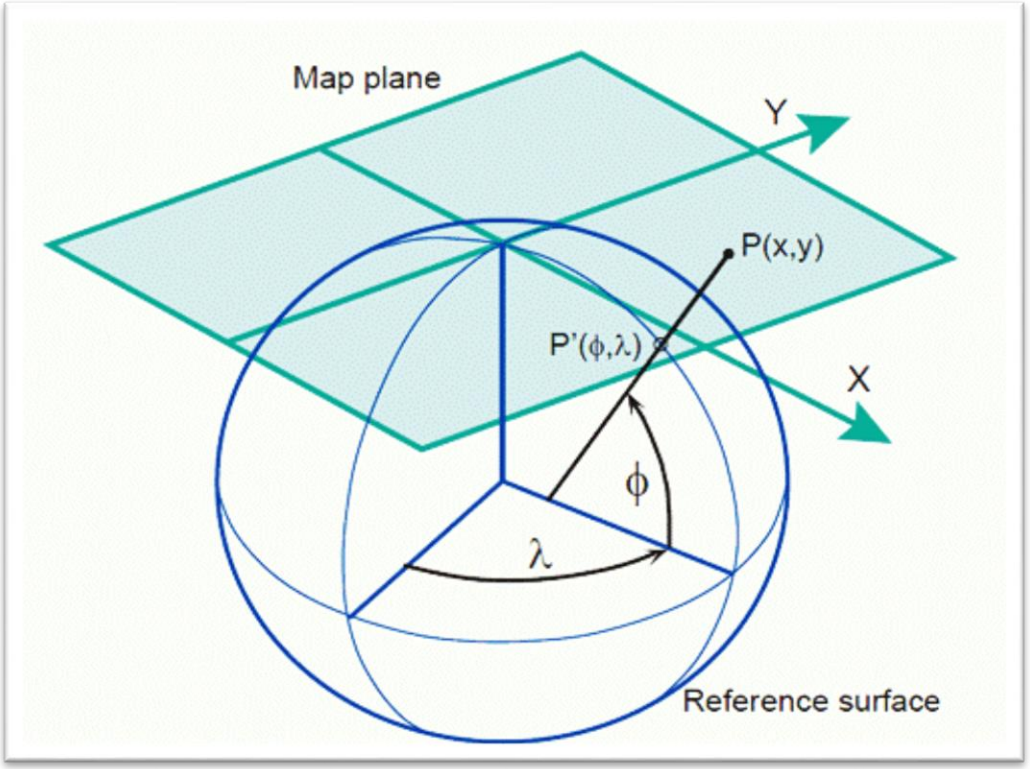
Geographic Information System Projections

Lecture #2

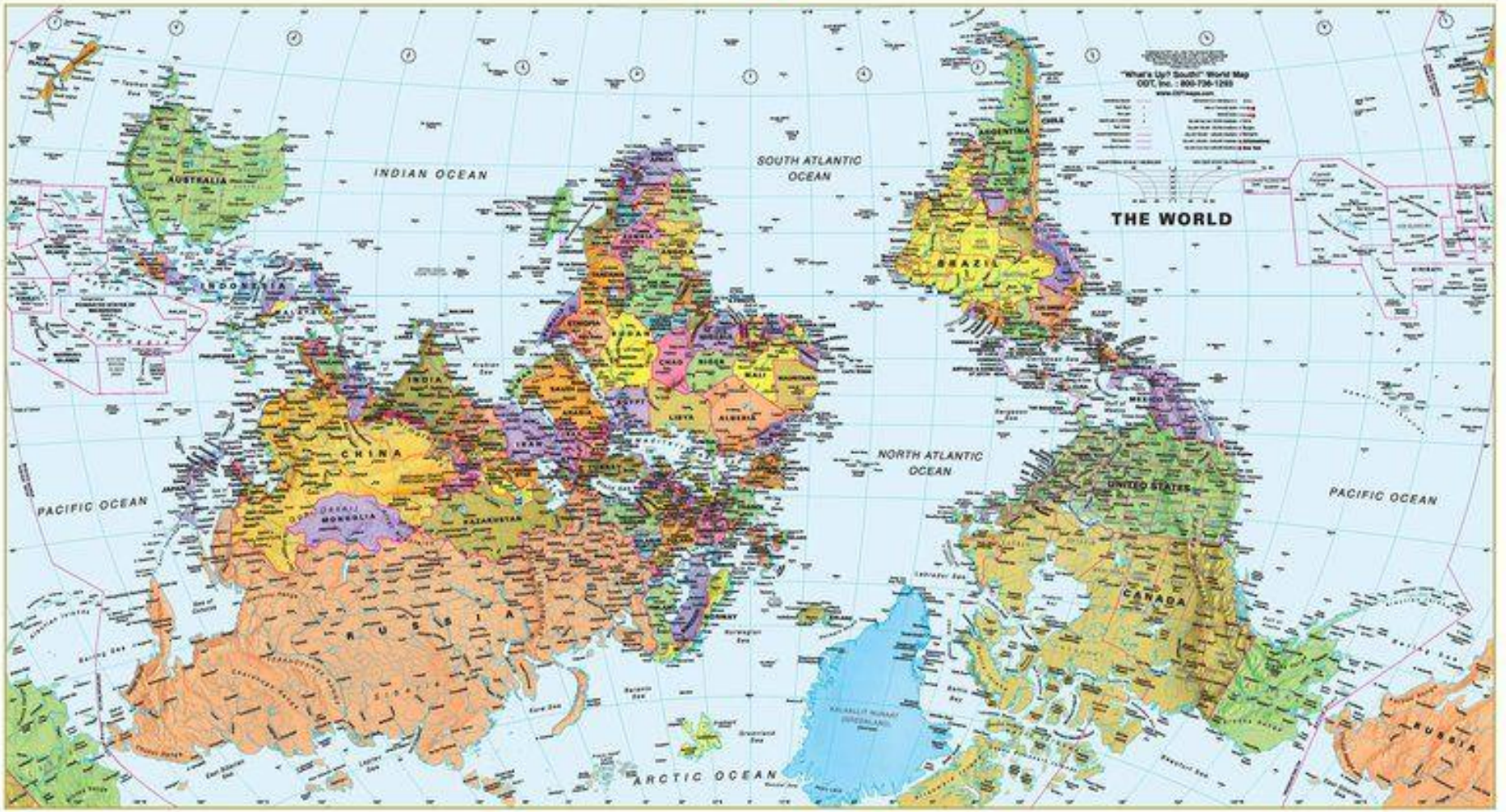


Concept Summary

- A spheroid or approximation of the Earth *shape* is required to calculate a datum.
- A datum is a mathematical model that serves as a 'home base' to that may be used to calculate the coordinates of another location.
- A map projection converts a 3D spheroid into a 2D plane. (Globes versus Maps)

Summary continued…

- Projected coordinate systems are built ON a map projection.
  - These are specific grids that may be used to define a specific geographic location on the Earth's surface.
- It is important to be aware that there are many different ways to determine a geographic location!
  - Because if you run into a problem where your data do not line up as they should, it is likely that they come from 2 or more different projections…


"What's Up? South!" World Map
OGT, Inc. : 800-736-1293
www.OGTmaps.com
THE WORLD
INDIAN OCEAN
SOUTH ATLANTIC OCEAN
NORTH ATLANTIC OCEAN
PACIFIC OCEAN
PACIFIC OCEAN
ARCTIC OCEAN
AUSTRALIA
INDONESIA
CHINA
INDIA
RUSSIA
MONGOLIA
KAZAKHSTAN
BRAZIL
ARGENTINA
CHILE
MEXICO
UNITED STATES
CANADA
RUSSIA


WHO SAID "NORTH" WAS "UP"?

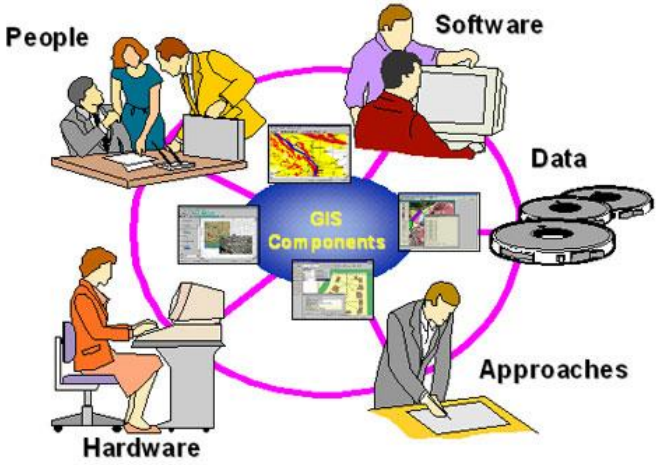

WHAT'S UP? SOUTH! WORLD MAP

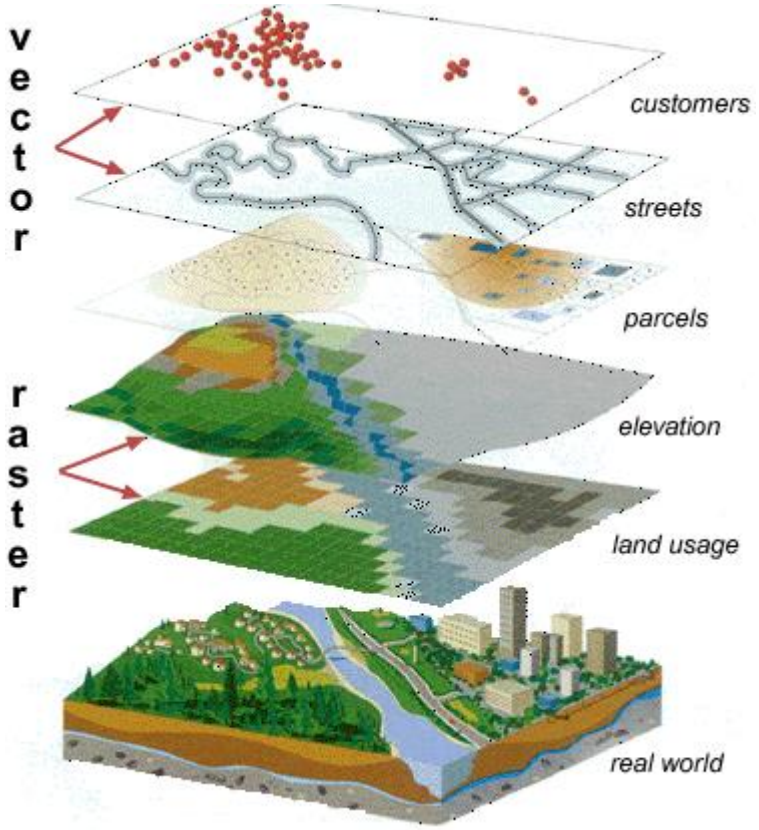
GPS vs. GIS

Global Positioning System

The 24 GPS satellites
-altitude of ~11,000 miles
-travelling at a speed of ~7000 mph.
-two full orbits in just under 24 hours

Geographic Information Systems





Geospatial features & attributes

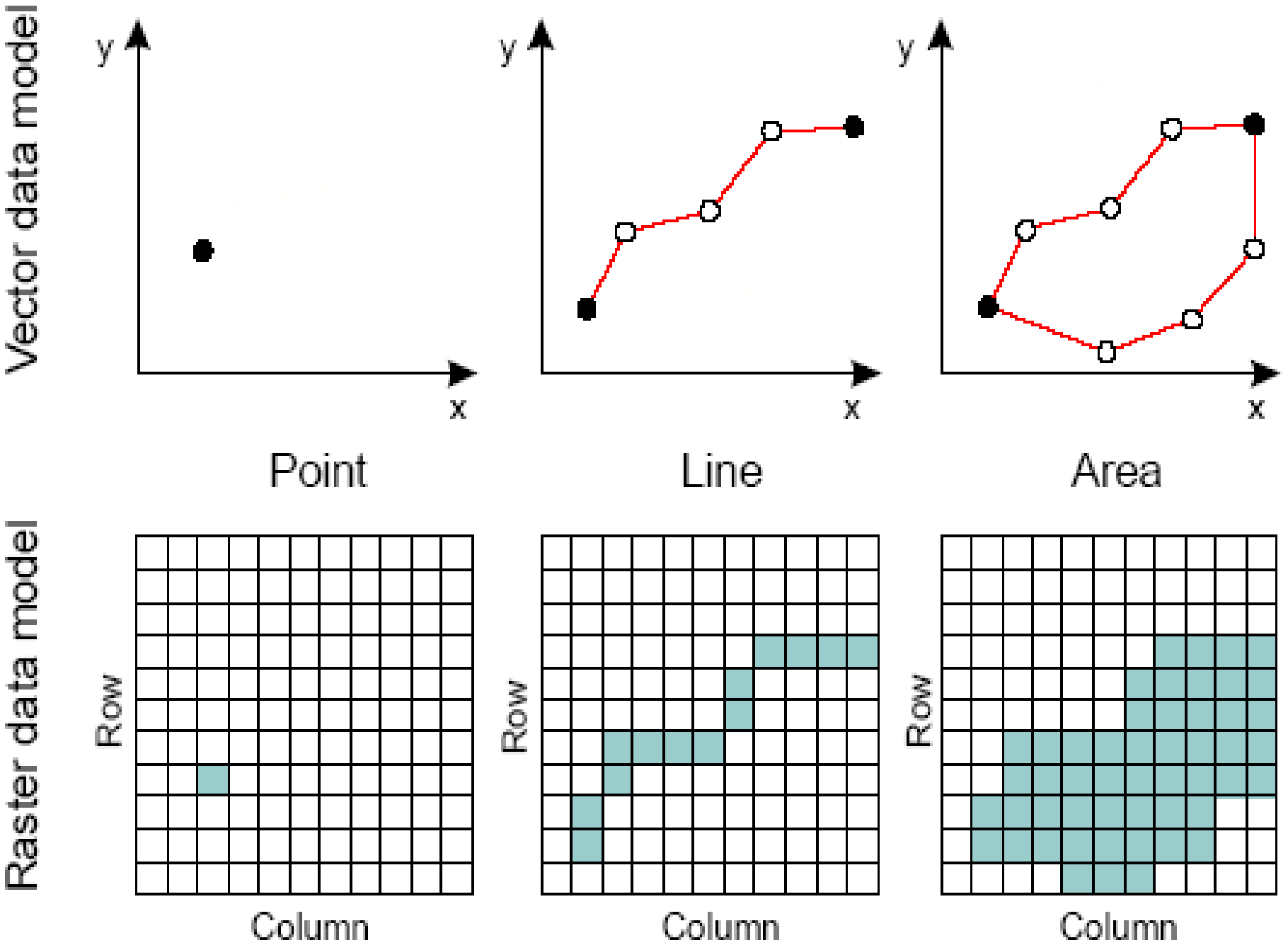
Place

Vegetation

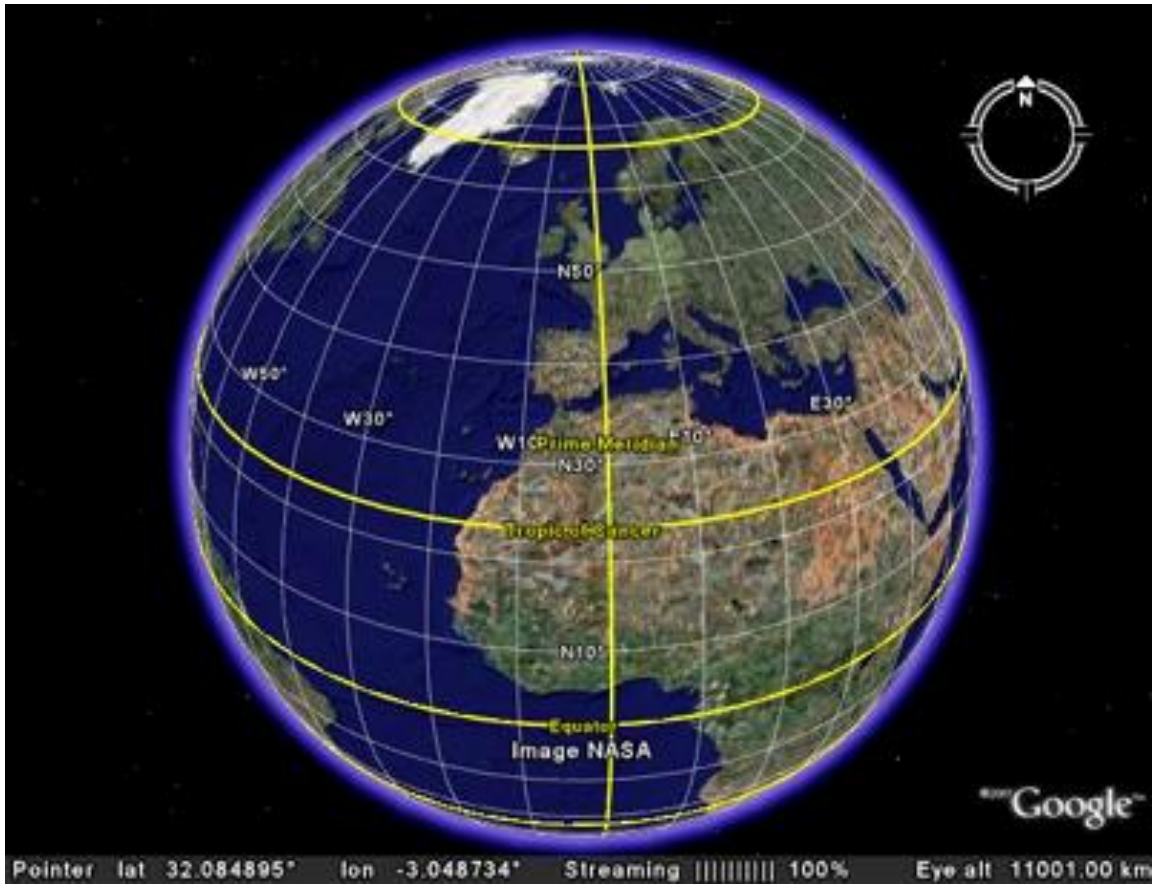
Geology

Eruption history

Deaths


Vector data model
y
x
Point
y
x
Line
y
x
Area
Raster data model
Row
Column
Row
Column
Row
Column

Coordinate System Vocabulary



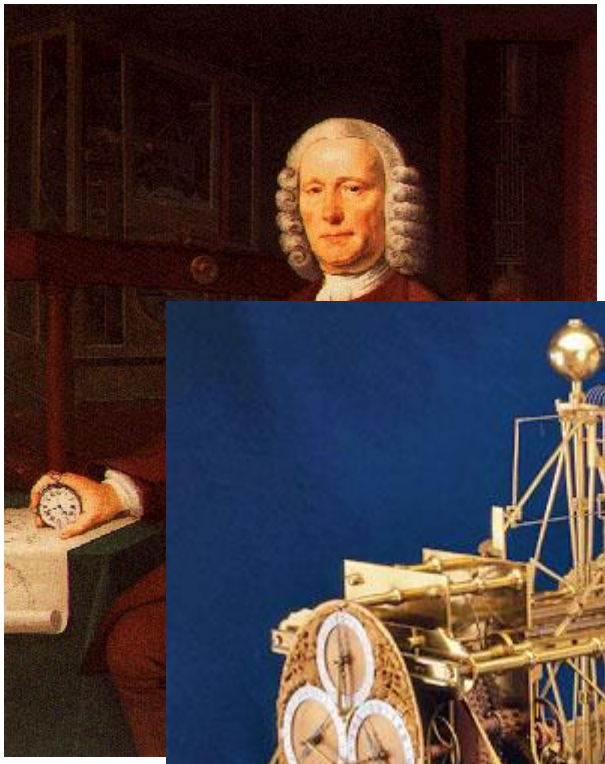
- Meridians = lines of equal longitude
- Parallels = lines of equal latitude
- Method of angular measure (E-W/N-S)
- (DMS) degrees, minutes, seconds

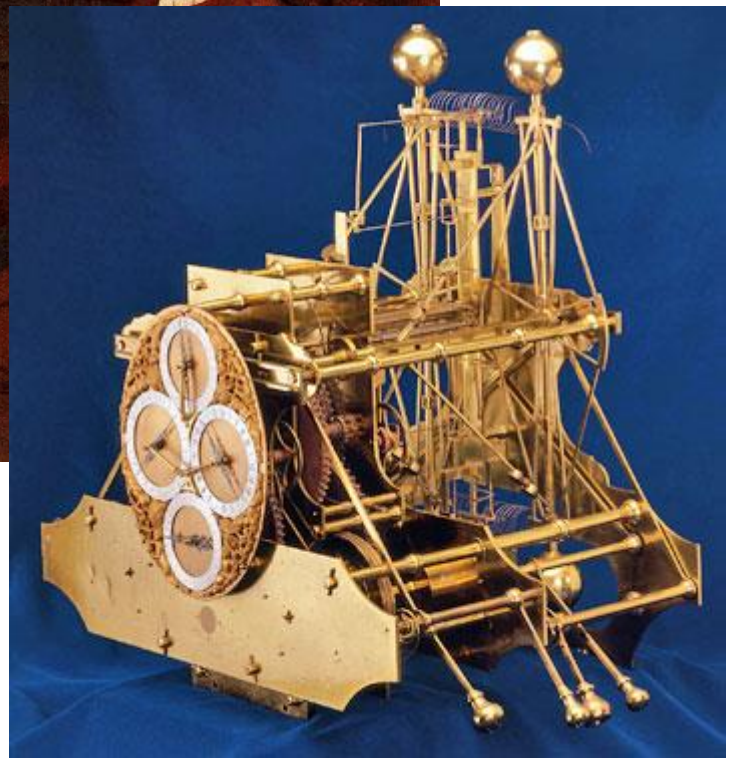
Developing a Coordinate System

Claudius Ptolemy, 140

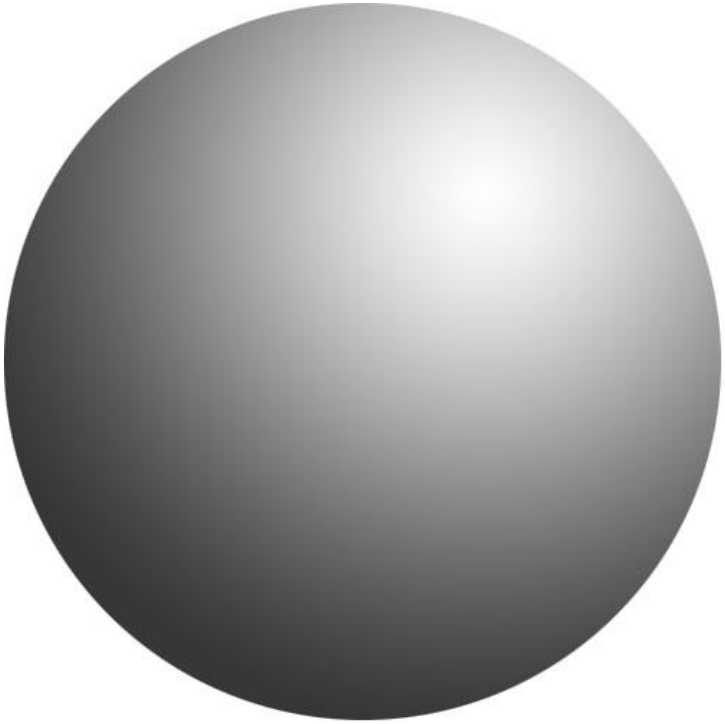
‘First’ to use mathematical projection to show a round earth on a flat surface

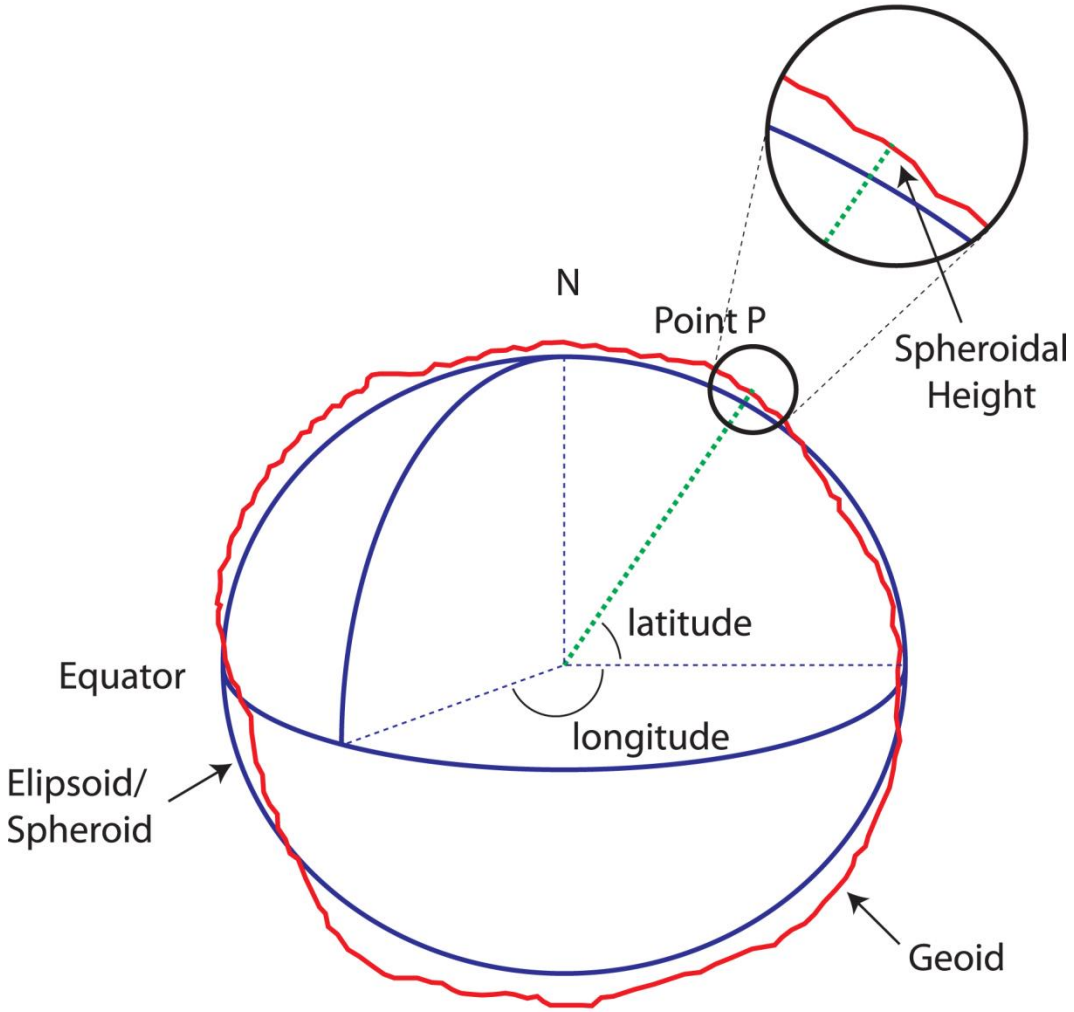
John Harrison, 1740





Issue #1 Approximation of the Earth





Datum

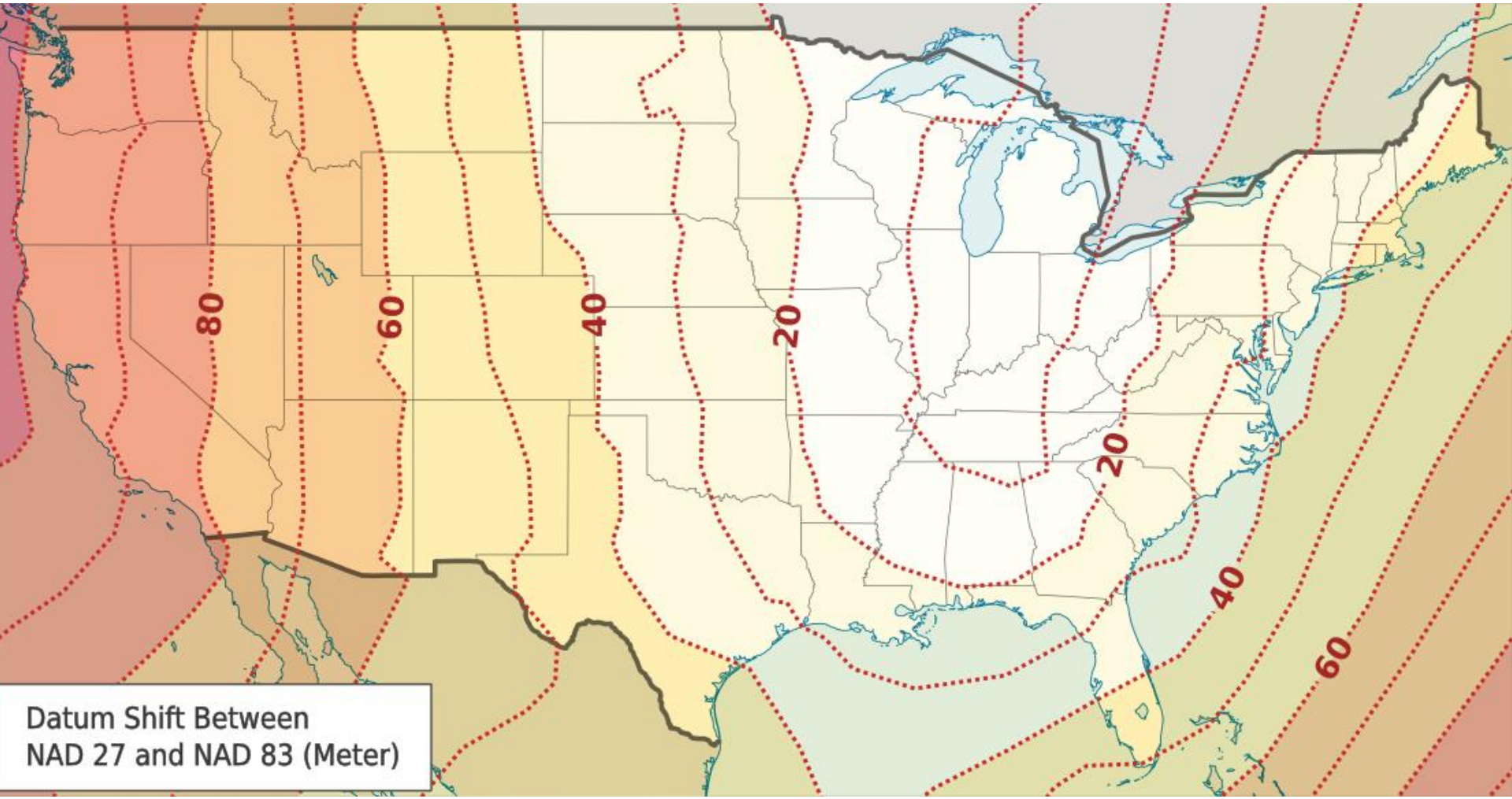
- Mathematical model of the Earth that serves as the reference point for calculating the geographic coordinates of a location.

Issue # 2

Types/Progressions

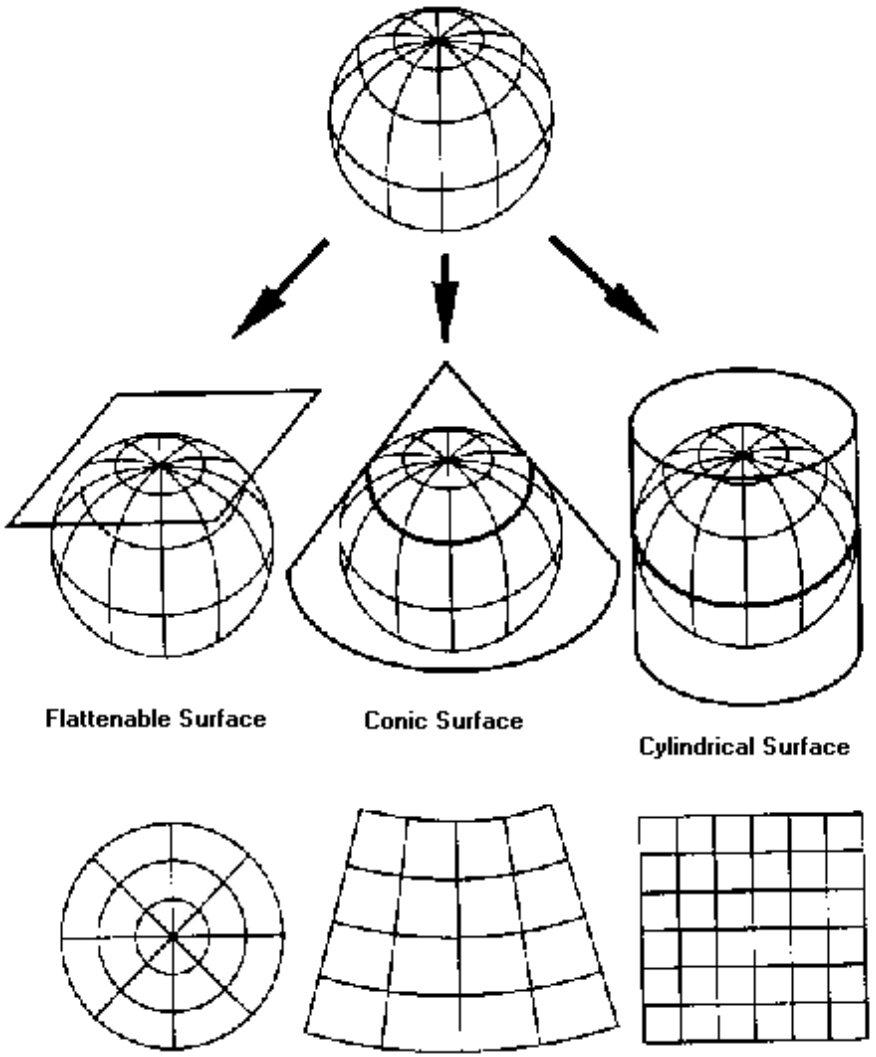
- Clarke 1866
- NAD27
- NAD83
- GRS80 (Geodetic Ref. System)
- WGS (World Geodetic System)

Importance



Map projections

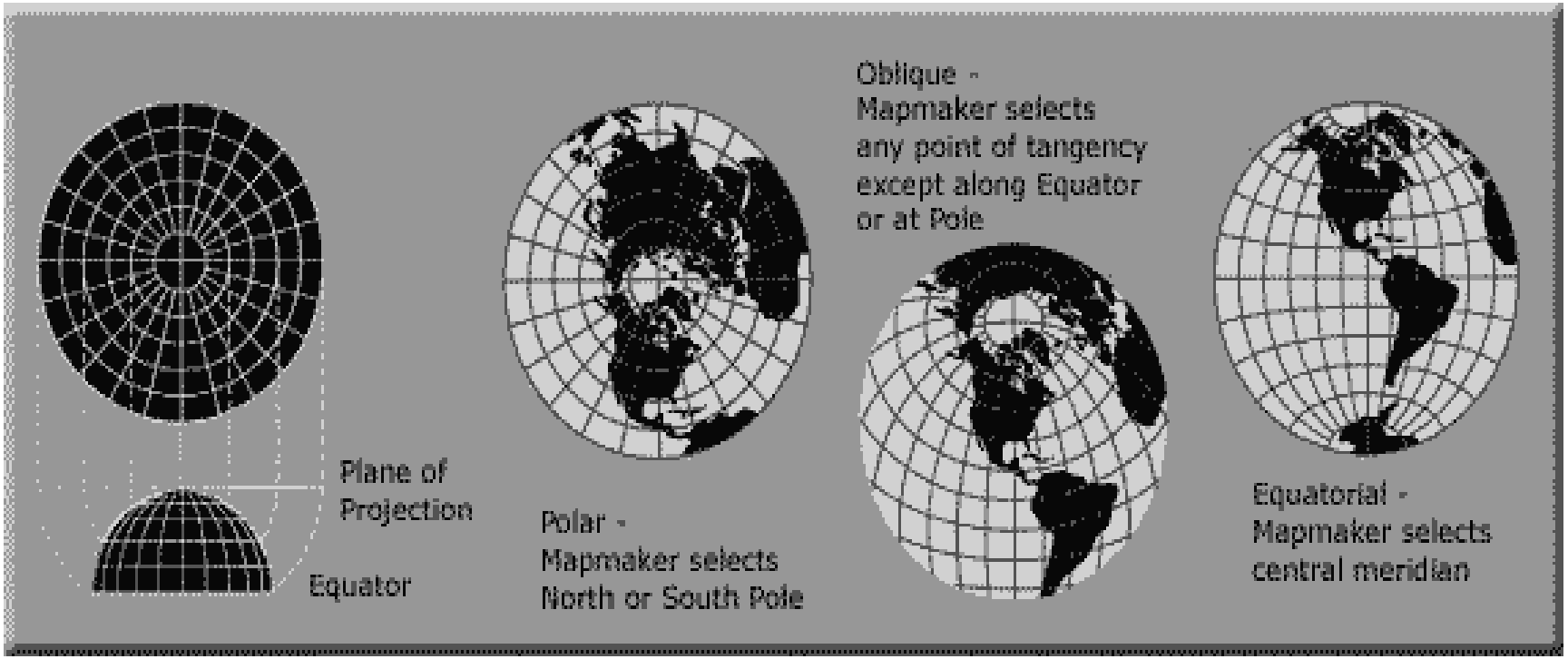
- Transforming a sphere to into a plane…



Projection types

- **Conformal** preserves local angles and shapes
- **Equivalent** retains areas in the correct relative size
- **Equidistant** maintains scale consistency along specific lines
- **Azimuthal** retains specified/accurate directions

Aspects and projections



http://egsc.usgs.gov/isb//pubs/MapProjections/projections.html

Common map projections

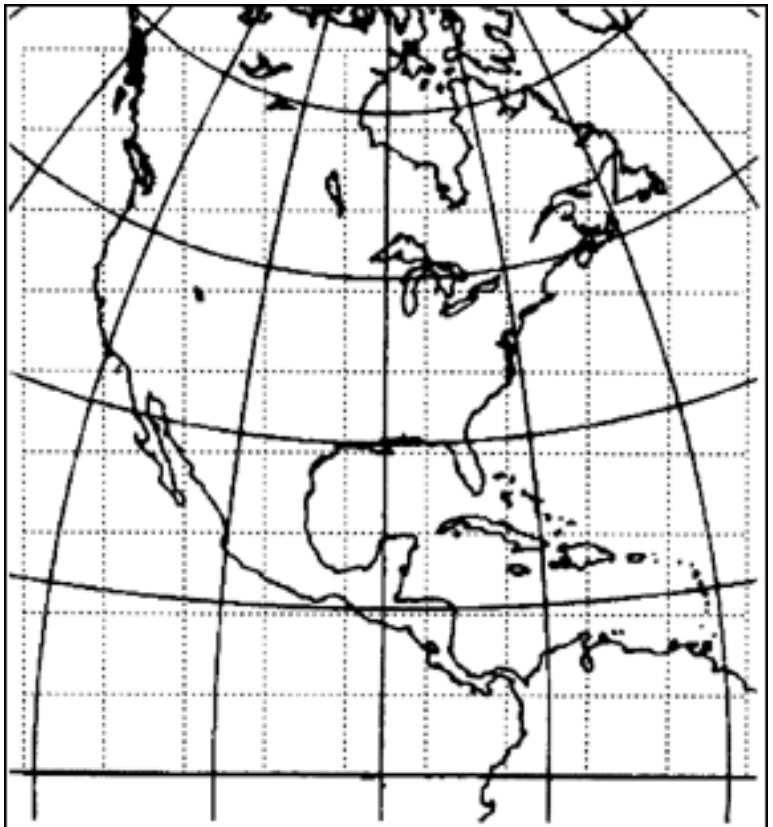
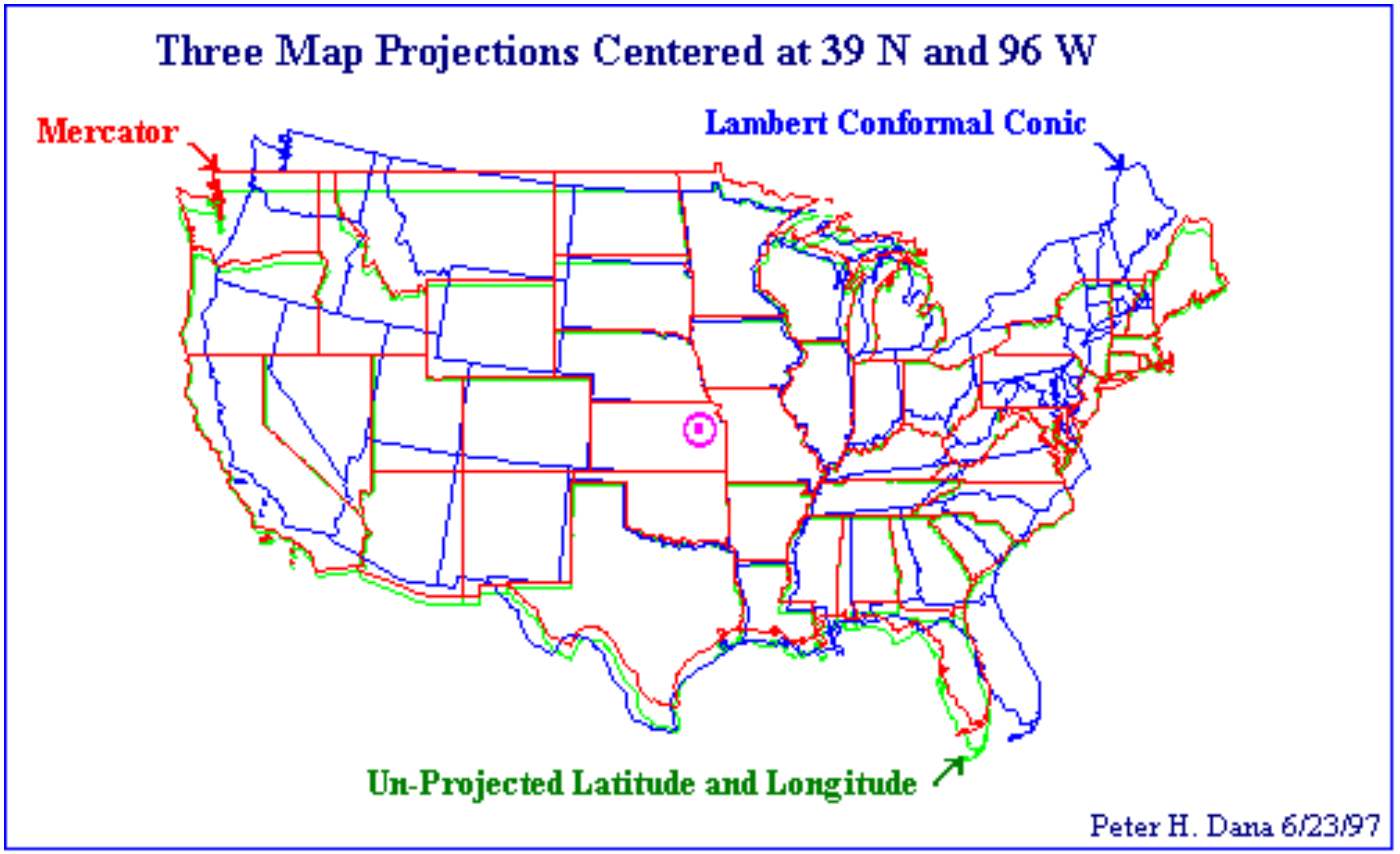


Figure 3. Transverse Mercator Projection with nonstandard plane grid.

- Transverse Mercator
  - Uses a standard meridian
  - Is conformal

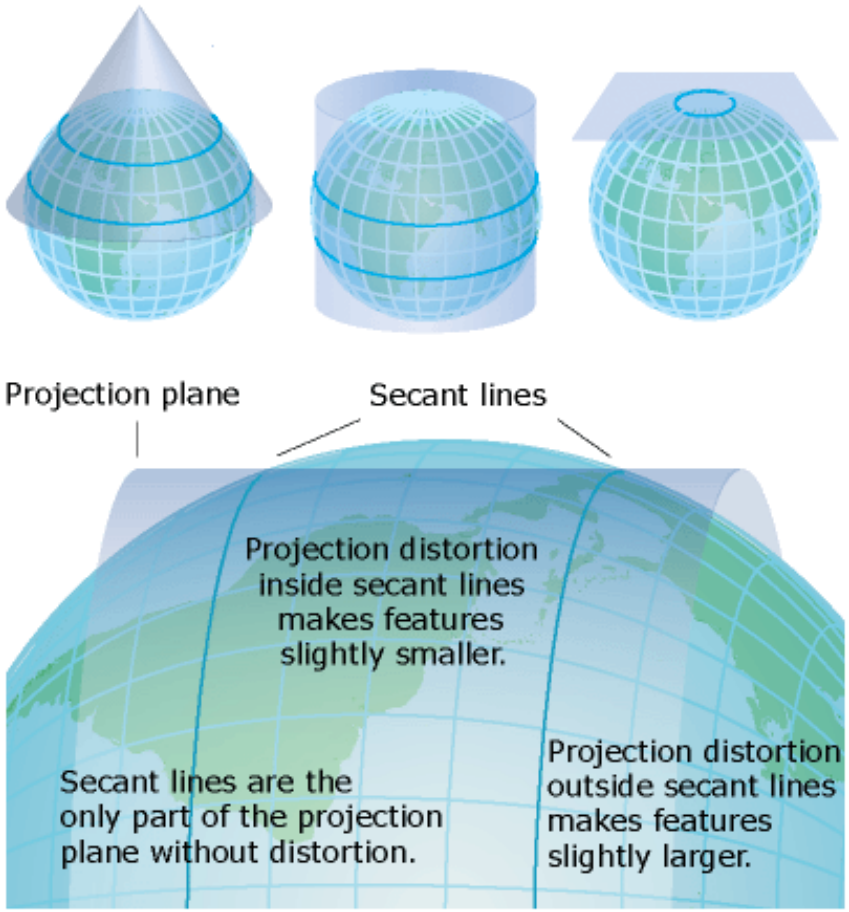
Common map projections

- Lambert Conformal Conic… USGS Topo maps since 1957



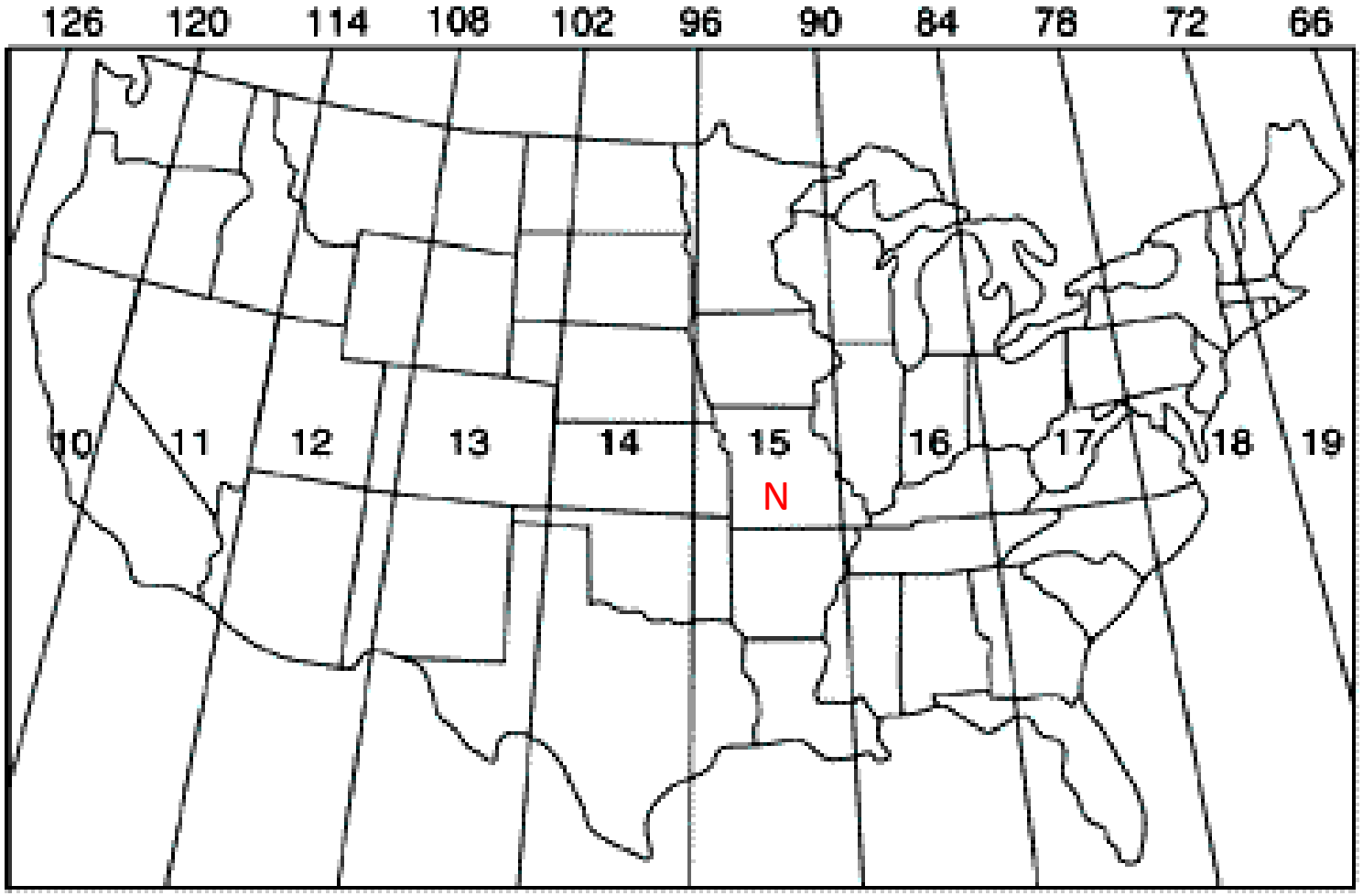
Projected Coordinate Systems

- Or plane coordinate system is built ON a map projection!
- Designed for detailed calculations and positioning for scales of 1: 24,000 or larger
- Fractional scales…

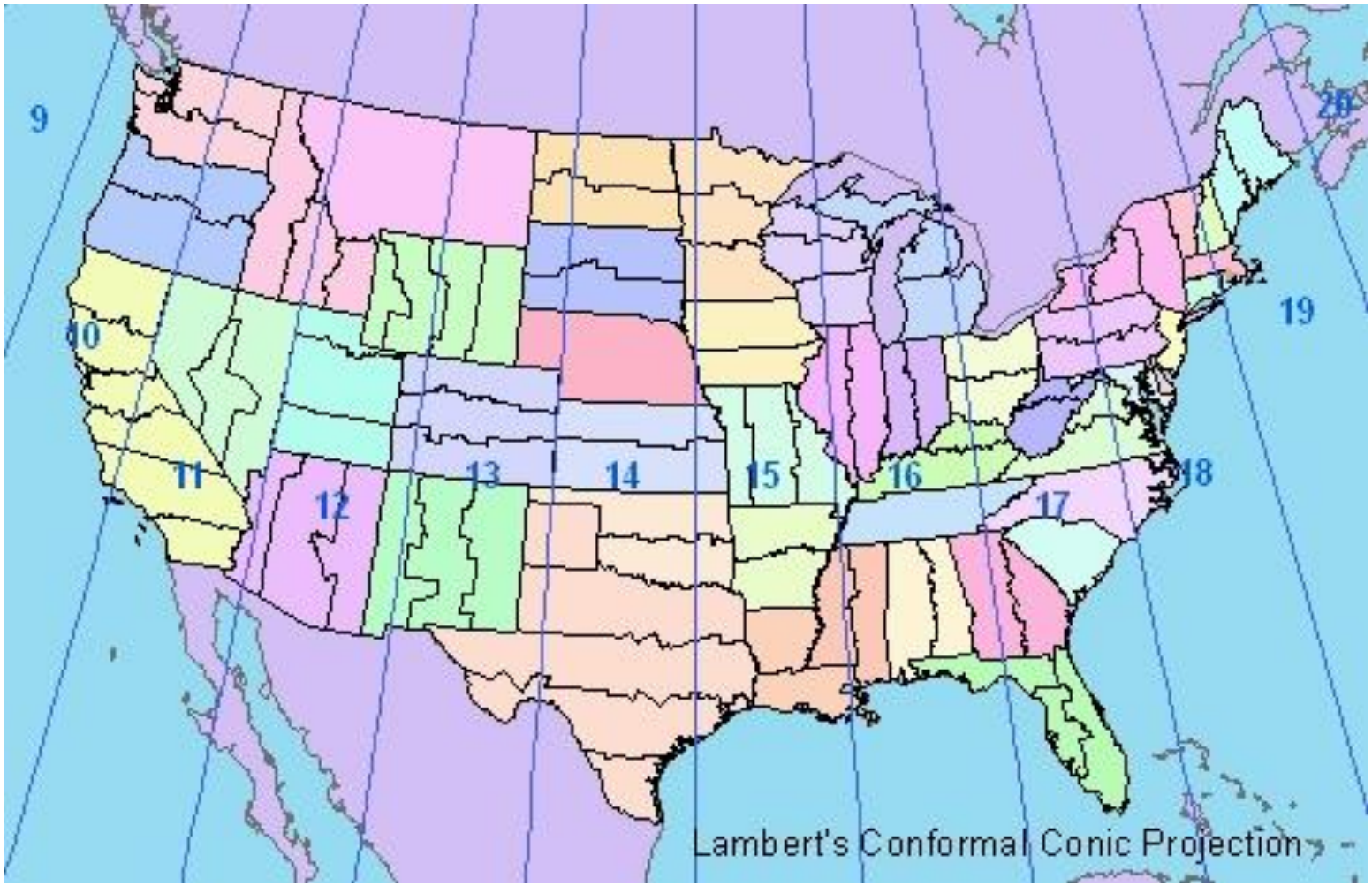


Common Projected Coordinate Systems

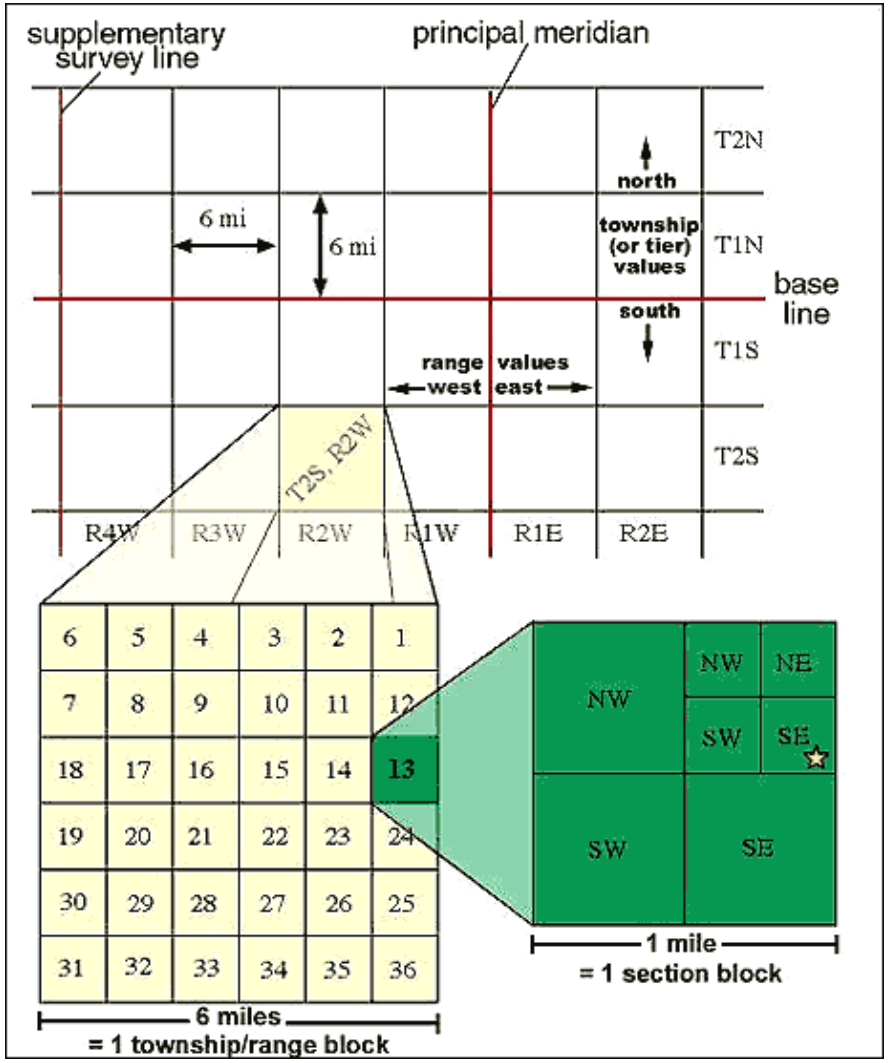
Universal
Transverse
Mercator



State Plane Coordinate system

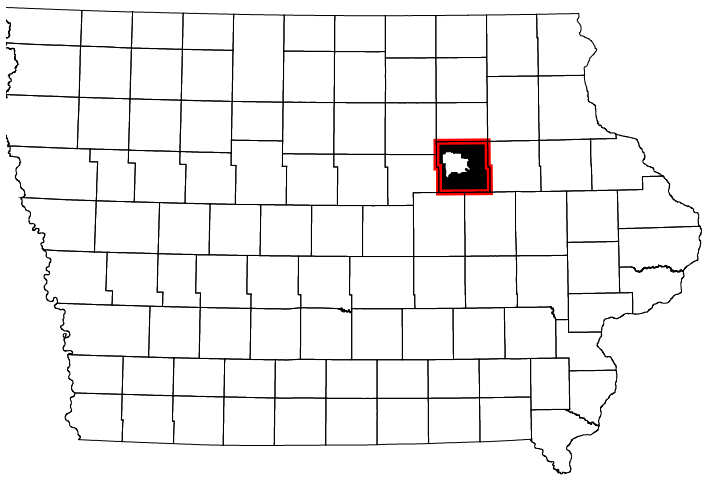


Public Land Survey System (plss)



- Township, Range, Section, 1/4s
- 6 by 6 miles squares
- 640 acres per section

Most data available in Iowa



- NAD_1983_UTM_Zone_15N
- Projection: Transverse_Mercator
- False_Easting: 500000.000000
- False_Northing: 0.000000
- Central_Meridian: -93.000000
- Scale_Factor: 0.999600
- Latitude_Of_Origin: 0.000000
- Linear Unit: Meter

- GCS_North_American_1983
- Datum: D_North_American_1983

GIS and Coordinate Systems

- Projections files
- Predefined Coordinate Systems
- On-the-fly projections

Conversions