

3-D GSDM Computations - BK8 & BK9

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This spreadsheet performs BK8 & BK9 computations on user selected ellipsoid - default is GRS80.

Ellipsoid: GRS80 (The ellipsoid name and parameters may be changed by the user.)

$$a = 6,378,137.000$$

$$1/f = 298.25722210088 \quad e^2 = 2 * f - f^2 \quad e^2 = 0.006694380022903$$

Excel uses angular units of radians for trigonometric functions.

This spreadsheet uses seconds per radian (spr) for conversion - spr = 206,264.806247096

BK8 Input - beginning latitude/longitude of Pt 1 & ECEF coordinate differences Pt 1 to Pt2.

Output - Local coordinate differences Pt 1 to Pt 2 in meters.

Notes:

1. This routine rotates an ECEF vector Pt 1 to Pt 2 into local Δe , Δn , Δu components.
2. Stated differently, this routine computes the local components of a GPS vector.
3. Uses latitude/longitude of Pt 1 -may be obtained from ECEF values using BK2.
4. Latitude is positive N and negative S. Longitude must be EAST longitude.

Equations:

$$\Delta e = -\Delta X \sin \lambda + \Delta Y \cos \lambda$$

$$\Delta n = -\Delta X \sin \varphi \cos \lambda - \Delta Y \sin \varphi \sin \lambda + \Delta Z \cos \varphi$$

$$\Delta u = \Delta X \cos \varphi \cos \lambda + \Delta Y \cos \varphi \sin \lambda + \Delta Z \sin \varphi$$

Pt 1	SW Cor Sec 31, T23S-R1E	ECEF Differences	to NW Cor Sec 31, T23S-R1E
Lat =	32 15 24.28753 DMS	$\Delta X = 251.1226$ m	$\Delta e = 0.8636$ m
Lat =	0.5629864330 rad	$\Delta Y = 824.1955$ m	$\Delta n = 1,609.1171$ m
Long =	253 6 43.45845 DMS	$\Delta Z = 1,359.0102$ m	$\Delta u = -3.3047$ m
Long =	4.4176390293 rad		

BK9 Input - beginning latitude/longitude of Pt 1 & local coordinate differences Pt 1 to Pt 2.

Output - Geocentric coordinate differences between the two points.

- Notes:
1. This routine rotates a local vector Pt 1 to Pt 2 into ECEF ΔX , ΔY , ΔZ components.
 2. Stated differently, this routine computes the ECEF components of a local vector.
 3. Same as items 3 & 4 above.

Equations:

$$\Delta X = -\Delta e \sin \lambda - \Delta n \sin \varphi \cos \lambda + \Delta u \cos \varphi \cos \lambda$$

$$\Delta Y = \Delta e \cos \lambda - \Delta n \sin \varphi \sin \lambda + \Delta u \cos \varphi \sin \lambda$$

$$\Delta Z = \Delta n \cos \varphi + \Delta u \sin \varphi$$

Pt 1	SW Cor Sec 31, T23S-R1E	Local Differences	to NW Cor Sec 31, T23S-R1E
Lat =	32 15 24.2875 DMS	$\Delta e = 0.8636$ m	$\Delta X = 251.1226$ m
Lat =	0.5629864330 rad	$\Delta n = 1609.1171$ m	$\Delta Y = 824.1955$ m
Long =	253 6 43.4585 DMS	$\Delta u = -3.3047$ m	$\Delta Z = 1359.0102$ m
Long =	4.4176390293 rad		

Note: It is prudent to perform the computation both ways to check your work!

