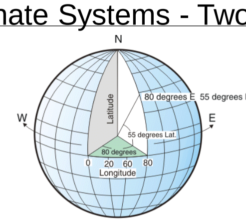
Offset of WGS84 (red line) on a NAD27 map

What is a coordinate system?

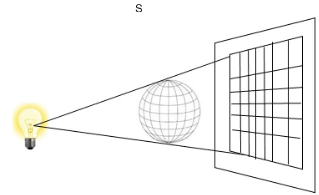
A reference system that is used to represent the locations of objects on the Earth's surface and within a common geographic frame of reference.

Coordinate Systems - Two Types:

Geographic:

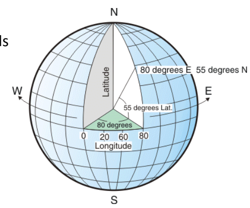


Projected:

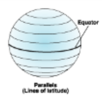


Geographic Coordinate Systems:

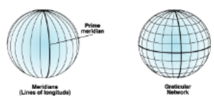
Location is determined from centre to a point on earth's surface.
→ Measure in degrees indicates the angle.
→ Decimal degrees or degrees, minutes, seconds



Lines of Latitude:
→ Horizontal lines running east to west
→ Called *parallels*



Lines of Longitude:
→ Run north to south, have equal longitude.
→ Called *meridians*



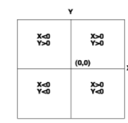
Graticular network →Latitude and Longitude grid.

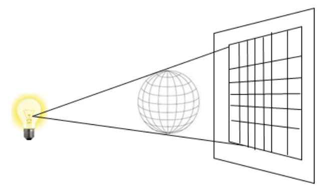
Projected Coordinate Systems:

A flat, two dimensional surface where the distance between locations have constant lengths, angles, and areas.

Mathematical transform used to *project* from 3D sphere to flat surface.

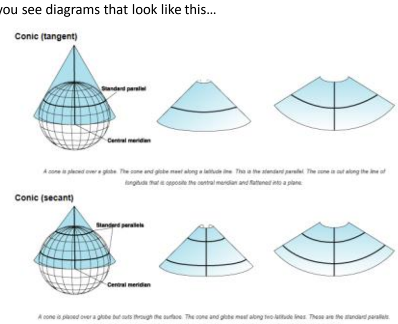
- Locations determined using x, y on a grid → represent points on a horizontal and vertical axes:





Projected Coordinate Systems:

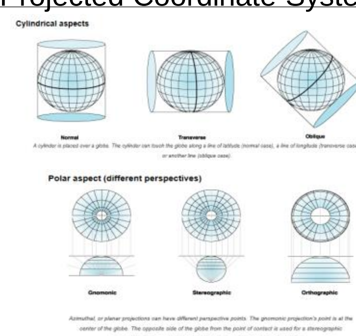
So when you see diagrams that look like this…



From ArcGIS Resources.

Projected Coordinate Systems:

Or this…

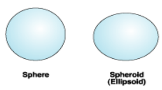


And some parts look really weird, stretched… but others look well in perspective – they are projected. (Don't bother memorizing all of the different types…)

Ellipsoid/Spheroid and the Geoid:

Latitude and Longitude requires understanding of radius of Earth at locations:

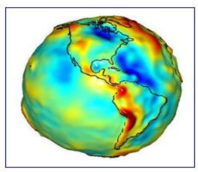
→ Not so easy…



Sir Isaac Newton first thought Earth was *not* spherical. Later confirmed with measurements

<u>*Geoid*</u> – Defined as *the surface of the earth's gravity field* → *"Earth Model"*

Gives us more accurate estimate of Earth geometry = more accurate latitude and longitude.



→ Approx same as mean sea level.

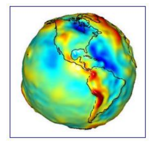
→ Varies perpendicular to pull of gravity.

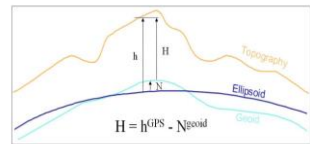
→ Mass of Earth varies → gravity and shape of Earth also vary.

Ellipsoid/Spheroid and the Geoid:

The Geoid is a more accurate representation than the Spheroid(Ellipsoid).

- Also includes elevation influences.





- Geoid provides difference between Geoid and reference *Ellipsoid.*

→ Difference is *Geoid Height (*N)

e.g. N > 0 when geoid > ellipsoid;
N < 0 when geoid < ellipsoid

Allows conversion from ellipsoidal heights (h) to orthometric heights (H) (geoid - elevation).

Datums: Based on the Spheroid

If we vary the datum, coordinates change:

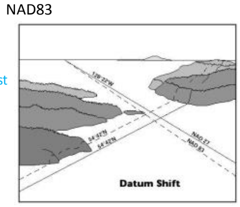
- E.g. Lethbridge:
- WGS84 / NAD83 → -112.874 deg long; 49.675 deg lat.
- Same location in NAD27 →-112.874 deg long; 49.673 deg lat.

In UTM coordinates:

- 364797 easting; 5504183 northing (Zone 12) NAD83
- 364792 E; 5503964 N (zone 12) NAD27

** The same location using NAD83 is 5 m to the west of that location using NAD27

and is 219 m north of that same location using NAD27!!



Map Scale, Resolution and Accuracy

<u>Two Different Types of Scale:</u>

<u>*Geographic Scale*</u>: Something that takes up a large area.

E.g. Canada has a much *larger* geographic scale than Lethbridge

<u>*Map Scale*</u>: The number of units on a map = the number of *same* units in the real world.

Recall: 1:24,000 → 1 unit on the map = 24,000 of the same units on Earth.

*A *Representative Fraction.*

Scale, Resolution and Accuracy

A ***Large Scale Map:*** Shows a *smaller* geographic area.

→ Scale fraction is *larger*

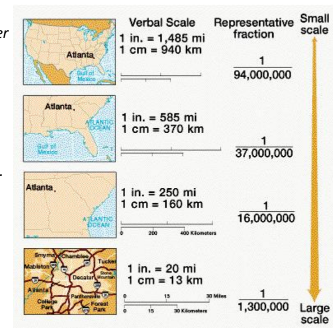
e.g. 1:4000 scale map

A ***Small Scale Map:*** Shows a *Larger* geographic area.

→ Scale fraction is *smaller*

e.g. 1:250,000 scale map

Scale → how much information do you want to include?

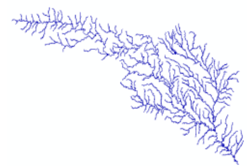


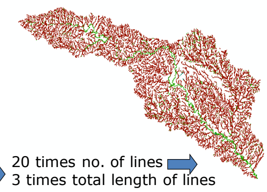
In A GIS → Isn't formal Scale because you can zoom in and out!

Scale, Resolution and Accuracy

Scale allows for Generalisation: Reduces complexity, detail…enhanced clarity

1:100,000 scale **1:24,000 scale**





20 times no. of lines

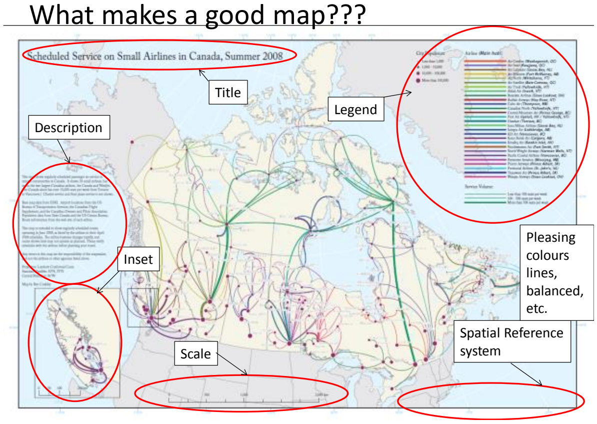
3 times total length of lines

River Basin Flow Lines
1:100,000 scale – 557 lines,
Total length 1890 km

River Basin Flow Lines
1:24,000 scale – 11,338 lines,
Total length 5559 km

Craig Coburn

What makes a good map???



Locating Objects on Earth and on Maps: Global Positioning Systems

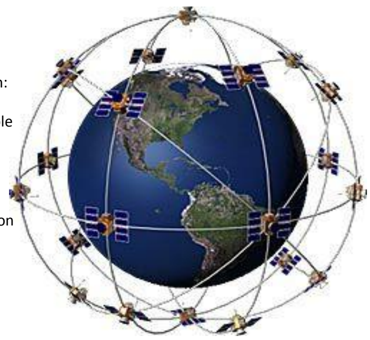
Has 3 components:

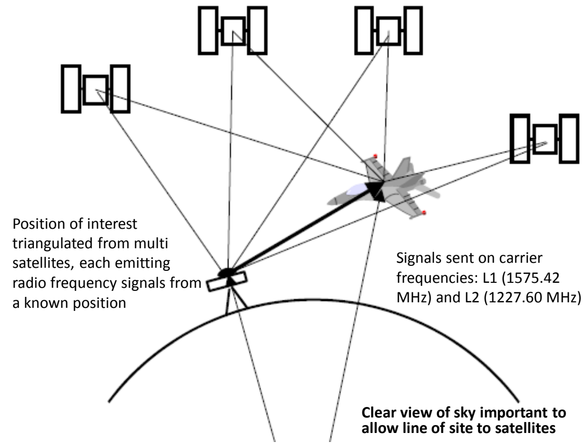
1. Space segment: GPS satellites ("space vehicles") orbiting Earth.
   - → 2 Orbits per day at 20,200 kms above earth.
   - → "constellation"
   - → Known position at precise *time* of signal transmission.

Space Segment:
Global Navigation Satellite System (GNSS)

Satellites → "constellation:

- Allows for enough visible satellites (24 satellite minimum) for full constellation.
- Viewable by someone on earth → location





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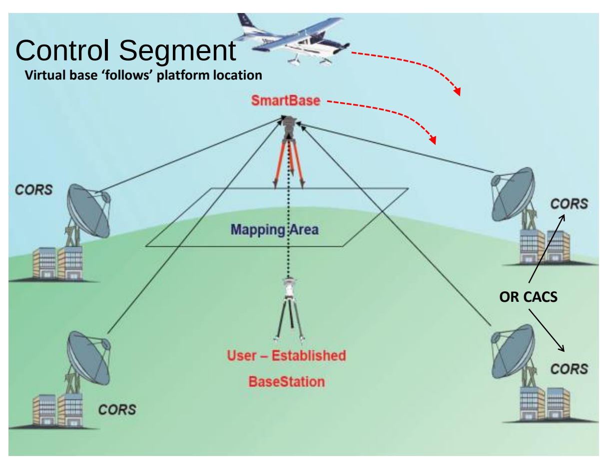
2. Control segment: Series of global ground control stations
   → monitor and track satellite signals
   → signals sent to central location for broadcasting



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3. User segment: A GPS unit used by a person on Earth. Receives signals from satellites, but does not transmit.
   → Information used to determine location.
   → number of channels = number of satellite signals received.
   → Can also read L1 and or L2 frequencies

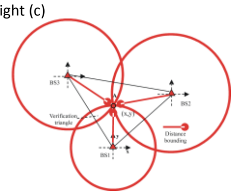
User Segment

How Does GPS Find Your Position?

Radio waves sent as "Electromagnetic radiation":
→ Measures transmission time from satellite (t)
→ Knows that radio waves moving at speed of light (c)

Therefore: t x c = distance (*pseudorange)*

Trilateration → Position determined based on three points of (satellite) reference:



→Get you a closer, more *precise* understanding of where you are.
→*But* in 3D (spherical distances)
→Intersection of 3 spheres

improved using 4th satellite