CVEN303 ENGINEERING MEASUREMENT

Lecture 2– Location Referencing Systems (Sec 1.8 & 1.9)
2013

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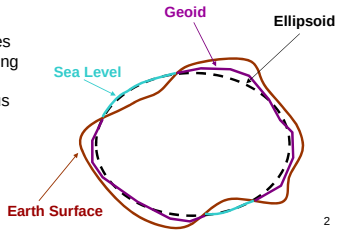
Earth Models

- Ellipsiod
- Geoid
- In the continental United States, the geoid is below the ellipsoid.

Understanding earth surfaces is necessary for understanding vertical and horizontal referencing systems and thus the position of objects on earth.



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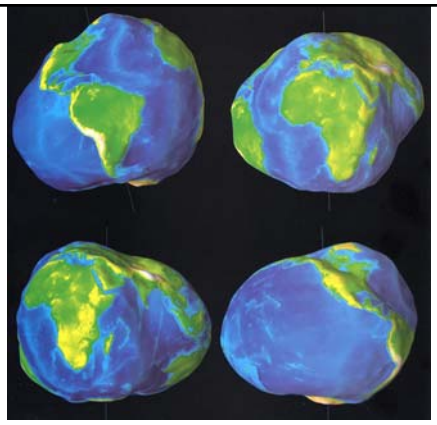
Geoid



From: http://www.seas.harvard.edu/climate/eli/Courses/EPS131/2010spring/

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Location Referencing Systems

- Horizontal References
  - Geographic: Latitude & Longitude
  - Plane: X, Y coordinate systems.
  - Map Projections – mathematical/geometrical models for transforming a curved earth to a flat map
- Vertical (Elevation) References
  - Ellipsoid: such as the Geodetic Reference System of 1980 (GRS80) and the World Geodetic System of 1984 (WGS84)
  - Geiod: Mean Sea Level (MSL)

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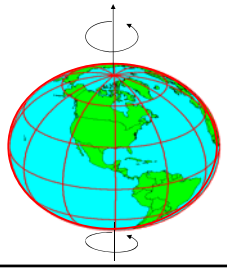
Earth Representation for Longitude and Latitude

- Latitude and Longitude are defined using an ellipsoid



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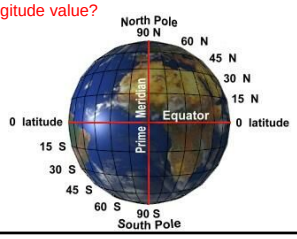
Latitude and Longitude

- Latitude lines: The Earth's equator is the base line for latitude.
  - What is the maximum latitude and where is it located on earth?
- Longitude lines: The base line for longitude runs through the Prime Meridian (in a little town in England called Greenwich).
  - What is the maximum longitude value?



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Latitude & Longitude

- Lat and Long are angles, not distances.
- Can we use these angles directly to determine distances?

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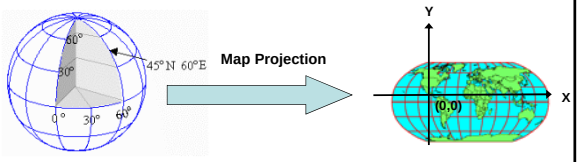
Map Projections



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Example Plane Coordinate Systems

- Universal Transverse Mercator (UTM) - a global system developed by the US Military Services
- State Plane Coordinate System – every State has a statewide coordinate system

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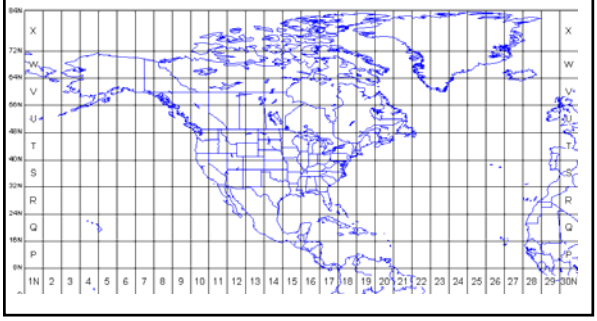
Universal Transverse Mercator (UTM)

- Divides the world into 60 north-south zones (from east to west)
- In each zone, coordinates are measured north and east in meters.



State Plane Coordinate System

- All states have adopted local map projections suitable for the shape of their territory.
- These State Plane Coordinate Systems are tied to a national datum
  - North American Datum 1927 (NAD27)
  - North American Datum 1983 (NAD83)
- Large States are divided into several plane zones (often follow county boundaries).

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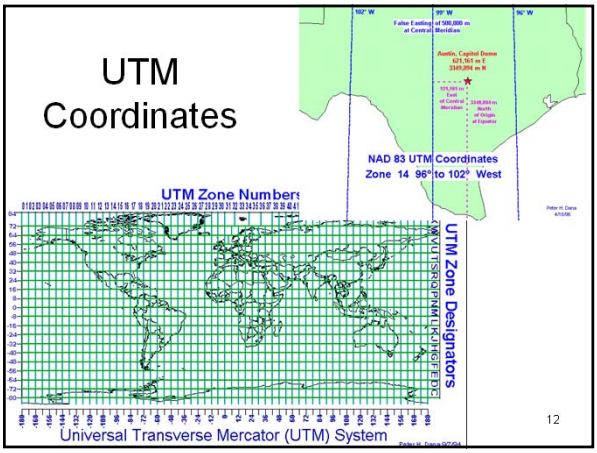
UTM Coordinates



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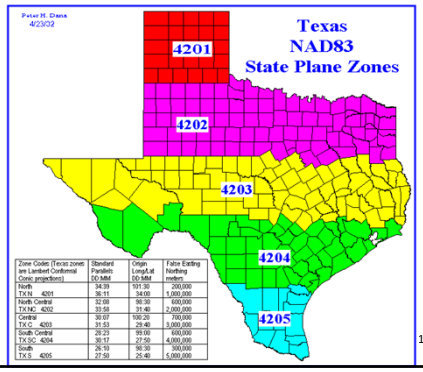
Texas State Plane Coordinates



Zone Codes (Texas zones are Lambert Conformal Conic projections)	Standard Parallels DD:MM	Origin Long/Lat DD:MM	False Easting Northing meters
North 4201	34:39 31:10	101:30 34:00	200,000 1,000,000
North Central 4202	32:08 33:58	98:30 31:40	600,000 2,000,000
Central 4203	30:07 31:53	100:20 29:40	700,000 3,000,000
South Central 4204	28:23 30:17	99:00 27:50	600,000 4,000,000
South 4205	26:10 27:50	98:30 25:40	300,000 5,000,000

Picture developed by Peter H. Dana

Types of Horizontal Distance

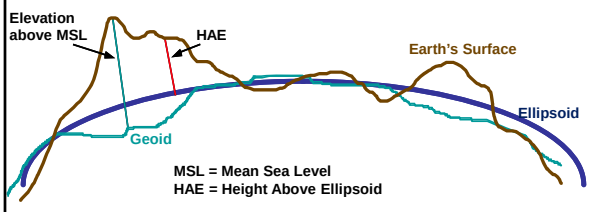
- Ground (or horizontal) distance (obtained from Total Station)
- Geodetic Distance (obtained from GPS)
- Grid (or projected) Distance (can be obtained from GPS if projection algorithms are programmed into the GPS receiver)

We need to be able to convert one distance type to another.

Later in the semester, we will learn how to do these calculations.

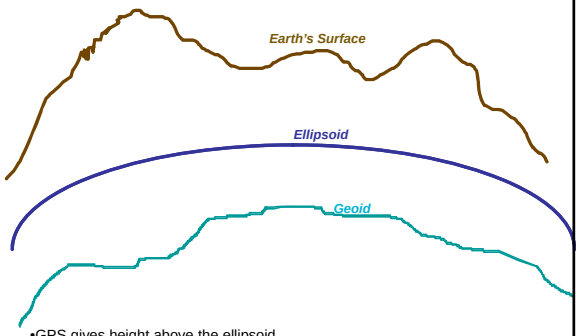
Vertical (Elevation) References

- Ellipsoid: World Geodetic System of 1984 (WGS84) (used by GPS), Geodetic Reference System of 1980 (GRS80), etc.
  - A smooth, mathematically defined ellipsoidal model of the earth's surface
- Geiod (or Mean Sea Level, MSL)
  - A surface of equal gravitational pull (equipotential) best fitting the average sea surface over the whole globe



MSL = Mean Sea Level
HAE = Height Above Ellipsoid

Types of Elevation



- GPS gives height above the ellipsoid
- Surveyors and Engineers use height above the MSL, or the geoid (called orthometric height)

Types of Elevations

- GPS measures elevation as the distance from the surface of the ellipsoid to the point in question (h)
- Surveyors often need the elevation above (or below) the mean sea level (H)

We need to be able to convert one elevation type to another.

Later in the semester, we will learn how to do these calculations.