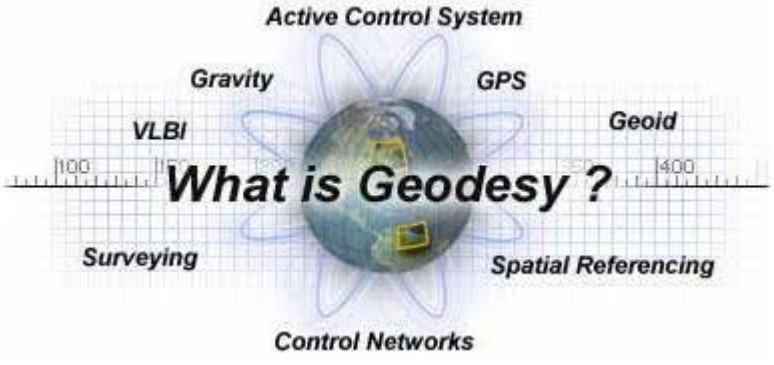
Geodesy 1B (GED209)

Instructors

Ali ELSAGHEER, Mohamed FREESHAH, Reda FEKRY

Email: mohamedfreeshah@whu.edu.cn

Mohamed.freeshah@feng.bu.edu.eg



Geodesy 1B Course Contents

1. Introduction.
2. Precise leveling and trigonometric leveling.
3. Height Systems.
4. Coordinate Systems.
5. Geodetic Networks.
6. Strength of figure, Conditions, equal shift.
7. Satellite station.
8. Direct and inverse problems

Geodesy 1B

Knowledge Objectives

1. Understand principles of geodesy and its contributions to Earth sciences.
2. Become familiar with the Earth as a planet, and its motions.
3. Develop knowledge and understanding on different coordinate systems, the fundamental components of Geodesy.

4. identify the actual and mathematical figure of the earth.
5. Familiar with identify the applications of geodesy in surveying fields.
6. solve the main geodetic problems.
7. Gain knowledge of some geodetic instruments and complete surveying missions using traditional geodesy.

Geodesy 1B

Suggested Text Books

Jiming Guo and Wang,J.,(2011). Foundation of Geodesy . Surveying and Mapping Press, Beijing

Seeber, G., (2004). Satellite Geodesy, Walter de Gruyter, Berlin

Torge, W., (2001), Geodesy. Walter de Gruyter. Berlin (3rd Edition).

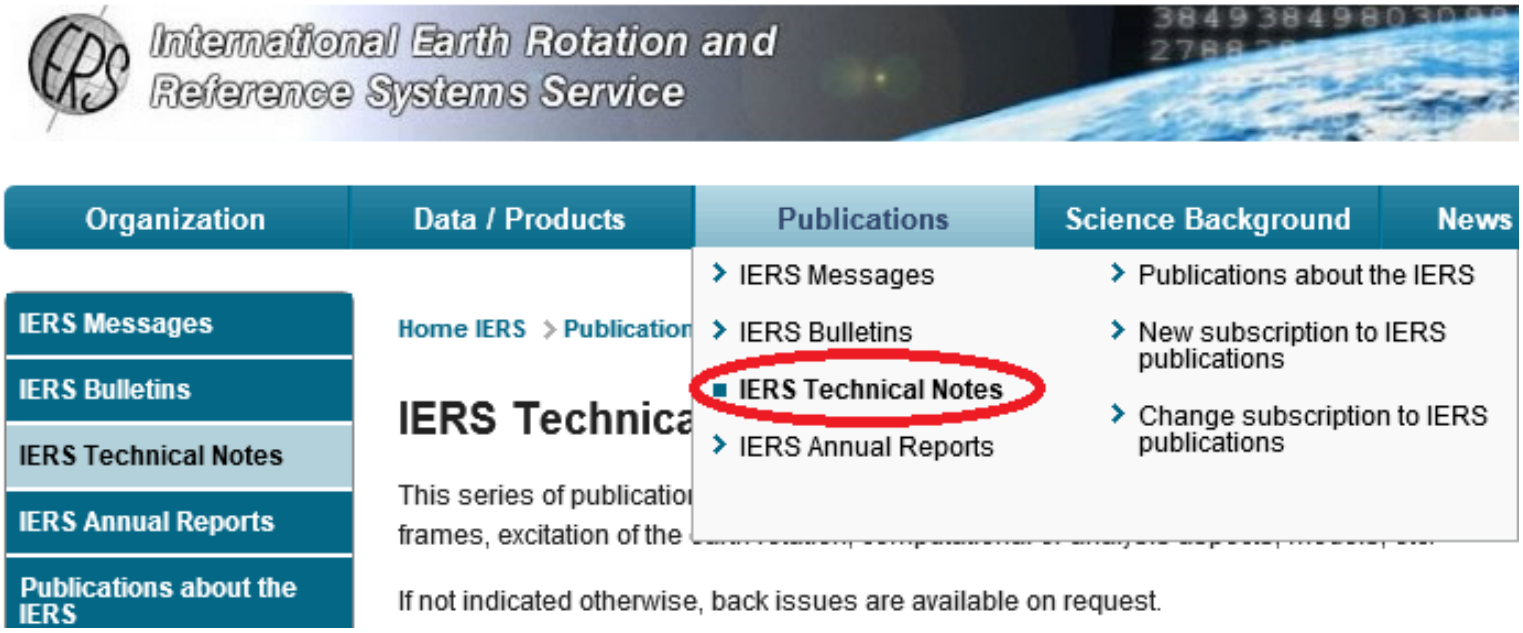
Vaníček P., and E. Krakiwsky (1986). Geodesy: The Concepts. North Holland, Amsterdam (2nd Edition).

Maarten Hooijberg, Practical Geodesy, Springer, 1997

Duggal, S. K., Surveying Volume 2, 2002

Reference documents from Website

http://www.ngs.noaa.gov
http://www.iugg.org/
http://www.iag-aig.org
http://www2.unb.ca/gge/HotList.html
http://www.nrcan.gc.ca/
http://www.iers.org



Geodesy 1B

Assessment

Midterm, Quizzes, Assignments,
Attendance..etc. 20%
Oral (oral, practical, Tasks..etc) 20%
Final Exam 60%

1. Introduction

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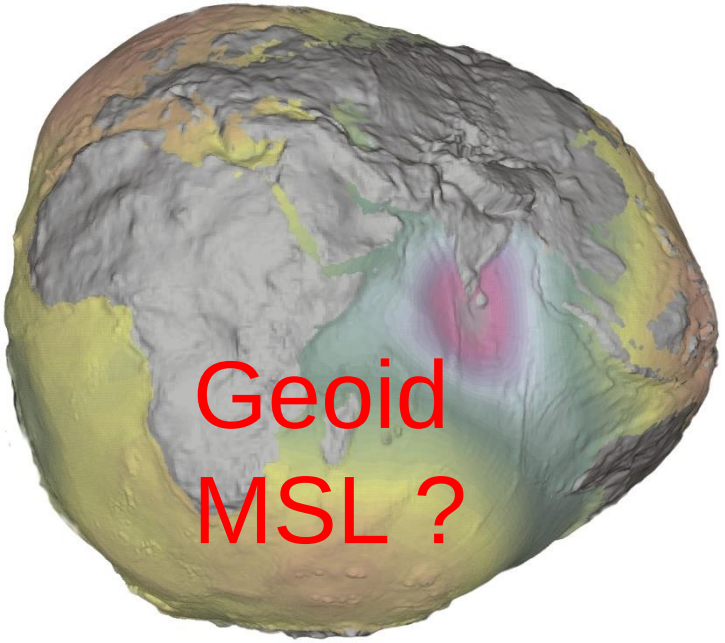
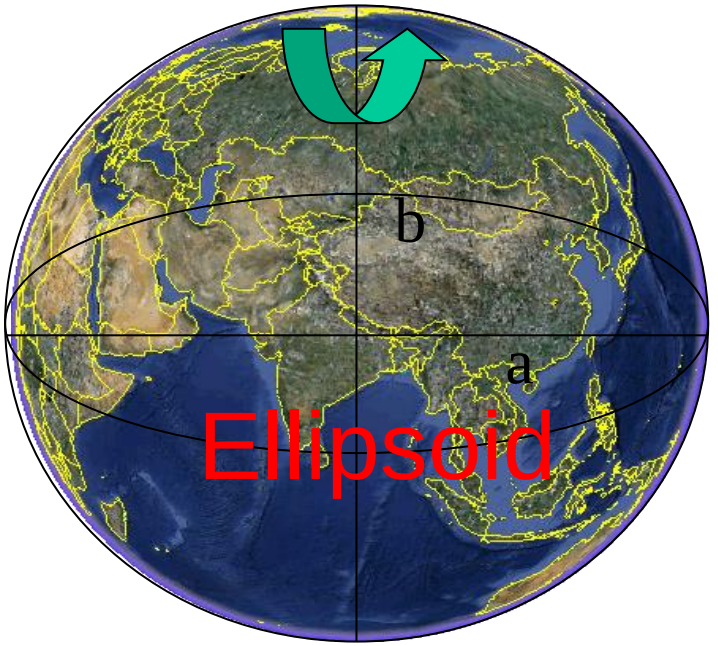
Geodesy: The science concerned with the determination of size, shape and gravity field of the Earth as well as positioning of objects near the Earth.





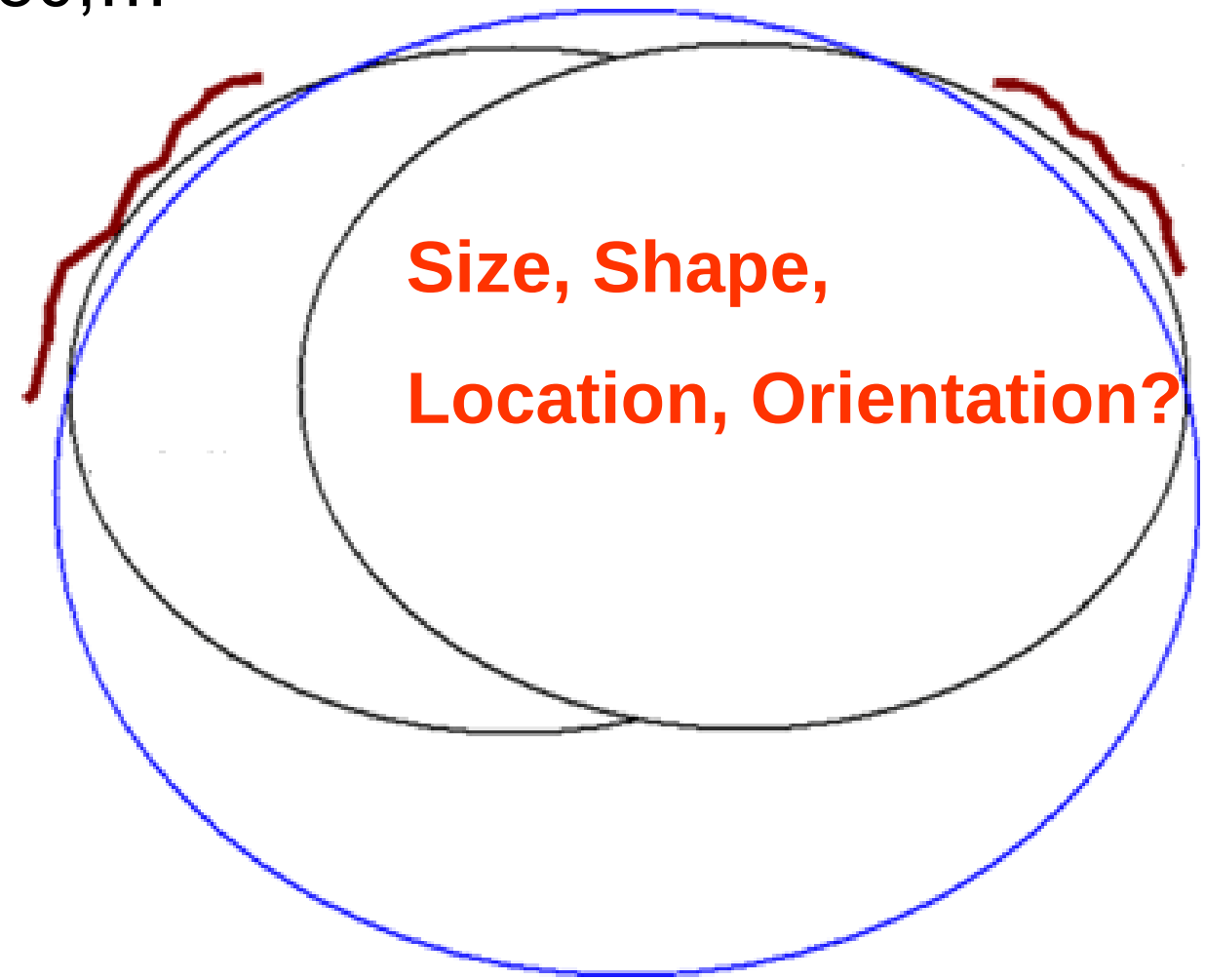
Local Ellipsoid

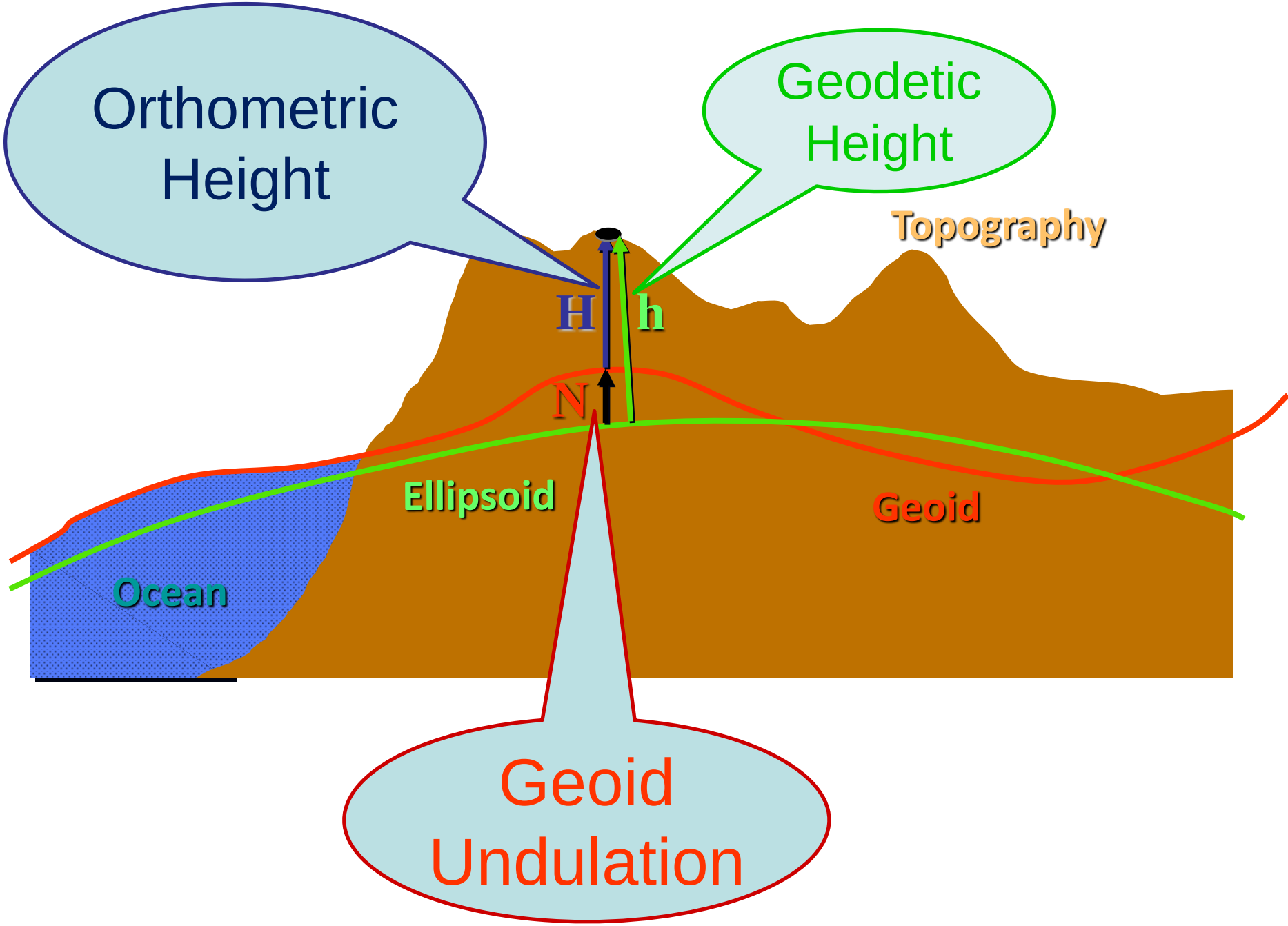
Helmart, Hayford, BJ54, Xian80,…

Global Ellipsoid

WGS84,GRS80,CGCS2000

…

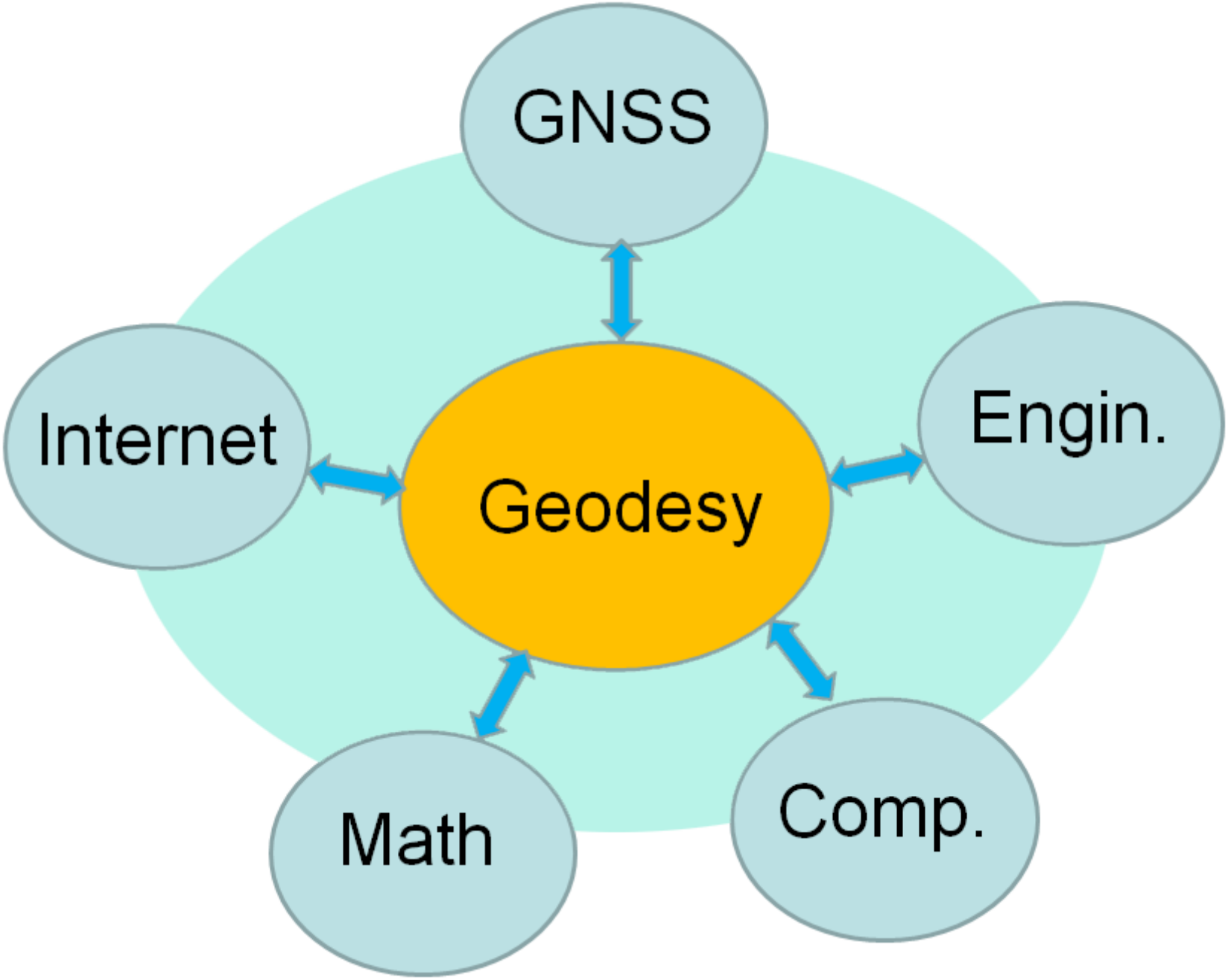



Orthometric Height
Geodetic Height
Topography
H
h
N
Ellipsoid
Geoid
Ocean
Geoid Undulation

Geodesy: branches, tasks and problems

Geometric Geodesy	Physical Geodesy	Space Geodesy
Geodetic Control Network	Geoid Gravity Field	GNSS,VLBI, SLR
Positioning	Gravity	Space Vehicle

Other names: Applied Geodesy, Ellipsoidal Geodesy, Satellite Geodesy, Inertial Geodesy, Geophysical Geodesy…


GNSS
Internet
Geodesy
Engin.
Math
Comp.

Task of Geodesy

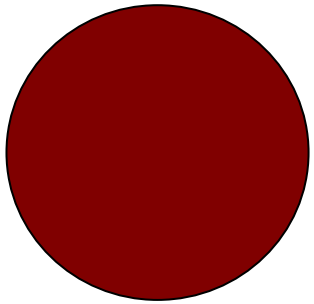
(1)To determine the shape of the Earth and its external gravity field as well as their changes with time, to study the crust deformation, and to observe the polar motion and monitoring the ocean surface.

(2)To set up the geodetic coordinate system and to maintain the national horizontal geodetic control network and the vertical leveling network.

(3)To study the observation methods for geodetic instruments such as total stations, levels, GPS, VLBI etc. and to perform the data processing for distances, directions, height differences, GPS baselines.

(4)To describe the mathematic models for the geodetic calculation on the Earth ellipsoidal surface and the map projection from ellipsoid surface to plane.

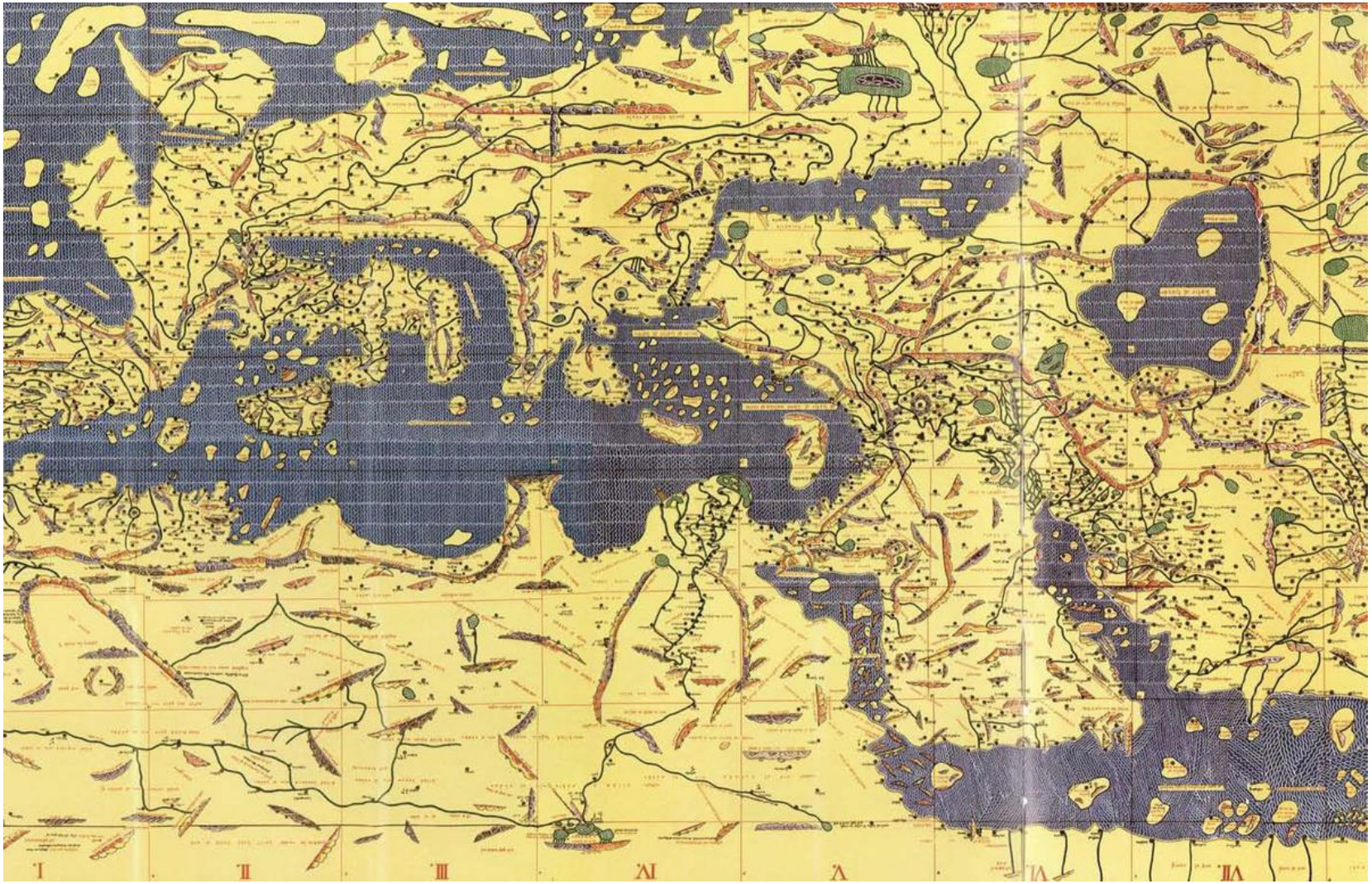
Historic Development of Geodesy

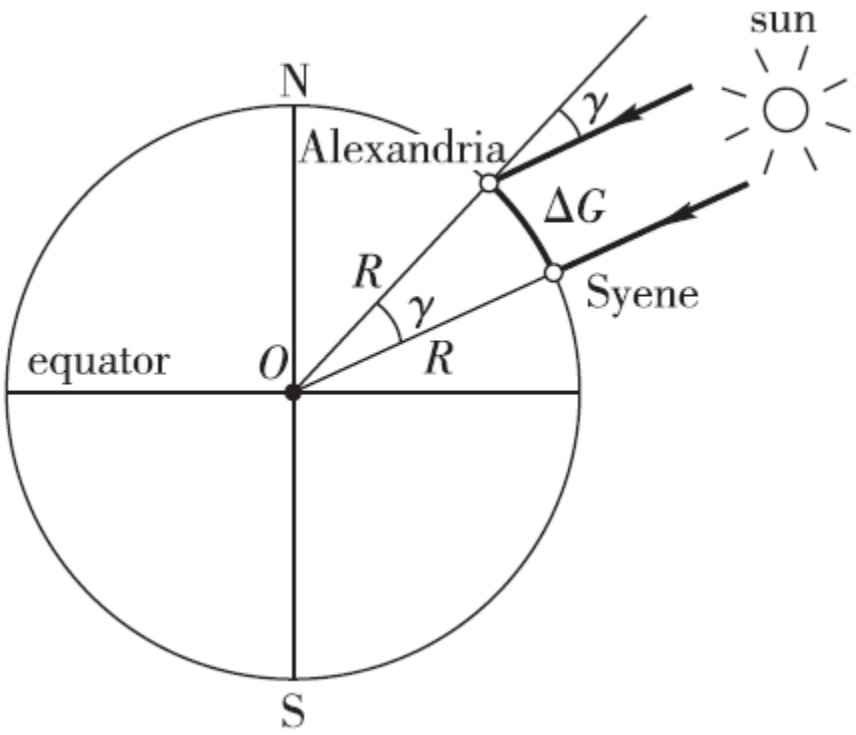


First Stage: Spherical Earth Model

- Pythagoras, 6 Century BC, Sphere Earth
- Eratosthenes, 276-194 BC, Greek Mathematician, Semi-major radius of the Earth (6267km)
- ZHANG Sui, 724 AD, China, Arc of Meridian
- Muhammed Al-Idrisi, 1175 AD, 1st Atlas of world

idrisi map



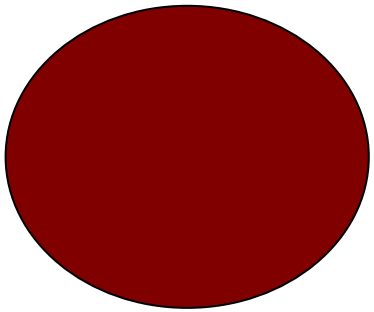


$$R = \frac{\Delta G}{\gamma}$$

R = 6267 km

Eratosthenes

Second Stage: Ellipsoidal Earth Model



- Snell,1615, Netherland, Trigonometry
- Newton, 1687, flattening $f = \dfrac{a-b}{a}$
- Clairaut,1743, France,

$$\gamma_\varphi = \gamma_e(1+\beta\sin^2\varphi),\quad \beta = \frac{5}{2}q - f,\quad q = \frac{\omega^2 a}{\gamma_e}$$

$$\beta = (\gamma_p - \gamma_e)/\gamma_e$$

- Delambre, 1792, Germany, define unit of length 1m=1/40,000,000 of meridian
- Legendre and Gauss, 1794, Least Square
- Gauss, 1822, Map projection

C.F.Gauss,

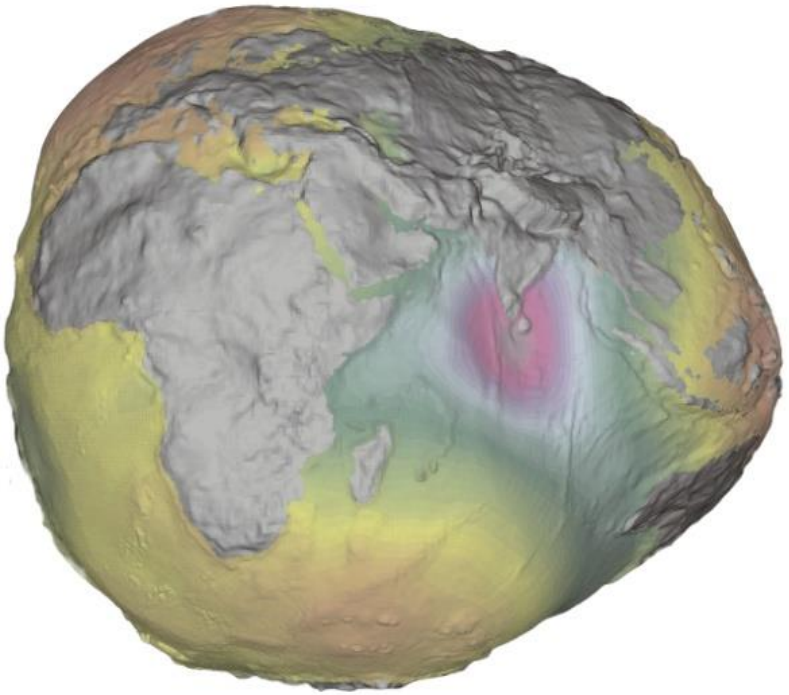
1777~1855

- Least Square
- Gaussian Distribution
- Map Projection

……

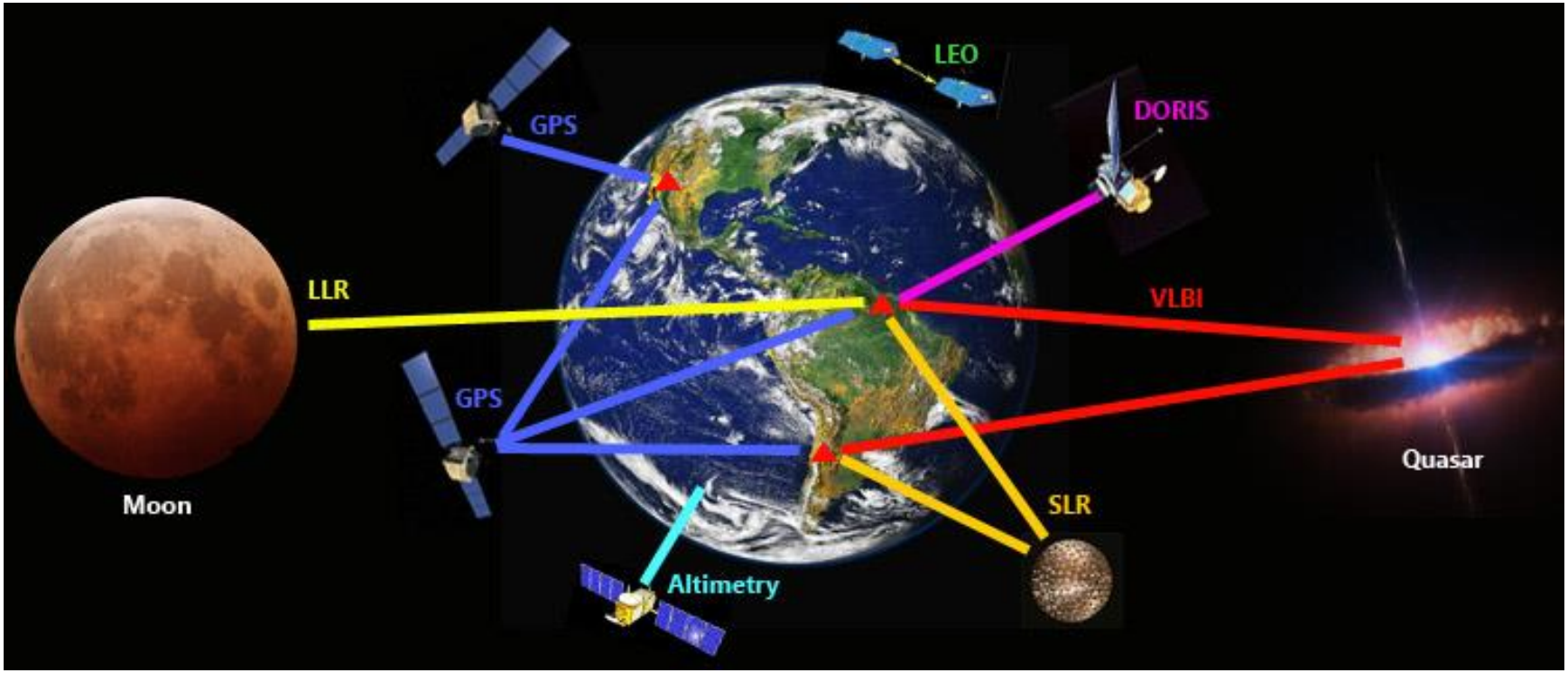
Third Stage: Geoid

- Stokes, 1849, Geoid
- 1920, Theodolite (Wild)
- Molodensky, 1945, Soviet Union
- 1960s, EDM
- 1970s, Totalstation



Latest Development

- 1980s, GPS,GLONASS
- 2000s, GALELIO, BEIDOU
- VLBI,SLR,DORIS,CORS
- ITRS & ITRF



2.Trigonometric Leveling(TL)

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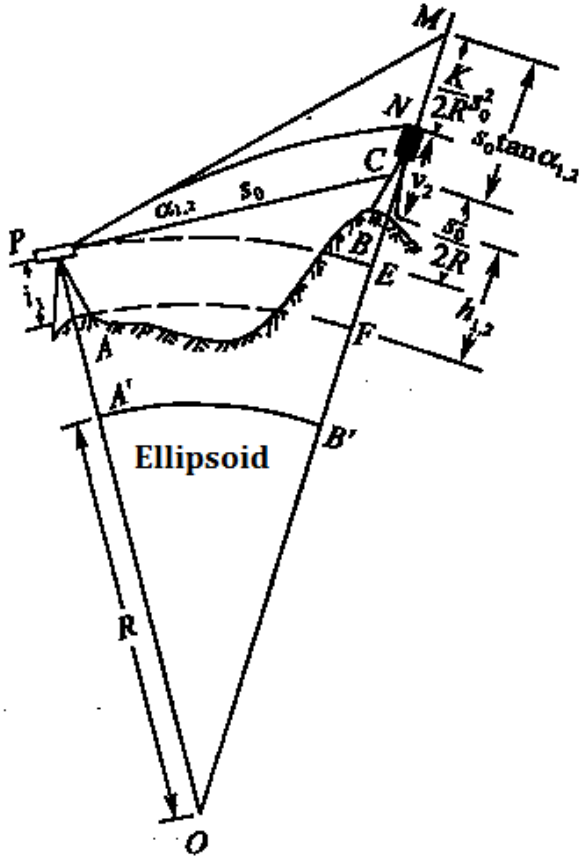
- the process of determining the different elevation of station from observed vertical angle and known distance.

- Two methods of TL

1- Single observation method

2- Reciprocal method

Which one is better?



Trigonometric Leveling (TL)

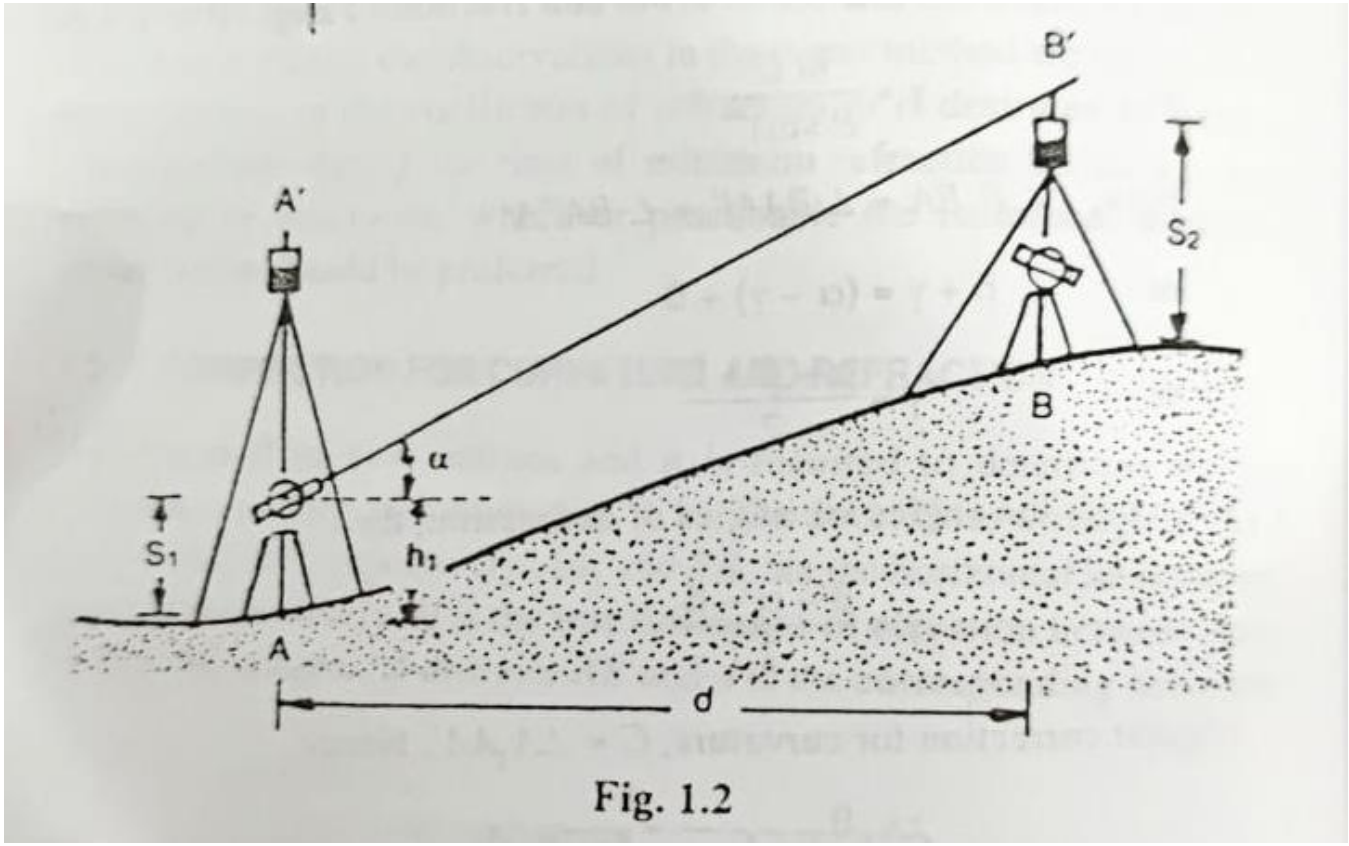
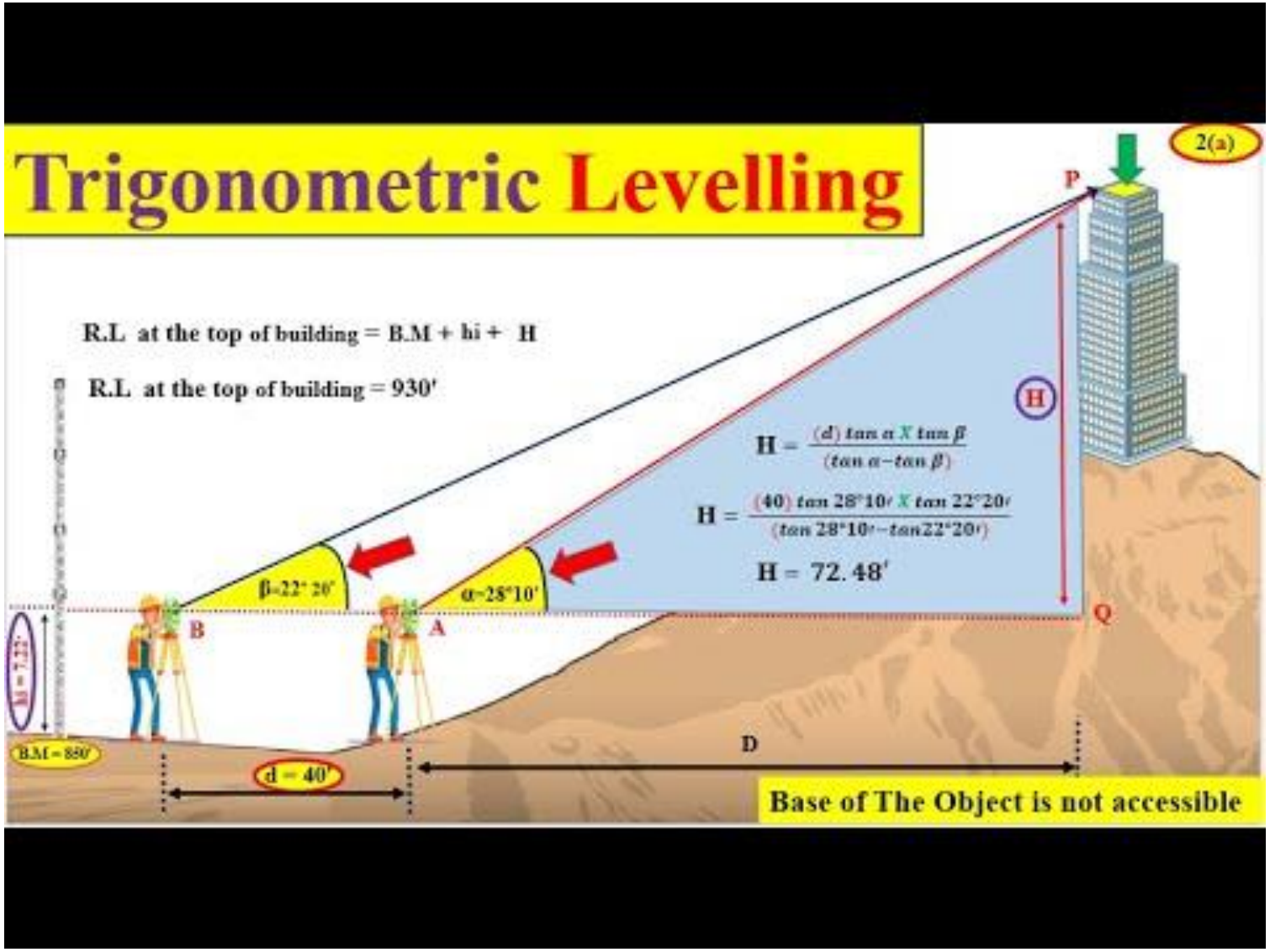


Fig. 1.2

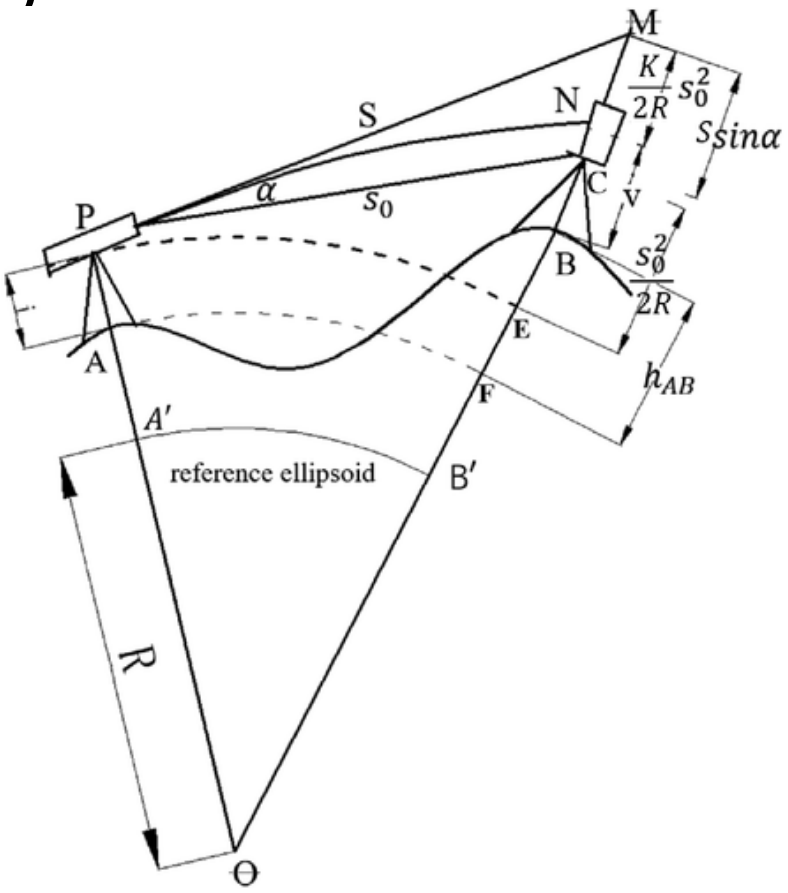
Trigonometric Leveling



Trigonometric Leveling (Corrections)

- 1- Correction for curvature (c) and refraction (γ)
- 2- Axis signal correction (δ)

- How to avoid or eliminate these kind of errors?



Trigonometric Leveling (Example)

- A vertical angle of elevation was observed from a station P as 2^{o} 32’ 25’’ . Determine its true value if the height of instrument at P is 1.2 m and height of signal at the other station Q is 5.2 m. The two stations P and Q are 5200 m apart. Take the value of R sin1’’ as 30.88 m. The coefficient of refraction is 0.07. Find also the true value of the angle observed if it was an angle of depression.

Review Questions

(1) What is geodesy?

(2) Classify the different geodetic branches

(3) Summarize the tasks in geodesy

(4) Why to model the Earth as an ellipsoid?

(5) Why is a geoid needed?

(6) Describe the trend in geodesy

(7) Describe the difference between the techniques of reciprocal leveling and reciprocal trigonometrical leveling.

Discussion

- The development of geodesy in Egypt
- The national geodetic coordinate system
- The geodetic control network
- The related organizations for geodesy
- The education programs for geodesy
- ……


Thanks for your Attention