

GPS Systems for Sport Rockets



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<https://www.ssl.berkeley.edu/about/>

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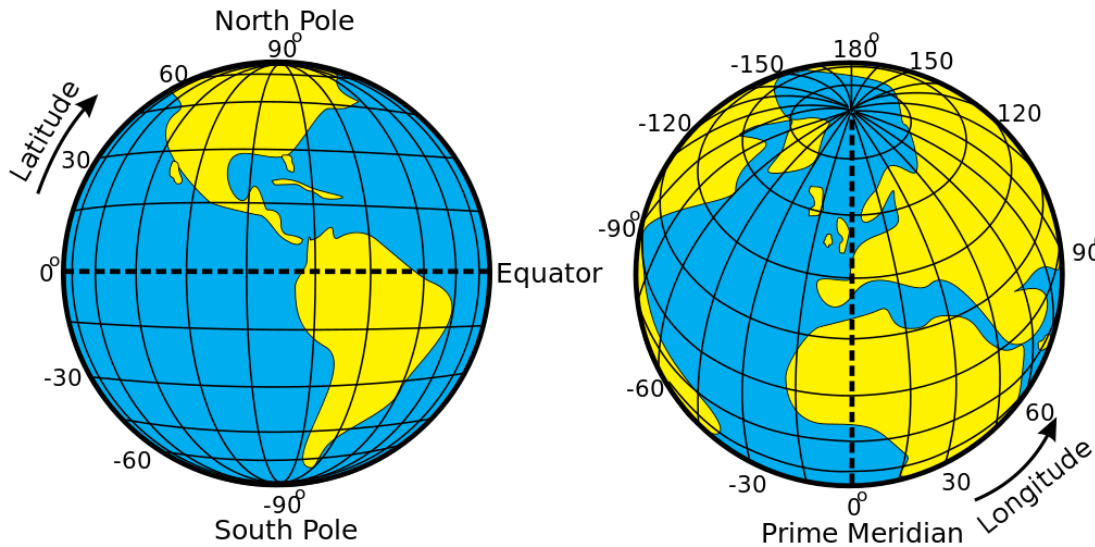
Courtesy of Orbital Sciences Corporation

- SPHERE_x
- TRACERS
- MOAB



- NOVAAR
- MicroMaxx to M!
- BP, APCP, & N₂O

Map Refresher



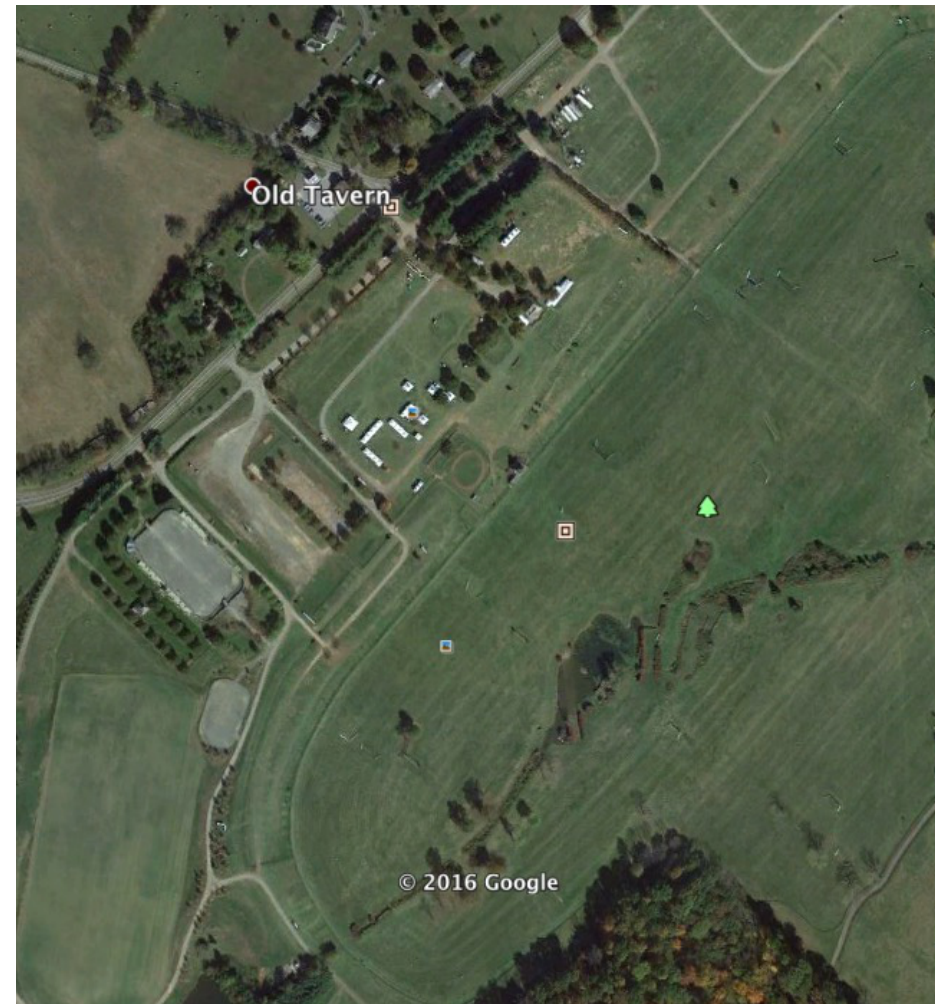
By Djexplor (Own work) [CC0], via Wikimedia Commons



https://en.wikipedia.org/wiki/Gladys_West

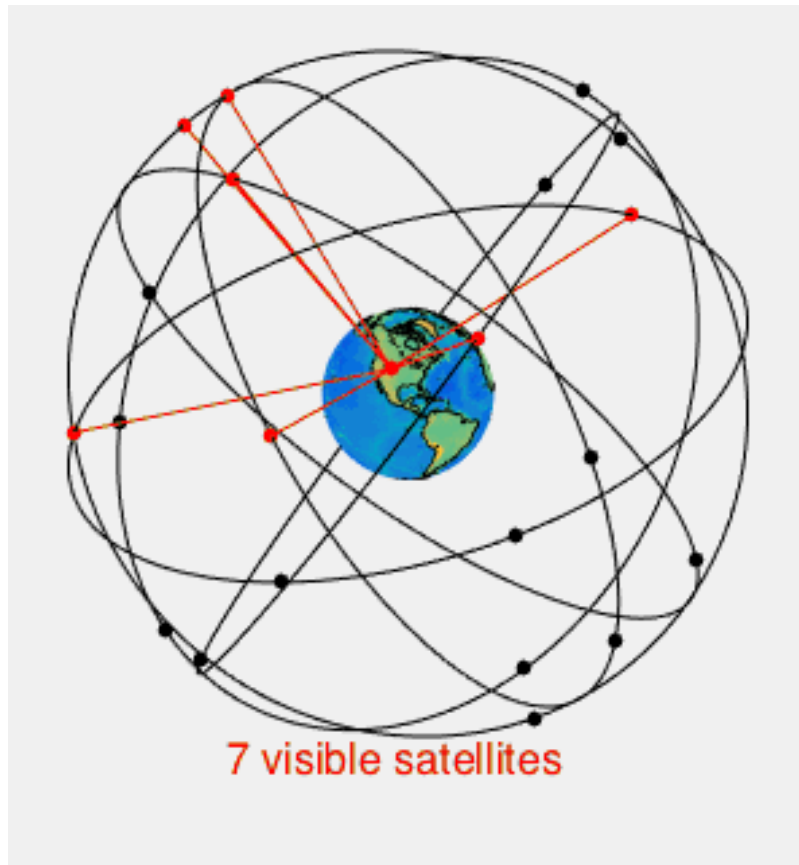
- Latitude, Longitude
 - Decimal degrees, DM and DMS
 - East is +, West is –
- Geodetic Datum
 - WGS84
 - World Geodetic System
 - NAD27, NAD83

Coordinate Refresher



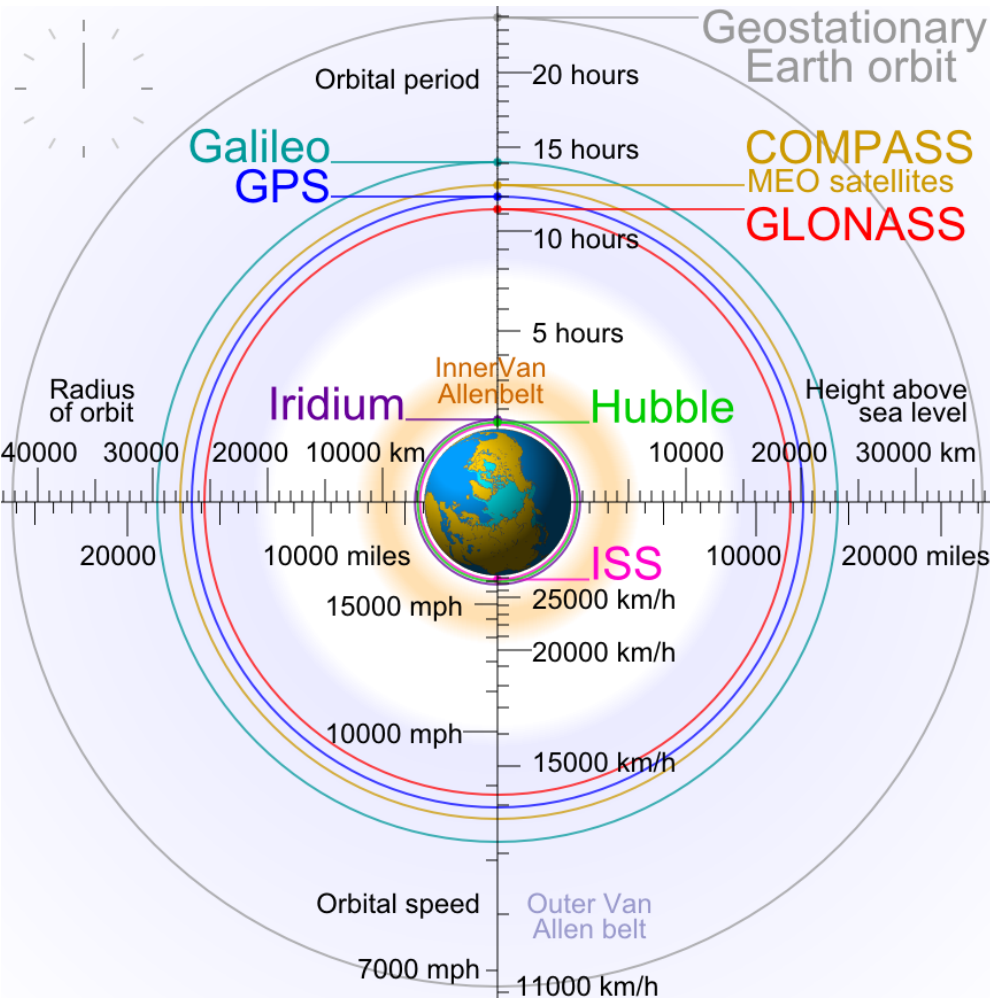
- Great Meadow field in DMS:
 - $38^{\circ} 49' 44.8''$ N
 - $77^{\circ} 48' 39.7''$ W
- Decimal degrees
 - 38.829121,-77.8110397
- Degrees Minutes
 - $38^{\circ} 49.7467$ N
 - $77^{\circ} 48.6617$ W

What is GPS?



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

History of GPS



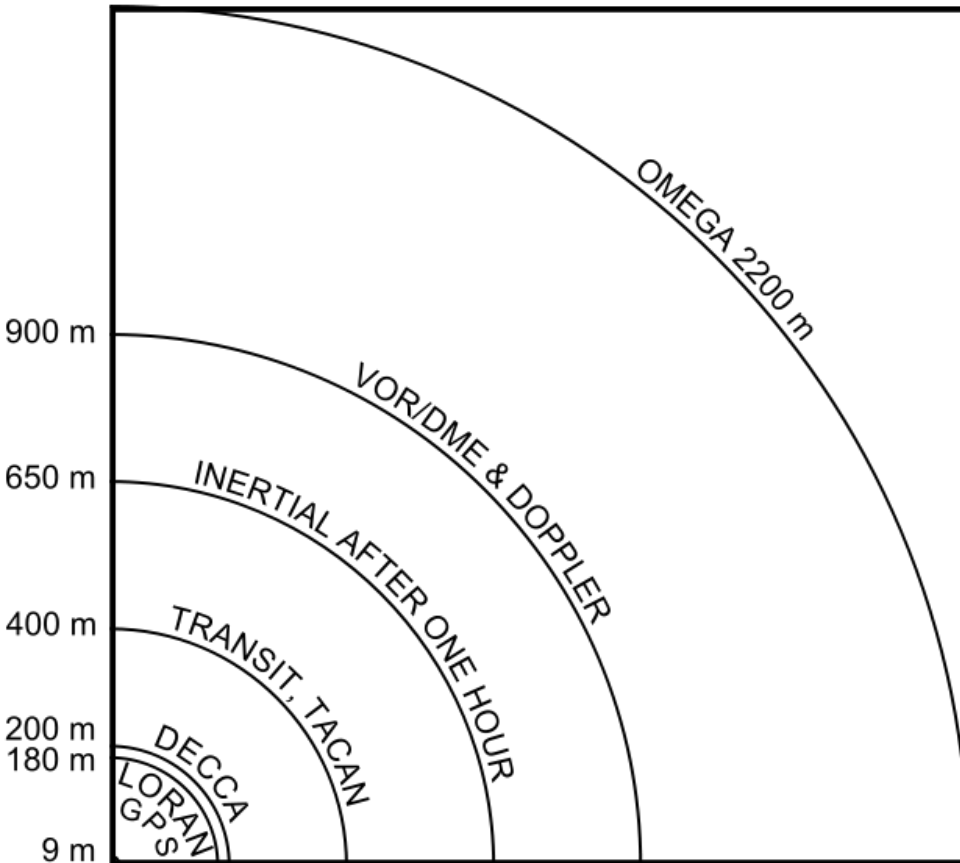
- Precision targeting
- Replaces celestial, radio, and early satellite navigation systems
- First launch 1978

What might be limitations of GPS?

(answers in chat, please)

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?

Who is currently
using GPS?

(answers in chat, please)

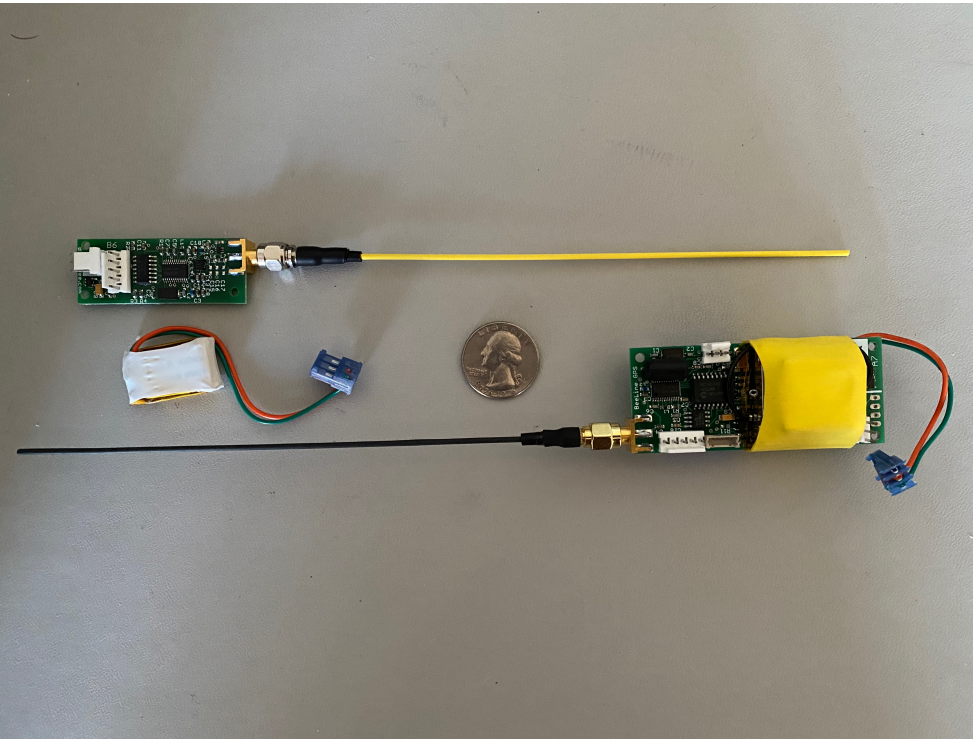
GPS Uses



- Tracking
- On-board logging
- Dual-deploy?
- Research
- Flight/attitude control

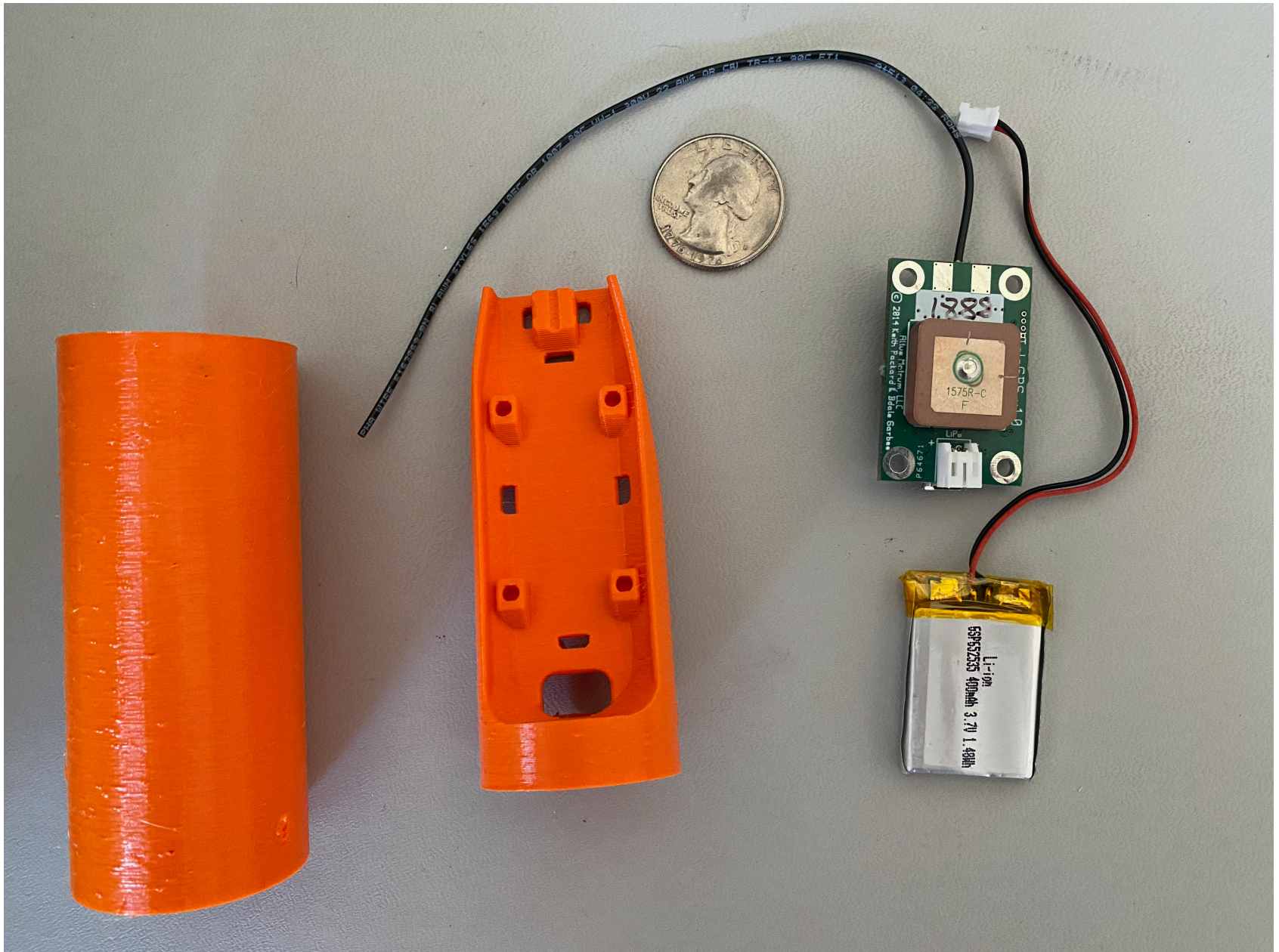
Current Products

- Consumer
- UAS Platforms
- Rocketry specific



<http://www.bigredbee.com/>

Altus Metrum GPS



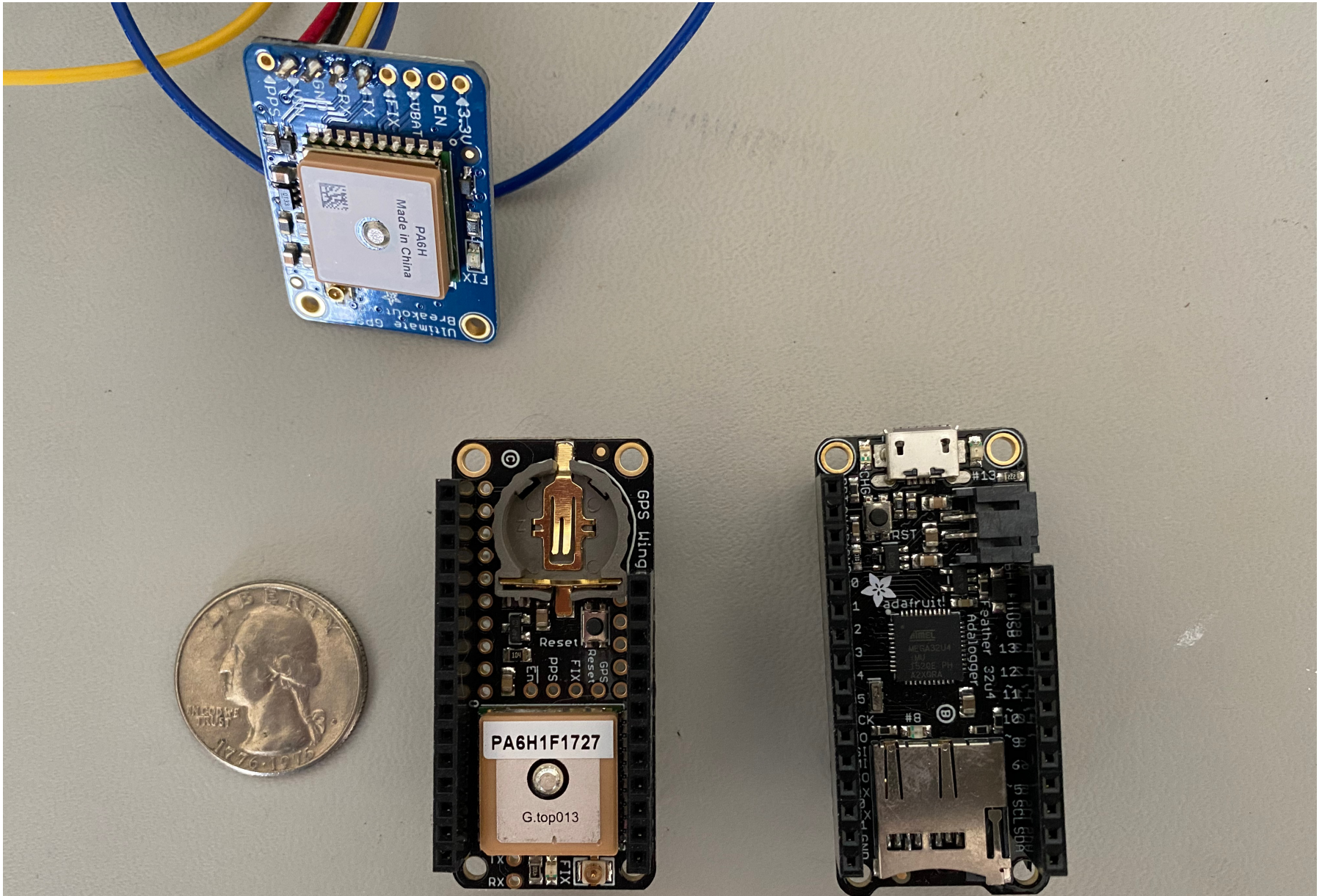
On-board Data Logging

- Lots of commercial options
- Roll your own
 - Arduino
 - <https://www.adafruit.com/feather>

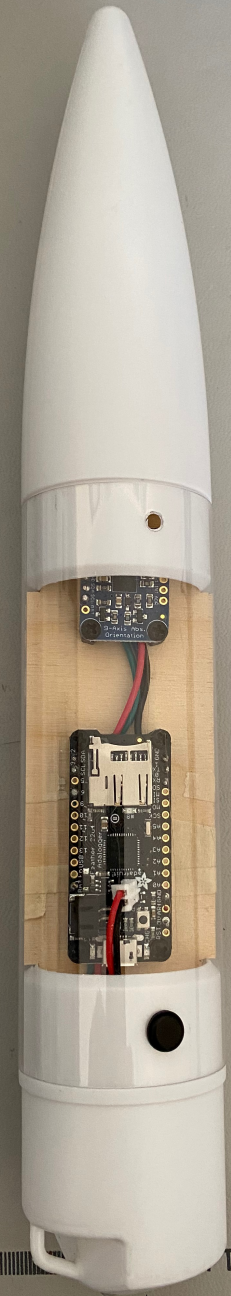
Any Arduino users?

(answers in chat, please)

Adafruit Arduino “feathers”



Estes "Green Eggs" Payload Bay



TOUCH TO ELIMINATE STATIC TOUCH TO ELIMINATE STATIC

BT-65

Any ham radio
operators in the
house?

(answers in chat, please)

Telemetry Considerations

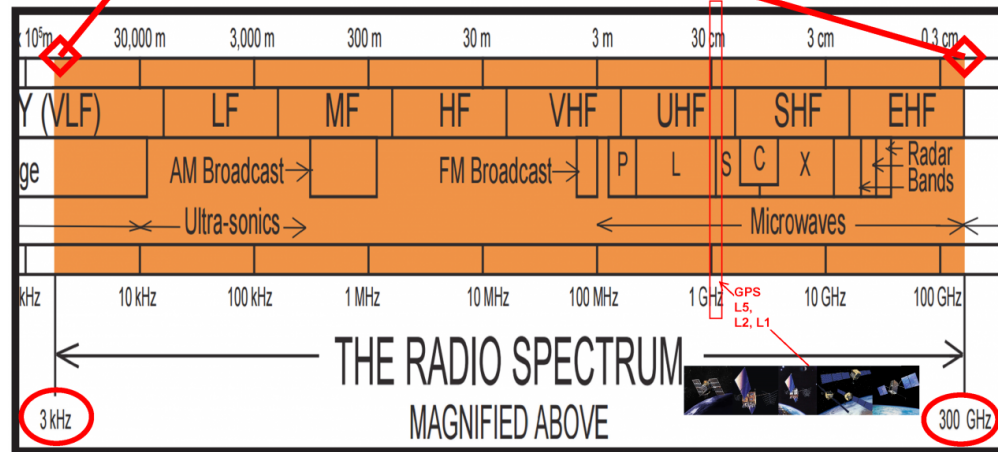
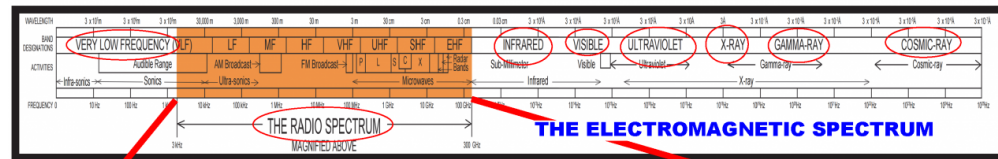


- Transmit frequency
 - Cell coverage?
 - Ham or not to ham?
- Need RDF capability?
 - Spread Spectrum

https://commons.wikimedia.org/wiki/File:Tracking_Mountain_Lions.jpg
USFWS Mountain-Prairie, Public domain, via Wikimedia Commons

Frequency bands

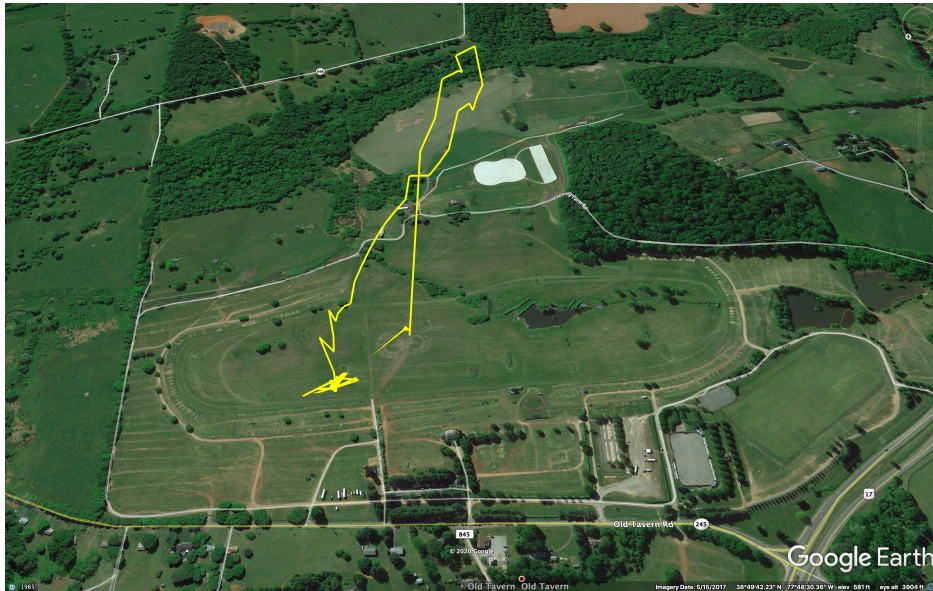
- 145 MHz “ham radio”
- 216-219 “wildlife tracking”
- 222-225 ham band
- 440 MHz ham band
- 443.92 MHz
- 900 MHz
- 2 GHz spread spectrum



<https://www.transportation.gov/pnt/what-radio-spectrum>

Using the Data

- Post processing
 - Google Maps
- Apps
- Computer tools
- Standalone tools
 - Kenwood TH-D74
- Web based
 - aprs.fi



References

- <https://kw4wz.com/NARCON2021/>
- Email: marchant at novaar.org