A Quick Note on Coordinate Systems and Map Projections

Coordinate Systems

- A Coordinate System is a way of associating mapped objects with their real location on the Earth
- Any coordinate system needs to reference a datum point from which all mapped measurements can be tied back to the Earth
- They also need a geoid/ellipsoid to help tie the geometry of a flat map to a curved Earth
- A coordinate system is not necessarily projected
- Projections are coordinate systems that mathematically "unbend" curvilinear distances into flat distances

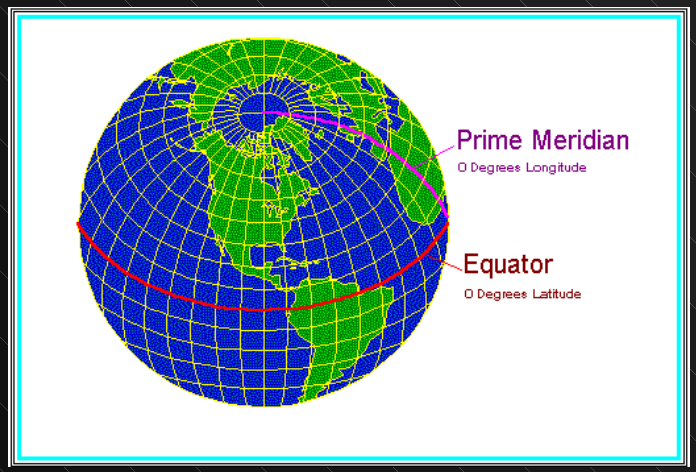
Coordinate Systems

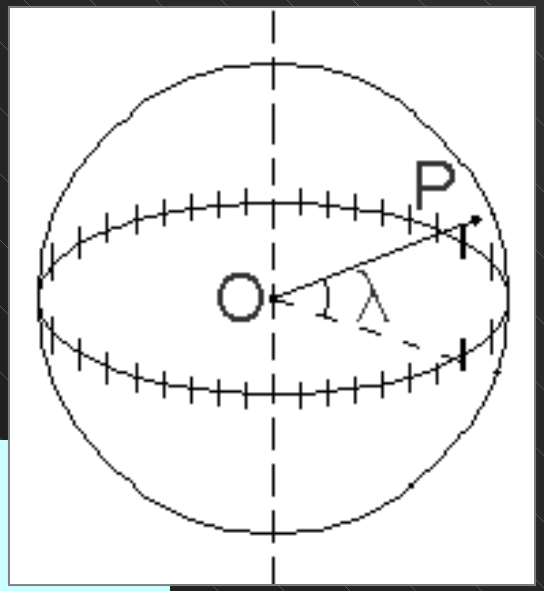
- Coordinate systems are standardized methods for assigning codes to real locations so that locations can be found using the codes alone
- In a coordinate system, these codes are coordinate pairs where the x-direction value is the easting and the y-direction value is the northing. Most systems make both values positive
- A paper map is based on relative locations (i.e., relative to the edge of the paper).
- A GIS needs to relate the relative coordinates of a map with a standard earth coordinate system.

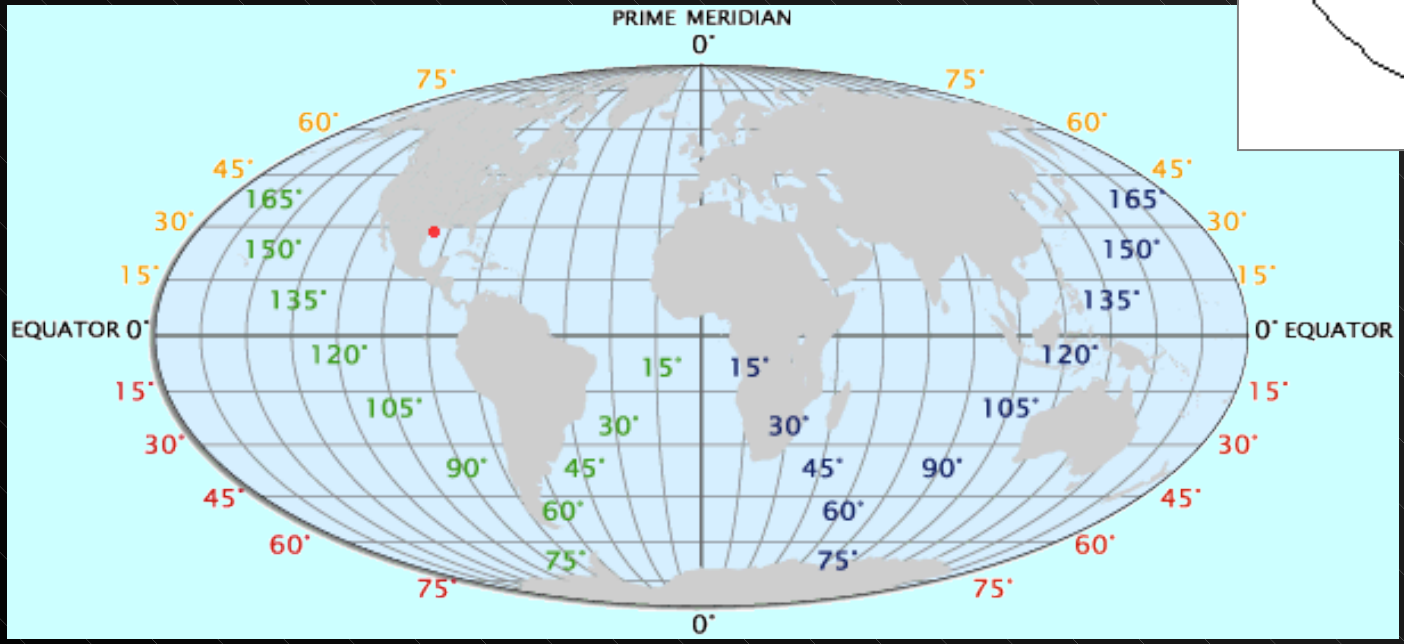
Geographic Coordinate System

- A geographic coordinate system: works worldwide
- Latitude/Longitude (Lat/Lon)
- All distances in this type of projection are measured as fractions of the Earths diameter (degrees/minutes/seconds, or decimal degrees)

Latitude/Longitude







Latitude Longitude

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....
0.215  9.297
0.166  9.319
0.050  9.340
0.055  9.324
0.006  9.324
-0.022  9.308
-0.105  9.286
-0.243  9.281
-0.530  9.270
-0.640  9.276
....
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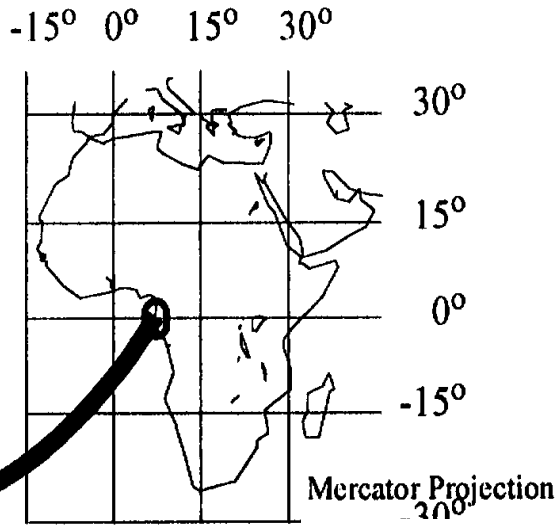
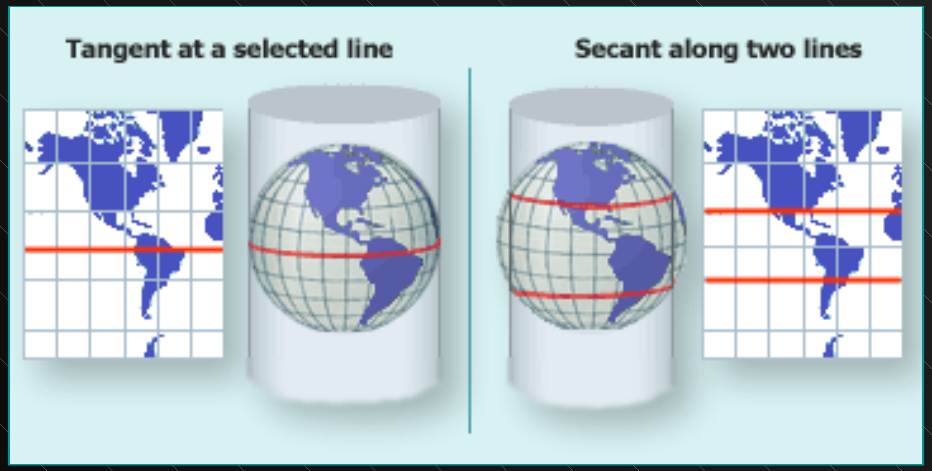


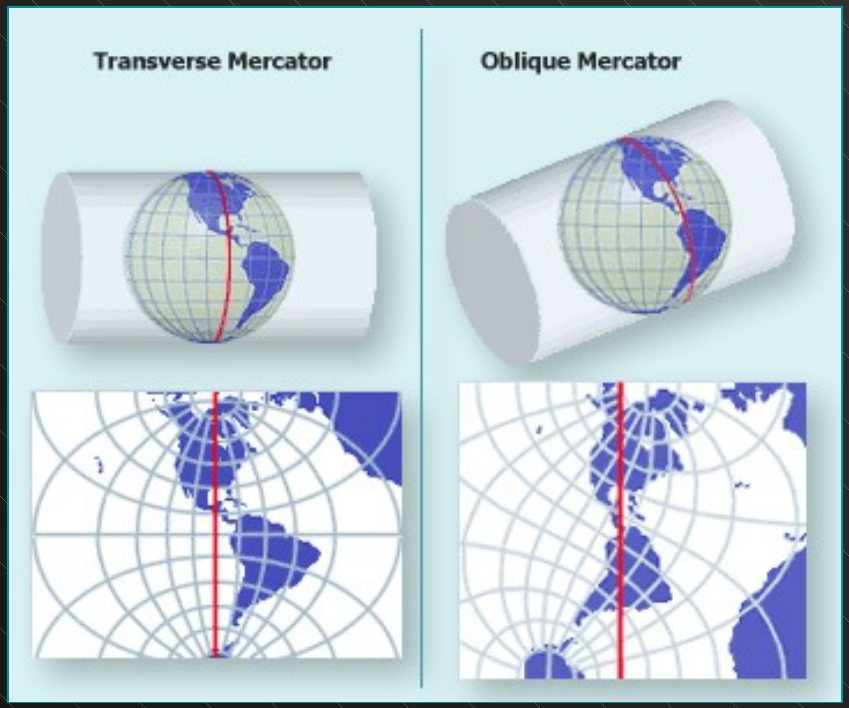
Figure 2.10 Part of the World Data Bank I listing of the coordinates of the coastline of Africa. Format is geographic coordinates in decimal degrees.

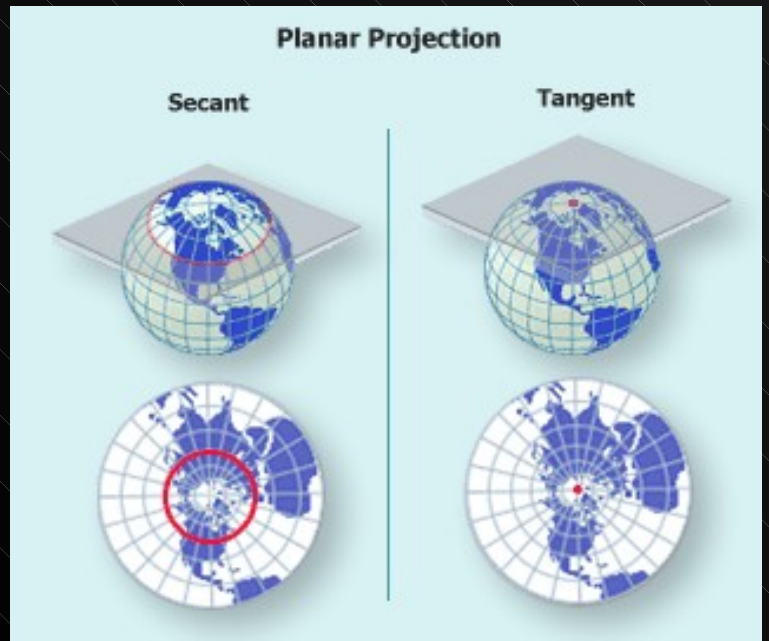
Projected Coordinate Systems

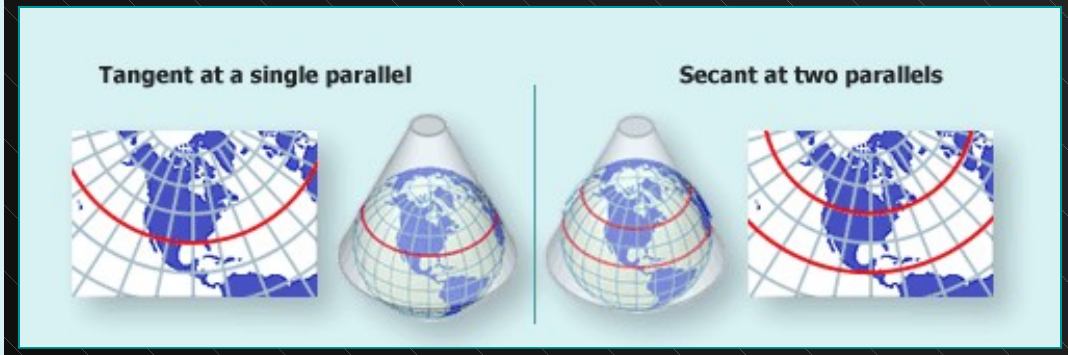
- “Unbend” a curvilinear world to fit it on a flat map.
- Several different ways of doing this: Cylindrical, Conic, Planar, etc.

Map Projection Types





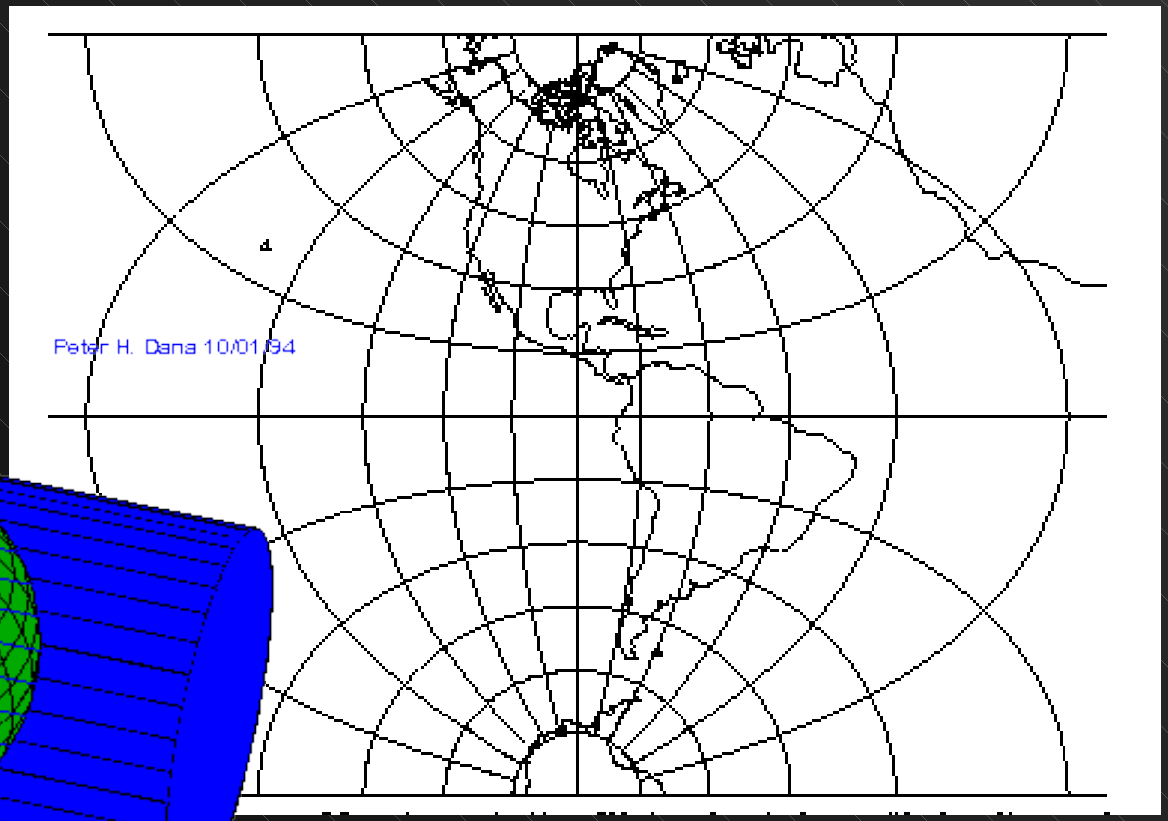


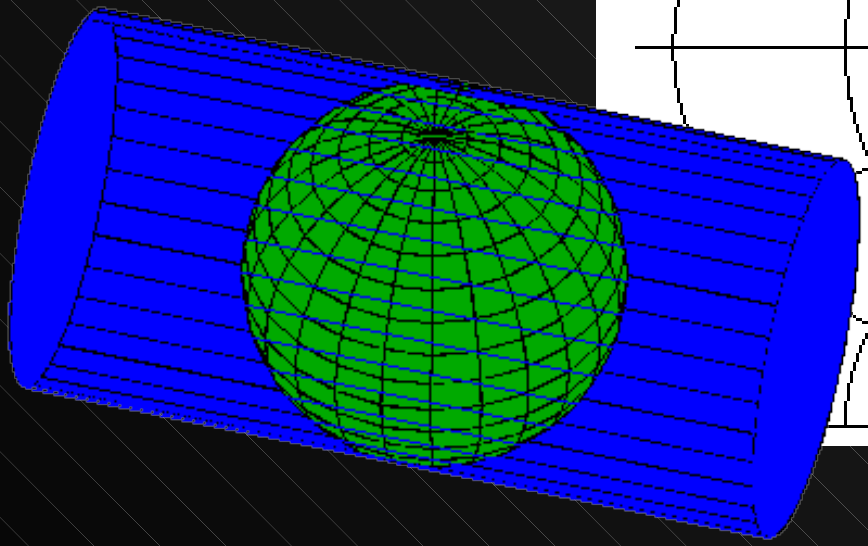


Projected Coordinate Systems

- “Unbend” a curvilinear world to fit it on a flat map.
- Several different ways of doing this: Cylindrical, Conic, etc.
- Universal Transverse Mercator (UTM) projection is most common
- Is a projected coordinate system: broken up into a series of zones across the world
- It’s units are meters, but you must stay within only the correct zone, or your data will become distorted

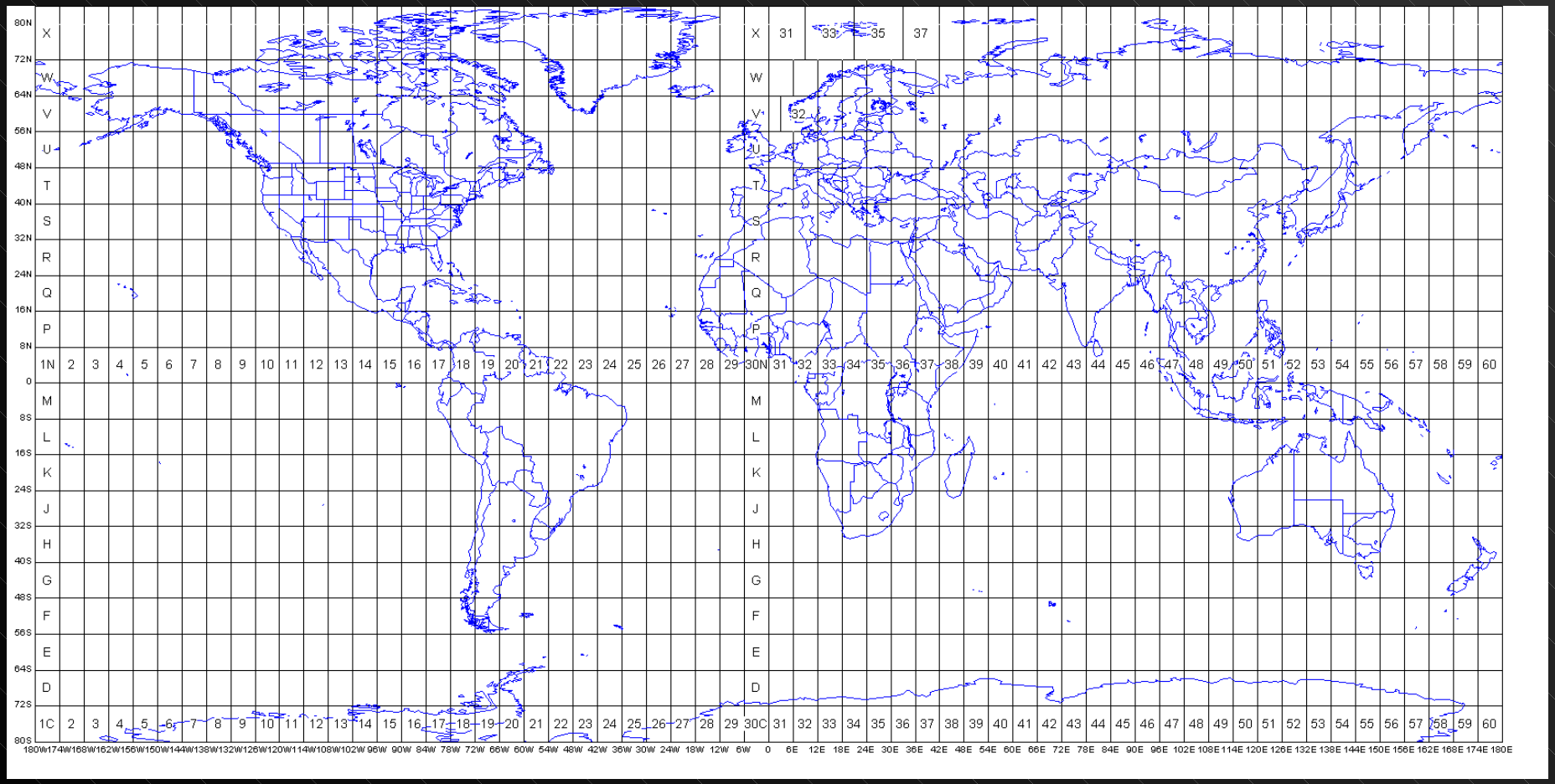
UTM Projection



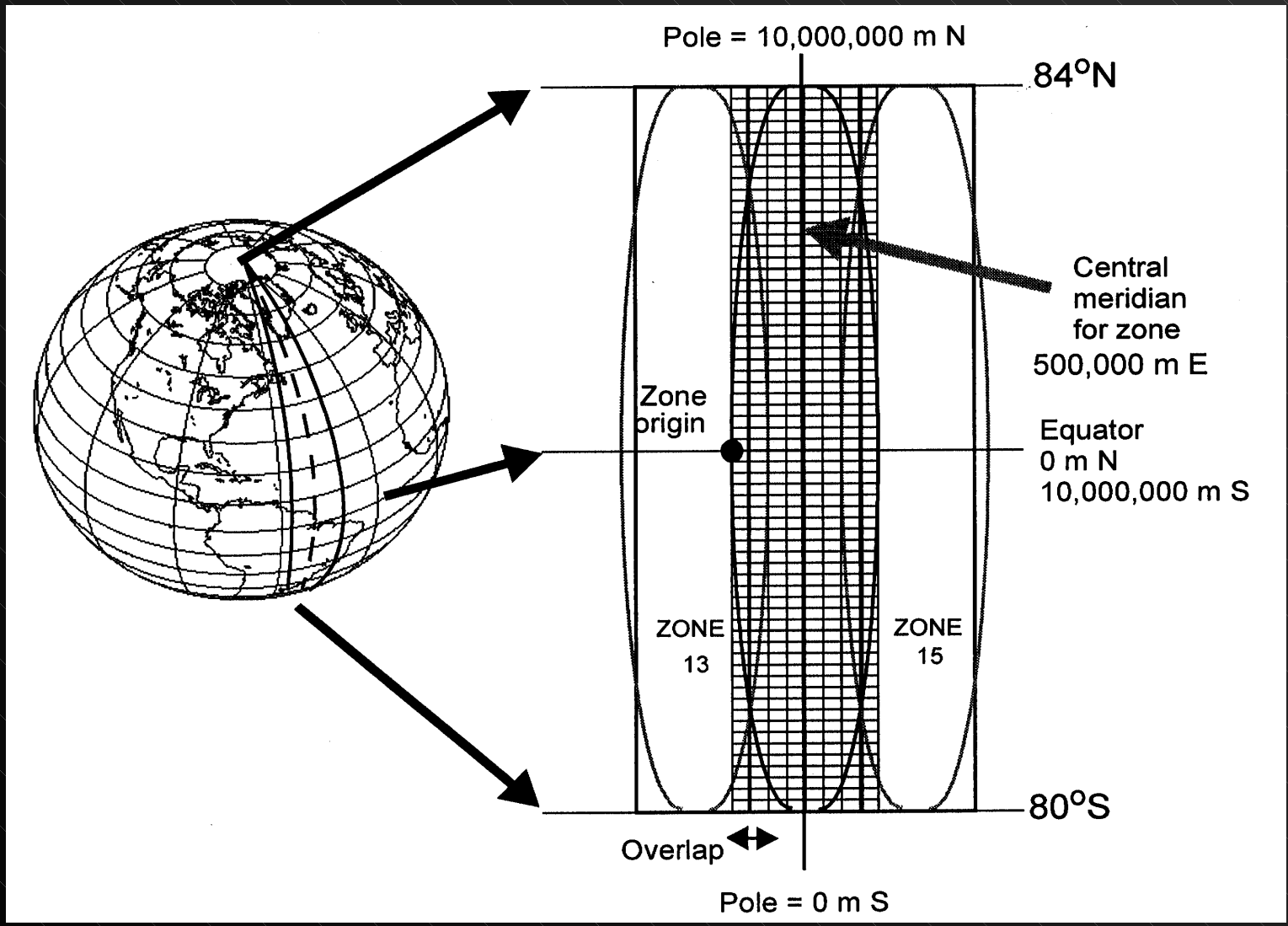


Transverse Cylindrical Projection Surface

UTM Zones


80N
72N
64N
56N
48N
40N
32N
24N
16N
8N
0
8S
16S
24S
32S
40S
48S
56S
64S
72S
80S
X W V U T S R Q P
X 31 33 35 37
W V 32 U T S R Q P
1N 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30N 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60
M L K J H G F E D
1C 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30C 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60
180W 174W 168W 162W 156W 150W 144W 138W 132W 126W 120W 114W 108W 102W 96W 90W 84W 78W 72W 66W 60W 54W 48W 42W 36W 30W 24W 18W 12W 6W 0 6E 12E 18E 24E 30E 36E 42E 48E 54E 60E 66E 72E 78E 84E 90E 96E 102E 108E 114E 120E 126E 132E 138E 144E 150E 156E 162E 168E 174E 180E

Coordinate Systems: UTM



GIS and Map Scale

- A Map Scale is based on the representative fraction, the ratio of a distance on the map to the same distance on the ground.
- A GIS can be considered scaleless because maps can be enlarged and reduced and plotted at many scales other than that of the original data.
- This is true even for raster data formats, which, while they do have specific cell resolutions, can still be viewed at any scale.