

Global Positioning Systems



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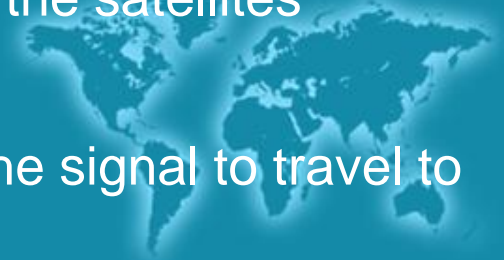
Objectives for this afternoon

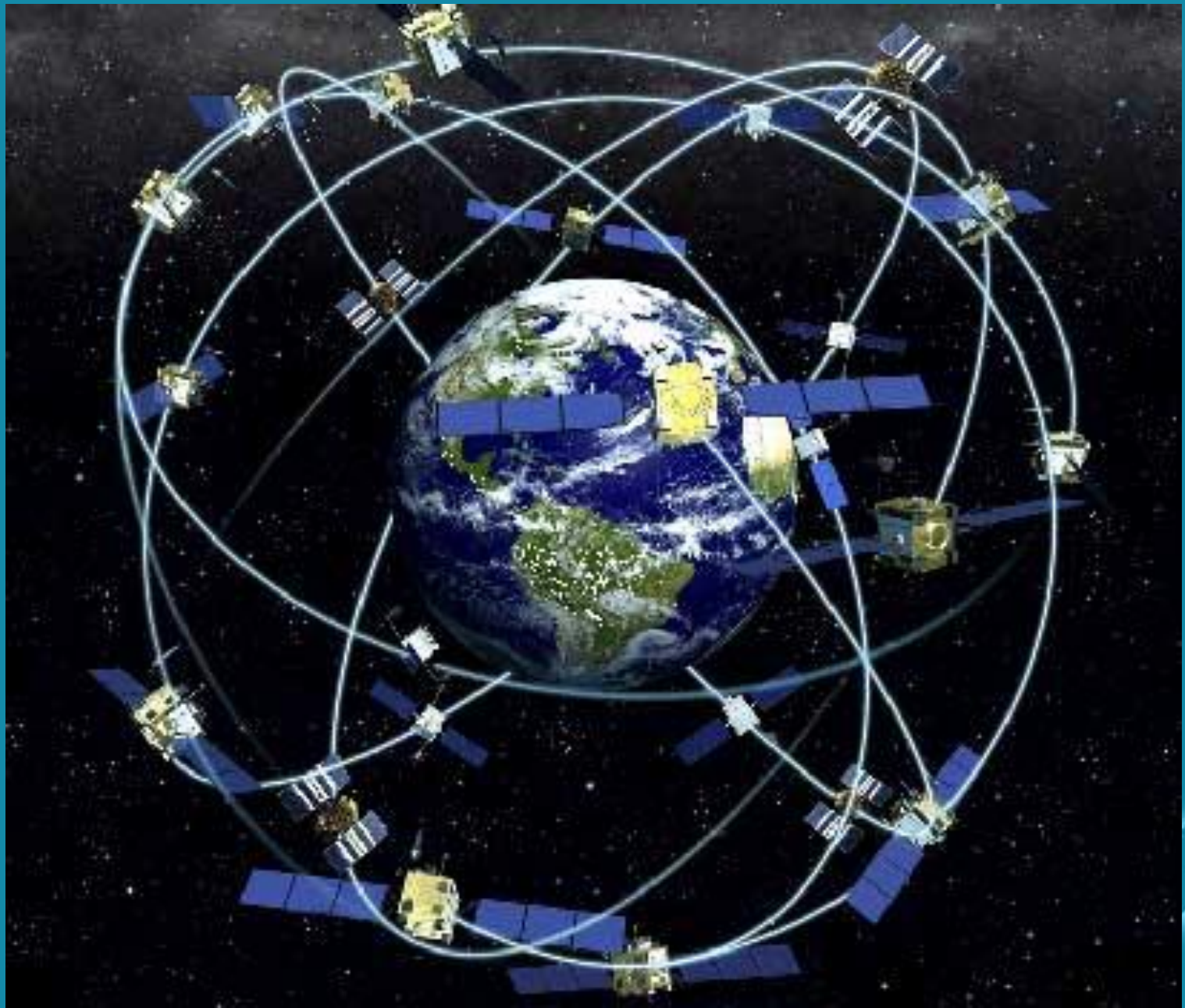
- Learn what GPS is all about
- Learn how a GPS receiver works
- Learn the importance of projections
- Learn how to download and store GPS data
- Apply GPS to field activities to use for work or play



What is GPS?

- GPS = Global Positioning System
- Created and operated by USDOD
- The SYSTEM is made up of 3 major components:
 1. **Satellites**
 - 27 total (24 orbiting earth, 3 extras) traveling at 12,000 nautical miles, twice a day.
 - The Satellites continuously send radio signals to earth
 - Those radio signals are picked up by GPS receivers
 2. **Ground Control Station**
 - There are 5 Control Stations that transmit to the satellites
 3. **GPS receiver (Unit)**
 - The GPS receiver knows how long it takes the signal to travel to the receiver.





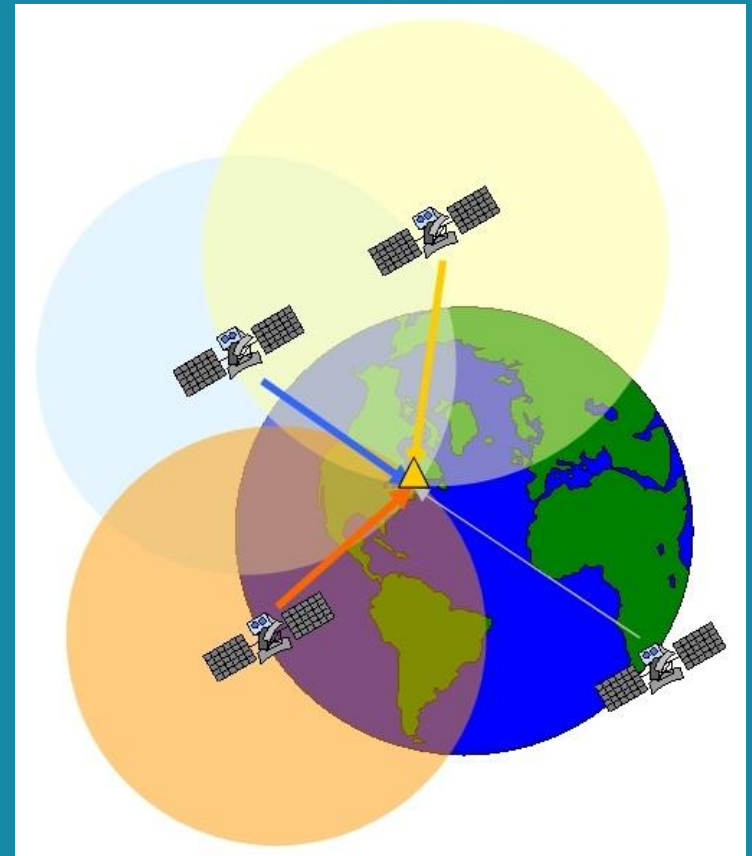
Handheld GPS receivers are a great resource for:

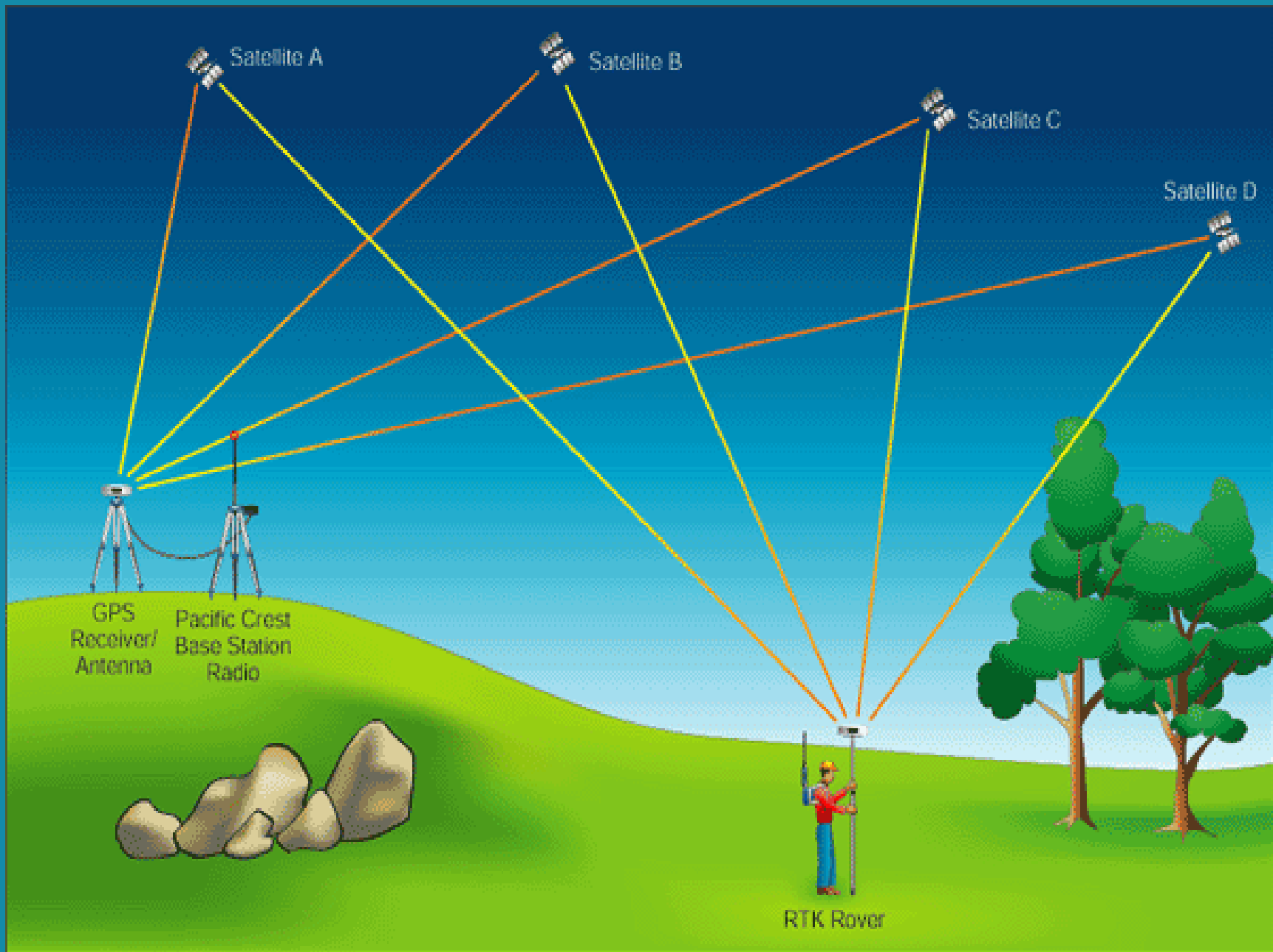
- **Landowners**
 - Plotting a patch of noxious weeds
 - Fence lines / Property boundaries
- **Natural resource professionals**
 - Marking streams, structures, wells
 - Wildlife habitat, wildlife corridors
 - Plant inventories
- **Other Outdoor recreationalists**
 - Hunting locations
 - Fishing holes
 - ATV routes



How a GPS works

- GPS uses Trilateration – specifically 3-D Trilateration.





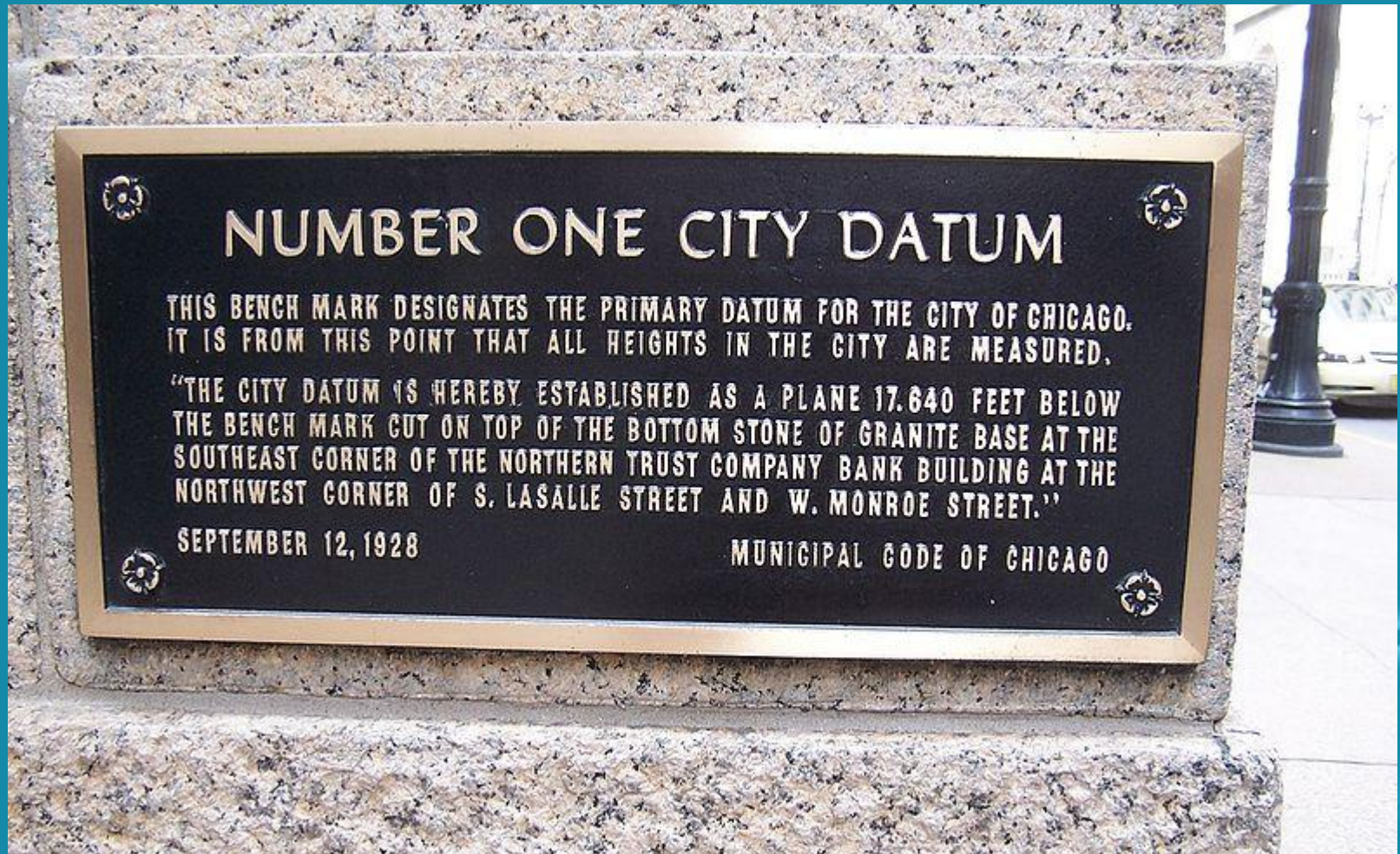
Signal Accuracy

- Positional Accuracy:
 - Grade of GPS
 - Military
 - Civilian (selective availability-scrambling)
 - Signal Quality
 - Angles
 - Ground Control Station
 - Background
- Relationship to the world
 - WGS84 Datum



Datum:

How we reference the world



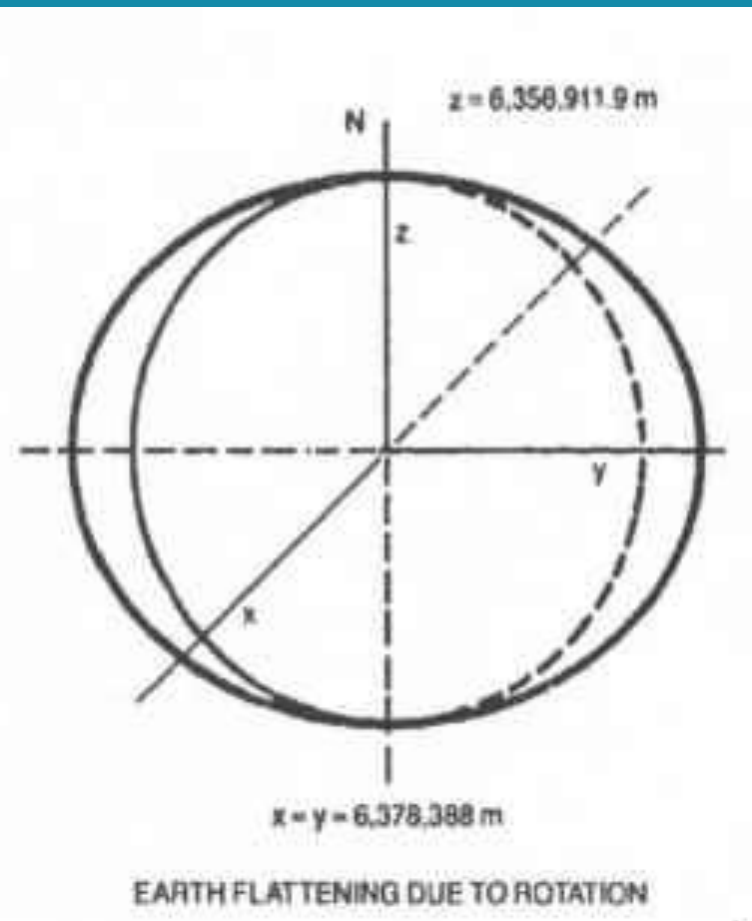
Datums

- The North American Datum of 1927 (NAD 27) is “with origin at (the survey station) Meades Ranch (Kansas).” ... The geoidal height at Meades Ranch was assumed to be zero
- The North American Datum of 1983 (NAD 83) is “based on a geocentric origin and the Geodetic Reference System 1980 (GRS80) is based on the adjustment of 250,000 points including 600 satellite Doppler stations...
- The WGS84 datum, which is almost identical to the NAD83 datum used in North America, is the only world referencing system in place today. WGS84 is the default standard datum for coordinates stored in recreational and commercial GPS units.



Datums

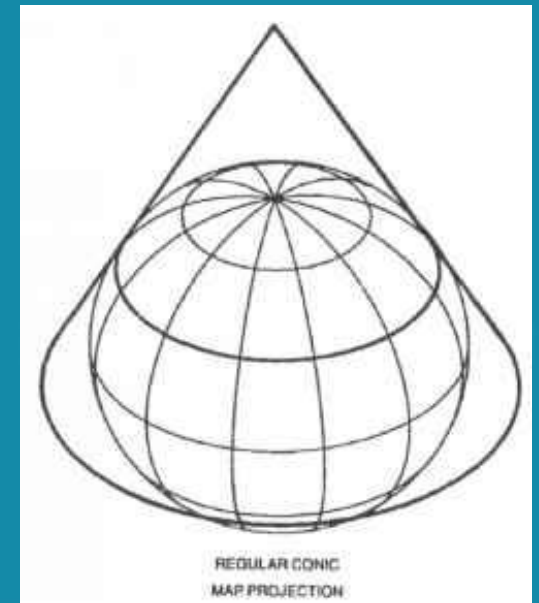
- A reference datum (mathematical model) is a known and constant surface which is used to describe the location of unknown points on the earth
 - The Earth is NOT FLAT
 - Where is the Center?



Projections: How we see the world

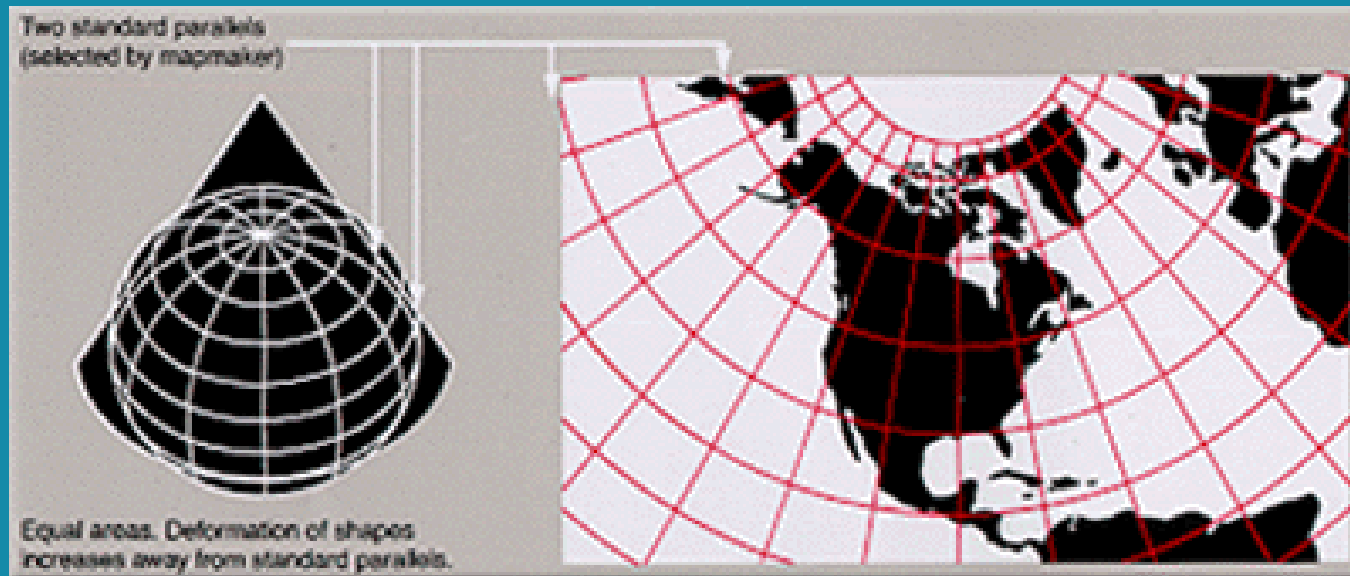
- Projection of a sphere (or an ellipsoid) onto a plane will have to distort the image.
 - Flatten an orange peel without tearing it

- Conical Projections
- Cylindrical Projections



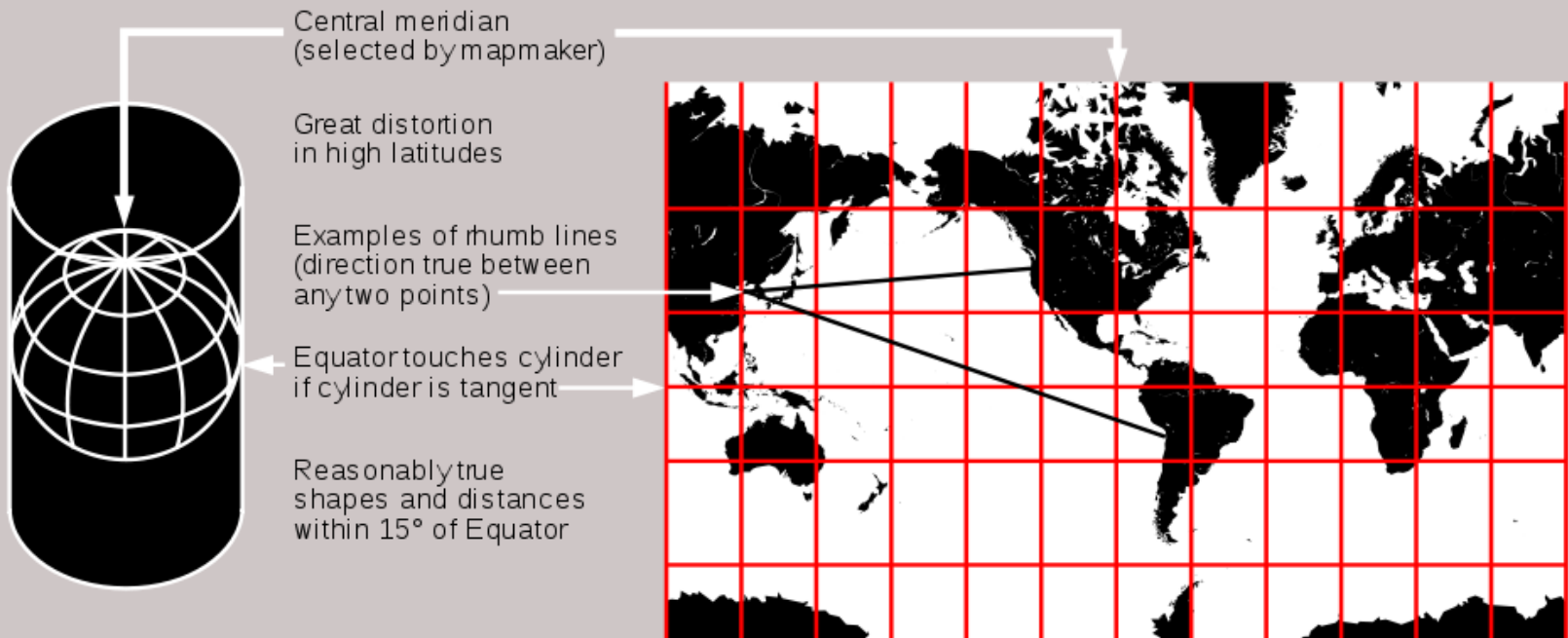
Albers Conical Projection

- Shows Area Accurately
- Distorts Shape



Cylindrical Projections

- Directionally true
- Shapes exaggerated at high latitude



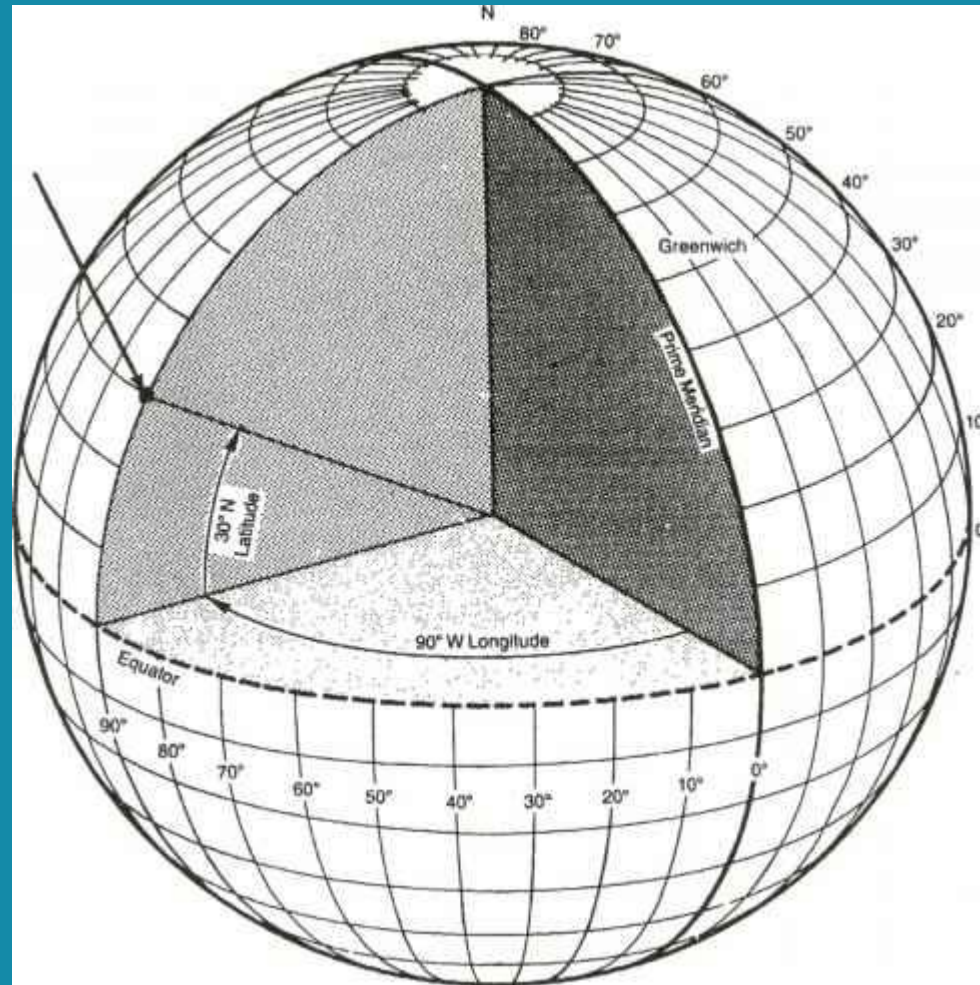
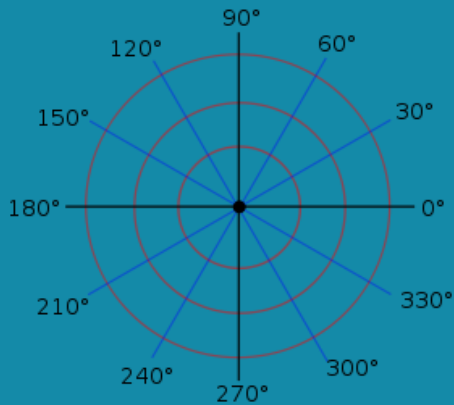
Coordinate Systems:

How we measure the world

- Polar Coordinates
 - Latitude and Longitude
- Cartesian
 - Universal Transverse Mercator
 - State Plane

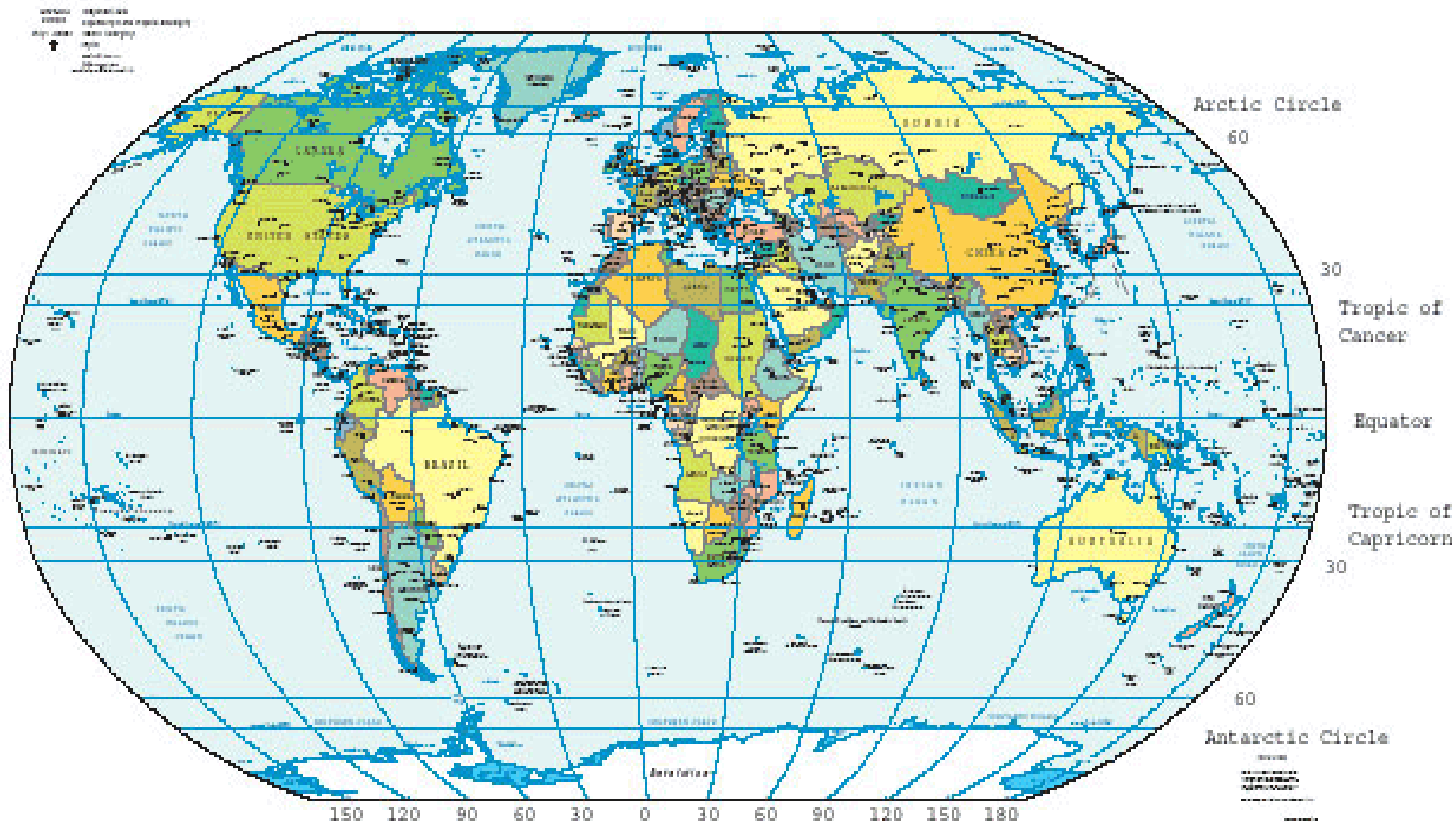


Polar Coordinates



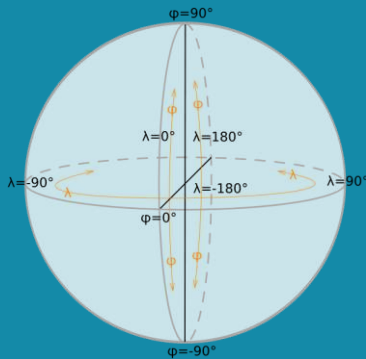
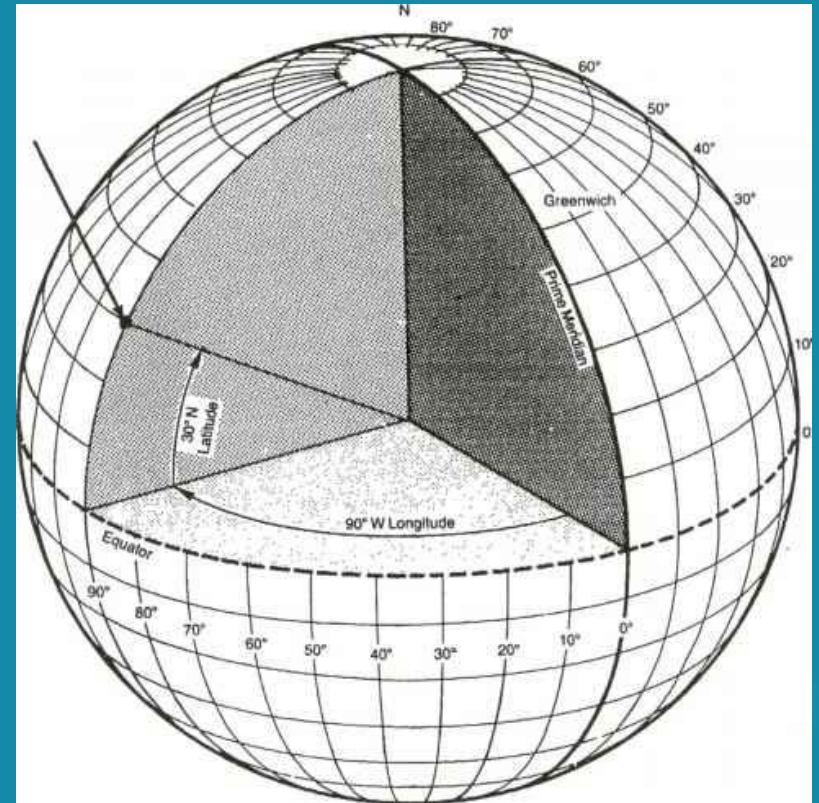
Latitude/Longitude

Political Map of the World, June 2003



Lat/Long

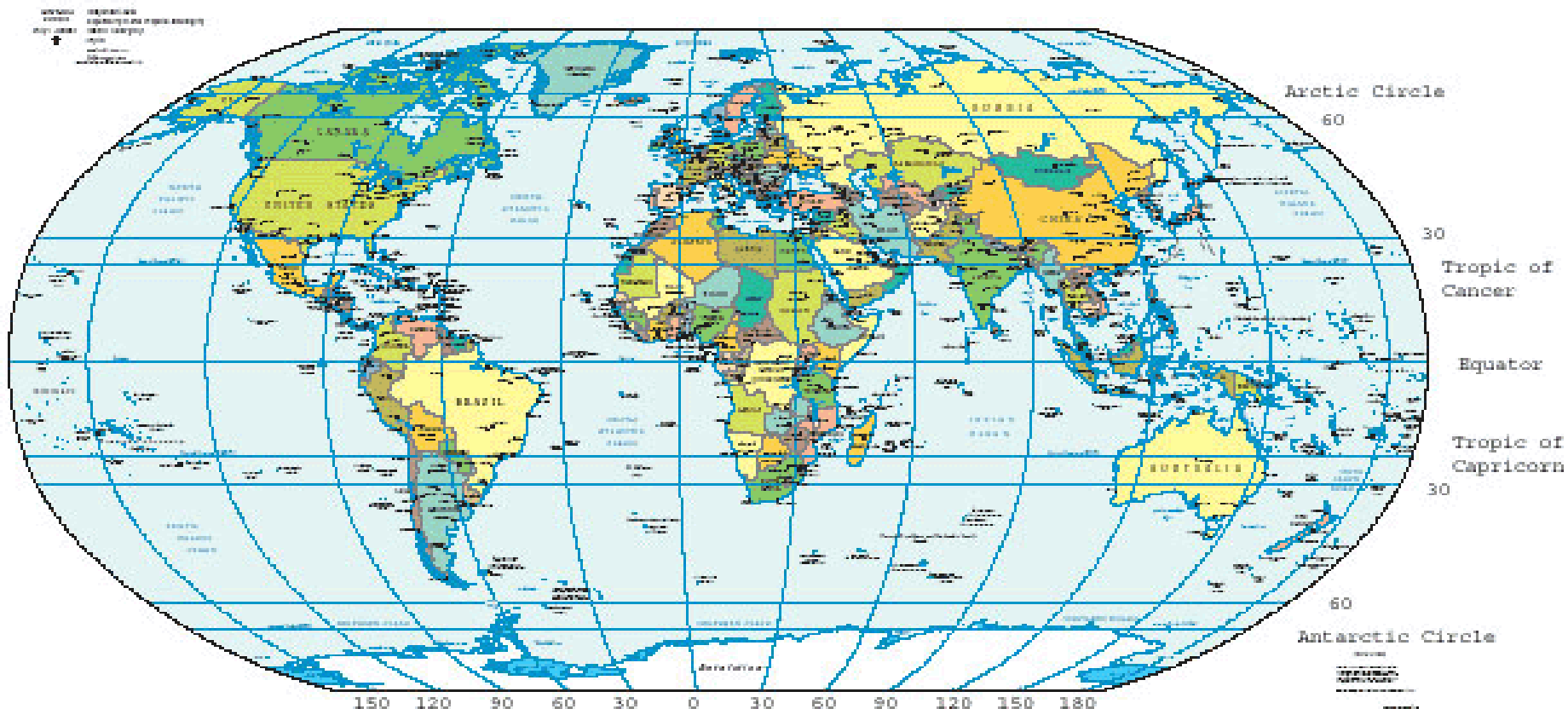
- Latitude
 - Up/Down (Attitude)
- Longitude
 - Horizontal
 - Long ways away



Lat/Long: Center of The World

- A line passing near the Royal Observatory, Greenwich
 - zero-longitude reference line, the Prime Meridian.
 - Places to the east are in the eastern hemisphere (i.e. 90° E), places to the west (i.e. 90° W) are considered the western hemisphere.

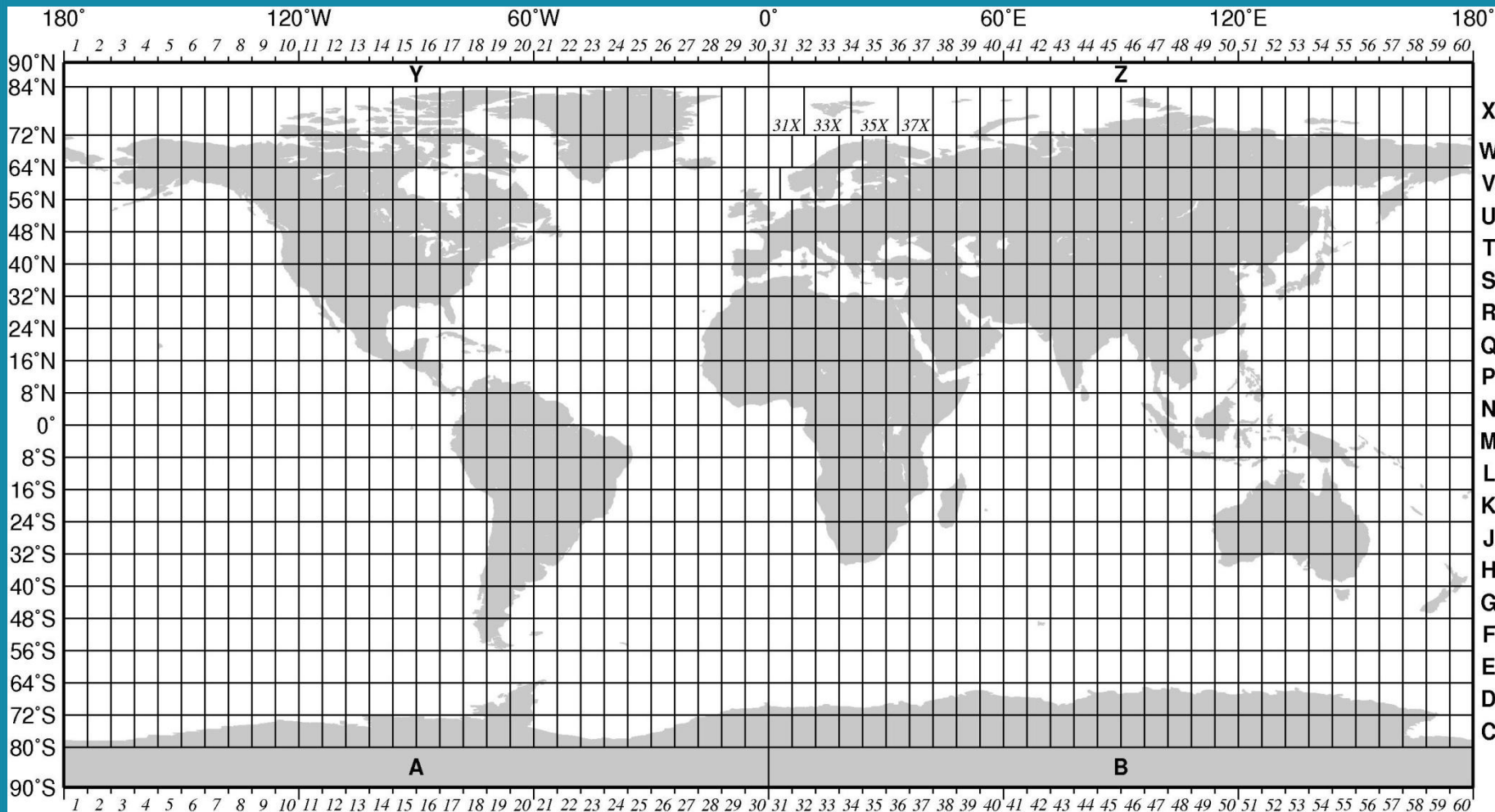
Political Map of the World, June 2003



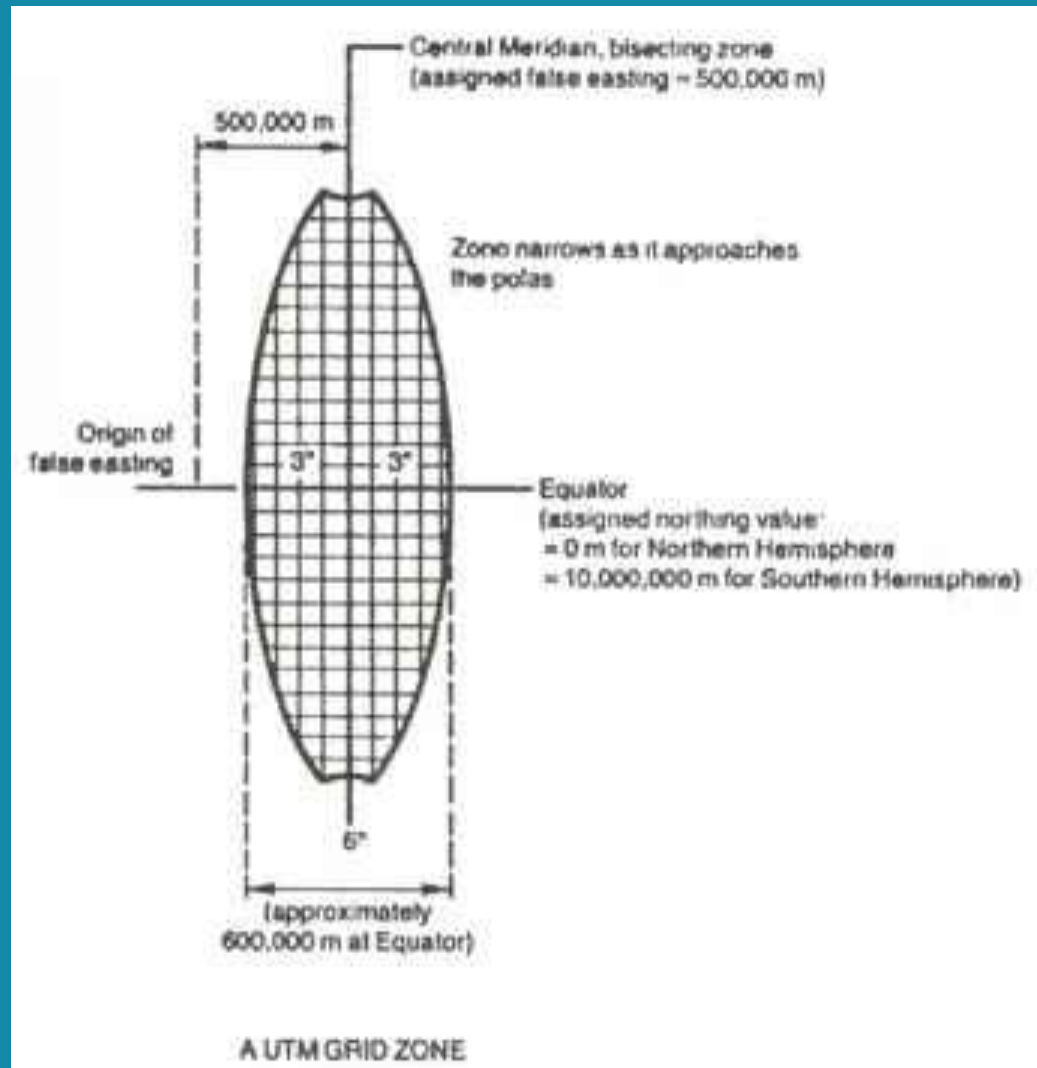


Circa .1590

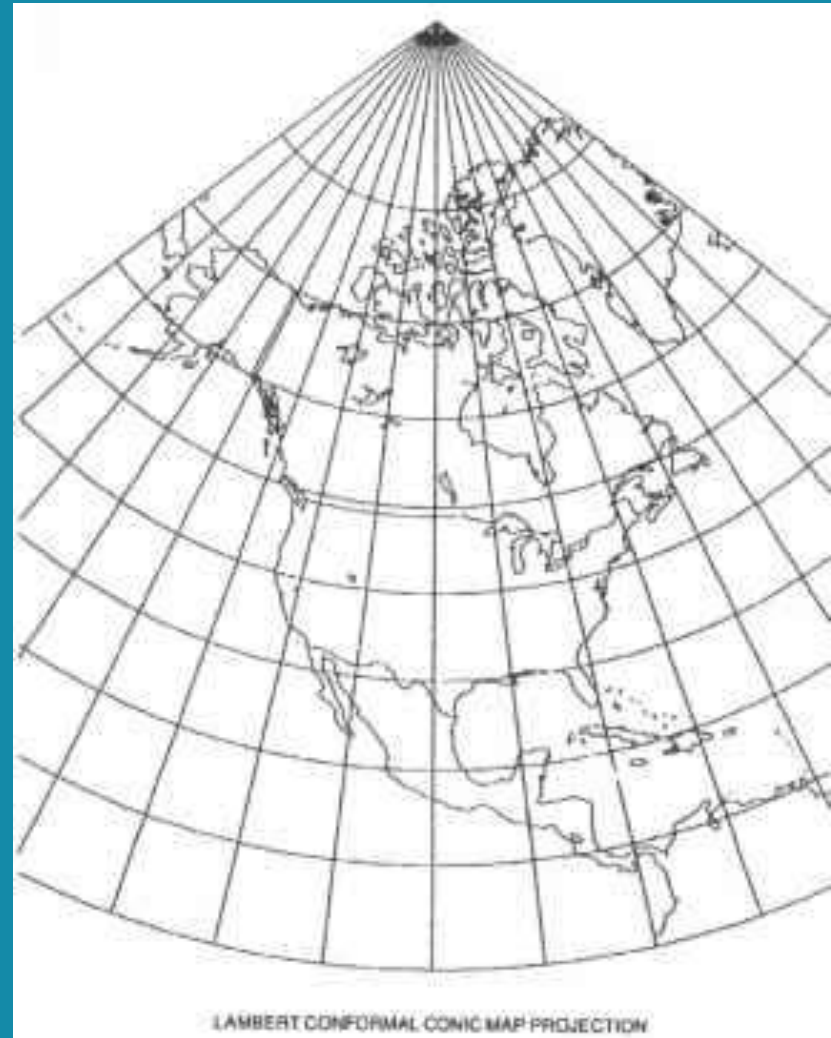
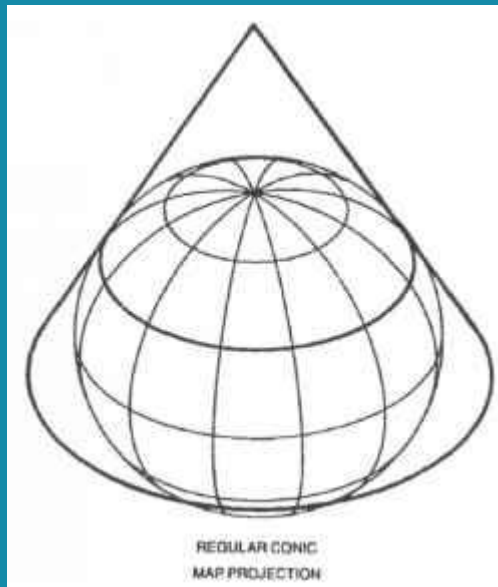
Universal Transverse Mercator UTM/UPS



UTM Zones

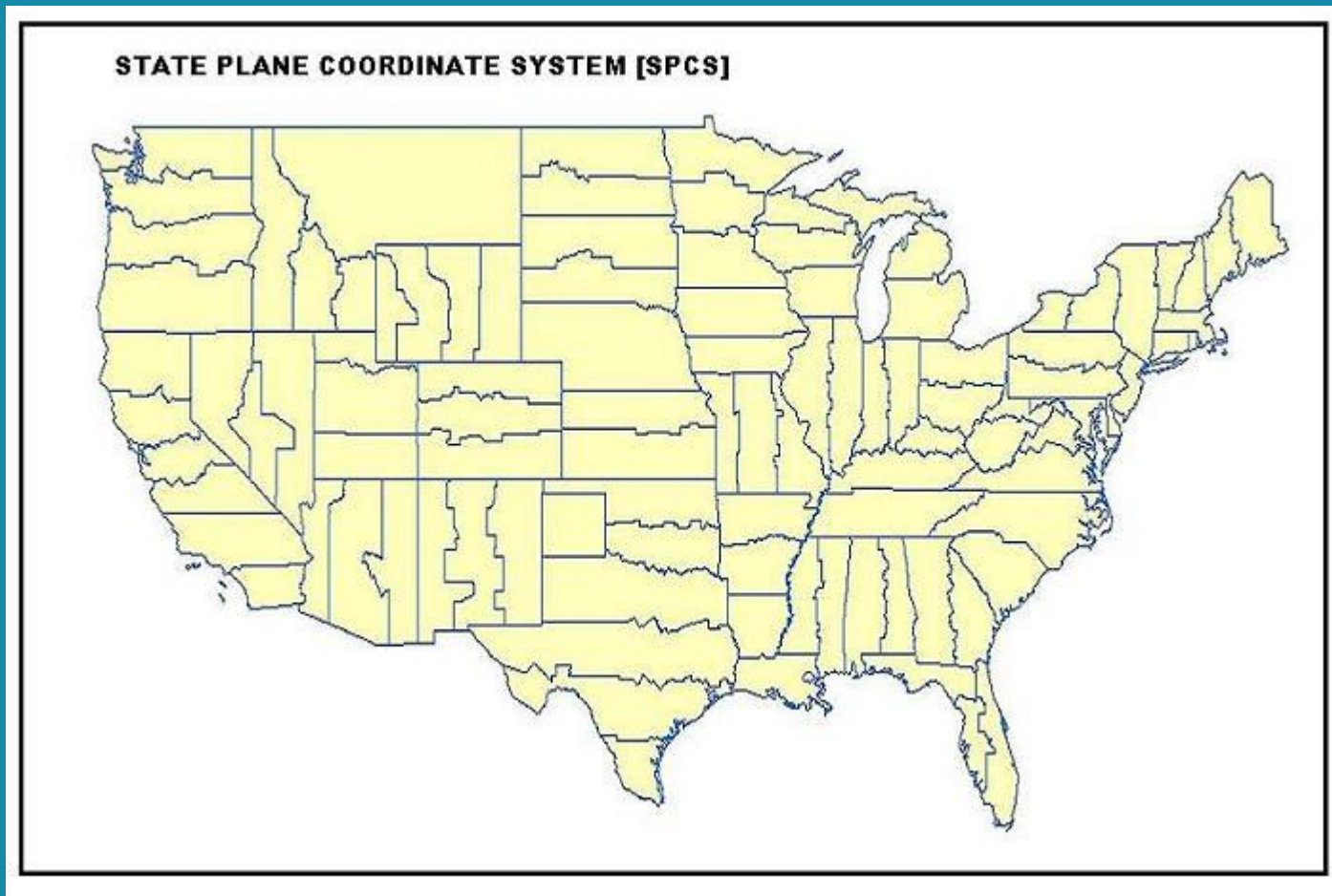


Lambert Conical Projection



State Plane Coordinate System

Wyoming uses a Transverse Mercator projection, most others use the Lambert Conical Projection





Mapped, edited, and published by the Geological Survey

Control by USGS and USC&GS

Topography by photogrammetric methods from aerial photographs taken 1961. Field checked 1962

Polyconic projection. 1927 North American datum

10,000-foot grid based on Pennsylvania coordinate system, north zone
1000-meter Universal Transverse Mercator grid ticks,
zone 18, shown in blue

Maps

- Abstract Representations of reality
 - Models
- GPS
 - Location in reality
 - Transferred to a map



