GIS Mapping of Dominica Study Abroad

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Abstract

Geographic Information Systems is a technology being employed more and more often as the available technology improves. In the United States, GIS data is readily available and abundant for many cities and states. In lesser developed parts of the world, such as the Commonwealth of Dominica, GIS mapping has not yet been thoroughly explored. The purpose of this study was to create a GIS map for Dominica that integrated general island data and data displaying the research of Texas A&M students. In order to create this map, data was collected from personal and online sources, as well as GPS units taken around the island.

Introduction

Dominica, the nature island of the Caribbean, has been the site of a Texas A&M Study Abroad research trip for 21 years. Students coming to do research in Dominica for the first time should have access to the knowledge of the island accumulated by past visitors, especially regarding sites best for their area of study. Thus I decided to employ GIS mapping skills using ArcInfo to map the island of Dominica, its natural features, and research sites used by students. Using this map, researchers and government offices can make spatial interpretations regarding geographic issues that were previously unclear.

Materials

1. Garmin GPS unit
2. USB cable to attach GPS to computer
3. ArcInfo software program (designed by ESRI)
4. GPS Trackmaker
5. Microsoft Excel
6. GIS data

Methods*

*In order to compile this data, a basic understanding of how to use ArcInfo is recommended.

The first step in putting together a GIS map was collecting data. Data entered into my Dominica Base Map was compiled from several sources that provide free GIS data, including[1]:

-Dr. William Heyman

-Geocommunity.com

-World Database of Protected Areas

-ESRI.com

-Maps department of Texas A&M Evans Library

The data layers I added from these existing sources are:

-Cities

-Airports

-Ports

-Volcanoes

-Reef Locations

-Marine Protected Areas

-Watersheds

-Dive Sites

-SRTM DEM

-Ore Deposits

-Earthquake Sites

-Climate Monitoring Stations

-Ecoregions

-Soils

-Country Borders

-Land Cover

-Percent Tree Cover

-Background Map

I organized these data layers into four groups[2]:

-Water

-Urban

-Land

-Maps

The next key step in creating a GIS map was formatting all data layers to the same projection. For this map, all layers were projected to WGS_1984. Sometimes, when adding data from various sources, one may find that they vary greatly in projection types[3]. I needed to alter projection information for many files that had been added from various sources.

Once data from outside sources were successfully formatted, I created and added *new* data files. These data files where either in the form of created features in ArcInfo[4] or imported GPS coordinate tables[5]. GPS coordinates can be collected as either tracks or waypoints. Tracks are simply paths traveled by the GPS unit while it is turned on. Waypoints are specified locations that can be named, such as cities or landmarks. The GPS data for this map was collected by a few GPS units (handheld Garmin 12 and 76) used by students when traveling around the island. We collected tracks for roads traveled and miles hiked, as well as waypoints for pertinent landmarks of the trip. I added all track and waypoint data to a new group layer named Study Abroad.

In any added layer, attribute information such as name of the feature, its location, or other background information was entered[6]. I added fields with information on the points collected to give the data more meaning and to make it easy for others to understand.

Once tracks and waypoints were in place on the map that were geospatially correct, I added a background Which one map and positioned it in the correct spatial location[7]. This method is known as georeferencing, and needs to be done with any image file added, such as a .jpeg.

After georeferencing the background map, I added the following created shapefiles to the Study Abroad layer group:

-Trails

-Scott's Head

-Champagne Bay

Finally, I added a subgroup to Study Abroad named Research Sites, to which I added shapefiles for all the project study areas:

-Gobies

-Stream Ecology

-Insects

-EcoLodges

-Bats

-Birds

-Active Quarries

-Marine Ecology

Discussion

Although previous students have mapped out the Archbold Tropical Research and Education Center (ATREC), as well as various hikes taken on the trip, a comprehensive picture of student involvement on the island, as well as pertinent island features have not previously

been developed. This project incorporated island data with student data to get a more holistic view of the island as related to the Dominica study abroad trip. A series of new collected and named waypoints (Table 1) can be added to over time.

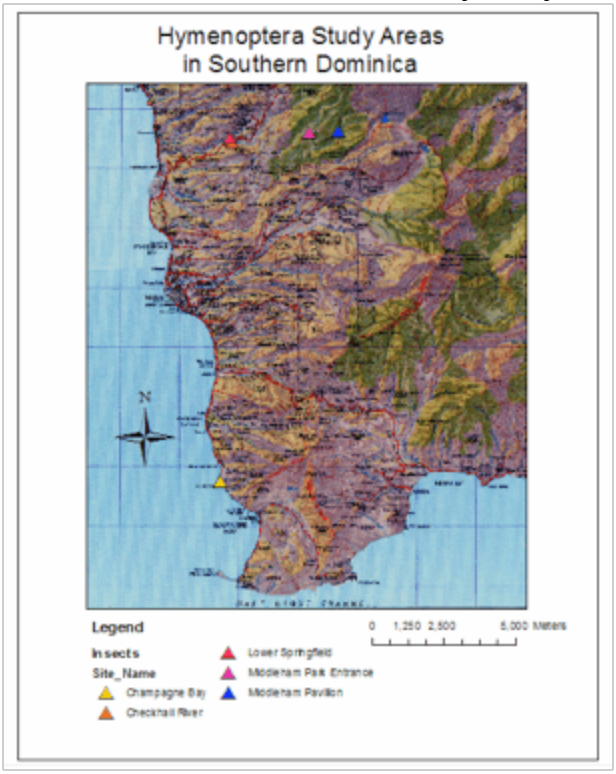
Table 1: GPS Waypoints included in the geodatabase.

N	Y	X	D	T
Bat Tunnel	15.34791	-61.3663	5/26/2010	16:04:00
Bee House	15.34766	-61.368	5/26/2010	16:11:00
Kapok	15.35184	-61.3634	5/26/2010	15:40:00
Main Pool	15.34555	-61.3692	5/29/2010	13:28:00
Parkenter	15.34834	-61.3455	5/28/2010	13:42:00
Pavilion	15.34863	-61.3361	5/28/2010	14:57:00
Roadodeath	15.34479	-61.3693	5/28/2010	12:21:00
Springfield	15.34674	-61.3687	5/26/2010	16:16:00
Fig	15.34612	-61.3731	5/26/2010	16:54:00
Kapok	15.35209	-61.3633	5/26/2010	19:38:00
Cabrits Entrance	15.58311	-61.4715	5/31/2010	14:01:00
Fort Shirley	15.5836	-61.4733	5/31/2010	14:49:00
Indian River Crossing	15.57104	-61.4558	5/31/2010	13:51:00
Layou River Crossing	15.39767	-61.4189	5/31/2010	12:01:00
Ross University	15.55618	-61.4585	5/31/2010	13:48:00
Rodney Rock	15.38111	-61.4104	5/31/2010	11:56:00
Cabrits Shore	15.58966	-61.4738	5/31/2010	15:27:00
Syndicate Trail	15.52399	-61.4206	5/31/2010	18:43:00
Cassava bakery	15.49579	-61.2593	6/2/2010	15:58:00
Cemetary	15.49554	-61.2538	6/2/2010	15:51:00
Gold River	15.40877	-61.2954	6/2/2010	12:13:00
Pont Casse	15.37784	-61.3443	6/2/2010	11:59:00
Springfield	15.34668	-61.3685	6/2/2010	19:20:00
St. David's bay	15.43572	-61.2579	6/2/2010	12:24:00
Boiling lake	15.31857	-61.2949	6/9/2010	15:41:00
Morne trois pitons park	15.32288	-61.3095	6/9/2010	12:54:00
Titou Gorge	15.3291	-61.3247	6/9/2010	11:58:00
Top	15.31576	-61.3042	6/9/2010	13:55:00

It is my ultimate goal to include an interactive web version of the map I created on the Hymenoptera website. This map can be perused by students curious about the trip or those deciding in which areas they should conduct their research. All will be able to see what kinds of projects are available through visual exploration, which for many is easier to understand and

access than textual descriptions. Over time, this geodatabase will grow and develop into a valuable resource to all involved in the Dominica study abroad trip.

Figure 1: Example Map of Student Research Areas on a study of Hymenoptera.



Conclusion

In summary, I was able to successfully map out the island of Dominica with data on urban, natural, and water features as well as student research areas. Future projects should build on the data assembled and continue to map out additional sites that students choose for their research. Although Dominica has many valleys and frequent cloud cover, good GPS data can still be collected and added to the GIS map created.

Acknowledgements

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Sources

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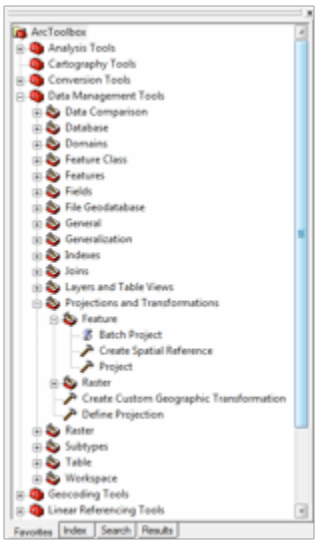
Footnotes

[1]To add data to an ArcInfo map, click the add data tool  and browse to the data file desired. Edit projection to WGS_1984.

[2]To add a group, right click on “Layers” and choose “New Group Layer”.

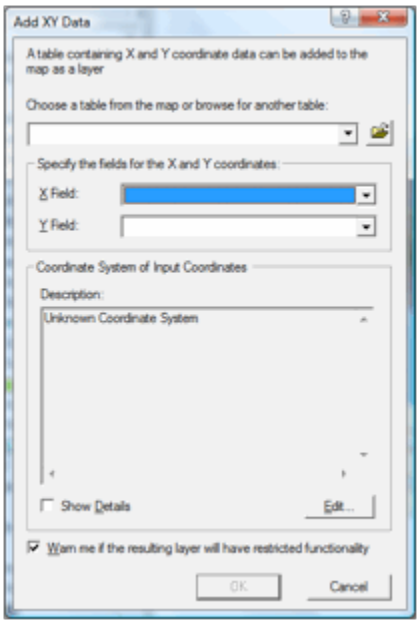
[3]To change the projection of a data layer, click the ArcToolbox icon  .

Navigate to Data Management Tools > Projections and Transformations > Feature > Project. Add the layer you want to change as the input, specify the projection as WGS_1984, and click ok.



[4]To create a feature, open ArcCatalog and navigate to the file in which you wish to organize created shapefiles. Right click in the empty space, and click New > Shapefile. Name it according to the data is will contain, and specify feature type (Point, Polyline, & Polygon are most common). Edit the coordinate system to WGS_1984. Then, simply add the data to your map in ArcInfo. To add data to the layer, open the Editor toolbar and start editing the appropriate layer file. To add features, click the pencil icon  , and make sure Task is set to Create New Feature and Target is set to the appropriate layer. Click the map along points you want to add and double click to finish creating the feature. Once finished, click Editor, Save Edits, and Stop Editing.

[5]To add data points recorded by a GPS device, connect your GPS unit to the computer to download the data. Open GPS Trackmaker and navigate to GPS > Garmin. Turn on your GPS unit and click Product ID. Once it is ready, click capture all to download all data points collected by the GPS. Save as a .txt file, and open Microsoft Excel. Navigate to Data > Import External Data > Import Data. Once the Text Import Wizard opens, click Next, check the box for Comma (keep Tab checked), and click Finish. Edit data to only include N (name), Y (latitude), X (longitude), D (date), and T (time). See Figure 1 for an example. To add the data to ArcInfo, navigate to Tools > Add XY Data.

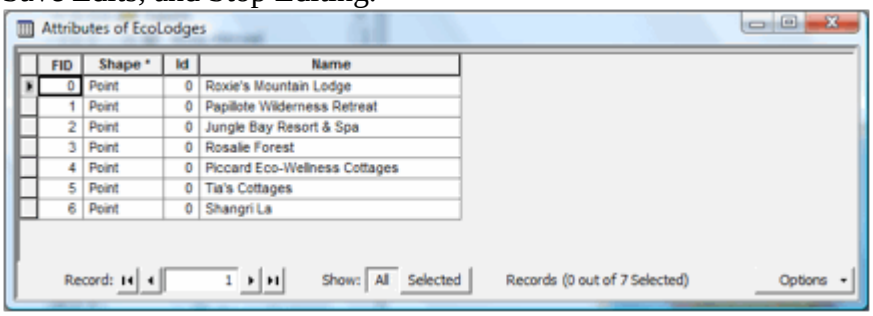


Browse to the Excel file and specify the coordinate system as WGS_1984. After clicking OK, right click on the added layer and click Save As Layer File. After saving, you must add the created layer file and delete the previous copy.

N	Y	X	D	T
Bat Tunnel	15.34791062	-61.3663	5/26/2010	16:04:00
Bee House	15.34765623	-61.368	5/26/2010	16:11:00

-Figure 1: Organization of GPS data in Excel-

[6]To add information fields, right click on the layer and select Open Attribute Table. Click Options, and Add Field. Specify name and field type. To add text to the field, open the Editor toolbar and Start Editing (select the appropriate file). Make sure the target is the file you want to edit. Open the attribute table again, and you are now able to add text. To finish, click Editor, Save Edits, and Stop Editing.



[7]To georeference an image, open the Georeferencing toolbar. Choose the layer you want to edit under the Layer drop down menu. Next, click the Add Control Points icon and begin adding control points by first clicking a specific spot on the image, then clicking the corresponding same spot on the map that has already been spatially formatted. Continue this process until the two layers are aligned (you must have at least 12 control points). To check the accuracy of your georeferencing, open the Link Table and check the RMSE value, which should ideally be 2 or less (values as high as 50 are acceptable for georeferencing large areas, such as a country). To lower the RMSE, delete points with a high Residual by selecting them and clicking the X icon.