Collecting and Correcting Spatial Data

Wendy Barrios, Oregon State University

National Ecological Observatory Network

Importance to the NEON Project

The purpose of this project was to:

- Locate the installed infrastructure at NEON Project field sites
  - Groundwater wells, portal, camera, etc.
- Post-process spatial data to ensure accuracy and precision
- Develop step-by-step procedure for future replication

Accuracy and precision benefit the quality of NEON data. By determining the location of data sensors within a few centimeters, Battelle staff and researchers can maintain consistency in data collection.

Further, surveyed accuracy within one millimeter ensures precision in measuring groundwater depth, a major focus of aquatic data collection.

How GPS Works

GPS works by using satellites to send radio signals to receivers. By using precise atomic clocks, the distance traveled by the signal can be calculated by measuring time traveled.

Distance= speed x time

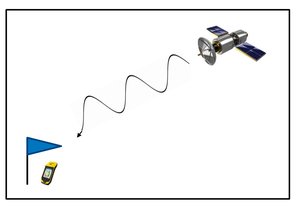


Figure 1. Radio signal travels from satellite to GPS receiver

For an accurate location, at least three satellites are needed in a widespread formation in the sky.

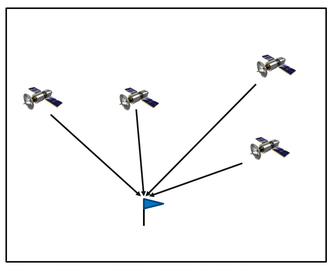


Figure 2. Four satellites distributed in sky ensure accuracy

To correct for atmosphere interference, a fixed base station is referenced. It experiences the same interference, and the exact distance traveled is known. The difference in actual distance and calculated distance helps adjust the moving GPS data collected.

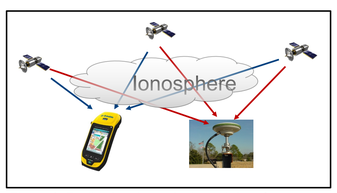
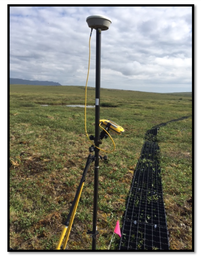


Figure 2. Radio signal travels through interference to GPS and base station

How GPS Works with a Total Station

Two instruments were used to survey installed NEON infrastructure:

- GPS Receiver
- Robotic Total Station



The total station creates a local coordinate system to locate data sensors in relation to each other. The GPS relates the total station data to the real world, and together they improve spatial accuracy.

The total station consists of a laser, recorder, and a prism:

- Laser shoots infrared signal to prism
- Prism sends signal back
- Controller records data points

Figure 3. Total station set up on Toolik Lake's edge

Figures 4 and 5. Prism rod is carried across lake and hills, while maintaining infrared signal from total station

Figure 6. Total station accuracy must be adjusted for fractions of a millimeter

The total station is a very precise surveying instrument.

- Accuracy within 1mm
- Be wary of direct sunlight for hours or slightest impact
- Control points allow total stations to move along site
  - After each move, shoot back to control points
  - Maintains one local coordinate system

Post-Processing the Data

After data collection, software used to correct spatial data:

- Pathfinder Office
  - Differential correction using base station reference
- ArcGIS
  - Relates data to real world geographic coordinate system

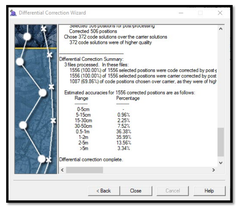


Figure 7. Pathfinder Office corrects GPS data with variety of accuracies. Here, ground cover interference decreases accuracy.

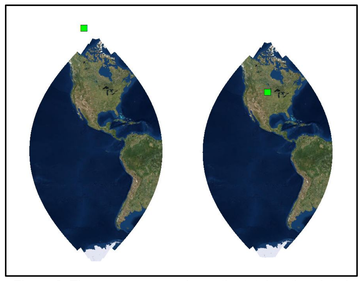


Figure 8. The green square shows the total station data is located off the earth's surface. After projecting into the correct geographic coordinate system, the data is correctly shown in the North Dakota area for Prairie Lake.

After correction and transformation, ArcGIS is also used to create maps to indicate where features are located and relative distances. These maps will be used by staff and researchers using NEON data.

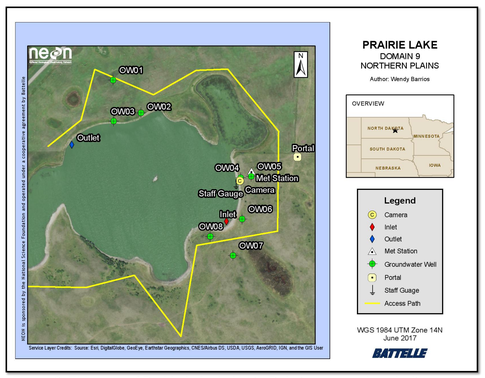


Figure 9. This map of Prairie Lake in North Dakota was produced with ArcGIS, showing only data sensors, not the extra control points and benchmarks taken with the total station and GPS receiver.

Acknowledgements

Many thanks to my mentor Melissa Slater, GIS Specialist, and Dr. Megan Jones, Staff Scientist and Science Educator.