



Ohio Geospatial Program for Agriculture and Natural Resources

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Creating and Using Geo-Referenced Field Boundaries

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Field or area boundaries are an essential part to mapping and reporting. They have many uses but are specifically used as a boundary or region for getting measurements such as square feet/meters or acres/hectares. They are also used as a basis for making additional analysis of data collected within the field boundary. (ie, field variable rate chemical application, amount of seed required, water runoff from watershed boundaries).

This data is typically represented as vector polygon information. This data is obtained either by **differential GPS** or **digitized from existing data** such as a geo-referenced map or image.

GPS Obtained Field Boundaries

This method requires a field boundary to be collected from GPS using a mobile GPS data collection system. This will be the most accurate method for collecting a field boundary. This consists of a data computing device with an attached or embedded GPS. There are different combinations and make-ups of these systems. They can consist of a PocketPC, GIS data collection software, and an attached GPS unit. Some systems are all self-contained with all components. Typical costs range from \$1,200 to \$4,000. The most expense depends on the grade of the receiver. The more accurate the receiver, the more the expense. Depending on the accuracy needed for your field boundary depends on what level GPS receiver is needed. Most agricultural field boundaries used for farming are collected with low to middle grade receivers. This can be anywhere from 3-12 feet static accuracy. Obviously, a survey grade receiver using real time kinematic (RTK) will be most accurate and the highest cost. Most of these systems are mounted to brackets on an all-terrain vehicle or field machine to speed up the process of data collection around a perimeter of a field.

There are other examples of field data collection systems used for collecting a field boundary. These can include a vehicle mounted system using a yield monitoring or VRT mapping system that has site verification features built-in to the monitor. A RTK equipped tractor can use the GPS signal and an attached PocketPC with mapping software to collect the field boundary. A handheld GPS unit like a Garmin or Magellan can only collect points and tracks. However, this data can be imported into GIS and used as a guide for digitizing field boundaries discussed in the next section.

The key to collecting a good field boundary is relying on good GPS signals. Sometimes GPS error can prevent specific areas to be collected correctly. Tree lines or low areas such as ravines can degrade the GPS signal and cause incorrect data recordings of your field boundary. Lower grade receivers that have 1 hertz readings are slow to hone in on your

location if you are driving fast between data collection points. You can select a receiver to collect data automatically or manually. It is recommended for lower grade receivers to collect it manually. In addition, before collecting a point you should wait a few seconds before selecting a point of reference. It takes some time for the satellite signal to respond and get a good position if you are traveling fast between points. Pay particular attention to corners of fields and take your time particularly at these locations when collecting data. Double check your field boundary before leaving the field to make sure it has been fully collected.

For legal purposes, most areas collected for real estate property has to be collected by a certified surveyor. Even if you rely on a survey grade receiver it still has to be approved by someone certified.

Digitized Field Boundaries

Field boundaries can also be obtained by digitizing existing maps, drawings, and images that are already geo-referenced. The accuracy of these maps are dependant on the error of the existing geo-referenced image plus the error in visualizing and digitizing process from your own computer equipment.

Common Land Units (CLU) - One example of boundaries digitized from a geo-referenced map includes Common Land Units (CLU) designated across the US for use by USDA Natural Resources Conservation Service (NRCS) and Farm Services Agency (FSA) office.

By definition, a "CLU is the smallest unit of land that has a permanent, contiguous boundary, a common land cover and land management, a common owner and a common producer in agricultural land associated with USDA farm programs. CLU boundaries are delineated from relatively permanent features such as fence lines, roads, and/or waterways." *Reference: USDA Farm Services Agency.* These CLUs are vector polygons derived by digitizing features from existing aerial photographs. They have an error around 3 meters (10 feet). This data is available in shapefile format and comes in UTM or State Plane projections. Generally, the CLUs have shown to be much larger in areas reporting total acres than when collected by GPS.

You can download county level CLU data from the USDA Geospatial Data Gateway (<http://datagateway.nrcs.usda.gov/>). You can also send for a CD for \$50 for your county. For obtaining individual field CLUs from the county level data you will need GIS software (ie, ESRI, Manifold, TatumGIS, MapInfo) that will enable you to extract the specific feature from the county-level data set. All USDA FSA offices can also assist you in obtaining individual field boundaries. You will need to be the owner of the CLU to obtain this data.

For more information about CLUs visit the web site at:

<http://www.fsa.usda.gov/FSA/apfoapp?area=home&subject=prod&topic=clu>

GIS and Geo-Referenced Images - Another method of digitizing field boundaries is doing it yourself using geo-referenced images or maps with GIS software. Images, such as 1 meter black and white digital orthoquadrangles (DOQs), can be obtained online for download from your state geospatial data gateway (ie, Ohio Metadata Explorer - <http://metadataexplorer.gis.state.oh.us/>), Microsoft Terraserver (<http://terraserver.microsoft.com/>), or USAPhotoMaps (<http://www.jdmcox.com>). These images are usually projected in UTM or State Plane coordinates. Using the image or map as a backdrop you can create a new polygon file by tracing over features found in the image. Most field boundaries can stand out due to pattern changes from grass areas, tree lines, roadways, to cultivated areas in farm ground. In some cases, these areas may not be able

to be differentiated due to field boundaries falling within cultivated areas that look the same in the image. This may require the use of a GPS unit. A recreational grade GPS receiver like a Garmin or Magellan handheld unit or higher grade receivers can collect reference points or tracks and be imported into GIS to serve as a guide when digitizing field boundaries. Essentially you can retrace over existing tracks or connect the points shown over the aerial reference map.

GIS and Other Geo-Referenced Data - Another method of digitizing field boundaries can be self-automated from specific farm GIS mapping software using yield monitor data or other dense data sets filling up a field area. Another term for this has been called “shrink-wrapping.” Most agricultural GIS software (ie, AgLeader SMS, Farmworks Farm Site, MapShots EasiSuite, SSToolbox) can automatically generate a field boundary around existing data collected in a field. Even though this is not perfect it can be a starting point for certain applications.

Considerations when Using Geo-Referenced Field Boundaries

The following are some considerations when using geo-referenced field boundaries.

- When collecting GPS derived field boundaries take note of information like type of GPS receiver, date collected, PDOP, number of satellites, and other potential GPS errors. In the future, you may need to reflect on the quality of this data in case it needs to be recollected or is questioned by some other intended use.
- Take your time when recording GPS data particularly with lower grade receivers with 1 hertz readings. Manually select data points when marking a reference location. Automatic settings collect data all the time so you may have stray reference points you do not need as the GPS location may not be at it's true location.
- The application of your field boundary depends on how accurate you need your data collected. The highest accuracy will be an RTK survey grade receiver collecting the information. Digitizing boundaries from existing data or maps can contain more error than a recreational grade GPS receiver collecting reference information.
- In some cases you may need to use two different field boundaries. You can use either GPS or digitized boundary for accuracy in field applications for determining amount of inputs needed for VRT. The other using CLUs for reporting and accounting for farm programs, insurance claims, and signing up for conservation programs.
- Using a State Plane coordinate system usually provides 4 times better accuracy in linear measurements than a UTM projection. However, the differences in the end result will usually be in the tenths of acres.

Additional Resources

For more information about remote sensing for agriculture and natural resource applications visit <http://geospatial.osu.edu/> and <http://precisionag.osu.edu>.