- A Global Navigation Satellite System (GNSS) is a network, or constellation, of satellites that transmit ranging signals that are used for determining position location anywhere on the globe.

- The current global constellations are:

  - The global positioning system (GPS) – United States.
  - The global orbital navigation satellite system (GLONASS) – Russia.
  - The Galileo global navigation satellite system – Europe.
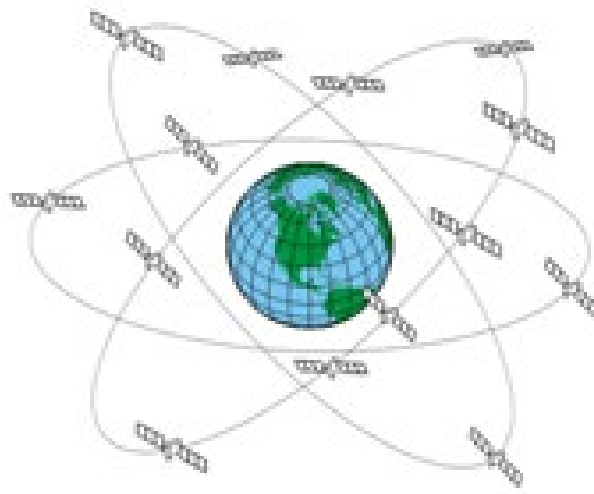 - The Beidou global navigation satellite system – China.
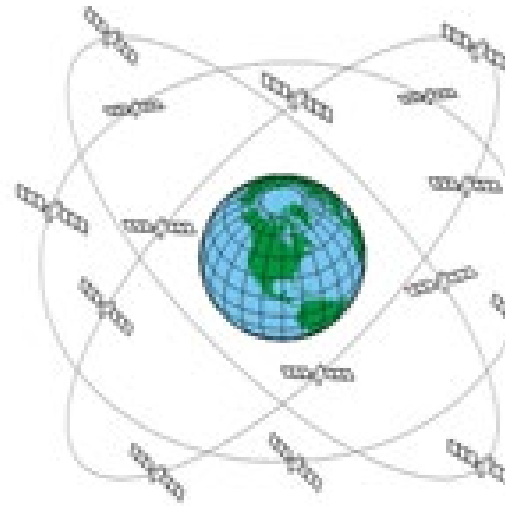
GLOBAL NAVIGATION SATELLITE SYSTEMS
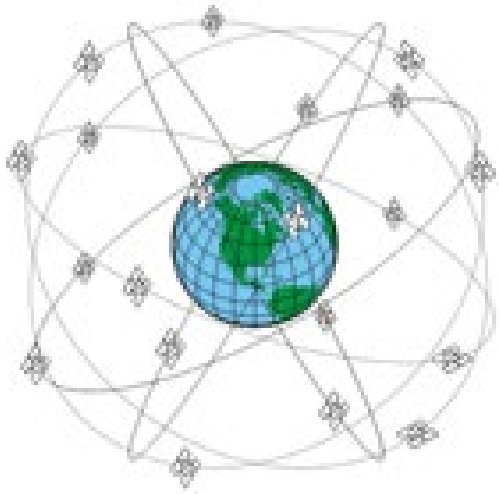
GPS

- Six Orbital planes.
- 24 Satellites.
- 55º Inclination Angle.
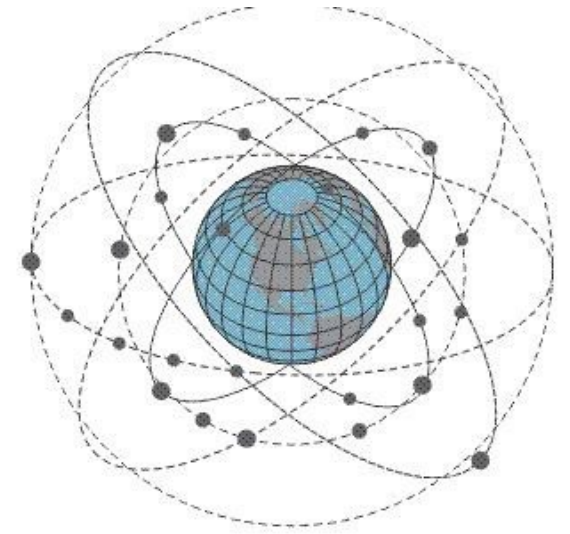- Altitude 22,200 kilometers.

Galileo

- Three Orbital planes.
- 27 Satellites.
- 56º Inclination Angle.
- Altitude 23,616 kilometers.

GLONASS

- Three Orbital planes.
- 21 Satellites.
- 64.8º Inclination Angle.
- Altitude 19,100 kilometers.

Beidou

- Six Orbital planes.
- 35 Satellites.
- 55º Inclination Angle.
- Altitude 38,500 and 21,500 kilometers.

Source: Penn State Department of Geography

Satellite-Based Augmentation Systems (SBAS).

Help resolve positioning errors caused by delays and distortions of GNSS satellite signs as they pass through the atmosphere's ionosphere.

- The Wide Area Augmentation System (WAAS) transmits correction data for GPS GNSS satellite signals.

- The European Geostationary Navigation Overlay System (EGNOS) transmits correction data for Galileo GNSS satellite signals.

- SBAS signals typically correct data to less than two-meter accuracy where autonomous (non-corrected) has an accuracy around five meters.

NON-GNSS LOCATION DATA

- Locations from a cell phone or tablet internal location provider use a combination of signals from satellites and cellular towers, and do not provide GNSS based location data.

- These non-GNSS location data do not meet data quality requirements for Status and Trend Networks projects.

GLOBAL NAVIGATION SATELLITE SYSTEMS AND THE BAD ELF 2500

- The Bad Elf 2500 uses all four satellite constellations,

- The Bad Elf uses SBAS signals from both WAAS and EGNOS.

USING THE BAD ELF 2500 UNITS

**Global Navigation Satellite Systems
and the Bad Elf 2500 Units**

System requirements.

- iOS version 11 or newer/Android version 4.1x or newer.

- Bluetooth connection enabled.

Software applications.

- Installed on phone or table for Status and Trend monitoring projects.

- Required:
  - Bad Elf Flex application.
  - ArcGIS Field Maps.
  - ArcGIS Survey123.

- Recommended:
  - Google Maps or Apple Maps.
  - Organic maps offline maps.

BAD ELF DO'S AND DON'TS

General.

- Do read the GNSS basics manual. Detailed instructions for setup, navigation and data collection are included.

- Don't attempt to use the Bad Elf indoors.

- Do keep the antenna oriented towards the sky.

- Don't collect location data with the Bad Elf on a lanyard or in your pocket.

- Do use flexible tripods or other accessories to help with positioning the unit, especially during travel in vehicle/boat.

- Don't submerge in water for extended periods of time. Units have IP67 rating and can withstand rain and accidental submersion for brief time periods.

Navigation and Data Collection.

- Do ensure that Bad Elf is set as the location provider – this requires adjusting settings in multiple applications:

  - Bluetooth pairing.
  - Bad Elf Flex.
  - ArcGIS Field Maps.
  - ArcGIS Survey123.

- Do keep the Bad Elf Flex application open in the background when attempting to use the Bad Elf with other applications.

- Do prepare for offline navigation (no cellular data signal).

  - Download offline areas in field maps.
  - download map areas in organic maps and save KML (Keyhole Markup Language) files with site information on tablet or phone.

BAD ELF DO'S AND DON'TS

Navigation and Data Collection.

- Don't leave the Bad Elf in the vehicle when walking or boating to the site. The location displayed is the location of the Bad Elf, not of the tablet.

- Do follow on-screen warnings when collecting data in Survey123.

  - Always use Bad Elf external receiver.
  - Wait for SBAS GNSS fix.
  - Use position averaging mode and collect at least 30 positions.

TROUBLESHOOTING SBAS FIX

Loss of SBAS signal is the most common encountered warning in Survey123.

- Turn on Bad Elf outdoors several minutes before it is needed.

- Ensure antenna is oriented correctly and has clear sky view (as clear as possible given site conditions).

- Wait at least five minutes at the site to attempt to get SBAS fix.

- If unable to get an SBAS fix, proceed with data collection and add a comment in Survey123. Data will be marked as autonomous collection method, but position averaging and number of satellites used will help to increase accuracy.

Do Read the GNSS Basics Manual.

- You will find the answers to most your questions in the manual.

- For manual see:
  https://publicfiles.dep.state.fl.us/dear/DEARweb/WMS/Reports_Docs_SOPs/Standard%20Operating%20Procedures/GPS%20Manual/WMS-GPSBasicsManual.pdf.

THANK YOU

Tom Biernacki
Division of Environmental Assessment and Restoration
Florida Department of Environmental Protection

Contact Information:
850-245-8515
Thomas.Biernacki@FloridaDEP.gov