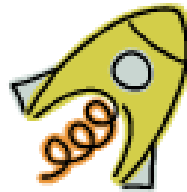


# GPS in HPR



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- B.S. Computer Science-  
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- M.S. Space Studies-  
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Courtesy of Orbital Sciences Corporation

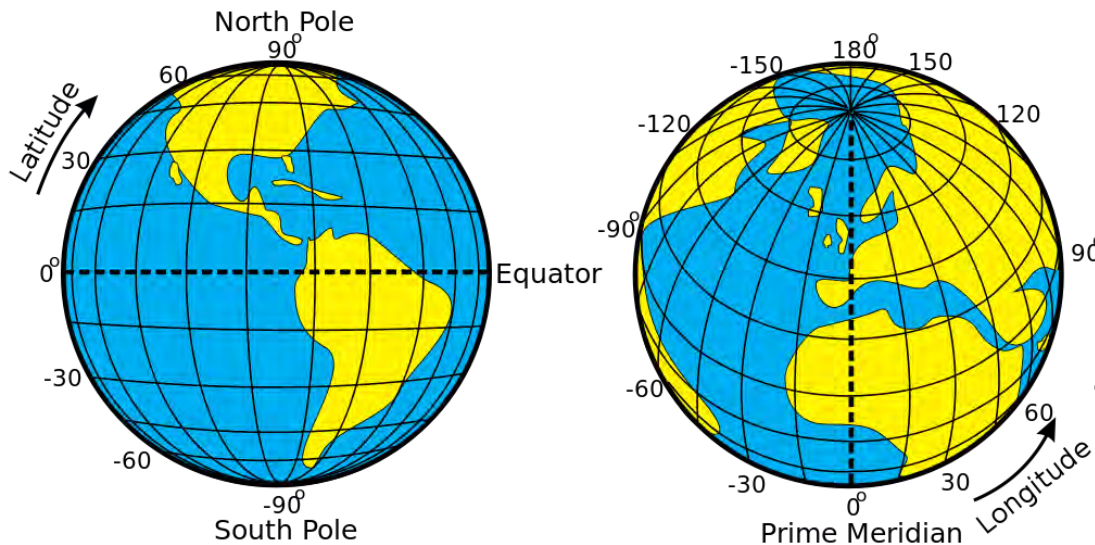


- NuSTAR
- Stardust@Home
- STEREO
- Solar Probe+
- ICON



- NAR- NOVAAR
- Tripoli- Central VA
- MicroMaxx to M!
- BP, APCP, & N<sub>2</sub>O

# Map Refresher



By Djexplo (Own work) [CC0], via Wikimedia Commons

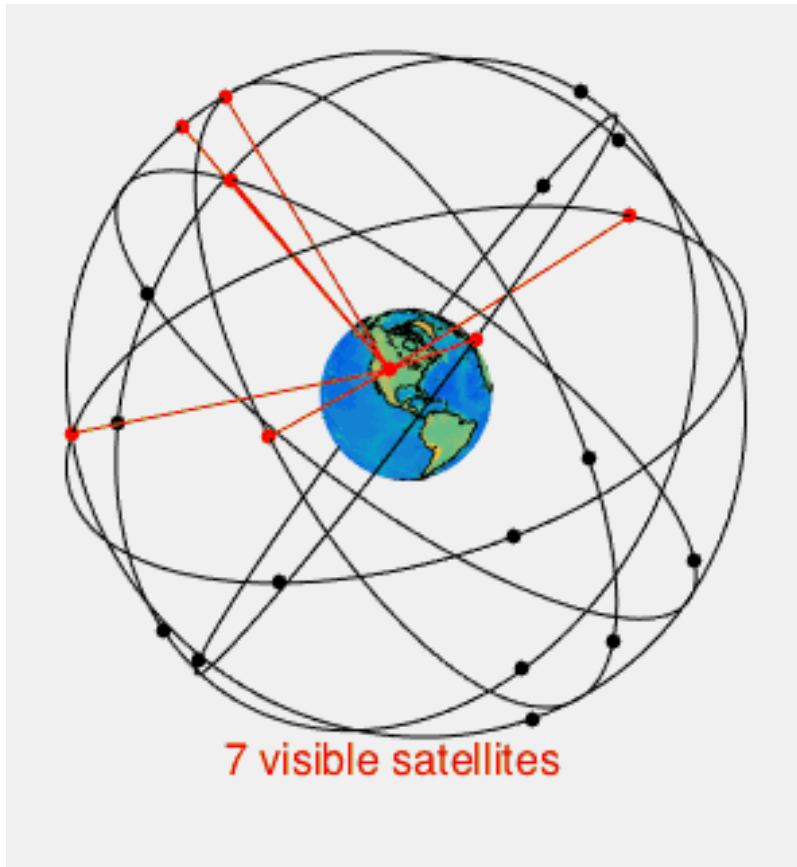
- Latitude, Longitude
  - Decimal degrees, DM and DMS
  - East is +, West is –
- Geodetic Datum
  - WGS84
    - World Geodetic System
  - NAD27, NAD83

# Coordinate Refresher



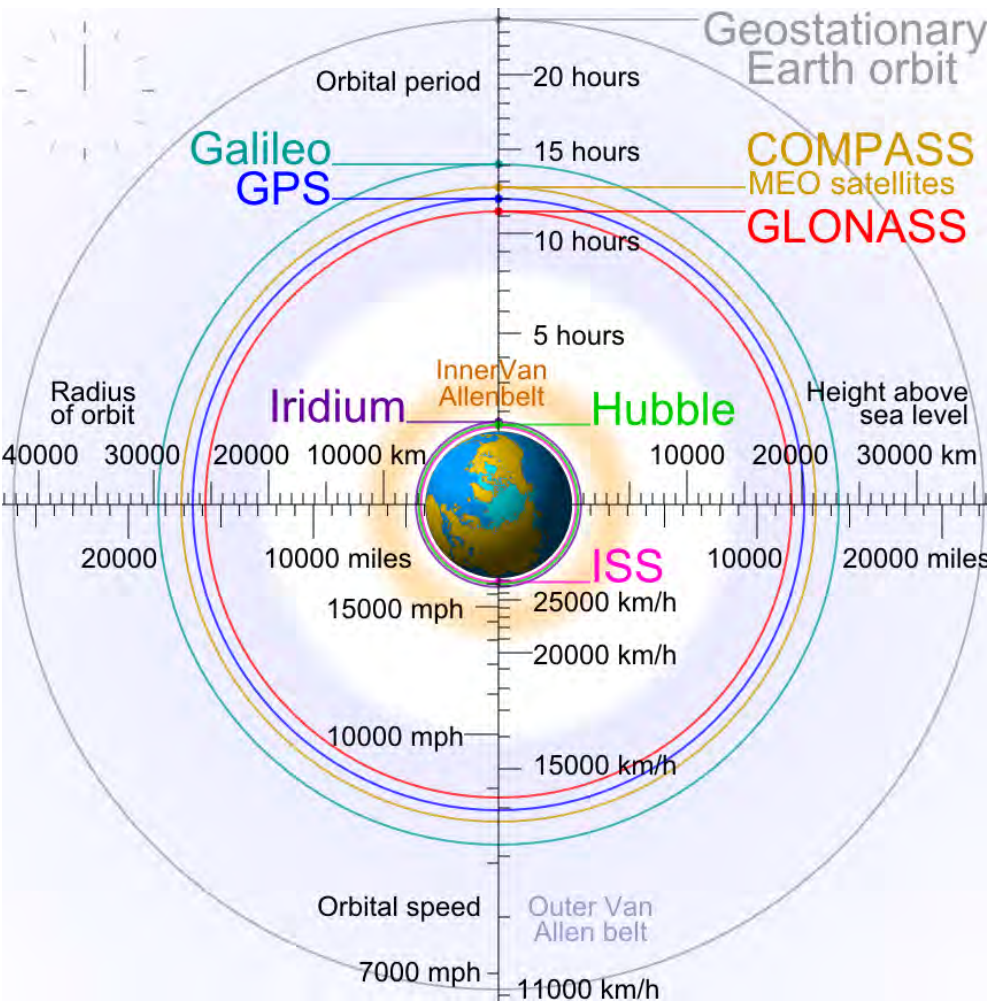
- Great Meadow field in DMS:
  - $38^{\circ} 49' 44.8''$  N
  - $77^{\circ} 48' 39.7''$  W
- Decimal degrees
  - 38.829121,-77.8110397
- Degrees Minutes
  - $38^{\circ} 49.7467$  N
  - $77^{\circ} 48.6617$  W

# What is GPS?



- Satellite based
- Global
- Time, position, velocity
- Receive only
- Military with civilian subset
- Compatible systems: GLONASS, Galileo, Beidou

# History of GPS

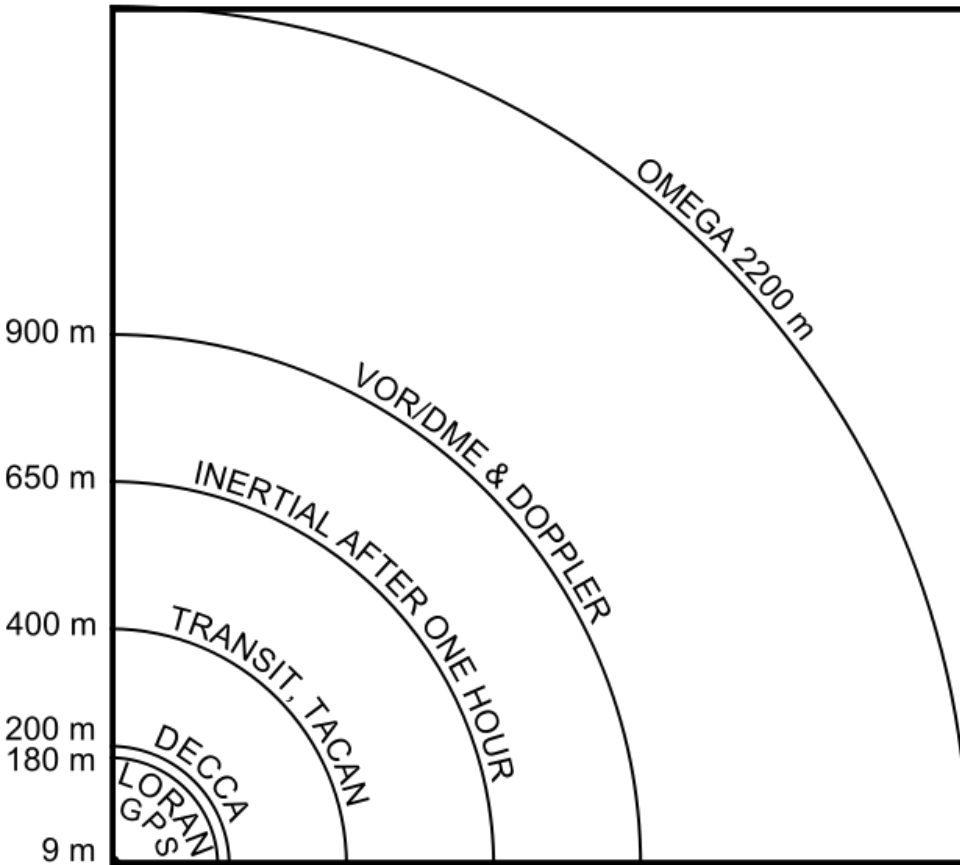


- Precision targeting
- Replaces celestial, radio, and early satellite navigation systems
- First launch 1978

What might be  
limitations of GPS?

# GPS Limitations

ACCURACY OF NAVIGATION SYSTEMS  
(2-dimensional)



- Accuracy:
  - Selective Availability
  - Ionosphere
  - Geometry
- Signal blockage

# GPS Limitations (cont)



- Need telemetry for tracking
- Altitude & speed lockouts: 18km & 515 m/s
- Jerk

# GPS Hints and Tips



- Set firmware to air mode
- Check for RF opaque materials
- Type of antenna and orientation
- “Soft” mounts to minimize jerk?

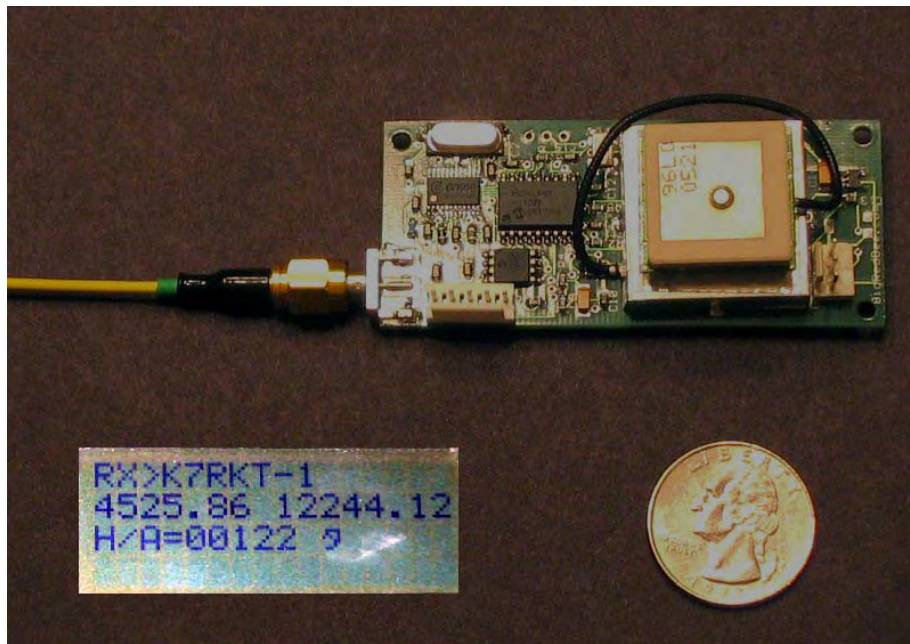
# GPS Uses



- Tracking
- Dual-deploy?
- Research
- Flight/attitude control

# Current Products

- Consumer
- UAS Platforms
- Rocketry specific



RX>K7RKT-1  
4525.86 12244.12  
H/A=00122 5

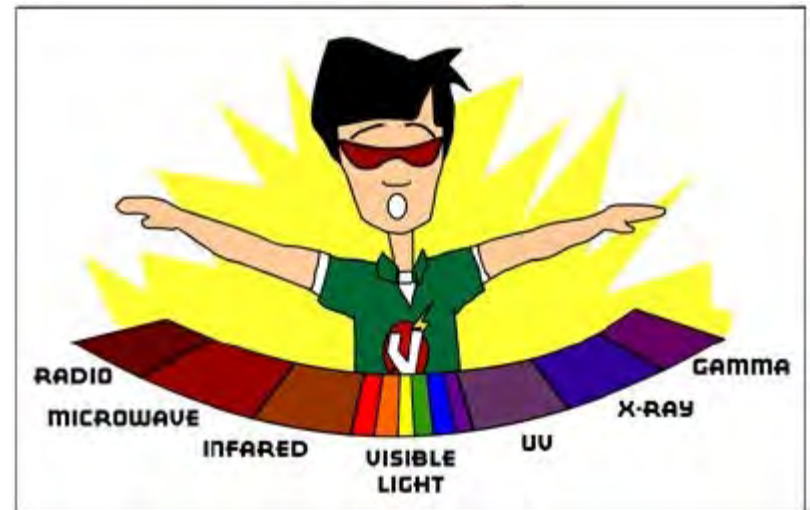
# Telemetry Considerations



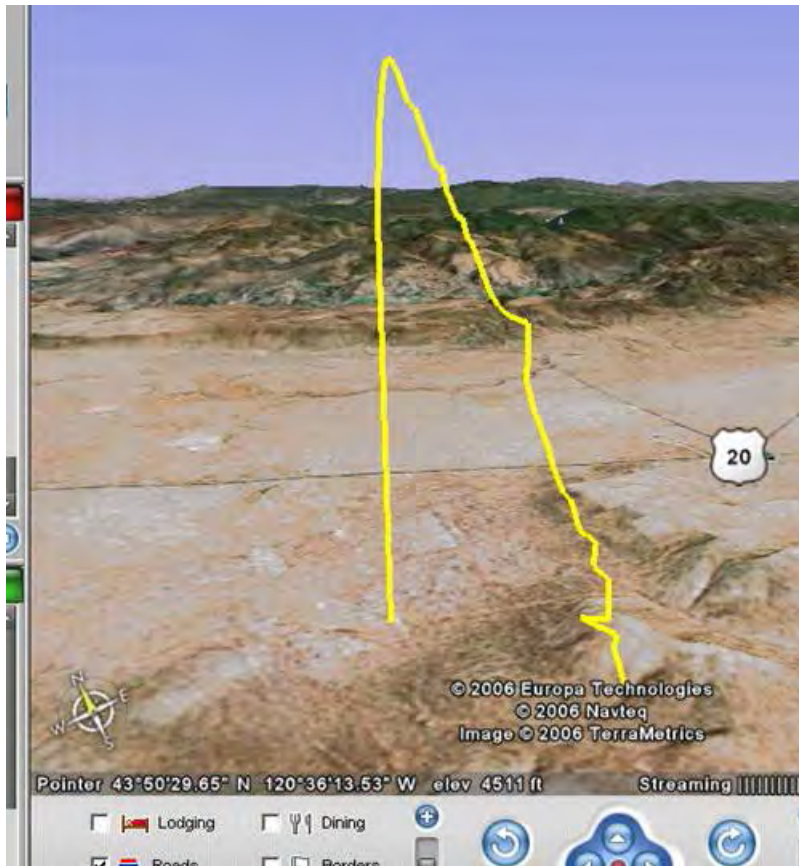
- Transmit frequency
  - Ham or not to ham?
- Need RDF capability?
  - Spread Spectrum

# Frequency bands

- 145 MHz “ham radio”
- 216-219 “wildlife tracking”
- 222-225 ham band
- 440 MHz ham band
- 443.92 MHz
- 900 MHz
- 2 GHz spread spectrum



# Using the Data



- Post processing
  - Google Maps
- Apps
- Computer tools
- Standalone tools
  - Kenwood TH-D74
- Web based
  - [aprs.fi](http://aprs.fi)

# References

- [https://en.wikipedia.org/wiki/Global\\_Positioning\\_System](https://en.wikipedia.org/wiki/Global_Positioning_System)
- Altusmetrum.com
- BigRedBee.com
- APRS.org and aprs.fi
- [www.homingin.com](http://www.homingin.com)