Geocoding and Georeferencing

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Learning Outcomes

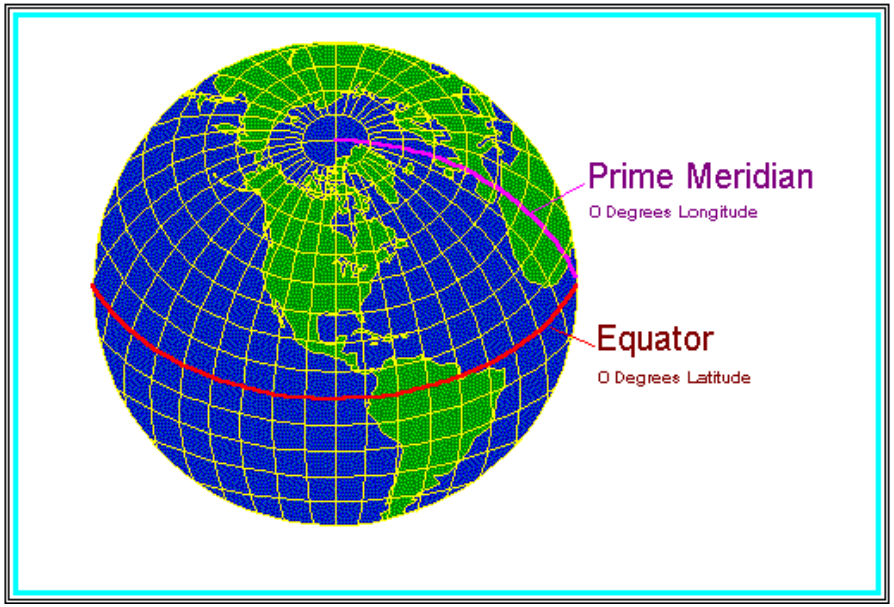
- Define coordinate system and map projection
  - Relate coordinate systems and map projections
- Distinguish between *defining* and *changing* coordinate systems
- Create new GIS data from addresses and paper maps
- Explain how to integrate GPS point data

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

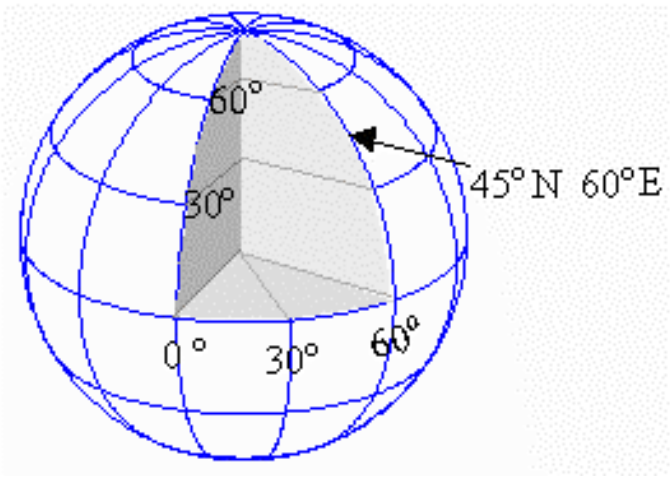
- Global: systems that provide discrete coordinates for locations anywhere on the Earth's surface
- The **geodetic latitude** of a point is the angle between the equatorial plane and a line normal to the reference ellipsoid.
- The **geodetic longitude** of a point is the angle between a reference plane 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.

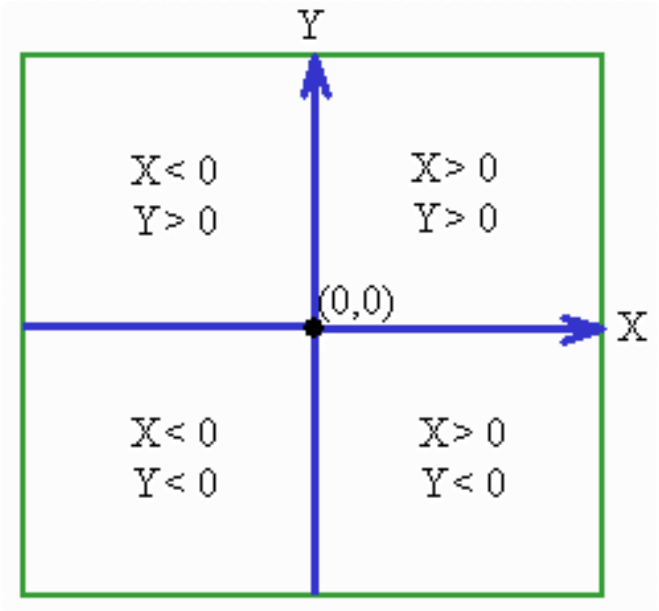


Frames of Reference

- 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

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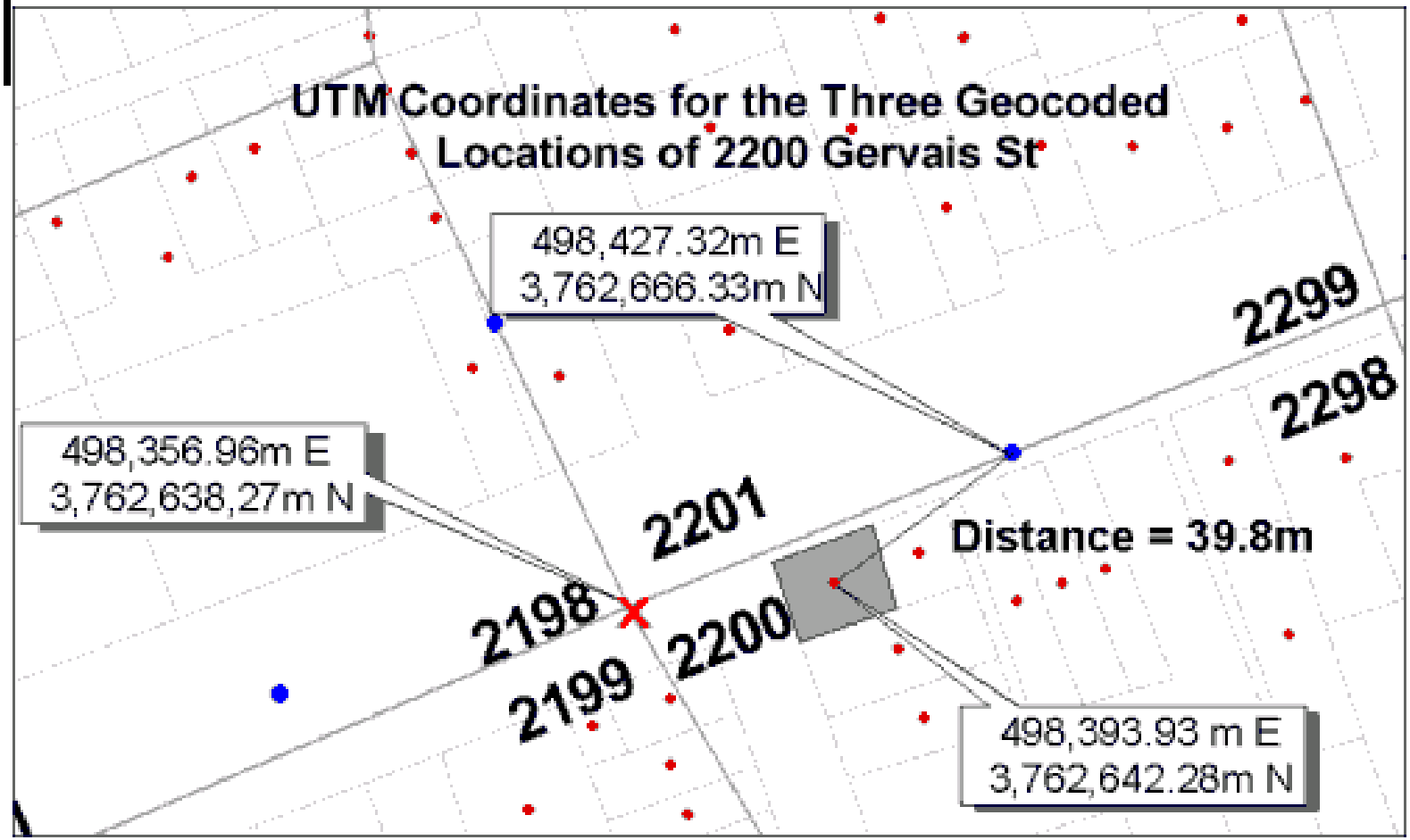
Coordinate Systems in ArcGIS

- 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



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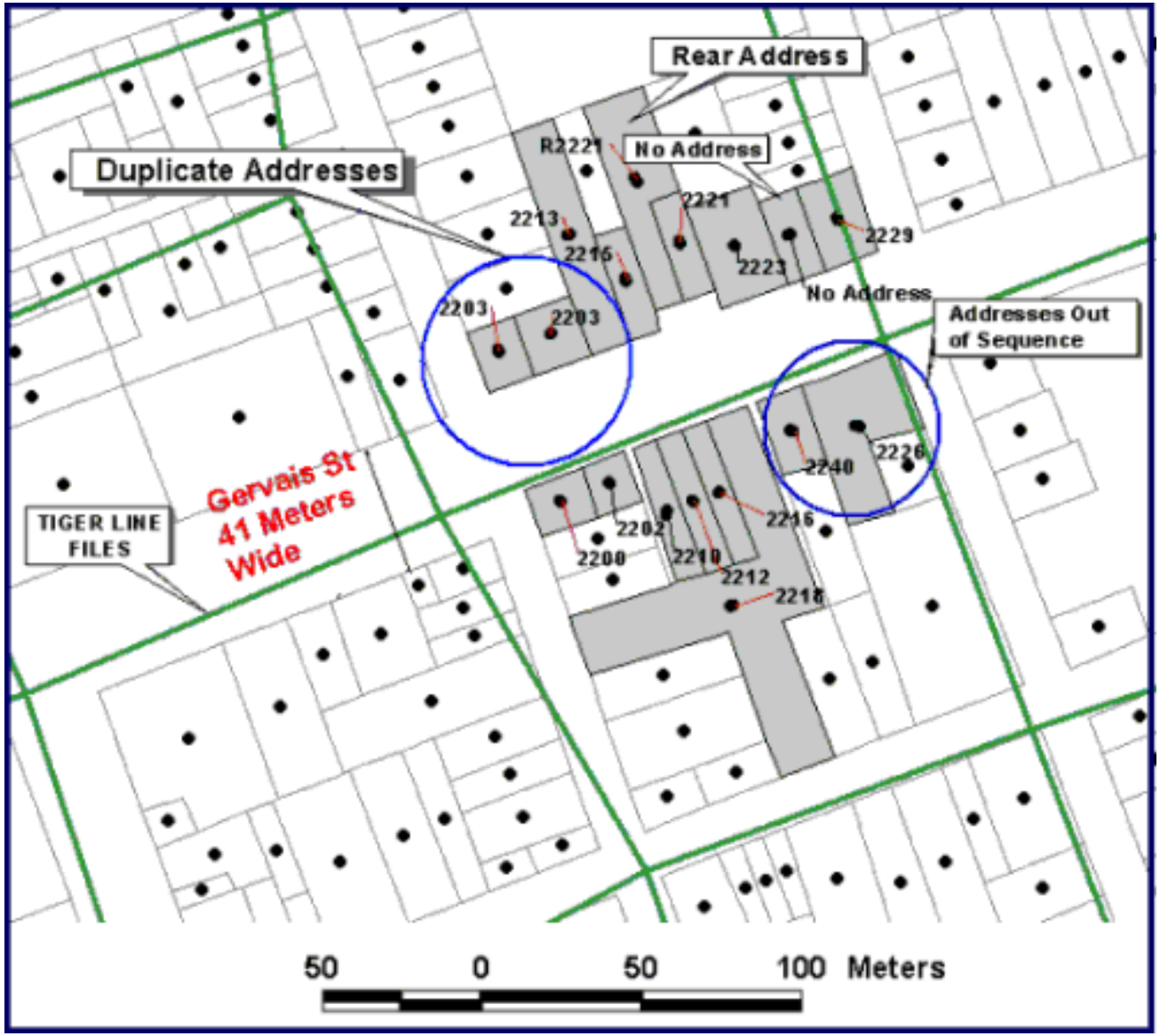

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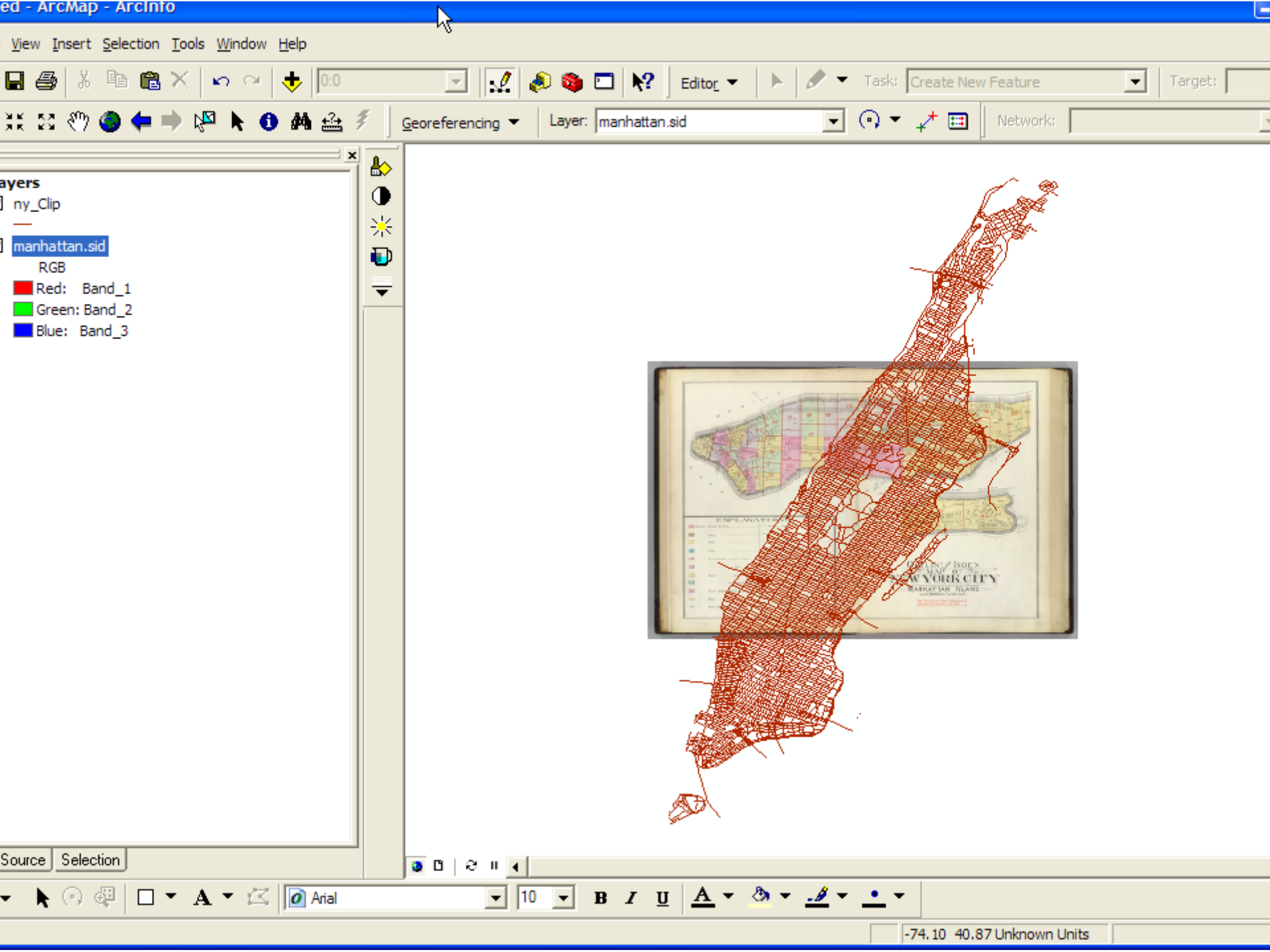
Georeferencing a Paper Map

- 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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Green: Band_2
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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)

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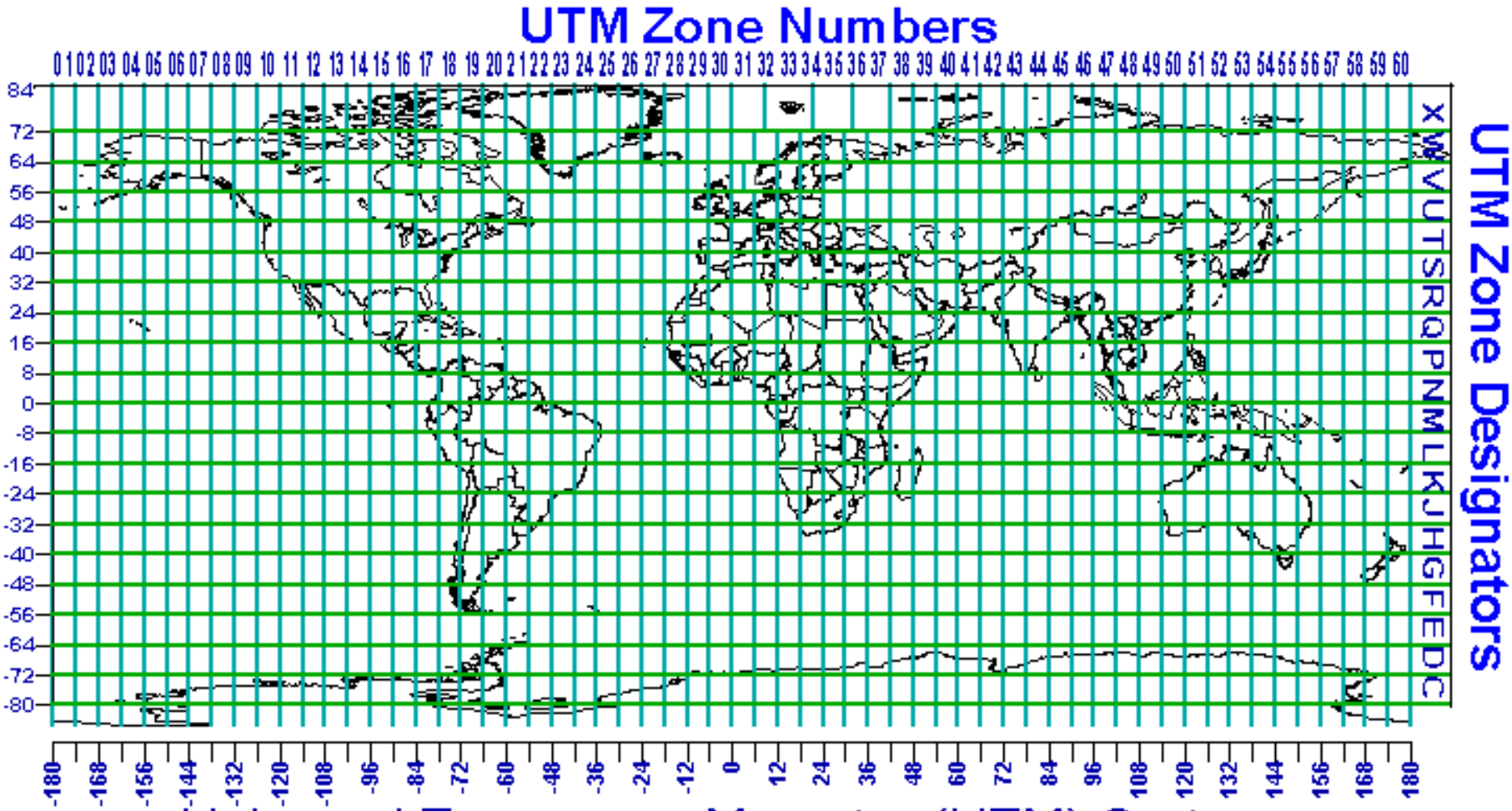
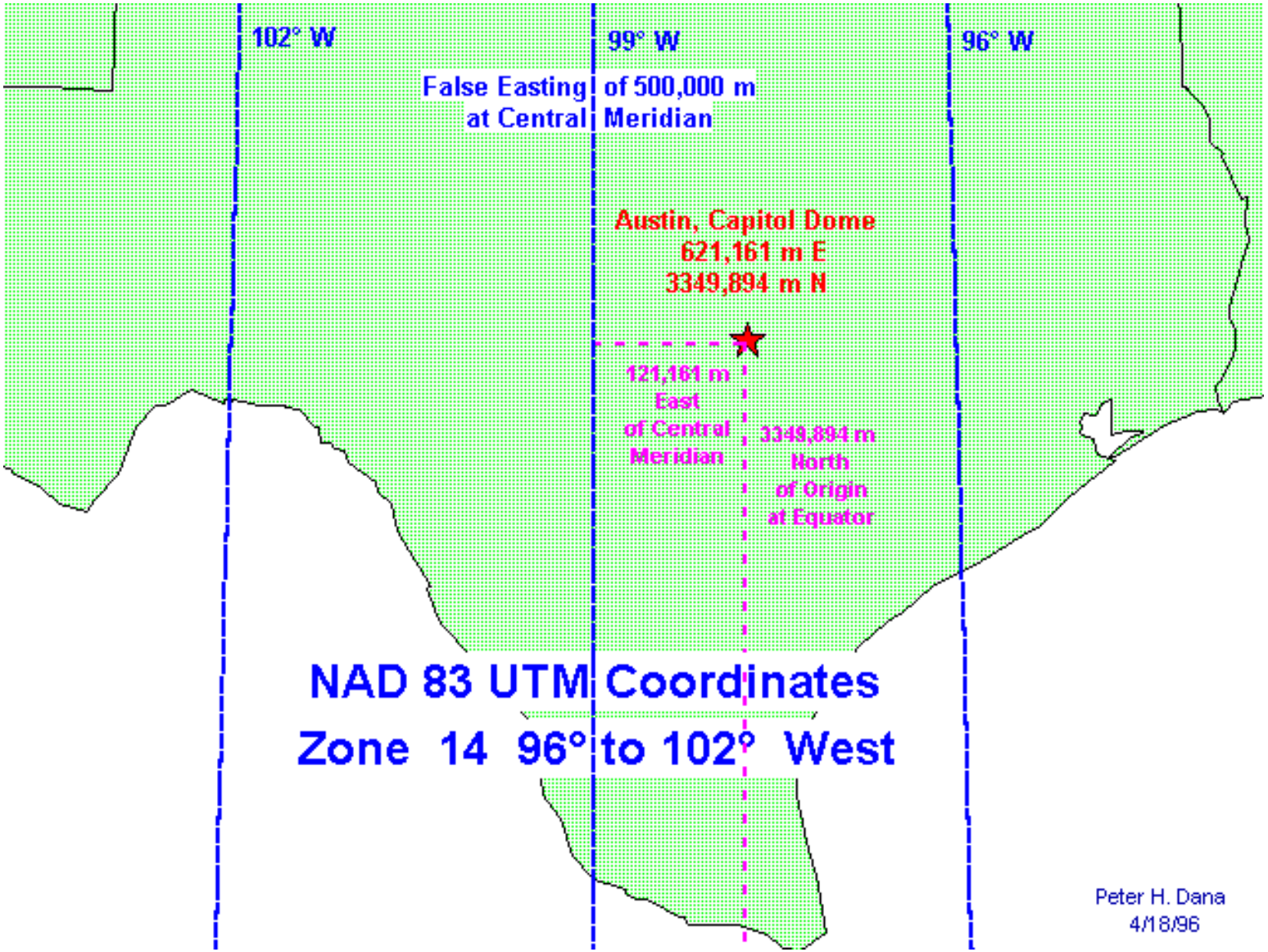
Universal Transverse Mercator

- 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
0 1 0 2 0 3 0 4 0 5 0 6 0 7 0 8 0 9 10 11 12 13 14 15 16 17 18 19 20 2 1 2 2 23 24 25 26 27 2 8 2 9 30 31 32 33 3 4 3 5 3 6 3 7 38 39 40 4 1 42 43 44 45 46 47 48 49 50 51 52 53 54 5 5 5 6 57 58 59 60
84 72 64 56 48 40 32 24 16 8 0 -8 -16 -24 -32 -40 -48 -56 -64 -72 -80
X W V U T S R Q P N M L K J H G F E D C
UTM Zone Designators
-180 -168 -156 -144 -132 -120 -108 -96 -84 -72 -60 -48 -36 -24 -12 0 12 24 36 48 60 72 84 96 108 120 132 144 156 168 180
Universal Transverse Mercator (UTM) System
Peter H. Dana 9/7/94



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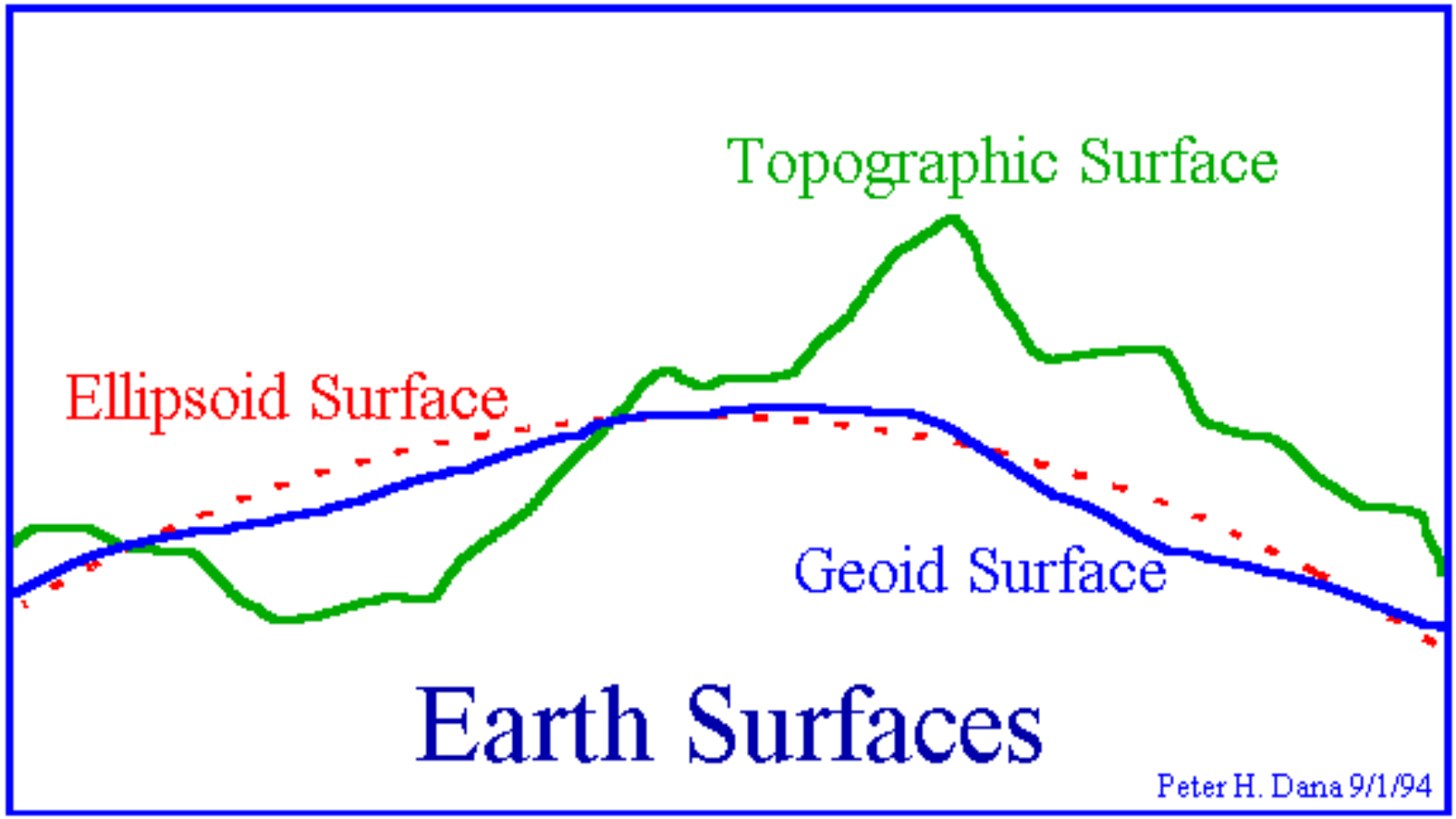
Geodetic Datums



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