Simple Tools for Using GPS and GIS in Your Course

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Introduction

Many courses taught in agriculture at both the secondary and post-secondary level deal with spatial components. The entire field of precision agriculture is based on the use of Global Positioning Systems (GPS) and Geographic Information Systems (GIS). While most students have interacted with GIS systems in the form of Mapquest or similar products, most do not have an understanding of this technology. Anderson, et al. (2009) found that nearly 80% of incoming freshman had little or no skills in GPS technology at an agricultural college. Kitchen, et al. (2002) notes that a major hurdle in the adoption of precision agricultural technologies is lack of knowledgeable people and educational programs. Hunter and Xie (2001) suggested that GIS increases a student's ability to understand and visualize data. GPS and GIS can be introduced using inexpensive GPS units and free software. Better yet, GPS/GIS can be applied to the subject area of a course thus it is integrated into existing curriculum as fun activities. Major barriers to introduction of these technologies into a course are the cost and complexity of the hardware and software. The technique described here can be implemented at a reasonable cost and with minimal instructor preparation. At the secondary level, agricultural standards that address GPS, GIS, and precision agriculture are being adopted for secondary agricultural education programs (California Department of Education, 2005 and Wisconsin Department of Public Instruction, 1998). This technique can be applied at the secondary level as well.

How It Works

The instructor should have a basic understanding of GPS, learn how to store and upload data on the GPS, and learn how to use Google Maps. Fortunately many online references are available (see references) that can prepare the instructor to use this technique. Instructors can use the DNR Garmin software (Minnesota Department of Natural Resources, 2008) to capture screen shots (Garmin GPS) which are useful in making custom lab sheets that quickly show how to use the GPS. Since inexpensive GPS units cannot collect data instructors should create a datasheet where the students can record any attribute data appropriate to the activity since the simple GPS can't record this information. The activity follows the general procedure shown below:

1. Students go to a location where they will collect data, such as a soil sample site. GPS units are used to locate and save the location called waypoints. They record waypoint attribute data on the data collection sheet along with the GPS waypoint number assigned by the GPS unit.
2. Waypoints are downloaded from the GPS unit with DNR Garmin and saved as a "Keyhole" format (KML) file. One or two laptops can be used for this part of the activity and students can save their data file on a USB drive.
3. Students then create a Google account (gmail users already have one) and create a custom map by importing the KML file. Support for Google Maps (Google, 2008a) is available in a user guide and video (Google, 2008b and Google, 2008c). These resources can be placed on a course web site for easy access. The waypoints are plotted on the map. Depending on the application you can use the satellite photo, terrain (topo), or road map as a background. Waypoints can be edited with names and other descriptive information. The map can be saved, and the URL submitted electronically for grading.

Google Maps has somewhat limited output options, but Google Earth can also be used. Data can be used in a GIS viewer like ESRI's ArcExplorer. Maps can be shared between students and published on the web. Additional free software such as GPSBabel and Easy GPS to upload, download, manage, and convert GPS data are available (see references). The availability of these free tools to students is a further encouragement for students to engage in this technology.

Example Google map of soil sample locations (Spiess, 2000b)
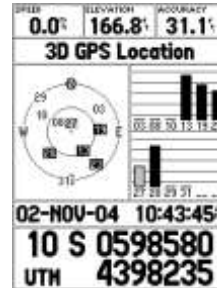
Sample GPS screen capture using DNR Garmin

Results to Date

This technique has been implemented in an introductory GIS course for agriculture and natural resources as an introductory GPS activity. It has also been used in an Introduction to Agricultural Mechanics class as part of the land measurement activity. In both cases students enjoyed being able to make their own maps using Google's online mapping tools. By plotting GPS locations the students seem to have a better understanding of the spatial data they are collecting. There are many better tools for plotting data, but the ease of use and accessibility of Google Maps has made it an ideal tool for a casual introduction to GPS and GIS.

Future Plans/Advice to Others

This technique works well in both a nontechnical class as well as a class that introduces GIS technology. It is not a substitute for "real" GIS tools. Google Maps and Google Earth are simply too limiting. Plans are underway to use this technique in a forage course to plot sample locations. Once the GPS units are available in the college or department, they can be used in many classes. This technique has been used in reverse as well where a map of existing waypoints has been provided in Google Maps, the waypoints were downloaded to the GPS and the students used the GPS to navigate to the points. This technique can be used at the secondary level as well to introduce GPS/GIS to agricultural students (Spiess, 2008c). Other suggestions for use of Google maps that will enhance students' spatial awareness are to display the location of your states FFA chapters (Spiess, 2008a) or map student teacher sites.

Cost

Sport GPS units such as the Garmin Extex units are now selling with Wide Area Augmentation System (WAAS) correction for under $100. These units are generally accurate to 3m or better and come with a cable for downloading. While one unit per person is ideal groups of two or three work well if each person uses the GPS unit in the field. USB-Serial cables (needed for computers that don't have a serial port) are about $20. The units can be run on rechargeable AA batteries which are readily available. The programs listed are all free.

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