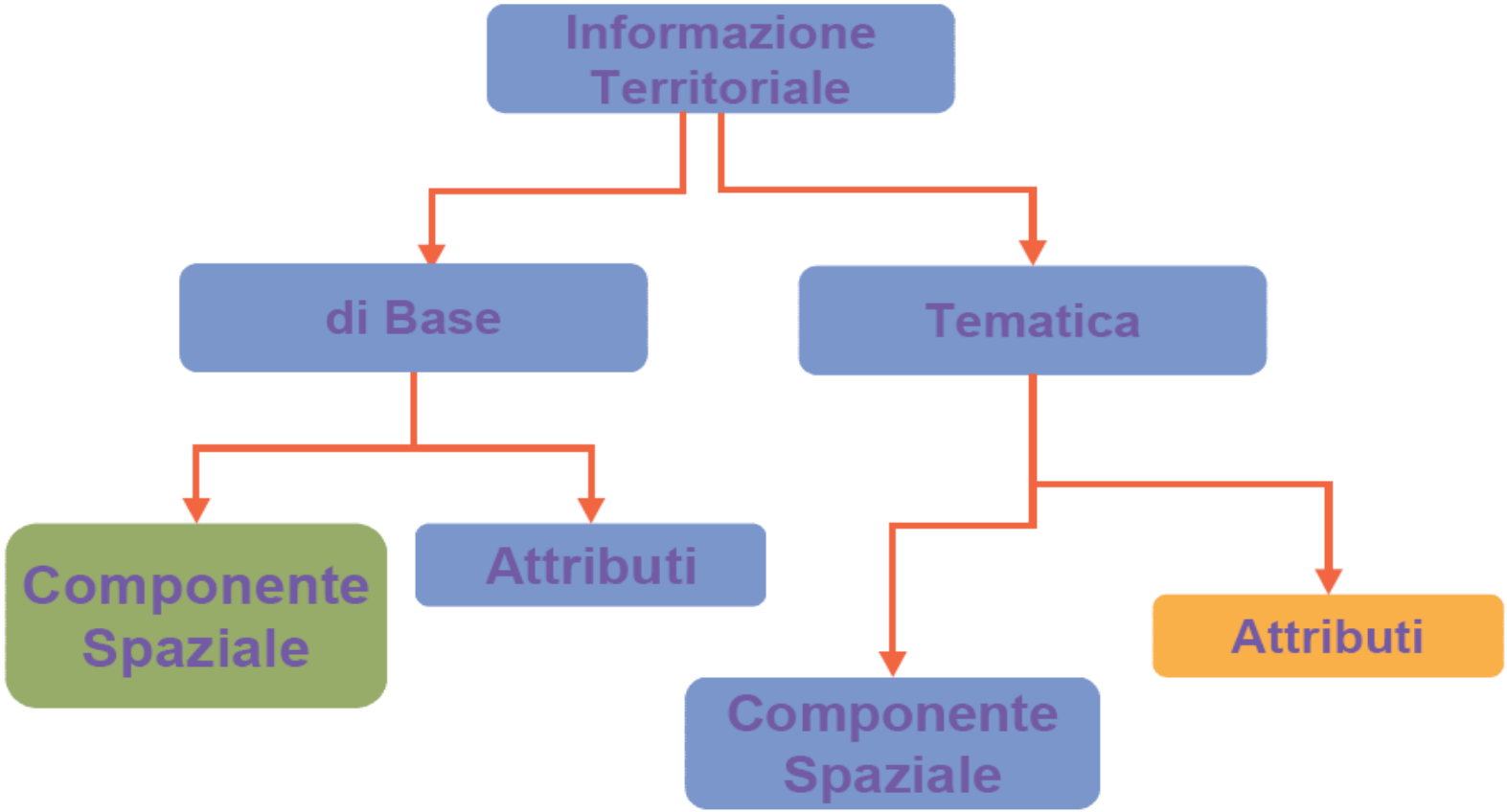
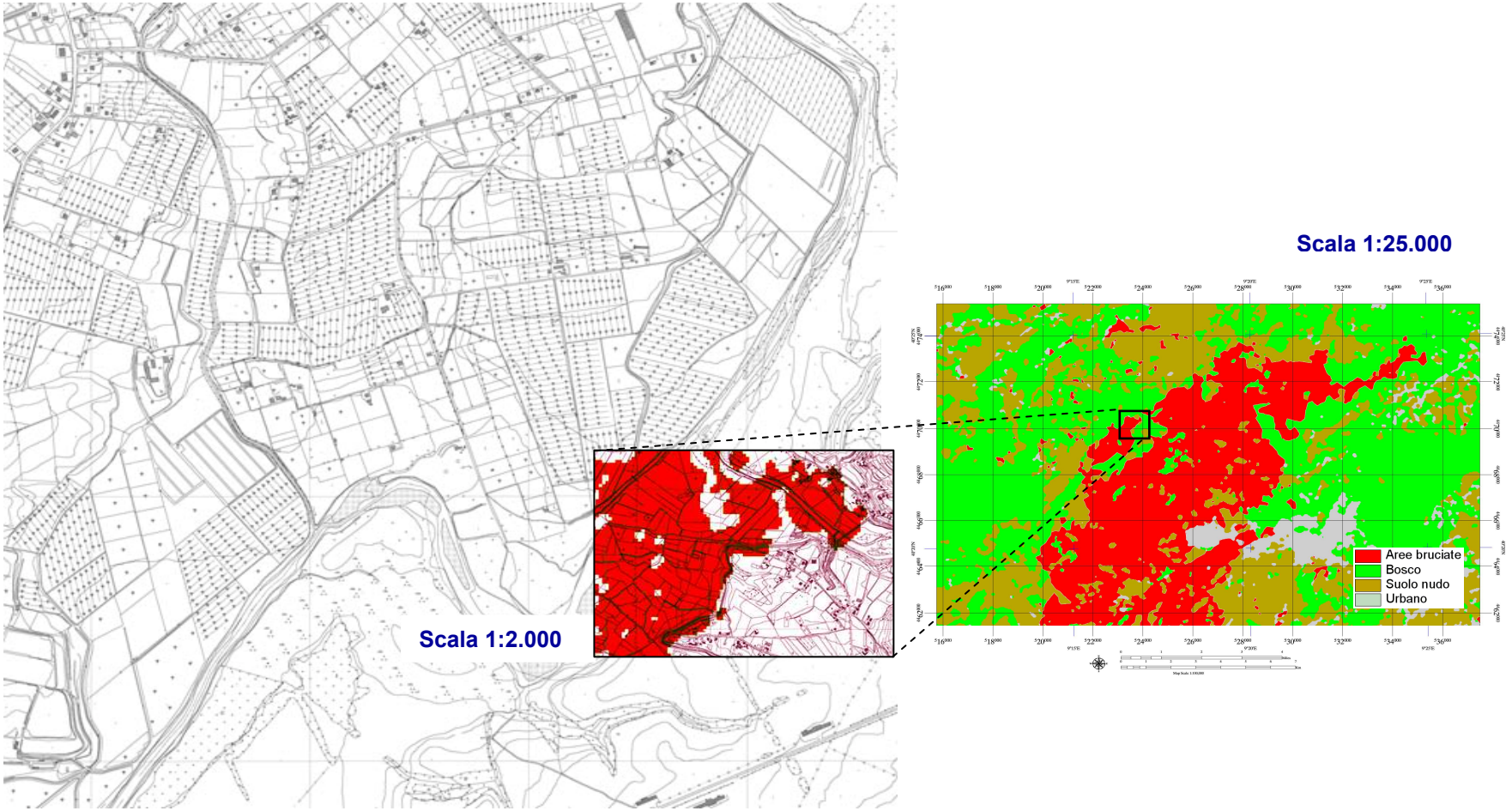
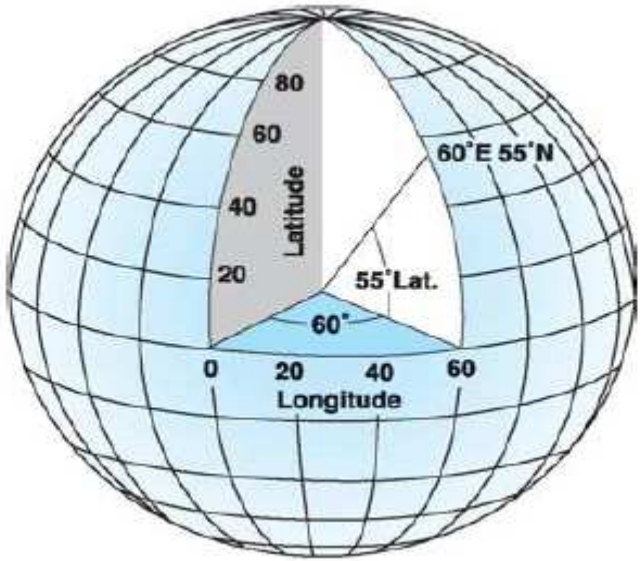

Informazione Territoriale
di Base
Tematica
Componente Spaziale
Attributi
Componente Spaziale
Attributi

Cartografia tematica



GEOGRAPHIC COORDINATE SYSTEMS (GCS)

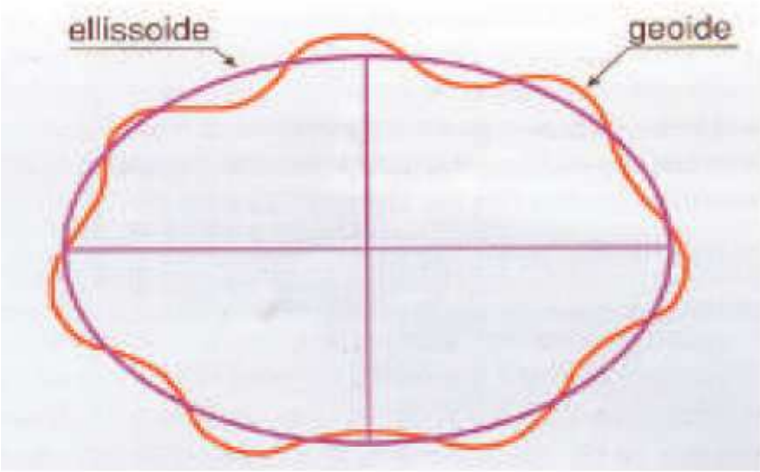


Latitude and Longitude

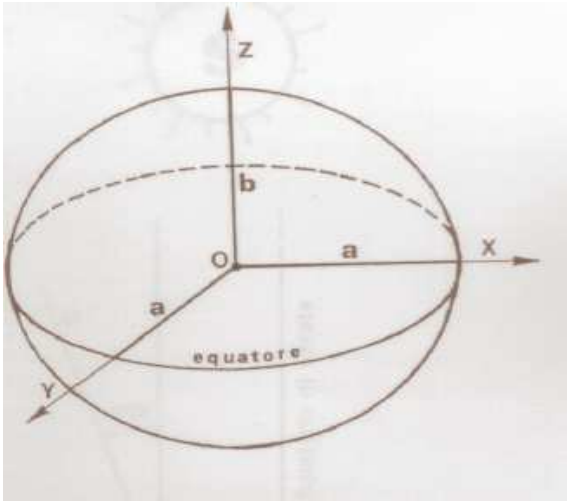
SPHEROIDS AND SPHERES

Geodesy:

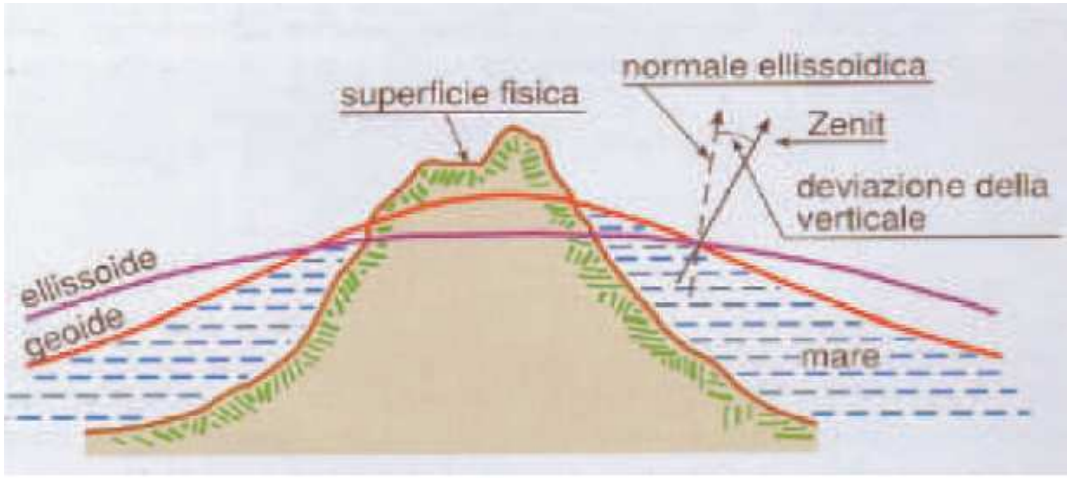
Earth can be approximated by a spheroid generated by the rotation of an ellipse which axis are *a* and *b*.



$$\frac{x^2 + y^2}{a^2} + \frac{z^2}{b^2} = 1$$



The approximation gives a maximum difference of about 400 m between the spheroid and the actual Earth.



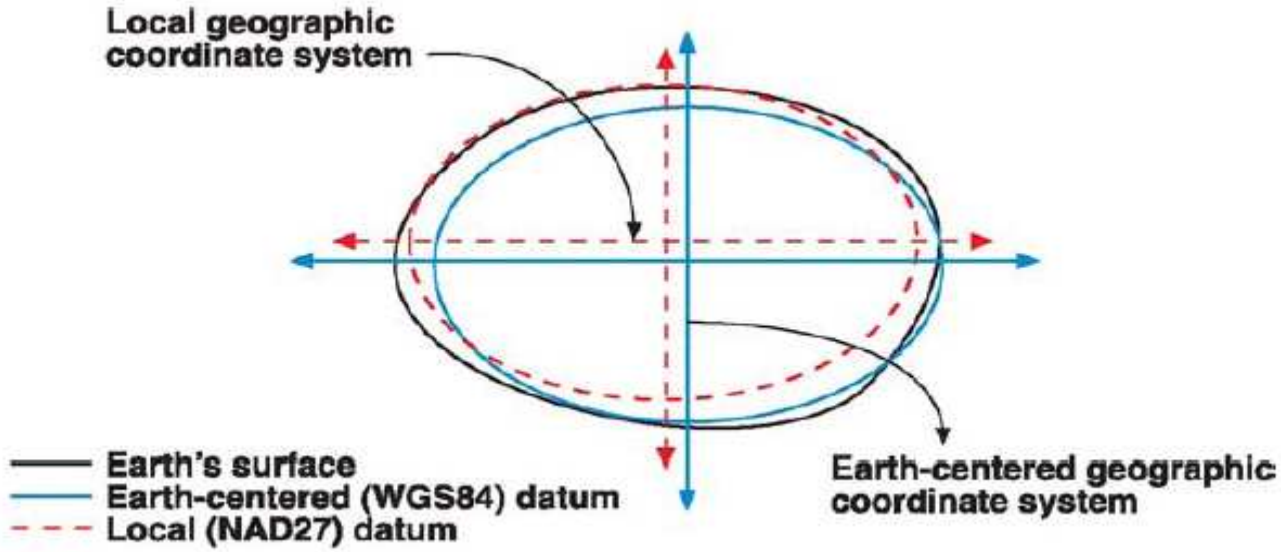
flattening

$$\alpha = \frac{a - b}{a}$$

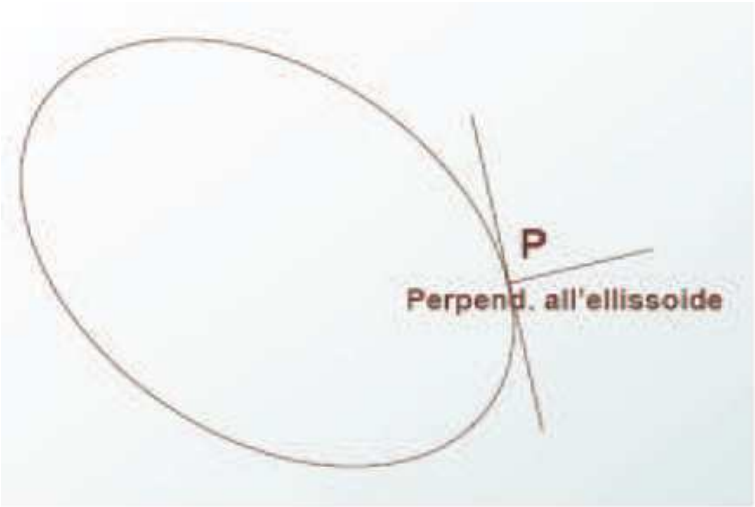
Most common spheroids:

Bessel (1841)	a=6377397 m	α=1/299.2
Clarke (1880)	a=6378243 m	α=1/293.5
Helmert (1906)	a=6378140 m	α=1/298.3
Hayford(1909)	a=6378388 m	α=1/297.0
Krassovsky(1942)	a=6378245 m	α=1/298.3
WGS84 (1984)	a=6378137 m	α=1/298.3

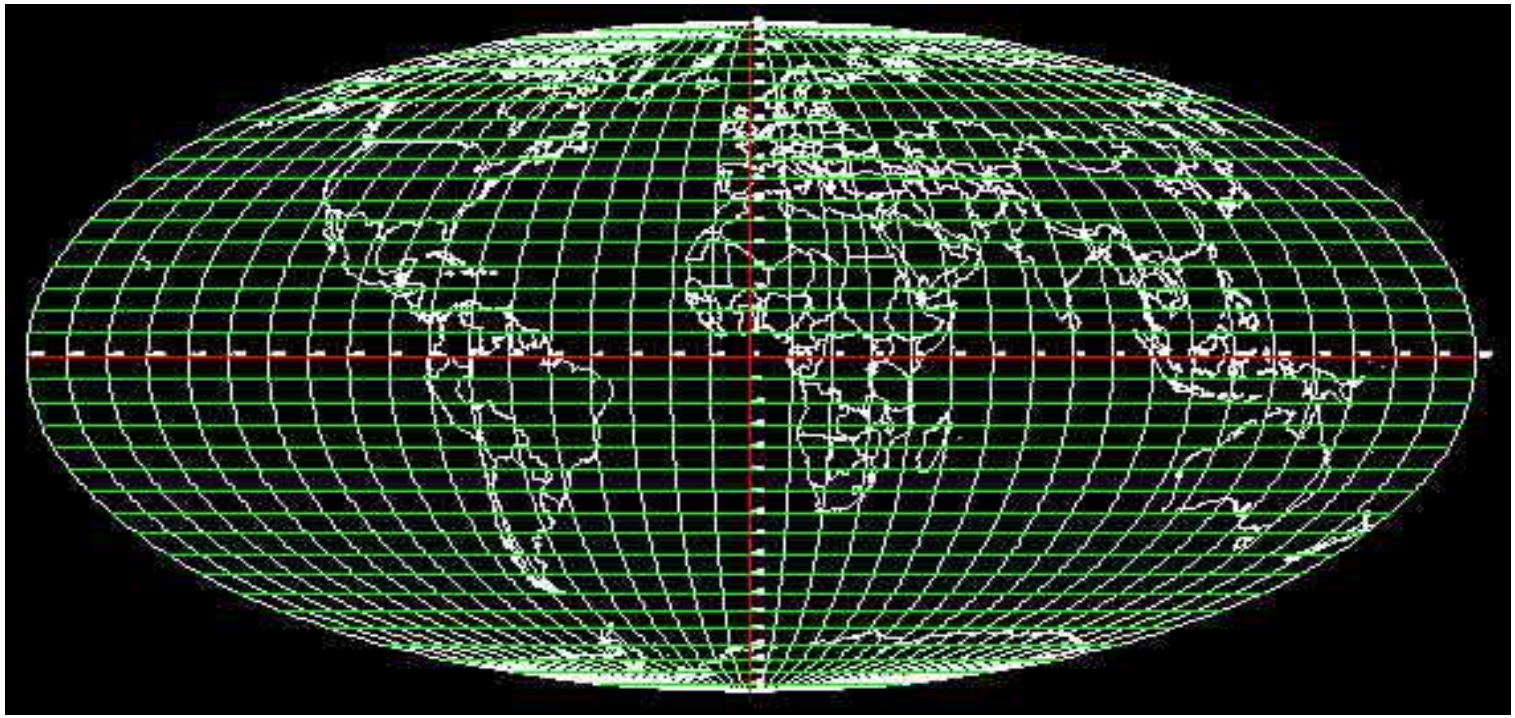
DATUMS



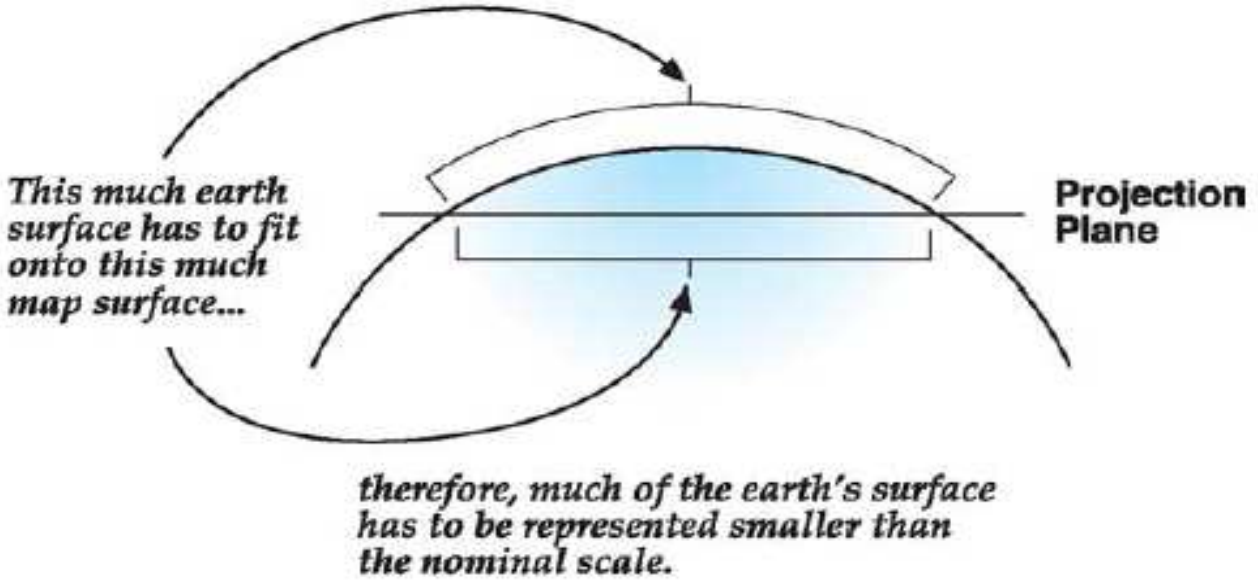
DATUMS are parameters used to align the spheroid in a particular area to closely fit the Earth surface



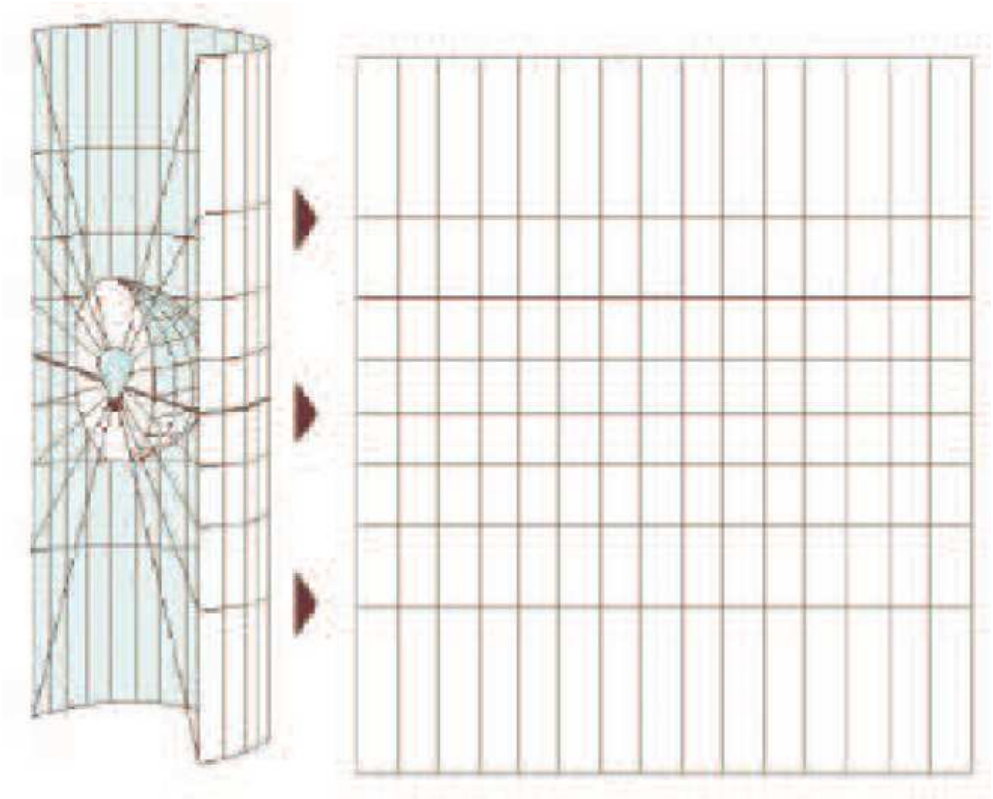
PROJECTED COORDINATE SYSTEMS



Projection is needed to represent the Earth surface on a planar coordinate system (MAP)



Projection is needed to represent the Earth surface on a planar coordinate system (MAP)



We have to pay something….

DEFORMATION:

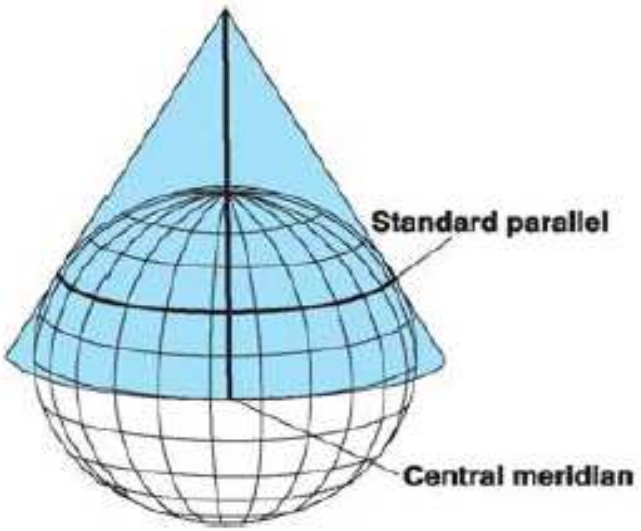
EQUAL DISTANCE: we preserve the distance measurements along given directions

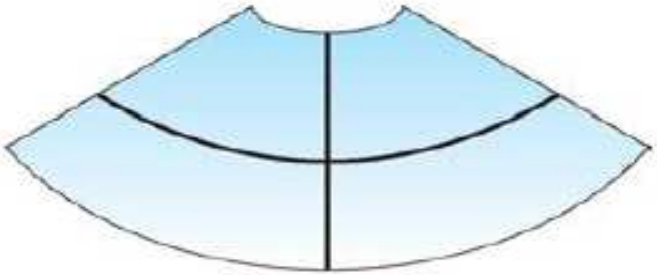
EQUAL AREA: we preserve the area measurements

CONFORMAL: we preserv ANGLES in all directions (and shapes as a consequence)

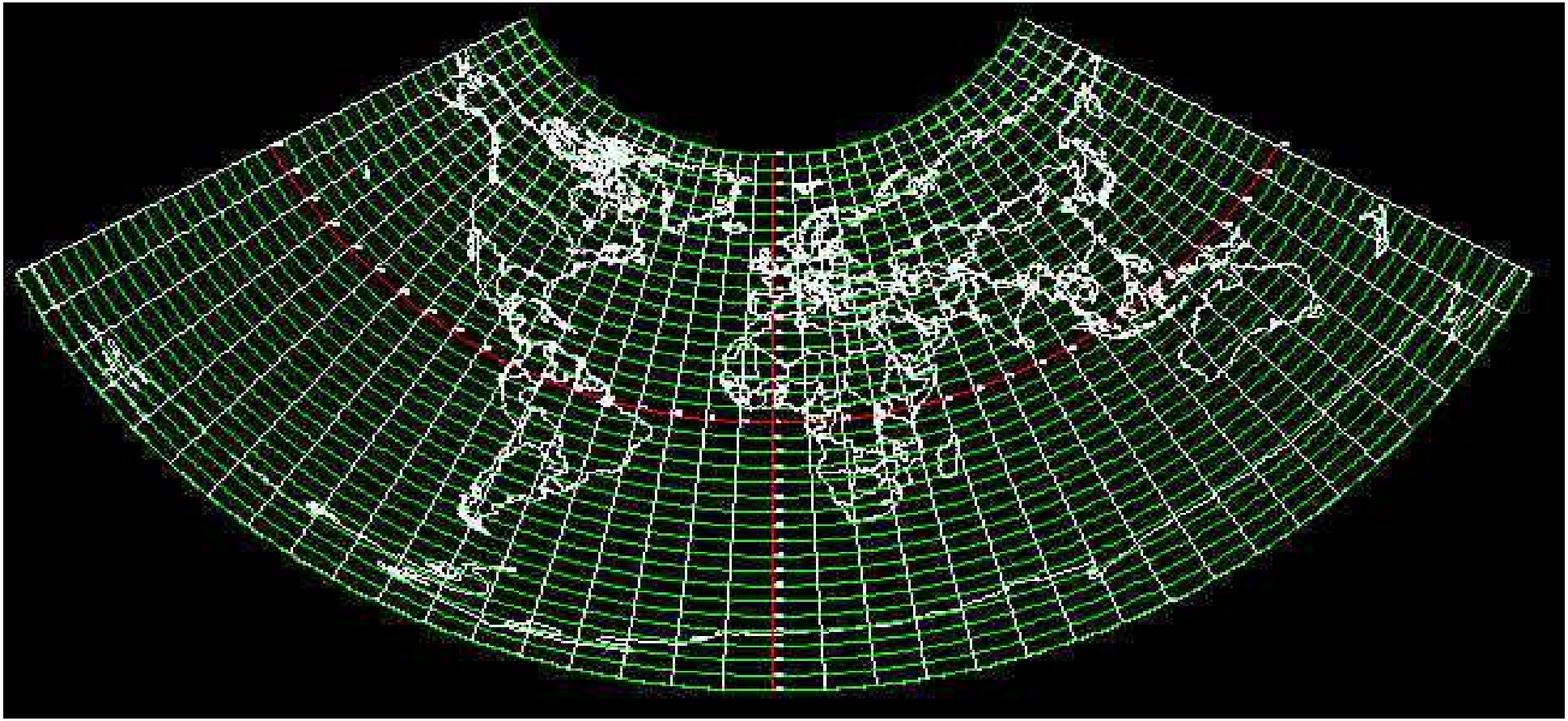
TYPES of PROJECTION

CONIC
A cone is taken as tangent to a meridian (long) or a parallel (lat)



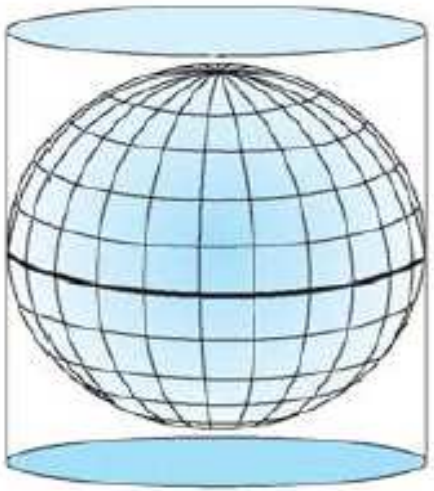


Proiezione conica equidistante

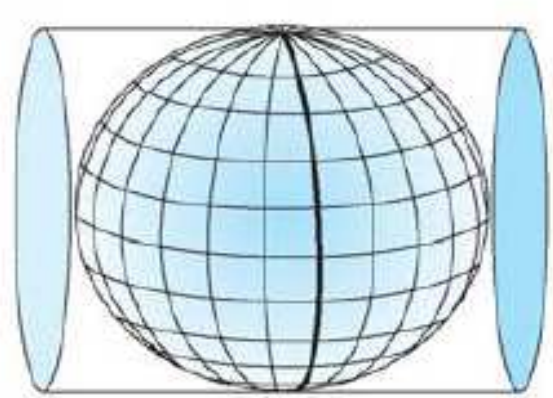


TYPES of PROJECTION

CYLINDRICAL
A cylinder is taken as tangent to a meridian (long), a parallel (lat) or any other great circle line



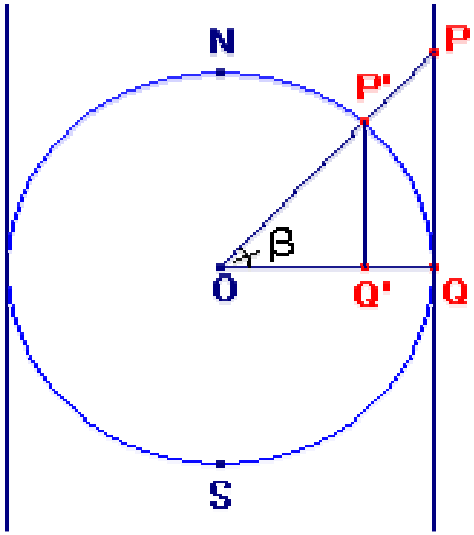
Normal

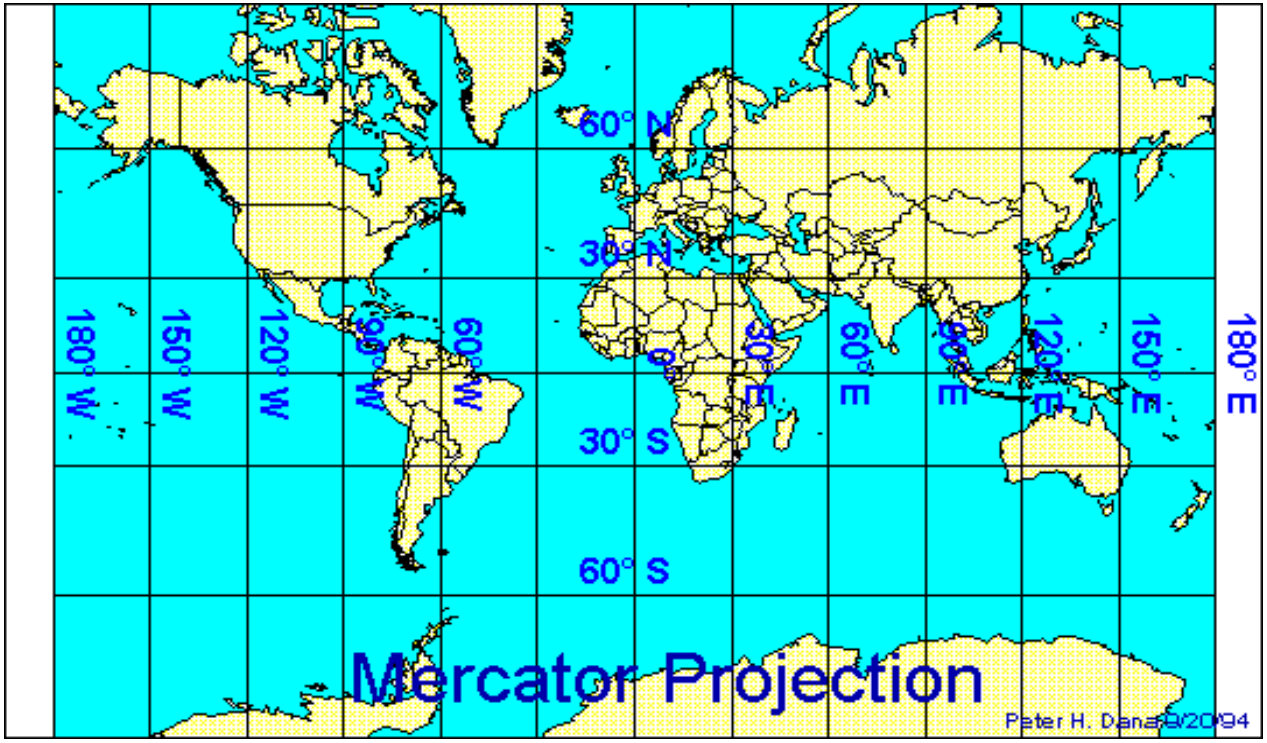


Transverse

Oblique

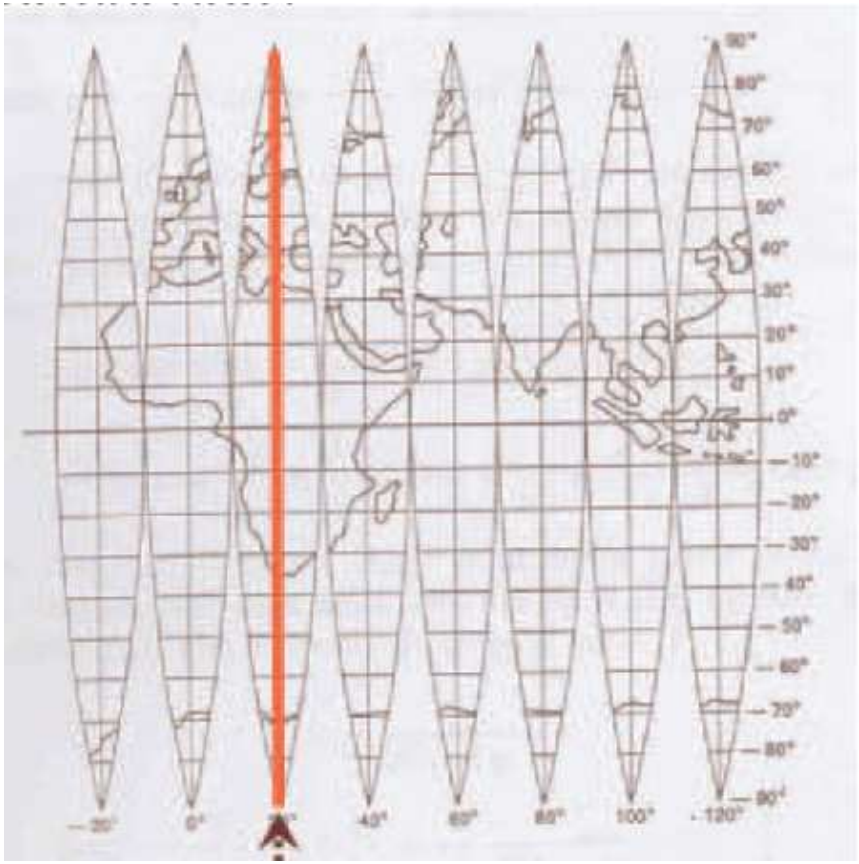
Mercator (XVI sec.)





UTM
(Universal Transverse Mercator)

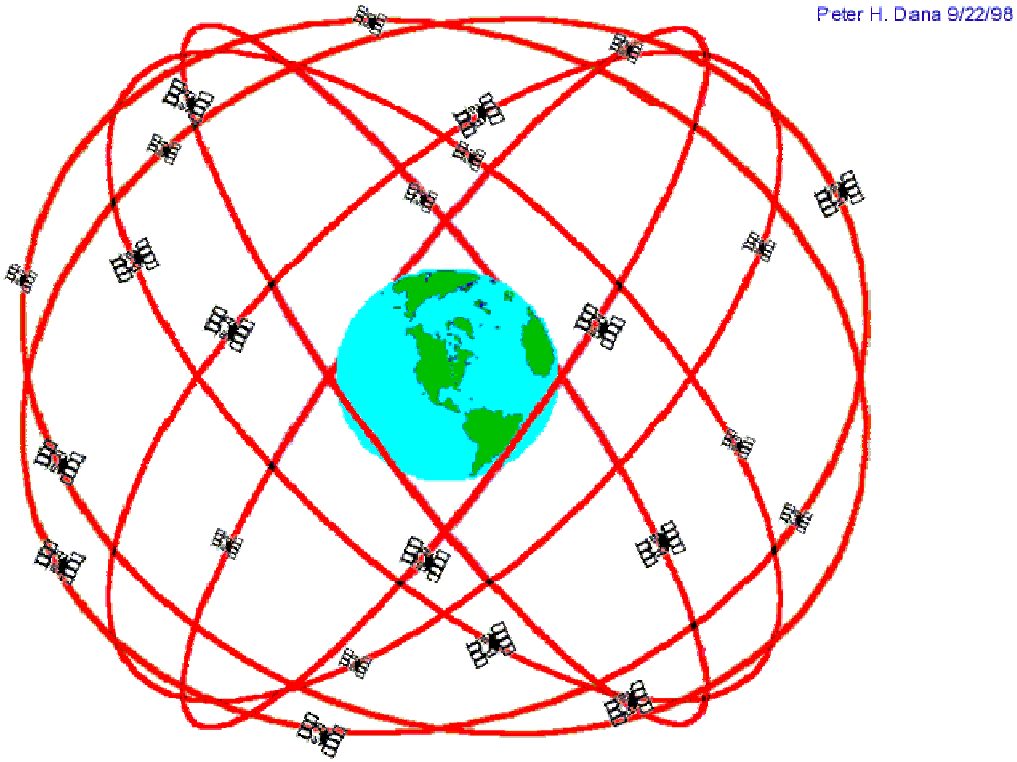
The so-called UTM system is a cylindrical transverse projection.
In order to reduce deformations, the spheroid is divided in 60 fuses, each one having extent 6°.



Global Position System (GPS)

- complete name is **NAVSTAR GPS: Nav**igation **S**atellite **T**iming **A**nd **R**anging **G**lobal **P**ositioning **S**ystem
- It is based on a constellation of satellites, launched by U.S. Defense Department in 1989 and entirely managed by USA
- Since 1993, the system has been made available for civilian use, although the signal has been intentionally degraded to reduce the accuracy
- From 2000, un-degraded signals have been introduced *sub-conditionem*
- *Briefly*: satellites **send radio signals to Earth** which are codified and then processed by receiving devices to get UTC (universal time) and three coordinates (*X,Y,Z*).

Global Position System (GPS)

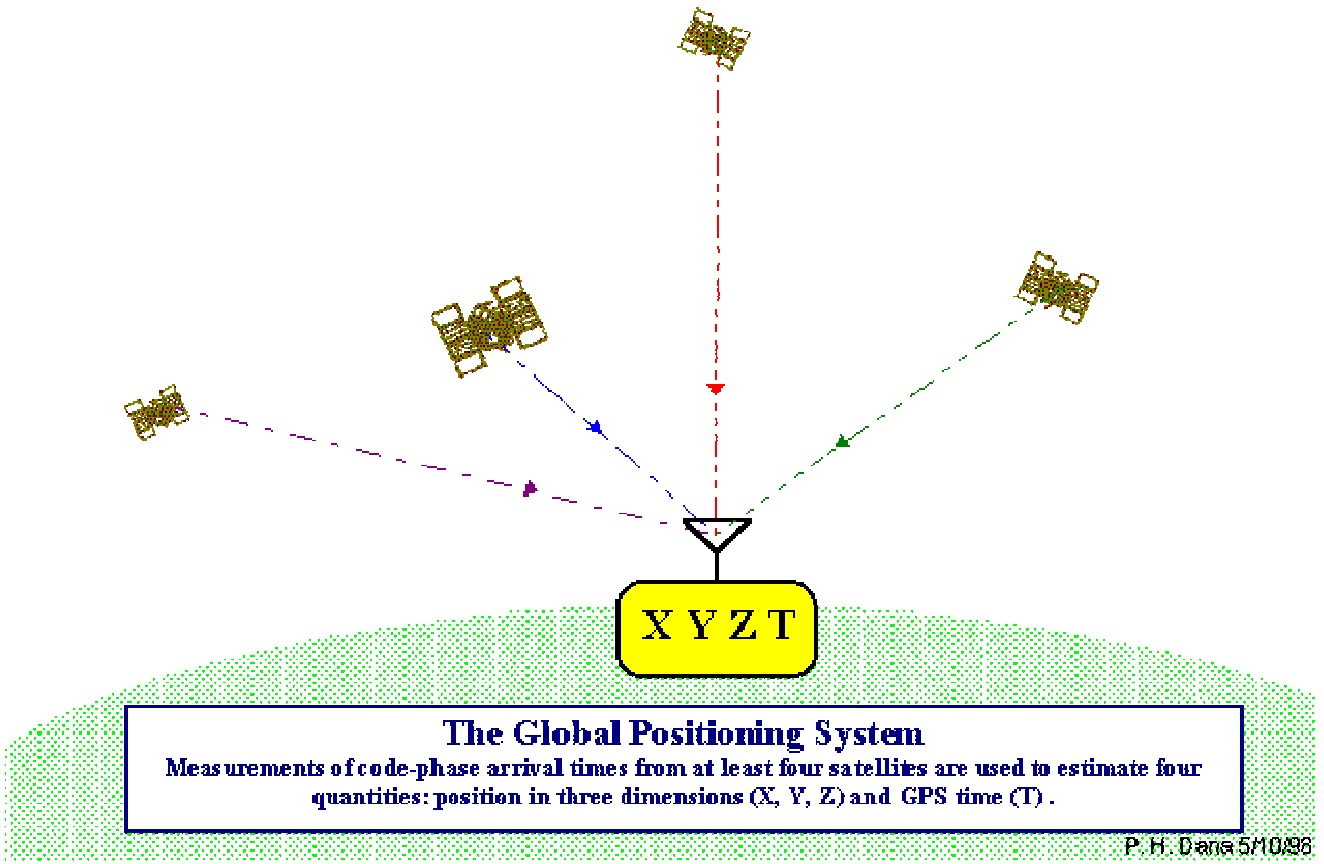


GPS Nominal Constellation
24 Satellites in 6 Orbital Planes
4 Satellites in each Plane
20,200 km Altitudes, 55 Degree Inclination

Global Position System (GPS)

- The constellation is composed of **24 satellites**, with two complete orbits every day.
- We need at least **3** satellites to mathematically determine the three coordinates with acceptable accuracy – redundancy increases the precision of positioning
- In absence of obstructions, a presence of at least **4** (and maximum **12**) satellites **visible** above the horizon is guaranteed in any point of Earth surface.
- Receiving devices always gives an accuracy estimation.
- *Similar Systems:* **GLONASS** (Russia, *partially operative)*
- *Future Systems:* **GALILEO** (European Union, precision better than 1 m, planned *2010; 2012 ...?*)

Global Position System (GPS)



Global Position System (GPS)

- Accuracy of positioning

Causa:	Effetto:
Ionospheric effects	± 5 meters
Ephemeris errors	± 2.5 meters
Satellite clock errors	± 2 meters
Multipath distortion	± 1 meter
Tropospheric effects	± 0.5 meters
Numerical errors	± 1 meter or less

- *Attention!* Artificial or natural obstacles (*mountains, building, bridges, dense vegetation, fog...*) deteriorate the quality of the signal to such extent that operation is compromised).

Global Position System (GPS)

Modern portable receiving devices *(trekking, bicycles...)*