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To: VSRT Group
From: Alan E.E. Rogers
Subject: Calculation of a geometry of antenna beam intersection with the mesosphere.

The calculation of the location of the region sensed by the ozone spectrometer involves several coordinate transformations (see Figure 1 for geometry) as follows:

1] Transform latitude and longitude of the antenna to rectangular coordinates x, y, z where

   x is the direction of zero longitude

   z is the direction of the Earth's pole

2] Calculate the distance from the antenna to the mesosphere say at the height of 100 km using the method given in memo #33.

3] Derive the local coordinates

   E = d sin (az) cos (el)

   N = d cos (az) cos (el)

   U = d sin (el)

Where d = distance from 2]

   az, el = azimuth and elevation of the antenna

4] Transform E,N,U to *x,y,z* and add to the *x,y,z* coordinates of the antenna

5] Transform *x,y,z* to latitude and longitude

For the setup at CHS

Antenna potions = 42 37.298, -71 22.54 (deg, min)

Antenna az = 172±2 degrees

   el = 8±1 degrees

Intersection with mesosphere at 100 km at 37.813, - 70.525 (deg)

Also shown in Figure 1 is the "local" and "Earth" horizons at altitude. For an altitude of 100 km the "Earth" horizon is about 10 degrees below the local horizon.
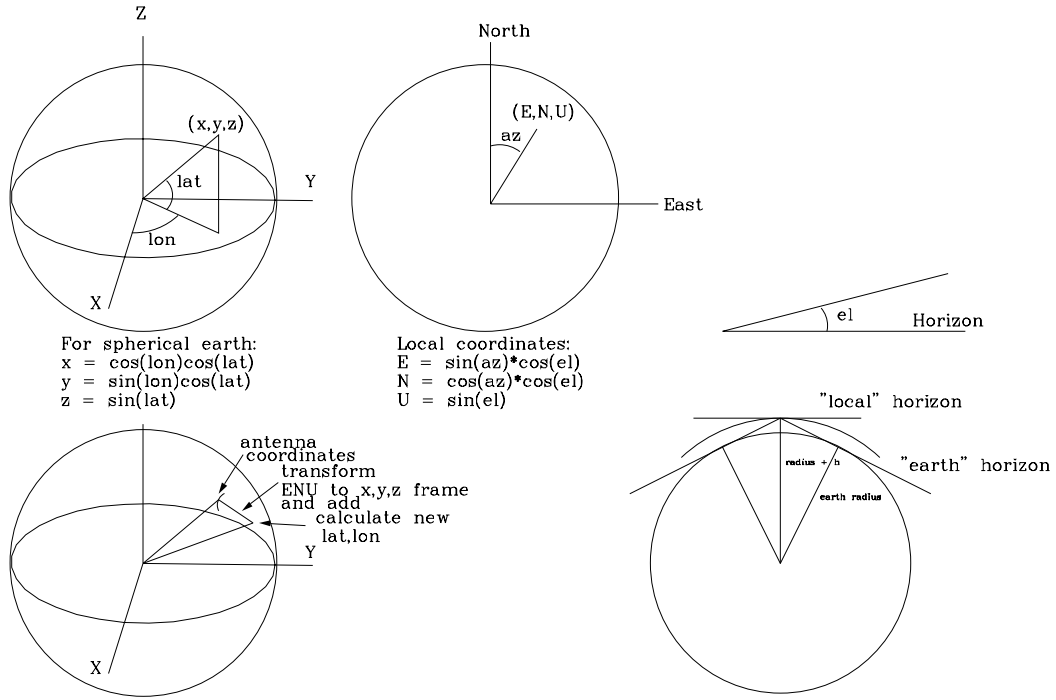
Figure 1.

For spherical earth:
x = cos(lon)cos(lat)
y = sin(lon)cos(lat)
z = sin(lat)

Local coordinates:
E = sin(az)*cos(el)
N = cos(az)*cos(el)
U = sin(el)

antenna
coordinates
transform
ENU to x,y,z frame
and add
calculate new
lat,lon

"local" horizon
"earth" horizon
radius + h
earth radius