AGR 1515 Intro to GPS

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GPS in Agriculture

- Define Boundaries
- Reduce farmer fatigue
- Automate equipment
- Tie it to information (GIS)

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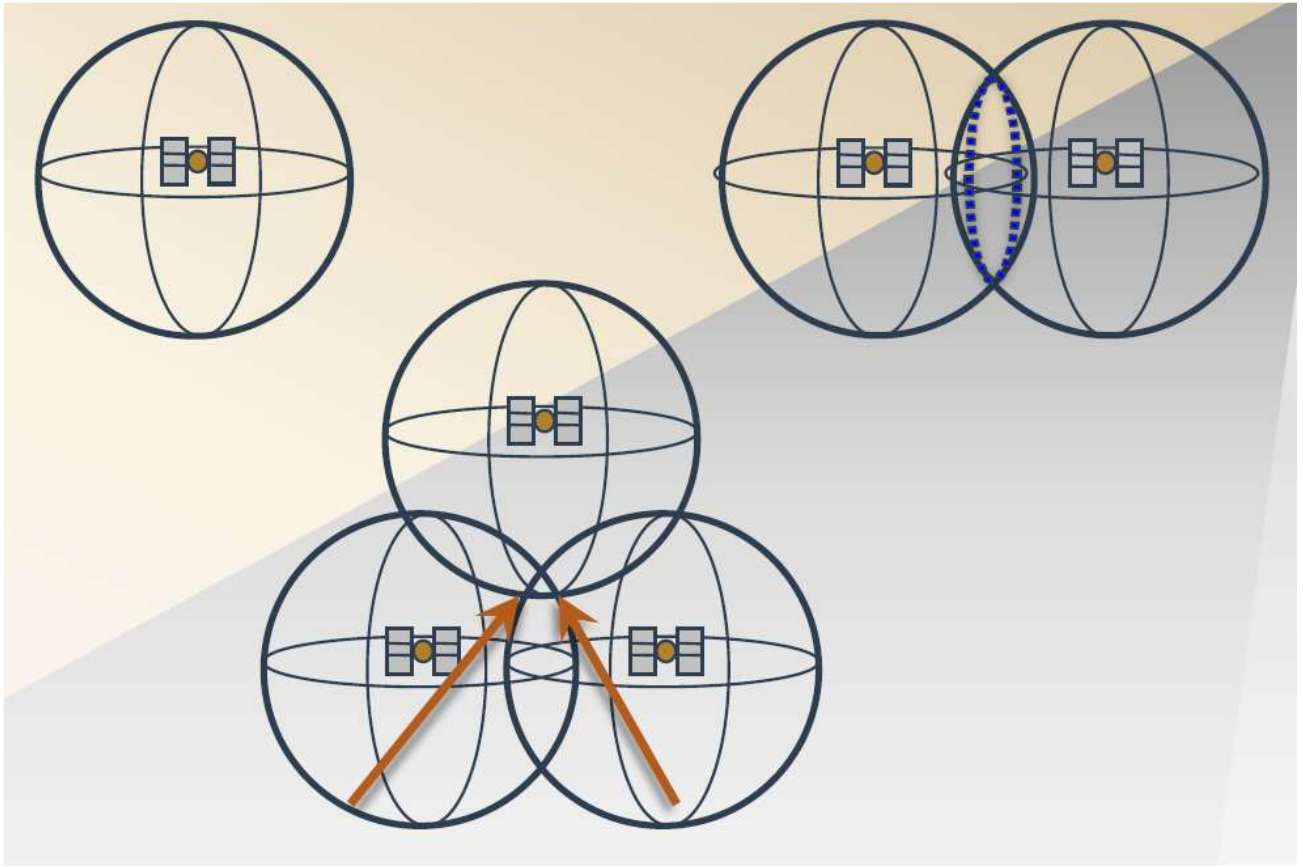
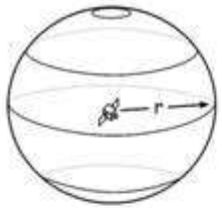
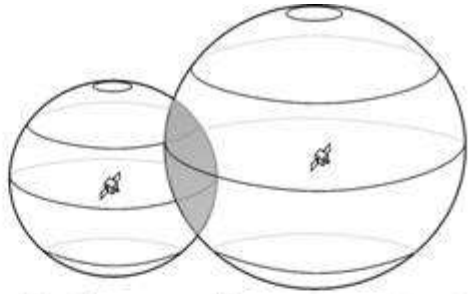
Triangulation

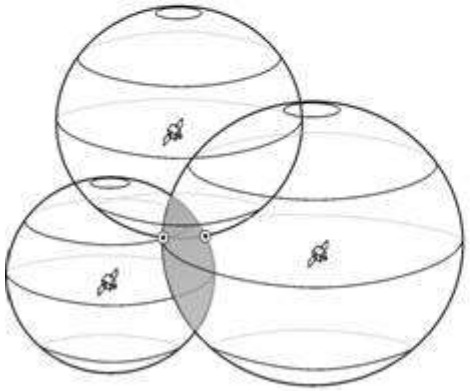




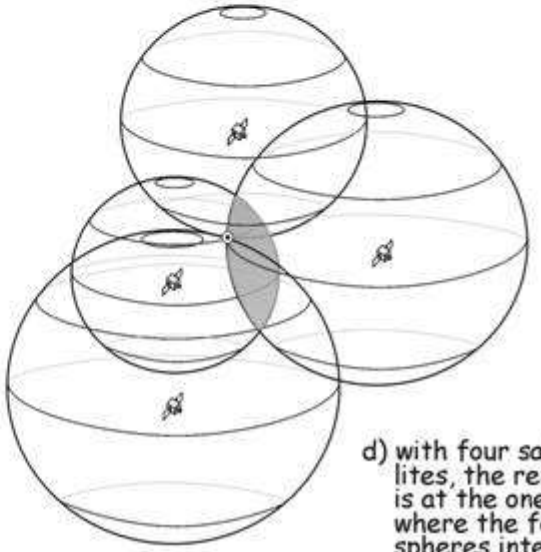
a) with a range measurement from one satellite, the receiver is positioned somewhere on the sphere defined by the satellite position and the range distance, r



b) with two satellites, the receiver is somewhere on a circle where the two spheres intersect



c) with three satellites the receiver is at one of two points where the three spheres intersect

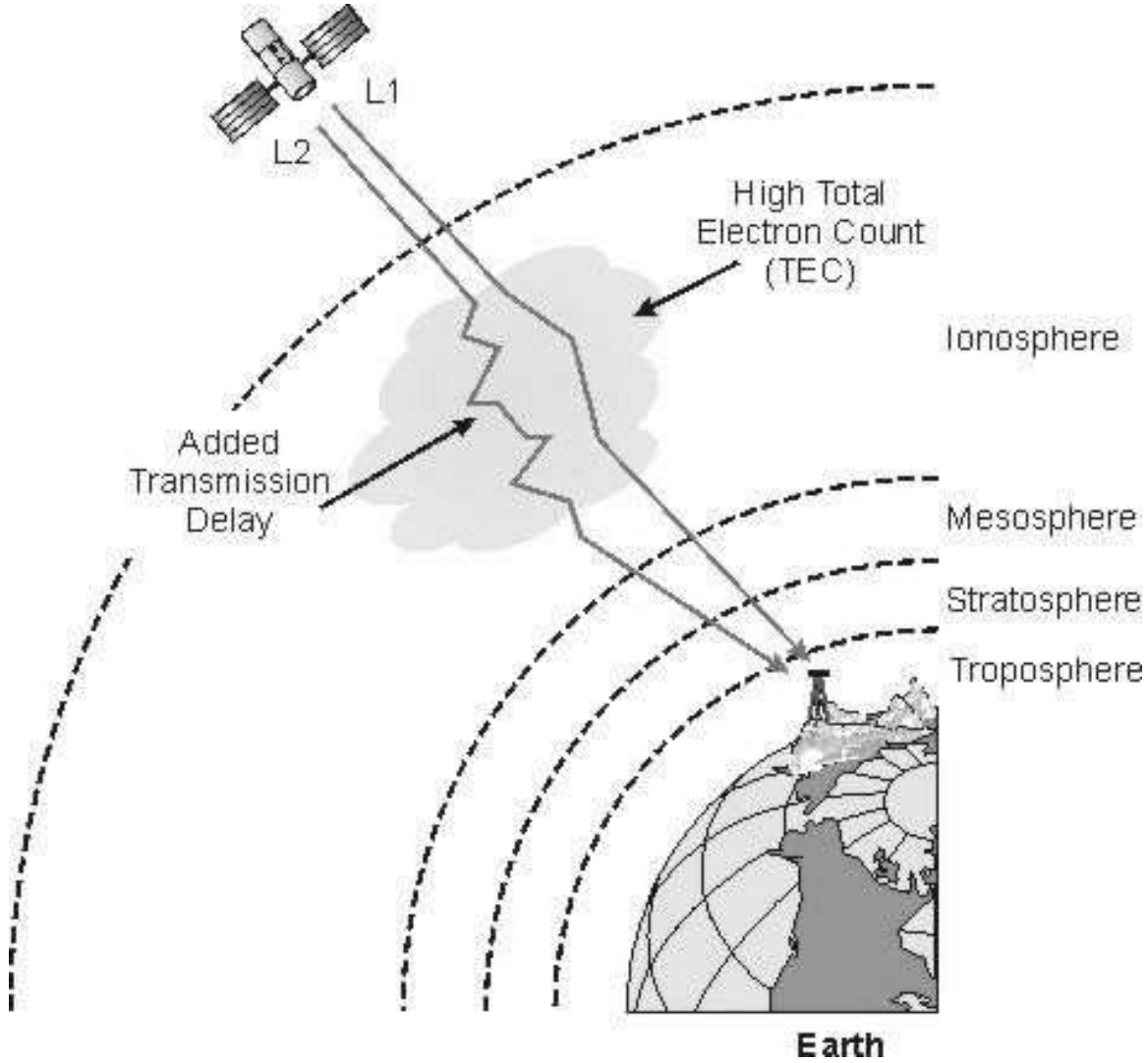


d) with four satellites, the receiver is at the one point where the four spheres intersect.

https://gis.depaul.edu/shwang/teaching/geog258/GPS.htm

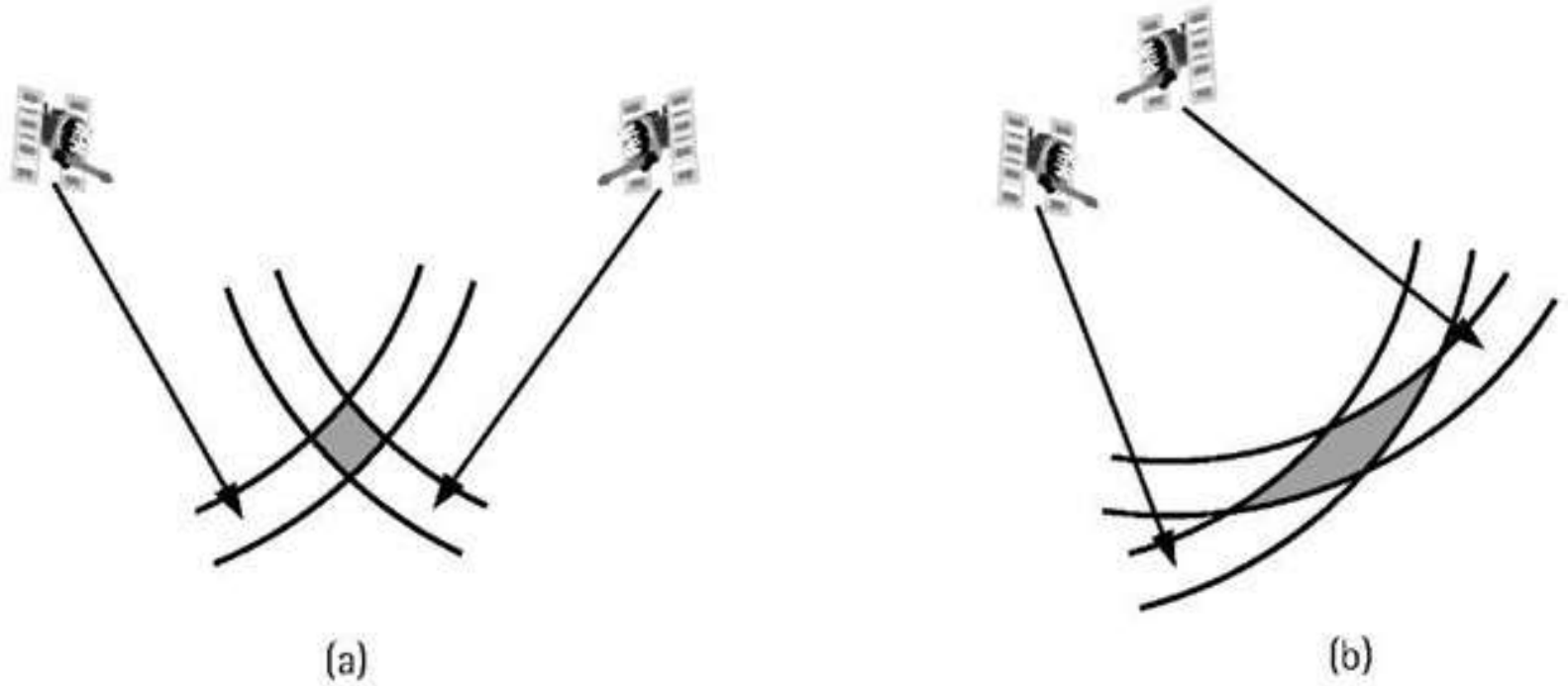
Sources of Error

- Atmospheric delay
- Signal multi-path (reflection of signal)
- Receiver clock errors
- Orbital errors (satellite position error)
- Number of satellites visible
- Satellite geometry



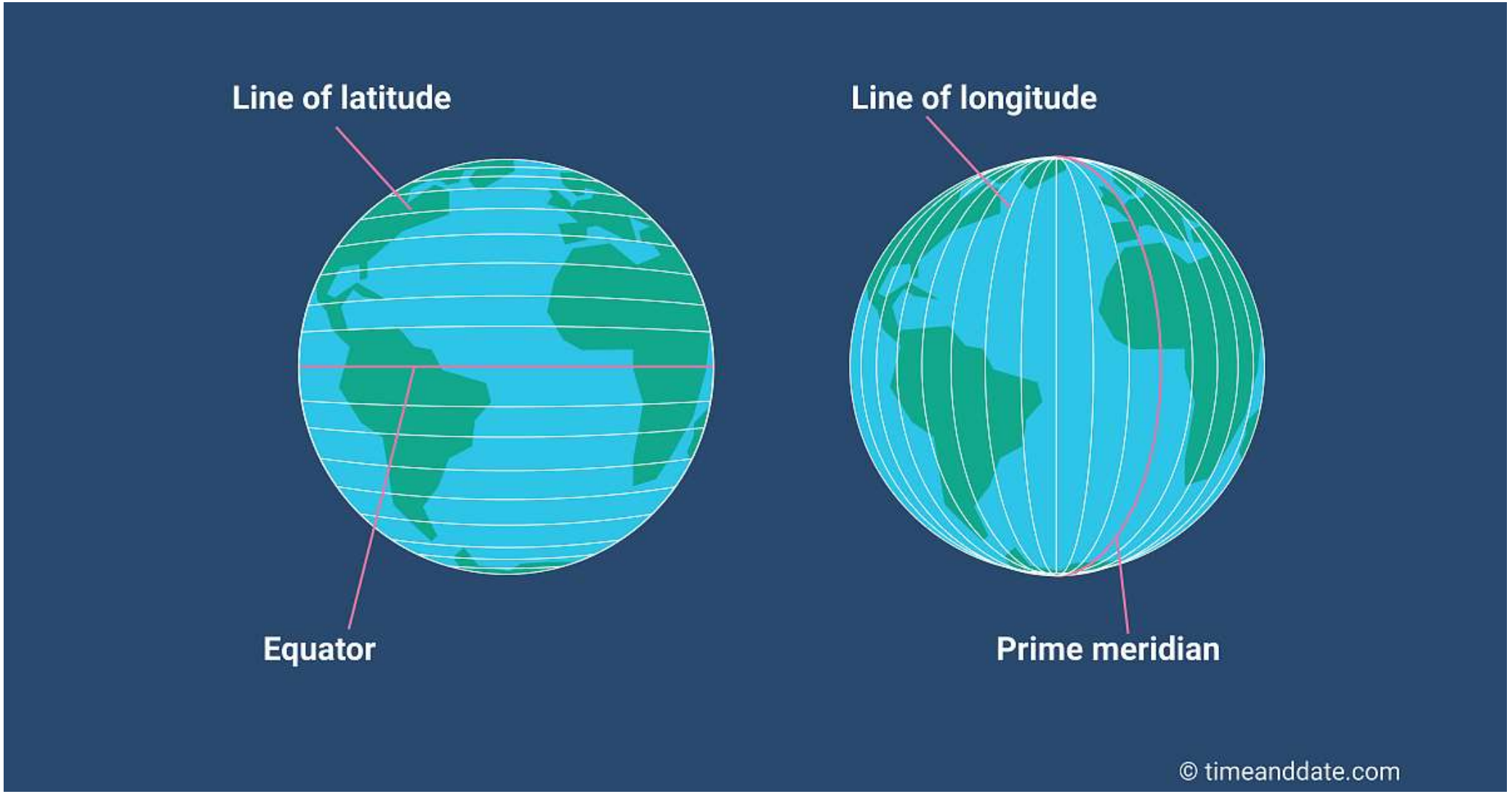
https://irp.cdn-website.com/402600db/dms3rep/multi/opt/Ionospheric-effect-on-GPS-signals-640w.png

Satellite Geometry



Global Navigation Satellite System (GNSS)

- GPS (United States) – 31 satellites
- GLONASS (Russia) – 24+ satellites
- Galileo (EU) – 24+ satellites
- Beidou (China) – 35 satellites
- QZSS (Japan) – 4+ satellites
- IRNSS (India) – 7 satellites


Line of latitude
Line of longitude
Equator
Prime meridian
© timeanddate.com

Understanding Longitude and Latitude

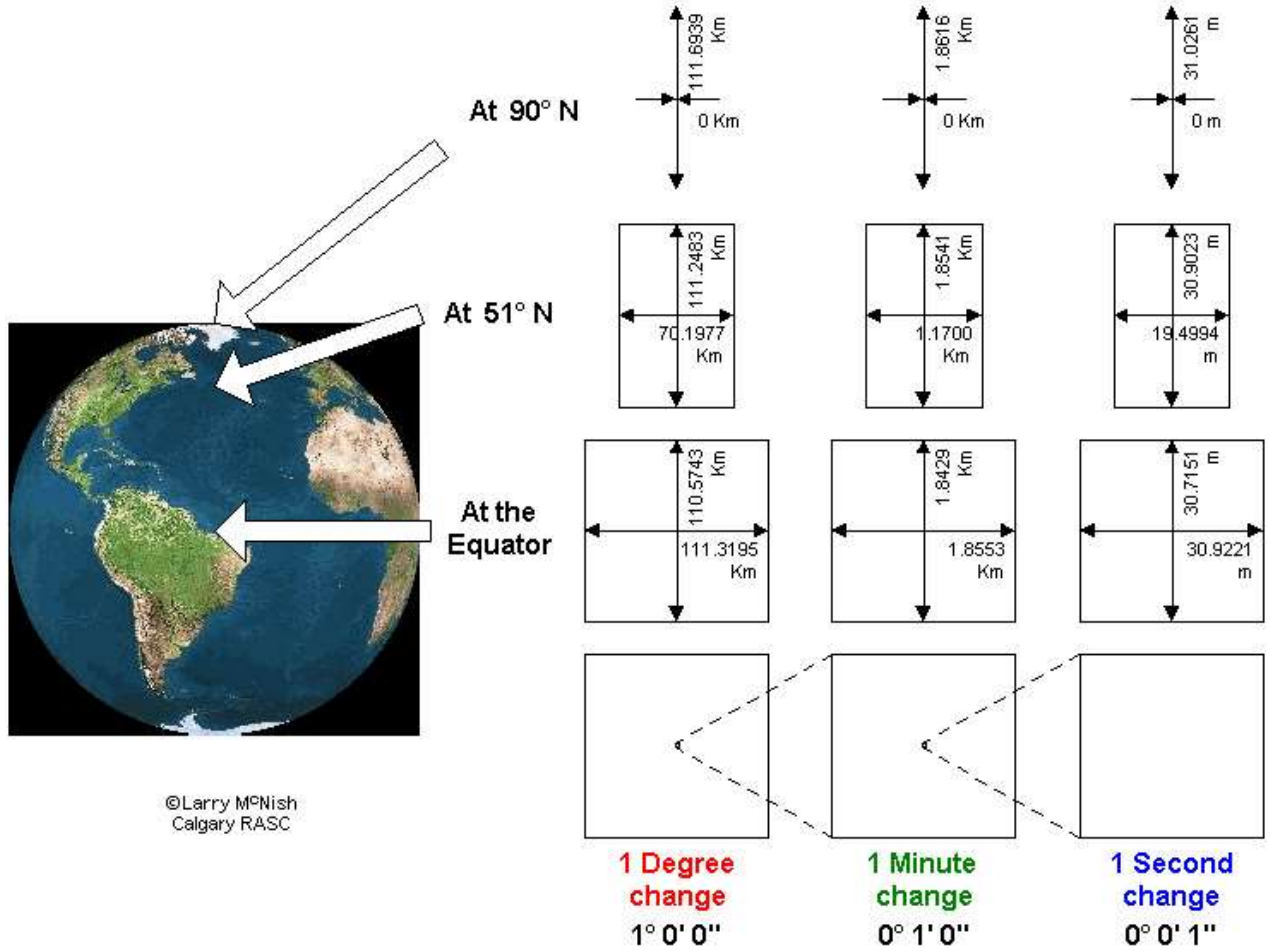
- ° = degrees, ‘ = minutes, “ = seconds

- 1’ = 1/60 °, 1 minute = 1/60 degree
- 1” = 1/60’, 1 second = 1/60 minute
  - 1” = 1/3600°, 1 second = 1/3600 degree

Understanding Longitude and Latitude

- ° = degrees, ‘ = minutes, “ = seconds

- 41° 56’ 54.3732” N, 87° 39’ 19.2024” W
- “41 degrees, 56 minutes, 54.3732 seconds north”
- “87 degrees, 39 minutes, 19.2024 seconds west”



https://calgary.rasc.ca/images/latlongdist.gif

Other Forms

- Degree Decimal system
  - 41° 56’ 54.3732” N, 87° 39’ 19.2024” W
  - Equal to…
  - 41.9484°N, 87.6553°W

  - How do we do this?

One degree is equal to 60 minutes and equal to 3600 seconds:

$$1° = 60' = 3600''$$

One minute is equal to 1/60 degrees:

$$1' = (1/60)° = 0.01666667°$$

One second is equal to 1/3600 degrees:

$$1'' = (1/3600)° = 2.77778e\text{-}4° = 0.000277778°$$

For angle with d integer degrees m minutes and s seconds:

$$d° \; m' \; s''$$

The decimal degrees dd is equal to:

$$dd = d + m/60 + s/3600$$

Convert 30 degrees 15 minutes and 50 seconds angle to decimal degrees:

$$30^\circ\ 15'\ 50''$$

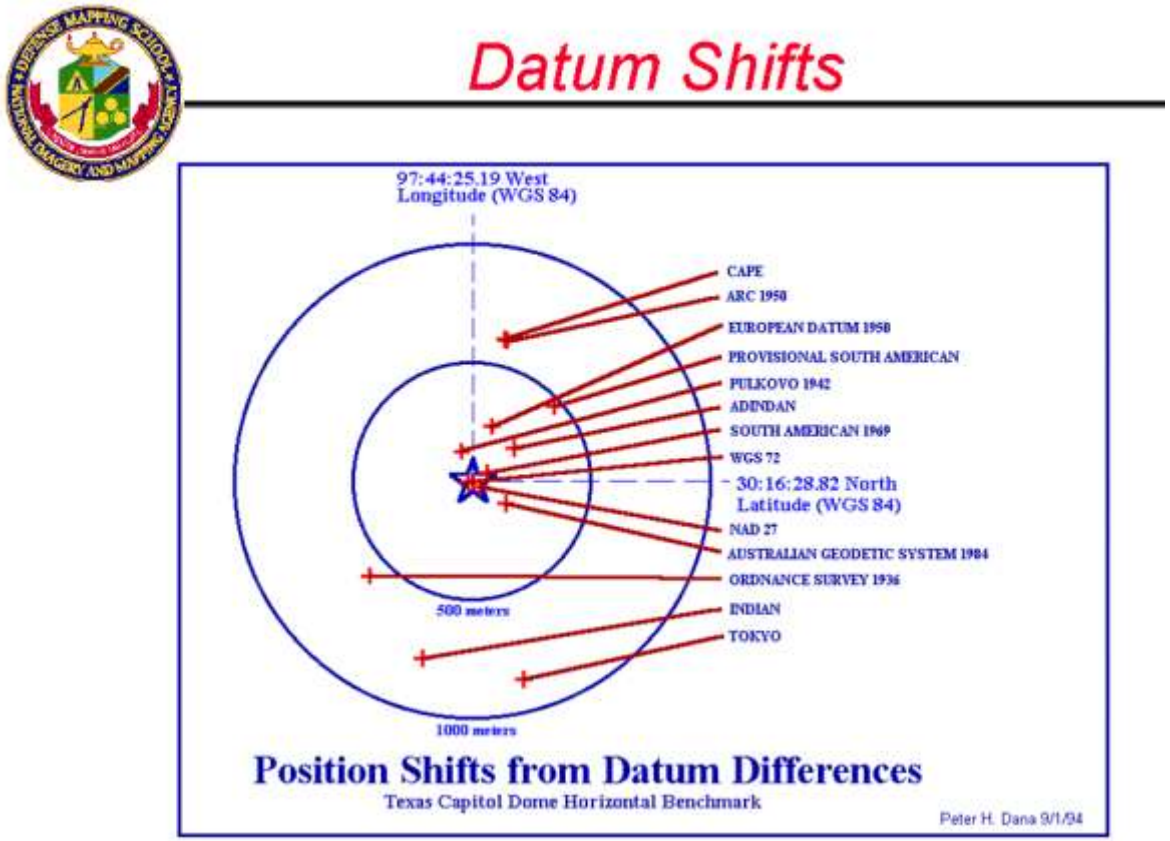
The decimal degrees dd is equal to:

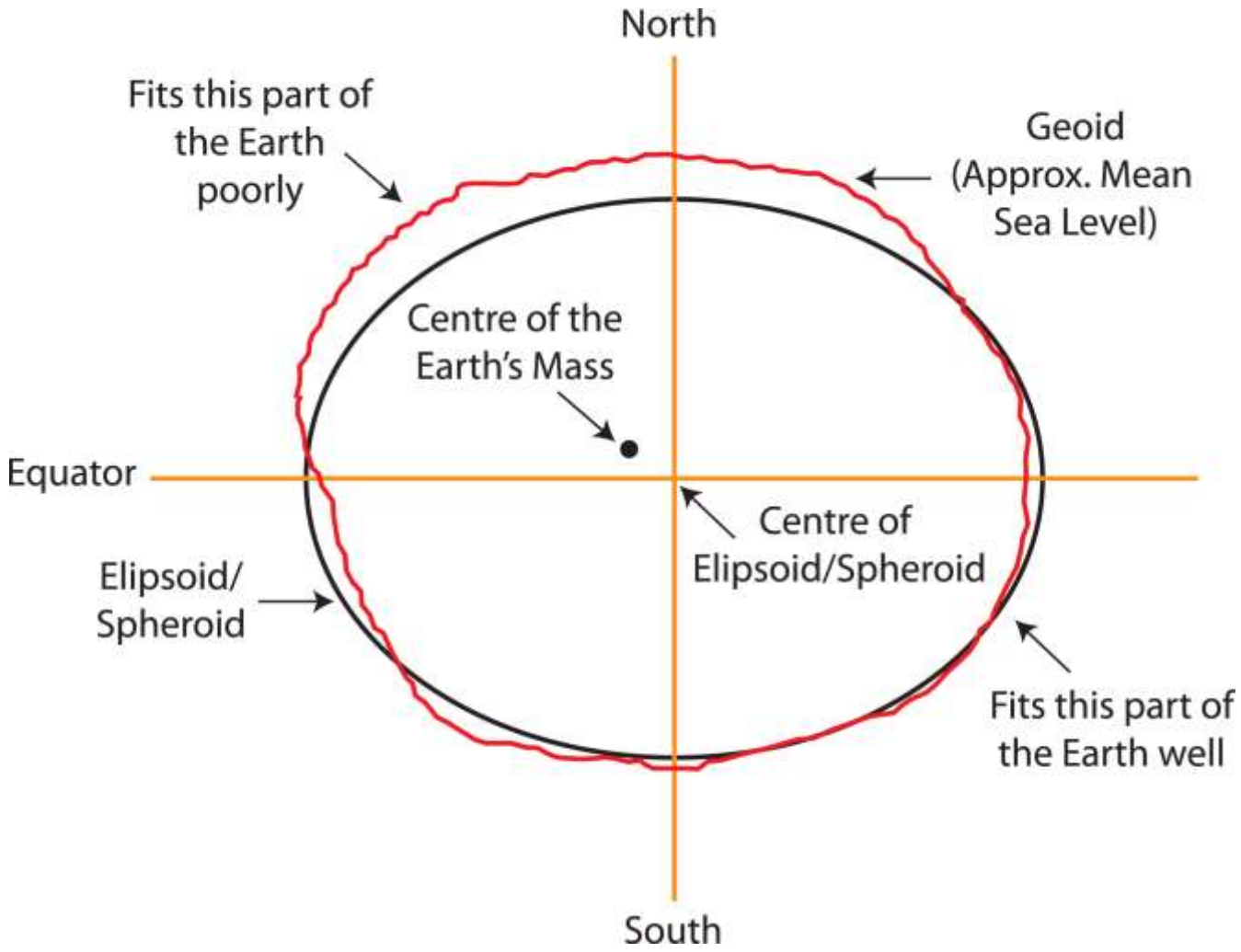
$$dd = d + m/60 + s/3600 = 30^\circ + 15'/60 + 50''/3600 =$$

$$30.263888889^\circ$$

Datum

- **Datum:** an abstract coordinate system with a reference surface that serves to provide known locations to begin surveys and create maps




North
Fits this part of the Earth poorly
Geoid (Approx. Mean Sea Level)
Centre of the Earth's Mass
Equator
Centre of Elipsoid/Spheroid
Elipsoid/ Spheroid
Fits this part of the Earth well
South