

How to Use a GPS for Agro-Ecological Work

Exercise 01

This exercise will introduce students to the use of a GPS for agro-ecological work. We will identify locations on the landscape or in fields either by using a hand-held GPS unit such as the one shown at the right (Figure 1.), or a Smartphone equipped with an app that provides the GPS coordinates of the phone. These apps, which are available for the major smartphone operating systems, iOS (iPhone/iPod touch/iPad), Android, and Windows Phone typically, provide the location in Geographic Coordinates using the World Geodetic System (WGS) of 1984 (WGS84)(Figure 2). Geographic coordinates (longitude and latitude) can be provided as degrees, minutes, and seconds or as decimal degrees. We prefer data to be recorded in decimal degree format because it is somewhat easier to deal with. On hand-held GPS devices (and some smartphone apps) we can set our units to show positions in the UTM system which is metric and easier to use for calculations. If you use the UTM system be sure to permanently record the UTM zone along with the other collected data.



Figure 1. This is the Garmin eTrex® 10 hand-held GPS receiver. Many manufacturers offer hand-holds at prices between 100 \$US and 500 \$US depending upon features and software.

We will collect positions that represent the boundaries of an agricultural field to demonstrate the value of information that can be collected in this fashion. We used a Magellan eXplorist 110 WAAS DGPS unit manufactured by Thales Navigation of San Dimas, California to locate the boundaries of a pasture. You can do the same for a research field or property in your area. Remember to respect private property rights! Under no circumstances should you trespass! We collected the data walking around the field and taking a GPS location each time we deviated from a straight line and changed directions. As we traversed around the area we filled out the data form that is attached.

Longitude	Latitude	Elevation	Point Number
36.9576267	36.02400748	292	1
36.95802119	36.02771558	284	2
36.96075446	36.02693735	281	3
36.96061357	36.02565555	282	4
36.96205065	36.02556399	285	5
36.96207883	36.02437372	289	6
36.9576267	36.02400748	292	7

Be sure to “close the polygon” by recording the same values for the first and last points.

When you view this information, it is obvious that dealing with it in latitude and longitude can be daunting. For example if you were told to go .0035 arc degrees to the west, how far would you go? For small areas on the surface of the earth it is much better to work with values that are in the metric system i.e. meters or kilometers. The Universal Transverse Mercator (UTM) system allows you to do this; however, you must be able to convert from geographic coordinates to UTM coordinates in order to make simple calculations using this data.

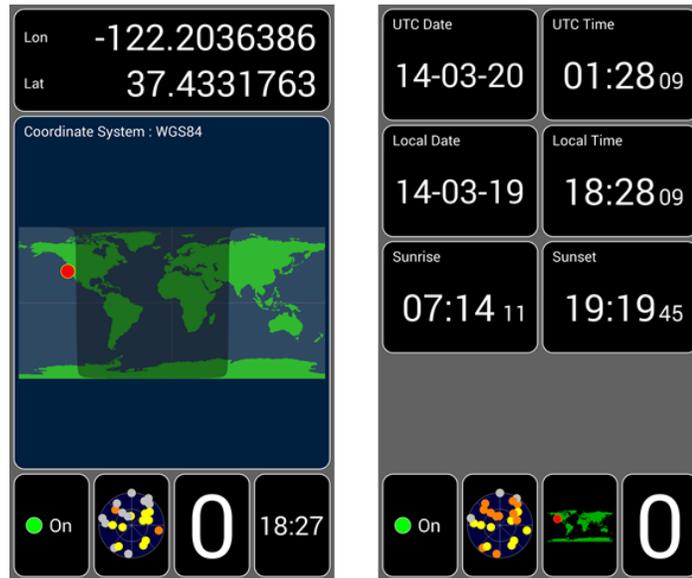


Figure 2. Two screen captures from a Smartphone with the GPS Test Application. This application also allows you to collect data in a UTM format.

Conversion from Geographic to UTM can be done at: <http://www.latlong.net/lat-long-utm.html>. Be sure to record the UTM zone that your parcel is in. Ours is in Zone 37 North which covers from 36° to 42° E Longitude in the Northern Hemisphere.

After conversion the table becomes as follows:

Easting	Northing	Elevation	Point Number
315969.438	3988540.756	292	1
316013.616	3988951.376	284	2
316258.113	3988859.88	281	3
316242.439	3988717.947	282	4
316371.73	3988705.078	285	5
316371.506	3988572.98	289	6
315969.438	3988540.756	292	7

We can process this information to determine the following:

- 1) Length of the perimeter of the field
- 2) Maximum distance east/west
- 3) Maximum distance north/south

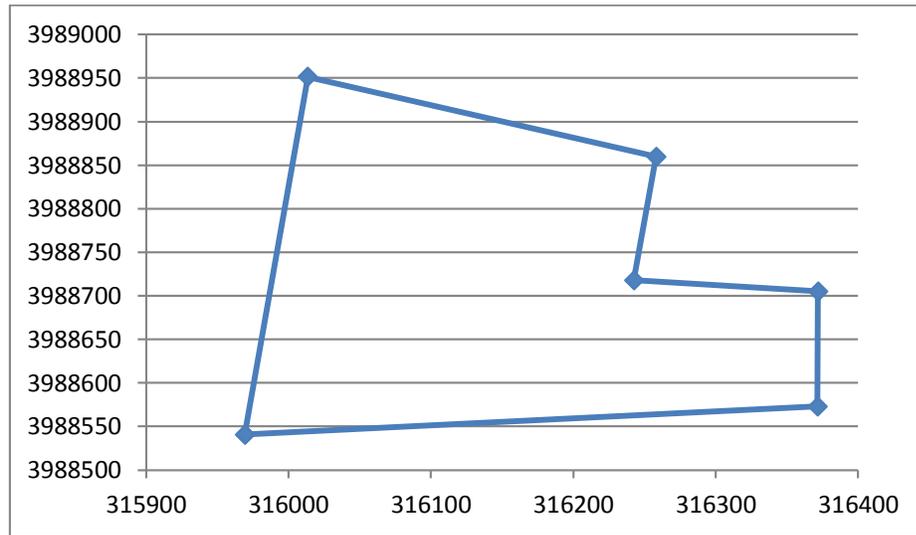
The length of each line segment can be calculated using the Pythagorean Theorem, which is expressed as:

$$a^2 + b^2 = c^2$$

It is an easy process in MS Excel or some other spreadsheet program to determine the length of each line segment then sum to get the perimeter of the field.

Easting (m)	Northing (m)	Elevation (m)	Number	Segment Length (m)
315969.4	3988541	292	1	
316013.6	3988951	284	2	413.0
316258.1	3988860	281	3	261.1
316242.4	3988718	282	4	142.8
316371.7	3988705	285	5	129.9
316371.5	3988573	289	6	132.1
315969.4	3988541	292	7	403.4
Total				1482.2

What happens if we plot the Easting and Northing of these locations in MS Excel using the “Insert Scatter Chart” option? We obtain a chart like the one shown below:



The parcel can also be entered into a GIS program or viewed in on-line in programs such as Google Earth once its location is known.

Assignment

For this exercise, please do the following:

1. Identify 2 parcels of interest.
2. Collect GPS locations that define the parcel using a hand-held GPS or smartphone.
3. Convert the Geographic Coordinates to UTM coordinates being sure to identify the UTM Zone.
4. Determine the perimeter of the parcel.

Thought Questions

A similar process could be used to identify point features such as wells, springs or peaks or linear features such as roads and rivers. If we wanted to map a continuous variable such as soil depth, how would you approach this task?

