

# Conducting a Field Geology Course on a University Campus

- G.A. Richard, Mineral Physics Institute, Stony Brook University, Stony Brook, NY 11794-2100; Glenn.Richard@sunysb.edu
- G.N. Hanson, Department of Geosciences, Stony Brook University, Stony Brook, NY 11794-2100; Gilbert.Hanson@sunysb.edu
- J. Munster, Department of Geosciences, Stony Brook University, Stony Brook, NY 11794-2100; jmunster@notes2.cc.sunysb.edu
- E.T. Rasbury, Department of Geosciences, Stony Brook University, Stony Brook, NY 11794-2100; Troy.Rasbury@sunysb.edu
- D.M. Davis, Department of Geosciences, Stony Brook University, Stony Brook, NY 11794-2100; Daniel.Davis@sunysb.edu
- D.B. Marcus, Department of Geosciences, Stony Brook University, Stony Brook, NY 11794-2100; OnyinRing@aol.com

During the fall, 2003 semester the Department of Geosciences at Stony Brook University piloted a new course, GEO 305: Field Geology, which was designed to provide undergraduates with an opportunity to learn field mapping techniques by engaging in projects on the University campus. The skills that students exercised through hands on experience during the course activities included making observations regarding the physical landscape, collecting detailed and accurate data in the field, and preparing maps and reports using a variety of data collecting techniques and software tools. Specific examples of assignments that students were responsible for completing included the mapping of: 1) trails in the Ashley Schiff Preserve, 2) ridges and valleys in the Ashley Schiff Preserve, 3) buried electric and water lines adjacent to the Earth and Space Sciences building, and 4) human-generated infrastructure in the vicinity of the Tabler Quadrangle Dormitories. During the early part of the semester, the students created their maps by hand. About midway through the semester, the students were introduced to ArcView 3.3 GIS software, developed by the Environmental Systems Research Institute, and they used it to complete subsequent mapping projects.

The students learned to map point features based on their geographic coordinates by first working with seismic event data downloaded from the United States geological Survey's National Earthquake Information Center. With minor modifications, they were able to load the data into ArcView as a comma-delimited text table. A portion of the table is shown in figure 1. Using the standard "Add Event Theme" item in ArcView's View Menu, the students added the data to a map with each event represented by a point. They were then able to represent the magnitude of the events with graduated symbol sizes and the depths of the events with color ramps.

Year	Month	Day	Time	Latitude	Longitude	Magnitude	Depth
2002	01	01	003703.35	19.30	-65.04	3.7	25
2002	01	01	010701.50	-32.72	-73.01	3.5	23
2002	01	01	023447.06	37.22	-3.70	1.5	0
2002	01	01	034414.50	-33.95	-70.36	3.1	113
2002	01	01	042252.64	47.99	9.44	2.5	10
2002	01	01	050732.31	44.79	8.36	2.7	0
2002	01	01	051948.26	-6.37	146.82	4.8	33
2002	01	01	052323.68	44.57	7.19	2.2	9
2002	01	01	062344.40	-32.33	-69.39	3.2	161
2002	01	01	064419.72	63.31	-151.21	3.3	10

Figure 1 - A portion of the data downloaded from the United States geological Survey's National Earthquake Information Center that students used to create an event theme.

Having learned to add event themes to maps, the students could determine the coordinates of features in the field on campus, then map these features as event themes. They used this method to map points along trails in the Ashley Schiff Preserve with coordinates that they computed during a pace and compass exercise. The instructors provided the students with two custom-made menu items that were added to ArcView, and a custom-made Java application, in order to assist them with the mapping of features such as trails, ridges, valleys, and underground utilities, which are better represented as broken lines, or polylines, than as series of points. The menu items activated scripts that were written in ArcView's Avenue scripting language. The instructors also provided an Excel spreadsheet for converting tape and compass coordinates in meters, with a specified origin, to UTM coordinates. Excel is a product of Microsoft Corporation. The custom "Add Trail Polyline" item that was created and added to ArcView's standard menu by the course instructors invoked an Avenue script that created a polyline theme from a table of x (number) and y (number) attributes, and at least one other (text) attribute. The students used this to map trails and utilities. An example of hypothetical trail data that the students worked with to learn to use this feature is shown in figure 2. The names of the fields are delimited by tabs on the first line of the table. The data values corresponding to each field appear on successive lines, separated by tabs. Blank lines delimit groups of records, each of which creates one polyline when the script is invoked on the table.

pointid	Easting	Northing
1	658181	4530239
2	658259	4530207
3	658345	4530194
4	658397	4530179
5	658459	4530208
6	658218	4530264
7	658181	4530239
8	658139	4530194
9	658100	4530181
10	658397	4530179
11	658369	4530139
12	658302	4530088
13	658247	4530074
14	658188	4530039
15	658139	4529972

Figure 2 - Data used to represent three hypothetical trail polylines in an ArcView table.

The custom "Add Ridge Valley Polyline" item invoked an Avenue script that created a polyline theme from a table of x (number), y (number), bearing (number), length (number), and ftype (text) attributes. The students employed this item to map ridges and valleys in the Ashley Schiff Preserve. Example data that the students used to learn this feature is presented in figure 3 and a map created by a students appears in figure 4.

x	y	bearing	length	ftype
658188	4530039	127	190	valley
658397	4530179	317	96	ridge
658369	4530139	121	102	valley
658302	4530088	301	117	ridge

Figure 3 - Data used to represent ridges and valleys in an ArcView table.

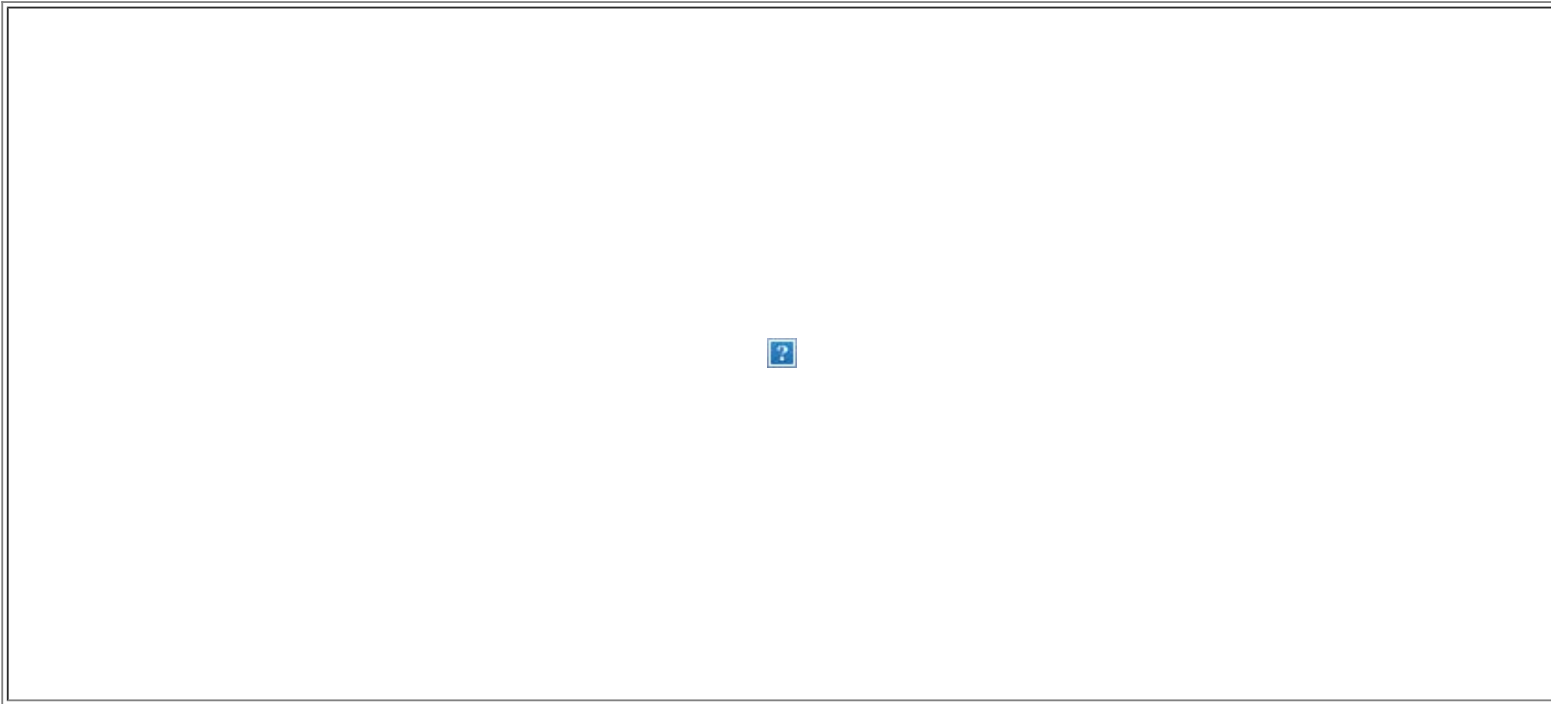


Figure 4 - GIS-generated map of trails, ridges and valleys in the Ashley Schiff Preserve that was created with the aid of custom tools.

For their utilities mapping assignment, the students needed to find the UTM coordinates of surface markers that represented the locations of buried electric and telephone lines. The instructors provided them with an orthoimage marked with the locations of reference points with known coordinates (Figure 5). For each utility marker, the students could compute coordinates by measuring the distance to two of the reference points. The coordinates of the utility marker were computed as the intersection of two arcs that represented the locii of points that resided at the measured distances from their respective reference points.



Figure 5 - 1996 New York State orthoimage of the earth aand Space Sciences Building vicinity with reference points.

The arc-intersection method used to compute the locations of the utility markers is illustrated by figure 6. The figure represents a hypothetical underground burrow system that the students used to learn this method. The locations of the numbered points were computed using distances from known reference points, marked by letters. Arcs representing the distances of one of the unknown points (point 4) from two reference points (points a and b) are illustrated in figure 7. The computations of the coordinates of the numbered points were performed by the Arc Intersection Calculator, a custom Java application created by one of the course instructors and illustrated in figure 8. The Java 2 Software Development Kit was used to develop this application, and is available as a free dowload from Sun Microsystems. To map the unknown points, the output from the Arc Intersection Calculator was copied and pasted into a text editor or Excel spreadsheet, then saved as a tab-delimited text file. From that file, it could be loaded into ArcView as a table, and one of the standard or custom menu items could be invoked to map the table as a point or polyline theme.



Figure 6 - Map of the hypothetical burrow system with tables used to create the map.



Figure 7 - The intersecting arcs are the locii of points that lie a specified distance from two reference points (a and b) that have known coordinates. The known coordinates and distances were used to map the location of unknown point 4.



Figure 8 - The Arc Intersection Calculator Java application with hypothetical input and output data for the burrow system exercise.

At the conclusion of the course, several of the students reported that their experience with ArcView and the custom tools was helpful in enhancing their understanding of mapping techniques, since it provided an efficient method for rendering their data in a visual format. GIS software was beneficial because it resulted in accurate, more professional-looking maps than any that they were equipped to create prior to its introduction to the students during the semester. Its most valuable benefit to the class was its versatility. Objects could be added or removed from a map through menu items, the click of a button, or the use of automated mapping tools. The program enabled them to add trees, ridges and valleys, and footpaths to an area map that was otherwise very difficult to create by hand. This allowed them to have all the information easily available, while they focused on specific aspects of the map at any given time. The students could query, analyze and symbolize their data in a wide variety of ways in order to create their maps. In addition, the GIS software provided them with the ability to create multiple maps almost instantaneously. A major asset of ArcView 3.3 is that it is quite user-friendly, and therefore requires only a short learning curve on the part of the students for mastering the basic functions. It provides tools for adding accessory documentation to maps, including a scale, legend, text and north arrow or compass. In mapping assignments completed prior to the introduction of GIS to the course, this supporting documentation was produced by hand and resulted in problems such as incorrect scales and sloppy legends. GIS and other digital tools enabled students to expedite much of the repetitive tasks associated with analyzing data and creating maps so they could devote the bulk of their effort to exercising their higher order problem solving skills.

## References

Environmental Systems Research Institute (ESRI) <http://www.esri.com>

Microsoft <http://www.microsoft.com>

National Earthquake Information Center <http://neic.usgs.gov/>

Sun Microsystems <http://www.sun.com>