Geographic Information Systems for Natural Resource Management

FW 3540

Lecture 3

Georeferenced Data & Geographic Coordinate Systems

Georeferenced data is information that is linked to a physical location on the earth's surface via an X, Y coordinate system. Z coordinates are used to represent topography (elevation), bathymetry or attribute information.

Coordinate system must be geographic or projected

Geographic information is tied to the earth's surface via a ***geographic*** coordinate system measured as latitude and longitude

A geographic coordinate system is defined as regular spaced grid placed over the earth's surface with a defined origin. Note that lines of longitude converge at the poles

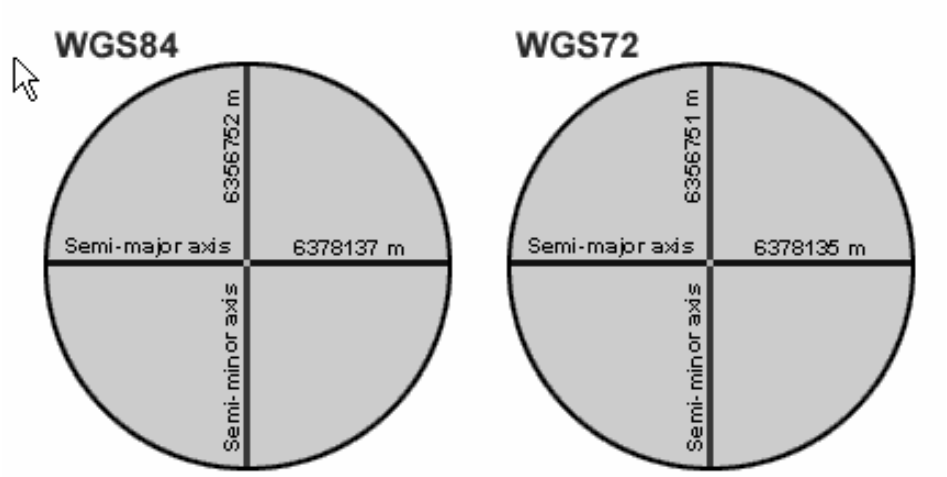
X coordinate- easting

Y coordinate- northing

Z coordinate(s)- attribute(s), most common is elevation

The Earth's Shape is a Spheroid

The earth is a spheroid, but its major and minor axes do not vary greatly. In fact its shape is so close to a sphere is often called an ellipsoid. Most map projection authorities use "spheroid" and "ellipsoid" interchangeably.



Two spheroids commonly used today. Difference between major and minor axes is less than 0.34%.

WGS- World Geodetic System

Major axis length (meters)

1984- 6,378,137.0 meters GPS survey

1972- 6,378,135 meters ground survey

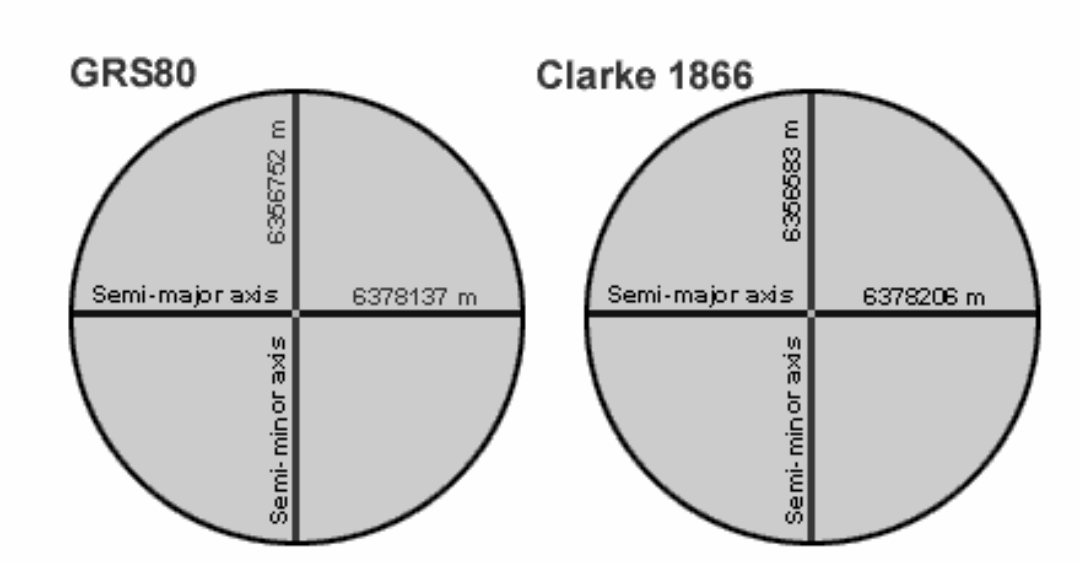
The Need for Different Spheroids

Earth is not a perfect spheroid, it's lumpy. So the semi-major and semi-minor axes that fit one geographic area will not fit another.

Satellite technology has revealed several elliptical deviations. For example, the South Pole is closer to the equator than the North Pole.

To account for such local deviations and undulations, a different shape, a geoid, is sometimes used.

Geoids



Many different geoids are used throughout the world. In North America the 2 most common are the GRS80 and the Clarke 1866.

Clarke 1866	6378206.4 meters	North America
GRS1980	6378137 meters	Worldwide
Airy 1830	6377563 meters	Great Britain
Bessel 1841	6377397.2 meters	Central Europe
Everest 1830	6377276.3 meters	Indian subcontinent

Datums

Geodetic Datums:

- Horizontal Datum: considers the curvature of the earth
- Vertical Datum: a reference point for calculating elevations

Horizontal Geodetic Datums

The datum is established by first selecting a point of origin.

(North America – Meades Ranch, Kansas)

Next a series of triangulation stations are located across the geographic area of interest. (North America – includes stations in Canada, US, and Mexico).

An ellipsoid (spheroid, geoid) is selected.

Locations of the triangulation stations are precisely located (X,Y coordinates in reference to the origin). Note also that flattening is considered using the equation of the selected ellipsoid and the X, Y coordinates are adjusted.

Properties of Map Projections

Any time work with georeferenced data, must have two requisite pieces of information:

Map Projection

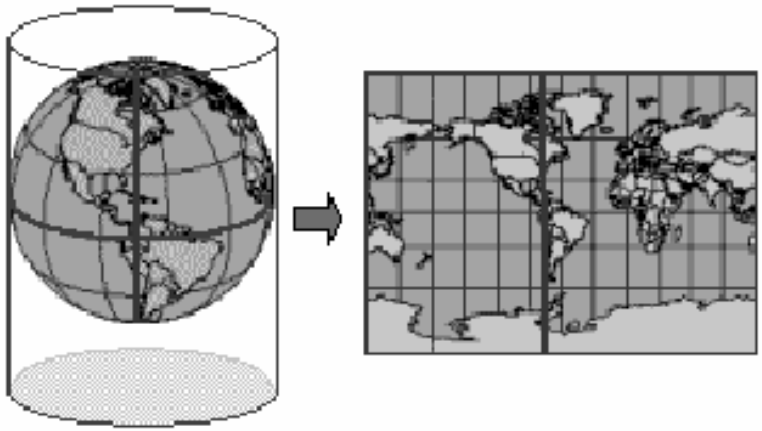
Coordinate System

Map projection

The manner in which the spherical surface of the earth is represented on a flat (two dimensional surface). Can be accomplished by direct geometric projection or by mathematically derived transformations.

The projection is the feature which maintains the link between the geographic coordinate system and the geodetic ellipsoid.

Types of Projections



Cylindrical Projections- created by wrapping a cylinder around a globe and project light from the center of the globe onto the surface of the cylinder.

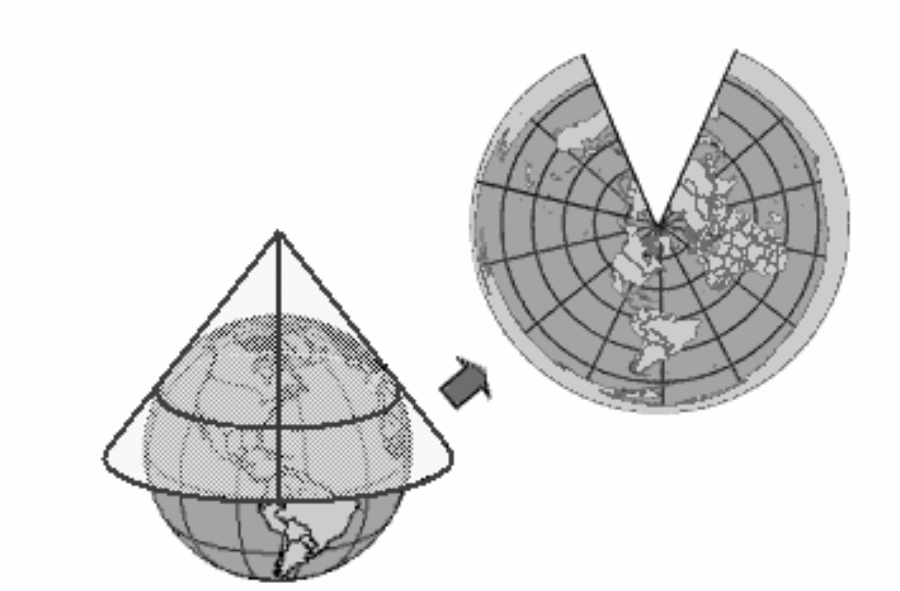
The cylinder is cut along any meridian and is unrolled to produce a flat map. The meridian opposite the cut is called the central meridian (the red line).

Conic Projection

Conic Projection- created by setting a cone over a globe and projecting light from the center of the globe onto the cone.

Simplest cone contact the globe along a single latitude line, a tangent, and is called the standard parallel.

The cone may also intersection at 2 latitudes and these are called the first and second standard parallels.



Planar (Azimuthal) Projection

Planar projections- project map data onto a flat surface. Is generally tangent to the globe at one point. North and south poles are the most common point of contact. Area and shape distortion are circular around the point of contact. Therefore planar projections accommodate circular regions better the rectangular areas. Most often used around the poles.