

Ellipsoid Computation of Safety Fairway Intersections with Lease Block Grid Lines in the Gulf of Mexico

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Types of *Ellipsoidal* Latitudes

- Conformal Latitude* (χ)
- Isometric Latitude (τ)
- Authalic Latitude* (β)
- Geocentric Latitude (ψ)
- Rectifying Latitude* (ω)
- Parametric Latitude (θ)

* *associated Equivalent Sphere*

Conformal Latitude (χ)

$$\chi = \phi - C_1 \sin 2\phi + C_2 \sin 4\phi - C_3 \sin 6\phi + C_4 \sin 8\phi$$

$$C_1 = \frac{e^2}{2} + \frac{5e^4}{24} + \frac{3e^6}{32} + \frac{281e^8}{5760}$$

$$C_2 = \frac{5e^4}{48} + \frac{7e^6}{80} + \frac{697e^8}{11520}$$

$$C_3 = \frac{13e^6}{480} + \frac{461e^8}{13440}$$

$$C_4 = \frac{1237e^8}{161280}$$

Isometric Latitude (τ)

$$\tau = Ln \left\{ \tan \left(\frac{\pi}{4} + \frac{\chi}{2} \right) \right\}$$

The normal Mercator projection mapping equations are merely:

$$\begin{aligned}x &= a \cdot \Delta\lambda, \\y &= a \cdot \tau\end{aligned}$$

The equation of a line of constant azimuth is termed a loxodrome or rhumb line. In isometric Mercator space, it is simply expressed as: .

$$y = mx + b$$

However, a Safety Fairway is a straight line only in Isometric (Mercator) space.

Offshore Lease Blocks in the Gulf of Mexico are straight lines only in Lambert space or in Transverse Mercator (UTM) space.

Lambert Conformal Conic

basic mapping equations:

$$X = r_{\phi} \cdot \sin \theta + FE$$

$$Y = (r_o - r_{\phi}) \cdot \cos \theta + FN$$

Gauss-Krüger Transverse Mercator

$$X = \text{F.E.} + m_o \cdot v \left\{ \begin{aligned} & \Delta\lambda \cos \phi + \frac{\Delta\lambda^3}{3!} \cos^3 \phi (\eta - \tan^2 \phi) \\ & + \frac{\Delta\lambda^5}{5!} \cos^5 \phi (4\eta^3 (1 - 6 \tan^2 \phi) + \eta^2 (1 + 8 \tan^2 \phi) - \eta (2 \tan^2 \phi) + \tan^4 \phi) \\ & + \frac{\Delta\lambda^7}{7!} \cos^7 \phi (61 - 479 \tan^2 \phi + 179 \tan^4 \phi - \tan^6 \phi) + \dots \end{aligned} \right\}$$

$$Y = \text{F.N.} + m_o \left\{ M_\phi + v \sin \phi \left[\begin{aligned} & \frac{\Delta\lambda^2 \cos \phi}{2!} + \frac{\Delta\lambda^4 \cos^3 \phi}{4!} (4\eta^2 + \eta - \tan^2 \phi) \\ & + \frac{\Delta\lambda^6 \cos^5 \phi}{6!} \left(8\eta^4 (11 - 24 \tan^2 \phi) - 28\eta^3 (1 - 6 \tan^2 \phi) \right) \right. \\ & \quad \left. + \eta^2 (1 - 32 \tan^2 \phi) - 2 \tan^2 \phi + \tan^4 \phi \right] \\ & + \frac{\Delta\lambda^8 \cos^7 \phi}{8!} (1385 - 3111 \tan^2 \phi + 543 \tan^4 \phi - \tan^6 \phi) + \dots \end{aligned} \right\}$$

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SUBROUTINE GRIDLOX (griddir, gridinv)
c   compute intersection of loxodrome with constant x or y grid line.
  implicit real*8 (a-h,o-z)
  real*8 lam1, lam2, lam
  integer*2 nc
  external TAU, CHItoPHI, griddir, gridinv
  common /zoncon/ CM, PHIAO, SFaO, PHIAFN, FE, FN, FEaFO, FNaFO
  common /params/ a, e2, units, sss, az, pi, iproj, istat, iutm, jutm
  common /lambert/ AN, DK, RHOaO, Rb
  common /names/ zone, elname, datum, prtype, unname, cty, ist, idtm
  character*25 zone*40, elname, datum, prtype*40, unname*12, cty*50
  character*15 phia*15, lama*15, resp*1, dmsa, rdmsa

c
10  write (*,1)
1   format('/' Enter lat - long for the loxodrome start point/'
           ' in packed dms form - ddmms.sss  dddmms.sss : ')
  read (*,*) d1, d2
  phia = dmsa (d1)
  phi1 = dmsr (d1)
  lama = dmsa (d2)
  lam1 = dmsr (d2)
  call GRIDDIR (phi1,lam1,xlox1,ylox1,dum1,dum2)
  write(9,2)phia, lama, xlox1, ylox1
2   format(' Loxodrome Start =', 2a16, 2x, 2f13.3)
c

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Loxodrome Intersections

Latitude	Longitude	X(Meters)	Y(Meters)
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Enter lat - long for the loxodrome start point
in packed dms form - ddmms.sss dddmms.sss : 273306. -963021.

Enter lat - long for the loxodrome final point
in packed dms form - ddmms.sss dddmms.sss : 280036. -900818.

Enter value of grid line : 1000000.

Enter [1] if this is an X grid line, [2] if Y : 1

Intersection	=	27 55 26.8778	-91 20 00.0000	1000000.000	-63845.566
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TITLE 33 — NAVIGATION AND NAVIGABLE WATERS [33 CFR]

PART 166 — SHIPPING SAFETY FAIRWAYS [33 CFR 166]

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Subpart A — General

§ 166.100 — Purpose. [Last FR update: 06/30/1983]

§ 166.103 — Geographic coordinates. [Last FR update: 09/08/1987]

§ 166.105 — Definitions. [Last FR update: 06/30/1983]

§ 166.110 — Modification of areas. [Last FR update: 06/30/1983]

Subpart B — Designations of Fairways and Fairway Anchorages

§ 166.200 — Shipping safety fairways and anchorage areas, Gulf of Mexico. [Last FR update: 05/13/1982]

§ 166.300 — Areas along the coast of California. [Last FR update: 10/24/1983]

§ 166.400 — Areas along the coast of Alaska. [Last FR update: 12/02/1986]

§ 166.500 — Areas along the Atlantic Coast. [Last FR update: 09/28/1987]

Before and After (Entire GoM)

NAD27

- BRAZOS SANTIAGO
- PASS SAFETY FAIRWAY
- 26 03 27. 97 08 36.
- 26 02 57. 97 97 11.
- 26 02 06. 96 57 24.
- 25 58 54. 96 19 00.

NAD83

- BRAZOS SANTIAGO
- PASS SAFETY FAIRWAY
- 26 03 27. 97 08 36.
- 26 02 57. 97 97 11.
- 26 02 06. 96 57 24.
- 25 58 54. 96 19 00.

SHIFT Output from NADCON

- Gulf Safety Fairway (W) = 42 meters
- Gulf Safety Fairway (E) = 29 meters
- Atchafalaya Pass = 27 meters
- Tampa Safety Fairway = 38 meters

- Maximum overlap allowed = 38 meters

QUESTIONS?

