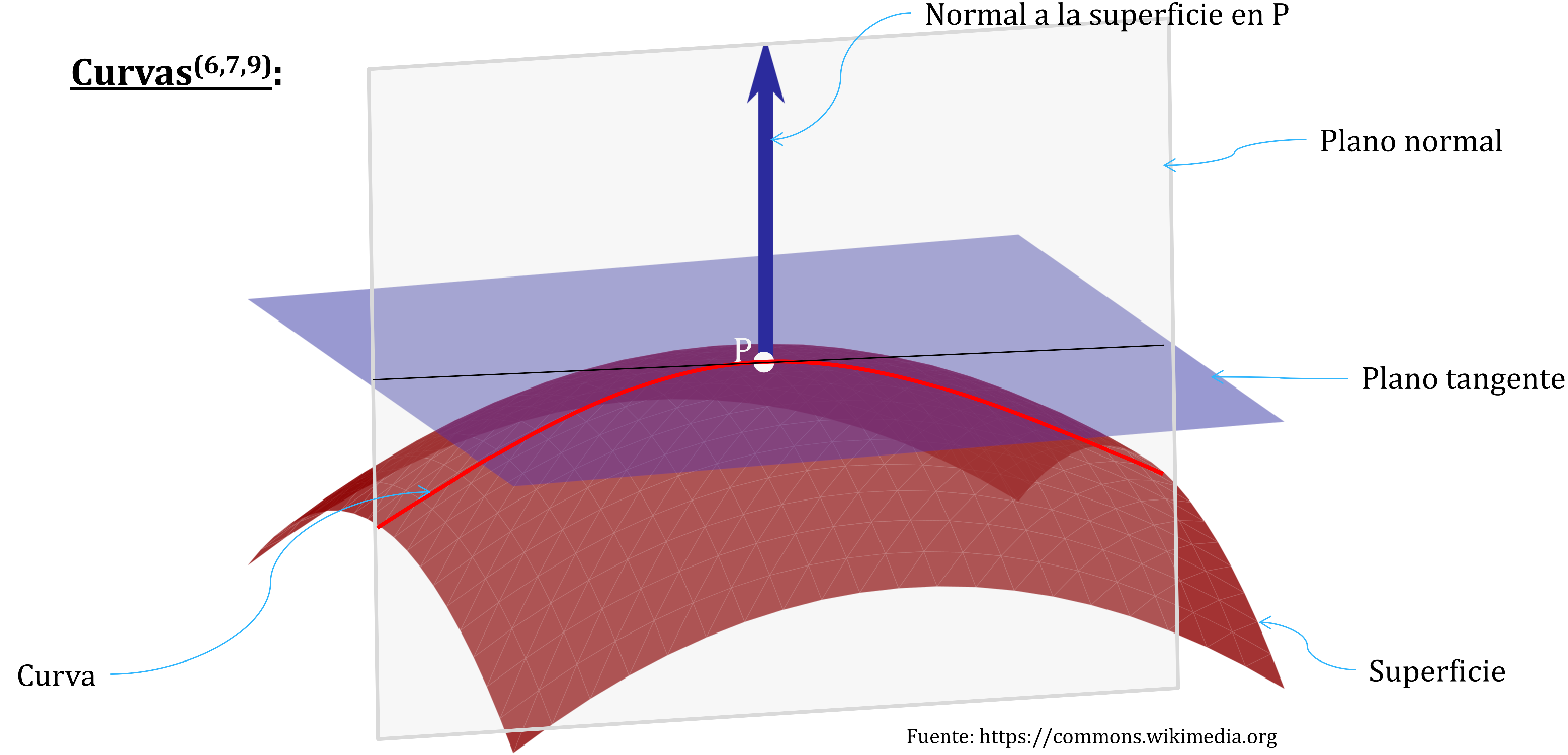
GEODESIA

Wilhelm Jordan (1842–1899)
Handbook of Geodesy

Brigadier Guy Bomford (1899–1996)
Geodesy

Geodesia

Curvas[6,7,9]:



Fuente: https://commons.wikimedia.org

Curva de sección normal: es una curva plana creada por la intersección de un plano que contiene la normal a la superficie (un plano de sección normal) con la superficie.

(6) Krakiwsky, Edward J., and Donald B. Thomson (1974). *Geodetic position computations*.. Department of Surveying Engineering, University of New Brunswick.
(7) Rapp, Richard H. (1991). *Geometric geodesy part I*. Department of Geodetic Science and Surveying, Ohio State University.
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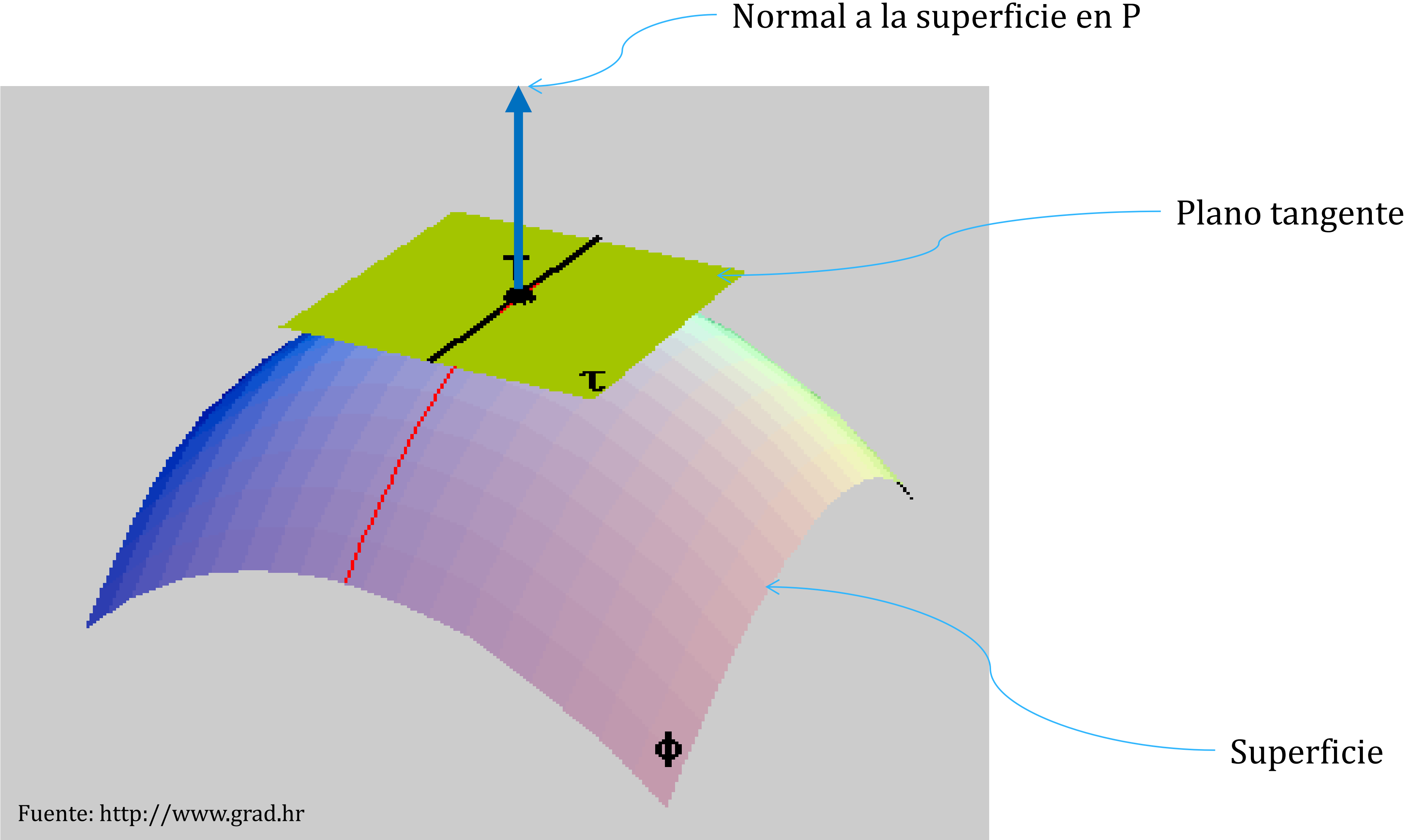
Curvas(6,7,9):



Curva de sección normal: es una curva plana creada por la intersección de un plano que contiene la normal a la superficie (un plano de sección normal) con la superficie.

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(7) Rapp, Richard H. (1991). *Geometric geodesy part I*. Department of Geodetic Science and Surveying, Ohio State University.
(9) Jekeli, C. (2006). *Geometric reference systems in geodesy*. Division of Geodetic Science, School of Earth Sciences. Ohio State University.

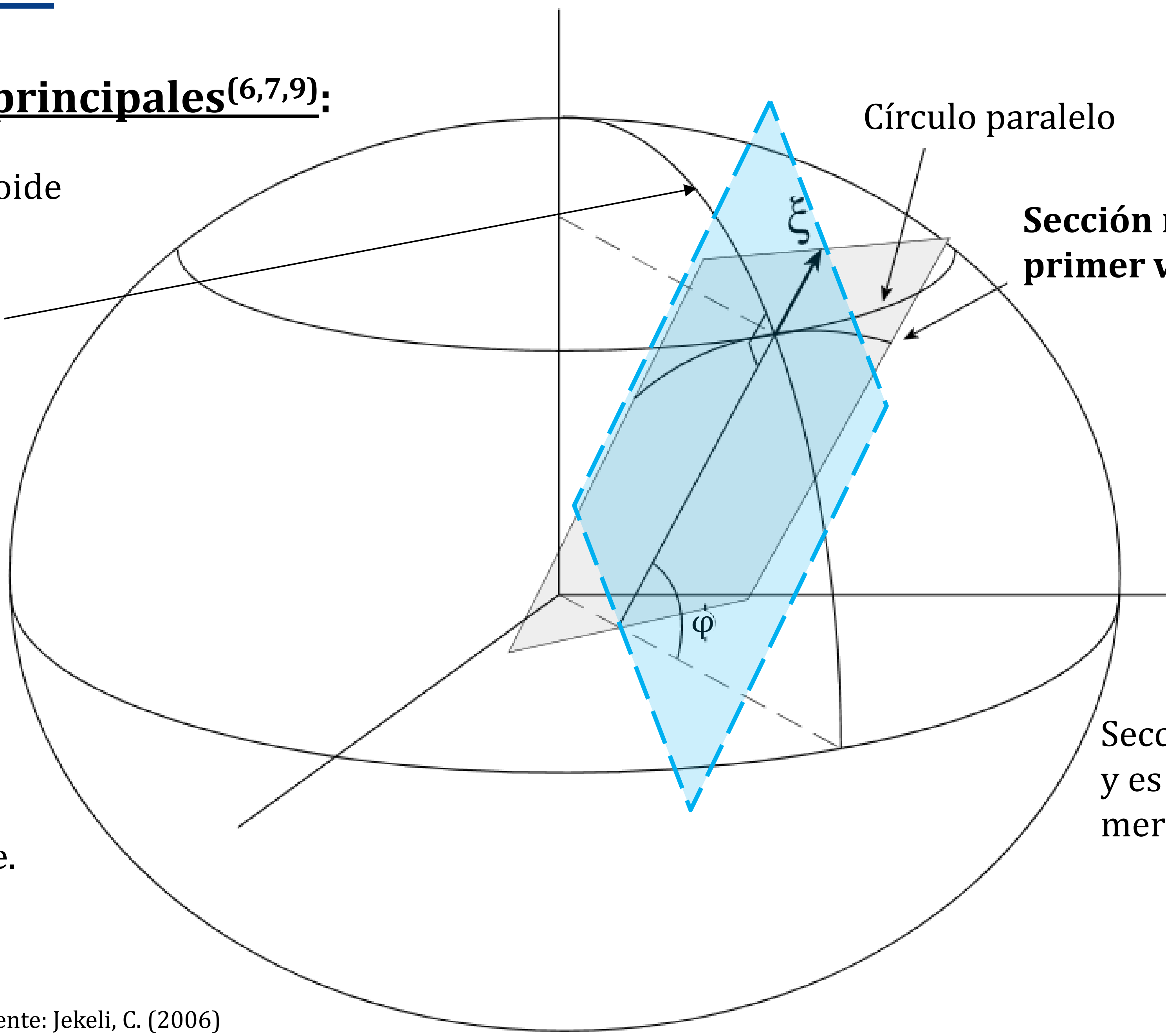
Geodesia

Secciones principales[6,7,9]:

ξ: Normal al elipsoide

Sección meridiana

Sección que pasa por un punto y contiene a los polos del elipsoide.



Fuente: Jekeli, C. (2006)

Sección normal a la meridiana (ó primer vertical)

Sección que pasa por un punto y es perpendicular a la sección meridiana.

(6) Krakiwsky, Edward J., and Donald B. Thomson (1974). *Geodetic position computations*.. Department of Surveying Engineering, University of New Brunswick.
(7) Rapp, Richard H. (1991). *Geometric geodesy part I*. Department of Geodetic Science and Surveying, Ohio State University.
(9) Jekeli, C. (2006). *Geometric reference systems in geodesy*. Division of Geodetic Science, School of Earth Sciences. Ohio State University.

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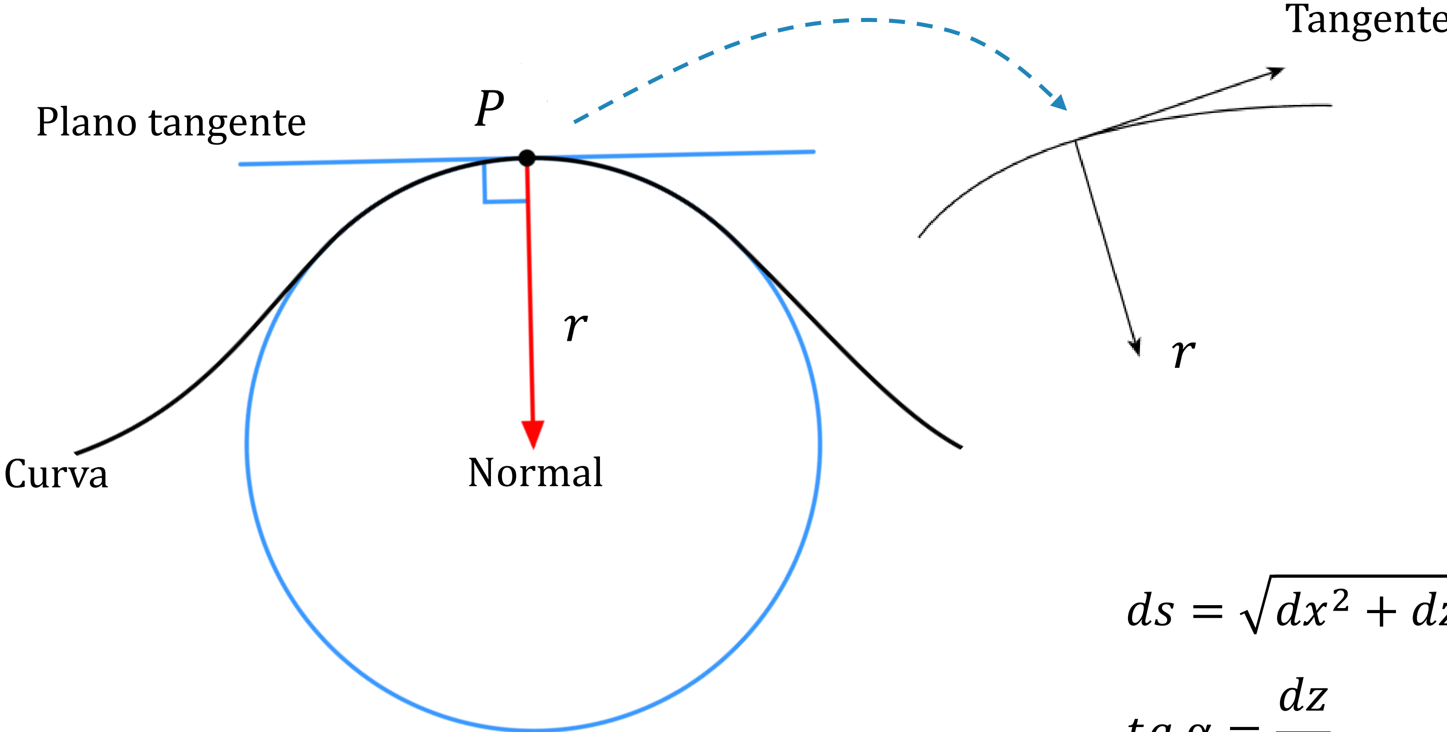
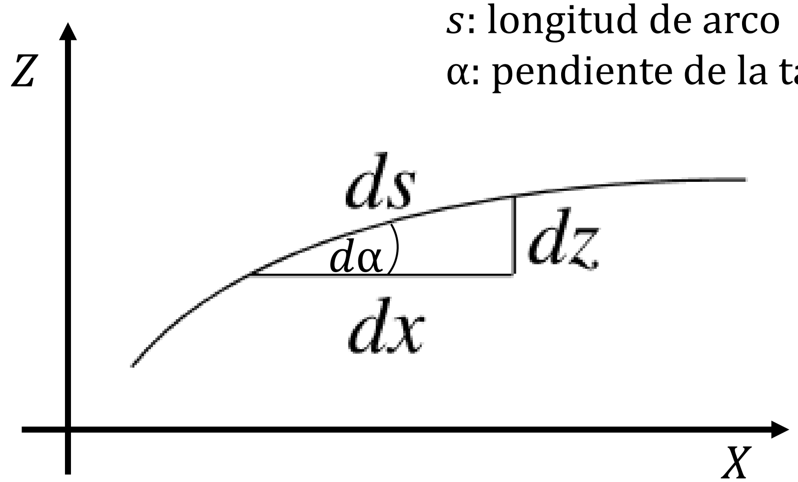
Curvatura[6,7,9]: tasa de cambio absoluta del ángulo de la tangente a la curva respecto a un elemento de longitud de arco de la curva.

$$\chi = \left|\frac{d\alpha}{ds}\right|$$

s: longitud de arco
α: pendiente de la tangente



Fuente: https://commons.wikimedia.org
https://solitaryroad.com/c361.html



$$ds = \sqrt{dx^2 + dz^2}$$

$$tg\ \alpha = \frac{dz}{dx}$$

$$\chi = \frac{\left|\frac{d^2z}{dx^2}\right|}{\left(1 + \left(\frac{dz}{dx}\right)^2\right)^{3/2}}$$

Radio de Curvatura: inversa de la curvatura. $\rho = \dfrac{1}{\chi}$

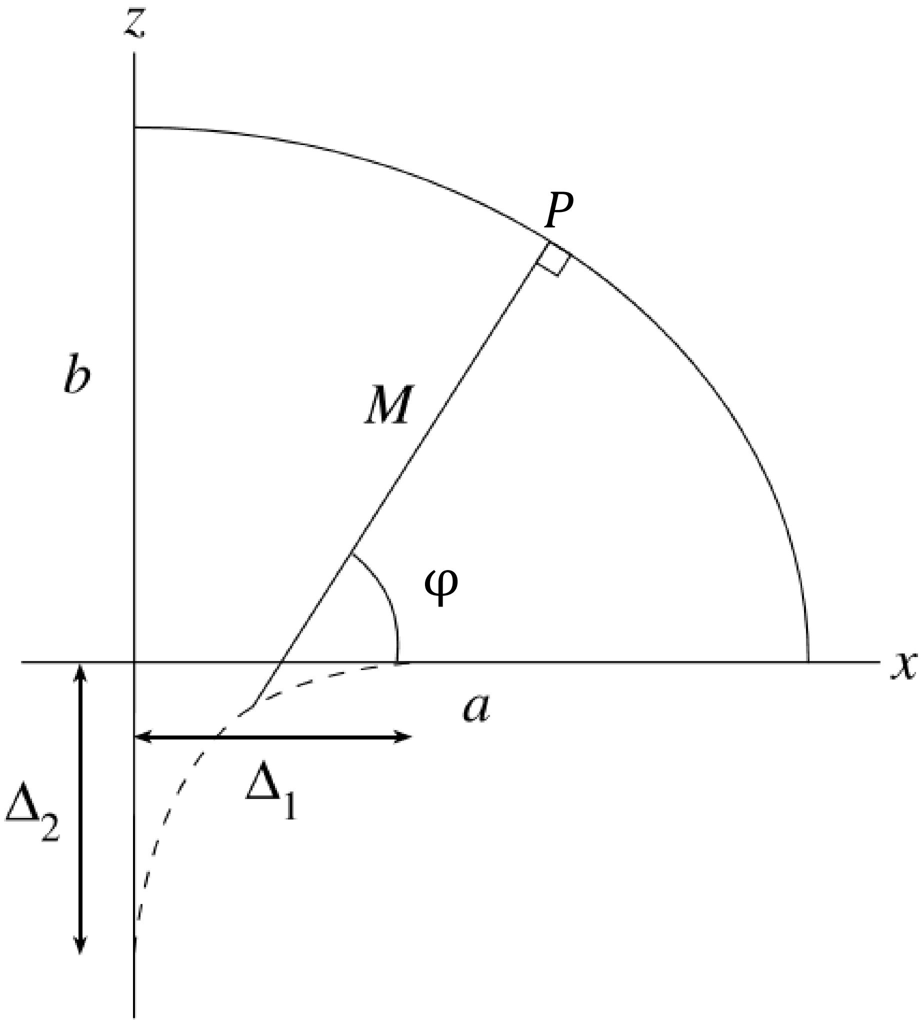
Curvatura: “es una medida de cuánto se aparta una curva de ser recta”

(6) Krakiwsky, Edward J., and Donald B. Thomson (1974). *Geodetic position computations*.. Department of Surveying Engineering, University of New Brunswick.
(7) Rapp, Richard H. (1991). *Geometric geodesy part I*. Department of Geodetic Science and Surveying, Ohio State University.
(9) Jekeli, C. (2006). *Geometric reference systems in geodesy*. Division of Geodetic Science, School of Earth Sciences. Ohio State University.

Geodesia

Radio de curvatura[6,7,9]:

Sección Meridiana



Fuente: Jekeli, C. (2006)

$$\chi = \frac{\left|\frac{d^2z}{dx^2}\right|}{\left(1+\left(\frac{dz}{dx}\right)^2\right)^{3/2}}$$

$$\frac{dz}{dx} = -\frac{a^2}{b^2}\frac{x}{z} = -cotg\ \varphi$$

$$\begin{cases} \chi = \frac{a}{b^2}(1-e^2sen^2\varphi)^{3/2} \\ \frac{1}{\chi} = \rho = \frac{a(1-e^2)}{(1-e^2sen^2\varphi)^{3/2}} \end{cases}$$

$$\chi = \left|\frac{d\alpha}{ds}\right| \rightarrow \frac{1}{M} = \left|\frac{d\varphi}{ds}\right| \Longrightarrow ds_{meridiana} = Md\varphi$$

$$\varphi_{ecuador} = ? \Longrightarrow M_{ecuador} = \frac{a(1-e^2)}{(1-e^2sen^2\varphi)^{3/2}} = ?$$

$$\varphi_{polo} = ? \Longrightarrow M_{polo} = \frac{a(1-e^2)}{(1-e^2sen^2\varphi)^{3/2}} = ?$$

(6) Krakiwsky, Edward J., and Donald B. Thomson (1974). *Geodetic position computations*.. Department of Surveying Engineering, University of New Brunswick.
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(9) Jekeli, C. (2006). *Geometric reference systems in geodesy*. Division of Geodetic Science, School of Earth Sciences. Ohio State University.

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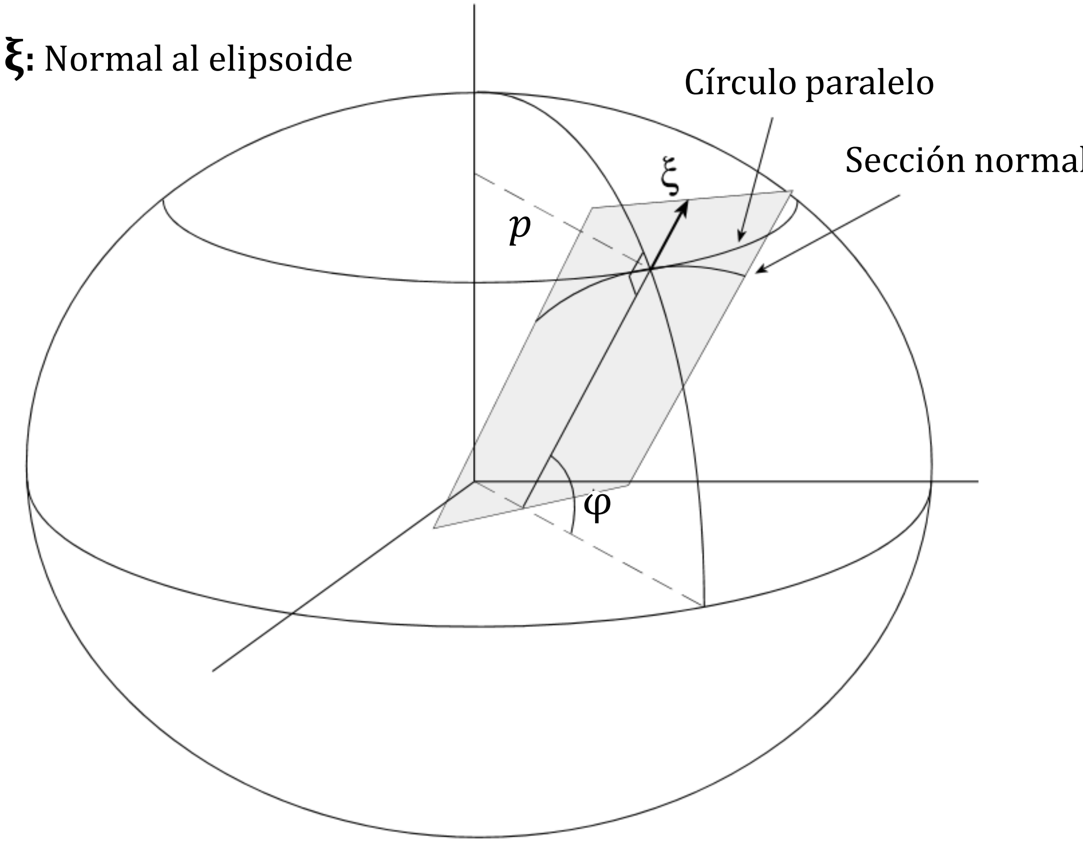
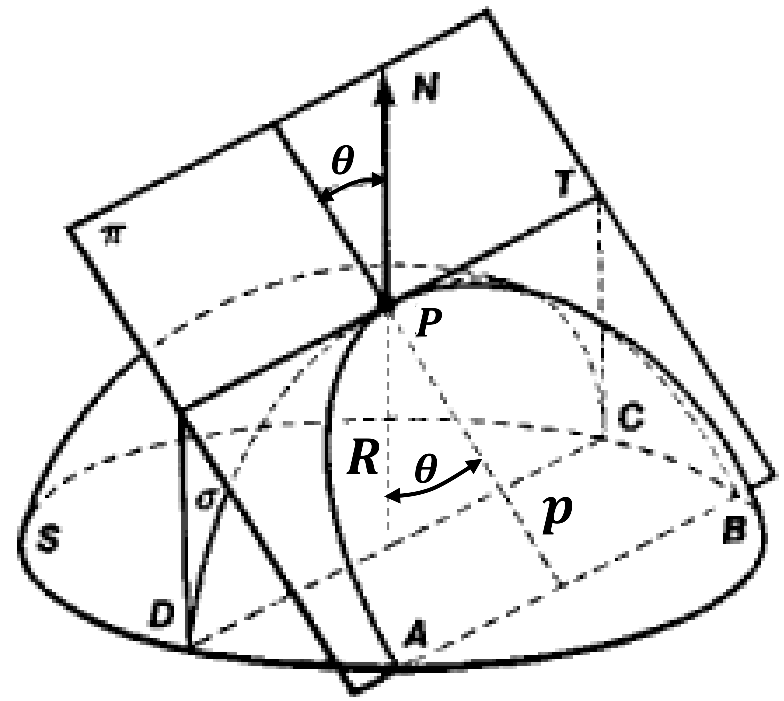
Radio de curvatura[6,7,9]**:**
Sección Normal a la Meridiana

ξ: Normal al elipsoide



Fuente: Jekeli, C. (2006)

Meusnier: el radio de curvatura de una sección inclinada es igual al radio de curvatura de una sección normal multiplicada por el coseno del ángulo entre ambas.



Fuente: https://encyclopedia2.thefreedictionary.com

$$p = R\ cos\theta \iff \frac{1}{p} cos\theta = \frac{1}{R}$$

(6) Krakiwsky, Edward J., and Donald B. Thomson (1974). *Geodetic position computations*.. Department of Surveying Engineering, University of New Brunswick.
(7) Rapp, Richard H. (1991). *Geometric geodesy part I*. Department of Geodetic Science and Surveying, Ohio State University.
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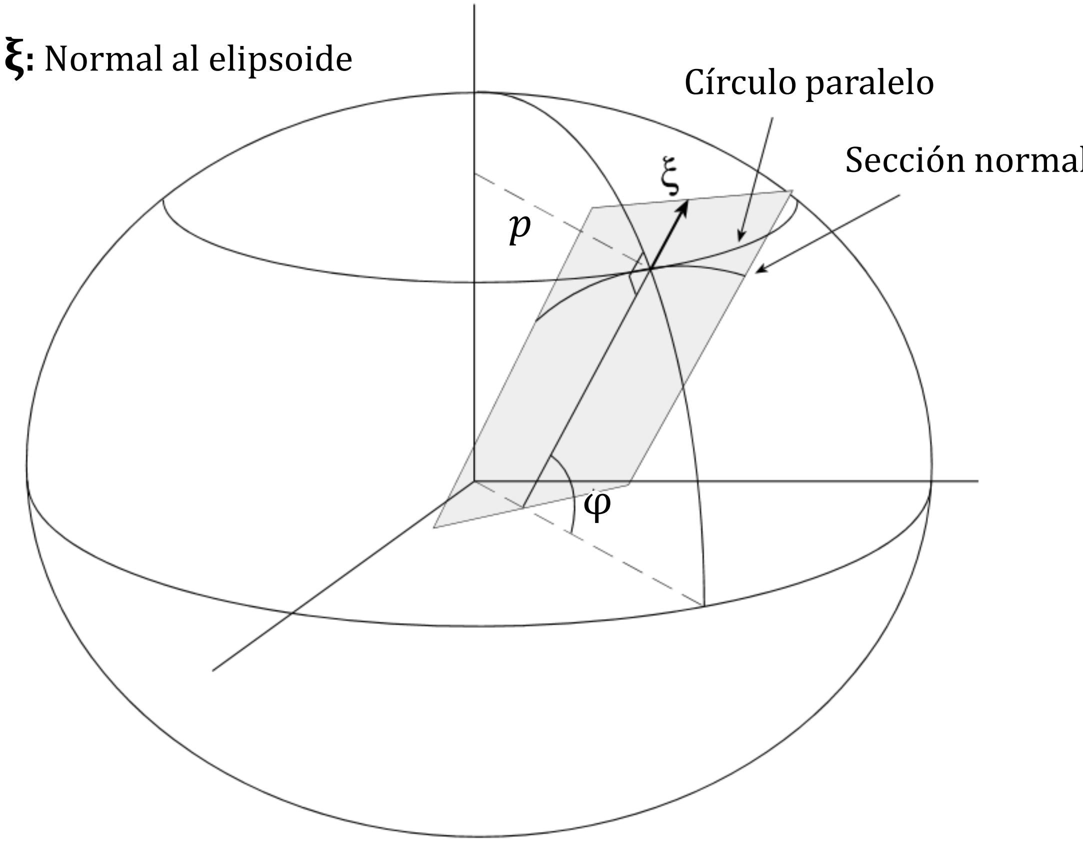
Geodesia

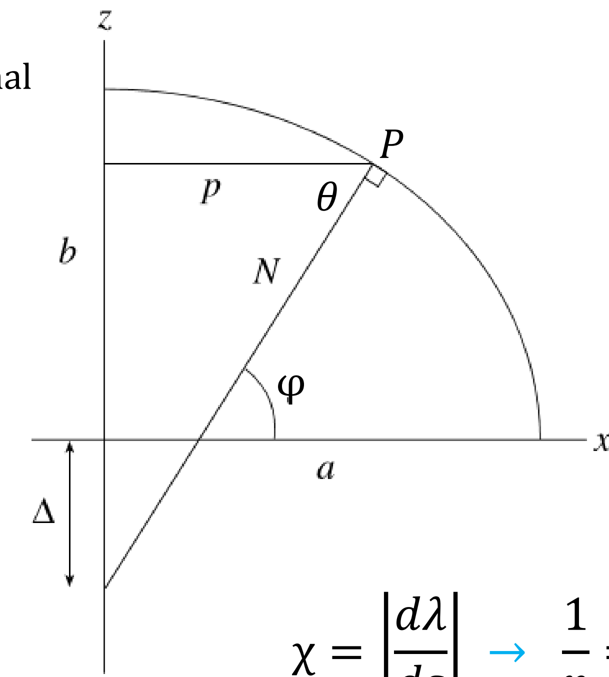
Radio de curvatura[6,7,9]:
Sección Normal a la Meridiana

ξ: Normal al elipsoide



Fuente: Jekeli, C. (2006)

Meusnier: el radio de curvatura de una sección inclinada es igual al radio de curvatura de una sección normal multiplicada por el coseno del ángulo entre ambas.



$$\frac{1}{p} cos\theta = \frac{1}{R} \rightarrow \frac{1}{p} cos\varphi = \frac{1}{N}$$

$$\begin{cases} p = N \cos\varphi \\ x = \dfrac{a\ cos\varphi}{(1 - e^2 sen^2\varphi)^{1/2}} \end{cases}$$

$$N = \frac{a}{(1 - e^2 sen^2\varphi)^{1/2}}$$

$$\chi = \left|\frac{d\lambda}{ds}\right| \rightarrow \frac{1}{p} = \left|\frac{d\lambda}{ds}\right| \Rightarrow ds_{paralelo} = N\ cos\varphi\ d\lambda$$

$$\varphi_{ecuador} = ? \Rightarrow N_{ecuador} = \frac{a}{(1 - e^2 sen^2\varphi)^{1/2}} = ?$$

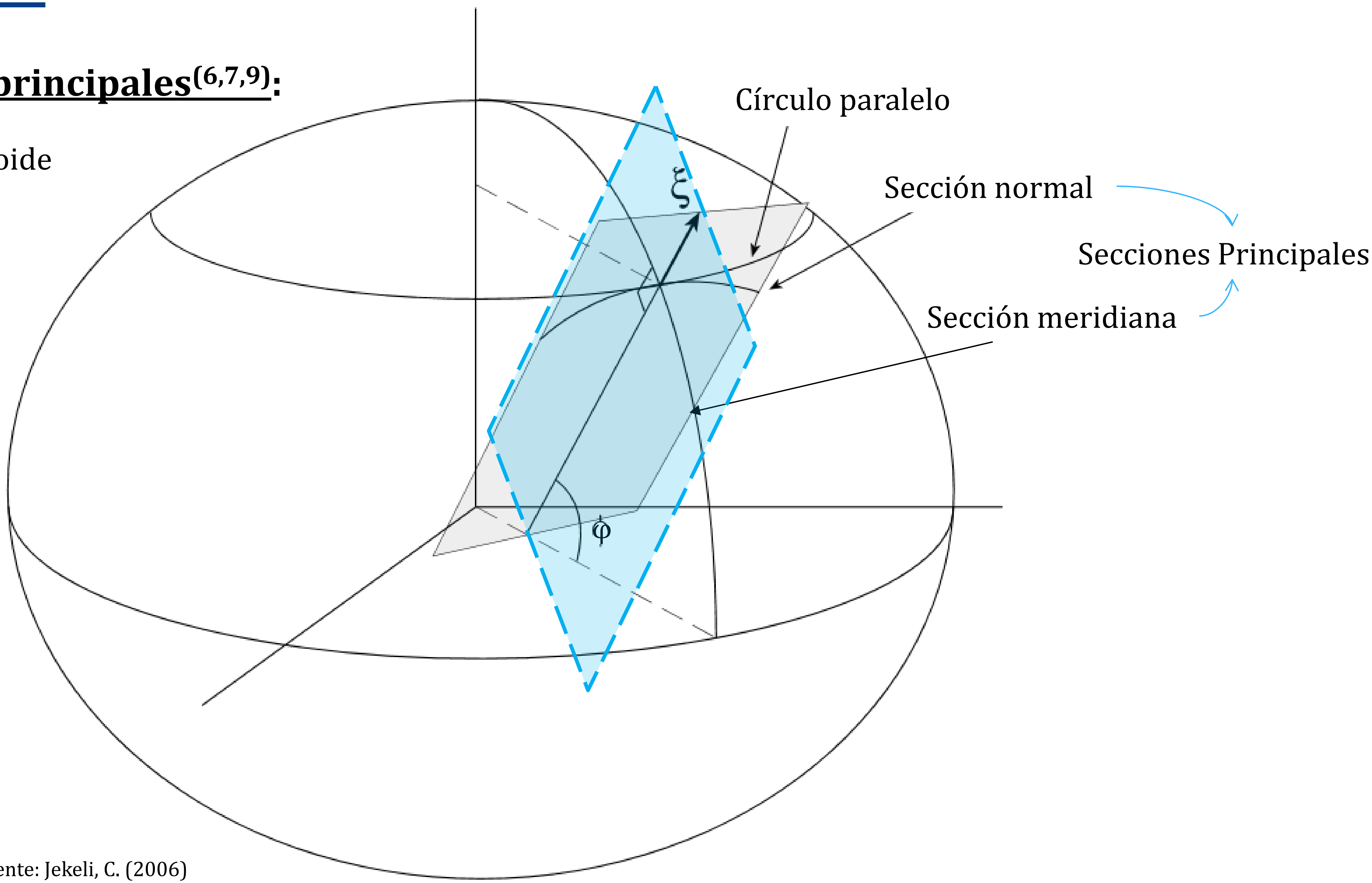
$$\varphi_{polo} = ? \Rightarrow N_{polo} = \frac{a}{(1 - e^2 sen^2\varphi)^{1/2}} = ?$$

(6) Krakiwsky, Edward J., and Donald B. Thomson (1974). *Geodetic position computations*.. Department of Surveying Engineering, University of New Brunswick.
(7) Rapp, Richard H. (1991). *Geometric geodesy part I*. Department of Geodetic Science and Surveying, Ohio State University.
(9) Jekeli, C. (2006). *Geometric reference systems in geodesy*. Division of Geodetic Science, School of Earth Sciences. Ohio State University.

Geodesia

Secciones principales[6,7,9]**:**

ξ: Normal al elipsoide

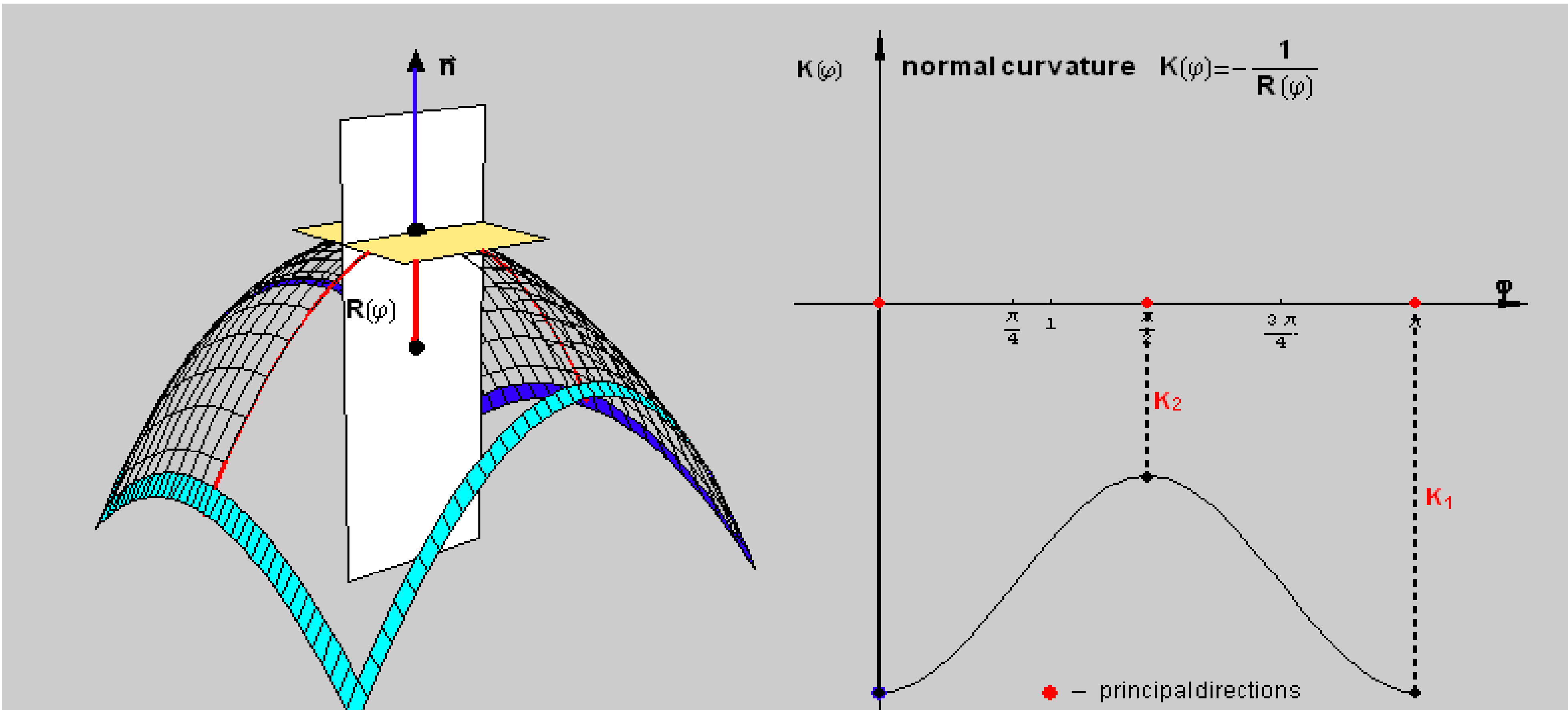


Fuente: Jekeli, C. (2006)

(6) Krakiwsky, Edward J., and Donald B. Thomson (1974). *Geodetic position computations*.. Department of Surveying Engineering, University of New Brunswick.
(7) Rapp, Richard H. (1991). *Geometric geodesy part I*. Department of Geodetic Science and Surveying, Ohio State University.
(9) Jekeli, C. (2006). *Geometric reference systems in geodesy*. Division of Geodetic Science, School of Earth Sciences. Ohio State University.

Geodesia

Curvatura y Radio de Curvatura [6,7,9]:

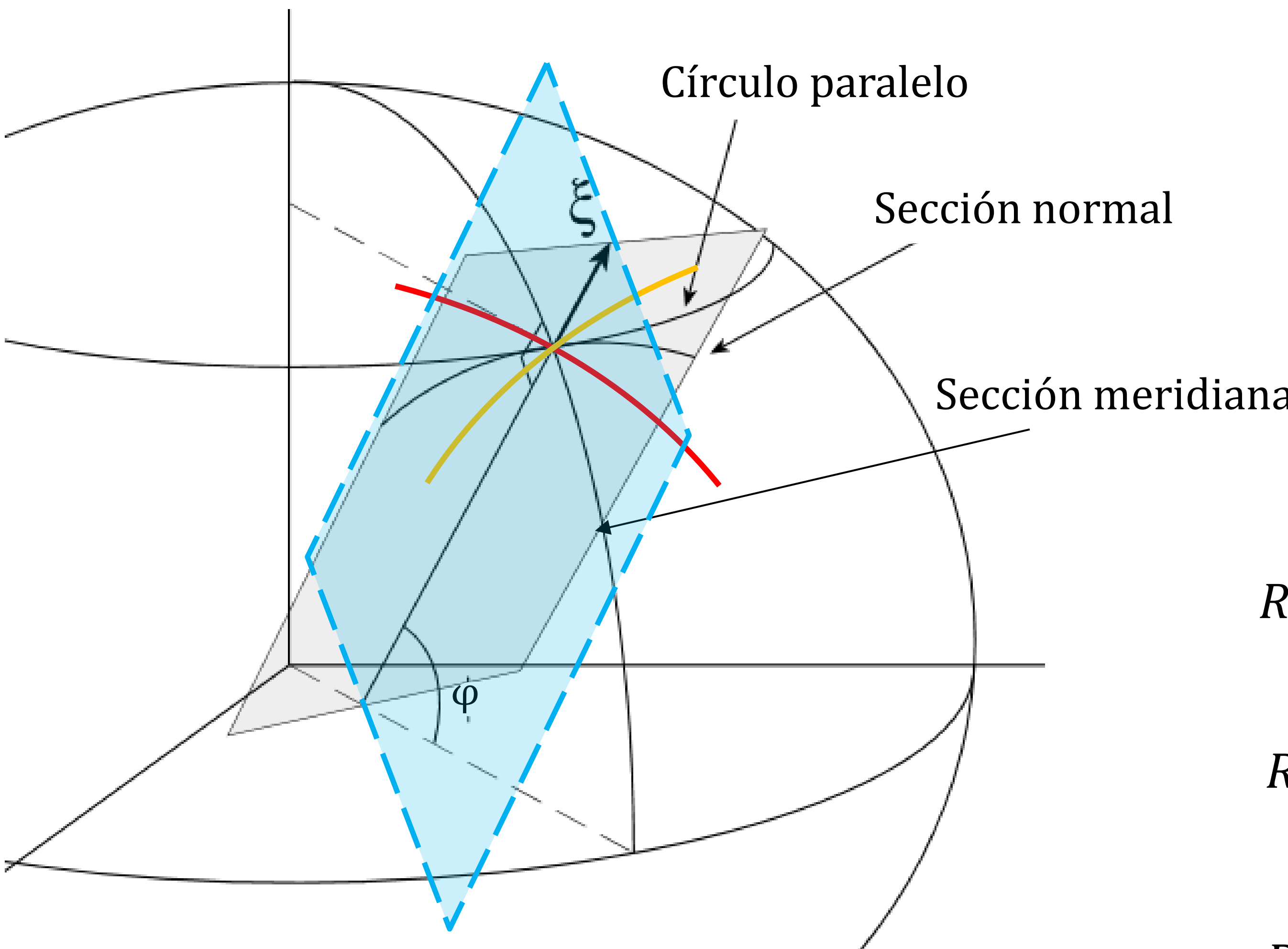


Fuente: http://www.grad.hr

(6) Krakiwsky, Edward J., and Donald B. Thomson (1974). *Geodetic position computations*.. Department of Surveying Engineering, University of New Brunswick.
(7) Rapp, Richard H. (1991). *Geometric geodesy part I*. Department of Geodetic Science and Surveying, Ohio State University.
(9) Jekeli, C. (2006). *Geometric reference systems in geodesy*. Division of Geodetic Science, School of Earth Sciences. Ohio State University.

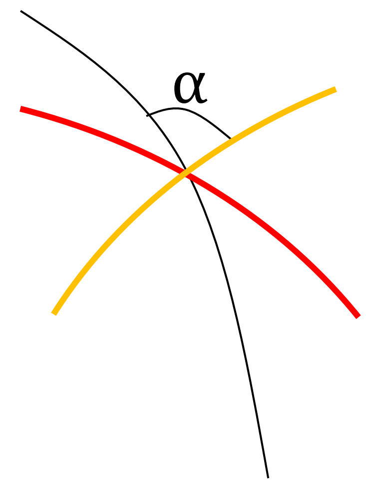
Curvas en el elipsoide[6,7,9]:

ξ: Normal al elipsoide



Fuente: Jekeli, C. (2006)

Teorema de Euler: curvatura de una sección de acimut α en función de los radio de curvaturas de las secciones principales.



$$\chi_{\alpha} = \frac{1}{R_{\alpha}} = \frac{sen^2\alpha}{N} + \frac{cos^2\alpha}{M}$$

Aproximaciones

$$R_G = \frac{1}{2\pi}\int_0^{2\pi} R_{\alpha} d\alpha = \int_0^{2\pi} \frac{d\alpha}{\frac{sen^2\alpha}{N} + \frac{cos^2\alpha}{M}} = \sqrt{MN}$$

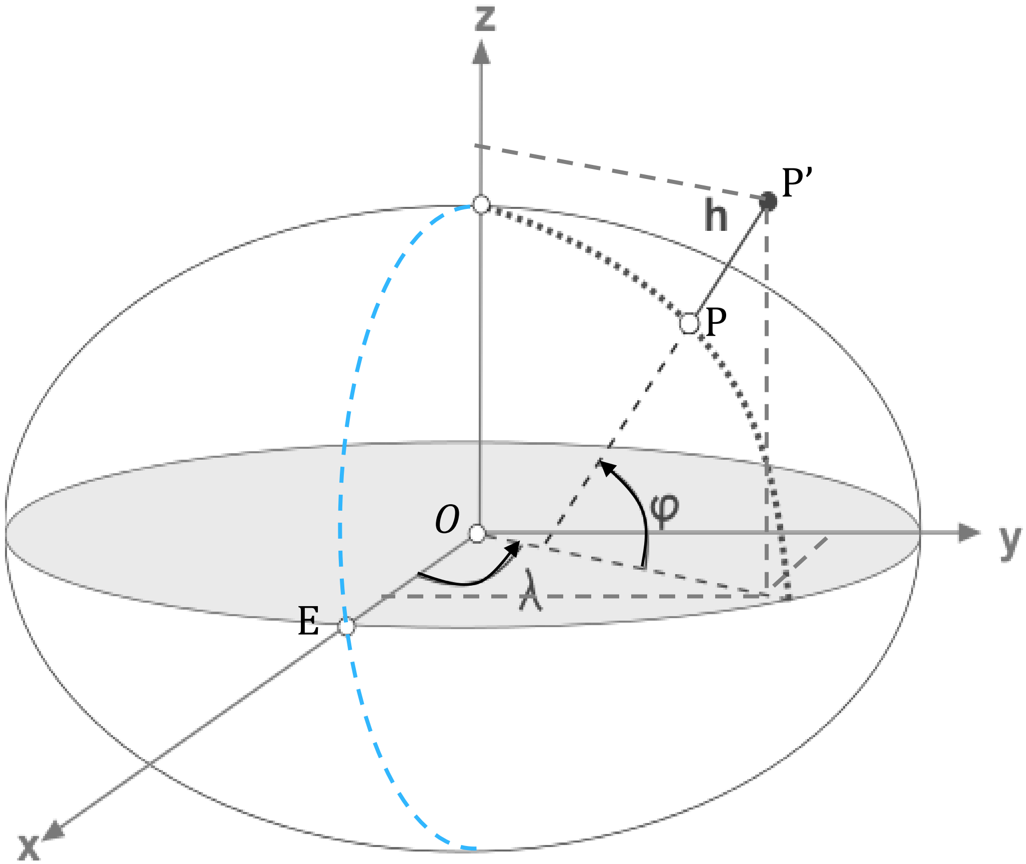
$$R_m = \frac{1}{\frac{1}{2}\left(\frac{1}{N} + \frac{1}{M}\right)}$$

$$R = \frac{1}{3}(a + a + b) \rightarrow R = a\left(1 - \frac{e^2}{6} - \frac{e^4}{24} - \frac{e^6}{48} - \ldots\right)$$

(6) Krakiwsky, Edward J., and Donald B. Thomson (1974). *Geodetic position computations*.. Department of Surveying Engineering, University of New Brunswick.
(7) Rapp, Richard H. (1991). *Geometric geodesy part I*. Department of Geodetic Science and Surveying, Ohio State University.
(9) Jekeli, C. (2006). *Geometric reference systems in geodesy*. Division of Geodetic Science, School of Earth Sciences. Ohio State University.

Geodesia

Coordenadas Cartesianas Rectangulares(6,7,9) asociadas al elipsoide de referencia

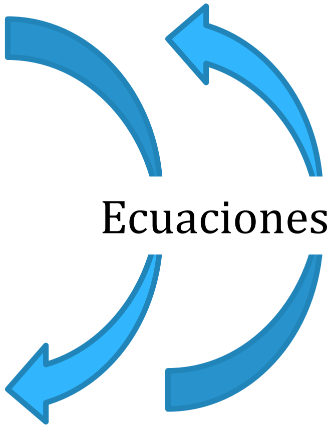


Fuente: https://gssc.esa.int
ESA: European Space Agency

OX
OY
OZ
Sistema de la mano derecha

φ
λ
Coordenadas curvilíneas en la superficie del elipsoide

h: Altura sobre el elipsoide



Ecuaciones de transformación

(6) Krakiwsky, Edward J., and Donald B. Thomson (1974). *Geodetic position computations*.. Department of Surveying Engineering, University of New Brunswick.
(7) Rapp, Richard H. (1991). *Geometric geodesy part I*. Department of Geodetic Science and Surveying, Ohio State University.
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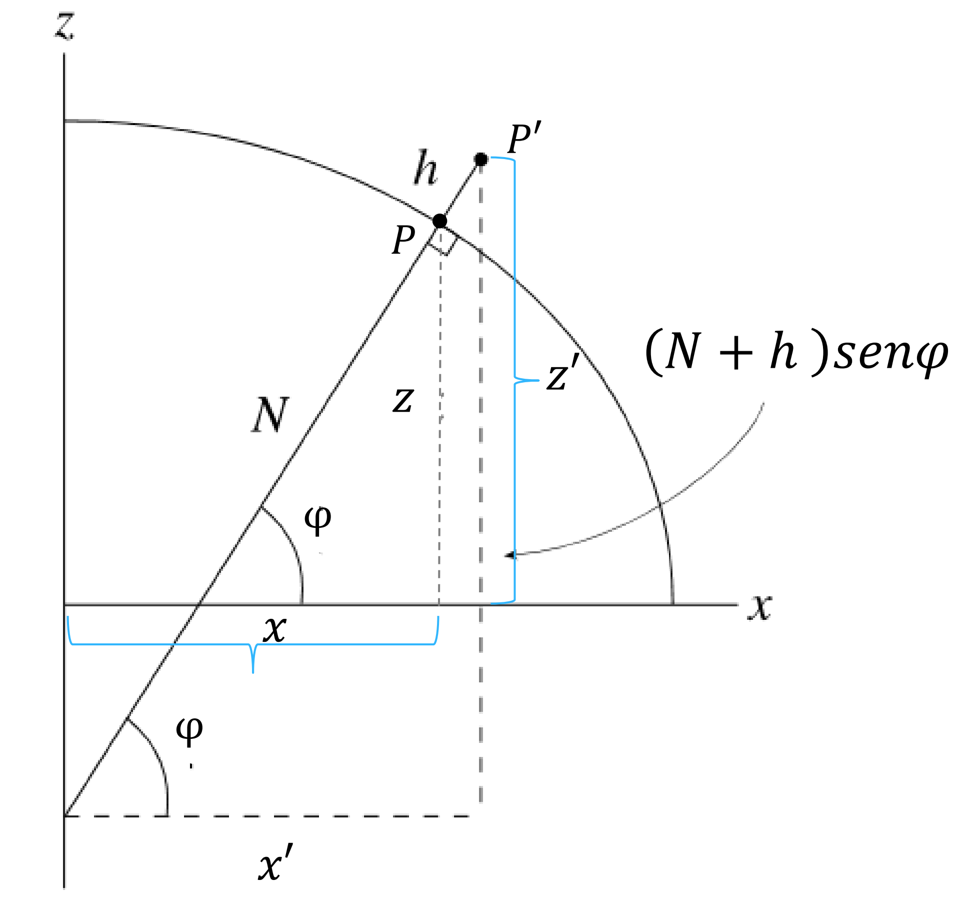
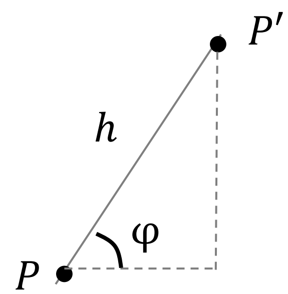
Coordenadas Cartesianas Rectangulares[6,7,9] asociadas al elipsoide de referencia



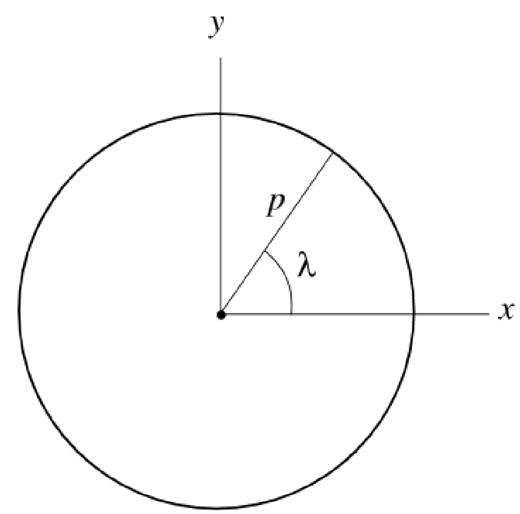
Fuente: Jekeli, C. (2006)

Obtención de ***x*** y ***z*** del punto P

$$\begin{cases} x = \dfrac{a\,cos\varphi}{(1-e^2sen^2\varphi)^{1/2}} \\ z = \dfrac{a\,(1-e^2)sen\varphi}{(1-e^2sen^2\varphi)^{1/2}} \end{cases}$$



$$x' = x + h\,cos\varphi$$
$$z' = z + h\,sen\varphi$$



$$x' = (x + h\,cos\varphi)\,cos\lambda$$
$$y' = (y + h\,cos\varphi)\,sen\lambda$$

(6) Krakiwsky, Edward J., and Donald B. Thomson (1974). *Geodetic position computations*.. Department of Surveying Engineering, University of New Brunswick.
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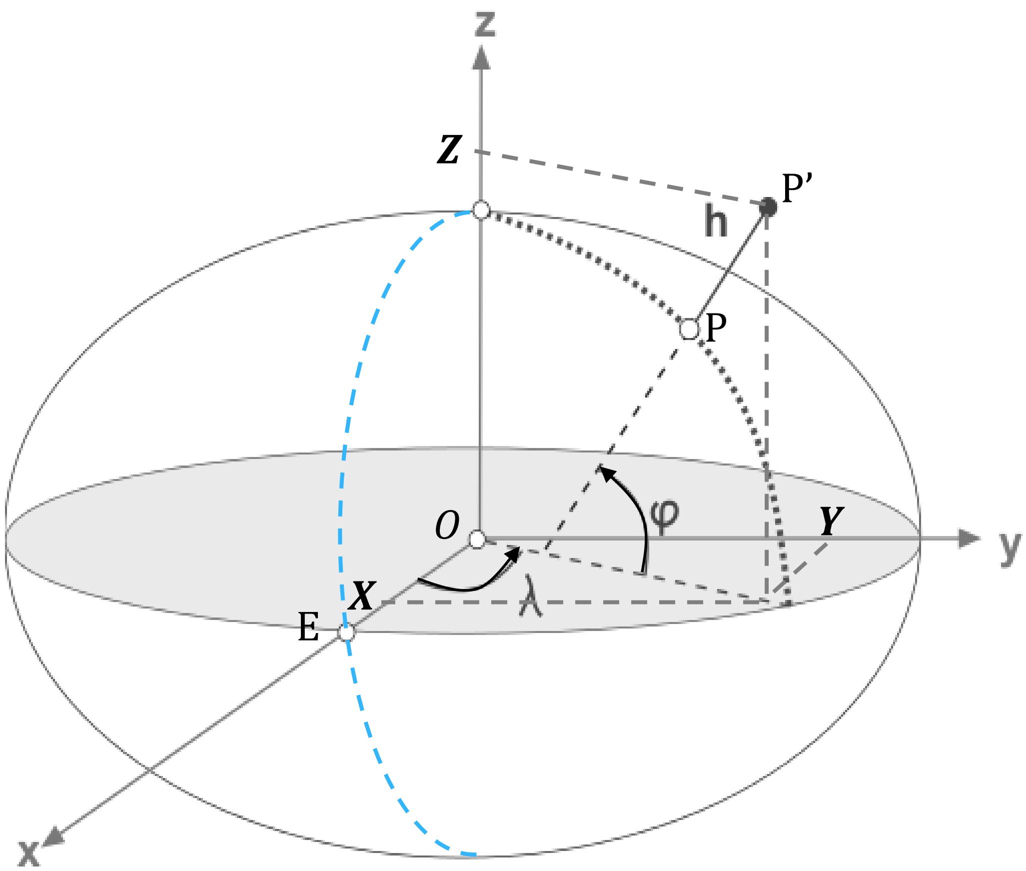
Coordenadas Cartesianas Rectangulares(6,7,9) asociadas al elipsoide de referencia



Fuente: https://gssc.esa.int
ESA: European Space Agency

$$N = \frac{a}{(1 - e^2 sen^2 \varphi)^{1/2}}$$

$$x = \frac{a\ cos\varphi}{(1 - e^2 sen^2 \varphi)^{1/2}}$$

$$z = \frac{a\ (1 - e^2) sen\varphi}{(1 - e^2 sen^2 \varphi)^{1/2}}$$

$$x' = (x + h\ cos\varphi)\ cos\lambda$$

$$y' = (y + h\ cos\varphi)\ sen\lambda$$

$$z' = z + h\ sen\varphi$$

$$X = (N + h)cos\varphi\ cos\lambda$$

$$Y = (N + h)\ cos\varphi\ sen\lambda$$

$$Z = (N(1 - e^2) + h)\ sen\varphi$$

(6) Krakiwsky, Edward J., and Donald B. Thomson (1974). *Geodetic position computations*.. Department of Surveying Engineering, University of New Brunswick.
(7) Rapp, Richard H. (1991). *Geometric geodesy part I*. Department of Geodetic Science and Surveying, Ohio State University.
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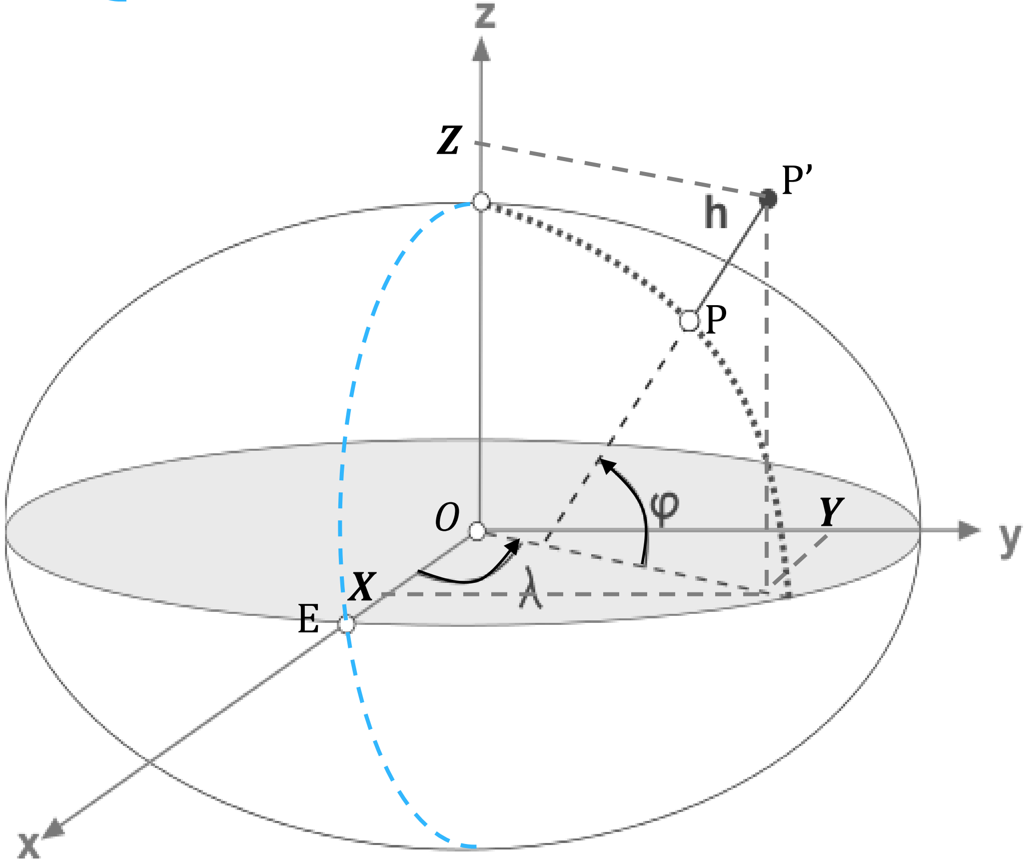
Coordenadas Cartesianas Rectangulares[6,7,9] asociadas al elipsoide de referencia

$$\begin{cases} X = (N + h)\cos\varphi \cos\lambda \\ Y = (N + h)\cos\varphi\, sen\lambda \\ Z = (N(1 - e^2) + h)\, sen\varphi \end{cases}$$



Fuente: https://gssc.esa.int
ESA: European Space Agency

$$\frac{Y}{X} = \frac{(N + h)\cos\varphi\, sen\lambda}{(N + h)\cos\varphi \cos\lambda} \rightarrow tg\lambda = \frac{Y}{X}$$

$$tg\varphi = \frac{(N + h)\, sen\,\varphi}{\sqrt{X^2 + Y^2}} \rightarrow \varphi = tg^{-1}\left(\frac{Z}{\sqrt{X^2 + Y^2}}\left(1 + \frac{Ne^2 sen\varphi}{Z}\right)\right)$$

Si $\rightarrow h = 0$

$$\varphi^0 = tg^{-1}\left(\frac{Z}{\sqrt{X^2 + Y^2}}\left(1 + \frac{e^2}{1 - e^2}\right)\right)$$

$$\varphi^1 = tg^{-1}\left(\frac{Z}{\sqrt{X^2 + Y^2}}\left(1 + \frac{N(\varphi^0)e^2 sen\varphi^0}{Z}\right)\right), \quad n\ iteraciones$$

$$\sqrt{X^2 + Y^2} = (N + h)\cos\varphi \rightarrow h = \frac{\sqrt{X^2 + Y^2}}{\cos\varphi} - N, \quad si\ \varphi \neq 90°$$

$$Z = (N(1 - e^2) + h)\, sen\varphi \rightarrow h = \frac{Z}{sen\varphi} - N(1 - e^2), \quad si\ \varphi \neq 0°$$

(6) Krakiwsky, Edward J., and Donald B. Thomson (1974). *Geodetic position computations*.. Department of Surveying Engineering, University of New Brunswick.
(7) Rapp, Richard H. (1991). *Geometric geodesy part I*. Department of Geodetic Science and Surveying, Ohio State University.
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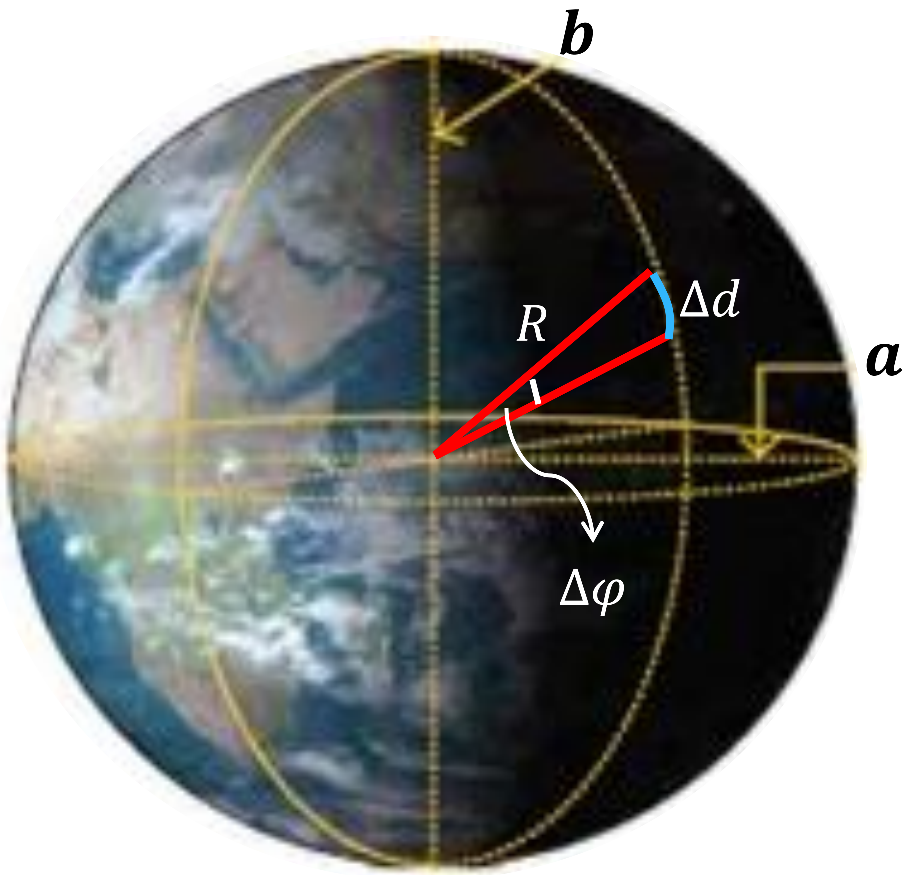
Geodesia

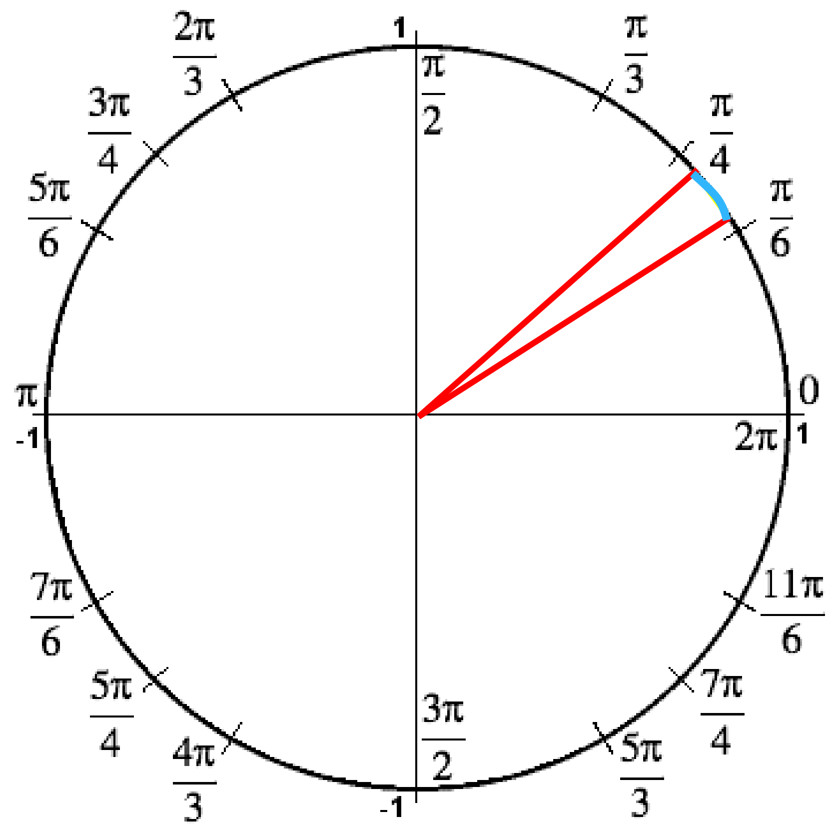
Relación de magnitudes[6,7,9]

Elipsoide de revolución



Fuente: https://civilgeeks.com

Aproximación → $R = \frac{1}{3}(a + a + b) \approx 6371008\ m$



$360° \equiv 2\pi R$

$360° \equiv 2\pi\ 6371008\ m$

$1° \approx 111195.066 \ldots\ m$

$3600'' \approx 111195.066\ m$

$1'' \approx 30.887 \ldots\ m$

$0.1'' \approx 3.0887\ m$

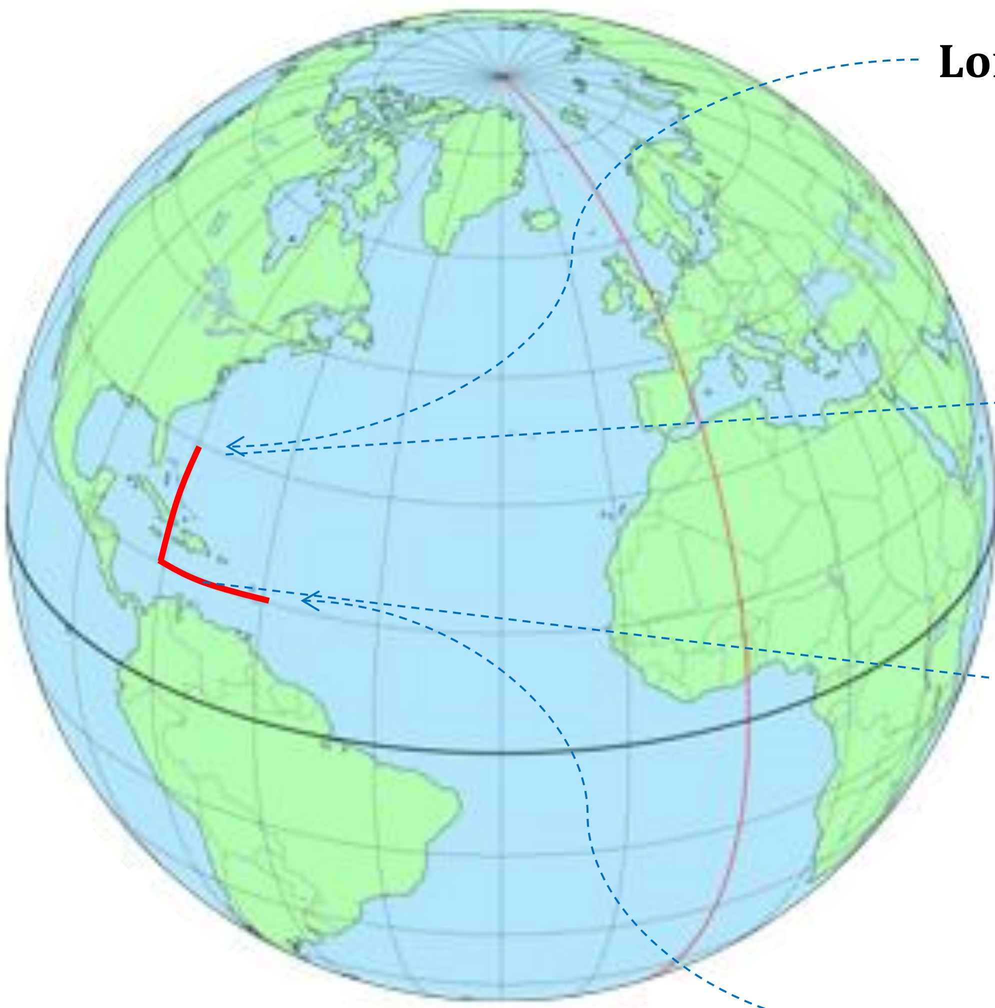
$0.01'' \approx 0.30887\ m$

$0.001'' \approx$

(6) Krakiwsky, Edward J., and Donald B. Thomson (1974). *Geodetic position computations*.. Department of Surveying Engineering, University of New Brunswick.
(7) Rapp, Richard H. (1991). *Geometric geodesy part I*. Department of Geodetic Science and Surveying, Ohio State University.
(9) Jekeli, C. (2006). *Geometric reference systems in geodesy*. Division of Geodetic Science, School of Earth Sciences. Ohio State University.

Geodesia

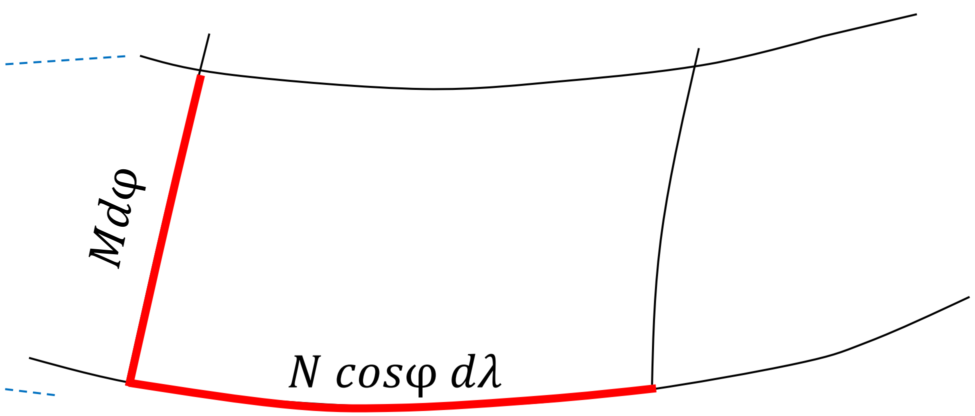
Longitudes de arcos[7,9,10]:



Fuente: www.thegreenwichmeridian.org

Longitud de elemento de Arco de Meridiano

$$\chi = \left|\frac{d\alpha}{ds}\right| \rightarrow \frac{1}{M} = \left|\frac{d\varphi}{ds}\right| \Longrightarrow ds_{meridiana} = M d\varphi$$



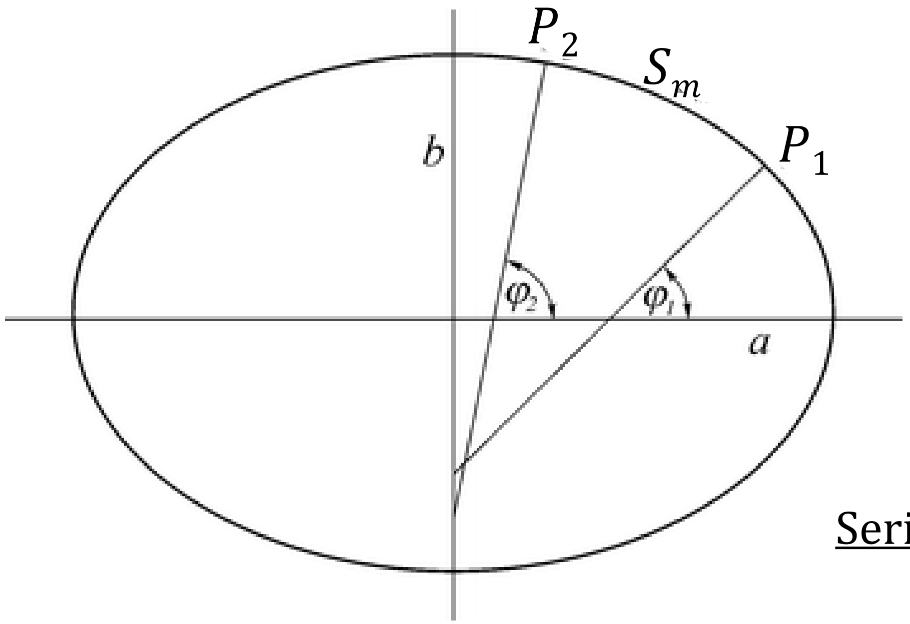
$$\chi = \left|\frac{d\alpha}{ds}\right| \rightarrow \frac{1}{p} = \left|\frac{d\lambda}{ds}\right| \Longrightarrow ds_{paralelo} = N\, cos\varphi\, d\lambda$$

Longitud de elemento de Arco de Paralelo

(7) Rapp, Richard H. (1991). *Geometric geodesy part I*. Department of Geodetic Science and Surveying, Ohio State University.
(9) Jekeli, C. (2006). *Geometric reference systems in geodesy*. Division of Geodetic Science, School of Earth Sciences. Ohio State University.
(10) Jordan, W. (1962). *Handbook of Geodesy* (Vol. 3). Corps of Engineers, United States Army, Army Map Service

Geodesia

Longitudes de arcos[7,9,10]:



Fuente: Lapaine M. (2017)

$$\chi = \left|\frac{d\alpha}{ds}\right| \rightarrow \frac{1}{M} = \left|\frac{d\varphi}{ds}\right| \Longrightarrow ds_{meridiana} = Md\varphi$$

$$S_m = \int_{\varphi_1}^{\varphi_2} Md\varphi = \int_{\varphi_1}^{\varphi_2} \frac{a(1-e^2)}{(1-e^2sen^2\varphi)^{3/2}}d\varphi$$

$$S_m = a(1-e^2)\int_{\varphi_1}^{\varphi_2}(1-e^2sen^2\varphi)^{-3/2}d\varphi$$ Integral elíptica

Series de Maclaurin $f(x) = f(x_0) + (x-x_0)f'(x_0) + \frac{(x-x_0)^2}{2!}f''(x_0) + \cdots$

$$\frac{1}{(1-e^2sen^2\varphi)^{3/2}} = 1 + \frac{3}{2}e^2sen^2\varphi + \frac{15}{8}e^4sen^4\varphi + \frac{35}{16}e^6sen^6\varphi + \frac{315}{128}e^8sen^8\varphi + \frac{693}{256}e^{10}sen^{10}\varphi + \ldots$$

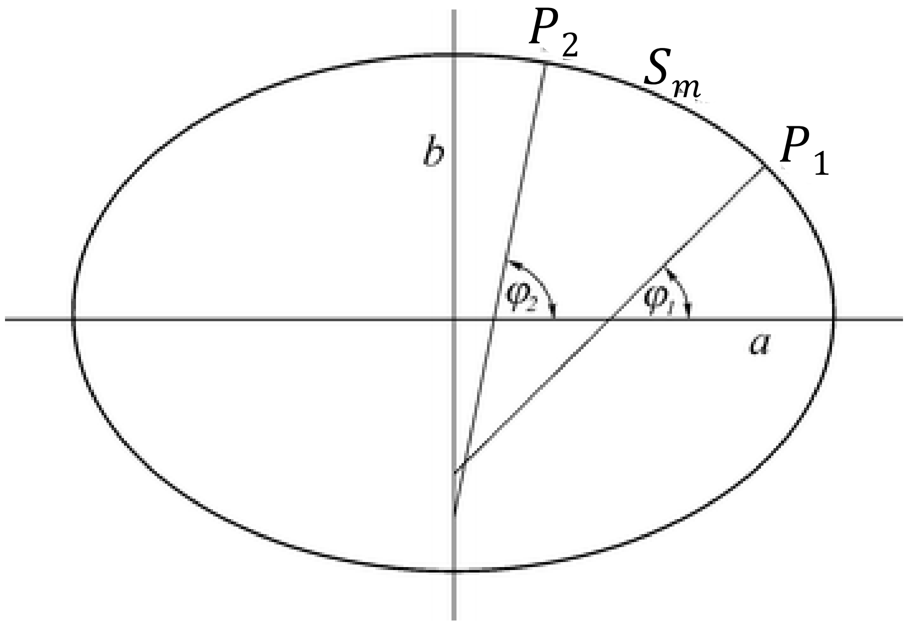
$$sen^2\varphi = \frac{1}{2} - \frac{1}{2}cos2\varphi\ ;\ sen^4\varphi = \frac{3}{8} - \frac{1}{2}cos2\varphi + \frac{1}{8}cos4\varphi; \ldots$$

$$\frac{1}{(1-e^2sen^2\varphi)^{3/2}} = A - B\ cos2\varphi + C\ cos4\varphi - D\ cos6\varphi + E\ cos8\varphi - F\ cos10\varphi + \ldots$$

$$\int cos2\varphi\ d\varphi = \frac{1}{2}sen2\varphi$$

(7) Rapp, Richard H. (1991). *Geometric geodesy part I*. Department of Geodetic Science and Surveying, Ohio State University.
(9) Jekeli, C. (2006). *Geometric reference systems in geodesy*. Division of Geodetic Science, School of Earth Sciences. Ohio State University.
(10) Jordan, W. (1962). *Handbook of Geodesy* (Vol. 3). Corps of Engineers, United States Army, Army Map Service

Longitudes de arcos[7,9,10]:



Fuente: Lapaine M. (2017)

$$S_m = a(1-e^2)\left[\boldsymbol{A}(\varphi_2-\varphi_1) - \frac{\boldsymbol{B}}{2}(sen2\varphi_2 - sen2\varphi_1) + \frac{\boldsymbol{C}}{4}(sen4\varphi_2 - sen4\varphi_1) - \frac{\boldsymbol{D}}{6}(sen6\varphi_2 - sen6\varphi_1) + \frac{\boldsymbol{E}}{8}(sen8\varphi_2 - sen8\varphi_1) - \frac{\boldsymbol{F}}{10}(sen10\varphi_2 - sen10\varphi_1)\right]$$

$$A = 1 + \frac{3}{4}e^2 + \frac{45}{64}e^4 + \frac{175}{256}e^6 + \frac{11025}{16384}e^8 + \frac{43659}{65536}e^{10} + \ldots$$

$$B = \frac{3}{4}e^2 + \frac{15}{16}e^4 + \frac{525}{512}e^6 + \frac{2205}{2048}e^8 + \frac{72765}{65536}e^{10} + \ldots$$

$$C = \frac{15}{64}e^4 + \frac{105}{256}e^6 + \frac{2205}{4096}e^8 + \frac{10395}{16384}e^{10} + \ldots$$

$$D = \frac{35}{512}e^6 + \frac{315}{2048}e^8 + \frac{31185}{131072}e^{10} + \ldots$$

$$E = \frac{315}{16384}e^8 + \frac{3465}{65536}e^{10} + \ldots$$

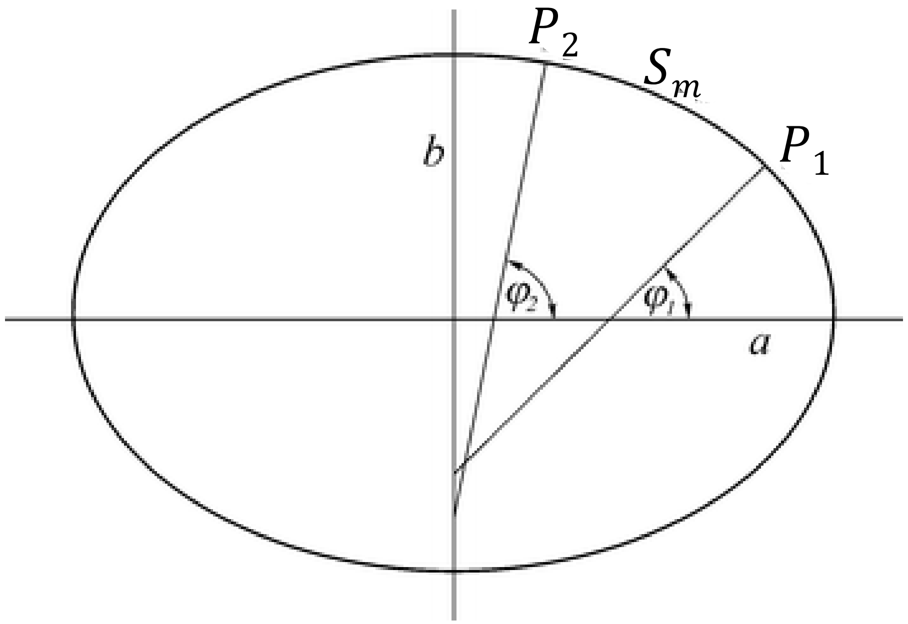
$$F = \frac{693}{131072}e^{10} + \ldots$$

Fuente: Jordan, W. (1962).

Si $\varphi_1 = 0°$ $\rightarrow$ *Longitud de arco desde el ecuador al polo*

(7) Rapp, Richard H. (1991). *Geometric geodesy part I*. Department of Geodetic Science and Surveying, Ohio State University.
(9) Jekeli, C. (2006). *Geometric reference systems in geodesy*. Division of Geodetic Science, School of Earth Sciences. Ohio State University.
(10) Jordan, W. (1962). *Handbook of Geodesy* (Vol. 3). Corps of Engineers, United States Army, Army Map Service

Longitudes de arcos(7,9,10):



Fuente: Lapaine M. (2017)

Si $\varphi_1 = 0°$ $\rightarrow$ *Longitud de arco desde el ecuador al polo*

Helmert

$$S_m = \frac{a}{1+n}\left[a_0\varphi_2 - a_2 sen2\varphi_2 + a_4 sen4\varphi_2 - a_6 sen6\varphi_2 + a_8 sen8\varphi_2\right]$$

$$a_0 = 1 + \frac{n^2}{4} + \frac{n^4}{64} \qquad n = \frac{f}{2-f} = \frac{1-\sqrt{1-e^2}}{1+\sqrt{1-e^2}}$$

$$a_2 = \frac{3}{2}\left(n - \frac{n^3}{8}\right)$$

$$a_4 = \frac{15}{16}\left(n^2 - \frac{n^4}{4}\right)$$

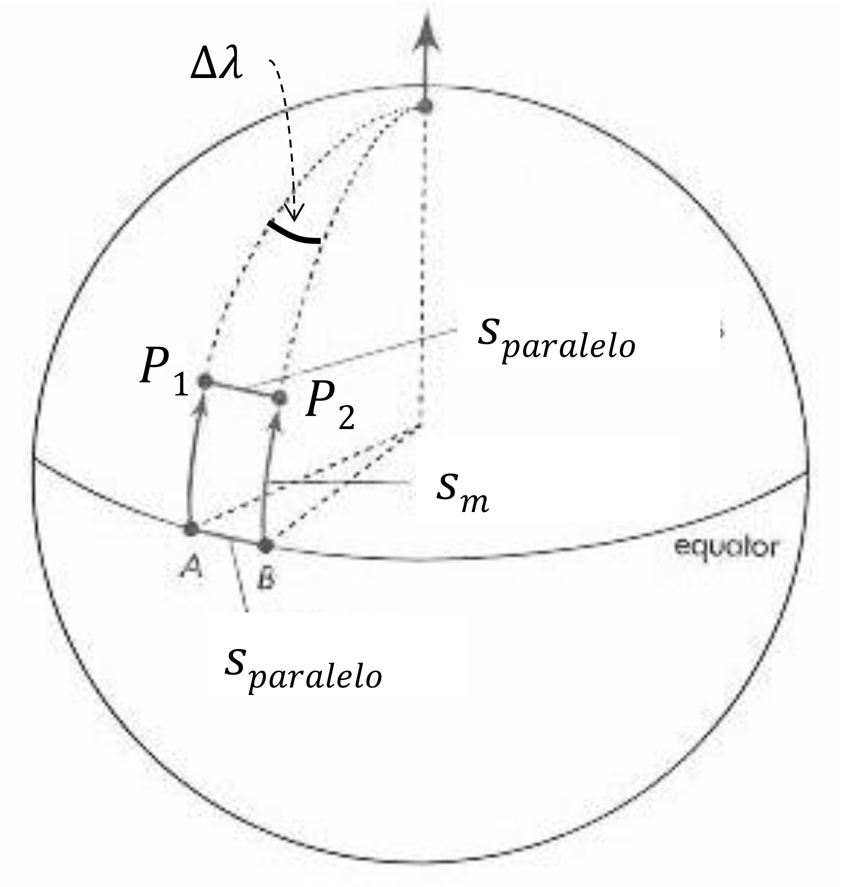
$$a_6 = \frac{35}{45}n^3$$

$$a_8 = \frac{315}{512}n^4$$

(7) Rapp, Richard H. (1991). *Geometric geodesy part I*. Department of Geodetic Science and Surveying, Ohio State University.
(9) Jekeli, C. (2006). *Geometric reference systems in geodesy*. Division of Geodetic Science, School of Earth Sciences. Ohio State University.
(10) Jordan, W. (1962). *Handbook of Geodesy* (Vol. 3). Corps of Engineers, United States Army, Army Map Service

Geodesia

Longitudes de arcos[7,9,10]:



$$\chi = \left|\frac{d\alpha}{ds}\right| \rightarrow \frac{1}{p} = \left|\frac{d\lambda}{ds}\right| \Longrightarrow ds_{paralelo} = N\, cos\varphi\, d\lambda$$

$$s_{paralelo} = N\, cos\varphi\, \Delta\lambda \quad , \quad \Delta\lambda = \lambda_2 - \lambda_1$$

(7) Rapp, Richard H. (1991). *Geometric geodesy part I*. Department of Geodetic Science and Surveying, Ohio State University.
(9) Jekeli, C. (2006). *Geometric reference systems in geodesy*. Division of Geodetic Science, School of Earth Sciences. Ohio State University.
(10) Jordan, W. (1962). *Handbook of Geodesy* (Vol. 3). Corps of Engineers, United States Army, Army Map Service

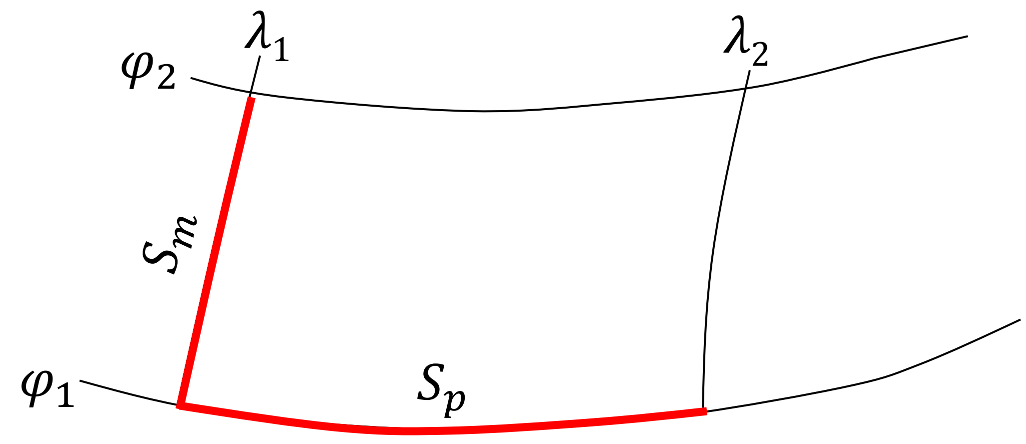
Geodesia

Longitudes de arcos[7,9,10]:

Longitud de Arco de Meridiano

$$S_m = a(1-e^2)\left[\boldsymbol{A}(\varphi_2-\varphi_1) - \frac{\boldsymbol{B}}{2}(sen2\varphi_2 - sen2\varphi_1) + \frac{\boldsymbol{C}}{4}(sen4\varphi_2 - sen4\varphi_1) - \frac{\boldsymbol{D}}{6}(sen6\varphi_2 - sen6\varphi_1) + \frac{\boldsymbol{E}}{8}(sen8\varphi_2 - sen8\varphi_1) - \frac{\boldsymbol{F}}{10}(sen10\varphi_2 - sen10\varphi_1)\right]$$

Fuente: www.thegreenwichmeridian.org



Longitud de Arco de Paralelo $S_p = N\, cos\varphi\, \Delta\lambda$

(7) Rapp, Richard H. (1991). *Geometric geodesy part I*. Department of Geodetic Science and Surveying, Ohio State University.
(9) Jekeli, C. (2006). *Geometric reference systems in geodesy*. Division of Geodetic Science, School of Earth Sciences. Ohio State University.
(10) Jordan, W. (1962). *Handbook of Geodesy* (Vol. 3). Corps of Engineers, United States Army, Army Map Service