



# *Geocoding and Georeferencing*



Scott Bell  
GIS Institute



# Learning Outcomes

- Define coordinate system and map projection
  - Relate coordinate systems and map projections
- Distinguish between *defining* and *changing* coordinate systems
- Create new GIS data from addresses and paper maps
- Explain how to integrate GPS point data





# Processing Geographic Information

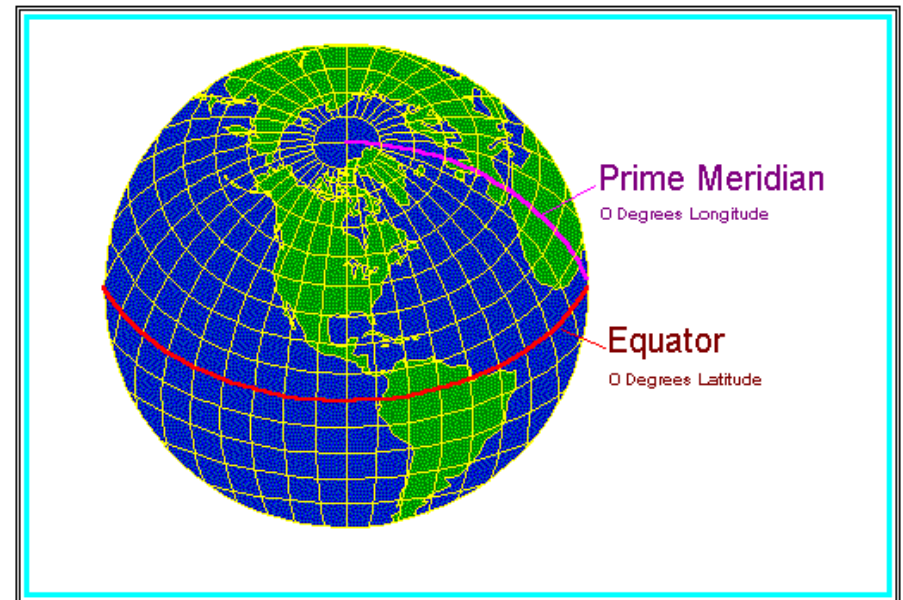
- Georeferencing and Geocoding
  - Linking data we have to geographic frames of reference
    - Supporting the display of our data in a GIS and its integration with other geographic data
  - Geocoding: matching addresses to geographic coordinates (latitude and longitude)
  - Georeferencing: matching geographic images to coordinates





# Frames of Reference

- Global: systems that provide discrete coordinates for locations anywhere on the Earth's surface
- The **geodetic latitude** of a point is the angle between the equatorial plane and a line normal to the reference ellipsoid.
- The **geodetic longitude** of a point is the angle between a reference plane and a plane passing through the point, both planes being perpendicular to the equatorial plane.
- The geodetic **height** at a point is the distance from the reference ellipsoid to the point in a direction normal to the ellipsoid.





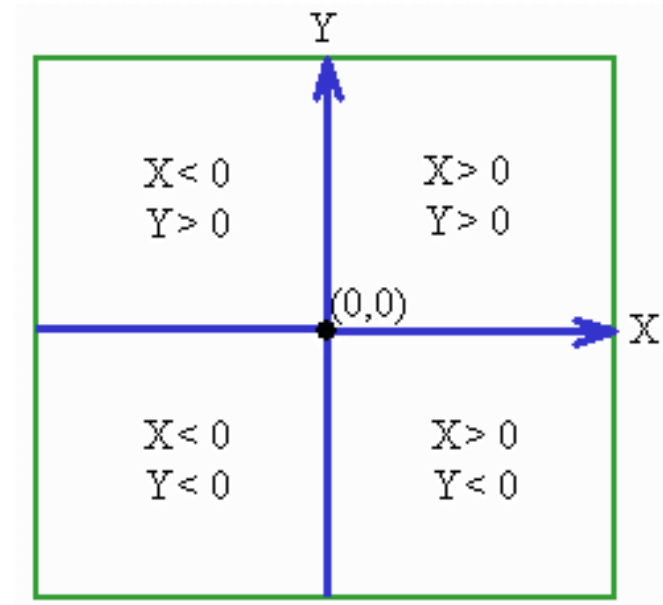
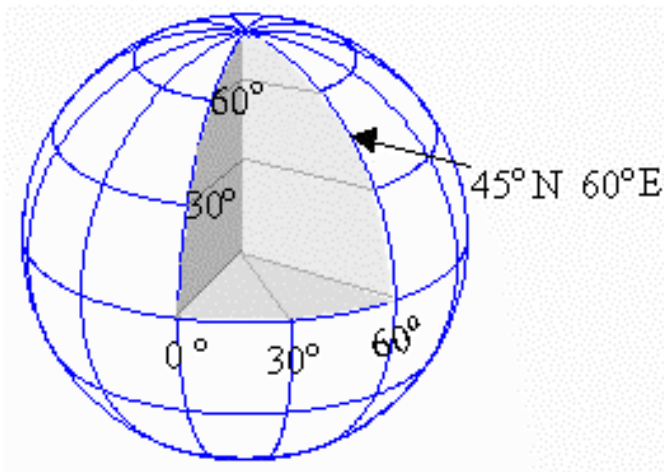
# Frames of Reference

- Global Frames of reference are applied to a model of the Earth (size and shape)
  - Earth's actual shape is too complicated
  - Spheroidal and Ellipsoidal models are used
  - Any single model of the Earth's size and shape is called a geodetic datum





# Geographic and Projected Coordinates



$(\phi, \lambda)$   $\longleftrightarrow$   $(x, y)$   
Map Projection





# Coordinate Systems in ArcGIS

- Latitude and Longitude (3-D object surface, locations indicated in degrees)
- Projected (2 D and Planar, X, Y in distances)
- All GIS data is stored according to a coordinate system
  - Sometimes the information about the coordinate system DOESN'T come with the data (but the underlying information is still stored with respect to one)
    - In these situations we need to define or specify the coordinate system (“define” command)
  - Sometimes we want to change the data from one coordinate system to another
    - In these situations need to transform or project the data from one coordinate system to another (“project” command)





# Address Matching and Geocoding

- Frames of Reference

- Continuous

- Discrete, Objects, and Areas

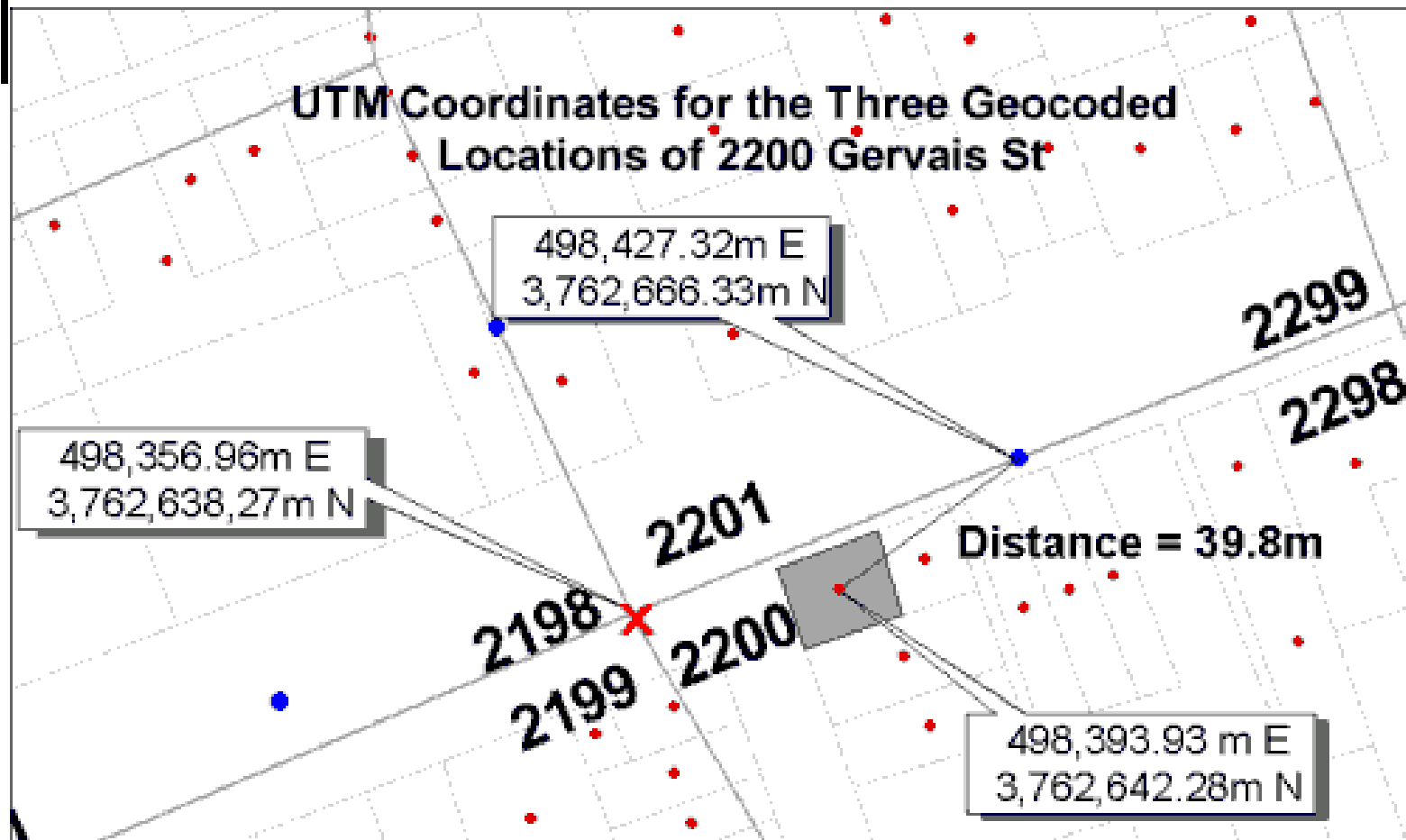
- Street Address: Palmetto Seafood Co.  
2200 Gervais St.  
Columbia, SC 29204-1808 USA
    - Section, ¼ section, township
    - Larger? City, province, etc

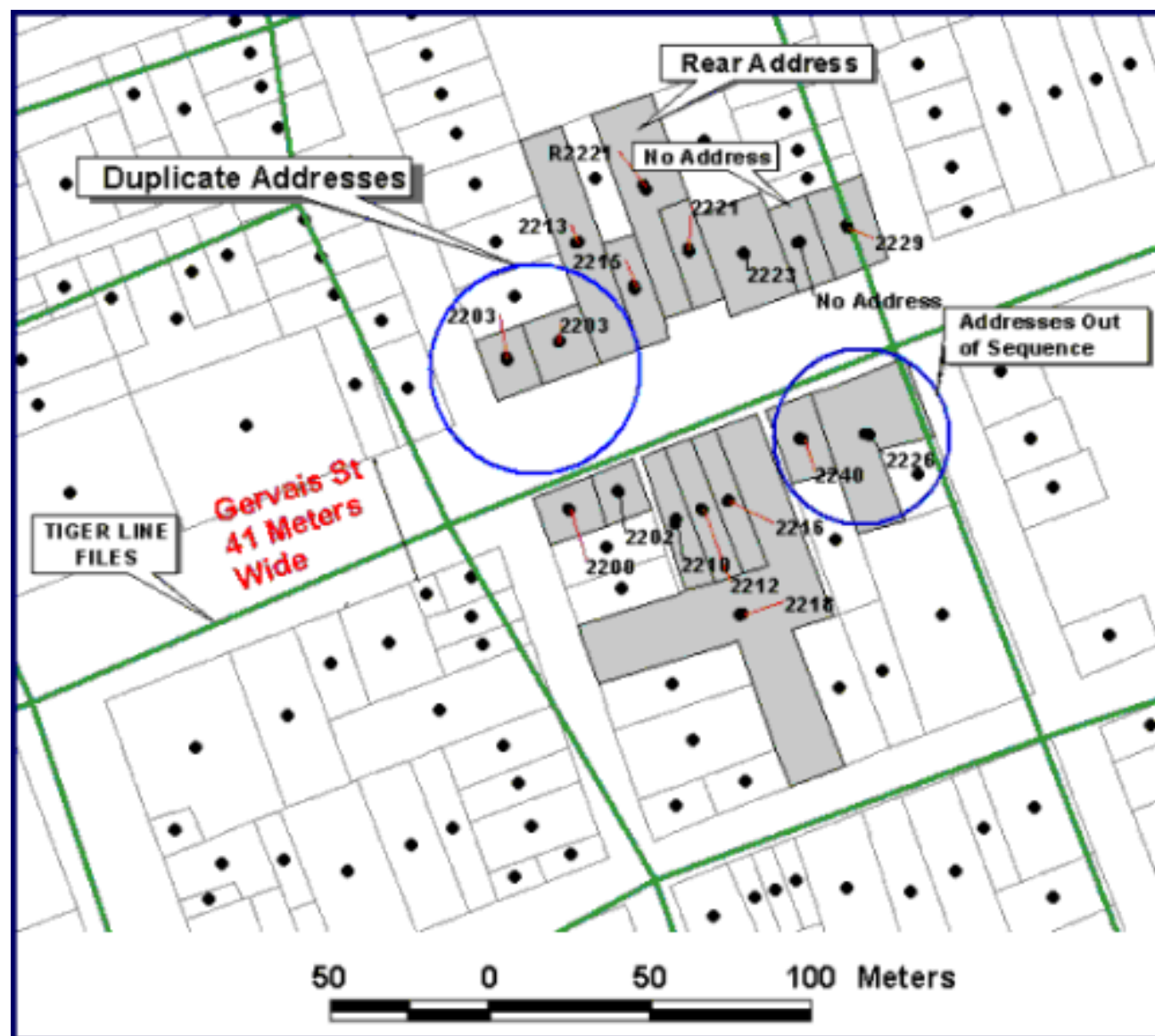
- Uh-oh, problems

- For the most part databases produce successful geocoding results









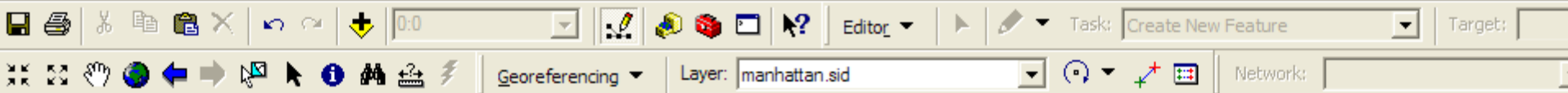




# Georeferencing a Paper Map

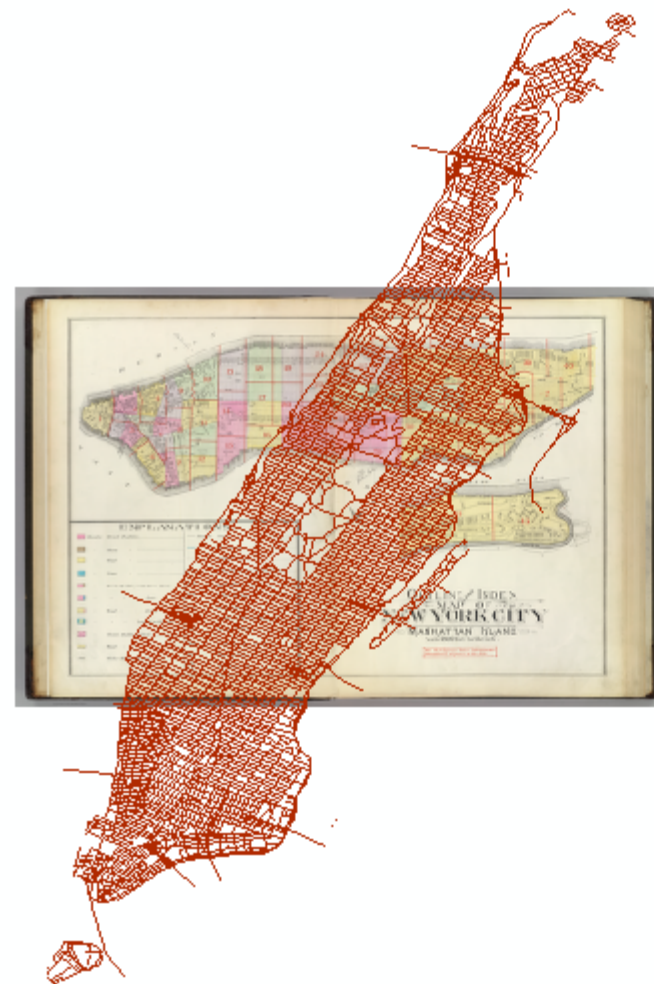
- Sometimes the data we want is only available in a hard copy
  - Or is an image
- If we know some important things about the contents of the image or map we can coordinate it with global reference systems
- Establish links between the image and a geographically known database





## Layers

ny\_Clip  
manhattan.sid  
RGB  
Red: Band\_1  
Green: Band\_2  
Blue: Band\_3





# Control Points

- Link points are called “control points”
- Control points should be:
  - Easy to confirm (same location in the world)
  - Be spread across the space being georeferenced
  - Have good overlap between the two datasets
  - Established by clicking as close as possible to your intended target is important (zooming in helps)





# Frames of Reference

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# Universal Transverse Mercator

- Locations indicated in meters (from a pair of origins)
  - Lat/Long locations in degrees make it difficult to derive distances between places or make measurements in non-spherical coordinates
  - Most of us intuitively understand meters, kilometers, etc. for distance and area better than degrees, minutes, and seconds







# UTM

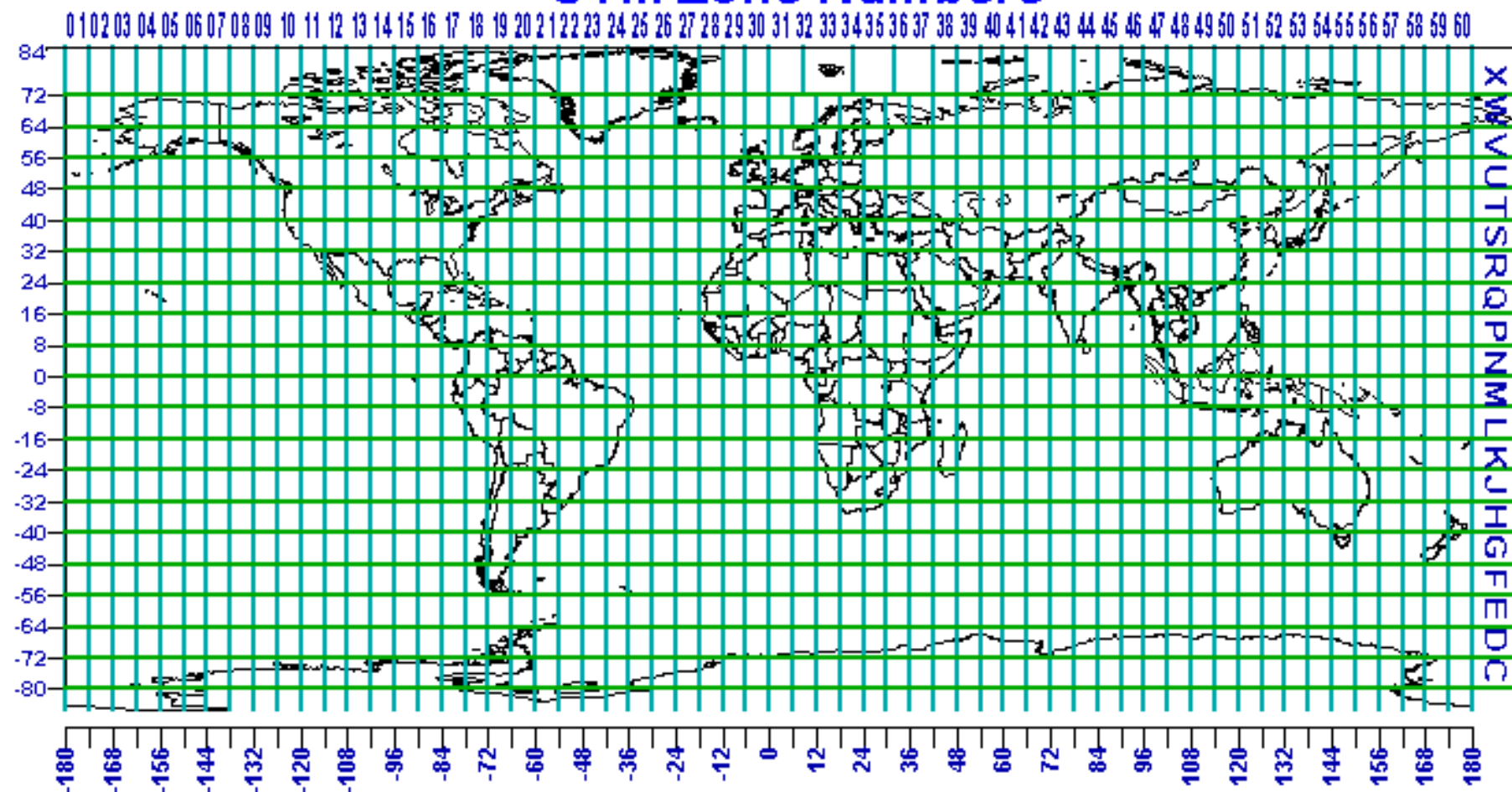
- However...
- This apparent simplicity comes at the cost of a complex frame of reference and multiple origins



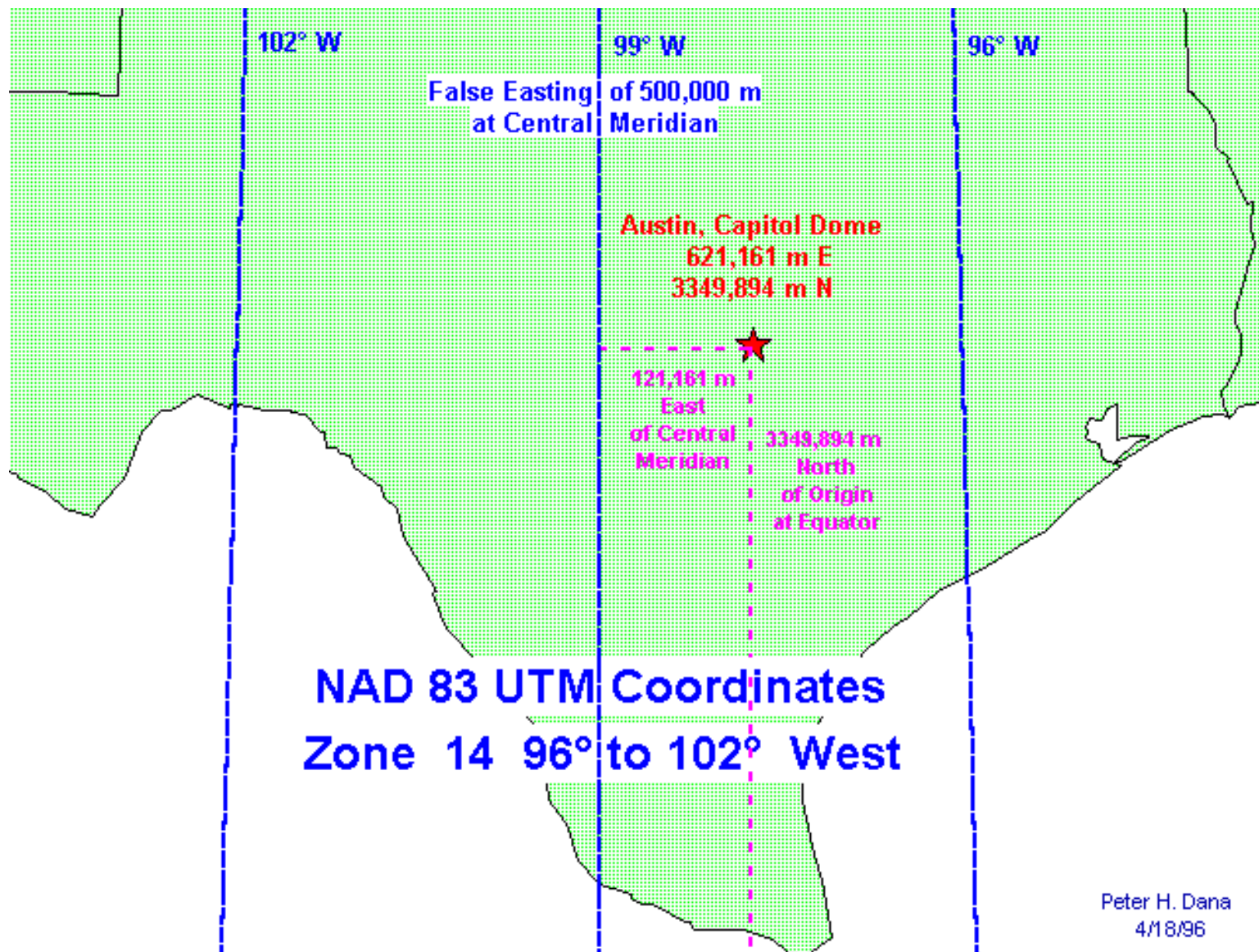


## UTM Zone Numbers

## UTM Zone Designators



Universal Transverse Mercator (UTM) System



Peter H. Dana  
4/18/96





# Geodetic Datums

