COORDINATE SYSTEMS ON THE EARTH ELLIPSOID AND ON THE MAPS

INFORMATIONS

practical lesson, attendance compulsory

Online: Teams, temporarily Thursday 1pm

Face to face: Monday 1pm, room 7.87

Consultation: temporarily Monday 6pm (as agreed if it is necessary)

Canvas (canvas.elte.hu)

Lecture notes

http://mercator.elte.hu/~gyorffy/jegyzete/MapProjGIS/MapProjGIS.html

Written examination

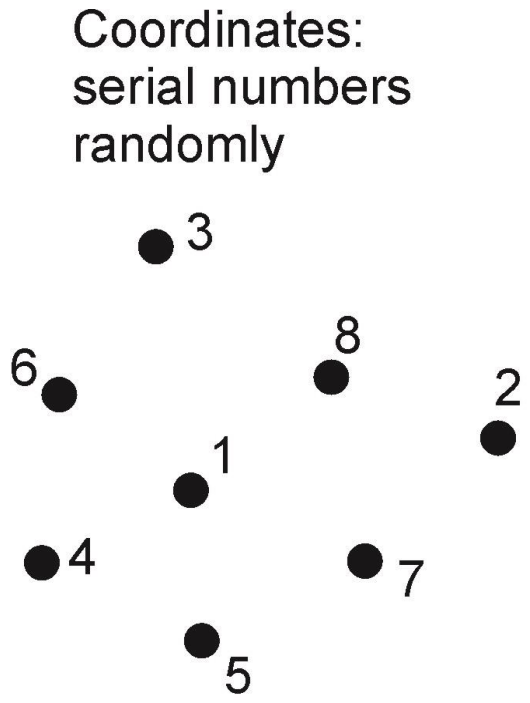
Concept of coordinates and coordinate systems in the geometry

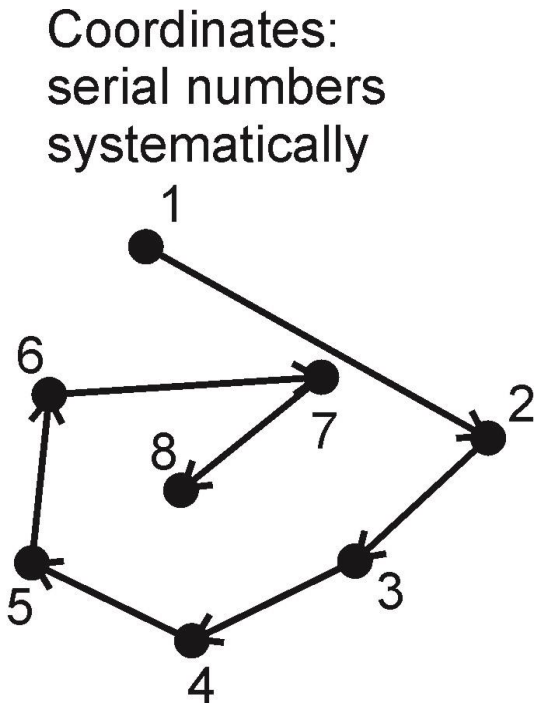
Given a set of geometric points

Coordinate(s) – numbers identifying the points of the set

Coordinate system (in the geodesy it is called rather **reference system) –** a prescription: how to assign the coordinate(s) to the points of the set

Illustrative example – the points of the set are identified by serial numbers





- In the field of geodesy and cartography, the coordinate(s) should refer to the geographic location of the points

Control point 1 (Lágymányos Campus Northern Building sun physics terrace centre point)

Geographic coordinates:

	Φ	Λ
WGS-84	47° 28' 29.262"	19° 3' 43.303"
GK-S42*(Krasovsky)*	47° 28' 30.496"	19° 3' 49.135"
HD72*(IUGG67)*	47° 28' 30.206"	19° 3' 47.2824"
HD1909*(Bessel)*	47° 28' 26.076"	19° 3' 49.3709"

Height above ellipsoid=187.575 m

Map coordinates:

	Y	X
EOV	**651097.685 m**	**236759.995 m**
(UTM-WGS84)	(353975.846 m)	(5259748.201)
Bp. sztereo	**-1097.61 m**	**1345.08 m**

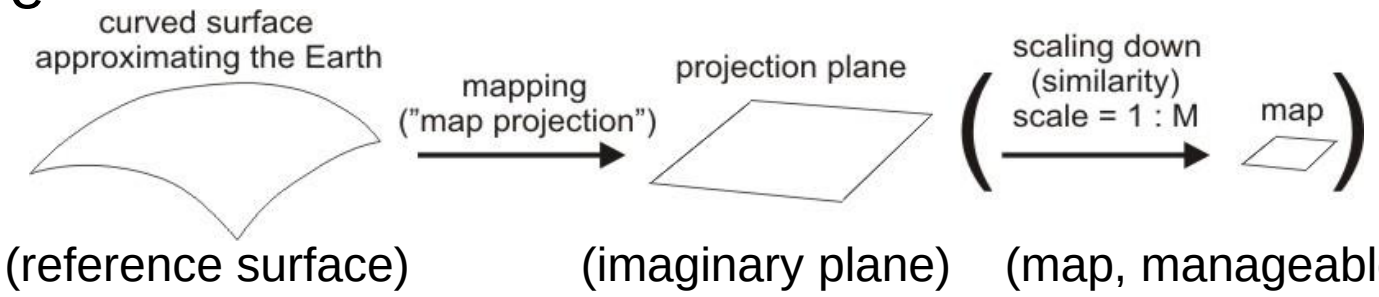
Height above geoid=143.755 m

SYLLABUS

- **A) Mapping the Earth's surface onto a plane - fundamentals**
- Basic concepts of coordinates and coordinate systems in the geometry
- Elementary geometric coordinate systems
- Approaching the Earth's surface by reference surface. The basic properties of ellipsoid of revolution.
- **B) Earth coordinates**
- Spatial rectangular, geographic and superficial polar coordinate systems. Metacoordinates
- Transformations among diverse coordinate systems on the spherical and ellipsoidal surface
- Geodesic datum, approaching sphere
- The transformation of the geographic coordinates among different reference systems
- **C) Map coordinates**
- Map projections in general, map distortions
- Azimuthal projections
  - Oblique azimuthal projections and their cartographic application
- Cylindrical projections
  - Oblique cylindrical projections and their cartographic application
  - Transverse cylindrical projections and their cartographic application
- The Gauss-Krüger and UTM projections
- Conical projections and their cartographic application
- Conversions among coordinates of diverse map projections
- **D) Positioning and reporting systems** (GEOREF, MGRS)

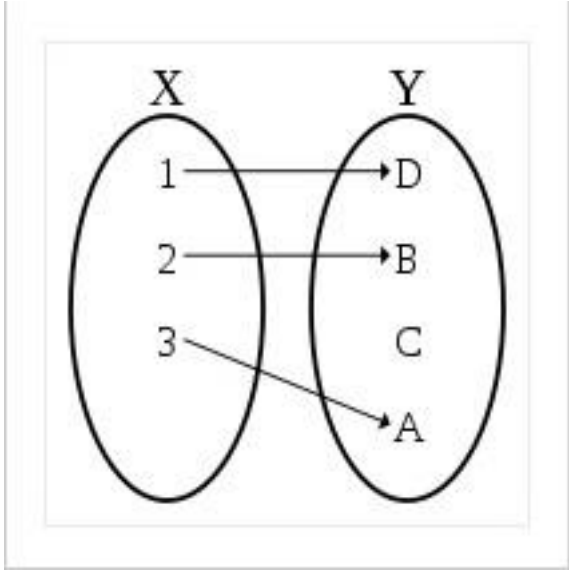
The geometric principle of representation on maps

- The curved earth surface with its objects – 3D figure
- It is represented on plane (paper- or screen map) – 2D figure



- The points of the earth's surface and its objects are located with earth or map coordinates on these ***continuous***, ***regular*** surfaces which can be described by a ***mathematical formula*** or ***series***. The mathematical relationship between the two coordinates is ***injective (one-to-one)***, it is given by a ***twice continuously differentiable*** mapping (a so-called map projection) and can be described by a ***mathematical formula*** or ***series***.

Injective mapping or one to one mapping



sequence:

1, 3, 5, 7, … 1, ½, ¼, 1/8, …

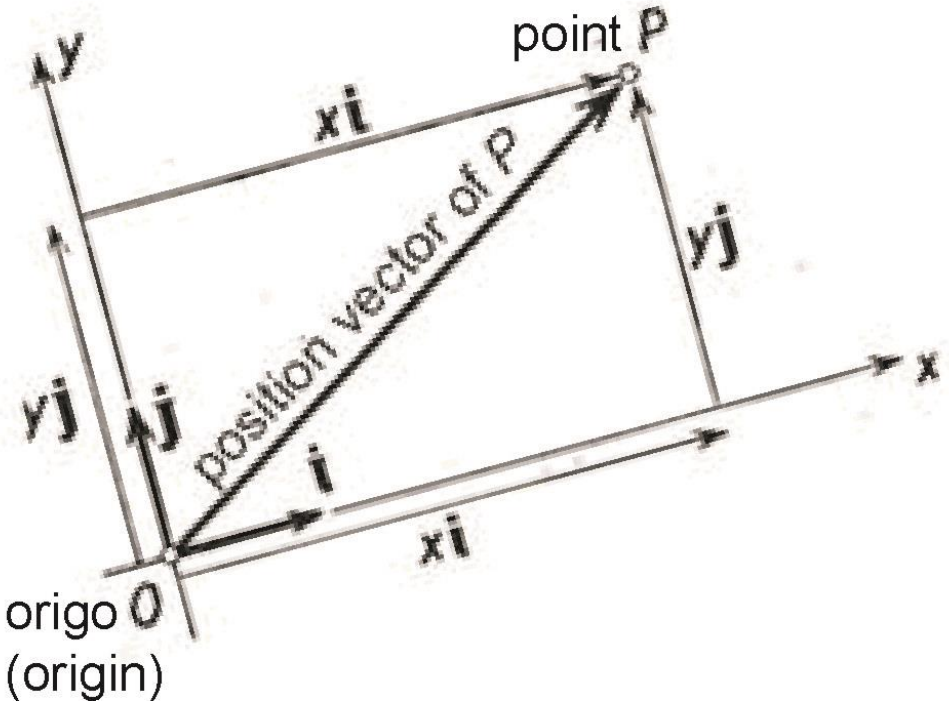
series:

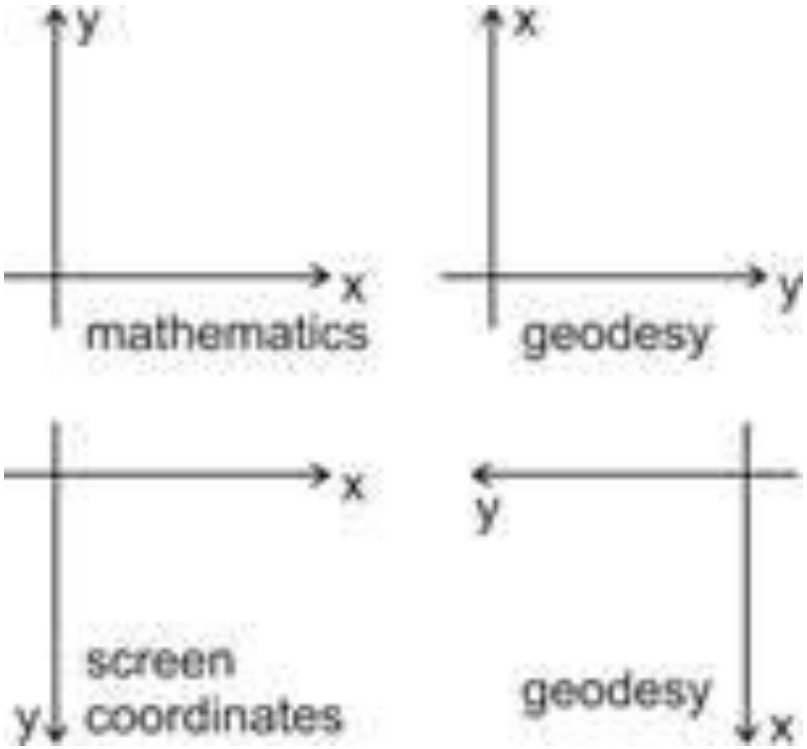
1+3+5+7+… 1+½+¼+1/8+ …

Elementary geometric coordinate systems on plane, in space and on surface of revolution

Elementary coordinate systems on plane (1):

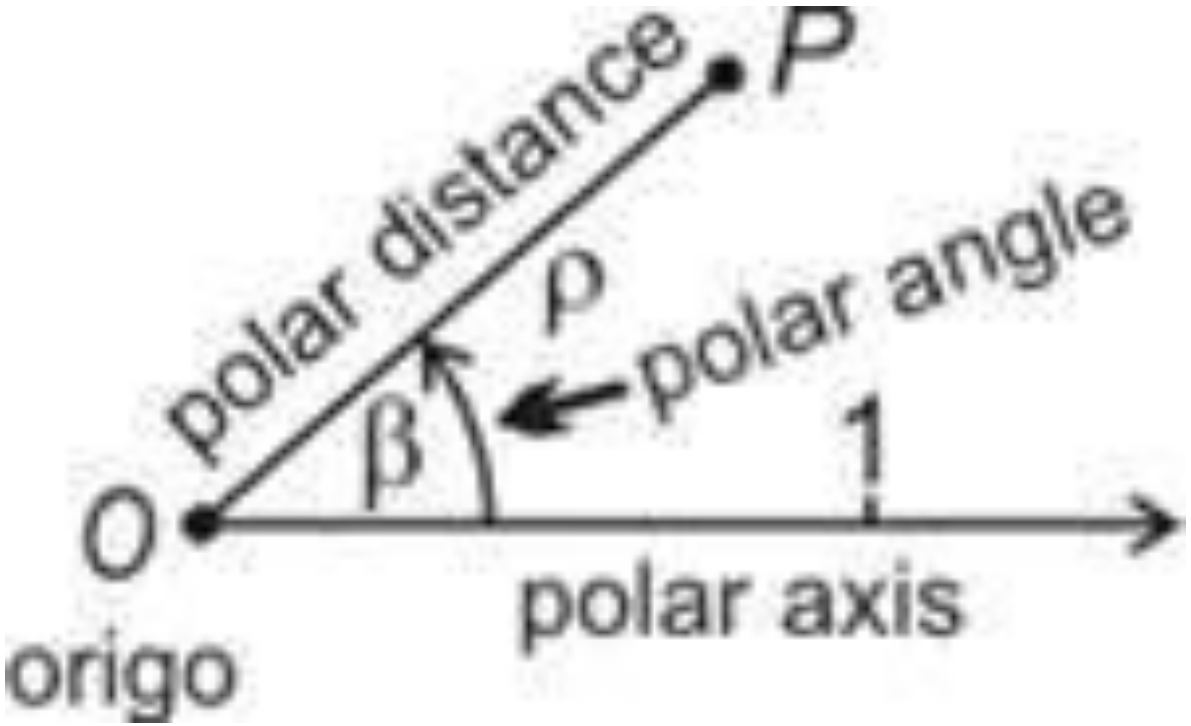
planar **rectangular** (Cartesian) coordinate system:





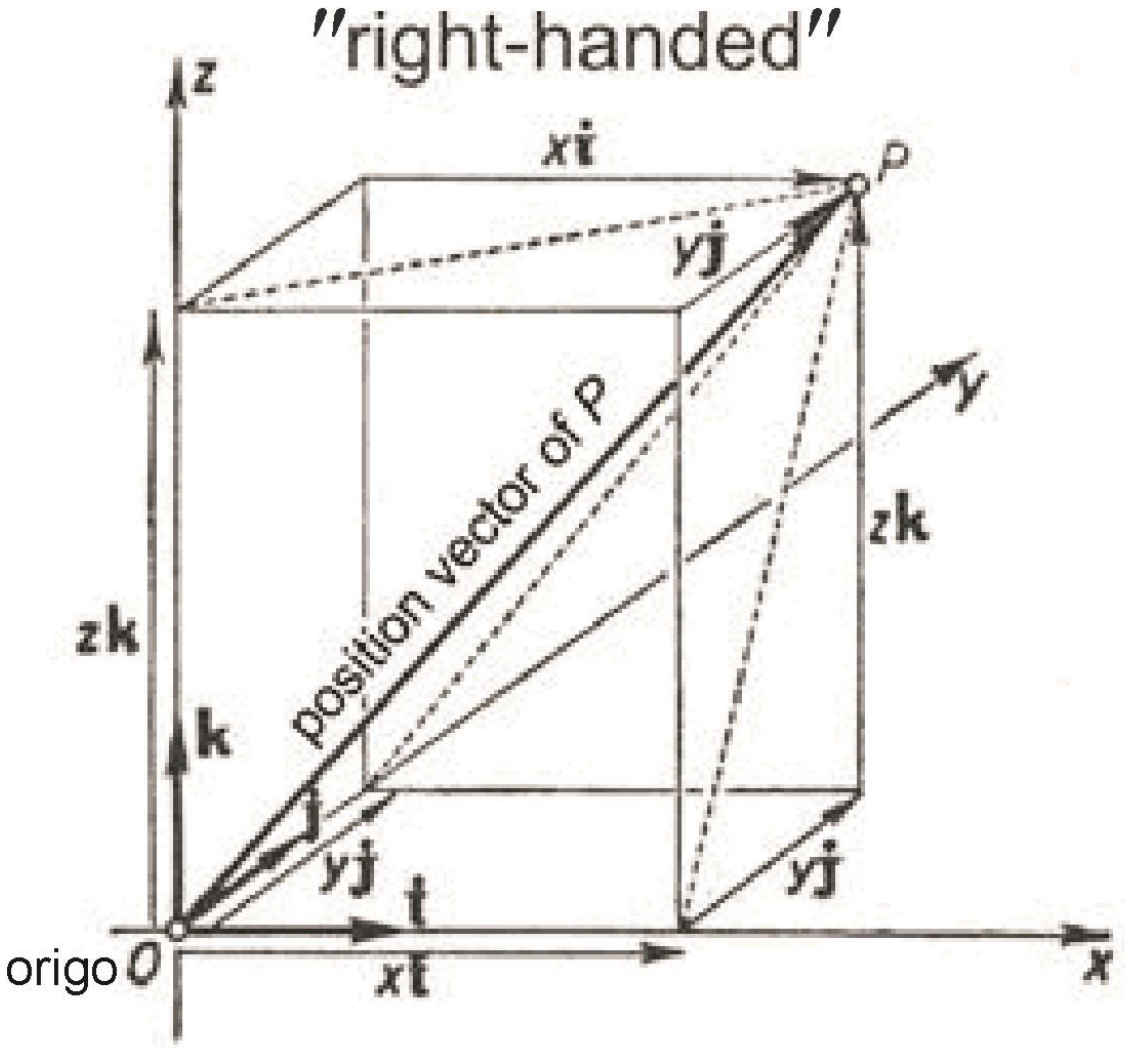
Elementary coordinate systems on plane (2):

planar **polar** coordinate system



Elementary coordinate systems in space (1):

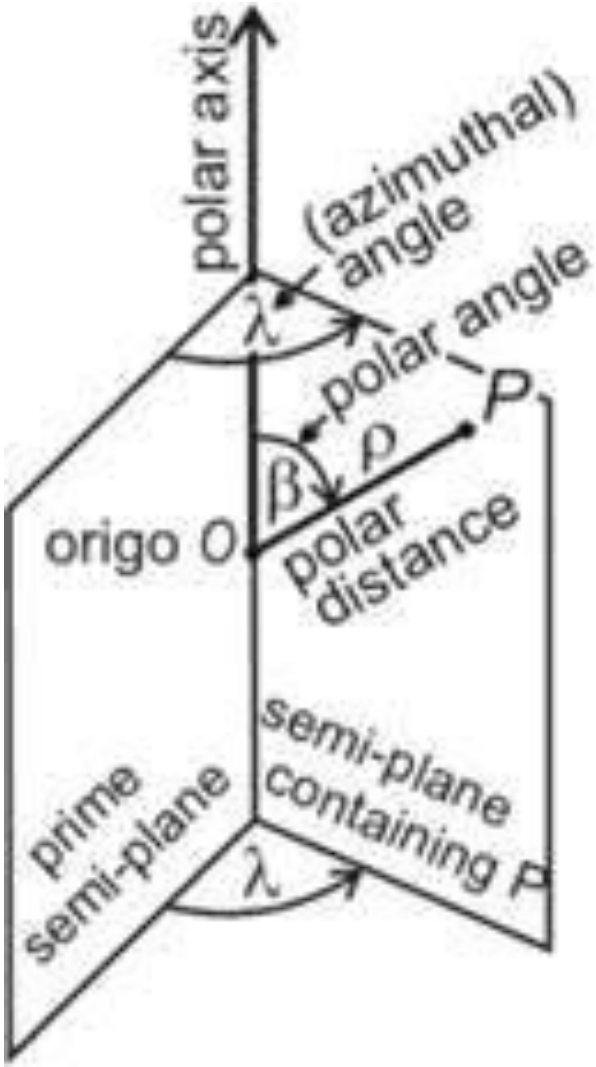
spatial **rectangular** (Cartesian) coordinate system



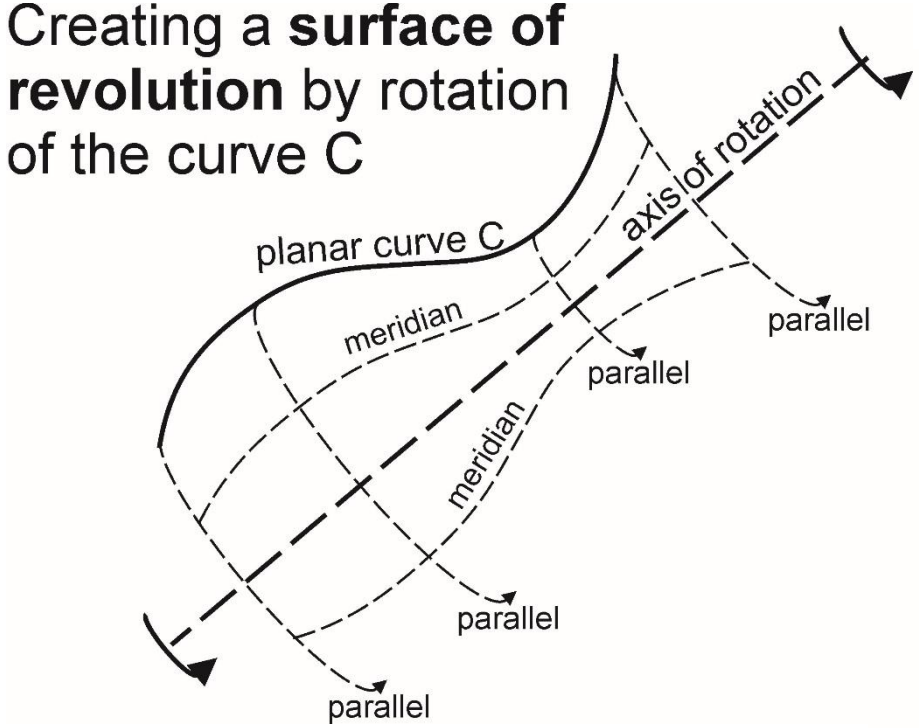
Elementary coordinate systems in space (2):

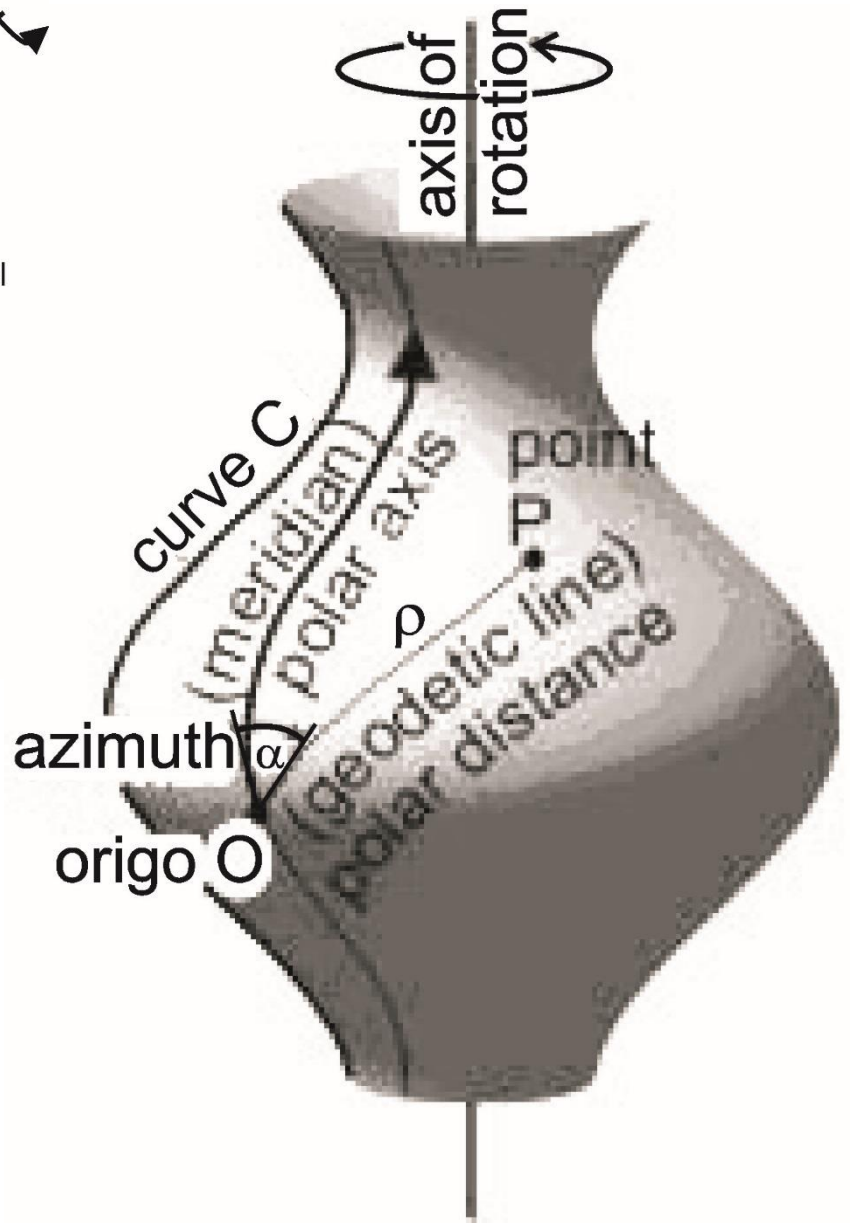
spatial **polar c**oordinate system

(the angle λ is directed from the direction of the polar axis **counterclockwise**)



Superficial polar coordinate system on surface of revolution

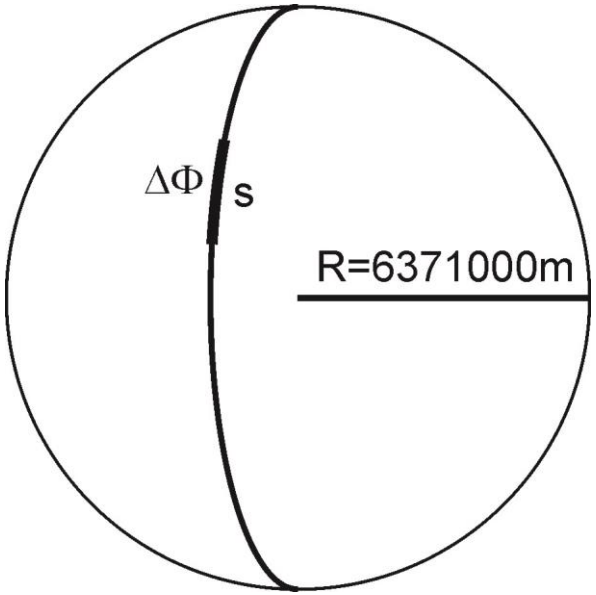




ρ **polar distance**: the length of the shortest arc connecting the origin O and the point P on the surface („geodetic line”)

the **polar angle** (the **azimuth** α) is directed **counterclockwise**

Home work



- What is the greatest angular difference $\Delta\Phi$ (in seconds) among the geographic latitudes of the Control point 1 refering to different reference systems?
- How long longitude line arc s corresponds to this angular difference on a sphere with the radius of R=6 378 000m?