



Yildiz Technical University
Faculty of Civil Engineering
Department of Geomatic Engineering



TOPOGRAPHY (HRT3351)

Lecture Notes

Prof. Dr. Burak AKPINAR

Title	Code	Local Credit	ECTS	Lecture (hour/week)	Practical (hour/week)	Laboratory (hour/week)
Topography	HRT3351	3	4	3	0	0

Course Objectives

The aim of this course, gains required skills of basic of surveying techniques, mathematical definitions using for large scale map production.

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TOPOGRAPHY (HRT3351)

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Week	Subject
1	Introduction to Topography
2	Measurement Units and Sources of Measurement Errors
3	Types of Errors
4	Coordinate Systems and Map Projections
5	Geodetic Network Points and Distance Measurements
6	Direction Measurements
7	Traverse Computations
8	Height Measurements
9	Midterm exam 1
10	Area and Volume Computations
11	Field work
12	Field work
13	Geographic Information System, GIS
14	Midterm exam 2
15	GNSS Global Positioning Systems
16	Final exam

Week-4

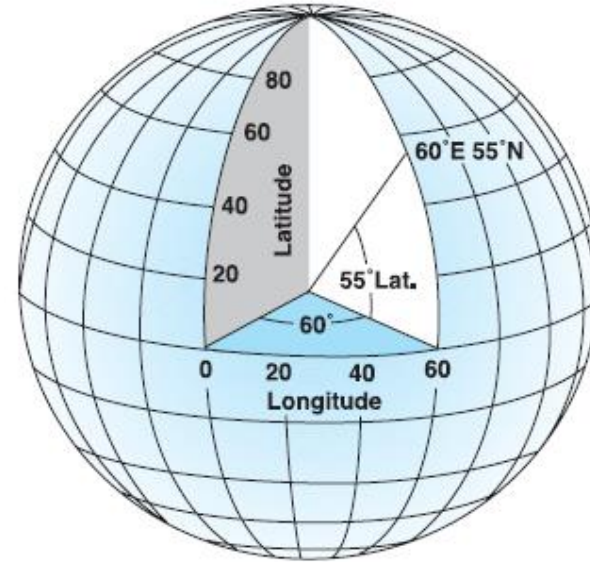
Coordinate Systems and Map Projections

TOPOGRAPHY (HRT3351)

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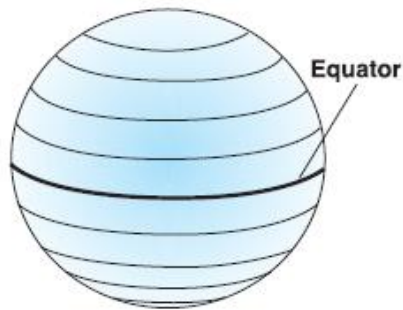
Geographic Coordinate System

- Geographic Coordinate System defined locations on the earth using three-dimensional spherical surface.
- A feature is referenced by its longitude and latitude values.
- Longitude and latitude are angles measured from the earth's center to a point on the earth's surface.

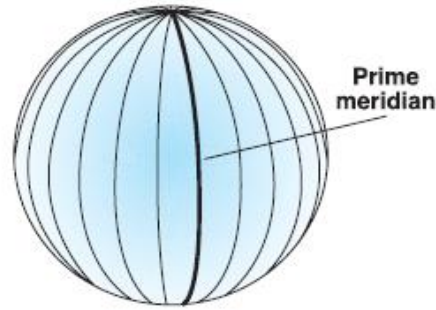


Geographic Coordinate System

- In the spherical system, 'horizontal' or East-West lines are lines of equal latitude or parallels.
- 'Vertical' or North-South lines are of equal longitude or meridians.
- These lines encompass the globe and form a gridded network called a graticule.
- The line of latitude midway between the poles, the horizontal axis is called the equator and defines the line of zero latitude.
- The vertical axis, which defines the line of zero longitude is called prime meridian. Prime meridian is the longitude that passes through Greenwich, England.



Parallels
(Lines of latitude)



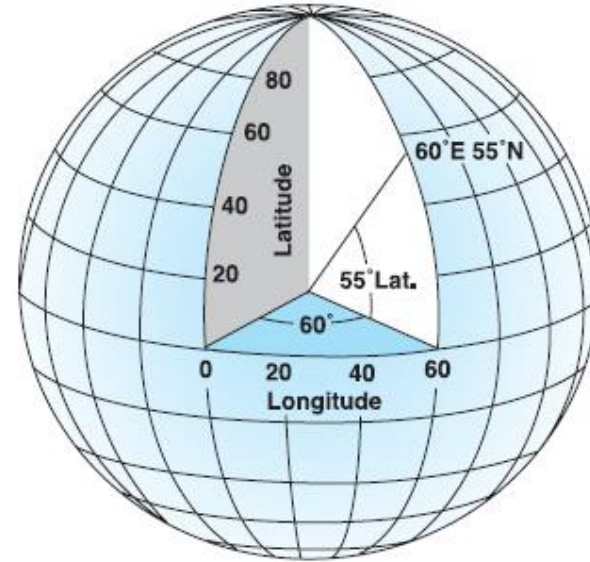
Meridians
(Lines of longitude)



Graticular
Network

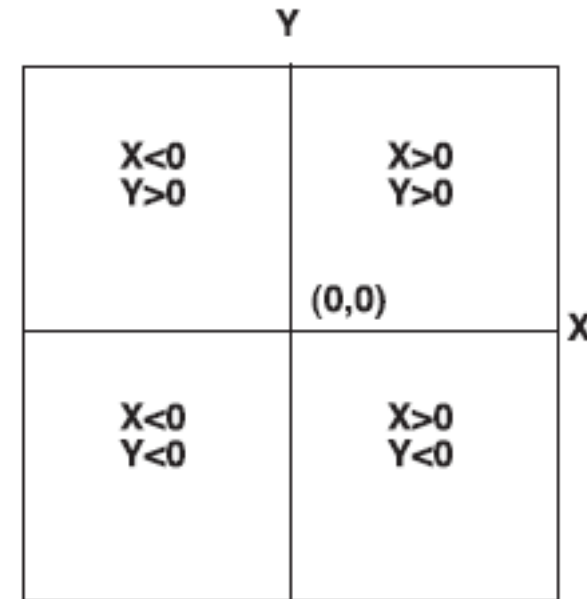
Geographic Coordinate System

- Where the equator and prime meridian intersect defines the origin (0,0).
- The globe is divided into four geographical quadrants based on compass bearings from the origin.
- Above and below the equator are North and South, and to the left and right of the prime meridian are West and east.
- Latitudes are measured relative to the equator and range from -90° at the South Pole and $+90^\circ$ at the North Pole.
- Longitude is measured relative to the prime meridian positively up to 180° when travelling east and negatively up to -180° when travelling West.



Projected Coordinate System

- A projected coordinate system is defined on a flat, two-dimensional surface.
- A projected coordinate system, unlike a geographic one, has the advantage that lengths, angles and areas are constant across the two dimensions.
- In a projected coordinate system, locations are identified by x, y coordinates on a grid, with the origin at the center of the grid.
- Each position has two values referencing it to central location.
- On a gridded network of equally spaced horizontal and vertical lines, the horizontal line in the center is called the x-axis and the central vertical line is called the y-axis.



Map Projections

Map projection is a systematic transformation of the latitudes and longitudes on the surface of a sphere or an ellipsoid into locations on a plane. Map projections are necessary for creating maps.



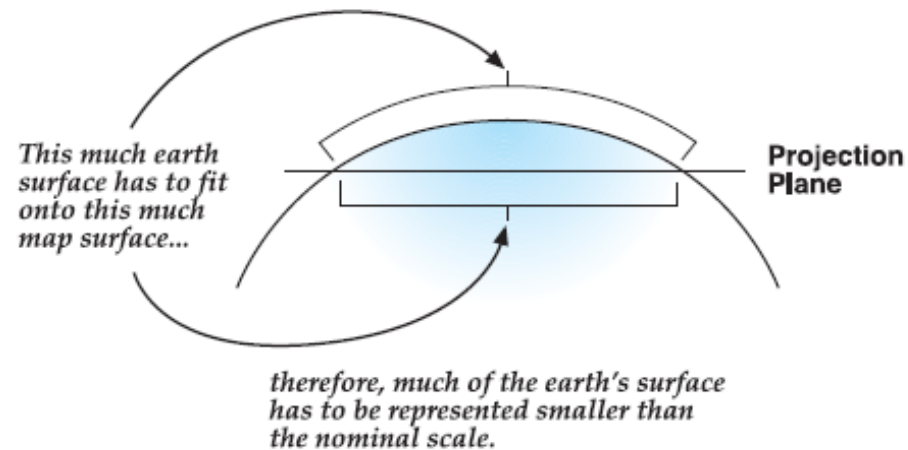
Map Projections

A map projection uses mathematical formulas to relate spherical coordinates on the globe to flat, planar coordinates.

$$(\lambda, \varphi) \mapsto (x, y)$$

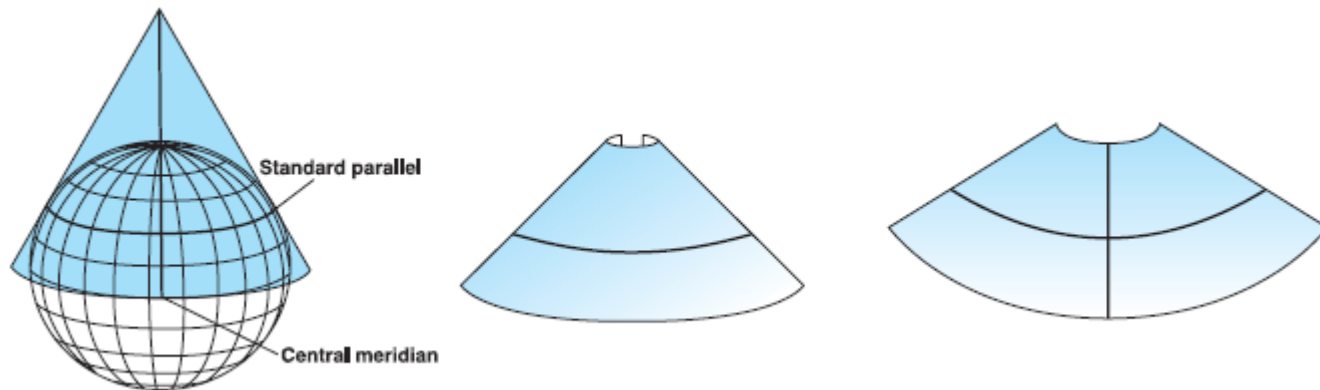
Representing the earth's surface in two dimensions causes distortion in the shape, area, distance or direction of data.

Different projections cause different types of distortions. Some projections are designed to minimize the distortion of one or two of the data's characteristics.



Conic Projections

- The most simple conic projection is tangent to the globe along a line of latitude. This line is called the standard parallel.
- The meridians are projected onto the conical surface, meeting at the apex or point of the cone. Parallel lines of latitude are projected onto the cone as rings.
- In general, distortions increase away from the standard parallel. Thus, cutting off the top of the cone produces a more accurate projection. This is accomplished by not using the polar region of the projected area.
- Conic projections are used for mid-latitude zones that have an east to West orientation.



Cylindrical Projections

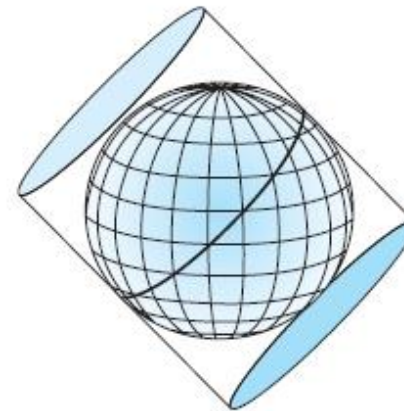
- The Mercator projection is one of the most common cylindrical projections. And the equator is usually its line of tangency.
- Meridians are geometrically projected onto the cylindrical surface, and parallels are mathematically projected, producing graticular angles of 90 degrees.
- In all cylindrical projections, the line of tangency have no distortion and thus are lines of equidistance. Other geographical properties vary according to the specific projection.



Normal



Transverse



Oblique

Planar Projections

- Planar projections project map data onto flat surface touching the globe. A planar projection also known as an azimuthal projection or a zenithal projection.
- This type of projection is usually tangent to the globe at one point but may be secant.
- The point of contact may be the North Pole, the South Pole, a point on the equator or any point.



Polar



Equatorial



Oblique

Week-5

Geodetic Network Points and Distance Measurements