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Coordinate Systems

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10/6/2010

Introduction

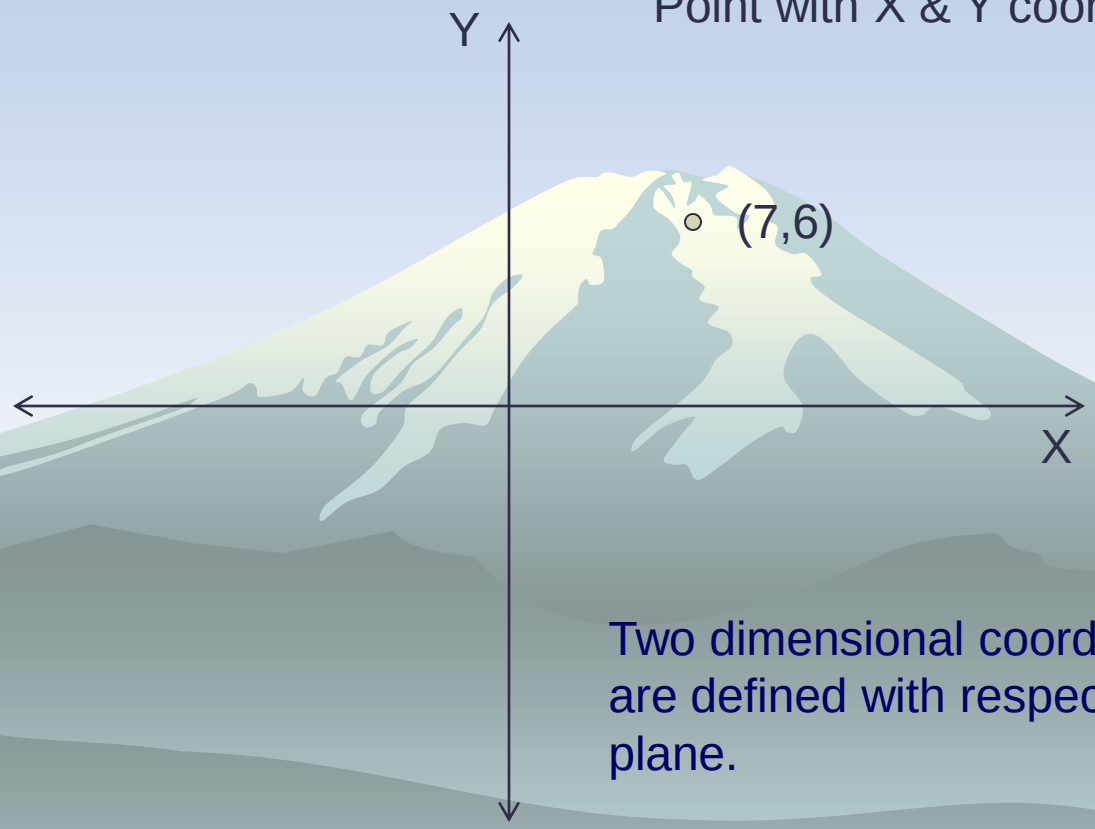
- This overview of coordinate systems for georeferencing provides a brief description local & global systems for use in precise positioning, navigation and geographic information systems for the location of points in space.

Used co-ordinate systems

- There are many different coordinate systems based on a variety of geodetic datum, units, projections and reference systems in use today.

Datum	Coordinate System	Units
NAD 83	Geodetic Latitude, Longitude	Deg:Min:Sec
WGS 84	World Geographic Reference System	Deg:Min:Sec

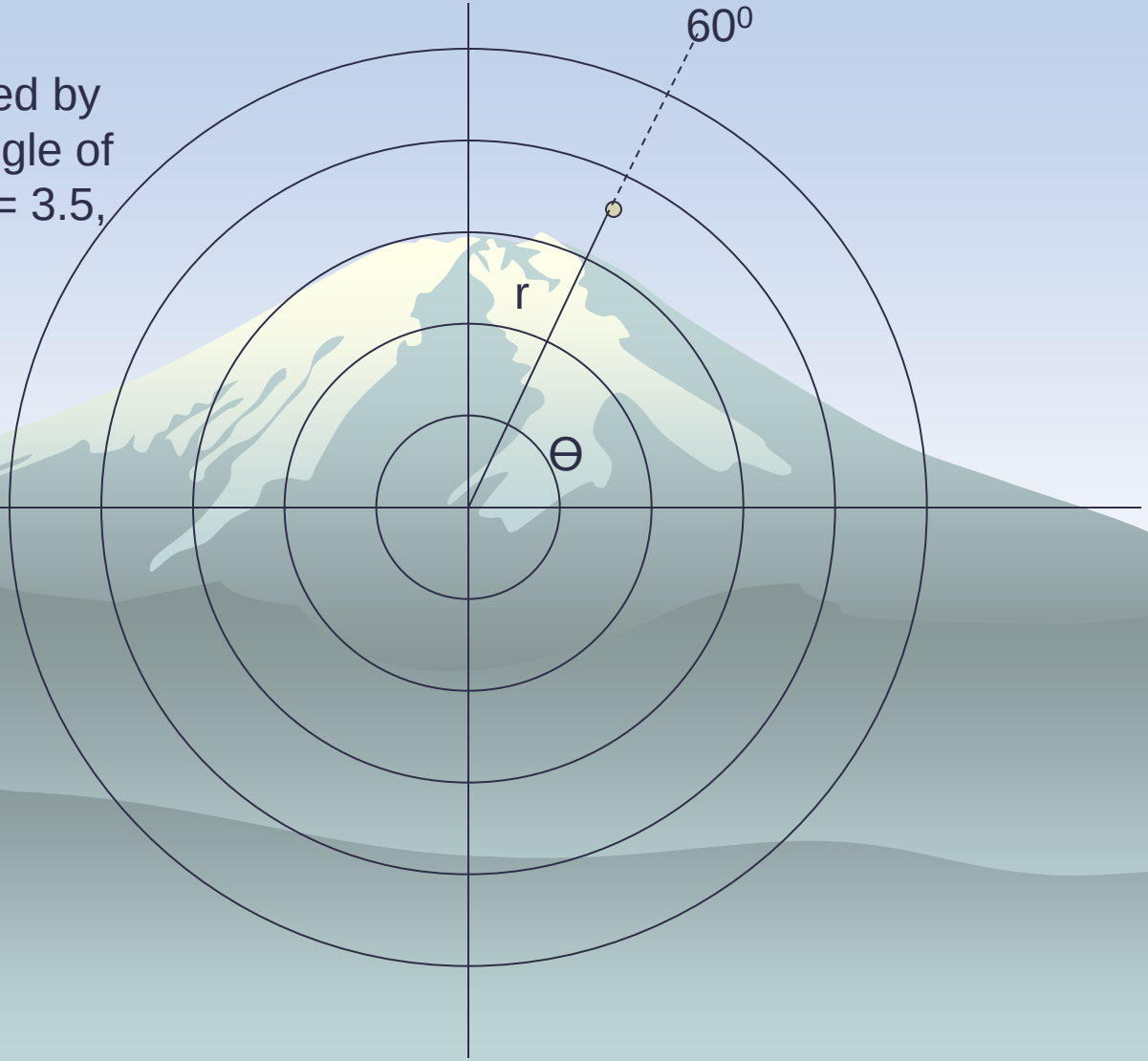
Plane Coordinate System



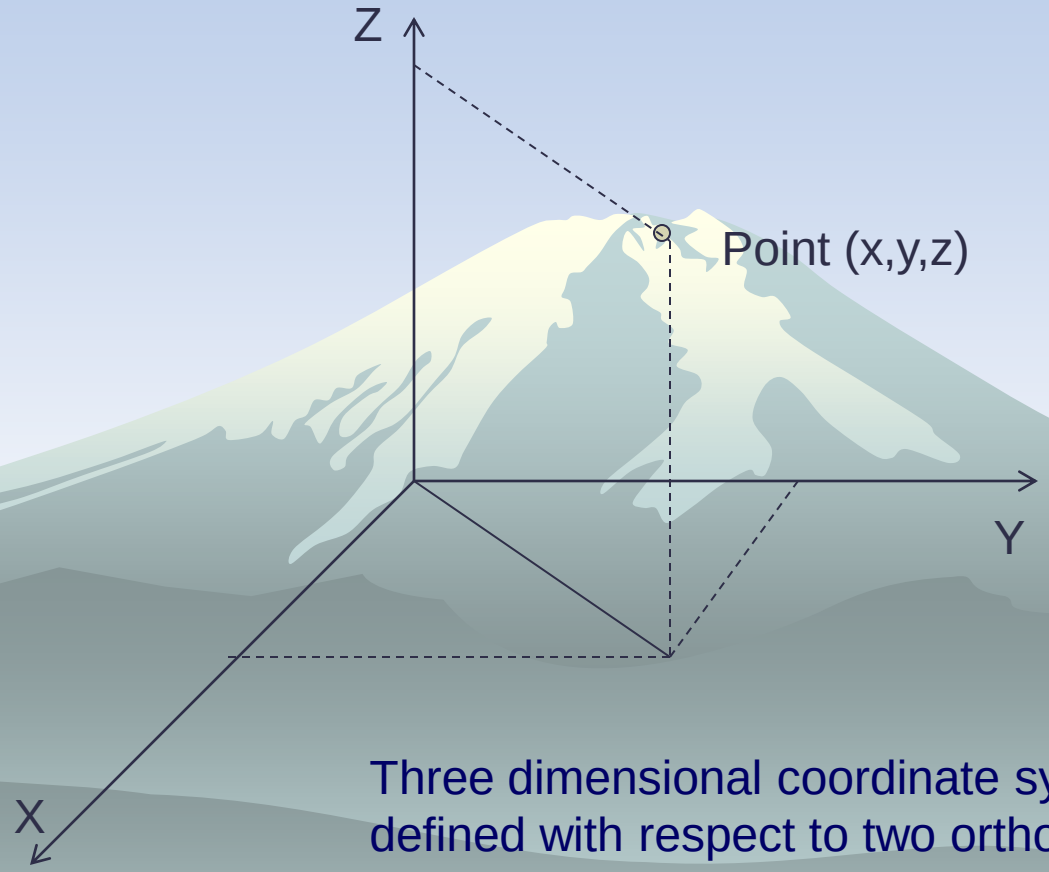
Two dimensional coordinate systems are defined with respect to a single plane.

Polar Coordinates in a plane

Point referenced by Radius and Angle of directed line r = 3.5, $\Theta = 60^0$



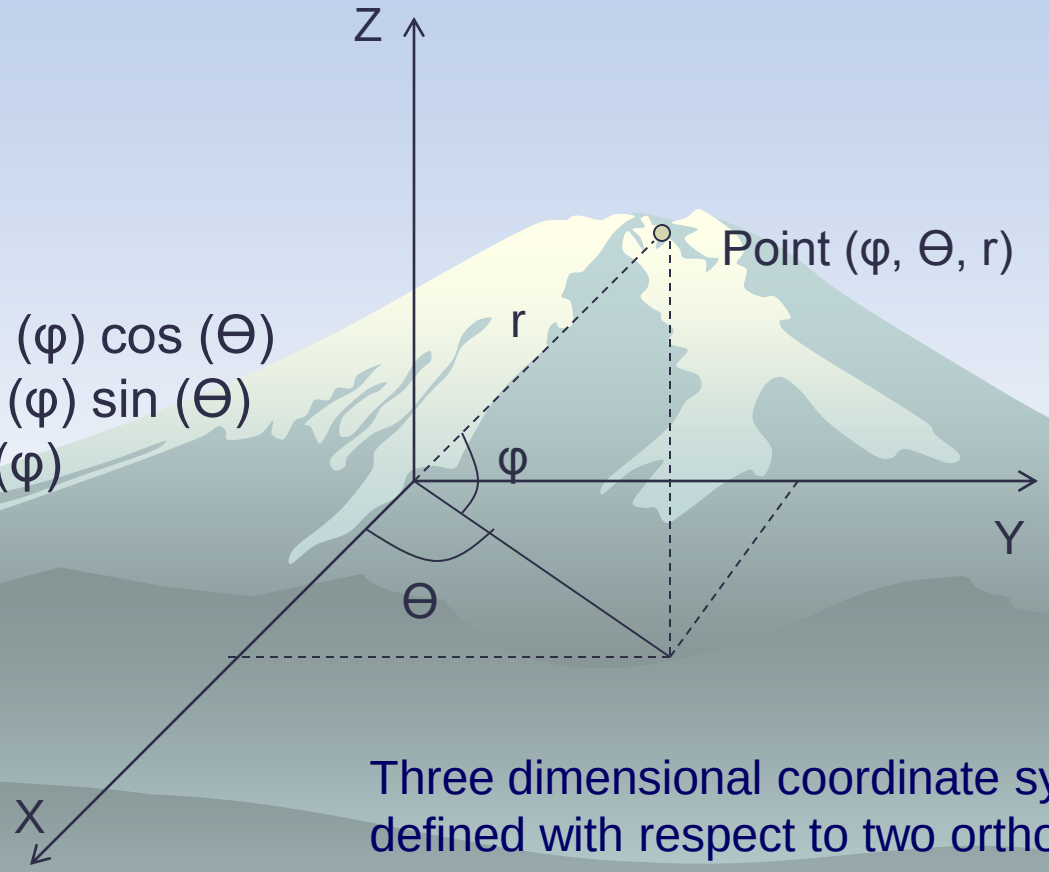
3-d Cartesian Coordinates



Three dimensional coordinate systems can be defined with respect to two orthogonal planes.

3-d Polar Coordinates

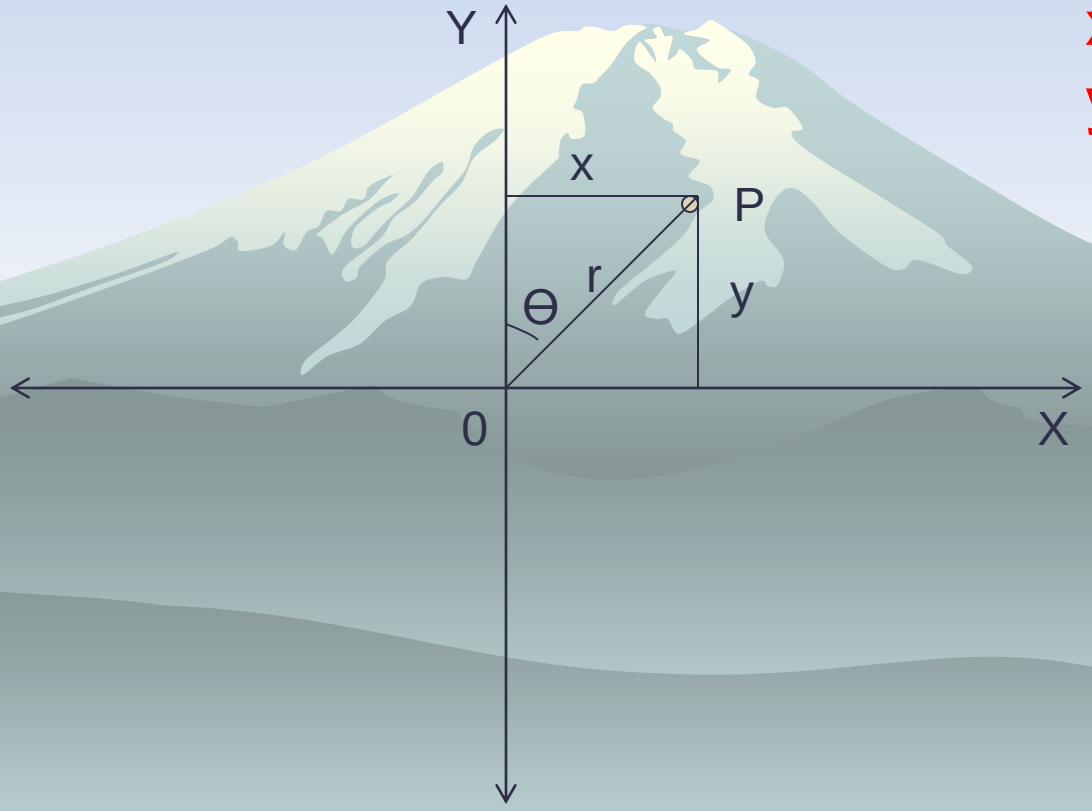
$X = r \cos(\varphi) \cos(\Theta)$
$y = r \cos(\varphi) \sin(\Theta)$
$z = r \sin(\varphi)$



Three dimensional coordinate systems can be defined with respect to two orthogonal planes.

2-D coordinate transformation

- Transformation from polar into rectangular coordinates



$$x = r \sin \Theta$$
$$y = r \cos \Theta$$

Linear conformal, similarity or Helmert transformation

$$X = A + Cx + Dy$$

$$Y = B - Dx + Cy$$

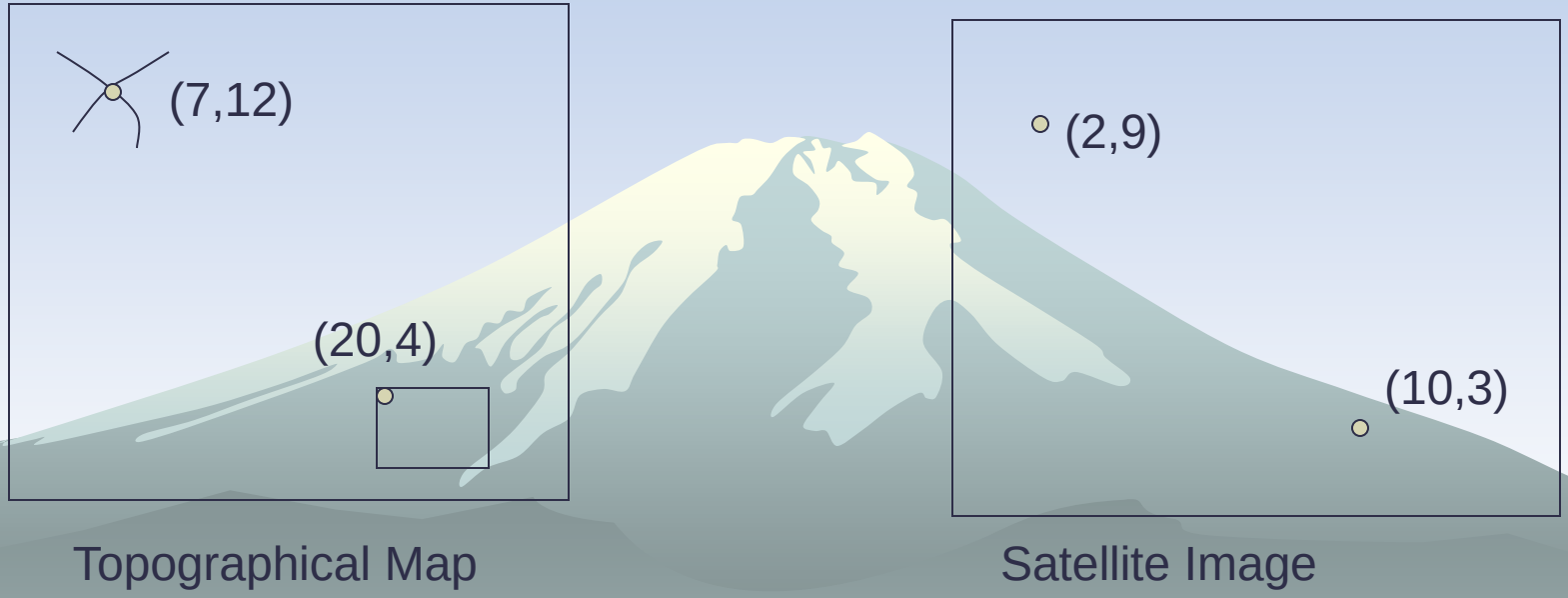
(X,Y) – Coordinate System 1 (Terrain coordinates)
(x,y) – Coordinate System 2 (Image coordinates)

(A,B,C,D) – Transformation parameters

$C = \cos \alpha$
$D = \sin \alpha$

A = Shift in x direction
B = Shift in y direction

The position on Map & Image



Affine Transformation

$$X = A + Cx + Dy$$

$$Y = B - Ex + Fy$$

(X,Y) – Coordinate System 1 (Terrain coordinates)
(x,y) – Coordinate System 2 (Image coordinates)

(A,B,C,D,E,F) – Transformation parameters

$C = m1 \cos \alpha$
$D = m1 \sin \alpha$
$E = m2 \sin \beta$
$F = m2 \cos \beta$

A = Shift in x direction
B = Shift in y direction

Helmert Vs Affine Transformation

Translation of the axes or change of origin, corresponding to the coefficients A and B in both equations

Change of scale from one grid system to other

Rotation of the axes of one grid system with respect to other directions in the other

References :

http://www.cnr.berkeley.edu/~gong/textbook/

http://www.science.edu.sg/ssc/virtual_ssc.jsp

http://www.map-reading.com

http://www.gsd.harvard.edu/gis/manual/projections/fundamentals/

http://www.w3.org/TR/SVG/coords.html