GIS details

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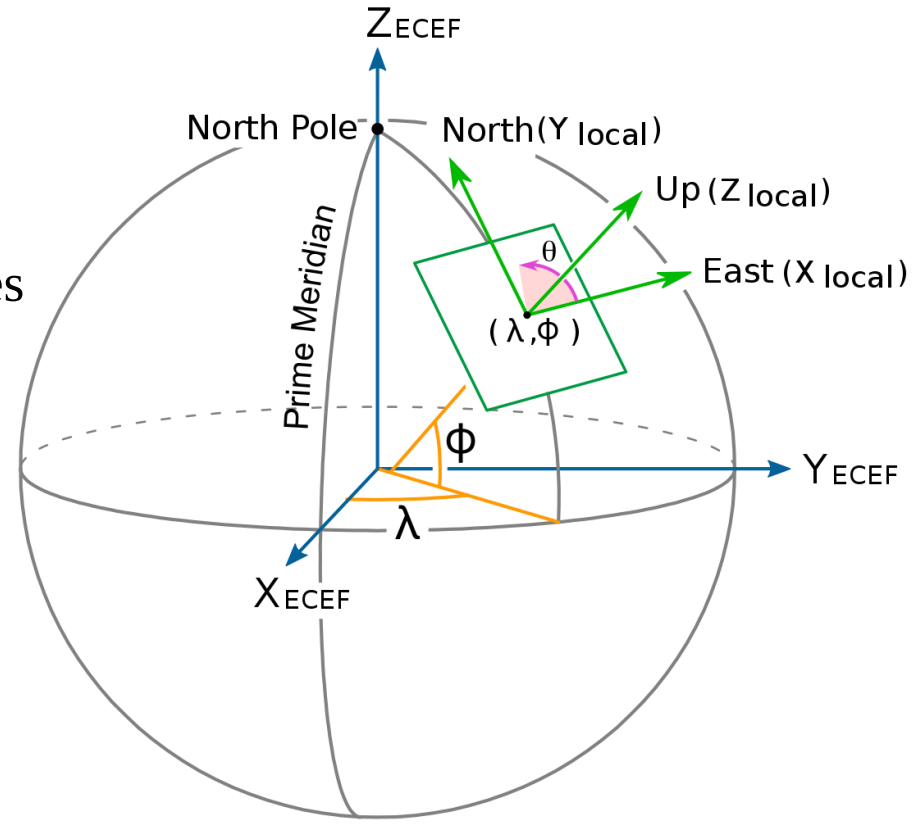
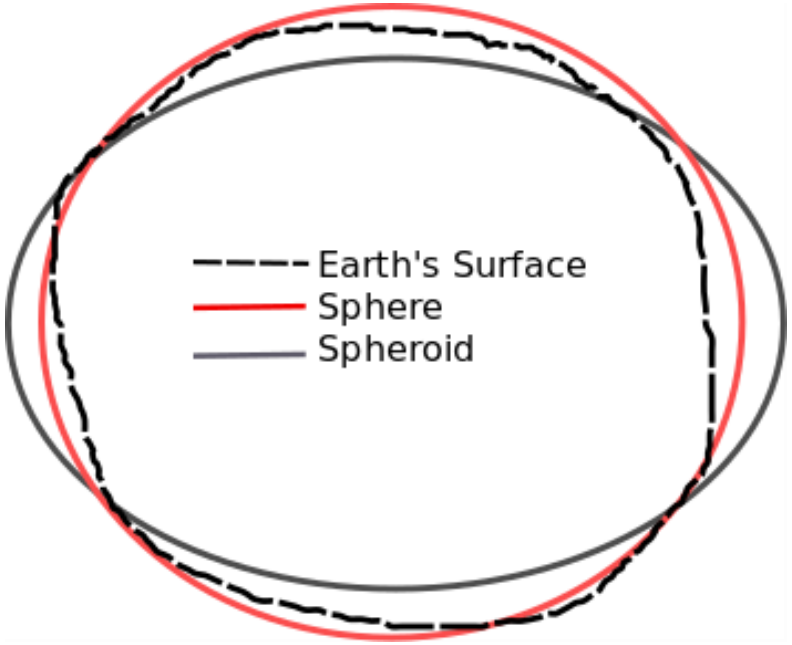
GIS fundamentals: Geographic coordinate systems (GCS)

- A point is referenced by its *longitude* and *latitude*, which are angles measured from the Earth's center to a point on its surface.
  - Latitude is also the angle from Polaris to horizon (in N. hemisphere)
- Latitude and longitude are measured either in decimal degrees or in degrees, minutes and seconds.



GIS fundamentals: Geographic coordinate systems (GCS)

- The shape and size of a GCS's surface is defined by a sphere or a spheroid
- In fact, the Earth is neither a perfect sphere nor spheroid (the South Pole is closer to the equator than the North pole!)
- A *datum* defines the origin and orientation of latitude and longitude lines.
- Changing a GCS's spheroid or datum changes all values!
- The standard global system is called World Geodetic System 1984 (WGS1984)



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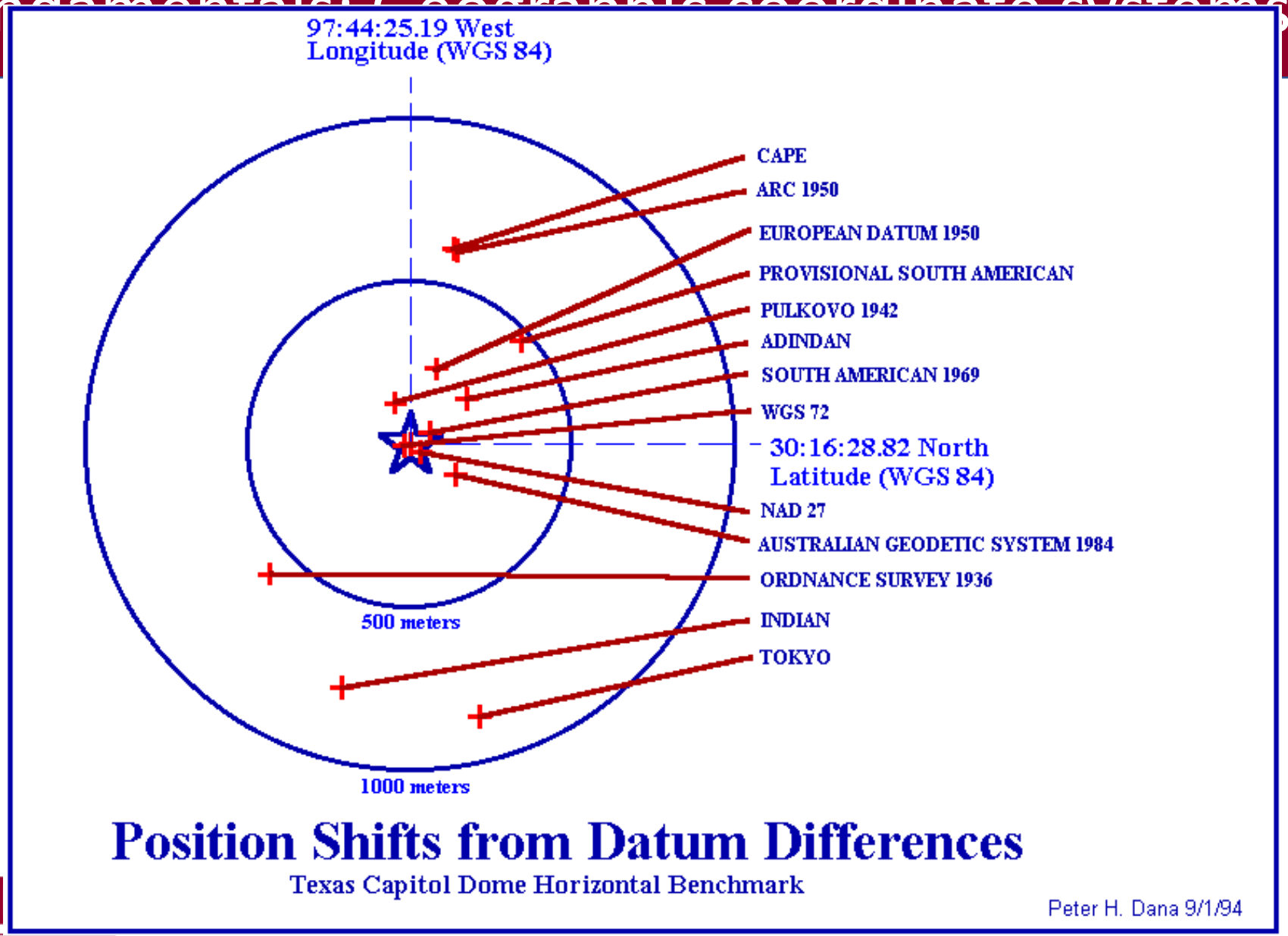
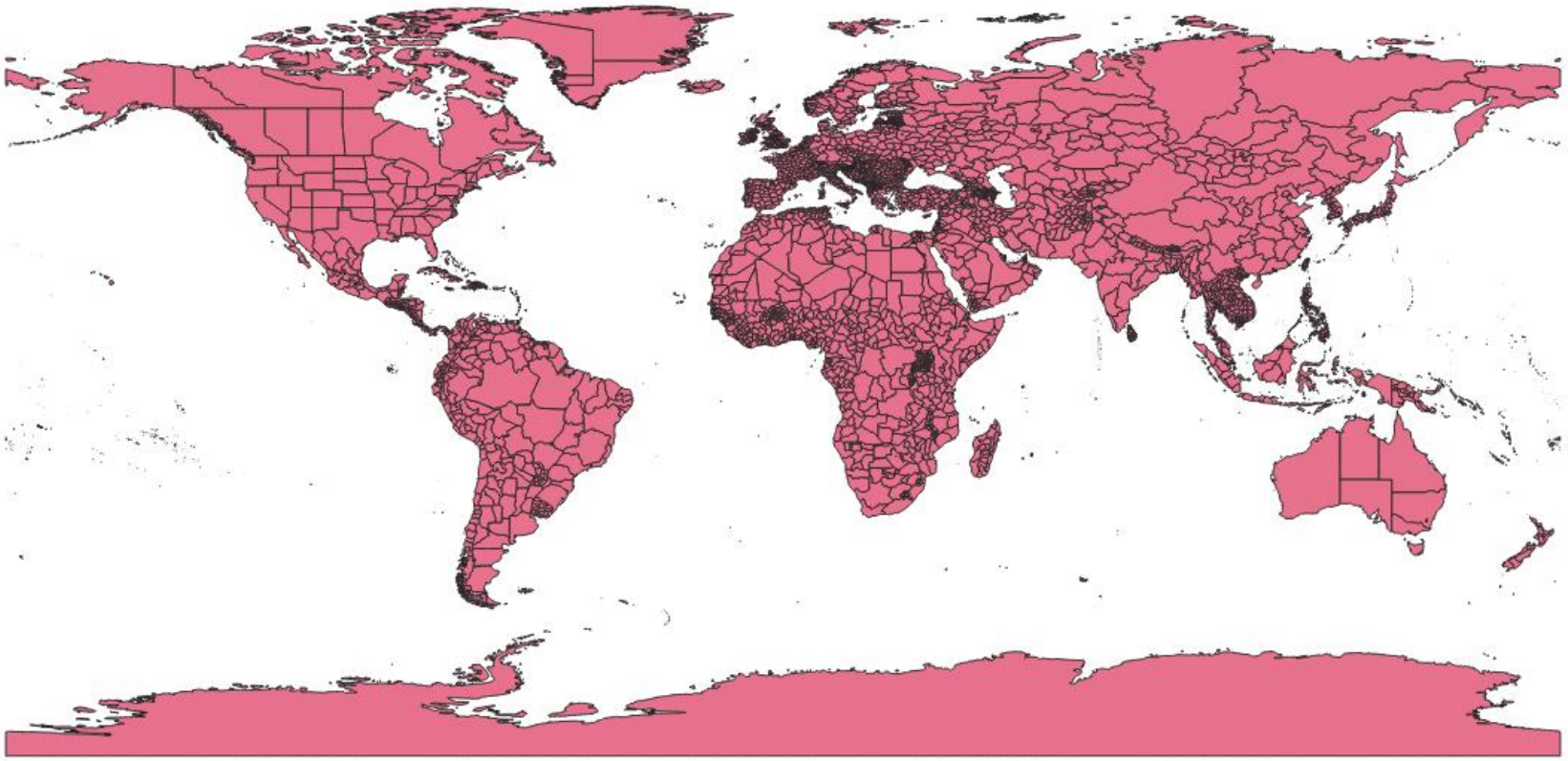


GIS fundamentals: Geographic coordinate systems (GCS)

- WGS84
  - Default Datum for GPS units
  - Pretty good for global measurements
  - Small changes in landmass movements can be significant at global scale
    - Melting glaciers cause rising elevation
    - Tectonic movements
  - Local datums are better for local maps (e.g., North American Datum; NAD83) and reduce significance of landmass movements.

GIS fundamentals: Geographic coordinate systems (GCS)

- WGS84 – Unprojected: Distortion near extents of map



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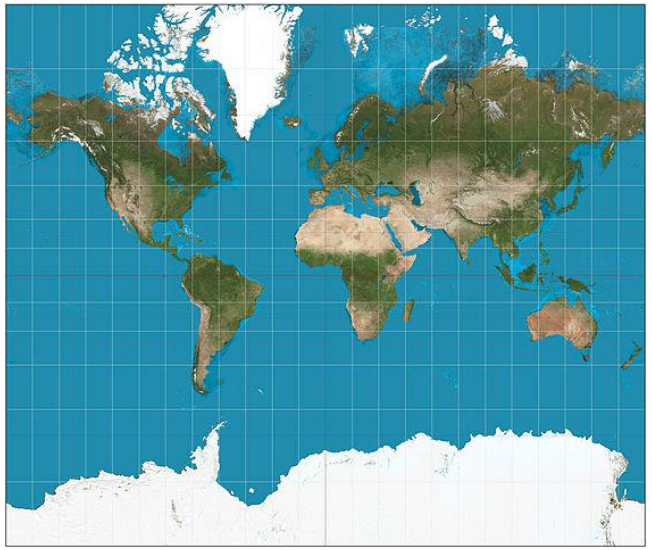
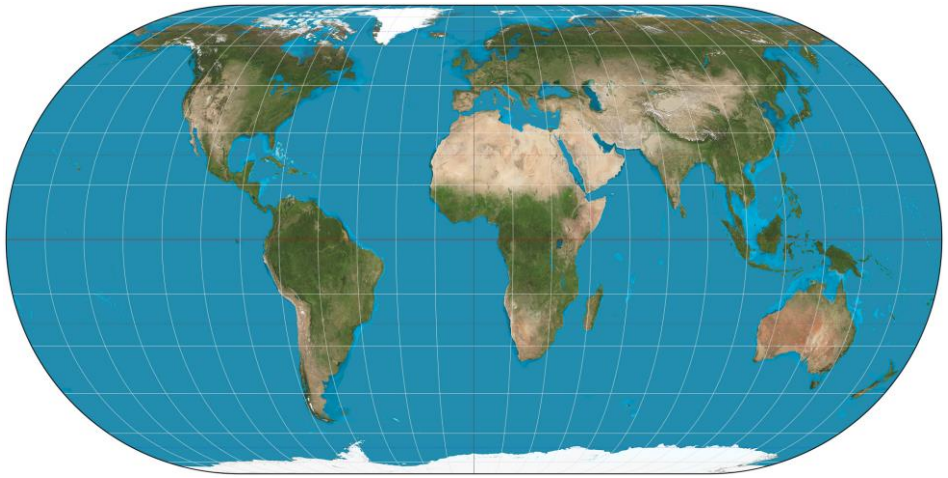
GIS fundamentals: Geographic coordinate systems (GCS)

- Representing the earth's surface in two dimensions causes distortion in the shape, area, distance, or direction of the data.
  - Impossible to show spherical object in 2 dimensions without distortion
- A map projection uses mathematical formulas to relate spherical coordinates on the globe to flat, planar coordinates.
- Different projections are designed to minimize different distortions.



Mercator: maintains direction



Eckert IV: maintains area

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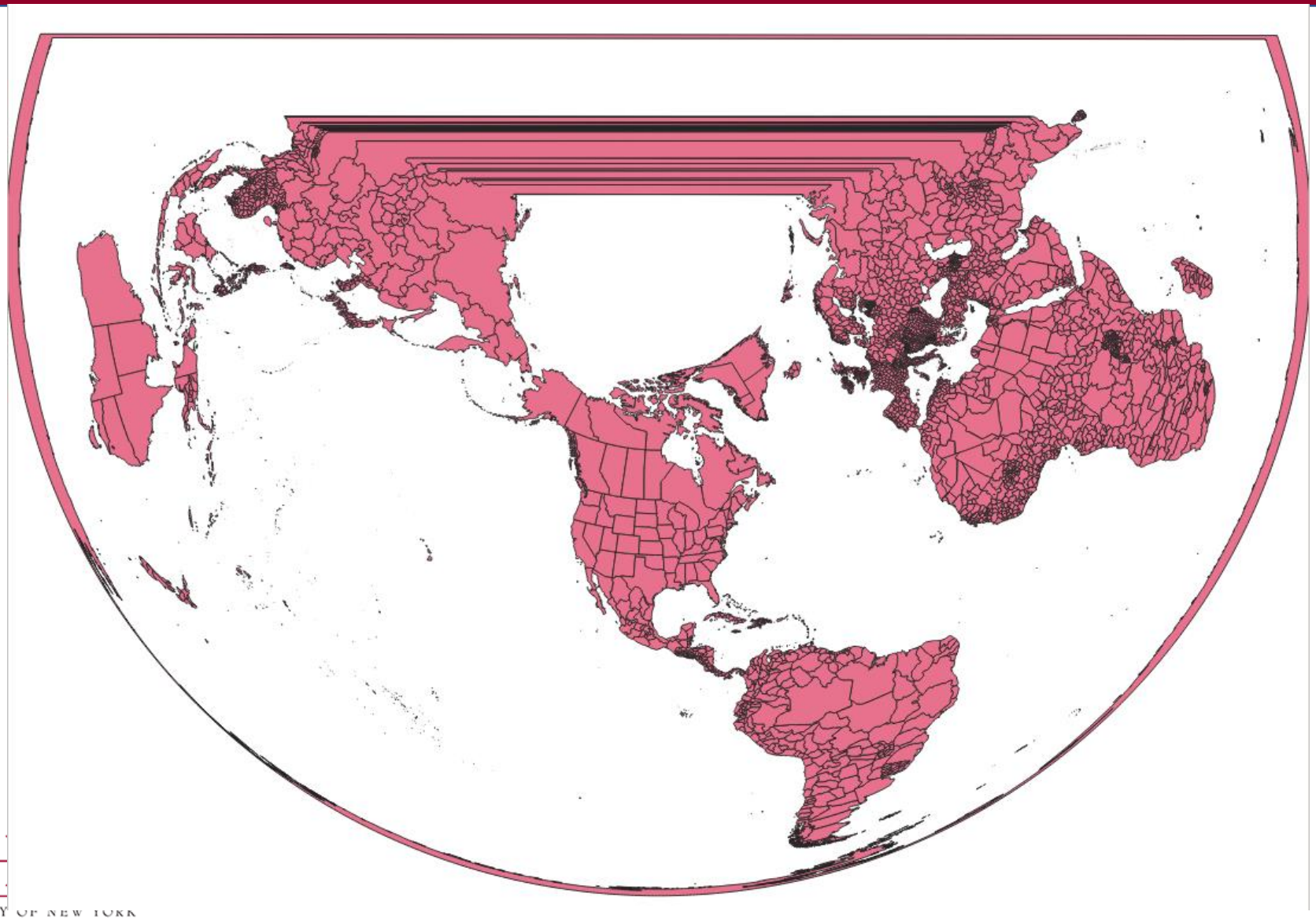

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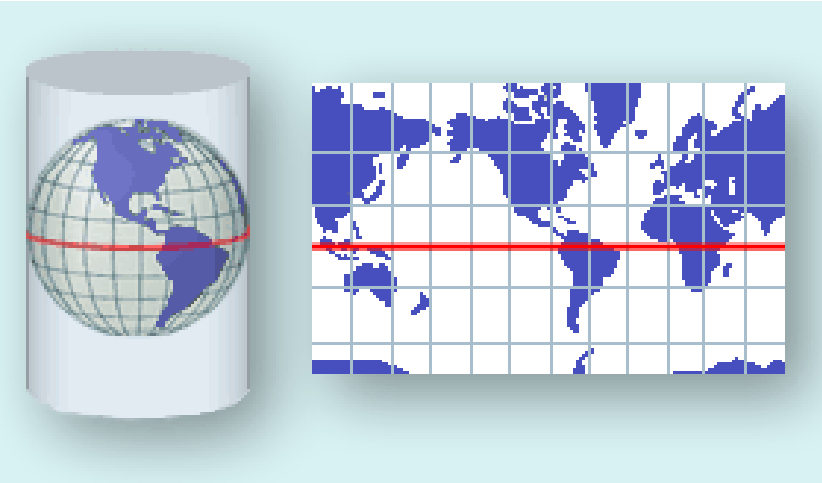
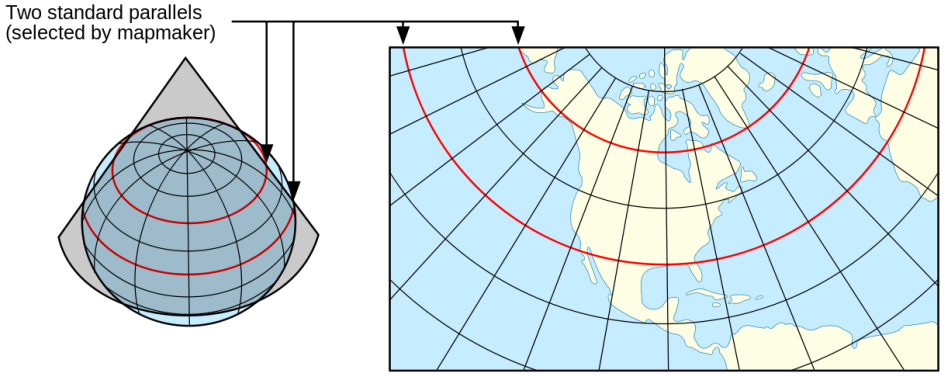
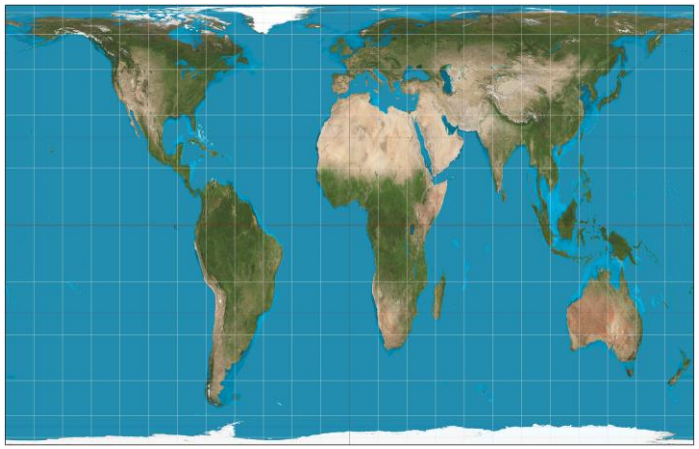


Mercator Projection
- Maintains direction
- Good for navigating
- Distorts near pole, pretty good near equator



Conic Projection
- Maintains area near center
- Distortion near edges
- Good for east/west because distortion constant

Gall-Peters Projection
- Maintains relative areas
- High distortion



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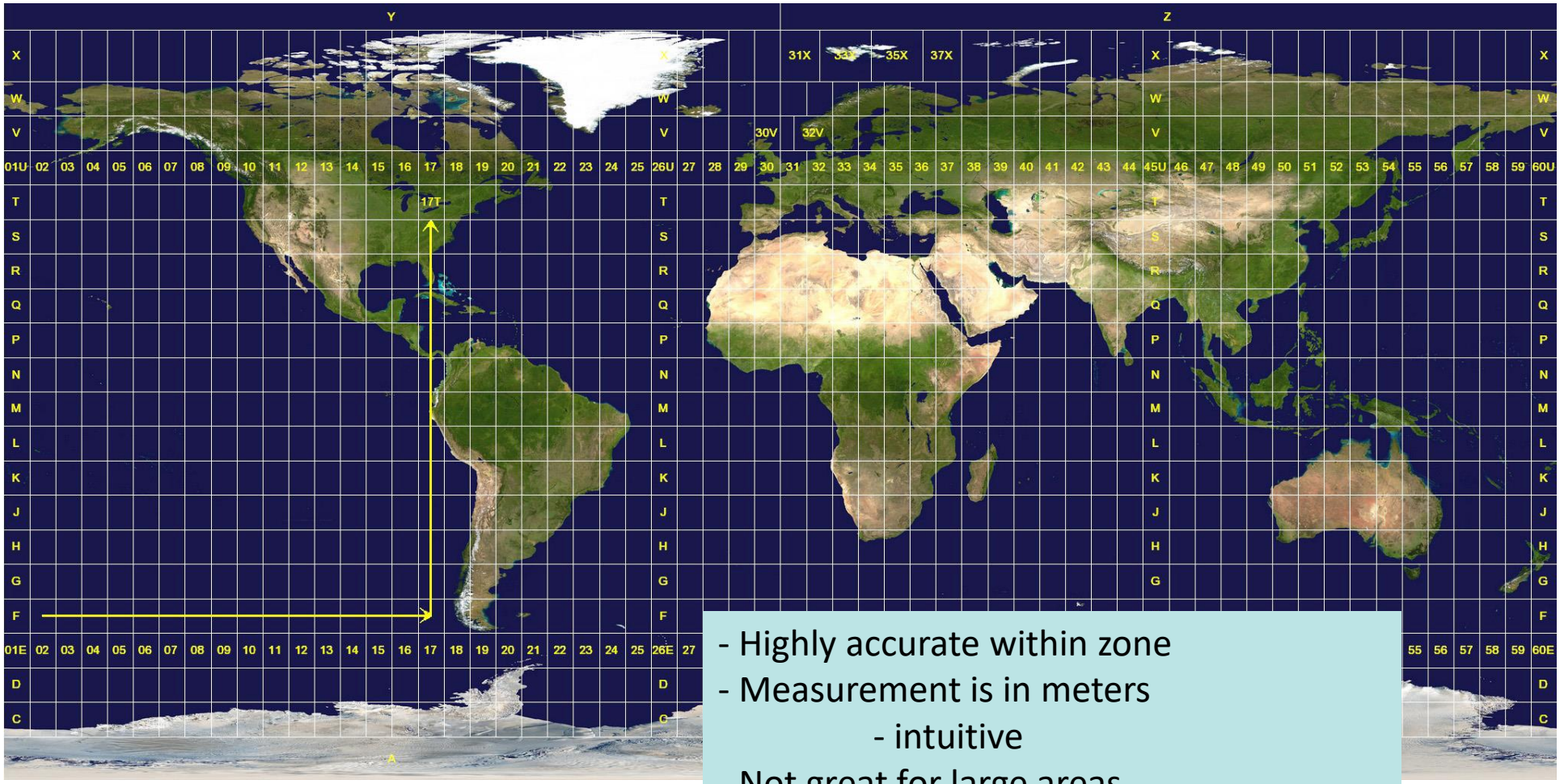
GIS fundamentals: Geographic coordinate systems (GCS)

Universal Transverse Mercator -



- Highly accurate within zone
- Measurement is in meters
  - intuitive
- Not great for large areas (across zones)

GIS fundamentals: Geographic coordinate systems (GCS)

- Modern GIS make dealing with coordinate systems relatively straightforward; however:

IT IS ESSENTIAL TO KNOW THE COORDINATE SYSTEM OF ANY DATA WITH WHICH YOU ARE WORKING!