WELCOME

TO THE CLASS ON

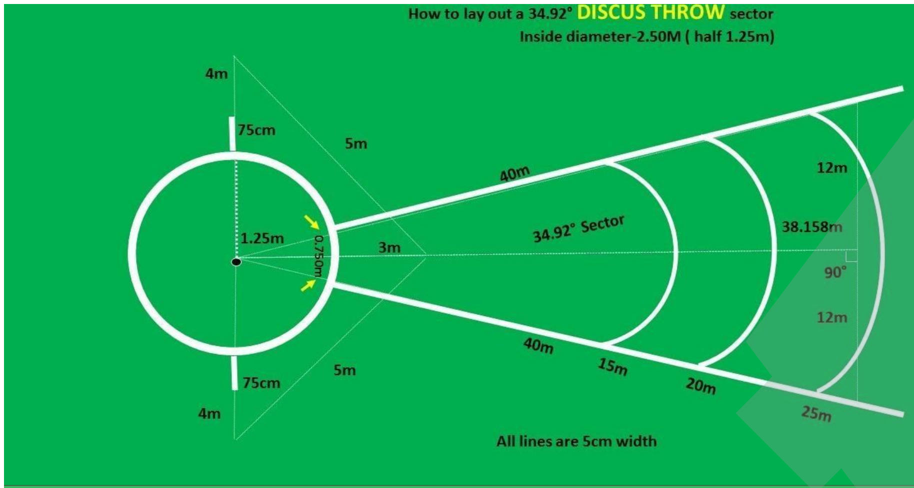
DATUMS, COORDINATE SYSTEM & PROJECTIONS

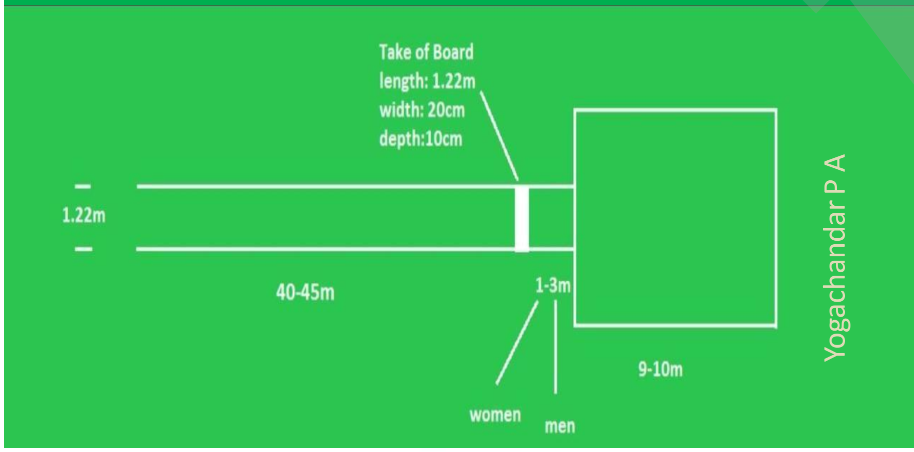
OBJECTIVES

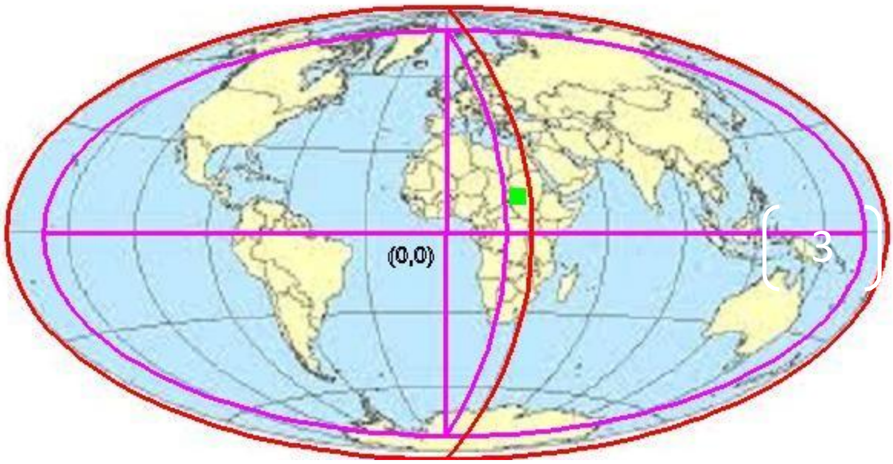
The primary objective of this lecture is to provide a broad overview about the Datums Projections and Coordinate systems its uses

Datum

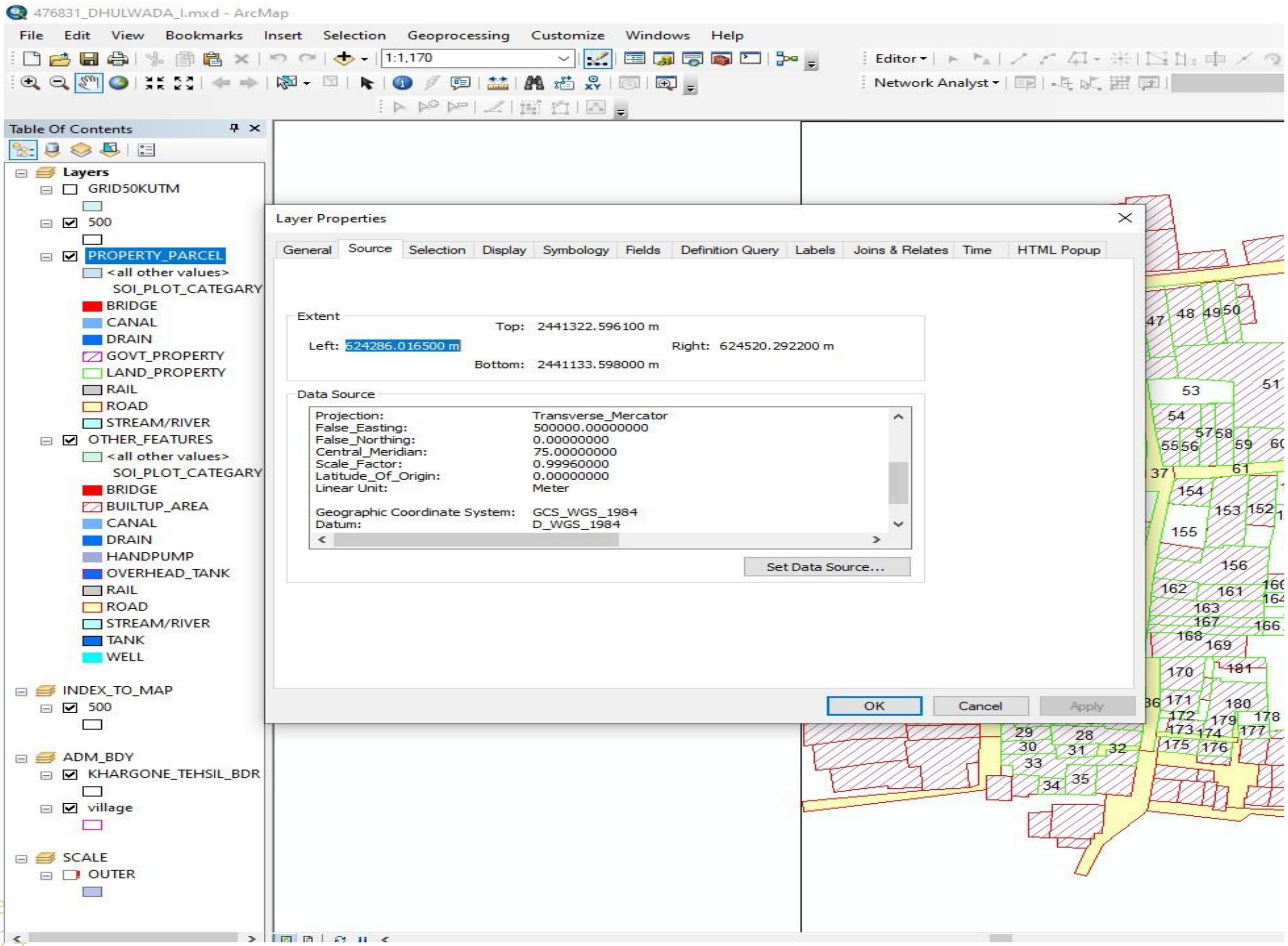
A point, line, or **surface** used as a reference, as in surveying, mapping, or geology. Surfaces can be broadly divided into two dimensional and three Dimensional Surfaces. In this session we will be treating the earth surface as an ellipsoid.



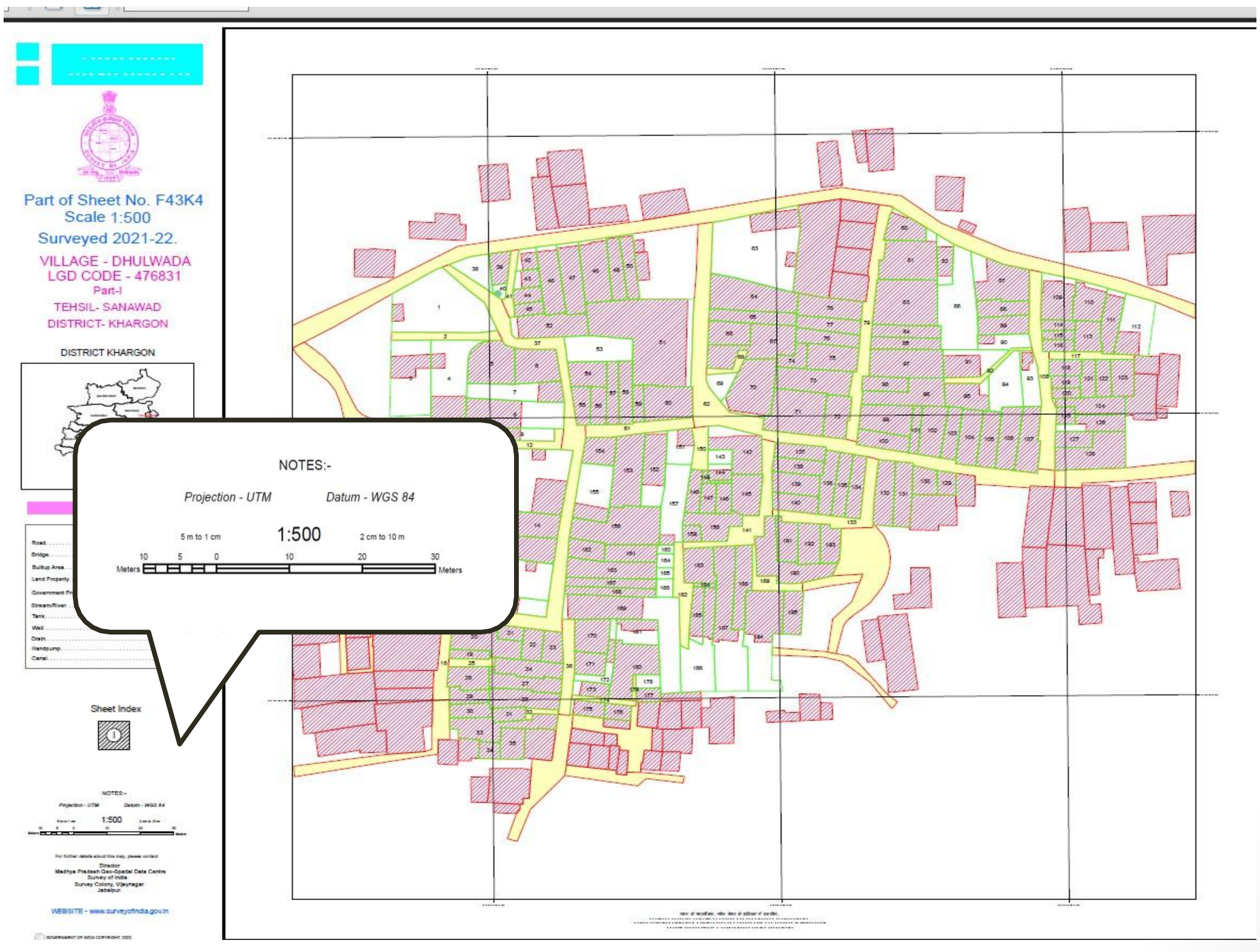




Datum and Projection of a vector data

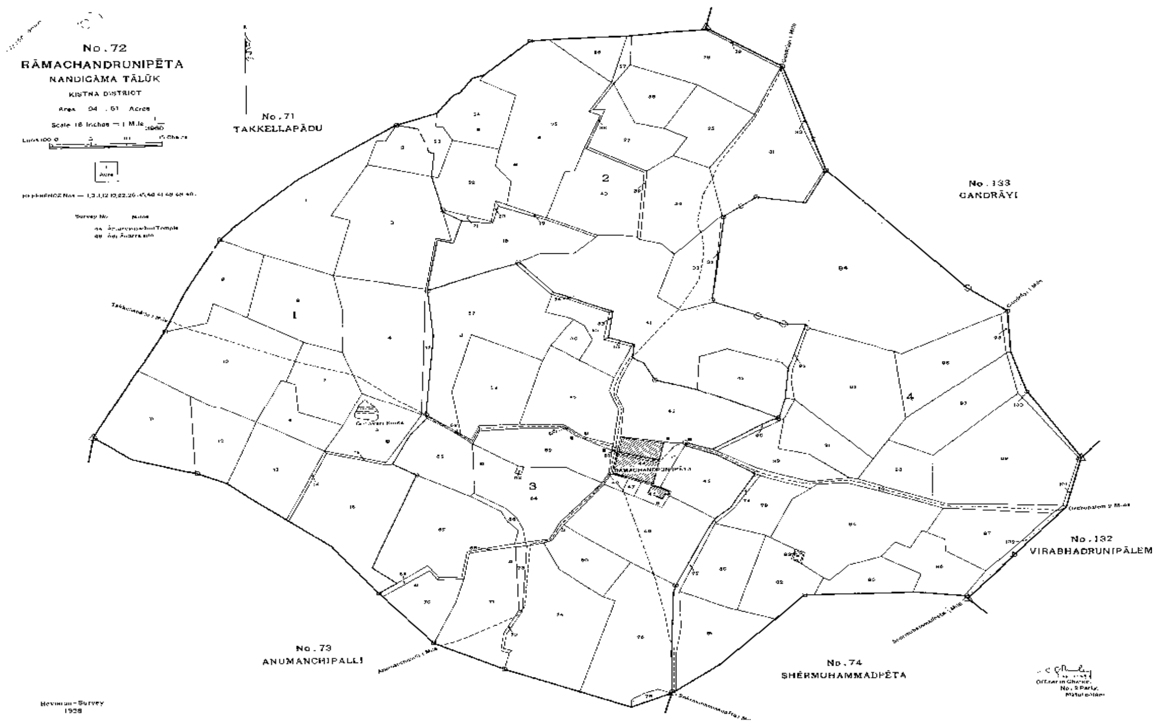


Where do we find a datum in any map (raster)?



Datum and Projection in SOI MAPS

The Village map without any Datum or Projection



Wednesday, September 4, 2024

WHY DO WE NEED A DATUM?

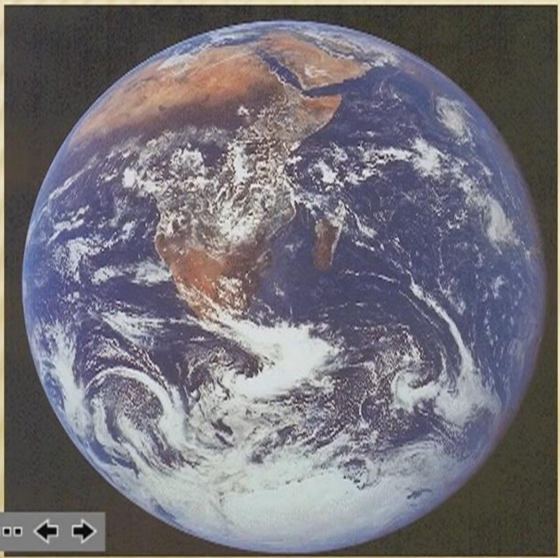
SHAPE OF THE EARTH

- So far, you have viewed the different shapes of the earth. All are of different shapes which cannot be assigned to any mathematical geometrical shape.
- As a result, we are treating the earth as per our convenience, such a mathematical geometric figure satisfying our local requirements for measuring different parameters on the earth.

Yogachandar P A

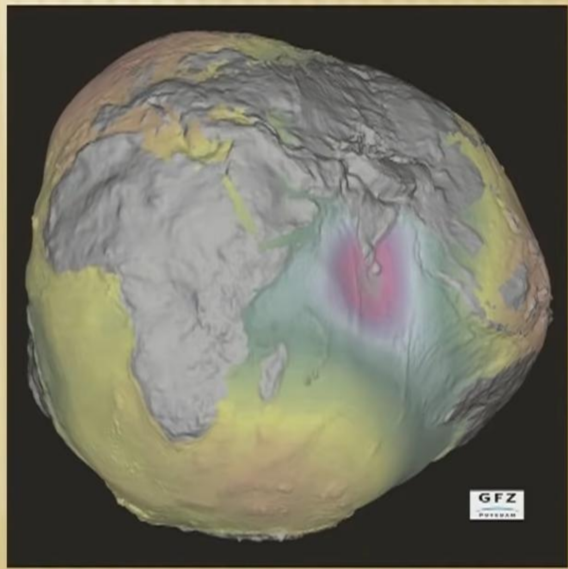
Geodesy Helps Define How

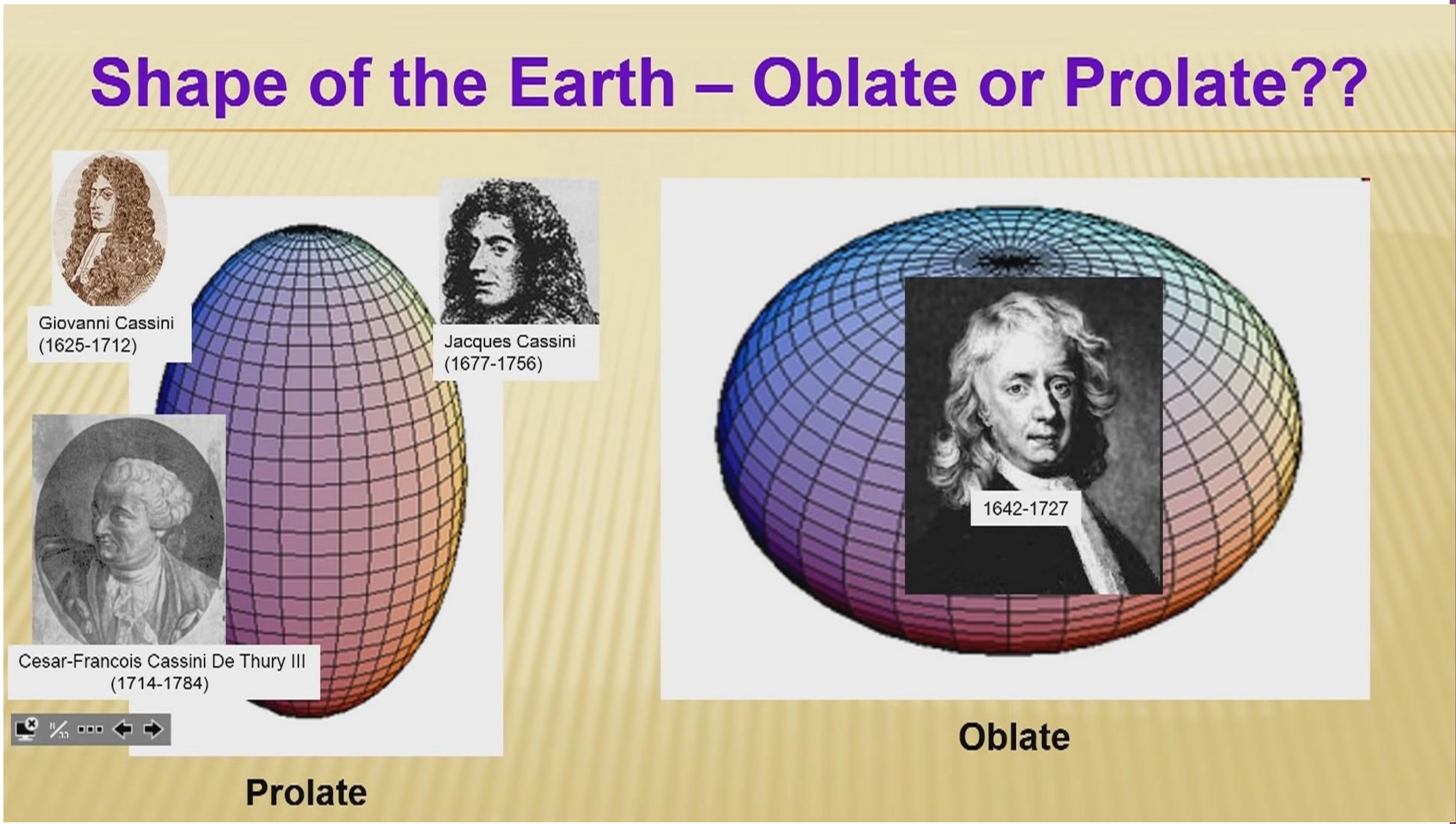
What looks like this

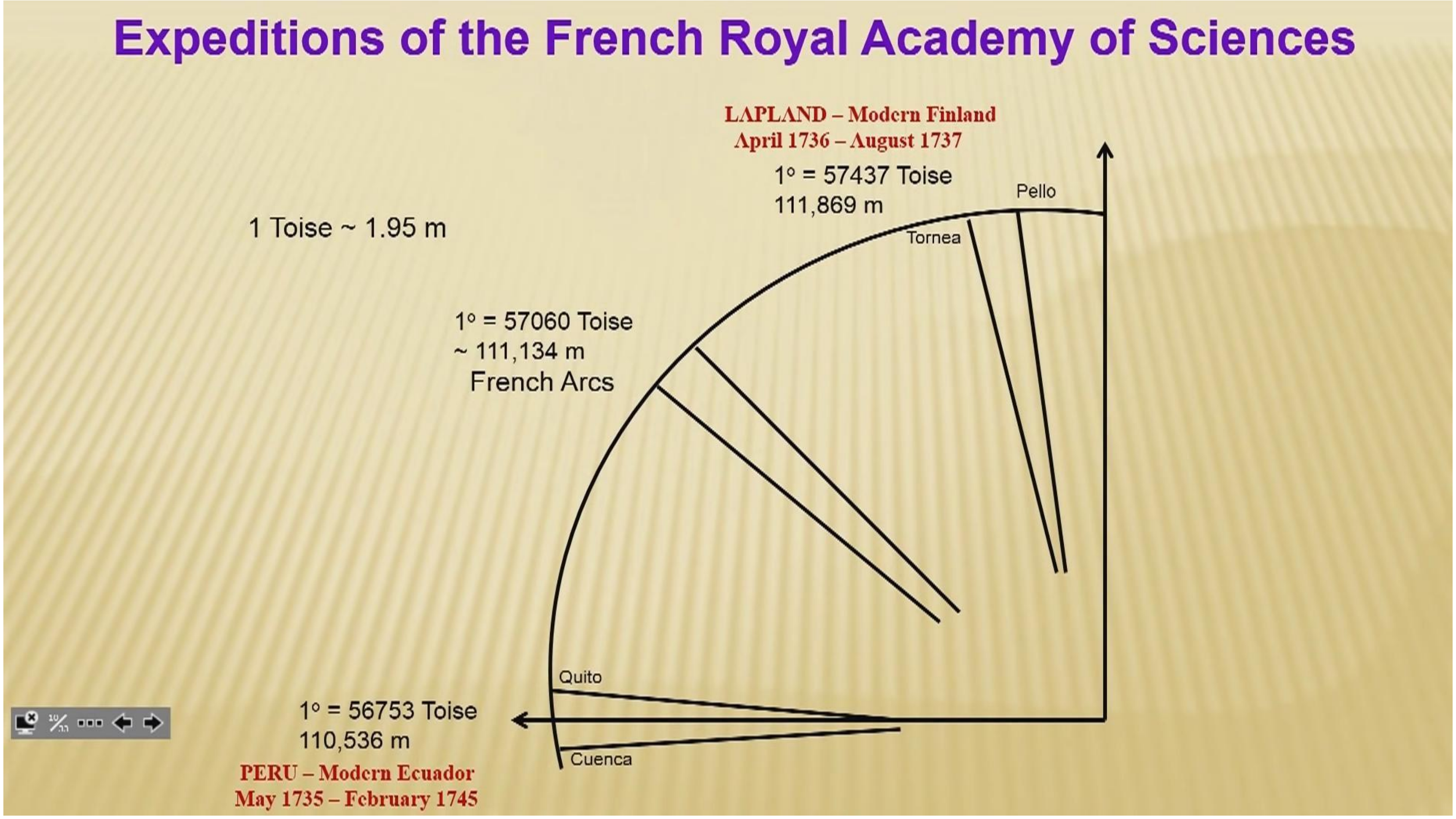


Is really……

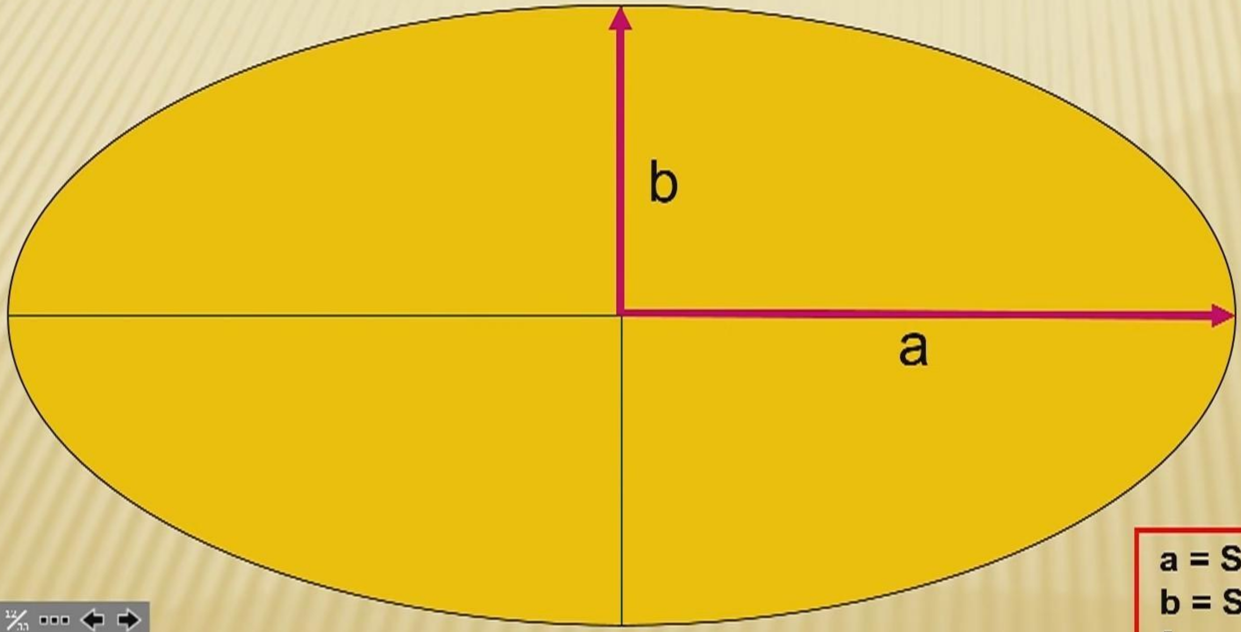
this




Shape of the Earth – Oblate or Prolate??
Giovanni Cassini
(1625-1712)
Jacques Cassini
(1677-1756)
Cesar-Francois Cassini De Thury III
(1714-1784)
Prolate
1642-1727
Oblate


Expeditions of the French Royal Academy of Sciences
LAPLAND – Modern Finland
April 1736 – August 1737
1° = 57437 Toise
111,869 m
Pello
Tornea
1 Toise ~ 1.95 m
1° = 57060 Toise
~ 111,134 m
French Arcs
Quito
1° = 56753 Toise
110,536 m
Cuenca
PERU – Modern Ecuador
May 1735 – February 1745

THE ELLIPSOID
MATHEMATICAL MODEL OF THE EARTH



a = Semi major axis
b = Semi minor axis
$f = \frac{a-b}{a}$ = Flattening

12

Official Ellipsoids

UNLV

Geodetic surveys are conducted to measure locations on the surface of the Earth

Observed locations are used to fit an Ellipsoid to model the shape of the Earth

Each country, continent or other comparably large areas have specific ellipsoid parameters to fit an "Official Ellipsoid"

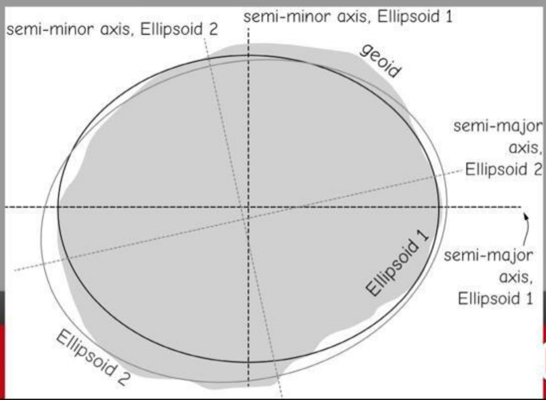


Table 3-1: Official ellipsoids. Radii may be specified more precisely than the 0.1 meter shown here (from Snyder, 1987 and other sources).

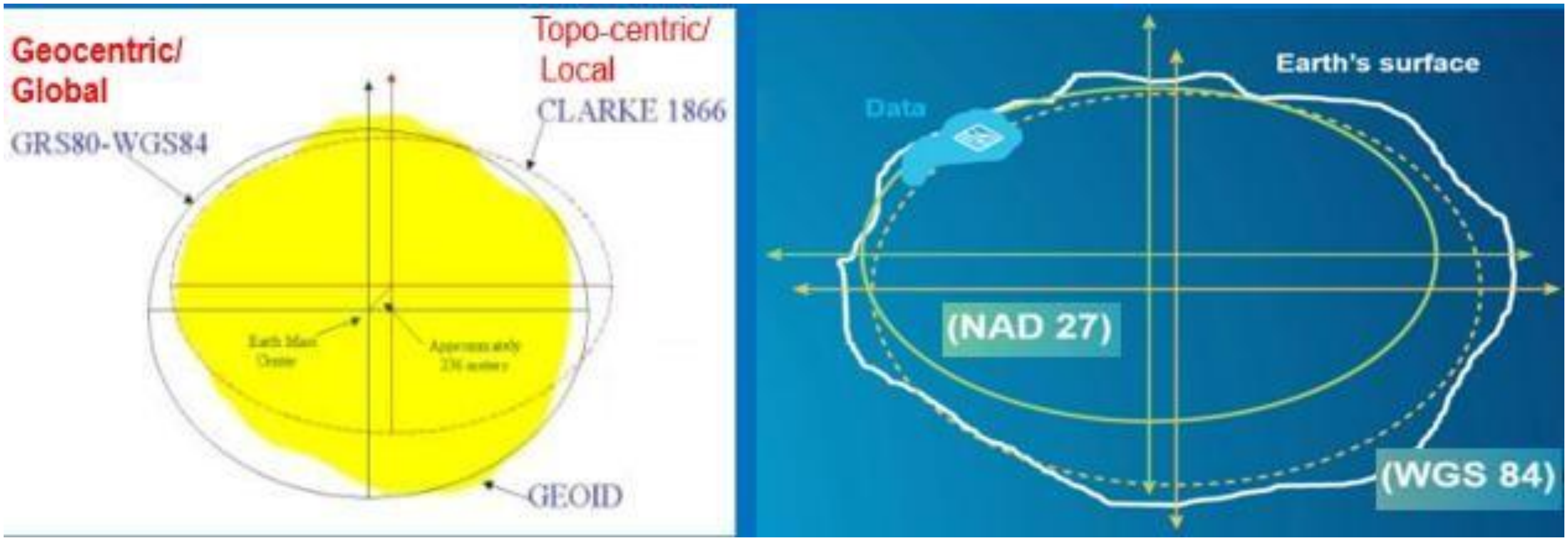
Name	Year	equatorial Radius, a meters	Polar Radius, b meters	Flatten-ing Factor	Users
Airy	1830	6,377,563.4	6,356,256.9	1/299.32	Great Britain
Bessel	1841	6,377,397.2	6,356,079.0	1/299.15	Central Europe, Chile, Indonesia
Clarke	1866	6,378,206.4	6,356,583.8	1/294.98	North America; Philip-pines
Clarke	1880	6,378,249.1	6,356,514.9	1/293.46	Most of Africa; France
Interna-tional	1924	6,378,388.0	6,356,911.9	1/297.00	Much of the world
Australian	1965	6,378,160.0	6,356,774.7	1/298.25	Australia
WGS72	1972	6,378,135.0	6,356,750.5	1/298.26	NASA, U.S. DOD
GRS80	1980	6,378,137.0	6,356,752.3	1/298.26	Worldwide
WGS84	1987 – current	6,378,137.0	6,356,752.3	1/298.26	U.S. DOD, Worldwide

Commonly Used Ellipsoids

ELLIPSOID	a	1/f
AIRY 1830	6377563	299.324965
APPLIED PHYSICS (APL) 1965	6378137	298.25
AUSTRALIAN NATIONAL	6378160	298.25
BESSEL 1841	6377397	299.152813
CLARKE 1858	6378294	294.26068
CLARKE 1866	6378206	294.978698
CLARKE 1880	6378249	294.978698
DELAMBRE 1800	6375653	334
EVEREST 1830	6377276	300.8017
EVEREST (INDIA 1956)	6377301	300.8017
EVEREST (PAKISTAN 1975)	6377310	300.8017
FISHER 1960 (MERCURY)	6378166	298.3
FISHER 1968 (SE ASIA)	6378150	298.3
GEODETIC REFERENCE SYSTEM 1967 (IUGG 67)	6378160	298.247
GEODETIC REFERENCE SYSTEM 1980 (IUGG 79)	6378137	298.257222
HOUGH 1956	6378270	297
INTERNATIONAL 1924 (HAYFORD 1909)	6378388	297
KRASSOVSKY 1938 (1940?)	6378245	298.3
PARAMETRY ZEMLI 1990 (PZ 90)	6378136	298.257839
SOUTH AMERICAN 1969	6378160	298.25
STRUVE 1860	6378297	294.73
WORLD GEODETIC SYSTEM 1960 (WGS 60)	6378165	298.3
WORLD GEODETIC SYSTEM 1972 (WGS 72)	6378135	298.26

Global & Local Datum

•A local datum aligns its spheroid to closely fit the earth's surface in a particular area. A point on the surface of the spheroid is matched to a particular position on the surface of the earth. This point is known as the origin point of the datum. The coordinates of the origin point are fixed, and all other points are calculated from it.

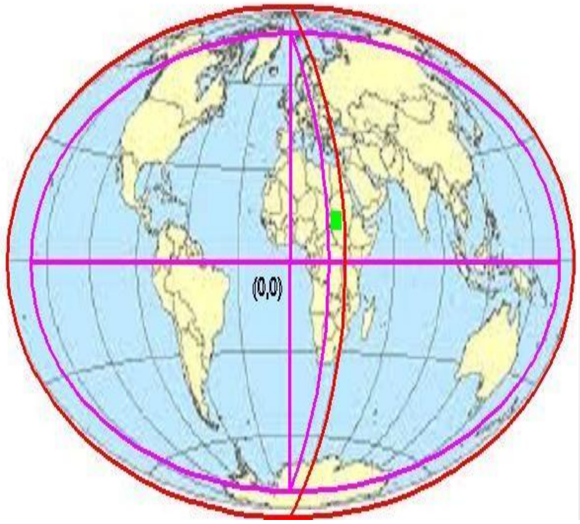


INTRODUCTION TO WGS-84 DATUM (World Geodetic System -1984)

Even though several ellipsoidal definitions are proposed as universal unique datum prior to the year 1984 they are not much popularized. A popularized new World Geodetic System, called WGS 84 is introduced as a horizontal reference in the year 1987. It is currently the reference system being used by the Global Positioning System.

The earth ellipsoid is named as **WGS-84** with the following parameters.

Semi Major Axis - a = 6378137.0
Semi Minor axis - b = 6356752.3142
Flattening - f = 1 / 298.2572
Eccentricity = 0.00669437999013



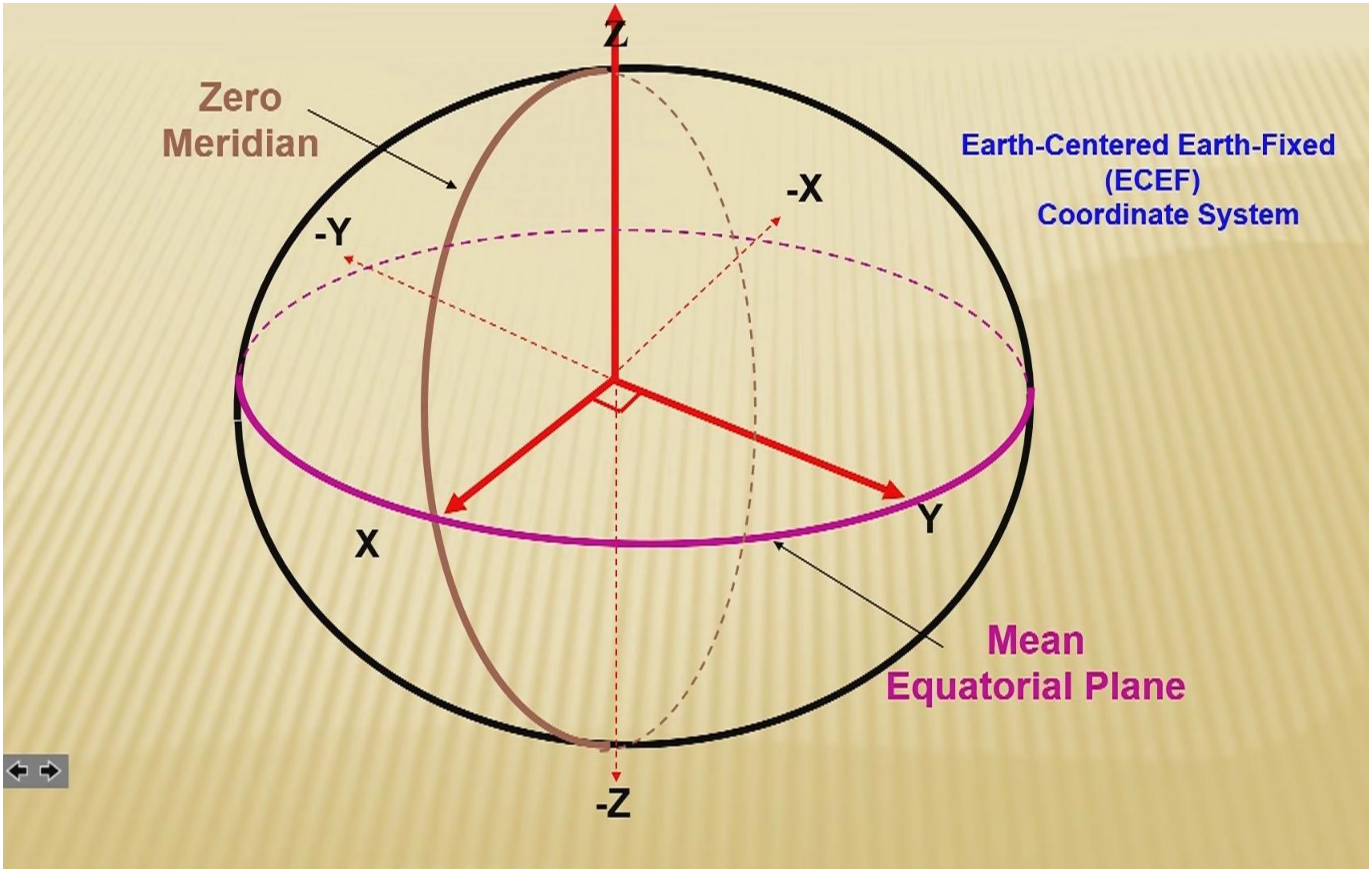
Horizontal/Geometric Datums

8 Basic Constants

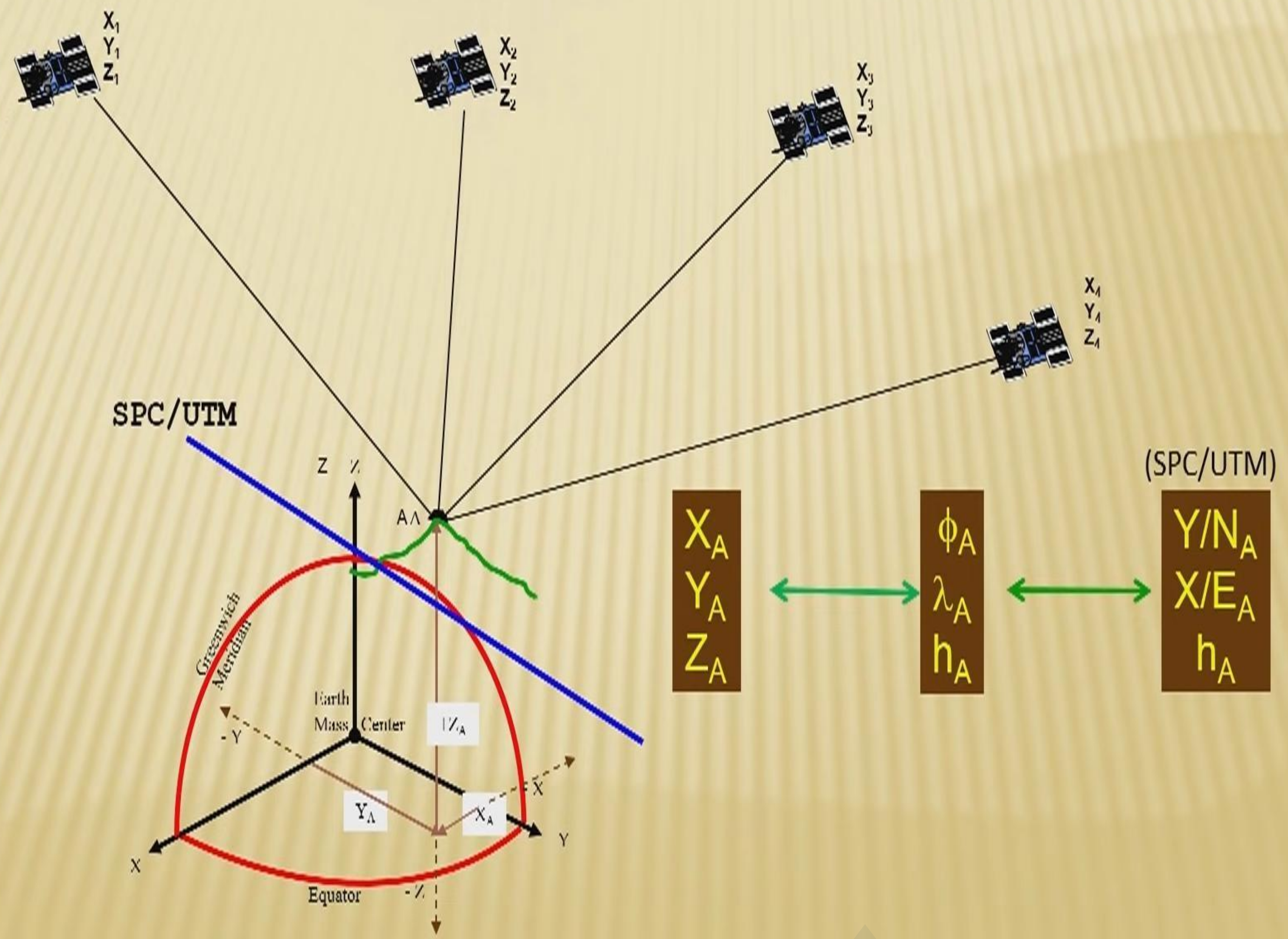
3 – specify the location of the origin of the coordinate system.

3– specify the orientation of the coordinate system.

2 – specify the dimensions of the reference ellipsoid

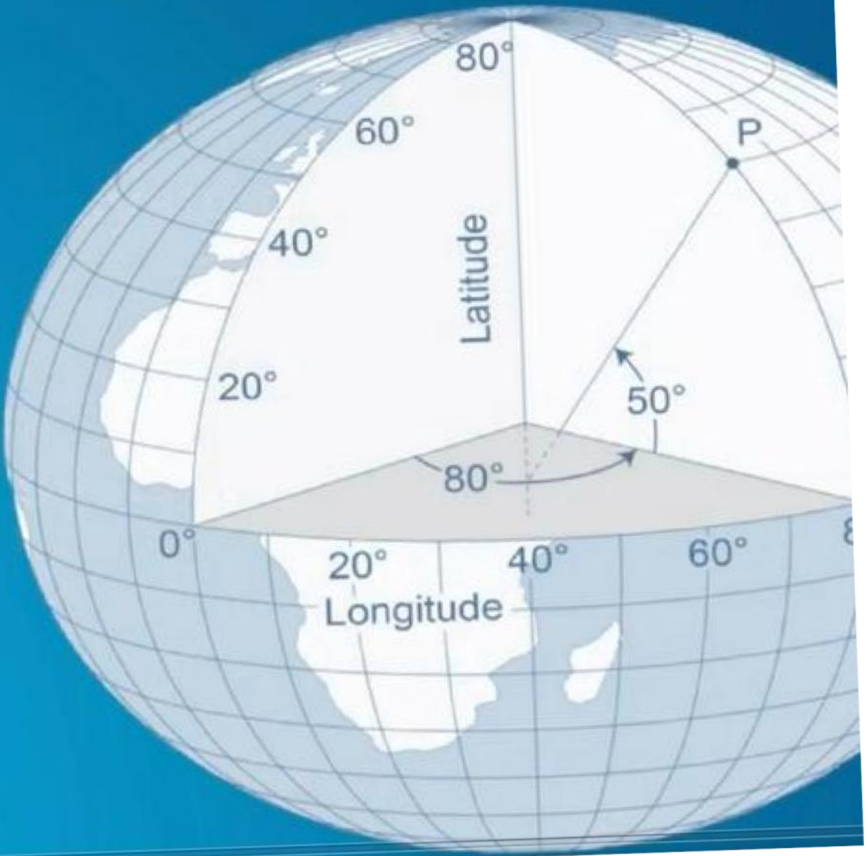

Z
Zero
Meridian
Earth-Centered Earth-Fixed
(ECEF)
Coordinate System
-X
-Y
X
Y
Mean
Equatorial Plane
-Z

3-D Coordinates Derived from GPS



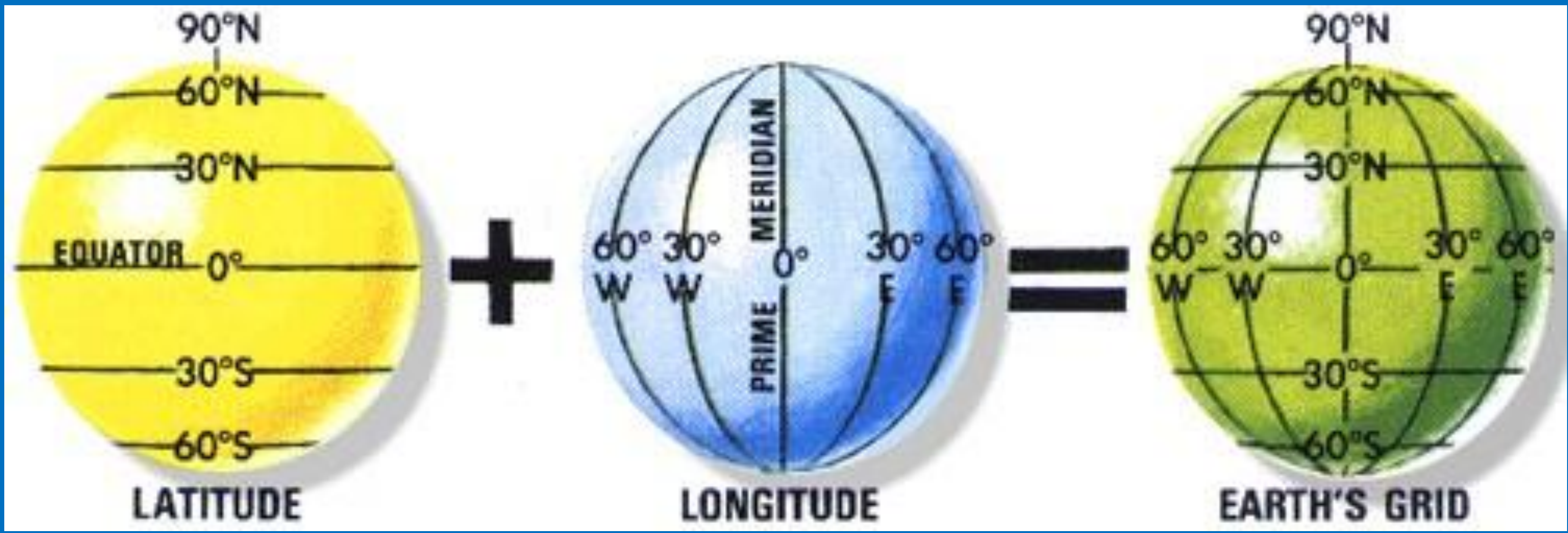
Geographic Coordinate System (GCS)

- 3D spherical surface
- Point P has:
  - Longitude – 80º E
  - Latitude – 50º N



DIVISIONS ON GLOBE

The globe /earth is further divided from the origin.
From the origin -180° West and from the origin to 180° East.
From the origin 90° North to 90° South



Lines of “parallels” are called Latitudes (ϕ) .

Lines of “meridians” are called Longitudes (λ) .

TYPES OF ELLIPSOIDS
(GLOBAL AND LOCAL REFERENCE ELLIPSOIDS)

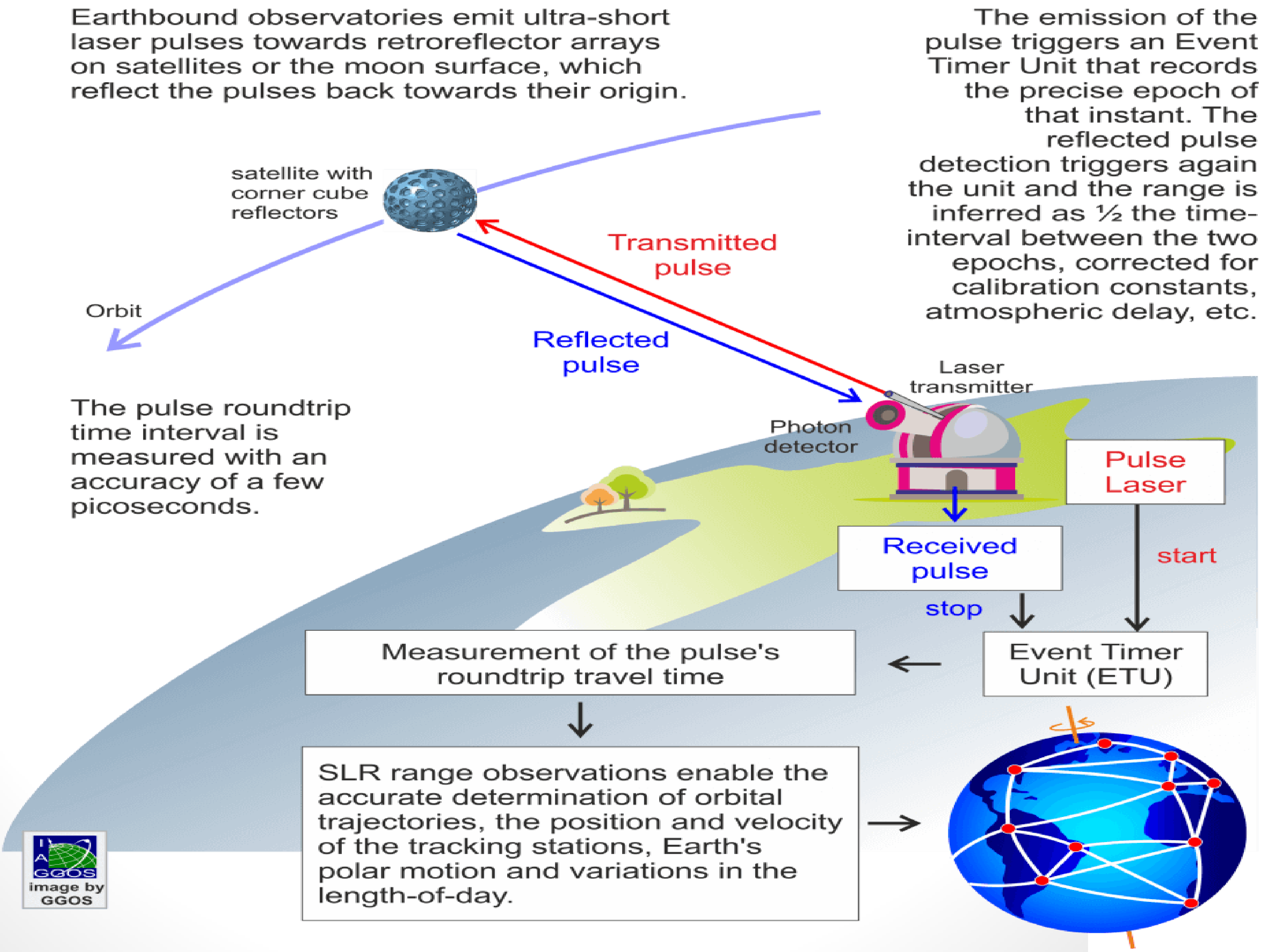
Global reference Ellipsoid: The Center of Gravity of the actual earth coincide with the center of the ellipsoid. This type of ellipsoids are called Geo-centric ellipsoid. Example: WGS-72, WGS-84 etc.

Local reference Ellipsoid: The ellipsoid is chosen in such a way that it fits with the local datum of interest as closely as possible.

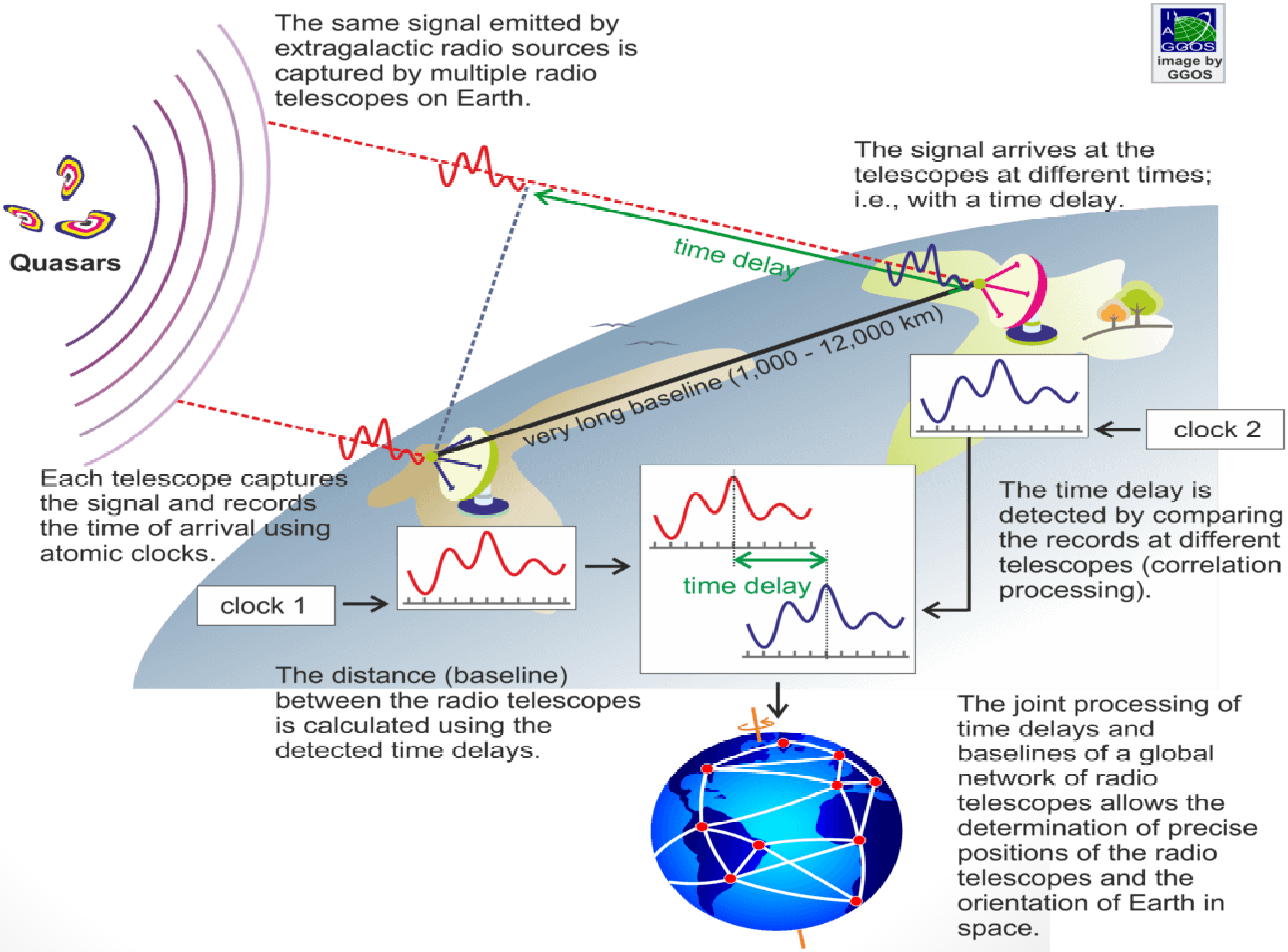
Example: Everest, Bessel etc.

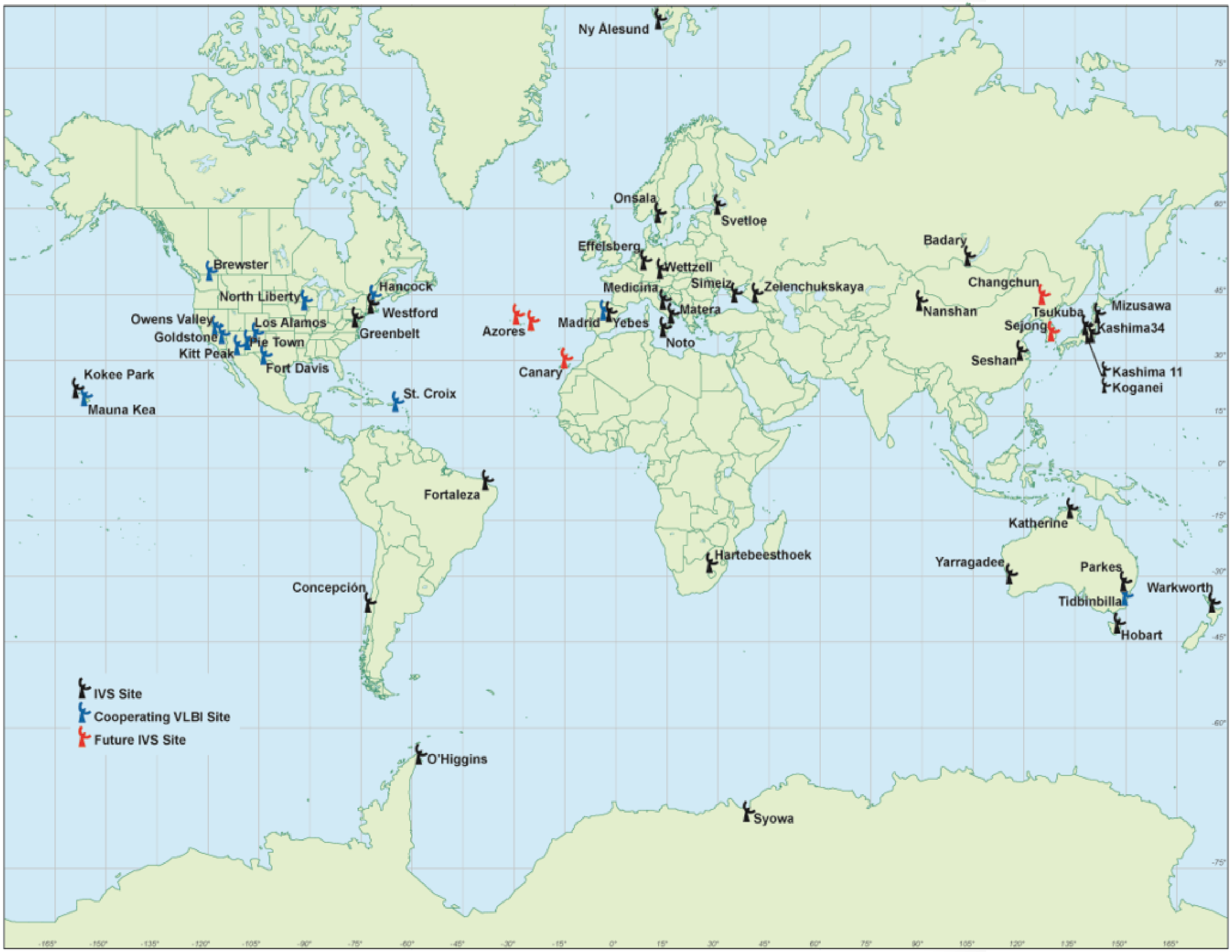
Doppler orbitography and RadioPositioning Integrated by satellite


SLR
Satellite Laser Ranging

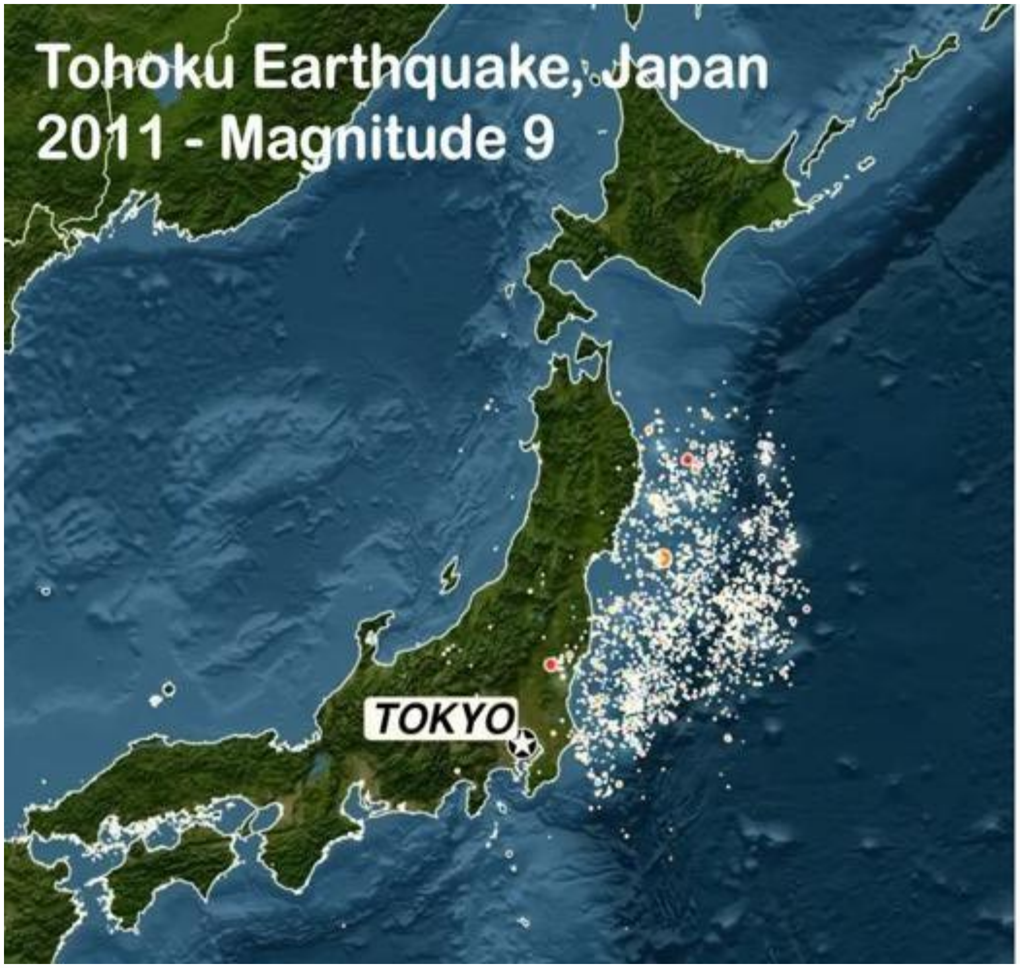

Earthbound observatories emit ultra-short laser pulses towards retroreflector arrays on satellites or the moon surface, which reflect the pulses back towards their origin.
The emission of the pulse triggers an Event Timer Unit that records the precise epoch of that instant. The reflected pulse detection triggers again the unit and the range is inferred as ½ the time-interval between the two epochs, corrected for calibration constants, atmospheric delay, etc.
satellite with corner cube reflectors
Transmitted pulse
Orbit
Reflected pulse
The pulse roundtrip time interval is measured with an accuracy of a few picoseconds.
Laser transmitter
Photon detector
Pulse Laser
Received pulse
start
stop
Measurement of the pulse's roundtrip travel time
Event Timer Unit (ETU)
SLR range observations enable the accurate determination of orbital trajectories, the position and velocity of the tracking stations, Earth's polar motion and variations in the length-of-day.
image by GGOS

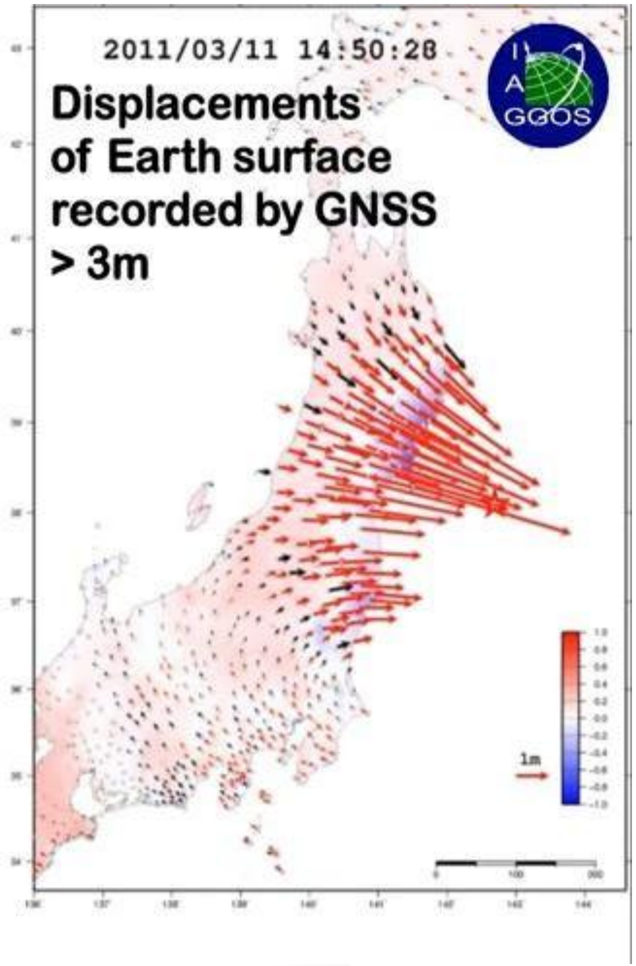

VLBI
GGOS
Very Long Baseline Interferometry

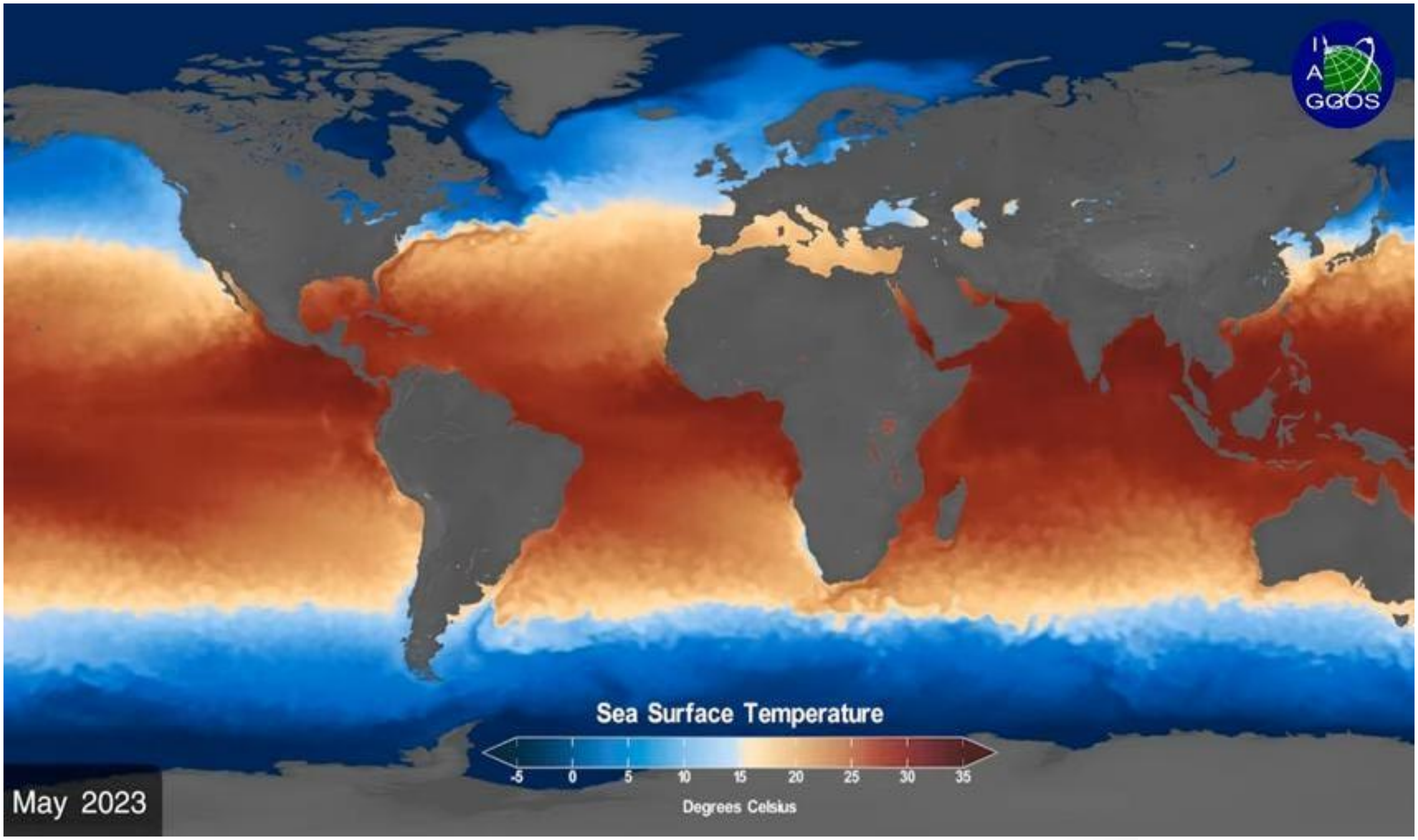

The same signal emitted by extragalactic radio sources is captured by multiple radio telescopes on Earth.
image by GGOS
Quasars
The signal arrives at the telescopes at different times; i.e., with a time delay.
time delay
very long baseline (1,000 - 12,000 km)
clock 2
Each telescope captures the signal and records the time of arrival using atomic clocks.
The time delay is detected by comparing the records at different telescopes (correlation processing).
clock 1
time delay
The distance (baseline) between the radio telescopes is calculated using the detected time delays.
The joint processing of time delays and baselines of a global network of radio telescopes allows the determination of precise positions of the radio telescopes and the orientation of Earth in space.



Ny Ålesund
Onsala
Svetloe
Effelsberg
Wettzell
Medicina
Simeiz
Zelenchukskaya
Matera
Madrid
Yebes
Noto
Azores
Canary
Badary
Changchun
Nanshan
Mizusawa
Tsukuba
Sejong
Kashima34
Seshan
Kashima 11
Koganei
Brewster
Hancock
North Liberty
Westford
Owens Valley
Los Alamos
Goldstone
Pie Town
Kitt Peak
Fort Davis
Greenbelt
Kokee Park
Mauna Kea
St. Croix
Fortaleza
Katherine
Hartebeesthoek
Yarragadee
Parkes
Warkworth
Tidbinbilla
Hobart
Concepción
IVS Site
Cooperating VLBI Site
Future IVS Site
O'Higgins
Syowa


Tohoku Earthquake, Japan
2011 - Magnitude 9
TOKYO


2011/03/11 14:50:28
Displacements
of Earth surface
recorded by GNSS
> 3m
GGOS
1m



Sea Surface Temperature
-5
0
5
10
15
20
25
30
35
Degrees Celsius
May 2023
GGOS

Datum Adjustment

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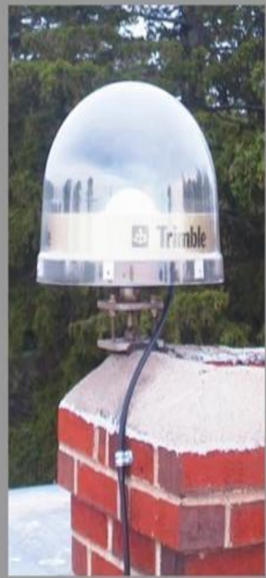
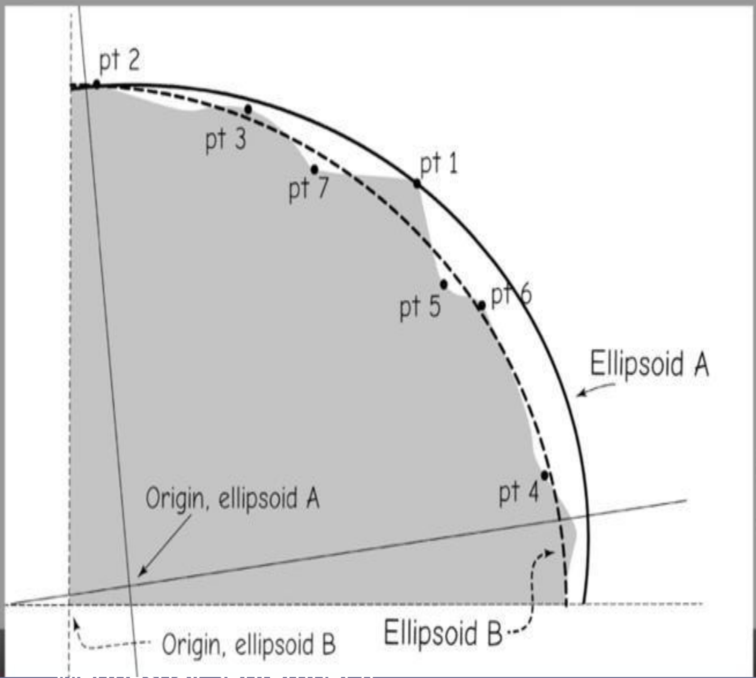
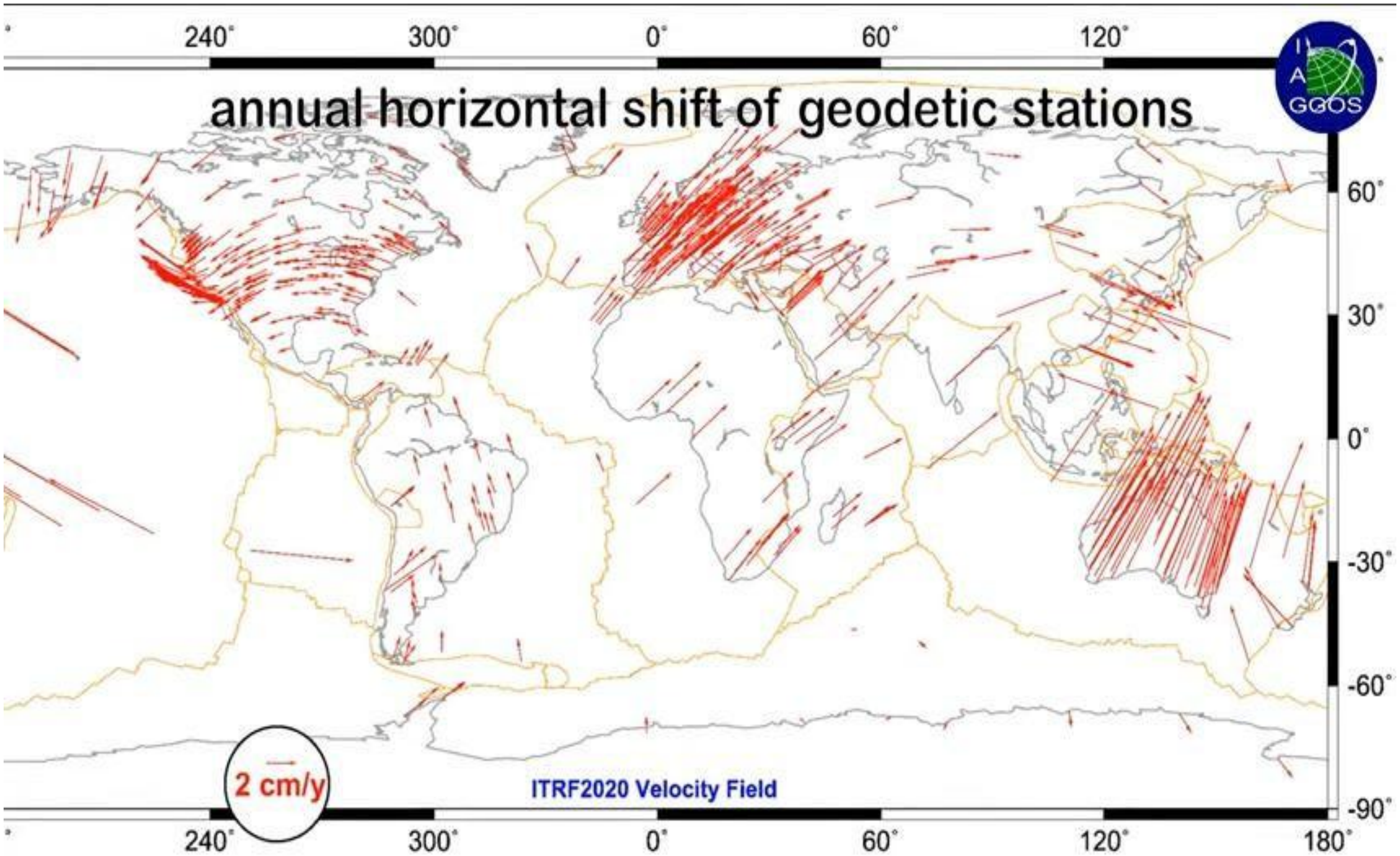
- Datum is adjusted as we collect more observational data
- GPS satellite data is used to gradually improve the datum
  - HARN (High Accuracy Reference Network) ... Private Survey
  - CORS (Continuously Operating Reference System) .... Based on GPS satellites

CORS Station





- Ellipsoid A is based on pt 1 and pt 2
- Ellipsoid B is achieved based on additional survey points pt 3 to pt 7


annual horizontal shift of geodetic stations
240° 300° 0° 60° 120° 180°
60° 30° 0° -30° -60° -90°
IAG GGOS
2 cm/y
ITRF2020 Velocity Field

What does a coordinate system tell us?

CO-ORDINATE SYSTEM

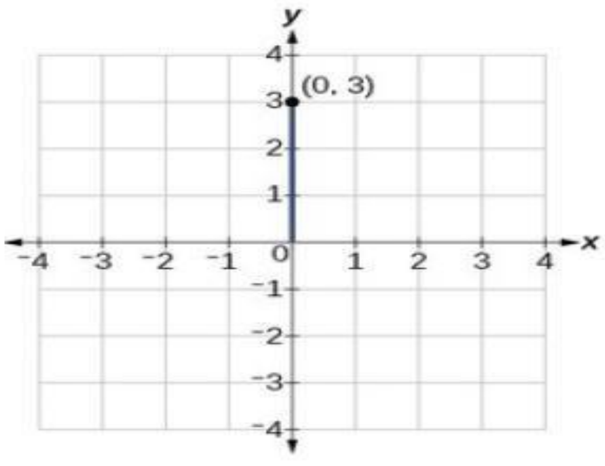
- **What is a coordinate system**

- A coordinate system is a method for identifying the location of a point.
- In our school education we come across the coordinate system in mathematics namely

- 1. Cartesian coordinate system or Rectangular Coordinate System.
- 2. The polar coordinate system

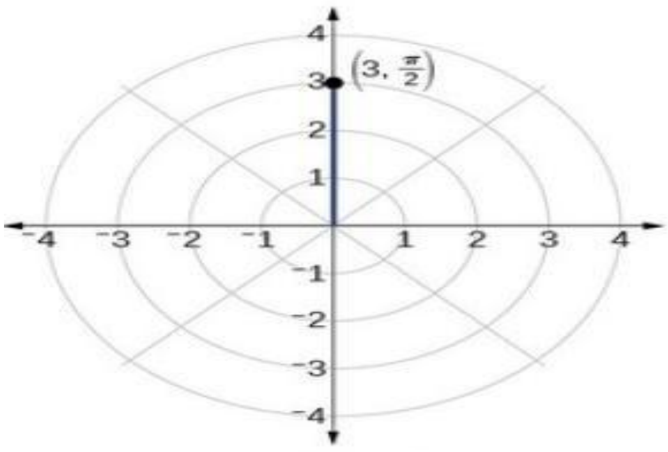
Cartesian & Polar

- The Cartesian coordinate system, also called the rectangular coordinate system
- It is based on a two-dimensional plane consisting of the *x*-axis and the *y*-axis. Perpendicular to each other, the axes divide the plane into four sections.
- Each section is called a **quadrant**; the quadrants are numbered counterclockwise

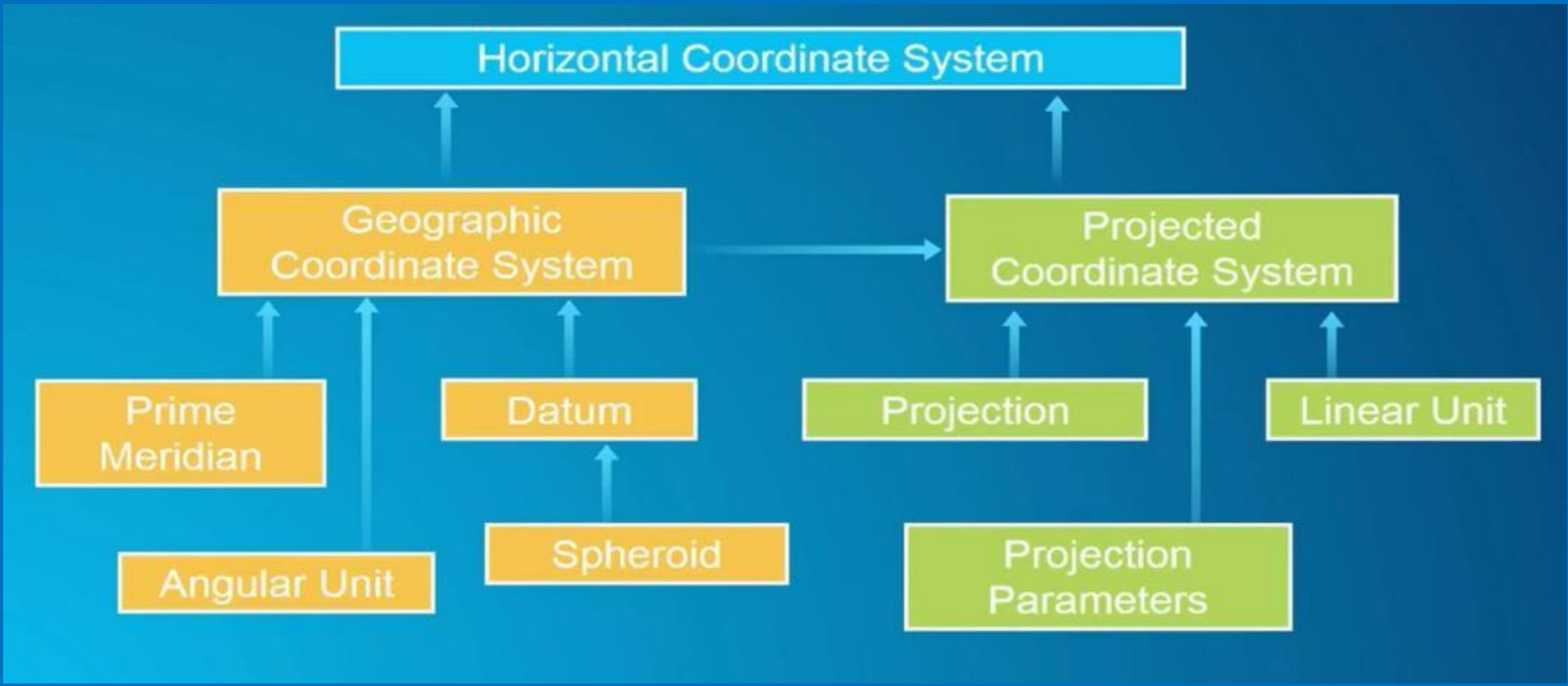


Coordinate Grid

- The polar coordinate system is an alternate coordinate system where the two variables are 'r' and 'θ' , instead of 'x' and 'y'.
- Polar coordinates are points labeled (r, θ) and plotted on a polar grid.
- The polar grid is represented as a series of concentric circles radiating out from the pole, or the origin of the coordinate plane.



Polar Grid

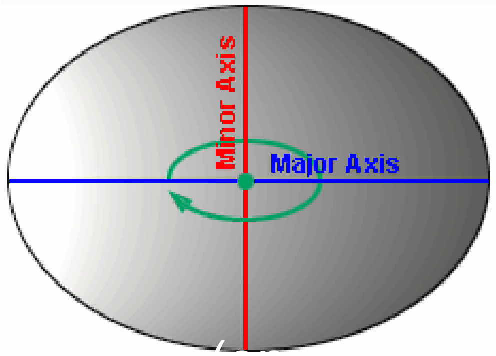


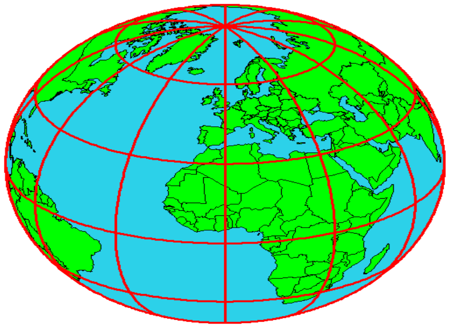
What is GCS

Geographic Coordinate System

Geographic Coordinate System

- We have already concluded that from know onwards, we have to consider the shape of the earth as ellipsoid
- The ellipsoid has one major axis and one minor axis as shown in the figure.

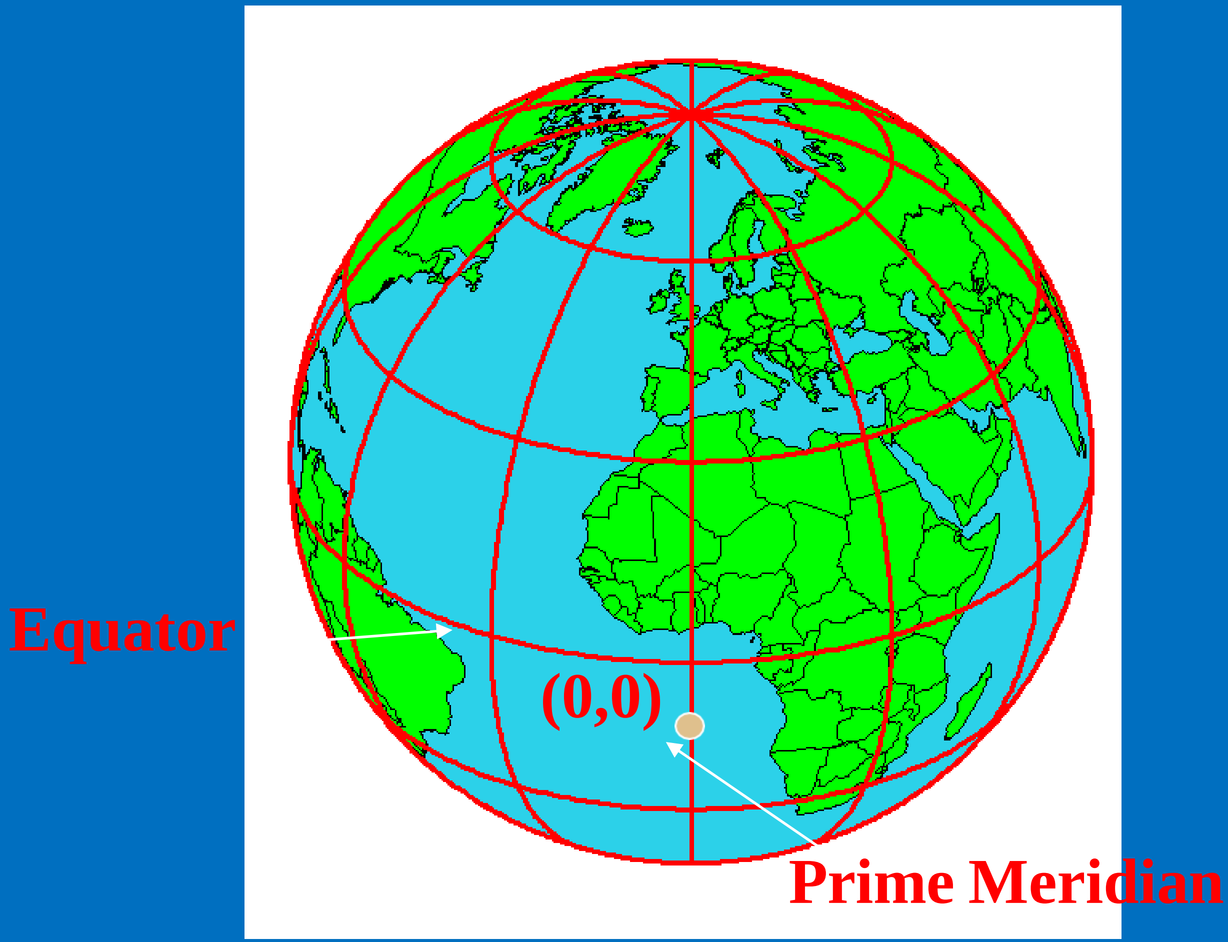




Equator, which divides globe centrally. The entire upper part of the equator is known as **Northern Hemisphere** and the lower part of the equator is known as **Southern Hemisphere.**

- In the globe (on the right), the minor axis is the line of 0^o Meridian called as **Prime Meridian**, which passes through a place known as Greenwich of England and is frequently called as **Greenwich meridian.**

Origin of Earth
(for Geographic Coordinates)



The Horizontal Origin of Earth for Geographic coordinate System is the intersection of the Equator and the Prime Meridian/Greenwich Meridian.

TYPES OF ELLIPSOIDS
(GLOBAL AND LOCAL REFERENCE ELLIPSOIDS)

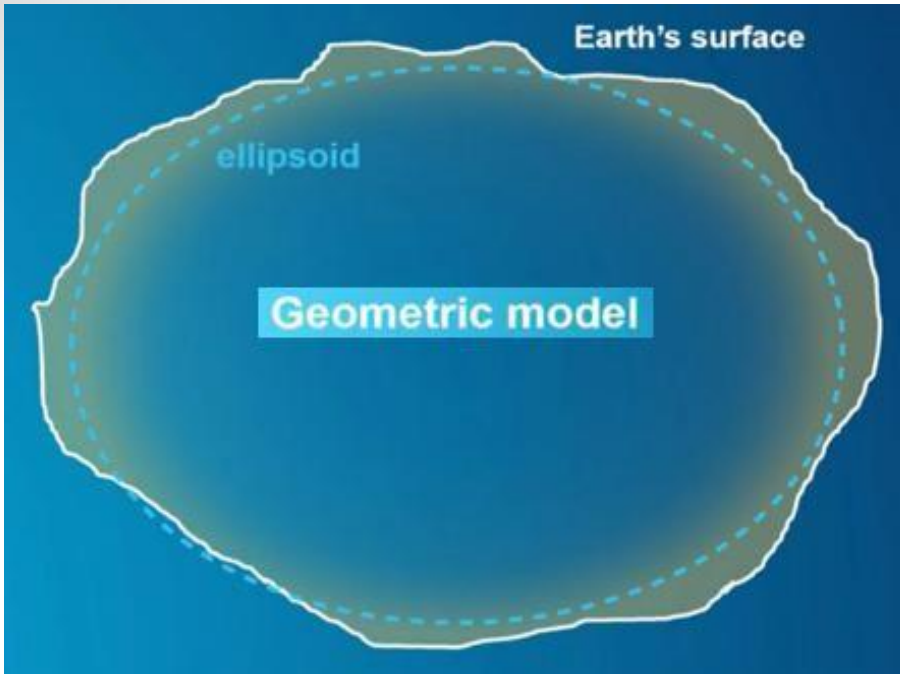
Global reference Ellipsoid: The Center of Gravity of the actual earth coincide with the center of the ellipsoid. This type of ellipsoids are called Geo-centric ellipsoid. Example: WGS-72, WGS-84 etc.

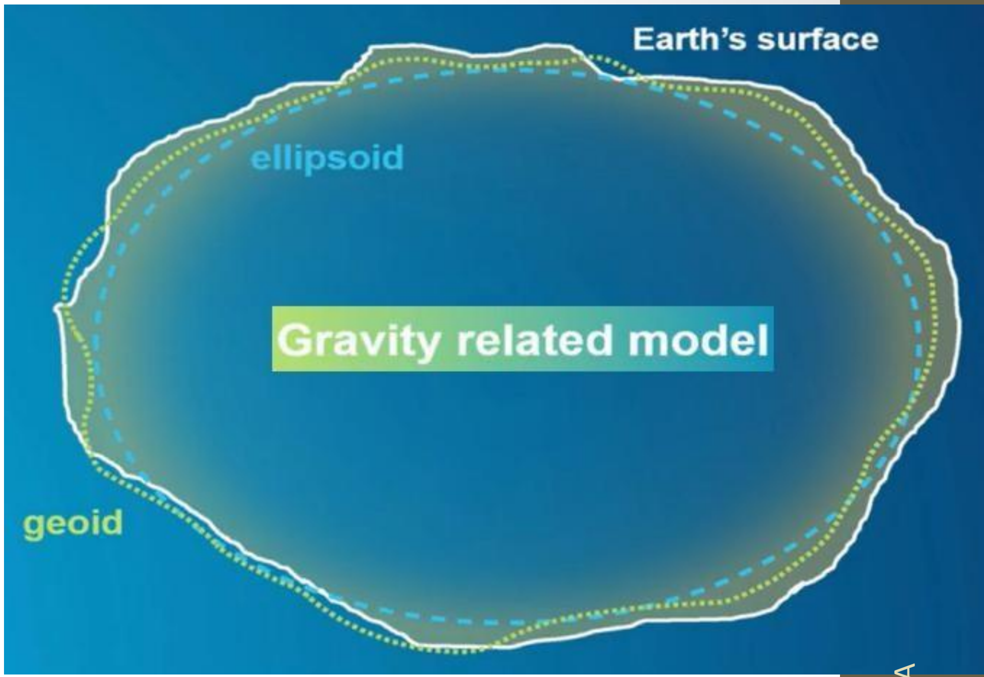
Local reference Ellipsoid: The ellipsoid is chosen in such a way that it fits with the local datum of interest as closely as possible.

Example: Everest, Bessel etc.

Horizontal datums are used for describing a point on the earth's surface, in latitude and longitude or another coordinate system. Vertical datums are used to measure elevations or underwater depths.

- **Horizontal datum surface : Ellipsoid**
- **Vertical datum surface : Geoid**





The **geoid** is defined as the equipotential surface, which closely approximates the mean sea level. It is perpendicular to the direction of gravity pull. Since the mass of the Earth is not uniform at all points, the magnitude of gravity varies, and the shape of the **geoid** is irregular.

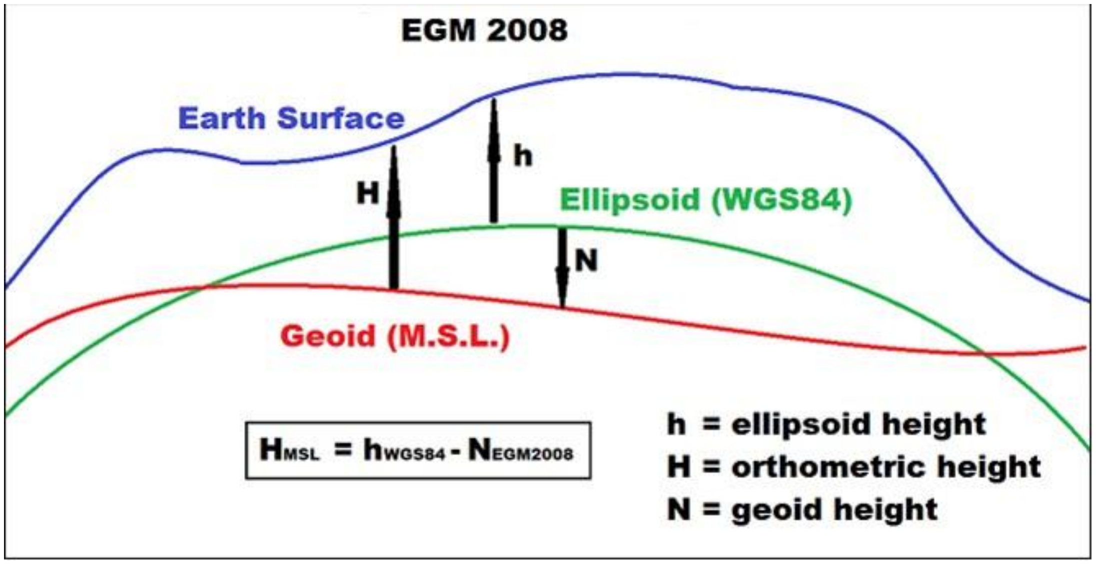
(A **gravimeter** is an instrument used in **gravimetry** for measuring the local gravitational field of the Earth.)

FORMULA FOR COMPUTING GEOIDAL HEIGHT (or Geoidal Undulation)

Local geoid: vertical datum with origin at one point close to mean sea level

$$H = h - N$$

Geoidal undulation (N) is about -78mtr
Then MSL height is (H)= 485 – (-78)=485+78=563 mtr.



H= Geoidal Height   h = Reference ellipsoid height   N= Geoidal Undulation

Although the physical Earth has excursions of +8,848 m (Mount Everest) and −429 m (Dead Sea), but the geoid's variation ranges from −106 to +85 m, less than 200 m total compared to a perfect mathematical ellipsoid.

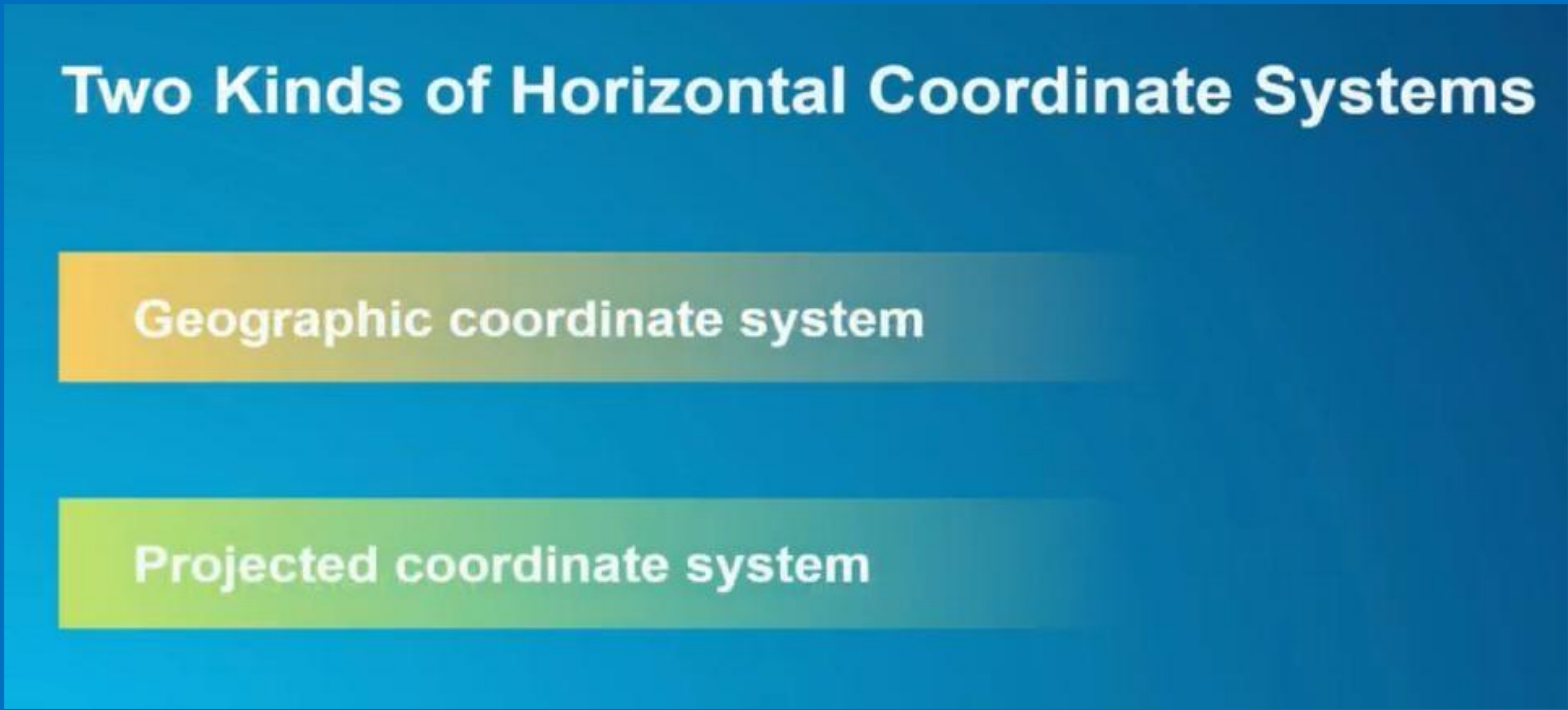
DATUMS used by SOI

Countries have started preparing maps based on WGS-84 as the global refrence for Horizontal positioning.

The old toposheets of Survey of India were based on EVEREST-1956 ellipsoid which differs with the WGS-84 ellipsoid. After the National Map policy 2005 the OSM & DSM of Survey of India are based on WGS-84 System only.

COORDINATE SYSTEM

The surface can decide how the coordinate system can be derived. As far as the earth is considered it is a ellipsoid, so to derive exact horizontal coordinate of a place on earth two types of coordinate systems are developed.

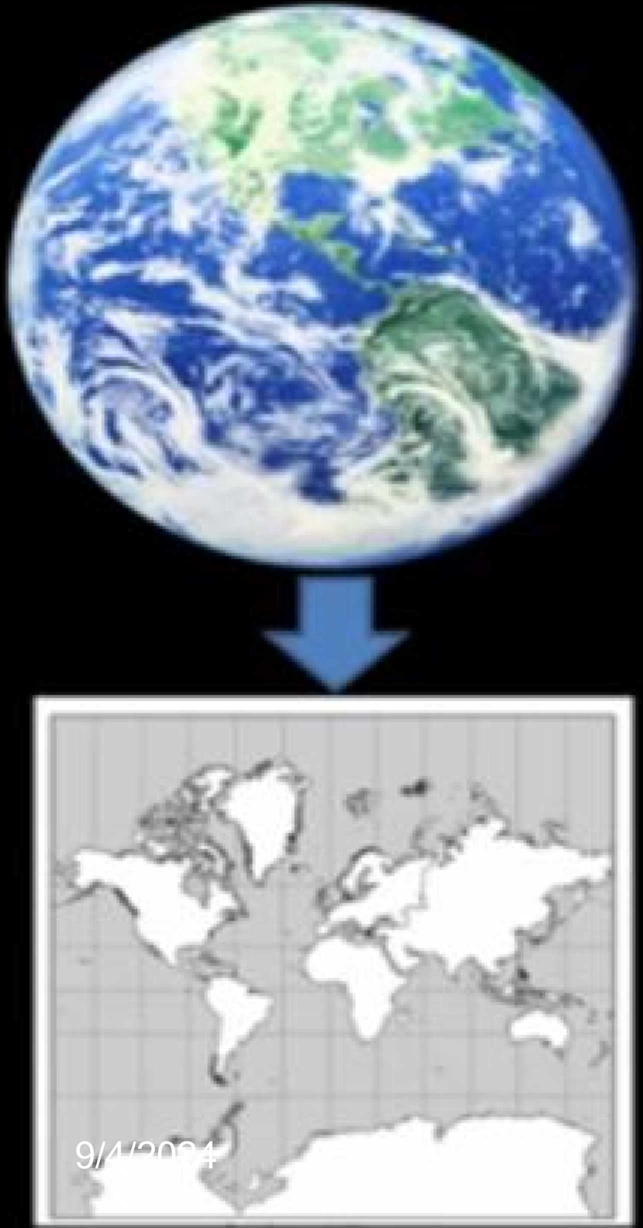


Projections

Projected Coordinate System

P C S

What is a Map Projection?



A method of representing the earth's three-dimensional surface as a flat two-dimensional surface

Whether you treat the earth as a sphere or a spheroid, you must transform its three-dimensional surface to create a flat map sheet. This mathematical transformation is commonly referred to as a map projection.

MAP PROJECTIONS

Why do we need Map projection

The Earth's surface is curved (nearly spherical) but maps are flat. In order to represent any curved surface on a flat map, you have to adjust things in an orderly way. This is called projection, and there are several ways to do it, depending on what about the surface you most want to preserve.

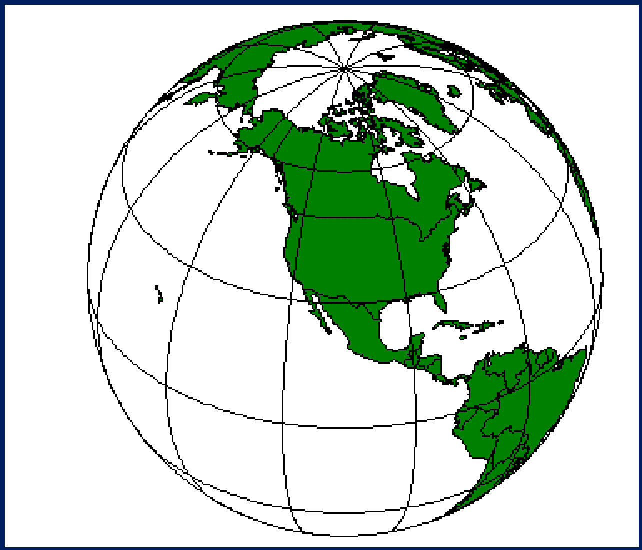
Why project data?

- Data often comes in geographic, or spherical coordinates (latitude and longitude) and cannot be used for area calculations.

- Some projections work better for different parts of the globe giving more accurate calculations.

MAP PROJECTION

A map projection is a method for mapping spatial patterns on a curved surface (the Earth's surface) to a flat surface.



Curved Earth

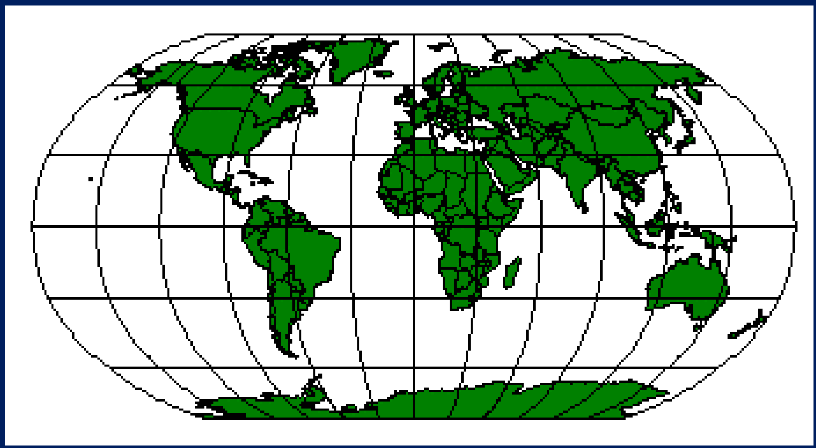
Geographic coordinates: ϕ, λ

(Latitude & Longitude)

Flat Map

Cartesian coordinates: x,y

(Easting & Northing)



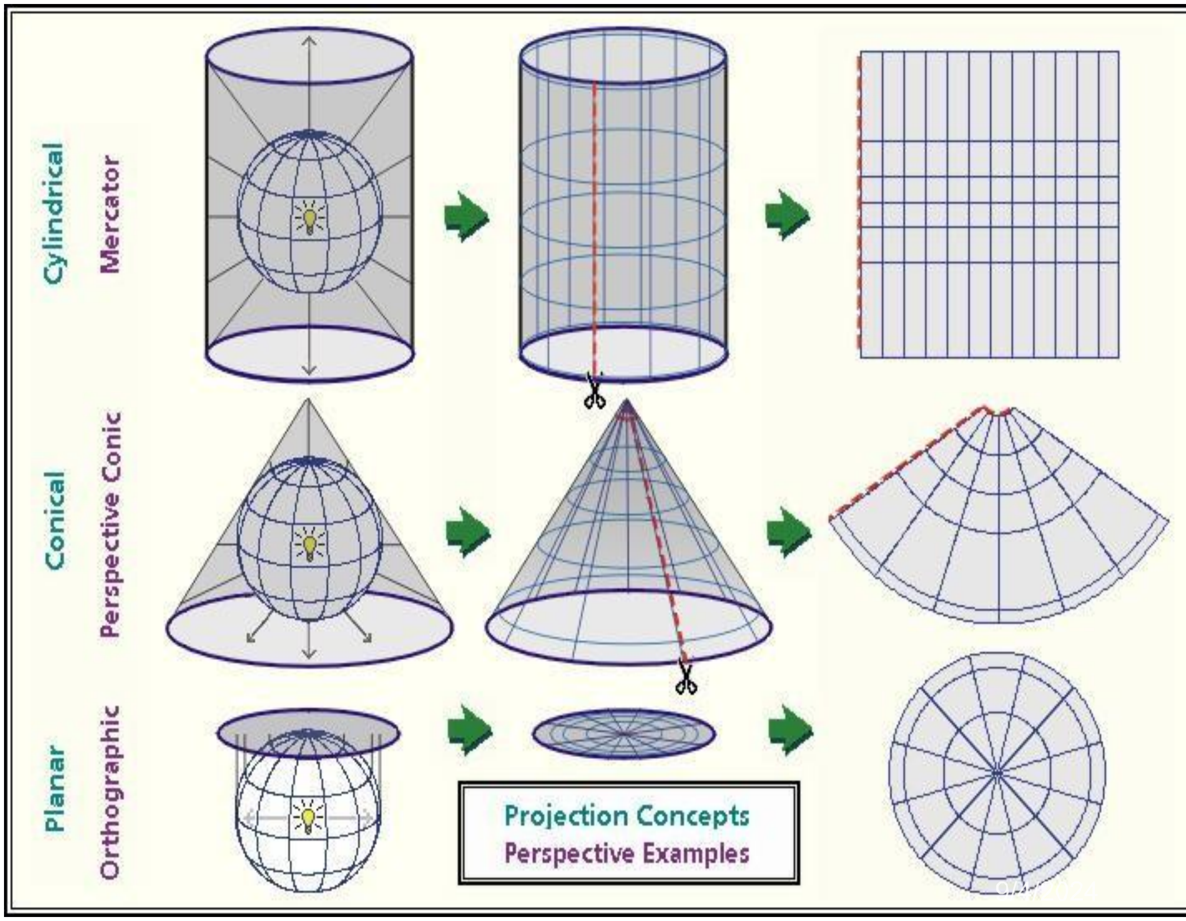
PROJECTED COORDINATE SYSTEM

A projected coordinate system is defined on a flat, two-dimensional surface. A projected coordinate system is **always based on a geographic coordinate system** that is based on a sphere or spheroid.

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 that reference it to that central location. One specifies its horizontal position and the other its vertical position. The two values are called the x-coordinate and y-coordinate. Using this notation, the coordinates at the origin are user defined or internationally fixed.

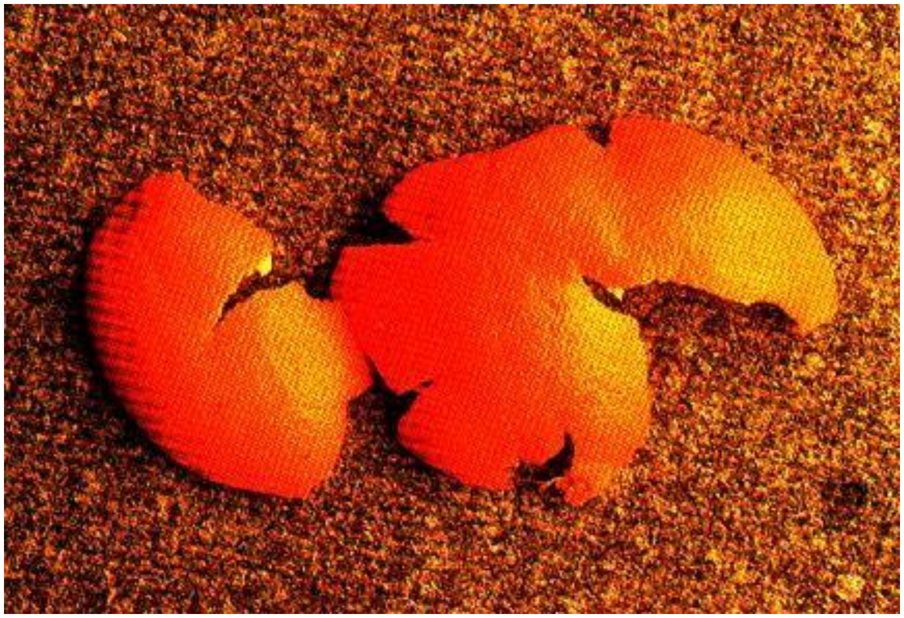
When working with data in a geographic coordinate system, it is sometimes useful to equate the longitude values with the X axis and the latitude values with the Y axis.

Types of Projections (Nature of Projection Surface)



Globes are 3-Dimensional Models of the Earth

3D GLOBE



PEEL OF ORANGE
MAKING SIT IT ON A PLANE

A spheroid can't be flattened to a plane any more easily than a piece of orange peel can be flattened—it will rip.

DISTORTIONS IN MAP PROJECTION

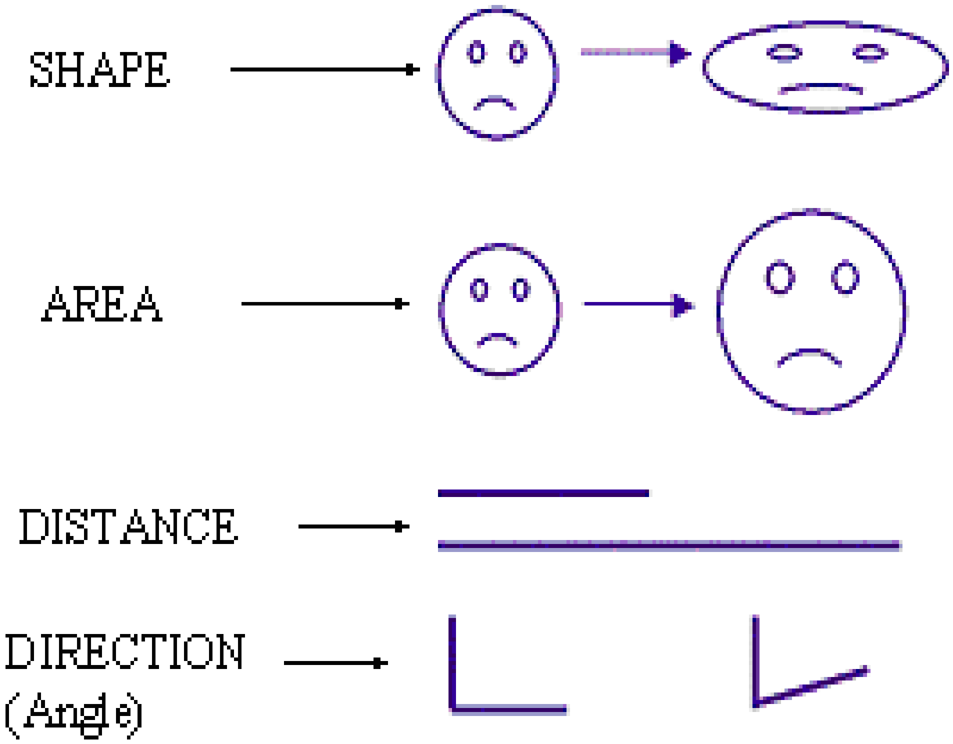
Representing the earth's surface in two dimensions causes distortion in the shape, area, distance, or direction of the data.

- Shape
- Area
- Distance/Scale
- Direction/Angle

So, one has to choose the specific type of projection which best fits and suits the requirement. It depends on various factors viz scale, terrain nature etc.

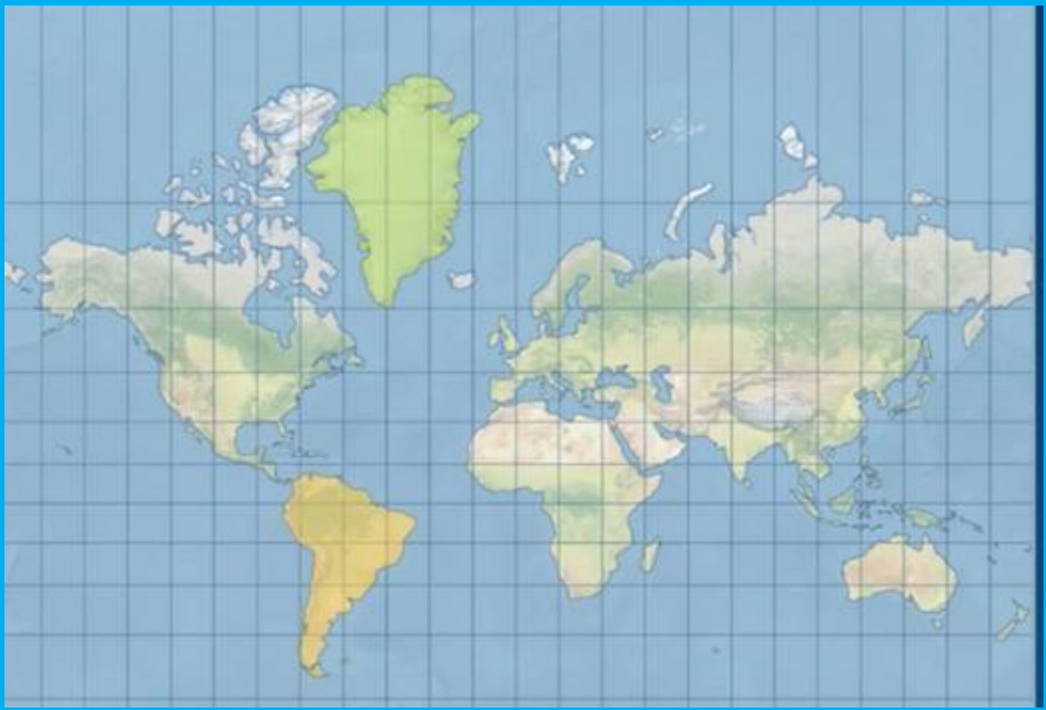
MAP PROJECTIONS LEAD TO DISTORTIONS … ..

Choice of Projections depends on allowable distortions in:



Adopted from ESRI

SOME EXAMPLES OF DISTORATIONS



Web Mercator Projected Map

South America	~	17 840 000 km^2
Greenland	~	2 166 000 km^2
Antarctica	~	14 000 000 km^2

The above country areas are actuals, i.e., South America has a very large area compared to that of Greenland.

But, in the projected map it appears that Greenland is bigger than South America.

<u>Distortion in Area.</u>

SOME EXAMPLES OF DISTORATIONS

Web Mercator Projected Map

In the Web Mercator Projection the size of the Greenland and Africa has shown as nearly equal, where as in reality the Greenland is much smaller in size when compared with Africa.

Distortion in size but Directions are preserved.

Choosing a Map Projection

Depends on

- Which region to display (e.g. world, north pole, equator, US)
- Resolution of the region
- Purpose of using maps
- Which property among **shape /area /direction /distance** to be persevered on priority basis and to see that other **distortions** be minimized.

Different Map Projections

Aitoff
Albers
Azimuthal equidistant
Behrmann
Berghaus Star
Bonne
Cassini
Compact Miller
Craster Parabolic
Cube
Cylindrical equal-area
Double stereographic
Eckert Greifendorff
Eckert I
Eckert II
Eckert III
Eckert IV
Eckert V
Eckert VI

Equidistant conic
Equidistant cylindrical
Flat polar quartic
Fuller
Gall stereographic
Gauss Kruger
Gnomonic
Goode Homolosine
Hammer-Aitoff
Hotine oblique Mercator
IGAC Plano Cartesiano
Krovak
Laborde oblique Mercator
Lambert azimuthal equal-area
Lambert conformal conic
Local
Loximuthal
Mercator
Miller cylindrical

Mollweide
Natural Earth
Natural Earth II
New Zealand map grid
Ney modified conic
Orthographic
Patterson
Plate Carree
Polyconic
Quartic authalic
Rectified skew orthomorphic
Robinson
Sinusoidal
Stereographic
Times
Transverse cylindrical equal-area
Transverse Mercator
Two point equidistant
Van der Grinten I

DIFFERENT TYPE OF PROJECTIONS USED IN SURVEY OF INDIA

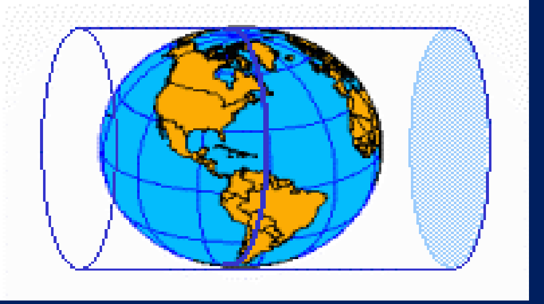
POLYCONIC PROJECTION

LAMBERT CONFORMAL CONIC PROJECTION (IN DSM)

UNIVERSAL TRANSVERSE MERCATOR PROJECTION (In OSM)

WEB MERCATOR PROJECTION **(FOR ONLINE RESOURCES)**

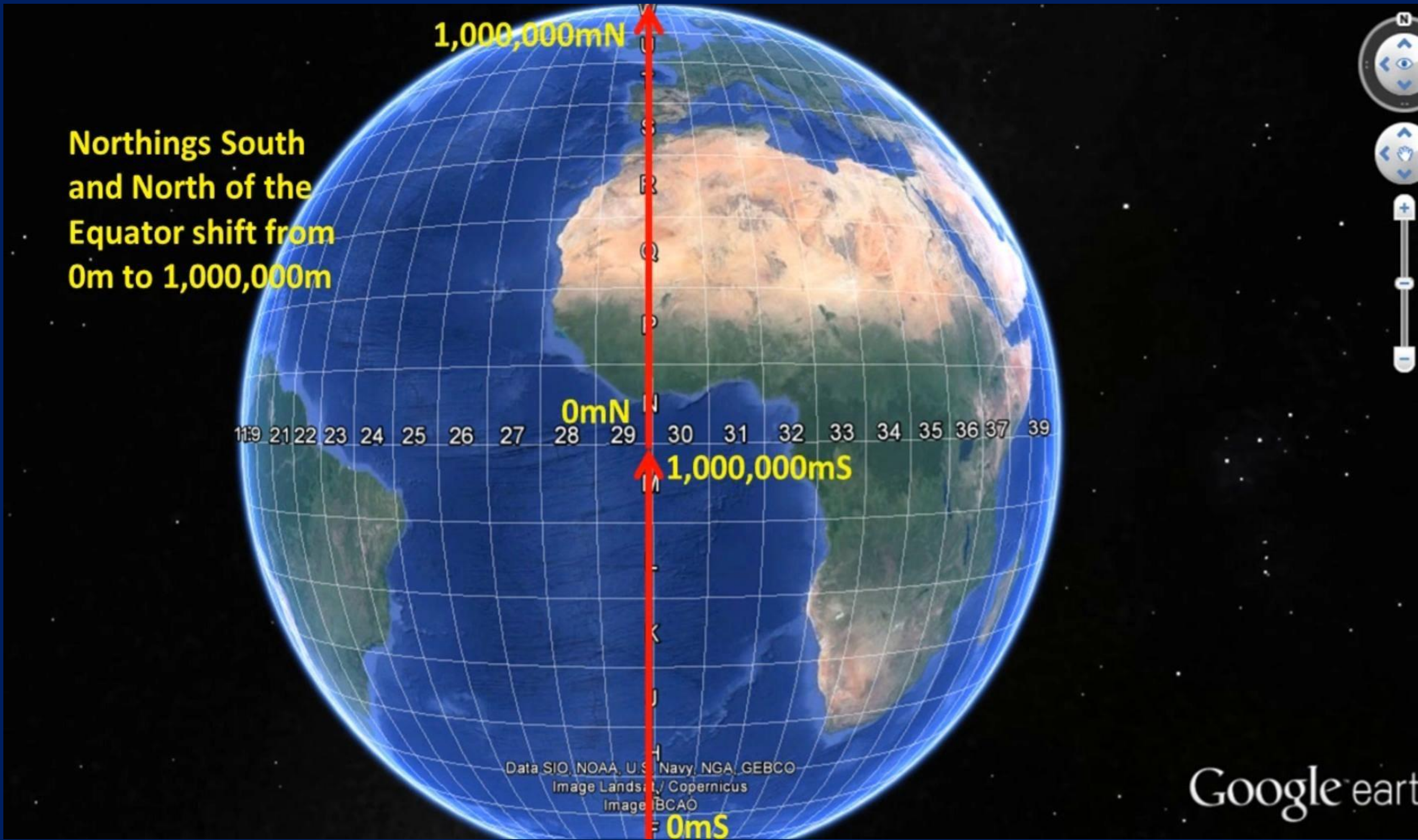
Universal Transverse Mercator Projection (UTM)



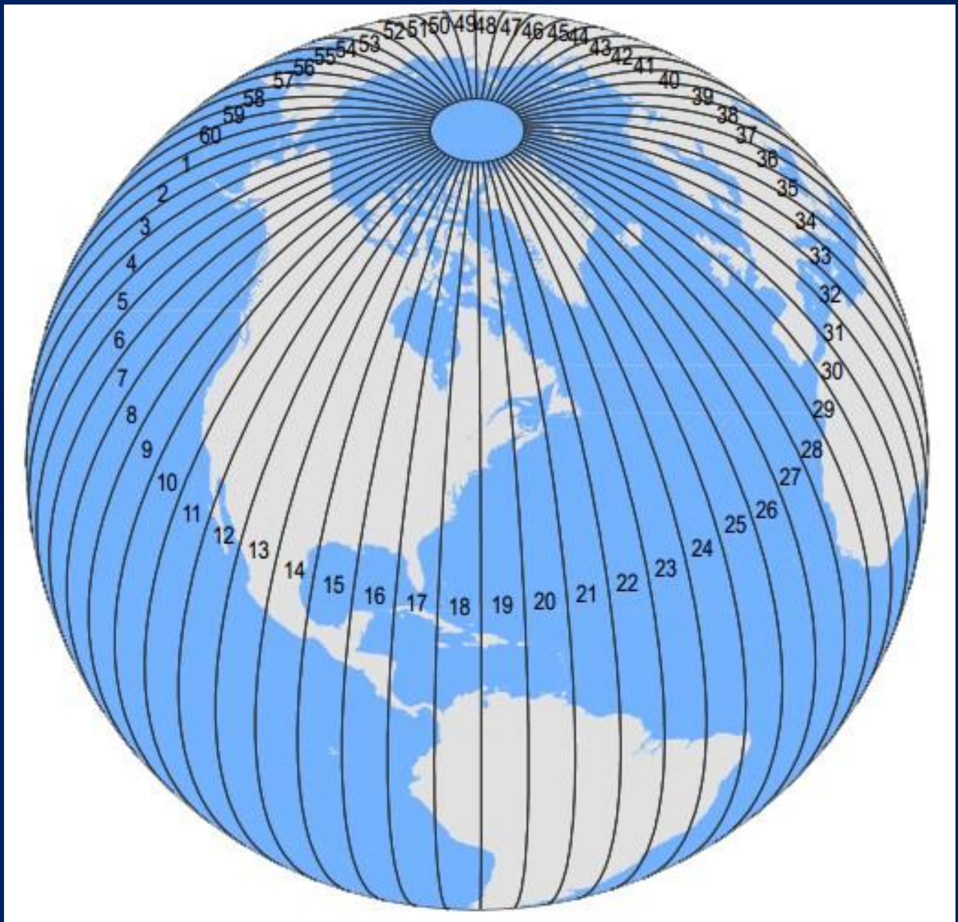
The Universal Transverse Mercator (UTM) system is a specialized application of the transverse Mercator projection. The globe is divided into 60 north and south zones, each spanning 6° of longitude. Each zone has its own central meridian. Zones 1N and 1S start at 180° W. The limits of each zone are 84° N and 80° S, with the division between north and south zones occurring at the equator. The polar regions use the Universal Polar Stereographic coordinate system.

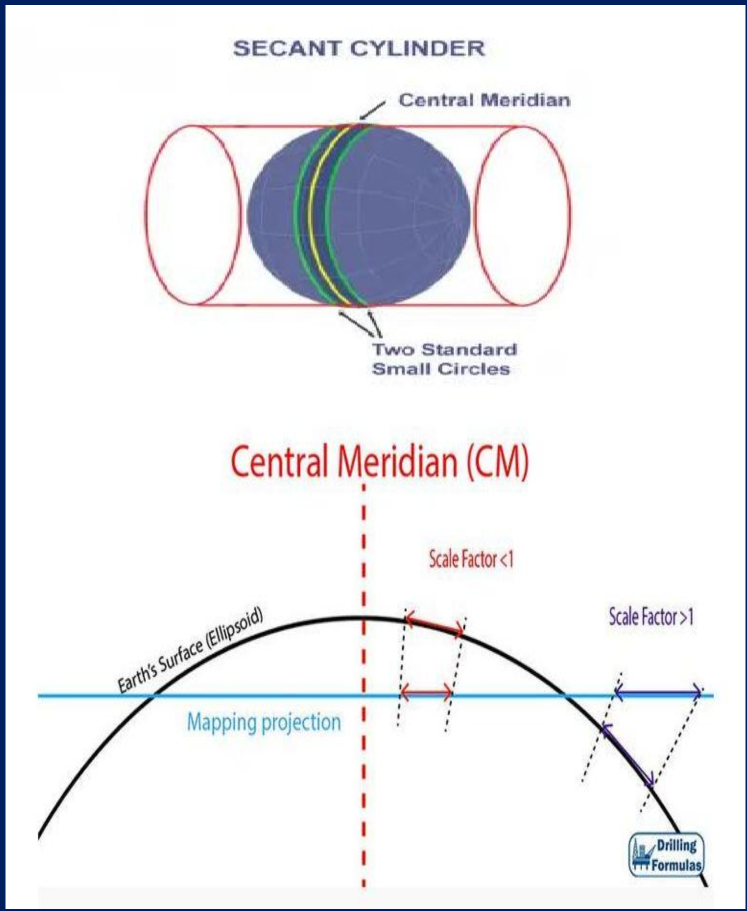
The origin for each zone is its central meridian and the equator. To eliminate negative coordinates, the coordinate system alters the coordinate values at the origin. The value given to the central meridian is the false easting, and the value assigned to the equator is the false northing. A false easting of 500,000 meters is applied. A north zone has a false northing of zero, while a south zone has a false northing of 10,000,000 meters.

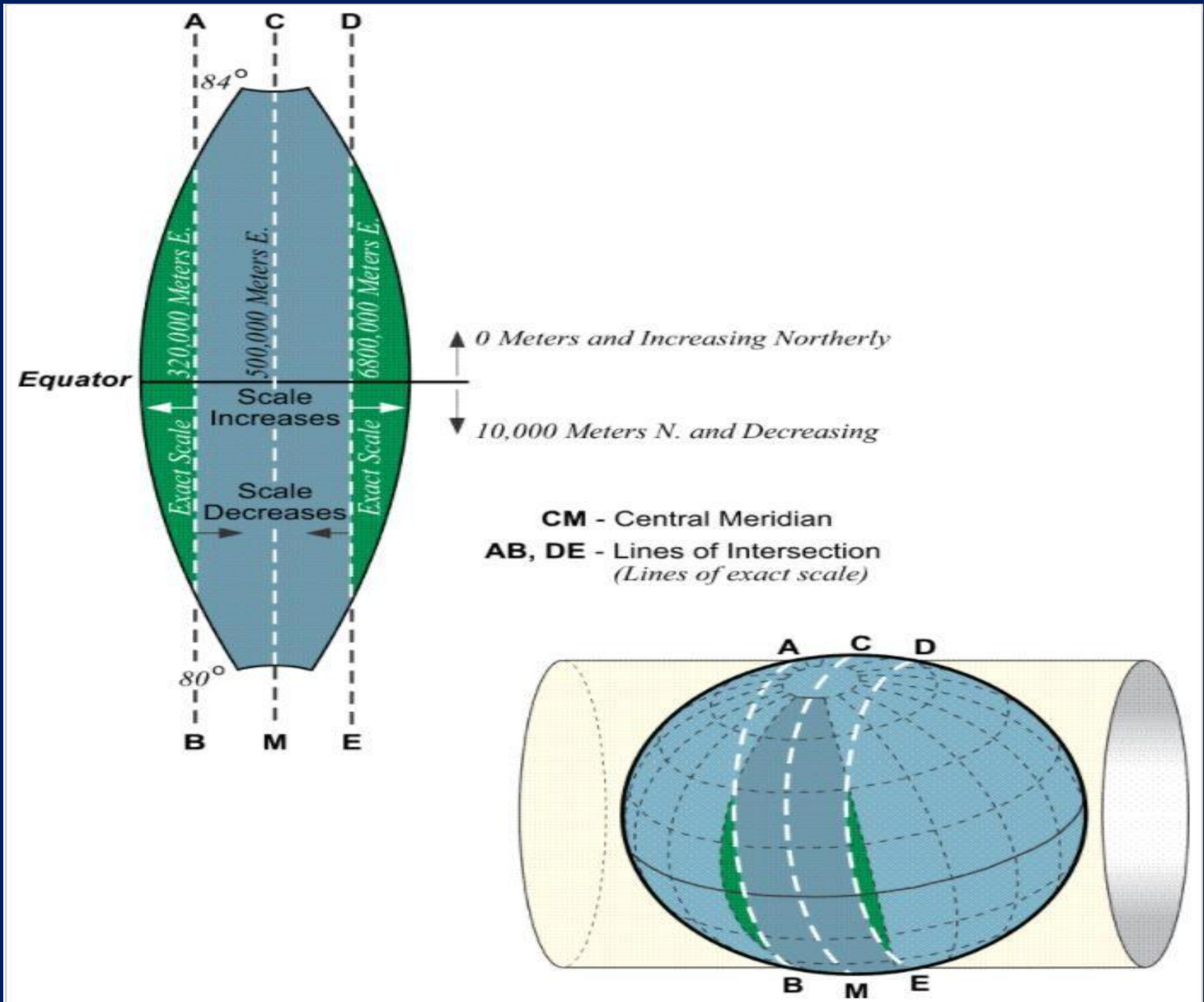
False Northing



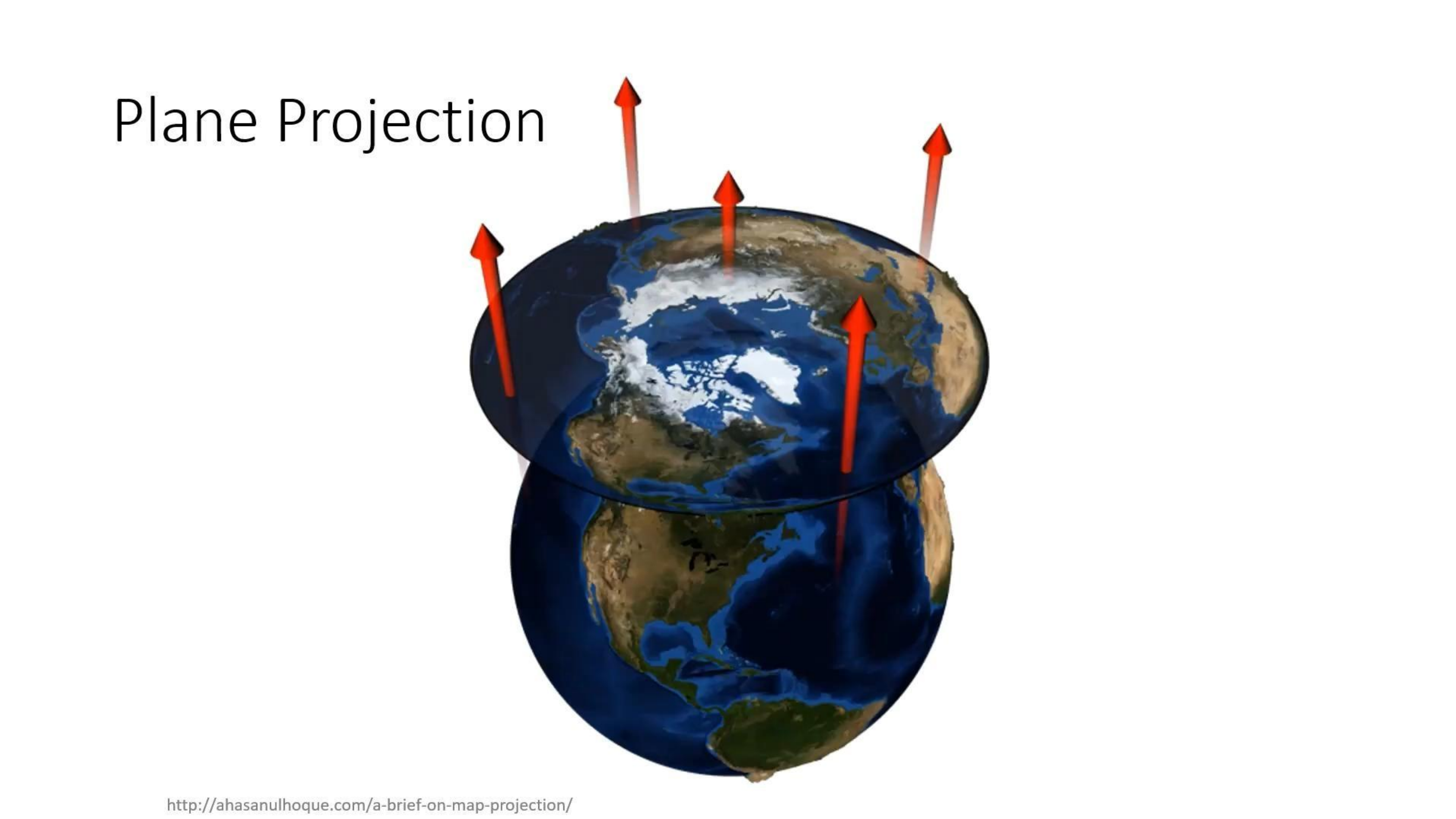
The UTM Projection surfaces



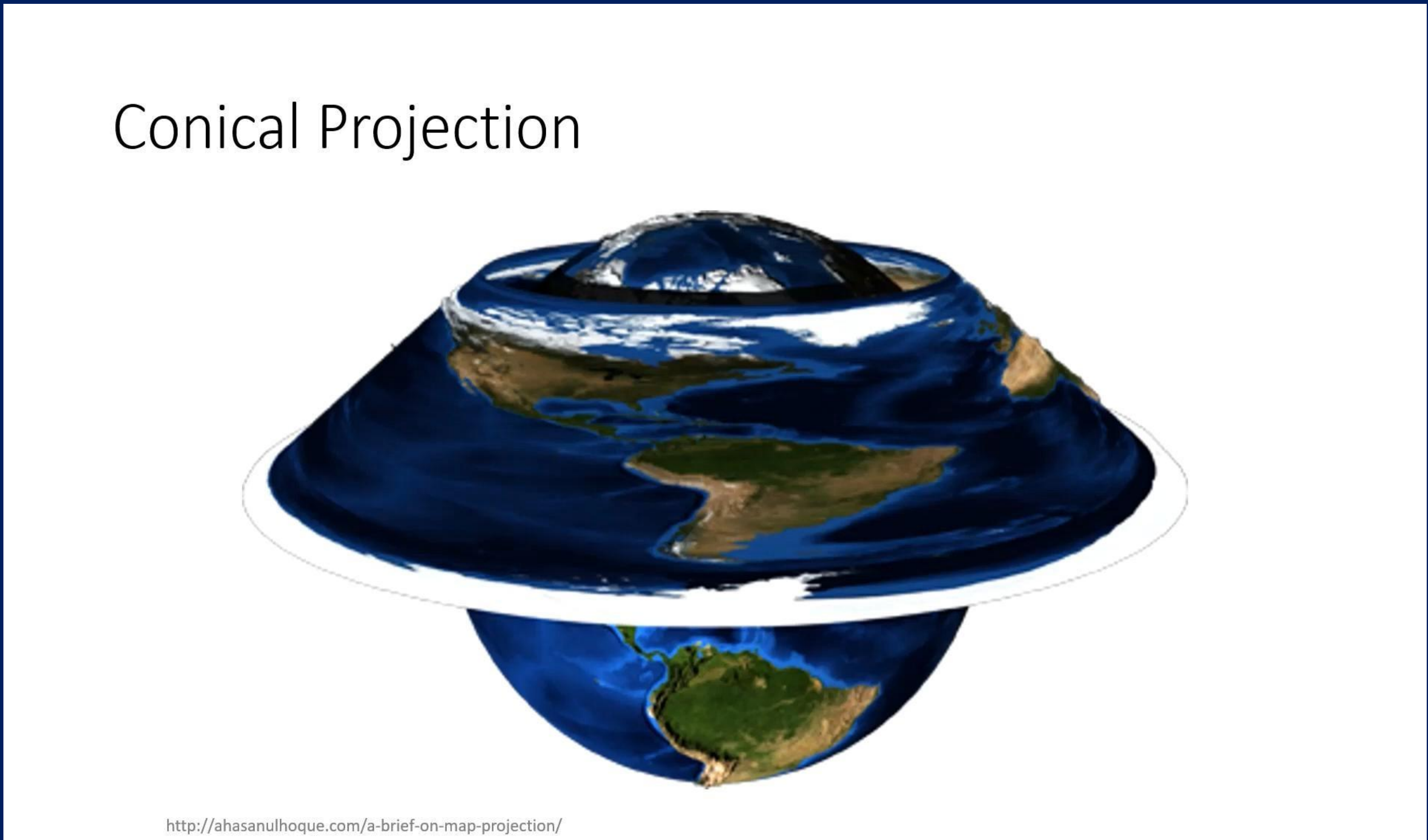



A
C
D
84°
320,000 Meters E.
500,000 Meters E.
6800,000 Meters E.
Equator
0 Meters and Increasing Northerly
Scale
Increases
10,000 Meters N. and Decreasing
Exact Scale
Scale
Decreases
Exact Scale
CM - Central Meridian
AB, DE - Lines of Intersection
(Lines of exact scale)
80°
B
M
E
A
C
D
B
M
E

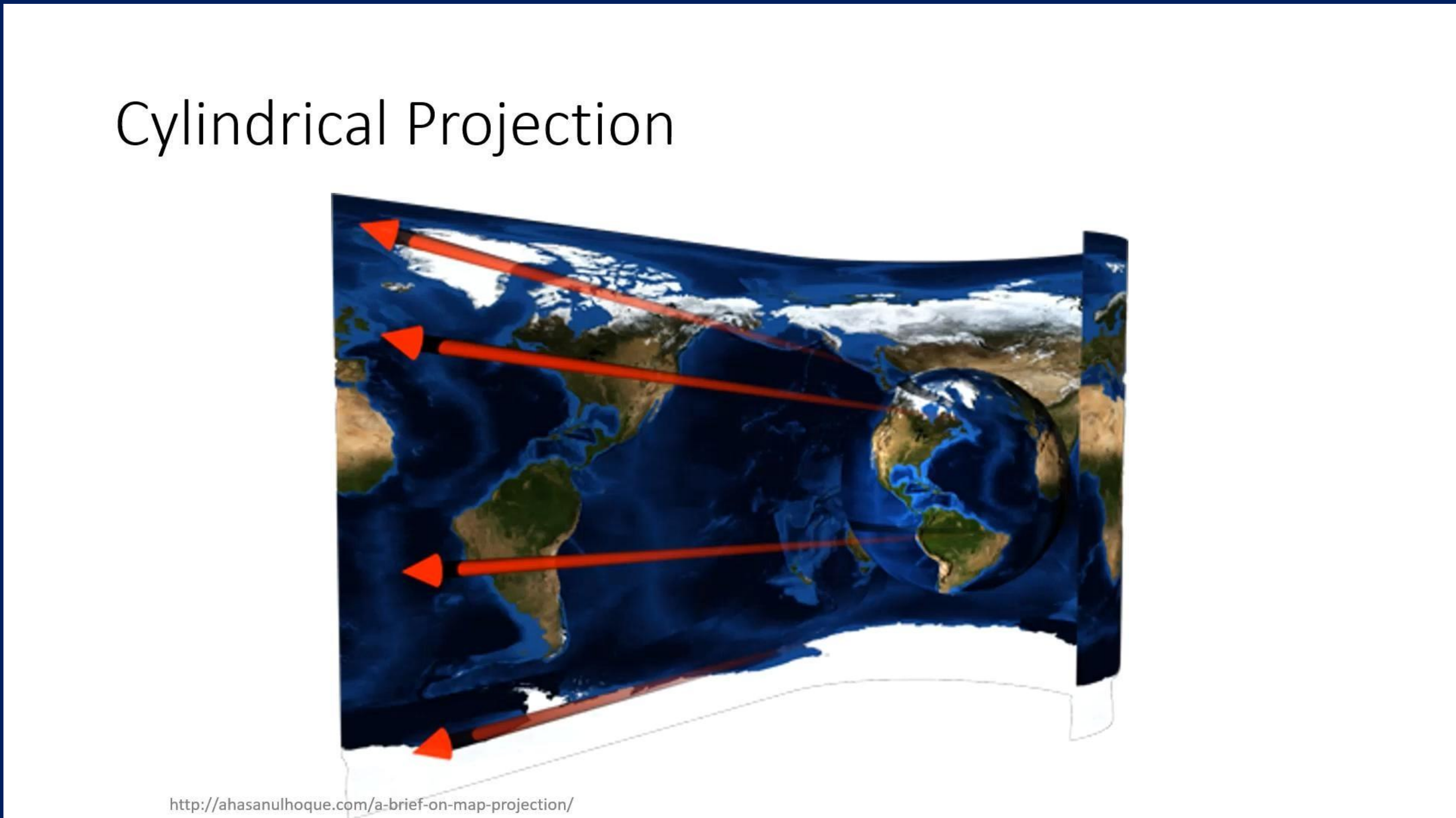
Planar projection



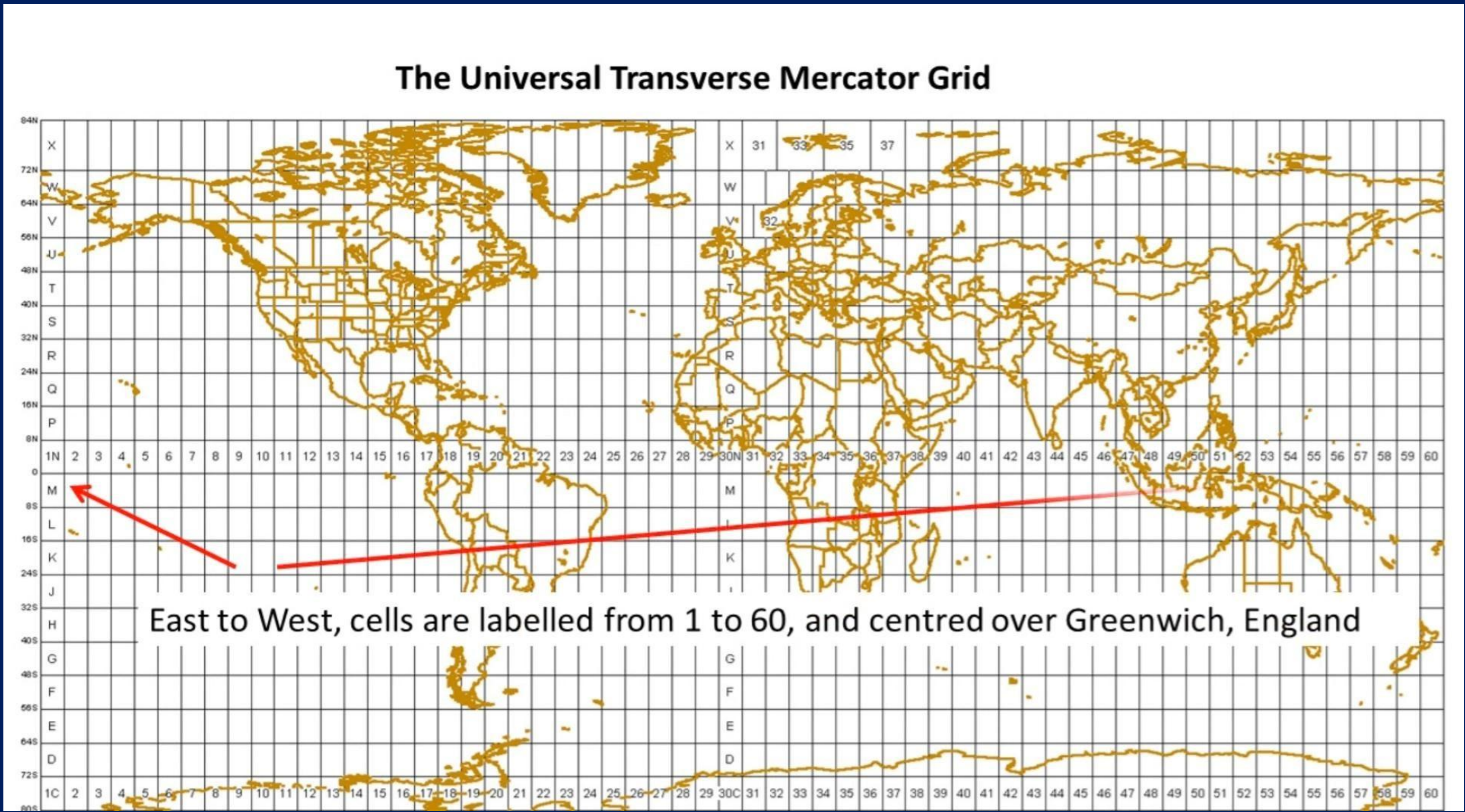
Conical Projection



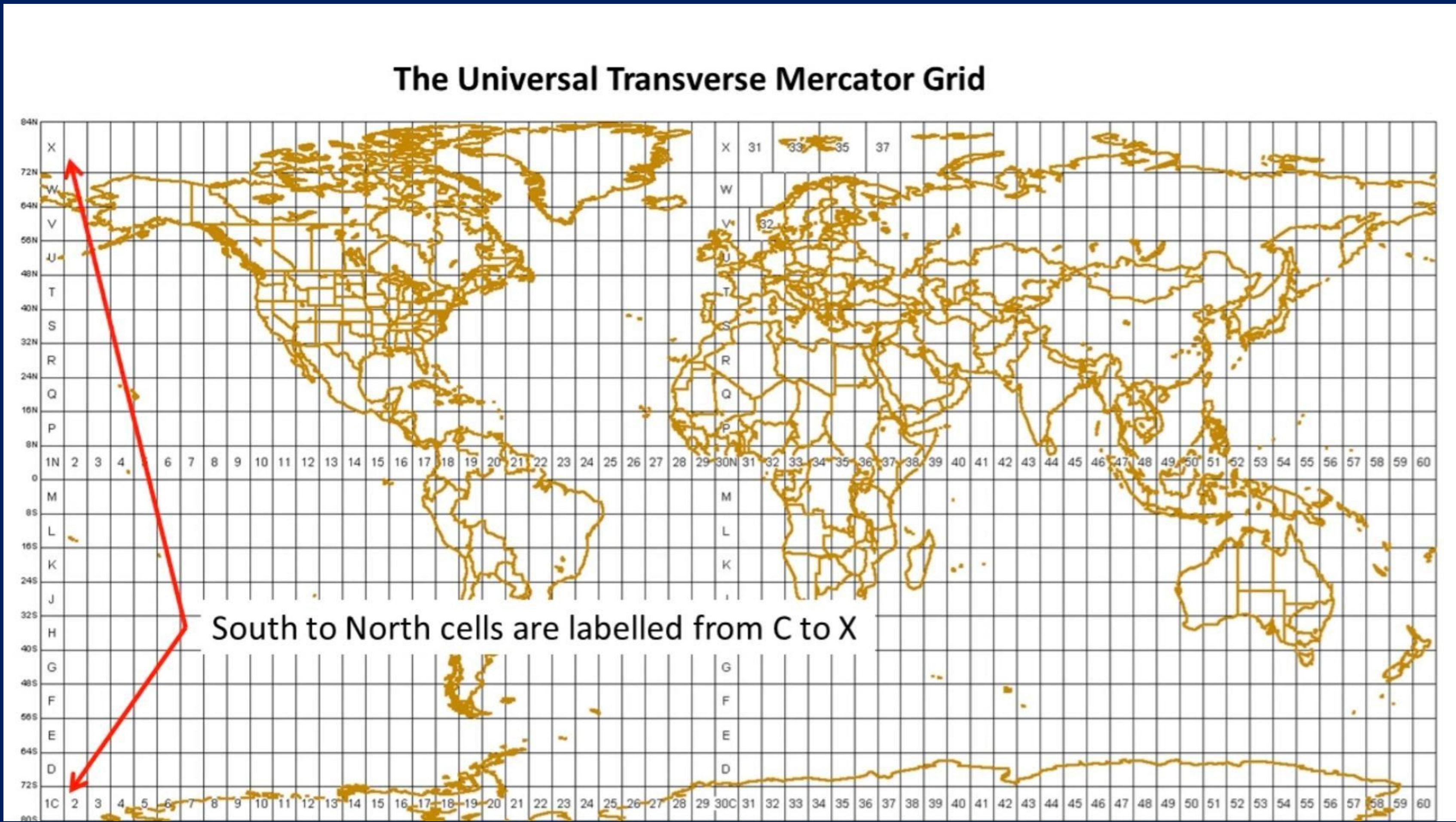
Cylindrical projection



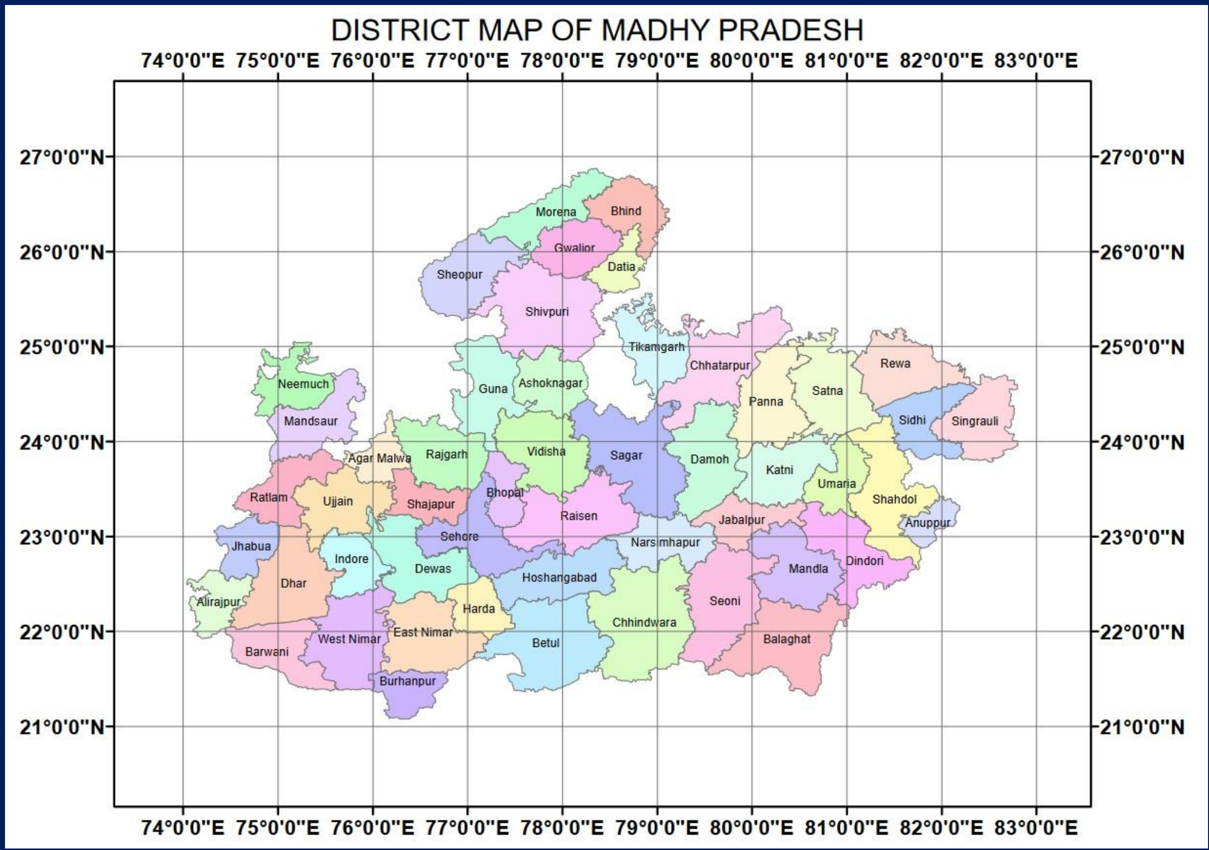
UTM GRID NUMBERING

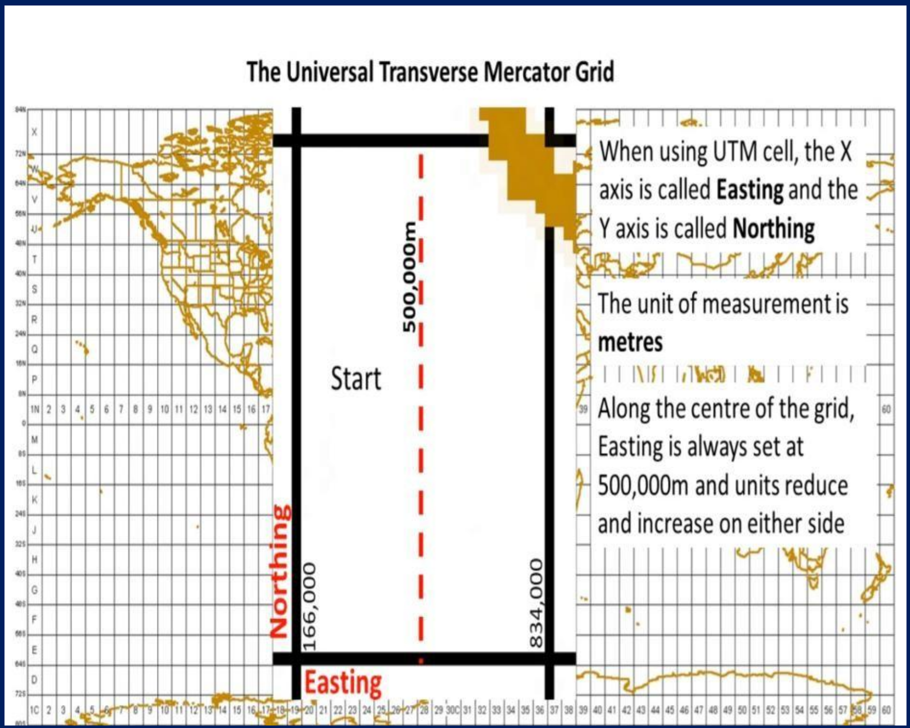


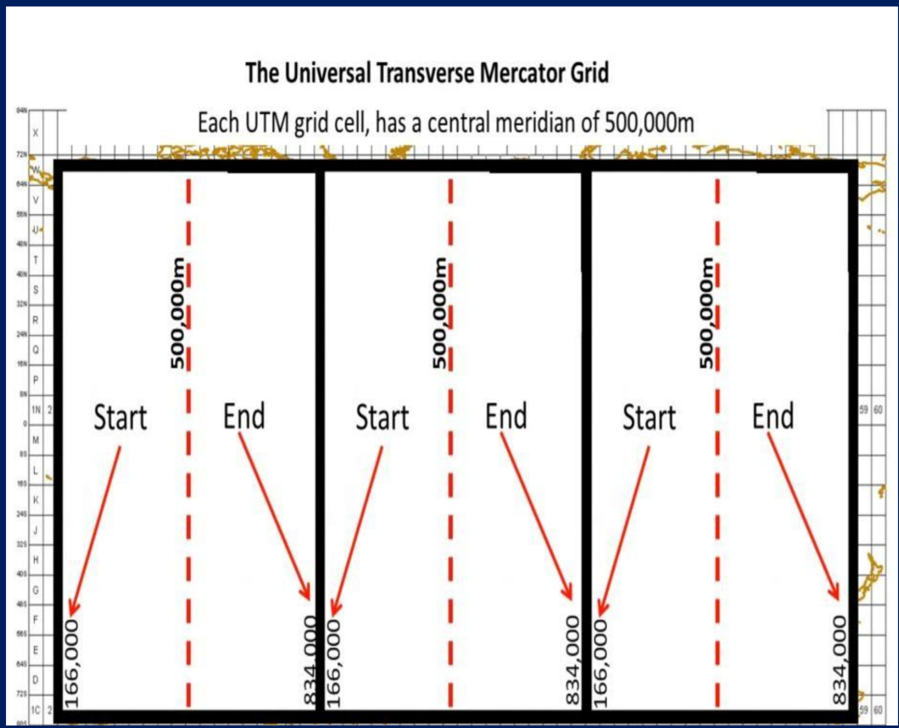
UTM GRID NUMBERING

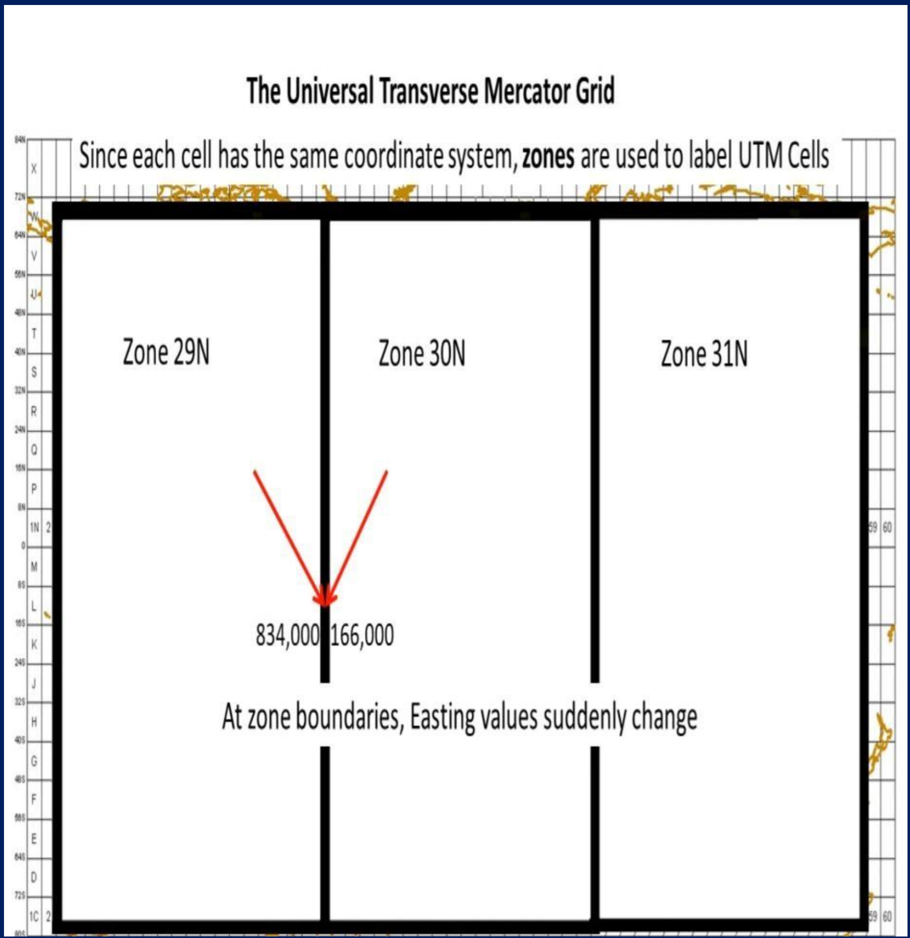


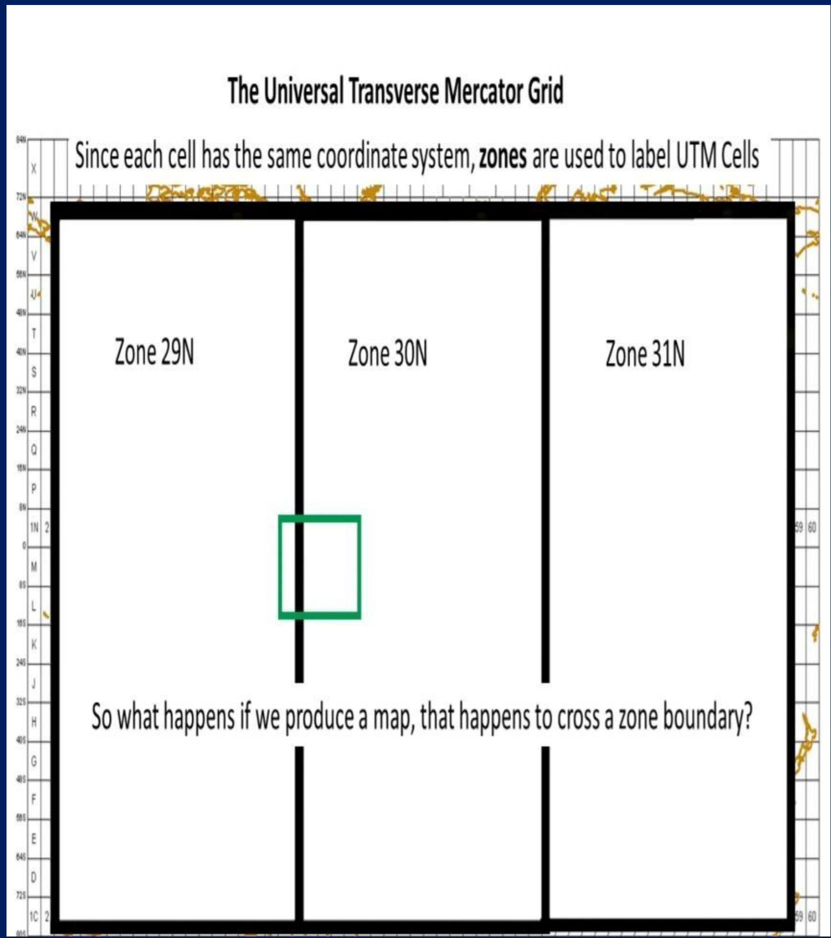
The Two Zones 43 N & 44 N in state of Madhya Pradesh

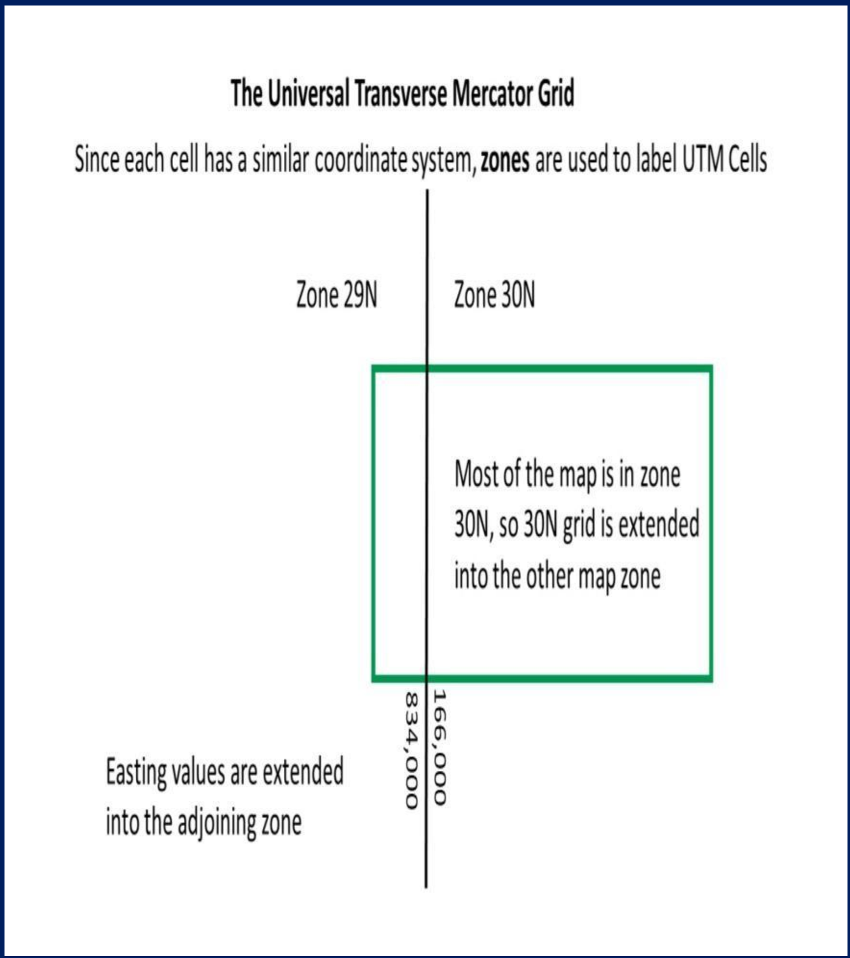


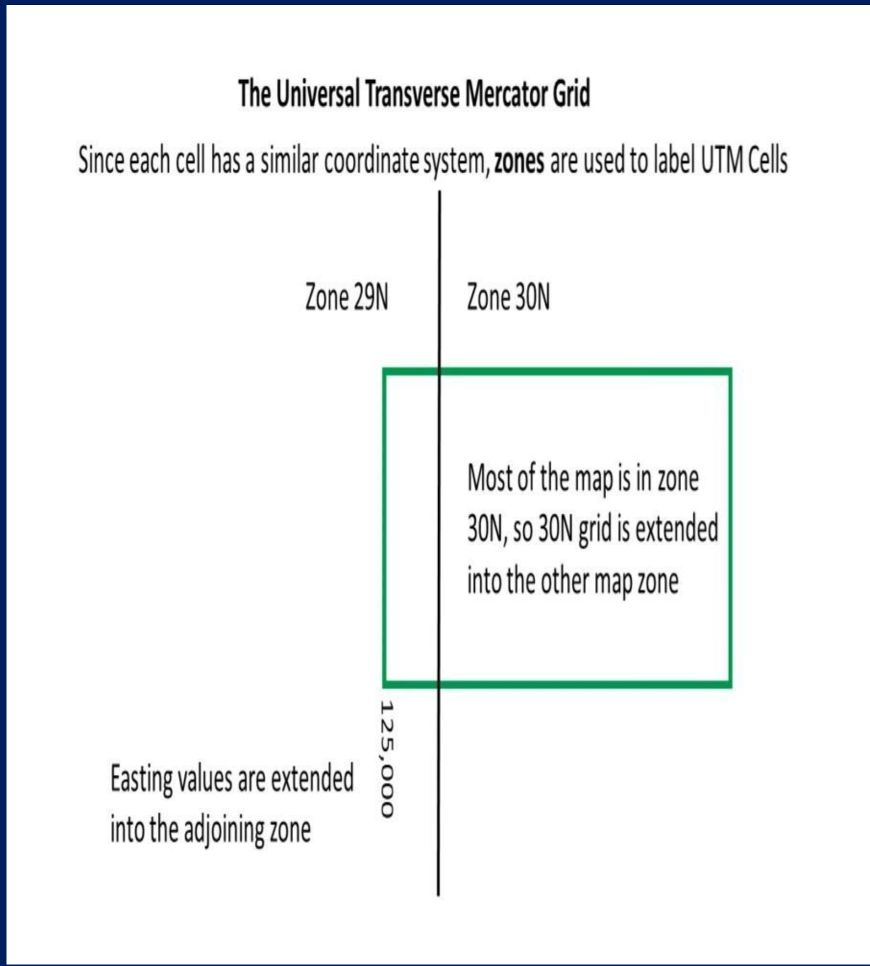

The Universal Transverse Mercator Grid
When using UTM cell, the X axis is called **Easting** and the Y axis is called **Northing**
The unit of measurement is **metres**
Along the centre of the grid, Easting is always set at 500,000m and units reduce and increase on either side
500,000m
Start
Northing
166,000
834,000
Easting

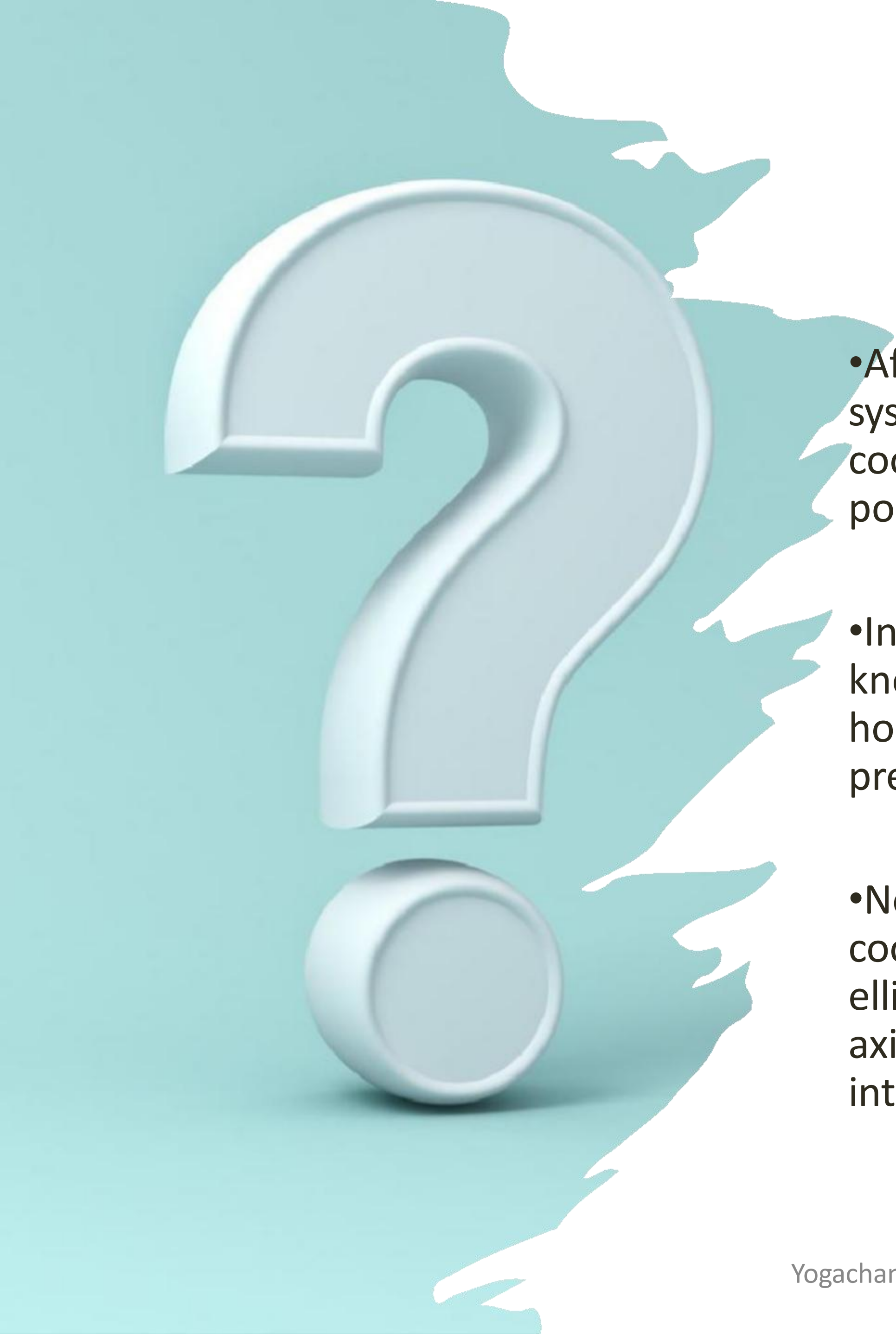

The Universal Transverse Mercator Grid
Each UTM grid cell, has a central meridian of 500,000m
500,000m
Start
End
166,000
834,000


The Universal Transverse Mercator Grid
Since each cell has the same coordinate system, **zones** are used to label UTM Cells
Zone 29N
Zone 30N
Zone 31N
834,000
166,000
At zone boundaries, Easting values suddenly change


The Universal Transverse Mercator Grid
Since each cell has the same coordinate system, **zones** are used to label UTM Cells
Zone 29N
Zone 30N
Zone 31N
So what happens if we produce a map, that happens to cross a zone boundary?


The Universal Transverse Mercator Grid
Since each cell has a similar coordinate system, **zones** are used to label UTM Cells
Zone 29N
Zone 30N
Most of the map is in zone 30N, so 30N grid is extended into the other map zone
834,000
166,000
Easting values are extended into the adjoining zone


The Universal Transverse Mercator Grid
Since each cell has a similar coordinate system, **zones** are used to label UTM Cells
Zone 29N
Zone 30N
Most of the map is in zone 30N, so 30N grid is extended into the other map zone
125,000
Easting values are extended into the adjoining zone



COORDINATE SYSTEMS (Conclusion)

- After observing the various co-ordinate systems, it is to note that merely having the coordinates does not confirm precisely the position on the globe.

- In addition to the co-ordinate we should know the reference datum both for horizontal and vertical. Then only we can precisely no position on the globe.

- Note that we can have different coordinates for a position with different ellipsoids since the values of semi major axis and semi minor axis can determine the interval gap of latitude and longitude.

Need for a common co-ordinate system?

- A few decades before there were only a very few ways and means to find out the co-ordinates (latitude and longitude) a location in three dimensional surface of an ellipsoid.
- Even the few methods adopted were very tedious and required a skilled man-power. eg. Triangulation, Astronomical survey
- Hence, it was very difficult for any individual to locate the coordinates, this is also one of the reasons that the Geographic Coordinate system was adopted only in the small & medium scale mapping such a topographic maps but not in large scale mapping such as the cadastral mapping

ADVANTAGES of using common Coordinate system

After opening the GPS for civilian use in the year 1983 and subsequent augmentation in the accuracy in year 2000 (by removing the S.A.) also the increase in the number GNSS constellations, any individual with a GNSS instrument would be able to locate co-ordinate of the points accurately up-to a few millimetres to centimeters.

This has rendered any type of survey work (Topographical, Engineering Geodetic ,cadastral survey) shall be referenced on common national/global reference framework

The data thus produced would be more consistent and comparable catering to the various needs of the country development.

THANKYOU