Salahaddin University-Erbil
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Second Year Students
1st Semester
2020-2021

Introduction to GIS

Introduction

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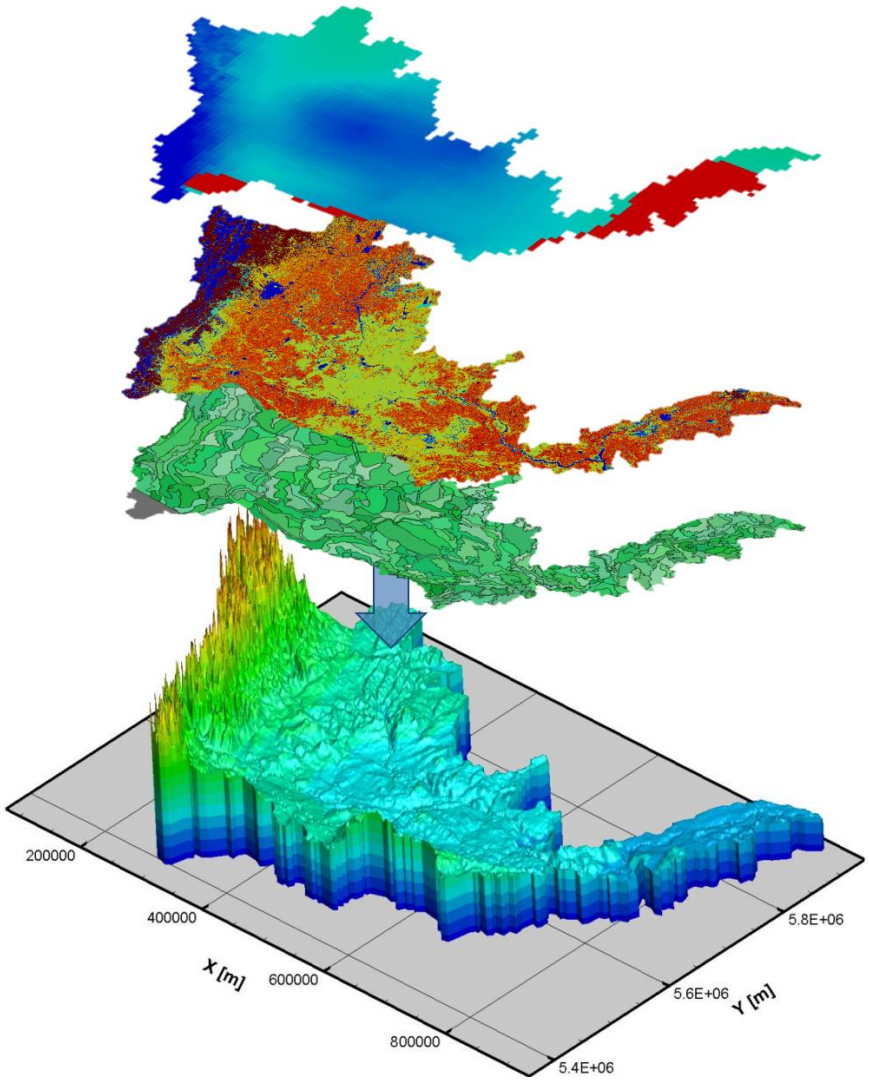


What we Learned in the Previouse class

What is a GIS?

Types of GIS Data

GIS Functions and Components

Outline

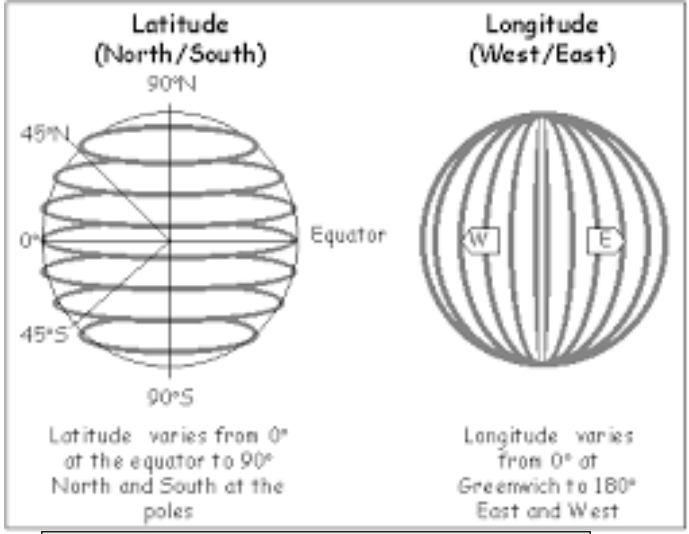
- A List of GIS Applications
- Geographic Coordinate System
- Datum

A List of GIS Applications

GIS is a useful tool because a high percentage of information has a spatial component, the following are some areas that GIS participate in analysis and management:

natural resources, natural hazards, surface and groundwater hydrology, meteorology, environmental analysis and monitoring, flood risk, soils, ecosystem management, wildlife habitat, agriculture, forestry, landscape analysis and management, land use management, invasive species, archaeology, urban planning, transportation, health care, real estate, tourism, community planning, pollution assessment, public services, and military operations

Geographic Coordinate System



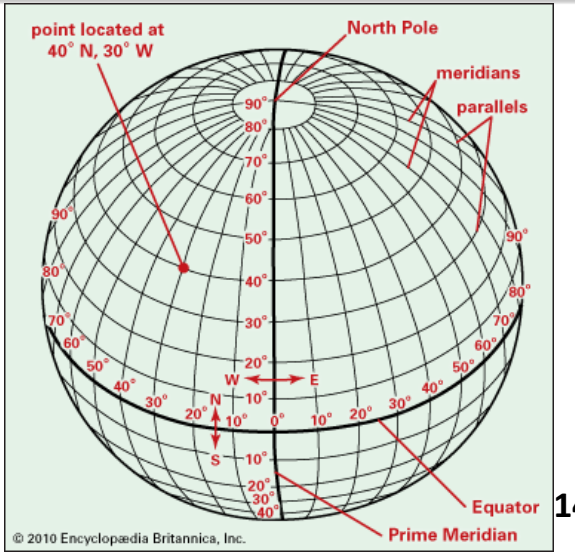
The geographic coordinate system is the reference system for locating spatial features on the Earth's surface.

The geographic coordinate system is defined by **longitude** and **latitude.**

Both longitude and latitude are angular measures: **longitude** measures the angle *east or west* from the prime meridian (Greenwich), and **latitude** measures the angle *north or south* of the equatorial plane.

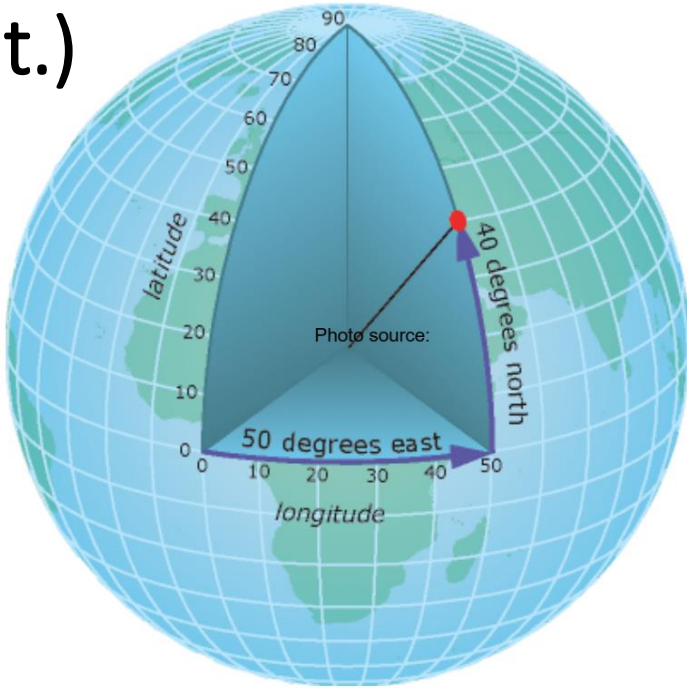
Longitude (X): 0º to 180º from Greenwich to East (E) or West (W).

Latitude (Y): 0º to 90º from earth equator to North (N) or South (S).



Geographic Coordinate System (Cont.)

If the specific location on the earth is required to find its position, it is required to know longitude angle and latitude angle.



for example:

50°E 40°N it means that the location position on 50° East of Greenwich in longitude and 40° North of equator.

It is conventional in GIS to enter longitude and latitude values with ***positive*** or ***negative*** signs. *Longitude values are* ***positive in the eastern hemisphere*** and ***negative in the western hemisphere***. *Latitude values are* ***positive if north of the equator***, and ***negative if south of the equator***.

For example: 50°W 40°N = -50° 40°, 25°E 60°S = 25° -60°

Geographic Coordinate System (Cont.)

Because the distance between longitude and latitude angles are very long, it is important to refine values to cover everywhere on the planet as follow:

The angular measures of longitude and latitude may be expressed in **Degrees-Minutes-Seconds** (DMS), **decimal degrees** (DD).

Given that 1 degree equals 60 minutes and 1 minute equals 60 seconds, we can convert between DMS and DD.

DMS $\Rightarrow$ D= Degree (X^o), M=Minute (X'), and S= Second (X")

Example:

Convert 45.875^o N latitude from DD to DMS:

$D=45^o$

M= 0.875 * 60 =52.5'

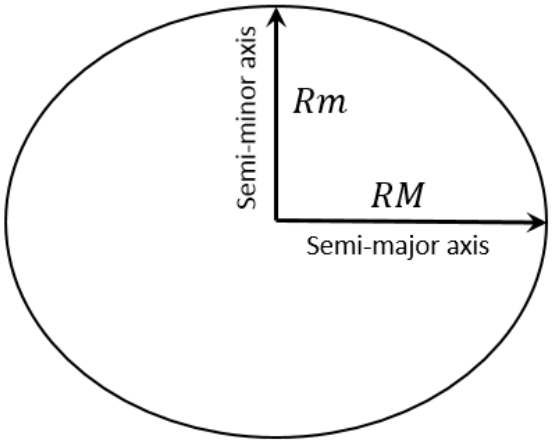
S= 0.5 * 60= 30" $\therefore$ the angle in DMS= $45^o52'30"$

Datum

A datum is a mathematical model of the Earth, which serves as the reference or base for calculating the geographic coordinates in the case of a horizontal datum and for calculating elevations in the case of a vertical datum.

NAD27 (North American Datum 1927) is a local datum based on the Clarke 1866 ellipsoid, a ground-measured ellipsoid with its origin at Meades Ranch in Kansas.

Clarke 1866's semimajor axis (equatorial radius) and semiminor axis (polar radius) measure 6,378,206 meters and 6,356,584 meters respectively, with the flattening of 1/294.98



$$\text{Flattening Factor} = \frac{RM - Rm}{RM}$$

Datum (Cont.)

NAD83 based on the GRS80 (Geodetic Reference System 1980) ellipsoid. GRS80's semimajor axis and seminor axis measure 6,378,137 meters and 6,356,752 meters, respectively, with the flattening of 1/298.26.

Datum Accuracy

A spatial reference system requires a datum. Datum accuracy is therefore an important topic in mapping. NAD27 was based on surveys of approximately 26,000 stations, with latitude and longitude coordinates collected at each station. To improve the accuracy of NAD27, NAD83 used a total of 250,000 stations by combining those stations from NAD27 and additional positions measured from Doppler satellite data.

Datum (Cont.)

WGS84 (World Geodetic System 1984) is used by the U.S. Department of Defense as a global reference system for supporting positioning and navigation. It is the datum for GPS readings.

The original WGS84 was established in 1987 using Doppler satellite observations; therefore, the original WGS84 is identical to the original NAD83 in North America.

Since 1987, WGS84 has been readjusted using GPS data. A total of five realizations were made between 1994 and 2013 by taking advantage of new data and methods to improve its accuracy.